APPENDIX Q
LONG-TERM HUMAN HEALTH DOSE AND RISK ANALYSIS

This appendix presents methods and results for assessment of potential human health impacts due to releases of radionuclides and chemicals from the high-level radioactive waste tanks, Fast Flux Test Facility decommissioning, and waste management activities over long periods of time following stabilization or closure.

Q.1 INTRODUCTION

Adverse impacts on human health and the environment may occur over long periods of time following stabilization or closure of the Hanford Site (Hanford) tanks, decommissioning of the Fast Flux Test Facility (FFTF), and closure of the Integrated Disposal Facility in the 200-East (IDF-East) and 200-West (IDF-West) Areas and the River Protection Project Disposal Facility (RPPDF). Because these impacts would occur in the future and cannot be known solely from measurements made at this time, mathematical models were used to estimate the magnitude of the potential impacts. This appendix presents methods and results for assessment of potential human health impacts due to releases of radionuclides and chemicals from the high-level radioactive waste (HLW) tanks, FFTF decommissioning, and waste management activities over long periods of time following stabilization or closure. The objectives of the analysis include development of (1) objective measures of potential impacts on human health, (2) quantitative measures for comparison with regulatory criteria, and (3) understanding of the dependence of human health impacts on facility designs and environmental processes. Because of the large uncertainties involved in projection of impacts beyond a period of 1,000 years, U.S. Department of Energy (DOE) guidance recommends a period of analysis of 1,000 years for assessment of performance of low-level radioactive waste disposal facilities (DOE Guide 435.1-1). However, the low rate of movement of water and solutes through the vadose zone at Hanford and the objective of identifying peak impacts support selection of a longer period of analysis for this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (*TC & WM EIS*). Analysis of travel time in the vadose zone presented in Appendix N, Section N.5.1, appropriate for constituents that move at the velocity of water, and in Appendix O, Section O.6.4, for uranium, a constituent that moves slower than groundwater, supports selection of a 10,000-year period of analysis. Thus, long-term groundwater impacts in this *TC & WM EIS* are estimated for a 10,000-year period of analysis extending over calendar years (CYs) 1940 to 11,939.

Q.2 APPROACH FOR LONG-TERM PERFORMANCE ASSESSMENT

The approach used for estimation of long-term impacts on human health is development and analysis of a set of scenarios that provides a reasonable bound on potential impacts. Each scenario includes a combination of releases from a facility, transport through the environment, and exposure of receptors that could produce an adverse impact. Steps in the procedure include the following:

- Development of a conceptual model of the site
- Characterization of sources of residual contamination
- Identification of environmental transport pathways
- Identification of receptors
- Development of exposure scenarios
- Selection and development of models for the analysis of scenarios
- Estimation of impacts of reasonably conservative deterministic conditions
- Characterization of sensitivity and uncertainty

The process of impacts analysis is iterative in nature, with execution of initial passes through the steps at a high level so as to screen out less important conditions and produce a manageable set of scenarios for

analysis. An initial iteration through the procedure was used to establish the number of constituents to be included in the analysis. For radionuclides in this screening analysis, groundwater release and direct intrusion scenarios were considered. For the groundwater release screening scenario, only drinking water consumption was considered, release was assumed to be partition limited, and decay during transport was considered. For the direct intrusion scenario, inadvertent soil ingestion and inhalation pathways were considered. The analysis involved estimation of relative impacts based on the distribution of radionuclides in all tanks; FFTF decommissioning; waste proposed for disposal at IDF-East, IDF-West, and the RPPDF; and contamination in place at cumulative analysis sites. In reviewing constituents at a given source area, radionuclides contributing in combination less than 1 percent of impacts for intruder or well scenarios were not included in the detailed analysis. The inventories for these sources are provided in Appendix D for the alternatives sources and Appendix S for the cumulative impacts analysis. To account for hazardous chemicals in this screening analysis, drinking water impacts were estimated for each constituent, and those contributing more than 99 percent of impacts were selected for detailed analysis. The list of radionuclides and chemicals used in the analysis is presented in Table Q–1. The screening resulted in reduction of the original set of radioactive and chemical constituents to a final set of 14 radioactive and 26 chemical constituents, which represents both alternatives and cumulative impact sources. In the screening analysis, consideration of one-space dimensional, transient movement of chains of radionuclides through the vadose zone established that progeny radionuclides contributed a small fraction of dose relative to that due to parent radionuclides present in the HLW tank farm Best-Basis Inventory and that consideration of ingrowth in transport through the vadose zone and unconfined aquifer was not required for *TC & WM EIS* detailed analysis of groundwater release scenarios. Ingrowth of radionuclides was considered in *TC & WM EIS* detailed analysis of intruder scenarios. Degradation of chemical constituents and production of chemical constituent degradation products are not considered in *TC & WM EIS* detailed analysis.

Table Q–1. Constituents Selected for Detailed Analysis

Radionuclides	Chemicals	
Hydrogen-3 (tritium)	1,2-Dichloroethane	Lead
Carbon-14	1,4-Dioxane	Manganese
Potassium-40	1-Butanol	Mercury
Strontium-90	2,4,6-Trichlorophenol	Molybdenum
Zirconium-93	Acetonitrile	Nickel (soluble salts)
Technetium-99	Arsenic, inorganic	Nitrate
Iodine-129	Benzene	Polychlorinated biphenyls
Cesium-137	Boron and compounds	Silver
Gadolinium-152	Cadmium	Strontium (stable)
Thorium-232	Carbon tetrachloride	Total uranium
Uranium isotopes (includes U-233, -234, -235, -238)	Chromium	Trichloroethylene
Neptunium-237	Dichloromethane	Vinyl chloride
Plutonium isotopes (includes Pu-239, -240)	Fluoride	
Americium-241	Hydrazine/hydrazine sulfate	

Key: Pu=plutonium; U=uranium.

Q.2.1 Identification of Receptors

Identification of potential receptors is based on current demography and guidance developed by state and Federal agencies. Currently, there are no permanent onsite receptors, and the population assumed to use the Columbia River water each year for the foreseeable future is approximately 5 million people (DOE 1987). A detailed description of the population distribution is presented in Chapter 3 of this *TC & WM EIS*. Recent agency guidance recommends consideration of the average member of the critical group as the basis for comparison with regulatory criteria (DOE 1995; NRC 2000). The average member of the critical group is a member of a group reasonably expected to receive the greatest exposure to releases from a facility. The range of activities of the average member of the critical group includes inhalation of contaminated air, ingestion of contaminated drinking water, establishment of a residence on or near contaminated material, and establishment of a garden on contaminated soil. For these scenarios, use of contaminated groundwater from a well is the source of contamination of the surface soil. Guidance for performance analysis of waste disposal facilities also recommends consideration of individuals directly intruding into residual contamination (DOE Guide 435.1-1). In addition, Executive Order 12898 directs Federal decisionmakers to identify and address high and adverse environmental impacts that disproportionately affect minority and low-income populations.

On the basis of this agency guidance, onsite use of groundwater and offsite use of surface water were selected for consideration. The groundwater receptors are a drinking-water well user, a resident farmer, and an American Indian resident farmer located on the site near the source of contamination, at the Core Zone Boundary, or at the Columbia River. In addition, an American Indian hunter-gatherer contacting a combination of groundwater and surface water is located on the Columbia River nearshore. The surface-water receptors are a resident farmer and American Indian resident farmer located on the Columbia River near the site and a member of the population located downstream from the site. Members of the offsite populations are assumed to have the activity pattern of a residential farmer, using surface water to meet the total annual drinking water requirement and to irrigate a garden that provides approximately 25 percent of annual crop and animal product requirements. These receptors are also assumed to consume fish harvested from the river. Impacts on an individual of the offsite population are the same as those reported in tables in this appendix for the resident farmer at the Columbia River surface-water location. The final receptor is an intruder located on a tank farm barrier, waste disposal facility, or FFTF barrier whose activities lead to direct contact with residual contamination.

The human health impacts on each of these receptors were estimated for each alternative and are presented with the appropriate discussion throughout the main text. In addition, estimated impacts for a hunter-gatherer that is representative of a member of the Confederated Tribes of the Umatilla Indian Reservation and another that is representative of a member of the Confederated Tribes and Bands of the Yakama Nation, each based on exposure parameters provided by the tribes, are reported in Appendix W, Section W.3.

Q.2.2 Development of Exposure Scenarios

Scenarios identified for analysis are the combinations of the sources, environmental transport pathways, receptors, and locations described in the preceding paragraphs. The locations of the Core Zone Boundary, barriers, and Columbia River are illustrated in Appendix O, Figure O–16. Given 12 potential onsite locations (the10 barriers, the Core Zone Boundary, and the Columbia River nearshore), 3 groundwater receptor types (drinking-water well user, resident farmer, and American Indian resident farmer), and 19 alternatives (as described in Chapter 2 of this *TC & WM EIS*), and noting that not all receptors are present at each location for each alternative, a total of 148 onsite groundwater scenarios have been identified. Taking into account a river location with the surface-water receptors (resident farmer, American Indian resident farmer, American Indian hunter-gatherer, and downstream population) for

19 alternatives adds 76 scenarios, for a total of 224 scenarios. Each scenario involves release of radionuclides and chemicals to produce the impacts summarized in Section Q.3.

Q.2.2.1 Approach for Selection and Development of Mathematical Models

The preferred approach for impacts analysis is use of generally available, peer-reviewed models. However, no single model is available for the variety of sources, environmental conditions, and receptors under consideration in this analysis. Thus, the approach selected is use of a combination of generally available and site-specific models representing physical processes expected to occur. The approach for development of site-specific models, involving conceptualization and the formulation, solution, and use of mathematical models, is summarized in Table Q–2. Details of groundwater flow, release from source, vadose zone transport, and saturated zone transport are described in Appendices L, M, N, and O, respectively.

Table Q–2. Procedure for Development and Use of Site-Specific Models

Step	Action
1	Characterize physical processes
2	Develop conceptual model of physical processes
3	Formulate mathematical equations describing the concept
4	Develop algorithm for solution of equations
5	Implement algorithm in computer code
6	Verify computer code
7	Document procedure
8	Apply model

Q.2.2.2 Mathematical Models for Long-Term Performance Assessment

Two sets of mathematical models have been developed for analysis of scenarios describing potential human health impacts occurring over long periods of time following stabilization or closure of the HLW tanks at Hanford, final decommissioning of FFTF, and stabilization and closure of waste management disposal facilities. The first set of models assesses impacts of release to groundwater using modules simulating release to the vadose zone, transport through the vadose zone, and transport through the unconfined aquifer. Potential receptors for the release-to-groundwater impact models indirectly contact contamination transported from the tank farms, six sets of cribs and trenches (ditches) analyzed in the alternatives, and waste disposal areas. The second set assesses impacts on individuals who directly intrude into residual contamination at the tank farms and waste disposal areas.

The release-to-groundwater impacts analysis uses a set of physical-mechanism-specific release models described in Appendix M. The vadose zone transport analysis uses the STOMP [Subsurface Transport Over Multiple Phases] model (White and Oostrom 2000, 2006), which simulates transient movement of water through a three-dimensional study volume. Details of the vadose zone analysis using the STOMP model are presented in Appendix N. Direction and rate of groundwater movement through the unconfined aquifer are simulated using MODFLOW [modular three-dimensional finite-difference groundwater flow model] (USGS 2004). MODFLOW is a transient, three-dimensional simulation of Hanford and is described in Appendix O. Transport of solutes through the unconfined aquifer is simulated using the particle-tracking model described in Appendix O. For release-to-groundwater scenarios, concentrations of contaminants calculated using the above-described sequence of models serve as input data for estimation of human health impacts. Methods used for estimation of human health impacts are described in the following section.

The intruder impact model evaluates impacts of construction of a home or drilling of a well at a tank farm, decommissioned facility, or disposal area. Residual contamination is brought to the surface, resulting in exposure of construction or drilling workers and subsequent exposure of resident farmers. A detailed description of the intruder model is presented in Section Q.2.3.

The health effects module estimates dose, hazard, and cancer morbidity risk at a specified time for one of the following six exposure scenarios:

1. Use of groundwater for drinking water only
2. Use of surface water by a resident farmer
3. Use of surface water by an American Indian resident farmer
4. Use of groundwater by a resident farmer
5. Use of groundwater by an American Indian resident farmer
6. Use of a combination of groundwater and surface water by an American Indian hunter-gatherer

In the resident farmer scenarios (the second through the fifth cases), contaminated groundwater or surface water is used by the average member of the critical group for domestic purposes and irrigation of a garden. The primary functions performed in developing the estimate of health impact using a calculated value of contaminant concentration in water are calculation of contaminant concentration in soil and calculation of dose, Hazard Quotient, and risk. Information used to initiate the calculations includes concentration of the contaminant in groundwater or surface water at the access point and physical constants such as distribution coefficient, irrigation rate, and infiltration rate affecting rate of buildup of contamination in soil irrigated with contaminated water. The contaminant concentration in soil is calculated as:

$$C_s = (1/f_v)\, K_d\, C_w$$

where:

C_s	=	contaminant concentration in soil, grams per gram
f_v	=	conversion constant, 1×10^6 milliliters per cubic meter
K_d	=	distribution coefficient for contaminant and water, milliliters per gram
C_w	=	contaminant concentration in either groundwater or surface water in contact with the soil, grams per cubic meter

The exposure model calculates health impacts for a specified contaminant and time for one of the six scenarios identified above. Because of the differing nature of health endpoints, slightly different approaches are used for radionuclides and chemicals. For radionuclides, impacts are estimated as dose and risk. Cumulative impacts of a mixture of radionuclides are estimated as the sum of dose or risk of the individual radionuclides. For chemicals, health impacts are represented as Hazard Quotient for noncarcinogens and as risk for carcinogens. Cumulative impacts of a mixture are represented as the sum of the Hazard Quotients, termed “Hazard Index,” of the individual chemicals or as the sum of risk of the individual chemicals. Methods used for each of the six exposure scenarios are described in the following paragraphs. Values for physical constants, dose and risk factors, and model parameters are presented in Section Q.2.4.

SCENARIO 1: USE OF GROUNDWATER FOR DRINKING WATER ONLY

For a radionuclide, the dose due to consumption of contaminated water is estimated as:

$$D_{dw} = C_r \, IR_{dw} \, DCF_{\text{ing}}$$

where:

D_{dw}	=	drinking water dose for an individual radionuclide, rem per year
C_r	=	concentration of radionuclide in water, curies per cubic meter
IR_{dw}	=	drinking water consumption rate, cubic meters per year
DCF_{ing}	=	radionuclide-specific dose conversion factor for ingestion, rem per curie

Lifetime risk from the radionuclide is estimated as:

$$R_{dw} = f_a \, C_r \, IR_{dw} \, ED_{dw} \, SF_{dw}$$

where:

R_{dw}	=	lifetime risk due to ingestion of the radionuclide in drinking water, unitless
f_a	=	conversion constant, 1×10^{12} picocuries per curie
C_r	=	concentration of radionuclide in water, curies per cubic meter
IR_{dw}	=	drinking water consumption rate, cubic meters per year
ED_{dw}	=	exposure duration for the drinking water scenario, years
SF_{dw}	=	Health Effects Assessment Summary Tables (HEAST) radionuclide-specific slope factor for drinking water ingestion, 1 per picocurie

For ingestion of a chemical in drinking water, intake is defined as:

$$I_{dw} = (f_m / f_t) \, [\, (IR_{dw} \, EF_{dw} \, ED_{dw}) / (BW \, AT) \,] \, C_c$$

where:

I_{dw}	=	chronic intake rate of chemical in drinking water, milligrams per kilogram-day
f_m	=	conversion constant, 1,000 milligrams per gram
f_t	=	conversion constant, 365 days per year
IR_{dw}	=	drinking water consumption rate, cubic meters per year
EF_{dw}	=	exposure frequency for drinking water ingestion, days per year
ED_{dw}	=	exposure duration for the drinking water scenario, years
BW	=	body weight, kilograms
AT	=	averaging time, days
C_c	=	concentration of chemical in water, grams per cubic meter

The averaging time depends on the type of effect being considered. In the case of noncarcinogens, averaging is over the time of exposure, assumed to be 30 years. In the case of carcinogens, averaging is over a lifetime, assumed to be 70 years.

The Hazard Quotient, a measure of noncarcinogenic risk or toxic effects, is calculated as:

$$HQ_{dw} = I_{dw} / RfD$$

where:

HQ_{dw}	=	Hazard Quotient for ingestion of the chemical in drinking water, unitless
I_{dw}	=	chronic intake rate of chemical in drinking water, milligrams per kilogram-day
RfD	=	Integrated Risk Information System (IRIS) reference dose for chronic ingestion of the chemical, milligrams per kilogram-day

Lifetime risk is estimated as:

$$R_{dw} = I_{dw} SF_{\text{ing}}$$

where:

R_{dw}	=	lifetime risk due to ingestion of the chemical in drinking water, unitless
I_{dw}	=	chronic intake rate of chemical in drinking water, milligrams per kilogram-day
SF_{ing}	=	IRIS slope factor for ingestion of the chemical, 1 per milligram per kilogram-day

SCENARIOS 2 AND 3: USE OF SURFACE WATER

Use of contaminated surface water involves drinking water, fish consumption, and residential agriculture exposure. The resident farmer and American Indian receptors differ in consumption rates and exposure conditions, but the same approach is used for each type of receptor. The receptors also differ in that the American Indian uses a sweat lodge and produces more food and products and consequently has a larger-area garden than the resident farmer. Dose, Hazard Quotient, and risk from ingestion of drinking water are calculated as described for Scenario 1, except contaminant surface-water concentrations are used.

For radionuclides, dose for fish consumption is calculated as:

$$D_f = C_{sw} (B_f/f_v) IR_f DCF_{\text{ing}}$$

where:

D_f	=	dose for a radionuclide due to consumption of fish, rem per year
C_{sw}	=	radionuclide concentration in surface water, curies per cubic meter
B_f	=	radionuclide bioaccumulation factor for fish, picocuries per kilogram/picocuries per liter
f_v	=	conversion constant, 1,000 liters per cubic meter
IR_f	=	consumption rate for fish, kilograms per year
DCF_{ing}	=	radionuclide-specific dose conversion factor for ingestion, rem per curie

Lifetime risk due to ingestion of the radionuclide in fish is calculated as:

$$R_f = C_{sw}\,(B_f/f_v)\,IR_f\,f_a\,ED_f\,SF_{\text{ing}}$$

where:

R_f	=	lifetime risk from ingestion of contaminant in fish, unitless
C_{sw}	=	radionuclide concentration in surface water, curies per cubic meter
B_f	=	radionuclide bioaccumulation factor for fish, picocuries per kilogram/picocuries per liter
f_v	=	conversion constant, 1,000 liters per cubic meter
IR_f	=	consumption rate for fish, kilograms per year
f_a	=	conversion constant, 1×10^{12} picocuries per curie
ED_f	=	exposure duration for fish consumption, years
SF_{ing}	=	HEAST radionuclide-specific slope factor for food ingestion, 1 per picocurie

For chemicals, intake due to consumption of fish is calculated as:

$$I_f = (f_m/f_v)\,[\,(IR_f\,ED_f\,B_f)\,/\,(\,BW\,AT\,)\,]\,C_{sw}$$

where:

I_f	=	intake of chemical in fish, milligrams per kilogram-day
f_m	=	conversion constant, 1,000 milligrams per gram
f_v	=	conversion constant, 1,000 liters per cubic meter
IR_f	=	consumption rate of fish, kilograms per year
ED_f	=	exposure duration for fish consumption, years
B_f	=	bioaccumulation factor of chemical in fish, milligrams per kilogram/milligrams per liter
BW	=	body weight, kilograms
AT	=	averaging time, days
C_{sw}	=	concentration of chemical in surface water, grams per cubic meter

Hazard Quotient for consumption of the chemical in fish is:

$$HQ_f = I_f\,/\,RfD$$

where:

HQ_f	=	Hazard Quotient for ingestion of chemical in fish, unitless
I_f	=	intake of chemical in fish, milligrams per kilogram-day
RfD	=	IRIS reference dose for ingestion of chemical, milligrams per kilogram-day

Lifetime risk due to ingestion of the chemical in fish is calculated as:

$$R_f = I_f\,SF_{ing}$$

where:

R_f	=	lifetime risk from ingestion of chemical in fish, unitless
I_f	=	intake of chemical in fish, milligrams per kilogram-day
SF_{ing}	=	IRIS slope factor for food ingestion, 1 per milligram per kilogram-day

Residential agriculture activities for the resident farmer and American Indian resident farmer involve exposure to radionuclides through a variety of pathways. These include the following:

1. External exposure from radionuclides in soil
2. Inadvertent ingestion of radionuclides in soil
3. Inhalation of fugitive dust containing radionuclides
4. Ingestion of crops grown on contaminated soil
5. Ingestion of animal products (beef and milk) from animals raised on contaminated soil
6. Ingestion of animal products (beef and milk) from animals who drink contaminated water

For radionuclides, Version 6.4 of the RESRAD [RESidual RADioactivity] computer code (Yu et al. 2001) is used to calculate unit dose and risk factors for those exposure pathways based on soil concentrations (the first five pathways listed above). The last pathway, involving exposure via animals' drinking water, is calculated outside of RESRAD.

Dose due to intake of a radionuclide is then estimated as:

$$D_{ra} = C_s\, DuRSRD + C_{sw}\, B_{\text{water-beef}}\, IR_{\text{beef-DW}}\, IR_{\text{beef}}\, DCF_{\text{ing}} + C_{sw}\, B_{\text{water-milk}} IR_{\text{dairy-DW}}\, IR_{\text{milk}}\, DCF_{\text{ing}}$$

where:

D_{ra}	=	dose for residential agriculture, rem per year
C_s	=	concentration of radionuclide in soil, picocuries per gram
$DuRSRD$	=	RESRAD unit dose factor for residential agriculture, rem per year/picocuries per gram
C_{sw}	=	concentration of the radionuclide *i* in the surface water, curies per liter
$B_{\text{water-beef}}$	=	radionuclide-specific water-to-beef biotransfer factor, days per kilogram
$IR_{\text{beef-DW}}$	=	consumption rate of drinking water by beef cattle, liters per day
IR_{beef}	=	consumption rate of beef by the farmer, kilograms per year
DCF_{ing}	=	radionuclide-specific dose conversion factor for ingestion, rem per curie
$B_{\text{water-milk}}$	=	radionuclide-specific water-to-milk biotransfer factor, days per liter
$IR_{\text{dairy-DW}}$	=	consumption rate of drinking water by dairy cattle, liters per day
IR_{milk}	=	consumption rate of milk by the resident farmer, liters per year

In general, values for water-to-beef and water-to-milk biotransfer factors are not available; hence, the plant-to-beef and plant-to-milk biotransfer factors ($B_{\text{plant-beef}}$, days per kilogram, and $B_{\text{plant-milk}}$, days per liter) are used in their place, that is:

$$B_{\text{water-beef}} = B_{\text{plant-beef}}$$

and

$$B_{\text{water-milk}} = B_{\text{plant-milk}}\, \rho_{\text{milk}}$$

where ρ_{milk} is the appropriate density of milk, 1.0 kilogram per liter.

Lifetime risk is calculated in a similar manner:

$$R_{ra} = C_s\ RuRSRD\ ED_{ra} + C_{sw}\ f_a\ (\ B_{\text{water-beef}}\ IR_{\text{beef-DW}}\ IR_{\text{beef}} + B_{\text{water-milk}} IR_{\text{dairy-DW}}\ IR_{\text{milk}}\ )\ ED_{ra}\ SF_{\text{ing}}$$

where:

R_{ra}	=	lifetime risk from residential agriculture, unitless
C_s	=	radionuclide concentration in soil, picocuries per gram
$RuRSRD$	=	RESRAD unit risk factor for residential agriculture, 1 per year per picocuries per gram
ED_{ra}	=	exposure duration for residential agriculture, years
C_{sw}	=	concentration of the radionuclide *i* in the surface water, curies per liter
f_a	=	conversion factor, 1×10^{12} picocuries per curie
$B_{\text{water-beef}}$	=	radionuclide-specific water-to-beef biotransfer factor, days per kilogram
$IR_{\text{beef-DW}}$	=	consumption rate of drinking water by beef cattle, liters per day
IR_{beef}	=	consumption rate of beef by the farmer, kilograms per year
$B_{\text{water-milk}}$	=	radionuclide-specific water-to-milk biotransfer factor, days per liter
$IR_{\text{dairy-DW}}$	=	consumption rate of drinking water by dairy cattle, liters per day
IR_{milk}	=	consumption rate of milk by the resident farmer, liters per year
SF_{ing}	=	HEAST radionuclide-specific slope factor for food ingestion, 1 per picocurie

The values of the RESRAD unit dose and risk factors differ for different radionuclides and for the resident farmer and American Indian resident farmer.

The agriculture activities of the resident farmer and American Indian resident farmer involve exposure to chemicals through all of the same pathways as radionuclides except the external (direct radiation) pathway. However, for hazardous chemicals, hazard and risk from residential agriculture exposures are estimated using individual algebraic equations for each of the pathways: inadvertent soil ingestion, fugitive dust inhalation, crop ingestion, and consumption of animal and dairy products consistent with agency guidance (EPA 1996a, 1996b, 2002).

For inadvertent ingestion of soil, intake of a chemical is estimated as:

$$I_{si} = [\ (\ IR_s\ EF_{si}\ ED_{si}\ )\ /\ (\ BW\ AT\ )\ ]\ C_s$$

where:

I_{si}	=	intake rate of chemical by inadvertent ingestion of soil, milligrams per kilogram-day
IR_s	=	rate of inadvertent ingestion of soil, milligrams per day
EF_{si}	=	exposure frequency for inadvertent ingestion of soil, days per year
ED_{si}	=	exposure duration for inadvertent ingestion of soil, years
BW	=	body weight, kilograms
AT	=	averaging time, days
C_s	=	contaminant concentration in soil, grams per gram

Hazard Quotient for the chemical is calculated as:

$$HQ_{si} = I_{si}\ /\ RfD$$

where:

HQ_{si}	=	Hazard Quotient for inadvertent ingestion of chemical in soil, unitless
I_{si}	=	intake rate of chemical by inadvertent ingestion of soil, milligrams per kilogram-day
RfD	=	IRIS reference dose for ingestion of chemical, milligrams per kilogram-day

Lifetime risk due to inadvertent ingestion of the chemical in soil is calculated as:

$$R_{si} = I_{si}\, SF_{ing}$$

where:

R_{si}	=	lifetime risk, unitless
I_{si}	=	intake rate of chemical by inadvertent ingestion of soil, milligrams per kilogram-day
SF_{ing}	=	IRIS slope factor for food ingestion, 1 per milligram per kilogram-day

For inhalation of a contaminant in fugitive dust, intake concentration is calculated as:

$$I_{fd} = \{ (f_m/PEF)\, EF_{fd}\, ED_{fd} [ET_o + (ET_i\, DF_i)]\, C_s \} / AT$$

where:

I_{fd}	=	intake concentration of chemical in fugitive dust, milligrams per cubic meter
f_m	=	conversion constant, 1×10^6 milligrams per kilogram
PEF	=	particulate emission factor, cubic meters per kilogram
EF_{fd}	=	exposure frequency for inhalation of fugitive dust, days per year
ED_{fd}	=	exposure duration for inhalation of fugitive dust, years
ET_o	=	exposure time fraction, outdoors, unitless
ET_i	=	exposure time fraction, indoors, unitless
DF_i	=	dilution factor for indoor inhalation of fugitive dust, unitless
C_s	=	contaminant concentration in soil, grams per gram
AT	=	averaging time, days

The Hazard Quotient is calculated as:

$$HQ_{fd} = I_{fd} / RfC$$

where:

HQ_{fd}	=	Hazard Quotient for inhalation of the chemical in fugitive dust, unitless
I_{fd}	=	intake concentration of chemical in fugitive dust, milligrams per cubic meter
RfC	=	IRIS reference concentration for inhalation of the chemical, milligrams per cubic meter

Lifetime risk due to ingestion of the chemical in fugitive dust is:

$$R_{fd} = I_{fd}\, IUR$$

where:

R_{fd}	=	lifetime risk from inhalation of the chemical in fugitive dust, unitless
I_{fd}	=	intake concentration of chemical in fugitive dust, milligrams per cubic meter
IUR	=	inhalation unit risk for the chemical, 1 per milligram per cubic meter

For ingestion of a chemical in crops, intake is calculated as:

$$I_c = [(IR_{vf} + IR_{lv}) (f_{m1}\, ED_c\, f_{m2})\, TF_p / (BW\, AT)]\, C_{cs}$$

where:

I_c	=	intake from chemical in crops, milligrams per kilogram-day
IR_{vf}	=	consumption rate of vegetables and fruit, kilograms per year
IR_{lv}	=	consumption rate of leafy vegetables, kilograms per year
f_{m1}	=	conversion factor, 1,000 grams per kilogram
ED_c	=	exposure duration for crop ingestion, years
f_{m2}	=	conversion constant, 1,000 milligrams per gram
TF_p	=	soil-to-plant transfer factor of chemical, milligrams per kilogram/milligrams per kilogram
BW	=	body weight, kilograms
AT	=	averaging time, days
C_{cs}	=	concentration of chemical in soil, grams per gram

Hazard Quotient for ingestion of the chemical in crops is calculated as:

$$HQ_c = I_c / RfD$$

where:

HQ_c	=	Hazard Quotient for ingestion of chemical in crops, unitless
I_c	=	intake of chemical in crops, milligrams per kilogram-day
RfD	=	IRIS reference dose for ingestion of chemical, milligrams per kilogram-day

Lifetime risk due to ingestion of a chemical in crops is calculated as:

$$R_c = I_c\, SF_{\text{ing}}$$

where:

R_c	=	lifetime risk due to ingestion of chemical in crops, unitless
I_c	=	intake of chemical in crops, milligrams per kilogram-day
SF_{ing}	=	IRIS slope factor for food ingestion, 1 per milligram per kilogram-day

The farmer's intake I_{beef} for ingestion of a chemical in meat results from consumption of an animal that has ingested fodder and/or forage grown in contaminated soil, directly ingested the soil, and ingested contaminated water:

$$I_{\text{beef}} = I_{\text{fodder}} + I_{\text{soil}} + I_{\text{water}}$$

where:

$$I_{\text{fodder}} = C_{cs}\, f_{m1}\, f_{m2}\, TF_p\, IR_{\text{beef;v}}\, B_{\text{plant-beef}}\, IR_{\text{beef}}\, ED_c / (BW\, AT)$$

$$I_{\text{soil}} = C_{cs}\, f_{m1}\, f_{m2}\, B_{\text{soil-beef}}\, IR_{\text{beef-soil}}\, IR_{\text{beef}}\, ED_c / (BW\, AT)$$

$$I_{\text{water}} = C_{sw}\, (f_{m2} / \rho_{\text{water}})\, B_{\text{water-beef}}\, IR_{\text{beef-DW}}\, IR_{\text{beef}}\, ED_c / (BW\, AT)$$

and where:

I_{beef}	=	total intake of chemical by the farmer from consumption of the beef, milligrams per kilogram-day
I_{fodder}	=	animal-fodder-ingestion-related intake by the farmer from consumption of the beef, milligrams per kilogram-day

I_{soil}	=	animal-soil-ingestion-related intake by the farmer from consumption of the beef, milligrams per kilogram-day
I_{water}	=	animal-drinking-water-related intake by the farmer from consumption of the beef, milligrams per kilogram-day
C_{cs}	=	concentration of chemical in soil, grams per gram
f_{m1}	=	conversion factor, 1,000 grams per kilogram
f_{m2}	=	conversion constant, 1,000 milligrams per gram
TF_p	=	soil-to-plant transfer factor of chemical, milligrams per kilogram/milligrams per kilogram
$IR_{beef;v}$	=	consumption rate of air-dried fodder/forage by beef cattle, kilograms per day
$B_{plant\text{-}beef}$	=	chemical-specific plant-to-beef biotransfer factor, days per kilogram
IR_{beef}	=	consumption rate of beef by farmer, kilograms per year
ED_c	=	exposure duration for crop ingestion, years
BW	=	body weight, kilograms
AT	=	averaging time, days
$B_{soil\text{-}beef}$	=	chemical-specific soil-to-beef biotransfer factor, days per kilogram
$IR_{beef\text{-}soil}$	=	consumption rate of soil by beef cattle, kilograms per day
C_{sw}	=	concentration of the chemical in the surface water, grams per cubic meter
ρ_{water}	=	density of water, 1,000 kilograms per cubic meter
$B_{water\text{-}beef}$	=	chemical-specific water-to-beef biotransfer factor, days per liter
$IR_{beef\text{-}DW}$	=	consumption rate of drinking water by beef cattle, liters per day

In general, values for the soil-to-beef and water-to-beef biotransfer factors ($B_{soil\text{-}beef}$ and $B_{water\text{-}beef}$, respectively) are not available; hence, the plant-to-beef biotransfer factor ($B_{plant\text{-}beef}$, days per kilogram) is used in their place, that is:

$$B_{soil\text{-}beef} = B_{plant\text{-}beef}$$

and

$$B_{water\text{-}beef} = B_{plant\text{-}beef}\,\rho_{water}$$

where ρ_{water} is the density of water, 1.0 kilogram per liter

The Hazard Quotient for ingestion of the chemical in crops is calculated as:

$$HQ_c = I_c / RfD$$

where:

HQ_c	=	Hazard Quotient for ingestion of chemical in crops, unitless
I_c	=	intake of chemical in crops, milligrams per kilogram-day
RfD	=	IRIS reference dose for ingestion of chemical, milligrams per kilogram-day

Lifetime risk due to ingestion of a chemical in crops is calculated as:

$$R_c = I_c\, SF_{ing}$$

where:

R_c	=	lifetime risk due to ingestion of chemical in crops, unitless
I_c	=	intake of chemical in crops, milligrams per kilogram-day
SF_{ing}	=	IRIS slope factor for food ingestion, 1 per milligram per kilogram-day

Doses occurring in use of a sweat lodge are due to inhalation of radionuclides in liquid droplets suspended in air and inhalation of radionuclides conveyed into the air during evaporation of water. In each case, the concentration of a radionuclide in the water used in the sweat lodge is the concentration of the radionuclide in the source surface water. The approach for estimating the concentration of droplets in air is to use a value representative of that observed in fog (Mann and Puigh 2001). The approach for estimating the concentration of a radionuclide in air due to water evaporation is to estimate the quantity of liquid water evaporated to produce the quantity of water vapor present at equilibrium saturation at the temperature of the sweat lodge followed by application of a radionuclide-specific decontamination factor to reflect incomplete entrainment of nonvolatile radionuclides (Mann and Puigh 2001).

The concentration of a radionuclide in air due to droplets in air is estimated as:

$$C_{sn,d} = VR_{d,a}\, C_{sw}$$

where:

$C_{sn,d}$	=	concentration of a radionuclide in air in the sweat lodge due to presence of droplets, curies per cubic meter
$VR_{d,a}$	=	ratio of volume of droplets to volume of air in the sweat lodge, unitless
C_{sw}	=	concentration of radionuclide in surface water, curies per cubic meter

The concentration of a radionuclide in the air in the sweat lodge due to evaporation of water was estimated as:

$$C_{sn,e} = \{\, DF_{sn,e}\, [(\rho_{wv}\, V_{sn}) / \rho_{wl}\,]\, C_{sw}\, \} / V_{sn}$$

where:

$C_{sn,e}$	=	concentration of a radionuclide in air in the sweat lodge due to evaporation of water, curies per cubic meter
$DF_{sn,e}$	=	entrainment factor for a radionuclide due to evaporation, unitless
ρ_{wv}	=	density of water vapor in air in the sweat lodge, grams per cubic meter
V_{sn}	=	volume of the sweat lodge, cubic meters
ρ_{wl}	=	density of liquid water, grams per cubic meter
C_{sw}	=	concentration of a radionuclide in surface water, curies per cubic meter

Annual dose due to inhalation of a radionuclide in the sweat lodge was estimated as:

$$D_{sn} = (C_{sn,d} + C_{sn,e})\, (\, BR_{sn}\, DCF_{\mathrm{inh}}\, EF_{sn}\,)$$

where:

D_{sn}	=	dose due to use of the sweat lodge, rem per year
$C_{sn,d}$	=	concentration of a radionuclide in air in the sweat lodge due to presence of droplets, curies per cubic meter
$C_{sn,e}$	=	concentration of a radionuclide in air in the sweat lodge due to evaporation of water, curies per cubic meter
BR_{sn}	=	breathing rate in the sweat lodge, cubic meters per year
DCF_{inh}	=	radionuclide-specific dose conversion factor for inhalation, rem per curie
EF_{sn}	=	exposure frequency for the sweat lodge, years per year

Lifetime risk due to inhalation of a radionuclide during use of the sweat lodge was estimated as:

$$R_{sn} = (C_{sn,d} + C_{sn,e}) (BR_{sn}\ EF_{sn}\ ED_{sn}\ f_a\ SF_{\text{inh}})$$

where:

R_{sn}	=	lifetime risk from use of the sweat lodge, unitless
$C_{sn,d}$	=	concentration of a radionuclide in air in the sweat lodge due to presence of droplets, curies per cubic meter
$C_{sn,e}$	=	concentration of a radionuclide in air in the sweat lodge due to evaporation of water, curies per cubic meter
BR_{sn}	=	breathing rate in the sweat lodge, cubic meters per year
EF_{sn}	=	exposure frequency for the sweat lodge, years per year
ED_{sn}	=	exposure duration for use of the sweat lodge, years
f_a	=	conversion factor, 1×10^{12} picocuries per curie
SF_{inh}	=	HEAST radionuclide-specific slope factor for inhalation, 1 per picocurie

Hazard Quotient and risk from exposure to chemicals in a sweat lodge were estimated using the approach applied for radionuclides. The concentration of a chemical in air due to droplets in air was estimated as:

$$C_{sn,d} = VR_{d,a}\ f_m\ C_{sw}$$

where:

$C_{sn,d}$	=	concentration of chemical in air in the sweat lodge due to presence of droplets, milligrams per cubic meter
$VR_{d,a}$	=	ratio of volume of droplets to volume of air in the sweat lodge, unitless
f_m	=	conversion factor, 1,000 milligrams per gram
C_{sw}	=	concentration of chemical in surface water, grams per cubic meter

The concentration of a chemical in air in the sweat lodge due to evaporation of water was estimated as:

$$C_{sn,e} = \{ DF_{sn,e}\ f_m\ [(\rho_{wv}\ V_{sn}) / \rho_{wl}]\ C_{sw} \} / V_{sn}$$

where:

$C_{sn,e}$	=	concentration of chemical in air in the sweat lodge due to evaporation of water, milligrams per cubic meter
$DF_{sn,e}$	=	entrainment factor for chemical due to evaporation, unitless
f_m	=	conversion factor, 1,000 milligrams per gram
ρ_{wv}	=	density of water vapor in air in the sweat lodge, grams per cubic meter
V_{sn}	=	volume of the sweat lodge, cubic meters
ρ_{wl}	=	density of liquid water, grams per cubic meter
C_{sw}	=	concentration of chemical in surface water, grams per cubic meter

Hazard Quotient for a chemical from use of the sweat lodge was estimated as:

$$HQ_{sn} = \{ (C_{sn,d} + C_{sn,e}) [(EF_{sn}\ ED_{sn}\ f_t) / AT] \} / RfC$$

where:

HQ_{sn}	=	Hazard Quotient for inhalation of chemical during use of a sweat lodge, unitless
$C_{sn,d}$	=	concentration of chemical in air in the sweat lodge due to presence of droplets, milligrams per cubic meter
$C_{sn,e}$	=	concentration of chemical in air in the sweat lodge due to evaporation of water, milligrams per cubic meter
EF_{sn}	=	exposure frequency for use of the sweat lodge, years per year
ED_{sn}	=	exposure duration for use of the sweat lodge, years
f_t	=	conversion factor, 365 days per year
AT	=	averaging time, days
RfC	=	reference concentration for the chemical, milligrams per cubic meter

Lifetime risk from inhalation of a chemical during use of a sweat lodge was estimated as:

$$R_{sn} = (C_{sn,d} + C_{sn,e}) \, [(EF_{sn} \, ED_{sn} \, f_t) / AT] \, IUR$$

where:

R_{sn}	=	lifetime risk from inhalation of chemical during use of the sweat lodge, unitless
$C_{sn,d}$	=	concentration of chemical in air in the sweat lodge due to presence of droplets, milligrams per cubic meter
$C_{sn,e}$	=	concentration of chemical in air in the sweat lodge due to evaporation of water, milligrams per cubic meter
EF_{sn}	=	exposure frequency for use of the sweat lodge, years per year
ED_{sn}	=	exposure duration for use of the sweat lodge, years
f_t	=	conversion factor, 365 days per year
AT	=	averaging time, days
IUR	=	inhalation unit risk for the chemical, 1 per milligram per cubic meter

SCENARIOS 4 AND 5: USE OF GROUNDWATER

The methods and models used in the analysis of groundwater use are the same as those described above for the drinking water scenario and for the residential agriculture pathway of the surface-water use scenarios. The differences are absence of fish consumption and use of the contaminant concentration in groundwater in place of that in surface water.

SCENARIO 6: AMERICAN INDIAN HUNTER-GATHERER PATHWAYS

This scenario is similar to the American Indian resident farmer scenarios in that it considers radiological and chemical exposures from drinking contaminated water, consuming contaminated meat, inadvertently ingesting soil, consuming contaminated fish, inhaling contaminated dust, and participating in ceremonial sweat lodge ceremonies. However, in this hunter-gatherer scenario, the exposed adult American Indian is assumed to live a more traditional American Indian lifestyle. The domestic-garden exposure pathway of the resident farmer scenarios is replaced by the consumption of wild plants, and the consumption of domestic livestock is replaced with that of game, specifically deer, although the annual consumption rates for plants, meats, and fish, regardless of origin, are similar in magnitude. As is the case with the resident farmer and American Indian resident farmer assessments, this exposure assessment is directed toward a representative or typical adult member of the population of interest.

An important difference between this scenario and the resident farmer scenarios described in the preceding section is that the individual of interest, or receptor in the scenario, is exposed to contamination from both surface water and groundwater. In each of the resident farmer scenarios described in the

preceding paragraphs, the source of exposure is either surface water or groundwater, but not both. The American Indian hunter-gatherer is exposed to groundwater-related contamination through the consumption of wild plants and deer meat, inadvertent soil ingestion, and participation in sweat lodge ceremonies. The link with groundwater occurs as a direct result of the location of the scenario—near the river where groundwater, i.e., the saturated zone, is assumed to be near the land surface and extending up into the root zone. In the root zone, groundwater contamination then is available for uptake by plants that can be consumed either directly by the receptor or by deer, which in turn may be consumed by the receptor. The proximity of the groundwater to the land surface is also assumed to be sufficient at times for soil at the land surface to become contaminated, resulting in exposure through the inhalation of resuspended soil. Exposure pathways involving surface water, i.e., the Columbia River, include the hunter-gatherer's drinking water (100 percent) and consumption of fish. The deer are also assumed to use the river for drinking water (100 percent), resulting in an additional component to the exposure through the consumption of deer meat. Depending on the purpose, sweat lodge ceremonies may use either groundwater or surface water, and so this scenario assumes 50 percent use of the former and 50 percent use of the latter.

The equations needed for estimation of the chemical health impacts in the hunter-gatherer scenario are the same as given above for the surface-water (and groundwater) estimates. However, the groundwater concentrations are used to arrive at soil concentrations used in the food (plants and deer [forage]), soil ingestion, and dust inhalation pathways, while surface-water concentrations are used in the drinking water, fish, and deer (drinking water) calculations. Like the deer pathway, the sweat lodge exposure pathway uses both groundwater and surface-water concentrations. Most of the exposure parameters in the hunter-gatherer scenario are the same as used in the American Indian resident farmer scenario. This includes annual intake of meat and produce/wild plants, duration of exposures, and chemical- and radionuclide-specific parameters. Aside from the simultaneous use of groundwater and surface water, a primary difference in exposure parameterization for the two scenarios relates to animals in terms of their sizes, forage intakes, soil ingestion, and drinking water intakes.

The radiological calculations for the hunter-gatherer are the same as those for the American Indian resident farmer in that RESRAD was employed in the calculation of agricultural activity unit dose factors or unit risk factors. However, separate RESRAD calculations were needed—one for a groundwater component and one for a surface-water component.

Q.2.3 Intruder Scenario Models

Past practice, current regulatory frameworks, and site-specific conditions (DOE Guide 435.1-1; NRC 1982) were reviewed to develop two site-specific intrusion scenarios for exposure to radionuclides. These are characterized as home construction and well drilling, and each comprises two phases. For the home construction scenario, a worker excavates soil to construct the foundation for a home. In this activity, the worker is subject to inhalation of contaminated soil and external exposure from the floor and walls of the excavation. Subsequently, soil removed from the excavation is mixed across the surrounding area used for a residence and garden. In the well-drilling scenario, a worker completes a well intersecting subsurface contamination and deposits contaminated drill cuttings in a pond. In the course of this activity, the worker inhales suspended dust and experiences external exposure from the contamination in the pond. Subsequently, soil removed from the cuttings pond is mixed across the surrounding area used for a residence and garden. Impacts are estimated for receptors present at the site at a series of times specified for analysis, including a delay representing a period of institutional control. The first of the following sections discusses the upper-level organization of the model, while the second section discusses details of the dose calculation for each of the receptors. As in prior analysis, American Indian and resident farmer receptors are considered. For direct intrusion scenarios of limited extent in time as anticipated in DOE guidance, acceptance criteria have been established for radioactive constituents but not for chemical constituents.

Q.2.3.1 Organization of the Model

The intruder model comprises two major elements: an executive routine and a dose module. Functions performed in the executive routine include interpretation of input data, control of sequence of calculations, and writing of results to output files. The overall organization of the code is represented in Figure Q–1. The input data include specification of radionuclides and radionuclide inventories and of time periods for which dose will be estimated. As indicated in this figure, the code cycles through each radionuclide and time step and calculates dose at each step in the process. Following completion of the dose calculation at each time step, the code identifies the maximum dose and time of maximum dose.

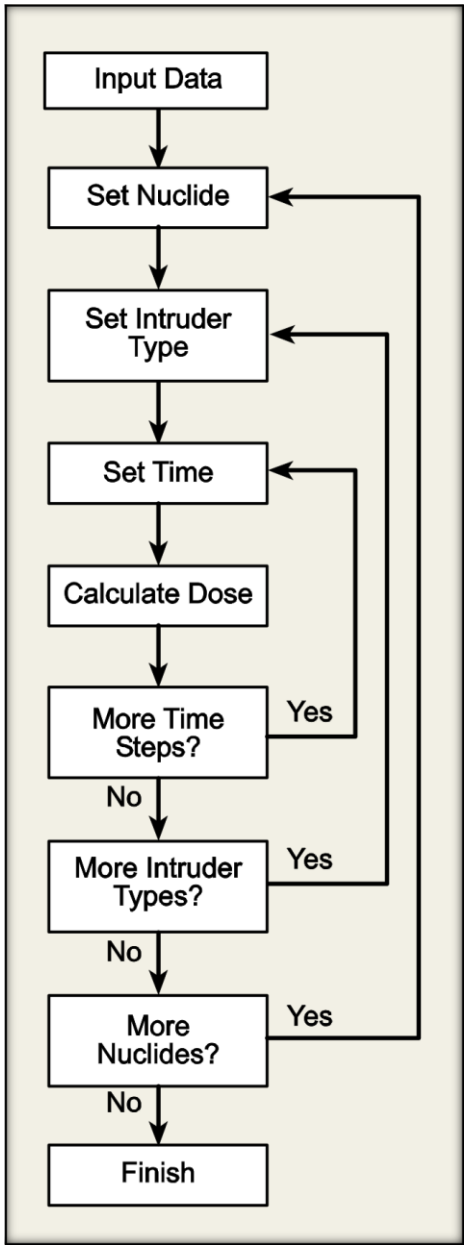

Figure Q–1. Algorithm for Intruder Scenario Analysis Computer Code

The time sequence of total dose and the dose for each radionuclide for the time of maximum dose for each intruder are provided as output data.

Q.2.3.2 Intruder Dose Models

The magnitude of dose estimated for each intruder depends in part on the range of intruder activities. The following sections present equations used for calculation of dose for each type of intruder. Intruder activities and scenario parameter values are consistent with past analyses and current guidance (DOE Guide 435.1-1; NRC 1982), and dose conversion factors used in the analysis are consistent with current Federal guidance (Eckerman and Ryman 1993; Eckerman et al. 1999). Values used for dose factors and model parameters are presented in the following subsection. At each time step during the calculation of dose, radionuclide concentrations are adjusted to reflect decay and ingrowth.

Q.2.3.2.1 Home Construction Worker

The home construction intruder excavates a foundation for a home, spending a specified length of time in the excavation. The excavation work generates airborne dust that is inhaled by the worker. The worker is also simultaneously exposed to direct radiation emitted from radioactive material in the surrounding soil. In the course of the work, residual contamination is brought to the surface. The amount of activity brought to the surface during home construction is estimated as:

$$A_{hc} = W_{\text{exc}}\, L_{\text{exc}}\, H_{\text{rmvd}}\, \rho_w\, f_v\, C_w$$

where:

A_{hc}	=	activity of a radionuclide removed from the excavation during home construction, picocuries
W_{exc}	=	width of the excavation, meters
L_{exc}	=	length of the excavation, meters
H_{rmvd}	=	height of waste removed from the excavation, meters
ρ_w	=	density of waste removed from the excavation, grams per cubic centimeter
f_v	=	conversion constant, 1×10^6 cubic centimeters per cubic meter
C_w	=	concentration of radionuclide in waste, picocuries per gram

The dose due to inhalation of a given radionuclide was estimated as:

$$D_{\text{inh}} = (1 / f_a\, f_m)\, M_{\text{load}}\, BR\, T_{\text{exc}}\, C_{\text{soil}}\, DCF_{\text{inh}}$$

where:

D_{inh}	=	inhalation dose, rem
f_{a}	=	conversion factor, 1×10^{12} picocuries per curie
f_m	=	conversion, 1,000 milligrams per gram
M_{load}	=	mass loading of dust in the air, milligrams per cubic meter
BR	=	breathing rate, cubic meters per year
T_{exc}	=	time spent in the excavation, years
C_{soil}	=	radionuclide concentration in the soil, picocuries per gram
DCF_{inh}	=	radionuclide-specific dose conversion factor for inhalation, rem per curie

Direct external dose was estimated as:

$$D_{\text{ext}} = N_s\, DEN_s\, C_s\, T_{\text{exc}}\, DCF_{exV}$$

where:

D_{ext}	=	external dose, rem
N_s	=	number of surfaces in excavation, unitless
DEN_s	=	density of soil, grams per cubic centimeter
C_s	=	concentration of radionuclide in the soil, picocuries per gram
T_{exc}	=	time spent in the excavation, years
DCF_{exV}	=	dose conversion factor for external radiation from a volume source, rem per year/picocuries per cubic centimeter

Five surfaces (four walls and a floor) and dose factors for semi-infinite media not corrected for finite size of the excavation were used in the calculations.

Q.2.3.2.2 Well-Drilling Worker

In this scenario, a worker completing a well is assumed to inhale dust mobilized by drilling activity and to be exposed to radiation emitted by waste brought to the surface in the drilling mud. Dose due to inhalation was estimated using the same approach and equation as described above for the home construction scenario worker. The drilling mud is pumped to a pond where it is covered by 0.6 meters (2 feet) of water. The worker remains in the vicinity of the pond and is exposed to direct radiation emitted from the radioactive material in the pond. The activity brought to the surface is:

$$A_{wd} = (\pi/4)\,(D_{well})^2\, Z_w\, DEN_w\, f_v\, C_w$$

where:

A_{wd}	=	activity of a radionuclide deposited in the pond, picocuries
π	=	mathematical constant, value = 3.1415
D_{well}	=	diameter of the well, meters
Z_w	=	thickness of waste horizon intersected by the well, meters
DEN_w	=	density of waste, grams per cubic centimeter
f_v	=	conversion factor, 1×10^6 cubic centimeters per cubic meter
C_w	=	radionuclide concentration in the waste, picocuries per gram

The activity was distributed at the upper surface of the mud layer, below the overlying water. The shielding of the pond water would reduce the dose by a factor of approximately 75. The dose to a receptor near the pond was estimated as:

$$D_{drill} = [(A_{wd}/f_a)/A_p]\,(1.0/f_{shld})\, T_{drill}\, DCF_{exS}$$

where:

D_{drill}	=	dose during drilling activity, rem
A_{wd}	=	activity of a radionuclide deposited in the pond, picocuries
f_a	=	conversion factor, 1×10^{12} picocuries per curie
A_p	=	area of pond, square meters
f_{shld}	=	factor for reduction of dose due to shielding by water in pond, unitless
T_{drill}	=	time of exposure near pond, years
DCF_{exS}	=	dose conversion factor for external radiation from a source of surface contamination, rem per year/curies per square meter

Q.2.3.2.3 Residential Agriculture Intruder

In the residential agriculture scenario, an individual lives in a home and cultivates a garden on soil containing residual contamination, resulting in exposure to radionuclides through a variety of direct radiation and inhalation and ingestion pathways. Analysis of this scenario was conducted using the RESRAD computer code (Yu et al. 2001) developed for the Formerly Utilized Sites Remedial Action Program. RESRAD estimates annual dose to an individual who establishes a residence on a site having residual contamination; raises and consumes crops; raises livestock and consumes meat, poultry, and milk; drinks contaminated groundwater; and obtains fish from a contaminated pond. Use of the model for site-specific application requires selection of appropriate operating modes of the model and specification of values for parameters characterizing site physical conditions and the range of likely activity of the individual. For this *TC & WM EIS*, American Indian and resident farmer receptors having different production rates were selected for analysis. Parameter values for intruder analysis are the same as those presented for the residential agriculture scenarios of long-term analysis and are presented in the following section. For the above considerations, exposure pathways included in this analysis are as follows:

- Direct radiation
- Inhalation of volatile compounds
- Inhalation of dust
- Ingestion of vegetables, grain, fruit, meat (not fish), poultry, and milk
- Inadvertent ingestion of soil

Intrusion impacts for the above pathways result from transport of waste to the surface due to human activity and occur primarily in the near term. Impacts for the drinking water pathway involve transport of radionuclides through the vadose zone to groundwater and occur in the future, with reduction of dose due to decay of short-lived radionuclides. For these reasons, doses due to ingestion of drinking water are not included in the intruder analysis. Doses due to ingestion of drinking water are reported in the long-term impacts analysis. The concentration of a radionuclide in the soil for residential agriculture is determined by the amount of activity brought to the surface, the area required for the residence and garden, and the mixing depth into the soil.

The concentration in soil for residential agriculture is estimated as:

$$C_{ra} = A_{\mathrm{rmvd}} / (A_{ra}\, H_{\mathrm{mix}}\, f_v\, \rho_s)$$

where:

C_{ra}	=	concentration of radionuclide in soil for residential agriculture, picocuries per gram
A_{rmvd}	=	activity removed from the home construction excavation or well borehole, picocuries
A_{ra}	=	area required for the residence and garden, square meters
H_{mix}	=	height for mixing activity into soil, meters
f_v	=	conversion constant, cubic centimeters per cubic meter
ρ_s	=	density of soil in the garden, grams per cubic centimeter

Unit impact factors derived using RESRAD allow calculation of dose as:

$$D_{ra} = C_{ra}\, DCF_{ra}$$

where:

D_{ra} = dose to a resident farmer, rem per year
C_{ra} = radionuclide concentration in soil, picocuries per gram
DCF_{ra} = unit dose conversion factor reflecting dose through RESRAD pathways, rem per year/picocuries per gram

Q.2.4 Values of Physical Constants and Parameters for Long-Term Impacts Analysis

The mathematical models used for estimation of long-term human health impacts described in Sections Q.2.2 and Q.2.3 require specification of a number of physical constants and parameter values. This section provides the values used for these constants and parameters in the exposure modeling. First, values of constants and parameters used in radionuclide and chemical contaminant release and transport analysis are presented. Next, values of dose and health effect coefficients are presented. Lastly, values used in scenario analysis are presented.

Q.2.4.1 Constants and Parameters Used in Scenario Analysis

The models used in analysis of drinking water and residential agriculture scenarios and described in Sections Q.2.2 and Q.2.3 depend on a number of physical constants and parameters that must be quantified, i.e., values assigned. For consumption of drinking water, the primary parameter is ingestion rate. The receptors in the drinking water only, the residential farmer, and the American Indian resident farmer scenarios are each assumed to drink 2.0 liters (0.53 gallons) per day. This corresponds to the 90th percentile of use for the United States (Beyeler et al. 1999). The American Indian hunter-gatherer is assumed to drink 4.0 liters (1.06 gallons) per day, including in the sweat lodge.

There are both many similarities and some differences in the exposure models used in the evaluation of impacts due to radionuclides and chemical contaminants. As a consequence, the two sets of calculations share a number of parameters, but each also has some unique data requirements. For the radionuclides, RESRAD (Yu et al. 2001) was used to estimate impacts due to exposure in the residential garden scenarios, the terrestrial components of the hunter-gatherer scenario, and the intruder scenarios. A set of approximately 70 parameters was employed in RESRAD, but many of these same parameters are also used in the chemical calculations. Both for radionuclides and chemicals, the two initial steps of model implementation are (1) the identification of activities and utilization rates for the selected average member of the critical group and (2) the specification of physical conditions of the site. Tables Q–3 through Q–8 present values for the utilization parameters and general site hydraulic parameters used in the RESRAD and other radiological calculations described in the preceding sections. The organization of these tables reflects the organization of the RESRAD input: utilization parameters quantify the behavioral aspects, e.g., exposure frequencies, human and animal dietary data, etc., of the exposure scenarios being modeled, and the hydraulic and most of the other site parameters are grouped in four zones—contaminated, uncontaminated, unsaturated, and saturated zones. Also, some of the data are radionuclide or chemical specific, whereas other data are independent of the contaminant being considered.

Activities modeled in the RESRAD calculations include occupation of a residence and cultivation of a garden for crops and animal products. Two average members of the critical group were considered as receptors. The first is a resident farmer whose consumption rates of vegetables and produce are approximately 25 percent of national average values. This receptor is consistent with the *Hanford Site Risk Assessment Methodology* (DOE 1995). The second is an American Indian whose utilization rates of produce and animal products are 100 percent of the national average values. Based upon these utilization

rates; site-specific crop yields (Napier et al. 2004), where available; and national average yields (Beyeler et al. 1999), where site data were unavailable, the area of the garden was estimated as the quotient of utilization rate and yield. Utilization data for these receptors are summarized in Tables Q–3 through Q–5.

Table Q–3. Dietary Data

Parameter	Parameter Value		Residential Agriculture Scenario	Source
	American Indian Scenario	American Indian Hunter-Gatherer		
Fruit, vegetable, and grain consumption rate	330 kilograms per year	330 kilograms per year	58 kilograms per year	Site specific, *HSRAM* [a, b]
Leafy vegetable consumption rate	65 kilograms per year	65 kilograms per year	21 kilograms per year	Site specific, *HSRAM* [a]
Milk consumption rate	219 liters per year	0 liters per year	110 liters per year	Site specific, *HSRAM* [a]
Meat and poultry consumption rate	154 kilograms per year	154 kilograms per year	57 kilograms per year	Site specific, *HSRAM* [a, c]
Soil ingestion rate	0.044 kilograms per year	0.044 kilograms per year	0.044 kilograms per year	Agency guidance[d]
Fraction of contaminated livestock water	1	1	1	Site specific
Fraction of contaminated irrigation water	1	1	1	Site specific
Fraction of contaminated plant food	1	1	1	Site specific
Fraction of contaminated meat	1	1	1	Site specific
Fraction of contaminated milk	1	1	1	Site specific

[a] Value from *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (DOE and Ecology 1996) for American Indian scenario and *Hanford Site Risk Assessment Methodology* (DOE 1995) for residential agriculture scenario.

[b] Sum of individual means for fruit, grain, and other vegetables.

[c] Sum of individual means for meat and poultry.

[d] Exposure duration weighted average of child and adult ingestion rates (EPA 2000).

Note: To convert kilograms to pounds, multiply by 2.2046; liters to gallons, by 0.26417.

Key: *HSRAM=Hanford Site Risk Assessment Methodology*.

Table Q–4. Nondietary Data

Parameter	Parameter Value	Source
Livestock fodder intake for meat	27.3 kilograms per day[a]	Beyeler et al. 1999
Livestock fodder intake for milk	64.2 kilograms per day[b]	Beyeler et al. 1999
Deer forage intake for meat	1.63 kilograms per day	Sample et al. 1997
Livestock water intake for meat	50 liters per day	Site specific
Livestock water intake for milk	60 liters per day	Site specific
Livestock intake of soil	0.5 kilograms per day[c]	Yu et al. 2001
Deer water intake for meat	3.27 liters per day	Sample et al. 1997
Deer intake of soil	0.033 kilograms per day	Sample et al. 1997
Mass loading for foliar deposition	4×10^{-4} grams per cubic meter[d]	Beyeler et al. 1999
Depth of soil mixing layer	0.15 meters	Beyeler et al. 1999
Depth of roots	0.9 meters[c]	Yu et al. 2001
Fraction of livestock water from groundwater	0	Site specific
Fraction of irrigation water from groundwater	0	Site specific

[a] National average values.
[b] Sum of individual medians for forage, hay, and grain.
[c] Default parameter value from RESRAD.
[d] Value for gardening.
Note: To convert kilograms to pounds, multiply by 2.2046; liters to gallons, by 0.26417; meters to feet, by 3.281.

Table Q–5. Dust Inhalation and External Gamma Data

Parameter	Parameter Value	Source
Inhalation rate	8,400 cubic meters per year[a]	Beyeler et al. 1999
Mass loading for inhalation	4.5×10^{-6} grams per cubic meter[b]	Beyeler et al. 1999
Exposure duration	1 year	Site specific
Indoor dust filtration factor	1	Site specific
Shielding factor, external gamma	0.59[c]	Beyeler et al. 1999
Fraction of time indoors, on site	0.66[a]	Beyeler et al. 1999
Fraction of time outdoors, on site	0.12[a]	Beyeler et al. 1999
Shape factor, external gamma	1[d]	Yu et al. 2001

[a] National average values.
[b] Activity at time average of national average values.
[c] Sum of products of the means of the fraction of time and shielding factors for indoor and outdoor exposure.
[d] Default parameter value from RESRAD.
Note: To convert cubic meters to cubic feet, multiply by 35.315.

Three values were used for fish consumption in the surface-water usage scenarios:

1. 0.003 kilograms per year (0.007 pounds per year) for the resident farmer. This is an estimated average Columbia River fish consumption for members of the regional population (Mann and Puigh 2001). That is, most of the fish consumed are obtained from other sources.
2. 25.6 kilograms per year (56.4 pounds per year) for the American Indian using surface water. This is the average American Indian annual subsistence fish consumption (EPA 1999a).
3. 226 kilograms per year (500 pounds per year) for the American Indian hunter-gatherer. This rate is an often high-end estimate of tribal subsistence rates (e.g., Harper and Harris 2008).

Where possible, the properties of the soil and subsurface sediments were based on site-specific measurements, e.g., texture, available water content; descriptions of the soil; and a compilation of national average values of soil characteristics by texture class (Beyeler et al. 1999). For soil at the surface in the contaminated zone, U.S. Department of Agriculture Soil Conservation Service data for Benton County, Washington, soils (Evans, Hattendorf, and Kincaid 2000) were used to fit the RESRAD soil hydraulic parameters. First, the soil parameters were estimated using observed textures for site soils and a RESRAD compilation of parameter values delineated by texture (Yu et al. 2001: Appendix E). Hydraulic conductivity and field capacity were estimated using the Benton County data with deep percolation assumed to be 5 percent. As a last step, the water balance was then iteratively solved for the evapotranspiration coefficient, also needed by RESRAD. Parameterization of the deeper sediments was based on site data (Mann and Puigh 2001) and Beyeler's compilation (Beyeler et al. 1999). Note that of the four RESRAD delineations of hydrologic zones, the parameterization of the contaminated zone is of principal importance in determination of the impacts. Data for the four hydrologic zones are presented in Tables Q–6 through Q–8.

Table Q–6. Contaminated Zone Data

Parameter	Parameter Value		Source
	American Indian Scenario	Residential Agriculture Scenario	
Area	4,200 square meters	1,500 square meters	Kennedy and Strenge 1992[a]
Thickness	1 meter	1 meter	Site specific[b]
Length parallel to aquifer flow	65 meters	40 meters	Derived from area
Bulk density	1.6 grams per cubic centimeter	1.6 grams per cubic centimeter	Site specific[b]
Erosion rate	1×10^{-5} meters per year	1×10^{-5} meters per year	Site specific[b]
Total porosity	0.41	0.41	Composite based on site texture data and literature[b]
Field capacity	0.159	0.159	Based on data in Evans, Hattendorf, and Kincaid 2000
Hydraulic conductivity	876 meters per year	876 meters per year	Based on permeability data in Evans, Hattendorf, and Kincaid 2000
b parameter	4.5	4.5	Composite based on site data and literature[b]
Evapotranspiration coefficient	0.959	0.959	Water balance using data in Evans, Hattendorf, and Kincaid 2000
Windspeed	3.4 meters per second	3.4 meters per second	Site specific[c]
Precipitation	0.17 meters per year	0.17 meters per year	Site specific[c]
Irrigation rate	0.66 meters per year	0.66 meters per year	Beyeler et al. 1999[d]
Runoff coefficient	0.1	0.1	Estimate based on Yu et al. 2001[e]

[a] Estimated using method and national average production rates from Kennedy and Strenge (1992) and site-specific crop yields and site-specific utilization rates from Table 5.
[b] Value is consistent with site conditions, e.g., values found in Meyer and Gee (1999).
[c] Hoitink et al. 2005.
[d] Average value for State of Washington (Beyeler et al. 1999).
[e] Table E–1 (Yu et al. 2001).
Note: To convert meters to feet, multiply by 3.281; square meters to square feet, by 10.7639.

Table Q–7. Saturated Zone Hydrologic Data

Parameter	Parameter Value	Source
Bulk density	1.6 grams per cubic centimeter	Site specific[a]
Total porosity	0.43	Site specific[a]
Effective porosity	0.35	Site specific[a]
Hydraulic conductivity	4.7 meters per year	Site specific[a]
Hydraulic gradient	0.01	Site specific[a]
Water table drop rate	0 meters per year	Site specific
Well pump intake depth	2 meters (below water table)	Site specific
Mixing model	Nondispersion	Site specific
Well pumping rate	0 cubic meters per year	Site specific

[a] Value for silty clay loam (Meyer and Gee 1999) is based on site conditions.
Note: To convert meters to feet, multiply by 3.281.

Table Q–8. Uncontaminated and Unsaturated Zone Hydrologic Data

Parameter	Parameter Value	Source
Number of strata	1	Site specific
Thickness	75 meters	Site specific
Bulk density	1.6 grams per cubic centimeter	Site specific[a]
Total porosity	0.43	Site specific[a]
Effective porosity	0.35	Site specific[a]
Hydraulic conductivity	4.7 meters per year	Site specific[a]
b parameter	7.1	Site specific[a]

[a] Value for silty clay loam (Meyer and Gee 1999) is based on site conditions.

Note: To convert meters to feet, multiply by 3.281.

The surface soil in the contaminated zone is assumed to be a coarse-textured agricultural soil. While it might be expected to differ from the deeper sediments from which it is derived as a result of weathering and biological processes, its properties are influenced by the characteristics of those materials. The collection of distribution coefficients (K_d) for the radionuclides shown in Table Q–9 is a composite taken from several sources. Where possible, values taken from site-specific guidance for this *TC & WM EIS* (DOE 2005) are used. One exception is hydrogen-3 (tritium). The small, but not zero (0), value used for tritium is based on the discussion in the 1999 review of distribution coefficients for several key radionuclides in the environment (EPA 1999b). In other cases, distribution coefficents were taken from compilations presented in Sheppard and Thibault (1990) and Beyeler et al. (1999). The radionuclide-specific values for the soil-to-plant, plant-to-beef, and water-to-fish transfer factors (Lee and Coffield 2007) compiled for use at the site are presented in Table Q–10.

Table Q–9. Distribution Coefficients for Radionuclides

Constituent	Distribution Coefficient, K_d (milliliters per gram)	Constituent	Distribution Coefficient, K_d (milliliters per gram)
Hydrogen-3 (tritium)	0.04[a]	Cesium-137	280[b]
Carbon-14	5[b]	Gadolinium-152	5[c]
Potassium-40	15[b]	Thorium-232	3,200[b]
Strontium-90	15[b]	Uranium-238	35[b]
Zirconium-93	600[b]	Neptunium-237	5[b]
Technetium-99	0.1[b]	Plutonium-239	550[b]
Iodine-129	1[b]	Americium-241	2,000[b]

[a] EPA 1999b.

[b] Sheppard and Thibault 1990.

[c] Beyeler et al. 1999.

Table Q–10. Exposure Pathway Transfer Factors for Radionuclides

Radionuclide	Transfer Factors			
	Soil-plant[a, b] (unitless)	Plant-meat[c] (day per kilogram)	Water-fish[d] (liters per kilogram)	Plant-milk[e] (day per liter)
Hydrogen-3 (tritium)	4.80×10	1.20×10^{-2}	1	1×10^{-2}
Carbon-14	1.37×10^{-1}	4.89×10^{-2}	5×10^{4}	1.2×10^{-2}
Potassium-40	1.07×10^{-1}	2×10^{-2}	1×10^{4}	7×10^{-3}
Strontium-90	9.75×10^{-2}	1×10^{-2}	5.01×10^{2}	2×10^{-3}
Zirconium-93	1.95×10^{-4}	3.40×10^{-2}	3×10^{2}	6×10^{-7}
Technetium-99	4.68×10^{-2}	4×10^{-1}	2×10^{1}	1×10^{-3}
Iodine-129	7.80×10^{-3}	4×10^{-2}	5×10^{2}	1×10^{-2}
Cesium-137	9×10^{-1}	5×10^{-2}	4.70×10^{3}	8×10^{-3}
Gadolinium-152	3.90×10^{-3}	3.50×10^{-3}	3×10^{1}	2×10^{-5}
Thorium-232	6.44×10^{-5}	2×10^{-4}	1×10^{2}	5×10^{-6}
Uranium-238	2.34×10^{-3}	8×10^{-4}	5×10^{1}	6×10^{-4}
Neptunium-237	2.54×10^{-3}	1×10^{-3}	2.50×10^{2}	5×10^{-6}
Plutonium-239	2.15×10^{-4}	1×10^{-4}	4.70×10^{3}	1×10^{-6}
Americium-241	6.83×10^{-5}	2×10^{-4}	2.40×10^{3}	2×10^{-6}

[a] Transfer factors are updated values taken from Lee and Coffield (2007:Table B–1).
[b] These are wet basis numbers. To obtain corresponding values for fodder, multiply by 5.13 (Lee and Coffield 2007:Table B–1).
[c] Transfer factors are maximum values taken from Lee and Coffield (2007:Table B–3).
[d] Transfer factors are maximum values taken from Lee and Coffield (2007:Table B–4).
[e] RESRAD default value from Yu et al. (2001).

For impacts due to ingestion or inhalation of chemical contaminants in the residential agriculture scenario, the set of algebraic equations presented in Section Q.2.2.2 was used. Values for crop and soil ingestion rates were the same as for the analysis of impacts for radionuclides, while other model-specific values were based on agency guidance (EPA 1991, 1996a, 1996b, 2000, 2002). The fugitive dust models used by RESRAD and the chemical models are different, with the former using mass loading in the air and the latter using a particulate emission factor. Also, the chemical calculations in the present analyses consider the total vegetable intake. These differences are reflected in Table Q–11. Other values of parameters common to each of the contributing pathways were the exposure frequency of 365 days per year, exposure duration of 30 years, and averaging time of 70 years.

Table Q–11. Residential Agriculture Scenario Parameter Values for Chemical Contaminants

Parameter/Pathway	Value	Source
Fugitive Dust Inhalation		
Particulate emission factor	1.36×10^{9}	EPA 2002
Exposure time fraction, outdoors	0.073	EPA 2000
Exposure time fraction, indoors	0.683	EPA 2000
Dilution factor, indoors	0.4	EPA 2000
Crop Ingestion		
Ingestion rate, vegetables and fruit[a]	79 kilograms per year (RF) 395 kilograms per year (AI&AIHG)	DOE 1995 Beyeler et al. 1999

[a] Total for leafy vegetables, other vegetables, grains, and fruit.
Note: To convert milligrams to ounces, multiply by 0.00003527; kilograms to pounds, by 2.2046.
Key: AI=American Indian; AIHG=American Indian hunter-gatherer; RF=resident farmer.

Except for hydrazine, the distribution coefficients for the inorganic contaminants were taken from existing compilations (Sheppard and Thibault 1990; Baes et al. 1984; Serne 2007; Yu et al. 2001). The hydrazine value, taken from the U.S. Environmental Protection Agency's Risk Assessment Information System website, operated by Oak Ridge National Laboratory (RAIS 2009), was estimated using the empirical relationship between the distribution coefficient and the octanol-water partition coefficient described for organic contaminants in the next paragraph. Except for boron, nitrate, and hydrazine, the transfer factors are again from Lee and Coffield (2007). The boron fish transfer factor is based on information in the *Borax Pesticide Fact Sheet* (USDA 1994), and the remaining boron transfer factors are taken from Baes et al. (1984). All of the hydrazine transfer factors and nitrate fish transfer factors were taken from the U.S. Environmental Protection Agency's Risk Assessment Information System (RAIS 2009). The remaining nitrate transfer factors are based on default values taken from Baes et al. (1984).

Organic contaminant distribution coefficients were estimated using an empirical formula (following EPA 1996b) that uses the octanol-water partition coefficient, K_{ow}, as follows:

$$\log K_d = 1.01 \log K_{ow} - 0.36$$

One adjustment is for the partially ionizing organic acid 2,4,6-trichlorophenol, or 2,4,6-TCP. That distribution coefficient is calculated using a modified procedure described for ionized organics (EPA 1996b). Similar empirical formulas were used to estimate transfer factors for the organics. These include expressions for the soil-to-plant transfer factor, B_v (McKone 1994):

$$\log B_v = 1.58 - 0.58 \log K_{ow}$$

the plant-to-beef transfer factor $B_{\text{plant-beef}}$ (McKone 1994):

$$\log B_{\text{plant-beef}} = \log K_{ow} - 7.6$$

the plant-to-milk transfer factor $B_{\text{plant-milk}}$ (McKone 1994):

$$\log B_{\text{plant-milk}} = \log K_{ow} - 8.1$$

and the water-to-fish transfer factor B_{fish} (Chiao, Currie, and McKone 1995):

$$B_{\text{fish}} = 0.048\, K_{ow}$$

The values for the chemical distribution coefficients and food-chain transfer factors used in the impacts calculations are shown in Tables Q–12 and Q–13, respectively.

Table Q–12. Distribution Coefficients for Chemicals

Chemical	K_d	K_{ow}	Source
1,2-Dichloroethane	13.3	29.5	a
1,4-Dioxane	0.23	0.54	b
1-Butanol	3.14	7.1	a
2,4,6-Trichlorophenol	0.38	4,900	b
Acetonitrile	0.20	0.46	b
Arsenic, inorganic	7	–	c, d
Benzene	61.6	135	b
Boron and compounds	3	–	e
Cadmium	6.4	–	c
Carbon tetrachloride	249	537	b
Chromium	3	–	f
Dichloromethane	7.96	17.8	b
Fluoride	150	–	e
Hydrazine/hydrazine sulfate	0.5	–	b
Lead	600	–	f
Manganese	65	–	g
Mercury	10	–	c
Molybdenum	20	–	g
Nickel (soluble salts)	200	–	f
Nitrate	0.5	–	e
Polychlorinated biphenyls	188,000	380,000	b
Silver	46	–	c
Strontium (stable)	15	–	h
Total uranium	35	–	h
Trichloroethylene	237	513	b
Vinyl chloride	14.2	31.6	b

[a] K_{ow} source: EPA 1996b: Table 39.
[b] K_{ow} source: Risk Assessment Information System (RAIS) database (RAIS 2009).
[c] K_d source: EPA 1996b: Table 43.
[d] A high oxidation state assumed, e.g., $HAsO4^{-2}$.
[e] K_d source: Baes et al. 1984.
[f] K_d source: Serne 2007.
[g] K_d source: Sheppard and Thibault 1990.
[h] K_d source: DOE 2005.
Key: K_d=distribution coefficient; K_{ow}=octanol-water partition coefficient.

Table Q–13. Exposure Pathway Transfer Factors for Chemicals[a]

Constituent	Soil-to-Plant (B_v) (unitless)	Soil-to-Fodder (B_{fodder}) (unitless)[b]	Plant-to-Beef (B_{beef}) (d/kg)	Plant-to-Milk (B_{milk}) (d/L)	Water-to-Fish (B_{fish}) (L/kg)	Entrainment Factor ($DF_{sn,e}$) (unitless)[c]
1,2-Dichloroethane	1.05[d]	5.37	7.41×10^{-7}[e]	2.34×10^{-7}[f]	1.42[g]	1
1,4-Dioxane	1.06×10^{1}[d]	5.44×10^{1}	1.35×10^{-8}[e]	4.27×10^{-9}[f]	2.58×10^{-2}[g]	1
1-Butanol	2.39[d]	1.23×10^{1}	1.78×10^{-7}[e]	5.62×10^{-8}[f]	3.40×10^{-1}[g]	1
2,4,6-Trichlorophenol	5.46×10^{-2}[d]	2.80×10^{-1}	1.23×10^{-4}[e]	3.89×10^{-5}[f]	2.35×10^{2}[g]	1
Acetonitrile	1.17×10^{1}[d]	5.97×10^{1}	1.15×10^{-8}[e]	3.63×10^{-9}[f]	2.19×10^{-2}[g]	1
Arsenic, inorganic	1.17×10^{-3}	6×10^{-3}	2×10^{-3}	6×10^{-5}	1.70×10^{3}	0.01
Benzene	4.35×10^{-1}[d]	2.23	3.39×10^{-6}[e]	1.07×10^{-6}[f]	6.48[g]	1
Boron and compounds	3.90×10^{-2}[h]	2×10^{-1}	8×10^{-4}[h]	1.50×10^{-3}[h]	1[i]	0.01
Cadmium	2.93×10^{-2}	1.50×10^{-1}	4×10^{-4}	1×10^{-3}	2×10^{2}	0.01
Carbon tetrachloride	1.96×10^{-1}[d]	1	1.35×10^{-5}[e]	4.27×10^{-6}[f]	2.58×10^{1}[g]	1
Chromium	8.78×10^{-4}	4.50×10^{-3}	9×10^{-3}	1×10^{-5}	4	0.01
Dichloromethane	1.40[d]	7.20	4.47×10^{-7}[e]	1.41×10^{-7}[f]	8.54×10^{-1}[g]	1
Fluoride	1.17×10^{-3}	6×10^{-3}	1.50×10^{-1}	1×10^{-3}	1×10^{1}	0.01
Hydrazine/hydrazine sulfate	1.30×10^{2}[j]	6.67×10^{2}	2×10^{-10}[j]	6.30×10^{-11}[j]	1.50×10^{5}[j]	1
Lead	1.17×10^{-3}	6×10^{-3}	4×10^{-4}	2.60×10^{-4}	3×10^{2}	0.01
Manganese	3.90×10^{-2}	2×10^{-1}	5×10^{-4}	3×10^{-5}	4×10^{2}	0.01
Mercury	3.90×10^{-2}	2×10^{-1}	2.50×10^{-1}	4.70×10^{-4}	1×10^{3}	0.01
Molybdenum	1.56×10^{-1}	8×10^{-1}	1×10^{-3}	1.70×10^{-3}	1×10^{1}	0.01
Nickel (soluble salts)	1.17×10^{-2}	6×10^{-2}	5×10^{-3}	1.60×10^{-2}	1×10^{2}	0.01
Nitrate	5.85[k]	3×10^{1}	7.50×10^{-2}[k]	2.50×10^{-2}[k]	1.50×10^{5}[i]	0.01
Polychlorinated biphenyls	4.41×10^{-3}[d]	2.26×10^{-2}	9.55×10^{-3}[e]	3.02×10^{-3}[f]	1.82×10^{4}[g]	1
Silver	2.54×10^{-4}	1.30×10^{-3}	3×10^{-3}	5×10^{-5}	5	0.01
Strontium (stable)	9.75×10^{-2}	5×10^{-1}	8×10^{-3}	2.80×10^{-3}	6×10^{1}	0.01
Total uranium	2.34×10^{-3}	1.20×10^{-2}	3×10^{-4}	4×10^{-4}	1×10^{1}	0.01
Trichloroethylene	2.01×10^{-1}[d]	1.03	1.29×10^{-5}[e]	4.07×10^{-6}[f]	2.46×10^{1}[g]	1
Vinyl chloride	1.01[d]	5.16	7.94×10^{-7}[e]	2.51×10^{-7}[f]	1.52[g]	1

[a] Value taken from Staven et al. (2003) unless indicated otherwise.
[b] $B_{fodder} = B_v$ 10.195 (Lee and Coffield 2007).
[c] A value of 0.01 is assumed for all organic chemicals and hydrazine. The remaining chemicals are inorganic and are assumed to have an entrainment factor of 0.01.
[d] $\log B_v = 1.58 - 0.58 \log K_{ow}$ (McKone 1994).
[e] $\log B_{plant\text{-}beef} = \log K_{ow} - 7.6$ (McKone 1994).
[f] $\log B_{plant\text{-}milk} = \log K_{ow} - 8.1$ (McKone 1994).
[g] $B_{fish} = 0.048\ K_{ow}$ (Chiao, Currie, and McKone 1995).
[h] Baes et al. 1984.
[i] There is very little bioaccumulation of boron (borate) in fish (USDA 1994). The value is set equal to 1.0.
[j] Risk Assessment Information System (RAIS) database (RAIS 2009).
[k] Default value for nitrogen (N) from Baes et al. (1984).
Key: d=day; kg=kilogram; L=liter.

For impacts due to use of a sweat lodge, the scenario-specific parameters are those related to temperature of the sweat lodge and amounts of water droplets and water vapor in the air in the sweat lodge. Values for scenario-specific parameters are summarized in Table Q–14. Description of the scenario and equations for estimation of impact are presented in Section Q.2.2.2.

Table Q–14. Values of Parameters for Estimation of Impact Due to Use of a Sweat Lodge

Parameter	Value
Temperature of sweat lodge,[a] degrees Celsius	50
Ratio of volume of airborne droplets to volume of air in the sweat lodge,[a] unitless	1.0×10^{-8}
Entrainment factor for evaporation,[a] unitless	1.0 for hydrogen-3 (tritium), organics, and hydrazine; 0.01 for all other constituents
Density of water vapor in the sweat lodge,[b] grams per cubic meter	82.6
Density of liquid water, grams per cubic meter	1.0×10^{6}
Frequency of use,[c] year per year	0.042, 0.083[c]

[a] Value adopted from Mann and Puigh (2001).
[b] Calculated using the ideal gas law and assumption of water vapor at saturation pressure (1.79 pounds per square inch absolute) at the temperature of the sweat lodge.
[c] Assumes use of 1 hour per day each day of the year for the American Indian resident farmer. The American Indian hunter-gatherer use is assumed to be 2 hours per day each day of the year.
Note: To convert degrees Celsius to degrees Fahrenheit, multiply by 1.8, then add 32.

Physical constants and parameters are also required in the site-specific direct intrusion scenario model described in Section Q.2.3. For the home construction intruder scenarios, parameter values for worker impacts are an excavation depth of 3 meters (10 feet), a breathing rate of 8,400 cubic meters per year (297,000 cubic feet per year), a mass loading for inhalation of 0.4 milligrams per cubic meter (2.5×10^{-8} pounds per cubic foot), and an exposure duration of 0.057 years (500 hours). For the well-drilling intruder scenario, parameter values for worker impacts are a drill diameter of 0.15 meters (0.5 feet), a drill advance rate of 80,000 meters per year (30 feet per hour), a mass loading for inhalation of 0.4 milligrams per cubic meter (2.5×10^{-8} pounds per cubic foot), and a breathing rate of 8,400 cubic meters per year (297,000 cubic feet per year). For the resident farmer exposure initiated by both home construction and well drilling, values of exposure parameters are those presented in Tables Q–3 through Q–8, and dose impacts were estimated using Version 6.4 of the RESRAD computer code (Yu et al. 2001).

Q.2.4.2 Values for Health Effect Conversion Factors

Health effect conversion factors are used for estimation of dose, hazard, and risk from radionuclides and chemical contaminants. For radiation dose conversion factors, Federal guidance (Eckerman and Ryman 1993; Eckerman et al. 1999) was used. The recommended factors apply to the average adult members of the population, taking into account averaging over age and gender. Values for radionuclide-specific dose conversion factors are presented in Table Q–15. For carcinogenicity slope factors (risk coefficients) for radionuclides, values recommended in Federal guidance (EPA 2001) were used. These values are summarized in Table Q–16. For chemical contaminants, Federal guidance also recommends health coefficient values for measures of noncancer and cancer impacts (EPA 2009a). Values for these parameters used in this *TC & WM EIS* are presented in Table Q–17.

Table Q–15. Values of Radiation Dose Conversion Factors

Radionuclide	Ingestion[a] (rem per curie)	Inhalation[a] (rem per curie)	External Surface Source[b] (rem per year/ curies per square meter)	External Volume Source[b] (rem per year/ picocuries per cubic centimeter)
Hydrogen-3 (tritium)	1.60×10^{2}	2.30×10^{1}	0	0
Carbon-14	2.20×10^{3}	7.60×10^{2}	1.90	8.40×10^{-9}
Potassium-40	2.28×10^{4}	3.14×10^{5}	1.70×10^{4}	6.50×10^{-4}
Strontium-90	1×10^{5}	8.90×10^{4}	3.30×10^{1}	4.40×10^{-7}
Zirconium-93	4.11×10^{3}	9.28×10^{4}	0	0
Technetium-99	2.40×10^{3}	1.10×10^{3}	9.10	7.90×10^{-8}
Iodine-129	3.90×10^{5}	1.30×10^{5}	3×10^{3}	8.10×10^{-6}
Cesium-137	5×10^{4}	1.70×10^{4}	6.50×10^{4}	2.10×10^{-3}
Gadolinium-152	1.52×10^{5}	7.04×10^{7}	0	0
Thorium-232	8.50×10^{5}	4.10×10^{8}	6.40×10^{1}	3.30×10^{-7}
Uranium-238	1.70×10^{5}	1.10×10^{7}	6.40×10^{1}	6.50×10^{-8}
Neptunium-237	4×10^{5}	1.80×10^{8}	3.40×10^{3}	4.90×10^{-5}
Plutonium-239	9.30×10^{5}	4.40×10^{8}	4.30×10^{1}	1.80×10^{-7}
Americium-241	7.60×10^{5}	3.60×10^{8}	3.20×10^{3}	2.70×10^{-5}

[a] Eckerman et al. 1999.
[b] Eckerman and Ryman 1993.

Table Q–16. Radionuclide Carcinogenicity Slope Factors (1 per picocurie)

Radionuclide	Water Ingestion	Food Ingestion	Inhalation
Hydrogen-3 (tritium)	5.07×10^{-14}	6.51×10^{-14}	5.62×10^{-14}
Carbon-14	1.55×10^{-12}	2×10^{-12}	7.07×10^{-12}
Potassium-40	2.47×10^{-11}	3.43×10^{-11}	1.03×10^{-11}
Strontium-90	5.59×10^{-11}	6.88×10^{-11}	1.05×10^{-10}
Zirconium-93	1.11×10^{-12}	1.44×10^{-12}	7.29×10^{-12}
Technetium-99	2.75×10^{-12}	4×10^{-12}	1.41×10^{-11}
Iodine-129	1.48×10^{-10}	3.22×10^{-10}	6.07×10^{-11}
Cesium-137	3.04×10^{-11}	3.74×10^{-11}	1.19×10^{-11}
Gadolinium-152	2.97×10^{-11}	3.85×10^{-11}	9.10×10^{-9}
Thorium-232	1.01×10^{-10}	1.33×10^{-10}	4.33×10^{-8}
Uranium-238	6.40×10^{-11}	8.66×10^{-11}	9.32×10^{-9}
Neptunium-237	6.18×10^{-11}	8.29×10^{-11}	1.77×10^{-8}
Plutonium-239	1.35×10^{-10}	1.74×10^{-10}	3.33×10^{-8}
Americium-241	1.04×10^{-10}	1.34×10^{-10}	2.81×10^{-8}

Source: EPA 2001.

Table Q–17. Health Effect Factors for Chemical Contaminants[a]

Contaminant	Ingestion Reference Dose (mg/kg-d)	Inhalation Reference Concentration (mg/m^3)	Cancer Morbidity	
			Ingestion Slope Factor [1/(mg/kg-d)]	Inhalation Unit Risk [1/(mg/m^3)]
1,2-Dichloroethane	2×10^{-2}[b]	N/A	9.10×10^{-2}	2.60×10^{-2}
1,4-Dioxane	N/A	N/A	1.09×10^{-2}[c]	N/A
1-Butanol	1×10^{-1}[b]	N/A	N/A	N/A
2,4,6-Trichlorophenol	N/A	N/A	1.09×10^{-2}[c]	3.10×10^{-3}[d]
Acetonitrile	6×10^{-3}[b]	6×10^{-2}	N/A	N/A
Arsenic, inorganic	3×10^{-4}	N/A	1.50	4.30
Benzene	4×10^{-3}	3×10^{-2}	5.50×10^{-2}	7.80×10^{-3}
Boron and compounds	2×10^{-1}	2×10^{-2}[b]	N/A	N/A
Cadmium	1×10^{-3}	N/A	N/A	1.80
Carbon tetrachloride	7×10^{-4}	N/A	1.30×10^{-1}	1.50×10^{-2}
Chromium	3×10^{-3}	8×10^{-6}	N/A	1.20×10^{1}
Dichloromethane	6×10^{-2}	3[b]	7.50×10^{-3}	4.70×10^{-4}
Fluoride	6×10^{-2}	N/A	N/A	N/A
Hydrazine/hydrazine sulfate	N/A	N/A	3	4.90
Lead	N/A	N/A	N/A	N/A
Manganese	1.40×10^{-1}	5×10^{-5}	N/A	N/A
Mercury	3×10^{-4}	N/A	N/A	N/A
Molybdenum	5×10^{-3}	N/A	N/A	N/A
Nickel (soluble salts)	2×10^{-2}	N/A	N/A	N/A
Nitrate	1.60	N/A	N/A	N/A
Polychlorinated biphenyls	N/A	N/A	4×10^{-1}	1×10^{-1}
Silver	5×10^{-3}	N/A	N/A	N/A
Strontium (stable)	6×10^{-1}	N/A	N/A	N/A
Total uranium	3×10^{-3}	N/A	N/A	N/A
Trichloroethylene	3×10^{-4}[b]	4×10^{-2}[b]	4×10^{-1}[b]	N/A
Vinyl chloride	3×10^{-3}	1×10^{-1}	1.50	8.80×10^{-3}

[a] EPA IRIS database (EPA 2009a).
[b] Risk Assessment Information System (RAIS) database (RAIS 2009).
[c] Calculated from EPA IRIS oral unit risk (EPA 2009a).
[d] Calculated from EPA IRIS inhalation unit risk (EPA 2009a, 2009b).
Key: EPA=U.S. Environmental Protection Agency; IRIS=Integrated Risk Information System; mg/kg-d=milligrams per kilogram-day; mg/m^3=milligrams per cubic meter; N/A=not assessed in guidance document.

Q.3 RESULTS OF HUMAN HEALTH IMPACTS

This section discusses the potential long-term human health impacts of each set of proposed actions: Section Q.3.1, the Tank Closure alternatives; Section Q.3.2, the FFTF Decommissioning alternatives; and Section Q.3.3, the Waste Management alternatives.

Q.3.1 Long-Term Human Health Impacts of Tank Closure Alternatives

Impacts on human health over the long time period following stabilization or closure of the HLW tanks would be due primarily to discharges to cribs and trenches (ditches) and releases from the tanks and

related equipment. These releases would involve both radioactive and chemical constituents. Because a large number of constituents, sources, and scenarios have been considered, screening analysis was used to identify a reduced number of controlling scenarios. The results of this human health impacts analysis for onsite, offsite, and intruder receptors are summarized in the following sections.

Q.3.1.1 Impacts on Onsite and Offsite Receptors of Expected Conditions Under Tank Closure Alternatives

Implementation of activities defined for the Tank Closure alternatives could lead to releases of radioactive and chemical constituents to the environment over long periods of time. In the case of Tank Closure Alternatives 1 and 2A, these releases would not be controlled by engineered closure of the tanks, while under the other Tank Closure alternatives, releases would be controlled by stabilization of the tanks and of wastes generated during retrieval and closure activities. Potential human health impacts due to release of radioactive constituents are estimated as dose and as lifetime risk of incidence of cancer. Potential human health effects due to release of chemical constituents include both carcinogenic effects and other forms of toxicity. Impacts of carcinogenic chemicals are estimated as lifetime risk of incidence of cancer. Noncarcinogenic effects are estimated as Hazard Quotient, the ratio of the long-term intake of a single chemical to the highest intake that produces no observable effect, and as Hazard Index, the sum of the Hazard Quotients of the group of chemicals contributing to impacts through the exposure pathways evaluated in a particular scenario. Further information on the nature of human health effects in response to exposure to radioactive and chemical constituents is provided in Appendix K, Section K.1. As previously discussed in Section Q.2 of this appendix, the screening analysis identified 14 radioactive and 26 chemical constituents as contributing the greatest risk of adverse impacts. Impacts due to exposure to these constituents are presented in this appendix.

The four measures of human health impacts considered in this analysis—lifetime risks of developing cancer from radioactive and chemical constituents, dose from radioactive constituents, and Hazard Index from chemical constituents—were calculated for each year from CYs 1940 through 11,939 (i.e., 10,000 years) for each receptor at eight locations (i.e., A, B, S, T and U Barriers; Core Zone Boundary; Columbia River nearshore; and Columbia River surface water). This is a large amount of information that must be summarized to allow interpretation of results. The method chosen is to present dose for the year of maximum dose, risk for the year of maximum risk, and Hazard Index for the year of maximum Hazard Index. This choice is based on regulation of radiological impacts expressed as dose and the observation that peak risk and peak noncarcinogenic impacts expressed as Hazard Index may occur at times other than that of peak dose. The significance of dose impacts is evaluated by comparison against the 100-millirem-per-year all-exposure-modes standard specified for protection of the public and the environment in DOE Order 458.1. Population doses are compared against a total effective dose equivalent from natural background sources of 311 millirem per year for a member of the population of the United States (NCRP 2009). The significance of noncarcinogenic chemical impacts is evaluated by comparison against a guideline value of unity (1) for Hazard Index. The level of protection provided for the drinking water pathway is evaluated by comparison against the maximum contaminant levels (MCLs) of the "National Primary Drinking Water Regulations" (40 CFR 141) and other benchmarks presented in Appendix O. In addition, only those radioactive and chemical constituents that resulted in a lifetime risk or Hazard Index greater than 1×10^{-10} for all impacts analysis locations for a given source are included in the human health impact tables presented in this section to reduce the size of the tables. Although a regulatory standard for risk has not been proposed for tank closure impacts, perspective on magnitude of estimated risks may be gained by comparison against the Hanford site-specific cleanup goal of 1×10^{-5}. Also, to provide a basis for understanding the evolution of impacts over time, graphs are presented to depict the lifetime radiological risk for the drinking-water well user at the Core Zone Boundary due to releases from individual sources and due to releases from the combined sources. In interpreting these figures, note that the graph of time series of risk for the combined sources may overlay or obscure the time series of risk for a single dominant source.

Impacts related to tank farm operations, retrieval and closure are due to three types of release. The first type of release is the past practice of direct discharge of liquid to cribs and trenches (ditches). The second type of release is due to past activity at the tank farms and includes past leaks from damaged tanks. The third type of release is due to future activities and includes leaks during retrieval of waste from the tanks, and long-term leaching of waste material in tanks and ancillary equipment. The combination of unplanned releases from past events and retrieval leaks and releases from tank residuals on ancillary equipment in the future is referred to as "other tank farm sources" in subsequent text.

The balance of this section summarizes the potential human health effects due to implementation of each Tank Closure alternative. Seven onsite locations at which an individual may contact groundwater and an offsite location were selected for analysis. The seven onsite locations are the boundaries of tank farm barriers, the Core Zone Boundary, and the Columbia River nearshore. The offsite location is an access point to Columbia River surface water, which could be at various points near the site and at population centers downstream of the site. Total offsite population is 5 million people.

Consistent with DOE guidance (DOE Guide 435.1-1), the potential consequences of loss of administrative or institutional control are considered by estimation of impacts on onsite receptors. Because DOE does not anticipate loss of control of the site, these onsite receptors are considered hypothetical and are applied to develop estimates for past and future periods of time.

Four types of receptors are considered. The first type, a drinking-water well user, uses groundwater as a source of drinking water. The second type, a resident farmer, uses either groundwater or surface water, but not both, for drinking water consumption and irrigation of crops. Garden size and crop yield are adequate to produce approximately 25 percent of average requirements of crops and animal products. The third type, an American Indian resident farmer, also uses either groundwater or surface water, but not both, for drinking water consumption and irrigation of crops. Garden size and crop yield are adequate to produce the entirety of average requirements of crops and animal products. The fourth type, an American Indian hunter-gatherer, is impacted by both groundwater and surface water because he uses surface water for drinking water consumption and consumes wild plant materials, which use groundwater, and game, which use surface water. In subsequent subsections, estimates of impacts are presented in two sets of tables, one set for receptors using groundwater and one set for users of surface water. To facilitate presentation, estimates of impact on the American Indian hunter-gatherer are presented in the set of tables for surface-water users. Members of the offsite populations are assumed to have the activity pattern of a residential farmer, using surface water to meet the total annual drinking water requirement and to irrigate a garden that provides approximately 25 percent of annual crop and animal product requirements. These receptors are also assumed to consume fish harvested from the river. Impacts on an individual of the offsite population are the same as those reported in tables in this appendix for the resident farmer at the Columbia River surface-water location.

Impacts that depend upon or would be affected by Tank Closure alternatives would be evident after CY 2050, the approximate time assumed for placement of engineered caps. However, releases to the vadose zone associated with past practices such as planned discharges to cribs and trenches (ditches) and with leaks from tanks occurring after CY 1940 but before CY 2050, may continue to produce impacts into the future. Because of uncertainties in estimates of the time of occurrence of impacts and the perspective that could be added by knowledge of past impacts, estimates of peak impacts are provided for time periods beginning in CY 1940 and in CY 2050. In addition, a time series of estimates of radiological risk for the drinking-water well user at the Core Zone Boundary is presented to provide a view of the evolution of impacts over the entire period of analysis. Further discussion about these receptors is provided in Section Q.2 of this appendix.

The results of the analysis for drinking-water well users after CY 2050 are summarized in Tables Q–18 through Q–21 for radioactive and chemical constituents. Impacts due to ingestion of

drinking water under Tank Closure Alternative 1, which assumes catastrophic failure of the tanks, would approach but not exceed the 100-millirem-per-year dose standard at the A Barrier. For the other Tank Closure alternatives, the results indicate that planned discharges to cribs and trenches (ditches) and past leaks at the B, BX, BY, T, and TX tank farms would be important contributors to radiological and chemical impacts (see subsequent text for detailed results). Under Tank Closure Alternatives 2A, 2B, 3A, 3B, 3C, 4, 5, 6A (Base and Option Cases), 6B (Base and Option Cases), and 6C, doses would not be greater than the 100-millirem-per-year standard at any location. Under all Tank Closure alternatives, doses estimated for drinking water ingestion are less than 10 millirem per year at the Columbia River nearshore location. For impacts occurring prior to CY 5000, radiological impacts would be due to tritium, technetium-99 and iodine-129; chemical impacts would be due to chromium and nitrate. For impacts occurring after CY 5000, radiological impacts would be due to uranium isotopes; chemical impacts would be due to total uranium.

Table Q–18. Summary of Radiation Dose at Year of Peak Dose for the Drinking-Water Well User (millirem per year)

	Tank Closure Alternative								
Location	**1**	**2A**	**2B, 3A, 3B, 3C, 6C**	**4**	**5**	**6A, Base Case**	**6A, Option Case**	**6B, Base Case**	**6B, Option Case**
A Barrier	8.37×10^{1} (2121)	2.17 (2095)	1.74 (2102)	1.78 (2100)	2.00 (4155)	2.16 (2103)	2.16 (2103)	1.99 (2093)	1.99 (2093)
B Barrier	5.88×10^{1} (4313)	8.64 (2069)	7.55 (2056)	7.38 (2056)	7.54 (2056)	7.34 (2056)	7.64 (2066)	7.32 (2056)	7.92 (2065)
S Barrier	4.73×10^{1} (3072)	3.50 (2051)	3.43 (2051)	4.54×10^{-1} (2050)	6.15 (4321)	3.36 (2052)	3.36 (2052)	3.42 (2050)	3.42 (2050)
T Barrier	1.52×10^{1} (2051)	1.51×10^{1} (2050)	1.55×10^{1} (2050)	1.55×10^{1} (2050)	1.56×10^{1} (2050)	1.54×10^{1} (2050)	1.53×10^{1} (2050)	1.52×10^{1} (2050)	1.51×10^{1} (2051)
U Barrier	2.23×10^{1} (4002)	1.14 (2100)	5.20×10^{-1} (3296)	3.14×10^{-1} (2058)	2.58 (3949)	2.89×10^{-1} (2067)	2.89×10^{-1} (2067)	2.86×10^{-1} (2067)	2.86×10^{-1} (2067)
Core Zone Boundary	5.88×10^{1} (4313)	8.64 (2069)	7.58 (2056)	7.41 (2056)	7.57 (2056)	7.37 (2056)	7.64 (2066)	7.35 (2056)	7.92 (2065)
Columbia River nearshore	4.37 (4978)	9.41×10^{-1} (2317)	8.85×10^{-1} (2242)	8.82×10^{-1} (2242)	8.94×10^{-1} (4809)	8.76×10^{-1} (2251)	8.99×10^{-1} (2251)	8.22×10^{-1} (2218)	8.07×10^{-1} (2218)

Note: Dose for year of peak dose, with calendar year of peak dose in parentheses.

Table Q–19. Summary of Radiological Risk at Year of Peak Radiological Risk for the Drinking-Water Well User

Location	Tank Closure Alternative								
	1	2A	2B, 3A, 3B, 3C, 6C	4	5	6A, Base Case	6A, Option Case	6B, Base Case	6B, Option Case
A Barrier	2.63×10^{-3} (2121)	6.35×10^{-5} (2095)	5.09×10^{-5} (2102)	5.20×10^{-5} (2100)	6.76×10^{-5} (4155)	6.33×10^{-5} (2103)	6.33×10^{-5} (2103)	5.79×10^{-5} (2093)	5.79×10^{-5} (2093)
B Barrier	1.73×10^{-3} (3957)	2.59×10^{-4} (2069)	2.30×10^{-4} (2056)	2.25×10^{-4} (2056)	2.38×10^{-4} (3616)	2.24×10^{-4} (2056)	2.34×10^{-4} (2066)	2.23×10^{-4} (2056)	2.41×10^{-4} (2065)
S Barrier	1.46×10^{-3} (3072)	1.02×10^{-4} (2051)	9.97×10^{-5} (2051)	1.31×10^{-5} (2050)	2.08×10^{-4} (4314)	9.76×10^{-5} (2052)	9.76×10^{-5} (2052)	9.87×10^{-5} (2050)	9.87×10^{-5} (2050)
T Barrier	4.33×10^{-4} (2050)	4.33×10^{-4} (2050)	4.41×10^{-4} (2050)	4.41×10^{-4} (2050)	4.44×10^{-4} (2050)	4.37×10^{-4} (2050)	4.36×10^{-4} (2050)	4.32×10^{-4} (2050)	4.31×10^{-4} (2051)
U Barrier	6.48×10^{-4} (3985)	3.34×10^{-5} (2100)	1.63×10^{-5} (3296)	9.47×10^{-6} (2058)	8.64×10^{-5} (3949)	8.84×10^{-6} (2067)	8.84×10^{-6} (2067)	8.76×10^{-6} (2067)	8.76×10^{-6} (2067)
Core Zone Boundary	1.73×10^{-3} (3957)	2.59×10^{-4} (2069)	2.30×10^{-4} (2056)	2.25×10^{-4} (2056)	2.38×10^{-4} (3616)	2.24×10^{-4} (2056)	2.34×10^{-4} (2066)	2.24×10^{-4} (2056)	2.41×10^{-4} (2065)
Columbia River nearshore	1.11×10^{-4} (4978)	2.75×10^{-5} (2317)	2.60×10^{-5} (2254)	2.58×10^{-5} (2242)	2.94×10^{-5} (4809)	2.54×10^{-5} (2251)	2.61×10^{-5} (2239)	2.38×10^{-5} (2221)	2.33×10^{-5} (2256)

Note: Radiological risk for year of peak radiological risk, with calendar year of peak radiological risk in parentheses.

Table Q–20. Summary of Hazard Index at Year of Peak Hazard Index for the Drinking-Water Well User

Location	Tank Closure Alternative								
	1	2A	2B, 3A, 3B, 3C, 6C	4	5	6A, Base Case	6A, Option Case	6B, Base Case	6B, Option Case
A Barrier	3.64 (3710)	1.43 (2170)	1.05 (2168)	9.48×10^{-1} (2168)	1.03 (2168)	1.06 (2168)	1.07 (2164)	9.53×10^{-1} (2168)	8.26×10^{-1} (2097)
B Barrier	9.20 (3696)	5.26 (2068)	4.81 (2050)	4.80 (2050)	4.81 (2050)	4.80 (2050)	5.22 (2051)	4.80 (2050)	5.23 (2083)
S Barrier	5.91 (3242)	1.58 (2050)	1.57 (2051)	2.72×10^{-1} (2059)	1.59 (2050)	1.56 (2050)	1.56 (2050)	1.58 (2051)	1.58 (2051)
T Barrier	4.28 (2051)	4.32 (2053)	4.47 (2051)	4.47 (2051)	4.48 (2051)	4.48 (2051)	4.35 (2050)	4.47 (2051)	4.31 (2050)
U Barrier	2.33 (4027)	2.44×10^{-1} (2092)	6.73×10^{-2} (2056)	6.73×10^{-2} (2056)	3.42×10^{-1} (3565)	6.09×10^{-2} (2050)	6.09×10^{-2} (2050)	6.18×10^{-2} (2050)	6.18×10^{-2} (2050)
Core Zone Boundary	9.20 (3696)	5.26 (2068)	4.81 (2050)	4.80 (2050)	4.81 (2050)	4.80 (2050)	5.22 (2051)	4.80 (2050)	5.23 (2083)
Columbia River nearshore	1.01 (4498)	1.01 (2079)	9.71×10^{-1} (2076)	9.71×10^{-1} (2076)	9.71×10^{-1} (2076)	9.71×10^{-1} (2076)	9.12×10^{-1} (2076)	9.72×10^{-1} (2076)	8.30×10^{-1} (2074)

Note: Hazard Index for year of peak Hazard Index, with calendar year of Hazard Index peak in parentheses.

Table Q–21. Summary of Nonradiological Risk at Year of Peak Nonradiological Risk for the Drinking-Water Well User

Tank Closure Alternative	Location						
	A Barrier	B Barrier	S Barrier	T Barrier	U Barrier	Core Zone Boundary	Columbia River Nearshore
1	1.93×10^{-12} (11,778)	5.39×10^{-13} (11,929)	3.50×10^{-12} (11,843)	0.00 (1940)	0.00 (1940)	1.13×10^{-12} (11,776)	2.41×10^{-13} (11,904)
2A–6C[a]	Not applicable						

[a] Including Alternatives 6A and 6B, Base and Option Cases.

Note: Nonradiological risk for year of peak radiological risk, with calendar year of peak nonradiological risk in parentheses. The nonradiological risk driver is 2,4,6-trichlorophenol, which is below the 1×10^{-10} cutoff concentration and is therefore not shown in the alternative-specific table.

Q.3.1.1.1 Tank Closure Alternative 1

Under Tank Closure Alternative 1, the tank farms would be maintained in the current condition indefinitely but, for analysis purposes, are assumed to fail after an institutional control period of 100 years. At this time, the salt cake in the single-shell tanks is assumed available for leaching into the vadose zone, and the liquid contents of the double-shell tanks are assumed to be discharged directly to the vadose zone. Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–22 through Q–26; to past leaks after CY 1940, in Tables Q–27 through Q–34; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–35 through Q–42.

Table Q–22. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.60×10^{-4}	7.72×10^{1}	7.32×10^{-4}	6.60×10^{-4}	8.97×10^{1}	8.84×10^{-4}	6.60×10^{-4}	1.07×10^{2}	1.12×10^{-3}
Technetium-99	3.50×10^{-5}	6.13×10^{1}	2.11×10^{-3}	3.50×10^{-5}	1.58×10^{2}	6.94×10^{-3}	3.50×10^{-5}	3.23×10^{2}	1.52×10^{-2}
Iodine-129	4.40×10^{-8}	1.25×10^{1}	1.43×10^{-4}	4.40×10^{-8}	1.57×10^{1}	2.20×10^{-4}	4.40×10^{-8}	2.02×10^{1}	3.34×10^{-4}
Total	**N/A**	**1.51×10^{2}**	**2.98×10^{-3}**	**N/A**	**2.63×10^{2}**	**8.04×10^{-3}**	**N/A**	**4.50×10^{2}**	**1.66×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1964	1964	1964
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.08	5.79×10^{1}	0.00	2.88	2.84×10^{1}	2.39×10^{-8}	2.88	4.27×10^{1}	1.09×10^{-3}
Nitrate	1.71×10^{3}	3.05×10^{1}	0.00	2.03×10^{3}	2.84×10^{2}	0.00	2.03×10^{3}	6.34×10^{2}	0.00
Total	**N/A**	**8.84×10^{1}**	**0.00**	**N/A**	**3.13×10^{2}**	**2.39×10^{-8}**	**N/A**	**6.77×10^{2}**	**1.09×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–23. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.59×10^{-3}	8.88×10^{2}	8.42×10^{-3}	7.59×10^{-3}	1.03×10^{3}	1.02×10^{-2}	7.59×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.20×10^{-7}	2.11×10^{-1}	7.25×10^{-6}	1.20×10^{-7}	5.43×10^{-1}	2.38×10^{-5}	1.20×10^{-7}	1.11	5.21×10^{-5}
Iodine-129	1.10×10^{-9}	3.13×10^{-1}	3.56×10^{-6}	1.10×10^{-9}	3.91×10^{-1}	5.50×10^{-6}	1.10×10^{-9}	5.05×10^{-1}	8.32×10^{-6}
Total	**N/A**	**8.88×10^{2}**	**8.43×10^{-3}**	**N/A**	**1.03×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.72	6.40×10^{1}	0.00	6.72	6.64×10^{1}	2.64×10^{-8}	6.72	9.99×10^{1}	1.21×10^{-3}
Nitrate	1.56×10^{3}	2.78×10^{1}	0.00	1.56×10^{3}	2.19×10^{2}	0.00	1.56×10^{3}	4.88×10^{2}	0.00
Total	**N/A**	**9.18×10^{1}**	**0.00**	**N/A**	**2.85×10^{2}**	**2.64×10^{-8}**	**N/A**	**5.88×10^{2}**	**1.21×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–24. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.60×10^{-4}	7.72×10^{1}	7.32×10^{-4}	6.60×10^{-4}	8.97×10^{1}	8.84×10^{-4}	6.60×10^{-4}	1.07×10^{2}	1.12×10^{-3}
Technetium-99	3.50×10^{-5}	6.13×10^{1}	2.11×10^{-3}	3.50×10^{-5}	1.58×10^{2}	6.94×10^{-3}	3.50×10^{-5}	3.23×10^{2}	1.52×10^{-2}
Iodine-129	4.40×10^{-8}	1.25×10^{1}	1.43×10^{-4}	4.40×10^{-8}	1.57×10^{1}	2.20×10^{-4}	4.40×10^{-8}	2.02×10^{1}	3.34×10^{-4}
Total	**N/A**	**1.51×10^{2}**	**2.98×10^{-3}**	**N/A**	**2.63×10^{2}**	**8.04×10^{-3}**	**N/A**	**4.50×10^{2}**	**1.66×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.08	5.79×10^{1}	0.00	2.88	2.84×10^{1}	2.39×10^{-8}	2.88	4.27×10^{1}	1.09×10^{-3}
Nitrate	1.71×10^{3}	3.05×10^{1}	0.00	2.03×10^{3}	2.84×10^{2}	0.00	2.03×10^{3}	6.34×10^{2}	0.00
Total	**N/A**	**8.84×10^{1}**	**0.00**	**N/A**	**3.13×10^{2}**	**2.39×10^{-8}**	**N/A**	**6.77×10^{2}**	**1.09×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–25. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.06×10^{-5}	1.24	1.18×10^{-5}	1.06×10^{-5}	1.45	1.43×10^{-5}	1.06×10^{-5}	1.72	1.81×10^{-5}
Technetium-99	8.61×10^{-7}	1.51	5.18×10^{-5}	8.61×10^{-7}	3.88	1.70×10^{-4}	8.61×10^{-7}	7.93	3.73×10^{-4}
Iodine-129	1.10×10^{-9}	3.13×10^{-1}	3.56×10^{-6}	1.10×10^{-9}	3.91×10^{-1}	5.50×10^{-6}	1.10×10^{-9}	5.05×10^{-1}	8.32×10^{-6}
Total	**N/A**	**3.06**	**6.72×10^{-5}**	**N/A**	**5.72**	**1.90×10^{-4}**	**N/A**	**1.02×10^{1}**	**3.99×10^{-4}**
Year of peak impact	1964	1964	1964	1964	1964	1964	1964	1964	1964
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.32×10^{-1}	2.21	0.00	1.35×10^{-1}	1.34	9.09×10^{-10}	1.35×10^{-1}	2.01	4.17×10^{-5}
Nitrate	4.26×10^{1}	7.61×10^{-1}	0.00	7.16×10^{1}	1.01×10^{1}	0.00	7.16×10^{1}	2.24×10^{1}	0.00
Total	**N/A**	**2.97**	**0.00**	**N/A**	**1.14×10^{1}**	**9.09×10^{-10}**	**7.18×10^{1}**	**2.44×10^{1}**	**4.17×10^{-5}**
Year of peak impact	2017	2017	N/A	1964	1964	2017	1964	1964	2017

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–26. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.24×10^{-10}	9.85×10^{-5}	9.70×10^{-10}	7.24×10^{-10}	1.20×10^{-4}	1.27×10^{-9}	1.06×10^{-5}	6.76×10^{-2}	1.25×10^{-6}
Technetium-99	4.92×10^{-11}	2.22×10^{-4}	9.74×10^{-9}	4.92×10^{-11}	5.12×10^{-4}	2.43×10^{-8}	8.61×10^{-7}	2.59×10^{-2}	1.39×10^{-6}
Iodine-129	6.35×10^{-14}	2.27×10^{-5}	3.19×10^{-10}	6.35×10^{-14}	3.46×10^{-4}	8.31×10^{-9}	1.10×10^{-9}	3.98×10^{-3}	9.77×10^{-8}
Total	**N/A**	**3.43×10^{-4}**	**1.10×10^{-8}**	**N/A**	**9.78×10^{-4}**	**3.39×10^{-8}**	**N/A**	**9.75×10^{-2}**	**2.73×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.68×10^{-5}	1.66×10^{-4}	6.85×10^{-14}	1.68×10^{-5}	2.72×10^{-4}	3.14×10^{-9}	3.04×10^{-2}	1.34×10^{-1}	4.17×10^{-5}
Nitrate	4.78×10^{-3}	7.24×10^{-4}	0.00	4.78×10^{-3}	4.51×10^{-1}	0.00	1.33×10^{1}	4.44	0.00
Total	**N/A**	**8.90×10^{-4}**	**6.85×10^{-14}**	**N/A**	**4.51×10^{-1}**	**3.14×10^{-9}**	**N/A**	**4.58**	**4.17×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2017

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–27. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.91×10^{-7}	2.24×10^{-2}	2.12×10^{-7}	1.91×10^{-7}	2.60×10^{-2}	2.56×10^{-7}	1.91×10^{-7}	3.10×10^{-2}	3.25×10^{-7}
Technetium-99	1.36×10^{-6}	2.39	8.21×10^{-5}	1.36×10^{-6}	6.15	2.70×10^{-4}	1.36×10^{-6}	1.26×10^{1}	5.90×10^{-4}
Iodine-129	5.41×10^{-10}	1.54×10^{-1}	1.75×10^{-6}	5.41×10^{-10}	1.93×10^{-1}	2.71×10^{-6}	5.41×10^{-10}	2.49×10^{-1}	4.10×10^{-6}
Total	**N/A**	**2.56**	**8.40×10^{-5}**	**N/A**	**6.37**	**2.73×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.95×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.67×10^{-2}	6.35×10^{-1}	0.00	6.67×10^{-2}	6.59×10^{-1}	2.62×10^{-10}	6.67×10^{-2}	9.91×10^{-1}	1.20×10^{-5}
Nitrate	2.23	3.99×10^{-2}	0.00	2.23	3.13×10^{-1}	0.00	2.23	6.99×10^{-1}	0.00
Total	**N/A**	**6.75×10^{-1}**	**0.00**	**N/A**	**9.72×10^{-1}**	**2.62×10^{-10}**	**N/A**	**1.69**	**1.20×10^{-5}**
Year of peak impact	2102	2102	N/A	2102	2102	2102	2102	2102	2102

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–28. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.23×10^{-9}	2.61×10^{-4}	2.48×10^{-9}	2.23×10^{-9}	3.04×10^{-4}	2.99×10^{-9}	2.23×10^{-9}	3.62×10^{-4}	3.80×10^{-9}
Technetium-99	2.43×10^{-6}	4.26	1.47×10^{-4}	2.43×10^{-6}	1.10×10^{1}	4.82×10^{-4}	2.43×10^{-6}	2.24×10^{1}	1.05×10^{-3}
Iodine-129	4.73×10^{-9}	1.35	1.53×10^{-5}	4.73×10^{-9}	1.68	2.37×10^{-5}	4.73×10^{-9}	2.18	3.58×10^{-5}
Total	**N/A**	**5.61**	**1.62×10^{-4}**	**N/A**	**1.27×10^{1}**	**5.06×10^{-4}**	**N/A**	**2.46×10^{1}**	**1.09×10^{-3}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.15×10^{-2}	5.86×10^{-1}	0.00	6.15×10^{-2}	6.07×10^{-1}	2.45×10^{-10}	6.15×10^{-2}	9.14×10^{-1}	1.12×10^{-5}
Nitrate	4.09	7.31×10^{-2}	0.00	4.09	5.74×10^{-1}	0.00	4.09	1.28	0.00
Total	**N/A**	**6.59×10^{-1}**	**0.00**	**N/A**	**1.18**	**2.45×10^{-10}**	**N/A**	**2.19**	**1.12×10^{-5}**
Year of peak impact	2096	2096	N/A	2096	2096	2115	2096	2096	2115

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–29. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.62×10^{-7}	1.90×10^{-2}	1.80×10^{-7}	1.62×10^{-7}	2.20×10^{-2}	2.17×10^{-7}	1.62×10^{-7}	2.63×10^{-2}	2.76×10^{-7}
Technetium-99	2.47×10^{-6}	4.32	1.49×10^{-4}	2.47×10^{-6}	1.11×10^{1}	4.89×10^{-4}	2.47×10^{-6}	2.27×10^{1}	1.07×10^{-3}
Iodine-129	4.64×10^{-9}	1.32	1.50×10^{-5}	4.64×10^{-9}	1.65	2.32×10^{-5}	4.64×10^{-9}	2.13	3.52×10^{-5}
Total	**N/A**	**5.66**	**1.64×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.12×10^{-4}**	**N/A**	**2.49×10^{1}**	**1.10×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.44×10^{-1}	2.32	0.00	2.43×10^{-1}	2.40	9.59×10^{-10}	2.43×10^{-1}	3.62	4.40×10^{-5}
Nitrate	6.92	1.24×10^{-1}	0.00	6.98	9.80×10^{-1}	0.00	6.98	2.18	0.00
Total	**N/A**	**2.45**	**0.00**	**N/A**	**3.38**	**9.59×10^{-10}**	**N/A**	**5.80**	**4.40×10^{-5}**
Year of peak impact	2030	2030	N/A	2026	2026	2030	2026	2026	2030

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–30. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.06×10^{-6}	2.41×10^{-1}	2.29×10^{-6}	2.06×10^{-6}	2.80×10^{-1}	2.76×10^{-6}	2.06×10^{-6}	3.34×10^{-1}	3.50×10^{-6}
Technetium-99	1.06×10^{-5}	1.85×10^{1}	6.36×10^{-4}	1.06×10^{-5}	4.76×10^{1}	2.09×10^{-3}	1.06×10^{-5}	9.73×10^{1}	4.57×10^{-3}
Iodine-129	2.05×10^{-8}	5.84	6.64×10^{-5}	2.05×10^{-8}	7.29	1.03×10^{-4}	2.05×10^{-8}	9.42	1.55×10^{-4}
Total	**N/A**	**2.46×10^{1}**	**7.04×10^{-4}**	**N/A**	**5.52×10^{1}**	**2.20×10^{-3}**	**N/A**	**1.07×10^{2}**	**4.73×10^{-3}**
Year of peak impact	2023	2023	2023	2023	2023	2023	2023	2023	2023
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.03×10^{-1}	2.88	0.00	3.00×10^{-1}	2.96	1.19×10^{-9}	3.00×10^{-1}	4.46	5.45×10^{-5}
Nitrate	2.38×10^{1}	4.25×10^{-1}	0.00	2.40×10^{1}	3.37	0.00	2.40×10^{1}	7.52	0.00
Total	**N/A**	**3.31**	**0.00**	**N/A**	**6.34**	**1.19×10^{-9}**	**N/A**	**1.20×10^{1}**	**5.45×10^{-5}**
Year of peak impact	2023	2023	N/A	2024	2024	2023	2024	2024	2023

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–31. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.81×10^{-9}	5.63×10^{-4}	5.34×10^{-9}	4.81×10^{-9}	6.54×10^{-4}	3.57×10^{-9}	4.81×10^{-9}	7.79×10^{-4}	4.53×10^{-9}
Technetium-99	1.36×10^{-7}	2.38×10^{-1}	8.19×10^{-6}	1.36×10^{-7}	6.13×10^{-1}	2.69×10^{-5}	1.36×10^{-7}	1.25	5.89×10^{-5}
Iodine-129	1.61×10^{-10}	4.60×10^{-2}	5.23×10^{-7}	1.61×10^{-10}	5.74×10^{-2}	7.99×10^{-7}	1.61×10^{-10}	7.42×10^{-2}	1.21×10^{-6}
Total	**N/A**	**2.85×10^{-1}**	**8.72×10^{-6}**	**N/A**	**6.71×10^{-1}**	**2.77×10^{-5}**	**N/A**	**1.33**	**6.01×10^{-5}**
Year of peak impact	2071	2071	2071	2071	2071	2081	2071	2071	2081
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.21×10^{-3}	5.91×10^{-2}	0.00	6.21×10^{-3}	6.13×10^{-2}	2.44×10^{-11}	6.21×10^{-3}	9.23×10^{-2}	1.12×10^{-6}
Nitrate	4.46×10^{-1}	7.96×10^{-3}	0.00	4.46×10^{-1}	6.25×10^{-2}	0.00	4.46×10^{-1}	1.39×10^{-1}	0.00
Total	**N/A**	**6.71×10^{-2}**	**0.00**	**N/A**	**1.24×10^{-1}**	**2.44×10^{-11}**	**N/A**	**2.32×10^{-1}**	**1.12×10^{-6}**
Year of peak impact	2040	2040	N/A	2040	2040	2040	2040	2040	2040

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–32. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.23×10^{-9}	2.61×10^{-4}	2.48×10^{-9}	2.23×10^{-9}	3.04×10^{-4}	2.99×10^{-9}	2.23×10^{-9}	3.62×10^{-4}	3.80×10^{-9}
Technetium-99	2.43×10^{-6}	4.26	1.47×10^{-4}	2.43×10^{-6}	1.10×10^{1}	4.82×10^{-4}	2.43×10^{-6}	2.24×10^{1}	1.05×10^{-3}
Iodine-129	4.73×10^{-9}	1.35	1.53×10^{-5}	4.73×10^{-9}	1.68	2.37×10^{-5}	4.73×10^{-9}	2.18	3.58×10^{-5}
Total	**N/A**	**5.61**	**1.62×10^{-4}**	**N/A**	**1.27×10^{1}**	**5.06×10^{-4}**	**N/A**	**2.46×10^{1}**	**1.09×10^{-3}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.27×10^{-2}	7.87×10^{-1}	0.00	7.89×10^{-2}	7.79×10^{-1}	3.25×10^{-10}	7.89×10^{-2}	1.17	1.49×10^{-5}
Nitrate	3.25	5.80×10^{-2}	0.00	4.09	5.74×10^{-1}	0.00	4.09	1.28	0.00
Total	**N/A**	**8.45×10^{-1}**	**0.00**	**N/A**	**1.35**	**3.25×10^{-10}**	**N/A**	**2.45**	**1.49×10^{-5}**
Year of peak impact	2110	2110	N/A	2096	2096	2110	2096	2096	2110

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–33. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.41×10^{-7}	5.97×10^{-1}	2.08×10^{-5}	3.45×10^{-7}	1.56	6.84×10^{-5}	3.45×10^{-7}	3.18	1.50×10^{-4}
Iodine-129	6.63×10^{-10}	1.89×10^{-1}	2.03×10^{-6}	6.28×10^{-10}	2.24×10^{-1}	3.15×10^{-6}	6.28×10^{-10}	2.89×10^{-1}	4.76×10^{-6}
Total	**3.42×10^{-7}**	**7.86×10^{-1}**	**2.28×10^{-5}**	**3.46×10^{-7}**	**1.78**	**7.15×10^{-5}**	**3.46×10^{-7}**	**3.47**	**1.54×10^{-4}**
Year of peak impact	2222	2222	2214	2214	2214	2214	2214	2214	2214
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.54×10^{-3}	8.13×10^{-2}	0.00	8.38×10^{-3}	8.28×10^{-2}	3.35×10^{-11}	8.38×10^{-3}	1.25×10^{-1}	1.54×10^{-6}
Nitrate	6.22×10^{-1}	1.11×10^{-2}	0.00	6.34×10^{-1}	8.90×10^{-2}	0.00	6.34×10^{-1}	1.98×10^{-1}	0.00
Total	**6.30×10^{-1}**	**9.24×10^{-2}**	**0.00**	**6.42×10^{-1}**	**1.72×10^{-1}**	**3.35×10^{-11}**	**6.42×10^{-1}**	**3.23×10^{-1}**	**1.54×10^{-6}**
Year of peak impact	2239	2239	N/A	2245	2245	2239	2245	2245	2239

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–34. Tank Closure Alternative 1 Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.85×10^{-12}	3.54×10^{-5}	1.55×10^{-9}	7.71×10^{-12}	8.02×10^{-5}	3.88×10^{-9}	3.45×10^{-7}	1.04×10^{-2}	5.57×10^{-7}
Iodine-129	1.46×10^{-14}	5.20×10^{-6}	7.33×10^{-11}	1.49×10^{-14}	8.12×10^{-5}	1.91×10^{-9}	6.28×10^{-10}	2.45×10^{-3}	6.01×10^{-8}
Total	**N/A**	**4.06×10^{-5}**	**1.63×10^{-9}**	**N/A**	**1.61×10^{-4}**	**5.79×10^{-9}**	**N/A**	**1.29×10^{-2}**	**6.18×10^{-7}**
Year of peak impact	2188	2188	2188	2185	2185	2188	2214	2214	2214
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.03×10^{-7}	2.99×10^{-6}	1.19×10^{-15}	2.88×10^{-7}	4.66×10^{-6}	5.45×10^{-11}	8.54×10^{-3}	3.76×10^{-2}	1.54×10^{-6}
Nitrate	1.61×10^{-5}	2.44×10^{-6}	0.00	1.63×10^{-5}	1.53×10^{-3}	0.00	6.22×10^{-1}	3.29×10^{-2}	0.00
Total	**N/A**	**5.43×10^{-6}**	**1.19×10^{-15}**	**N/A**	**1.54×10^{-3}**	**5.45×10^{-11}**	**N/A**	**7.05×10^{-2}**	**1.54×10^{-6}**
Year of peak impact	2199	2199	2199	2193	2193	2199	2239	2239	2239

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–35. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.82×10^{-6}	2.13×10^{-1}	2.02×10^{-6}	1.82×10^{-6}	2.48×10^{-1}	2.44×10^{-6}	1.82×10^{-6}	2.95×10^{-1}	3.09×10^{-6}
Technetium-99	4.17×10^{-5}	7.30×10^{1}	2.51×10^{-3}	4.17×10^{-5}	1.88×10^{2}	8.25×10^{-3}	4.17×10^{-5}	3.84×10^{2}	1.81×10^{-2}
Iodine-129	3.69×10^{-8}	1.05×10^{1}	1.19×10^{-4}	3.69×10^{-8}	1.31×10^{1}	1.85×10^{-4}	3.69×10^{-8}	1.70×10^{1}	2.79×10^{-4}
Total	**N/A**	**8.37×10^{1}**	**2.63×10^{-3}**	**N/A**	**2.01×10^{2}**	**8.44×10^{-3}**	**N/A**	**4.01×10^{2}**	**1.83×10^{-2}**
Year of peak impact	2121	2121	2121	2121	2121	2121	2121	2121	2121

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	5.46×10^{-3}	2.60×10^{-2}	0.00	5.01×10^{-2}	2.98×10^{-1}	0.00	5.01×10^{-2}	5.39×10^{-1}	0.00
Chromium	3.23×10^{-1}	3.08	0.00	1.36×10^{-1}	1.34	1.27×10^{-9}	1.36×10^{-1}	2.01	5.82×10^{-5}
Nitrate	3.02×10^{1}	5.38×10^{-1}	0.00	4.69×10^{1}	6.58	0.00	4.69×10^{1}	1.47×10^{1}	0.00
Total uranium	3.90×10^{-7}	3.71×10^{-6}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**N/A**	**3.64**	**0.00**	**N/A**	**8.22**	**1.27×10^{-9}**	**N/A**	**1.72×10^{1}**	**5.82×10^{-5}**
Year of peak impact	3710	3710	N/A	2136	2136	3710	2136	2136	3710

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–36. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.59×10^{-5}	4.53×10^{1}	1.59×10^{-3}	2.65×10^{-5}	1.19×10^{2}	5.24×10^{-3}	2.65×10^{-5}	2.44×10^{2}	1.15×10^{-2}
Iodine-129	4.73×10^{-8}	1.35×10^{1}	1.34×10^{-4}	4.13×10^{-8}	1.47×10^{1}	2.07×10^{-4}	4.13×10^{-8}	1.90×10^{1}	3.13×10^{-4}
Uranium-238	1.22×10^{-12}	1.52×10^{-4}	1.09×10^{-9}	7.77×10^{-13}	1.00×10^{-4}	1.17×10^{-9}	7.77×10^{-13}	1.08×10^{-4}	1.34×10^{-9}
Total	**N/A**	**5.88×10^{1}**	**1.73×10^{-3}**	**N/A**	**1.34×10^{2}**	**5.45×10^{-3}**	**N/A**	**2.63×10^{2}**	**1.18×10^{-2}**
Year of peak impact	4313	4313	3957	3957	3957	3957	3957	3957	3957
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	2.05×10^{-3}	9.74×10^{-3}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chromium	8.62×10^{-1}	8.21	0.00	1.82×10^{-1}	1.80	3.39×10^{-9}	1.58×10^{-1}	2.35	1.56×10^{-4}
Nitrate	5.49×10^{1}	9.79×10^{-1}	0.00	1.86×10^{2}	2.61×10^{1}	0.00	1.87×10^{2}	5.86×10^{1}	0.00
Total uranium	1.80×10^{-5}	1.71×10^{-4}	0.00	1.09×10^{-6}	1.05×10^{-5}	0.00	3.25×10^{-6}	3.29×10^{-5}	0.00
Total	**N/A**	**9.20**	**0.00**	**N/A**	**2.79×10^{1}**	**3.39×10^{-9}**	**N/A**	**6.10×10^{1}**	**1.56×10^{-4}**
Year of peak impact	3696	3696	N/A	2065	2065	3882	2066	2066	3882

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A/=not applicable.

Table Q–37. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.28×10^{-5}	4.00×10^{1}	1.37×10^{-3}	2.28×10^{-5}	1.03×10^{2}	4.52×10^{-3}	2.28×10^{-5}	2.10×10^{2}	9.89×10^{-3}
Iodine-129	2.57×10^{-8}	7.32	8.33×10^{-5}	2.57×10^{-8}	9.15	1.29×10^{-4}	2.57×10^{-8}	1.18×10^{1}	1.95×10^{-4}
Total	**N/A**	**4.73×10^{1}**	**1.46×10^{-3}**	**N/A**	**1.12×10^{2}**	**4.65×10^{-3}**	**N/A**	**2.22×10^{2}**	**1.01×10^{-2}**
Year of peak impact	3072	3072	3072	3072	3072	3072	3072	3072	3072
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.24×10^{-2}	1.06×10^{-1}	0.00	2.24×10^{-2}	1.33×10^{-1}	0.00	2.24×10^{-2}	2.41×10^{-1}	0.00
Chromium	5.41×10^{-1}	5.15	0.00	5.41×10^{-1}	5.34	2.12×10^{-9}	5.41×10^{-1}	8.03	9.74×10^{-5}
Nitrate	3.66×10^{1}	6.53×10^{-1}	0.00	3.66×10^{1}	5.14	0.00	3.66×10^{1}	1.15×10^{1}	0.00
Total uranium	3.89×10^{-7}	3.71×10^{-6}	0.00	3.89×10^{-7}	3.78×10^{-6}	0.00	3.89×10^{-7}	3.94×10^{-6}	0.00
Total	**N/A**	**5.91**	**0.00**	**N/A**	**1.06×10^{1}**	**2.12×10^{-9}**	**N/A**	**1.97×10^{1}**	**9.74×10^{-5}**
Year of peak impact	3242	3242	N/A	3242	3242	3242	3242	3242	3242

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–38. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.64×10^{-6}	3.09×10^{-1}	2.47×10^{-6}	2.23×10^{-6}	3.03×10^{-1}	2.98×10^{-6}	2.23×10^{-6}	3.61×10^{-1}	3.78×10^{-6}
Technetium-99	6.46×10^{-6}	1.13×10^{1}	3.90×10^{-4}	6.48×10^{-6}	2.92×10^{1}	1.28×10^{-3}	6.48×10^{-6}	5.97×10^{1}	2.81×10^{-3}
Iodine-129	1.26×10^{-8}	3.58	4.07×10^{-5}	1.26×10^{-8}	4.47	6.30×10^{-5}	1.26×10^{-8}	5.78	9.53×10^{-5}
Uranium-238	1.51×10^{-11}	1.87×10^{-3}	2.14×10^{-8}	1.53×10^{-11}	1.97×10^{-3}	2.31×10^{-8}	1.53×10^{-11}	2.12×10^{-3}	2.63×10^{-8}
Total	**N/A**	**1.52×10^{1}**	**4.33×10^{-4}**	**N/A**	**3.40×10^{1}**	**1.35×10^{-3}**	**N/A**	**6.58×10^{1}**	**2.90×10^{-3}**
Year of peak impact	2051	2051	2050	2050	2050	2050	2050	2050	2050
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.36×10^{-1}	3.20	0.00	3.22×10^{-1}	3.18	1.32×10^{-9}	3.22×10^{-1}	4.78	6.06×10^{-5}
Nitrate	6.03×10^{1}	1.08	0.00	6.20×10^{1}	8.71	0.00	6.20×10^{1}	1.94×10^{1}	0.00
Total uranium	2.26×10^{-5}	2.15×10^{-4}	0.00	2.24×10^{-5}	2.18×10^{-4}	0.00	2.24×10^{-5}	2.27×10^{-4}	0.00
Total	**N/A**	**4.28**	**0.00**	**N/A**	**1.19×10^{1}**	**1.32×10^{-9}**	**N/A**	**2.42×10^{1}**	**6.06×10^{-5}**
Year of peak impact	2051	2051	N/A	2056	2056	2036	2056	2056	2036

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–39. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	9.70×10^{-6}	1.70×10^{1}	5.92×10^{-4}	9.83×10^{-6}	4.43×10^{1}	1.95×10^{-3}	9.83×10^{-6}	9.05×10^{1}	4.26×10^{-3}
Iodine-129	1.85×10^{-8}	5.28	5.58×10^{-5}	1.72×10^{-8}	6.13	8.62×10^{-5}	1.72×10^{-8}	7.92	1.30×10^{-4}
Uranium-238	1.95×10^{-13}	2.41×10^{-5}	2.72×10^{-10}	1.94×10^{-13}	2.51×10^{-5}	2.93×10^{-10}	1.94×10^{-13}	2.70×10^{-5}	3.34×10^{-10}
Total	**N/A**	**2.23×10^{1}**	**6.48×10^{-4}**	**N/A**	**5.05×10^{1}**	**2.03×10^{-3}**	**N/A**	**9.85×10^{1}**	**4.39×10^{-3}**
Year of peak impact	4002	4002	3985	3985	3985	3985	3985	3985	3985
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	2.87×10^{-5}	1.37×10^{-4}	0.00	2.02×10^{-7}	1.20×10^{-6}	0.00	2.02×10^{-7}	2.17×10^{-6}	0.00
Chromium	2.08×10^{-1}	1.98	0.00	2.01×10^{-1}	1.98	8.18×10^{-10}	2.01×10^{-1}	2.98	3.75×10^{-5}
Nitrate	1.93×10^{1}	3.44×10^{-1}	0.00	2.25×10^{1}	3.15	0.00	2.25×10^{1}	7.03	0.00
Total uranium	1.89×10^{-7}	1.80×10^{-6}	0.00	2.84×10^{-7}	2.75×10^{-6}	0.00	2.84×10^{-7}	2.87×10^{-6}	0.00
Total	**N/A**	**2.33**	**0.00**	**N/A**	**5.13**	**8.18×10^{-10}**	**N/A**	**1.00×10^{1}**	**3.75×10^{-5}**
Year of peak impact	4027	4027	N/A	3957	3957	4027	3957	3957	4027

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–40. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.59×10^{-5}	4.53×10^{1}	1.59×10^{-3}	2.65×10^{-5}	1.19×10^{2}	5.24×10^{-3}	2.65×10^{-5}	2.44×10^{2}	1.15×10^{-2}
Iodine-129	4.73×10^{-8}	1.35×10^{1}	1.34×10^{-4}	4.13×10^{-8}	1.47×10^{1}	2.07×10^{-4}	4.13×10^{-8}	1.90×10^{1}	3.13×10^{-4}
Uranium-238	2.13×10^{-12}	2.64×10^{-4}	1.09×10^{-9}	7.77×10^{-13}	1.00×10^{-4}	1.17×10^{-9}	7.77×10^{-13}	1.08×10^{-4}	1.34×10^{-9}
Total	**N/A**	**5.88×10^{1}**	**1.73×10^{-3}**	**N/A**	**1.34×10^{2}**	**5.45×10^{-3}**	**N/A**	**2.63×10^{2}**	**1.18×10^{-2}**
Year of peak impact	4313	4313	3957	3957	3957	3957	3957	3957	3957

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	2.88×10^{-3}	1.37×10^{-2}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chromium	8.62×10^{-1}	8.21	0.00	1.82×10^{-1}	1.80	3.39×10^{-9}	1.58×10^{-1}	2.35	1.56×10^{-4}
Nitrate	5.49×10^{1}	9.79×10^{-1}	0.00	1.86×10^{2}	2.61×10^{1}	0.00	1.87×10^{2}	5.86×10^{1}	0.00
Total uranium	1.80×10^{-5}	1.71×10^{-4}	0.00	1.09×10^{-6}	1.05×10^{-5}	0.00	3.25×10^{-6}	3.29×10^{-5}	0.00
Total	**N/A**	**9.20**	**0.00**	**N/A**	**2.79×10^{1}**	**3.39×10^{-9}**	**N/A**	**6.10×10^{1}**	**1.56×10^{-4}**
Year of peak impact	3696	3696	N/A	2065	2065	3882	2066	2066	3882

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–41. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.53×10^{-6}	2.68	9.20×10^{-5}	1.53×10^{-6}	6.90	3.36×10^{-4}	1.53×10^{-6}	1.41×10^{1}	7.35×10^{-4}
Iodine-129	5.94×10^{-9}	1.69	1.92×10^{-5}	5.94×10^{-9}	2.11	9.42×10^{-6}	5.94×10^{-9}	2.73	1.43×10^{-5}
Uranium-238	3.03×10^{-13}	3.76×10^{-5}	4.24×10^{-10}	3.03×10^{-13}	3.91×10^{-5}	3.78×10^{-10}	3.03×10^{-13}	4.21×10^{-5}	4.30×10^{-10}
Total	**N/A**	**4.37**	**1.11×10^{-4}**	**N/A**	**9.01**	**3.45×10^{-4}**	**N/A**	**1.68×10^{1}**	**7.49×10^{-4}**
Year of peak impact	4978	4978	4978	4978	4978	2999	4978	4978	2999
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	3.03×10^{-4}	1.44×10^{-3}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chromium	8.35×10^{-2}	7.95×10^{-1}	0.00	6.62×10^{-2}	6.54×10^{-1}	3.28×10^{-10}	6.04×10^{-2}	8.98×10^{-1}	1.50×10^{-5}
Nitrate	1.19×10^{1}	2.12×10^{-1}	0.00	1.58×10^{1}	2.21	0.00	1.61×10^{1}	5.03	0.00
Total uranium	3.91×10^{-7}	3.72×10^{-6}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**N/A**	**1.01**	**0.00**	**N/A**	**2.86**	**3.28×10^{-10}**	**N/A**	**5.92**	**1.50×10^{-5}**
Year of peak impact	4498	4498	N/A	2067	2067	4498	2062	2062	4498

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–42. Tank Closure Alternative 1 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.23×10^{-10}	5.56×10^{-4}	2.44×10^{-8}	1.23×10^{-10}	1.28×10^{-3}	6.09×10^{-8}	1.53×10^{-6}	4.62×10^{-2}	2.79×10^{-6}
Iodine-129	1.91×10^{-13}	6.82×10^{-5}	9.61×10^{-10}	1.91×10^{-13}	1.04×10^{-3}	2.50×10^{-8}	5.94×10^{-9}	2.20×10^{-2}	2.94×10^{-7}
Uranium-238	0.00	0.00	0.00	0.00	0.00	0.00	3.03×10^{-13}	3.76×10^{-6}	6.78×10^{-11}
Total	**N/A**	**6.24×10^{-4}**	**2.54×10^{-8}**	**N/A**	**2.32×10^{-3}**	**8.59×10^{-8}**	**N/A**	**6.82×10^{-2}**	**3.08×10^{-6}**
Year of peak impact	3394	3394	3394	3394	3394	3394	4978	4978	2999
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	8.08×10^{-8}	4.81×10^{-7}	0.00	0.00	0.00	0.00	4.06×10^{-4}	2.44×10^{-3}	0.00
Chromium	2.73×10^{-6}	2.70×10^{-5}	1.09×10^{-14}	1.04×10^{-6}	1.69×10^{-5}	5.02×10^{-10}	7.94×10^{-2}	3.49×10^{-1}	1.50×10^{-5}
Nitrate	3.10×10^{-4}	4.70×10^{-5}	0.00	3.32×10^{-4}	3.13×10^{-2}	0.00	1.39×10^{1}	6.72×10^{-1}	0.00
Total uranium	0.00	0.00	0.00	0.00	0.00	0.00	4.24×10^{-7}	1.88×10^{-7}	0.00
Total	**N/A**	**7.44×10^{-5}**	**1.09×10^{-14}**	**N/A**	**3.13×10^{-2}**	**5.02×10^{-10}**	**N/A**	**1.02**	**1.50×10^{-5}**
Year of peak impact	3848	3848	3912	2155	2155	3912	4619	4619	4498

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Due to the large magnitude of the liquid release, transport through the vadose zone is rapid, and impacts exceeding dose standards are estimated for onsite locations. The largest contributor at the year of peak dose are the cribs and trenches (ditches) and the presence of tritium, technetium-99, iodine-129, uranium-238, chromium, nitrates, and total uranium. Due to large dilution in the Columbia River, offsite impacts on individuals are small. Population dose is estimated as 3.12 person-rem per year for the year of maximum impact.

Figure Q–2 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by technetium-99 and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2090 for the Core Zone Boundary and is dominated by technetium-99 and iodine-129. After CY 2150, peak radiological risk is dominated by the contributions from other tank farm sources, primarily tank residuals. The peak radiological risk resulting from all three sources occurs around CY 3960 and is dominated by technetium-99 and iodine-129. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater.

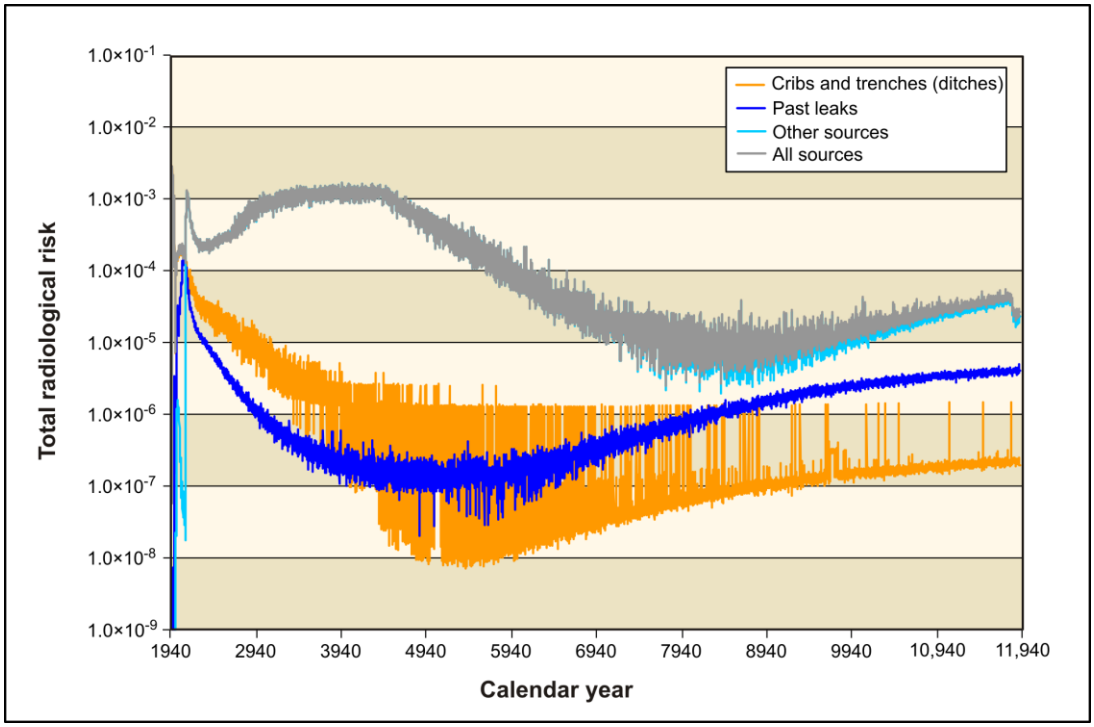

Figure Q–2. Tank Closure Alternative 1 Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.1.1.2 Tank Closure Alternative 2A

Under Tank Closure Alternative 2A, tank waste would be retrieved to a volume corresponding to 99 percent retrieval, but the residual material in tanks would not be stabilized. After an institutional control period of 100 years, salt cake in the tanks is assumed available for dissolution in infiltrating water.

Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–43 through Q–47; to past leaks after CY 1940, in Tables Q–48 through Q–55; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–56 through Q–63.

Table Q–43. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.75×10^{-4}	7.90×10^{1}	7.50×10^{-4}	6.75×10^{-4}	9.19×10^{1}	9.05×10^{-4}	6.75×10^{-4}	1.09×10^{2}	1.15×10^{-3}
Technetium-99	3.35×10^{-5}	5.86×10^{1}	2.01×10^{-3}	3.35×10^{-5}	1.51×10^{2}	6.63×10^{-3}	3.35×10^{-5}	3.08×10^{2}	1.45×10^{-2}
Iodine-129	4.37×10^{-8}	1.25×10^{1}	1.42×10^{-4}	4.37×10^{-8}	1.56×10^{1}	2.19×10^{-4}	4.37×10^{-8}	2.01×10^{1}	3.32×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.75×10^{-3}**	**N/A**	**4.38×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.03	5.74×10^{1}	0.00	2.79	2.76×10^{1}	2.37×10^{-8}	2.79	4.15×10^{1}	1.09×10^{-3}
Nitrate	1.77×10^{3}	3.16×10^{1}	0.00	2.04×10^{3}	2.87×10^{2}	0.00	2.04×10^{3}	6.40×10^{2}	0.00
Total	**N/A**	**8.90×10^{1}**	**0.00**	**N/A**	**3.14×10^{2}**	**2.37×10^{-8}**	**N/A**	**6.81×10^{2}**	**1.09×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–44. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.59×10^{-3}	8.88×10^{2}	8.42×10^{-3}	7.59×10^{-3}	1.03×10^{3}	1.02×10^{-2}	7.59×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.24×10^{-7}	2.17×10^{-1}	7.47×10^{-6}	1.24×10^{-7}	5.60×10^{-1}	2.46×10^{-5}	1.24×10^{-7}	1.14	5.37×10^{-5}
Iodine-129	1.10×10^{-9}	3.12×10^{-1}	3.55×10^{-6}	1.10×10^{-9}	3.90×10^{-1}	5.49×10^{-6}	1.10×10^{-9}	5.04×10^{-1}	8.31×10^{-6}
Total	**N/A**	**8.89×10^{2}**	**8.44×10^{-3}**	**N/A**	**1.03×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.71	6.39×10^{1}	0.00	6.71	6.62×10^{1}	2.63×10^{-8}	6.71	9.97×10^{1}	1.21×10^{-3}
Nitrate	1.55×10^{3}	2.77×10^{1}	0.00	1.55×10^{3}	2.18×10^{2}	0.00	1.55×10^{3}	4.86×10^{2}	0.00
Total	**N/A**	**9.16×10^{1}**	**0.00**	**N/A**	**2.84×10^{2}**	**2.63×10^{-8}**	**N/A**	**5.86×10^{2}**	**1.21×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–45. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.75×10^{-4}	7.90×10^{1}	7.50×10^{-4}	6.75×10^{-4}	9.19×10^{1}	9.05×10^{-4}	6.75×10^{-4}	1.09×10^{2}	1.15×10^{-3}
Technetium-99	3.35×10^{-5}	5.86×10^{1}	2.01×10^{-3}	3.35×10^{-5}	1.51×10^{2}	6.63×10^{-3}	3.35×10^{-5}	3.08×10^{2}	1.45×10^{-2}
Iodine-129	4.37×10^{-8}	1.25×10^{1}	1.42×10^{-4}	4.37×10^{-8}	1.56×10^{1}	2.19×10^{-4}	4.37×10^{-8}	2.01×10^{1}	3.32×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.75×10^{-3}**	**N/A**	**4.38×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.03	5.74×10^{1}	0.00	2.79	2.76×10^{1}	2.37×10^{-8}	2.79	4.15×10^{1}	1.09×10^{-3}
Nitrate	1.77×10^{3}	3.16×10^{1}	0.00	2.04×10^{3}	2.87×10^{2}	0.00	2.04×10^{3}	6.40×10^{2}	0.00
Total	**N/A**	**8.90×10^{1}**	**0.00**	**N/A**	**3.14×10^{2}**	**2.37×10^{-8}**	**N/A**	**6.81×10^{2}**	**1.09×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–46. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.07×10^{-5}	1.25	1.18×10^{-5}	1.07×10^{-5}	1.45	1.43×10^{-5}	1.07×10^{-5}	1.73	1.81×10^{-5}
Technetium-99	8.63×10^{-7}	1.51	5.19×10^{-5}	8.63×10^{-7}	3.89	1.71×10^{-4}	8.63×10^{-7}	7.95	3.74×10^{-4}
Iodine-129	1.06×10^{-9}	3.03×10^{-1}	3.45×10^{-6}	1.06×10^{-9}	3.79×10^{-1}	5.33×10^{-6}	1.06×10^{-9}	4.89×10^{-1}	8.07×10^{-6}
Total	**N/A**	**3.06**	**6.72×10^{-5}**	**N/A**	**5.72**	**1.90×10^{-4}**	**N/A**	**1.02×10^{1}**	**4.00×10^{-4}**
Year of peak impact	1964	1964	1964	1964	1964	1964	1964	1964	1964
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.22×10^{-1}	2.11	0.00	1.38×10^{-1}	1.36	8.70×10^{-10}	1.38×10^{-1}	2.05	3.99×10^{-5}
Nitrate	4.49×10^{1}	8.02×10^{-1}	0.00	7.01×10^{1}	9.84	0.00	7.01×10^{1}	2.19×10^{1}	0.00
Total	**N/A**	**2.91**	**0.00**	**N/A**	**1.12×10^{1}**	**8.70×10^{-10}**	**N/A**	**2.40×10^{1}**	**3.99×10^{-5}**
Year of peak impact	2016	2016	N/A	1964	1964	2016	1964	1964	2016

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–47. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.24×10^{-10}	9.84×10^{-5}	9.70×10^{-10}	7.24×10^{-10}	1.20×10^{-4}	1.27×10^{-9}	1.07×10^{-5}	6.77×10^{-2}	1.25×10^{-6}
Technetium-99	4.94×10^{-11}	2.23×10^{-4}	9.77×10^{-9}	4.94×10^{-11}	5.13×10^{-4}	2.44×10^{-8}	8.63×10^{-7}	2.60×10^{-2}	1.39×10^{-6}
Iodine-129	6.33×10^{-14}	2.26×10^{-5}	3.18×10^{-10}	6.33×10^{-14}	3.45×10^{-4}	8.29×10^{-9}	1.06×10^{-9}	3.88×10^{-3}	9.53×10^{-8}
Total	**N/A**	**3.44×10^{-4}**	**1.11×10^{-8}**	**N/A**	**9.78×10^{-4}**	**3.39×10^{-8}**	**N/A**	**9.76×10^{-2}**	**2.73×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.66×10^{-5}	1.64×10^{-4}	6.83×10^{-14}	1.66×10^{-5}	2.69×10^{-4}	3.13×10^{-9}	2.92×10^{-2}	1.29×10^{-1}	3.99×10^{-5}
Nitrate	4.79×10^{-3}	7.26×10^{-4}	0.00	4.79×10^{-3}	4.52×10^{-1}	0.00	1.42×10^{1}	4.48	0.00
Total	**N/A**	**8.90×10^{-4}**	**6.83×10^{-14}**	**N/A**	**4.52×10^{-1}**	**3.13×10^{-9}**	**N/A**	**4.61**	**3.99×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2016

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–48. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.88×10^{-7}	2.20×10^{-2}	2.09×10^{-7}	1.88×10^{-7}	2.56×10^{-2}	2.52×10^{-7}	1.88×10^{-7}	3.05×10^{-2}	3.20×10^{-7}
Technetium-99	1.39×10^{-6}	2.43	8.37×10^{-5}	1.39×10^{-6}	6.27	2.75×10^{-4}	1.39×10^{-6}	1.28×10^{1}	6.02×10^{-4}
Iodine-129	5.43×10^{-10}	1.55×10^{-1}	1.76×10^{-6}	5.43×10^{-10}	1.93×10^{-1}	2.72×10^{-6}	5.43×10^{-10}	2.50×10^{-1}	4.12×10^{-6}
Total	**N/A**	**2.61**	**8.57×10^{-5}**	**N/A**	**6.49**	**2.78×10^{-4}**	**N/A**	**1.31×10^{1}**	**6.07×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.07×10^{-2}	6.73×10^{-1}	0.00	7.07×10^{-2}	6.98×10^{-1}	2.78×10^{-10}	7.07×10^{-2}	1.05	1.27×10^{-5}
Nitrate	2.19	3.90×10^{-2}	0.00	2.19	3.07×10^{-1}	0.00	2.19	6.84×10^{-1}	0.00
Total	**N/A**	**7.12×10^{-1}**	**0.00**	**N/A**	**1.00**	**2.78×10^{-10}**	**N/A**	**1.73**	**1.27×10^{-5}**
Year of peak impact	2106	2106	N/A	2106	2106	2106	2106	2106	2106

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–49. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.41×10^{-9}	2.82×10^{-4}	2.67×10^{-9}	2.41×10^{-9}	3.27×10^{-4}	3.22×10^{-9}	2.41×10^{-9}	3.90×10^{-4}	4.09×10^{-9}
Technetium-99	2.45×10^{-6}	4.29	1.48×10^{-4}	2.45×10^{-6}	1.11×10^{1}	4.86×10^{-4}	2.45×10^{-6}	2.26×10^{1}	1.06×10^{-3}
Iodine-129	4.69×10^{-9}	1.34	1.52×10^{-5}	4.69×10^{-9}	1.67	2.35×10^{-5}	4.69×10^{-9}	2.16	3.55×10^{-5}
Total	**N/A**	**5.63**	**1.63×10^{-4}**	**N/A**	**1.27×10^{1}**	**5.09×10^{-4}**	**N/A**	**2.47×10^{1}**	**1.10×10^{-3}**
Year of peak impact	2088	2088	2088	2088	2088	2088	2088	2088	2088
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.75×10^{-2}	6.43×10^{-1}	0.00	6.05×10^{-2}	5.98×10^{-1}	2.65×10^{-10}	6.05×10^{-2}	8.99×10^{-1}	1.22×10^{-5}
Nitrate	3.44	6.14×10^{-2}	0.00	4.01	5.63×10^{-1}	0.00	4.01	1.26	0.00
Total	**N/A**	**7.04×10^{-1}**	**0.00**	**N/A**	**1.16**	**2.65×10^{-10}**	**N/A**	**2.15**	**1.22×10^{-5}**
Year of peak impact	2101	2101	N/A	2093	2093	2101	2093	2093	2101

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–50. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.58×10^{-7}	1.85×10^{-2}	1.75×10^{-7}	1.58×10^{-7}	2.15×10^{-2}	2.11×10^{-7}	1.58×10^{-7}	2.56×10^{-2}	2.68×10^{-7}
Technetium-99	2.48×10^{-6}	4.34	1.49×10^{-4}	2.48×10^{-6}	1.12×10^{1}	4.91×10^{-4}	2.48×10^{-6}	2.28×10^{1}	1.07×10^{-3}
Iodine-129	4.66×10^{-9}	1.33	1.51×10^{-5}	4.66×10^{-9}	1.66	2.33×10^{-5}	4.66×10^{-9}	2.14	3.53×10^{-5}
Total	**N/A**	**5.69**	**1.65×10^{-4}**	**N/A**	**1.29×10^{1}**	**5.15×10^{-4}**	**N/A**	**2.50×10^{1}**	**1.11×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.44×10^{-1}	2.32	0.00	2.44×10^{-1}	2.41	9.58×10^{-10}	2.44×10^{-1}	3.63	4.39×10^{-5}
Nitrate	7.10	1.27×10^{-1}	0.00	7.10	9.97×10^{-1}	0.00	7.10	2.22	0.00
Total	**N/A**	**2.45**	**0.00**	**N/A**	**3.41**	**9.58×10^{-10}**	**N/A**	**5.85**	**4.39×10^{-5}**
Year of peak impact	2032	2032	N/A	2032	2032	2032	2032	2032	2032

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–51. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.14×10^{-6}	2.50×10^{-1}	2.37×10^{-6}	2.14×10^{-6}	2.91×10^{-1}	2.86×10^{-6}	2.14×10^{-6}	3.46×10^{-1}	3.63×10^{-6}
Technetium-99	1.06×10^{-5}	1.85×10^{1}	6.38×10^{-4}	1.06×10^{-5}	4.78×10^{1}	2.10×10^{-3}	1.06×10^{-5}	9.75×10^{1}	4.59×10^{-3}
Iodine-129	1.98×10^{-8}	5.65	6.42×10^{-5}	1.98×10^{-8}	7.06	9.93×10^{-5}	1.98×10^{-8}	9.12	1.50×10^{-4}
Total	**N/A**	$\mathbf{2.44\times10^{1}}$	$\mathbf{7.04\times10^{-4}}$	**N/A**	$\mathbf{5.51\times10^{1}}$	$\mathbf{2.20\times10^{-3}}$	**N/A**	$\mathbf{1.07\times10^{2}}$	$\mathbf{4.74\times10^{-3}}$
Year of peak impact	2022	2022	2022	2022	2022	2022	2022	2022	2022
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.02×10^{-1}	2.87	0.00	3.02×10^{-1}	2.98	1.18×10^{-9}	3.02×10^{-1}	4.48	5.43×10^{-5}
Nitrate	2.41×10^{1}	4.30×10^{-1}	0.00	2.41×10^{1}	3.38	0.00	2.41×10^{1}	7.55	0.00
Total	**N/A**	**3.30**	**0.00**	**N/A**	**6.36**	$\mathbf{1.18\times10^{-9}}$	**N/A**	$\mathbf{1.20\times10^{1}}$	$\mathbf{5.43\times10^{-5}}$
Year of peak impact	2024	2024	N/A	2024	2024	2024	2024	2024	2024

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–52. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.73×10^{-9}	3.20×10^{-4}	3.03×10^{-9}	2.73×10^{-9}	3.71×10^{-4}	3.66×10^{-9}	2.73×10^{-9}	4.42×10^{-4}	4.64×10^{-9}
Technetium-99	1.37×10^{-7}	2.40×10^{-1}	8.27×10^{-6}	1.37×10^{-7}	6.20×10^{-1}	2.72×10^{-5}	1.37×10^{-7}	1.27	5.95×10^{-5}
Iodine-129	1.63×10^{-10}	4.65×10^{-2}	5.28×10^{-7}	1.63×10^{-10}	5.81×10^{-2}	8.17×10^{-7}	1.63×10^{-10}	7.50×10^{-2}	1.24×10^{-6}
Total	**N/A**	**2.87×10^{-1}**	**8.80×10^{-6}**	**N/A**	**6.78×10^{-1}**	**2.80×10^{-5}**	**N/A**	**1.34**	**6.07×10^{-5}**
Year of peak impact	2081	2081	2081	2081	2081	2081	2081	2081	2081
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.07×10^{-3}	5.78×10^{-2}	0.00	6.07×10^{-3}	5.99×10^{-2}	2.39×10^{-11}	6.07×10^{-3}	9.01×10^{-2}	1.09×10^{-6}
Nitrate	4.40×10^{-1}	7.85×10^{-3}	0.00	4.40×10^{-1}	6.17×10^{-2}	0.00	4.40×10^{-1}	1.38×10^{-1}	0.00
Total	**N/A**	**6.56×10^{-2}**	**0.00**	**N/A**	**1.22×10^{-1}**	**2.39×10^{-11}**	**N/A**	**2.28×10^{-1}**	**1.09×10^{-6}**
Year of peak impact	2040	2040	N/A	2040	2040	2041	2040	2040	2041

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–53. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	2.60×10^{-9}	3.04×10^{-4}	2.88×10^{-9}	2.60×10^{-9}	3.53×10^{-4}	3.48×10^{-9}	2.60×10^{-9}	4.21×10^{-4}	4.41×10^{-9}
Technetium-99	2.45×10^{-6}	4.29	1.48×10^{-4}	2.45×10^{-6}	1.11×10^{1}	4.86×10^{-4}	2.45×10^{-6}	2.26×10^{1}	1.06×10^{-3}
Iodine-129	4.69×10^{-9}	1.34	1.52×10^{-5}	4.69×10^{-9}	1.67	2.35×10^{-5}	4.69×10^{-9}	2.16	3.55×10^{-5}
Total	**N/A**	**5.63**	**1.63×10^{-4}**	**N/A**	**1.27×10^{1}**	**5.09×10^{-4}**	**N/A**	**2.47×10^{1}**	**1.10×10^{-3}**
Year of peak impact	2088	2088	2088	2088	2088	2088	2088	2088	2088
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.34×10^{-2}	7.94×10^{-1}	0.00	8.06×10^{-2}	7.96×10^{-1}	3.27×10^{-10}	8.06×10^{-2}	1.20	1.50×10^{-5}
Nitrate	3.44	6.14×10^{-2}	0.00	3.85	5.41×10^{-1}	0.00	3.85	1.21	0.00
Total	**N/A**	**8.55×10^{-1}**	**0.00**	**N/A**	**1.34**	**3.27×10^{-10}**	**N/A**	**2.40**	**1.50×10^{-5}**
Year of peak impact	2101	2101	N/A	2102	2102	2101	2102	2102	2101

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–54. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.46×10^{-7}	6.06×10^{-1}	2.08×10^{-5}	3.46×10^{-7}	1.56	6.85×10^{-5}	3.46×10^{-7}	3.19	1.50×10^{-4}
Iodine-129	6.12×10^{-10}	1.74×10^{-1}	1.98×10^{-6}	6.12×10^{-10}	2.18×10^{-1}	3.06×10^{-6}	6.12×10^{-10}	2.81×10^{-1}	4.64×10^{-6}
Total	**N/A**	**7.80×10^{-1}**	**2.28×10^{-5}**	**N/A**	**1.78**	**7.16×10^{-5}**	**N/A**	**3.47**	**1.54×10^{-4}**
Year of peak impact	2317	2317	2317	2317	2317	2317	2317	2317	2317
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.37×10^{-3}	7.98×10^{-2}	0.00	8.03×10^{-3}	7.93×10^{-2}	3.29×10^{-11}	8.03×10^{-3}	1.19×10^{-1}	1.51×10^{-6}
Nitrate	6.30×10^{-1}	1.12×10^{-2}	0.00	6.67×10^{-1}	9.36×10^{-2}	0.00	6.67×10^{-1}	2.09×10^{-1}	0.00
Total	**N/A**	**9.10×10^{-2}**	**0.00**	**N/A**	**1.73×10^{-1}**	**3.29×10^{-11}**	**N/A**	**3.28×10^{-1}**	**1.51×10^{-6}**
Year of peak impact	2275	2275	N/A	2271	2271	2275	2271	2271	2275

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–55. Tank Closure Alternative 2A Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.85×10^{-12}	3.54×10^{-5}	1.55×10^{-9}	7.76×10^{-12}	8.07×10^{-5}	3.86×10^{-9}	3.46×10^{-7}	1.04×10^{-2}	5.56×10^{-7}
Iodine-129	1.45×10^{-14}	5.17×10^{-6}	7.29×10^{-11}	1.48×10^{-14}	8.04×10^{-5}	1.92×10^{-9}	6.12×10^{-10}	2.12×10^{-3}	5.21×10^{-8}
Total	**N/A**	**4.06×10^{-5}**	**1.63×10^{-9}**	**N/A**	**1.61×10^{-4}**	**5.78×10^{-9}**	**N/A**	**1.25×10^{-2}**	**6.08×10^{-7}**
Year of peak impact	2189	2189	2189	2186	2186	2191	2317	2317	2317
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.05×10^{-7}	3.02×10^{-6}	1.20×10^{-15}	2.95×10^{-7}	4.77×10^{-6}	5.50×10^{-11}	8.06×10^{-3}	3.55×10^{-2}	1.51×10^{-6}
Nitrate	1.61×10^{-5}	2.44×10^{-6}	0.00	1.63×10^{-5}	1.53×10^{-3}	0.00	6.12×10^{-1}	3.40×10^{-2}	0.00
Total	**N/A**	**5.45×10^{-6}**	**1.20×10^{-15}**	**N/A**	**1.54×10^{-3}**	**5.50×10^{-11}**	**N/A**	**6.95×10^{-2}**	**1.51×10^{-6}**
Year of peak impact	2200	2200	2200	2194	2194	2200	2200	2200	2275

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–56. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.42×10^{-9}	1.66×10^{-4}	1.57×10^{-9}	1.42×10^{-9}	1.93×10^{-4}	1.90×10^{-9}	1.42×10^{-9}	2.30×10^{-4}	2.41×10^{-9}
Technetium-99	9.64×10^{-7}	1.69	5.80×10^{-5}	9.64×10^{-7}	4.35	1.91×10^{-4}	9.64×10^{-7}	8.88	4.17×10^{-4}
Iodine-129	1.69×10^{-9}	4.81×10^{-1}	5.47×10^{-6}	1.69×10^{-9}	6.01×10^{-1}	8.46×10^{-6}	1.69×10^{-9}	7.76×10^{-1}	1.28×10^{-5}
Total	**N/A**	**2.17**	**6.35×10^{-5}**	**N/A**	**4.95**	**1.99×10^{-4}**	**N/A**	**9.66**	**4.30×10^{-4}**
Year of peak impact	2095	2095	2095	2095	2095	2095	2095	2095	2095
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.08×10^{-1}	1.03	0.00	1.08×10^{-1}	1.07	4.25×10^{-10}	1.08×10^{-1}	1.61	1.95×10^{-5}
Nitrate	2.21×10^{1}	3.95×10^{-1}	0.00	2.21×10^{1}	3.10	0.00	2.21×10^{1}	6.92	0.00
Total	**N/A**	**1.43**	**0.00**	**N/A**	**4.17**	**4.25×10^{-10}**	**N/A**	**8.53**	**1.95×10^{-5}**
Year of peak impact	2170	2170	N/A	2170	2170	2170	2170	2170	2170

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–57. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.47×10^{-7}	1.72×10^{-2}	1.63×10^{-7}	1.47×10^{-7}	2.00×10^{-2}	4.91×10^{-7}	1.47×10^{-7}	2.38×10^{-2}	6.23×10^{-7}
Technetium-99	3.99×10^{-6}	6.97	2.40×10^{-4}	3.99×10^{-6}	1.80×10^{1}	7.92×10^{-4}	3.99×10^{-6}	3.67×10^{1}	1.73×10^{-3}
Iodine-129	5.79×10^{-9}	1.65	1.88×10^{-5}	5.79×10^{-9}	2.06	2.57×10^{-5}	5.79×10^{-9}	2.66	3.89×10^{-5}
Uranium-238	0.00	0.00	0.00	0.00	0.00	1.31×10^{-9}	0.00	0.00	1.50×10^{-9}
Total	**N/A**	**8.64**	**2.59×10^{-4}**	**N/A**	**2.01×10^{1}**	**8.19×10^{-4}**	**N/A**	**3.94×10^{1}**	**1.77×10^{-3}**
Year of peak impact	2069	2069	2069	2069	2069	2068	2069	2069	2068
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.93×10^{-1}	1.84	0.00	1.93×10^{-1}	1.91	8.94×10^{-10}	1.93×10^{-1}	2.87	4.10×10^{-5}
Nitrate	1.92×10^{2}	3.42	0.00	1.92×10^{2}	2.69×10^{1}	0.00	1.92×10^{2}	6.00×10^{1}	0.00
Total uranium	1.27×10^{-6}	1.21×10^{-5}	0.00	1.27×10^{-6}	1.23×10^{-5}	0.00	1.27×10^{-6}	1.28×10^{-5}	0.00
Total	**N/A**	**5.26**	**0.00**	**N/A**	**2.88×10^{1}**	**8.94×10^{-10}**	**N/A**	**6.29×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2068	2068	N/A	2068	2068	2158	2068	2068	2158

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–58. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.86×10^{-8}	3.34×10^{-3}	3.17×10^{-8}	2.86×10^{-8}	3.88×10^{-3}	3.83×10^{-8}	2.86×10^{-8}	4.63×10^{-3}	4.85×10^{-8}
Technetium-99	1.54×10^{-6}	2.69	9.26×10^{-5}	1.54×10^{-6}	6.94	3.05×10^{-4}	1.54×10^{-6}	1.42×10^{1}	6.66×10^{-4}
Iodine-129	2.83×10^{-9}	8.07×10^{-1}	9.18×10^{-6}	2.83×10^{-9}	1.01	1.42×10^{-5}	2.83×10^{-9}	1.30	2.15×10^{-5}
Total	**N/A**	**3.50**	**1.02×10^{-4}**	**N/A**	**7.95**	**3.19×10^{-4}**	**N/A**	**1.55×10^{1}**	**6.88×10^{-4}**
Year of peak impact	2051	2051	2051	2051	2051	2051	2051	2051	2051
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.57×10^{-1}	1.49	0.00	1.57×10^{-1}	1.55	6.15×10^{-10}	1.57×10^{-1}	2.33	2.82×10^{-5}
Nitrate	4.70	8.40×10^{-2}	0.00	4.70	6.60×10^{-1}	0.00	4.70	1.47	0.00
Total	**N/A**	**1.58**	**0.00**	**N/A**	**2.21**	**6.15×10^{-10}**	**N/A**	**3.80**	**2.82×10^{-5}**
Year of peak impact	2050	2050	N/A	2050	2050	2050	2050	2050	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–59. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.50×10^{-6}	1.75×10^{-1}	1.66×10^{-6}	1.50×10^{-6}	2.04×10^{-1}	2.01×10^{-6}	1.50×10^{-6}	2.43×10^{-1}	2.55×10^{-6}
Technetium-99	6.48×10^{-6}	1.13×10^{1}	3.90×10^{-4}	6.48×10^{-6}	2.92×10^{1}	1.28×10^{-3}	6.48×10^{-6}	5.97×10^{1}	2.81×10^{-3}
Iodine-129	1.27×10^{-8}	3.61	4.11×10^{-5}	1.27×10^{-8}	4.51	6.35×10^{-5}	1.27×10^{-8}	5.83	9.60×10^{-5}
Uranium-238	1.51×10^{-11}	1.88×10^{-3}	2.12×10^{-8}	1.51×10^{-11}	1.95×10^{-3}	2.29×10^{-8}	1.51×10^{-11}	2.10×10^{-3}	2.60×10^{-8}
Total	**N/A**	**1.51×10^{1}**	**4.33×10^{-4}**	**N/A**	**3.39×10^{1}**	**1.35×10^{-3}**	**N/A**	**6.58×10^{1}**	**2.90×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.37×10^{-1}	3.21	0.00	3.37×10^{-1}	3.33	1.34×10^{-9}	3.37×10^{-1}	5.00	6.15×10^{-5}
Nitrate	6.23×10^{1}	1.11	0.00	6.23×10^{1}	8.75	0.00	6.23×10^{1}	1.95×10^{1}	0.00
Total uranium	2.28×10^{-5}	2.17×10^{-4}	0.00	2.28×10^{-5}	2.21×10^{-4}	0.00	2.28×10^{-5}	2.31×10^{-4}	0.00
Total	**N/A**	**4.32**	**0.00**	**N/A**	**1.21×10^{1}**	**1.34×10^{-9}**	**N/A**	**2.45×10^{1}**	**6.15×10^{-5}**
Year of peak impact	2053	2053	N/A	2053	2053	2051	2053	2053	2051

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–60. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.89×10^{-9}	3.38×10^{-4}	3.21×10^{-9}	2.89×10^{-9}	3.93×10^{-4}	3.87×10^{-9}	2.89×10^{-9}	4.68×10^{-4}	4.91×10^{-9}
Technetium-99	5.08×10^{-7}	8.89×10^{-1}	3.06×10^{-5}	5.08×10^{-7}	2.29	1.01×10^{-4}	5.08×10^{-7}	4.68	2.20×10^{-4}
Iodine-129	8.75×10^{-10}	2.49×10^{-1}	2.84×10^{-6}	8.75×10^{-10}	3.12×10^{-1}	4.38×10^{-6}	8.75×10^{-10}	4.03×10^{-1}	6.63×10^{-6}
Total	**N/A**	**1.14**	**3.34×10^{-5}**	**N/A**	**2.60**	**1.05×10^{-4}**	**N/A**	**5.08**	**2.27×10^{-4}**
Year of peak impact	2100	2100	2100	2100	2100	2100	2100	2100	2100
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.50×10^{-2}	1.43×10^{-1}	0.00	1.45×10^{-2}	1.43×10^{-1}	5.90×10^{-11}	1.45×10^{-2}	2.15×10^{-1}	2.71×10^{-6}
Nitrate	5.64	1.01×10^{-1}	0.00	5.69	7.98×10^{-1}	0.00	5.69	1.78	0.00
Total	**N/A**	**2.44×10^{-1}**	**0.00**	**N/A**	**9.41×10^{-1}**	**5.90×10^{-11}**	**N/A**	**2.00**	**2.71×10^{-6}**
Year of peak impact	2092	2092	N/A	2099	2099	2092	2099	2099	2092

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–61. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.47×10^{-7}	1.72×10^{-2}	1.63×10^{-7}	1.47×10^{-7}	2.00×10^{-2}	4.91×10^{-7}	1.47×10^{-7}	2.38×10^{-2}	6.23×10^{-7}
Technetium-99	3.99×10^{-6}	6.97	2.40×10^{-4}	3.99×10^{-6}	1.80×10^{1}	7.92×10^{-4}	3.99×10^{-6}	3.67×10^{1}	1.73×10^{-3}
Iodine-129	5.79×10^{-9}	1.65	1.88×10^{-5}	5.79×10^{-9}	2.06	2.57×10^{-5}	5.79×10^{-9}	2.66	3.89×10^{-5}
Uranium-238	0.00	0.00	0.00	0.00	0.00	1.31×10^{-9}	0.00	0.00	1.50×10^{-9}
Total	**N/A**	**8.64**	**2.59×10^{-4}**	**N/A**	**2.01×10^{1}**	**8.19×10^{-4}**	**N/A**	**3.94×10^{1}**	**1.77×10^{-3}**
Year of peak impact	2069	2069	2069	2069	2069	2068	2069	2069	2068
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.93×10^{-1}	1.84	0.00	1.93×10^{-1}	1.91	8.94×10^{-10}	1.93×10^{-1}	2.87	4.10×10^{-5}
Nitrate	1.92×10^{2}	3.42	0.00	1.92×10^{2}	2.69×10^{1}	0.00	1.92×10^{2}	6.00×10^{1}	0.00
Total uranium	1.27×10^{-6}	1.21×10^{-5}	0.00	1.27×10^{-6}	1.23×10^{-5}	0.00	1.27×10^{-6}	1.28×10^{-5}	0.00
Total	**N/A**	**5.26**	**0.00**	**N/A**	**2.88×10^{1}**	**8.94×10^{-10}**	**N/A**	**6.29×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2068	2068	N/A	2068	2068	2158	2068	2068	2158

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–62. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.18×10^{-7}	7.31×10^{-1}	2.52×10^{-5}	4.18×10^{-7}	1.88	8.27×10^{-5}	4.18×10^{-7}	3.85	1.81×10^{-4}
Iodine-129	7.38×10^{-10}	2.10×10^{-1}	2.39×10^{-6}	7.38×10^{-10}	2.63×10^{-1}	3.70×10^{-6}	7.38×10^{-10}	3.39×10^{-1}	5.59×10^{-6}
Total	**N/A**	**9.41×10^{-1}**	**2.75×10^{-5}**	**N/A**	**2.15**	**8.64×10^{-5}**	**N/A**	**4.19**	**1.87×10^{-4}**
Year of peak impact	2317	2317	2317	2317	2317	2317	2317	2317	2317
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.44×10^{-2}	7.08×10^{-1}	0.00	7.44×10^{-2}	7.34×10^{-1}	2.92×10^{-10}	7.44×10^{-2}	1.10	1.34×10^{-5}
Nitrate	1.69×10^{1}	3.02×10^{-1}	0.00	1.69×10^{1}	2.38	0.00	1.69×10^{1}	5.30	0.00
Total	**N/A**	**1.01**	**0.00**	**N/A**	**3.11**	**2.92×10^{-10}**	**N/A**	**6.40**	**1.34×10^{-5}**
Year of peak impact	2079	2079	N/A	2079	2079	2079	2079	2079	2079

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–63. Tank Closure Alternative 2A Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.04×10^{-11}	4.70×10^{-5}	2.06×10^{-9}	1.04×10^{-11}	1.08×10^{-4}	5.15×10^{-9}	4.18×10^{-7}	1.26×10^{-2}	6.73×10^{-7}
Iodine-129	1.85×10^{-14}	6.62×10^{-6}	9.33×10^{-11}	1.85×10^{-14}	1.01×10^{-4}	2.43×10^{-9}	7.38×10^{-10}	2.69×10^{-3}	6.59×10^{-8}
Total	**N/A**	**5.37×10^{-5}**	**2.16×10^{-9}**	**N/A**	**2.10×10^{-4}**	**7.58×10^{-9}**	**N/A**	**1.53×10^{-2}**	**7.39×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2317	2317	2317
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.05×10^{-6}	1.04×10^{-5}	4.13×10^{-15}	1.05×10^{-6}	1.70×10^{-5}	1.89×10^{-10}	7.44×10^{-2}	3.27×10^{-1}	1.34×10^{-5}
Nitrate	3.55×10^{-4}	5.37×10^{-5}	0.00	3.55×10^{-4}	3.34×10^{-2}	0.00	1.69×10^{1}	7.32×10^{-1}	0.00
Total	**N/A**	**6.41×10^{-5}**	**4.13×10^{-15}**	**N/A**	**3.34×10^{-2}**	**1.89×10^{-10}**	**N/A**	**1.06**	**1.34×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2079	2079	2079

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

The dose standard would be exceeded at the B Barrier, T Barrier, and Core Zone Boundary for the drinking-water well user, resident farmer, and American Indian resident farmer due to the presence of tritium, technetium-99, and iodine-129 released from the cribs and trenches (ditches), but would not be exceeded at the other locations. The Hazard Index guideline would be exceeded at the B Barrier, T Barrier, Core Zone Boundary, and Columbia River nearshore location for the same receptors due primarily to release of chromium and nitrate from the cribs and trenches (ditches). The Hazard Index guideline would also be exceeded for the American Indian hunter-gatherer located near the Columbia River.

The dose standard would be exceeded at the T Barrier for the American Indian resident farmer due to the presence of tritium, technetium-99, and iodine-129 released from past leaks. The Hazard Index guideline would be exceeded for the drinking-water well user at the S Barrier and T Barrier and for the resident farmer and American Indian resident farmer at the A Barrier, B Barrier, S Barrier, T Barrier, and the Core Zone Boundary due primarily to release of chromium and nitrate from past leaks.

After CY 2050, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded at the A Barrier, B Barrier, S Barrier, T Barrier, Core Zone Boundary, and Columbia River nearshore for the drinking-water well user, resident farmer, and the American Indian resident farmer due primarily to chromium, nitrate, and total uranium. In addition, the Hazard Index guideline would be exceeded for the American Indian hunter-gatherer located near the Columbia River. Population dose is estimated as 2.68×10^{-1} person-rem per year for the year of maximum impact.

Figure Q–3 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2300 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. For the period of time between CYs 2650 and 4950, peak radiological risk is due to other tank farm sources, primarily tank residuals. The peak radiological risk resulting from all three sources occurs around CY 2090 and is dominated by tritium, technetium-99, iodine-129, and uranium-238. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater.

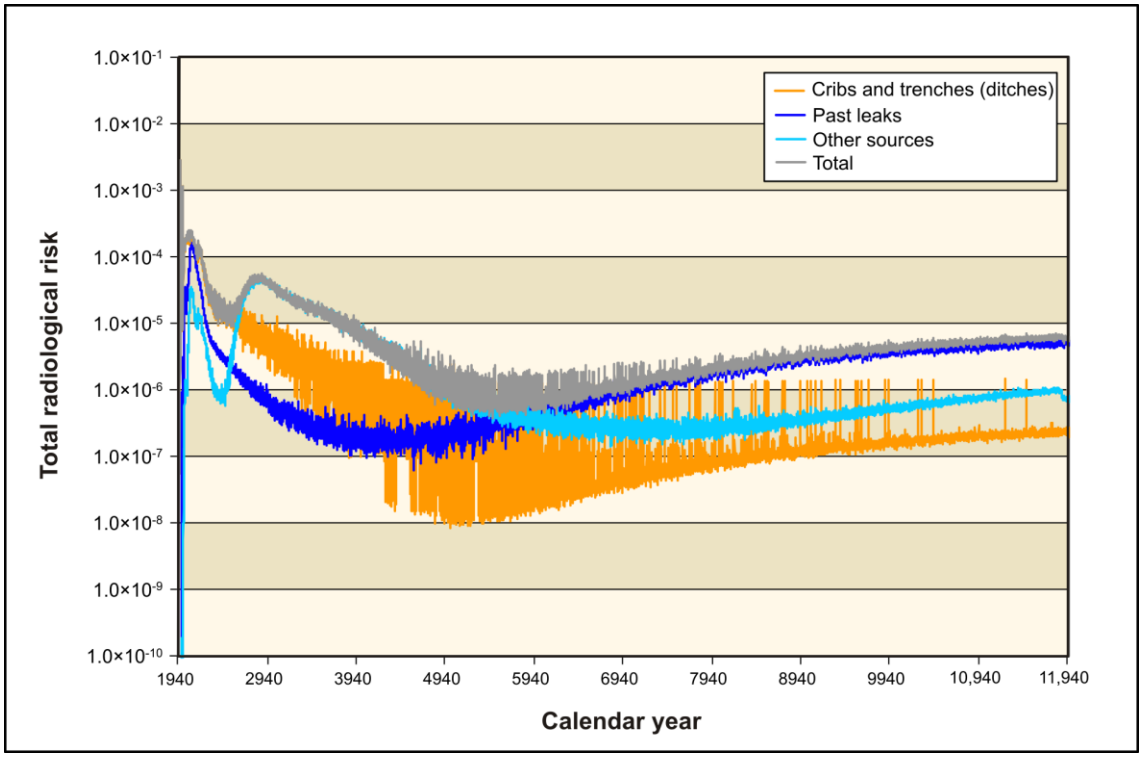

Figure Q–3. Tank Closure Alternative 2A Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.1.1.3 Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C

Activities under Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C would be similar to those under Tank Closure Alternative 2A, except that residual material in tanks would be stabilized in place. Soil would be removed down to 4.6 meters (15 feet) for the BX and SX tank farms and replaced with clean soils from onsite sources. The tank farms and six sets of adjacent cribs and trenches (ditches) would be covered with an engineered, modified Resource Conservation and Recovery Act (RCRA) Subtitle C barrier.

Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–64 through Q–68; to past leaks after CY 1940, in Tables Q–69 through Q–76; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after the year 2050, in Tables Q–77 through Q–84.

The risk and hazard drivers are tritium, technetium-99, iodine-129, uranium-238, chromium, nitrate, and total uranium. Impacts would be slightly less than those under Alternative 2A, and standards would be exceeded, as under Alternative 2A. Prior to CY 2050, exceedances of both radioactive and chemical constituent standards are due primarily to releases from cribs and trenches (ditches). Following CY 2050, exceedances of radiological standards are not projected to occur, but exceedances of standards for chemical constituents are expected to occur. Population dose is estimated as 2.51×10^{-1} person-rem per year for the year of maximum impact.

Table Q–64. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–65. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.61×10^{-3}	8.91×10^{2}	8.45×10^{-3}	7.61×10^{-3}	1.04×10^{3}	1.02×10^{-2}	7.61×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.23×10^{-7}	2.15×10^{-1}	7.39×10^{-6}	1.23×10^{-7}	5.54×10^{-1}	2.43×10^{-5}	1.23×10^{-7}	1.13	5.32×10^{-5}
Iodine-129	1.09×10^{-9}	3.11×10^{-1}	3.53×10^{-6}	1.09×10^{-9}	3.88×10^{-1}	5.46×10^{-6}	1.09×10^{-9}	5.01×10^{-1}	8.26×10^{-6}
Total	**N/A**	**8.91×10^{2}**	**8.46×10^{-3}**	**N/A**	**1.04×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.74	6.42×10^{1}	0.00	6.74	6.65×10^{1}	2.65×10^{-8}	6.74	1.00×10^{2}	1.21×10^{-3}
Nitrate	1.55×10^{3}	2.77×10^{1}	0.00	1.55×10^{3}	2.18×10^{2}	0.00	1.55×10^{3}	4.85×10^{2}	0.00
Total	**N/A**	**9.18×10^{1}**	**0.00**	**N/A**	**2.84×10^{2}**	**2.65×10^{-8}**	**N/A**	**5.85×10^{2}**	**1.21×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–66. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–67. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.07×10^{-5}	1.26	1.09×10^{-5}	1.07×10^{-5}	1.46	1.32×10^{-5}	9.86×10^{-6}	1.60	1.68×10^{-5}
Technetium-99	8.08×10^{-7}	1.41	5.08×10^{-5}	8.08×10^{-7}	3.64	1.67×10^{-4}	8.44×10^{-7}	7.77	3.65×10^{-4}
Iodine-129	1.14×10^{-9}	3.26×10^{-1}	3.19×10^{-6}	1.14×10^{-9}	4.07×10^{-1}	4.94×10^{-6}	9.86×10^{-10}	4.53×10^{-1}	7.47×10^{-6}
Total	**N/A**	**3.00**	**6.49×10^{-5}**	**N/A**	**5.51**	**1.85×10^{-4}**	**N/A**	**9.82**	**3.90×10^{-4}**
Year of peak impact	1964	1964	1965	1964	1964	1965	1965	1965	1965

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.28×10^{-1}	2.17	0.00	1.38×10^{-1}	1.36	8.95×10^{-10}	1.38×10^{-1}	2.04	4.10×10^{-5}
Nitrate	3.97×10^{1}	7.09×10^{-1}	0.00	7.23×10^{1}	1.02×10^{1}	0.00	7.23×10^{1}	2.26×10^{1}	0.00
Total	**N/A**	**2.88**	**0.00**	**N/A**	**1.15×10^{1}**	**8.95×10^{-10}**	**N/A**	**2.47×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2019	2019	N/A	1964	1964	2019	1964	1964	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–68. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.22×10^{-10}	9.82×10^{-5}	9.67×10^{-10}	7.22×10^{-10}	1.20×10^{-4}	1.26×10^{-9}	1.07×10^{-5}	6.82×10^{-2}	1.26×10^{-6}
Technetium-99	4.96×10^{-11}	2.24×10^{-4}	9.81×10^{-9}	4.96×10^{-11}	5.16×10^{-4}	2.45×10^{-8}	8.08×10^{-7}	2.43×10^{-2}	1.30×10^{-6}
Iodine-129	6.35×10^{-14}	2.27×10^{-5}	3.20×10^{-10}	6.35×10^{-14}	3.46×10^{-4}	8.32×10^{-9}	1.14×10^{-9}	4.12×10^{-3}	1.01×10^{-7}
Total	**N/A**	**3.44×10^{-4}**	**1.11×10^{-8}**	**N/A**	**9.82×10^{-4}**	**3.41×10^{-8}**	**N/A**	**9.67×10^{-2}**	**2.66×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.68×10^{-5}	1.66×10^{-4}	6.82×10^{-14}	1.68×10^{-5}	2.72×10^{-4}	3.13×10^{-9}	3.48×10^{-2}	1.54×10^{-1}	4.10×10^{-5}
Nitrate	4.82×10^{-3}	7.30×10^{-4}	0.00	4.82×10^{-3}	4.54×10^{-1}	0.00	1.28×10^{1}	4.45	0.00
Total	**N/A**	**8.95×10^{-4}**	**6.82×10^{-14}**	**N/A**	**4.54×10^{-1}**	**3.13×10^{-9}**	**N/A**	**4.61**	**4.10×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–69. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.90×10^{-7}	2.23×10^{-2}	2.11×10^{-7}	1.90×10^{-7}	2.59×10^{-2}	2.55×10^{-7}	1.90×10^{-7}	3.08×10^{-2}	3.23×10^{-7}
Technetium-99	1.40×10^{-6}	2.44	8.40×10^{-5}	1.40×10^{-6}	6.30	2.76×10^{-4}	1.40×10^{-6}	1.29×10^{1}	6.04×10^{-4}
Iodine-129	5.45×10^{-10}	1.55×10^{-1}	1.76×10^{-6}	5.45×10^{-10}	1.94×10^{-1}	2.73×10^{-6}	5.45×10^{-10}	2.51×10^{-1}	4.13×10^{-6}
Total	**N/A**	**2.62**	**8.60×10^{-5}**	**N/A**	**6.52**	**2.79×10^{-4}**	**N/A**	**1.31×10^{1}**	**6.09×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.58×10^{-2}	6.26×10^{-1}	0.00	6.58×10^{-2}	6.49×10^{-1}	2.58×10^{-10}	6.58×10^{-2}	9.77×10^{-1}	1.18×10^{-5}
Nitrate	2.13	3.81×10^{-2}	0.00	2.13	2.99×10^{-1}	0.00	2.13	6.67×10^{-1}	0.00
Total	**N/A**	**6.64×10^{-1}**	**0.00**	**N/A**	**9.49×10^{-1}**	**2.58×10^{-10}**	**N/A**	**1.64**	**1.18×10^{-5}**
Year of peak impact	2104	2104	N/A	2104	2104	2104	2104	2104	2104

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–70. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.02×10^{-9}	2.36×10^{-4}	2.24×10^{-9}	2.02×10^{-9}	2.75×10^{-4}	2.71×10^{-9}	2.02×10^{-9}	3.27×10^{-4}	3.43×10^{-9}
Technetium-99	1.55×10^{-6}	2.71	9.34×10^{-5}	1.55×10^{-6}	7.00	3.07×10^{-4}	1.55×10^{-6}	1.43×10^{1}	6.72×10^{-4}
Iodine-129	2.72×10^{-9}	7.76×10^{-1}	8.82×10^{-6}	2.72×10^{-9}	9.69×10^{-1}	1.36×10^{-5}	2.72×10^{-9}	1.25	2.06×10^{-5}
Total	**N/A**	**3.49**	**1.02×10^{-4}**	**N/A**	**7.96**	**3.21×10^{-4}**	**N/A**	**1.55×10^{1}**	**6.92×10^{-4}**
Year of peak impact	2084	2084	2084	2084	2084	2084	2084	2084	2084

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	5.83×10^{-2}	5.55×10^{-1}	0.00	5.78×10^{-2}	5.71×10^{-1}	2.29×10^{-10}	5.06×10^{-2}	7.52×10^{-1}	1.05×10^{-5}
Nitrate	2.54	4.54×10^{-2}	0.00	2.68	3.76×10^{-1}	0.00	3.03	9.49×10^{-1}	0.00
Total	**N/A**	**6.01×10^{-1}**	**0.00**	**N/A**	**9.47×10^{-1}**	**2.29×10^{-10}**	**N/A**	**1.70**	**1.05×10^{-5}**
Year of peak impact	2104	2104	N/A	2097	2097	2104	2095	2095	2104

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–71. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.58×10^{-7}	1.85×10^{-2}	1.75×10^{-7}	1.58×10^{-7}	2.15×10^{-2}	2.12×10^{-7}	1.58×10^{-7}	2.56×10^{-2}	2.69×10^{-7}
Technetium-99	2.48×10^{-6}	4.33	1.49×10^{-4}	2.48×10^{-6}	1.12×10^{1}	4.90×10^{-4}	2.48×10^{-6}	2.28×10^{1}	1.07×10^{-3}
Iodine-129	4.58×10^{-9}	1.30	1.48×10^{-5}	4.58×10^{-9}	1.63	2.29×10^{-5}	4.58×10^{-9}	2.11	3.47×10^{-5}
Total	**N/A**	**5.65**	**1.64×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.13×10^{-4}**	**N/A**	**2.49×10^{1}**	**1.11×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.47×10^{-1}	2.35	0.00	2.47×10^{-1}	2.44	9.68×10^{-10}	2.47×10^{-1}	3.66	4.44×10^{-5}
Nitrate	7.03	1.26×10^{-1}	0.00	7.03	9.88×10^{-1}	0.00	7.03	2.20	0.00
Total	**N/A**	**2.47**	**0.00**	**N/A**	**3.42**	**9.68×10^{-10}**	**N/A**	**5.87**	**4.44×10^{-5}**
Year of peak impact	2032	2032	N/A	2032	2032	2032	2032	2032	2032

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–72. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.07×10^{-6}	2.42×10^{-1}	2.30×10^{-6}	2.07×10^{-6}	2.82×10^{-1}	2.78×10^{-6}	2.07×10^{-6}	3.36×10^{-1}	3.52×10^{-6}
Technetium-99	1.05×10^{-5}	1.84×10^{1}	6.34×10^{-4}	1.05×10^{-5}	4.75×10^{1}	2.08×10^{-3}	1.05×10^{-5}	9.70×10^{1}	4.56×10^{-3}
Iodine-129	2.00×10^{-8}	5.70	6.48×10^{-5}	2.00×10^{-8}	7.12	1.00×10^{-4}	2.00×10^{-8}	9.20	1.52×10^{-4}
Total	**N/A**	**2.44×10^{1}**	**7.01×10^{-4}**	**N/A**	**5.49×10^{1}**	**2.19×10^{-3}**	**N/A**	**1.07×10^{2}**	**4.71×10^{-3}**
Year of peak impact	2023	2023	2023	2023	2023	2023	2023	2023	2023

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.03×10^{-1}	2.88	0.00	3.03×10^{-1}	2.99	1.19×10^{-9}	3.03×10^{-1}	4.50	5.46×10^{-5}
Nitrate	2.41×10^{1}	4.30×10^{-1}	0.00	2.41×10^{1}	3.38	0.00	2.41×10^{1}	7.53	0.00
Total	**N/A**	**3.31**	**0.00**	**N/A**	**6.37**	**1.19×10^{-9}**	**N/A**	**1.20×10^{1}**	**5.46×10^{-5}**
Year of peak impact	2023	2023	N/A	2023	2023	2023	2023	2023	2023

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–73. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.49×10^{-8}	1.74×10^{-3}	1.65×10^{-8}	1.49×10^{-8}	2.03×10^{-3}	2.00×10^{-8}	1.49×10^{-8}	2.41×10^{-3}	2.53×10^{-8}
Technetium-99	1.29×10^{-7}	2.26×10^{-1}	7.79×10^{-6}	1.29×10^{-7}	5.84×10^{-1}	2.56×10^{-5}	1.29×10^{-7}	1.19	5.60×10^{-5}
Iodine-129	1.55×10^{-10}	4.41×10^{-2}	5.02×10^{-7}	1.55×10^{-10}	5.51×10^{-2}	7.76×10^{-7}	1.55×10^{-10}	7.12×10^{-2}	1.17×10^{-6}
Total	**N/A**	**2.72×10^{-1}**	**8.31×10^{-6}**	**N/A**	**6.41×10^{-1}**	**2.64×10^{-5}**	**N/A**	**1.27**	**5.72×10^{-5}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.16×10^{-3}	5.86×10^{-2}	0.00	6.16×10^{-3}	6.08×10^{-2}	2.42×10^{-11}	5.99×10^{-3}	8.90×10^{-2}	1.11×10^{-6}
Nitrate	4.28×10^{-1}	7.64×10^{-3}	0.00	4.28×10^{-1}	6.01×10^{-2}	0.00	4.38×10^{-1}	1.37×10^{-1}	0.00
Total	**N/A**	**6.63×10^{-2}**	**0.00**	**N/A**	**1.21×10^{-1}**	**2.42×10^{-11}**	**N/A**	**2.26×10^{-1}**	**1.11×10^{-6}**
Year of peak impact	2032	2032	N/A	2032	2032	2032	2041	2041	2032

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–74. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	3.82×10^{-9}	4.47×10^{-4}	4.24×10^{-9}	3.82×10^{-9}	5.19×10^{-4}	5.12×10^{-9}	3.82×10^{-9}	6.19×10^{-4}	6.49×10^{-9}
Technetium-99	1.55×10^{-6}	2.71	9.34×10^{-5}	1.55×10^{-6}	7.00	3.07×10^{-4}	1.55×10^{-6}	1.43×10^{1}	6.72×10^{-4}
Iodine-129	2.72×10^{-9}	7.76×10^{-1}	8.82×10^{-6}	2.72×10^{-9}	9.69×10^{-1}	1.36×10^{-5}	2.72×10^{-9}	1.25	2.06×10^{-5}
Total	**N/A**	**3.49**	**1.02×10^{-4}**	**N/A**	**7.96**	**3.21×10^{-4}**	**N/A**	**1.55×10^{1}**	**6.92×10^{-4}**
Year of peak impact	2084	2084	2084	2084	2084	2084	2084	2084	2084
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.81×10^{-2}	7.44×10^{-1}	0.00	7.38×10^{-2}	7.29×10^{-1}	3.07×10^{-10}	7.38×10^{-2}	1.10	1.41×10^{-5}
Nitrate	2.63	4.69×10^{-2}	0.00	3.03	4.26×10^{-1}	0.00	3.03	9.49×10^{-1}	0.00
Total	**N/A**	**7.90×10^{-1}**	**0.00**	**N/A**	**1.15**	**3.07×10^{-10}**	**N/A**	**2.05**	**1.41×10^{-5}**
Year of peak impact	2105	2105	N/A	2095	2095	2105	2095	2095	2105

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–75. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.58×10^{-7}	6.27×10^{-1}	2.17×10^{-5}	3.61×10^{-7}	1.63	7.15×10^{-5}	3.61×10^{-7}	3.33	1.56×10^{-4}
Iodine-129	6.26×10^{-10}	1.78×10^{-1}	1.96×10^{-6}	6.04×10^{-10}	2.15×10^{-1}	3.03×10^{-6}	6.04×10^{-10}	2.78×10^{-1}	4.58×10^{-6}
Total	**N/A**	**8.05×10^{-1}**	**2.37×10^{-5}**	**N/A**	**1.84**	**7.45×10^{-5}**	**N/A**	**3.60**	**1.61×10^{-4}**
Year of peak impact	2242	2242	2228	2228	2228	2228	2228	2228	2228
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.49×10^{-3}	7.13×10^{-2}	0.00	7.22×10^{-3}	7.13×10^{-2}	2.94×10^{-11}	6.72×10^{-3}	9.99×10^{-2}	1.35×10^{-6}
Nitrate	5.84×10^{-1}	1.04×10^{-2}	0.00	6.14×10^{-1}	8.61×10^{-2}	0.00	6.48×10^{-1}	2.03×10^{-1}	0.00
Total	**N/A**	**8.18×10^{-2}**	**0.00**	**N/A**	**1.57×10^{-1}**	**2.94×10^{-11}**	**N/A**	**3.03×10^{-1}**	**1.35×10^{-6}**
Year of peak impact	2253	2253	N/A	2266	2266	2253	2222	2222	2253

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–76. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	7.49×10^{-12}	3.38×10^{-5}	1.48×10^{-9}	7.42×10^{-12}	7.72×10^{-5}	3.70×10^{-9}	3.61×10^{-7}	1.09×10^{-2}	5.82×10^{-7}
Iodine-129	1.41×10^{-14}	5.05×10^{-6}	7.11×10^{-11}	1.43×10^{-14}	7.79×10^{-5}	1.85×10^{-9}	6.04×10^{-10}	2.28×10^{-3}	5.60×10^{-8}
Total	**N/A**	**3.88×10^{-5}**	**1.55×10^{-9}**	**N/A**	**1.55×10^{-4}**	**5.55×10^{-9}**	**N/A**	**1.32×10^{-2}**	**6.38×10^{-7}**
Year of peak impact	2180	2180	2180	2189	2189	2180	2228	2228	2228
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.88×10^{-7}	2.85×10^{-6}	1.15×10^{-15}	2.66×10^{-7}	4.30×10^{-6}	5.27×10^{-11}	6.72×10^{-3}	2.96×10^{-2}	1.35×10^{-6}
Nitrate	1.56×10^{-5}	2.36×10^{-6}	0.00	1.57×10^{-5}	1.48×10^{-3}	0.00	6.48×10^{-1}	3.39×10^{-2}	0.00
Total	**N/A**	**5.21×10^{-6}**	**1.15×10^{-15}**	**N/A**	**1.48×10^{-3}**	**5.27×10^{-11}**	**N/A**	**6.35×10^{-2}**	**1.35×10^{-6}**
Year of peak impact	2192	2192	2204	2184	2184	2204	2222	2222	2253

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–77. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.76×10^{-10}	9.08×10^{-5}	8.62×10^{-10}	7.76×10^{-10}	1.06×10^{-4}	1.04×10^{-9}	7.76×10^{-10}	1.26×10^{-4}	1.32×10^{-9}
Technetium-99	7.74×10^{-7}	1.35	4.66×10^{-5}	7.74×10^{-7}	3.49	1.53×10^{-4}	7.74×10^{-7}	7.13	3.35×10^{-4}
Iodine-129	1.34×10^{-9}	3.80×10^{-1}	4.33×10^{-6}	1.34×10^{-9}	4.75×10^{-1}	6.69×10^{-6}	1.34×10^{-9}	6.14×10^{-1}	1.01×10^{-5}
Total	**N/A**	**1.74**	**5.09×10^{-5}**	**N/A**	**3.97**	**1.60×10^{-4}**	**N/A**	**7.74**	**3.45×10^{-4}**
Year of peak impact	2102	2102	2102	2102	2102	2102	2102	2102	2102

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	8.09×10^{-2}	7.71×10^{-1}	0.00	6.65×10^{-2}	6.56×10^{-1}	3.18×10^{-10}	6.65×10^{-2}	9.88×10^{-1}	1.46×10^{-5}
Nitrate	1.56×10^{1}	2.78×10^{-1}	0.00	1.79×10^{1}	2.51	0.00	1.79×10^{1}	5.60	0.00
Total	**N/A**	**1.05**	**0.00**	**N/A**	**3.17**	**3.18×10^{-10}**	**N/A**	**6.59**	**1.46×10^{-5}**
Year of peak impact	2168	2168	N/A	2172	2172	2168	2172	2172	2168

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–78. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.31×10^{-7}	2.70×10^{-2}	2.56×10^{-7}	2.31×10^{-7}	3.14×10^{-2}	3.09×10^{-7}	2.31×10^{-7}	3.74×10^{-2}	3.92×10^{-7}
Technetium-99	3.57×10^{-6}	6.25	2.15×10^{-4}	3.57×10^{-6}	1.61×10^{1}	7.07×10^{-4}	3.57×10^{-6}	3.29×10^{1}	1.55×10^{-3}
Iodine-129	4.49×10^{-9}	1.28	1.45×10^{-5}	4.49×10^{-9}	1.60	2.25×10^{-5}	4.49×10^{-9}	2.06	3.40×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.55**	**2.30×10^{-4}**	**N/A**	**1.77×10^{1}**	**7.30×10^{-4}**	**N/A**	**3.50×10^{1}**	**1.58×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.05	0.00	1.74×10^{-1}	1.72	8.44×10^{-10}	1.74×10^{-1}	2.58	3.87×10^{-5}
Nitrate	1.55×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.36×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.81**	**0.00**	**N/A**	**2.57×10^{1}**	**8.44×10^{-10}**	**N/A**	**5.62×10^{1}**	**3.87×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–79. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	3.01×10^{-8}	3.52×10^{-3}	3.34×10^{-8}	3.01×10^{-8}	4.09×10^{-3}	4.03×10^{-8}	3.01×10^{-8}	4.87×10^{-3}	5.11×10^{-8}
Technetium-99	1.51×10^{-6}	2.64	9.08×10^{-5}	1.51×10^{-6}	6.80	2.99×10^{-4}	1.51×10^{-6}	1.39×10^{1}	6.53×10^{-4}
Iodine-129	2.75×10^{-9}	7.85×10^{-1}	8.92×10^{-6}	2.75×10^{-9}	9.80×10^{-1}	1.38×10^{-5}	2.75×10^{-9}	1.27	2.09×10^{-5}
Total	**N/A**	**3.43**	**9.97×10^{-5}**	**N/A**	**7.79**	**3.12×10^{-4}**	**N/A**	**1.52×10^{1}**	**6.74×10^{-4}**
Year of peak impact	2051	2051	2051	2051	2051	2051	2051	2051	2051

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.56×10^{-1}	1.49	0.00	1.56×10^{-1}	1.54	6.14×10^{-10}	1.56×10^{-1}	2.32	2.81×10^{-5}
Nitrate	4.78	8.53×10^{-2}	0.00	4.78	6.71×10^{-1}	0.00	4.78	1.50	0.00
Total	**N/A**	**1.57**	**0.00**	**N/A**	**2.21**	**6.14×10^{-10}**	**N/A**	**3.82**	**2.81×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2050	2051	2051	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–80. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.87×10^{-6}	3.36×10^{-1}	3.19×10^{-6}	2.87×10^{-6}	3.91×10^{-1}	3.85×10^{-6}	2.87×10^{-6}	4.65×10^{-1}	4.88×10^{-6}
Technetium-99	6.59×10^{-6}	1.15×10^{1}	3.97×10^{-4}	6.59×10^{-6}	2.97×10^{1}	1.31×10^{-3}	6.59×10^{-6}	6.07×10^{1}	2.86×10^{-3}
Iodine-129	1.26×10^{-8}	3.60	4.09×10^{-5}	1.26×10^{-8}	4.49	6.32×10^{-5}	1.26×10^{-8}	5.81	9.57×10^{-5}
Uranium-238	1.44×10^{-11}	1.79×10^{-3}	2.02×10^{-8}	1.44×10^{-11}	1.86×10^{-3}	2.18×10^{-8}	1.44×10^{-11}	2.00×10^{-3}	2.48×10^{-8}
Total	**N/A**	**1.55×10^{1}**	**4.41×10^{-4}**	**N/A**	**3.46×10^{1}**	**1.37×10^{-3}**	**N/A**	**6.70×10^{1}**	**2.96×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.53×10^{-1}	3.36	0.00	3.53×10^{-1}	3.49	1.39×10^{-9}	3.53×10^{-1}	5.25	6.36×10^{-5}
Nitrate	6.20×10^{1}	1.11	0.00	6.20×10^{1}	8.70	0.00	6.20×10^{1}	1.94×10^{1}	0.00
Total uranium	2.31×10^{-5}	2.20×10^{-4}	0.00	2.31×10^{-5}	2.24×10^{-4}	0.00	2.31×10^{-5}	2.34×10^{-4}	0.00
Total	**N/A**	**4.47**	**0.00**	**N/A**	**1.22×10^{1}**	**1.39×10^{-9}**	**N/A**	**2.46×10^{1}**	**6.36×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2045	2051	2051	2045

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–81. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.59×10^{-7}	4.53×10^{-1}	1.56×10^{-5}	2.59×10^{-7}	1.17	5.13×10^{-5}	2.59×10^{-7}	2.38	1.12×10^{-4}
Iodine-129	2.33×10^{-10}	6.64×10^{-2}	7.55×10^{-7}	2.33×10^{-10}	8.30×10^{-2}	1.17×10^{-6}	2.33×10^{-10}	1.07×10^{-1}	1.77×10^{-6}
Total	**N/A**	**5.20×10^{-1}**	**1.63×10^{-5}**	**N/A**	**1.25**	**5.24×10^{-5}**	**N/A**	**2.49**	**1.14×10^{-4}**
Year of peak impact	3296	3296	3296	3296	3296	3296	3296	3296	3296
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.76×10^{-3}	5.48×10^{-2}	0.00	4.90×10^{-3}	4.84×10^{-2}	2.30×10^{-11}	4.90×10^{-3}	7.28×10^{-2}	1.06×10^{-6}
Nitrate	7.01×10^{-1}	1.25×10^{-2}	0.00	9.09×10^{-1}	1.28×10^{-1}	0.00	9.09×10^{-1}	2.85×10^{-1}	0.00
Total	**N/A**	**6.73×10^{-2}**	**0.00**	**N/A**	**1.76×10^{-1}**	**2.30×10^{-11}**	**N/A**	**3.57×10^{-1}**	**1.06×10^{-6}**
Year of peak impact	2056	2056	N/A	2071	2071	2050	2071	2071	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–82. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.75×10^{-7}	5.56×10^{-2}	5.27×10^{-7}	4.75×10^{-7}	6.46×10^{-2}	6.37×10^{-7}	4.75×10^{-7}	7.70×10^{-2}	8.08×10^{-7}
Technetium-99	3.57×10^{-6}	6.25	2.15×10^{-4}	3.57×10^{-6}	1.61×10^{1}	7.07×10^{-4}	3.57×10^{-6}	3.29×10^{1}	1.55×10^{-3}
Iodine-129	4.49×10^{-9}	1.28	1.45×10^{-5}	4.49×10^{-9}	1.60	2.25×10^{-5}	4.49×10^{-9}	2.06	3.40×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.58**	**2.30×10^{-4}**	**N/A**	**1.78×10^{1}**	**7.30×10^{-4}**	**N/A**	**3.50×10^{1}**	**1.58×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.05	0.00	1.74×10^{-1}	1.72	8.44×10^{-10}	1.74×10^{-1}	2.58	3.87×10^{-5}
Nitrate	1.55×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.36×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.81**	**0.00**	**N/A**	**2.57×10^{1}**	**8.44×10^{-10}**	**N/A**	**5.62×10^{1}**	**3.87×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–83. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.90×10^{-11}	2.22×10^{-6}	1.07×10^{-11}	9.64×10^{-12}	1.31×10^{-6}	1.29×10^{-11}	9.64×10^{-12}	1.56×10^{-6}	1.64×10^{-11}
Technetium-99	3.93×10^{-7}	6.88×10^{-1}	2.38×10^{-5}	3.96×10^{-7}	1.79	7.84×10^{-5}	3.96×10^{-7}	3.65	1.71×10^{-4}
Iodine-129	6.93×10^{-10}	1.98×10^{-1}	2.19×10^{-6}	6.76×10^{-10}	2.41×10^{-1}	3.39×10^{-6}	6.76×10^{-10}	3.11×10^{-1}	5.13×10^{-6}
Total	**N/A**	**8.85×10^{-1}**	**2.60×10^{-5}**	**N/A**	**2.03**	**8.18×10^{-5}**	**N/A**	**3.96**	**1.77×10^{-4}**
Year of peak impact	2242	2242	2254	2254	2254	2254	2254	2254	2254
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.09×10^{-2}	6.75×10^{-1}	0.00	7.09×10^{-2}	7.00×10^{-1}	2.78×10^{-10}	7.09×10^{-2}	1.05	1.28×10^{-5}
Nitrate	1.66×10^{1}	2.96×10^{-1}	0.00	1.66×10^{1}	2.33	0.00	1.66×10^{1}	5.19	0.00
Total	**N/A**	**9.71×10^{-1}**	**0.00**	**N/A**	**3.03**	**2.78×10^{-10}**	**N/A**	**6.24**	**1.28×10^{-5}**
Year of peak impact	2076	2076	N/A	2076	2076	2076	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–84. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	0.00	0.00	0.00	0.00	0.00	0.00	1.90×10^{-11}	1.21×10^{-7}	1.13×10^{-12}
Technetium-99	9.81×10^{-12}	4.42×10^{-5}	1.94×10^{-9}	9.81×10^{-12}	1.02×10^{-4}	4.84×10^{-9}	3.93×10^{-7}	1.19×10^{-2}	6.38×10^{-7}
Iodine-129	1.68×10^{-14}	5.98×10^{-6}	8.43×10^{-11}	1.68×10^{-14}	9.13×10^{-5}	2.19×10^{-9}	6.93×10^{-10}	2.60×10^{-3}	6.17×10^{-8}
Total	**N/A**	**5.02×10^{-5}**	**2.03×10^{-9}**	**N/A**	**1.93×10^{-4}**	**7.04×10^{-9}**	**N/A**	**1.45×10^{-2}**	**6.99×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2242	2242	2254
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	9.79×10^{-7}	9.67×10^{-6}	3.85×10^{-15}	9.79×10^{-7}	1.59×10^{-5}	1.76×10^{-10}	7.09×10^{-2}	3.12×10^{-1}	1.28×10^{-5}
Nitrate	3.17×10^{-4}	4.80×10^{-5}	0.00	3.17×10^{-4}	2.99×10^{-2}	0.00	1.66×10^{1}	7.22×10^{-1}	0.00
Total	**N/A**	**5.77×10^{-5}**	**3.85×10^{-15}**	**N/A**	**2.99×10^{-2}**	**1.76×10^{-10}**	**N/A**	**1.03**	**1.28×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Figure Q–4 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g. tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2080 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. For the period of time between CYs 2900 and 7000, peak radiological risk is due to other tank farm sources, primarily tank residuals. The peak radiological risk resulting from all three sources occurs around CY 2050 and is dominated by tritium, technetium-99, and iodine-129.

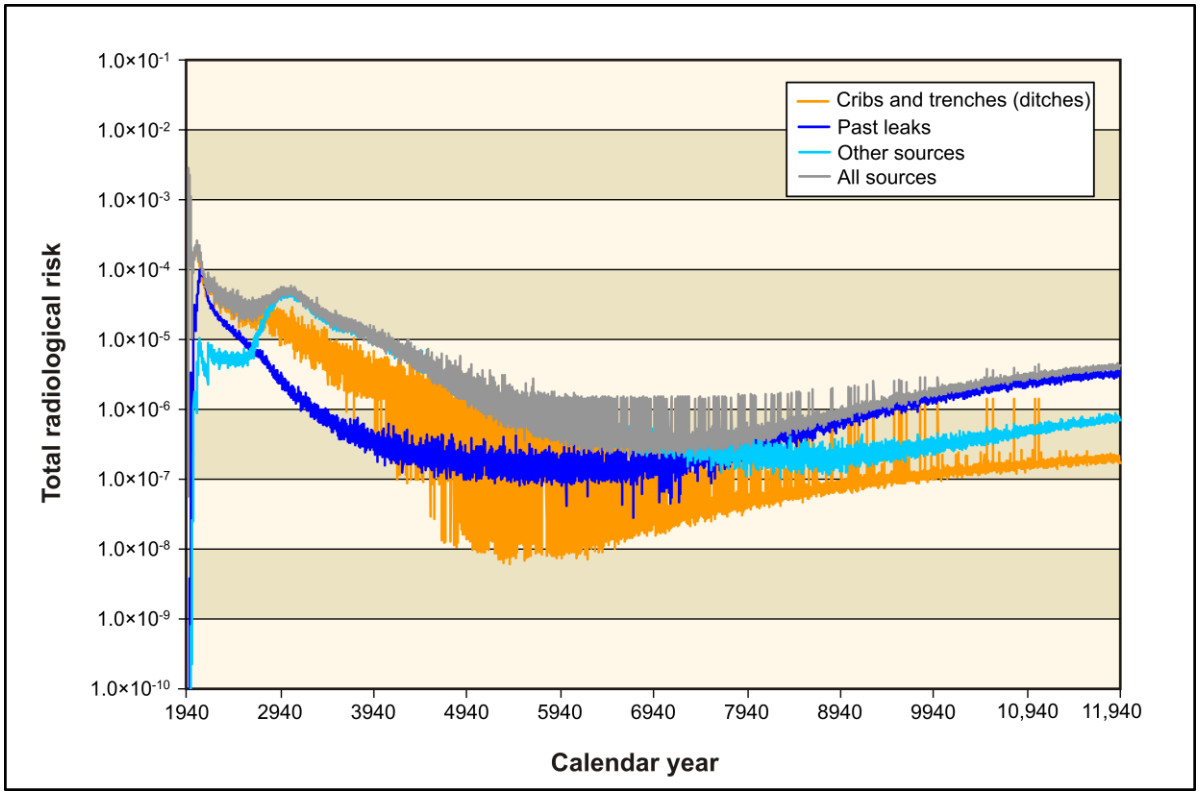

Figure Q–4. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Estimates of peak impacts for sources comprising unplanned releases, retrieval leaks, and releases from ancillary equipment and tank residuals are presented in Tables Q–85 through Q–115. In addition, the time series of radiological risk for the drinking-water well user at the Core Zone Boundary from these types of releases is presented in Figure Q–5. Exceedances of the radiological standard are not projected for these sources. Exceedances of chemical constituent standards are also not projected, except for the American Indian resident farmer at the A Barrier due to retrieval leaks. The peak radiological risk for the drinking-water well user at the Core Zone Boundary of approximately 3×10^{-5} is projected to occur around CY 2940 due primarily to releases from tank residuals. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater.

Table Q–85. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.88×10^{-8}	6.79×10^{-2}	2.34×10^{-6}	3.88×10^{-8}	1.75×10^{-1}	7.69×10^{-6}	3.88×10^{-8}	3.58×10^{-1}	1.68×10^{-5}
Iodine-129	1.78×10^{-11}	5.07×10^{-3}	5.76×10^{-8}	1.78×10^{-11}	6.33×10^{-3}	8.91×10^{-8}	1.78×10^{-11}	8.18×10^{-3}	1.35×10^{-7}
Total	**N/A**	**7.30×10^{-2}**	**2.39×10^{-6}**	**N/A**	**1.81×10^{-1}**	**7.78×10^{-6}**	**N/A**	**3.66×10^{-1}**	**1.69×10^{-5}**
Year of peak impact	2901	2901	2901	2901	2901	2901	2901	2901	2901
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.04×10^{-3}	9.88×10^{-3}	0.00	1.04×10^{-3}	1.02×10^{-2}	4.24×10^{-12}	1.04×10^{-3}	1.54×10^{-2}	1.94×10^{-7}
Nitrate	3.63×10^{-1}	6.47×10^{-3}	0.00	3.63×10^{-1}	5.09×10^{-2}	0.00	3.63×10^{-1}	1.14×10^{-1}	0.00
Total	**N/A**	**1.64×10^{-2}**	**0.00**	**N/A**	**6.12×10^{-2}**	**4.24×10^{-12}**	**N/A**	**1.29×10^{-1}**	**1.94×10^{-7}**
Year of peak impact	2038	2038	N/A	2038	2038	2032	3648	2038	2032

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–86. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.06×10^{-13}	3.61×10^{-7}	1.24×10^{-11}	2.06×10^{-13}	9.30×10^{-7}	4.08×10^{-11}	2.06×10^{-13}	1.90×10^{-6}	8.92×10^{-11}
Total	**N/A**	**3.61×10^{-7}**	**1.24×10^{-11}**	**N/A**	**9.30×10^{-7}**	**4.08×10^{-11}**	**N/A**	**1.90×10^{-6}**	**8.92×10^{-11}**
Year of peak impact	5396	5396	5396	5396	5396	5396	5396	5396	5396

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–87. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.22×10^{-11}	2.60×10^{-6}	2.59×10^{-11}	2.33×10^{-11}	3.17×10^{-6}	3.12×10^{-11}	2.33×10^{-11}	3.77×10^{-6}	3.96×10^{-11}
Technetium-99	2.85×10^{-11}	4.98×10^{-5}	1.79×10^{-9}	2.97×10^{-11}	1.34×10^{-4}	5.88×10^{-9}	2.97×10^{-11}	2.74×10^{-4}	1.29×10^{-8}
Iodine-129	2.59×10^{-13}	7.38×10^{-5}	7.89×10^{-10}	2.44×10^{-13}	8.67×10^{-5}	1.22×10^{-9}	2.44×10^{-13}	1.12×10^{-4}	1.85×10^{-9}
Total	**N/A**	**1.26×10^{-4}**	**2.60×10^{-9}**	**N/A**	**2.24×10^{-4}**	**7.13×10^{-9}**	**N/A**	**3.89×10^{-4}**	**1.47×10^{-8}**
Year of peak impact	2064	2064	2063	2063	2063	2063	2063	2063	2063
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.96×10^{-5}	4.73×10^{-4}	0.00	4.96×10^{-5}	4.90×10^{-4}	1.95×10^{-13}	4.96×10^{-5}	7.38×10^{-4}	8.96×10^{-9}
Nitrate	1.55×10^{-2}	2.77×10^{-4}	0.00	1.55×10^{-2}	2.18×10^{-3}	0.00	1.55×10^{-2}	4.86×10^{-3}	0.00
Total	**N/A**	**7.50×10^{-4}**	**0.00**	**N/A**	**2.67×10^{-3}**	**1.95×10^{-13}**	**N/A**	**5.59×10^{-3}**	**8.96×10^{-9}**
Year of peak impact	2061	2061	N/A	2061	2061	2062	2061	2061	2062

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–88. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.21×10^{-10}	2.11×10^{-4}	7.26×10^{-9}	1.21×10^{-10}	5.44×10^{-4}	2.39×10^{-8}	1.21×10^{-10}	1.11×10^{-3}	5.22×10^{-8}
Iodine-129	1.23×10^{-13}	3.50×10^{-5}	3.98×10^{-10}	1.23×10^{-13}	4.38×10^{-5}	6.16×10^{-10}	1.23×10^{-13}	5.65×10^{-5}	9.32×10^{-10}
Total	**N/A**	**2.46×10^{-4}**	**7.66×10^{-9}**	**N/A**	**5.88×10^{-4}**	**2.45×10^{-8}**	**N/A**	**1.17×10^{-3}**	**5.32×10^{-8}**
Year of peak impact	2698	2698	2698	2698	2698	2698	2698	2698	2698
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.11×10^{-6}	2.01×10^{-5}	0.00	1.96×10^{-6}	1.94×10^{-5}	8.27×10^{-15}	1.96×10^{-6}	2.91×10^{-5}	3.79×10^{-10}
Nitrate	1.26×10^{-4}	2.25×10^{-6}	0.00	1.37×10^{-4}	1.92×10^{-5}	0.00	1.37×10^{-4}	4.28×10^{-5}	0.00
Total	**N/A**	**2.23×10^{-5}**	**0.00**	**N/A**	**3.86×10^{-5}**	**8.27×10^{-15}**	**N/A**	**7.20×10^{-5}**	**3.79×10^{-10}**
Year of peak impact	2703	2703	N/A	2697	2697	2703	2697	2697	2703

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–89. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.64×10^{-8}	8.12×10^{-2}	2.79×10^{-6}	4.64×10^{-8}	2.09×10^{-1}	9.19×10^{-6}	4.64×10^{-8}	4.27×10^{-1}	2.01×10^{-5}
Iodine-129	8.16×10^{-11}	2.32×10^{-2}	2.64×10^{-7}	8.16×10^{-11}	2.90×10^{-2}	4.09×10^{-7}	8.16×10^{-11}	3.75×10^{-2}	6.18×10^{-7}
Total	**N/A**	**1.04×10^{-1}**	**3.06×10^{-6}**	**N/A**	**2.38×10^{-1}**	**9.60×10^{-6}**	**N/A**	**4.65×10^{-1}**	**2.07×10^{-5}**
Year of peak impact	2970	2970	2970	2970	2970	2970	2970	2970	2970
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.04×10^{-3}	9.88×10^{-3}	0.00	1.04×10^{-3}	1.02×10^{-2}	4.24×10^{-12}	1.04×10^{-3}	1.54×10^{-2}	1.94×10^{-7}
Nitrate	3.63×10^{-1}	6.47×10^{-3}	0.00	3.63×10^{-1}	5.09×10^{-2}	0.00	3.63×10^{-1}	1.14×10^{-1}	0.00
Total	**N/A**	**1.64×10^{-2}**	**0.00**	**N/A**	**6.12×10^{-2}**	**4.24×10^{-12}**	**N/A**	**1.29×10^{-1}**	**1.94×10^{-7}**
Year of peak impact	2038	2038	N/A	2038	2038	2032	2038	2038	2032

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–90. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	8.66×10^{-10}	1.52×10^{-3}	5.21×10^{-8}	8.66×10^{-10}	3.91×10^{-3}	1.71×10^{-7}	8.66×10^{-10}	7.98×10^{-3}	3.97×10^{-7}
Iodine-129	5.53×10^{-12}	1.58×10^{-3}	1.79×10^{-8}	5.53×10^{-12}	1.97×10^{-3}	2.77×10^{-8}	5.53×10^{-12}	2.54×10^{-3}	2.42×10^{-8}
Total	**N/A**	**3.09×10^{-3}**	**7.01×10^{-8}**	**N/A**	**5.88×10^{-3}**	**1.99×10^{-7}**	**N/A**	**1.05×10^{-2}**	**4.21×10^{-7}**
Year of peak impact	3081	3081	3081	3081	3081	3081	3081	3081	3196
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.40×10^{-5}	2.28×10^{-4}	0.00	1.89×10^{-5}	1.87×10^{-4}	9.41×10^{-14}	1.89×10^{-5}	2.81×10^{-4}	4.32×10^{-9}
Nitrate	5.59×10^{-3}	9.98×10^{-5}	0.00	6.37×10^{-3}	8.94×10^{-4}	0.00	6.37×10^{-3}	1.99×10^{-3}	0.00
Total	**N/A**	**3.28×10^{-4}**	**0.00**	**N/A**	**1.08×10^{-3}**	**9.41×10^{-14}**	**N/A**	**2.28×10^{-3}**	**4.32×10^{-9}**
Year of peak impact	2770	2770	N/A	2781	2781	2770	2781	2781	2770

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–91. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Unplanned Releases at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	0.00	0.00	0.00	0.00	0.00	0.00	8.66×10^{-10}	2.59×10^{-5}	1.39×10^{-9}
Iodine-129	3.78×10^{-16}	1.35×10^{-7}	1.90×10^{-12}	3.78×10^{-16}	2.06×10^{-6}	4.95×10^{-11}	5.53×10^{-12}	3.16×10^{-5}	7.76×10^{-10}
Total	**N/A**	**1.35×10^{-7}**	**1.90×10^{-12}**	**N/A**	**2.06×10^{-6}**	**4.95×10^{-11}**	**N/A**	**5.75×10^{-5}**	**2.16×10^{-9}**
Year of peak impact	2939	2939	2939	2939	2939	2939	3081	3081	3081
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.89×10^{-5}	8.33×10^{-5}	4.31×10^{-9}
Nitrate	0.00	0.00	0.00	0.00	0.00	0.00	6.37×10^{-3}	2.24×10^{-4}	0.00
Total	**N/A**	**0.00**	**0.00**	**N/A**	**0.00**	**0.00**	**N/A**	**3.08×10^{-4}**	**4.31×10^{-9}**
Year of peak impact	N/A	N/A	N/A	N/A	N/A	N/A	2781	2781	2770

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–92. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.63×10^{-9}	1.91×10^{-4}	1.81×10^{-9}	1.63×10^{-9}	2.22×10^{-4}	2.18×10^{-9}	1.63×10^{-9}	2.64×10^{-4}	2.77×10^{-9}
Technetium-99	9.44×10^{-8}	1.65×10^{-1}	5.68×10^{-6}	9.44×10^{-8}	4.26×10^{-1}	1.87×10^{-5}	9.44×10^{-8}	8.70×10^{-1}	4.09×10^{-5}
Iodine-129	1.62×10^{-10}	4.62×10^{-2}	5.26×10^{-7}	1.62×10^{-10}	5.77×10^{-2}	8.13×10^{-7}	1.62×10^{-10}	7.46×10^{-2}	1.23×10^{-6}
Total	**N/A**	**2.12×10^{-1}**	**6.21×10^{-6}**	**N/A**	**4.84×10^{-1}**	**1.95×10^{-5}**	**N/A**	**9.45×10^{-1}**	**4.21×10^{-5}**
Year of peak impact	2063	2063	2063	2063	2063	2063	2063	2063	2063
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.35×10^{-3}	1.28×10^{-2}	0.00	1.35×10^{-3}	1.33×10^{-2}	1.27×10^{-11}	1.35×10^{-3}	2.00×10^{-2}	5.82×10^{-7}
Nitrate	3.19	5.69×10^{-2}	0.00	3.19	4.47×10^{-1}	0.00	3.19	9.98×10^{-1}	0.00
Total	**N/A**	**6.97×10^{-2}**	**0.00**	**N/A**	**4.61×10^{-1}**	**1.27×10^{-11}**	**N/A**	**1.02**	**5.82×10^{-7}**
Year of peak impact	2062	2062	N/A	2062	2062	2163	2062	2062	2163

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–93. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.72×10^{-9}	5.52×10^{-4}	5.24×10^{-9}	4.72×10^{-9}	6.42×10^{-4}	6.32×10^{-9}	4.72×10^{-9}	7.64×10^{-4}	8.02×10^{-9}
Technetium-99	1.60×10^{-7}	2.81×10^{-1}	9.66×10^{-6}	1.60×10^{-7}	7.23×10^{-1}	3.20×10^{-5}	1.60×10^{-7}	1.48	6.99×10^{-5}
Iodine-129	3.12×10^{-10}	8.89×10^{-2}	1.01×10^{-6}	3.12×10^{-10}	1.11×10^{-1}	1.42×10^{-6}	3.12×10^{-10}	1.43×10^{-1}	2.15×10^{-6}
Total	**N/A**	**3.70×10^{-1}**	**1.07×10^{-5}**	**N/A**	**8.35×10^{-1}**	**3.34×10^{-5}**	**N/A**	**1.62**	**7.21×10^{-5}**
Year of peak impact	2064	2064	2064	2064	2064	2065	2064	2064	2065
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	4.47×10^{-3}	4.26×10^{-2}	0.00	3.66×10^{-3}	3.62×10^{-2}	2.24×10^{-11}	3.66×10^{-3}	5.44×10^{-2}	1.03×10^{-6}
Nitrate	1.74	3.11×10^{-2}	0.00	2.11	2.96×10^{-1}	0.00	2.11	6.59×10^{-1}	0.00
Total	**N/A**	**7.37×10^{-2}**	**0.00**	**N/A**	**3.32×10^{-1}**	**2.24×10^{-11}**	**N/A**	**7.14×10^{-1}**	**1.03×10^{-6}**
Year of peak impact	2079	2079	N/A	2090	2090	2064	2090	2090	2064

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–94. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.97×10^{-9}	2.31×10^{-4}	2.19×10^{-9}	1.97×10^{-9}	2.68×10^{-4}	2.64×10^{-9}	1.97×10^{-9}	3.20×10^{-4}	3.35×10^{-9}
Technetium-99	9.89×10^{-8}	1.73×10^{-1}	5.95×10^{-6}	9.89×10^{-8}	4.46×10^{-1}	1.96×10^{-5}	9.89×10^{-8}	9.11×10^{-1}	4.28×10^{-5}
Iodine-129	1.66×10^{-10}	4.74×10^{-2}	5.39×10^{-7}	1.66×10^{-10}	5.92×10^{-2}	8.33×10^{-7}	1.66×10^{-10}	7.65×10^{-2}	1.26×10^{-6}
Total	**N/A**	**2.21×10^{-1}**	**6.49×10^{-6}**	**N/A**	**5.05×10^{-1}**	**2.04×10^{-5}**	**N/A**	**9.87×10^{-1}**	**4.41×10^{-5}**
Year of peak impact	2082	2082	2082	2082	2082	2082	2082	2082	2082
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.77×10^{-3}	7.40×10^{-2}	0.00	7.77×10^{-3}	7.67×10^{-2}	3.05×10^{-11}	7.77×10^{-3}	1.15×10^{-1}	1.40×10^{-6}
Nitrate	9.86×10^{-1}	1.76×10^{-2}	0.00	9.86×10^{-1}	1.38×10^{-1}	0.00	9.86×10^{-1}	3.09×10^{-1}	0.00
Total	**N/A**	**9.16×10^{-2}**	**0.00**	**N/A**	**2.15×10^{-1}**	**3.05×10^{-11}**	**N/A**	**4.24×10^{-1}**	**1.40×10^{-6}**
Year of peak impact	2082	2082	N/A	2082	2082	2082	2082	2082	2082

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–95. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	3.72×10^{-9}	4.35×10^{-4}	4.13×10^{-9}	3.72×10^{-9}	5.06×10^{-4}	4.98×10^{-9}	3.72×10^{-9}	6.02×10^{-4}	6.32×10^{-9}
Technetium-99	2.18×10^{-7}	3.82×10^{-1}	1.31×10^{-5}	2.18×10^{-7}	9.85×10^{-1}	4.32×10^{-5}	2.18×10^{-7}	2.01	9.46×10^{-5}
Iodine-129	4.10×10^{-10}	1.17×10^{-1}	1.33×10^{-6}	4.10×10^{-10}	1.46×10^{-1}	2.06×10^{-6}	4.10×10^{-10}	1.89×10^{-1}	3.11×10^{-6}
Total	**N/A**	**5.00×10^{-1}**	**1.45×10^{-5}**	**N/A**	**1.13**	**4.53×10^{-5}**	**N/A**	**2.20**	**9.77×10^{-5}**
Year of peak impact	2080	2080	2080	2080	2080	2080	2080	2080	2080
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.44×10^{-3}	4.23×10^{-2}	0.00	4.27×10^{-3}	4.22×10^{-2}	1.74×10^{-11}	4.27×10^{-3}	6.35×10^{-2}	8.00×10^{-7}
Nitrate	8.05×10^{-1}	1.44×10^{-2}	0.00	8.18×10^{-1}	1.15×10^{-1}	0.00	8.18×10^{-1}	2.56×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-2}**	**0.00**	**N/A**	**1.57×10^{-1}**	**1.74×10^{-11}**	**N/A**	**3.20×10^{-1}**	**8.00×10^{-7}**
Year of peak impact	2080	2080	N/A	2079	2079	2080	2079	2079	2080

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–96. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.99×10^{-10}	9.35×10^{-5}	9.00×10^{-10}	8.11×10^{-10}	1.10×10^{-4}	8.07×10^{-10}	8.11×10^{-10}	1.31×10^{-4}	1.02×10^{-9}
Technetium-99	4.86×10^{-8}	8.50×10^{-2}	2.96×10^{-6}	4.92×10^{-8}	2.22×10^{-1}	9.76×10^{-6}	4.92×10^{-8}	4.53×10^{-1}	2.13×10^{-5}
Iodine-129	9.95×10^{-11}	2.84×10^{-2}	3.02×10^{-7}	9.33×10^{-11}	3.32×10^{-2}	4.58×10^{-7}	9.33×10^{-11}	4.29×10^{-2}	6.94×10^{-7}
Total	**N/A**	**1.13×10^{-1}**	**3.27×10^{-6}**	**N/A**	**2.55×10^{-1}**	**1.02×10^{-5}**	**N/A**	**4.96×10^{-1}**	**2.20×10^{-5}**
Year of peak impact	2082	2082	2081	2081	2081	2085	2081	2081	2085
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.36×10^{-3}	1.29×10^{-2}	0.00	1.27×10^{-3}	1.25×10^{-2}	5.36×10^{-12}	1.27×10^{-3}	1.88×10^{-2}	2.46×10^{-7}
Nitrate	6.88×10^{-1}	1.23×10^{-2}	0.00	7.12×10^{-1}	1.00×10^{-1}	0.00	7.12×10^{-1}	2.23×10^{-1}	0.00
Total	**N/A**	**2.52×10^{-2}**	**0.00**	**N/A**	**1.12×10^{-1}**	**5.36×10^{-12}**	**N/A**	**2.42×10^{-1}**	**2.46×10^{-7}**
Year of peak impact	2079	2079	N/A	2082	2082	2074	2082	2082	2074

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–97. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.72×10^{-9}	5.52×10^{-4}	5.24×10^{-9}	4.72×10^{-9}	6.42×10^{-4}	6.32×10^{-9}	4.72×10^{-9}	7.64×10^{-4}	8.02×10^{-9}
Technetium-99	1.60×10^{-7}	2.81×10^{-1}	9.66×10^{-6}	1.60×10^{-7}	7.23×10^{-1}	3.20×10^{-5}	1.60×10^{-7}	1.48	6.99×10^{-5}
Iodine-129	3.12×10^{-10}	8.89×10^{-2}	1.01×10^{-6}	3.12×10^{-10}	1.11×10^{-1}	1.42×10^{-6}	3.12×10^{-10}	1.43×10^{-1}	2.15×10^{-6}
Total	**N/A**	**3.70×10^{-1}**	**1.07×10^{-5}**	**N/A**	**8.35×10^{-1}**	**3.34×10^{-5}**	**N/A**	**1.62**	**7.21×10^{-5}**
Year of peak impact	2064	2064	2064	2064	2064	2065	2064	2064	2065
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	5.58×10^{-3}	5.31×10^{-2}	0.00	3.66×10^{-3}	3.62×10^{-2}	2.24×10^{-11}	3.66×10^{-3}	5.44×10^{-2}	1.03×10^{-6}
Nitrate	1.62	2.89×10^{-2}	0.00	2.11	2.96×10^{-1}	0.00	2.11	6.59×10^{-1}	0.00
Total	**N/A**	**8.20×10^{-2}**	**0.00**	**N/A**	**3.32×10^{-1}**	**2.24×10^{-11}**	**N/A**	**7.14×10^{-1}**	**1.03×10^{-6}**
Year of peak impact	2070	2070	N/A	2090	2090	2064	2090	2090	2064

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–98. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.48×10^{-8}	2.60×10^{-2}	8.93×10^{-7}	1.48×10^{-8}	6.69×10^{-2}	2.95×10^{-6}	1.48×10^{-8}	1.37×10^{-1}	6.45×10^{-6}
Iodine-129	2.23×10^{-11}	6.36×10^{-3}	7.23×10^{-8}	2.23×10^{-11}	7.95×10^{-3}	1.04×10^{-7}	2.23×10^{-11}	1.03×10^{-2}	1.58×10^{-7}
Total	**N/A**	**3.23×10^{-2}**	**9.65×10^{-7}**	**N/A**	**7.48×10^{-2}**	**3.05×10^{-6}**	**N/A**	**1.47×10^{-1}**	**6.61×10^{-6}**
Year of peak impact	3272	3272	3272	3272	3272	3276	3272	3272	3276
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	4.98×10^{-4}	4.74×10^{-3}	0.00	4.71×10^{-4}	4.65×10^{-3}	2.01×10^{-12}	4.71×10^{-4}	7.00×10^{-3}	9.24×10^{-8}
Nitrate	1.25×10^{-1}	2.24×10^{-3}	0.00	1.34×10^{-1}	1.88×10^{-2}	0.00	1.34×10^{-1}	4.20×10^{-2}	0.00
Total	**N/A**	**6.98×10^{-3}**	**0.00**	**N/A**	**2.35×10^{-2}**	**2.01×10^{-12}**	**N/A**	**4.90×10^{-2}**	**9.24×10^{-8}**
Year of peak impact	3330	3330	N/A	3174	3174	2833	3174	3174	2833

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–99. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Retrieval Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.75×10^{-13}	2.14×10^{-6}	9.40×10^{-11}	4.68×10^{-13}	4.87×10^{-6}	2.35×10^{-10}	1.48×10^{-8}	4.49×10^{-4}	2.41×10^{-8}
Iodine-129	6.33×10^{-16}	2.26×10^{-7}	3.19×10^{-12}	6.51×10^{-16}	3.55×10^{-6}	8.30×10^{-11}	2.23×10^{-11}	8.71×10^{-5}	2.04×10^{-9}
Total	**N/A**	**2.37×10^{-6}**	**9.72×10^{-11}**	**N/A**	**8.42×10^{-6}**	**3.18×10^{-10}**	**N/A**	**5.36×10^{-4}**	**2.61×10^{-8}**
Year of peak impact	2954	2954	2954	2925	2925	2954	3272	3272	3276
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.45×10^{-8}	1.43×10^{-7}	5.69×10^{-17}	1.45×10^{-8}	2.34×10^{-7}	2.61×10^{-12}	4.71×10^{-4}	2.07×10^{-3}	9.24×10^{-8}
Nitrate	0.00	0.00	0.00	0.00	0.00	0.00	1.34×10^{-1}	4.72×10^{-3}	0.00
Total	**N/A**	**1.43×10^{-7}**	**5.69×10^{-17}**	**N/A**	**2.34×10^{-7}**	**2.61×10^{-12}**	**N/A**	**6.79×10^{-3}**	**9.24×10^{-8}**
Year of peak impact	2268	2268	2268	2268	2268	2268	3174	3174	2833

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–100. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.11×10^{-8}	5.43×10^{-2}	1.87×10^{-6}	3.11×10^{-8}	1.40×10^{-1}	6.15×10^{-6}	3.11×10^{-8}	2.86×10^{-1}	1.34×10^{-5}
Iodine-129	3.68×10^{-11}	1.05×10^{-2}	1.19×10^{-7}	3.68×10^{-11}	1.31×10^{-2}	1.84×10^{-7}	3.68×10^{-11}	1.69×10^{-2}	2.79×10^{-7}
Total	**N/A**	**6.48×10^{-2}**	**1.99×10^{-6}**	**N/A**	**1.53×10^{-1}**	**6.33×10^{-6}**	**N/A**	**3.03×10^{-1}**	**1.37×10^{-5}**
Year of peak impact	3610	3610	3610	3610	3610	3610	3610	3610	3610
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	8.09×10^{-6}	3.85×10^{-5}	0.00	9.35×10^{-6}	5.56×10^{-5}	0.00	9.35×10^{-6}	1.01×10^{-4}	0.00
Chromium	1.30×10^{-3}	1.24×10^{-2}	0.00	1.25×10^{-3}	1.23×10^{-2}	5.12×10^{-12}	1.25×10^{-3}	1.85×10^{-2}	2.35×10^{-7}
Nitrate	1.67×10^{-1}	2.97×10^{-3}	0.00	1.83×10^{-1}	2.56×10^{-2}	0.00	1.83×10^{-1}	5.71×10^{-2}	0.00
Total	**N/A**	**1.54×10^{-2}**	**0.00**	**N/A**	**3.80×10^{-2}**	**5.12×10^{-12}**	**N/A**	**7.58×10^{-2}**	**2.35×10^{-7}**
Year of peak impact	3647	3647	N/A	3648	3648	3647	3648	3648	3647

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–101. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.91×10^{-7}	3.35×10^{-1}	1.15×10^{-5}	1.91×10^{-7}	8.63×10^{-1}	3.79×10^{-5}	1.91×10^{-7}	1.76	8.28×10^{-5}
Iodine-129	1.30×10^{-10}	3.71×10^{-2}	4.21×10^{-7}	1.30×10^{-10}	4.63×10^{-2}	6.51×10^{-7}	1.30×10^{-10}	5.98×10^{-2}	9.85×10^{-7}
Total	**N/A**	**3.72×10^{-1}**	**1.19×10^{-5}**	**N/A**	**9.09×10^{-1}**	**3.85×10^{-5}**	**N/A**	**1.82**	**8.38×10^{-5}**
Year of peak impact	3113	3113	3113	3113	3113	3113	3113	3113	3113
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	7.19×10^{-8}	3.42×10^{-7}	0.00	1.08×10^{-7}	6.40×10^{-7}	0.00	1.08×10^{-7}	1.16×10^{-6}	0.00
Chromium	5.27×10^{-3}	5.02×10^{-2}	0.00	4.36×10^{-3}	4.30×10^{-2}	2.07×10^{-11}	4.36×10^{-3}	6.48×10^{-2}	9.49×10^{-7}
Nitrate	3.66×10^{-1}	6.54×10^{-3}	0.00	4.90×10^{-1}	6.88×10^{-2}	0.00	4.90×10^{-1}	1.53×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-2}**	**0.00**	**N/A**	**1.12×10^{-1}**	**2.07×10^{-11}**	**N/A**	**2.18×10^{-1}**	**9.49×10^{-7}**
Year of peak impact	3115	3115	N/A	3045	3045	3115	3648	3045	3115

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–102. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.82×10^{-8}	8.43×10^{-2}	2.91×10^{-6}	4.83×10^{-8}	2.18×10^{-1}	9.61×10^{-6}	4.83×10^{-8}	4.45×10^{-1}	2.10×10^{-5}
Iodine-129	8.02×10^{-11}	2.29×10^{-2}	2.57×10^{-7}	7.92×10^{-11}	2.82×10^{-2}	3.59×10^{-7}	7.92×10^{-11}	3.65×10^{-2}	5.43×10^{-7}
Total	**N/A**	**1.07×10^{-1}**	**3.16×10^{-6}**	**N/A**	**2.46×10^{-1}**	**9.97×10^{-6}**	**N/A**	**4.81×10^{-1}**	**2.16×10^{-5}**
Year of peak impact	3750	3750	3766	3766	3766	3675	3766	3766	3675
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.03×10^{-5}	4.89×10^{-5}	0.00	1.03×10^{-5}	6.10×10^{-5}	0.00	9.81×10^{-6}	1.06×10^{-4}	0.00
Chromium	2.01×10^{-3}	1.92×10^{-2}	0.00	2.01×10^{-3}	1.99×10^{-2}	7.91×10^{-12}	1.84×10^{-3}	2.74×10^{-2}	3.63×10^{-7}
Nitrate	1.66×10^{-1}	2.96×10^{-3}	0.00	1.66×10^{-1}	2.33×10^{-2}	0.00	1.74×10^{-1}	5.45×10^{-2}	0.00
Total	**N/A**	**2.22×10^{-2}**	**0.00**	**N/A**	**4.33×10^{-2}**	**7.91×10^{-12}**	**N/A**	**8.20×10^{-2}**	**3.63×10^{-7}**
Year of peak impact	3724	3724	N/A	3724	3724	3724	3617	3617	3724

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–103. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	9.36×10^{-8}	1.64×10^{-1}	5.63×10^{-6}	9.36×10^{-8}	4.22×10^{-1}	1.85×10^{-5}	9.36×10^{-8}	8.62×10^{-1}	4.05×10^{-5}
Iodine-129	1.42×10^{-10}	4.04×10^{-2}	4.59×10^{-7}	1.42×10^{-10}	5.04×10^{-2}	7.09×10^{-7}	1.42×10^{-10}	6.51×10^{-2}	1.07×10^{-6}
Total	**N/A**	**2.04×10^{-1}**	**6.09×10^{-6}**	**N/A**	**4.72×10^{-1}**	**1.92×10^{-5}**	**N/A**	**9.27×10^{-1}**	**4.16×10^{-5}**
Year of peak impact	3469	3469	3469	3469	3469	3469	3469	3469	3469
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.52×10^{-3}	1.45×10^{-2}	0.00	1.45×10^{-3}	1.43×10^{-2}	5.97×10^{-12}	1.45×10^{-3}	2.15×10^{-2}	2.74×10^{-7}
Nitrate	3.22×10^{-1}	5.75×10^{-3}	0.00	3.36×10^{-1}	4.71×10^{-2}	0.00	3.36×10^{-1}	1.05×10^{-1}	0.00
Total	**N/A**	**2.02×10^{-2}**	**0.00**	**N/A**	**6.14×10^{-2}**	**5.97×10^{-12}**	**N/A**	**1.27×10^{-1}**	**2.74×10^{-7}**
Year of peak impact	3412	3412	N/A	3379	3379	3412	3379	3379	3412

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–104. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	8.13×10^{-8}	1.42×10^{-1}	4.89×10^{-6}	8.13×10^{-8}	3.67×10^{-1}	1.62×10^{-5}	8.13×10^{-8}	7.49×10^{-1}	3.55×10^{-5}
Iodine-129	1.03×10^{-10}	2.94×10^{-2}	3.34×10^{-7}	1.03×10^{-10}	3.67×10^{-2}	4.32×10^{-7}	1.03×10^{-10}	4.75×10^{-2}	6.53×10^{-7}
Total	**N/A**	**1.72×10^{-1}**	**5.23×10^{-6}**	**N/A**	**4.03×10^{-1}**	**1.67×10^{-5}**	**N/A**	**7.96×10^{-1}**	**3.62×10^{-5}**
Year of peak impact	3353	3353	3353	3353	3353	3307	3353	3353	3307
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.68×10^{-3}	1.60×10^{-2}	0.00	1.57×10^{-3}	1.55×10^{-2}	6.61×10^{-12}	1.57×10^{-3}	2.34×10^{-2}	3.03×10^{-7}
Nitrate	1.68×10^{-1}	3.01×10^{-3}	0.00	1.77×10^{-1}	2.48×10^{-2}	0.00	1.77×10^{-1}	5.54×10^{-2}	0.00
Total	**N/A**	**1.90×10^{-2}**	**0.00**	**N/A**	**4.04×10^{-2}**	**6.61×10^{-12}**	**N/A**	**7.87×10^{-2}**	**3.03×10^{-7}**
Year of peak impact	3273	3273	N/A	3293	3293	3273	3293	3293	3273

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–105. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the Core Zone Boundary

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.91×10^{-7}	3.35×10^{-1}	1.15×10^{-5}	1.91×10^{-7}	8.63×10^{-1}	3.79×10^{-5}	1.91×10^{-7}	1.76	8.28×10^{-5}
Iodine-129	1.30×10^{-10}	3.71×10^{-2}	4.21×10^{-7}	1.30×10^{-10}	4.63×10^{-2}	6.51×10^{-7}	1.30×10^{-10}	5.98×10^{-2}	9.85×10^{-7}
Total	**N/A**	**3.72×10^{-1}**	**1.19×10^{-5}**	**N/A**	**9.09×10^{-1}**	**3.85×10^{-5}**	**N/A**	**1.82**	**8.38×10^{-5}**
Year of peak impact	3113	3113	3113	3113	3113	3113	3113	3113	3113
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	3.22×10^{-7}	1.53×10^{-6}	0.00	2.26×10^{-7}	1.34×10^{-6}	0.00	2.26×10^{-7}	2.43×10^{-6}	0.00
Chromium	5.27×10^{-3}	5.02×10^{-2}	0.00	4.36×10^{-3}	4.30×10^{-2}	2.07×10^{-11}	4.36×10^{-3}	6.48×10^{-2}	9.49×10^{-7}
Nitrate	3.66×10^{-1}	6.54×10^{-3}	0.00	4.90×10^{-1}	6.88×10^{-2}	0.00	4.90×10^{-1}	1.53×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-2}**	**0.00**	**N/A**	**1.12×10^{-1}**	**2.07×10^{-11}**	**N/A**	**2.18×10^{-1}**	**9.49×10^{-7}**
Year of peak impact	3115	3115	N/A	3045	3045	3115	3045	3045	3115

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–106. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the Columbia River Nearshore

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.44×10^{-8}	2.51×10^{-2}	8.78×10^{-7}	1.46×10^{-8}	6.58×10^{-2}	2.89×10^{-6}	1.46×10^{-8}	1.34×10^{-1}	6.32×10^{-6}
Iodine-129	2.26×10^{-11}	6.43×10^{-3}	6.80×10^{-8}	2.10×10^{-11}	7.47×10^{-3}	1.05×10^{-7}	2.10×10^{-11}	9.66×10^{-3}	1.59×10^{-7}
Total	**N/A**	**3.15×10^{-2}**	**9.46×10^{-7}**	**N/A**	**7.33×10^{-2}**	**2.99×10^{-6}**	**N/A**	**1.44×10^{-1}**	**6.48×10^{-6}**
Year of peak impact	4330	4330	4161	4161	4161	4161	4161	4161	4161
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	8.38×10^{-7}	3.99×10^{-6}	0.00	8.38×10^{-7}	4.98×10^{-6}	0.00	7.07×10^{-7}	7.61×10^{-6}	0.00
Chromium	3.89×10^{-4}	3.70×10^{-3}	0.00	3.89×10^{-4}	3.84×10^{-3}	1.56×10^{-12}	3.82×10^{-4}	5.68×10^{-3}	7.14×10^{-8}
Nitrate	5.28×10^{-2}	9.44×10^{-4}	0.00	5.28×10^{-2}	7.42×10^{-3}	0.00	5.32×10^{-2}	1.67×10^{-2}	0.00
Total	**N/A**	**4.65×10^{-3}**	**0.00**	**N/A**	**1.13×10^{-2}**	**1.56×10^{-12}**	**N/A**	**2.23×10^{-2}**	**7.14×10^{-8}**
Year of peak impact	4267	4267	N/A	4267	4267	4217	4266	4266	4217

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–107. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Ancillary Equipment at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.36×10^{-13}	1.97×10^{-6}	8.64×10^{-11}	4.22×10^{-13}	4.38×10^{-6}	2.08×10^{-10}	1.46×10^{-8}	4.40×10^{-4}	2.35×10^{-8}
Iodine-129	6.22×10^{-16}	2.22×10^{-7}	3.13×10^{-12}	6.91×10^{-16}	3.76×10^{-6}	9.05×10^{-11}	2.10×10^{-11}	9.02×10^{-5}	2.21×10^{-9}
Total	**N/A**	**2.19×10^{-6}**	**8.95×10^{-11}**	**N/A**	**8.15×10^{-6}**	**2.99×10^{-10}**	**N/A**	**5.31×10^{-4}**	**2.58×10^{-8}**
Year of peak impact	3736	3736	3736	3811	3811	3811	4161	4161	4161
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	8.38×10^{-7}	5.03×10^{-6}	0.00
Chromium	1.09×10^{-8}	1.07×10^{-7}	4.27×10^{-17}	1.09×10^{-8}	1.76×10^{-7}	1.96×10^{-12}	3.89×10^{-4}	1.71×10^{-3}	7.13×10^{-8}
Nitrate	0.00	0.00	0.00	0.00	0.00	0.00	5.28×10^{-2}	1.86×10^{-3}	0.00
Total	**N/A**	**1.07×10^{-7}**	**4.27×10^{-17}**	**N/A**	**1.76×10^{-7}**	**1.96×10^{-12}**	**N/A**	**3.58×10^{-3}**	**7.13×10^{-8}**
Year of peak impact	3671	3671	3671	3671	3671	3671	4267	4267	4217

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–108. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.60×10^{-7}	2.79×10^{-1}	9.60×10^{-6}	1.60×10^{-7}	7.19×10^{-1}	3.16×10^{-5}	1.60×10^{-7}	1.47	6.91×10^{-5}
Iodine-129	7.02×10^{-11}	2.00×10^{-2}	2.28×10^{-7}	7.02×10^{-11}	2.50×10^{-2}	3.52×10^{-7}	7.02×10^{-11}	3.23×10^{-2}	5.32×10^{-7}
Total	**N/A**	**2.99×10^{-1}**	**9.83×10^{-6}**	**N/A**	**7.44×10^{-1}**	**3.19×10^{-5}**	**N/A**	**1.50**	**6.96×10^{-5}**
Year of peak impact	3685	3685	3685	3685	3685	3685	3685	3685	3685
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.43×10^{-4}	1.15×10^{-3}	0.00	3.24×10^{-4}	1.93×10^{-3}	0.00	1.76×10^{-4}	1.89×10^{-3}	0.00
Chromium	5.42×10^{-3}	5.16×10^{-2}	0.00	4.67×10^{-3}	4.61×10^{-2}	2.13×10^{-11}	4.33×10^{-3}	6.43×10^{-2}	9.77×10^{-7}
Nitrate	4.17×10^{-1}	7.44×10^{-3}	0.00	4.95×10^{-1}	6.95×10^{-2}	0.00	5.23×10^{-1}	1.64×10^{-1}	0.00
Total	**N/A**	**6.02×10^{-2}**	**0.00**	**N/A**	**1.18×10^{-1}**	**2.13×10^{-11}**	**N/A**	**2.30×10^{-1}**	**9.77×10^{-7}**
Year of peak impact	3451	3451	N/A	3573	3573	3451	3443	3443	3451

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–109. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.12×10^{-7}	1.07	3.69×10^{-5}	6.12×10^{-7}	2.76	1.22×10^{-4}	6.12×10^{-7}	5.64	2.67×10^{-4}
Iodine-129	2.57×10^{-10}	7.31×10^{-2}	8.31×10^{-7}	2.57×10^{-10}	9.13×10^{-2}	6.01×10^{-7}	2.57×10^{-10}	1.18×10^{-1}	9.10×10^{-7}
Total	**N/A**	**1.14**	**3.77×10^{-5}**	**N/A**	**2.85**	**1.23×10^{-4}**	**N/A**	**5.76**	**2.68×10^{-4}**
Year of peak impact	3083	3083	3083	3083	3083	2965	3083	3083	2965
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.77×10^{-6}	8.41×10^{-6}	0.00	6.72×10^{-7}	4.00×10^{-6}	0.00	6.72×10^{-7}	7.23×10^{-6}	0.00
Chromium	1.88×10^{-2}	1.79×10^{-1}	0.00	1.75×10^{-2}	1.72×10^{-1}	7.39×10^{-11}	1.75×10^{-2}	2.59×10^{-1}	3.39×10^{-6}
Nitrate	1.39	2.48×10^{-2}	0.00	1.60	2.25×10^{-1}	0.00	1.60	5.02×10^{-1}	0.00
Total	**N/A**	**2.04×10^{-1}**	**0.00**	**N/A**	**3.97×10^{-1}**	**7.39×10^{-11}**	**N/A**	**7.61×10^{-1}**	**3.39×10^{-6}**
Year of peak impact	2960	2960	N/A	2903	2903	2873	2903	2903	2873

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–110. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.52×10^{-7}	7.92×10^{-1}	2.76×10^{-5}	4.59×10^{-7}	2.07	9.08×10^{-5}	4.59×10^{-7}	4.22	1.99×10^{-4}
Iodine-129	2.38×10^{-10}	6.79×10^{-2}	6.12×10^{-7}	1.89×10^{-10}	6.72×10^{-2}	9.46×10^{-7}	1.89×10^{-10}	8.69×10^{-2}	1.43×10^{-6}
Total	**N/A**	**8.59×10^{-1}**	**2.82×10^{-5}**	**N/A**	**2.14**	**9.18×10^{-5}**	**N/A**	**4.31**	**2.00×10^{-4}**
Year of peak impact	3765	3765	3674	3674	3674	3674	3674	3674	3674
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	3.43×10^{-4}	1.63×10^{-3}	0.00	3.44×10^{-4}	2.05×10^{-3}	0.00	3.44×10^{-4}	3.70×10^{-3}	0.00
Chromium	1.38×10^{-2}	1.31×10^{-1}	0.00	1.29×10^{-2}	1.28×10^{-1}	5.40×10^{-11}	1.29×10^{-2}	1.92×10^{-1}	2.48×10^{-6}
Nitrate	1.00	1.79×10^{-2}	0.00	1.08	1.51×10^{-1}	0.00	1.08	3.37×10^{-1}	0.00
Total	**N/A**	**1.51×10^{-1}**	**0.00**	**N/A**	**2.81×10^{-1}**	**5.40×10^{-11}**	**N/A**	**5.33×10^{-1}**	**2.48×10^{-6}**
Year of peak impact	3620	3620	N/A	3586	3586	3620	3586	3586	3620

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–111. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.48×10^{-7}	6.08×10^{-1}	2.18×10^{-5}	3.62×10^{-7}	1.63	7.16×10^{-5}	3.62×10^{-7}	3.33	1.57×10^{-4}
Iodine-129	2.44×10^{-10}	6.96×10^{-2}	4.70×10^{-7}	1.45×10^{-10}	5.17×10^{-2}	7.27×10^{-7}	1.45×10^{-10}	6.68×10^{-2}	1.10×10^{-6}
Total	**N/A**	**6.78×10^{-1}**	**2.22×10^{-5}**	**N/A**	**1.68**	**7.23×10^{-5}**	**N/A**	**3.40**	**1.58×10^{-4}**
Year of peak impact	3434	3434	3329	3329	3329	3329	3329	3329	3329
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.76×10^{-3}	5.49×10^{-2}	0.00	5.11×10^{-3}	5.04×10^{-2}	2.26×10^{-11}	5.11×10^{-3}	7.59×10^{-2}	1.04×10^{-6}
Nitrate	1.19	2.12×10^{-2}	0.00	1.32	1.85×10^{-1}	0.00	1.32	4.12×10^{-1}	0.00
Total	**N/A**	**7.61×10^{-2}**	**0.00**	**N/A**	**2.35×10^{-1}**	**2.26×10^{-11}**	**N/A**	**4.88×10^{-1}**	**1.04×10^{-6}**
Year of peak impact	3311	3311	N/A	3354	3354	3311	3354	3354	3311

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–112. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.66×10^{-7}	2.90×10^{-1}	1.02×10^{-5}	1.69×10^{-7}	7.64×10^{-1}	3.35×10^{-5}	1.69×10^{-7}	1.56	7.33×10^{-5}
Iodine-129	1.24×10^{-10}	3.53×10^{-2}	2.78×10^{-7}	8.58×10^{-11}	3.05×10^{-2}	4.30×10^{-7}	8.58×10^{-11}	3.95×10^{-2}	6.50×10^{-7}
Total	**N/A**	**3.25×10^{-1}**	**1.05×10^{-5}**	**N/A**	**7.94×10^{-1}**	**3.40×10^{-5}**	**N/A**	**1.60**	**7.40×10^{-5}**
Year of peak impact	3296	3296	3201	3201	3201	3201	3201	3201	3201
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.82×10^{-7}	1.34×10^{-6}	0.00	5.66×10^{-7}	3.36×10^{-6}	0.00	5.66×10^{-7}	6.08×10^{-6}	0.00
Chromium	3.52×10^{-3}	3.35×10^{-2}	0.00	3.48×10^{-3}	3.44×10^{-2}	1.38×10^{-11}	3.48×10^{-3}	5.17×10^{-2}	6.34×10^{-7}
Nitrate	3.56×10^{-1}	6.36×10^{-3}	0.00	3.67×10^{-1}	5.16×10^{-2}	0.00	3.67×10^{-1}	1.15×10^{-1}	0.00
Total	**N/A**	**3.99×10^{-2}**	**0.00**	**N/A**	**8.59×10^{-2}**	**1.38×10^{-11}**	**N/A**	**1.67×10^{-1}**	**6.34×10^{-7}**
Year of peak impact	3194	3194	N/A	3168	3168	3194	3168	3168	3194

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–113. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.12×10^{-7}	1.07	3.69×10^{-5}	6.12×10^{-7}	2.76	1.22×10^{-4}	6.12×10^{-7}	5.64	2.67×10^{-4}
Iodine-129	2.57×10^{-10}	7.31×10^{-2}	8.31×10^{-7}	2.57×10^{-10}	9.13×10^{-2}	6.01×10^{-7}	2.57×10^{-10}	1.18×10^{-1}	9.10×10^{-7}
Total	**N/A**	**1.14**	**3.77×10^{-5}**	**N/A**	**2.85**	**1.23×10^{-4}**	**N/A**	**5.76**	**2.68×10^{-4}**
Year of peak impact	3083	3083	3083	3083	3083	2965	3083	3083	2965
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	4.17×10^{-6}	1.98×10^{-5}	0.00	2.62×10^{-6}	1.56×10^{-5}	0.00	2.62×10^{-6}	2.82×10^{-5}	0.00
Chromium	1.88×10^{-2}	1.79×10^{-1}	0.00	1.75×10^{-2}	1.72×10^{-1}	7.39×10^{-11}	1.75×10^{-2}	2.59×10^{-1}	3.39×10^{-6}
Nitrate	1.39	2.48×10^{-2}	0.00	1.60	2.25×10^{-1}	0.00	1.60	5.02×10^{-1}	0.00
Total	**N/A**	**2.04×10^{-1}**	**0.00**	**N/A**	**3.97×10^{-1}**	**7.39×10^{-11}**	**N/A**	**7.61×10^{-1}**	**3.39×10^{-6}**
Year of peak impact	2960	2960	N/A	2903	2903	2873	2903	2903	2873

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–114. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.70×10^{-8}	8.23×10^{-2}	2.83×10^{-6}	4.70×10^{-8}	2.12×10^{-1}	9.31×10^{-6}	4.70×10^{-8}	4.33×10^{-1}	2.04×10^{-5}
Iodine-129	4.59×10^{-11}	1.31×10^{-2}	1.49×10^{-7}	4.59×10^{-11}	1.63×10^{-2}	2.30×10^{-7}	4.59×10^{-11}	2.11×10^{-2}	3.48×10^{-7}
Total	**N/A**	**9.54×10^{-2}**	**2.98×10^{-6}**	**N/A**	**2.28×10^{-1}**	**9.54×10^{-6}**	**N/A**	**4.54×10^{-1}**	**2.07×10^{-5}**
Year of peak impact	4230	4230	4230	4230	4230	4230	4230	4230	4230
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	3.43×10^{-5}	1.63×10^{-4}	0.00	2.51×10^{-5}	1.49×10^{-4}	0.00	2.51×10^{-5}	2.70×10^{-4}	0.00
Chromium	1.04×10^{-3}	9.91×10^{-3}	0.00	1.01×10^{-3}	9.98×10^{-3}	4.18×10^{-12}	1.01×10^{-3}	1.50×10^{-2}	1.92×10^{-7}
Nitrate	1.50×10^{-1}	2.69×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.65×10^{-1}	5.16×10^{-2}	0.00
Total	**N/A**	**1.28×10^{-2}**	**0.00**	**N/A**	**3.33×10^{-2}**	**4.18×10^{-12}**	**N/A**	**6.69×10^{-2}**	**1.92×10^{-7}**
Year of peak impact	3914	3914	N/A	4221	4221	4025	4221	4221	4025

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–115. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Human Health Impacts Related to Releases from Tank Residuals at the Columbia River Surface Water

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.32×10^{-12}	1.05×10^{-5}	4.60×10^{-10}	2.29×10^{-12}	2.39×10^{-5}	1.13×10^{-9}	4.70×10^{-8}	1.43×10^{-3}	7.64×10^{-8}
Iodine-129	1.75×10^{-15}	6.24×10^{-7}	8.79×10^{-12}	1.88×10^{-15}	1.02×10^{-5}	2.46×10^{-10}	4.59×10^{-11}	2.27×10^{-4}	5.57×10^{-9}
Total	**N/A**	**1.11×10^{-5}**	**4.69×10^{-10}**	**N/A**	**3.41×10^{-5}**	**1.38×10^{-9}**	**N/A**	**1.66×10^{-3}**	**8.20×10^{-8}**
Year of peak impact	3896	3896	3896	3941	3941	3941	4230	4230	4230
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	4.83×10^{-5}	2.90×10^{-4}	0.00
Chromium	4.72×10^{-8}	4.67×10^{-7}	1.90×10^{-16}	4.72×10^{-8}	7.65×10^{-7}	8.74×10^{-12}	1.01×10^{-3}	4.45×10^{-3}	1.92×10^{-7}
Nitrate	5.76×10^{-6}	8.72×10^{-7}	0.00	5.76×10^{-6}	5.43×10^{-4}	0.00	1.49×10^{-1}	9.83×10^{-3}	0.00
Total	**N/A**	**1.34×10^{-6}**	**1.90×10^{-16}**	**N/A**	**5.44×10^{-4}**	**8.74×10^{-12}**	**N/A**	**1.46×10^{-2}**	**1.92×10^{-7}**
Year of peak impact	3728	3728	3719	3728	3728	3719	3750	3750	4025

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

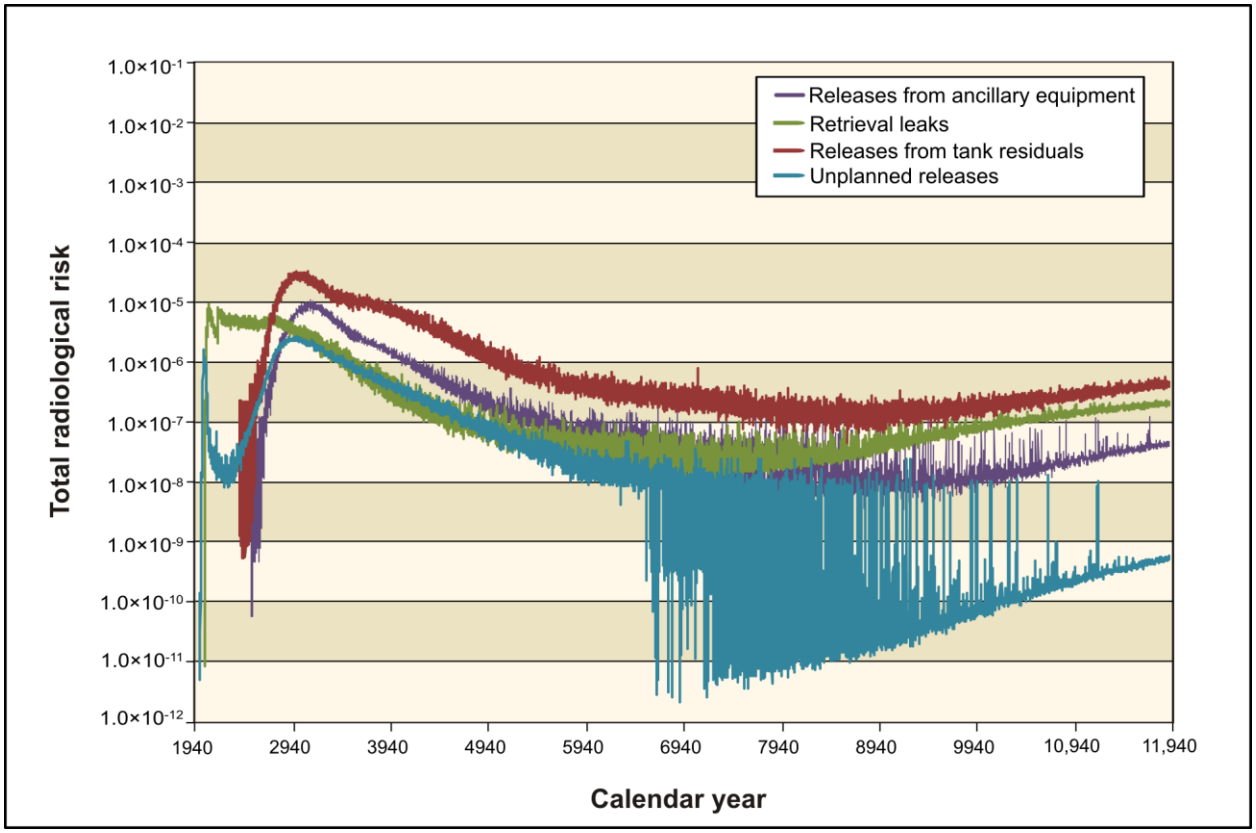

Figure Q–5. Tank Closure Alternatives 2B, 3A, 3B, 3C, and 6C Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary from Unplanned Releases, Retrieval Leaks, and Releases from Ancillary Equipment and Tank Residuals

Q.3.1.1.4 Tank Closure Alternative 4

Under Tank Closure Alternative 4, tank waste would be retrieved to a volume corresponding to 99.9 percent retrieval. Except for the BX and SX tank farms, residual material in tanks would be stabilized in place and the tank farms and adjacent cribs and trenches (ditches) would be covered with an engineered modified RCRA Subtitle C barrier. The BX and SX tank farms would be clean-closed by removing the tanks, ancillary equipment, and soils to a depth of 3 meters (10 feet) below the tank base. Where necessary, deep soil excavation would also be conducted to remove contamination plumes within the soil column.

Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–116 through Q–120; to past leaks after CY 1940, in Tables Q–121 through Q–128; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–129 through Q–136.

Table Q–116. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–117. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.61×10^{-3}	8.91×10^{2}	8.45×10^{-3}	7.61×10^{-3}	1.04×10^{3}	1.02×10^{-2}	7.61×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.23×10^{-7}	2.15×10^{-1}	7.39×10^{-6}	1.23×10^{-7}	5.54×10^{-1}	2.43×10^{-5}	1.23×10^{-7}	1.13	5.32×10^{-5}
Iodine-129	1.09×10^{-9}	3.11×10^{-1}	3.53×10^{-6}	1.09×10^{-9}	3.88×10^{-1}	5.46×10^{-6}	1.09×10^{-9}	5.01×10^{-1}	8.26×10^{-6}
Total	**N/A**	**8.91×10^{2}**	**8.46×10^{-3}**	**N/A**	**1.04×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.74	6.42×10^{1}	0.00	6.74	6.65×10^{1}	2.65×10^{-8}	6.74	1.00×10^{2}	1.21×10^{-3}
Nitrate	1.55×10^{3}	2.77×10^{1}	0.00	1.55×10^{3}	2.18×10^{2}	0.00	1.55×10^{3}	4.85×10^{2}	0.00
Total	**N/A**	**9.18×10^{1}**	**0.00**	**N/A**	**2.84×10^{2}**	**2.65×10^{-8}**	**N/A**	**5.85×10^{2}**	**1.21×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–118. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–119. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.07×10^{-5}	1.26	1.09×10^{-5}	1.07×10^{-5}	1.46	1.32×10^{-5}	9.86×10^{-6}	1.60	1.68×10^{-5}
Technetium-99	8.08×10^{-7}	1.41	5.08×10^{-5}	8.08×10^{-7}	3.64	1.67×10^{-4}	8.44×10^{-7}	7.77	3.65×10^{-4}
Iodine-129	1.14×10^{-9}	3.26×10^{-1}	3.19×10^{-6}	1.14×10^{-9}	4.07×10^{-1}	4.94×10^{-6}	9.86×10^{-10}	4.53×10^{-1}	7.47×10^{-6}
Total	**N/A**	**3.00**	**6.49×10^{-5}**	**N/A**	**5.51**	**1.85×10^{-4}**	**N/A**	**9.82**	**3.90×10^{-4}**
Year of peak impact	1964	1964	1965	1964	1964	1965	1965	1965	1965
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.28×10^{-1}	2.17	0.00	1.38×10^{-1}	1.36	8.95×10^{-10}	1.38×10^{-1}	2.04	4.10×10^{-5}
Nitrate	3.97×10^{1}	7.09×10^{-1}	0.00	7.23×10^{1}	1.02×10^{1}	0.00	7.23×10^{1}	2.26×10^{1}	0.00
Total uranium	5.39×10^{-8}	5.13×10^{-7}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**N/A**	**2.88**	**0.00**	**N/A**	**1.15×10^{1}**	**8.95×10^{-10}**	**N/A**	**2.47×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2019	2019	N/A	1964	1964	2019	1964	1964	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–120. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	7.22×10^{-10}	9.82×10^{-5}	9.67×10^{-10}	7.22×10^{-10}	1.20×10^{-4}	1.26×10^{-9}	1.07×10^{-5}	6.82×10^{-2}	1.26×10^{-6}
Technetium-99	4.96×10^{-11}	2.24×10^{-4}	9.81×10^{-9}	4.96×10^{-11}	5.16×10^{-4}	2.45×10^{-8}	8.08×10^{-7}	2.43×10^{-2}	1.30×10^{-6}
Iodine-129	6.35×10^{-14}	2.27×10^{-5}	3.20×10^{-10}	6.35×10^{-14}	3.46×10^{-4}	8.32×10^{-9}	1.14×10^{-9}	4.12×10^{-3}	1.01×10^{-7}
Total	**N/A**	**3.44×10^{-4}**	**1.11×10^{-8}**	**N/A**	**9.82×10^{-4}**	**3.41×10^{-8}**	**N/A**	**9.67×10^{-2}**	**2.66×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.68×10^{-5}	1.66×10^{-4}	6.82×10^{-14}	1.68×10^{-5}	2.72×10^{-4}	3.13×10^{-9}	3.48×10^{-2}	1.54×10^{-1}	4.10×10^{-5}
Nitrate	4.82×10^{-3}	7.30×10^{-4}	0.00	4.82×10^{-3}	4.54×10^{-1}	0.00	1.28×10^{1}	4.45	0.00
Total	**N/A**	**8.95×10^{-4}**	**6.82×10^{-14}**	**N/A**	**4.54×10^{-1}**	**3.13×10^{-9}**	**N/A**	**4.61**	**4.10×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–121. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.90×10^{-7}	2.23×10^{-2}	2.11×10^{-7}	1.90×10^{-7}	2.59×10^{-2}	2.55×10^{-7}	1.90×10^{-7}	3.08×10^{-2}	3.23×10^{-7}
Technetium-99	1.40×10^{-6}	2.44	8.40×10^{-5}	1.40×10^{-6}	6.30	2.76×10^{-4}	1.40×10^{-6}	1.29×10^{1}	6.04×10^{-4}
Iodine-129	5.45×10^{-10}	1.55×10^{-1}	1.76×10^{-6}	5.45×10^{-10}	1.94×10^{-1}	2.73×10^{-6}	5.45×10^{-10}	2.51×10^{-1}	4.13×10^{-6}
Total	**N/A**	**2.62**	**8.60×10^{-5}**	**N/A**	**6.52**	**2.79×10^{-4}**	**N/A**	**1.31×10^{1}**	**6.09×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.25×10^{-2}	5.95×10^{-1}	0.00	6.25×10^{-2}	6.17×10^{-1}	2.45×10^{-10}	6.25×10^{-2}	9.28×10^{-1}	1.13×10^{-5}
Nitrate	1.97	3.51×10^{-2}	0.00	1.97	2.76×10^{-1}	0.00	1.97	6.16×10^{-1}	0.00
Total	**N/A**	**6.30×10^{-1}**	**0.00**	**N/A**	**8.93×10^{-1}**	**2.45×10^{-10}**	**N/A**	**1.54**	**1.13×10^{-5}**
Year of peak impact	2103	2103	N/A	2103	2103	2103	2103	2103	2103

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–122. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.78×10^{-9}	3.26×10^{-4}	3.09×10^{-9}	2.78×10^{-9}	3.78×10^{-4}	3.73×10^{-9}	2.78×10^{-9}	4.51×10^{-4}	4.73×10^{-9}
Technetium-99	1.58×10^{-6}	2.76	9.50×10^{-5}	1.58×10^{-6}	7.12	3.12×10^{-4}	1.58×10^{-6}	1.45×10^{1}	6.83×10^{-4}
Iodine-129	2.41×10^{-9}	6.88×10^{-1}	7.82×10^{-6}	2.41×10^{-9}	8.59×10^{-1}	1.21×10^{-5}	2.41×10^{-9}	1.11	1.83×10^{-5}
Total	**N/A**	**3.45**	**1.03×10^{-4}**	**N/A**	**7.98**	**3.25×10^{-4}**	**N/A**	**1.56×10^{1}**	**7.02×10^{-4}**
Year of peak impact	2074	2074	2074	2074	2074	2074	2074	2074	2074
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.63×10^{-2}	5.36×10^{-1}	0.00	5.63×10^{-2}	5.56×10^{-1}	2.21×10^{-10}	5.38×10^{-2}	7.99×10^{-1}	1.01×10^{-5}
Nitrate	2.51	4.49×10^{-2}	0.00	2.51	3.53×10^{-1}	0.00	2.67	8.37×10^{-1}	0.00
Total	**N/A**	**5.81×10^{-1}**	**0.00**	**N/A**	**9.09×10^{-1}**	**2.21×10^{-10}**	**N/A**	**1.64**	**1.01×10^{-5}**
Year of peak impact	2093	2093	N/A	2093	2093	2093	2095	2095	2093

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–123. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Hydrogen-3 (tritium)	1.64×10^{-7}	1.91×10^{-2}	1.81×10^{-7}	1.64×10^{-7}	2.22×10^{-2}	2.19×10^{-7}	1.64×10^{-7}	2.65×10^{-2}	2.78×10^{-7}
Technetium-99	2.46×10^{-6}	4.30	1.48×10^{-4}	2.46×10^{-6}	1.11×10^{1}	4.86×10^{-4}	2.46×10^{-6}	2.26×10^{1}	1.06×10^{-3}
Iodine-129	4.64×10^{-9}	1.32	1.50×10^{-5}	4.64×10^{-9}	1.65	2.33×10^{-5}	4.64×10^{-9}	2.14	3.52×10^{-5}
Total	**N/A**	**5.64**	**1.63×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.10×10^{-4}**	**N/A**	**2.48×10^{1}**	**1.10×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.46×10^{-1}	2.34	0.00	2.46×10^{-1}	2.43	9.65×10^{-10}	2.46×10^{-1}	3.65	4.43×10^{-5}
Nitrate	7.03	1.25×10^{-1}	0.00	7.03	9.86×10^{-1}	0.00	7.03	2.20	0.00
Total	**N/A**	**2.47**	**0.00**	**N/A**	**3.41**	**9.65×10^{-10}**	**N/A**	**5.85**	**4.43×10^{-5}**
Year of peak impact	2026	2026	N/A	2026	2026	2026	2026	2026	2026

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–124. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.07×10^{-6}	2.42×10^{-1}	2.30×10^{-6}	2.07×10^{-6}	2.82×10^{-1}	2.78×10^{-6}	2.07×10^{-6}	3.36×10^{-1}	3.52×10^{-6}
Technetium-99	1.05×10^{-5}	1.84×10^{1}	6.34×10^{-4}	1.05×10^{-5}	4.75×10^{1}	2.08×10^{-3}	1.05×10^{-5}	9.70×10^{1}	4.56×10^{-3}
Iodine-129	2.00×10^{-8}	5.70	6.48×10^{-5}	2.00×10^{-8}	7.12	1.00×10^{-4}	2.00×10^{-8}	9.20	1.52×10^{-4}
Total	**N/A**	**2.44×10^{1}**	**7.01×10^{-4}**	**N/A**	**5.49×10^{1}**	**2.19×10^{-3}**	**N/A**	**1.07×10^{2}**	**4.71×10^{-3}**
Year of peak impact	2023	2023	2023	2023	2023	2023	2023	2023	2023
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.03×10^{-1}	2.88	0.00	3.03×10^{-1}	2.99	1.19×10^{-9}	3.03×10^{-1}	4.50	5.46×10^{-5}
Nitrate	2.41×10^{1}	4.30×10^{-1}	0.00	2.41×10^{1}	3.38	0.00	2.41×10^{1}	7.53	0.00
Total	**N/A**	**3.31**	**0.00**	**N/A**	**6.37**	**1.19×10^{-9}**	**N/A**	**1.20×10^{1}**	**5.46×10^{-5}**
Year of peak impact	2023	2023	N/A	2023	2023	2023	2023	2023	2023

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–125. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.49×10^{-8}	1.74×10^{-3}	1.65×10^{-8}	1.49×10^{-8}	2.03×10^{-3}	2.00×10^{-8}	1.49×10^{-8}	2.41×10^{-3}	2.53×10^{-8}
Technetium-99	1.29×10^{-7}	2.26×10^{-1}	7.79×10^{-6}	1.29×10^{-7}	5.84×10^{-1}	2.56×10^{-5}	1.29×10^{-7}	1.19	5.60×10^{-5}
Iodine-129	1.55×10^{-10}	4.41×10^{-2}	5.02×10^{-7}	1.55×10^{-10}	5.51×10^{-2}	7.76×10^{-7}	1.55×10^{-10}	7.12×10^{-2}	1.17×10^{-6}
Total	**N/A**	**2.72×10^{-1}**	**8.31×10^{-6}**	**N/A**	**6.41×10^{-1}**	**2.64×10^{-5}**	**N/A**	**1.27**	**5.72×10^{-5}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.16×10^{-3}	5.86×10^{-2}	0.00	6.16×10^{-3}	6.08×10^{-2}	2.42×10^{-11}	5.99×10^{-3}	8.90×10^{-2}	1.11×10^{-6}
Nitrate	4.28×10^{-1}	7.64×10^{-3}	0.00	4.28×10^{-1}	6.01×10^{-2}	0.00	4.38×10^{-1}	1.37×10^{-1}	0.00
Total	**N/A**	**6.63×10^{-2}**	**0.00**	**N/A**	**1.21×10^{-1}**	**2.42×10^{-11}**	**N/A**	**2.26×10^{-1}**	**1.11×10^{-6}**
Year of peak impact	2032	2032	N/A	2032	2032	2032	2041	2041	2032

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–126. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	9.20×10^{-9}	1.08×10^{-3}	1.02×10^{-8}	9.20×10^{-9}	1.25×10^{-3}	1.23×10^{-8}	9.20×10^{-9}	1.49×10^{-3}	1.56×10^{-8}
Technetium-99	1.58×10^{-6}	2.76	9.50×10^{-5}	1.58×10^{-6}	7.12	3.12×10^{-4}	1.58×10^{-6}	1.45×10^{1}	6.83×10^{-4}
Iodine-129	2.41×10^{-9}	6.88×10^{-1}	7.82×10^{-6}	2.41×10^{-9}	8.59×10^{-1}	1.21×10^{-5}	2.41×10^{-9}	1.11	1.83×10^{-5}
Total	**N/A**	**3.45**	**1.03×10^{-4}**	**N/A**	**7.98**	**3.25×10^{-4}**	**N/A**	**1.56×10^{1}**	**7.02×10^{-4}**
Year of peak impact	2074	2074	2074	2074	2074	2074	2074	2074	2074
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.31×10^{-2}	6.96×10^{-1}	0.00	7.31×10^{-2}	7.22×10^{-1}	2.87×10^{-10}	7.31×10^{-2}	1.09	1.32×10^{-5}
Nitrate	2.62	4.68×10^{-2}	0.00	2.62	3.68×10^{-1}	0.00	2.62	8.21×10^{-1}	0.00
Total	**N/A**	**7.43×10^{-1}**	**0.00**	**N/A**	**1.09**	**2.87×10^{-10}**	**N/A**	**1.91**	**1.32×10^{-5}**
Year of peak impact	2098	2098	N/A	2098	2098	2098	2098	2098	2098

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–127. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	3.57×10^{-7}	6.25×10^{-1}	2.16×10^{-5}	3.59×10^{-7}	1.62	7.10×10^{-5}	3.59×10^{-7}	3.30	1.55×10^{-4}
Iodine-129	6.21×10^{-10}	1.77×10^{-1}	1.96×10^{-6}	6.04×10^{-10}	2.15×10^{-1}	3.02×10^{-6}	6.04×10^{-10}	2.78×10^{-1}	4.58×10^{-6}
Total	**N/A**	**8.02×10^{-1}**	**2.35×10^{-5}**	**N/A**	**1.83**	**7.40×10^{-5}**	**N/A**	**3.58**	**1.60×10^{-4}**
Year of peak impact	2242	2242	2228	2228	2228	2228	2228	2228	2228
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.37×10^{-3}	7.02×10^{-2}	0.00	6.74×10^{-3}	6.66×10^{-2}	2.89×10^{-11}	6.74×10^{-3}	1.00×10^{-1}	1.33×10^{-6}
Nitrate	5.76×10^{-1}	1.03×10^{-2}	0.00	6.45×10^{-1}	9.05×10^{-2}	0.00	6.45×10^{-1}	2.02×10^{-1}	0.00
Total	**N/A**	**8.04×10^{-2}**	**0.00**	**N/A**	**1.57×10^{-1}**	**2.89×10^{-11}**	**N/A**	**3.02×10^{-1}**	**1.33×10^{-6}**
Year of peak impact	2253	2253	N/A	2222	2222	2253	2222	2222	2253

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–128. Tank Closure Alternative 4 Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.45×10^{-12}	3.36×10^{-5}	1.47×10^{-9}	7.42×10^{-12}	7.72×10^{-5}	3.67×10^{-9}	3.59×10^{-7}	1.08×10^{-2}	5.77×10^{-7}
Iodine-129	1.39×10^{-14}	4.96×10^{-6}	6.99×10^{-11}	1.40×10^{-14}	7.65×10^{-5}	1.84×10^{-9}	6.04×10^{-10}	2.23×10^{-3}	5.47×10^{-8}
Total	**N/A**	**3.85×10^{-5}**	**1.54×10^{-9}**	**N/A**	**1.54×10^{-4}**	**5.50×10^{-9}**	**N/A**	**1.30×10^{-2}**	**6.32×10^{-7}**
Year of peak impact	2180	2180	2180	2184	2184	2184	2228	2228	2228
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.76×10^{-7}	2.73×10^{-6}	1.09×10^{-15}	2.60×10^{-7}	4.20×10^{-6}	4.99×10^{-11}	6.74×10^{-3}	2.97×10^{-2}	1.33×10^{-6}
Nitrate	1.50×10^{-5}	2.26×10^{-6}	0.00	1.52×10^{-5}	1.43×10^{-3}	0.00	6.45×10^{-1}	3.23×10^{-2}	0.00
Total	**N/A**	**4.99×10^{-6}**	**1.09×10^{-15}**	**N/A**	**1.44×10^{-3}**	**4.99×10^{-11}**	**N/A**	**6.19×10^{-2}**	**1.33×10^{-6}**
Year of peak impact	2195	2195	2193	2184	2184	2193	2222	2222	2253

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–129. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	9.40×10^{-10}	1.10×10^{-4}	1.04×10^{-9}	9.40×10^{-10}	1.28×10^{-4}	1.26×10^{-9}	9.40×10^{-10}	1.52×10^{-4}	1.60×10^{-9}
Technetium-99	7.90×10^{-7}	1.38	4.75×10^{-5}	7.90×10^{-7}	3.56	1.56×10^{-4}	7.90×10^{-7}	7.27	3.42×10^{-4}
Iodine-129	1.39×10^{-9}	3.95×10^{-1}	4.49×10^{-6}	1.39×10^{-9}	4.93×10^{-1}	6.94×10^{-6}	1.39×10^{-9}	6.38×10^{-1}	1.05×10^{-5}
Total	**N/A**	**1.78**	**5.20×10^{-5}**	**N/A**	**4.06**	**1.63×10^{-4}**	**N/A**	**7.91**	**3.52×10^{-4}**
Year of peak impact	2100	2100	2100	2100	2100	2100	2100	2100	2100
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.11×10^{-2}	6.77×10^{-1}	0.00	6.09×10^{-2}	6.01×10^{-1}	2.79×10^{-10}	6.09×10^{-2}	9.05×10^{-1}	1.28×10^{-5}
Nitrate	1.52×10^{1}	2.71×10^{-1}	0.00	1.76×10^{1}	2.47	0.00	1.76×10^{1}	5.50	0.00
Total	**N/A**	**9.48×10^{-1}**	**0.00**	**N/A**	**3.07**	**2.79×10^{-10}**	**N/A**	**6.41**	**1.28×10^{-5}**
Year of peak impact	2168	2168	N/A	2172	2172	2168	2172	2172	2168

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–130. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.30×10^{-7}	2.69×10^{-2}	2.55×10^{-7}	2.30×10^{-7}	3.13×10^{-2}	3.08×10^{-7}	2.30×10^{-7}	3.72×10^{-2}	3.91×10^{-7}
Technetium-99	3.50×10^{-6}	6.13	2.11×10^{-4}	3.50×10^{-6}	1.58×10^{1}	6.93×10^{-4}	3.50×10^{-6}	3.22×10^{1}	1.52×10^{-3}
Iodine-129	4.33×10^{-9}	1.23	1.40×10^{-5}	4.33×10^{-9}	1.54	2.17×10^{-5}	4.33×10^{-9}	1.99	3.28×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.38**	**2.25×10^{-4}**	**N/A**	**1.74×10^{1}**	**7.15×10^{-4}**	**N/A**	**3.43×10^{1}**	**1.55×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.05	0.00	1.73×10^{-1}	1.71	8.44×10^{-10}	1.73×10^{-1}	2.57	3.87×10^{-5}
Nitrate	1.54×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.35×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.80**	**0.00**	**N/A**	**2.57×10^{1}**	**8.44×10^{-10}**	**N/A**	**5.60×10^{1}**	**3.87×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–131. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.35×10^{-9}	5.09×10^{-4}	4.83×10^{-9}	4.35×10^{-9}	5.92×10^{-4}	5.83×10^{-9}	4.35×10^{-9}	7.05×10^{-4}	7.40×10^{-9}
Technetium-99	1.96×10^{-7}	3.44×10^{-1}	1.18×10^{-5}	1.96×10^{-7}	8.85×10^{-1}	3.89×10^{-5}	1.96×10^{-7}	1.81	8.50×10^{-5}
Iodine-129	3.84×10^{-10}	1.10×10^{-1}	1.25×10^{-6}	3.84×10^{-10}	1.37×10^{-1}	1.93×10^{-6}	3.84×10^{-10}	1.77×10^{-1}	2.91×10^{-6}
Total	**N/A**	**4.54×10^{-1}**	**1.31×10^{-5}**	**N/A**	**1.02**	**4.08×10^{-5}**	**N/A**	**1.99**	**8.79×10^{-5}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.69×10^{-2}	2.56×10^{-1}	0.00	2.62×10^{-2}	2.58×10^{-1}	1.05×10^{-10}	2.62×10^{-2}	3.89×10^{-1}	4.84×10^{-6}
Nitrate	9.06×10^{-1}	1.62×10^{-2}	0.00	9.65×10^{-1}	1.35×10^{-1}	0.00	9.65×10^{-1}	3.02×10^{-1}	0.00
Total	**N/A**	**2.72×10^{-1}**	**0.00**	**N/A**	**3.94×10^{-1}**	**1.05×10^{-10}**	**N/A**	**6.91×10^{-1}**	**4.84×10^{-6}**
Year of peak impact	2059	2059	N/A	2070	2070	2059	2070	2070	2059

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–132. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.87×10^{-6}	3.36×10^{-1}	3.19×10^{-6}	2.87×10^{-6}	3.91×10^{-1}	3.85×10^{-6}	2.87×10^{-6}	4.65×10^{-1}	4.88×10^{-6}
Technetium-99	6.59×10^{-6}	1.15×10^{1}	3.97×10^{-4}	6.59×10^{-6}	2.97×10^{1}	1.31×10^{-3}	6.59×10^{-6}	6.07×10^{1}	2.86×10^{-3}
Iodine-129	1.26×10^{-8}	3.60	4.09×10^{-5}	1.26×10^{-8}	4.49	6.32×10^{-5}	1.26×10^{-8}	5.81	9.57×10^{-5}
Uranium-238	1.44×10^{-11}	1.79×10^{-3}	2.02×10^{-8}	1.44×10^{-11}	1.86×10^{-3}	2.18×10^{-8}	1.44×10^{-11}	2.00×10^{-3}	2.48×10^{-8}
Total	**N/A**	**1.55×10^{1}**	**4.41×10^{-4}**	**N/A**	**3.46×10^{1}**	**1.37×10^{-3}**	**N/A**	**6.70×10^{1}**	**2.96×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.53×10^{-1}	3.36	0.00	3.53×10^{-1}	3.49	1.39×10^{-9}	3.53×10^{-1}	5.25	6.36×10^{-5}
Nitrate	6.20×10^{1}	1.11	0.00	6.20×10^{1}	8.70	0.00	6.20×10^{1}	1.94×10^{1}	0.00
Total uranium	2.31×10^{-5}	2.20×10^{-4}	0.00	2.31×10^{-5}	2.24×10^{-4}	0.00	2.31×10^{-5}	2.34×10^{-4}	0.00
Total	**N/A**	**4.47**	**0.00**	**N/A**	**1.22×10^{1}**	**1.39×10^{-9}**	**N/A**	**2.46×10^{1}**	**6.36×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2045	2051	2051	2045

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–133. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.09×10^{-8}	1.28×10^{-3}	1.21×10^{-8}	1.09×10^{-8}	1.49×10^{-3}	1.46×10^{-8}	1.09×10^{-8}	1.77×10^{-3}	1.86×10^{-8}
Technetium-99	1.47×10^{-7}	2.57×10^{-1}	8.83×10^{-6}	1.47×10^{-7}	6.61×10^{-1}	2.90×10^{-5}	1.47×10^{-7}	1.35	6.35×10^{-5}
Iodine-129	1.96×10^{-10}	5.60×10^{-2}	6.36×10^{-7}	1.96×10^{-10}	6.99×10^{-2}	9.84×10^{-7}	1.96×10^{-10}	9.03×10^{-2}	1.49×10^{-6}
Total	**N/A**	**3.14×10^{-1}**	**9.47×10^{-6}**	**N/A**	**7.33×10^{-1}**	**3.00×10^{-5}**	**N/A**	**1.44**	**6.50×10^{-5}**
Year of peak impact	2058	2058	2058	2058	2058	2058	2058	2058	2058
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	5.76×10^{-3}	5.48×10^{-2}	0.00	4.90×10^{-3}	4.84×10^{-2}	2.30×10^{-11}	4.90×10^{-3}	7.28×10^{-2}	1.06×10^{-6}
Nitrate	7.01×10^{-1}	1.25×10^{-2}	0.00	9.09×10^{-1}	1.28×10^{-1}	0.00	9.09×10^{-1}	2.85×10^{-1}	0.00
Total	**N/A**	**6.73×10^{-2}**	**0.00**	**N/A**	**1.76×10^{-1}**	**2.30×10^{-11}**	**N/A**	**3.57×10^{-1}**	**1.06×10^{-6}**
Year of peak impact	2056	2056	N/A	2071	2071	2050	2071	2071	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–134. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.75×10^{-7}	5.56×10^{-2}	5.27×10^{-7}	4.75×10^{-7}	6.46×10^{-2}	6.37×10^{-7}	4.75×10^{-7}	7.70×10^{-2}	8.08×10^{-7}
Technetium-99	3.50×10^{-6}	6.13	2.11×10^{-4}	3.50×10^{-6}	1.58×10^{1}	6.93×10^{-4}	3.50×10^{-6}	3.22×10^{1}	1.52×10^{-3}
Iodine-129	4.33×10^{-9}	1.23	1.40×10^{-5}	4.33×10^{-9}	1.54	2.17×10^{-5}	4.33×10^{-9}	1.99	3.28×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.41**	**2.25×10^{-4}**	**N/A**	**1.74×10^{1}**	**7.15×10^{-4}**	**N/A**	**3.43×10^{1}**	**1.55×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.05	0.00	1.73×10^{-1}	1.71	8.44×10^{-10}	1.73×10^{-1}	2.57	3.87×10^{-5}
Nitrate	1.54×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.35×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.80**	**0.00**	**N/A**	**2.57×10^{1}**	**8.44×10^{-10}**	**N/A**	**5.60×10^{1}**	**3.87×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–135. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.90×10^{-11}	2.22×10^{-6}	2.11×10^{-11}	1.90×10^{-11}	2.58×10^{-6}	1.29×10^{-11}	1.90×10^{-11}	3.08×10^{-6}	1.64×10^{-11}
Technetium-99	3.92×10^{-7}	6.85×10^{-1}	2.36×10^{-5}	3.92×10^{-7}	1.77	7.76×10^{-5}	3.92×10^{-7}	3.61	1.70×10^{-4}
Iodine-129	6.88×10^{-10}	1.96×10^{-1}	2.23×10^{-6}	6.88×10^{-10}	2.45×10^{-1}	3.39×10^{-6}	6.88×10^{-10}	3.17×10^{-1}	5.13×10^{-6}
Total	**N/A**	**8.82×10^{-1}**	**2.58×10^{-5}**	**N/A**	**2.01**	**8.10×10^{-5}**	**N/A**	**3.92**	**1.75×10^{-4}**
Year of peak impact	2242	2242	2242	2242	2242	2254	2242	2242	2254
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.09×10^{-2}	6.75×10^{-1}	0.00	7.09×10^{-2}	7.00×10^{-1}	2.78×10^{-10}	7.09×10^{-2}	1.05	1.28×10^{-5}
Nitrate	1.66×10^{1}	2.96×10^{-1}	0.00	1.66×10^{1}	2.33	0.00	1.66×10^{1}	5.19	0.00
Total	**N/A**	**9.71×10^{-1}**	**0.00**	**N/A**	**3.03**	**2.78×10^{-10}**	**N/A**	**6.24**	**1.28×10^{-5}**
Year of peak impact	2076	2076	N/A	2076	2076	2076	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–136. Tank Closure Alternative 4 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	9.71×10^{-12}	4.38×10^{-5}	1.92×10^{-9}	9.71×10^{-12}	1.01×10^{-4}	4.79×10^{-9}	3.92×10^{-7}	1.18×10^{-2}	6.31×10^{-7}
Iodine-129	1.66×10^{-14}	5.94×10^{-6}	8.37×10^{-11}	1.66×10^{-14}	9.07×10^{-5}	2.18×10^{-9}	6.88×10^{-10}	2.53×10^{-3}	6.22×10^{-8}
Total	**N/A**	**4.97×10^{-5}**	**2.01×10^{-9}**	**N/A**	**1.92×10^{-4}**	**6.97×10^{-9}**	**N/A**	**1.43×10^{-2}**	**6.93×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2242	2242	2242
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	9.79×10^{-7}	9.67×10^{-6}	3.84×10^{-15}	9.79×10^{-7}	1.58×10^{-5}	1.76×10^{-10}	7.09×10^{-2}	3.12×10^{-1}	1.28×10^{-5}
Nitrate	3.17×10^{-4}	4.79×10^{-5}	0.00	3.17×10^{-4}	2.98×10^{-2}	0.00	1.66×10^{1}	7.22×10^{-1}	0.00
Total	**N/A**	**5.76×10^{-5}**	**3.84×10^{-15}**	**N/A**	**2.99×10^{-2}**	**1.76×10^{-10}**	**N/A**	**1.03**	**1.28×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Similar to Alternatives 2A, 2B, 3A, 3B, and 3C, the risk and hazard drivers are tritium, technetium-99, iodine-129, uranium-238, chromium, nitrate, and total uranium. The dose standard and Hazard Index guidelines would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, and 3C for releases from cribs and trenches (ditches). The dose standard would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, and 3C for releases from past leaks with slightly less impacts at the B Barrier, S Barrier, and Core Zone Boundary as a result of clean closure at the two tank farms located within the B and S Barriers. Impacts would be slightly less than under Alternatives 2B, 3A, 3B, 3C, and 6C as a result of the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), except for the S Barrier, where no exceedances were identified. Overall, the population dose is estimated as 2.49×10^{-1} person-rem per year for the year of maximum impact.

Figure Q–6 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2070 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. For the period of time between CYs 3100 and 5500, other tank farm sources, primarily tank residuals, make a major contribution to peak radiological risk. The peak radiological risk resulting from all three sources occurs around CY 2050 and is dominated by tritium, technetium-99, and iodine-129. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater.

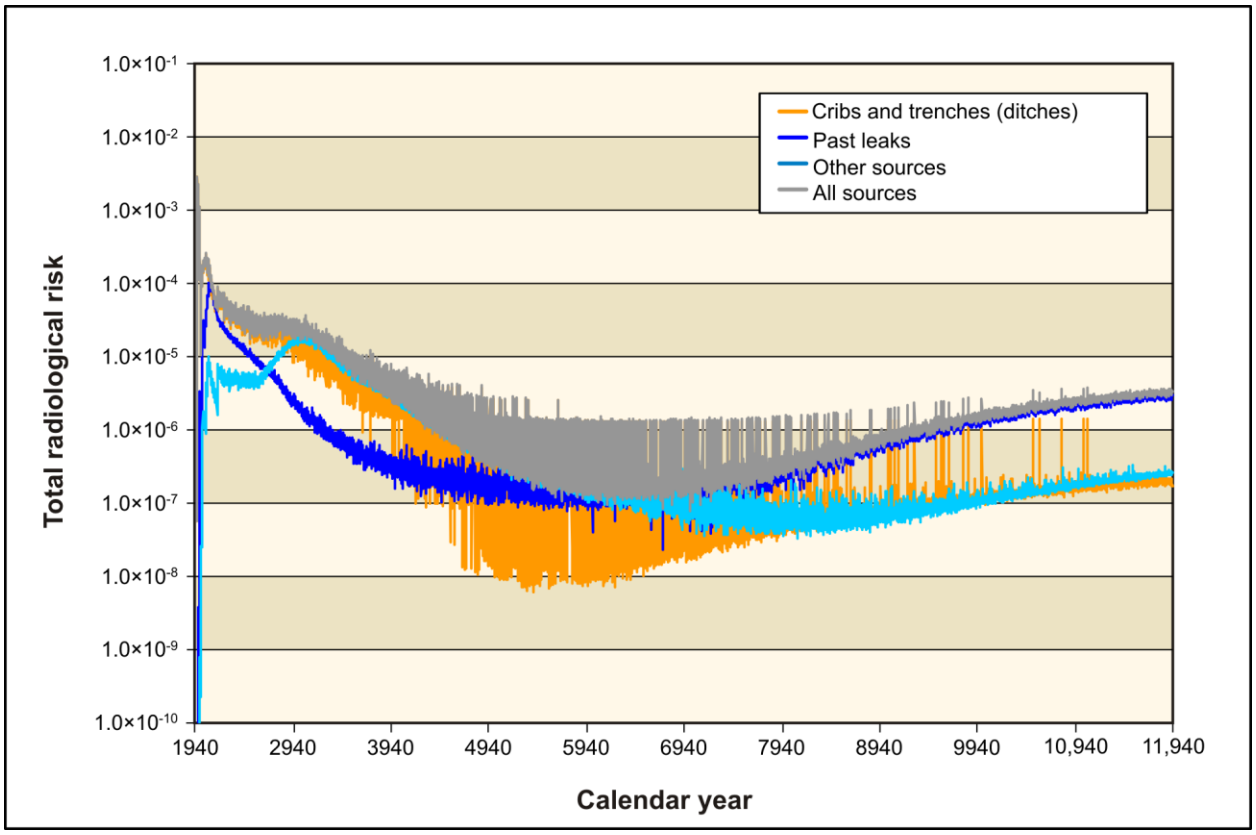

Figure Q–6. Tank Closure Alternative 4 Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.1.1.5 Tank Closure Alternative 5

Under Tank Closure Alternative 5, tank waste would be retrieved to a volume corresponding to 90 percent retrieval, residual material in tanks would be stabilized in place, and the tank farms and adjacent cribs and trenches (ditches) would be covered with a Hanford barrier. Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–137 through Q–141; to past leaks after CY 1940, in Tables Q–142 through Q–149; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–150 through Q–157.

The dose standard and Hazard Index guideline would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, 3C, and 4 for releases from cribs and trenches (ditches). The dose standard and Hazard Index guideline would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, and 3C, but would be slightly higher than under those alternatives. Population dose is estimated as 4.24×10^{-1} person-rem per year for the year of maximum impact.

Table Q–137. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–138. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.61×10^{-3}	8.91×10^{2}	8.45×10^{-3}	7.61×10^{-3}	1.04×10^{3}	1.02×10^{-2}	7.61×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.23×10^{-7}	2.15×10^{-1}	7.39×10^{-6}	1.23×10^{-7}	5.54×10^{-1}	2.43×10^{-5}	1.23×10^{-7}	1.13	5.32×10^{-5}
Iodine-129	1.09×10^{-9}	3.11×10^{-1}	3.53×10^{-6}	1.09×10^{-9}	3.88×10^{-1}	5.46×10^{-6}	1.09×10^{-9}	5.01×10^{-1}	8.26×10^{-6}
Total	**N/A**	**8.91×10^{2}**	**8.46×10^{-3}**	**N/A**	**1.04×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.74	6.42×10^{1}	0.00	6.74	6.65×10^{1}	2.65×10^{-8}	6.74	1.00×10^{2}	1.21×10^{-3}
Nitrate	1.55×10^{3}	2.77×10^{1}	0.00	1.55×10^{3}	2.18×10^{2}	0.00	1.55×10^{3}	4.85×10^{2}	0.00
Total	**N/A**	**9.18×10^{1}**	**0.00**	**N/A**	**2.84×10^{2}**	**2.65×10^{-8}**	**N/A**	**5.85×10^{2}**	**1.21×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–139. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–140. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.07×10^{-5}	1.26	1.09×10^{-5}	1.07×10^{-5}	1.46	1.32×10^{-5}	9.86×10^{-6}	1.60	1.68×10^{-5}
Technetium-99	8.08×10^{-7}	1.41	5.08×10^{-5}	8.08×10^{-7}	3.64	1.67×10^{-4}	8.44×10^{-7}	7.77	3.65×10^{-4}
Iodine-129	1.14×10^{-9}	3.26×10^{-1}	3.19×10^{-6}	1.14×10^{-9}	4.07×10^{-1}	4.94×10^{-6}	9.86×10^{-10}	4.53×10^{-1}	7.47×10^{-6}
Total	**N/A**	**3.00**	**6.49×10^{-5}**	**N/A**	**5.51**	**1.85×10^{-4}**	**N/A**	**9.82**	**3.90×10^{-4}**
Year of peak impact	1964	1964	1965	1964	1964	1965	1965	1965	1965
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.28×10^{-1}	2.17	0.00	1.38×10^{-1}	1.36	8.95×10^{-10}	1.38×10^{-1}	2.04	4.10×10^{-5}
Nitrate	3.97×10^{1}	7.09×10^{-1}	0.00	7.23×10^{1}	1.02×10^{1}	0.00	7.23×10^{1}	2.26×10^{1}	0.00
Total uranium	5.39×10^{-8}	5.13×10^{-7}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**N/A**	**2.88**	**0.00**	**N/A**	**1.15×10^{1}**	**8.95×10^{-10}**	**N/A**	**2.47×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2019	2019	N/A	1964	1964	2019	1964	1964	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–141. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.22×10^{-10}	9.82×10^{-5}	9.67×10^{-10}	7.22×10^{-10}	1.20×10^{-4}	1.26×10^{-9}	1.07×10^{-5}	6.82×10^{-2}	1.26×10^{-6}
Technetium-99	4.96×10^{-11}	2.24×10^{-4}	9.81×10^{-9}	4.96×10^{-11}	5.16×10^{-4}	2.45×10^{-8}	8.08×10^{-7}	2.43×10^{-2}	1.30×10^{-6}
Iodine-129	6.35×10^{-14}	2.27×10^{-5}	3.20×10^{-10}	6.35×10^{-14}	3.46×10^{-4}	8.32×10^{-9}	1.14×10^{-9}	4.12×10^{-3}	1.01×10^{-7}
Total	**N/A**	**3.44×10^{-4}**	**1.11×10^{-8}**	**N/A**	**9.82×10^{-4}**	**3.41×10^{-8}**	**N/A**	**9.67×10^{-2}**	**2.66×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.68×10^{-5}	1.66×10^{-4}	6.82×10^{-14}	1.68×10^{-5}	2.72×10^{-4}	3.13×10^{-9}	3.48×10^{-2}	1.54×10^{-1}	4.10×10^{-5}
Nitrate	4.82×10^{-3}	7.30×10^{-4}	0.00	4.82×10^{-3}	4.54×10^{-1}	0.00	1.28×10^{1}	4.45	0.00
Total	**N/A**	**8.95×10^{-4}**	**6.82×10^{-14}**	**N/A**	**4.54×10^{-1}**	**3.13×10^{-9}**	**N/A**	**4.61**	**4.10×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–142. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.90×10^{-7}	2.23×10^{-2}	2.11×10^{-7}	1.90×10^{-7}	2.59×10^{-2}	2.55×10^{-7}	1.90×10^{-7}	3.08×10^{-2}	3.23×10^{-7}
Technetium-99	1.36×10^{-6}	2.38	8.19×10^{-5}	1.36×10^{-6}	6.14	2.69×10^{-4}	1.36×10^{-6}	1.25×10^{1}	5.89×10^{-4}
Iodine-129	5.37×10^{-10}	1.53×10^{-1}	1.74×10^{-6}	5.37×10^{-10}	1.91×10^{-1}	2.69×10^{-6}	5.37×10^{-10}	2.47×10^{-1}	4.07×10^{-6}
Total	**N/A**	**2.56**	**8.39×10^{-5}**	**N/A**	**6.36**	**2.72×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.94×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.69×10^{-2}	6.37×10^{-1}	0.00	6.69×10^{-2}	6.61×10^{-1}	2.63×10^{-10}	6.69×10^{-2}	9.94×10^{-1}	1.21×10^{-5}
Nitrate	1.98	3.53×10^{-2}	0.00	1.98	2.77×10^{-1}	0.00	1.98	6.18×10^{-1}	0.00
Total	**N/A**	**6.73×10^{-1}**	**0.00**	**N/A**	**9.38×10^{-1}**	**2.63×10^{-10}**	**N/A**	**1.61**	**1.21×10^{-5}**
Year of peak impact	2105	2105	N/A	2105	2105	2105	2105	2105	2105

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–143. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.48×10^{-9}	1.73×10^{-4}	1.64×10^{-9}	1.48×10^{-9}	2.01×10^{-4}	1.98×10^{-9}	1.48×10^{-9}	2.39×10^{-4}	2.51×10^{-9}
Technetium-99	1.53×10^{-6}	2.68	9.22×10^{-5}	1.53×10^{-6}	6.91	3.03×10^{-4}	1.53×10^{-6}	1.41×10^{1}	6.63×10^{-4}
Iodine-129	2.79×10^{-9}	7.96×10^{-1}	9.05×10^{-6}	2.79×10^{-9}	9.94×10^{-1}	1.40×10^{-5}	2.79×10^{-9}	1.28	2.12×10^{-5}
Total	**N/A**	**3.48**	**1.01×10^{-4}**	**N/A**	**7.90**	**3.17×10^{-4}**	**N/A**	**1.54×10^{1}**	**6.85×10^{-4}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.51×10^{-2}	6.20×10^{-1}	0.00	6.51×10^{-2}	6.43×10^{-1}	2.56×10^{-10}	6.51×10^{-2}	9.67×10^{-1}	1.17×10^{-5}
Nitrate	2.51	4.48×10^{-2}	0.00	2.51	3.52×10^{-1}	0.00	2.51	7.86×10^{-1}	0.00
Total	**N/A**	**6.65×10^{-1}**	**0.00**	**N/A**	**9.95×10^{-1}**	**2.56×10^{-10}**	**N/A**	**1.75**	**1.17×10^{-5}**
Year of peak impact	2107	2107	N/A	2107	2107	2107	2107	2107	2107

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–144. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.58×10^{-7}	1.85×10^{-2}	1.75×10^{-7}	1.58×10^{-7}	2.15×10^{-2}	2.12×10^{-7}	1.58×10^{-7}	2.56×10^{-2}	2.69×10^{-7}
Technetium-99	2.45×10^{-6}	4.28	1.47×10^{-4}	2.45×10^{-6}	1.10×10^{1}	4.84×10^{-4}	2.45×10^{-6}	2.25×10^{1}	1.06×10^{-3}
Iodine-129	4.66×10^{-9}	1.33	1.51×10^{-5}	4.66×10^{-9}	1.66	2.33×10^{-5}	4.66×10^{-9}	2.14	3.53×10^{-5}
Total	**N/A**	**5.63**	**1.63×10^{-4}**	**N/A**	**1.27×10^{1}**	**5.08×10^{-4}**	**N/A**	**2.47×10^{1}**	**1.09×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.39×10^{-1}	2.28	0.00	2.39×10^{-1}	2.36	9.39×10^{-10}	2.39×10^{-1}	3.55	4.30×10^{-5}
Nitrate	7.05	1.26×10^{-1}	0.00	7.05	9.90×10^{-1}	0.00	7.05	2.21	0.00
Total	**N/A**	**2.40**	**0.00**	**N/A**	**3.35**	**9.39×10^{-10}**	**N/A**	**5.76**	**4.30×10^{-5}**
Year of peak impact	2030	2030	N/A	2030	2030	2030	2030	2030	2030

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–145. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.91×10^{-6}	2.24×10^{-1}	2.34×10^{-6}	2.11×10^{-6}	2.87×10^{-1}	2.83×10^{-6}	2.11×10^{-6}	3.42×10^{-1}	3.59×10^{-6}
Technetium-99	1.04×10^{-5}	1.83×10^{1}	6.30×10^{-4}	1.05×10^{-5}	4.72×10^{1}	2.07×10^{-3}	1.05×10^{-5}	9.64×10^{1}	4.53×10^{-3}
Iodine-129	2.03×10^{-8}	5.79	6.45×10^{-5}	1.99×10^{-8}	7.09	9.98×10^{-5}	1.99×10^{-8}	9.16	1.51×10^{-4}
Total	**N/A**	**2.43×10^{1}**	**6.97×10^{-4}**	**N/A**	**5.46×10^{1}**	**2.18×10^{-3}**	**N/A**	**1.06×10^{2}**	**4.69×10^{-3}**
Year of peak impact	2024	2024	2022	2022	2022	2022	2022	2022	2022
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.01×10^{-1}	2.87	0.00	3.01×10^{-1}	2.98	1.18×10^{-9}	3.01×10^{-1}	4.48	5.43×10^{-5}
Nitrate	2.38×10^{1}	4.25×10^{-1}	0.00	2.38×10^{1}	3.34	0.00	2.38×10^{1}	7.45	0.00
Total	**N/A**	**3.30**	**0.00**	**N/A**	**6.32**	**1.18×10^{-9}**	**N/A**	**1.19×10^{1}**	**5.43×10^{-5}**
Year of peak impact	2023	2023	N/A	2023	2023	2023	2023	2023	2023

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–146. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.58×10^{-8}	1.85×10^{-3}	1.75×10^{-8}	1.58×10^{-8}	2.15×10^{-3}	2.11×10^{-8}	1.58×10^{-8}	2.56×10^{-3}	2.68×10^{-8}
Technetium-99	1.27×10^{-7}	2.22×10^{-1}	7.63×10^{-6}	1.27×10^{-7}	5.72×10^{-1}	2.51×10^{-5}	1.27×10^{-7}	1.17	5.49×10^{-5}
Iodine-129	1.58×10^{-10}	4.50×10^{-2}	5.12×10^{-7}	1.58×10^{-10}	5.62×10^{-2}	7.91×10^{-7}	1.58×10^{-10}	7.26×10^{-2}	1.20×10^{-6}
Total	**N/A**	**2.69×10^{-1}**	**8.16×10^{-6}**	**N/A**	**6.30×10^{-1}**	**2.59×10^{-5}**	**N/A**	**1.24**	**5.61×10^{-5}**
Year of peak impact	2049	2049	2049	2049	2049	2049	2049	2049	2049
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.17×10^{-3}	5.88×10^{-2}	0.00	6.17×10^{-3}	6.10×10^{-2}	2.42×10^{-11}	6.00×10^{-3}	8.91×10^{-2}	1.11×10^{-6}
Nitrate	4.33×10^{-1}	7.73×10^{-3}	0.00	4.33×10^{-1}	6.08×10^{-2}	0.00	4.45×10^{-1}	1.39×10^{-1}	0.00
Total	**N/A**	**6.65×10^{-2}**	**0.00**	**N/A**	**1.22×10^{-1}**	**2.42×10^{-11}**	**N/A**	**2.28×10^{-1}**	**1.11×10^{-6}**
Year of peak impact	2038	2038	N/A	2038	2038	2038	2040	2040	2038

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–147. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.81×10^{-9}	2.12×10^{-4}	2.01×10^{-9}	1.81×10^{-9}	2.46×10^{-4}	2.43×10^{-9}	1.81×10^{-9}	2.93×10^{-4}	3.08×10^{-9}
Technetium-99	1.53×10^{-6}	2.68	9.22×10^{-5}	1.53×10^{-6}	6.91	3.03×10^{-4}	1.53×10^{-6}	1.41×10^{1}	6.63×10^{-4}
Iodine-129	2.79×10^{-9}	7.96×10^{-1}	9.05×10^{-6}	2.79×10^{-9}	9.94×10^{-1}	1.40×10^{-5}	2.79×10^{-9}	1.28	2.12×10^{-5}
Total	**N/A**	**3.48**	**1.01×10^{-4}**	**N/A**	**7.90**	**3.17×10^{-4}**	**N/A**	**1.54×10^{1}**	**6.85×10^{-4}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.01×10^{-2}	7.63×10^{-1}	0.00	7.72×10^{-2}	7.62×10^{-1}	3.14×10^{-10}	7.72×10^{-2}	1.15	1.44×10^{-5}
Nitrate	2.47	4.42×10^{-2}	0.00	2.69	3.77×10^{-1}	0.00	2.69	8.41×10^{-1}	0.00
Total	**N/A**	**8.07×10^{-1}**	**0.00**	**N/A**	**1.14**	**3.14×10^{-10}**	**N/A**	**1.99**	**1.44×10^{-5}**
Year of peak impact	2102	2102	N/A	2098	2098	2102	2098	2098	2102

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–148. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.46×10^{-7}	6.06×10^{-1}	2.08×10^{-5}	3.46×10^{-7}	1.56	6.85×10^{-5}	3.46×10^{-7}	3.19	1.50×10^{-4}
Iodine-129	6.79×10^{-10}	1.94×10^{-1}	2.20×10^{-6}	6.79×10^{-10}	2.42×10^{-1}	3.40×10^{-6}	6.79×10^{-10}	3.12×10^{-1}	5.15×10^{-6}
Total	**N/A**	**7.99×10^{-1}**	**2.30×10^{-5}**	**N/A**	**1.80**	**7.19×10^{-5}**	**N/A**	**3.50**	**1.55×10^{-4}**
Year of peak impact	2265	2265	2265	2265	2265	2265	2265	2265	2265
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.61×10^{-3}	8.20×10^{-2}	0.00	8.61×10^{-3}	8.51×10^{-2}	3.38×10^{-11}	8.23×10^{-3}	1.22×10^{-1}	1.55×10^{-6}
Nitrate	6.05×10^{-1}	1.08×10^{-2}	0.00	6.05×10^{-1}	8.49×10^{-2}	0.00	6.28×10^{-1}	1.97×10^{-1}	0.00
Total	**N/A**	**9.28×10^{-2}**	**0.00**	**N/A**	**1.70×10^{-1}**	**3.38×10^{-11}**	**N/A**	**3.19×10^{-1}**	**1.55×10^{-6}**
Year of peak impact	2283	2283	N/A	2283	2283	2283	2285	2285	2283

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–149. Tank Closure Alternative 5 Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.54×10^{-12}	3.40×10^{-5}	1.49×10^{-9}	7.50×10^{-12}	7.80×10^{-5}	3.71×10^{-9}	3.46×10^{-7}	1.04×10^{-2}	5.57×10^{-7}
Iodine-129	1.41×10^{-14}	5.02×10^{-6}	7.08×10^{-11}	1.45×10^{-14}	7.91×10^{-5}	1.90×10^{-9}	6.79×10^{-10}	2.39×10^{-3}	5.86×10^{-8}
Total	**N/A**	**3.90×10^{-5}**	**1.56×10^{-9}**	**N/A**	**1.57×10^{-4}**	**5.61×10^{-9}**	**N/A**	**1.28×10^{-2}**	**6.15×10^{-7}**
Year of peak impact	2180	2180	2180	2185	2185	2185	2265	2265	2265
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.95×10^{-7}	2.91×10^{-6}	1.16×10^{-15}	2.86×10^{-7}	4.63×10^{-6}	5.31×10^{-11}	8.61×10^{-3}	3.79×10^{-2}	1.55×10^{-6}
Nitrate	1.53×10^{-5}	2.31×10^{-6}	0.00	1.55×10^{-5}	1.46×10^{-3}	0.00	6.05×10^{-1}	2.87×10^{-2}	0.00
Total	**N/A**	**5.22×10^{-6}**	**1.16×10^{-15}**	**N/A**	**1.47×10^{-3}**	**5.31×10^{-11}**	**N/A**	**6.66×10^{-2}**	**1.55×10^{-6}**
Year of peak impact	2199	2199	2199	2192	2192	2199	2283	2283	2283

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–150. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.11×10^{-6}	1.95	6.70×10^{-5}	1.11×10^{-6}	5.02	2.20×10^{-4}	1.11×10^{-6}	1.03×10^{1}	4.82×10^{-4}
Iodine-129	1.81×10^{-10}	5.15×10^{-2}	5.85×10^{-7}	1.81×10^{-10}	6.43×10^{-2}	9.05×10^{-7}	1.81×10^{-10}	8.31×10^{-2}	1.37×10^{-6}
Uranium-238	4.00×10^{-13}	4.96×10^{-5}	5.60×10^{-10}	4.00×10^{-13}	5.16×10^{-5}	6.04×10^{-10}	4.00×10^{-13}	5.56×10^{-5}	6.89×10^{-10}
Total	**N/A**	**2.00**	**6.76×10^{-5}**	**N/A**	**5.08**	**2.21×10^{-4}**	**N/A**	**1.03×10^{1}**	**4.83×10^{-4}**
Year of peak impact	4155	4155	4155	4155	4155	4155	4155	4155	4155

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.88×10^{-2}	7.50×10^{-1}	0.00	6.75×10^{-2}	6.67×10^{-1}	3.09×10^{-10}	6.75×10^{-2}	1.00	1.42×10^{-5}
Nitrate	1.55×10^{1}	2.77×10^{-1}	0.00	1.78×10^{1}	2.49	0.00	1.78×10^{1}	5.56	0.00
Total	**N/A**	**1.03**	**0.00**	**N/A**	**3.16**	**3.09×10^{-10}**	**N/A**	**6.56**	**1.42×10^{-5}**
Year of peak impact	2168	2168	N/A	2172	2172	2168	2172	2172	2168

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–151. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.31×10^{-7}	2.70×10^{-2}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Technetium-99	3.58×10^{-6}	6.26	2.34×10^{-4}	3.88×10^{-6}	1.75×10^{1}	7.69×10^{-4}	3.88×10^{-6}	3.58×10^{1}	1.68×10^{-3}
Iodine-129	4.41×10^{-9}	1.26	3.87×10^{-6}	1.20×10^{-9}	4.25×10^{-1}	5.99×10^{-6}	1.20×10^{-9}	5.50×10^{-1}	9.06×10^{-6}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	9.82×10^{-10}	7.01×10^{-13}	9.04×10^{-5}	1.06×10^{-9}	7.01×10^{-13}	9.75×10^{-5}	1.21×10^{-9}
Total	**N/A**	**7.54**	**2.38×10^{-4}**	**N/A**	**1.79×10^{1}**	**7.75×10^{-4}**	**N/A**	**3.63×10^{1}**	**1.69×10^{-3}**
Year of peak impact	2056	2056	3616	3616	3616	3616	3616	3616	3616
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.04	0.00	1.72×10^{-1}	1.70	8.42×10^{-10}	1.72×10^{-1}	2.55	3.86×10^{-5}
Nitrate	1.55×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.36×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.81**	**0.00**	**N/A**	**2.57×10^{1}**	**8.42×10^{-10}**	**N/A**	**5.62×10^{1}**	**3.86×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–152. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.44×10^{-6}	6.01	2.07×10^{-4}	3.44×10^{-6}	1.55×10^{1}	6.81×10^{-4}	3.44×10^{-6}	3.17×10^{1}	1.49×10^{-3}
Iodine-129	4.76×10^{-10}	1.36×10^{-1}	1.38×10^{-6}	4.76×10^{-10}	1.69×10^{-1}	2.14×10^{-6}	4.27×10^{-10}	1.96×10^{-1}	3.23×10^{-6}
Uranium-238	1.18×10^{-13}	1.46×10^{-5}	8.18×10^{-11}	1.18×10^{-13}	1.52×10^{-5}	8.82×10^{-11}	5.84×10^{-14}	8.12×10^{-6}	1.00×10^{-10}
Total	**N/A**	**6.15**	**2.08×10^{-4}**	**N/A**	**1.57×10^{1}**	**6.83×10^{-4}**	**N/A**	**3.19×10^{1}**	**1.49×10^{-3}**
Year of peak impact	4321	4321	4314	4321	4321	4314	4314	4314	4314
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	0.00	0.00	0.00	3.01×10^{-3}	1.79×10^{-2}	0.00	3.01×10^{-3}	3.24×10^{-2}	0.00
Chromium	1.58×10^{-1}	1.51	0.00	1.26×10^{-1}	1.24	6.22×10^{-10}	1.26×10^{-1}	1.87	2.85×10^{-5}
Nitrate	4.70	8.39×10^{-2}	0.00	1.01×10^{1}	1.41	0.00	1.01×10^{1}	3.15	0.00
Total	**N/A**	**1.59**	**0.00**	**N/A**	**2.67**	**6.22×10^{-10}**	**N/A**	**5.05**	**2.85×10^{-5}**
Year of peak impact	2050	2050	N/A	4088	4088	2050	4088	4088	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–153. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.87×10^{-6}	3.36×10^{-1}	3.19×10^{-6}	2.87×10^{-6}	3.91×10^{-1}	3.85×10^{-6}	2.87×10^{-6}	4.65×10^{-1}	4.88×10^{-6}
Technetium-99	6.63×10^{-6}	1.16×10^{1}	3.99×10^{-4}	6.63×10^{-6}	2.99×10^{1}	1.31×10^{-3}	6.63×10^{-6}	6.11×10^{1}	2.87×10^{-3}
Iodine-129	1.28×10^{-8}	3.63	4.13×10^{-5}	1.28×10^{-8}	4.54	6.39×10^{-5}	1.28×10^{-8}	5.87	9.66×10^{-5}
Uranium-238	1.44×10^{-11}	1.79×10^{-3}	2.02×10^{-8}	1.44×10^{-11}	1.86×10^{-3}	2.18×10^{-8}	1.44×10^{-11}	2.00×10^{-3}	2.48×10^{-8}
Total	**N/A**	**1.56×10^{1}**	**4.44×10^{-4}**	**N/A**	**3.48×10^{1}**	**1.38×10^{-3}**	**N/A**	**6.74×10^{1}**	**2.97×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.54×10^{-1}	3.38	0.00	3.54×10^{-1}	3.50	1.39×10^{-9}	3.54×10^{-1}	5.27	6.38×10^{-5}
Nitrate	6.18×10^{1}	1.10	0.00	6.18×10^{1}	8.68	0.00	6.18×10^{1}	1.93×10^{1}	0.00
Total uranium	2.31×10^{-5}	2.20×10^{-4}	0.00	2.31×10^{-5}	2.24×10^{-4}	0.00	2.31×10^{-5}	2.34×10^{-4}	0.00
Total	**N/A**	**4.48**	**0.00**	**N/A**	**1.22×10^{1}**	**1.39×10^{-9}**	**N/A**	**2.46×10^{1}**	**6.38×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2051	2051	2051	2051

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–154. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.42×10^{-6}	2.48	8.52×10^{-5}	1.42×10^{-6}	6.39	2.80×10^{-4}	1.42×10^{-6}	1.30×10^{1}	6.13×10^{-4}
Iodine-129	3.67×10^{-10}	1.05×10^{-1}	1.19×10^{-6}	3.67×10^{-10}	1.31×10^{-1}	1.84×10^{-6}	3.67×10^{-10}	1.69×10^{-1}	2.78×10^{-6}
Uranium-238	3.63×10^{-14}	4.51×10^{-6}	5.09×10^{-11}	3.63×10^{-14}	4.69×10^{-6}	5.49×10^{-11}	3.63×10^{-14}	5.05×10^{-6}	6.25×10^{-11}
Total	**N/A**	**2.58**	**8.64×10^{-5}**	**N/A**	**6.52**	**2.82×10^{-4}**	**N/A**	**1.32×10^{1}**	**6.16×10^{-4}**
Year of peak impact	3949	3949	3949	3949	3949	3949	3949	3949	3949
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	0.00	0.00	0.00	2.84×10^{-6}	1.69×10^{-5}	0.00	0.00	0.00	0.00
Chromium	3.03×10^{-2}	2.89×10^{-1}	0.00	2.95×10^{-2}	2.92×10^{-1}	1.19×10^{-10}	2.76×10^{-2}	4.10×10^{-1}	5.46×10^{-6}
Nitrate	3.00	5.35×10^{-2}	0.00	3.34	4.69×10^{-1}	0.00	3.44	1.08	0.00
Total	**N/A**	**3.42×10^{-1}**	**0.00**	**N/A**	**7.60×10^{-1}**	**1.19×10^{-10}**	**N/A**	**1.49**	**5.46×10^{-6}**
Year of peak impact	3565	3565	N/A	3598	3598	3565	3568	3568	3565

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–155. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.75×10^{-7}	5.56×10^{-2}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Technetium-99	3.58×10^{-6}	6.26	2.34×10^{-4}	3.88×10^{-6}	1.75×10^{1}	7.69×10^{-4}	3.88×10^{-6}	3.58×10^{1}	1.68×10^{-3}
Iodine-129	4.41×10^{-9}	1.26	3.87×10^{-6}	1.20×10^{-9}	4.25×10^{-1}	5.99×10^{-6}	1.20×10^{-9}	5.50×10^{-1}	9.06×10^{-6}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	9.82×10^{-10}	7.01×10^{-13}	9.04×10^{-5}	1.06×10^{-9}	7.01×10^{-13}	9.75×10^{-5}	1.21×10^{-9}
Total	**N/A**	**7.57**	**2.38×10^{-4}**	**N/A**	**1.79×10^{1}**	**7.75×10^{-4}**	**N/A**	**3.63×10^{1}**	**1.69×10^{-3}**
Year of peak impact	2056	2056	3616	3616	3616	3616	3616	3616	3616
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.04	0.00	1.72×10^{-1}	1.70	8.42×10^{-10}	1.72×10^{-1}	2.55	3.86×10^{-5}
Nitrate	1.55×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.36×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.81**	**0.00**	**N/A**	**2.57×10^{1}**	**8.42×10^{-10}**	**N/A**	**5.62×10^{1}**	**3.86×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–156. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.78×10^{-7}	8.37×10^{-1}	2.88×10^{-5}	4.78×10^{-7}	2.16	9.47×10^{-5}	4.78×10^{-7}	4.41	2.07×10^{-4}
Iodine-129	2.01×10^{-10}	5.74×10^{-2}	6.52×10^{-7}	2.01×10^{-10}	7.17×10^{-2}	1.01×10^{-6}	2.01×10^{-10}	9.26×10^{-2}	1.53×10^{-6}
Uranium-238	2.15×10^{-13}	2.66×10^{-5}	3.00×10^{-10}	2.15×10^{-13}	2.77×10^{-5}	3.24×10^{-10}	2.15×10^{-13}	2.98×10^{-5}	3.69×10^{-10}
Total	**N/A**	**8.94×10^{-1}**	**2.94×10^{-5}**	**N/A**	**2.23**	**9.57×10^{-5}**	**N/A**	**4.50**	**2.09×10^{-4}**
Year of peak impact	4809	4809	4809	4809	4809	4809	4809	4809	4809
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.08×10^{-2}	6.75×10^{-1}	0.00	7.08×10^{-2}	7.00×10^{-1}	2.78×10^{-10}	7.08×10^{-2}	1.05	1.28×10^{-5}
Nitrate	1.66×10^{1}	2.96×10^{-1}	0.00	1.66×10^{1}	2.33	0.00	1.66×10^{1}	5.19	0.00
Total	**N/A**	**9.71×10^{-1}**	**0.00**	**N/A**	**3.03**	**2.78×10^{-10}**	**N/A**	**6.24**	**1.28×10^{-5}**
Year of peak impact	2076	2076	N/A	2076	2076	2076	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–157. Tank Closure Alternative 5 Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.85×10^{-11}	8.32×10^{-5}	3.65×10^{-9}	1.85×10^{-11}	1.92×10^{-4}	9.12×10^{-9}	4.78×10^{-7}	1.45×10^{-2}	7.76×10^{-7}
Iodine-129	4.36×10^{-15}	1.56×10^{-6}	2.20×10^{-11}	4.36×10^{-15}	2.38×10^{-5}	5.72×10^{-10}	2.01×10^{-10}	8.04×10^{-4}	1.97×10^{-8}
Uranium-238	0.00	0.00	0.00	0.00	0.00	0.00	2.15×10^{-13}	2.66×10^{-6}	5.81×10^{-11}
Total	**N/A**	**8.48×10^{-5}**	**3.68×10^{-9}**	**N/A**	**2.16×10^{-4}**	**9.69×10^{-9}**	**N/A**	**1.53×10^{-2}**	**7.95×10^{-7}**
Year of peak impact	4440	4440	4440	4440	4440	4440	4809	4809	4809
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	9.81×10^{-7}	9.69×10^{-6}	3.85×10^{-15}	9.81×10^{-7}	1.59×10^{-5}	1.77×10^{-10}	7.08×10^{-2}	3.12×10^{-1}	1.28×10^{-5}
Nitrate	3.17×10^{-4}	4.80×10^{-5}	0.00	3.17×10^{-4}	2.99×10^{-2}	0.00	1.66×10^{1}	7.22×10^{-1}	0.00
Total	**N/A**	**5.77×10^{-5}**	**3.85×10^{-15}**	**N/A**	**2.99×10^{-2}**	**1.77×10^{-10}**	**N/A**	**1.03**	**1.28×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figure Q–7 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2090 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. Between CYs 3000 and 9600, peak radiological risk is due to other tank farm sources, primarily tank residuals. The peak radiological risk resulting from all three sources occurs around CY 2050 and is dominated by technetium-99, iodine-129, and uranium-238. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater.

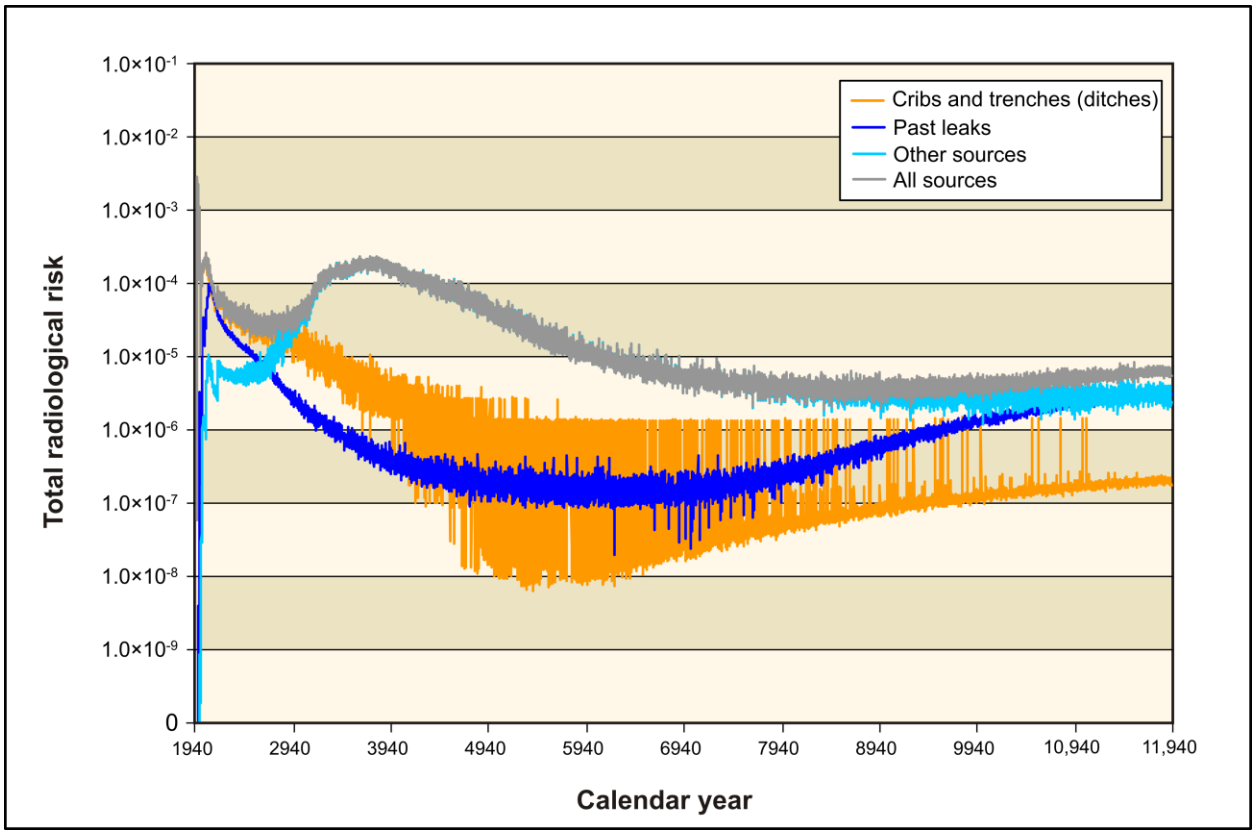

Figure Q–7. Tank Closure Alternative 5 Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.1.1.6 Tank Closure Alternative 6A, Base and Option Cases

Under Tank Closure Alternative 6A, Base Case, tank waste would be retrieved to a volume corresponding to 99.9 percent retrieval, all tanks farms would be clean-closed by removing the tanks, ancillary equipment, and soils to a depth of 3 meters (10 feet) below the tank base. Where necessary, deep soil excavation would also be conducted to remove contamination plumes within the soil column. The adjacent cribs and trenches (ditches) would be covered with an engineered modified RCRA Subtitle C barrier. Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–158 through Q–162; to past leaks after CY 1940, in Tables Q–163 through Q–170; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–171 through Q–178.

Table Q–158. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–159. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.61×10^{-3}	8.91×10^{2}	8.45×10^{-3}	7.61×10^{-3}	1.04×10^{3}	1.02×10^{-2}	7.61×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.23×10^{-7}	2.15×10^{-1}	7.39×10^{-6}	1.23×10^{-7}	5.54×10^{-1}	2.43×10^{-5}	1.23×10^{-7}	1.13	5.32×10^{-5}
Iodine-129	1.09×10^{-9}	3.11×10^{-1}	3.53×10^{-6}	1.09×10^{-9}	3.88×10^{-1}	5.46×10^{-6}	1.09×10^{-9}	5.01×10^{-1}	8.26×10^{-6}
Total	**N/A**	**8.91×10^{2}**	**8.46×10^{-3}**	**N/A**	**1.04×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.74	6.42×10^{1}	0.00	6.74	6.65×10^{1}	2.65×10^{-8}	6.74	1.00×10^{2}	1.21×10^{-3}
Nitrate	1.55×10^{3}	2.77×10^{1}	0.00	1.55×10^{3}	2.18×10^{2}	0.00	1.55×10^{3}	4.85×10^{2}	0.00
Total	**N/A**	**9.18×10^{1}**	**0.00**	**N/A**	**2.84×10^{2}**	**2.65×10^{-8}**	**N/A**	**5.85×10^{2}**	**1.21×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–160. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–161. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.07×10^{-5}	1.26	1.09×10^{-5}	1.07×10^{-5}	1.46	1.32×10^{-5}	9.86×10^{-6}	1.60	1.68×10^{-5}
Technetium-99	8.08×10^{-7}	1.41	5.08×10^{-5}	8.08×10^{-7}	3.64	1.67×10^{-4}	8.44×10^{-7}	7.77	3.65×10^{-4}
Iodine-129	1.14×10^{-9}	3.26×10^{-1}	3.19×10^{-6}	1.14×10^{-9}	4.07×10^{-1}	4.94×10^{-6}	9.86×10^{-10}	4.53×10^{-1}	7.47×10^{-6}
Total	**N/A**	**3.00**	**6.49×10^{-5}**	**N/A**	**5.51**	**1.85×10^{-4}**	**N/A**	**9.82**	**3.90×10^{-4}**
Year of peak impact	1964	1964	1965	1964	1964	1965	1965	1965	1965

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.28×10^{-1}	2.17	0.00	1.38×10^{-1}	1.36	8.95×10^{-10}	1.38×10^{-1}	2.04	4.10×10^{-5}
Nitrate	3.97×10^{1}	7.09×10^{-1}	0.00	7.23×10^{1}	1.02×10^{1}	0.00	7.23×10^{1}	2.26×10^{1}	0.00
Total uranium	5.39×10^{-8}	5.13×10^{-7}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**N/A**	**2.88**	**0.00**	**N/A**	**1.15×10^{1}**	**8.95×10^{-10}**	**N/A**	**2.47×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2019	2019	N/A	1964	1964	2019	1964	1964	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–162. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.22×10^{-10}	9.82×10^{-5}	9.67×10^{-10}	7.22×10^{-10}	1.20×10^{-4}	1.26×10^{-9}	1.07×10^{-5}	6.82×10^{-2}	1.26×10^{-6}
Technetium-99	4.96×10^{-11}	2.24×10^{-4}	9.81×10^{-9}	4.96×10^{-11}	5.16×10^{-4}	2.45×10^{-8}	8.08×10^{-7}	2.43×10^{-2}	1.30×10^{-6}
Iodine-129	6.35×10^{-14}	2.27×10^{-5}	3.20×10^{-10}	6.35×10^{-14}	3.46×10^{-4}	8.32×10^{-9}	1.14×10^{-9}	4.12×10^{-3}	1.01×10^{-7}
Total	**N/A**	**3.44×10^{-4}**	**1.11×10^{-8}**	**N/A**	**9.82×10^{-4}**	**3.41×10^{-8}**	**N/A**	**9.67×10^{-2}**	**2.66×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.68×10^{-5}	1.66×10^{-4}	6.82×10^{-14}	1.68×10^{-5}	2.72×10^{-4}	3.13×10^{-9}	3.48×10^{-2}	1.54×10^{-1}	4.10×10^{-5}
Nitrate	4.82×10^{-3}	7.30×10^{-4}	0.00	4.82×10^{-3}	4.54×10^{-1}	0.00	1.28×10^{1}	4.45	0.00
Total	**N/A**	**8.95×10^{-4}**	**6.82×10^{-14}**	**N/A**	**4.54×10^{-1}**	**3.13×10^{-9}**	**N/A**	**4.61**	**4.10×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–163. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.89×10^{-7}	2.22×10^{-2}	2.10×10^{-7}	1.89×10^{-7}	2.58×10^{-2}	2.54×10^{-7}	1.89×10^{-7}	3.07×10^{-2}	3.22×10^{-7}
Technetium-99	1.34×10^{-6}	2.35	8.07×10^{-5}	1.34×10^{-6}	6.05	2.66×10^{-4}	1.34×10^{-6}	1.24×10^{1}	5.81×10^{-4}
Iodine-129	5.38×10^{-10}	1.53×10^{-1}	1.74×10^{-6}	5.38×10^{-10}	1.92×10^{-1}	2.70×10^{-6}	5.38×10^{-10}	2.48×10^{-1}	4.08×10^{-6}
Total	**N/A**	**2.52**	**8.27×10^{-5}**	**N/A**	**6.27**	**2.68×10^{-4}**	**N/A**	**1.26×10^{1}**	**5.85×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.01×10^{-2}	6.67×10^{-1}	0.00	6.98×10^{-2}	6.89×10^{-1}	2.75×10^{-10}	6.98×10^{-2}	1.04	1.26×10^{-5}
Nitrate	2.10	3.75×10^{-2}	0.00	2.15	3.02×10^{-1}	0.00	2.15	6.74×10^{-1}	0.00
Total	**N/A**	**7.05×10^{-1}**	**0.00**	**N/A**	**9.91×10^{-1}**	**2.75×10^{-10}**	**N/A**	**1.71**	**1.26×10^{-5}**
Year of peak impact	2102	2102	N/A	2110	2110	2102	2110	2110	2102

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–164. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.70×10^{-9}	3.16×10^{-4}	3.00×10^{-9}	2.70×10^{-9}	3.67×10^{-4}	3.62×10^{-9}	2.70×10^{-9}	4.37×10^{-4}	4.59×10^{-9}
Technetium-99	2.38×10^{-6}	4.17	1.43×10^{-4}	2.38×10^{-6}	1.07×10^{1}	4.72×10^{-4}	2.38×10^{-6}	2.19×10^{1}	1.03×10^{-3}
Iodine-129	4.44×10^{-9}	1.27	1.44×10^{-5}	4.44×10^{-9}	1.58	2.22×10^{-5}	4.44×10^{-9}	2.04	3.37×10^{-5}
Total	**N/A**	**5.44**	**1.58×10^{-4}**	**N/A**	**1.23×10^{1}**	**4.94×10^{-4}**	**N/A**	**2.40×10^{1}**	**1.07×10^{-3}**
Year of peak impact	2087	2087	2087	2087	2087	2087	2087	2087	2087
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.51×10^{-2}	6.20×10^{-1}	0.00	6.51×10^{-2}	6.43×10^{-1}	2.56×10^{-10}	6.51×10^{-2}	9.67×10^{-1}	1.17×10^{-5}
Nitrate	3.81	6.79×10^{-2}	0.00	3.81	5.34×10^{-1}	0.00	3.81	1.19	0.00
Total	**N/A**	**6.88×10^{-1}**	**0.00**	**N/A**	**1.18**	**2.56×10^{-10}**	**N/A**	**2.16**	**1.17×10^{-5}**
Year of peak impact	2090	2090	N/A	2090	2090	2090	2090	2090	2090

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–165. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.61×10^{-7}	1.88×10^{-2}	1.79×10^{-7}	1.61×10^{-7}	2.19×10^{-2}	2.16×10^{-7}	1.61×10^{-7}	2.61×10^{-2}	2.74×10^{-7}
Technetium-99	2.51×10^{-6}	4.39	1.51×10^{-4}	2.51×10^{-6}	1.13×10^{1}	4.97×10^{-4}	2.51×10^{-6}	2.31×10^{1}	1.09×10^{-3}
Iodine-129	4.68×10^{-9}	1.33	1.52×10^{-5}	4.68×10^{-9}	1.67	2.34×10^{-5}	4.68×10^{-9}	2.15	3.55×10^{-5}
Total	**N/A**	**5.75**	**1.67×10^{-4}**	**N/A**	**1.30×10^{1}**	**5.21×10^{-4}**	**N/A**	**2.53×10^{1}**	**1.12×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.46×10^{-1}	2.35	0.00	2.46×10^{-1}	2.43	9.67×10^{-10}	2.46×10^{-1}	3.66	4.44×10^{-5}
Nitrate	7.21	1.29×10^{-1}	0.00	7.21	1.01	0.00	7.21	2.26	0.00
Total	**N/A**	**2.47**	**0.00**	**N/A**	**3.44**	**9.67×10^{-10}**	**N/A**	**5.92**	**4.44×10^{-5}**
Year of peak impact	2030	2030	N/A	2030	2030	2030	2030	2030	2030

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–166. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.06×10^{-6}	2.41×10^{-1}	2.29×10^{-6}	2.06×10^{-6}	2.80×10^{-1}	2.76×10^{-6}	2.06×10^{-6}	3.34×10^{-1}	3.50×10^{-6}
Technetium-99	1.06×10^{-5}	1.85×10^{1}	6.38×10^{-4}	1.06×10^{-5}	4.78×10^{1}	2.10×10^{-3}	1.06×10^{-5}	9.75×10^{1}	4.59×10^{-3}
Iodine-129	2.03×10^{-8}	5.77	6.56×10^{-5}	2.03×10^{-8}	7.21	1.01×10^{-4}	2.03×10^{-8}	9.32	1.53×10^{-4}
Total	**N/A**	**2.45×10^{1}**	**7.05×10^{-4}**	**N/A**	**5.52×10^{1}**	**2.20×10^{-3}**	**N/A**	**1.07×10^{2}**	**4.74×10^{-3}**
Year of peak impact	2023	2023	2023	2023	2023	2023	2023	2023	2023
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.00×10^{-1}	2.86	0.00	3.00×10^{-1}	2.96	1.18×10^{-9}	3.00×10^{-1}	4.46	5.40×10^{-5}
Nitrate	2.37×10^{1}	4.24×10^{-1}	0.00	2.37×10^{1}	3.33	0.00	2.37×10^{1}	7.43	0.00
Total	**N/A**	**3.28**	**0.00**	**N/A**	**6.29**	**1.18×10^{-9}**	**N/A**	**1.19×10^{1}**	**5.40×10^{-5}**
Year of peak impact	2023	2023	N/A	2023	2023	2023	2023	2023	2023

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–167. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.22×10^{-9}	7.28×10^{-4}	6.91×10^{-9}	6.22×10^{-9}	8.46×10^{-4}	8.34×10^{-9}	6.22×10^{-9}	1.01×10^{-3}	1.06×10^{-8}
Technetium-99	1.38×10^{-7}	2.41×10^{-1}	8.30×10^{-6}	1.38×10^{-7}	6.21×10^{-1}	2.73×10^{-5}	1.38×10^{-7}	1.27	5.97×10^{-5}
Iodine-129	1.65×10^{-10}	4.71×10^{-2}	5.35×10^{-7}	1.65×10^{-10}	5.88×10^{-2}	8.28×10^{-7}	1.65×10^{-10}	7.60×10^{-2}	1.25×10^{-6}
Total	**1.44×10^{-7}**	**2.89×10^{-1}**	**8.84×10^{-6}**	**1.44×10^{-7}**	**6.81×10^{-1}**	**2.81×10^{-5}**	**1.44×10^{-7}**	**1.35**	**6.09×10^{-5}**
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.16×10^{-3}	5.87×10^{-2}	0.00	6.10×10^{-3}	6.03×10^{-2}	2.42×10^{-11}	6.10×10^{-3}	9.07×10^{-2}	1.11×10^{-6}
Nitrate	4.34×10^{-1}	7.75×10^{-3}	0.00	4.42×10^{-1}	6.20×10^{-2}	0.00	4.42×10^{-1}	1.38×10^{-1}	0.00
Total	**4.40×10^{-1}**	**6.64×10^{-2}**	**0.00**	**4.48×10^{-1}**	**1.22×10^{-1}**	**2.42×10^{-11}**	**4.48×10^{-1}**	**2.29×10^{-1}**	**1.11×10^{-6}**
Year of peak impact	2040	2040	N/A	2041	2041	2040	2041	2041	2040

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–168. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	3.63×10^{-9}	4.24×10^{-4}	4.02×10^{-9}	3.63×10^{-9}	4.93×10^{-4}	4.86×10^{-9}	3.63×10^{-9}	5.87×10^{-4}	6.16×10^{-9}
Technetium-99	2.38×10^{-6}	4.17	1.43×10^{-4}	2.38×10^{-6}	1.07×10^{1}	4.72×10^{-4}	2.38×10^{-6}	2.19×10^{1}	1.03×10^{-3}
Iodine-129	4.44×10^{-9}	1.27	1.44×10^{-5}	4.44×10^{-9}	1.58	2.22×10^{-5}	4.44×10^{-9}	2.04	3.37×10^{-5}
Total	**N/A**	**5.44**	**1.58×10^{-4}**	**N/A**	**1.23×10^{1}**	**4.94×10^{-4}**	**N/A**	**2.40×10^{1}**	**1.07×10^{-3}**
Year of peak impact	2087	2087	2087	2087	2087	2087	2087	2087	2087
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.65×10^{-2}	8.24×10^{-1}	0.00	8.65×10^{-2}	8.54×10^{-1}	3.40×10^{-10}	8.65×10^{-2}	1.29	1.56×10^{-5}
Nitrate	3.65	6.52×10^{-2}	0.00	3.65	5.13×10^{-1}	0.00	3.65	1.14	0.00
Total	**N/A**	**8.89×10^{-1}**	**0.00**	**N/A**	**1.37**	**3.40×10^{-10}**	**N/A**	**2.43**	**1.56×10^{-5}**
Year of peak impact	2098	2098	N/A	2098	2098	2098	2098	2098	2098

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–169. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.54×10^{-7}	6.19×10^{-1}	2.13×10^{-5}	3.54×10^{-7}	1.60	7.00×10^{-5}	3.54×10^{-7}	3.26	1.53×10^{-4}
Iodine-129	6.86×10^{-10}	1.96×10^{-1}	2.22×10^{-6}	6.86×10^{-10}	2.44×10^{-1}	3.44×10^{-6}	6.86×10^{-10}	3.16×10^{-1}	5.20×10^{-6}
Total	**N/A**	**8.15×10^{-1}**	**2.35×10^{-5}**	**N/A**	**1.84**	**7.35×10^{-5}**	**N/A**	**3.57**	**1.58×10^{-4}**
Year of peak impact	2251	2251	2251	2251	2251	2251	2251	2251	2251
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.24×10^{-3}	7.84×10^{-2}	0.00	8.14×10^{-3}	8.04×10^{-2}	3.23×10^{-11}	8.14×10^{-3}	1.21×10^{-1}	1.48×10^{-6}
Nitrate	6.75×10^{-1}	1.21×10^{-2}	0.00	6.84×10^{-1}	9.61×10^{-2}	0.00	6.84×10^{-1}	2.14×10^{-1}	0.00
Total	**N/A**	**9.05×10^{-2}**	**0.00**	**N/A**	**1.76×10^{-1}**	**3.23×10^{-11}**	**N/A**	**3.35×10^{-1}**	**1.48×10^{-6}**
Year of peak impact	2285	2285	N/A	2284	2284	2285	2284	2284	2285

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–170. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	7.90×10^{-12}	3.57×10^{-5}	1.57×10^{-9}	7.90×10^{-12}	8.22×10^{-5}	3.90×10^{-9}	3.54×10^{-7}	1.07×10^{-2}	5.70×10^{-7}
Iodine-129	1.48×10^{-14}	5.27×10^{-6}	7.42×10^{-11}	1.48×10^{-14}	8.04×10^{-5}	1.93×10^{-9}	6.86×10^{-10}	2.49×10^{-3}	6.12×10^{-8}
Total	**N/A**	**4.09×10^{-5}**	**1.64×10^{-9}**	**N/A**	**1.63×10^{-4}**	**5.84×10^{-9}**	**N/A**	**1.32×10^{-2}**	**6.31×10^{-7}**
Year of peak impact	2184	2184	2184	2184	2184	2184	2251	2251	2251
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.02×10^{-7}	2.98×10^{-6}	1.19×10^{-15}	3.02×10^{-7}	4.88×10^{-6}	5.47×10^{-11}	7.99×10^{-3}	3.51×10^{-2}	1.48×10^{-6}
Nitrate	1.66×10^{-5}	2.51×10^{-6}	0.00	1.66×10^{-5}	1.56×10^{-3}	0.00	6.30×10^{-1}	3.54×10^{-2}	0.00
Total	**N/A**	**5.49×10^{-6}**	**1.19×10^{-15}**	**N/A**	**1.57×10^{-3}**	**5.47×10^{-11}**	**N/A**	**7.06×10^{-2}**	**1.48×10^{-6}**
Year of peak impact	2201	2201	2200	2201	2201	2200	2208	2208	2285

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–171. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.89×10^{-10}	9.23×10^{-5}	8.76×10^{-10}	7.89×10^{-10}	1.07×10^{-4}	1.06×10^{-9}	7.89×10^{-10}	1.28×10^{-4}	1.34×10^{-9}
Technetium-99	9.63×10^{-7}	1.69	5.80×10^{-5}	9.63×10^{-7}	4.34	1.91×10^{-4}	9.63×10^{-7}	8.87	4.17×10^{-4}
Iodine-129	1.65×10^{-9}	4.69×10^{-1}	5.34×10^{-6}	1.65×10^{-9}	5.86×10^{-1}	8.25×10^{-6}	1.65×10^{-9}	7.58×10^{-1}	1.25×10^{-5}
Total	**N/A**	**2.16**	**6.33×10^{-5}**	**N/A**	**4.93**	**1.99×10^{-4}**	**N/A**	**9.63**	**4.30×10^{-4}**
Year of peak impact	2103	2103	2103	2103	2103	2103	2103	2103	2103
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	8.32×10^{-2}	7.93×10^{-1}	0.00	6.97×10^{-2}	6.88×10^{-1}	3.27×10^{-10}	6.97×10^{-2}	1.04	1.50×10^{-5}
Nitrate	1.48×10^{1}	2.63×10^{-1}	0.00	1.68×10^{1}	2.36	0.00	1.68×10^{1}	5.26	0.00
Total	**N/A**	**1.06**	**0.00**	**N/A**	**3.05**	**3.27×10^{-10}**	**N/A**	**6.30**	**1.50×10^{-5}**
Year of peak impact	2168	2168	N/A	2172	2172	2168	2172	2172	2168

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–172. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.23×10^{-7}	2.61×10^{-2}	2.48×10^{-7}	2.23×10^{-7}	3.04×10^{-2}	2.99×10^{-7}	2.23×10^{-7}	3.62×10^{-2}	3.80×10^{-7}
Technetium-99	3.48×10^{-6}	6.09	2.10×10^{-4}	3.48×10^{-6}	1.57×10^{1}	6.89×10^{-4}	3.48×10^{-6}	3.21×10^{1}	1.51×10^{-3}
Iodine-129	4.29×10^{-9}	1.22	1.39×10^{-5}	4.29×10^{-9}	1.53	2.15×10^{-5}	4.29×10^{-9}	1.97	3.25×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.34**	**2.24×10^{-4}**	**N/A**	**1.73×10^{1}**	**7.11×10^{-4}**	**N/A**	**3.41×10^{1}**	**1.54×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.14×10^{-1}	2.04	0.00	1.74×10^{-1}	1.72	8.40×10^{-10}	1.74×10^{-1}	2.58	3.85×10^{-5}
Nitrate	1.55×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.35×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.80**	**0.00**	**N/A**	**2.57×10^{1}**	**8.40×10^{-10}**	**N/A**	**5.61×10^{1}**	**3.85×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–173. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.43×10^{-8}	2.84×10^{-3}	2.70×10^{-8}	2.43×10^{-8}	3.31×10^{-3}	3.26×10^{-8}	2.43×10^{-8}	3.94×10^{-3}	4.13×10^{-8}
Technetium-99	1.48×10^{-6}	2.58	8.88×10^{-5}	1.48×10^{-6}	6.65	2.92×10^{-4}	1.48×10^{-6}	1.36×10^{1}	6.39×10^{-4}
Iodine-129	2.72×10^{-9}	7.75×10^{-1}	8.81×10^{-6}	2.72×10^{-9}	9.68×10^{-1}	1.36×10^{-5}	2.72×10^{-9}	1.25	2.06×10^{-5}
Total	**N/A**	**3.36**	**9.76×10^{-5}**	**N/A**	**7.62**	**3.06×10^{-4}**	**N/A**	**1.48×10^{1}**	**6.59×10^{-4}**
Year of peak impact	2052	2052	2052	2052	2052	2052	2052	2052	2052

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.56×10^{-1}	1.48	0.00	1.56×10^{-1}	1.54	6.11×10^{-10}	1.56×10^{-1}	2.31	2.80×10^{-5}
Nitrate	4.61	8.22×10^{-2}	0.00	4.61	6.47×10^{-1}	0.00	4.61	1.44	0.00
Total	**N/A**	**1.56**	**0.00**	**N/A**	**2.18**	**6.11×10^{-10}**	**N/A**	**3.75**	**2.80×10^{-5}**
Year of peak impact	2050	2050	N/A	2050	2050	2050	2050	2050	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–174. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.87×10^{-6}	3.36×10^{-1}	3.19×10^{-6}	2.87×10^{-6}	3.91×10^{-1}	3.85×10^{-6}	2.87×10^{-6}	4.65×10^{-1}	4.88×10^{-6}
Technetium-99	6.53×10^{-6}	1.14×10^{1}	3.93×10^{-4}	6.53×10^{-6}	2.94×10^{1}	1.29×10^{-3}	6.53×10^{-6}	6.01×10^{1}	2.83×10^{-3}
Iodine-129	1.26×10^{-8}	3.60	4.09×10^{-5}	1.26×10^{-8}	4.50	6.33×10^{-5}	1.26×10^{-8}	5.81	9.57×10^{-5}
Uranium-238	1.44×10^{-11}	1.79×10^{-3}	2.02×10^{-8}	1.44×10^{-11}	1.86×10^{-3}	2.18×10^{-8}	1.44×10^{-11}	2.00×10^{-3}	2.48×10^{-8}
Total	**N/A**	**1.54×10^{1}**	**4.37×10^{-4}**	**N/A**	**3.43×10^{1}**	**1.36×10^{-3}**	**N/A**	**6.64×10^{1}**	**2.93×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.54×10^{-1}	3.37	0.00	3.54×10^{-1}	3.50	1.39×10^{-9}	3.54×10^{-1}	5.26	6.38×10^{-5}
Nitrate	6.18×10^{1}	1.10	0.00	6.18×10^{1}	8.67	0.00	6.18×10^{1}	1.93×10^{1}	0.00
Total uranium	2.31×10^{-5}	2.20×10^{-4}	0.00	2.31×10^{-5}	2.24×10^{-4}	0.00	2.31×10^{-5}	2.34×10^{-4}	0.00
Total	**N/A**	**4.48**	**0.00**	**N/A**	**1.22×10^{1}**	**1.39×10^{-9}**	**N/A**	**2.46×10^{1}**	**6.38×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2045	2051	2051	2045

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–175. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.22×10^{-9}	7.28×10^{-4}	6.91×10^{-9}	6.22×10^{-9}	8.46×10^{-4}	8.34×10^{-9}	6.22×10^{-9}	1.01×10^{-3}	1.06×10^{-8}
Technetium-99	1.38×10^{-7}	2.41×10^{-1}	8.30×10^{-6}	1.38×10^{-7}	6.21×10^{-1}	2.73×10^{-5}	1.38×10^{-7}	1.27	5.97×10^{-5}
Iodine-129	1.65×10^{-10}	4.71×10^{-2}	5.35×10^{-7}	1.65×10^{-10}	5.88×10^{-2}	8.28×10^{-7}	1.65×10^{-10}	7.60×10^{-2}	1.25×10^{-6}
Total	**1.44×10^{-7}**	**2.89×10^{-1}**	**8.84×10^{-6}**	**1.44×10^{-7}**	**6.81×10^{-1}**	**2.81×10^{-5}**	**1.44×10^{-7}**	**1.35**	**6.09×10^{-5}**
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	5.63×10^{-3}	5.36×10^{-2}	0.00	5.63×10^{-3}	5.56×10^{-2}	2.21×10^{-11}	5.63×10^{-3}	8.36×10^{-2}	1.01×10^{-6}
Nitrate	4.13×10^{-1}	7.37×10^{-3}	0.00	4.13×10^{-1}	5.80×10^{-2}	0.00	4.13×10^{-1}	1.29×10^{-1}	0.00
Total	**4.19×10^{-1}**	**6.09×10^{-2}**	**0.00**	**4.19×10^{-1}**	**1.14×10^{-1}**	**2.21×10^{-11}**	**4.19×10^{-1}**	**2.13×10^{-1}**	**1.01×10^{-6}**
Year of peak impact	2050	2050	N/A	2050	2050	2050	2050	2050	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–176. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.75×10^{-7}	5.56×10^{-2}	5.27×10^{-7}	4.75×10^{-7}	6.46×10^{-2}	6.36×10^{-7}	4.75×10^{-7}	7.69×10^{-2}	8.07×10^{-7}
Technetium-99	3.48×10^{-6}	6.09	2.10×10^{-4}	3.48×10^{-6}	1.57×10^{1}	6.89×10^{-4}	3.48×10^{-6}	3.21×10^{1}	1.51×10^{-3}
Iodine-129	4.29×10^{-9}	1.22	1.39×10^{-5}	4.29×10^{-9}	1.53	2.15×10^{-5}	4.29×10^{-9}	1.97	3.25×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.37**	**2.24×10^{-4}**	**N/A**	**1.73×10^{1}**	**7.12×10^{-4}**	**N/A**	**3.41×10^{1}**	**1.54×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.14×10^{-1}	2.04	0.00	1.74×10^{-1}	1.72	8.40×10^{-10}	1.74×10^{-1}	2.58	3.85×10^{-5}
Nitrate	1.55×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.35×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.80**	**0.00**	**N/A**	**2.57×10^{1}**	**8.40×10^{-10}**	**N/A**	**5.61×10^{1}**	**3.85×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–177. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.09×10^{-11}	1.28×10^{-6}	1.21×10^{-11}	1.09×10^{-11}	1.49×10^{-6}	1.46×10^{-11}	1.09×10^{-11}	1.77×10^{-6}	1.86×10^{-11}
Technetium-99	3.82×10^{-7}	6.69×10^{-1}	2.30×10^{-5}	3.82×10^{-7}	1.72	7.57×10^{-5}	3.82×10^{-7}	3.52	1.65×10^{-4}
Iodine-129	7.27×10^{-10}	2.07×10^{-1}	2.35×10^{-6}	7.27×10^{-10}	2.59×10^{-1}	3.64×10^{-6}	7.27×10^{-10}	3.34×10^{-1}	5.51×10^{-6}
Uranium-238	3.72×10^{-14}	4.61×10^{-6}	5.21×10^{-11}	3.72×10^{-14}	4.80×10^{-6}	5.61×10^{-11}	3.72×10^{-14}	5.17×10^{-6}	6.39×10^{-11}
Total	**N/A**	**8.76×10^{-1}**	**2.54×10^{-5}**	**N/A**	**1.98**	**7.93×10^{-5}**	**N/A**	**3.85**	**1.71×10^{-4}**
Year of peak impact	2251	2251	2251	2251	2251	2251	2251	2251	2251
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.09×10^{-2}	6.75×10^{-1}	0.00	7.09×10^{-2}	7.00×10^{-1}	2.78×10^{-10}	7.09×10^{-2}	1.05	1.28×10^{-5}
Nitrate	1.66×10^{1}	2.96×10^{-1}	0.00	1.66×10^{1}	2.33	0.00	1.66×10^{1}	5.19	0.00
Total	**N/A**	**9.71×10^{-1}**	**0.00**	**N/A**	**3.03**	**2.78×10^{-10}**	**N/A**	**6.24**	**1.28×10^{-5}**
Year of peak impact	2076	2076	N/A	2076	2076	2076	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–178. Tank Closure Alternative 6A, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	0.00	0.00	0.00	0.00	0.00	0.00	1.09×10^{-11}	6.93×10^{-8}	1.28×10^{-12}
Technetium-99	9.69×10^{-12}	4.37×10^{-5}	1.92×10^{-9}	9.69×10^{-12}	1.01×10^{-4}	4.79×10^{-9}	3.82×10^{-7}	1.15×10^{-2}	6.16×10^{-7}
Iodine-129	1.69×10^{-14}	6.03×10^{-6}	8.50×10^{-11}	1.69×10^{-14}	9.21×10^{-5}	2.21×10^{-9}	7.27×10^{-10}	2.69×10^{-3}	6.60×10^{-8}
Uranium-238	0.00	0.00	0.00	0.00	0.00	0.00	3.72×10^{-14}	4.61×10^{-7}	1.01×10^{-11}
Total	**N/A**	**4.97×10^{-5}**	**2.00×10^{-9}**	**N/A**	**1.93×10^{-4}**	**7.00×10^{-9}**	**N/A**	**1.42×10^{-2}**	**6.82×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2251	2251	2251
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	9.81×10^{-7}	9.69×10^{-6}	3.85×10^{-15}	9.81×10^{-7}	1.59×10^{-5}	1.77×10^{-10}	7.09×10^{-2}	3.12×10^{-1}	1.28×10^{-5}
Nitrate	3.13×10^{-4}	4.74×10^{-5}	0.00	3.13×10^{-4}	2.95×10^{-2}	0.00	1.66×10^{1}	7.22×10^{-1}	0.00
Total	**N/A**	**5.71×10^{-5}**	**3.85×10^{-15}**	**N/A**	**2.95×10^{-2}**	**1.77×10^{-10}**	**N/A**	**1.03**	**1.28×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

The dose standard and Hazard Index guideline would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, 3C, 4, and 5 for releases from cribs and trenches (ditches). The dose standard and Hazard Index guideline would be exceeded at the same locations and for the same receptors as under Alternatives 2B, 3A, 3B, 3C, and 4 for releases from past leaks. Impacts would be slightly higher than under Alternatives 2B, 3A, 3B, 3C, and 6C for onsite locations as a result of the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases). However, after CY 2940, the impacts drop significantly as a result of tank farm removal and clean closure activities. Population dose is estimated as 2.49×10^{-1} person-rem per year for the year of maximum impact.

Figure Q–8 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2090 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. Prior to CY 2100, other tank farm sources make a minor contribution to peak radiological risk and contribute a small fraction of the impacts of cribs and trenches (ditches) at all times. The peak radiological risk resulting from all three sources occurs around CY 2050 and is dominated by technetium-99, iodine-129, and uranium-238. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater. After approximately CY 4940, nearly all contamination due to past leaks and other sources has exited the unconfined aquifer, and Figure Q–8 is interpreted as reporting no risk due to these sources.

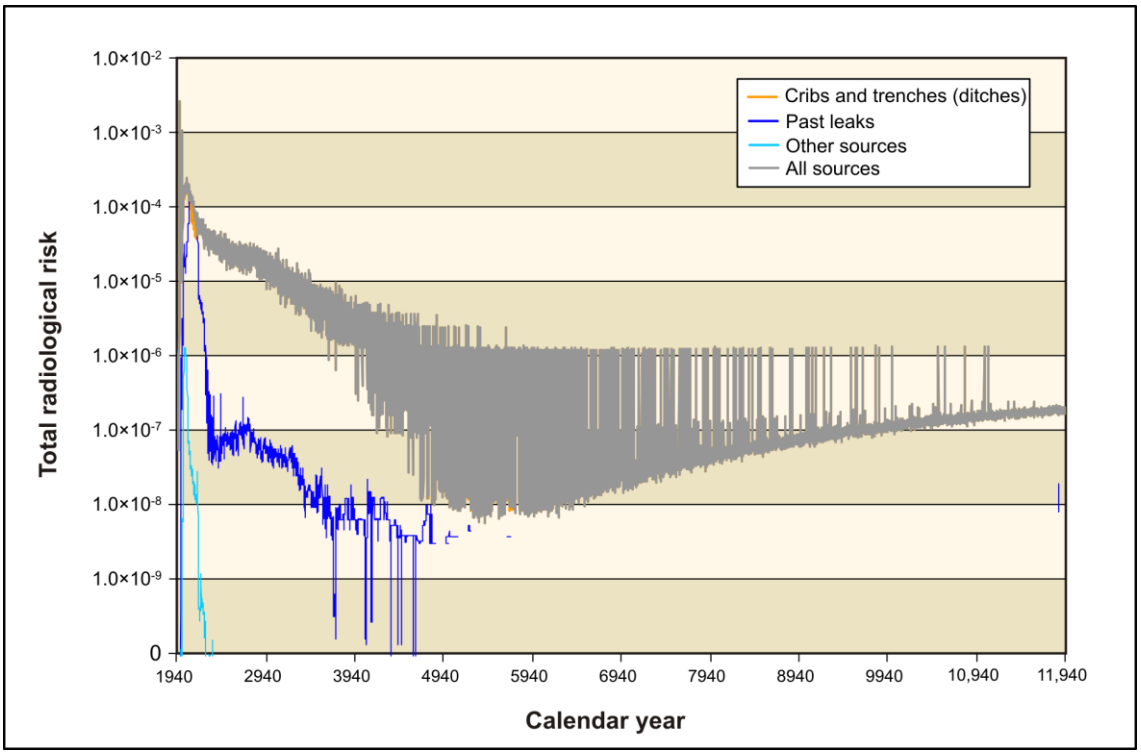

Figure Q–8. Tank Closure Alternative 6A, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Under Tank Closure Alternative 6A, Option Case, tank waste would be retrieved to a volume corresponding to 99.9 percent retrieval, all tanks farms would be clean-closed by removing the tanks, ancillary equipment, and soils to a depth of 3 meters (10 feet) below the tank base. Where necessary, deep soil excavation would also be conducted to remove contamination plumes within the soil column. In addition, the adjacent cribs and trenches (ditches) would be clean-closed. Potential human health impacts of this alternative related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–179 through Q–183; to past leaks after CY 1940, in Tables Q–184 through Q–191; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–192 through Q–199.

Table Q–179. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.75×10^{-4}	7.89×10^{1}	7.49×10^{-4}	6.75×10^{-4}	9.17×10^{1}	9.04×10^{-4}	6.75×10^{-4}	1.09×10^{2}	1.15×10^{-3}
Technetium-99	3.25×10^{-5}	5.68×10^{1}	1.95×10^{-3}	3.25×10^{-5}	1.46×10^{2}	6.43×10^{-3}	3.25×10^{-5}	2.99×10^{2}	1.41×10^{-2}
Iodine-129	4.30×10^{-8}	1.22×10^{1}	1.39×10^{-4}	4.30×10^{-8}	1.53×10^{1}	2.15×10^{-4}	4.30×10^{-8}	1.98×10^{1}	3.26×10^{-4}
Total	**N/A**	**1.48×10^{2}**	**2.84×10^{-3}**	**N/A**	**2.53×10^{2}**	**7.55×10^{-3}**	**N/A**	**4.28×10^{2}**	**1.55×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.14	5.84×10^{1}	0.00	2.85	2.82×10^{1}	2.41×10^{-8}	2.85	4.24×10^{1}	1.10×10^{-3}
Nitrate	1.72×10^{3}	3.07×10^{1}	0.00	2.05×10^{3}	2.87×10^{2}	0.00	2.05×10^{3}	6.40×10^{2}	0.00
Total	**N/A**	**8.92×10^{1}**	**0.00**	**N/A**	**3.15×10^{2}**	**2.41×10^{-8}**	**N/A**	**6.83×10^{2}**	**1.10×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–180. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.62×10^{-3}	8.92×10^{2}	8.46×10^{-3}	7.62×10^{-3}	1.04×10^{3}	1.02×10^{-2}	7.62×10^{-3}	1.24×10^{3}	1.30×10^{-2}
Technetium-99	1.20×10^{-7}	2.11×10^{-1}	7.25×10^{-6}	1.20×10^{-7}	5.43×10^{-1}	2.38×10^{-5}	1.20×10^{-7}	1.11	5.21×10^{-5}
Iodine-129	1.11×10^{-9}	3.17×10^{-1}	3.61×10^{-6}	1.11×10^{-9}	3.96×10^{-1}	5.58×10^{-6}	1.11×10^{-9}	5.12×10^{-1}	8.44×10^{-6}
Total	**N/A**	**8.93×10^{2}**	**8.47×10^{-3}**	**N/A**	**1.04×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.24×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.33	6.02×10^{1}	0.00	6.33	6.25×10^{1}	2.48×10^{-8}	6.33	9.40×10^{1}	1.14×10^{-3}
Nitrate	1.55×10^{3}	2.76×10^{1}	0.00	1.55×10^{3}	2.17×10^{2}	0.00	1.55×10^{3}	4.85×10^{2}	0.00
Total	**N/A**	**8.79×10^{1}**	**0.00**	**N/A**	**2.80×10^{2}**	**2.48×10^{-8}**	**N/A**	**5.79×10^{2}**	**1.14×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–181. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.75×10^{-4}	7.89×10^{1}	7.49×10^{-4}	6.75×10^{-4}	9.17×10^{1}	9.04×10^{-4}	6.75×10^{-4}	1.09×10^{2}	1.15×10^{-3}
Technetium-99	3.25×10^{-5}	5.68×10^{1}	1.95×10^{-3}	3.25×10^{-5}	1.46×10^{2}	6.43×10^{-3}	3.25×10^{-5}	2.99×10^{2}	1.41×10^{-2}
Iodine-129	4.30×10^{-8}	1.22×10^{1}	1.39×10^{-4}	4.30×10^{-8}	1.53×10^{1}	2.15×10^{-4}	4.30×10^{-8}	1.98×10^{1}	3.26×10^{-4}
Total	**N/A**	**1.48×10^{2}**	**2.84×10^{-3}**	**N/A**	**2.53×10^{2}**	**7.55×10^{-3}**	**N/A**	**4.28×10^{2}**	**1.55×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.14	5.84×10^{1}	0.00	2.85	2.82×10^{1}	2.41×10^{-8}	2.85	4.24×10^{1}	1.10×10^{-3}
Nitrate	1.72×10^{3}	3.07×10^{1}	0.00	2.05×10^{3}	2.87×10^{2}	0.00	2.05×10^{3}	6.40×10^{2}	0.00
Total	**N/A**	**8.92×10^{1}**	**0.00**	**N/A**	**3.15×10^{2}**	**2.41×10^{-8}**	**N/A**	**6.83×10^{2}**	**1.10×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–182. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.08×10^{-5}	1.26	1.19×10^{-5}	1.08×10^{-5}	1.46	1.44×10^{-5}	1.08×10^{-5}	1.74	1.83×10^{-5}
Technetium-99	8.67×10^{-7}	1.52	5.22×10^{-5}	8.67×10^{-7}	3.91	1.72×10^{-4}	8.67×10^{-7}	7.98	3.75×10^{-4}
Iodine-129	1.13×10^{-9}	3.21×10^{-1}	3.65×10^{-6}	1.13×10^{-9}	4.01×10^{-1}	5.65×10^{-6}	1.13×10^{-9}	5.18×10^{-1}	8.54×10^{-6}
Total	**N/A**	**3.10**	**6.78×10^{-5}**	**N/A**	**5.77**	**1.92×10^{-4}**	**N/A**	**1.02×10^{1}**	**4.02×10^{-4}**
Year of peak impact	1964	1964	1964	1964	1964	1964	1964	1964	1964
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.99×10^{-1}	1.89	0.00	1.38×10^{-1}	1.37	7.80×10^{-10}	1.38×10^{-1}	2.06	3.58×10^{-5}
Nitrate	4.23×10^{1}	7.56×10^{-1}	0.00	6.94×10^{1}	9.74	0.00	6.94×10^{1}	2.17×10^{1}	0.00
Total	**N/A**	**2.65**	**0.00**	**N/A**	**1.11×10^{1}**	**7.80×10^{-10}**	**N/A**	**2.38×10^{1}**	**3.58×10^{-5}**
Year of peak impact	2017	2017	N/A	1964	1964	2017	1964	1964	2017

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–183. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.23×10^{-10}	9.83×10^{-5}	9.69×10^{-10}	7.23×10^{-10}	1.20×10^{-4}	1.27×10^{-9}	1.08×10^{-5}	6.84×10^{-2}	1.26×10^{-6}
Technetium-99	4.97×10^{-11}	2.24×10^{-4}	9.83×10^{-9}	4.97×10^{-11}	5.16×10^{-4}	2.45×10^{-8}	8.67×10^{-7}	2.61×10^{-2}	1.40×10^{-6}
Iodine-129	6.32×10^{-14}	2.26×10^{-5}	3.18×10^{-10}	6.32×10^{-14}	3.45×10^{-4}	8.28×10^{-9}	1.13×10^{-9}	4.08×10^{-3}	1.00×10^{-7}
Total	**N/A**	**3.45×10^{-4}**	**1.11×10^{-8}**	**N/A**	**9.81×10^{-4}**	**3.41×10^{-8}**	**N/A**	**9.85×10^{-2}**	**2.75×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.70×10^{-5}	1.68×10^{-4}	7.03×10^{-14}	1.70×10^{-5}	2.75×10^{-4}	3.22×10^{-9}	3.31×10^{-2}	1.46×10^{-1}	3.57×10^{-5}
Nitrate	4.81×10^{-3}	7.29×10^{-4}	0.00	4.81×10^{-3}	4.54×10^{-1}	0.00	1.42×10^{1}	4.50	0.00
Total	**N/A**	**8.96×10^{-4}**	**7.03×10^{-14}**	**N/A**	**4.54×10^{-1}**	**3.22×10^{-9}**	**N/A**	**4.64**	**3.57×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2017

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–184. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.89×10^{-7}	2.22×10^{-2}	2.10×10^{-7}	1.89×10^{-7}	2.58×10^{-2}	2.54×10^{-7}	1.89×10^{-7}	3.07×10^{-2}	3.22×10^{-7}
Technetium-99	1.34×10^{-6}	2.35	8.07×10^{-5}	1.34×10^{-6}	6.05	2.66×10^{-4}	1.34×10^{-6}	1.24×10^{1}	5.81×10^{-4}
Iodine-129	5.38×10^{-10}	1.53×10^{-1}	1.74×10^{-6}	5.38×10^{-10}	1.92×10^{-1}	2.70×10^{-6}	5.38×10^{-10}	2.48×10^{-1}	4.08×10^{-6}
Total	**N/A**	**2.52**	**8.27×10^{-5}**	**N/A**	**6.27**	**2.68×10^{-4}**	**N/A**	**1.26×10^{1}**	**5.85×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.01×10^{-2}	6.67×10^{-1}	0.00	6.98×10^{-2}	6.89×10^{-1}	2.75×10^{-10}	6.98×10^{-2}	1.04	1.26×10^{-5}
Nitrate	2.10	3.75×10^{-2}	0.00	2.15	3.02×10^{-1}	0.00	2.15	6.74×10^{-1}	0.00
Total	**N/A**	**7.05×10^{-1}**	**0.00**	**N/A**	**9.91×10^{-1}**	**2.75×10^{-10}**	**N/A**	**1.71**	**1.26×10^{-5}**
Year of peak impact	2102	2102	N/A	2110	2110	2102	2110	2110	2102

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–185. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.70×10^{-9}	3.16×10^{-4}	3.00×10^{-9}	2.70×10^{-9}	3.67×10^{-4}	3.62×10^{-9}	2.70×10^{-9}	4.37×10^{-4}	4.59×10^{-9}
Technetium-99	2.38×10^{-6}	4.17	1.43×10^{-4}	2.38×10^{-6}	1.07×10^{1}	4.72×10^{-4}	2.38×10^{-6}	2.19×10^{1}	1.03×10^{-3}
Iodine-129	4.44×10^{-9}	1.27	1.44×10^{-5}	4.44×10^{-9}	1.58	2.22×10^{-5}	4.44×10^{-9}	2.04	3.37×10^{-5}
Total	**N/A**	**5.44**	**1.58×10^{-4}**	**N/A**	**1.23×10^{1}**	**4.94×10^{-4}**	**N/A**	**2.40×10^{1}**	**1.07×10^{-3}**
Year of peak impact	2087	2087	2087	2087	2087	2087	2087	2087	2087
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.51×10^{-2}	6.20×10^{-1}	0.00	6.51×10^{-2}	6.43×10^{-1}	2.56×10^{-10}	6.51×10^{-2}	9.67×10^{-1}	1.17×10^{-5}
Nitrate	3.81	6.79×10^{-2}	0.00	3.81	5.34×10^{-1}	0.00	3.81	1.19	0.00
Total	**N/A**	**6.88×10^{-1}**	**0.00**	**N/A**	**1.18**	**2.56×10^{-10}**	**N/A**	**2.16**	**1.17×10^{-5}**
Year of peak impact	2090	2090	N/A	2090	2090	2090	2090	2090	2090

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–186. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.61×10^{-7}	1.88×10^{-2}	1.79×10^{-7}	1.61×10^{-7}	2.19×10^{-2}	2.16×10^{-7}	1.61×10^{-7}	2.61×10^{-2}	2.74×10^{-7}
Technetium-99	2.51×10^{-6}	4.39	1.51×10^{-4}	2.51×10^{-6}	1.13×10^{1}	4.97×10^{-4}	2.51×10^{-6}	2.31×10^{1}	1.09×10^{-3}
Iodine-129	4.68×10^{-9}	1.33	1.52×10^{-5}	4.68×10^{-9}	1.67	2.34×10^{-5}	4.68×10^{-9}	2.15	3.55×10^{-5}
Total	**N/A**	**5.75**	**1.67×10^{-4}**	**N/A**	**1.30×10^{1}**	**5.21×10^{-4}**	**N/A**	**2.53×10^{1}**	**1.12×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.46×10^{-1}	2.35	0.00	2.46×10^{-1}	2.43	9.67×10^{-10}	2.46×10^{-1}	3.66	4.44×10^{-5}
Nitrate	7.21	1.29×10^{-1}	0.00	7.21	1.01	0.00	7.21	2.26	0.00
Total	**N/A**	**2.47**	**0.00**	**N/A**	**3.44**	**9.67×10^{-10}**	**N/A**	**5.92**	**4.44×10^{-5}**
Year of peak impact	2030	2030	N/A	2030	2030	2030	2030	2030	2030

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–187. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.06×10^{-6}	2.41×10^{-1}	2.29×10^{-6}	2.06×10^{-6}	2.80×10^{-1}	2.76×10^{-6}	2.06×10^{-6}	3.34×10^{-1}	3.50×10^{-6}
Technetium-99	1.06×10^{-5}	1.85×10^{1}	6.38×10^{-4}	1.06×10^{-5}	4.78×10^{1}	2.10×10^{-3}	1.06×10^{-5}	9.75×10^{1}	4.59×10^{-3}
Iodine-129	2.03×10^{-8}	5.77	6.56×10^{-5}	2.03×10^{-8}	7.21	1.01×10^{-4}	2.03×10^{-8}	9.32	1.53×10^{-4}
Total	**N/A**	**2.45×10^{1}**	**7.05×10^{-4}**	**N/A**	**5.52×10^{1}**	**2.20×10^{-3}**	**N/A**	**1.07×10^{2}**	**4.74×10^{-3}**
Year of peak impact	2023	2023	2023	2023	2023	2023	2023	2023	2023
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.00×10^{-1}	2.86	0.00	3.00×10^{-1}	2.96	1.18×10^{-9}	3.00×10^{-1}	4.46	5.40×10^{-5}
Nitrate	2.37×10^{1}	4.24×10^{-1}	0.00	2.37×10^{1}	3.33	0.00	2.37×10^{1}	7.43	0.00
Total	**N/A**	**3.28**	**0.00**	**N/A**	**6.29**	**1.18×10^{-9}**	**N/A**	**1.19×10^{1}**	**5.40×10^{-5}**
Year of peak impact	2023	2023	N/A	2023	2023	2023	2023	2023	2023

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–188. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.22×10^{-9}	7.28×10^{-4}	6.91×10^{-9}	6.22×10^{-9}	8.46×10^{-4}	8.34×10^{-9}	6.22×10^{-9}	1.01×10^{-3}	1.06×10^{-8}
Technetium-99	1.38×10^{-7}	2.41×10^{-1}	8.30×10^{-6}	1.38×10^{-7}	6.21×10^{-1}	2.73×10^{-5}	1.38×10^{-7}	1.27	5.97×10^{-5}
Iodine-129	1.65×10^{-10}	4.71×10^{-2}	5.35×10^{-7}	1.65×10^{-10}	5.88×10^{-2}	8.28×10^{-7}	1.65×10^{-10}	7.60×10^{-2}	1.25×10^{-6}
Total	**1.44×10^{-7}**	**2.89×10^{-1}**	**8.84×10^{-6}**	**1.44×10^{-7}**	**6.81×10^{-1}**	**2.81×10^{-5}**	**1.44×10^{-7}**	**1.35**	**6.09×10^{-5}**
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.16×10^{-3}	5.87×10^{-2}	0.00	6.10×10^{-3}	6.03×10^{-2}	2.42×10^{-11}	6.10×10^{-3}	9.07×10^{-2}	1.11×10^{-6}
Nitrate	4.34×10^{-1}	7.75×10^{-3}	0.00	4.42×10^{-1}	6.20×10^{-2}	0.00	4.42×10^{-1}	1.38×10^{-1}	0.00
Total	**4.40×10^{-1}**	**6.64×10^{-2}**	**0.00**	**4.48×10^{-1}**	**1.22×10^{-1}**	**2.42×10^{-11}**	**4.48×10^{-1}**	**2.29×10^{-1}**	**1.11×10^{-6}**
Year of peak impact	2040	2040	N/A	2041	2041	2040	2041	2041	2040

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–189. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	3.63×10^{-9}	4.24×10^{-4}	4.02×10^{-9}	3.63×10^{-9}	4.93×10^{-4}	4.86×10^{-9}	3.63×10^{-9}	5.87×10^{-4}	6.16×10^{-9}
Technetium-99	2.38×10^{-6}	4.17	1.43×10^{-4}	2.38×10^{-6}	1.07×10^{1}	4.72×10^{-4}	2.38×10^{-6}	2.19×10^{1}	1.03×10^{-3}
Iodine-129	4.44×10^{-9}	1.27	1.44×10^{-5}	4.44×10^{-9}	1.58	2.22×10^{-5}	4.44×10^{-9}	2.04	3.37×10^{-5}
Total	**N/A**	**5.44**	**1.58×10^{-4}**	**N/A**	**1.23×10^{1}**	**4.94×10^{-4}**	**N/A**	**2.40×10^{1}**	**1.07×10^{-3}**
Year of peak impact	2087	2087	2087	2087	2087	2087	2087	2087	2087
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.65×10^{-2}	8.24×10^{-1}	0.00	8.65×10^{-2}	8.54×10^{-1}	3.40×10^{-10}	8.65×10^{-2}	1.29	1.56×10^{-5}
Nitrate	3.65	6.52×10^{-2}	0.00	3.65	5.13×10^{-1}	0.00	3.65	1.14	0.00
Total	**N/A**	**8.89×10^{-1}**	**0.00**	**N/A**	**1.37**	**3.40×10^{-10}**	**N/A**	**2.43**	**1.56×10^{-5}**
Year of peak impact	2098	2098	N/A	2098	2098	2098	2098	2098	2098

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–190. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.54×10^{-7}	6.19×10^{-1}	2.13×10^{-5}	3.54×10^{-7}	1.60	7.00×10^{-5}	3.54×10^{-7}	3.26	1.53×10^{-4}
Iodine-129	6.86×10^{-10}	1.96×10^{-1}	2.22×10^{-6}	6.86×10^{-10}	2.44×10^{-1}	3.44×10^{-6}	6.86×10^{-10}	3.16×10^{-1}	5.20×10^{-6}
Total	**N/A**	**8.15×10^{-1}**	**2.35×10^{-5}**	**N/A**	**1.84**	**7.35×10^{-5}**	**N/A**	**3.57**	**1.58×10^{-4}**
Year of peak impact	2251	2251	2251	2251	2251	2251	2251	2251	2251
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.24×10^{-3}	7.84×10^{-2}	0.00	8.14×10^{-3}	8.04×10^{-2}	3.23×10^{-11}	8.14×10^{-3}	1.21×10^{-1}	1.48×10^{-6}
Nitrate	6.75×10^{-1}	1.21×10^{-2}	0.00	6.84×10^{-1}	9.61×10^{-2}	0.00	6.84×10^{-1}	2.14×10^{-1}	0.00
Total	**N/A**	**9.05×10^{-2}**	**0.00**	**N/A**	**1.76×10^{-1}**	**3.23×10^{-11}**	**N/A**	**3.35×10^{-1}**	**1.48×10^{-6}**
Year of peak impact	2285	2285	N/A	2284	2284	2285	2284	2284	2285

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–191. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.90×10^{-12}	3.57×10^{-5}	1.57×10^{-9}	7.90×10^{-12}	8.22×10^{-5}	3.90×10^{-9}	3.54×10^{-7}	1.07×10^{-2}	5.70×10^{-7}
Iodine-129	1.48×10^{-14}	5.27×10^{-6}	7.42×10^{-11}	1.48×10^{-14}	8.04×10^{-5}	1.93×10^{-9}	6.86×10^{-10}	2.49×10^{-3}	6.12×10^{-8}
Total	**N/A**	**4.09×10^{-5}**	**1.64×10^{-9}**	**N/A**	**1.63×10^{-4}**	**5.84×10^{-9}**	**N/A**	**1.32×10^{-2}**	**6.31×10^{-7}**
Year of peak impact	2184	2184	2184	2184	2184	2184	2251	2251	2251
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.02×10^{-7}	2.98×10^{-6}	1.19×10^{-15}	3.02×10^{-7}	4.88×10^{-6}	5.47×10^{-11}	7.99×10^{-3}	3.51×10^{-2}	1.48×10^{-6}
Nitrate	1.66×10^{-5}	2.51×10^{-6}	0.00	1.66×10^{-5}	1.56×10^{-3}	0.00	6.30×10^{-1}	3.54×10^{-2}	0.00
Total	**N/A**	**5.49×10^{-6}**	**1.19×10^{-15}**	**N/A**	**1.57×10^{-3}**	**5.47×10^{-11}**	**N/A**	**7.06×10^{-2}**	**1.48×10^{-6}**
Year of peak impact	2201	2201	2200	2201	2201	2200	2208	2208	2285

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–192. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.89×10^{-10}	9.23×10^{-5}	8.76×10^{-10}	7.89×10^{-10}	1.07×10^{-4}	1.06×10^{-9}	7.89×10^{-10}	1.28×10^{-4}	1.34×10^{-9}
Technetium-99	9.63×10^{-7}	1.69	5.80×10^{-5}	9.63×10^{-7}	4.34	1.91×10^{-4}	9.63×10^{-7}	8.87	4.17×10^{-4}
Iodine-129	1.65×10^{-9}	4.69×10^{-1}	5.34×10^{-6}	1.65×10^{-9}	5.86×10^{-1}	8.25×10^{-6}	1.65×10^{-9}	7.58×10^{-1}	1.25×10^{-5}
Total	**N/A**	**2.16**	**6.33×10^{-5}**	**N/A**	**4.93**	**1.99×10^{-4}**	**N/A**	**9.63**	**4.30×10^{-4}**
Year of peak impact	2103	2103	2103	2103	2103	2103	2103	2103	2103
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.98×10^{-2}	7.60×10^{-1}	0.00	7.98×10^{-2}	7.88×10^{-1}	3.13×10^{-10}	7.98×10^{-2}	1.19	1.44×10^{-5}
Nitrate	1.74×10^{1}	3.11×10^{-1}	0.00	1.74×10^{1}	2.45	0.00	1.74×10^{1}	5.46	0.00
Total	**N/A**	**1.07**	**0.00**	**N/A**	**3.24**	**3.13×10^{-10}**	**N/A**	**6.64**	**1.44×10^{-5}**
Year of peak impact	2164	2164	N/A	2164	2164	2164	2164	2164	2164

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–193. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.41×10^{-7}	1.65×10^{-2}	1.56×10^{-7}	1.41×10^{-7}	1.91×10^{-2}	1.89×10^{-7}	1.41×10^{-7}	2.28×10^{-2}	2.39×10^{-7}
Technetium-99	3.65×10^{-6}	6.38	2.20×10^{-4}	3.65×10^{-6}	1.65×10^{1}	7.22×10^{-4}	3.65×10^{-6}	3.36×10^{1}	1.58×10^{-3}
Iodine-129	4.34×10^{-9}	1.24	1.40×10^{-5}	4.34×10^{-9}	1.54	2.17×10^{-5}	4.34×10^{-9}	1.99	3.29×10^{-5}
Uranium-238	7.48×10^{-13}	9.28×10^{-5}	1.05×10^{-9}	7.48×10^{-13}	9.65×10^{-5}	1.13×10^{-9}	7.48×10^{-13}	1.04×10^{-4}	1.29×10^{-9}
Total	**N/A**	**7.64**	**2.34×10^{-4}**	**N/A**	**1.80×10^{1}**	**7.44×10^{-4}**	**N/A**	**3.56×10^{1}**	**1.61×10^{-3}**
Year of peak impact	2066	2066	2066	2066	2066	2066	2066	2066	2066
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.95×10^{-1}	1.86	0.00	1.95×10^{-1}	1.92	8.18×10^{-10}	1.95×10^{-1}	2.89	3.75×10^{-5}
Nitrate	1.88×10^{2}	3.36	0.00	1.88×10^{2}	2.65×10^{1}	0.00	1.88×10^{2}	5.90×10^{1}	0.00
Total uranium	1.24×10^{-6}	1.18×10^{-5}	0.00	1.24×10^{-6}	1.21×10^{-5}	0.00	1.24×10^{-6}	1.26×10^{-5}	0.00
Total	**N/A**	**5.22**	**0.00**	**N/A**	**2.84×10^{1}**	**8.18×10^{-10}**	**N/A**	**6.19×10^{1}**	**3.75×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2050	2051	2051	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–194. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.43×10^{-8}	2.84×10^{-3}	2.70×10^{-8}	2.43×10^{-8}	3.31×10^{-3}	3.26×10^{-8}	2.43×10^{-8}	3.94×10^{-3}	4.13×10^{-8}
Technetium-99	1.48×10^{-6}	2.58	8.88×10^{-5}	1.48×10^{-6}	6.65	2.92×10^{-4}	1.48×10^{-6}	1.36×10^{1}	6.39×10^{-4}
Iodine-129	2.72×10^{-9}	7.75×10^{-1}	8.81×10^{-6}	2.72×10^{-9}	9.68×10^{-1}	1.36×10^{-5}	2.72×10^{-9}	1.25	2.06×10^{-5}
Total	**N/A**	**3.36**	**9.76×10^{-5}**	**N/A**	**7.62**	**3.06×10^{-4}**	**N/A**	**1.48×10^{1}**	**6.59×10^{-4}**
Year of peak impact	2052	2052	2052	2052	2052	2052	2052	2052	2052
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.56×10^{-1}	1.48	0.00	1.56×10^{-1}	1.54	6.11×10^{-10}	1.56×10^{-1}	2.31	2.80×10^{-5}
Nitrate	4.61	8.22×10^{-2}	0.00	4.61	6.47×10^{-1}	0.00	4.61	1.44	0.00
Total	**N/A**	**1.56**	**0.00**	**N/A**	**2.18**	**6.11×10^{-10}**	**N/A**	**3.75**	**2.80×10^{-5}**
Year of peak impact	2050	2050	N/A	2050	2050	2050	2050	2050	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–195. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.25×10^{-6}	2.63×10^{-1}	2.50×10^{-6}	2.25×10^{-6}	3.06×10^{-1}	3.01×10^{-6}	2.25×10^{-6}	3.64×10^{-1}	3.82×10^{-6}
Technetium-99	6.53×10^{-6}	1.14×10^{1}	3.93×10^{-4}	6.53×10^{-6}	2.94×10^{1}	1.29×10^{-3}	6.53×10^{-6}	6.01×10^{1}	2.83×10^{-3}
Iodine-129	1.26×10^{-8}	3.60	4.09×10^{-5}	1.26×10^{-8}	4.50	6.33×10^{-5}	1.26×10^{-8}	5.81	9.57×10^{-5}
Uranium-238	1.47×10^{-11}	1.82×10^{-3}	2.06×10^{-8}	1.47×10^{-11}	1.90×10^{-3}	2.22×10^{-8}	1.47×10^{-11}	2.04×10^{-3}	2.53×10^{-8}
Total	**N/A**	**1.53×10^{1}**	**4.36×10^{-4}**	**N/A**	**3.42×10^{1}**	**1.36×10^{-3}**	**N/A**	**6.63×10^{1}**	**2.93×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.39×10^{-1}	3.23	0.00	3.39×10^{-1}	3.35	1.33×10^{-9}	3.39×10^{-1}	5.04	6.11×10^{-5}
Nitrate	6.30×10^{1}	1.12	0.00	6.30×10^{1}	8.84	0.00	6.30×10^{1}	1.97×10^{1}	0.00
Total uranium	2.23×10^{-5}	2.13×10^{-4}	0.00	2.23×10^{-5}	2.17×10^{-4}	0.00	2.23×10^{-5}	2.26×10^{-4}	0.00
Total	**N/A**	**4.35**	**0.00**	**N/A**	**1.22×10^{1}**	**1.33×10^{-9}**	**N/A**	**2.47×10^{1}**	**6.11×10^{-5}**
Year of peak impact	2050	2050	N/A	2050	2050	2050	2050	2050	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–196. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.22×10^{-9}	7.28×10^{-4}	6.91×10^{-9}	6.22×10^{-9}	8.46×10^{-4}	8.34×10^{-9}	6.22×10^{-9}	1.01×10^{-3}	1.06×10^{-8}
Technetium-99	1.38×10^{-7}	2.41×10^{-1}	8.30×10^{-6}	1.38×10^{-7}	6.21×10^{-1}	2.73×10^{-5}	1.38×10^{-7}	1.27	5.97×10^{-5}
Iodine-129	1.65×10^{-10}	4.71×10^{-2}	5.35×10^{-7}	1.65×10^{-10}	5.88×10^{-2}	8.28×10^{-7}	1.65×10^{-10}	7.60×10^{-2}	1.25×10^{-6}
Total	**1.44×10^{-7}**	**2.89×10^{-1}**	**8.84×10^{-6}**	**1.44×10^{-7}**	**6.81×10^{-1}**	**2.81×10^{-5}**	**1.44×10^{-7}**	**1.35**	**6.09×10^{-5}**
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.63×10^{-3}	5.36×10^{-2}	0.00	5.63×10^{-3}	5.56×10^{-2}	2.21×10^{-11}	5.63×10^{-3}	8.36×10^{-2}	1.01×10^{-6}
Nitrate	4.13×10^{-1}	7.37×10^{-3}	0.00	4.13×10^{-1}	5.80×10^{-2}	0.00	4.13×10^{-1}	1.29×10^{-1}	0.00
Total	**4.19×10^{-1}**	**6.09×10^{-2}**	**0.00**	**4.19×10^{-1}**	**1.14×10^{-1}**	**2.21×10^{-11}**	**4.19×10^{-1}**	**2.13×10^{-1}**	**1.01×10^{-6}**
Year of peak impact	2050	2050	N/A	2050	2050	2050	2050	2050	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–197. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.95×10^{-7}	2.28×10^{-2}	2.16×10^{-7}	1.95×10^{-7}	2.65×10^{-2}	2.61×10^{-7}	1.95×10^{-7}	3.15×10^{-2}	3.31×10^{-7}
Technetium-99	3.65×10^{-6}	6.38	2.20×10^{-4}	3.65×10^{-6}	1.65×10^{1}	7.22×10^{-4}	3.65×10^{-6}	3.36×10^{1}	1.58×10^{-3}
Iodine-129	4.34×10^{-9}	1.24	1.40×10^{-5}	4.34×10^{-9}	1.54	2.17×10^{-5}	4.34×10^{-9}	1.99	3.29×10^{-5}
Uranium-238	7.48×10^{-13}	9.28×10^{-5}	1.05×10^{-9}	7.48×10^{-13}	9.65×10^{-5}	1.13×10^{-9}	7.48×10^{-13}	1.04×10^{-4}	1.29×10^{-9}
Total	**N/A**	**7.64**	**2.34×10^{-4}**	**N/A**	**1.80×10^{1}**	**7.44×10^{-4}**	**N/A**	**3.56×10^{1}**	**1.61×10^{-3}**
Year of peak impact	2066	2066	2066	2066	2066	2066	2066	2066	2066
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.95×10^{-1}	1.86	0.00	1.95×10^{-1}	1.92	8.18×10^{-10}	1.95×10^{-1}	2.89	3.75×10^{-5}
Nitrate	1.88×10^{2}	3.36	0.00	1.88×10^{2}	2.65×10^{1}	0.00	1.88×10^{2}	5.90×10^{1}	0.00
Total uranium	1.24×10^{-6}	1.18×10^{-5}	0.00	1.24×10^{-6}	1.21×10^{-5}	0.00	1.24×10^{-6}	1.26×10^{-5}	0.00
Total	**N/A**	**5.22**	**0.00**	**N/A**	**2.84×10^{1}**	**8.18×10^{-10}**	**N/A**	**6.19×10^{1}**	**3.75×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2050	2051	2051	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–198. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.00×10^{-11}	1.17×10^{-6}	2.24×10^{-11}	2.02×10^{-11}	2.74×10^{-6}	2.70×10^{-11}	2.02×10^{-11}	3.27×10^{-6}	3.43×10^{-11}
Technetium-99	3.92×10^{-7}	6.86×10^{-1}	2.38×10^{-5}	3.96×10^{-7}	1.78	7.83×10^{-5}	3.96×10^{-7}	3.64	1.71×10^{-4}
Iodine-129	7.47×10^{-10}	2.13×10^{-1}	2.32×10^{-6}	7.15×10^{-10}	2.54×10^{-1}	3.58×10^{-6}	7.15×10^{-10}	3.29×10^{-1}	5.42×10^{-6}
Uranium-238	7.99×10^{-15}	9.91×10^{-7}	1.15×10^{-11}	8.23×10^{-15}	1.06×10^{-6}	1.24×10^{-11}	8.23×10^{-15}	1.14×10^{-6}	1.42×10^{-11}
Total	**N/A**	**8.99×10^{-1}**	**2.61×10^{-5}**	**N/A**	**2.04**	**8.19×10^{-5}**	**N/A**	**3.97**	**1.77×10^{-4}**
Year of peak impact	2251	2251	2239	2239	2239	2239	2239	2239	2239
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.43×10^{-2}	6.13×10^{-1}	0.00	6.43×10^{-2}	6.35×10^{-1}	2.53×10^{-10}	6.43×10^{-2}	9.56×10^{-1}	1.16×10^{-5}
Nitrate	1.68×10^{1}	2.99×10^{-1}	0.00	1.68×10^{1}	2.35	0.00	1.68×10^{1}	5.25	0.00
Total uranium	2.26×10^{-8}	2.16×10^{-7}	0.00	2.26×10^{-8}	2.20×10^{-7}	0.00	2.26×10^{-8}	2.29×10^{-7}	0.00
Total	**N/A**	**9.12×10^{-1}**	**0.00**	**N/A**	**2.99**	**2.53×10^{-10}**	**N/A**	**6.21**	**1.16×10^{-5}**
Year of peak impact	2076	2076	N/A	2076	2076	2076	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–199. Tank Closure Alternative 6A, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.01×10^{-11}	4.57×10^{-5}	2.00×10^{-9}	1.01×10^{-11}	1.05×10^{-4}	5.00×10^{-9}	3.96×10^{-7}	1.19×10^{-2}	6.38×10^{-7}
Iodine-129	1.75×10^{-14}	6.25×10^{-6}	8.80×10^{-11}	1.75×10^{-14}	9.54×10^{-5}	2.29×10^{-9}	7.15×10^{-10}	2.73×10^{-3}	6.69×10^{-8}
Uranium-238	0.00	0.00	0.00	0.00	0.00	0.00	8.23×10^{-15}	1.02×10^{-7}	2.23×10^{-12}
Total	**N/A**	**5.19×10^{-5}**	**2.09×10^{-9}**	**N/A**	**2.01×10^{-4}**	**7.29×10^{-9}**	**N/A**	**1.47×10^{-2}**	**7.05×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2239	2239	2239
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.02×10^{-6}	1.01×10^{-5}	4.00×10^{-15}	1.02×10^{-6}	1.65×10^{-5}	1.83×10^{-10}	6.43×10^{-2}	2.83×10^{-1}	1.16×10^{-5}
Nitrate	3.46×10^{-4}	5.24×10^{-5}	0.00	3.46×10^{-4}	3.26×10^{-2}	0.00	1.68×10^{1}	7.34×10^{-1}	0.00
Total uranium	0.00	0.00	0.00	0.00	0.00	0.00	2.26×10^{-8}	1.00×10^{-8}	0.00
Total	**N/A**	**6.25×10^{-5}**	**4.00×10^{-15}**	**N/A**	**3.26×10^{-2}**	**1.83×10^{-10}**	**N/A**	**1.02**	**1.16×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

The dose standard and Hazard Index guideline would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, 3C, 4, 5, and 6A, Base Case, for releases from cribs and trenches (ditches). Similar to Alternative 6A, Base Case, the dose standard and Hazard Index guideline would be exceeded at the same locations and for the same receptors as under Alternatives 2A, 2B, 3A, 3B, and 3C, but would be slightly higher than under those alternatives. Impacts would be slightly higher than under Alternatives 2B, 3A, 3B, 3C, and 6C for onsite locations as a result of the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases). However, after CY 2940, the impacts drop significantly as a result of tank farm removal. Population dose is estimated as 2.60×10^{-1} person-rem per year for the year of maximum impact.

Figure Q–9 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2090 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. Prior to CY 2100, other tank farm sources make a minor contribution to peak radiological risk and contribute a small fraction of the impacts of cribs and trenches (ditches) at all times. The peak radiological risk resulting from all three sources occurs around CY 2070 and is dominated by technetium-99, iodine-129, and uranium-238. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater. After approximately CY 4940, nearly all contamination has exited the unconfined aquifer, and Figure Q–9 is interpreted as reporting no risk due to these sources.

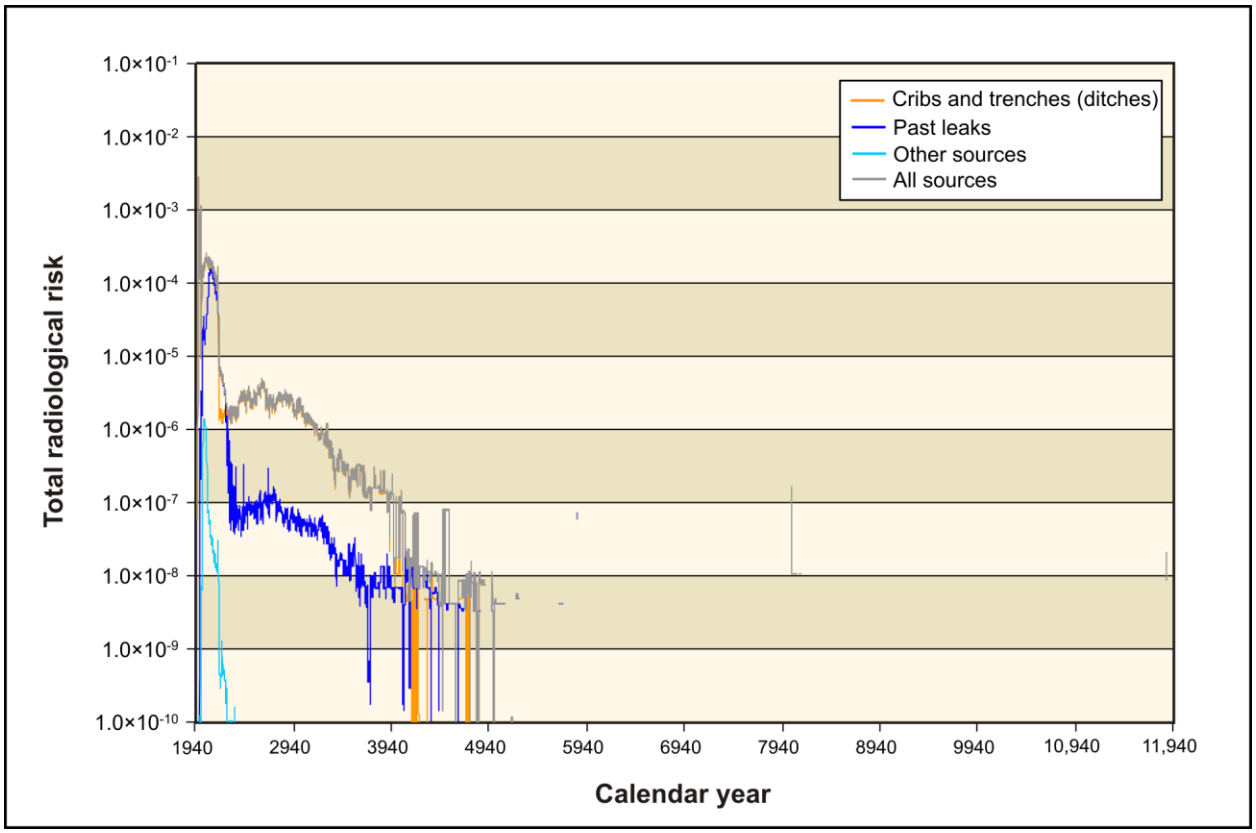

Figure Q–9. Tank Closure Alternative 6A, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.1.1.7 Tank Closure Alternative 6B, Base and Option Cases

Tank Closure Alternative 6B, Base and Option Cases, resembles Tank Closure Alternative 6A, Base and Option Cases, except that waste retrieval and processing would proceed at a faster rate and closure would occur at an earlier date. All tank farms would be clean-closed under Tank Closure Alternative 6B. Under the Base Case, the adjacent cribs and trenches (ditches) would be covered with an engineered modified RCRA Subtitle C barrier, while under the Option Case, the adjacent cribs and trenches (ditches) would be clean-closed.

Potential human health impacts of Alternative 6B, Base Case, related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–200 through Q–204; to past leaks after CY 1940, in Tables Q–205 through Q–212; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–213 through Q–220. Impacts would be similar to those of Alternative 6A, and standards would be exceeded, as under Alternative 6A. Population dose is estimated as 2.43×10^{-1} person-rem per year for the year of maximum impact.

Table Q–200. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–201. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.61×10^{-3}	8.91×10^{2}	8.45×10^{-3}	7.61×10^{-3}	1.04×10^{3}	1.02×10^{-2}	7.61×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.23×10^{-7}	2.15×10^{-1}	7.39×10^{-6}	1.23×10^{-7}	5.54×10^{-1}	2.43×10^{-5}	1.23×10^{-7}	1.13	5.32×10^{-5}
Iodine-129	1.09×10^{-9}	3.11×10^{-1}	3.53×10^{-6}	1.09×10^{-9}	3.88×10^{-1}	5.46×10^{-6}	1.09×10^{-9}	5.01×10^{-1}	8.26×10^{-6}
Total	**N/A**	**8.91×10^{2}**	**8.46×10^{-3}**	**N/A**	**1.04×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.74	6.42×10^{1}	0.00	6.74	6.65×10^{1}	2.65×10^{-8}	6.74	1.00×10^{2}	1.21×10^{-3}
Nitrate	1.55×10^{3}	2.77×10^{1}	0.00	1.55×10^{3}	2.18×10^{2}	0.00	1.55×10^{3}	4.85×10^{2}	0.00
Total	**N/A**	**9.18×10^{1}**	**0.00**	**N/A**	**2.84×10^{2}**	**2.65×10^{-8}**	**N/A**	**5.85×10^{2}**	**1.21×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–202. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.72×10^{-4}	7.87×10^{1}	7.46×10^{-4}	6.72×10^{-4}	9.14×10^{1}	9.01×10^{-4}	6.72×10^{-4}	1.09×10^{2}	1.14×10^{-3}
Technetium-99	3.37×10^{-5}	5.89×10^{1}	2.03×10^{-3}	3.37×10^{-5}	1.52×10^{2}	6.67×10^{-3}	3.37×10^{-5}	3.10×10^{2}	1.46×10^{-2}
Iodine-129	4.23×10^{-8}	1.21×10^{1}	1.37×10^{-4}	4.23×10^{-8}	1.51×10^{1}	2.12×10^{-4}	4.23×10^{-8}	1.95×10^{1}	3.21×10^{-4}
Total	**N/A**	**1.50×10^{2}**	**2.91×10^{-3}**	**N/A**	**2.58×10^{2}**	**7.78×10^{-3}**	**N/A**	**4.39×10^{2}**	**1.60×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.15	5.85×10^{1}	0.00	2.82	2.79×10^{1}	2.41×10^{-8}	2.82	4.20×10^{1}	1.11×10^{-3}
Nitrate	1.74×10^{3}	3.11×10^{1}	0.00	2.12×10^{3}	2.97×10^{2}	0.00	2.12×10^{3}	6.62×10^{2}	0.00
Total	**N/A**	**8.96×10^{1}**	**0.00**	**N/A**	**3.25×10^{2}**	**2.41×10^{-8}**	**N/A**	**7.04×10^{2}**	**1.11×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–203. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.07×10^{-5}	1.26	1.09×10^{-5}	1.07×10^{-5}	1.46	1.32×10^{-5}	9.86×10^{-6}	1.60	1.68×10^{-5}
Technetium-99	8.08×10^{-7}	1.41	5.08×10^{-5}	8.08×10^{-7}	3.64	1.67×10^{-4}	8.44×10^{-7}	7.77	3.65×10^{-4}
Iodine-129	1.14×10^{-9}	3.26×10^{-1}	3.19×10^{-6}	1.14×10^{-9}	4.07×10^{-1}	4.94×10^{-6}	9.86×10^{-10}	4.53×10^{-1}	7.47×10^{-6}
Total	**N/A**	**3.00**	**6.49×10^{-5}**	**N/A**	**5.51**	**1.85×10^{-4}**	**N/A**	**9.82**	**3.90×10^{-4}**
Year of peak impact	1964	1964	1965	1964	1964	1965	1965	1965	1965
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.28×10^{-1}	2.17	0.00	1.38×10^{-1}	1.36	8.95×10^{-10}	1.38×10^{-1}	2.04	4.10×10^{-5}
Nitrate	3.97×10^{1}	7.09×10^{-1}	0.00	7.23×10^{1}	1.02×10^{1}	0.00	7.23×10^{1}	2.26×10^{1}	0.00
Total uranium	5.39×10^{-8}	5.13×10^{-7}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**N/A**	**2.88**	**0.00**	**N/A**	**1.15×10^{1}**	**8.95×10^{-10}**	**N/A**	**2.47×10^{1}**	**4.10×10^{-5}**
Year of peak impact	2019	2019	N/A	1964	1964	2019	1964	1964	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–204. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.22×10^{-10}	9.82×10^{-5}	9.67×10^{-10}	7.22×10^{-10}	1.20×10^{-4}	1.26×10^{-9}	1.07×10^{-5}	6.82×10^{-2}	1.26×10^{-6}
Technetium-99	4.96×10^{-11}	2.24×10^{-4}	9.81×10^{-9}	4.96×10^{-11}	5.16×10^{-4}	2.45×10^{-8}	8.08×10^{-7}	2.43×10^{-2}	1.30×10^{-6}
Iodine-129	6.35×10^{-14}	2.27×10^{-5}	3.20×10^{-10}	6.35×10^{-14}	3.46×10^{-4}	8.32×10^{-9}	1.14×10^{-9}	4.12×10^{-3}	1.01×10^{-7}
Total	**N/A**	**3.44×10^{-4}**	**1.11×10^{-8}**	**N/A**	**9.82×10^{-4}**	**3.41×10^{-8}**	**N/A**	**9.67×10^{-2}**	**2.66×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.68×10^{-5}	1.66×10^{-4}	6.82×10^{-14}	1.68×10^{-5}	2.72×10^{-4}	3.13×10^{-9}	3.48×10^{-2}	1.54×10^{-1}	4.10×10^{-5}
Nitrate	4.82×10^{-3}	7.30×10^{-4}	0.00	4.82×10^{-3}	4.54×10^{-1}	0.00	1.28×10^{1}	4.45	0.00
Total	**N/A**	**8.95×10^{-4}**	**6.82×10^{-14}**	**N/A**	**4.54×10^{-1}**	**3.13×10^{-9}**	**N/A**	**4.61**	**4.10×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2019

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–205. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.91×10^{-7}	2.23×10^{-2}	2.12×10^{-7}	1.91×10^{-7}	2.60×10^{-2}	2.56×10^{-7}	1.91×10^{-7}	3.09×10^{-2}	3.25×10^{-7}
Technetium-99	1.36×10^{-6}	2.39	8.21×10^{-5}	1.36×10^{-6}	6.15	2.70×10^{-4}	1.36×10^{-6}	1.26×10^{1}	5.90×10^{-4}
Iodine-129	5.42×10^{-10}	1.54×10^{-1}	1.76×10^{-6}	5.42×10^{-10}	1.93×10^{-1}	2.71×10^{-6}	5.42×10^{-10}	2.49×10^{-1}	4.11×10^{-6}
Total	**N/A**	**2.56**	**8.40×10^{-5}**	**N/A**	**6.37**	**2.73×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.95×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.94×10^{-2}	6.60×10^{-1}	0.00	6.94×10^{-2}	6.85×10^{-1}	2.72×10^{-10}	6.94×10^{-2}	1.03	1.25×10^{-5}
Nitrate	1.97	3.52×10^{-2}	0.00	1.97	2.77×10^{-1}	0.00	1.97	6.18×10^{-1}	0.00
Total	**N/A**	**6.96×10^{-1}**	**0.00**	**N/A**	**9.62×10^{-1}**	**2.72×10^{-10}**	**N/A**	**1.65**	**1.25×10^{-5}**
Year of peak impact	2097	2097	N/A	2097	2097	2097	2097	2097	2097

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–206. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.07×10^{-9}	2.42×10^{-4}	2.30×10^{-9}	2.07×10^{-9}	2.82×10^{-4}	2.78×10^{-9}	2.07×10^{-9}	3.36×10^{-4}	3.52×10^{-9}
Technetium-99	2.53×10^{-6}	4.42	1.52×10^{-4}	2.53×10^{-6}	1.14×10^{1}	5.01×10^{-4}	2.53×10^{-6}	2.33×10^{1}	1.09×10^{-3}
Iodine-129	4.61×10^{-9}	1.31	1.49×10^{-5}	4.61×10^{-9}	1.64	2.31×10^{-5}	4.61×10^{-9}	2.12	3.50×10^{-5}
Total	**N/A**	**5.74**	**1.67×10^{-4}**	**N/A**	**1.30×10^{1}**	**5.24×10^{-4}**	**N/A**	**2.54×10^{1}**	**1.13×10^{-3}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.18×10^{-2}	5.89×10^{-1}	0.00	6.18×10^{-2}	6.10×10^{-1}	2.43×10^{-10}	5.95×10^{-2}	8.83×10^{-1}	1.11×10^{-5}
Nitrate	3.54	6.32×10^{-2}	0.00	3.54	4.97×10^{-1}	0.00	3.68	1.15	0.00
Total	**N/A**	**6.52×10^{-1}**	**0.00**	**N/A**	**1.11**	**2.43×10^{-10}**	**N/A**	**2.04**	**1.11×10^{-5}**
Year of peak impact	2092	2092	N/A	2092	2092	2092	2090	2090	2092

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–207. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.62×10^{-7}	1.89×10^{-2}	1.79×10^{-7}	1.62×10^{-7}	2.20×10^{-2}	2.17×10^{-7}	1.62×10^{-7}	2.62×10^{-2}	2.75×10^{-7}
Technetium-99	2.45×10^{-6}	4.29	1.47×10^{-4}	2.45×10^{-6}	1.10×10^{1}	4.85×10^{-4}	2.45×10^{-6}	2.26×10^{1}	1.06×10^{-3}
Iodine-129	4.68×10^{-9}	1.33	1.52×10^{-5}	4.68×10^{-9}	1.66	2.34×10^{-5}	4.68×10^{-9}	2.15	3.54×10^{-5}
Total	**N/A**	**5.64**	**1.63×10^{-4}**	**N/A**	**1.27×10^{1}**	**5.09×10^{-4}**	**N/A**	**2.47×10^{1}**	**1.10×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.46×10^{-1}	2.35	0.00	2.46×10^{-1}	2.43	9.67×10^{-10}	2.46×10^{-1}	3.66	4.44×10^{-5}
Nitrate	7.00	1.25×10^{-1}	0.00	7.00	9.82×10^{-1}	0.00	7.00	2.19	0.00
Total	**N/A**	**2.47**	**0.00**	**N/A**	**3.41**	**9.67×10^{-10}**	**N/A**	**5.85**	**4.44×10^{-5}**
Year of peak impact	2030	2030	N/A	2030	2030	2030	2030	2030	2030

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–208. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.14×10^{-6}	2.50×10^{-1}	2.37×10^{-6}	2.14×10^{-6}	2.91×10^{-1}	2.87×10^{-6}	2.14×10^{-6}	3.47×10^{-1}	3.64×10^{-6}
Technetium-99	1.05×10^{-5}	1.84×10^{1}	6.33×10^{-4}	1.05×10^{-5}	4.74×10^{1}	2.08×10^{-3}	1.05×10^{-5}	9.68×10^{1}	4.55×10^{-3}
Iodine-129	2.01×10^{-8}	5.72	6.50×10^{-5}	2.01×10^{-8}	7.14	1.01×10^{-4}	2.01×10^{-8}	9.23	1.52×10^{-4}
Total	**N/A**	**2.44×10^{1}**	**7.00×10^{-4}**	**N/A**	**5.48×10^{1}**	**2.18×10^{-3}**	**N/A**	**1.06×10^{2}**	**4.71×10^{-3}**
Year of peak impact	2022	2022	2022	2022	2022	2022	2022	2022	2022
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.00×10^{-1}	2.85	0.00	3.00×10^{-1}	2.96	1.18×10^{-9}	3.00×10^{-1}	4.45	5.41×10^{-5}
Nitrate	2.45×10^{1}	4.37×10^{-1}	0.00	2.45×10^{1}	3.43	0.00	2.45×10^{1}	7.66	0.00
Total	**N/A**	**3.29**	**0.00**	**N/A**	**6.39**	**1.18×10^{-9}**	**N/A**	**1.21×10^{1}**	**5.41×10^{-5}**
Year of peak impact	2024	2024	N/A	2024	2024	2022	2024	2024	2022

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–209. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.28×10^{-9}	7.35×10^{-4}	6.97×10^{-9}	6.28×10^{-9}	8.54×10^{-4}	8.42×10^{-9}	6.28×10^{-9}	1.02×10^{-3}	1.07×10^{-8}
Technetium-99	1.37×10^{-7}	2.39×10^{-1}	8.22×10^{-6}	1.37×10^{-7}	6.16×10^{-1}	2.70×10^{-5}	1.37×10^{-7}	1.26	5.91×10^{-5}
Iodine-129	1.63×10^{-10}	4.63×10^{-2}	5.27×10^{-7}	1.63×10^{-10}	5.79×10^{-2}	8.14×10^{-7}	1.63×10^{-10}	7.48×10^{-2}	1.23×10^{-6}
Total	**1.43×10^{-7}**	**2.86×10^{-1}**	**8.76×10^{-6}**	**1.43×10^{-7}**	**6.75×10^{-1}**	**2.79×10^{-5}**	**1.43×10^{-7}**	**1.33**	**6.04×10^{-5}**
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.07×10^{-3}	5.78×10^{-2}	0.00	6.07×10^{-3}	5.99×10^{-2}	2.38×10^{-11}	6.07×10^{-3}	9.02×10^{-2}	1.09×10^{-6}
Nitrate	4.37×10^{-1}	7.81×10^{-3}	0.00	4.37×10^{-1}	6.14×10^{-2}	0.00	4.37×10^{-1}	1.37×10^{-1}	0.00
Total	**4.43×10^{-1}**	**6.56×10^{-2}**	**0.00**	**4.43×10^{-1}**	**1.21×10^{-1}**	**2.38×10^{-11}**	**4.43×10^{-1}**	**2.27×10^{-1}**	**1.09×10^{-6}**
Year of peak impact	2041	2041	N/A	2041	2041	2038	2041	2041	2038

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–210. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.11×10^{-9}	2.47×10^{-4}	2.34×10^{-9}	2.11×10^{-9}	2.87×10^{-4}	2.82×10^{-9}	2.11×10^{-9}	3.41×10^{-4}	3.58×10^{-9}
Technetium-99	2.53×10^{-6}	4.42	1.52×10^{-4}	2.53×10^{-6}	1.14×10^{1}	5.01×10^{-4}	2.53×10^{-6}	2.33×10^{1}	1.09×10^{-3}
Iodine-129	4.61×10^{-9}	1.31	1.49×10^{-5}	4.61×10^{-9}	1.64	2.31×10^{-5}	4.61×10^{-9}	2.12	3.50×10^{-5}
Total	**N/A**	**5.74**	**1.67×10^{-4}**	**N/A**	**1.30×10^{1}**	**5.24×10^{-4}**	**N/A**	**2.54×10^{1}**	**1.13×10^{-3}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.14×10^{-2}	7.75×10^{-1}	0.00	7.21×10^{-2}	7.12×10^{-1}	3.20×10^{-10}	7.21×10^{-2}	1.07	1.47×10^{-5}
Nitrate	2.73	4.87×10^{-2}	0.00	3.62	5.08×10^{-1}	0.00	3.62	1.13	0.00
Total	**N/A**	**8.24×10^{-1}**	**0.00**	**N/A**	**1.22**	**3.20×10^{-10}**	**N/A**	**2.20**	**1.47×10^{-5}**
Year of peak impact	2101	2101	N/A	2093	2093	2101	2093	2093	2101

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–211. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.21×10^{-7}	5.62×10^{-1}	1.96×10^{-5}	3.26×10^{-7}	1.47	6.48×10^{-5}	3.26×10^{-7}	3.00	1.42×10^{-4}
Iodine-129	6.54×10^{-10}	1.86×10^{-1}	1.99×10^{-6}	6.16×10^{-10}	2.19×10^{-1}	2.93×10^{-6}	6.16×10^{-10}	2.83×10^{-1}	4.43×10^{-6}
Total	**N/A**	**7.48×10^{-1}**	**2.16×10^{-5}**	**N/A**	**1.69**	**6.77×10^{-5}**	**N/A**	**3.28**	**1.46×10^{-4}**
Year of peak impact	2218	2218	2232	2232	2232	2227	2232	2232	2227
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.24×10^{-3}	7.84×10^{-2}	0.00	8.24×10^{-3}	8.13×10^{-2}	3.23×10^{-11}	7.82×10^{-3}	1.16×10^{-1}	1.48×10^{-6}
Nitrate	5.71×10^{-1}	1.02×10^{-2}	0.00	5.71×10^{-1}	8.02×10^{-2}	0.00	5.99×10^{-1}	1.88×10^{-1}	0.00
Total	**N/A**	**8.86×10^{-2}**	**0.00**	**N/A**	**1.62×10^{-1}**	**3.23×10^{-11}**	**N/A**	**3.04×10^{-1}**	**1.48×10^{-6}**
Year of peak impact	2246	2246	N/A	2246	2246	2246	2269	2269	2246

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–212. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.82×10^{-12}	3.53×10^{-5}	1.55×10^{-9}	7.79×10^{-12}	8.10×10^{-5}	3.86×10^{-9}	3.21×10^{-7}	9.69×10^{-3}	5.27×10^{-7}
Iodine-129	1.43×10^{-14}	5.09×10^{-6}	7.17×10^{-11}	1.43×10^{-14}	7.82×10^{-5}	1.87×10^{-9}	6.54×10^{-10}	2.45×10^{-3}	5.48×10^{-8}
Total	**N/A**	**4.03×10^{-5}**	**1.62×10^{-9}**	**N/A**	**1.59×10^{-4}**	**5.73×10^{-9}**	**N/A**	**1.21×10^{-2}**	**5.82×10^{-7}**
Year of peak impact	2180	2180	2180	2185	2185	2180	2218	2218	2227
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.96×10^{-7}	2.93×10^{-6}	1.17×10^{-15}	2.92×10^{-7}	4.73×10^{-6}	5.38×10^{-11}	7.97×10^{-3}	3.51×10^{-2}	1.48×10^{-6}
Nitrate	1.58×10^{-5}	2.39×10^{-6}	0.00	1.59×10^{-5}	1.50×10^{-3}	0.00	5.76×10^{-1}	3.16×10^{-2}	0.00
Total	**N/A**	**5.32×10^{-6}**	**1.17×10^{-15}**	**N/A**	**1.50×10^{-3}**	**5.38×10^{-11}**	**N/A**	**6.66×10^{-2}**	**1.48×10^{-6}**
Year of peak impact	2197	2197	2204	2192	2192	2204	2226	2226	2246

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–213. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.29×10^{-9}	1.51×10^{-4}	1.43×10^{-9}	1.29×10^{-9}	1.75×10^{-4}	1.73×10^{-9}	1.29×10^{-9}	2.09×10^{-4}	2.19×10^{-9}
Technetium-99	8.75×10^{-7}	1.53	5.27×10^{-5}	8.75×10^{-7}	3.95	1.73×10^{-4}	8.75×10^{-7}	8.06	3.79×10^{-4}
Iodine-129	1.60×10^{-9}	4.57×10^{-1}	5.19×10^{-6}	1.60×10^{-9}	5.71×10^{-1}	8.03×10^{-6}	1.60×10^{-9}	7.37×10^{-1}	1.22×10^{-5}
Total	**N/A**	**1.99**	**5.79×10^{-5}**	**N/A**	**4.52**	**1.81×10^{-4}**	**N/A**	**8.80**	**3.91×10^{-4}**
Year of peak impact	2093	2093	2093	2093	2093	2093	2093	2093	2093
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.35×10^{-2}	7.00×10^{-1}	0.00	6.02×10^{-2}	5.95×10^{-1}	3.02×10^{-10}	6.02×10^{-2}	8.95×10^{-1}	1.38×10^{-5}
Nitrate	1.42×10^{1}	2.54×10^{-1}	0.00	1.66×10^{1}	2.33	0.00	1.66×10^{1}	5.19	0.00
Total	**N/A**	**9.53×10^{-1}**	**0.00**	**N/A**	**2.92**	**3.02×10^{-10}**	**N/A**	**6.08**	**1.38×10^{-5}**
Year of peak impact	2168	2168	N/A	2172	2172	2097	2172	2172	2097

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–214. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.23×10^{-7}	2.61×10^{-2}	2.47×10^{-7}	2.23×10^{-7}	3.03×10^{-2}	2.99×10^{-7}	2.23×10^{-7}	3.61×10^{-2}	3.79×10^{-7}
Technetium-99	3.48×10^{-6}	6.09	2.09×10^{-4}	3.48×10^{-6}	1.57×10^{1}	6.89×10^{-4}	3.48×10^{-6}	3.21×10^{1}	1.51×10^{-3}
Iodine-129	4.24×10^{-9}	1.21	1.37×10^{-5}	4.24×10^{-9}	1.51	2.12×10^{-5}	4.24×10^{-9}	1.95	3.21×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.32**	**2.23×10^{-4}**	**N/A**	**1.72×10^{1}**	**7.11×10^{-4}**	**N/A**	**3.40×10^{1}**	**1.54×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.04	0.00	1.74×10^{-1}	1.72	8.43×10^{-10}	1.74×10^{-1}	2.59	3.86×10^{-5}
Nitrate	1.54×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.35×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.80**	**0.00**	**N/A**	**2.57×10^{1}**	**8.43×10^{-10}**	**N/A**	**5.61×10^{1}**	**3.86×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–215. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	3.00×10^{-8}	3.51×10^{-3}	3.33×10^{-8}	3.00×10^{-8}	4.08×10^{-3}	4.02×10^{-8}	3.00×10^{-8}	4.86×10^{-3}	5.10×10^{-8}
Technetium-99	1.49×10^{-6}	2.60	8.94×10^{-5}	1.49×10^{-6}	6.70	2.94×10^{-4}	1.49×10^{-6}	1.37×10^{1}	6.43×10^{-4}
Iodine-129	2.85×10^{-9}	8.13×10^{-1}	9.24×10^{-6}	2.85×10^{-9}	1.02	1.43×10^{-5}	2.85×10^{-9}	1.31	2.16×10^{-5}
Total	**N/A**	**3.42**	**9.87×10^{-5}**	**N/A**	**7.72**	**3.08×10^{-4}**	**N/A**	**1.50×10^{1}**	**6.65×10^{-4}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.58×10^{-1}	1.50	0.00	1.58×10^{-1}	1.56	6.19×10^{-10}	1.58×10^{-1}	2.34	2.84×10^{-5}
Nitrate	4.59	8.19×10^{-2}	0.00	4.59	6.44×10^{-1}	0.00	4.59	1.44	0.00
Total	**N/A**	**1.58**	**0.00**	**N/A**	**2.20**	**6.19×10^{-10}**	**N/A**	**3.78**	**2.84×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2051	2051	2051	2051

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–216. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.87×10^{-6}	3.36×10^{-1}	3.19×10^{-6}	2.87×10^{-6}	3.91×10^{-1}	3.85×10^{-6}	2.87×10^{-6}	4.65×10^{-1}	3.76×10^{-6}
Technetium-99	6.44×10^{-6}	1.13×10^{1}	3.88×10^{-4}	6.44×10^{-6}	2.91×10^{1}	1.28×10^{-3}	6.44×10^{-6}	5.93×10^{1}	2.79×10^{-3}
Iodine-129	1.27×10^{-8}	3.61	4.10×10^{-5}	1.27×10^{-8}	4.51	6.34×10^{-5}	1.27×10^{-8}	5.82	9.51×10^{-5}
Uranium-238	1.44×10^{-11}	1.79×10^{-3}	2.02×10^{-8}	1.44×10^{-11}	1.86×10^{-3}	2.18×10^{-8}	1.44×10^{-11}	2.00×10^{-3}	2.56×10^{-8}
Total	**N/A**	**1.52×10^{1}**	**4.32×10^{-4}**	**N/A**	**3.40×10^{1}**	**1.34×10^{-3}**	**N/A**	**6.56×10^{1}**	**2.89×10^{-3}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2051

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.53×10^{-1}	3.36	0.00	3.53×10^{-1}	3.49	1.39×10^{-9}	3.53×10^{-1}	5.25	6.36×10^{-5}
Nitrate	6.17×10^{1}	1.10	0.00	6.17×10^{1}	8.66	0.00	6.17×10^{1}	1.93×10^{1}	0.00
Total uranium	2.31×10^{-5}	2.20×10^{-4}	0.00	2.31×10^{-5}	2.24×10^{-4}	0.00	2.31×10^{-5}	2.34×10^{-4}	0.00
Total	**N/A**	**4.47**	**0.00**	**N/A**	**1.22×10^{1}**	**1.39×10^{-9}**	**N/A**	**2.46×10^{1}**	**6.36×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2051	2051	2051	2051

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–217. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.28×10^{-9}	7.35×10^{-4}	6.97×10^{-9}	6.28×10^{-9}	8.54×10^{-4}	8.42×10^{-9}	6.28×10^{-9}	1.02×10^{-3}	1.07×10^{-8}
Technetium-99	1.37×10^{-7}	2.39×10^{-1}	8.22×10^{-6}	1.37×10^{-7}	6.16×10^{-1}	2.70×10^{-5}	1.37×10^{-7}	1.26	5.91×10^{-5}
Iodine-129	1.63×10^{-10}	4.63×10^{-2}	5.27×10^{-7}	1.63×10^{-10}	5.79×10^{-2}	8.14×10^{-7}	1.63×10^{-10}	7.48×10^{-2}	1.23×10^{-6}
Total	**1.43×10^{-7}**	**2.86×10^{-1}**	**8.76×10^{-6}**	**1.43×10^{-7}**	**6.75×10^{-1}**	**2.79×10^{-5}**	**1.43×10^{-7}**	**1.33**	**6.04×10^{-5}**
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.73×10^{-3}	5.46×10^{-2}	0.00	5.68×10^{-3}	5.61×10^{-2}	2.25×10^{-11}	5.68×10^{-3}	8.44×10^{-2}	1.03×10^{-6}
Nitrate	4.02×10^{-1}	7.18×10^{-3}	0.00	4.07×10^{-1}	5.71×10^{-2}	0.00	4.07×10^{-1}	1.27×10^{-1}	0.00
Total	**4.08×10^{-1}**	**6.18×10^{-2}**	**0.00**	**4.12×10^{-1}**	**1.13×10^{-1}**	**2.25×10^{-11}**	**4.12×10^{-1}**	**2.12×10^{-1}**	**1.03×10^{-6}**
Year of peak impact	2050	2050	N/A	2051	2051	2050	2051	2051	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–218. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.76×10^{-7}	5.56×10^{-2}	5.28×10^{-7}	4.76×10^{-7}	6.47×10^{-2}	6.37×10^{-7}	4.76×10^{-7}	7.70×10^{-2}	8.09×10^{-7}
Technetium-99	3.48×10^{-6}	6.09	2.09×10^{-4}	3.48×10^{-6}	1.57×10^{1}	6.89×10^{-4}	3.48×10^{-6}	3.21×10^{1}	1.51×10^{-3}
Iodine-129	4.24×10^{-9}	1.21	1.37×10^{-5}	4.24×10^{-9}	1.51	2.12×10^{-5}	4.24×10^{-9}	1.95	3.21×10^{-5}
Uranium-238	1.17×10^{-12}	1.45×10^{-4}	1.64×10^{-9}	1.17×10^{-12}	1.51×10^{-4}	1.77×10^{-9}	1.17×10^{-12}	1.62×10^{-4}	2.01×10^{-9}
Total	**N/A**	**7.35**	**2.24×10^{-4}**	**N/A**	**1.73×10^{1}**	**7.11×10^{-4}**	**N/A**	**3.41×10^{1}**	**1.54×10^{-3}**
Year of peak impact	2056	2056	2056	2056	2056	2056	2056	2056	2056
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.15×10^{-1}	2.04	0.00	1.74×10^{-1}	1.72	8.43×10^{-10}	1.74×10^{-1}	2.59	3.86×10^{-5}
Nitrate	1.54×10^{2}	2.76	0.00	1.71×10^{2}	2.40×10^{1}	0.00	1.71×10^{2}	5.35×10^{1}	0.00
Total uranium	1.70×10^{-6}	1.62×10^{-5}	0.00	1.70×10^{-6}	1.65×10^{-5}	0.00	1.70×10^{-6}	1.72×10^{-5}	0.00
Total	**N/A**	**4.80**	**0.00**	**N/A**	**2.57×10^{1}**	**8.43×10^{-10}**	**N/A**	**5.61×10^{1}**	**3.86×10^{-5}**
Year of peak impact	2050	2050	N/A	2055	2055	2050	2055	2055	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–219. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.99×10^{-11}	8.18×10^{-6}	6.72×10^{-11}	6.06×10^{-11}	8.24×10^{-6}	8.12×10^{-11}	6.06×10^{-11}	9.81×10^{-6}	1.03×10^{-10}
Technetium-99	3.53×10^{-7}	6.17×10^{-1}	2.16×10^{-5}	3.58×10^{-7}	1.62	7.09×10^{-5}	3.58×10^{-7}	3.30	1.55×10^{-4}
Iodine-129	7.19×10^{-10}	2.05×10^{-1}	2.18×10^{-6}	6.73×10^{-10}	2.40×10^{-1}	3.37×10^{-6}	6.73×10^{-10}	3.10×10^{-1}	5.10×10^{-6}
Total	**N/A**	**8.22×10^{-1}**	**2.38×10^{-5}**	**N/A**	**1.86**	**7.43×10^{-5}**	**N/A**	**3.61**	**1.60×10^{-4}**
Year of peak impact	2218	2218	2221	2221	2221	2221	2221	2221	2221
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	7.10×10^{-2}	6.76×10^{-1}	0.00	7.10×10^{-2}	7.01×10^{-1}	2.79×10^{-10}	7.10×10^{-2}	1.05	1.28×10^{-5}
Nitrate	1.66×10^{1}	2.96×10^{-1}	0.00	1.66×10^{1}	2.33	0.00	1.66×10^{1}	5.19	0.00
Total	**N/A**	**9.72×10^{-1}**	**0.00**	**N/A**	**3.03**	**2.79×10^{-10}**	**N/A**	**6.24**	**1.28×10^{-5}**
Year of peak impact	2076	2076	N/A	2076	2076	2076	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–220. Tank Closure Alternative 6B, Base Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	9.50×10^{-12}	4.29×10^{-5}	1.88×10^{-9}	9.50×10^{-12}	9.88×10^{-5}	4.69×10^{-9}	3.58×10^{-7}	1.08×10^{-2}	5.78×10^{-7}
Iodine-129	1.59×10^{-14}	5.69×10^{-6}	8.02×10^{-11}	1.59×10^{-14}	8.69×10^{-5}	2.09×10^{-9}	6.73×10^{-10}	2.62×10^{-3}	6.43×10^{-8}
Total	**N/A**	**4.85×10^{-5}**	**1.96×10^{-9}**	**N/A**	**1.86×10^{-4}**	**6.78×10^{-9}**	**N/A**	**1.34×10^{-2}**	**6.43×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2221	2221	2221
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	9.72×10^{-7}	9.60×10^{-6}	3.82×10^{-15}	9.72×10^{-7}	1.57×10^{-5}	1.75×10^{-10}	7.10×10^{-2}	3.12×10^{-1}	1.28×10^{-5}
Nitrate	3.13×10^{-4}	4.74×10^{-5}	0.00	3.13×10^{-4}	2.95×10^{-2}	0.00	1.66×10^{1}	7.22×10^{-1}	0.00
Total	**N/A**	**5.70×10^{-5}**	**3.82×10^{-15}**	**N/A**	**2.95×10^{-2}**	**1.75×10^{-10}**	**N/A**	**1.03**	**1.28×10^{-5}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2076	2076	2076

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figure Q–10 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2090 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. Prior to CY 2100, other tank farm sources make a minor contribution to peak radiological risk and contribute a small fraction of the impacts of cribs and trenches (ditches) at all times. The peak radiological risk resulting from all three sources occurs around CY 2050 and is dominated by technetium-99 and iodine-129. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater. After approximately CY 4940, nearly all contamination due to cribs and trenches (ditches) and past leaks has exited the unconfined aquifer, and Figure Q–10 is interpreted as reporting no risk due to these sources.

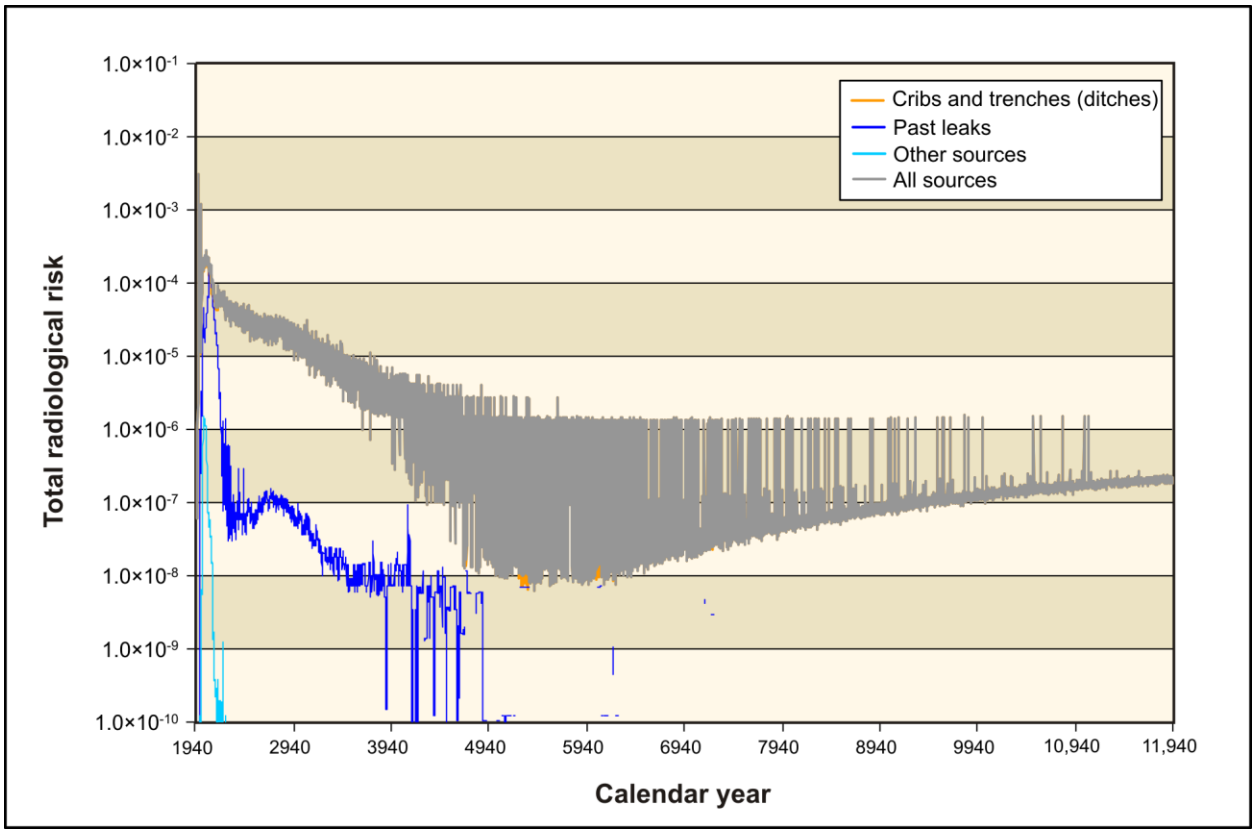

Figure Q–10. Tank Closure Alternative 6B, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Potential human health impacts of Alternative 6B, Option Case, related to cribs and trenches (ditches) after CY 1940 are summarized in Tables Q–221 through Q–225; to past leaks after CY 1940, in Tables Q–226 through Q–233; and to the combination of cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases) after CY 2050, in Tables Q–234 through Q–241. Impacts would be slightly less than those under Alternative 6B, Base Case, and standards would be exceeded, as under Alternative 6B, Base Case. Population dose is estimated as 2.44×10^{-1} person-rem per year for the year of maximum impact.

Table Q–221. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.70×10^{-4}	7.83×10^{1}	7.43×10^{-4}	6.70×10^{-4}	9.11×10^{1}	8.97×10^{-4}	6.70×10^{-4}	1.08×10^{2}	1.14×10^{-3}
Technetium-99	3.42×10^{-5}	5.98×10^{1}	2.06×10^{-3}	3.42×10^{-5}	1.54×10^{2}	6.76×10^{-3}	3.42×10^{-5}	3.15×10^{2}	1.48×10^{-2}
Iodine-129	4.47×10^{-8}	1.27×10^{1}	1.45×10^{-4}	4.47×10^{-8}	1.59×10^{1}	2.24×10^{-4}	4.47×10^{-8}	2.06×10^{1}	3.39×10^{-4}
Total	**N/A**	**1.51×10^{2}**	**2.94×10^{-3}**	**N/A**	**2.61×10^{2}**	**7.88×10^{-3}**	**N/A**	**4.44×10^{2}**	**1.63×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.24	5.94×10^{1}	0.00	2.83	2.80×10^{1}	2.45×10^{-8}	2.83	4.21×10^{1}	1.12×10^{-3}
Nitrate	1.71×10^{3}	3.05×10^{1}	0.00	2.06×10^{3}	2.89×10^{2}	0.00	2.06×10^{3}	6.45×10^{2}	0.00
Total	**N/A**	**8.99×10^{1}**	**0.00**	**N/A**	**3.17×10^{2}**	**2.45×10^{-8}**	**N/A**	**6.87×10^{2}**	**1.12×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–222. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.61×10^{-3}	8.90×10^{2}	8.45×10^{-3}	7.61×10^{-3}	1.03×10^{3}	1.02×10^{-2}	7.61×10^{-3}	1.23×10^{3}	1.29×10^{-2}
Technetium-99	1.17×10^{-7}	2.05×10^{-1}	7.04×10^{-6}	1.17×10^{-7}	5.28×10^{-1}	2.32×10^{-5}	1.17×10^{-7}	1.08	5.07×10^{-5}
Iodine-129	1.06×10^{-9}	3.01×10^{-1}	3.42×10^{-6}	1.06×10^{-9}	3.76×10^{-1}	5.29×10^{-6}	1.06×10^{-9}	4.86×10^{-1}	8.00×10^{-6}
Total	**N/A**	**8.91×10^{2}**	**8.46×10^{-3}**	**N/A**	**1.04×10^{3}**	**1.02×10^{-2}**	**N/A**	**1.23×10^{3}**	**1.30×10^{-2}**
Year of peak impact	1976	1976	1976	1976	1976	1976	1976	1976	1976
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.32	6.02×10^{1}	0.00	6.32	6.24×10^{1}	2.48×10^{-8}	6.32	9.39×10^{1}	1.14×10^{-3}
Nitrate	1.56×10^{3}	2.78×10^{1}	0.00	1.56×10^{3}	2.19×10^{2}	0.00	1.56×10^{3}	4.87×10^{2}	0.00
Total	**N/A**	**8.80×10^{1}**	**0.00**	**N/A**	**2.81×10^{2}**	**2.48×10^{-8}**	**N/A**	**5.81×10^{2}**	**1.14×10^{-3}**
Year of peak impact	1962	1962	N/A	1962	1962	1962	1962	1962	1962

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–223. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.70×10^{-4}	7.83×10^{1}	7.43×10^{-4}	6.70×10^{-4}	9.11×10^{1}	8.97×10^{-4}	6.70×10^{-4}	1.08×10^{2}	1.14×10^{-3}
Technetium-99	3.42×10^{-5}	5.98×10^{1}	2.06×10^{-3}	3.42×10^{-5}	1.54×10^{2}	6.76×10^{-3}	3.42×10^{-5}	3.15×10^{2}	1.48×10^{-2}
Iodine-129	4.47×10^{-8}	1.27×10^{1}	1.45×10^{-4}	4.47×10^{-8}	1.59×10^{1}	2.24×10^{-4}	4.47×10^{-8}	2.06×10^{1}	3.39×10^{-4}
Total	**N/A**	**1.51×10^{2}**	**2.94×10^{-3}**	**N/A**	**2.61×10^{2}**	**7.88×10^{-3}**	**N/A**	**4.44×10^{2}**	**1.63×10^{-2}**
Year of peak impact	1956	1956	1956	1956	1956	1956	1956	1956	1956
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.24	5.94×10^{1}	0.00	2.83	2.80×10^{1}	2.45×10^{-8}	2.83	4.21×10^{1}	1.12×10^{-3}
Nitrate	1.71×10^{3}	3.05×10^{1}	0.00	2.06×10^{3}	2.89×10^{2}	0.00	2.06×10^{3}	6.45×10^{2}	0.00
Total	**N/A**	**8.99×10^{1}**	**0.00**	**N/A**	**3.17×10^{2}**	**2.45×10^{-8}**	**N/A**	**6.87×10^{2}**	**1.12×10^{-3}**
Year of peak impact	1955	1955	N/A	1956	1956	1955	1956	1956	1955

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–224. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.09×10^{-5}	1.27	1.21×10^{-5}	1.09×10^{-5}	1.48	1.46×10^{-5}	1.09×10^{-5}	1.76	1.85×10^{-5}
Technetium-99	8.91×10^{-7}	1.56	5.36×10^{-5}	8.91×10^{-7}	4.02	1.76×10^{-4}	8.91×10^{-7}	8.21	3.86×10^{-4}
Iodine-129	1.11×10^{-9}	3.16×10^{-1}	3.59×10^{-6}	1.11×10^{-9}	3.94×10^{-1}	5.55×10^{-6}	1.11×10^{-9}	5.10×10^{-1}	8.40×10^{-6}
Total	**N/A**	**3.15**	**6.93×10^{-5}**	**N/A**	**5.89**	**1.97×10^{-4}**	**N/A**	**1.05×10^{1}**	**4.13×10^{-4}**
Year of peak impact	1964	1964	1964	1964	1964	1964	1964	1964	1964
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.94×10^{-1}	1.84	0.00	1.34×10^{-1}	1.32	7.60×10^{-10}	1.34×10^{-1}	1.99	3.48×10^{-5}
Nitrate	4.16×10^{1}	7.42×10^{-1}	0.00	7.00×10^{1}	9.83	0.00	7.00×10^{1}	2.19×10^{1}	0.00
Total	**N/A**	**2.58**	**0.00**	**N/A**	**1.12×10^{1}**	**7.60×10^{-10}**	**N/A**	**2.39×10^{1}**	**3.48×10^{-5}**
Year of peak impact	2014	2014	N/A	1964	1964	2014	1964	1964	2014

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–225. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches) at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	7.25×10^{-10}	9.86×10^{-5}	9.72×10^{-10}	7.25×10^{-10}	1.20×10^{-4}	1.27×10^{-9}	1.09×10^{-5}	6.90×10^{-2}	1.27×10^{-6}
Technetium-99	4.95×10^{-11}	2.23×10^{-4}	9.81×10^{-9}	4.95×10^{-11}	5.15×10^{-4}	2.45×10^{-8}	8.91×10^{-7}	2.68×10^{-2}	1.43×10^{-6}
Iodine-129	6.37×10^{-14}	2.27×10^{-5}	3.20×10^{-10}	6.37×10^{-14}	3.47×10^{-4}	8.34×10^{-9}	1.11×10^{-9}	4.03×10^{-3}	9.89×10^{-8}
Total	**N/A**	**3.45×10^{-4}**	**1.11×10^{-8}**	**N/A**	**9.83×10^{-4}**	**3.41×10^{-8}**	**N/A**	**9.99×10^{-2}**	**2.80×10^{-6}**
Year of peak impact	1962	1962	1962	1962	1962	1962	1964	1964	1964
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.71×10^{-5}	1.68×10^{-4}	7.04×10^{-14}	1.71×10^{-5}	2.76×10^{-4}	3.23×10^{-9}	3.31×10^{-2}	1.46×10^{-1}	3.48×10^{-5}
Nitrate	4.80×10^{-3}	7.27×10^{-4}	0.00	4.80×10^{-3}	4.53×10^{-1}	0.00	1.43×10^{1}	4.50	0.00
Total	**N/A**	**8.96×10^{-4}**	**7.04×10^{-14}**	**N/A**	**4.53×10^{-1}**	**3.23×10^{-9}**	**N/A**	**4.64**	**3.48×10^{-5}**
Year of peak impact	1985	1985	1984	1985	1985	1984	1985	1985	2014

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–226. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.91×10^{-7}	2.23×10^{-2}	2.12×10^{-7}	1.91×10^{-7}	2.60×10^{-2}	2.56×10^{-7}	1.91×10^{-7}	3.09×10^{-2}	3.25×10^{-7}
Technetium-99	1.36×10^{-6}	2.39	8.21×10^{-5}	1.36×10^{-6}	6.15	2.70×10^{-4}	1.36×10^{-6}	1.26×10^{1}	5.90×10^{-4}
Iodine-129	5.42×10^{-10}	1.54×10^{-1}	1.76×10^{-6}	5.42×10^{-10}	1.93×10^{-1}	2.71×10^{-6}	5.42×10^{-10}	2.49×10^{-1}	4.11×10^{-6}
Total	**N/A**	**2.56**	**8.40×10^{-5}**	**N/A**	**6.37**	**2.73×10^{-4}**	**N/A**	**1.28×10^{1}**	**5.95×10^{-4}**
Year of peak impact	2004	2004	2004	2004	2004	2004	2004	2004	2004
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.94×10^{-2}	6.60×10^{-1}	0.00	6.94×10^{-2}	6.85×10^{-1}	2.72×10^{-10}	6.94×10^{-2}	1.03	1.25×10^{-5}
Nitrate	1.97	3.52×10^{-2}	0.00	1.97	2.77×10^{-1}	0.00	1.97	6.18×10^{-1}	0.00
Total	**N/A**	**6.96×10^{-1}**	**0.00**	**N/A**	**9.62×10^{-1}**	**2.72×10^{-10}**	**N/A**	**1.65**	**1.25×10^{-5}**
Year of peak impact	2097	2097	N/A	2097	2097	2097	2097	2097	2097

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–227. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.07×10^{-9}	2.42×10^{-4}	2.30×10^{-9}	2.07×10^{-9}	2.82×10^{-4}	2.78×10^{-9}	2.07×10^{-9}	3.36×10^{-4}	3.52×10^{-9}
Technetium-99	2.53×10^{-6}	4.42	1.52×10^{-4}	2.53×10^{-6}	1.14×10^{1}	5.01×10^{-4}	2.53×10^{-6}	2.33×10^{1}	1.09×10^{-3}
Iodine-129	4.61×10^{-9}	1.31	1.49×10^{-5}	4.61×10^{-9}	1.64	2.31×10^{-5}	4.61×10^{-9}	2.12	3.50×10^{-5}
Total	**N/A**	**5.74**	**1.67×10^{-4}**	**N/A**	**1.30×10^{1}**	**5.24×10^{-4}**	**N/A**	**2.54×10^{1}**	**1.13×10^{-3}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.18×10^{-2}	5.89×10^{-1}	0.00	6.18×10^{-2}	6.10×10^{-1}	2.43×10^{-10}	5.95×10^{-2}	8.83×10^{-1}	1.11×10^{-5}
Nitrate	3.54	6.32×10^{-2}	0.00	3.54	4.97×10^{-1}	0.00	3.68	1.15	0.00
Total	**N/A**	**6.52×10^{-1}**	**0.00**	**N/A**	**1.11**	**2.43×10^{-10}**	**N/A**	**2.04**	**1.11×10^{-5}**
Year of peak impact	2092	2092	N/A	2092	2092	2092	2090	2090	2092

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–228. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.62×10^{-7}	1.89×10^{-2}	1.79×10^{-7}	1.62×10^{-7}	2.20×10^{-2}	2.17×10^{-7}	1.62×10^{-7}	2.62×10^{-2}	2.75×10^{-7}
Technetium-99	2.45×10^{-6}	4.29	1.47×10^{-4}	2.45×10^{-6}	1.10×10^{1}	4.85×10^{-4}	2.45×10^{-6}	2.26×10^{1}	1.06×10^{-3}
Iodine-129	4.68×10^{-9}	1.33	1.52×10^{-5}	4.68×10^{-9}	1.66	2.34×10^{-5}	4.68×10^{-9}	2.15	3.54×10^{-5}
Total	**N/A**	**5.64**	**1.63×10^{-4}**	**N/A**	**1.27×10^{1}**	**5.09×10^{-4}**	**N/A**	**2.47×10^{1}**	**1.10×10^{-3}**
Year of peak impact	2030	2030	2030	2030	2030	2030	2030	2030	2030
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.46×10^{-1}	2.35	0.00	2.46×10^{-1}	2.43	9.67×10^{-10}	2.46×10^{-1}	3.66	4.44×10^{-5}
Nitrate	7.00	1.25×10^{-1}	0.00	7.00	9.82×10^{-1}	0.00	7.00	2.19	0.00
Total	**N/A**	**2.47**	**0.00**	**N/A**	**3.41**	**9.67×10^{-10}**	**N/A**	**5.85**	**4.44×10^{-5}**
Year of peak impact	2030	2030	N/A	2030	2030	2030	2030	2030	2030

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–229. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.14×10^{-6}	2.50×10^{-1}	2.37×10^{-6}	2.14×10^{-6}	2.91×10^{-1}	2.87×10^{-6}	2.14×10^{-6}	3.47×10^{-1}	3.64×10^{-6}
Technetium-99	1.05×10^{-5}	1.84×10^{1}	6.33×10^{-4}	1.05×10^{-5}	4.74×10^{1}	2.08×10^{-3}	1.05×10^{-5}	9.68×10^{1}	4.55×10^{-3}
Iodine-129	2.01×10^{-8}	5.72	6.50×10^{-5}	2.01×10^{-8}	7.14	1.01×10^{-4}	2.01×10^{-8}	9.23	1.52×10^{-4}
Total	**N/A**	**2.44×10^{1}**	**7.00×10^{-4}**	**N/A**	**5.48×10^{1}**	**2.18×10^{-3}**	**N/A**	**1.06×10^{2}**	**4.71×10^{-3}**
Year of peak impact	2022	2022	2022	2022	2022	2022	2022	2022	2022
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.00×10^{-1}	2.85	0.00	3.00×10^{-1}	2.96	1.18×10^{-9}	3.00×10^{-1}	4.45	5.41×10^{-5}
Nitrate	2.45×10^{1}	4.37×10^{-1}	0.00	2.45×10^{1}	3.43	0.00	2.45×10^{1}	7.66	0.00
Total	**N/A**	**3.29**	**0.00**	**N/A**	**6.39**	**1.18×10^{-9}**	**N/A**	**1.21×10^{1}**	**5.41×10^{-5}**
Year of peak impact	2024	2024	N/A	2024	2024	2022	2024	2024	2022

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–230. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.28×10^{-9}	7.35×10^{-4}	6.97×10^{-9}	6.28×10^{-9}	8.54×10^{-4}	8.42×10^{-9}	6.28×10^{-9}	1.02×10^{-3}	1.07×10^{-8}
Technetium-99	1.37×10^{-7}	2.39×10^{-1}	8.22×10^{-6}	1.37×10^{-7}	6.16×10^{-1}	2.70×10^{-5}	1.37×10^{-7}	1.26	5.91×10^{-5}
Iodine-129	1.63×10^{-10}	4.63×10^{-2}	5.27×10^{-7}	1.63×10^{-10}	5.79×10^{-2}	8.14×10^{-7}	1.63×10^{-10}	7.48×10^{-2}	1.23×10^{-6}
Total	**1.43×10^{-7}**	**2.86×10^{-1}**	**8.76×10^{-6}**	**1.43×10^{-7}**	**6.75×10^{-1}**	**2.79×10^{-5}**	**1.43×10^{-7}**	**1.33**	**6.04×10^{-5}**
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.07×10^{-3}	5.78×10^{-2}	0.00	6.07×10^{-3}	5.99×10^{-2}	2.38×10^{-11}	6.07×10^{-3}	9.02×10^{-2}	1.09×10^{-6}
Nitrate	4.37×10^{-1}	7.81×10^{-3}	0.00	4.37×10^{-1}	6.14×10^{-2}	0.00	4.37×10^{-1}	1.37×10^{-1}	0.00
Total	**4.43×10^{-1}**	**6.56×10^{-2}**	**0.00**	**4.43×10^{-1}**	**1.21×10^{-1}**	**2.38×10^{-11}**	**4.43×10^{-1}**	**2.27×10^{-1}**	**1.09×10^{-6}**
Year of peak impact	2041	2041	N/A	2041	2041	2038	2041	2041	2038

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–231. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	2.11×10^{-9}	2.47×10^{-4}	2.34×10^{-9}	2.11×10^{-9}	2.87×10^{-4}	2.82×10^{-9}	2.11×10^{-9}	3.41×10^{-4}	3.58×10^{-9}
Technetium-99	2.53×10^{-6}	4.42	1.52×10^{-4}	2.53×10^{-6}	1.14×10^{1}	5.01×10^{-4}	2.53×10^{-6}	2.33×10^{1}	1.09×10^{-3}
Iodine-129	4.61×10^{-9}	1.31	1.49×10^{-5}	4.61×10^{-9}	1.64	2.31×10^{-5}	4.61×10^{-9}	2.12	3.50×10^{-5}
Total	**N/A**	**5.74**	**1.67×10^{-4}**	**N/A**	**1.30×10^{1}**	**5.24×10^{-4}**	**N/A**	**2.54×10^{1}**	**1.13×10^{-3}**
Year of peak impact	2092	2092	2092	2092	2092	2092	2092	2092	2092
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.14×10^{-2}	7.75×10^{-1}	0.00	7.21×10^{-2}	7.12×10^{-1}	3.20×10^{-10}	7.21×10^{-2}	1.07	1.47×10^{-5}
Nitrate	2.73	4.87×10^{-2}	0.00	3.62	5.08×10^{-1}	0.00	3.62	1.13	0.00
Total	**N/A**	**8.24×10^{-1}**	**0.00**	**N/A**	**1.22**	**3.20×10^{-10}**	**N/A**	**2.20**	**1.47×10^{-5}**
Year of peak impact	2101	2101	N/A	2093	2093	2101	2093	2093	2101

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–232. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.21×10^{-7}	5.62×10^{-1}	1.96×10^{-5}	3.26×10^{-7}	1.47	6.48×10^{-5}	3.26×10^{-7}	3.00	1.42×10^{-4}
Iodine-129	6.54×10^{-10}	1.86×10^{-1}	1.99×10^{-6}	6.16×10^{-10}	2.19×10^{-1}	2.93×10^{-6}	6.16×10^{-10}	2.83×10^{-1}	4.43×10^{-6}
Total	**N/A**	**7.48×10^{-1}**	**2.16×10^{-5}**	**N/A**	**1.69**	**6.77×10^{-5}**	**N/A**	**3.28**	**1.46×10^{-4}**
Year of peak impact	2218	2218	2232	2232	2232	2227	2232	2232	2227
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	8.24×10^{-3}	7.84×10^{-2}	0.00	8.24×10^{-3}	8.13×10^{-2}	3.23×10^{-11}	7.82×10^{-3}	1.16×10^{-1}	1.48×10^{-6}
Nitrate	5.71×10^{-1}	1.02×10^{-2}	0.00	5.71×10^{-1}	8.02×10^{-2}	0.00	5.99×10^{-1}	1.88×10^{-1}	0.00
Total	**N/A**	**8.86×10^{-2}**	**0.00**	**N/A**	**1.62×10^{-1}**	**3.23×10^{-11}**	**N/A**	**3.04×10^{-1}**	**1.48×10^{-6}**
Year of peak impact	2246	2246	N/A	2246	2246	2246	2269	2246	2246

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–233. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Past Leaks at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.82×10^{-12}	3.53×10^{-5}	1.55×10^{-9}	7.79×10^{-12}	8.10×10^{-5}	3.86×10^{-9}	3.21×10^{-7}	9.69×10^{-3}	5.27×10^{-7}
Iodine-129	1.43×10^{-14}	5.09×10^{-6}	7.17×10^{-11}	1.43×10^{-14}	7.82×10^{-5}	1.87×10^{-9}	6.54×10^{-10}	2.45×10^{-3}	5.48×10^{-8}
Total	**N/A**	**4.03×10^{-5}**	**1.62×10^{-9}**	**N/A**	**1.59×10^{-4}**	**5.73×10^{-9}**	**N/A**	**1.21×10^{-2}**	**5.82×10^{-7}**
Year of peak impact	2180	2180	2180	2185	2185	2180	2218	2218	2227
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.96×10^{-7}	2.93×10^{-6}	1.17×10^{-15}	2.92×10^{-7}	4.73×10^{-6}	5.38×10^{-11}	7.97×10^{-3}	3.51×10^{-2}	1.48×10^{-6}
Nitrate	1.58×10^{-5}	2.39×10^{-6}	0.00	1.59×10^{-5}	1.50×10^{-3}	0.00	5.76×10^{-1}	3.16×10^{-2}	0.00
Total	**N/A**	**5.32×10^{-6}**	**1.17×10^{-15}**	**N/A**	**1.50×10^{-3}**	**5.38×10^{-11}**	**N/A**	**6.66×10^{-2}**	**1.48×10^{-6}**
Year of peak impact	2197	2197	2204	2192	2192	2204	2226	2226	2246

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–234. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the A Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.30×10^{-9}	1.53×10^{-4}	1.45×10^{-9}	1.30×10^{-9}	1.77×10^{-4}	1.75×10^{-9}	1.30×10^{-9}	2.11×10^{-4}	2.22×10^{-9}
Technetium-99	8.75×10^{-7}	1.53	5.27×10^{-5}	8.75×10^{-7}	3.95	1.73×10^{-4}	8.75×10^{-7}	8.06	3.79×10^{-4}
Iodine-129	1.60×10^{-9}	4.57×10^{-1}	5.19×10^{-6}	1.60×10^{-9}	5.71×10^{-1}	8.03×10^{-6}	1.60×10^{-9}	7.37×10^{-1}	1.22×10^{-5}
Total	**N/A**	**1.99**	**5.79×10^{-5}**	**N/A**	**4.52**	**1.81×10^{-4}**	**N/A**	**8.80**	**3.91×10^{-4}**
Year of peak impact	2093	2093	2093	2093	2093	2093	2093	2093	2093
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	7.46×10^{-2}	7.10×10^{-1}	0.00	1.34×10^{-2}	1.33×10^{-1}	2.93×10^{-10}	1.34×10^{-2}	2.00×10^{-1}	1.34×10^{-5}
Nitrate	6.49	1.16×10^{-1}	0.00	1.23×10^{1}	1.72	0.00	1.23×10^{1}	3.84	0.00
Total	**N/A**	**8.26×10^{-1}**	**0.00**	**N/A**	**1.85**	**2.93×10^{-10}**	**N/A**	**4.04**	**1.34×10^{-5}**
Year of peak impact	2097	2097	N/A	2247	2247	2097	2247	2247	2097

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–235. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the B Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.72×10^{-7}	5.52×10^{-2}	5.24×10^{-7}	4.72×10^{-7}	6.42×10^{-2}	6.32×10^{-7}	4.72×10^{-7}	7.65×10^{-2}	8.02×10^{-7}
Technetium-99	3.76×10^{-6}	6.58	2.26×10^{-4}	3.76×10^{-6}	1.70×10^{1}	7.44×10^{-4}	3.76×10^{-6}	3.46×10^{1}	1.63×10^{-3}
Iodine-129	4.50×10^{-9}	1.28	1.46×10^{-5}	4.50×10^{-9}	1.60	2.26×10^{-5}	4.50×10^{-9}	2.07	3.41×10^{-5}
Uranium-238	7.66×10^{-13}	9.50×10^{-5}	1.07×10^{-9}	7.66×10^{-13}	9.89×10^{-5}	1.16×10^{-9}	7.66×10^{-13}	1.07×10^{-4}	1.32×10^{-9}
Total	**N/A**	**7.92**	**2.41×10^{-4}**	**N/A**	**1.86×10^{1}**	**7.67×10^{-4}**	**N/A**	**3.68×10^{1}**	**1.66×10^{-3}**
Year of peak impact	2065	2065	2065	2065	2065	2065	2065	2065	2065

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.80×10^{-1}	1.71	0.00	1.67×10^{-1}	1.65	7.70×10^{-10}	1.67×10^{-1}	2.49	3.53×10^{-5}
Nitrate	1.97×10^{2}	3.52	0.00	2.00×10^{2}	2.81×10^{1}	0.00	2.00×10^{2}	6.26×10^{1}	0.00
Total uranium	1.45×10^{-6}	1.38×10^{-5}	0.00	1.40×10^{-6}	1.36×10^{-5}	0.00	1.40×10^{-6}	1.42×10^{-5}	0.00
Total	**N/A**	**5.23**	**0.00**	**N/A**	**2.97×10^{1}**	**7.70×10^{-10}**	**N/A**	**6.51×10^{1}**	**3.53×10^{-5}**
Year of peak impact	2083	2083	N/A	2077	2077	2087	2077	2077	2087

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–236. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the S Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	3.00×10^{-8}	3.51×10^{-3}	3.33×10^{-8}	3.00×10^{-8}	4.08×10^{-3}	4.02×10^{-8}	3.00×10^{-8}	4.86×10^{-3}	5.10×10^{-8}
Technetium-99	1.49×10^{-6}	2.60	8.94×10^{-5}	1.49×10^{-6}	6.70	2.94×10^{-4}	1.49×10^{-6}	1.37×10^{1}	6.43×10^{-4}
Iodine-129	2.85×10^{-9}	8.13×10^{-1}	9.24×10^{-6}	2.85×10^{-9}	1.02	1.43×10^{-5}	2.85×10^{-9}	1.31	2.16×10^{-5}
Total	**N/A**	**3.42**	**9.87×10^{-5}**	**N/A**	**7.72**	**3.08×10^{-4}**	**N/A**	**1.50×10^{1}**	**6.65×10^{-4}**
Year of peak impact	2050	2050	2050	2050	2050	2050	2050	2050	2050
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.58×10^{-1}	1.50	0.00	1.58×10^{-1}	1.56	6.19×10^{-10}	1.58×10^{-1}	2.34	2.84×10^{-5}
Nitrate	4.59	8.19×10^{-2}	0.00	4.59	6.44×10^{-1}	0.00	4.59	1.44	0.00
Total	**N/A**	**1.58**	**0.00**	**N/A**	**2.20**	**6.19×10^{-10}**	**N/A**	**3.78**	**2.84×10^{-5}**
Year of peak impact	2051	2051	N/A	2051	2051	2051	2051	2051	2051

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–237. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the T Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	1.88×10^{-6}	2.19×10^{-1}	2.08×10^{-6}	1.88×10^{-6}	2.55×10^{-1}	2.51×10^{-6}	1.88×10^{-6}	3.04×10^{-1}	3.19×10^{-6}
Technetium-99	6.45×10^{-6}	1.13×10^{1}	3.88×10^{-4}	6.45×10^{-6}	2.91×10^{1}	1.28×10^{-3}	6.45×10^{-6}	5.94×10^{1}	2.79×10^{-3}
Iodine-129	1.26×10^{-8}	3.58	4.07×10^{-5}	1.26×10^{-8}	4.47	6.29×10^{-5}	1.26×10^{-8}	5.77	9.51×10^{-5}
Uranium-238	1.49×10^{-11}	1.85×10^{-3}	2.08×10^{-8}	1.49×10^{-11}	1.92×10^{-3}	2.25×10^{-8}	1.49×10^{-11}	2.07×10^{-3}	2.56×10^{-8}
Total	**N/A**	**1.51×10^{1}**	**4.31×10^{-4}**	**N/A**	**3.38×10^{1}**	**1.34×10^{-3}**	**N/A**	**6.55×10^{1}**	**2.89×10^{-3}**
Year of peak impact	2051	2051	2051	2051	2051	2051	2051	2051	2051

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	3.37×10^{-1}	3.21	0.00	3.25×10^{-1}	3.21	1.32×10^{-9}	3.25×10^{-1}	4.83	6.07×10^{-5}
Nitrate	6.18×10^{1}	1.10	0.00	6.40×10^{1}	8.98	0.00	6.40×10^{1}	2.00×10^{1}	0.00
Total uranium	2.24×10^{-5}	2.14×10^{-4}	0.00	2.24×10^{-5}	2.17×10^{-4}	0.00	2.24×10^{-5}	2.27×10^{-4}	0.00
Total	**N/A**	**4.31**	**0.00**	**N/A**	**1.22×10^{1}**	**1.32×10^{-9}**	**N/A**	**2.49×10^{1}**	**6.07×10^{-5}**
Year of peak impact	2050	2050	N/A	2051	2051	2050	2051	2051	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–238. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the U Barrier Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	6.28×10^{-9}	7.35×10^{-4}	6.97×10^{-9}	6.28×10^{-9}	8.54×10^{-4}	8.42×10^{-9}	6.28×10^{-9}	1.02×10^{-3}	1.07×10^{-8}
Technetium-99	1.37×10^{-7}	2.39×10^{-1}	8.22×10^{-6}	1.37×10^{-7}	6.16×10^{-1}	2.70×10^{-5}	1.37×10^{-7}	1.26	5.91×10^{-5}
Iodine-129	1.63×10^{-10}	4.63×10^{-2}	5.27×10^{-7}	1.63×10^{-10}	5.79×10^{-2}	8.14×10^{-7}	1.63×10^{-10}	7.48×10^{-2}	1.23×10^{-6}
Total	**1.43×10^{-7}**	**2.86×10^{-1}**	**8.76×10^{-6}**	**1.43×10^{-7}**	**6.75×10^{-1}**	**2.79×10^{-5}**	**1.43×10^{-7}**	**1.33**	**6.04×10^{-5}**
Year of peak impact	2067	2067	2067	2067	2067	2067	2067	2067	2067
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.73×10^{-3}	5.46×10^{-2}	0.00	5.68×10^{-3}	5.61×10^{-2}	2.25×10^{-11}	5.68×10^{-3}	8.44×10^{-2}	1.03×10^{-6}
Nitrate	4.02×10^{-1}	7.18×10^{-3}	0.00	4.07×10^{-1}	5.71×10^{-2}	0.00	4.07×10^{-1}	1.27×10^{-1}	0.00
Total	**4.08×10^{-1}**	**6.18×10^{-2}**	**0.00**	**4.12×10^{-1}**	**1.13×10^{-1}**	**2.25×10^{-11}**	**4.12×10^{-1}**	**2.12×10^{-1}**	**1.03×10^{-6}**
Year of peak impact	2050	2050	N/A	2051	2051	2050	2051	2051	2050

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–239. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	4.72×10^{-7}	5.52×10^{-2}	5.24×10^{-7}	4.72×10^{-7}	6.42×10^{-2}	6.32×10^{-7}	4.72×10^{-7}	7.65×10^{-2}	8.02×10^{-7}
Technetium-99	3.76×10^{-6}	6.58	2.26×10^{-4}	3.76×10^{-6}	1.70×10^{1}	7.44×10^{-4}	3.76×10^{-6}	3.46×10^{1}	1.63×10^{-3}
Iodine-129	4.50×10^{-9}	1.28	1.46×10^{-5}	4.50×10^{-9}	1.60	2.26×10^{-5}	4.50×10^{-9}	2.07	3.41×10^{-5}
Uranium-238	7.66×10^{-13}	9.50×10^{-5}	1.07×10^{-9}	7.66×10^{-13}	9.89×10^{-5}	1.16×10^{-9}	7.66×10^{-13}	1.07×10^{-4}	1.32×10^{-9}
Total	**N/A**	**7.92**	**2.41×10^{-4}**	**N/A**	**1.86×10^{1}**	**7.67×10^{-4}**	**N/A**	**3.68×10^{1}**	**1.66×10^{-3}**
Year of peak impact	2065	2065	2065	2065	2065	2065	2065	2065	2065

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.80×10^{-1}	1.71	0.00	1.67×10^{-1}	1.65	7.70×10^{-10}	1.67×10^{-1}	2.49	3.53×10^{-5}
Nitrate	1.97×10^{2}	3.52	0.00	2.00×10^{2}	2.81×10^{1}	0.00	2.00×10^{2}	6.26×10^{1}	0.00
Total uranium	1.45×10^{-6}	1.38×10^{-5}	0.00	1.40×10^{-6}	1.36×10^{-5}	0.00	1.40×10^{-6}	1.42×10^{-5}	0.00
Total	**N/A**	**5.23**	**0.00**	**N/A**	**2.97×10^{1}**	**7.70×10^{-10}**	**N/A**	**6.51×10^{1}**	**3.53×10^{-5}**
Year of peak impact	2083	2083	N/A	2077	2077	2087	2077	2077	2087

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–240. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Hydrogen-3 (tritium)	9.48×10^{-11}	1.11×10^{-5}	9.79×10^{-12}	8.82×10^{-12}	1.20×10^{-6}	1.18×10^{-11}	8.82×10^{-12}	1.43×10^{-6}	1.50×10^{-11}
Technetium-99	3.45×10^{-7}	6.03×10^{-1}	2.11×10^{-5}	3.50×10^{-7}	1.58	6.94×10^{-5}	3.50×10^{-7}	3.23	1.52×10^{-4}
Iodine-129	7.17×10^{-10}	2.04×10^{-1}	2.20×10^{-6}	6.78×10^{-10}	2.41×10^{-1}	3.40×10^{-6}	6.78×10^{-10}	3.12×10^{-1}	5.14×10^{-6}
Uranium-238	1.25×10^{-14}	1.55×10^{-6}	1.27×10^{-11}	9.08×10^{-15}	1.17×10^{-6}	1.37×10^{-11}	9.08×10^{-15}	1.26×10^{-6}	1.56×10^{-11}
Total	**N/A**	**8.07×10^{-1}**	**2.33×10^{-5}**	**N/A**	**1.82**	**7.28×10^{-5}**	**N/A**	**3.54**	**1.57×10^{-4}**
Year of peak impact	2218	2218	2256	2256	2256	2256	2256	2256	2256
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	5.95×10^{-2}	5.67×10^{-1}	0.00	5.61×10^{-2}	5.54×10^{-1}	2.34×10^{-10}	5.61×10^{-2}	8.34×10^{-1}	1.07×10^{-5}
Nitrate	1.47×10^{1}	2.62×10^{-1}	0.00	1.50×10^{1}	2.10	0.00	1.50×10^{1}	4.69	0.00
Total uranium	1.98×10^{-8}	1.89×10^{-7}	0.00	2.29×10^{-8}	2.22×10^{-7}	0.00	2.29×10^{-8}	2.32×10^{-7}	0.00
Total	**N/A**	**8.30×10^{-1}**	**0.00**	**N/A**	**2.66**	**2.34×10^{-10}**	**N/A**	**5.53**	**1.07×10^{-5}**
Year of peak impact	2074	2074	N/A	2076	2076	2074	2076	2076	2074

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–241. Tank Closure Alternative 6B, Option Case, Human Health Impacts Related to Cribs and Trenches (Ditches), Past Leaks, and Other Sources at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	9.54×10^{-12}	4.30×10^{-5}	1.89×10^{-9}	9.54×10^{-12}	9.93×10^{-5}	4.71×10^{-9}	3.45×10^{-7}	1.04×10^{-2}	5.62×10^{-7}
Iodine-129	1.60×10^{-14}	5.70×10^{-6}	8.03×10^{-11}	1.60×10^{-14}	8.70×10^{-5}	2.09×10^{-9}	7.17×10^{-10}	2.72×10^{-3}	6.32×10^{-8}
Total	**N/A**	**4.87×10^{-5}**	**1.97×10^{-9}**	**N/A**	**1.86×10^{-4}**	**6.81×10^{-9}**	**N/A**	**1.31×10^{-2}**	**6.26×10^{-7}**
Year of peak impact	2155	2155	2155	2155	2155	2155	2218	2218	2232
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	8.95×10^{-7}	8.84×10^{-6}	3.53×10^{-15}	8.95×10^{-7}	1.45×10^{-5}	1.62×10^{-10}	5.95×10^{-2}	2.62×10^{-1}	1.07×10^{-5}
Nitrate	2.98×10^{-4}	4.51×10^{-5}	0.00	2.98×10^{-4}	2.81×10^{-2}	0.00	1.47×10^{1}	6.59×10^{-1}	0.00
Total	**N/A**	**5.40×10^{-5}**	**3.53×10^{-15}**	**N/A**	**2.81×10^{-2}**	**1.62×10^{-10}**	**N/A**	**9.21×10^{-1}**	**1.07×10^{-5}**
Year of peak impact	2155	2155	2193	2155	2155	2193	2074	2074	2074

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figure Q–11 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time from cribs and trenches (ditches), past leaks, and other sources (e.g., tank residuals, ancillary equipment, unplanned releases), and the total from all three sources. The peak radiological risk resulting from cribs and trenches (ditches) occurs around CY 1956 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. The peak radiological risk resulting from past leaks occurs around CY 2090 for the Core Zone Boundary and is dominated by tritium, technetium-99, and iodine-129. Prior to CY 2100, other tank farm sources make a minor contribution to peak radiological risk and contribute a small fraction of the impacts of cribs and trenches (ditches) at all times. The peak radiological risk resulting from all three sources occurs around CY 2055 and is dominated by technetium-99 and iodine-129. Tritium, technetium-99, and iodine-129 move at the same velocity as groundwater. After approximately CY 4940, nearly all contamination has exited the unconfined aquifer, and Figure Q–11 is interpreted as reporting no risk due to these sources.

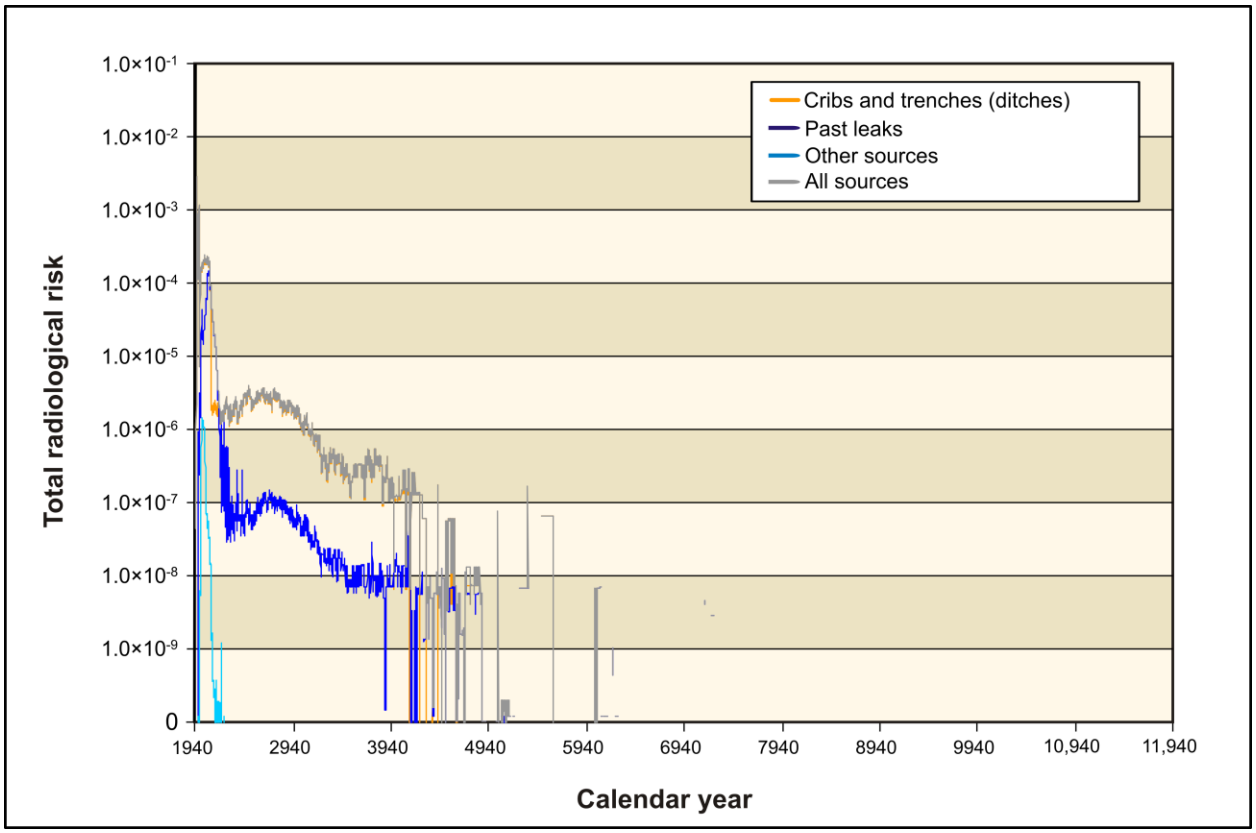

Figure Q–11. Tank Closure Alternative 6B, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.1.1.8 Tank Closure Intruder Scenario

Intruders are individuals who enter a tank farm area and engage in activity that could cause direct contact with residual contamination in the stabilized or closed tanks. Two types of receptors and two types of scenarios were considered. The receptor types were the American Indian resident farmer and the resident farmer, and the scenario types were home construction and well drilling. Because the majority of the waste at the tank farms is at a depth greater than that of the foundation for a home, the home construction scenario was screened from the analysis. Also, sensitivity analysis determined that in all cases for residential agriculture, impacts on the American Indian resident farmer exceeded impacts on the resident farmer. Screening analysis also determined that impacts of intrusion were dominated by contact with short-lived radionuclides, strontium-90 and cesium-137. Consequently, impacts of intrusion at the tank

farms are represented by the well-drilling scenario, in which a worker inhales dust and receives external radiation while drilling the well and an American Indian resident farmer contacts residual contamination brought to the surface during development of the well. Because complete removal of tanks is proposed under Tank Closure Alternatives 6A, Base and Option Cases, and 6B, Base and Option Cases, no tank farm intruder impacts would occur under these alternatives. In addition, complete removal of tanks is proposed for the BX and SX tank farms under Alternative 4 and intruder impacts would be avoided. Estimates of impact under this intrusion scenario for the eighteen tank farms and Tank Closure Alternatives 1 through 5 and 6C are summarized in Table Q–242 for American Indian resident farmer intruders. For all tank farms and alternatives, resident farmer impacts are dominated by exposure to strontium-90 and cesium-137. Because inhalation and external exposure are the only exposure modes for the well-drilling worker, impacts on the worker involved in well drilling would be the same for resident farmer and American Indian receptors. Estimates of impact on the drilling worker are presented in Table Q–243. For all tank farms and alternatives, drilling worker doses are dominated by external exposure to cesium-137 and inhalation exposure to plutonium-239 and americium-241. For both the resident farmer and drilling worker, impacts are presented as dose for the year of peak dose. Because doses are dominated by radionuclides with short half-lives, the year of peak dose occurs immediately after loss of institutional control. Due to high concentrations of strontium-90 and cesium-137, the DOE intruder dose guideline of 500 millirem (DOE Guide 435.1-1) is exceeded for single-shell tank farms under Alternative 1 and 5 and for double-shell tank farms under all alternatives.

Table Q–242. Doses to an American Indian Engaged in Residential Agriculture Following Well Drilling at the Tank Farms

Tank Farm	Dose (rem per year)					
	Tank Closure Alternative					
	1	2	3	4	5	6C
A	48.4	0.484	0.484	0.048	4.84	0.484
AX	36.8	0.368	0.368	0.0368	3.68	0.368
B	6.84	0.068	0.068	0.0068	0.68	0.068
BX	5.71	0.0571	0.0571	N/A[a]	0.571	0.0571
BY	27.8	0.278	0.278	0.0278	2.78	0.278
C	25.0	0.250	0.250	0.0250	2.50	0.250
S	33.2	0.332	0.332	0.0332	3.32	0.332
SX	30.7	0.307	0.307	N/A[a]	3.07	0.307
T	2.38	0.0238	0.0238	0.0024	0.238	0.0238
TX	19.5	0.195	0.195	0.0195	1.95	0.195
TY	2.23	0.0223	0.0223	0.0022	0.223	0.0223
U	26.8	0.268	0.268	0.0268	2.68	0.268
AN	166	1.66	1.66	0.166	16.6	1.66
AP	90.3	0.903	0.903	0.0903	9.03	0.903
AW	74.1	0.741	0.741	0.0741	7.41	0.741
AY	82.6	0.826	0.826	0.0826	8.26	0.826
AZ	738	7.38	7.38	0.738	73.8	7.38
SY	117	1.17	1.17	0.117	11.7	1.17

[a] BX and SX tank farms would be clean-closed under Tank Closure Alternative 4.

Key: N/A=not applicable.

Table Q–243. Doses to a Well-Drilling Worker at the Tank Farms

Tank Farm	Dose (rem)					
	Tank Closure Alternative					
	1	2	3	4	5	6C
A	1.38×10^{-1}	1.38×10^{-3}	1.38×10^{-3}	1.38×10^{-4}	1.38×10^{-2}	1.38×10^{-3}
AX	8.78×10^{-2}	8.78×10^{-4}	8.78×10^{-4}	8.78×10^{-5}	8.73×10^{-3}	8.78×10^{-4}
B	1.93×10^{-2}	1.93×10^{-4}	1.93×10^{-4}	1.93×10^{-5}	1.93×10^{-3}	1.93×10^{-4}
BX	2.30×10^{-2}	2.30×10^{-4}	2.30×10^{-4}	N/A[a]	2.30×10^{-3}	2.30×10^{-4}
BY	6.20×10^{-2}	6.20×10^{-4}	6.20×10^{-4}	6.20×10^{-5}	6.20×10^{-3}	6.20×10^{-4}
C	1.95×10^{-1}	1.95×10^{-3}	1.95×10^{-3}	1.95×10^{-4}	1.95×10^{-2}	1.95×10^{-3}
S	9.10×10^{-2}	9.10×10^{-4}	9.10×10^{-4}	9.10×10^{-5}	9.10×10^{-3}	9.10×10^{-4}
SX	8.85×10^{-2}	8.85×10^{-4}	8.85×10^{-4}	N/A[a]	8.85×10^{-3}	8.85×10^{-4}
T	1.22×10^{-2}	1.22×10^{-4}	1.22×10^{-4}	1.22×10^{-5}	1.22×10^{-3}	1.22×10^{-4}
TX	1.33×10^{-1}	1.33×10^{-3}	1.33×10^{-3}	1.33×10^{-4}	1.33×10^{-2}	1.33×10^{-3}
TY	6.99×10^{-3}	6.99×10^{-5}	6.99×10^{-5}	6.99×10^{-6}	6.99×10^{-4}	6.99×10^{-5}
U	7.94×10^{-2}	7.94×10^{-4}	7.94×10^{-4}	7.94×10^{-5}	7.94×10^{-3}	7.94×10^{-4}
AN	3.75×10^{-1}	3.75×10^{-3}	3.75×10^{-3}	3.75×10^{-4}	3.75×10^{-2}	3.75×10^{-3}
AP	1.90×10^{-1}	1.90×10^{-3}	1.90×10^{-3}	1.90×10^{-4}	1.90×10^{-2}	1.90×10^{-3}
AW	1.91×10^{-1}	1.91×10^{-3}	1.91×10^{-3}	1.91×10^{-4}	1.91×10^{-2}	1.91×10^{-3}
AY	4.71×10^{-1}	4.71×10^{-3}	4.71×10^{-3}	4.71×10^{-4}	4.71×10^{-2}	4.71×10^{-3}
AZ	2.43	2.43×10^{-2}	2.43×10^{-2}	2.43×10^{-3}	2.43×10^{-1}	2.43×10^{-2}
SY	6.87×10^{-1}	6.87×10^{-3}	6.87×10^{-3}	6.87×10^{-4}	6.87×10^{-2}	6.87×10^{-3}

[a] BX and SX tank farms would be clean-closed under Tank Closure Alternative 4.

Key: N/A=not applicable.

Q.3.2 Long-Term Human Health Impacts of FFTF Decommissioning Alternatives

Impacts on human health over the long time period following decommissioning of FFTF would be due primarily to the materials left in place following no action, entombment, or removal. These releases would involve both radioactive and chemical constituents. The results of this human health impacts analysis for onsite, offsite, and intruder receptors are summarized in the following sections.

Q.3.2.1 Impacts on Onsite and Offsite Receptors of Expected Conditions Under FFTF Decommissioning Alternatives

Implementation of activities defined for the FFTF Decommissioning alternatives could lead to releases of radioactive and chemical constituents to the environment over long periods of time. In the case of FFTF Decommissioning Alternative 1, these releases would not be controlled by final decommissioning activities. In the case of FFTF Decommissioning Alternative 2, these releases would be controlled by removal of all aboveground structures and minimal removal of below-grade structures, equipment, and materials. An RCRA-compliant barrier would be constructed over the Reactor Containment Building and any other remaining below-grade structures (including the reactor vessel). In the case of FFTF Decommissioning Alternative 3, these releases would be further controlled by removal of all aboveground structures, as well as contaminated below-grade structures (including the reactor vessel), equipment and materials.

Potential human health impacts of the release of radioactive constituents are estimated as dose and as lifetime risk of incidence of cancer. Potential human health effects due to release of chemical constituents include both carcinogenic effects and other forms of toxicity. Impacts of carcinogenic chemicals are estimated as lifetime risk of incidence of cancer. Noncarcinogenic effects are estimated as Hazard Quotient, the ratio of the long-term intake of a single chemical to the highest intake that produces no observable effect, and as Hazard Index, the sum of the Hazard Quotients of the group of chemicals contributing to impacts through the exposure pathways evaluated in a particular scenario. Further information on the nature of human health effects in response to exposure to radioactive and chemical constituents is provided in Appendix K, Section K.1. Impacts due to exposure to these constituents are presented in this appendix.

The four measures of human health impacts considered in this analysis—lifetime risks of developing cancer from radioactive and chemical constituents, dose from radioactive constituents, and Hazard Index from chemical constituents—were calculated for each year for 10,000 years for each receptor at three locations (i.e., FFTF barrier, Columbia River nearshore, and Columbia River surface water). This is a large amount of information that must be summarized to allow interpretation of results. The method chosen is to present dose for the year of maximum dose, risk for the year of maximum risk, and Hazard Index for the year of maximum Hazard Index. This choice is based on regulation of radiological impacts expressed as dose and the observation that peak risk and peak noncarcinogenic impacts expressed as Hazard Index may occur at times other than that of peak dose. The significance of dose impacts is evaluated by comparison against the 100-millirem-per-year all-exposure-modes standard specified for protection of the public and the environment in DOE Order 458.1. Population doses are compared against a total effective dose equivalent from natural background sources of 311 millirem per year for a member of the population of the United States (NCRP 2009). The significance of noncarcinogenic chemical impacts is evaluated by comparison against a guideline value of unity (1) for Hazard Index. The level of protection provided for the drinking water pathway is evaluated by comparison against the MCLs of the "National Primary Drinking Water Regulations" (40 CFR 141) and other benchmarks presented in Appendix O. In addition, only those radioactive and chemical constituents that resulted in a lifetime risk or Hazard Index greater than 1×10^{-10} for all impacts analysis locations for a given source are included in the human health impact tables presented in this section to reduce the size of the tables. Members of the offsite populations are assumed to have the activity pattern of a residential farmer, using surface water to meet the total annual drinking water requirement and to irrigate a garden that provides approximately 25 percent of annual crop and animal product requirements. These receptors are also assumed to consume fish harvested from the river. Impacts on an individual of the offsite population are the same as those reported in tables in this appendix for the resident farmer at the Columbia River surface-water location.

The results of the analysis for drinking-water well user are summarized in Tables Q–244 and Q–245 for radioactive and chemical constituents, respectively. Impacts due to ingestion of drinking water under FFTF Decommissioning Alternatives 1 and 2 would not be higher than the 100-millirem-per-year dose standard at the FFTF barrier. Under both FFTF Decommissioning Alternatives 1 and 2, doses estimated for drinking water ingestion are less than 10 millirem per year at the Columbia River nearshore location. The peak radiological impacts would be due to technetium-99, and chemical impacts would be due to uranium. As a result of removal of all contaminated material under FFTF Decommissioning Alternative 3, there would be no impacts on groundwater and no impacts on human health.

Table Q–244. Summary of Radiological Human Health Impacts on Drinking-Water Well User

Location	Alternative 1		Alternative 2	
	Radiation Dose at Year of Peak Dose (millirem per year)	**Radiological Risk at Year of Peak Radiological Risk**	**Radiation Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Fast Flux Test Facility barrier	7.19×10^{-1} (2790)	2.47×10^{-5} (2790)	7.02×10^{-1} (3137)	2.42×10^{-5} (3137)
Columbia River nearshore	5.57×10^{-2} (2978)	1.91×10^{-6} (2978)	5.86×10^{-2} (3307)	2.02×10^{-6} (3307)

Note: Calendar year of peak impact presented in parentheses.

Table Q–245. Summary of Chemical Human Health Impacts on Drinking-Water Well User

	Alternative 1		Alternative 2	
	Hazard Index at Year of Peak Hazard Index	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Fast Flux Test Facility barrier	1.91×10^{-1} (11,842)	Not applicable	Not applicable	Not applicable
Columbia River nearshore	7.99×10^{-3} (11,788)	Not applicable	Not applicable	Not applicable

Note: Calendar year of peak impact presented in parentheses.

Q.3.2.1.1 FFTF Decommissioning Alternative 1: No Action

Under FFTF Decommissioning Alternative 1, only those actions consistent with previous DOE actions under the National Environmental Policy Act would be completed. Final decommissioning of FFTF would not occur. For analysis purposes, the remaining waste would be available for release to the environment after an institutional control period of 100 years. Potential human health impacts of this alternative are summarized in Tables Q–246 through Q–248. The key constituent contributors to radiological risk would be tritium and technetium-99. Dose standards would not be exceeded at any location, and the Hazard Index guideline would not be exceeded at any location. Population dose is estimated as 1.16×10^{-2} person-rem per year for the year of maximum impact.

Table Q–246. FFTF Decommissioning Alternative 1 Human Health Impacts at the Fast Flux Test Facility Barrier

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.11×10^{-7}	7.19×10^{-1}	2.47×10^{-5}	4.11×10^{-7}	1.85	8.14×10^{-5}	4.11×10^{-7}	3.79	1.78×10^{-4}
Total	**N/A**	**7.19×10^{-1}**	**2.47×10^{-5}**	**N/A**	**1.85**	**8.14×10^{-5}**	**N/A**	**3.79**	**1.78×10^{-4}**
Year of peak impact	2790	2790	2790	2790	2790	2790	2790	2790	2790
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Total uranium	2.01×10^{-2}	1.91×10^{-1}	0.00	2.01×10^{-2}	1.95×10^{-1}	0.00	2.01×10^{-2}	2.03×10^{-1}	0.00
Total	**N/A**	**1.91×10^{-1}**	**0.00**	**N/A**	**1.95×10^{-1}**	**3.87×10^{-16}**	**N/A**	**2.03×10^{-1}**	**1.77×10^{-11}**
Year of peak impact	11,842	11,842	N/A	11,842	11,842	2735	11,842	11,842	2735

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Table Q–247. FFTF Decommissioning Alternative 1 Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.18×10^{-8}	5.57×10^{-2}	1.91×10^{-6}	3.18×10^{-8}	1.43×10^{-1}	6.30×10^{-6}	3.18×10^{-8}	2.93×10^{-1}	1.38×10^{-5}
Total	**N/A**	**5.57×10^{-2}**	**1.91×10^{-6}**	**N/A**	**1.43×10^{-1}**	**6.30×10^{-6}**	**N/A**	**2.93×10^{-1}**	**1.38×10^{-5}**
Year of peak impact	2978	2978	2978	2978	2978	2978	2978	2978	2978
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Total uranium	8.39×10^{-4}	7.99×10^{-3}	0.00	8.39×10^{-4}	8.14×10^{-3}	0.00	8.39×10^{-4}	8.50×10^{-3}	0.00
Total	**N/A**	**7.99×10^{-3}**	**0.00**	**N/A**	**8.14×10^{-3}**	**0.00**	**N/A**	**8.50×10^{-3}**	**0.00**
Year of peak impact	11,788	11,788	N/A	11,788	11,788	N/A	11,788	11,788	N/A

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Table Q–248. FFTF Decommissioning Alternative 1 Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	5.12×10^{-13}	2.31×10^{-6}	1.01×10^{-10}	5.12×10^{-13}	5.33×10^{-6}	2.53×10^{-10}	3.18×10^{-8}	9.58×10^{-4}	5.12×10^{-8}
Total	**N/A**	**2.31×10^{-6}**	**1.01×10^{-10}**	**N/A**	**5.33×10^{-6}**	**2.53×10^{-10}**	**N/A**	**9.58×10^{-4}**	**5.12×10^{-8}**
Year of peak impact	2930	2930	2930	2930	2930	2930	2978	2978	2978
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Total uranium	2.15×10^{-8}	2.09×10^{-7}	0.00	2.15×10^{-8}	2.90×10^{-7}	0.00	8.39×10^{-4}	3.72×10^{-4}	0.00
Total	**N/A**	**2.09×10^{-7}**	**0.00**	**N/A**	**2.90×10^{-7}**	**0.00**	**N/A**	**3.72×10^{-4}**	**0.00**
Year of peak impact	11,936	11,936	N/A	11,936	11,936	N/A	11,788	11,788	N/A

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Figure Q–12 depicts the cumulative radiological lifetime risk of incidence of cancer at the FFTF barrier for the drinking-water well user over time. The peak radiological risk occurs around CY 2800 at the FFTF barrier and is dominated by technetium-99. Technetium-99 is a relatively mobile radionuclide that moves at the same velocity as groundwater.

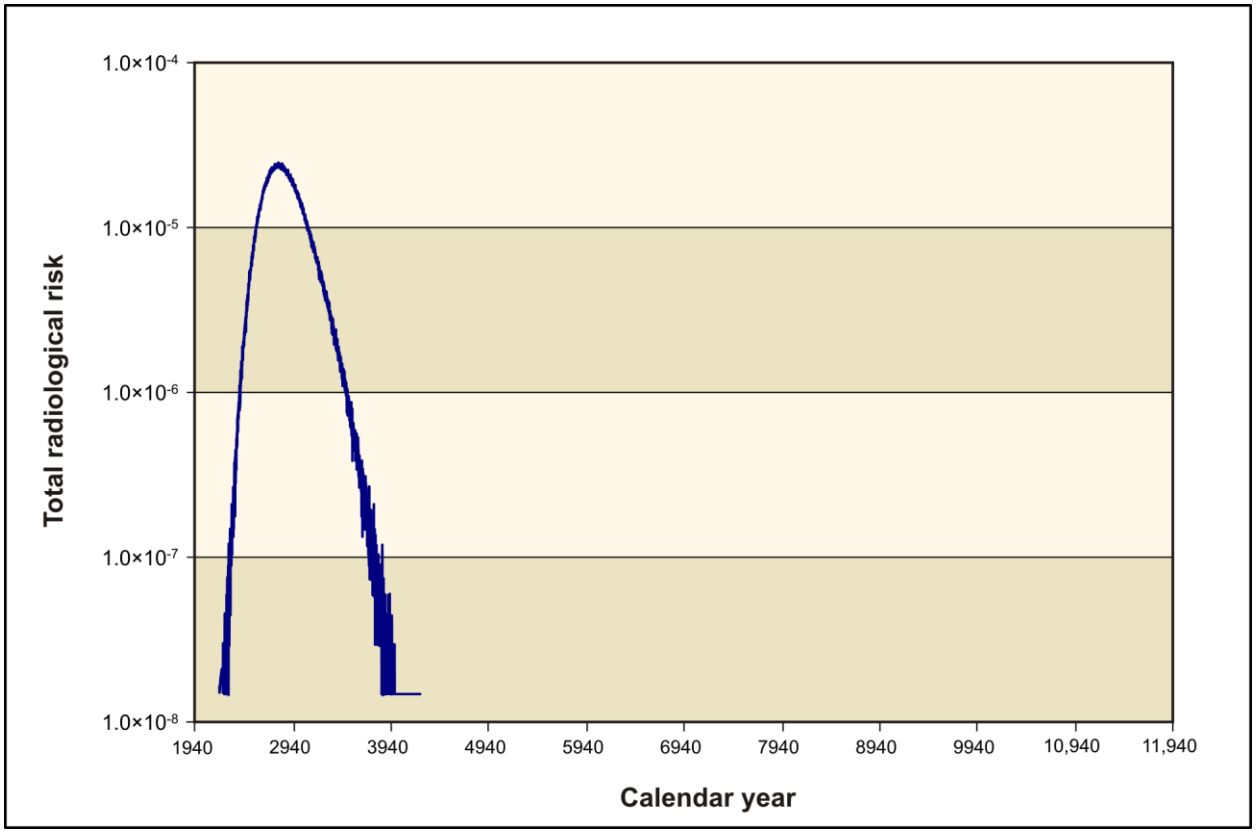

Figure Q–12. FFTF Decommissioning Alternative 1 Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Fast Flux Test Facility Barrier

Q.3.2.1.2 FFTF Decommissioning Alternative 2: Entombment

Under FFTF Decommissioning Alternative 2, all aboveground structures and minimal below-grade structures, equipment, and materials would be removed. An RCRA-compliant barrier would be constructed over the Reactor Containment Building and any other remaining below-grade structures (including the reactor vessel). Potential human health impacts of this alternative are summarized in Tables Q–249 through Q–251. The key constituent contributor to radiological risk would be technetium-99. The chemical risk and hazard drivers would be essentially negligible. For radionuclides, the dose standard would not be exceeded at any location. In addition, the Hazard Index guideline would not be exceeded at any location. Population dose is estimated as 1.15×10^{-2} person-rem per year for the year of maximum impact.

Table Q–249. FFTF Decommissioning Alternative 2 Human Health Impacts at the Fast Flux Test Facility Barrier

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.01×10^{-7}	7.02×10^{-1}	2.42×10^{-5}	4.01×10^{-7}	1.81	7.94×10^{-5}	4.01×10^{-7}	3.70	1.74×10^{-4}
Total	**N/A**	**7.02×10^{-1}**	**2.42×10^{-5}**	**N/A**	**1.81**	**7.94×10^{-5}**	**N/A**	**3.70**	**1.74×10^{-4}**
Year of peak impact	3137	3137	3137	3137	3137	3137	3137	3137	3137

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Table Q–250. FFTF Decommissioning Alternative 2 Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.35×10^{-8}	5.86×10^{-2}	2.02×10^{-6}	3.35×10^{-8}	1.51×10^{-1}	6.63×10^{-6}	3.35×10^{-8}	3.09×10^{-1}	1.45×10^{-5}
Total	**N/A**	**5.86×10^{-2}**	**2.02×10^{-6}**	**N/A**	**1.51×10^{-1}**	**6.63×10^{-6}**	**N/A**	**3.09×10^{-1}**	**1.45×10^{-5}**
Year of peak impact	3307	3307	3307	3307	3307	3307	3307	3307	3307

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Table Q–251. FFTF Decommissioning Alternative 2 Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.10×10^{-13}	2.30×10^{-6}	1.01×10^{-10}	5.10×10^{-13}	5.30×10^{-6}	2.52×10^{-10}	3.35×10^{-8}	1.01×10^{-3}	5.39×10^{-8}
Total	**N/A**	**2.30×10^{-6}**	**1.01×10^{-10}**	**N/A**	**5.30×10^{-6}**	**2.52×10^{-10}**	**N/A**	**1.01×10^{-3}**	**5.39×10^{-8}**
Year of peak impact	3233	3233	3233	3233	3233	3233	3307	3307	3307

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Figure Q–13 depicts the cumulative radiological lifetime risk of incidence of cancer at the FFTF barrier for the drinking-water well user over time. The peak radiological risk occurs around CY 3100 at the FFTF barrier and is dominated by technetium-99. Technetium-99 is a relatively mobile radionuclide that moves at the same velocity as groundwater.

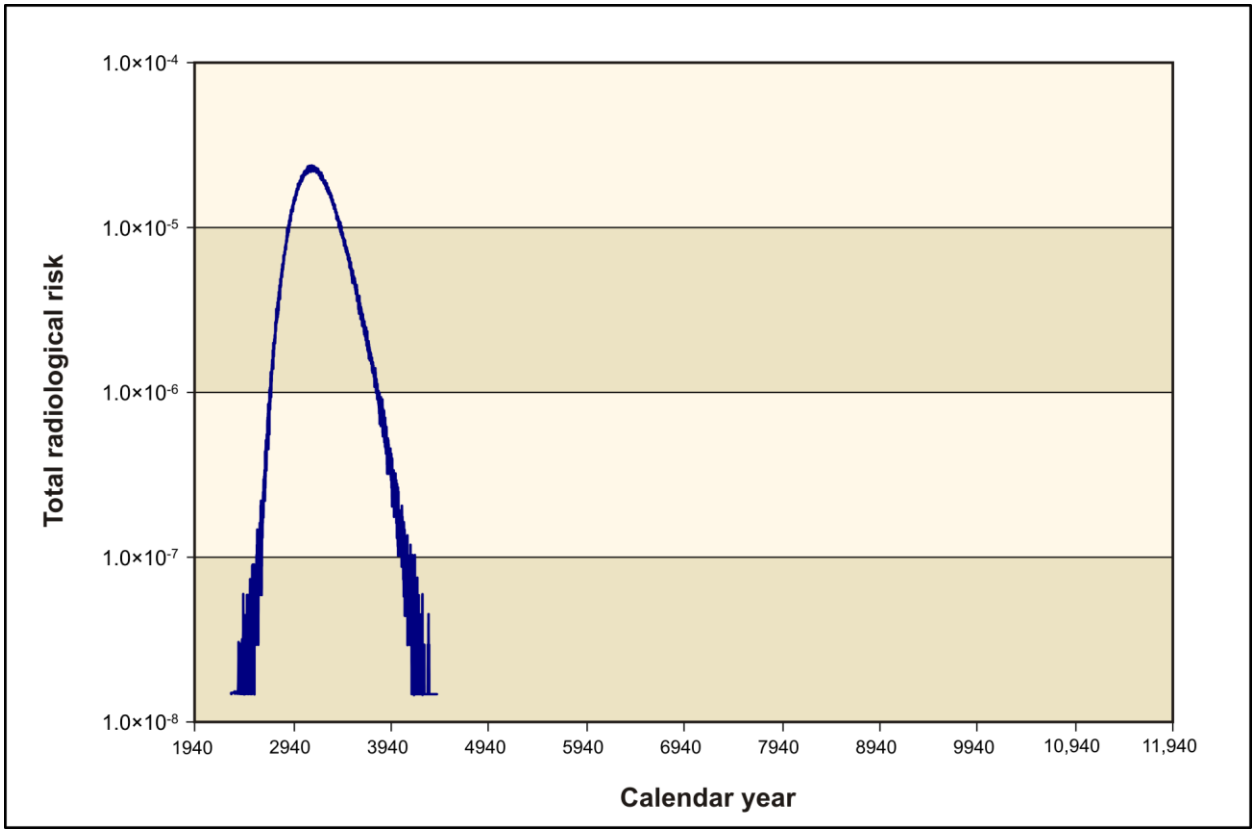

Figure Q–13. FFTF Decommissioning Alternative 2 Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Fast Flux Test Facility Barrier

Q.3.2.1.3 FFTF Decommissioning Alternative 3: Removal

Under FFTF Decommissioning Alternative 3, all aboveground structures, as well as contaminated below-grade structures, equipment, and materials, would be removed. As a result of removal of nearly all contaminated material, only small impacts are projected for groundwater and human health. At the FFTF barrier, dose for the drinking-water well user, resident farmer, and American Indian resident farmer are estimated as 1.6×10^{-7}, 4.2×10^{-7}, and 8.6×10^{-7} millirem per year, respectively.

Q.3.2.1.4 FFTF Decommissioning Intruder Scenario

Intruders are individuals who enter the FFTF area and engage in activity that could cause direct contact with residual contamination in the abandoned or stabilized structures. As in the case of Tank Closure alternatives, two types of receptors and two types of scenarios were considered. The receptor types were the American Indian resident farmer and the resident farmer, and the scenario types were home construction and well drilling. Because the majority of radionuclides at the FFTF area are in hardware at a depth greater than that of the foundation for a home, the home construction scenario was screened from the analysis. Also, sensitivity analysis determined that in all cases for residential agriculture, impacts on the American Indian resident farmer exceeded impacts on the resident farmer. Because inhalation and external exposure are the only exposure modes for the well-drilling worker, impacts on the worker

involved in well drilling would be the same for the resident farmer and American Indian resident farmer. For FFTF, estimates of inventory indicate that the greatest hazard is due to quantities of the long-lived radionuclides carbon-14 and technetium-99 and isotopes of uranium remaining at the site. Relatively small amounts of short-lived radionuclides are estimated to remain at the site. Consequently, impacts of intrusion at the FFTF area are represented by the well-drilling scenario, in which a worker inhales dust and receives external radiation while drilling the well and an American Indian resident farmer contacts residual contamination brought to the surface during development of the well. The impacts under this intrusion scenario for the three FFTF Decommissioning alternatives are summarized in Table Q–252 for the drilling worker and American Indian resident farmer intruders. Resident farmer impacts are dominated by exposure to carbon-14, while for the worker carbon-14, technetium-99, and uranium isotopes contribute to dose through the direct external and inhalation pathways. For both the resident farmer and drilling worker, impacts are presented as dose for the year of peak dose. Because radionuclides appearing due to decay and ingrowth did not have major contributions to these, the year of peak dose occurs immediately after loss of institutional control. The DOE intruder dose guideline of 500 millirem is not exceeded for any alternative.

Table Q–252. Doses to a Well-Drilling Worker and an American Indian Engaged in Residential Agriculture Following Well Drilling at the FFTF Area

Receptor	Dose (rem per year)		
	FFTF Decommissioning Alternative		
	1	2	3
Worker	4.5×10^{-6}	4.5×10^{-6}	2.7×10^{-14}
Resident farmer	1.1×10^{-3}	1.1×10^{-3}	1.4×10^{-8}

Key: FFTF=Fast Flux Test Facility.

Q.3.3 Long-Term Human Health Impacts of Waste Management Alternatives

Impacts on human health over the long time period following stabilization and closure of the waste management disposal facilities would be due primarily to naturally occurring release mechanisms, such as dissolution, diffusion, and radioactive groundwater flow and the degradation of waste forms over time. These releases would involve both radioactive and chemical constituents. Because a large number of constituents, sources, and scenarios have been considered, screening analysis was used to identify a reduced number of controlling scenarios. The results of this human health impacts analysis for onsite, offsite, and intruder receptors are summarized in the following sections.

Q.3.3.1 Impacts on Onsite and Offsite Receptors of Expected Conditions Under Waste Management Alternatives

Implementation of activities defined for the Waste Management alternatives could lead to releases of radioactive and chemical constituents to the environment over long periods of time. In the case of Waste Management Alternative 1, these releases would come from Low-Level Radioactive Waste Burial Ground (LLBG) 218-W-5, trenches 31 and 34. In the case of Waste Management Alternative 2, these releases would come from IDF-East and the RPPDF. In the case of Waste Management Alternative 3, these releases would come from IDF-East, IDF-West, and the RPPDF. Potential human health impacts due to release of radionuclides are estimated as dose and as lifetime risk of incidence of cancer. Potential human health effects due to release of chemical constituents include both carcinogenic effects and other forms of toxicity. Impacts of carcinogenic chemicals are estimated as lifetime risk of incidence of cancer. Noncarcinogenic effects are estimated as Hazard Quotient, the ratio of the long-term intake of a single chemical to the highest intake that produces no observable effect, and as Hazard Index, the sum of the Hazard Quotients of the group of chemicals contributing to impacts through the exposure pathways evaluated in a particular scenario. Further information on the nature of human health effects in response

to exposure to radioactive and chemical constituents is provided in Appendix K, Section K.1. As previously discussed in Section Q.1, the screening analysis identified 14 radioactive and 27 chemical constituents as contributing the greatest risk of adverse impacts. Impacts due to exposure to these constituents are presented in this appendix.

The four measures of human health impacts considered in this analysis—lifetime risks of developing cancer from radioactive and chemical constituents, dose from radioactive constituents, and Hazard Index from chemical constituents—were calculated for each year for 10,000 years for each receptor at six locations (i.e., IDF-East, IDF-West, RPPDF, Core Zone Boundary, Columbia River nearshore, and Columbia River surface water). This is a large amount of information that must be summarized to allow interpretation of results. The method chosen is to present dose for the year of maximum dose, risk for the year of maximum risk, and Hazard Index for the year of maximum Hazard Index. This choice is based on regulation of radiological impacts expressed as dose and the observations that peak risks and noncarcinogenic impacts expressed as Hazard Index may occur at times other than that of peak dose. The significance of dose impacts is evaluated by comparison against the 100-millirem-per-year all-exposure-modes standard specified for protection of the public and the environment in DOE Order 458.1. Population doses are compared against a total effective dose equivalent from natural background sources of 311 millirem per year for a member of the population of the United States (NCRP 2009). The significance of noncarcinogenic chemical impacts is evaluated by comparison against a guideline value of unity (1) for Hazard Index. The level of protection provided for the drinking water pathway is evaluated by comparison against the MCLs of the "National Primary Drinking Water Regulations" (40 CFR 141) and other benchmarks presented in Appendix O. In addition, only those radioactive and chemical constituents that resulted in a lifetime risk or Hazard Index greater than 1×10^{-10} for all impacts analysis locations for a given source are included in the human health impact tables presented in this section to reduce the size of the tables. Members of the offsite populations are assumed to have the activity pattern of a residential farmer, using surface water to meet the total annual drinking water requirement and to irrigate a garden that provides approximately 25 percent of annual crop and animal product requirements. These receptors are also assumed to consume fish harvested from the river. Impacts on an individual of the offsite population are the same as those reported in tables in this appendix for the resident farmer at the Columbia River surface-water location.

The results of the analysis for drinking-water well users are summarized in Tables Q–253 through Q–259 for radioactive and chemical constituents. Under all the Waste Management alternatives and disposal groups, doses would not be greater than the 100-millirem-per-year standard at any location. Under all Waste Management alternatives except Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, and Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, doses estimated for drinking water ingestion are less than 10 millirem per year at the Columbia River nearshore location.

Peak radiological impacts would be due to technetium-99 and iodine-129, and chemical impacts would be due to boron and boron compounds, chromium, fluoride, and nitrate. For peak impacts occurring after CY 5000, radiological impacts would be due to uranium isotopes, and chemical impacts would be due to total uranium.

Table Q–253. Waste Management Alternative 1 Summary of Human Health Impacts on Drinking-Water Well User

Location	Radiation Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Trenches 31 and 34	1.39×10^{-2} (3434)	4.36×10^{-7} (3443)	1.00×10^{-2} (3490)	N/A
Core Zone Boundary	9.90×10^{-4} (3462)	3.21×10^{-8} (3462)	6.87×10^{-4} (3519)	N/A
Columbia River nearshore	2.42×10^{-3} (3980)	7.67×10^{-8} (3980)	1.66×10^{-3} (3993)	N/A

Note: Calendar year of peak impact presented in parentheses.
Key: N/A= not applicable.

Table Q–254. Waste Management Alternative 2 Summary of Radiation Dose at Year of Peak Dose for Drinking-Water Well User (millirem per year)

Location	Disposal Group 1, Subgroup							Disposal Group 2, Subgroup			Disposal Group 3	
	1-A	1-B	1-C	1-D	1-E	1-F	1-G	2-A	2-B, Base Case	2-B, Option Case	Base Case	Option Case
IDF-East	2.70 (7826)	3.06 (8002)	5.31 (10,774)	2.88 (7826)	6.89 (10,921)	3.01 (7826)	2.70 (7826)	5.08 (7644)	5.03 (8117)	5.07 (7644)	5.19 (7678)	5.22 (7832)
RPPDF	8.94×10^{-2} (3818)	8.94×10^{-2} (3818)	8.94×10^{-2} (3818)	8.94×10^{-2} (3818)	2.37×10^{-1} (3785)	N/A	8.94×10^{-2} (3818)	N/A	3.26×10^{-1} (3769)	4.70×10^{-1} (3812)	3.14×10^{-1} (4013)	4.75×10^{-1} (4018)
Core Zone Boundary	1.01 (7439)	1.43 (7848)	1.94 (8334)	1.18 (8237)	2.49 (9662)	1.34 (8302)	1.01 (7439)	1.16 (7328)	1.16 (7328)	1.17 (7328)	1.21 (7891)	1.17 (7723)
Columbia River nearshore	7.56×10^{-1} (7847)	1.17 (8014)	1.60 (10,429)	9.66×10^{-1} (8174)	2.07 (10,639)	1.07 (8014)	7.46×10^{-1} (7847)	7.43×10^{-1} (7754)	7.66×10^{-1} (7754)	7.70×10^{-1} (7754)	7.52×10^{-1} (8233)	7.65×10^{-1} (8233)

Note: Calendar year of peak impact presented in parentheses.

Key: IDF-East=200-East Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table Q–255. Waste Management Alternative 2 Summary of Radiological Risk at Year of Peak Radiological Risk for Drinking-Water Well User

Location	Disposal Group 1, Subgroup							Disposal Group 2, Subgroup			Disposal Group 3	
	1-A	1-B	1-C	1-D	1-E	1-F	1-G	2-A	2-B, Base Case	2-B, Option Case	Base Case	Option Case
IDF-East	8.14×10^{-5} (7826)	9.68×10^{-5} (7629)	1.81×10^{-4} (10,774)	8.72×10^{-5} (7826)	2.34×10^{-4} (10,921)	9.20×10^{-5} (7826)	8.14×10^{-5} (7826)	1.50×10^{-4} (7644)	1.49×10^{-4} (8117)	1.50×10^{-4} (7644)	1.57×10^{-4} (7678)	1.56×10^{-4} (7678)
RPPDF	2.69×10^{-6} (3818)	2.69×10^{-6} (3818)	2.69×10^{-6} (3818)	2.69×10^{-6} (3818)	7.01×10^{-6} (3785)	N/A	2.69×10^{-6} (3818)	N/A	9.96×10^{-6} (3769)	1.42×10^{-5} (3812)	9.51×10^{-6} (4013)	1.49×10^{-5} (4018)
Core Zone Boundary	3.14×10^{-5} (7709)	4.64×10^{-5} (7848)	6.44×10^{-5} (8334)	3.80×10^{-5} (8237)	8.45×10^{-5} (9662)	4.33×10^{-5} (8302)	3.14×10^{-5} (7709)	3.56×10^{-5} (7328)	3.57×10^{-5} (7328)	3.57×10^{-5} (7328)	3.70×10^{-5} (7891)	3.66×10^{-5} (7723)
Columbia River nearshore	2.38×10^{-5} (7847)	3.78×10^{-5} (8014)	5.46×10^{-5} (10,429)	3.04×10^{-5} (8130)	7.07×10^{-5} (10,639)	3.47×10^{-5} (8014)	2.38×10^{-5} (8130)	2.35×10^{-5} (7754)	2.39×10^{-5} (7754)	2.40×10^{-5} (7754)	2.34×10^{-5} (8233)	2.37×10^{-5} (8233)

Note: Calendar year of peak impact presented in parentheses.

Key: IDF-East=200-East Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table Q–256. Waste Management Alternative 2 Summary of Hazard Index at Year of Peak Hazard Index for Drinking-Water Well User

Location	Disposal Group 1, Subgroup							Disposal Group 2, Subgroup			Disposal Group 3	
	1-A	1-B	1-C	1-D	1-E	1-F	1-G	2-A	2-B, Base Case	2-B, Option Case	Base Case	Option Case
IDF-East	2.29×10^{-1} (7962)	1.89×10^{-1} (8052)	3.40 (8608)	3.05×10^{-1} (8207)	2.08 (9008)	3.03 (8882)	2.29×10^{-1} (7962)	1.77×10^{-1} (7960)	1.82×10^{-1} (7983)	2.78×10^{-1} (7954)	1.82×10^{-1} (7983)	2.78×10^{-1} (7954)
RPPDF	2.84×10^{-2} (3792)	2.84×10^{-2} (3792)	2.84×10^{-2} (3792)	2.84×10^{-2} (3792)	6.92×10^{-2} (3666)	N/A	2.84×10^{-2} (3792)	N/A	3.78×10^{-2} (3710)	4.41×10^{-1} (3680)	3.92×10^{-2} (3929)	4.39×10^{-1} (3916)
Core Zone Boundary	5.76×10^{-2} (8248)	5.16×10^{-2} (8095)	1.11 (8680)	9.26×10^{-2} (8317)	6.26×10^{-1} (8873)	8.21×10^{-1} (8588)	5.78×10^{-2} (8248)	5.65×10^{-2} (8123)	6.05×10^{-2} (7860)	3.56×10^{-1} (3688)	6.05×10^{-2} (7860)	3.75×10^{-1} (3865)
Columbia River nearshore	3.80×10^{-2} (7927)	4.05×10^{-2} (7940)	8.56×10^{-1} (8594)	6.38×10^{-2} (8284)	4.68×10^{-1} (8827)	6.12×10^{-1} (8535)	3.81×10^{-2} (8798)	3.58×10^{-2} (8406)	3.95×10^{-2} (7994)	2.34×10^{-1} (4560)	3.96×10^{-2} (7994)	2.58×10^{-1} (4487)

Note: Calendar year of peak impact presented in parentheses.
Key: IDF-East=200-East Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table Q–257. Waste Management Alternative 3 Summary of Radiation Dose at Year of Peak Dose (millirem per year) for Drinking-Water Well User

Location	Disposal Group 1, Subgroup							Disposal Group 2, Subgroup			Disposal Group 3	
	1-A	1-B	1-C	1-D	1-E	1-F	1-G	2-A	2-B, Base Case	2-B, Option Case	Base Case	Option Case
IDF-East	5.64×10^{-1} (9827)	2.59 (7629)	5.27 (10,774)	2.28 (11,434)	6.84 (10,921)	2.53 (8878)	5.50×10^{-1} (11,385)	4.98×10^{-1} (10,979)	5.27×10^{-1} (10,636)	5.08×10^{-1} (9990)	5.27×10^{-1} (10,636)	5.08×10^{-1} (9990)
IDF-West	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)	2.87×10^{1} (3818)
RPPDF	8.94×10^{-2} (3818)	8.94×10^{-2} (3818)	8.94×10^{-2} (3818)	8.94×10^{-2} (3818)	2.37×10^{-1} (3785)	N/A	8.94×10^{-2} (3818)	N/A	3.26×10^{-1} (3769)	4.70×10^{-1} (3812)	3.14×10^{-1} (4013)	4.75×10^{-1} (4018)
Core Zone Boundary	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)	2.92 (3859)
Columbia River nearshore	3.52 (3920)	3.52 (3920)	3.52 (3920)	3.52 (3920)	3.52 (3920)	3.52 (3920)	3.52 (3920)	3.52 (3920)	3.53 (3920)	3.52 (3920)	3.52 (3920)	3.52 (3920)

Note: Calendar year of peak impact presented in parentheses.
Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table Q–258. Waste Management Alternative 3
Summary of Radiological Risk at Year of Peak Radiological Risk for Drinking-Water Well User

	Disposal Group 1, Subgroup							Disposal Group 2, Subgroup			Disposal Group 3	
Location	**1-A**	**1-B**	**1-C**	**1-D**	**1-E**	**1-F**	**1-G**	**2-A**	**2-B, Base Case**	**2-B, Option Case**	**Base Case**	**Option Case**
IDF-East	1.44×10^{-5} (10,129)	8.70×10^{-5} (7629)	1.80×10^{-4} (10,774)	7.26×10^{-5} (11,434)	2.32×10^{-4} (10,921)	8.45×10^{-5} (8878)	1.46×10^{-5} (11,385)	1.32×10^{-5} (11,050)	1.36×10^{-5} (10,188)	1.35×10^{-5} (9705)	1.36×10^{-5} (10,188)	1.35×10^{-5} (9705)
IDF-West	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)	8.59×10^{-4} (3818)
RPPDF	2.69×10^{-6} (3818)	2.69×10^{-6} (3818)	2.69×10^{-6} (3818)	2.69×10^{-6} (3818)	7.01×10^{-6} (3785)	N/A	2.69×10^{-6} (3818)	N/A	9.96×10^{-6} (3769)	1.42×10^{-5} (3812)	9.51×10^{-6} (4013)	1.49×10^{-5} (4018)
Core Zone Boundary	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)	8.86×10^{-5} (3859)
Columbia River nearshore	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)	1.07×10^{-4} (3920)

Note: Calendar year of peak impact presented in parentheses.
Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table Q–259. Waste Management Alternative 3
Summary of Hazard Index at Year of Peak Hazard Index for Drinking-Water Well User

	Disposal Group 1, Subgroup							Disposal Group 2, Subgroup			Disposal Group 3	
Location	**1-A**	**1-B**	**1-C**	**1-D**	**1-E**	**1-F**	**1-G**	**2-A**	**2-B, Base Case**	**2-B, Option Case**	**Base Case**	**Option Case**
IDF-East	2.29×10^{-1} (7962)	1.89×10^{-1} (8052)	3.39 (8608)	3.04×10^{-1} (8207)	2.08 (9008)	3.03 (8882)	2.29×10^{-1} (7962)	1.77×10^{-1} (7960)	1.82×10^{-1} (7983)	2.78×10^{-1} (7954)	1.82×10^{-1} (7983)	2.78×10^{-1} (7954)
IDF-West	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)	1.03×10^{-2} (3813)
RPPDF	2.84×10^{-2} (3792)	2.84×10^{-2} (3792)	2.84×10^{-2} (3792)	2.84×10^{-2} (3792)	6.92×10^{-2} (3666)	N/A	2.84×10^{-2} (3792)	N/A	3.78×10^{-2} (3710)	4.41×10^{-1} (3680)	3.92×10^{-2} (3929)	4.39×10^{-1} (3916)
Core Zone Boundary	5.76×10^{-2} (8248)	5.15×10^{-2} (8095)	1.11 (8680)	9.23×10^{-2} (8317)	6.26×10^{-1} (8873)	8.20×10^{-1} (8588)	5.77×10^{-2} (8248)	5.64×10^{-2} (8123)	6.02×10^{-2} (7860)	3.56×10^{-1} (3688)	6.02×10^{-2} (7860)	3.75×10^{-1} (3865)
Columbia River nearshore	3.77×10^{-2} (7927)	4.04×10^{-2} (7940)	8.56×10^{-1} (8594)	6.35×10^{-2} (8284)	4.68×10^{-1} (8827)	6.11×10^{-1} (8535)	3.78×10^{-2} (7927)	3.57×10^{-2} (8406)	3.95×10^{-2} (7994)	2.36×10^{-1} (4560)	3.95×10^{-2} (7994)	2.60×10^{-1} (4487)

Note: Calendar year of peak impact presented in parentheses.
Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Q.3.3.1.1 Waste Management Alternative 1: No Action

Under Waste Management Alternative 1, only those wastes currently generated on site at Hanford from non–Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) actions would continue to be disposed of in LLBG 218-W-5, trenches 31 and 34. Although the short-term impacts do not address the impacts associated with closure activities for this site, for the purpose of analyzing long-term impacts, it was assumed that these trenches would be closed using an RCRA-compliant barrier consistent with the closure plans for these burial grounds. As a result, the non-CERCLA waste disposed of in these trenches from 2008 to 2035 would become available for release to the environment. Potential human health impacts of this alternative at the disposal area boundary, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–260 through Q–263, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. In addition, the Hazard Index guideline would not be exceeded at any location. Population dose is estimated as 2.23×10^{-4} person-rem per year for the year of maximum impact.

Table Q–260. Waste Management Alternative 1
Human Health Impacts at Low-Level Radioactive Waste Burial Ground 218-W-5, Trenches 31 and 34

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.86×10^{-9}	1.20×10^{-2}	4.16×10^{-7}	6.92×10^{-9}	3.12×10^{-2}	1.37×10^{-6}	6.92×10^{-9}	6.37×10^{-2}	3.00×10^{-6}
Iodine-129	6.49×10^{-12}	1.85×10^{-3}	1.99×10^{-8}	6.14×10^{-12}	2.19×10^{-3}	3.08×10^{-8}	6.14×10^{-12}	2.83×10^{-3}	4.66×10^{-8}
Total	**N/A**	**1.39×10^{-2}**	**4.36×10^{-7}**	**N/A**	**3.34×10^{-2}**	**1.40×10^{-6}**	**N/A**	**6.65×10^{-2}**	**3.04×10^{-6}**
Year of peak impact	3434	3434	3443	3443	3443	3443	3443	3443	3443
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	1.84×10^{-5}	2.63×10^{-6}	0.00	1.84×10^{-5}	2.73×10^{-6}	0.00	1.84×10^{-5}	2.97×10^{-6}	0.00
Chromium	9.44×10^{-4}	8.99×10^{-3}	0.00	9.44×10^{-4}	9.32×10^{-3}	3.71×10^{-12}	9.44×10^{-4}	1.40×10^{-2}	1.70×10^{-7}
Fluoride	1.55×10^{-3}	7.40×10^{-4}	0.00	1.55×10^{-3}	2.08×10^{-3}	0.00	1.55×10^{-3}	4.36×10^{-3}	0.00
Nitrate	1.77×10^{-2}	3.16×10^{-4}	0.00	1.77×10^{-2}	2.48×10^{-3}	0.00	1.77×10^{-2}	5.54×10^{-3}	0.00
Total	**N/A**	**1.00×10^{-2}**	**0.00**	**N/A**	**1.39×10^{-2}**	**3.71×10^{-12}**	**N/A**	**2.39×10^{-2}**	**1.70×10^{-7}**
Year of peak impact	3490	3490	N/A	3490	3490	3490	3490	3490	3490

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–261. Waste Management Alternative 1 Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	5.17×10^{-10}	9.04×10^{-4}	3.11×10^{-8}	5.17×10^{-10}	2.33×10^{-3}	1.02×10^{-7}	5.17×10^{-10}	4.76×10^{-3}	2.24×10^{-7}
Iodine-129	3.02×10^{-13}	8.61×10^{-5}	9.79×10^{-10}	3.02×10^{-13}	1.08×10^{-4}	1.51×10^{-9}	3.02×10^{-13}	1.39×10^{-4}	2.29×10^{-9}
Total	**N/A**	**9.90×10^{-4}**	**3.21×10^{-8}**	**N/A**	**2.44×10^{-3}**	**1.04×10^{-7}**	**N/A**	**4.90×10^{-3}**	**2.26×10^{-7}**
Year of peak impact	3462	3462	3462	3462	3462	3462	3462	3462	3462
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	1.14×10^{-6}	1.63×10^{-7}	0.00	1.14×10^{-6}	1.69×10^{-7}	0.00	1.14×10^{-6}	1.84×10^{-7}	0.00
Chromium	6.64×10^{-5}	6.32×10^{-4}	0.00	6.31×10^{-5}	6.23×10^{-4}	2.61×10^{-13}	6.31×10^{-5}	9.38×10^{-4}	1.19×10^{-8}
Fluoride	7.52×10^{-5}	3.58×10^{-5}	0.00	9.87×10^{-5}	1.32×10^{-4}	0.00	9.87×10^{-5}	2.77×10^{-4}	0.00
Nitrate	1.09×10^{-3}	1.94×10^{-5}	0.00	1.11×10^{-3}	1.56×10^{-4}	0.00	1.11×10^{-3}	3.48×10^{-4}	0.00
Total	**N/A**	**6.87×10^{-4}**	**0.00**	**N/A**	**9.12×10^{-4}**	**2.61×10^{-13}**	**N/A**	**1.56×10^{-3}**	**1.19×10^{-8}**
Year of peak impact	3519	3519	N/A	3551	3551	3519	3551	3551	3519

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–262. Waste Management Alternative 1 Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.22×10^{-9}	2.14×10^{-3}	7.36×10^{-8}	1.22×10^{-9}	5.51×10^{-3}	2.42×10^{-7}	1.22×10^{-9}	1.13×10^{-2}	5.29×10^{-7}
Iodine-129	9.78×10^{-13}	2.79×10^{-4}	3.17×10^{-9}	9.78×10^{-13}	3.48×10^{-4}	4.90×10^{-9}	9.78×10^{-13}	4.50×10^{-4}	7.41×10^{-9}
Total	**N/A**	**2.42×10^{-3}**	**7.67×10^{-8}**	**N/A**	**5.86×10^{-3}**	**2.47×10^{-7}**	**N/A**	**1.17×10^{-2}**	**5.37×10^{-7}**
Year of peak impact	3980	3980	3980	3980	3980	3980	3980	3980	3980
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.82×10^{-6}	4.03×10^{-7}	0.00	2.82×10^{-6}	4.19×10^{-7}	0.00	2.82×10^{-6}	4.56×10^{-7}	0.00
Chromium	1.58×10^{-4}	1.50×10^{-3}	0.00	1.58×10^{-4}	1.56×10^{-3}	6.20×10^{-13}	1.58×10^{-4}	2.34×10^{-3}	2.84×10^{-8}
Fluoride	2.33×10^{-4}	1.11×10^{-4}	0.00	2.33×10^{-4}	3.12×10^{-4}	0.00	2.33×10^{-4}	6.54×10^{-4}	0.00
Nitrate	2.64×10^{-3}	4.72×10^{-5}	0.00	2.64×10^{-3}	3.71×10^{-4}	0.00	2.64×10^{-3}	8.28×10^{-4}	0.00
Total	**N/A**	**1.66×10^{-3}**	**0.00**	**N/A**	**2.24×10^{-3}**	**6.20×10^{-13}**	**N/A**	**3.83×10^{-3}**	**2.84×10^{-8}**
Year of peak impact	3993	3993	N/A	3993	3993	3993	3993	3993	3993

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–263. Waste Management Alternative 1 Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	0.00	0.00	0.00	0.00	0.00	0.00	1.22×10^{-9}	3.65×10^{-5}	1.96×10^{-9}
Iodine-129	0.00	0.00	0.00	0.00	0.00	0.00	9.78×10^{-13}	2.90×10^{-6}	7.12×10^{-11}
Total	**N/A**	**0.00**	**0.00**	**N/A**	**0.00**	**0.00**	**N/A**	**3.94×10^{-5}**	**2.03×10^{-9}**
Year of peak impact	N/A	N/A	N/A	N/A	N/A	N/A	3980	3980	3980
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	0.00	0.00	0.00	0.00	0.00	0.00	2.82×10^{-6}	3.07×10^{-8}	0.00
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.58×10^{-4}	6.94×10^{-4}	2.84×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.33×10^{-4}	3.40×10^{-5}	0.00
Nitrate	0.00	0.00	0.00	0.00	0.00	0.00	2.64×10^{-3}	9.30×10^{-5}	0.00
Total	**N/A**	**0.00**	**0.00**	**N/A**	**0.00**	**0.00**	**N/A**	**8.21×10^{-4}**	**2.84×10^{-8}**
Year of peak impact	N/A	N/A	N/A	N/A	N/A	N/A	3993	3993	3993

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figure Q–14 depicts the cumulative radiological lifetime risk of incidence of cancer at the Core Zone Boundary for the drinking-water well user over time. The peak radiological risk occurs around CY 3470 and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in LLBG 218-W-5, trenches 31 and 34. These are relatively mobile radionuclides that move at the same velocity as groundwater.

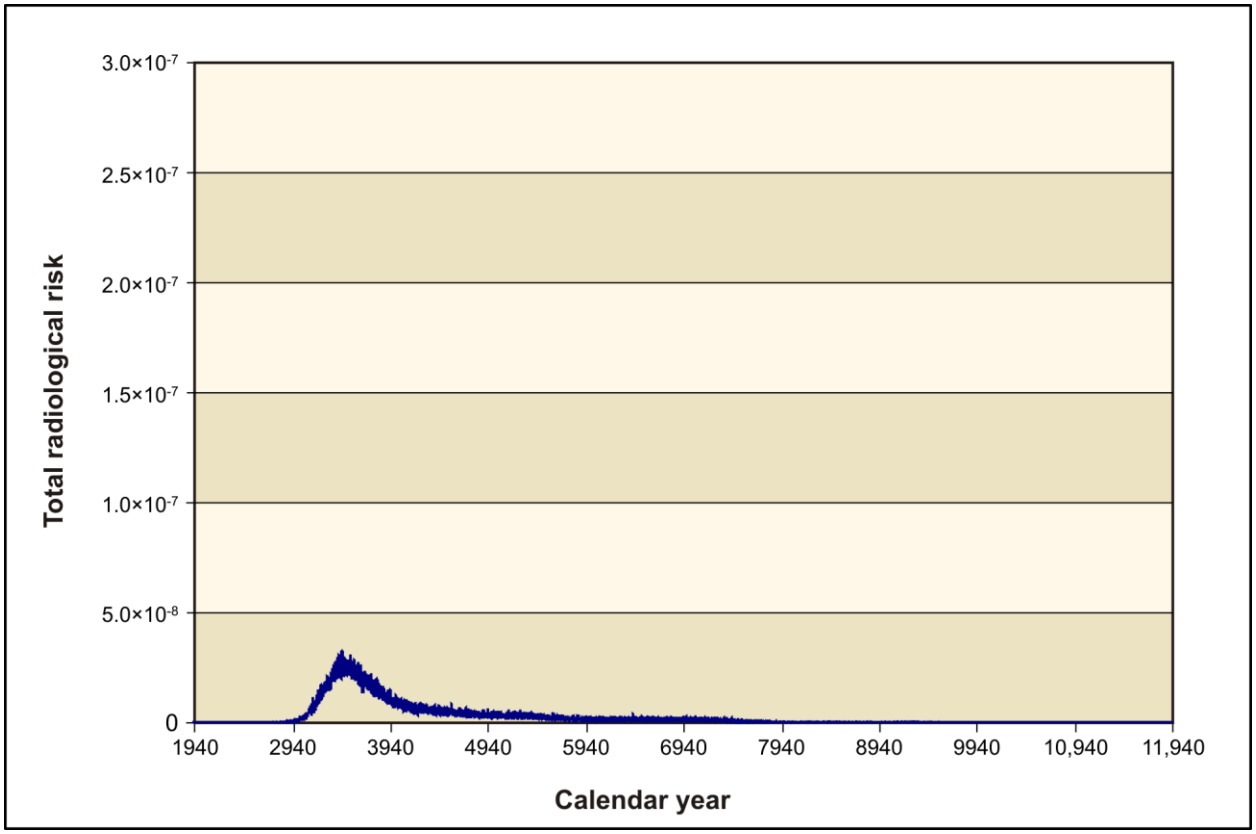

Figure Q–14. Waste Management Alternative 1 Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only

Under Waste Management Alternative 2, waste from tank treatment operations, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites would be disposed of in IDF-East. Waste from tank farm cleanup activities would be disposed of in the RPPDF. As a result, the waste disposed of in these two facilities would become available for release to the environment. Because different waste types would result from the Tank Closure action alternatives, three disposal groups were considered to account for the different IDF-East sizes and operational time periods. In addition, within these three disposal groups, subgroups were identified to allow consideration of the different waste types resulting from the Tank Closure alternatives. Potential human health impacts of these subgroups under this alternative are discussed in the following sections.

Q.3.3.1.2.1 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A

Disposal Group 1, Subgroup 1-A, addresses the waste resulting from Tank Closure Alternative 2B, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- Immobilized low-activity waste (ILAW) glass
- LAW melters
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 2B.

Potential human health impacts at the IDF-East barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–264 through Q–268, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 1.68×10^{-1} person-rem per year for the year of maximum impact.

Table Q–264. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.26×10^{-6}	2.20	7.58×10^{-5}	1.26×10^{-6}	5.68	2.49×10^{-4}	1.26×10^{-6}	1.16×10^{1}	5.45×10^{-4}
Iodine-129	1.74×10^{-9}	4.95×10^{-1}	5.63×10^{-6}	1.74×10^{-9}	6.19×10^{-1}	8.71×10^{-6}	1.74×10^{-9}	7.99×10^{-1}	1.32×10^{-5}
Total	**N/A**	**2.70**	**8.14×10^{-5}**	**N/A**	**6.30**	**2.58×10^{-4}**	**N/A**	**1.24×10^{1}**	**5.58×10^{-4}**
Year of peak impact	7826	7826	7826	7826	7826	7826	7826	7826	7826
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.94×10^{-6}	4.20×10^{-7}	0.00	2.94×10^{-6}	4.37×10^{-7}	0.00	2.94×10^{-6}	4.76×10^{-7}	0.00
Chromium	1.32×10^{-3}	1.25×10^{-2}	0.00	1.32×10^{-3}	1.30×10^{-2}	8.22×10^{-12}	1.32×10^{-3}	1.96×10^{-2}	3.77×10^{-7}
Fluoride	2.07×10^{-4}	9.87×10^{-5}	0.00	2.07×10^{-4}	2.77×10^{-4}	0.00	2.07×10^{-4}	5.82×10^{-4}	0.00
Nitrate	1.21×10^{1}	2.16×10^{-1}	0.00	1.21×10^{1}	1.70	0.00	1.21×10^{1}	3.79	0.00
Total	**N/A**	**2.29×10^{-1}**	**0.00**	**N/A**	**1.71**	**8.22×10^{-12}**	**N/A**	**3.81**	**3.77×10^{-7}**
Year of peak impact	7962	7962	N/A	7962	7962	8438	7962	7962	8438

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–265. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–266. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.93×10^{-7}	8.63×10^{-1}	2.99×10^{-5}	4.93×10^{-7}	2.22	9.84×10^{-5}	4.97×10^{-7}	4.58	2.15×10^{-4}
Iodine-129	5.20×10^{-10}	1.48×10^{-1}	1.48×10^{-6}	5.20×10^{-10}	1.85×10^{-1}	2.29×10^{-6}	4.58×10^{-10}	2.11×10^{-1}	3.47×10^{-6}
Total	**N/A**	**1.01**	**3.14×10^{-5}**	**N/A**	**2.41**	**1.01×10^{-4}**	**N/A**	**4.79**	**2.19×10^{-4}**
Year of peak impact	7439	7439	7709	7439	7439	7709	7709	7709	7709

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	7.27×10^{-7}	1.04×10^{-7}	0.00	7.27×10^{-7}	1.08×10^{-7}	0.00	7.27×10^{-7}	1.18×10^{-7}	0.00
Chromium	4.01×10^{-4}	3.82×10^{-3}	0.00	4.01×10^{-4}	3.96×10^{-3}	2.94×10^{-12}	4.01×10^{-4}	5.96×10^{-3}	1.35×10^{-7}
Fluoride	4.95×10^{-5}	2.36×10^{-5}	0.00	4.95×10^{-5}	6.62×10^{-5}	0.00	4.95×10^{-5}	1.39×10^{-4}	0.00
Nitrate	3.01	5.38×10^{-2}	0.00	3.01	4.23×10^{-1}	0.00	3.01	9.43×10^{-1}	0.00
Total	**N/A**	**5.76×10^{-2}**	**0.00**	**N/A**	**4.27×10^{-1}**	**2.94×10^{-12}**	**N/A**	**9.49×10^{-1}**	**1.35×10^{-7}**
Year of peak impact	8248	8248	N/A	8248	8248	3846	8248	8248	3846

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–267. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.77×10^{-7}	6.60×10^{-1}	2.27×10^{-5}	3.77×10^{-7}	1.70	7.46×10^{-5}	3.77×10^{-7}	3.47	1.63×10^{-4}
Iodine-129	3.37×10^{-10}	9.60×10^{-2}	1.09×10^{-6}	3.37×10^{-10}	1.20×10^{-1}	1.69×10^{-6}	3.37×10^{-10}	1.55×10^{-1}	2.55×10^{-6}
Total	**N/A**	**7.56×10^{-1}**	**2.38×10^{-5}**	**N/A**	**1.82**	**7.63×10^{-5}**	**N/A**	**3.63**	**1.66×10^{-4}**
Year of peak impact	7847	7847	7847	7847	7847	7847	7847	7847	7847
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.72×10^{-4}	1.63×10^{-3}	0.00	1.72×10^{-4}	1.69×10^{-3}	1.67×10^{-12}	1.72×10^{-4}	2.55×10^{-3}	7.64×10^{-8}
Fluoride	2.97×10^{-5}	1.41×10^{-5}	0.00	2.97×10^{-5}	3.97×10^{-5}	0.00	2.97×10^{-5}	8.33×10^{-5}	0.00
Nitrate	2.03	3.63×10^{-2}	0.00	2.03	2.86×10^{-1}	0.00	2.03	6.37×10^{-1}	0.00
Total	**N/A**	**3.80×10^{-2}**	**0.00**	**N/A**	**2.87×10^{-1}**	**1.67×10^{-12}**	**N/A**	**6.39×10^{-1}**	**7.64×10^{-8}**
Year of peak impact	7927	7927	N/A	7927	7927	8236	7927	7927	8236

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–268. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	6.63×10^{-12}	2.99×10^{-5}	1.31×10^{-9}	6.50×10^{-12}	6.76×10^{-5}	3.28×10^{-9}	3.77×10^{-7}	1.14×10^{-2}	6.07×10^{-7}
Iodine-129	1.02×10^{-14}	3.63×10^{-6}	5.11×10^{-11}	1.06×10^{-14}	5.78×10^{-5}	1.33×10^{-9}	3.37×10^{-10}	1.45×10^{-3}	3.56×10^{-8}
Total	**N/A**	**3.35×10^{-5}**	**1.36×10^{-9}**	**N/A**	**1.25×10^{-4}**	**4.61×10^{-9}**	**N/A**	**1.28×10^{-2}**	**6.43×10^{-7}**
Year of peak impact	7861	7861	7861	7935	7935	7861	7847	7847	7847
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Nitrate	3.74×10^{-5}	5.67×10^{-6}	0.00	3.74×10^{-5}	3.53×10^{-3}	0.00	2.03	1.00×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-6}**	**0.00**	**N/A**	**3.53×10^{-3}**	**0.00**	**N/A**	**1.01×10^{-1}**	**7.64×10^{-8}**
Year of peak impact	8064	8064	N/A	8064	8064	N/A	7927	7927	8236

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–15 and Q–16 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 7700 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

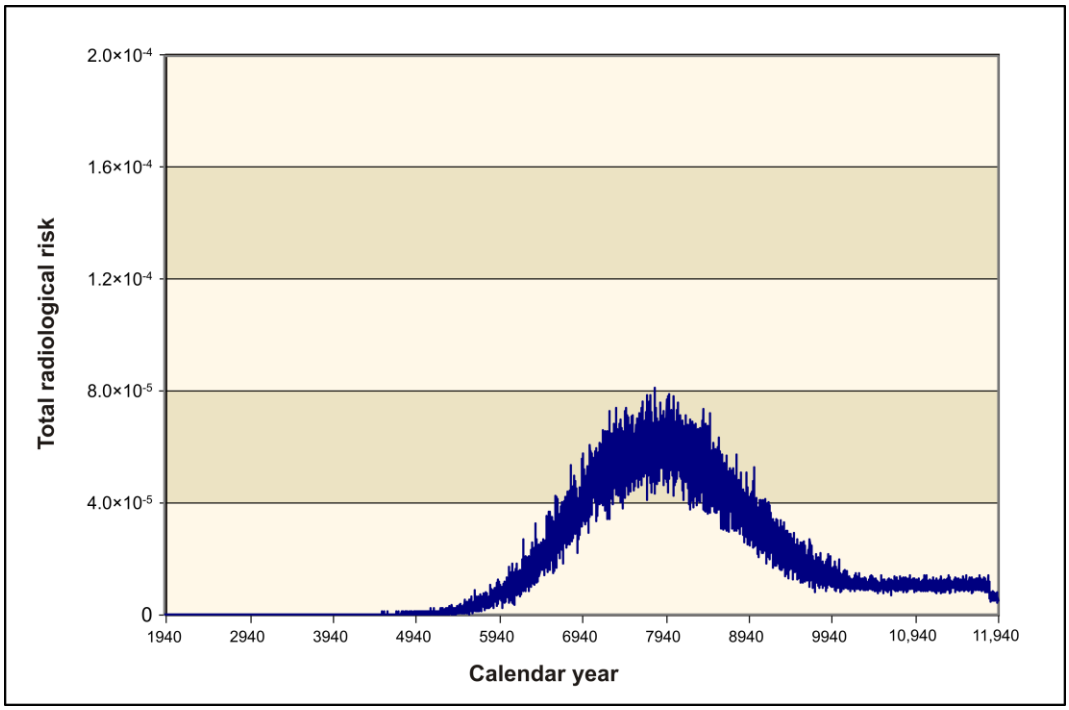

Figure Q–15. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

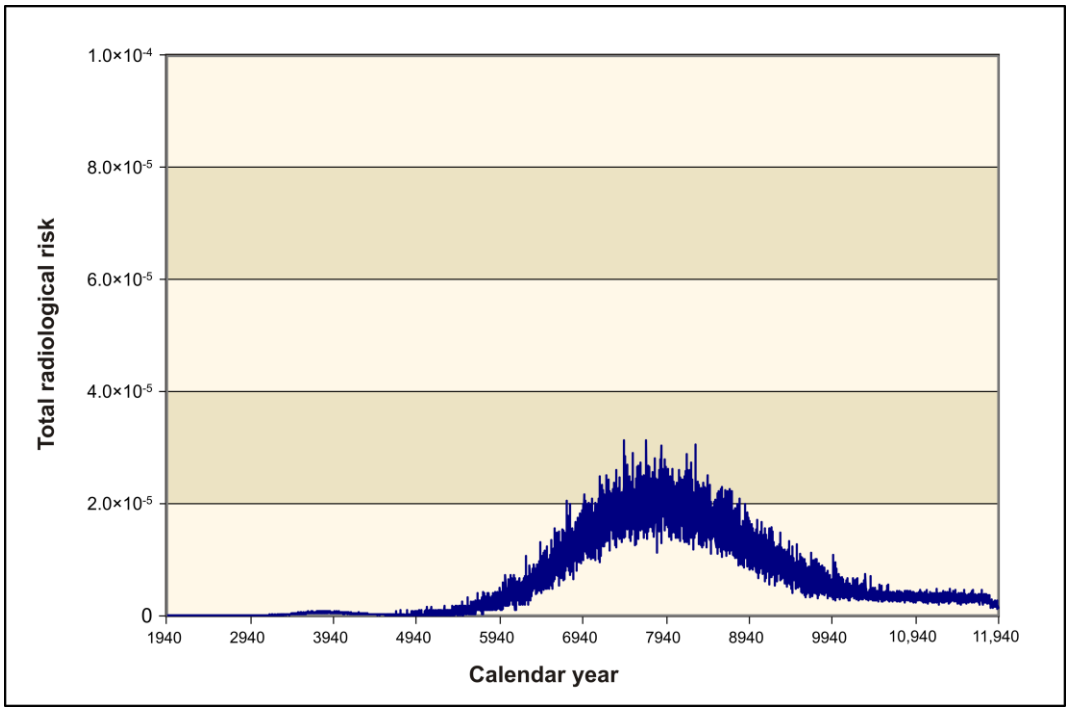

Figure Q–16. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.2 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B

Disposal Group 1, Subgroup 1-B, addresses the waste resulting from Tank Closure Alternative 3A, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Bulk vitrification glass
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 3A.

Potential human health impacts at the IDF-East barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–269 through Q–273, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded for the resident farmer and American Indian resident farmer at the IDF-East barrier due primarily to release of nitrate. Population dose is estimated as 2.78×10^{-1} person-rem per year for the year of maximum impact.

Table Q–269. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.49×10^{-6}	2.61	9.28×10^{-5}	1.54×10^{-6}	6.95	3.05×10^{-4}	1.54×10^{-6}	1.42×10^{1}	6.68×10^{-4}
Iodine-129	1.58×10^{-9}	4.50×10^{-1}	3.99×10^{-6}	1.23×10^{-9}	4.38×10^{-1}	6.16×10^{-6}	1.23×10^{-9}	5.66×10^{-1}	9.32×10^{-6}
Total	**N/A**	**3.06**	**9.68×10^{-5}**	**N/A**	**7.39**	**3.11×10^{-4}**	**N/A**	**1.48×10^{1}**	**6.77×10^{-4}**
Year of peak impact	8002	8002	7629	7629	7629	7629	7629	7629	7629
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	2.47×10^{-6}	3.52×10^{-7}	0.00	2.47×10^{-6}	3.66×10^{-7}	0.00	2.47×10^{-6}	3.99×10^{-7}	0.00
Chromium	5.87×10^{-4}	5.59×10^{-3}	0.00	5.87×10^{-4}	5.80×10^{-3}	3.72×10^{-12}	5.87×10^{-4}	8.72×10^{-3}	1.71×10^{-7}
Fluoride	1.46×10^{-4}	6.94×10^{-5}	0.00	1.46×10^{-4}	1.95×10^{-4}	0.00	1.46×10^{-4}	4.09×10^{-4}	0.00
Nitrate	1.03×10^{1}	1.83×10^{-1}	0.00	1.03×10^{1}	1.44	0.00	1.03×10^{1}	3.22	0.00
Total	**N/A**	**1.89×10^{-1}**	**0.00**	**N/A**	**1.45**	**3.72×10^{-12}**	**N/A**	**3.22**	**1.71×10^{-7}**
Year of peak impact	8052	8052	N/A	8052	8052	8691	8052	8052	8691

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–270. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–271. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	7.48×10^{-7}	1.31	4.50×10^{-5}	7.48×10^{-7}	3.37	1.48×10^{-4}	7.48×10^{-7}	6.89	3.24×10^{-4}
Iodine-129	4.30×10^{-10}	1.22×10^{-1}	1.39×10^{-6}	4.30×10^{-10}	1.53×10^{-1}	2.15×10^{-6}	4.30×10^{-10}	1.98×10^{-1}	3.26×10^{-6}
Total	**N/A**	**1.43**	**4.64×10^{-5}**	**N/A**	**3.53**	**1.50×10^{-4}**	**N/A**	**7.09**	**3.27×10^{-4}**
Year of peak impact	7848	7848	7848	7848	7848	7848	7848	7848	7848
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	7.60×10^{-7}	1.09×10^{-7}	0.00	7.60×10^{-7}	1.13×10^{-7}	0.00	7.60×10^{-7}	1.23×10^{-7}	0.00
Chromium	1.82×10^{-4}	1.73×10^{-3}	0.00	1.82×10^{-4}	1.79×10^{-3}	2.94×10^{-12}	1.82×10^{-4}	2.70×10^{-3}	1.35×10^{-7}
Fluoride	3.96×10^{-5}	1.88×10^{-5}	0.00	3.96×10^{-5}	5.30×10^{-5}	0.00	3.96×10^{-5}	1.11×10^{-4}	0.00
Nitrate	2.79	4.99×10^{-2}	0.00	2.79	3.92×10^{-1}	0.00	2.79	8.75×10^{-1}	0.00
Total	**N/A**	**5.16×10^{-2}**	**0.00**	**N/A**	**3.94×10^{-1}**	**2.94×10^{-12}**	**N/A**	**8.78×10^{-1}**	**1.35×10^{-7}**
Year of peak impact	8095	8095	N/A	8095	8095	3846	8095	8095	3846

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–272. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.08×10^{-7}	1.06	3.66×10^{-5}	6.08×10^{-7}	2.74	1.20×10^{-4}	6.08×10^{-7}	5.60	2.63×10^{-4}
Iodine-129	3.61×10^{-10}	1.03×10^{-1}	1.17×10^{-6}	3.61×10^{-10}	1.28×10^{-1}	1.81×10^{-6}	3.61×10^{-10}	1.66×10^{-1}	2.73×10^{-6}
Total	**N/A**	**1.17**	**3.78×10^{-5}**	**N/A**	**2.87**	**1.22×10^{-4}**	**N/A**	**5.77**	**2.66×10^{-4}**
Year of peak impact	8014	8014	8014	8014	8014	8014	8014	8014	8014
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.21×10^{-4}	1.15×10^{-3}	0.00	1.21×10^{-4}	1.19×10^{-3}	1.11×10^{-12}	1.21×10^{-4}	1.80×10^{-3}	5.07×10^{-8}
Fluoride	3.46×10^{-5}	1.65×10^{-5}	0.00	3.46×10^{-5}	4.63×10^{-5}	0.00	3.46×10^{-5}	9.72×10^{-5}	0.00
Nitrate	2.21	3.94×10^{-2}	0.00	2.21	3.10×10^{-1}	0.00	2.21	6.90×10^{-1}	0.00
Total	**N/A**	**4.05×10^{-2}**	**0.00**	**N/A**	**3.11×10^{-1}**	**1.11×10^{-12}**	**N/A**	**6.92×10^{-1}**	**5.07×10^{-8}**
Year of peak impact	7940	7940	N/A	7940	7940	4250	7940	7940	4250

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–273. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.16×10^{-11}	5.22×10^{-5}	2.29×10^{-9}	1.12×10^{-11}	1.17×10^{-4}	5.71×10^{-9}	6.08×10^{-7}	1.83×10^{-2}	9.80×10^{-7}
Iodine-129	9.50×10^{-15}	3.39×10^{-6}	4.78×10^{-11}	1.06×10^{-14}	5.78×10^{-5}	1.24×10^{-9}	3.61×10^{-10}	1.53×10^{-3}	3.75×10^{-8}
Total	**N/A**	**5.55×10^{-5}**	**2.34×10^{-9}**	**N/A**	**1.75×10^{-4}**	**6.96×10^{-9}**	**N/A**	**1.99×10^{-2}**	**1.02×10^{-6}**
Year of peak impact	7806	7806	7806	8104	8104	7806	8014	8014	8014
	Resident Farmer			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
Chemical Constituent	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.21×10^{-4}	5.32×10^{-4}	5.07×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	3.46×10^{-5}	5.06×10^{-6}	0.00
Nitrate	3.38×10^{-5}	5.11×10^{-6}	0.00	3.38×10^{-5}	3.18×10^{-3}	0.00	2.21	1.00×10^{-1}	0.00
Total	**N/A**	**5.11×10^{-6}**	**0.00**	**N/A**	**3.18×10^{-3}**	**0.00**	**N/A**	**1.01×10^{-1}**	**5.07×10^{-8}**
Year of peak impact	8025	8025	N/A	8025	8025	N/A	7940	7940	4250

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–17 and Q–18 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 8000 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

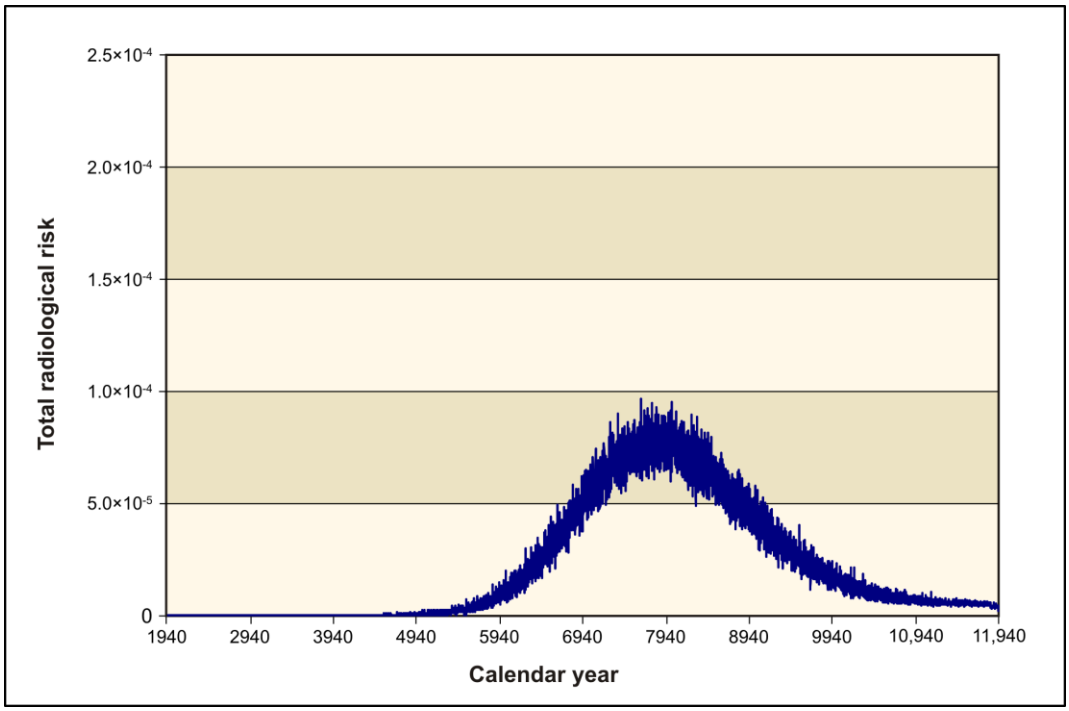

Figure Q–17. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

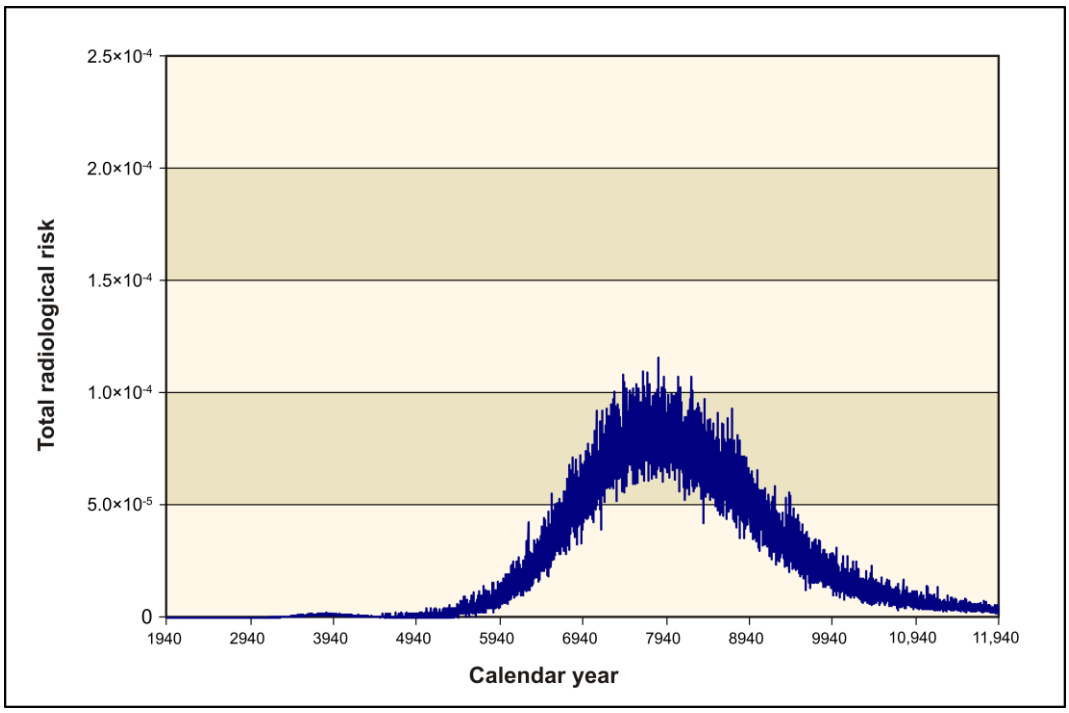

Figure Q–18. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.3 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C

Disposal Group 1, Subgroup 1-C, addresses the waste resulting from Tank Closure Alternative 3B, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Cast stone waste
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 3B.

Potential human health impacts are summarized in Tables Q–274 through Q–278, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. However, the Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier and the Core Zone Boundary for the drinking-water well user, the resident farmer, and the American Indian resident farmer and at the Columbia River nearshore for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.29×10^{-1} person-rem per year for the year of maximum impact.

Table Q–274. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.99×10^{-6}	5.24	1.80×10^{-4}	2.99×10^{-6}	1.35×10^{1}	5.92×10^{-4}	2.99×10^{-6}	2.76×10^{1}	1.30×10^{-3}
Iodine-129	2.47×10^{-10}	7.05×10^{-2}	8.02×10^{-7}	2.47×10^{-10}	8.81×10^{-2}	1.24×10^{-6}	2.47×10^{-10}	1.14×10^{-1}	1.88×10^{-6}
Total	**N/A**	**5.31**	**1.81×10^{-4}**	**N/A**	**1.36×10^{1}**	**5.94×10^{-4}**	**N/A**	**2.77×10^{1}**	**1.30×10^{-3}**
Year of peak impact	10,774	10,774	10,774	10,774	10,774	10,774	10,774	10,774	10,774
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.15×10^{-2}	5.45×10^{-2}	0.00	1.63×10^{-2}	9.69×10^{-2}	0.00	1.63×10^{-2}	1.75×10^{-1}	0.00
Boron and compounds	2.68×10^{-6}	3.83×10^{-7}	0.00	1.95×10^{-6}	2.89×10^{-7}	0.00	1.95×10^{-6}	3.15×10^{-7}	0.00
Chromium	2.95×10^{-1}	2.81	0.00	2.34×10^{-1}	2.31	1.16×10^{-9}	2.34×10^{-1}	3.47	5.32×10^{-5}
Fluoride	1.30×10^{-4}	6.17×10^{-5}	0.00	1.43×10^{-4}	1.91×10^{-4}	0.00	1.43×10^{-4}	4.00×10^{-4}	0.00
Nitrate	2.96×10^{1}	5.28×10^{-1}	0.00	4.26×10^{1}	5.98	0.00	4.26×10^{1}	1.33×10^{1}	0.00
Total	**N/A**	**3.40**	**0.00**	**N/A**	**8.39**	**1.16×10^{-9}**	**N/A**	**1.70×10^{1}**	**5.32×10^{-5}**
Year of peak impact	8608	8608	N/A	8888	8888	8608	8888	8888	8608

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–275. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–276. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.05×10^{-6}	1.84	6.33×10^{-5}	1.05×10^{-6}	4.74	2.08×10^{-4}	1.05×10^{-6}	9.68	4.55×10^{-4}
Iodine-129	3.45×10^{-10}	9.84×10^{-2}	1.12×10^{-6}	3.45×10^{-10}	1.23×10^{-1}	1.73×10^{-6}	3.45×10^{-10}	1.59×10^{-1}	2.62×10^{-6}
Total	**N/A**	**1.94**	**6.44×10^{-5}**	**N/A**	**4.86**	**2.10×10^{-4}**	**N/A**	**9.84**	**4.58×10^{-4}**
Year of peak impact	8334	8334	8334	8334	8334	8334	8334	8334	8334

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	3.24×10^{-3}	1.54×10^{-2}	0.00	3.60×10^{-3}	2.14×10^{-2}	0.00	3.60×10^{-3}	3.88×10^{-2}	0.00
Chromium	1.02×10^{-1}	9.69×10^{-1}	0.00	7.55×10^{-2}	7.46×10^{-1}	3.99×10^{-10}	7.55×10^{-2}	1.12	1.83×10^{-5}
Fluoride	5.69×10^{-5}	2.71×10^{-5}	0.00	4.95×10^{-5}	6.62×10^{-5}	0.00	4.95×10^{-5}	1.39×10^{-4}	0.00
Nitrate	7.02	1.25×10^{-1}	0.00	1.61×10^{1}	2.26	0.00	1.61×10^{1}	5.04	0.00
Total	**N/A**	**1.11**	**0.00**	**N/A**	**3.03**	**3.99×10^{-10}**	**N/A**	**6.20**	**1.83×10^{-5}**
Year of peak impact	8680	8680	N/A	8973	8973	8680	8973	8973	8680

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–277. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	9.04×10^{-7}	1.58	5.44×10^{-5}	9.04×10^{-7}	4.08	1.79×10^{-4}	9.04×10^{-7}	8.33	3.91×10^{-4}
Iodine-129	4.92×10^{-11}	1.40×10^{-2}	1.60×10^{-7}	4.92×10^{-11}	1.75×10^{-2}	2.47×10^{-7}	4.92×10^{-11}	2.26×10^{-2}	3.73×10^{-7}
Total	**N/A**	**1.60**	**5.46×10^{-5}**	**N/A**	**4.09**	**1.79×10^{-4}**	**N/A**	**8.35**	**3.92×10^{-4}**
Year of peak impact	10,429	10,429	10,429	10,429	10,429	10,429	10,429	10,429	10,429
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.34×10^{-3}	1.12×10^{-2}	0.00	2.16×10^{-3}	1.29×10^{-2}	0.00	2.16×10^{-3}	2.33×10^{-2}	0.00
Chromium	7.85×10^{-2}	7.47×10^{-1}	0.00	6.40×10^{-2}	6.32×10^{-1}	3.08×10^{-10}	6.40×10^{-2}	9.51×10^{-1}	1.41×10^{-5}
Fluoride	3.96×10^{-5}	1.88×10^{-5}	0.00	1.98×10^{-5}	2.65×10^{-5}	0.00	1.98×10^{-5}	5.56×10^{-5}	0.00
Nitrate	5.45	9.74×10^{-2}	0.00	1.09×10^{1}	1.52	0.00	1.09×10^{1}	3.40	0.00
Total	**N/A**	**8.56×10^{-1}**	**0.00**	**N/A**	**2.17**	**3.08×10^{-10}**	**N/A**	**4.37**	**1.41×10^{-5}**
Year of peak impact	8594	8594	N/A	8469	8469	8594	8469	8469	8594

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–278. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.41×10^{-11}	6.36×10^{-5}	2.79×10^{-9}	1.38×10^{-11}	1.43×10^{-4}	6.81×10^{-9}	9.04×10^{-7}	2.72×10^{-2}	1.45×10^{-6}
Iodine-129	5.83×10^{-15}	2.08×10^{-6}	2.93×10^{-11}	8.32×10^{-15}	4.54×10^{-5}	1.09×10^{-9}	4.92×10^{-11}	2.64×10^{-4}	6.47×10^{-9}
Total	**N/A**	**6.57×10^{-5}**	**2.82×10^{-9}**	**N/A**	**1.89×10^{-4}**	**7.90×10^{-9}**	**N/A**	**2.75×10^{-2}**	**1.46×10^{-6}**
Year of peak impact	9164	9164	9164	8574	8574	8574	10,429	10,429	10,429
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	5.92×10^{-8}	3.52×10^{-7}	0.00	5.89×10^{-8}	6.34×10^{-7}	0.00	2.16×10^{-3}	1.30×10^{-2}	0.00
Chromium	1.06×10^{-6}	1.05×10^{-5}	4.59×10^{-15}	1.04×10^{-6}	1.68×10^{-5}	2.11×10^{-10}	6.40×10^{-2}	2.81×10^{-1}	1.41×10^{-5}
Nitrate	1.89×10^{-4}	2.87×10^{-5}	0.00	1.91×10^{-4}	1.80×10^{-2}	0.00	1.09×10^{1}	5.23×10^{-1}	0.00
Total	**N/A**	**3.95×10^{-5}**	**4.59×10^{-15}**	**N/A**	**1.80×10^{-2}**	**2.11×10^{-10}**	**N/A**	**8.18×10^{-1}**	**1.41×10^{-5}**
Year of peak impact	8702	8702	9094	8672	8672	9094	8469	8469	8594

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–19 and Q–20 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 8300 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

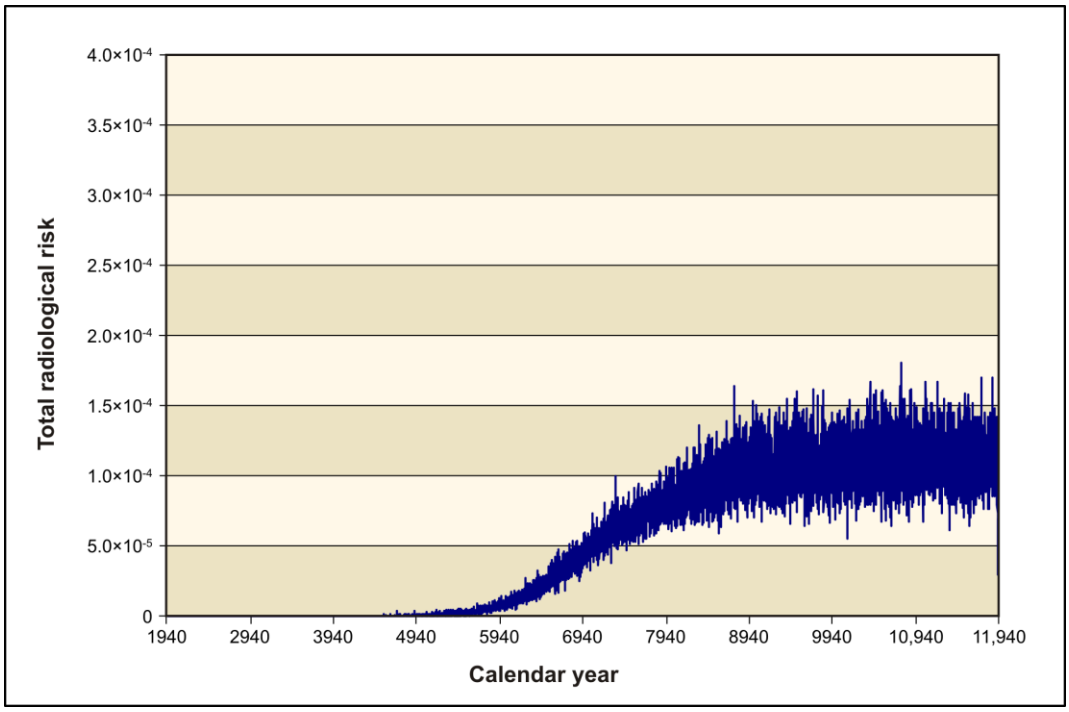

Figure Q–19. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

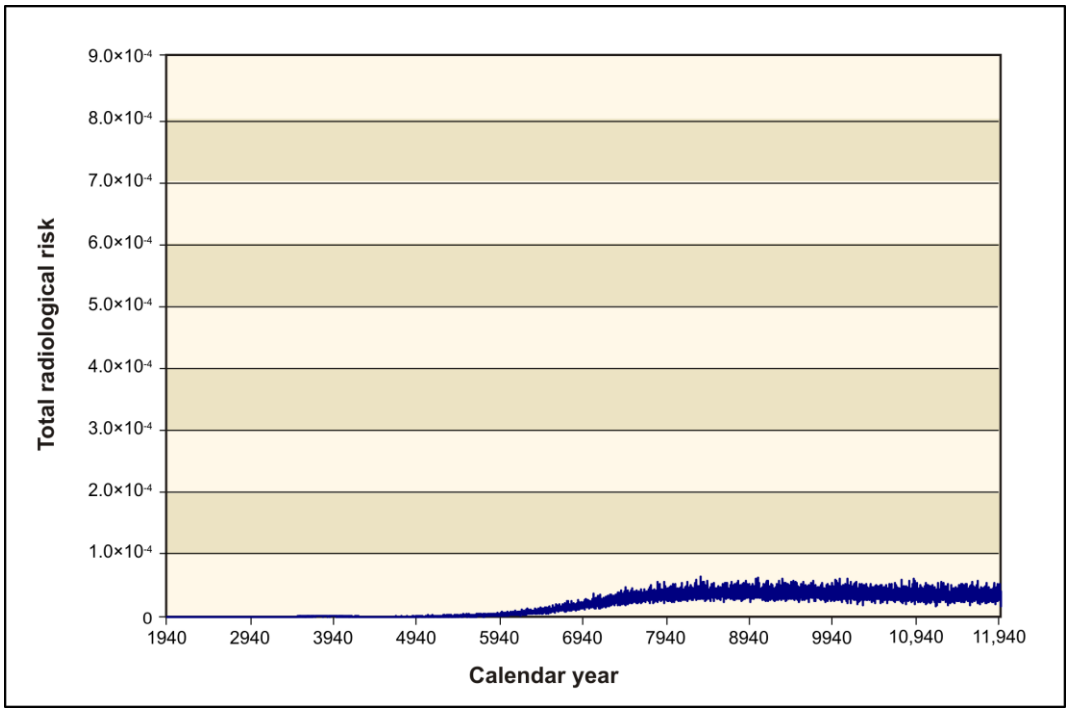

Figure Q–20. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.4 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D

Disposal Group 1, Subgroup 1-D, addresses the waste resulting from Tank Closure Alternative 3C, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Steam reforming waste
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 3C.

Potential human health impacts are summarized in Tables Q–279 through Q–283, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the resident farmer and the American Indian resident farmer and at the Core Zone Boundary for the American Indian resident farmer. Population dose is estimated as 2.11×10^{-1} person-rem per year for the year of maximum impact.

Table Q–279. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.35×10^{-6}	2.37	8.15×10^{-5}	1.35×10^{-6}	6.10	2.76×10^{-4}	1.39×10^{-6}	1.28×10^{1}	6.04×10^{-4}
Iodine-129	1.79×10^{-9}	5.10×10^{-1}	5.79×10^{-6}	1.79×10^{-9}	6.37×10^{-1}	5.02×10^{-6}	1.00×10^{-9}	4.60×10^{-1}	7.59×10^{-6}
Total	**N/A**	**2.88**	**8.72×10^{-5}**	**N/A**	**6.74**	**2.81×10^{-4}**	**N/A**	**1.33×10^{1}**	**6.11×10^{-4}**
Year of peak impact	7826	7826	7826	7826	7826	8054	8054	8054	8054
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	1.82×10^{-6}	2.60×10^{-7}	0.00	1.82×10^{-6}	2.70×10^{-7}	0.00	1.82×10^{-6}	2.94×10^{-7}	0.00
Chromium	1.05×10^{-2}	1.00×10^{-1}	0.00	1.05×10^{-2}	1.04×10^{-1}	7.57×10^{-11}	1.05×10^{-2}	1.56×10^{-1}	3.47×10^{-6}
Fluoride	2.07×10^{-4}	9.87×10^{-5}	0.00	2.07×10^{-4}	2.77×10^{-4}	0.00	2.07×10^{-4}	5.82×10^{-4}	0.00
Nitrate	1.15×10^{1}	2.04×10^{-1}	0.00	1.15×10^{1}	1.61	0.00	1.15×10^{1}	3.58	0.00
Total	**N/A**	**3.05×10^{-1}**	**0.00**	**N/A**	**1.71**	**7.57×10^{-11}**	**N/A**	**3.74**	**3.47×10^{-6}**
Year of peak impact	8207	8207	N/A	8207	8207	11,378	8207	8207	11,378

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–280. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–281. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.10×10^{-7}	1.07	3.67×10^{-5}	6.10×10^{-7}	2.75	1.21×10^{-4}	6.10×10^{-7}	5.62	2.64×10^{-4}
Iodine-129	4.13×10^{-10}	1.18×10^{-1}	1.34×10^{-6}	4.13×10^{-10}	1.47×10^{-1}	2.07×10^{-6}	4.13×10^{-10}	1.90×10^{-1}	3.13×10^{-6}
Total	**N/A**	**1.18**	**3.80×10^{-5}**	**N/A**	**2.90**	**1.23×10^{-4}**	**N/A**	**5.81**	**2.67×10^{-4}**
Year of peak impact	8237	8237	8237	8237	8237	8237	8237	8237	8237
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	7.93×10^{-7}	1.13×10^{-7}	0.00	7.27×10^{-7}	1.08×10^{-7}	0.00	7.27×10^{-7}	1.18×10^{-7}	0.00
Chromium	4.28×10^{-3}	4.08×10^{-2}	0.00	2.44×10^{-3}	2.41×10^{-2}	2.38×10^{-11}	2.44×10^{-3}	3.63×10^{-2}	1.09×10^{-6}
Fluoride	5.94×10^{-5}	2.83×10^{-5}	0.00	4.95×10^{-5}	6.62×10^{-5}	0.00	4.95×10^{-5}	1.39×10^{-4}	0.00
Nitrate	2.90	5.18×10^{-2}	0.00	3.15	4.42×10^{-1}	0.00	3.15	9.86×10^{-1}	0.00
Total	**N/A**	**9.26×10^{-2}**	**0.00**	**N/A**	**4.66×10^{-1}**	**2.38×10^{-11}**	**N/A**	**1.02**	**1.09×10^{-6}**
Year of peak impact	8317	8317	N/A	8121	8121	10,691	8121	8121	10,691

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–282. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.74×10^{-7}	8.30×10^{-1}	2.93×10^{-5}	4.86×10^{-7}	2.19	9.63×10^{-5}	4.86×10^{-7}	4.48	2.11×10^{-4}
Iodine-129	4.76×10^{-10}	1.36×10^{-1}	1.08×10^{-6}	3.32×10^{-10}	1.18×10^{-1}	1.66×10^{-6}	3.32×10^{-10}	1.53×10^{-1}	2.52×10^{-6}
Total	**N/A**	$\mathbf{9.66\times10^{-1}}$	$\mathbf{3.04\times10^{-5}}$	**N/A**	**2.31**	$\mathbf{9.80\times10^{-5}}$	**N/A**	**4.63**	$\mathbf{2.13\times10^{-4}}$
Year of peak impact	8174	8174	8130	8130	8130	8130	8130	8130	8130
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.59×10^{-3}	3.42×10^{-2}	0.00	1.97×10^{-3}	1.95×10^{-2}	1.83×10^{-11}	1.97×10^{-3}	2.93×10^{-2}	8.39×10^{-7}
Fluoride	5.44×10^{-5}	2.59×10^{-5}	0.00	3.46×10^{-5}	4.63×10^{-5}	0.00	3.46×10^{-5}	9.72×10^{-5}	0.00
Nitrate	1.66	2.96×10^{-2}	0.00	2.40	3.38×10^{-1}	0.00	2.40	7.53×10^{-1}	0.00
Total	**N/A**	$\mathbf{6.38\times10^{-2}}$	**0.00**	**N/A**	$\mathbf{3.57\times10^{-1}}$	$\mathbf{1.83\times10^{-11}}$	**N/A**	$\mathbf{7.82\times10^{-1}}$	$\mathbf{8.39\times10^{-7}}$
Year of peak impact	8284	8284	N/A	7899	7899	11,049	7899	7899	11,049

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–283. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	8.54×10^{-12}	3.85×10^{-5}	1.69×10^{-9}	8.40×10^{-12}	8.73×10^{-5}	4.15×10^{-9}	4.74×10^{-7}	1.43×10^{-2}	7.83×10^{-7}
Iodine-129	1.04×10^{-14}	3.71×10^{-6}	5.22×10^{-11}	1.13×10^{-14}	6.15×10^{-5}	1.48×10^{-9}	4.76×10^{-10}	1.87×10^{-3}	3.61×10^{-8}
Total	**N/A**	**4.22×10^{-5}**	**1.74×10^{-9}**	**N/A**	**1.49×10^{-4}**	**5.63×10^{-9}**	**N/A**	**1.62×10^{-2}**	**8.19×10^{-7}**
Year of peak impact	8489	8489	8489	8279	8279	8279	8174	8174	8130
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.10×10^{-8}	4.05×10^{-7}	2.90×10^{-16}	3.55×10^{-8}	5.75×10^{-7}	1.33×10^{-11}	1.97×10^{-3}	8.68×10^{-3}	8.38×10^{-7}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	3.46×10^{-5}	5.06×10^{-6}	0.00
Nitrate	3.88×10^{-5}	5.87×10^{-6}	0.00	3.90×10^{-5}	3.68×10^{-3}	0.00	2.40	1.11×10^{-1}	0.00
Total	**N/A**	**6.27×10^{-6}**	**2.90×10^{-16}**	**N/A**	**3.68×10^{-3}**	**1.33×10^{-11}**	**N/A**	**1.20×10^{-1}**	**8.38×10^{-7}**
Year of peak impact	8293	8293	11,332	8166	8166	11,332	7899	7899	11,049

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–21 and Q–22 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 8200 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

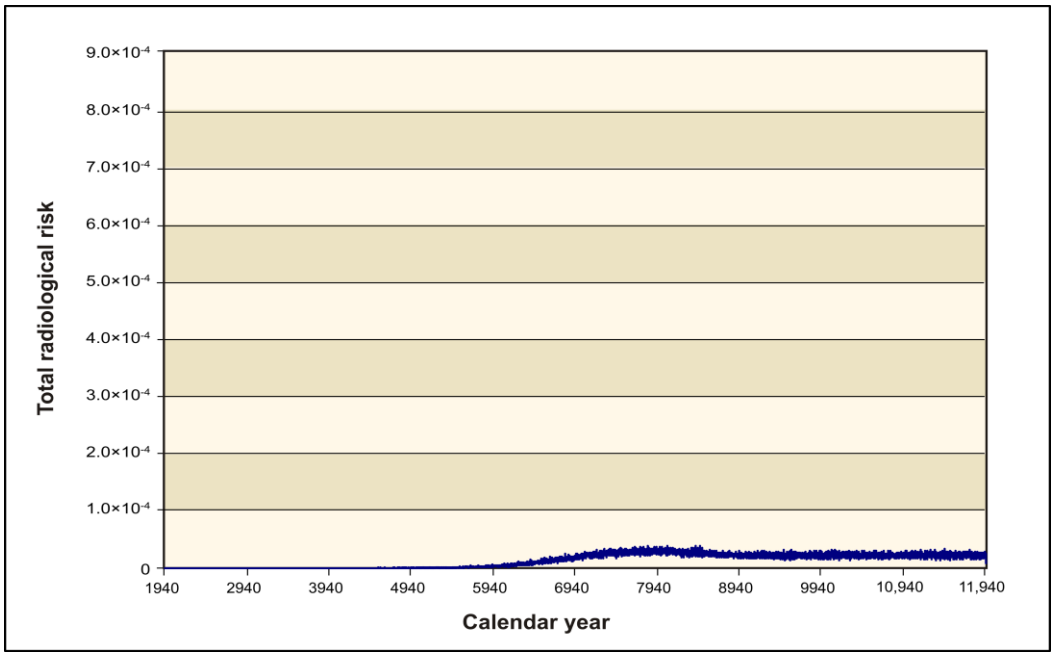

Figure Q–21. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

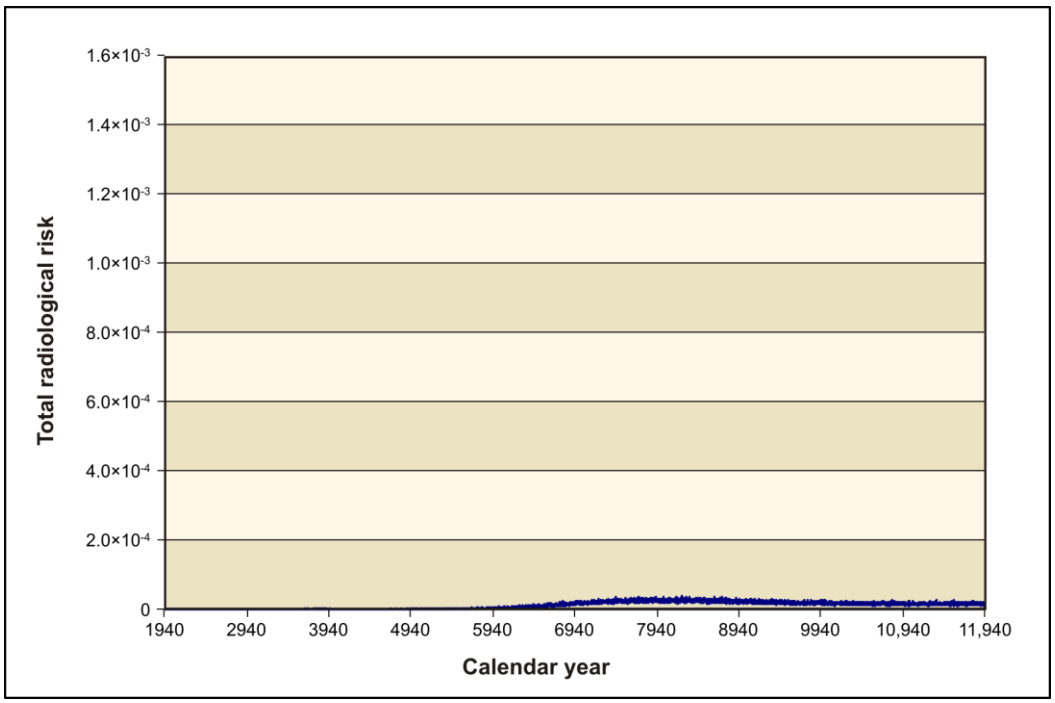

Figure Q–22. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.5 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E

Disposal Group 1, Subgroup 1-E, addresses the waste resulting from Tank Closure Alternative 4, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Bulk vitrification glass
- Cast stone waste
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 4.

Potential human health impacts at the IDF-East barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–284 through Q–288, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the drinking-water well user, the resident farmer, and the American Indian resident farmer, and would be exceeded at the Core Zone Boundary and Columbia River nearshore for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.99×10^{-1} person-rem per year for the year of maximum impact.

Table Q–284. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.86×10^{-6}	6.76	2.32×10^{-4}	3.86×10^{-6}	1.74×10^{1}	7.64×10^{-4}	3.86×10^{-6}	3.56×10^{1}	1.67×10^{-3}
Iodine-129	4.59×10^{-10}	1.31×10^{-1}	1.49×10^{-6}	4.59×10^{-10}	1.63×10^{-1}	2.30×10^{-6}	4.59×10^{-10}	2.11×10^{-1}	3.48×10^{-6}
Total	**N/A**	**6.89**	**2.34×10^{-4}**	**N/A**	**1.76×10^{1}**	**7.67×10^{-4}**	**N/A**	**3.58×10^{1}**	**1.67×10^{-3}**
Year of peak impact	10,921	10,921	10,921	10,921	10,921	10,921	10,921	10,921	10,921
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	9.03×10^{-3}	4.30×10^{-2}	0.00	7.76×10^{-3}	4.62×10^{-2}	0.00	7.76×10^{-3}	8.35×10^{-2}	0.00
Boron and compounds	1.86×10^{-6}	2.66×10^{-7}	0.00	2.34×10^{-6}	3.47×10^{-7}	0.00	2.34×10^{-6}	3.78×10^{-7}	0.00
Chromium	1.75×10^{-1}	1.67	0.00	1.42×10^{-1}	1.40	6.88×10^{-10}	1.42×10^{-1}	2.10	3.16×10^{-5}
Fluoride	1.04×10^{-4}	4.93×10^{-5}	0.00	1.52×10^{-4}	2.04×10^{-4}	0.00	1.52×10^{-4}	4.27×10^{-4}	0.00
Nitrate	2.05×10^{1}	3.67×10^{-1}	0.00	2.63×10^{1}	3.70	0.00	2.63×10^{1}	8.24	0.00
Total	**N/A**	**2.08**	**0.00**	**N/A**	**5.14**	**6.88×10^{-10}**	**N/A**	**1.04×10^{1}**	**3.16×10^{-5}**
Year of peak impact	9008	9008	N/A	8599	8599	9008	8599	8599	9008

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–285. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.07×10^{-7}	1.87×10^{-1}	6.45×10^{-6}	1.07×10^{-7}	4.83×10^{-1}	2.12×10^{-5}	1.07×10^{-7}	9.86×10^{-1}	4.64×10^{-5}
Iodine-129	1.74×10^{-10}	4.95×10^{-2}	5.62×10^{-7}	1.74×10^{-10}	6.18×10^{-2}	8.70×10^{-7}	1.74×10^{-10}	7.99×10^{-2}	1.32×10^{-6}
Total	**N/A**	**2.37×10^{-1}**	**7.01×10^{-6}**	**N/A**	**5.45×10^{-1}**	**2.21×10^{-5}**	**N/A**	**1.07**	**4.77×10^{-5}**
Year of peak impact	3785	3785	3785	3785	3785	3785	3785	3785	3785
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	6.84×10^{-3}	6.51×10^{-2}	0.00	6.47×10^{-3}	6.39×10^{-2}	2.69×10^{-11}	6.47×10^{-3}	9.61×10^{-2}	1.23×10^{-6}
Nitrate	2.25×10^{-1}	4.01×10^{-3}	0.00	2.63×10^{-1}	3.69×10^{-2}	0.00	2.63×10^{-1}	8.23×10^{-2}	0.00
Total	**N/A**	**6.92×10^{-2}**	**0.00**	**N/A**	**1.01×10^{-1}**	**2.69×10^{-11}**	**N/A**	**1.78×10^{-1}**	**1.23×10^{-6}**
Year of peak impact	3666	3666	N/A	3682	3682	3666	3682	3682	3666

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–286. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.39×10^{-6}	2.44	8.39×10^{-5}	1.39×10^{-6}	6.28	2.76×10^{-4}	1.39×10^{-6}	1.28×10^{1}	6.03×10^{-4}
Iodine-129	1.83×10^{-10}	5.21×10^{-2}	5.92×10^{-7}	1.83×10^{-10}	6.51×10^{-2}	9.16×10^{-7}	1.83×10^{-10}	8.41×10^{-2}	1.39×10^{-6}
Total	**N/A**	**2.49**	**8.45×10^{-5}**	**N/A**	**6.35**	**2.77×10^{-4}**	**N/A**	**1.29×10^{1}**	**6.05×10^{-4}**
Year of peak impact	9662	9662	9662	9662	9662	9662	9662	9662	9662
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	1.60×10^{-3}	7.61×10^{-3}	0.00	2.30×10^{-3}	1.37×10^{-2}	0.00	2.00×10^{-3}	2.15×10^{-2}	0.00
Chromium	5.25×10^{-2}	5.00×10^{-1}	0.00	4.46×10^{-2}	4.40×10^{-1}	2.06×10^{-10}	3.35×10^{-2}	4.97×10^{-1}	9.46×10^{-6}
Fluoride	5.44×10^{-5}	2.59×10^{-5}	0.00	6.18×10^{-5}	8.27×10^{-5}	0.00	5.94×10^{-5}	1.67×10^{-4}	0.00
Nitrate	6.66	1.19×10^{-1}	0.00	8.37	1.18	0.00	8.96	2.80	0.00
Total	**N/A**	**6.26×10^{-1}**	**0.00**	**N/A**	**1.63**	**2.06×10^{-10}**	**N/A**	**3.32**	**9.46×10^{-6}**
Year of peak impact	8873	8873	N/A	8787	8787	8873	8189	8189	8873

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–287. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.17×10^{-6}	2.05	7.04×10^{-5}	1.17×10^{-6}	5.27	2.31×10^{-4}	1.17×10^{-6}	1.08×10^{1}	5.06×10^{-4}
Iodine-129	9.94×10^{-11}	2.83×10^{-2}	3.22×10^{-7}	9.94×10^{-11}	3.54×10^{-2}	4.98×10^{-7}	9.94×10^{-11}	4.57×10^{-2}	7.53×10^{-7}
Total	**N/A**	**2.07**	**7.07×10^{-5}**	**N/A**	**5.31**	**2.32×10^{-4}**	**N/A**	**1.08×10^{1}**	**5.07×10^{-4}**
Year of peak impact	10,639	10,639	10,639	10,639	10,639	10,639	10,639	10,639	10,639
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.30×10^{-3}	6.18×10^{-3}	0.00	1.60×10^{-3}	9.51×10^{-3}	0.00	1.60×10^{-3}	1.72×10^{-2}	0.00
Chromium	3.98×10^{-2}	3.79×10^{-1}	0.00	1.91×10^{-2}	1.89×10^{-1}	1.56×10^{-10}	1.91×10^{-2}	2.84×10^{-1}	7.17×10^{-6}
Fluoride	2.97×10^{-5}	1.41×10^{-5}	0.00	1.98×10^{-5}	2.65×10^{-5}	0.00	1.98×10^{-5}	5.56×10^{-5}	0.00
Nitrate	4.62	8.25×10^{-2}	0.00	6.82	9.57×10^{-1}	0.00	6.82	2.13	0.00
Total	**N/A**	**4.68×10^{-1}**	**0.00**	**N/A**	**1.16**	**1.56×10^{-10}**	**N/A**	**2.44**	**7.17×10^{-6}**
Year of peak impact	8827	8827	N/A	9059	9059	8827	9059	9059	8827

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–288. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.70×10^{-11}	7.65×10^{-5}	3.40×10^{-9}	1.70×10^{-11}	1.76×10^{-4}	8.38×10^{-9}	1.17×10^{-6}	3.51×10^{-2}	1.88×10^{-6}
Iodine-129	9.44×10^{-15}	3.37×10^{-6}	3.07×10^{-11}	9.44×10^{-15}	5.15×10^{-5}	1.24×10^{-9}	9.94×10^{-11}	4.18×10^{-4}	1.03×10^{-8}
Total	**N/A**	**7.98×10^{-5}**	**3.43×10^{-9}**	**N/A**	**2.28×10^{-4}**	**9.61×10^{-9}**	**N/A**	**3.55×10^{-2}**	**1.89×10^{-6}**
Year of peak impact	8389	8389	9205	8389	8389	8389	10,639	10,639	10,639
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	3.12×10^{-8}	1.86×10^{-7}	0.00	3.12×10^{-8}	3.36×10^{-7}	0.00	1.30×10^{-3}	7.79×10^{-3}	0.00
Chromium	5.50×10^{-7}	5.44×10^{-6}	2.59×10^{-15}	5.50×10^{-7}	8.91×10^{-6}	1.19×10^{-10}	3.98×10^{-2}	1.75×10^{-1}	7.17×10^{-6}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.97×10^{-5}	4.33×10^{-6}	0.00
Nitrate	1.16×10^{-4}	1.76×10^{-5}	0.00	1.16×10^{-4}	1.09×10^{-2}	0.00	4.62	2.46×10^{-1}	0.00
Total	**N/A**	**2.32×10^{-5}**	**2.59×10^{-15}**	**N/A**	**1.09×10^{-2}**	**1.19×10^{-10}**	**N/A**	**4.29×10^{-1}**	**7.17×10^{-6}**
Year of peak impact	8855	8855	8960	8855	8855	8960	8827	8827	8827

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–23 and Q–24 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 9700 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

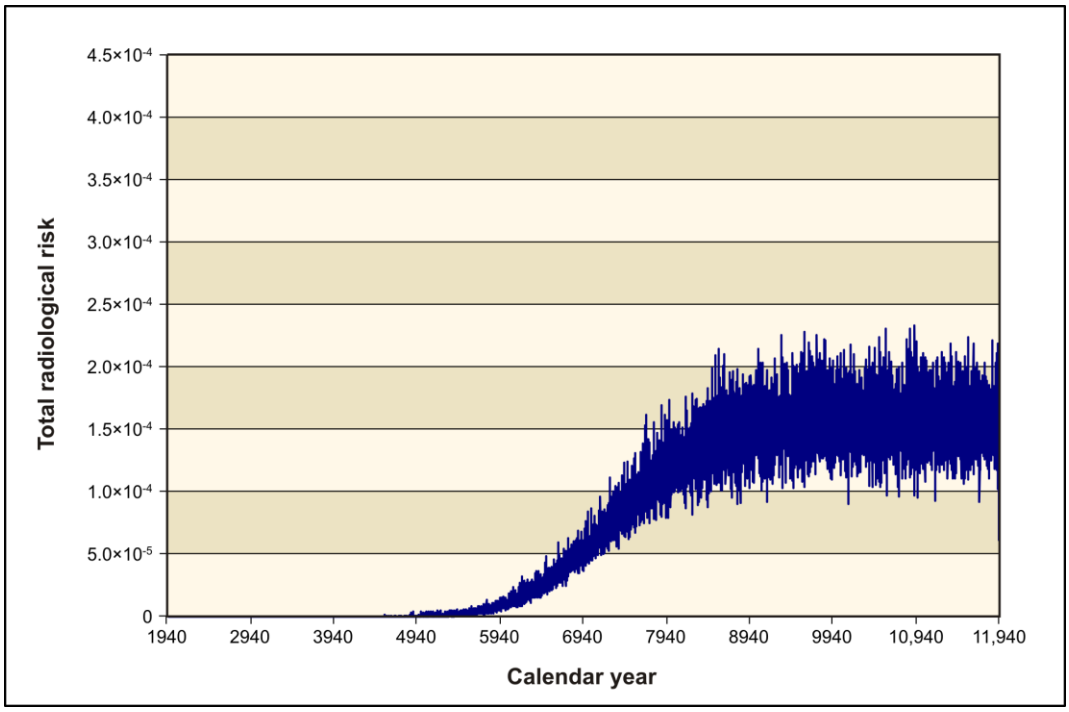

Figure Q–23. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

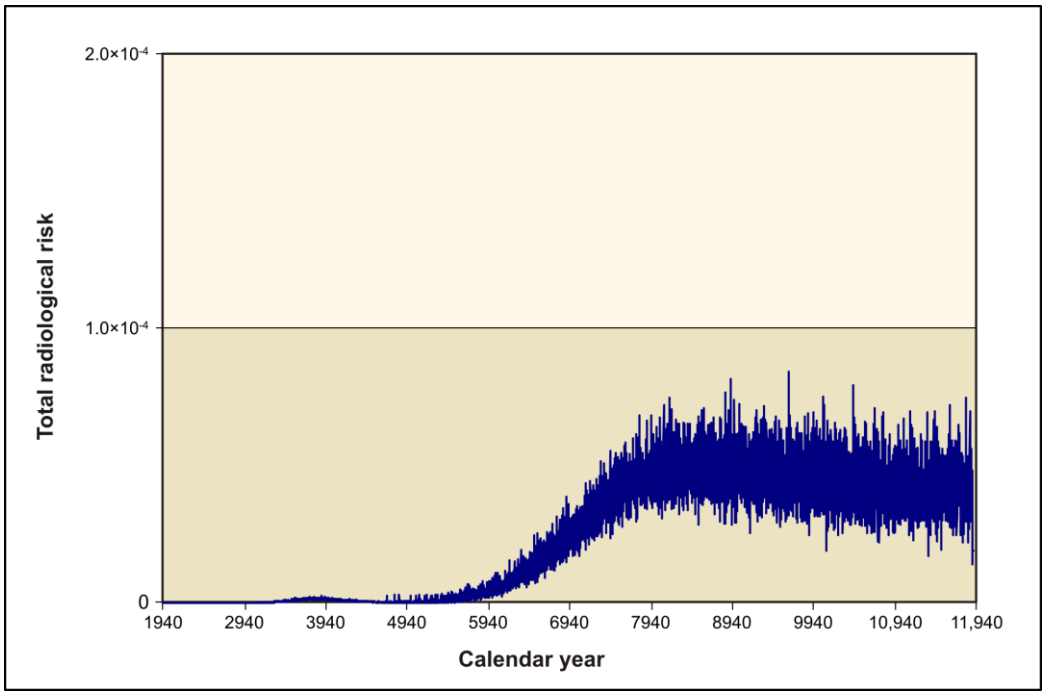

Figure Q–24. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.6 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F

Disposal Group 1, Subgroup 1-F, addresses the waste resulting from Tank Closure Alternative 5, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Bulk vitrification glass
- Cast stone waste
- Sulfate grout
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

The RPPDF would not be constructed or operated under Tank Closure Alternative 5 because tank closure cleanup activities would not be conducted.

Potential human health impacts at the IDF-East barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–289 through Q–292, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the drinking-water well user, the resident farmer, and the American Indian

resident farmer; at the Core Zone Boundary for the resident farmer and American Indian resident farmer; and at the Columbia River nearshore for the American Indian resident farmer. Population dose is estimated as 2.59×10^{-1} person-rem per year for the year of maximum impact.

Table Q–289. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.43×10^{-6}	2.51	8.63×10^{-5}	1.43×10^{-6}	6.47	2.87×10^{-4}	1.43×10^{-6}	1.32×10^{1}	6.27×10^{-4}
Iodine-129	1.74×10^{-9}	4.96×10^{-1}	5.63×10^{-6}	1.74×10^{-9}	6.19×10^{-1}	6.70×10^{-6}	1.74×10^{-9}	8.00×10^{-1}	1.01×10^{-5}
Total	**N/A**	**3.01**	**9.20×10^{-5}**	**N/A**	**7.09**	**2.93×10^{-4}**	**N/A**	**1.40×10^{1}**	**6.37×10^{-4}**
Year of peak impact	7826	7826	7826	7826	7826	7985	7826	7826	7985
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.15×10^{-3}	1.02×10^{-2}	0.00	2.34×10^{-3}	1.39×10^{-2}	0.00	2.34×10^{-3}	2.51×10^{-2}	0.00
Boron and compounds	1.49×10^{-6}	2.13×10^{-7}	0.00	2.21×10^{-6}	3.28×10^{-7}	0.00	2.21×10^{-6}	3.57×10^{-7}	0.00
Chromium	2.95×10^{-1}	2.81	0.00	2.50×10^{-1}	2.47	1.16×10^{-9}	2.50×10^{-1}	3.72	5.31×10^{-5}
Fluoride	1.36×10^{-4}	6.48×10^{-5}	0.00	1.43×10^{-4}	1.91×10^{-4}	0.00	1.43×10^{-4}	4.00×10^{-4}	0.00
Nitrate	1.16×10^{1}	2.07×10^{-1}	0.00	1.78×10^{1}	2.49	0.00	1.78×10^{1}	5.56	0.00
Total	**N/A**	**3.03**	**0.00**	**N/A**	**4.98**	**1.16×10^{-9}**	**N/A**	**9.31**	**5.31×10^{-5}**
Year of peak impact	8882	8882	N/A	8636	8636	8882	8636	8636	8882

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–290. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.96×10^{-7}	1.22	4.19×10^{-5}	6.96×10^{-7}	3.14	1.38×10^{-4}	6.96×10^{-7}	6.41	3.01×10^{-4}
Iodine-129	4.41×10^{-10}	1.26×10^{-1}	1.43×10^{-6}	4.41×10^{-10}	1.57×10^{-1}	2.21×10^{-6}	4.41×10^{-10}	2.03×10^{-1}	3.34×10^{-6}
Total	**N/A**	**1.34**	**4.33×10^{-5}**	**N/A**	**3.30**	**1.40×10^{-4}**	**N/A**	**6.61**	**3.05×10^{-4}**
Year of peak impact	8302	8302	8302	8302	8302	8302	8302	8302	8302
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	9.92×10^{-4}	4.72×10^{-3}	0.00	3.97×10^{-4}	2.36×10^{-3}	0.00	3.97×10^{-4}	4.27×10^{-3}	0.00
Chromium	7.78×10^{-2}	7.41×10^{-1}	0.00	5.78×10^{-2}	5.71×10^{-1}	3.06×10^{-10}	5.78×10^{-2}	8.59×10^{-1}	1.40×10^{-5}
Fluoride	6.18×10^{-5}	2.94×10^{-5}	0.00	5.44×10^{-5}	7.28×10^{-5}	0.00	5.44×10^{-5}	1.53×10^{-4}	0.00
Nitrate	4.19	7.48×10^{-2}	0.00	6.25	8.77×10^{-1}	0.00	6.25	1.96	0.00
Total	**N/A**	**8.21×10^{-1}**	**0.00**	**N/A**	**1.45**	**3.06×10^{-10}**	**N/A**	**2.82**	**1.40×10^{-5}**
Year of peak impact	8588	8588	N/A	7810	7810	9057	7810	7810	9057

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–291. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	5.59×10^{-7}	9.77×10^{-1}	3.36×10^{-5}	5.59×10^{-7}	2.52	1.11×10^{-4}	5.59×10^{-7}	5.14	2.42×10^{-4}
Iodine-129	3.30×10^{-10}	9.40×10^{-2}	1.07×10^{-6}	3.30×10^{-10}	1.17×10^{-1}	1.65×10^{-6}	3.30×10^{-10}	1.52×10^{-1}	2.50×10^{-6}
Total	**N/A**	**1.07**	**3.47×10^{-5}**	**N/A**	**2.64**	**1.12×10^{-4}**	**N/A**	**5.30**	**2.44×10^{-4}**
Year of peak impact	8014	8014	8014	8014	8014	8014	8014	8014	8014
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.62×10^{-4}	2.68×10^{-3}	0.00	5.62×10^{-4}	3.35×10^{-3}	0.00	3.97×10^{-4}	4.27×10^{-3}	0.00
Chromium	5.87×10^{-2}	5.59×10^{-1}	0.00	5.87×10^{-2}	5.80×10^{-1}	2.34×10^{-10}	4.39×10^{-2}	6.53×10^{-1}	1.07×10^{-5}
Fluoride	2.23×10^{-5}	1.06×10^{-5}	0.00	2.23×10^{-5}	2.98×10^{-5}	0.00	3.96×10^{-5}	1.11×10^{-4}	0.00
Nitrate	2.80	4.99×10^{-2}	0.00	2.80	3.93×10^{-1}	0.00	3.66	1.15	0.00
Total	**N/A**	**6.12×10^{-1}**	**0.00**	**N/A**	**9.76×10^{-1}**	**2.34×10^{-10}**	**N/A**	**1.80**	**1.07×10^{-5}**
Year of peak impact	8535	8535	N/A	8535	8535	8241	8522	8522	8241

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–292. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.07×10^{-11}	4.81×10^{-5}	2.11×10^{-9}	1.07×10^{-11}	1.11×10^{-4}	5.27×10^{-9}	5.59×10^{-7}	1.68×10^{-2}	9.00×10^{-7}
Iodine-129	1.02×10^{-14}	3.65×10^{-6}	5.15×10^{-11}	1.02×10^{-14}	5.58×10^{-5}	1.34×10^{-9}	3.30×10^{-10}	1.44×10^{-3}	3.53×10^{-8}
Total	**N/A**	**5.18×10^{-5}**	**2.16×10^{-9}**	**N/A**	**1.67×10^{-4}**	**6.61×10^{-9}**	**N/A**	**1.83×10^{-2}**	**9.35×10^{-7}**
Year of peak impact	7935	7935	7935	7935	7935	7935	8014	8014	8014
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.06×10^{-8}	6.29×10^{-8}	0.00	1.04×10^{-8}	1.12×10^{-7}	0.00	5.62×10^{-4}	3.37×10^{-3}	0.00
Chromium	9.74×10^{-7}	9.62×10^{-6}	4.03×10^{-15}	8.18×10^{-7}	1.32×10^{-5}	1.85×10^{-10}	5.87×10^{-2}	2.58×10^{-1}	1.07×10^{-5}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.23×10^{-5}	3.25×10^{-6}	0.00
Nitrate	7.30×10^{-5}	1.11×10^{-5}	0.00	7.90×10^{-5}	7.44×10^{-3}	0.00	2.80	1.55×10^{-1}	0.00
Total	**N/A**	**2.07×10^{-5}**	**4.03×10^{-15}**	**N/A**	**7.46×10^{-3}**	**1.85×10^{-10}**	**N/A**	**4.17×10^{-1}**	**1.07×10^{-5}**
Year of peak impact	8457	8457	8987	8385	8385	8987	8535	8535	8241

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–25 and Q–26 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 8000 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

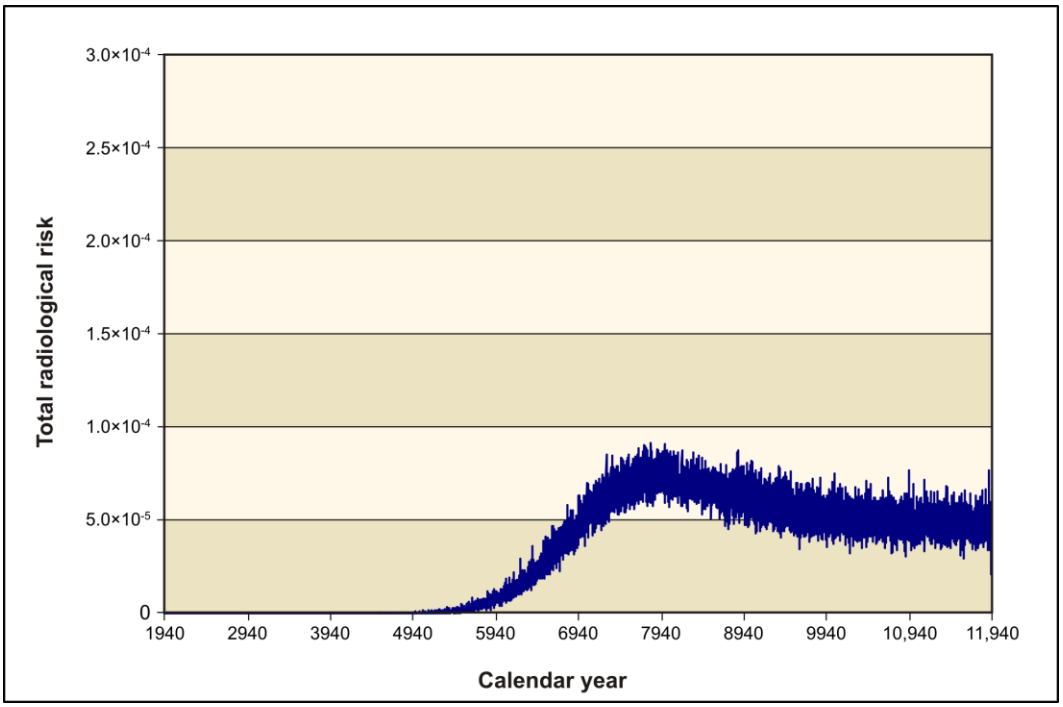

Figure Q–25. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

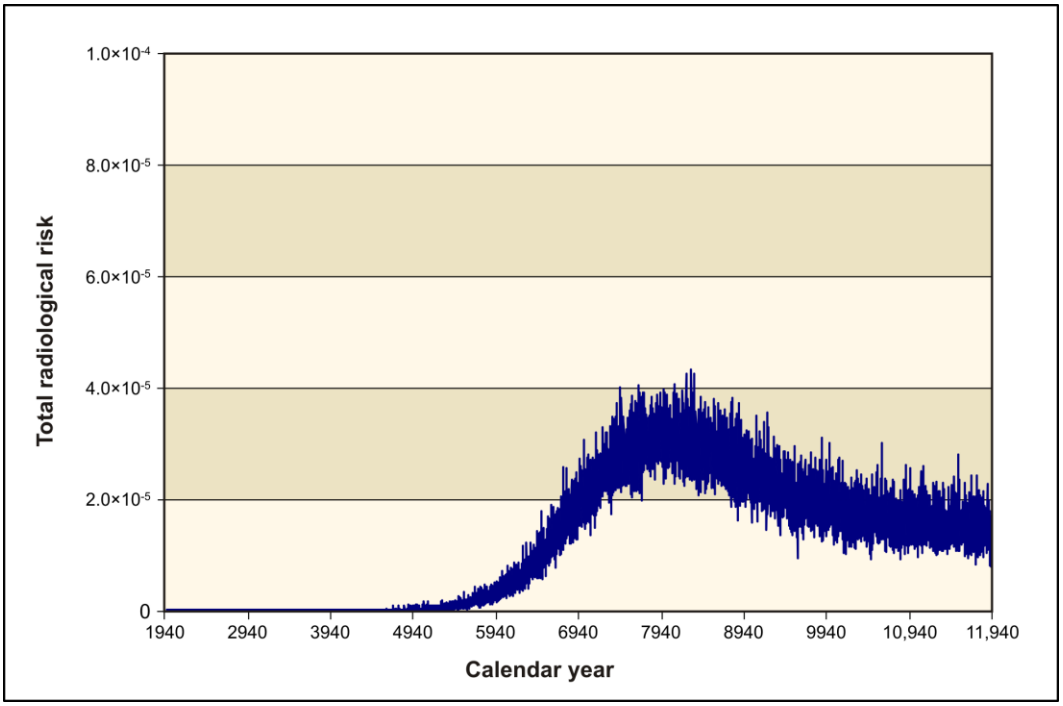

Figure Q–26. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.7 Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G

Disposal Group 1, Subgroup 1-G, addresses the waste resulting from Tank Closure Alternative 6C, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities for Tank Closure Alternative 6C.

Potential human health impacts at the IDF-East barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–293 through Q–297, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 1.67×10^{-1} person-rem per year for the year of maximum impact.

Table Q–293. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.26×10^{-6}	2.20	7.58×10^{-5}	1.26×10^{-6}	5.68	2.49×10^{-4}	1.26×10^{-6}	1.16×10^{1}	5.45×10^{-4}
Iodine-129	1.74×10^{-9}	4.95×10^{-1}	5.63×10^{-6}	1.74×10^{-9}	6.19×10^{-1}	8.71×10^{-6}	1.74×10^{-9}	7.99×10^{-1}	1.32×10^{-5}
Total	**N/A**	**2.70**	**8.14×10^{-5}**	**N/A**	**6.30**	**2.58×10^{-4}**	**N/A**	**1.24×10^{1}**	**5.58×10^{-4}**
Year of peak impact	7826	7826	7826	7826	7826	7826	7826	7826	7826
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.94×10^{-6}	4.20×10^{-7}	0.00	2.94×10^{-6}	4.37×10^{-7}	0.00	2.94×10^{-6}	4.76×10^{-7}	0.00
Chromium	1.31×10^{-3}	1.24×10^{-2}	0.00	1.31×10^{-3}	1.29×10^{-2}	8.05×10^{-12}	1.31×10^{-3}	1.94×10^{-2}	3.69×10^{-7}
Fluoride	2.07×10^{-4}	9.87×10^{-5}	0.00	2.07×10^{-4}	2.77×10^{-4}	0.00	2.07×10^{-4}	5.82×10^{-4}	0.00
Nitrate	1.21×10^{1}	2.16×10^{-1}	0.00	1.21×10^{1}	1.70	0.00	1.21×10^{1}	3.79	0.00
Total	**N/A**	**2.29×10^{-1}**	**0.00**	**N/A**	**1.71**	**8.05×10^{-12}**	**N/A**	**3.81**	**3.69×10^{-7}**
Year of peak impact	7962	7962	N/A	7962	7962	8555	7962	7962	8555

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–294. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–295. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.93×10^{-7}	8.63×10^{-1}	2.99×10^{-5}	4.93×10^{-7}	2.22	9.84×10^{-5}	4.97×10^{-7}	4.58	2.15×10^{-4}
Iodine-129	5.21×10^{-10}	1.48×10^{-1}	1.49×10^{-6}	5.21×10^{-10}	1.85×10^{-1}	2.30×10^{-6}	4.59×10^{-10}	2.11×10^{-1}	3.48×10^{-6}
Total	**N/A**	**1.01**	**3.14×10^{-5}**	**N/A**	**2.41**	**1.01×10^{-4}**	**N/A**	**4.79**	**2.19×10^{-4}**
Year of peak impact	7439	7439	7709	7439	7439	7709	7709	7709	7709

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	7.27×10^{-7}	1.04×10^{-7}	0.00	7.27×10^{-7}	1.08×10^{-7}	0.00	7.27×10^{-7}	1.18×10^{-7}	0.00
Chromium	4.17×10^{-4}	3.97×10^{-3}	0.00	4.17×10^{-4}	4.12×10^{-3}	2.94×10^{-12}	4.17×10^{-4}	6.20×10^{-3}	1.35×10^{-7}
Fluoride	4.95×10^{-5}	2.36×10^{-5}	0.00	4.95×10^{-5}	6.62×10^{-5}	0.00	4.95×10^{-5}	1.39×10^{-4}	0.00
Nitrate	3.01	5.38×10^{-2}	0.00	3.01	4.23×10^{-1}	0.00	3.01	9.43×10^{-1}	0.00
Total	**N/A**	**5.78×10^{-2}**	**0.00**	**N/A**	**4.27×10^{-1}**	**2.94×10^{-12}**	**N/A**	**9.49×10^{-1}**	**1.35×10^{-7}**
Year of peak impact	8248	8248	N/A	8248	8248	3846	8248	8248	3846

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–296. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.71×10^{-7}	6.50×10^{-1}	2.28×10^{-5}	3.79×10^{-7}	1.71	7.51×10^{-5}	3.79×10^{-7}	3.49	1.64×10^{-4}
Iodine-129	3.38×10^{-10}	9.64×10^{-2}	9.34×10^{-7}	2.88×10^{-10}	1.03×10^{-1}	1.44×10^{-6}	2.88×10^{-10}	1.33×10^{-1}	2.18×10^{-6}
Total	**N/A**	**7.46×10^{-1}**	**2.38×10^{-5}**	**N/A**	**1.81**	**7.65×10^{-5}**	**N/A**	**3.63**	**1.66×10^{-4}**
Year of peak impact	7847	7847	8130	8130	8130	8130	8130	8130	8130
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.35×10^{-4}	3.19×10^{-3}	0.00	1.72×10^{-4}	1.70×10^{-3}	1.63×10^{-12}	1.72×10^{-4}	2.55×10^{-3}	7.46×10^{-8}
Fluoride	2.97×10^{-5}	1.41×10^{-5}	0.00	2.97×10^{-5}	3.97×10^{-5}	0.00	2.97×10^{-5}	8.33×10^{-5}	0.00
Nitrate	1.95	3.49×10^{-2}	0.00	2.03	2.86×10^{-1}	0.00	2.03	6.37×10^{-1}	0.00
Total	**N/A**	**3.81×10^{-2}**	**0.00**	**N/A**	**2.87×10^{-1}**	**1.63×10^{-12}**	**N/A**	**6.39×10^{-1}**	**7.46×10^{-8}**
Year of peak impact	8798	8798	N/A	7927	7927	8735	7927	7927	8735

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–297. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.60×10^{-12}	2.97×10^{-5}	1.31×10^{-9}	6.50×10^{-12}	6.76×10^{-5}	3.21×10^{-9}	3.79×10^{-7}	1.14×10^{-2}	6.10×10^{-7}
Iodine-129	1.01×10^{-14}	3.62×10^{-6}	5.10×10^{-11}	1.06×10^{-14}	5.77×10^{-5}	1.39×10^{-9}	2.88×10^{-10}	1.31×10^{-3}	3.21×10^{-8}
Total	**N/A**	**3.34×10^{-5}**	**1.36×10^{-9}**	**N/A**	**1.25×10^{-4}**	**4.60×10^{-9}**	**N/A**	**1.27×10^{-2}**	**6.43×10^{-7}**
Year of peak impact	7861	7861	7861	7935	7935	7935	8130	8130	8130
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.72×10^{-4}	7.55×10^{-4}	7.46×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.97×10^{-5}	4.33×10^{-6}	0.00
Nitrate	3.74×10^{-5}	5.67×10^{-6}	0.00	3.74×10^{-5}	3.53×10^{-3}	0.00	2.03	1.00×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-6}**	**0.00**	**N/A**	**3.53×10^{-3}**	**0.00**	**N/A**	**1.01×10^{-1}**	**7.46×10^{-8}**
Year of peak impact	8064	8064	N/A	8064	8064	N/A	7927	7927	8735

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–27 and Q–28 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 7700 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

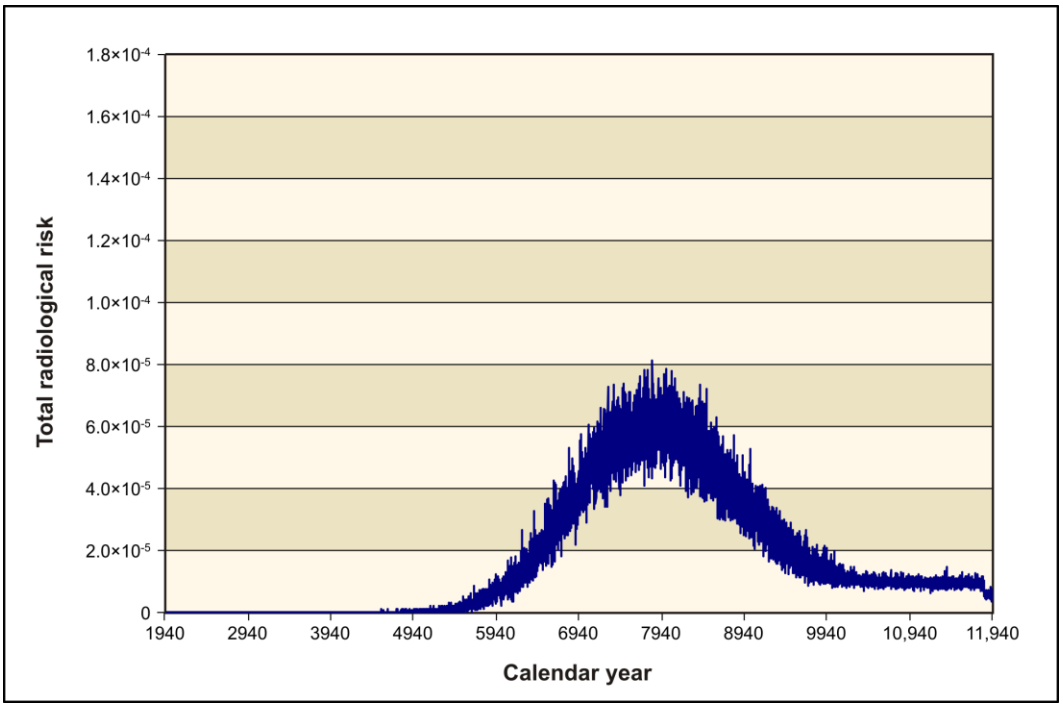

Figure Q–27. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

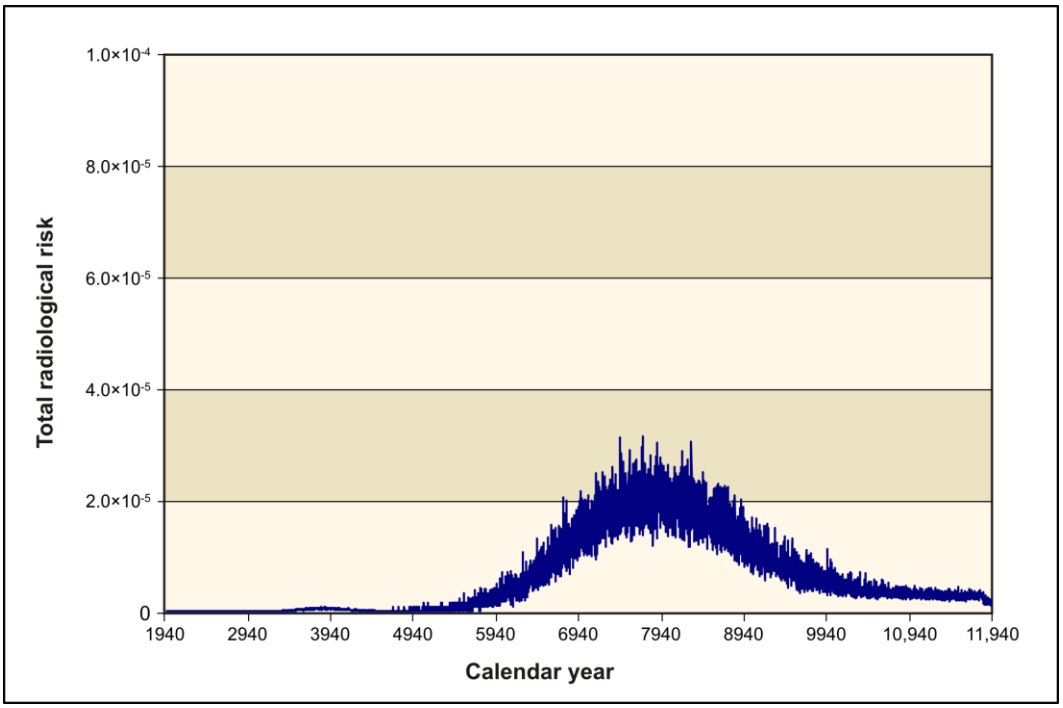

Figure Q–28. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.8 Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A

Disposal Group 2, Subgroup 2-A, addresses the waste resulting from Tank Closure Alternative 2A, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

The RPPDF would not be constructed or operated under Tank Closure Alternative 2A because tank closure cleanup activities would not be conducted.

Potential human health impacts at the IDF-East barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–298 through Q–301, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 1.68×10^{-1} person-rem per year for the year of maximum impact.

Table Q–298. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.29×10^{-6}	4.01	1.38×10^{-4}	2.29×10^{-6}	1.03×10^{1}	4.58×10^{-4}	2.29×10^{-6}	2.11×10^{1}	1.00×10^{-3}
Iodine-129	3.75×10^{-9}	1.07	1.22×10^{-5}	3.75×10^{-9}	1.34	1.45×10^{-5}	3.75×10^{-9}	1.73	2.20×10^{-5}
Total	**N/A**	**5.08**	**1.50×10^{-4}**	**N/A**	**1.17×10^{1}**	**4.72×10^{-4}**	**N/A**	**2.28×10^{1}**	**1.02×10^{-3}**
Year of peak impact	7644	7644	7644	7644	7644	7764	7644	7644	7764
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.08×10^{-6}	2.97×10^{-7}	0.00	2.08×10^{-6}	3.09×10^{-7}	0.00	2.08×10^{-6}	3.36×10^{-7}	0.00
Chromium	1.11×10^{-3}	1.06×10^{-2}	0.00	1.11×10^{-3}	1.10×10^{-2}	7.23×10^{-12}	1.11×10^{-3}	1.65×10^{-2}	3.32×10^{-7}
Fluoride	1.52×10^{-4}	7.22×10^{-5}	0.00	1.52×10^{-4}	2.03×10^{-4}	0.00	1.52×10^{-4}	4.26×10^{-4}	0.00
Nitrate	9.30	1.66×10^{-1}	0.00	9.30	1.31	0.00	9.30	2.91	0.00
Total	**N/A**	**1.77×10^{-1}**	**0.00**	**N/A**	**1.32**	**7.23×10^{-12}**	**N/A**	**2.93**	**3.32×10^{-7}**
Year of peak impact	7960	7960	N/A	7960	7960	8791	7960	7960	8791

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–299. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.56×10^{-7}	9.73×10^{-1}	3.35×10^{-5}	5.56×10^{-7}	2.51	1.10×10^{-4}	5.56×10^{-7}	5.12	2.41×10^{-4}
Iodine-129	6.61×10^{-10}	1.88×10^{-1}	2.14×10^{-6}	6.61×10^{-10}	2.35×10^{-1}	3.31×10^{-6}	6.61×10^{-10}	3.04×10^{-1}	5.01×10^{-6}
Total	**N/A**	**1.16**	**3.56×10^{-5}**	**N/A**	**2.74**	**1.13×10^{-4}**	**N/A**	**5.43**	**2.46×10^{-4}**
Year of peak impact	7328	7328	7328	7328	7328	7328	7328	7328	7328
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	4.60×10^{-4}	4.38×10^{-3}	0.00	4.48×10^{-4}	4.43×10^{-3}	2.92×10^{-12}	4.48×10^{-4}	6.66×10^{-3}	1.34×10^{-7}
Fluoride	5.37×10^{-5}	2.55×10^{-5}	0.00	4.15×10^{-5}	5.55×10^{-5}	0.00	4.15×10^{-5}	1.16×10^{-4}	0.00
Nitrate	2.92	5.21×10^{-2}	0.00	2.92	4.10×10^{-1}	0.00	2.92	9.14×10^{-1}	0.00
Total	**N/A**	**5.65×10^{-2}**	**0.00**	**N/A**	**4.14×10^{-1}**	**2.92×10^{-12}**	**N/A**	**9.21×10^{-1}**	**1.34×10^{-7}**
Year of peak impact	8123	8123	N/A	8291	8291	8053	8291	8291	8053

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–300. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.73×10^{-7}	6.52×10^{-1}	2.24×10^{-5}	3.73×10^{-7}	1.68	7.38×10^{-5}	3.73×10^{-7}	3.43	1.61×10^{-4}
Iodine-129	3.18×10^{-10}	9.07×10^{-2}	1.03×10^{-6}	3.18×10^{-10}	1.13×10^{-1}	1.59×10^{-6}	3.18×10^{-10}	1.46×10^{-1}	2.41×10^{-6}
Total	**N/A**	**7.43×10^{-1}**	**2.35×10^{-5}**	**N/A**	**1.79**	**7.54×10^{-5}**	**N/A**	**3.58**	**1.64×10^{-4}**
Year of peak impact	7754	7754	7754	7754	7754	7754	7754	7754	7754
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.65×10^{-4}	2.52×10^{-3}	0.00	2.65×10^{-4}	2.62×10^{-3}	1.77×10^{-12}	2.65×10^{-4}	3.94×10^{-3}	8.11×10^{-8}
Fluoride	2.68×10^{-5}	1.28×10^{-5}	0.00	2.68×10^{-5}	3.59×10^{-5}	0.00	2.68×10^{-5}	7.53×10^{-5}	0.00
Nitrate	1.86	3.33×10^{-2}	0.00	1.86	2.62×10^{-1}	0.00	1.86	5.84×10^{-1}	0.00
Total	**N/A**	**3.58×10^{-2}**	**0.00**	**N/A**	**2.64×10^{-1}**	**1.77×10^{-12}**	**N/A**	**5.88×10^{-1}**	**8.11×10^{-8}**
Year of peak impact	8406	8406	N/A	8406	8406	7640	8406	8406	7640

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–301. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.63×10^{-12}	2.99×10^{-5}	1.31×10^{-9}	6.63×10^{-12}	6.89×10^{-5}	3.27×10^{-9}	3.73×10^{-7}	1.12×10^{-2}	6.00×10^{-7}
Iodine-129	9.97×10^{-15}	3.56×10^{-6}	5.01×10^{-11}	9.97×10^{-15}	5.43×10^{-5}	1.31×10^{-9}	3.18×10^{-10}	1.38×10^{-3}	3.38×10^{-8}
Total	**N/A**	**3.35×10^{-5}**	**1.36×10^{-9}**	**N/A**	**1.23×10^{-4}**	**4.58×10^{-9}**	**N/A**	**1.26×10^{-2}**	**6.34×10^{-7}**
Year of peak impact	7990	7990	7990	7990	7990	7990	7754	7754	7754
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	2.65×10^{-4}	1.17×10^{-3}	8.10×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.68×10^{-5}	3.92×10^{-6}	0.00
Nitrate	3.55×10^{-5}	5.37×10^{-6}	0.00	3.55×10^{-5}	3.34×10^{-3}	0.00	1.86	9.02×10^{-2}	0.00
Total	**N/A**	**5.37×10^{-6}**	**0.00**	**N/A**	**3.34×10^{-3}**	**0.00**	**N/A**	**9.14×10^{-2}**	**8.10×10^{-8}**
Year of peak impact	8238	8238	N/A	8238	8238	N/A	8406	8406	7640

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–29 and Q–30 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 7300 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

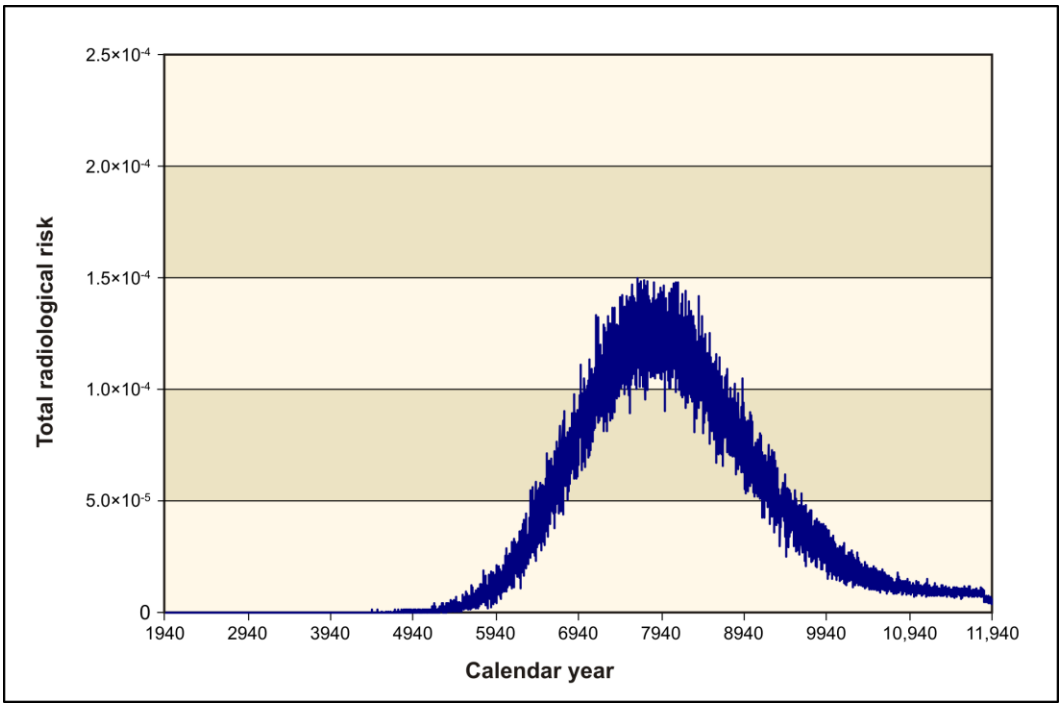

Figure Q–29. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

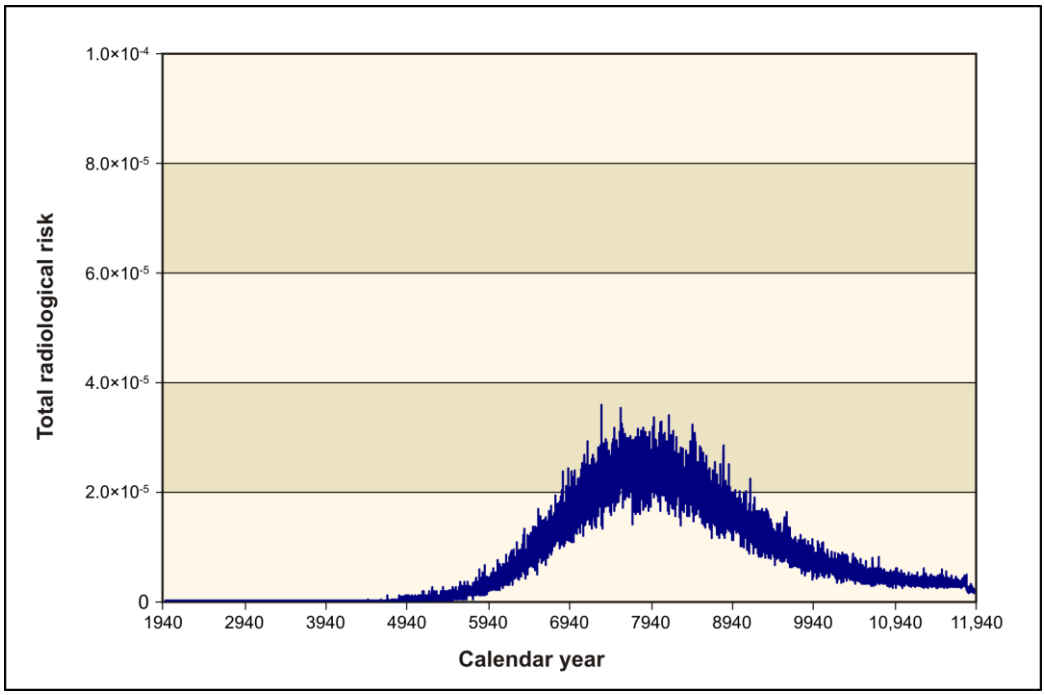

Figure Q–30. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.9 Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B

Disposal Group 2, Subgroup 2-B, addresses the waste resulting from Tank Closure Alternative 6B (Base and Option Cases), onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- Preprocessing Facility (PPF) glass
- PPF melters
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 6B, Base and Option Cases.

Potential human health impacts at the IDF-East barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–302 through Q–311, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, nitrate, and total uranium. For radionuclides, the dose standard would not be exceeded at any location. Under both the Base and Option Cases, the Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer due to release of nitrate. In addition, under the Option Case, the Hazard Index guideline would be exceeded at the RPPDF barrier and the Core Zone Boundary for the resident farmer and American Indian resident farmer and at the Columbia River nearshore for the American Indian resident farmer. Population dose is estimated for Subgroup 2-B, Base and Option Cases, as 1.65×10^{-1} person-rem per year for the year of maximum impact.

Table Q–302. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.29×10^{-6}	4.01	1.38×10^{-4}	2.29×10^{-6}	1.03×10^{1}	4.55×10^{-4}	2.29×10^{-6}	2.11×10^{1}	9.95×10^{-4}
Iodine-129	3.61×10^{-9}	1.03	1.17×10^{-5}	3.61×10^{-9}	1.28	1.67×10^{-5}	3.61×10^{-9}	1.66	2.52×10^{-5}
Total	**N/A**	**5.03**	**1.49×10^{-4}**	**N/A**	**1.16×10^{1}**	**4.72×10^{-4}**	**N/A**	**2.27×10^{1}**	**1.02×10^{-3}**
Year of peak impact	8117	8117	8117	8117	8117	7843	8117	8117	7843
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.47×10^{-6}	3.52×10^{-7}	0.00	2.47×10^{-6}	3.66×10^{-7}	0.00	2.47×10^{-6}	3.99×10^{-7}	0.00
Chromium	1.13×10^{-3}	1.08×10^{-2}	0.00	1.13×10^{-3}	1.12×10^{-2}	7.73×10^{-12}	1.13×10^{-3}	1.68×10^{-2}	3.55×10^{-7}
Fluoride	1.85×10^{-4}	8.79×10^{-5}	0.00	1.85×10^{-4}	2.47×10^{-4}	0.00	1.85×10^{-4}	5.18×10^{-4}	0.00
Nitrate	9.59	1.71×10^{-1}	0.00	9.59	1.35	0.00	9.59	3.00	0.00
Total	**N/A**	**1.82×10^{-1}**	**0.00**	**N/A**	**1.36**	**7.73×10^{-12}**	**N/A**	**3.02**	**3.55×10^{-7}**
Year of peak impact	7983	7983	N/A	7983	7983	8251	7983	7983	8251

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–303. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.55×10^{-7}	2.71×10^{-1}	9.34×10^{-6}	1.55×10^{-7}	7.00×10^{-1}	3.07×10^{-5}	1.55×10^{-7}	1.43	6.72×10^{-5}
Iodine-129	1.92×10^{-10}	5.48×10^{-2}	6.23×10^{-7}	1.92×10^{-10}	6.84×10^{-2}	9.63×10^{-7}	1.92×10^{-10}	8.84×10^{-2}	1.46×10^{-6}
Total	**N/A**	**3.26×10^{-1}**	**9.96×10^{-6}**	**N/A**	**7.68×10^{-1}**	**3.17×10^{-5}**	**N/A**	**1.52**	**6.86×10^{-5}**
Year of peak impact	3769	3769	3769	3769	3769	3769	3769	3769	3769
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	1.04×10^{-6}	4.93×10^{-6}	0.00	9.29×10^{-7}	5.53×10^{-6}	0.00	7.28×10^{-7}	7.83×10^{-6}	0.00
Chromium	3.65×10^{-3}	3.48×10^{-2}	0.00	3.00×10^{-3}	2.97×10^{-2}	1.43×10^{-11}	2.65×10^{-3}	3.94×10^{-2}	6.58×10^{-7}
Nitrate	1.67×10^{-1}	2.98×10^{-3}	0.00	2.52×10^{-1}	3.54×10^{-2}	0.00	2.77×10^{-1}	8.66×10^{-2}	0.00
Total	**N/A**	**3.78×10^{-2}**	**0.00**	**N/A**	**6.51×10^{-2}**	**1.43×10^{-11}**	**N/A**	**1.26×10^{-1}**	**6.58×10^{-7}**
Year of peak impact	3710	3710	N/A	3724	3724	3710	3789	3789	3710

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–304. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.57×10^{-7}	9.75×10^{-1}	3.35×10^{-5}	5.57×10^{-7}	2.51	1.10×10^{-4}	5.57×10^{-7}	5.13	2.41×10^{-4}
Iodine-129	6.65×10^{-10}	1.89×10^{-1}	2.15×10^{-6}	6.65×10^{-10}	2.37×10^{-1}	3.33×10^{-6}	6.65×10^{-10}	3.06×10^{-1}	5.04×10^{-6}
Total	**N/A**	**1.16**	**3.57×10^{-5}**	**N/A**	**2.75**	**1.14×10^{-4}**	**N/A**	**5.44**	**2.46×10^{-4}**
Year of peak impact	7328	7328	7328	7328	7328	7328	7328	7328	7328
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.87×10^{-4}	4.64×10^{-3}	0.00	4.87×10^{-4}	4.81×10^{-3}	1.34×10^{-11}	4.87×10^{-4}	7.24×10^{-3}	6.13×10^{-7}
Fluoride	3.66×10^{-5}	1.74×10^{-5}	0.00	3.66×10^{-5}	4.89×10^{-5}	0.00	3.66×10^{-5}	1.03×10^{-4}	0.00
Nitrate	3.13	5.59×10^{-2}	0.00	3.13	4.39×10^{-1}	0.00	3.13	9.80×10^{-1}	0.00
Total	**N/A**	**6.05×10^{-2}**	**0.00**	**N/A**	**4.44×10^{-1}**	**1.34×10^{-11}**	**N/A**	**9.87×10^{-1}**	**6.13×10^{-7}**
Year of peak impact	7860	7860	N/A	7860	7860	3977	7860	7860	3977

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–305. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.77×10^{-7}	6.59×10^{-1}	2.27×10^{-5}	3.77×10^{-7}	1.70	7.46×10^{-5}	3.77×10^{-7}	3.47	1.63×10^{-4}
Iodine-129	3.75×10^{-10}	1.07×10^{-1}	1.22×10^{-6}	3.75×10^{-10}	1.34×10^{-1}	1.88×10^{-6}	3.75×10^{-10}	1.73×10^{-1}	2.84×10^{-6}
Total	**N/A**	**7.66×10^{-1}**	**2.39×10^{-5}**	**N/A**	**1.83**	**7.65×10^{-5}**	**N/A**	**3.64**	**1.66×10^{-4}**
Year of peak impact	**7754**	**7754**	**7754**	**7754**	**7754**	**7754**	**7754**	**7754**	**7754**
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.33×10^{-8}	6.35×10^{-8}	0.00	1.33×10^{-8}	7.93×10^{-8}	0.00	1.33×10^{-8}	1.43×10^{-7}	0.00
Chromium	1.34×10^{-4}	1.28×10^{-3}	0.00	1.34×10^{-4}	1.32×10^{-3}	8.03×10^{-12}	1.34×10^{-4}	1.99×10^{-3}	3.68×10^{-7}
Fluoride	1.71×10^{-5}	8.13×10^{-6}	0.00	1.71×10^{-5}	2.28×10^{-5}	0.00	1.71×10^{-5}	4.79×10^{-5}	0.00
Nitrate	2.14	3.82×10^{-2}	0.00	2.14	3.01×10^{-1}	0.00	2.14	6.70×10^{-1}	0.00
Total	**N/A**	**3.95×10^{-2}**	**0.00**	**N/A**	**3.02×10^{-1}**	**8.03×10^{-12}**	**N/A**	**6.72×10^{-1}**	**3.68×10^{-7}**
Year of peak impact	7994	7994	N/A	7994	7994	4632	7994	7994	4632

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–306. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.52×10^{-12}	2.94×10^{-5}	1.29×10^{-9}	6.29×10^{-12}	6.55×10^{-5}	3.20×10^{-9}	3.77×10^{-7}	1.13×10^{-2}	6.07×10^{-7}
Iodine-129	9.64×10^{-15}	3.44×10^{-6}	4.85×10^{-11}	1.06×10^{-14}	5.75×10^{-5}	1.32×10^{-9}	3.75×10^{-10}	1.55×10^{-3}	3.79×10^{-8}
Total	**N/A**	**3.29×10^{-5}**	**1.34×10^{-9}**	**N/A**	**1.23×10^{-4}**	**4.52×10^{-9}**	**N/A**	**1.29×10^{-2}**	**6.45×10^{-7}**
Year of peak impact	7990	7990	7990	7964	7964	7960	7754	7754	7754
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	1.33×10^{-8}	8.00×10^{-8}	0.00
Chromium	0.00	0.00	1.64×10^{-16}	0.00	0.00	7.52×10^{-12}	1.34×10^{-4}	5.90×10^{-4}	3.68×10^{-7}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	1.71×10^{-5}	2.49×10^{-6}	0.00
Nitrate	3.56×10^{-5}	5.38×10^{-6}	0.00	3.56×10^{-5}	3.35×10^{-3}	0.00	2.14	1.00×10^{-1}	0.00
Total	**N/A**	**5.38×10^{-6}**	**1.64×10^{-16}**	**N/A**	**3.35×10^{-3}**	**7.52×10^{-12}**	**N/A**	**1.01×10^{-1}**	**3.68×10^{-7}**
Year of peak impact	8188	8188	4046	8188	8188	4046	7994	7994	4632

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–307. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.28×10^{-6}	3.99	1.37×10^{-4}	2.28×10^{-6}	1.03×10^{1}	4.52×10^{-4}	2.28×10^{-6}	2.10×10^{1}	9.88×10^{-4}
Iodine-129	3.78×10^{-9}	1.08	1.22×10^{-5}	3.78×10^{-9}	1.34	1.89×10^{-5}	3.78×10^{-9}	1.74	2.86×10^{-5}
Total	**N/A**	**5.07**	**1.50×10^{-4}**	**N/A**	**1.16×10^{1}**	**4.71×10^{-4}**	**N/A**	**2.28×10^{1}**	**1.02×10^{-3}**
Year of peak impact	7644	7644	7644	7644	7644	7644	7644	7644	7644
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.25×10^{-6}	3.21×10^{-7}	0.00	2.25×10^{-6}	3.34×10^{-7}	0.00	2.25×10^{-6}	3.63×10^{-7}	0.00
Chromium	1.75×10^{-3}	1.67×10^{-2}	0.00	1.75×10^{-3}	1.73×10^{-2}	8.83×10^{-12}	1.75×10^{-3}	2.61×10^{-2}	4.05×10^{-7}
Fluoride	1.85×10^{-4}	8.79×10^{-5}	0.00	1.85×10^{-4}	2.47×10^{-4}	0.00	1.85×10^{-4}	5.18×10^{-4}	0.00
Nitrate	1.46×10^{1}	2.61×10^{-1}	0.00	1.46×10^{1}	2.05	0.00	1.46×10^{1}	4.58	0.00
Total	**N/A**	**2.78×10^{-1}**	**0.00**	**N/A**	**2.07**	**8.83×10^{-12}**	**N/A**	**4.60**	**4.05×10^{-7}**
Year of peak impact	7954	7954	N/A	7954	7954	8501	7954	7954	8501

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–308. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.20×10^{-7}	3.85×10^{-1}	1.32×10^{-5}	2.20×10^{-7}	9.92×10^{-1}	4.35×10^{-5}	2.20×10^{-7}	2.03	9.52×10^{-5}
Iodine-129	2.99×10^{-10}	8.53×10^{-2}	9.70×10^{-7}	2.99×10^{-10}	1.07×10^{-1}	1.50×10^{-6}	2.99×10^{-10}	1.38×10^{-1}	2.27×10^{-6}
Total	**N/A**	**4.70×10^{-1}**	**1.42×10^{-5}**	**N/A**	**1.10**	**4.50×10^{-5}**	**N/A**	**2.16**	**9.75×10^{-5}**
Year of peak impact	3812	3812	3812	3812	3812	3812	3812	3812	3812
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	8.24×10^{-7}	3.92×10^{-6}	0.00	1.04×10^{-6}	6.16×10^{-6}	0.00	1.04×10^{-6}	1.11×10^{-5}	0.00
Chromium	3.29×10^{-2}	3.13×10^{-1}	0.00	2.28×10^{-2}	2.25×10^{-1}	1.33×10^{-10}	2.28×10^{-2}	3.39×10^{-1}	6.11×10^{-6}
Nitrate	7.17	1.28×10^{-1}	0.00	9.86	1.38	0.00	9.86	3.09	0.00
Total	**N/A**	**4.41×10^{-1}**	**0.00**	**N/A**	**1.61**	**1.33×10^{-10}**	**N/A**	**3.43**	**6.11×10^{-6}**
Year of peak impact	3680	3680	N/A	3733	3733	3807	3733	3733	3807

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–309. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.57×10^{-7}	9.75×10^{-1}	3.35×10^{-5}	5.57×10^{-7}	2.51	1.10×10^{-4}	5.57×10^{-7}	5.13	2.41×10^{-4}
Iodine-129	6.75×10^{-10}	1.92×10^{-1}	2.19×10^{-6}	6.75×10^{-10}	2.40×10^{-1}	3.38×10^{-6}	6.75×10^{-10}	3.11×10^{-1}	5.12×10^{-6}
Total	**N/A**	**1.17**	**3.57×10^{-5}**	**N/A**	**2.75**	**1.14×10^{-4}**	**N/A**	**5.44**	**2.46×10^{-4}**
Year of peak impact	7328	7328	7328	7328	7328	7328	7328	7328	7328
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.39×10^{-7}	2.57×10^{-6}	0.00	6.91×10^{-7}	4.11×10^{-6}	0.00	6.91×10^{-7}	7.44×10^{-6}	0.00
Chromium	2.84×10^{-2}	2.70×10^{-1}	0.00	2.08×10^{-2}	2.06×10^{-1}	1.12×10^{-10}	2.08×10^{-2}	3.09×10^{-1}	5.15×10^{-6}
Nitrate	4.79	8.56×10^{-2}	0.00	7.22	1.01	0.00	7.22	2.26	0.00
Total	**N/A**	**3.56×10^{-1}**	**0.00**	**N/A**	**1.22**	**1.12×10^{-10}**	**N/A**	**2.57**	**5.15×10^{-6}**
Year of peak impact	3688	3688	N/A	3858	3858	3901	3858	3858	3901

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–310. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.79×10^{-7}	6.63×10^{-1}	2.28×10^{-5}	3.79×10^{-7}	1.71	7.50×10^{-5}	3.79×10^{-7}	3.49	1.64×10^{-4}
Iodine-129	3.77×10^{-10}	1.07×10^{-1}	1.22×10^{-6}	3.77×10^{-10}	1.34×10^{-1}	1.89×10^{-6}	3.77×10^{-10}	1.73×10^{-1}	2.86×10^{-6}
Total	**N/A**	**7.70×10^{-1}**	**2.40×10^{-5}**	**N/A**	**1.84**	**7.69×10^{-5}**	**N/A**	**3.66**	**1.67×10^{-4}**
Year of peak impact	7754	7754	7754	7754	7754	7754	7754	7754	7754
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.60×10^{-7}	2.67×10^{-6}	0.00	4.93×10^{-7}	2.93×10^{-6}	0.00	4.93×10^{-7}	5.31×10^{-6}	0.00
Chromium	1.84×10^{-2}	1.75×10^{-1}	0.00	1.47×10^{-2}	1.45×10^{-1}	7.49×10^{-11}	1.47×10^{-2}	2.19×10^{-1}	3.43×10^{-6}
Nitrate	3.30	5.89×10^{-2}	0.00	4.15	5.83×10^{-1}	0.00	4.15	1.30	0.00
Total	**N/A**	**2.34×10^{-1}**	**0.00**	**N/A**	**7.28×10^{-1}**	**7.49×10^{-11}**	**N/A**	**1.52**	**3.43×10^{-6}**
Year of peak impact	4560	4560	N/A	4465	4465	4558	4465	4465	4558

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–311. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.59×10^{-12}	2.97×10^{-5}	1.30×10^{-9}	6.09×10^{-12}	6.33×10^{-5}	3.25×10^{-9}	3.79×10^{-7}	1.14×10^{-2}	6.10×10^{-7}
Iodine-129	9.79×10^{-15}	3.50×10^{-6}	4.93×10^{-11}	1.11×10^{-14}	6.04×10^{-5}	1.28×10^{-9}	3.77×10^{-10}	1.55×10^{-3}	3.80×10^{-8}
Total	**N/A**	**3.32×10^{-5}**	**1.35×10^{-9}**	**N/A**	**1.24×10^{-4}**	**4.54×10^{-9}**	**N/A**	**1.30×10^{-2}**	**6.48×10^{-7}**
Year of peak impact	7990	7990	7990	7896	7896	7990	7754	7754	7754
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	4.00×10^{-7}	2.40×10^{-6}	0.00
Chromium	3.67×10^{-7}	3.62×10^{-6}	1.54×10^{-15}	3.67×10^{-7}	5.94×10^{-6}	7.06×10^{-11}	1.20×10^{-2}	5.30×10^{-2}	3.43×10^{-6}
Nitrate	1.10×10^{-4}	1.67×10^{-5}	0.00	1.10×10^{-4}	1.04×10^{-2}	0.00	3.96	2.29×10^{-1}	0.00
Total	**N/A**	**2.03×10^{-5}**	**1.54×10^{-15}**	**N/A**	**1.04×10^{-2}**	**7.06×10^{-11}**	**N/A**	**2.82×10^{-1}**	**3.43×10^{-6}**
Year of peak impact	4079	4079	4055	4079	4079	4055	4055	4055	4558

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–31 through Q–34 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary for the drinking-water well user over time. Under both the Base and Option Cases, the peak radiological risk occurs around CY 7300 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

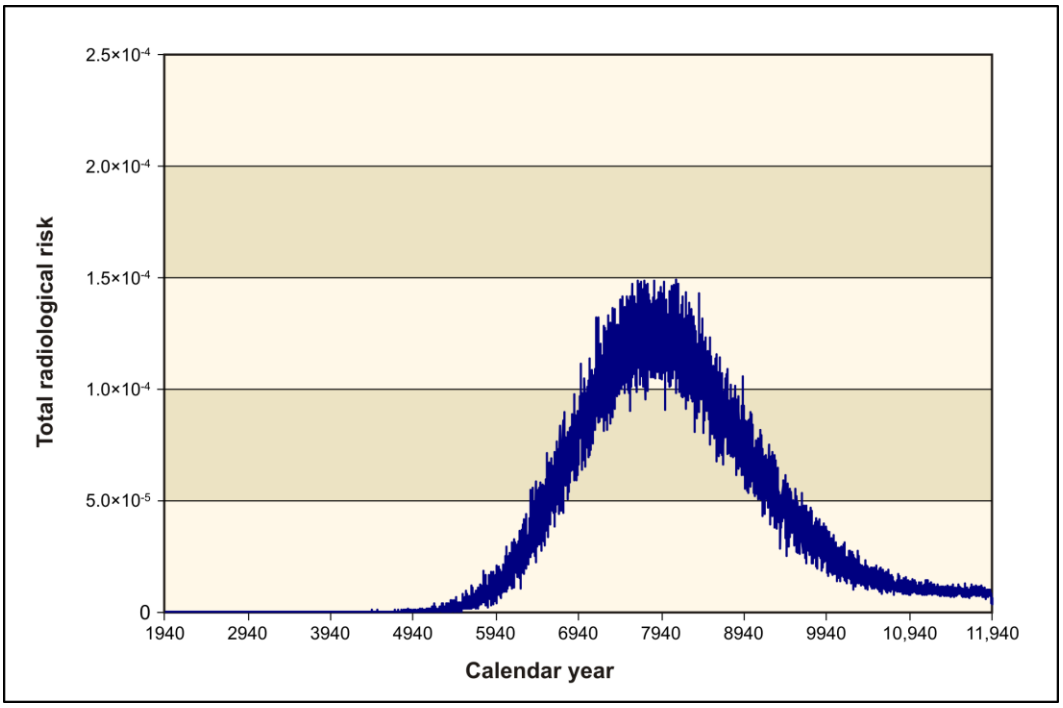

Figure Q–31. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

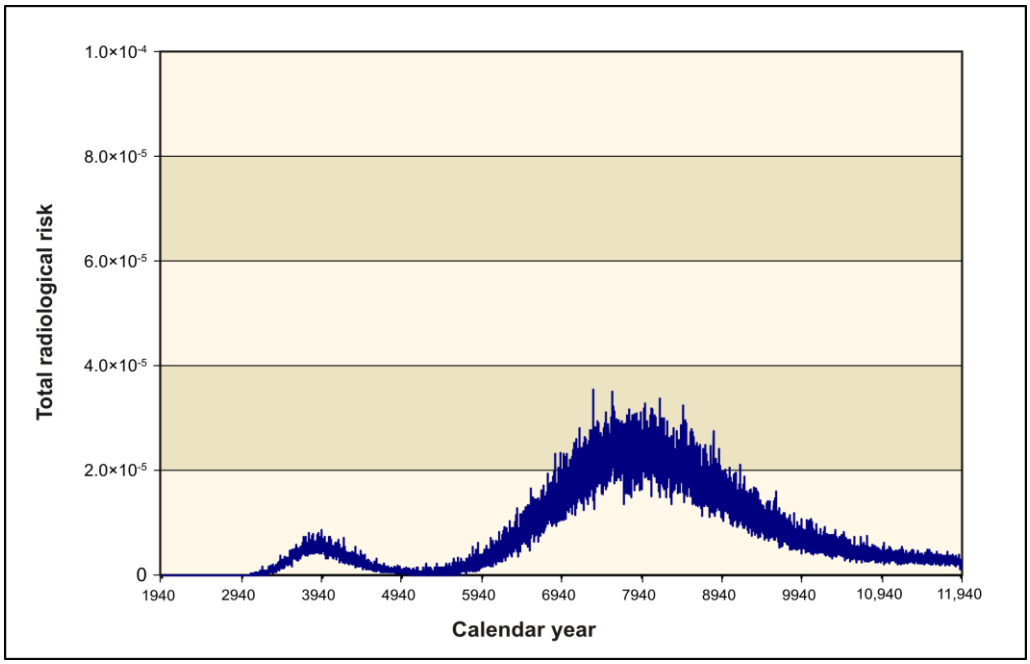

Figure Q–32. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

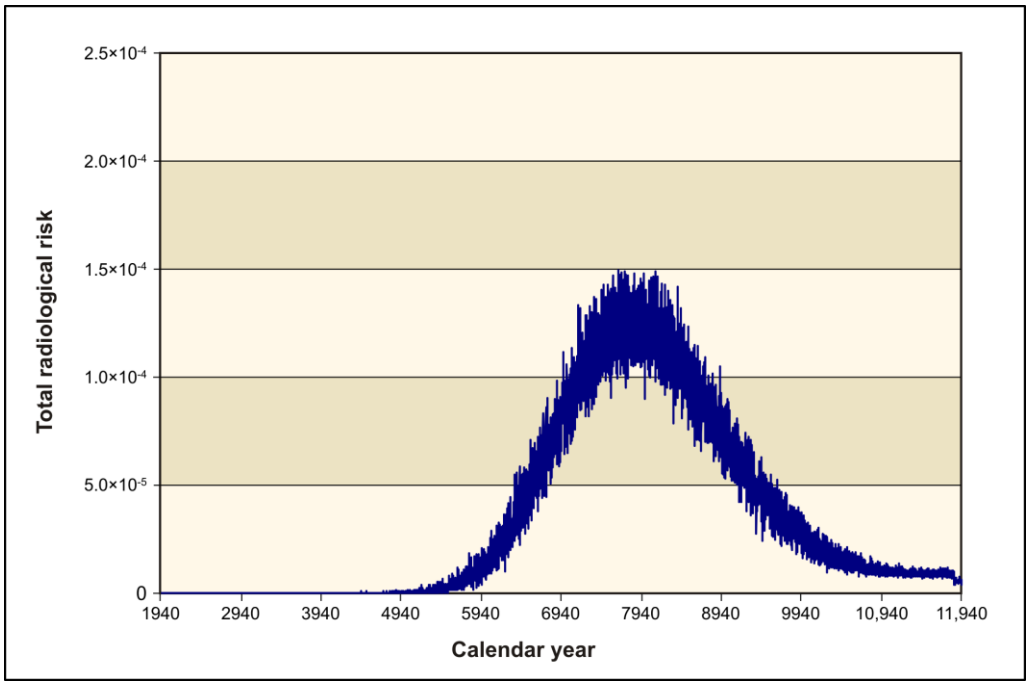

Figure Q–33. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

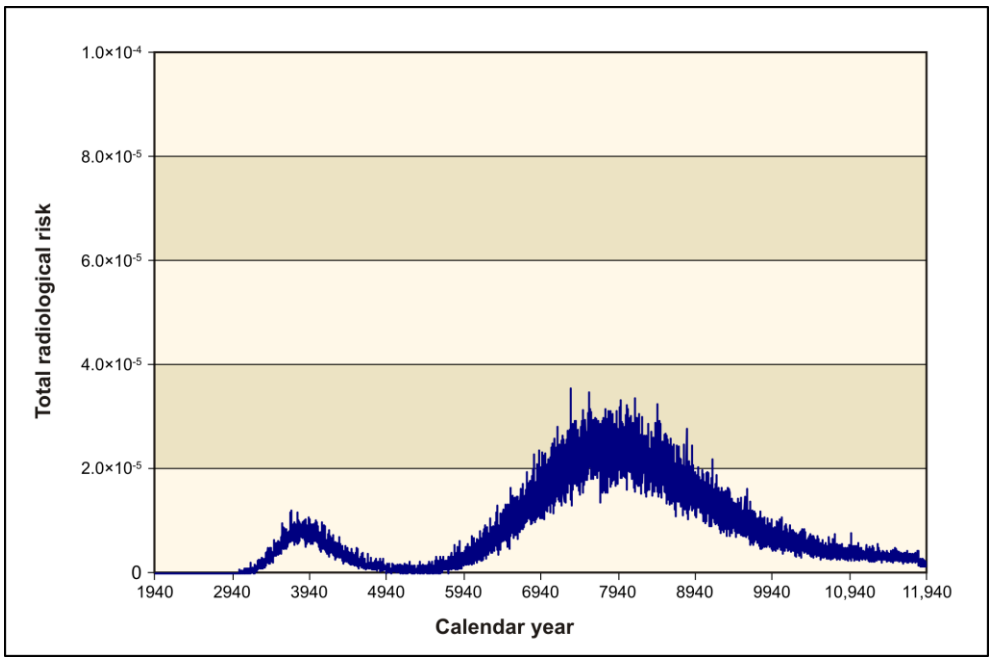

Figure Q–34. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.2.10 Waste Management Alternative 2, Disposal Group 3

Disposal Group 3 addresses the waste resulting from Tank Closure Alternative 6A (Base and Option Cases), onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- PPF glass
- PPF melters
- Tank closure secondary waste
- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 6A, Base and Option Cases.

Potential human health impacts at the IDF-East barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–312 through Q–321, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would not be exceeded at any location under both the Base and Option Cases. Under the Base Case, the Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer due primarily to release of nitrate. Under the Option Case, the Hazard Index guideline would be exceeded for the resident farmer and American Indian resident farmer at the IDF-East barrier, the RPPDF barrier, and the Core Zone Boundary and for the American Indian resident farmer, at the Columbia River nearshore. Population dose is estimated for Disposal Group 3, Base Case, as 1.71×10^{-1} person-rem per year for the year of maximum impact and for Disposal Group 3, Option Case, as 1.73×10^{-1} person-rem per year for the year of maximum impact.

Table Q–312. Waste Management Alternative 2, Disposal Group 3, Base Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.44×10^{-6}	4.27	1.47×10^{-4}	2.44×10^{-6}	1.10×10^{1}	4.83×10^{-4}	2.44×10^{-6}	2.25×10^{1}	1.06×10^{-3}
Iodine-129	3.23×10^{-9}	9.21×10^{-1}	1.05×10^{-5}	3.23×10^{-9}	1.15	1.62×10^{-5}	3.23×10^{-9}	1.49	2.45×10^{-5}
Total	**N/A**	**5.19**	**1.57×10^{-4}**	**N/A**	**1.21×10^{1}**	**4.99×10^{-4}**	**N/A**	**2.39×10^{1}**	**1.08×10^{-3}**
Year of peak impact	7678	7678	7678	7678	7678	7678	7678	7678	7678

Chemical Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	2.46×10^{-6}	3.51×10^{-7}	0.00	2.46×10^{-6}	3.65×10^{-7}	0.00	2.46×10^{-6}	3.98×10^{-7}	0.00
Chromium	1.14×10^{-3}	1.08×10^{-2}	0.00	1.14×10^{-3}	1.12×10^{-2}	7.64×10^{-12}	1.14×10^{-3}	1.69×10^{-2}	3.50×10^{-7}
Fluoride	2.09×10^{-4}	9.94×10^{-5}	0.00	2.09×10^{-4}	2.79×10^{-4}	0.00	2.09×10^{-4}	5.86×10^{-4}	0.00
Nitrate	9.59	1.71×10^{-1}	0.00	9.59	1.35	0.00	9.59	3.00	0.00
Total	**N/A**	**1.82×10^{-1}**	**0.00**	**N/A**	**1.36**	**7.64×10^{-12}**	**N/A**	**3.02**	**3.50×10^{-7}**
Year of peak impact	7983	7983	N/A	7983	7983	8326	7983	7983	8326

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–313. Waste Management Alternative 2, Disposal Group 3, Base Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.47×10^{-7}	2.58×10^{-1}	8.87×10^{-6}	1.47×10^{-7}	6.65×10^{-1}	2.92×10^{-5}	1.47×10^{-7}	1.36	6.38×10^{-5}
Iodine-129	1.97×10^{-10}	5.62×10^{-2}	6.39×10^{-7}	1.97×10^{-10}	7.02×10^{-2}	9.87×10^{-7}	1.97×10^{-10}	9.07×10^{-2}	1.49×10^{-6}
Total	**N/A**	**3.14×10^{-1}**	**9.51×10^{-6}**	**N/A**	**7.35×10^{-1}**	**3.02×10^{-5}**	**N/A**	**1.45**	**6.53×10^{-5}**
Year of peak impact	4013	4013	4013	4013	4013	4013	4013	4013	4013
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	8.66×10^{-7}	4.12×10^{-6}	0.00	8.66×10^{-7}	5.15×10^{-6}	0.00	8.66×10^{-7}	9.32×10^{-6}	0.00
Chromium	3.65×10^{-3}	3.48×10^{-2}	0.00	3.65×10^{-3}	3.61×10^{-2}	1.48×10^{-11}	3.65×10^{-3}	5.43×10^{-2}	6.79×10^{-7}
Nitrate	2.44×10^{-1}	4.36×10^{-3}	0.00	2.44×10^{-1}	3.43×10^{-2}	0.00	2.44×10^{-1}	7.64×10^{-2}	0.00
Total	**N/A**	**3.92×10^{-2}**	**0.00**	**N/A**	**7.03×10^{-2}**	**1.48×10^{-11}**	**N/A**	**1.31×10^{-1}**	**6.79×10^{-7}**
Year of peak impact	3929	3929	N/A	3929	3929	3869	3929	3929	3869

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–314. Waste Management Alternative 2, Disposal Group 3, Base Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.77×10^{-7}	1.01	3.48×10^{-5}	5.77×10^{-7}	2.60	1.14×10^{-4}	5.77×10^{-7}	5.32	2.50×10^{-4}
Iodine-129	6.86×10^{-10}	1.96×10^{-1}	2.22×10^{-6}	6.86×10^{-10}	2.44×10^{-1}	3.44×10^{-6}	6.86×10^{-10}	3.16×10^{-1}	5.20×10^{-6}
Total	**N/A**	**1.21**	**3.70×10^{-5}**	**N/A**	**2.85**	**1.18×10^{-4}**	**N/A**	**5.63**	**2.55×10^{-4}**
Year of peak impact	7891	7891	7891	7891	7891	7891	7891	7891	7891
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	4.86×10^{-4}	4.63×10^{-3}	0.00	4.86×10^{-4}	4.80×10^{-3}	1.29×10^{-11}	4.86×10^{-4}	7.22×10^{-3}	5.90×10^{-7}
Fluoride	5.11×10^{-5}	2.43×10^{-5}	0.00	5.11×10^{-5}	6.84×10^{-5}	0.00	5.11×10^{-5}	1.43×10^{-4}	0.00
Nitrate	3.13	5.59×10^{-2}	0.00	3.13	4.39×10^{-1}	0.00	3.13	9.80×10^{-1}	0.00
Total	**N/A**	**6.05×10^{-2}**	**0.00**	**N/A**	**4.44×10^{-1}**	**1.29×10^{-11}**	**N/A**	**9.87×10^{-1}**	**5.90×10^{-7}**
Year of peak impact	7860	7860	N/A	7860	7860	3701	7860	7860	3701

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–315. Waste Management Alternative 2, Disposal Group 3, Base Case, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.70×10^{-7}	6.47×10^{-1}	2.22×10^{-5}	3.70×10^{-7}	1.67	7.32×10^{-5}	3.70×10^{-7}	3.40	1.60×10^{-4}
Iodine-129	3.70×10^{-10}	1.05×10^{-1}	1.20×10^{-6}	3.70×10^{-10}	1.32×10^{-1}	1.85×10^{-6}	3.70×10^{-10}	1.70×10^{-1}	2.80×10^{-6}
Total	**N/A**	**7.52×10^{-1}**	**2.34×10^{-5}**	**N/A**	**1.80**	**7.50×10^{-5}**	**N/A**	**3.57**	**1.63×10^{-4}**
Year of peak impact	8233	8233	8233	8233	8233	8233	8233	8233	8233
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.67×10^{-8}	1.27×10^{-7}	0.00	2.67×10^{-8}	1.59×10^{-7}	0.00	2.67×10^{-8}	2.87×10^{-7}	0.00
Chromium	1.43×10^{-4}	1.36×10^{-3}	0.00	1.43×10^{-4}	1.41×10^{-3}	7.45×10^{-12}	1.43×10^{-4}	2.12×10^{-3}	3.42×10^{-7}
Fluoride	1.46×10^{-5}	6.95×10^{-6}	0.00	1.46×10^{-5}	1.95×10^{-5}	0.00	1.46×10^{-5}	4.10×10^{-5}	0.00
Nitrate	2.14	3.82×10^{-2}	0.00	2.14	3.01×10^{-1}	0.00	2.14	6.70×10^{-1}	0.00
Total	**N/A**	**3.96×10^{-2}**	**0.00**	**N/A**	**3.02×10^{-1}**	**7.45×10^{-12}**	**N/A**	**6.73×10^{-1}**	**3.42×10^{-7}**
Year of peak impact	7994	7994	N/A	7994	7994	4608	7994	7994	4608

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–316. Waste Management Alternative 2, Disposal Group 3, Base Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	6.81×10^{-12}	3.07×10^{-5}	1.35×10^{-9}	6.69×10^{-12}	6.96×10^{-5}	3.30×10^{-9}	3.70×10^{-7}	1.11×10^{-2}	5.95×10^{-7}
Iodine-129	9.88×10^{-15}	3.53×10^{-6}	4.97×10^{-11}	1.07×10^{-14}	5.86×10^{-5}	1.41×10^{-9}	3.70×10^{-10}	1.54×10^{-3}	3.78×10^{-8}
Total	**N/A**	**3.42×10^{-5}**	**1.40×10^{-9}**	**N/A**	**1.28×10^{-4}**	**4.71×10^{-9}**	**N/A**	**1.27×10^{-2}**	**6.33×10^{-7}**
Year of peak impact	8027	8027	8027	8234	8234	8234	8233	8233	8233
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	2.67×10^{-8}	1.60×10^{-7}	0.00
Chromium	0.00	0.00	1.64×10^{-16}	0.00	0.00	7.54×10^{-12}	1.43×10^{-4}	6.29×10^{-4}	3.41×10^{-7}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	1.46×10^{-5}	2.13×10^{-6}	0.00
Nitrate	3.56×10^{-5}	5.38×10^{-6}	0.00	3.56×10^{-5}	3.35×10^{-3}	0.00	2.14	1.00×10^{-1}	0.00
Total	**N/A**	**5.38×10^{-6}**	**1.64×10^{-16}**	**N/A**	**3.35×10^{-3}**	**7.54×10^{-12}**	**N/A**	**1.01×10^{-1}**	**3.41×10^{-7}**
Year of peak impact	8188	8188	4184	8188	8188	4184	7994	7994	4608

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–317. Waste Management Alternative 2, Disposal Group 3, Option Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	2.35×10^{-6}	4.11	1.46×10^{-4}	2.42×10^{-6}	1.09×10^{1}	4.80×10^{-4}	2.42×10^{-6}	2.23×10^{1}	1.05×10^{-3}
Iodine-129	3.90×10^{-9}	1.11	1.04×10^{-5}	3.22×10^{-9}	1.15	1.61×10^{-5}	3.22×10^{-9}	1.48	2.44×10^{-5}
Total	**N/A**	**5.22**	**1.56×10^{-4}**	**N/A**	**1.21×10^{1}**	**4.96×10^{-4}**	**N/A**	**2.38×10^{1}**	**1.07×10^{-3}**
Year of peak impact	7832	7832	7678	7678	7678	7678	7678	7678	7678
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	2.13×10^{-6}	3.05×10^{-7}	0.00	2.13×10^{-6}	3.17×10^{-7}	0.00	2.13×10^{-6}	3.45×10^{-7}	0.00
Chromium	1.75×10^{-3}	1.67×10^{-2}	0.00	1.75×10^{-3}	1.73×10^{-2}	8.82×10^{-12}	1.75×10^{-3}	2.60×10^{-2}	4.05×10^{-7}
Fluoride	1.35×10^{-4}	6.43×10^{-5}	0.00	1.35×10^{-4}	1.81×10^{-4}	0.00	1.35×10^{-4}	3.79×10^{-4}	0.00
Nitrate	1.46×10^{1}	2.61×10^{-1}	0.00	1.46×10^{1}	2.05	0.00	1.46×10^{1}	4.58	0.00
Total	**N/A**	**2.78×10^{-1}**	**0.00**	**N/A**	**2.07**	**8.82×10^{-12}**	**N/A**	**4.60**	**4.05×10^{-7}**
Year of peak impact	7954	7954	N/A	7954	7954	8501	7954	7954	8501

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–318. Waste Management Alternative 2, Disposal Group 3, Option Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.35×10^{-7}	4.12×10^{-1}	1.42×10^{-5}	2.35×10^{-7}	1.06	4.66×10^{-5}	2.35×10^{-7}	2.17	1.02×10^{-4}
Iodine-129	2.21×10^{-10}	6.30×10^{-2}	7.16×10^{-7}	2.21×10^{-10}	7.86×10^{-2}	1.11×10^{-6}	2.21×10^{-10}	1.02×10^{-1}	1.67×10^{-6}
Total	**N/A**	**4.75×10^{-1}**	**1.49×10^{-5}**	**N/A**	**1.14**	**4.77×10^{-5}**	**N/A**	**2.27**	**1.04×10^{-4}**
Year of peak impact	4018	4018	4018	4018	4018	4018	4018	4018	4018
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	7.61×10^{-7}	3.62×10^{-6}	0.00	1.04×10^{-6}	6.16×10^{-6}	0.00	1.04×10^{-6}	1.11×10^{-5}	0.00
Chromium	3.13×10^{-2}	2.98×10^{-1}	0.00	2.28×10^{-2}	2.25×10^{-1}	1.27×10^{-10}	2.28×10^{-2}	3.39×10^{-1}	5.82×10^{-6}
Nitrate	7.92	1.41×10^{-1}	0.00	9.27	1.30	0.00	9.27	2.90	0.00
Total	**N/A**	**4.39×10^{-1}**	**0.00**	**N/A**	**1.53**	**1.27×10^{-10}**	**N/A**	**3.24**	**5.82×10^{-6}**
Year of peak impact	3916	3916	N/A	3930	3930	3873	3930	3930	3873

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–319. Waste Management Alternative 2, Disposal Group 3, Option Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	5.77×10^{-7}	1.01	3.47×10^{-5}	5.77×10^{-7}	2.60	1.14×10^{-4}	5.77×10^{-7}	5.31	2.50×10^{-4}
Iodine-129	5.72×10^{-10}	1.63×10^{-1}	1.85×10^{-6}	5.72×10^{-10}	2.04×10^{-1}	2.86×10^{-6}	5.72×10^{-10}	2.63×10^{-1}	4.33×10^{-6}
Total	**N/A**	**1.17**	**3.66×10^{-5}**	**N/A**	**2.81**	**1.17×10^{-4}**	**N/A**	**5.58**	**2.54×10^{-4}**
Year of peak impact	7723	7723	7723	7723	7723	7723	7723	7723	7723
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	6.57×10^{-7}	3.13×10^{-6}	0.00	4.84×10^{-7}	2.88×10^{-6}	0.00	4.84×10^{-7}	5.21×10^{-6}	0.00
Chromium	2.84×10^{-2}	2.71×10^{-1}	0.00	2.32×10^{-2}	2.29×10^{-1}	1.12×10^{-10}	2.32×10^{-2}	3.44×10^{-1}	5.12×10^{-6}
Nitrate	5.83	1.04×10^{-1}	0.00	7.82	1.10	0.00	7.82	2.45	0.00
Total	**N/A**	**3.75×10^{-1}**	**0.00**	**N/A**	**1.33**	**1.12×10^{-10}**	**N/A**	**2.79**	**5.12×10^{-6}**
Year of peak impact	3865	3865	N/A	3782	3782	3865	3782	3782	3865

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–320. Waste Management Alternative 2, Disposal Group 3, Option Case, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.73×10^{-7}	6.52×10^{-1}	2.24×10^{-5}	3.73×10^{-7}	1.68	7.38×10^{-5}	3.73×10^{-7}	3.43	1.61×10^{-4}
Iodine-129	3.98×10^{-10}	1.14×10^{-1}	1.29×10^{-6}	3.98×10^{-10}	1.42×10^{-1}	2.00×10^{-6}	3.98×10^{-10}	1.83×10^{-1}	3.02×10^{-6}
Total	**N/A**	**7.65×10^{-1}**	**2.37×10^{-5}**	**N/A**	**1.82**	**7.58×10^{-5}**	**N/A**	**3.61**	**1.64×10^{-4}**
Year of peak impact	8233	8233	8233	8233	8233	8233	8233	8233	8233
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	6.27×10^{-7}	2.98×10^{-6}	0.00	4.67×10^{-7}	2.78×10^{-6}	0.00	4.67×10^{-7}	5.02×10^{-6}	0.00
Chromium	2.08×10^{-2}	1.98×10^{-1}	0.00	1.10×10^{-2}	1.09×10^{-1}	8.15×10^{-11}	1.10×10^{-2}	1.64×10^{-1}	3.74×10^{-6}
Nitrate	3.40	6.06×10^{-2}	0.00	5.19	7.28×10^{-1}	0.00	5.19	1.62	0.00
Total	**N/A**	**2.58×10^{-1}**	**0.00**	**N/A**	**8.37×10^{-1}**	**8.15×10^{-11}**	**N/A**	**1.79**	**3.74×10^{-6}**
Year of peak impact	4487	4487	N/A	4701	4701	4487	4701	4701	4487

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–321. Waste Management Alternative 2, Disposal Group 3, Option Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	6.88×10^{-12}	3.10×10^{-5}	1.36×10^{-9}	6.63×10^{-12}	6.90×10^{-5}	3.28×10^{-9}	3.73×10^{-7}	1.12×10^{-2}	6.00×10^{-7}
Iodine-129	9.81×10^{-15}	3.50×10^{-6}	4.93×10^{-11}	1.10×10^{-14}	5.97×10^{-5}	1.43×10^{-9}	3.98×10^{-10}	1.62×10^{-3}	3.98×10^{-8}
Total	**N/A**	**3.45×10^{-5}**	**1.41×10^{-9}**	**N/A**	**1.29×10^{-4}**	**4.71×10^{-9}**	**N/A**	**1.28×10^{-2}**	**6.39×10^{-7}**
Year of peak impact	8027	8027	8027	8234	8234	8234	8233	8233	8233
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	4.13×10^{-7}	2.48×10^{-6}	0.00
Chromium	3.63×10^{-7}	3.58×10^{-6}	1.52×10^{-15}	3.63×10^{-7}	5.87×10^{-6}	6.98×10^{-11}	1.07×10^{-2}	4.71×10^{-2}	3.74×10^{-6}
Nitrate	1.10×10^{-4}	1.66×10^{-5}	0.00	1.10×10^{-4}	1.03×10^{-2}	0.00	4.53	2.39×10^{-1}	0.00
Total	**N/A**	**2.02×10^{-5}**	**1.52×10^{-15}**	**N/A**	**1.03×10^{-2}**	**6.98×10^{-11}**	**N/A**	**2.86×10^{-1}**	**3.74×10^{-6}**
Year of peak impact	4182	4182	4241	4182	4182	4241	4270	4270	4487

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–35 through Q–38 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier and the Core Zone Boundary for the drinking-water well user over time. Under the Base Case, the peak radiological risk occurs around CY 7900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. Under the Option Case, the peak radiological risk occurs around CY 7700 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater.

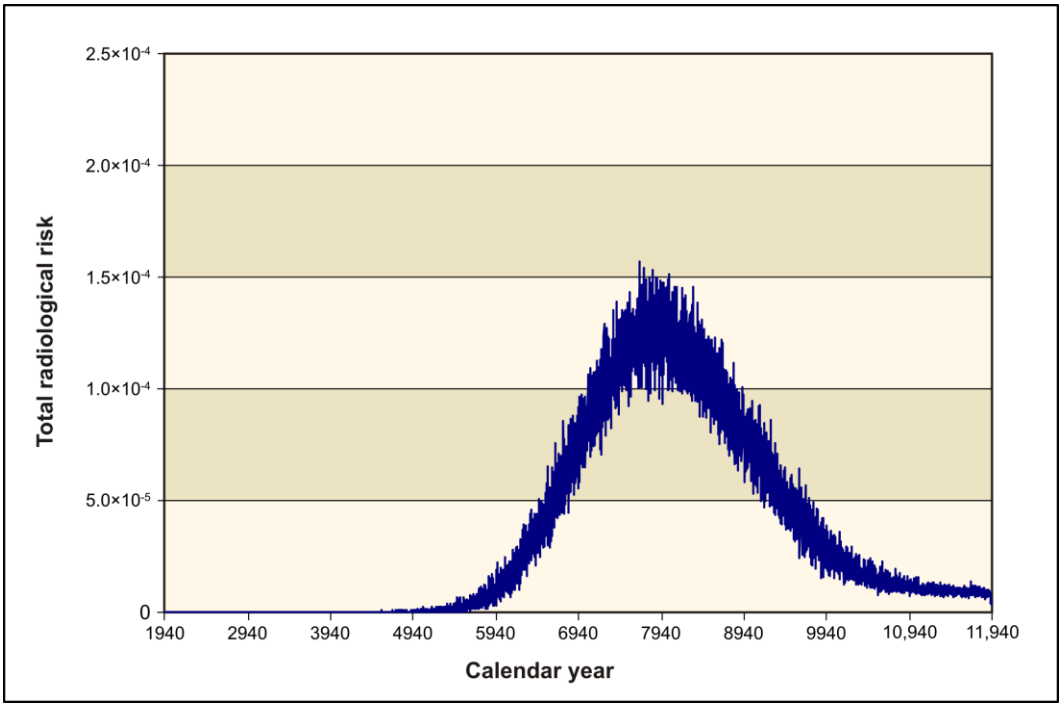

Figure Q–35. Waste Management Alternative 2, Disposal Group 3, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

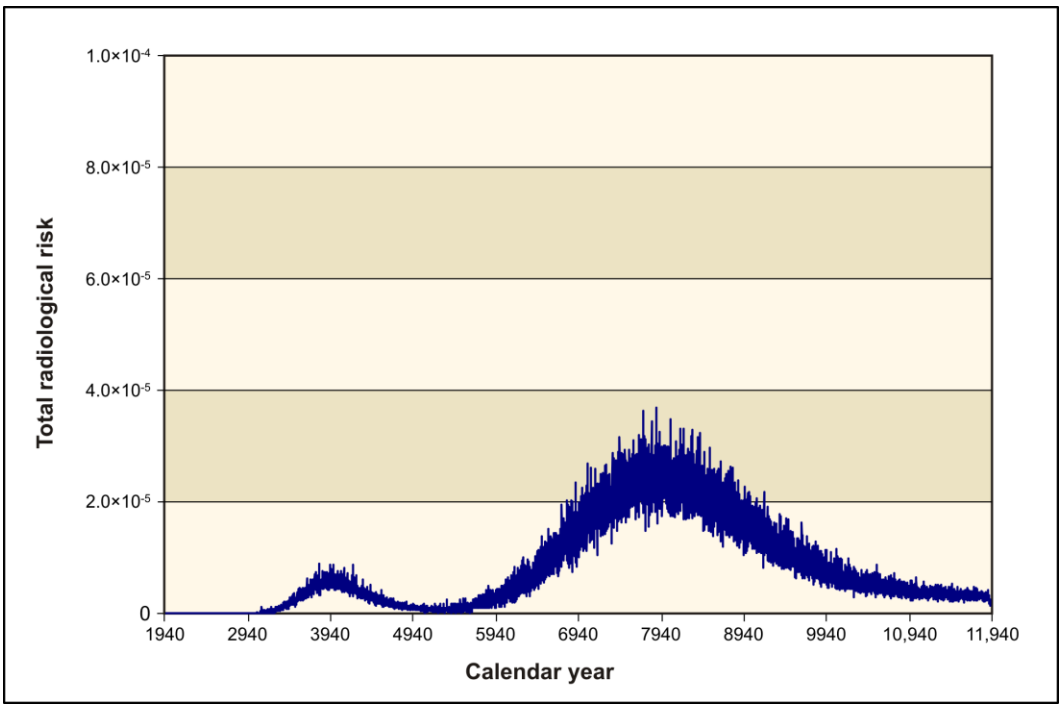

Figure Q–36. Waste Management Alternative 2, Disposal Group 3, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

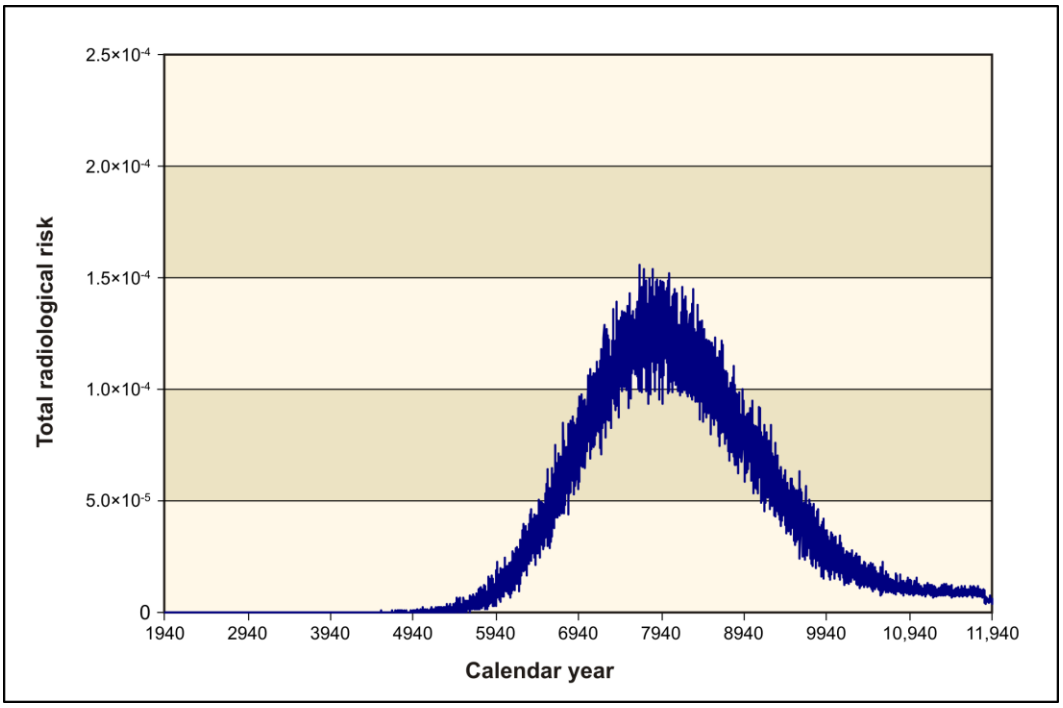

Figure Q–37. Waste Management Alternative 2, Disposal Group 3, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

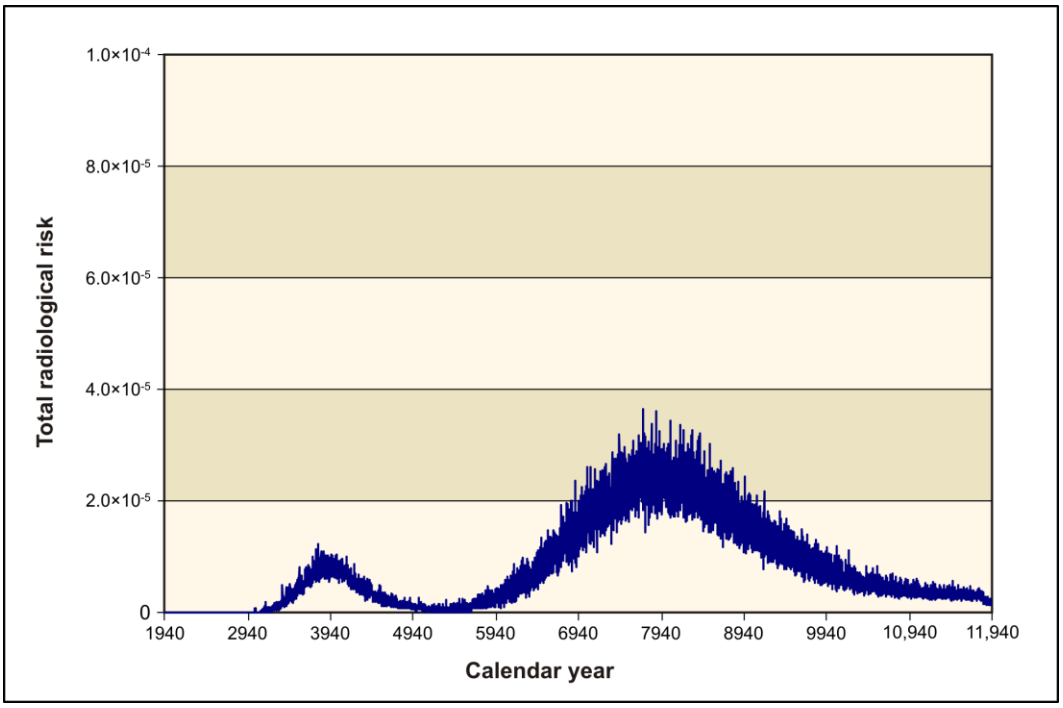

Figure Q–38. Waste Management Alternative 2, Disposal Group 3, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas

Under Waste Management Alternative 3, the waste from tank treatment operations would be disposed of in IDF-East, and waste from onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites would be disposed of in IDF-West. Waste from tank farm cleanup operations would be disposed of in the RPPDF. As a result, the waste disposed of in these three facilities would become available for release to the environment. Because of the different waste types that result from the Tank Closure action alternatives, three disposal groups were considered to account for the different IDF-East sizes and operational time periods. In addition, within these three disposal groups, subgroups were identified to allow consideration of the different waste types resulting from the Tank Closure alternatives. Potential human health impacts of these subgroups under this alternative are discussed in the following sections.

Q.3.3.1.3.1 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A

Disposal Group 1, Subgroup 1-A, addresses the waste resulting from Tank Closure Alternative 2B, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 2B.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–322 through Q–327, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129. The key chemical constituent contributors would be boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and the American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 3.42×10^{-1} person-rem per year for the year of maximum impact.

Table Q–322. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.90×10^{-7}	3.33×10^{-1}	1.24×10^{-5}	2.06×10^{-7}	9.27×10^{-1}	4.07×10^{-5}	2.06×10^{-7}	1.89	8.90×10^{-5}
Iodine-129	8.11×10^{-10}	2.31×10^{-1}	2.05×10^{-6}	6.34×10^{-10}	2.26×10^{-1}	3.18×10^{-6}	6.34×10^{-10}	2.92×10^{-1}	4.81×10^{-6}
Total	**N/A**	**5.64×10^{-1}**	**1.44×10^{-5}**	**N/A**	**1.15**	**4.39×10^{-5}**	**N/A**	**2.18**	**9.38×10^{-5}**
Year of peak impact	9827	9827	10129	10129	10129	10129	10129	10129	10129
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.32×10^{-3}	1.25×10^{-2}	0.00	1.32×10^{-3}	1.30×10^{-2}	8.22×10^{-12}	1.32×10^{-3}	1.96×10^{-2}	3.77×10^{-7}
Nitrate	1.21×10^{1}	2.16×10^{-1}	0.00	1.21×10^{1}	1.70	0.00	1.21×10^{1}	3.79	0.00
Total	**N/A**	**2.29×10^{-1}**	**0.00**	**N/A**	**1.71**	**8.22×10^{-12}**	**N/A**	**3.81**	**3.77×10^{-7}**
Year of peak impact	7962	7962	N/A	7962	7962	8438	7962	7962	8438

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–323. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–324. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–325. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.01×10^{-4}	3.82×10^{-3}	0.00	4.01×10^{-4}	3.96×10^{-3}	2.94×10^{-12}	4.01×10^{-4}	5.96×10^{-3}	1.35×10^{-7}
Nitrate	3.01	5.38×10^{-2}	0.00	3.01	4.23×10^{-1}	0.00	3.01	9.43×10^{-1}	0.00
Total	**N/A**	**5.76×10^{-2}**	**0.00**	**N/A**	**4.27×10^{-1}**	**2.94×10^{-12}**	**N/A**	**9.49×10^{-1}**	**1.35×10^{-7}**
Year of peak impact	8248	8248	N/A	8248	8248	3846	8248	8248	3846

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–326. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.45×10^{-4}	1.38×10^{-3}	0.00	1.45×10^{-4}	1.43×10^{-3}	1.87×10^{-12}	1.45×10^{-4}	2.15×10^{-3}	8.57×10^{-8}
Fluoride	9.90×10^{-6}	4.72×10^{-6}	0.00	9.90×10^{-6}	1.32×10^{-5}	0.00	9.90×10^{-6}	2.78×10^{-5}	0.00
Nitrate	2.03	3.63×10^{-2}	0.00	2.03	2.86×10^{-1}	0.00	2.03	6.37×10^{-1}	0.00
Total	**N/A**	**3.77×10^{-2}**	**0.00**	**N/A**	**2.87×10^{-1}**	**1.87×10^{-12}**	**N/A**	**6.39×10^{-1}**	**8.57×10^{-8}**
Year of peak impact	7927	7927	N/A	7927	7927	4481	7927	7927	4481

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–327. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.36×10^{-11}	6.13×10^{-5}	2.69×10^{-9}	1.34×10^{-11}	1.40×10^{-4}	6.63×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.96×10^{-14}	6.99×10^{-6}	9.84×10^{-11}	2.04×10^{-14}	1.11×10^{-4}	2.68×10^{-9}	2.11×10^{-9}	7.10×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.83×10^{-5}**	**2.79×10^{-9}**	**N/A**	**2.51×10^{-4}**	**9.31×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.45×10^{-4}	6.38×10^{-4}	8.56×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	9.90×10^{-6}	1.45×10^{-6}	0.00
Nitrate	3.74×10^{-5}	5.67×10^{-6}	0.00	3.74×10^{-5}	3.53×10^{-3}	0.00	2.03	1.00×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-6}**	**0.00**	**N/A**	**3.53×10^{-3}**	**0.00**	**N/A**	**1.01×10^{-1}**	**8.56×10^{-8}**
Year of peak impact	8064	8064	N/A	8064	8064	N/A	7927	7927	4481

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–39, Q–40, and Q–41 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 11,300 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

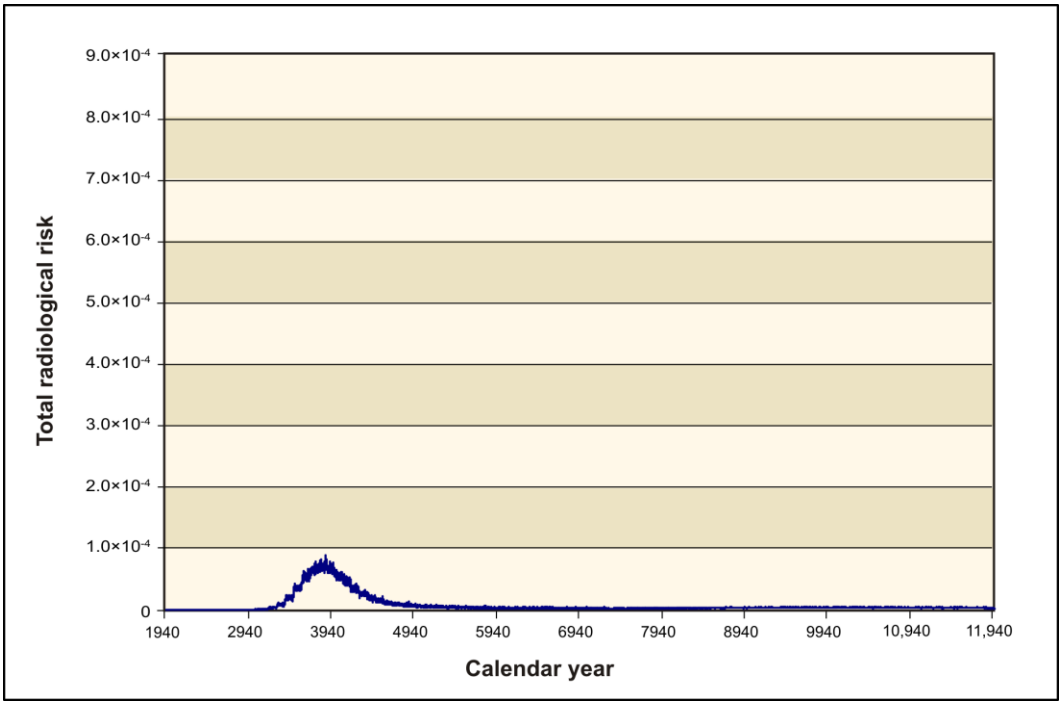

Figure Q–39. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

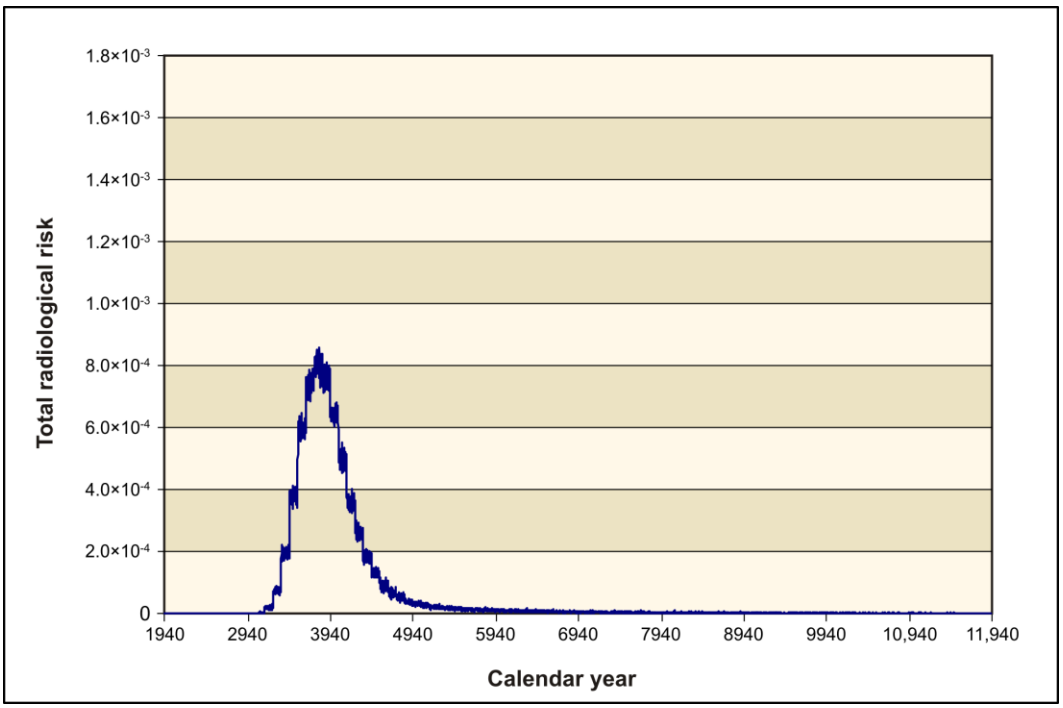

Figure Q–40. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

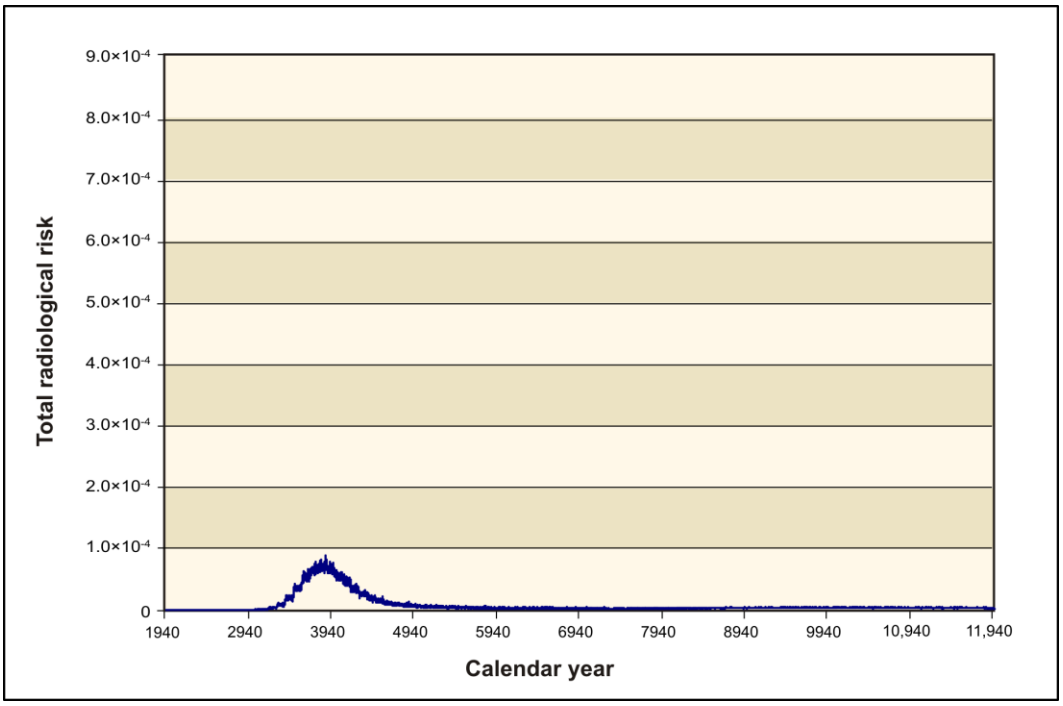

Figure Q–41. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.2 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B

Disposal Group 1, Subgroup 1-B, addresses the waste resulting from Tank Closure Alternative 3A, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Bulk vitrification glass
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 3A.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–328 through Q–333, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129. The key chemical constituent contributors would be boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 3.42×10^{-1} person-rem per year for the year of maximum impact.

Table Q–328. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.43×10^{-6}	2.50	8.60×10^{-5}	1.43×10^{-6}	6.44	2.83×10^{-4}	1.43×10^{-6}	1.32×10^{1}	6.19×10^{-4}
Iodine-129	3.08×10^{-10}	8.78×10^{-2}	9.98×10^{-7}	3.08×10^{-10}	1.10×10^{-1}	1.54×10^{-6}	3.08×10^{-10}	1.42×10^{-1}	2.34×10^{-6}
Total	**N/A**	**2.59**	**8.70×10^{-5}**	**N/A**	**6.55**	**2.84×10^{-4}**	**N/A**	**1.33×10^{1}**	**6.21×10^{-4}**
Year of peak impact	7629	7629	7629	7629	7629	7629	7629	7629	7629
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	5.87×10^{-4}	5.59×10^{-3}	0.00	5.87×10^{-4}	5.80×10^{-3}	3.72×10^{-12}	5.87×10^{-4}	8.72×10^{-3}	1.71×10^{-7}
Nitrate	1.03×10^{1}	1.83×10^{-1}	0.00	1.03×10^{1}	1.44	0.00	1.03×10^{1}	3.22	0.00
Total	**N/A**	**1.89×10^{-1}**	**0.00**	**N/A**	**1.45**	**3.72×10^{-12}**	**N/A**	**3.22**	**1.71×10^{-7}**
Year of peak impact	8052	8052	N/A	8052	8052	8691	8052	8052	8691

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–329. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–330. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–331. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.73×10^{-4}	1.65×10^{-3}	0.00	1.73×10^{-4}	1.71×10^{-3}	2.94×10^{-12}	1.73×10^{-4}	2.57×10^{-3}	1.35×10^{-7}
Nitrate	2.79	4.99×10^{-2}	0.00	2.79	3.92×10^{-1}	0.00	2.79	8.75×10^{-1}	0.00
Total	**N/A**	**5.15×10^{-2}**	**0.00**	**N/A**	**3.94×10^{-1}**	**2.94×10^{-12}**	**N/A**	**8.77×10^{-1}**	**1.35×10^{-7}**
Year of peak impact	8095	8095	N/A	8095	8095	3846	8095	8095	3846

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–332. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.04×10^{-4}	9.93×10^{-4}	0.00	1.04×10^{-4}	1.03×10^{-3}	1.87×10^{-12}	1.04×10^{-4}	1.55×10^{-3}	8.57×10^{-8}
Fluoride	1.24×10^{-5}	5.90×10^{-6}	0.00	1.24×10^{-5}	1.66×10^{-5}	0.00	1.24×10^{-5}	3.48×10^{-5}	0.00
Nitrate	2.21	3.94×10^{-2}	0.00	2.21	3.10×10^{-1}	0.00	2.21	6.90×10^{-1}	0.00
Total	**N/A**	**4.04×10^{-2}**	**0.00**	**N/A**	**3.11×10^{-1}**	**1.87×10^{-12}**	**N/A**	**6.92×10^{-1}**	**8.57×10^{-8}**
Year of peak impact	7940	7940	N/A	7940	7940	4481	7940	7940	4481

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–333. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.36×10^{-11}	6.13×10^{-5}	2.69×10^{-9}	1.34×10^{-11}	1.40×10^{-4}	6.63×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.96×10^{-14}	6.99×10^{-6}	9.84×10^{-11}	2.04×10^{-14}	1.11×10^{-4}	2.68×10^{-9}	2.11×10^{-9}	7.10×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.83×10^{-5}**	**2.79×10^{-9}**	**N/A**	**2.51×10^{-4}**	**9.31×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.04×10^{-4}	4.59×10^{-4}	8.56×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	1.24×10^{-5}	1.81×10^{-6}	0.00
Nitrate	3.37×10^{-5}	5.11×10^{-6}	0.00	3.37×10^{-5}	3.18×10^{-3}	0.00	2.21	1.00×10^{-1}	0.00
Total	**N/A**	**5.11×10^{-6}**	**0.00**	**N/A**	**3.18×10^{-3}**	**0.00**	**N/A**	**1.01×10^{-1}**	**8.56×10^{-8}**
Year of peak impact	8025	8025	N/A	8025	8025	N/A	7940	7940	4481

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–42, Q–43, and Q–44 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3800 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 7600 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

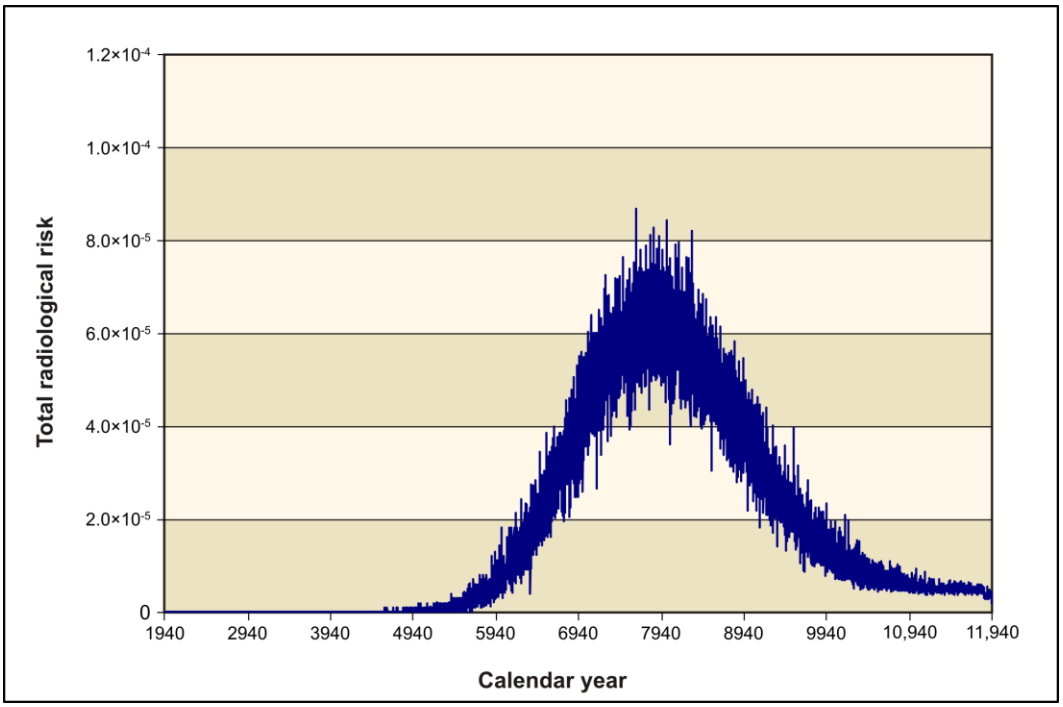

Figure Q–42. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

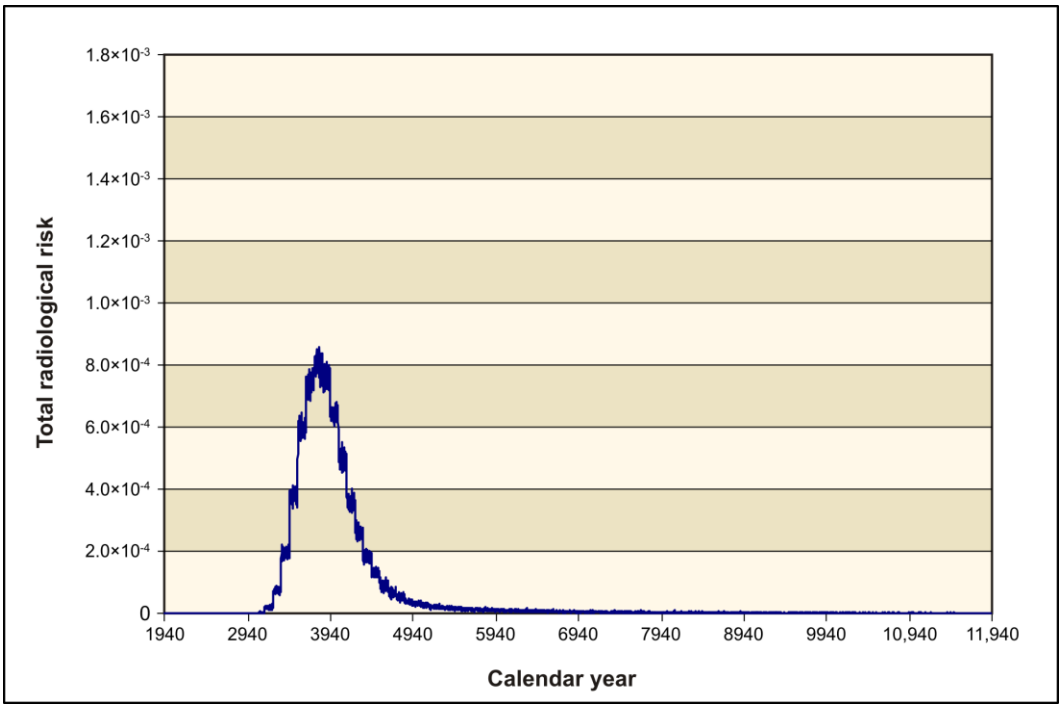

Figure Q–43. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

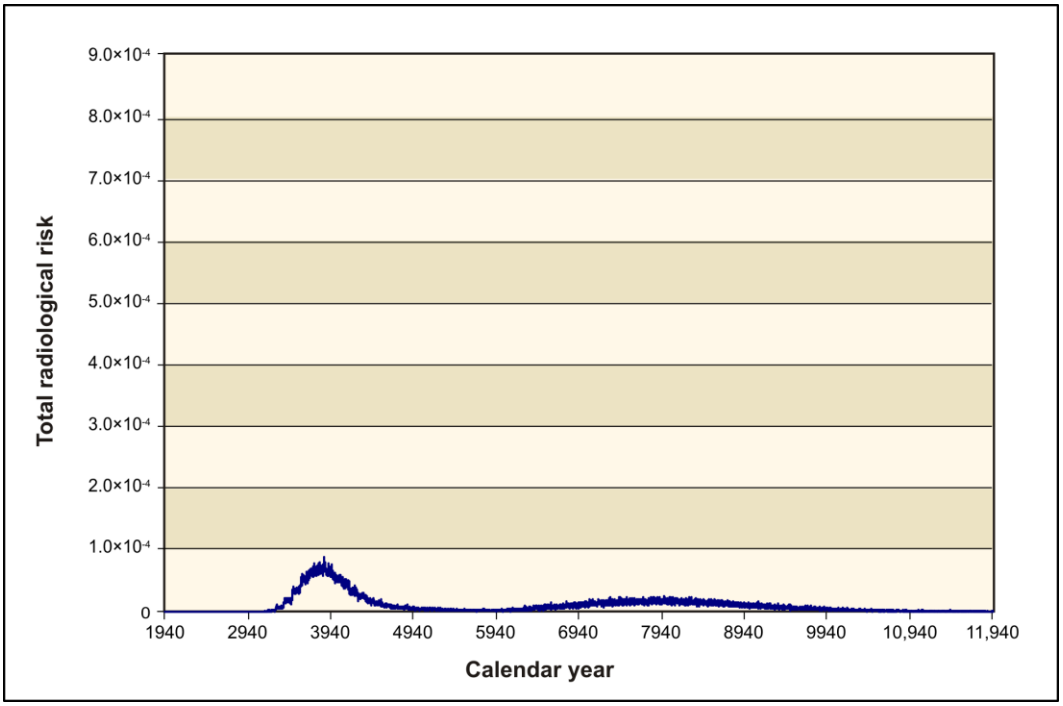

Figure Q–44. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.3 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C

Disposal Group 1, Subgroup 1-C, addresses the waste resulting from Tank Closure Alternative 3B, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Cast stone waste
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 3B.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–334 through Q–339, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier and the Core Zone Boundary for the drinking-water well user, resident farmer, and American Indian resident farmer. In addition, the Hazard Index guideline would be exceeded at the Columbia River nearshore for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.42×10^{-1} person-rem per year for the year of maximum impact.

Table Q–334. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.97×10^{-6}	5.20	1.79×10^{-4}	2.97×10^{-6}	1.34×10^{1}	5.88×10^{-4}	2.97×10^{-6}	2.73×10^{1}	1.29×10^{-3}
Iodine-129	2.47×10^{-10}	7.05×10^{-2}	8.02×10^{-7}	2.47×10^{-10}	8.81×10^{-2}	1.24×10^{-6}	2.47×10^{-10}	1.14×10^{-1}	1.88×10^{-6}
Total	**N/A**	**5.27**	**1.80×10^{-4}**	**N/A**	**1.35×10^{1}**	**5.89×10^{-4}**	**N/A**	**2.75×10^{1}**	**1.29×10^{-3}**
Year of peak impact	10,774	10,774	10,774	10,774	10,774	10,774	10,774	10,774	10,774
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.15×10^{-2}	5.45×10^{-2}	0.00	1.63×10^{-2}	9.69×10^{-2}	0.00	1.63×10^{-2}	1.75×10^{-1}	0.00
Chromium	2.95×10^{-1}	2.81	0.00	2.34×10^{-1}	2.31	1.16×10^{-9}	2.34×10^{-1}	3.47	5.32×10^{-5}
Nitrate	2.96×10^{1}	5.28×10^{-1}	0.00	4.26×10^{1}	5.98	0.00	4.26×10^{1}	1.33×10^{1}	0.00
Total	**N/A**	**3.39**	**0.00**	**N/A**	**8.38**	**1.16×10^{-9}**	**N/A**	**1.70×10^{1}**	**5.32×10^{-5}**
Year of peak impact	8608	8608	N/A	8888	8888	8608	8888	8888	8608

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–335. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–336. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–337. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	3.24×10^{-3}	1.54×10^{-2}	0.00	3.60×10^{-3}	2.14×10^{-2}	0.00	3.60×10^{-3}	3.88×10^{-2}	0.00
Chromium	1.02×10^{-1}	9.68×10^{-1}	0.00	7.55×10^{-2}	7.45×10^{-1}	3.99×10^{-10}	7.55×10^{-2}	1.12	1.83×10^{-5}
Nitrate	7.02	1.25×10^{-1}	0.00	1.61×10^{1}	2.26	0.00	1.61×10^{1}	5.04	0.00
Total	**N/A**	**1.11**	**0.00**	**N/A**	**3.03**	**3.99×10^{-10}**	**N/A**	**6.20**	**1.83×10^{-5}**
Year of peak impact	8680	8680	N/A	8973	8973	8680	8973	8973	8680

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–338. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.34×10^{-3}	1.12×10^{-2}	0.00	2.16×10^{-3}	1.29×10^{-2}	0.00	2.16×10^{-3}	2.33×10^{-2}	0.00
Chromium	7.85×10^{-2}	7.47×10^{-1}	0.00	6.39×10^{-2}	6.31×10^{-1}	3.08×10^{-10}	6.39×10^{-2}	9.50×10^{-1}	1.41×10^{-5}
Fluoride	2.48×10^{-6}	1.18×10^{-6}	0.00	4.95×10^{-6}	6.62×10^{-6}	0.00	4.95×10^{-6}	1.39×10^{-5}	0.00
Nitrate	5.45	9.74×10^{-2}	0.00	1.09×10^{1}	1.52	0.00	1.09×10^{1}	3.40	0.00
Total	**N/A**	**8.56×10^{-1}**	**0.00**	**N/A**	**2.17**	**3.08×10^{-10}**	**N/A**	**4.37**	**1.41×10^{-5}**
Year of peak impact	8594	8594	N/A	8469	8469	8594	8469	8469	8594

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–339. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.36×10^{-11}	6.13×10^{-5}	2.69×10^{-9}	1.34×10^{-11}	1.40×10^{-4}	6.63×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.96×10^{-14}	6.99×10^{-6}	9.84×10^{-11}	2.04×10^{-14}	1.11×10^{-4}	2.68×10^{-9}	2.11×10^{-9}	7.10×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.83×10^{-5}**	**2.79×10^{-9}**	**N/A**	**2.51×10^{-4}**	**9.31×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.92×10^{-8}	3.52×10^{-7}	0.00	5.89×10^{-8}	6.34×10^{-7}	0.00	2.16×10^{-3}	1.30×10^{-2}	0.00
Chromium	1.06×10^{-6}	1.05×10^{-5}	4.59×10^{-15}	1.04×10^{-6}	1.68×10^{-5}	2.10×10^{-10}	6.39×10^{-2}	2.81×10^{-1}	1.41×10^{-5}
Nitrate	1.89×10^{-4}	2.87×10^{-5}	0.00	1.91×10^{-4}	1.80×10^{-2}	0.00	1.09×10^{1}	5.23×10^{-1}	0.00
Total	**N/A**	**3.95×10^{-5}**	**4.59×10^{-15}**	**N/A**	**1.80×10^{-2}**	**2.10×10^{-10}**	**N/A**	**8.18×10^{-1}**	**1.41×10^{-5}**
Year of peak impact	8702	8702	9094	8672	8672	9094	8469	8469	8594

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–45, Q–46, and Q–47 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At IDF-East, the peak radiological lifetime risk of incidence of cancer occurs around CY 10,800 as a result of slower movement in the vadose zone for waste forms disposed of in IDF-East.

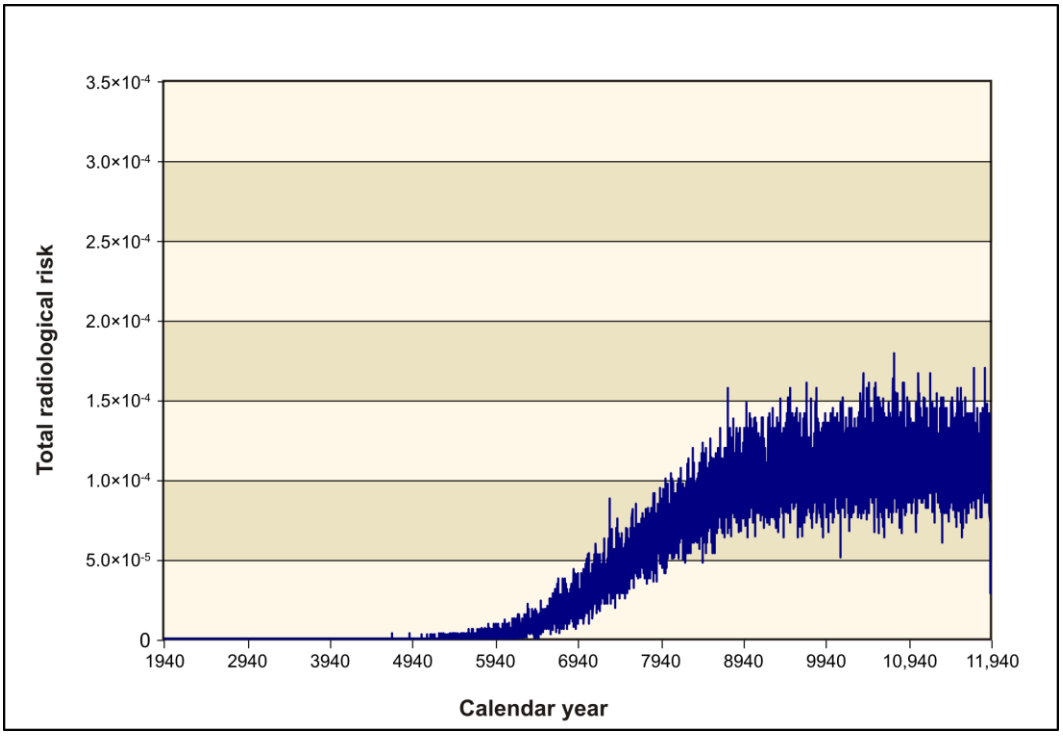

Figure Q–45. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

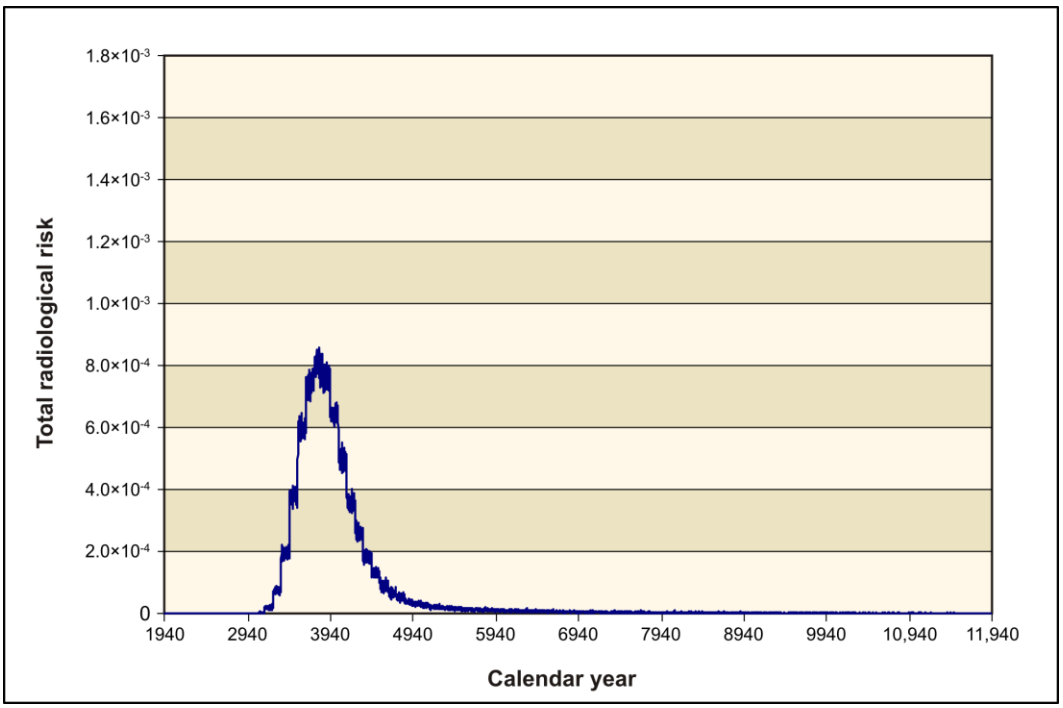

Figure Q–46. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

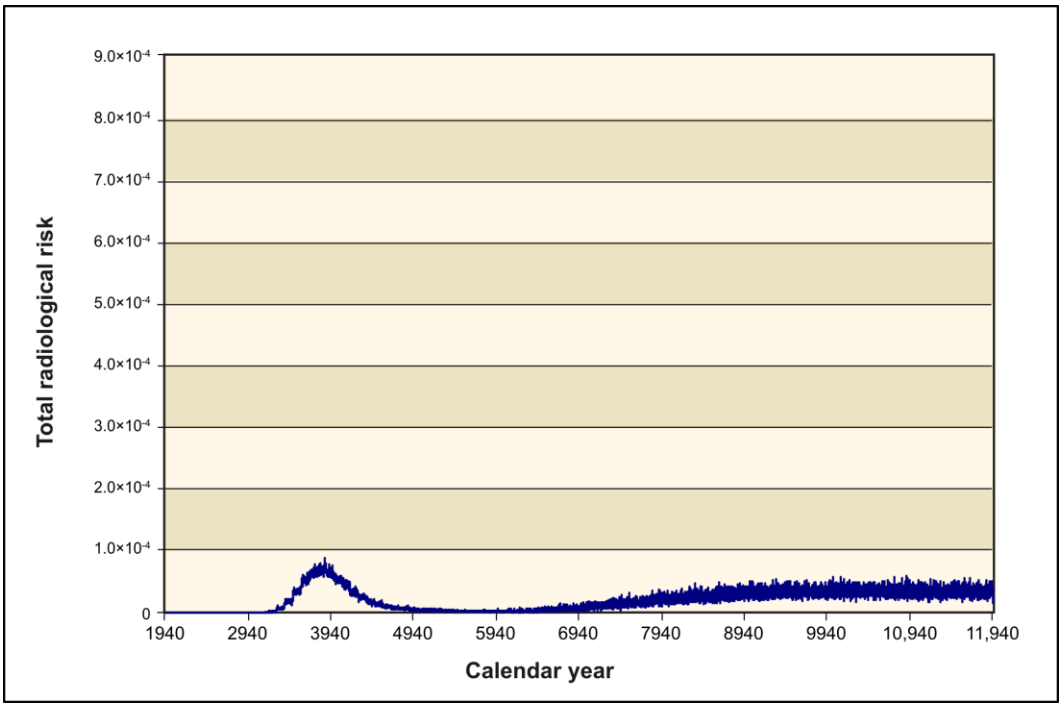

Figure Q–47. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.4 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D

Disposal Group 1, Subgroup 1-D, addresses the waste resulting from Tank Closure Alternative 3C, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Steam reforming waste
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 3C.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–340 through Q–345, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the resident farmer and American Indian resident farmer. In addition, the Hazard Index guideline would be exceeded at the Core Zone Boundary for the American Indian resident farmer. Population dose is estimated as 2.21×10^{-1} person-rem per year for the year of maximum impact.

Table Q–340. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.16×10^{-6}	2.02	6.97×10^{-5}	1.16×10^{-6}	5.22	2.29×10^{-4}	1.16×10^{-6}	1.07×10^{1}	5.01×10^{-4}
Iodine-129	9.00×10^{-10}	2.57×10^{-1}	2.92×10^{-6}	9.00×10^{-10}	3.21×10^{-1}	4.51×10^{-6}	9.00×10^{-10}	4.14×10^{-1}	6.83×10^{-6}
Total	**N/A**	**2.28**	**7.26×10^{-5}**	**N/A**	**5.54**	**2.34×10^{-4}**	**N/A**	**1.11×10^{1}**	**5.08×10^{-4}**
Year of peak impact	11,434	11,434	11,434	11,434	11,434	11,434	11,434	11,434	11,434
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.05×10^{-2}	9.95×10^{-2}	0.00	1.05×10^{-2}	1.03×10^{-1}	7.57×10^{-11}	1.05×10^{-2}	1.55×10^{-1}	3.47×10^{-6}
Nitrate	1.15×10^{1}	2.04×10^{-1}	0.00	1.15×10^{1}	1.61	0.00	1.15×10^{1}	3.58	0.00
Total	**N/A**	**3.04×10^{-1}**	**0.00**	**N/A**	**1.71**	**7.57×10^{-11}**	**N/A**	**3.74**	**3.47×10^{-6}**
Year of peak impact	8207	8207	N/A	8207	8207	11,378	8207	8207	11,378

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–341. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–342. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–343. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	4.26×10^{-3}	4.05×10^{-2}	0.00	2.42×10^{-3}	2.39×10^{-2}	2.38×10^{-11}	2.42×10^{-3}	3.59×10^{-2}	1.09×10^{-6}
Nitrate	2.90	5.18×10^{-2}	0.00	3.15	4.42×10^{-1}	0.00	3.15	9.86×10^{-1}	0.00
Total	**N/A**	**9.23×10^{-2}**	**0.00**	**N/A**	**4.66×10^{-1}**	**2.38×10^{-11}**	**N/A**	**1.02**	**1.09×10^{-6}**
Year of peak impact	8317	8317	N/A	8121	8121	10,691	8121	8121	10,691

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–344. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	3.56×10^{-3}	3.39×10^{-2}	0.00	1.95×10^{-3}	1.92×10^{-2}	1.83×10^{-11}	1.95×10^{-3}	2.89×10^{-2}	8.39×10^{-7}
Fluoride	7.43×10^{-6}	3.54×10^{-6}	0.00	9.90×10^{-6}	1.32×10^{-5}	0.00	9.90×10^{-6}	2.78×10^{-5}	0.00
Nitrate	1.66	2.96×10^{-2}	0.00	2.40	3.38×10^{-1}	0.00	2.40	7.53×10^{-1}	0.00
Total	**N/A**	**6.35×10^{-2}**	**0.00**	**N/A**	**3.57×10^{-1}**	**1.83×10^{-11}**	**N/A**	**7.82×10^{-1}**	**8.39×10^{-7}**
Year of peak impact	8284	8284	N/A	7899	7899	11,049	7899	7899	11,049

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–345. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.36×10^{-11}	6.13×10^{-5}	2.69×10^{-9}	1.34×10^{-11}	1.40×10^{-4}	6.63×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.96×10^{-14}	6.99×10^{-6}	9.84×10^{-11}	2.04×10^{-14}	1.11×10^{-4}	2.68×10^{-9}	2.11×10^{-9}	7.10×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.83×10^{-5}**	**2.79×10^{-9}**	**N/A**	**2.51×10^{-4}**	**9.31×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	4.01×10^{-8}	3.96×10^{-7}	2.90×10^{-16}	3.45×10^{-8}	5.59×10^{-7}	1.33×10^{-11}	1.95×10^{-3}	8.56×10^{-3}	8.38×10^{-7}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	9.90×10^{-6}	1.45×10^{-6}	0.00
Nitrate	3.88×10^{-5}	5.87×10^{-6}	0.00	3.90×10^{-5}	3.68×10^{-3}	0.00	2.40	1.11×10^{-1}	0.00
Total	**N/A**	**6.26×10^{-6}**	**2.90×10^{-16}**	**N/A**	**3.68×10^{-3}**	**1.33×10^{-11}**	**N/A**	**1.20×10^{-1}**	**8.38×10^{-7}**
Year of peak impact	8293	8293	11,332	8166	8166	11,332	7899	7899	11,049

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–48, Q–49, and Q–50 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 8200 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-East. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-West barrier, the radiological lifetime risk of incidence of cancer occurs around CY 3700, and at the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs near the end of the analysis period as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

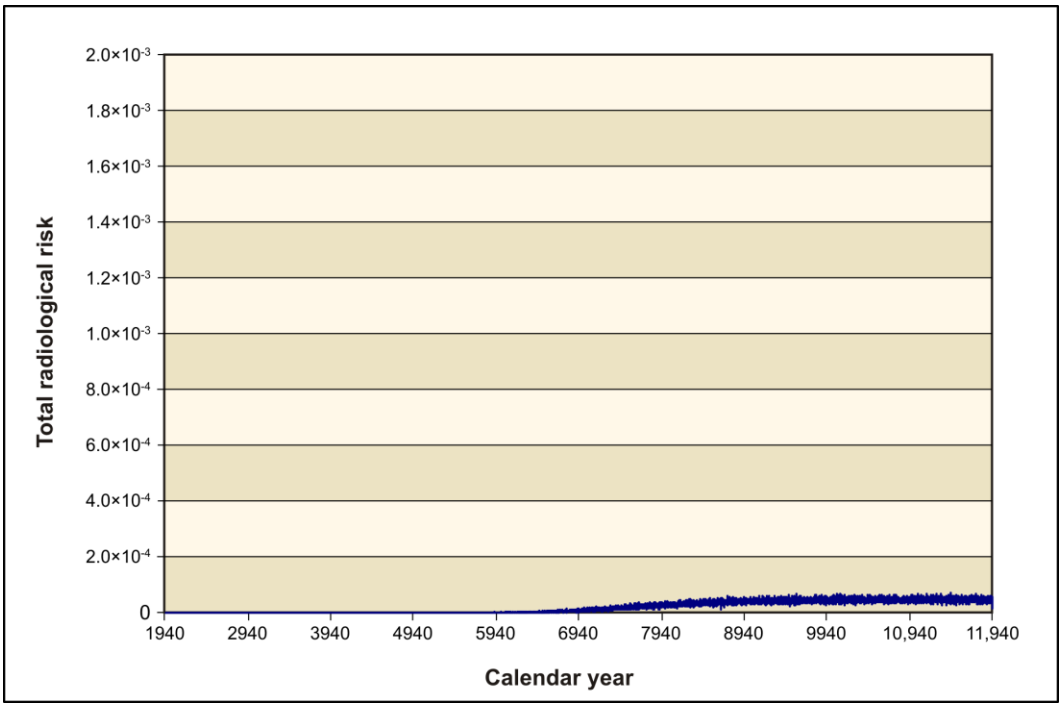

Figure Q–48. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

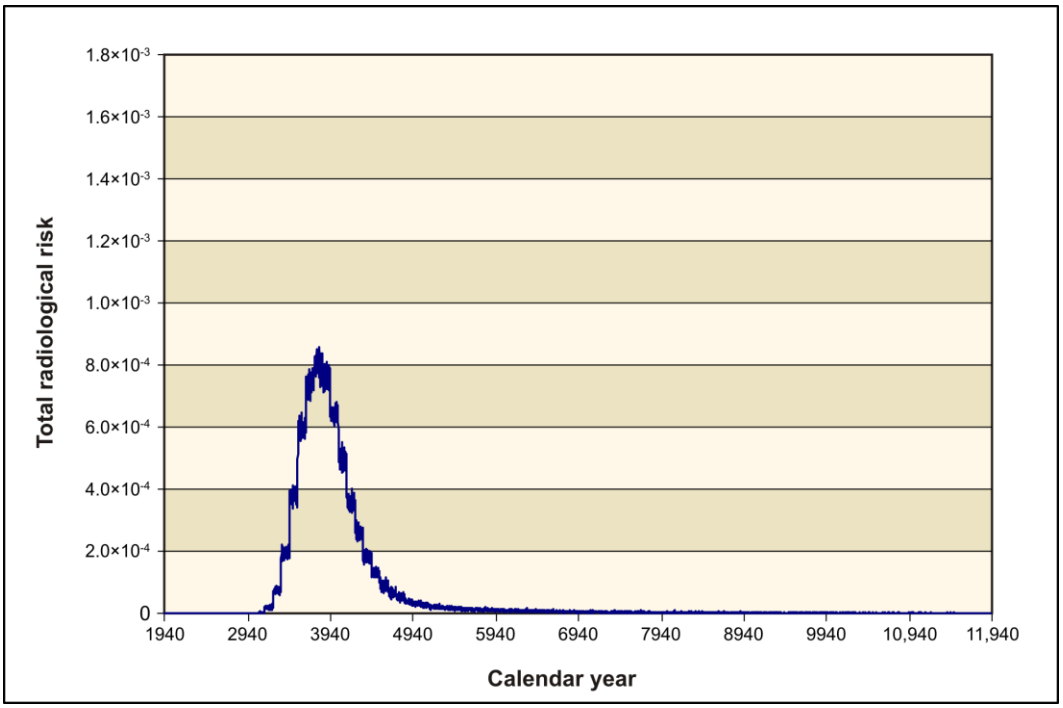

Figure Q–49. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

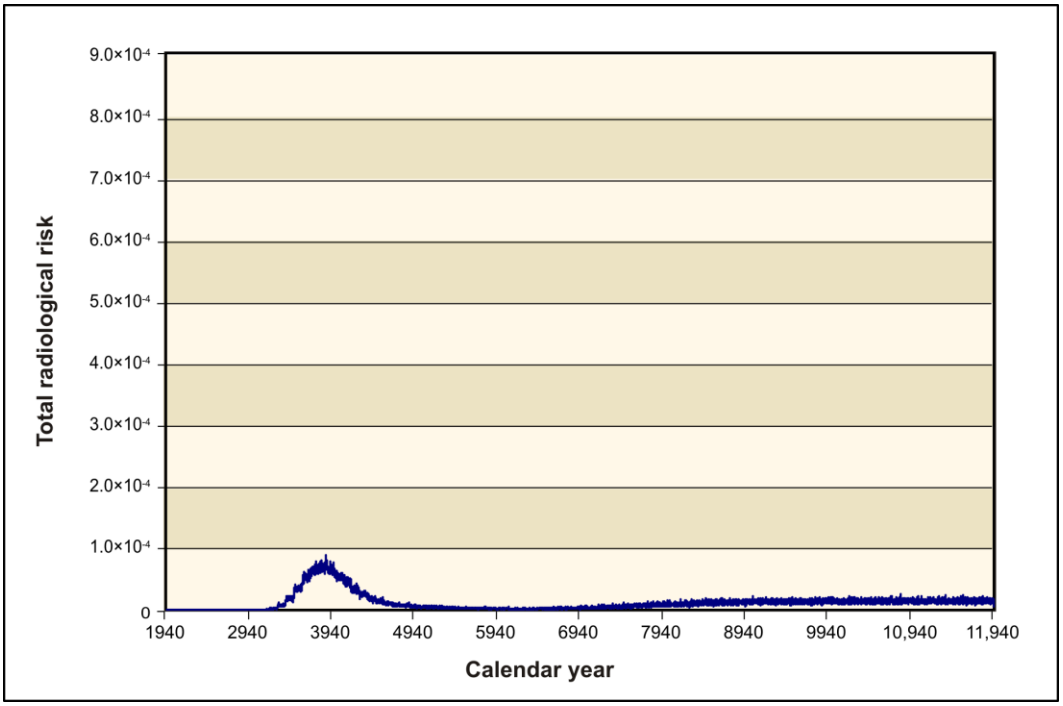

Figure Q–50. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.5 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E

Disposal Group 1, Subgroup 1-E, addresses the waste resulting from Tank Closure Alternative 4, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Bulk vitrification glass
- Cast stone waste
- Sulfate grout
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 4.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–346 through Q–351, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the drinking-water well user, resident farmer, and American Indian resident farmer, and at the Core Zone Boundary and Columbia River nearshore for the resident farmer and American Indian resident farmer. Population dose is estimated as 4.43×10^{-1} person-rem per year for the year of maximum impact.

Table Q–346. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	3.84×10^{-6}	6.71	2.31×10^{-4}	3.84×10^{-6}	1.73×10^{1}	7.60×10^{-4}	3.84×10^{-6}	3.53×10^{1}	1.66×10^{-3}
Iodine-129	4.59×10^{-10}	1.31×10^{-1}	1.49×10^{-6}	4.59×10^{-10}	1.63×10^{-1}	2.30×10^{-6}	4.59×10^{-10}	2.11×10^{-1}	3.48×10^{-6}
Total	**N/A**	**6.84**	**2.32×10^{-4}**	**N/A**	**1.75×10^{1}**	**7.62×10^{-4}**	**N/A**	**3.55×10^{1}**	**1.66×10^{-3}**
Year of peak impact	10,921	10,921	10,921	10,921	10,921	10,921	10,921	10,921	10,921
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	9.03×10^{-3}	4.30×10^{-2}	0.00	7.76×10^{-3}	4.62×10^{-2}	0.00	7.76×10^{-3}	8.35×10^{-2}	0.00
Chromium	1.75×10^{-1}	1.67	0.00	1.41×10^{-1}	1.40	6.88×10^{-10}	1.41×10^{-1}	2.10	3.15×10^{-5}
Nitrate	2.05×10^{1}	3.67×10^{-1}	0.00	2.63×10^{1}	3.70	0.00	2.63×10^{1}	8.24	0.00
Total	**N/A**	**2.08**	**0.00**	**N/A**	**5.14**	**6.88×10^{-10}**	**N/A**	**1.04×10^{1}**	**3.15×10^{-5}**
Year of peak impact	9008	9008	N/A	8599	8599	9008	8599	8599	9008

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–347. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–348. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.07×10^{-7}	1.87×10^{-1}	6.45×10^{-6}	1.07×10^{-7}	4.83×10^{-1}	2.12×10^{-5}	1.07×10^{-7}	9.86×10^{-1}	4.64×10^{-5}
Iodine-129	1.74×10^{-10}	4.95×10^{-2}	5.62×10^{-7}	1.74×10^{-10}	6.18×10^{-2}	8.70×10^{-7}	1.74×10^{-10}	7.99×10^{-2}	1.32×10^{-6}
Total	**N/A**	**2.37×10^{-1}**	**7.01×10^{-6}**	**N/A**	**5.45×10^{-1}**	**2.21×10^{-5}**	**N/A**	**1.07**	**4.77×10^{-5}**
Year of peak impact	3785	3785	3785	3785	3785	3785	3785	3785	3785
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	6.84×10^{-3}	6.51×10^{-2}	0.00	6.47×10^{-3}	6.39×10^{-2}	2.69×10^{-11}	6.47×10^{-3}	9.61×10^{-2}	1.23×10^{-6}
Nitrate	2.25×10^{-1}	4.01×10^{-3}	0.00	2.63×10^{-1}	3.69×10^{-2}	0.00	2.63×10^{-1}	8.23×10^{-2}	0.00
Total	**N/A**	**6.92×10^{-2}**	**0.00**	**N/A**	**1.01×10^{-1}**	**2.69×10^{-11}**	**N/A**	**1.78×10^{-1}**	**1.23×10^{-6}**
Year of peak impact	3666	3666	N/A	3682	3682	3666	3682	3682	3666

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.

Key: N/A=not applicable.

Table Q–349. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.60×10^{-3}	7.61×10^{-3}	0.00	2.30×10^{-3}	1.37×10^{-2}	0.00	2.00×10^{-3}	2.15×10^{-2}	0.00
Chromium	5.25×10^{-2}	5.00×10^{-1}	0.00	4.45×10^{-2}	4.40×10^{-1}	2.06×10^{-10}	3.34×10^{-2}	4.97×10^{-1}	9.45×10^{-6}
Nitrate	6.66	1.19×10^{-1}	0.00	8.37	1.18	0.00	8.96	2.80	0.00
Total	**N/A**	**6.26×10^{-1}**	**0.00**	**N/A**	**1.63**	**2.06×10^{-10}**	**N/A**	**3.32**	**9.45×10^{-6}**
Year of peak impact	8873	8873	N/A	8787	8787	8873	8189	8189	8873

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–350. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.30×10^{-3}	6.18×10^{-3}	0.00	1.60×10^{-3}	9.51×10^{-3}	0.00	1.60×10^{-3}	1.72×10^{-2}	0.00
Chromium	3.98×10^{-2}	3.79×10^{-1}	0.00	1.91×10^{-2}	1.89×10^{-1}	1.56×10^{-10}	1.91×10^{-2}	2.84×10^{-1}	7.17×10^{-6}
Fluoride	2.48×10^{-6}	1.18×10^{-6}	0.00	2.48×10^{-6}	3.31×10^{-6}	0.00	2.48×10^{-6}	6.95×10^{-6}	0.00
Nitrate	4.62	8.25×10^{-2}	0.00	6.82	9.57×10^{-1}	0.00	6.82	2.13	0.00
Total	**N/A**	**4.68×10^{-1}**	**0.00**	**N/A**	**1.16**	**1.56×10^{-10}**	**N/A**	**2.43**	**7.17×10^{-6}**
Year of peak impact	8827	8827	N/A	9059	9059	8827	9059	9059	8827

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–351. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.38×10^{-11}	6.21×10^{-5}	2.85×10^{-9}	1.36×10^{-11}	1.42×10^{-4}	6.73×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	2.00×10^{-14}	7.13×10^{-6}	1.14×10^{-11}	2.08×10^{-14}	1.14×10^{-4}	2.73×10^{-9}	2.11×10^{-9}	7.11×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.92×10^{-5}**	**2.86×10^{-9}**	**N/A**	**2.55×10^{-4}**	**9.46×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	9205	4077	4077	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	3.12×10^{-8}	1.86×10^{-7}	0.00	3.12×10^{-8}	3.36×10^{-7}	0.00	1.30×10^{-3}	7.79×10^{-3}	0.00
Chromium	5.50×10^{-7}	5.43×10^{-6}	2.58×10^{-15}	5.50×10^{-7}	8.90×10^{-6}	1.18×10^{-10}	3.98×10^{-2}	1.75×10^{-1}	7.16×10^{-6}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.48×10^{-6}	3.61×10^{-7}	0.00
Nitrate	1.16×10^{-4}	1.75×10^{-5}	0.00	1.16×10^{-4}	1.09×10^{-2}	0.00	4.62	2.46×10^{-1}	0.00
Total	**N/A**	**2.32×10^{-5}**	**2.58×10^{-15}**	**N/A**	**1.09×10^{-2}**	**1.18×10^{-10}**	**N/A**	**4.29×10^{-1}**	**7.16×10^{-6}**
Year of peak impact	8855	8855	8960	8855	8855	8960	8827	8827	8827

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–51, Q–52, and Q–53 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 10,900 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

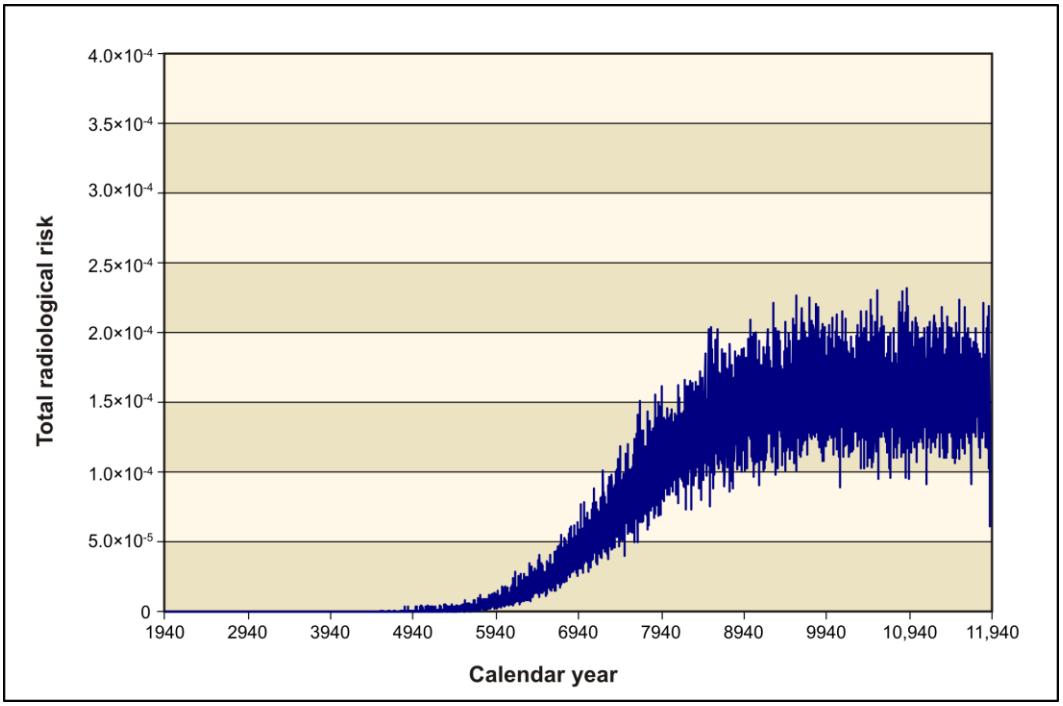

Figure Q–51. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

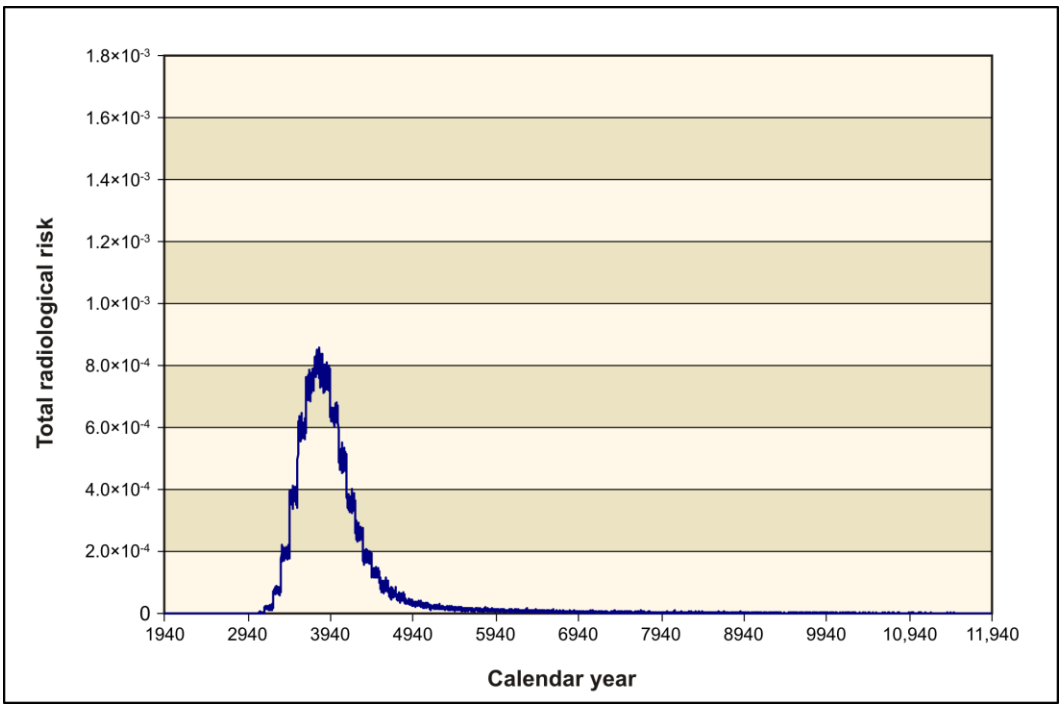

Figure Q–52. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

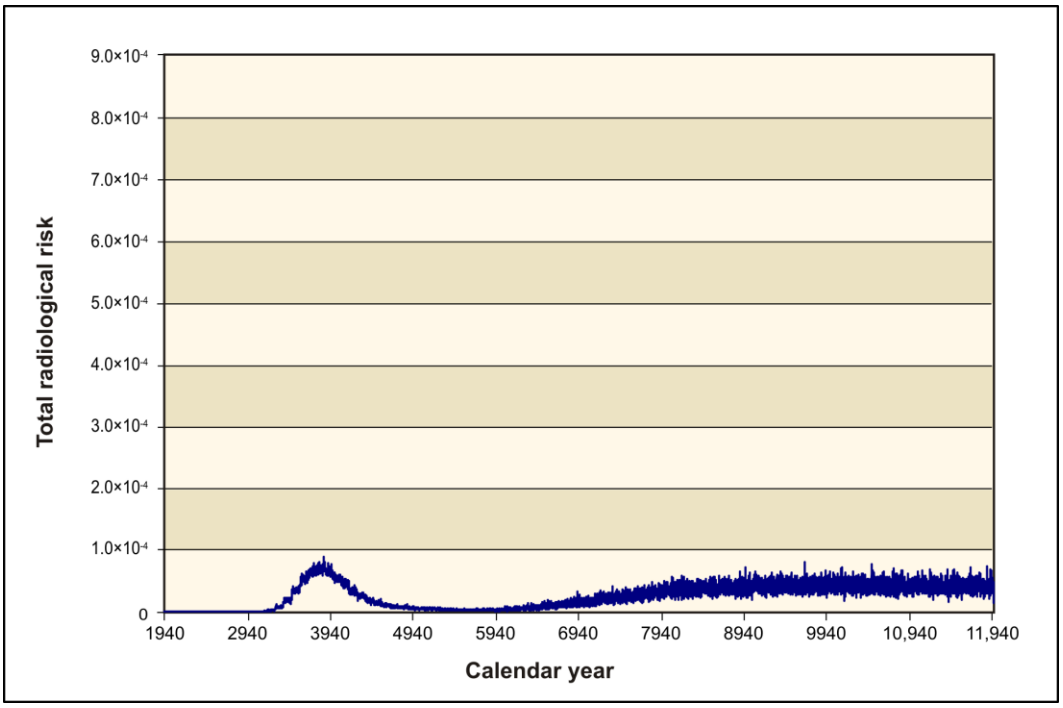

Figure Q–53. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.6 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F

Disposal Group 1, Subgroup 1-F, addresses the waste resulting from Tank Closure Alternative 5, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Bulk vitrification glass
- Cast stone waste
- Sulfate grout
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

The RPPDF would not be constructed or operated under Tank Closure Alternative 5 because tank closure cleanup activities would not be conducted.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–352 through Q–356, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded due primarily to chromium and nitrate at the IDF-East barrier for the drinking-water well user, resident farmer, and American Indian resident farmer. In addition, the Hazard Index guideline would be exceeded at the Core Zone Boundary for the resident farmer and American Indian resident farmer and at the Columbia River nearshore for the American Indian resident farmer. Population dose is estimated as 3.39×10^{-1} person-rem per year for the year of maximum impact.

Table Q–352. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.38×10^{-6}	2.42	8.33×10^{-5}	1.38×10^{-6}	6.24	2.74×10^{-4}	1.38×10^{-6}	1.27×10^{1}	5.99×10^{-4}
Iodine-129	3.97×10^{-10}	1.13×10^{-1}	1.29×10^{-6}	3.97×10^{-10}	1.41×10^{-1}	1.99×10^{-6}	3.97×10^{-10}	1.83×10^{-1}	3.01×10^{-6}
Total	**N/A**	**2.53**	**8.45×10^{-5}**	**N/A**	**6.38**	**2.76×10^{-4}**	**N/A**	**1.29×10^{1}**	**6.02×10^{-4}**
Year of peak impact	8878	8878	8878	8878	8878	8878	8878	8878	8878
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.15×10^{-3}	1.02×10^{-2}	0.00	2.34×10^{-3}	1.39×10^{-2}	0.00	2.34×10^{-3}	2.51×10^{-2}	0.00
Chromium	2.95×10^{-1}	2.81	0.00	2.50×10^{-1}	2.47	1.16×10^{-9}	2.50×10^{-1}	3.72	5.31×10^{-5}
Nitrate	1.16×10^{1}	2.07×10^{-1}	0.00	1.78×10^{1}	2.49	0.00	1.78×10^{1}	5.56	0.00
Total	**N/A**	**3.03**	**0.00**	**N/A**	**4.98**	**1.16×10^{-9}**	**N/A**	**9.31**	**5.31×10^{-5}**
Year of peak impact	8882	8882	N/A	8636	8636	8882	8636	8636	8882

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–353. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–354. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	9.92×10^{-4}	4.72×10^{-3}	0.00	3.97×10^{-4}	2.36×10^{-3}	0.00	3.97×10^{-4}	4.27×10^{-3}	0.00
Chromium	7.78×10^{-2}	7.41×10^{-1}	0.00	5.78×10^{-2}	5.71×10^{-1}	3.06×10^{-10}	5.78×10^{-2}	8.59×10^{-1}	1.40×10^{-5}
Nitrate	4.19	7.48×10^{-2}	0.00	6.25	8.77×10^{-1}	0.00	6.25	1.96	0.00
Total	**N/A**	**8.20×10^{-1}**	**0.00**	**N/A**	**1.45**	**3.06×10^{-10}**	**N/A**	**2.82**	**1.40×10^{-5}**
Year of peak impact	8588	8588	N/A	7810	7810	9057	7810	7810	9057

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–355. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.62×10^{-4}	2.68×10^{-3}	0.00	5.62×10^{-4}	3.35×10^{-3}	0.00	3.97×10^{-4}	4.27×10^{-3}	0.00
Chromium	5.87×10^{-2}	5.59×10^{-1}	0.00	5.87×10^{-2}	5.80×10^{-1}	2.34×10^{-10}	4.39×10^{-2}	6.53×10^{-1}	1.07×10^{-5}
Fluoride	4.95×10^{-6}	2.36×10^{-6}	0.00	4.95×10^{-6}	6.62×10^{-6}	0.00	4.95×10^{-6}	1.39×10^{-5}	0.00
Nitrate	2.80	4.99×10^{-2}	0.00	2.80	3.93×10^{-1}	0.00	3.66	1.15	0.00
Total	**N/A**	**6.11×10^{-1}**	**0.00**	**N/A**	**9.75×10^{-1}**	**2.34×10^{-10}**	**N/A**	**1.80**	**1.07×10^{-5}**
Year of peak impact	8535	8535	N/A	8535	8535	8241	8522	8522	8241

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–356. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.35×10^{-11}	6.08×10^{-5}	2.67×10^{-9}	1.33×10^{-11}	1.39×10^{-4}	6.58×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.94×10^{-14}	6.93×10^{-6}	9.77×10^{-11}	2.03×10^{-14}	1.10×10^{-4}	2.65×10^{-9}	2.11×10^{-9}	7.09×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.78×10^{-5}**	**2.77×10^{-9}**	**N/A**	**2.49×10^{-4}**	**9.24×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	1.06×10^{-8}	6.29×10^{-8}	0.00	1.04×10^{-8}	1.12×10^{-7}	0.00	5.62×10^{-4}	3.37×10^{-3}	0.00
Chromium	9.73×10^{-7}	9.61×10^{-6}	4.03×10^{-15}	8.17×10^{-7}	1.32×10^{-5}	1.85×10^{-10}	5.87×10^{-2}	2.58×10^{-1}	1.07×10^{-5}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	4.95×10^{-6}	7.23×10^{-7}	0.00
Nitrate	7.30×10^{-5}	1.11×10^{-5}	0.00	7.90×10^{-5}	7.44×10^{-3}	0.00	2.80	1.55×10^{-1}	0.00
Total	**N/A**	**2.07×10^{-5}**	**4.03×10^{-15}**	**N/A**	**7.45×10^{-3}**	**1.85×10^{-10}**	**N/A**	**4.16×10^{-1}**	**1.07×10^{-5}**
Year of peak impact	8457	8457	8987	8385	8385	8987	8535	8535	8241

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–54, Q–55, and Q–56 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 8900 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

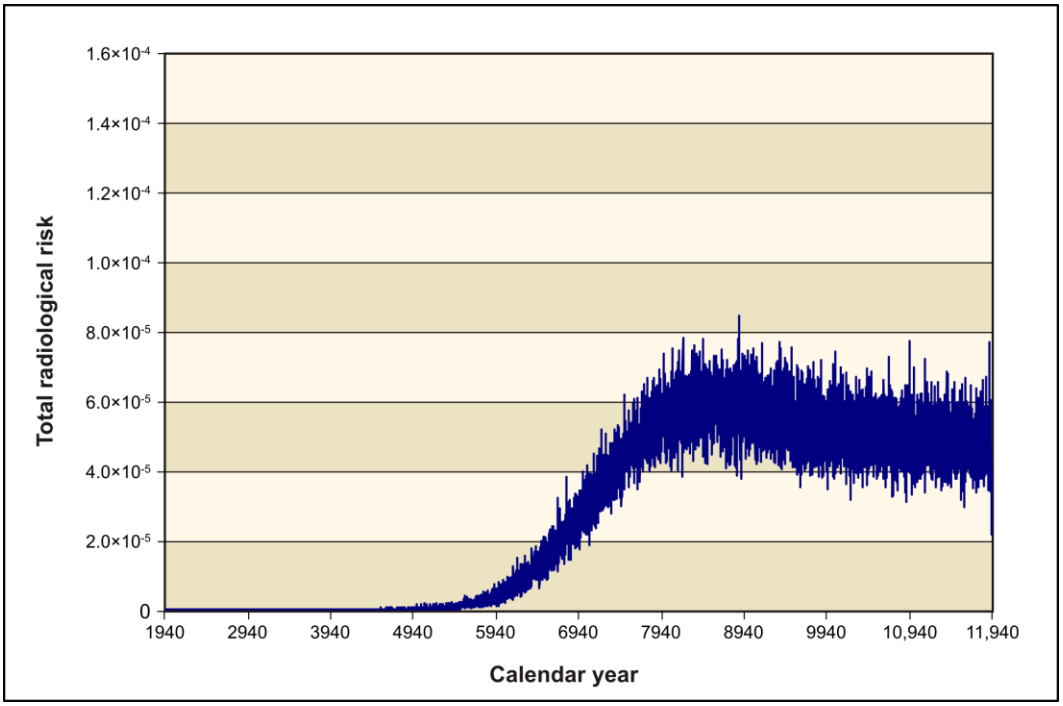

Figure Q–54. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

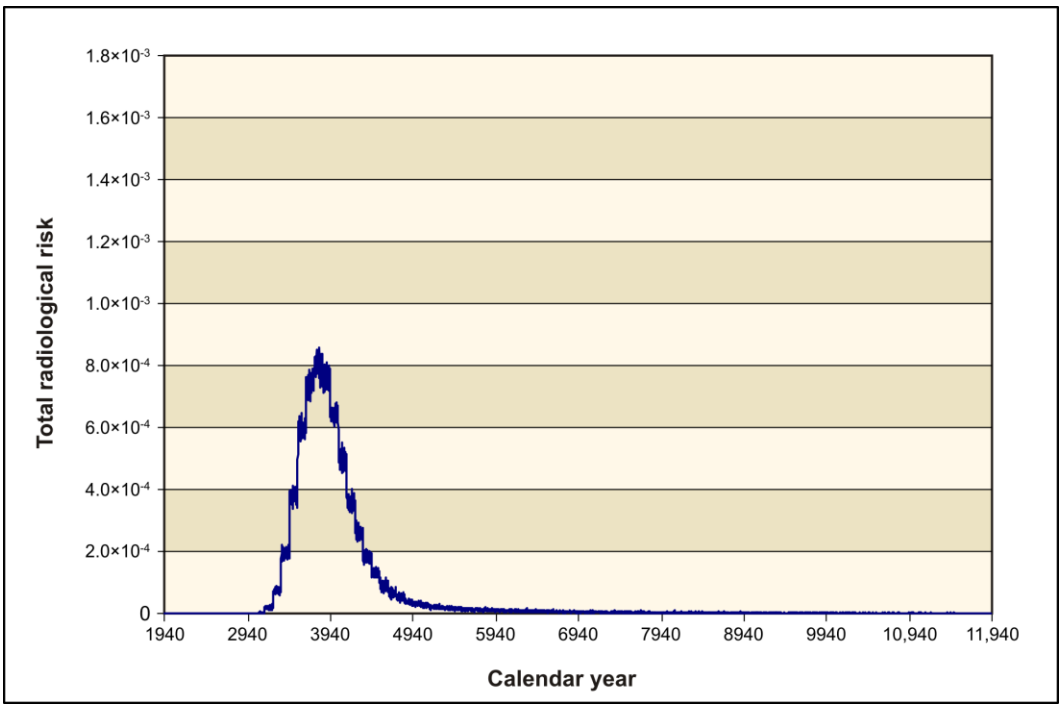

Figure Q–55. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

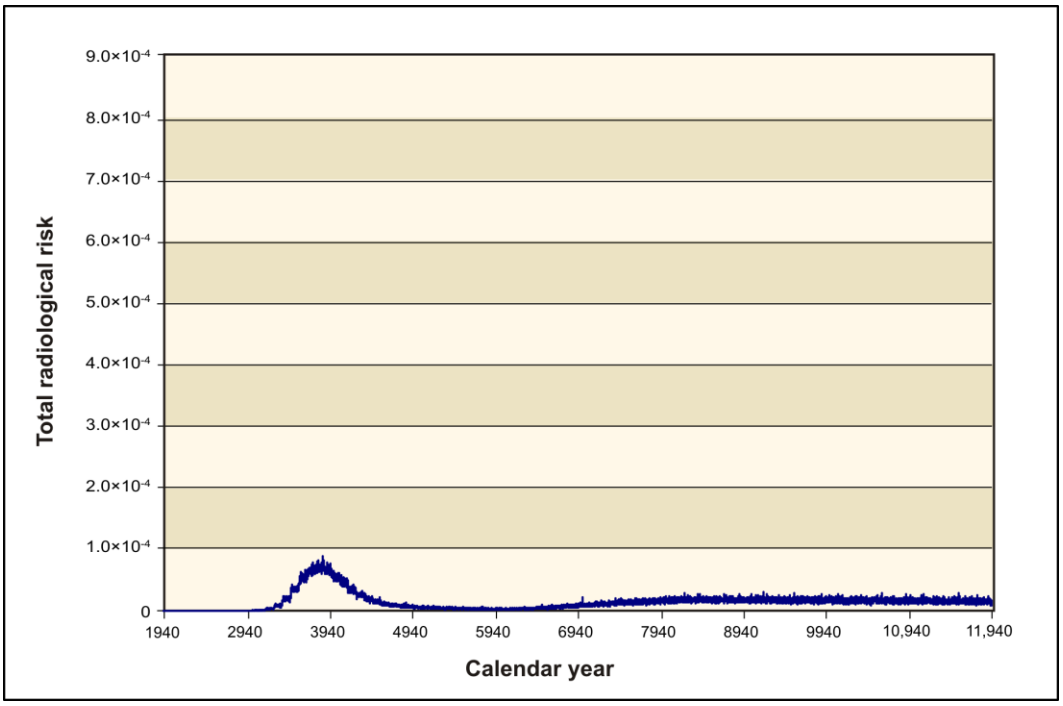

Figure Q–56. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.7 Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G

Disposal Group 1, Subgroup 1-G, addresses the waste resulting from Tank Closure Alternative 6C, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 6C.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–357 through Q–362, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and the American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 3.42×10^{-1} person-rem per year for the year of maximum impact.

Table Q–357. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.08×10^{-7}	3.64×10^{-1}	1.25×10^{-5}	2.08×10^{-7}	9.38×10^{-1}	4.12×10^{-5}	2.08×10^{-7}	1.92	9.01×10^{-5}
Iodine-129	6.52×10^{-10}	1.86×10^{-1}	2.11×10^{-6}	6.52×10^{-10}	2.32×10^{-1}	3.26×10^{-6}	6.52×10^{-10}	3.00×10^{-1}	4.94×10^{-6}
Total	**N/A**	**5.50×10^{-1}**	**1.46×10^{-5}**	**N/A**	**1.17**	**4.44×10^{-5}**	**N/A**	**2.22**	**9.50×10^{-5}**
Year of peak impact	11,385	11,385	11,385	11,385	11,385	11,385	11,385	11,385	11,385
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.31×10^{-3}	1.24×10^{-2}	0.00	1.31×10^{-3}	1.29×10^{-2}	8.05×10^{-12}	1.31×10^{-3}	1.94×10^{-2}	3.69×10^{-7}
Nitrate	1.21×10^{1}	2.16×10^{-1}	0.00	1.21×10^{1}	1.70	0.00	1.21×10^{1}	3.79	0.00
Total	**N/A**	**2.29×10^{-1}**	**0.00**	**N/A**	**1.71**	**8.05×10^{-12}**	**N/A**	**3.81**	**3.69×10^{-7}**
Year of peak impact	7962	7962	N/A	7962	7962	8555	7962	7962	8555

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–358. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–359. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	4.16×10^{-8}	7.29×10^{-2}	2.51×10^{-6}	4.16×10^{-8}	1.88×10^{-1}	8.24×10^{-6}	4.16×10^{-8}	3.84×10^{-1}	1.80×10^{-5}
Iodine-129	5.80×10^{-11}	1.65×10^{-2}	1.88×10^{-7}	5.80×10^{-11}	2.07×10^{-2}	2.91×10^{-7}	5.80×10^{-11}	2.67×10^{-2}	4.40×10^{-7}
Total	**N/A**	**8.94×10^{-2}**	**2.69×10^{-6}**	**N/A**	**2.08×10^{-1}**	**8.54×10^{-6}**	**N/A**	**4.10×10^{-1}**	**1.85×10^{-5}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.67×10^{-3}	2.54×10^{-2}	0.00	2.67×10^{-3}	2.64×10^{-2}	1.05×10^{-11}	2.37×10^{-3}	3.53×10^{-2}	4.81×10^{-7}
Nitrate	1.65×10^{-1}	2.95×10^{-3}	0.00	1.65×10^{-1}	2.32×10^{-2}	0.00	1.80×10^{-1}	5.64×10^{-2}	0.00
Total	**N/A**	**2.84×10^{-2}**	**0.00**	**N/A**	**4.96×10^{-2}**	**1.05×10^{-11}**	**N/A**	**9.17×10^{-2}**	**4.81×10^{-7}**
Year of peak impact	3792	3792	N/A	3792	3792	3740	3670	3670	3740

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–360. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.17×10^{-4}	3.97×10^{-3}	0.00	4.17×10^{-4}	4.12×10^{-3}	2.94×10^{-12}	4.17×10^{-4}	6.20×10^{-3}	1.35×10^{-7}
Nitrate	3.01	5.38×10^{-2}	0.00	3.01	4.23×10^{-1}	0.00	3.01	9.43×10^{-1}	0.00
Total	**N/A**	**5.77×10^{-2}**	**0.00**	**N/A**	**4.27×10^{-1}**	**2.94×10^{-12}**	**N/A**	**9.49×10^{-1}**	**1.35×10^{-7}**
Year of peak impact	8248	8248	N/A	8248	8248	3846	8248	8248	3846

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–361. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.60×10^{-4}	1.52×10^{-3}	0.00	1.60×10^{-4}	1.58×10^{-3}	1.87×10^{-12}	1.60×10^{-4}	2.38×10^{-3}	8.57×10^{-8}
Fluoride	9.90×10^{-6}	4.72×10^{-6}	0.00	9.90×10^{-6}	1.32×10^{-5}	0.00	9.90×10^{-6}	2.78×10^{-5}	0.00
Nitrate	2.03	3.63×10^{-2}	0.00	2.03	2.86×10^{-1}	0.00	2.03	6.37×10^{-1}	0.00
Total	**N/A**	**3.78×10^{-2}**	**0.00**	**N/A**	**2.87×10^{-1}**	**1.87×10^{-12}**	**N/A**	**6.39×10^{-1}**	**8.57×10^{-8}**
Year of peak impact	7927	7927	N/A	7927	7927	4481	7927	7927	4481

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–362. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.36×10^{-11}	6.13×10^{-5}	2.69×10^{-9}	1.34×10^{-11}	1.40×10^{-4}	6.63×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.96×10^{-14}	6.99×10^{-6}	9.84×10^{-11}	2.04×10^{-14}	1.11×10^{-4}	2.68×10^{-9}	2.11×10^{-9}	7.10×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.83×10^{-5}**	**2.79×10^{-9}**	**N/A**	**2.51×10^{-4}**	**9.31×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	1.60×10^{-4}	7.04×10^{-4}	8.56×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	9.90×10^{-6}	1.45×10^{-6}	0.00
Nitrate	3.74×10^{-5}	5.67×10^{-6}	0.00	3.74×10^{-5}	3.53×10^{-3}	0.00	2.03	1.00×10^{-1}	0.00
Total	**N/A**	**5.67×10^{-6}**	**0.00**	**N/A**	**3.53×10^{-3}**	**0.00**	**N/A**	**1.01×10^{-1}**	**8.56×10^{-8}**
Year of peak impact	8064	8064	N/A	8064	8064	N/A	7927	7927	4481

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–57, Q–58, and Q–59 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 11,400 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

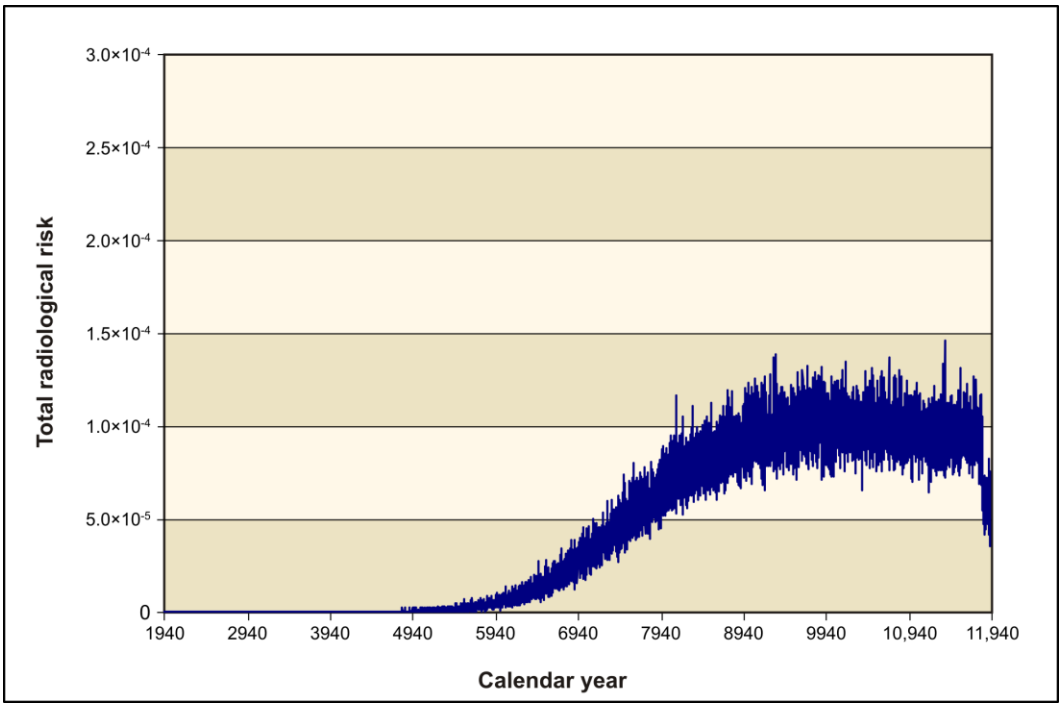

Figure Q–57. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

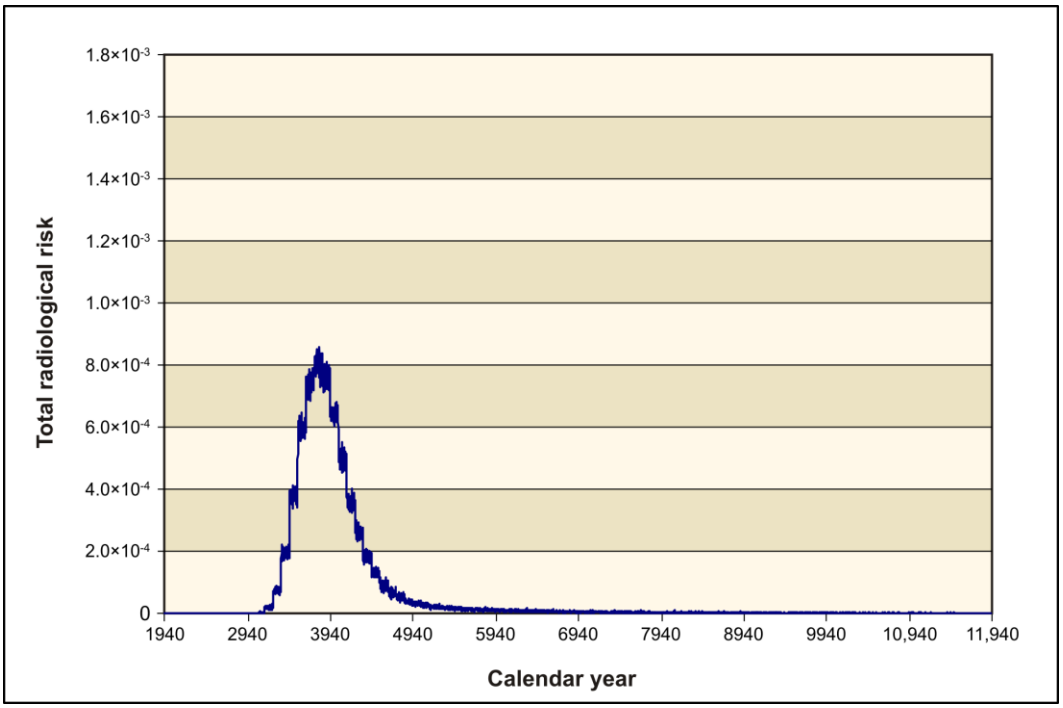

Figure Q–58. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

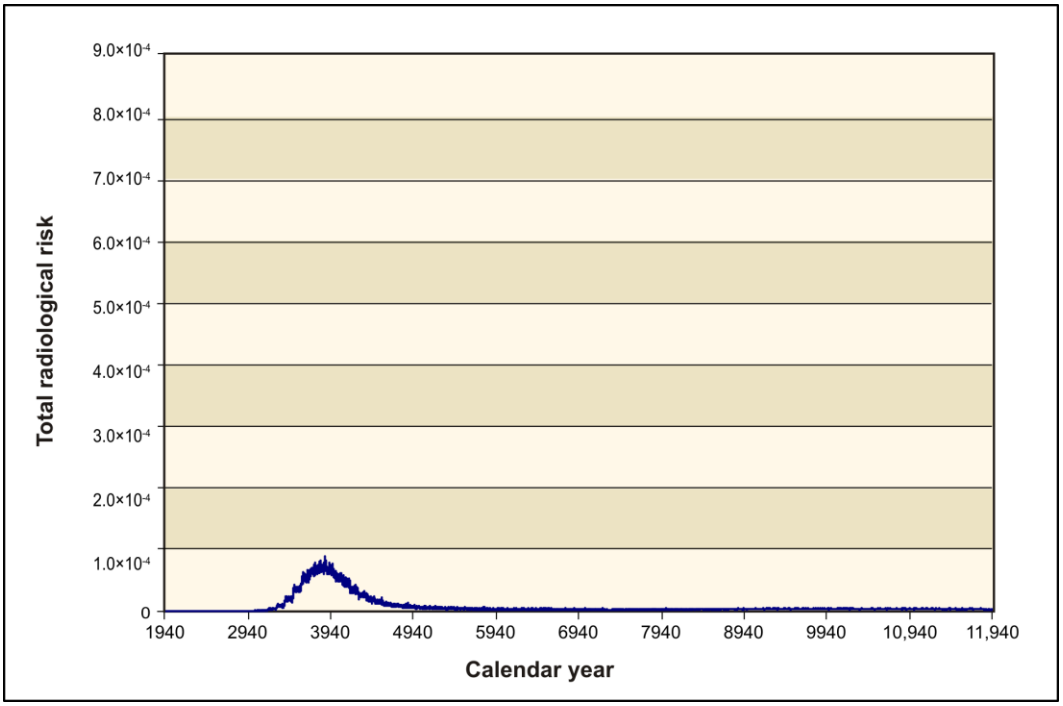

Figure Q–59. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.8 Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A

Disposal Group 2, Subgroup 2-A, addresses the waste resulting from Tank Closure Alternative 2A, onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- ILAW glass
- LAW melters
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

The RPPDF would not be constructed or operated under Tank Closure Alternative 2A because tank closure cleanup activities would not be conducted.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–363 through Q–367, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer. The Hazard Index guideline would be exceeded at the IDF-East barrier for the resident farmer and the American Indian resident farmer due primarily to release of nitrate. Population dose is estimated as 3.39×10^{-1} person-rem per year for the year of maximum impact.

Table Q–363. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.76×10^{-7}	3.09×10^{-1}	1.13×10^{-5}	1.88×10^{-7}	8.46×10^{-1}	3.83×10^{-5}	1.88×10^{-7}	1.73	8.37×10^{-5}
Iodine-129	6.65×10^{-10}	1.89×10^{-1}	1.93×10^{-6}	5.95×10^{-10}	2.12×10^{-1}	2.26×10^{-6}	5.95×10^{-10}	2.74×10^{-1}	3.42×10^{-6}
Total	**N/A**	**4.98×10^{-1}**	**1.32×10^{-5}**	**N/A**	**1.06**	**4.05×10^{-5}**	**N/A**	**2.00**	**8.71×10^{-5}**
Year of peak impact	10,979	10,979	11,050	11,050	11,050	10,056	11,050	11,050	10,056
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.11×10^{-3}	1.06×10^{-2}	0.00	1.11×10^{-3}	1.10×10^{-2}	6.97×10^{-12}	1.11×10^{-3}	1.65×10^{-2}	3.20×10^{-7}
Nitrate	9.30	1.66×10^{-1}	0.00	9.30	1.31	0.00	9.30	2.91	0.00
Total	**N/A**	**1.77×10^{-1}**	**0.00**	**N/A**	**1.32**	**6.97×10^{-12}**	**N/A**	**2.93**	**3.20×10^{-7}**
Year of peak impact	7960	7960	N/A	7960	7960	8791	7960	7960	8791

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–364. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–365. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.48×10^{-4}	4.26×10^{-3}	0.00	4.48×10^{-4}	4.42×10^{-3}	2.79×10^{-12}	4.48×10^{-4}	6.65×10^{-3}	1.28×10^{-7}
Nitrate	2.92	5.21×10^{-2}	0.00	2.92	4.10×10^{-1}	0.00	2.92	9.14×10^{-1}	0.00
Total	**N/A**	**5.64×10^{-2}**	**0.00**	**N/A**	**4.14×10^{-1}**	**2.79×10^{-12}**	**N/A**	**9.20×10^{-1}**	**1.28×10^{-7}**
Year of peak impact	8123	8123	N/A	8123	8123	8053	8123	8123	8053

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–366. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	2.49×10^{-4}	2.37×10^{-3}	0.00	2.49×10^{-4}	2.45×10^{-3}	1.68×10^{-12}	2.49×10^{-4}	3.69×10^{-3}	7.68×10^{-8}
Fluoride	2.48×10^{-6}	1.18×10^{-6}	0.00	2.48×10^{-6}	3.31×10^{-6}	0.00	2.48×10^{-6}	6.95×10^{-6}	0.00
Nitrate	1.86	3.33×10^{-2}	0.00	1.86	2.62×10^{-1}	0.00	1.86	5.84×10^{-1}	0.00
Total	**N/A**	**3.57×10^{-2}**	**0.00**	**N/A**	**2.64×10^{-1}**	**1.68×10^{-12}**	**N/A**	**5.87×10^{-1}**	**7.68×10^{-8}**
Year of peak impact	8406	8406	N/A	8406	8406	7640	8406	8406	7640

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–367. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.35×10^{-11}	6.08×10^{-5}	2.67×10^{-9}	1.33×10^{-11}	1.39×10^{-4}	6.58×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	1.94×10^{-14}	6.93×10^{-6}	9.77×10^{-11}	2.03×10^{-14}	1.10×10^{-4}	2.65×10^{-9}	2.11×10^{-9}	7.09×10^{-3}	1.74×10^{-7}
Total	**N/A**	**6.78×10^{-5}**	**2.77×10^{-9}**	**N/A**	**2.49×10^{-4}**	**9.24×10^{-9}**	**N/A**	**5.72×10^{-2}**	**2.85×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	0.00	0.00	0.00	0.00	0.00	0.00	2.49×10^{-4}	1.09×10^{-3}	7.68×10^{-8}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.48×10^{-6}	3.61×10^{-7}	0.00
Nitrate	3.55×10^{-5}	5.37×10^{-6}	0.00	3.55×10^{-5}	3.34×10^{-3}	0.00	1.86	9.02×10^{-2}	0.00
Total	**N/A**	**5.37×10^{-6}**	**0.00**	**N/A**	**3.34×10^{-3}**	**0.00**	**N/A**	**9.13×10^{-2}**	**7.68×10^{-8}**
Year of peak impact	8238	8238	N/A	8238	8238	N/A	8406	8406	7640

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–60, Q–61, and Q–62 depict the cumulative radiological lifetime risk of incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary, respectively, for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 11,000 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

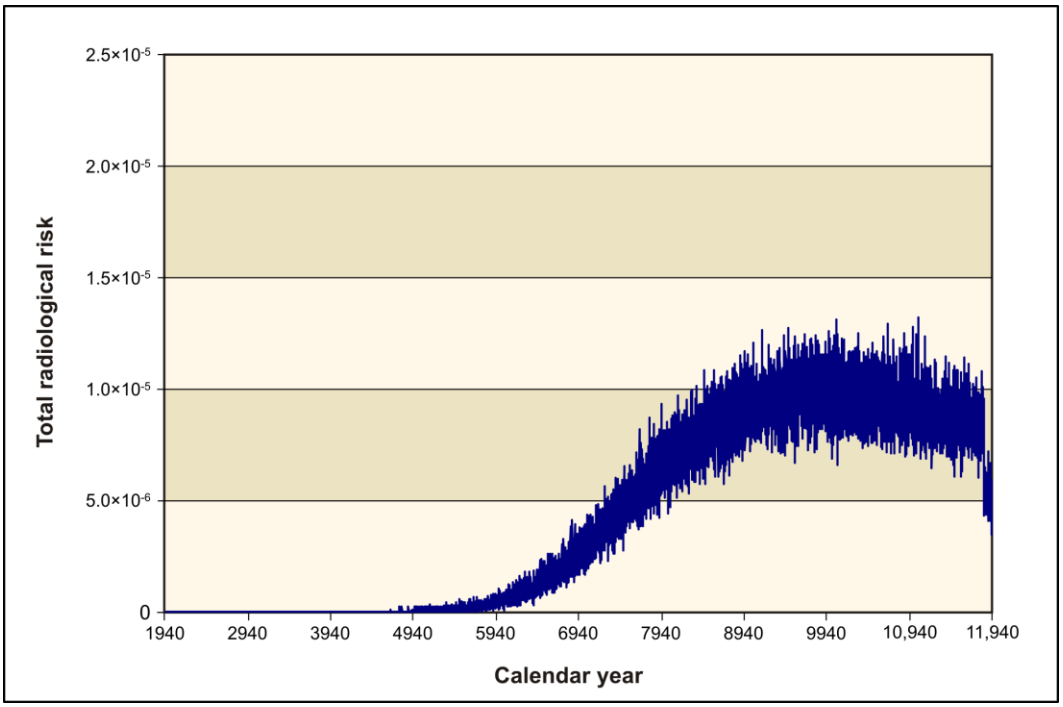

Figure Q–60. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

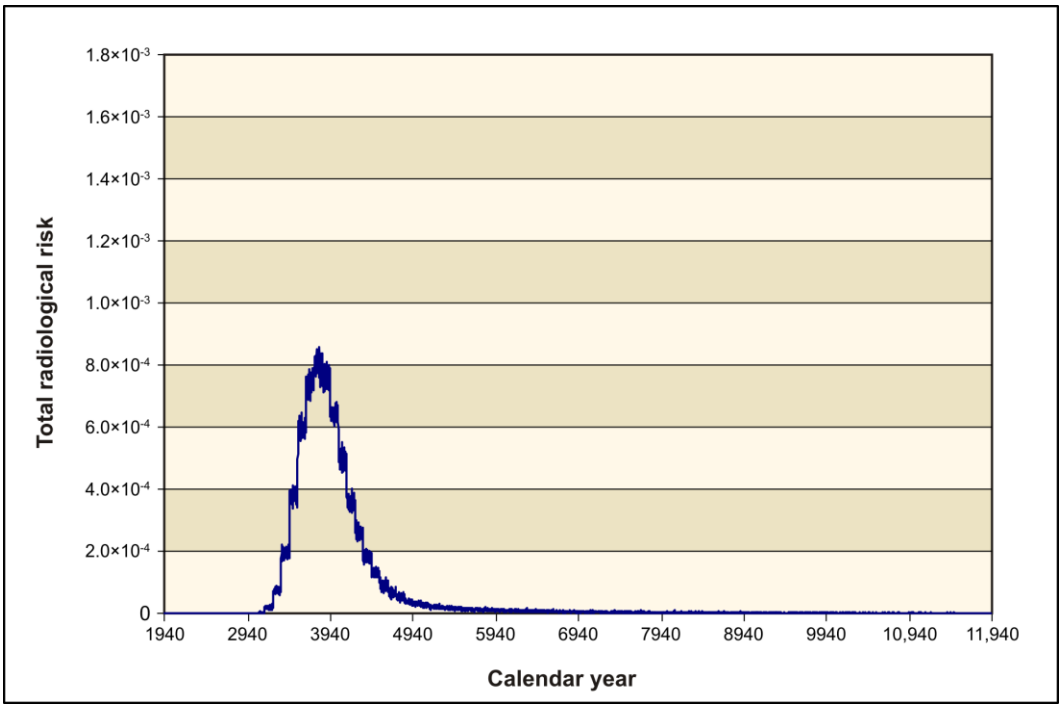

Figure Q–61. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

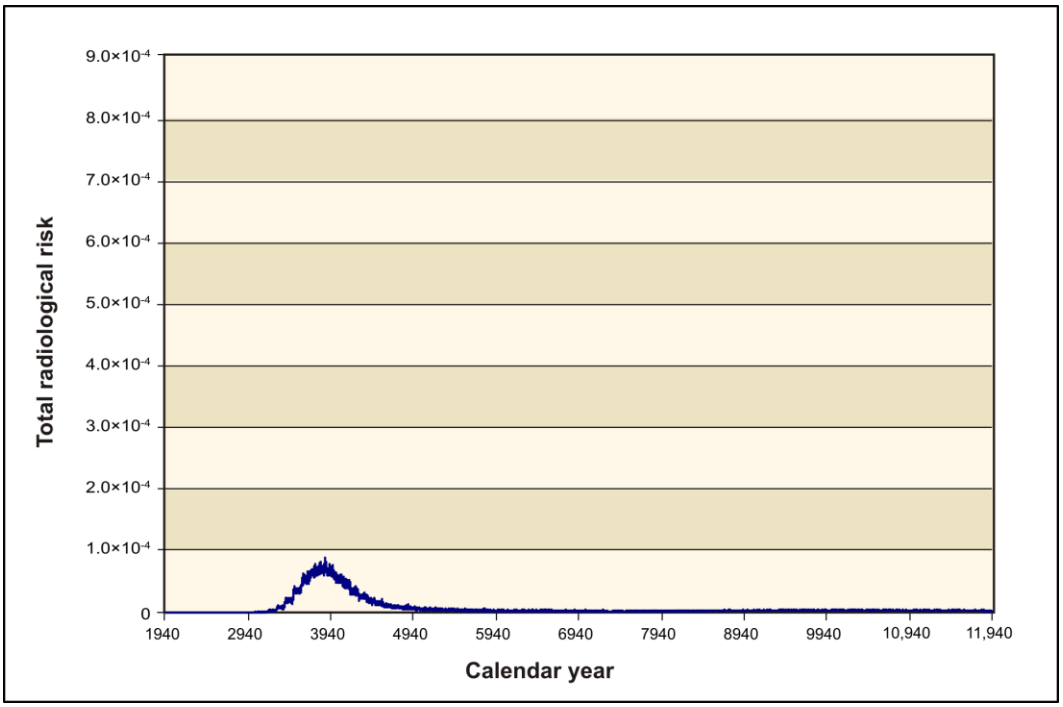

Figure Q–62. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.9 Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B

Disposal Group 2, Subgroup 2-B, addresses the waste resulting from Tank Closure Alternative 6B (Base and Option Cases), onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- PPF glass
- PPF melters
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 6B, Base and Option Cases.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–368 through Q–379. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer under both the Base and Option Cases. The Hazard Index guideline would be exceeded under both the Base and Option Cases at the IDF-East barrier for the resident farmer and the American Indian resident farmer. In addition, the Hazard Index guideline would be exceeded under the Option Case at the RPPDF barrier and Core Zone Boundary for the resident farmer and American Indian resident farmer and at the Columbia River nearshore for the American Indian resident farmer. Population dose under the Base Case is estimated as 3.77×10^{-1} person-rem per year for the year of maximum impact and under the Option Case, as 3.99×10^{-1} person-rem per year for the year of maximum impact.

Table Q–368. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-7}	2.93×10^{-1}	1.16×10^{-5}	1.94×10^{-7}	8.73×10^{-1}	3.83×10^{-5}	1.94×10^{-7}	1.78	8.38×10^{-5}
Iodine-129	8.21×10^{-10}	2.34×10^{-1}	1.92×10^{-6}	5.92×10^{-10}	2.11×10^{-1}	2.97×10^{-6}	5.92×10^{-10}	2.72×10^{-1}	4.49×10^{-6}
Total	**N/A**	**5.27×10^{-1}**	**1.36×10^{-5}**	**N/A**	**1.08**	**4.13×10^{-5}**	**N/A**	**2.05**	**8.83×10^{-5}**
Year of peak impact	10,636	10,636	10,188	10,188	10,188	10,188	10,188	10,188	10,188
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Chromium	1.09×10^{-3}	1.04×10^{-2}	0.00	1.09×10^{-3}	1.08×10^{-2}	7.44×10^{-12}	1.09×10^{-3}	1.62×10^{-2}	3.41×10^{-7}
Nitrate	9.59	1.71×10^{-1}	0.00	9.59	1.35	0.00	9.59	3.00	0.00
Total	**N/A**	**1.82×10^{-1}**	**0.00**	**N/A**	**1.36**	**7.44×10^{-12}**	**N/A**	**3.02**	**3.41×10^{-7}**
Year of peak impact	7983	7983	N/A	7983	7983	8251	7983	7983	8251

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–369. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–370. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.55×10^{-7}	2.71×10^{-1}	9.34×10^{-6}	1.55×10^{-7}	7.00×10^{-1}	3.07×10^{-5}	1.55×10^{-7}	1.43	6.72×10^{-5}
Iodine-129	1.92×10^{-10}	5.48×10^{-2}	6.23×10^{-7}	1.92×10^{-10}	6.84×10^{-2}	9.63×10^{-7}	1.92×10^{-10}	8.84×10^{-2}	1.46×10^{-6}
Total	**N/A**	**3.26×10^{-1}**	**9.96×10^{-6}**	**N/A**	**7.68×10^{-1}**	**3.17×10^{-5}**	**N/A**	**1.52**	**6.86×10^{-5}**
Year of peak impact	3769	3769	3769	3769	3769	3769	3769	3769	3769
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	1.04×10^{-6}	4.93×10^{-6}	0.00	9.29×10^{-7}	5.53×10^{-6}	0.00	7.28×10^{-7}	7.83×10^{-6}	0.00
Chromium	3.65×10^{-3}	3.48×10^{-2}	0.00	3.00×10^{-3}	2.97×10^{-2}	1.43×10^{-11}	2.65×10^{-3}	3.94×10^{-2}	6.58×10^{-7}
Nitrate	1.67×10^{-1}	2.98×10^{-3}	0.00	2.52×10^{-1}	3.54×10^{-2}	0.00	2.77×10^{-1}	8.66×10^{-2}	0.00
Total	**N/A**	**3.78×10^{-2}**	**0.00**	**N/A**	**6.51×10^{-2}**	**1.43×10^{-11}**	**N/A**	**1.26×10^{-1}**	**6.58×10^{-7}**
Year of peak impact	3710	3710	N/A	3724	3724	3710	3789	3789	3710

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–371. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.53×10^{-4}	4.31×10^{-3}	0.00	4.53×10^{-4}	4.47×10^{-3}	1.34×10^{-11}	4.53×10^{-4}	6.73×10^{-3}	6.13×10^{-7}
Nitrate	3.13	5.59×10^{-2}	0.00	3.13	4.39×10^{-1}	0.00	3.13	9.80×10^{-1}	0.00
Total	**N/A**	**6.02×10^{-2}**	**0.00**	**N/A**	**4.44×10^{-1}**	**1.34×10^{-11}**	**N/A**	**9.86×10^{-1}**	**6.13×10^{-7}**
Year of peak impact	7860	7860	N/A	7860	7860	3977	7860	7860	3977

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–372. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.01×10^{-4}	1.67×10^{-6}	7.54	3.31×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.24×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.53**	**1.07×10^{-4}**	**N/A**	**8.29**	**3.41×10^{-4}**	**N/A**	**1.64×10^{1}**	**7.40×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	1.33×10^{-8}	6.35×10^{-8}	0.00	1.33×10^{-8}	7.93×10^{-8}	0.00	1.33×10^{-8}	1.43×10^{-7}	0.00
Chromium	1.28×10^{-4}	1.22×10^{-3}	0.00	1.28×10^{-4}	1.26×10^{-3}	8.71×10^{-12}	1.28×10^{-4}	1.90×10^{-3}	3.99×10^{-7}
Fluoride	9.90×10^{-6}	4.72×10^{-6}	0.00	9.90×10^{-6}	1.32×10^{-5}	0.00	9.90×10^{-6}	2.78×10^{-5}	0.00
Nitrate	2.14	3.82×10^{-2}	0.00	2.14	3.01×10^{-1}	0.00	2.14	6.70×10^{-1}	0.00
Total	**N/A**	**3.95×10^{-2}**	**0.00**	**N/A**	**3.02×10^{-1}**	**8.71×10^{-12}**	**N/A**	**6.72×10^{-1}**	**3.99×10^{-7}**
Year of peak impact	7994	7994	N/A	7994	7994	4632	7994	7994	4632

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–373. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.49×10^{-11}	6.73×10^{-5}	2.95×10^{-9}	1.46×10^{-11}	1.52×10^{-4}	7.32×10^{-9}	1.67×10^{-6}	5.02×10^{-2}	2.68×10^{-6}
Iodine-129	2.26×10^{-14}	8.07×10^{-6}	1.14×10^{-10}	2.37×10^{-14}	1.29×10^{-4}	3.04×10^{-9}	2.11×10^{-9}	7.20×10^{-3}	1.77×10^{-7}
Total	**N/A**	**7.53×10^{-5}**	**3.07×10^{-9}**	**N/A**	**2.81×10^{-4}**	**1.04×10^{-8}**	**N/A**	**5.74×10^{-2}**	**2.86×10^{-6}**
Year of peak impact	4074	4074	4074	4095	4095	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	1.33×10^{-8}	8.00×10^{-8}	0.00
Chromium	0.00	0.00	1.73×10^{-16}	0.00	0.00	7.93×10^{-12}	1.28×10^{-4}	5.61×10^{-4}	3.99×10^{-7}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	9.90×10^{-6}	1.45×10^{-6}	0.00
Nitrate	3.56×10^{-5}	5.38×10^{-6}	0.00	3.56×10^{-5}	3.35×10^{-3}	0.00	2.14	1.00×10^{-1}	0.00
Total	**N/A**	**5.38×10^{-6}**	**1.73×10^{-16}**	**N/A**	**3.35×10^{-3}**	**7.93×10^{-12}**	**N/A**	**1.01×10^{-1}**	**3.99×10^{-7}**
Year of peak impact	8188	8188	4046	8188	8188	4046	7994	7994	4632

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–374. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.52×10^{-7}	2.67×10^{-1}	1.18×10^{-5}	1.96×10^{-7}	8.82×10^{-1}	3.87×10^{-5}	1.96×10^{-7}	1.80	8.47×10^{-5}
Iodine-129	8.46×10^{-10}	2.41×10^{-1}	1.74×10^{-6}	5.38×10^{-10}	1.92×10^{-1}	2.70×10^{-6}	5.38×10^{-10}	2.48×10^{-1}	4.08×10^{-6}
Total	**N/A**	**5.08×10^{-1}**	**1.35×10^{-5}**	**N/A**	**1.07**	**4.14×10^{-5}**	**N/A**	**2.05**	**8.87×10^{-5}**
Year of peak impact	9990	9990	9705	9705	9705	9705	9705	9705	9705
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.75×10^{-3}	1.67×10^{-2}	0.00	1.75×10^{-3}	1.73×10^{-2}	8.80×10^{-12}	1.75×10^{-3}	2.60×10^{-2}	4.04×10^{-7}
Nitrate	1.46×10^{1}	2.61×10^{-1}	0.00	1.46×10^{1}	2.05	0.00	1.46×10^{1}	4.58	0.00
Total	**N/A**	**2.78×10^{-1}**	**0.00**	**N/A**	**2.07**	**8.80×10^{-12}**	**N/A**	**4.60**	**4.04×10^{-7}**
Year of peak impact	7954	7954	N/A	7954	7954	8152	7954	7954	8152

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–375. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–376. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.20×10^{-7}	3.85×10^{-1}	1.32×10^{-5}	2.20×10^{-7}	9.92×10^{-1}	4.35×10^{-5}	2.20×10^{-7}	2.03	9.52×10^{-5}
Iodine-129	2.99×10^{-10}	8.53×10^{-2}	9.70×10^{-7}	2.99×10^{-10}	1.07×10^{-1}	1.50×10^{-6}	2.99×10^{-10}	1.38×10^{-1}	2.27×10^{-6}
Total	**N/A**	**4.70×10^{-1}**	**1.42×10^{-5}**	**N/A**	**1.10**	**4.50×10^{-5}**	**N/A**	**2.16**	**9.75×10^{-5}**
Year of peak impact	3812	3812	3812	3812	3812	3812	3812	3812	3812
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	8.24×10^{-7}	3.92×10^{-6}	0.00	1.04×10^{-6}	6.16×10^{-6}	0.00	1.04×10^{-6}	1.11×10^{-5}	0.00
Chromium	3.29×10^{-2}	3.13×10^{-1}	0.00	2.28×10^{-2}	2.25×10^{-1}	1.33×10^{-10}	2.28×10^{-2}	3.39×10^{-1}	6.11×10^{-6}
Nitrate	7.17	1.28×10^{-1}	0.00	9.86	1.38	0.00	9.86	3.09	0.00
Total	**N/A**	**4.41×10^{-1}**	**0.00**	**N/A**	**1.61**	**1.33×10^{-10}**	**N/A**	**3.43**	**6.11×10^{-6}**
Year of peak impact	3680	3680	N/A	3733	3733	3807	3733	3733	3807

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–377. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.39×10^{-7}	2.57×10^{-6}	0.00	6.91×10^{-7}	4.11×10^{-6}	0.00	6.91×10^{-7}	7.44×10^{-6}	0.00
Boron and compounds	2.22×10^{-6}	3.17×10^{-7}	0.00	3.04×10^{-6}	4.52×10^{-7}	0.00	3.04×10^{-6}	4.92×10^{-7}	0.00
Chromium	2.84×10^{-2}	2.70×10^{-1}	0.00	2.08×10^{-2}	2.06×10^{-1}	1.12×10^{-10}	2.08×10^{-2}	3.09×10^{-1}	5.15×10^{-6}
Fluoride	1.66×10^{-4}	7.90×10^{-5}	0.00	2.10×10^{-4}	2.82×10^{-4}	0.00	2.10×10^{-4}	5.91×10^{-4}	0.00
Nitrate	4.79	8.56×10^{-2}	0.00	7.22	1.01	0.00	7.22	2.26	0.00
Total	**N/A**	**3.56×10^{-1}**	**0.00**	**N/A**	**1.22**	**1.12×10^{-10}**	**N/A**	**2.57**	**5.15×10^{-6}**
Year of peak impact	3688	3688	N/A	3858	3858	3901	3858	3858	3901

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–378. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	5.60×10^{-7}	2.67×10^{-6}	0.00	4.93×10^{-7}	2.93×10^{-6}	0.00	4.93×10^{-7}	5.31×10^{-6}	0.00
Boron and compounds	3.34×10^{-6}	4.77×10^{-7}	0.00	3.61×10^{-6}	5.35×10^{-7}	0.00	3.61×10^{-6}	5.83×10^{-7}	0.00
Chromium	1.86×10^{-2}	1.77×10^{-1}	0.00	1.49×10^{-2}	1.47×10^{-1}	7.56×10^{-11}	1.49×10^{-2}	2.21×10^{-1}	3.47×10^{-6}
Fluoride	2.35×10^{-4}	1.12×10^{-4}	0.00	2.48×10^{-4}	3.31×10^{-4}	0.00	2.48×10^{-4}	6.95×10^{-4}	0.00
Nitrate	3.30	5.90×10^{-2}	0.00	4.15	5.83×10^{-1}	0.00	4.15	1.30	0.00
Total	**N/A**	**2.36×10^{-1}**	**0.00**	**N/A**	**7.30×10^{-1}**	**7.56×10^{-11}**	**N/A**	**1.52**	**3.47×10^{-6}**
Year of peak impact	4560	4560	N/A	4465	4465	4558	4465	4465	4558

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–379. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.58×10^{-11}	7.13×10^{-5}	3.13×10^{-9}	1.57×10^{-11}	1.63×10^{-4}	7.75×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	2.38×10^{-14}	8.51×10^{-6}	1.20×10^{-10}	2.48×10^{-14}	1.35×10^{-4}	3.25×10^{-9}	2.11×10^{-9}	7.26×10^{-3}	1.78×10^{-7}
Total	**N/A**	**7.98×10^{-5}**	**3.25×10^{-9}**	**N/A**	**2.98×10^{-4}**	**1.10×10^{-8}**	**N/A**	**5.74×10^{-2}**	**2.86×10^{-6}**
Year of peak impact	4019	4019	4019	4077	4077	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	4.00×10^{-7}	2.40×10^{-6}	0.00
Boron and compounds	0.00	0.00	0.00	0.00	0.00	0.00	3.64×10^{-6}	3.97×10^{-8}	0.00
Chromium	3.69×10^{-7}	3.64×10^{-6}	1.55×10^{-15}	3.69×10^{-7}	5.97×10^{-6}	7.10×10^{-11}	1.22×10^{-2}	5.36×10^{-2}	3.47×10^{-6}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.30×10^{-4}	3.36×10^{-5}	0.00
Nitrate	1.10×10^{-4}	1.67×10^{-5}	0.00	1.10×10^{-4}	1.04×10^{-2}	0.00	3.96	2.29×10^{-1}	0.00
Total	**N/A**	**2.03×10^{-5}**	**1.55×10^{-15}**	**N/A**	**1.04×10^{-2}**	**7.10×10^{-11}**	**N/A**	**2.83×10^{-1}**	**3.47×10^{-6}**
Year of peak impact	4079	4079	4055	4079	4079	4055	4055	4055	4558

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–63 through Q–68 depict the cumulative radiological lifetime risk of incidence of cancer over time at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary for the drinking-water well user. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary under the Base and Option Cases and is dominated by technetium-99 and iodine-129 from the naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 10,000 under the Base and Option Cases as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

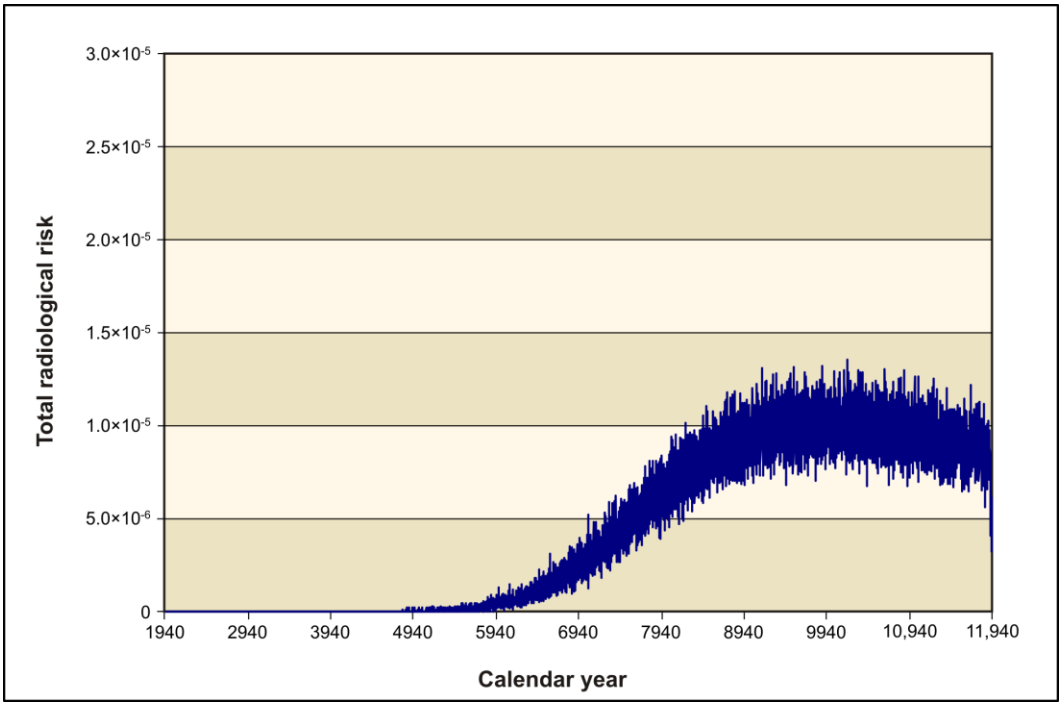

Figure Q–63. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

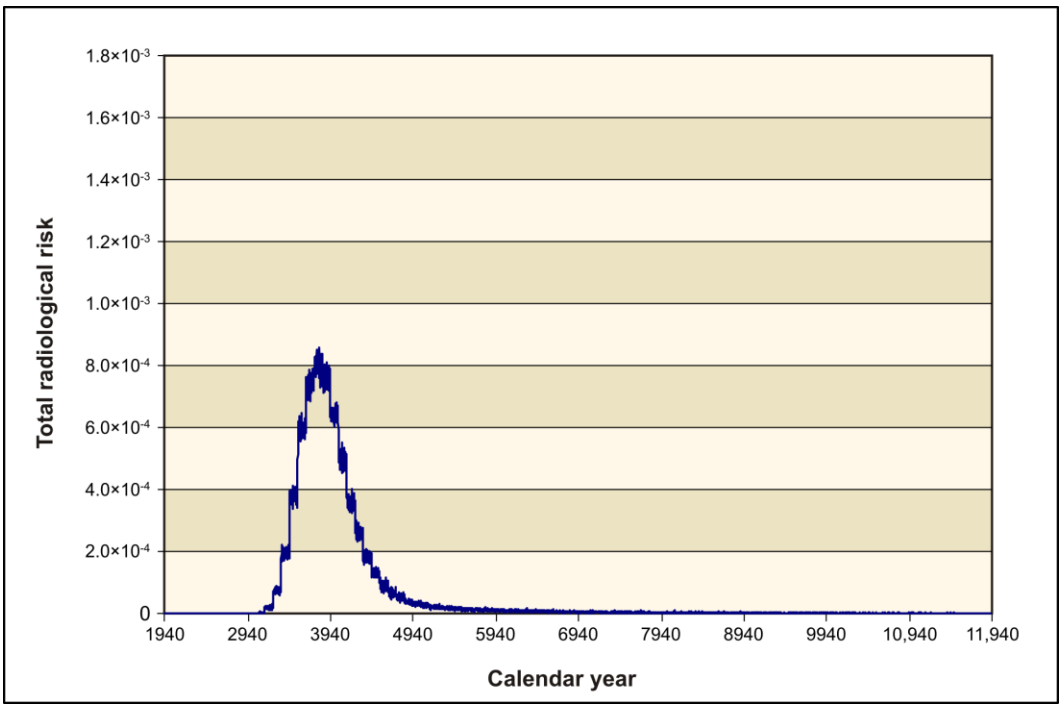

Figure Q–64. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

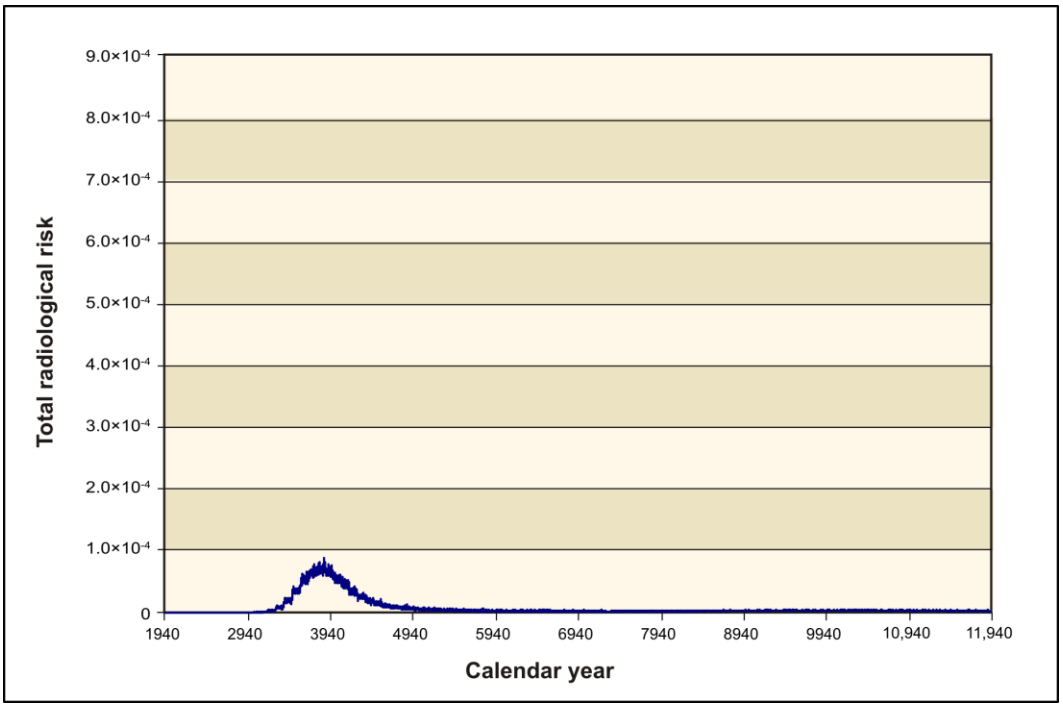

Figure Q–65. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

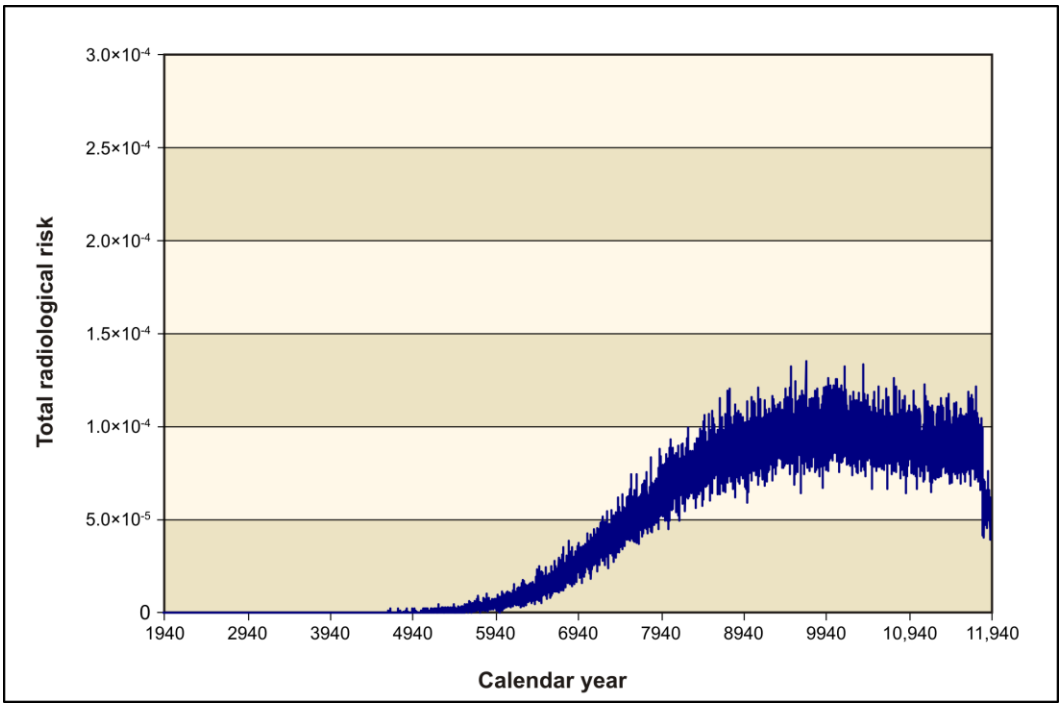

Figure Q–66. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

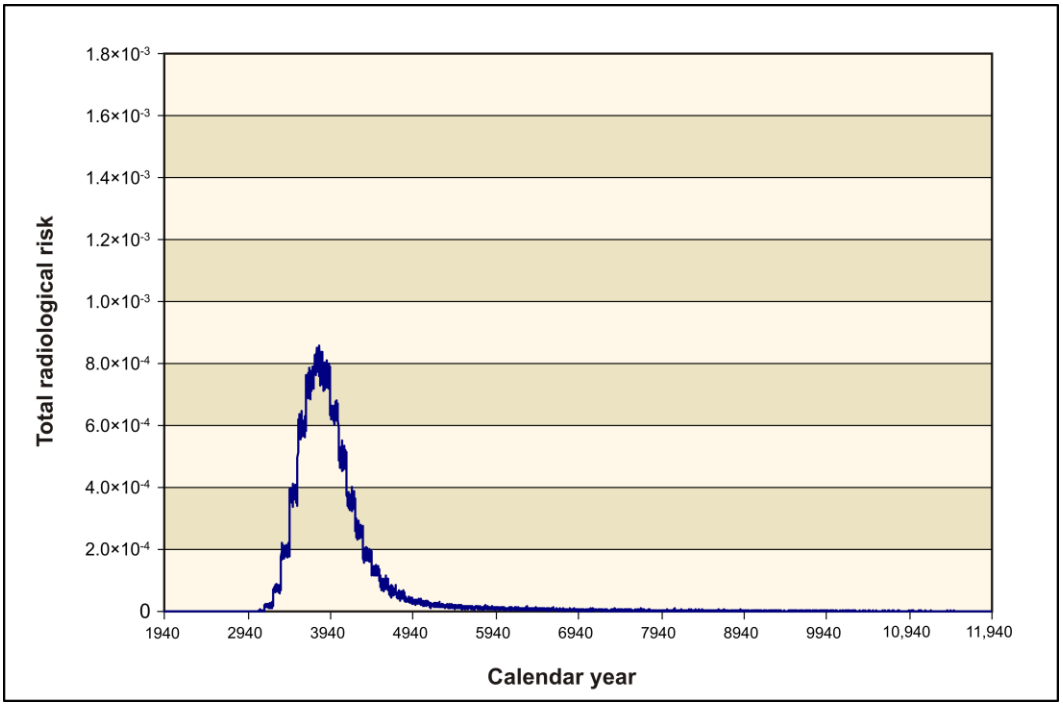

Figure Q–67. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

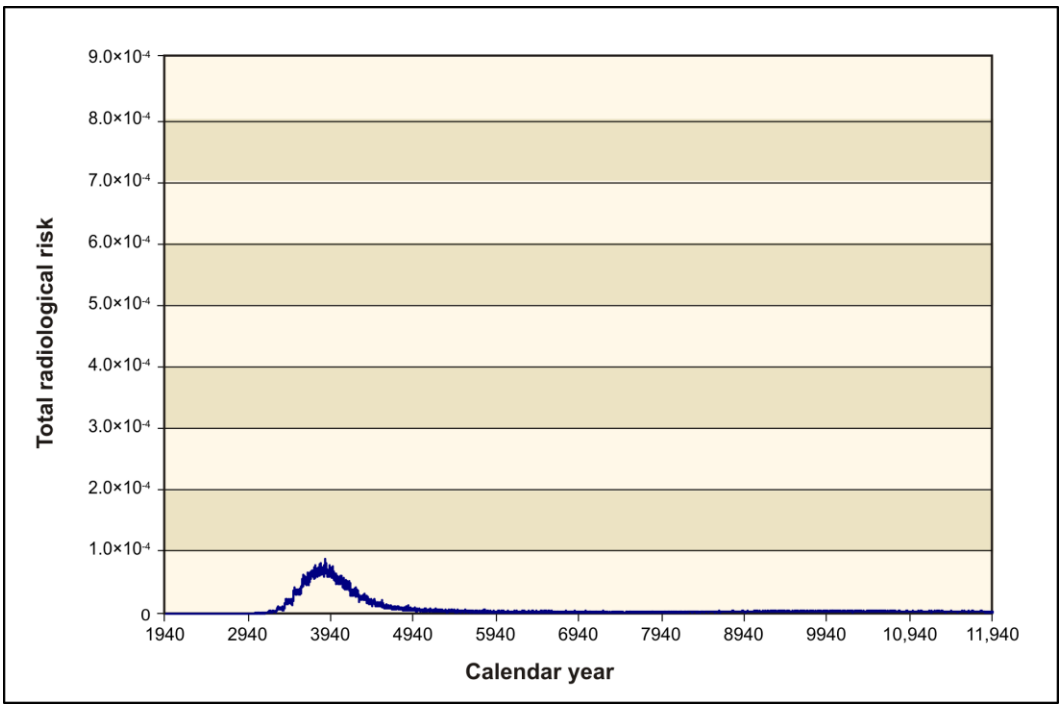

Figure Q–68. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.3.10 Waste Management Alternative 3, Disposal Group 3

Disposal Group 3 addresses the waste resulting from Tank Closure Alternative 6A (Base and Option Cases), onsite non-CERCLA sources, FFTF decommissioning, waste management, and other DOE sites. Waste forms for IDF-East include the following:

- PPF glass
- PPF melters
- Tank closure secondary waste

Waste forms for IDF-West include the following:

- FFTF decommissioning secondary waste
- Waste management secondary waste
- Offsite waste
- Onsite non-CERCLA waste

Waste forms for the RPPDF include those resulting from tank closure cleanup activities under Tank Closure Alternative 6A, Base and Option Cases.

Potential human health impacts at the IDF-East barrier, the IDF-West barrier, the RPPDF barrier, the Core Zone Boundary, the Columbia River nearshore, and the Columbia River surface-water locations are summarized in Tables Q–380 through Q–391, respectively. The key radioactive constituent contributors to human health risk would be technetium-99 and iodine-129; the key chemical constituent contributors, acetonitrile, boron and boron compounds, chromium, fluoride, and nitrate. For radionuclides, the dose standard would be exceeded at the IDF-West barrier for the American Indian resident farmer under the Base and Option Cases. Under both the Base and Option Cases, the Hazard Index guideline would be

exceeded at the IDF-East barrier for the resident farmer and the American Indian resident farmer. In addition, the Hazard Index guideline would be exceeded under the Option Case at the RPPDF barrier and Core Zone Boundary for the resident farmer and American Indian resident farmer and at the Columbia River nearshore for the American Indian resident farmer. Population dose under the Base Case is estimated as 3.76×10^{-1} person-rem per year for the year of maximum impact and under the Option Case, as 3.98×10^{-1} person-rem per year for the year of maximum impact.

Table Q–380. Waste Management Alternative 3, Disposal Group 3, Base Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-7}	2.93×10^{-1}	1.16×10^{-5}	1.94×10^{-7}	8.73×10^{-1}	3.83×10^{-5}	1.94×10^{-7}	1.78	8.38×10^{-5}
Iodine-129	8.21×10^{-10}	2.34×10^{-1}	1.92×10^{-6}	5.92×10^{-10}	2.11×10^{-1}	2.97×10^{-6}	5.92×10^{-10}	2.72×10^{-1}	4.49×10^{-6}
Total	**N/A**	**5.27×10^{-1}**	**1.36×10^{-5}**	**N/A**	**1.08**	**4.13×10^{-5}**	**N/A**	**2.05**	**8.83×10^{-5}**
Year of peak impact	10,636	10,636	10,188	10,188	10,188	10,188	10,188	10,188	10,188
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.09×10^{-3}	1.04×10^{-2}	0.00	1.09×10^{-3}	1.08×10^{-2}	7.44×10^{-12}	1.09×10^{-3}	1.62×10^{-2}	3.41×10^{-7}
Nitrate	9.59	1.71×10^{-1}	0.00	9.59	1.35	0.00	9.59	3.00	0.00
Total	**N/A**	**1.82×10^{-1}**	**0.00**	**N/A**	**1.36**	**7.44×10^{-12}**	**N/A**	**3.02**	**3.41×10^{-7}**
Year of peak impact	7983	7983	N/A	7983	7983	8251	7983	7983	8251

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–381. Waste Management Alternative 3, Disposal Group 3, Base Case, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–382. Waste Management Alternative 3, Disposal Group 3, Base Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**	**Concentration at Year of Peak Dose (curies per cubic meter)**	**Dose at Year of Peak Dose (millirem per year)**	**Radiological Risk at Year of Peak Radiological Risk**
Technetium-99	1.47×10^{-7}	2.58×10^{-1}	8.87×10^{-6}	1.47×10^{-7}	6.65×10^{-1}	2.92×10^{-5}	1.47×10^{-7}	1.36	6.38×10^{-5}
Iodine-129	1.97×10^{-10}	5.62×10^{-2}	6.39×10^{-7}	1.97×10^{-10}	7.02×10^{-2}	9.87×10^{-7}	1.97×10^{-10}	9.07×10^{-2}	1.49×10^{-6}
Total	**N/A**	**3.14×10^{-1}**	**9.51×10^{-6}**	**N/A**	**7.35×10^{-1}**	**3.02×10^{-5}**	**N/A**	**1.45**	**6.53×10^{-5}**
Year of peak impact	4013	4013	4013	4013	4013	4013	4013	4013	4013
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	8.66×10^{-7}	4.12×10^{-6}	0.00	8.66×10^{-7}	5.15×10^{-6}	0.00	8.66×10^{-7}	9.32×10^{-6}	0.00
Chromium	3.65×10^{-3}	3.48×10^{-2}	0.00	3.65×10^{-3}	3.61×10^{-2}	1.48×10^{-11}	3.65×10^{-3}	5.43×10^{-2}	6.79×10^{-7}
Nitrate	2.44×10^{-1}	4.36×10^{-3}	0.00	2.44×10^{-1}	3.43×10^{-2}	0.00	2.44×10^{-1}	7.64×10^{-2}	0.00
Total	**N/A**	**3.92×10^{-2}**	**0.00**	**N/A**	**7.03×10^{-2}**	**1.48×10^{-11}**	**N/A**	**1.31×10^{-1}**	**6.79×10^{-7}**
Year of peak impact	3929	3929	N/A	3929	3929	3869	3929	3929	3869

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–383. Waste Management Alternative 3, Disposal Group 3, Base Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	4.53×10^{-4}	4.32×10^{-3}	0.00	4.53×10^{-4}	4.47×10^{-3}	1.29×10^{-11}	4.53×10^{-4}	6.73×10^{-3}	5.90×10^{-7}
Nitrate	3.13	5.59×10^{-2}	0.00	3.13	4.39×10^{-1}	0.00	3.13	9.80×10^{-1}	0.00
Total	**N/A**	**6.02×10^{-2}**	**0.00**	**N/A**	**4.44×10^{-1}**	**1.29×10^{-11}**	**N/A**	**9.86×10^{-1}**	**5.90×10^{-7}**
Year of peak impact	7860	7860	N/A	7860	7860	3701	7860	7860	3701

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–384. Waste Management Alternative 3, Disposal Group 3, Base Case, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	2.67×10^{-8}	1.27×10^{-7}	0.00	2.67×10^{-8}	1.59×10^{-7}	0.00	2.67×10^{-8}	2.87×10^{-7}	0.00
Chromium	1.28×10^{-4}	1.22×10^{-3}	0.00	1.28×10^{-4}	1.26×10^{-3}	8.11×10^{-12}	1.28×10^{-4}	1.90×10^{-3}	3.72×10^{-7}
Fluoride	9.90×10^{-6}	4.72×10^{-6}	0.00	9.90×10^{-6}	1.32×10^{-5}	0.00	9.90×10^{-6}	2.78×10^{-5}	0.00
Nitrate	2.14	3.82×10^{-2}	0.00	2.14	3.01×10^{-1}	0.00	2.14	6.70×10^{-1}	0.00
Total	**N/A**	**3.95×10^{-2}**	**0.00**	**N/A**	**3.02×10^{-1}**	**8.11×10^{-12}**	**N/A**	**6.72×10^{-1}**	**3.72×10^{-7}**
Year of peak impact	7994	7994	N/A	7994	7994	4608	7994	7994	4608

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–385. Waste Management Alternative 3, Disposal Group 3, Base Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.49×10^{-11}	6.72×10^{-5}	2.95×10^{-9}	1.46×10^{-11}	1.51×10^{-4}	7.36×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	2.25×10^{-14}	8.02×10^{-6}	1.13×10^{-10}	2.36×10^{-14}	1.28×10^{-4}	2.94×10^{-9}	2.11×10^{-9}	7.19×10^{-3}	1.76×10^{-7}
Total	**N/A**	**7.52×10^{-5}**	**3.06×10^{-9}**	**N/A**	**2.80×10^{-4}**	**1.03×10^{-8}**	**N/A**	**5.73×10^{-2}**	**2.86×10^{-6}**
Year of peak impact	4074	4074	4074	4095	4095	4074	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	2.67×10^{-8}	1.60×10^{-7}	0.00
Chromium	0.00	0.00	1.74×10^{-16}	0.00	0.00	7.98×10^{-12}	1.28×10^{-4}	5.61×10^{-4}	3.72×10^{-7}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	9.90×10^{-6}	1.45×10^{-6}	0.00
Nitrate	3.56×10^{-5}	5.38×10^{-6}	0.00	3.56×10^{-5}	3.35×10^{-3}	0.00	2.14	1.00×10^{-1}	0.00
Total	**N/A**	**5.38×10^{-6}**	**1.74×10^{-16}**	**N/A**	**3.35×10^{-3}**	**7.98×10^{-12}**	**N/A**	**1.01×10^{-1}**	**3.72×10^{-7}**
Year of peak impact	8188	8188	4184	8188	8188	4184	7994	7994	4608

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–386. Waste Management Alternative 3, Disposal Group 3, Option Case, Human Health Impacts at the 200-East Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.52×10^{-7}	2.67×10^{-1}	1.18×10^{-5}	1.96×10^{-7}	8.82×10^{-1}	3.87×10^{-5}	1.96×10^{-7}	1.80	8.47×10^{-5}
Iodine-129	8.46×10^{-10}	2.41×10^{-1}	1.74×10^{-6}	5.38×10^{-10}	1.92×10^{-1}	2.70×10^{-6}	5.38×10^{-10}	2.48×10^{-1}	4.08×10^{-6}
Total	**N/A**	**5.08×10^{-1}**	**1.35×10^{-5}**	**N/A**	**1.07**	**4.14×10^{-5}**	**N/A**	**2.05**	**8.87×10^{-5}**
Year of peak impact	9990	9990	9705	9705	9705	9705	9705	9705	9705
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Chromium	1.75×10^{-3}	1.67×10^{-2}	0.00	1.75×10^{-3}	1.73×10^{-2}	8.80×10^{-12}	1.75×10^{-3}	2.60×10^{-2}	4.04×10^{-7}
Nitrate	1.46×10^{1}	2.61×10^{-1}	0.00	1.46×10^{1}	2.05	0.00	1.46×10^{1}	4.58	0.00
Total	**N/A**	**2.78×10^{-1}**	**0.00**	**N/A**	**2.07**	**8.80×10^{-12}**	**N/A**	**4.60**	**4.04×10^{-7}**
Year of peak impact	7954	7954	N/A	7954	7954	8501	7954	7954	8501

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–387. Waste Management Alternative 3, Disposal Group 3, Option Case, Human Health Impacts at the 200-West Area Integrated Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.32×10^{-5}	2.31×10^{1}	7.96×10^{-4}	1.32×10^{-5}	5.96×10^{1}	2.62×10^{-3}	1.32×10^{-5}	1.22×10^{2}	5.72×10^{-3}
Iodine-129	1.95×10^{-8}	5.55	6.31×10^{-5}	1.95×10^{-8}	6.93	9.75×10^{-5}	1.95×10^{-8}	8.96	1.48×10^{-4}
Total	**N/A**	**2.87×10^{1}**	**8.59×10^{-4}**	**N/A**	**6.66×10^{1}**	**2.72×10^{-3}**	**N/A**	**1.31×10^{2}**	**5.87×10^{-3}**
Year of peak impact	3818	3818	3818	3818	3818	3818	3818	3818	3818
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Boron and compounds	5.99×10^{-6}	8.55×10^{-7}	0.00	6.62×10^{-6}	9.82×10^{-7}	0.00	6.62×10^{-6}	1.07×10^{-6}	0.00
Chromium	1.05×10^{-3}	1.00×10^{-2}	0.00	1.02×10^{-3}	1.01×10^{-2}	4.13×10^{-12}	1.02×10^{-3}	1.52×10^{-2}	1.89×10^{-7}
Fluoride	3.94×10^{-4}	1.87×10^{-4}	0.00	5.55×10^{-4}	7.42×10^{-4}	0.00	5.55×10^{-4}	1.56×10^{-3}	0.00
Nitrate	4.62×10^{-3}	8.24×10^{-5}	0.00	6.26×10^{-3}	8.78×10^{-4}	0.00	6.26×10^{-3}	1.96×10^{-3}	0.00
Total	**N/A**	**1.03×10^{-2}**	**0.00**	**N/A**	**1.17×10^{-2}**	**4.13×10^{-12}**	**N/A**	**1.87×10^{-2}**	**1.89×10^{-7}**
Year of peak impact	3813	3813	N/A	3935	3935	3813	3935	3935	3813

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–388. Waste Management Alternative 3, Disposal Group 3, Option Case, Human Health Impacts at the River Protection Project Disposal Facility

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	2.35×10^{-7}	4.12×10^{-1}	1.42×10^{-5}	2.35×10^{-7}	1.06	4.66×10^{-5}	2.35×10^{-7}	2.17	1.02×10^{-4}
Iodine-129	2.21×10^{-10}	6.30×10^{-2}	7.16×10^{-7}	2.21×10^{-10}	7.86×10^{-2}	1.11×10^{-6}	2.21×10^{-10}	1.02×10^{-1}	1.67×10^{-6}
Total	**N/A**	**4.75×10^{-1}**	**1.49×10^{-5}**	**N/A**	**1.14**	**4.77×10^{-5}**	**N/A**	**2.27**	**1.04×10^{-4}**
Year of peak impact	4018	4018	4018	4018	4018	4018	4018	4018	4018
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	7.61×10^{-7}	3.62×10^{-6}	0.00	1.04×10^{-6}	6.16×10^{-6}	0.00	1.04×10^{-6}	1.11×10^{-5}	0.00
Chromium	3.13×10^{-2}	2.98×10^{-1}	0.00	2.28×10^{-2}	2.25×10^{-1}	1.27×10^{-10}	2.28×10^{-2}	3.39×10^{-1}	5.82×10^{-6}
Nitrate	7.92	1.41×10^{-1}	0.00	9.27	1.30	0.00	9.27	2.90	0.00
Total	**N/A**	**4.39×10^{-1}**	**0.00**	**N/A**	**1.53**	**1.27×10^{-10}**	**N/A**	**3.24**	**5.82×10^{-6}**
Year of peak impact	3916	3916	N/A	3930	3930	3873	3930	3930	3873

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–389. Waste Management Alternative 3, Disposal Group 3, Option Case, Human Health Impacts at the Core Zone Boundary

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.37×10^{-6}	2.40	8.27×10^{-5}	1.37×10^{-6}	6.20	2.72×10^{-4}	1.37×10^{-6}	1.27×10^{1}	5.95×10^{-4}
Iodine-129	1.81×10^{-9}	5.17×10^{-1}	5.87×10^{-6}	1.81×10^{-9}	6.45×10^{-1}	9.08×10^{-6}	1.81×10^{-9}	8.34×10^{-1}	1.37×10^{-5}
Total	**N/A**	**2.92**	**8.86×10^{-5}**	**N/A**	**6.84**	**2.81×10^{-4}**	**N/A**	**1.35×10^{1}**	**6.09×10^{-4}**
Year of peak impact	3859	3859	3859	3859	3859	3859	3859	3859	3859
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	6.57×10^{-7}	3.13×10^{-6}	0.00	4.84×10^{-7}	2.88×10^{-6}	0.00	4.84×10^{-7}	5.21×10^{-6}	0.00
Boron and compounds	3.34×10^{-6}	4.77×10^{-7}	0.00	2.38×10^{-6}	3.54×10^{-7}	0.00	2.38×10^{-6}	3.85×10^{-7}	0.00
Chromium	2.84×10^{-2}	2.71×10^{-1}	0.00	2.32×10^{-2}	2.29×10^{-1}	1.12×10^{-10}	2.32×10^{-2}	3.44×10^{-1}	5.12×10^{-6}
Fluoride	3.00×10^{-4}	1.43×10^{-4}	0.00	2.23×10^{-4}	2.98×10^{-4}	0.00	2.23×10^{-4}	6.25×10^{-4}	0.00
Nitrate	5.83	1.04×10^{-1}	0.00	7.82	1.10	0.00	7.82	2.45	0.00
Total	**N/A**	**3.75×10^{-1}**	**0.00**	**N/A**	**1.33**	**1.12×10^{-10}**	**N/A**	**2.79**	**5.12×10^{-6}**
Year of peak impact	3865	3865	N/A	3782	3782	3865	3782	3782	3865

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–390. Waste Management Alternative 3, Disposal Group 3, Option Case, Human Health Impacts at the Columbia River Nearshore

Radioactive Constituent	Drinking-Water Well User			Resident Farmer			American Indian Resident Farmer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.67×10^{-6}	2.92	1.00×10^{-4}	1.67×10^{-6}	7.53	3.30×10^{-4}	1.67×10^{-6}	1.54×10^{1}	7.23×10^{-4}
Iodine-129	2.11×10^{-9}	6.02×10^{-1}	6.84×10^{-6}	2.11×10^{-9}	7.52×10^{-1}	1.06×10^{-5}	2.11×10^{-9}	9.72×10^{-1}	1.60×10^{-5}
Total	**N/A**	**3.52**	**1.07×10^{-4}**	**N/A**	**8.28**	**3.41×10^{-4}**	**N/A**	**1.63×10^{1}**	**7.39×10^{-4}**
Year of peak impact	3920	3920	3920	3920	3920	3920	3920	3920	3920
Chemical Constituent	**Drinking-Water Well User**			**Resident Farmer**			**American Indian Resident Farmer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**	**Concentration at Year of Peak Hazard Index (grams per cubic meter)**	**Hazard Index at Year of Peak Hazard Index**	**Nonradiological Risk at Year of Peak Nonradiological Risk**
Acetonitrile	6.27×10^{-7}	2.98×10^{-6}	0.00	4.67×10^{-7}	2.78×10^{-6}	0.00	4.67×10^{-7}	5.02×10^{-6}	0.00
Boron and compounds	3.67×10^{-6}	5.25×10^{-7}	0.00	3.01×10^{-6}	4.47×10^{-7}	0.00	3.01×10^{-6}	4.87×10^{-7}	0.00
Chromium	2.09×10^{-2}	1.99×10^{-1}	0.00	1.12×10^{-2}	1.11×10^{-1}	8.22×10^{-11}	1.12×10^{-2}	1.67×10^{-1}	3.77×10^{-6}
Fluoride	2.55×10^{-4}	1.21×10^{-4}	0.00	2.08×10^{-4}	2.78×10^{-4}	0.00	2.08×10^{-4}	5.84×10^{-4}	0.00
Nitrate	3.40	6.07×10^{-2}	0.00	5.19	7.29×10^{-1}	0.00	5.19	1.62	0.00
Total	**N/A**	**2.60×10^{-1}**	**0.00**	**N/A**	**8.40×10^{-1}**	**8.22×10^{-11}**	**N/A**	**1.79**	**3.77×10^{-6}**
Year of peak impact	4487	4487	N/A	4701	4701	4487	4701	4701	4487

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Table Q–391. Waste Management Alternative 3, Disposal Group 3, Option Case, Human Health Impacts at the Columbia River Surface Water

Radioactive Constituent	Resident Farmer			American Indian Resident Farmer			American Indian Hunter-Gatherer		
	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk	Concentration at Year of Peak Dose (curies per cubic meter)	Dose at Year of Peak Dose (millirem per year)	Radiological Risk at Year of Peak Radiological Risk
Technetium-99	1.57×10^{-11}	7.09×10^{-5}	3.12×10^{-9}	1.54×10^{-11}	1.61×10^{-4}	7.77×10^{-9}	1.67×10^{-6}	5.01×10^{-2}	2.68×10^{-6}
Iodine-129	2.44×10^{-14}	8.71×10^{-6}	1.20×10^{-10}	2.51×10^{-14}	1.37×10^{-4}	3.20×10^{-9}	2.11×10^{-9}	7.23×10^{-3}	1.77×10^{-7}
Total	**N/A**	**7.96×10^{-5}**	**3.24×10^{-9}**	**N/A**	**2.98×10^{-4}**	**1.10×10^{-8}**	**N/A**	**5.73×10^{-2}**	**2.86×10^{-6}**
Year of peak impact	4077	4077	4074	4095	4095	4077	3920	3920	3920
Chemical Constituent	**Resident Farmer**			**American Indian Resident Farmer**			**American Indian Hunter-Gatherer**		
	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk	Concentration at Year of Peak Hazard Index (grams per cubic meter)	Hazard Index at Year of Peak Hazard Index	Nonradiological Risk at Year of Peak Nonradiological Risk
Acetonitrile	0.00	0.00	0.00	0.00	0.00	0.00	4.13×10^{-7}	2.48×10^{-6}	0.00
Boron and compounds	0.00	0.00	0.00	0.00	0.00	0.00	3.28×10^{-6}	3.57×10^{-8}	0.00
Chromium	3.65×10^{-7}	3.60×10^{-6}	1.53×10^{-15}	3.65×10^{-7}	5.91×10^{-6}	7.02×10^{-11}	1.09×10^{-2}	4.80×10^{-2}	3.77×10^{-6}
Fluoride	0.00	0.00	0.00	0.00	0.00	0.00	2.67×10^{-4}	3.90×10^{-5}	0.00
Nitrate	1.10×10^{-4}	1.66×10^{-5}	0.00	1.10×10^{-4}	1.03×10^{-2}	0.00	4.53	2.39×10^{-1}	0.00
Total	**N/A**	**2.02×10^{-5}**	**1.53×10^{-15}**	**N/A**	**1.03×10^{-2}**	**7.02×10^{-11}**	**N/A**	**2.87×10^{-1}**	**3.77×10^{-6}**
Year of peak impact	4182	4182	4241	4182	4182	4241	4270	4270	4487

Note: Concentrations are those reported for groundwater at the specified location. Total concentrations, although reported, are not used in the analysis.
Key: N/A=not applicable.

Figures Q–69 through Q–74 depict the cumulative radiological lifetime risk of the incidence of cancer at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary for the drinking-water well user over time. The peak radiological risk occurs around CY 3900 at the Core Zone Boundary under the Base and Option Cases and is dominated by technetium-99 and iodine-129 from naturally occurring release mechanisms and degradation of waste forms disposed of in IDF-West and the RPPDF. These are relatively mobile radionuclides that move at the same velocity as groundwater. At the IDF-East barrier, the peak radiological lifetime risk of incidence of cancer occurs around CY 10,000 as a result of slower movement through the vadose zone for waste forms disposed of in IDF-East.

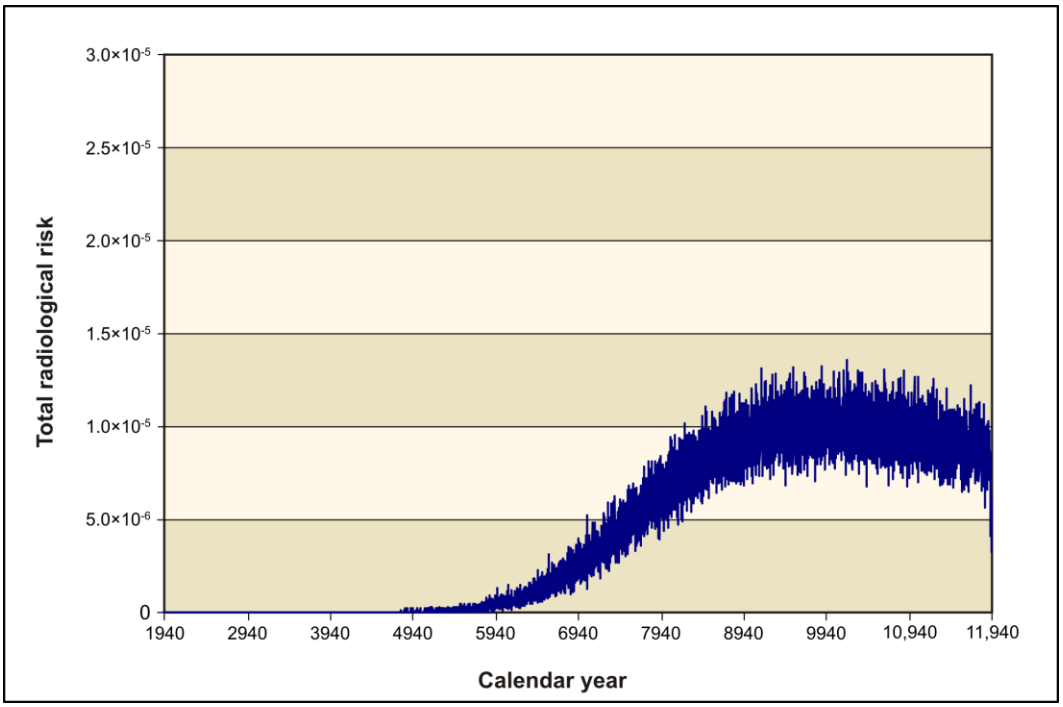

Figure Q–69. Waste Management Alternative 3, Disposal Group 3, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

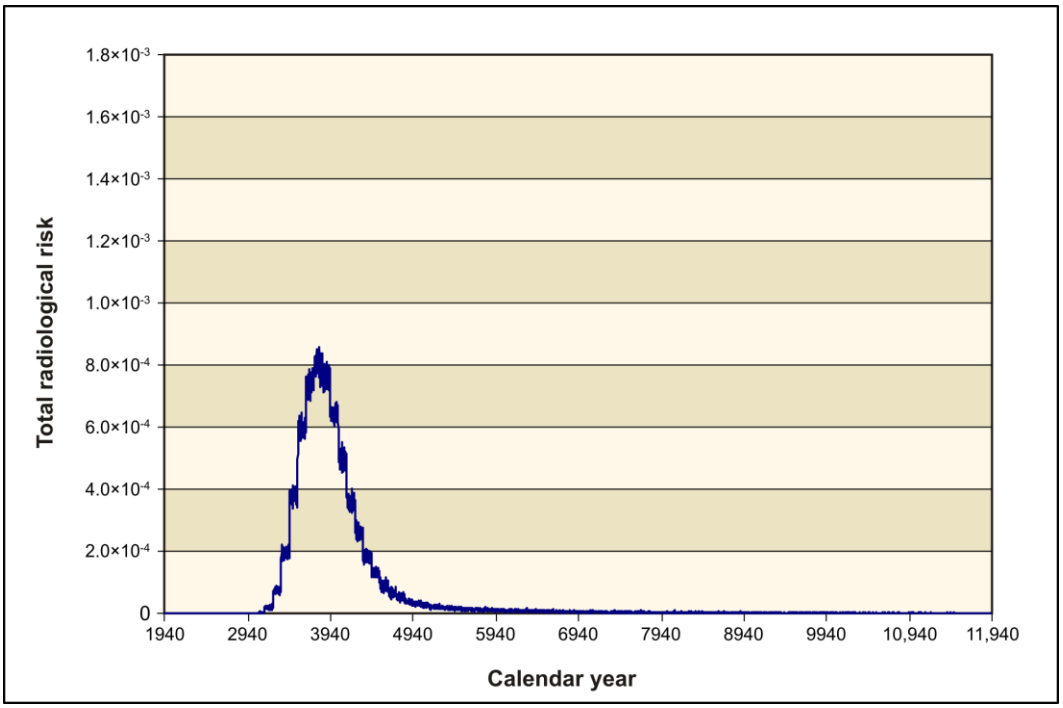

Figure Q–70. Waste Management Alternative 3, Disposal Group 3, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

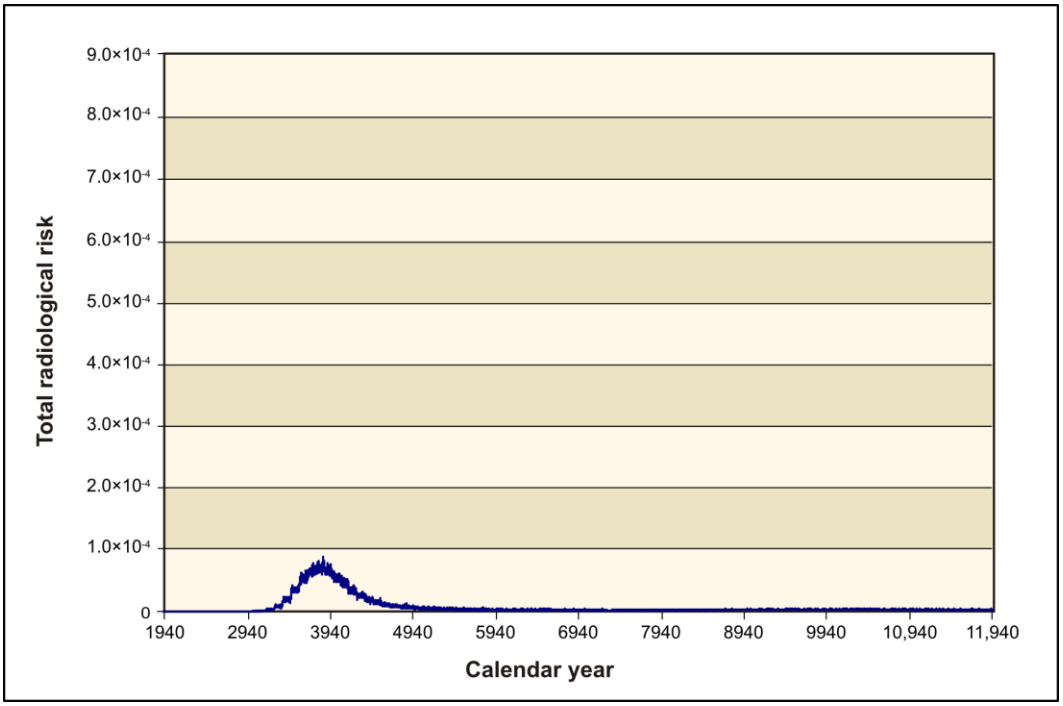

Figure Q–71. Waste Management Alternative 3, Disposal Group 3, Base Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

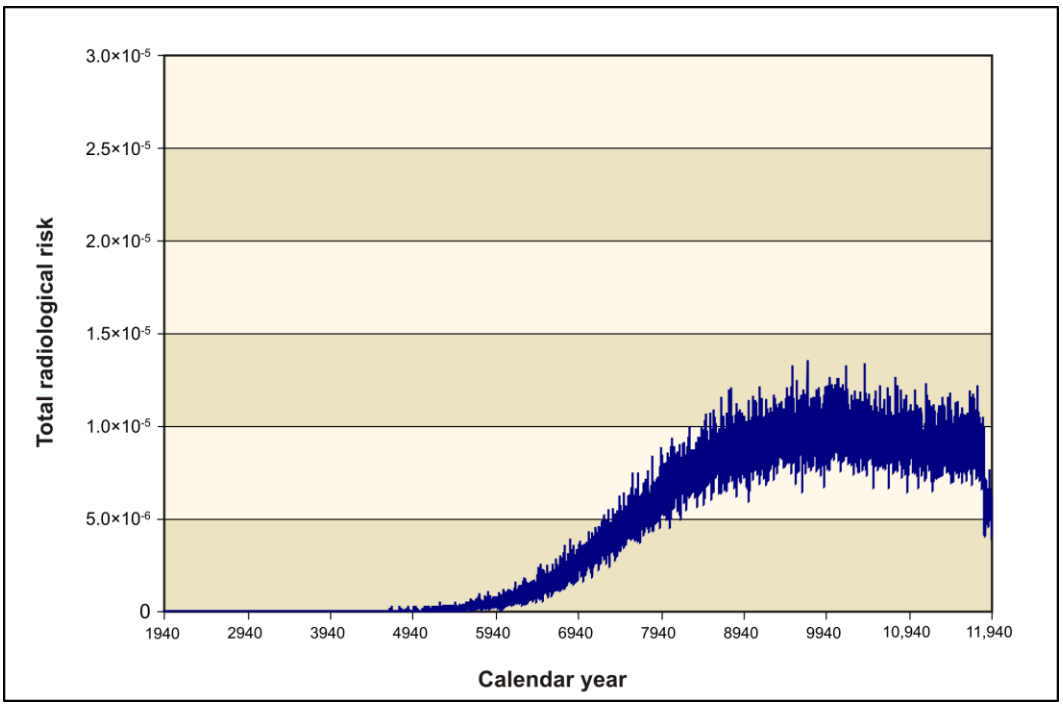

Figure Q–72. Waste Management Alternative 3, Disposal Group 3, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility

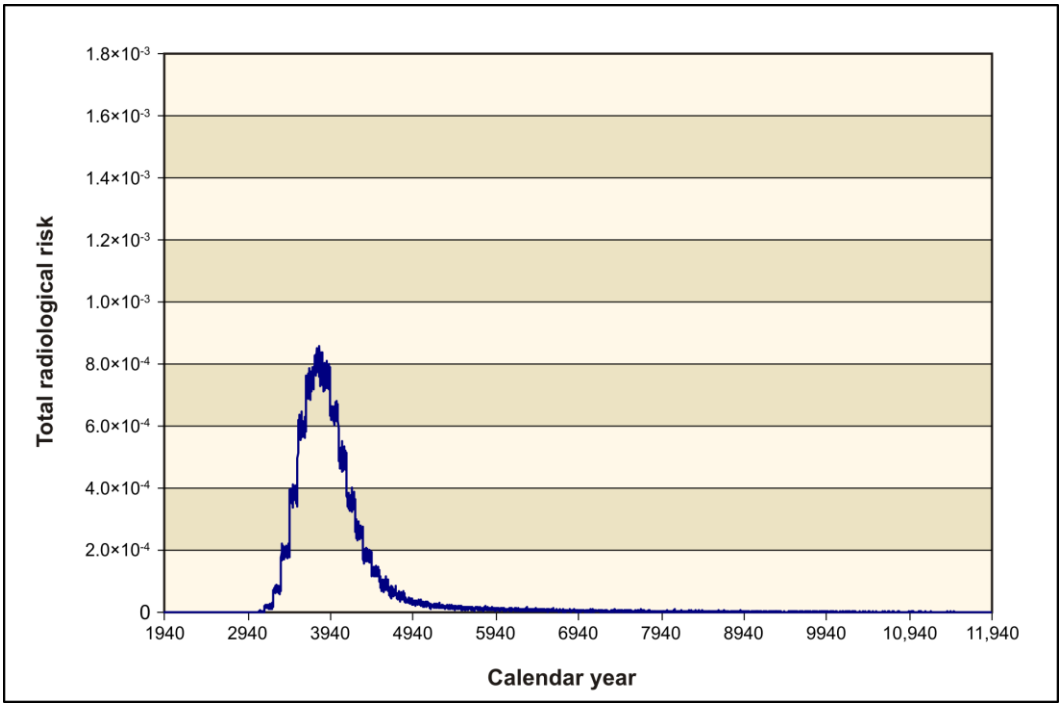

Figure Q–73. Waste Management Alternative 3, Disposal Group 3, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility

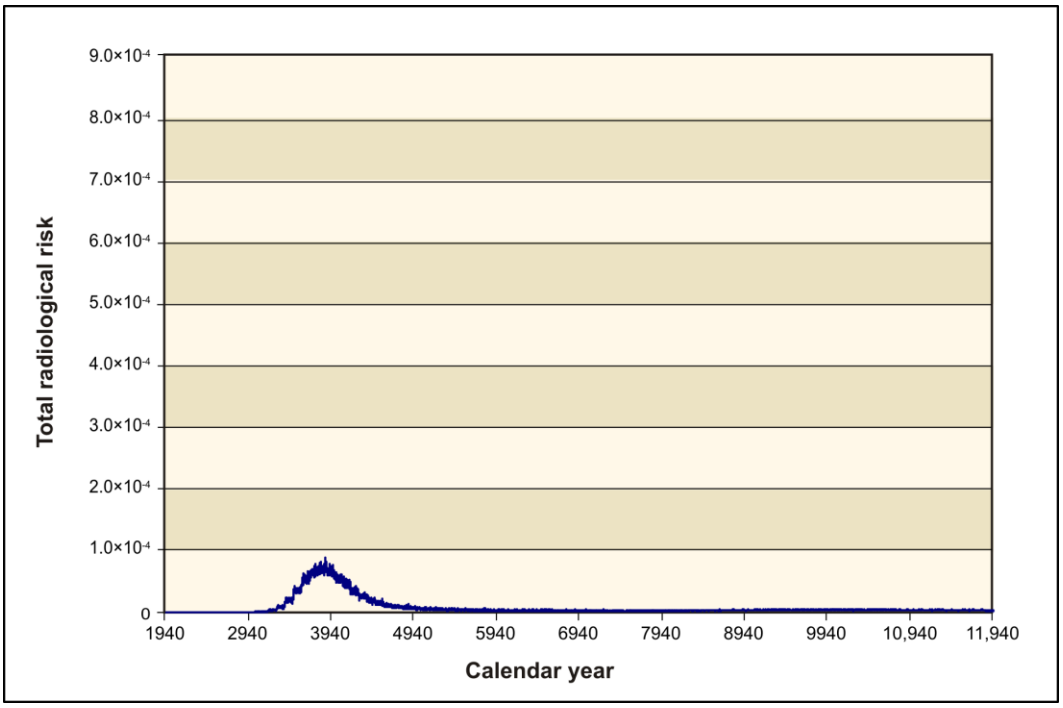

Figure Q–74. Waste Management Alternative 3, Disposal Group 3, Option Case, Summary of Long-Term Human Health Impacts on the Drinking-Water Well User at the Core Zone Boundary

Q.3.3.1.4 Waste Management Intruder Scenario

Intruders are individuals who enter IDF-East, IDF-West, or the RPPDF and engage in activity that could cause direct contact with residual contamination in the stabilized, below-grade waste. Waste types that would be disposed of in IDF-East and IDF-West include waste generated during activities related to tank closure and activities not related to tank closure. Waste types related to tank closure that would be disposed of in IDF-East include the following:

- ILAW glass
- Bulk vitrification glass
- Cast stone waste
- Steam reforming waste
- PPF glass
- Effluent Treatment Facility (ETF)–generated secondary waste
- Sulfate grout
- Tank closure secondary waste
- Discarded melters

In addition, rubble, soil and equipment generated during tank closure activities would be disposed of in the RPPDF under some Tank Closure alternatives. Waste types not related to tank closure that would be disposed of in either IDF-East or IDF-West include the following:

- Onsite non-CERCLA waste
- Waste management secondary waste
- Offsite waste
- FFTF decommissioning secondary waste

As in the case of Tank Closure alternatives, two types of receptors and two types of scenarios were considered. The receptor types were the resident farmer and American Indian resident farmer, and the scenario types were home construction and well drilling. Because the waste at the disposal areas is at a depth greater than that of the foundation for a home, the home construction scenario was screened from the analysis. Also, sensitivity analysis determined that in all cases for residential agriculture, impacts on the American Indian resident farmer exceeded impacts on the resident farmer. Because inhalation and external exposure are the only exposure modes for the well-drilling worker, impacts on the worker involved in well drilling would be the same for the resident farmer and American Indian resident farmer. Screening analysis also determined that impacts of intrusion were dominated by contact with short-lived radionuclides, strontium-90 and cesium-137, for all waste types except ETF-generated secondary waste. Consequently, impacts of intrusion at the disposal areas are represented by the well-drilling scenario, in which a worker inhales dust and receives external radiation while drilling the well and an American Indian resident farmer contacts residual contamination brought to the surface during development of the well. For both the resident farmer and drilling worker, impacts are presented as dose for the year of peak dose, which occurs immediately after loss of institutional control.

The impacts under this intrusion scenario at IDF-East or IDF-West for waste types related to tank closure are summarized in Tables Q–392 and Q–393 for the American Indian resident farmer and worker intruders, respectively. For all waste types and alternatives except ETF-generated secondary waste, resident farmer impacts are dominated by exposure to strontium-90 and cesium-137. Estimates of impact on the drilling worker are dominated by external exposure to cesium-137. For both the American Indian resident farmer and drilling worker, impacts related to ETF-generated secondary waste are dominated by exposure to iodine-129. Due to high waste loadings of cesium-137, the DOE intruder dose guideline of 500 millirem is exceeded for both primary- and secondary-waste forms. The estimated impacts of intrusion into the rubble, soil, and equipment related to tank closure that are disposed of in the RPPDF are presented in Table Q–394. As for other tank closure waste types, doses are dominated by exposure to cesium-137. The DOE intruder dose guideline is not exceeded for any Tank Closure alternatives. The estimated impacts of intrusion into waste types not related to tank closure that are disposed of in either IDF-East or IDF-West are presented in Table Q–395 for an American Indian resident farmer and a drilling worker. The DOE intruder dose guideline of 500 millirem is exceeded for offsite waste due to high loading of cesium-137.

Table Q–392. Doses by Tank Closure Waste Type to an American Indian Engaged in Residential Agriculture Following Well Drilling at an Integrated Disposal Facility

	Dose (rem per year)								
	Waste Type								
Alternative	ILAW Glass	Bulk Vitrification Glass	Cast Stone Waste	Steam Reforming Waste	PPF Glass	ETF-Generated Secondary Waste	Sulfate Grout	Tank Closure Secondary Waste	Discarded Melters
2A	0.74	N/A[a]	N/A[a]	N/A[a]	N/A[a]	0.34	N/A[a]	1.22	0.028
2B	0.74	N/A[a]	N/A[a]	N/A[a]	N/A[a]	0.34	N/A[a]	1.30	0.028
3A	0.93	7.7	N/A[a]	N/A[a]	N/A[a]	0.56	N/A[a]	1.64	0.035
3B	0.93	N/A[a]	5.9	N/A[a]	N/A[a]	0.26	N/A[a]	2.19	0.035
3C	0.93	N/A[a]	N/A[a]	7.7	N/A[a]	0.56	N/A[a]	2.20	0.035
4	1.30	18.6	0.47	N/A[a]	N/A[a]	0.62	N/A[a]	1.84	0.048
5	1.24	20.5	0.46	N/A[a]	N/A[a]	0.54	0.47	1.41	0.046
6A, Base Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	64.2	0.34	N/A[a]	1.46	0.91
6A, Option Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	2.37	0.34	N/A[a]	1.36	0.039
6B, Base Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	62.8	0.34	N/A[a]	1.46	0.91
6B, Option Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	2.36	0.34	N/A[a]	1.36	0.039
6C	N/A[a]	N/A[a]	N/A[a]	N/A[a]	N/A[a]	0.34	N/A[a]	1.30	N/A[a]

[a] This waste type would not be generated under this alternative.

Key: ETF=Effluent Treatment Facility; ILAW=immobilized low-activity waste; N/A=not applicable; PPF=Preprocessing Facility.

Table Q–393. Doses by Tank Closure Waste Type to a Well-Drilling Worker at an Integrated Disposal Facility

Alternative	Dose (rem)								
	Waste Type								
	ILAW Glass	Bulk Vitrification Glass	Cast Stone Waste	Steam Reforming Waste	PPF Glass	ETF-Generated Secondary Waste	Sulfate Grout	Tank Closure Secondary Waste	Discarded Melters
2A	1.6×10^{-3}	N/A[a]	N/A[a]	N/A[a]	N/A[a]	2.6×10^{-4}	N/A[a]	1.9×10^{-3}	5.8×10^{-5}
2B	1.6×10^{-3}	N/A[a]	N/A[a]	N/A[a]	N/A[a]	2.6×10^{-4}	N/A[a]	2.1×10^{-3}	5.8×10^{-5}
3A	2.0×10^{-3}	1.7×10^{-2}	N/A[a]	N/A[a]	N/A[a]	5.8×10^{-4}	N/A[a]	2.5×10^{-3}	7.3×10^{-5}
3B	2.0×10^{-3}	N/A[a]	1.3×10^{-2}	N/A[a]	N/A[a]	2.0×10^{-4}	N/A[a]	3.4×10^{-3}	7.3×10^{-5}
3C	2.0×10^{-3}	N/A[a]	N/A[a]	1.6×10^{-2}	N/A[a]	5.8×10^{-4}	N/A[a]	3.4×10^{-3}	7.3×10^{-5}
4	2.9×10^{-3}	4.0×10^{-2}	9.9×10^{-4}	N/A[a]	N/A[a]	6.8×10^{-4}	N/A[a]	2.8×10^{-3}	1.0×10^{-4}
5	2.7×10^{-3}	4.9×10^{-2}	9.6×10^{-4}	N/A[a]	N/A[a]	5.8×10^{-4}	9.9×10^{-4}	2.2×10^{-3}	9.7×10^{-5}
6A, Base Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	7.9×10^{-2}	2.6×10^{-4}	N/A[a]	2.3×10^{-3}	1.9×10^{-3}
6A, Option Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	6.0×10^{-3}	2.6×10^{-4}	N/A[a]	2.2×10^{-3}	1.2×10^{-4}
6B, Base Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	7.9×10^{-2}	2.6×10^{-4}	N/A[a]	2.3×10^{-3}	1.9×10^{-3}
6B, Option Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	6.0×10^{-3}	2.6×10^{-4}	N/A[a]	2.2×10^{-3}	1.2×10^{-4}
6C	N/A[a]	N/A[a]	N/A[a]	N/A[a]	N/A[a]	2.6×10^{-4}	N/A[a]	2.1×10^{-3}	N/A[a]

[a] This waste type would not be generated under this alternative.
Key: ETF=Effluent Treatment Facility; ILAW=immobilized low-activity waste; N/A=not applicable; PPF=Preprocessing Facility.

Table Q–394. Doses by Tank Closure Waste Type to an American Indian Engaged in Residential Agriculture and a Well-Drilling Worker at the RPPDF

Alternative	Dose for American Indian Resident Farmer (rem per year)	Dose for Drilling Worker (rem)
2A	N/A[a]	N/A[a]
2B	0.017	3.3×10^{-5}
3A	0.017	3.3×10^{-5}
3B	0.017	3.3×10^{-5}
3C	0.017	3.3×10^{-5}
4	0.044	8.9×10^{-5}
5	N/A[a]	N/A[a]
6A, Base Case	0.053	1.1×10^{-4}
6A, Option Case	0.016	3.5×10^{-5}
6B, Base Case	0.053	1.1×10^{-4}
6B, Option Case	0.016	3.5×10^{-5}
6C	0.017	3.3×10^{-5}

[a] The RPPDF would not be constructed under this alternative.
Key: N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table Q–395. Doses by Waste Management Waste Type to an American Indian Engaged in Residential Agriculture and a Well-Drilling Worker at an Integrated Disposal Facility

Waste Type	Dose for American Indian Resident Farmer (rem per year)	Dose for Drilling Worker (rem)
Onsite non-CERCLA waste	0.179	4.4×10^{-4}
Waste management secondary waste	6.6×10^{-4}	3.0×10^{-6}
Offsite waste	2.62	5.1×10^{-3}
FFTF decommissioning secondary waste	0.0034	1.4×10^{-5}

Key: CERCLA=Comprehensive Environmental Response, Compensation, and Liability Act; FFTF=Fast Flux Test Facility.

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