5.3.1.3 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas

This section describes the results for Waste Management Alternative 3, including long-term groundwater impacts of contaminant sources within the IDF-East, IDF-West, and RPPDF barriers. Impacts of sources remaining within the tank farm barriers are presented in Section 5.1, which discusses tank closure impacts. Impacts of sources remaining within the FFTF barrier are presented in Section 5.2, which discusses FFTF decommissioning impacts.

Waste Management Alternative 3 is designed to show the impacts of waste disposal at an IDF in the 200-East Area and an IDF in the 200-West Area. Summaries of the proposed actions and timelines for Waste Management Alternative 3 are provided in Chapter 2, Section 2.5. There are three disposal facilities, as follows:

- Two IDFs, one in the south-central part of the 200-East Area (IDF-East), which would receive tank waste, and the other in the northern part of the 200-West Area (IDF-West), which would receive FFTF decommissioning waste; onsite non-CERCLA waste; and offsite LLW and MLLW. The LLW and MLLW inventories for trenches 31 and 34 are also included in the IDF inventory in this analysis.

- The RPPDF, located in the Core Zone between the 200-East and 200-West Areas, which would receive lightly contaminated equipment and soils resulting from tank farm closure activities.

Three disposal groups were analyzed. Each has a different configuration and timeline for the IDFs and RPPDF. The three disposal groups are discussed in detail in the following subsections.

5.3.1.3.1 Disposal Group 1

Disposal Group 1 is characterized by an operational completion date of CY 2050 for IDF-East, IDF-West, and the RPPDF. Under Disposal Group 1, IDF-West would have a large capacity (90,000 cubic meters [117,720 cubic yards]); IDF-East, a larger capacity (1,300,000 cubic meters [1,700,400 cubic yards]); and the RPPDF, a capacity of 1,080,000 cubic meters (1,412,640 cubic yards). These capacities were designed to meet the waste generation volumes associated with Tank Closure Alternative 2B, 3A, 3B, 3C, 4, 5, or 6C and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste.

5.3.1.3.1.1 Disposal Group 1, Subgroup 1-A

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 2B and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Tank closure waste would be converted to IHLW and ILAW glass.

For the long-term groundwater impacts analysis, two major periods have been identified for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2050, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West,

and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, and nitrate) are all mobile (i.e., they move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable; they are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Four subtotals are plotted in Figures 5–713 through 5–718, representing releases from IDF-East, which include ILAW glass, ETF-generated secondary waste, retired melters, and tank closure secondary waste.

Figure 5–713 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–714, the chemical hazard drivers. For all four sources, the release to the vadose zone is controlled by retention within the waste form (i.e., less than 100 percent of the inventory is released during the post-disposal period). The predominant source of technetium-99 and chromium is tank closure secondary waste. For iodine-129 and nitrate, ETF-generated secondary waste is the predominant source. Fluoride is not released from IDF-East.

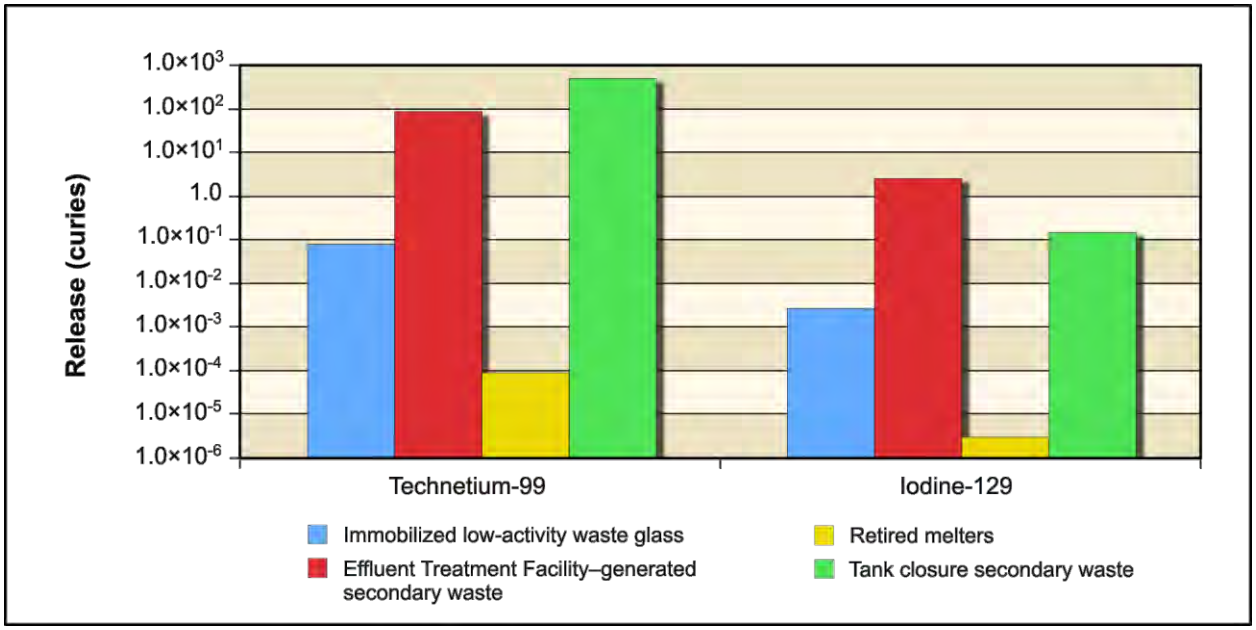


Figure 5–713. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

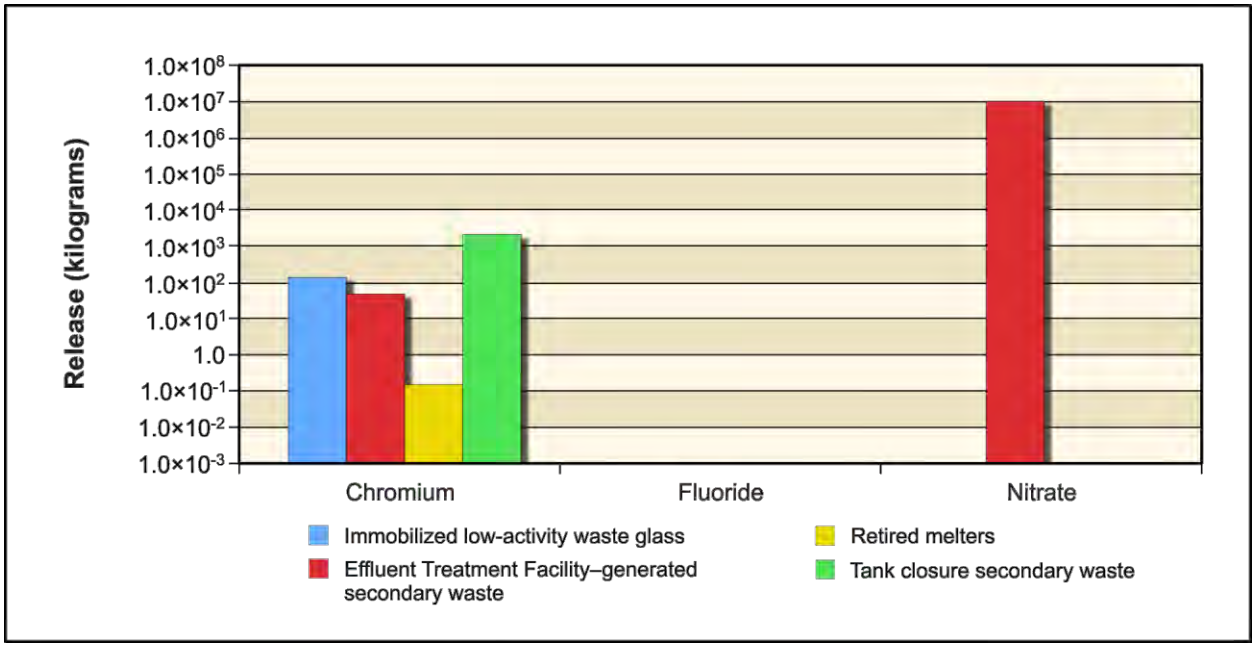


Figure 5–714. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–715 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–716, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For the conservative tracers (iodine-129, technetium-99, chromium, and nitrate), the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 60 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater; approximately 100 percent of the chemical quantity (kilograms) reaches groundwater.

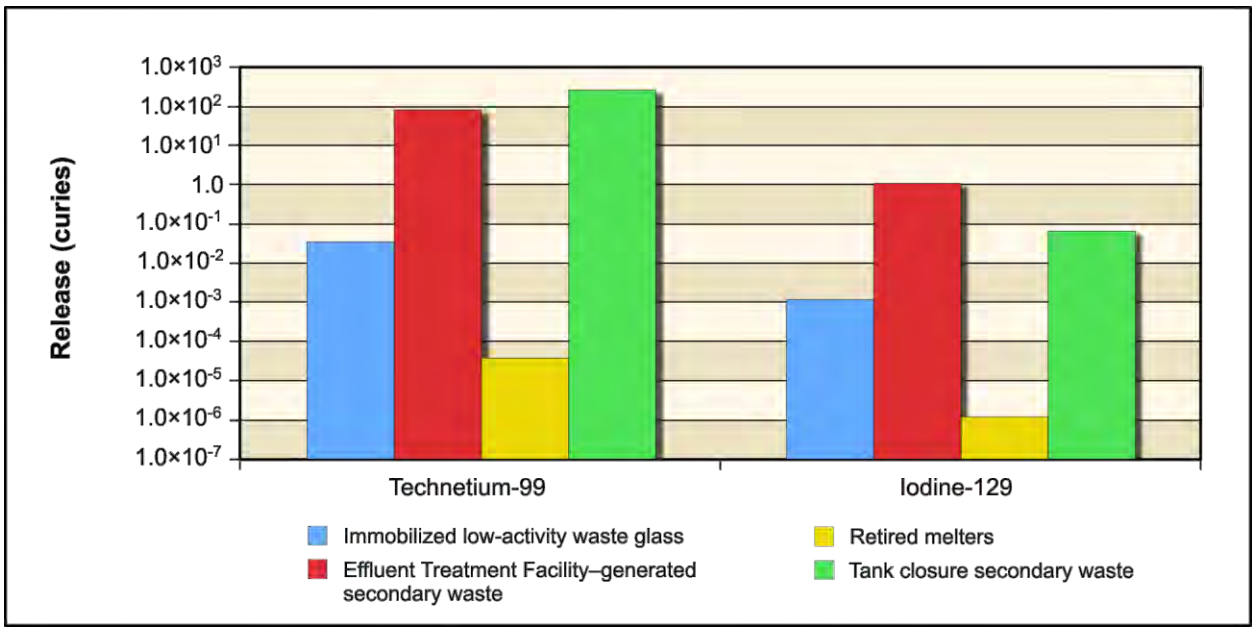


Figure 5–715. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

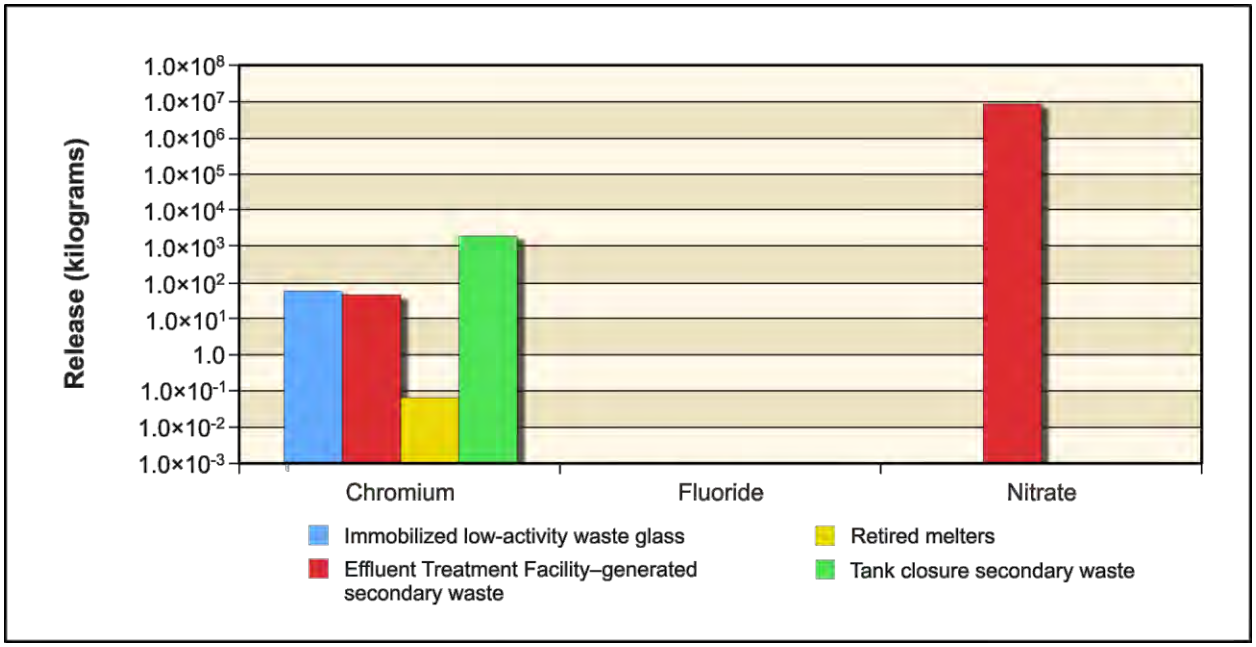


Figure 5–716. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–717 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–718, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For iodine-129, technetium-99, chromium, and nitrate, the total amount released to the Columbia River is essentially equal to the total amount released to groundwater. The contribution from waste from retired melters for technetium-99 and iodine-129 is very small, and releases to groundwater from the retired melters in small amounts reach the Columbia River. About 96 percent of the radionuclide amount (curies) released to groundwater during the period of analysis reaches the river; approximately 99 percent of the chemical quantity (kilograms) reaches the river.

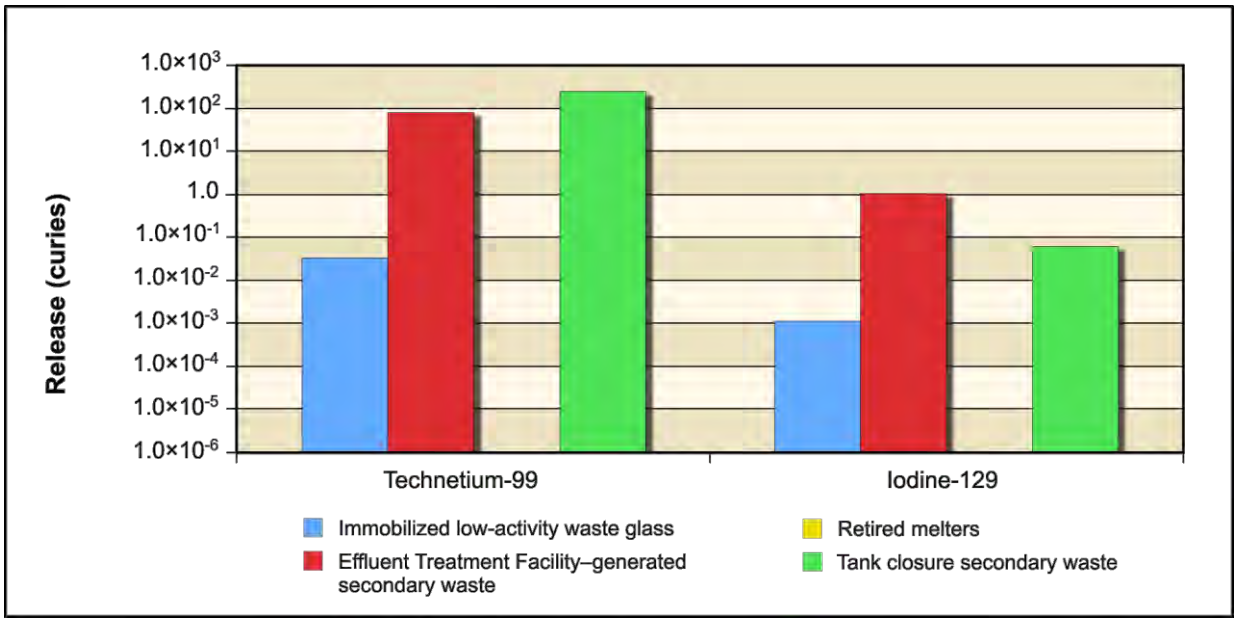


Figure 5–717. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

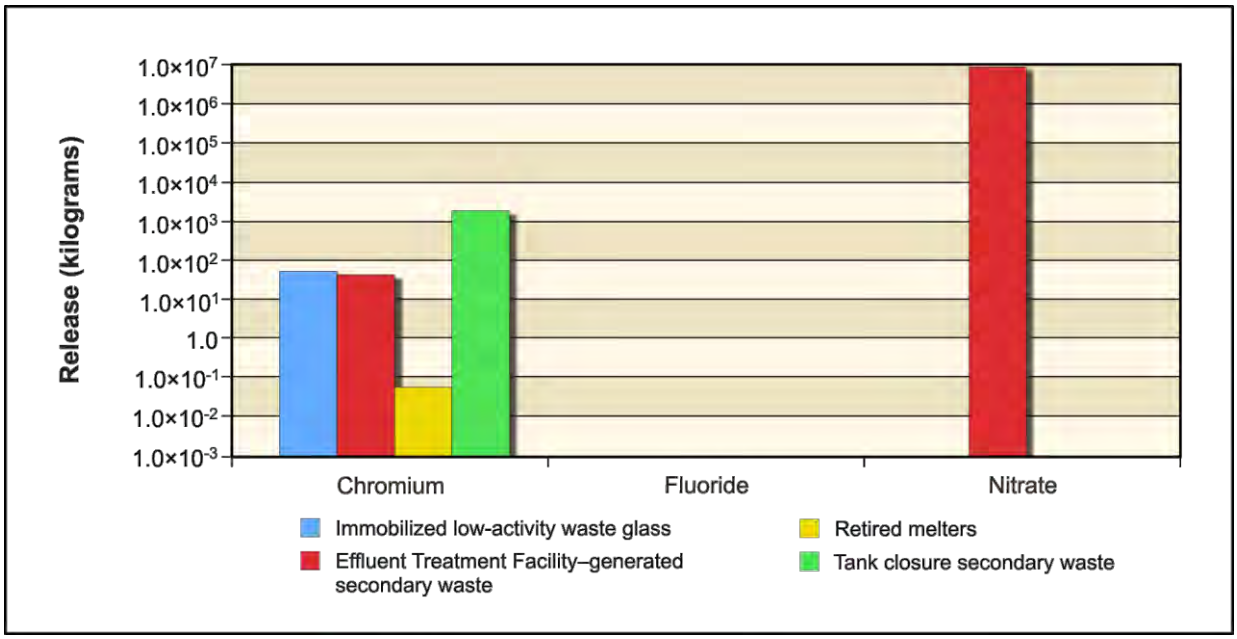


Figure 5–718. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5–719 through 5–724, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management and onsite waste, and offsite waste.

Figure 5–719 shows the estimated release to the vadose zone of the radiological risk drivers and Figure 5–720, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). The predominant source of technetium-99 and iodine-129 is offsite waste. For chromium, nitrate, and fluoride, the predominant source is waste management secondary waste and onsite waste.

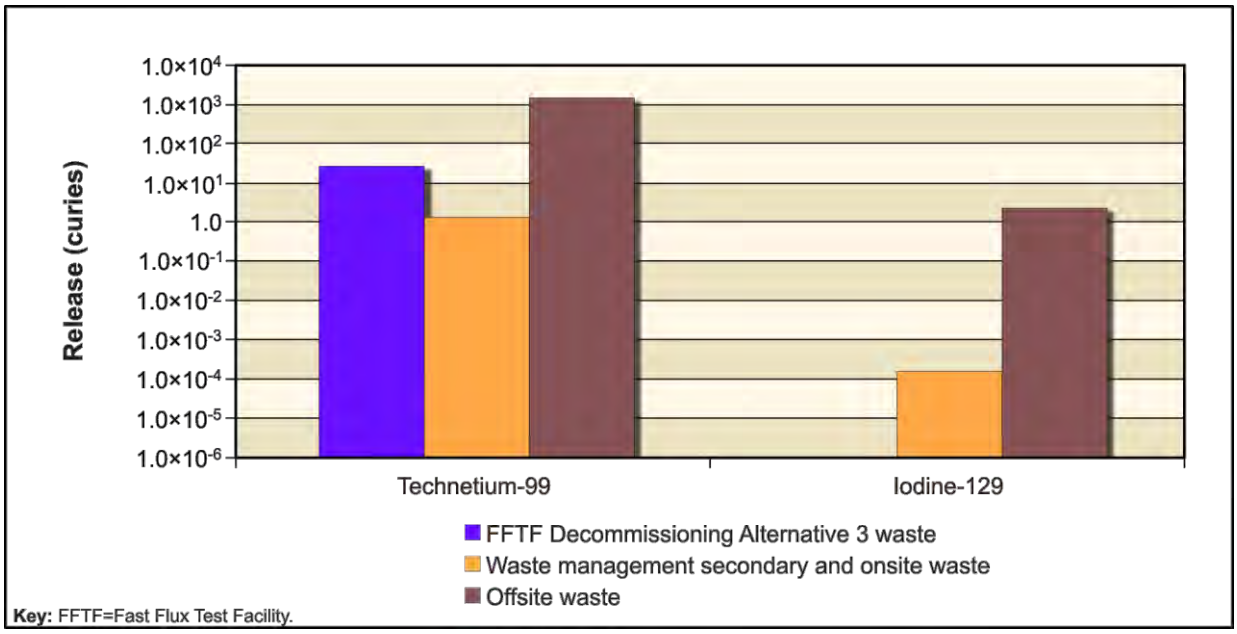


Figure 5–719. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

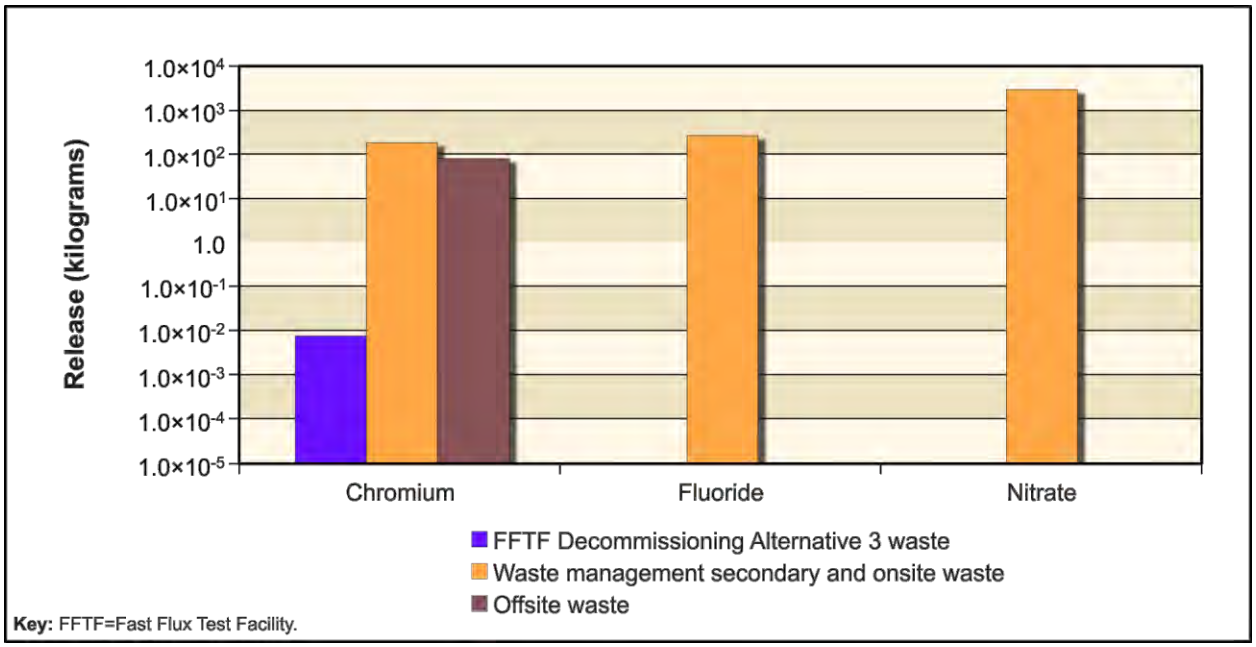


Figure 5–720. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–721 shows the estimated release to groundwater of the radiological risk drivers and Figure 5–722, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, nitrate, and fluoride, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 97 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater; approximately 100 percent of the chemical quantity (kilograms) reaches groundwater.

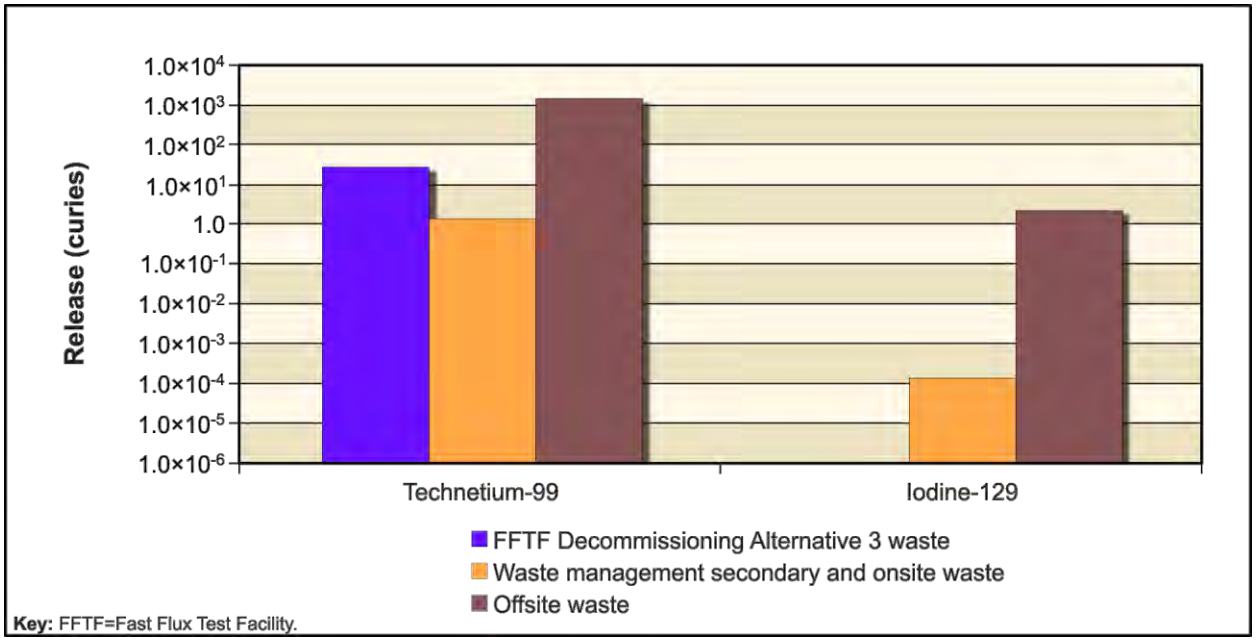


Figure 5–721. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

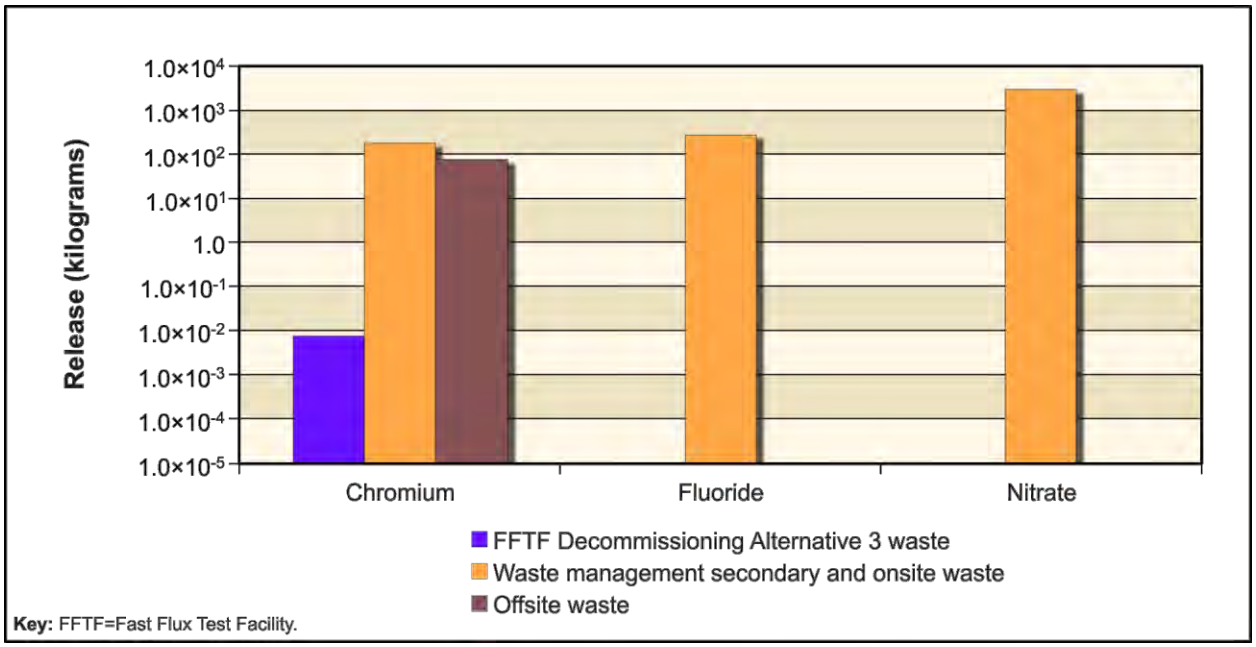


Figure 5–722. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–723 shows the estimated release to the Columbia River of the radiological risk drivers and Figure 5–724, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, nitrate, and fluoride, the amount released to the Columbia River is essentially equal to the amount released to groundwater. About 99 percent of the radionuclide amount (curies) released to groundwater during the period of analysis reaches the river, while approximately 100 percent of the chemical quantity (kilograms) reaches the river.

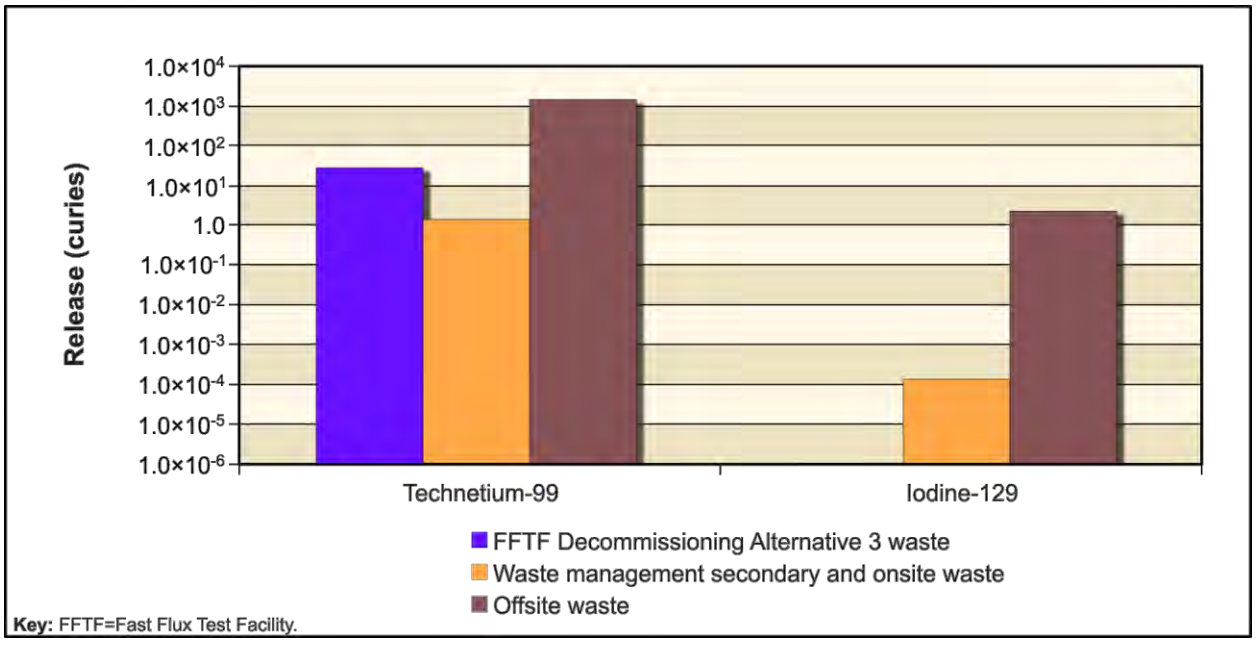


Figure 5–723. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

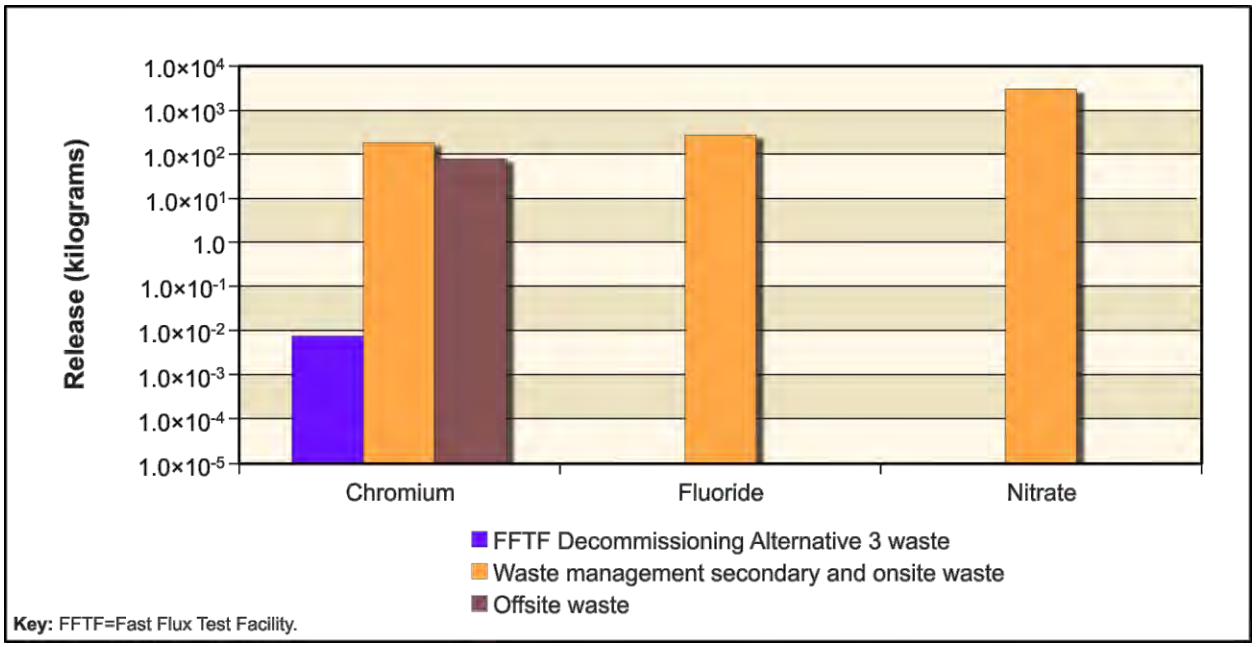


Figure 5–724. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5–725 shows the estimated release to the vadose zone of the radiological risk drivers and Figure 5–726, the chemical hazard drivers. Release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). Radionuclide releases from the RPPDF to the vadose zone comprise technetium-99 (largest source) and iodine-129 (smallest source). Chemical hazard releases from the RPPDF comprise nitrate (largest source) and chromium (smallest source). Fluoride is not released from the RPPDF.

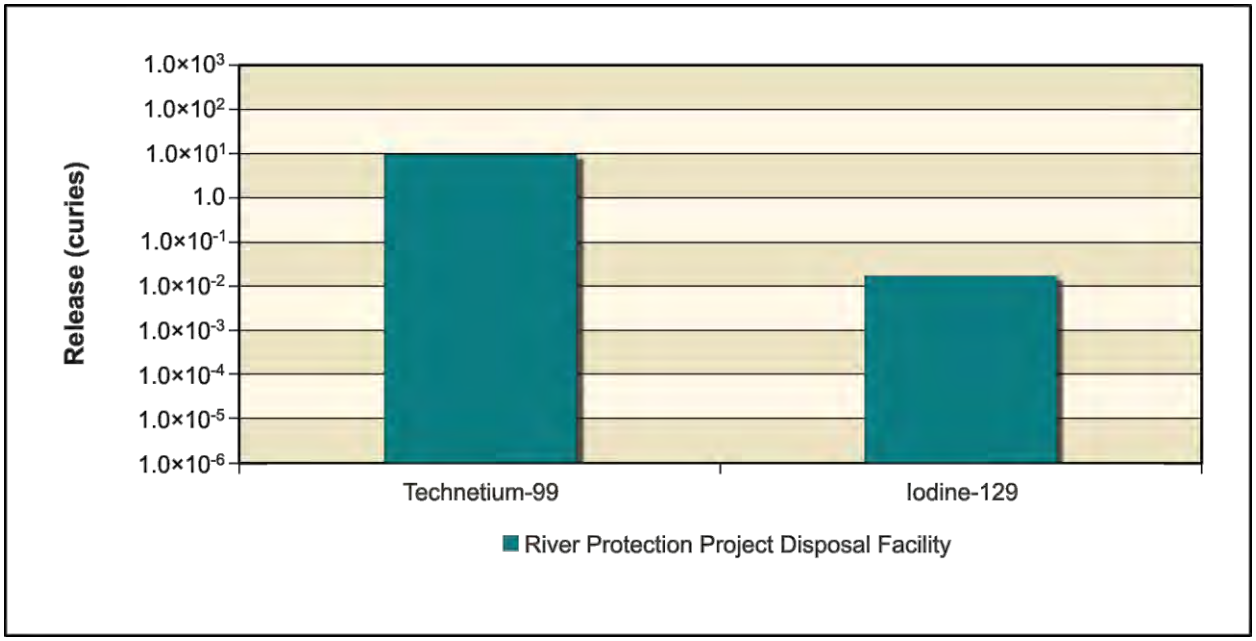


Figure 5–725. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

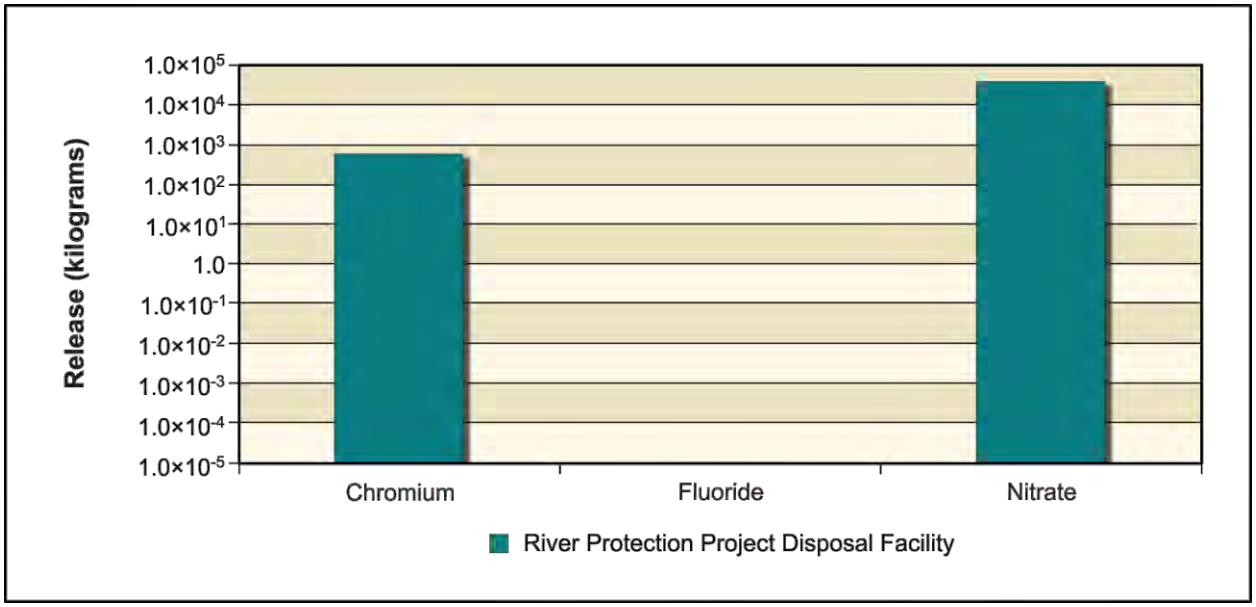


Figure 5–726. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–727 shows the estimated release to groundwater of the radiological risk drivers and Figure 5–728, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 100 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater; approximately 100 percent of the chemical quantity (kilograms) reaches groundwater.

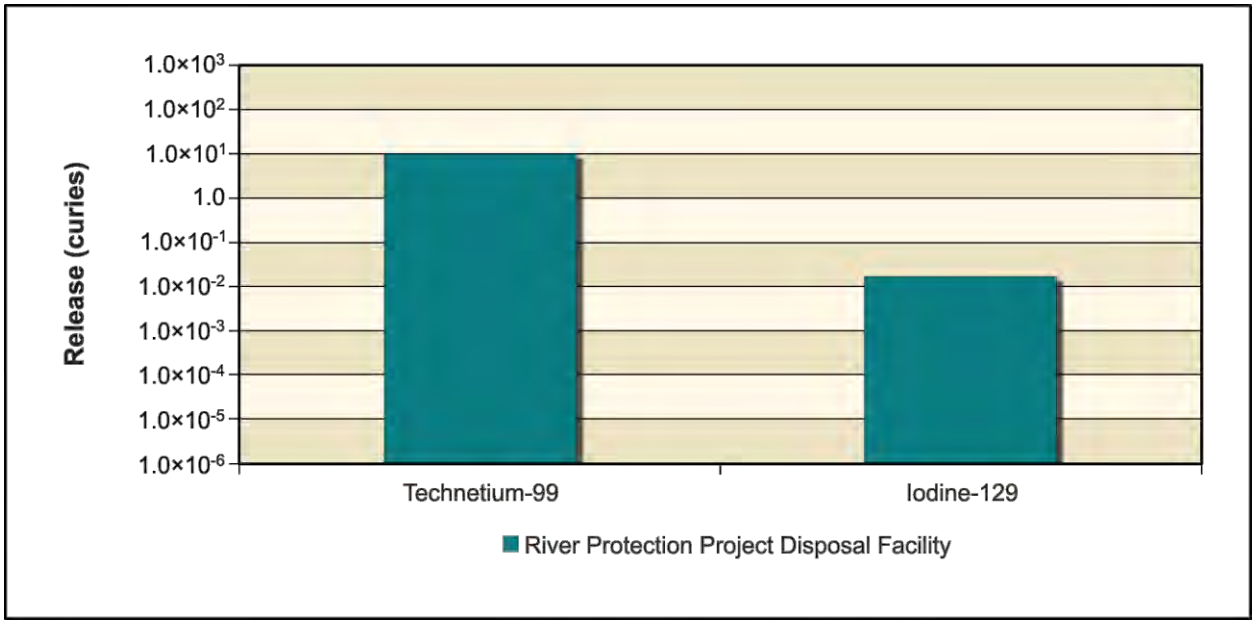


Figure 5–727. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

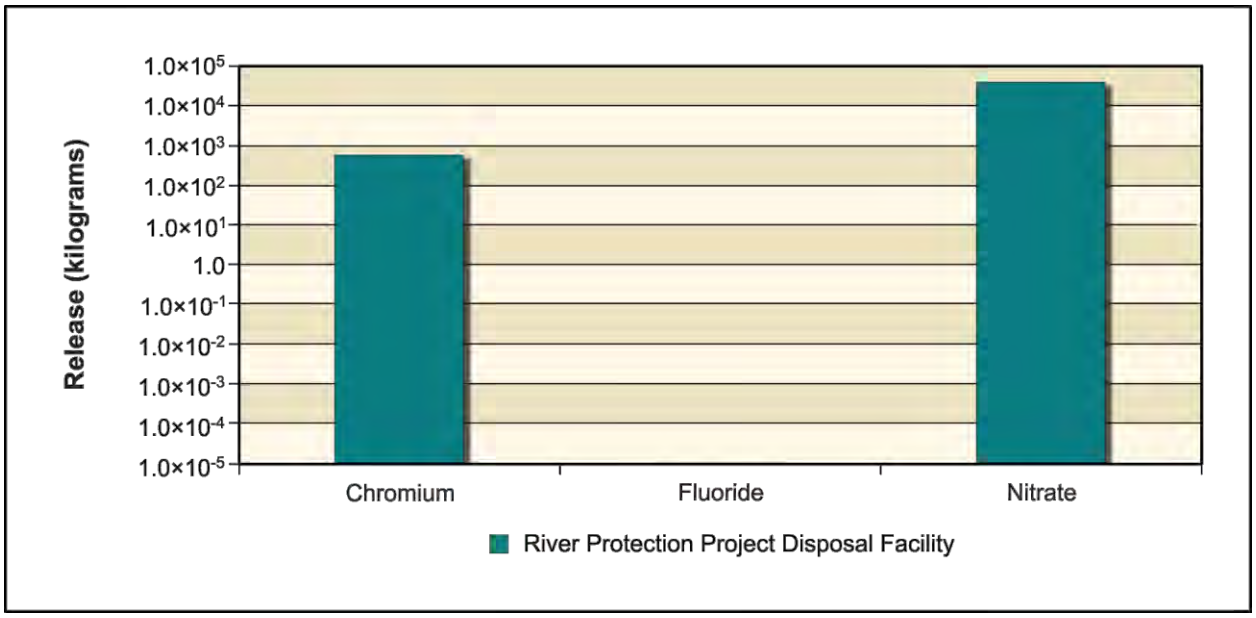


Figure 5–728. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–729 shows the estimated release to the Columbia River of the radiological risk drivers and Figure 5–730, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For iodine-129, technetium-99, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater. Overall, approximately 100 percent of the radionuclide amount (curies) released to groundwater during the period of analysis reaches the river; about 100 percent of the chemical quantity (kilograms) reaches the river.

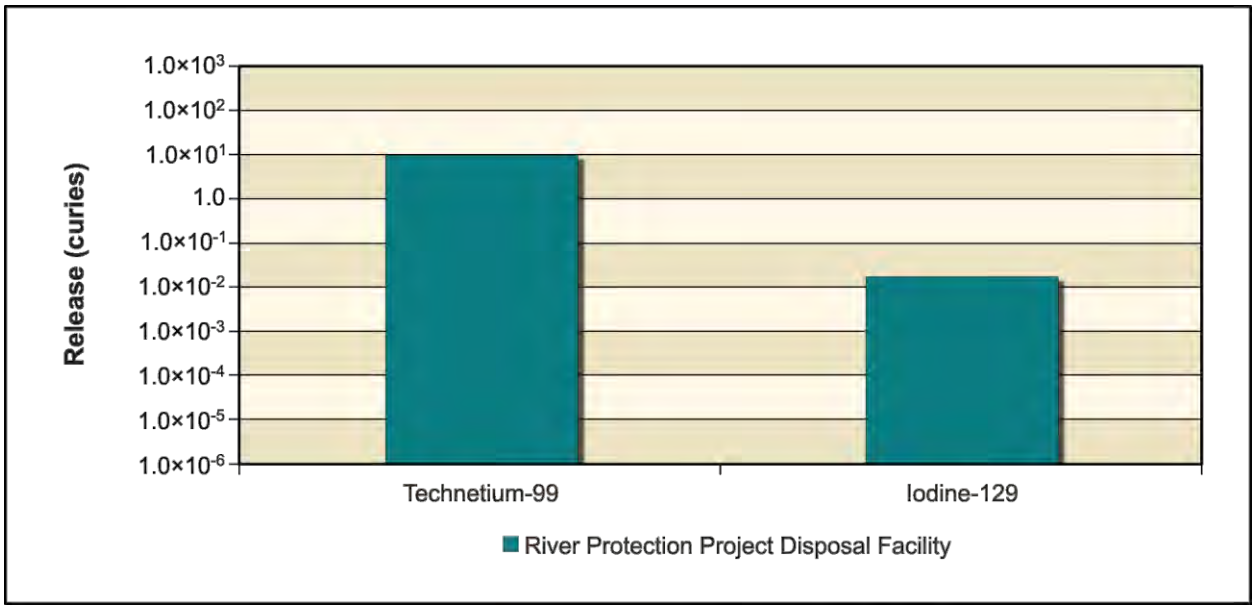


Figure 5–729. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

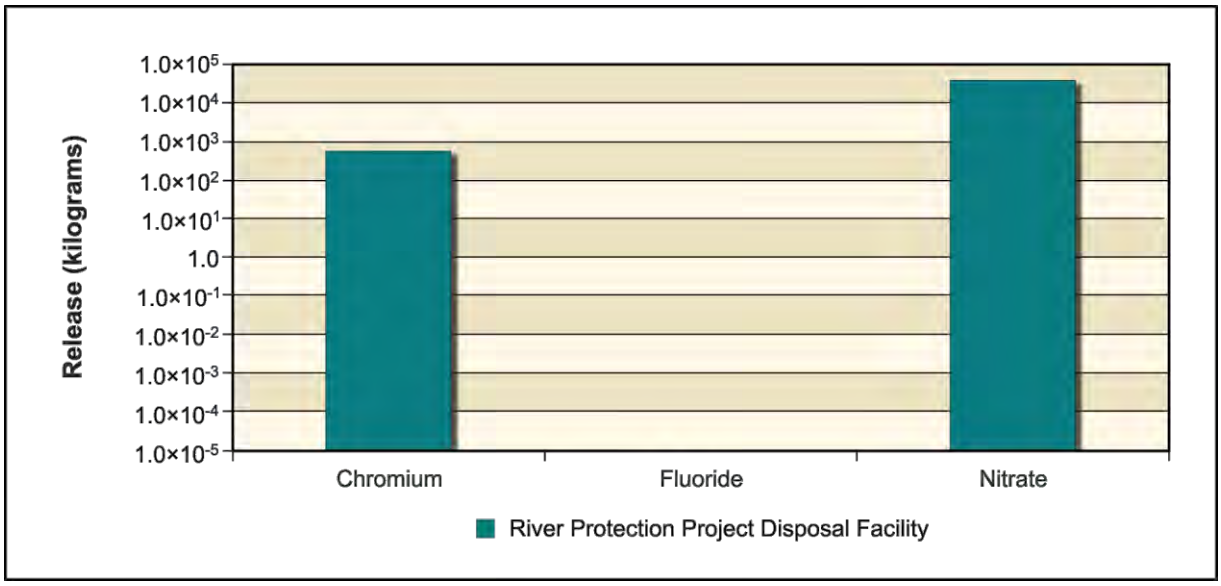


Figure 5–730. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, impacts in terms of groundwater concentration versus time at the RPPDF barrier, IDF-East barrier, IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations. Table 5–106 lists the maximum concentrations of the COPCs in the peak year at IDF-East, IDF-West, the RPPDF, the Core Zone Boundary, and the Columbia River nearshore. Exceedances of the benchmarks occur only for technetium-99 and iodine-129 at IDF-East, IDF-West, the Core Zone Boundary, and the Columbia River nearshore.

Table 5–106. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	206	**13,200**	42	**1,370**	**1,670**	900
	(10,129)	(3818)	(3818)	(3859)	(3920)	
Iodine-129	1.0	**20.6**	0.1	**2.1**	**2.4**	1
	(10,177)	(3794)	(3747)	(3937)	(3872)	
Chemical (micrograms per liter)						
Chromium	2	1	3	1	0	100
	(8438)	(3813)	(3740)	(3846)	(4481)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	12,100	7	180	3,010	2,030	45,000
	(7962)	(3927)	(3670)	(8248)	(7535)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figures 5–731 through 5–734 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate (the conservative tracers). Iodine-129 concentrations exceed the benchmark concentration at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. The greatest exceedance of the benchmark concentration is at the IDF-West barrier, where the benchmark is exceeded by about an order of magnitude from approximately CY 3200 until CY 4800. Iodine-129 concentrations never exceed the benchmark concentration at the RPPDF barrier or the IDF-East barrier. The iodine-129 benchmark concentration is exceeded by less than an order of magnitude at the Core Zone Boundary and Columbia River nearshore. Concentrations of iodine-129 exceed the benchmark concentration at the Columbia River nearshore for the longest period of time and fall below the benchmark in approximately CY 6000. Technetium-99 exhibits behavior similar to iodine-129, where concentrations at the IDF-West barrier exceed the benchmark by one order of magnitude. The duration of the benchmark exceedance is approximately 1,300 years. Nitrate and chromium do not exceed benchmark concentrations at the IDF-East barrier, IDF-West barrier, RPPDF barrier, Core Zone Boundary, or Columbia River nearshore.

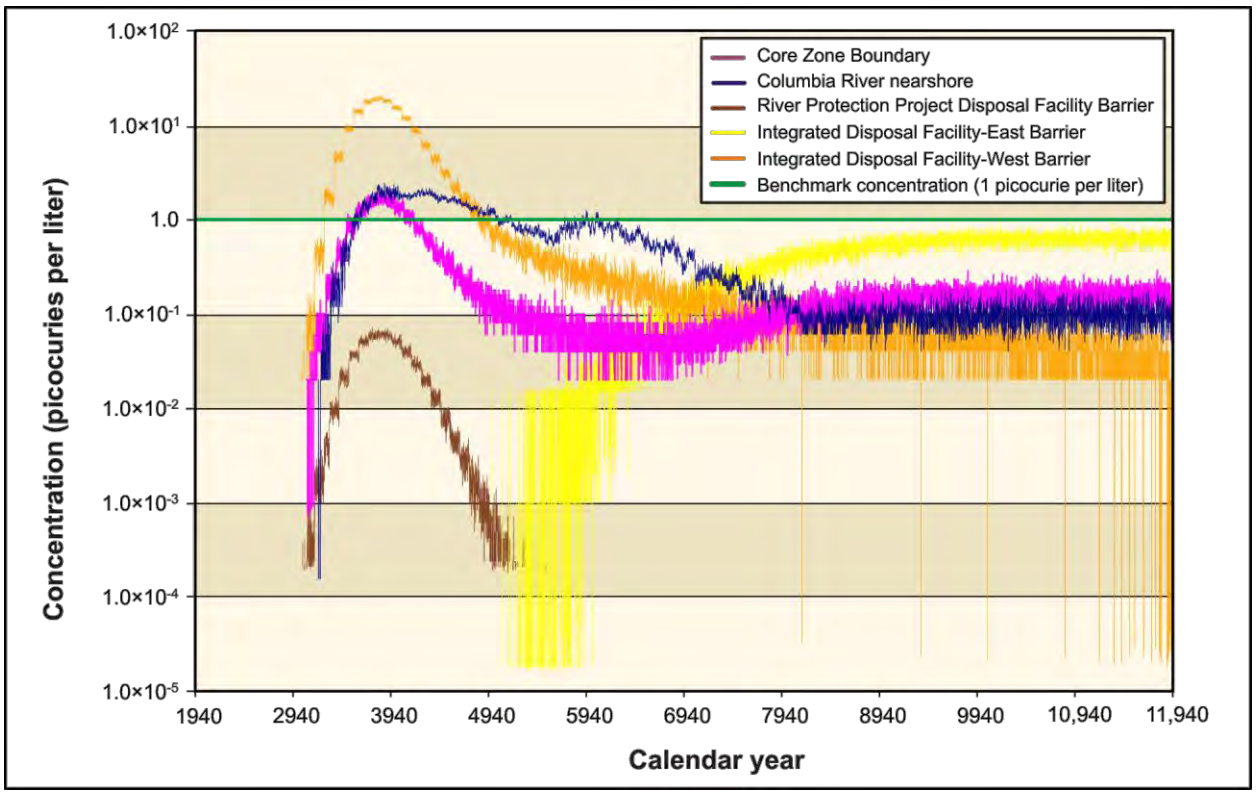


Figure 5–731. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Iodine-129 Concentration Versus Time

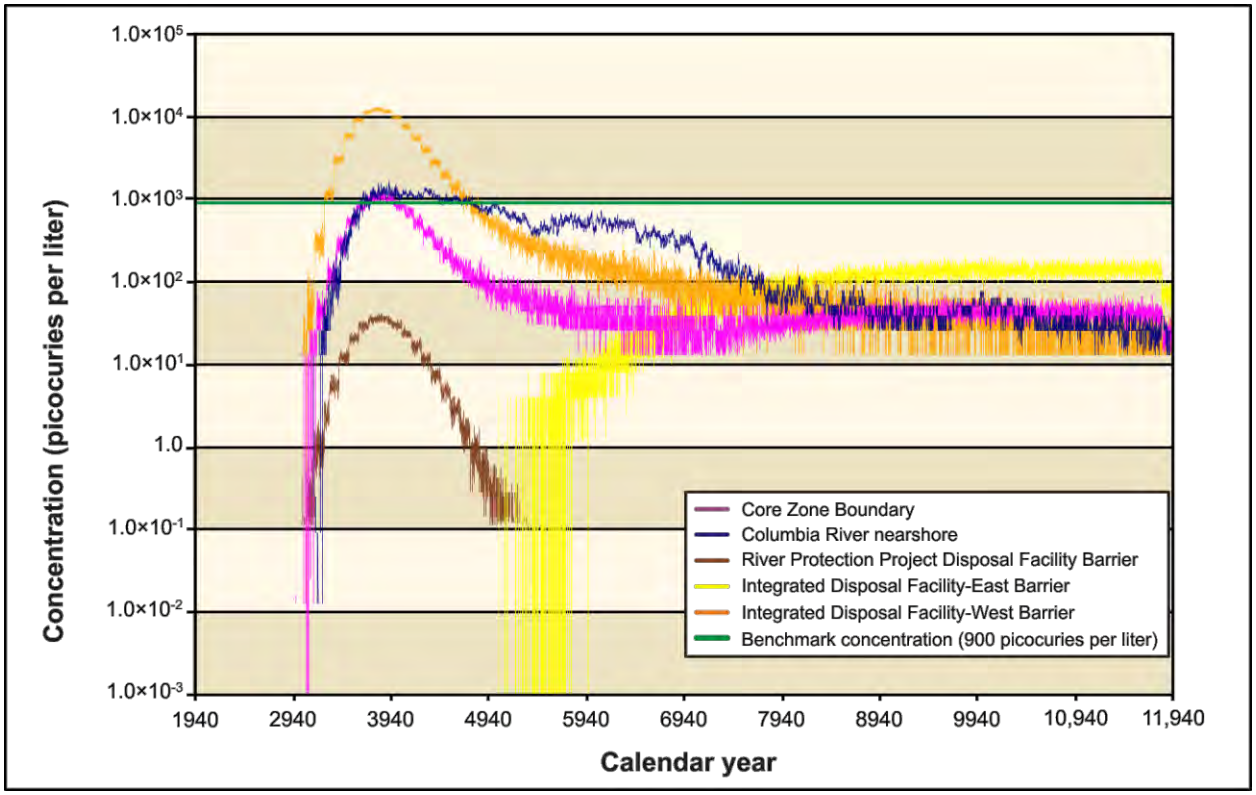


Figure 5–732. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Technetium-99 Concentration Versus Time

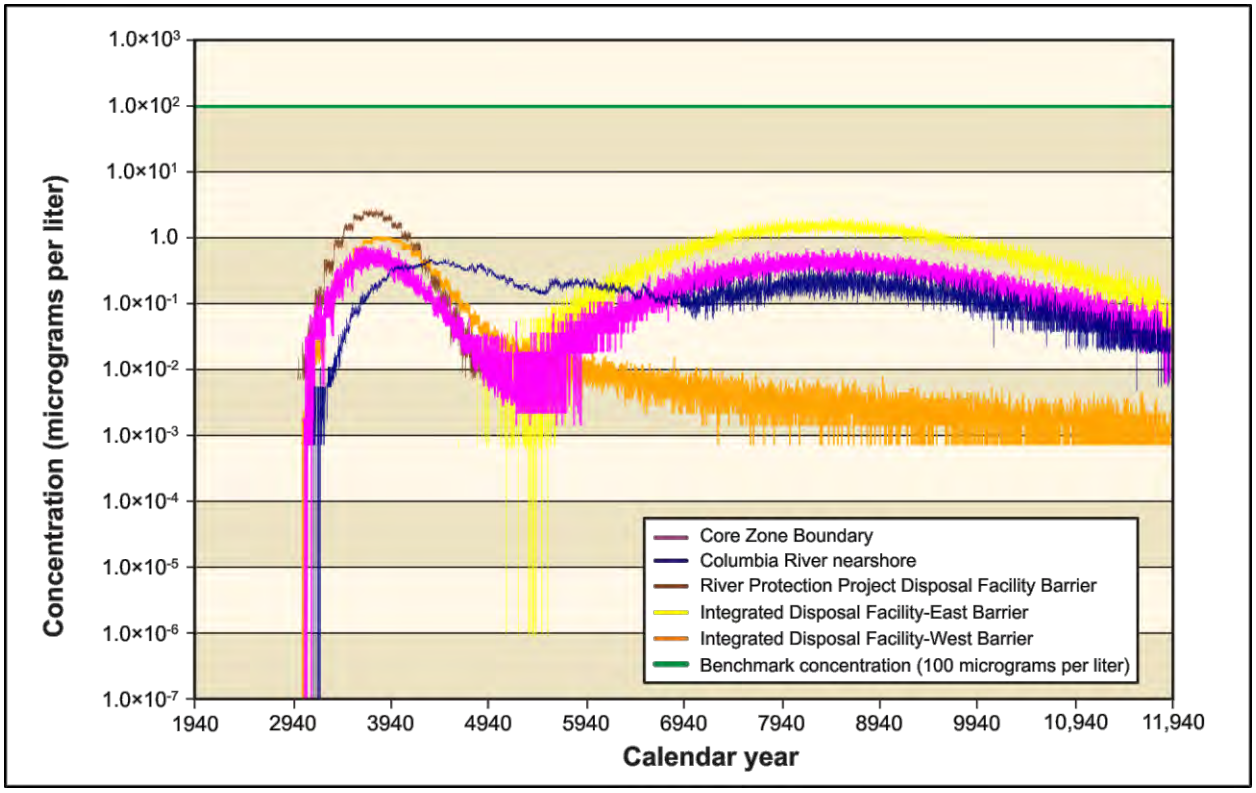


Figure 5–733. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Chromium Concentration Versus Time

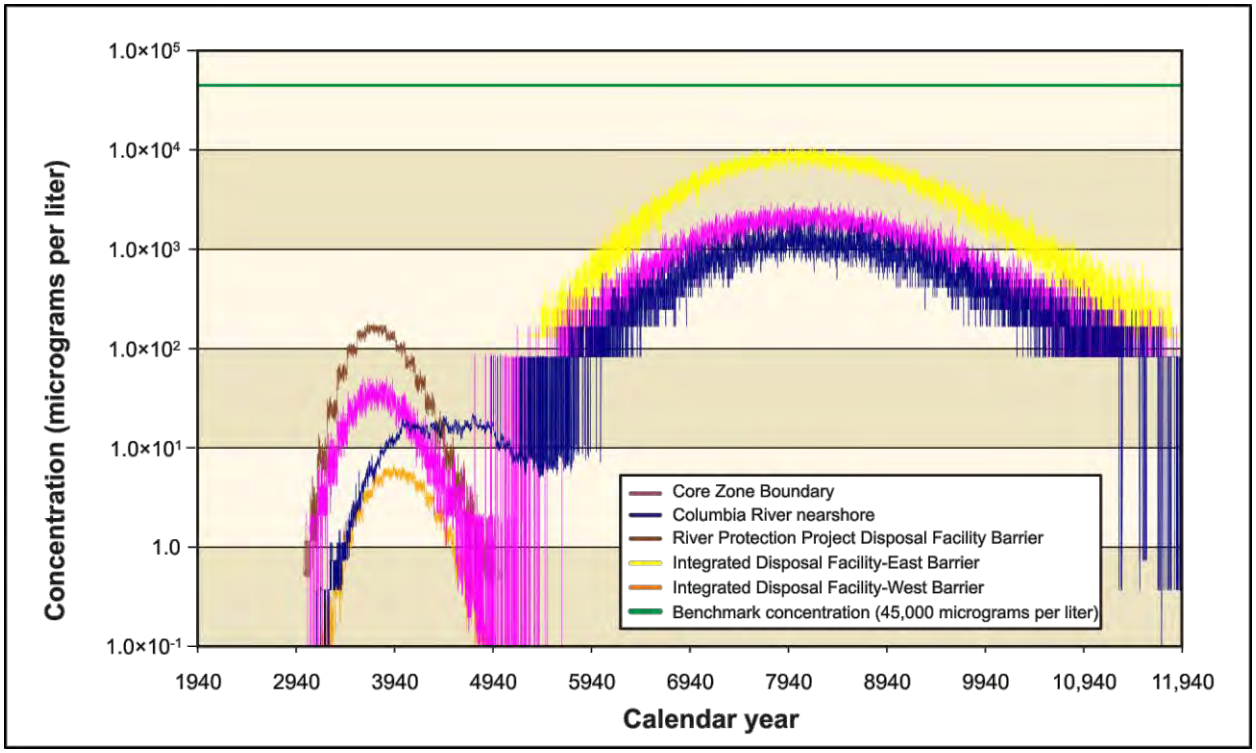


Figure 5–734. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Nitrate Concentration Versus Time

Figure 5–735 shows concentration versus time for total uranium. Because total uranium moves slowly through the vadose zone, releases from IDF-East, IDF-West, and the RPPDF result in groundwater concentrations that remain below about eight orders of magnitude lower than benchmark concentrations at the RPPDF barrier and Core Zone Boundary for the duration of the 10,000-year simulation period.

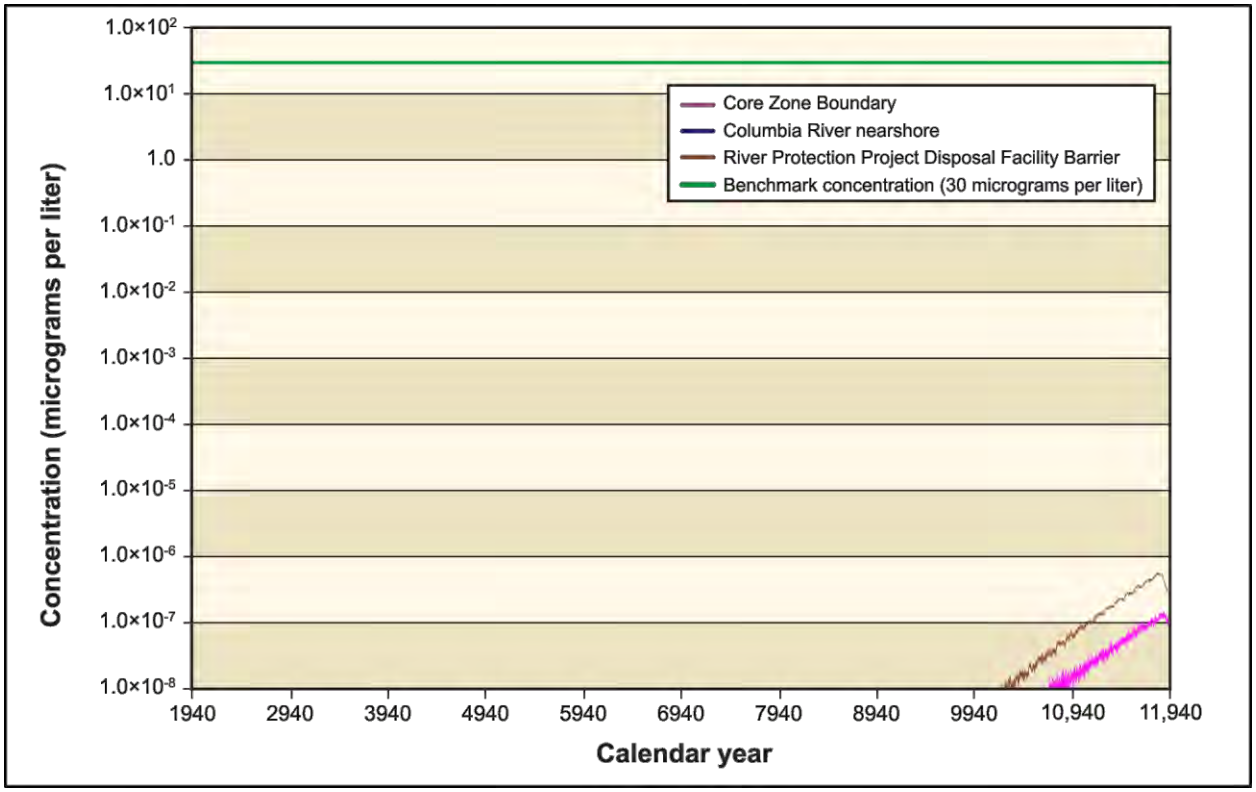
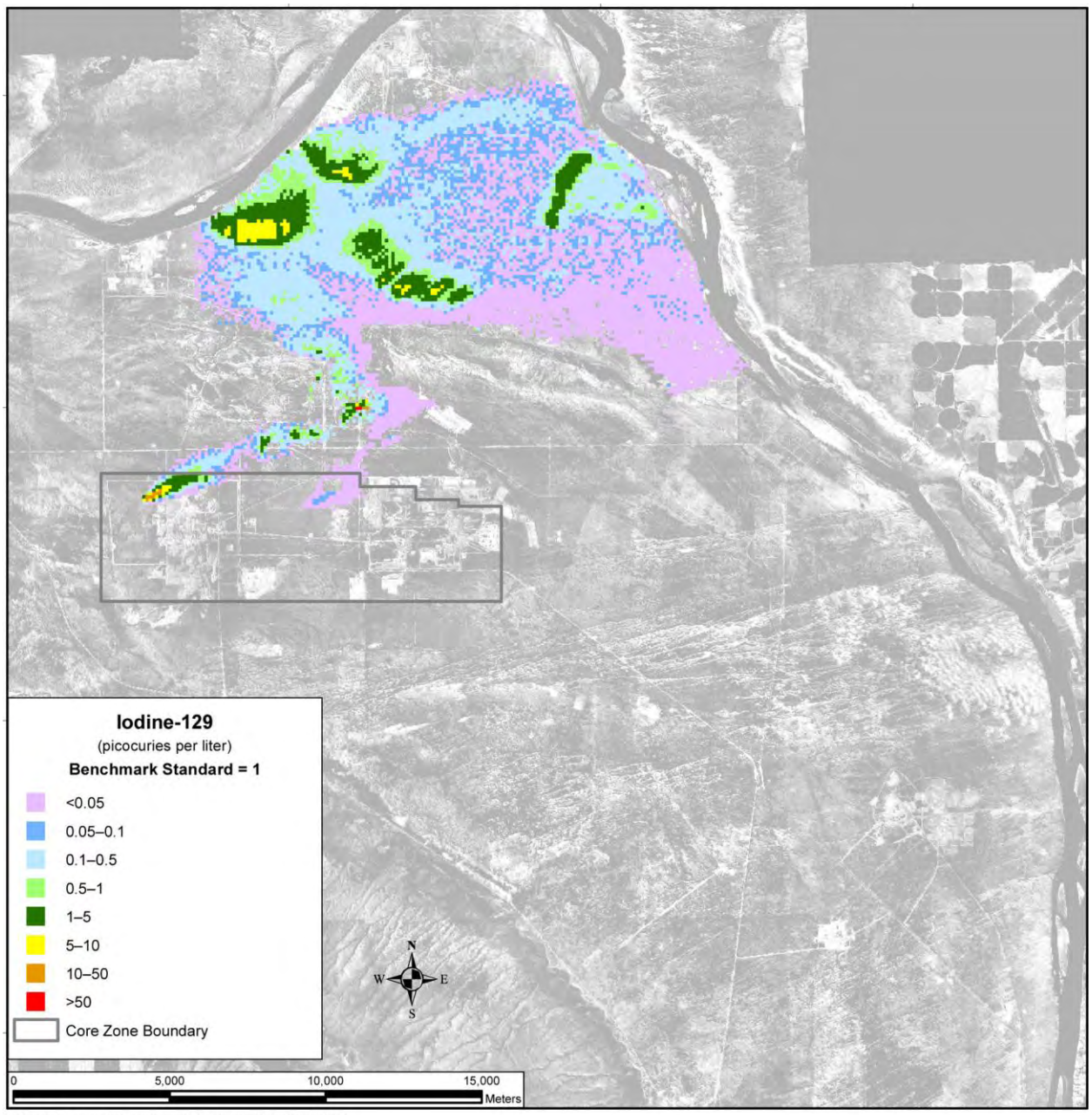


Figure 5–735. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

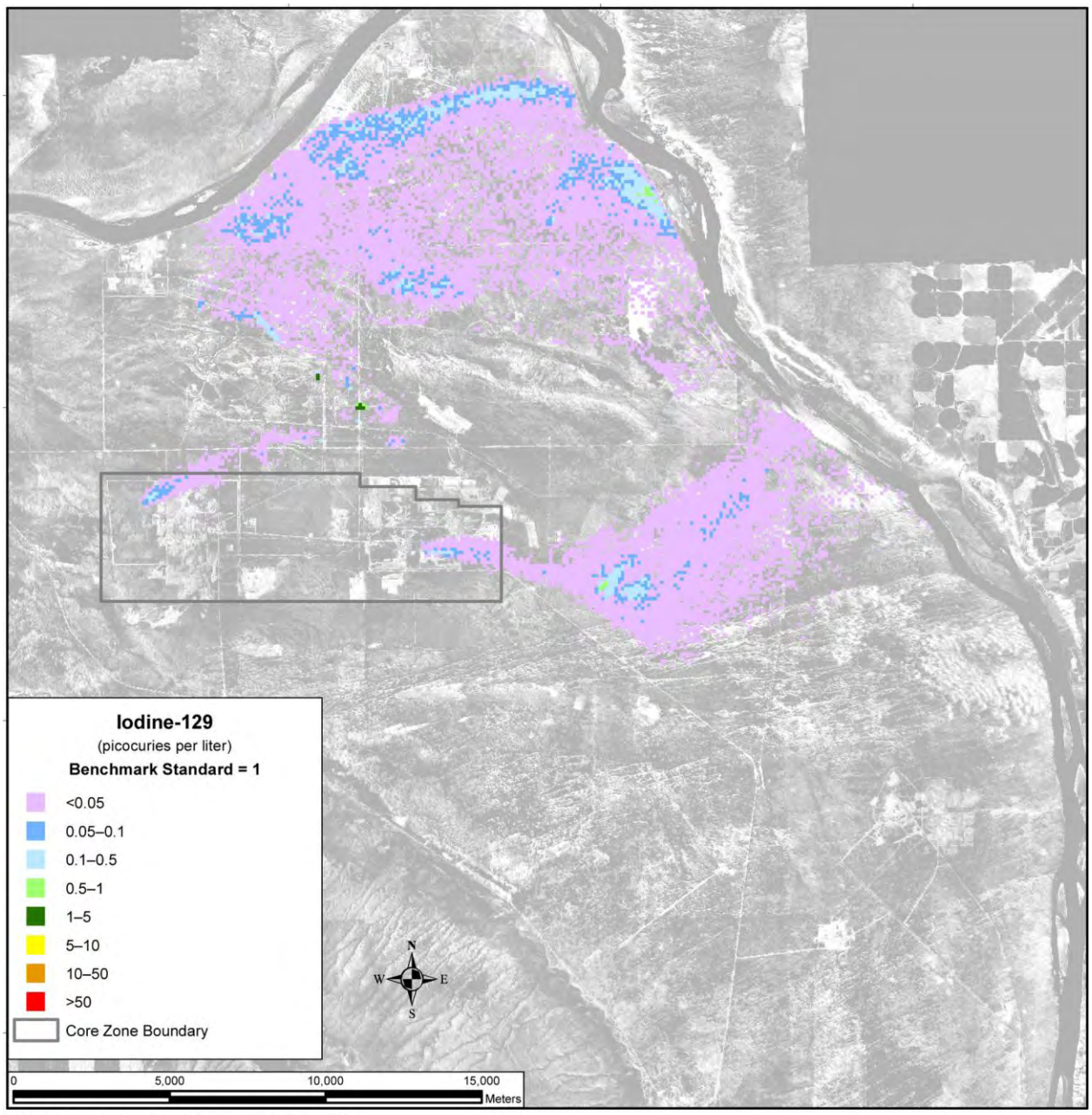
This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations.

Figure 5–736 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 3890. Releases from IDF-West and the RPPDF result in a groundwater plume starting in the Core Zone and heading north through Gable Mountain. This plume exceeds the benchmark concentration at the Core Zone Boundary and north of the Core Zone Boundary by one to two orders of magnitude. In CY 7140, releases from IDF-East create a groundwater plume, not exceeding the benchmark, that extends from the 200-East Area east toward the Columbia River (see Figure 5–737). Also by CY 7140, most of the IDF-West and RPPDF plume continues to move north and reaches the Columbia River. By CY 11,885, most of the mass in the IDF-East plume is still moving east toward the Columbia River, with only small, isolated pockets of concentration exceeding the benchmark (see Figure 5–738). Technetium-99 (see Figures 5–739 through 5–741) shows similar spatial distributions at selected times and exceeds its benchmark concentration at approximately the same time and locations. Chromium (see Figures 5–742 through 5–744) and nitrate (see Figures 5–745 through 5–747) show similar spatial distributions at selected times, but neither exceeds its benchmark concentration. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., move at the rate of the pore-water velocity).



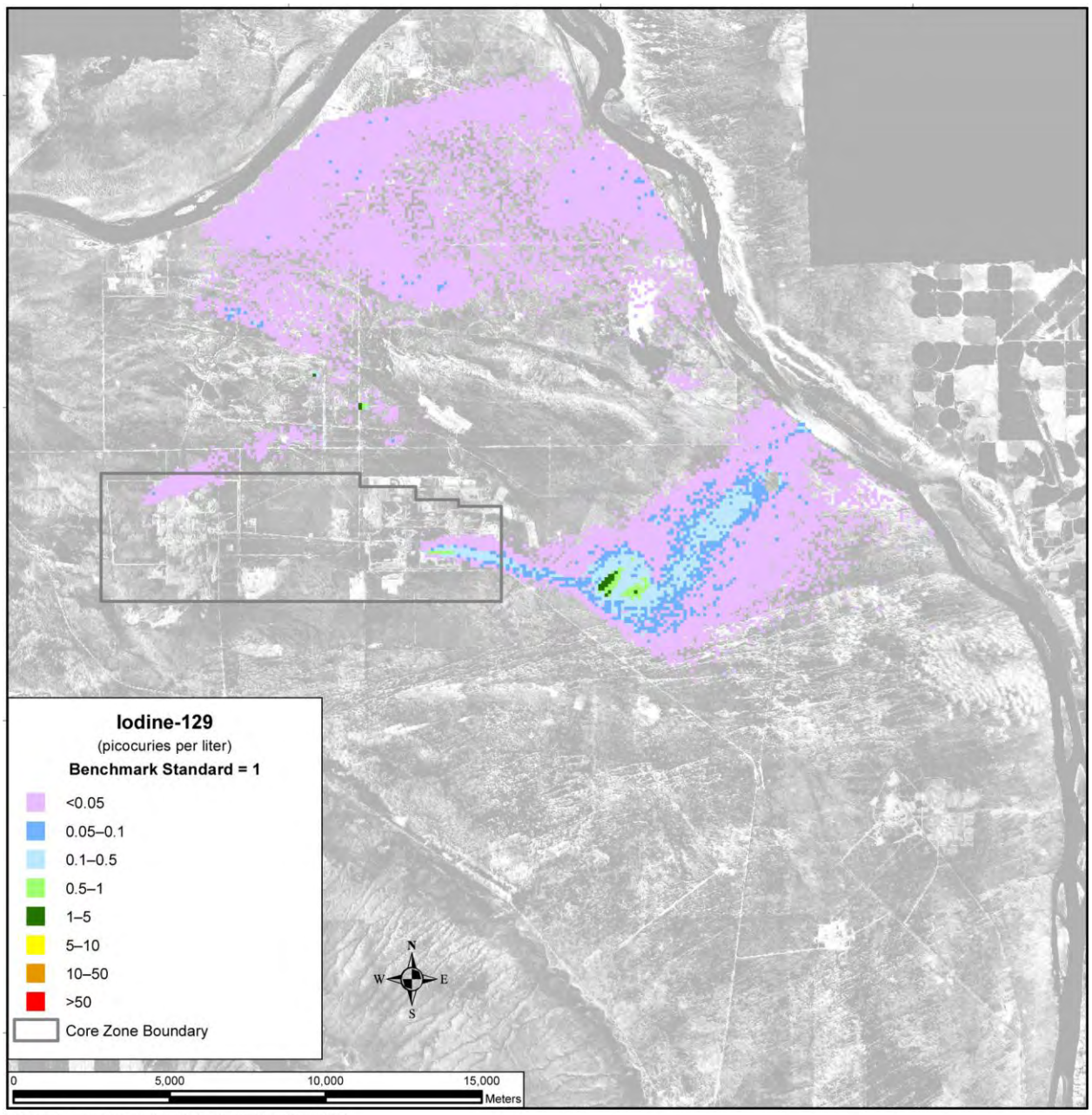
Note: To convert meters to feet, multiply by 3.281.

Figure 5–736. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



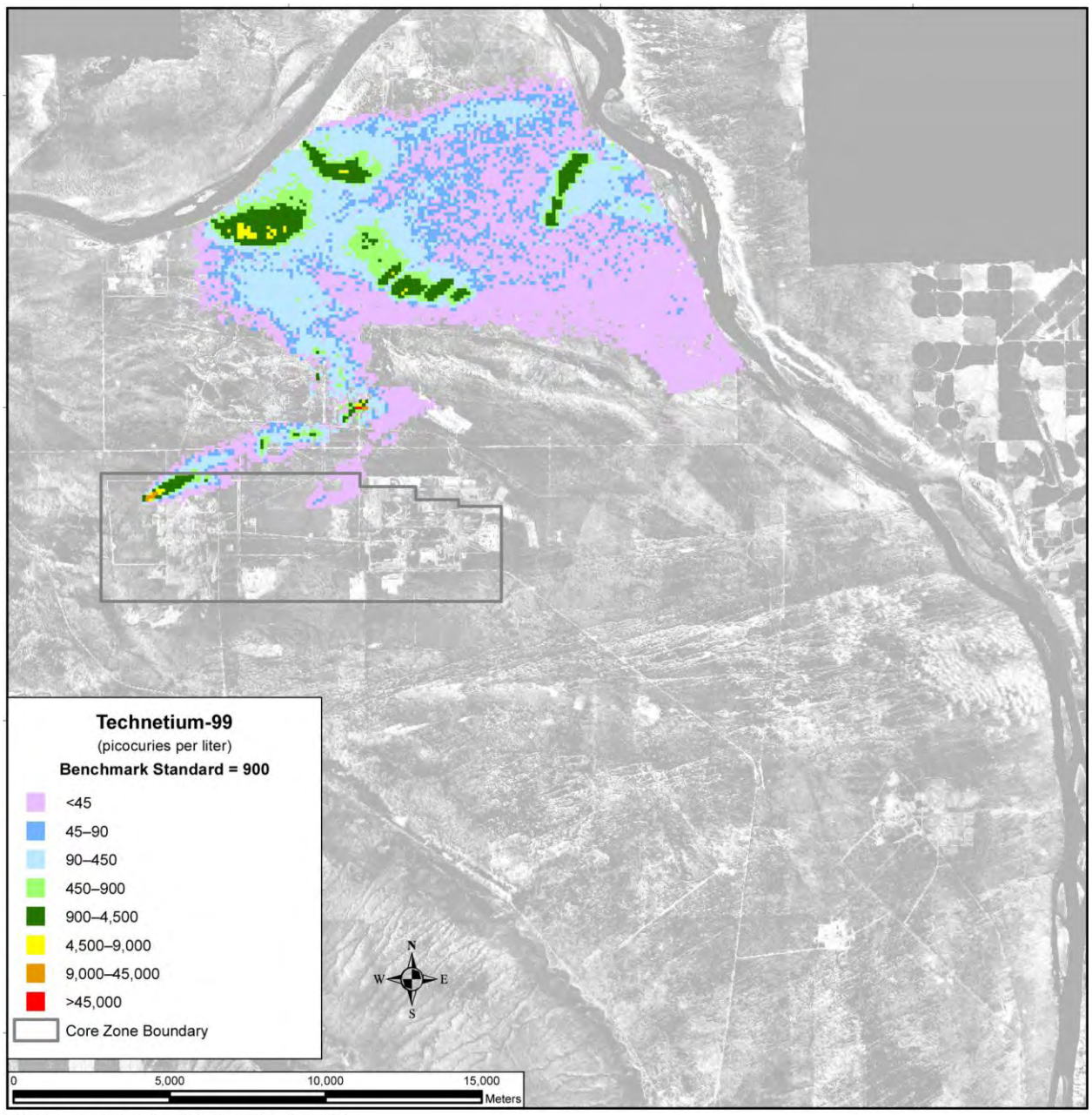
Note: To convert meters to feet, multiply by 3.281.

Figure 5–737. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



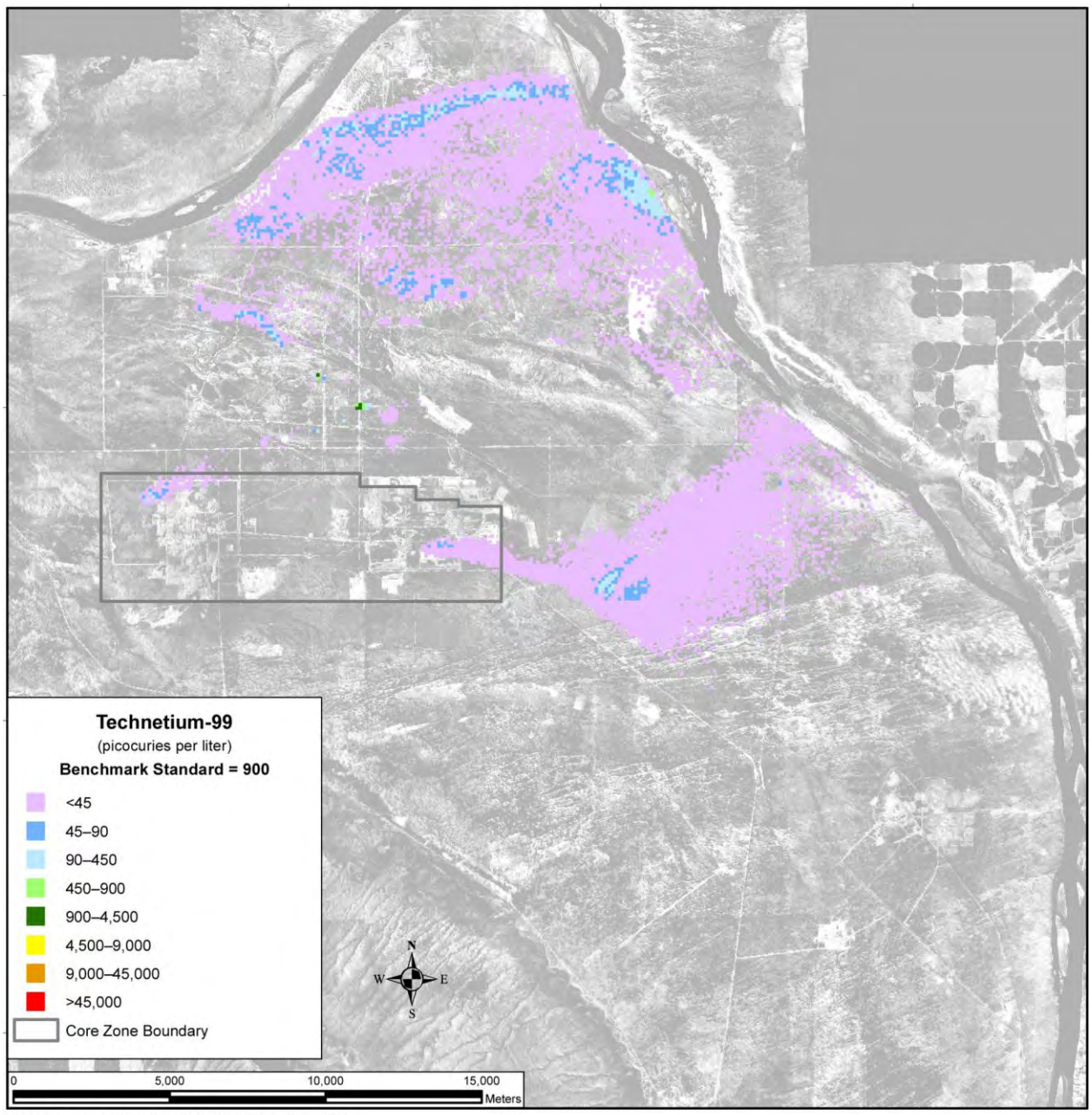
Note: To convert meters to feet, multiply by 3.281.

Figure 5–738. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



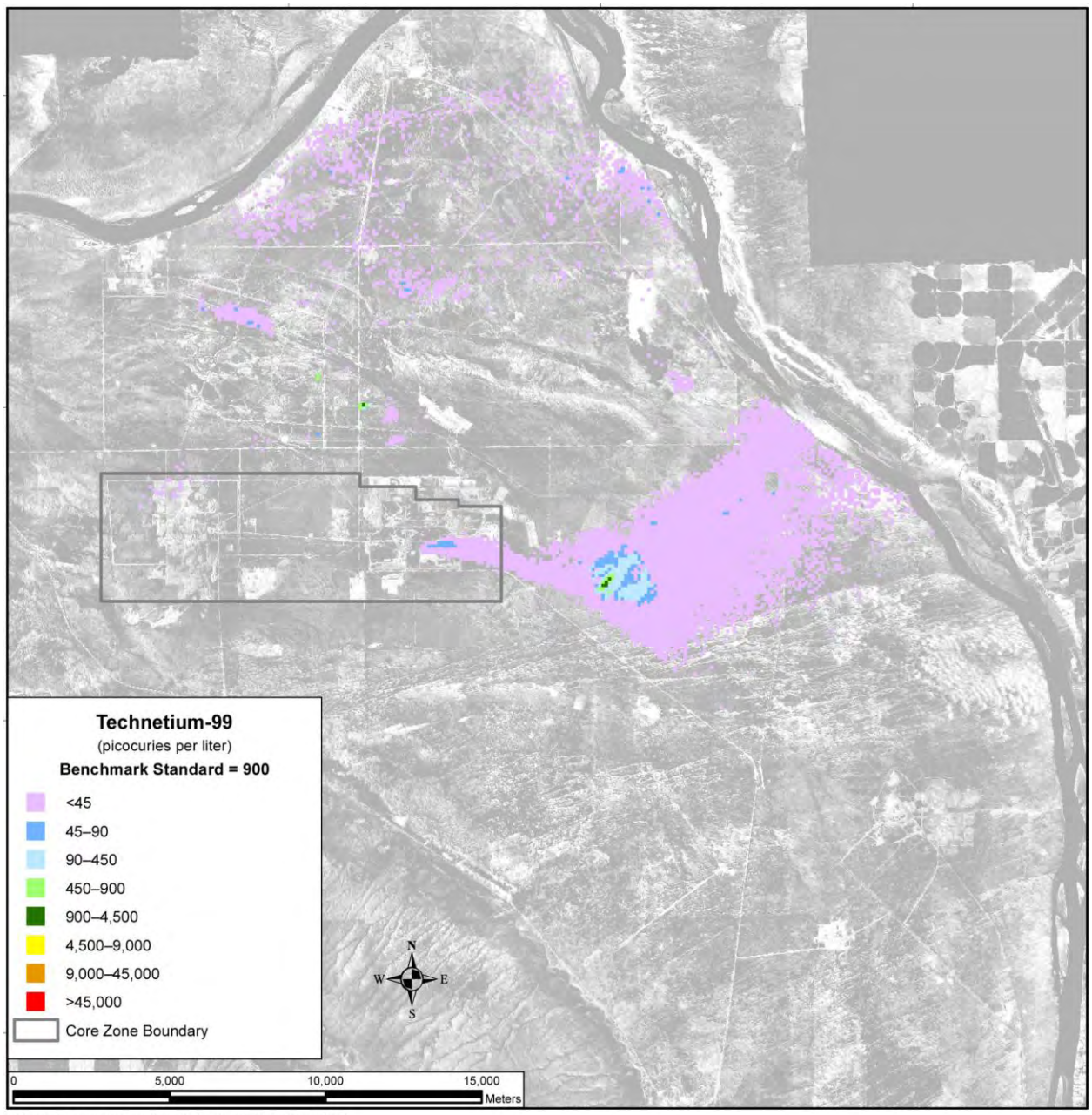
Note: To convert meters to feet, multiply by 3.281.

Figure 5–739. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



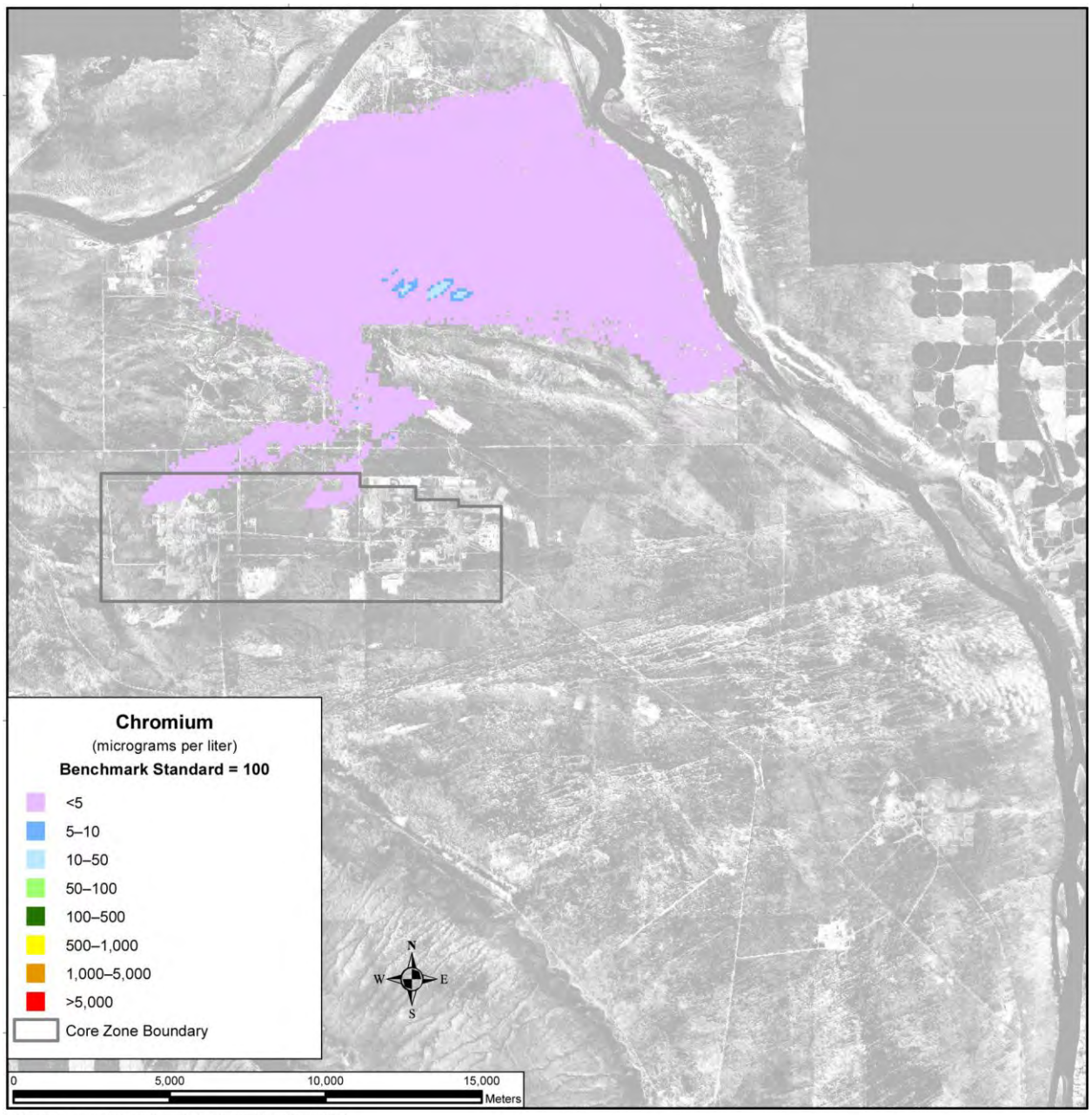
Note: To convert meters to feet, multiply by 3.281.

Figure 5–740. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



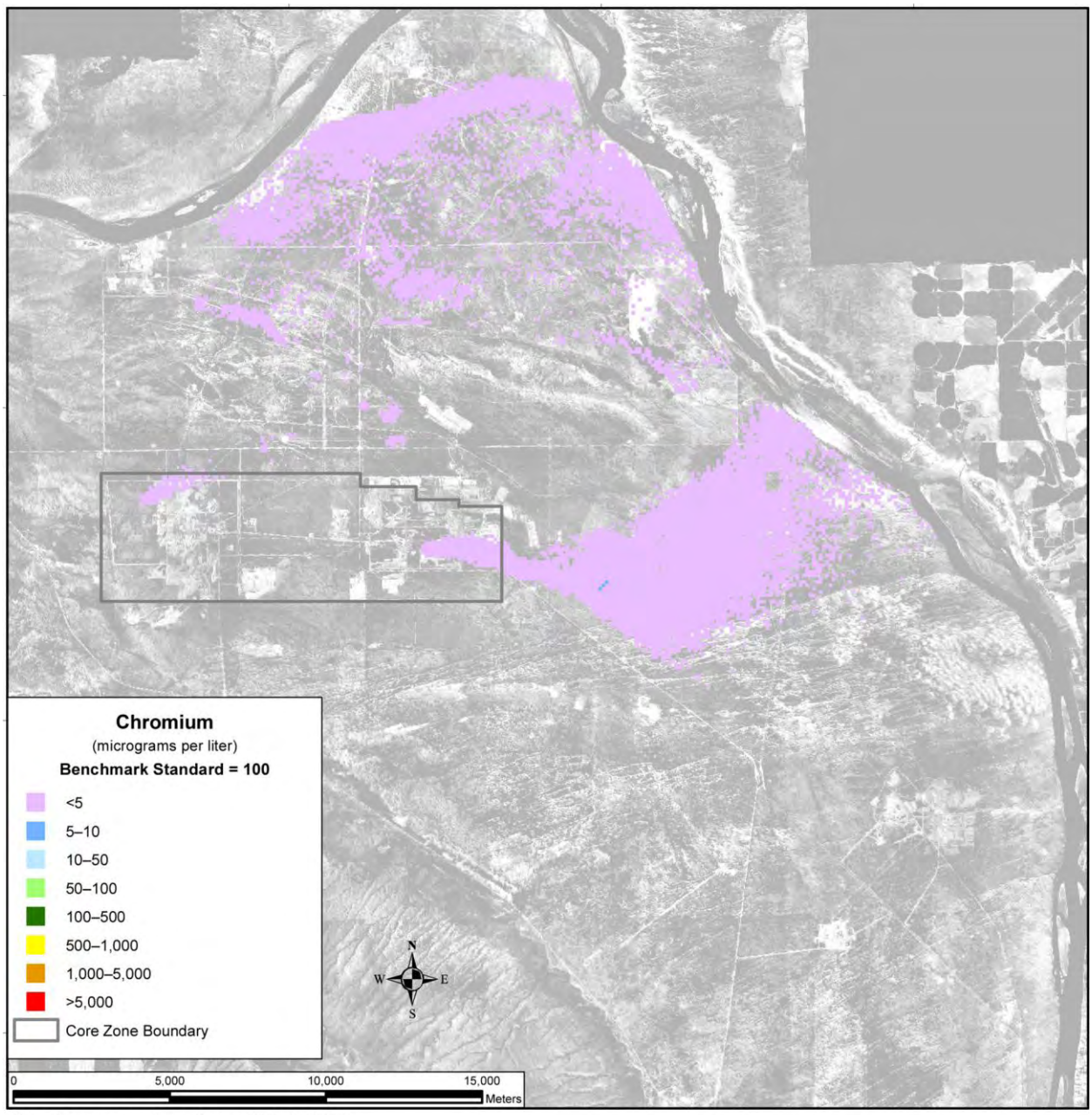
Note: To convert meters to feet, multiply by 3.281.

Figure 5–741. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Technetium-99, Concentration, Calendar Year 11,885



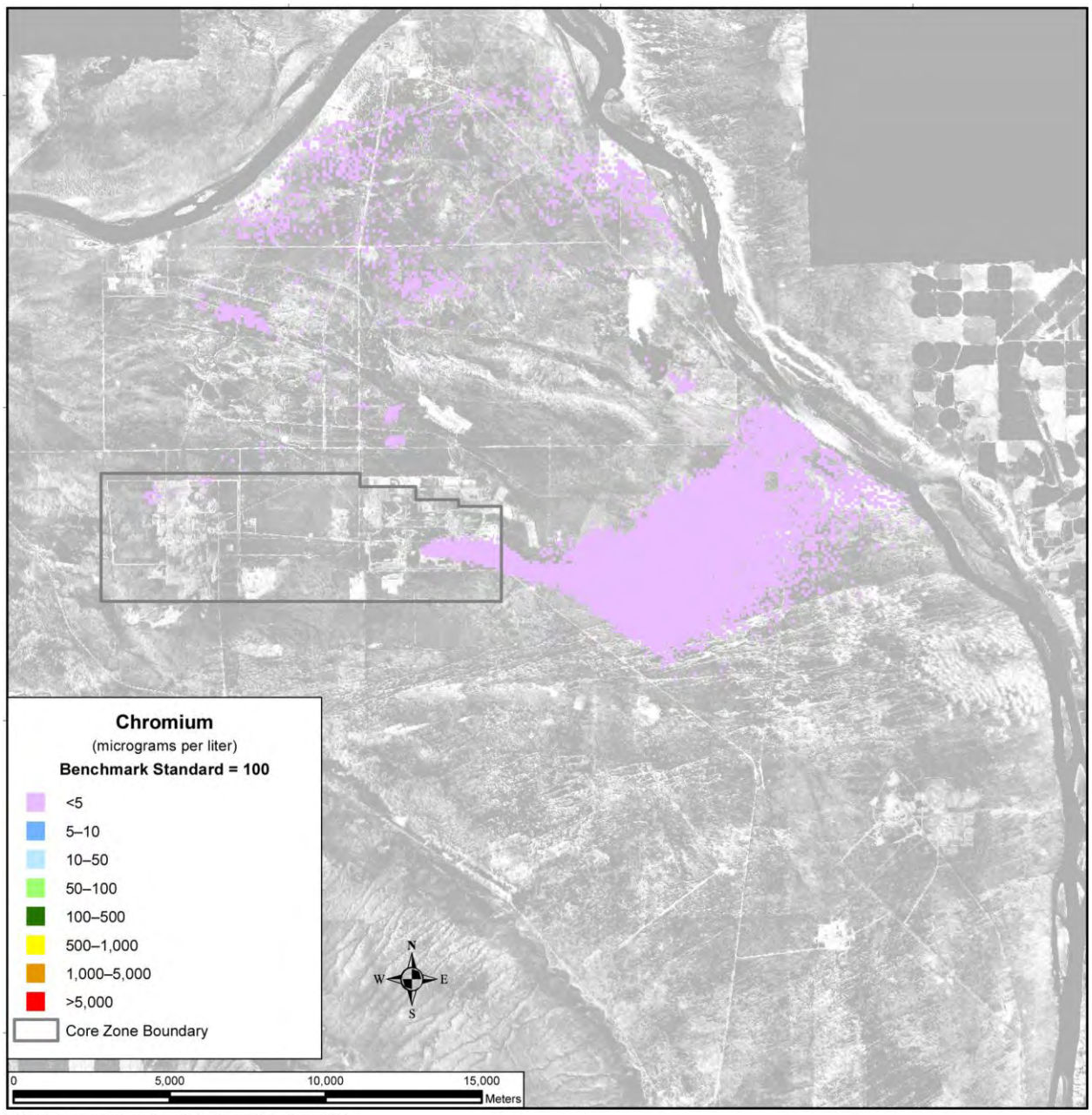
Note: To convert meters to feet, multiply by 3.281.

Figure 5–742. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



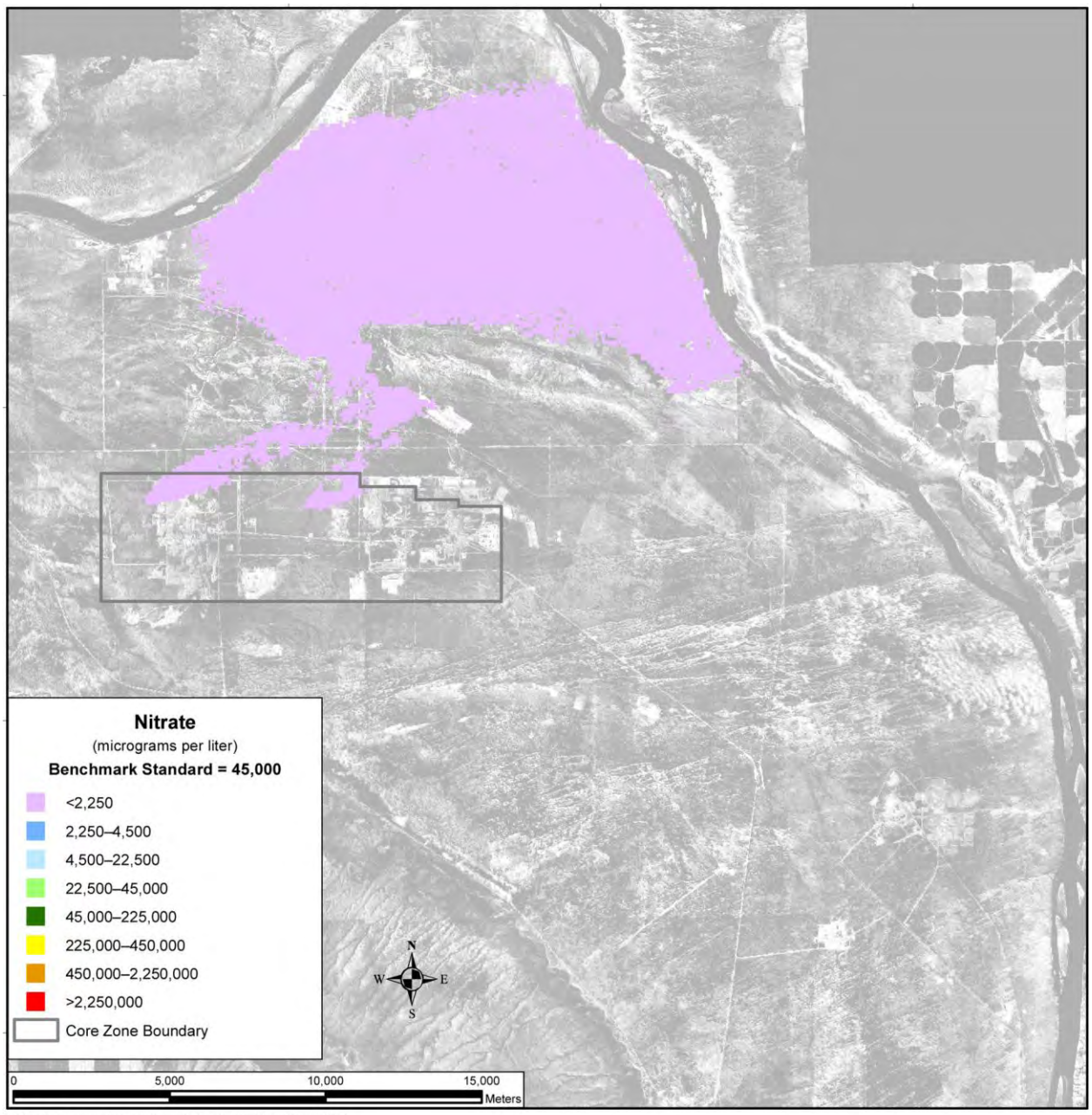
Note: To convert meters to feet, multiply by 3.281.

Figure 5–743. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



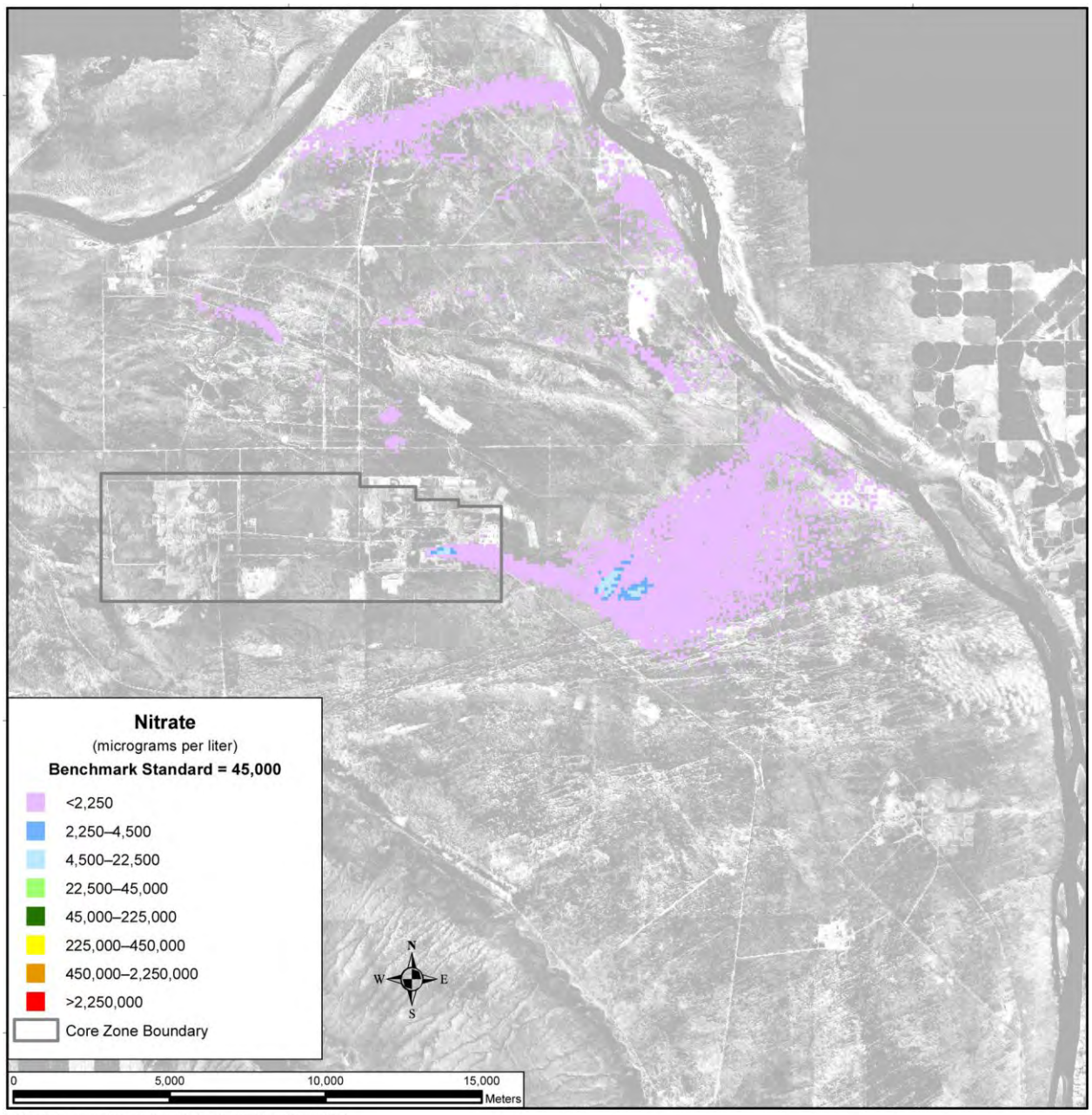
Note: To convert meters to feet, multiply by 3.281.

Figure 5–744. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



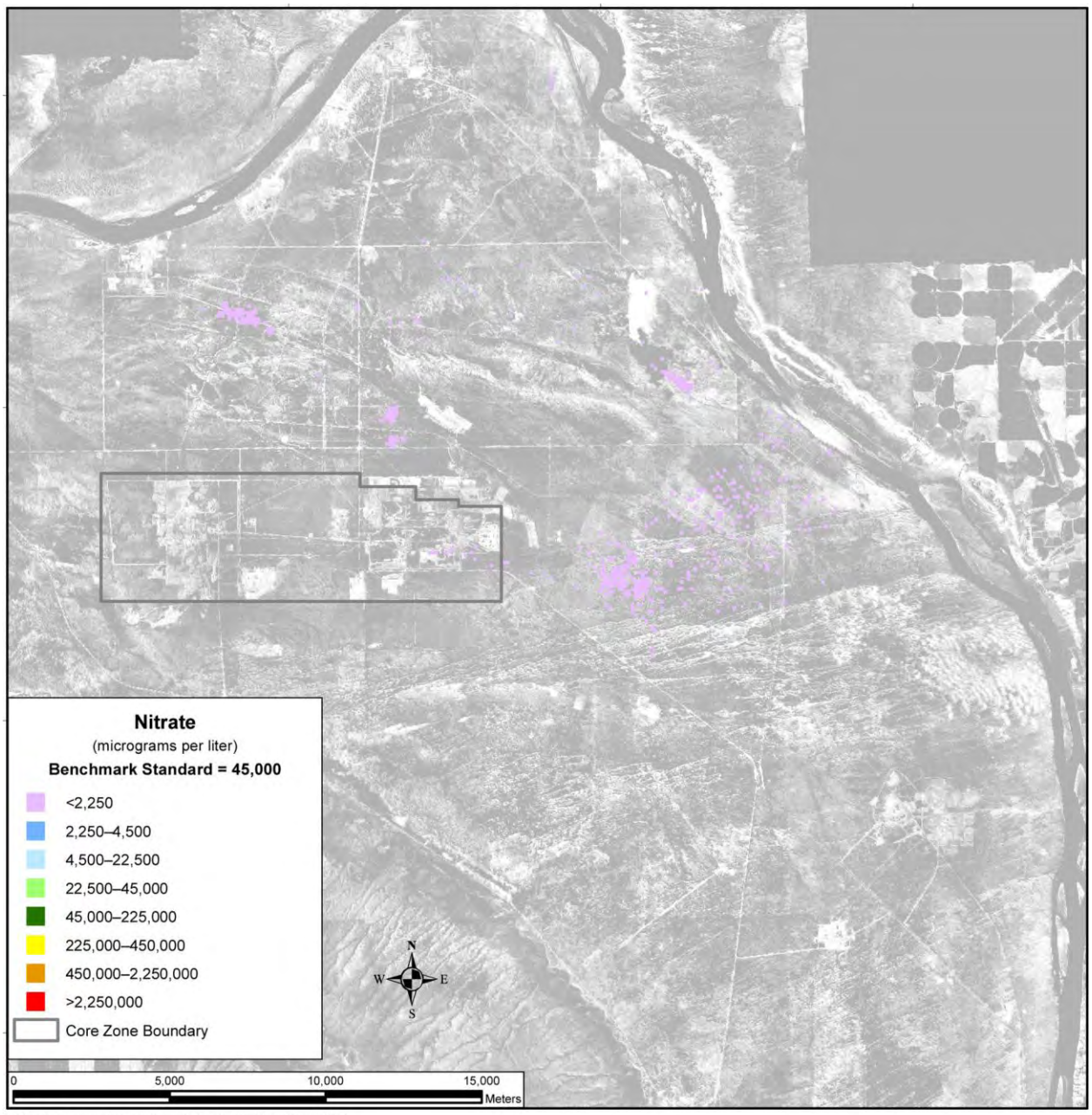
Note: To convert meters to feet, multiply by 3.281.

Figure 5–745. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



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

Figure 5–746. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



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

Figure 5–747. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in general, the inventories of the conservative tracers remaining in IDF-East, IDF-West, and the RPPDF, which are available for release to the environment at the start of the post-disposal period, are predominant contributors.

For iodine-129 and technetium-99, concentrations slightly outside the Core Zone Boundary exceed benchmark standards by one to two orders of magnitude during most of the period of analysis. Concentrations at the Columbia River nearshore are about one to two orders of magnitude lower. The intensities and areas of these groundwater plumes peak between CYs 3890 and 7140. Concentrations of

chromium and nitrate never exceed their respective benchmark concentrations at the Core Zone Boundary or Columbia River nearshore.

For uranium-238 and total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of these retarded species do not exceed the benchmark at the Core Zone Boundary or Columbia River nearshore.

5.3.1.3.1.2 Disposal Group 1, Subgroup 1-B

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 3A and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Tank closure waste would be converted to IHLW, ILAW glass, and bulk vitrification glass.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2050, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, and nitrate) are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary

during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Five subtotals are plotted in Figures 5–748 through 5–753, representing releases from IDF-East, which include ILAW glass, bulk vitrification glass, ETF-generated secondary waste, retired melters, and tank closure secondary waste.

Figure 5–748 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–749, the chemical hazard drivers. For bulk vitrification castable refractory, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). The predominant source of technetium-99 is bulk vitrification glass; of iodine-129, ETF-generated secondary waste. The predominant source of chromium is tank closure secondary waste, while the predominant source of nitrate is ETF-generated secondary waste. Boron and fluoride are not released from IDF-East.

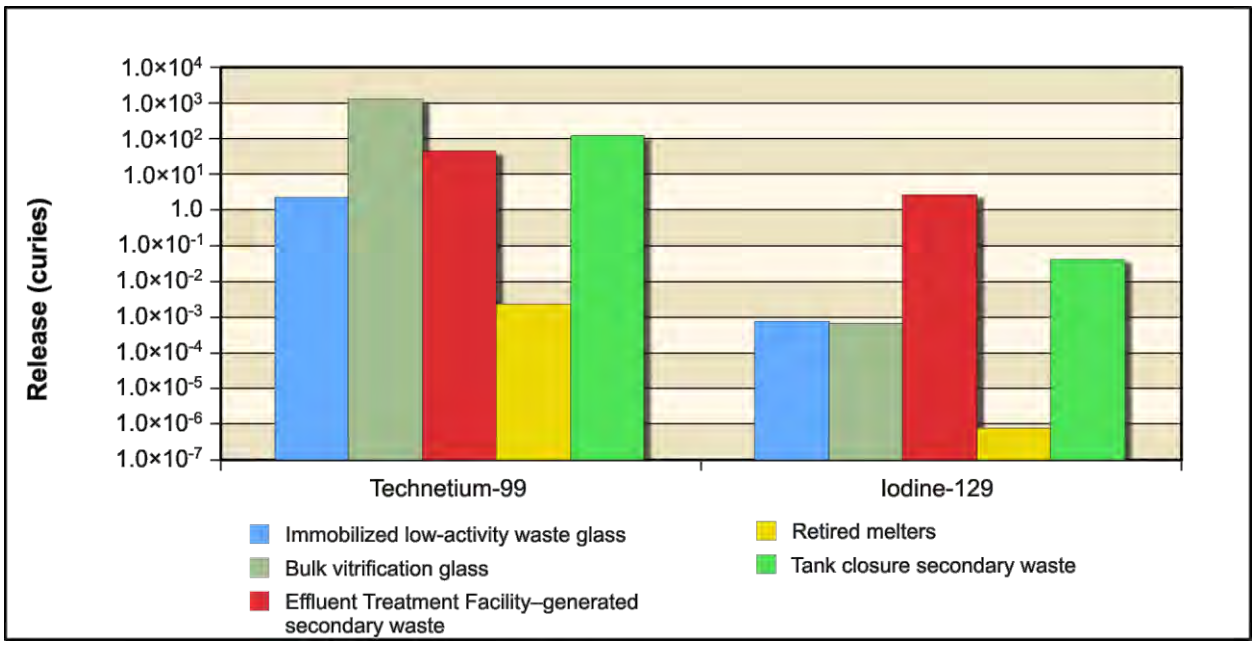


Figure 5–748. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–750 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–751, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99,

chromium, and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 91 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater; approximately 100 percent of the chemical quantity (kilograms) reaches groundwater.

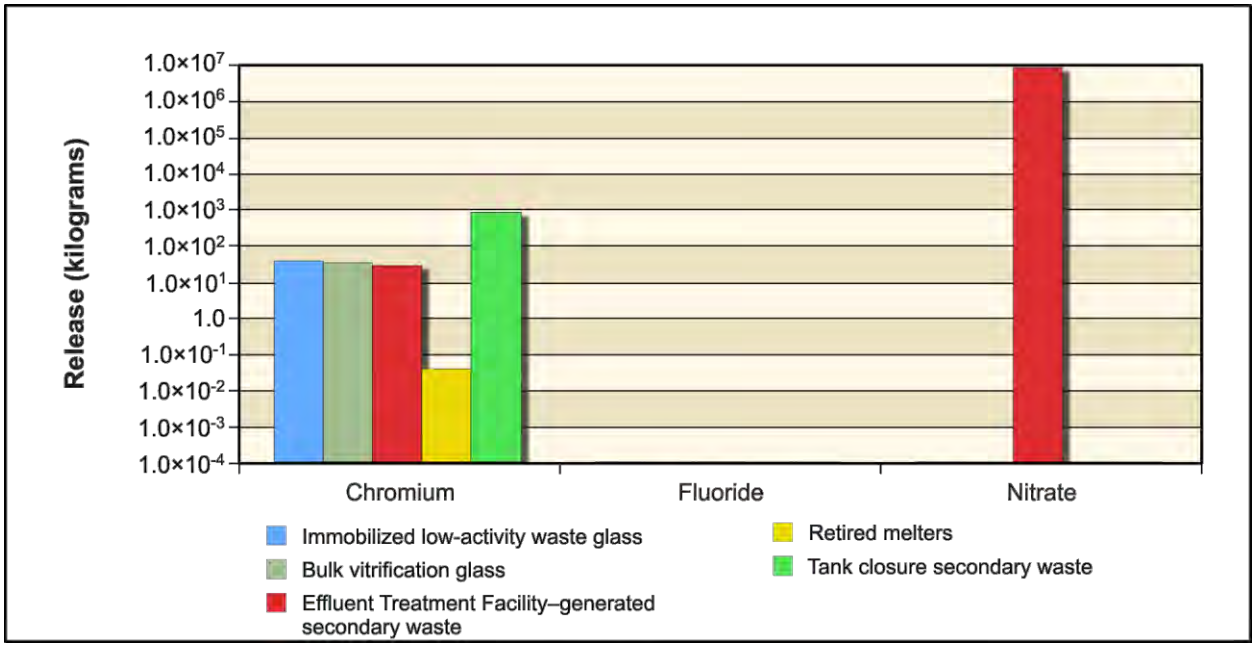


Figure 5–749. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

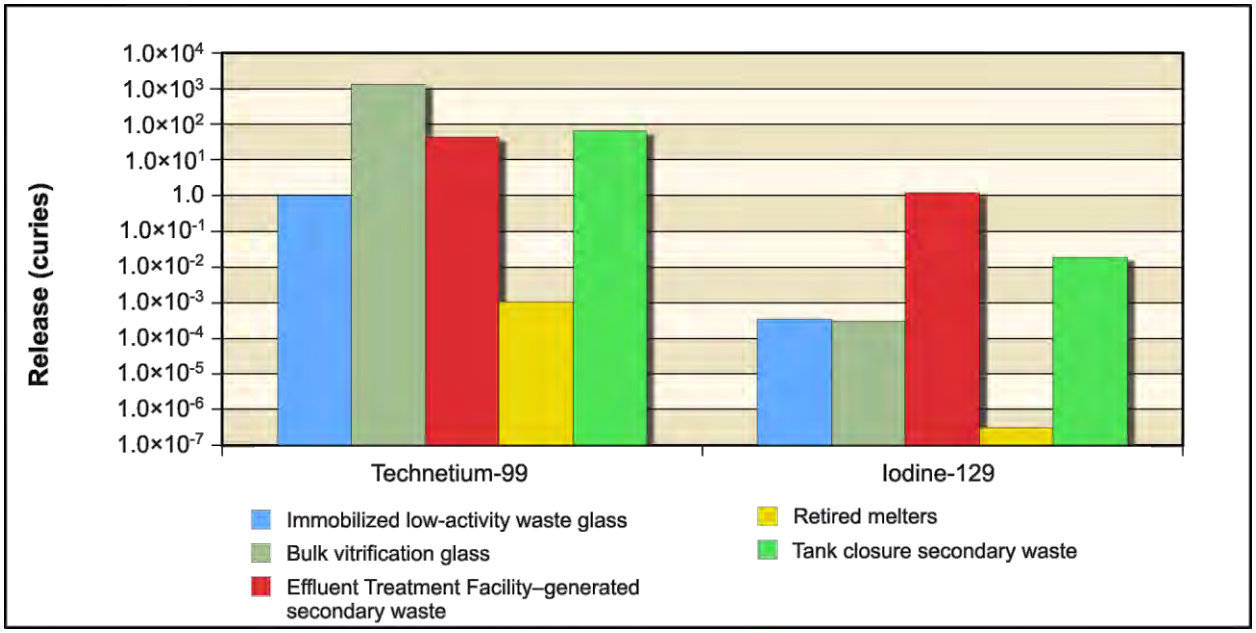


Figure 5–750. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

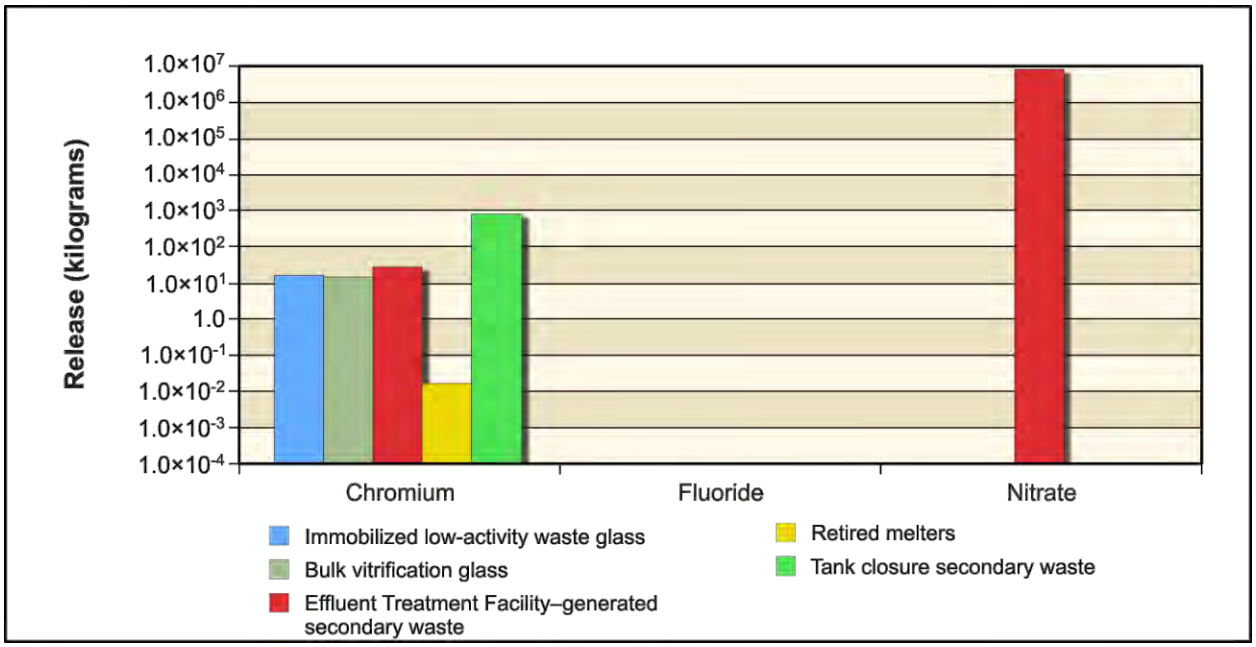


Figure 5–751. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–752 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–753, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater. About 100 percent of the radionuclide amount (curies) released to the groundwater during the period of analysis reaches the river; approximately 100 percent of the chemical quantity (kilograms) reaches the river.

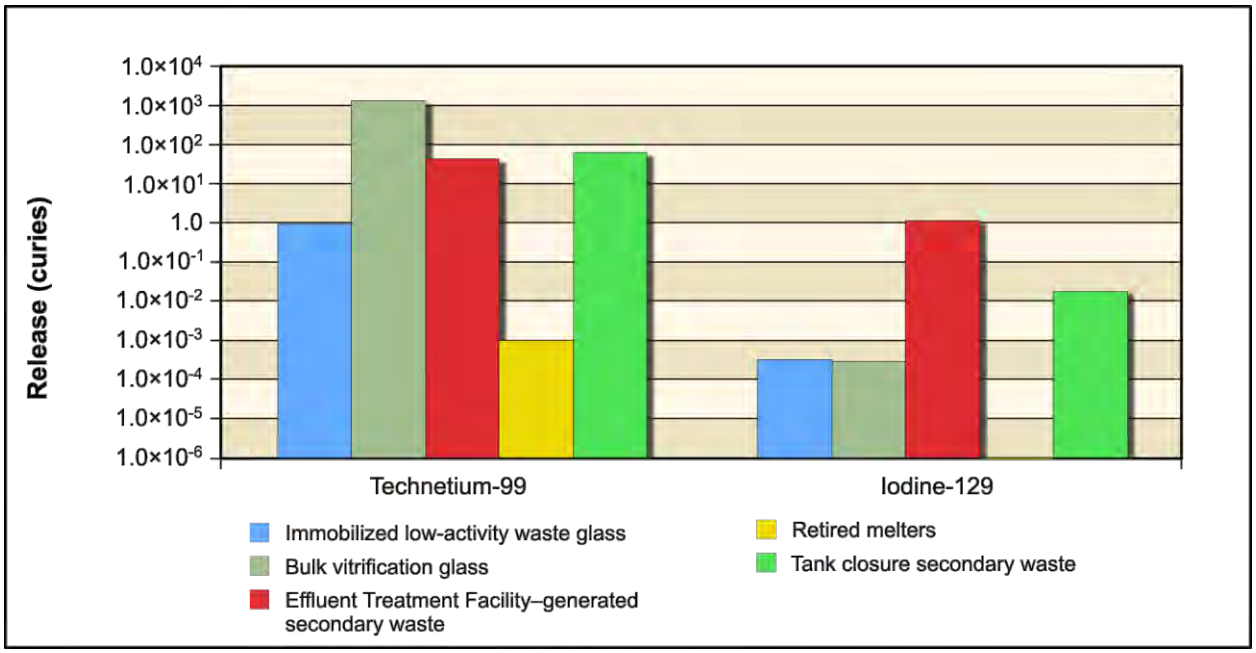


Figure 5–752. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

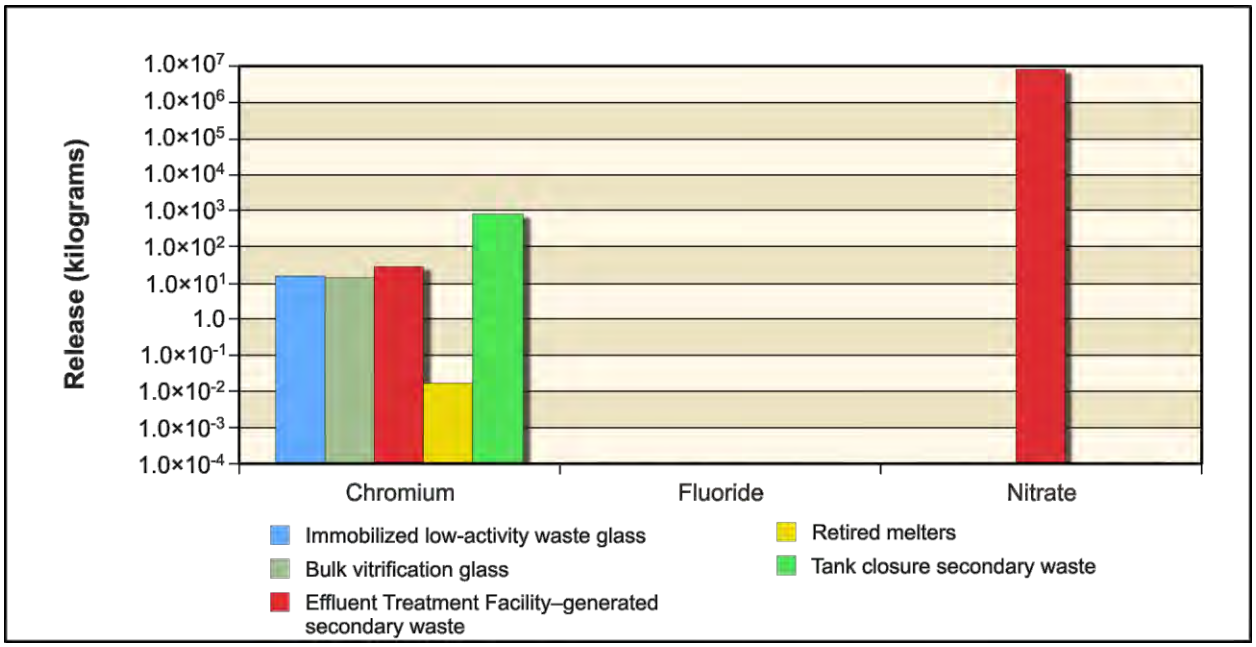


Figure 5–753. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5–754 through 5–759, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary waste and onsite waste, and offsite waste.

Figure 5–754 shows the estimated release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–755, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). The predominant source of technetium-99 and iodine-129 is offsite waste. The predominant source of chromium, nitrate, and fluoride is waste management secondary waste and onsite waste.

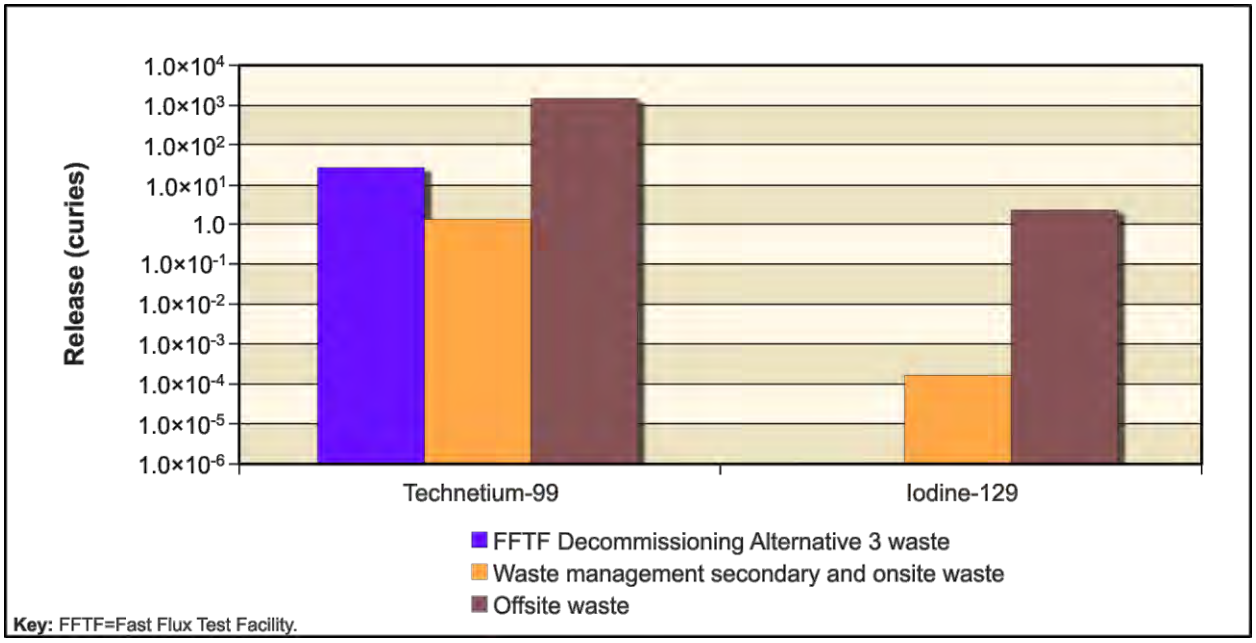


Figure 5–754. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

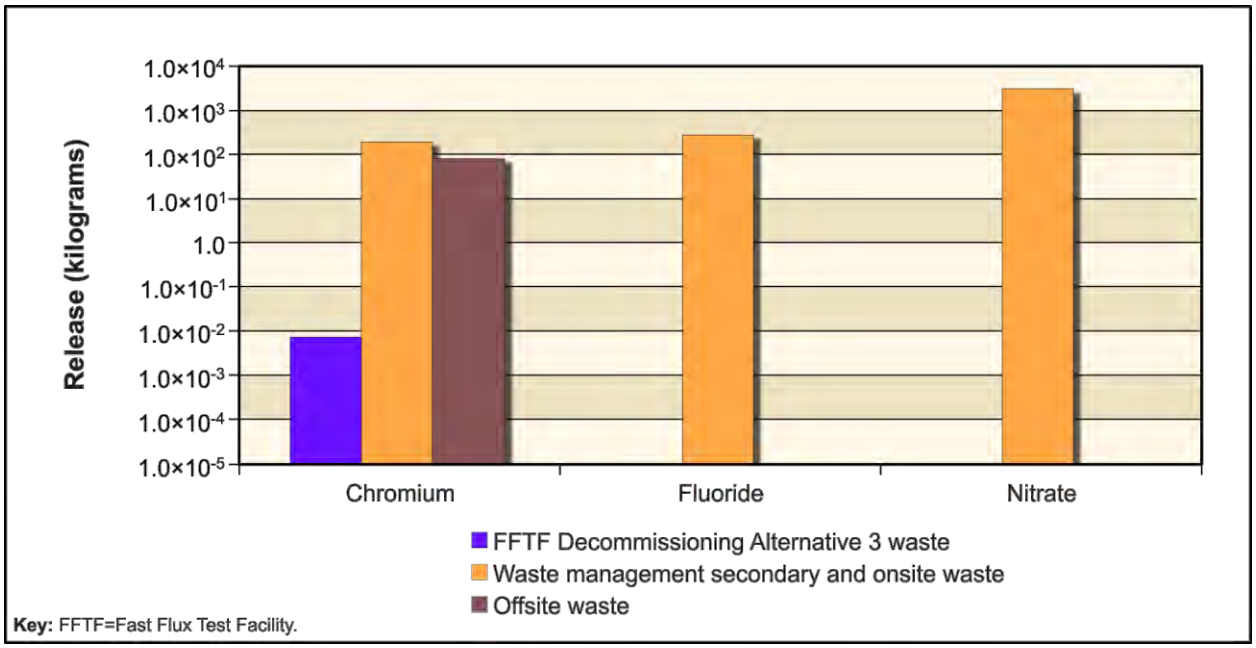


Figure 5–755. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–756 shows the estimated release from IDF-West to groundwater of the radiological risk drivers and Figure 5–757, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, nitrate, and fluoride, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 97 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater; approximately 100 percent of the chemical quantity (kilograms) reaches groundwater.

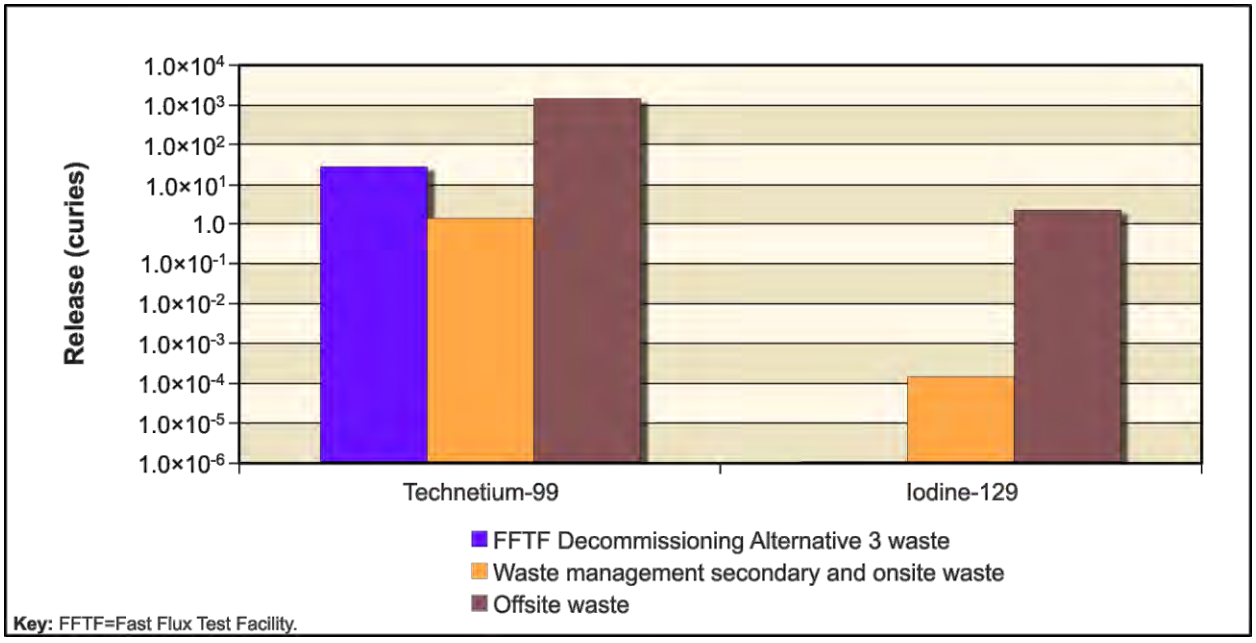


Figure 5–756. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

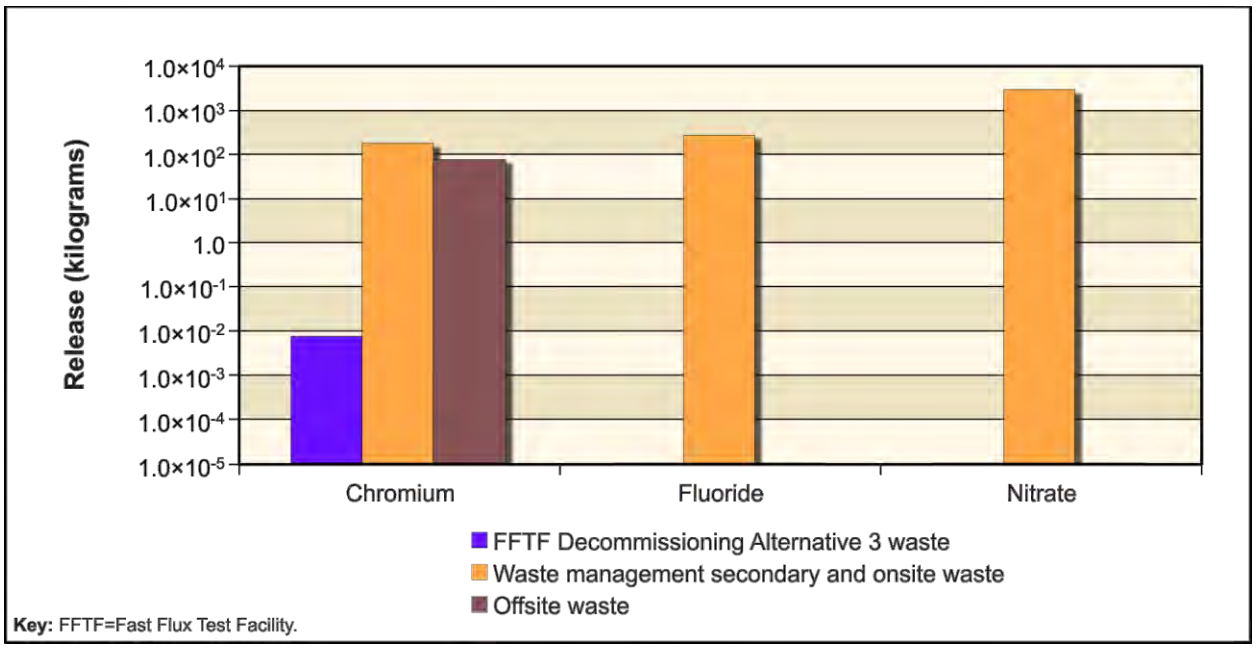


Figure 5–757. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–758 shows the estimated release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–759, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, nitrate, and fluoride, the amount released to the Columbia River is essentially equal to the amount released to groundwater. About 100 percent of the radionuclide amount (curies) released to groundwater during the period of analysis reaches the river; approximately 100 percent of the chemical quantity (kilograms) reaches the river.

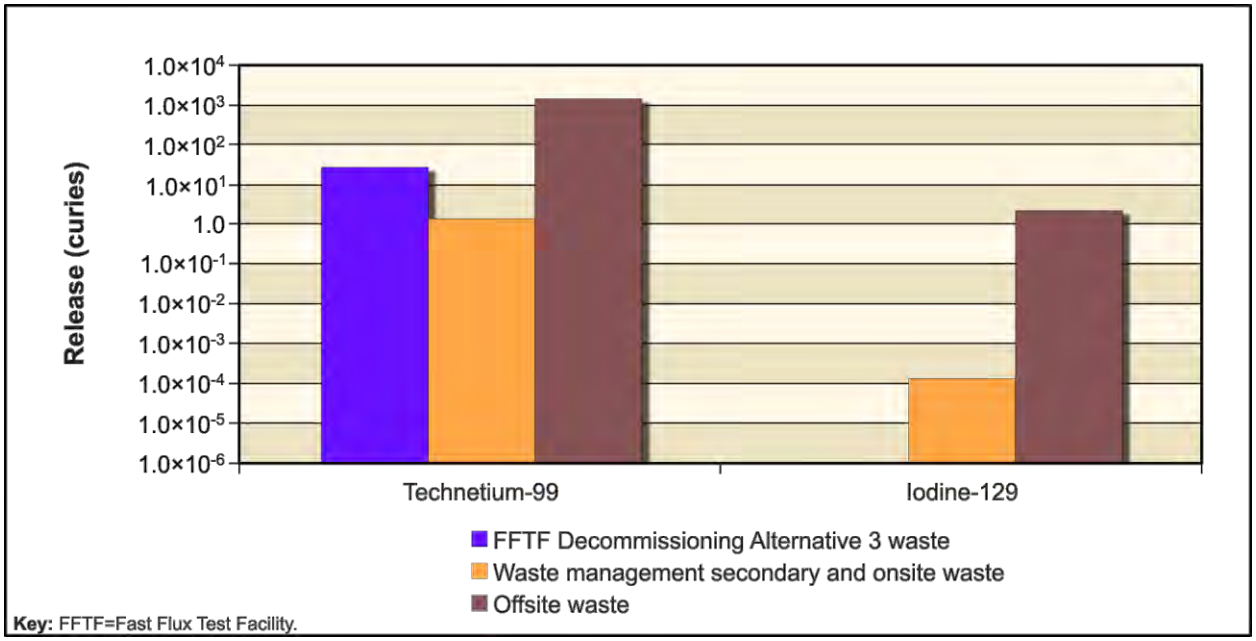


Figure 5–758. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

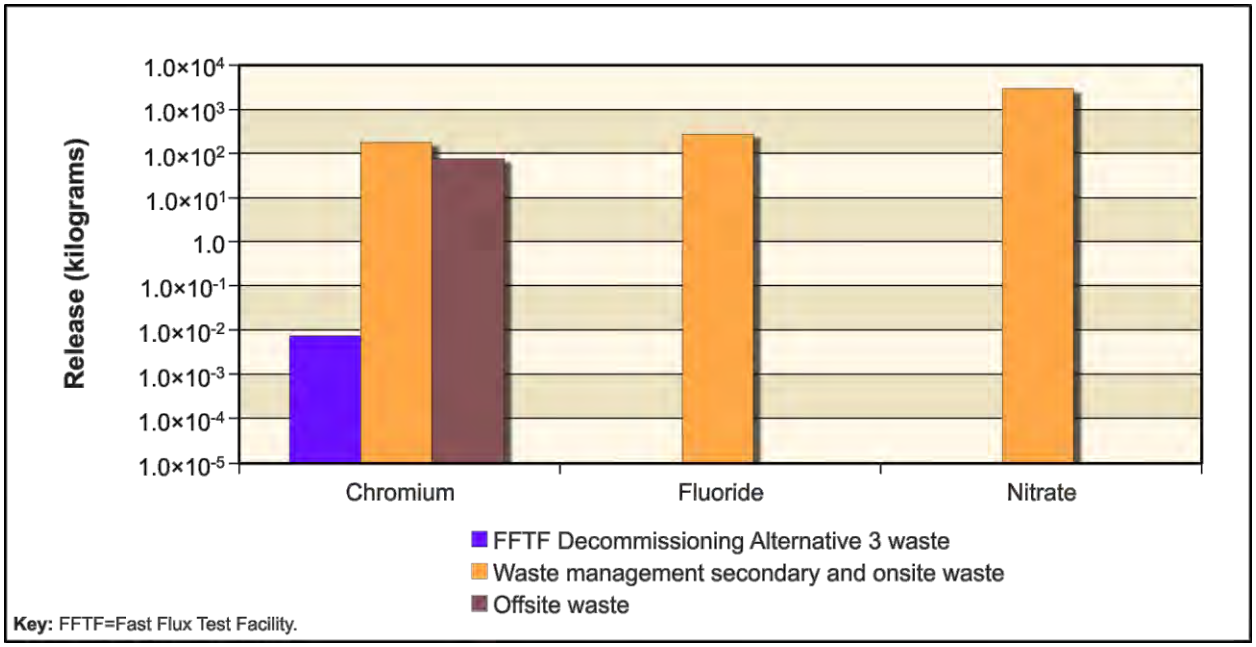


Figure 5–759. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5–760 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–761, the chemical hazard drivers. Release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). Radionuclide releases from the RPPDF to the vadose zone comprise technetium-99 (largest source) and iodine-129 (smallest source). Chemical hazard releases from the RPPDF comprise nitrate (largest source) and chromium (smallest source). Fluoride is not released from the RPPDF.

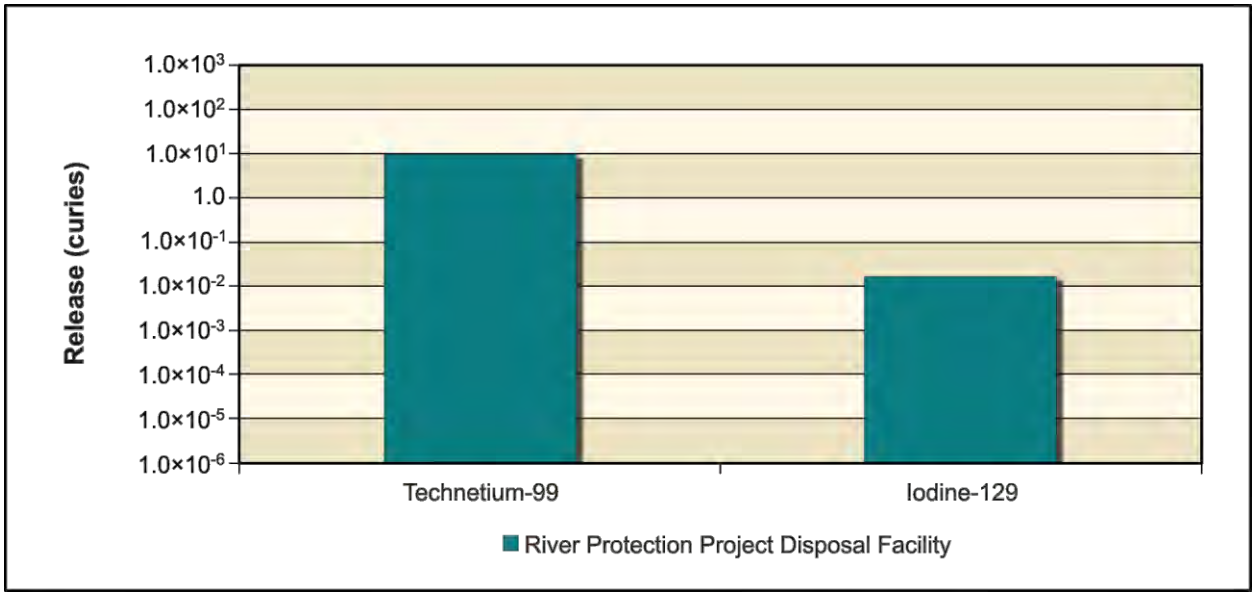


Figure 5–760. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

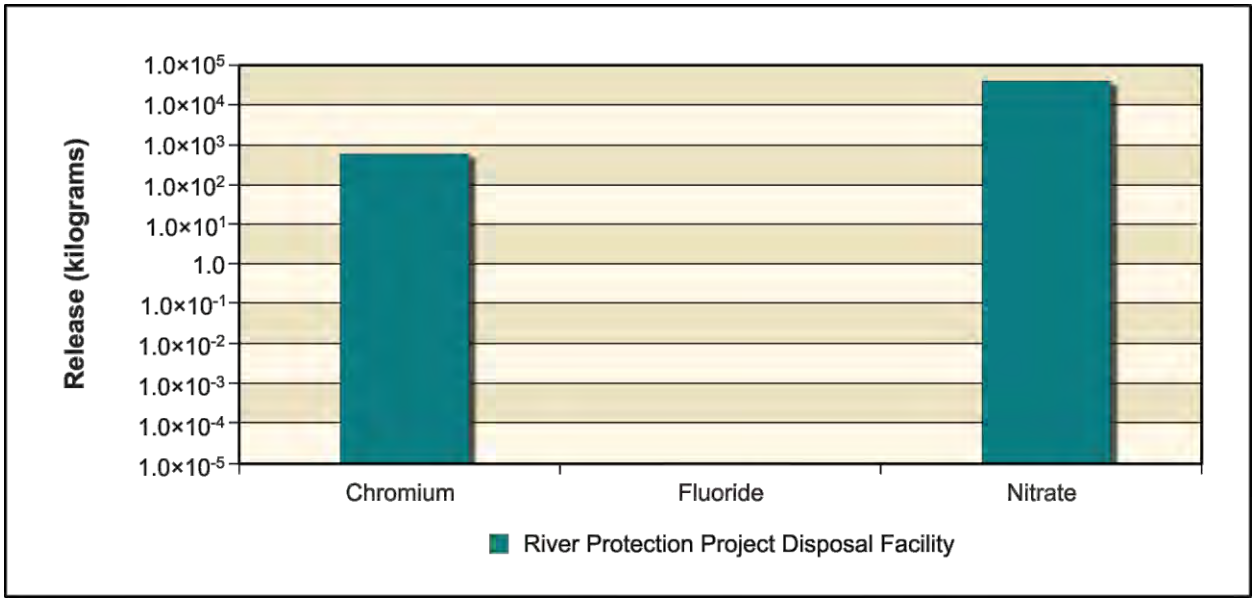


Figure 5–761. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–762 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–763, the chemical hazard drivers. In addition to the inventory considerations discussed in

the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 100 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater; approximately 100 percent of the chemical quantity (kilograms) reaches groundwater.

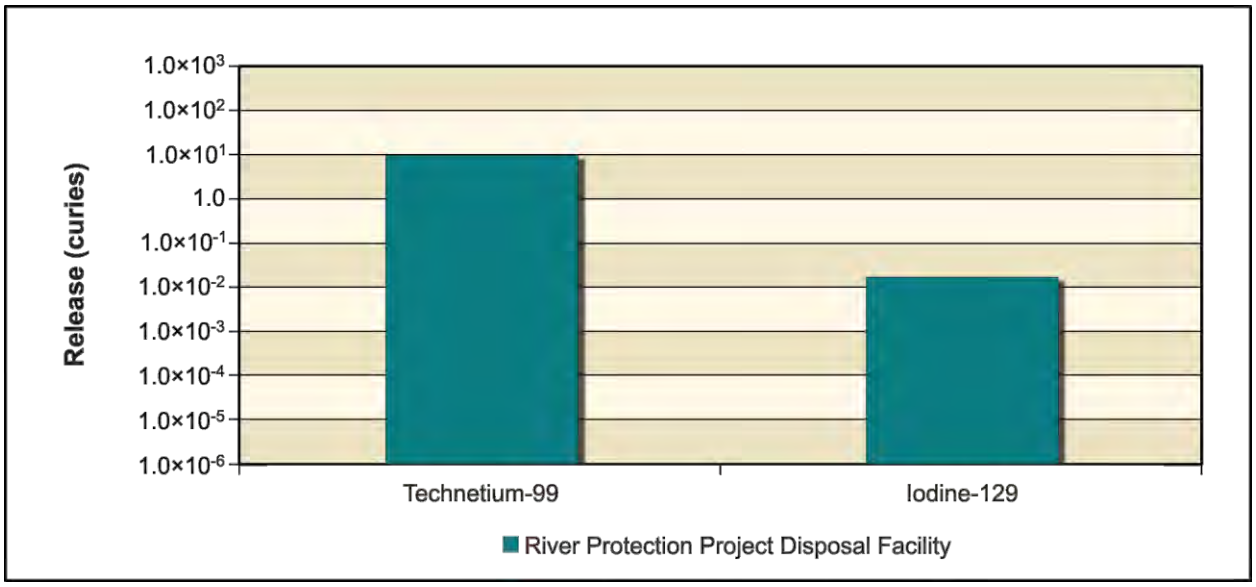


Figure 5–762. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

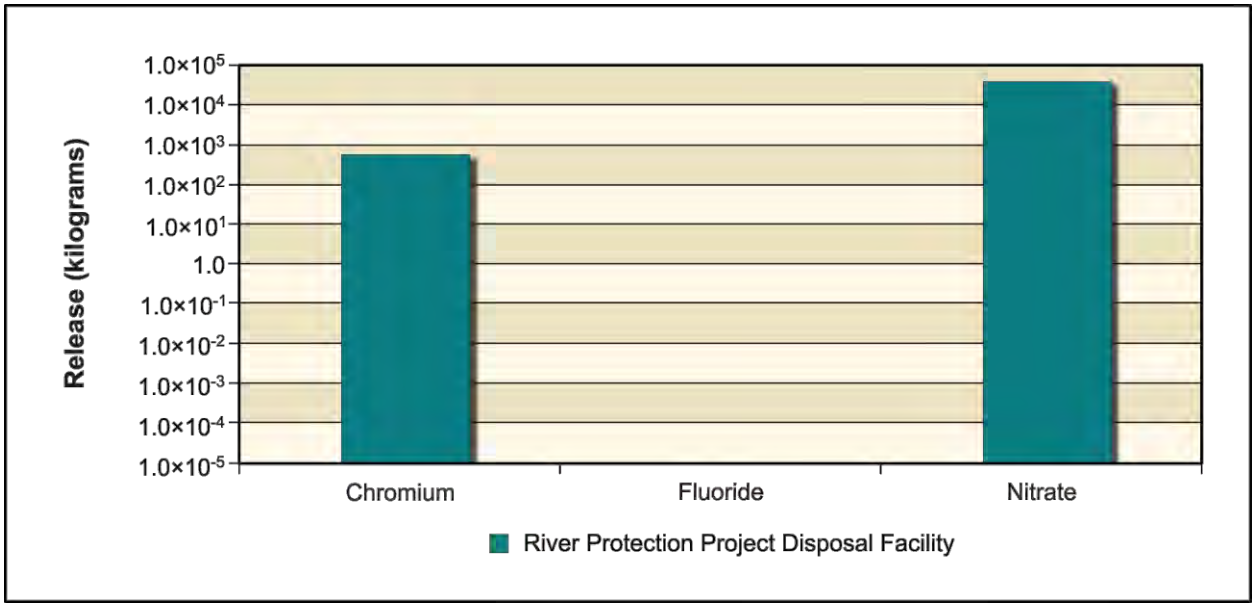


Figure 5–763. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–764 shows the estimated release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–765, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For iodine-129, technetium-99, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater.

Overall, 99 percent of the radionuclide amount (curies) released to the groundwater during the period of analysis reaches the river; 99 percent of the chemical quantity (kilograms) reaches the river.

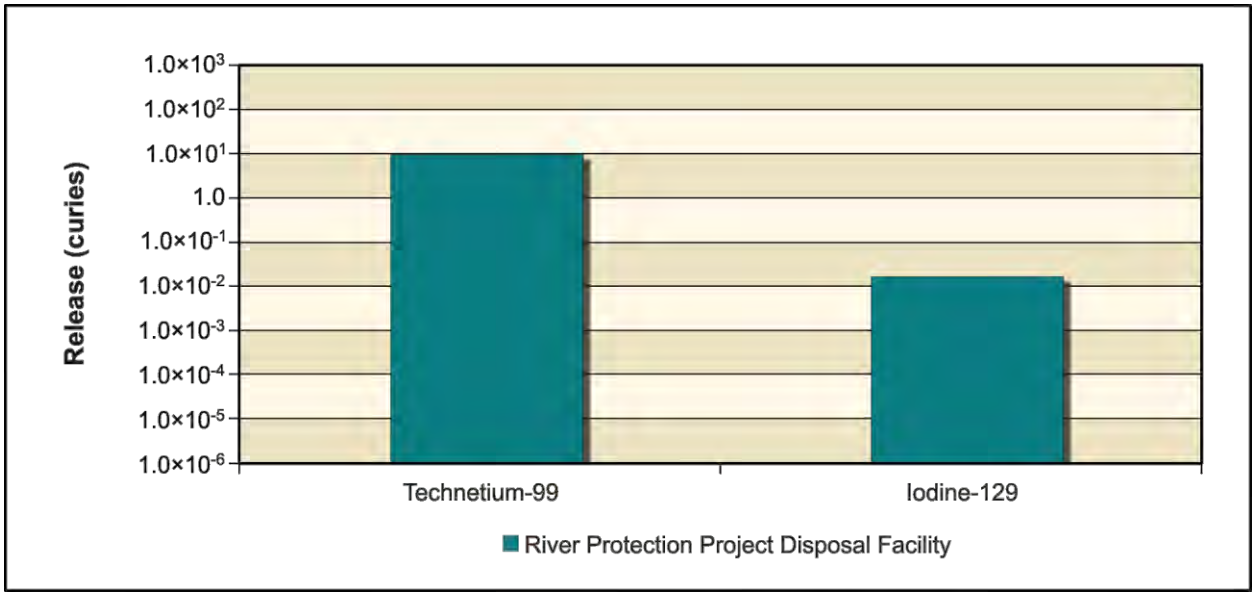


Figure 5–764. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

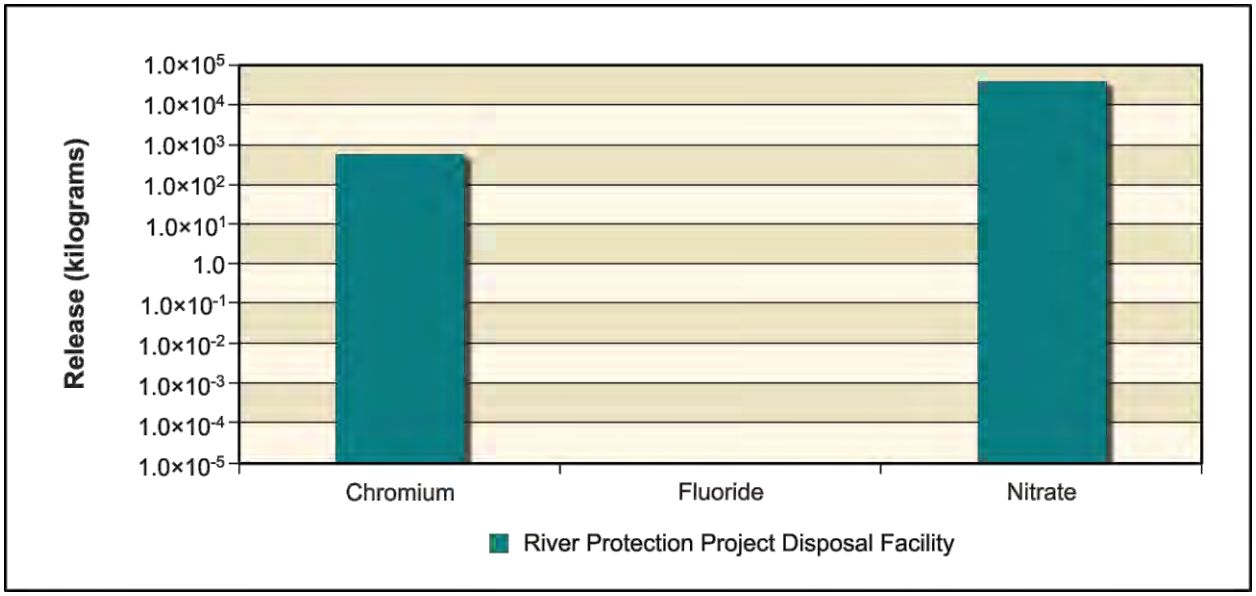


Figure 5–765. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, impacts in terms of groundwater concentration versus time at the RPPDF barrier, IDF-East barrier, IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures 5–766 through 5–770). The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations. Table 5–107 lists the

maximum concentrations of the COPCs in the peak year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River nearshore. Exceedances of the benchmarks occur only for technetium-99 and iodine-129 at IDF-East, IDF-West, the Core Zone Boundary, and the Columbia River nearshore.

Table 5–107. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	**1,430**	**13,200**	42	**1,370**	**1,670**	900
	(7629)	(3818)	(3818)	(3859)	(3920)	
Iodine-129	**1.1**	**20.6**	0.1	**2.1**	**2.4**	1
	(9967)	(3794)	(3747)	(3937)	(3872)	
Chemical (micrograms per liter)						
Chromium	1	1	3	1	0	100
	(8691)	(3813)	(3740)	(3846)	(4481)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	10,300	7	180	2,790	2,210	45,000
	(8052)	(3927)	(3670)	(8095)	(7940)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figures 5–766 through 5–769 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate, respectively. Iodine-129 concentrations exceed the benchmark concentration at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. The greatest exceedance of the benchmark concentration is at the IDF-West barrier, where the benchmark is exceeded by about an order of magnitude from approximately CY 3200 until CY 4800. Iodine-129 concentrations never exceed the benchmark concentration at the RPPDF barrier or the IDF-East barrier. The iodine-129 benchmark concentration is exceeded by less than an order of magnitude at the Core Zone Boundary and Columbia River nearshore. Concentrations of iodine-129 exceed the benchmark concentration at the Columbia River nearshore for the longest period of time and fall below the benchmark in approximately CY 6000. Technetium-99 exhibits behavior similar to iodine-129, where concentrations at the IDF-West barrier exceed the benchmark by one order of magnitude. The duration of the benchmark exceedance is approximately 1,300 years. In addition, the technetium-99 benchmark concentration is exceeded at the IDF-East barrier late in the simulation, between CY 7000 and CY 8700. Nitrate and chromium do not exceed their benchmark concentrations at the IDF-East barrier, IDF-West barrier, RPPDF barrier, Core Zone Boundary, or Columbia River nearshore.

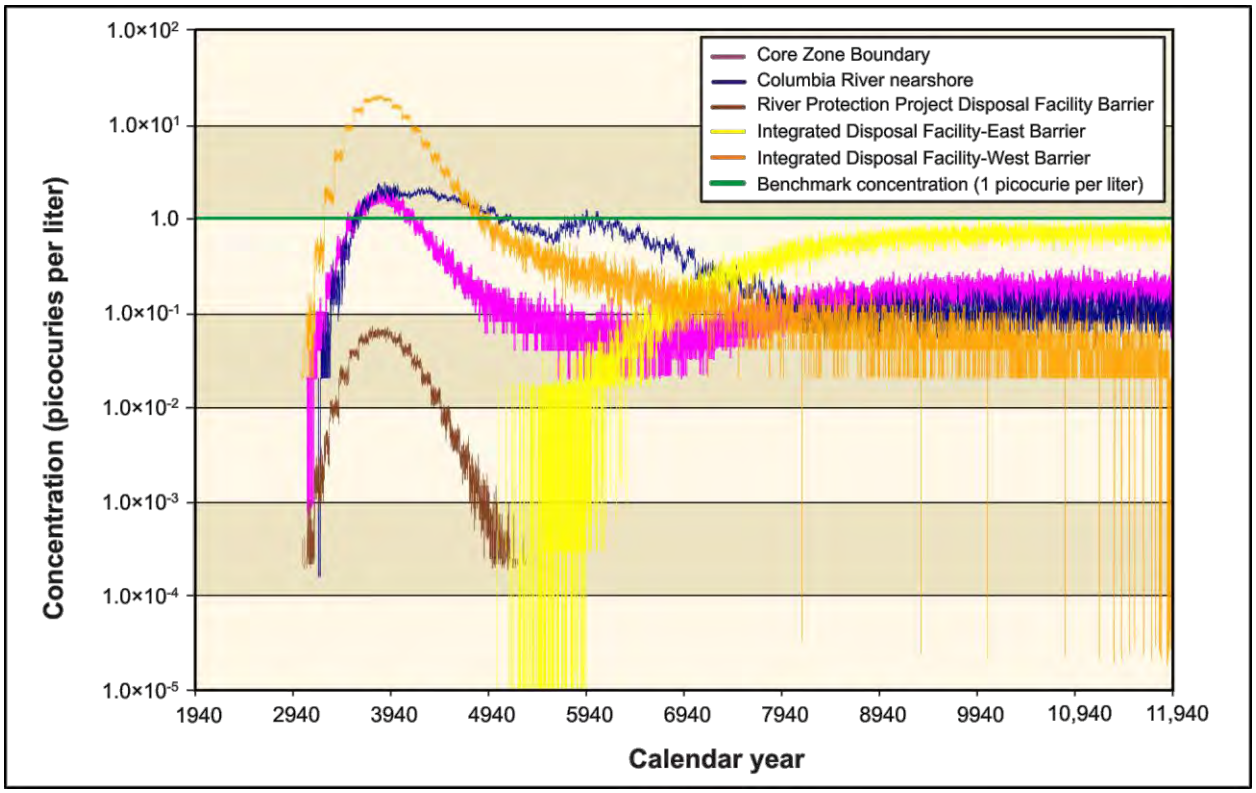


Figure 5–766. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Iodine-129 Concentration Versus Time

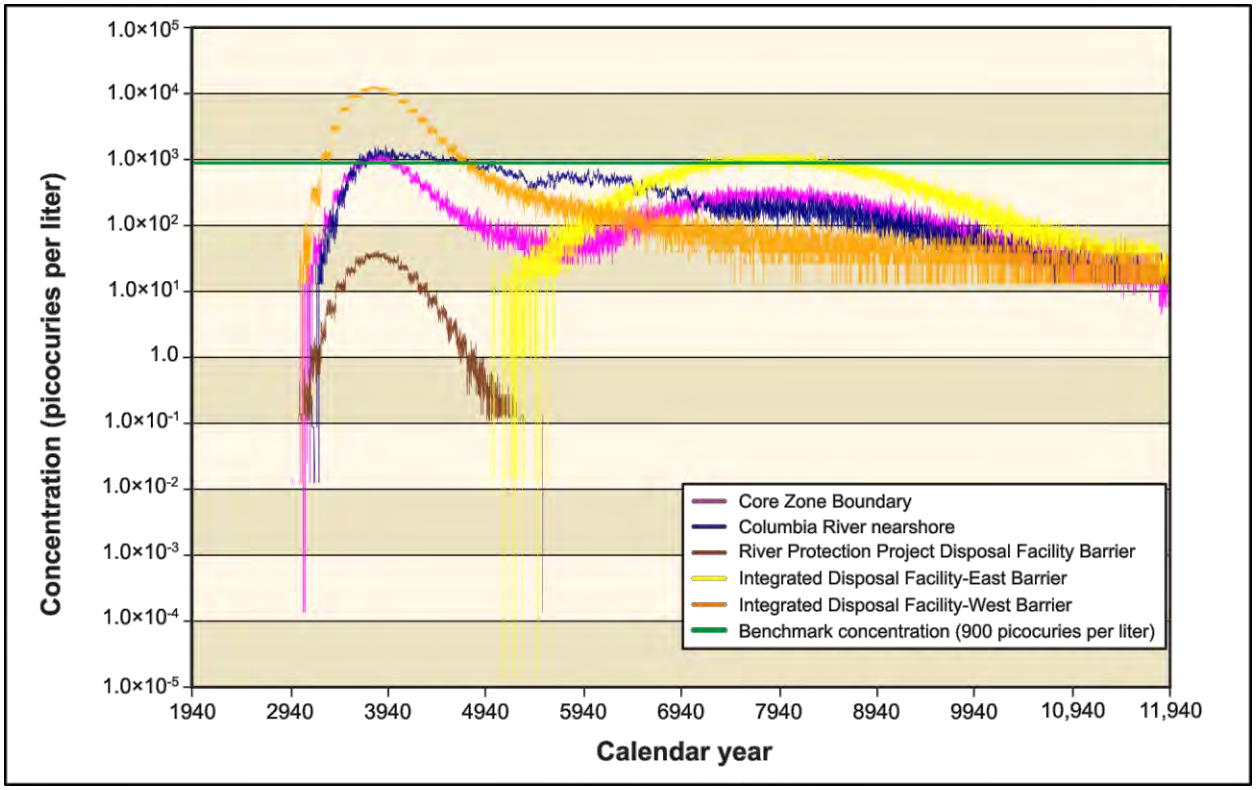


Figure 5–767. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Technetium-99 Concentration Versus Time

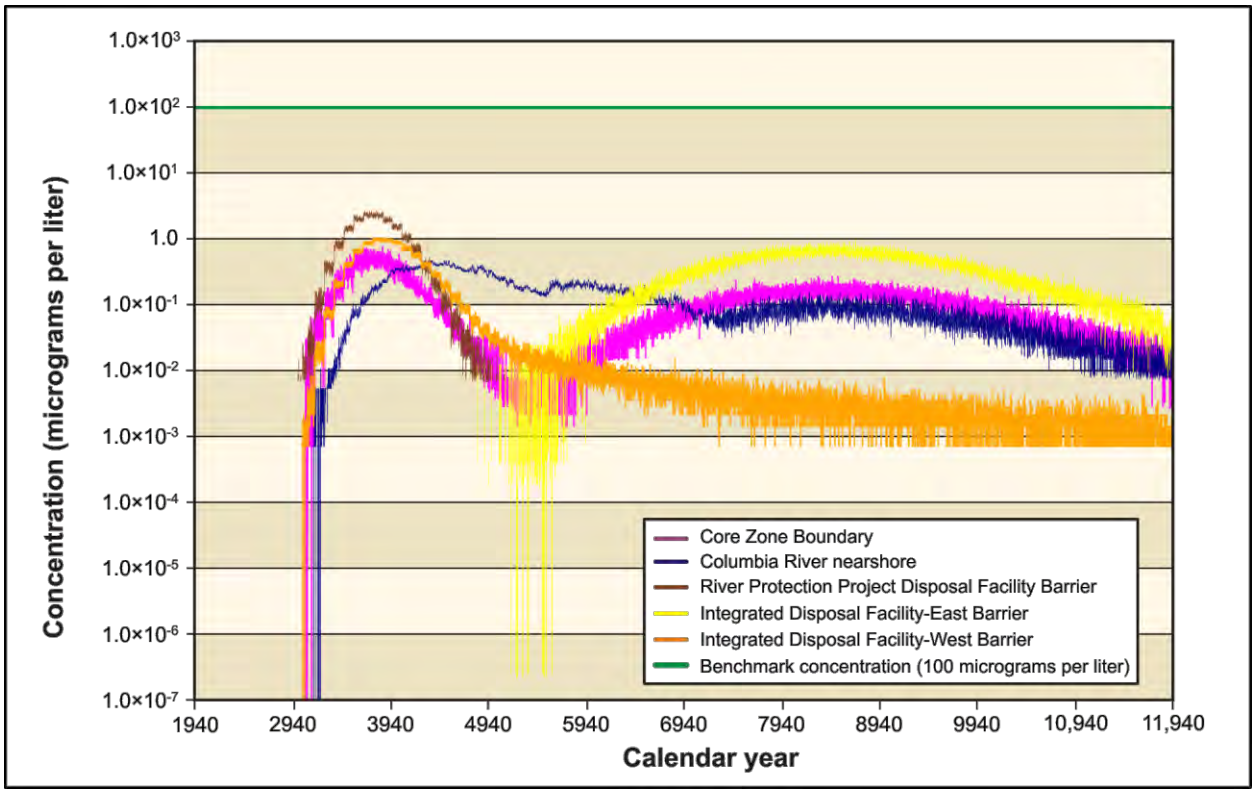


Figure 5–768. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Chromium Concentration Versus Time

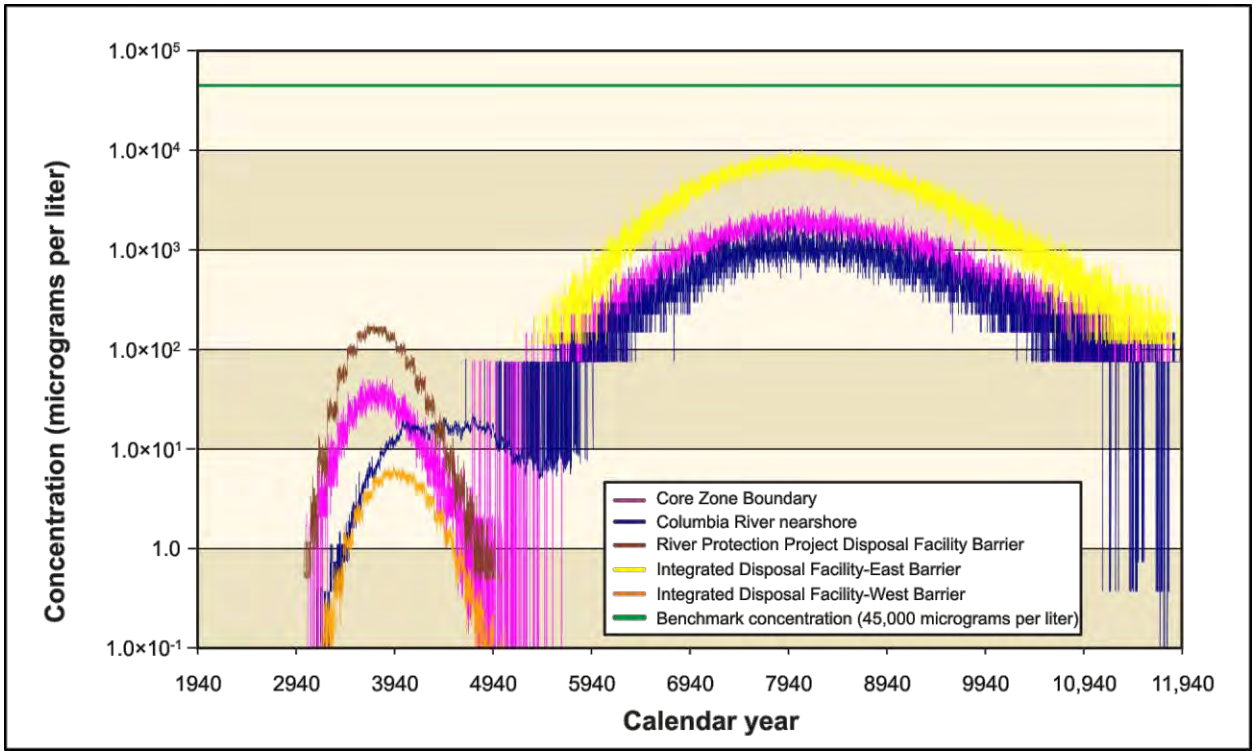


Figure 5–769. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Nitrate Concentration Versus Time

Figure 5–770 shows concentration versus time for total uranium. Because total uranium moves slowly through the vadose zone, releases from IDF-East, IDF-West, and the RPPDF result in groundwater concentrations that are many orders of magnitude lower than benchmark concentrations. Total uranium concentrations, while very minimal, begin to rise at the RPPDF barrier and Core Zone Boundary in approximately CY 10,000, but never get closer than six orders of magnitude of exceeding benchmark concentrations by the end of the period of analysis.

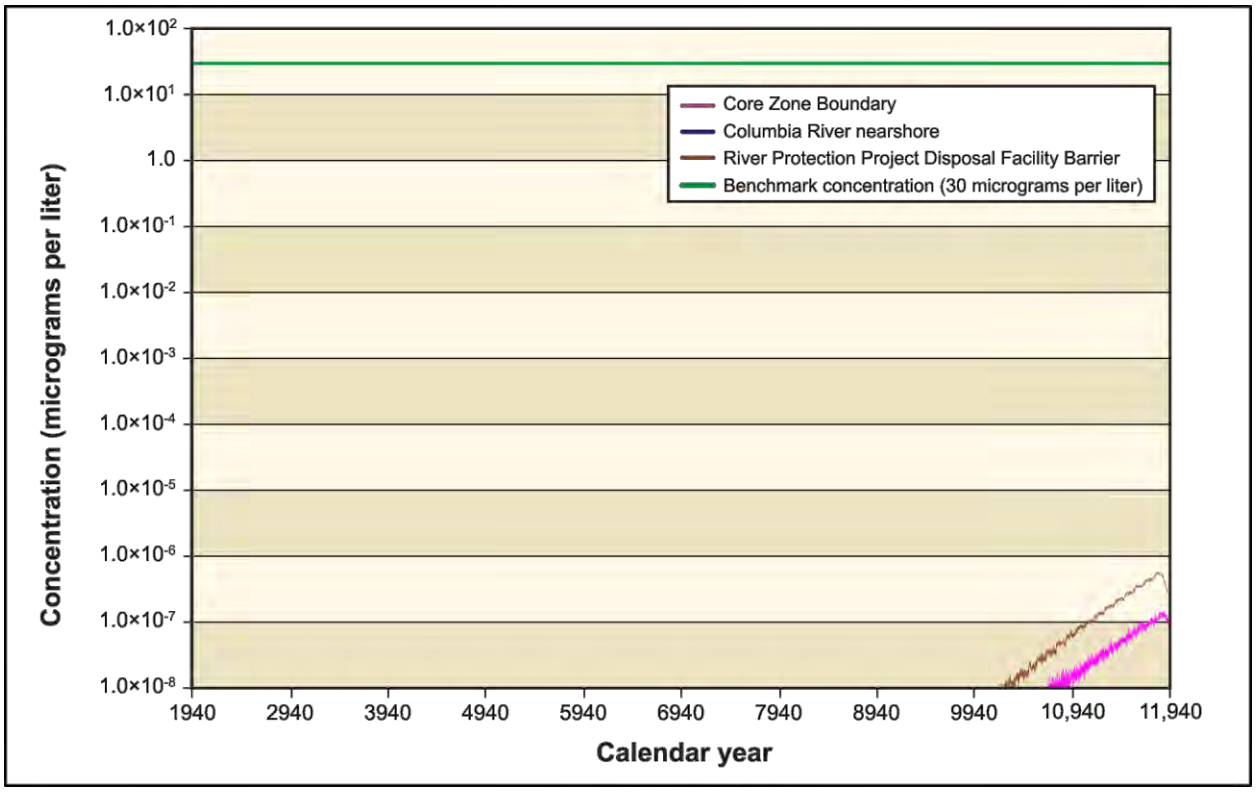


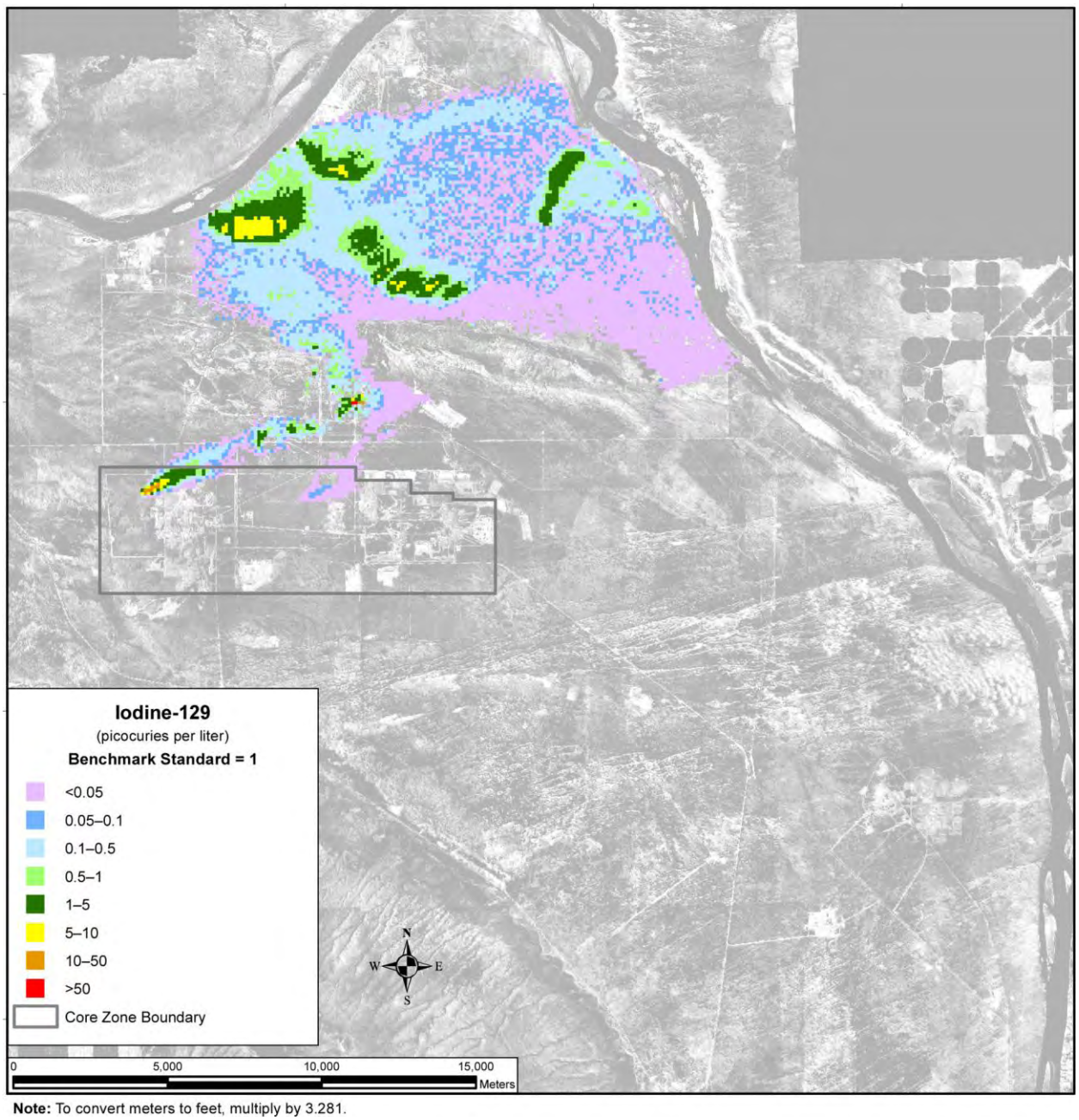
Figure 5–770. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter (see Figures 5–771 through 5–782). Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations.

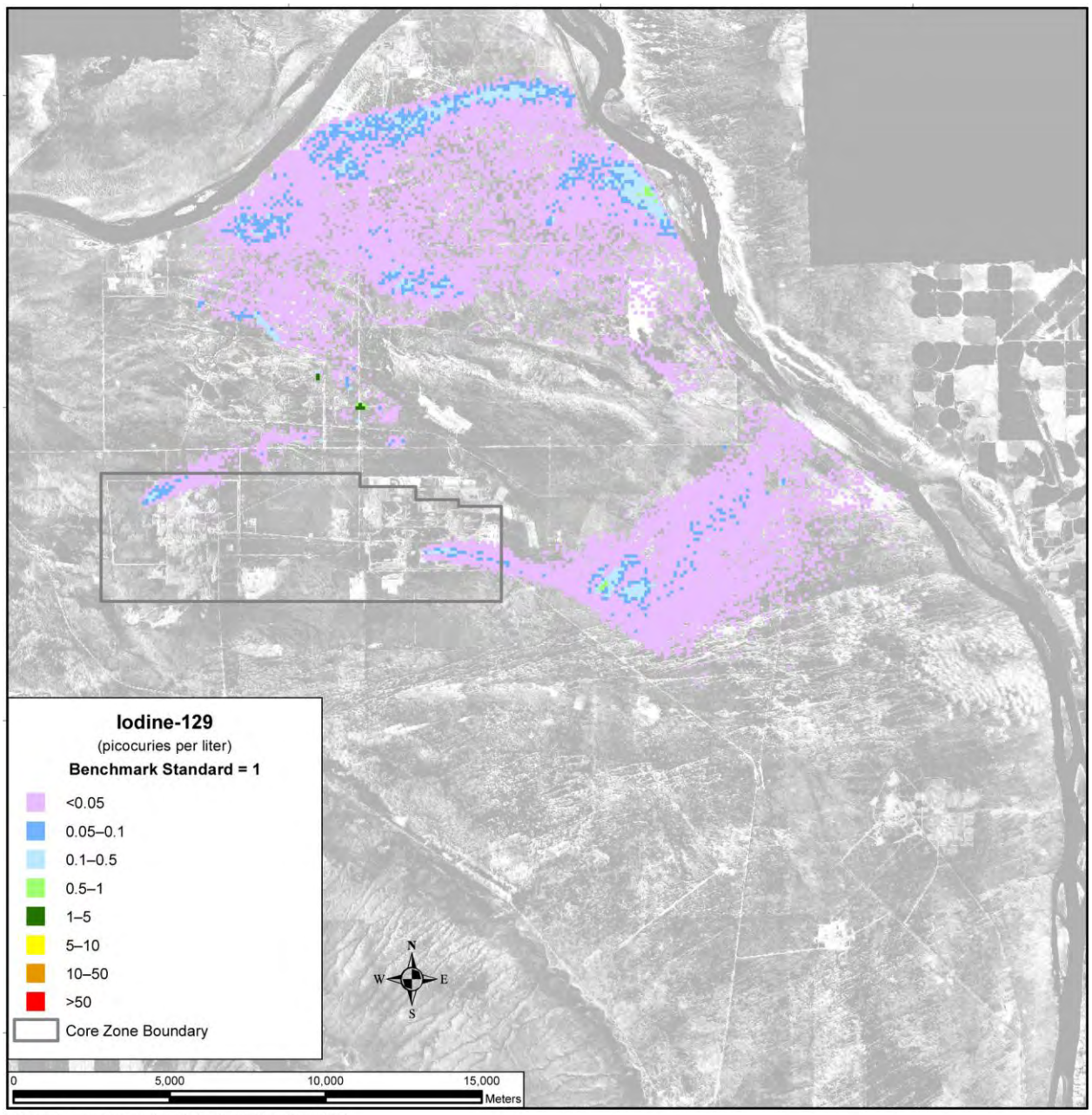
Figure 5–771 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 3890. Releases from IDF-West and the RPPDF result in a groundwater plume starting in the Core Zone and heading north through Gable Gap. This plume exceeds the benchmark concentration at the Core Zone Boundary and north of the Core Zone Boundary by one to two orders of magnitude. In CY 7140, releases from IDF-East create a groundwater plume, not exceeding the benchmark, that extends from the 200-East Area east toward the Columbia River (see Figure 5–772). Also, by CY 7140, most of the IDF-West and RPPDF plumes continue to move north and reach the Columbia River. By CY 11,885, most of the mass

in the IDF-East plume is still moving east toward the Columbia River, with only small, isolated pockets of concentration exceeding the benchmark (see Figure 5–773). Technetium-99 (see Figures 5–774 through 5–776) shows similar spatial distributions at selected times and exceeds the benchmark concentration at approximately the same time and locations. Chromium (see Figures 5–777 through 5–779) and nitrate (see Figures 5–780 through 5–782) show similar spatial distributions at selected times, but neither exceeds its benchmark concentration. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., move at the rate of the pore-water velocity).



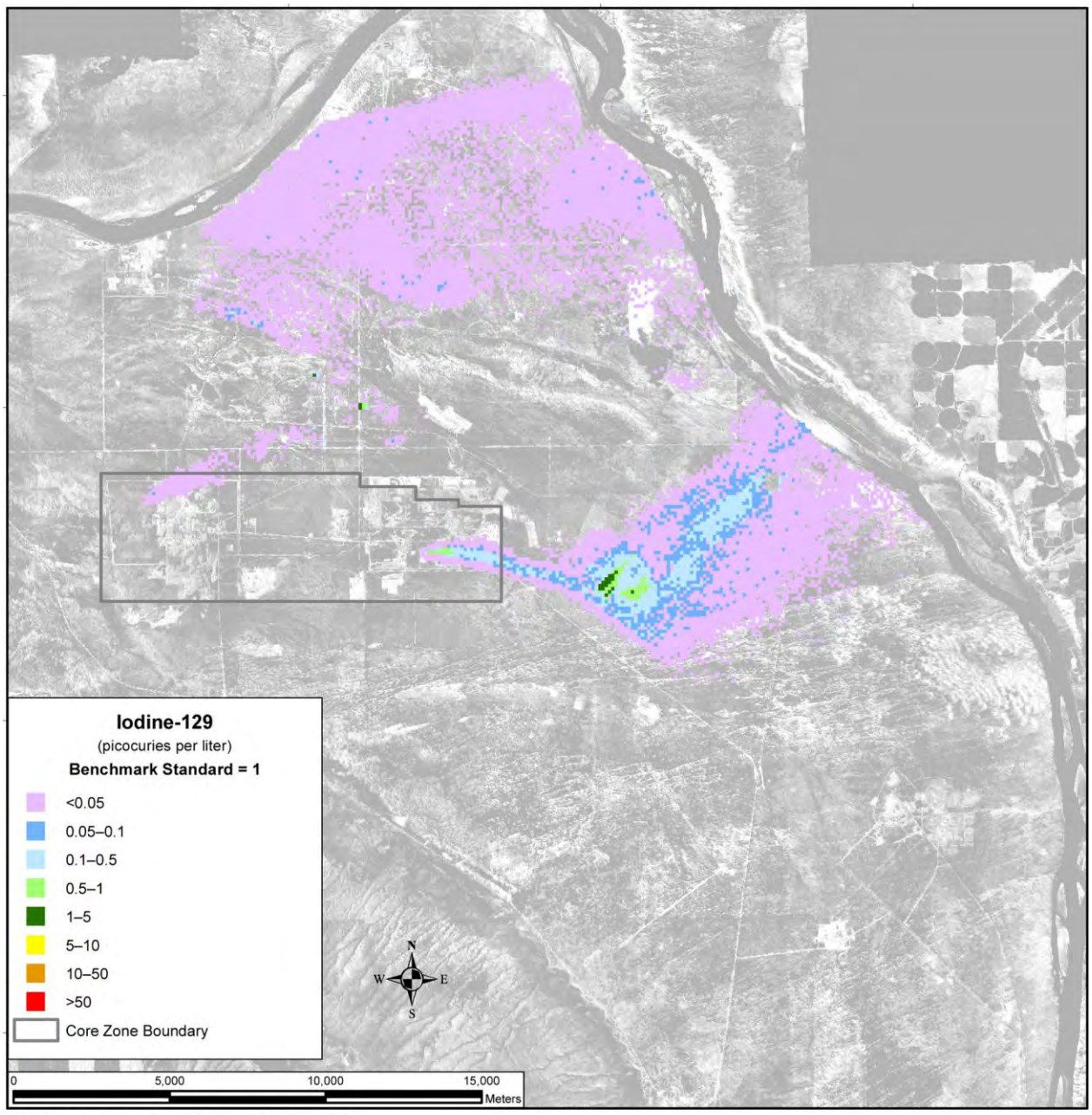
Note: To convert meters to feet, multiply by 3.281.

Figure 5–771. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



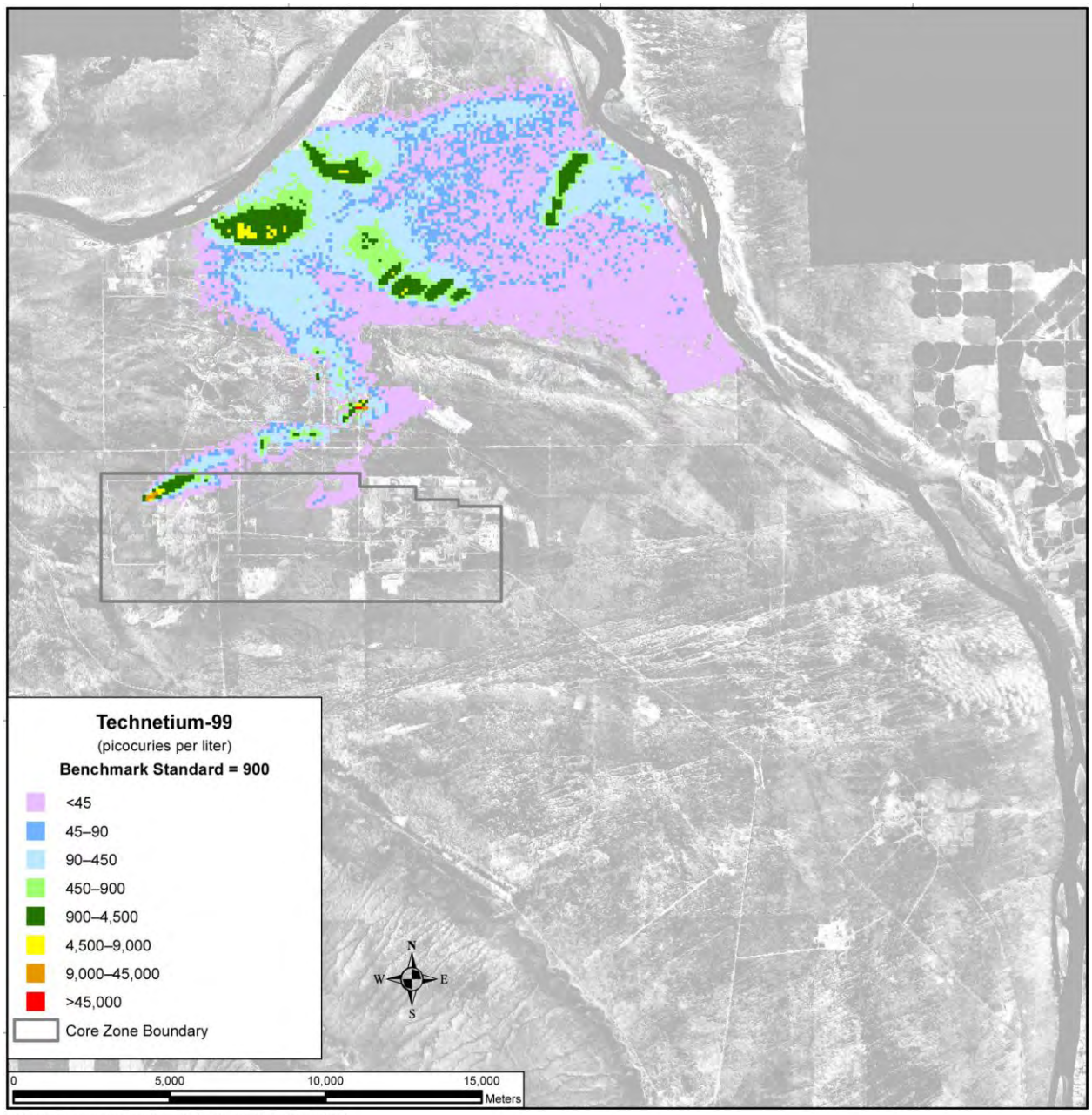
Note: To convert meters to feet, multiply by 3.281.

Figure 5–772. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



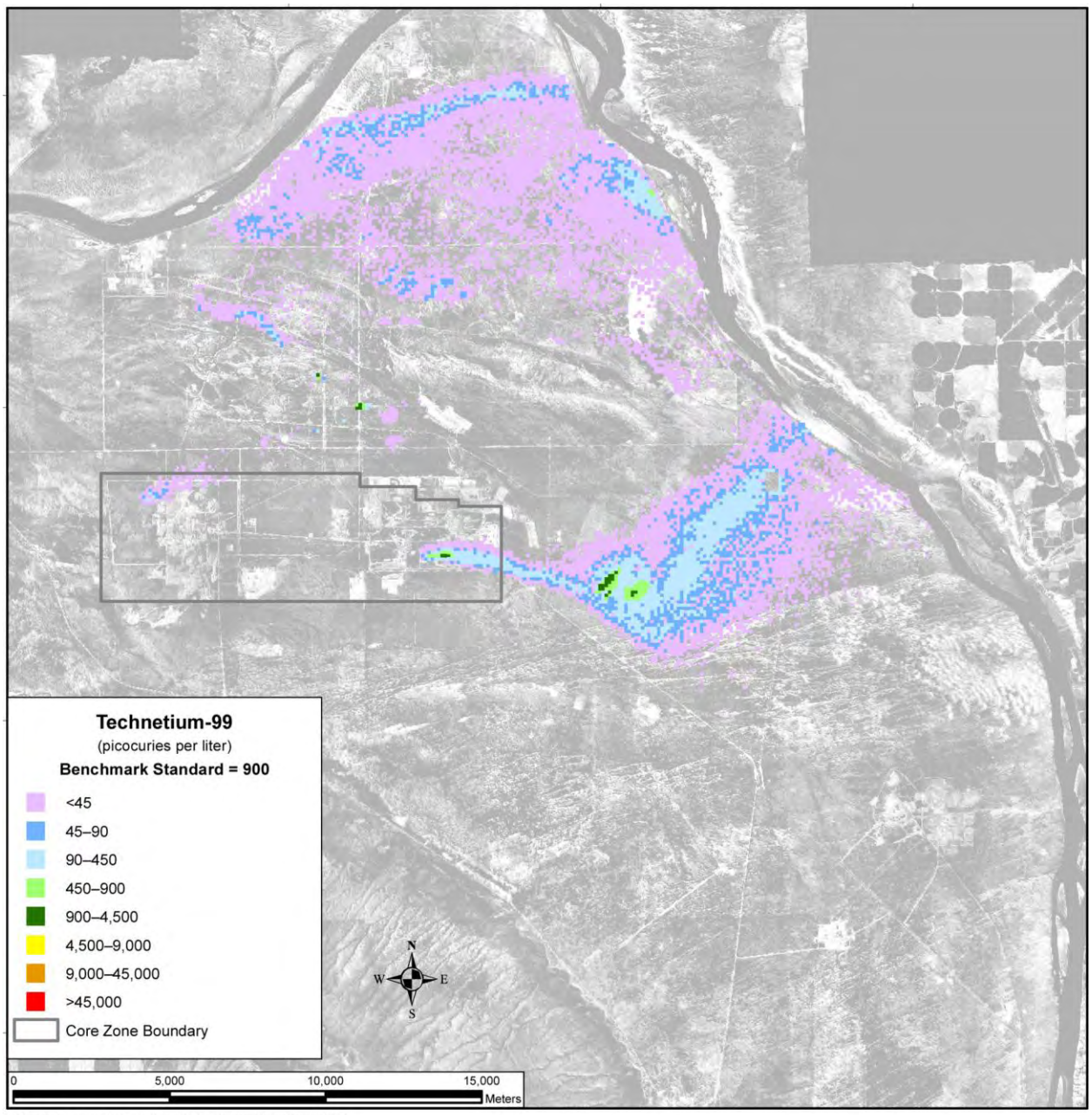
Note: To convert meters to feet, multiply by 3.281.

Figure 5–773. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



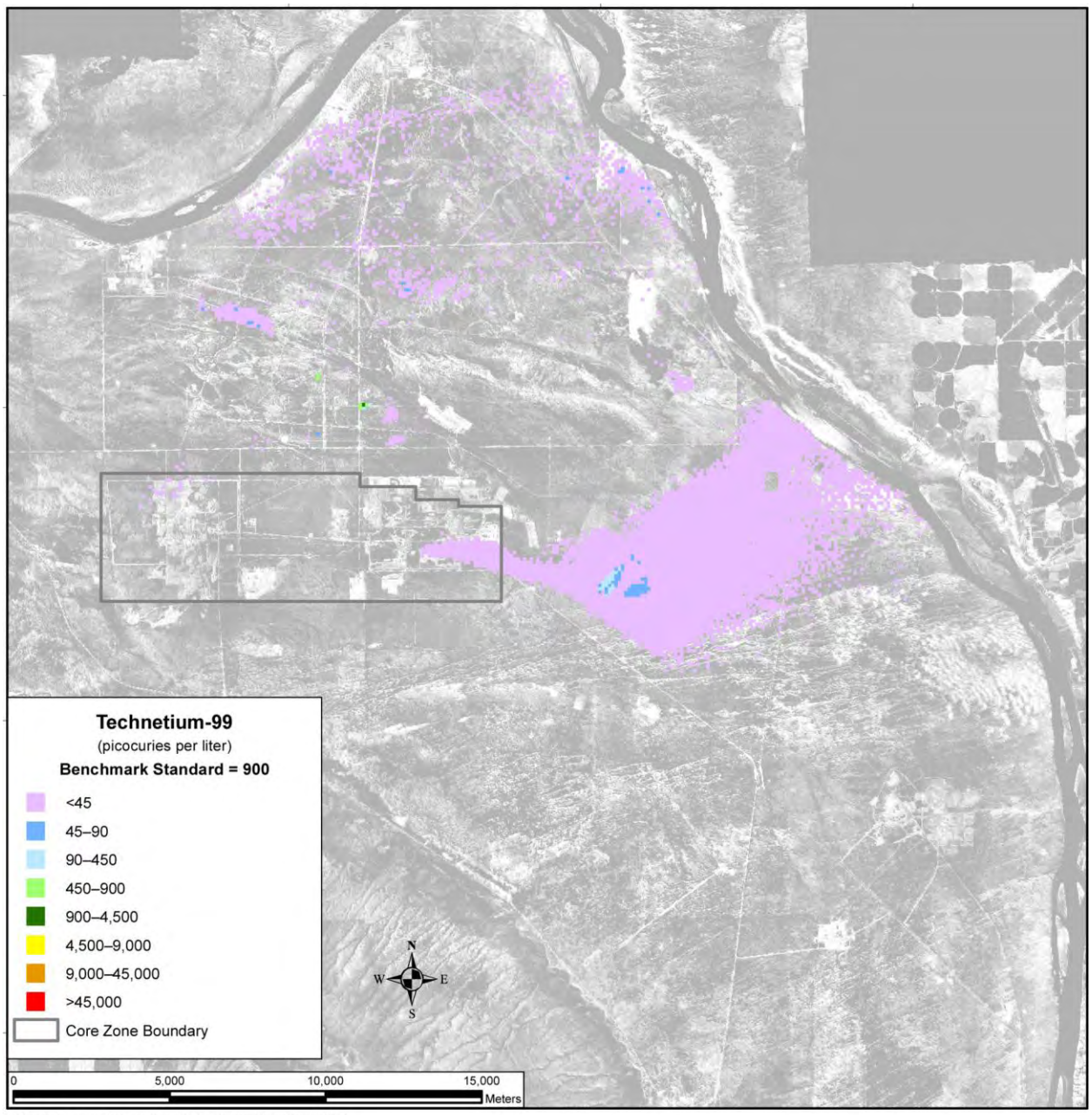
Note: To convert meters to feet, multiply by 3.281.

Figure 5–774. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



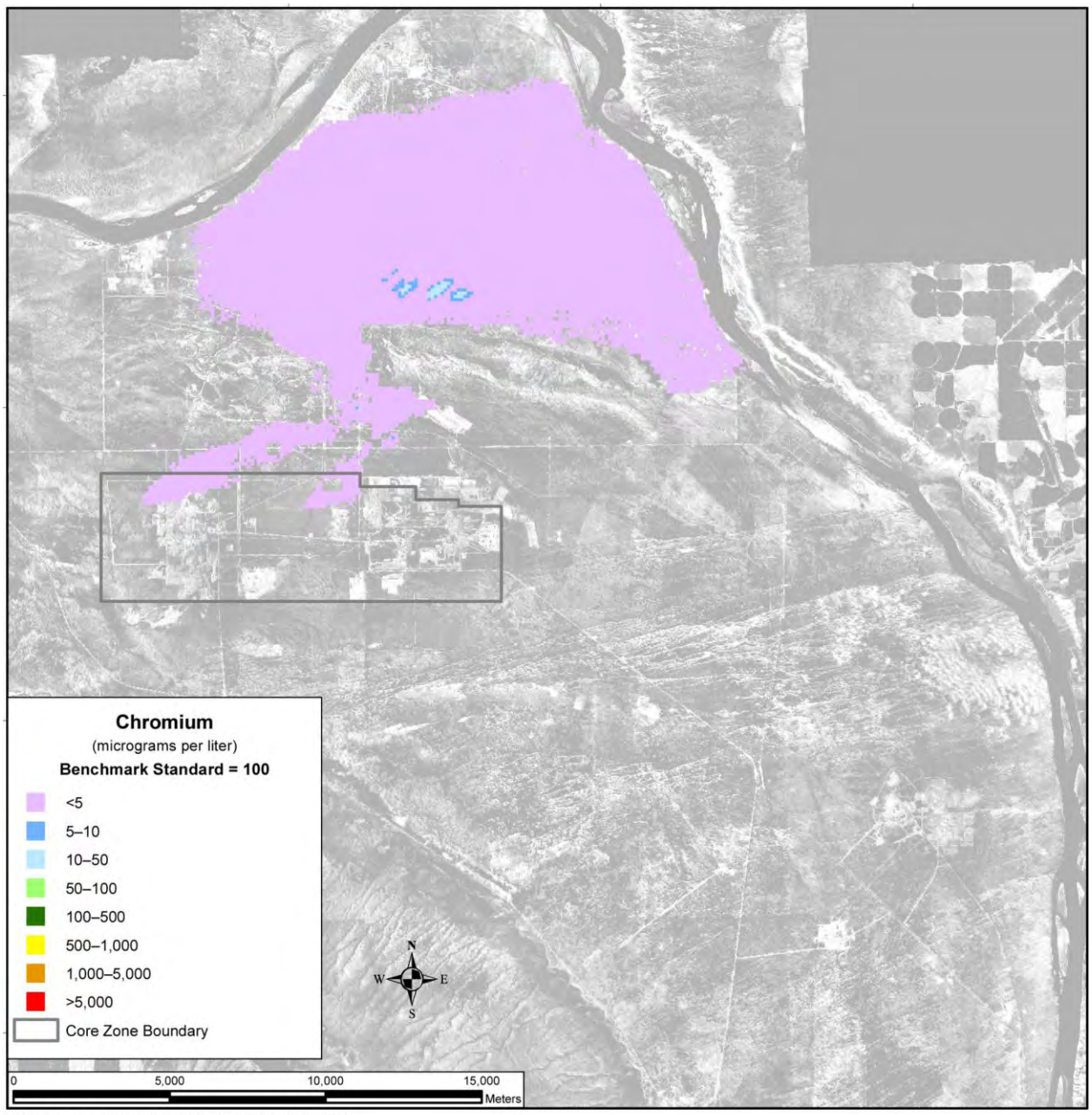
Note: To convert meters to feet, multiply by 3.281.

Figure 5–775. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



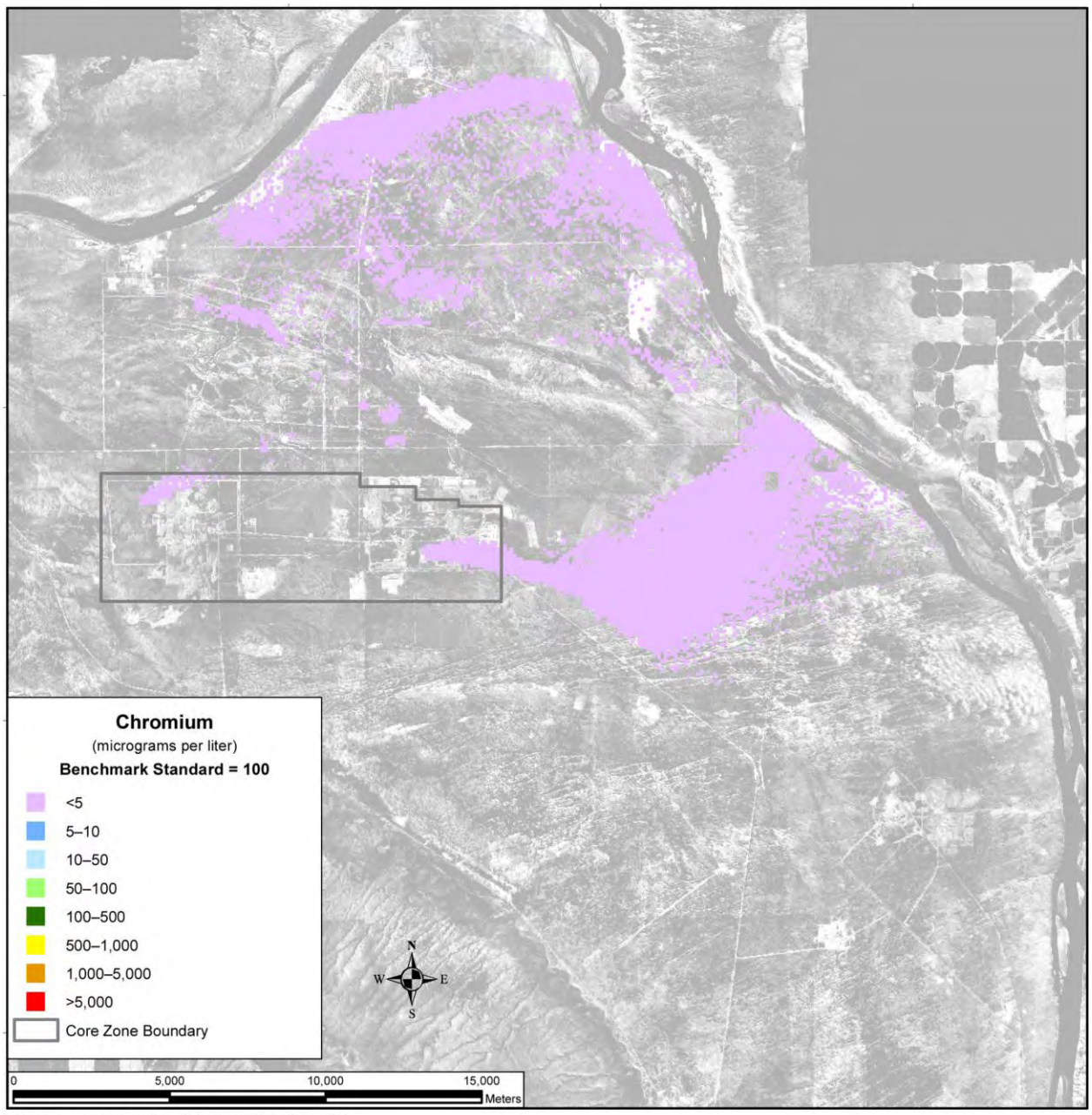
Note: To convert meters to feet, multiply by 3.281.

Figure 5–776. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



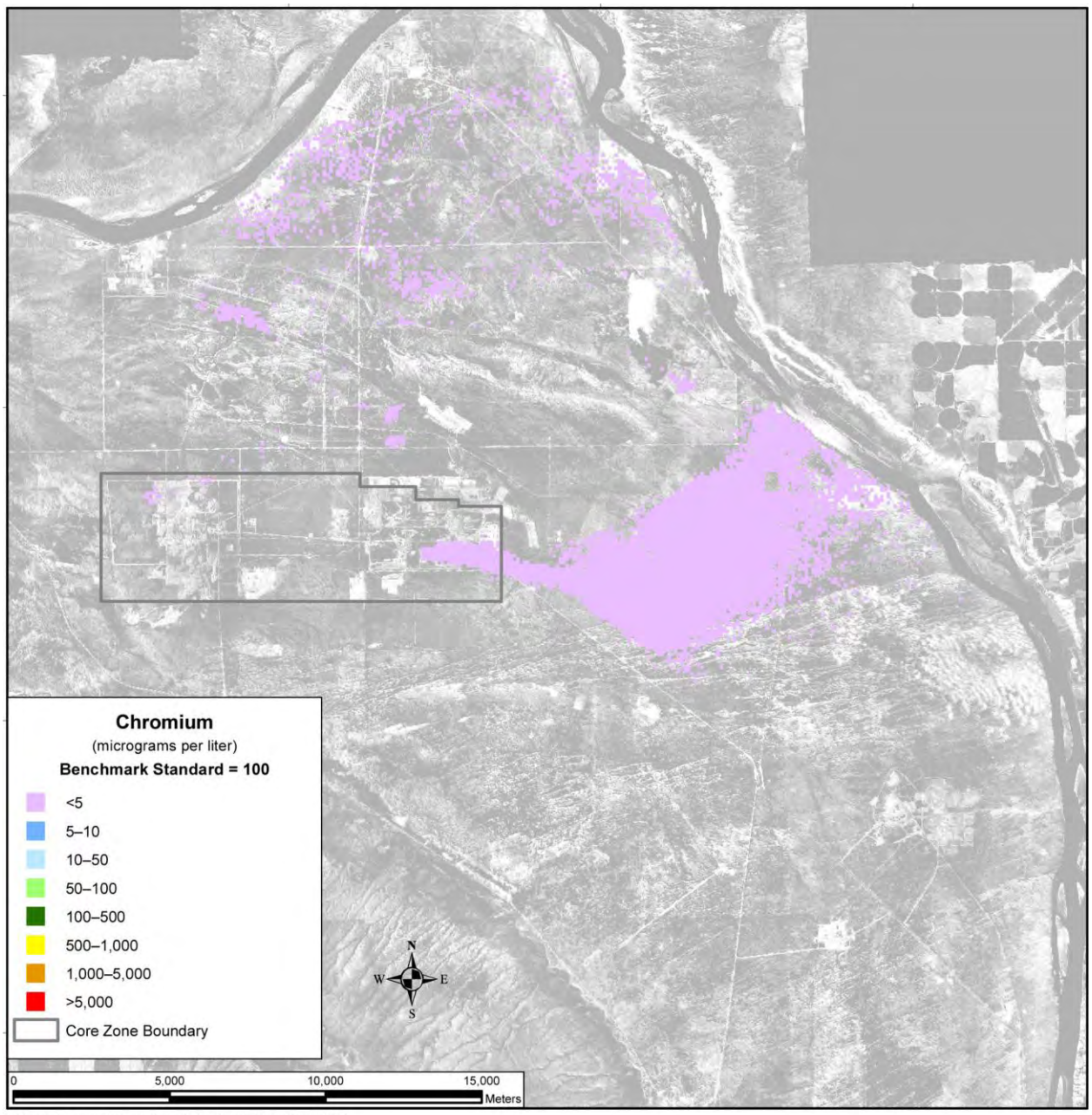
Note: To convert meters to feet, multiply by 3.281.

Figure 5–777. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



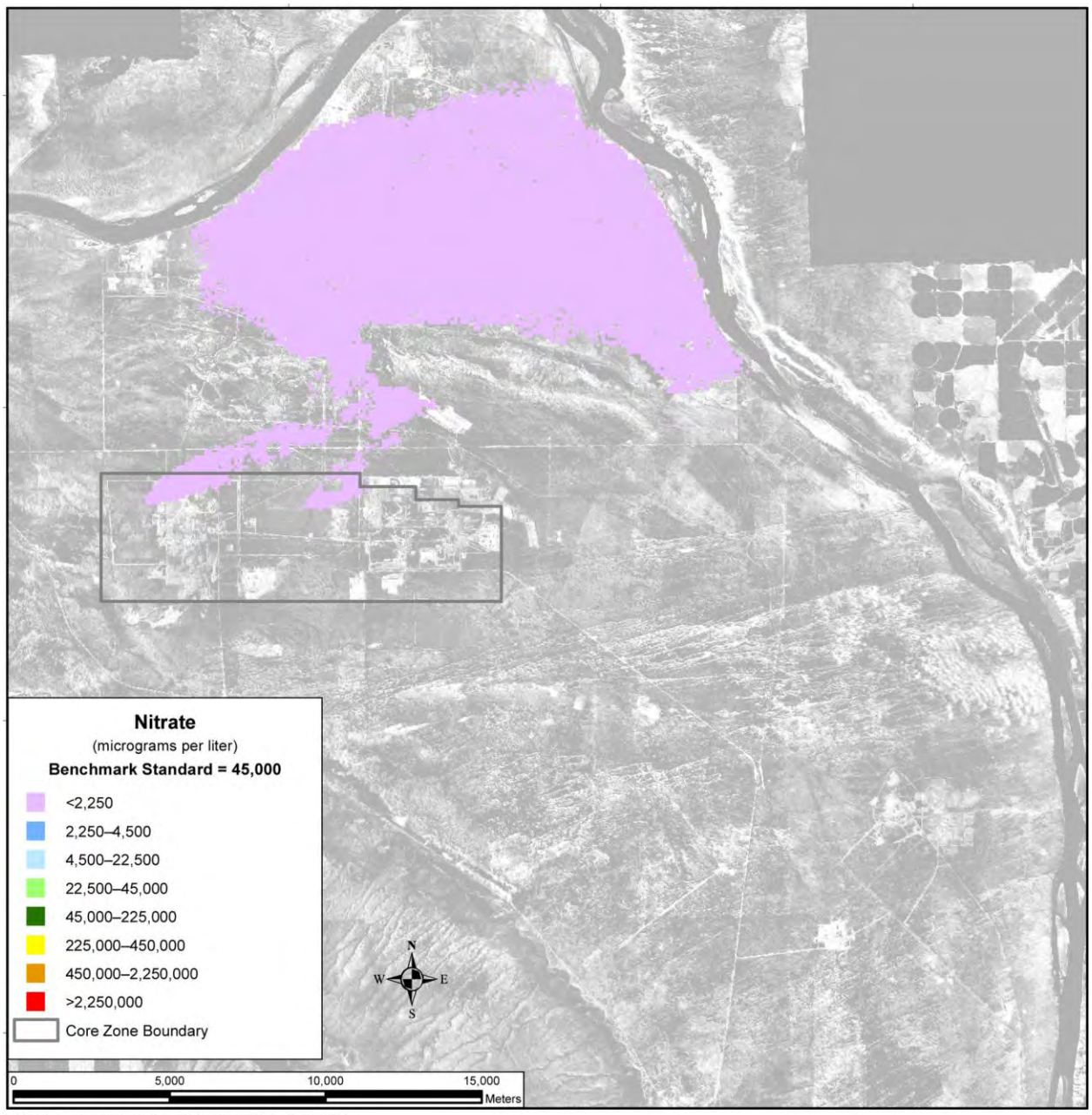
Note: To convert meters to feet, multiply by 3.281.

Figure 5–778. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



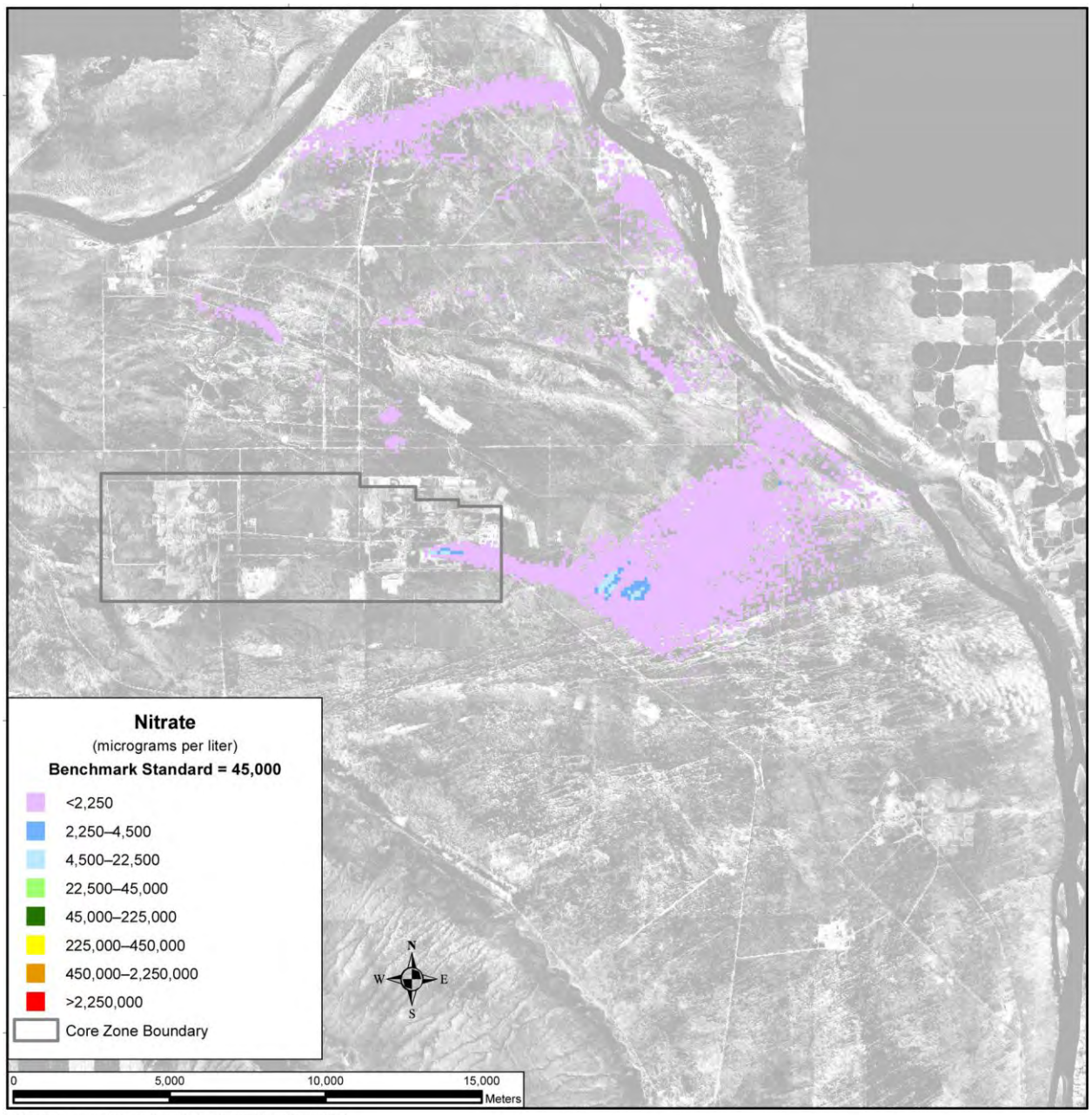
Note: To convert meters to feet, multiply by 3.281.

Figure 5–779. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



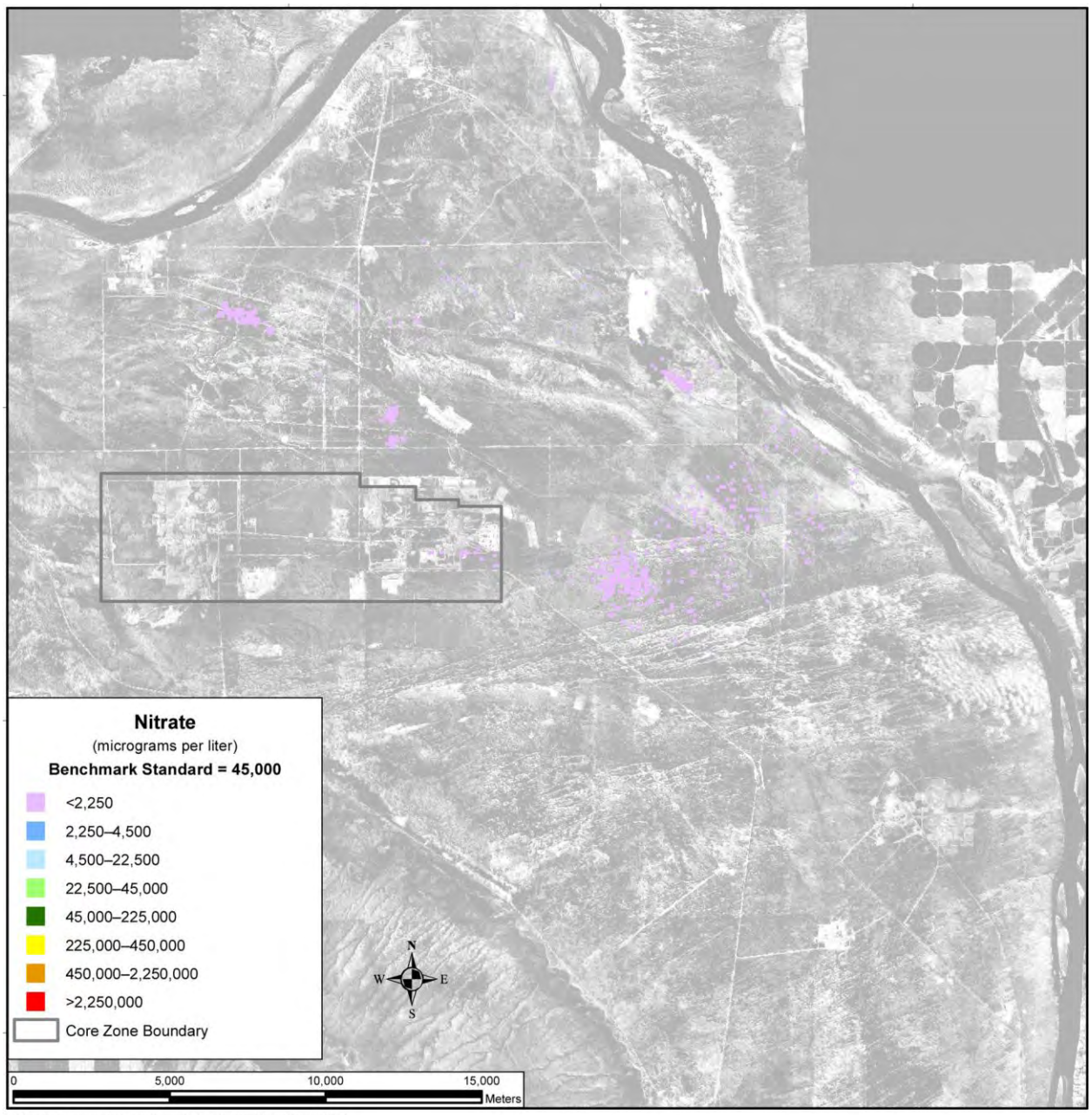
Note: To convert meters to feet, multiply by 3.281.

Figure 5–780. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



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

Figure 5–781. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



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

Figure 5–782. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, in general, the inventories remaining in IDF-East, IDF-West, and the RPPDF, which are available for release to the environment at the start of the post-disposal period, are predominant contributors.

For the conservative tracers, concentrations slightly outside the Core Zone Boundary exceed benchmark standards by one to two orders of magnitude during most of the period of analysis. Concentration at the Columbia River is about one to two orders of magnitude smaller. The intensities and areas of these groundwater plumes peak between CYs 3200 and 7000.

For total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of total uranium remain six orders of magnitude below the benchmark at the IDF-East barrier, IDF-West barrier, RPPDF barrier, Core Zone Boundary, and Columbia River nearshore for the duration of the 10,000-year simulation period.

5.3.1.3.1.3 Disposal Group 1, Subgroup 1-C

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 3B and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Waste would be converted to IHLW, ILAW glass, and cast stone waste. IHLW would be stored on site, while ILAW glass and cast stone waste would be disposed of in an IDF.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2050, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129, technetium-99, and uranium-238
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, nitrate, and total uranium

The COPC drivers for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. Uranium-238 and total uranium were added to the COPC drivers; although their contribution to risk and hazard are not dominant during the year of peak risk or hazard, they become major contributors toward the end of the period of analysis. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for 100 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C.

The COPC drivers that are discussed in detail in this section fall into two categories. Iodine-129, technetium-99, acetonitrile, chromium, and nitrate are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers.

Uranium-238 and total uranium are long-lived, or stable, but are not as mobile as the other COPC drivers. These constituents move about seven times more slowly than groundwater. As the analyses of release, concentration versus time, and spatial distribution of the COPC drivers are presented, the distinct behavior of these groups will become apparent.

The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Nine subtotals are plotted in Figures 5–783 through 5–800, representing releases from IDF-East, which include ILAW glass, cast stone waste, ETF-generated secondary waste, retired melters, and tank closure secondary waste; releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary waste and onsite waste, and offsite waste; and releases from the RPPDF. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over eight orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–783 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–784, the chemical hazard drivers. For technetium-99, chromium, and nitrate in grouted waste forms, the release to the vadose zone is controlled by the inventory (i.e., nearly all of the inventory is released during the period of analysis). The predominant source of chromium, nitrate, iodine-129, and technetium-99 is cast stone waste. Other sources of contamination examined include ILAW glass, ETF-generated secondary waste, retired melters, and tank closure secondary waste. Fluoride is not released from IDF-East.

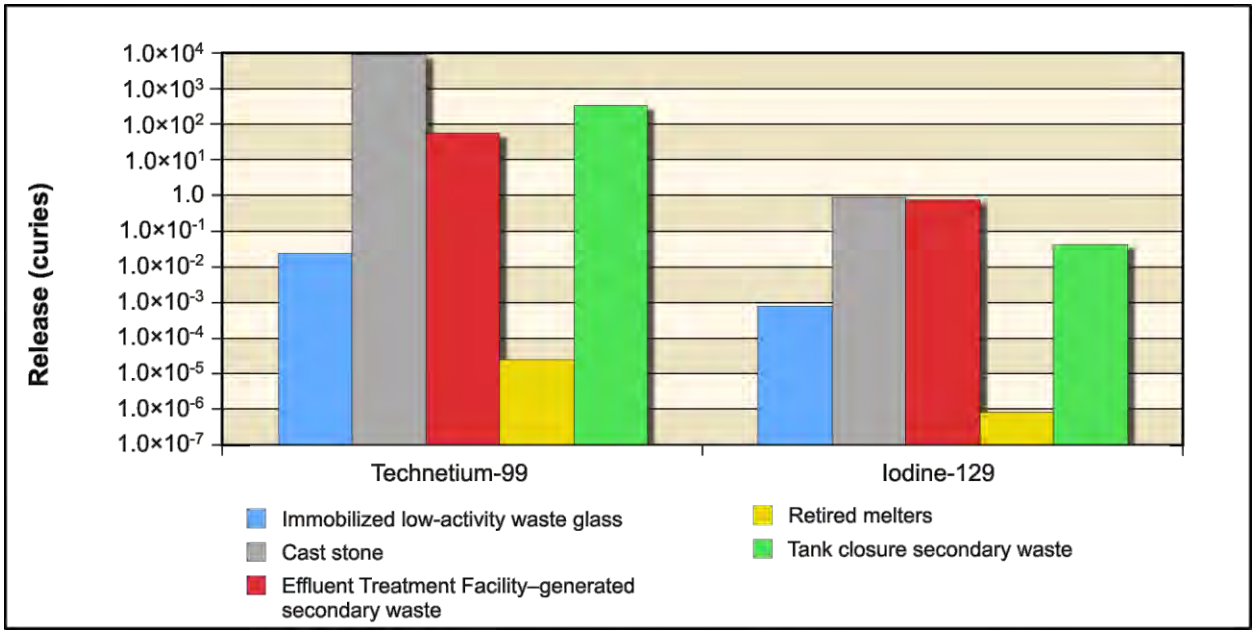


Figure 5–783. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

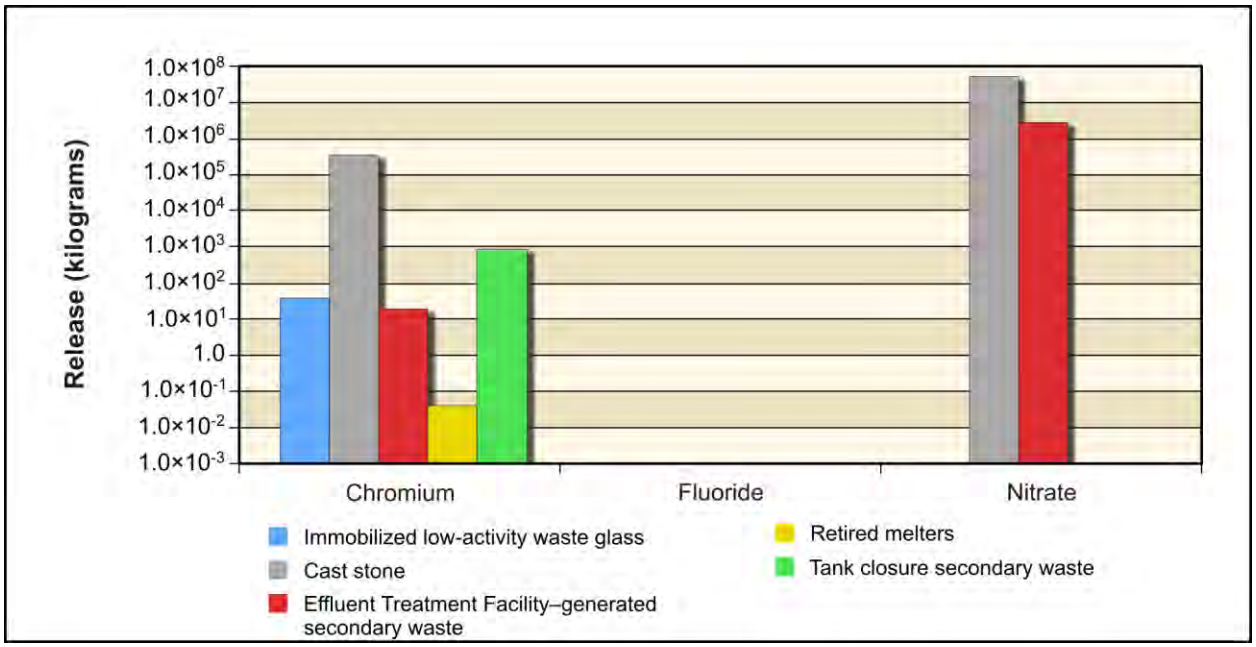


Figure 5–784. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–785 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–786, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Nearly all of the technetium-99 released from ETF-generated secondary waste to the vadose zone reaches groundwater during the period of analysis, but only 40 to 50 percent of the technetium-99 from other sources and iodine-129 released to the vadose zone reaches groundwater. Chromium from ILAW glass and retired melters behaves similarly to technetium-99 and iodine-129 in that only 40 to 50 percent of the chromium released to the vadose zone reaches groundwater. When released from other sources, nearly all the chromium that enters the vadose zone reaches groundwater during the analysis period. For nitrate, nearly everything released to the vadose zone reaches groundwater. Fluoride is not released to the vadose zone from IDF-East.

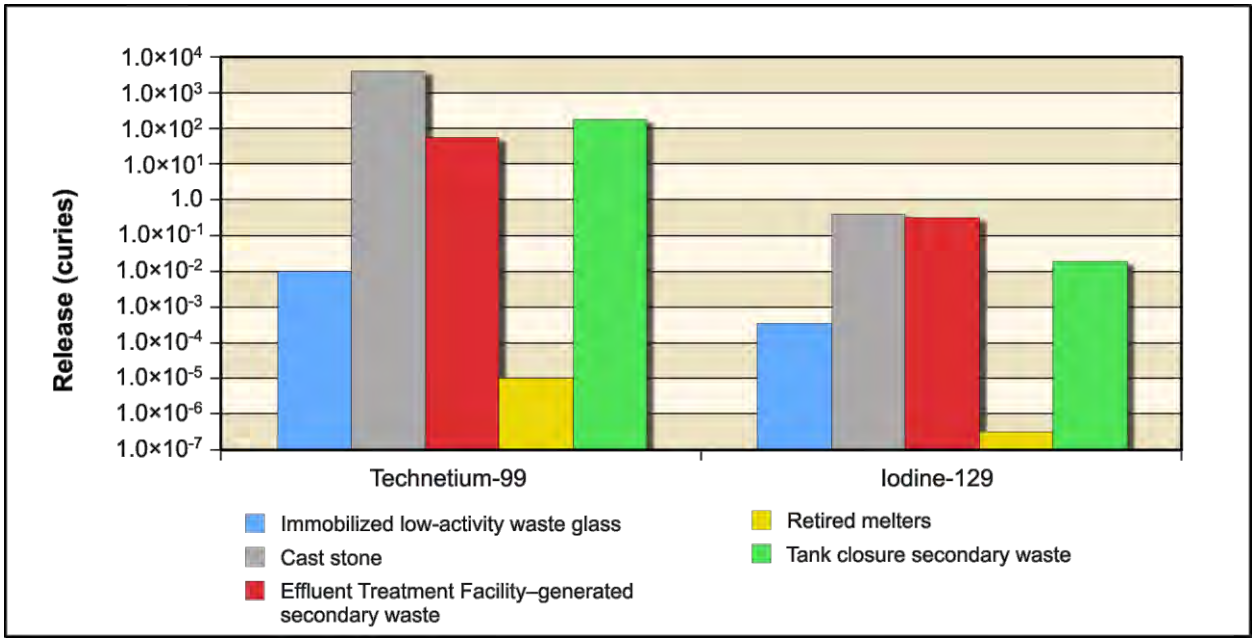


Figure 5–785. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

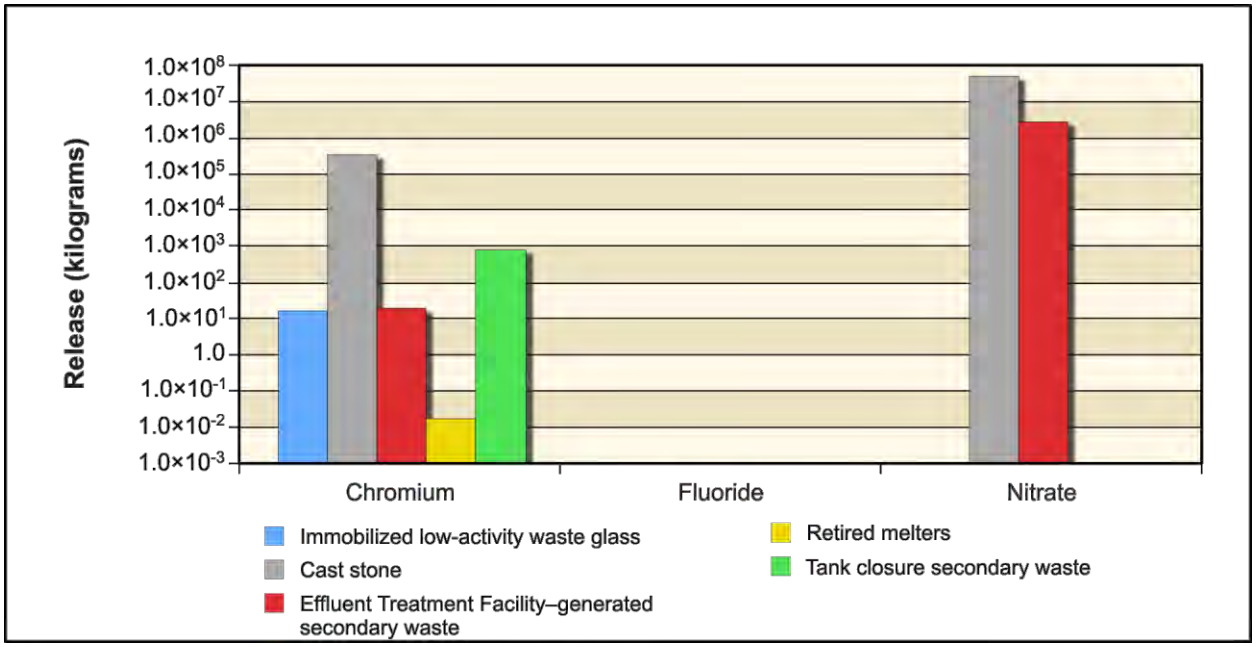


Figure 5–786. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–787 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–788, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. In nearly all cases, between 90 and 100 percent of the amount released to groundwater reaches the Columbia River in the analysis. The exception to this trend is waste from retired melters for technetium-99 and iodine-129. In this case, nothing released to groundwater reaches the Columbia River.

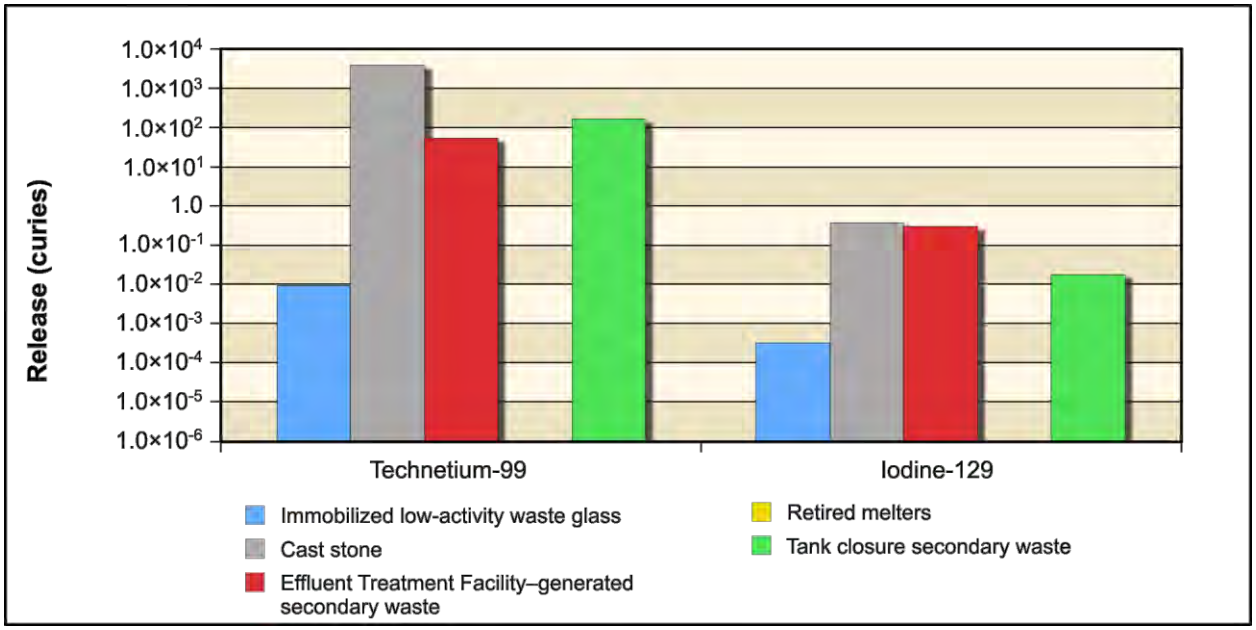


Figure 5–787. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

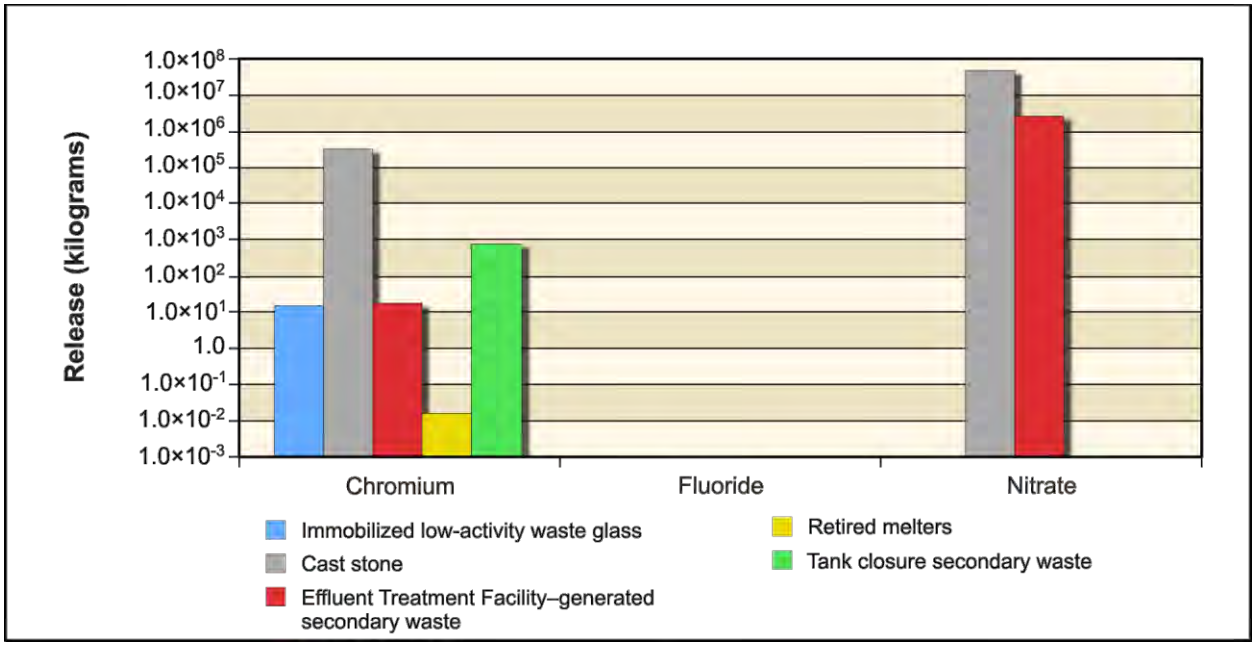


Figure 5–788. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Figure 5–789 shows the estimated release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–790, the chemical hazard drivers. For all types of sources, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). Technetium-99, iodine-129, chromium, fluoride, and nitrate are all present at IDF-West.

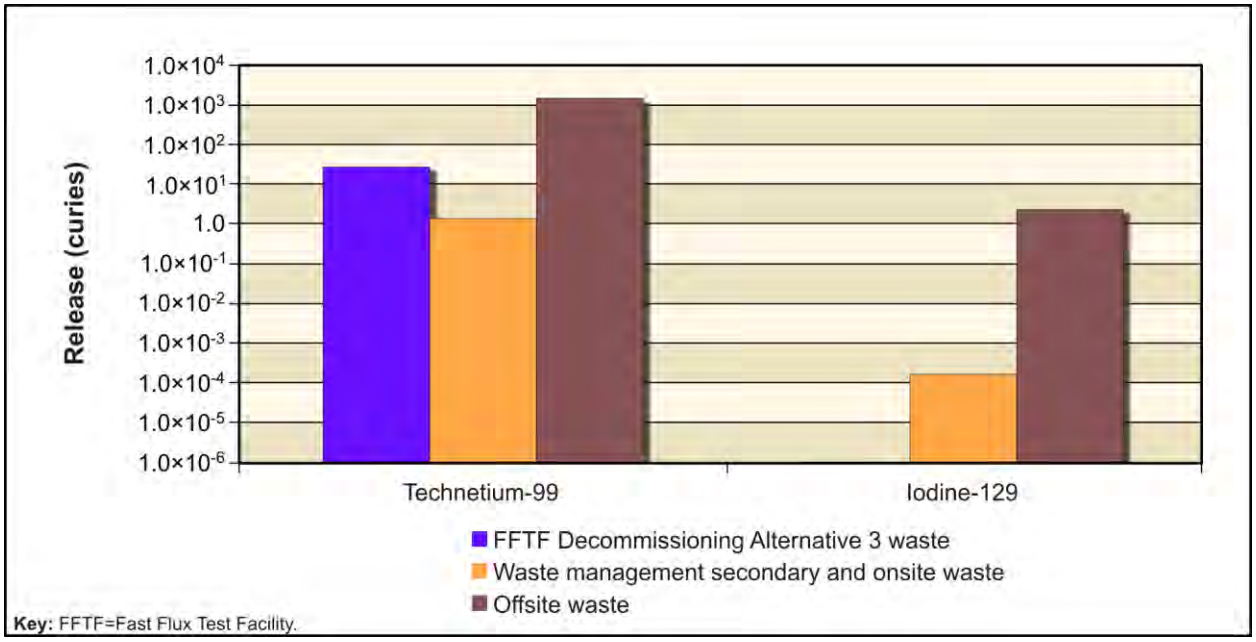


Figure 5–789. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

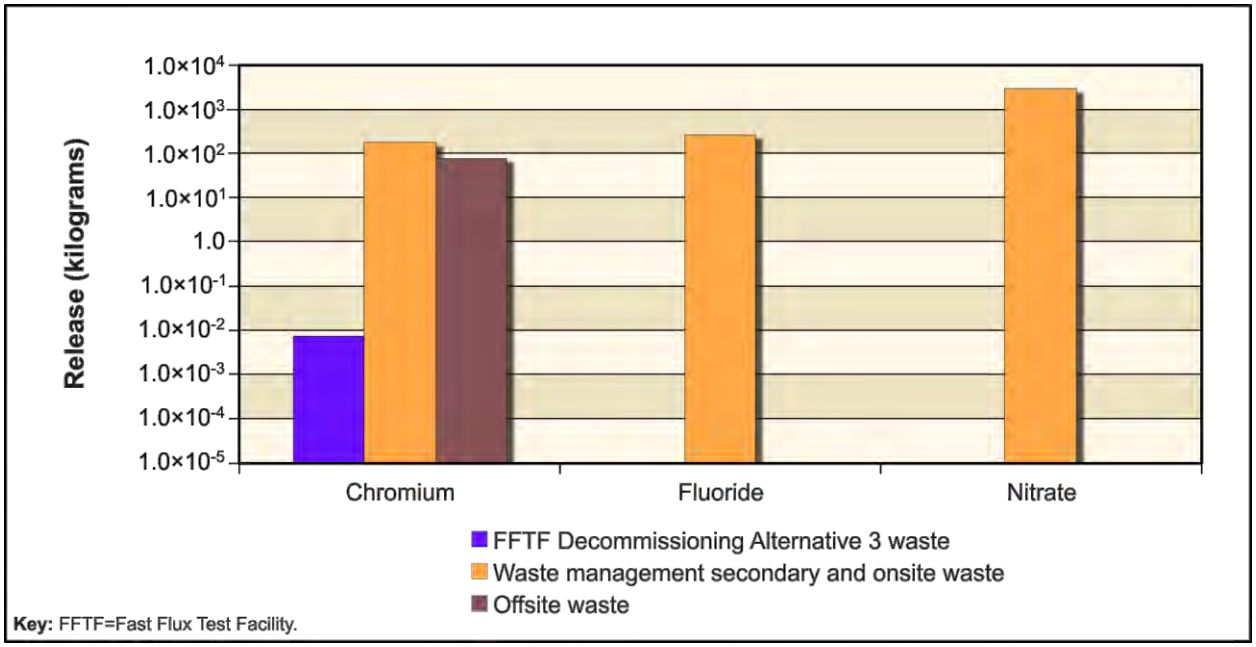


Figure 5–790. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–791 shows the estimated release from IDF-West to groundwater of the radiological risk drivers and Figure 5–792, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All of the COPC drivers present at IDF-West behave as conservative tracers; essentially all of the mass released to the vadose zone reaches groundwater in the analysis.

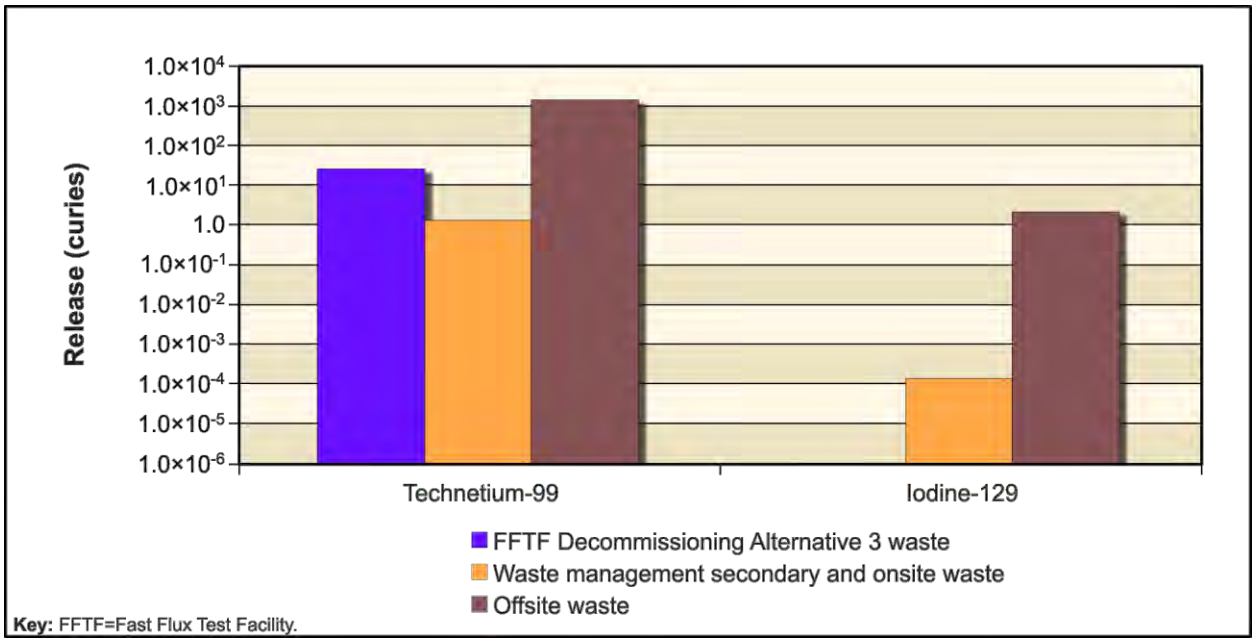


Figure 5–791. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

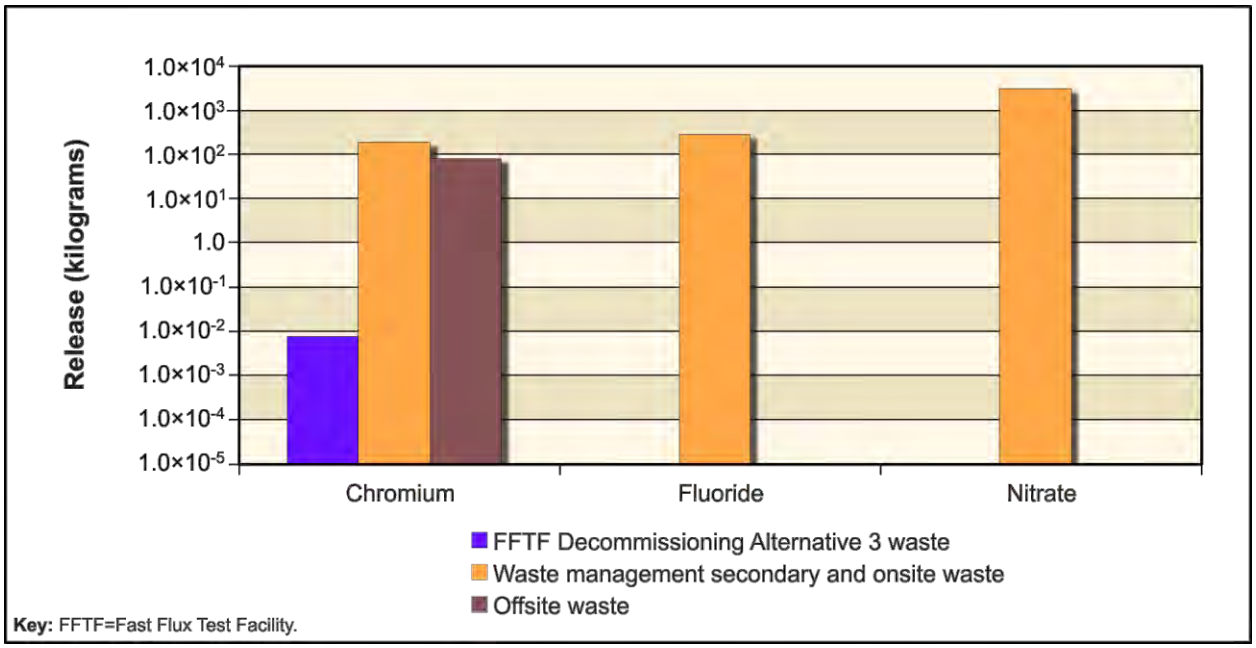


Figure 5–792. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–793 shows the estimated release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–794, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. In the analysis, essentially everything released to groundwater reaches the Columbia River for all COPC drivers present.

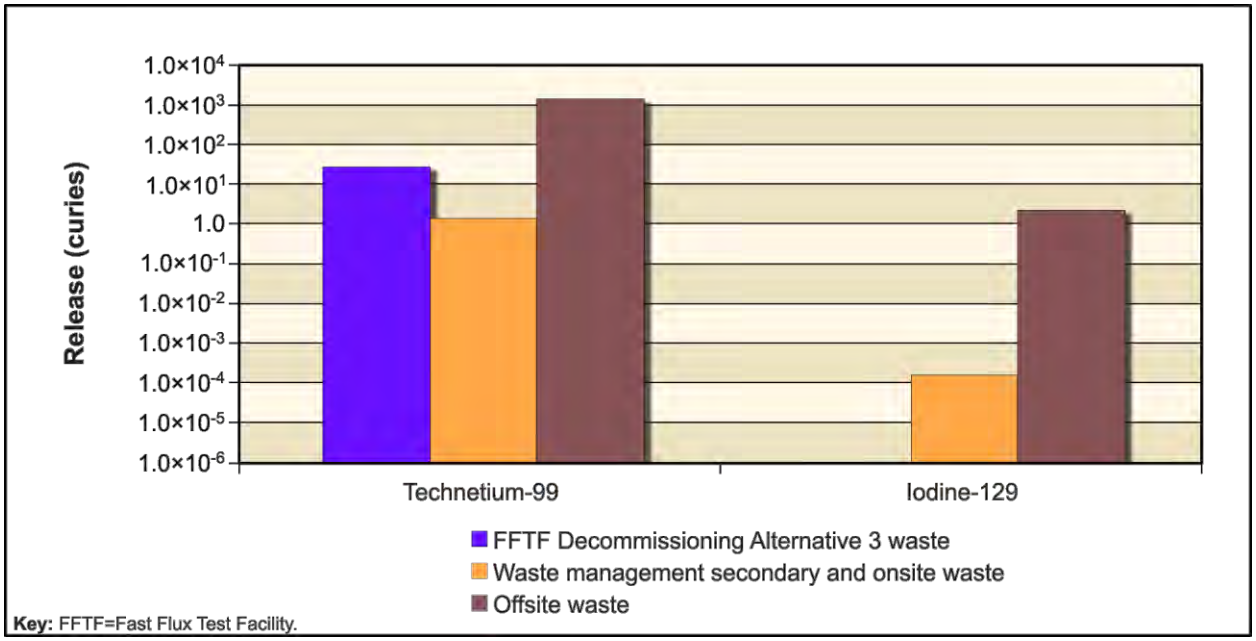


Figure 5–793. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

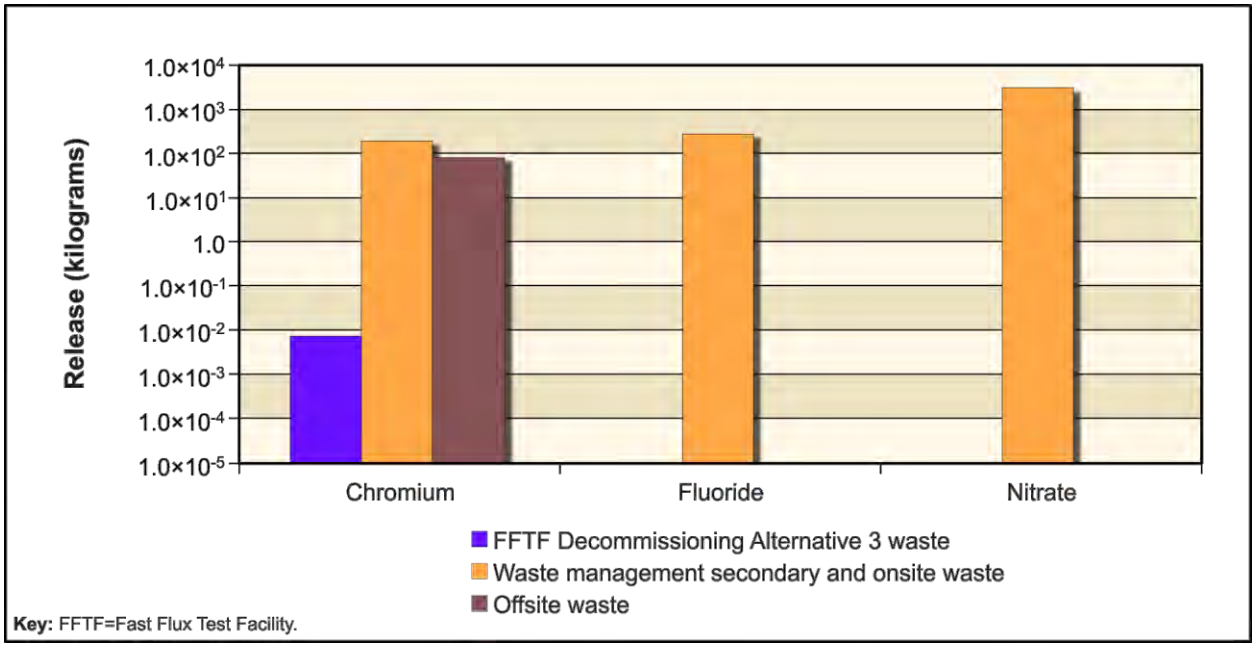


Figure 5–794. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5–795 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–796, the chemical hazard drivers. For all types of sources, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). Technetium-99, iodine-129, chromium, and nitrate are all present at the RPPDF.

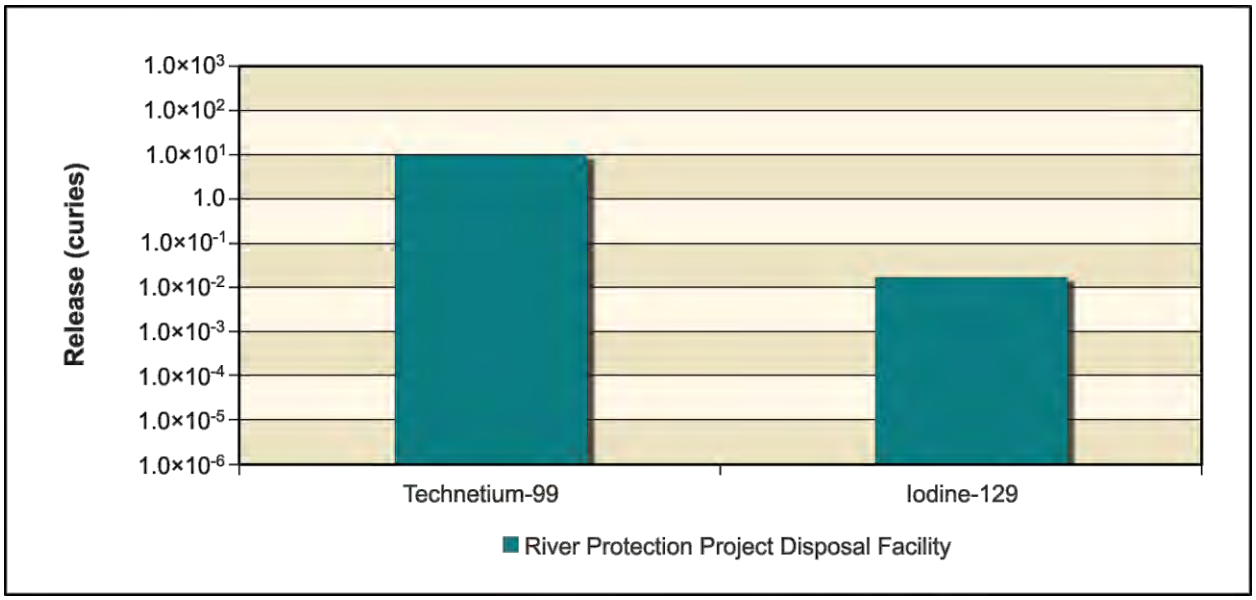


Figure 5–795. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

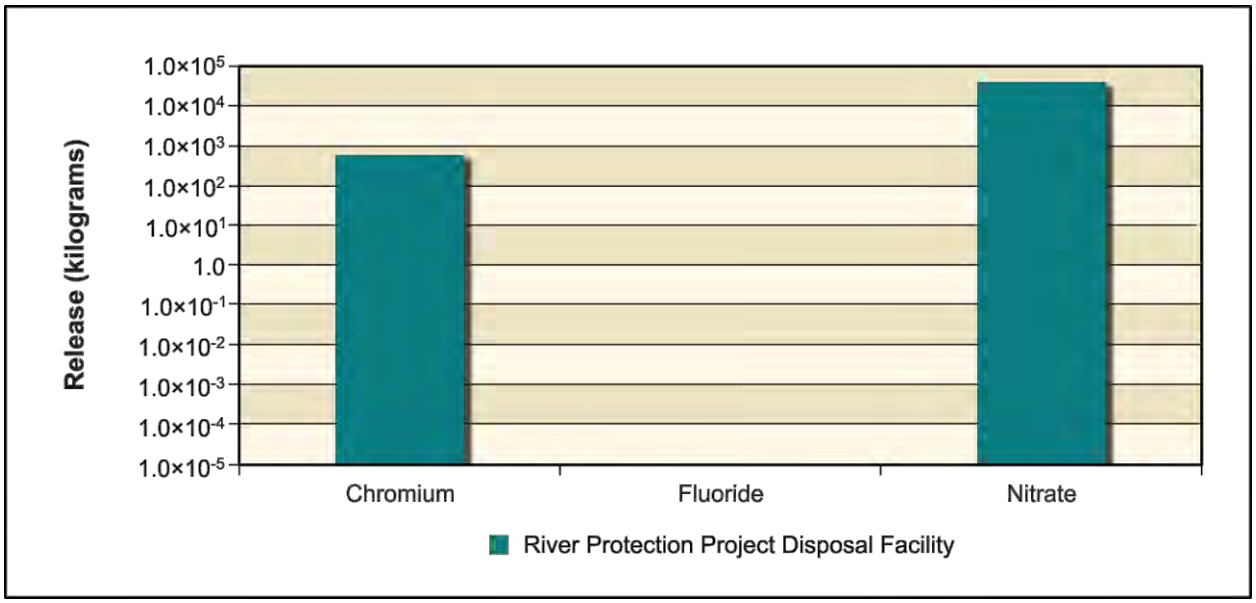


Figure 5–796. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–797 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–798, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All of the COPC drivers present at the RPPDF behave as conservative tracers; essentially all of the mass released to the vadose zone reaches groundwater in the analysis.

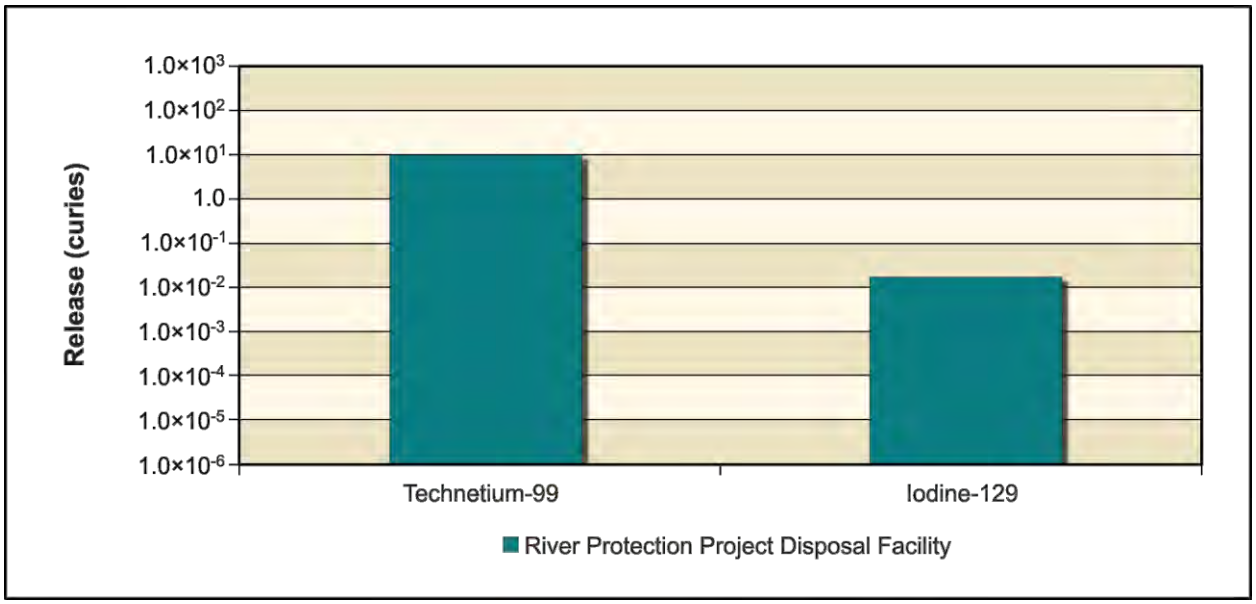


Figure 5–797. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

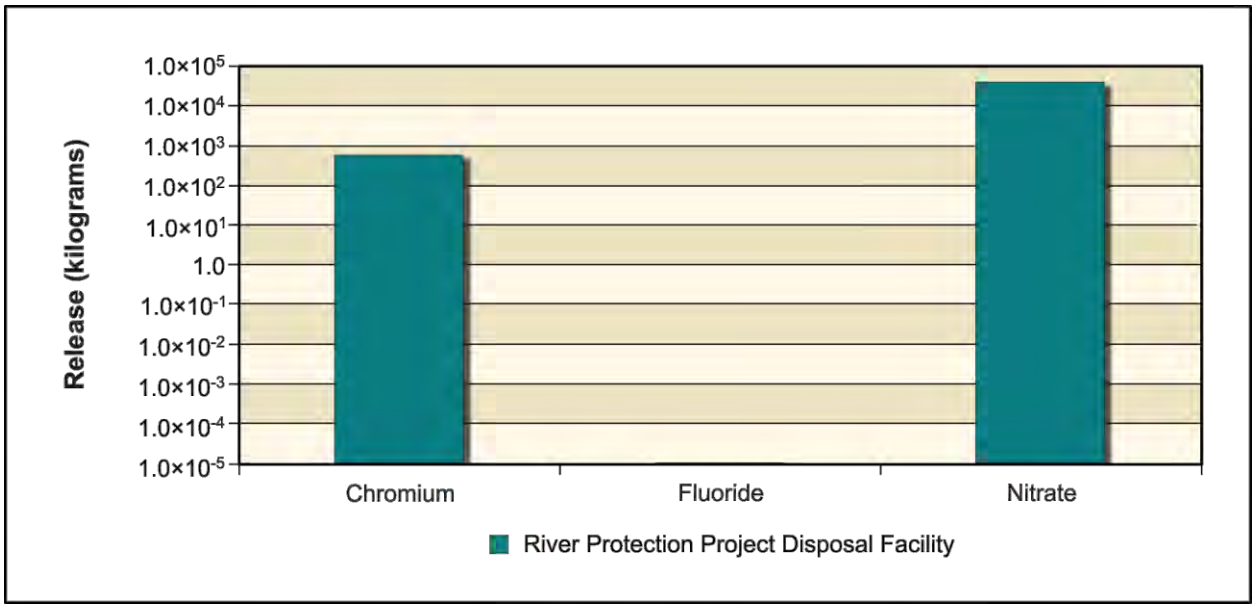


Figure 5–798. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–799 shows the estimated release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–800, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. In the analysis, essentially everything released to groundwater reaches the Columbia River for all COPC drivers present.

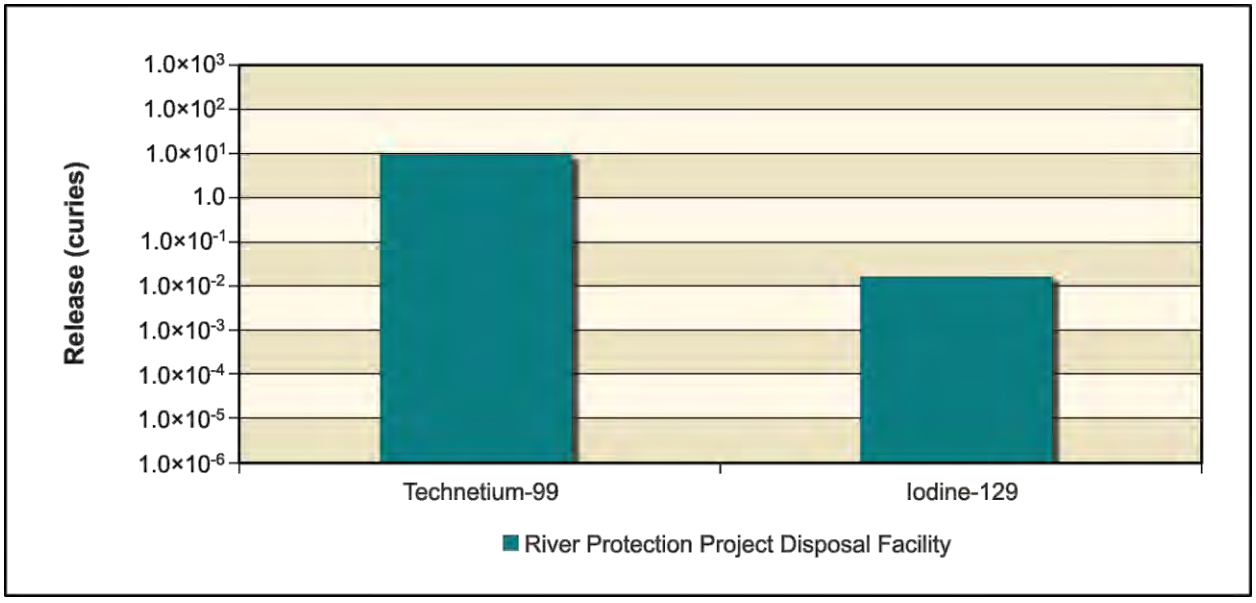


Figure 5–799. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

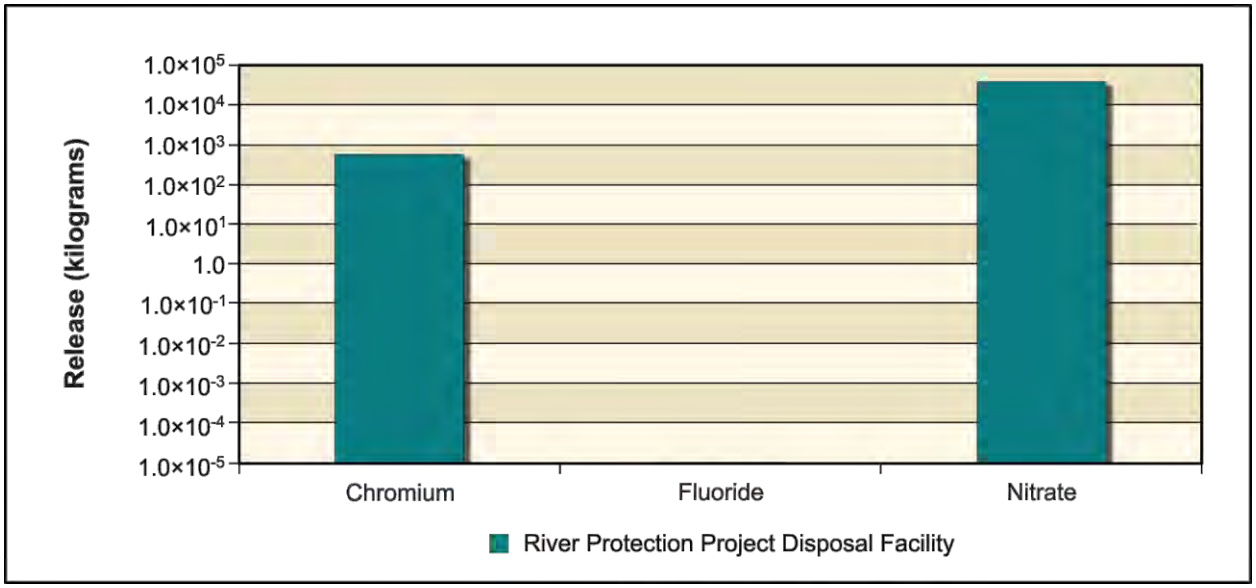


Figure 5–800. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, impacts in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the

concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over five orders of magnitude. Table 5–108 shows the maximum concentrations in groundwater. The most impacted barriers include IDF-West, the Core Zone Boundary, and the Columbia River nearshore, where technetium-99 and iodine-129 reach their maximum exceedances of the benchmark concentrations after about CY 3800; technetium-99 also exceeds the benchmark concentration at IDF-East late in the simulation. Chromium reaches its maximum exceedance of the benchmark concentration at IDF-East and the Core Zone Boundary, and nitrate reaches its maximum exceedance at IDF-East.

Table 5–108. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	**2,970**	**13,200**	42	**1,370**	**1,670**	900
	(10,774)	(3818)	(3818)	(3859)	(3920)	
Iodine-129	0.4	**20.6**	0.1	**2.1**	**2.4**	1
	(9623)	(3794)	(3747)	(3937)	(3872)	
Chemical (micrograms per liter)						
Acetonitrile	17	0	0	6	4	100
	(8821)	(1940)	(1940)	(8715)	(8940)	
Chromium	**295**	1	3	**102**	78	100
	(8608)	(3813)	(3740)	(8680)	(8594)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	42,600	7	180	16,100	12,200	45,000
	(8888)	(3927)	(3670)	(8973)	(8783)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figures 5–801 through 5–804 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate (the conservative tracers), respectively. Iodine-129 concentrations exceed the benchmark concentration at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. The greatest exceedance of the benchmark concentration is at the IDF-West barrier, where the benchmark is exceeded by about an order of magnitude from approximately CY 3200 until CY 5000. Iodine-129 concentrations never exceed the benchmark concentration at the RPPDF barrier or the IDF-East barrier. The iodine-129 benchmark concentration is exceeded by less than an order of magnitude at the Core Zone Boundary and Columbia River nearshore. Concentrations of iodine-129 exceed the benchmark concentration at the Columbia River nearshore for the longest period of time and fall below the benchmark in approximately CY 6500. Technetium-99 exhibits behavior similar to iodine-129, where concentrations at the IDF-West barrier exceed the benchmark by one order of magnitude. The duration of the benchmark exceedance is only approximately 1,500 years. In addition, the technetium-99 benchmark concentration is exceeded at the IDF-East barrier late in the analysis period, between CY 7000 and the end of the period, in CY 11,940. Chromium only exceeds the benchmark concentration at the IDF-East barrier over the time period from approximately CY 7000 to CY 11,000. Nitrate does not exceed its benchmark concentration at the IDF-East barrier, IDF-West barrier, RPPDF barrier, Core Zone Boundary, or Columbia River nearshore.

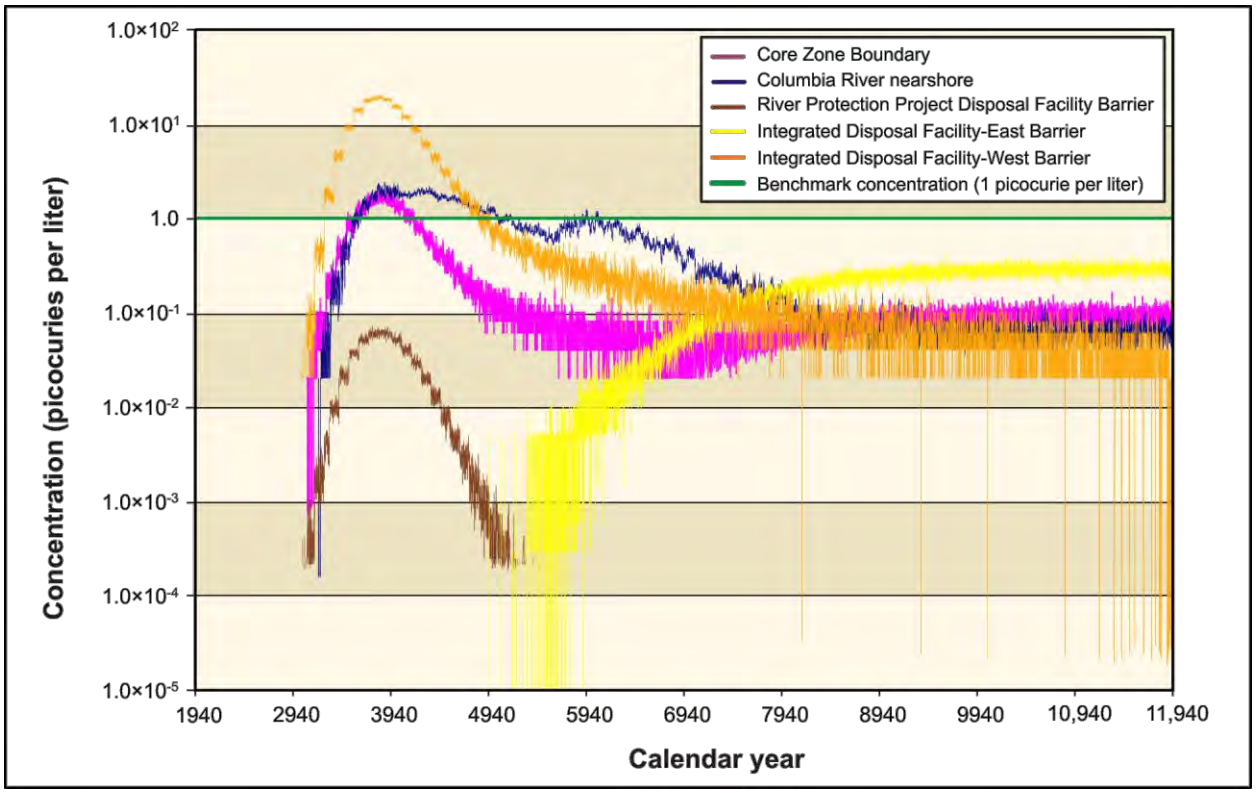


Figure 5–801. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Iodine-129 Concentration Versus Time

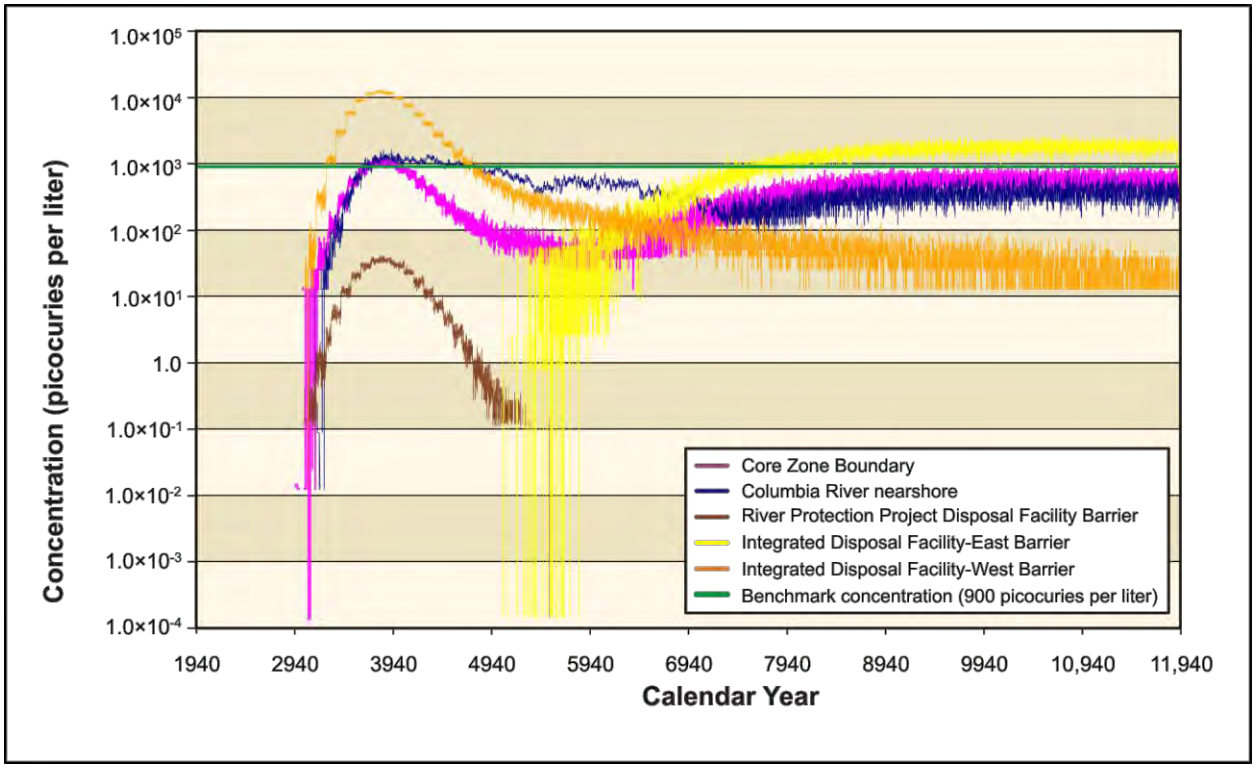


Figure 5–802. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Technetium-99 Concentration Versus Time

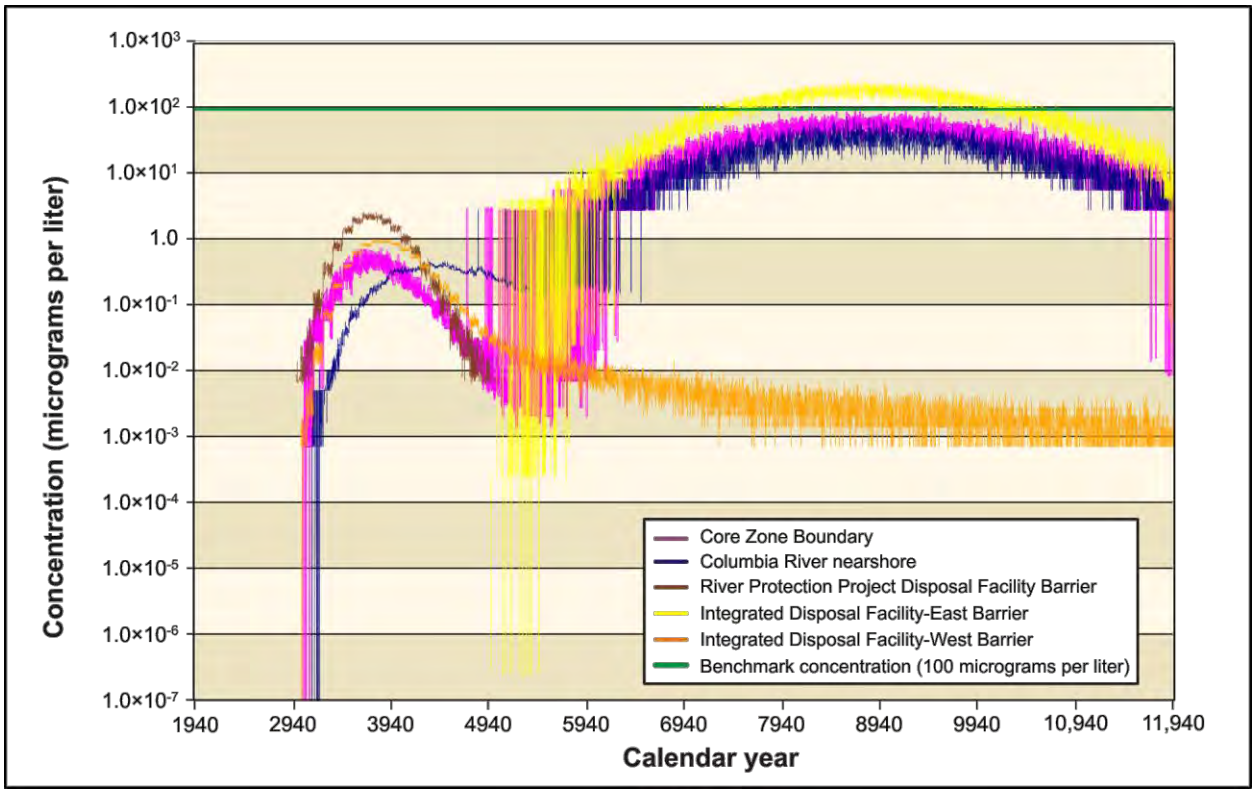


Figure 5–803. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Chromium Concentration Versus Time

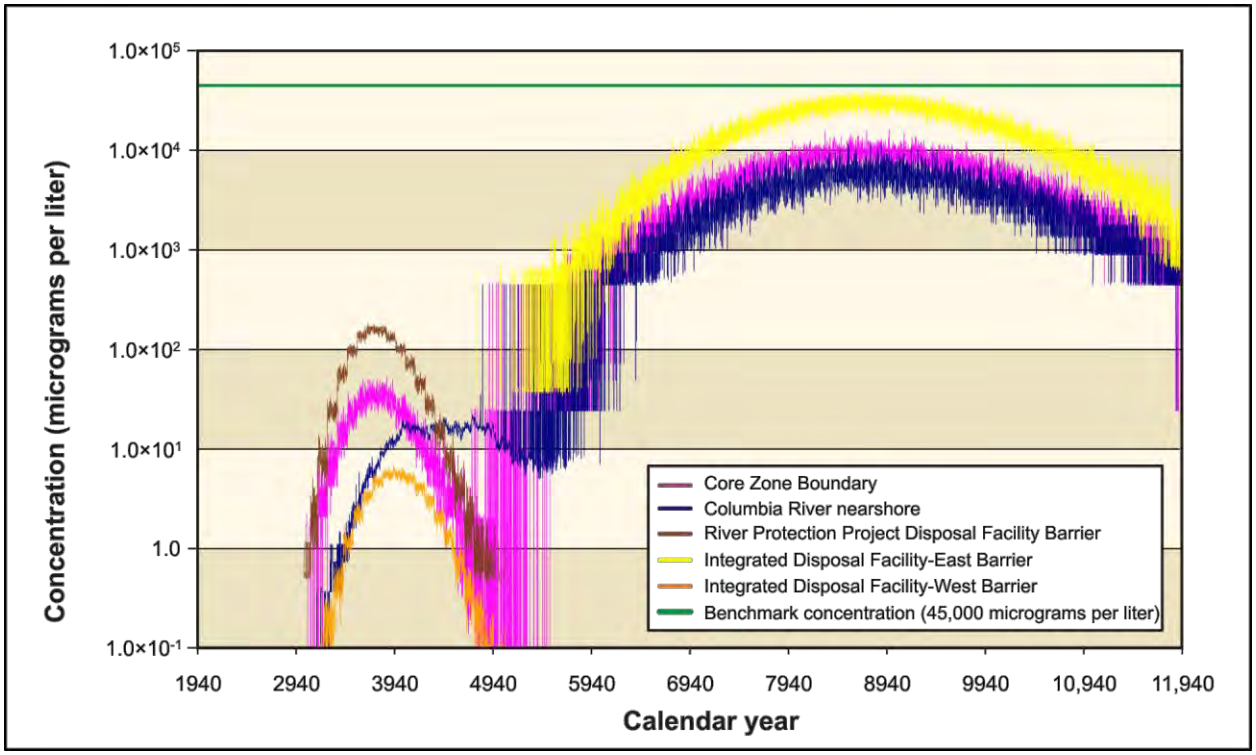


Figure 5–804. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Nitrate Concentration Versus Time

Figure 5–805 shows concentration versus time for total uranium. Because total uranium moves slowly through the vadose zone, releases from IDF-East, IDF-West, and the RPPDF result in groundwater concentrations that are many orders of magnitude lower than benchmark concentrations. Total uranium concentrations, while very minimal, begin to rise at the RPPDF barrier and Core Zone Boundary at approximately CY 10,000, but never get closer than seven orders of magnitude of exceeding benchmark concentrations by the end of the period of analysis.

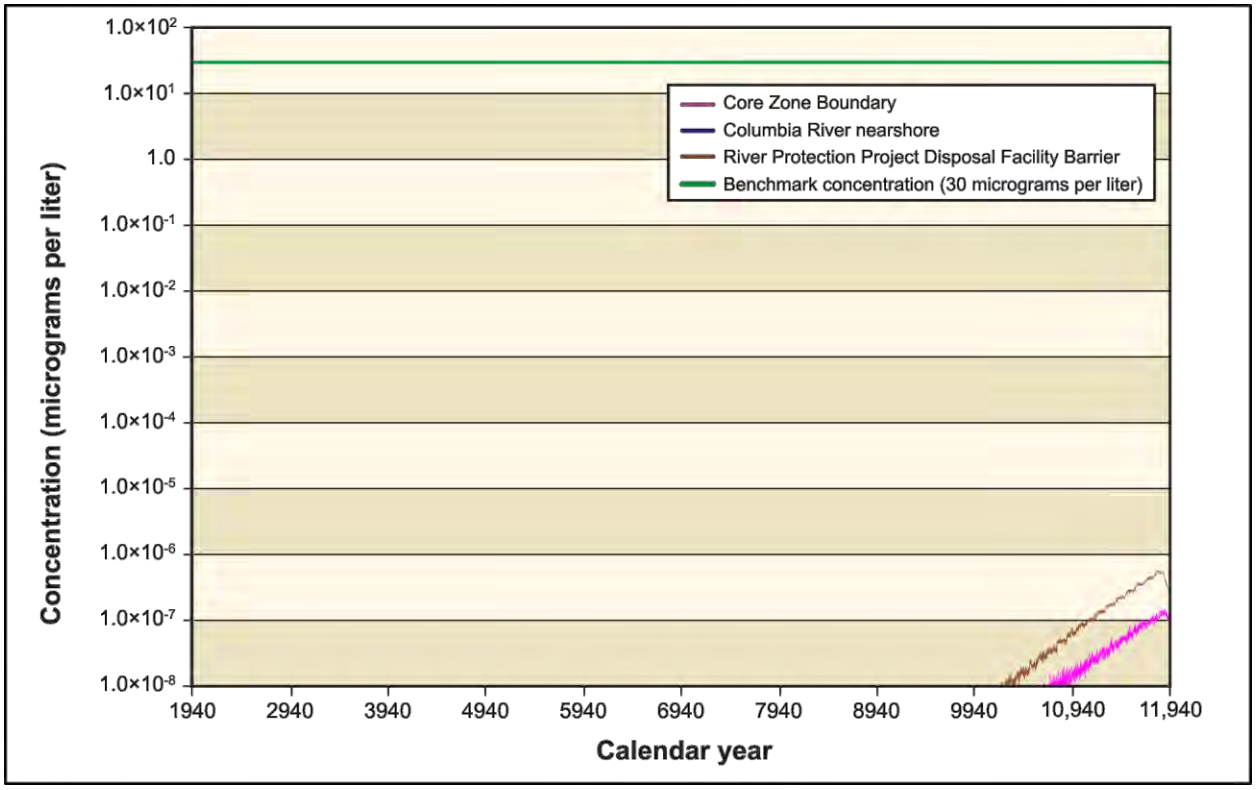


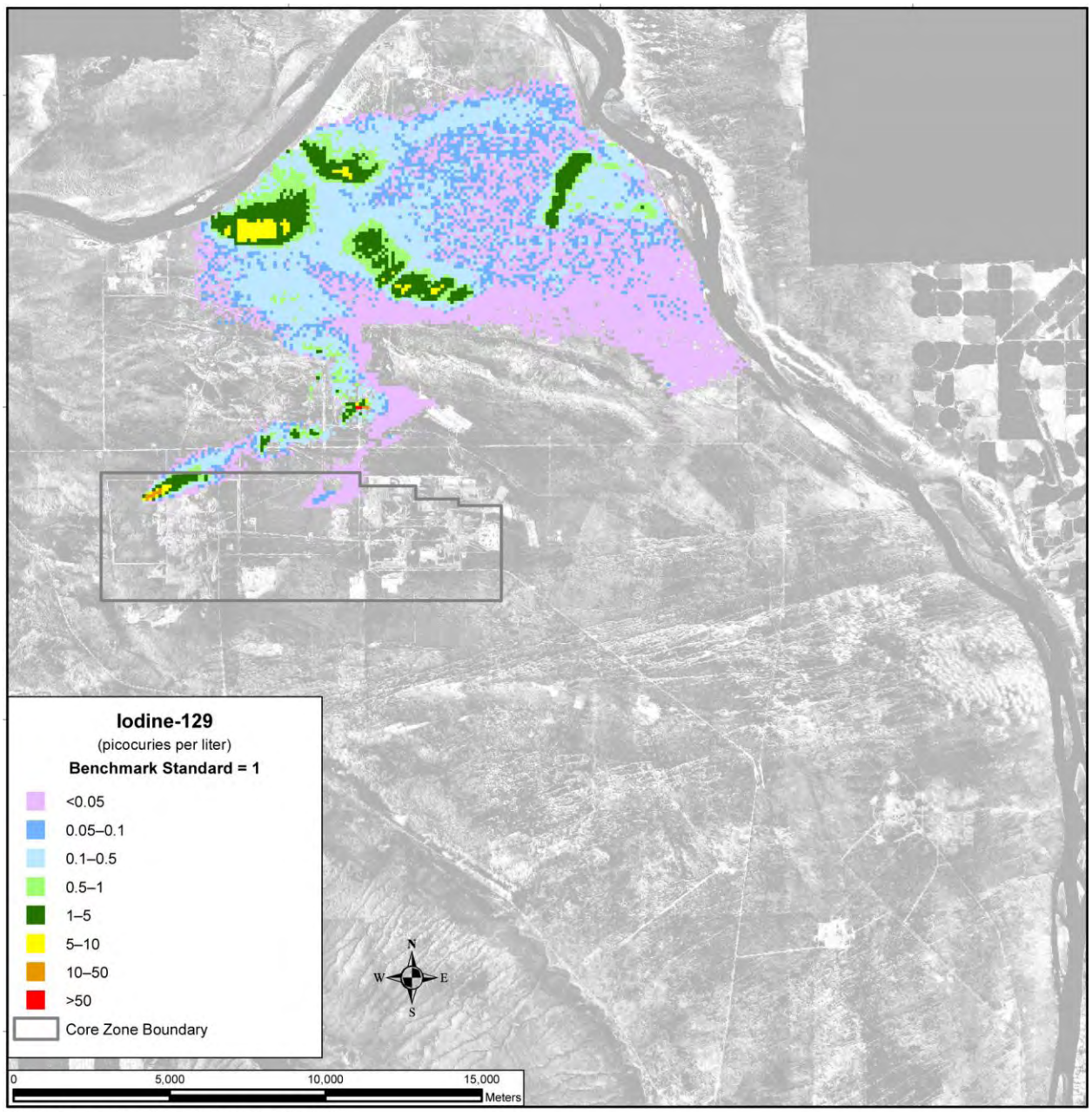
Figure 5–805. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

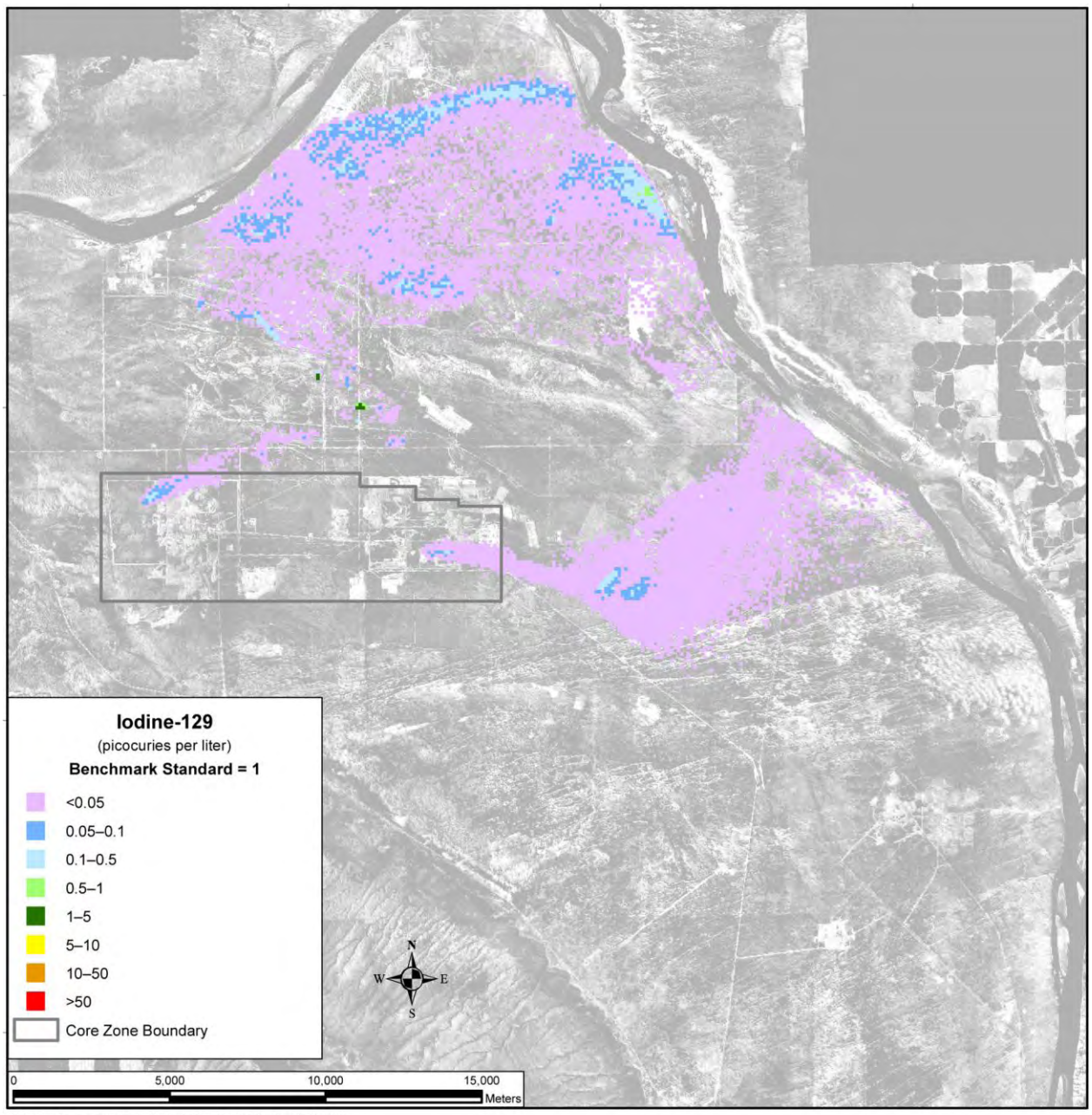
In CY 3890 (see Figure 5–806), there is a high-concentration plume of iodine-129 stretching northeast of IDF-West and a low-concentration plume stretching north from the RPPDF and through Gable Gap. Four separate high-concentration areas have also formed north of Gable Mountain and Gable Butte by CY 3890. By CY 7140 (see Figure 5–807), the plumes from IDF-West and the RPPDF have dissipated, but a new plume has formed, traveling east from IDF-East. Concentrations in this plume remain close to the benchmark. Figure 5–808 shows concentration distributions in CY 11,885. Technetium-99 (see Figures 5–809 through 5–811) shows a similar spatial distribution, but has higher concentrations in the

plume from IDF-East and lower concentrations in the plume from IDF-West. Chromium (see Figures 5–812 through 5–814) and nitrate (see Figures 5–815 through 5–817) show similar spatial distributions at selected times, but have consistently lower concentrations. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., move at the rate of the pore-water velocity).



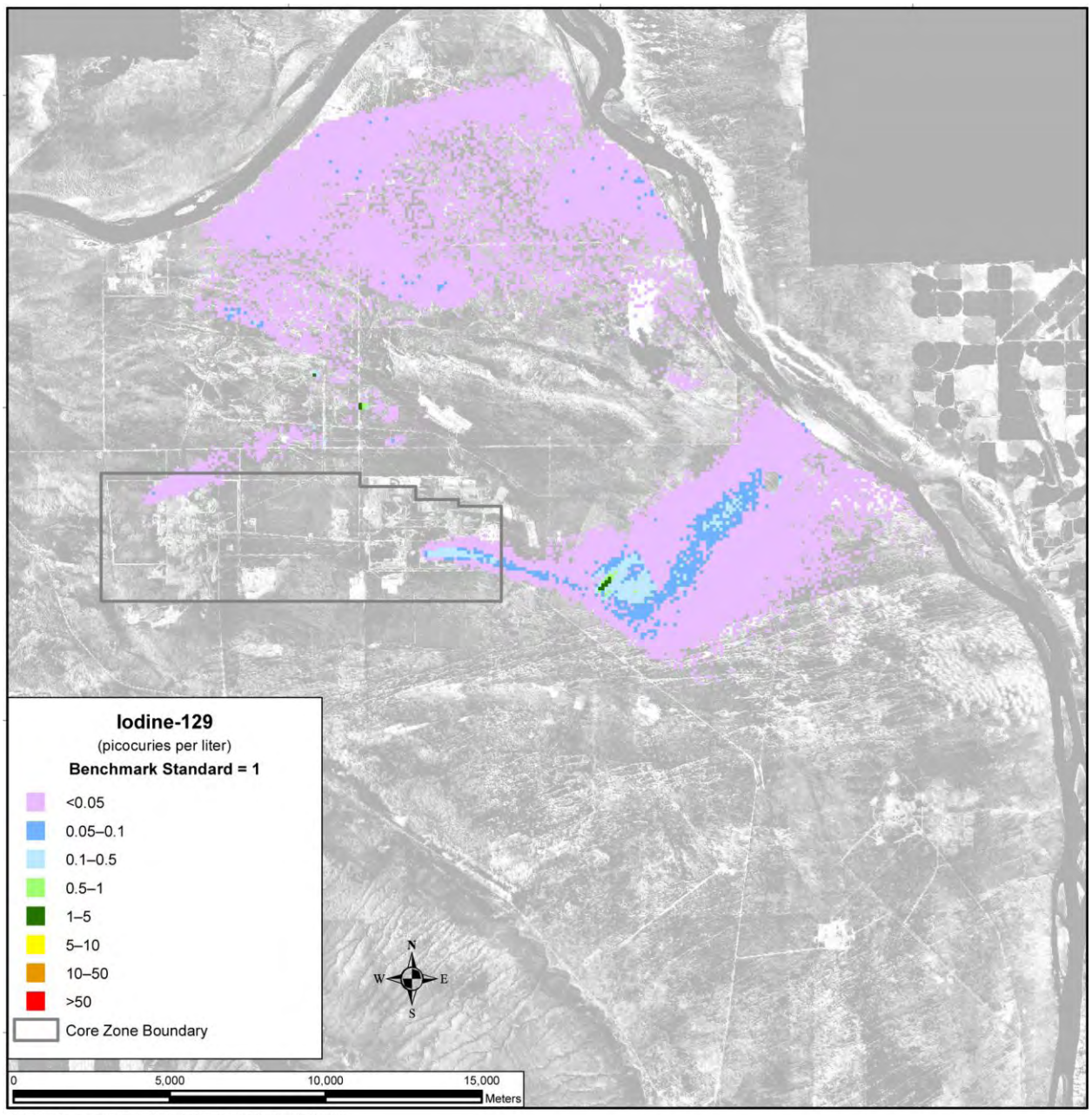
Note: To convert meters to feet, multiply by 3.281.

Figure 5–806. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



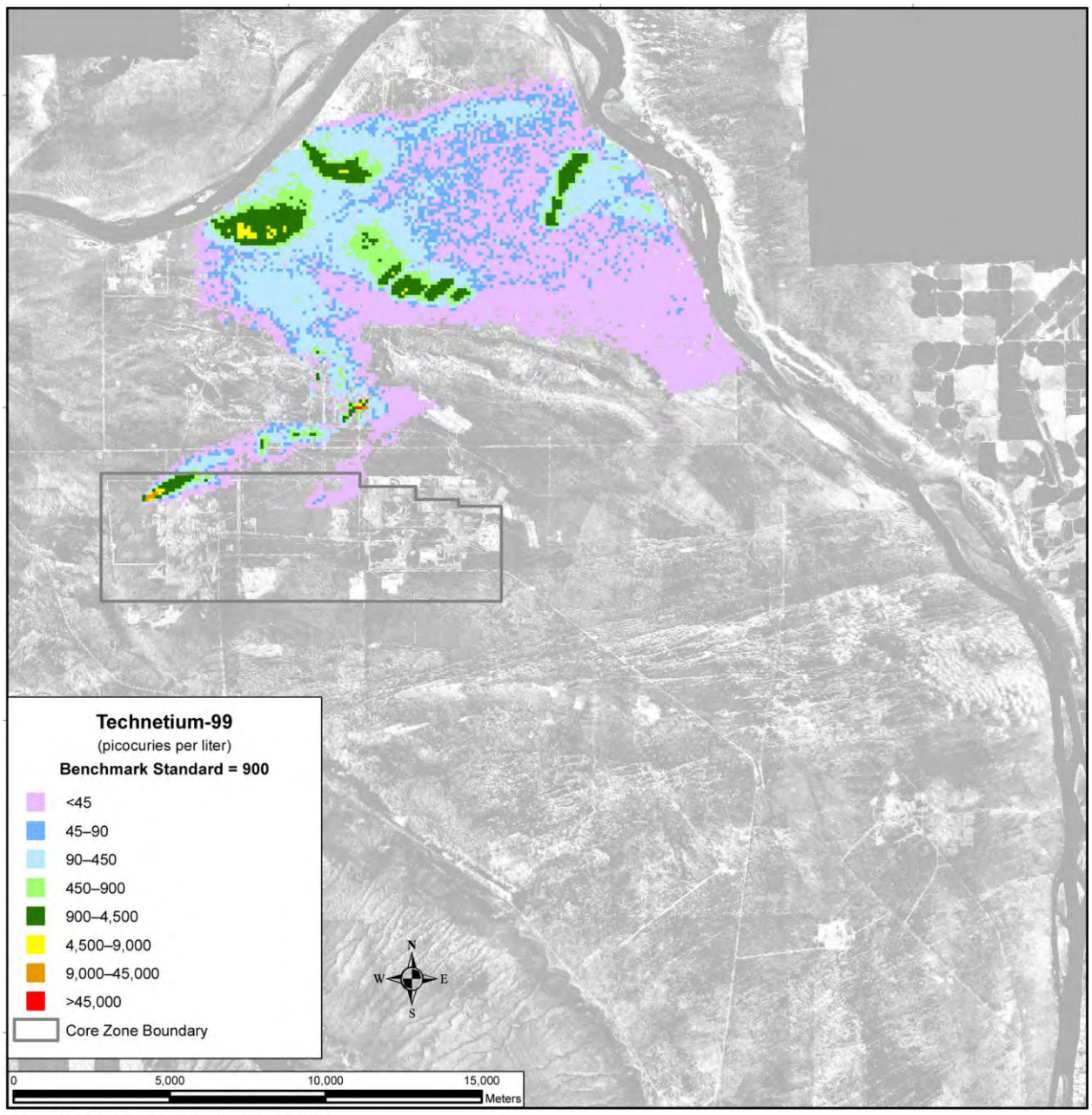
Note: To convert meters to feet, multiply by 3.281.

Figure 5–807. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



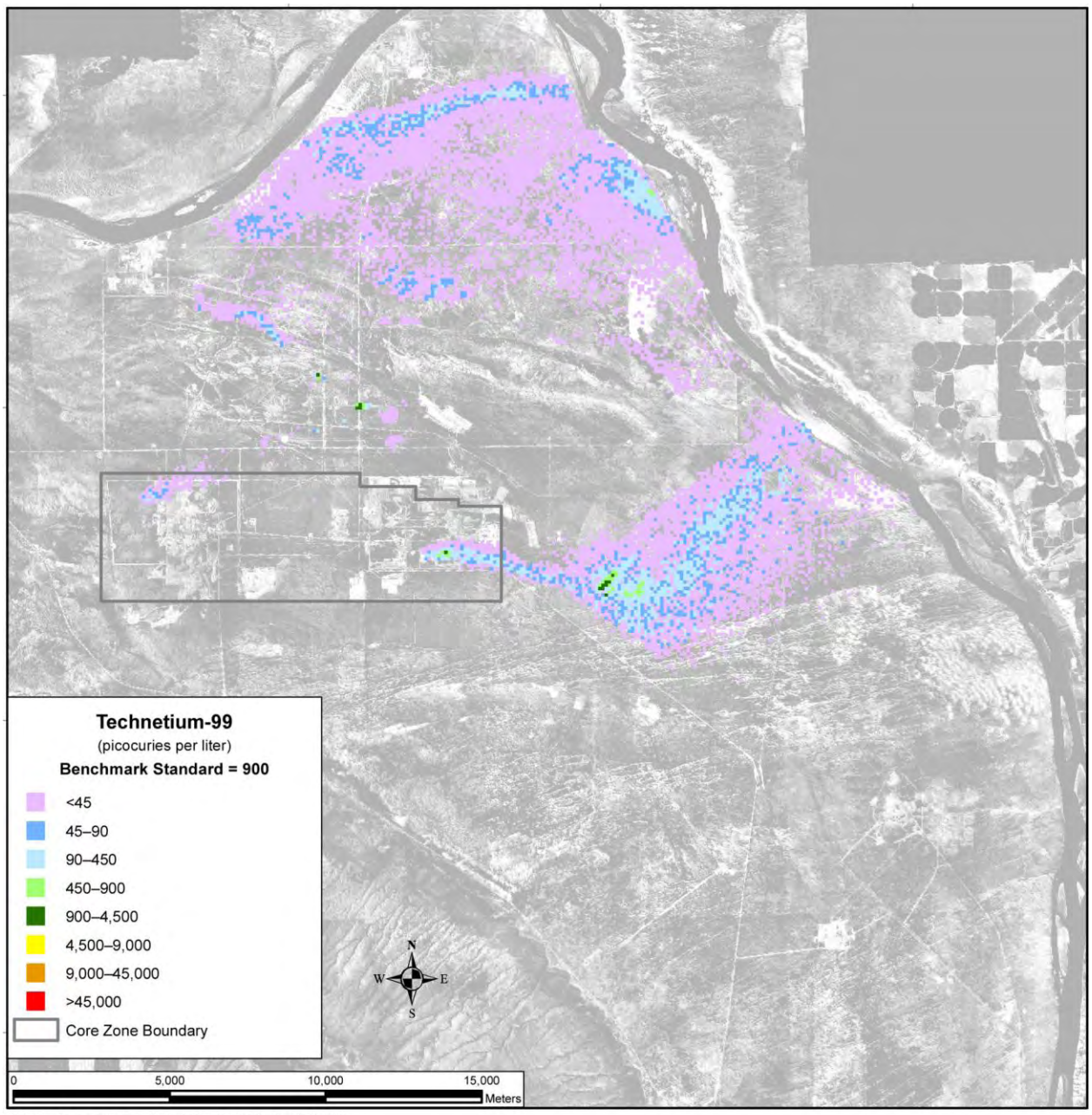
Note: To convert meters to feet, multiply by 3.281.

Figure 5–808. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



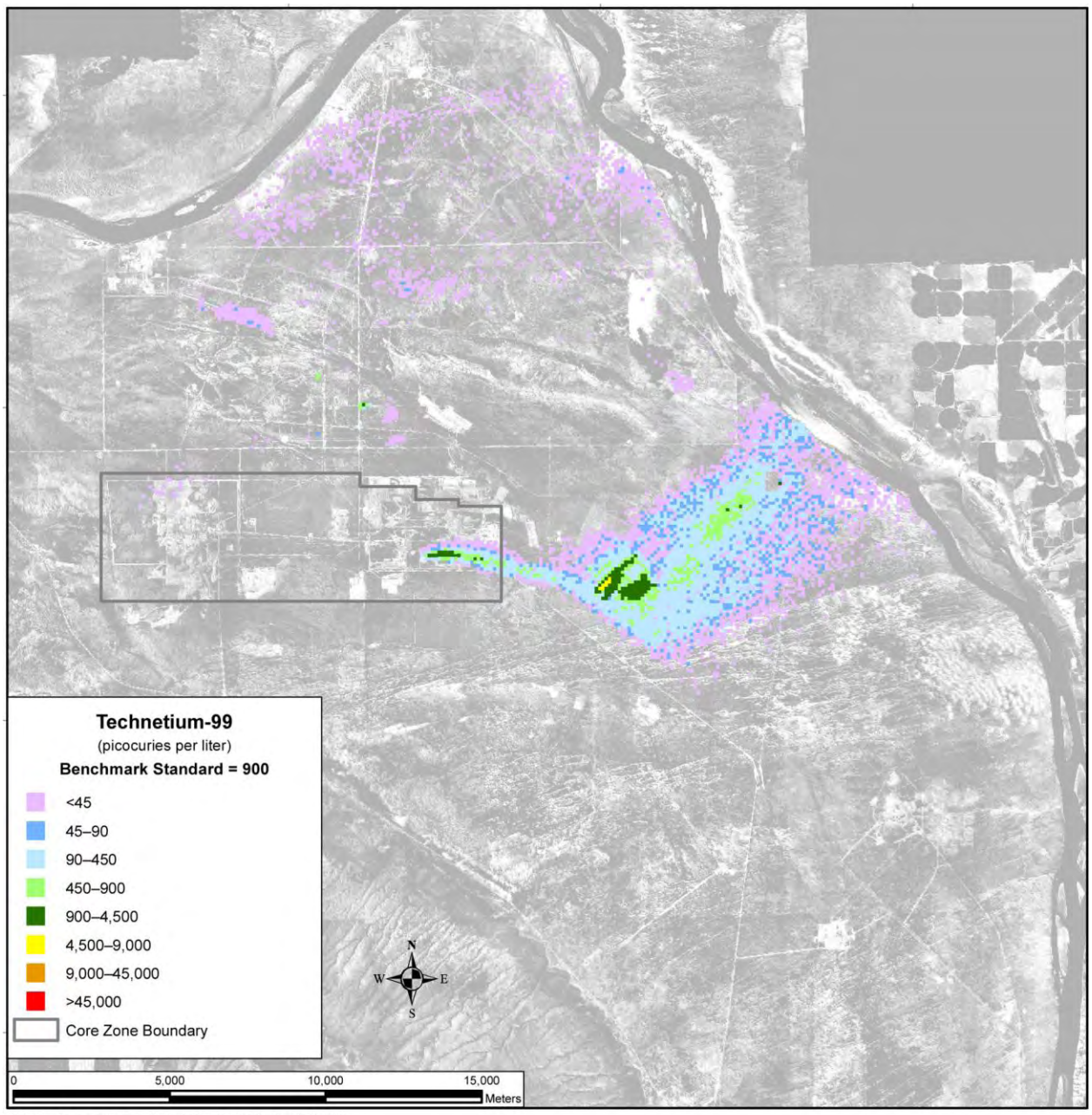
Note: To convert meters to feet, multiply by 3.281.

Figure 5–809. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



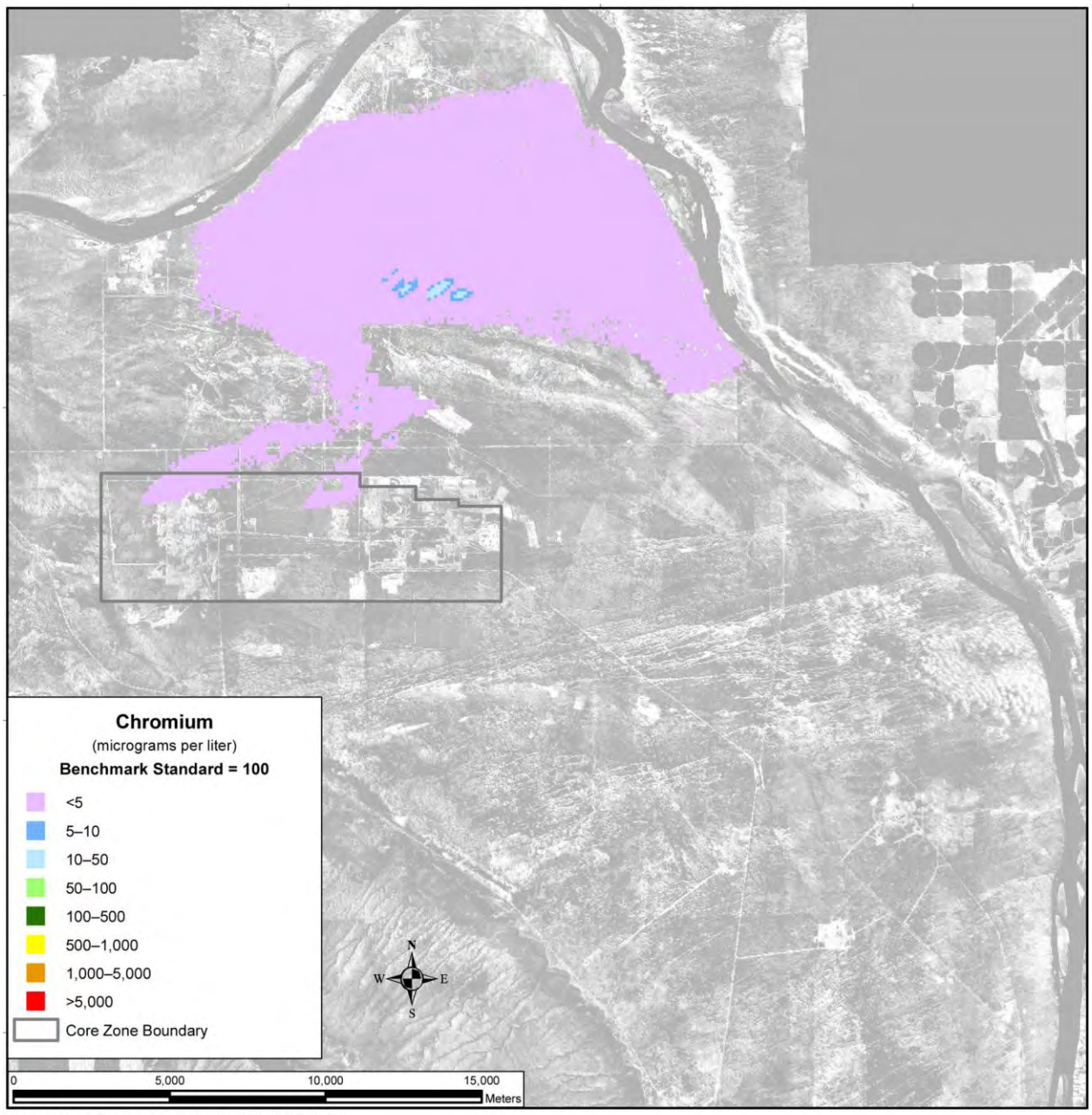
Note: To convert meters to feet, multiply by 3.281.

Figure 5–810. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



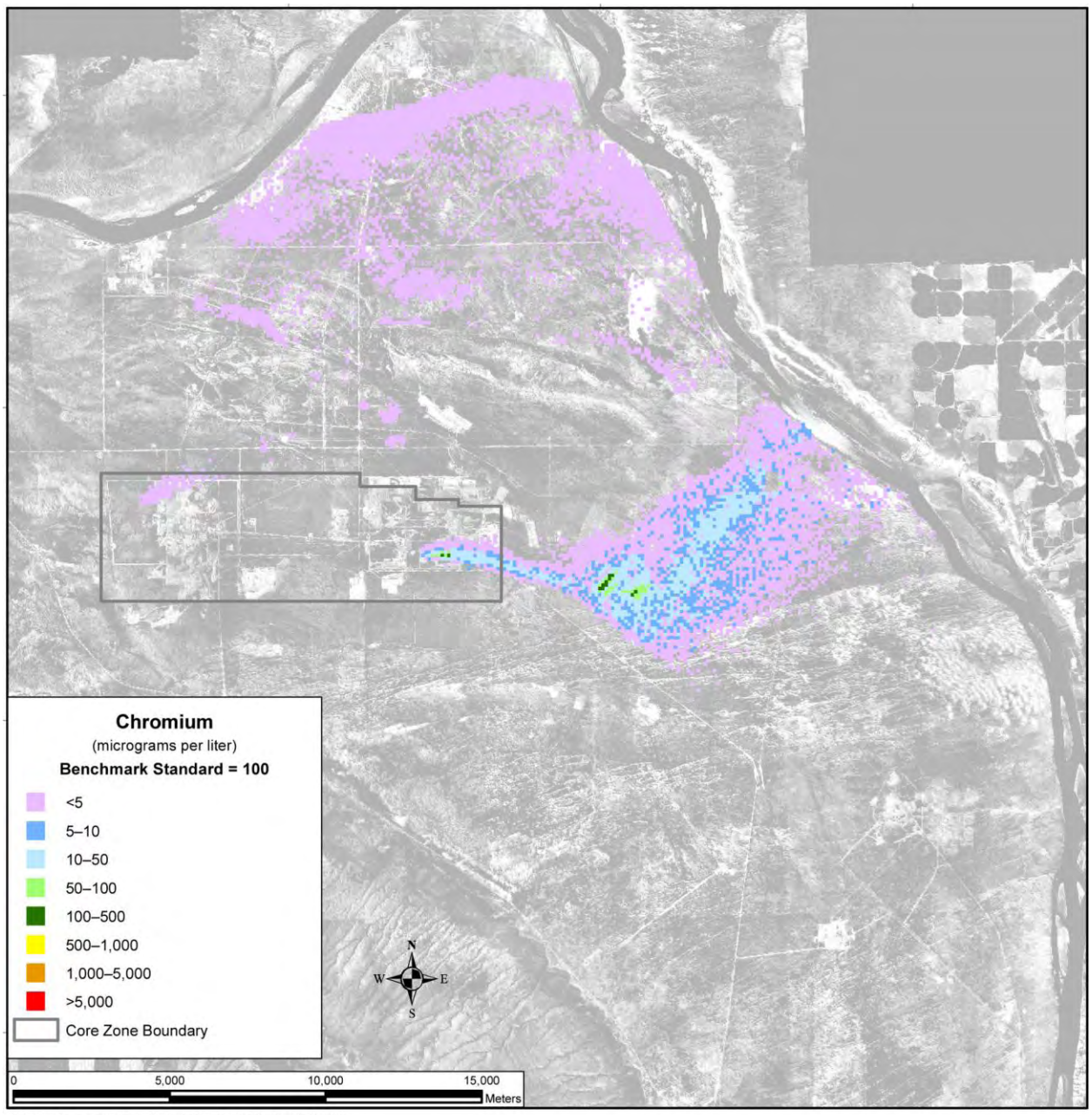
Note: To convert meters to feet, multiply by 3.281.

Figure 5–811. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



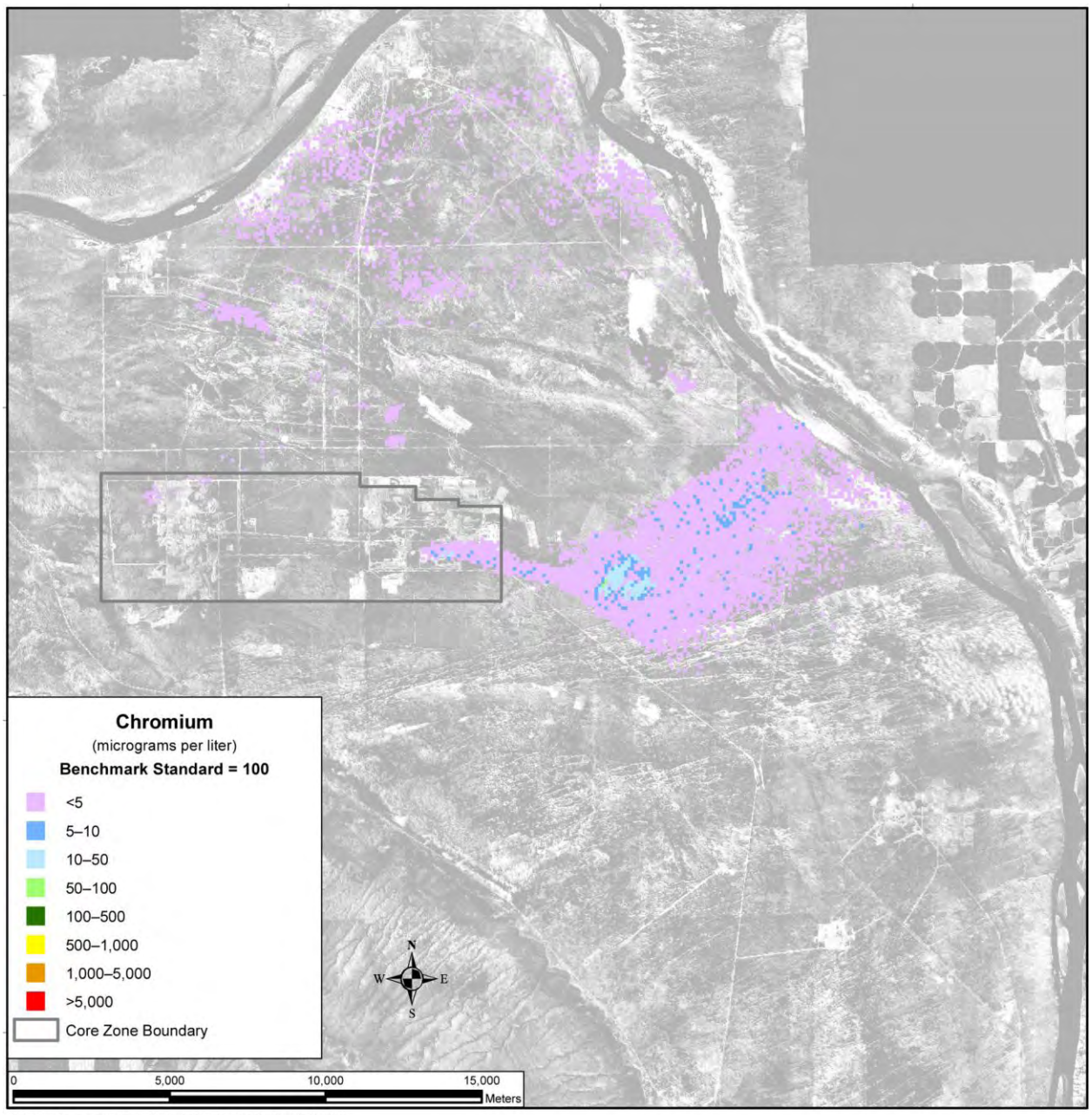
Note: To convert meters to feet, multiply by 3.281.

Figure 5–812. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



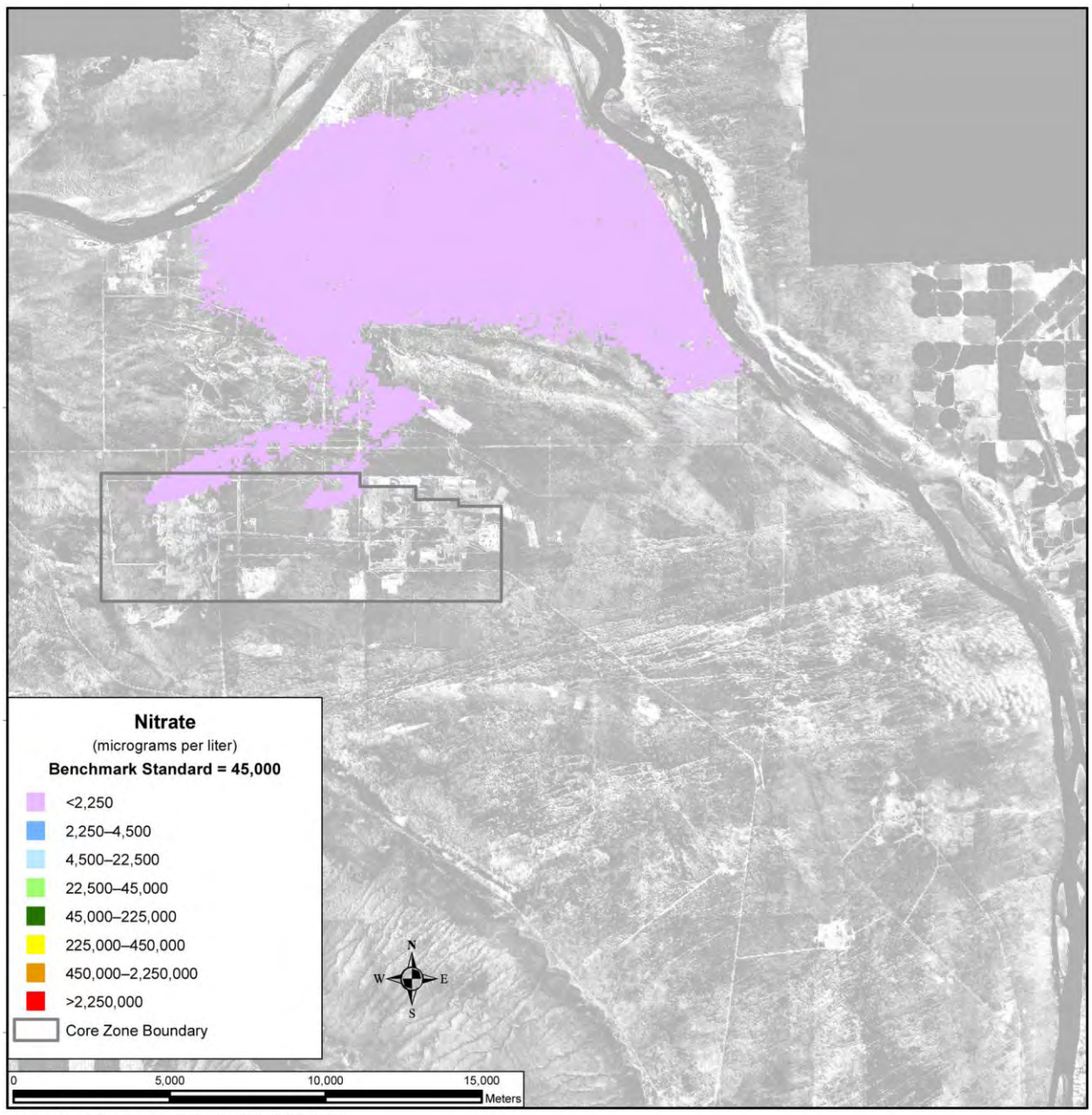
Note: To convert meters to feet, multiply by 3.281.

Figure 5–813. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



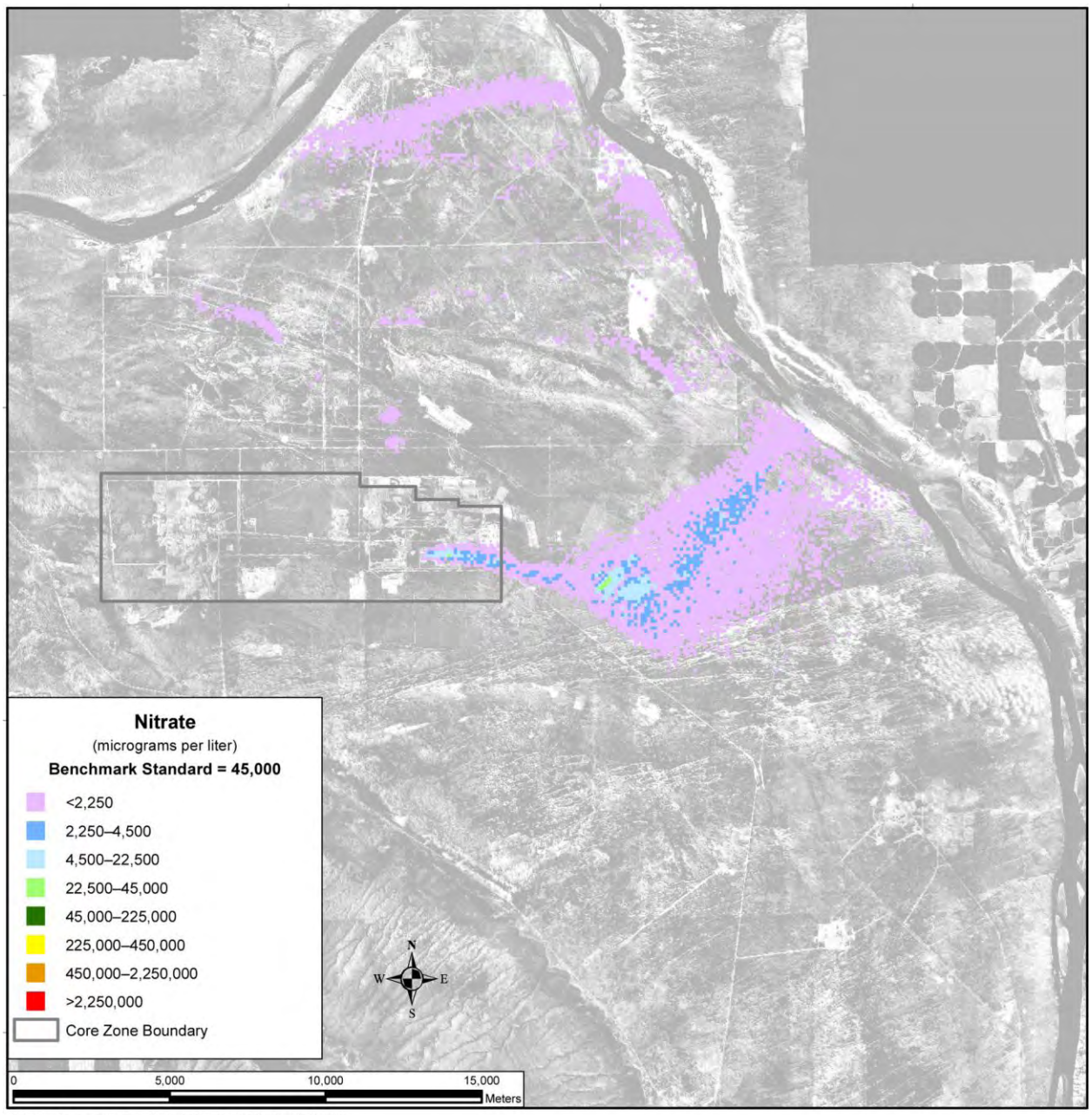
Note: To convert meters to feet, multiply by 3.281.

Figure 5–814. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



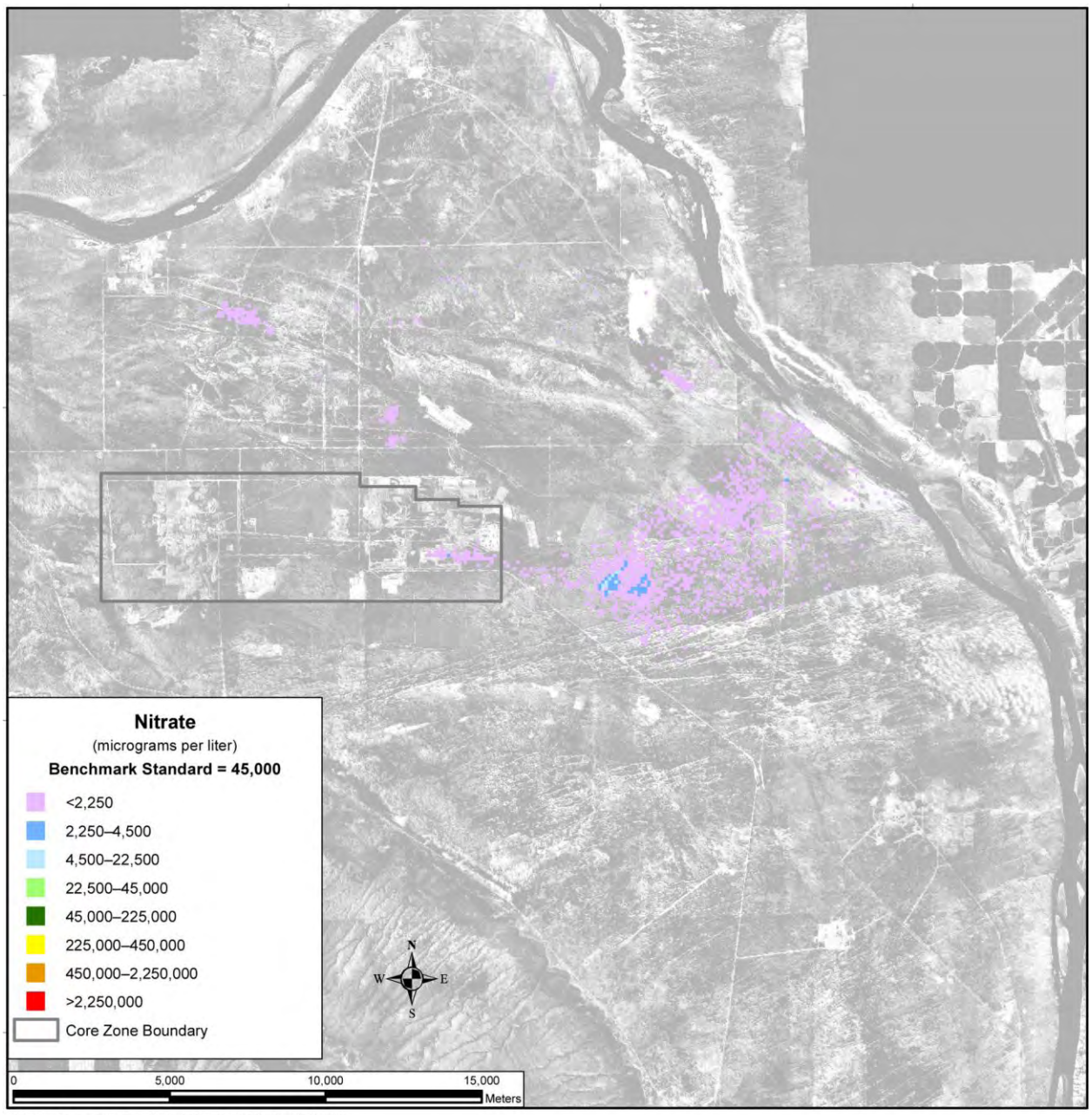
Note: To convert meters to feet, multiply by 3.281.

Figure 5–815. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



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

Figure 5–816. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



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

Figure 5–817. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, in general, discharges from IDF-East and IDF-West are the predominant contributors. Discharges from the RPPDF are secondary contributors.

Concentrations of iodine-129 and technetium-99 show a sharp rise and fall between CY 2940 and CY 4940 that exceed the benchmark by an order of magnitude or slightly more. Chromium and nitrate show a similar rise and fall, but both remain below their respective benchmarks. For all of the conservative tracers, concentrations at the Core Zone Boundary remain within an order of magnitude of

the benchmark concentration during the last 5,000 years of the period of analysis. Concentrations at the Columbia River nearshore are slightly lower, but within an order of magnitude of the concentrations at the Core Zone Boundary. The intensities and areas of these groundwater plumes stabilize around CY 6940.

For total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of total uranium remain seven orders of magnitude below the benchmark at the IDF-East barrier, IDF-West barrier, RPPDF barrier, Core Zone Boundary, and Columbia River nearshore for the duration of the 10,000-year simulation period. The intensity is highest and the area of the contamination plumes largest near the end of the period of analysis.

5.3.1.3.1.4 Disposal Group 1, Subgroup 1-D

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 3C and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Summaries of the proposed actions and timelines for Waste Management Alternative 3 are provided in Chapter 2, Section 2.5.

Five subtotals are plotted in Figures 5–818 through 5–823, representing releases from IDF-East, which include ILAW glass, steam reforming waste, ETF-generated secondary waste, retired melters, and tank closure secondary waste.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, as follows:

- The disposal period was assumed to start with the onset of disposal operations for IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2050, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially

100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, and nitrate) are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–818 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–819, the chemical hazard drivers. The inventories in the five waste forms are a major factor in the release quantities to the vadose zone. The predominant source of technetium-99 (96 percent) and chromium (greater than 99 percent) is steam reforming waste. The predominant sources of iodine-129 are steam reforming waste (31 percent) and ETF-generated secondary waste (69 percent). The predominant source of nitrate (greater than 99 percent) is ETF-generated secondary waste. No fluoride is released from IDF-East.

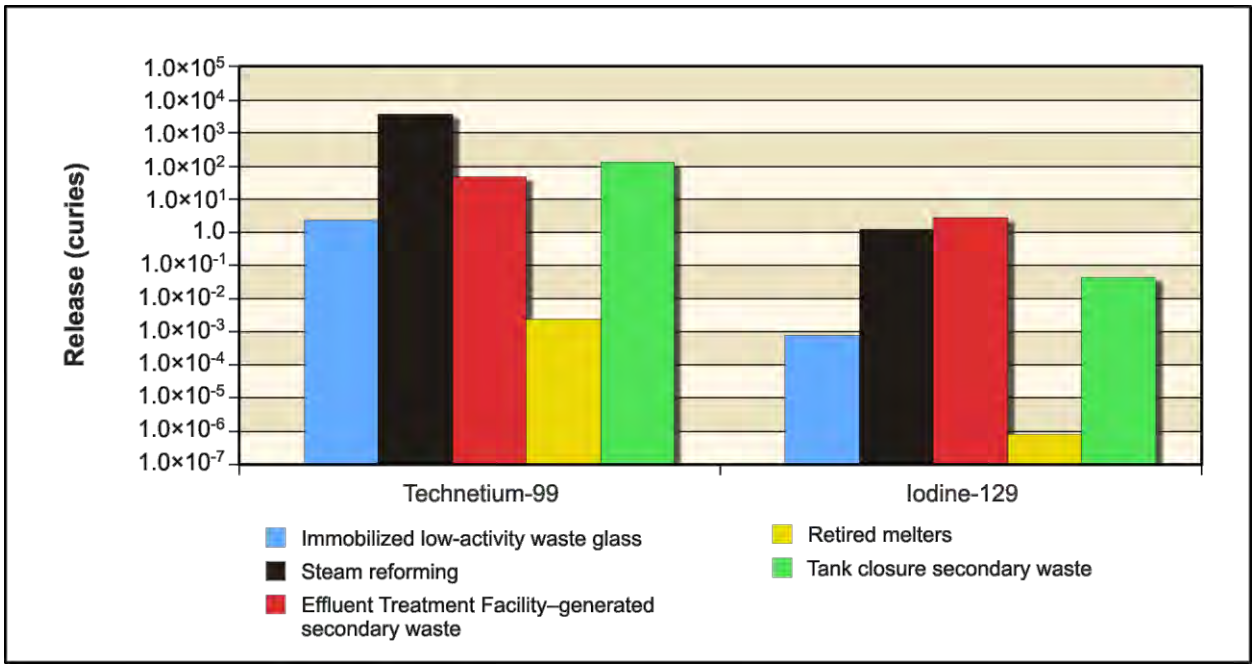


Figure 5–818. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

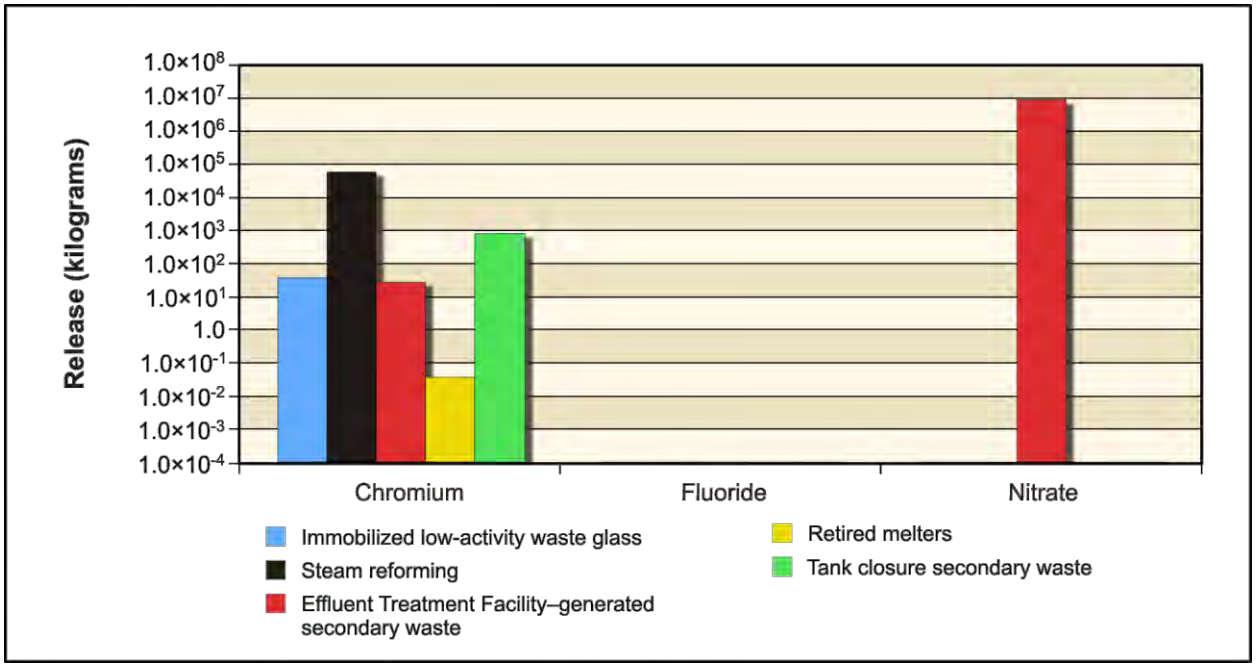


Figure 5–819. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–820 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–821, the chemical hazard drivers. In addition to the waste inventory, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Approximately 43 percent of the vadose zone technetium-99, iodine-129, and chromium are released to groundwater during the period of analysis and essentially all (greater than 99 percent) of the nitrate.

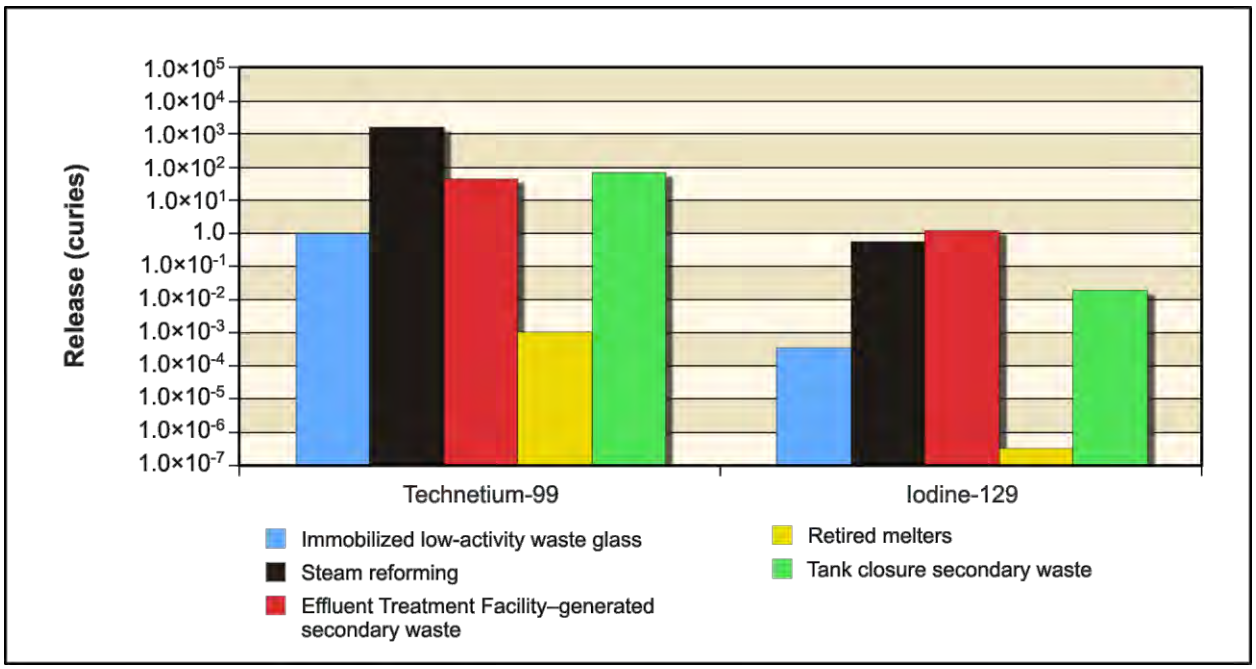


Figure 5–820. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

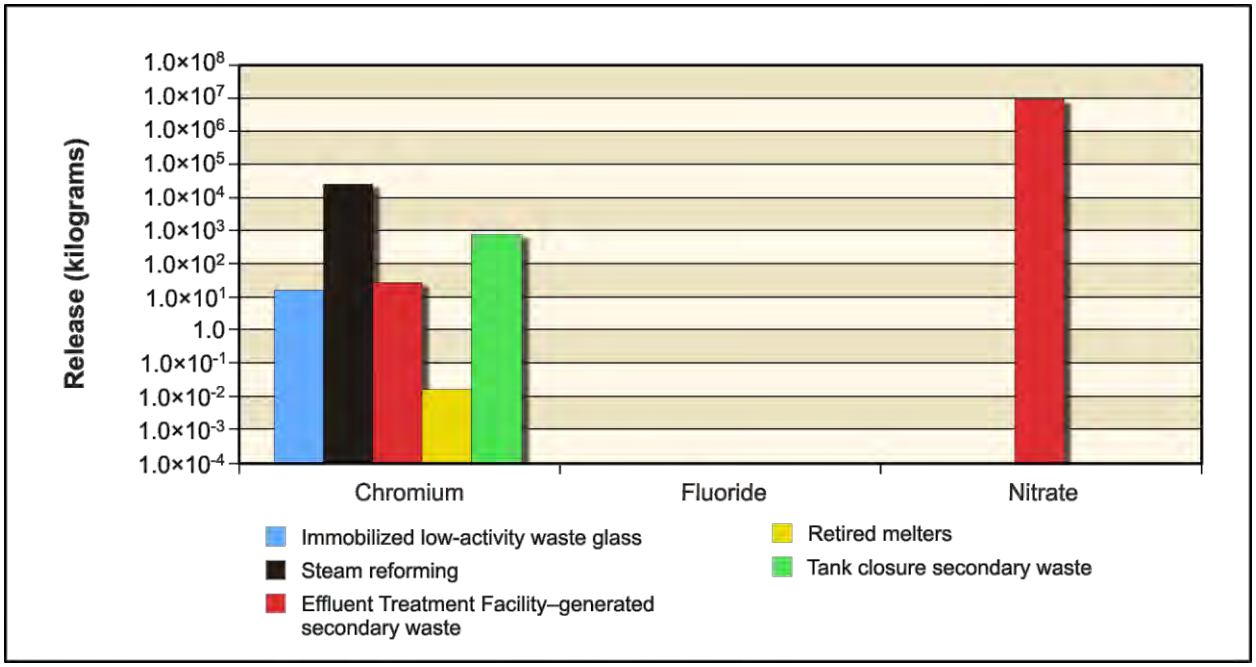


Figure 5–821. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–822 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–823, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Essentially all of the groundwater technetium-99 (97 percent), iodine-129 (96 percent), chromium (96 percent), and nitrate (99 percent) are released to the Columbia River.

Overall, approximately 42 percent of the IDF-East vadose zone technetium-99, iodine-129, and chromium reaches the Columbia River during the period of analysis. For nitrate, greater than 99 percent of the vadose zone release reaches the Columbia River.

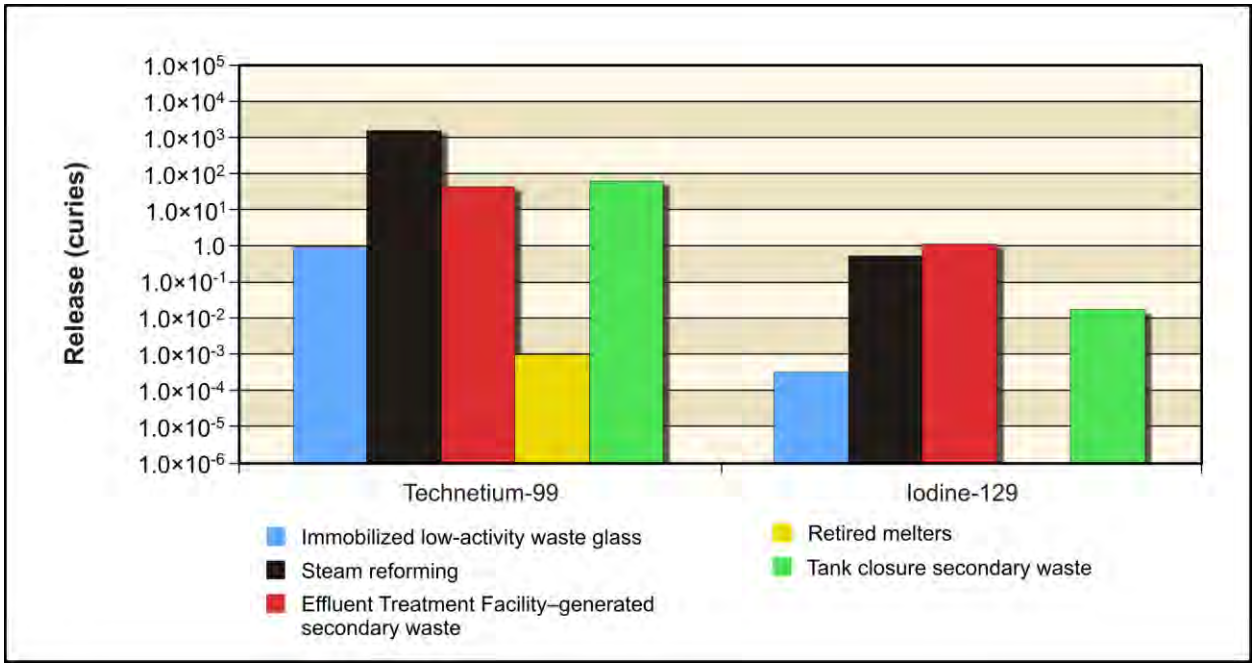


Figure 5–822. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

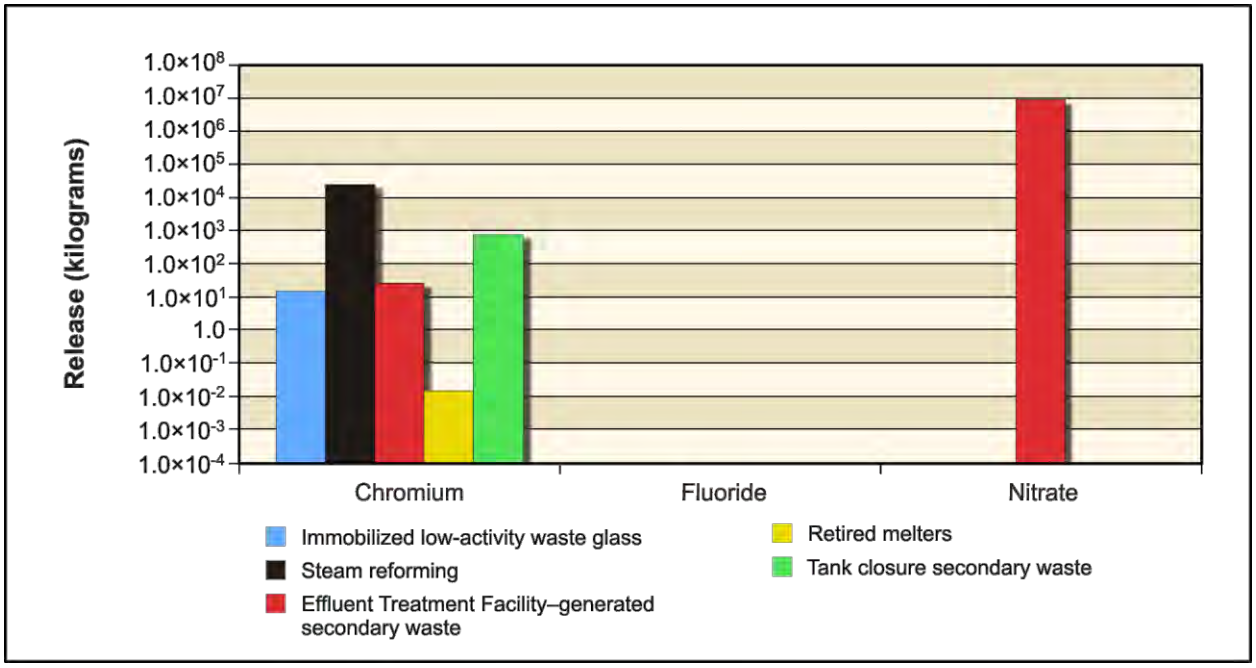


Figure 5–823. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5–824 through 5–829, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary waste and onsite waste, and offsite waste.

Figure 5–824 shows the estimated release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–825, the chemical hazard drivers. The inventories in the three waste forms are a major factor in the release quantities to the vadose zone. The predominant source of technetium-99 (greater than 99 percent) and iodine-129 (greater than 99 percent) is offsite waste released to the vadose zone. All (greater than 99 percent) of the nitrate and fluoride released to the vadose zone are from waste management secondary waste and onsite waste. The chromium released to the vadose zone is from waste management secondary waste and onsite waste (69 percent) and offsite waste (31 percent). FFTF Decommissioning Alternative 3 waste contributes less than 1 percent of the total release.

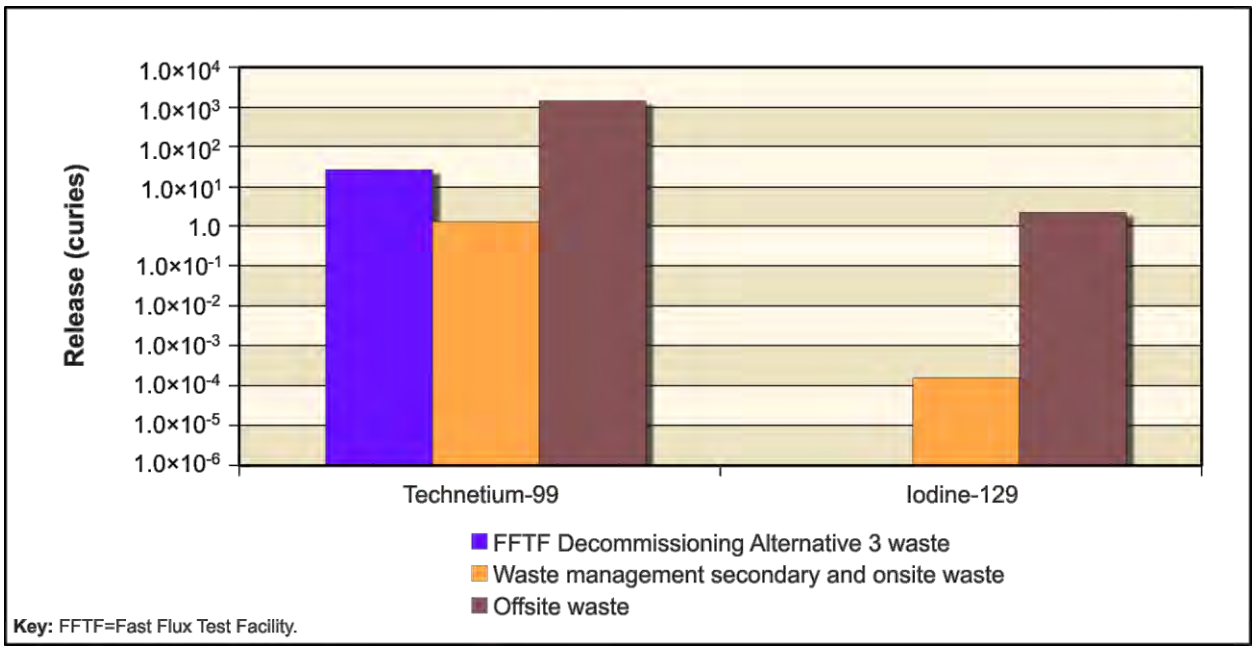


Figure 5–824. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

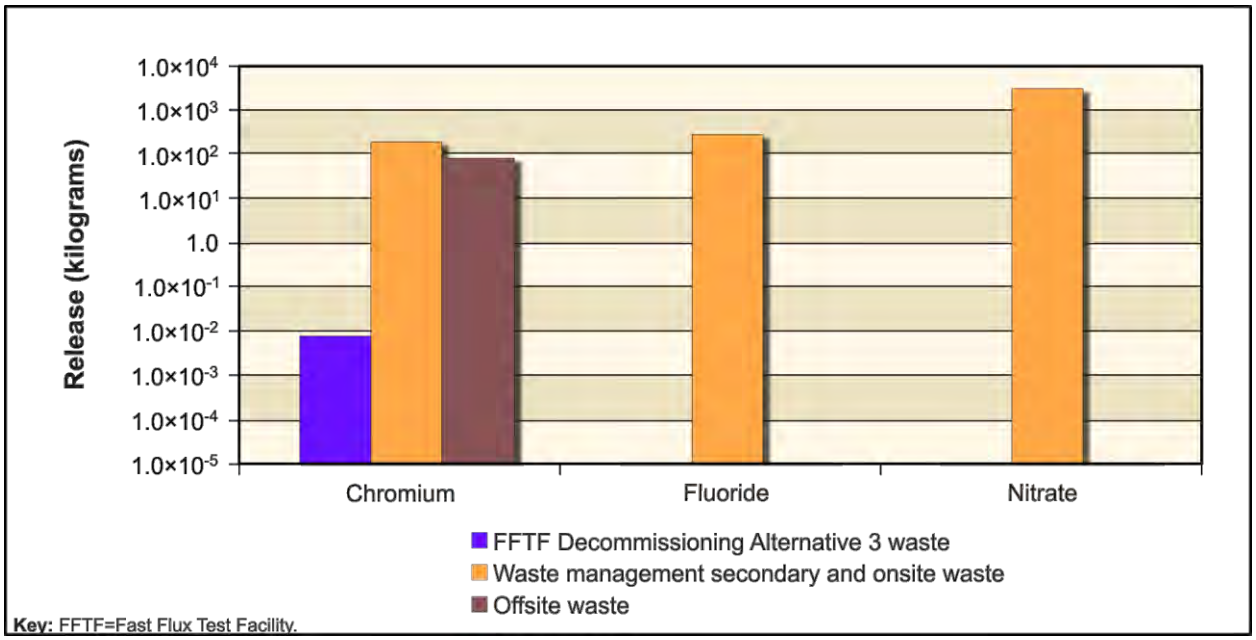


Figure 5–825. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–826 shows the estimated release from IDF-West to groundwater of the radiological risk drivers and Figure 5–827, the chemical hazard drivers. In addition to the waste form inventory, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Almost all of the vadose zone technetium-99 (98 percent), iodine-129 (97 percent), chromium (99 percent), nitrate (greater than 99 percent), and fluoride (greater than 99 percent) are released to groundwater during the period of analysis.

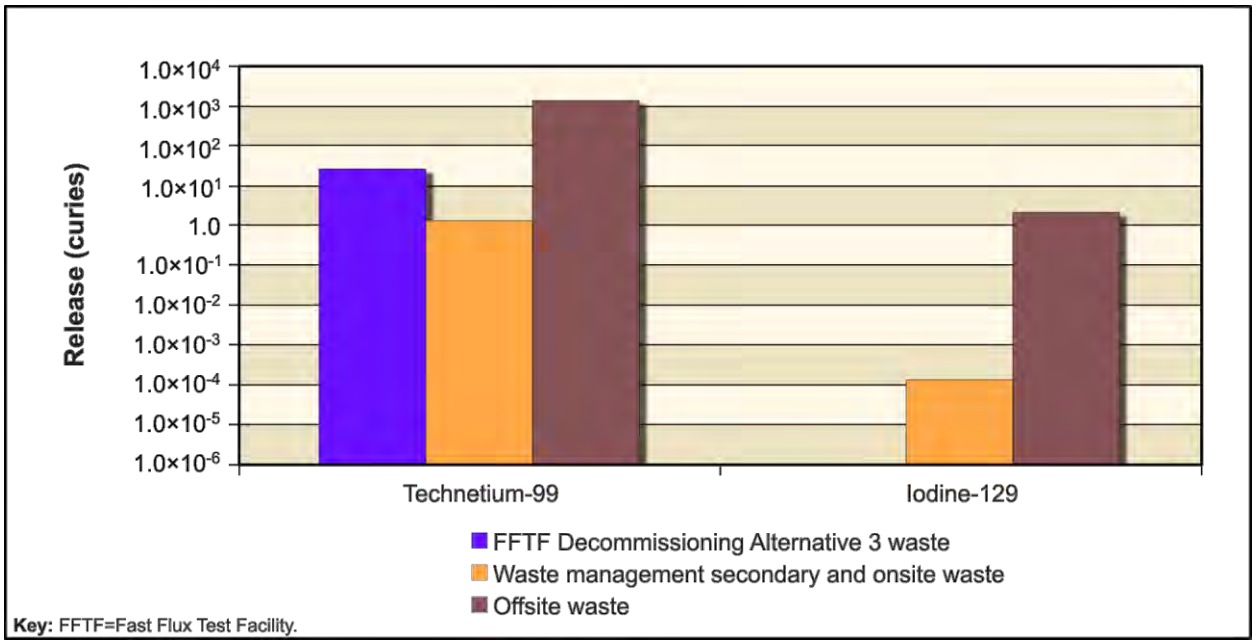


Figure 5–826. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

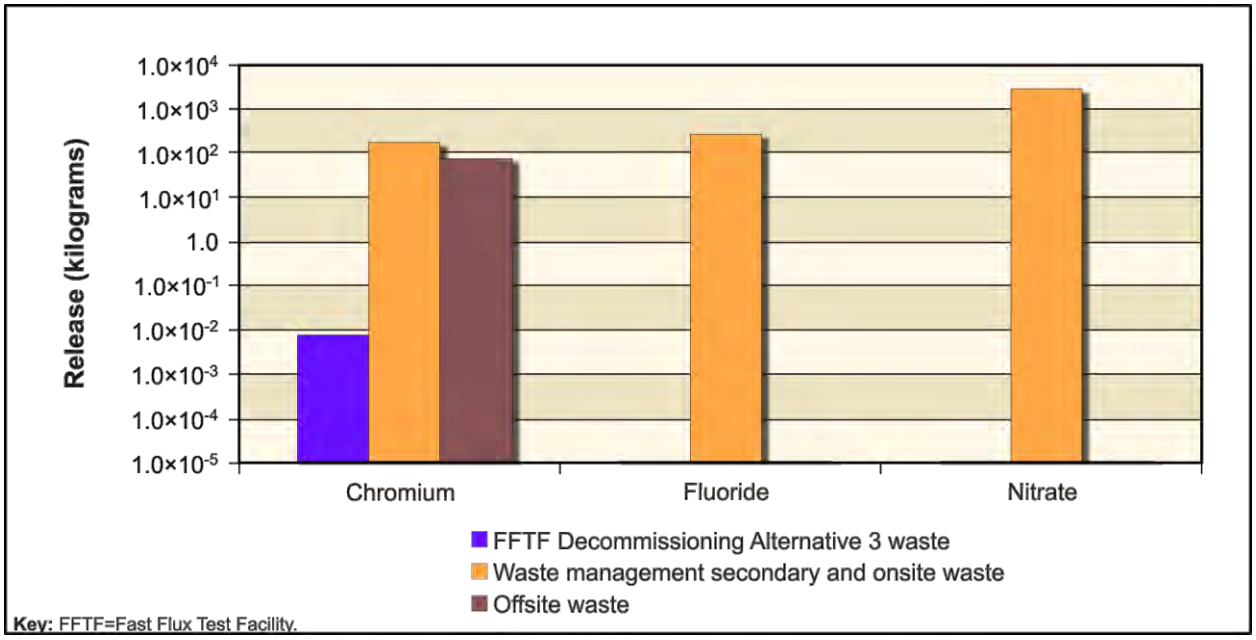


Figure 5–827. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–828 shows the estimated release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–829, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Most (greater than 99 percent) of the IDF-West groundwater technetium-99, iodine-129, chromium, nitrate, and fluoride are released to the Columbia River over the period of analysis.

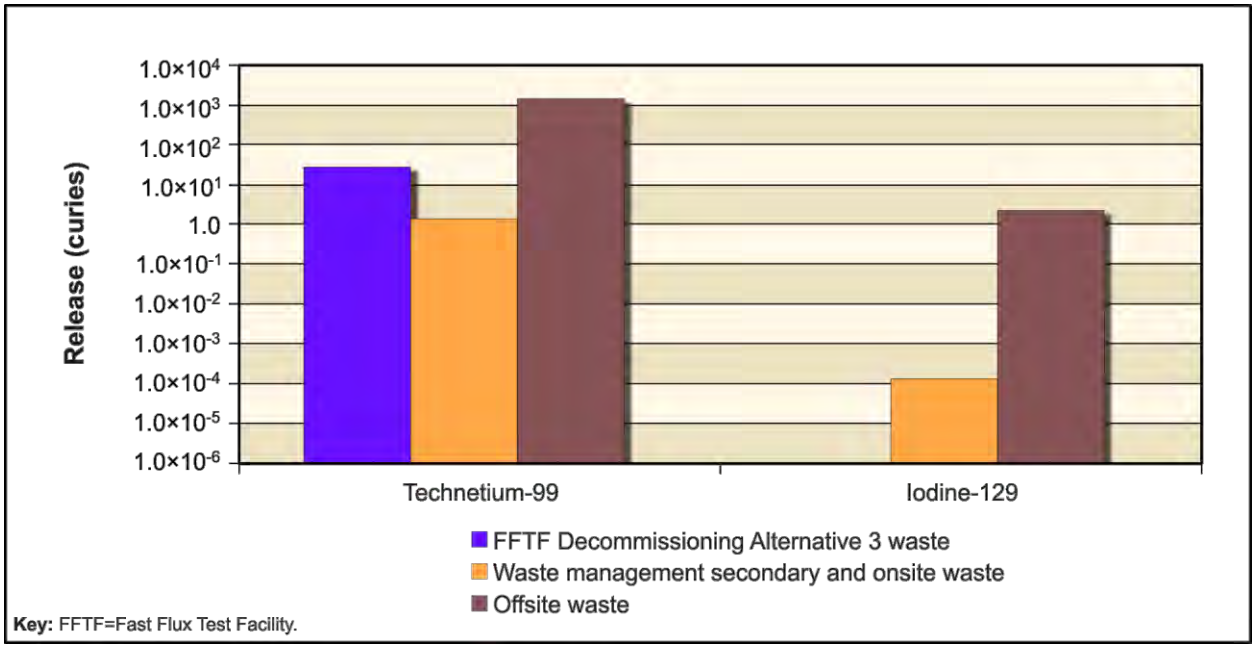


Figure 5–828. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

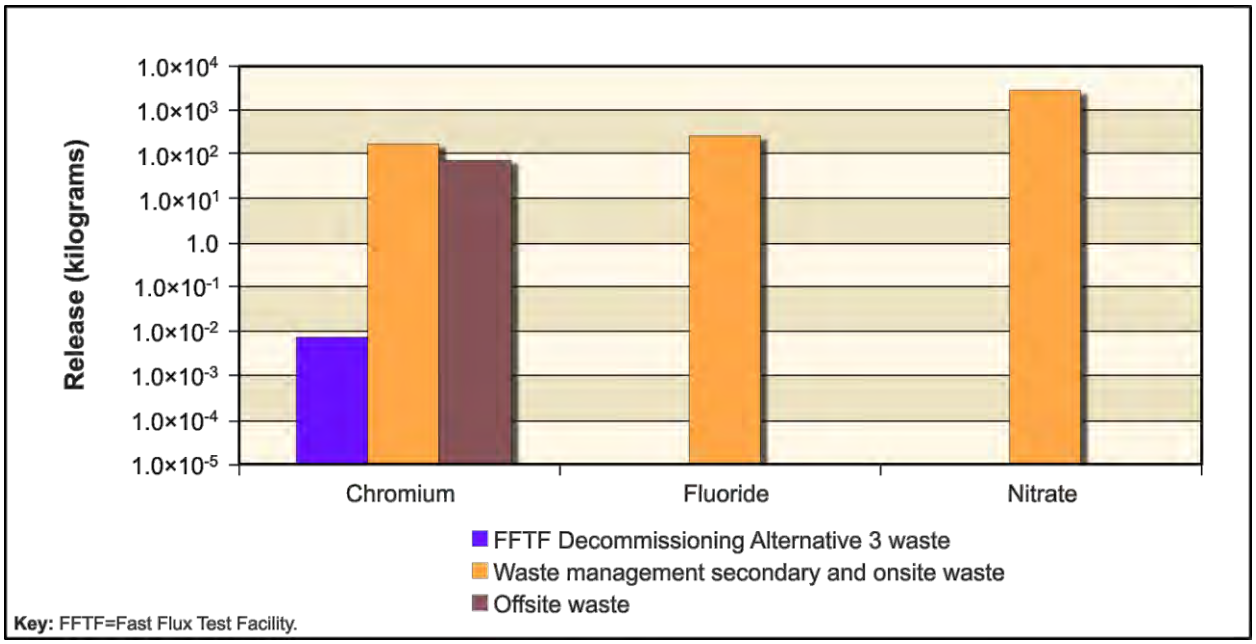


Figure 5–829. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

Overall, almost all (97–99 percent) of the IDF-West vadose zone technetium-99, iodine-129, chromium, nitrate, and fluoride reach the Columbia River over the period of analysis.

River Protection Project Disposal Facility

Figure 5–830 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–831, the chemical hazard drivers. Release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). Radionuclide releases from the RPPDF to the vadose zone comprise technetium-99 (largest source) and iodine-129 (smallest source). Chemical hazard releases from the RPPDF comprise nitrate (largest source) and chromium (smallest source). No fluoride is released from the RPPDF.

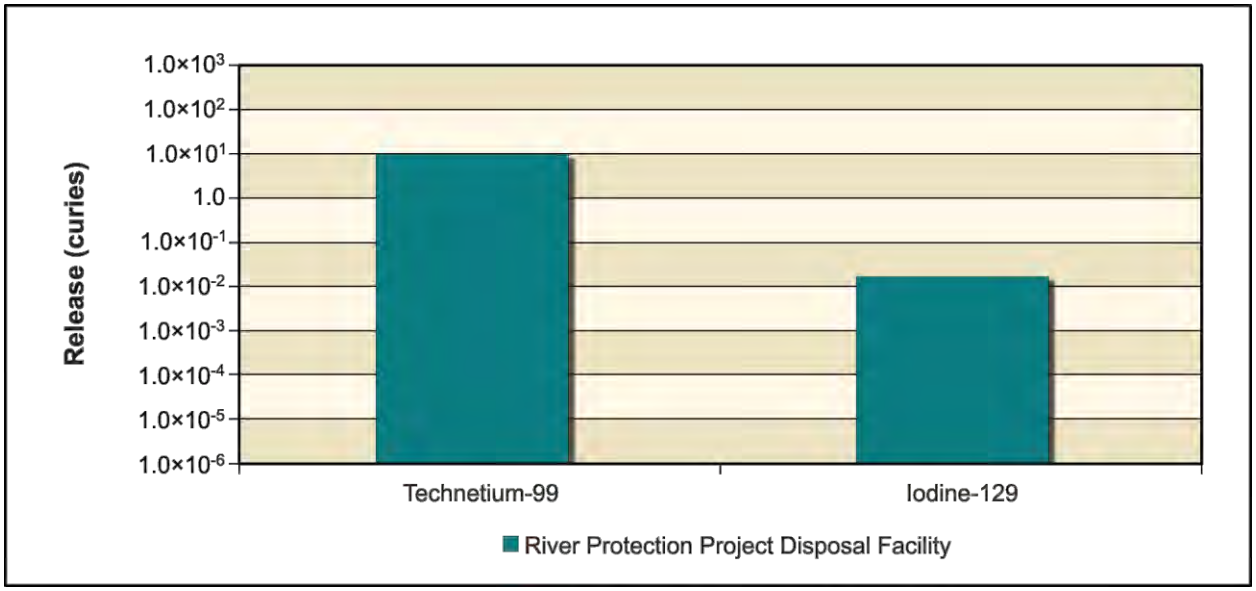


Figure 5–830. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

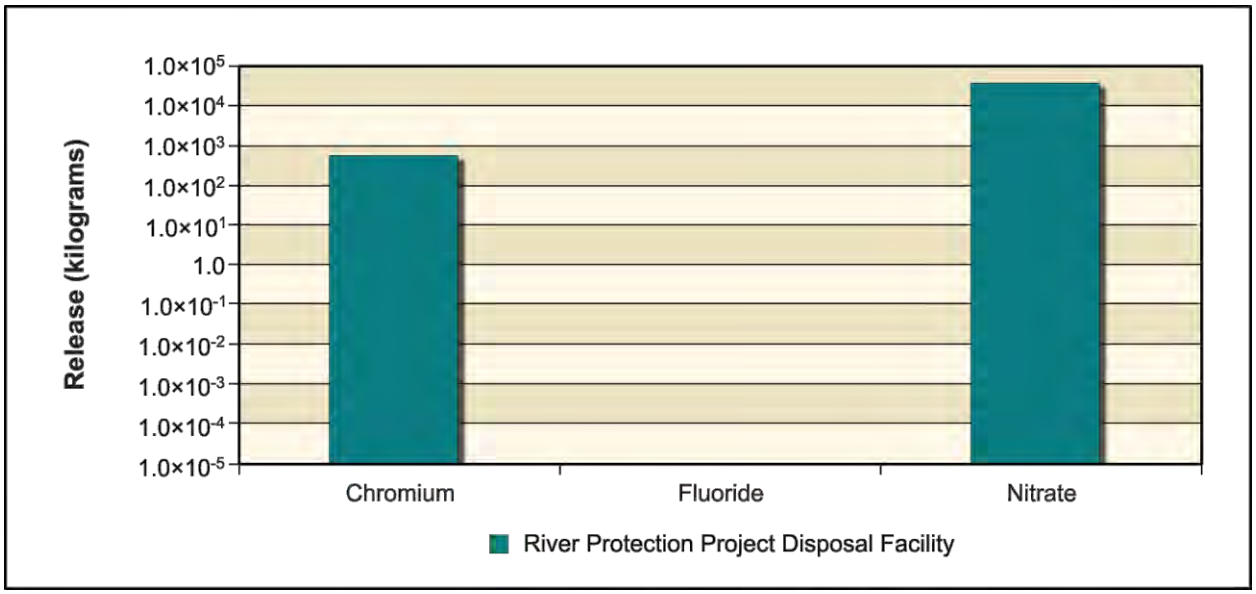


Figure 5–831. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–832 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–833, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Essentially all (greater than 99 percent) of the RPPDF vadose zone technetium-99, iodine-129, chromium, and nitrate are released to groundwater.

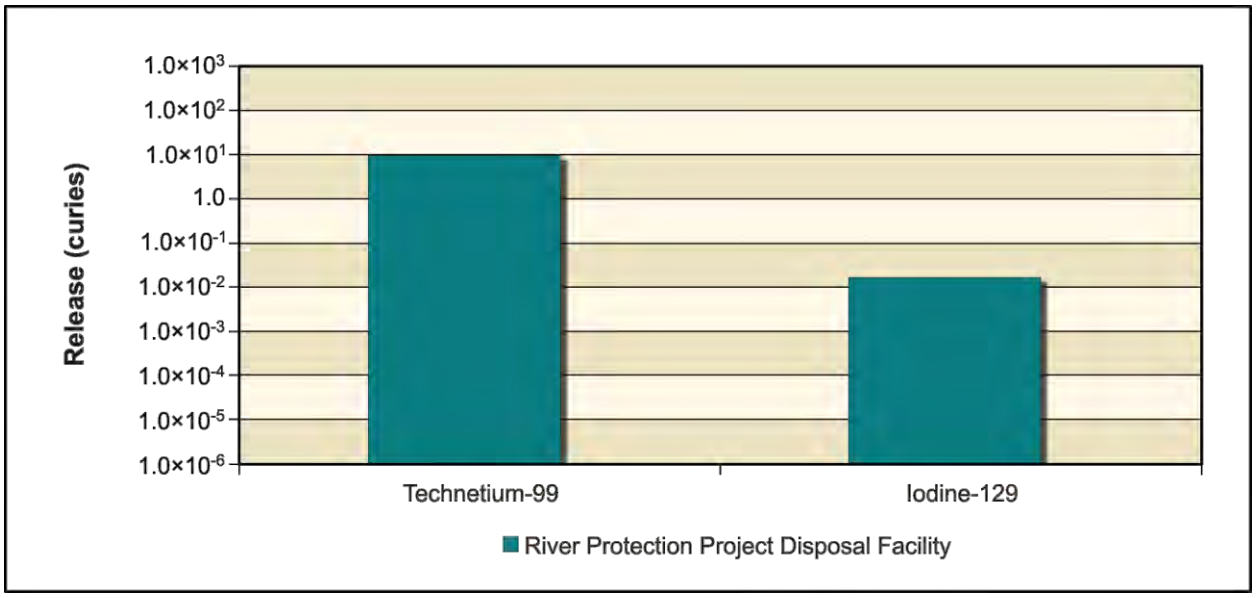


Figure 5–832. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

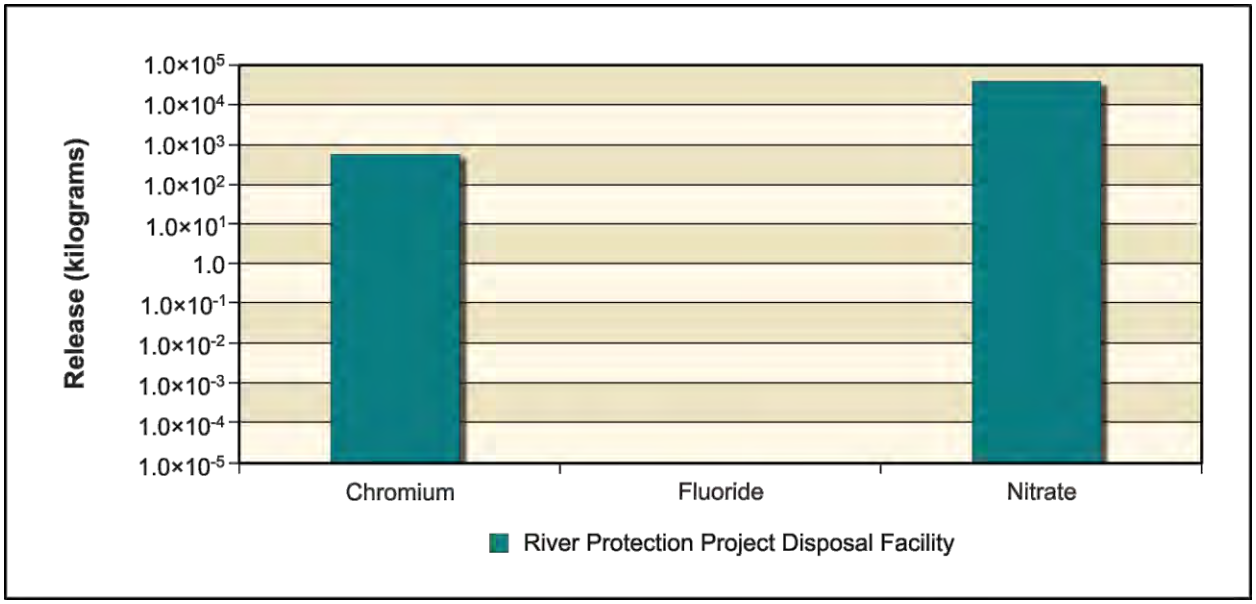


Figure 5–833. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–834 shows the estimated RPPDF release from groundwater to the Columbia River of the radiological risk drivers and Figure 5–835, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Most (greater than 99 percent) of the groundwater technetium-99, iodine-129, chromium, and nitrate are released to the Columbia River.

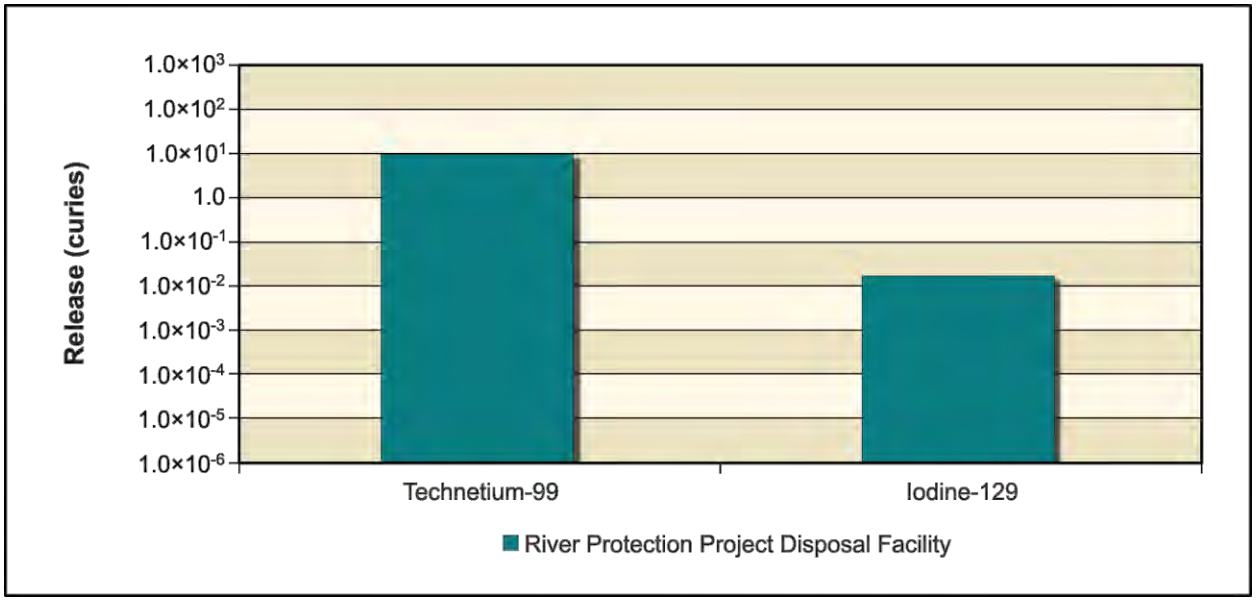


Figure 5–834. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

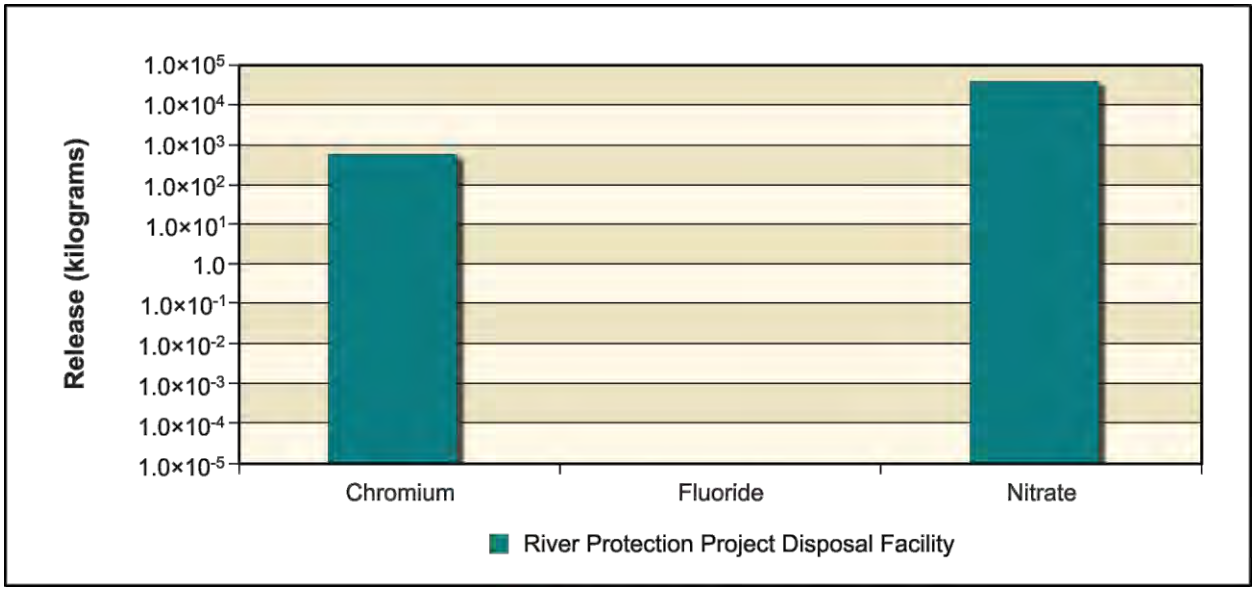


Figure 5–835. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chemical Releases from River Protection Project Disposal Facility to Columbia River

Overall, most (greater than 99 percent) of the RPPDF vadose zone technetium-99, iodine-129, chromium, and nitrate reach the Columbia River during the period of analysis.

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, impacts in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations. Table 5–109 shows the maximum concentrations in groundwater. The most impact occurs at the IDF-East barrier, IDF-West barrier, Core Zone Boundary, and Columbia River nearshore, where maximum concentrations of technetium-99 and iodine-129 exceed their respective benchmark values. None of the other COPC benchmark concentrations are exceeded.

Table 5–109. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	**1,160**	**13,200**	42	**1,370**	**1,670**	900
	(11,434)	(3818)	(3818)	(3859)	(3920)	
Iodine-129	**1.2**	**20.6**	0.1	**2.1**	**2.4**	1
	(11,054)	(3794)	(3747)	(3937)	(3872)	
Chemical (micrograms per liter)						
Chromium	19	1	3	6	5	100
	(11,378)	(3813)	(3740)	(10,691)	(11,049)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	11,500	7	180	3,150	2,400	45,000
	(8207)	(3927)	(3670)	(8121)	(7899)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figures 5–836 through 5–839 show concentration versus time for technetium-99, iodine-129, chromium, and nitrate. The releases of technetium-99 from IDF-East, IDF-West, and the RPPDF result in concentrations at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore that exceed the technetium-99 benchmark concentration over about 20 percent of the period of analysis (see Figure 5–836). After the post-disposal period, there is a short period (about 2,000 years) when technetium-99 concentrations at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore exceed the benchmark concentration. Technetium-99 concentrations then decrease for the duration of the 10,000-year analysis period. Technetium-99 concentrations at the IDF-East barrier reach the benchmark concentration in about CY 8900 and remain steady at this level for the 10,000-year period of analysis. The IDF-East, IDF-West, Core Zone Boundary, and Columbia River nearshore concentrations never exceed the benchmark concentrations by more than one order of magnitude.

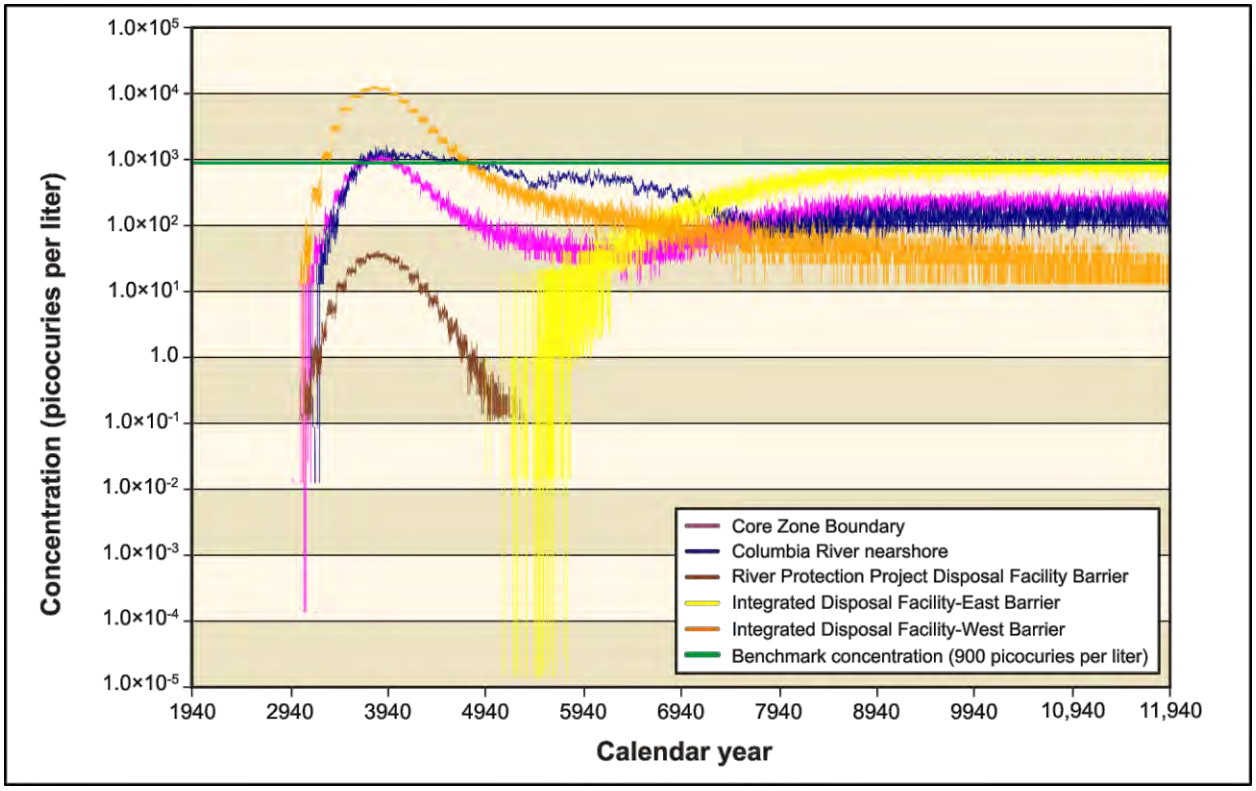


Figure 5–836. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Technetium-99 Concentration Versus Time

The iodine-129 concentrations (see Figure 5–837) at the IDF-West barrier, IDF-East barrier, Core Zone Boundary, and Columbia River nearshore have a similar time-versus-concentration profile as technetium-99. The initial IDF-West barrier iodine-129 peak is between one and two orders of magnitude over the benchmark concentration, and concentrations at the Core Zone Boundary and Columbia River nearshore are less than one order of magnitude above the benchmark. After the initial IDF-West iodine-129 peak, the concentrations at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore remain about one order of magnitude below the benchmark concentration. Iodine-129 concentrations at the IDF-East barrier reach the benchmark concentration in approximately CY 9000 and remain constant for the 10,000-year period of analysis.

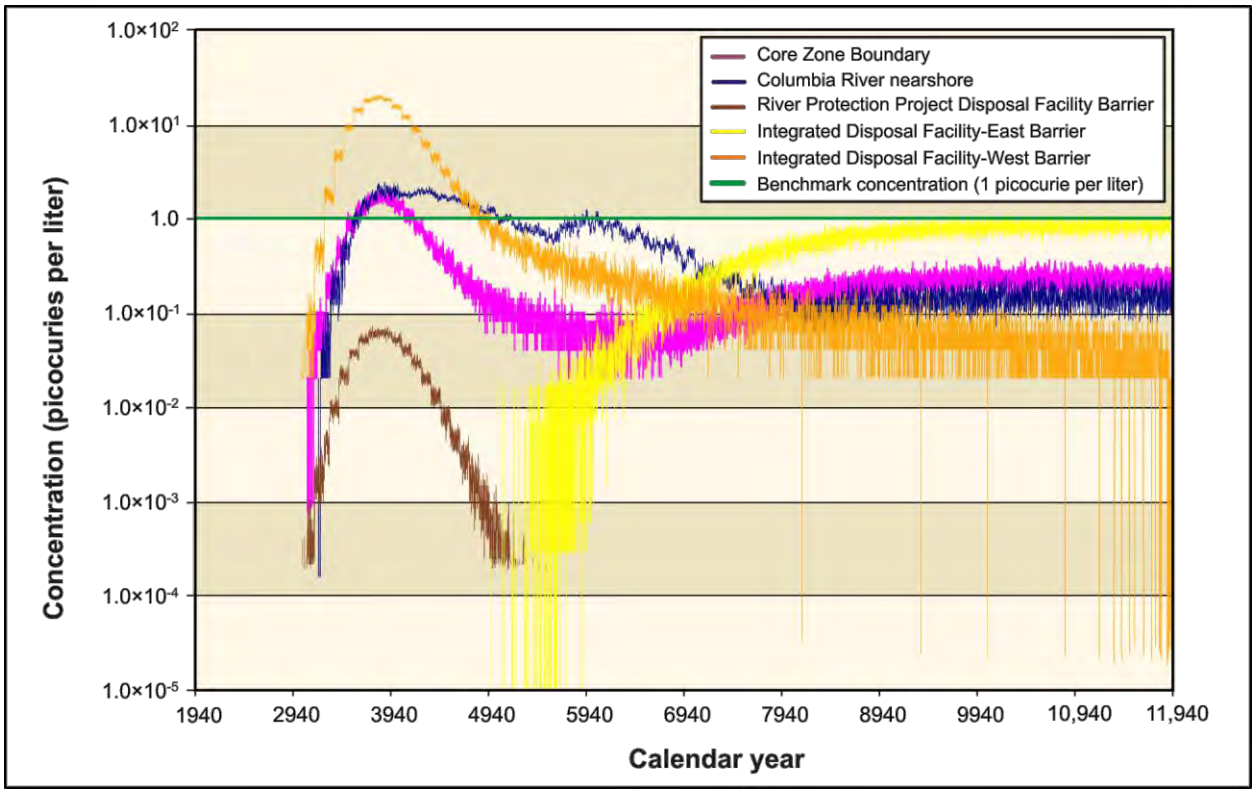


Figure 5–837. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Iodine-129 Concentration Versus Time

The time-versus-concentration profiles for chromium and nitrate (see Figures 5–838 and 5–839) also show initial peaks at the IDF-East barrier, RPPDF barrier, Core Zone Boundary, and Columbia River nearshore. However, unlike technetium-99 and iodine-129, these peaks are less than the respective benchmark concentrations. Both chromium and nitrate concentrations gradually increase through the latter half of the analysis period because of the rise in concentrations at the IDF-East barrier. The chromium and nitrate concentrations are always at least one order of magnitude less than the benchmark concentration.

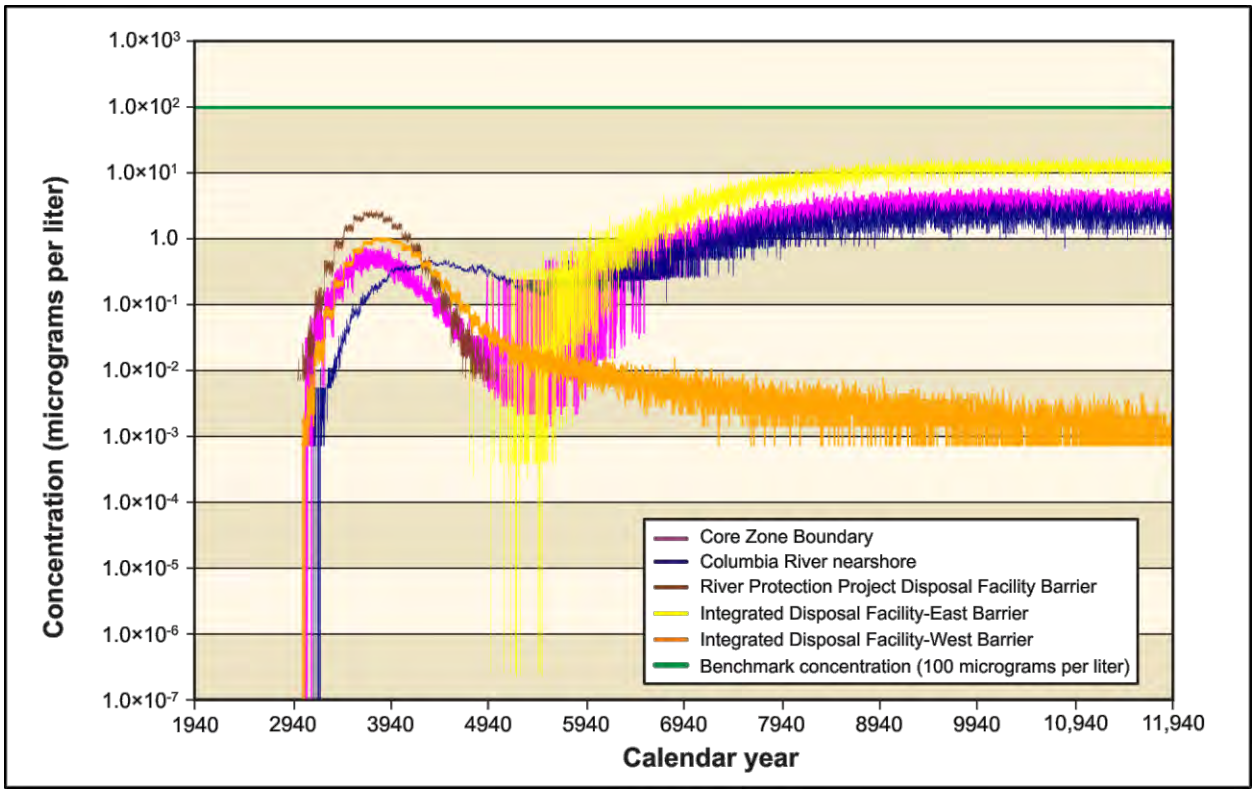


Figure 5–838. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Chromium Concentration Versus Time

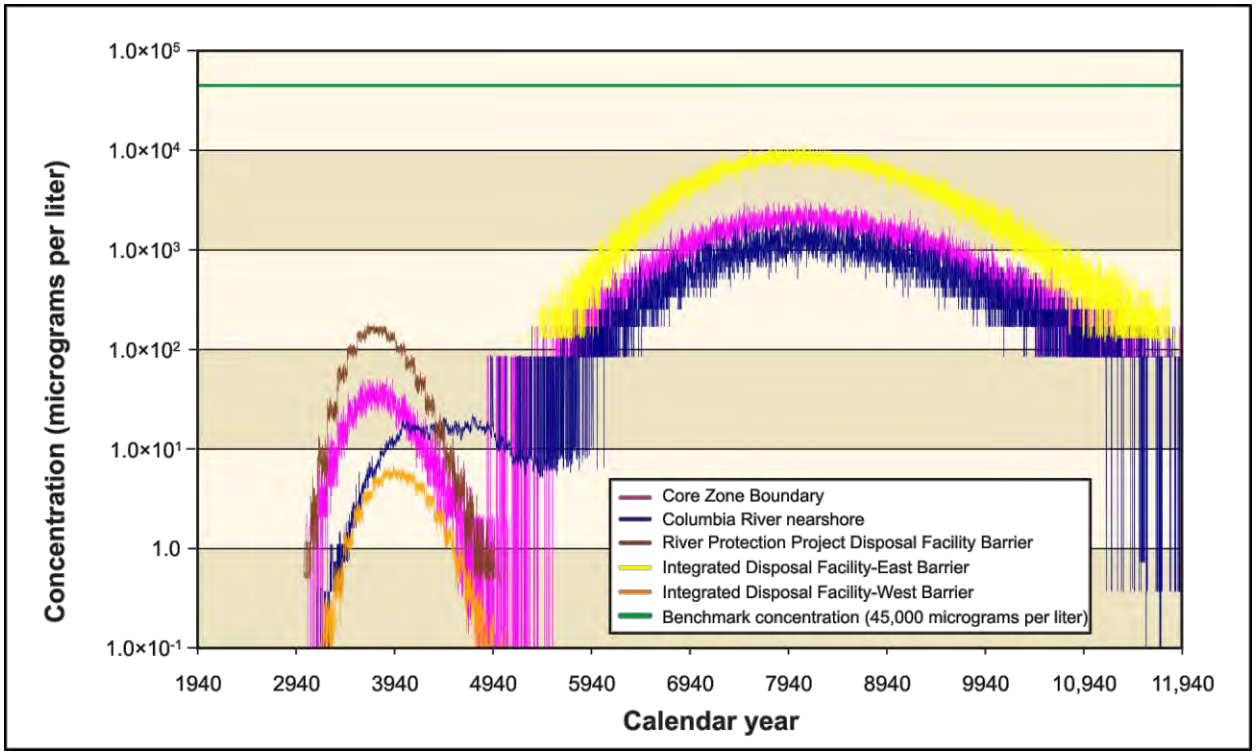


Figure 5–839. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Nitrate Concentration Versus Time

Figure 5–840 shows concentration versus time for total uranium. Because total uranium moves slowly through the vadose zone, releases from IDF-East, IDF-West, and the RPPDF result in groundwater concentrations that are always lower than the benchmark concentrations over the period of analysis. Total uranium (see Figure 5–840) shows increasing concentrations at the RPPDF barrier and Core Zone Boundary that occur late in the analysis, around CY 10,000. Total uranium concentrations remain more than seven orders of magnitude below the benchmark concentration.

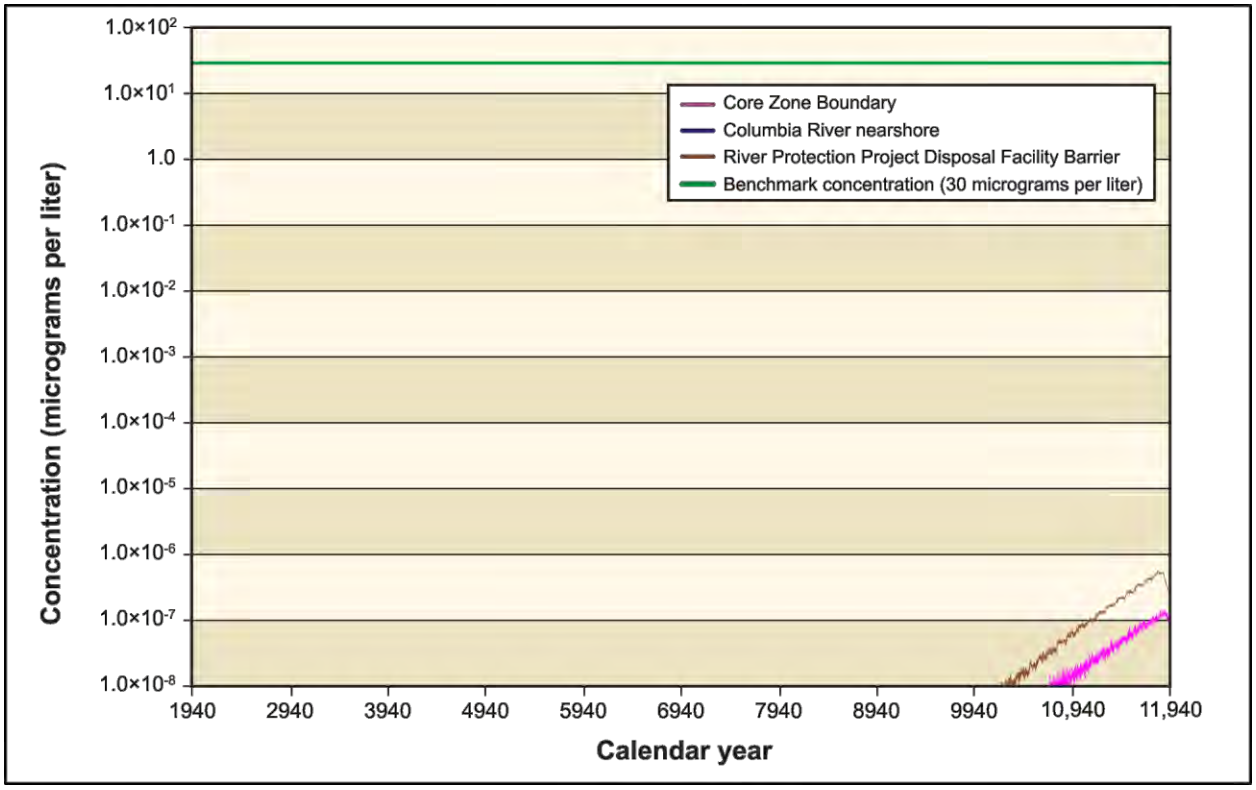


Figure 5–840. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Total Uranium Concentration Versus Time

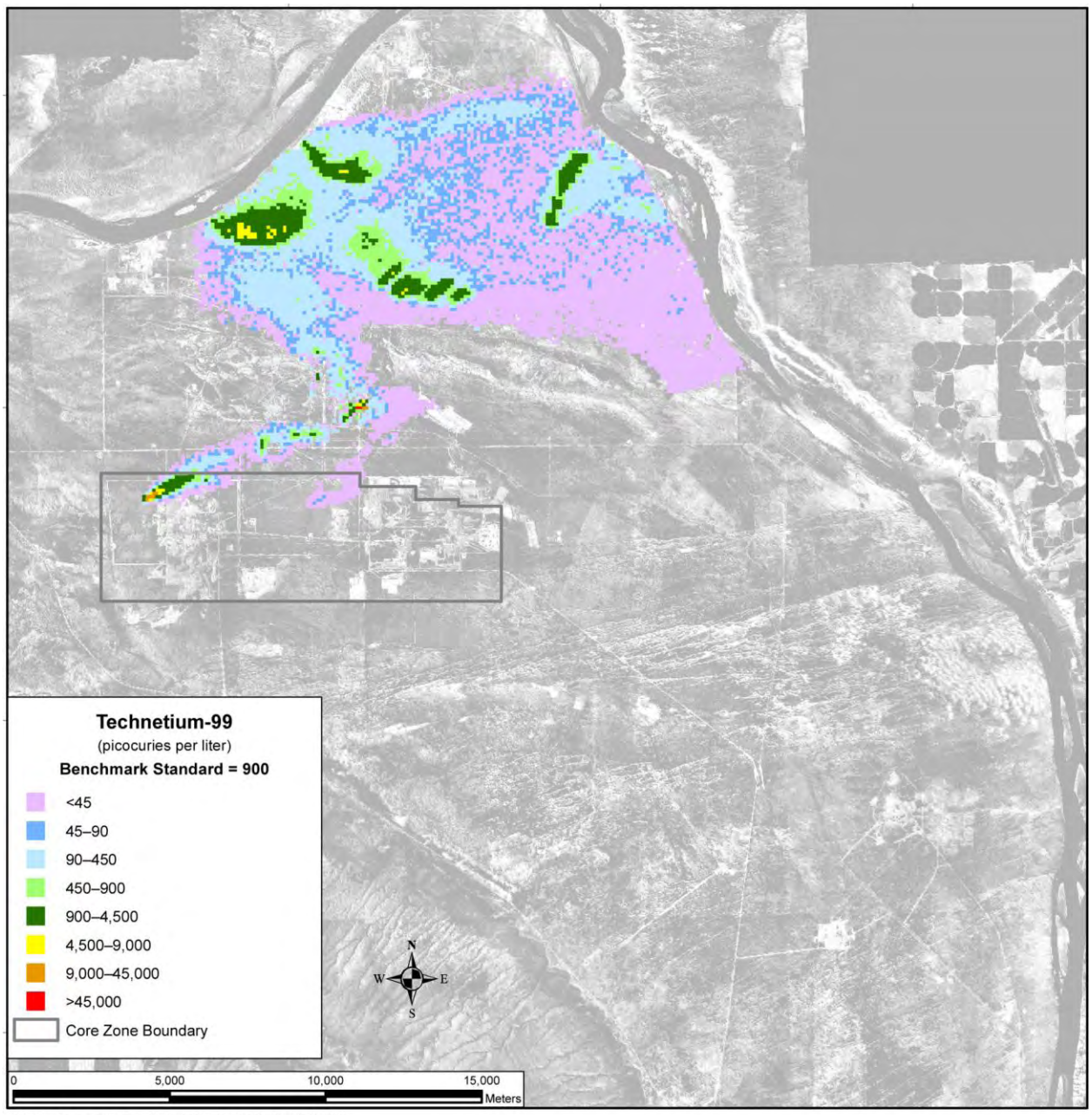
ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations.

Figures 5–841 through 5–852 show concentration distributions in CYs 3890, 7140, and 11,885 for technetium-99, iodine-129, nitrate, and chromium. These data show the groundwater releases from the RPPDF and IDF-West that extend north from within the Core Zone to the Columbia River. The IDF-East groundwater releases occur later and extend east from within the Core Zone to the Columbia River. The RPPDF and IDF-West releases remain in a fairly narrow channel (Gable Gap) until about halfway to the Columbia River nearshore boundary. The releases then spread out over the northern tip area of Hanford. The IDF-East releases remain in a relatively narrow channel until they reach about the one-quarter

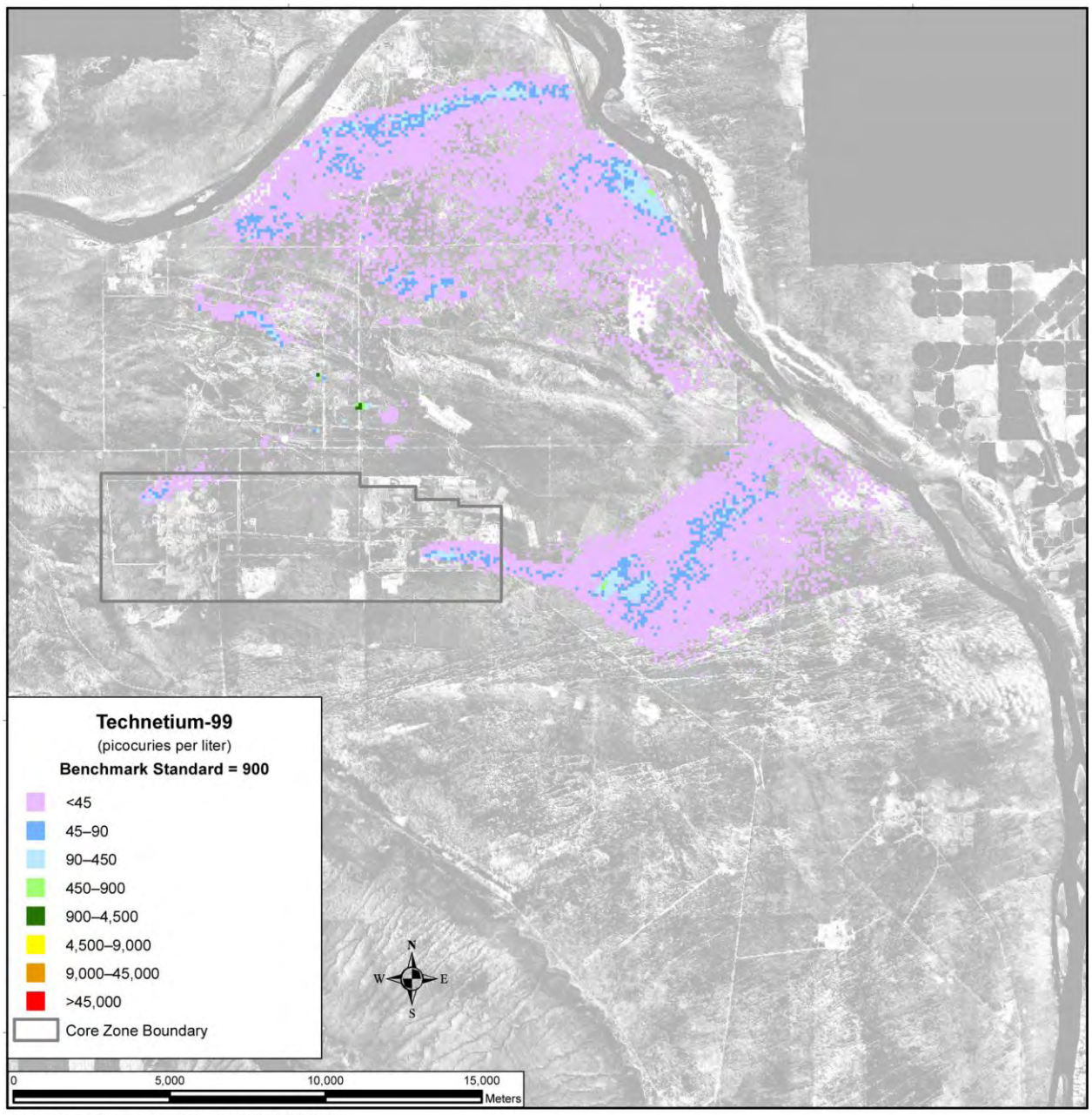
distance point to the Columbia River, where the releases spread out and continue to the Columbia River nearshore boundary.

Figure 5–841 shows the technetium-99 release from IDF-West and the RPPDF in CY 3890. This spatial distribution shows that technetium-99 exceeds the benchmark concentration within the Core Zone (due to the IDF-West release) and in several areas close to the Columbia River nearshore. Figure 5–842 shows that the technetium-99 release from IDF-West and the RPPDF has largely dissipated by CY 7140 and only exists in areas close to the Columbia River nearshore at concentrations at least one order of magnitude lower than the benchmark concentration. This figure also shows a technetium-99 release distribution from IDF-East. There are small areas where technetium-99 approaches the benchmark concentration. Figure 5–843 shows that the IDF-West and RPPDF groundwater technetium-99 is almost completely dissipated in CY 11,885. In CY 11,885, technetium-99 has continued to move to the Columbia River. There are several areas where the IDF-East release still approaches or exceeds the benchmark concentration within one order of magnitude.



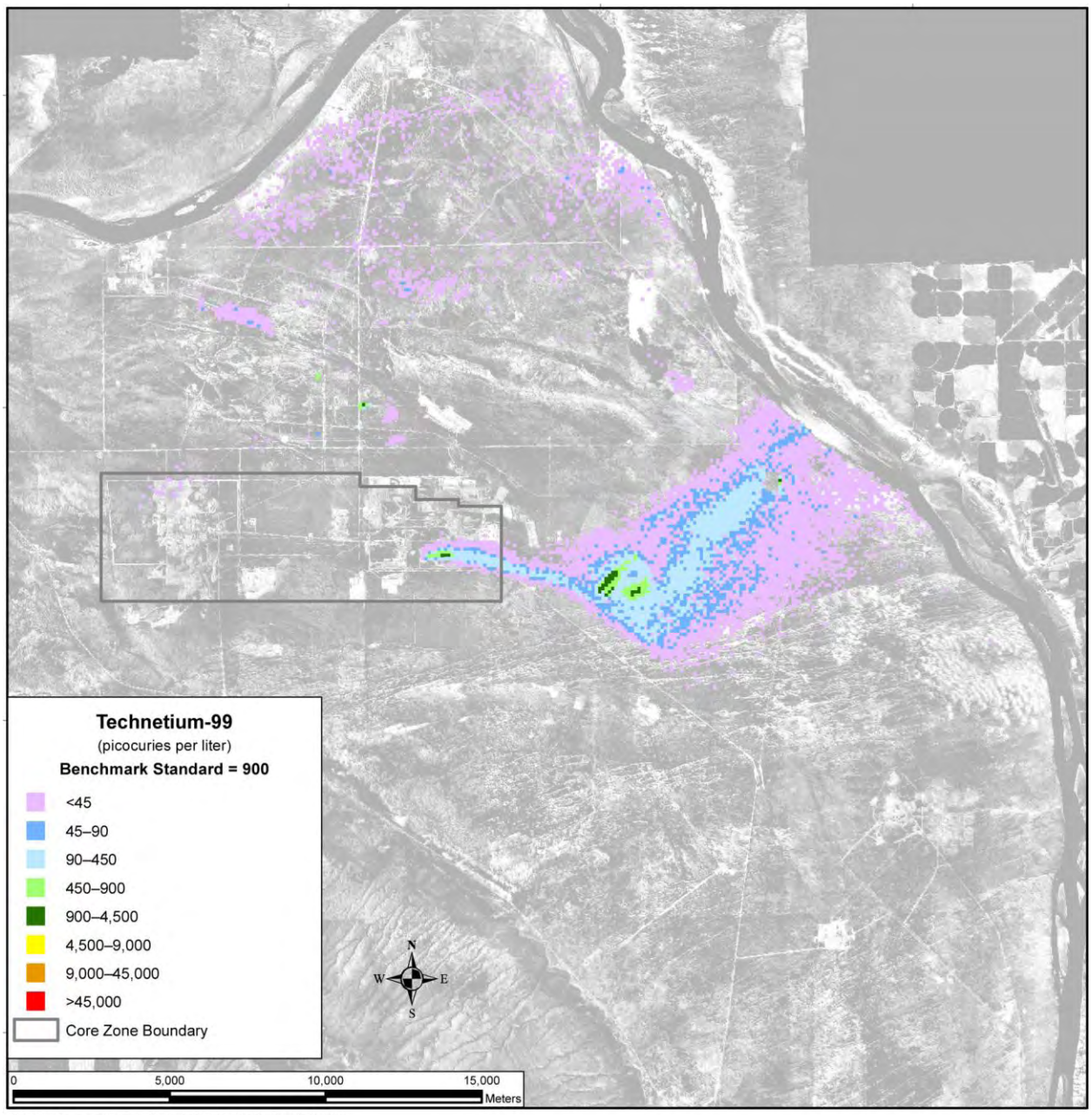
Note: To convert meters to feet, multiply by 3.281.

Figure 5–841. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



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

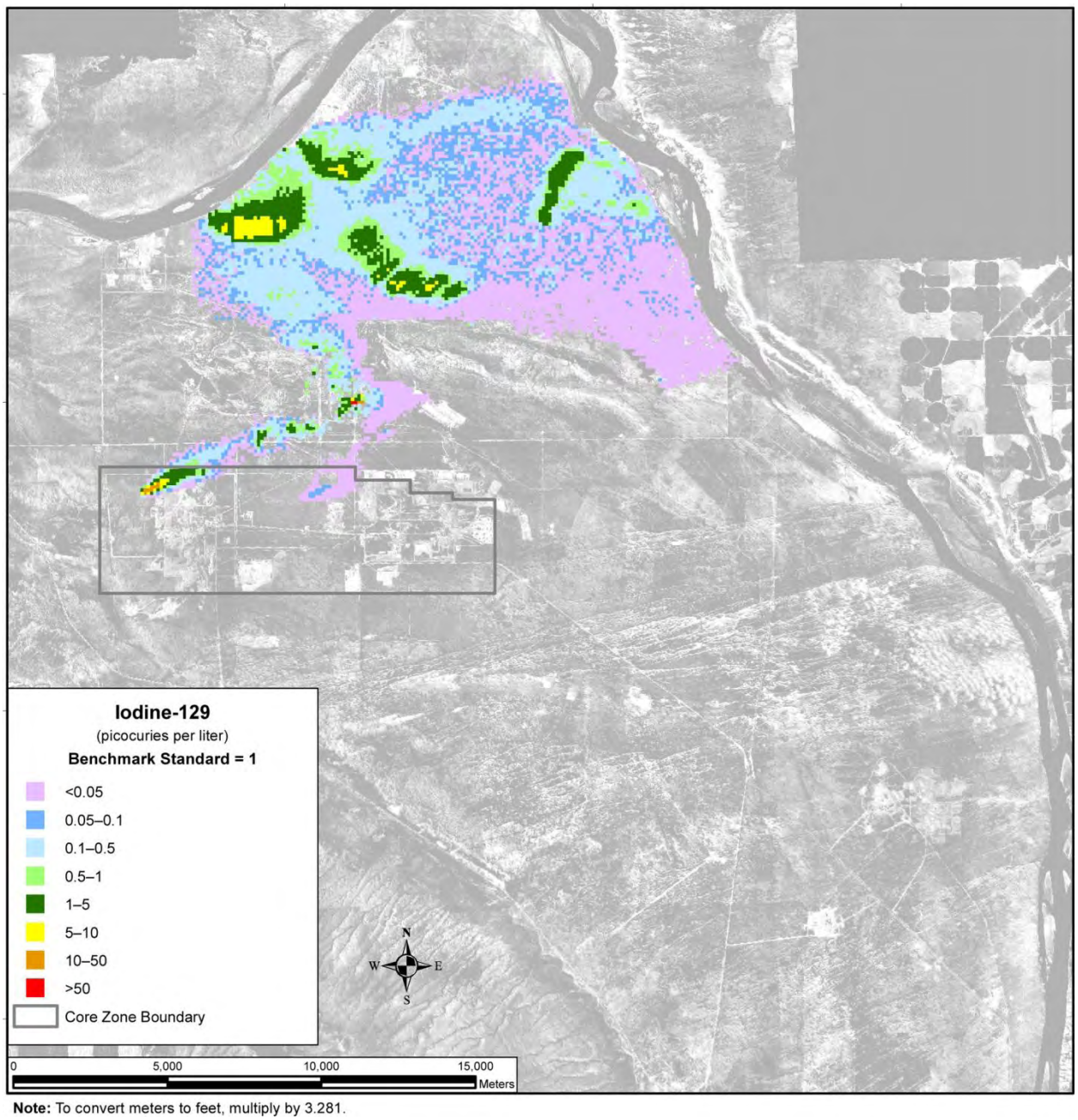
Figure 5–842. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



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

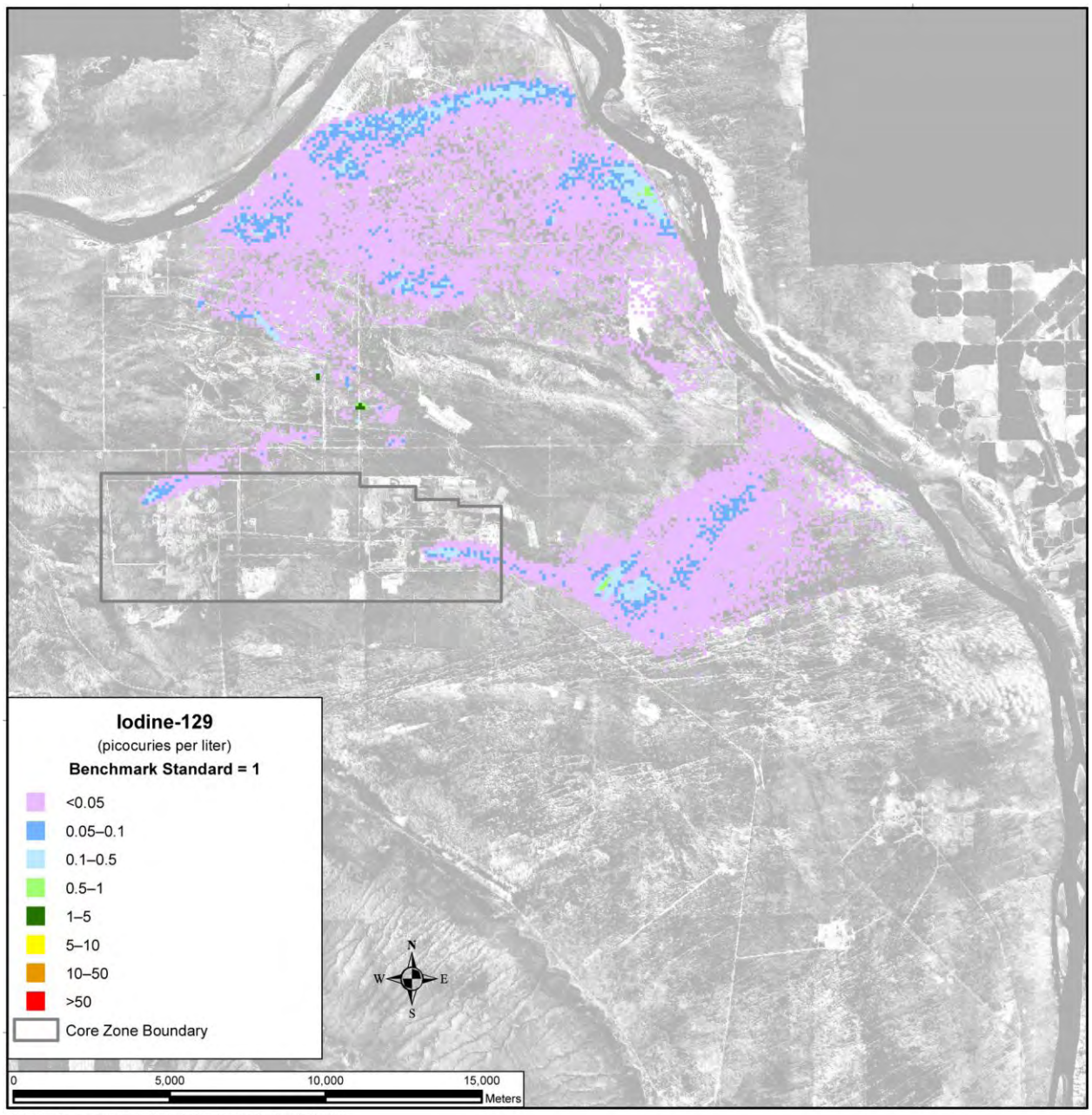
Figure 5–843. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885

Figures 5–844 through 5–846 show iodine-129 released from IDF-East, IDF-West, and the RPPDF; the time and spatial distributions of this release are very similar to the technetium-99 release. However, the CY 3890 iodine-129 release (see Figure 5–844) shows significantly higher iodine-129 concentrations compared to benchmark concentrations than the technetium-99 release. The areas of high concentrations are in approximately the same locales but have relatively higher concentrations. By CY 7140 (see Figure 5–845), concentrations of IDF-West and RPPDF iodine-129 have significantly dissipated, but there are areas where concentrations are equal to or above the benchmark concentration. The CY 11,885 IDF-East iodine-129 (see Figure 5–846) shows a continuing iodine-129 distribution, with areas that have concentrations that approach or exceed the benchmark concentration.



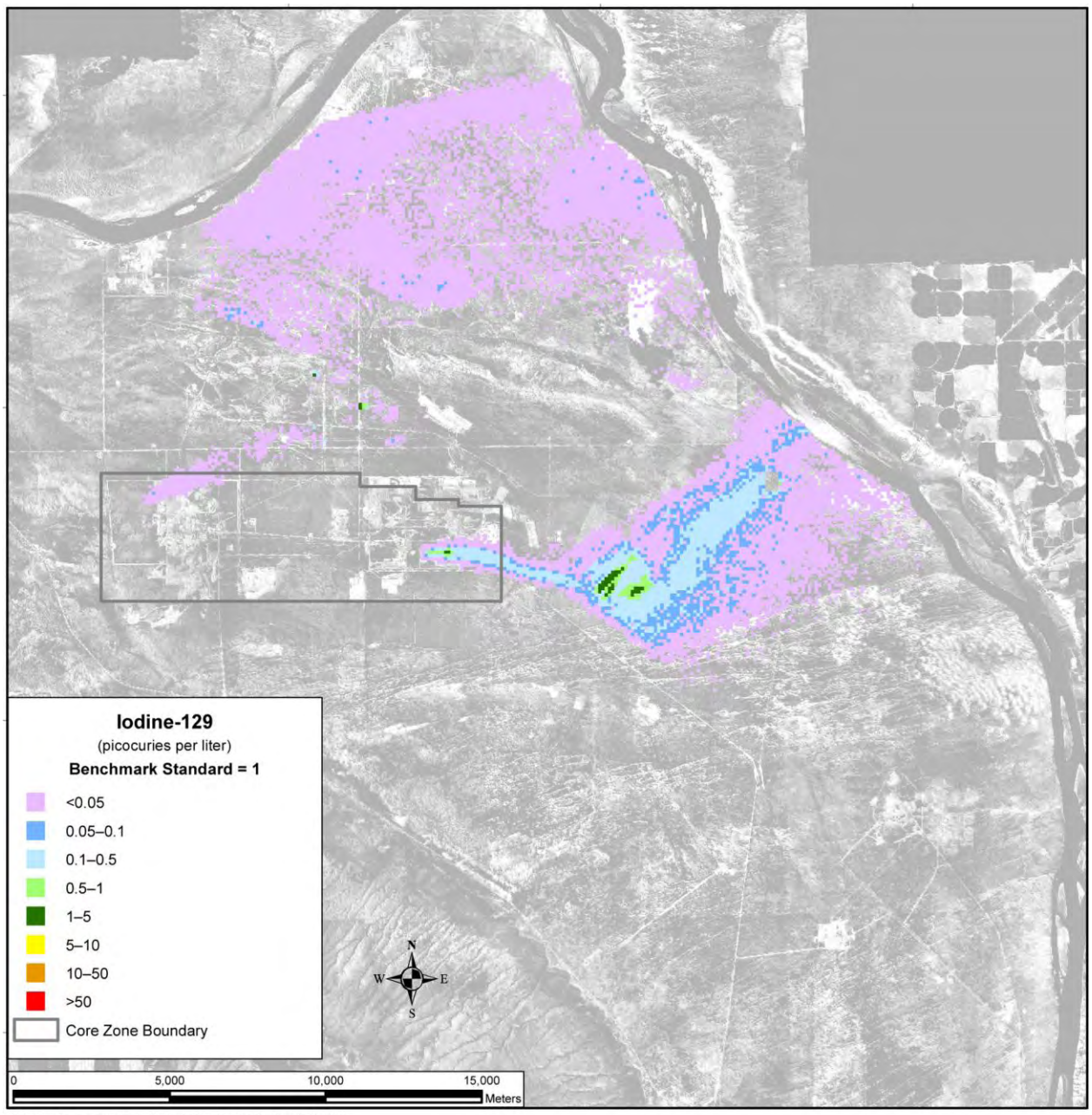
Note: To convert meters to feet, multiply by 3.281.

Figure 5–844. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



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

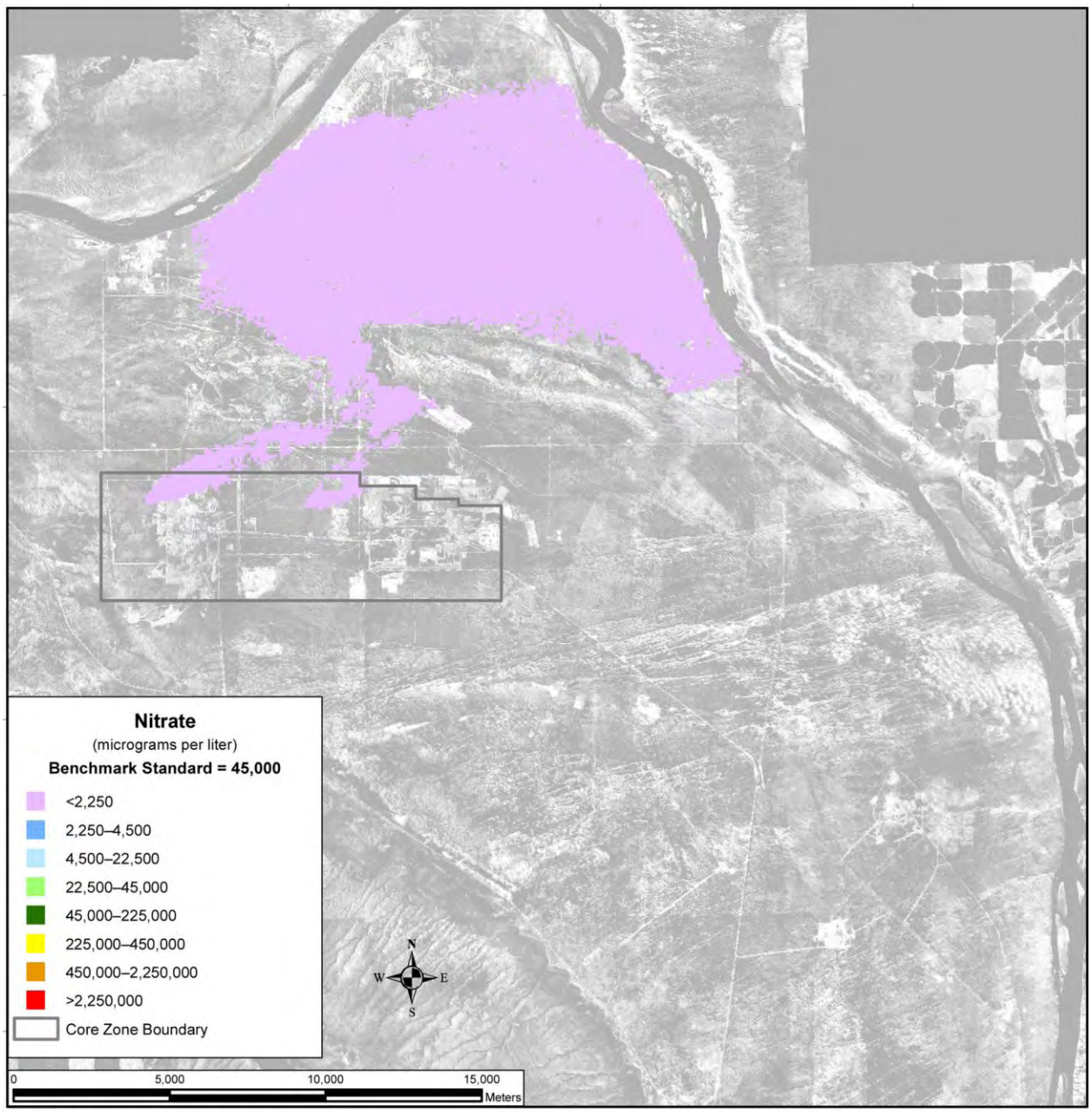
Figure 5–845. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



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

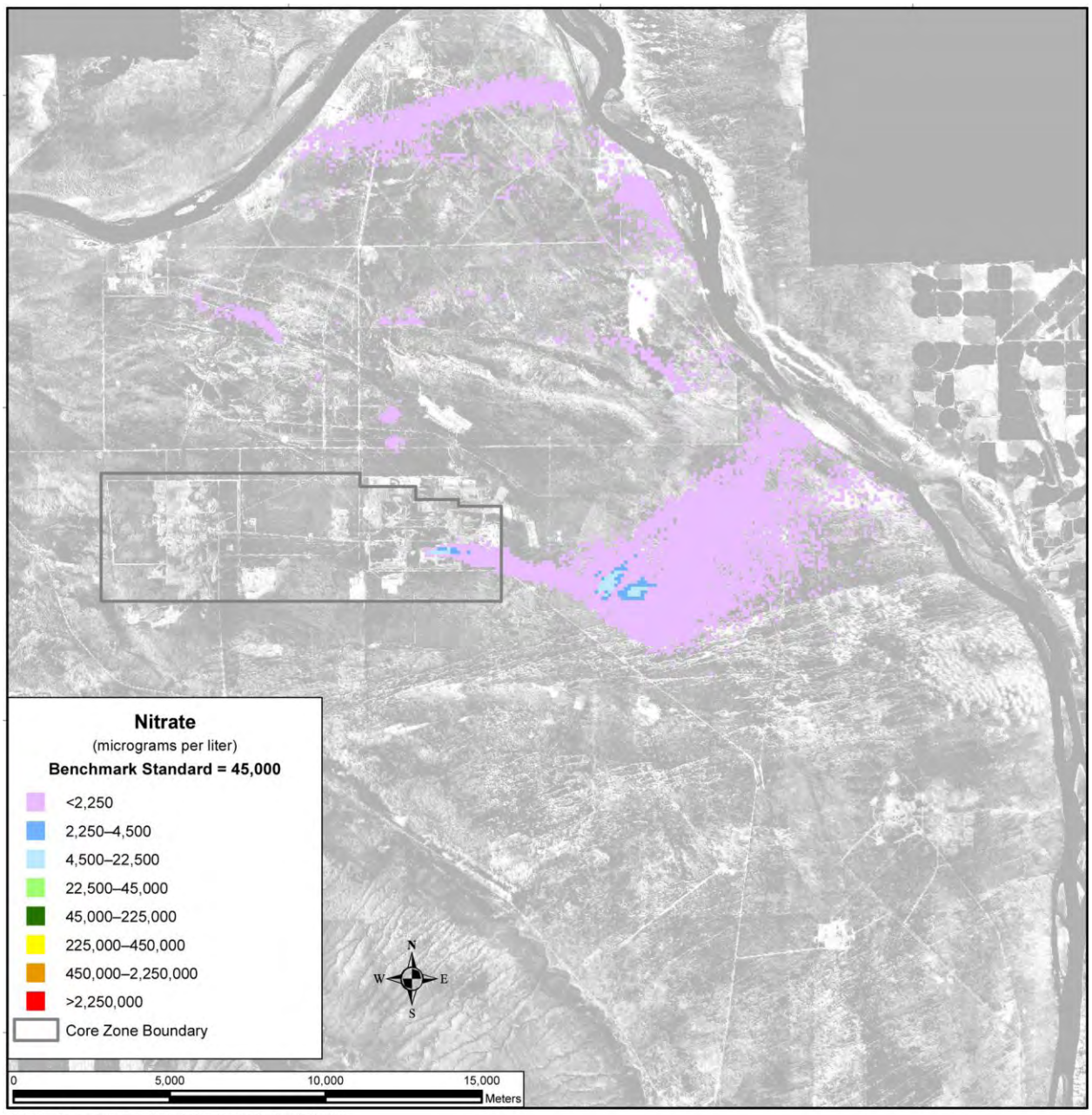
Figure 5–846. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885

The IDF-East, IDF-West, and RPPDF nitrate releases, shown in Figures 5–847 through 5–849, show time and spatial distributions similar to the released technetium-99 and iodine-129. These show that nitrate concentrations are below benchmark concentrations. By CY 11,885, almost all of the groundwater nitrate has dissipated.



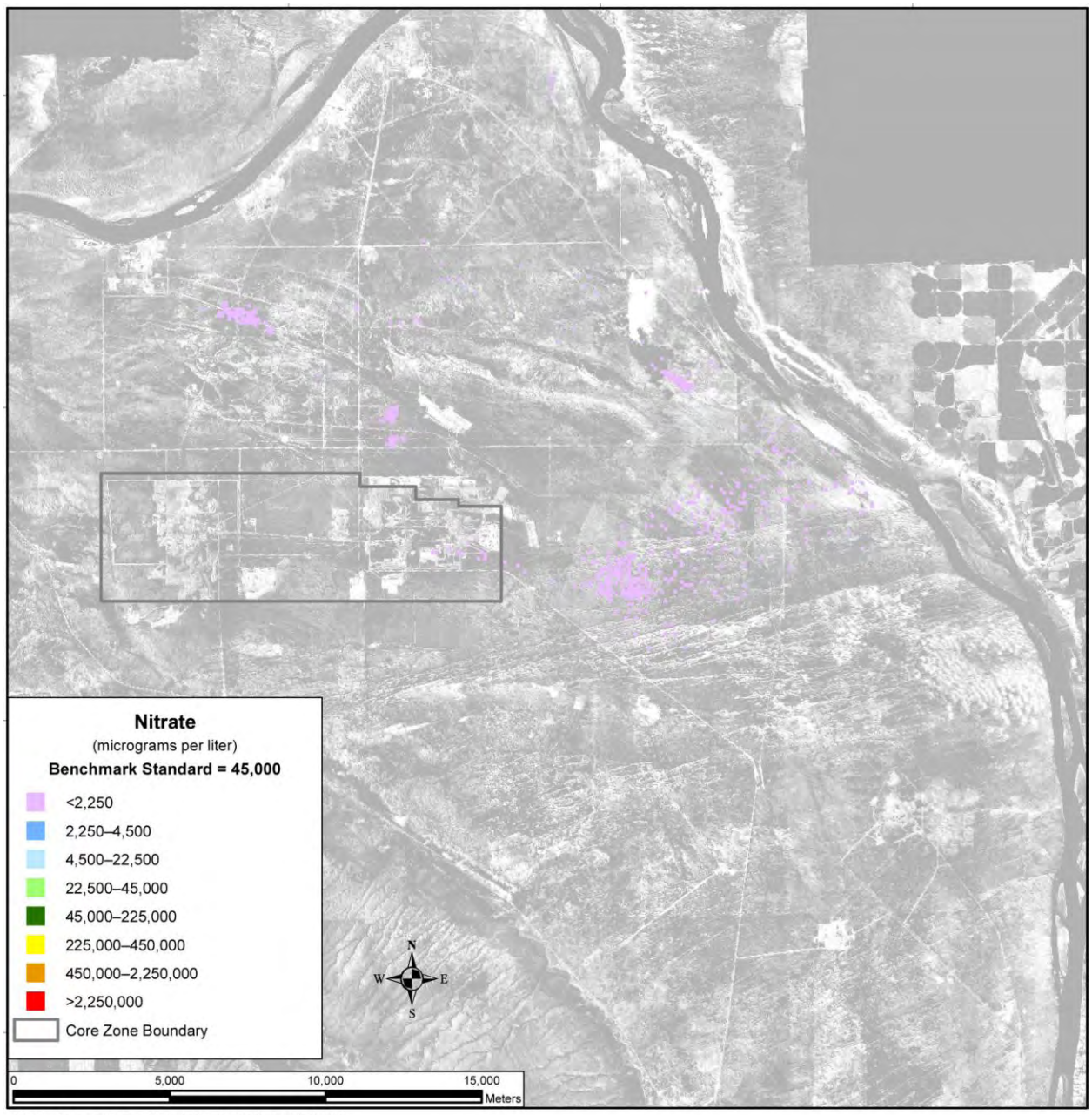
Note: To convert meters to feet, multiply by 3.281.

Figure 5–847. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



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

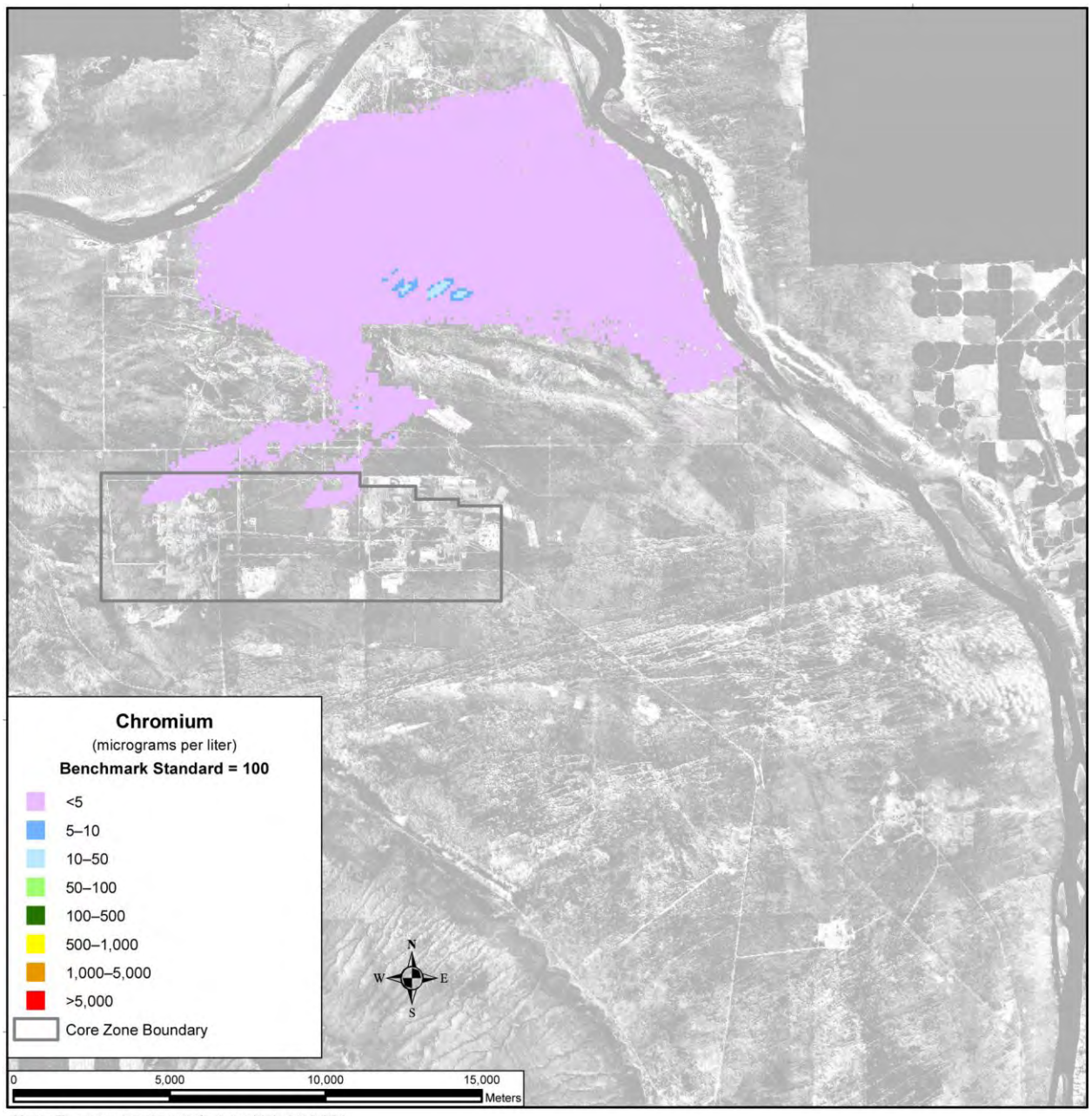
Figure 5–848. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



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

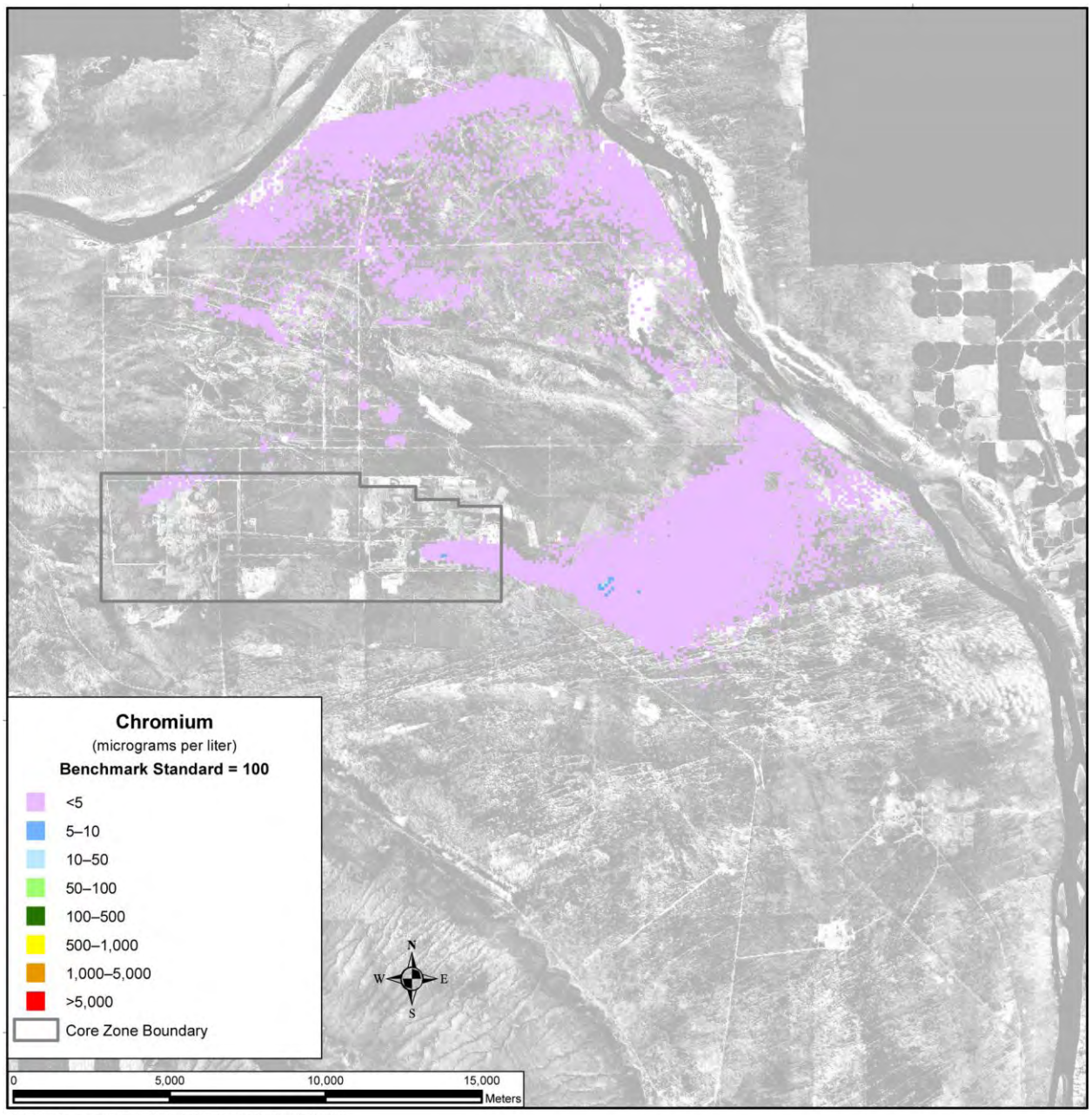
Figure 5–849. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

The CY 3890 and CY 7140 chromium releases in Figures 5–850 and 5–851 are similar to the respective nitrate releases. Chromium concentrations appear to approach the benchmark concentration in some areas north of Gable Mountain, at the IDF-East barrier, and east of the Core Zone Boundary. By CY 11,885 (see Figure 5–852), the chromium release has dissipated, but a significant amount of chromium remains distributed between IDF-East and the Columbia River nearshore. Chromium released from IDF-West and the RPPDF has almost totally dissipated.



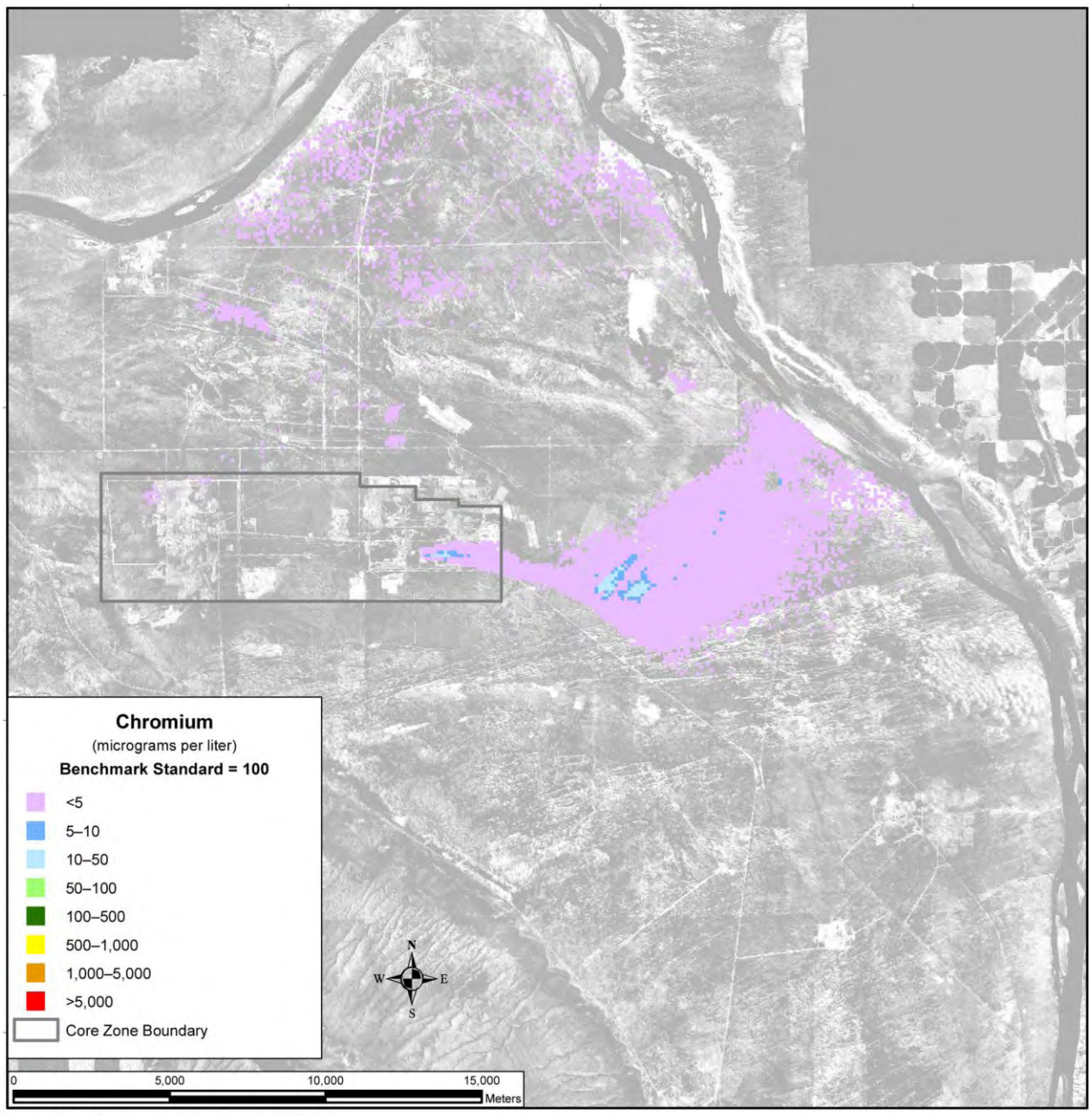
Note: To convert meters to feet, multiply by 3.281.

Figure 5–850. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



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

Figure 5–851. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



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

Figure 5–852. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

For Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, in general, the inventory remaining in IDF-West is the predominant contributor. The releases from IDF-East and the RPPDF are secondary contributors.

By the end of this period of analysis (CY 11,885), the chromium and nitrate distributions have largely dispersed below their benchmark concentrations. Significant spatial distributions of technetium-99 and iodine-129 remain. Most of the distribution area has concentrations below benchmark levels, but there are some small areas where technetium-99 and iodine-129 concentrations exceed the benchmark levels in

CY 11,885. The released iodine-129, which occurs at higher concentration levels relative to its benchmark than technetium-99, dissipates much more quickly than technetium-99.

For uranium-238 and total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of these retarded species do not exceed their benchmark levels at the Core Zone Boundary or Columbia River nearshore over this period of analysis. However, the spatial distributions of both uranium-238 and total uranium exist through the end of the analysis period (CY 11,885). Although the concentrations of uranium-238 and total uranium are both seven orders of magnitude smaller than either benchmark concentration during this analysis period, the trend appears to show a continuing increase through the end of the analysis period.

5.3.1.3.1.5 Disposal Group 1, Subgroup 1-E

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, was designed to accommodate disposal of waste generated under Tank Closure Alternative 4 and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Tank closure waste would be converted to IHLW, ILAW glass, bulk vitrification glass, and cast stone waste.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2050, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, nitrate, and acetonitrile) are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–853 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–854, the chemical hazard drivers. The inventories in the six waste forms are a major factor in the release quantities to the vadose zone. The predominant source of vadose zone technetium-99 is cast stone waste (93 percent), with the remainder coming from bulk vitrification glass (5 percent) and tank closure secondary waste (1 percent). The vadose zone iodine-129 is from ETF-generated secondary waste (75 percent) and cast stone waste (22 percent), as well as tank closure secondary waste (2 percent). The predominant source of chromium (greater than 99 percent) is cast stone waste. The sources of nitrate release to the vadose zone are cast stone waste (84 percent) and ETF-generated secondary waste (16 percent). Fluoride is not released from IDF-East.

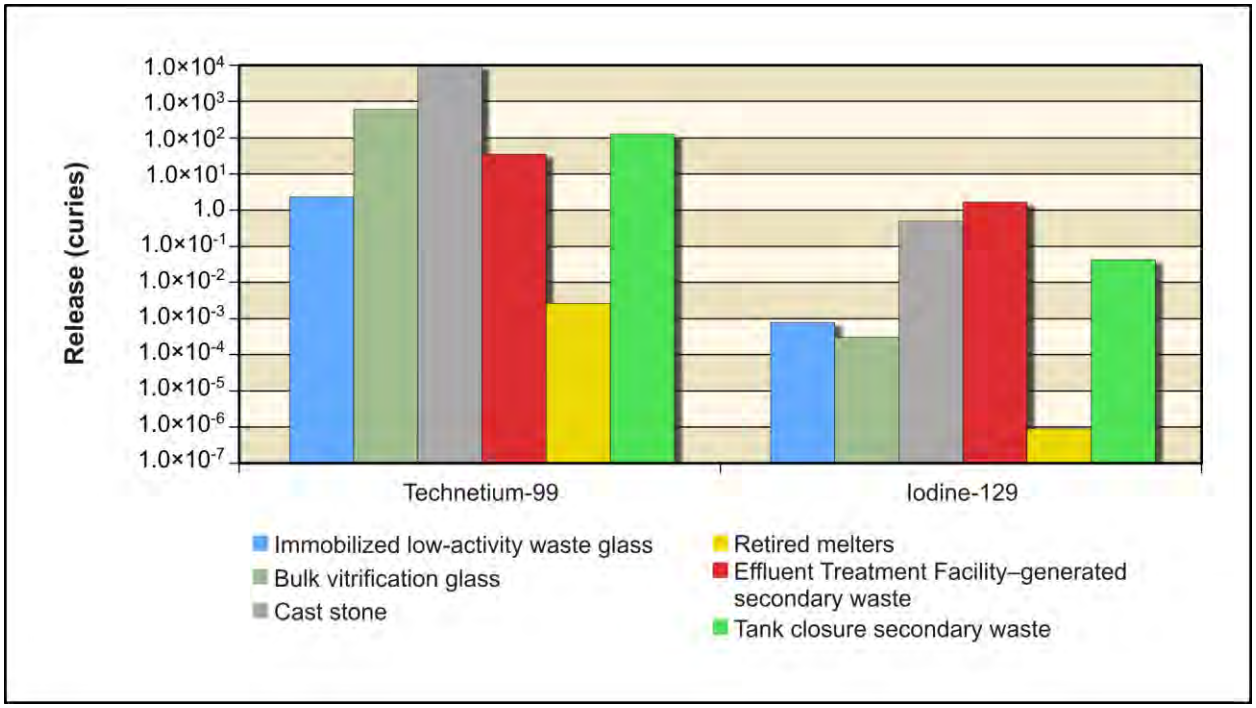


Figure 5–853. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

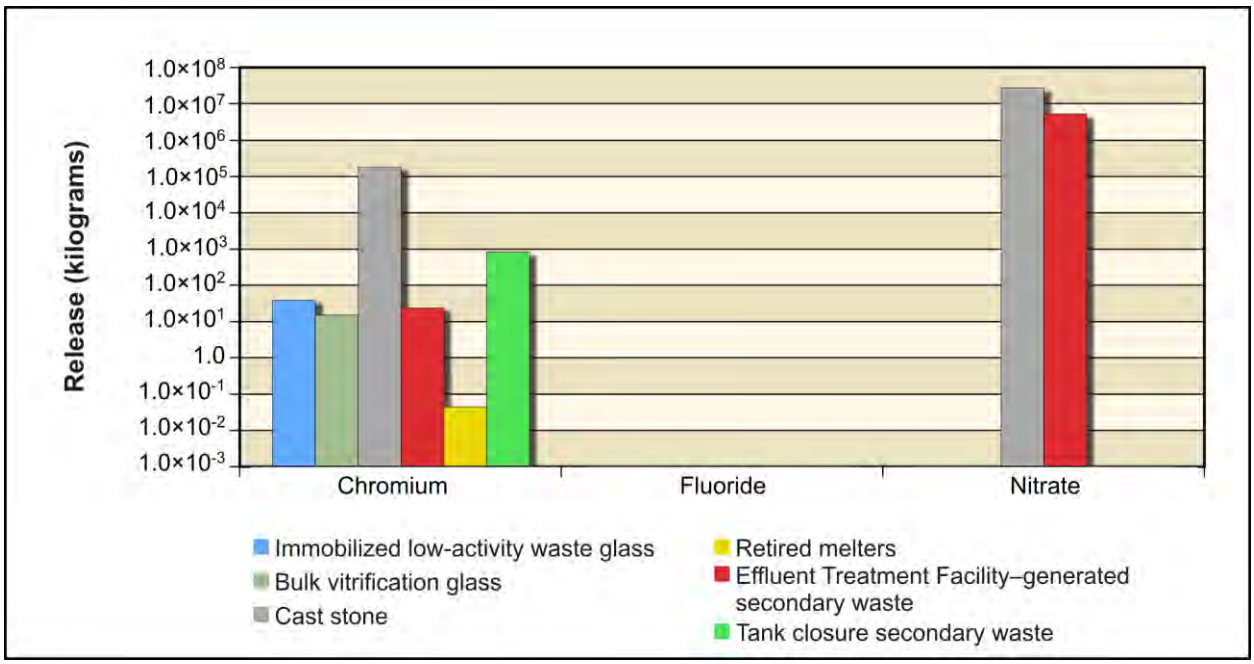


Figure 5–854. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–855 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–856, the chemical hazard drivers. In addition to the waste form inventory, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. The vadose zone releases some technetium-99 (48 percent) and iodine-129 (43 percent) to groundwater. Nearly all (99 percent) of the vadose zone chromium and nitrate are released to groundwater.

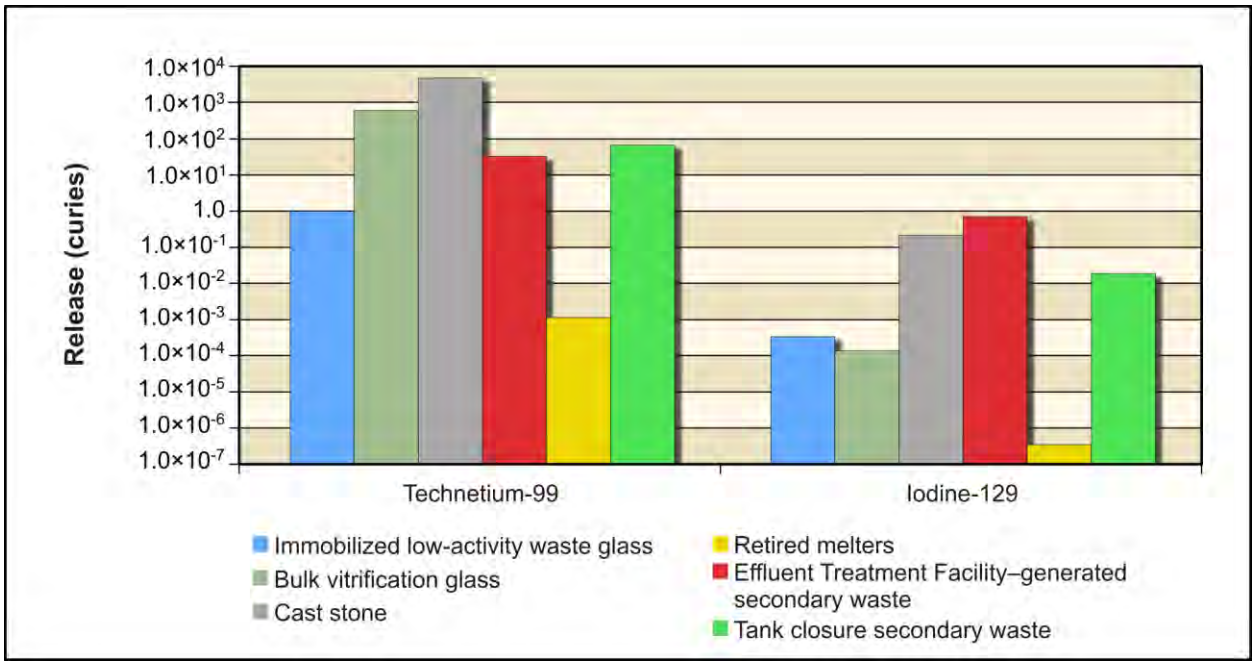


Figure 5–855. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

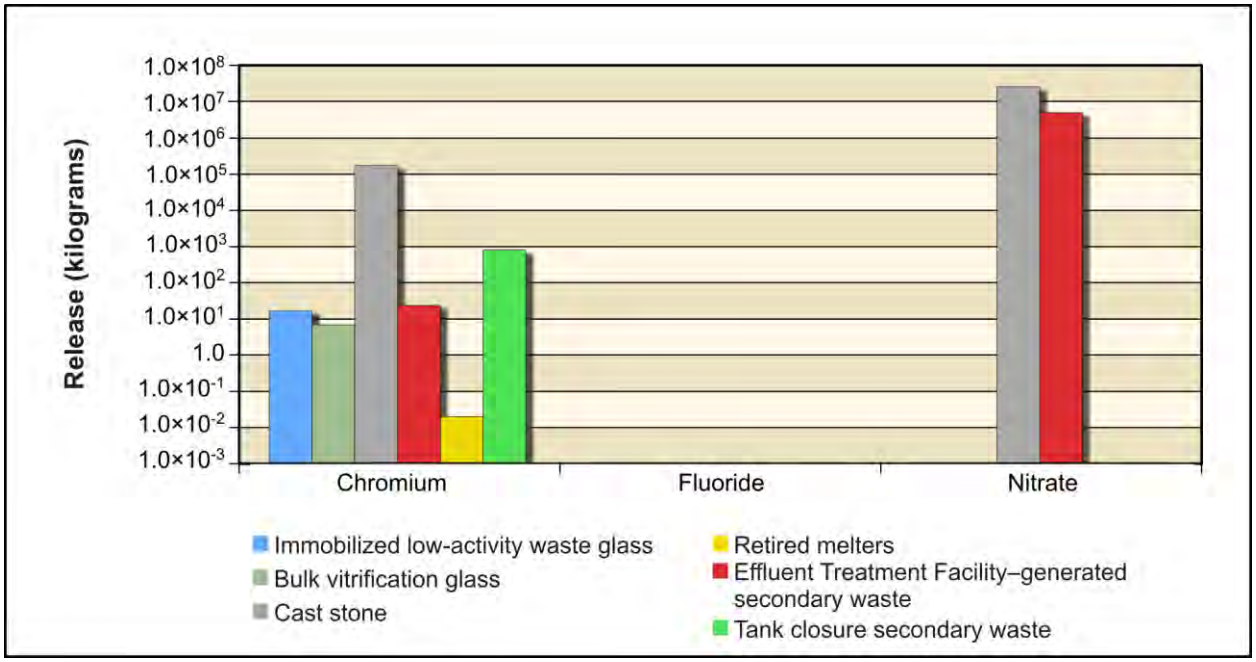


Figure 5–856. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–857 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–858, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. The groundwater releases most of its technetium-99 (97 percent), iodine-129 (96 percent), chromium (99 percent), and nitrate (99 percent) to the Columbia River.

Overall, most of the IDF-East vadose zone chromium (99 percent) and nitrate (99 percent) and some of the vadose zone technetium-99 (47 percent) and iodine-129 (41 percent) reach the Columbia River over the period of analysis.

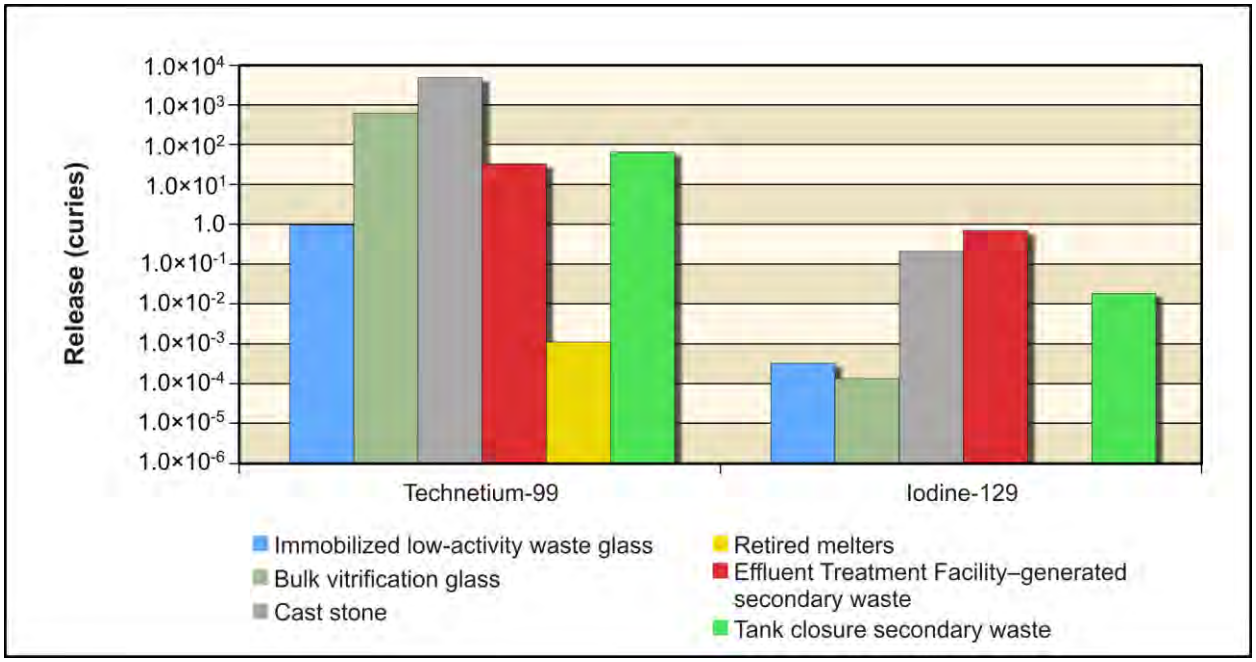


Figure 5–857. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

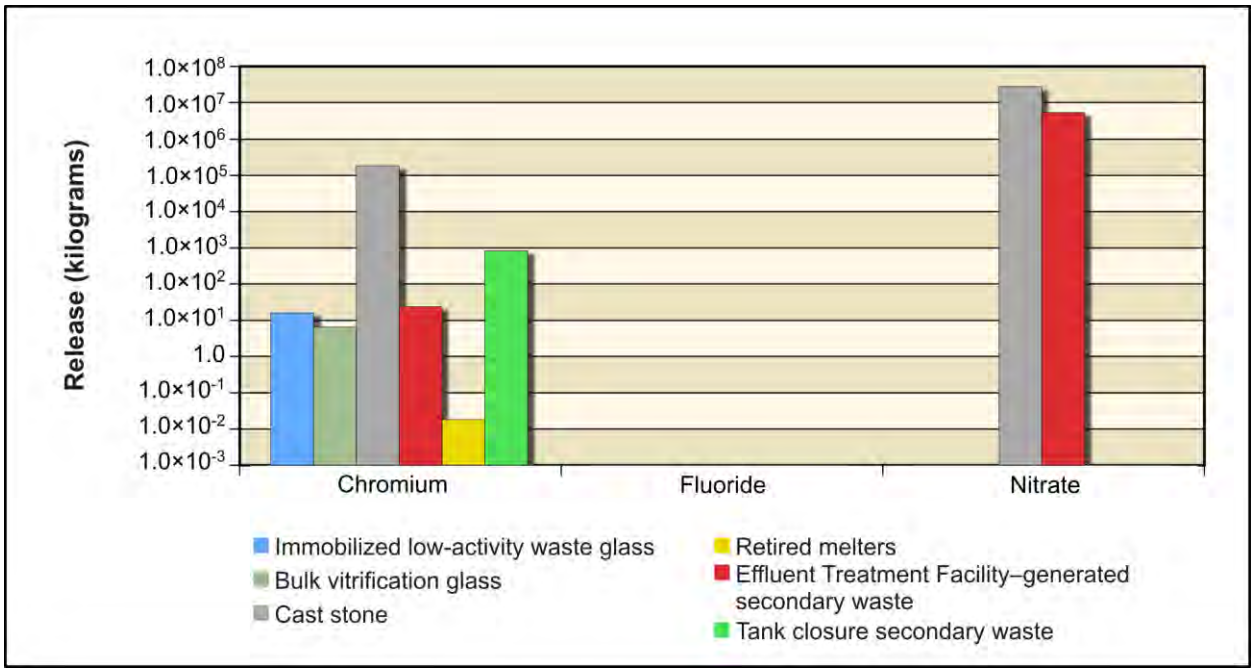


Figure 5–858. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5–859 through 5–864, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary waste and onsite waste, and offsite waste.

Figure 5–859 shows the estimated release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–860, the chemical hazard drivers. The inventories in the three waste forms are a major factor in the release quantities to the vadose zone. Offsite waste is the predominant source of the technetium-99 (greater than 99 percent) and iodine-129 (greater than 99 percent) released to the vadose zone. Essentially all (greater than 99 percent) of the nitrate and fluoride that is released to the vadose zone is from waste management secondary waste and onsite waste. Chromium released to the vadose zone is from waste management secondary waste and onsite waste (69 percent) and offsite waste (31 percent).

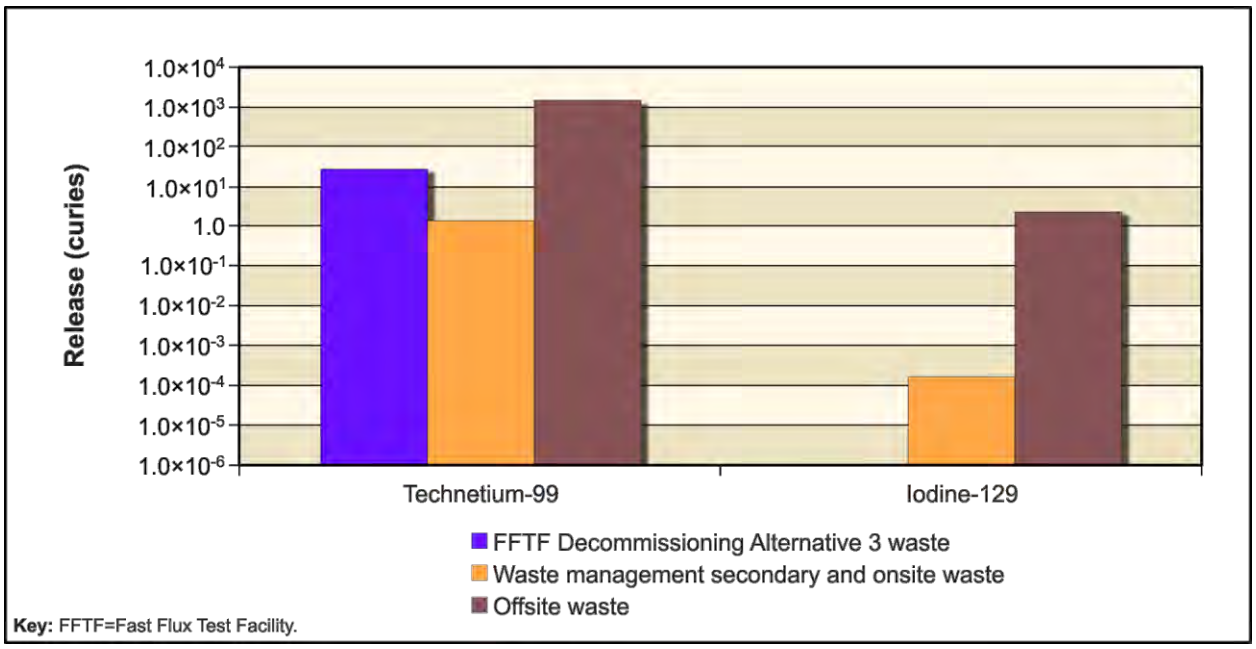


Figure 5–859. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

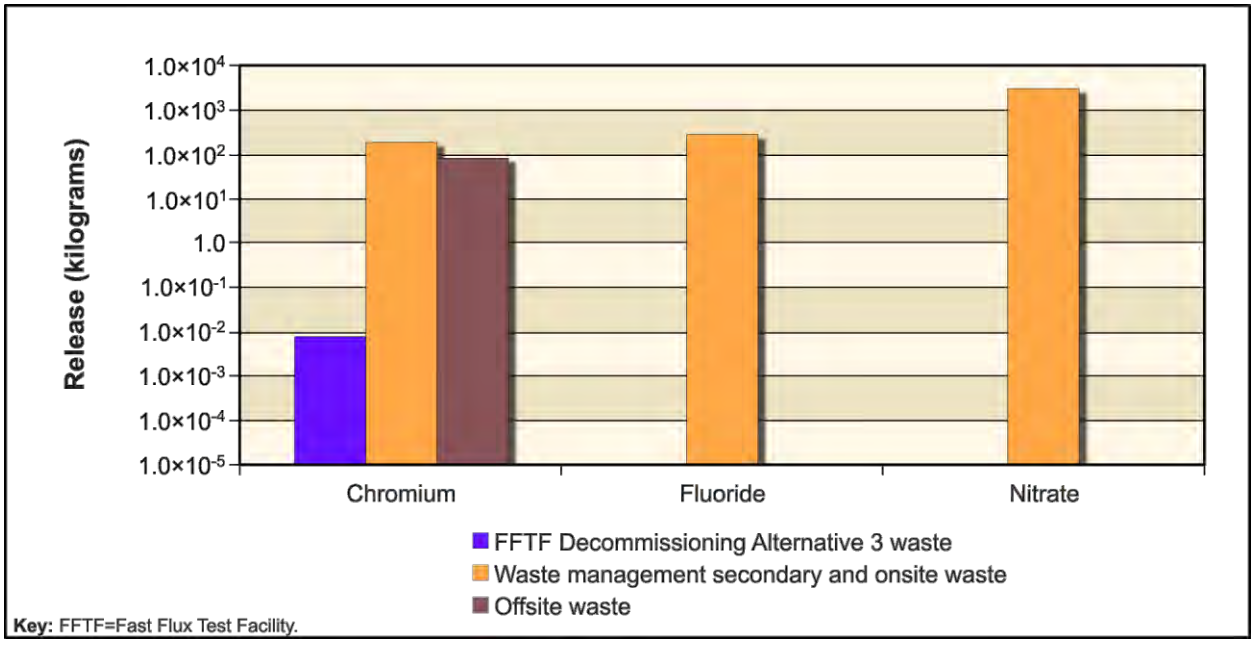


Figure 5–860. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–861 shows the estimated release from IDF-West to groundwater of the radiological risk drivers and Figure 5–862, the chemical hazard drivers. In addition to the waste form inventory, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Most of the IDF-West vadose zone technetium-99 (97 percent), iodine-129 (97 percent), chromium (99 percent), nitrate (greater than 99 percent), and fluoride (greater than 99 percent) are released to groundwater during the period of analysis.

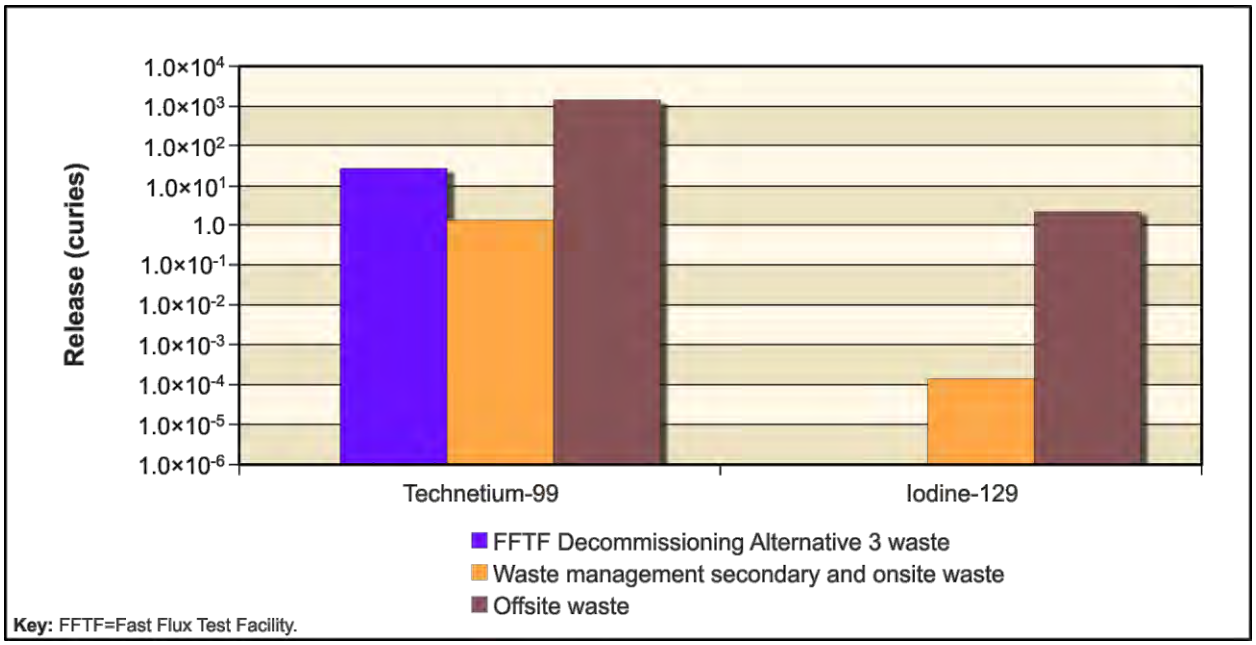


Figure 5–861. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

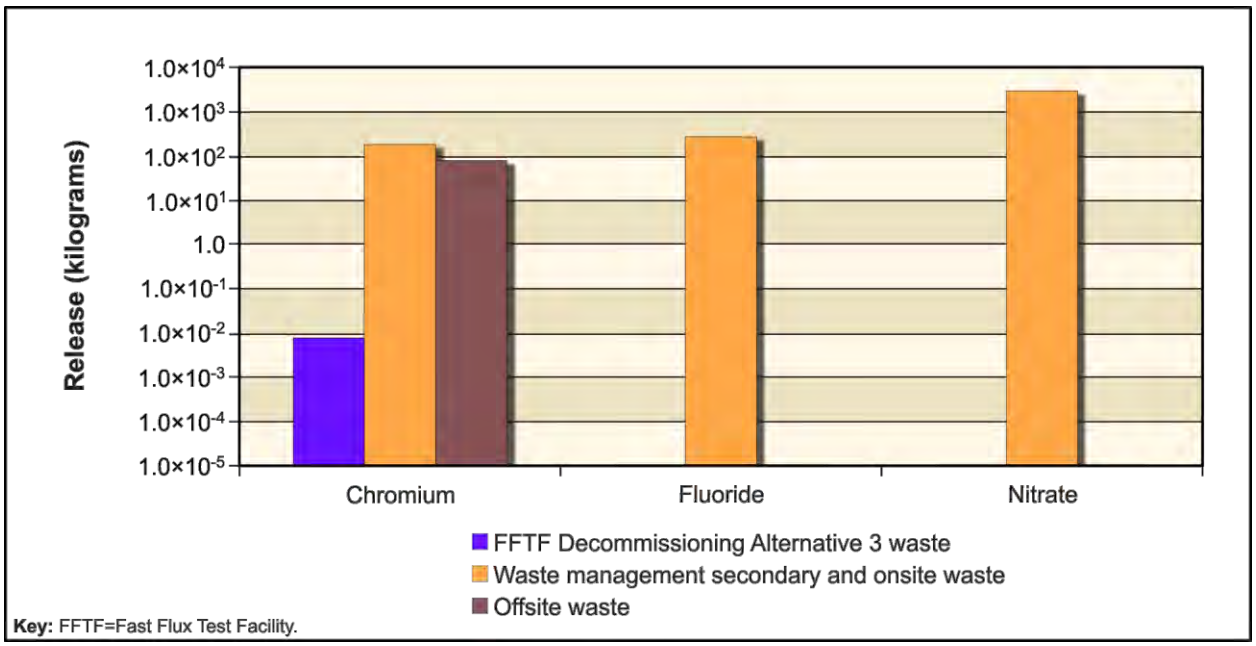


Figure 5–862. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–863 shows the estimated release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–864, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Nearly all (greater than 99 percent) of the IDF-West groundwater technetium-99, iodine-129, chromium, nitrate, and fluoride are released to the Columbia River during the period of analysis.

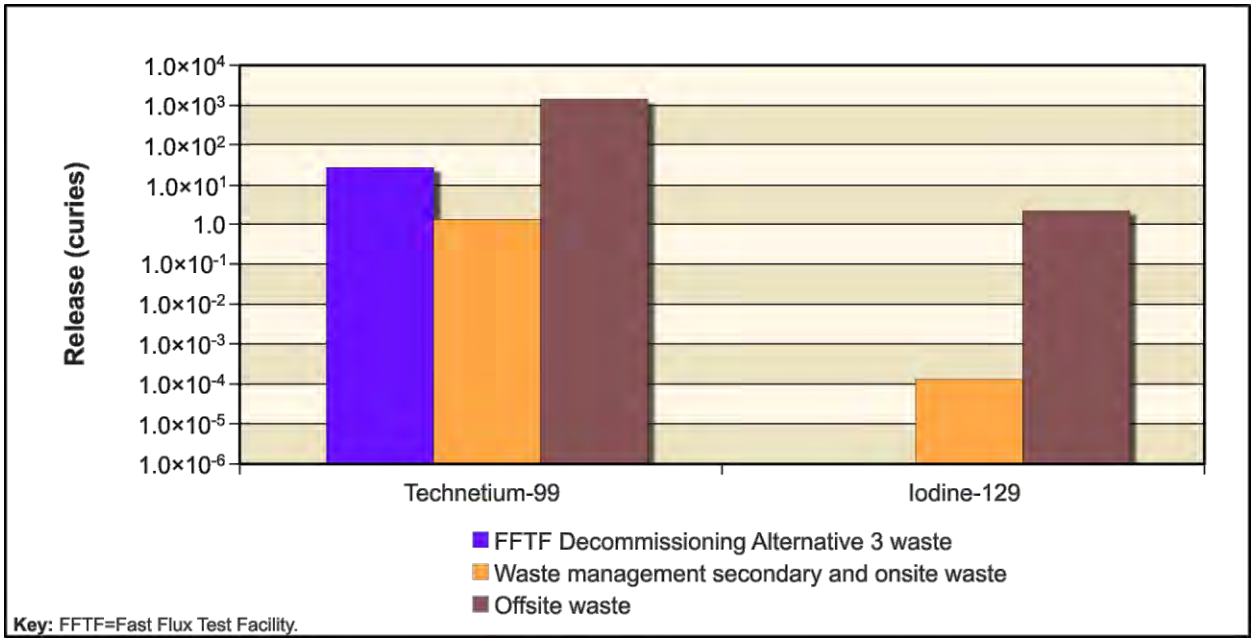


Figure 5–863. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

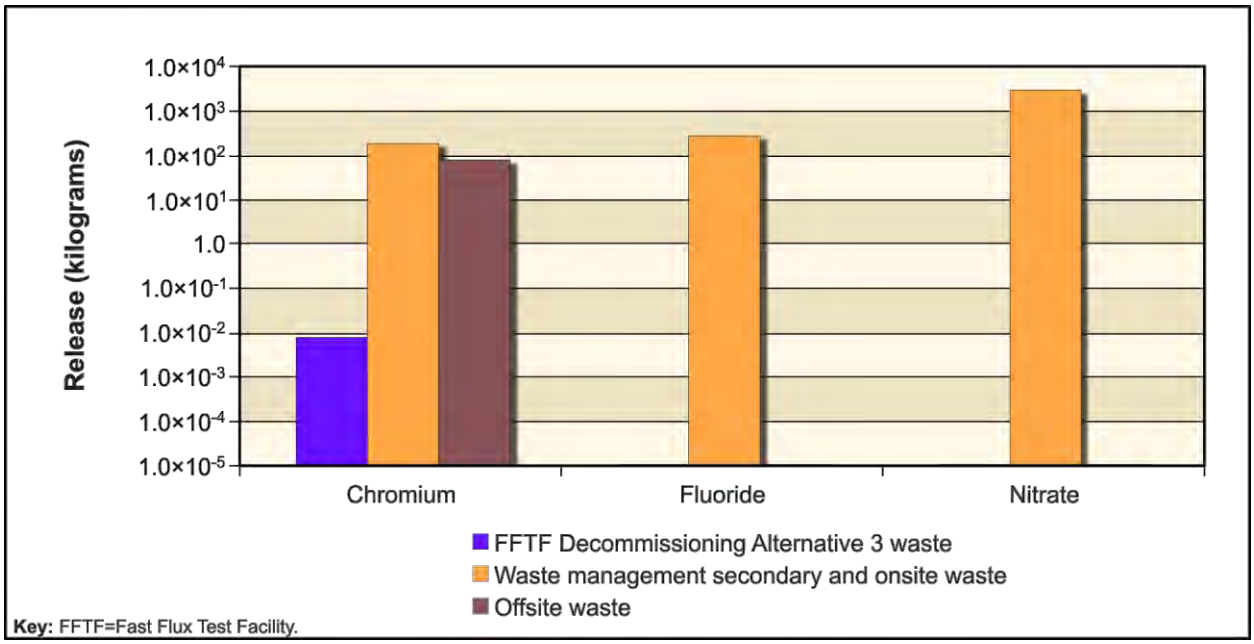


Figure 5–864. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

Overall, most (97 percent) of the IDF-West vadose zone technetium-99, iodine-129, chromium, nitrate, and fluoride reach the Columbia River during the period of analysis.

River Protection Project Disposal Facility

Figure 5–865 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–866, the chemical hazard drivers. Release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). Radionuclide releases from the RPPDF to the vadose zone comprise technetium-99 (largest source) and iodine-129 (smallest source). Chemical hazard releases from the RPPDF comprise nitrate (largest source) and chromium (smallest source). Fluoride is not released from the RPPDF.

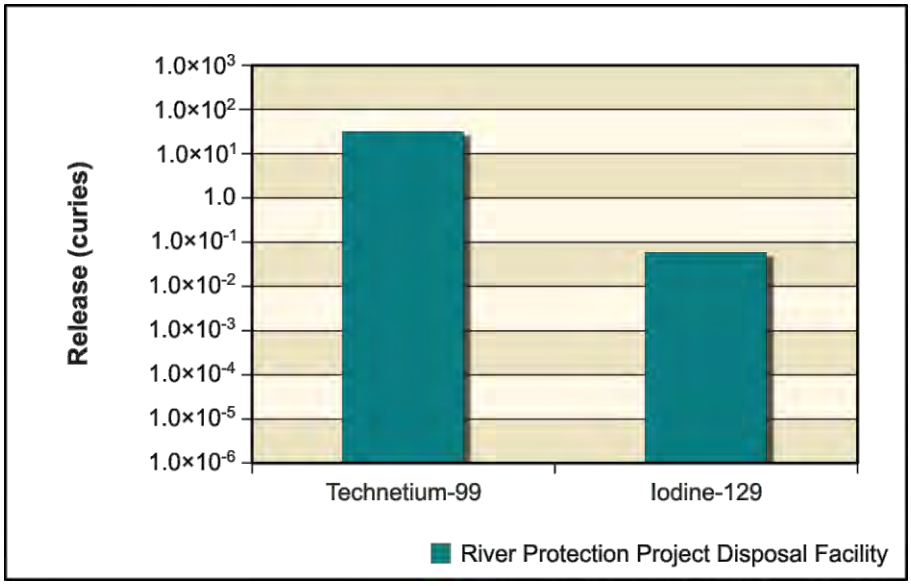


Figure 5–865. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

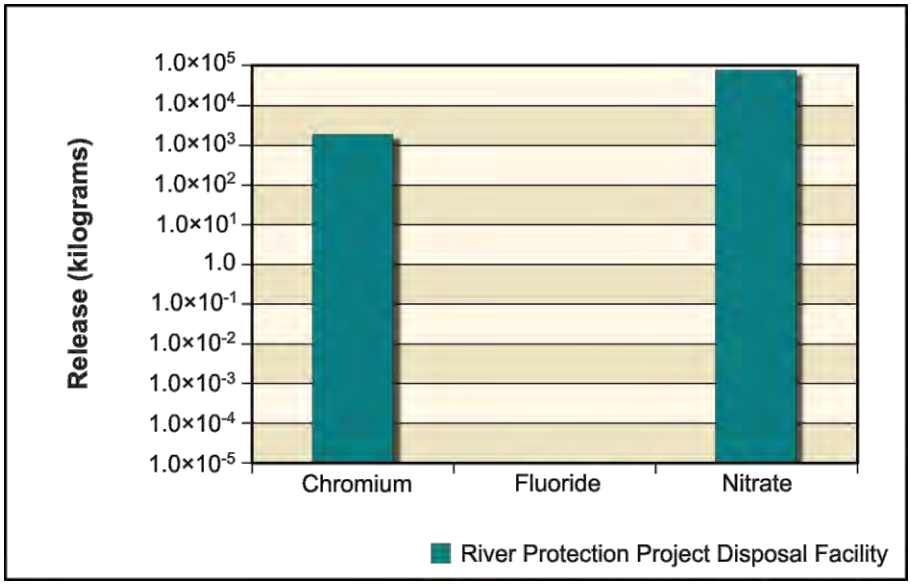


Figure 5–866. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–867 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–868, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Essentially all (99 percent) of the RPPDF vadose zone technetium-99, iodine-129, chromium, and nitrate are released to groundwater.

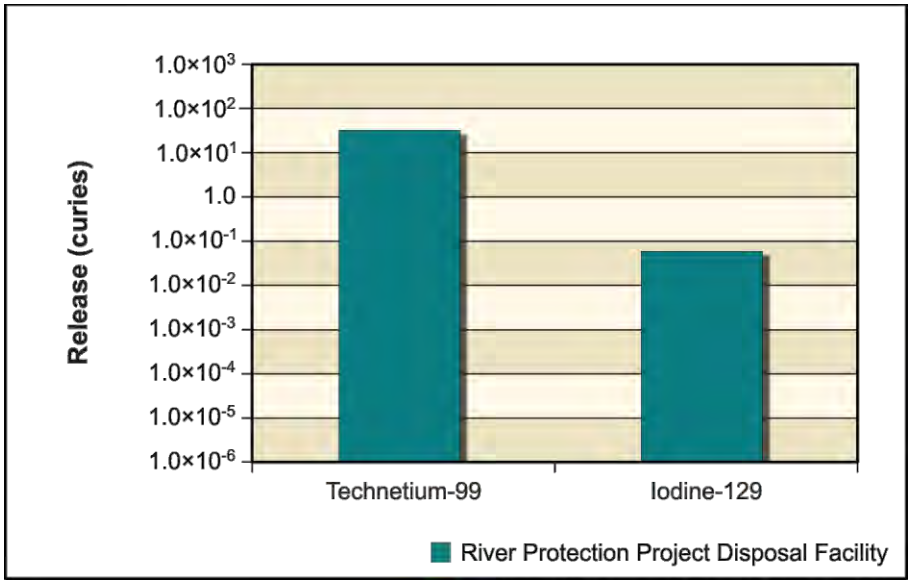


Figure 5–867. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

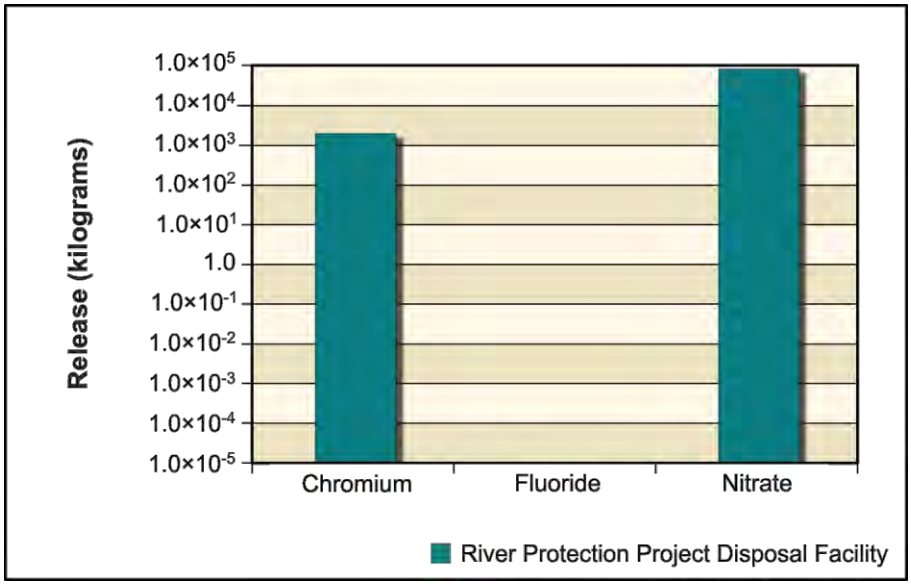


Figure 5–868. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–869 shows the estimated release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–870, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Most (99 percent) of the groundwater technetium-99, iodine-129, chromium, and nitrate are released to the Columbia River.

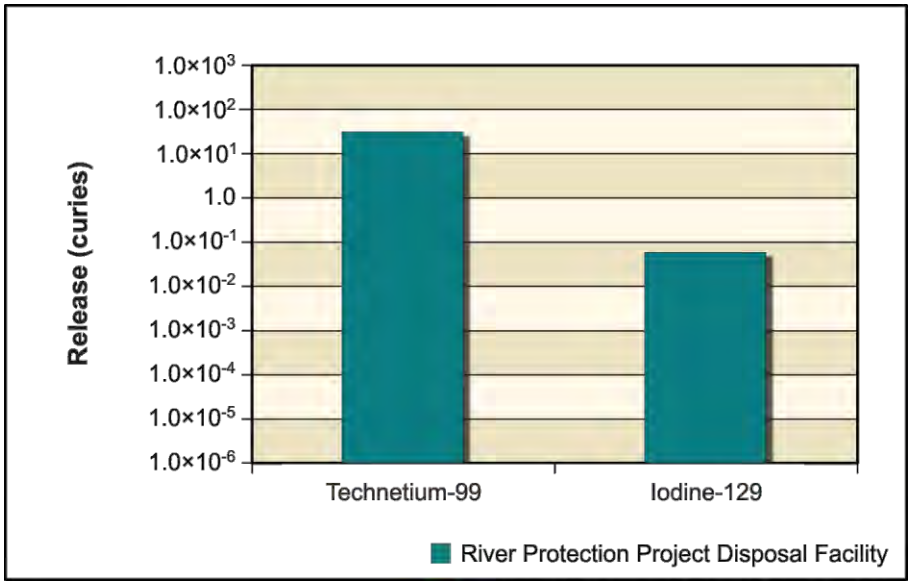


Figure 5–869. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

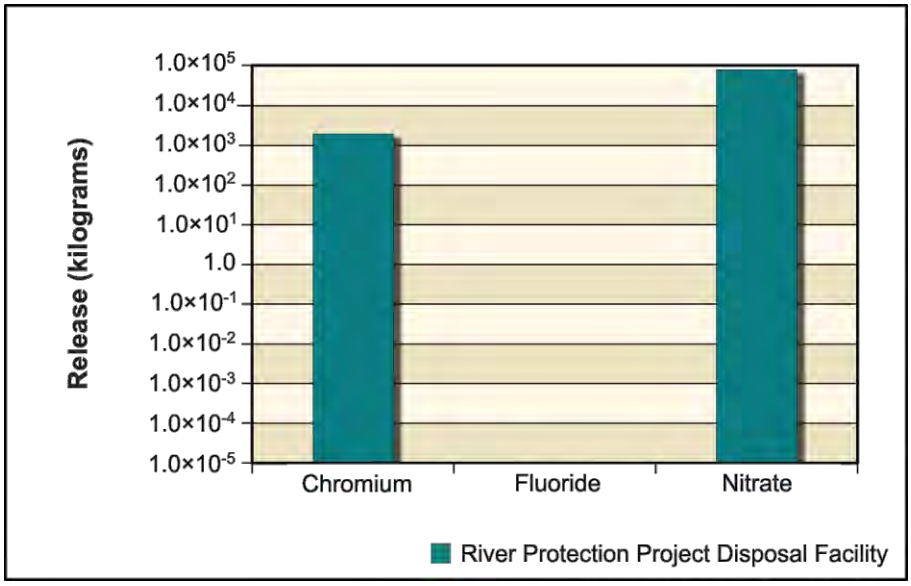


Figure 5–870. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chemical Releases from River Protection Project Disposal Facility to Columbia River

Overall, most (95–96 percent) of the RPPDF vadose zone technetium-99, iodine-129, chromium, and nitrate reach the Columbia River during the period of analysis.

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the analysis of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, impacts in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations. Table 5–110 shows the maximum concentrations in groundwater. Maximum concentrations of technetium-99 and iodine-129 exceed their respective benchmarks only at the IDF-East barrier, IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. The only other exceedance of a benchmark concentration occurs for chromium at the IDF-East barrier in CY 9008.

Table 5–110. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	**3,840**	**13,200**	107	**1,370**	**1,670**	900
	(10,921)	(3818)	(3785)	(3859)	(3920)	
Iodine-129	0.7	**20.6**	0.2	**2.1**	**2.4**	1
	(10,997)	(3794)	(3824)	(3937)	(3872)	
Chemical (micrograms per liter)						
Acetonitrile	11	0	0	3	3	100
	(8959)	(1940)	(1940)	(8894)	(9121)	
Chromium	**175**	1	7	52	40	100
	(9008)	(3813)	(3666)	(8873)	(8827)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	27,200	7	286	8,960	6,820	45,000
	(8700)	(3927)	(3728)	(8189)	(9059)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figures 5–871 through 5–874 show concentration versus time for technetium-99, iodine-129, chromium, and nitrate, respectively. The releases of technetium-99 from IDF-East, IDF-West, and the RPPDF result in concentrations at the IDF-West barrier, Core Zone Boundary, and the Columbia River nearshore that exceed the technetium-99 benchmark concentration over part of the period of analysis (see Figure 5–871). There is a relatively narrow technetium-99 increase after the post-disposal period, when the IDF-West barrier concentration exceeds the benchmark concentration by one order of magnitude for about 1,500 years. The peak, in about CY 3800, is less than one order of magnitude greater than the benchmark concentration at the Core Zone Boundary and Columbia River nearshore. The technetium-99 concentration at the IDF-West barrier then drops below the benchmark concentration by about one to two orders of magnitude. Technetium-99 concentrations at the Core Zone Boundary and Columbia River nearshore remain at about the benchmark level for the duration of the simulation. Technetium-99 concentrations at the IDF-East barrier begin to increase steadily beginning in about CY 4500 and exceed the benchmark concentration from approximately CY 7000 until CY 11,940.

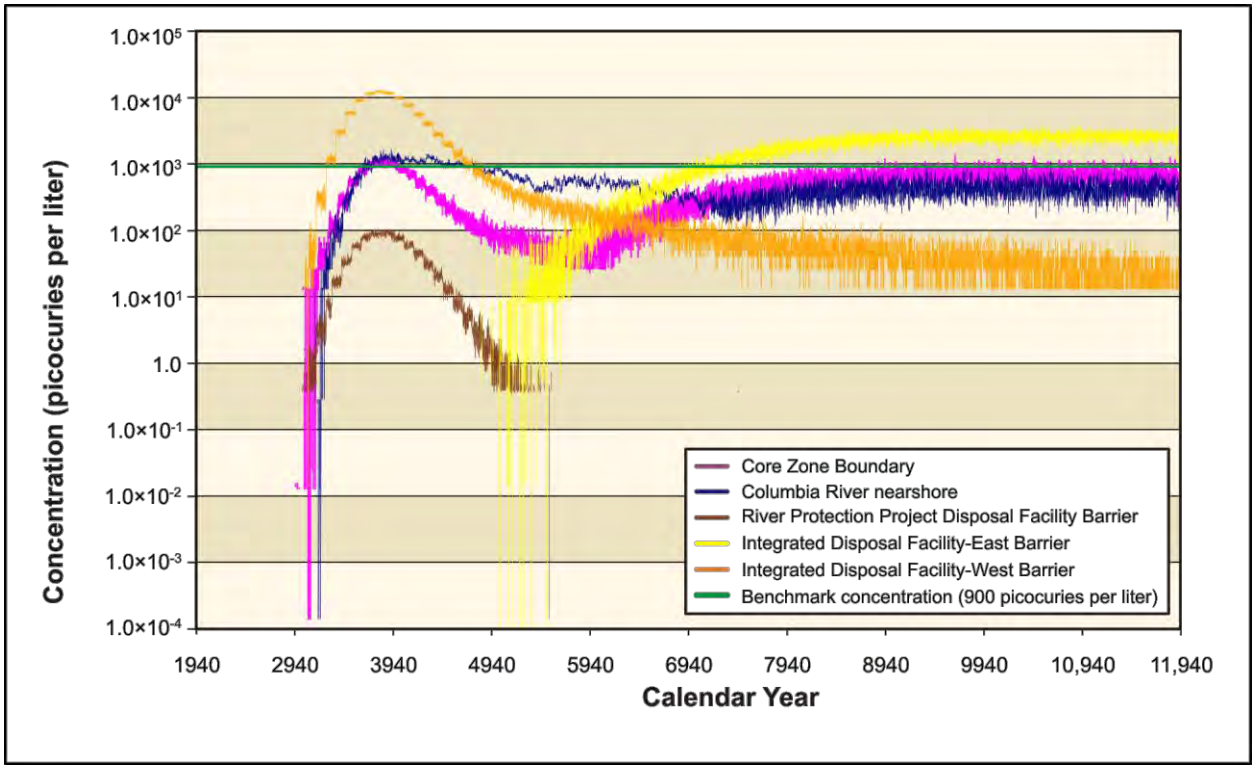


Figure 5–871. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Technetium-99 Concentration Versus Time

The iodine-129 concentration versus time (see Figure 5–872) shows a similar response at the Core Zone Boundary and the Columbia River nearshore. The iodine-129 peak in CY 3800 at the IDF-West barrier is one to two orders of magnitude above the benchmark and less than an order of magnitude above the benchmark at the Core Zone Boundary and Columbia River nearshore. The iodine-129 then decreases to an order of magnitude below the benchmark concentration level and remains steady at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore through the remainder of the period of analysis (CY 11,940). The later rise in iodine-129 concentrations at the IDF-East barrier never exceeds the benchmark concentration.

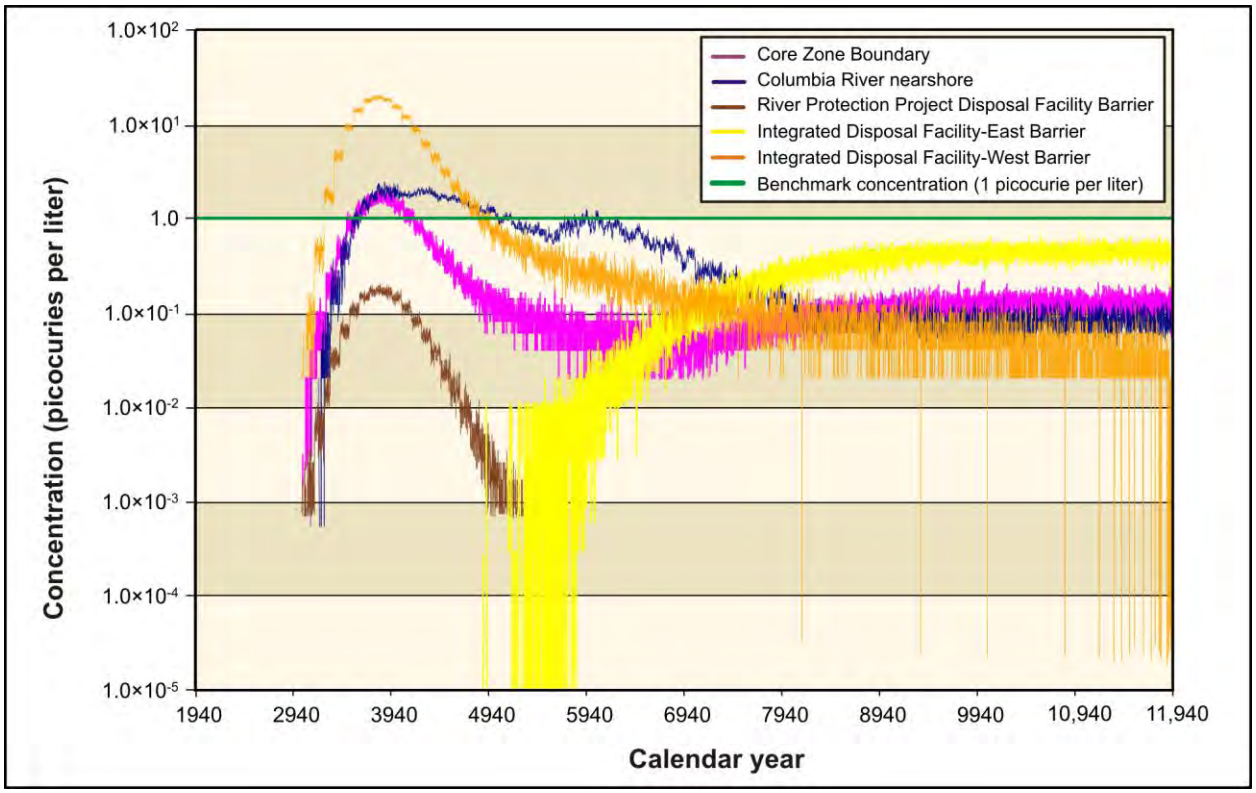


Figure 5–872. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Iodine-129 Concentration Versus Time

Figures 5–873 and 5–874 also show an initial increase in the IDF-West barrier, RPPDF barrier, and Core Zone Boundary chromium and nitrate, followed by a second, broader increase period related to the IDF-East releases that peaks at about the two-thirds point of the analysis period. The chromium concentrations exceed the benchmark concentration only at the IDF-East barrier from about CY 8000 to CY 10,000, but then decline; by CY 11,940, concentrations are about one order of magnitude below the benchmark concentration. The nitrate concentration remains less than one order of magnitude below the benchmark concentration throughout the period of analysis at the IDF-East barrier, IDF-West barrier, RPPDF barrier, Core Zone Boundary, and Columbia River nearshore.

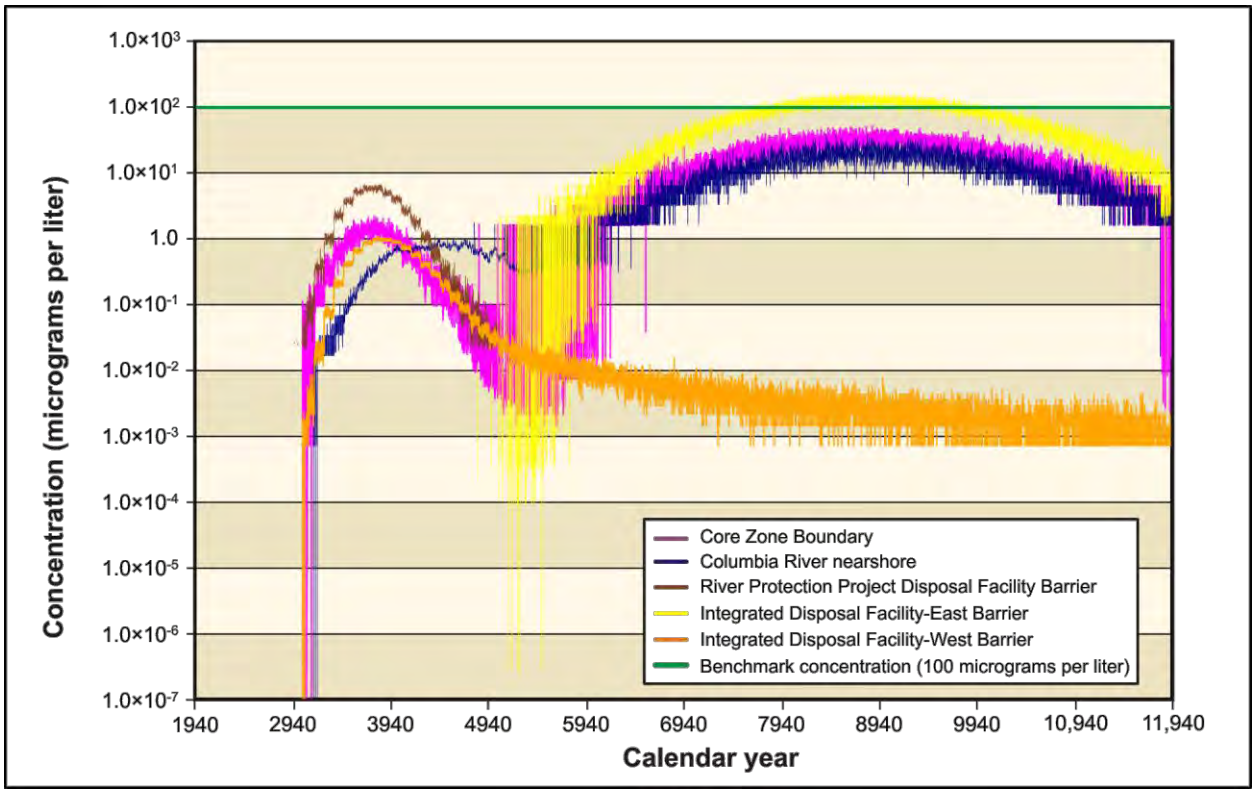


Figure 5–873. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Chromium Concentration Versus Time

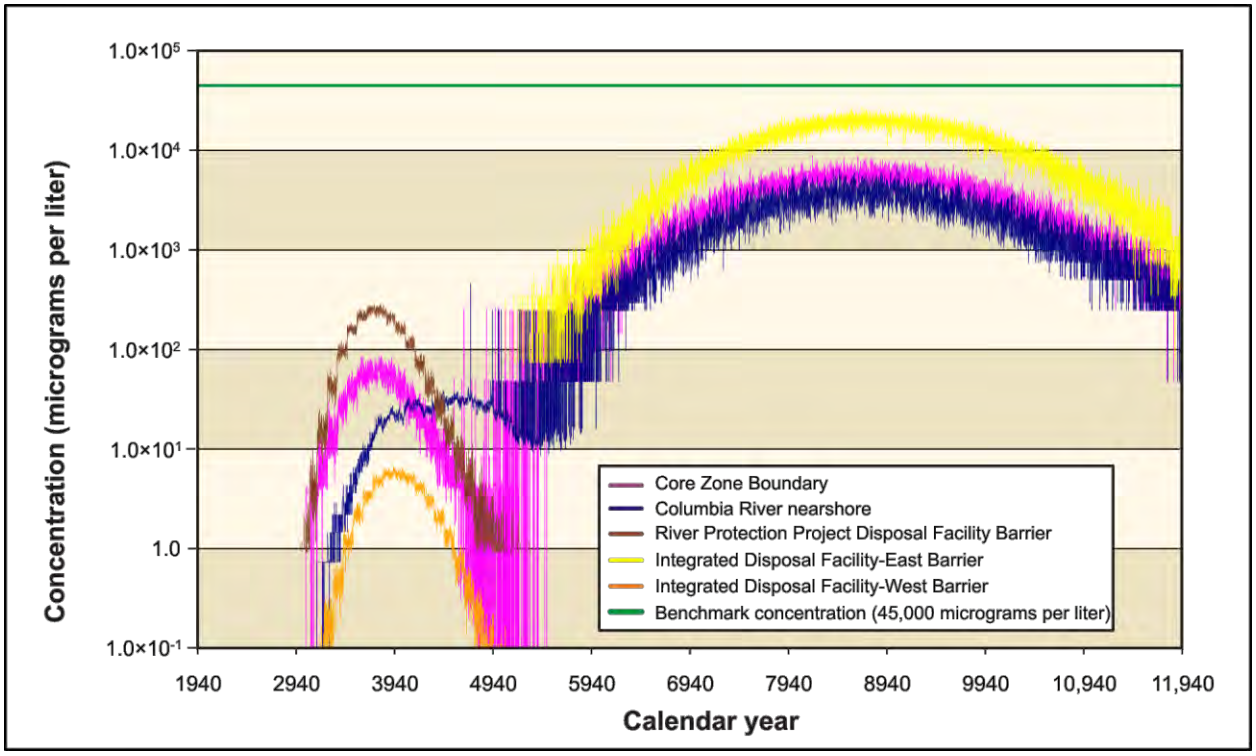


Figure 5–874. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Nitrate Concentration Versus Time

Figure 5–875 shows concentration versus time for total uranium. Because total uranium moves slowly through the vadose zone, releases from IDF-East, IDF-West, and the RPPDF result in groundwater concentrations at the Core Zone Boundary and the Columbia River nearshore that are always significantly lower than the benchmark concentrations. Toward the latter half of the period of analysis, total uranium (see Figure 5–875) concentrations at the RPPDF barrier, Core Zone Boundary, and Columbia River nearshore increase. The total uranium concentrations are less than six orders of magnitude below the benchmark concentration by the end of the period of analysis (CY 11,940).

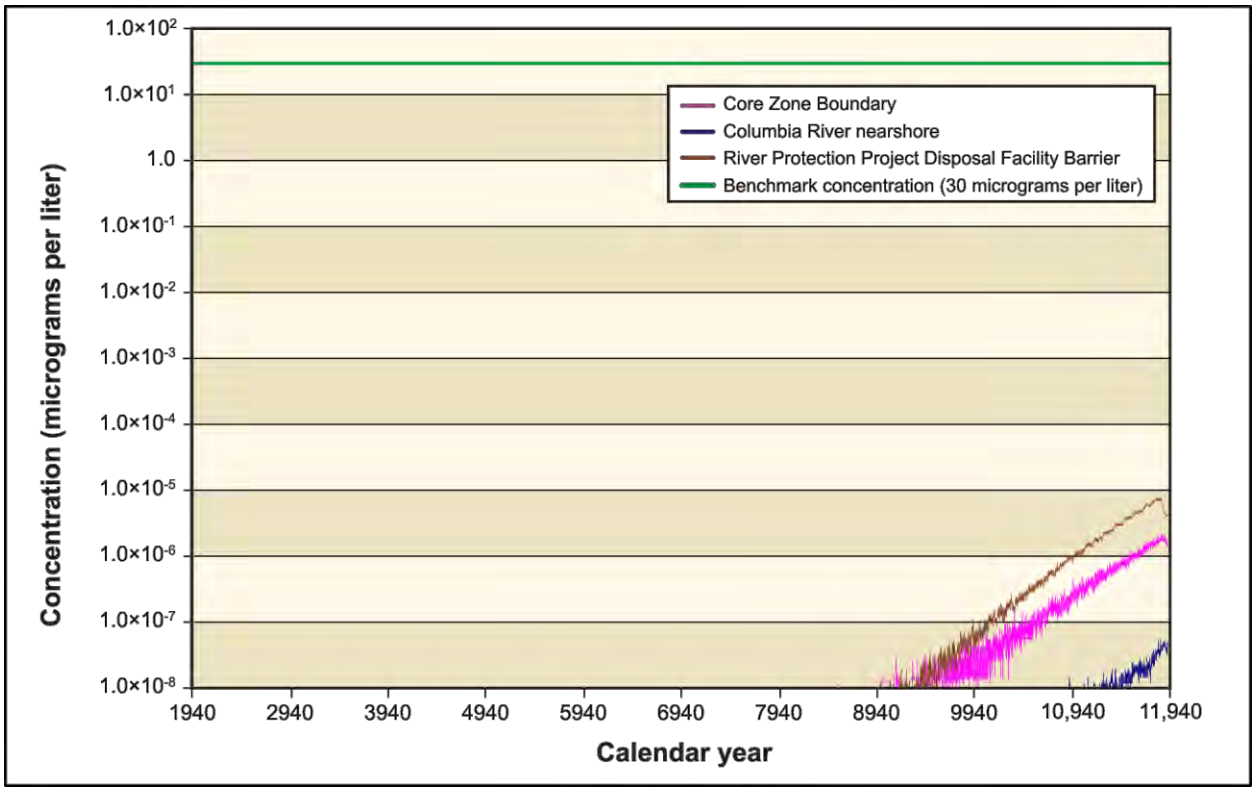


Figure 5–875. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Total Uranium Concentration Versus Time

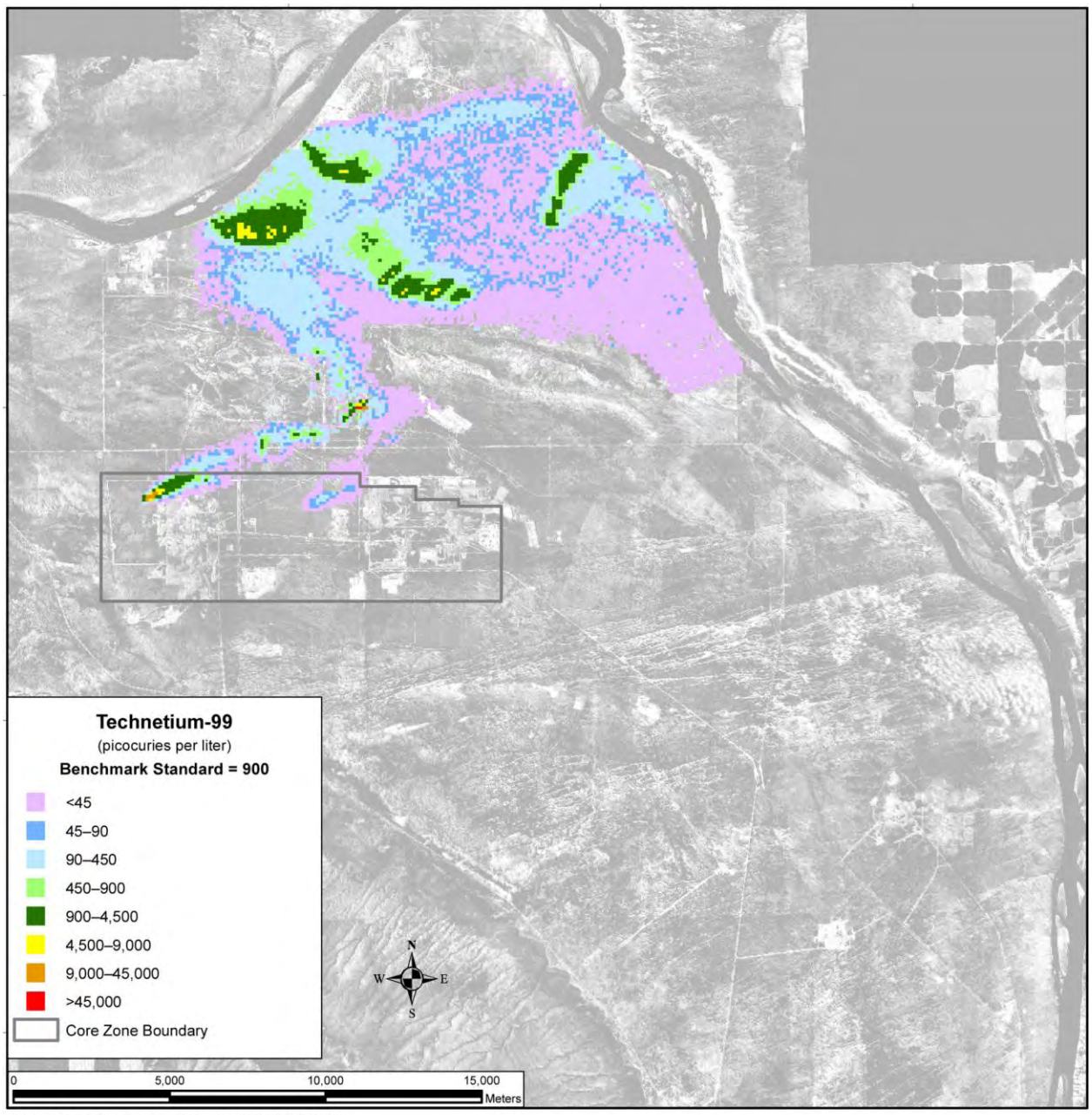
ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations.

Figures 5–876 through 5–887 show concentration distributions in CYs 3890, 7140, and 11,885 for technetium-99, iodine-129, nitrate, and chromium. Figure 5–888 shows the concentration distribution for total uranium in CY 11,885. These data show the groundwater releases from the RPPDF and IDF-West that extend north from within the Core Zone to the Columbia River. These concentration distributions show that the releases of technetium-99, iodine-129, nitrate, and chromium occur significantly earlier at the RPPDF and IDF-West than the same releases at IDF-East. The RPPDF and IDF-West releases remain

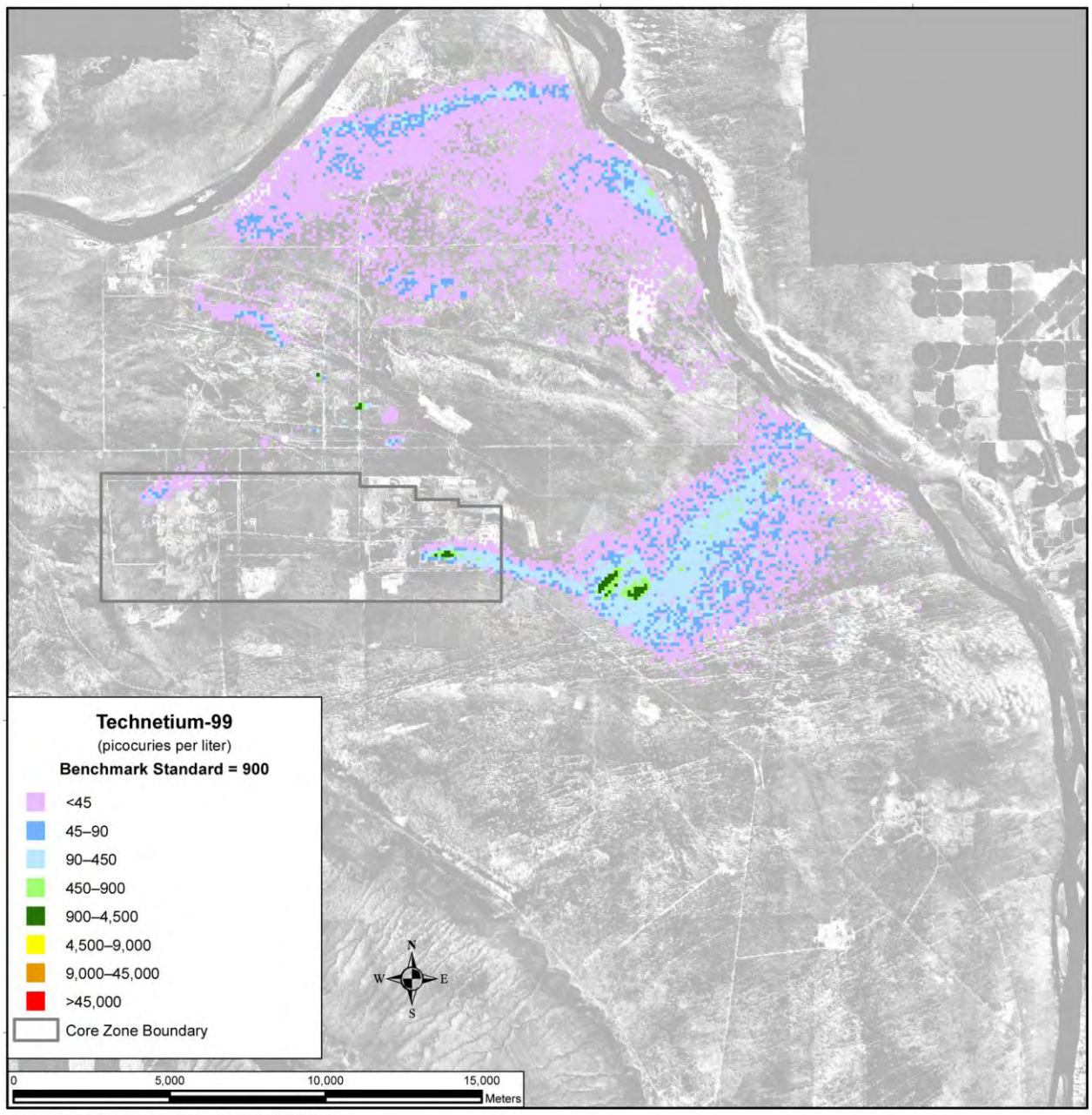
in a fairly narrow channel (Gable Gap) until about halfway to the Columbia River nearshore. The releases then spread out over the northern tip area of Hanford. The IDF-East releases remain in a relatively narrow channel until they reach about the one-quarter distance point to the Columbia River, where the releases spread out and continue to the Columbia River nearshore.

Figure 5–876 shows the technetium-99 release from IDF-West and the RPPDF in CY 3890. This spatial distribution shows that the technetium-99 exceeds the benchmark concentration within the Core Zone (due to the IDF-West release) and in several areas close to the Columbia River nearshore. There are several small areas with very high concentrations of technetium-99 (several orders of magnitude larger than the benchmark concentration) at the IDF-West barrier. Figure 5–877 shows that the technetium-99 release from IDF-West and the RPPDF has dissipated by CY 7140 and only exists in areas close to the Columbia River nearshore at concentrations at least one order of magnitude lower than the benchmark concentration. This figure also shows a technetium-99 release distribution from IDF-East. This shows significant areas where the technetium-99 approaches or exceeds the benchmark concentration. Figure 5–878 shows the continued dissipation of the IDF-West and RPPDF groundwater technetium-99 in CY 11,885. In contrast, in CY 11,885, the IDF-East technetium-99 distribution has continued to spread toward the Columbia River. In CY 11,885, significant areas exist where the technetium-99 concentrations from the IDF-East release still exceed the benchmark concentration; levels are at least one order of magnitude larger than the benchmark concentration in parts of these areas.



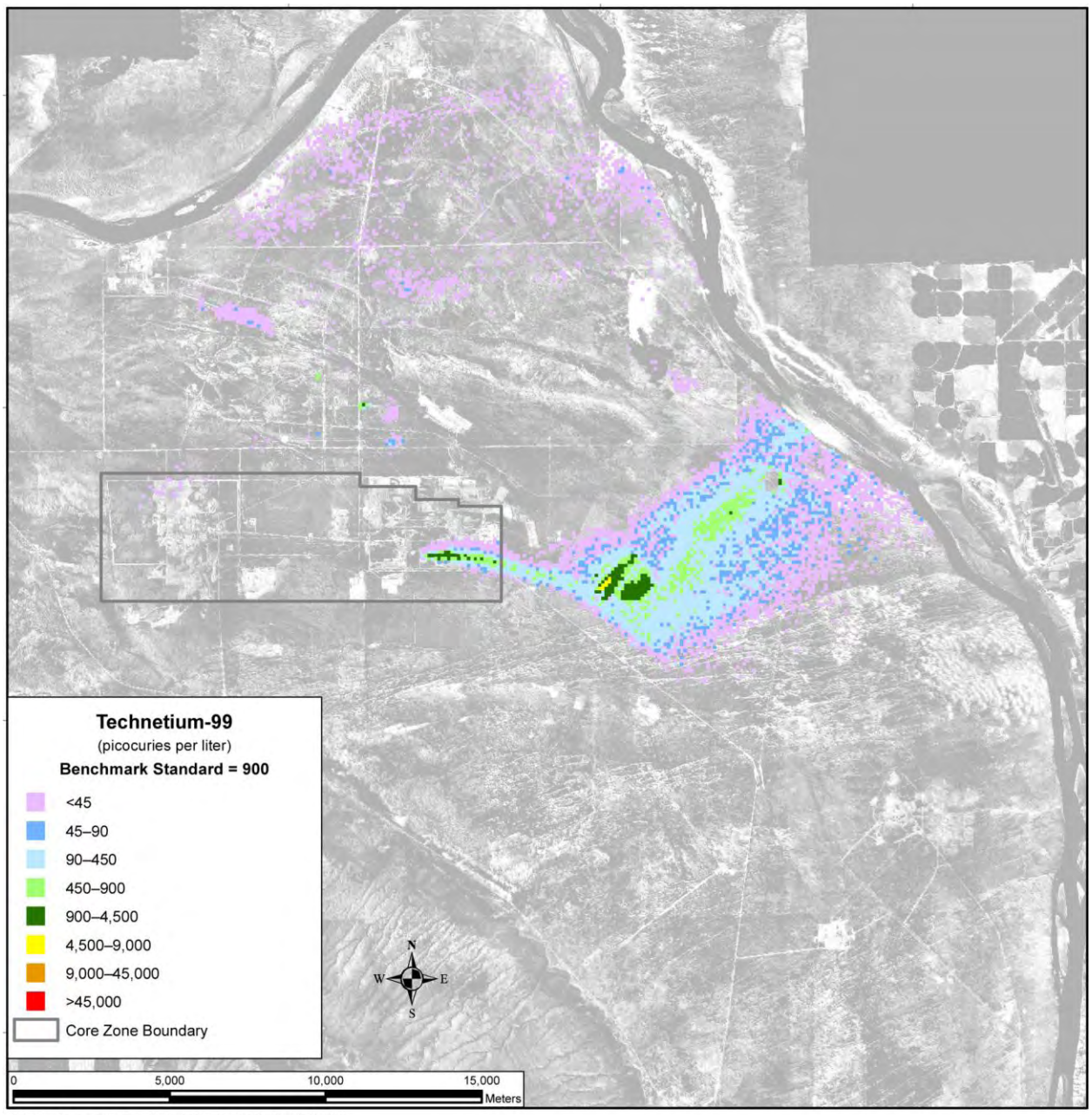
Note: To convert meters to feet, multiply by 3.281.

Figure 5–876. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



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

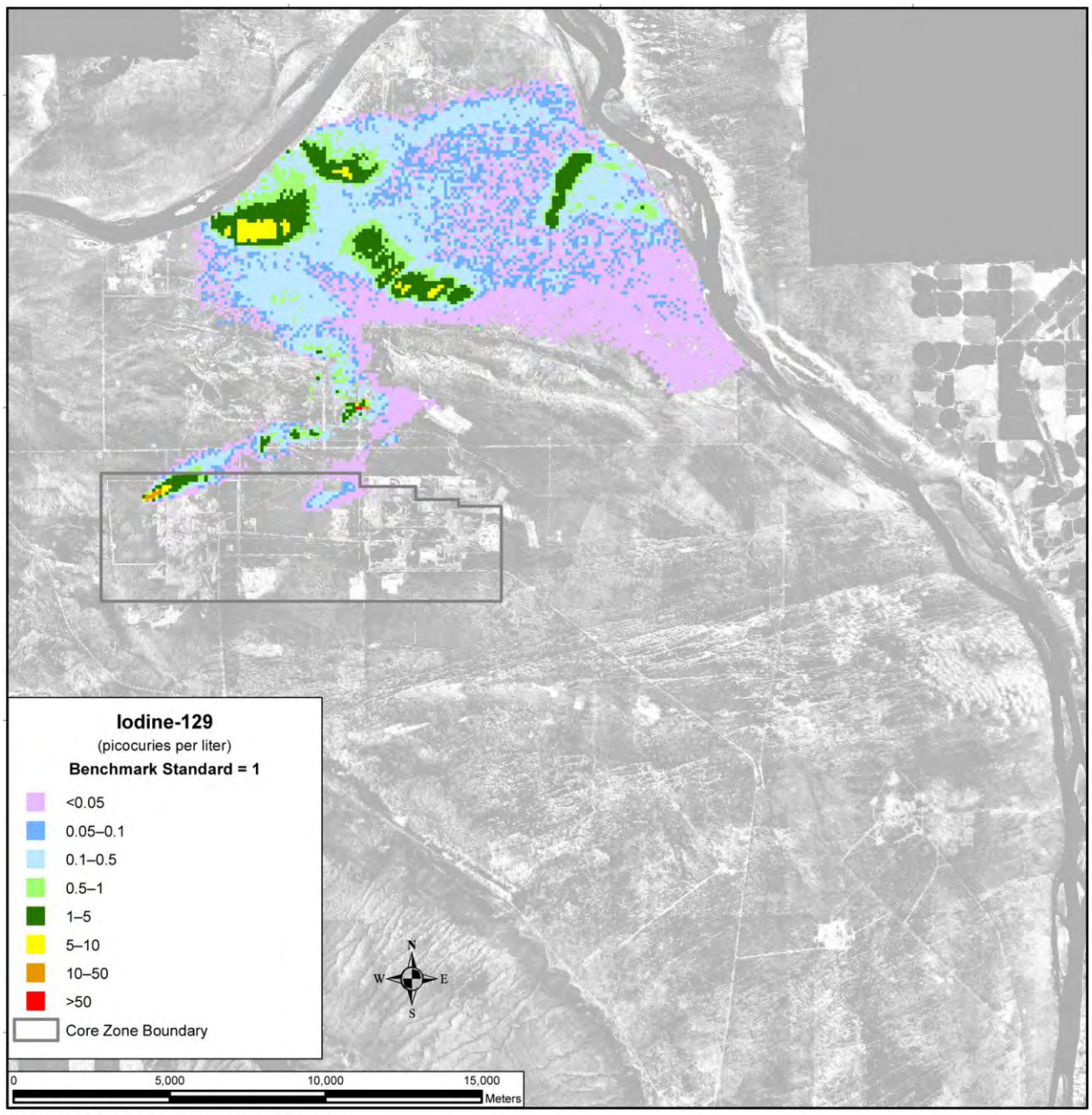
Figure 5–877. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



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

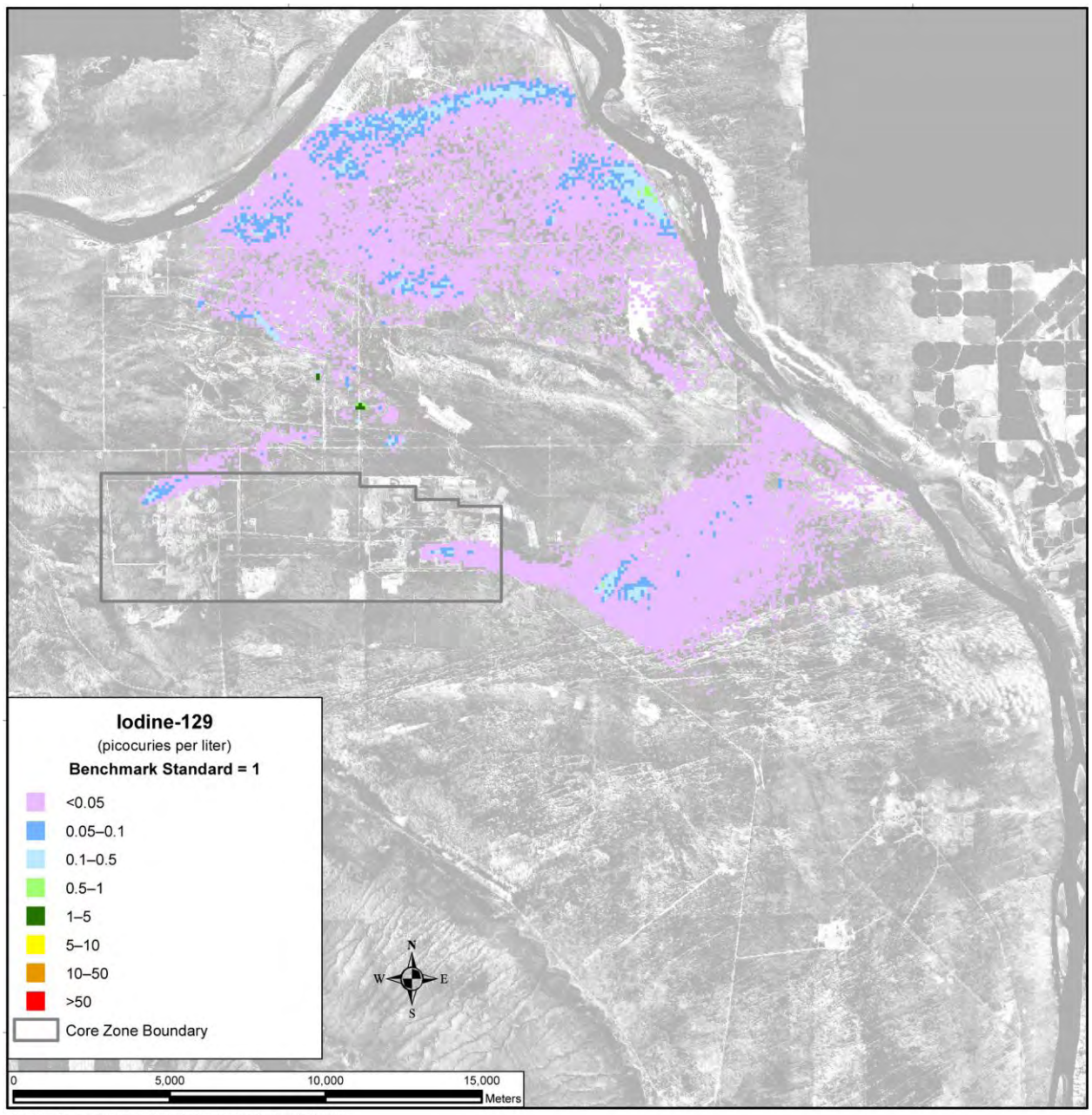
Figure 5–878. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885

Figures 5–879 through 5–881 show iodine-129 released from IDF-East, IDF-West, and the RPPDF with a spatial distribution very similar to the technetium-99 release. However, the CY 3890 iodine-129 release (see Figure 5–879) shows higher relative concentrations (compared with the benchmark concentration) than the technetium-99 release. The areas of high concentrations are in the same locales, but these areas have levels that exceed the benchmark concentration by at least one order of magnitude. The iodine-129 released from IDF-West and the RPPDF has significantly dissipated by CY 7140 (see Figure 5–880). The IDF-West iodine-129 release shows less area in which concentrations are at or above the benchmark concentration than the technetium-99 release. The iodine-129 released from IDF-East in CY 11,885 (see Figure 5–881) shows the same relative spatial distribution as technetium-99, but the areas that approach or exceed the benchmark concentration are significantly smaller.



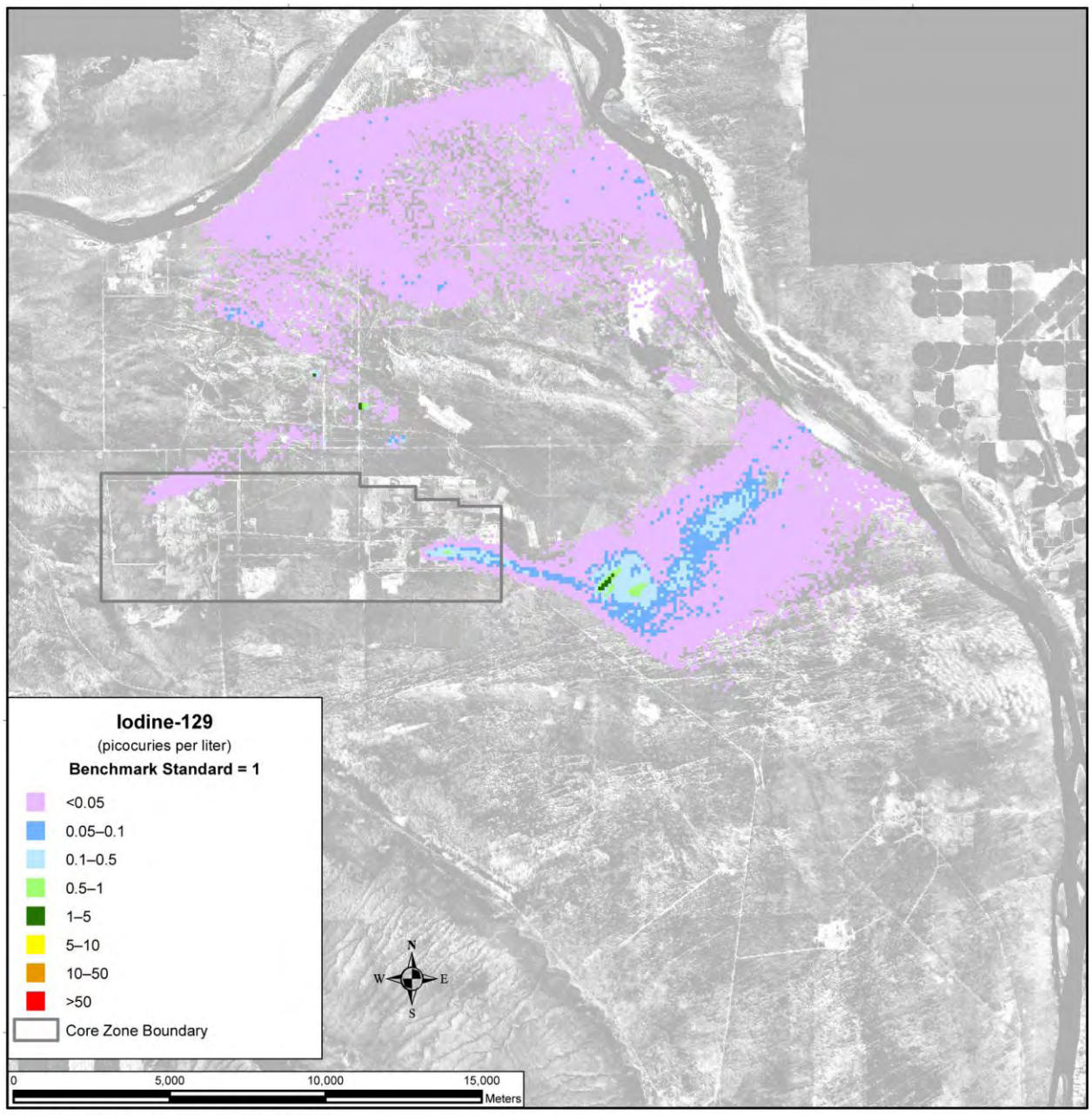
Note: To convert meters to feet, multiply by 3.281.

Figure 5–879. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



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

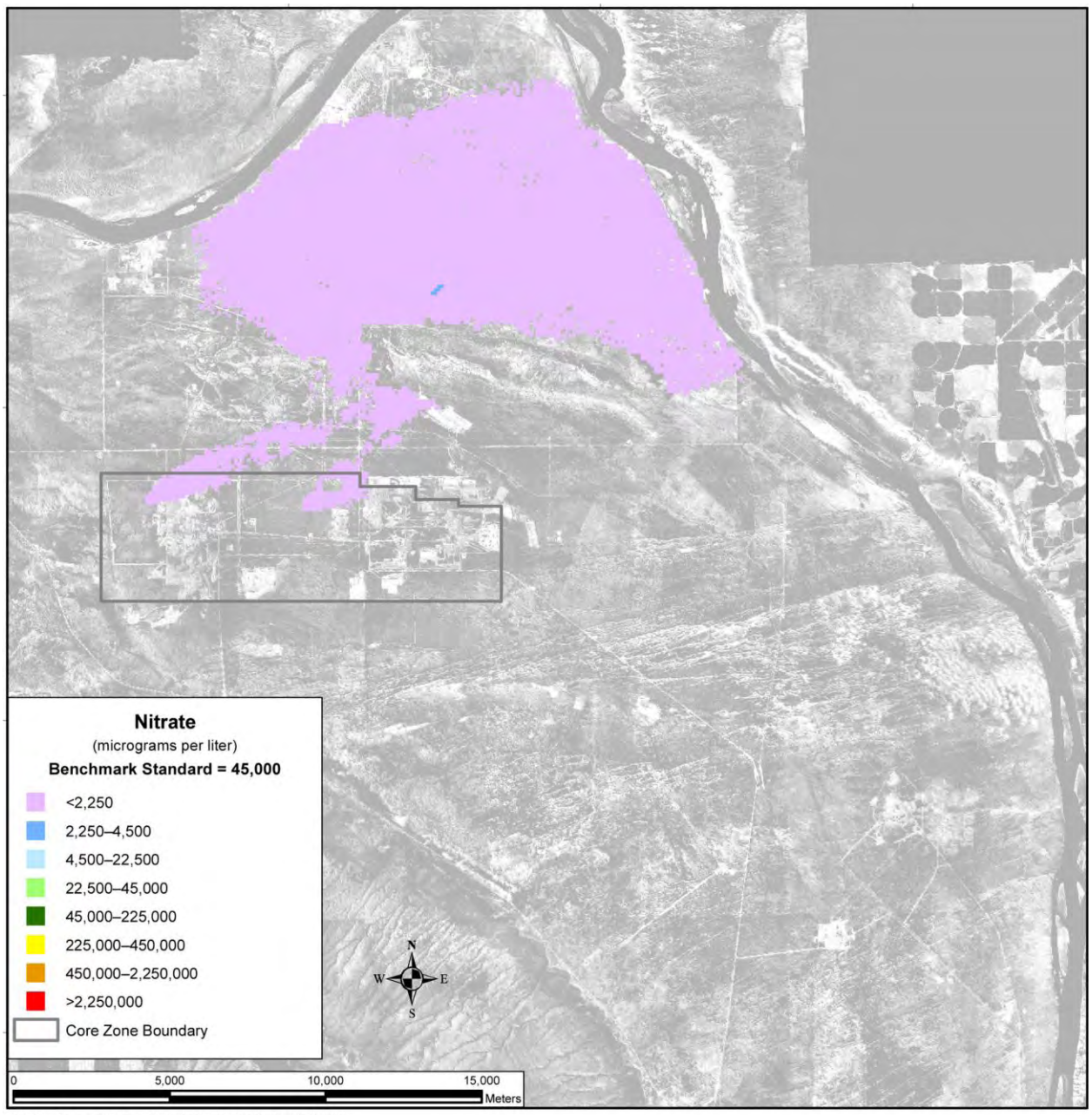
Figure 5–880. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



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

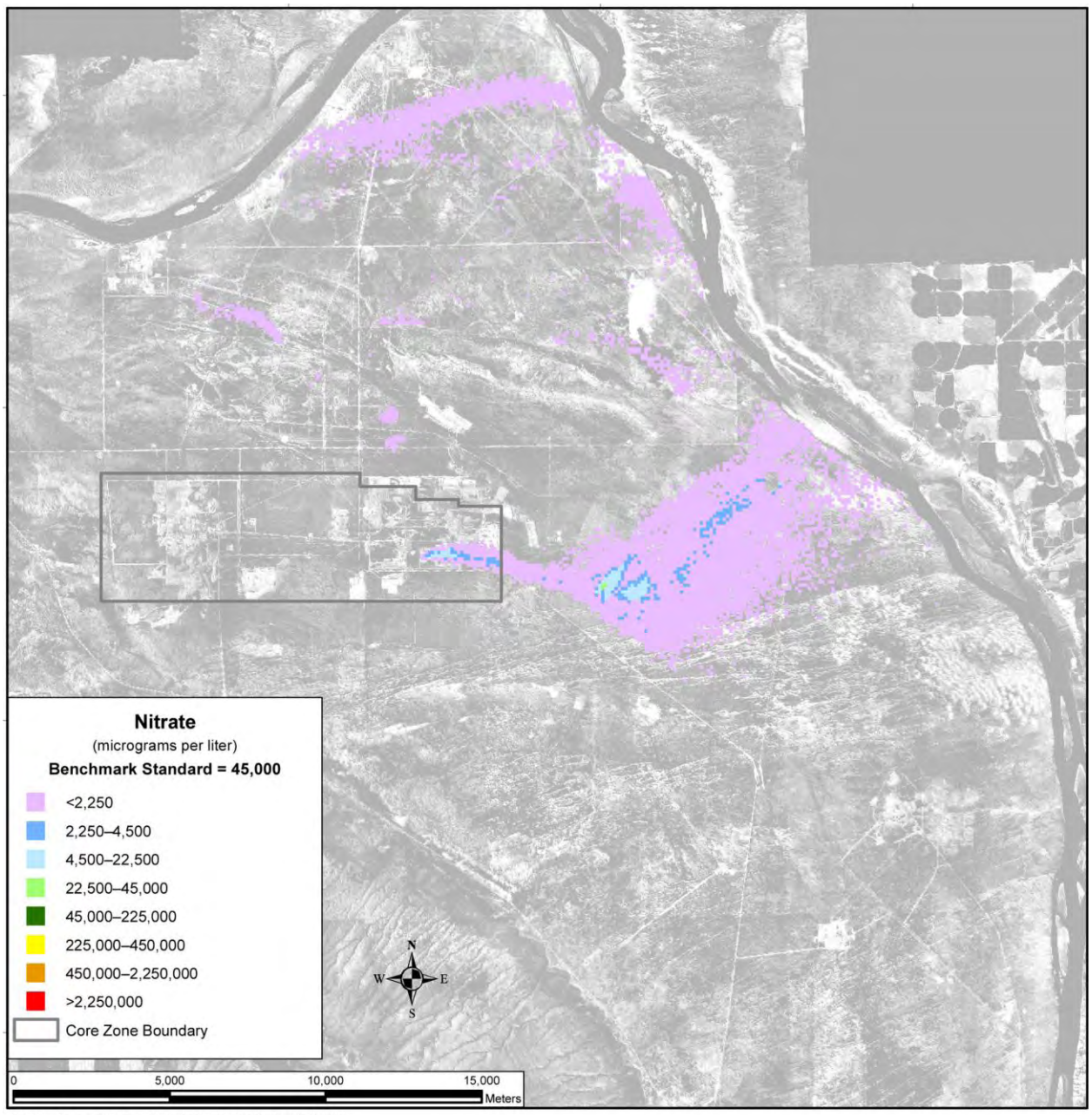
Figure 5–881. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885

The IDF-East, IDF-West, and RPPDF nitrate releases, shown in Figures 5–882 through 5–884, show time and spatial distributions similar to the technetium-99 and iodine-129 releases. However, because the inventory of nitrate is lower than that of technetium-99 and iodine-129, concentrations of nitrate in these distributions are significantly less than the nitrate benchmark concentration. By CY 11,885, most of the groundwater nitrate has dissipated.



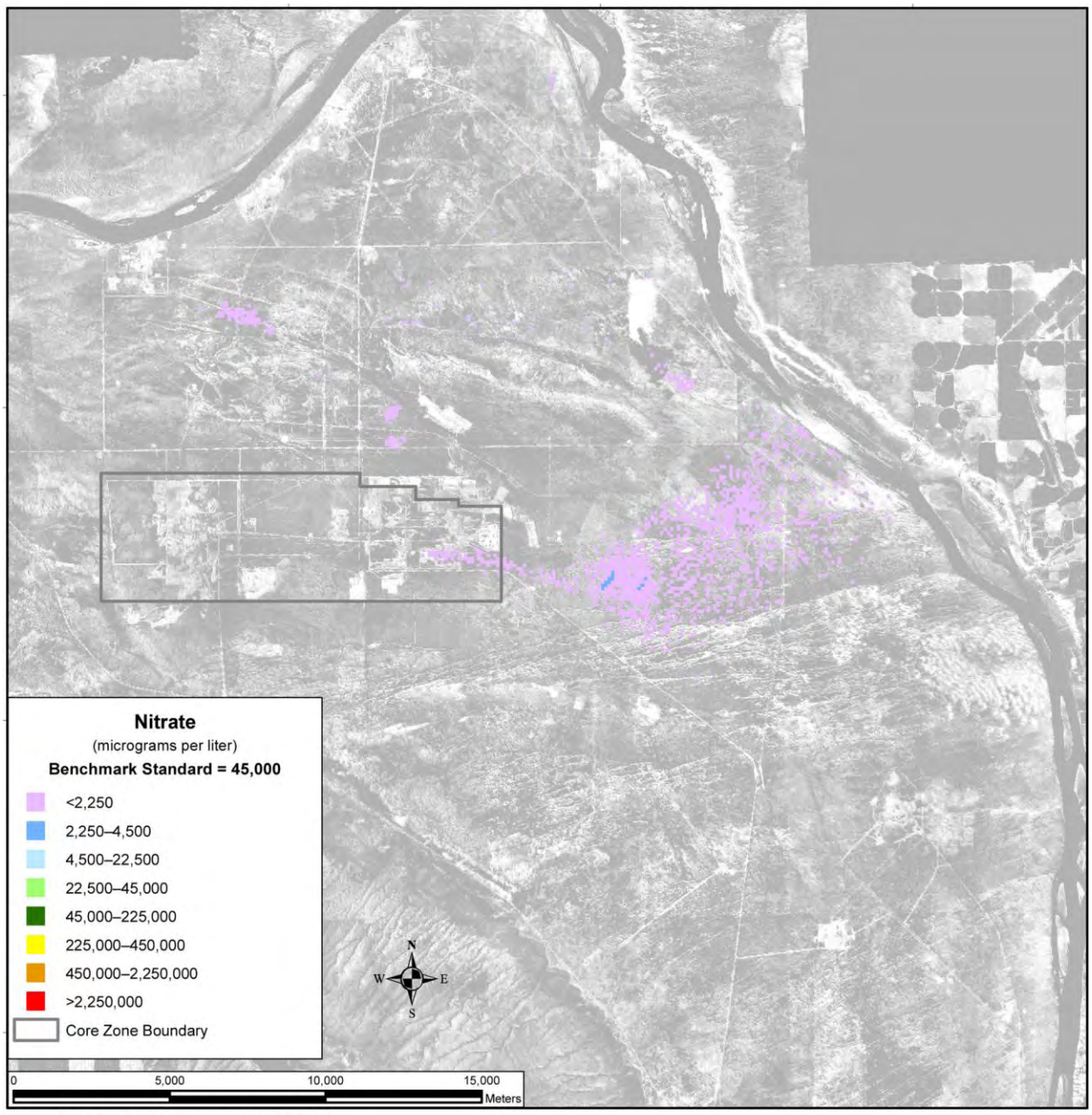
Note: To convert meters to feet, multiply by 3.281.

Figure 5–882. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



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

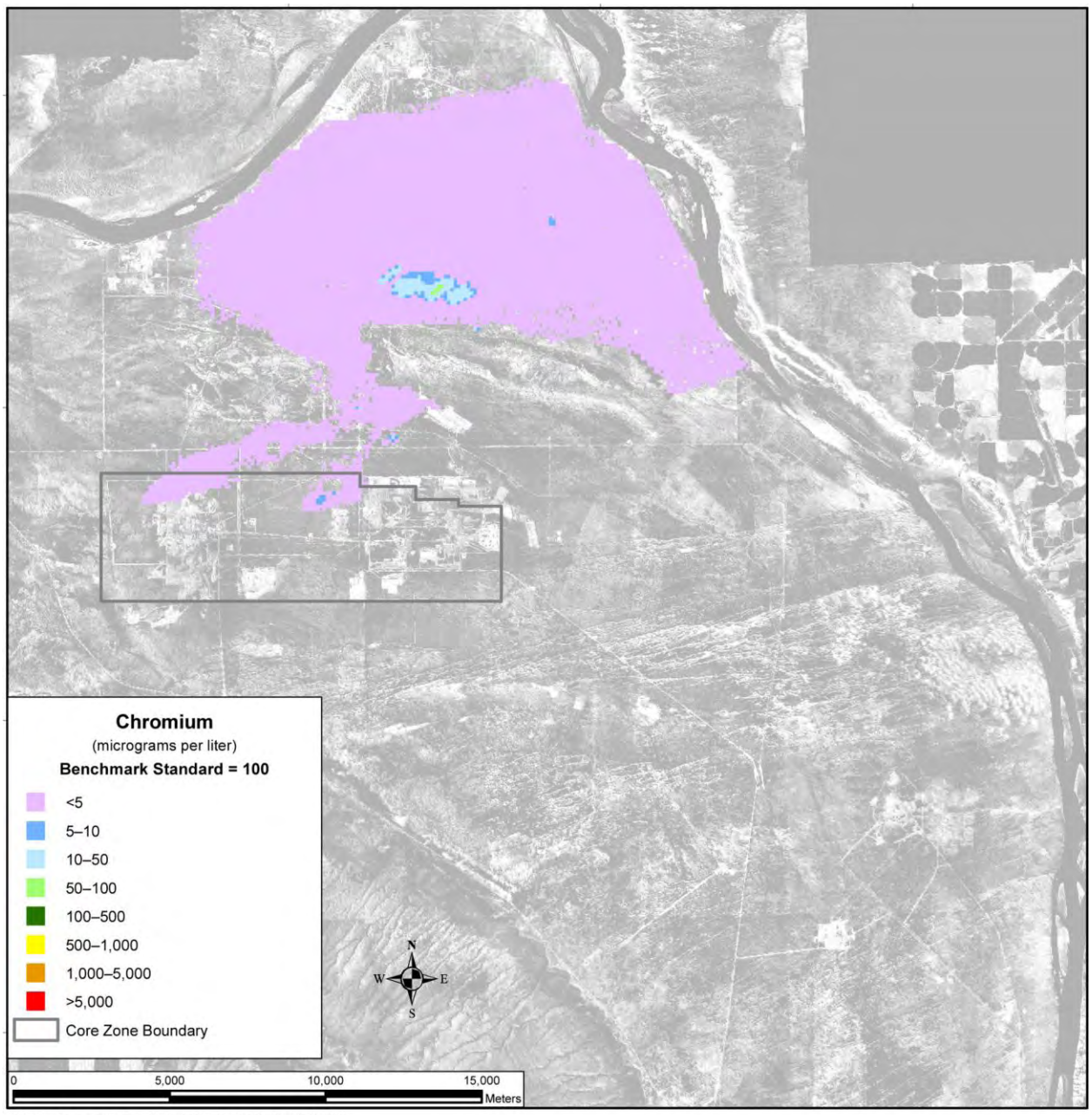
Figure 5–883. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



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

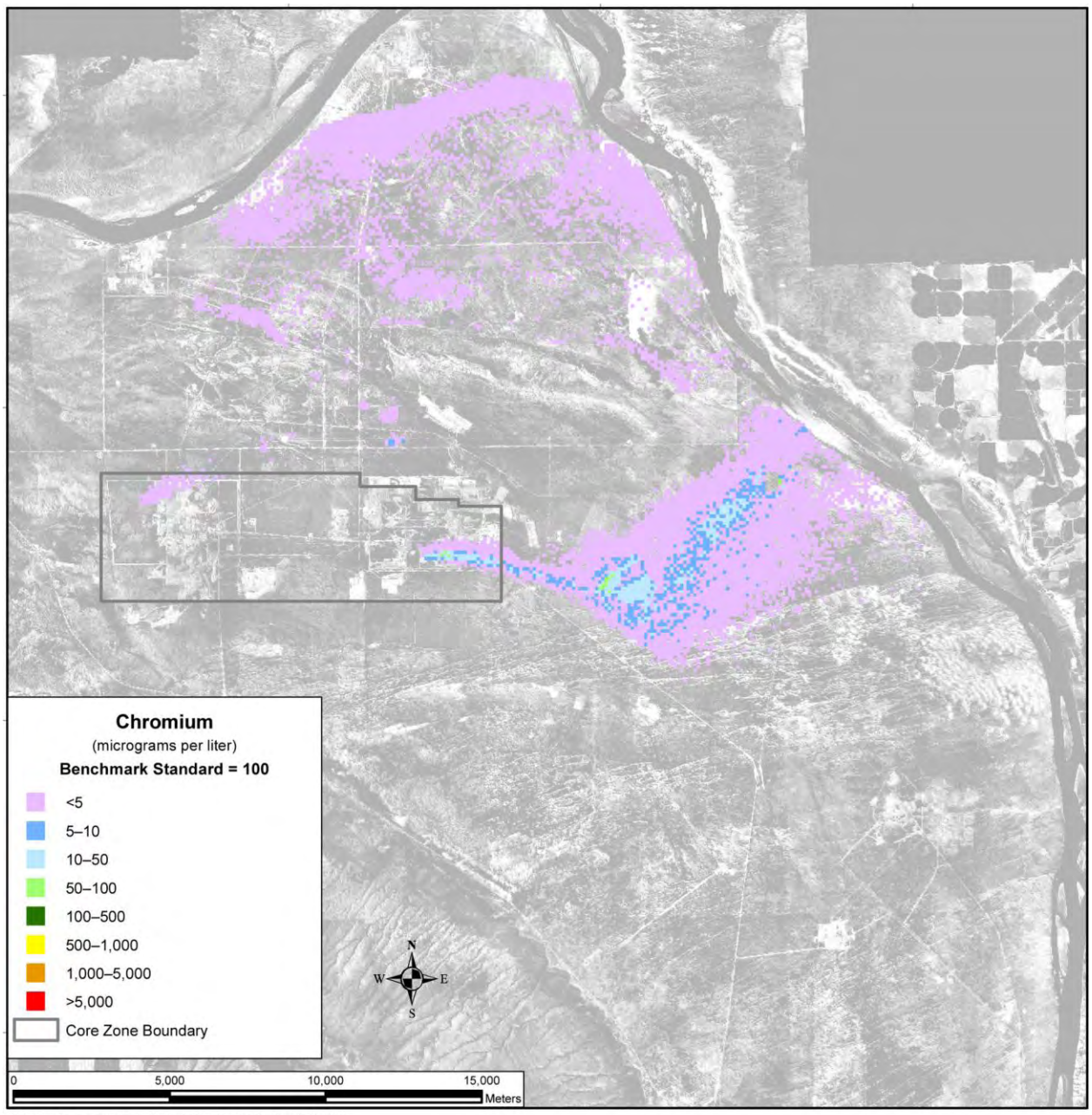
Figure 5–884. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

The initial chromium release time and spatial patterns in CY 3890 are nearly identical to the IDF-West and RPPDF nitrate releases (see Figure 5–885). There are several small areas where the chromium concentration approaches or exceeds its benchmark concentration. Most of the chromium released from IDF-West and the RPPDF has dissipated to the Columbia River by CY 7140 (see Figure 5–886). This figure also shows a significant chromium distribution from IDF-East with small areas that exceed benchmark concentrations. By CY 11,885, the IDF-West and RPPDF chromium has essentially dissipated (see Figure 5–887). However, there is a significant distribution of chromium that extends from the IDF-East release site to the Columbia River. Most of the distribution is well below benchmark concentrations.



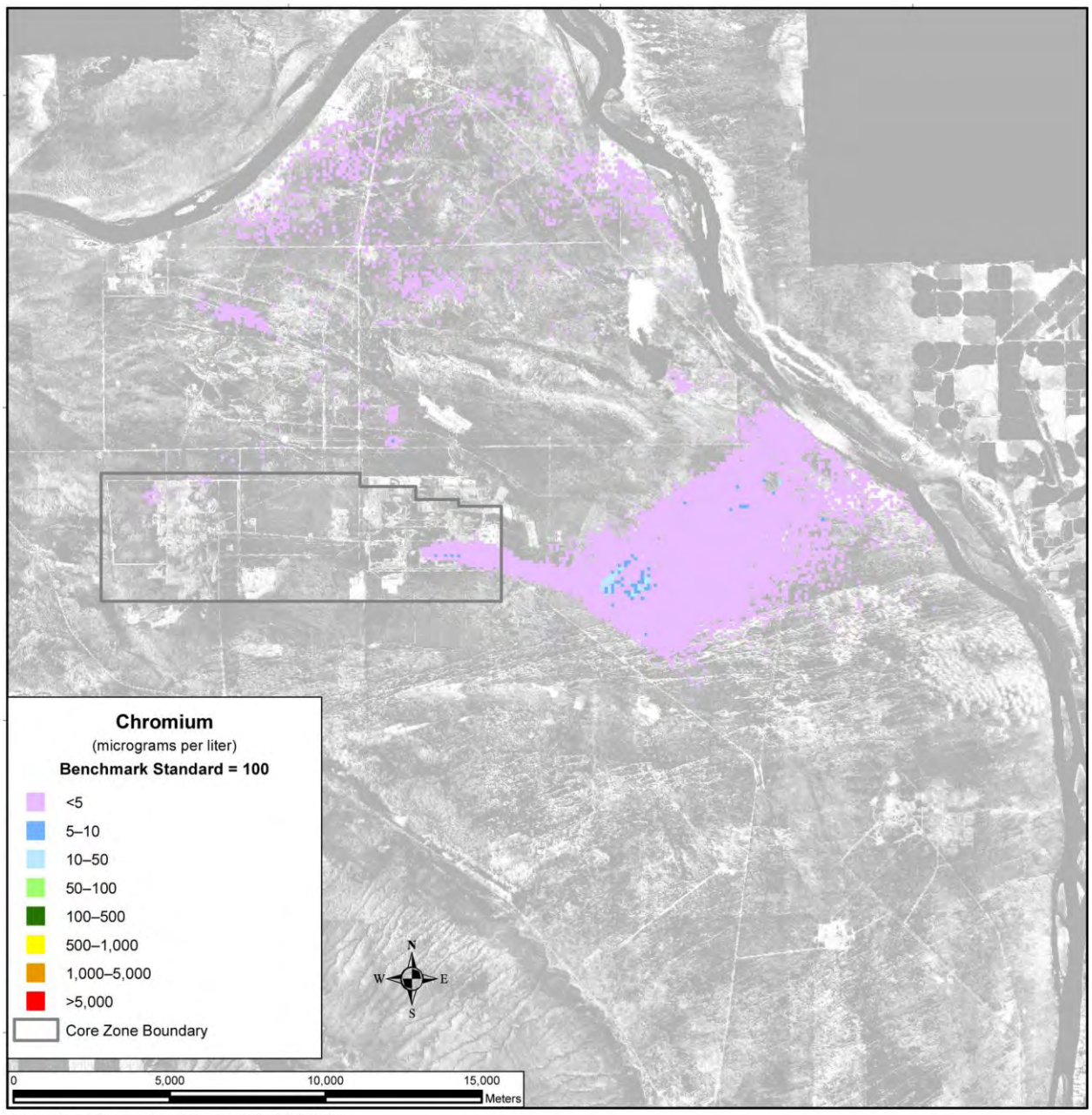
Note: To convert meters to feet, multiply by 3.281.

Figure 5–885. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



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

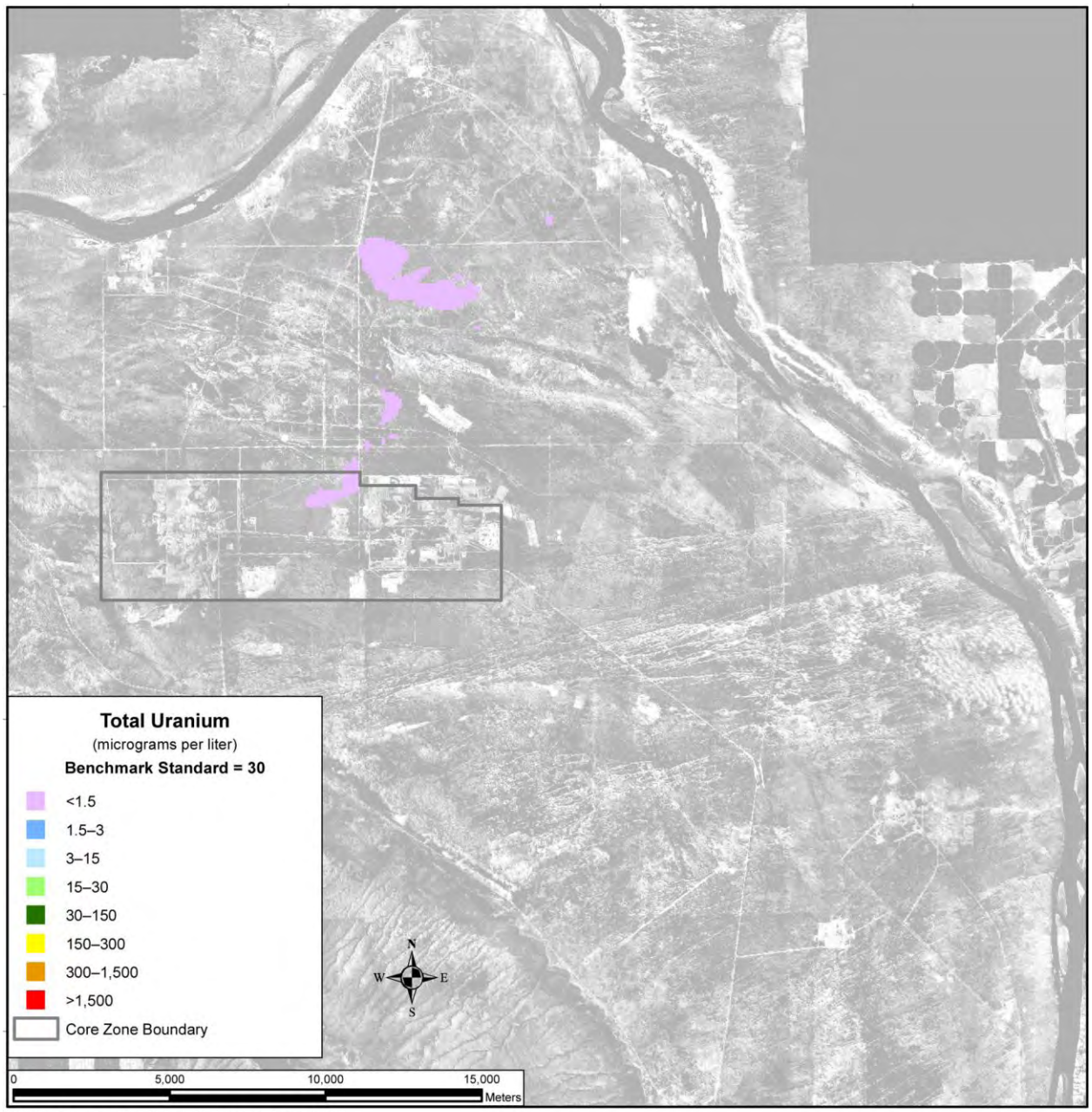
Figure 5–886. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



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

Figure 5–887. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885

The total uranium spatial distribution in Figure 5–888 (CY 11,885) shows a plume from the RPPDF. There is no total uranium release from IDF-East. The total uranium concentration remains well below the benchmark concentration over the period of analysis.



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

Figure 5–888. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Spatial Distribution of Groundwater Total Uranium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, in general, the inventories remaining in IDF-East, IDF-West, and the RPPDF, which are available for release to the environment at the start of the post-disposal period, are predominant contributors. The releases from IDF-West and the RPPDF occur earlier and dissipate earlier than releases from IDF-East.

By the end of this analysis period (CY 11,885), the chromium and nitrate distributions have largely dispersed below their benchmark concentrations. Significant spatial distributions of technetium-99 and iodine-129 remain. Most of the distribution area has concentrations below benchmark levels, but there are some small areas in which technetium-99 and iodine-129 concentrations exceed benchmark levels in CY 11,885. The released iodine-129, which occurs at higher concentration levels relative to its benchmark than technetium-99, dissipates much more quickly than technetium-99.

For total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of total uranium do not exceed the benchmark level at the IDF-West barrier, RPPDF barrier, IDF-East barrier, Core Zone Boundary, or Columbia River nearshore over this period of analysis. However, the spatial distribution of total uranium exists through the end of the analysis period (CY 11,885). Although the concentrations of total uranium remain six orders of magnitude smaller than the benchmark concentration during the analysis period, the trend appears to show a continuing increase through the end of the analysis period.

5.3.1.3.1.6 Disposal Group 1, Subgroup 1-F

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, was designed to accommodate the disposal of waste generated under Tank Closure Alternative 5 and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Tank closure waste would be converted to IHLW, ILAW glass, bulk vitrification glass, cast stone waste, and sulfate grout.

For the long-term groundwater impacts analysis, two major periods were identified for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West and continue through CY 2050, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East and IDF-West would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially

100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, nitrite, and acetonitrile) are all mobile (i.e., move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–889 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–890, the chemical hazard drivers. The inventories in the seven waste forms are a major factor in the release quantities to the vadose zone. Cast stone waste is the predominant vadose zone source of technetium-99 (82 percent), with the remainder coming largely from bulk vitrification glass (12 percent) and some from tank closure secondary waste (4 percent) and ETF-generated secondary waste (1 percent). The vadose zone iodine-129 is from ETF-generated secondary waste (89 percent) and cast stone waste (7 percent), with some from tank closure secondary waste (3 percent). Cast stone waste is the predominant vadose zone source of chromium (73 percent), with some from sulfate grout waste (26 percent). The nitrate is from ETF-generated secondary waste (56 percent) and cast stone waste (44 percent). Fluoride is not released from IDF-East.

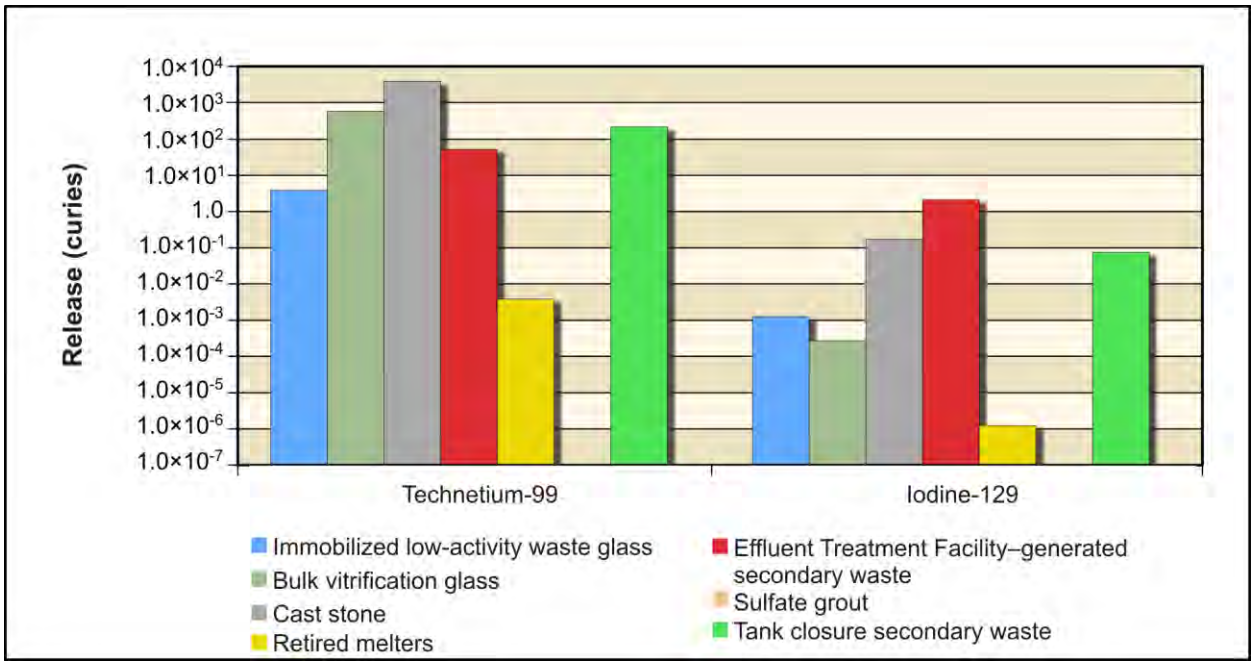


Figure 5–889. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

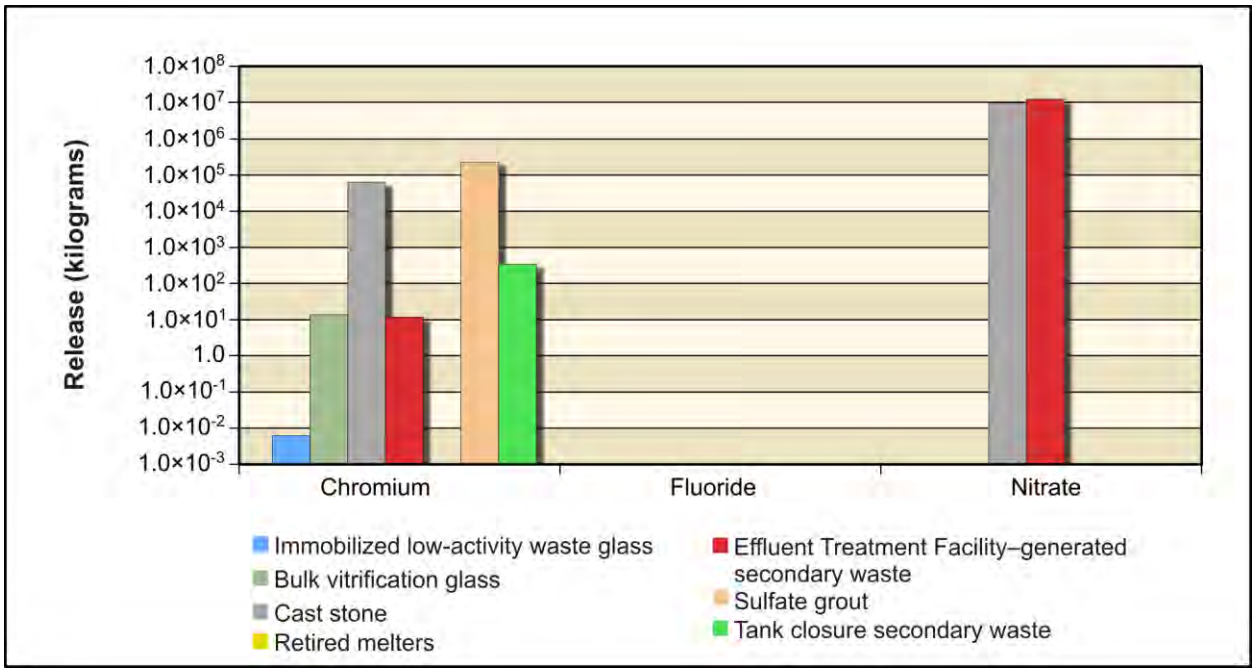


Figure 5–890. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–891 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–892, the chemical hazard drivers. In addition to the waste form inventory, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. The vadose zone releases some technetium-99 (52 percent) and iodine-129 (43 percent) to groundwater. Nearly all (99 percent) of the vadose zone chromium and nitrate are released to groundwater.

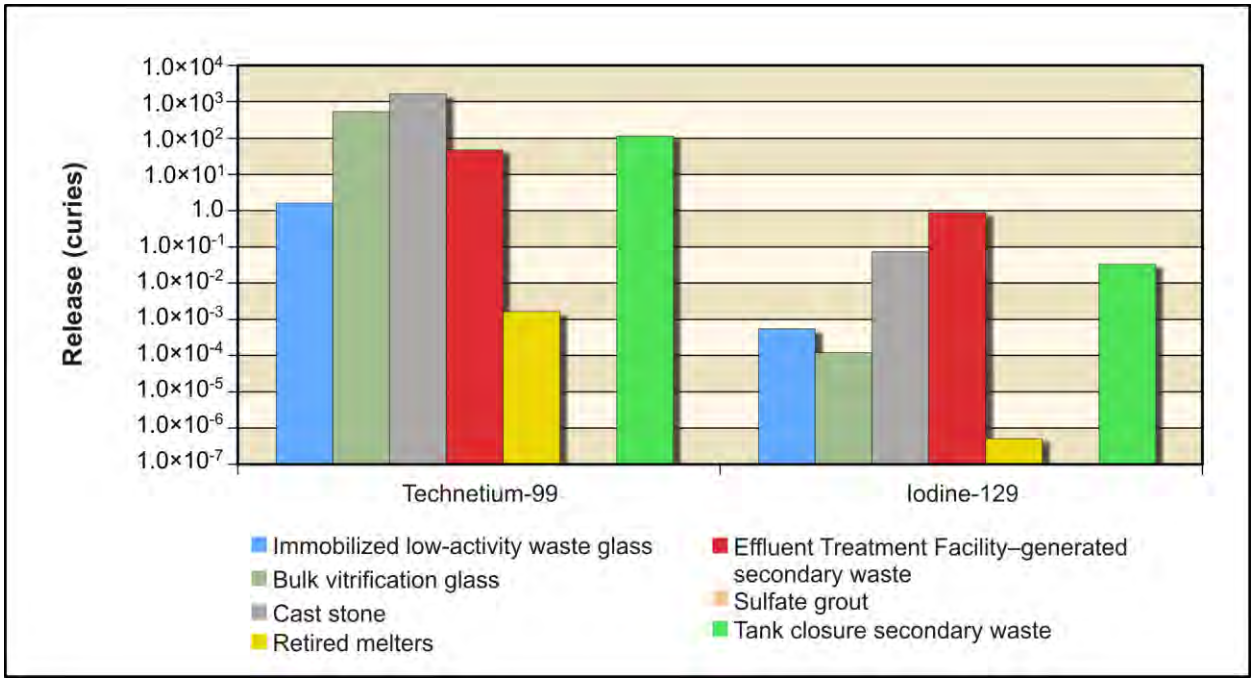


Figure 5–891. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

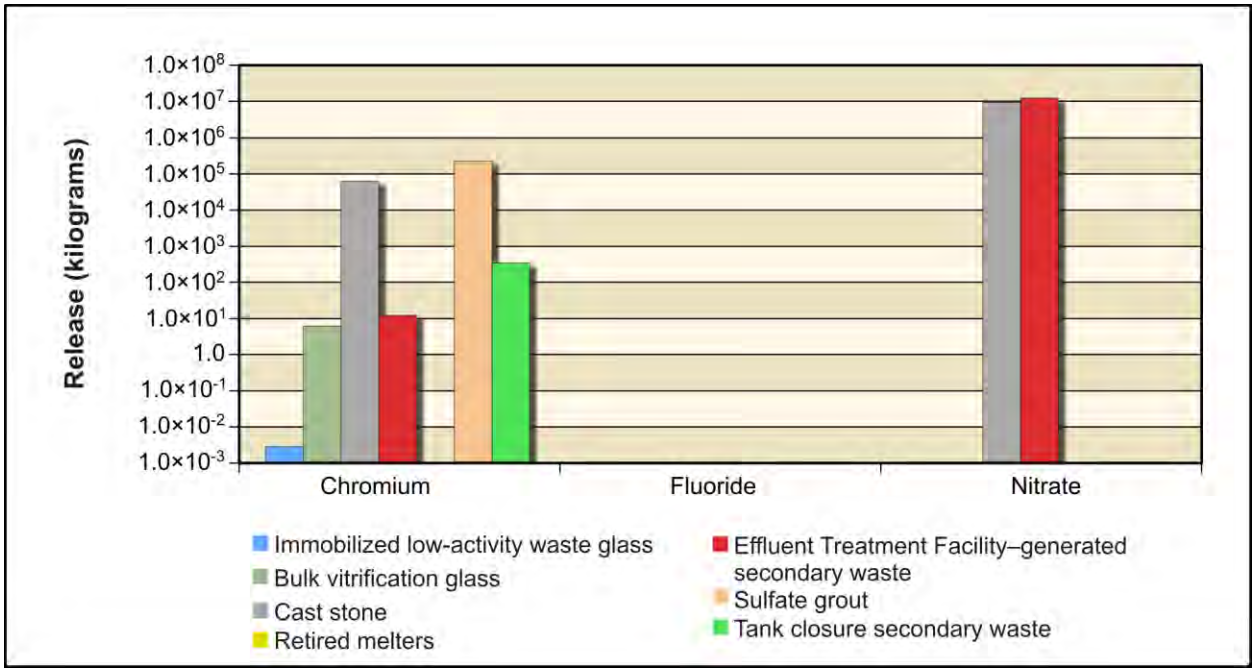


Figure 5–892. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–893 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–894, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. The groundwater releases most of its technetium-99 (97 percent), iodine-129 (96 percent), chromium (greater than 99 percent), and nitrate (greater than 99 percent) to the Columbia River.

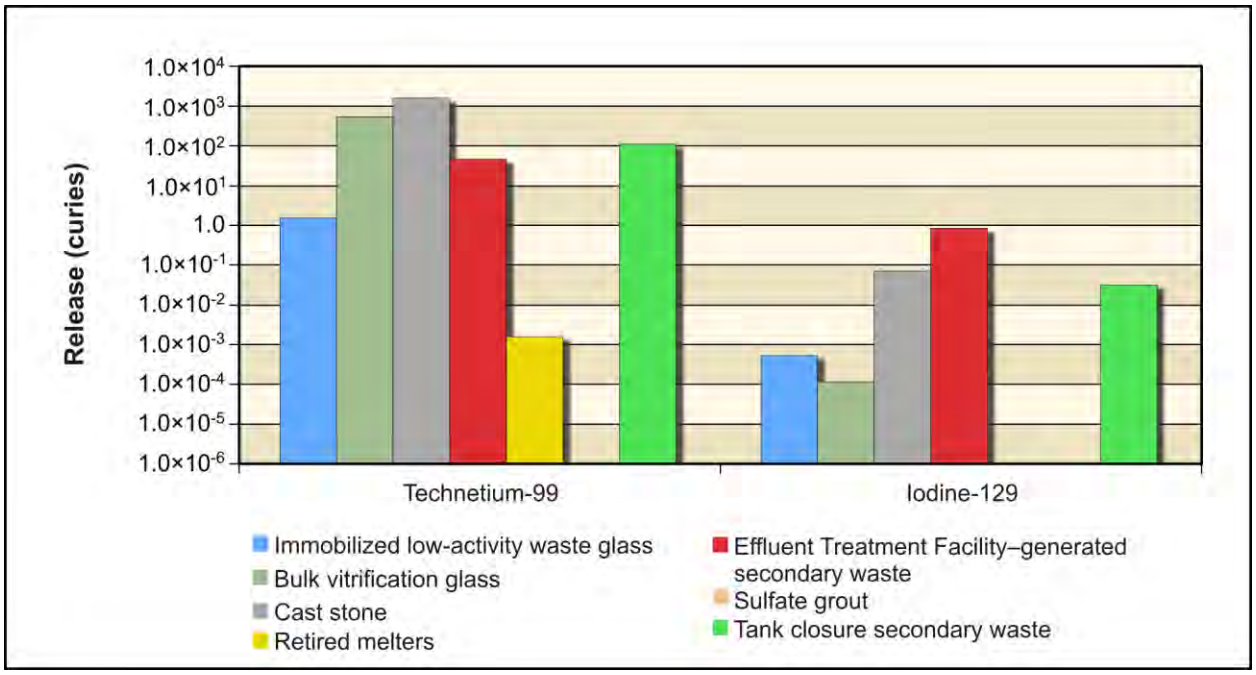


Figure 5–893. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

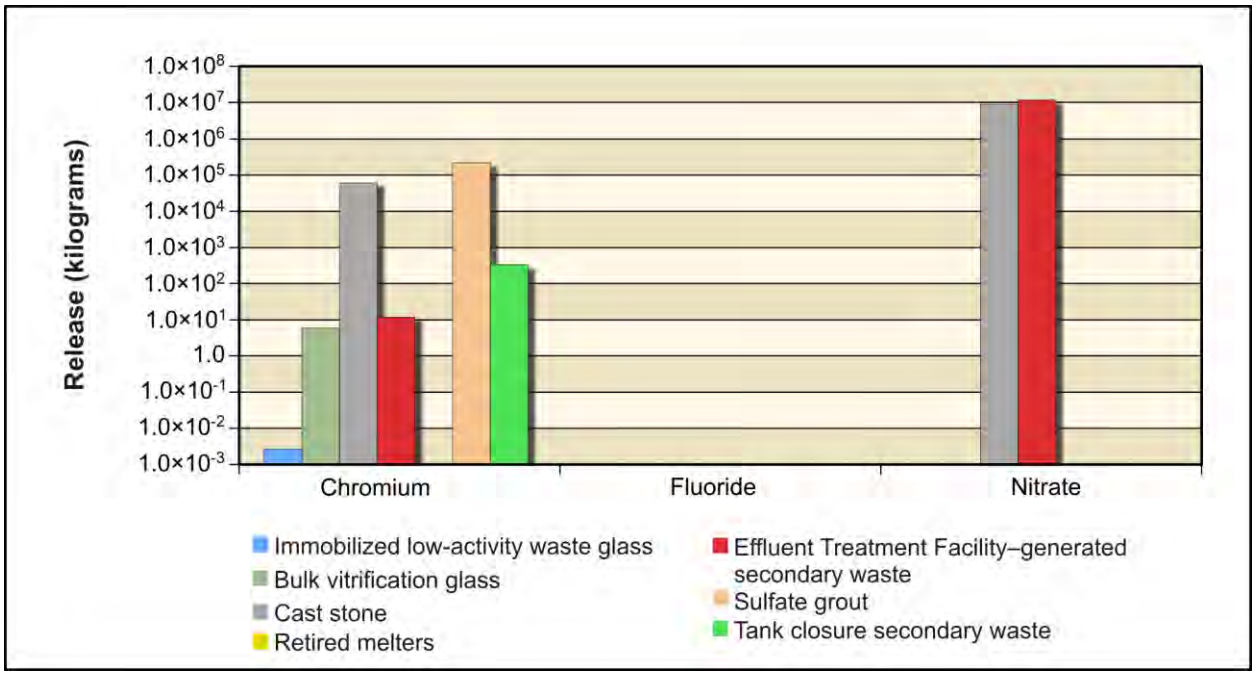


Figure 5–894. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

Overall, almost all of the IDF-East vadose zone chromium (99 percent) and nitrate (99 percent), as well as some of the vadose zone technetium-99 (51 percent) and iodine-129 (41 percent), reach the Columbia River over the period of analysis.

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5–895 through 5–900, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary waste and onsite waste, and offsite waste.

Figure 5–895 shows the estimated release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–896, the chemical hazard drivers. The inventories in the three waste forms are a major factor in the release quantities to the vadose zone. The predominant source of technetium-99 (98 percent) and iodine-129 (greater than 99 percent) released to the vadose zone is offsite waste. All (greater than 99 percent) of the nitrate and fluoride that is released to the vadose zone is from waste management secondary waste. The chromium released to the vadose zone is from waste management secondary waste and onsite waste (69 percent) and offsite waste (31 percent).

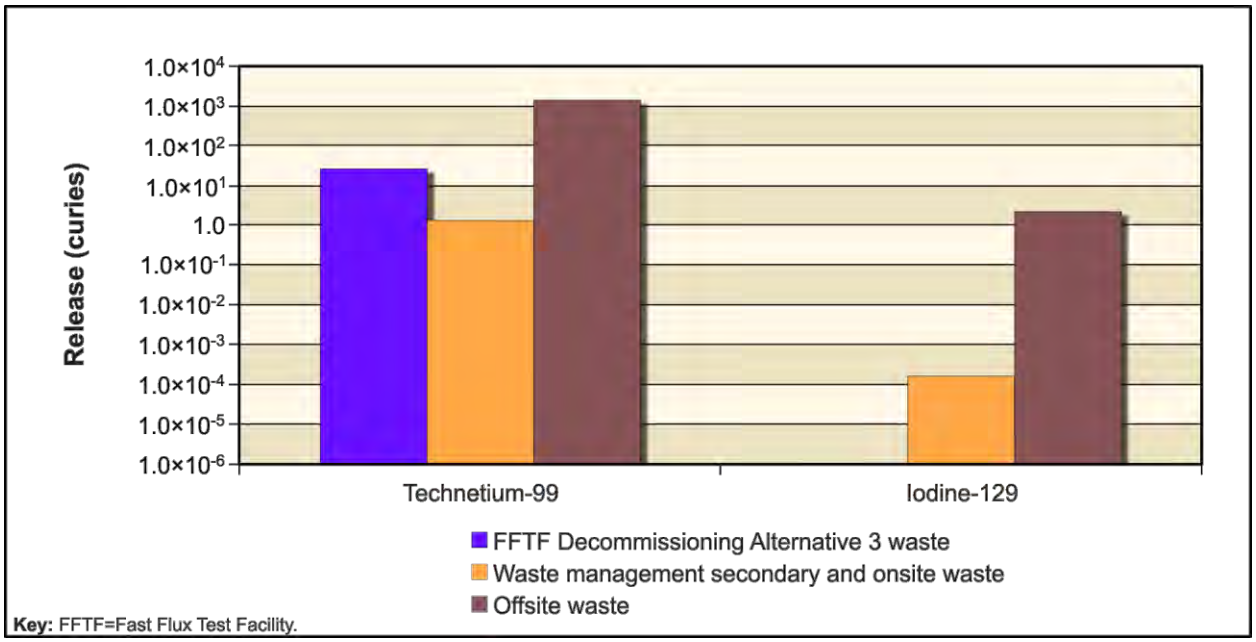


Figure 5–895. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

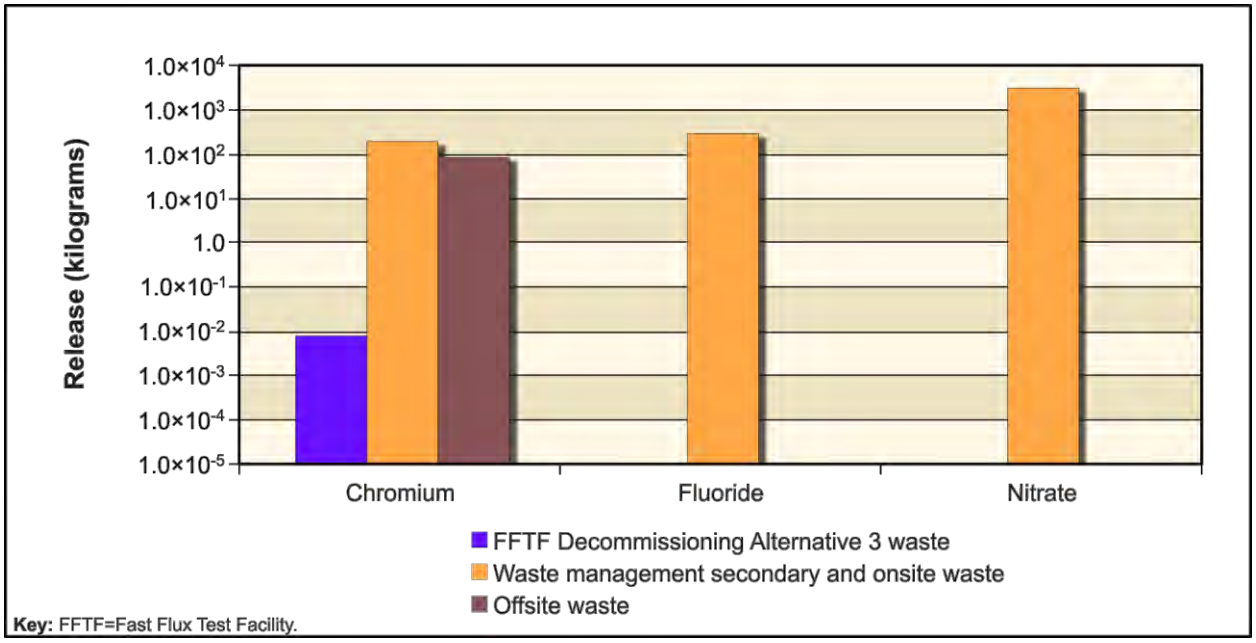


Figure 5–896. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–897 shows the estimated release from IDF-West to groundwater of the radiological risk drivers and Figure 5–898, the chemical hazard drivers. In addition to the waste form inventory, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Most of the IDF-West vadose zone technetium-99 (97 percent), iodine-129 (97 percent), chromium (99 percent), nitrate (greater than 99 percent), and fluoride (greater than 99 percent) are released to groundwater during the period of analysis.

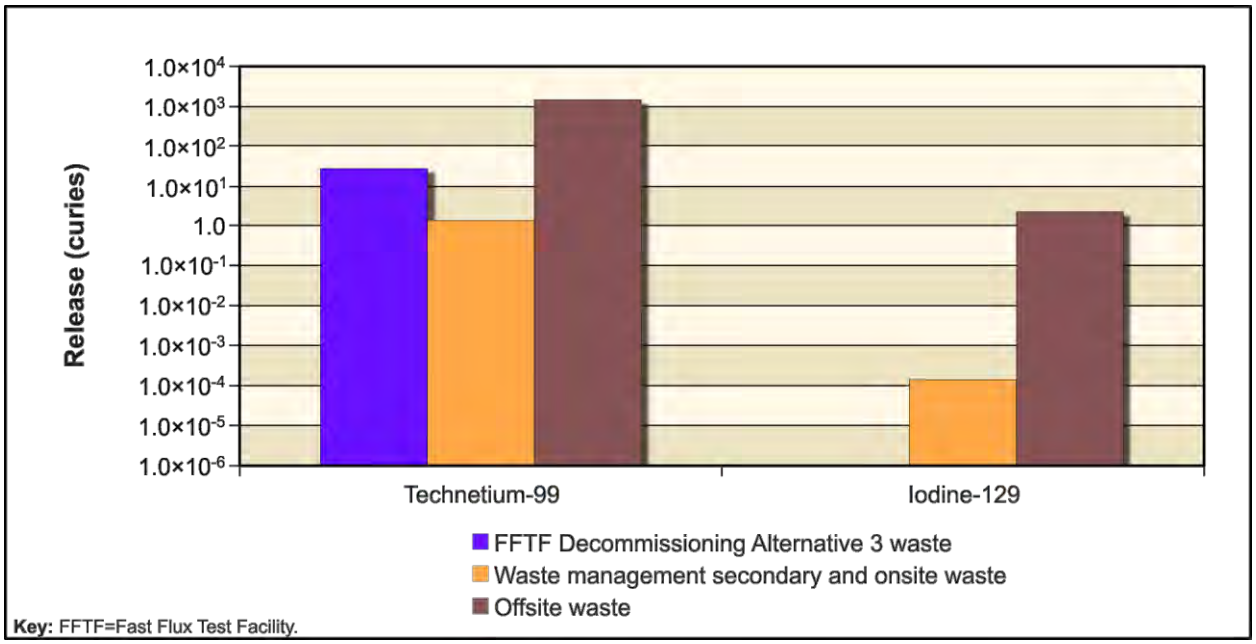


Figure 5–897. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

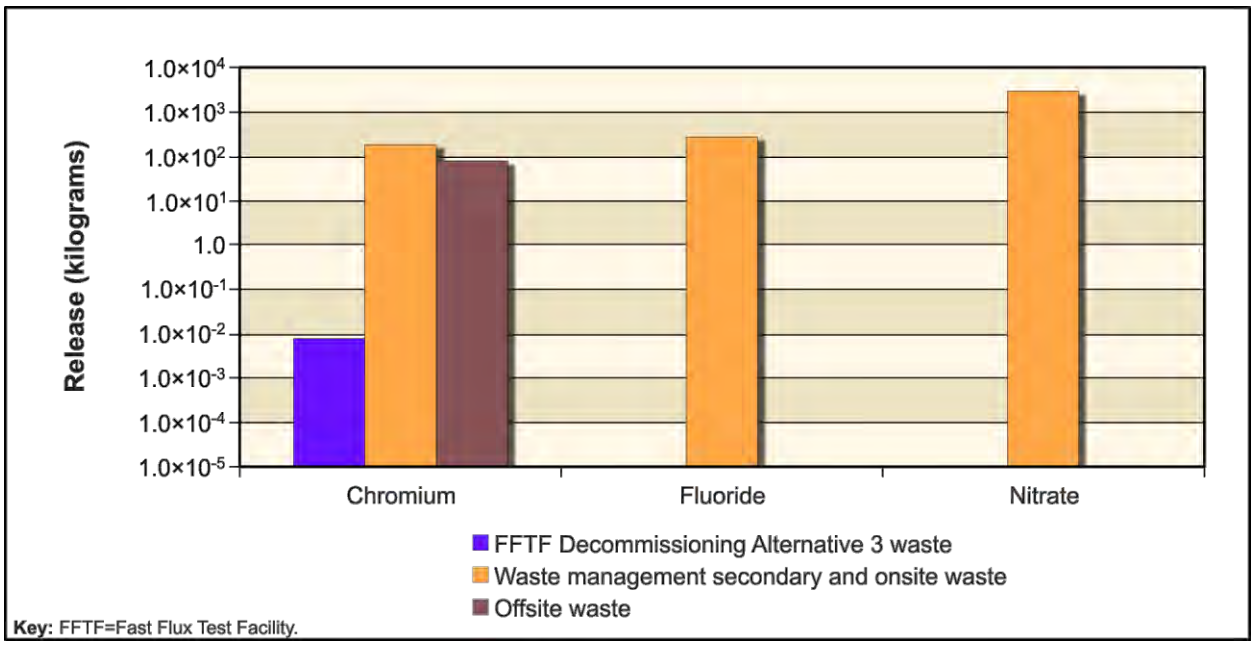


Figure 5–898. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–899 shows the estimated release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–900, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Nearly all (99–100 percent) of the IDF-West groundwater technetium-99, iodine-129, chromium, nitrate, and fluoride are released to the Columbia River during the period of analysis.

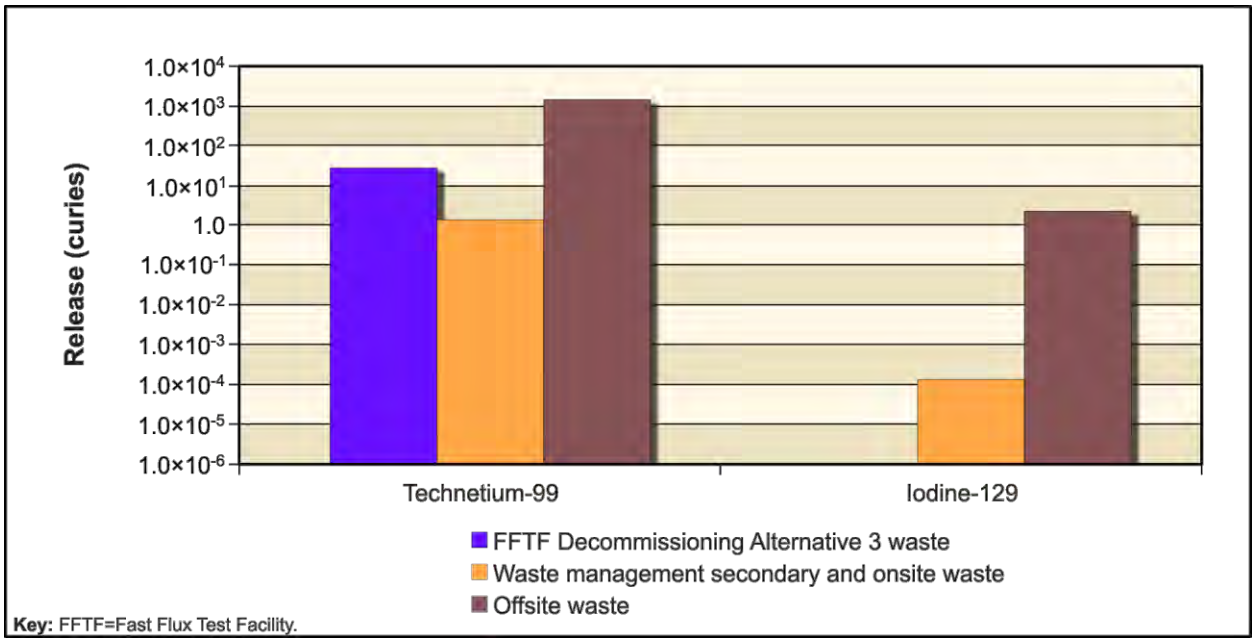


Figure 5–899. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

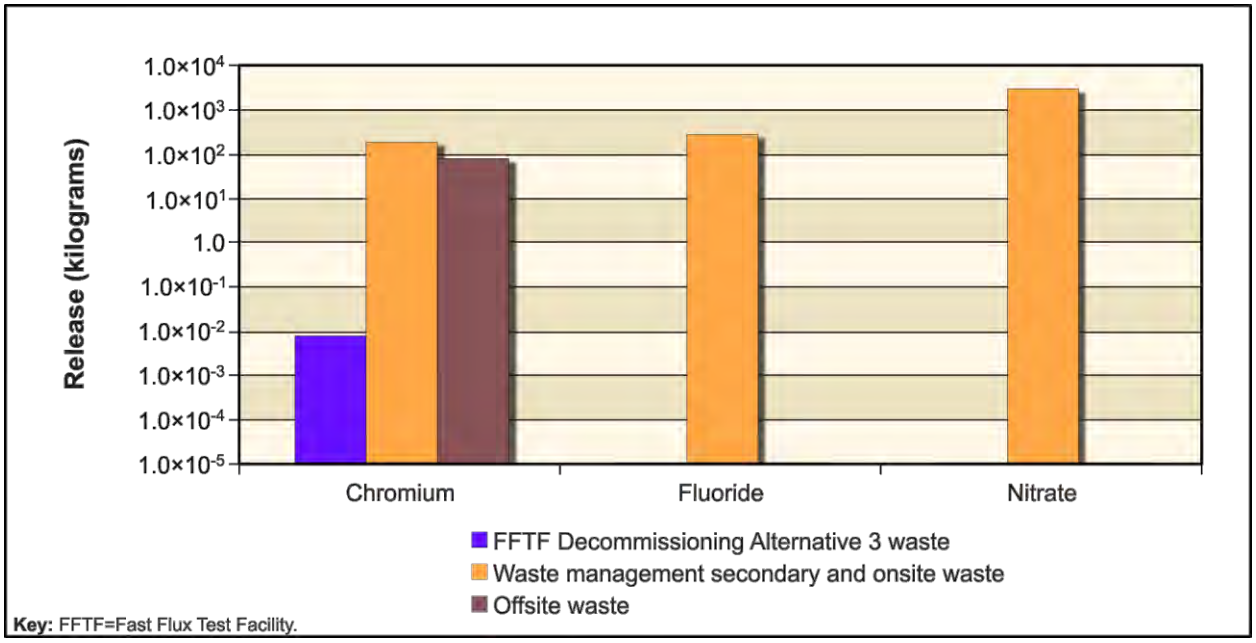


Figure 5–900. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

Overall, most (97–99 percent) of the IDF-West vadose zone technetium-99, iodine-129, chromium, nitrate and fluoride reach the Columbia River during the period of analysis.

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations. Table 5–111 shows maximum concentrations in groundwater. Exceedances of the respective benchmark concentrations occur at the IDF-East barrier, IDF-West barrier, Core Zone Boundary, and Columbia River nearshore, where concentrations of technetium-99 and iodine-129 exceed the benchmark. Chromium exceeds the benchmark concentration only at the IDF-East barrier. No other exceedances of benchmark concentrations occur for any of the other COPC drivers.

Table 5–111. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	**1,380** (8878)	**13,200** (3818)	N/A	**1,370** (3859)	**1,670** (3920)	900
Iodine-129	0.8 (9723)	**20.6** (3794)	N/A	**2.1** (3937)	**2.4** (3872)	1
Chemical (micrograms per liter)						
Acetonitrile	3 (8858)	0 (1940)	N/A	1 (8981)	1 (8696)	100
Chromium	**295** (8882)	1 (3813)	N/A	78 (9057)	60 (8241)	100
Fluoride	0 (1940)	1 (4014)	N/A	0 (3937)	0 (4307)	4,000
Nitrate	19,400 (8206)	7 (3927)	N/A	6,250 (7810)	4,140 (7984)	45,000

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; 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.

Figures 5–901 through 5–904 show concentration versus time for technetium-99, iodine-129, chromium, and nitrate. Figure 5–901 shows that, at the onset of the releases from IDF-East and IDF-West, there is a technetium-99 release peak (lasting about 1,500 years) that exceeds the benchmark concentration by about one order of magnitude at the IDF-West barrier. Technetium-99 concentrations also exceed the benchmark concentration by less than one order of magnitude at the Core Zone Boundary and Columbia River nearshore for a shorter period of time. The technetium-99 concentrations at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore then decrease below the benchmark concentration and remain at approximately one to two orders of magnitude below the benchmark for the remainder of the 10,000-year simulation period. Technetium-99 concentrations at the IDF-East barrier begin to increase later in the simulation, around CY 4500. Concentrations rise continuously and reach or exceed the technetium-99 benchmark value at about CY 8000 and remain constant at less than one order of magnitude above the benchmark until the end of the simulation (CY 11,940).

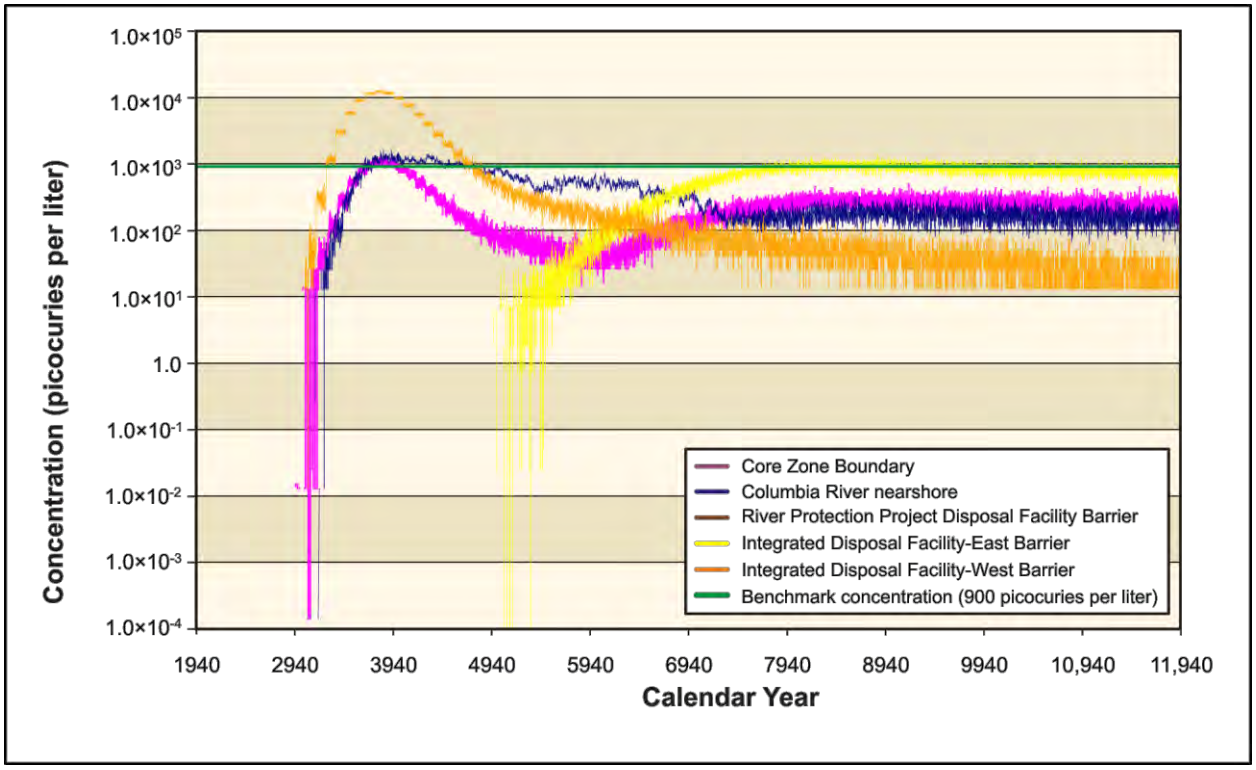


Figure 5–901. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Technetium-99 Concentration Versus Time

The IDF-West barrier, IDF-East barrier, Core Zone Boundary, and Columbia River nearshore show similar concentration peaks at the onset of the iodine-129 release (see Figure 5–902). The IDF-West barrier concentration peaks at between one and two orders of magnitude above the benchmark, whereas the Core Zone Boundary concentration peaks at less than one order of magnitude above the benchmark concentration. The Columbia River nearshore concentration peaks just above the benchmark concentration, but below one order of magnitude. All concentrations then continue on a slow decline that brings them to about one order of magnitude below the benchmark concentration for the latter half of the analysis period.

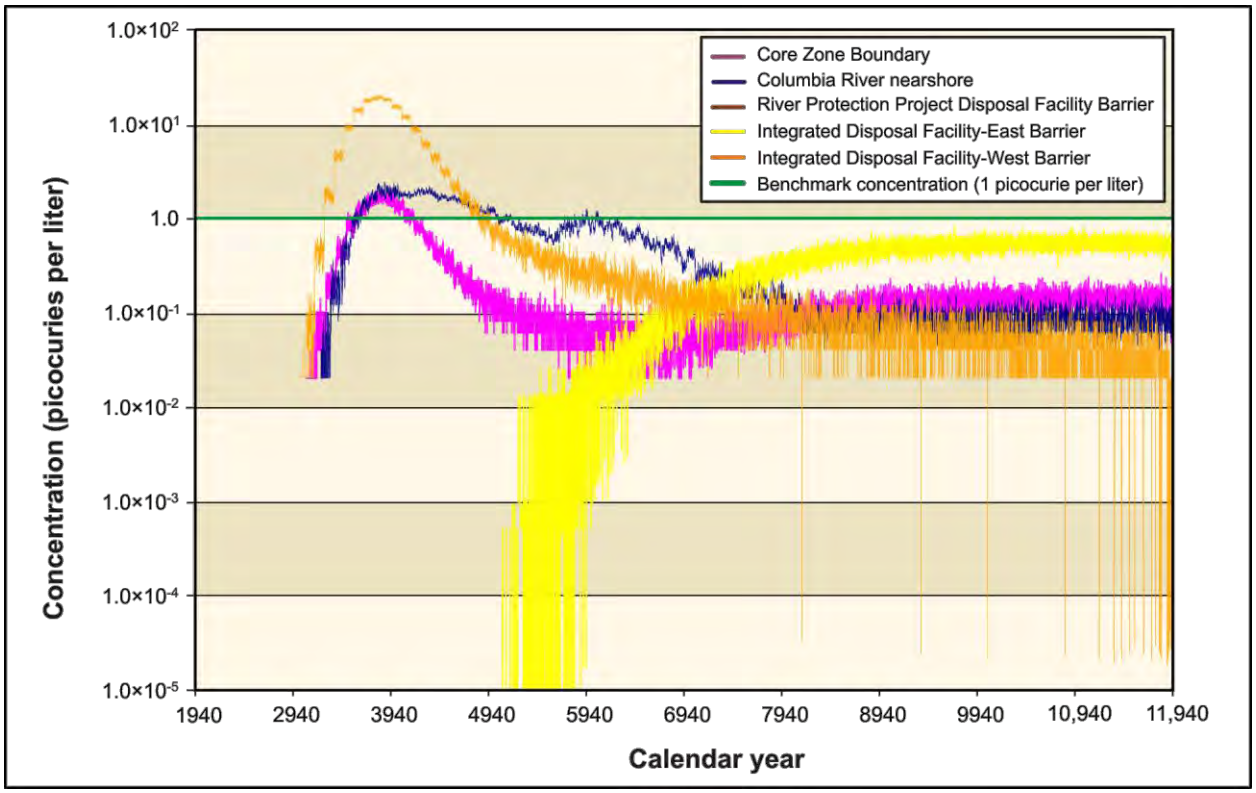


Figure 5–902. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Iodine-129 Concentration Versus Time

Figures 5–903 and 5–904 also show the initial increase in the IDF-West, Core Zone Boundary, and Columbia River nearshore chromium and nitrate. The chromium and nitrate concentrations at the Core Zone Boundary and Columbia River nearshore show a second, broader increase that extends over about two-thirds of the analysis period. The nitrate concentrations are always less than one order of magnitude from the benchmark concentration. The chromium concentrations (at the Core Zone Boundary and Columbia River nearshore) approach within one order of magnitude of the benchmark concentration for most of the analysis period. Chromium and nitrate concentrations at the IDF-West barrier do not show the second peak; rather, the concentrations decline continuously through the 10,000-year simulation period. Chromium and nitrate concentrations at the IDF-East barrier begin the characteristic rise at about CY 4500. Chromium concentrations exceed the benchmark concentration from about CY 7000 until about CY 10,000. Nitrate concentrations remain about one order of magnitude below the benchmark value over the same time period.

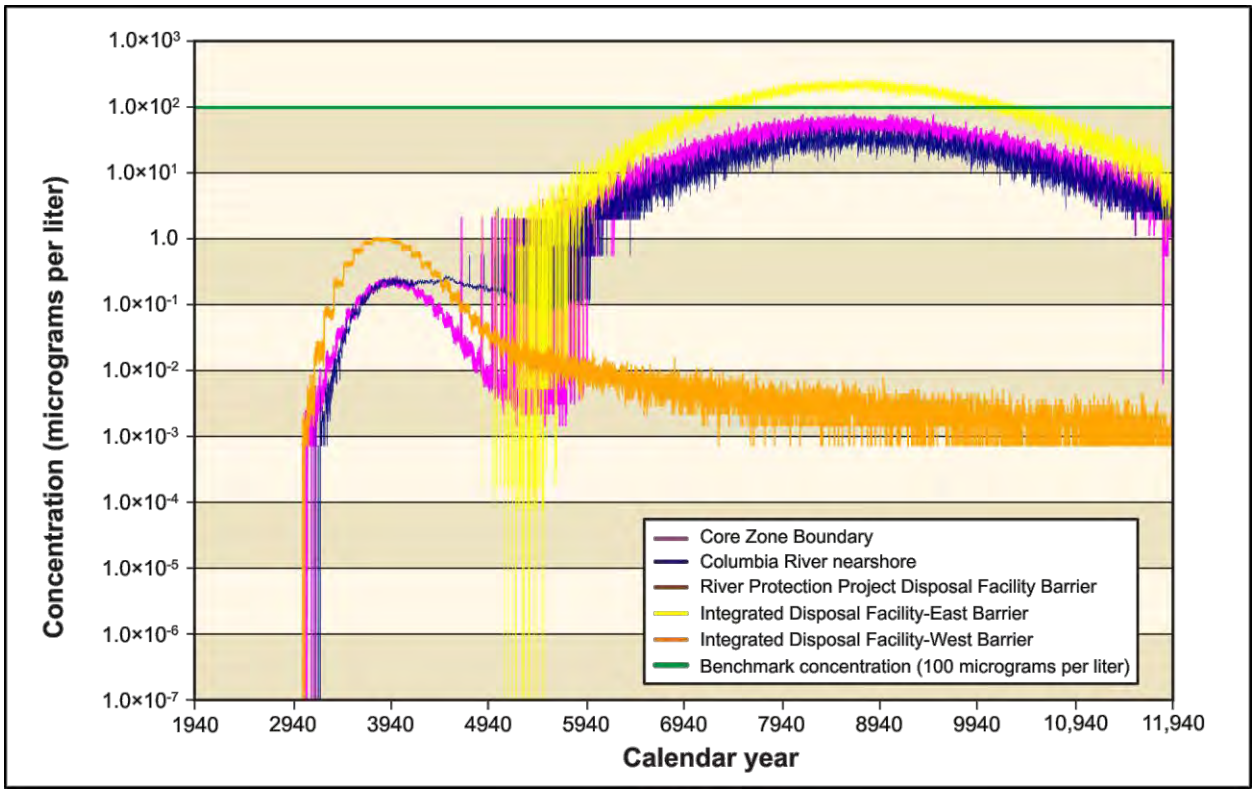


Figure 5–903. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Chromium Concentration Versus Time

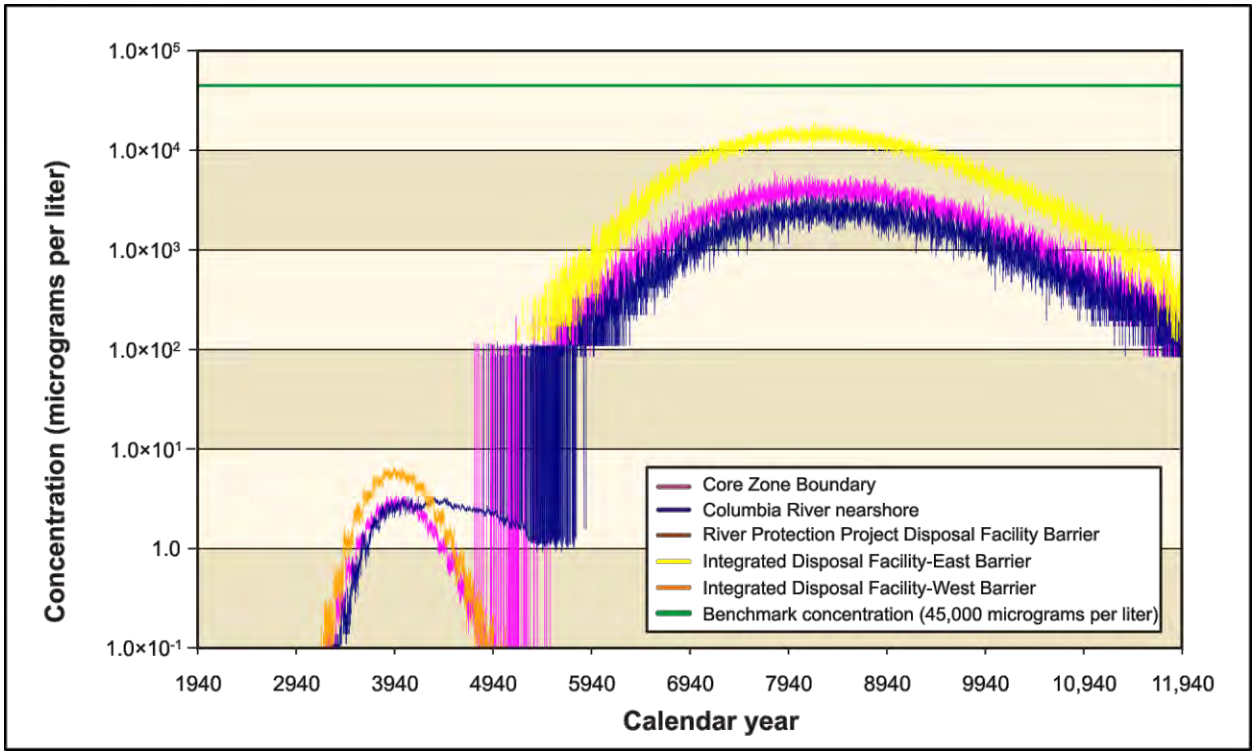


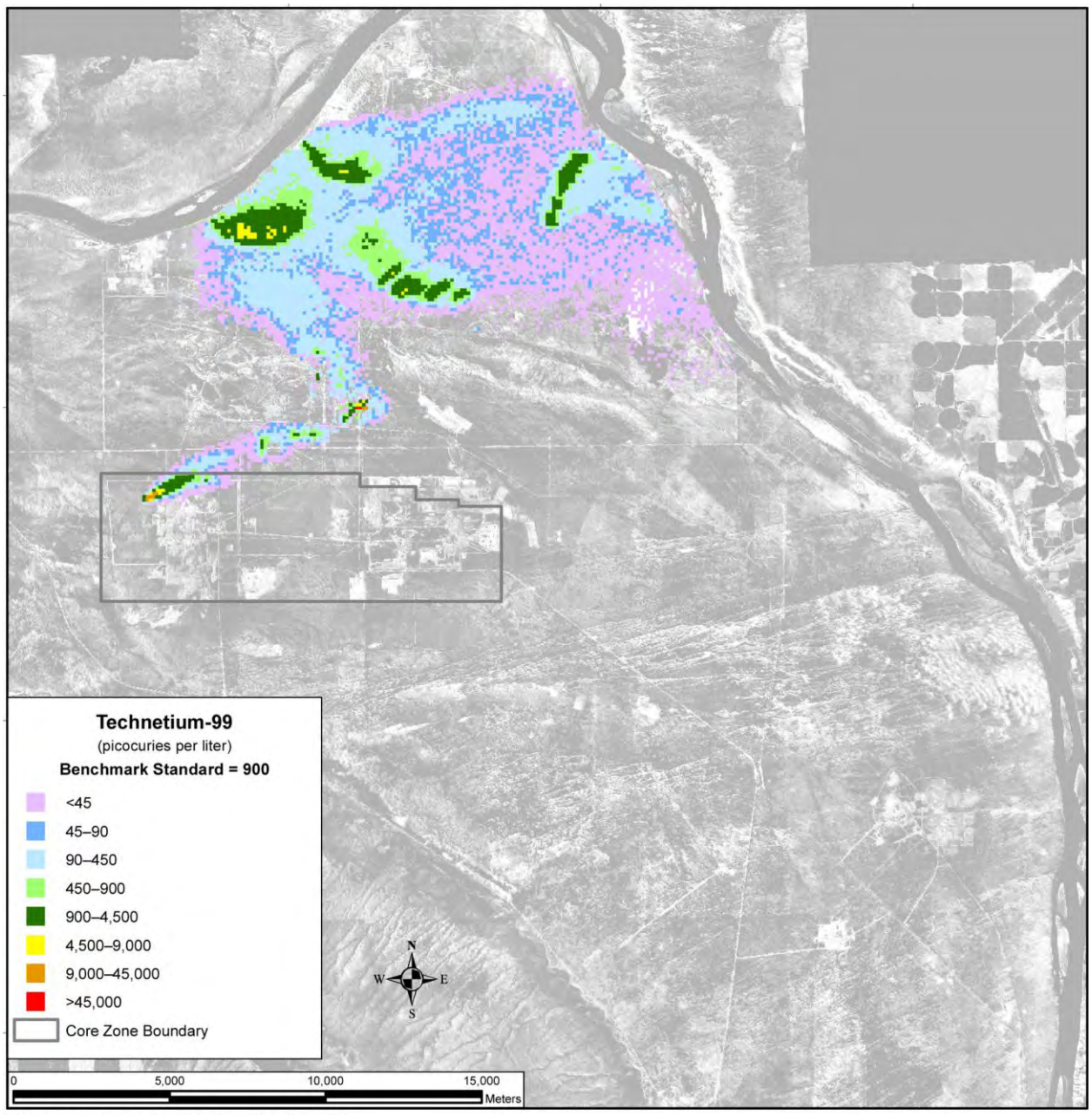
Figure 5–904. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Nitrate Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations.

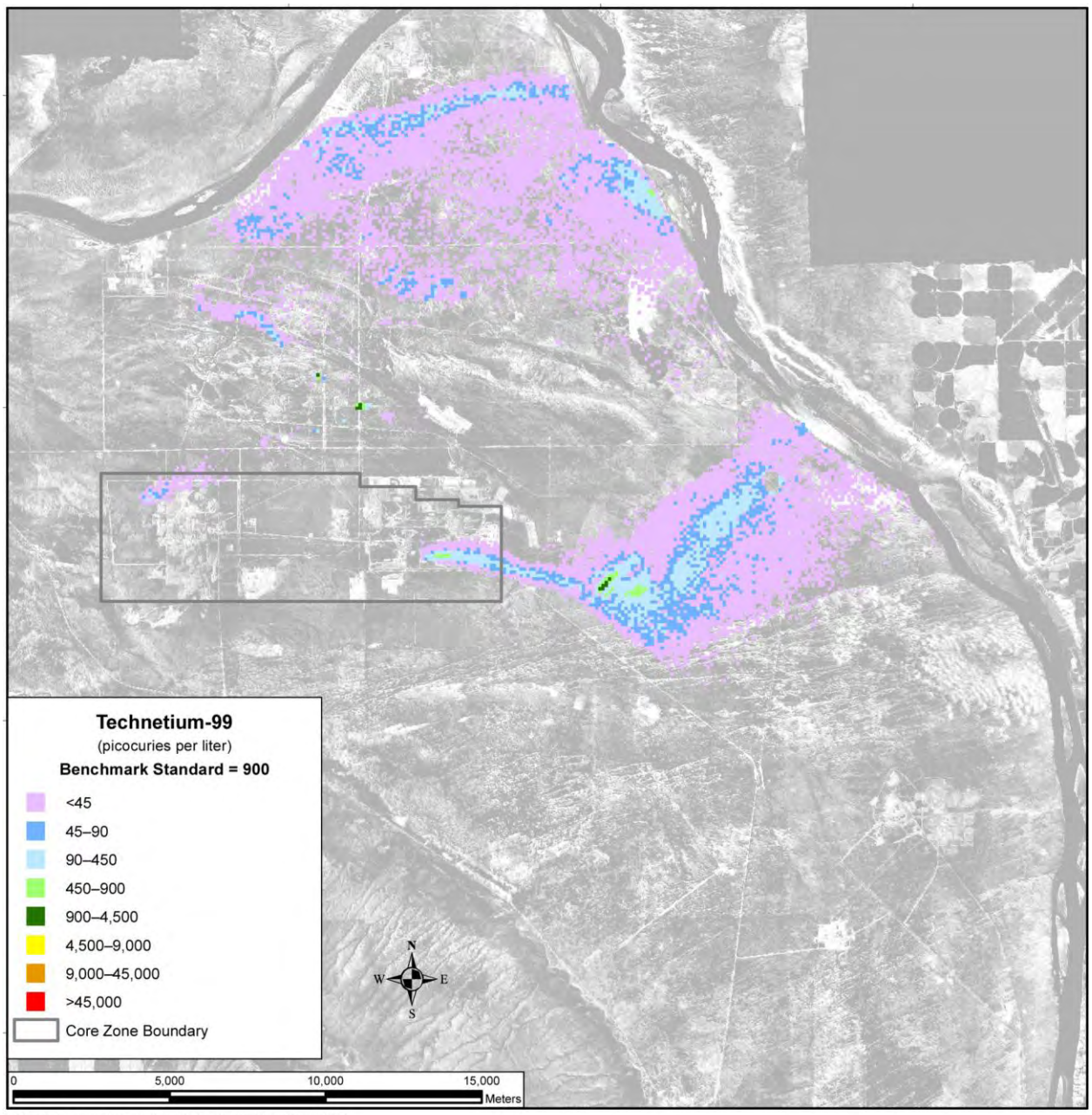
Figures 5–905 through 5–916 show concentration distributions in CYs 3890, 7140, and 11,885 for technetium-99, iodine-129, nitrate, and chromium. The groundwater releases from IDF-West extend north from the release site within the Core Zone to the Columbia River nearshore, with the distribution remaining in a fairly narrow channel (Gable Gap) until about halfway to the Columbia River nearshore. The IDF-East releases remain in a relatively narrow channel until they reach about the one-quarter distance point to the Columbia River, where they broaden and continue to the Columbia River nearshore. For technetium-99, iodine-129, nitrate, and chromium, the IDF-West releases occur earlier and dissipate sooner than those from IDF-East.

Figure 5–905 shows that the technetium-99 release from IDF-West exceeds its benchmark concentration by several orders of magnitude within the Core Zone and in several areas near the Columbia River nearshore in CY 3890. This figure shows no technetium-99 from IDF-East at this time. Figure 5–906 shows that the IDF-West technetium-99 plume has mostly dissipated by CY 7140. The technetium-99 IDF-East release is shown with concentrations that are mostly lower than the technetium-99 benchmark concentration. Figure 5–907 shows that the IDF-West groundwater technetium-99 continues to dissipate in CY 11,885, in contrast to the IDF-East technetium-99 distribution, which continues to spread toward the Columbia River, with peak concentrations that approach or exceed benchmark concentrations in an area east of the Core Zone Boundary. Most of the technetium-99 distribution is at least one order of magnitude below its benchmark concentration between IDF-East and the Columbia River nearshore.



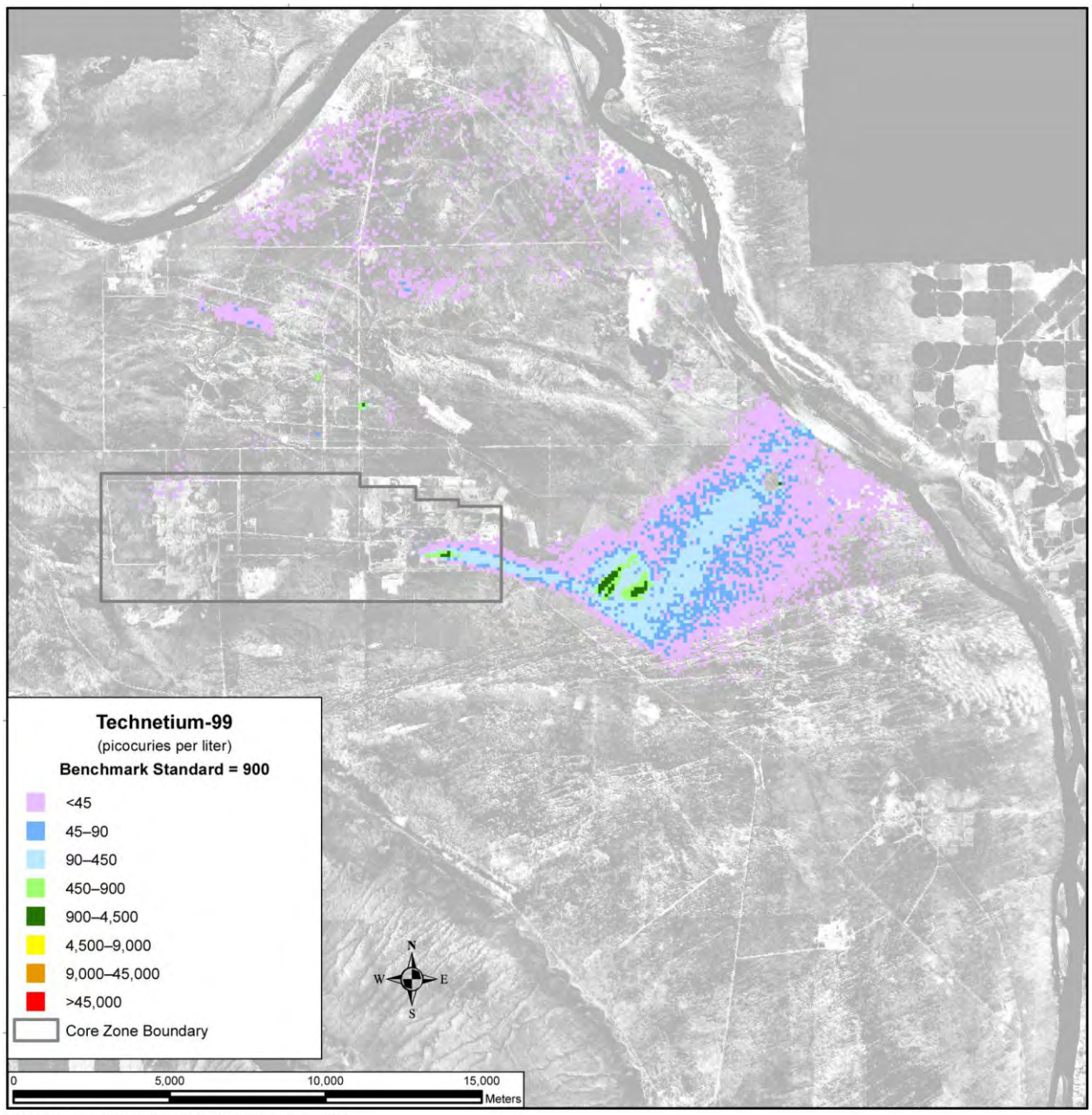
Note: To convert meters to feet, multiply by 3.281.

Figure 5–905. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



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

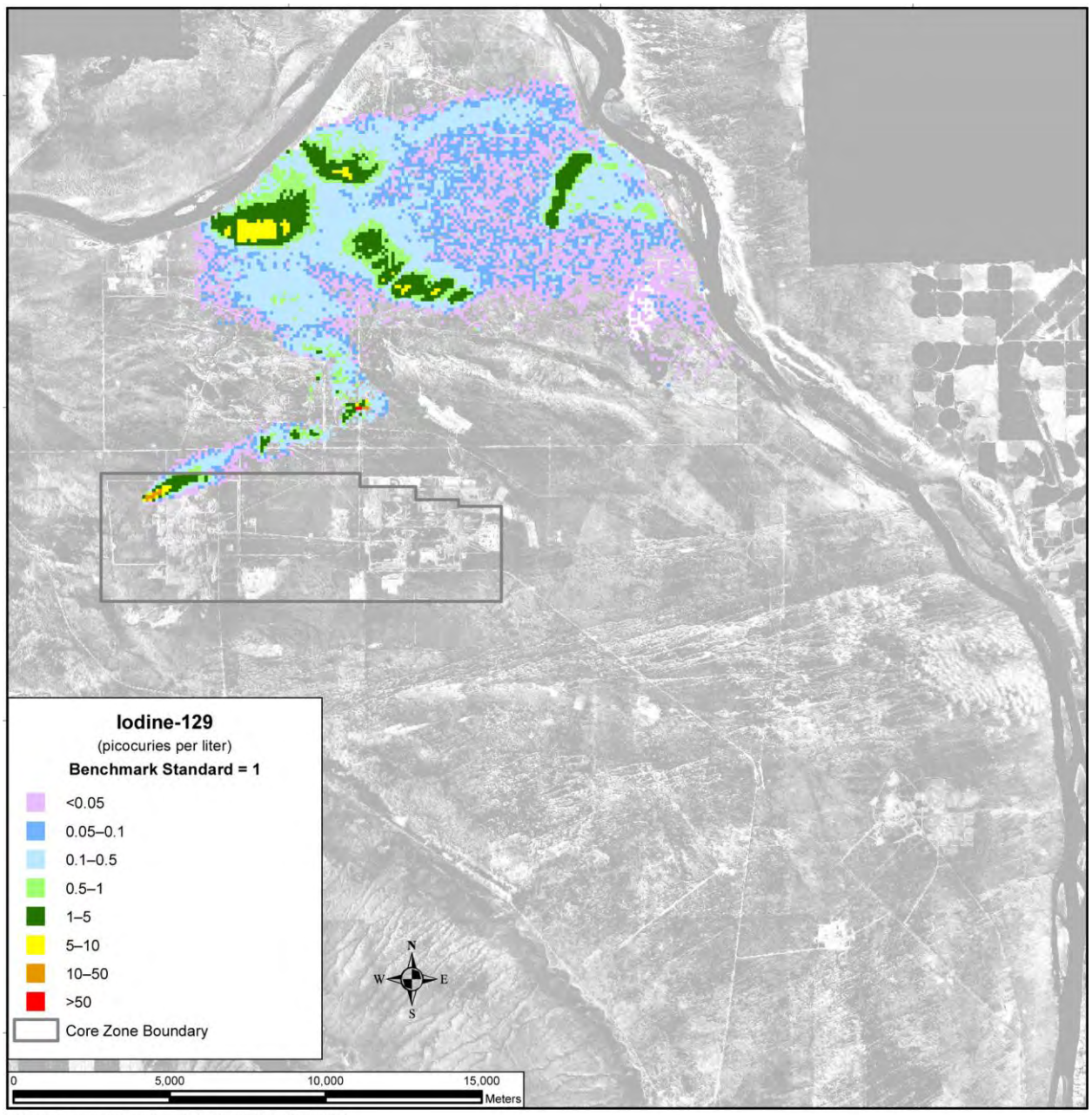
Figure 5–906. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



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

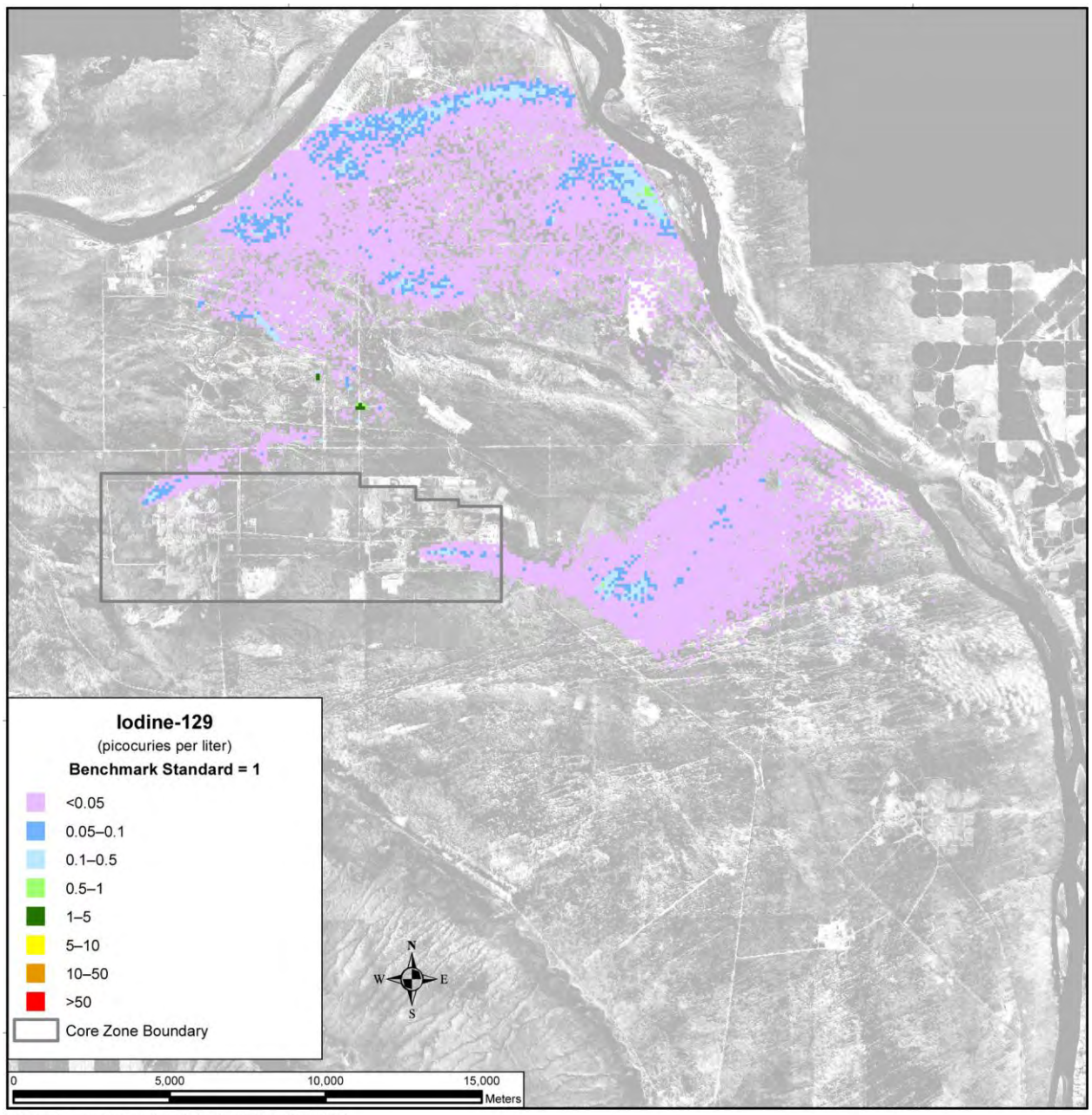
Figure 5–907. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885

Figures 5–908 through 5–910 show iodine-129 released from IDF-East and IDF-West with a spatial distribution very similar to the technetium-99 release. However, the CY 3890 iodine-129 release (see Figure 5–908) shows higher relative concentrations (compared with the benchmark concentration) than the technetium-99 release. The areas of high concentrations are in the same locales, but these areas have levels that exceed the benchmark concentration by at least one order of magnitude. No iodine-129 is released from IDF-East at this time. By CY 7140, the IDF-West iodine-129 release has significantly dissipated (see Figure 5–909); only small areas remain where iodine-129 is at or above its benchmark concentration. This shows the onset of the IDF-East iodine-129 release. By CY 11,885 (see Figure 5–910), the IDF-East iodine-129 distribution has significantly increased in size and concentration. Several small areas east of the Core Zone Boundary show concentrations at or above benchmark levels.



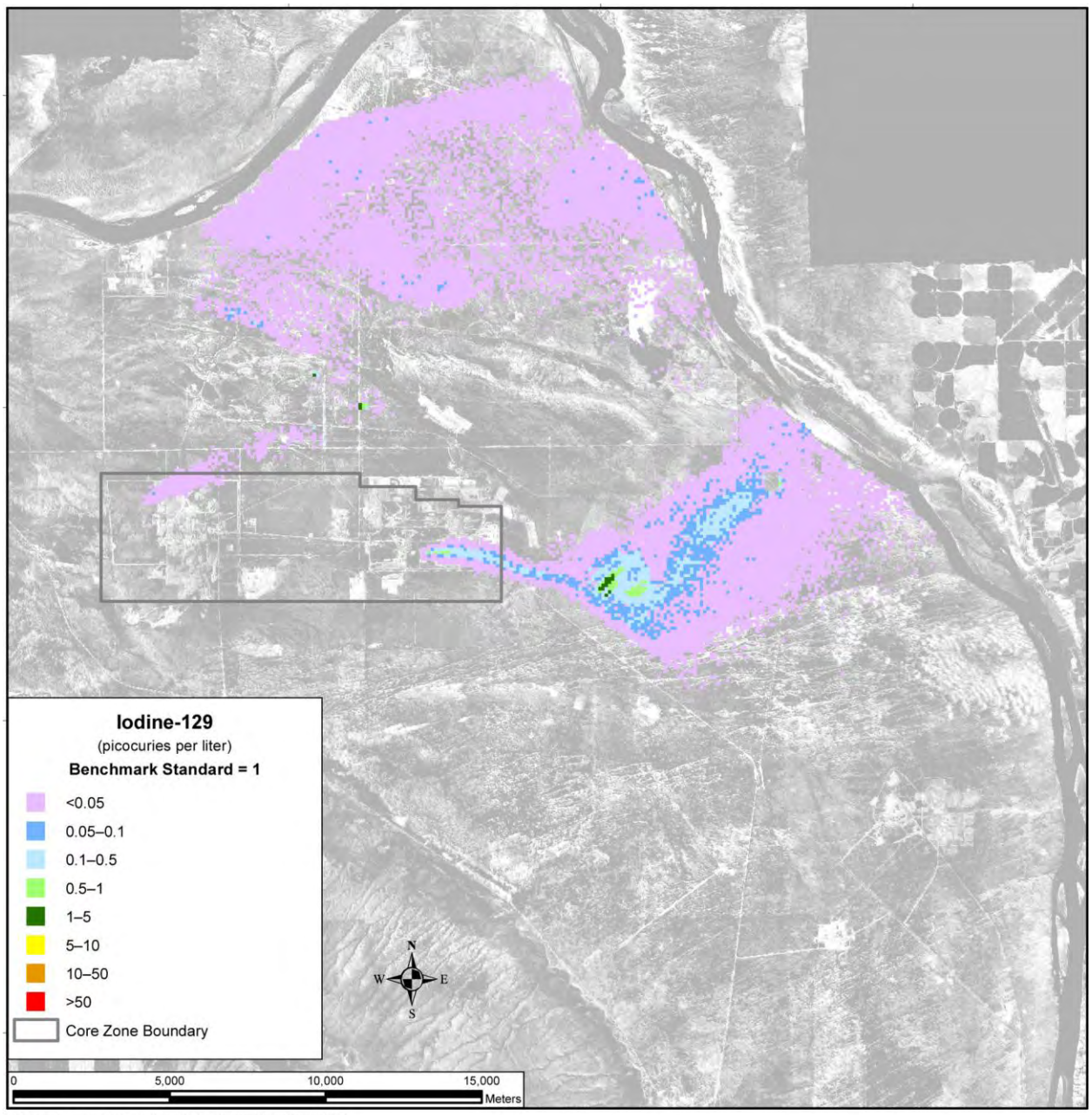
Note: To convert meters to feet, multiply by 3.281.

Figure 5–908. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



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

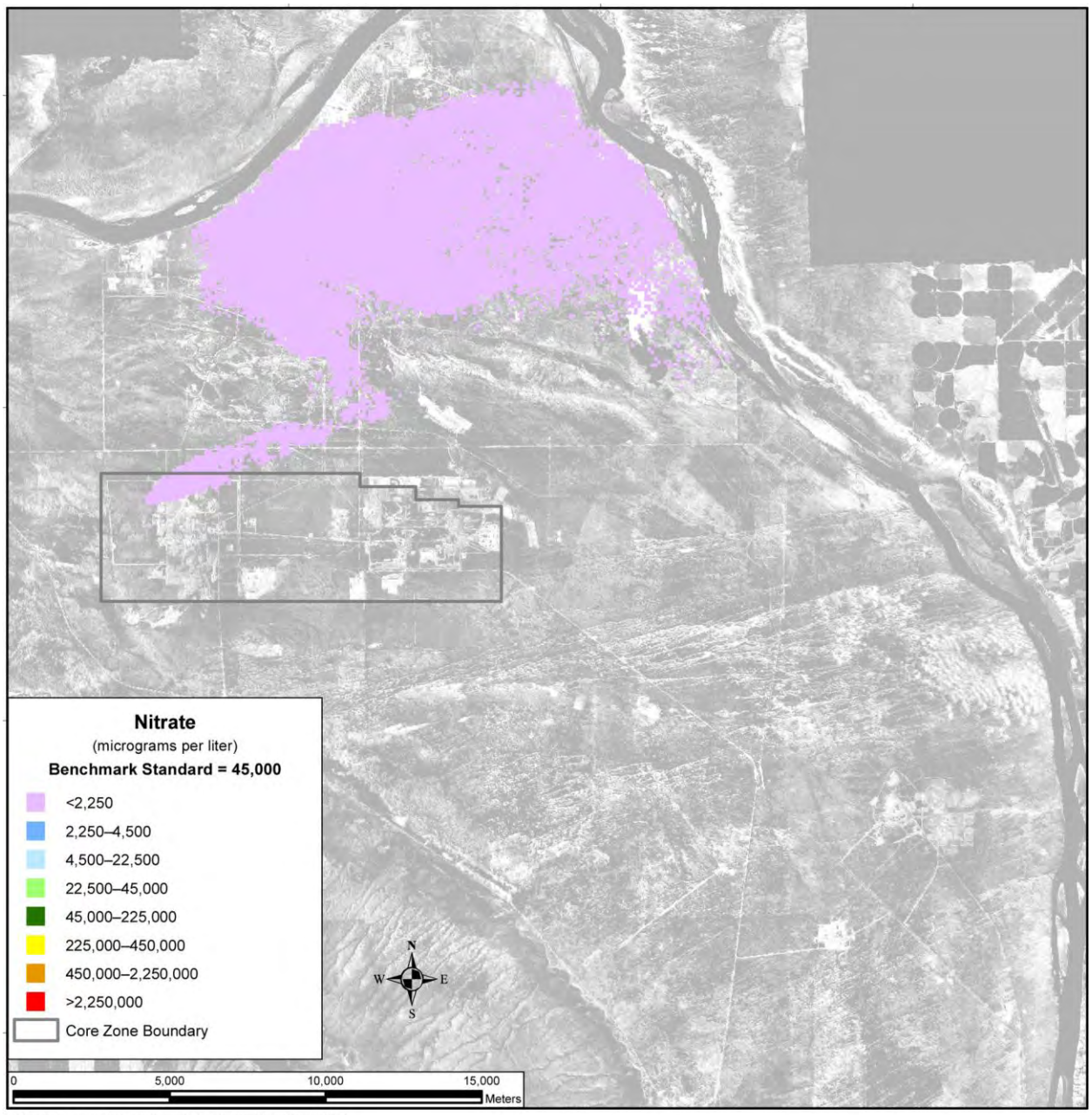
Figure 5–909. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



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

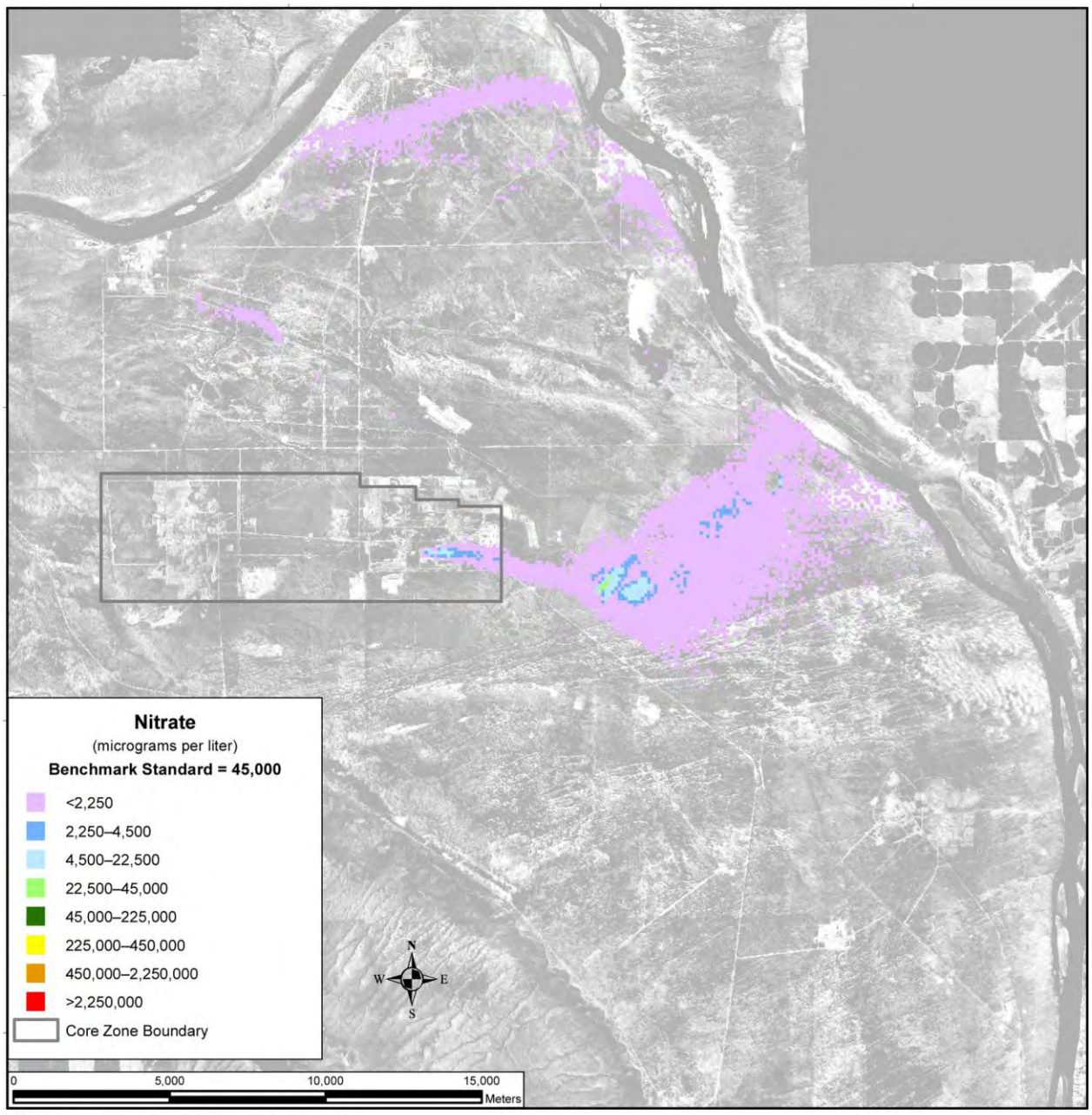
Figure 5–910. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885

The IDF-East and IDF-West nitrate releases, shown in Figures 5–911 through 5–913, show time and spatial distributions similar to the technetium-99 and iodine-129 releases. However, the IDF-East nitrate release never approaches benchmark concentrations and dissipates significantly by CY 7140 (almost nothing is showing in CY 11,885). The IDF-East nitrate release occurs later and does not appear in the CY 3890 data (see Figure 5–911). By CY 7140 (see Figure 5–912), the IDF-East nitrate release has reached the Columbia River. By CY 11,885 (see Figure 5–913), the nitrate has dissipated significantly and concentrations have fallen well below the benchmark concentration.



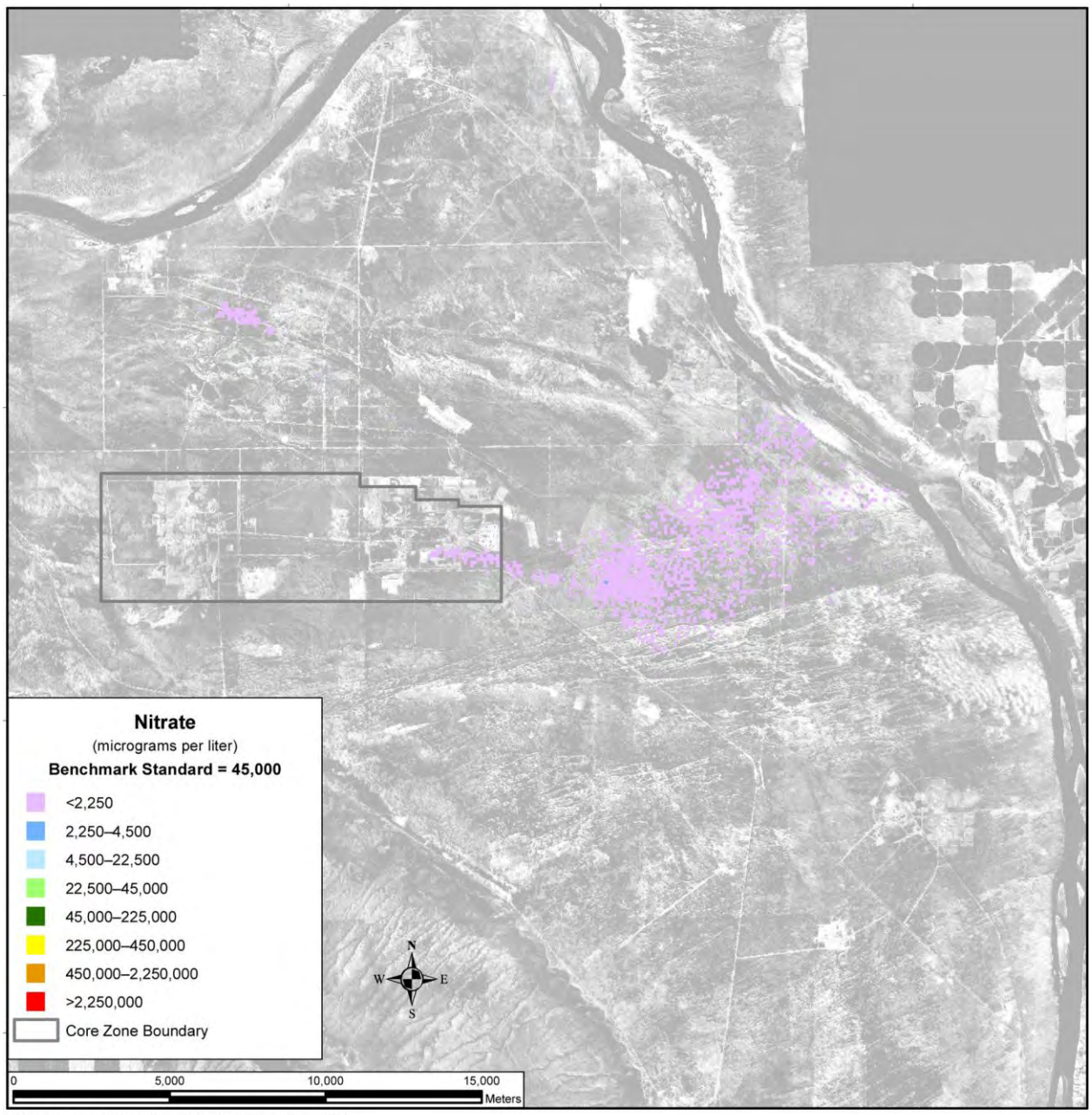
Note: To convert meters to feet, multiply by 3.281.

Figure 5–911. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



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

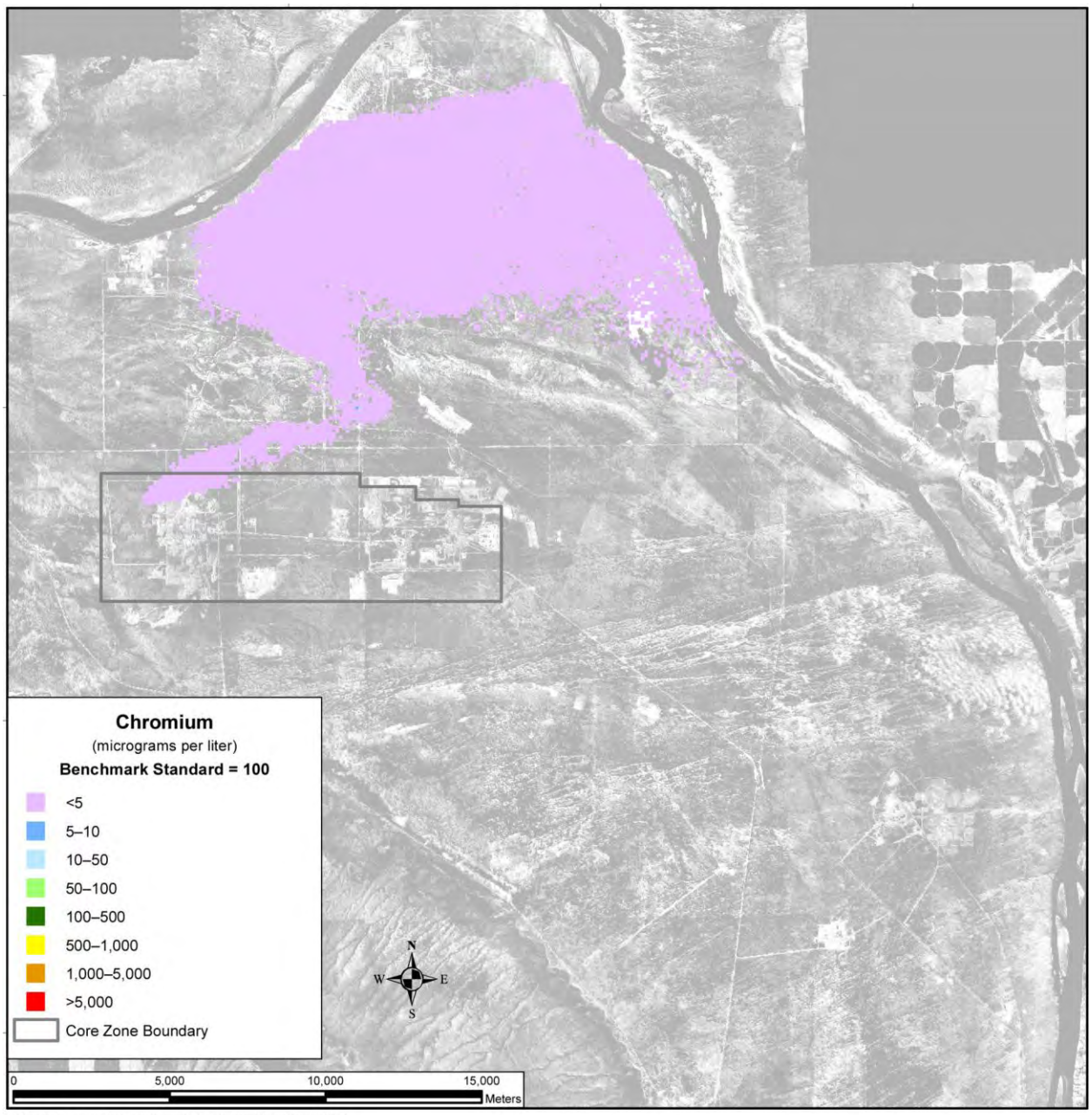
Figure 5–912. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



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

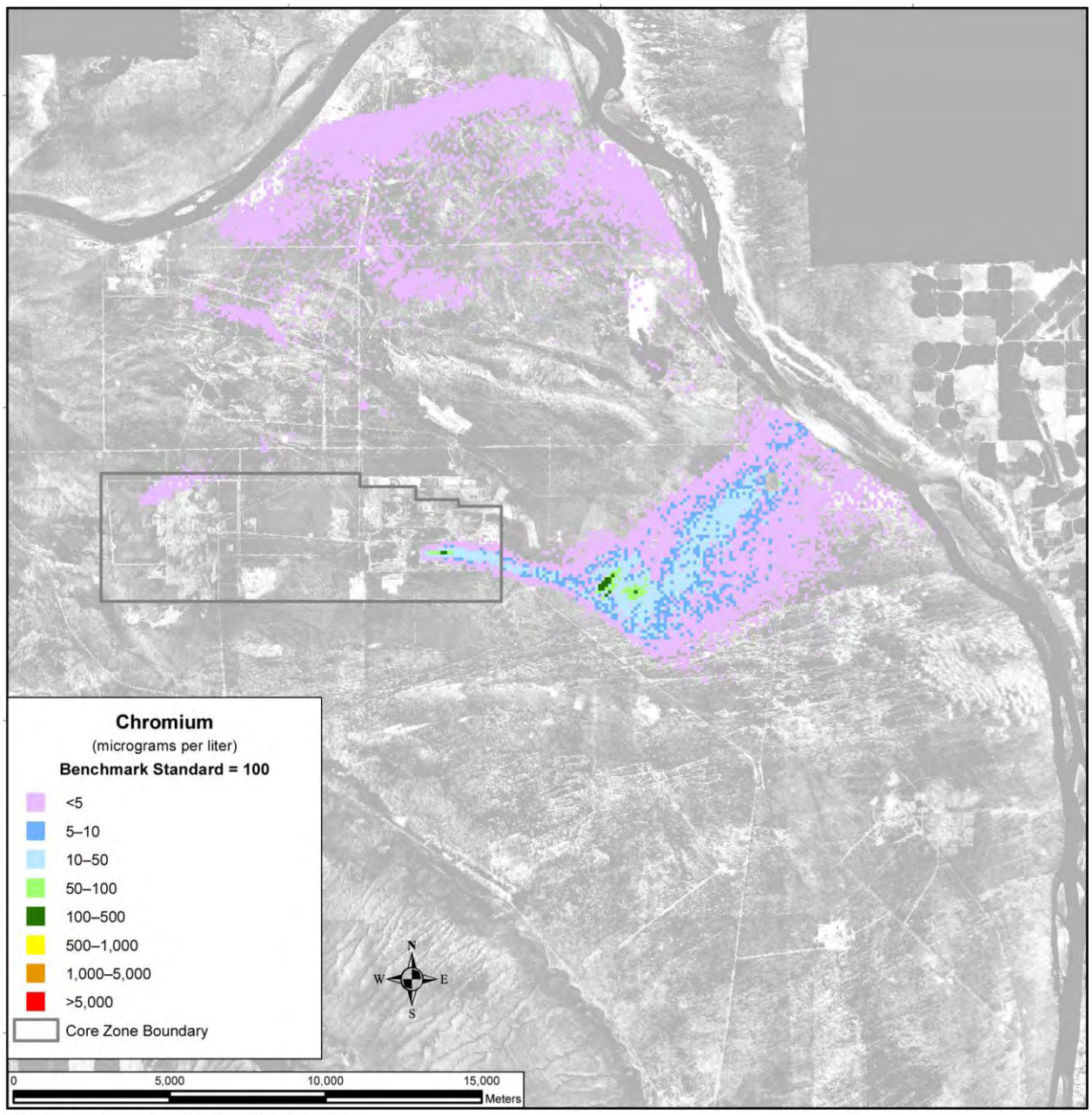
Figure 5–913. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

The initial chromium release time and spatial patterns in CY 3890 (see Figure 5–914) are nearly identical to the IDF-West nitrate release. The chromium concentrations in CY 3890 are several orders of magnitude below the benchmark level. By CY 7140, most of this low-concentration IDF-West chromium has dissipated to the Columbia River (see Figure 5–915). By CY 7140, there is a significant chromium distribution from IDF-East, with small areas that exceed benchmark concentrations. By CY 11,885 (see Figure 5–916), the IDF-West chromium has essentially dissipated. The IDF-East chromium release extends from the release site to the Columbia River, but with concentrations that are well below the chromium benchmark concentration.



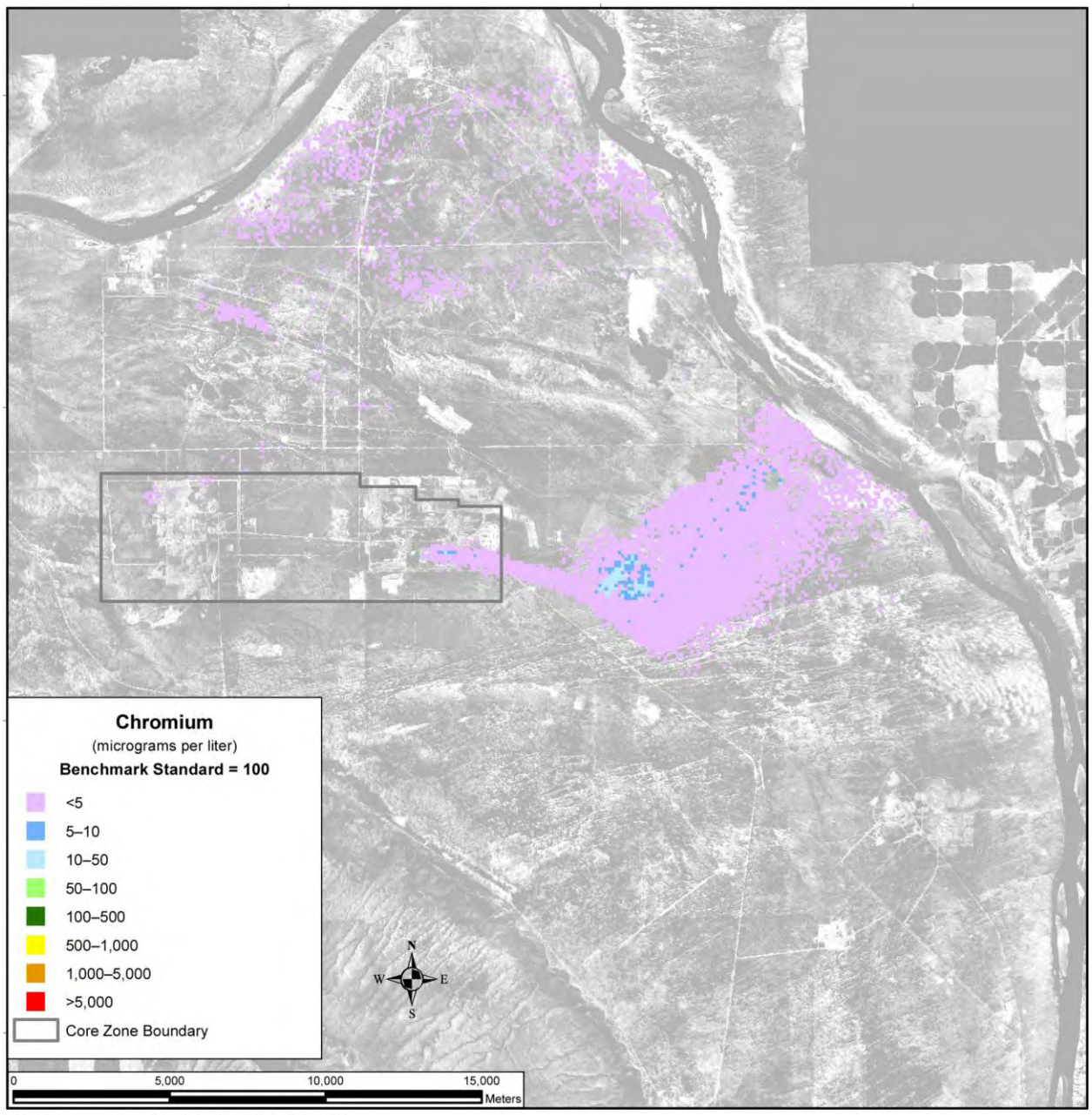
Note: To convert meters to feet, multiply by 3.281.

Figure 5–914. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



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

Figure 5–915. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



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

Figure 5–916. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, in general, the inventories remaining in IDF-East and IDF-West, which are available for release to the environment at the start of the post-disposal period, are predominant contributors. The releases from IDF-West occur earlier and dissipate earlier than releases from IDF-East.

By the end of this analysis period (CY 11,885), the chromium and nitrate distributions have largely dispersed below their benchmark concentrations. Significant spatial distributions of technetium-99 and iodine-129 remain. Most of the distribution area has concentrations below benchmark levels, but there are some small areas in which technetium-99 and iodine-129 concentrations exceed benchmark levels in

CY 11,885. The released iodine-129, which occurs at higher concentration levels relative to its benchmark than technetium-99, dissipates much more quickly than technetium-99.

For uranium-238 and total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of those retarded species do not exceed the benchmark levels at the Core Zone Boundary or Columbia River nearshore over the period of analysis.

5.3.1.3.1.7 Disposal Group 1, Subgroup 1-G

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, was designed to accommodate the disposal of wastes generated under Tank Closure Alternative 6C and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste. Tank closure waste would be converted to IHLW and ILAW glass. The ILAW glass would be stored on site as HLW pending disposition.

For the long-term groundwater impacts analysis, two major periods have been identified for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2050, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2051 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G. Complete results for all 40 COPCs are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129, technetium-99, and uranium-238
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, nitrate, and total uranium

The COPC drivers for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. Uranium-238 and total uranium were added to the COPC drivers; although their contribution to risk and hazard are not dominant during the year of peak risk or hazard, they become major contributors toward the end of the period of analysis. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for 100 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G.

The COPC drivers that are discussed in detail in this section fall into two categories. Iodine-129, technetium-99, chromium, and nitrate are all mobile (i.e., they move with groundwater) and long-lived

(relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. Uranium-238 and total uranium are long-lived, or stable, but are not as mobile as the other COPC drivers. These constituents move about seven times more slowly than groundwater. As the analyses of release, concentration versus time, and spatial distribution of the COPC drivers are presented, the distinct behavior of these groups will become apparent.

The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over six orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–917 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–918, the chemical hazard drivers. Two subtotals are plotted in Figures 5–917 through 5–922, representing releases from IDF-East, which include ETF-generated secondary waste and tank closure secondary waste. For technetium-99, chromium, and nitrate in grouted waste forms, the release to the vadose zone is controlled by the inventory (i.e., nearly all of the inventory is released during the period of analysis). The predominant source of technetium-99 and chromium is tank closure secondary waste. ETF-generated secondary waste is the predominant source of iodine-129 and nitrate.

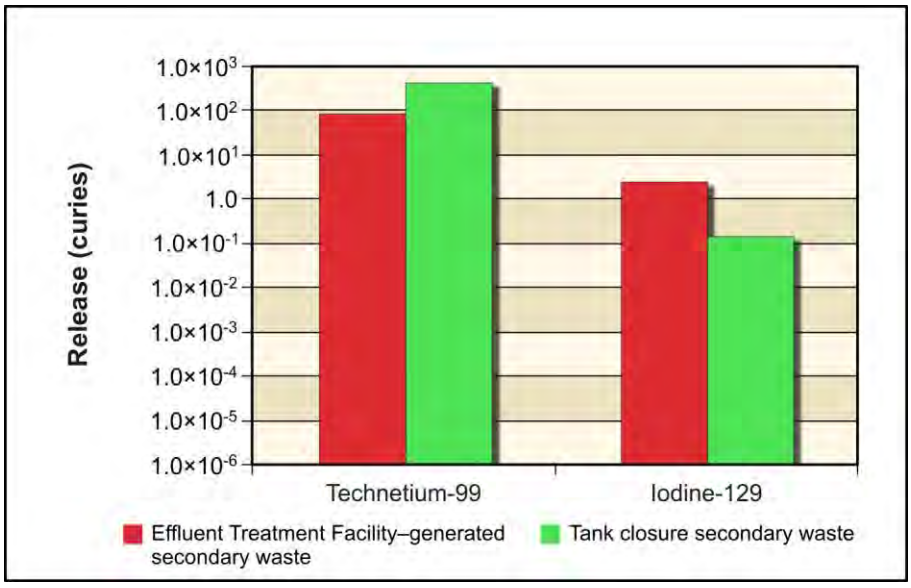


Figure 5–917. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

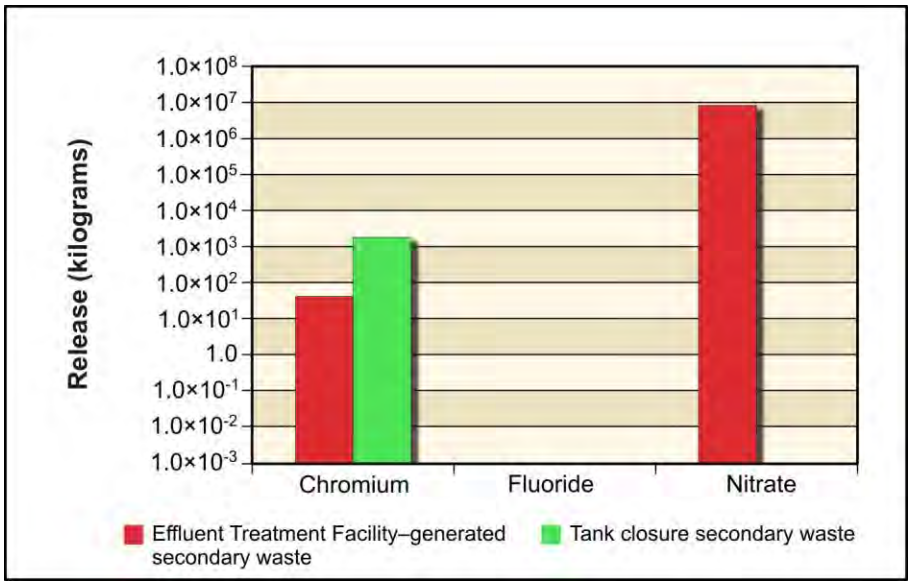


Figure 5–918. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–919 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–920, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Nearly all of the technetium-99 released from ETF-generated secondary waste to the vadose zone reaches groundwater during the period of analysis, but only approximately 40 to 50 percent of the technetium-99 from other sources and iodine-129 released to the vadose zone reaches groundwater. Nearly all chromium and nitrate released to the vadose zone reaches groundwater.

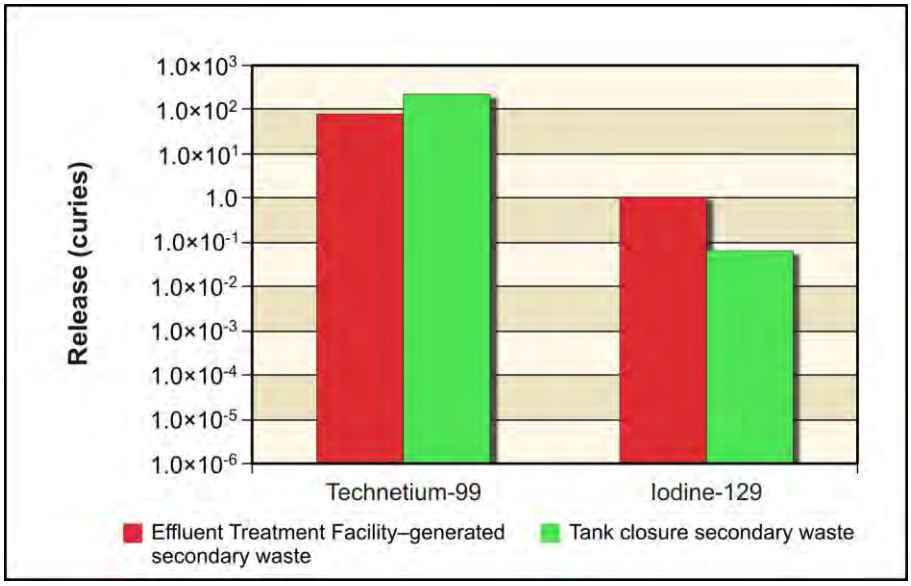


Figure 5–919. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

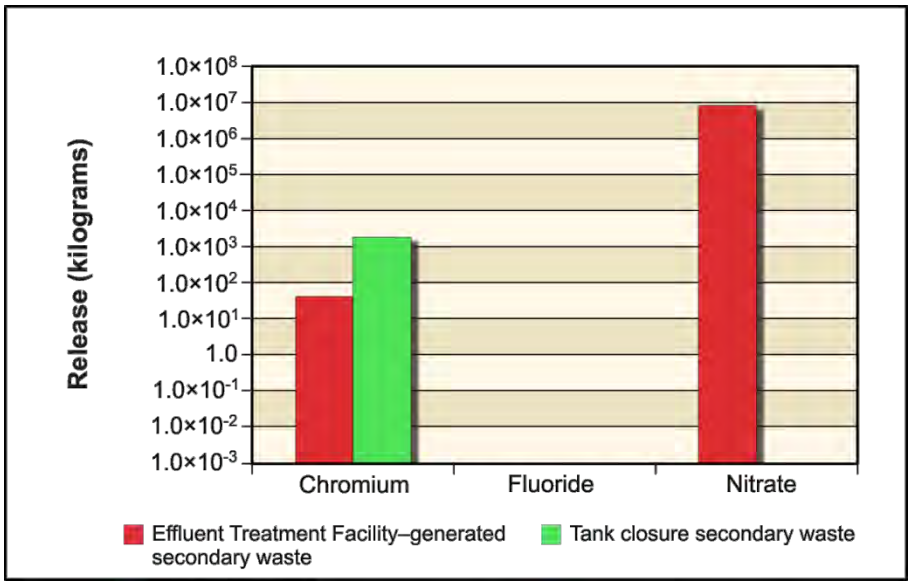


Figure 5–920. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–921 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–922, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. In all cases, between 96 and 100 percent of the amount released to groundwater reaches the Columbia River.

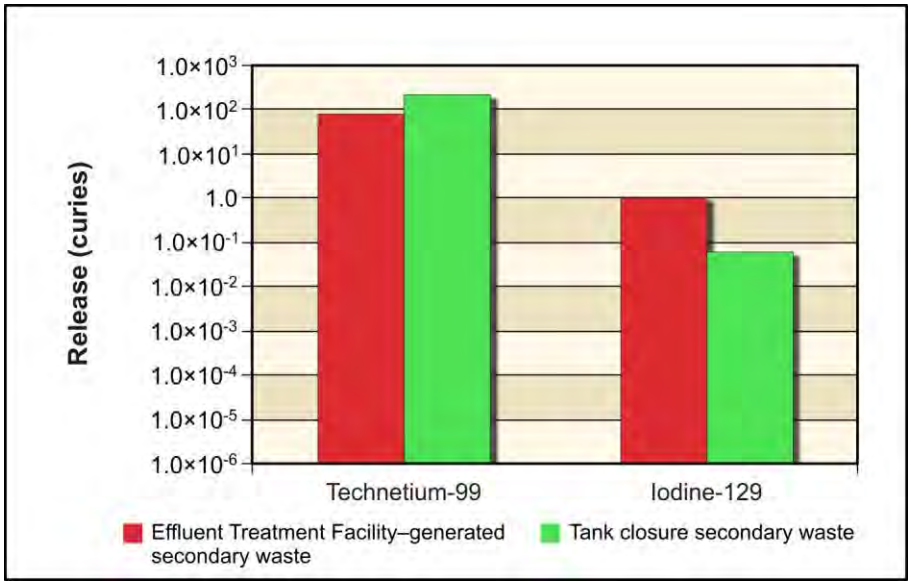


Figure 5–921. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

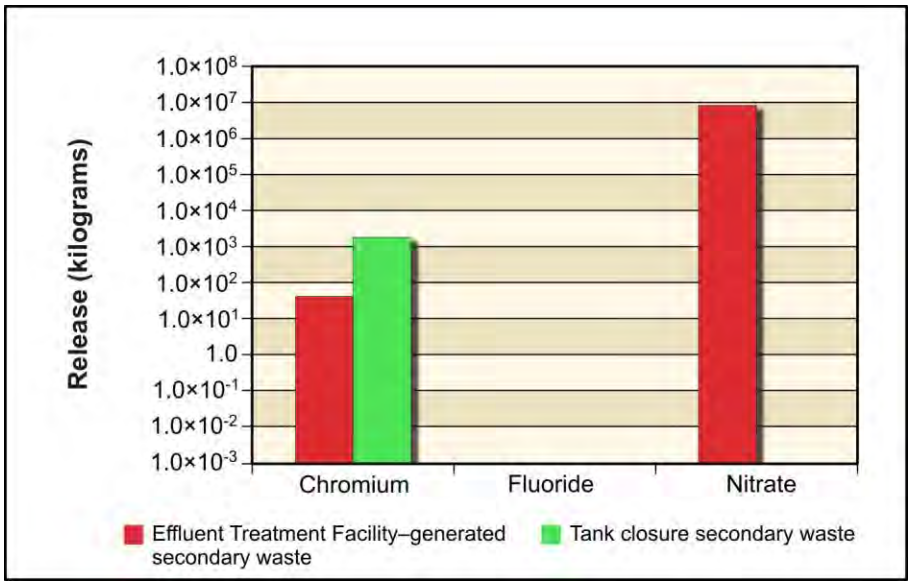


Figure 5–922. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5–923 through 5–928, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary waste and onsite waste, and offsite waste. Figure 5–923 shows the estimated release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–924, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). Technetium-99, iodine-129, chromium, fluoride, and nitrate are all present at IDF-West.

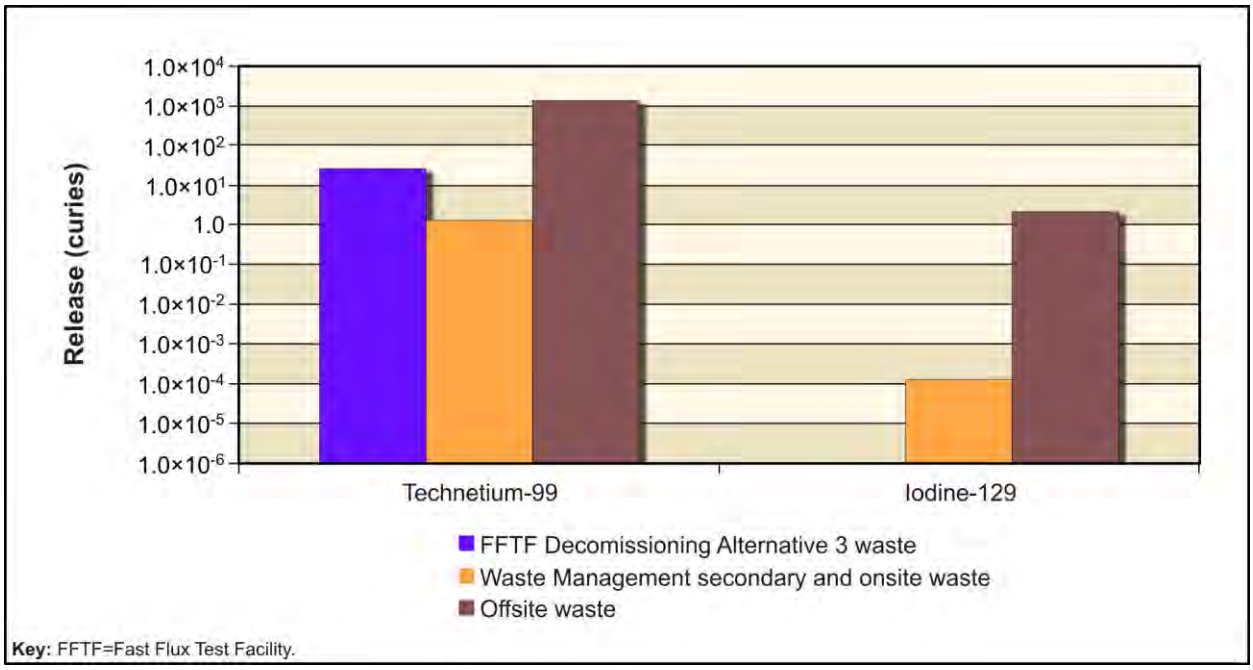


Figure 5–923. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

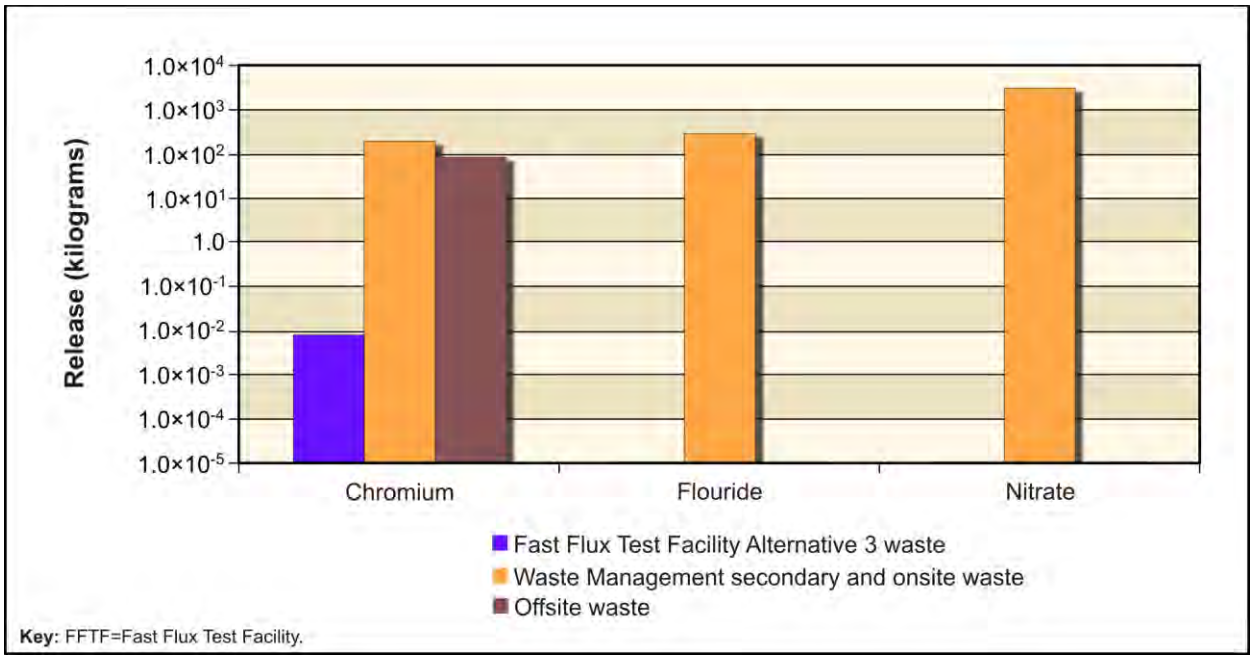


Figure 5–924. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–925 shows the estimated release from IDF-West to groundwater of the radiological risk drivers and Figure 5–926, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All of the COPC drivers present at IDF-West behave as conservative tracers, with essentially all of the mass released to the vadose zone reaching groundwater.

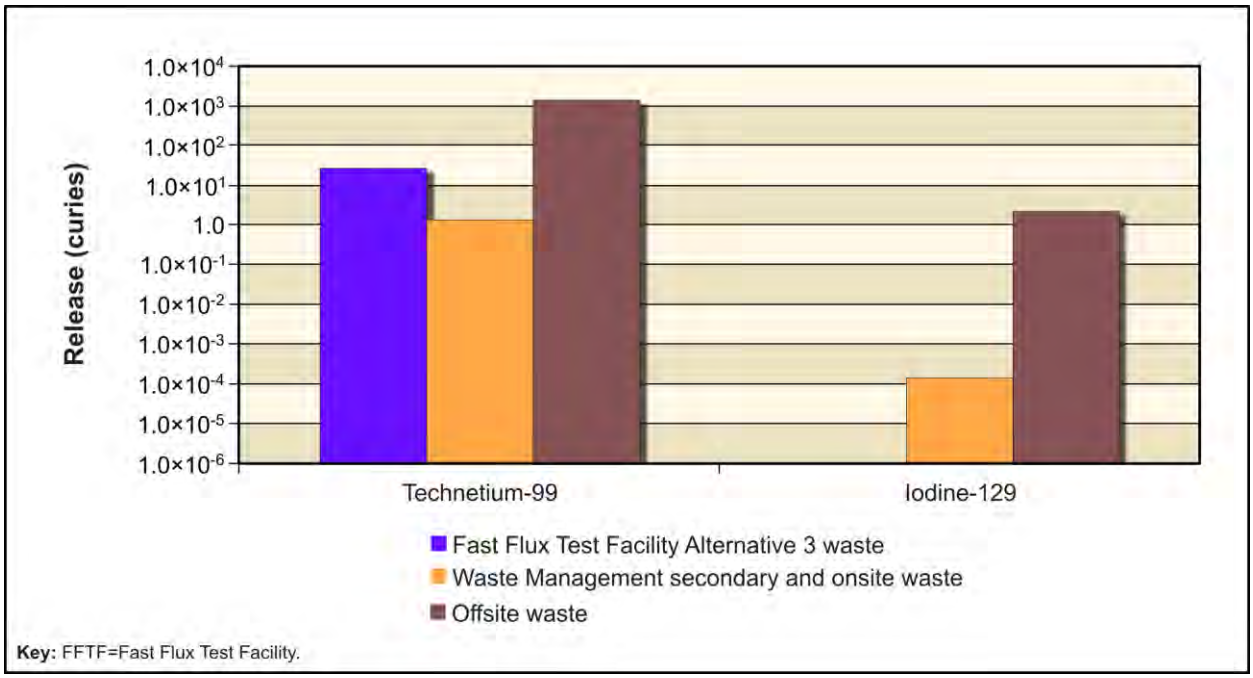


Figure 5–925. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

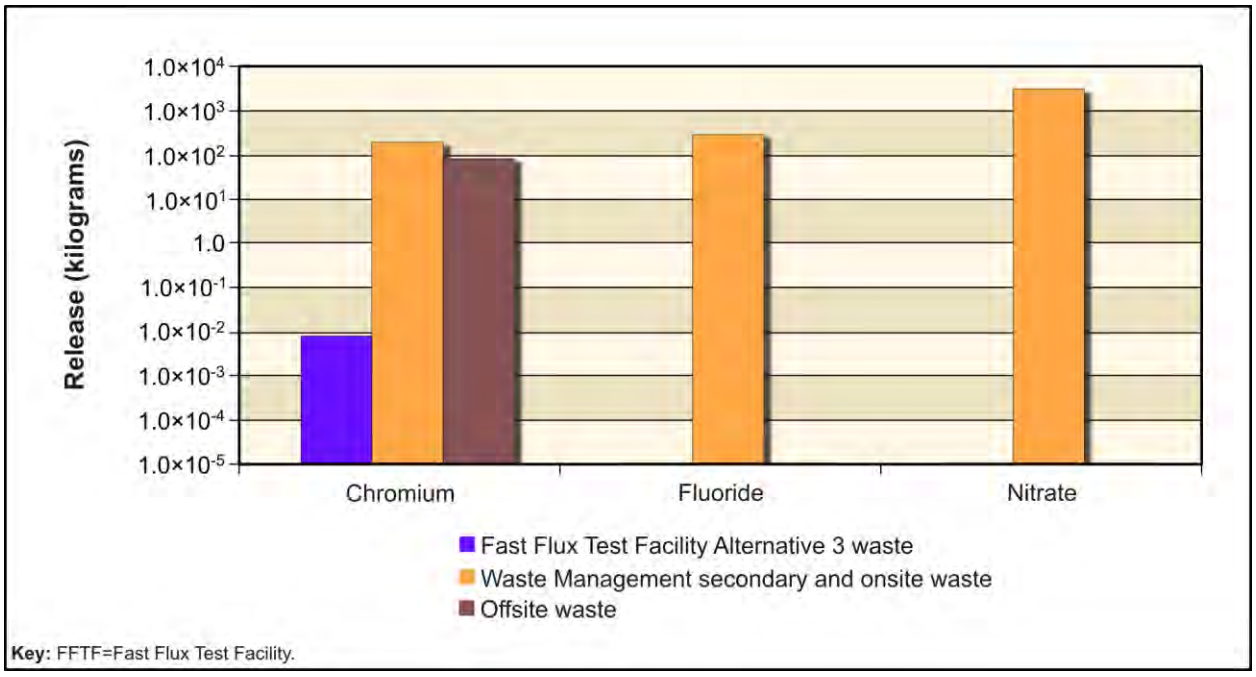


Figure 5–926. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–927 shows the estimated release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–928, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Essentially everything released to groundwater reaches the Columbia River for all COPC drivers present during the period of analysis.

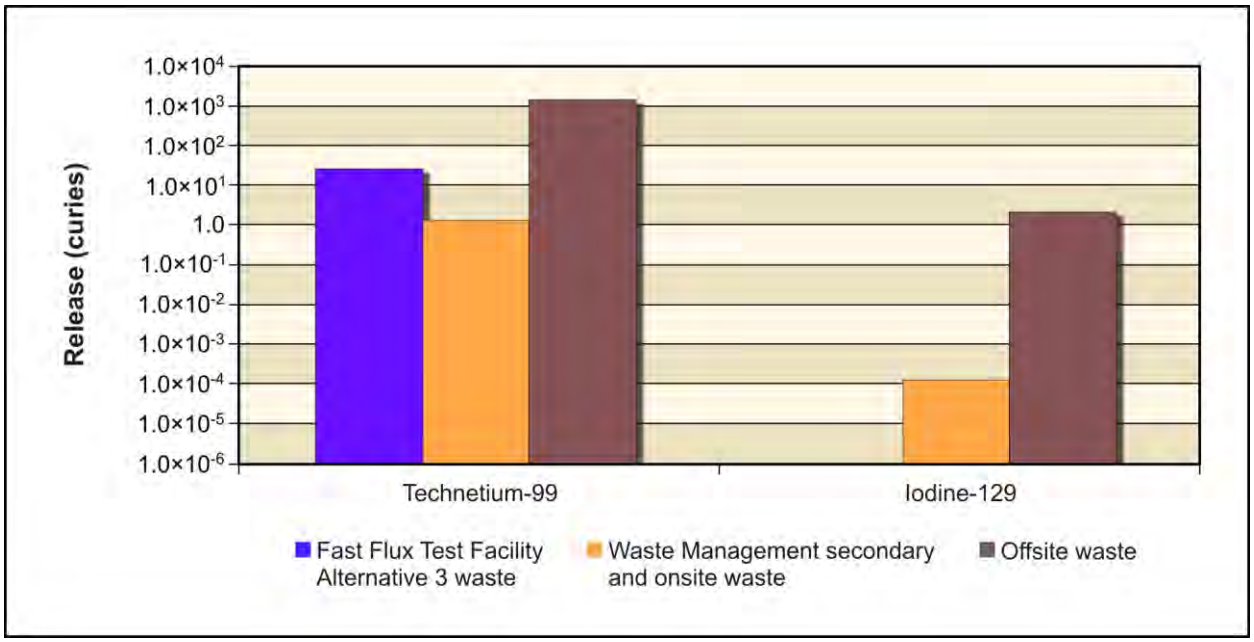


Figure 5–927. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

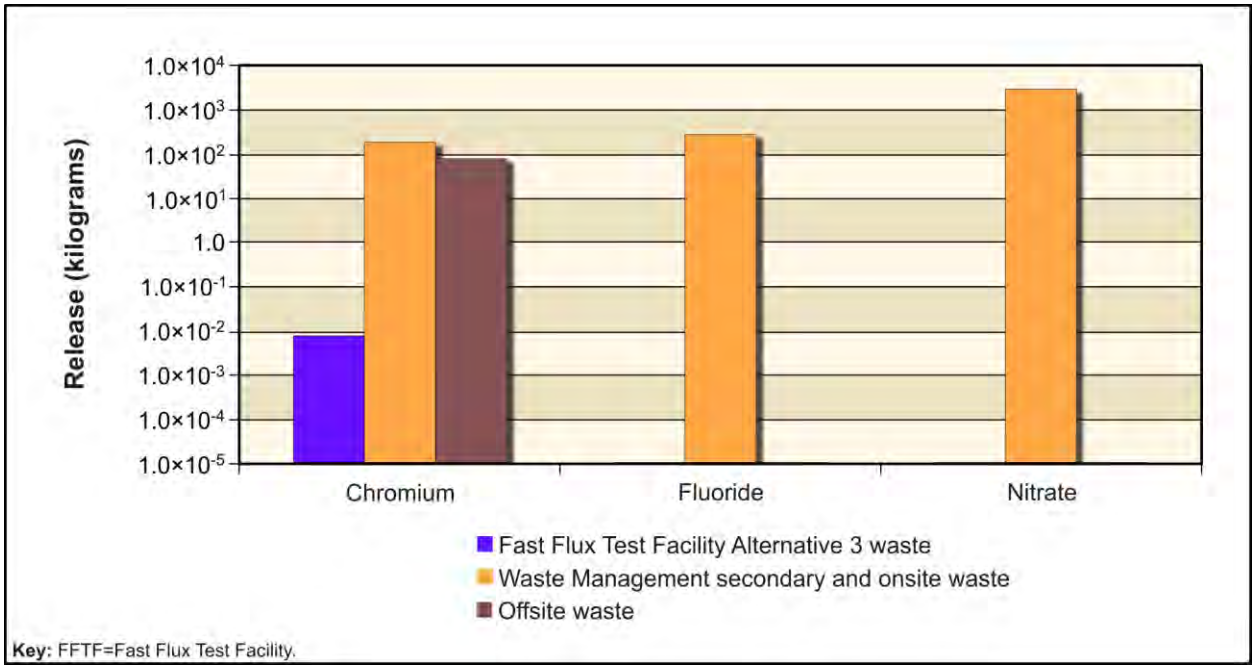


Figure 5–928. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

The RPPDF would receive lightly contaminated equipment and soils resulting from tank farm closure activities. Figure 5–929 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–930, the chemical hazard drivers. For all types of sources, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). Technetium-99, iodine-129, chromium, and nitrate are all present at the RPPDF.

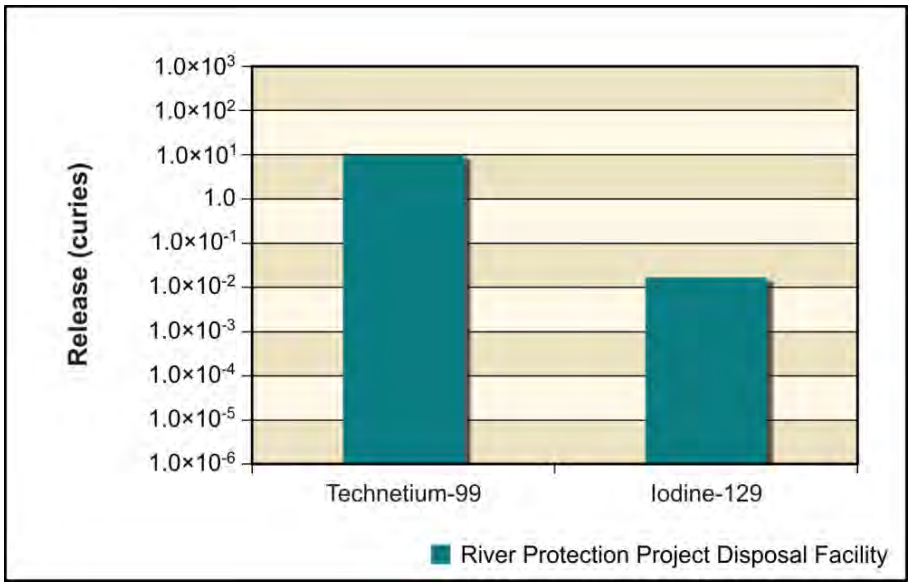


Figure 5–929. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

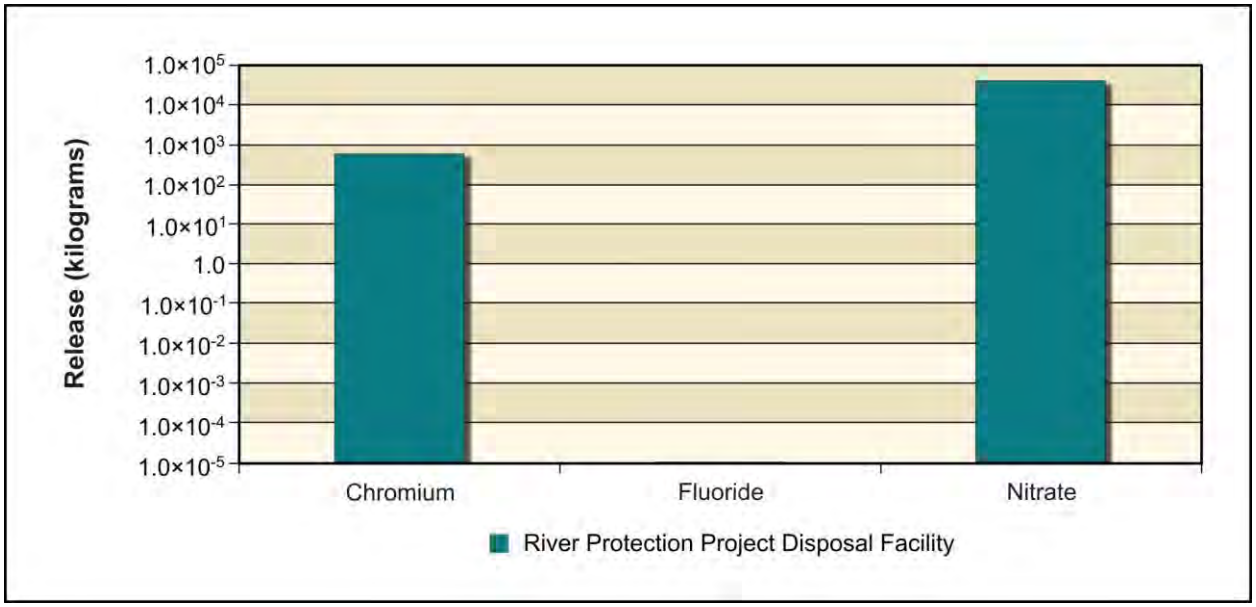


Figure 5–930. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–931 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–932, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All of the COPC drivers present at the RPPDF behave as conservative tracers, with essentially all of the mass released to the vadose zone reaching groundwater.

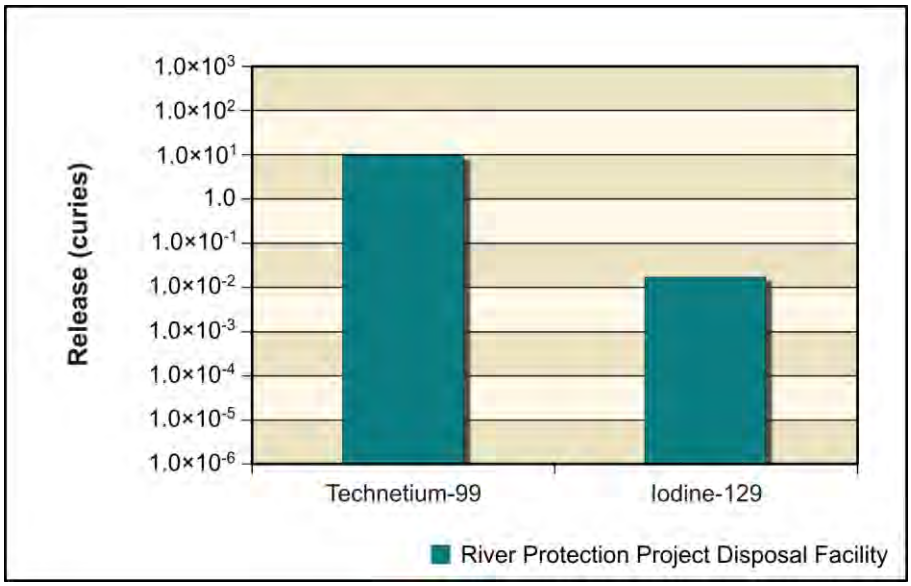


Figure 5–931. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

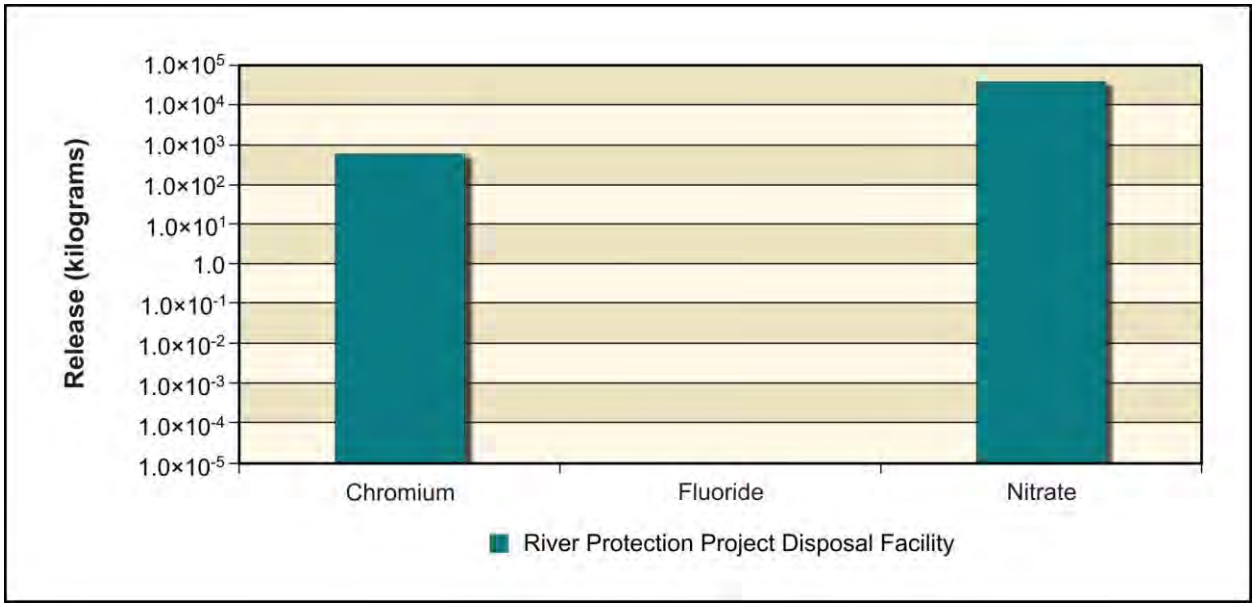


Figure 5–932. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–933 shows the estimated release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–934, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Essentially everything released to groundwater reaches the Columbia River for all COPC drivers present.

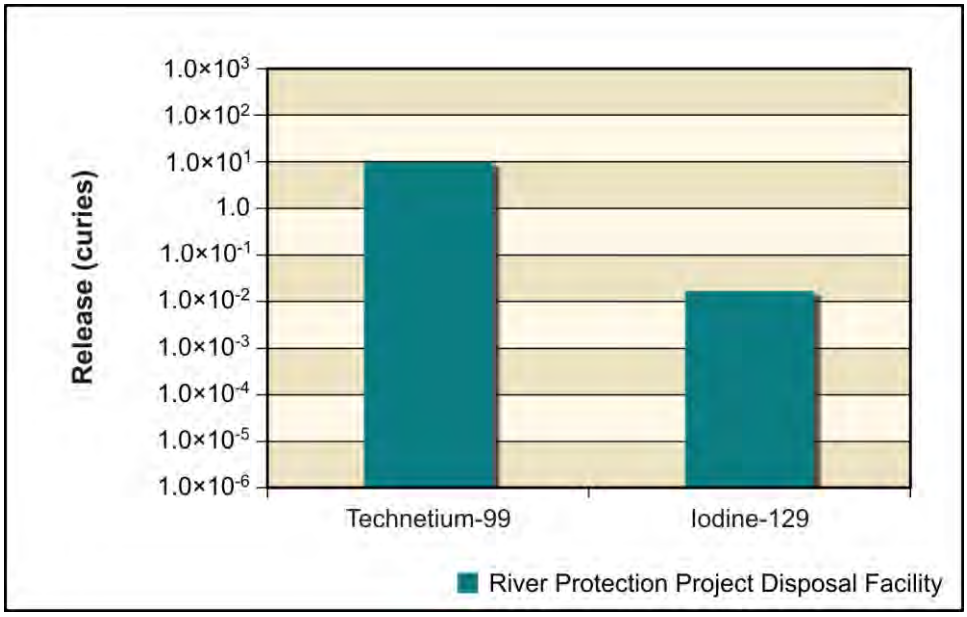


Figure 5–933. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

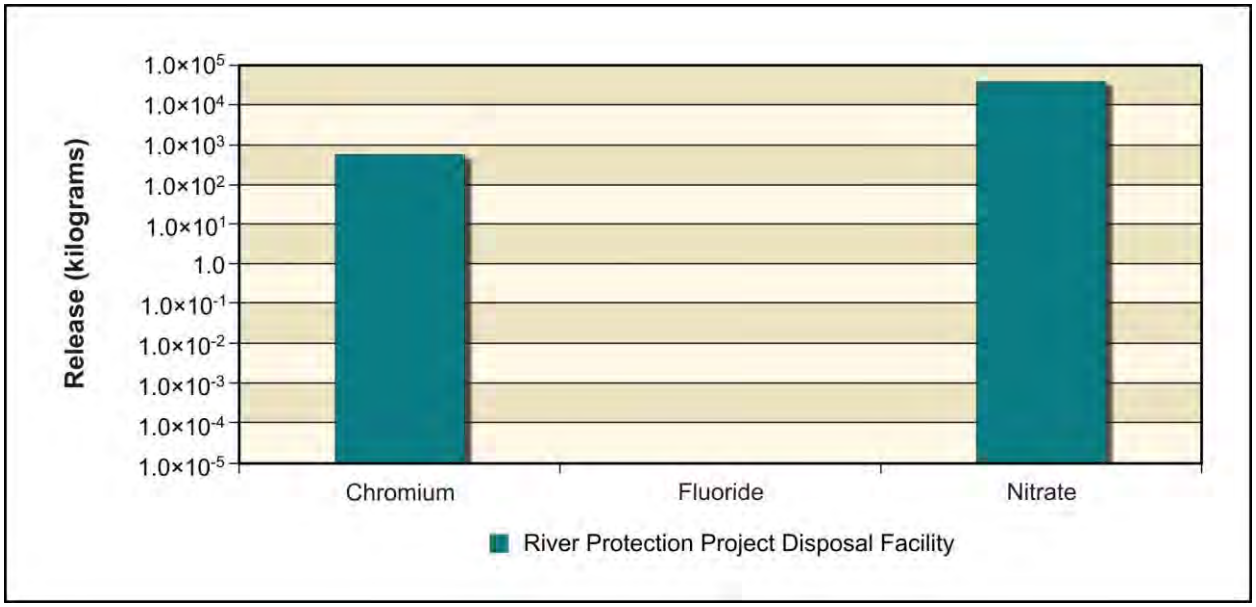


Figure 5–934. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude. Table 5–112 shows the maximum concentrations in groundwater. The data indicate that exceedances of benchmark concentrations are present primarily at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore because of high concentrations of technetium-99 and iodine-129. Concentrations of iodine-129 at the IDF-East barrier also reach the benchmark value in CY 10,177. No other COPC driver concentrations exceed the respective benchmark values.

Table 5–112. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	208	**13,200**	42	**1,370**	**1,670**	900
	(11,385)	(3818)	(3818)	(3859)	(3920)	
Iodine-129	1.0	**20.6**	0.1	**2.1**	**2.4**	1
	(10,177)	(3794)	(3747)	(3937)	(3872)	
Chemical (micrograms per liter)						
Chromium	2	1	3	1	0	100
	(8555)	(3813)	(3740)	(3846)	(4481)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	12,100	7	180	3,010	2,030	45,000
	(7962)	(3927)	(3670)	(8248)	(7535)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figures 5–935 through 5–938 show concentration versus time for technetium-99, iodine-129, chromium, and nitrate (the conservative tracers). For technetium-99, concentrations rise early in the simulation, reaching a peak around CY 3940, when concentrations at the IDF-West barrier are at about an order of magnitude above the benchmark concentration. Technetium-99 concentrations at the Core Zone Boundary and Columbia River nearshore are less than an order of magnitude above the benchmark. Concentrations drop until around CY 7940, when they begin to stabilize between one and two orders of magnitude below the benchmark. Technetium-99 concentrations at the IDF-East barrier begin to rise at around CY 4940 but level out at about one order of magnitude below the benchmark concentration. Iodine-129 follows a pattern similar to that of technetium-99, stabilizing an order of magnitude below the benchmark after peaking at between one and two orders of magnitude above the benchmark around CY 3940. Chromium concentrations at the Core Zone Boundary peak nearly two orders of magnitude below the benchmark before concentrations drop sharply. Around CY 5400, concentrations begin rising again, with a peak over two orders of magnitude below the benchmark. Nitrate has a similar two-peaked pattern, with the first peak remaining three orders of magnitude below the benchmark at the Core Zone Boundary, while the second peak is only one order of magnitude below the benchmark at the IDF-East barrier.

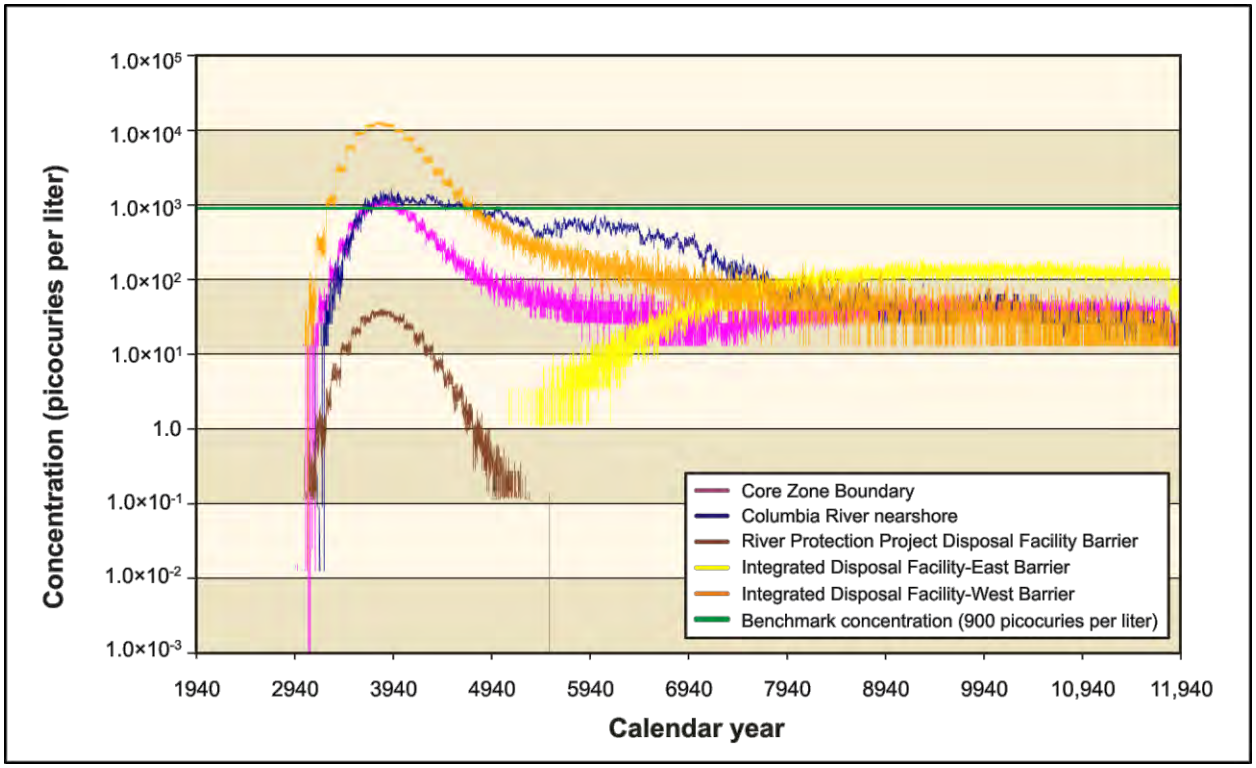


Figure 5–935. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Technetium-99 Concentration Versus Time

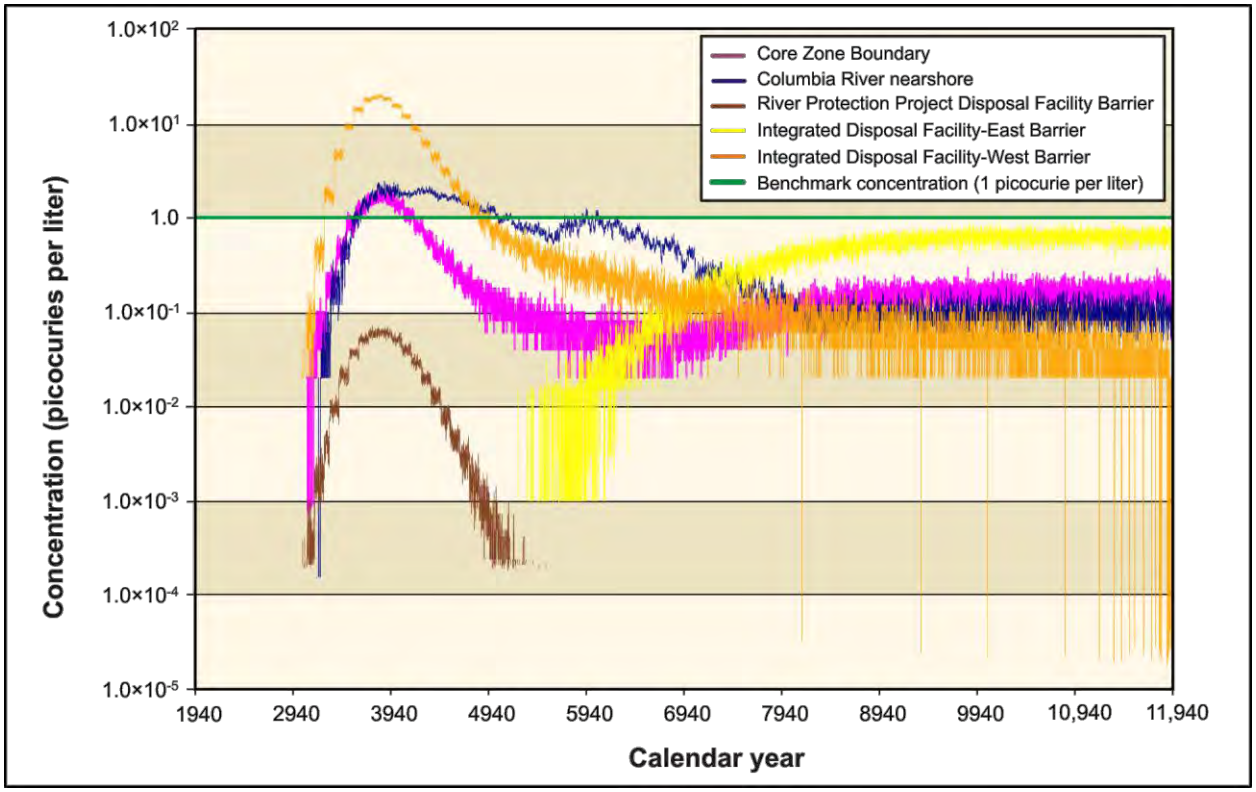


Figure 5–936. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Iodine-129 Concentration Versus Time

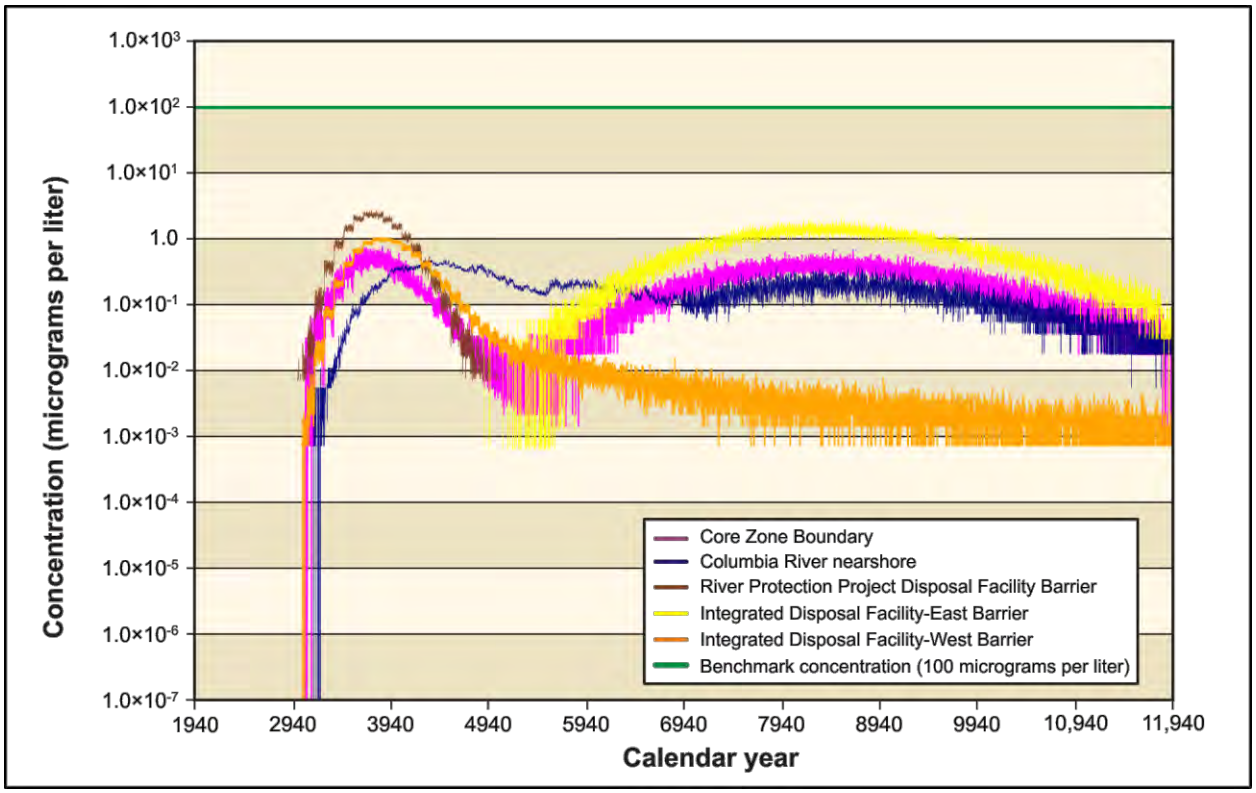


Figure 5–937. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Chromium Concentration Versus Time

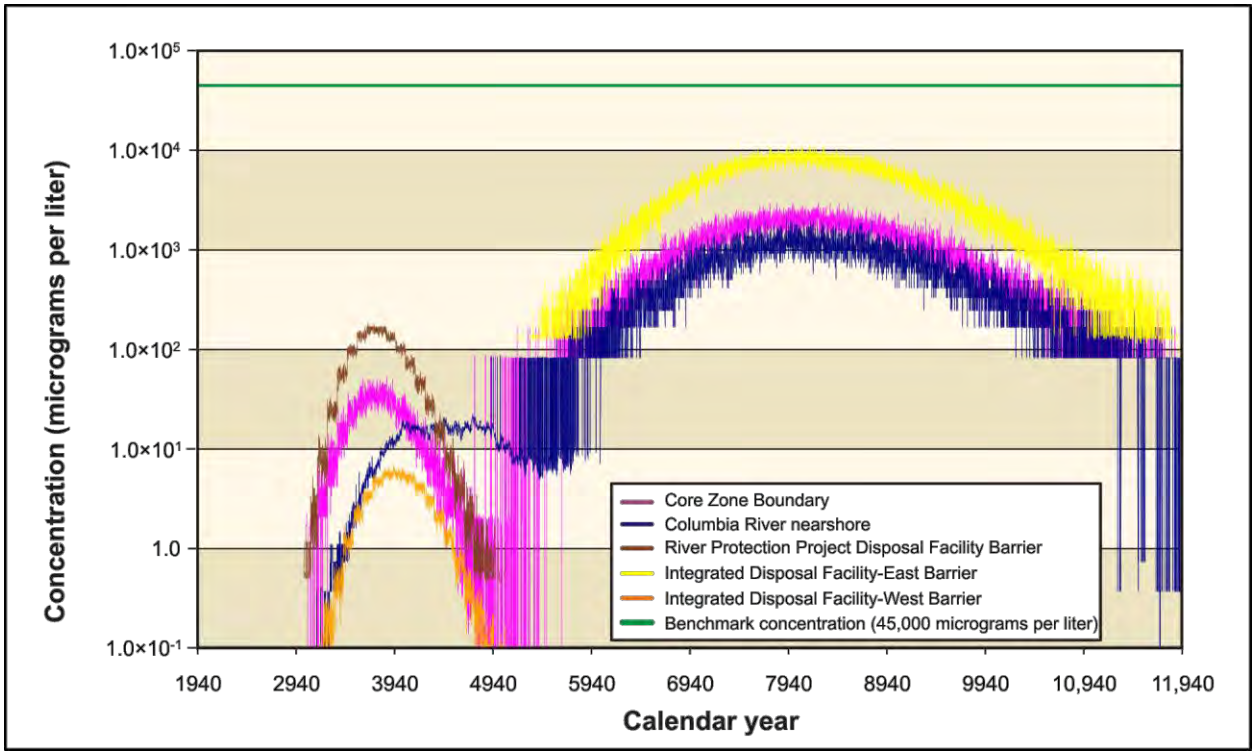


Figure 5–938. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Nitrate Concentration Versus Time

Figure 5–939 shows concentration versus time for total uranium. Because of the high retardation of uranium, no contamination appears until approximately CY 10,000, when total uranium concentrations at the RPPDF barrier first surpass 1.0×10^{-8} micrograms per liter. Total uranium remains over seven orders of magnitude below the benchmark concentration at the RPPDF barrier and Core Zone Boundary throughout the simulation.

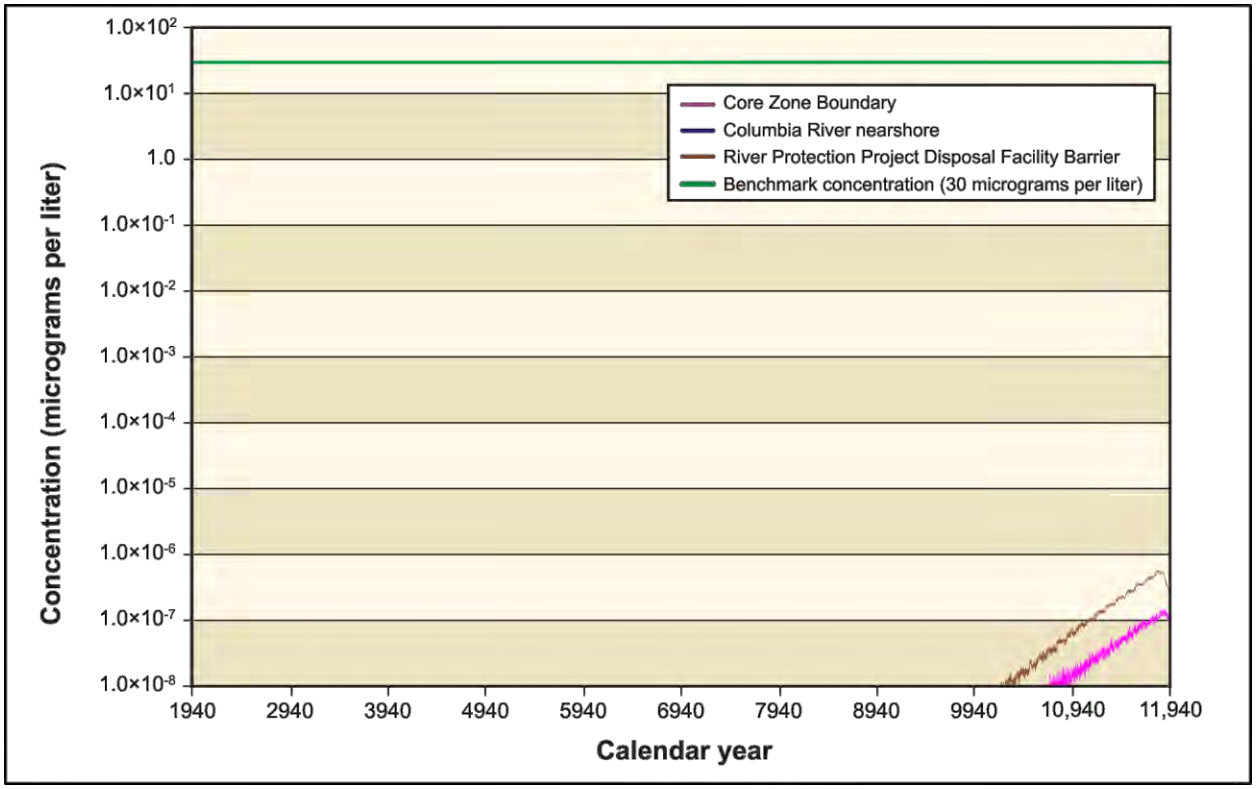


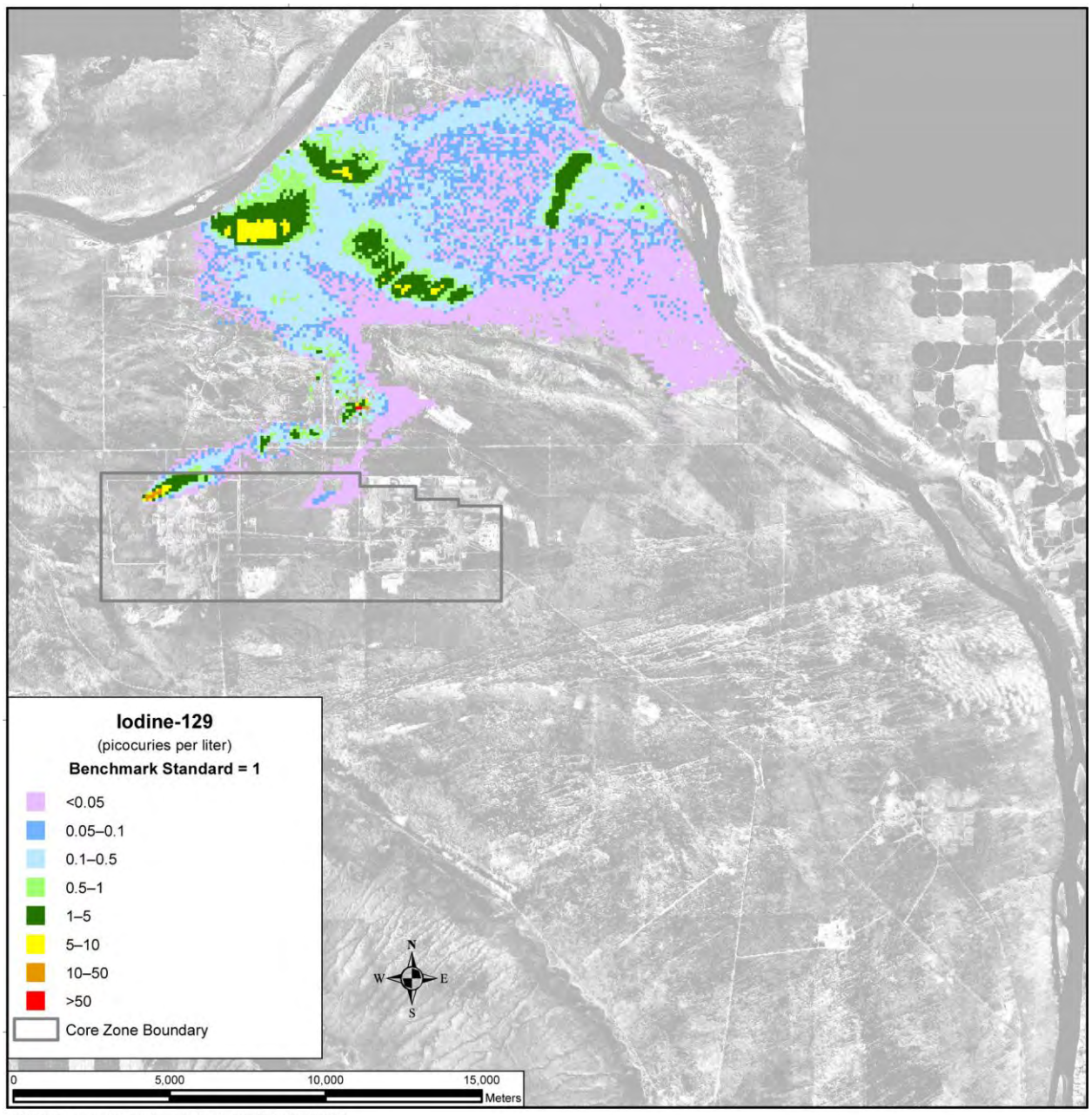
Figure 5–939. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

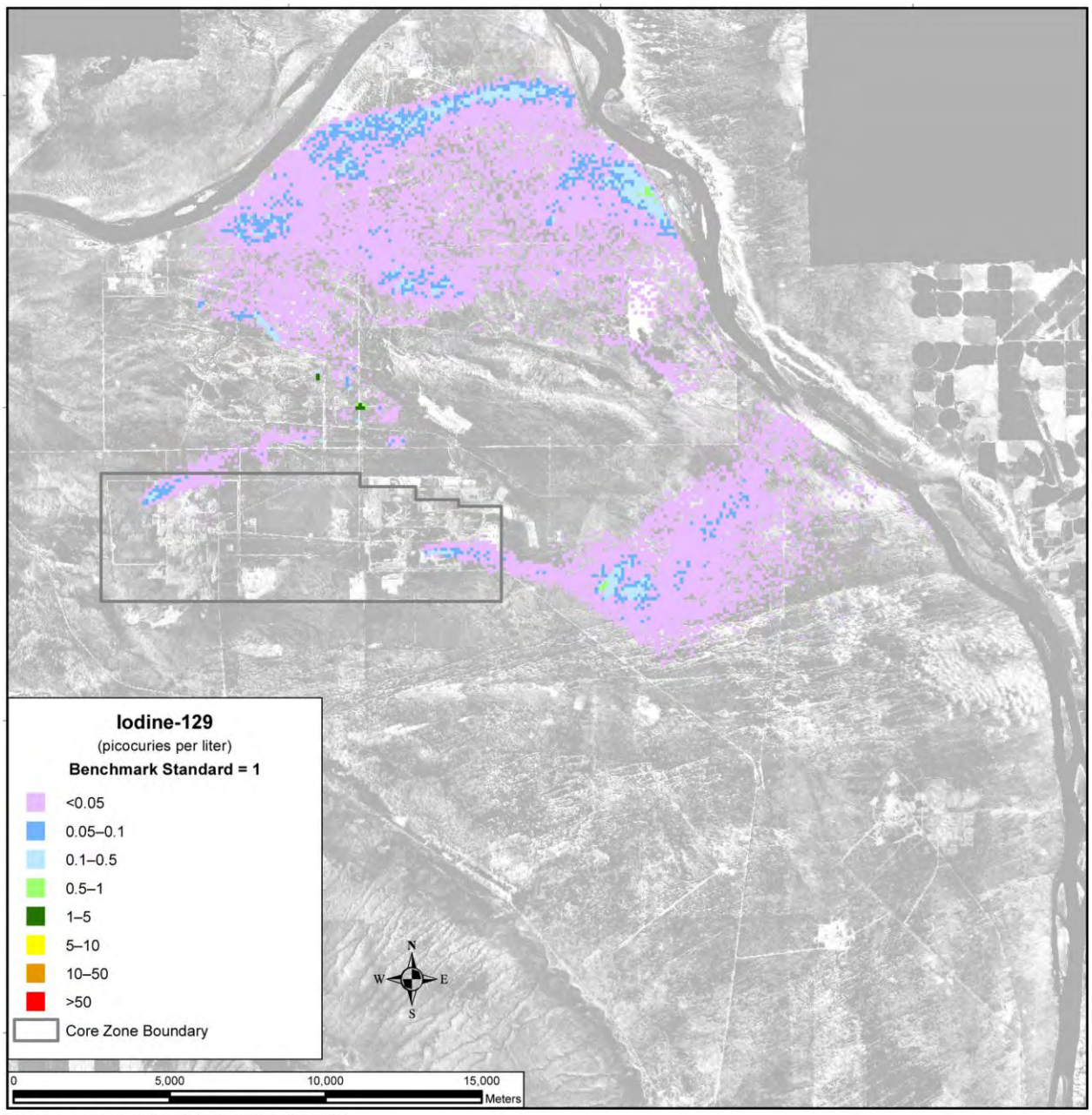
In CY 3890 (see Figure 5–940), there is a high-concentration plume of iodine-129 stretching northeast of IDF-West and a low-concentration plume stretching north from the RPPDF through Gable Gap. Four separate high-concentration areas have also formed north of Gable Mountain and Gable Butte. By CY 7140 (see Figure 5–941), the plumes from IDF-West and the RPPDF have dissipated, but a new plume has formed, traveling east from IDF-East. Concentrations in this plume remain close to the benchmark. Figure 5–942 shows the spatial concentration of iodine-129 in CY 11,885. Technetium-99 (see Figures 5–943 through 5–945) shows a similar spatial distribution, but has lower concentrations. Nitrate (see Figures 5–946 through 5–948) shows similar spatial distributions at selected times, but has

consistently lower concentrations that are well below the benchmark. Chromium (see Figures 5–949 through 5–951) has low-concentration plumes originating in IDF-East and the RPPDF in CY 3890, but no contamination originating in IDF-West until approximately CY 7140. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., they move at the pore-water velocity).



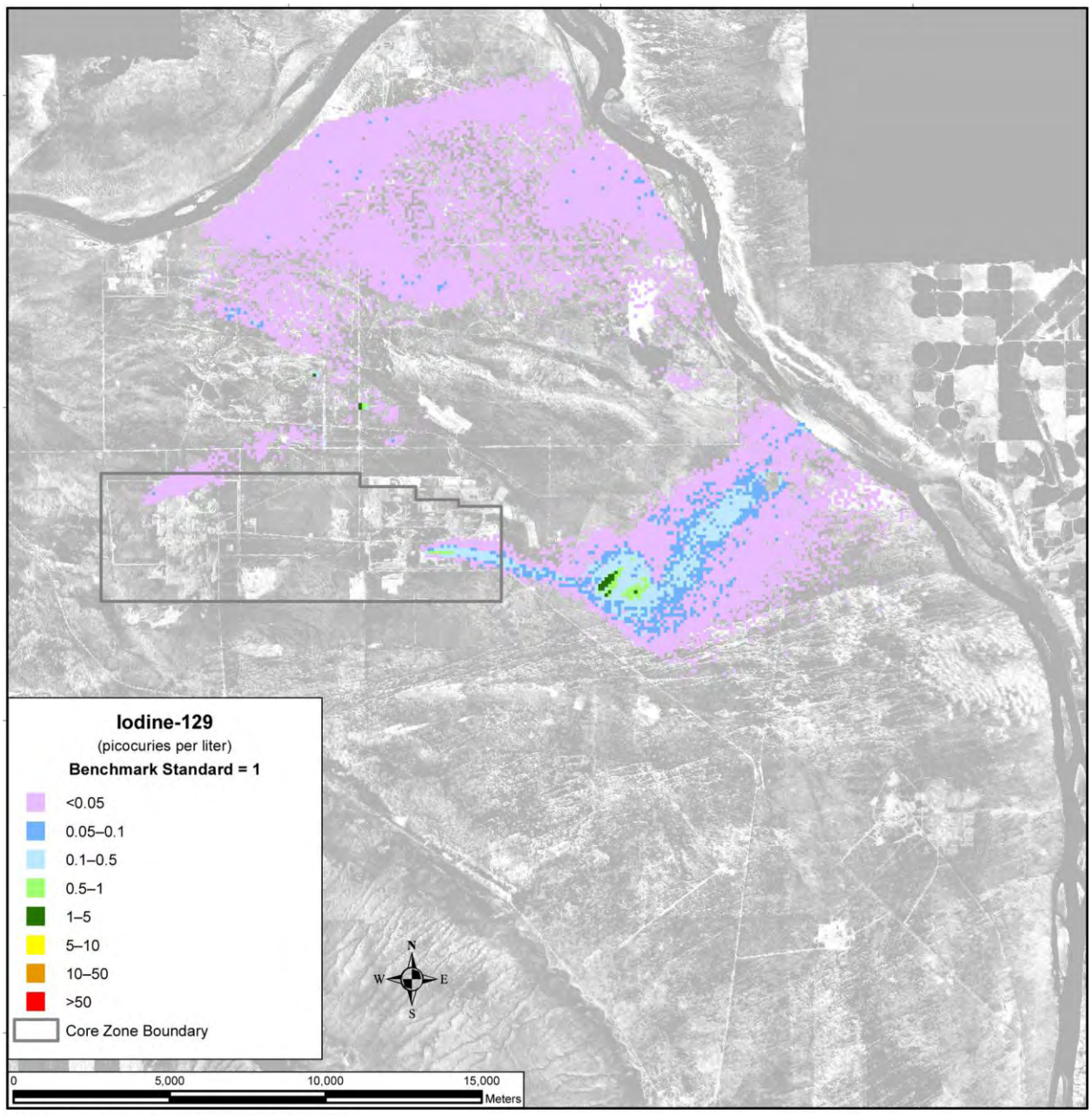
Note: To convert meters to feet, multiply by 3.281.

Figure 5–940. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



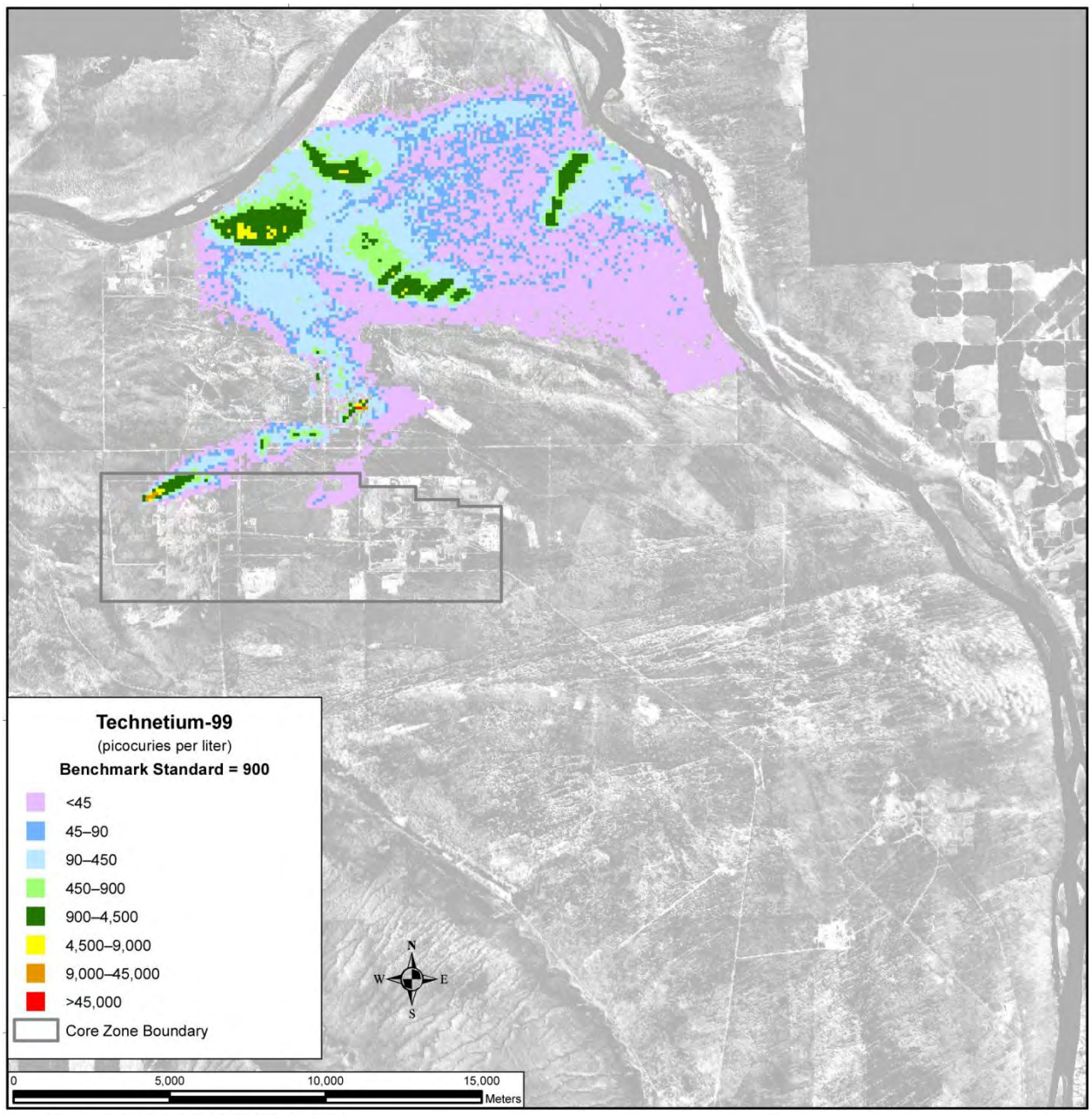
Note: To convert meters to feet, multiply by 3.281.

Figure 5–941. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



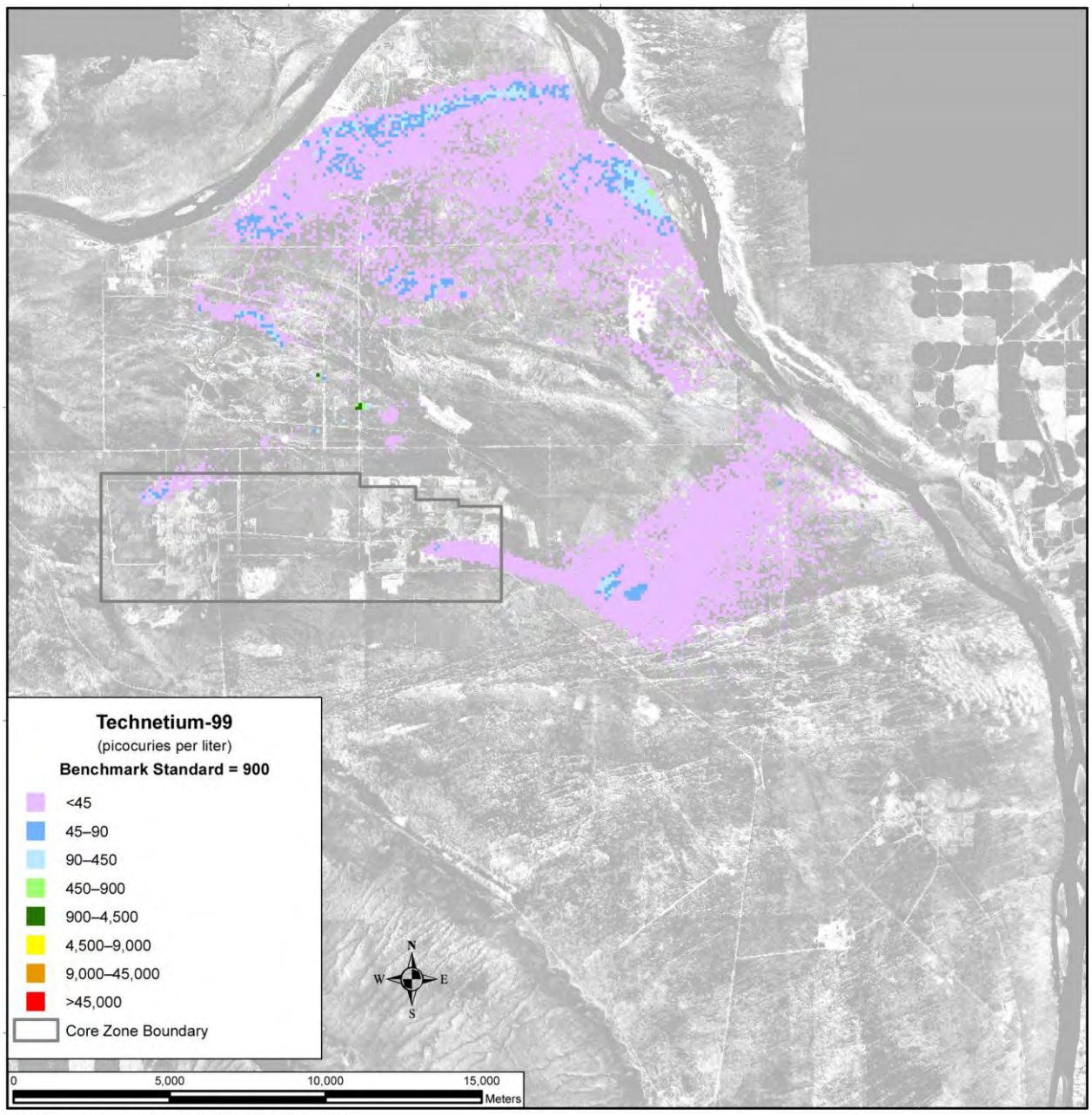
Note: To convert meters to feet, multiply by 3.281.

Figure 5–942. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



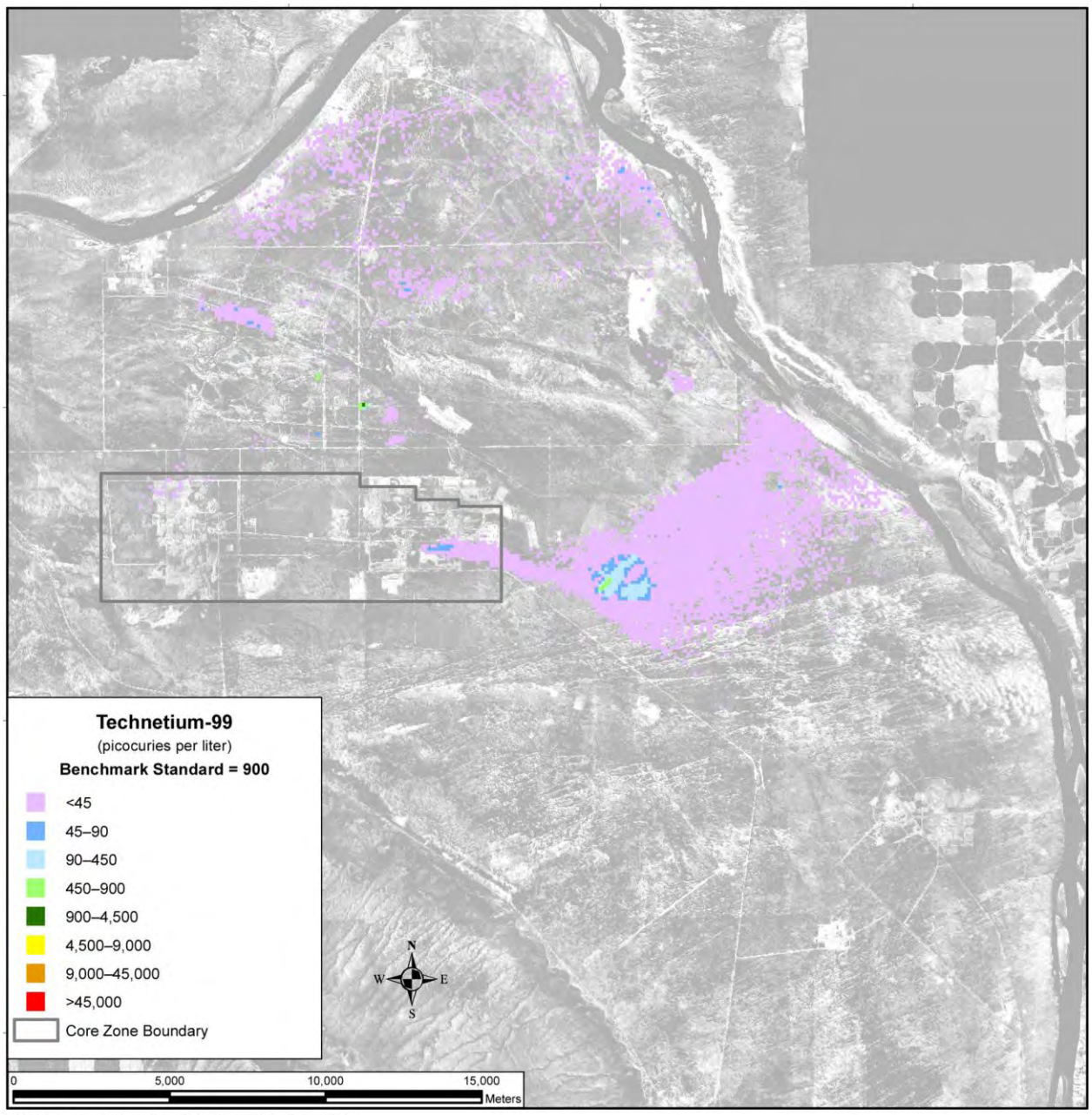
Note: To convert meters to feet, multiply by 3.281.

Figure 5–943. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



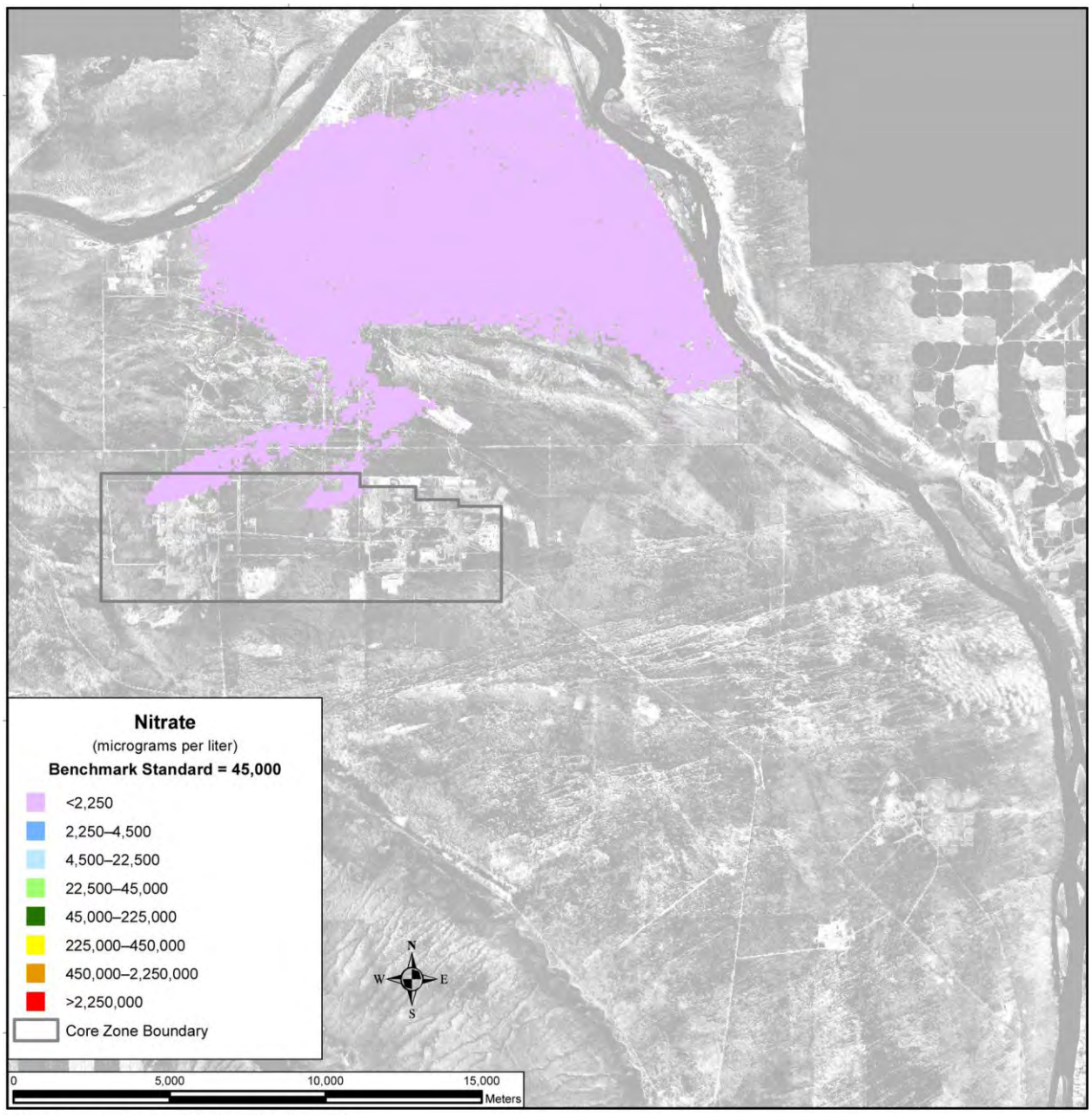
Note: To convert meters to feet, multiply by 3.281.

Figure 5–944. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



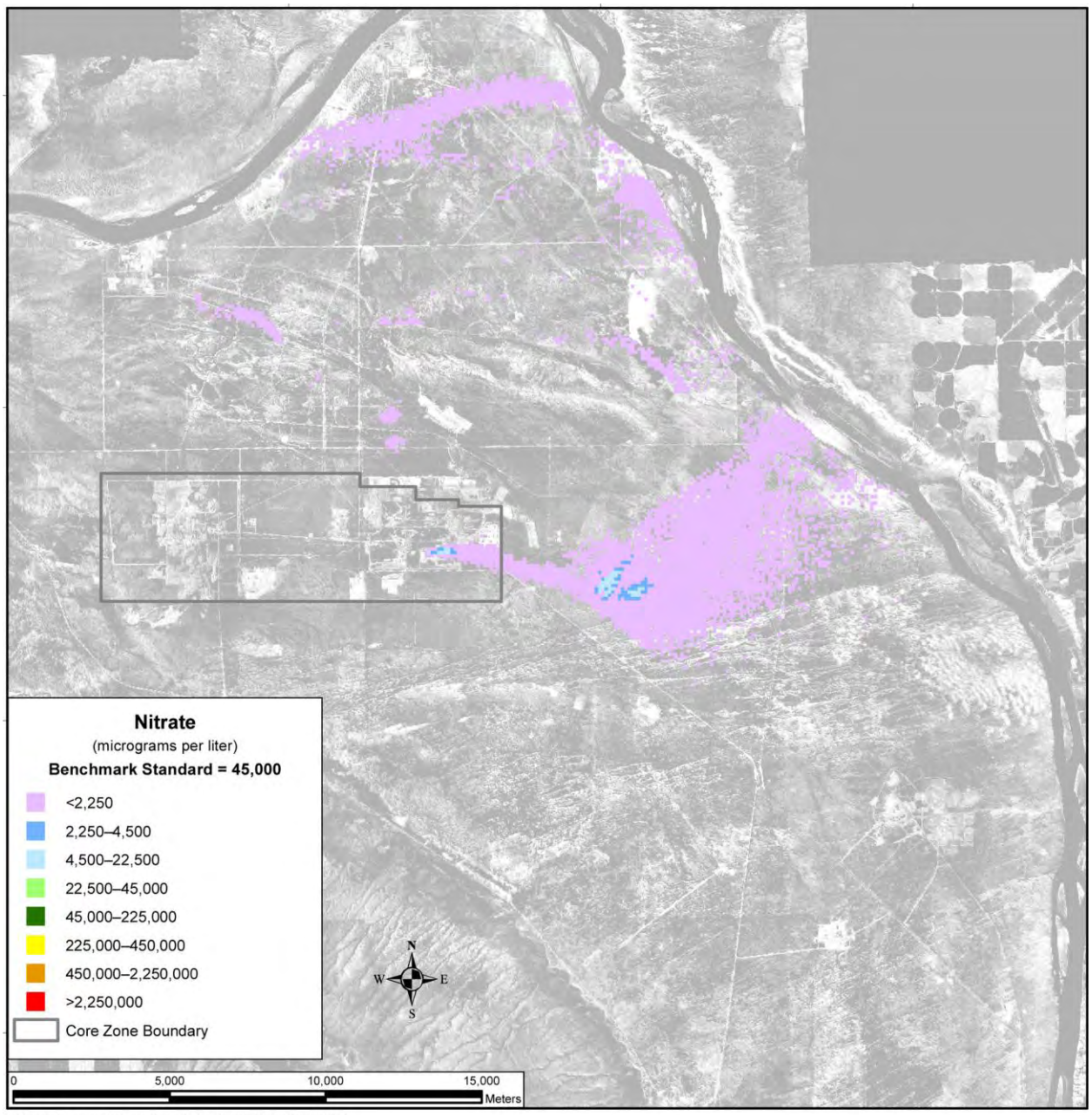
Note: To convert meters to feet, multiply by 3.281.

Figure 5–945. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



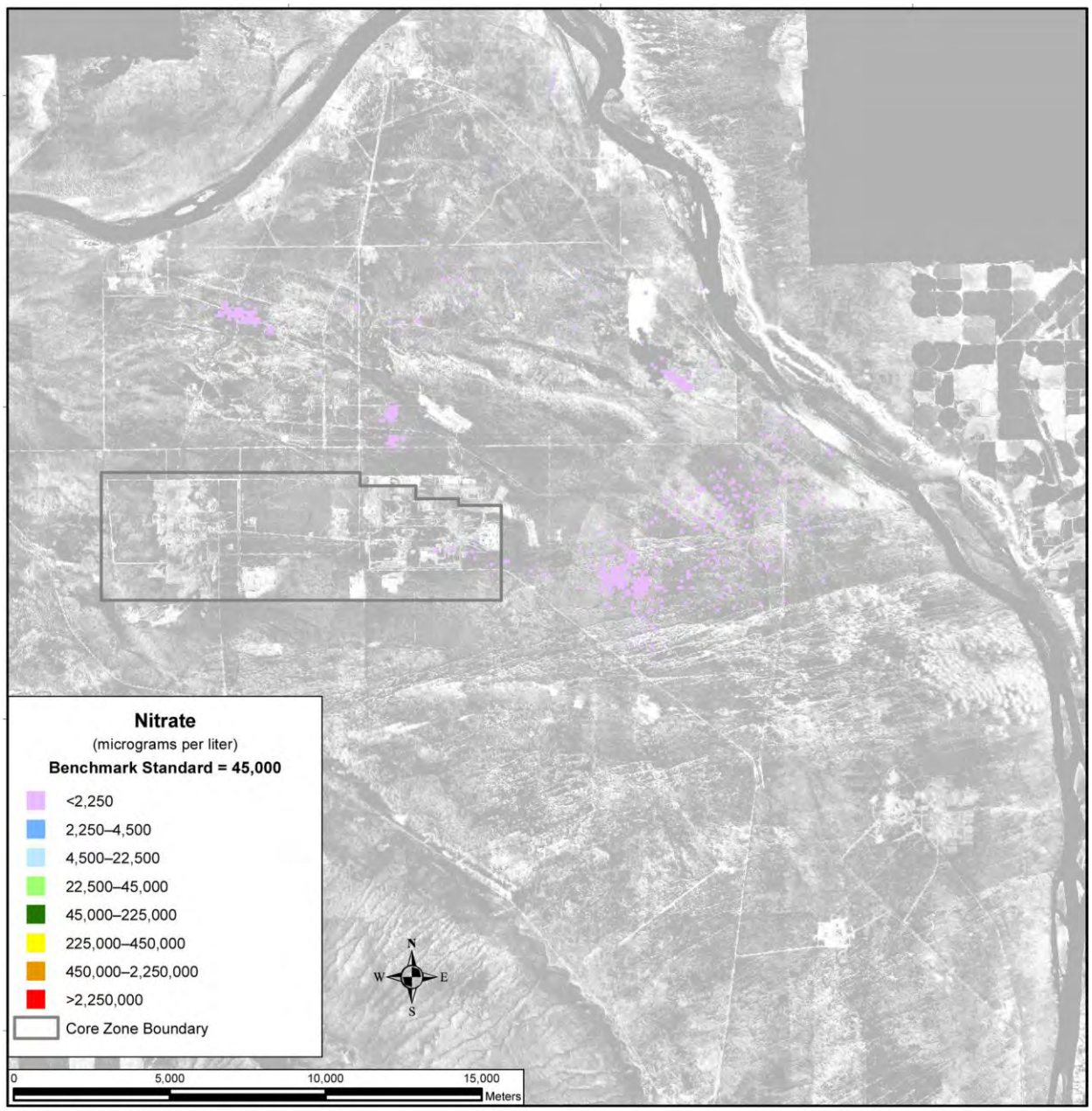
Note: To convert meters to feet, multiply by 3.281.

Figure 5–946. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



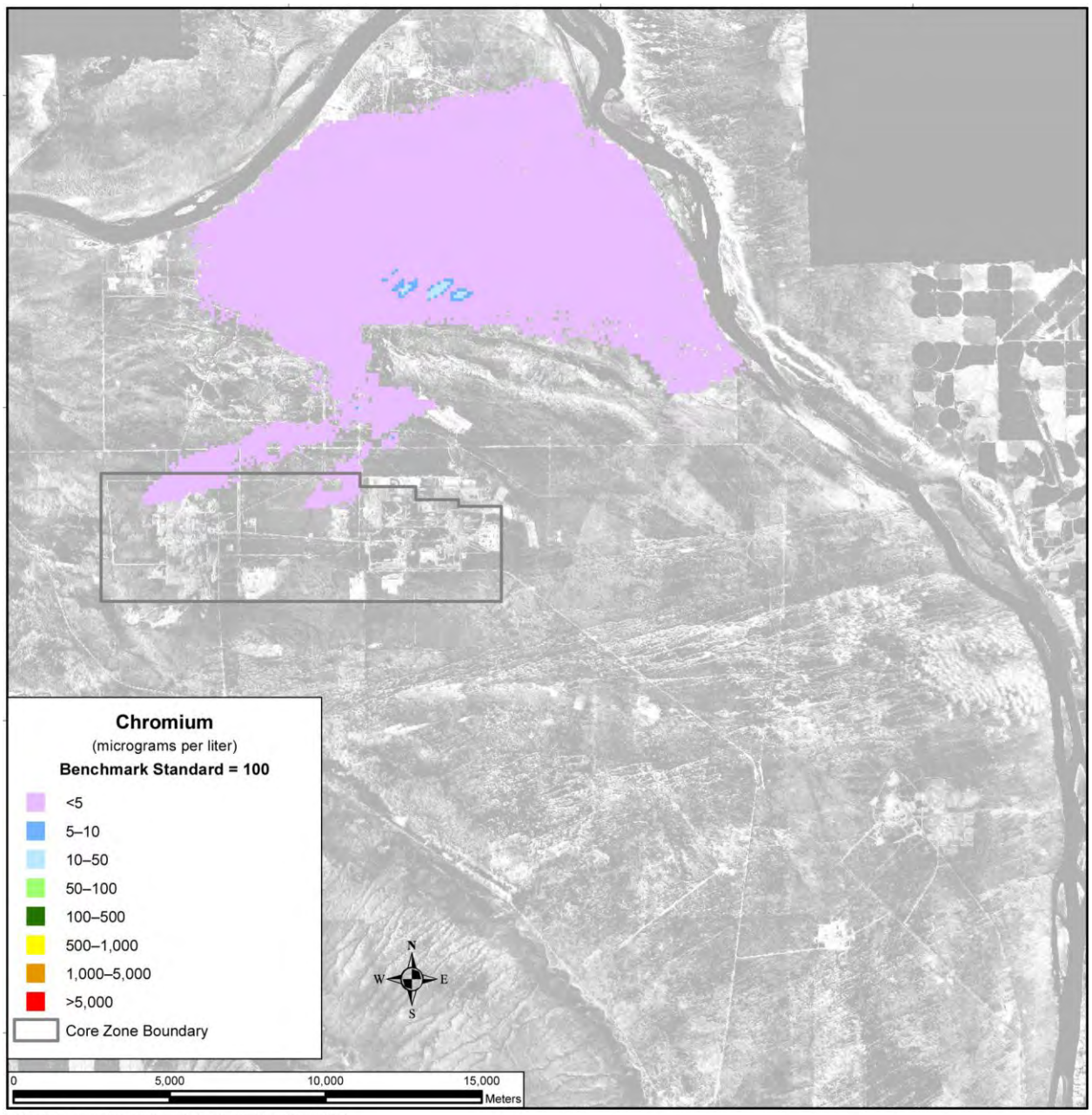
Note: To convert meters to feet, multiply by 3.281.

Figure 5–947. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



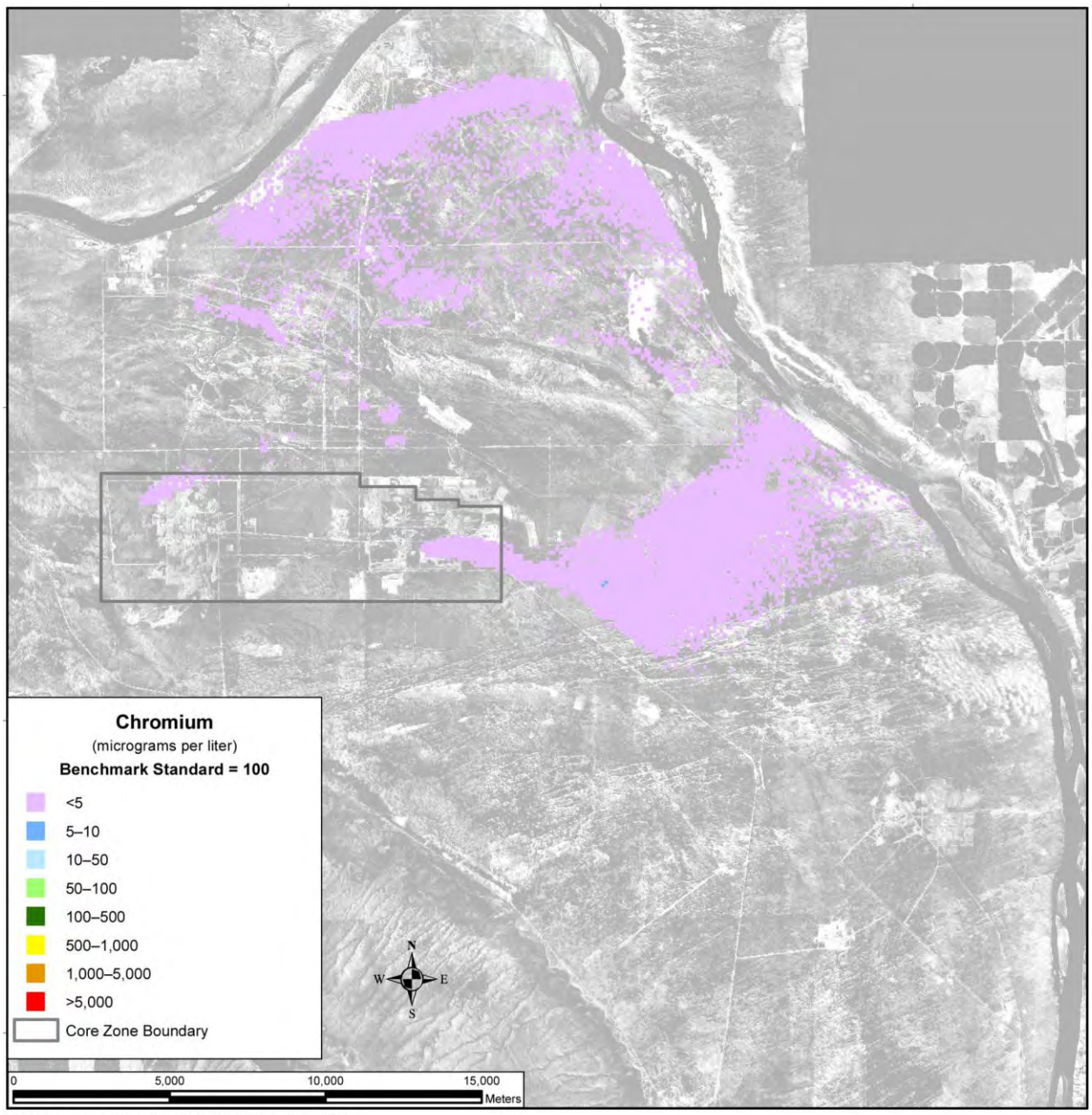
Note: To convert meters to feet, multiply by 3.281.

Figure 5–948. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885



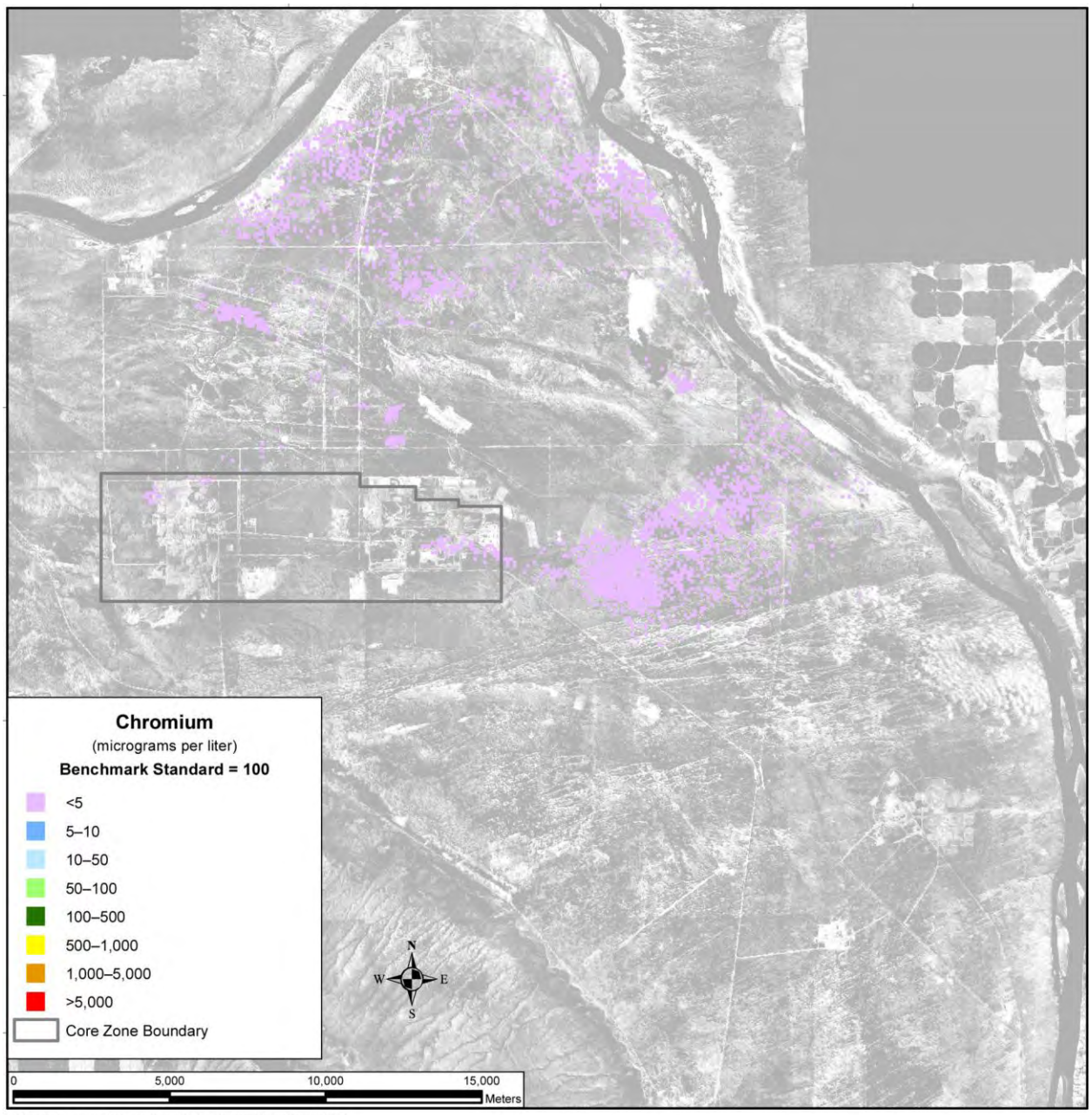
Note: To convert meters to feet, multiply by 3.281.

Figure 5–949. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



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

Figure 5–950. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



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

Figure 5–951. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, in general, discharges from IDF-West are predominant contributors. IDF-East and the RPPDF are secondary contributors.

Concentrations of iodine-129 and technetium-99 show a sharp rise and fall between CY 2940 and CY 4940 that exceeds the benchmark by an order of magnitude or slightly more. Concentrations of these COPCs stabilize near the benchmark concentration around CY 7940. Chromium shows a similar rise and fall but remains about two orders of magnitude below the benchmark. Nitrate has a similar rise and fall in concentrations between CY 2940 and CY 4940, followed by another rise in concentrations. This rise in

concentration stabilizes around CY 6940 and is about an order of magnitude greater than the first peak, but an order of magnitude below the benchmark concentration.

For uranium-238 and total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of these retarded species remain well below the benchmark at the Core Zone Boundary and the Columbia River nearshore throughout the 10,000-year period of analysis. The intensity is highest and the area of the contamination plumes largest near the end of the period of analysis.

5.3.1.3.2 Disposal Group 2

Disposal Group 2 is characterized by operational completion dates of CY 2100 for IDF-East and the RPPDF and CY 2050 for IDF-West. Under Disposal Group 2, IDF-West would have a large capacity (90,000 cubic meters [117,720 cubic yards]); IDF-East, a larger capacity (325,000 cubic meters [425,100 cubic yards]); and the RPPDF, an even larger capacity (8,370,000 cubic meters [10,947,960 cubic yards]). These capacities were designed to meet the waste generation volumes associated with Tank Closure Alternative 2A or 6B and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste.

5.3.1.3.2.1 Disposal Group 2, Subgroup 2-A

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, was designed to accommodate the disposal of wastes generated under Tank Closure Alternative 2A and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste.

For the long-term groundwater impacts analysis, two major periods have been identified for Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and continue through CY 2100 for IDF-East and through CY 2050 for IDF-West, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2101 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East and IDF-West would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, fluoride, and nitrate) are all mobile (i.e., they move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, in terms of the total amount of COPCs released from IDF-East and IDF-West to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Four subtotals are plotted in Figures 5–952 through 5–957, representing releases from IDF- East, which include ILAW glass, ETF-generated secondary waste, retired melters, and tank closure secondary waste.

Figure 5–952 shows the estimated release to the vadose zone of the radiological risk drivers and Figure 5–953, the chemical hazard drivers. For technetium-99, chromium, and nitrate in grouted waste forms, the release to the vadose zone is controlled by the inventory (i.e., nearly all of the inventory is released during the post-disposal period). The predominant source of technetium-99 and chromium is tank closure secondary waste. Iodine-129 and nitrate have ETF-generated secondary waste as the predominant source. Fluoride is not released from IDF-East.

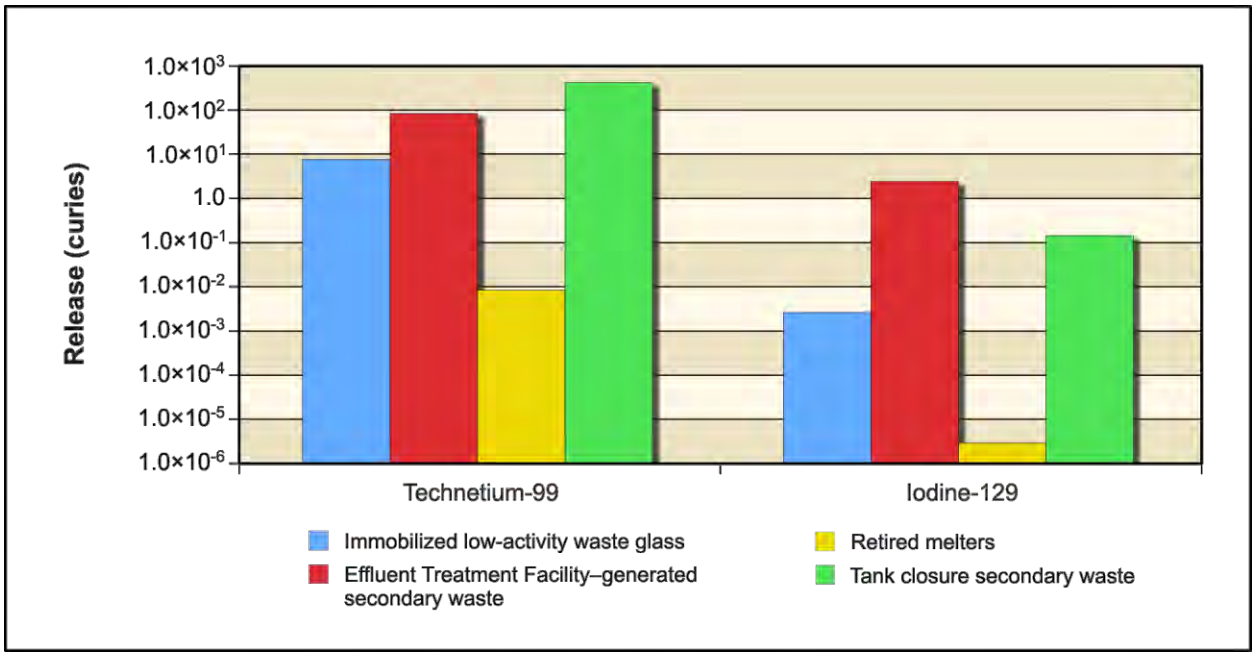


Figure 5–952. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

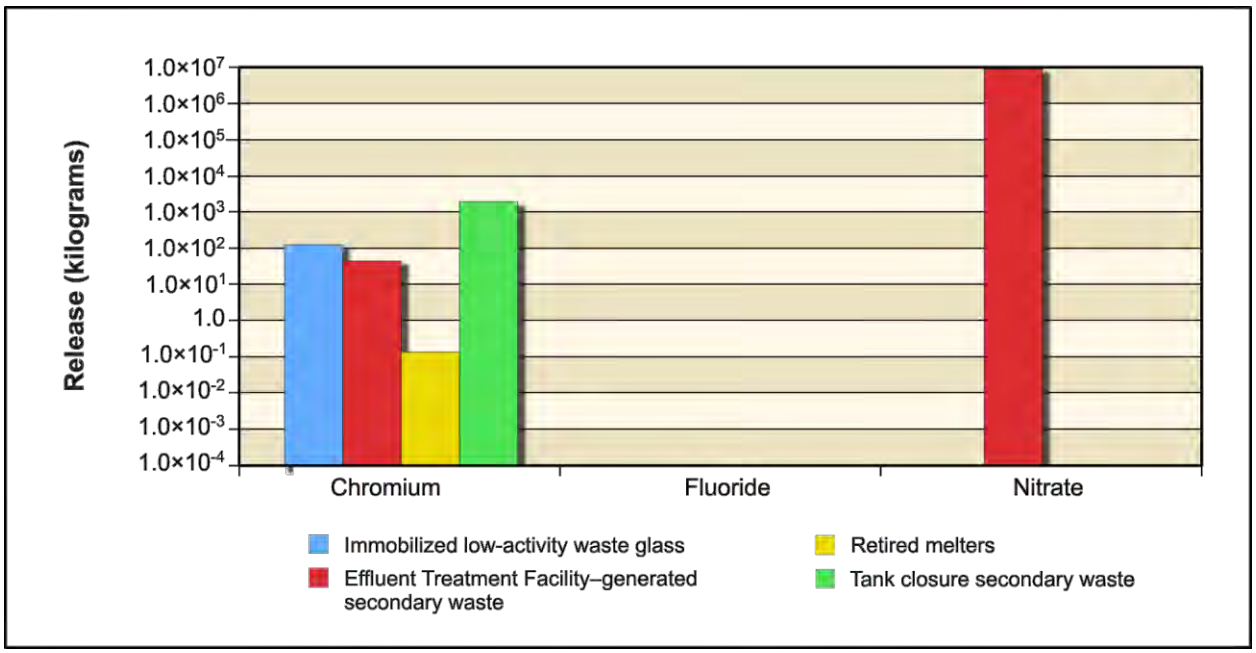


Figure 5–953. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–954 shows the estimated release to groundwater of the radiological risk drivers and Figure 5–955, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129 and technetium-99, the amount released to groundwater is 42 percent and 59 percent, respectively. For chromium and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 59 percent of the radionuclide amount (curies) released to the vadose zone during the period of

analysis reaches groundwater, while approximately 100 percent of the chemical quantity (kilograms) released to the vadose zone during the period of analysis reaches groundwater.

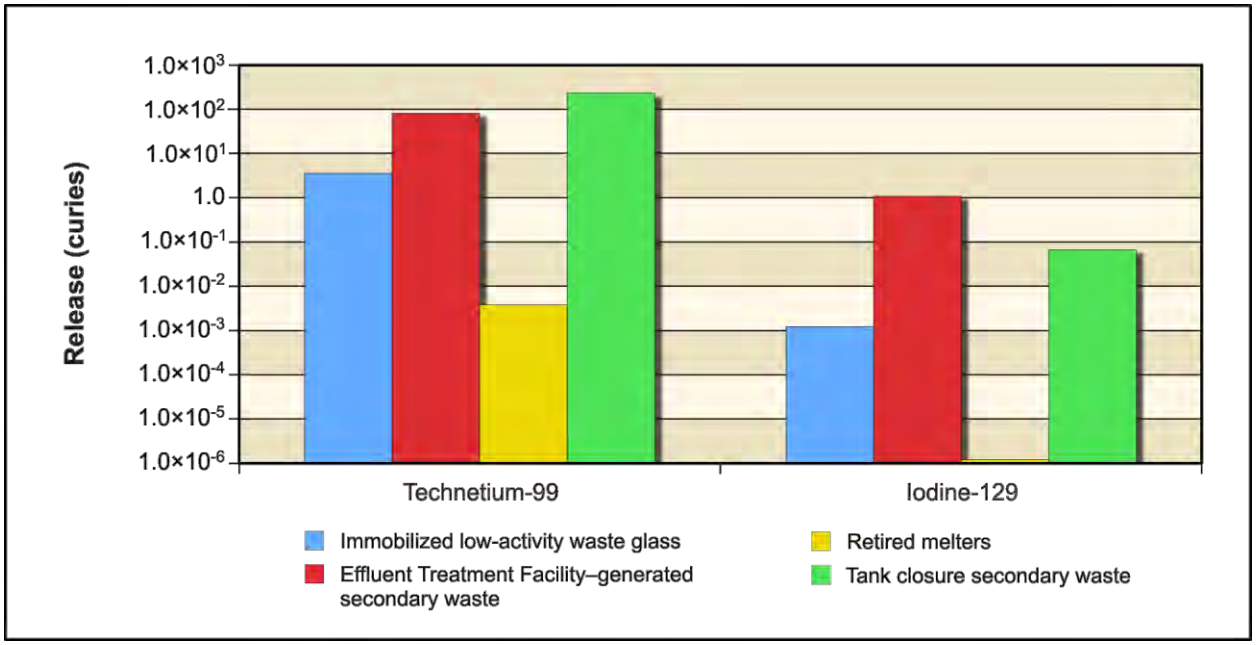


Figure 5–954. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

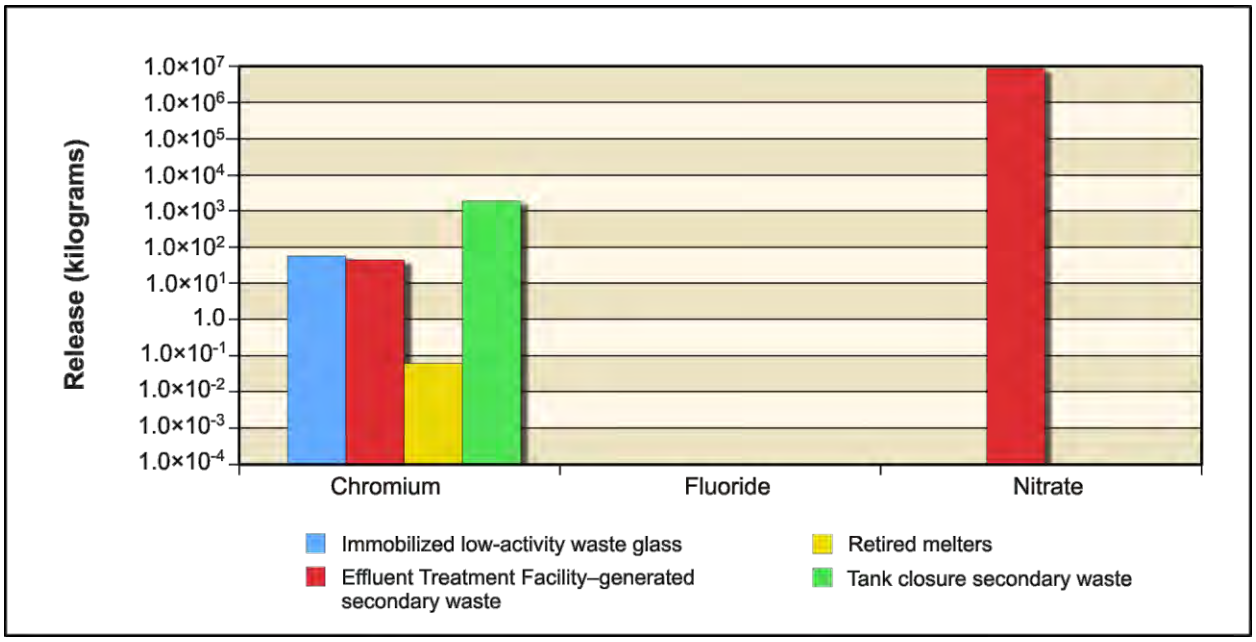


Figure 5–955. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–956 shows the estimated release to the Columbia River of the radiological risk drivers and Figure 5–957, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater. About 96 percent of the radionuclide amount (curies) released to groundwater during the period of analysis

reaches the river, while approximately 99 percent of the chemical quantity (kilograms) released to groundwater during the period of analysis reaches the river.

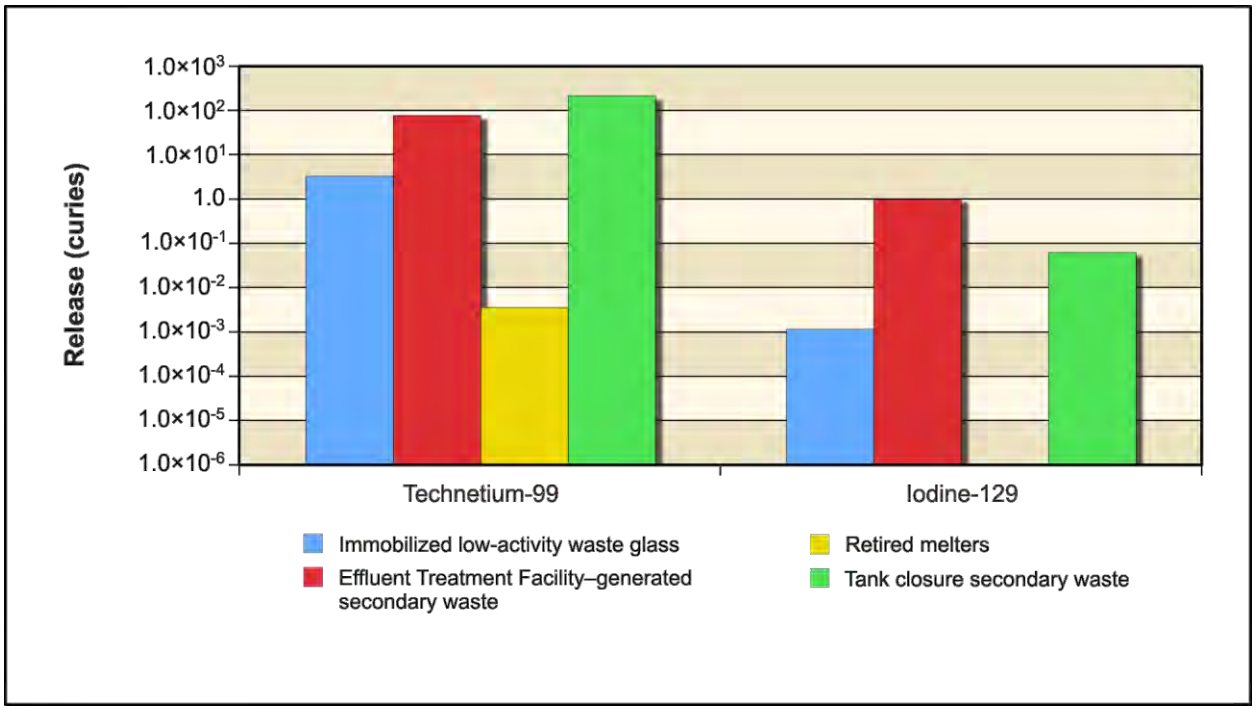


Figure 5–956. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

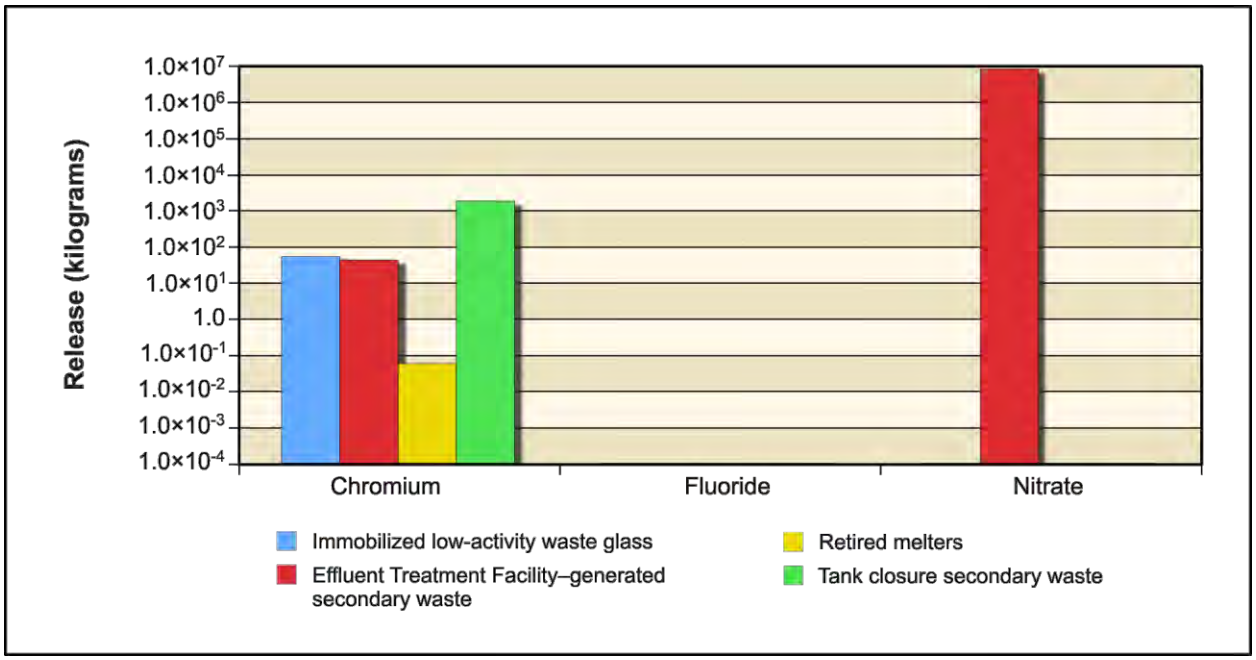


Figure 5–957. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5–958 through 5–963, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary and onsite waste, and offsite waste.

Figure 5–958 shows the estimated release to the vadose zone of the radiological risk drivers and Figure 5–959, the chemical hazard drivers. For all three types of sources, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). The predominant source of technetium-99 and iodine-129 is offsite waste. For chromium, nitrate, and fluoride, the predominant source is waste management secondary and onsite waste.

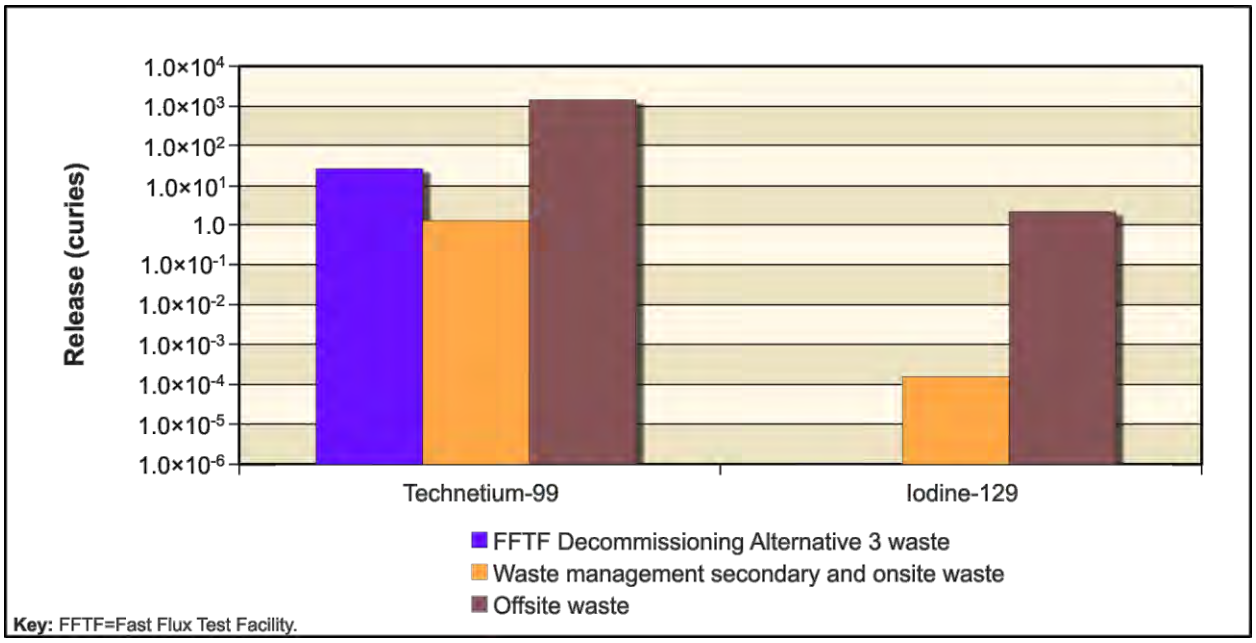


Figure 5–958. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

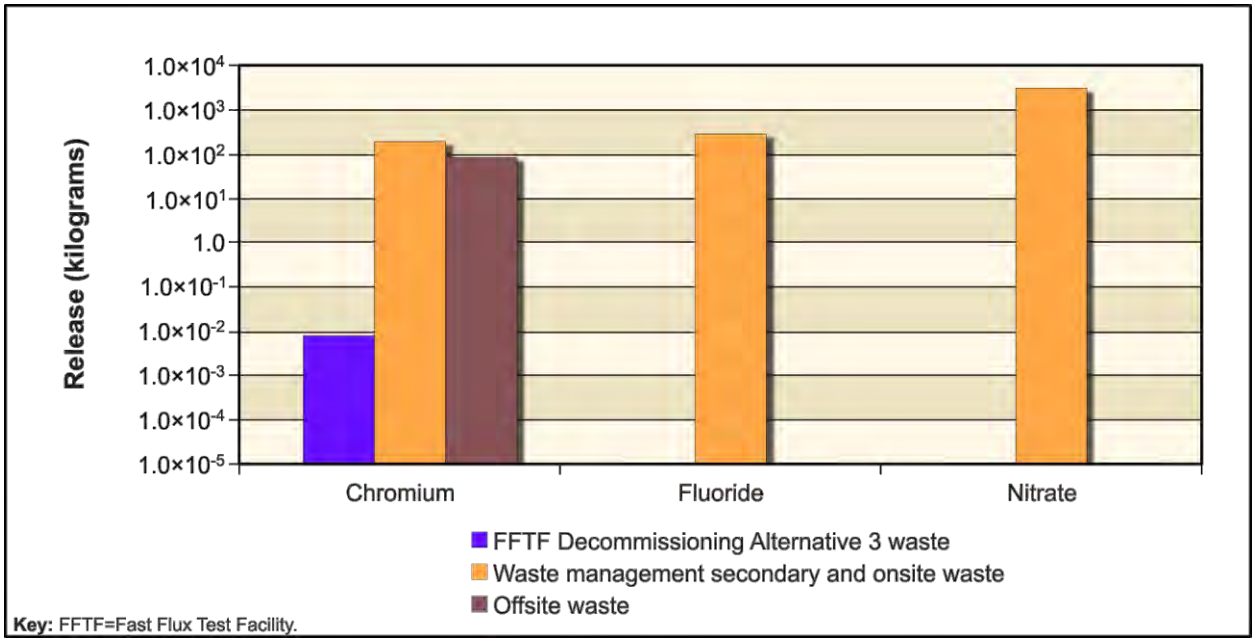


Figure 5–959. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–960 shows the estimated release to groundwater of the radiological risk drivers and Figure 5–961, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, nitrate, boron, and fluoride, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 98 percent of the radionuclide amount (curies) released to the vadose zone during the period of analysis reaches groundwater, while approximately 100 percent of the chemical quantity (kilograms) released to the vadose zone during the period of analysis reaches groundwater.

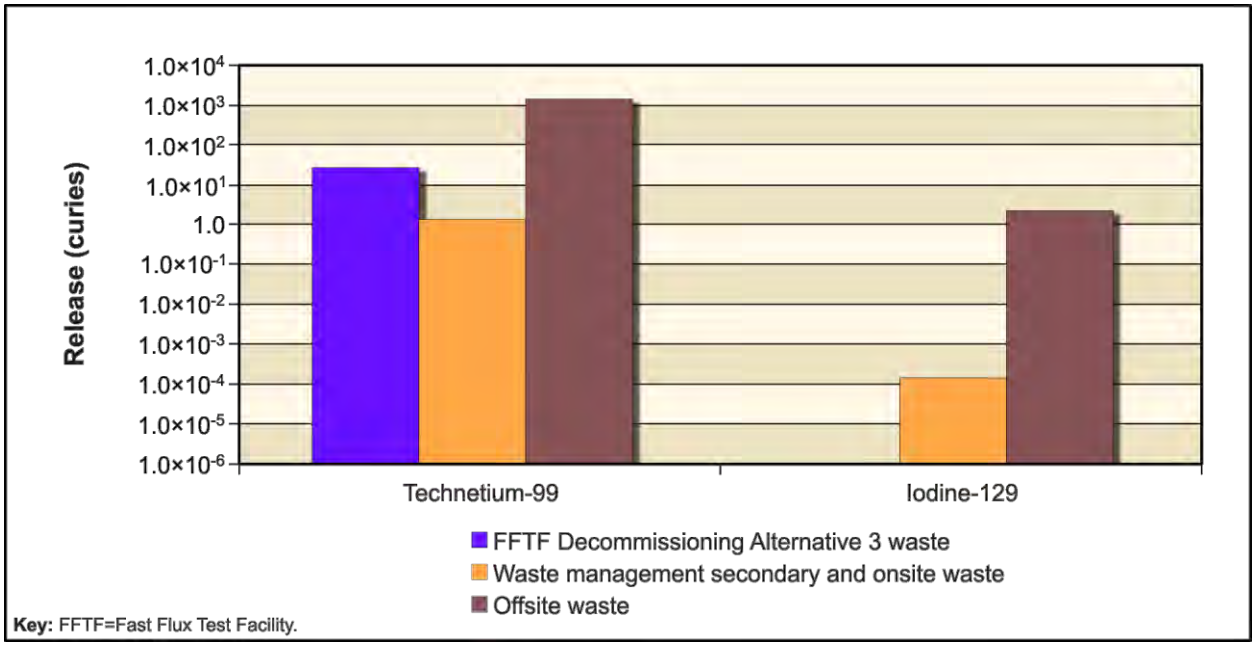


Figure 5–960. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

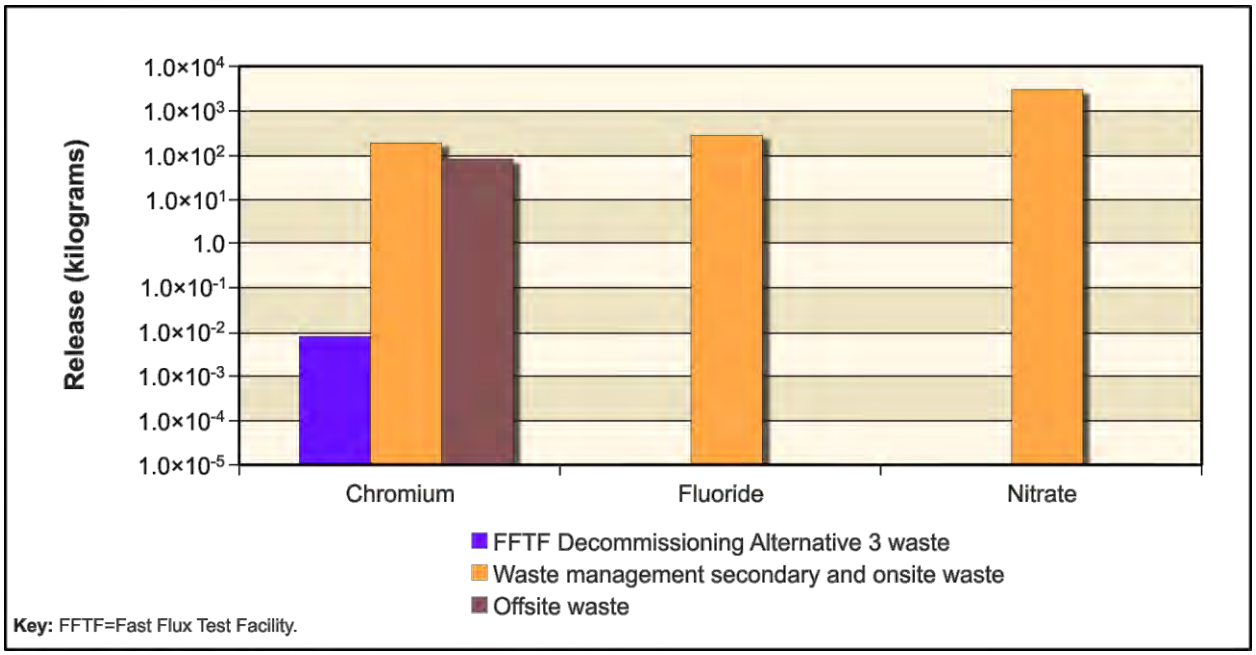


Figure 5–961. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–962 shows the estimated release to the Columbia River of the radiological risk drivers and Figure 5–963, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, nitrate, boron, and fluoride, the amount released to the Columbia River is essentially equal to the amount released to groundwater. About 100 percent of the radionuclide amount (curies) and chemical quantity (kilograms) released to groundwater during the period of analysis reaches the river.

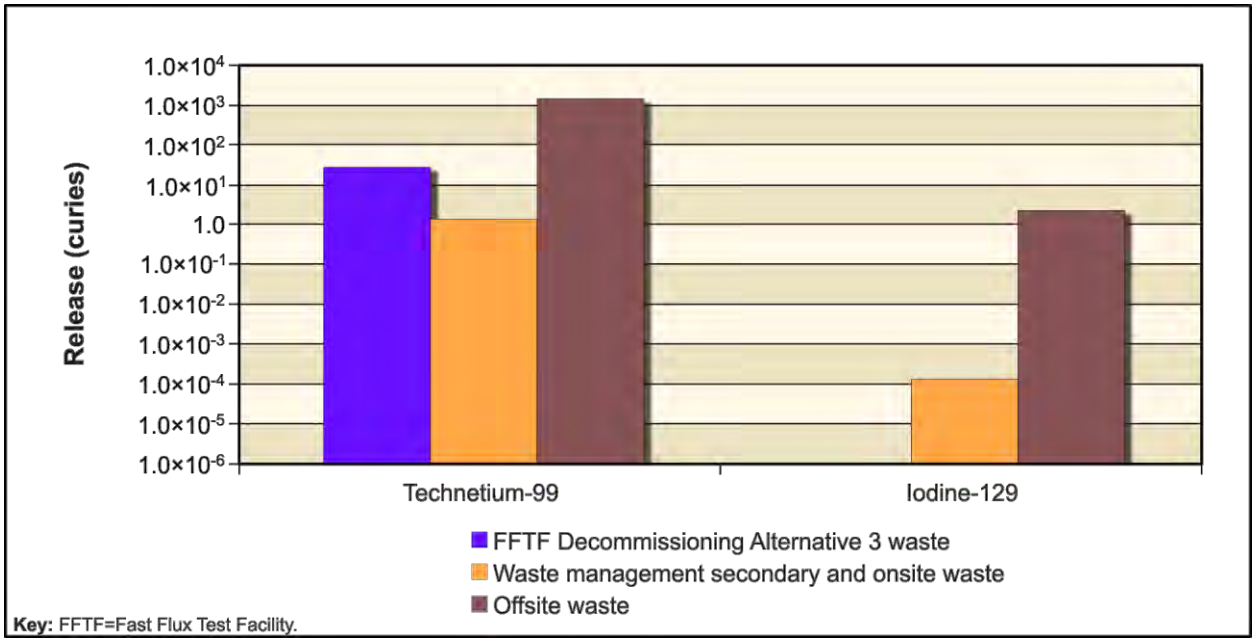


Figure 5–962. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

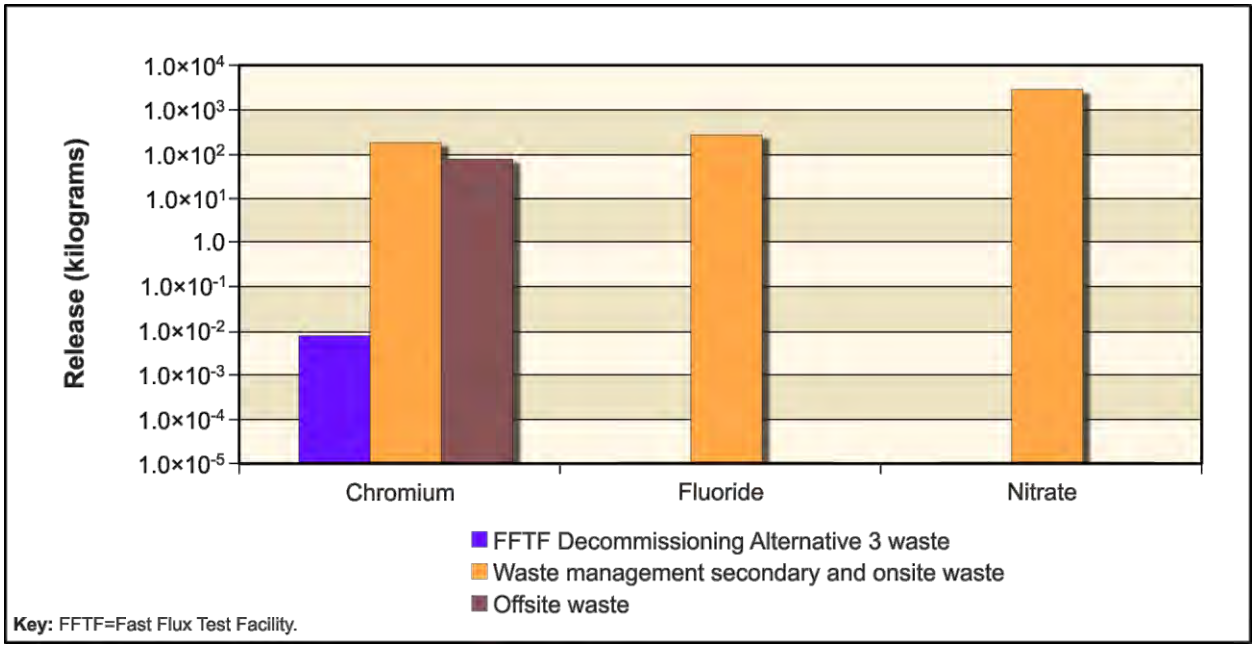


Figure 5–963. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the impacts of Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations.

Figures 5–964 through 5–967 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate. Iodine-129 concentrations exceed the benchmark concentration at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. The greatest exceedance of the benchmark concentration is at the IDF-West barrier, where the benchmark is exceeded by over an order of magnitude from approximately CY 3200 until CY 5000. Iodine-129 concentrations never exceed the benchmark concentration at the IDF-East barrier. The iodine-129 benchmark concentrations are exceeded by less than an order of magnitude at the Core Zone Boundary and Columbia River nearshore. Concentrations of iodine-129 exceed the benchmark concentration at the Columbia River nearshore for the longest period of time and fall below the benchmark in approximately CY 6500. Technetium-99 exhibits behavior similar to iodine-129, where concentrations at the IDF-West barrier exceed the benchmark by one order of magnitude. The duration of the benchmark exceedance is only approximately 1,500 years. In addition, technetium-99 benchmark concentrations are exceeded at the Columbia River nearshore from approximately CY 3500 to CY 5000. Concentrations at the Core Zone Boundary are exceeded from about CY 3500 to CY 4100. Chromium concentrations peak at just under two orders of magnitude below the benchmark. Nitrate does not exceed benchmark concentrations during the period of analysis.

Table 5–113 shows the maximum concentrations of the COPCs in the peak year at IDF-East, IDF-West, the Core Zone Boundary, and Columbia River nearshore. Under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, iodine-129 and technetium-99 concentrations both exceed their benchmarks at IDF-West, the Core Zone Boundary, and Columbia River nearshore around CY 3900. No other constituents exceed their benchmark concentrations under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A.

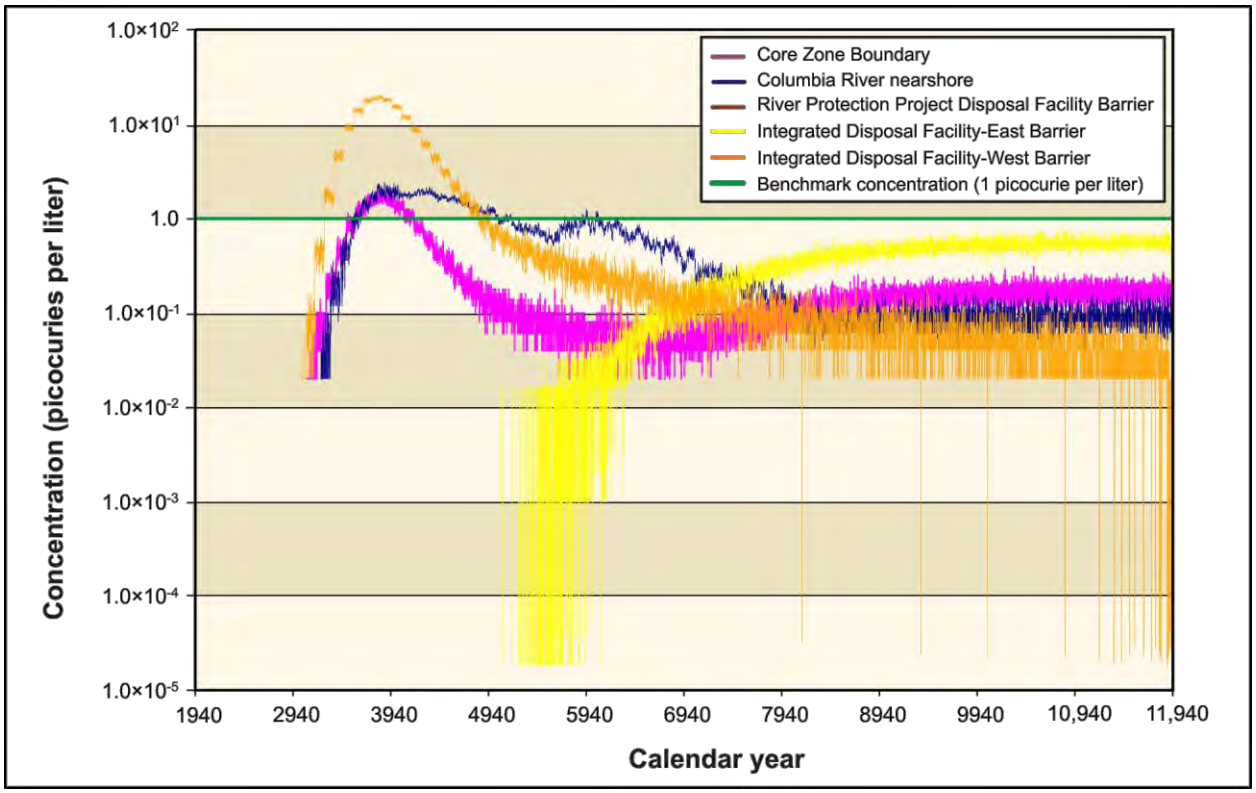


Figure 5–964. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Iodine-129 Concentration Versus Time

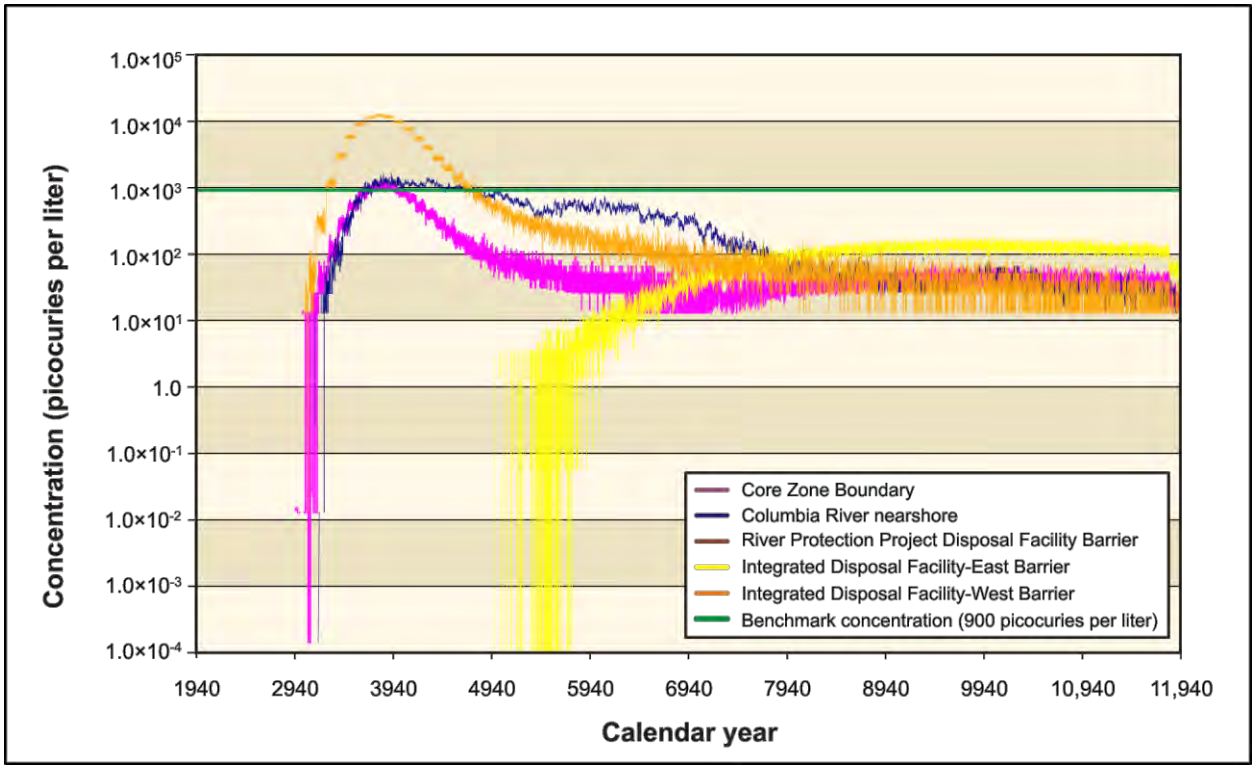


Figure 5–965. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Technetium-99 Concentration Versus Time

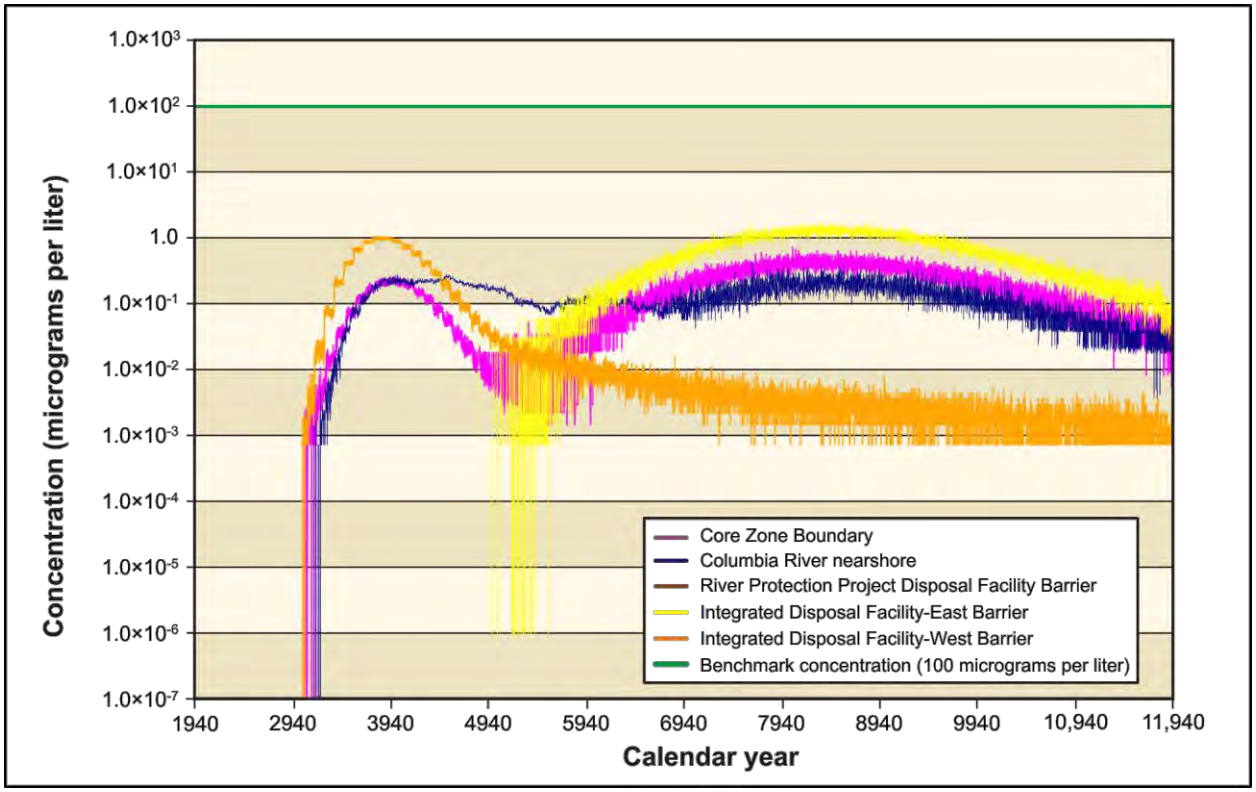


Figure 5–966. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Chromium Concentration Versus Time

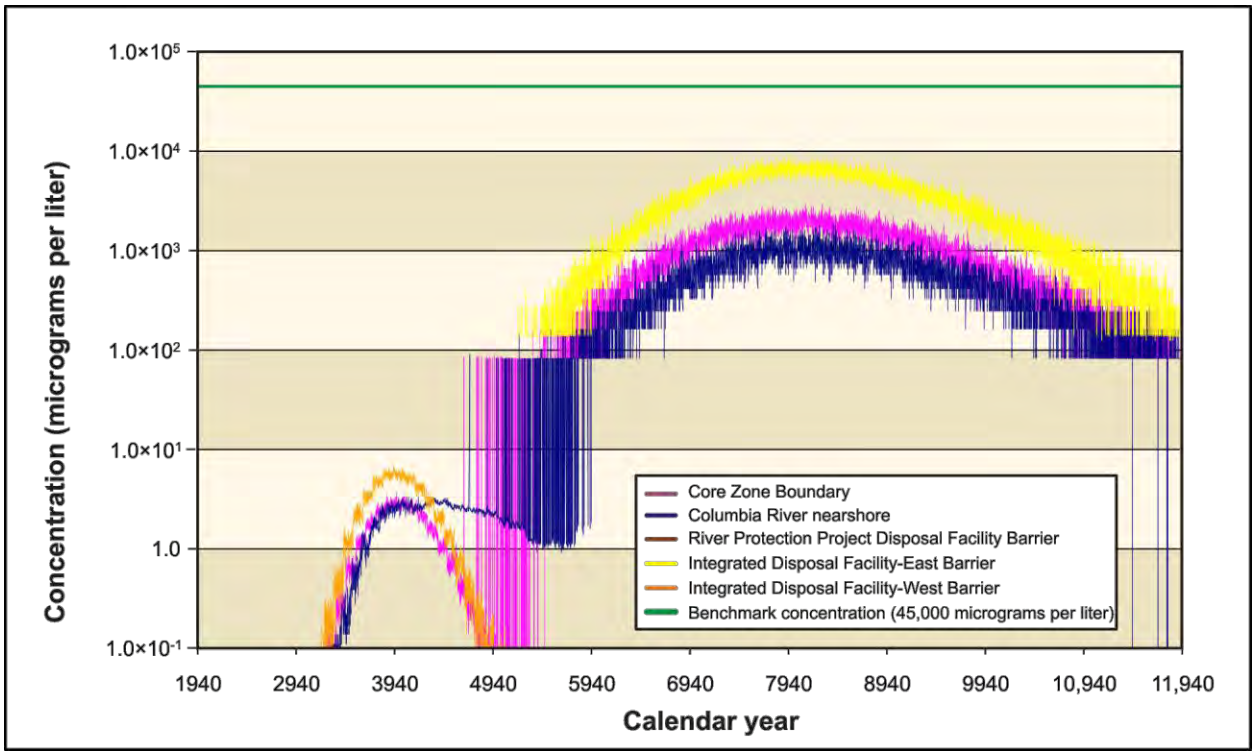


Figure 5–967. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Nitrate Concentration Versus Time

Table 5–113. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	193	**13,200**	N/A	**1,370**	**1,670**	900
	(10,056)	(3818)		(3859)	(3920)	
Iodine-129	0.8	**20.6**	N/A	**2.1**	**2.4**	1
	(9950)	(3794)		(3937)	(3872)	
Chemical (micrograms per liter)						
Chromium	2	1	N/A	1	0	100
	(8791)	(3813)		(8053)	(7640)	
Fluoride	0	1	N/A	0	0	4,000
	(1940)	(4014)		(3937)	(4307)	
Nitrate	9,300	7	N/A	2,920	1,860	45,000
	(7960)	(3927)		(8123)	(8406)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are identified in **bold** text.

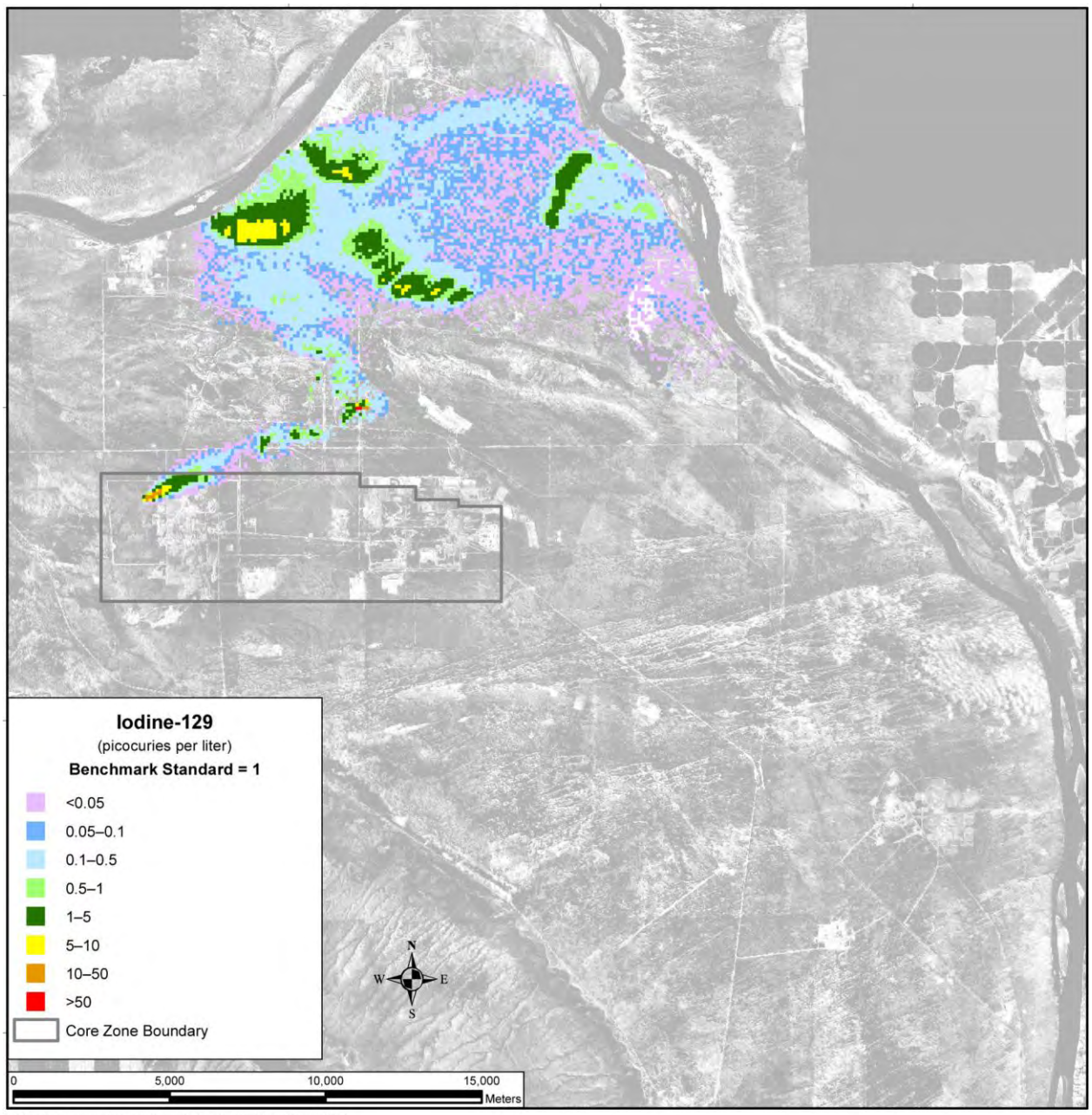
Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

There are no appreciable releases of either uranium-238 or total uranium to the environment over the analysis period under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A.

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

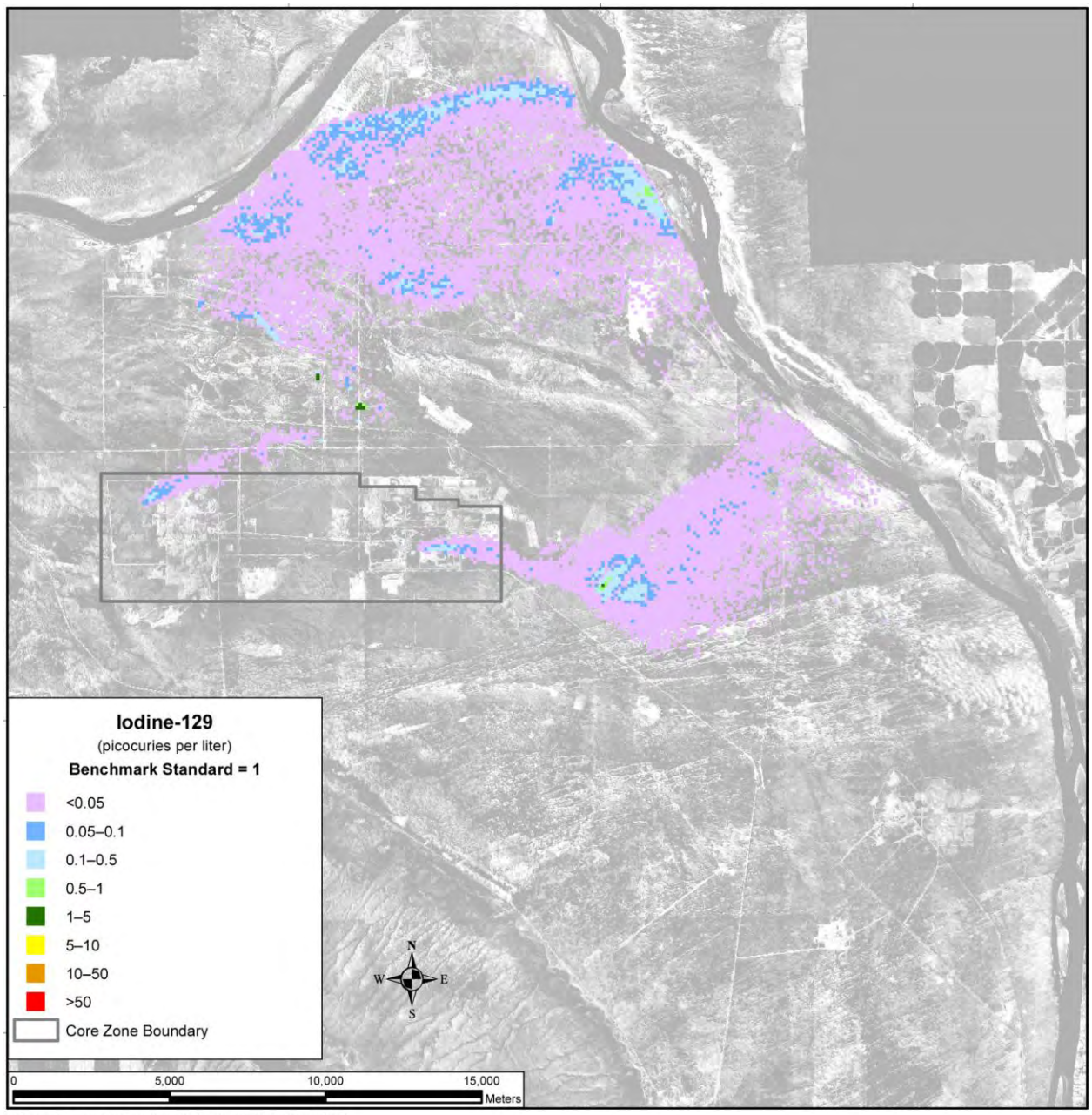
This section presents the impacts of Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations.

Figure 5–968 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 3890. Releases from IDF-West result in a groundwater plume starting in the Core Zone and heading north through Gable Gap. This plume exceeds the benchmark concentration at the Core Zone Boundary and north of the Core Zone Boundary by as much as 10 to 50 times. In CY 7140, releases from IDF-East create a groundwater plume, not exceeding the benchmark, that extends from the 200-East Area east toward the Columbia River (see Figure 5–969). Also by CY 7140, most of the IDF-West plume continues to move north and reaches the Columbia River. By CY 11,885, most of the mass in the IDF-East plume is still moving east toward the Columbia River, with peak concentrations exceeding the benchmark by up to 5 times (see Figure 5–970). Technetium-99 (see Figures 5–971 through 5–973) shows similar spatial distributions at selected times and exceeds its benchmark concentration at approximately the same time and locations. Chromium (see Figures 5–974 through 5–976) and nitrate (see Figures 5–977 through 5–979) show similar spatial distributions at selected times, but neither exceeds its benchmark concentration. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., they move at the pore-water velocity).



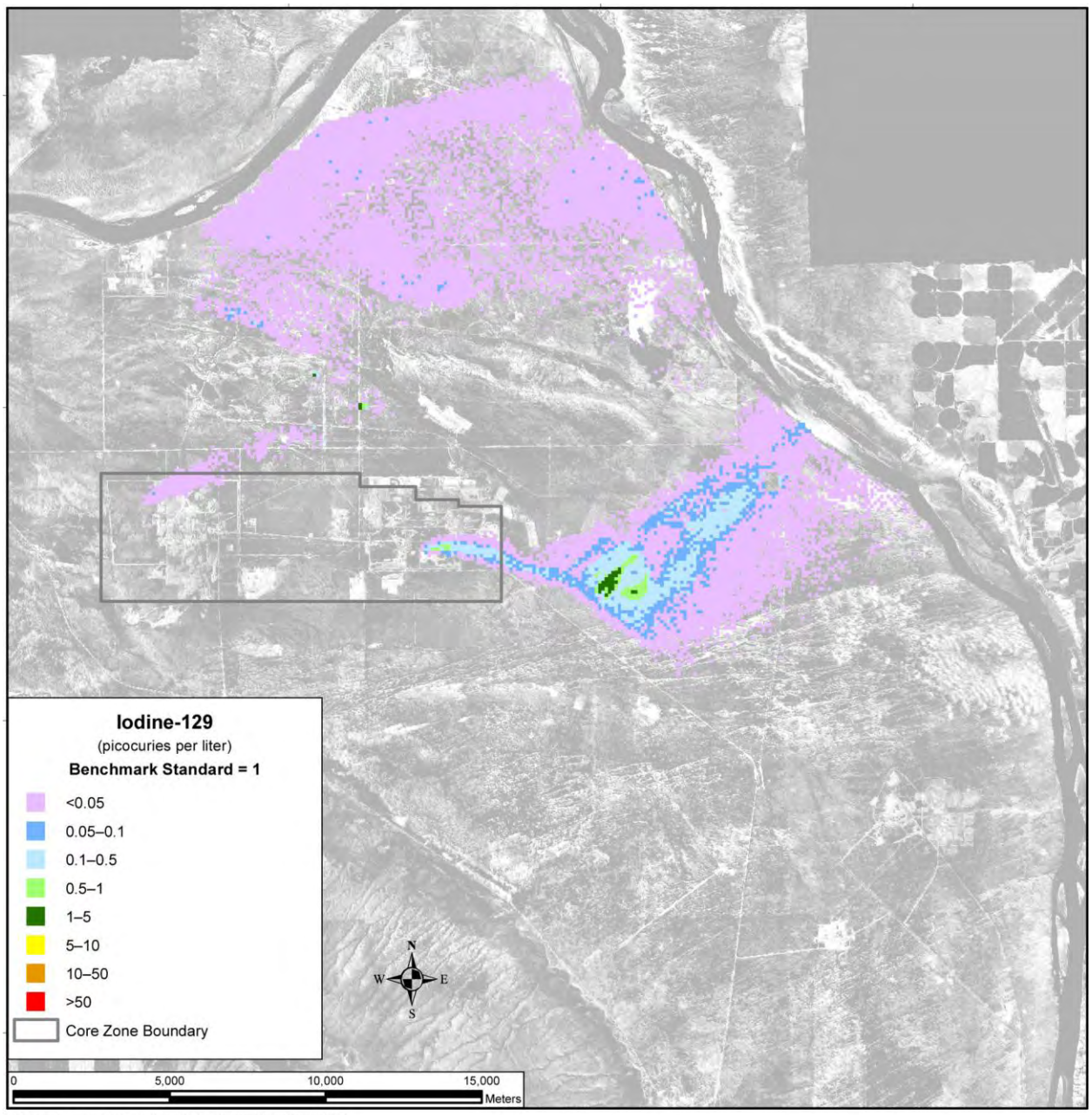
Note: To convert meters to feet, multiply by 3.281.

Figure 5–968. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



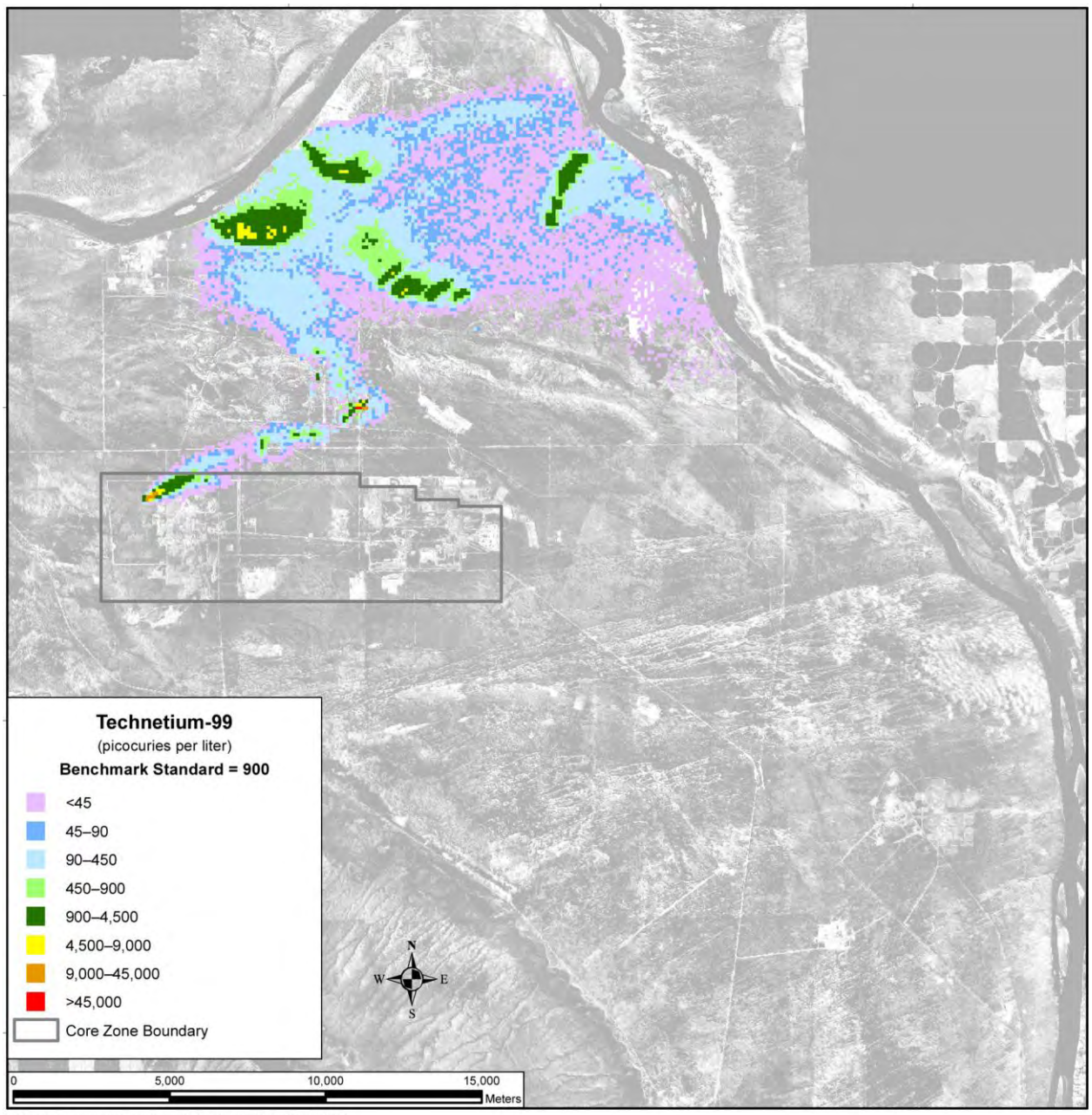
Note: To convert meters to feet, multiply by 3.281.

Figure 5–969. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



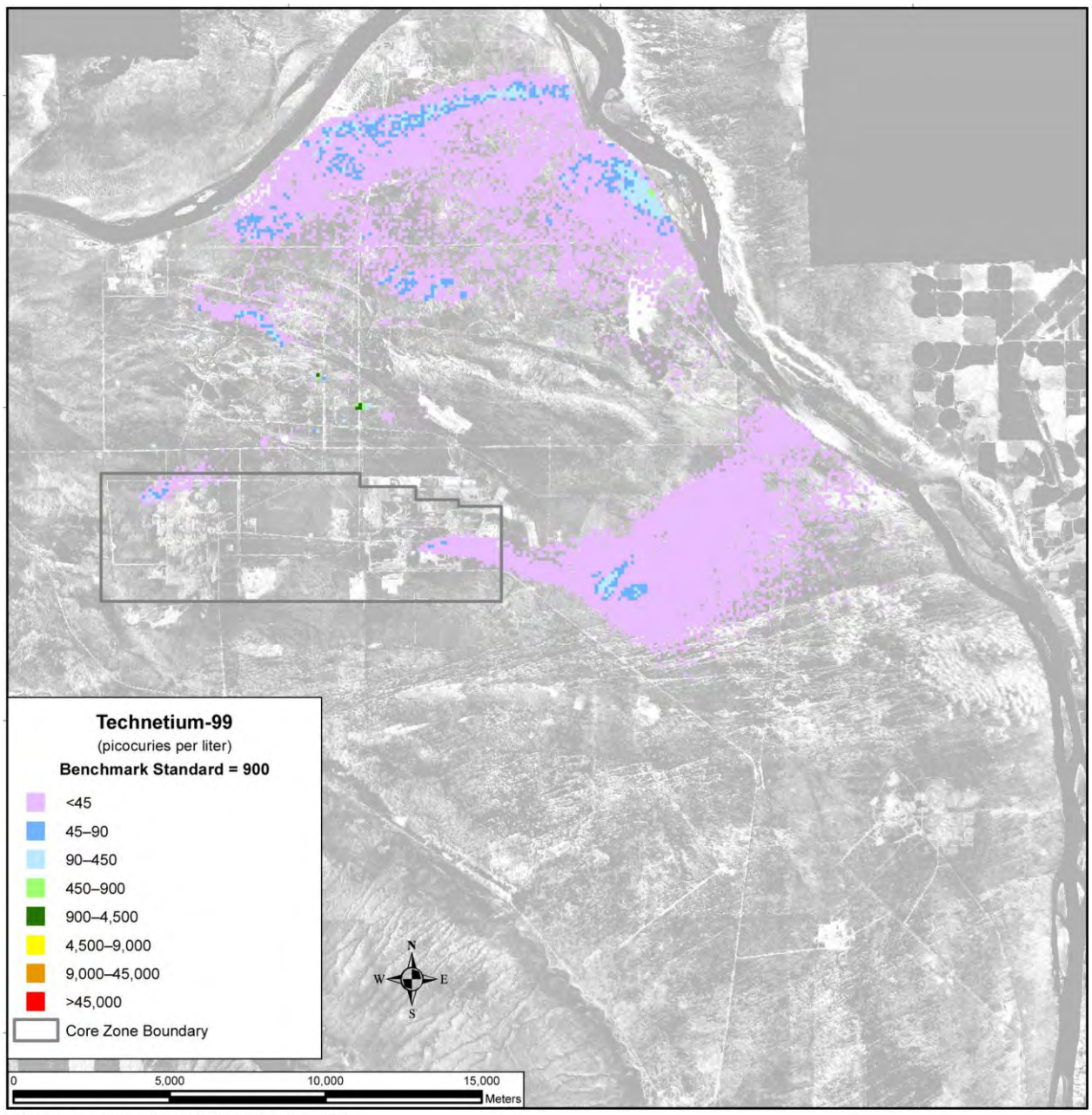
Note: To convert meters to feet, multiply by 3.281.

Figure 5–970. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



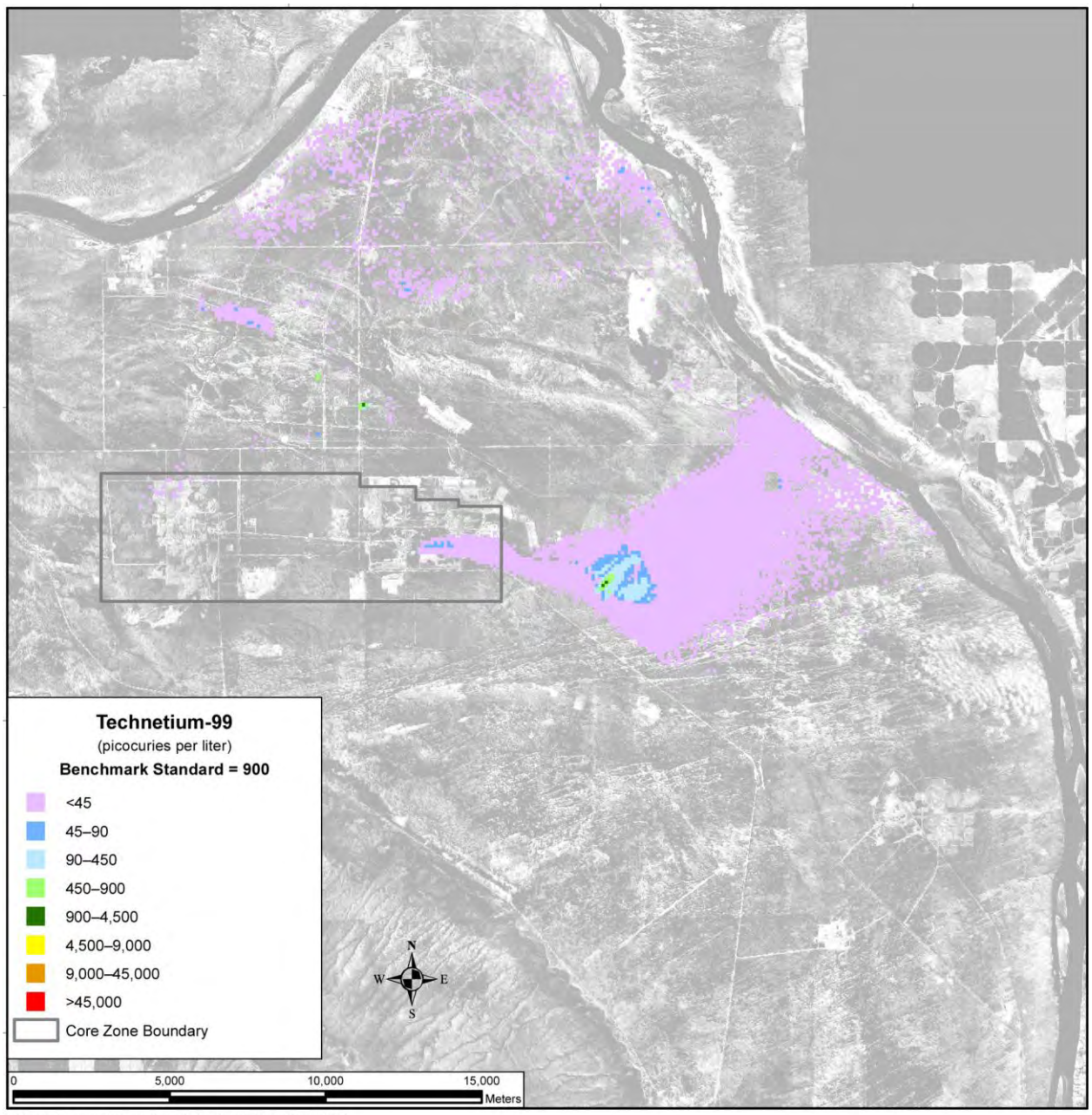
Note: To convert meters to feet, multiply by 3.281.

Figure 5–971. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



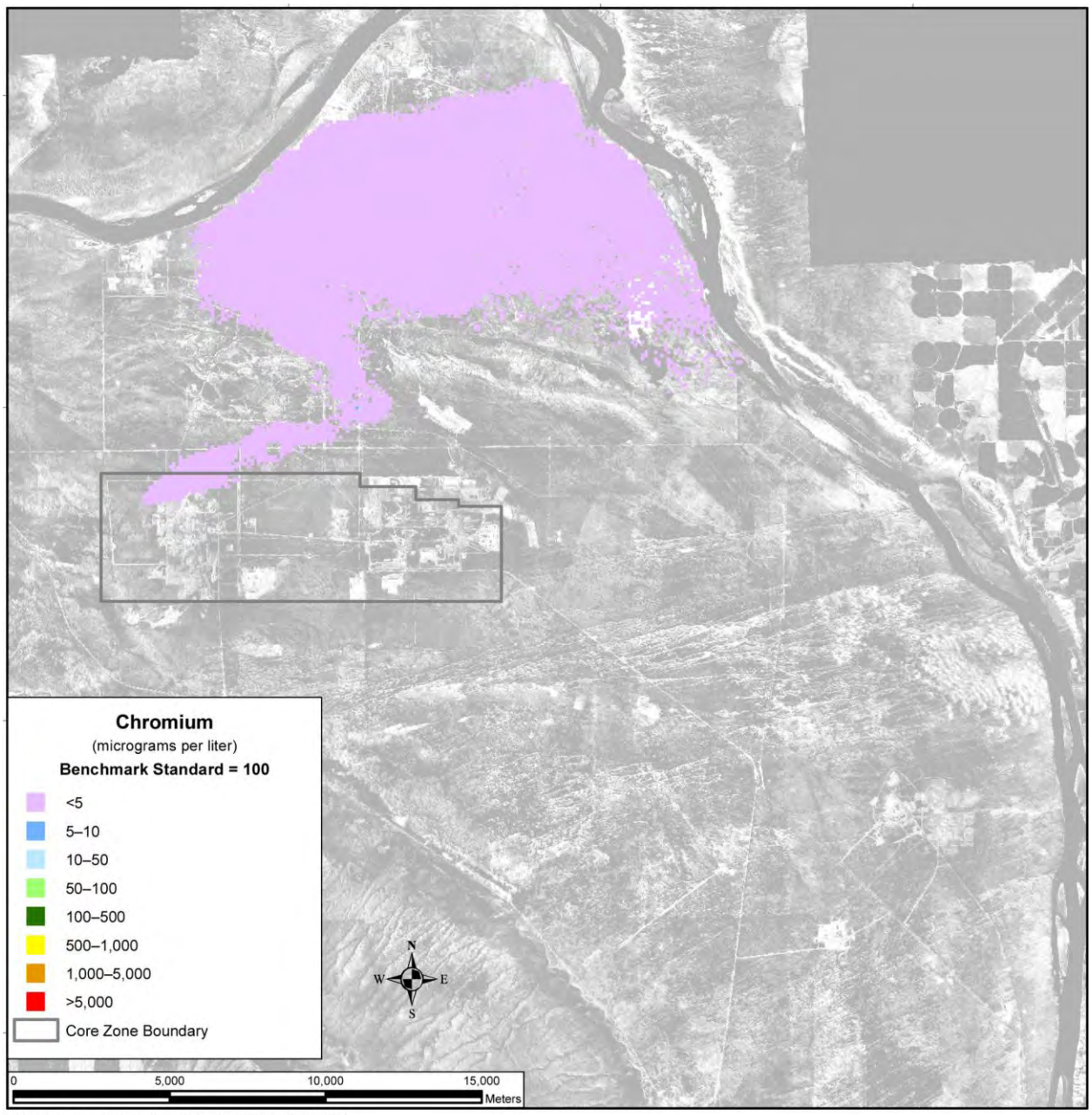
Note: To convert meters to feet, multiply by 3.281.

Figure 5–972. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



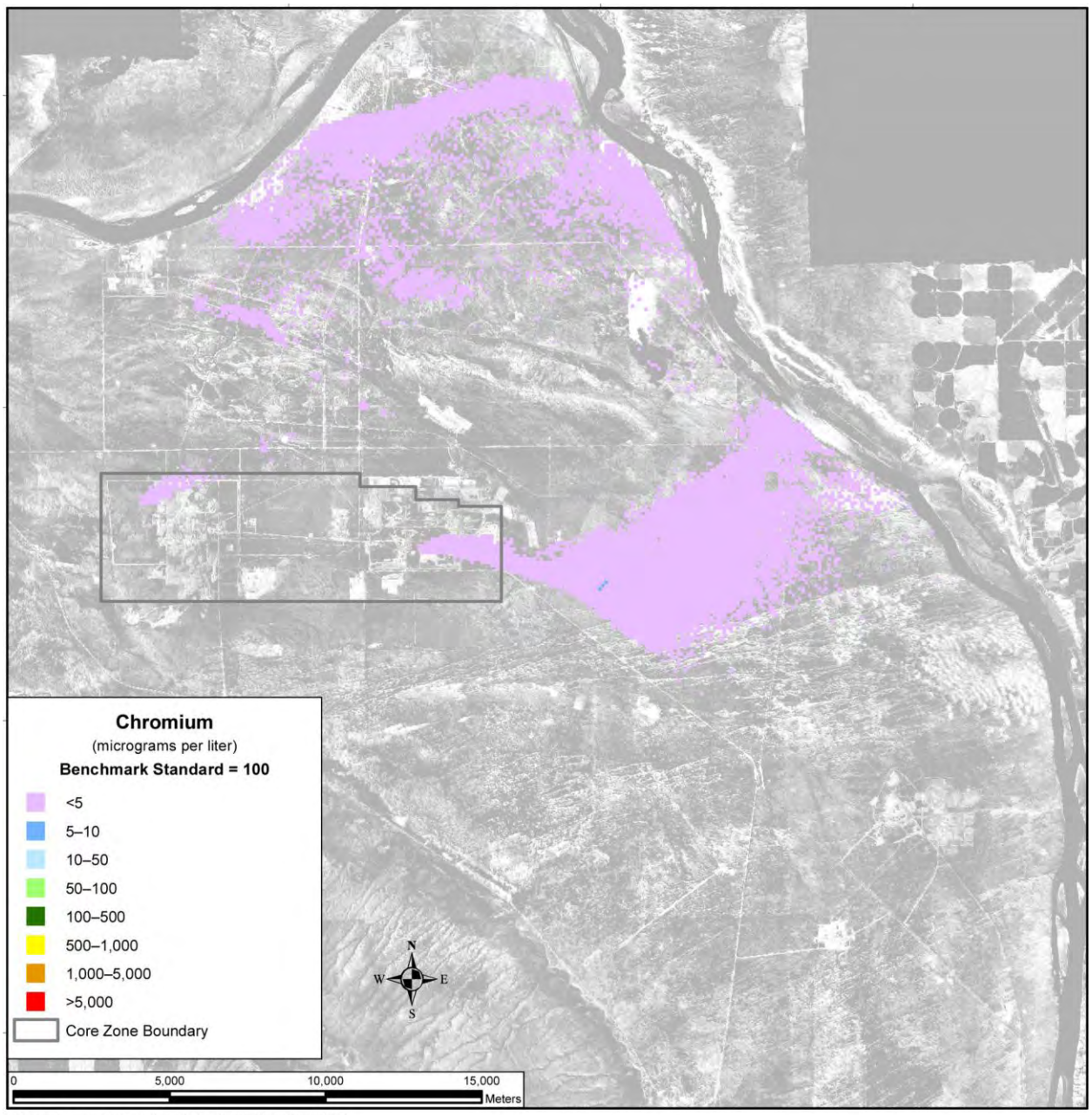
Note: To convert meters to feet, multiply by 3.281.

Figure 5–973. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



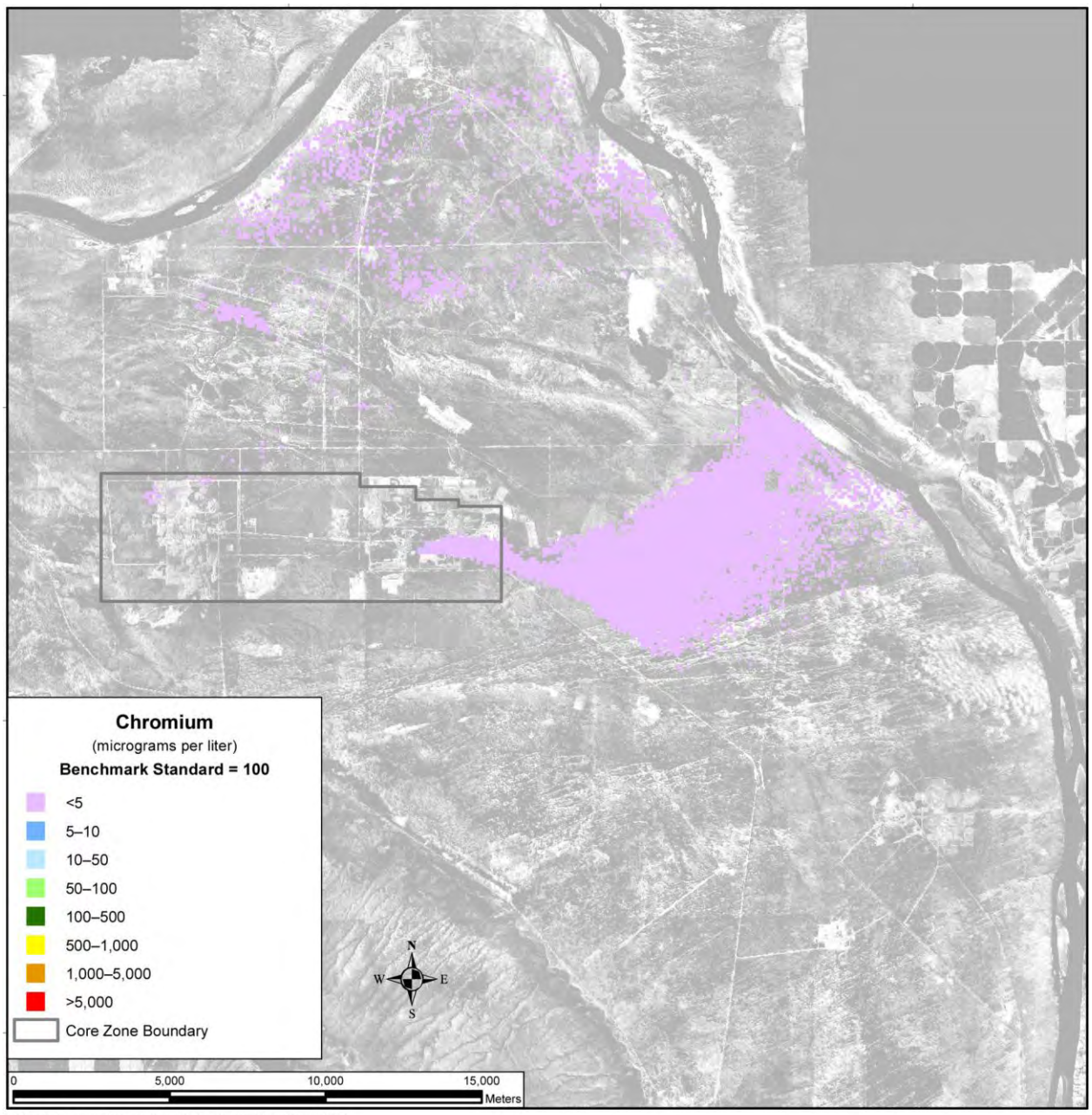
Note: To convert meters to feet, multiply by 3.281.

Figure 5–974. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



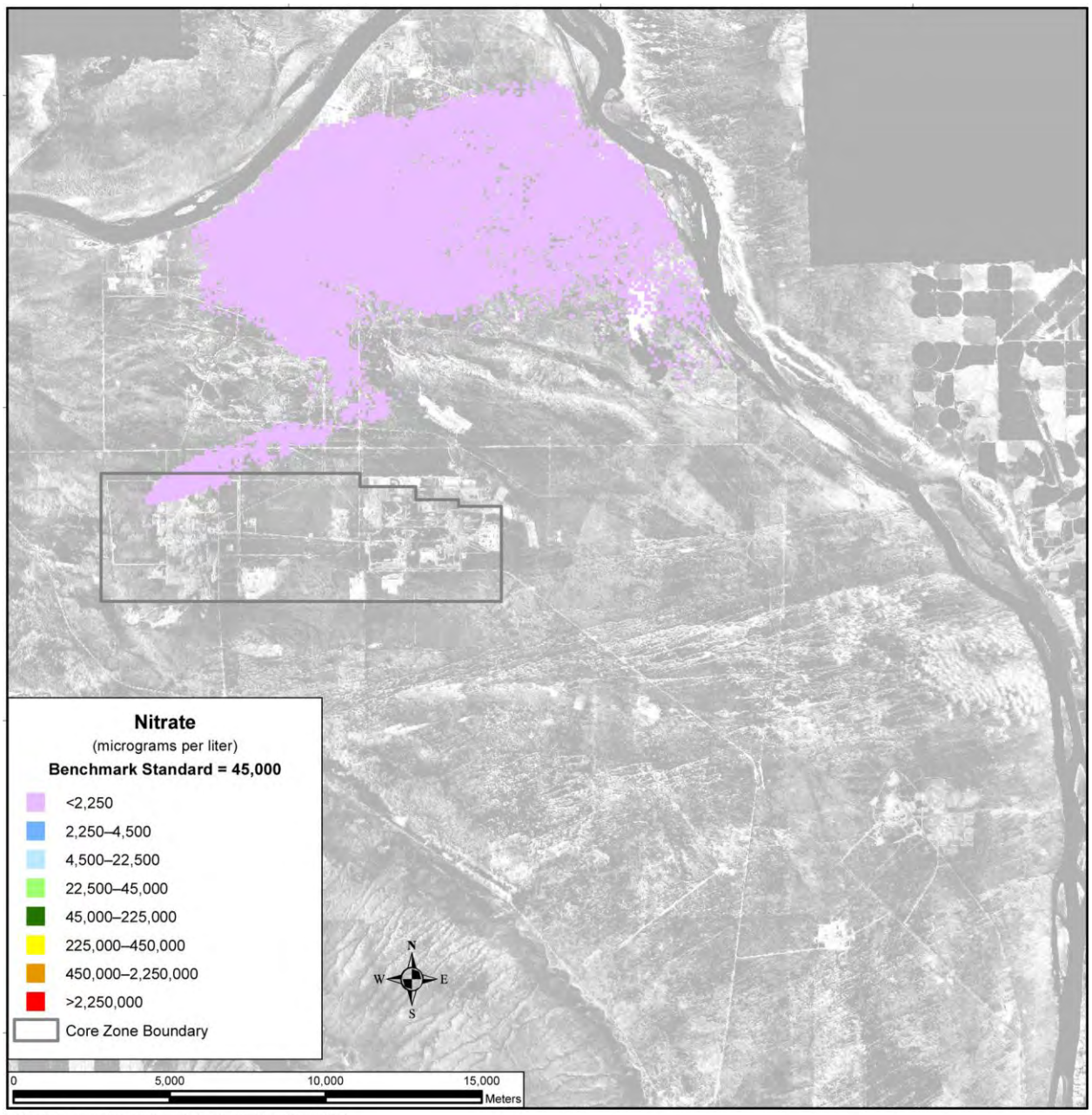
Note: To convert meters to feet, multiply by 3.281.

Figure 5–975. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



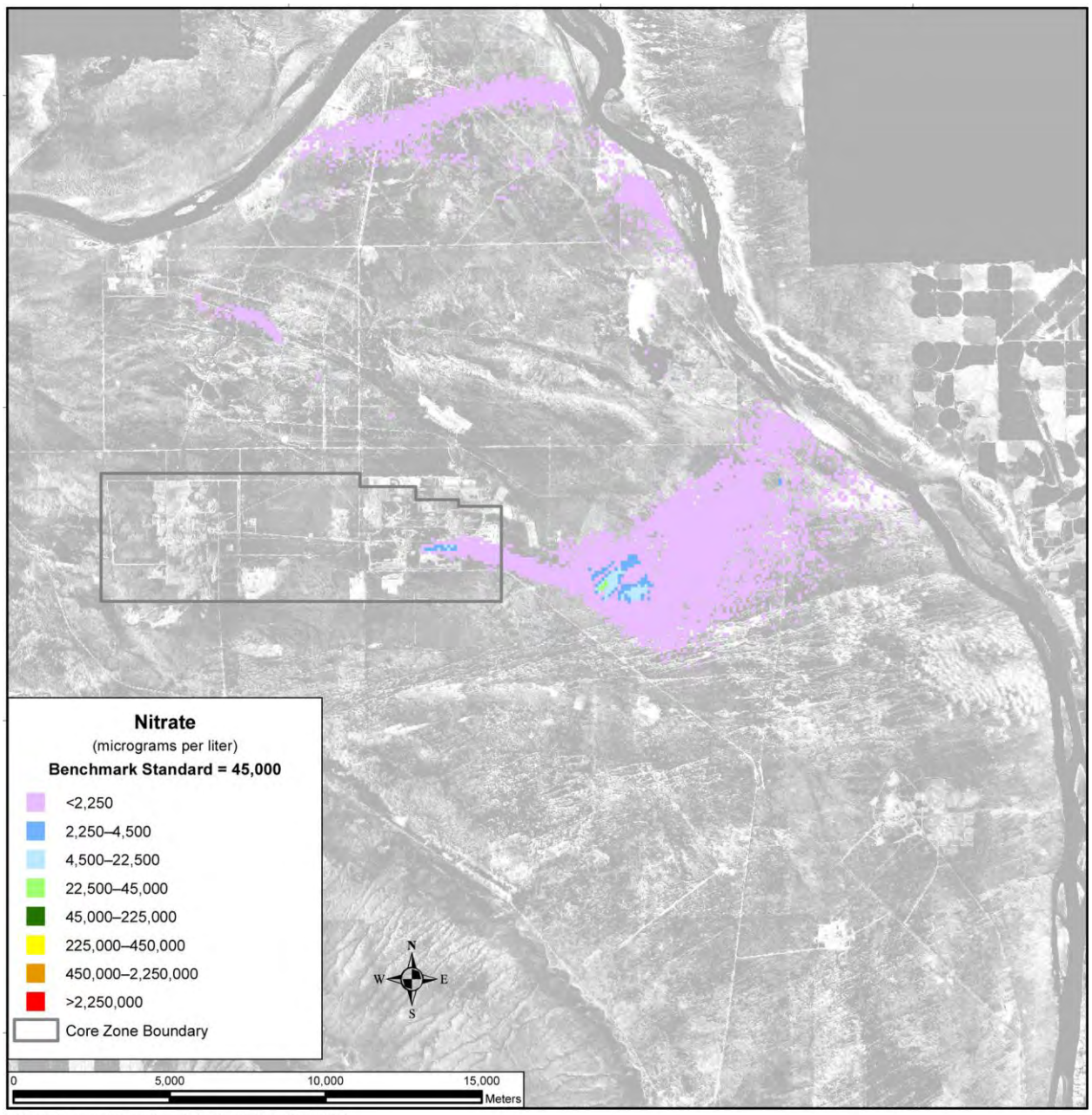
Note: To convert meters to feet, multiply by 3.281.

Figure 5–976. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



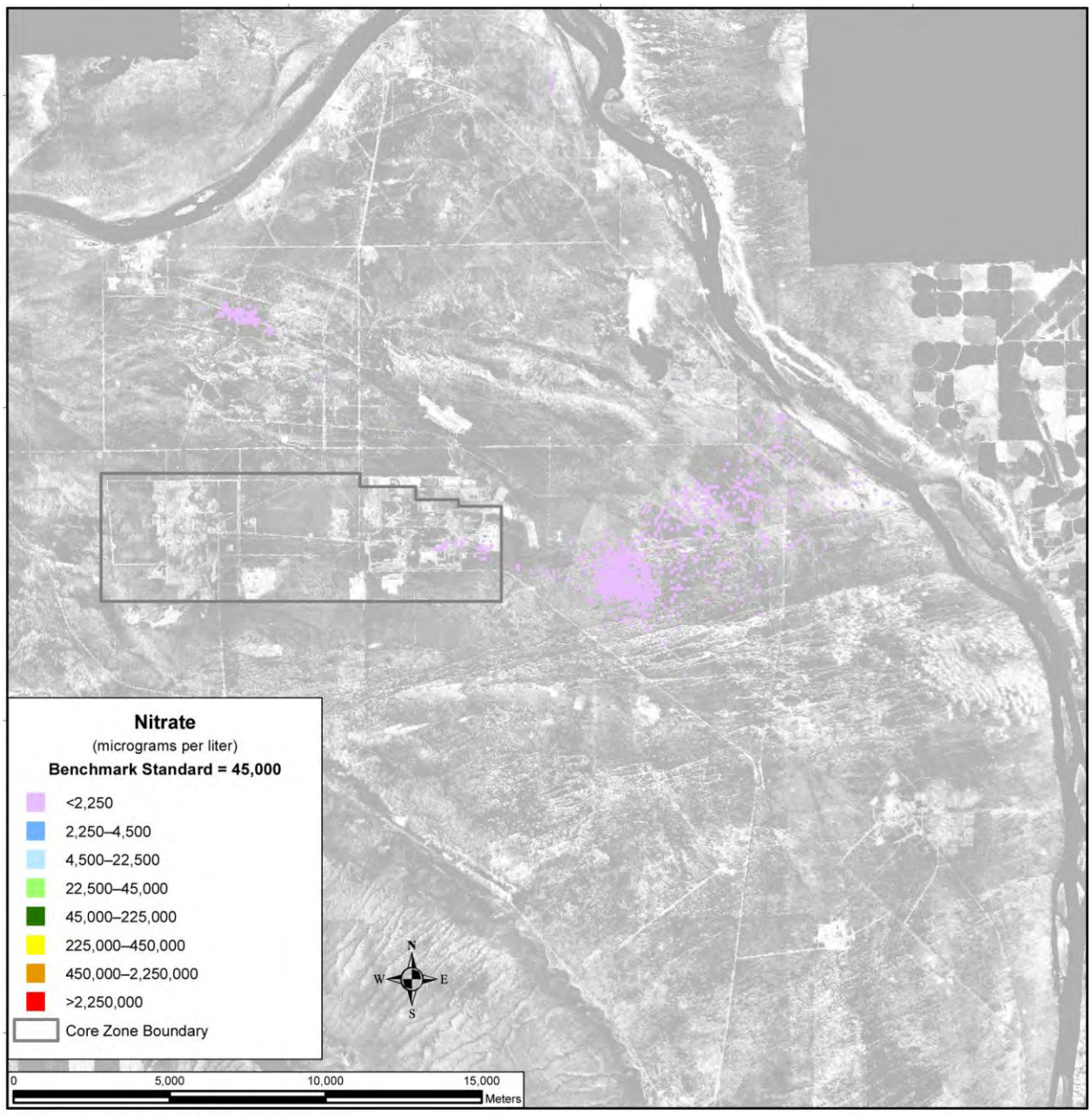
Note: To convert meters to feet, multiply by 3.281.

Figure 5–977. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



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

Figure 5–978. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



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

Figure 5–979. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

There are no appreciable releases of either uranium-238 or total uranium to the environment over the analysis period under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A.

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, in general, the inventories remaining in IDF-East and IDF-West, which are available for release to the environment at the start of the post-disposal period, are predominant contributors.

For the conservative tracers, only concentrations of technetium-99 and iodine-129 exceed their benchmarks at the IDF-West barrier, the Core Zone Boundary, and Columbia River nearshore. Both

constituents exceed the benchmark standards by over one order of magnitude at the IDF-West barrier and by less than one order of magnitude at the Core Zone Boundary and Columbia River nearshore around CY 3900.

There are no appreciable releases of either uranium-238 or total uranium to the environment over the analysis period under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A.

5.3.1.3.2.2 Disposal Group 2, Subgroup 2-B, Base Case

Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, was designed to show the impacts of waste disposal on IDF-East, IDF-West, and the RPPDF.

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, was designed to accommodate the disposal of wastes generated under Tank Closure Alternative 6B and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste.

For the long-term groundwater impacts analysis, two major periods have been identified for Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2100 for IDF-East and the RPPDF and through CY 2050 for IDF-West, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2101 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East and IDF-West would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case (i.e., Tank Closure Alternative 6B, Base Case; FFTF Decommissioning Alternative 2 or 3; and onsite and offsite waste), is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, fluoride, chromium, and nitrate) are all mobile (i.e., they move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Subtotals are plotted in Figures 5–980 through 5–997, representing releases from the three disposal facilities: PPF glass, ETF-generated secondary waste, retired melters, and tank closure secondary waste released from IDF-East; FFTF Decommissioning Alternative 3 waste, waste management secondary and onsite waste, and offsite waste released from IDF-West; and waste released from the RPPDF. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over more than 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–980 shows the estimated release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–981, the chemical hazard drivers. For technetium-99, chromium, and nitrate, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). For the radioactive COPCs (technetium-99 and iodine-129), the releases range over five orders of magnitude, depending on the source of both radionuclides. ETF-generated secondary waste and tank closure secondary waste account for most of the releases. The entire release of nitrate from IDF-East is associated with ETF-generated secondary waste. Sources of chromium include tank closure secondary waste, PPF glass, retired melters, and ETF-generated secondary waste.

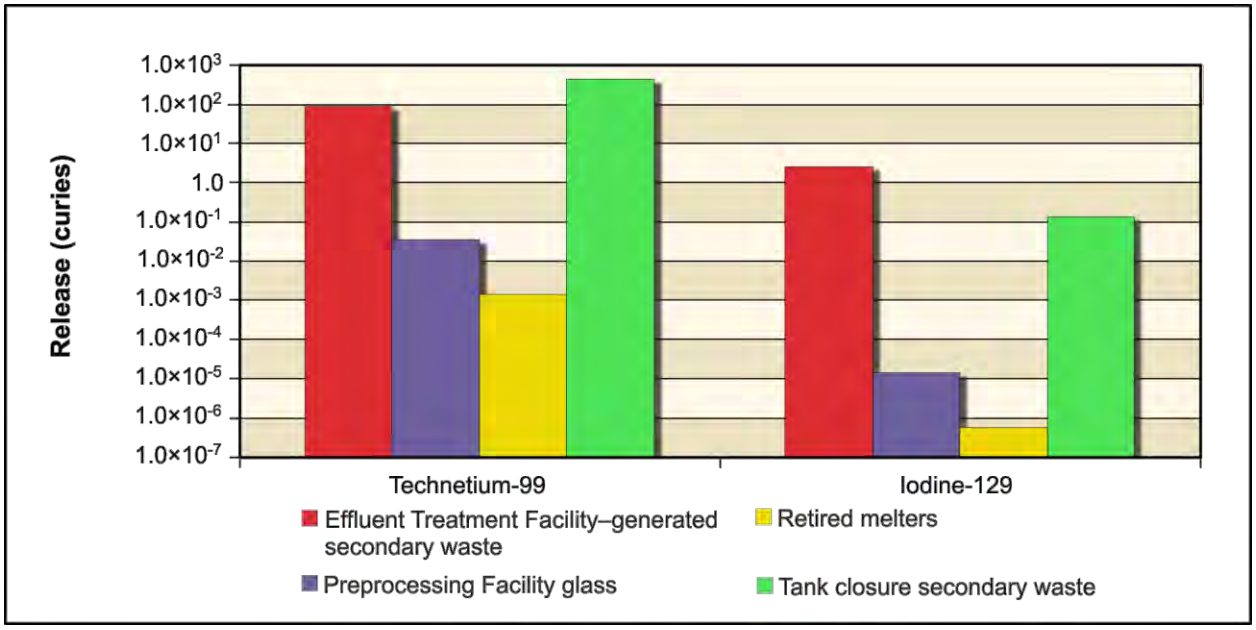


Figure 5–980. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

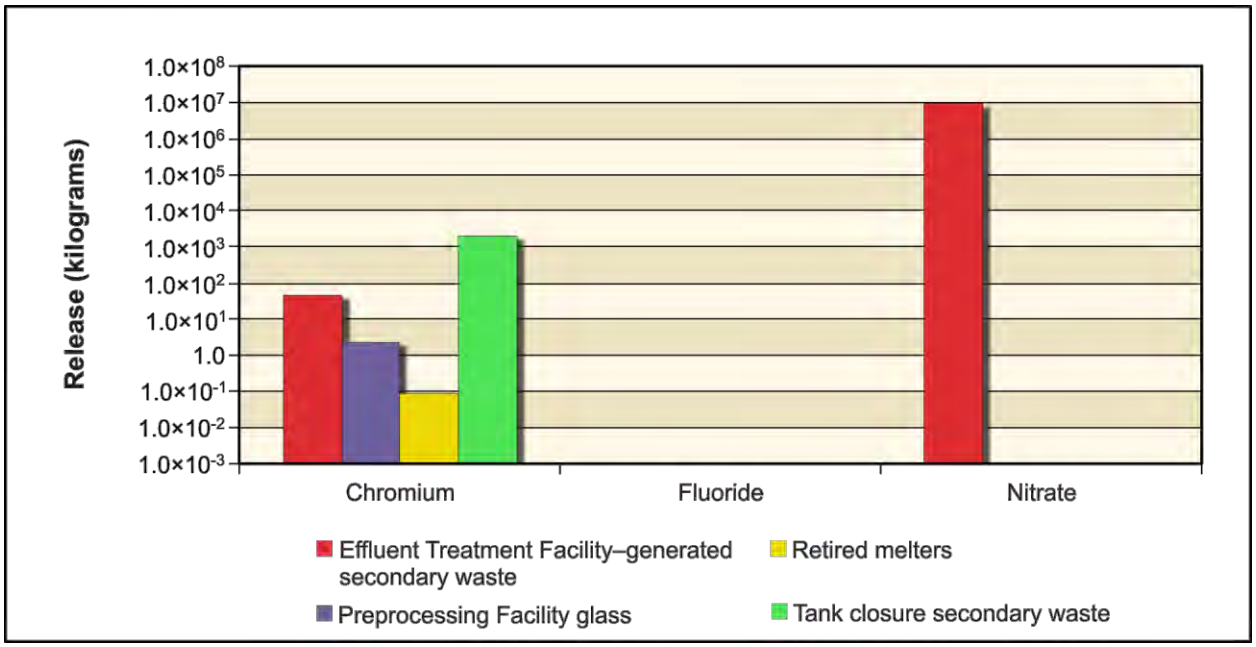


Figure 5–981. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–982 shows the estimated release from IDF-East to groundwater of the radiological risk drivers and Figure 5–983, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For the conservative tracers iodine-129 and technetium-99, the amount released to groundwater is approximately 42 and 58 percent, respectively. For chromium and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone.

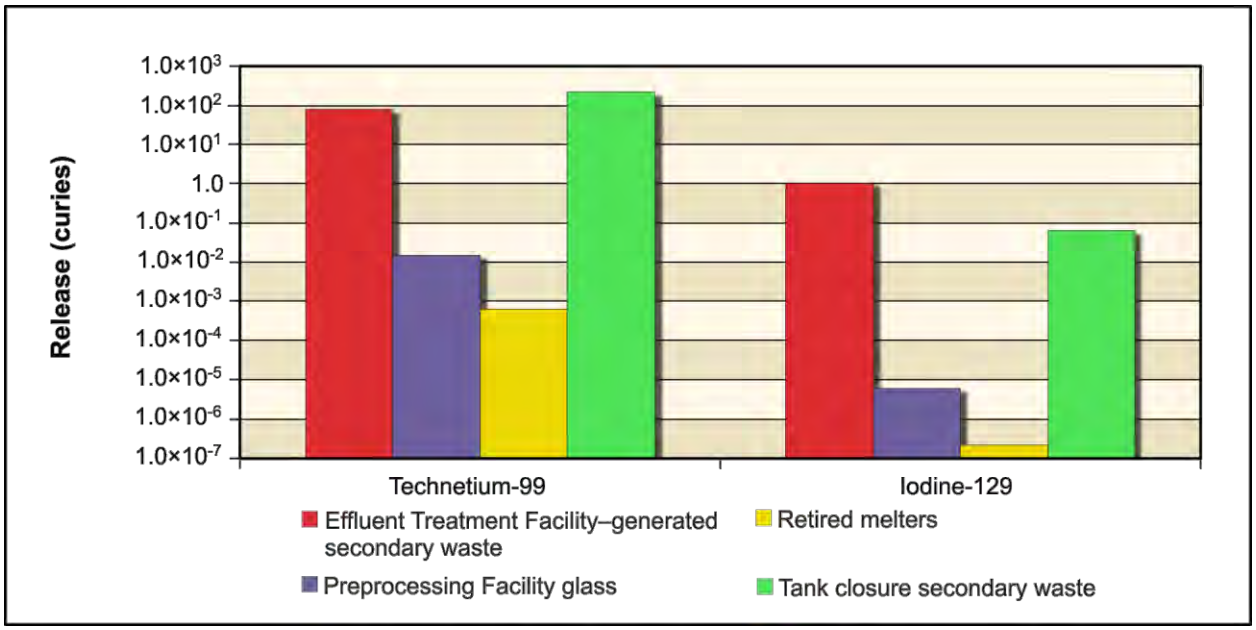


Figure 5–982. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

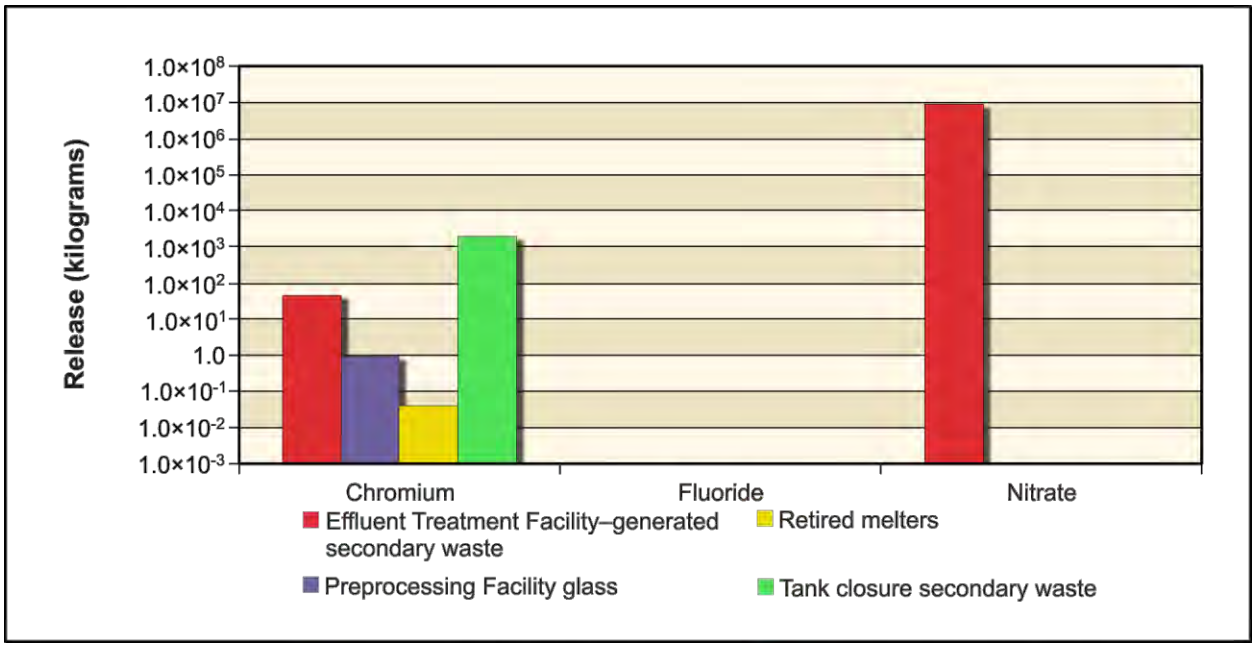


Figure 5–983. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–984 shows the estimated release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–985, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For the conservative tracers (iodine-129, technetium-99, chromium, and nitrate), the amount released to the Columbia River is essentially equal to the amount released to groundwater.

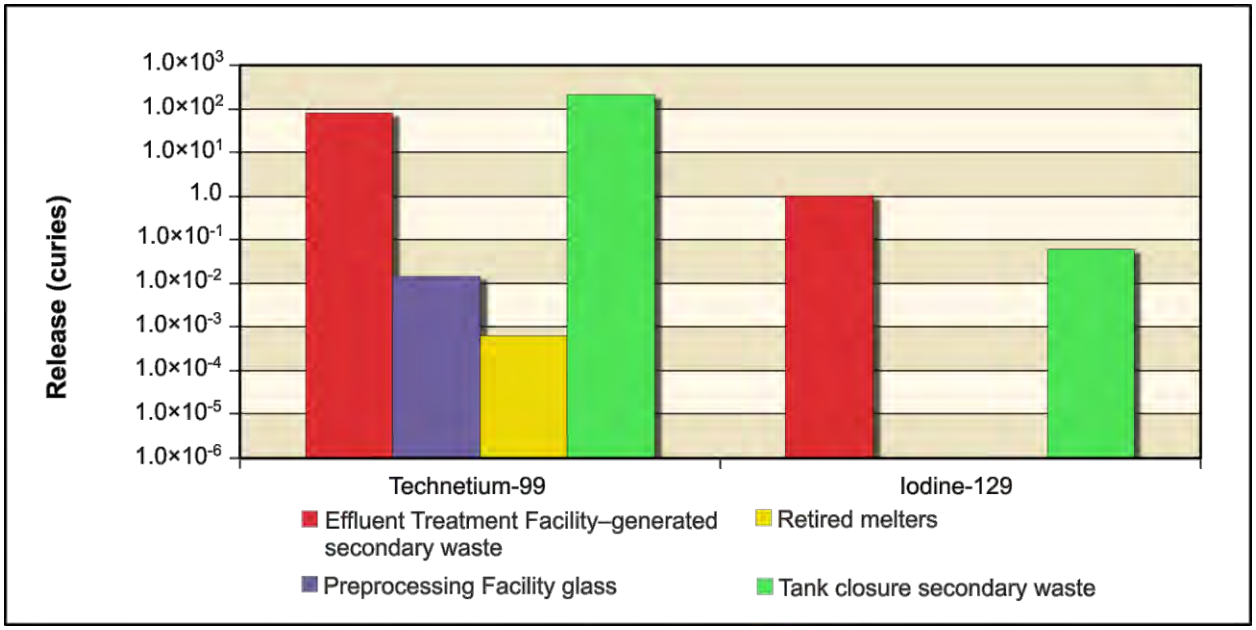


Figure 5–984. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

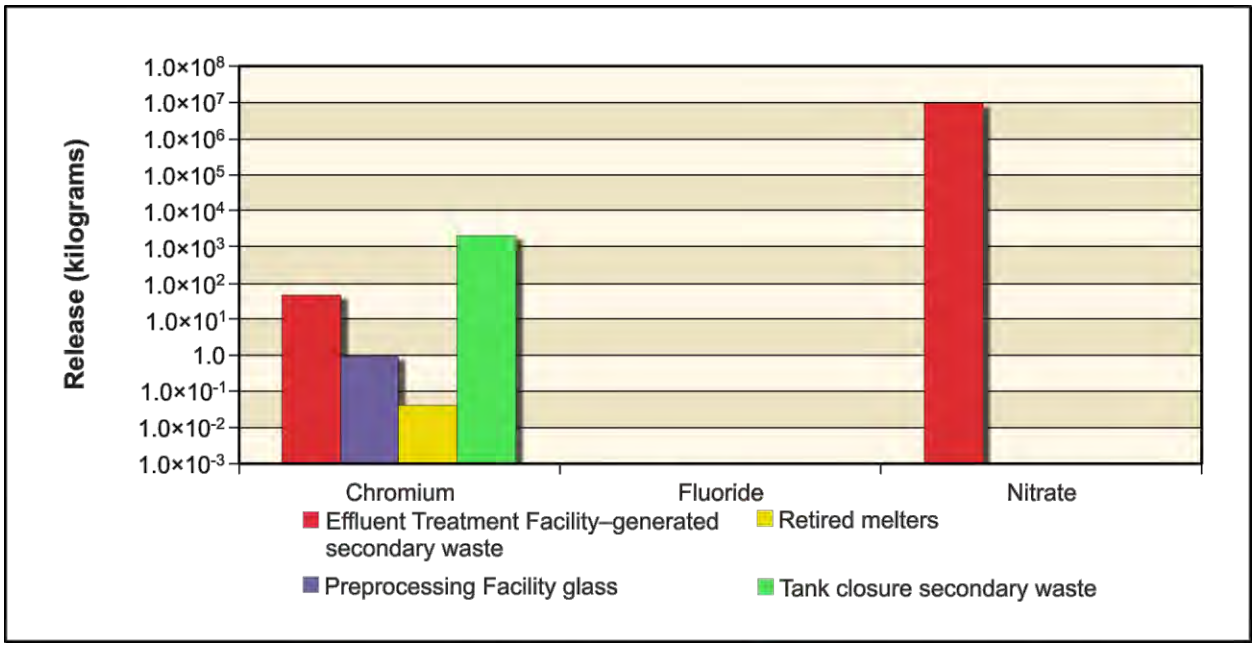


Figure 5–985. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Figure 5–986 shows the estimated release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–987, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). For the radioactive COPCs (technetium-99 and iodine-129) in IDF-West, the releases range over five orders of magnitude, depending on the source. Over 99 percent of the radioactive waste is from offsite waste. The chromium in IDF-West and essentially all of the nitrate and fluoride derive from releases associated with waste management secondary and onsite waste. Of the chromium sources, less than 1 percent is from FFTF Decommissioning Alternative 3 waste, 69 percent is from waste management secondary and onsite waste, and 31 percent is from offsite waste.

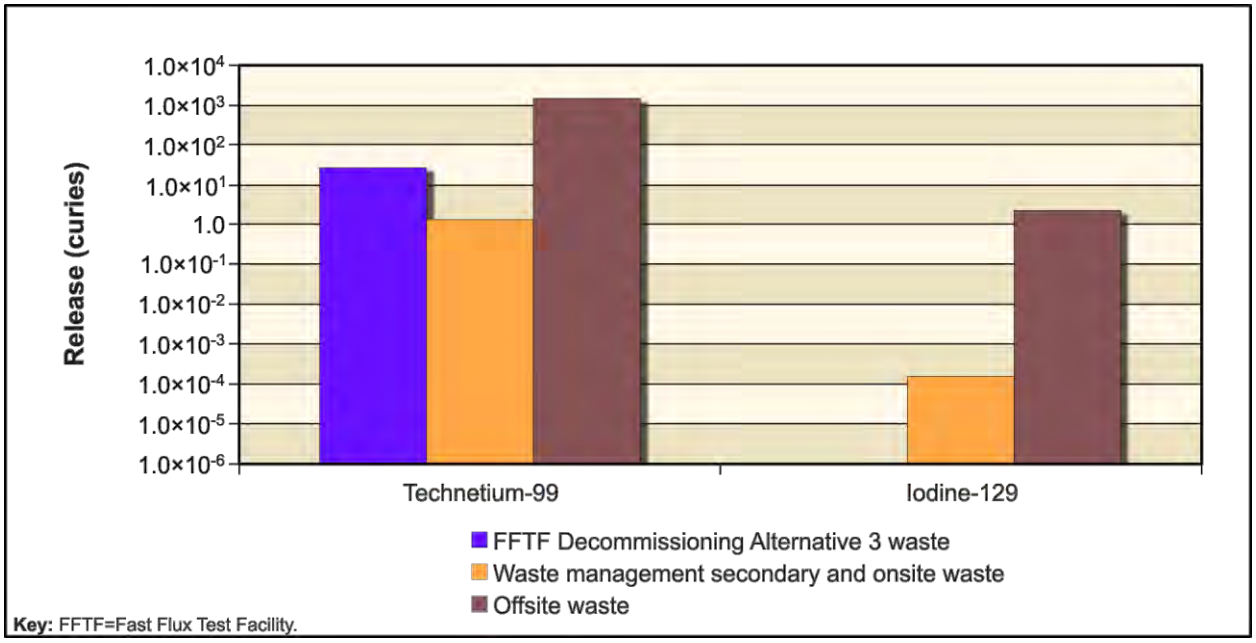


Figure 5–986. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

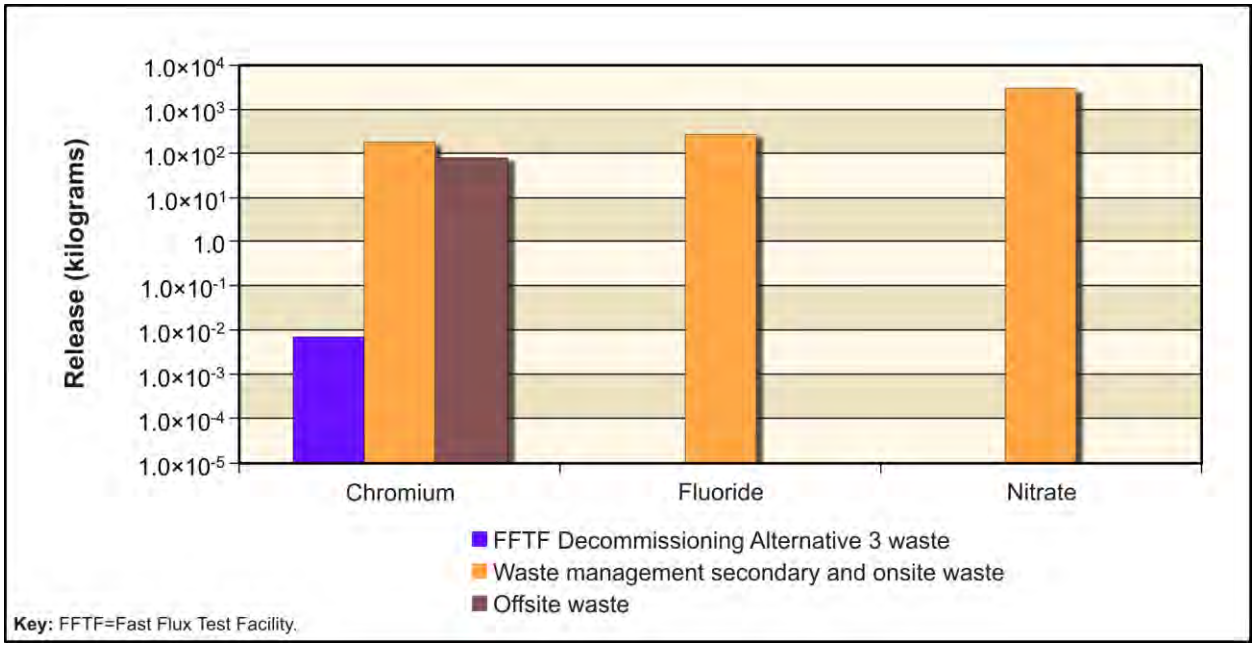


Figure 5–987. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–988 shows the estimated release from IDF-West to groundwater of the radiological risk drivers and Figure 5–989, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For the conservative tracers (iodine-129, technetium-99, chromium, fluoride, and nitrate), the amount released to groundwater is essentially equal to the amount released to the vadose zone.

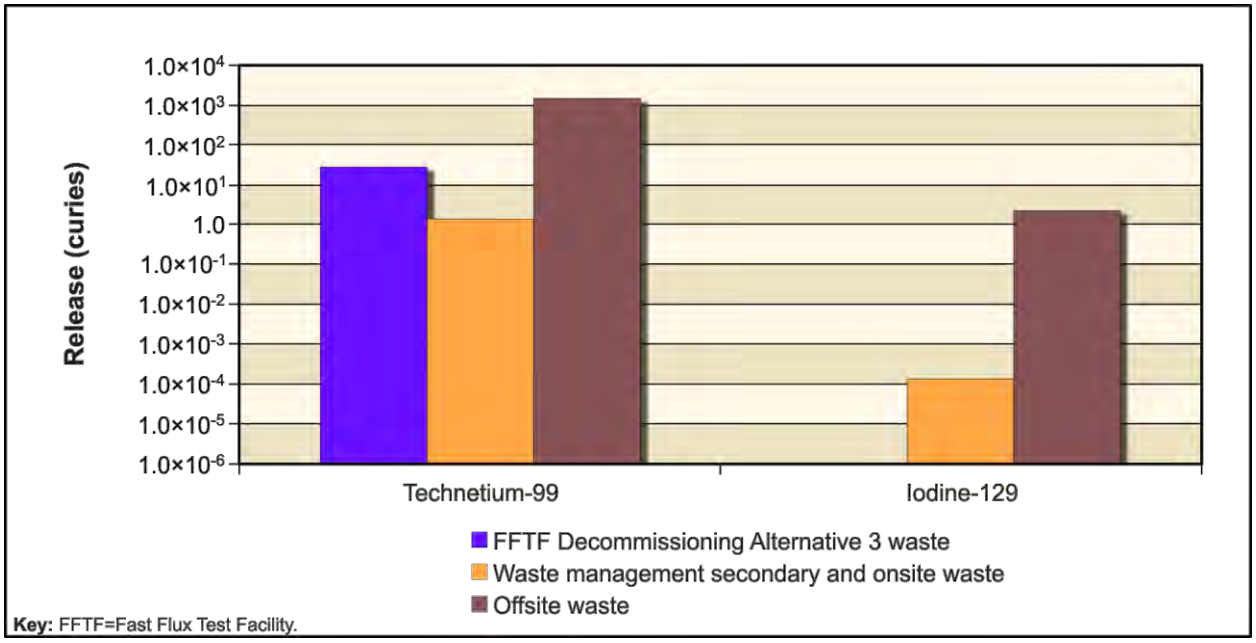


Figure 5–988. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

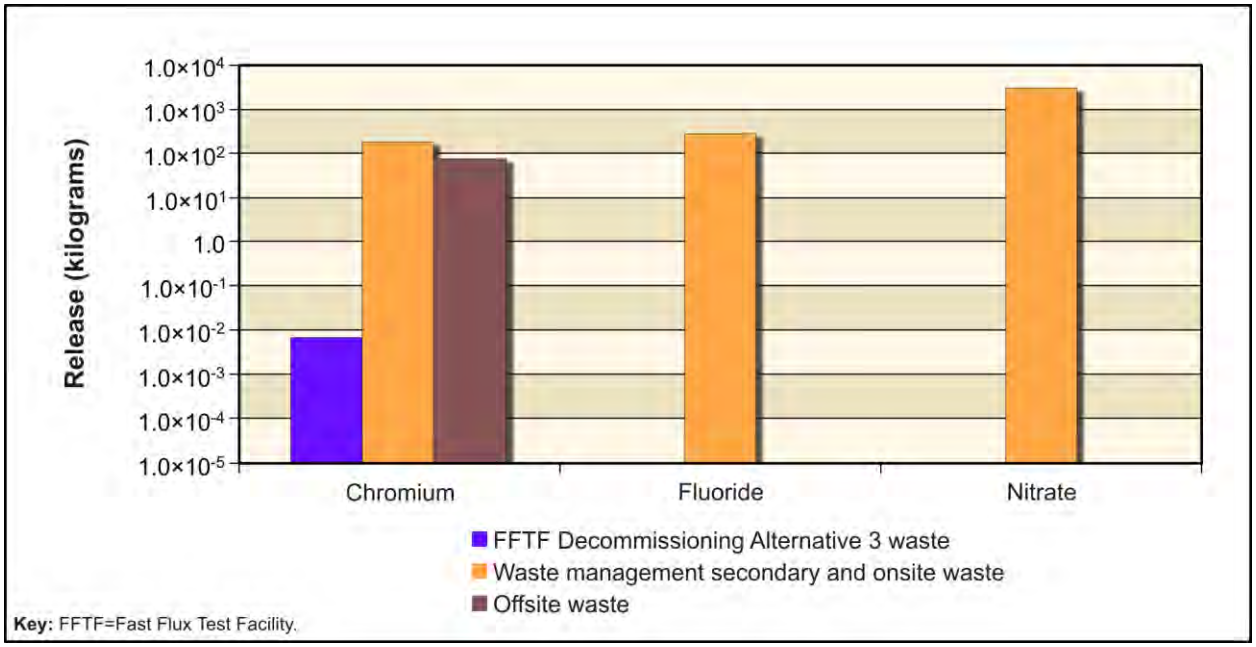


Figure 5–989. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–990 shows the estimated release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–991, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For the conservative tracers (iodine-129, technetium-99, chromium, and nitrate), the amount released to the Columbia River is approximately 97 to 100 percent of the amount released to the vadose zone.

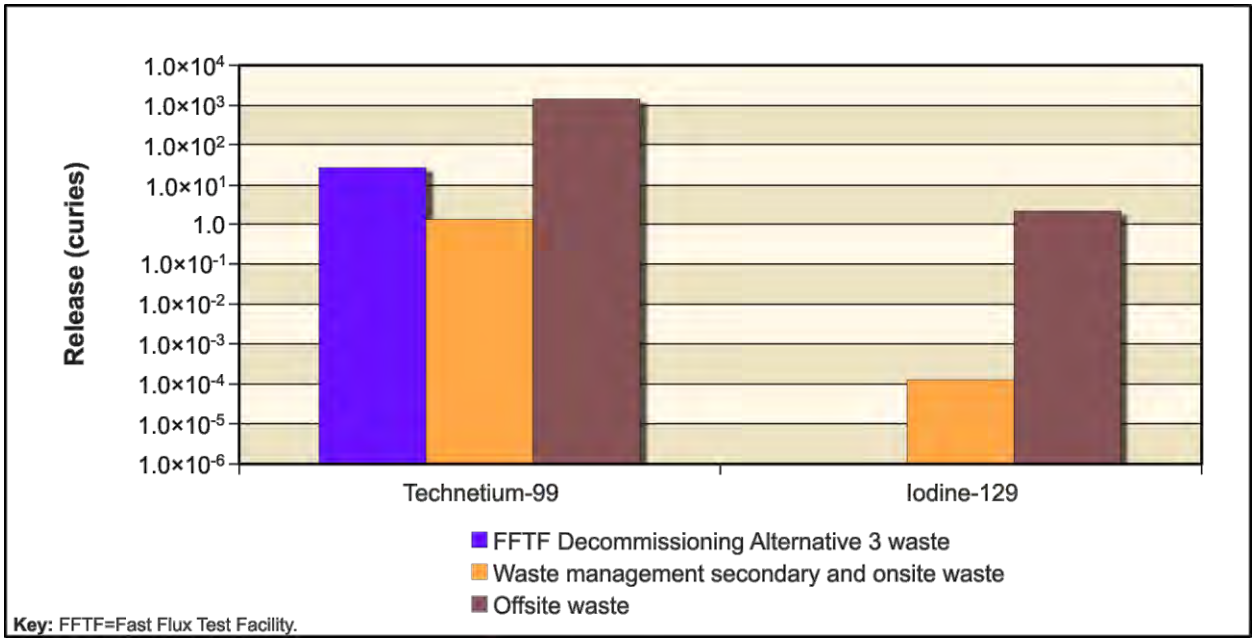


Figure 5–990. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

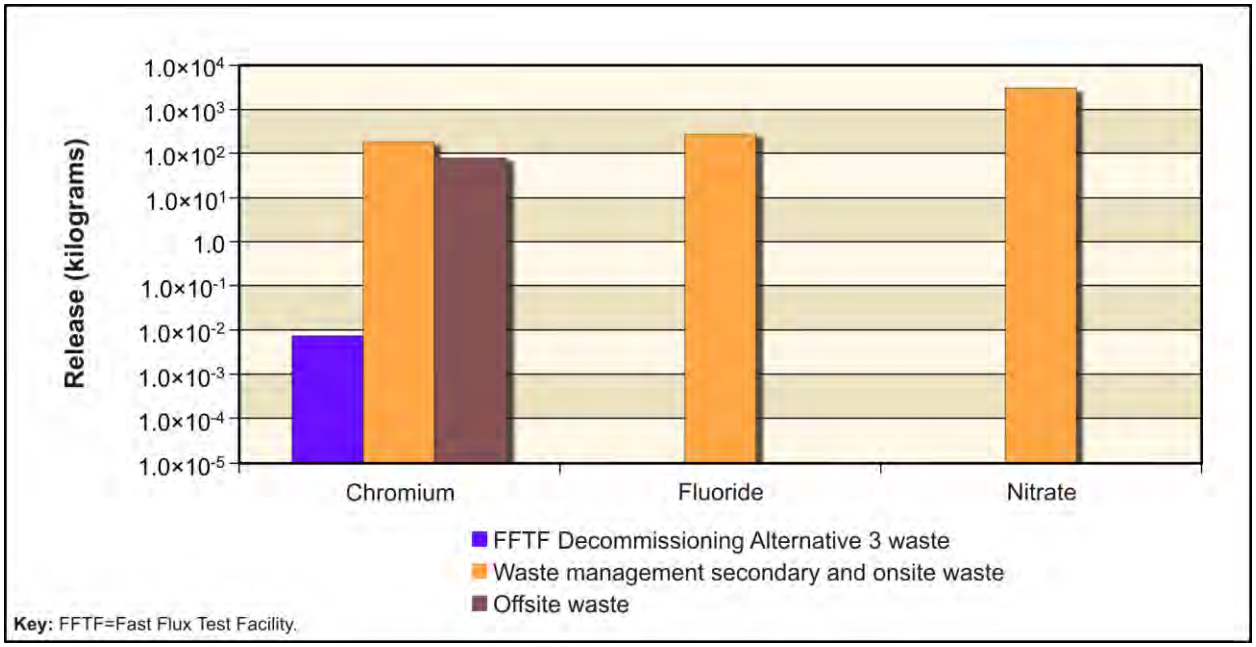


Figure 5–991. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5–992 shows the estimated release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–993, the chemical hazard drivers. The technetium-99 release is more than two orders of magnitude greater than the iodine-129 release from the RPPDF. Of the chemical hazard drivers, nitrate is the predominant COPC; its release is about two orders of magnitude greater than that of chromium.

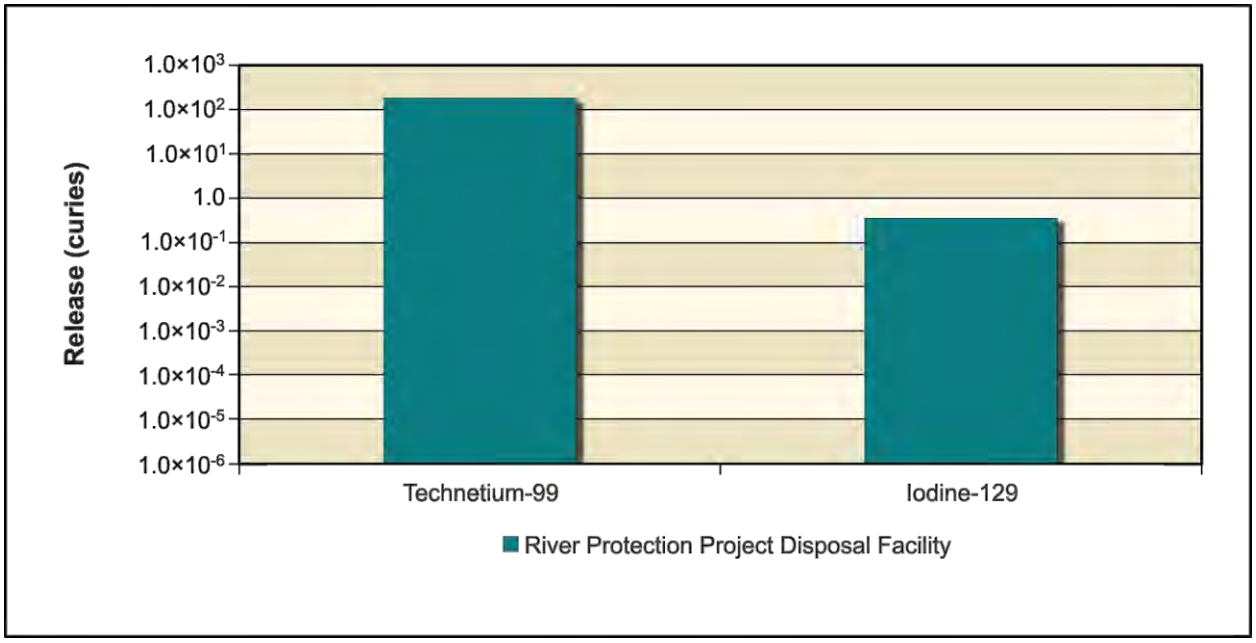


Figure 5–992. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

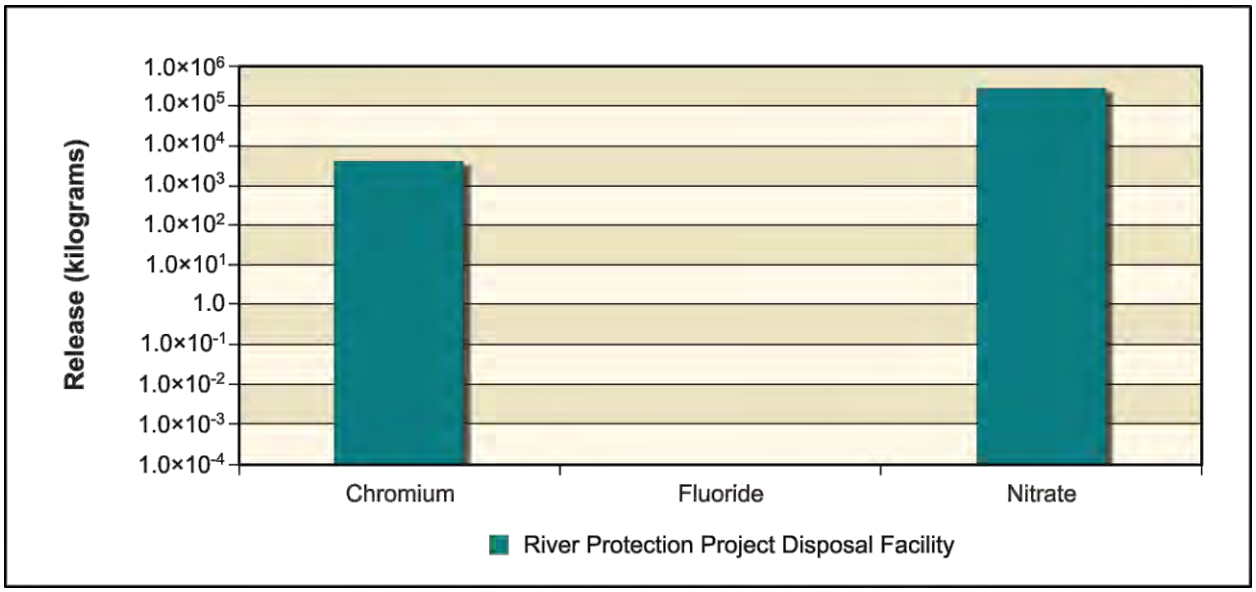


Figure 5–993. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–994 shows the estimated release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–995, the chemical hazard drivers. For the conservative tracers (iodine-129, technetium-99, chromium, and nitrate), the amount released to groundwater is essentially equal to the amount released to the vadose zone.

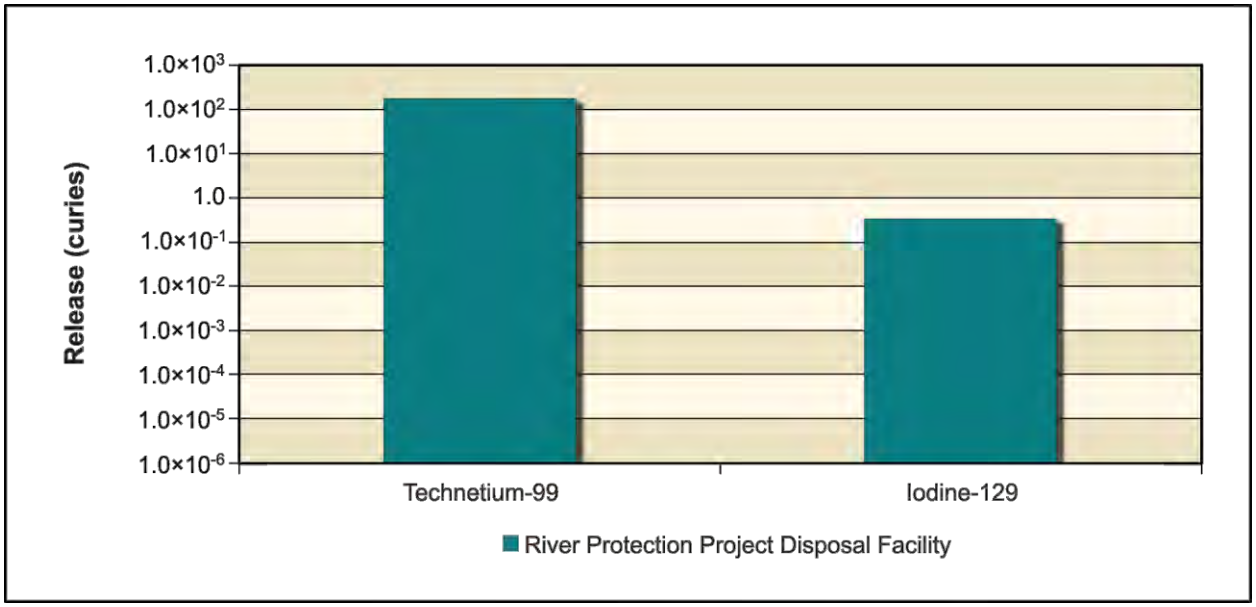


Figure 5–994. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

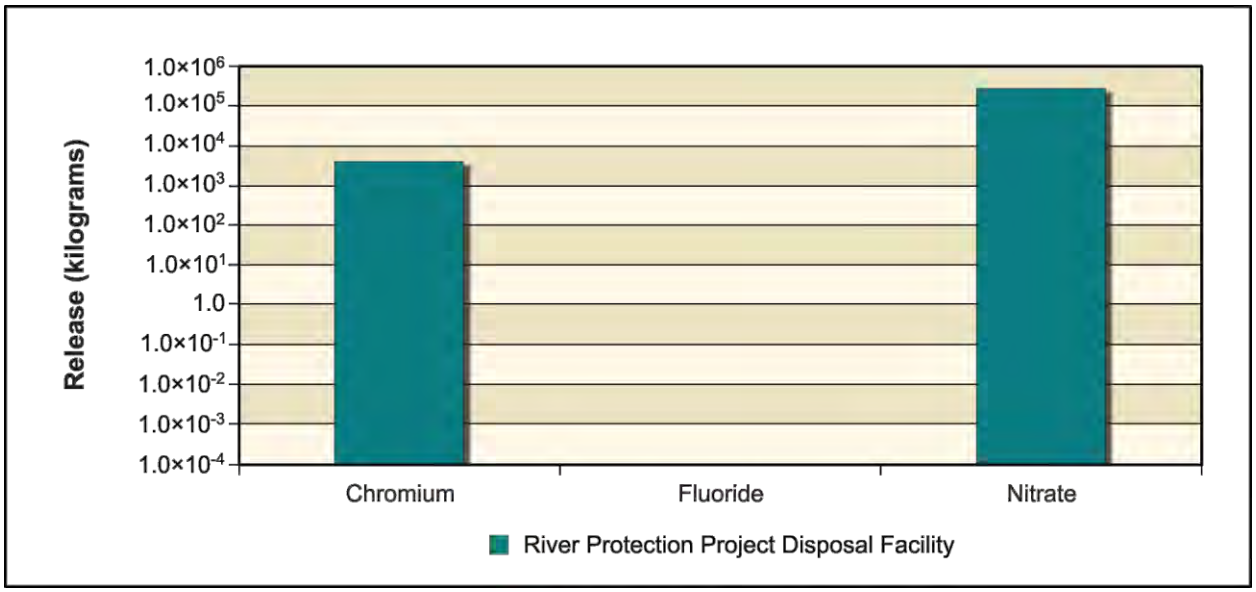


Figure 5–995. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–996 shows the release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–997, the chemical hazard drivers. Essentially all of the inventory of radionuclides and chemicals released to groundwater reach the Columbia River.

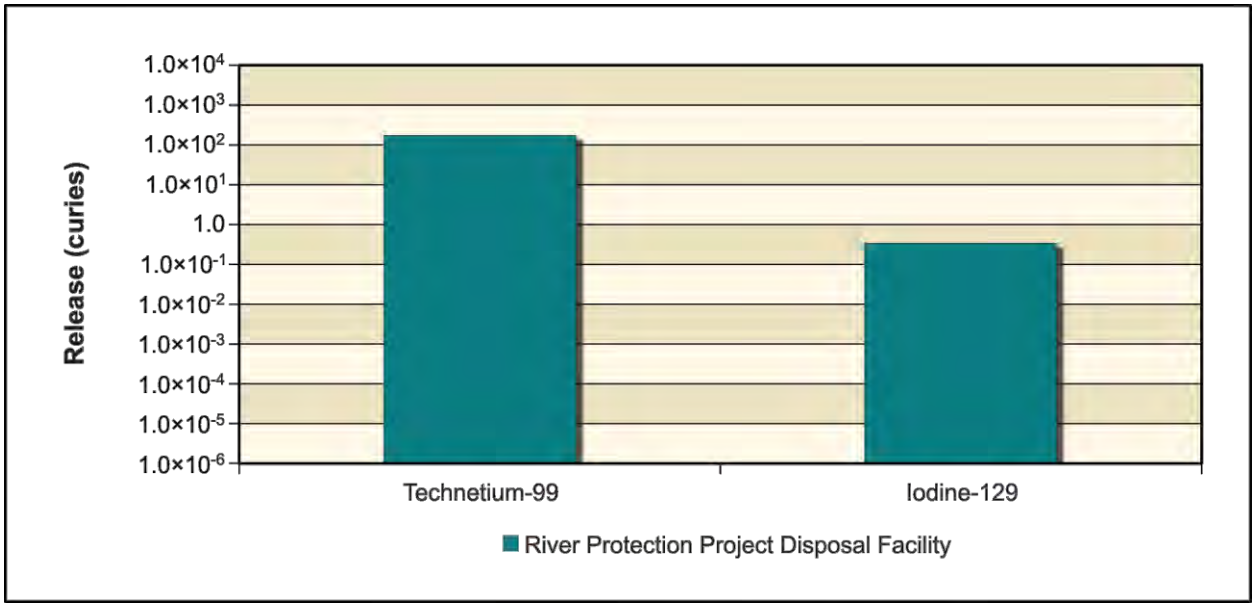


Figure 5–996. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

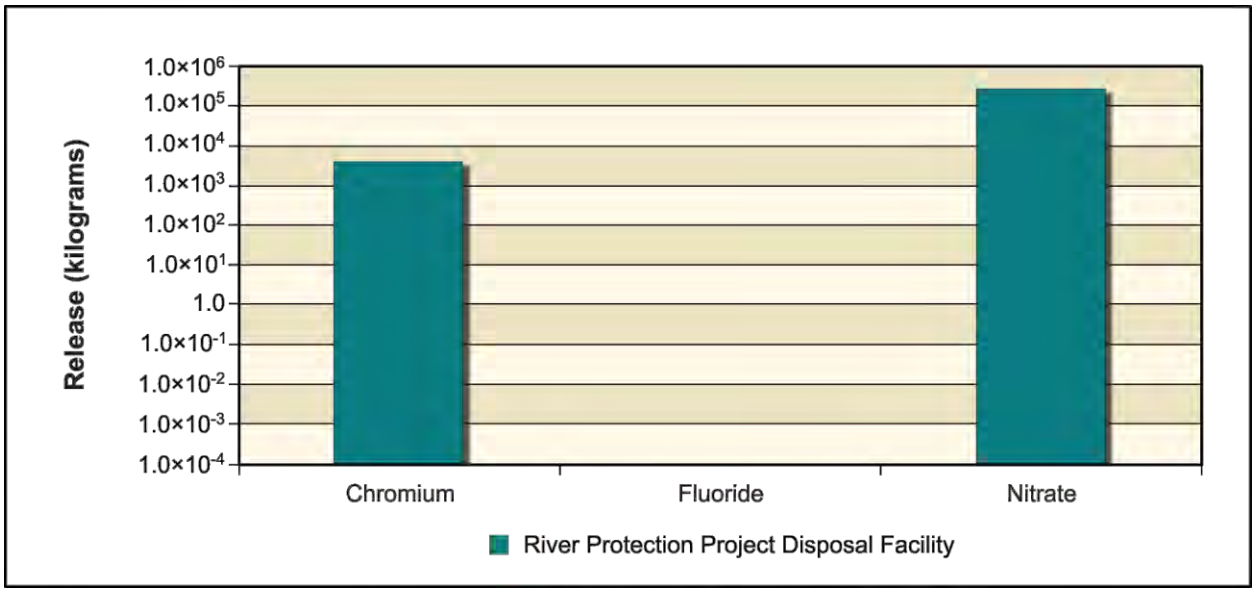


Figure 5–997. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the impacts of Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over five orders of magnitude.

Table 5–114 shows the maximum concentrations of the COPCs in the peak years at IDF-East, IDF-West, the RPPDF, the Core Zone Boundary, and Columbia River nearshore. Iodine-129 and technetium-99

concentrations both exceed their benchmarks at IDF-West, the Core Zone Boundary, and Columbia River nearshore around CY 3900. No other constituents exceed their benchmark concentrations under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case.

Table 5–114. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	194	**13,200**	155	**1,370**	**1,670**	900
	(10,188)	(3818)	(3769)	(3859)	(3920)	
Iodine-129	0.8	**20.6**	0.3	**2.1**	**2.4**	1
	(9907)	(3794)	(3746)	(3937)	(3872)	
Chemical (micrograms per liter)						
Chromium	2	1	4	3	2	100
	(8251)	(3813)	(3710)	(3977)	(4632)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	9,590	7	277	3,130	2,140	45,000
	(7983)	(3927)	(3789)	(7860)	(7994)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figures 5–998 through 5–1001 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate (the conservative tracers). Iodine-129 concentrations exceed the benchmark concentration at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. The greatest exceedance of the benchmark concentration is at the IDF-West barrier, where the benchmark is exceeded by over an order of magnitude from approximately CY 3200 until CY 4800. Iodine-129 concentrations never exceed the benchmark concentration at the IDF-East barrier or the RPPDF barrier. The iodine-129 benchmark concentrations are exceeded by less than an order of magnitude at the Core Zone Boundary and Columbia River nearshore. Technetium-99 exhibits behavior similar to iodine-129, where concentrations at the IDF-West barrier exceed the benchmark by over one order of magnitude. The duration of the benchmark exceedance is approximately 1,500 years. In addition, the technetium-99 benchmark concentration is exceeded at the Columbia River nearshore from approximately CY 3500 to CY 5000. The benchmark concentration is exceeded from about CY 3500 to CY 4100 at the Core Zone Boundary. Chromium concentrations peak at over one order of magnitude below the benchmark. Peak nitrate concentrations, less than an order of magnitude below the benchmark, are evident at the IDF-East barrier around CY 8000. Nitrate does not exceed its benchmark concentration during the period of analysis.

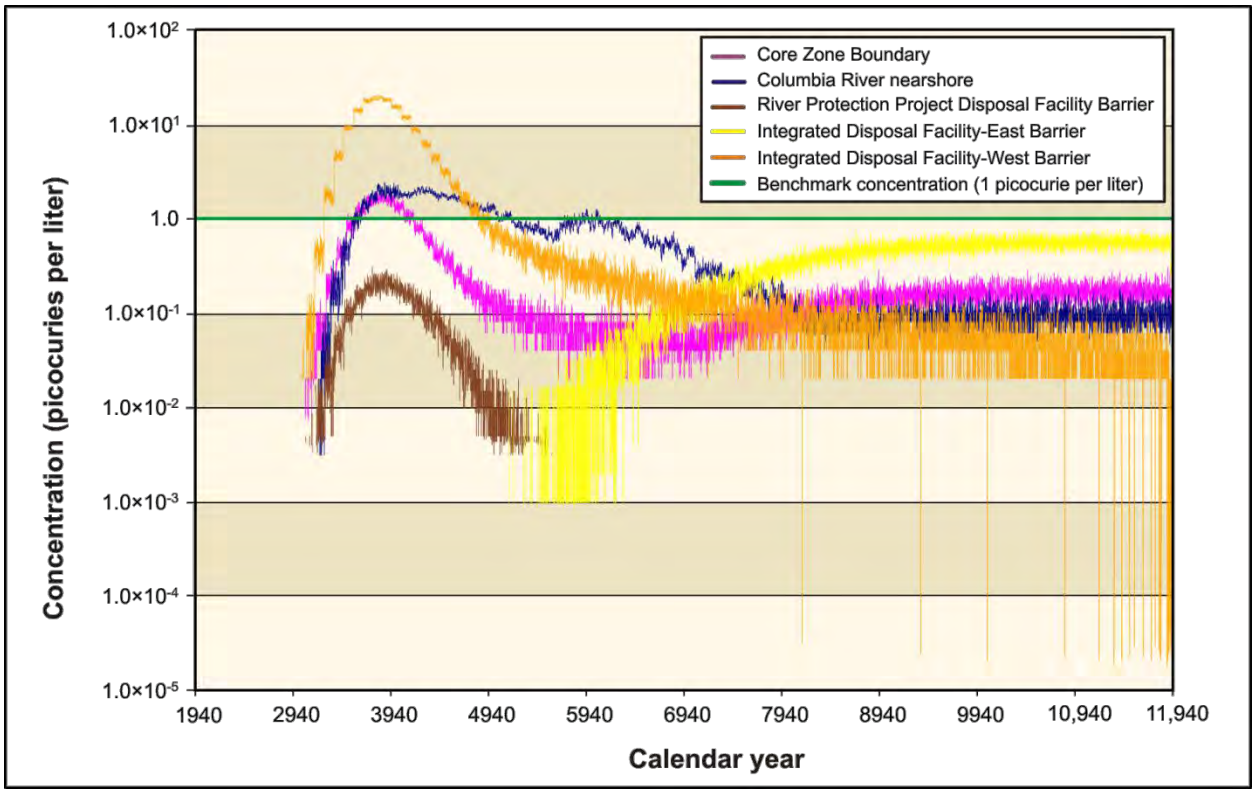


Figure 5–998. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Iodine-129 Concentration Versus Time

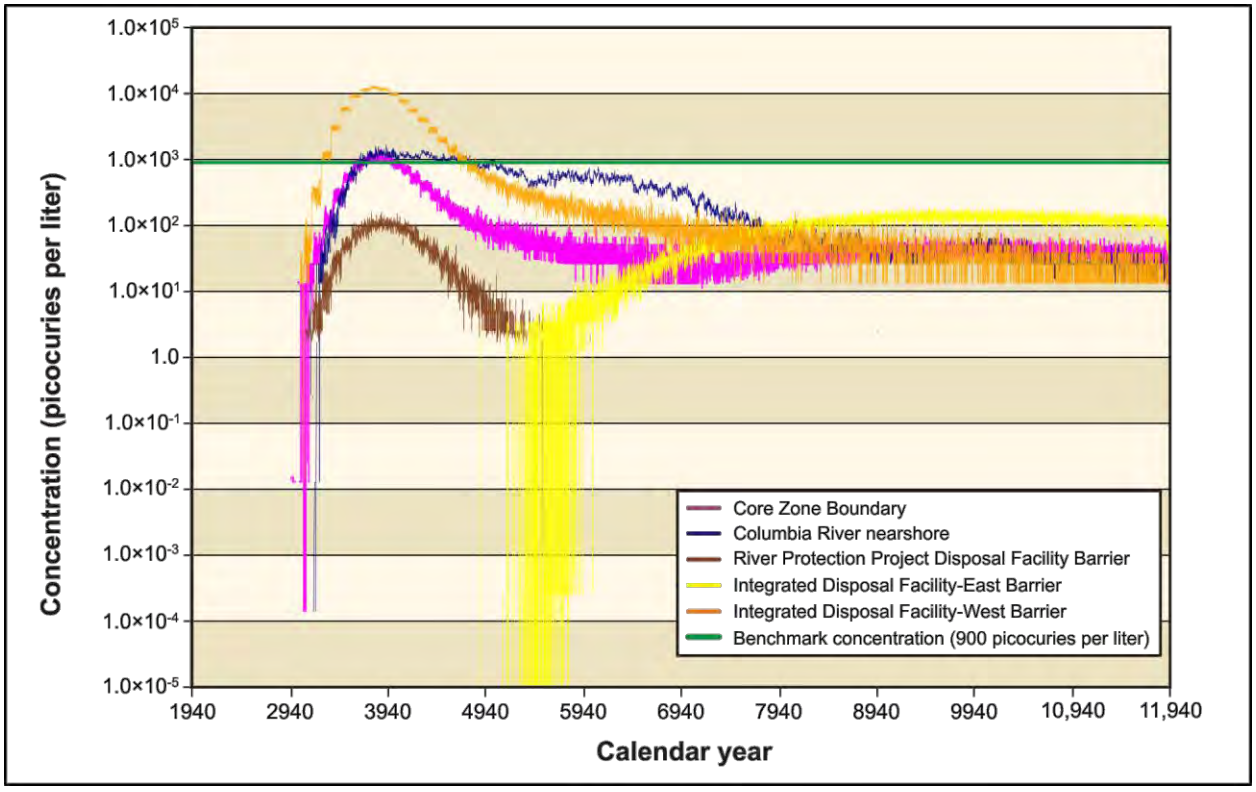


Figure 5–999. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Technetium-99 Concentration Versus Time

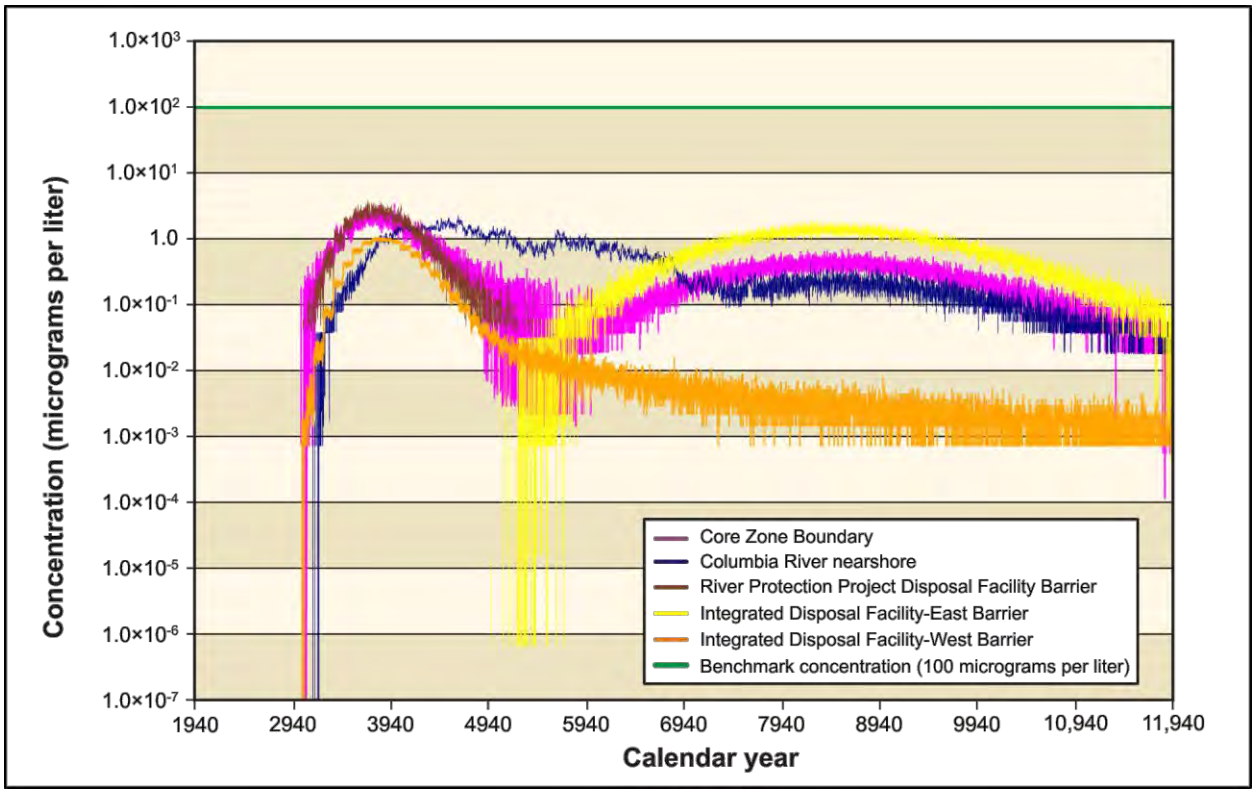


Figure 5–1000. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Chromium Concentration Versus Time

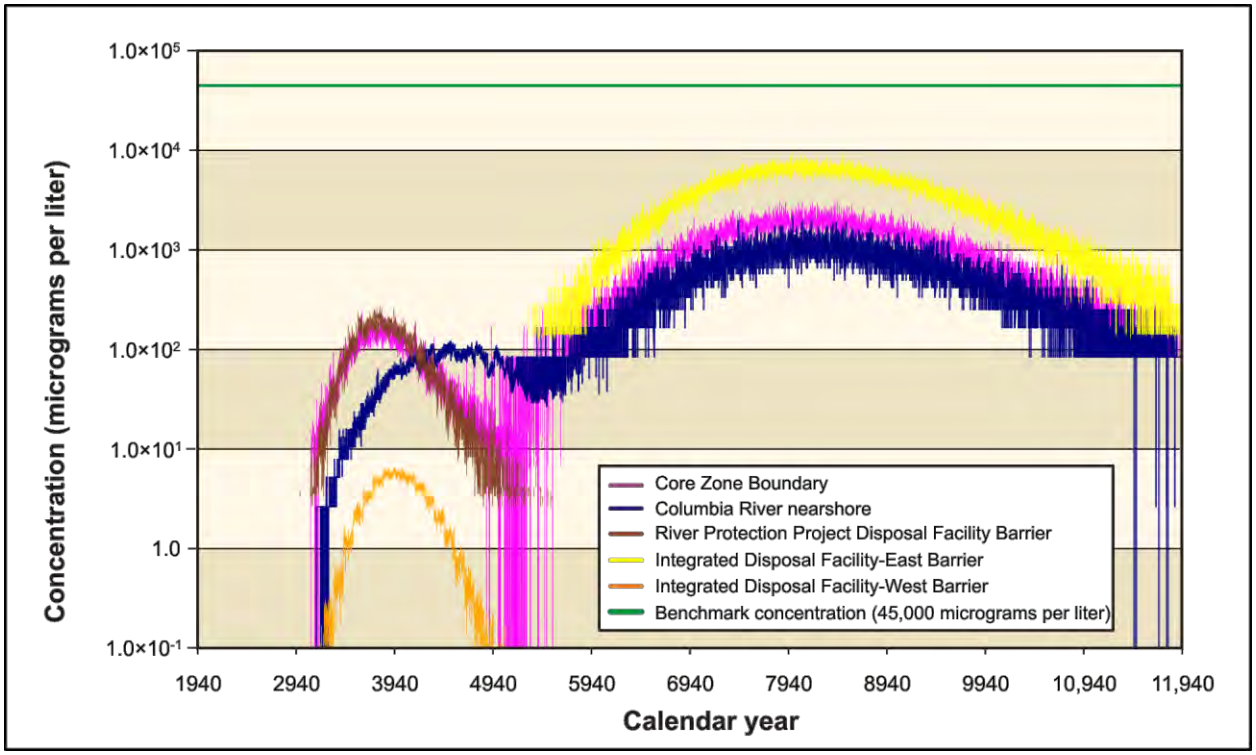


Figure 5–1001. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Nitrate Concentration Versus Time

Figure 5–1002 shows concentration versus time for total uranium. Because of the high retardation of total uranium, groundwater contamination doesn't appear until roughly CY 8000. Concentrations of total uranium continue to rise until the end of the 10,000-year period of analysis but remain at least six orders of magnitude below the benchmark concentration.

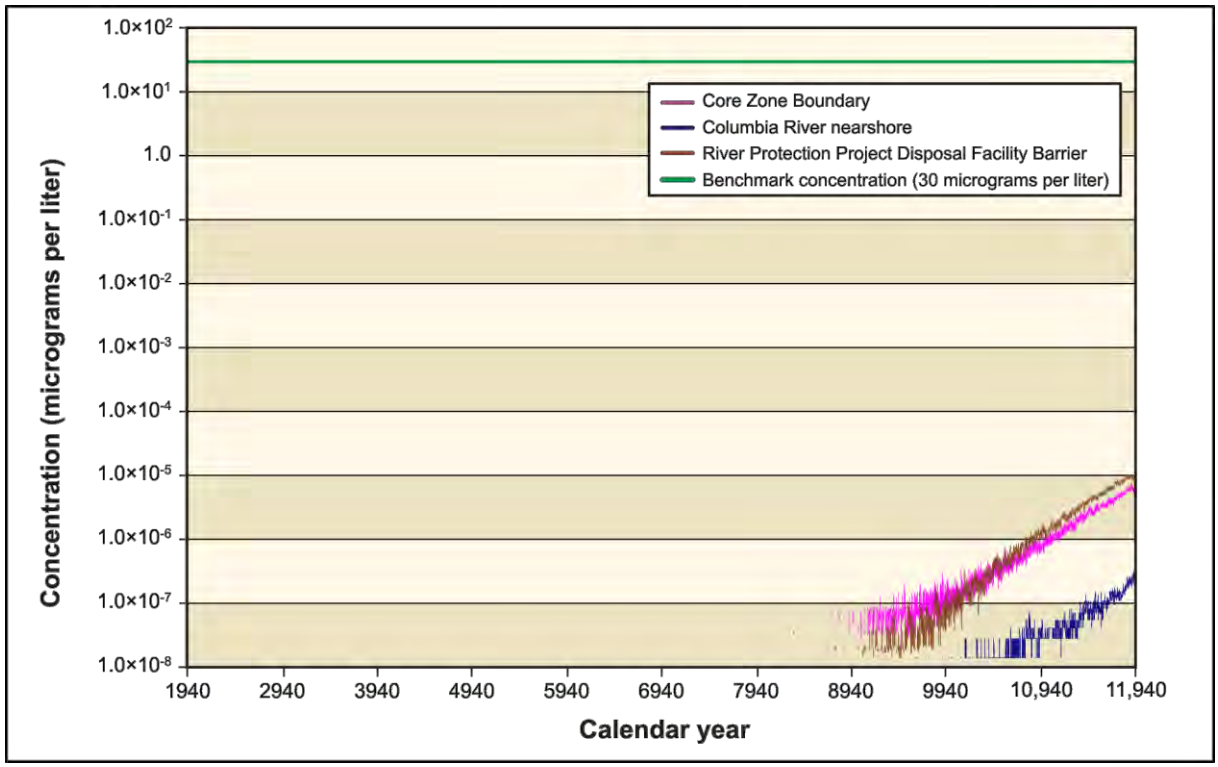
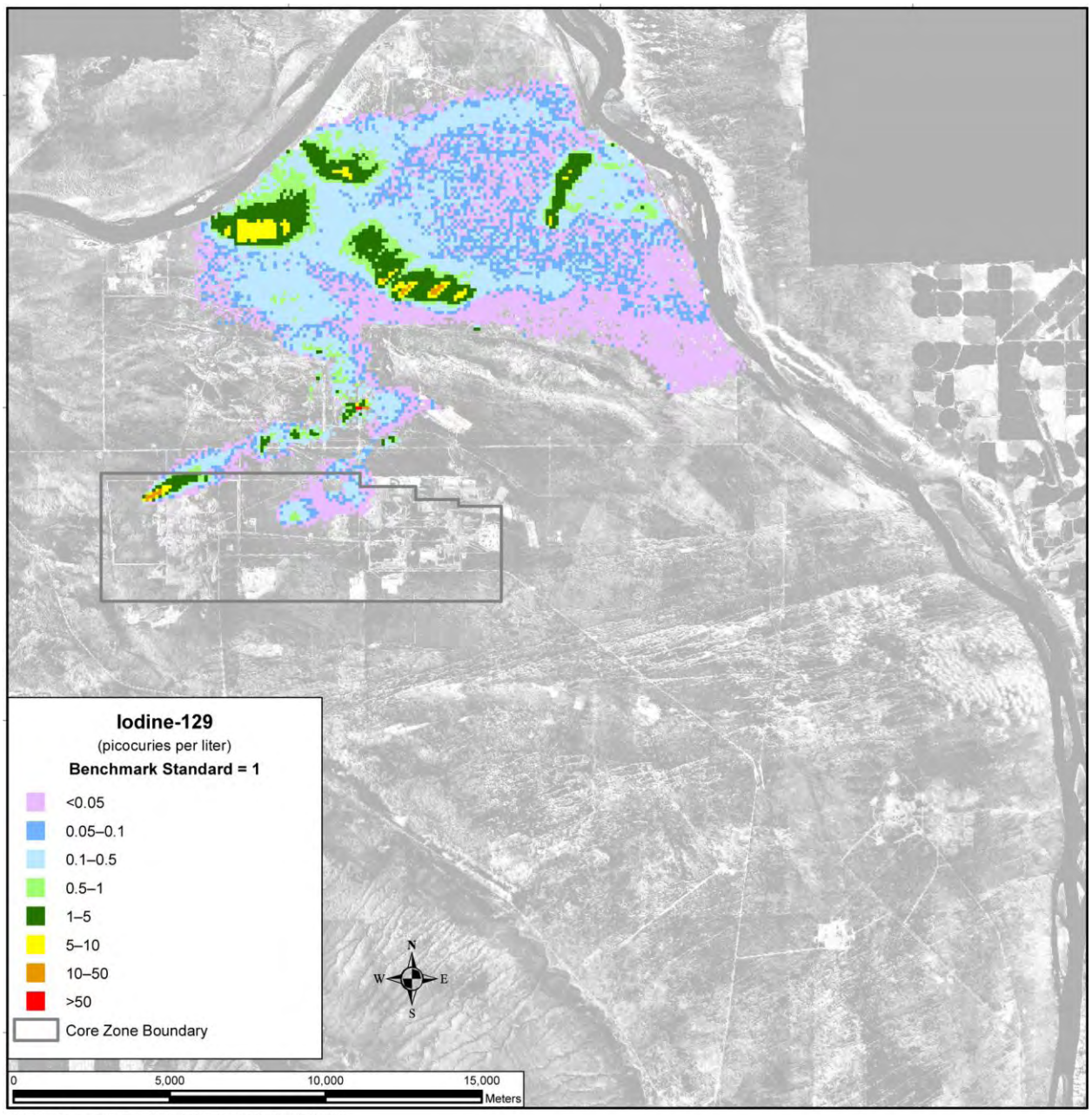


Figure 5–1002. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

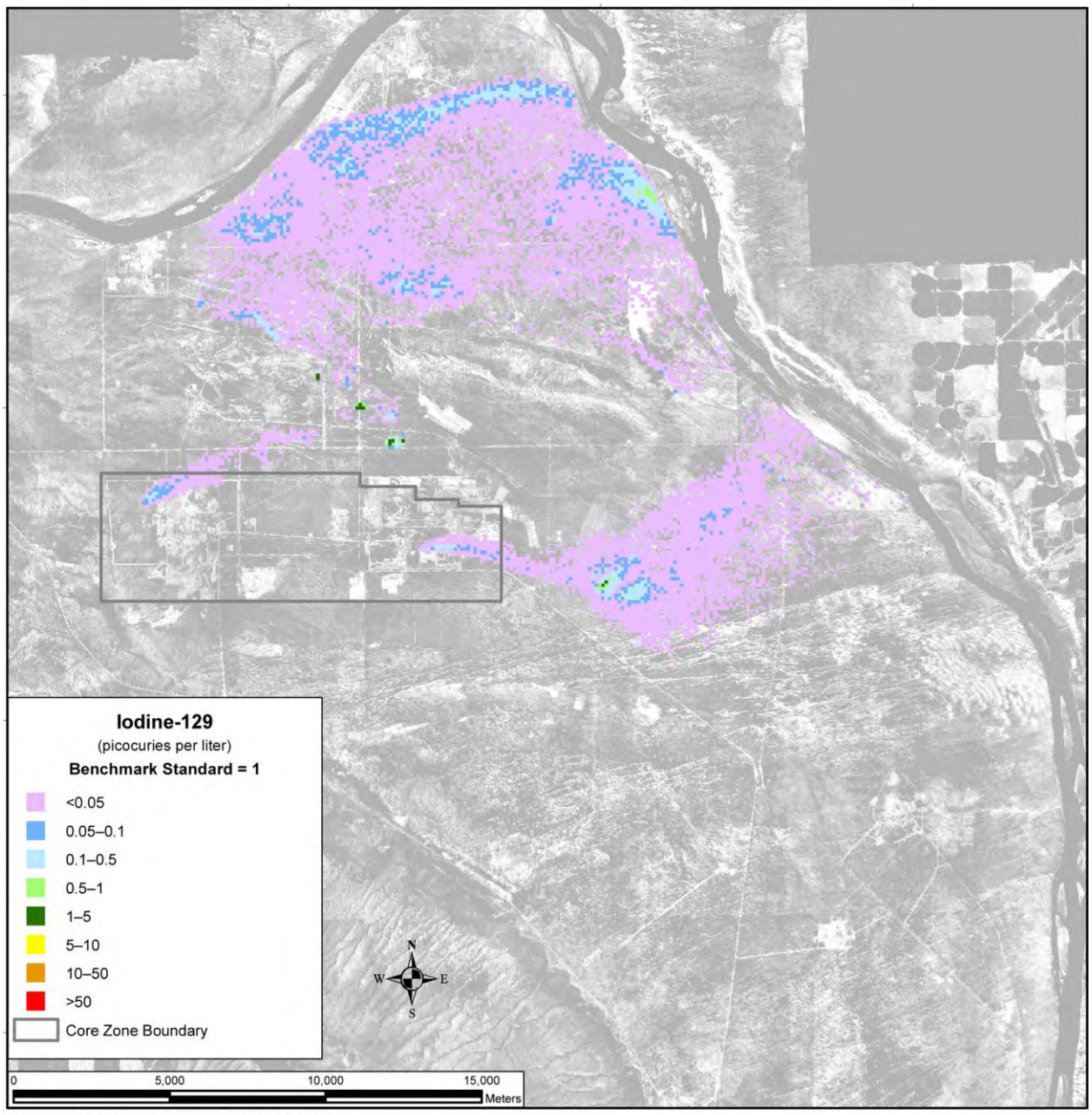
This section presents the impacts of Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

Figure 5–1003 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 3890, when there is a concentrated plume, with peak concentrations 10 to 50 times greater than the benchmark, that stretches north from IDF-West and the RPPDF through Gable Gap. By CY 7140 (see Figure 5–1004), the plume from the RPPDF is reduced, but a new plume is beginning to form, traveling east from IDF-East. The peak concentrations in the second plume are greater than the benchmark. By CY 11,885, the plume continues to spread toward the river and the concentrations continue to increase (see Figure 5–1005). Technetium-99 (see Figures 5–1006 through 5–1008), chromium (see Figures 5–1009 through 5–1011), and nitrate (see Figures 5–1012 through 5–1014) show similar spatial distributions at selected times, but the concentrations remain lower, similar to the later plumes mentioned above. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., they move at the pore-water velocity).



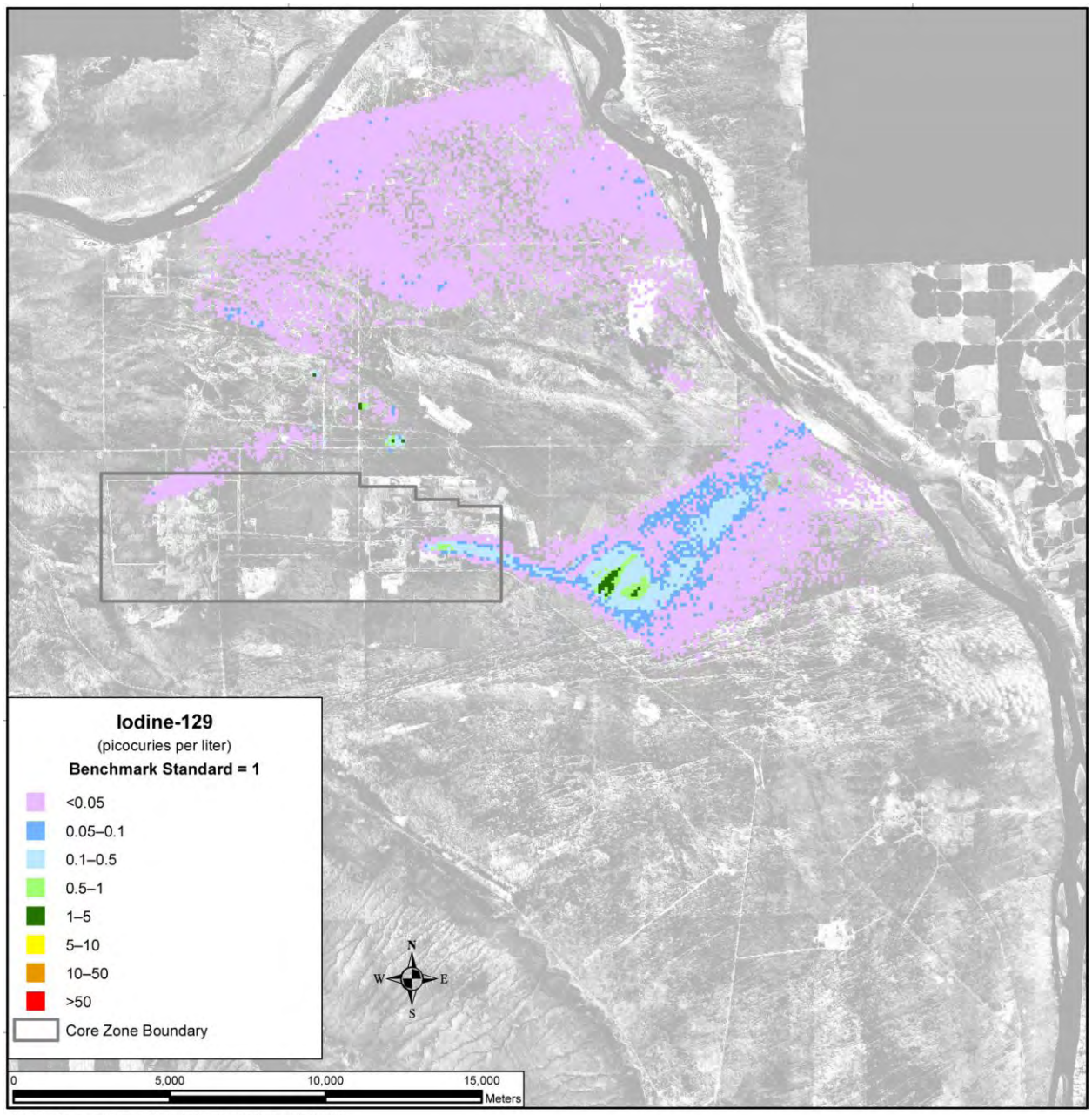
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1003. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



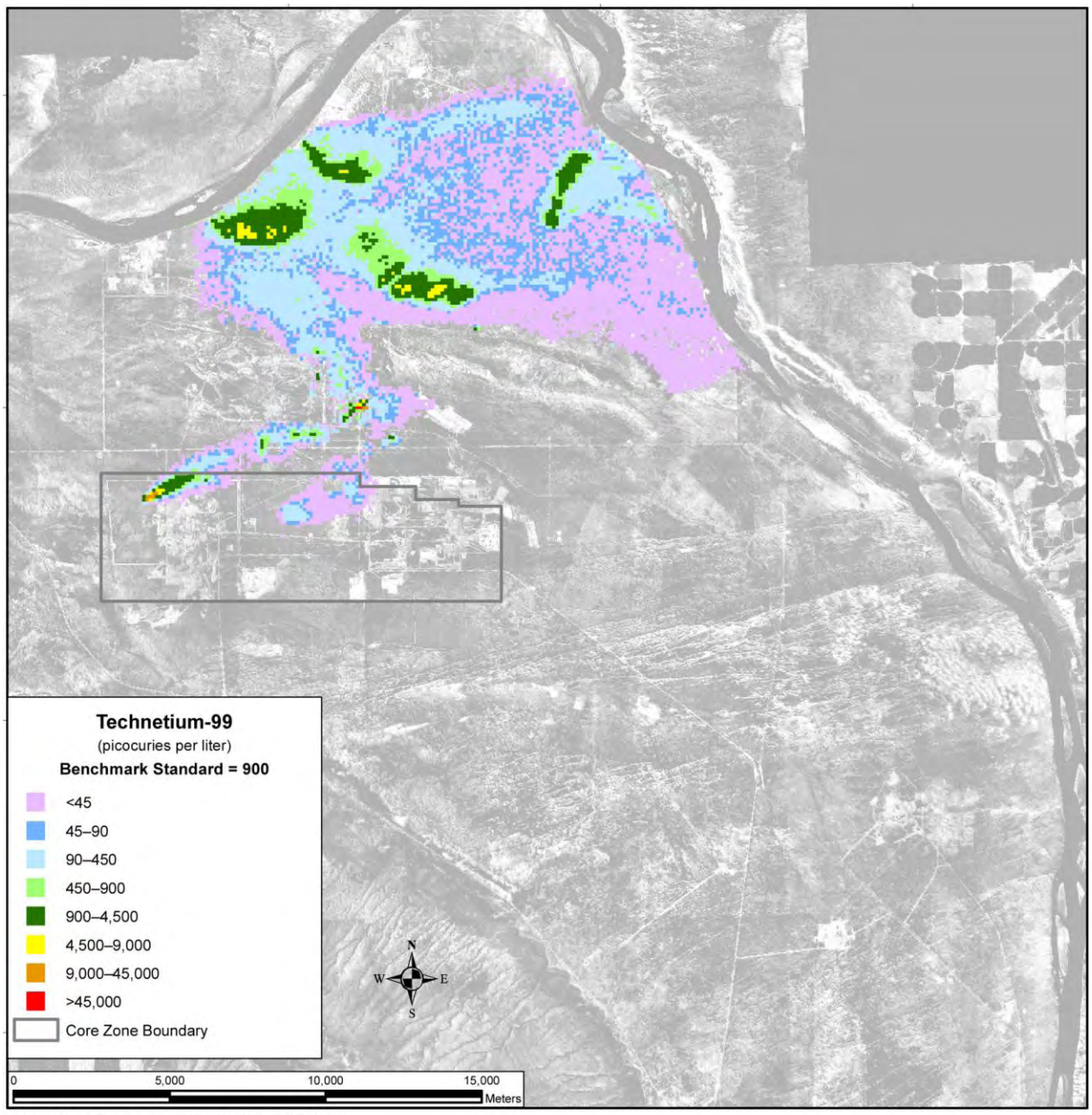
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1004. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



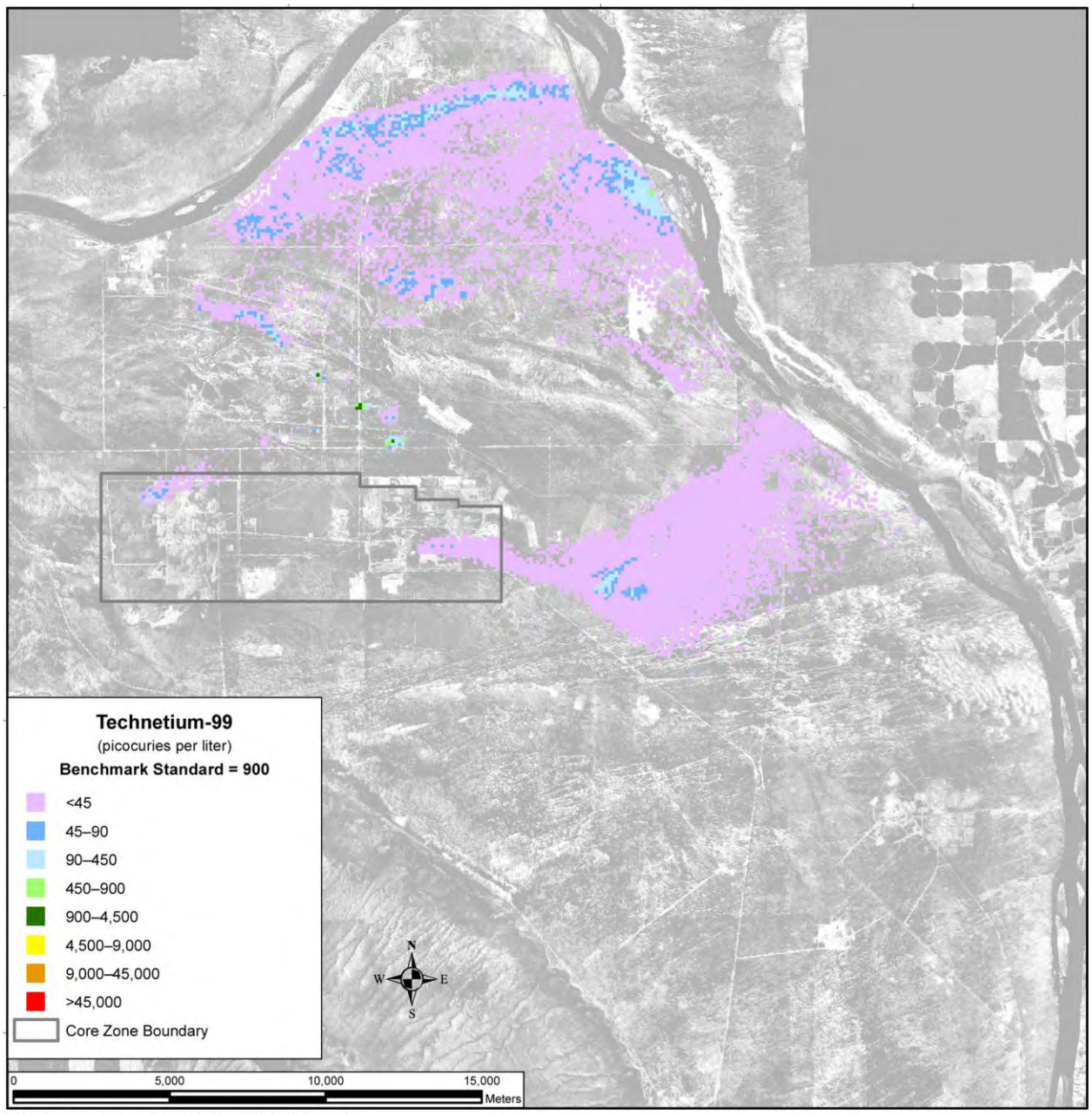
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1005. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



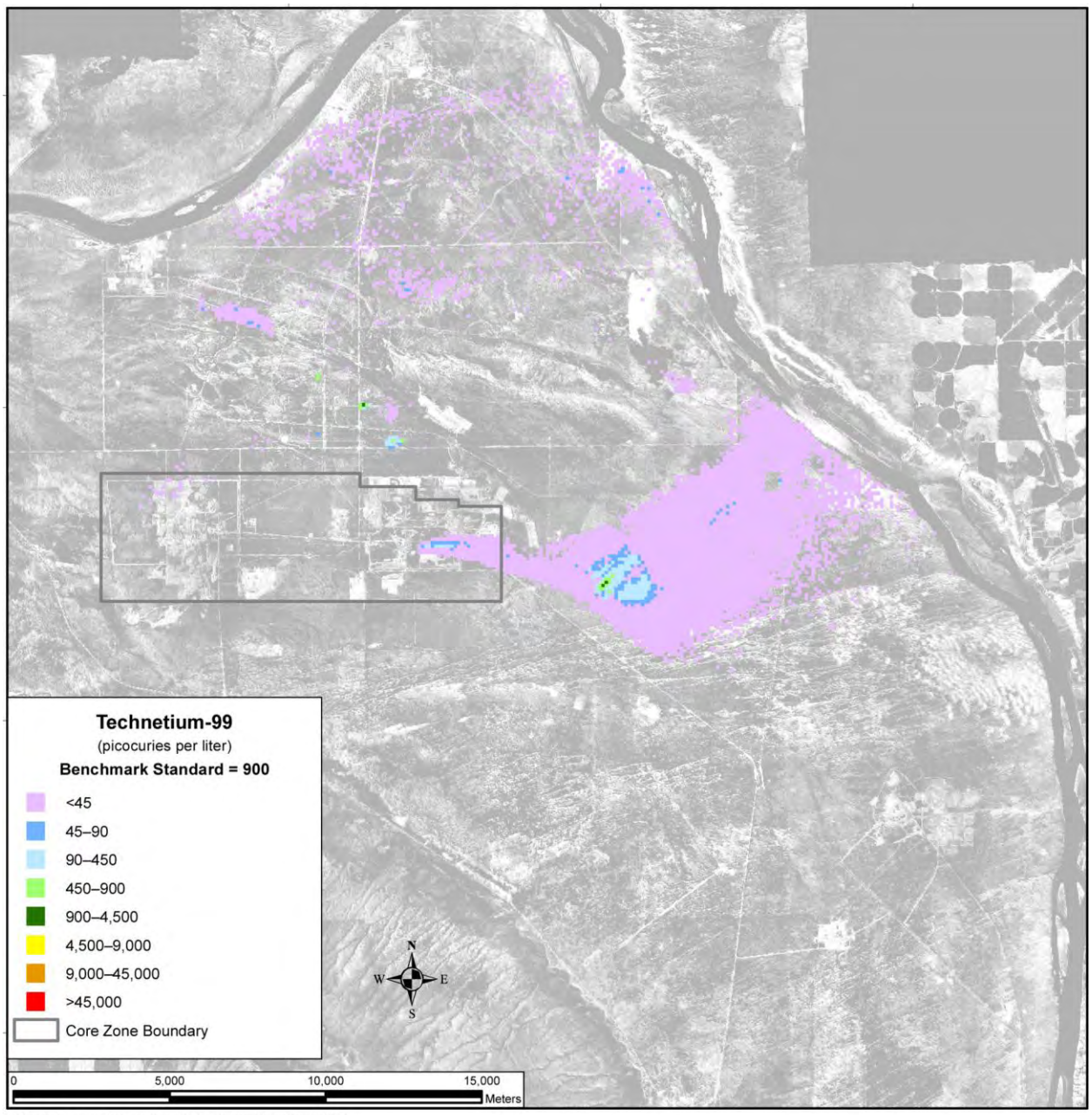
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1006. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



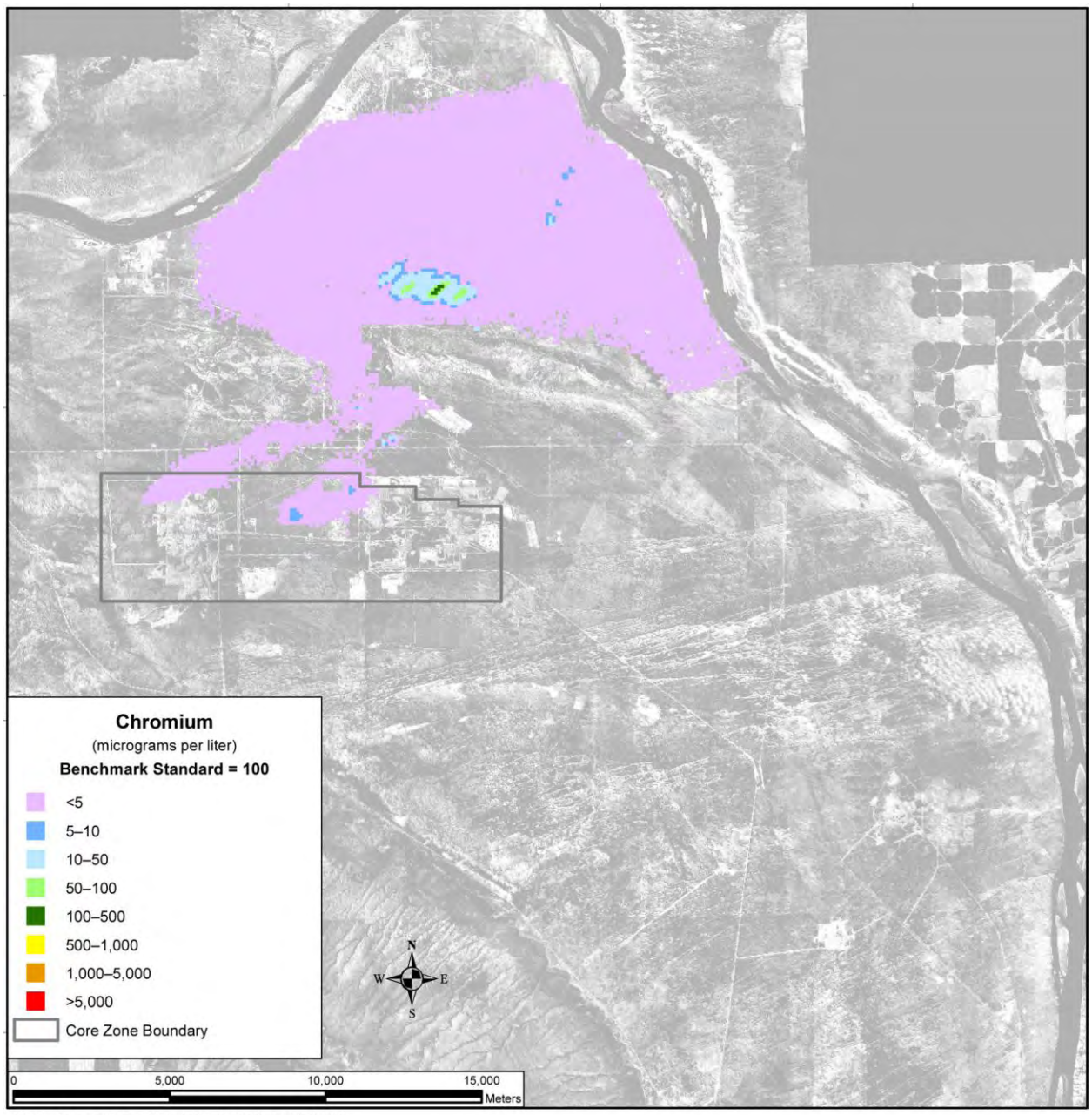
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1007. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



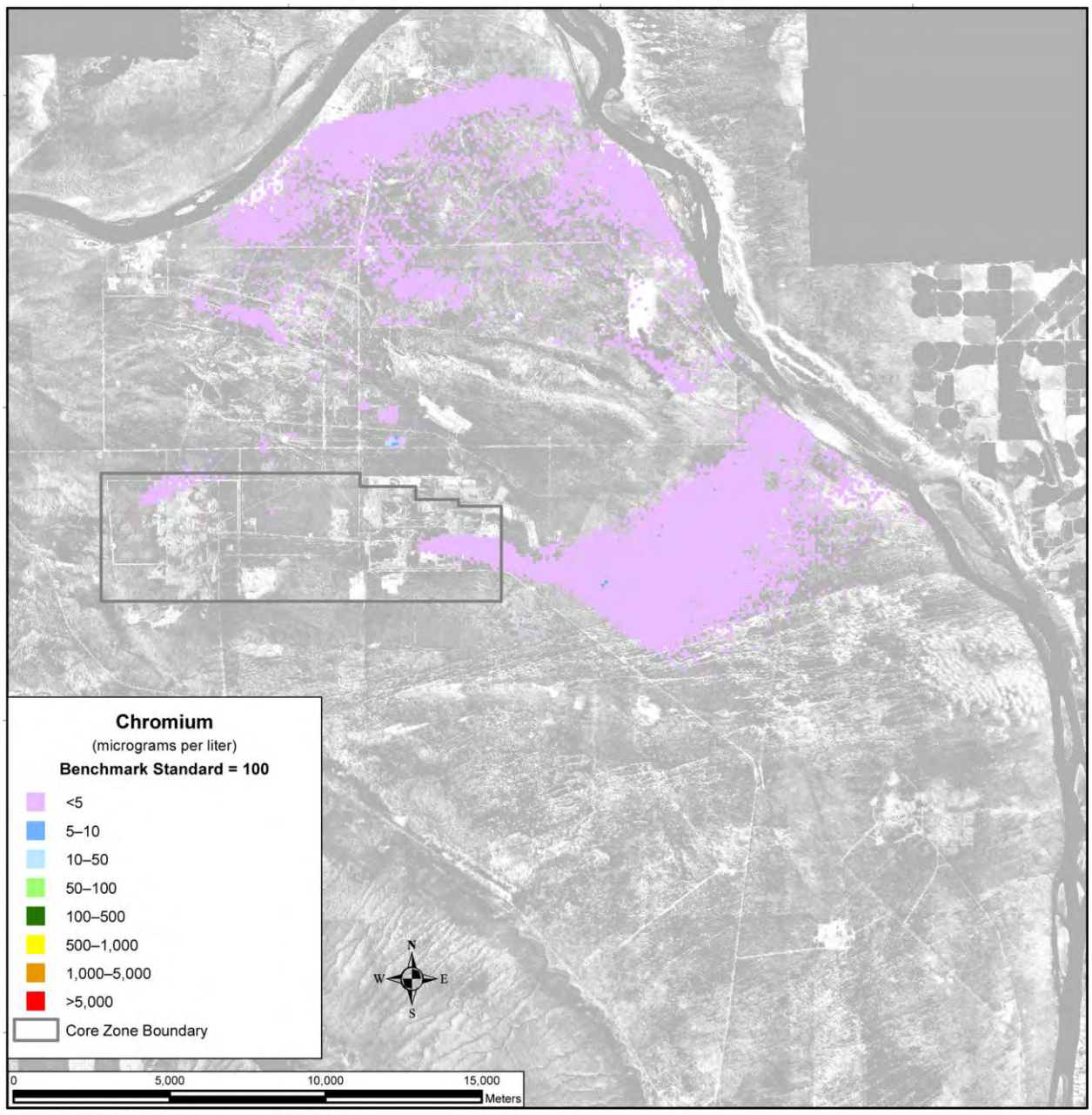
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1008. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



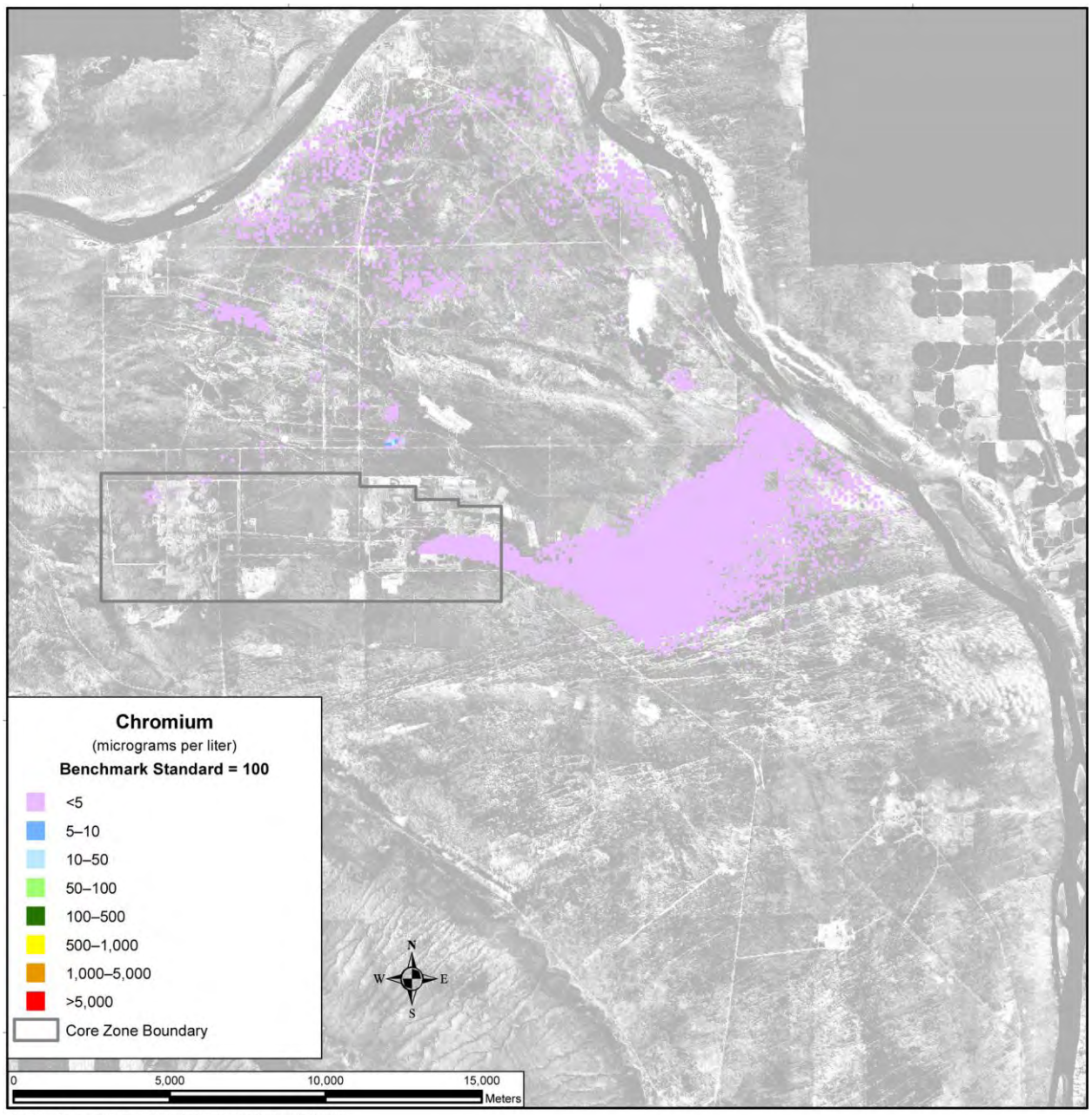
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1009. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



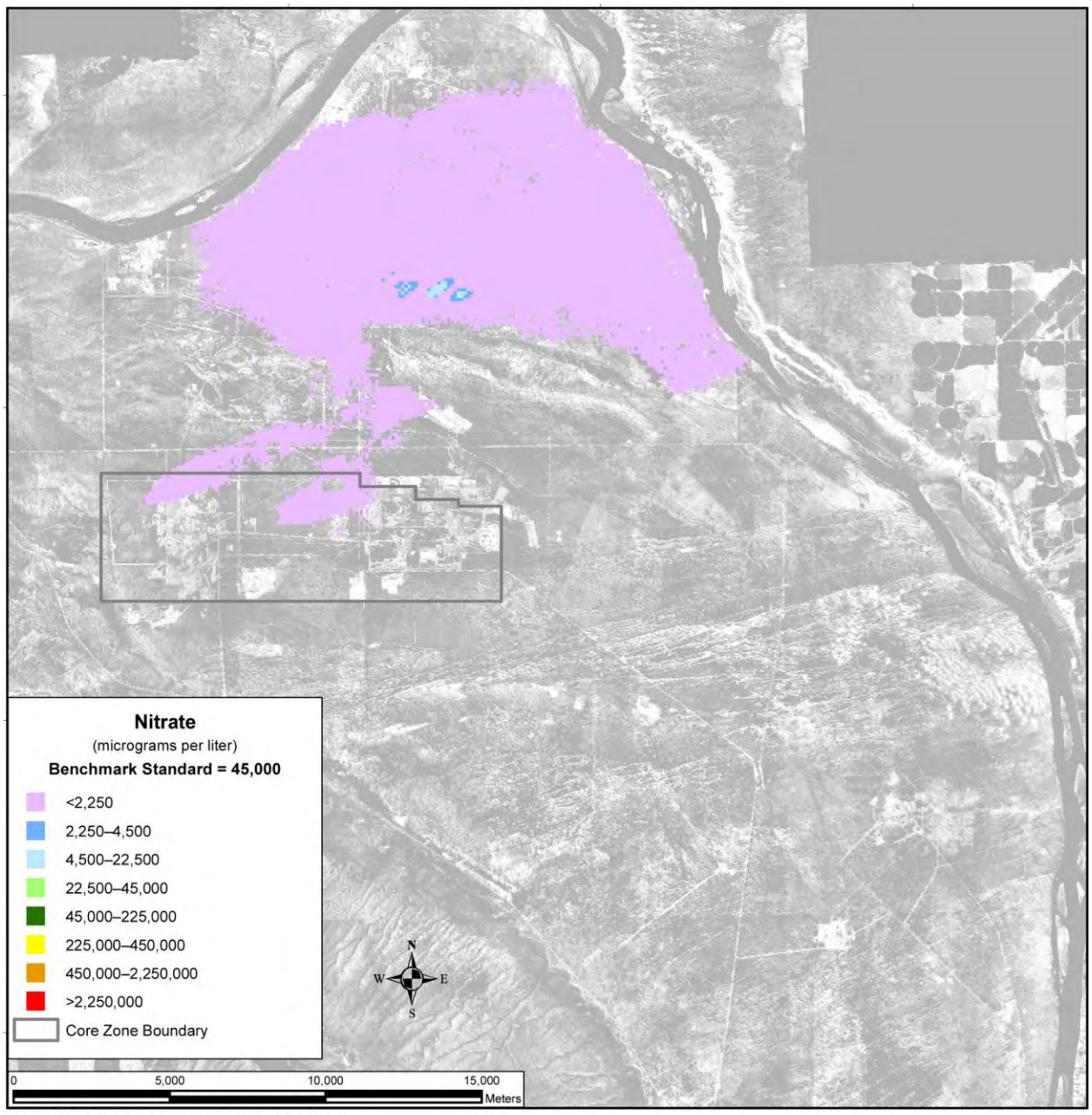
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1010. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



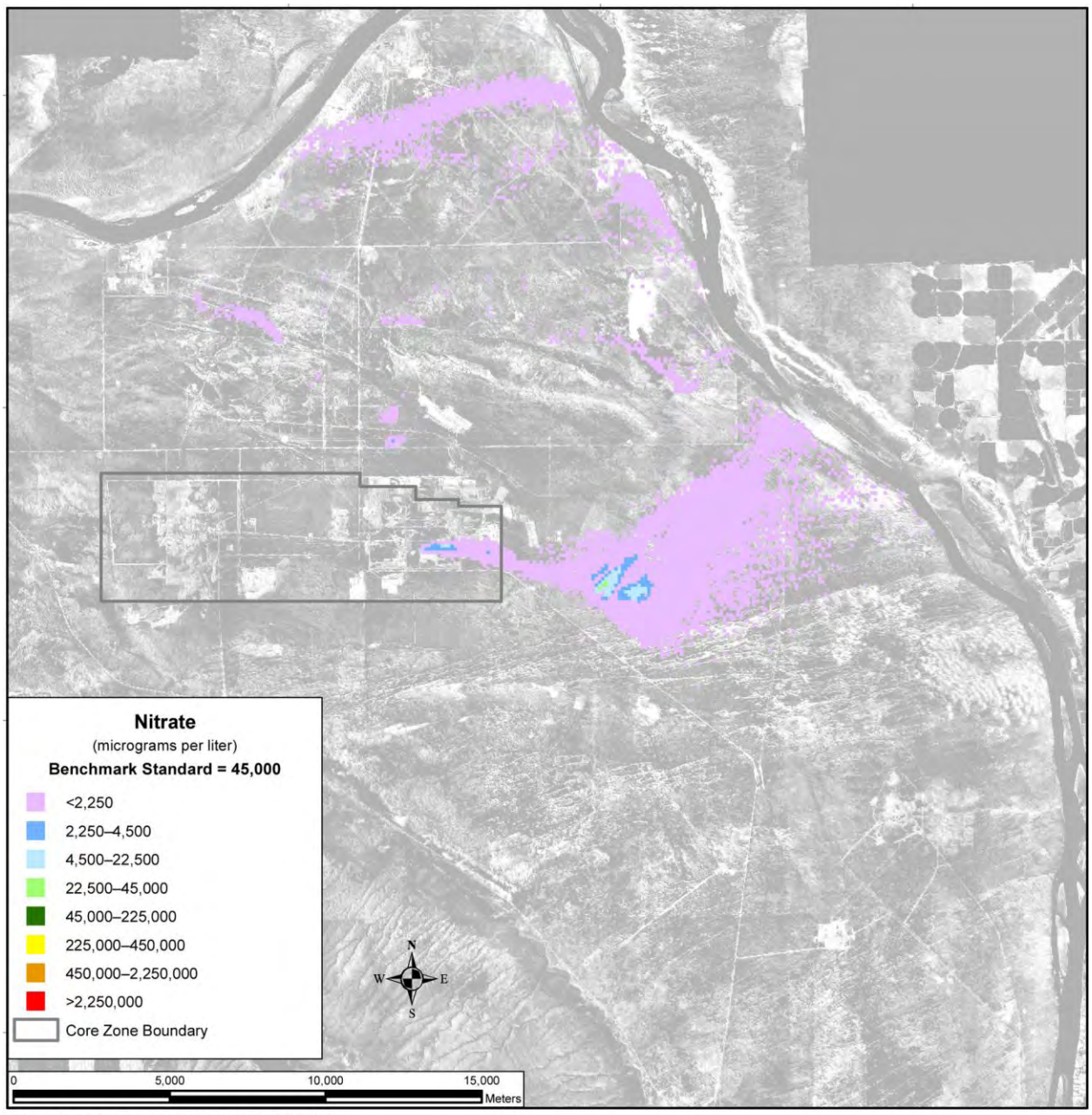
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1011. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



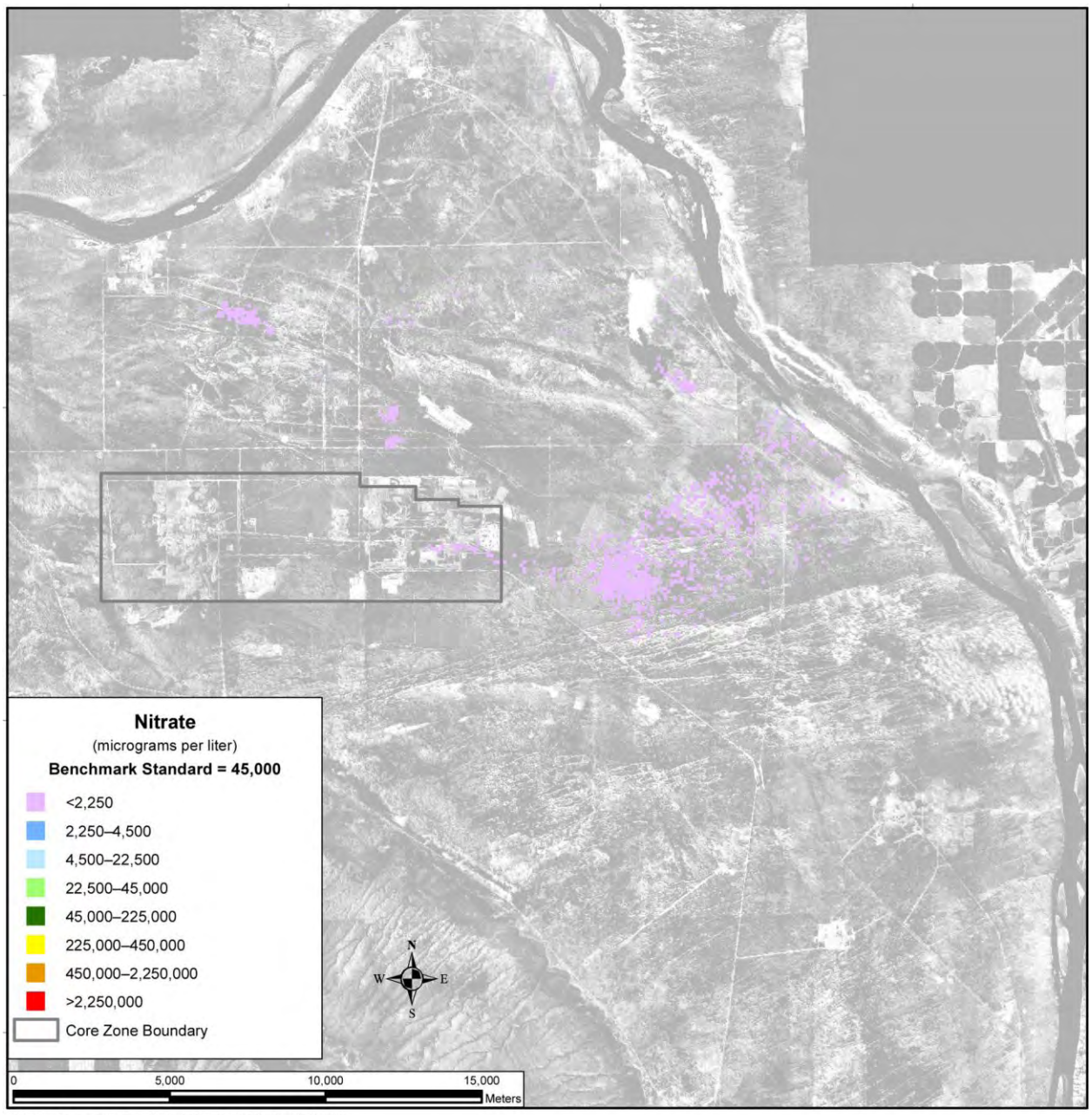
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1012. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



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

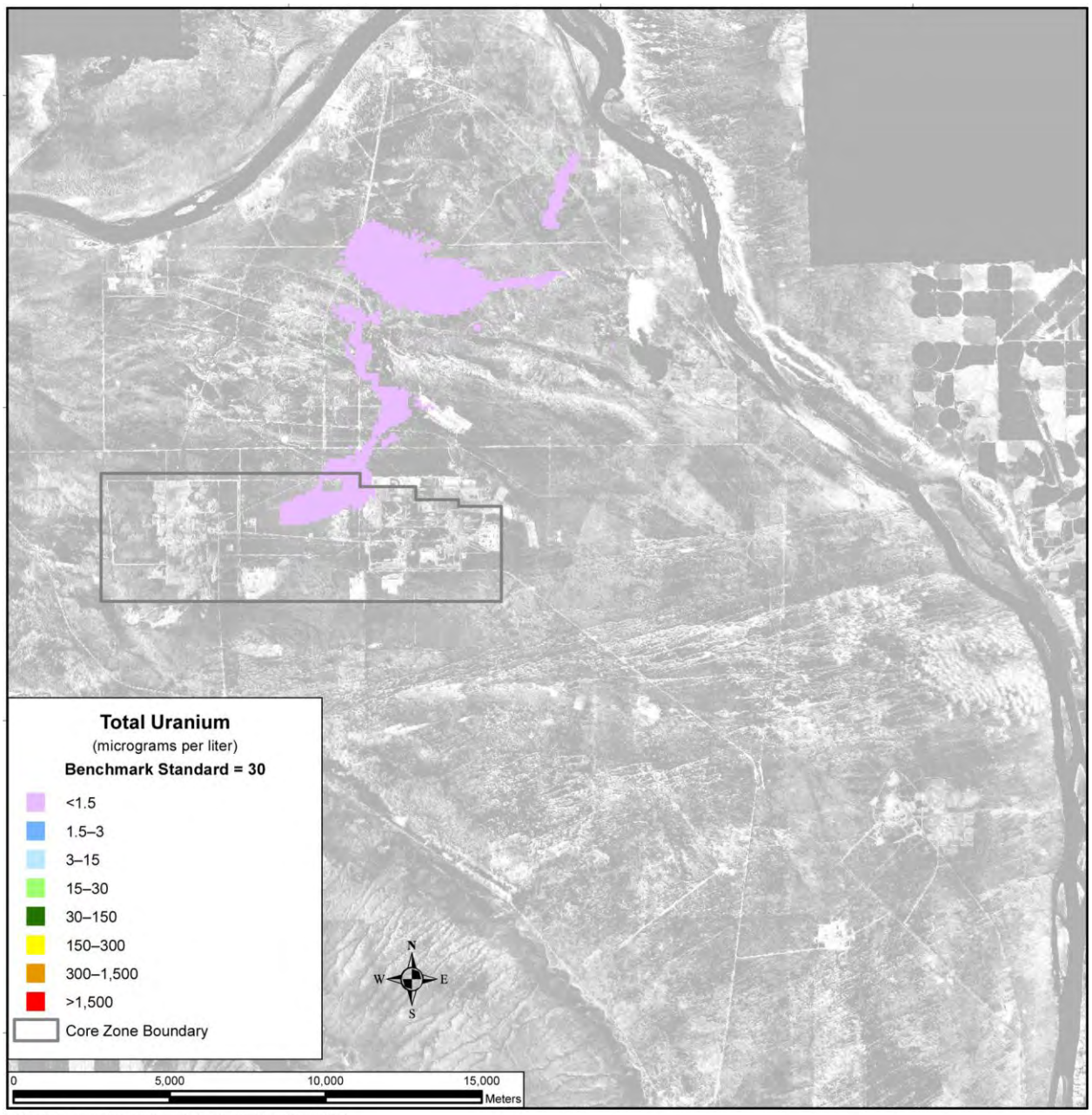
Figure 5–1013. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



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

Figure 5–1014. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

Total uranium shows a different spatial distribution over time. This COPC is not as mobile as those discussed above, moving about seven times more slowly than the pore-water velocity. As a result, travel times through the vadose zone are longer, release to the aquifer is delayed, and travel times through the aquifer to the Columbia River are longer. Figure 5–1015 shows the distribution of total uranium in CY 11,885. There is a low-concentration plume that stretches north from the RPPDF through Gable Gap. Concentrations in all areas of the plume remain below one-twentieth of the benchmark.



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

Figure 5–1015. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Spatial Distribution of Groundwater Total Uranium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, in general, the inventories remaining in IDF-East and IDF-West, which are available for release to the environment at the start of the post-disposal period, are predominant contributors. The inventory available for release from the RPPDF during the post-disposal period is a secondary contributor.

For the conservative tracers, only concentrations of technetium-99 and iodine-129 exceed their benchmarks at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. Both constituents exceed their benchmark standards by over one order of magnitude at the IDF-West barrier

and by less than one order of magnitude at the Core Zone Boundary and Columbia River nearshore around CY 3900.

For total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentration of this retarded species is less than one-twentieth of the benchmark by the end of the period of analysis. The intensity is highest and the area of the contamination plume largest near the end of the period of analysis.

5.3.1.3.2.3 Disposal Group 2, Subgroup 2-B, Option Case

Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, was designed to show the impacts of waste disposal at IDF-East and the RPPDF.

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, was designed to accommodate the disposal of wastes generated under Tank Closure Alternative 6B, Option Case, and FFTF Decommissioning Alternatives 2 or 3, as well as onsite and offsite waste.

For the long-term groundwater impacts analysis, two major periods have been identified for Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and continue through CY 2100 for IDF-East and the RPPDF and through CY 2050 for IDF-West, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2101 and continue through the 10,000-year period of analysis until CY 11,940. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case (i.e., Tank Closure Alternative 6B, Option Case; FFTF Decommissioning Alternative 2 or 3; and onsite and offsite waste), is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, and nitrate

The COPC drivers for Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, fluoride, chromium, and nitrate) are all mobile (i.e., they move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Subtotals are plotted in Figures 5–1016 through 5–1033, representing releases from the three disposal facilities: PPF glass, ETF-generated secondary waste, retired melters, and tank closure secondary waste released from IDF-East; FFTF Decommissioning Alternative 3 waste, waste management secondary and onsite waste, and offsite waste released from IDF-West; and waste released from the RPPDF. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over more than 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–1016 shows the release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–1017, the chemical hazard drivers. For technetium-99, chromium, and nitrate in grouted waste forms, the release to the vadose zone is controlled by the inventory (i.e., all of the inventory is released during the post-disposal period). For the radioactive COPCs (technetium-99 and iodine-129), the releases range over five orders of magnitude, depending on the source. ETF-generated secondary waste and tank closure secondary waste account for most of the releases. The entire release of nitrate from IDF-East is associated with ETF-generated secondary waste. Chromium comes from ETF-generated secondary waste, tank closure secondary waste, PPF glass, and retired melters. Fluoride is not released from IDF-East.

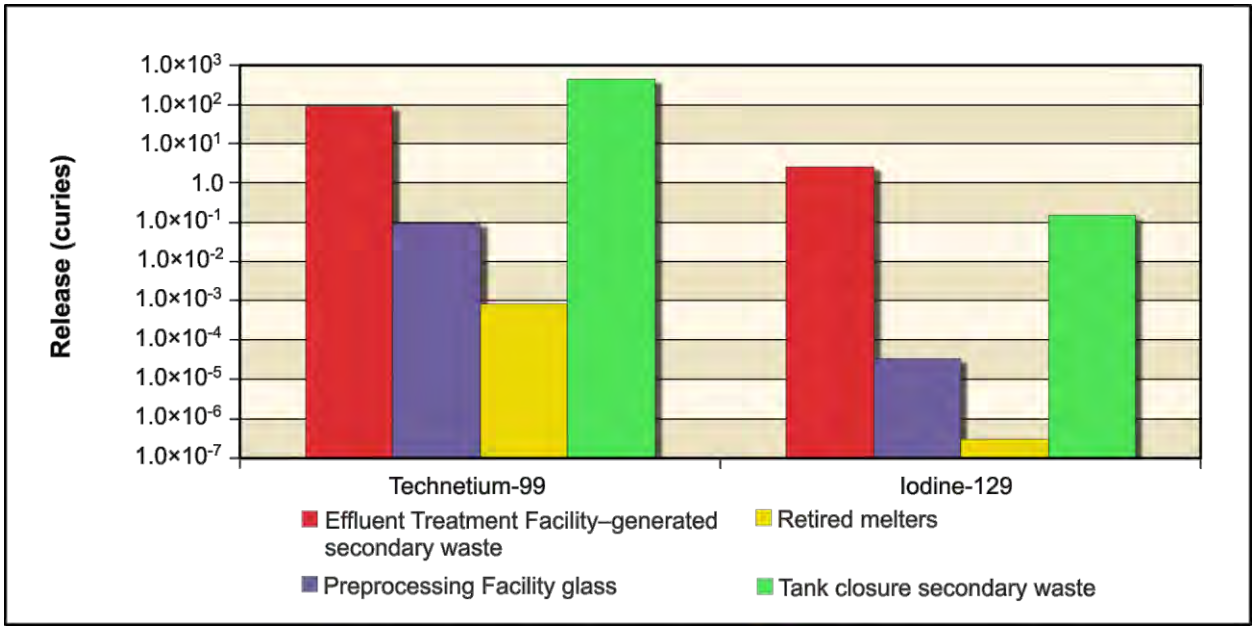


Figure 5–1016. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

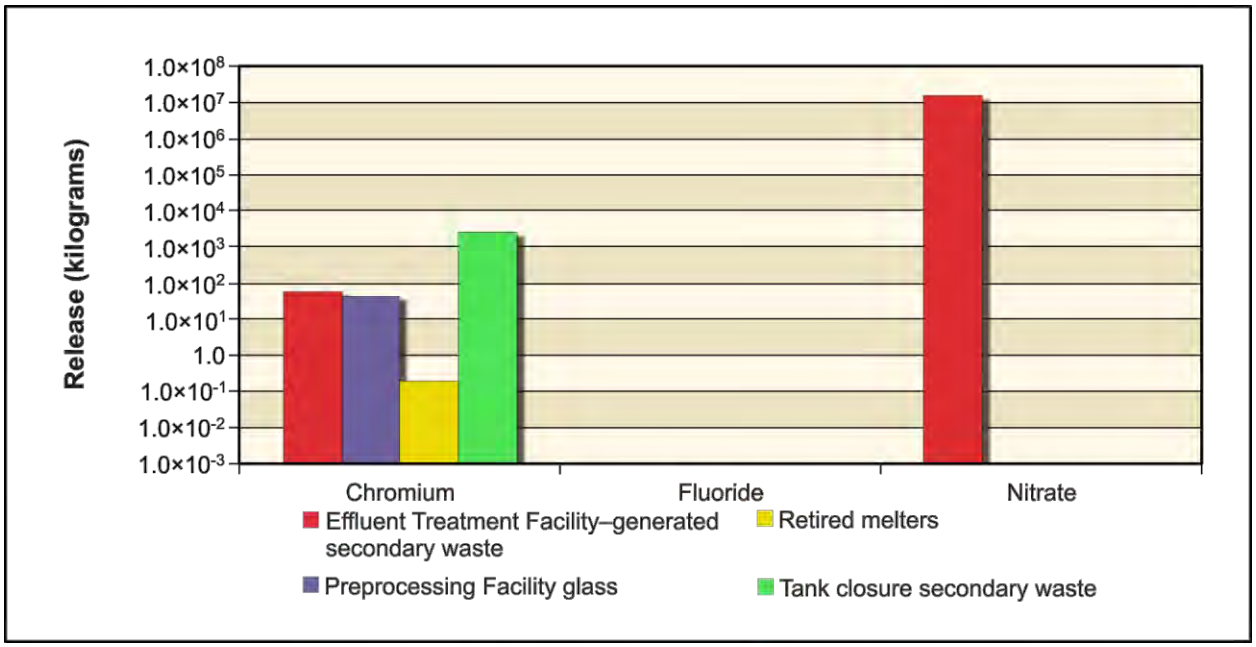


Figure 5–1017. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–1018 shows the release from IDF-East to groundwater of the radiological risk drivers and Figure 5–1019, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For the conservative tracers iodine-129 and technetium-99, the amount released to groundwater from the vadose zone is 43 and 60 percent, respectively. For chromium and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone.

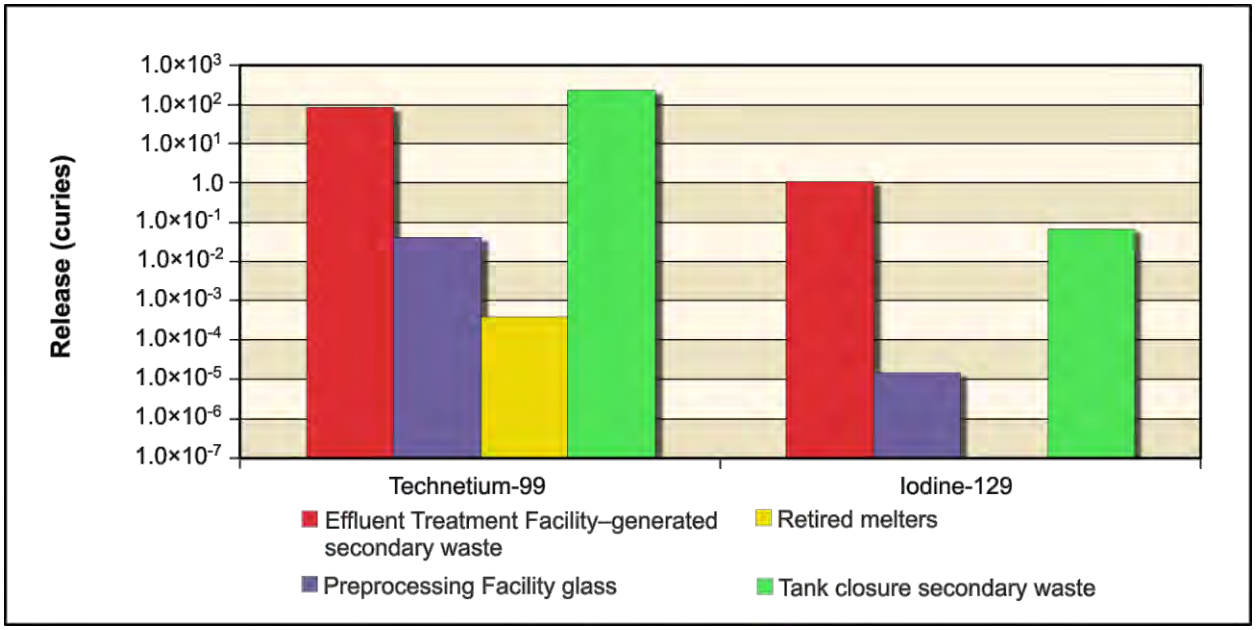


Figure 5–1018. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

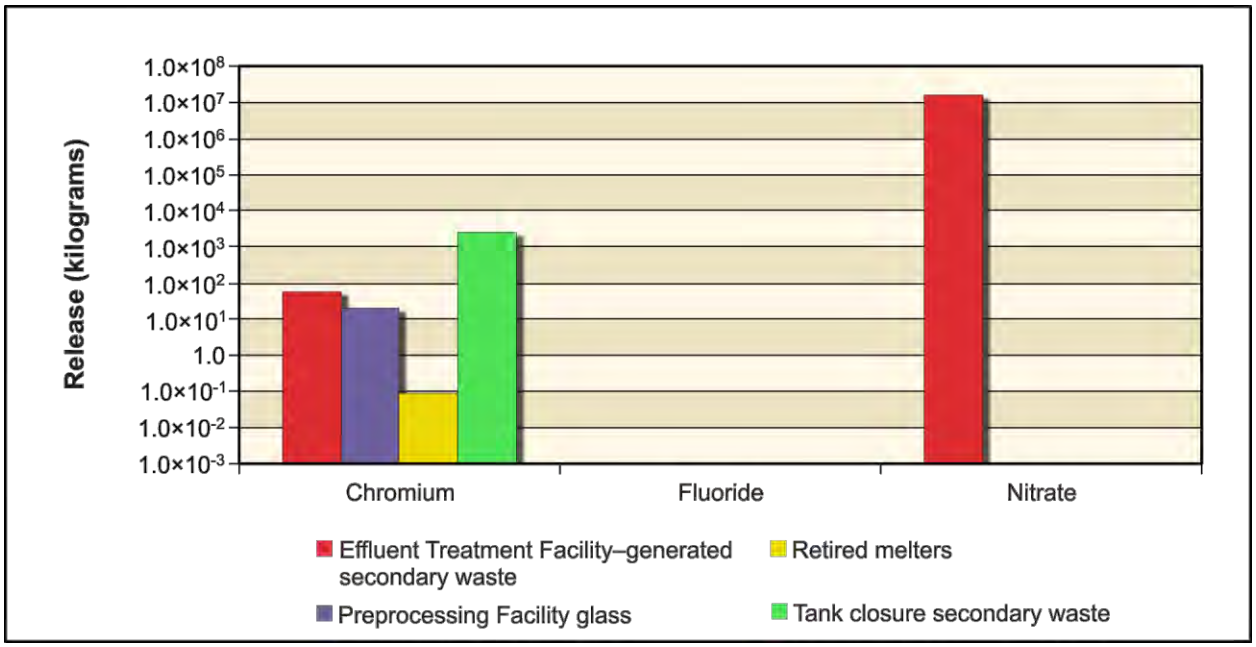


Figure 5–1019. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–1020 shows the release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–1021, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For the conservative tracers (iodine-129, technetium-99, chromium, and nitrate), the amount released to the Columbia River is essentially equal to the amount released to groundwater.

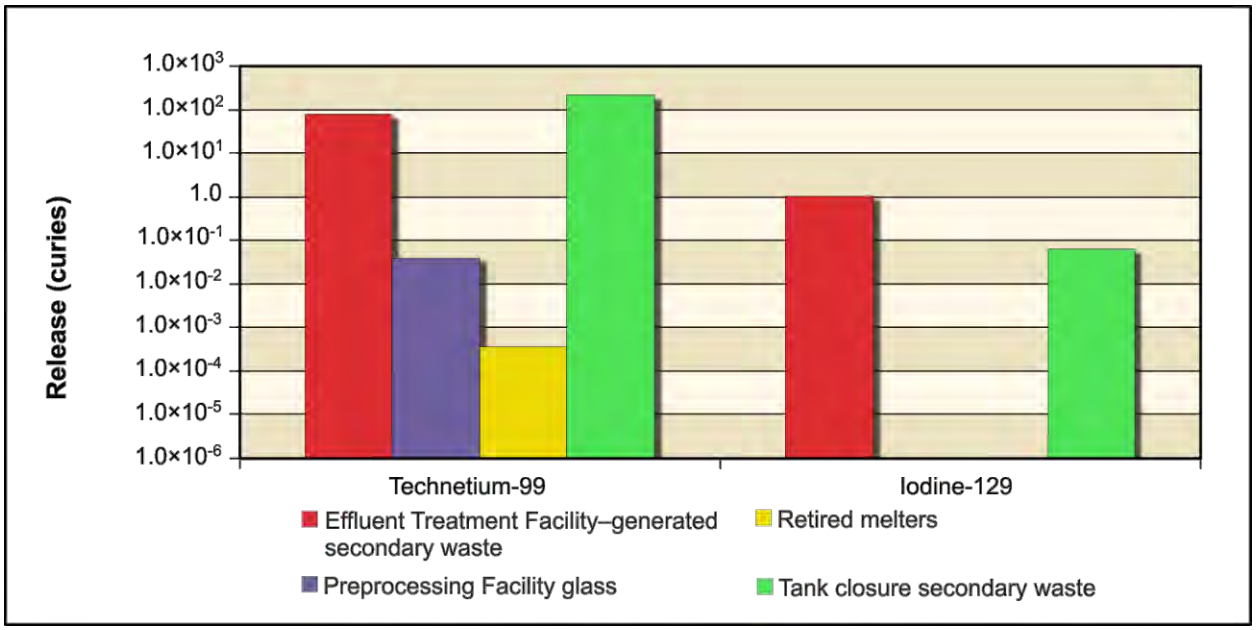


Figure 5–1020. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

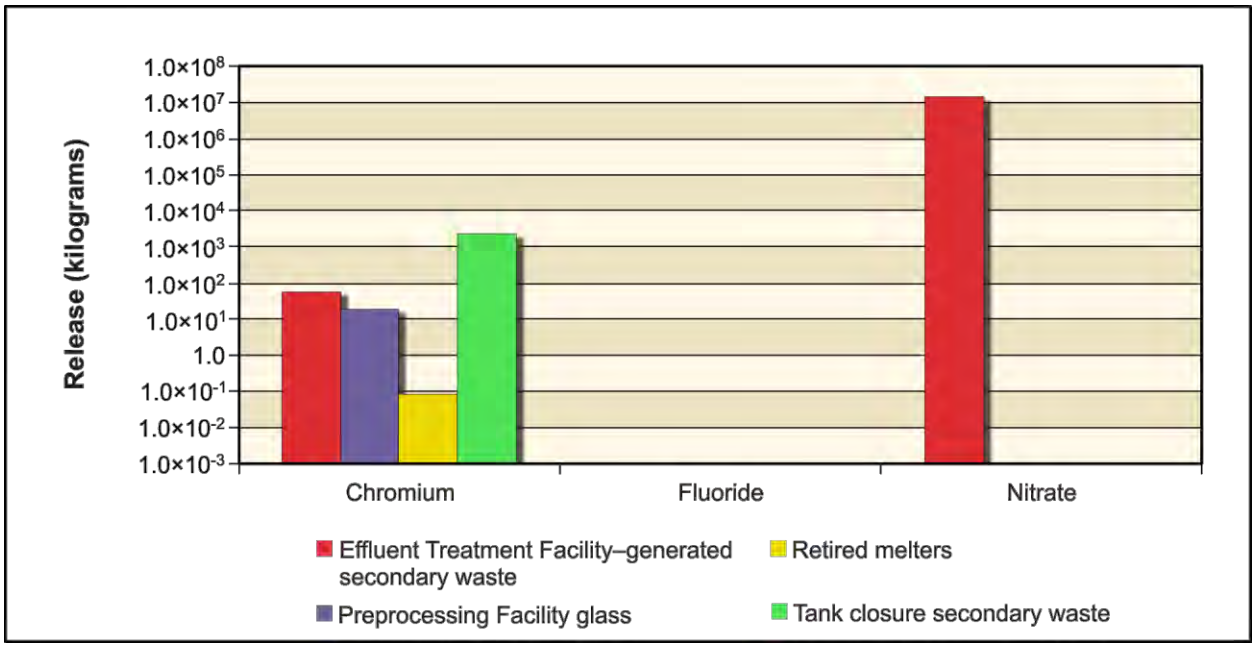


Figure 5–1021. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

Figure 5–1022 shows the release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–1023, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). For the radioactive COPCs (technetium-99 and iodine-129) in IDF-West, the releases range over five orders of magnitude, depending on the source. Over 99 percent of the radioactive waste is from offsite waste. The chemical COPCs (chromium and nitrate) in IDF-West and essentially all fluoride are released from waste management secondary and onsite waste. Of the chromium sources, less than 1 percent is from FFTF Decommissioning Alternative 3 waste, 69 percent is from waste management secondary and onsite waste, and 31 percent is from offsite waste.

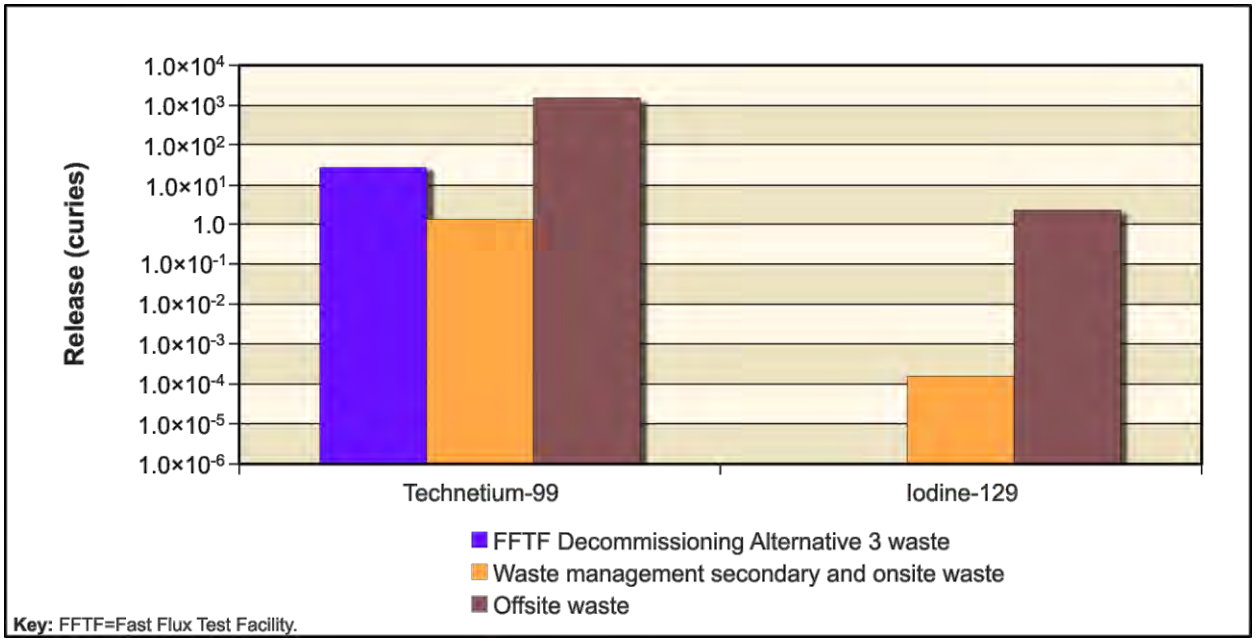


Figure 5–1022. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

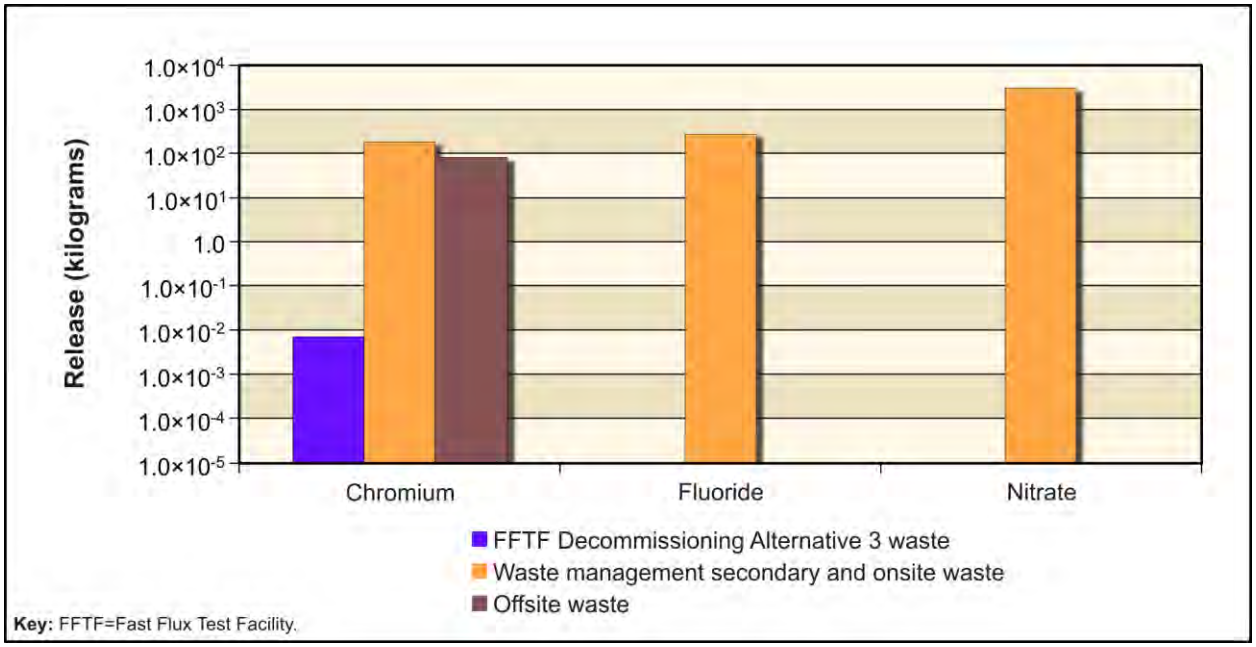


Figure 5–1023. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–1024 shows the release from IDF-West to groundwater of the radiological risk drivers and Figure 5–1025, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For the conservative tracers (iodine-129, technetium-99, chromium, fluoride, and nitrate), the amount released to groundwater is essentially equal to the amount released to the vadose zone.

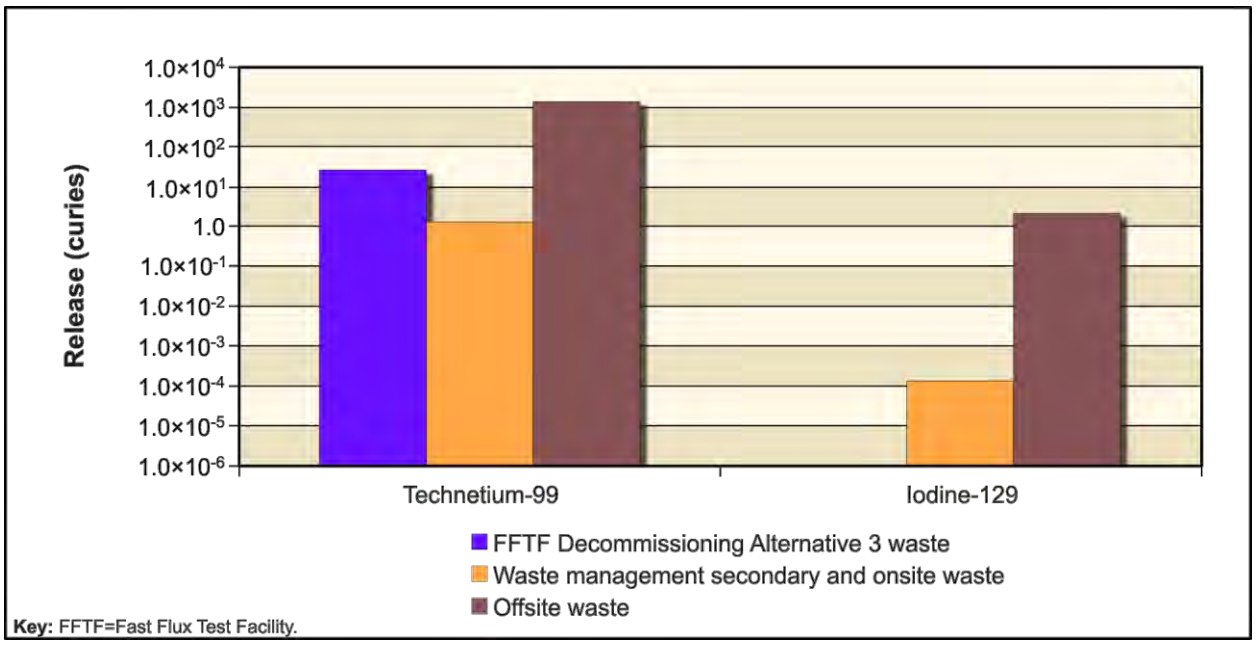


Figure 5–1024. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

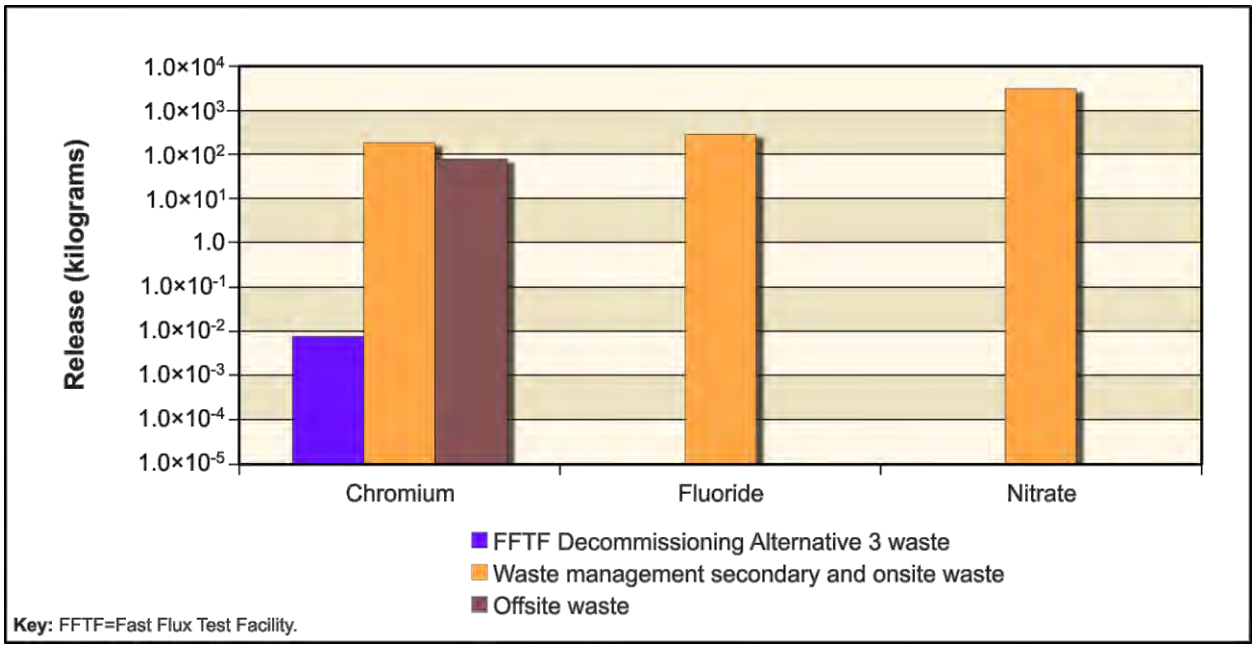


Figure 5–1025. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–1026 shows the release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–1027, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For the conservative tracers (iodine-129, technetium-99, chromium, and nitrate), the amount released to the Columbia River is approximately 97 to 100 percent of that released to the vadose zone.

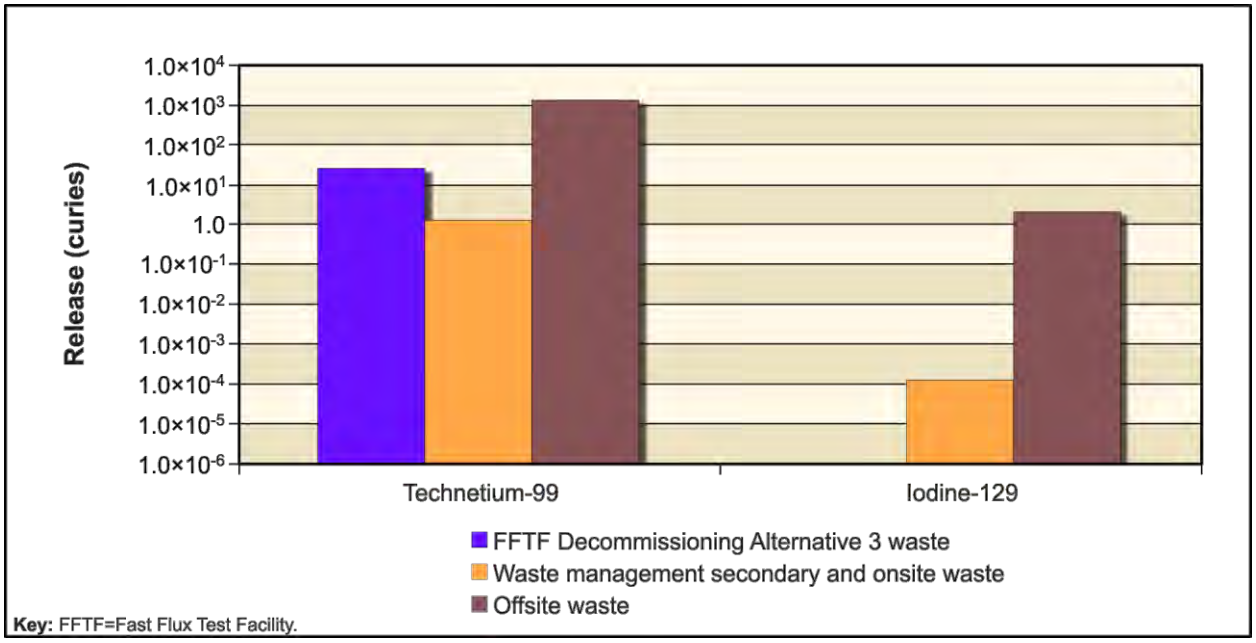


Figure 5–1026. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

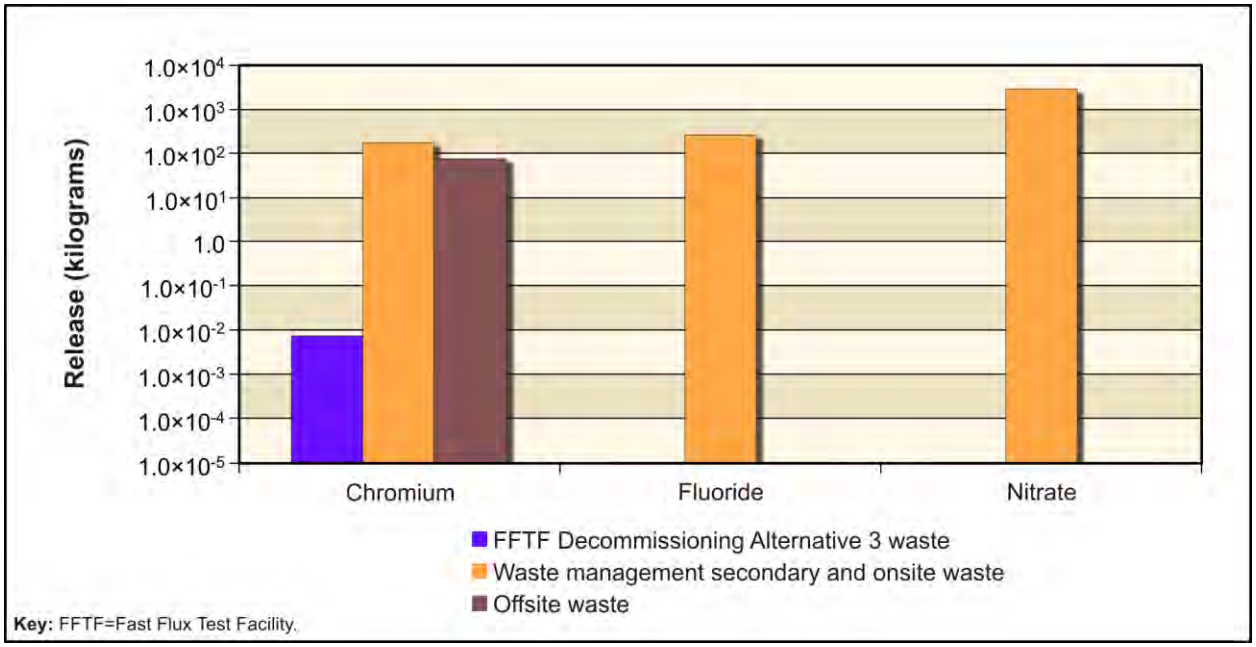


Figure 5–1027. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5–1028 shows the release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–1029, the chemical hazard drivers. The release of technetium-99 is more than two orders of magnitude greater than the release of iodine-129 from the RPPDF. Of the chemical hazard drivers, nitrate is the predominant COPC; its release is more than two orders of magnitude greater than that of chromium.

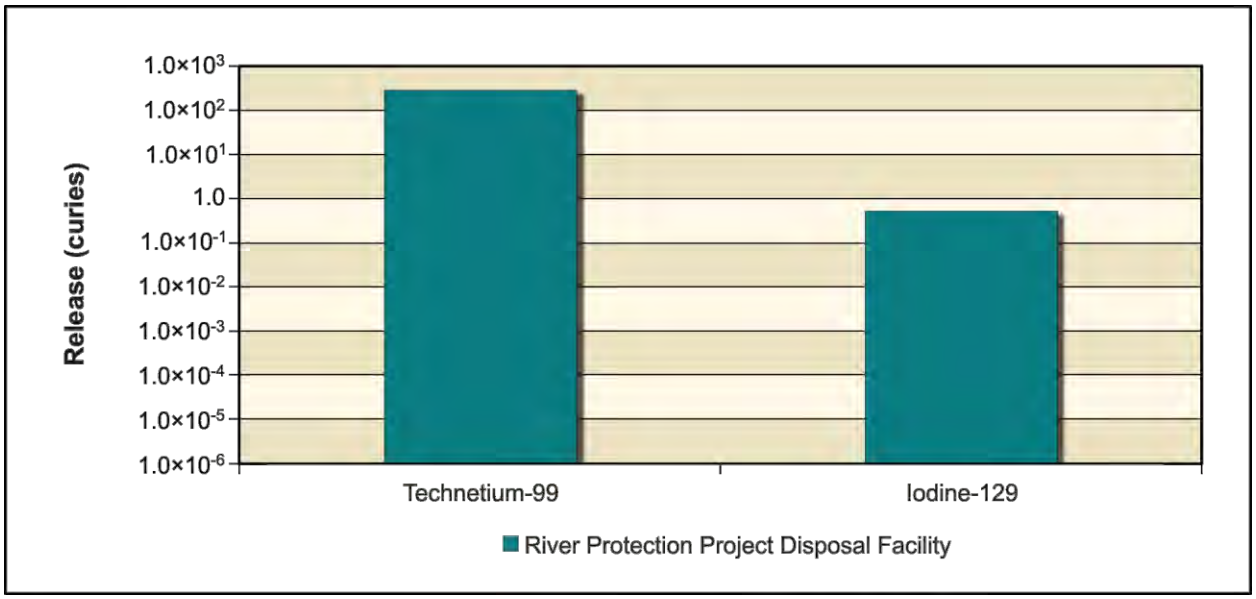


Figure 5–1028. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

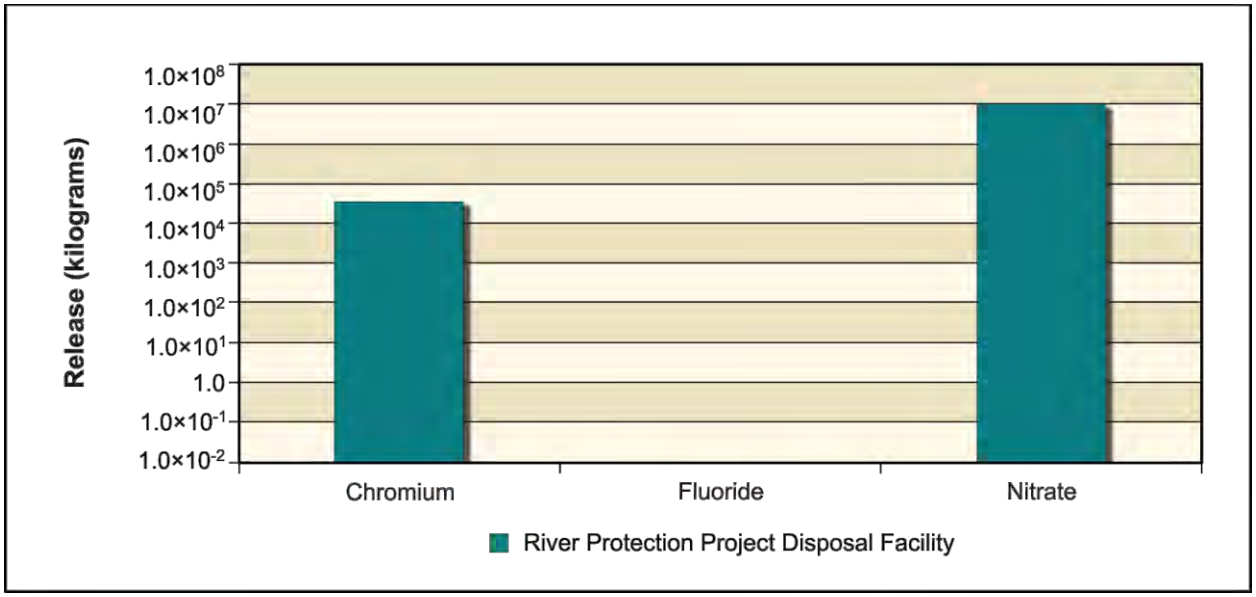


Figure 5–1029. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–1030 shows the release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–1031, the chemical hazard drivers. For the conservative tracers (iodine-129, technetium-99, chromium, and nitrate), the amount released to groundwater is essentially equal to the amount released to the vadose zone.

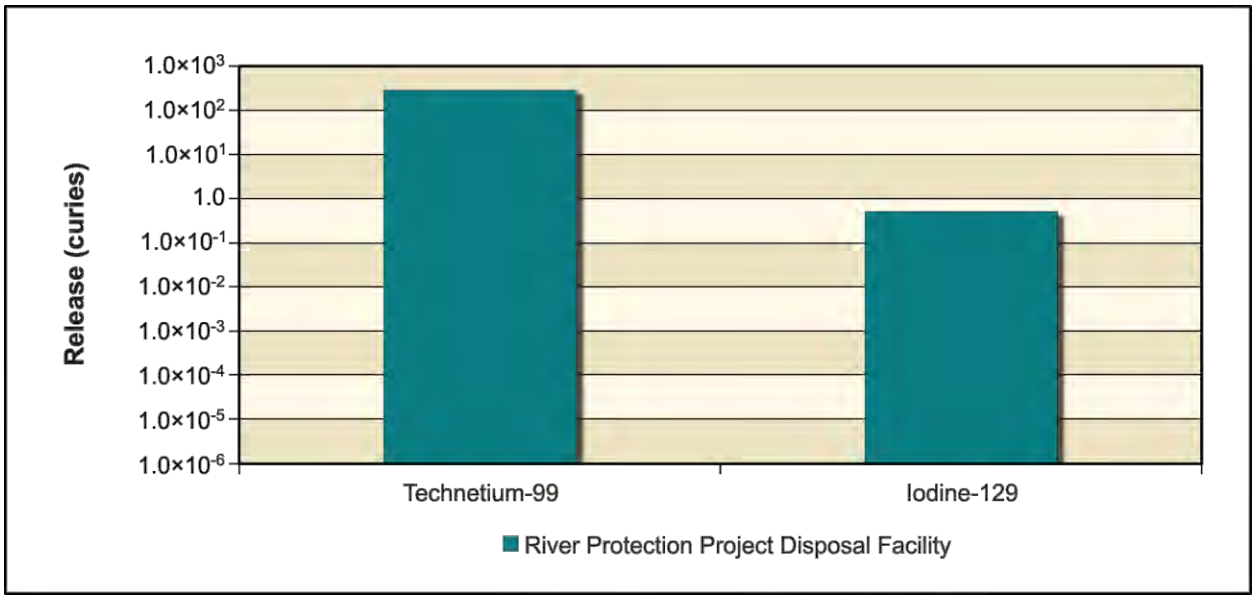


Figure 5–1030. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

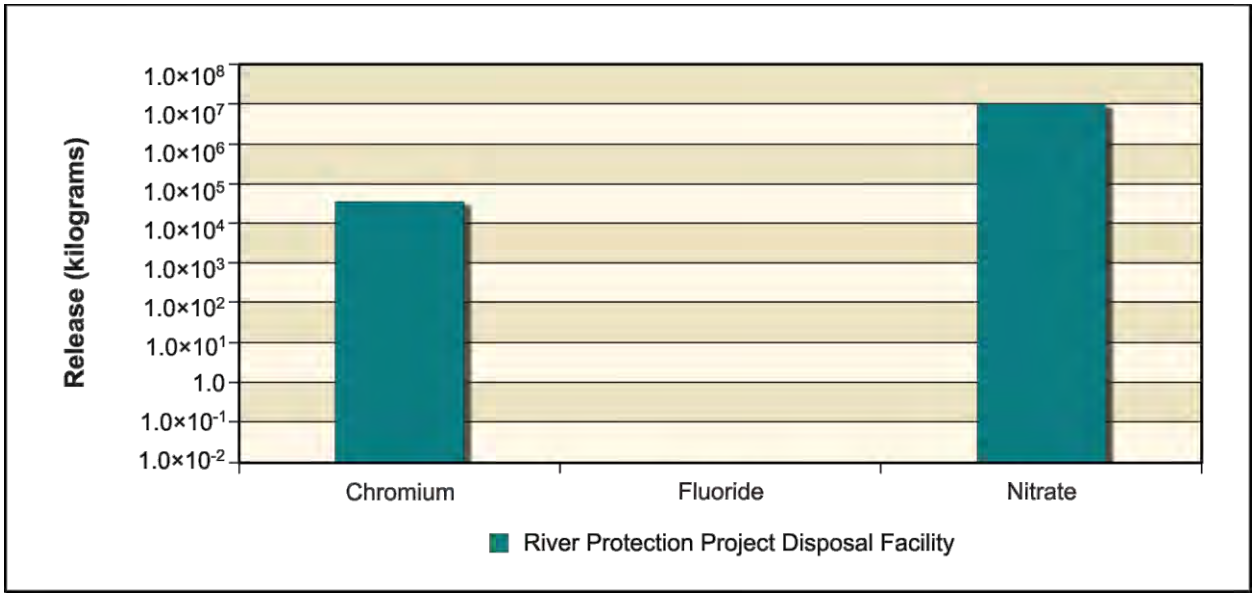


Figure 5–1031. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–1032 shows the release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–1033, the chemical hazard drivers. Essentially all of the inventory of radionuclides and chemicals released to groundwater reach the Columbia River.

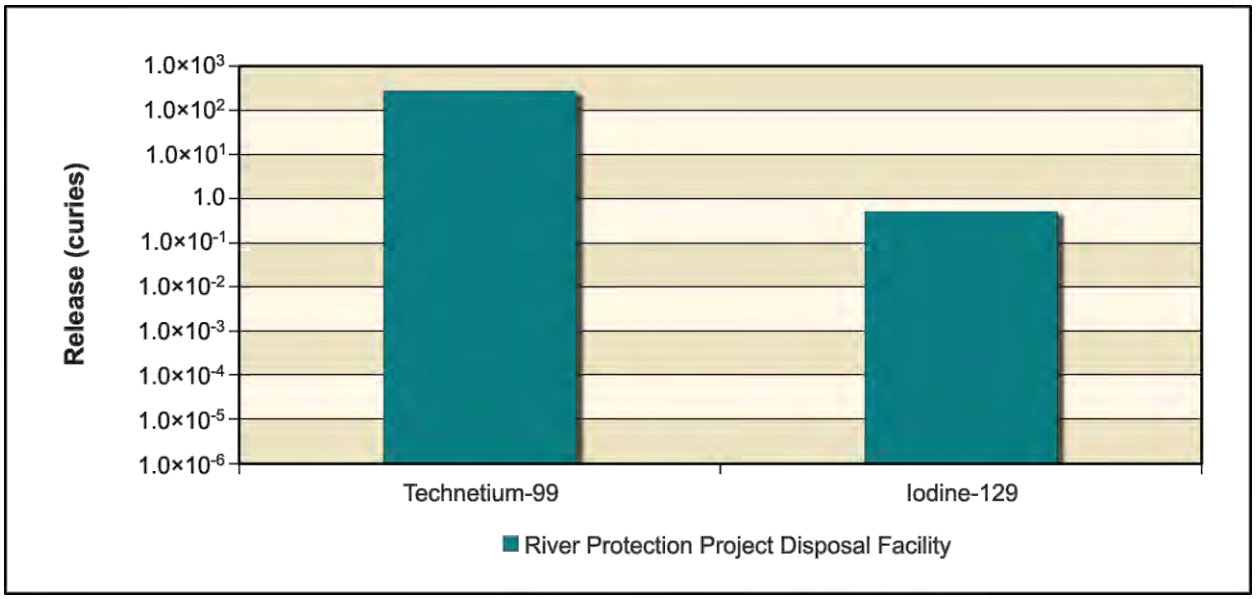


Figure 5–1032. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

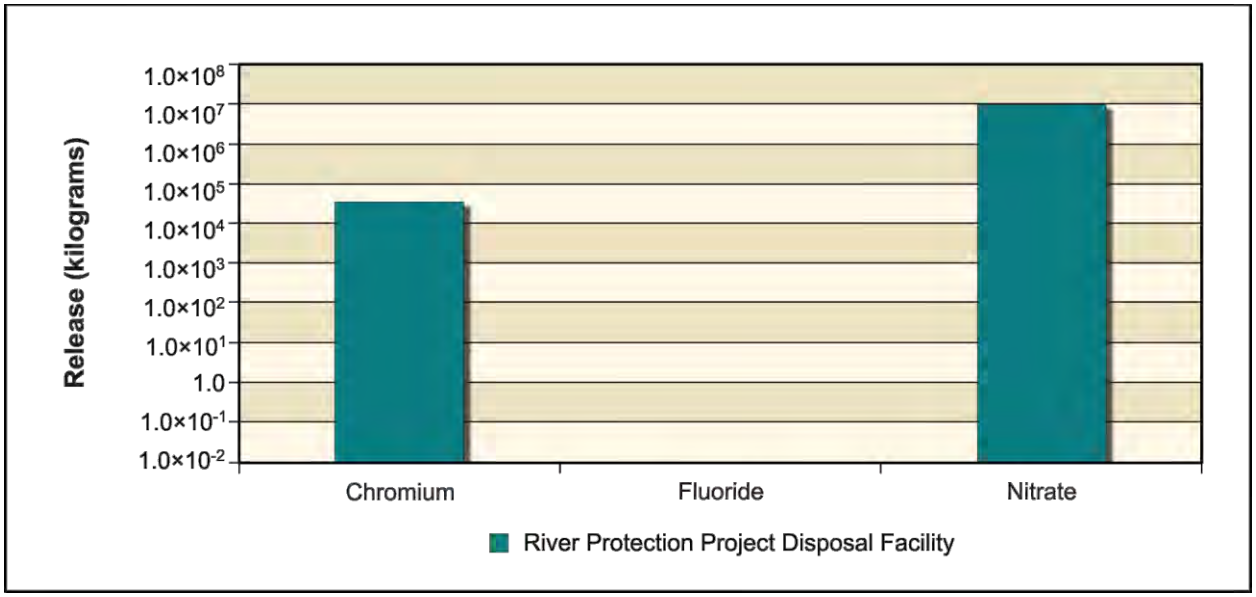


Figure 5–1033. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the impacts of Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over five orders of magnitude.

Figures 5–1034 through 5–1037 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate (the conservative tracers). Iodine-129 concentrations exceed the benchmark concentration at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. The greatest exceedance of the benchmark concentration is at the IDF-West barrier, where the benchmark is exceeded by over an order of magnitude from approximately CY 3200 until CY 4900. Iodine-129 concentrations never exceed the benchmark concentration at the IDF-East barrier or the RPPDF barrier. The iodine-129 benchmark concentration is exceeded by less than an order of magnitude at the Core Zone Boundary and Columbia River nearshore. Technetium-99 exhibits behavior similar to iodine-129, where concentrations at the IDF-West barrier exceed the benchmark by over one order of magnitude. The duration of the benchmark exceedance is approximately 1,500 years. In addition, the technetium-99 benchmark concentration is exceeded at the Columbia River nearshore from approximately CY 3500 to CY 5000. Concentrations at the Core Zone Boundary are exceeded from about CY 3500 to CY 4100. Chromium concentrations peak at less than one order of magnitude below the benchmark at the Core Zone Boundary and RPPDF barrier around CY 4000. Peak nitrate concentrations, less than an order of magnitude below the benchmark, are evident at the RPPDF barrier and IDF-East barrier around CY 3700 and CY 8000, respectively. Nitrate does not exceed benchmark concentrations during the period of analysis.

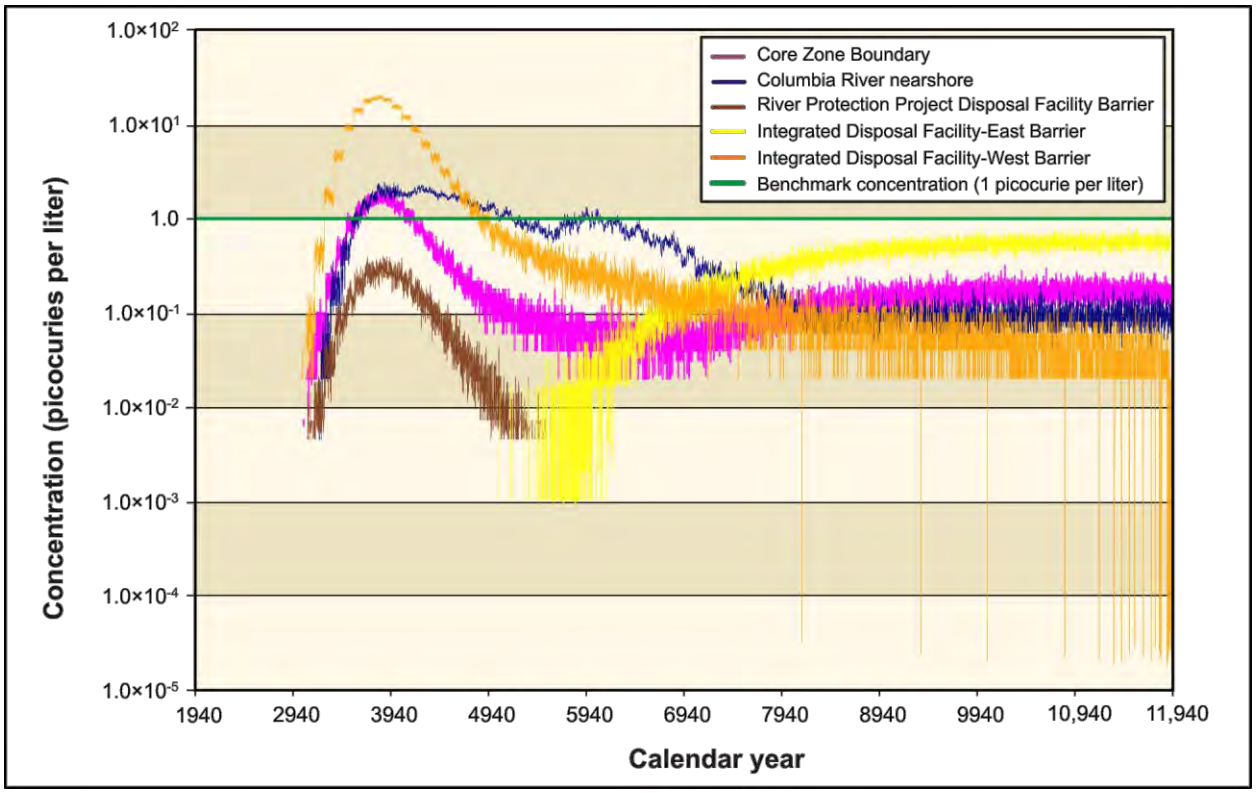


Figure 5–1034. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Iodine-129 Concentration Versus Time

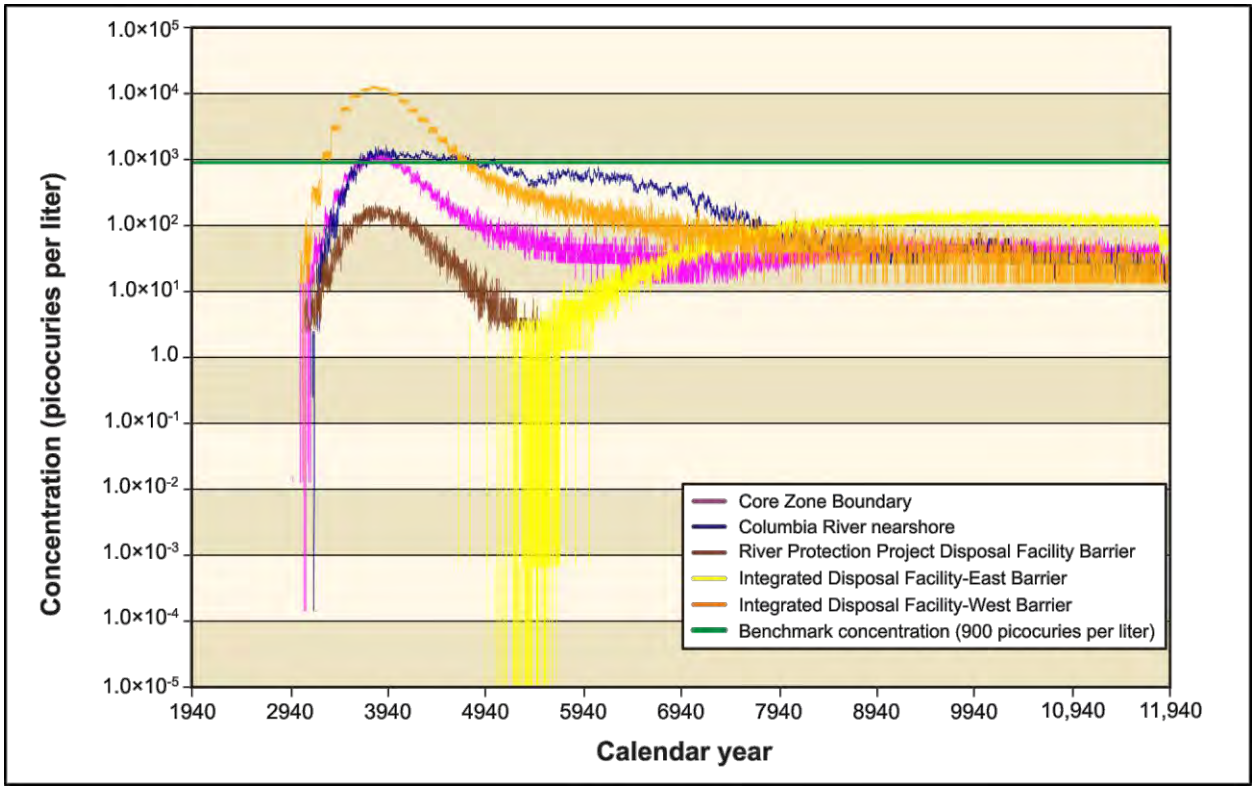


Figure 5–1035. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Technetium-99 Concentration Versus Time

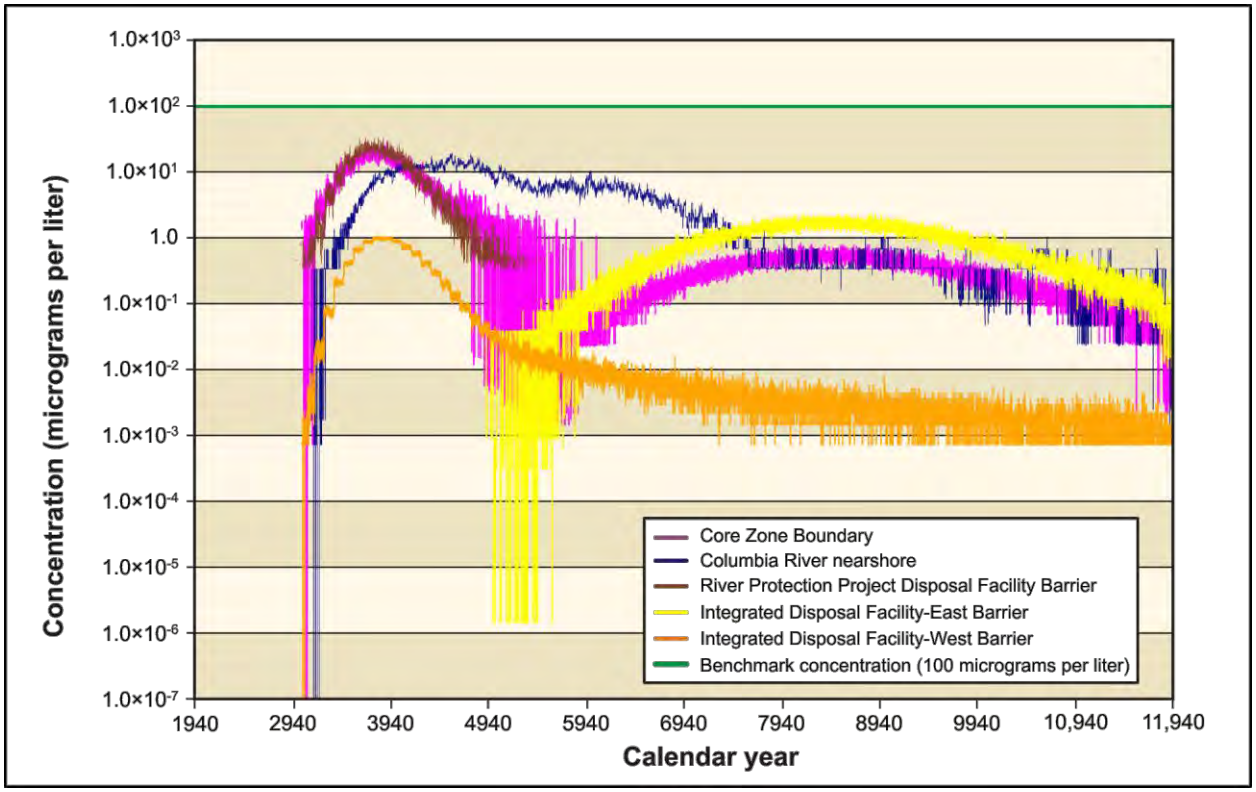


Figure 5–1036. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Chromium Concentration Versus Time

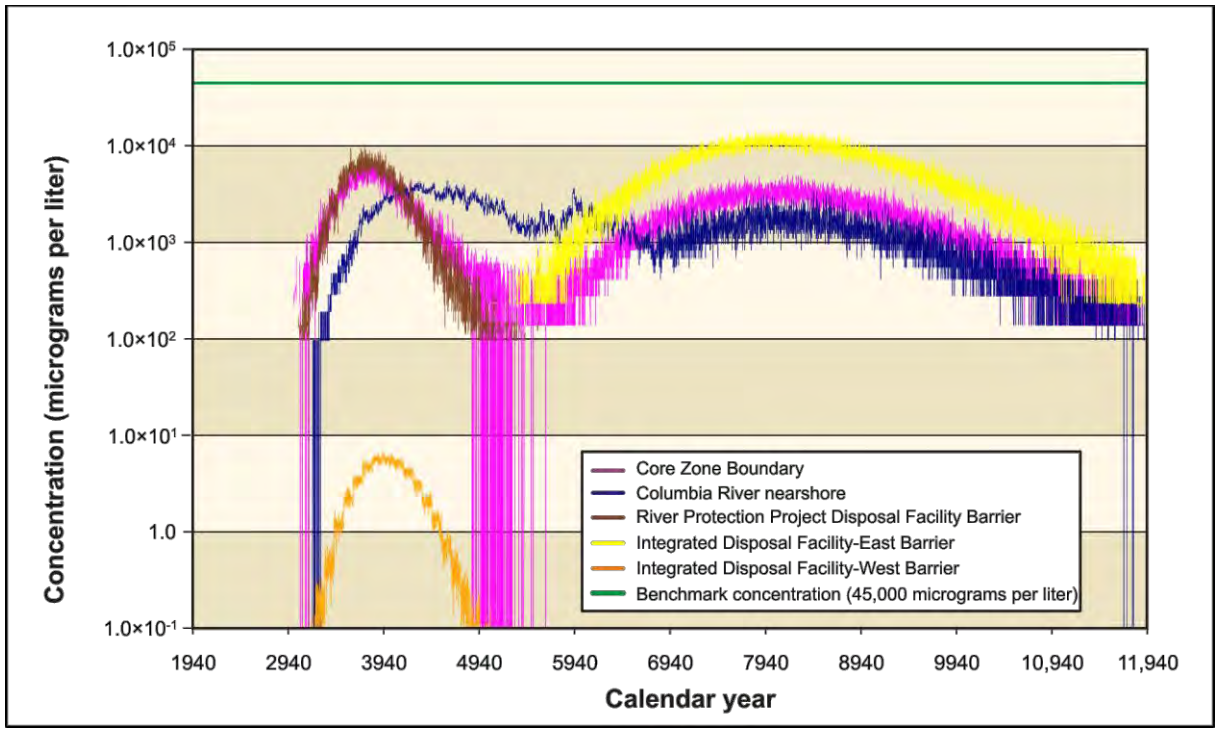


Figure 5–1037. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Nitrate Concentration Versus Time

Table 5–115 shows the maximum concentrations in groundwater. Under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, iodine-129 and technetium-99 concentrations both exceed their respective benchmarks at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore around CY 3900. No other constituents exceed their benchmark concentrations under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case.

Table 5–115. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	196	**13,200**	220	**1,370**	**1,670**	900
	(9705)	(3818)	(3812)	(3859)	(3920)	
Iodine-129	0.9	**20.6**	0.4	**2.1**	**2.4**	1
	(11,811)	(3794)	(3858)	(3937)	(3872)	
Chemical (micrograms per liter)						
Chromium	2	1	34	29	19	100
	(8152)	(3813)	(3807)	(3901)	(4558)	
Fluoride	0	1	0	0	0	4,000
	(1940)	(4014)	(3983)	(3937)	(4307)	
Nitrate	14,600	7	9,860	7,220	4,340	45,000
	(7954)	(3927)	(3733)	(3814)	(4606)	

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in bold text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figure 5–1038 shows concentration versus time for total uranium. Because of the high retardation of uranium, no contamination appears until roughly CY 7900. Total uranium concentrations rise throughout the remainder of the period of analysis, but remain at least five orders of magnitude lower than the benchmark concentration. Uranium-238 (see Figure 5–1039) also continues to rise after CY 8700, remaining at least six orders of magnitude below the benchmark at the end of the period of analysis.

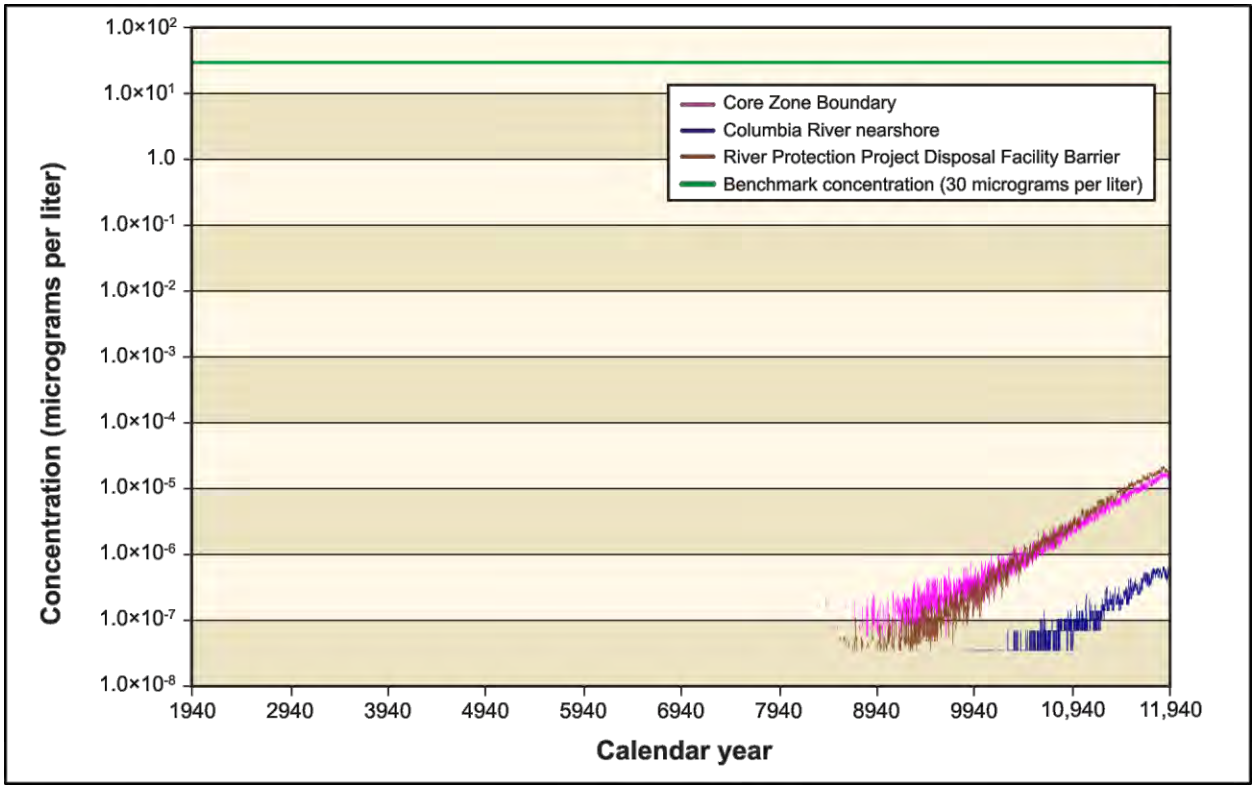


Figure 5–1038. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Total Uranium Concentration Versus Time

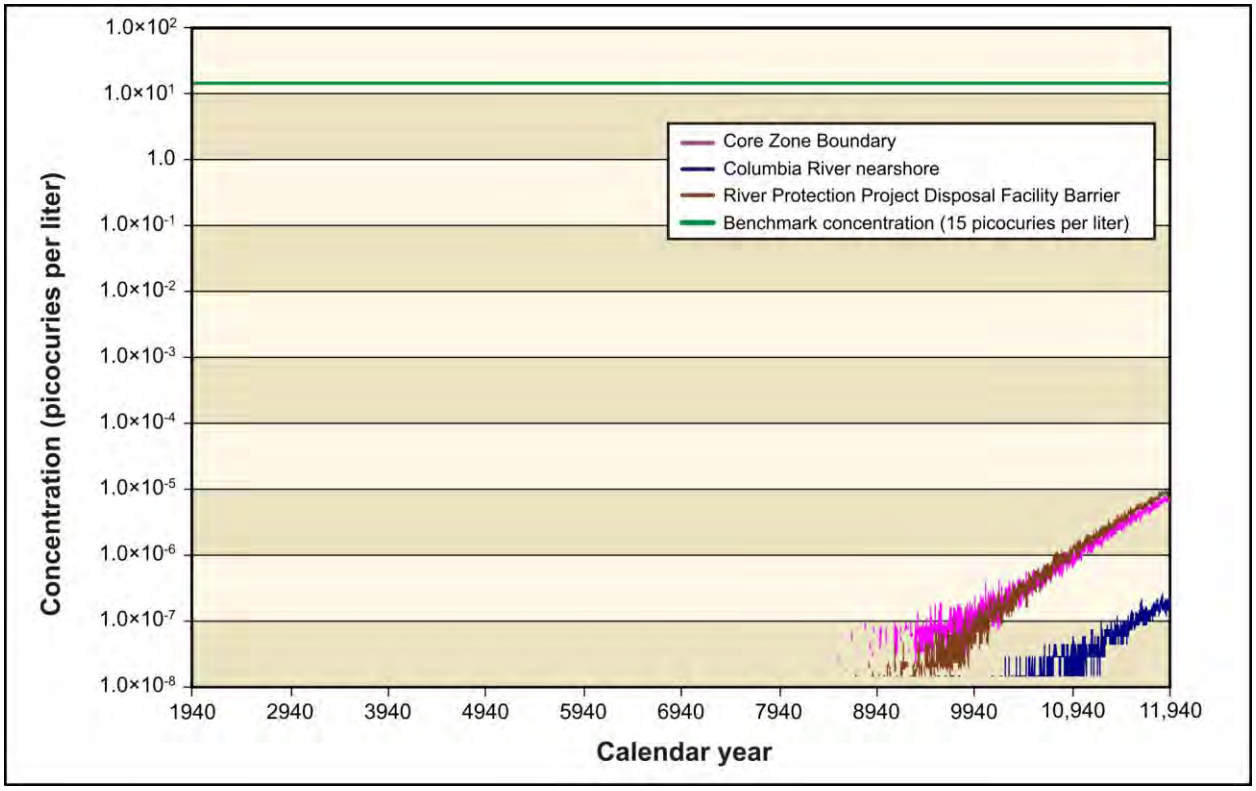
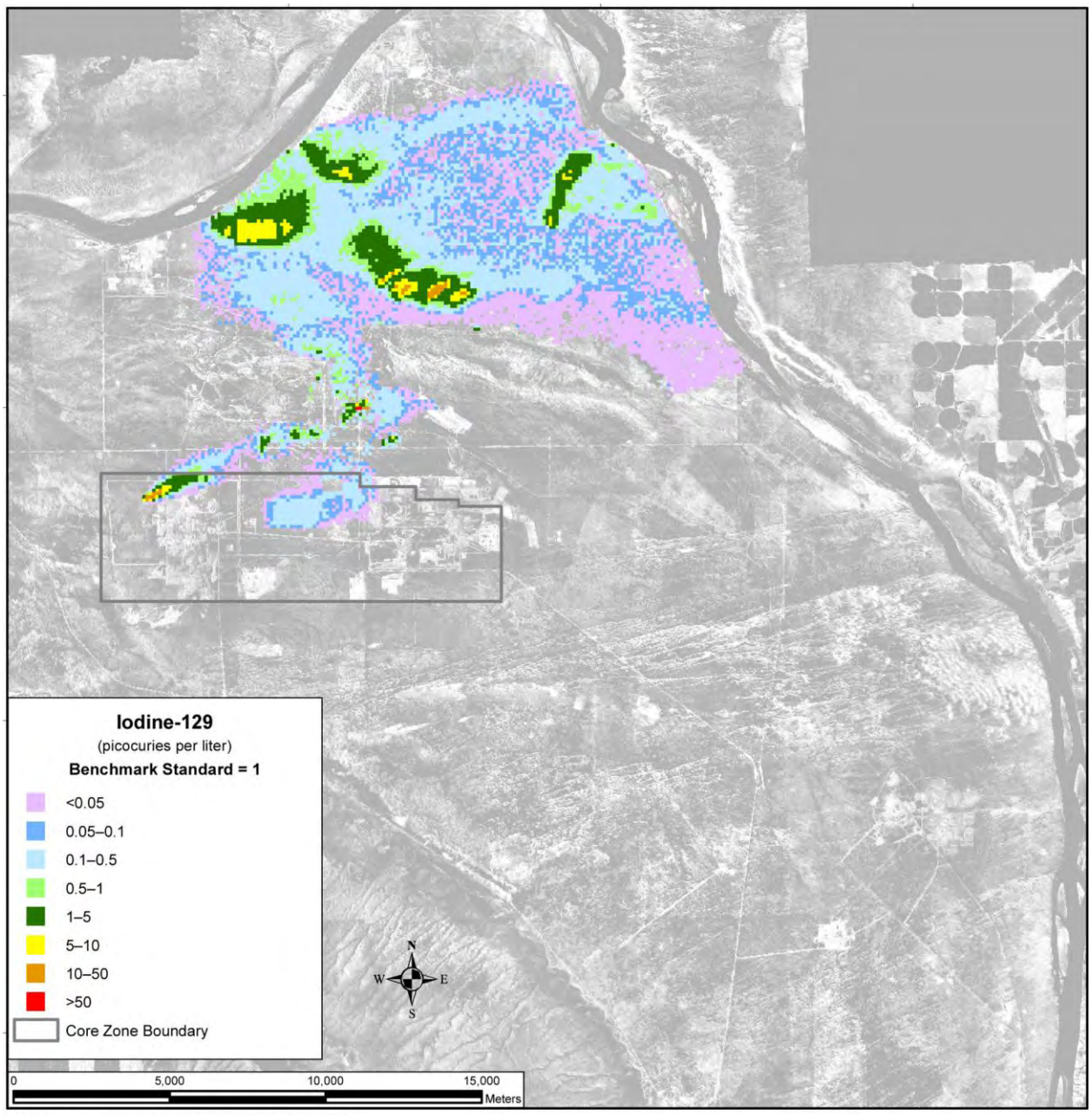


Figure 5–1039. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Uranium-238 Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

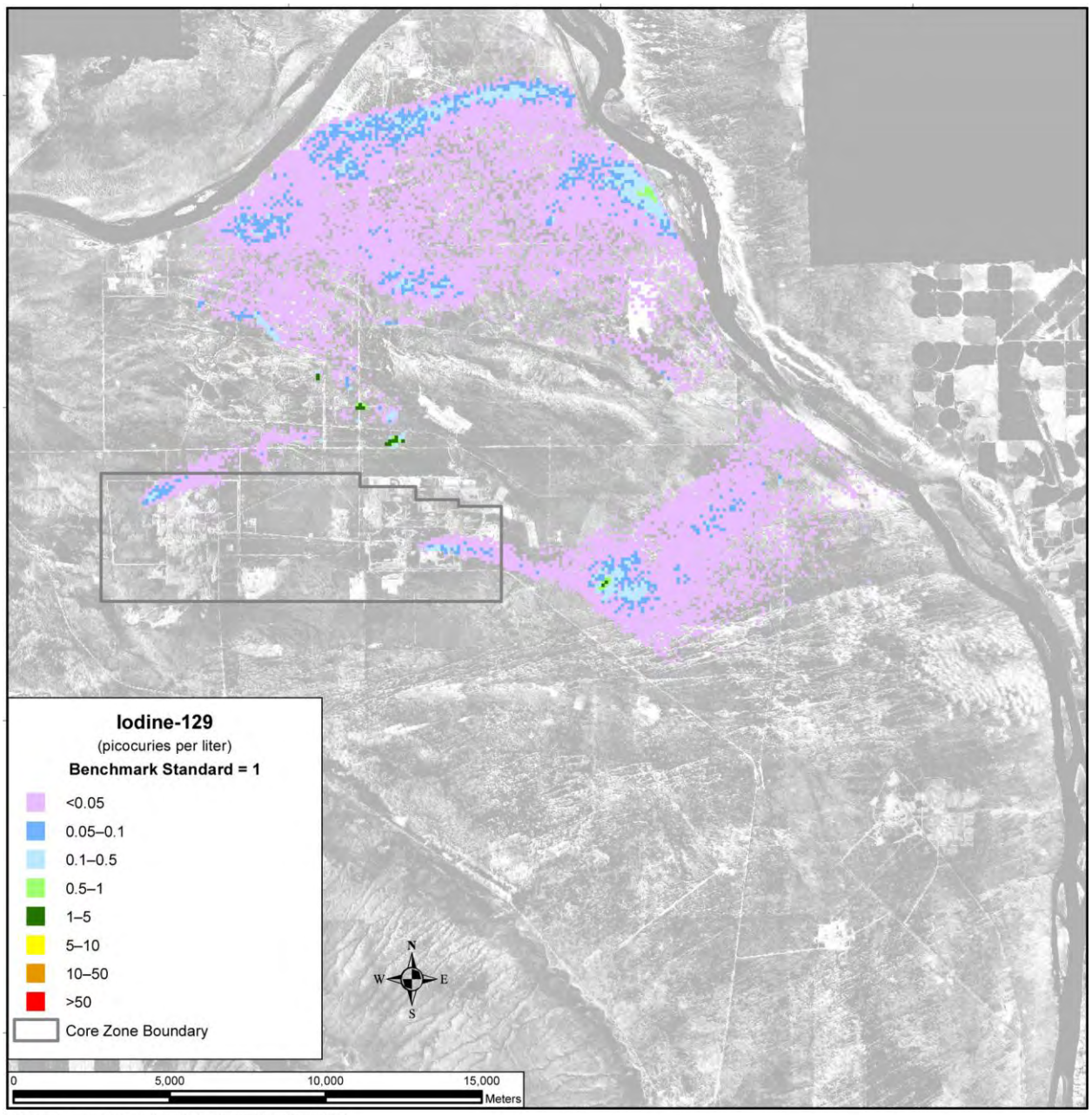
This section presents the impacts of Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

Figure 5–1040 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 3890 as a concentrated plume, with peak concentrations 10 to 50 times greater than the benchmark, that stretches north from IDF-West and the RPPDF through Gable Gap. By CY 7140 (see Figure 5–1041), the plume from the RPPDF is reduced, but a new plume is beginning to form, traveling east from IDF-East. The peak concentrations in the second plume are greater than the benchmark. By CY 11,885, the plume continues to spread toward the river and the concentrations continue to increase (see Figure 5–1042). Technetium-99 (see Figures5–1043 through 5–1045), chromium (see Figures 5–1046 through 5–1048), and nitrate (see Figures 5–1049 through 1051) show similar spatial distributions at selected times, but the concentrations remain lower, similar to the later plumes mentioned above. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., they move at the pore-water velocity).



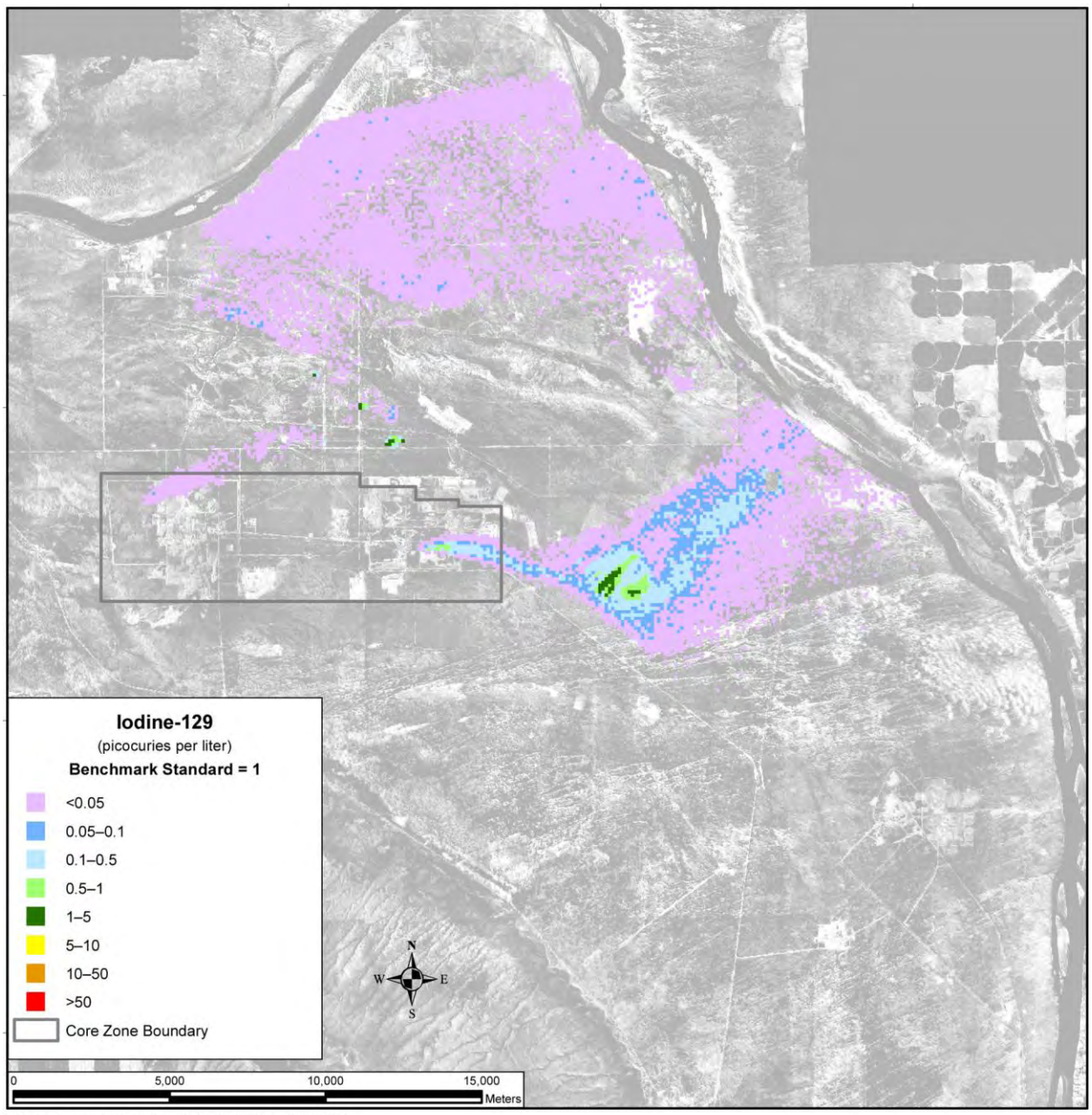
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1040. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



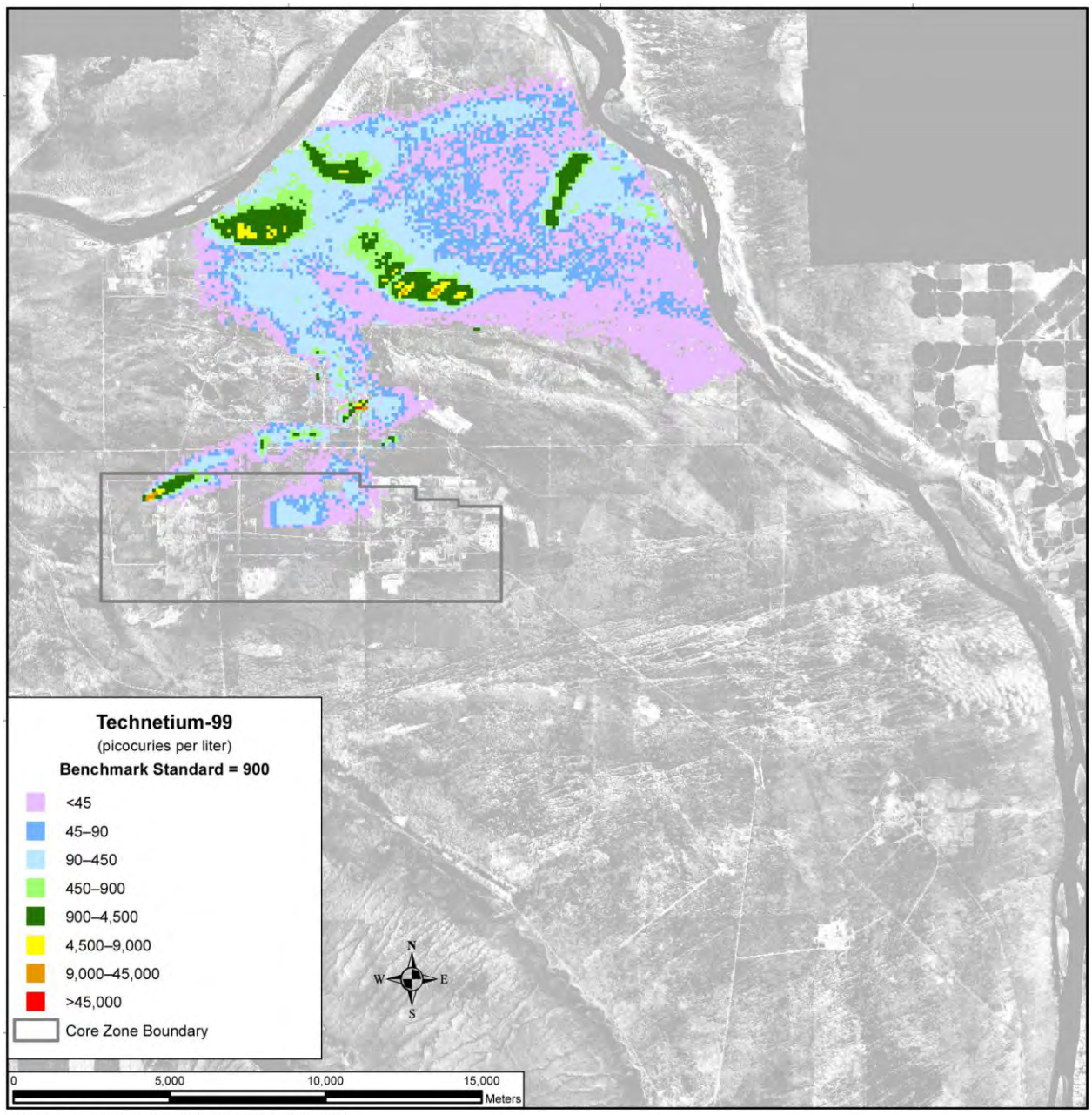
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1041. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



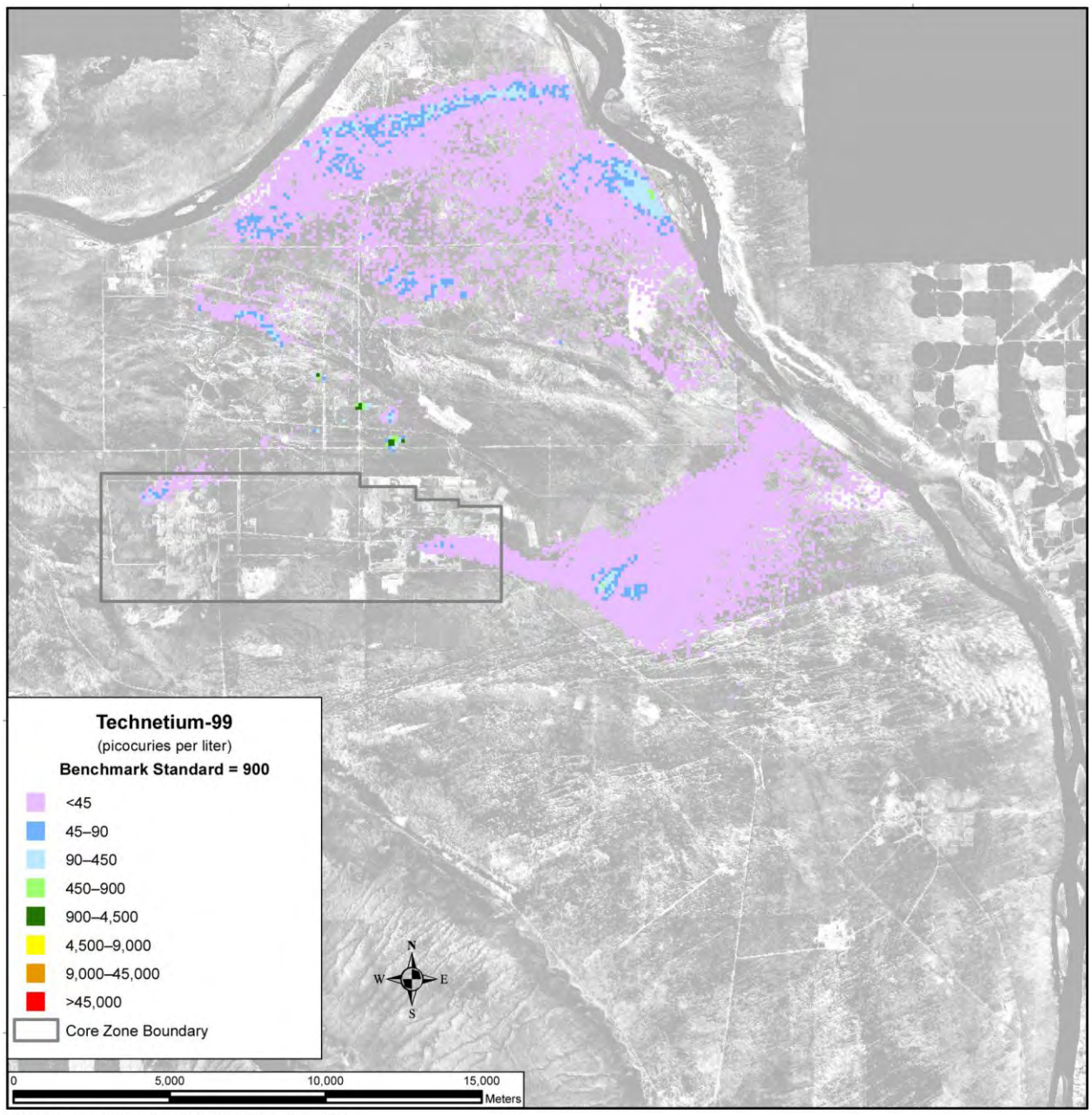
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1042. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



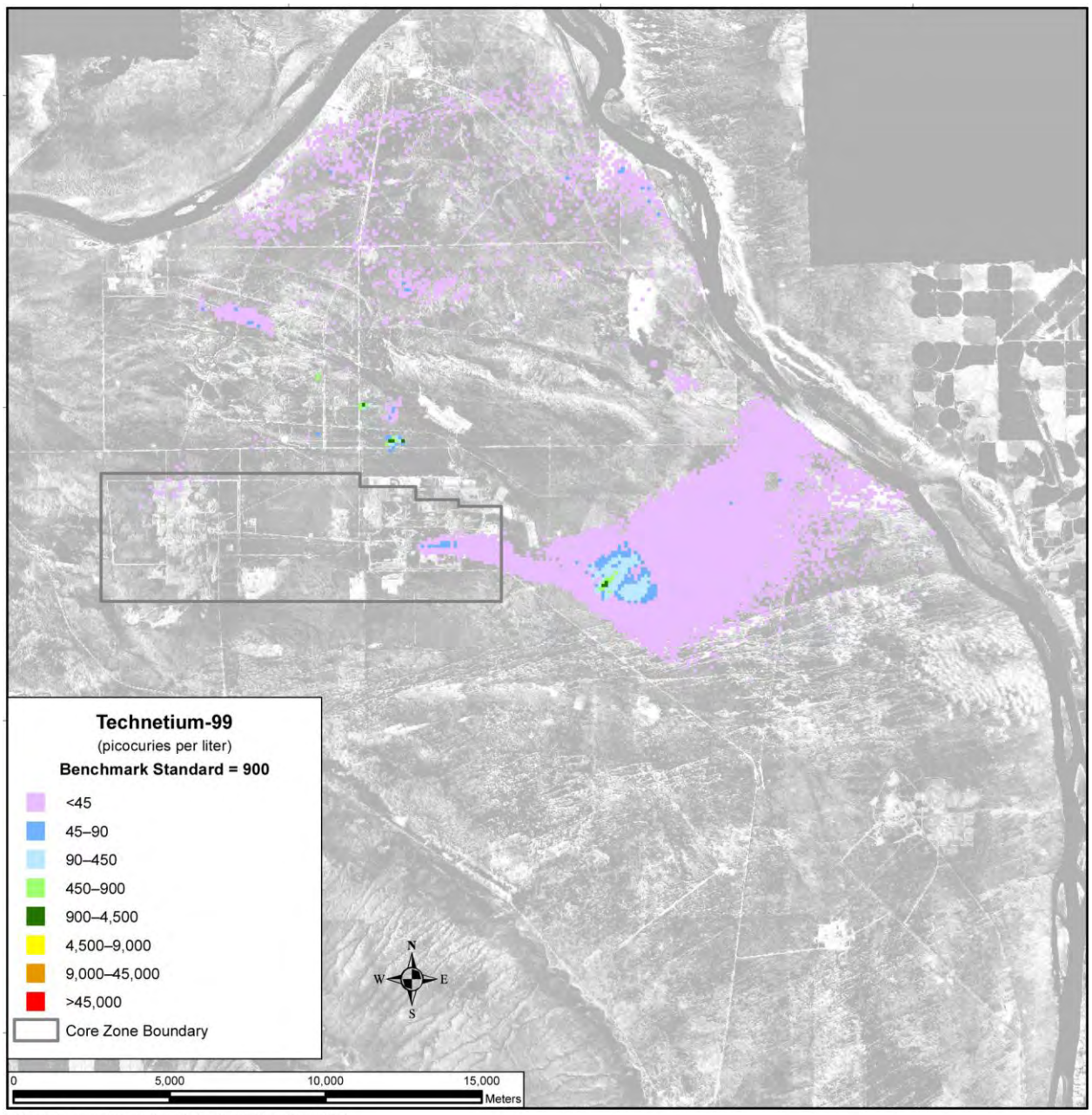
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1043. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



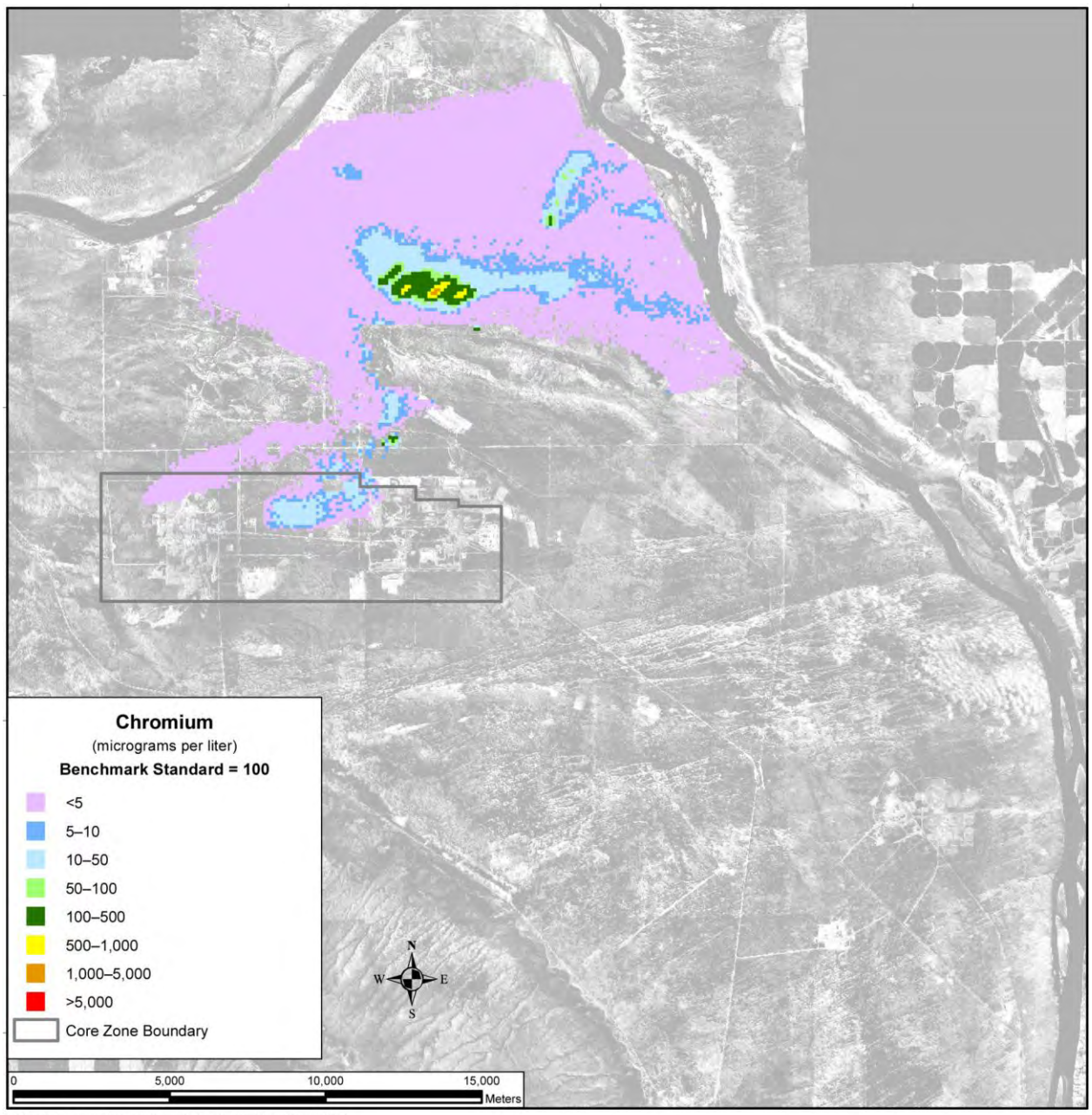
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1044. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



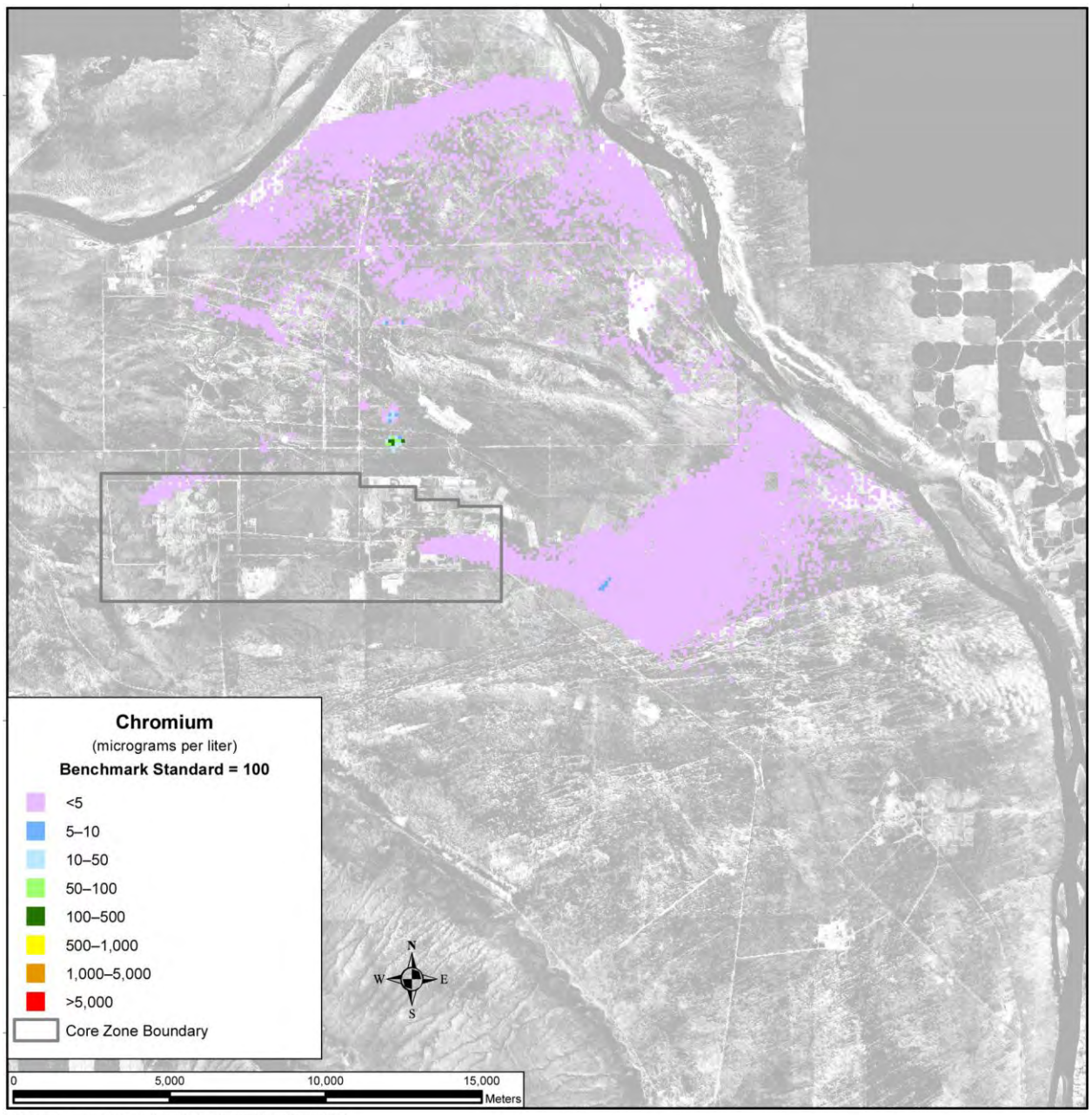
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1045. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



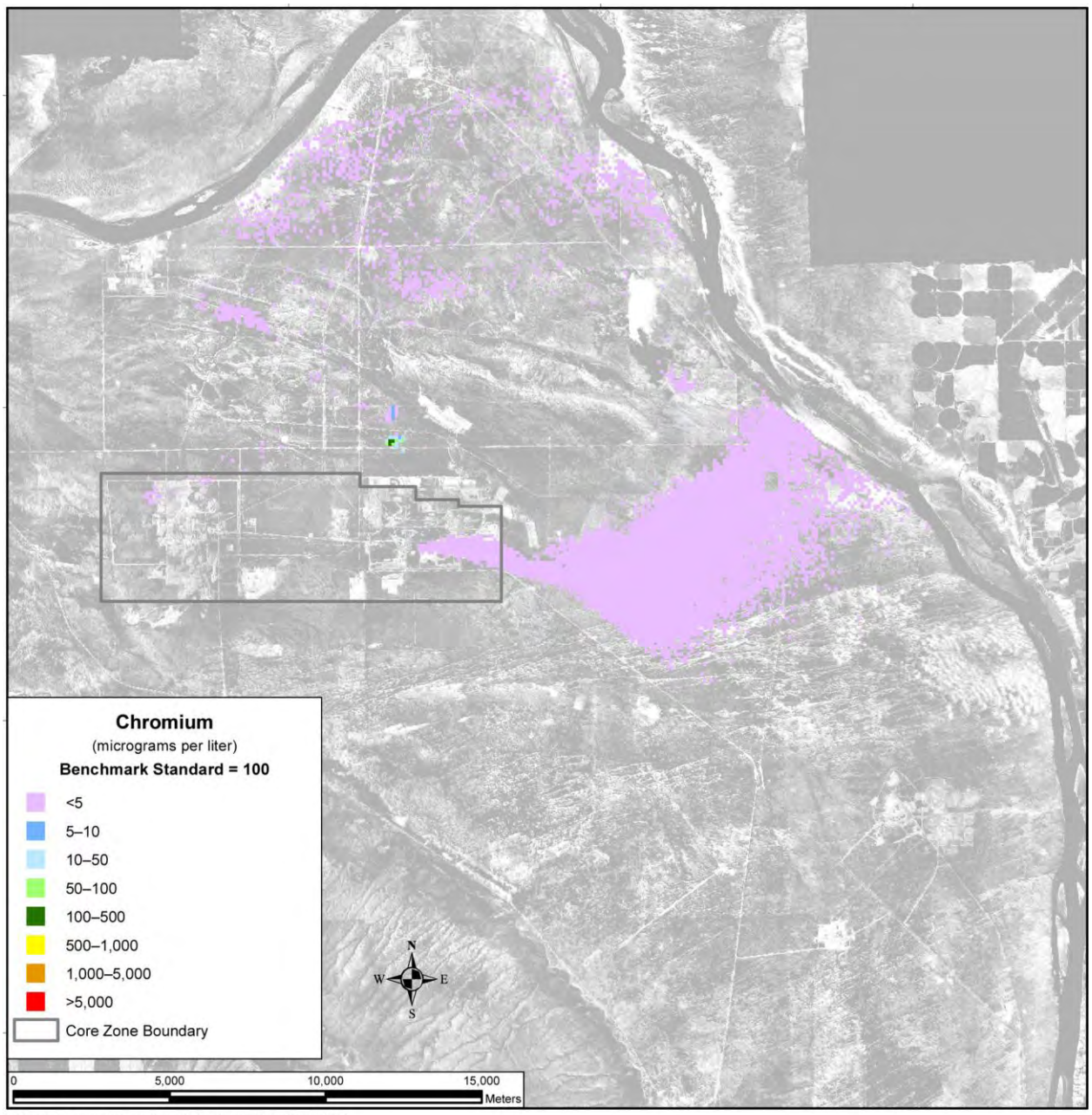
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1046. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



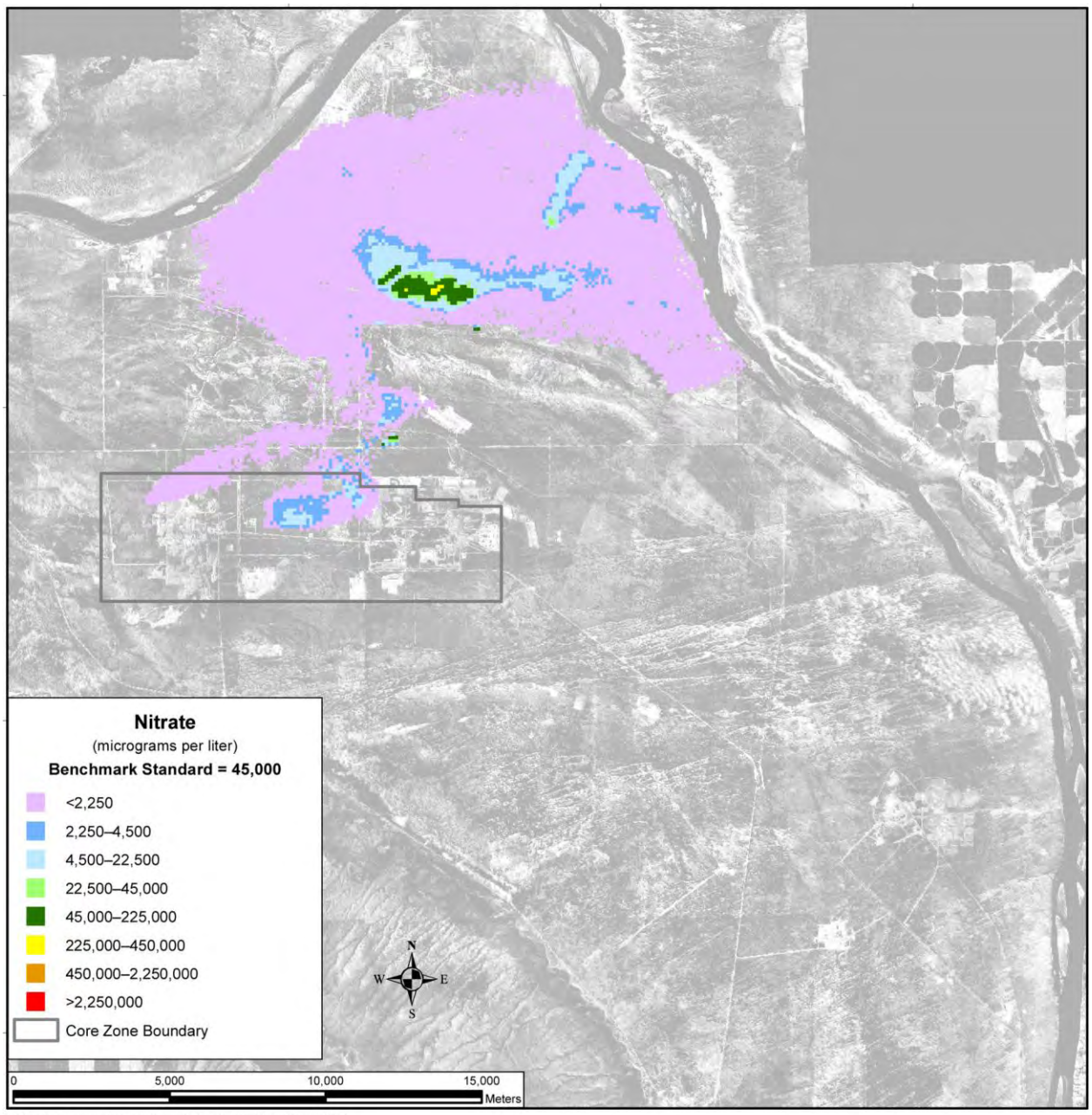
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1047. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



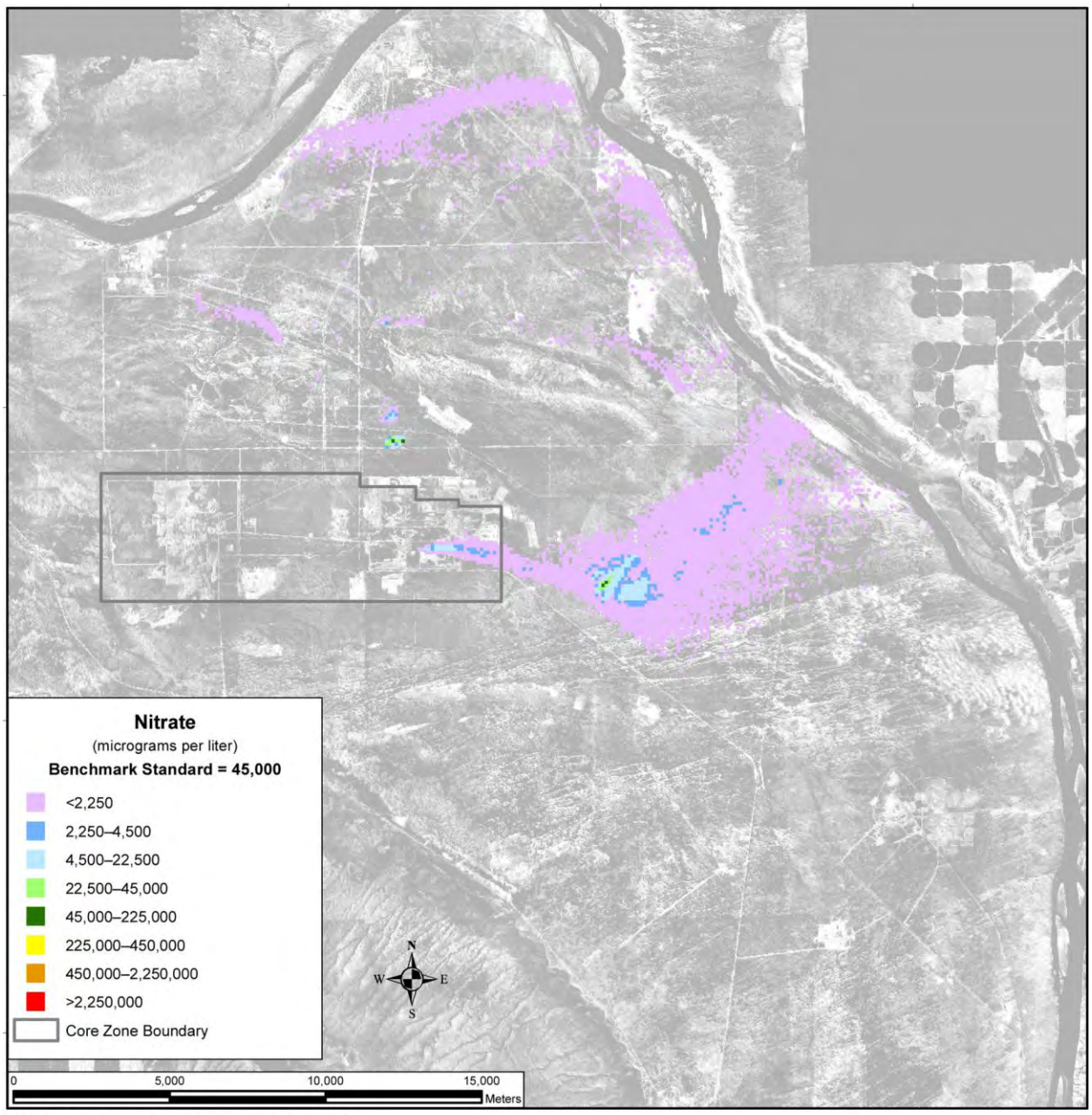
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1048. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



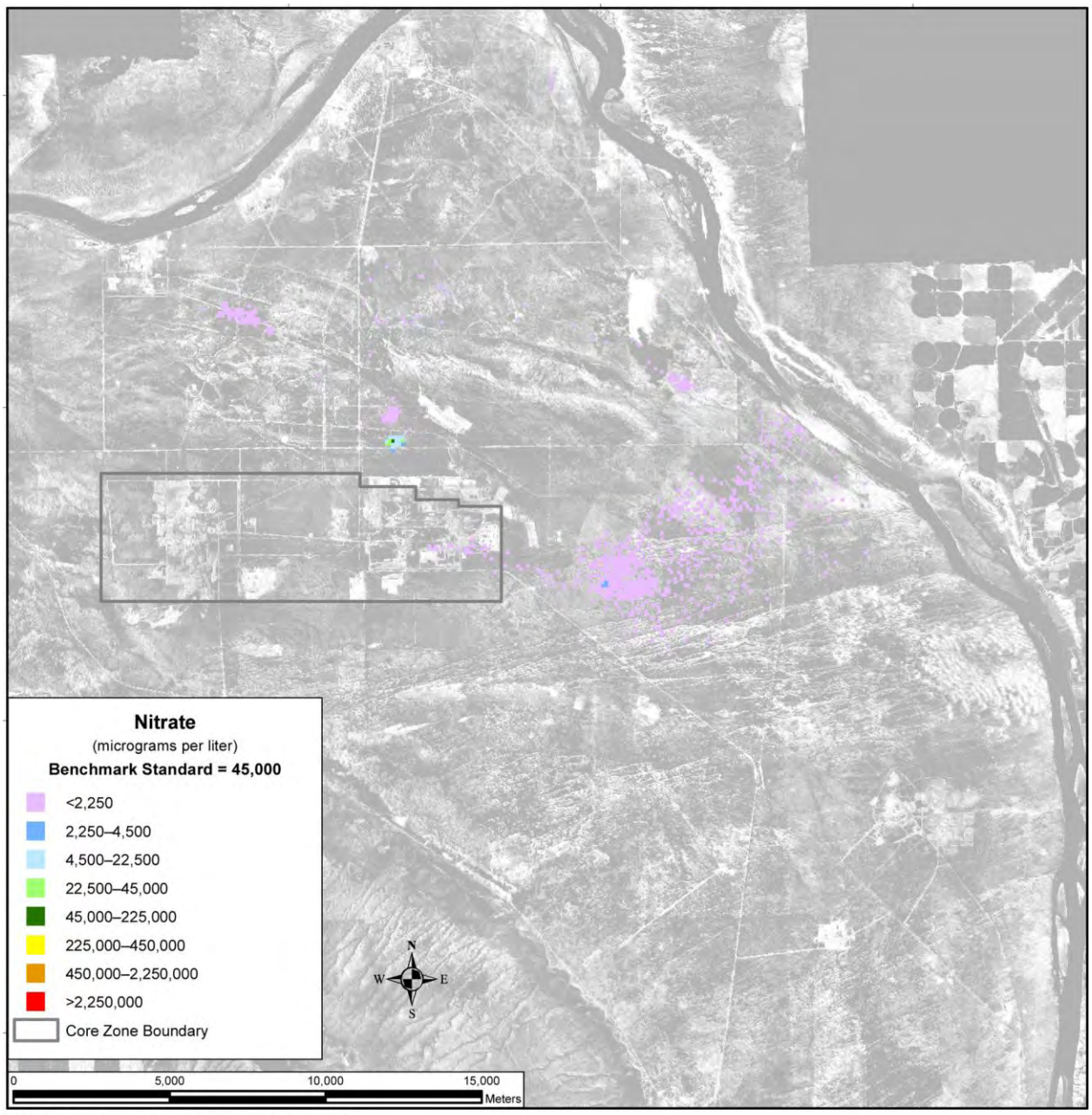
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1049. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



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

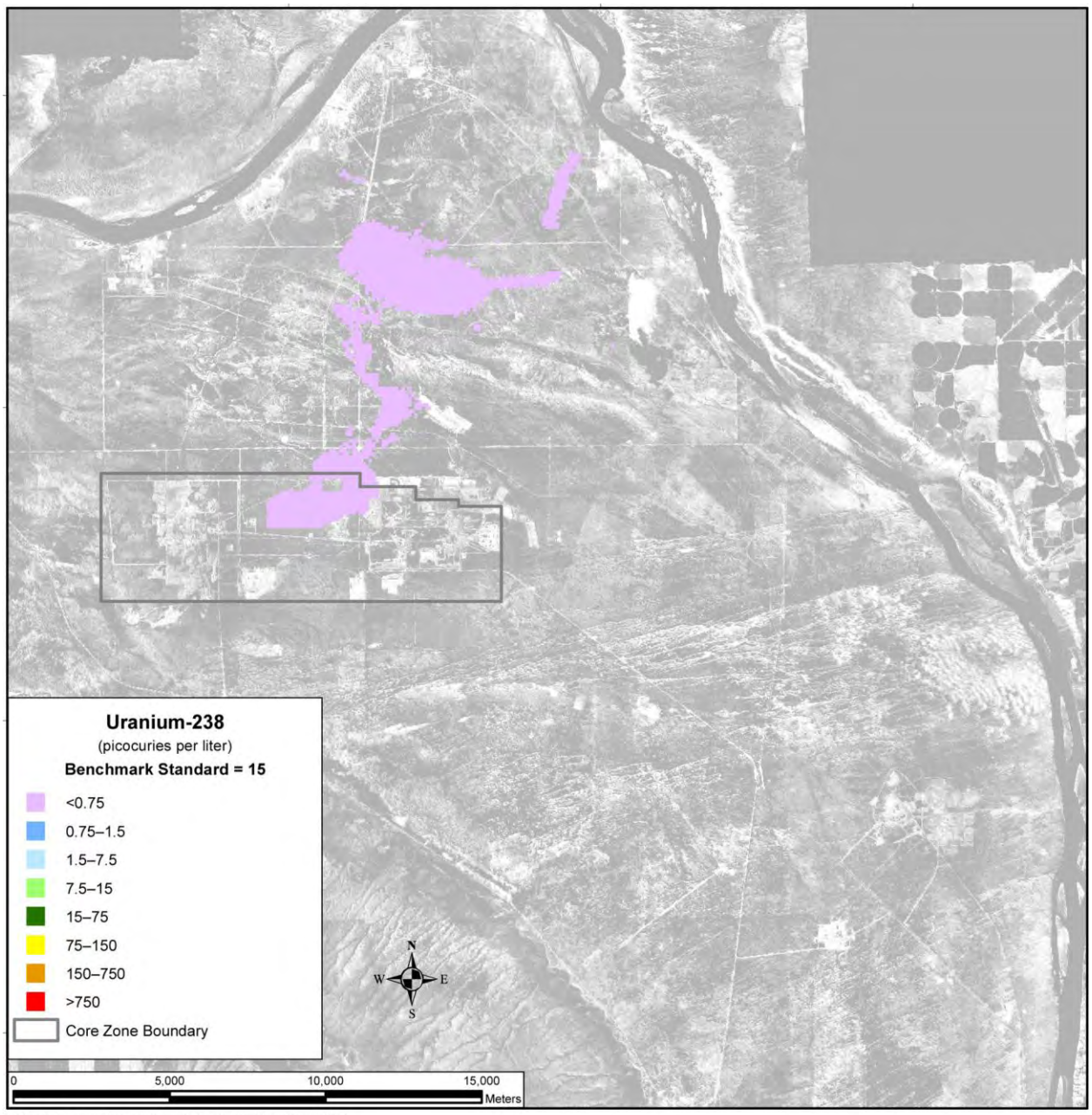
Figure 5–1050. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



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

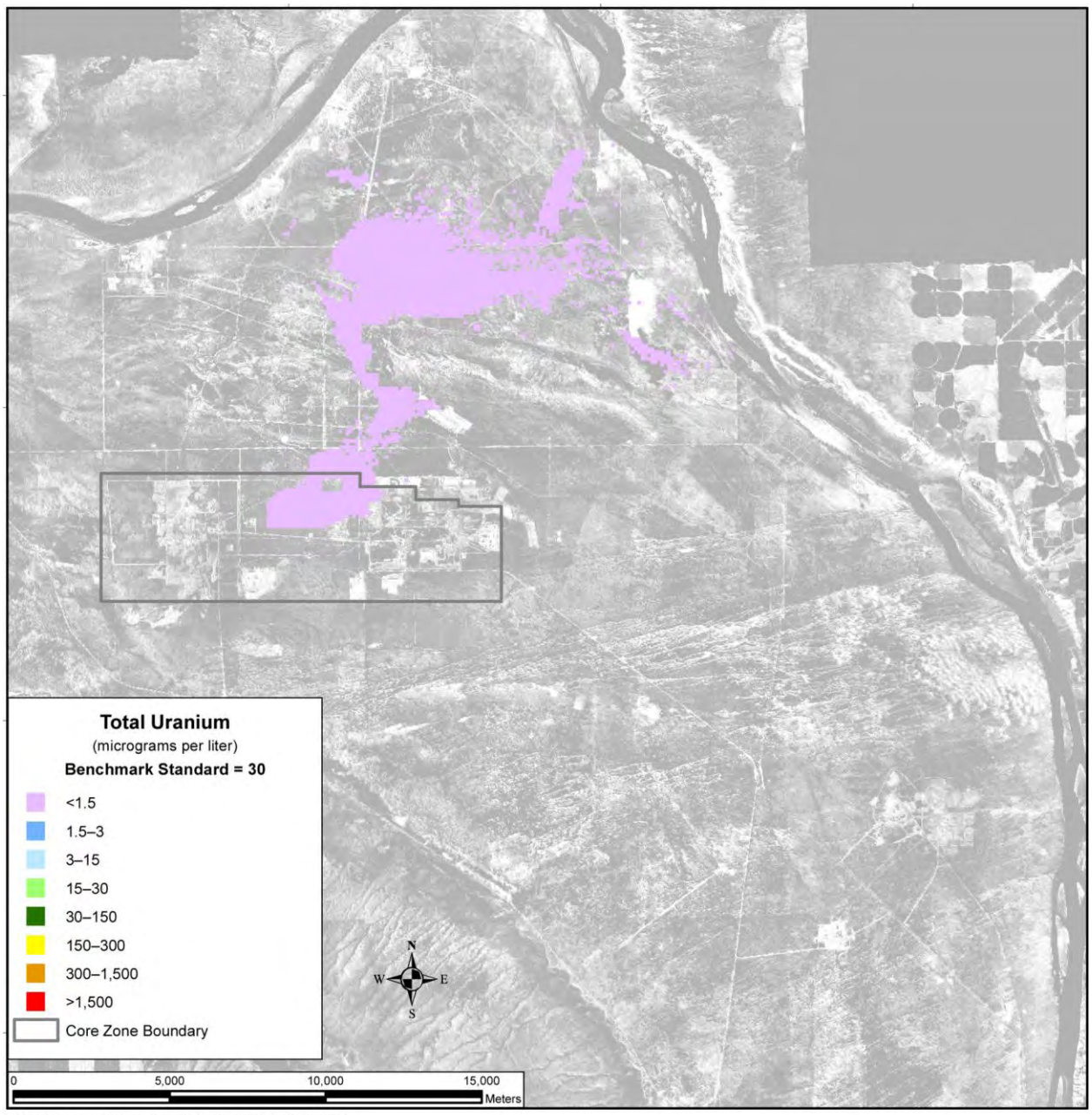
Figure 5–1051. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

Uranium COPCs show a different spatial distribution over time. These COPCs are not as mobile as those discussed above, moving about seven times more slowly than the pore-water velocity. As a result, travel times through the vadose zone are longer, release to the aquifer is delayed, and travel times through the aquifer to the Columbia River are longer. Figure 5–1052 shows the distribution of uranium-238 in CY 11,885. Figure 5–1053 shows the distribution of total uranium in CY 11,885. Both uranium-238 and total uranium show low-concentration plumes that stretch north from IDF-West and the RPPDF through Gable Gap. Concentrations in all areas of the plume remain below one-twentieth of the benchmark.



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

Figure 5–1052. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Uranium-238 Concentration, Calendar Year 11,885



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

Figure 5–1053. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Spatial Distribution of Groundwater Total Uranium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, in general, the inventories remaining in IDF-East and IDF-West, which are available for release to the environment at the start of the post-disposal period, are predominant contributors. The increased inventory available for release from the RPPDF during the post-disposal period is a secondary contributor.

For the conservative tracers, only concentrations of technetium-99 and iodine-129 exceed their benchmarks at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore. Both constituents exceed the benchmark standards by over one order of magnitude at the IDF-West barrier and

by less than one order of magnitude at the Core Zone Boundary and Columbia River nearshore around CY 3900.

For total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of this retarded species do not exceed the benchmark at the Core Zone Boundary or the Columbia River nearshore by CY 10,000. The intensity is highest and the area of the contamination plume largest near the end of the period of analysis.

5.3.1.3.3 Disposal Group 3

Disposal Group 3 is characterized by operational completion dates of CY 2165 for IDF-East and the RPPDF and CY 2050 for IDF-West. Under Disposal Group 3, IDF-West would have a large capacity (90,000 cubic meters [117,720 cubic yards]); IDF-East, a larger capacity (340,000 cubic meters [425,100 cubic yards]); and the RPPDF, an even larger capacity (8,330,000 cubic meters [10,947,960 cubic yards]). These capacities were designed to meet the waste generation volumes associated with Tank Closure Alternative 6A, Base or Option Case, and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste.

5.3.1.3.3.1 Disposal Group 3, Base Case

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 3, Base Case, was designed to accommodate the disposal of wastes generated under Tank Closure Alternative 6A, Base Case, and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste.

For the long-term groundwater impacts analysis, two major periods have been identified for Waste Management Alternative 3, Disposal Group 3, Base Case, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2165, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2166 and continue through the 10,000-year period of analysis. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 3, Base Case. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 3, Base Case, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129 and technetium-99
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, nitrate, and fluoride

The COPC drivers for Waste Management Alternative 3, Disposal Group 3, Base Case, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the

Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for over 99 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 3, Base Case.

The COPC drivers that are discussed in detail in this section (iodine-129, technetium-99, chromium, nitrate, and fluoride) are all mobile (i.e., they move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 3, Base Case, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over 10 orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Four subtotals are plotted in Figures 5–1054 through 5–1059, representing releases from IDF-East, which include ETF-generated secondary waste, PPF glass, retired melters, and tank closure secondary waste.

Figure 5–1054 shows the estimated release to the vadose zone of the radiological risk drivers and Figure 5–1055, the chemical hazard drivers. For technetium-99, chromium, and nitrate in grouted waste forms, the release to the vadose zone is controlled by the inventory (i.e., all of the inventory is released during the post-disposal period). The predominant source of technetium-99 and chromium is tank closure secondary waste. The predominant source of iodine-129 and nitrate is ETF-generated secondary waste. Fluoride is not released from IDF-East.

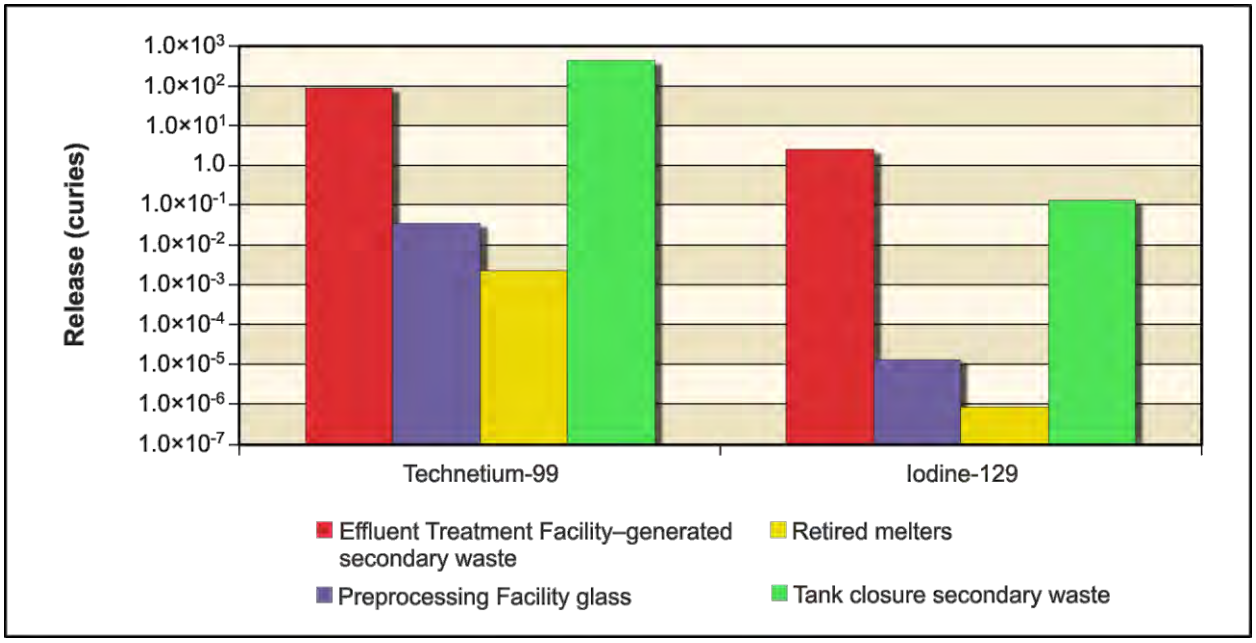


Figure 5–1054. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

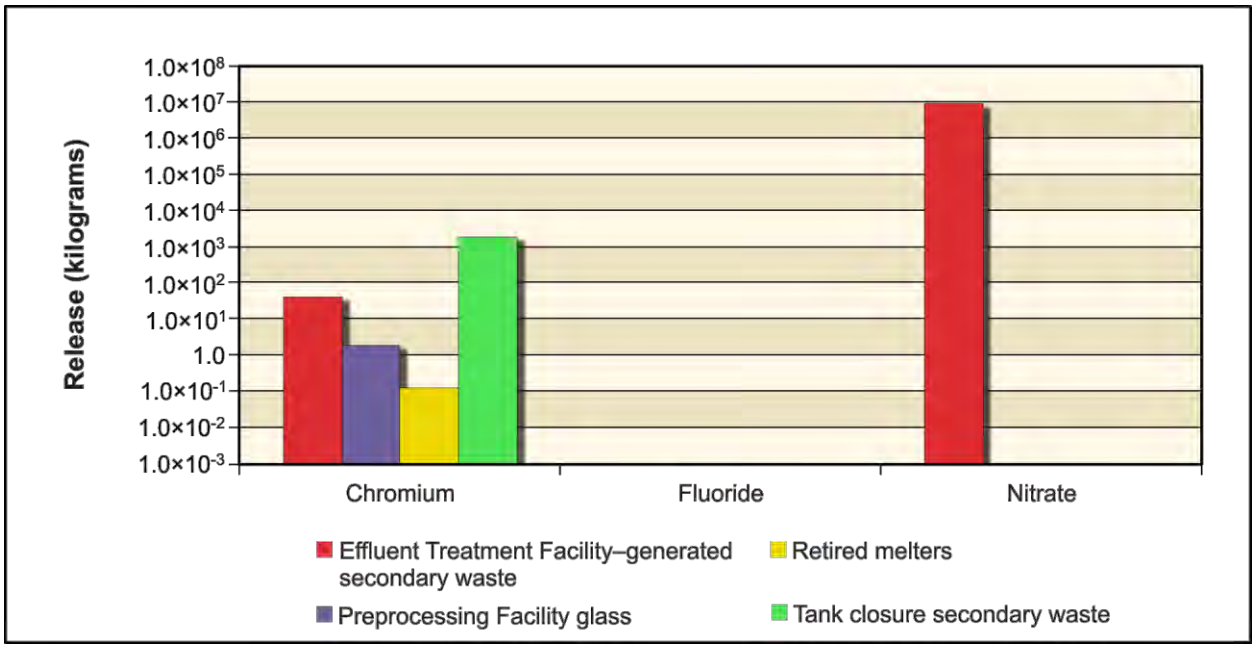


Figure 5–1055. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–1056 shows the release from IDF-East to groundwater of the radiological risk drivers and Figure 5–1057, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Approximately 40 percent of the iodine-129 and 58 percent of the technetium-99 released to the vadose zone reaches groundwater. For chromium and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 58 percent of the radionuclides (curies) released to the vadose zone

during the period of analysis reach groundwater; approximately 100 percent of the chemicals (kilograms) reach groundwater.

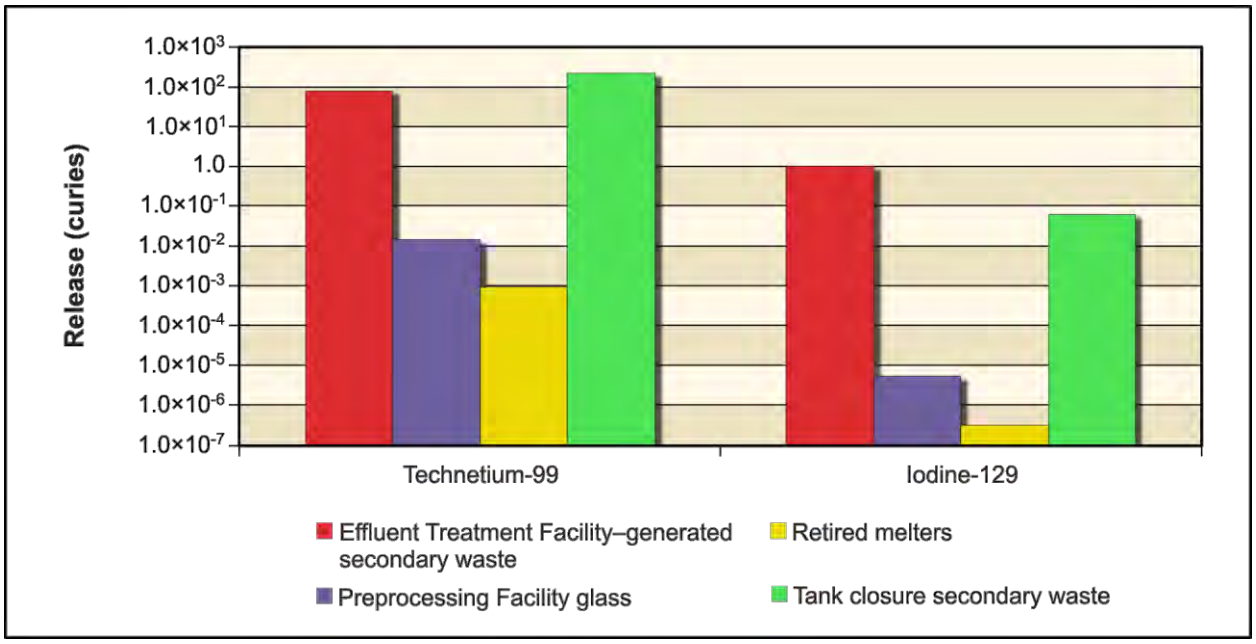


Figure 5–1056. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

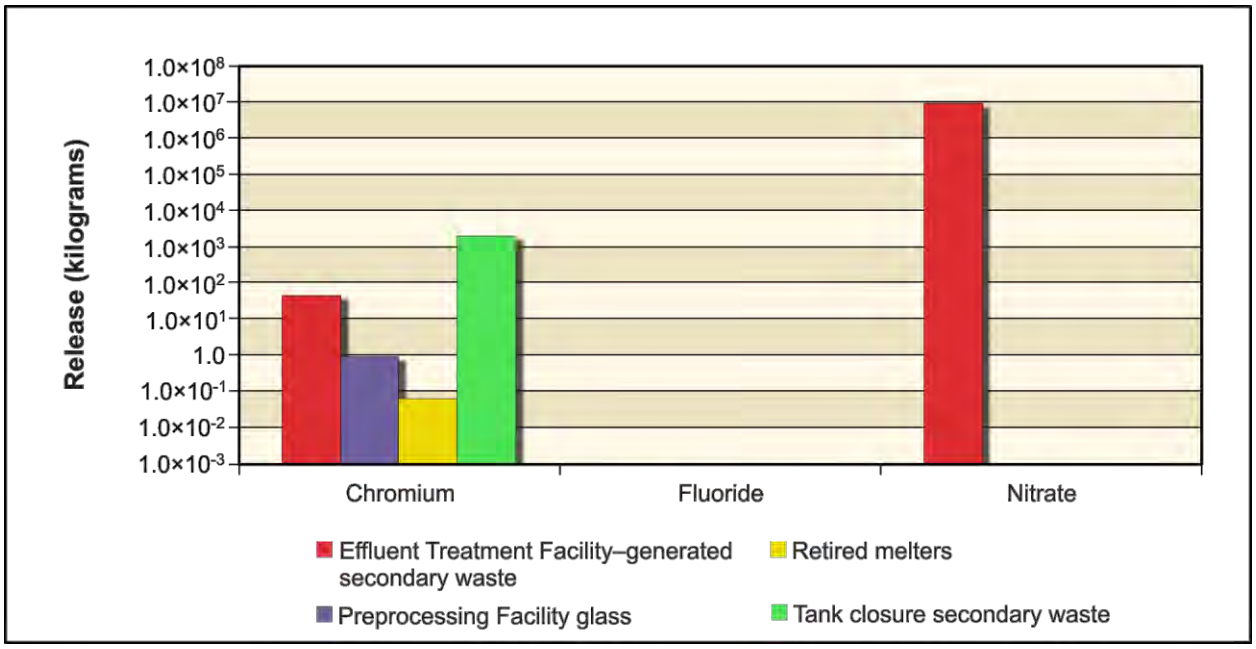


Figure 5–1057. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–1058 shows the release to the Columbia River of the radiological risk drivers and Figure 5–1059, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater. About

96 percent of the radionuclides (curies) released to groundwater during the period of analysis reach the river; approximately 99 percent of the chemicals (kilograms) reach the river.

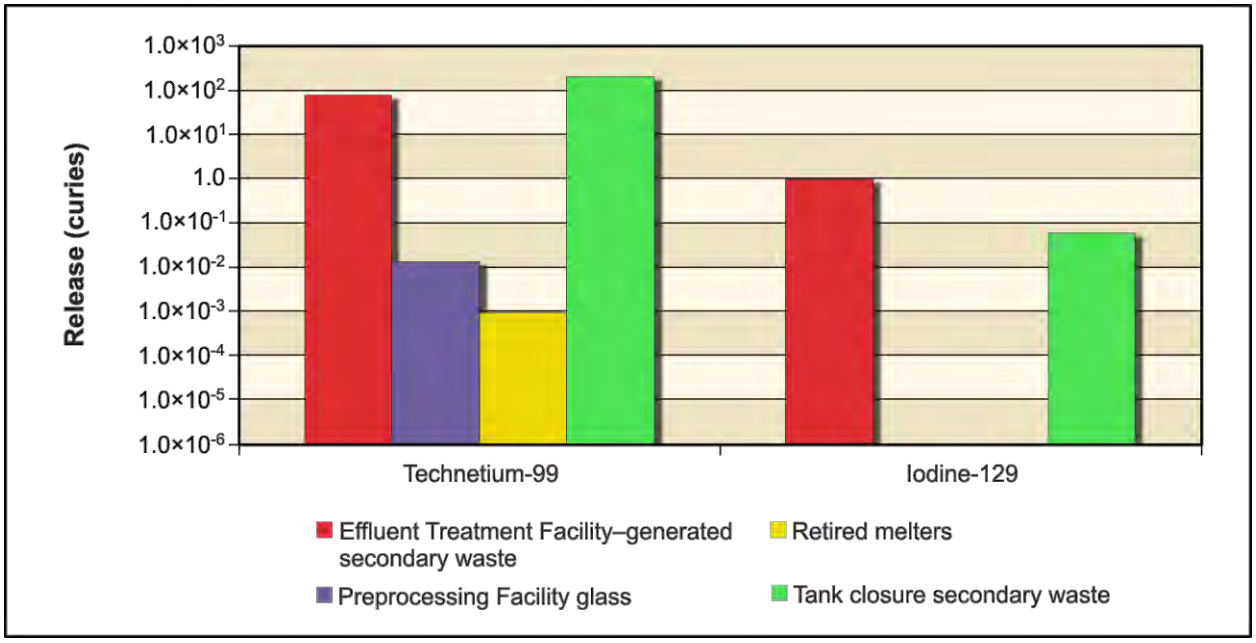


Figure 5–1058. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

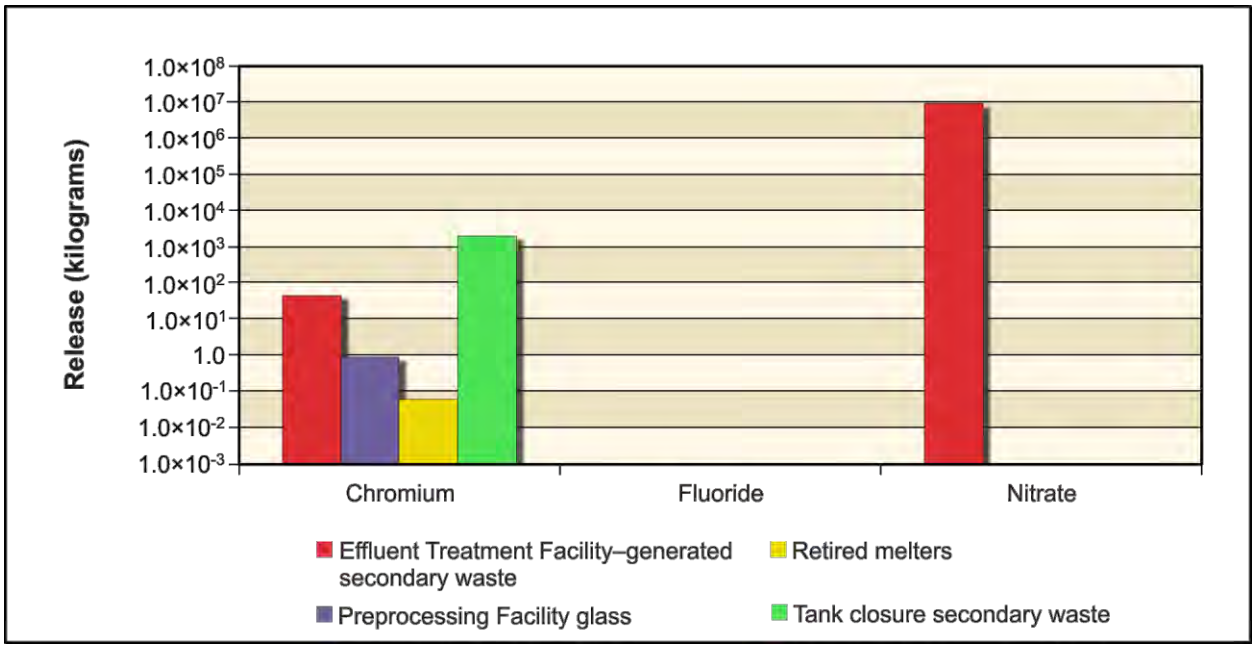


Figure 5–1059. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Three subtotals are plotted in Figures 5–1060 through 5–1065, representing releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary and onsite waste, and offsite waste.

Figure 5–1060 shows the release to the vadose zone of the radiological risk drivers and Figure 5–1061, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). The predominant source of technetium-99 and iodine-129 is offsite waste. For chromium and nitrate, the predominant source is waste management secondary and onsite waste.

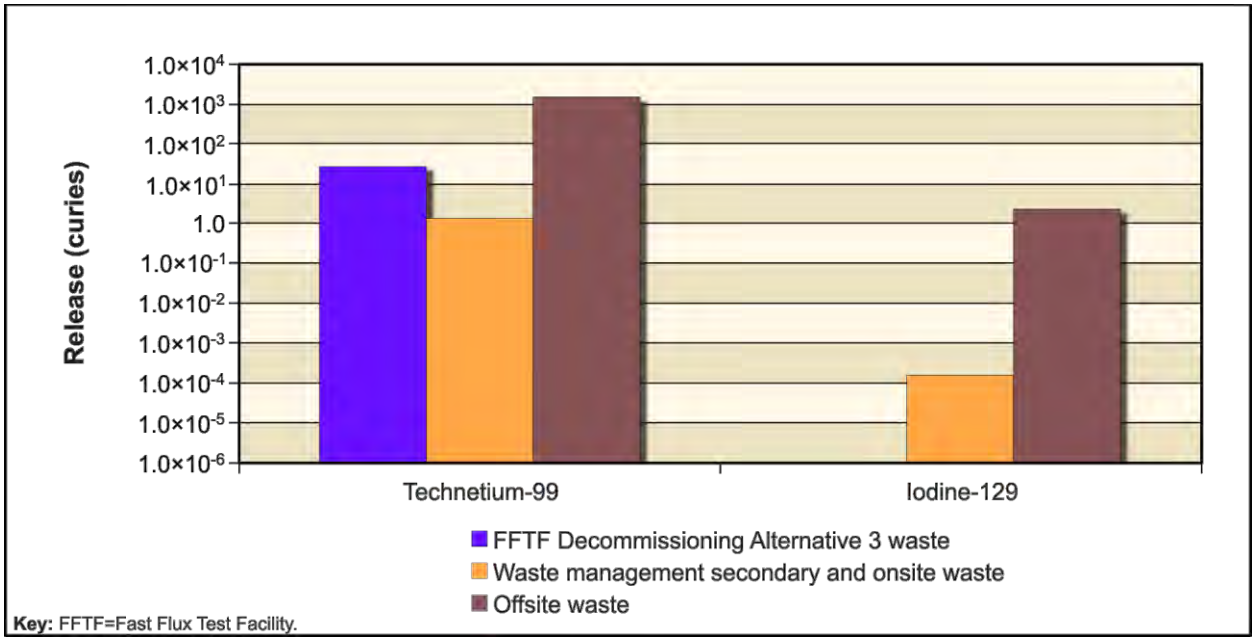


Figure 5–1060. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

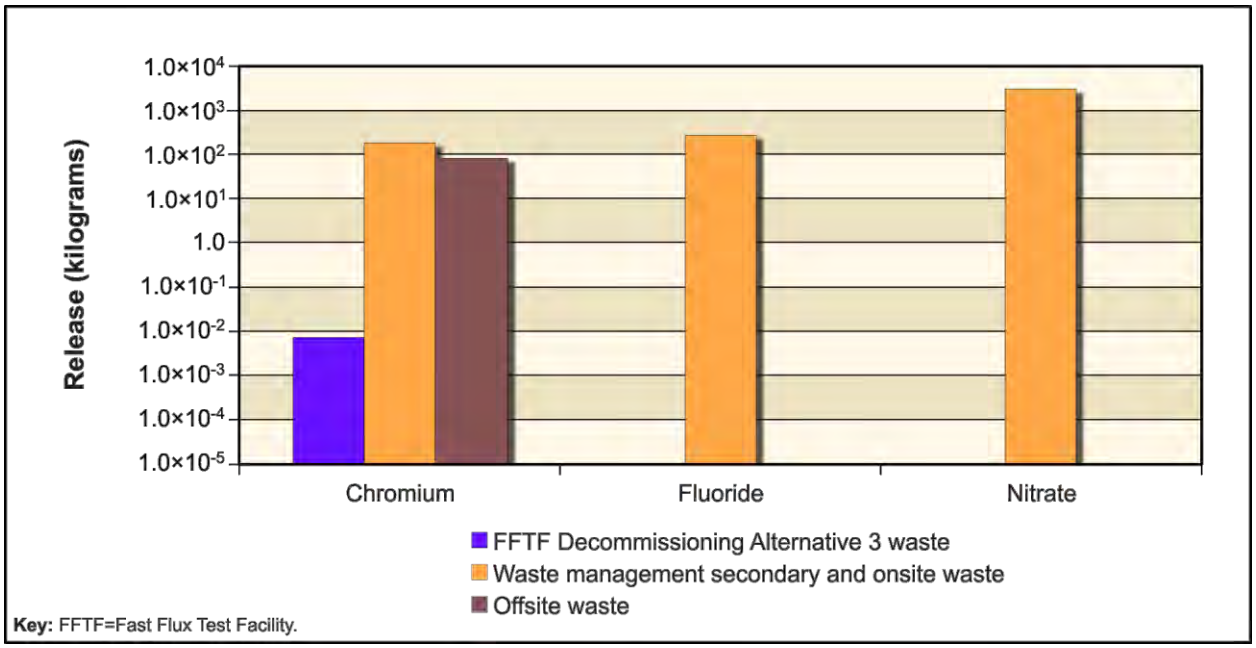


Figure 5–1061. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–1062 shows the release to groundwater of the radiological risk drivers and Figure 5–1063, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 98 percent of the radionuclides (curies) released to the vadose zone during the period of analysis reach groundwater; approximately 100 percent of the chemicals (kilograms) reach groundwater.

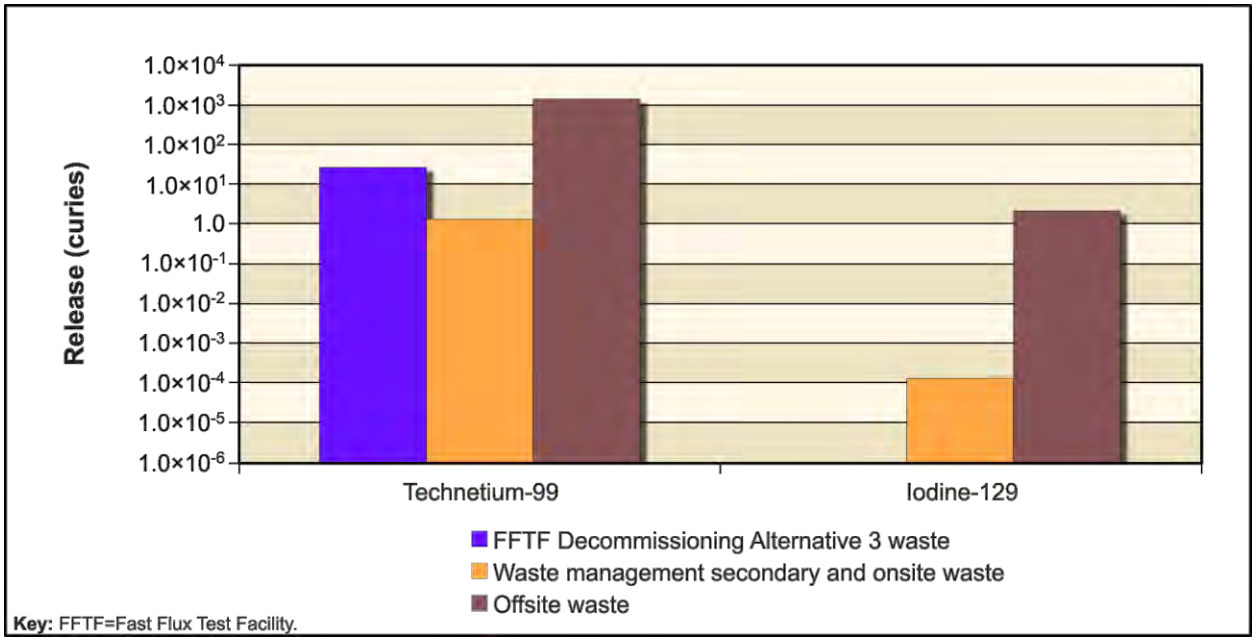


Figure 5–1062. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

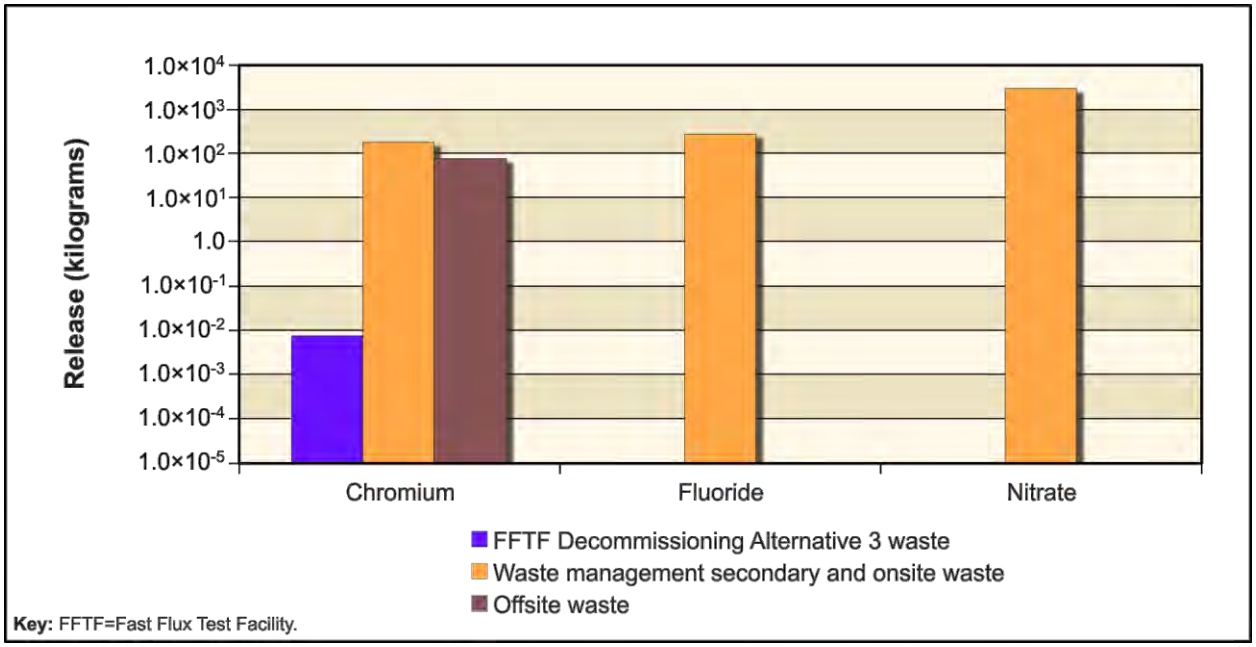


Figure 5–1063. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–1064 shows the release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–1065, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For technetium-99, iodine-129, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater. About 100 percent of the radionuclides (curies) and chemicals (kilograms) released to groundwater during the period of analysis reach the river.

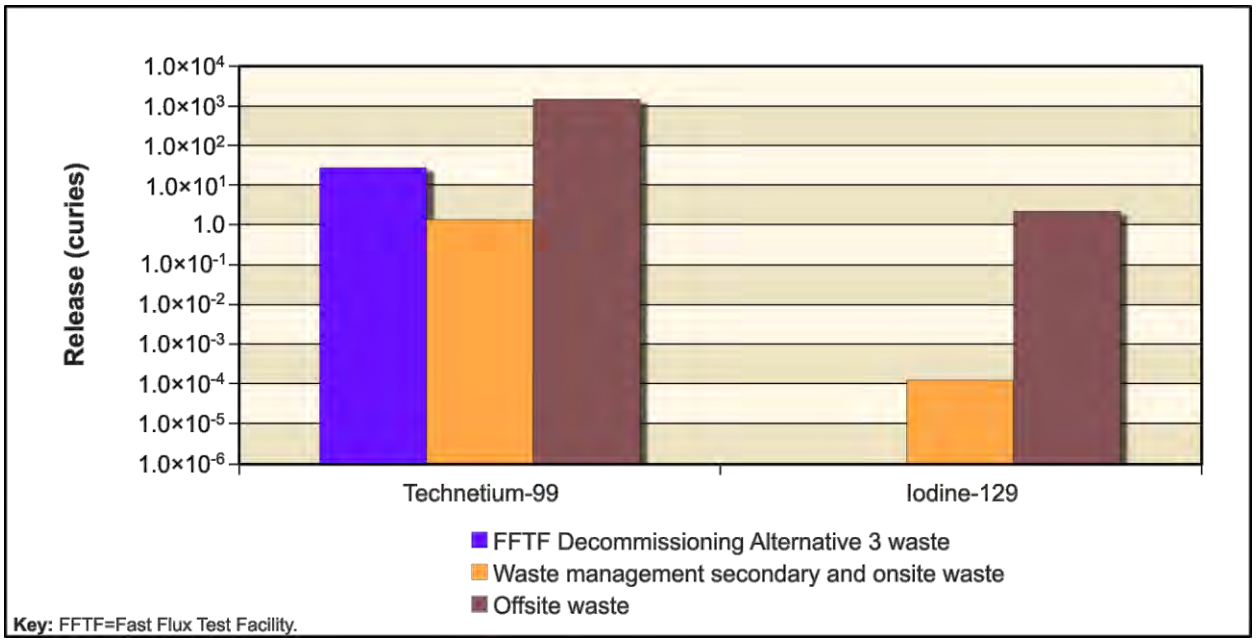


Figure 5–1064. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

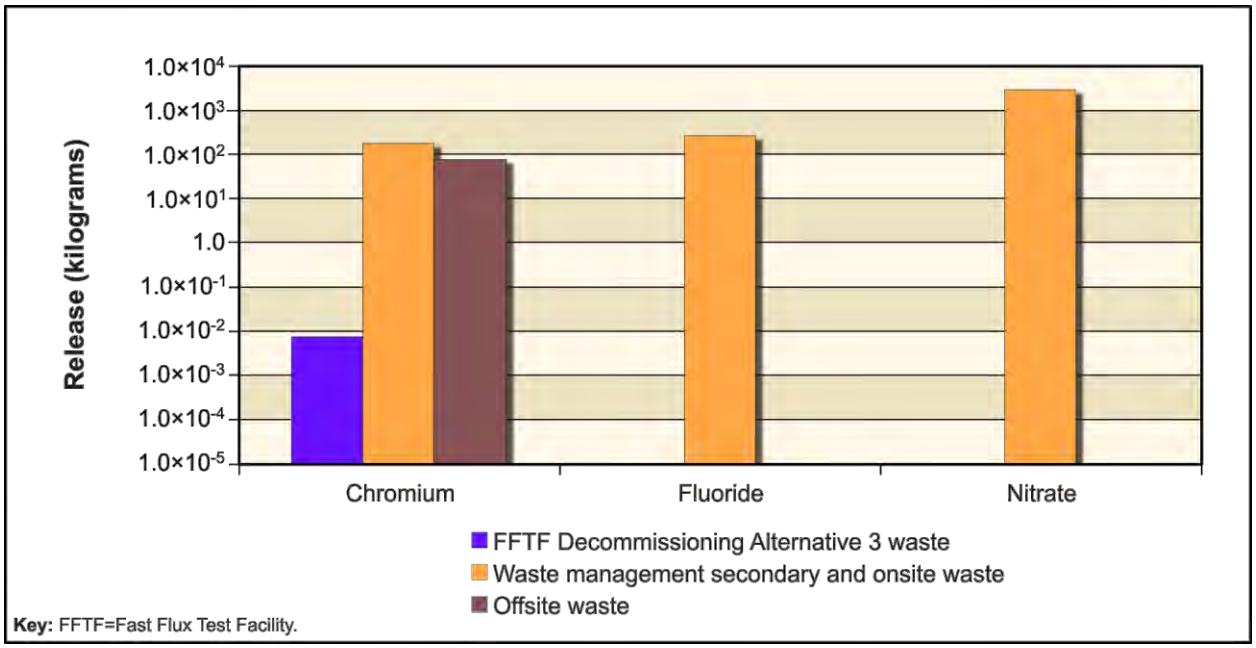


Figure 5–1065. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5–1066 shows the release to the vadose zone of the radiological risk drivers and Figure 5–1067, the chemical hazard drivers. Release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the post-disposal period). Radionuclide releases from the RPPDF to the vadose zone comprise technetium-99 (largest source) and iodine-129 (smallest source). Chemical hazard releases from the RPPDF comprise nitrate (largest source) and chromium (smallest source).

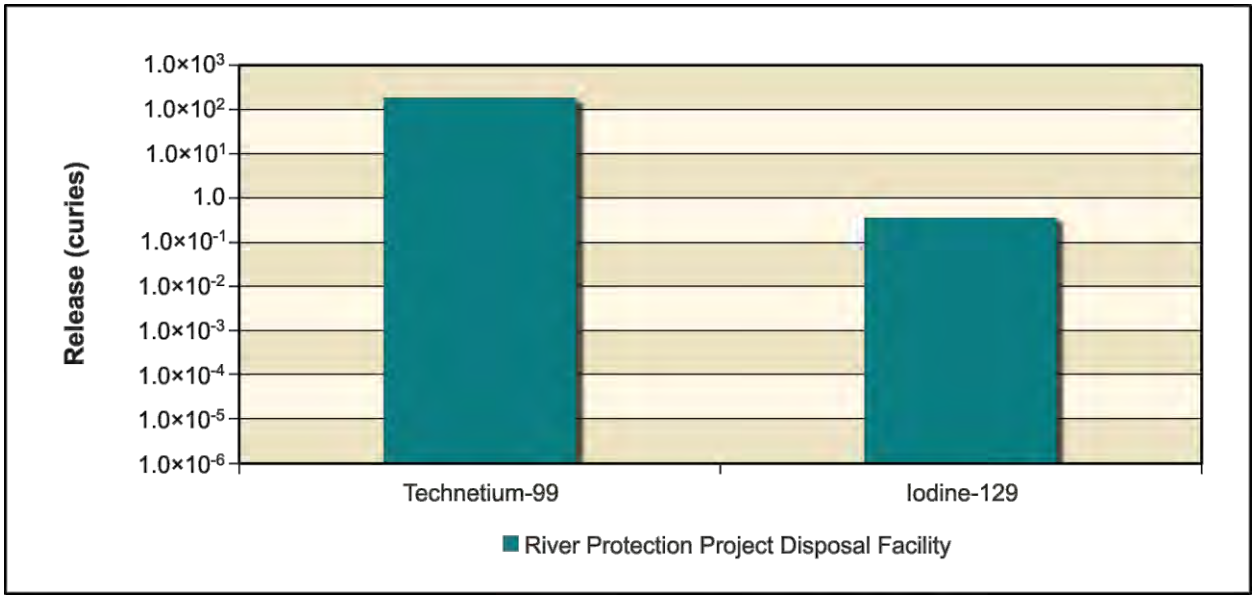


Figure 5–1066. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

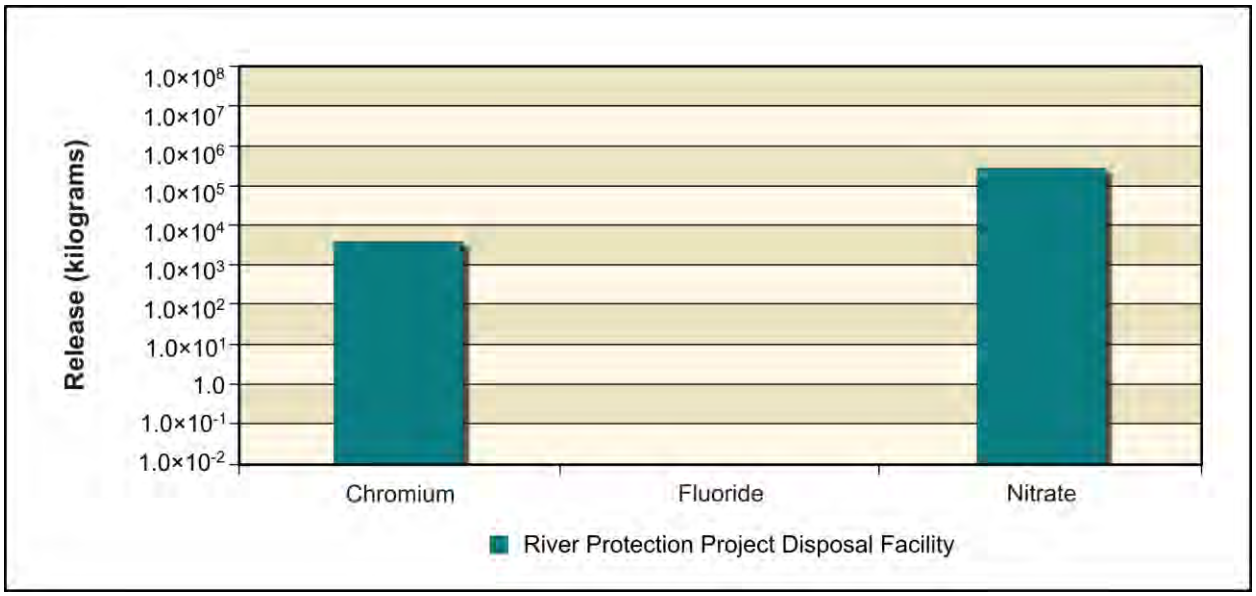


Figure 5–1067. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–1068 shows the release to groundwater of the radiological risk drivers and Figure 5–1069, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of

moisture movement through the vadose zone. For iodine-129, technetium-99, chromium, and nitrate, the amount released to groundwater is essentially equal to the amount released to the vadose zone. Overall, about 100 percent of the radionuclides (curies) released to the vadose zone during the period of analysis reach groundwater; approximately 100 percent of the chemicals (kilograms) reach groundwater.

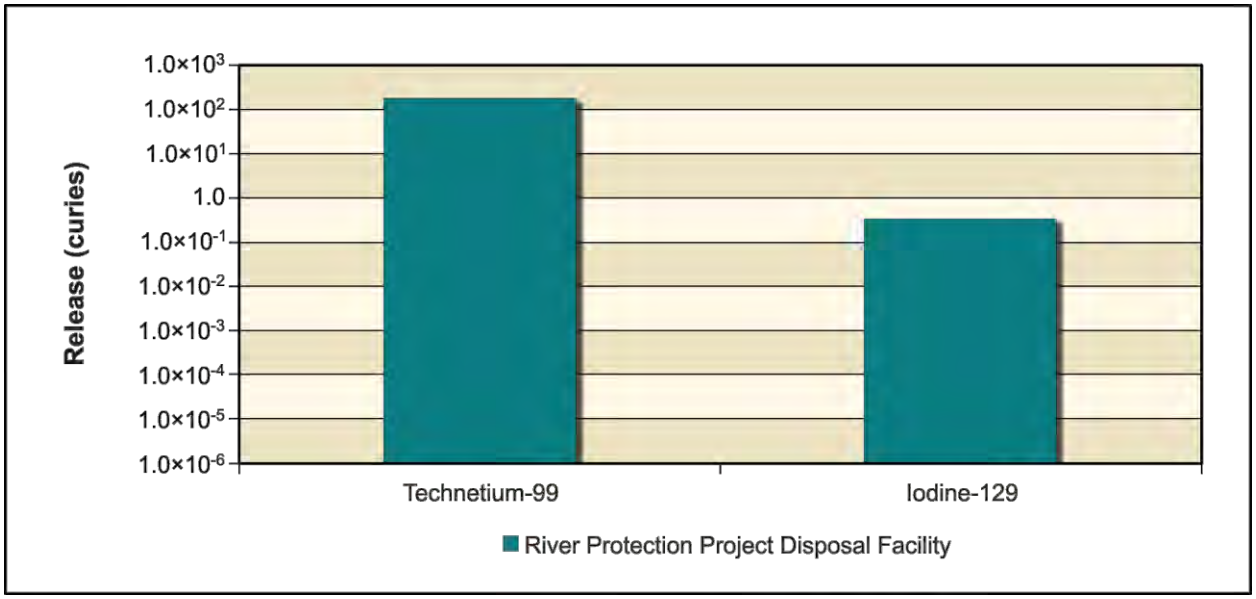


Figure 5–1068. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

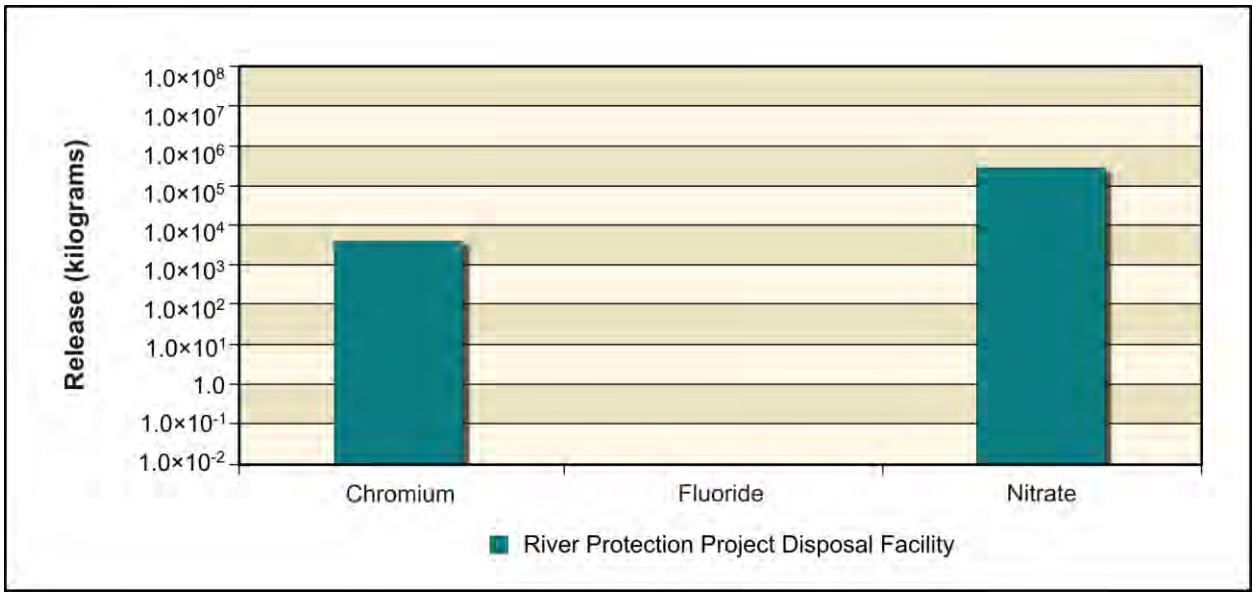


Figure 5–1069. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–1070 shows the release to the Columbia River of the radiological risk drivers and Figure 5–1071, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. For iodine-129, technetium-99, chromium, and nitrate, the amount released to the Columbia River is essentially equal to the amount released to groundwater. Overall, about 100 percent of the radionuclides (curies) released to groundwater during the period of analysis reach the river; likewise, approximately 100 percent of the chemicals (kilograms) reach the river.

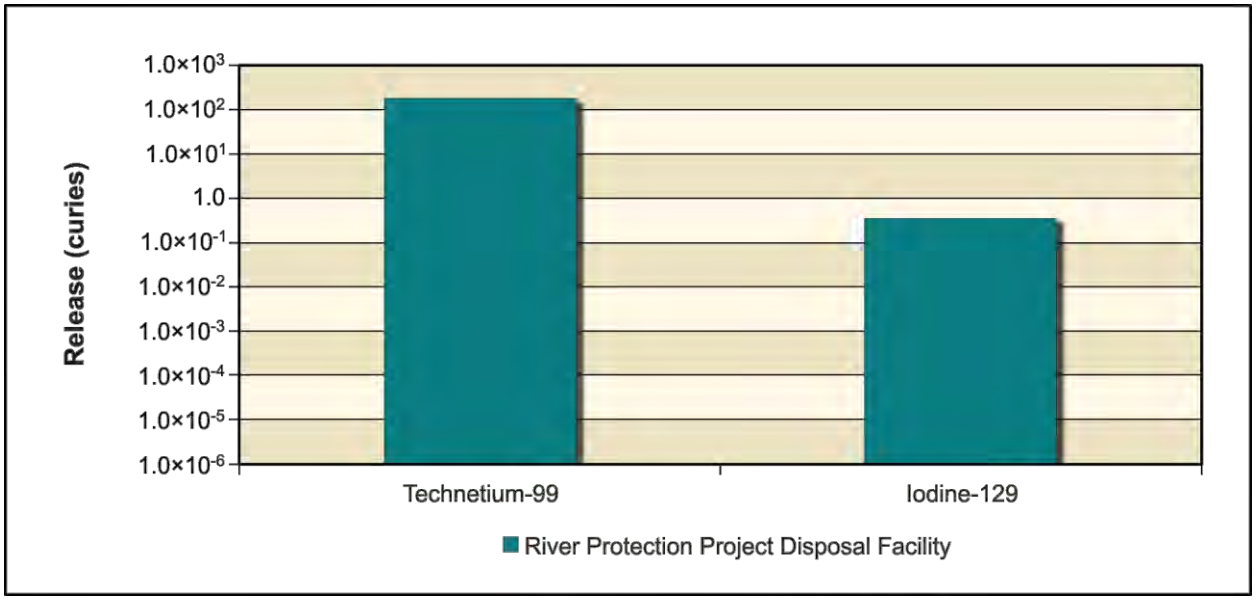


Figure 5–1070. Waste Management Alternative 3, Disposal Group 3, Base Case, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

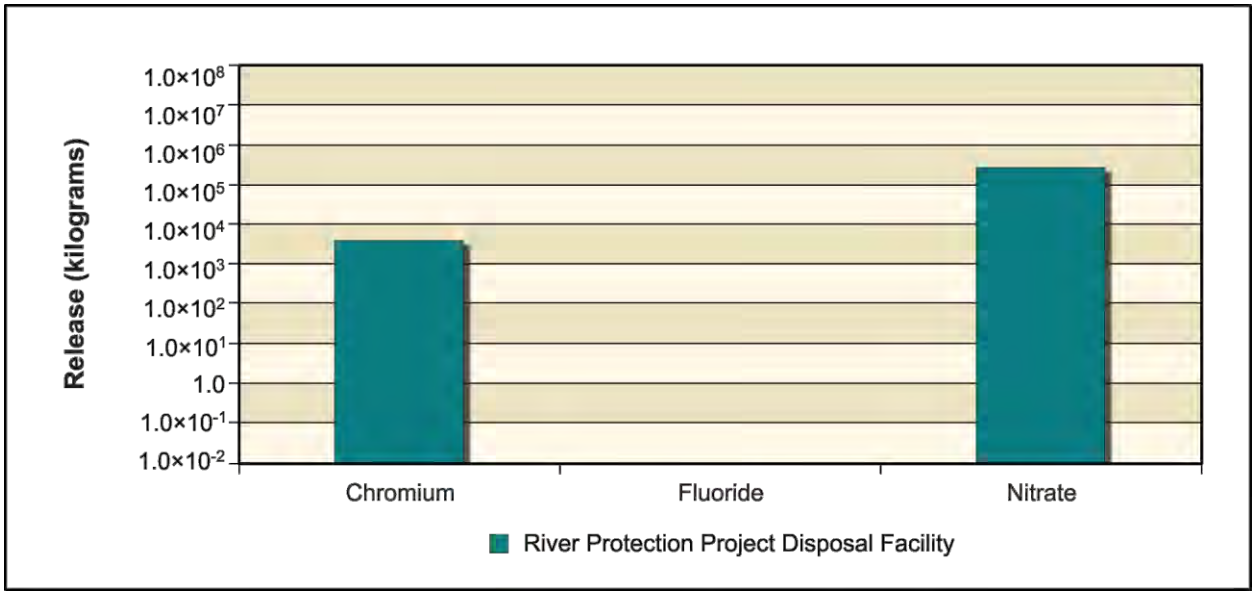


Figure 5–1071. Waste Management Alternative 3, Disposal Group 3, Base Case, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the impacts of Waste Management Alternative 3, Disposal Group 3, Base Case, in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations.

Figures 5–1072 through 5–1075 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate. Releases from IDF-East, IDF-West, and the RPPDF cause iodine-129 concentrations in groundwater to exceed benchmark concentrations in the earlier part of the period of analysis at the IDF-West barrier by about one order of magnitude and at the Core Zone Boundary and the Columbia River nearshore by less than one order of magnitude. Iodine-129 concentrations at the IDF-East barrier begin to increase beginning around CY 4500 and steadily increase before remaining constant at less than an order of magnitude below the benchmark concentration until the end of the simulation. Technetium-99 behavior is similar to that of iodine-129. Benchmark concentrations are exceeded by about one order of magnitude early in the analysis at the IDF-West barrier and by less than an order of magnitude at the Core Zone Boundary and Columbia River nearshore. Technetium-99 concentrations at the IDF-East barrier remain an order of magnitude below the benchmark concentration throughout the analysis period. Nitrate and chromium do not exceed benchmark concentrations at the IDF-West barrier, IDF-East barrier, RPPDF barrier, Core Zone Boundary, or Columbia River nearshore. Table 5–116 shows the maximum concentrations in groundwater. Exceedances of the benchmark concentrations occur primarily at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore, where high concentrations of technetium-99 and iodine-129 exceed their respective benchmarks. No other exceedances of benchmark concentration were recorded during the simulation.

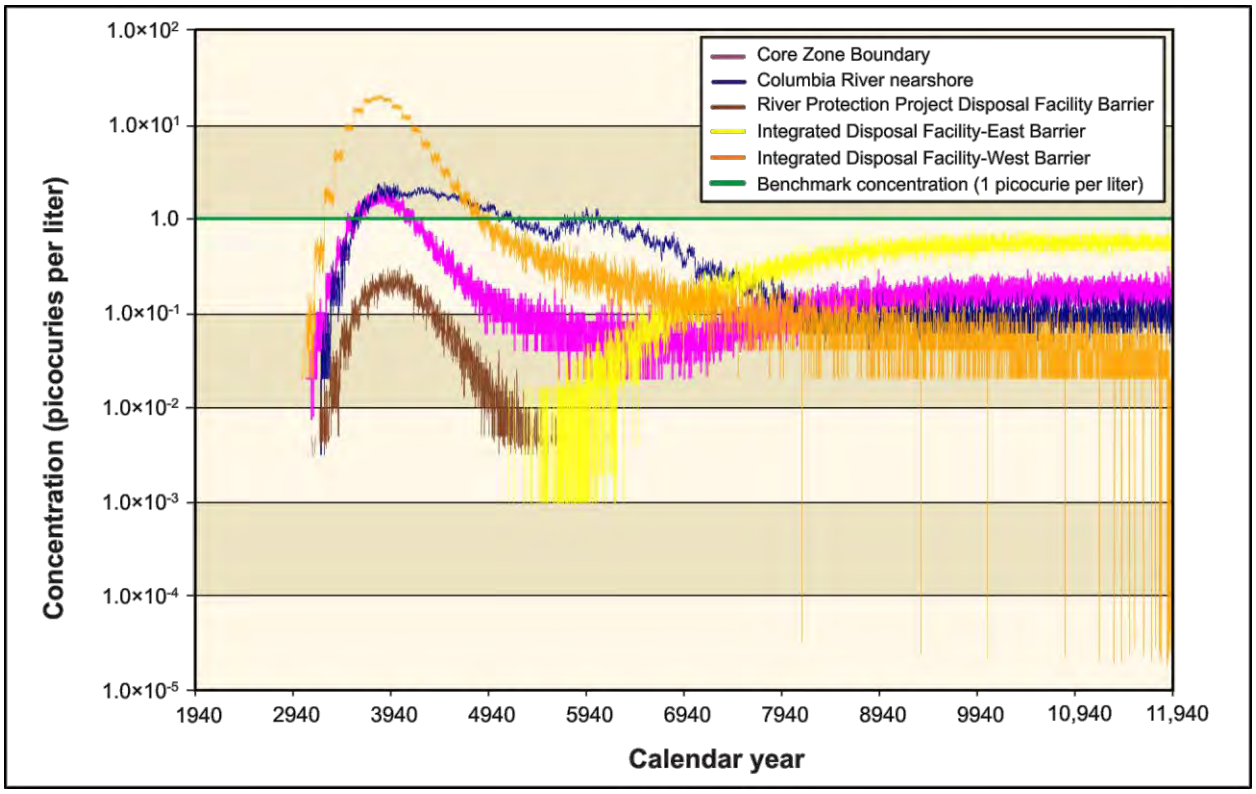


Figure 5–1072. Waste Management Alternative 3, Disposal Group 3, Base Case, Iodine-129 Concentration Versus Time

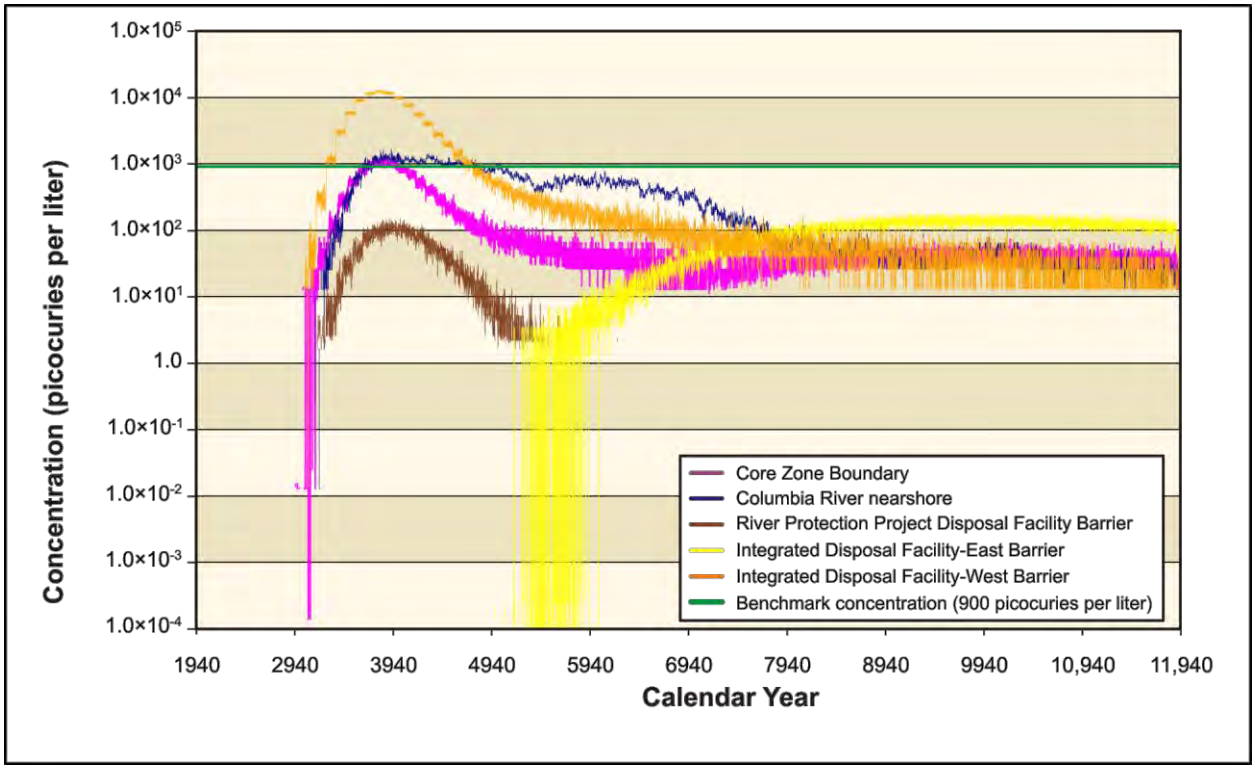


Figure 5–1073. Waste Management Alternative 3, Disposal Group 3, Base Case, Technetium-99 Concentration Versus Time

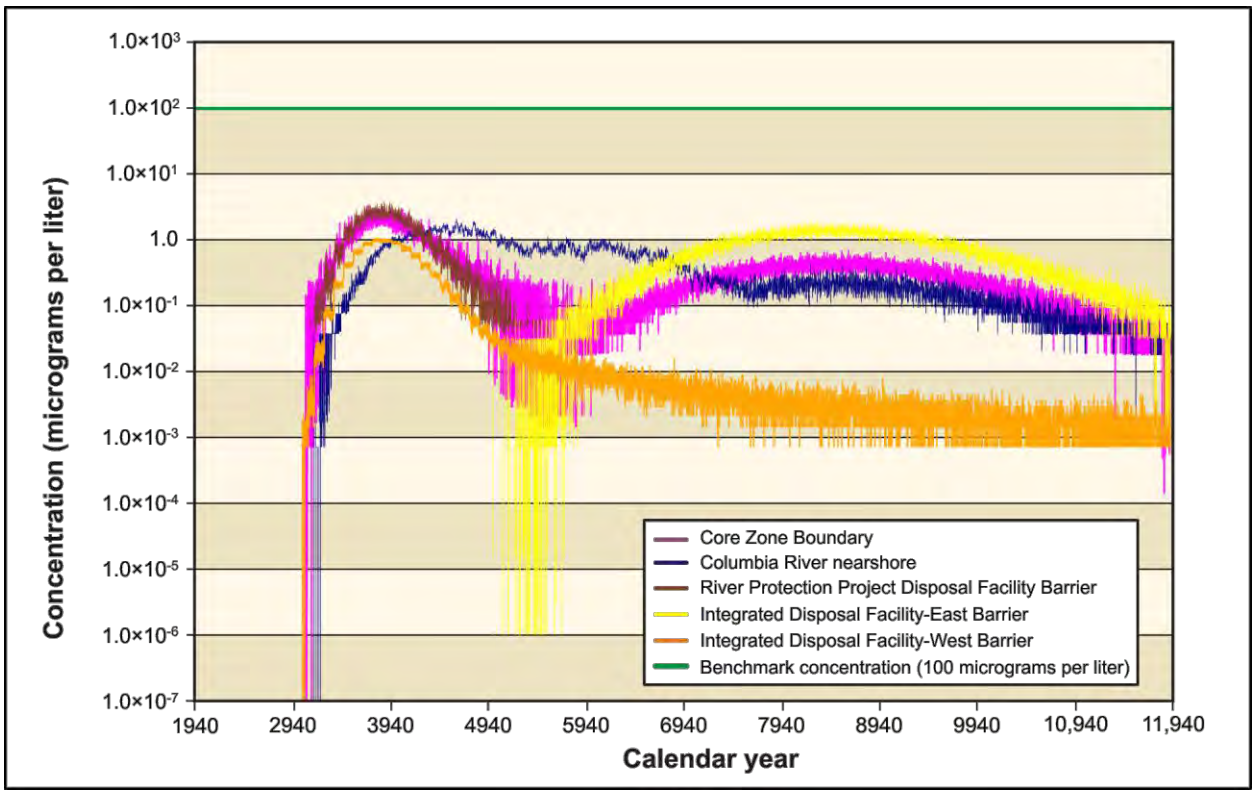


Figure 5–1074. Waste Management Alternative 3, Disposal Group 3, Base Case, Chromium Concentration Versus Time

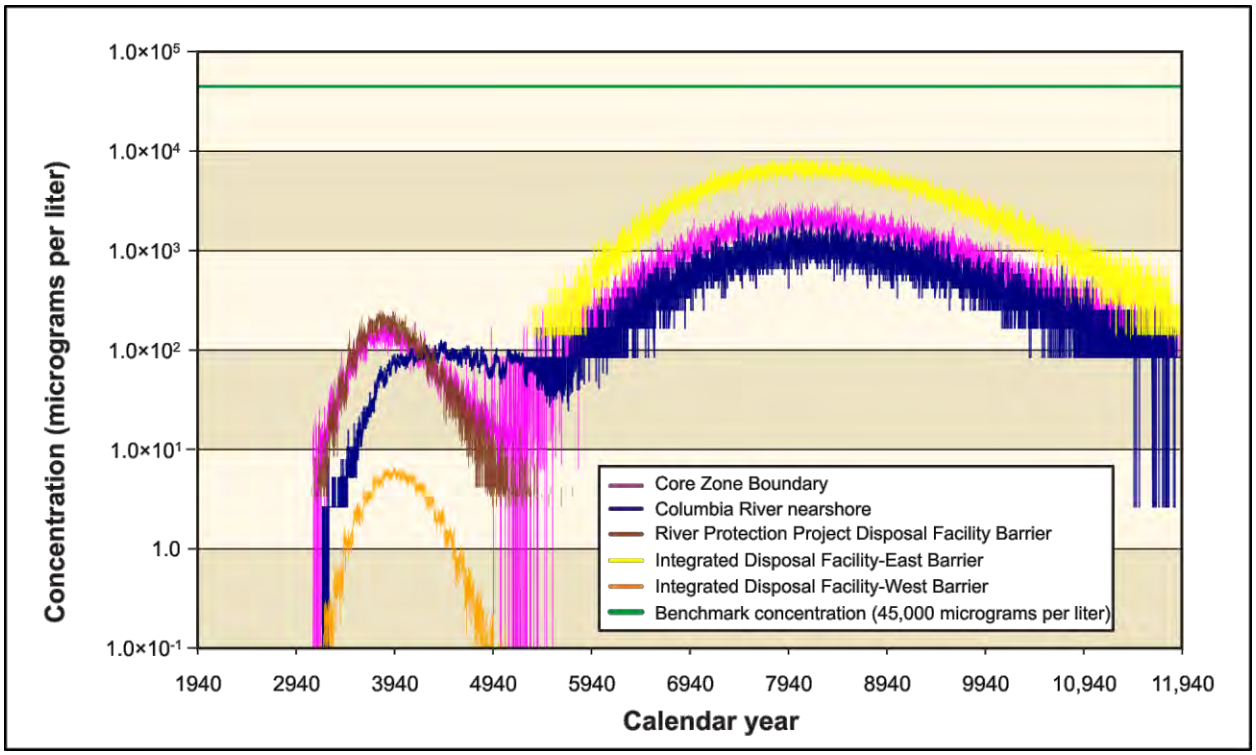


Figure 5–1075. Waste Management Alternative 3, Disposal Group 3, Base Case, Nitrate Concentration Versus Time

Table 5–116. Waste Management Alternative 3, Disposal Group 3, Base Case, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	194 (10,188)	**13,200** (3818)	147 (3896)	**1,370** (3859)	**1,670** (3920)	900
Iodine-129	0.8 (9907)	**20.6** (3794)	0.3 (4027)	**2.1** (3937)	**2.4** (3872)	1
Chemical (micrograms per liter)						
Chromium	2 (8251)	1 (3813)	4 (3869)	3 (3701)	2 (4608)	100
Fluoride	0 (1940)	1 (4014)	0 (3983)	0 (3937)	0 (4307)	4,000
Nitrate	9,590 (7983)	7 (3927)	248 (3783)	3,130 (7860)	2,140 (7994)	45,000

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.

Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figure 5–1076 shows concentration versus time for total uranium. Because total uranium moves slowly through the vadose zone, releases from IDF-East, IDF-West, and the RPPDF result in groundwater concentrations that are many orders of magnitude lower than benchmark concentrations. Total uranium concentrations, while minimal, rise late in the period of analysis and remain more than six orders of magnitude below the benchmark concentration during the 10,000-year simulation period.

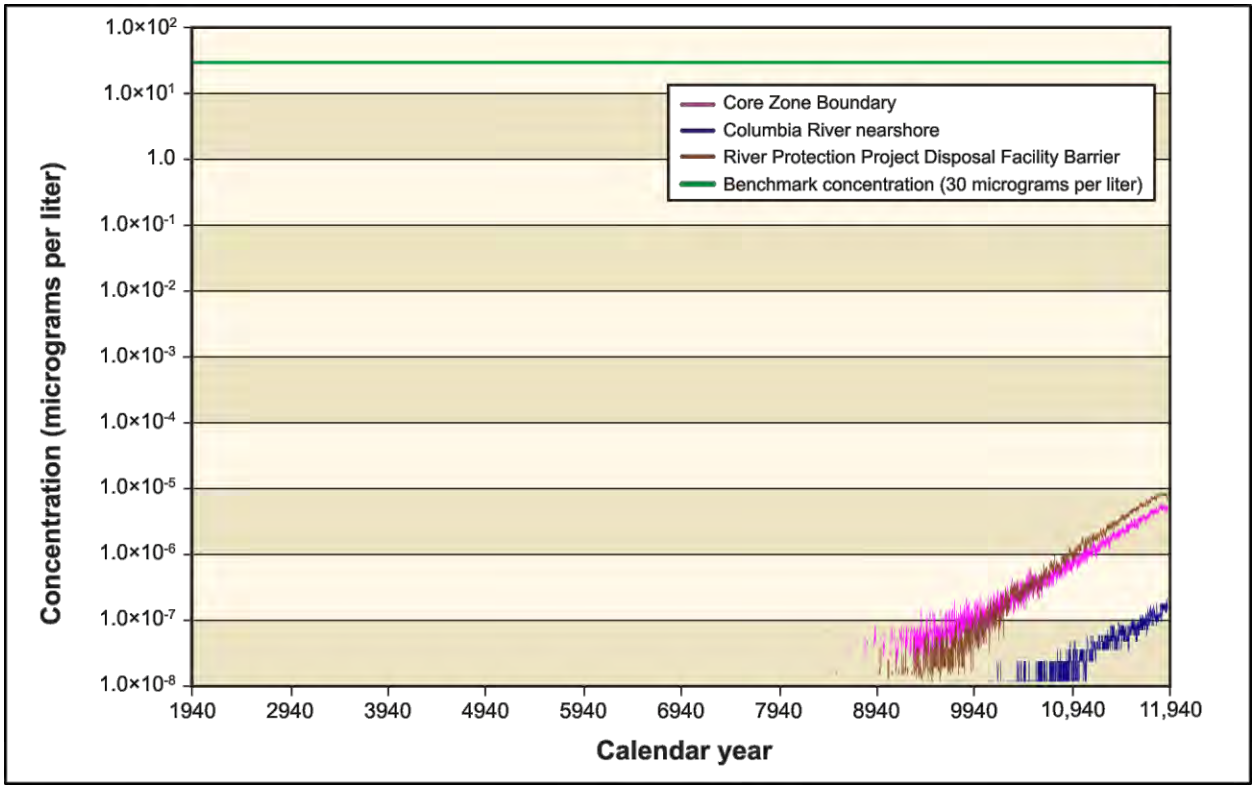


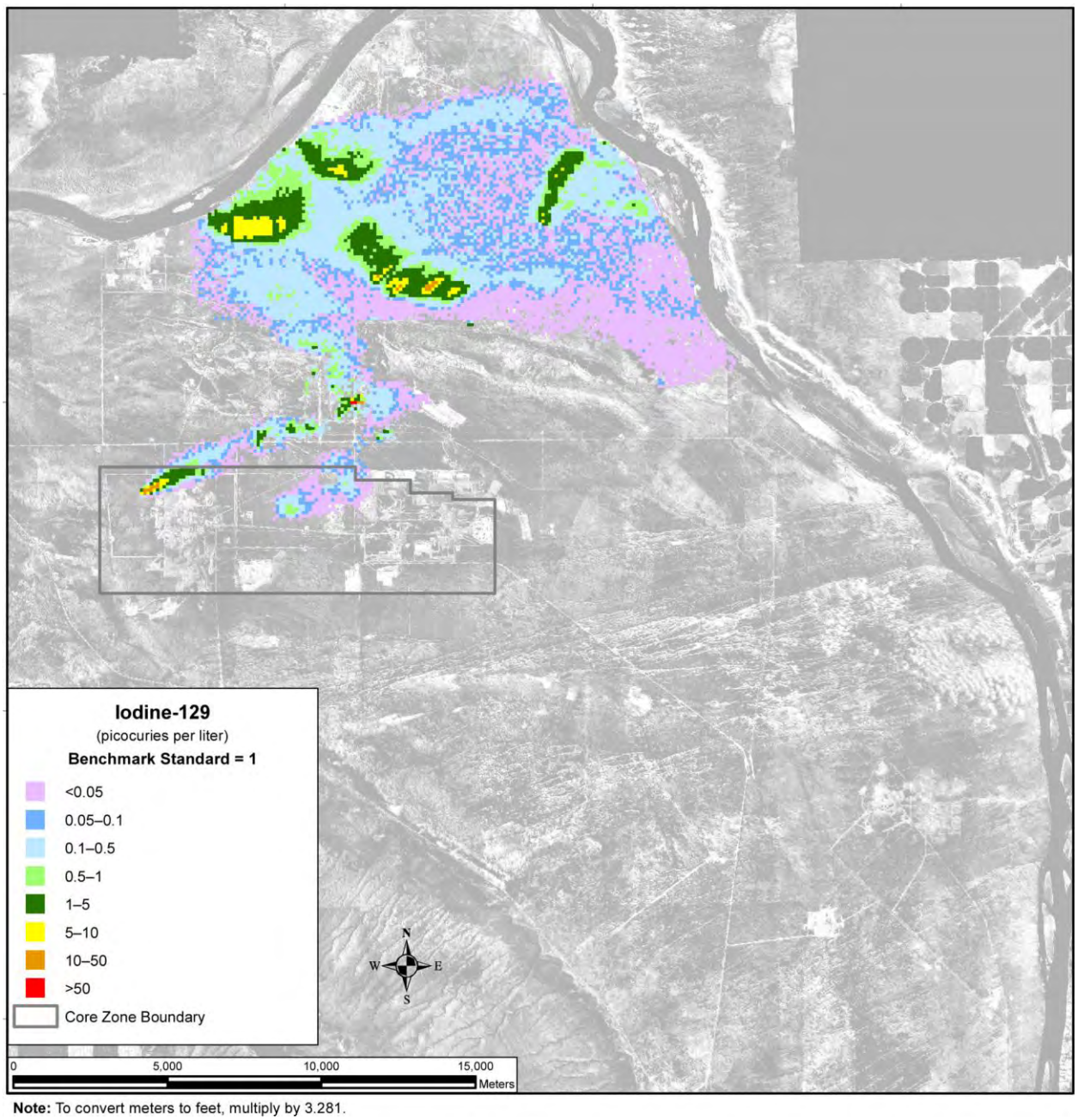
Figure 5–1076. Waste Management Alternative 3, Disposal Group 3, Base Case, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 3, Base Case, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations.

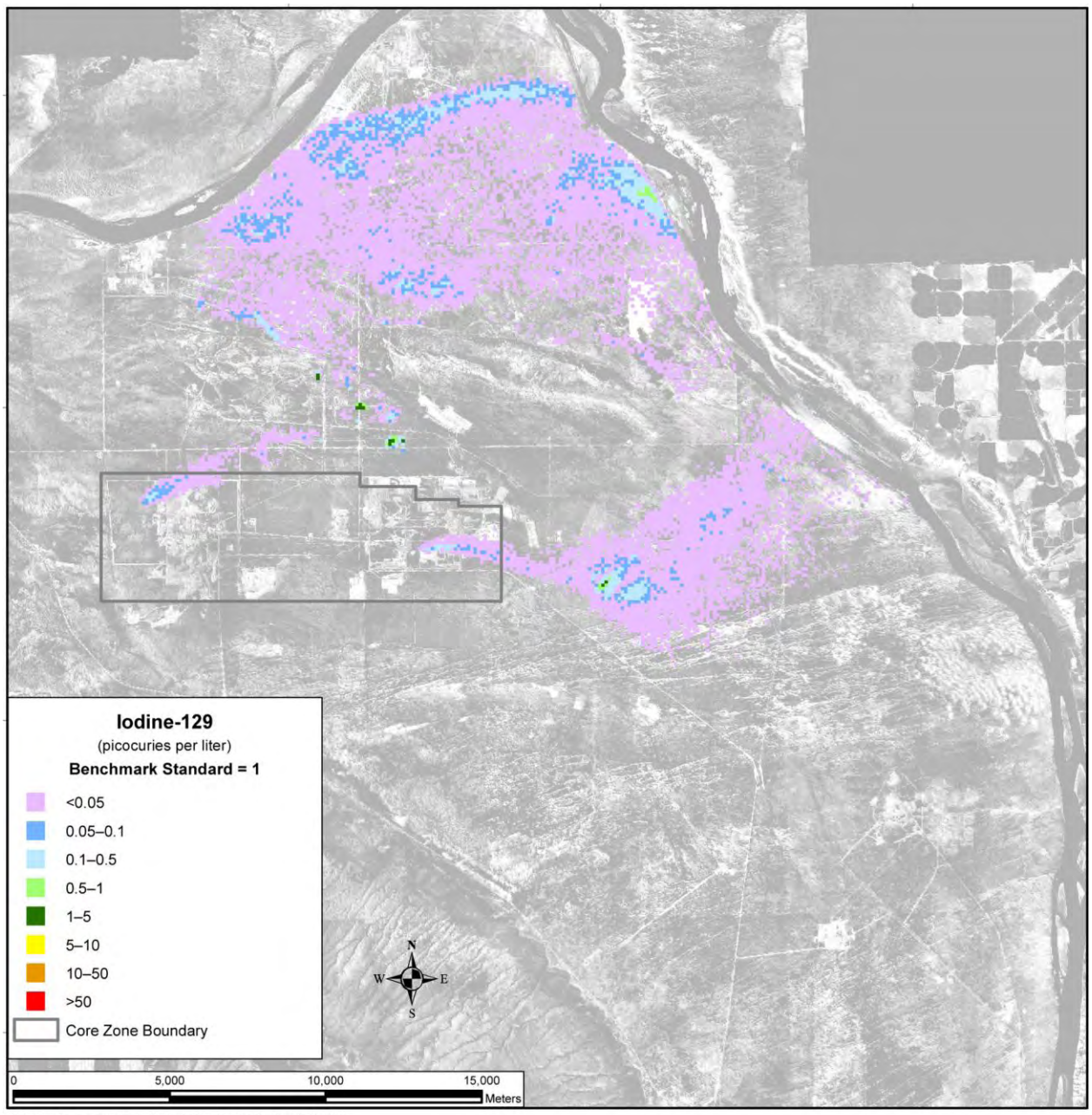
Figure 5–1077 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 3890. Releases from IDF-West and the RPPDF result in a groundwater plume starting in the Core Zone and heading north through Gable Gap. This plume exceeds the benchmark concentration at the Core Zone Boundary and north of the Core Zone Boundary by one to two orders of magnitude. In CY 7140, releases from IDF-East create a groundwater plume, not exceeding the benchmark, that extends from the 200-East Area east toward the Columbia River (see Figure 5–1078). Also by CY 7140, most of the IDF-West and RPPDF plume continues to move north and reaches the Columbia River. By CY 11,885, most of the mass in the IDF-East plume is still moving east toward the Columbia River with only small,

isolated pockets exceeding the benchmark concentration (see Figure 5–1079). Technetium-99 (see Figures 5–1080 through 5–1082) shows similar spatial distributions at selected times and exceeds the benchmark concentrations at approximately the same time and locations. Chromium (see Figures 5–1083 through 5–1085) and nitrate (see Figures 5–1086 through 5–1088) show similar spatial distributions at selected times, but the peak concentrations are lower than iodine-129 and technetium-99 relative to their respective benchmark concentrations. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., they move at the pore-water velocity).



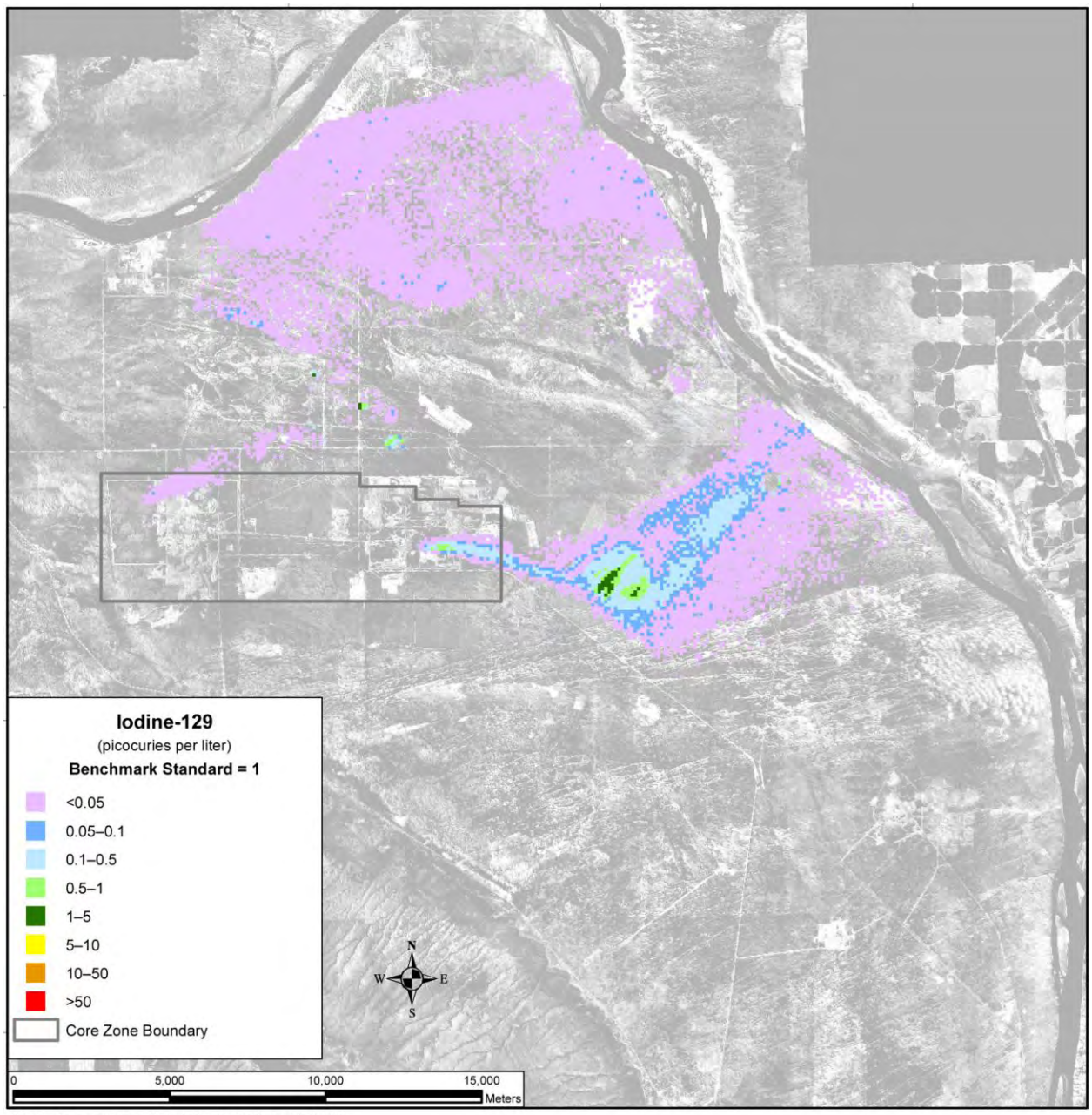
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1077. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



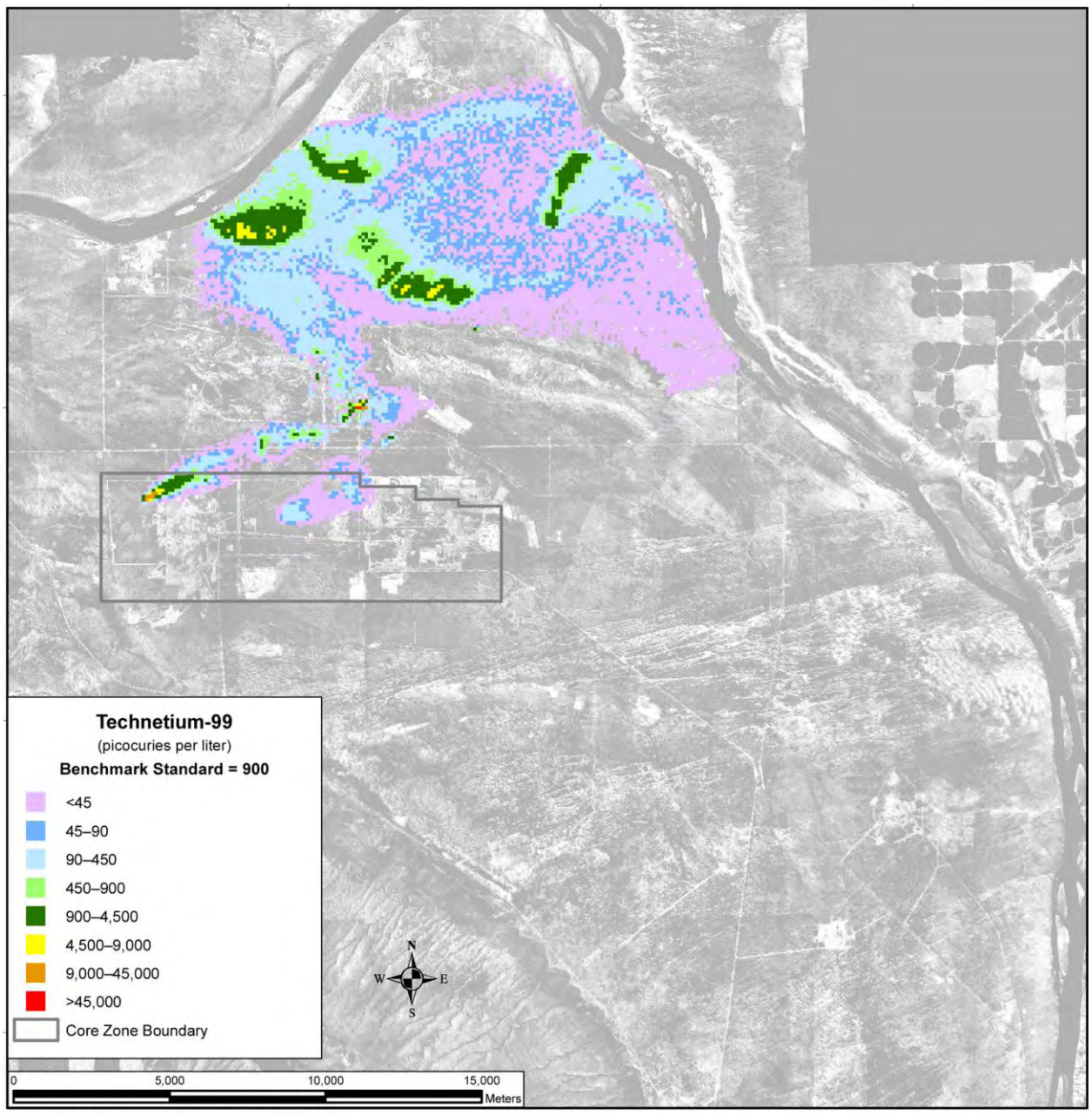
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1078. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



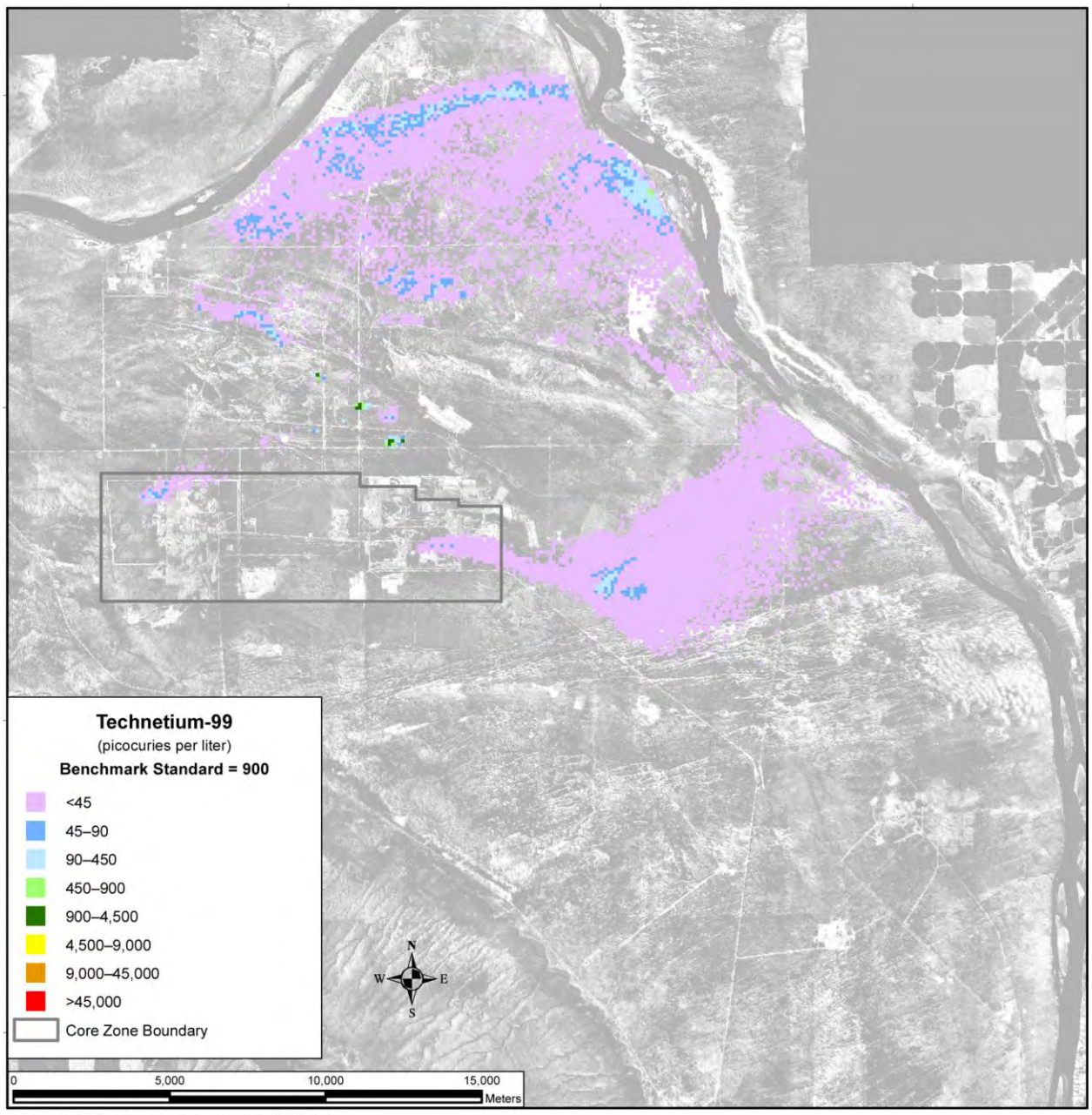
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1079. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



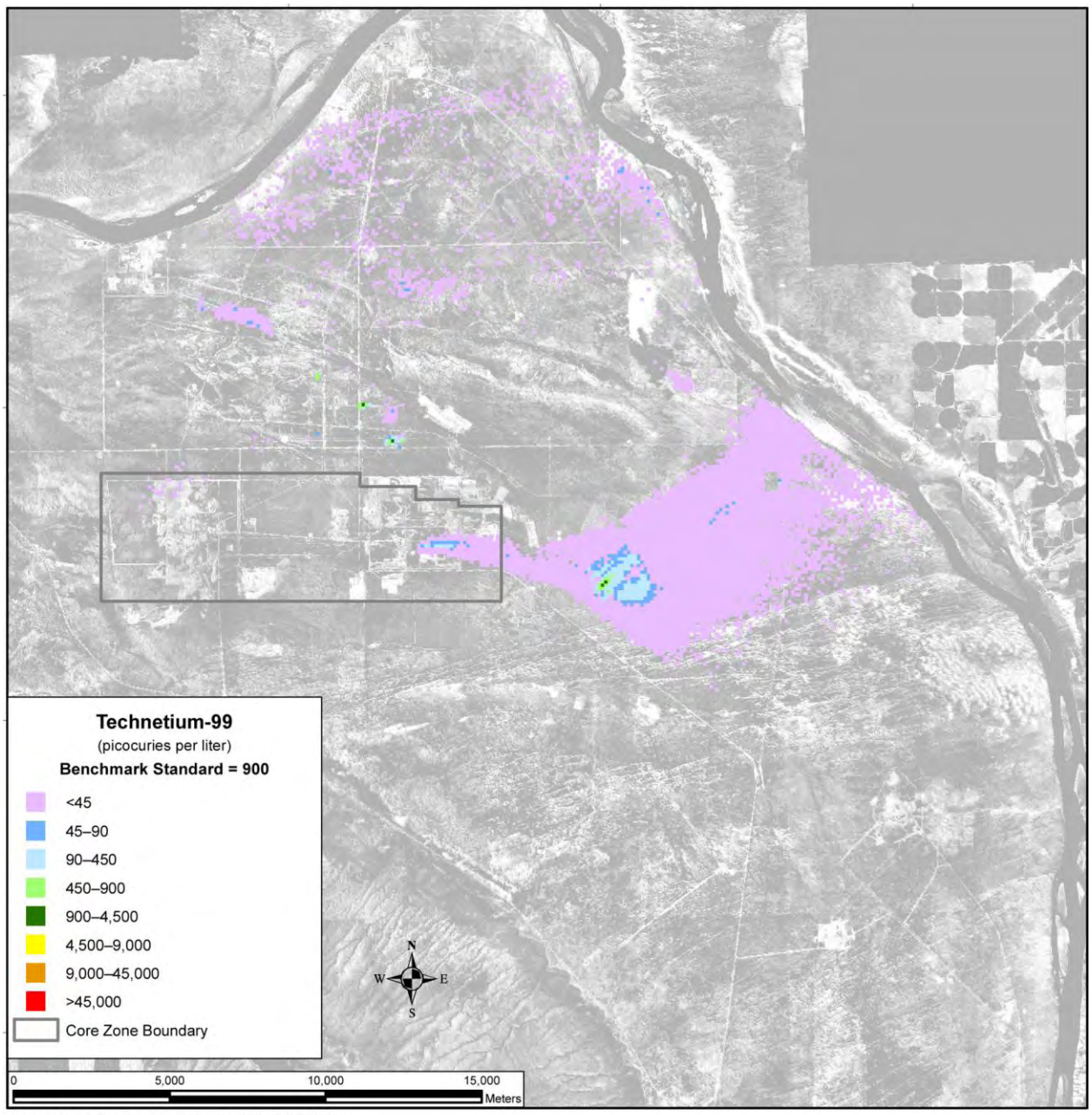
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1080. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



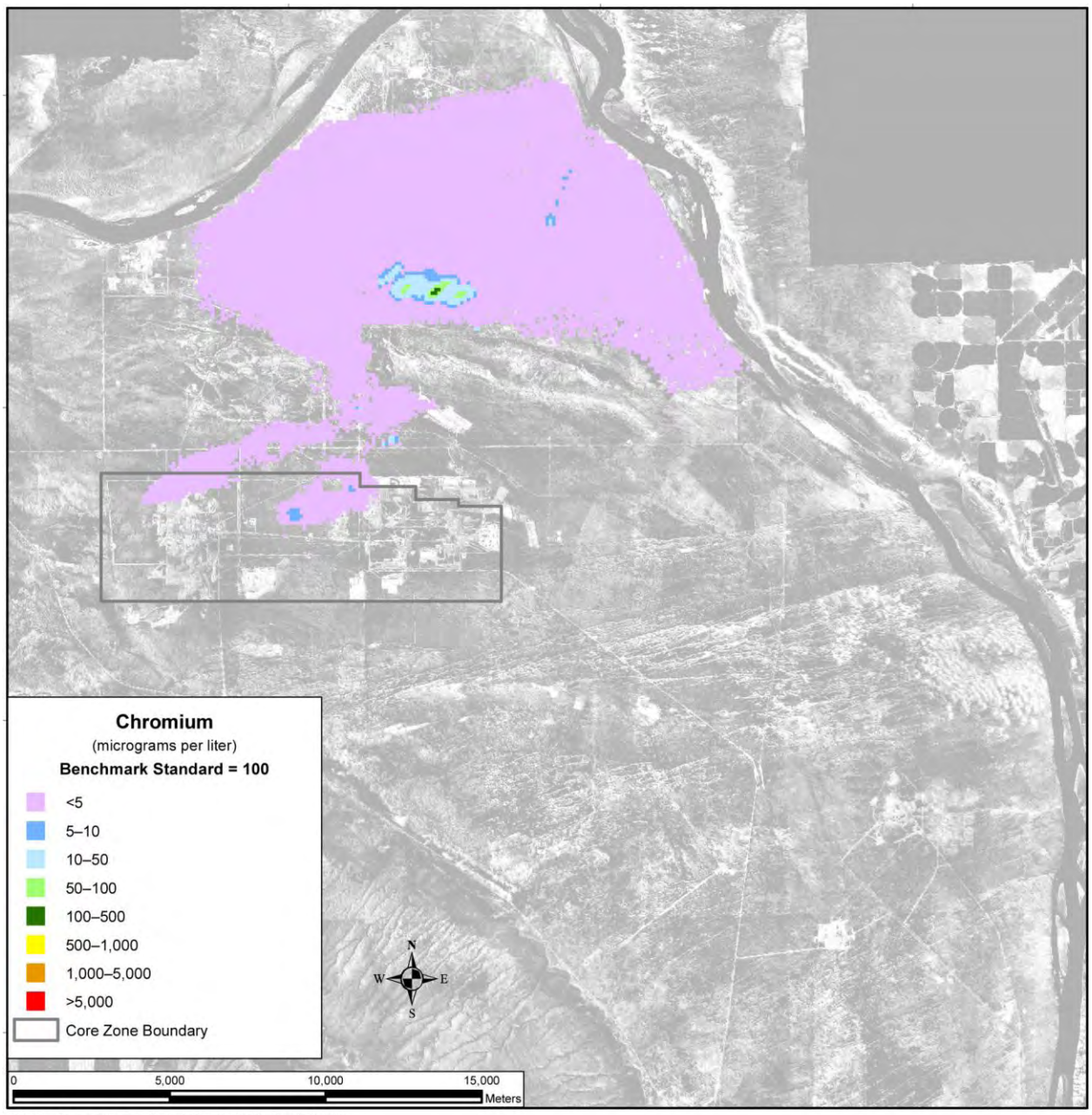
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1081. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



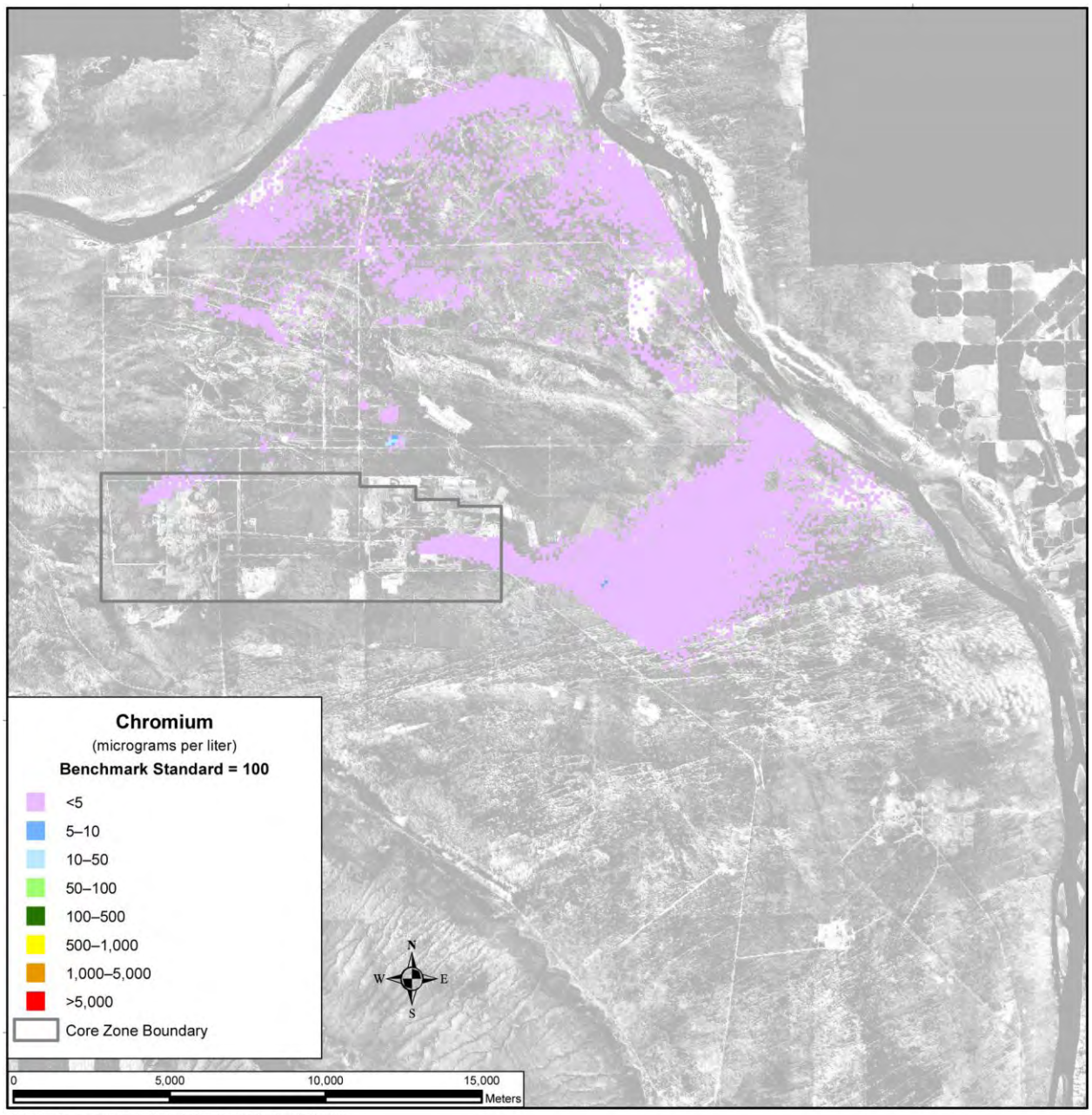
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1082. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



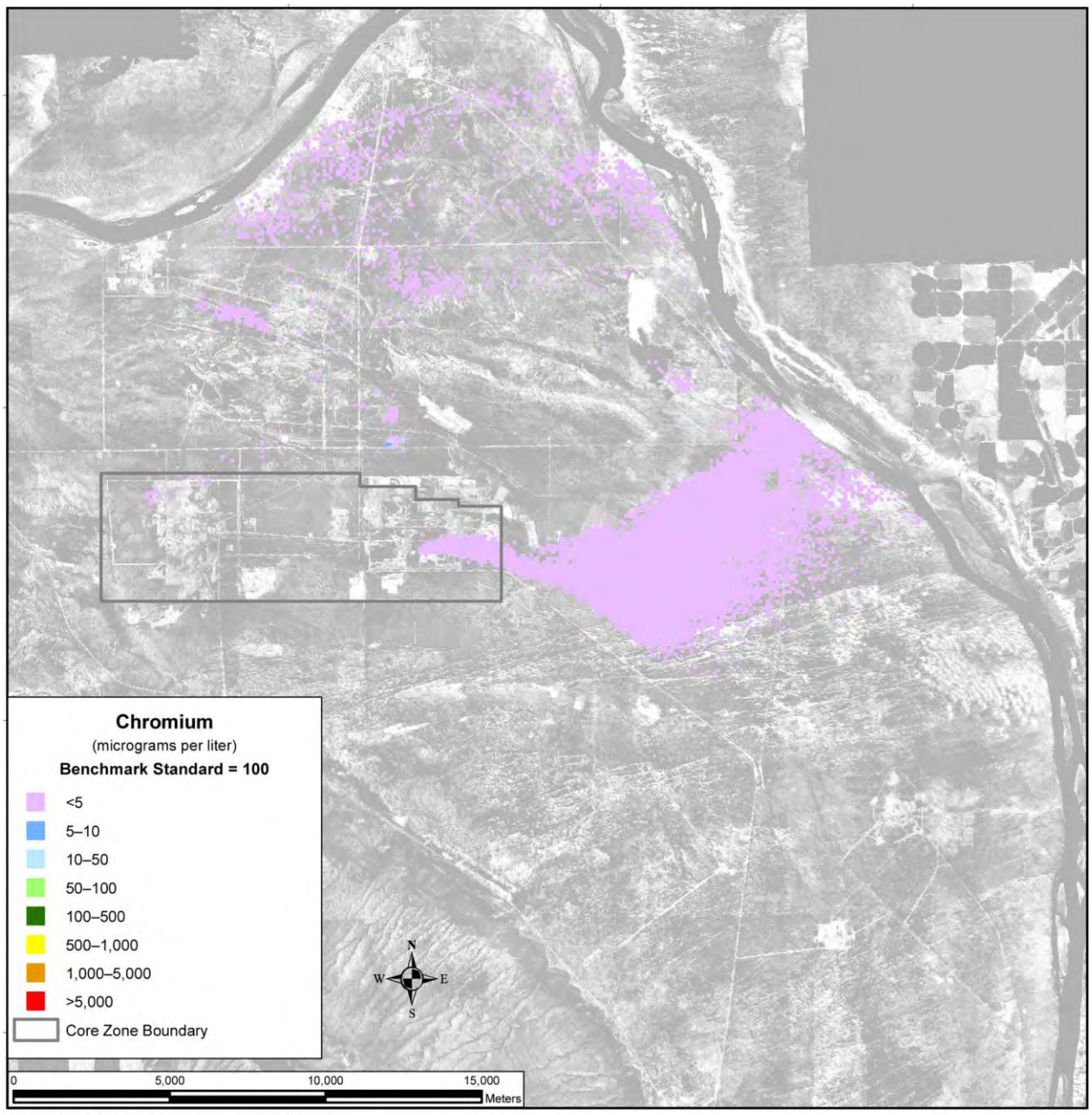
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1083. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



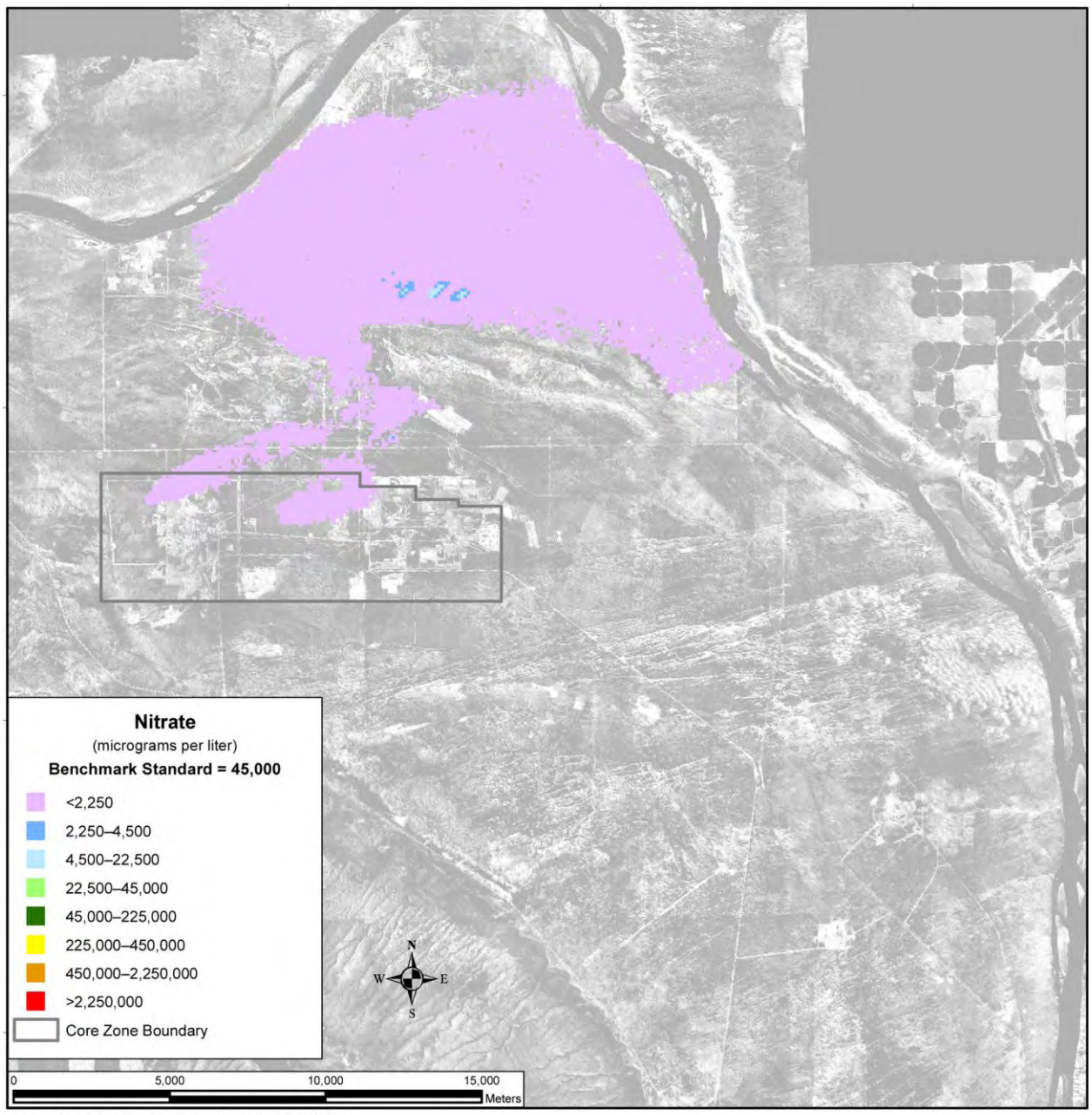
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1084. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



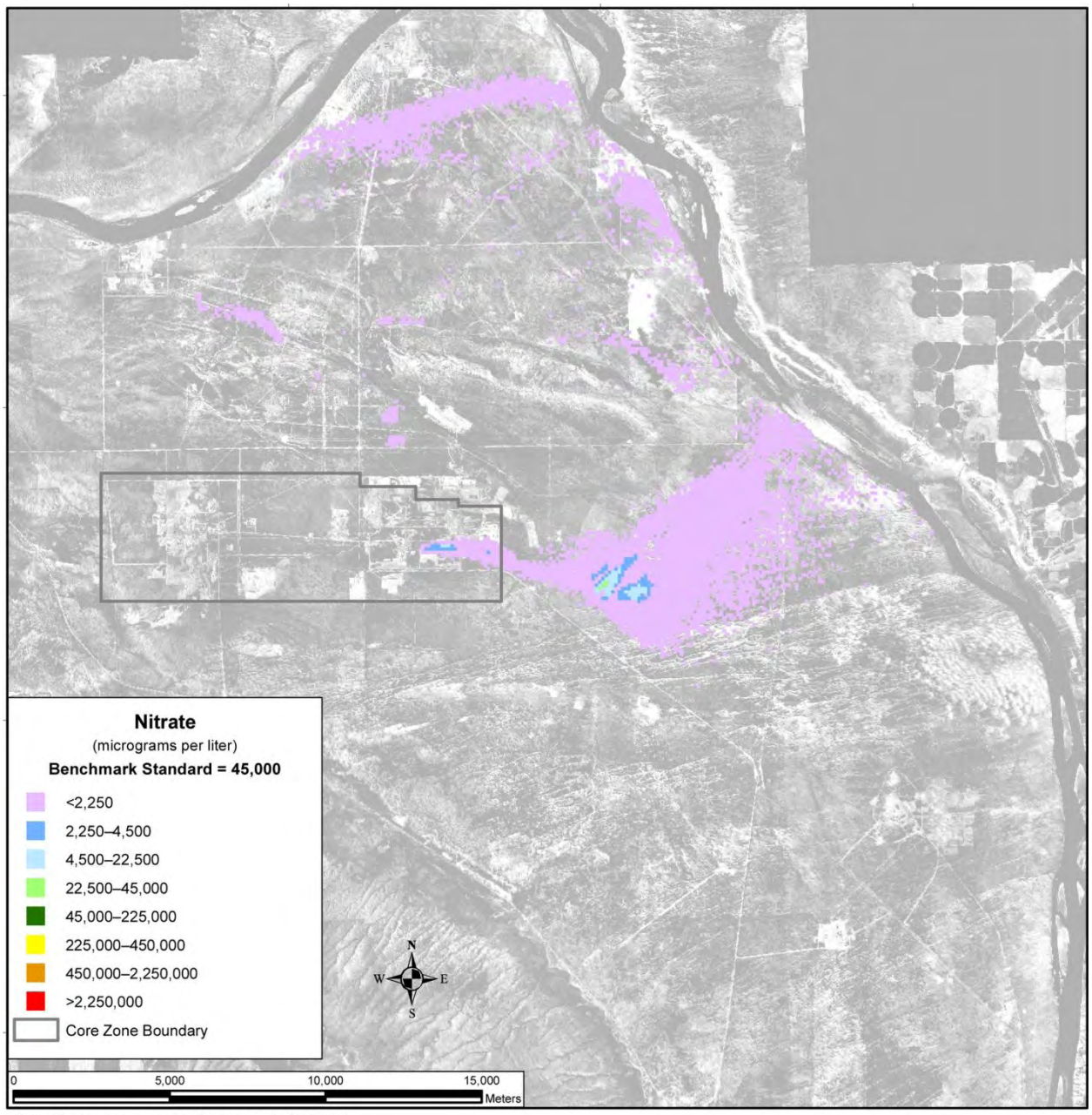
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1085. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



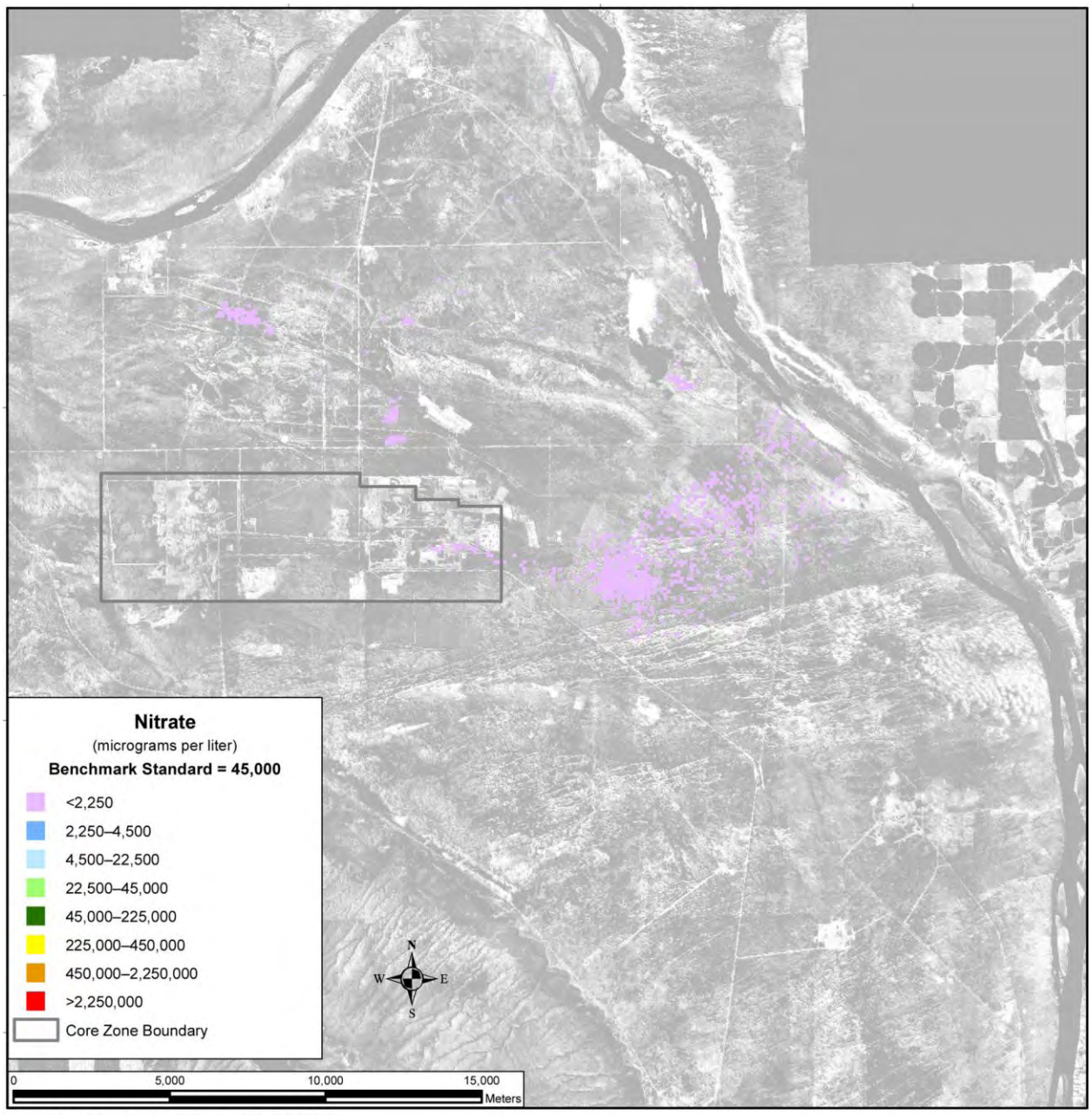
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1086. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



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

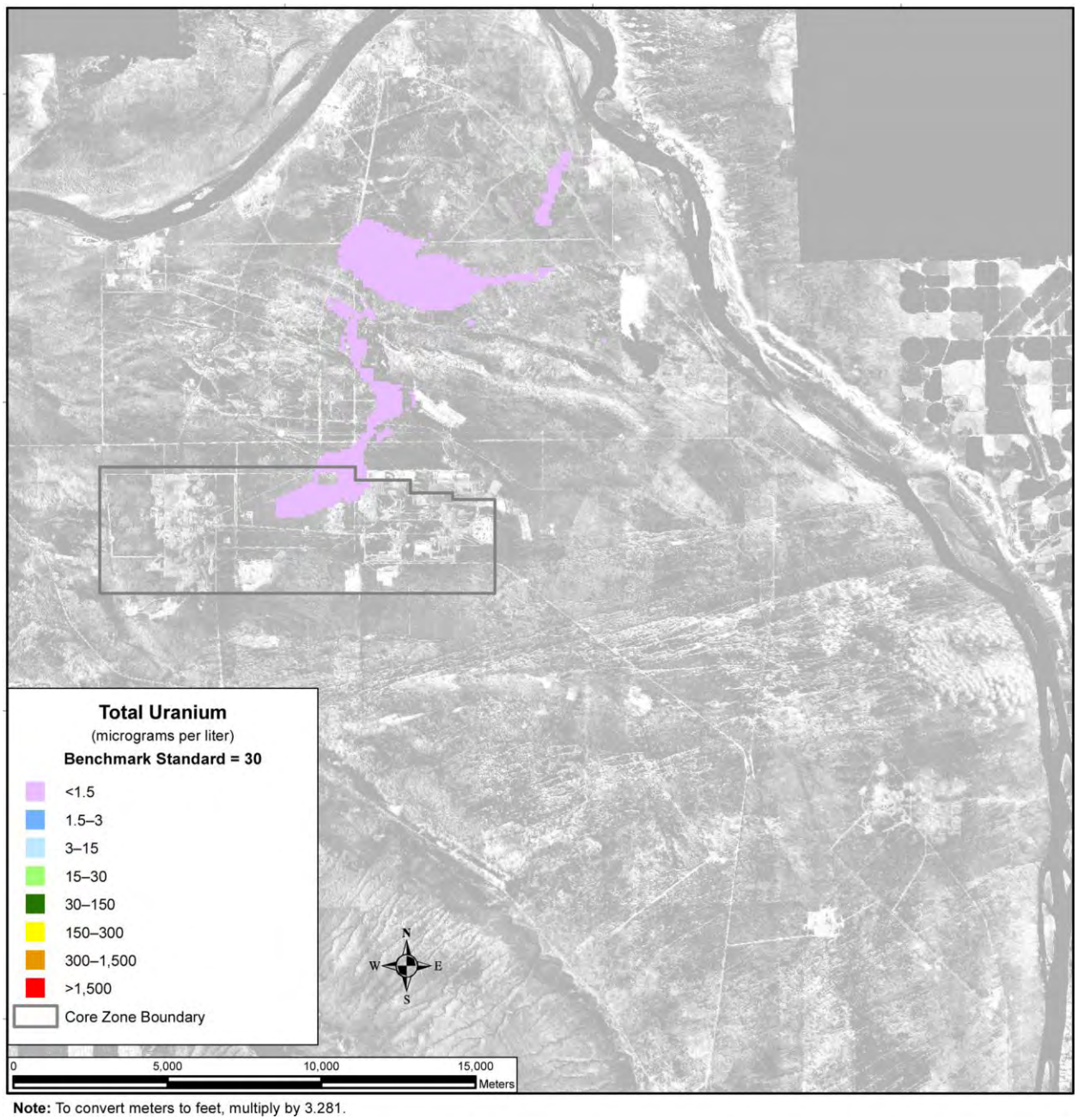
Figure 5–1087. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



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

Figure 5–1088. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 11,885

Total uranium shows a different spatial distribution over time. Uranium is not as mobile as those COPCs discussed above, moving about seven times more slowly than the pore-water velocity. As a result, travel times through the vadose zone are longer, release to the aquifer is delayed, and travel times through the aquifer to the Columbia River are longer. Figure 5–1089 shows the distribution of total uranium in CY 11,885. Releases from the RPPDF result in a groundwater plume that starts in the Core Zone and moves north through Gable Gap. However, concentrations in this plume do not exceed the benchmark concentration during the period of analysis.



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

Figure 5–1089. Waste Management Alternative 3, Disposal Group 3, Base Case, Spatial Distribution of Groundwater Total Uranium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 3, Base Case, in general, the inventories remaining in IDF-East, IDF-West, and the RPPDF, which are available for release to the environment at the start of the post-disposal period, are predominant contributors.

For the conservative tracers, concentrations slightly outside the Core Zone Boundary exceed benchmark standards by one to two orders of magnitude during most of the period of analysis. Concentrations at the Columbia River are about one to two orders of magnitude smaller. The intensities and areas of these groundwater plumes peak between CYs 3890 and 7140.

For total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentration of total uranium does not exceed the benchmark at the Core Zone Boundary or the Columbia River nearshore.

5.3.1.3.3.2 Disposal Group 3, Option Case

ACTIONS AND TIMEFRAMES INFLUENCING GROUNDWATER IMPACTS

Waste Management Alternative 3, Disposal Group 3, Option Case, was designed to accommodate the disposal of wastes generated under Tank Closure Alternative 6A, Option Case, and FFTF Decommissioning Alternative 2 or 3, as well as onsite and offsite waste.

For the long-term groundwater impacts analysis, two major periods have been identified for Waste Management Alternative 3, Disposal Group 3, Option Case, as follows:

- The disposal period was assumed to start with the onset of disposal operations in IDF-East and IDF-West in CY 2009 and in the RPPDF in CY 2022 and continue through CY 2165, when these disposal facilities would be operationally closed. During the disposal period, the materials in these permitted, operational facilities would not be available for release to the environment.

- The post-disposal period was assumed to start in CY 2166 and continue through the 10,000-year period of analysis. At the start of this period, materials in IDF-East, IDF-West, and the RPPDF would become available for release to the environment, and it was assumed for analysis purposes that barriers would be emplaced over the facilities to limit infiltration during the first 500 years of the post-disposal period.

COPC DRIVERS

A total of 40 COPCs were analyzed for Waste Management Alternative 3, Disposal Group 3, Option Case. Complete results are tabulated in Appendices M, N, and O, but this discussion of long-term impacts associated with Waste Management Alternative 3, Disposal Group 3, Option Case, is focused on the following COPC drivers:

- Radiological risk drivers: iodine-129, technetium-99, and uranium-238
- Chemical risk drivers: none
- Chemical hazard drivers: chromium, fluoride, nitrate, and total uranium

The COPC drivers for Waste Management Alternative 3, Disposal Group 3, Option Case, were selected by evaluating the risk or hazard associated with all 40 COPCs during the year of peak risk or hazard at the Core Zone Boundary during the 10,000-year period of analysis and selecting the major contributors. This process is described in Appendix Q. Uranium-238 and total uranium were added to the COPC drivers; although their contributions to risk and hazard are not dominant during the year of peak risk or hazard,

they become major contributors toward the end of the period of analysis. The radiological risk drivers listed above account for essentially 100 percent of the radiological risk. No chemical risk is predicted. The chemical hazard drivers above account for 100 percent of the chemical hazard associated with Waste Management Alternative 3, Disposal Group 3, Option Case.

The COPC drivers that are discussed in detail in this section fall into two categories. Iodine-129, technetium-99, chromium, and nitrate are all mobile (i.e., they move with groundwater) and long-lived (relative to the 10,000-year period of analysis), or stable. They are essentially conservative tracers. Uranium-238 and total uranium are long-lived, or stable, but are not as mobile as the other COPC drivers. These constituents move about seven times more slowly than groundwater. As the analyses of release, concentration versus time, and spatial distribution of the COPC drivers are presented, the distinct behavior of these groups will become apparent.

The other COPCs that were analyzed do not significantly contribute to drinking water risk at the Core Zone Boundary during the period of analysis because of high retardation factors (i.e., retention in the vadose zone), short half-lives (i.e., rapid radioactive decay), or a combination of both factors.

ANALYSIS OF RELEASE AND MASS BALANCE

This section presents the impacts of Waste Management Alternative 3, Disposal Group 3, Option Case, in terms of the total amount of COPCs released from IDF-East, IDF-West, and the RPPDF to the vadose zone, groundwater, and the Columbia River during the 10,000-year period of analysis. Releases of radionuclides are totaled in curies; chemicals, in kilograms. Three subtotals are plotted in Figures 5–1090 through 5–1095, representing releases from IDF-East, which include ETF-generated secondary waste, PPF glass, retired melters, and tank closure secondary waste; releases from IDF-West, which include FFTF Decommissioning Alternative 3 waste, waste management secondary and onsite waste, and offsite waste; and releases from the RPPDF. Note that the release amounts are plotted on a logarithmic scale to facilitate visual comparison of releases that vary over seven orders of magnitude within the same series of figures.

200-East Area Integrated Disposal Facility

Figure 5–1090 shows the release from IDF-East to the vadose zone of the radiological risk drivers and Figure 5–1091, the chemical hazard drivers. For technetium-99, chromium, and nitrate in grouted waste forms, the release to the vadose zone is controlled by the inventory (i.e., all of the inventory is released during the period of analysis). Tank closure secondary waste is the predominant source of technetium-99 and chromium. ETF-generated secondary waste is the predominant source of iodine-129 and nitrate.

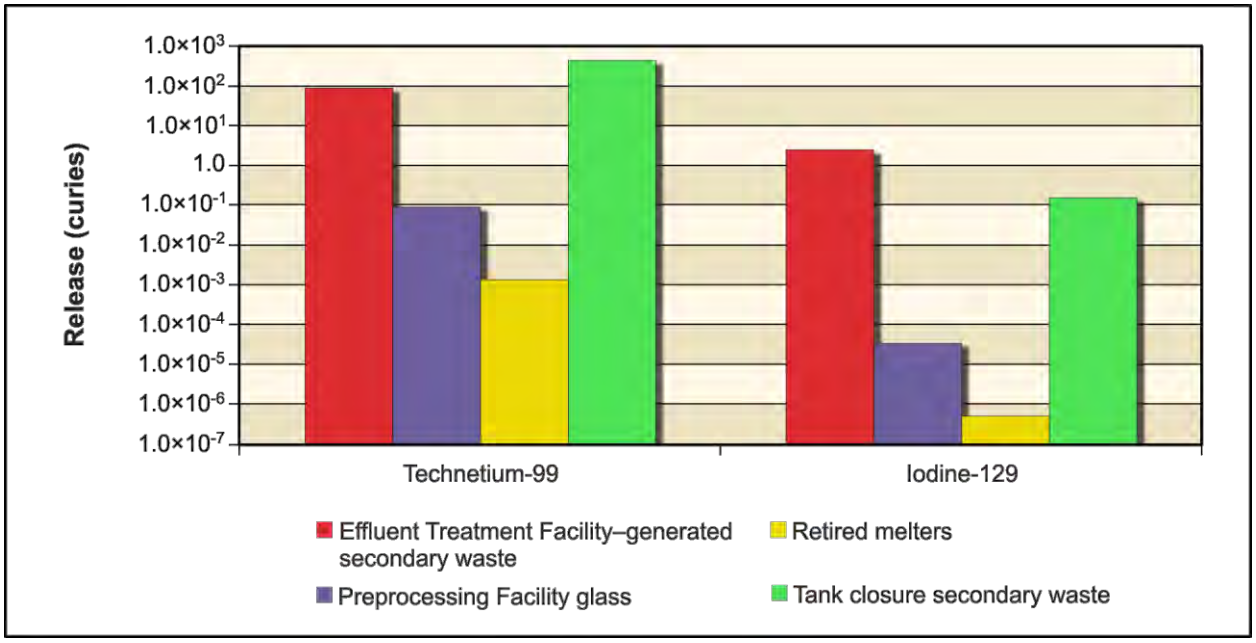


Figure 5–1090. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

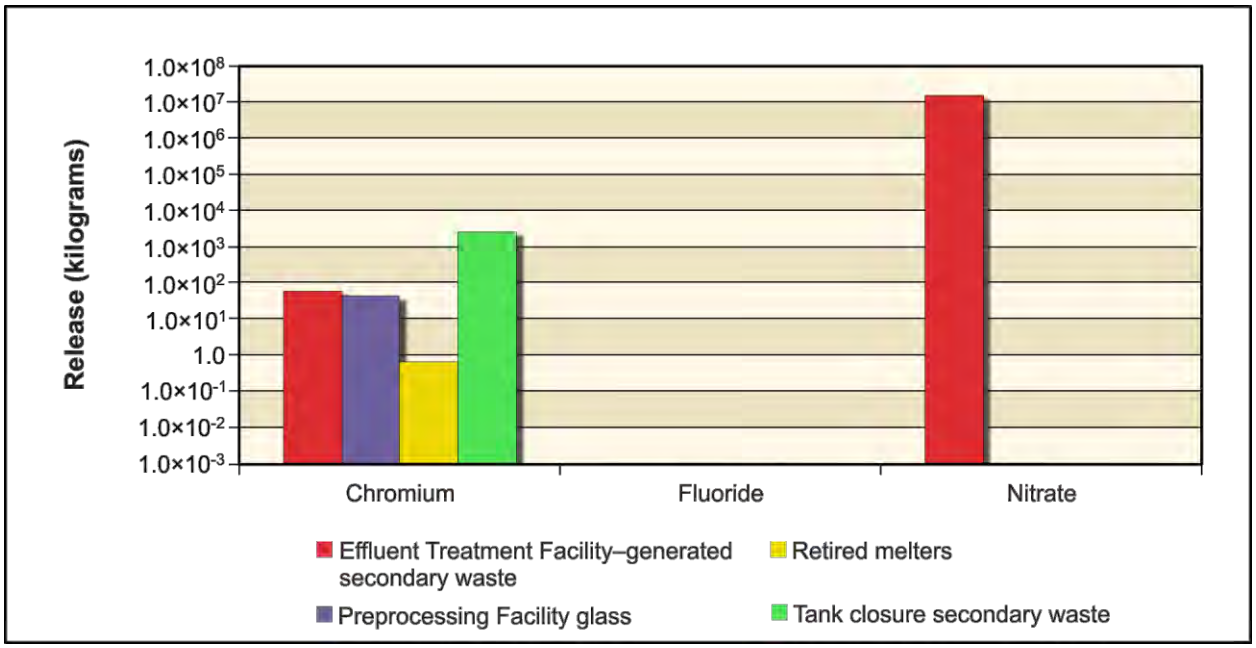


Figure 5–1091. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Vadose Zone

Figure 5–1092 shows the release from IDF-East to groundwater of the radiological risk drivers and Figure 5–1093, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. Nearly all (92 percent) of the technetium-99 released from ETF-generated secondary waste to the vadose zone reaches groundwater during the period of analysis, but only 40 to 50 percent of the technetium-99 from other sources and iodine-129 released to the vadose zone reaches groundwater. Only 45 to 50 percent of the chromium from PPF glass and retired melters reaches groundwater. Essentially all (99 percent) of the chromium

released from ETF-generated secondary waste and tank closure secondary waste reaches groundwater. Nearly all (greater than 99 percent) nitrate released to the vadose zone reaches groundwater.

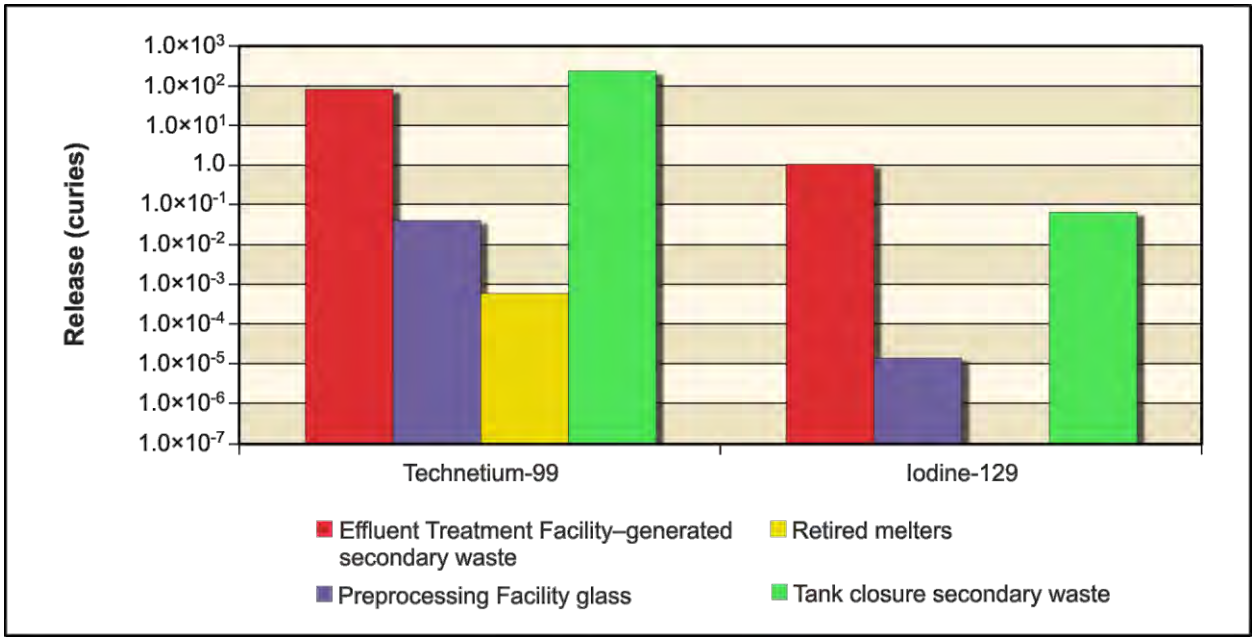


Figure 5–1092. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Groundwater

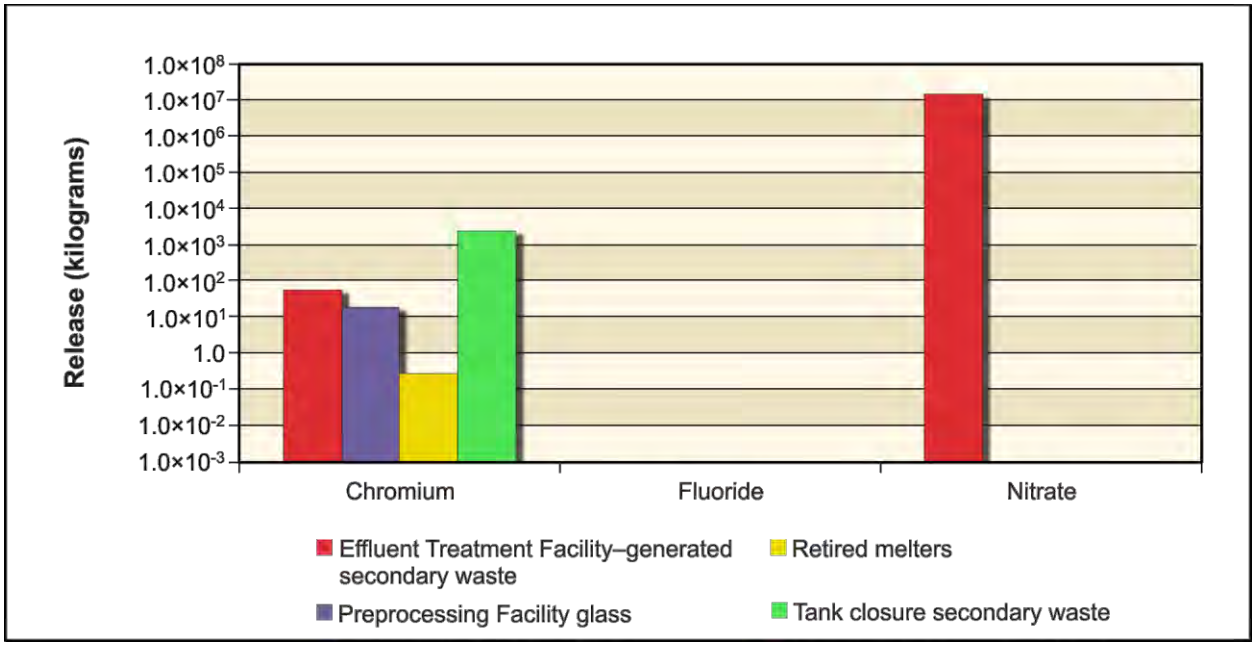


Figure 5–1093. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Groundwater

Figure 5–1094 shows the release from IDF-East to the Columbia River of the radiological risk drivers and Figure 5–1095, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. In all cases, between 90 and 100 percent of the amount released to groundwater reaches the Columbia River.

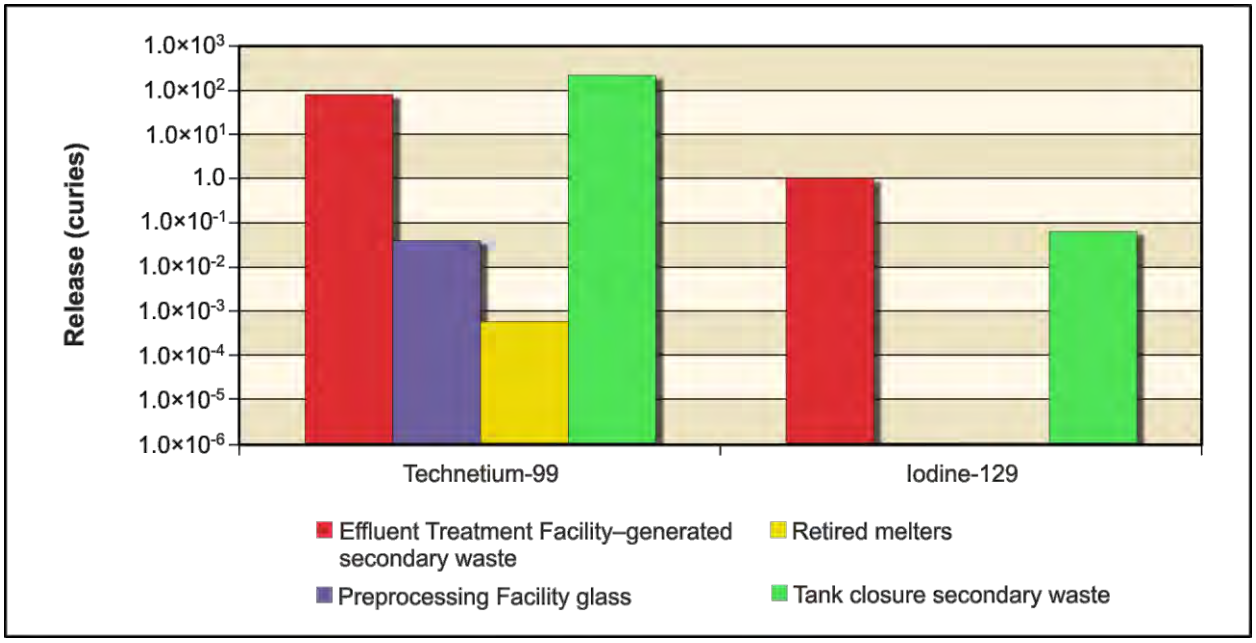


Figure 5–1094. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from 200-East Area Integrated Disposal Facility to Columbia River

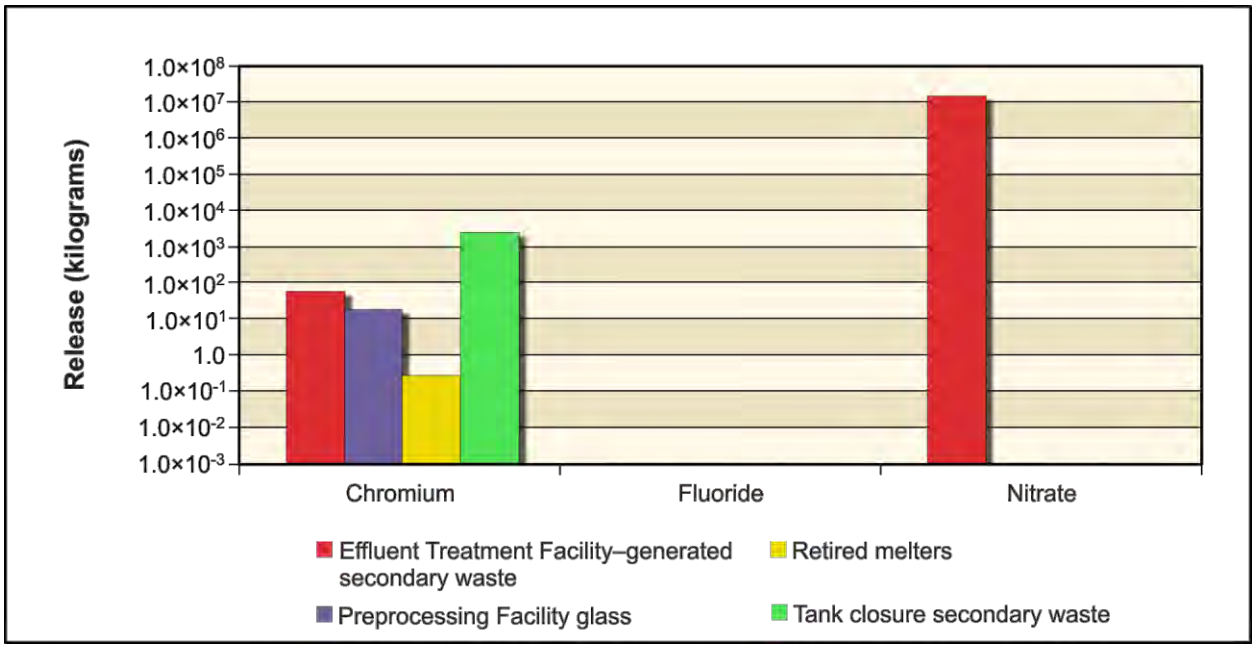


Figure 5–1095. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from 200-East Area Integrated Disposal Facility to Columbia River

200-West Area Integrated Disposal Facility

Figure 5–1096 shows the release from IDF-West to the vadose zone of the radiological risk drivers and Figure 5–1097, the chemical hazard drivers. For offsite waste, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). Technetium-99, iodine-129, chromium, and nitrate are all present in IDF-West.

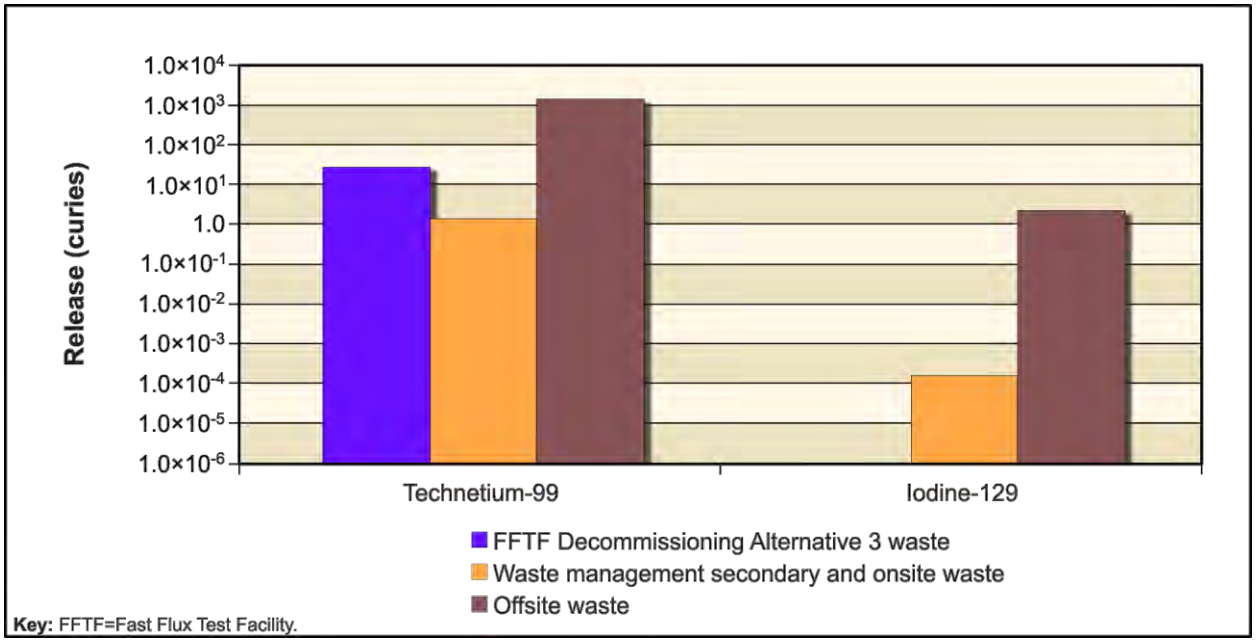


Figure 5–1096. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

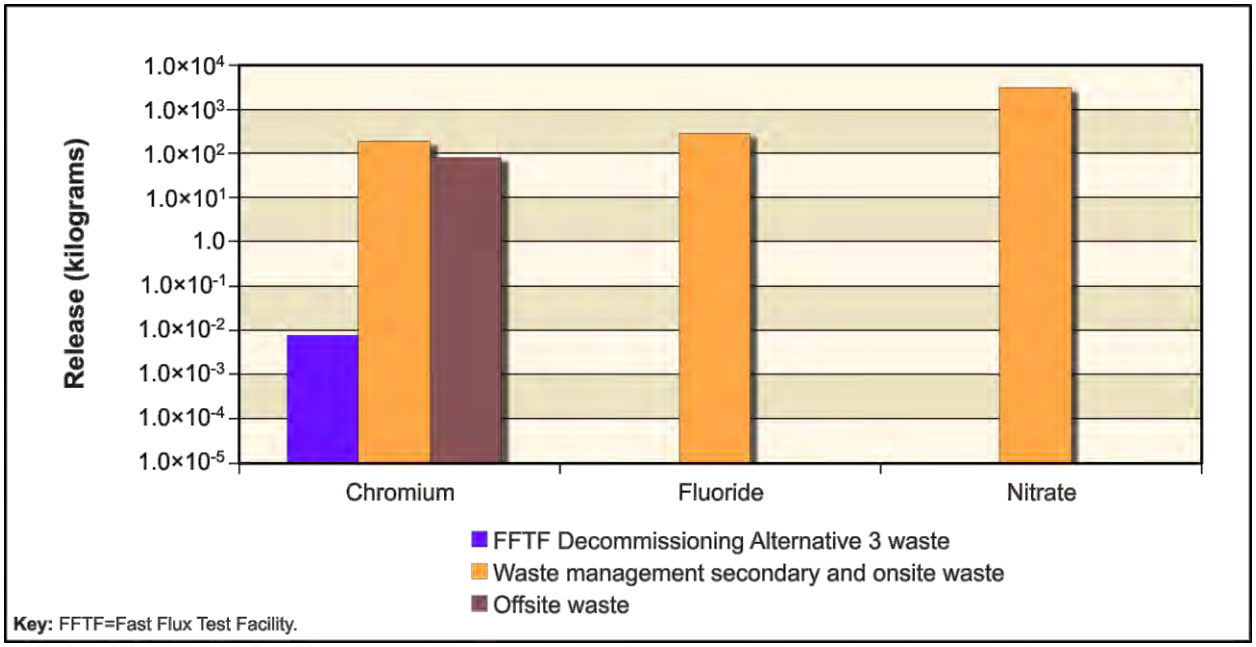


Figure 5–1097. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Vadose Zone

Figure 5–1098 shows the release from IDF-West to groundwater of the radiological risk drivers and Figure 5–1099, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All of the COPC drivers present in IDF-West behave as conservative tracers, with essentially all of the mass released to the vadose zone reaching groundwater.

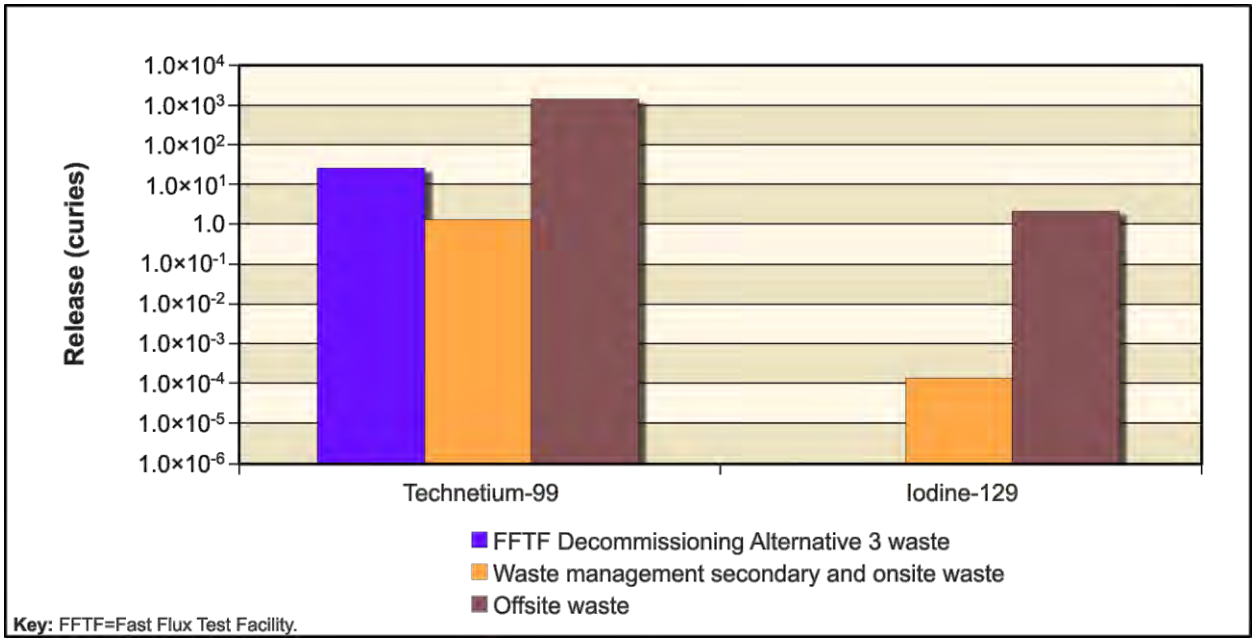


Figure 5–1098. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Groundwater

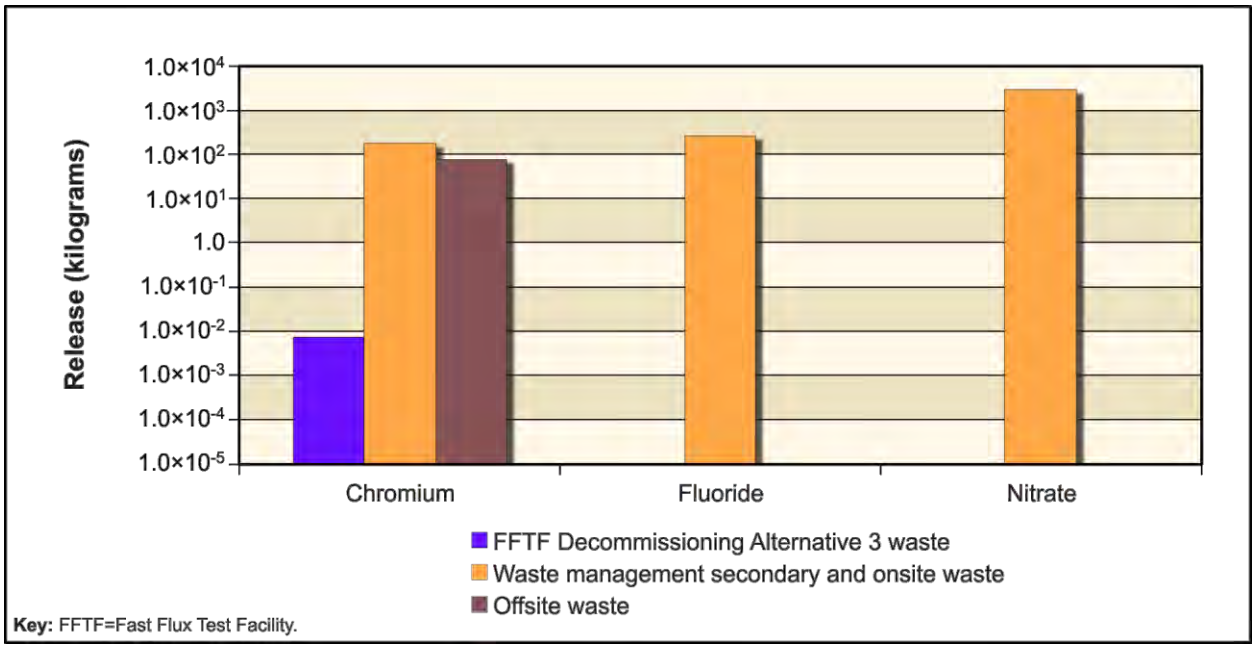


Figure 5–1099. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Groundwater

Figure 5–1100 shows the release from IDF-West to the Columbia River of the radiological risk drivers and Figure 5–1101, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Essentially all of the COPC drivers released to groundwater reach the Columbia River.

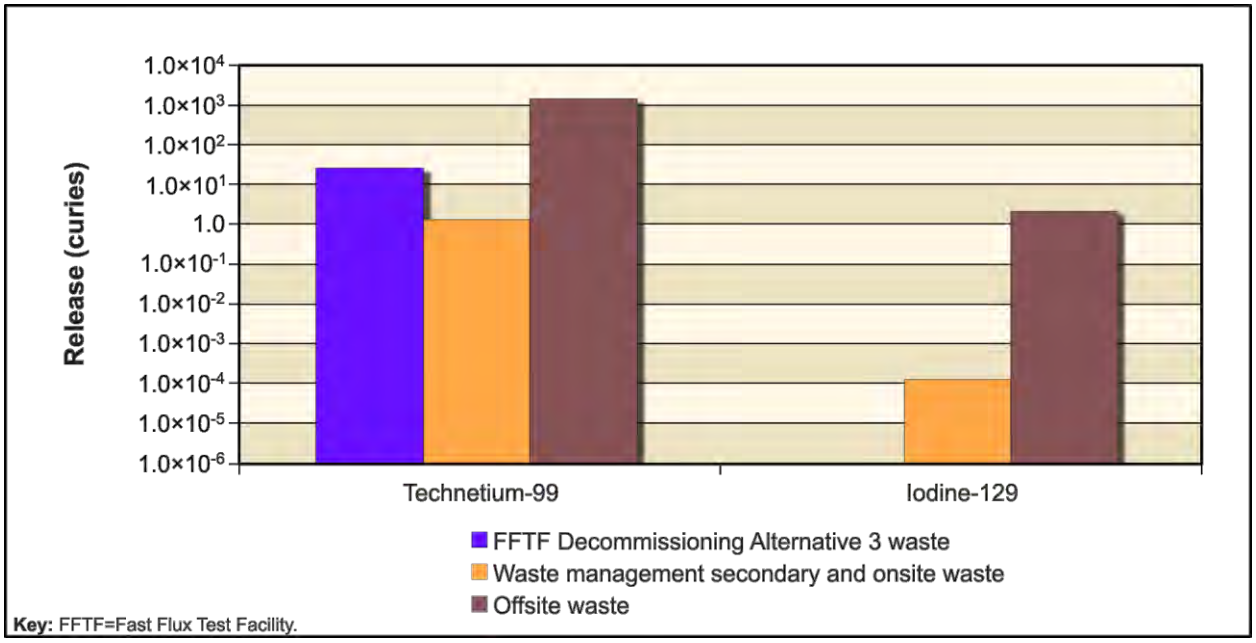


Figure 5–1100. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from 200-West Area Integrated Disposal Facility to Columbia River

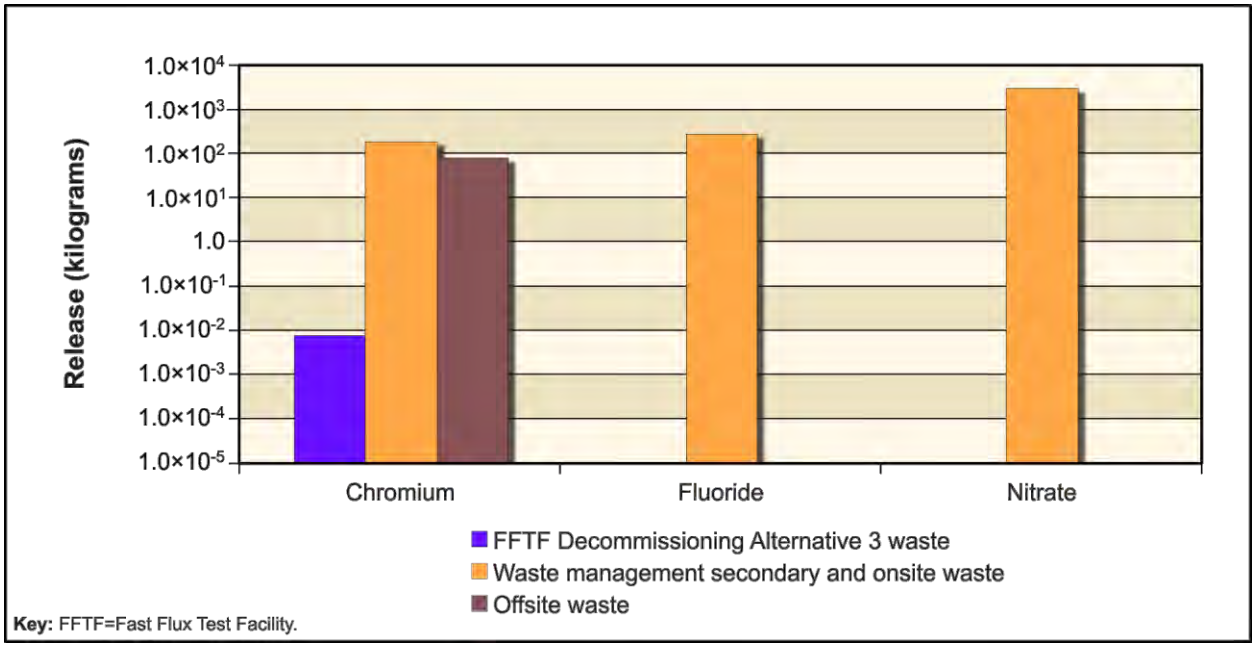


Figure 5–1101. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from 200-West Area Integrated Disposal Facility to Columbia River

River Protection Project Disposal Facility

Figure 5–1102 shows the release from the RPPDF to the vadose zone of the radiological risk drivers and Figure 5–1103, the chemical hazard drivers. For all types of sources, the release to the vadose zone is controlled by the inventory (i.e., 100 percent of the inventory is released during the period of analysis). Technetium-99, iodine-129, chromium, and nitrate are all present at the RPPDF.

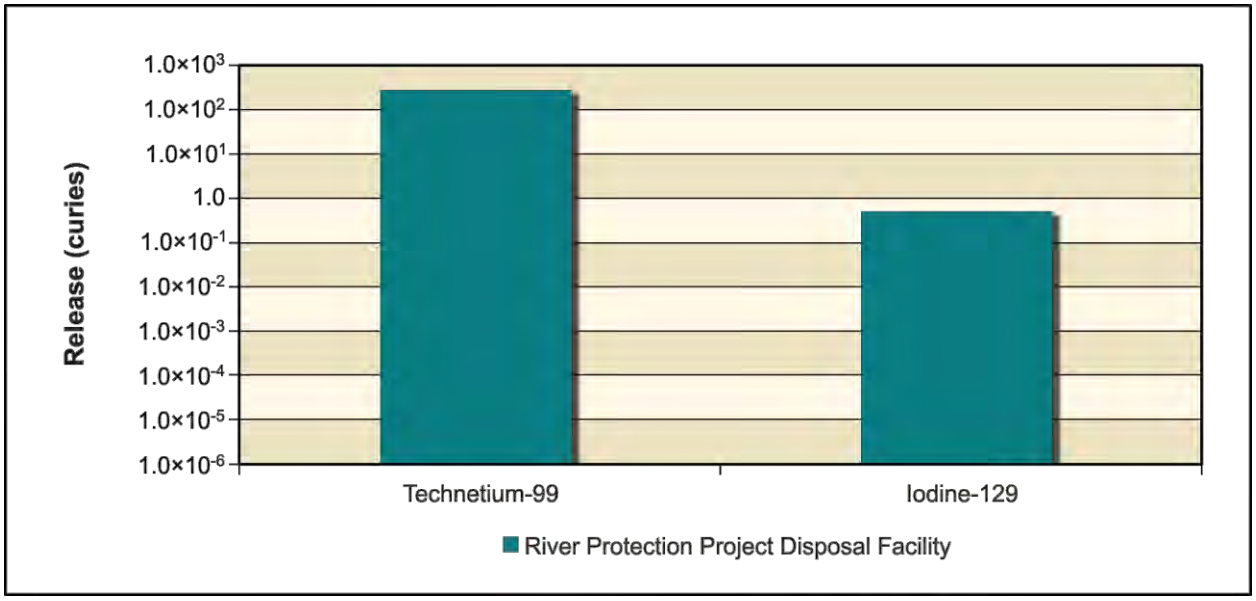


Figure 5–1102. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from River Protection Project Disposal Facility to Vadose Zone

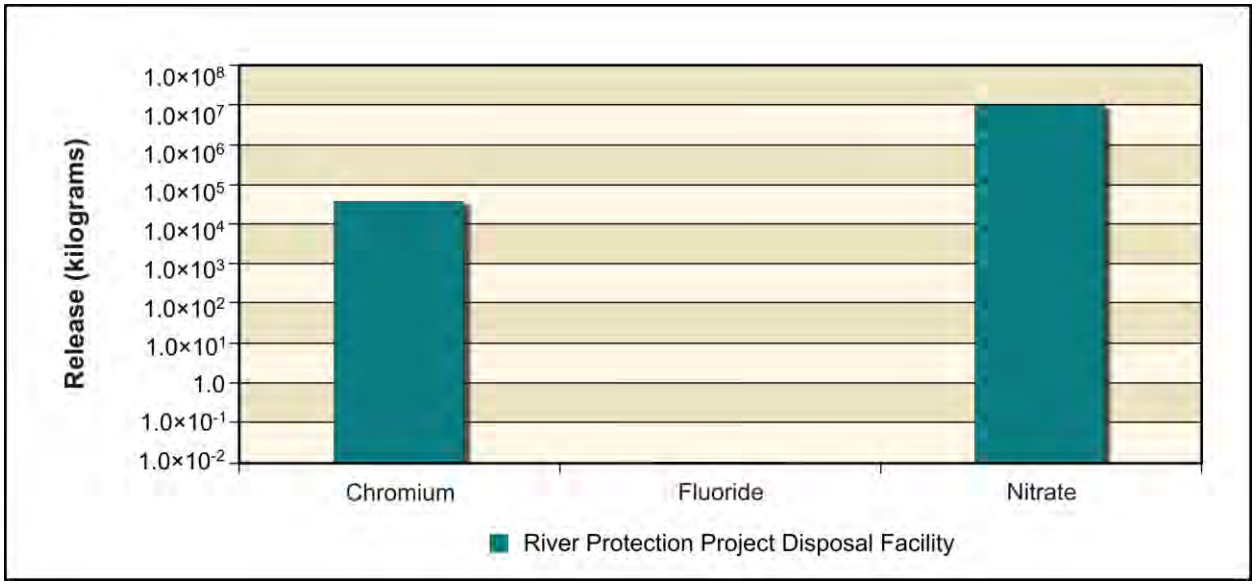


Figure 5–1103. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from River Protection Project Disposal Facility to Vadose Zone

Figure 5–1104 shows the release from the RPPDF to groundwater of the radiological risk drivers and Figure 5–1105, the chemical hazard drivers. In addition to the inventory considerations discussed in the previous paragraph, release to groundwater is controlled by the transport properties of the COPC drivers and by the rate of moisture movement through the vadose zone. All of the COPC drivers present at the RPPDF behave as conservative tracers, with essentially all of the mass released to the vadose zone reaching groundwater.

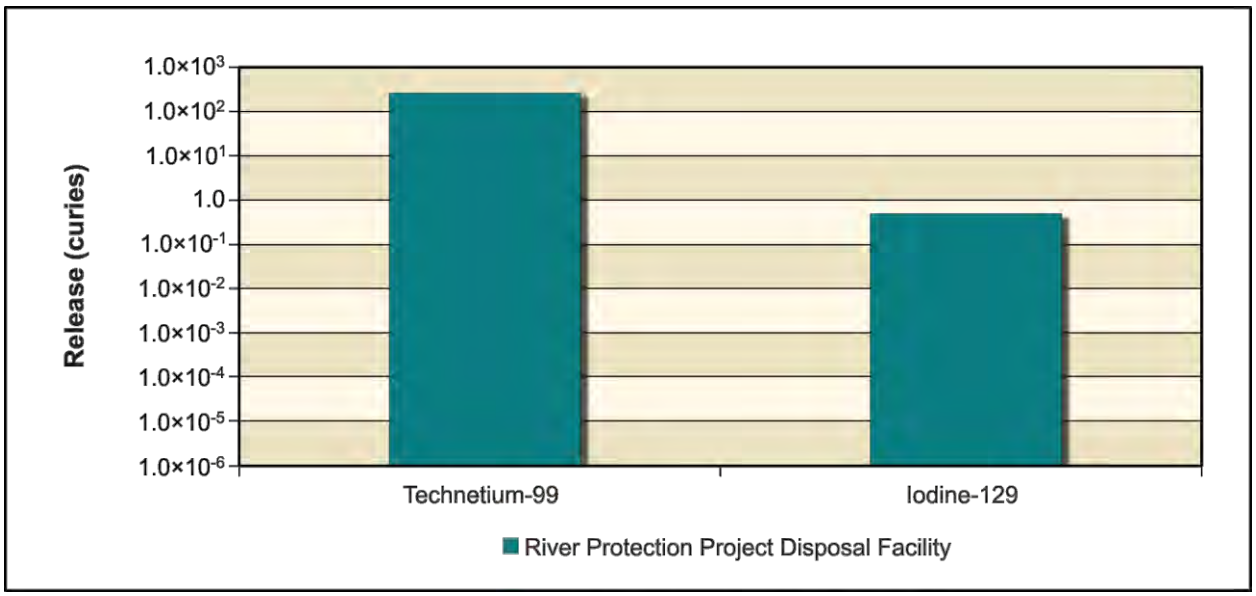


Figure 5–1104. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from River Protection Project Disposal Facility to Groundwater

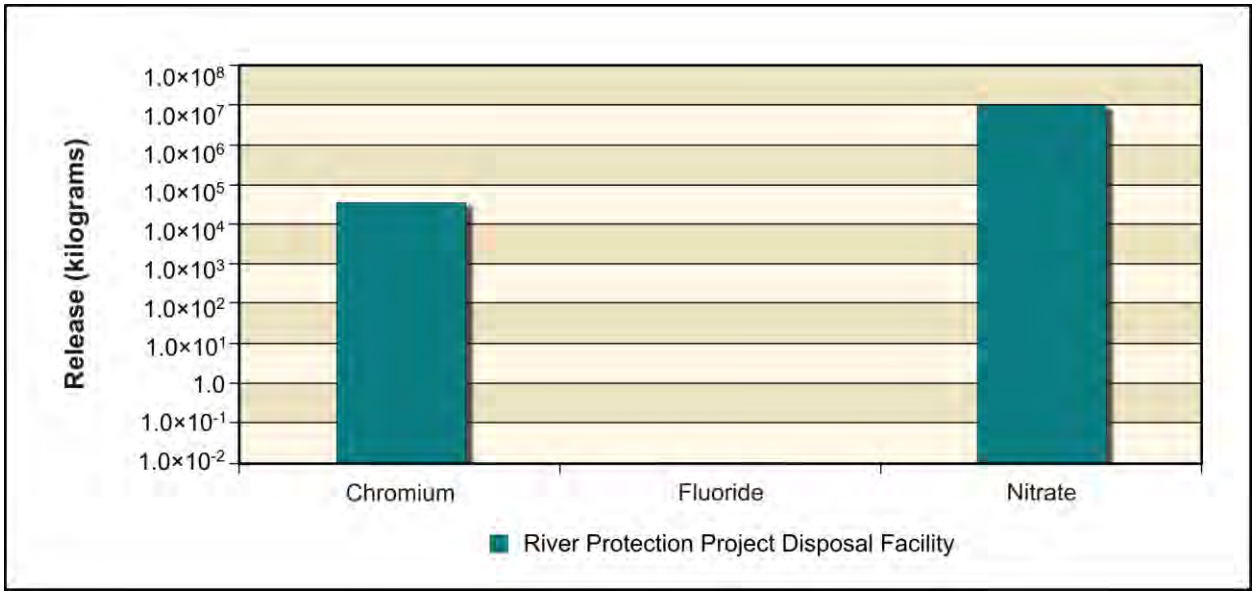


Figure 5–1105. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from River Protection Project Disposal Facility to Groundwater

Figure 5–1106 shows the release from the RPPDF to the Columbia River of the radiological risk drivers and Figure 5–1107, the chemical hazard drivers. Release to the Columbia River is controlled by the transport properties of the COPC drivers. Essentially all of the COPC drivers released to groundwater reach the Columbia River.

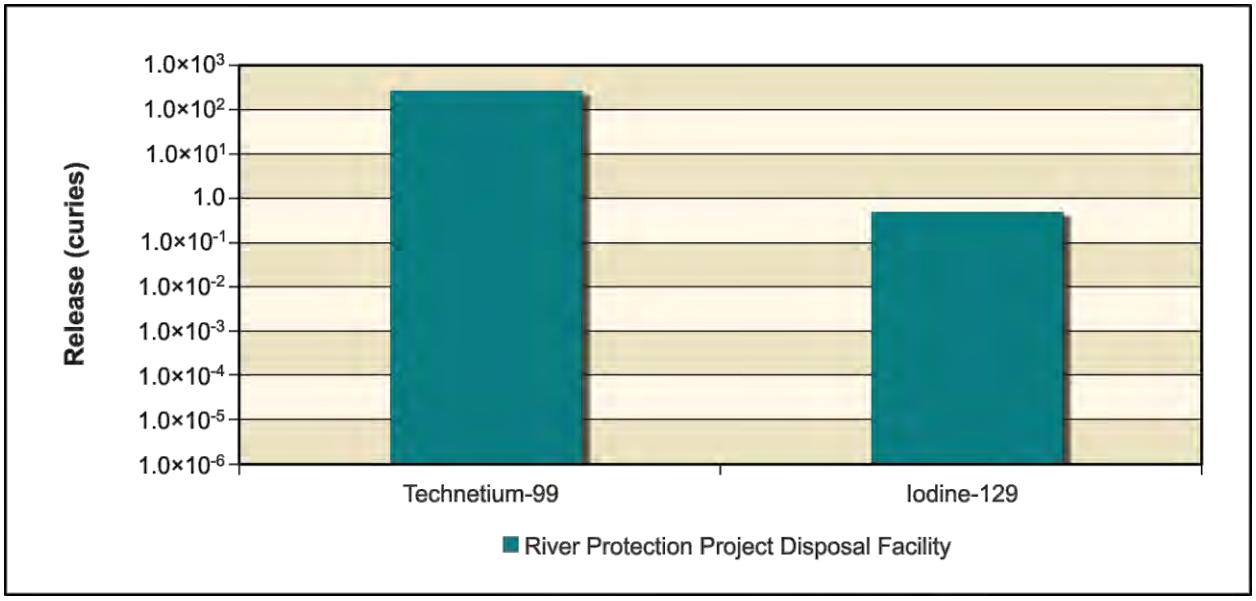


Figure 5–1106. Waste Management Alternative 3, Disposal Group 3, Option Case, Radionuclide Releases from River Protection Project Disposal Facility to Columbia River

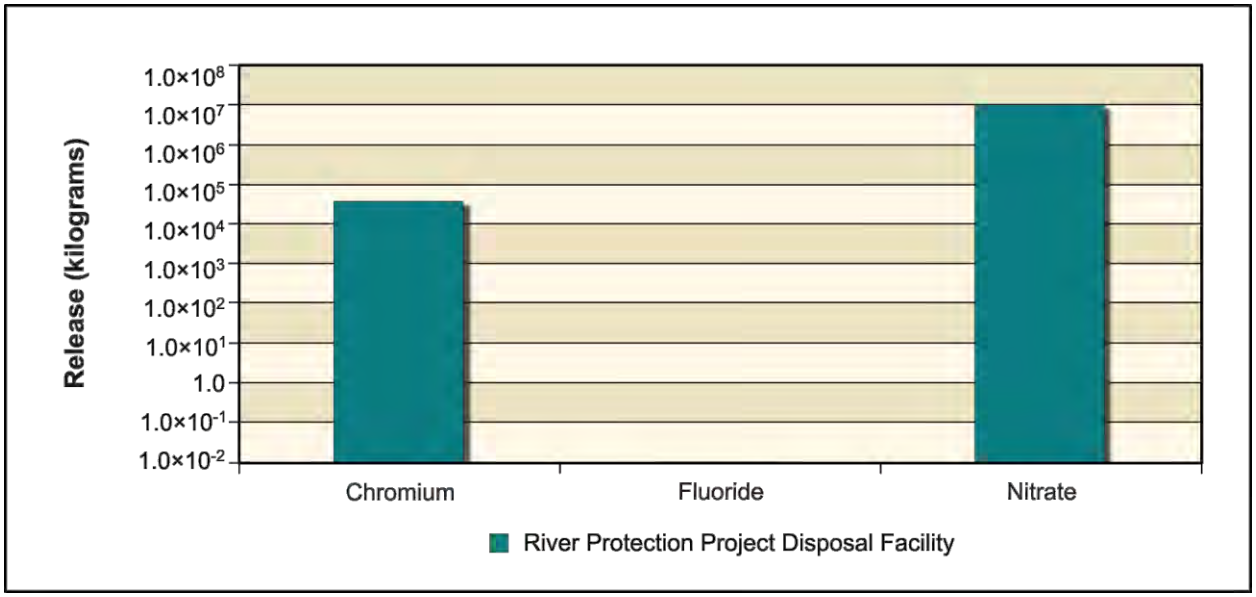


Figure 5–1107. Waste Management Alternative 3, Disposal Group 3, Option Case, Chemical Releases from River Protection Project Disposal Facility to Columbia River

ANALYSIS OF CONCENTRATION VERSUS TIME

This section presents the impacts of Waste Management Alternative 3, Disposal Group 3, Option Case, in terms of groundwater concentration versus time at the Core Zone Boundary and the Columbia River nearshore. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. The benchmark concentration of each radionuclide and chemical is also shown. Note that the concentrations are plotted on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

Figures 5–1108 through 5–1111 show concentration versus time for iodine-129, technetium-99, chromium, and nitrate (the conservative tracers). For technetium-99, concentrations at the IDF-West barrier and Core Zone Boundary rise early in the simulation, reaching a peak around CY 3940. Technetium-99 concentrations are about one order of magnitude greater than the benchmark concentration at the IDF-West barrier and are approximately equal to the benchmark concentration at the Core Zone Boundary and Columbia River nearshore. Concentrations then slowly decline to between one and two orders of magnitude below the benchmark. The technetium-99 release from IDF-East occurs later and levels off at about one order of magnitude below the benchmark concentration. Iodine-129 follows a pattern similar to that of technetium-99, with concentrations falling slightly below the benchmark after peaking from one to two orders of magnitude above the benchmark. Chromium and nitrate also follow a similar pattern, with an early peak in concentrations at the Core Zone Boundary, followed by a slow decline. Both chromium and nitrate concentrations (at the Core Zone Boundary) approach within one order of magnitude of the benchmark concentration for most of the analysis period. Note that the actual time periods of exceedance associated with the peak values (listed in Table 5–117) are extremely limited. Table 5–117 shows the maximum concentrations in groundwater. Exceedances of the benchmark values occur primarily at the IDF-West barrier, Core Zone Boundary, and Columbia River nearshore, where technetium-99 and iodine-129 concentrations are highest. At the IDF-East barrier, maximum iodine-129 concentrations approach the benchmark concentration in CY 11,811. None of the other COPC benchmark concentrations were exceeded during the simulation.

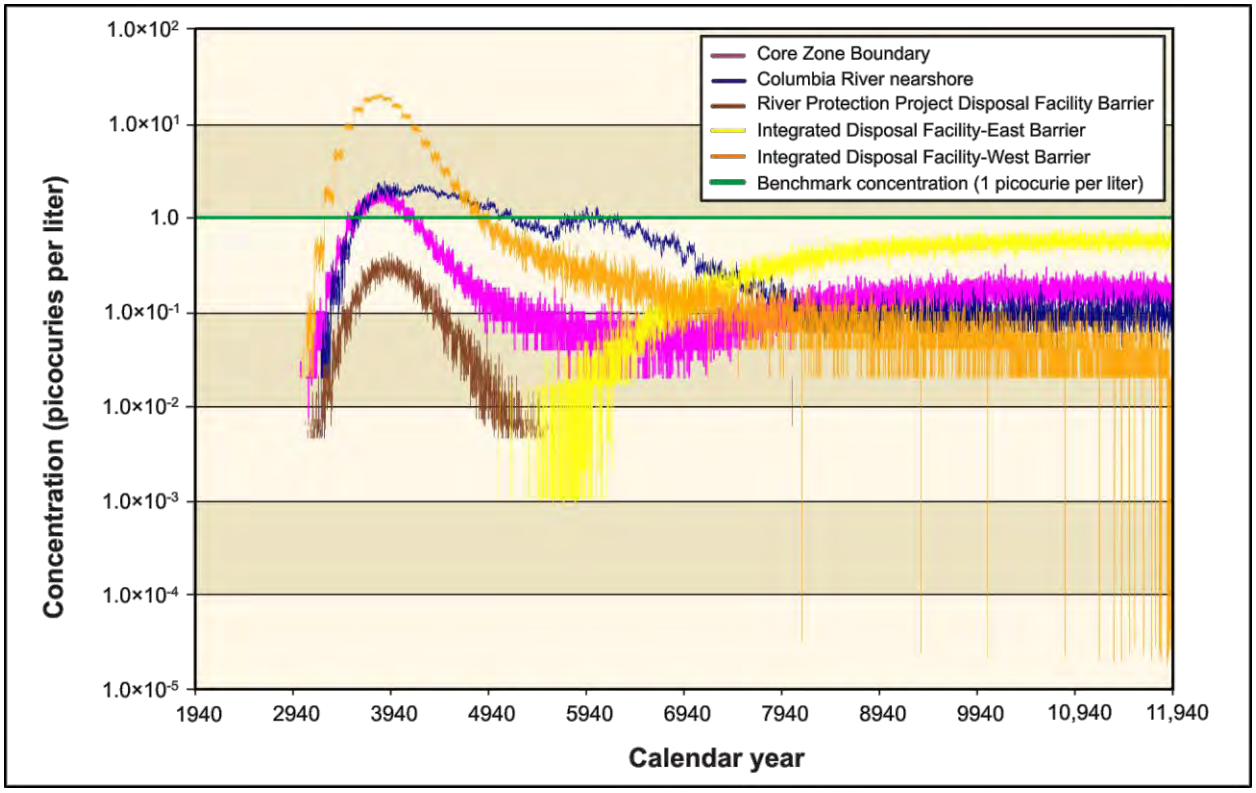


Figure 5–1108. Waste Management Alternative 3, Disposal Group 3, Option Case, Iodine-129 Concentration Versus Time

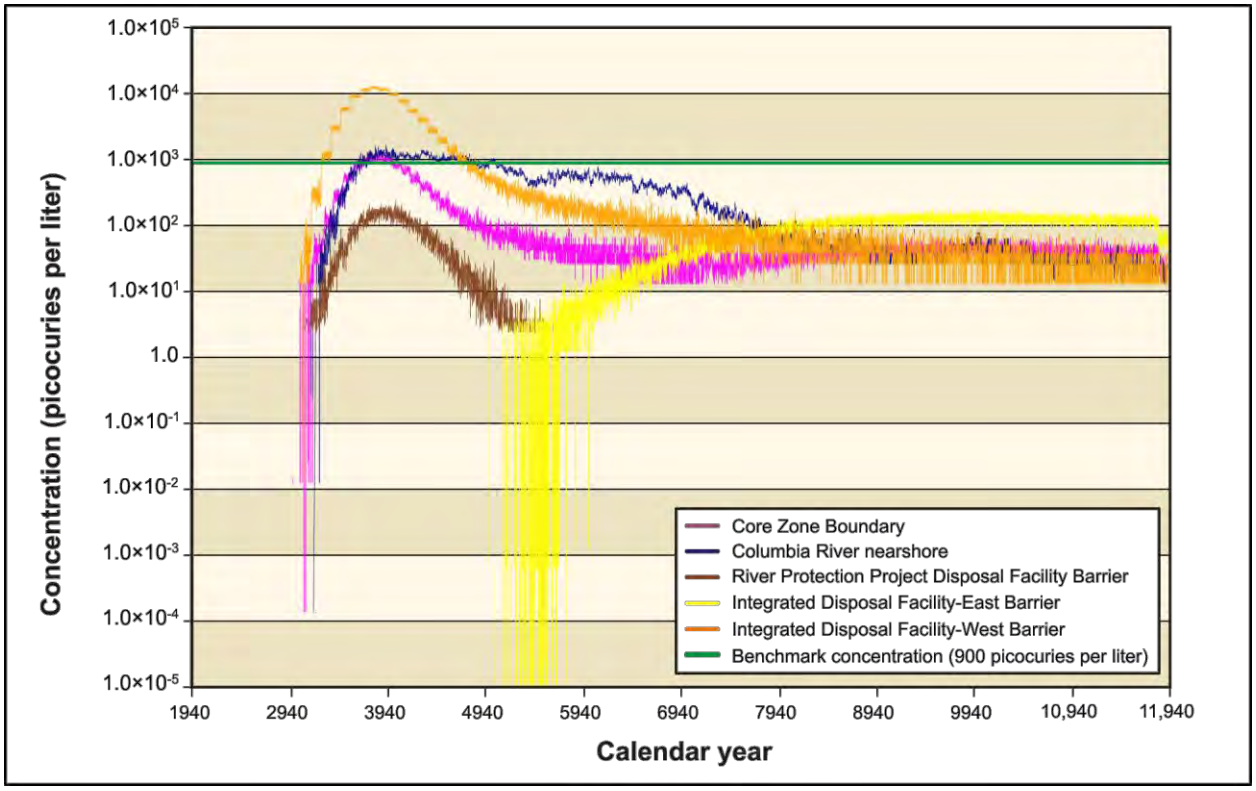


Figure 5–1109. Waste Management Alternative 3, Disposal Group 3, Option Case, Technetium-99 Concentration Versus Time

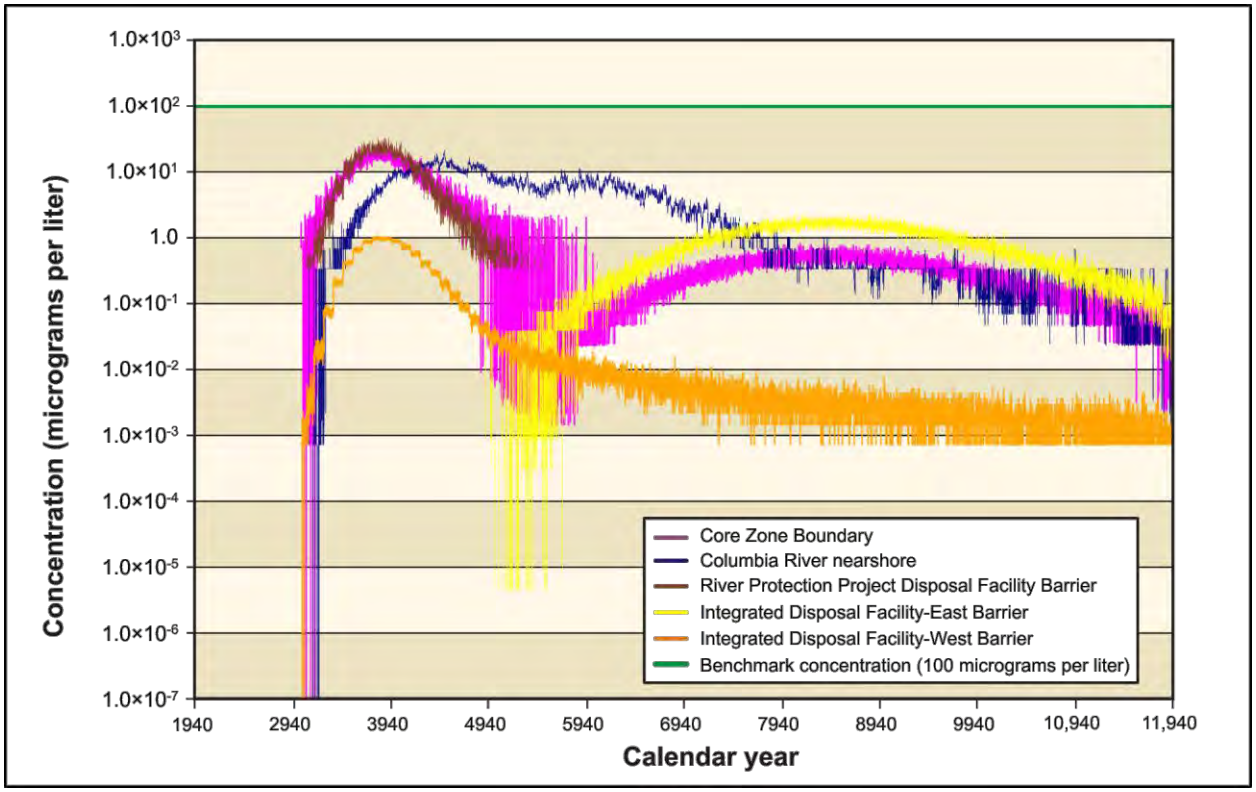


Figure 5–1110. Waste Management Alternative 3, Disposal Group 3, Option Case, Chromium Concentration Versus Time

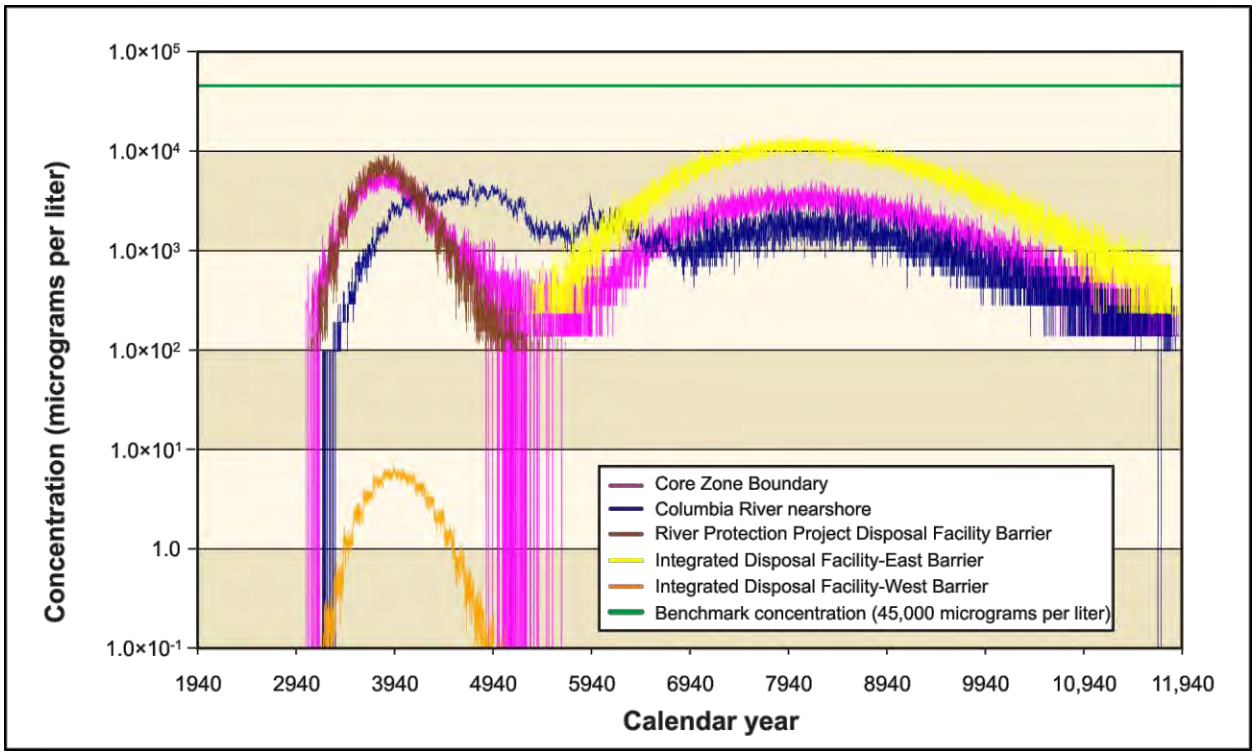


Figure 5–1111. Waste Management Alternative 3, Disposal Group 3, Option Case, Nitrate Concentration Versus Time

Table 5–117. Waste Management Alternative 3, Disposal Group 3, Option Case, Maximum COPC Concentrations in the Peak Year at IDF-East, IDF-West, and the RPPDF, Core Zone Boundary, and Columbia River Nearshore

Contaminant	IDF-East	IDF-West	RPPDF	Core Zone Boundary	Columbia River Nearshore	Benchmark Concentration
Radionuclide (picocuries per liter)						
Technetium-99	196 (9705)	**13,200** (3818)	235 (4018)	**1,370** (3859)	**1,670** (3920)	900
Iodine-129	0.9 (11,811)	**20.6** (3794)	0.4 (3919)	**2.1** (3937)	**2.4** (3872)	1
Chemical (micrograms per liter)						
Chromium	2 (8501)	1 (3813)	32 (3873)	28 (3865)	21 (4487)	100
Fluoride	0 (1940)	1 (4014)	0 (3983)	0 (3937)	0 (4307)	4,000
Nitrate	14,600 (7954)	7 (3937)	9,270 (3930)	7,820 (3782)	5,190 (4701)	45,000

Note: Corresponding calendar years shown in parentheses. Concentrations that would exceed the benchmark value are indicated in **bold** text.
Key: COPC=constituent of potential concern; IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; RPPDF=River Protection Project Disposal Facility.

Figure 5–1112 shows concentration versus time for total uranium. Because of the high retardation of uranium, no contamination appears until approximately CY 7940, when total uranium concentrations at

the Core Zone Boundary first surpass 1.0×10^{-8} micrograms per liter. Total uranium remains three orders of magnitude below the benchmark throughout the simulation. Total uranium remains over six orders of magnitude below the benchmark concentration at the RPPDF barrier and Core Zone Boundary throughout the 10,000-year period of analysis.

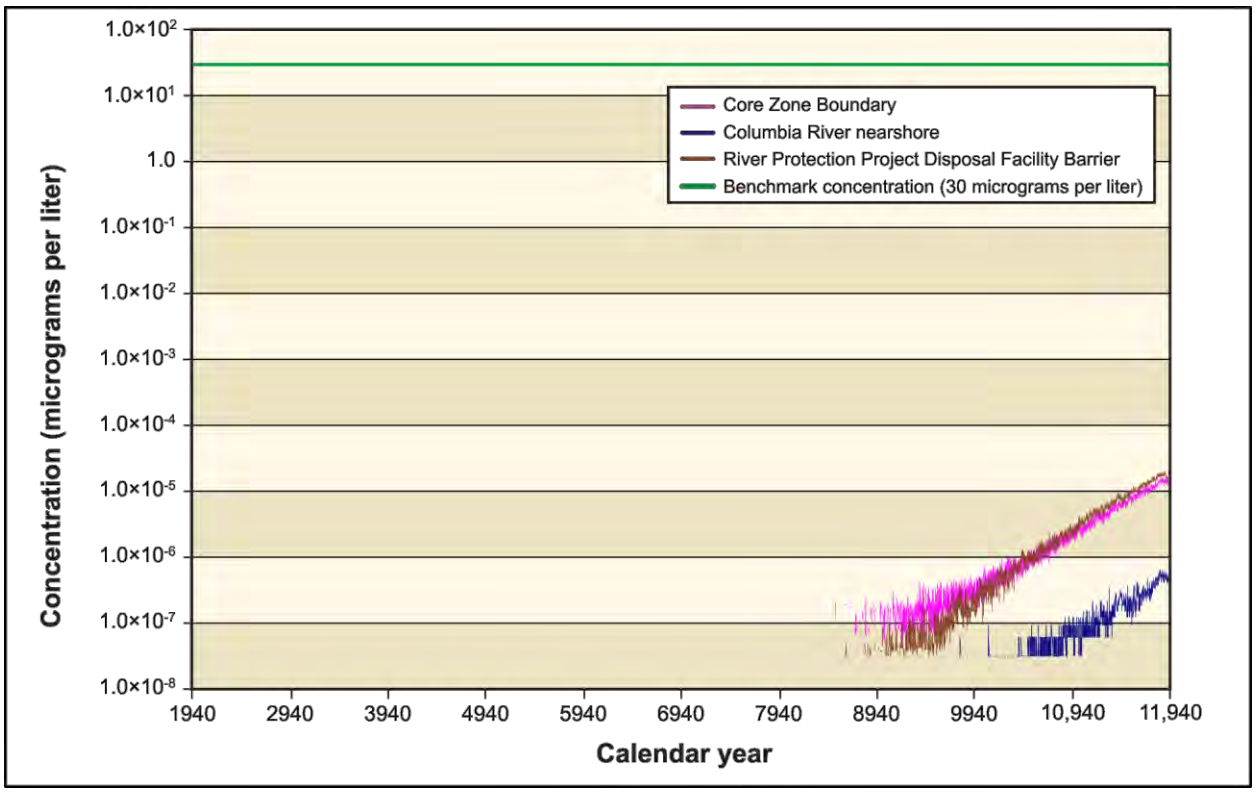


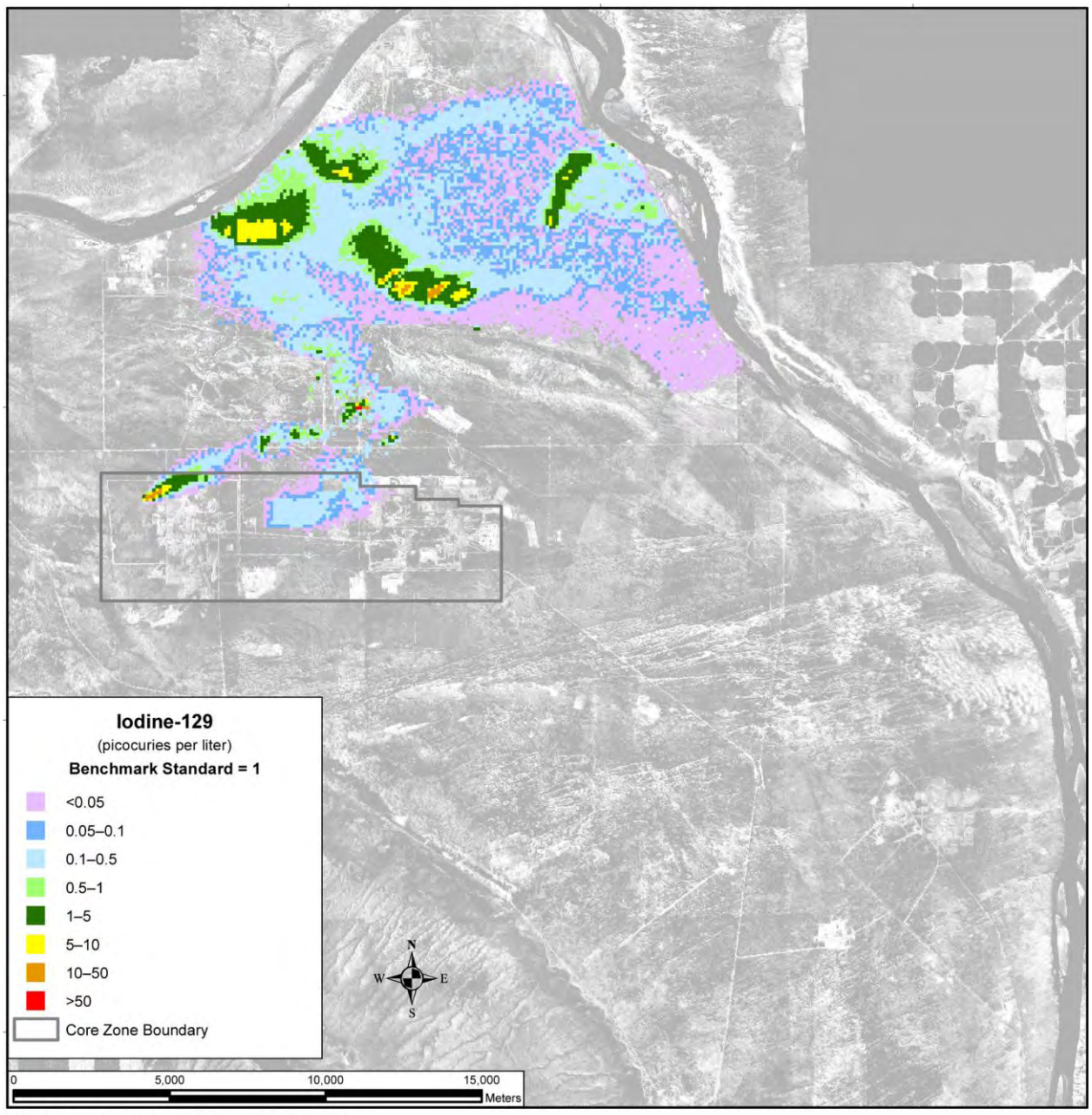
Figure 5–1112. Waste Management Alternative 3, Disposal Group 3, Option Case, Total Uranium Concentration Versus Time

ANALYSIS OF SPATIAL DISTRIBUTION OF CONCENTRATION

This section presents the impacts of Waste Management Alternative 3, Disposal Group 3, Option Case, in terms of the spatial distribution of COPC driver concentrations in groundwater at selected times. Concentrations of radionuclides are in picocuries per liter; chemicals, in micrograms per liter. Concentrations of each radionuclide and chemical are indicated by a color scale that is relative to the benchmark concentration. Concentrations greater than the benchmark concentration are indicated by the fully saturated colors green, yellow, orange, and red in order of increasing concentration. Concentrations less than the benchmark concentration are indicated by the faded colors green, blue, indigo, and violet in order of decreasing concentration. Note that the concentration ranges are on a logarithmic scale to facilitate visual comparison of concentrations that vary over three orders of magnitude.

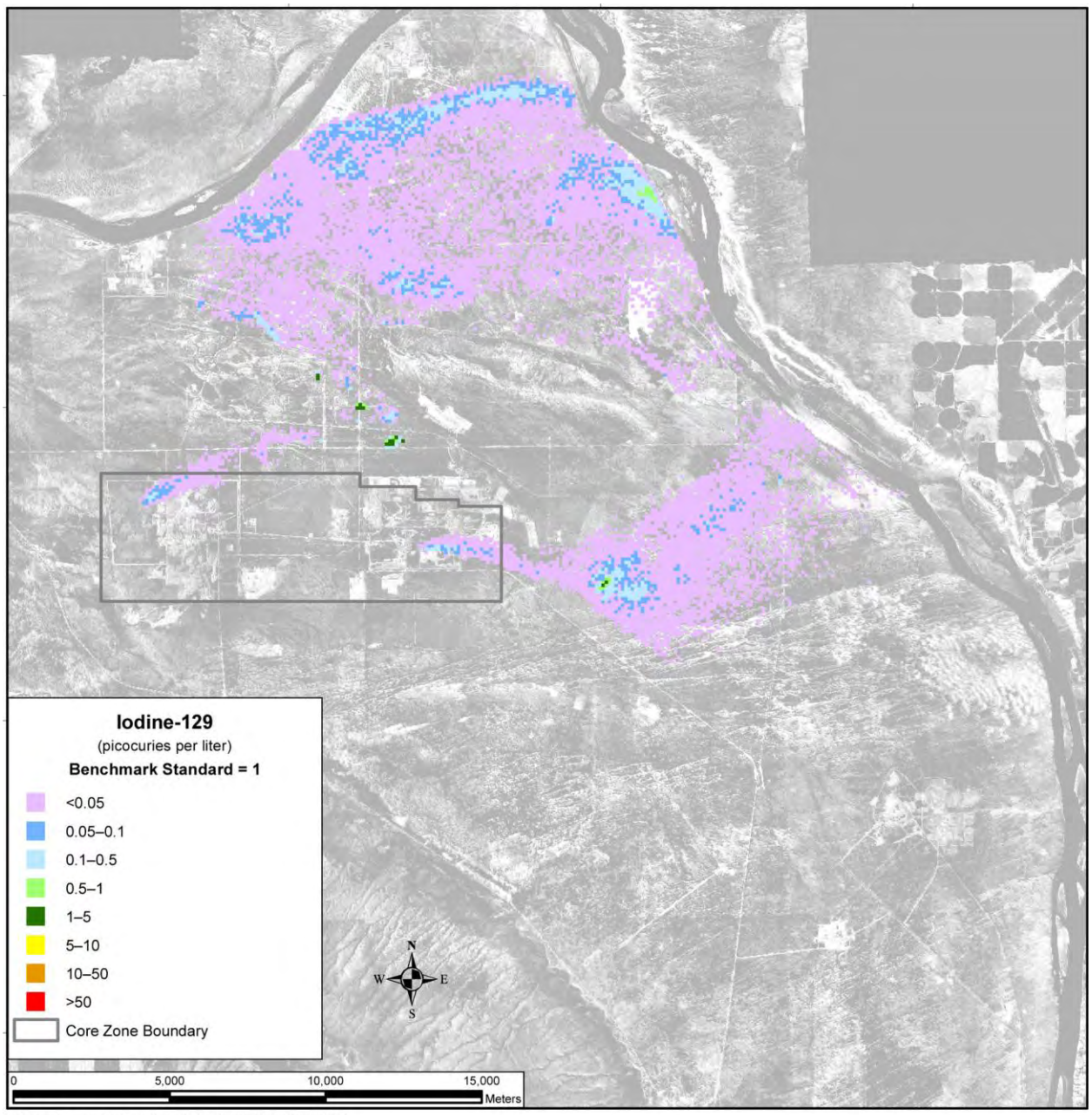
In CY 3890 (see Figure 5–1113), there is a high-concentration plume of iodine-129 stretching northeast of IDF-West and a low-concentration plume stretching north from the RPPDF through Gable Gap. Four separate high-concentration areas have also formed north of Gable Mountain and Gable Butte. By CY 7140 (see Figure 5–1114), the plumes from IDF-West and the RPPDF have dissipated, but a new plume has formed, traveling east from IDF-East. Figure 5–1115 shows the spatial distribution of iodine-129 concentrations in groundwater in CY 11,885. Concentrations in the IDF-East plume remain close to the benchmark. Technetium-99 (see Figures 5–1116 through 5–1118) shows a similar spatial distribution, but has lower concentrations relative to the benchmark value. Chromium and nitrate (see Figures 5–1119 through 5–1121 and Figures 5–1122 through 5–1124) show similar spatial distributions at

selected times, but have concentrations consistently well below the benchmark after CY 3890. Iodine-129, technetium-99, chromium, and nitrate are all conservative tracers (i.e., they move at the pore-water velocity).



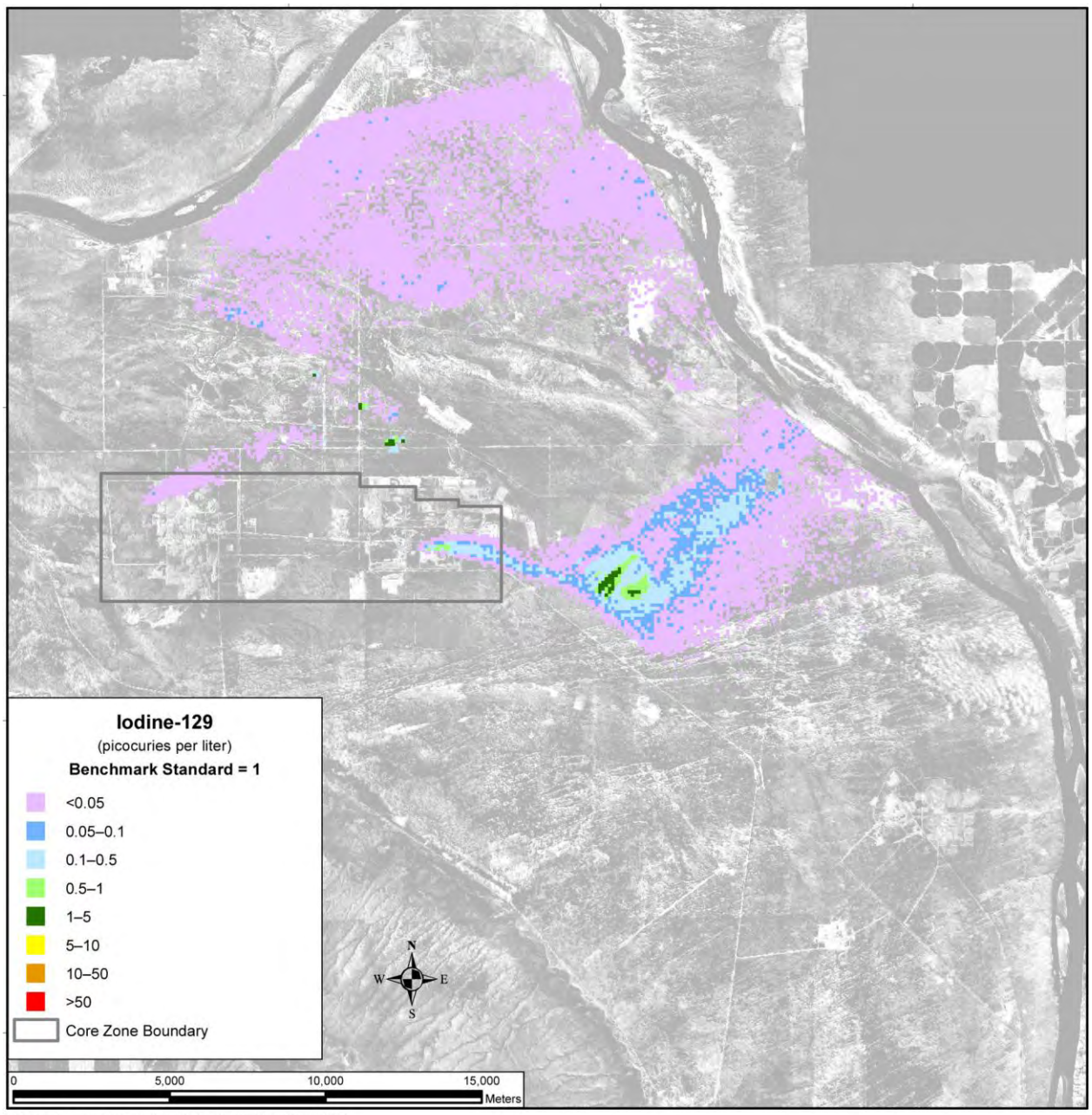
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1113. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 3890



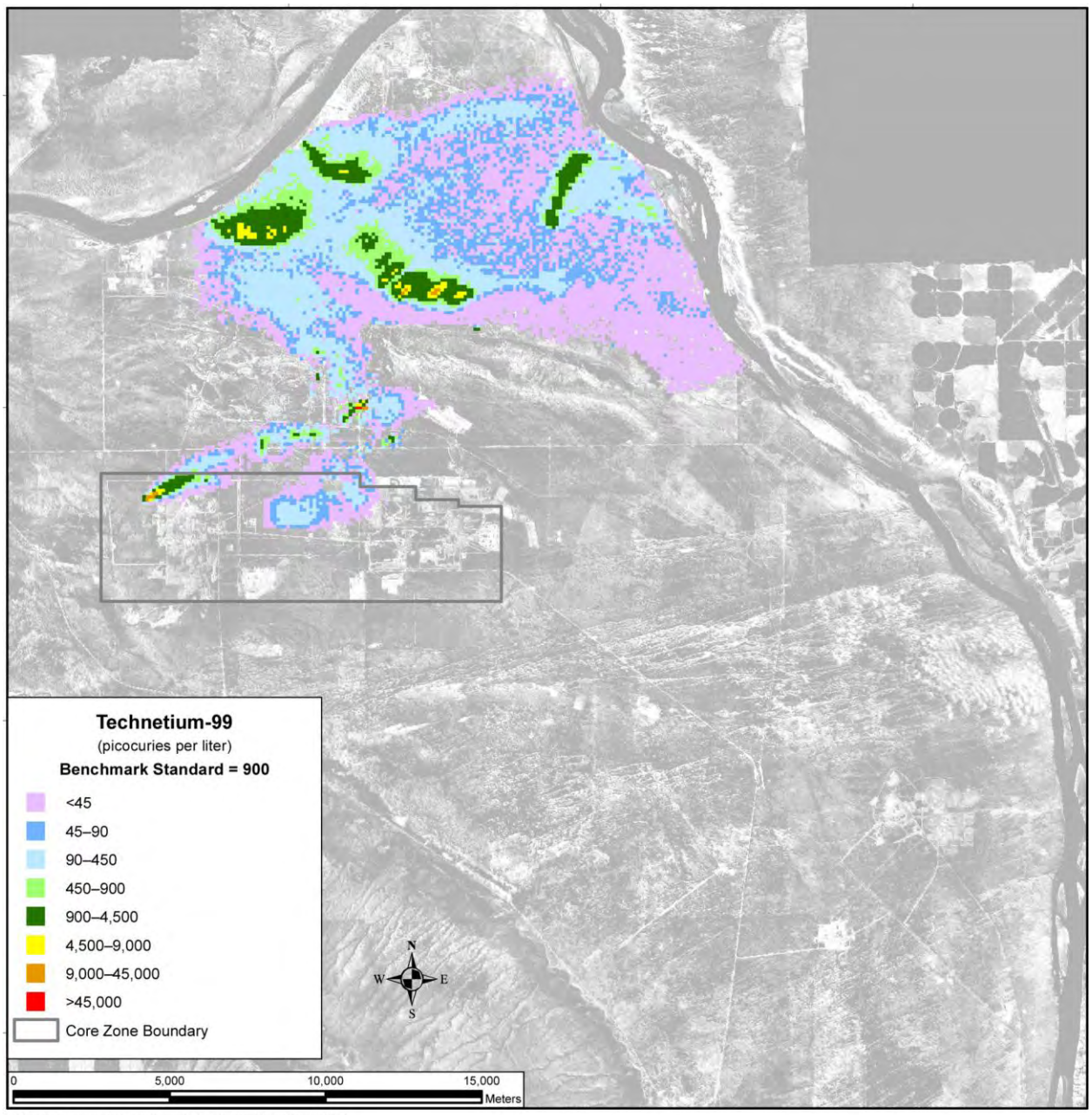
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1114. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 7140



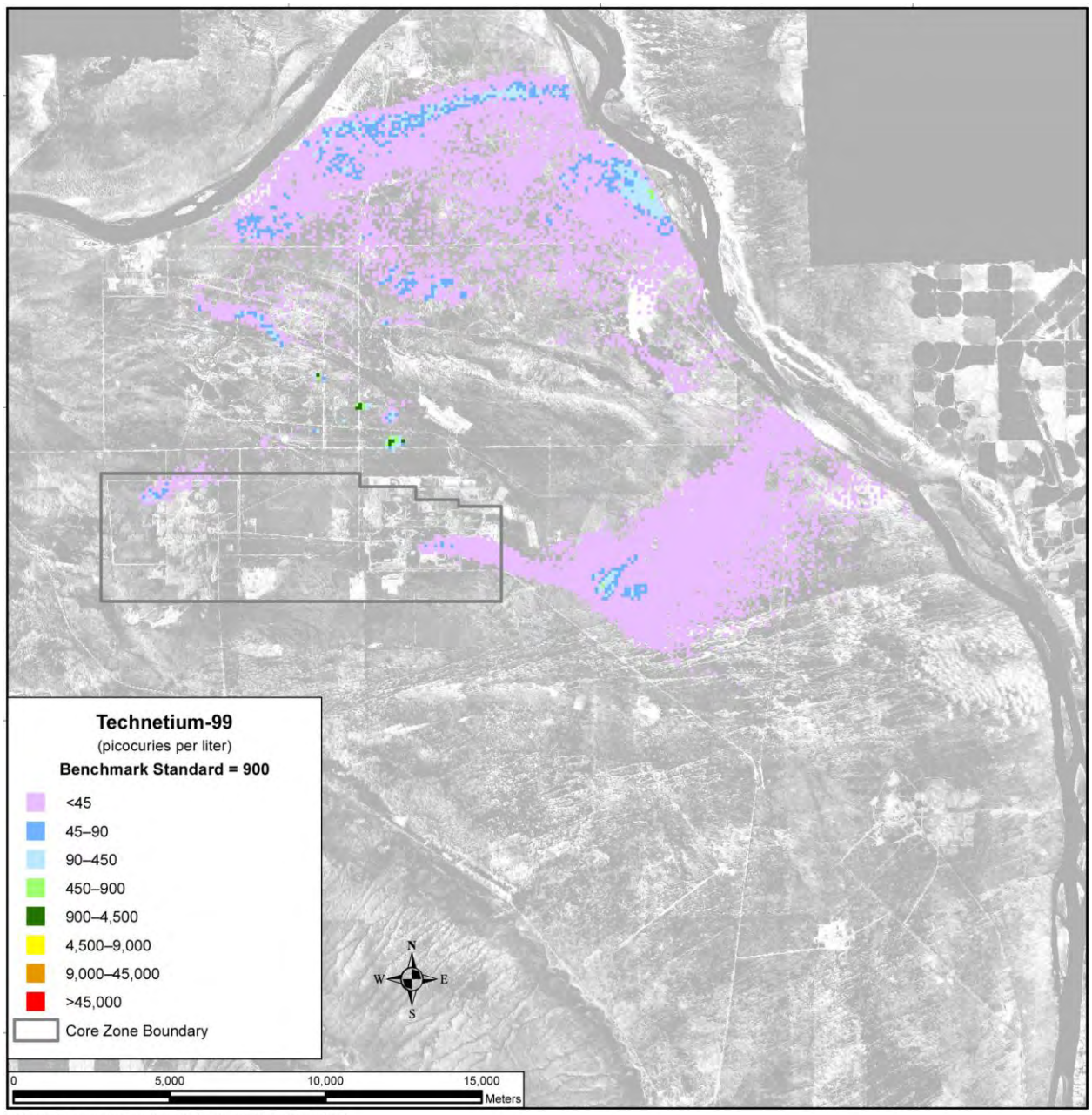
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1115. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Iodine-129 Concentration, Calendar Year 11,885



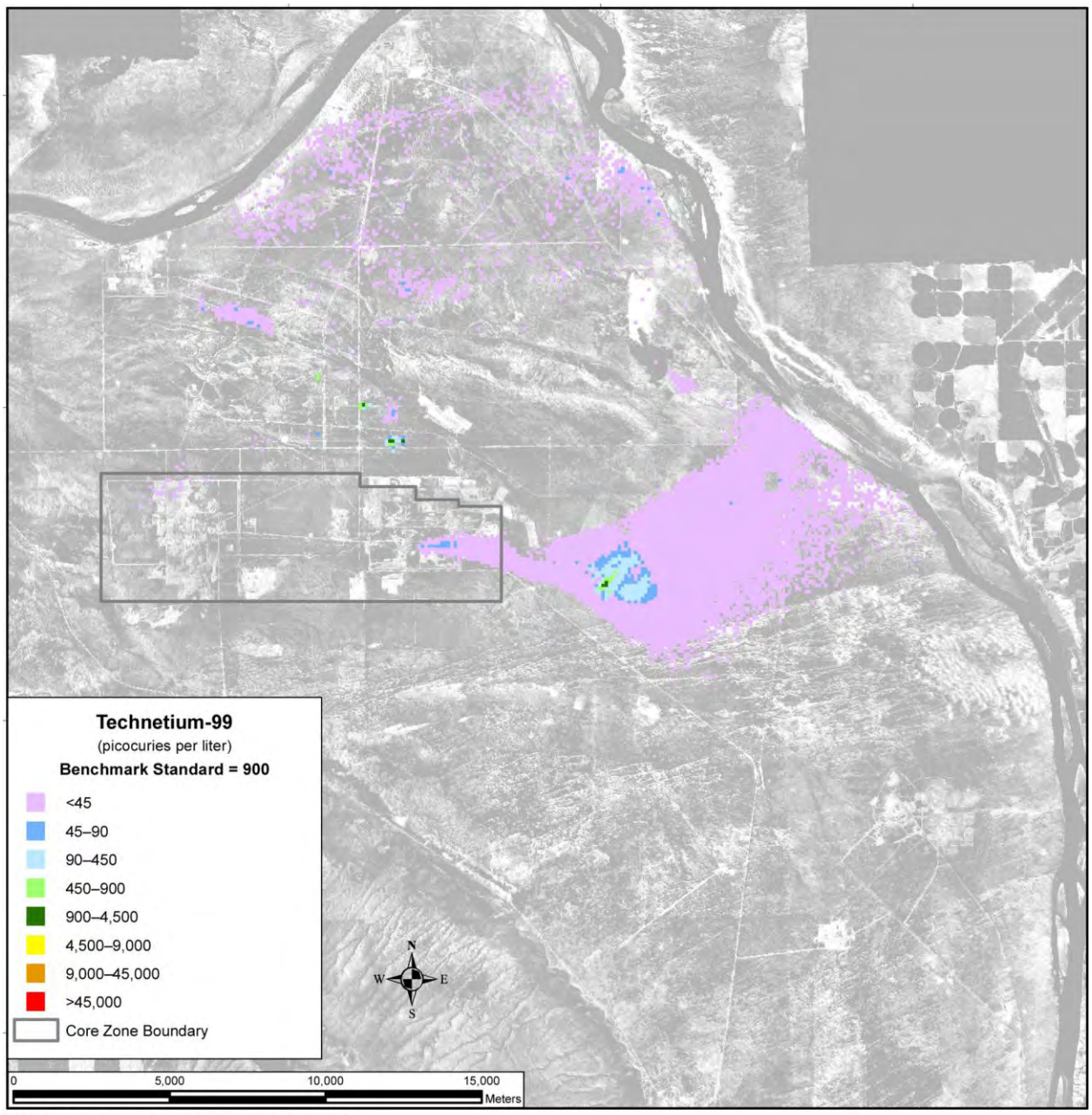
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1116. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 3890



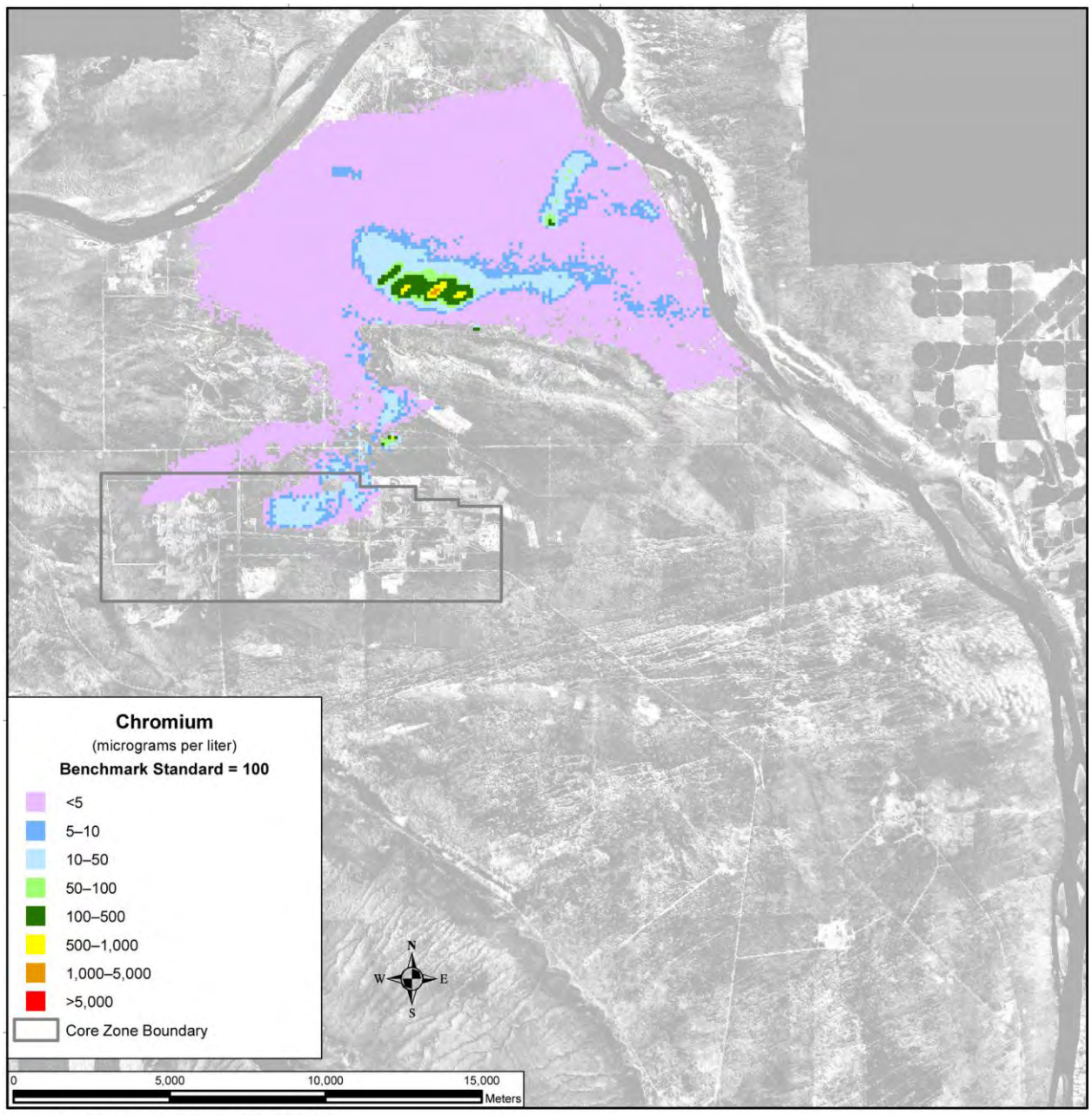
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1117. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 7140



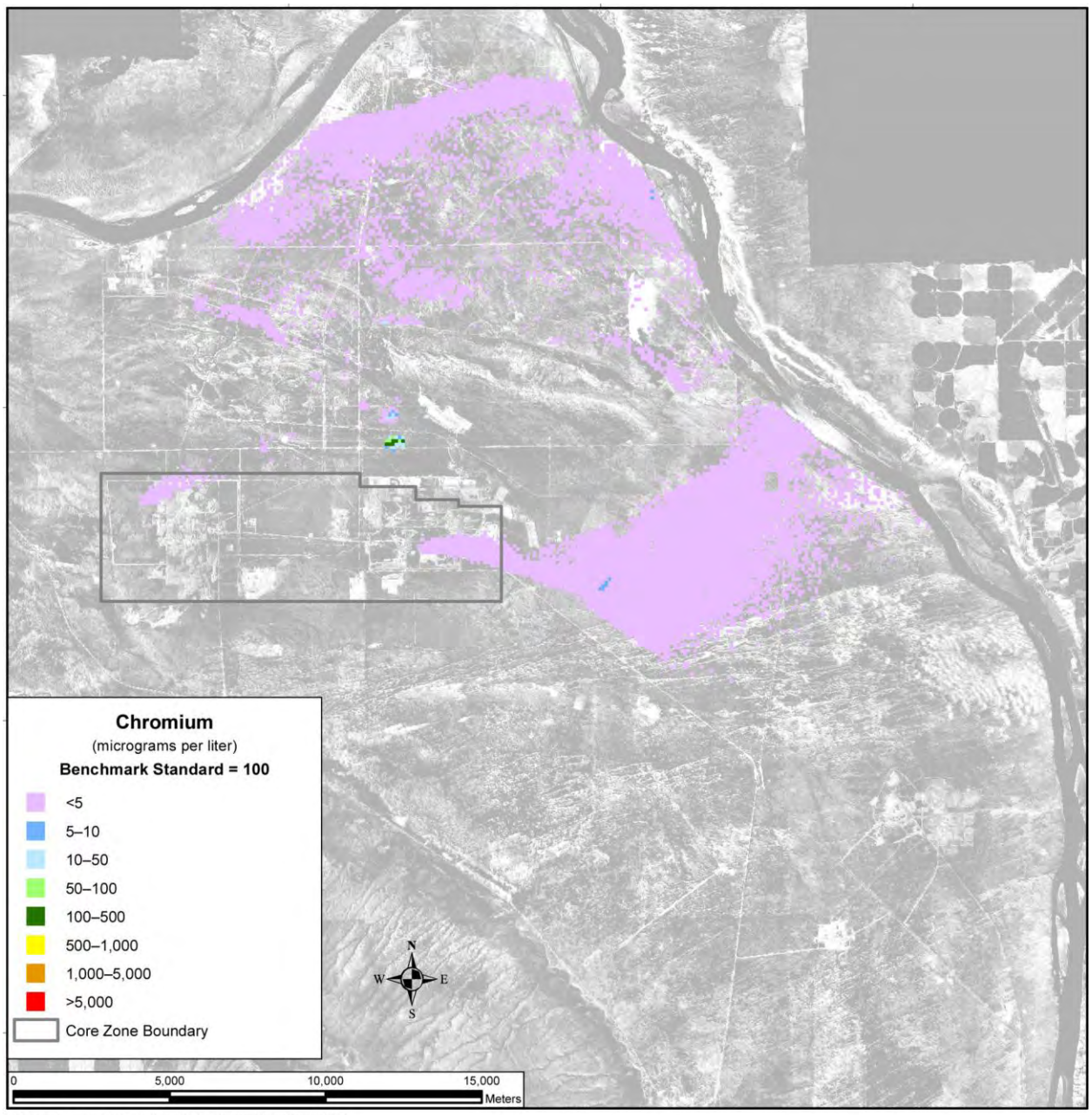
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1118. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Technetium-99 Concentration, Calendar Year 11,885



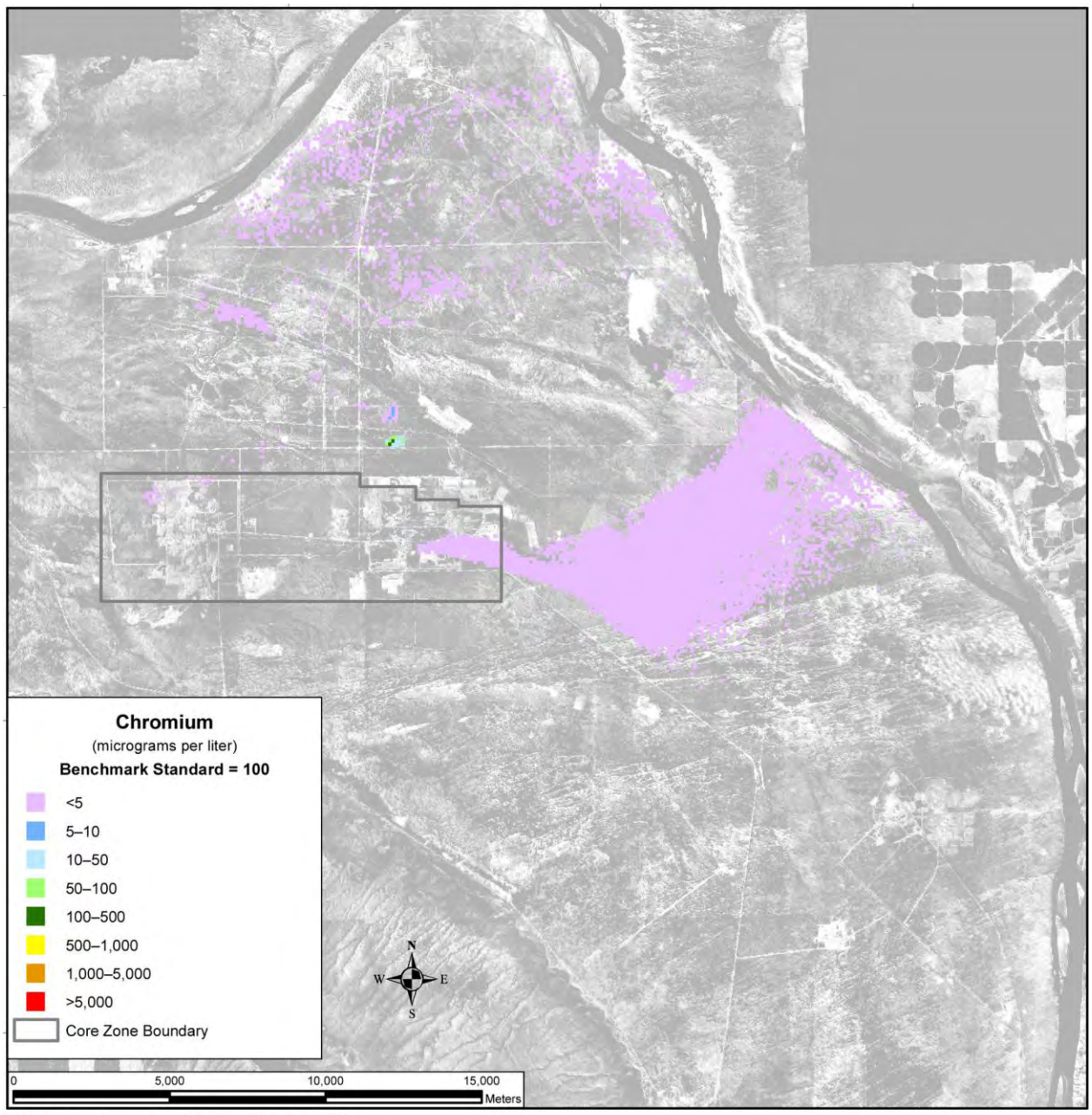
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1119. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 3890



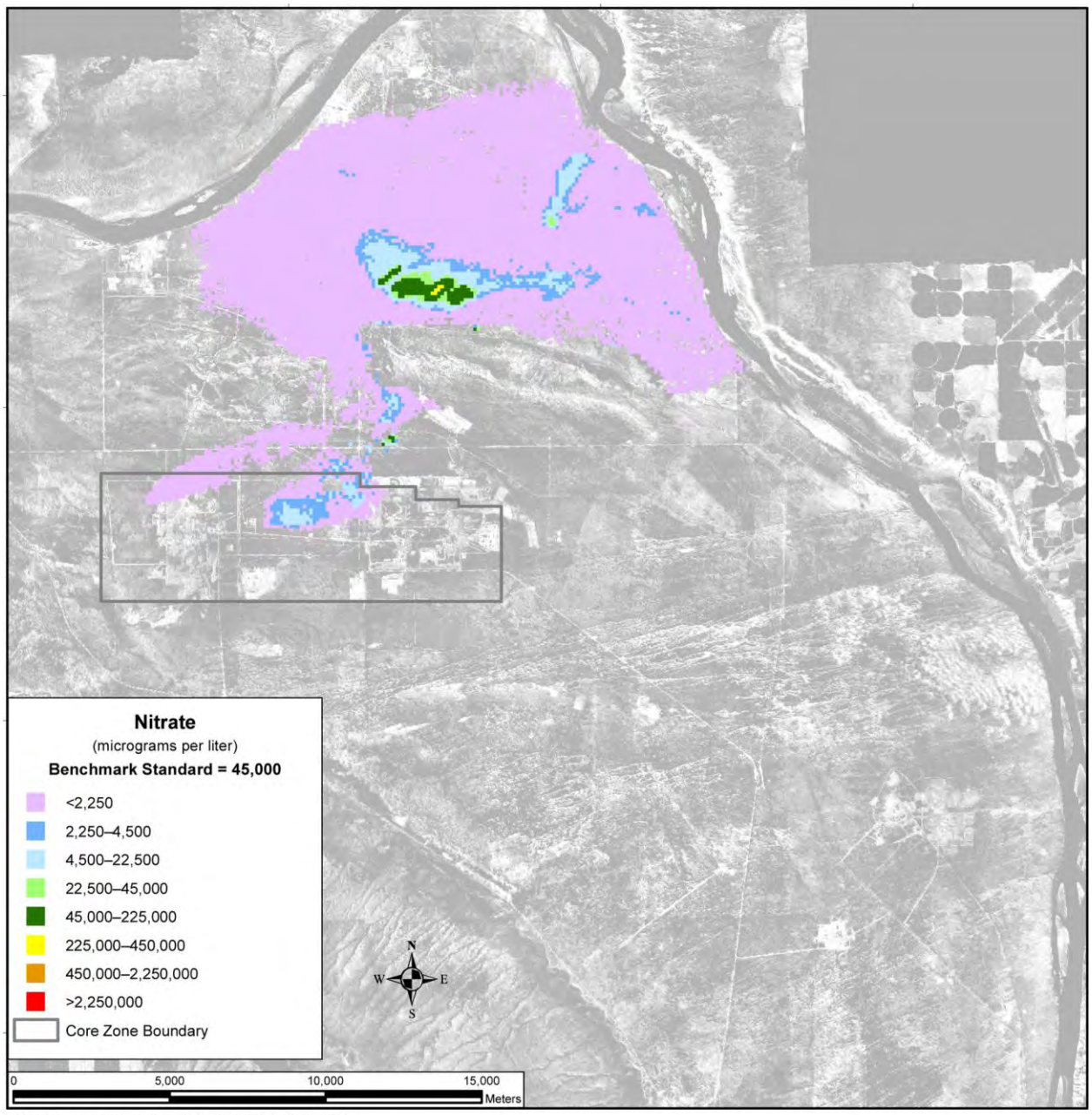
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1120. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 7140



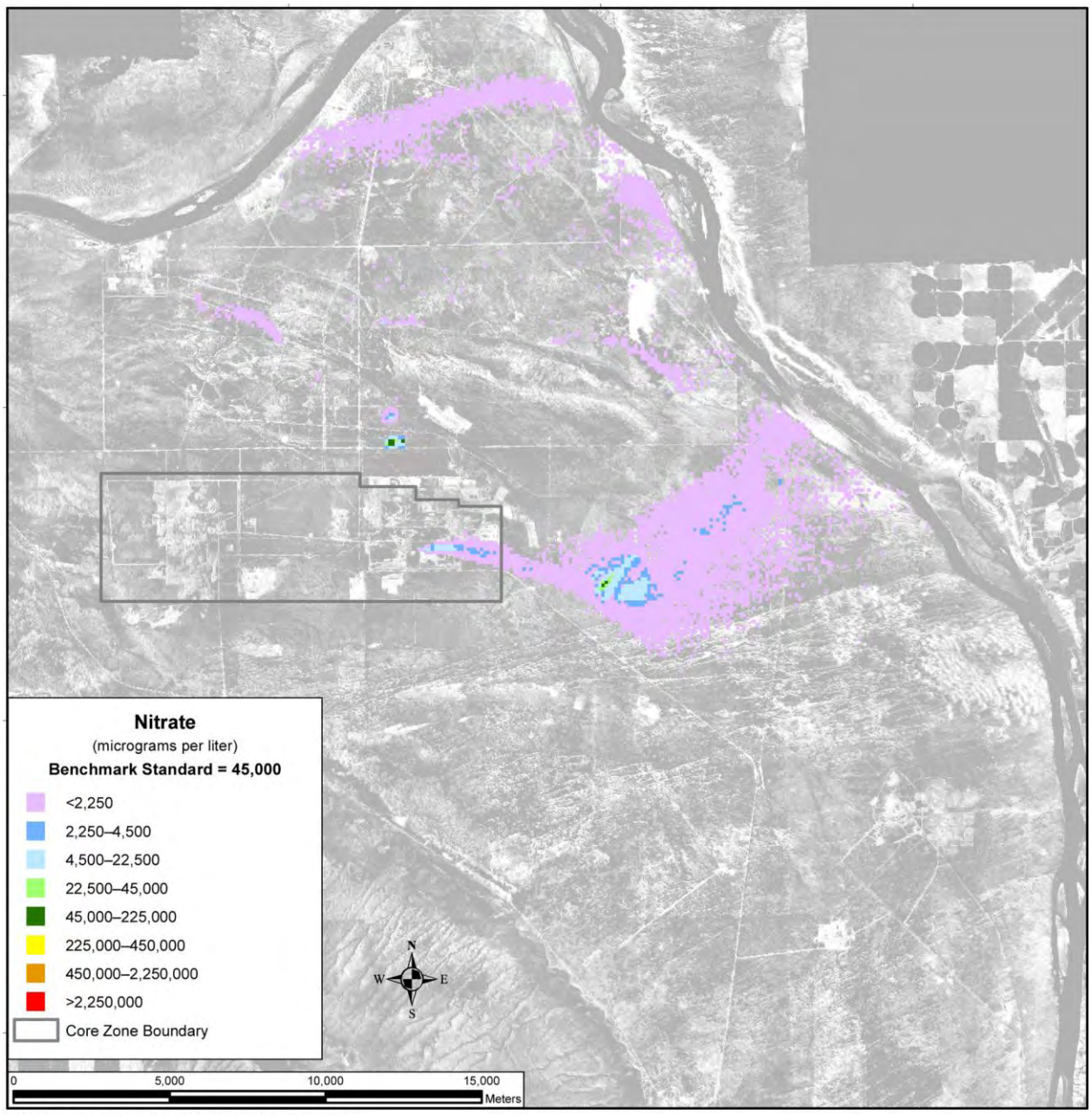
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1121. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Chromium Concentration, Calendar Year 11,885



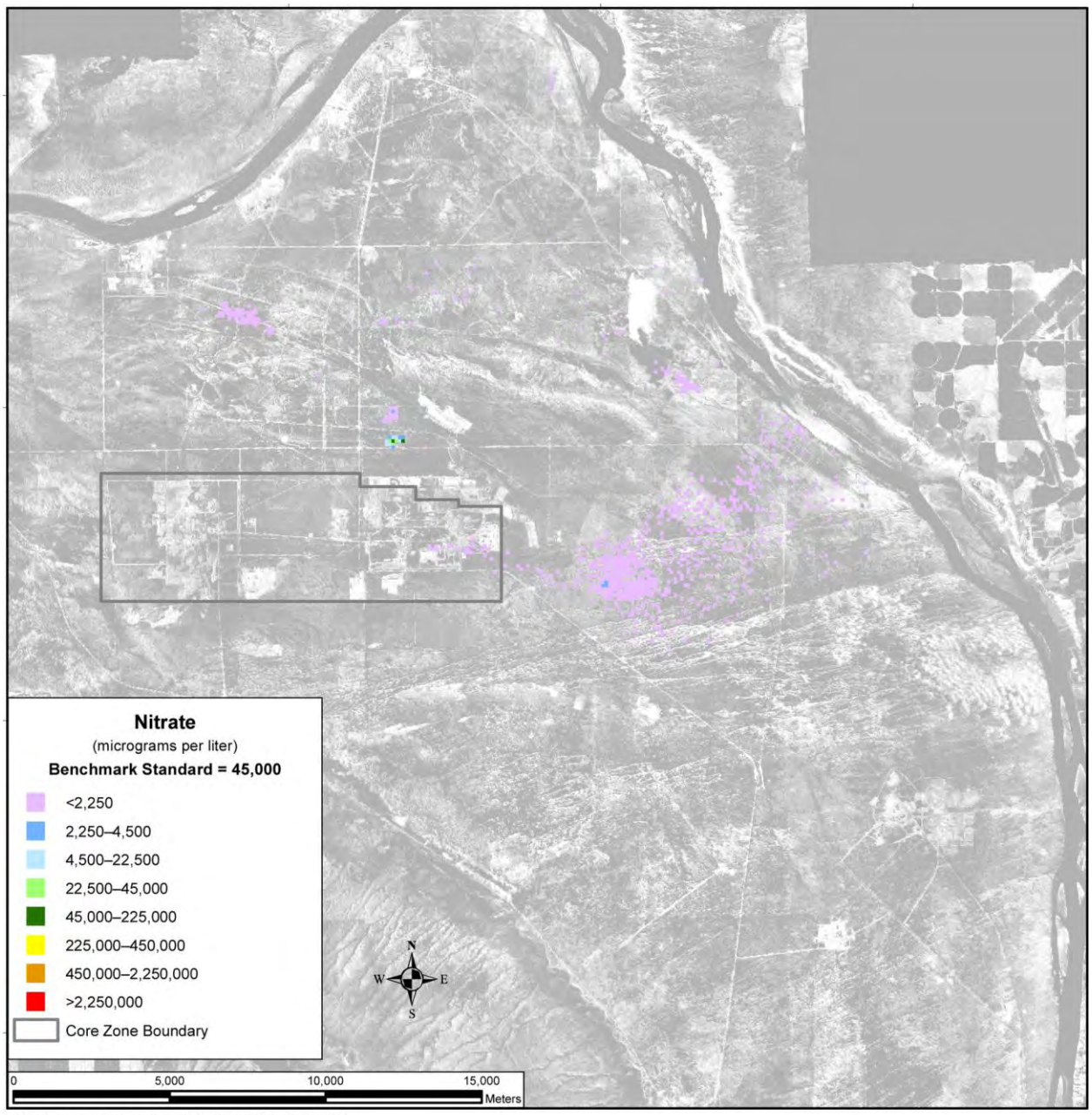
Note: To convert meters to feet, multiply by 3.281.

Figure 5–1122. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 3890



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

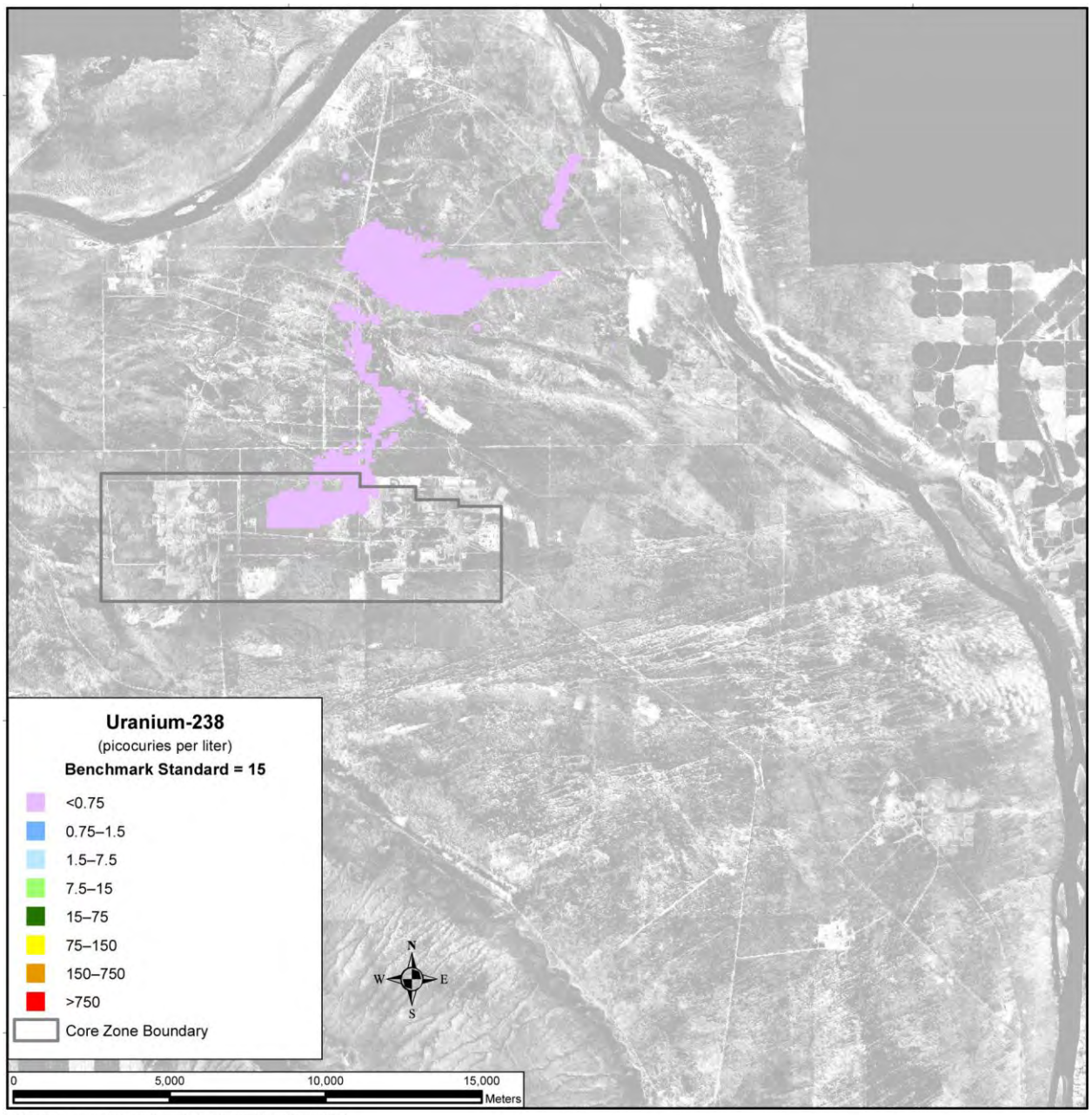
Figure 5–1123. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Nitrate Concentration, Calendar Year 7140



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

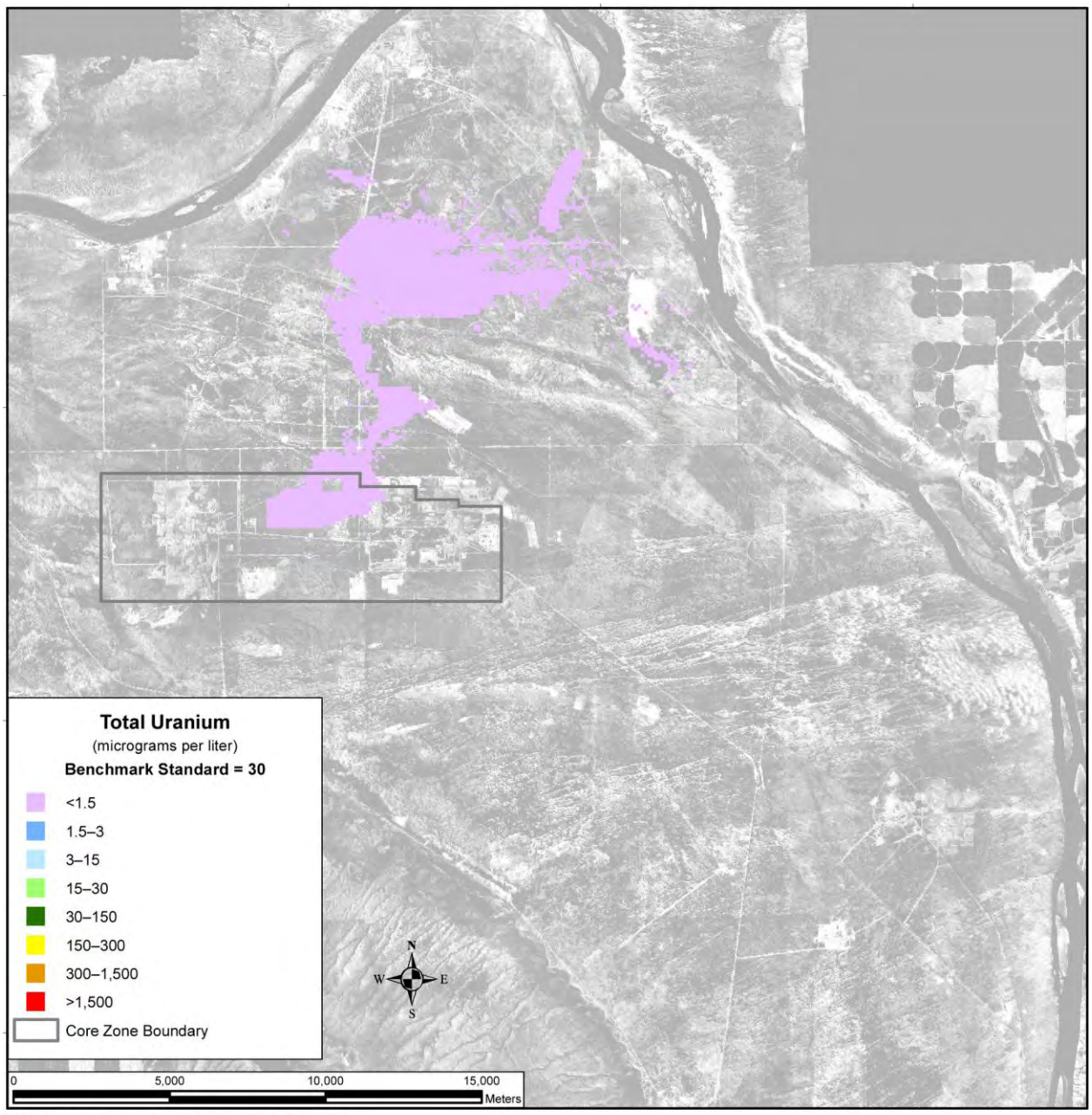
Figure 5–1124. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution Year of Groundwater Nitrate Concentration, Calendar Year 11,885

Total uranium and uranium-238 show a different spatial distribution over time. They are not as mobile as the COPCs discussed above, moving about seven times more slowly than the pore-water velocity. As a result, travel times through the vadose zone are longer, release to the aquifer is delayed, and travel times through the aquifer to the Columbia River are longer. By CY 11,885, there is a uranium-238 plume extending northeast from IDF-West through Gable Gap (see Figure 5–1125). A total uranium plume extends through Gable Gap from the RPPDF (see Figure 5–1126). Concentrations in all areas of the plumes remain below one-twentieth of the benchmark.



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

Figure 5–1125. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Uranium-238 Concentration, Calendar Year 11,885



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

Figure 5–1126. Waste Management Alternative 3, Disposal Group 3, Option Case, Spatial Distribution of Groundwater Total Uranium Concentration, Calendar Year 11,885

SUMMARY OF IMPACTS

Under Waste Management Alternative 3, Disposal Group 3, Option Case, in general, discharges from IDF-West are predominant contributors; those from IDF-East and the RPPDF are secondary contributors.

Concentrations of iodine-129 and technetium-99 show a sharp rise and fall between CY 2940 and CY 4940 that exceeds the benchmark by an order of magnitude or slightly more. Concentrations of these COPCs continue to decline at a slower rate after CY 4940, reaching a level around an order of magnitude below the benchmark. Chromium and nitrate show a similar rise and fall, but remain about two orders of magnitude below the benchmark.

For uranium-238 and total uranium, limited mobility is an important factor governing the timeframe and scale of groundwater impacts. The concentrations of these retarded species remain well below the benchmark at the Core Zone Boundary and the Columbia River throughout the simulation. The intensity is highest and the area of the contamination plumes largest near the end of the period of analysis.

5.3.2 Human Health Impacts

Potential human health impacts due to release of radionuclides are estimated as dose and as lifetime risk of incidence of cancer (i.e., radiological risk). For long-term performance assessment, radiological dose and risk are estimated consistent with the recommendations of *Cancer Risk Coefficients for Environmental Exposure to Radionuclides*, Federal Guidance Report No. 13 (Eckerman et al. 1999), including use of radionuclide-specific dose factors and risk coefficients. Potential human health effects due to the 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 intake that produces no observable effect, and as Hazard Index, the sum of the Hazard Quotients of a group of chemicals. 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. Screening analysis identified 14 radioactive and 26 chemical constituents as contributing the greatest risk of adverse impacts. Appendix Q provides more information on the screening analysis and on results of detailed analysis, including time of occurrence of peak impacts and constituent- and location-specific impacts under each Tank Closure, FFTF Decommissioning, and Waste Management alternative.

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 seven specific locations (i.e., LLBG 218-W-5, trenches 31 and 34; IDF-East; IDF-West; the RPPDF; the Core Zone Boundary; the Columbia River nearshore; and the 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. Also, to summarize time dependence of impacts, time series of lifetime risk are presented only for locations of likely maximum impact, that is, nearfield barriers and the Core Zone Boundary.

Impacts on human health over the long time period following stabilization or closure of the waste management disposal facilities would be due primarily to naturally occurring release mechanisms and the degradation of waste forms over time. These releases would involve both radioactive and chemical constituents.

Onsite locations comprise the barriers of LLBG 218-W-5, trenches 31 and 34; IDF-East; IDF-West; the RPPDF; the Core Zone Boundary; and the Columbia River nearshore. Offsite locations comprise access points to Columbia River surface water near the site and at population centers downstream of the site. Estimates of concentrations of constituents in the Columbia River surface water are used to calculate impacts for both offsite location points of analysis. The total population of downstream water users was assumed to be 5 million people for the entire 10,000-year period of analysis (DOE 1987). 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 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 for drinking water

consumption and irrigation of crops. Garden size and crop yield are adequate to produce the entirety of the receptor's average requirements for 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 both wild plant materials, which use groundwater, and game, which use surface water. Members of the offsite population 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 chapter for the resident farmer at the Columbia River surface-water location.

The significance of dose impacts is evaluated by comparison with the 100-millirem-per-year all-exposure-modes standard specified for protection of the public and the environment in DOE Order 458.1, *Radiation Protection of the Public and the Environment*. The level of protection provided for the drinking water pathway is evaluated by comparison with applicable drinking water standards presented in Section 5.3.1. 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. Estimation of Hazard Index less than unity indicates that observable effects would not occur.

5.3.2.1 Waste Management Alternative 1: No Action

Under Waste Management Alternative 1, only the wastes currently generated on site at Hanford from non-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-CERLCA waste disposed of in these trenches from CY 2008 through 2035 would become available for release to the environment.

Potential human health impacts of this alternative are summarized in Tables 5–118 and 5–119. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are 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. This corresponds to 1.43×10^{-8} percent of the annual population dose due to background exposure. The time series of lifetime radiological risk for the drinking-water well user at the Core Zone Boundary is presented in Figure 5–1127. The estimated lifetime risks are relatively low, with a peak of approximately 4×10^{-7}, indicating low rates of release from the disposal trenches.

Table 5–118. Waste Management Alternative 1 Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
Trenches 31 and 34	1.39×10^{-2}	1.00×10^{-2}	4.36×10^{-7}	0.00	4.36×10^{-7}	3.34×10^{-2}	1.39×10^{-2}	1.40×10^{-6}	3.71×10^{-12}	1.40×10^{-6}
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	9.90×10^{-4}	6.87×10^{-4}	3.21×10^{-8}	0.00	3.21×10^{-8}	2.44×10^{-3}	9.12×10^{-4}	1.04×10^{-7}	2.61×10^{-13}	1.04×10^{-7}
Columbia River nearshore	2.42×10^{-3}	1.66×10^{-3}	7.67×10^{-8}	0.00	7.67×10^{-8}	5.86×10^{-3}	2.24×10^{-3}	2.47×10^{-7}	6.20×10^{-13}	2.47×10^{-7}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	0.00	0.00	0.00	0.00	0.00

Key: mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–119. Waste Management Alternative 1 American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
Trenches 31 and 34	6.65×10^{-2}	2.39×10^{-2}	3.04×10^{-6}	1.70×10^{-7}	3.20×10^{-6}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	4.90×10^{-3}	1.56×10^{-3}	2.26×10^{-7}	1.19×10^{-8}	2.35×10^{-7}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.17×10^{-2}	3.83×10^{-3}	5.37×10^{-7}	2.84×10^{-8}	5.63×10^{-7}	3.94×10^{-5}	8.21×10^{-4}	2.03×10^{-9}	2.84×10^{-8}	3.03×10^{-8}
Off Site										
Columbia River	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	N/A	N/A

Key: mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

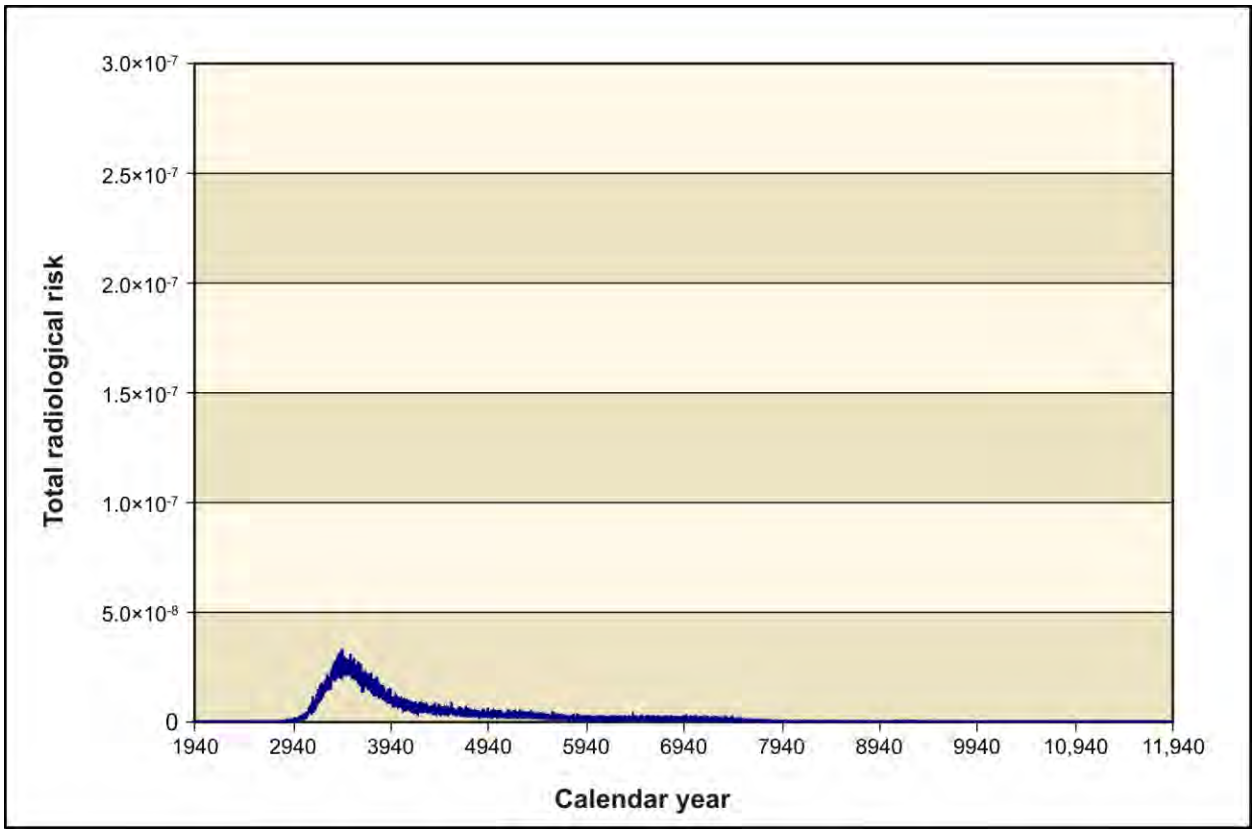


Figure 5–1127. Waste Management Alternative 1 Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2 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 sizes and operational time periods of IDF-East. 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.

5.3.2.2.1 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–120 and 5–121. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are 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. Population dose is estimated as 1.68×10^{-1} person-rem per year for the year of maximum impact. This

corresponds to 1.08×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and at the Core Zone Boundary are presented in Figures 5–1128 and 5–1129, respectively. Review of the source term inventories (see Appendix D), cumulative release to the unconfined aquifer (see Appendix N), sensitivity analysis (see Appendix N), and estimates of impact presented later in this section support the interpretation that the majority of the radiological impact in the year of peak dose at both the IDF-East barrier (see Figure 5–1128) and Core Zone Boundary (see Figure 5–1129) is due to release of technetium-99 and iodine-129 from offsite waste. For chemical constituents, greater than 90 percent of the noncarcinogenic impact during the year of peak impact is due to release of nitrate from ETF-generated secondary waste. Releases from ILAW glass provide a minor contribution to estimated impacts. The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1129) shows a small peak in CY 3700 due to releases from the RPPDF, while the larger peak in CY 8000 is due to releases from IDF-East.

Table 5–120. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.70	2.29×10^{-1}	8.14×10^{-5}	0.00	8.14×10^{-5}	6.30	1.71	2.58×10^{-4}	8.22×10^{-12}	2.58×10^{-4}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	1.01	5.76×10^{-2}	3.14×10^{-5}	0.00	3.14×10^{-5}	2.41	4.27×10^{-1}	1.01×10^{-4}	2.94×10^{-12}	1.01×10^{-4}
Columbia River nearshore	7.56×10^{-1}	3.80×10^{-2}	2.38×10^{-5}	0.00	2.38×10^{-5}	1.82	2.87×10^{-1}	7.63×10^{-5}	1.67×10^{-12}	7.63×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.35×10^{-5}	5.67×10^{-6}	1.36×10^{-9}	0.00	1.36×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–121. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.24×10^{1}	3.81	5.58×10^{-4}	3.77×10^{-7}	5.59×10^{-4}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	4.79	9.49×10^{-1}	2.19×10^{-4}	1.35×10^{-7}	2.19×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.63	6.39×10^{-1}	1.66×10^{-4}	7.64×10^{-8}	1.66×10^{-4}	1.28×10^{-2}	1.01×10^{-1}	6.43×10^{-7}	7.64×10^{-8}	6.82×10^{-7}
Off Site										
Columbia River	1.25×10^{-4}	3.53×10^{-3}	4.61×10^{-9}	0.00	4.61×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not available; Nonrad.=nonradiological; Rad.=radiological; yr=year.

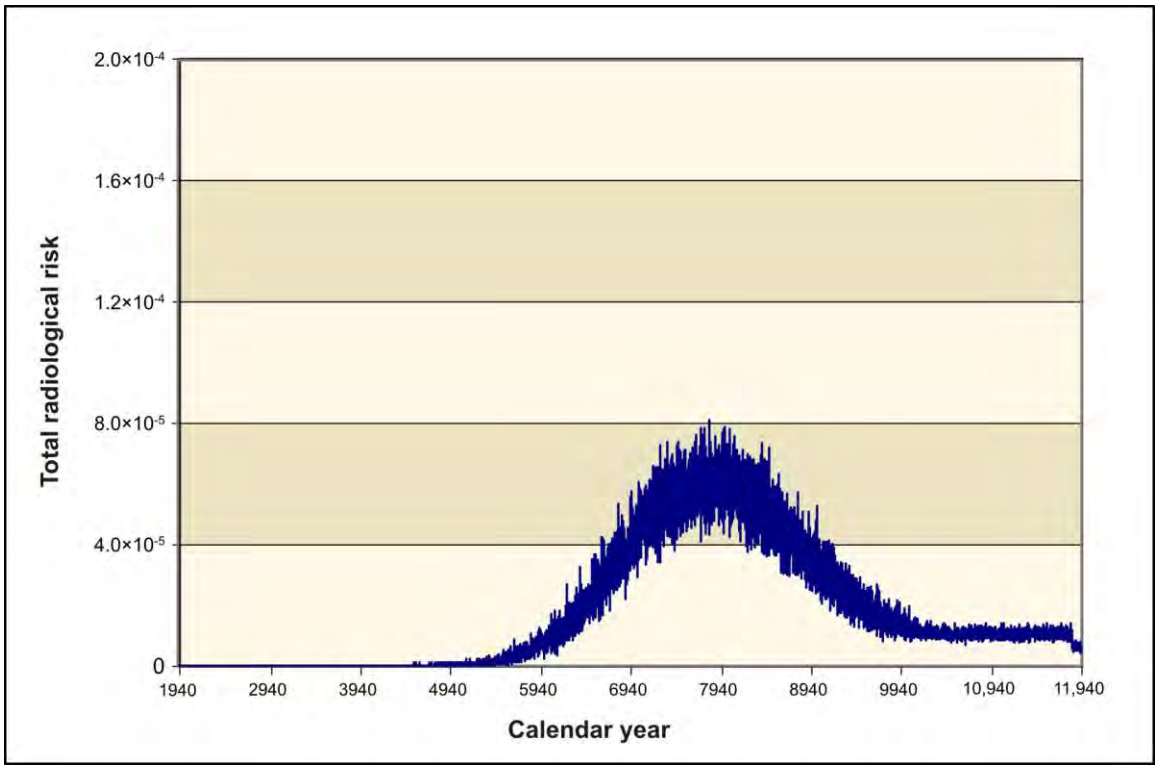


Figure 5–1128. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

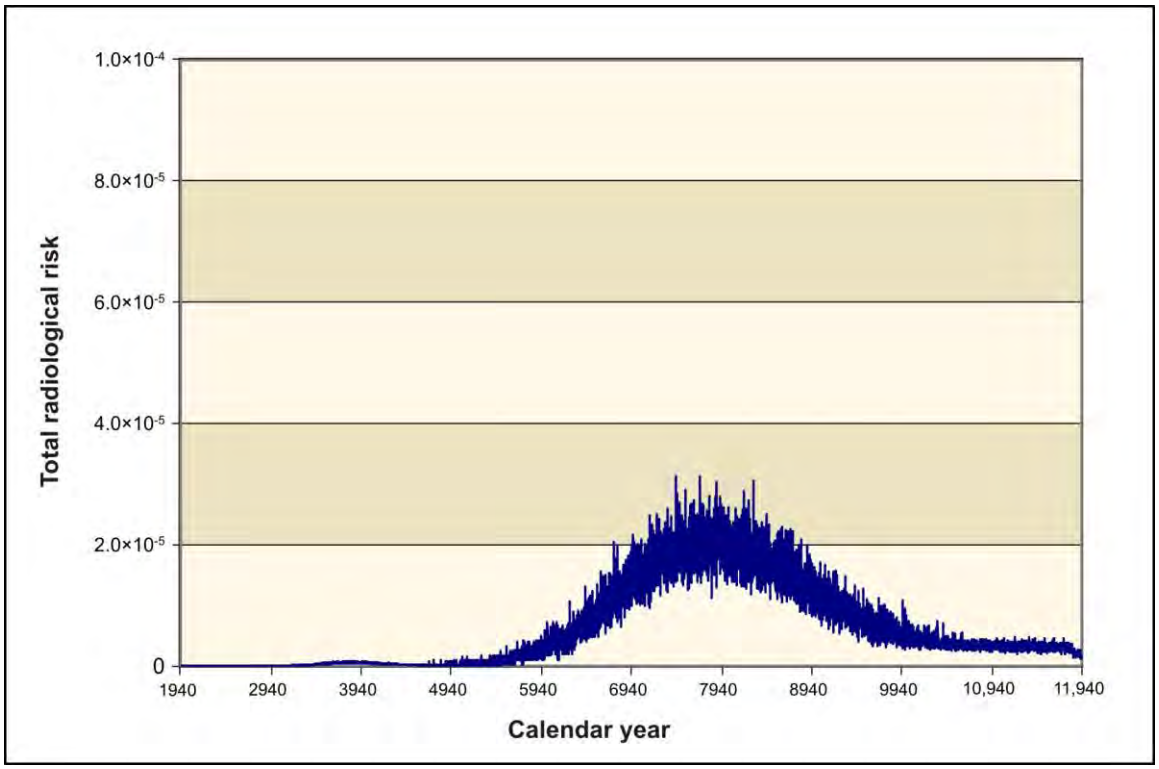


Figure 5–1129. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-A, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.2 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–122 and 5–123. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are 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. Population dose is estimated as 2.78×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 1.79×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1130 and 5–1131, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (9.7×10^{-5}) is due to release of radioactive constituents from offsite LLW. At both the IDF-East barrier and the Core Zone Boundary, approximately 85 and 15 percent of the dose in the year of peak dose is due to technetium-99 and iodine-129, respectively. In each case, the source of the constituent is offsite LLW. For chemical constituents at both the IDF-East barrier and the Core Zone Boundary, nearly the entirety of noncarcinogenic impact is due to release of nitrate from ETF-generated secondary waste.

The major contributor to risk for the bulk vitrification glass is release of technetium-99 from the castable refractory block portion of the waste form package. The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1131) comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East.

Table 5–122. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	3.06	1.89×10^{-1}	9.68×10^{-5}	0.00	9.68×10^{-5}	7.39	1.45	3.11×10^{-4}	3.72×10^{-12}	3.11×10^{-4}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	1.43	5.16×10^{-2}	4.64×10^{-5}	0.00	4.64×10^{-5}	3.53	3.94×10^{-1}	1.50×10^{-4}	2.94×10^{-12}	1.50×10^{-4}
Columbia River nearshore	1.17	4.05×10^{-2}	3.78×10^{-5}	0.00	3.78×10^{-5}	2.87	3.11×10^{-1}	1.22×10^{-4}	1.11×10^{-12}	1.22×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	5.55×10^{-5}	5.11×10^{-6}	2.34×10^{-9}	0.00	2.34×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–123. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.48×10^{1}	3.22	6.77×10^{-4}	1.71×10^{-7}	6.77×10^{-4}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	7.09	8.78×10^{-1}	3.27×10^{-4}	1.35×10^{-7}	3.27×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	5.77	6.92×10^{-1}	2.66×10^{-4}	5.07×10^{-8}	2.66×10^{-4}	1.99×10^{-2}	1.01×10^{-1}	1.02×10^{-6}	5.07×10^{-8}	1.04×10^{-6}
Off Site										
Columbia River	1.75×10^{-4}	3.18×10^{-3}	6.96×10^{-9}	0.00	6.96×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

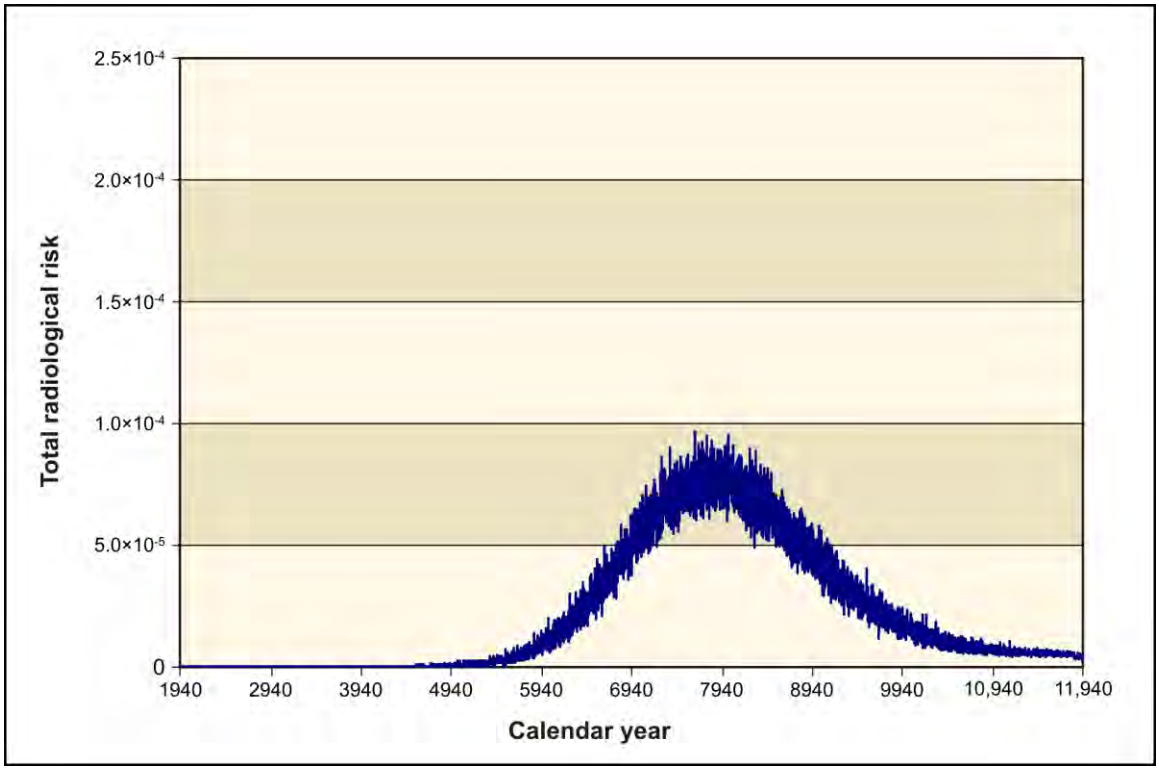


Figure 5–1130. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

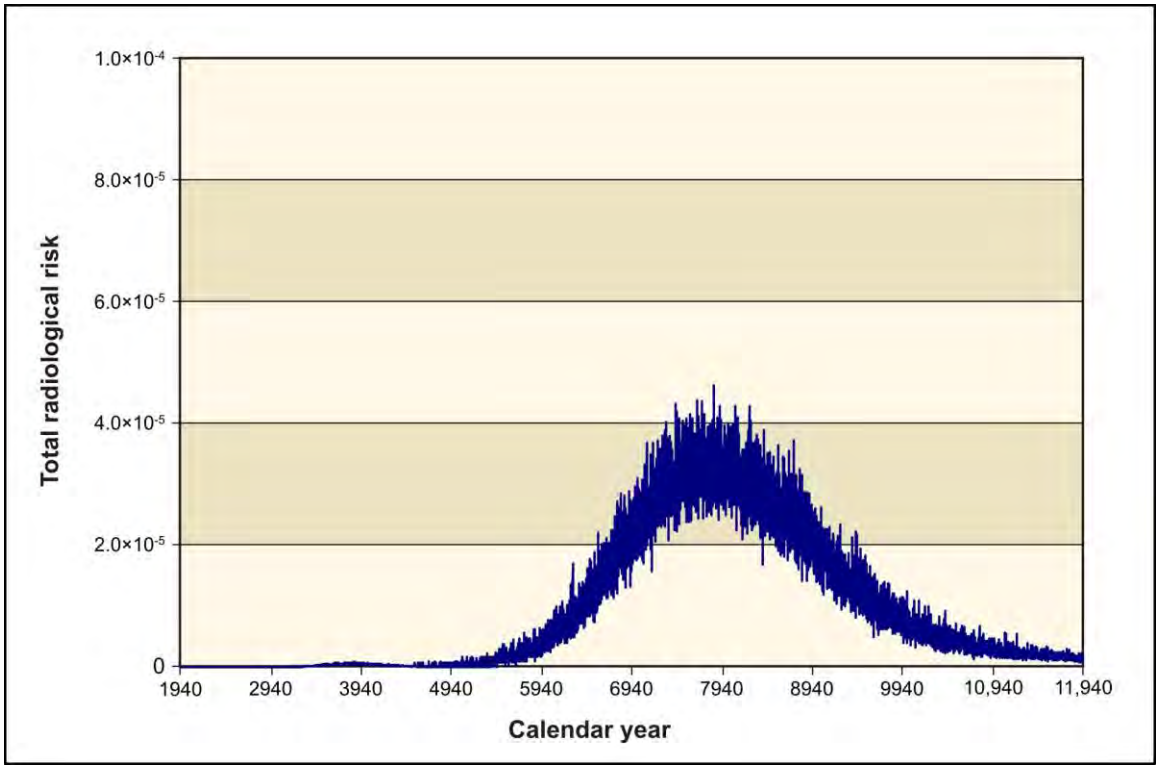


Figure 5–1131. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-B, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.3 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–124 and 5–125. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are 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, Core Zone Boundary, and Columbia River nearshore for the resident farmer and American Indian resident farmer and at the IDF-East barrier and Core Zone Boundary for the drinking-water well user. Population dose is estimated as 3.28×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.11×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1132 and 5–1133, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.8×10^{-4}) is due to release of radioactive constituents from cast stone waste. At both the IDF-East barrier and the Core Zone Boundary, greater than 95 percent of the dose in the year of peak dose is due to technetium-99 from the cast stone waste. Secondary contribution to dose is due to release of iodine-129 from the ETF-generated secondary waste and offsite LLW. For chemical constituents at both the IDF-East barrier and the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (85 percent of Hazard Index) and nitrate (15 percent of Hazard Index) from the cast stone waste.

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1133) comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East.

Table 5–124. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.31	3.40	1.81×10^{-4}	0.00	1.81×10^{-4}	1.36×10^{1}	8.39	5.94×10^{-4}	1.16×10^{-9}	5.94×10^{-4}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	1.94	1.11	6.44×10^{-5}	0.00	6.44×10^{-5}	4.86	3.03	2.10×10^{-4}	3.99×10^{-10}	2.10×10^{-4}
Columbia River nearshore	1.60	8.56×10^{-1}	5.46×10^{-5}	0.00	5.46×10^{-5}	4.09	2.17	1.79×10^{-4}	3.08×10^{-10}	1.79×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.57×10^{-5}	3.95×10^{-5}	2.82×10^{-9}	4.59×10^{-15}	2.82×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–125. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.77×10^{1}	1.70×10^{1}	1.30×10^{-3}	5.32×10^{-5}	1.31×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	9.84	6.20	4.58×10^{-4}	1.83×10^{-5}	4.67×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	8.35	4.37	3.92×10^{-4}	1.41×10^{-5}	3.95×10^{-4}	2.75×10^{-2}	8.18×10^{-1}	1.46×10^{-6}	1.41×10^{-5}	1.49×10^{-5}
Off Site										
Columbia River	1.89×10^{-4}	1.80×10^{-2}	7.90×10^{-9}	2.11×10^{-10}	8.07×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

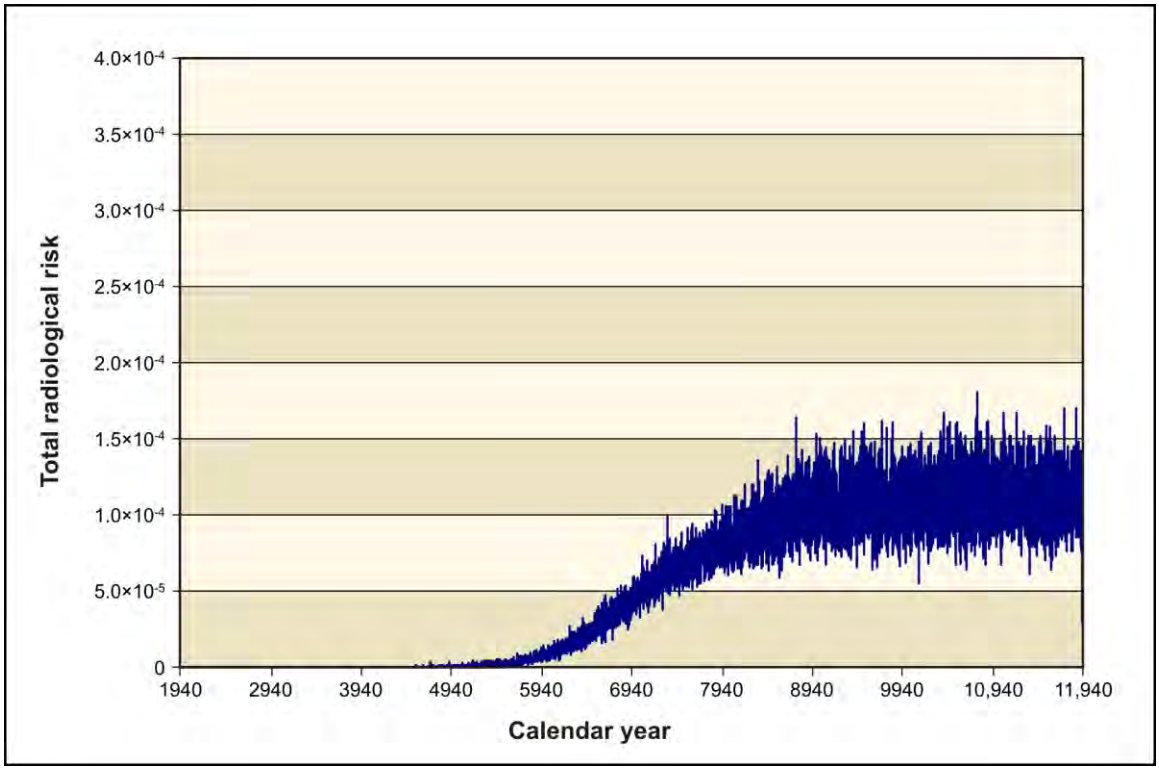


Figure 5–1132. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

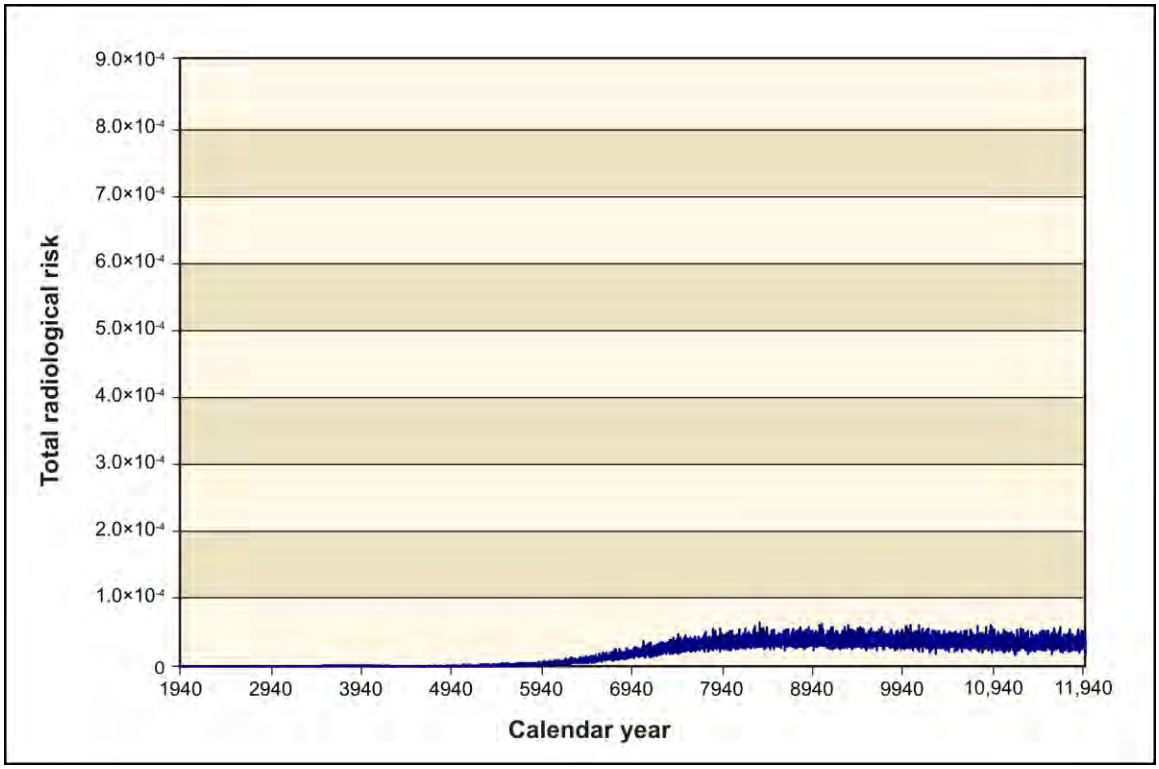


Figure 5–1133. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-C, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.4 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–126 and 5–127. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are 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 nitrate at the IDF-East barrier for the resident farmer and American Indian resident farmer. The Hazard Index guideline would also be exceeded 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. This corresponds to 1.36×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1134 and 5–1135, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (8.7×10^{-5}) is due to release of radioactive constituents from offsite LLW. At the IDF-East barrier, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (90 percent of peak dose) and iodine-129 (10 percent of peak dose). In each case, the source of the constituent is offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium from steam reforming waste (33 percent of Hazard Index) and nitrate from ETF-generated secondary waste (67 percent of Hazard Index). For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium from steam reforming waste (44 percent of Hazard Index) and nitrate from ETF-generated secondary waste (56 percent of Hazard Index).

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1135) comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East.

Table 5–126. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.88	3.05×10^{-1}	8.72×10^{-5}	0.00	8.72×10^{-5}	6.74	1.71	2.81×10^{-4}	7.57×10^{-11}	2.81×10^{-4}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	1.18	9.26×10^{-2}	3.80×10^{-5}	0.00	3.80×10^{-5}	2.90	4.66×10^{-1}	1.23×10^{-4}	2.38×10^{-11}	1.23×10^{-4}
Columbia River nearshore	9.66×10^{-1}	6.38×10^{-2}	3.04×10^{-5}	0.00	3.04×10^{-5}	2.31	3.57×10^{-1}	9.80×10^{-5}	1.83×10^{-11}	9.80×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	4.22×10^{-5}	6.27×10^{-6}	1.74×10^{-9}	2.90×10^{-16}	1.74×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–127. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.33×10^{1}	3.74	6.11×10^{-4}	3.47×10^{-6}	6.12×10^{-4}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	5.81	1.02	2.67×10^{-4}	1.09×10^{-6}	2.68×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	4.63	7.82×10^{-1}	2.13×10^{-4}	8.39×10^{-7}	2.13×10^{-4}	1.62×10^{-2}	1.20×10^{-1}	8.19×10^{-7}	8.38×10^{-7}	1.26×10^{-6}
Off Site										
Columbia River	1.49×10^{-4}	3.68×10^{-3}	5.63×10^{-9}	1.33×10^{-11}	5.63×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not available; Nonrad.=nonradiological; Rad.=radiological; yr=year.

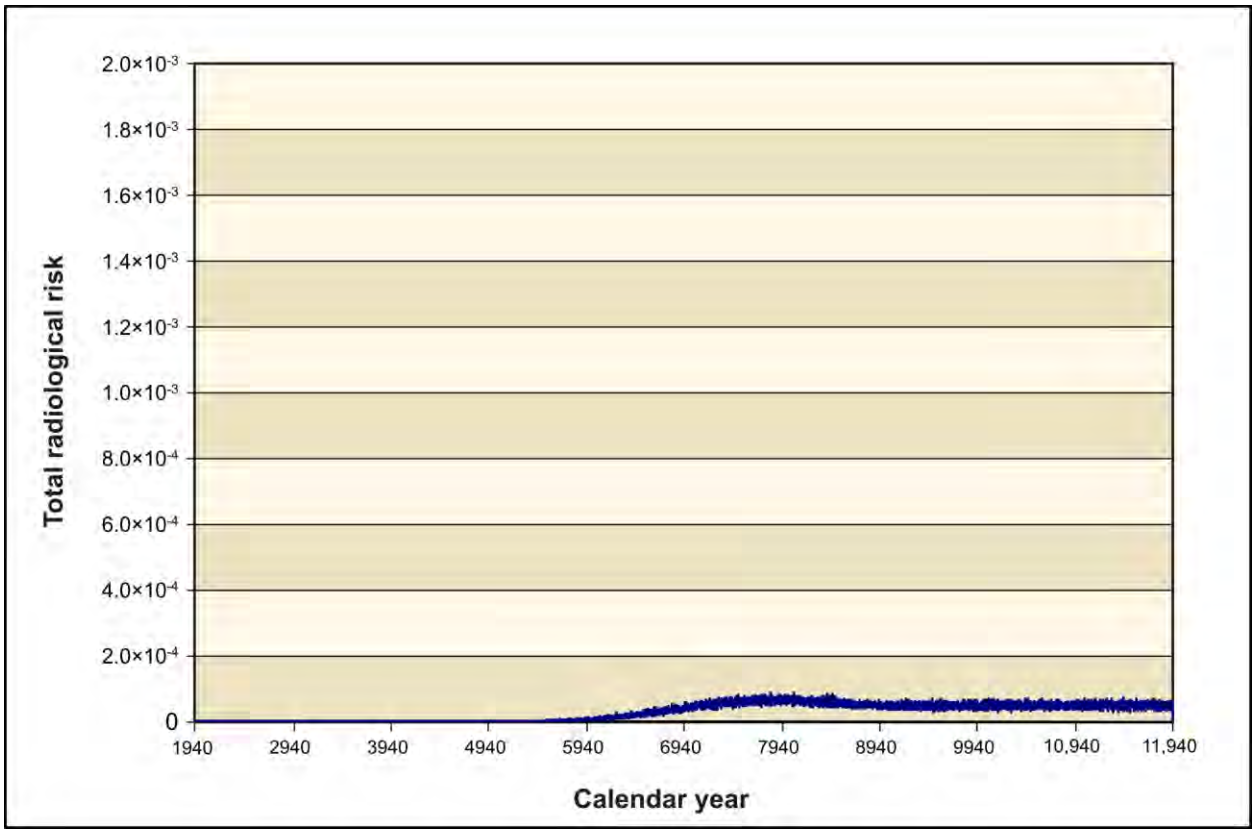


Figure 5–1134. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

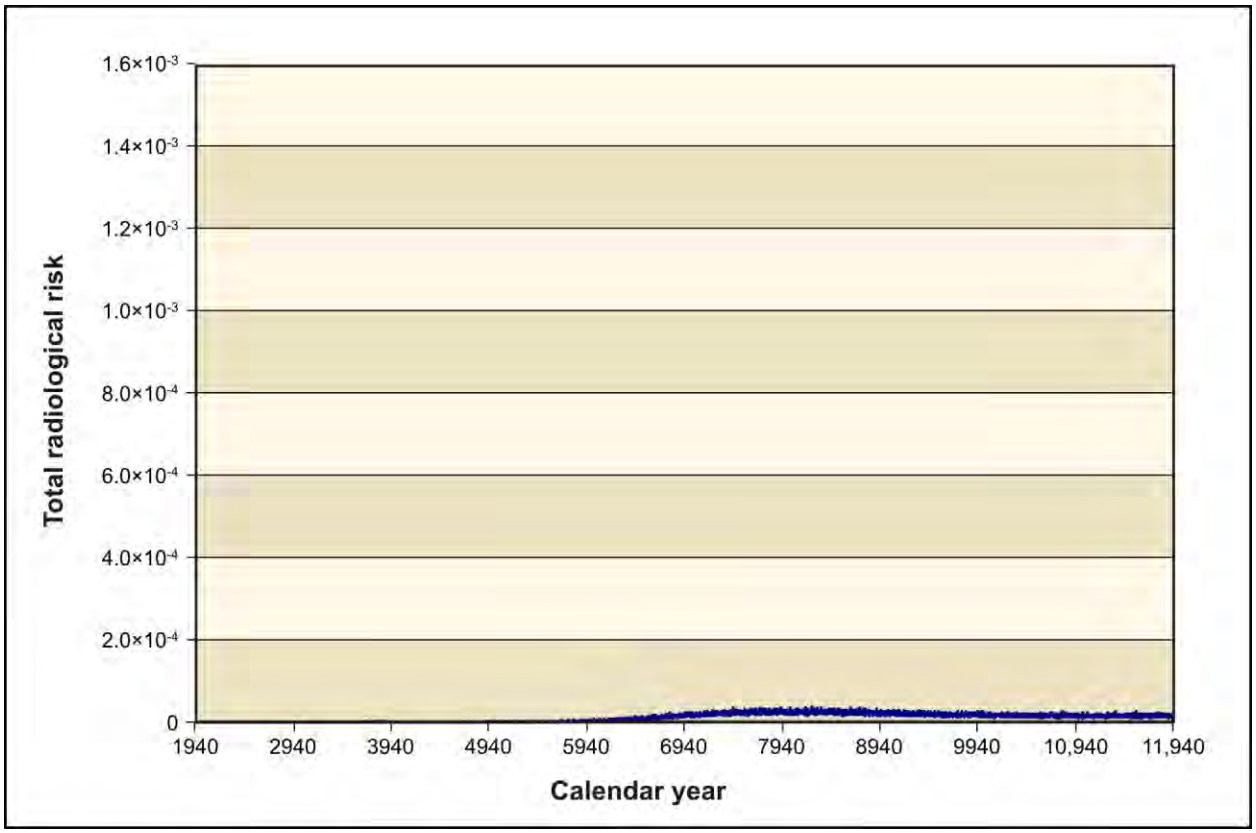


Figure 5–1135. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.5 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–128 and 5–129. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are 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 at the IDF-East barrier for the drinking-water well user, resident farmer, and American Indian resident farmer. The Hazard Index guideline would also be exceeded due primarily to chromium and nitrate at the Core Zone Boundary and Columbia River nearshore locations 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. This corresponds to 2.57×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1136 and 5–1137, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (2.3×10^{-3}) is due to release of radioactive constituents from cast stone waste. At both the IDF-East barrier and the Core Zone Boundary, greater than 97 percent of the dose in the year of peak dose is due to technetium-99. In each case, the source of the constituent is cast stone waste. For chemical constituents, greater than

80 percent of Hazard Index reported at the IDF-East barrier is due to chromium, while at the Core Zone Boundary, greater than 90 percent of Hazard Index is due to nitrate. In each case, the source is cast stone waste.

The major contributor to risk for the low-activity waste sources is release of technetium-99 from cast stone waste and the castable refractory block portion of the bulk vitrification glass waste form package. The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1137) comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East.

Table 5–128. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	6.89	2.08	2.34×10^{-4}	0.00	2.34×10^{-4}	1.76×10^{1}	5.14	7.67×10^{-4}	6.88×10^{-10}	7.67×10^{-4}
River Protection Project Disposal Facility	2.37×10^{-1}	6.92×10^{-2}	7.01×10^{-6}	0.00	7.01×10^{-6}	5.45×10^{-1}	1.01×10^{-1}	2.21×10^{-5}	2.69×10^{-11}	2.21×10^{-5}
Core Zone Boundary	2.49	6.26×10^{-1}	8.45×10^{-5}	0.00	8.45×10^{-5}	6.35	1.63	2.77×10^{-4}	2.06×10^{-10}	2.77×10^{-4}
Columbia River nearshore	2.07	4.68×10^{-1}	7.07×10^{-5}	0.00	7.07×10^{-5}	5.31	1.16	2.32×10^{-4}	1.56×10^{-10}	2.32×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	7.98×10^{-5}	2.32×10^{-5}	3.43×10^{-9}	2.59×10^{-15}	3.43×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–129. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	3.58×10^{1}	1.04×10^{1}	1.67×10^{-3}	3.16×10^{-5}	1.68×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	1.07	1.78×10^{-1}	4.77×10^{-5}	1.23×10^{-6}	4.86×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.29×10^{1}	3.32	6.05×10^{-4}	9.46×10^{-6}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.08×10^{1}	2.44	5.07×10^{-4}	7.17×10^{-6}	5.08×10^{-4}	3.55×10^{-2}	4.29×10^{-1}	1.89×10^{-6}	7.17×10^{-6}	7.99×10^{-6}
Off Site										
Columbia River	2.28×10^{-4}	1.09×10^{-2}	9.61×10^{-9}	1.19×10^{-10}	9.71×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not available; Nonrad.=nonradiological; Rad.=radiological; yr=year.

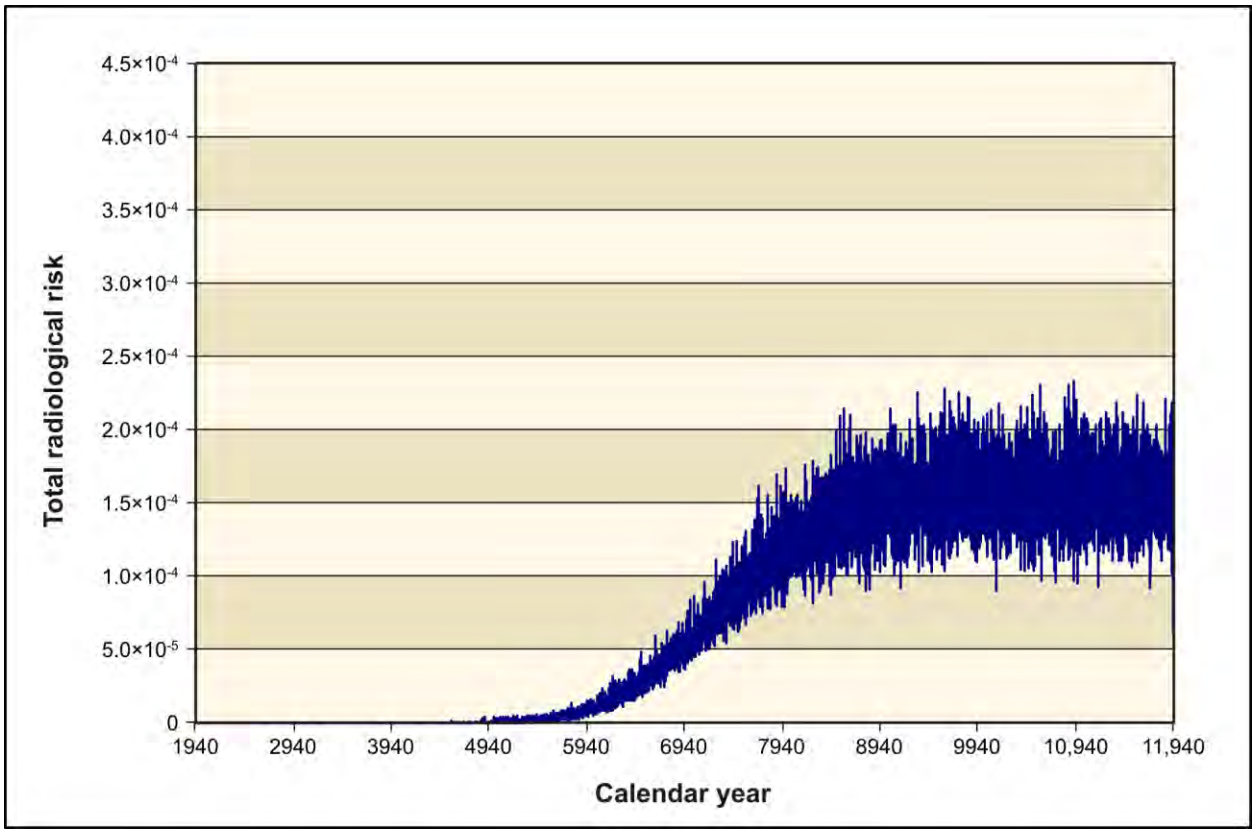


Figure 5–1136. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

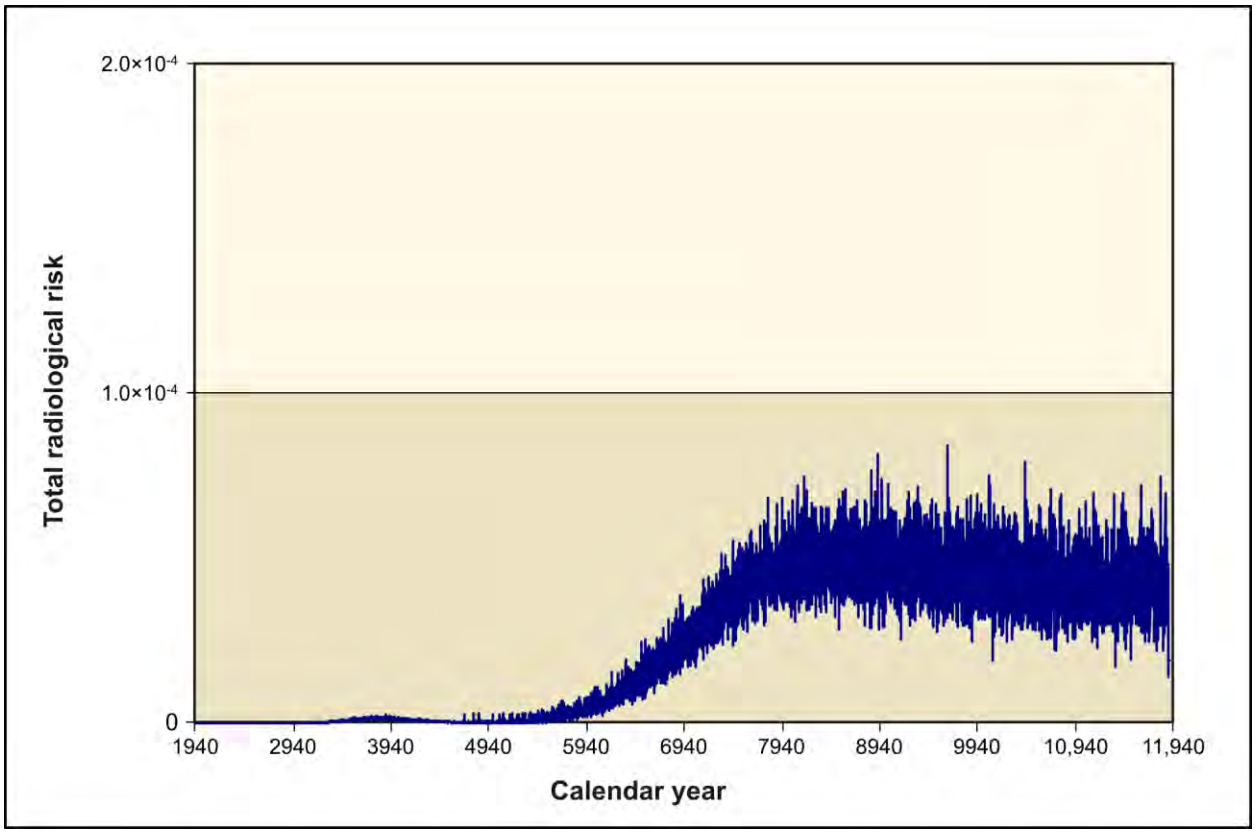


Figure 5–1137. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-E, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.6 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–130 and 5–131. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are 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, resident farmer, and American Indian resident farmer. The Hazard Index guideline would also 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 2.59×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 1.66×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1138 and 5–1139, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (9.2×10^{-5}) is due to release of radioactive constituents from offsite LLW. At the IDF-East barrier and the Core Zone Boundary, approximately 83 and 90 percent of the dose in the year of peak dose is due to technetium-99, respectively. In each case, the source of the constituent is offsite LLW. For chemical constituents, at both the IDF-East barrier and the Core Zone Boundary, greater than 90 percent of noncarcinogenic impact

is due to release of chromium from sulfate grout. The balance of the noncarcinogenic chemical impact is due to release of nitrate from ETF-generated secondary waste.

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1139) does not include an early peak, as the RPPDF is not constructed for this alternative, but does include a late peak due to sources at IDF-East.

Table 5–130. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	3.01	3.03	9.20×10^{-5}	0.00	9.20×10^{-5}	7.09	4.98	2.93×10^{-4}	1.16×10^{-9}	2.93×10^{-4}
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.34	8.21×10^{-1}	4.33×10^{-5}	0.00	4.33×10^{-5}	3.30	1.45	1.40×10^{-4}	3.06×10^{-10}	1.40×10^{-4}
Columbia River nearshore	1.07	6.12×10^{-1}	3.47×10^{-5}	0.00	3.47×10^{-5}	2.64	9.76×10^{-1}	1.12×10^{-4}	2.34×10^{-10}	1.12×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	5.18×10^{-5}	2.07×10^{-5}	2.16×10^{-9}	4.03×10^{-15}	2.16×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–131. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.40×10^{1}	9.31	6.37×10^{-4}	5.31×10^{-5}	6.69×10^{-4}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	6.61	2.82	3.05×10^{-4}	1.40×10^{-5}	3.14×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	5.30	1.80	2.44×10^{-4}	1.07×10^{-5}	2.48×10^{-4}	1.83×10^{-2}	4.17×10^{-1}	9.35×10^{-7}	1.07×10^{-5}	1.15×10^{-5}
Off Site										
Columbia River	1.67×10^{-4}	7.46×10^{-3}	6.61×10^{-9}	1.85×10^{-10}	6.74×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

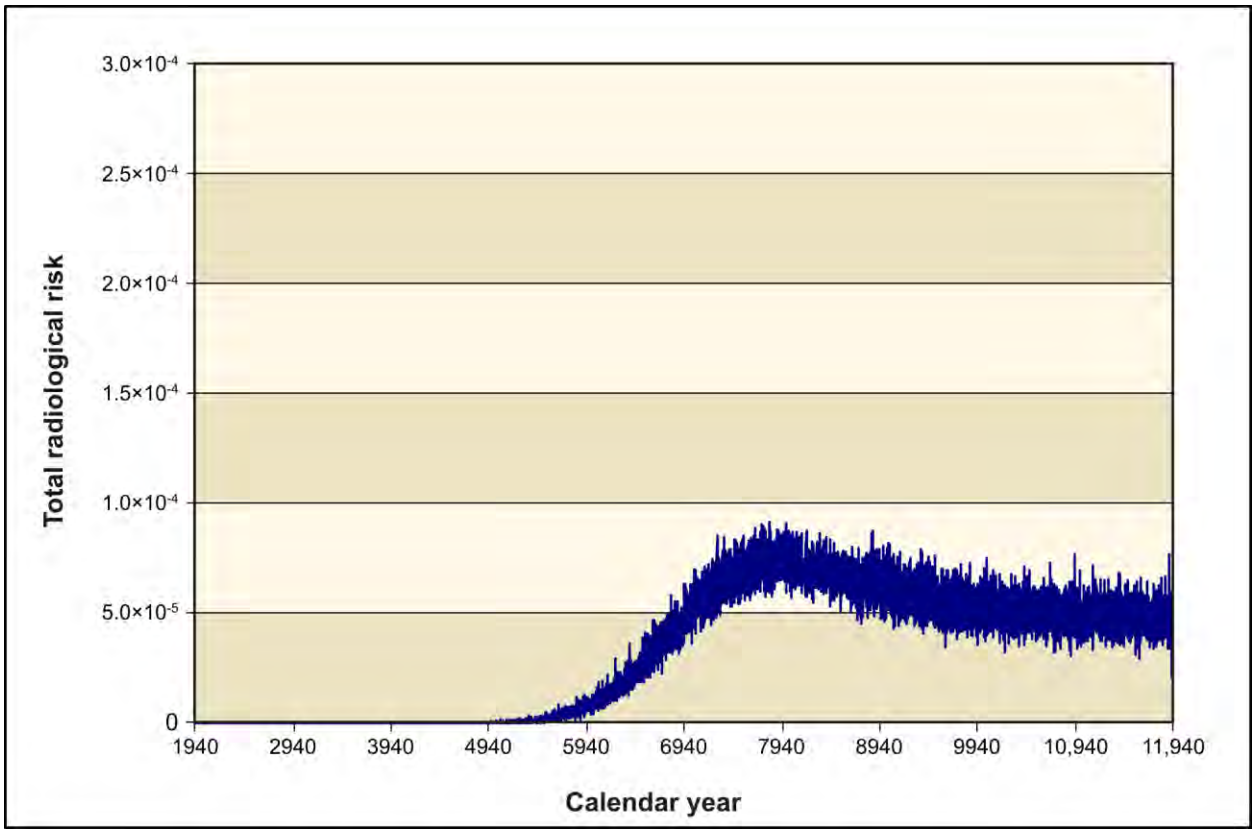


Figure 5–1138. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

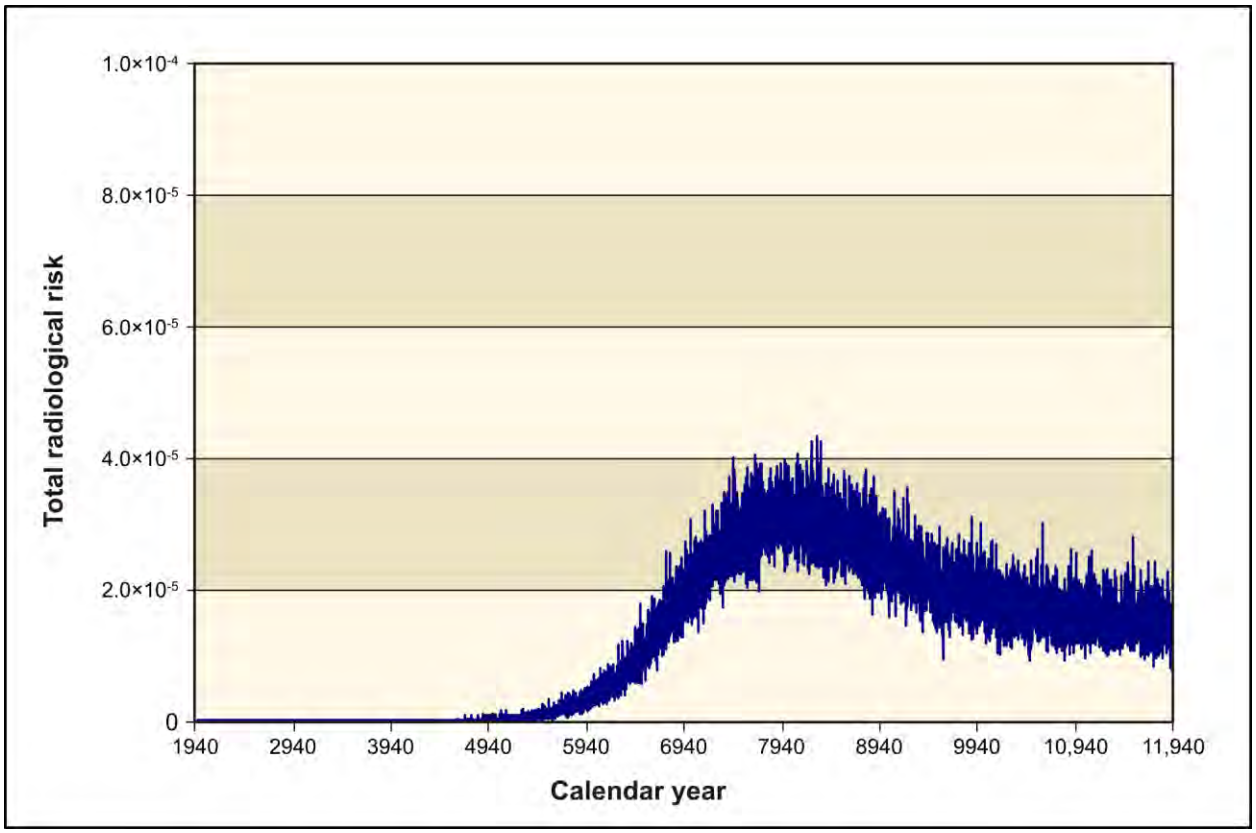


Figure 5–1139. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-F, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.7 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–132 and 5–133. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are 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. Population dose is estimated as 1.67×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 1.07×10^{-5} percent of the annual population dose due to background exposure. The time series of lifetime radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1140 and 5–1141, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (8.1×10^{-5}) is due to release of radioactive constituents from offsite LLW. At the IDF-East barrier and the Core Zone Boundary, greater than 85 percent of the dose in the year of peak dose is due to technetium-99 released from offsite LLW. The balance of dose in the year of peak dose is due to release of iodine-129 from offsite LLW. For chemical constituents at both the IDF-East barrier and the Core Zone Boundary, greater than 95 percent of noncarcinogenic impact is due to release of nitrate from ETF-generated secondary waste.

Table 5–132. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.70	2.29×10^{-1}	8.14×10^{-5}	0.00	8.14×10^{-5}	6.30	1.71	2.58×10^{-4}	8.05×10^{-12}	2.58×10^{-4}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	1.01	5.78×10^{-2}	3.14×10^{-5}	0.00	3.14×10^{-5}	2.41	4.27×10^{-1}	1.01×10^{-4}	2.94×10^{-12}	1.01×10^{-4}
Columbia River nearshore	7.46×10^{-1}	3.81×10^{-2}	2.38×10^{-5}	0.00	2.38×10^{-5}	1.81	2.87×10^{-1}	7.65×10^{-5}	1.63×10^{-12}	7.65×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.34×10^{-5}	5.67×10^{-6}	1.36×10^{-9}	0.00	1.36×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–133. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.24×10^{1}	3.81	5.58×10^{-4}	3.69×10^{-7}	5.59×10^{-4}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	4.79	9.49×10^{-1}	2.19×10^{-4}	1.35×10^{-7}	2.19×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.63	6.39×10^{-1}	1.66×10^{-4}	7.46×10^{-8}	1.66×10^{-4}	1.27×10^{-2}	1.01×10^{-1}	6.43×10^{-7}	7.46×10^{-8}	6.98×10^{-7}
Off Site										
Columbia River	1.25×10^{-4}	3.53×10^{-3}	4.60×10^{-9}	0.00	4.60×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

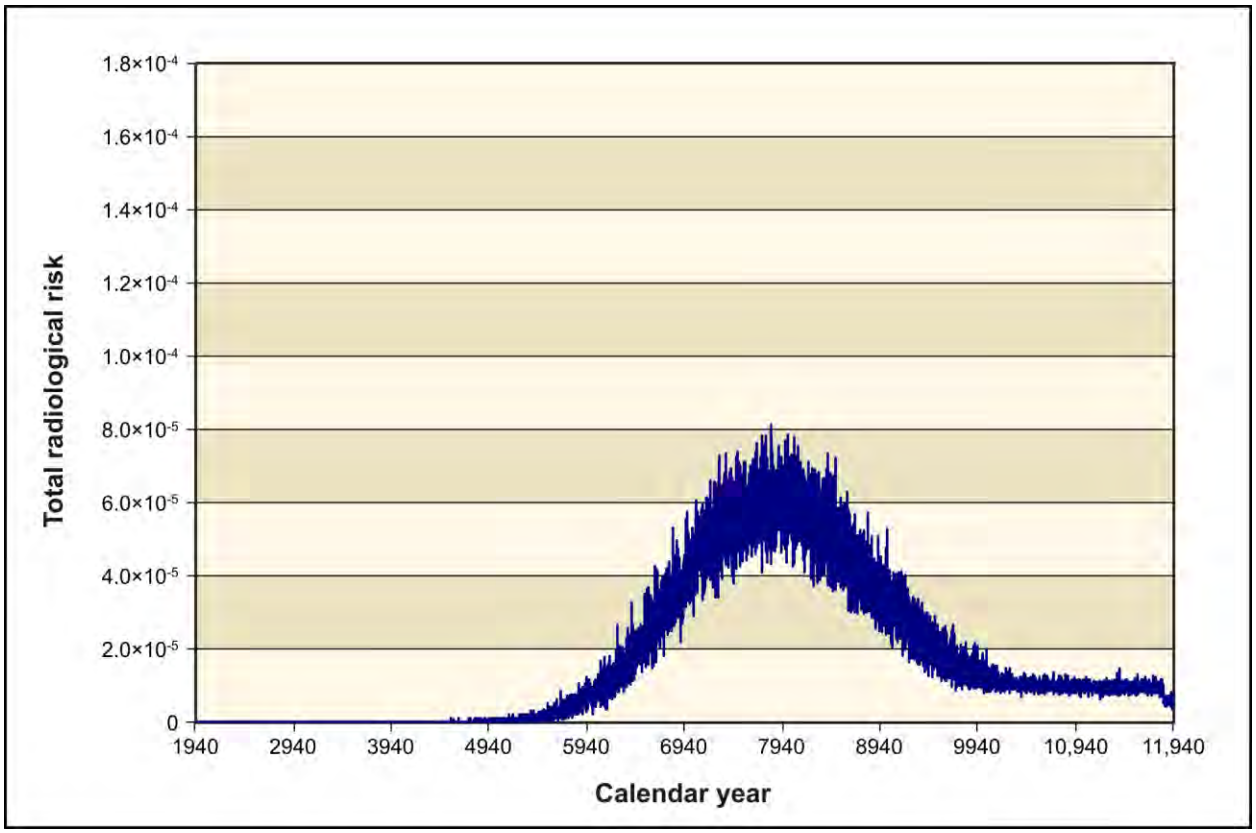


Figure 5–1140. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1141) comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East.

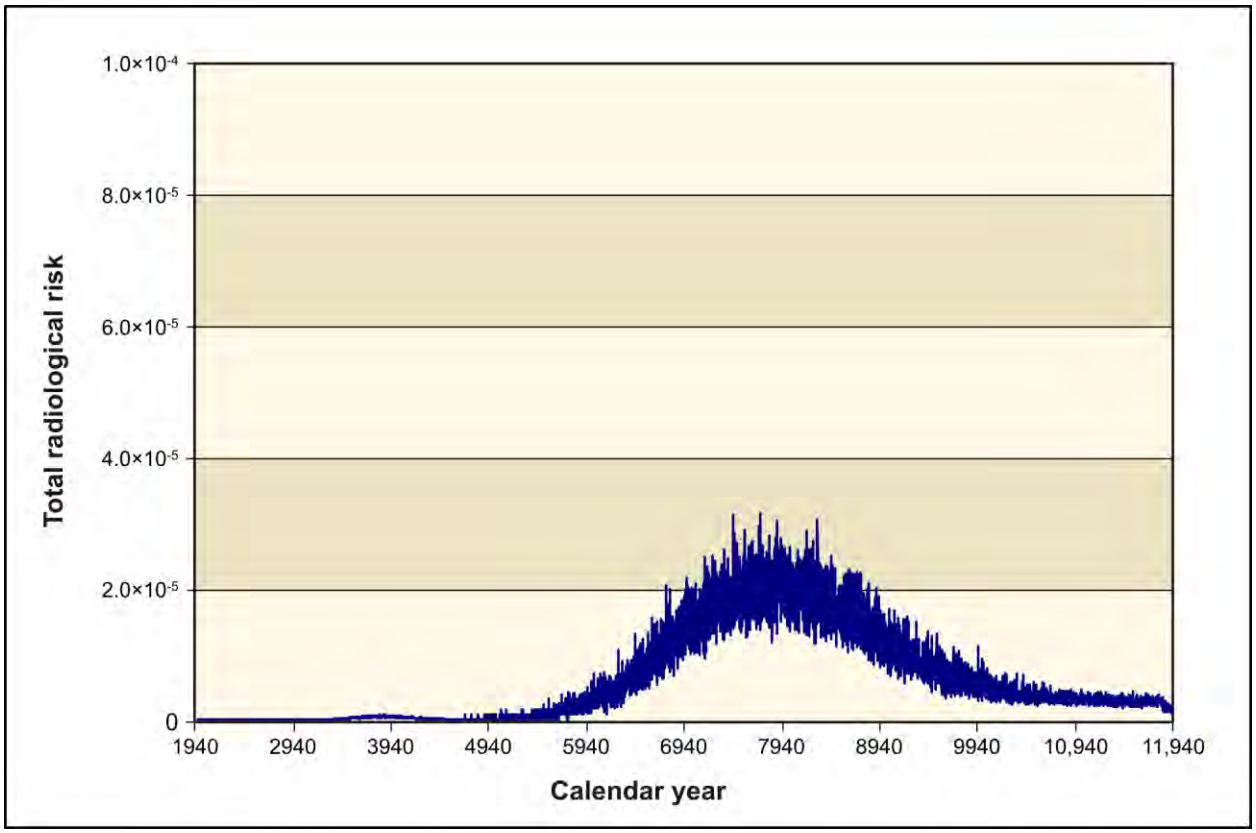


Figure 5–1141. Waste Management Alternative 2, Disposal Group 1, Subgroup 1-G, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.8 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–134 and 5–135. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are 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. Population dose is estimated as 1.67×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 1.08×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and at the Core Zone Boundary are presented in Figures 5–1142 and 5–1143, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.5×10^{-4}) is due to release of radioactive constituents from offsite LLW. At the IDF-East barrier and the Core Zone Boundary, approximately 75 percent of the dose in the year of peak dose is due to technetium-99 released from offsite LLW. The balance of dose in the year of peak dose is due to release of iodine-129 from offsite LLW. For chemical constituents at both the IDF-East barrier and the Core Zone Boundary, nearly the entirety of noncarcinogenic impact is due to release of nitrate from ETF-generated secondary waste.

Table 5–134. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.08	1.77×10^{-1}	1.50×10^{-4}	0.00	1.50×10^{-4}	1.17×10^{1}	1.32	4.72×10^{-4}	7.23×10^{-12}	4.72×10^{-4}
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.16	5.65×10^{-2}	3.56×10^{-5}	0.00	3.56×10^{-5}	2.74	4.14×10^{-1}	1.13×10^{-4}	2.92×10^{-12}	1.13×10^{-4}
Columbia River nearshore	7.43×10^{-1}	3.58×10^{-2}	2.35×10^{-5}	0.00	2.35×10^{-5}	1.79	2.64×10^{-1}	7.54×10^{-5}	1.77×10^{-12}	7.54×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.35×10^{-5}	5.37×10^{-6}	1.36×10^{-9}	0.00	1.36×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–135. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.28×10^{1}	2.93	1.02×10^{-3}	3.32×10^{-7}	1.02×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	5.43	9.21×10^{-1}	2.46×10^{-4}	1.34×10^{-7}	2.46×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.58	5.88×10^{-1}	1.64×10^{-4}	8.11×10^{-8}	1.64×10^{-4}	1.26×10^{-2}	9.14×10^{-2}	6.34×10^{-7}	8.10×10^{-8}	6.69×10^{-7}
Off Site										
Columbia River	1.23×10^{-4}	3.34×10^{-3}	4.58×10^{-9}	0.00	4.58×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

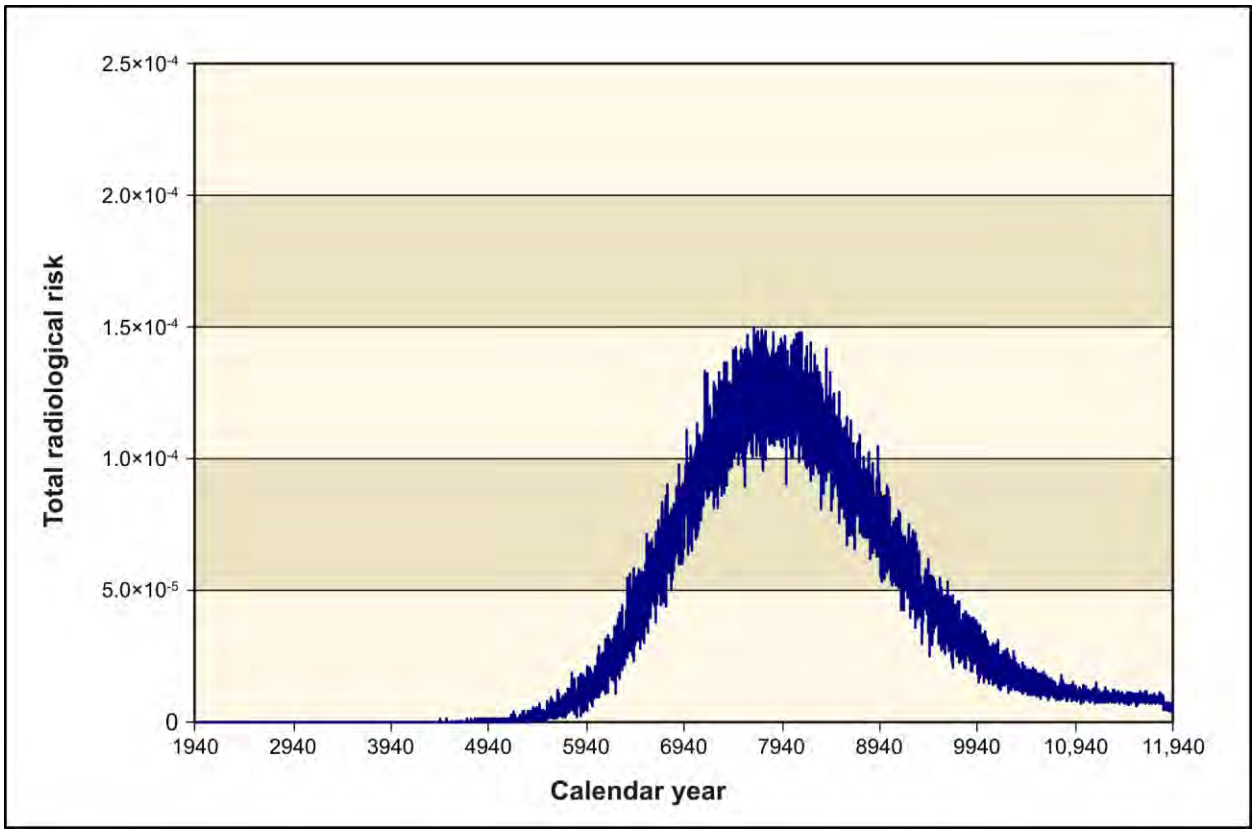


Figure 5–1142. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary (see Figure 5–1143) does not include an early peak, as the RPPDF would not be constructed under this alternative, but does include a later peak due to sources at IDF-East.

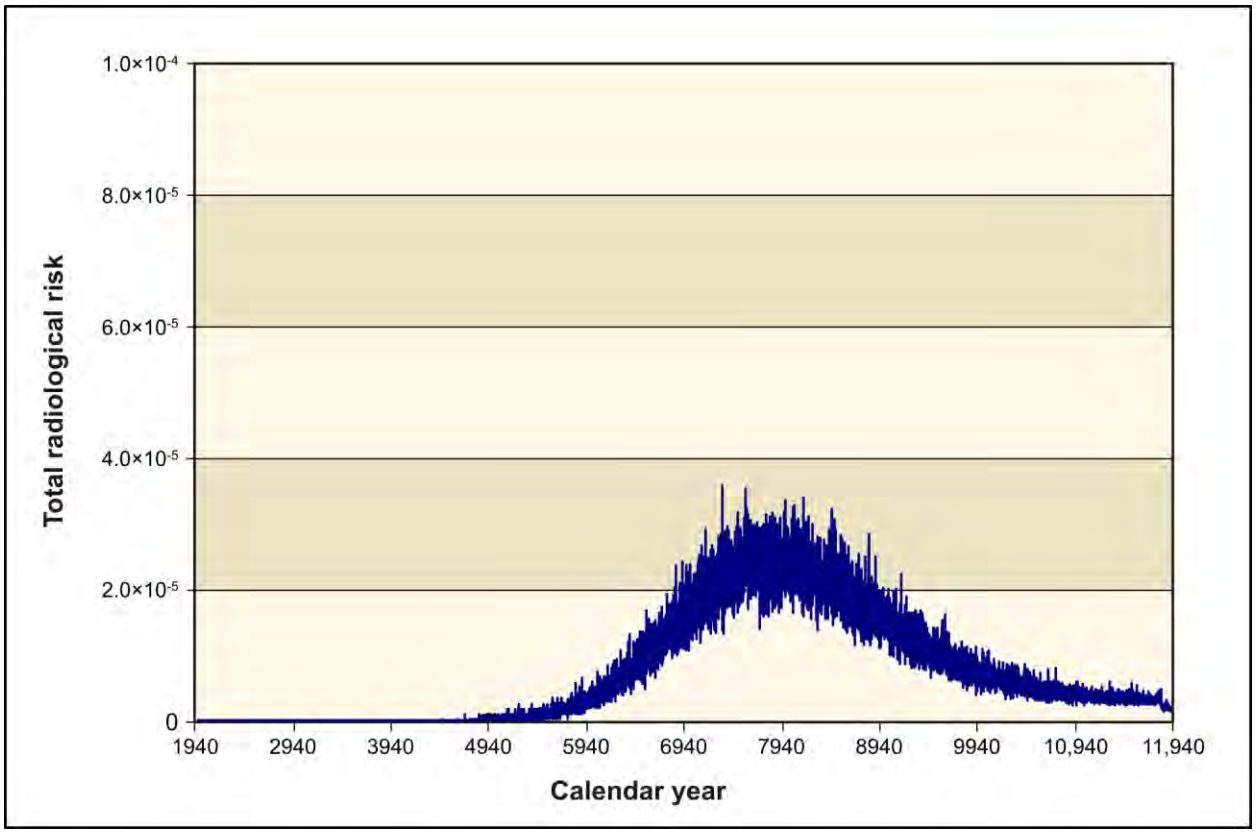


Figure 5–1143. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-A, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.9 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–136 through 5–139. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, nitrate, and total uranium. For radionuclides, the dose standard would not be exceeded at any location. 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. Under the Option Case, the Hazard Index guideline would be exceeded at the IDF-East barrier, RPPDF barrier, and Core Zone Boundary for the resident farmer and American Indian resident farmer due primarily to the presence of nitrate. In addition, the Hazard Index guideline would be exceeded at the Columbia River nearshore for the American Indian resident farmer. Population dose is estimated for Subgroup 2-B, Base Case, as 1.64×10^{-1} person-rem per year for the year of maximum impact and for Subgroup 2-B, Option Case, as 1.66×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 1.06×10^{-5} percent and 1.07×10^{-5} percent of the annual population dose due to background exposure under Subgroup 2-B, Base and Option Cases, respectively. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1144 and 5–1145 for the Base Case and in Figures 5–1146 and 5–1147 for the Option Case. The Base and Option Cases differ in the amounts of constituents disposed of

at the RPPDF because the Option Case includes removal of the Tank Closure alternative cribs and trenches (ditches). Estimates of impacts for IDF-East are the same for the two cases.

Under both the Base and Option Cases, the peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.5×10^{-4}) is due to release of radioactive constituents from offsite LLW. Under both the Base and Option Cases at the IDF-East barrier and the Core Zone Boundary, approximately 75 percent of the dose in the year of peak dose is due to technetium-99 released from offsite LLW. The balance of dose in the year of peak dose is due to release of iodine-129 from offsite LLW. For chemical constituents under the Base Case at both the IDF-East barrier and the Core Zone Boundary, noncarcinogenic impacts are due to release of nitrate (94 percent of Hazard Index) from ETF-generated secondary waste and chromium (6 percent of Hazard Index) from tank closure secondary waste. For chemical constituents under the Option Case at the IDF-East barrier, noncarcinogenic impacts are due to release of nitrate from ETF-generated secondary waste (94 percent of Hazard Index) and chromium from tank closure secondary waste (6 percent of Hazard Index). For chemical constituents under the Option Case at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (75 percent of Hazard Index) and nitrate (25 percent of Hazard Index) from RPPDF waste.

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary under the Base Case (see Figure 5–1145) and the Option Case (see Figure 5–1147) each comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East. The early peak is greater under the Option Case relative to the Base Case due to the inclusion of additional waste from cribs and trenches (ditches).

Table 5–136. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.03	1.82×10^{-1}	1.49×10^{-4}	0.00	1.49×10^{-4}	1.16×10^{1}	1.36	4.72×10^{-4}	7.73×10^{-12}	4.72×10^{-4}
River Protection Project Disposal Facility	3.26×10^{-1}	3.78×10^{-2}	9.96×10^{-6}	0.00	9.96×10^{-6}	7.68×10^{-1}	6.51×10^{-2}	3.17×10^{-5}	1.43×10^{-11}	3.17×10^{-5}
Core Zone Boundary	1.16	6.05×10^{-2}	3.57×10^{-5}	0.00	3.57×10^{-5}	2.75	4.44×10^{-1}	1.14×10^{-4}	1.34×10^{-11}	1.14×10^{-4}
Columbia River nearshore	7.66×10^{-1}	3.95×10^{-2}	2.39×10^{-5}	0.00	2.39×10^{-5}	1.83	3.02×10^{-1}	7.65×10^{-5}	8.03×10^{-12}	7.65×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.29×10^{-5}	5.38×10^{-6}	1.34×10^{-9}	1.64×10^{-16}	1.34×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–137. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.27×10^{1}	3.02	1.02×10^{-3}	3.55×10^{-7}	1.02×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	1.52	1.26×10^{-1}	6.86×10^{-5}	6.58×10^{-7}	6.91×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	5.44	9.87×10^{-1}	2.46×10^{-4}	6.13×10^{-7}	2.46×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.64	6.72×10^{-1}	1.66×10^{-4}	3.68×10^{-7}	1.66×10^{-4}	1.29×10^{-2}	1.01×10^{-1}	6.45×10^{-7}	3.68×10^{-7}	6.83×10^{-7}
Off Site										
Columbia River	1.23×10^{-4}	3.35×10^{-3}	4.52×10^{-9}	7.52×10^{-12}	4.52×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–138. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.07	2.78×10^{-1}	1.50×10^{-4}	0.00	1.50×10^{-4}	1.16×10^{1}	2.07	4.71×10^{-4}	8.83×10^{-12}	4.71×10^{-4}
River Protection Project Disposal Facility	4.70×10^{-1}	4.41×10^{-1}	1.42×10^{-5}	0.00	1.42×10^{-5}	1.10	1.61	4.50×10^{-5}	1.33×10^{-10}	4.50×10^{-5}
Core Zone Boundary	1.17	3.56×10^{-1}	3.57×10^{-5}	0.00	3.57×10^{-5}	2.75	1.22	1.14×10^{-4}	1.12×10^{-10}	1.14×10^{-4}
Columbia River nearshore	7.70×10^{-1}	2.34×10^{-1}	2.40×10^{-5}	0.00	2.40×10^{-5}	1.84	7.28×10^{-1}	7.69×10^{-5}	7.49×10^{-11}	7.69×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.32×10^{-5}	2.03×10^{-5}	1.35×10^{-9}	1.54×10^{-15}	1.35×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–139. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.28×10^{1}	4.60	1.02×10^{-3}	4.05×10^{-7}	1.02×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	2.16	3.43	9.75×10^{-5}	6.11×10^{-6}	1.01×10^{-4}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	5.44	2.57	2.46×10^{-4}	5.15×10^{-6}	2.46×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.66	1.52	1.67×10^{-4}	3.43×10^{-6}	1.67×10^{-4}	1.30×10^{-2}	2.82×10^{-1}	6.48×10^{-7}	3.43×10^{-6}	3.59×10^{-6}
Off Site										
Columbia River	1.24×10^{-4}	1.04×10^{-2}	4.54×10^{-9}	7.06×10^{-11}	4.54×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

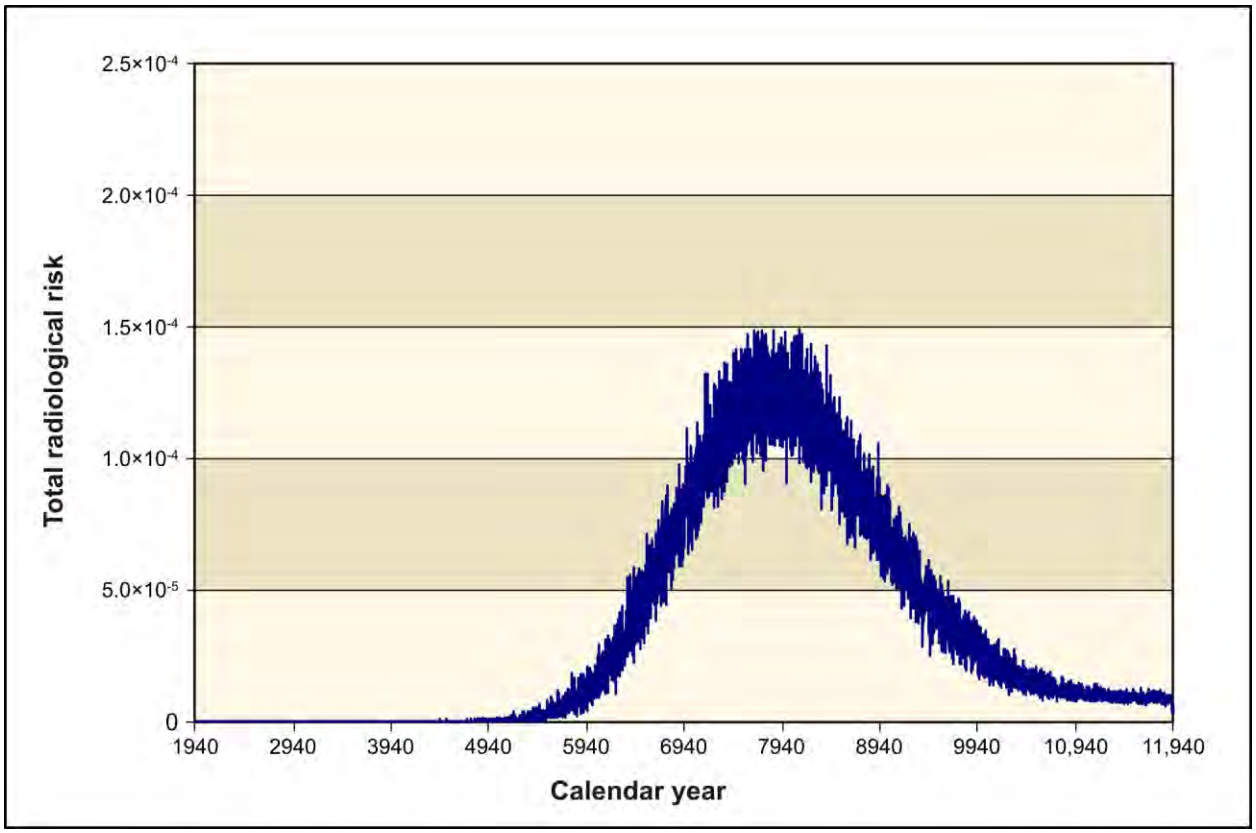


Figure 5–1144. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

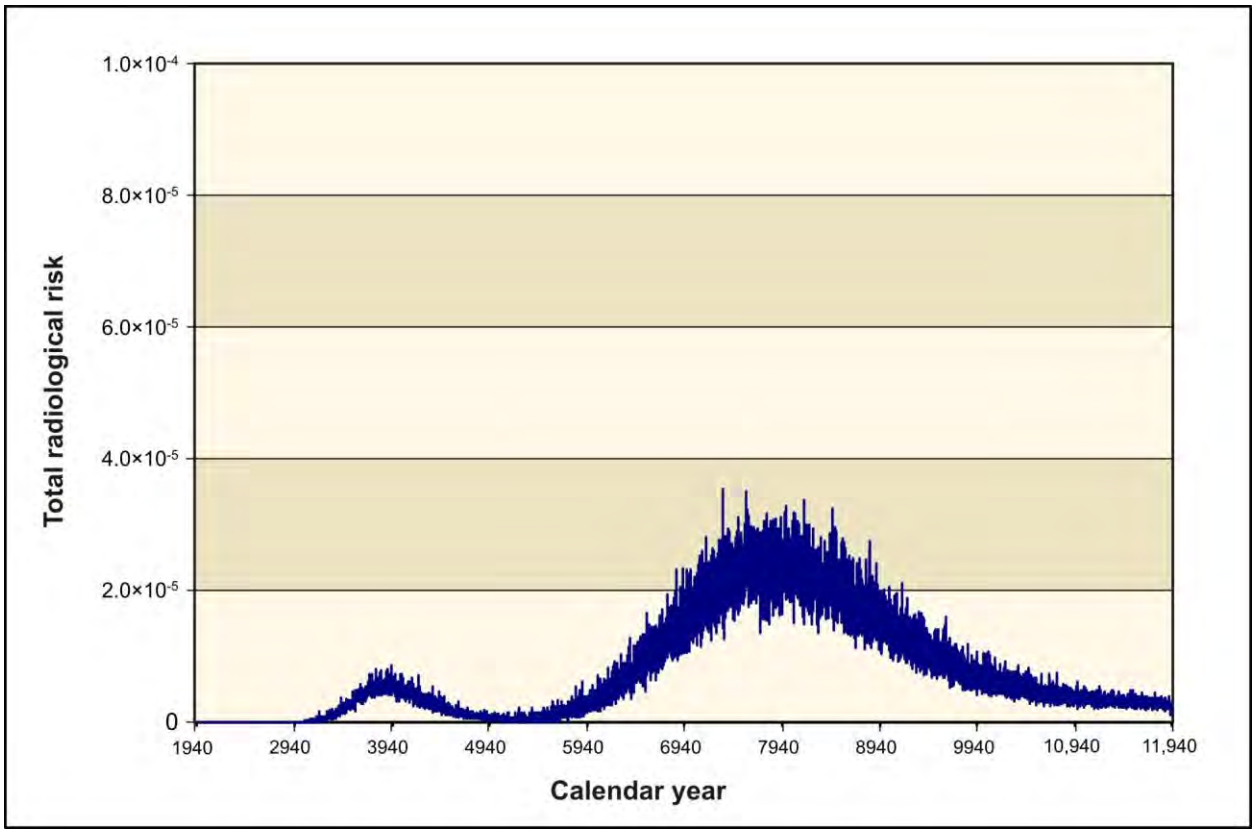


Figure 5–1145. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

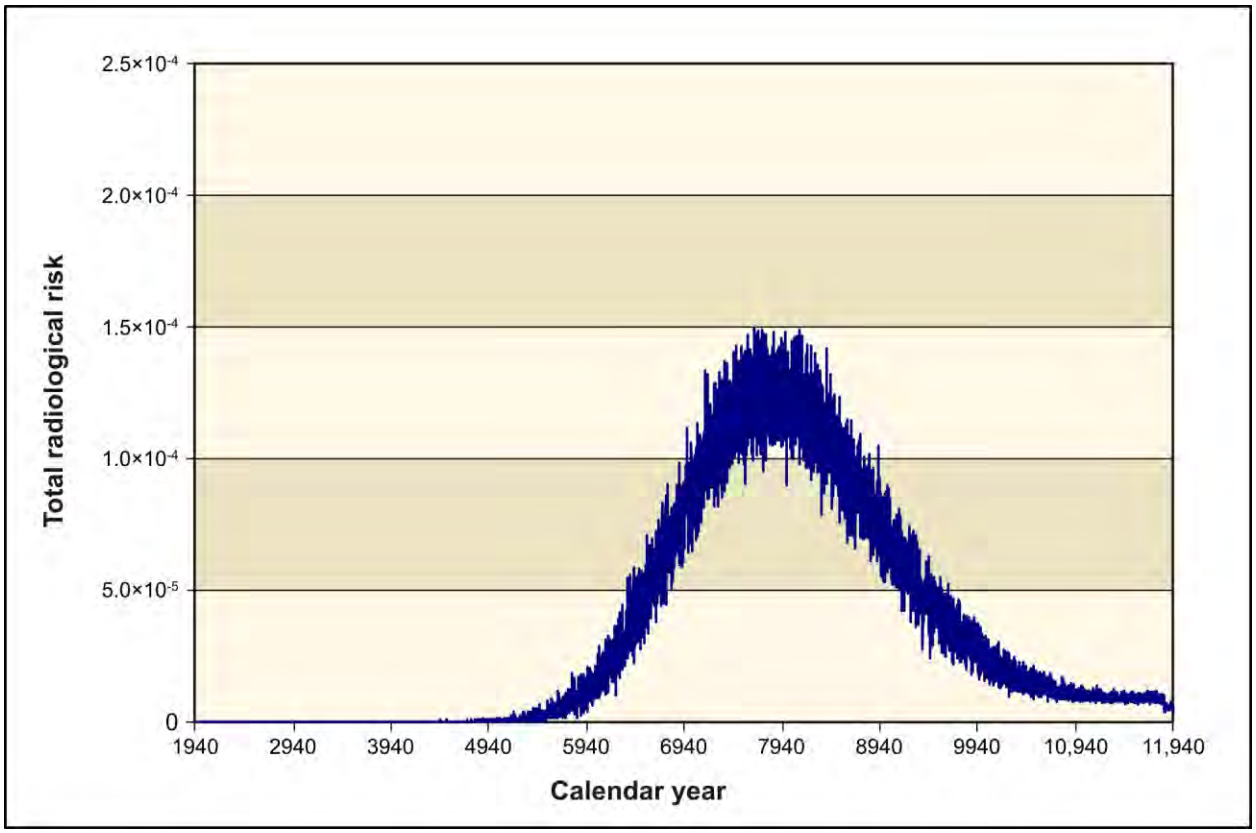


Figure 5–1146. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

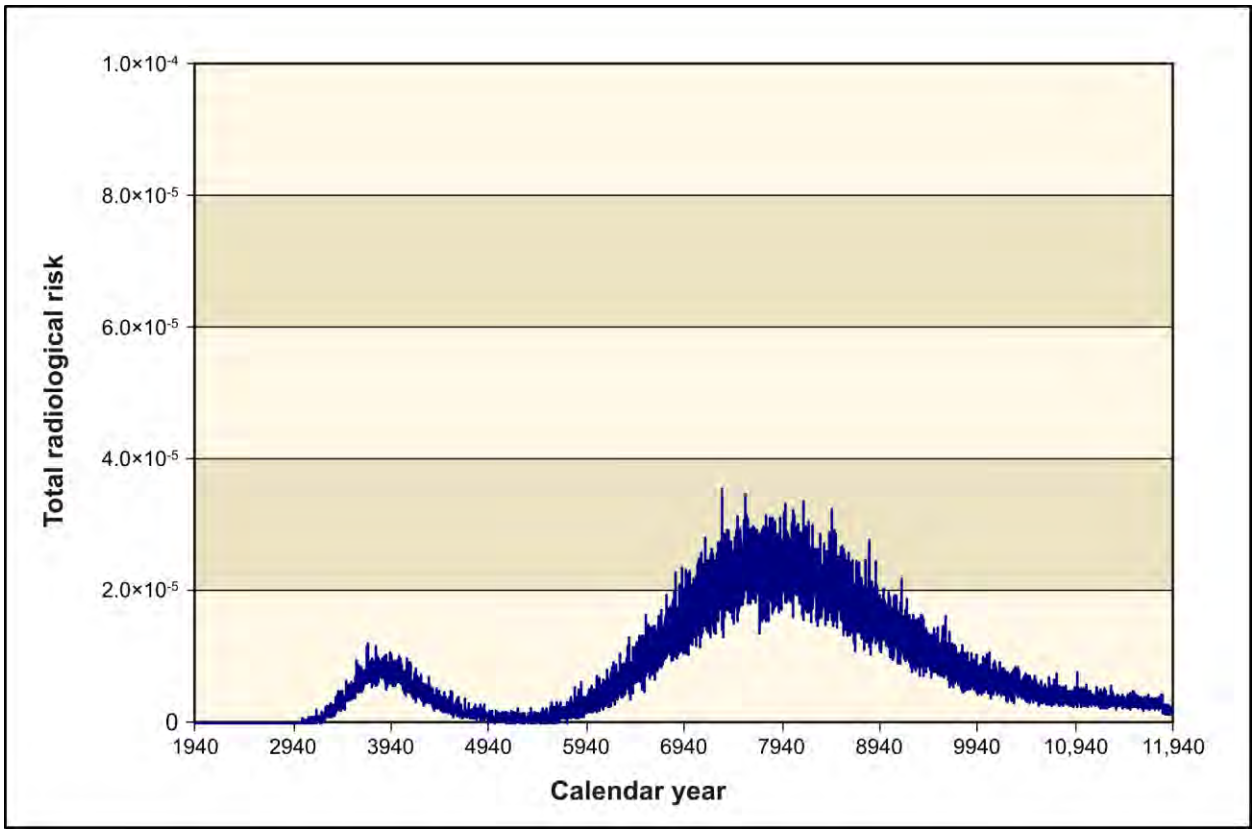


Figure 5–1147. Waste Management Alternative 2, Disposal Group 2, Subgroup 2-B, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.2.10 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this disposal group.

Potential human health impacts of this alternative are summarized in Tables 5–140 through 5–143. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are boron and boron compounds, chromium, fluoride, nitrate, and total uranium. For radionuclides, the dose standard would not be exceeded at any location under both Base and Option Cases. Under the Base Case, the Hazard Index guidelines would be exceeded at the IDF-East barrier for the resident farmer and American Indian resident farmer. Under the Option Case, the Hazard Index guideline would be exceeded at the IDF-East barrier, RPPDF barrier, and Core Zone Boundary for the resident farmer and American Indian resident farmer due primarily to the presence of chromium and nitrate. In addition, the Hazard Index guideline would be exceeded at the Columbia River nearshore for the American Indian resident farmer. 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. This corresponds to 1.10×10^{-5} percent and 1.11×10^{-5} percent of the annual population dose due to background exposure for Disposal Group 3, Base and Option Cases, respectively. The time series of lifetime radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in

Figures 5–1148 and 5–1149 for the Base Case and in Figures 5–1150 and 5–1151 for the Option Case. The Base and Option Cases differ in the amounts of constituents disposed of at the RPPDF because the Option Case includes removal of the Tank Closure alternative cribs and trenches (ditches). Estimates of impacts for IDF-East are the same for the two cases.

Under both the Base and Option Cases, the peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.6×10^{-4}) is due to release of radioactive constituents from offsite LLW. Under both the Base and Option Cases at the IDF-East barrier and the Core Zone Boundary, approximately 75 percent of the dose in the year of peak dose is due to technetium-99 released from offsite LLW. The balance of dose in the year of peak dose is due to release of iodine-129 from offsite LLW. For chemical constituents under the Base Case at both the IDF-East barrier and the Core Zone Boundary, noncarcinogenic impacts are due to release of nitrate (94 percent of Hazard Index) from ETF-generated secondary waste and chromium (6 percent of Hazard Index) from tank closure secondary waste. For chemical constituents under the Option Case at the IDF-East barrier, noncarcinogenic impacts are due to release of nitrate from ETF-generated secondary waste (94 percent of Hazard Index) and chromium from tank closure secondary waste (6 percent of Hazard Index). For chemical constituents under the Option Case at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (75 percent of Hazard Index) and nitrate (25 percent of Hazard Index) from RPPDF waste.

The time series of radiological risk for the drinking-water well user at the Core Zone Boundary under the Base Case (see Figure 5–1149) and the Option Case (see Figure 5–1151) each comprises a small, early peak due to sources at the RPPDF and a higher, later peak due to sources at IDF-East. The early peak is greater under the Option Case relative to the Base Case due to the inclusion of additional waste from cribs and trenches (ditches).

Table 5–140. Waste Management Alternative 2, Disposal Group 3, Base Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.19	1.82×10^{-1}	1.57×10^{-4}	0.00	1.57×10^{-4}	1.21×10^{1}	1.36	4.99×10^{-4}	7.64×10^{-12}	4.99×10^{-4}
River Protection Project Disposal Facility	3.14×10^{-1}	3.92×10^{-2}	9.51×10^{-6}	0.00	9.51×10^{-6}	7.35×10^{-1}	7.03×10^{-2}	3.02×10^{-5}	1.48×10^{-11}	3.02×10^{-5}
Core Zone Boundary	1.21	6.05×10^{-2}	3.70×10^{-5}	0.00	3.70×10^{-5}	2.85	4.44×10^{-1}	1.18×10^{-4}	1.29×10^{-11}	1.18×10^{-4}
Columbia River nearshore	7.52×10^{-1}	3.96×10^{-2}	2.34×10^{-5}	0.00	2.34×10^{-5}	1.80	3.02×10^{-1}	7.50×10^{-5}	7.45×10^{-12}	7.50×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.42×10^{-5}	5.38×10^{-6}	1.40×10^{-9}	1.64×10^{-16}	1.40×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–141. Waste Management Alternative 2, Disposal Group 3, Base Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.39×10^{1}	3.02	1.08×10^{-3}	3.50×10^{-7}	1.08×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	1.45	1.31×10^{-1}	6.53×10^{-5}	6.79×10^{-7}	6.58×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	5.63	9.87×10^{-1}	2.55×10^{-4}	5.90×10^{-7}	2.55×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.57	6.73×10^{-1}	1.63×10^{-4}	3.42×10^{-7}	1.63×10^{-4}	1.27×10^{-2}	1.01×10^{-1}	6.33×10^{-7}	3.41×10^{-7}	6.72×10^{-7}
Off Site										
Columbia River	1.28×10^{-4}	3.35×10^{-3}	4.71×10^{-9}	7.54×10^{-12}	4.71×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–142. Waste Management Alternative 2, Disposal Group 3, Option Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.22	2.78×10^{-1}	1.56×10^{-4}	0.00	1.56×10^{-4}	1.21×10^{1}	2.07	4.96×10^{-4}	8.82×10^{-12}	4.96×10^{-4}
River Protection Project Disposal Facility	4.75×10^{-1}	4.39×10^{-1}	1.49×10^{-5}	0.00	1.49×10^{-5}	1.14	1.53	4.77×10^{-5}	1.27×10^{-10}	4.77×10^{-5}
Core Zone Boundary	1.17	3.75×10^{-1}	3.66×10^{-5}	0.00	3.66×10^{-5}	2.81	1.33	1.17×10^{-4}	1.12×10^{-10}	1.17×10^{-4}
Columbia River nearshore	7.65×10^{-1}	2.58×10^{-1}	2.37×10^{-5}	0.00	2.37×10^{-5}	1.82	8.37×10^{-1}	7.58×10^{-5}	8.15×10^{-11}	7.58×10^{-5}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	3.45×10^{-5}	2.02×10^{-5}	1.41×10^{-9}	1.52×10^{-15}	1.41×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–143. Waste Management Alternative 2, Disposal Group 3, Option Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.38×10^{1}	4.60	1.07×10^{-3}	4.05×10^{-7}	1.07×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	2.27	3.24	1.04×10^{-4}	5.82×10^{-6}	1.07×10^{-4}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	5.58	2.79	2.54×10^{-4}	5.12×10^{-6}	2.54×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	3.61	1.79	1.64×10^{-4}	3.74×10^{-6}	1.64×10^{-4}	1.28×10^{-2}	2.86×10^{-1}	6.39×10^{-7}	3.74×10^{-6}	3.91×10^{-6}
Off Site										
Columbia River	1.29×10^{-4}	1.03×10^{-2}	4.71×10^{-9}	6.98×10^{-11}	4.71×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

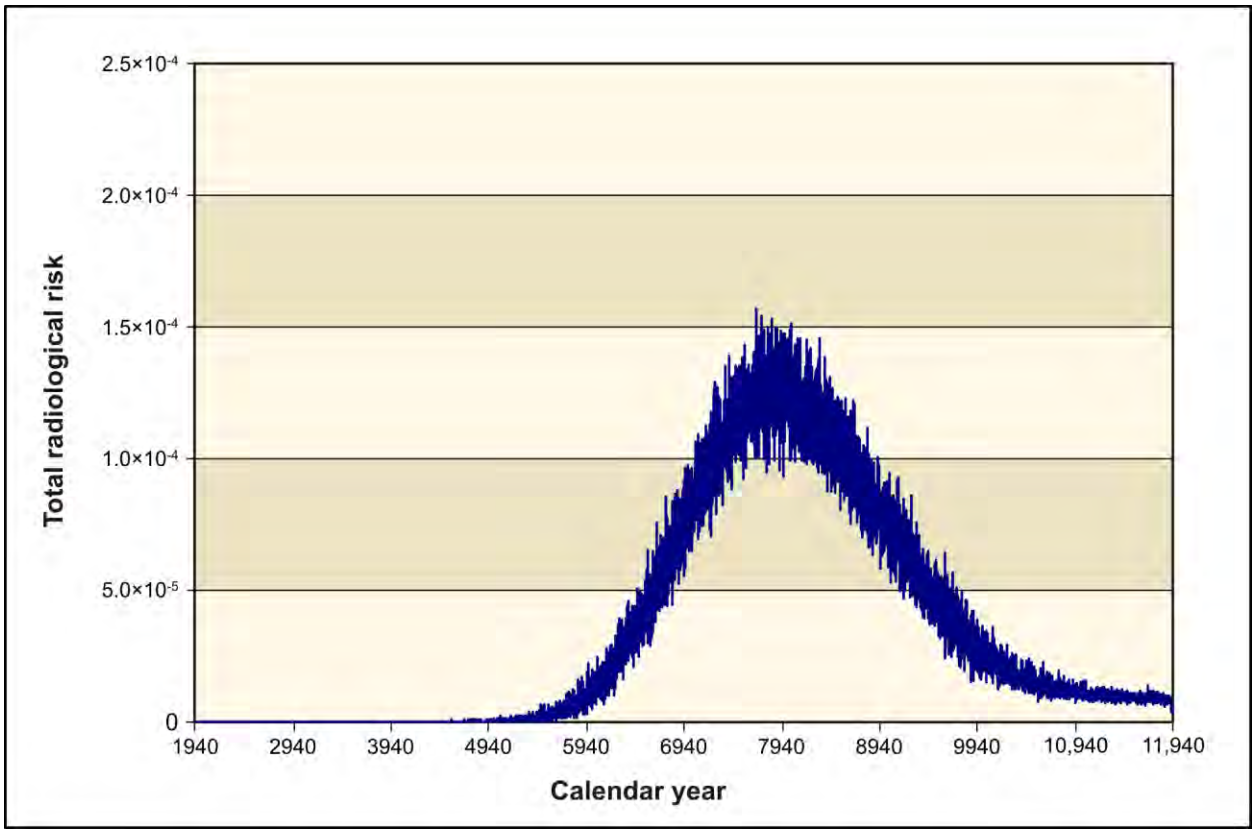


Figure 5–1148. Waste Management Alternative 2, Disposal Group 3, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

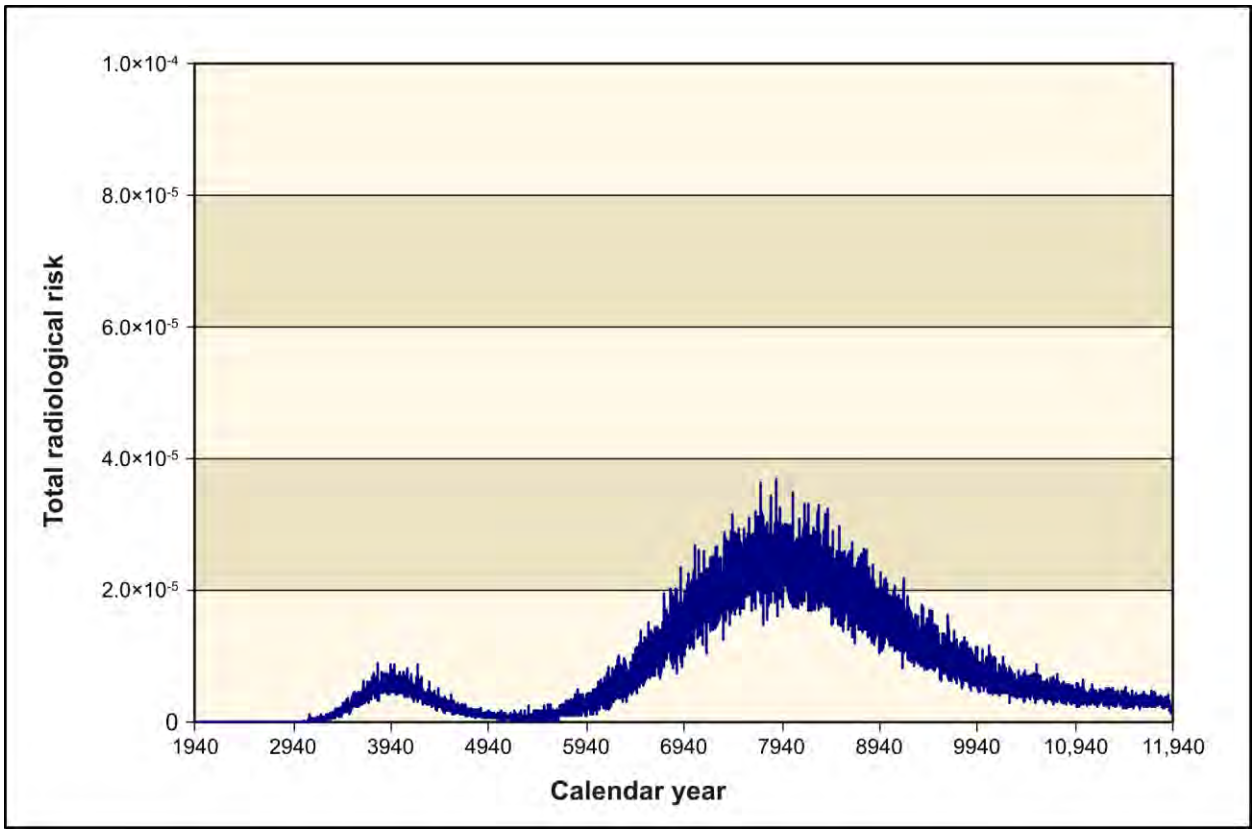


Figure 5–1149. Waste Management Alternative 2, Disposal Group 3, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

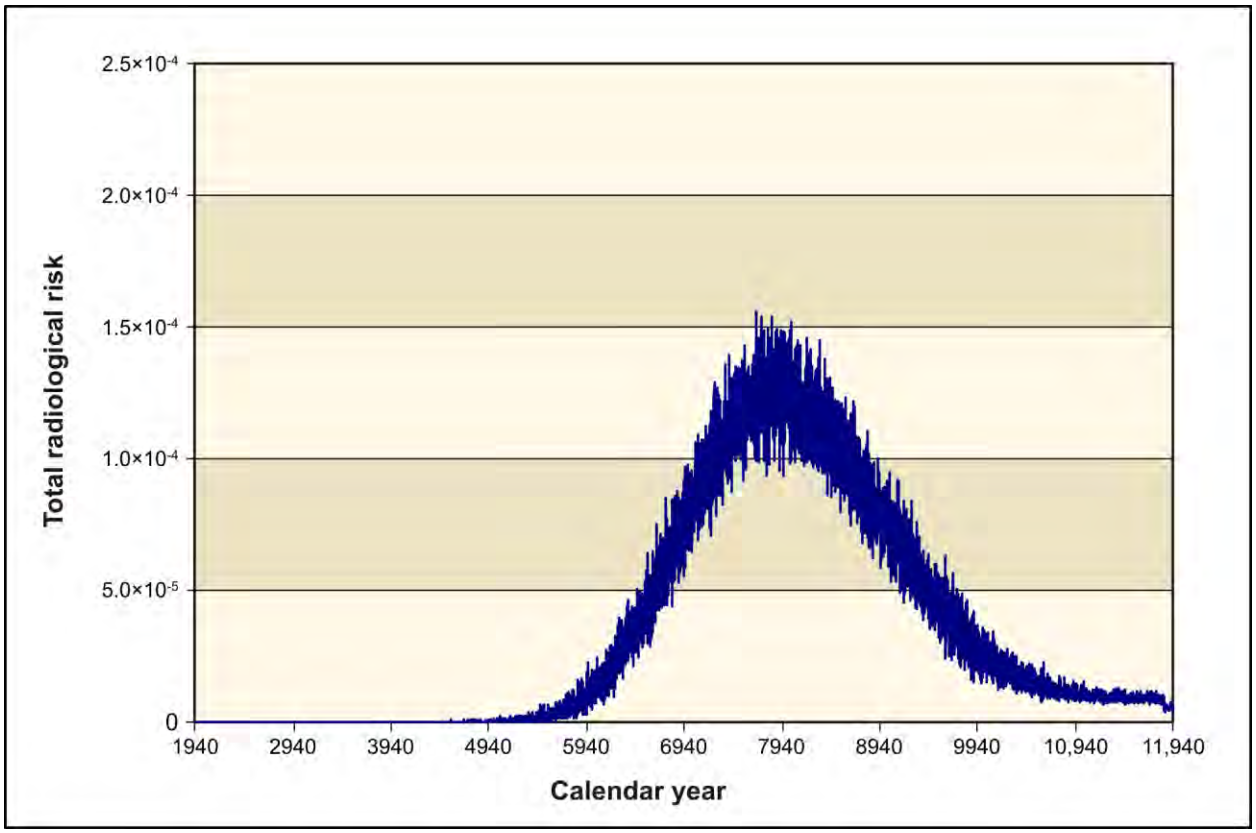


Figure 5–1150. Waste Management Alternative 2, Disposal Group 3, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

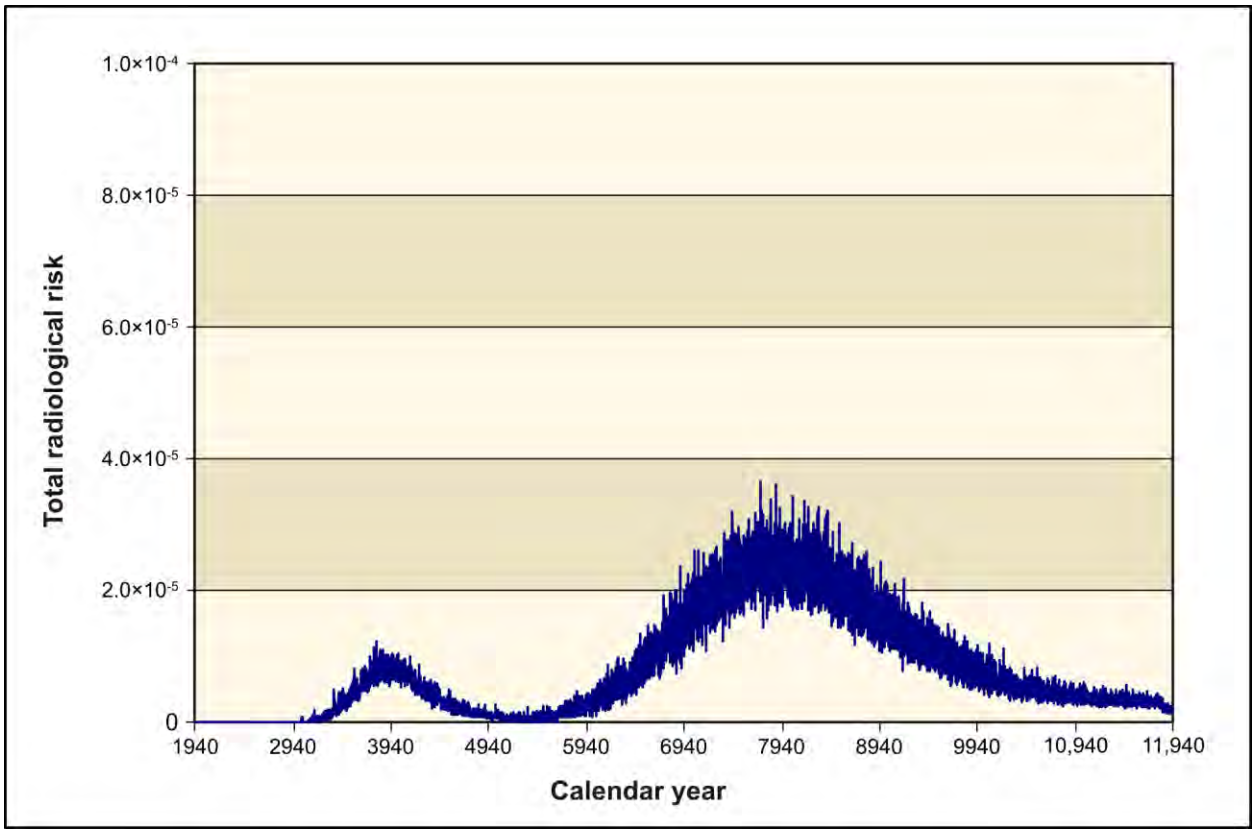


Figure 5–1151. Waste Management Alternative 2, Disposal Group 3, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3 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 the 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 sizes and operational time periods of IDF-East. 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.

5.3.2.3.1 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–144 and 5–145. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129. The key chemical constituents are 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 would be exceeded at the IDF-East barrier for the resident farmer and

American Indian resident farmer. Population dose is estimated as 3.41×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.19×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier, the IDF-West barrier, and the Core Zone Boundary are presented in Figures 5–1152, 5–1153, and 5–1154, respectively.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.4×10^{-5}) is due to release of radioactive constituents from tank closure and ETF-generated secondary waste. At the IDF-East barrier, the dose in the year of peak dose is due to technetium-99 released from tank closure secondary waste (59 percent of peak dose) and iodine-129 from ETF-generated secondary waste (41 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (4 percent of Hazard Index) and nitrate from ETF-generated secondary waste (96 percent of Hazard Index). For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (7 percent of Hazard Index) and nitrate from ETF-generated secondary waste (93 percent of Hazard Index).

Releases from ILAW glass contribute a minor portion of the risk. At IDF-West, the peak of the time-averaged lifetime radiological risk (8.6×10^{-4}) is due primarily to release of technetium-99 from offsite LLW. At the IDF-West barrier, estimates of noncarcinogenic impacts are low (Hazard Index of 0.01) and are due to release of chromium from offsite LLW. For the time series of risk at the Core Zone Boundary (see Figure 5–1154), the large, early peak in CY 3700 is due to releases from IDF-West, while the lower peak in CY 9900 is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–144. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.64×10^{-1}	2.29×10^{-1}	1.44×10^{-5}	0.00	1.44×10^{-5}	1.15	1.71	4.39×10^{-5}	8.22×10^{-12}	4.39×10^{-5}
IDF-West	2.87×10^{1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	2.92	5.76×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	4.27×10^{-1}	2.81×10^{-4}	2.94×10^{-12}	2.81×10^{-4}
Columbia River nearshore	3.52	3.77×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	2.87×10^{-1}	3.41×10^{-4}	1.87×10^{-12}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.83×10^{-5}	5.67×10^{-6}	2.79×10^{-9}	0.00	2.79×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–145. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.18	3.81	9.38×10^{-5}	3.77×10^{-7}	9.39×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{1}	9.49×10^{-1}	6.09×10^{-4}	1.35×10^{-7}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^{1}	6.39×10^{-1}	7.39×10^{-4}	8.57×10^{-8}	7.39×10^{-4}	5.72×10^{-2}	1.01×10^{-1}	2.85×10^{-6}	8.56×10^{-8}	2.90×10^{-6}
Off Site										
Columbia River	2.51×10^{-4}	3.53×10^{-3}	9.31×10^{-9}	0.00	9.31×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

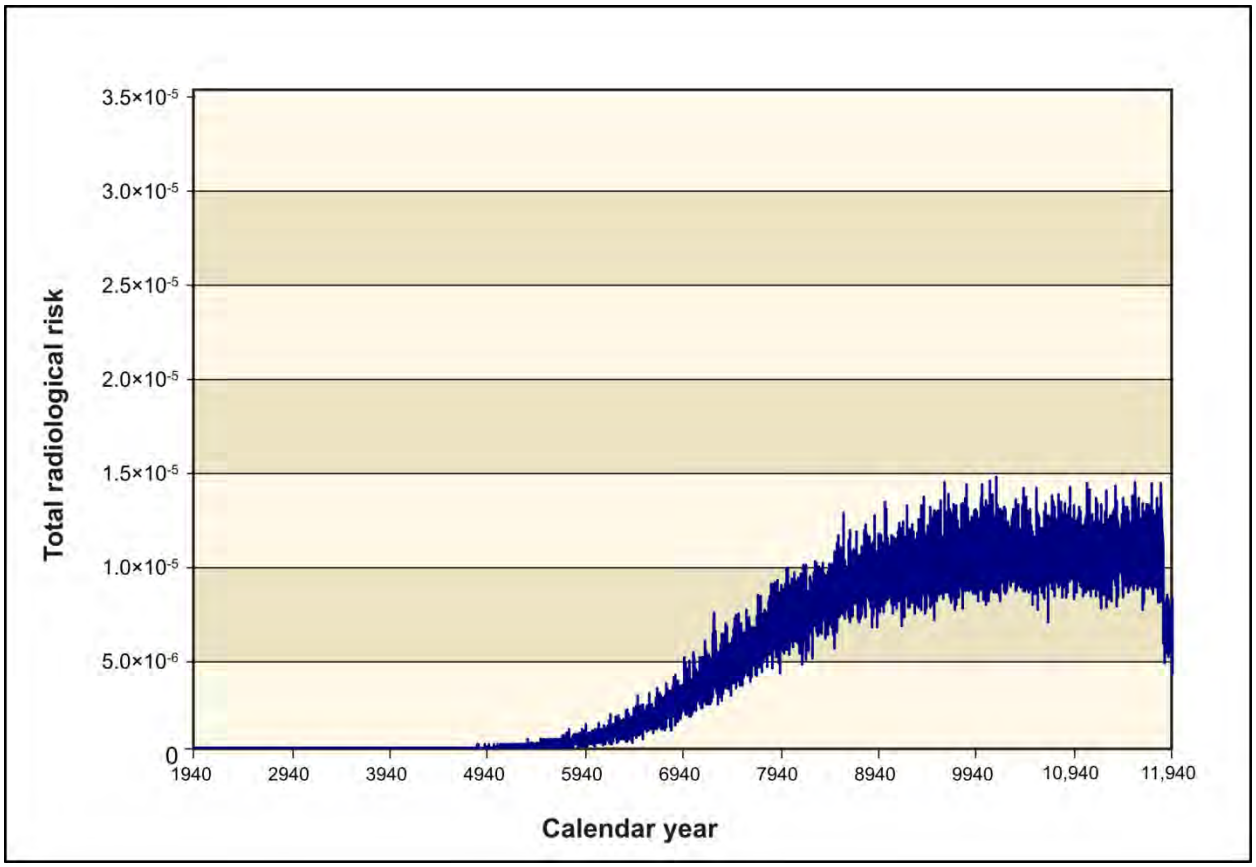


Figure 5–1152. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

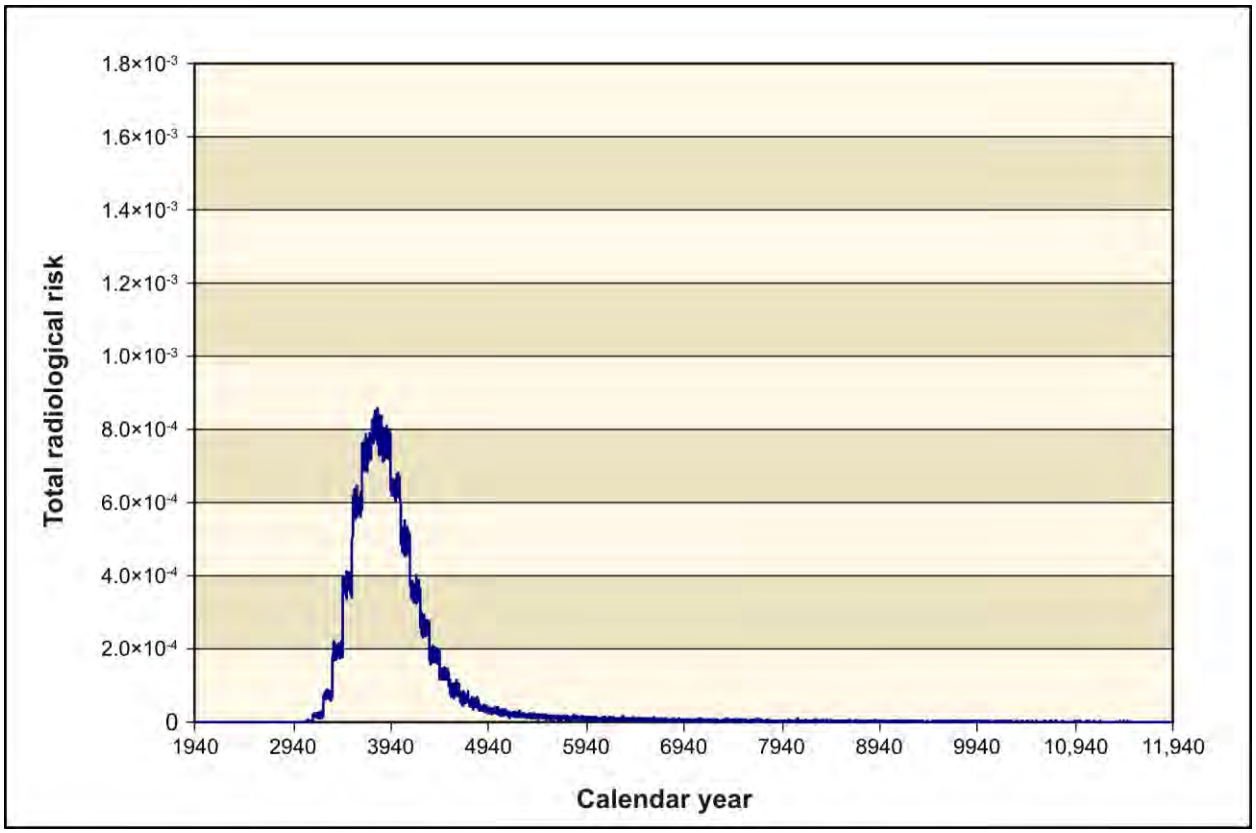


Figure 5–1153. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-West Area Integrated Disposal Facility Barrier

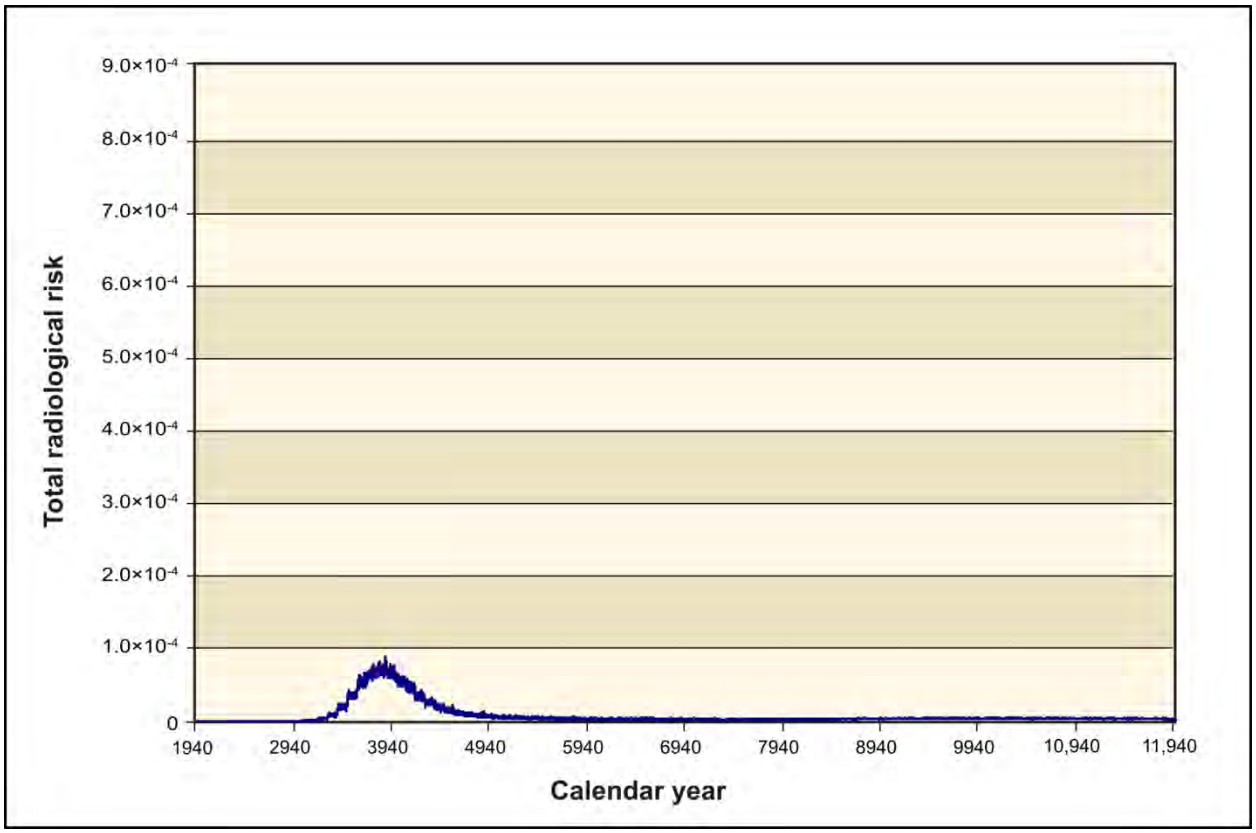


Figure 5–1154. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.2 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–146 and 5–147. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129. The key chemical constituents are 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. Population dose is estimated as 3.41×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.19×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1155 and 5–1156, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153, and peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (8.7×10^{-5}) is due to release of radioactive constituents from bulk vitrification glass. At the IDF-East barrier, the dose in the year of peak dose is due to technetium-99 released from bulk vitrification glass (97 percent of peak

dose) and iodine-129 from ETF-generated secondary waste (3 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (3 percent of Hazard Index) and nitrate from ETF-generated secondary waste (97 percent of Hazard Index). For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (67 percent of Hazard Index) and nitrate from ETF-generated secondary waste (33 percent of Hazard Index).

The major contributor to risk for the bulk vitrification glass is release of technetium-99 from the castable refractory block portion of the waste form package. For the time series of risk at the Core Zone Boundary (see Figure 5–1156), the large, early peak in CY 3700 is due to releases from IDF-West, while the low plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–146. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.59	1.89×10^{-1}	8.70×10^{-5}	0.00	8.70×10^{-5}	6.55	1.45	2.84×10^{-4}	3.72×10^{-12}	2.84×10^{-4}
IDF-West	2.87×10^{1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	2.92	5.15×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	3.94×10^{-1}	2.81×10^{-4}	2.94×10^{-12}	2.81×10^{-4}
Columbia River nearshore	3.52	4.04×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	3.11×10^{-1}	3.41×10^{-4}	1.87×10^{-12}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.83×10^{-5}	5.11×10^{-6}	2.79×10^{-9}	0.00	2.79×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–147. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.33×10^{1}	3.22	6.21×10^{-4}	1.71×10^{-7}	6.21×10^{-4}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{1}	8.77×10^{-1}	6.09×10^{-4}	1.35×10^{-7}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^{1}	6.92×10^{-1}	7.39×10^{-4}	8.57×10^{-8}	7.39×10^{-4}	5.72×10^{-2}	1.01×10^{-1}	2.85×10^{-6}	8.56×10^{-8}	2.90×10^{-6}
Off Site										
Columbia River	2.51×10^{-4}	3.18×10^{-3}	9.31×10^{-9}	0.00	9.31×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

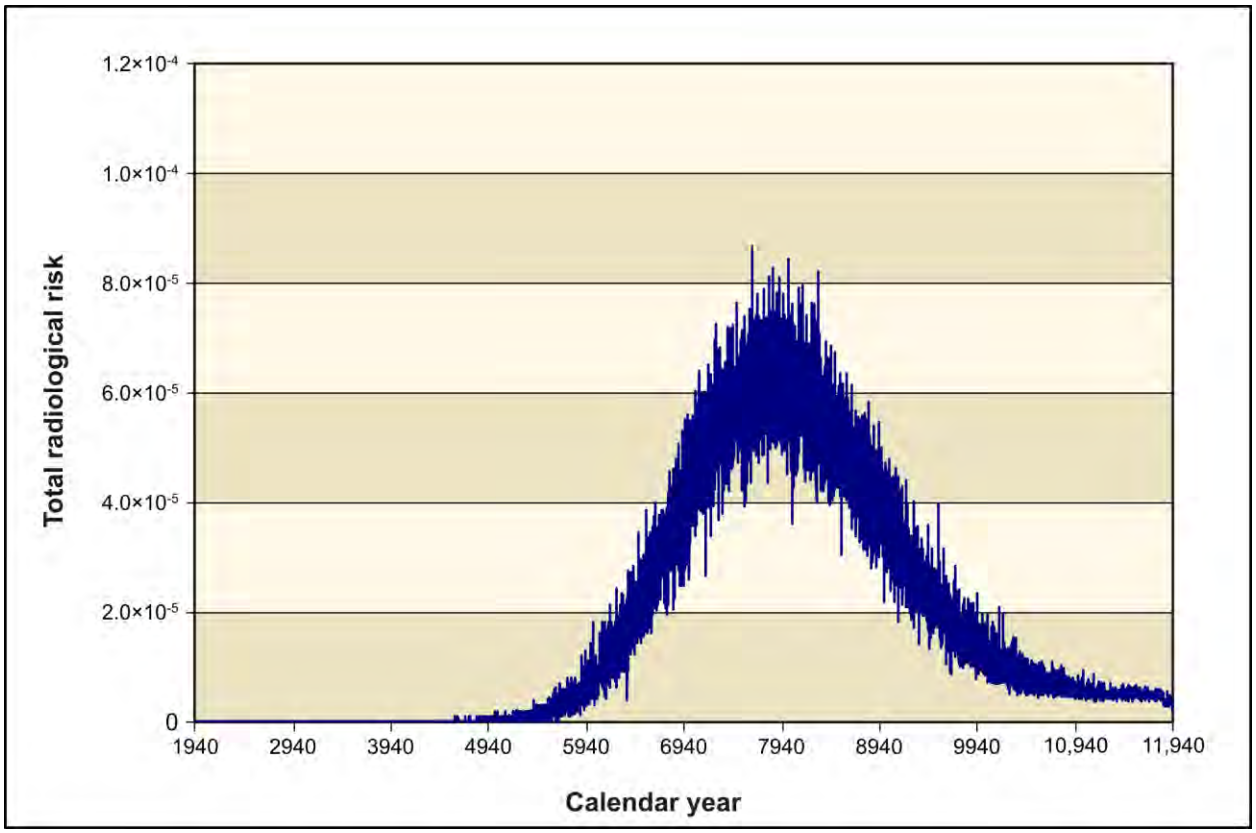


Figure 5–1155. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

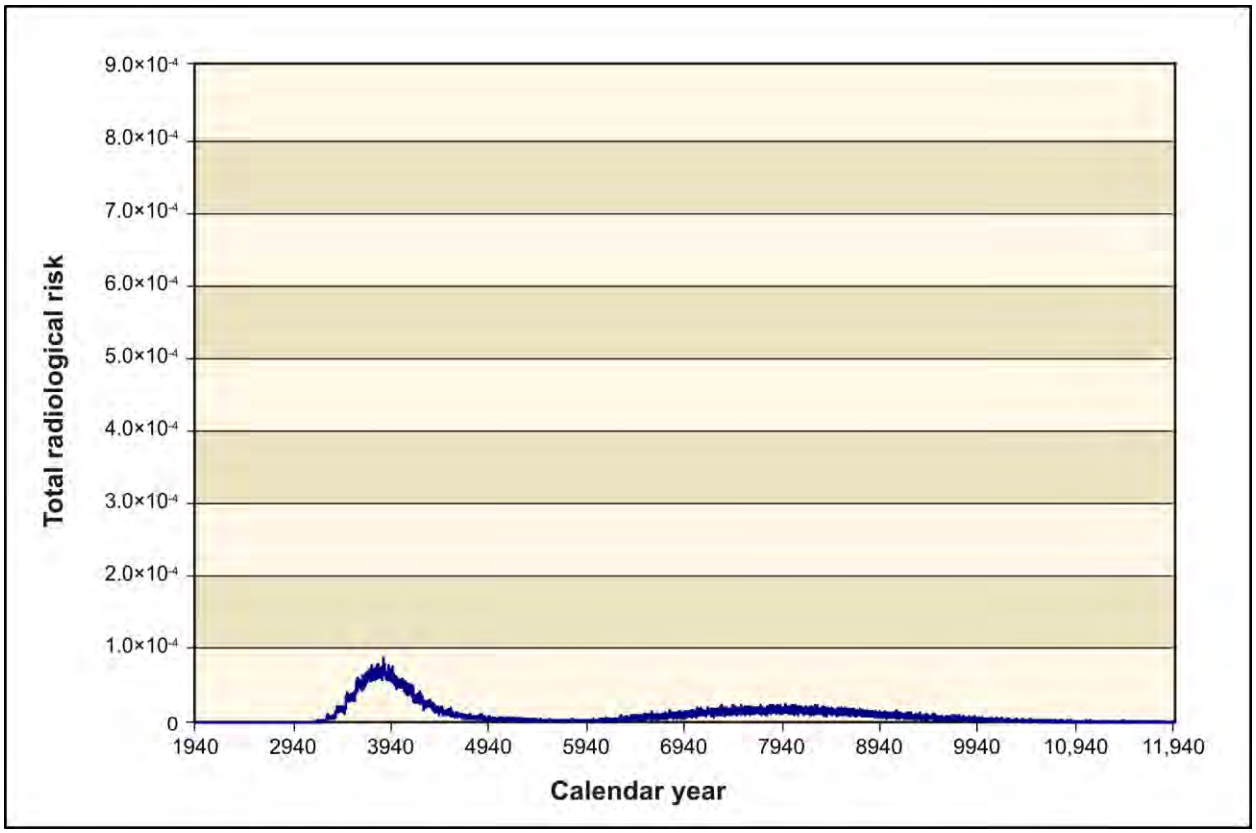


Figure 5–1156. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-B, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.3 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–148 and 5–149. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituents are 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. The Hazard Index guideline would also be exceeded at the Columbia River nearshore for the resident farmer and American Indian resident farmer. Population dose is estimated as 3.41×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.19×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1157 and 5–1158, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.8×10^{-4}) is due to release of radioactive constituents from cast stone waste. At the IDF-East barrier, the dose in the

year of peak dose is due to technetium-99 released from cast stone waste (99 percent of peak dose) and iodine-129 from ETF-generated secondary waste (1 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium (84 percent of Hazard Index) and nitrate (16 percent of Hazard Index) from cast stone waste. For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (88 percent of Hazard Index) and nitrate (12 percent of Hazard Index) from cast stone waste.

For the time series of risk at the Core Zone Boundary (see Figure 5–1158), the large, early peak in CY 3700 is due to releases from IDF-West, while the low plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–148. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.27	3.39	1.80×10^{-4}	0.00	1.80×10^{-4}	1.35×10^{1}	8.38	5.89×10^{-4}	1.16×10^{-9}	5.89×10^{-4}
IDF-West	2.87×10^{1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	2.92	1.11	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	3.03	2.81×10^{-4}	3.99×10^{-10}	2.81×10^{-4}
Columbia River nearshore	3.52	8.56×10^{-1}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	2.17	3.41×10^{-4}	3.08×10^{-10}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.83×10^{-5}	3.95×10^{-5}	2.79×10^{-9}	4.59×10^{-15}	2.79×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–149. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.75×10^{1}	1.70×10^{1}	1.29×10^{-3}	5.32×10^{-5}	1.30×10^{-3}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{1}	6.20	6.09×10^{-4}	1.83×10^{-5}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^{1}	4.37	7.39×10^{-4}	1.41×10^{-5}	7.39×10^{-4}	5.72×10^{-2}	8.18×10^{-1}	2.85×10^{-6}	1.41×10^{-5}	1.46×10^{-5}
Off Site										
Columbia River	2.51×10^{-4}	1.80×10^{-2}	9.31×10^{-9}	2.10×10^{-10}	9.31×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

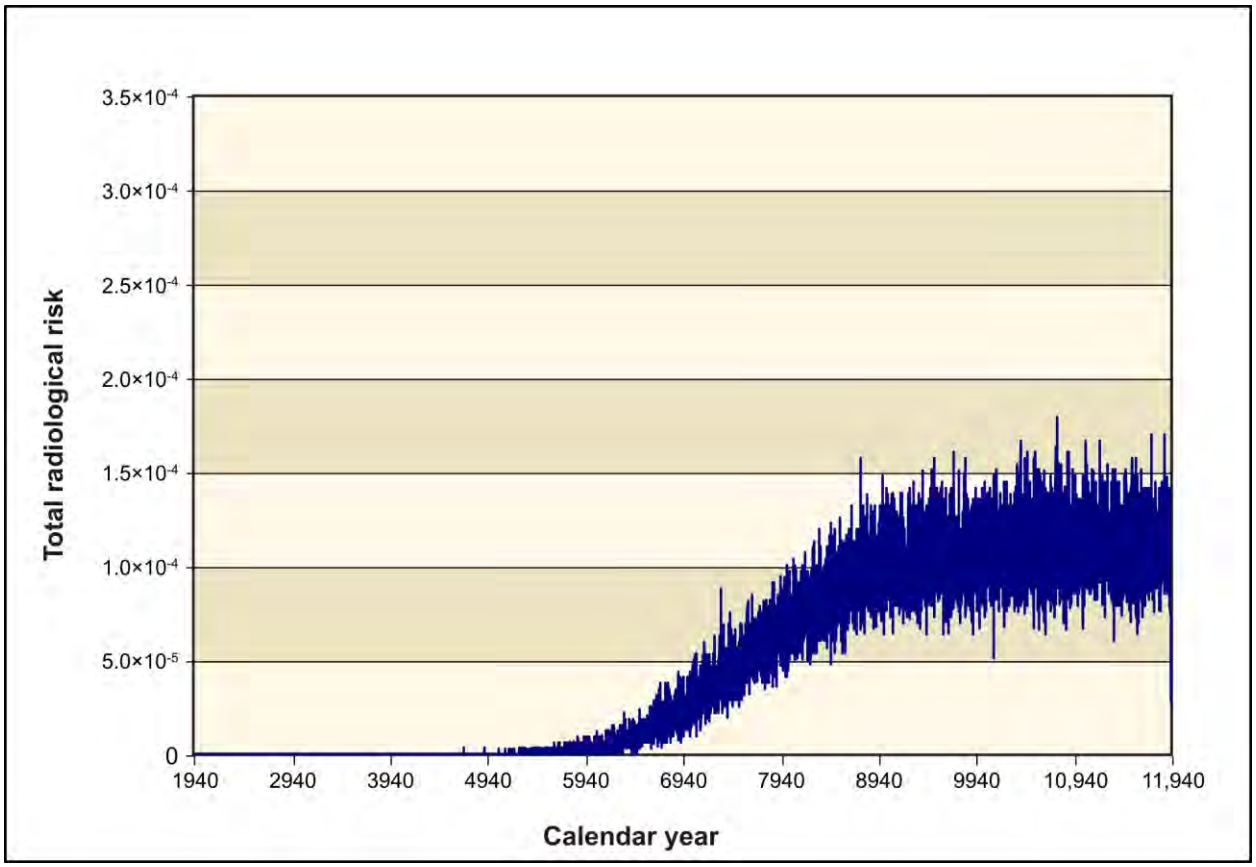


Figure 5–1157. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

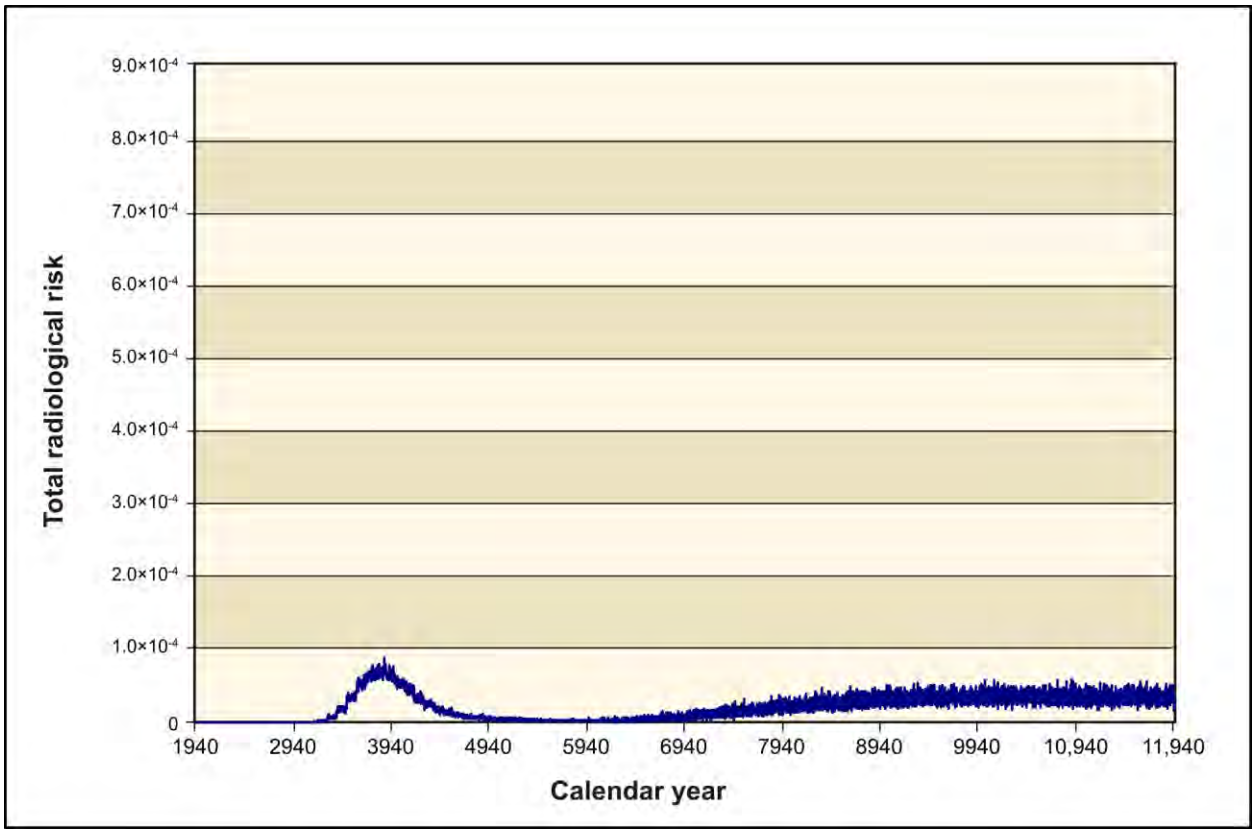


Figure 5–1158. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-C, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.4 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–150 and 5–151. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituents are 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 would be exceeded due primarily to nitrate at the IDF-East barrier for the resident farmer and American Indian resident farmer. The Hazard Index guideline would also be exceeded at the Core Zone Boundary for the American Indian resident farmer. Population dose is estimated as 3.41×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.19×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1159 and 5–1160, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (7.3×10^{-5}) is due to release of radioactive constituents from steam reforming waste. At the IDF-East barrier, the dose

in the year of peak dose is due to release of technetium-99 from steam reforming waste (89 percent of peak dose) and iodine-129 from ETF-generated secondary waste (11 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium from steam reforming waste (33 percent of Hazard Index) and nitrate from ETF-generated secondary waste (67 percent of Hazard Index). For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium from steam reforming waste (43 percent of Hazard Index) and nitrate from ETF-generated secondary waste (57 percent of Hazard Index).

For the time series of risk at the Core Zone Boundary (see Figure 5–1160), the large, early peak in CY 3700 is due to releases from IDF-West, while the subsequent peak in CY 8000 is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–150. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.28	3.04×10^{-1}	7.26×10^{-5}	0.00	7.26×10^{-5}	5.54	1.71	2.34×10^{-4}	7.57×10^{-11}	2.34×10^{-4}
IDF-West	2.87×10^{1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	2.92	9.23×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	4.66×10^{-1}	2.81×10^{-4}	2.38×10^{-11}	2.81×10^{-4}
Columbia River nearshore	3.52	6.35×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	3.57×10^{-1}	3.41×10^{-4}	1.83×10^{-11}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.83×10^{-5}	6.26×10^{-6}	2.79×10^{-9}	2.90×10^{-16}	2.79×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–151. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.11×10^{1}	3.74	5.08×10^{-4}	3.47×10^{-6}	5.10×10^{-4}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{1}	1.02	6.09×10^{-4}	1.09×10^{-6}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^{1}	7.82×10^{-1}	7.39×10^{-4}	8.39×10^{-7}	7.39×10^{-4}	5.72×10^{-2}	1.20×10^{-1}	2.85×10^{-6}	8.38×10^{-7}	2.90×10^{-6}
Off Site										
Columbia River	2.51×10^{-4}	3.68×10^{-3}	9.31×10^{-9}	1.33×10^{-11}	9.31×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

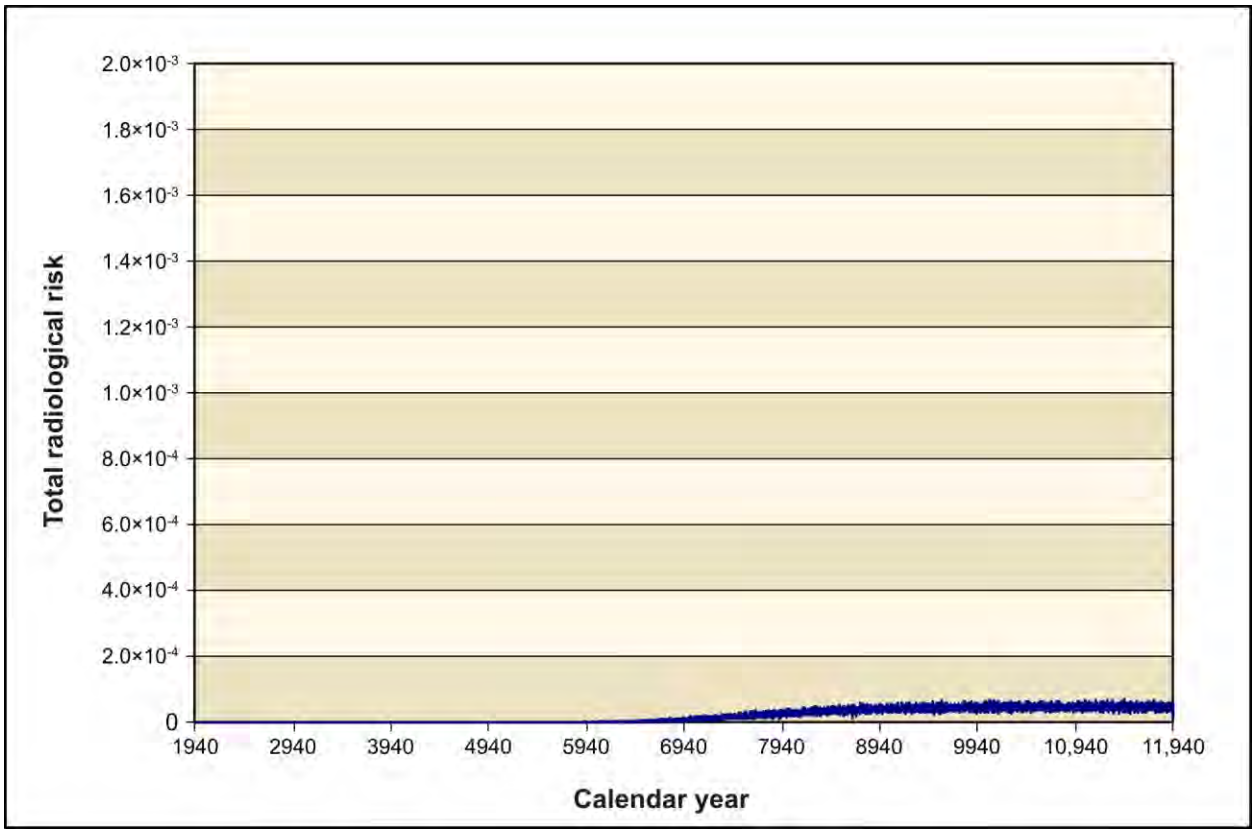


Figure 5–1159. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

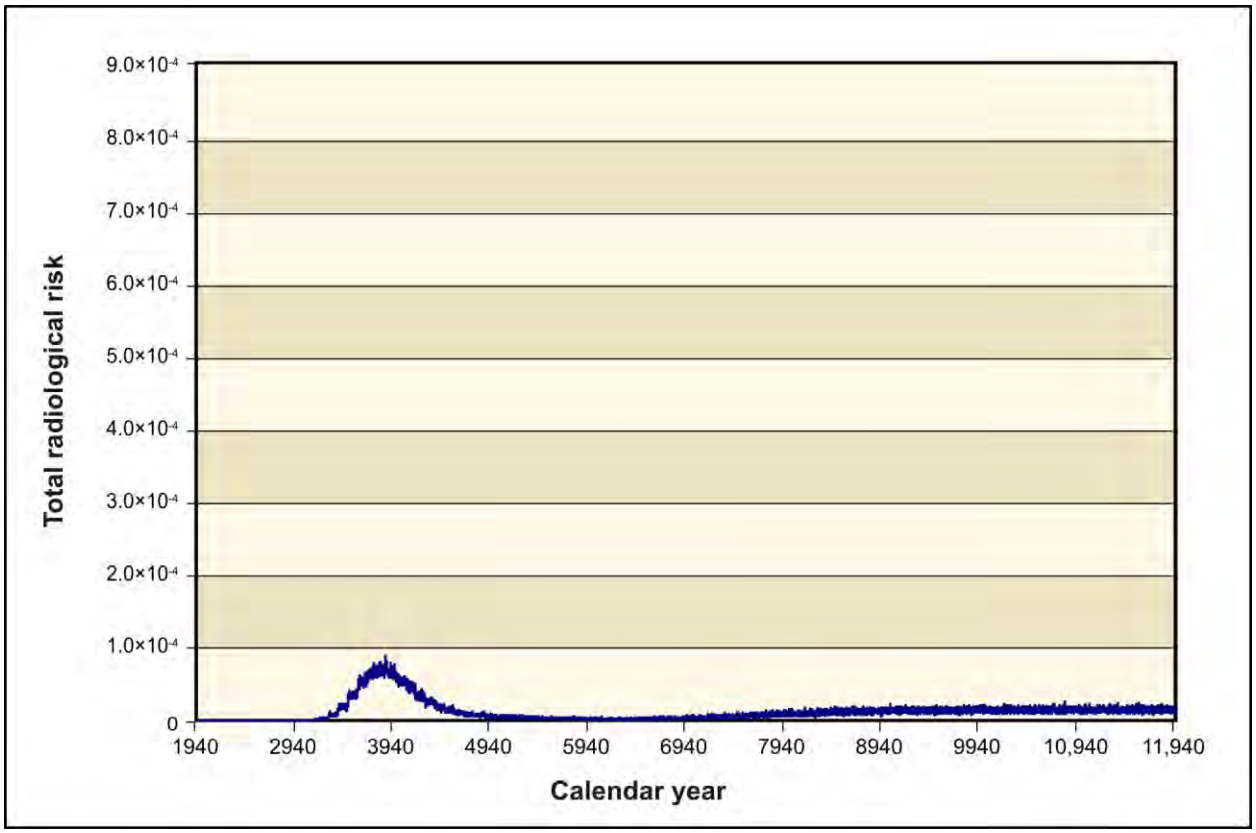


Figure 5–1160. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-D, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.5 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–152 and 5–153. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituents are 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 3.46×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.23×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1161 and 5–1162, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153, and peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (2.3×10^{-4}) is due to release of radioactive constituents from cast stone waste. At the IDF-East barrier, the dose in the

year of peak dose is due to technetium-99 released from cast stone waste (98 percent of peak dose) and iodine-129 from ETF-generated secondary waste (2 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium (82 percent of Hazard Index) and nitrate (14 percent of Hazard Index) from cast stone waste. For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (81 percent of Hazard Index) and nitrate (19 percent of Hazard Index) from cast stone waste.

For the time series of risk at the Core Zone Boundary (see Figure 5–1162), the large, early peak in CY 3700 is due to releases from IDF-West, while the subsequent plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–152. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	6.84	2.08	2.32×10^{-4}	0.00	2.32×10^{-4}	1.75×10^{1}	5.14	7.62×10^{-4}	6.88×10^{-10}	7.62×10^{-4}
IDF-West	2.87×10^{1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	2.37×10^{-1}	6.92×10^{-2}	7.01×10^{-6}	0.00	7.01×10^{-6}	5.45×10^{-1}	1.01×10^{-1}	2.21×10^{-5}	2.69×10^{-11}	2.21×10^{-5}
Core Zone Boundary	2.92	6.26×10^{-1}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	1.63	2.81×10^{-4}	2.06×10^{-10}	2.81×10^{-4}
Columbia River nearshore	3.52	4.68×10^{-1}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	1.16	3.41×10^{-4}	1.56×10^{-10}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.92×10^{-5}	2.32×10^{-5}	2.86×10^{-9}	2.58×10^{-15}	2.86×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–153. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	3.55×10^{1}	1.04×10^{1}	1.66×10^{-3}	3.15×10^{-5}	1.67×10^{-3}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	1.07	1.78×10^{-1}	4.77×10^{-5}	1.23×10^{-6}	4.86×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{1}	3.32	6.09×10^{-4}	9.45×10^{-6}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^{1}	2.43	7.39×10^{-4}	7.17×10^{-6}	7.39×10^{-4}	5.72×10^{-2}	4.29×10^{-1}	2.85×10^{-6}	7.16×10^{-6}	7.81×10^{-6}
Off Site										
Columbia River	2.55×10^{-4}	1.09×10^{-2}	9.46×10^{-9}	1.18×10^{-10}	9.46×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

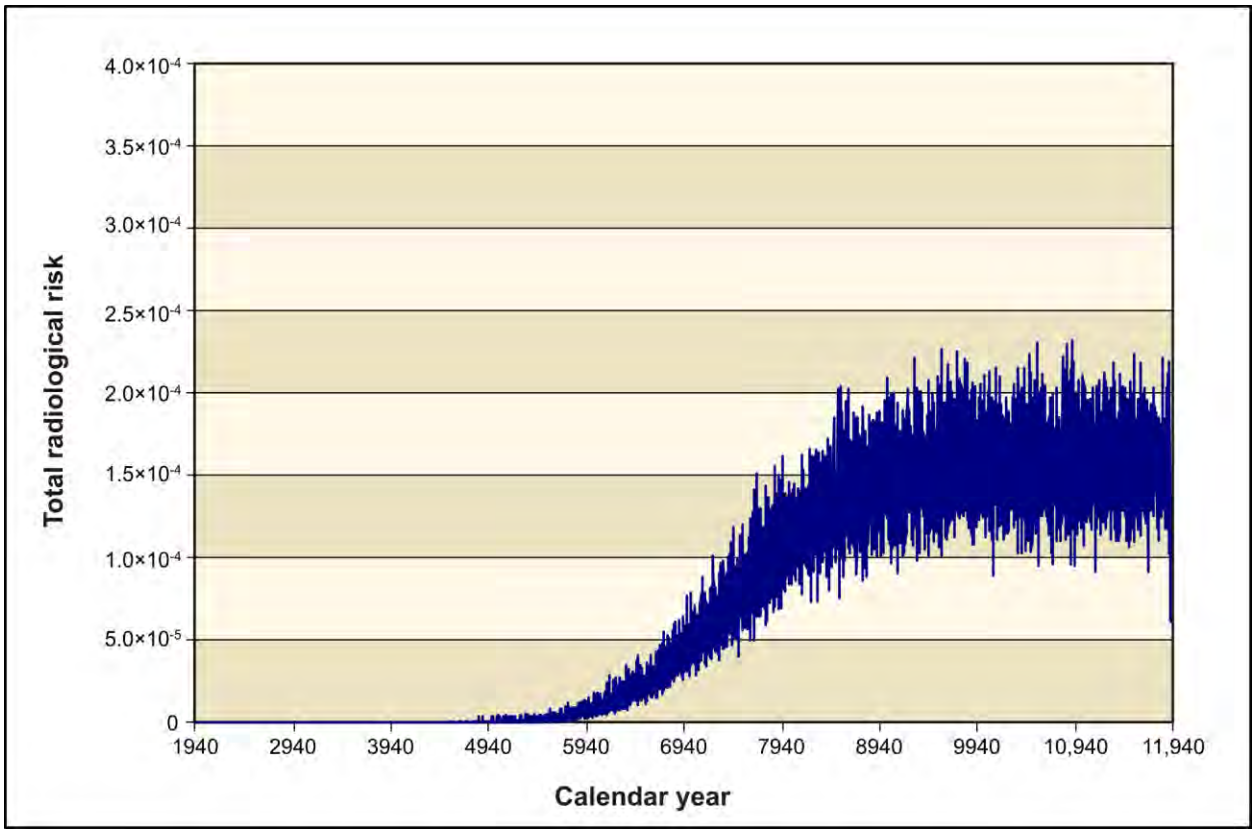


Figure 5–1161. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

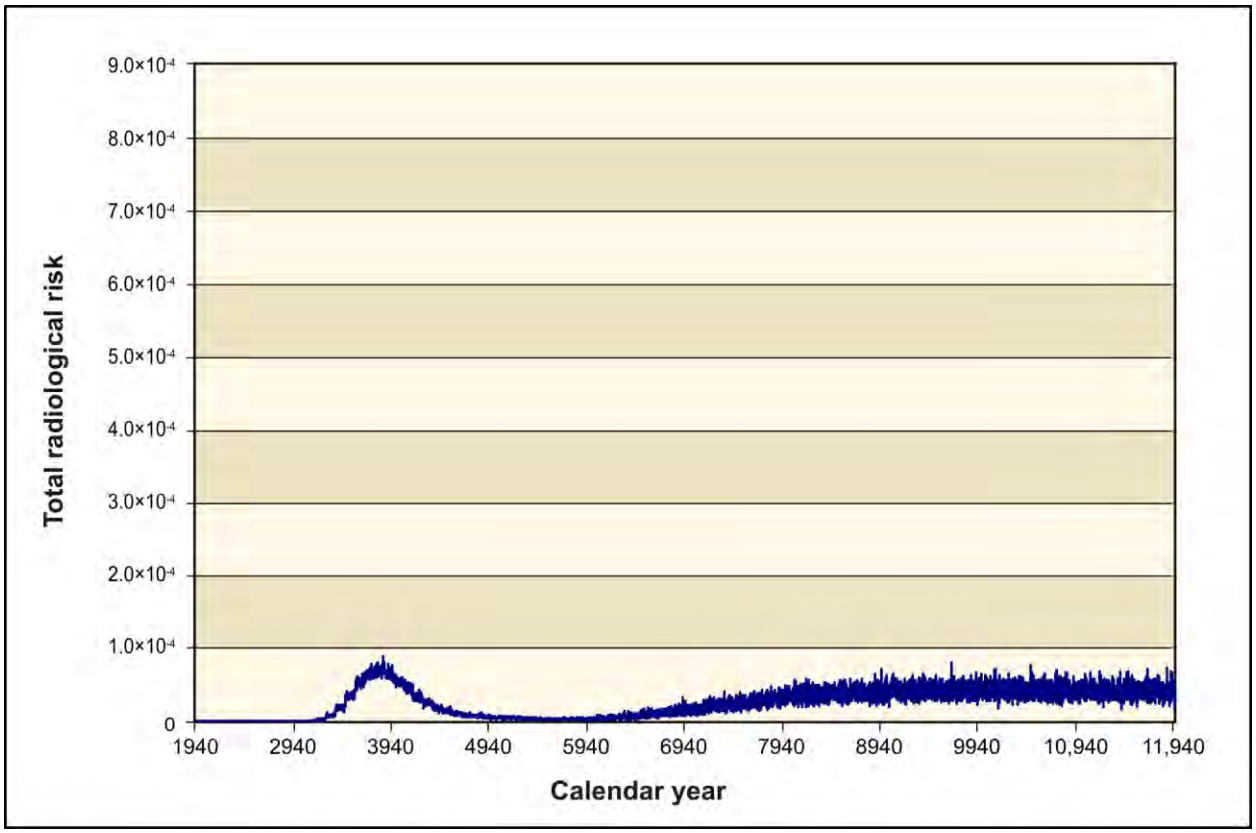


Figure 5–1162. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-E, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.6 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–154 and 5–155. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituents are 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. The Hazard Index guideline would also be exceeded at the Core Zone Boundary for the resident farmer and American Indian resident farmer and would be exceeded 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. This corresponds to 2.18×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1163 and 5–1164, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (8.5×10^{-5}) is due to release of radioactive constituents from cast stone waste and ETF-generated secondary waste. At the IDF-East barrier, the dose in the year of peak dose is due to technetium-99 released from cast stone waste (96 percent of peak dose) and iodine-129 from ETF-generated secondary waste (4 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium (93 percent of Hazard Index) from sulfate grout and nitrate (7 percent of Hazard Index) from ETF-generated secondary waste. For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (91 percent of Hazard Index) from sulfate grout and nitrate (9 percent of Hazard Index) from ETF-generated secondary waste.

For the time series of risk at the Core Zone Boundary (see Figure 5–1164), the large early peak in CY 3700 is due to releases from IDF-West, while the subsequent plateau extending over the long-term period is due to releases from IDF-East. The RPPDF would not be constructed under this alternative.

Table 5–154. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.53	3.03	8.45×10^{-5}	0.00	8.45×10^{-5}	6.38	4.98	2.76×10^{-4}	1.16×10^{-9}	2.76×10^{-4}
IDF-West	2.87×10^{1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	2.92	8.20×10^{-1}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	1.45	2.81×10^{-4}	3.06×10^{-10}	2.81×10^{-4}
Columbia River nearshore	3.52	6.11×10^{-1}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	9.75×10^{-1}	3.41×10^{-4}	2.34×10^{-10}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.78×10^{-5}	2.07×10^{-5}	2.77×10^{-9}	4.03×10^{-15}	2.77×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–155. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	1.29×10^{1}	9.31	6.02×10^{-4}	5.31×10^{-5}	6.33×10^{-4}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{1}	2.82	6.09×10^{-4}	1.40×10^{-5}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^{1}	1.80	7.39×10^{-4}	1.07×10^{-5}	7.39×10^{-4}	5.72×10^{-2}	4.16×10^{-1}	2.85×10^{-6}	1.07×10^{-5}	1.11×10^{-5}
Off Site										
Columbia River	2.49×10^{-4}	7.45×10^{-3}	9.24×10^{-9}	1.85×10^{-10}	9.24×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

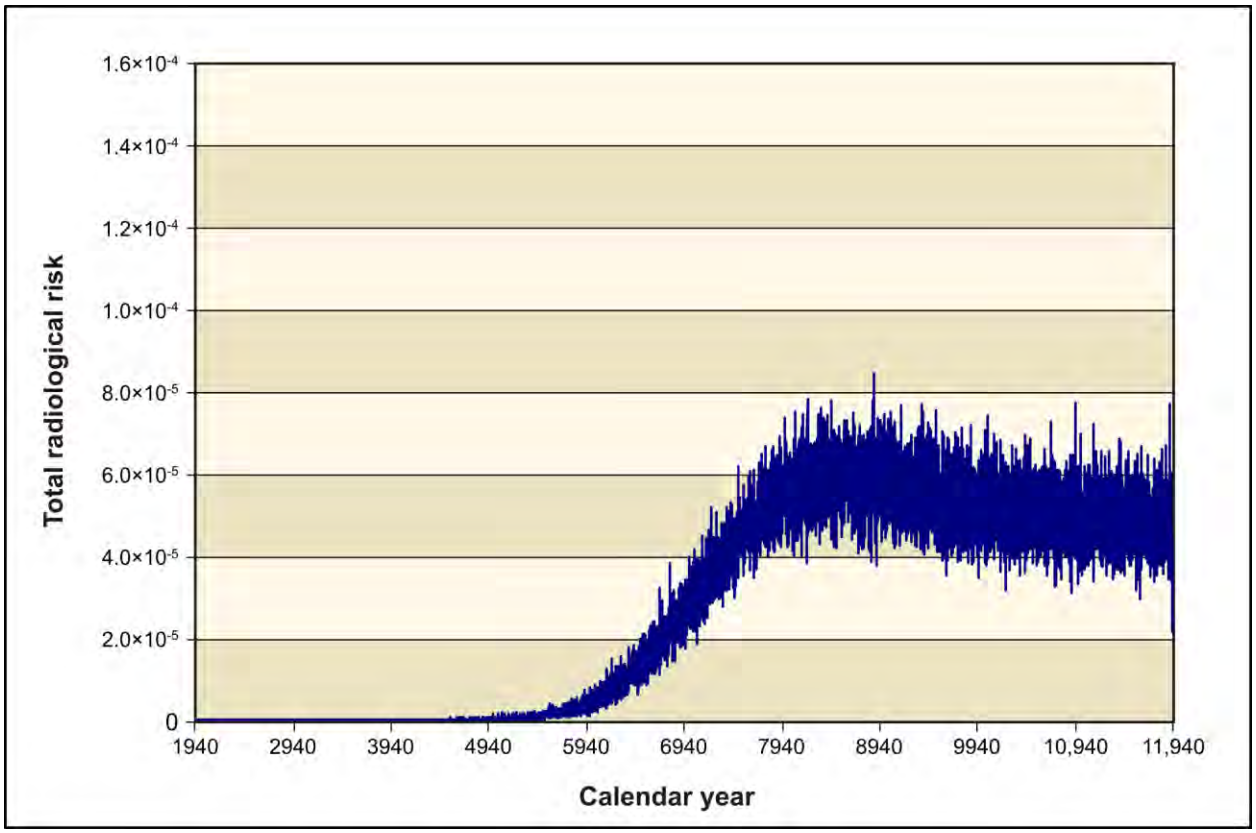


Figure 5–1163. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

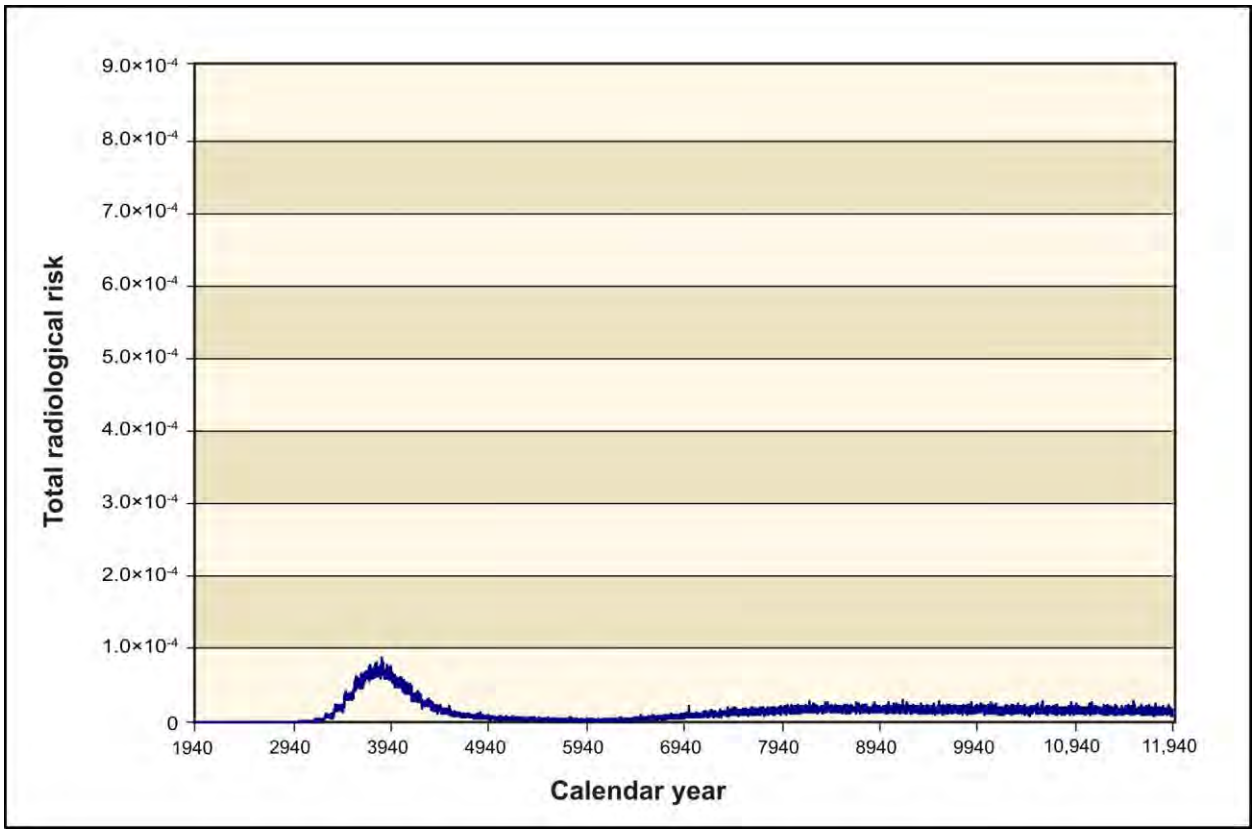


Figure 5–1164. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-F, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.7 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–156 and 5–157. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituents are 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. Population dose is estimated as 3.41×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.19×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1165 and 5–1166, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.5×10^{-5}) is due to release of radioactive constituents from tank closure and ETF-generated secondary waste. At the IDF-East barrier, the dose in the year of peak dose is due to technetium-99 released from tank closure

secondary waste (65 percent of peak dose) and iodine-129 from ETF-generated secondary waste (35 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (4 percent of Hazard Index) and nitrate from ETF-generated secondary waste (96 percent of Hazard Index). For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (1 percent of Hazard Index) and nitrate from ETF-generated secondary waste (99 percent of Hazard Index).

For the time series of risk at the Core Zone Boundary (see Figure 5–1166), the large, early peak in CY 3700 is due to releases from IDF-West, while the subsequent plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–156. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.50×10^{-1}	2.29×10^{-1}	1.46×10^{-5}	0.00	1.46×10^{-5}	1.17	1.71	4.44×10^{-5}	8.05×10^{-12}	4.44×10^{-5}
IDF-West	2.87×10^{1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	8.94×10^{-2}	2.84×10^{-2}	2.69×10^{-6}	0.00	2.69×10^{-6}	2.08×10^{-1}	4.96×10^{-2}	8.54×10^{-6}	1.05×10^{-11}	8.54×10^{-6}
Core Zone Boundary	2.92	5.77×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	4.27×10^{-1}	2.81×10^{-4}	2.94×10^{-12}	2.81×10^{-4}
Columbia River nearshore	3.52	3.78×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	2.87×10^{-1}	3.41×10^{-4}	1.87×10^{-12}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.83×10^{-5}	5.67×10^{-6}	2.79×10^{-9}	0.00	2.79×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–157. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.22	3.81	9.50×10^{-5}	3.69×10^{-7}	9.50×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	4.10×10^{-1}	9.17×10^{-2}	1.85×10^{-5}	4.81×10^{-7}	1.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{1}	9.49×10^{-1}	6.09×10^{-4}	1.35×10^{-7}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^{1}	6.39×10^{-1}	7.39×10^{-4}	8.57×10^{-8}	7.39×10^{-4}	5.72×10^{-2}	1.01×10^{-1}	2.85×10^{-6}	8.56×10^{-8}	2.90×10^{-6}
Off Site										
Columbia River	2.51×10^{-4}	3.53×10^{-3}	9.31×10^{-9}	0.00	9.31×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

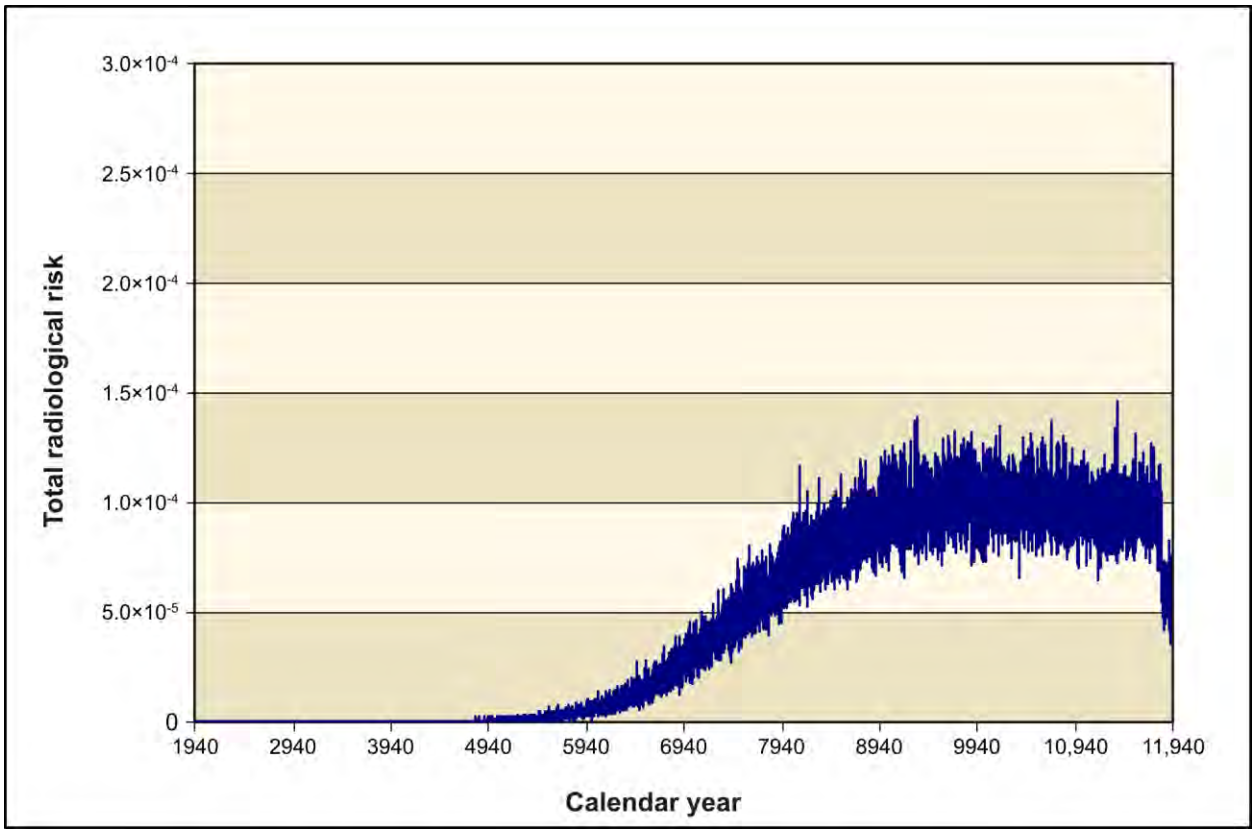


Figure 5–1165. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

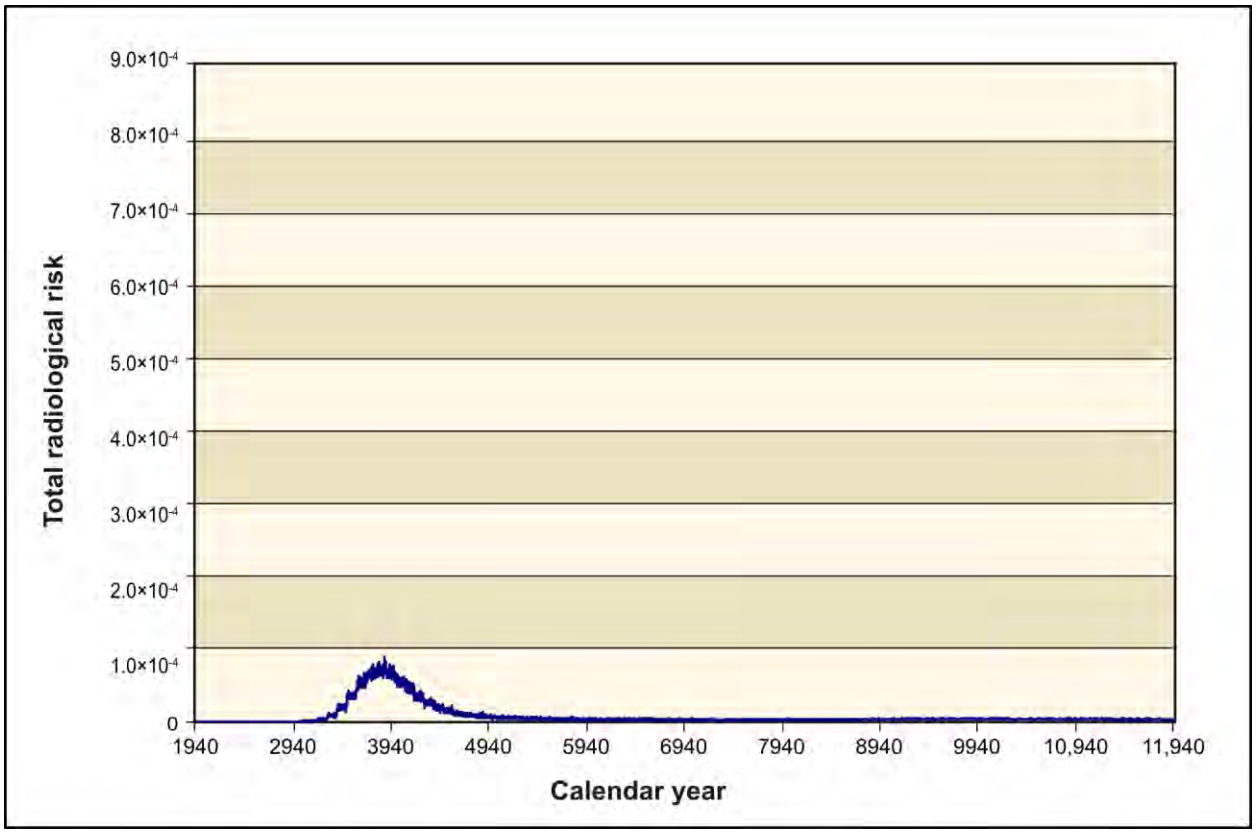


Figure 5–1166. Waste Management Alternative 3, Disposal Group 1, Subgroup 1-G, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.8 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–158 and 5–159. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituents are 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. Population dose is estimated as 3.39×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.18×10^{-5} percent of the annual population dose due to background exposure. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1167 and 5–1168, respectively. At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

The peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.3×10^{-5}) is due to release of radioactive constituents from tank closure and ETF-generated secondary waste. At the IDF-East barrier, the dose in the year of peak dose is due to technetium-99 released from tank closure

secondary waste (62 percent of peak dose) and iodine-129 from ETF-generated secondary waste (38 percent of peak dose). At the Core Zone Boundary, the dose in the year of peak dose is due to technetium-99 (82 percent of peak dose) and iodine-129 (18 percent of peak dose) released from offsite LLW. For chemical constituents at the IDF-East barrier, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (1 percent of Hazard Index) and nitrate from ETF-generated secondary waste (99 percent of Hazard Index). For chemical constituents at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium from tank closure secondary waste (7 percent of Hazard Index) and nitrate from ETF-generated secondary waste (93 percent of Hazard Index).

For the time series of risk at the Core Zone Boundary (see Figure 5–1168), the large, early peak in CY 3700 is due to releases from IDF-West, while the subsequent plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide a minor contribution to the early peak.

Table 5–158. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	4.98×10^{-1}	1.77×10^{-1}	1.32×10^{-5}	0.00	1.32×10^{-5}	1.06	1.32	4.05×10^{-5}	6.97×10^{-12}	4.05×10^{-5}
IDF-West	2.87×10^{1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	2.92	5.64×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	4.14×10^{-1}	2.81×10^{-4}	2.79×10^{-12}	2.81×10^{-4}
Columbia River nearshore	3.52	3.57×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	2.64×10^{-1}	3.41×10^{-4}	1.68×10^{-12}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	6.78×10^{-5}	5.37×10^{-6}	2.77×10^{-9}	0.00	2.77×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–159. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.00	2.93	8.71×10^{-5}	3.20×10^{-7}	8.72×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{1}	9.20×10^{-1}	6.09×10^{-4}	1.28×10^{-7}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^{1}	5.87×10^{-1}	7.39×10^{-4}	7.68×10^{-8}	7.39×10^{-4}	5.72×10^{-2}	9.13×10^{-2}	2.85×10^{-6}	7.68×10^{-8}	2.89×10^{-6}
Off Site										
Columbia River	2.49×10^{-4}	3.34×10^{-3}	9.24×10^{-9}	0.00	9.24×10^{-9}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

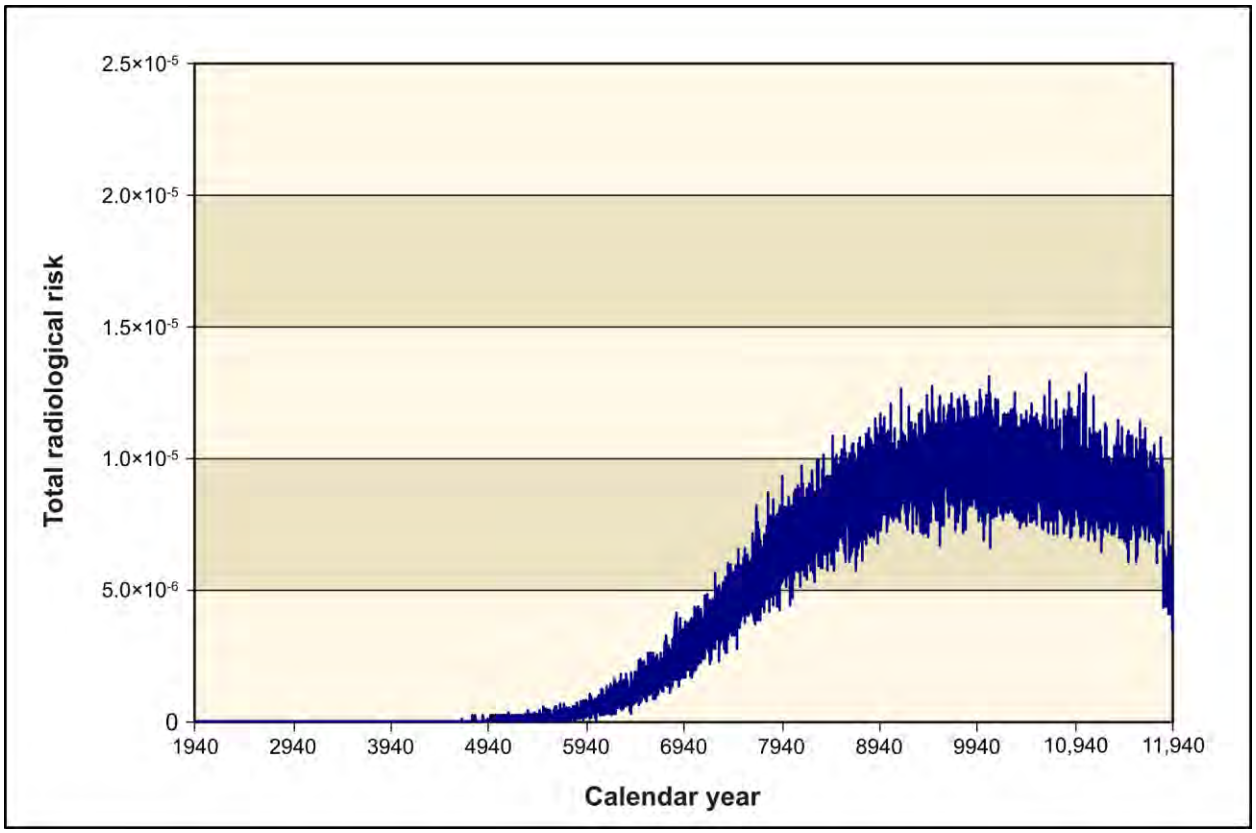


Figure 5–1167. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

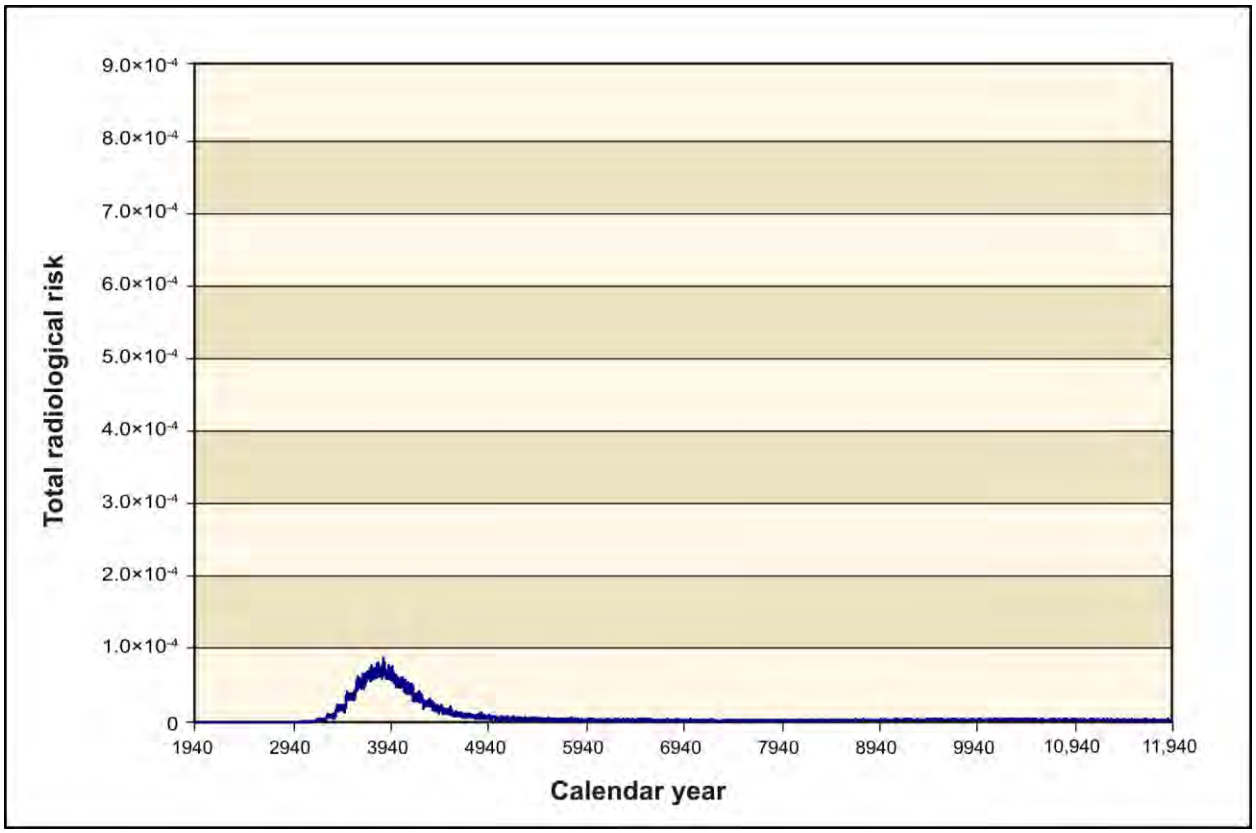


Figure 5–1168. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-A, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.9 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this subgroup.

Potential human health impacts of this alternative are summarized in Tables 5–160 through 5–163. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are 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 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 under the Base Case. The Hazard Index guideline would be exceeded at the IDF-East barrier, RPPDF barrier, and Core Zone Boundary for the resident farmer and American Indian resident farmer and would be exceeded at the Columbia River nearshore for the American Indian resident farmer under the Option Case. Population dose is estimated for Subgroup 2-B, Base Case, as 3.77×10^{-1} person-rem per year for the year of maximum impact and for Subgroup 2-B, Option Case, as 3.99×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.42×10^{-5} percent and 2.57×10^{-5} percent of the annual population dose due to background exposure for Subgroup 2-B, Base and Option Cases, respectively. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1169 and 5–1170 for the Base Case and in Figures 5–1171 and

5–1172 for the Option Case. The Base and Option Cases differ in the amount of constituents disposed of at the RPPDF because the Option Case includes removal of tank closure cribs and trenches (ditches). At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

Under both the Base and Option Cases, the peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.4×10^{-5}) is due to release of radioactive constituents from tank closure and ETF-generated secondary waste. Under both the Base and Option Cases at the IDF-East barrier, approximately 55 percent of the dose in the year of peak dose is due to technetium-99 released from tank closure secondary waste. The balance of dose in the year of peak dose is due to release of iodine-129 from ETF-generated secondary waste. Under both the Base and Option Cases at the Core Zone Boundary, approximately 82 percent of the dose in the year of peak dose is due to technetium-99, and approximately 18 percent of the peak dose is due to iodine-129. In each case, release is from offsite LLW. For chemical constituents under both the Base and Option Cases at the IDF-East barrier, noncarcinogenic impacts are due to release of nitrate (94 percent of Hazard Index) from ETF-generated secondary waste and chromium (6 percent of Hazard Index) from tank closure secondary waste. For chemical constituents under the Base Case at the Core Zone Boundary, noncarcinogenic impacts are due to release of nitrate (93 percent of Hazard Index) and chromium (7 percent of Hazard Index) from ETF-generated secondary waste. For chemical constituents under the Option Case at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (75 percent of Hazard Index) and nitrate (25 percent of Hazard Index) from RPPDF waste.

For the time series of risk at the Core Zone Boundary under the Base Case (see Figure 5–1170) and the Option Case (see Figure 5–1172), the large, early peak in CY 3700 is due to releases from IDF-West, while the subsequent plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide minor contributions to the early peak.

Table 5–160. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.27×10^{-1}	1.82×10^{-1}	1.36×10^{-5}	0.00	1.36×10^{-5}	1.08	1.36	4.13×10^{-5}	7.44×10^{-12}	4.13×10^{-5}
IDF-West	2.87×10^{1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	3.26×10^{-1}	3.78×10^{-2}	9.96×10^{-6}	0.00	9.96×10^{-6}	7.68×10^{-1}	6.51×10^{-2}	3.17×10^{-5}	1.43×10^{-11}	3.17×10^{-5}
Core Zone Boundary	2.92	6.02×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	4.44×10^{-1}	2.81×10^{-4}	1.34×10^{-11}	2.81×10^{-4}
Columbia River nearshore	3.53	3.95×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.29	3.02×10^{-1}	3.41×10^{-4}	8.71×10^{-12}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	7.53×10^{-5}	5.38×10^{-6}	3.07×10^{-9}	1.73×10^{-16}	3.07×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–161. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.05	3.02	8.83×10^{-5}	3.41×10^{-7}	8.84×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	1.52	1.26×10^{-1}	6.86×10^{-5}	6.58×10^{-7}	6.91×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{1}	9.86×10^{-1}	6.09×10^{-4}	6.13×10^{-7}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.64×10^{1}	6.72×10^{-1}	7.40×10^{-4}	3.99×10^{-7}	7.40×10^{-4}	5.74×10^{-2}	1.01×10^{-1}	2.86×10^{-6}	3.99×10^{-7}	3.03×10^{-6}
Off Site										
Columbia River	2.81×10^{-4}	3.35×10^{-3}	1.04×10^{-8}	7.93×10^{-12}	1.04×10^{-8}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–162. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.08×10^{-1}	2.78×10^{-1}	1.35×10^{-5}	0.00	1.35×10^{-5}	1.07	2.07	4.14×10^{-5}	8.80×10^{-12}	4.14×10^{-5}
IDF-West	2.87×10^{1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	4.70×10^{-1}	4.41×10^{-1}	1.42×10^{-5}	0.00	1.42×10^{-5}	1.10	1.61	4.50×10^{-5}	1.33×10^{-10}	4.50×10^{-5}
Core Zone Boundary	2.92	3.75×10^{-1}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	1.22	2.81×10^{-4}	1.12×10^{-10}	2.81×10^{-4}
Columbia River nearshore	3.52	2.60×10^{-1}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	7.30×10^{-1}	3.41×10^{-4}	7.56×10^{-11}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	7.98×10^{-5}	2.03×10^{-5}	3.25×10^{-9}	1.55×10^{-15}	3.25×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–163. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.05	4.60	8.87×10^{-5}	4.04×10^{-7}	8.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	2.16	3.43	9.75×10^{-5}	6.11×10^{-6}	1.01×10^{-4}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{1}	2.57	6.09×10^{-4}	5.15×10^{-6}	6.12×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^{1}	1.52	7.39×10^{-4}	3.47×10^{-6}	7.40×10^{-4}	5.74×10^{-2}	2.83×10^{-1}	2.86×10^{-6}	3.47×10^{-6}	5.43×10^{-6}
Off Site										
Columbia River	2.98×10^{-4}	1.04×10^{-2}	1.10×10^{-8}	7.10×10^{-11}	1.11×10^{-8}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

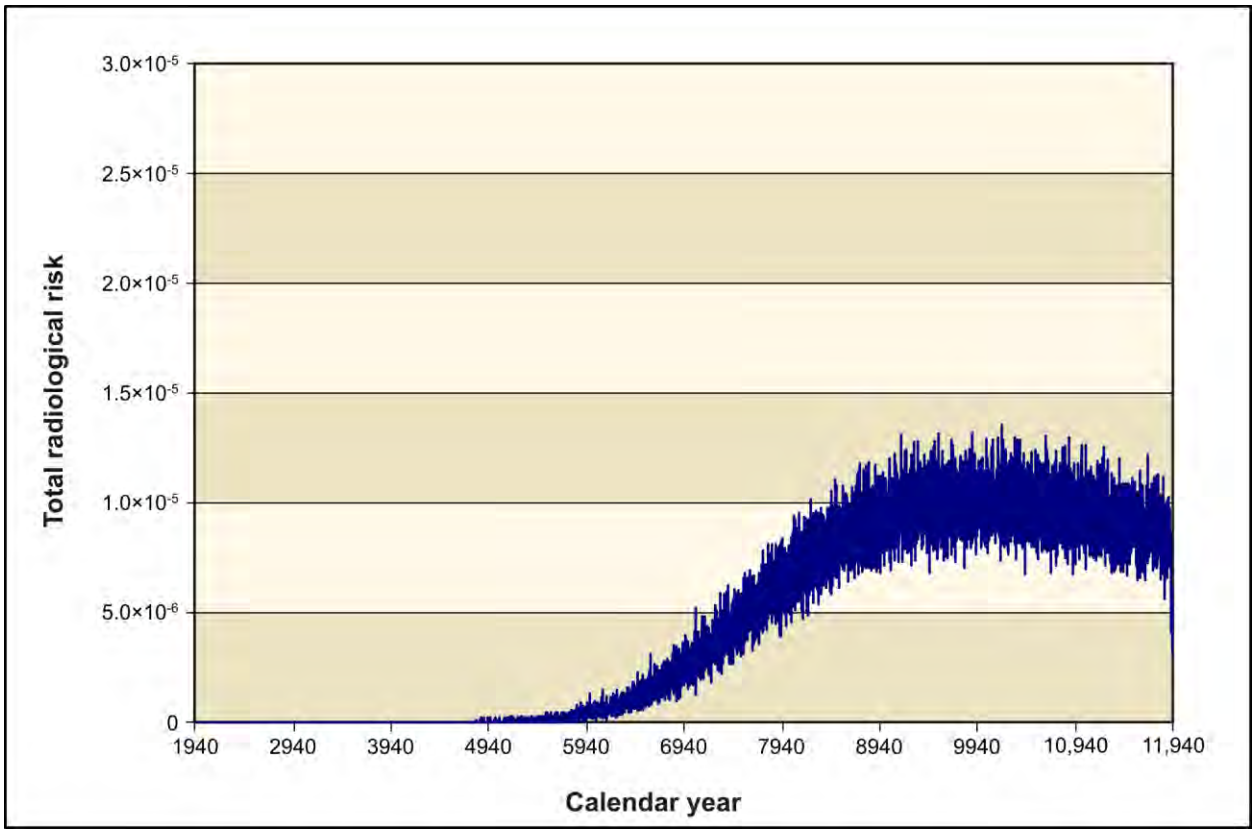


Figure 5–1169. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

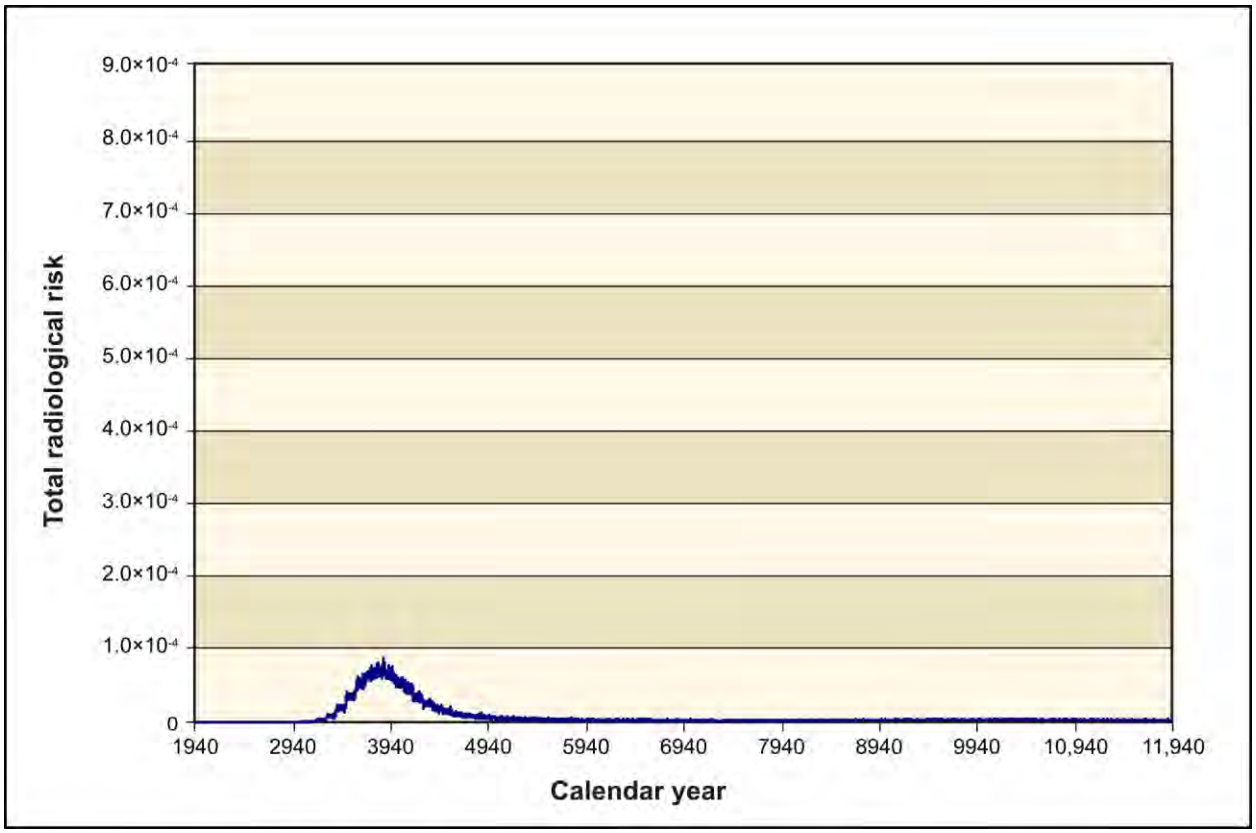


Figure 5–1170. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

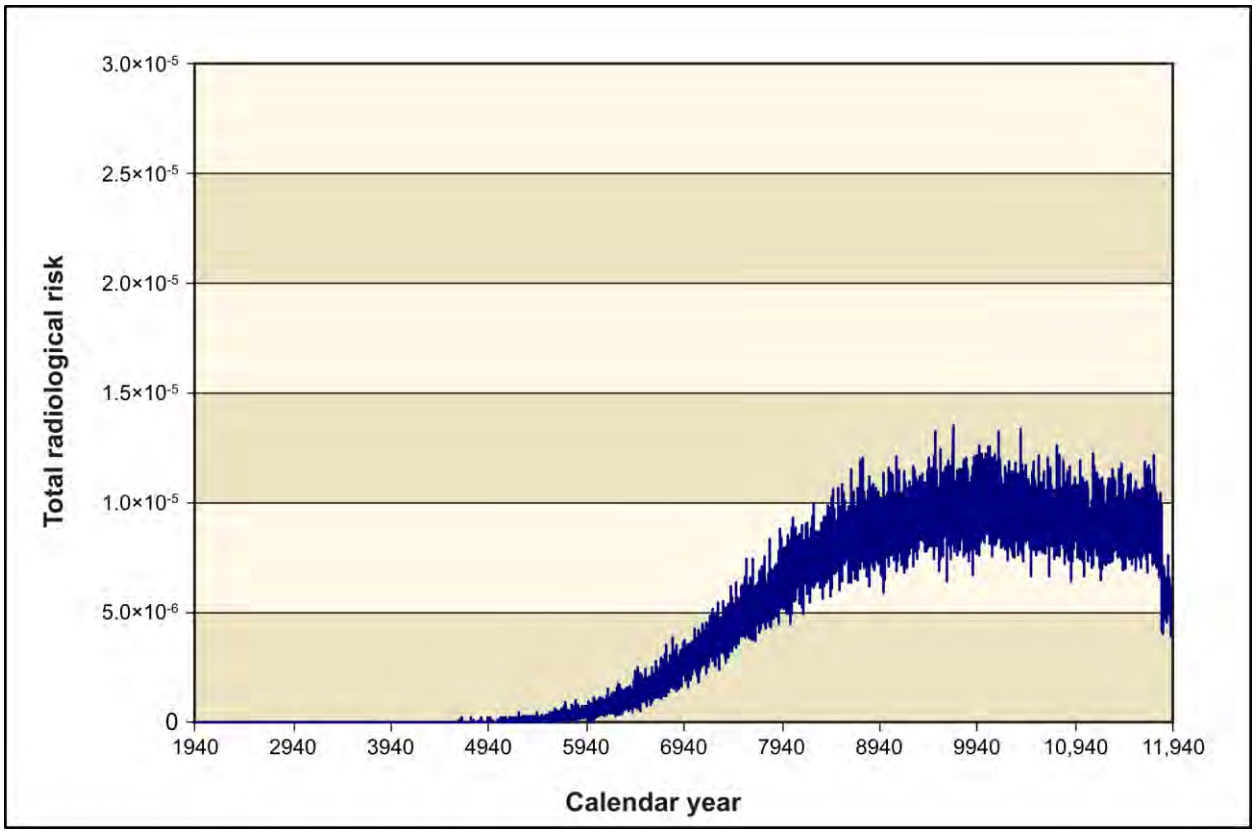


Figure 5–1171. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

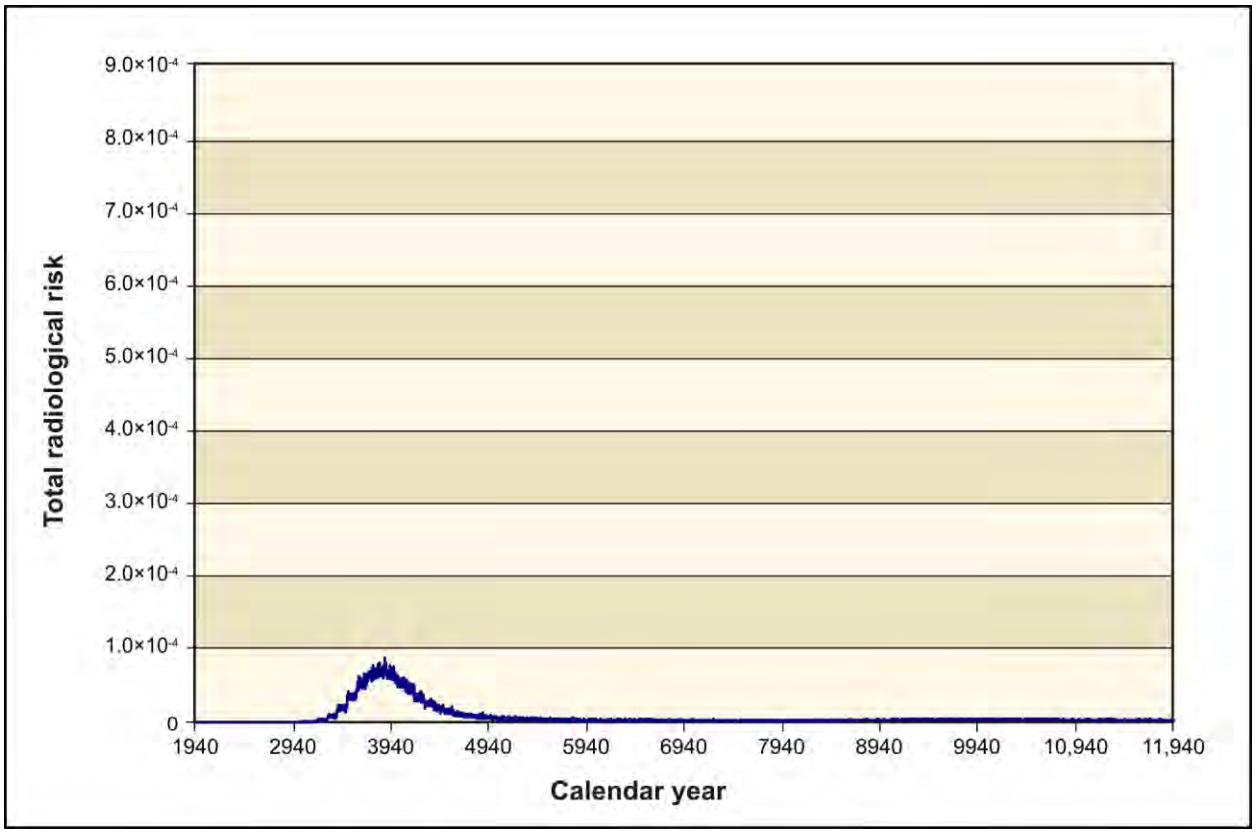


Figure 5–1172. Waste Management Alternative 3, Disposal Group 2, Subgroup 2-B, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.3.10 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas, 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. Table 5–92 provides a listing of the waste types and disposal locations considered under this disposal group.

Potential human health impacts of this alternative are summarized in Tables 5–164 through 5–167. The key radioactive constituent contributors to human health risk are technetium-99 and iodine-129, and the key chemical constituent contributors are 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 at the IDF-East barrier for the resident farmer and American Indian resident farmer under the Base Case. The Hazard Index guideline would be exceeded at the IDF-East barrier, RPPDF barrier, and Core Zone Boundary for the resident farmer and American Indian resident farmer and would be exceeded at the Columbia River nearshore for the American Indian resident farmer under the Option Case. Population dose is estimated for Disposal Group 3, Base Case, as 3.76×10^{-1} person-rem per year for the year of maximum impact and for Disposal Group 3, Option Case, as 3.98×10^{-1} person-rem per year for the year of maximum impact. This corresponds to 2.42×10^{-5} percent and 2.56×10^{-5} percent of the annual population dose due to background exposure for Disposal Group 3, Base and Option Cases, respectively. The time series of radiological risk for the drinking-water well user at the IDF-East barrier and the Core Zone Boundary are presented in Figures 5–1173 and 5–1174 for the Base Case and in Figures 5–1175 and 5–1176 for the Option Case. The Base and Option Cases differ in the amount of constituents disposed of

at the RPPDF because the Option Case includes removal of tank closure cribs and trenches (ditches). At the IDF-West barrier, the time sequence of impacts is the same as that presented for Waste Management Alternative 3, Disposal Group 1, Subgroup 1-A, in Figure 5–1153; peak impacts are due primarily to release of technetium-99 from offsite LLW.

Under both the Base and Option Cases, the peak of the total lifetime risk for the drinking-water well user at the IDF-East barrier (1.4×10^{-5}) is due to release of radioactive constituents from tank closure and ETF-generated secondary waste. Under both the Base and Option Cases at the IDF-East barrier, approximately 55 percent of the dose in the year of peak dose is due to technetium-99 released from tank closure secondary waste. The balance of dose in the year of peak dose is due to release of iodine-129 from ETF-generated secondary waste. Under both the Base and Option Cases at the Core Zone Boundary, approximately 82 percent of the dose in the year of peak dose is due to technetium-99 and approximately 18 percent of the peak dose is due to iodine-129. In each case, release is from offsite LLW. For chemical constituents under both the Base and Option Cases at the IDF-East barrier, noncarcinogenic impacts are due to release of nitrate (94 percent of Hazard Index) from ETF-generated secondary waste and chromium (6 percent of Hazard Index) from tank closure secondary waste. For chemical constituents under the Base Case at the Core Zone Boundary, noncarcinogenic impacts are due to release of nitrate (93 percent of Hazard Index) from ETF-generated secondary waste and chromium (7 percent of Hazard Index) from tank closure secondary waste. For chemical constituents under the Option Case at the Core Zone Boundary, noncarcinogenic impacts are due to release of chromium (75 percent of Hazard Index) and nitrate (25 percent of Hazard Index) from RPPDF waste.

For the time series of risk at the Core Zone Boundary under the Base Case (see Figure 5–1174) and the Option Case (see Figure 5–1176), the large, early peak in CY 3700 is due to releases from IDF-West, while the subsequent plateau extending over the long-term period is due to releases from IDF-East. Releases from the RPPDF would provide minor contributions to the early peak.

Table 5–164. Waste Management Alternative 3, Disposal Group 3, Base Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.27×10^{-1}	1.82×10^{-1}	1.36×10^{-5}	0.00	1.36×10^{-5}	1.08	1.36	4.13×10^{-5}	7.44×10^{-12}	4.13×10^{-5}
IDF-West	2.87×10^{1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	3.14×10^{-1}	3.92×10^{-2}	9.51×10^{-6}	0.00	9.51×10^{-6}	7.35×10^{-1}	7.03×10^{-2}	3.02×10^{-5}	1.48×10^{-11}	3.02×10^{-5}
Core Zone Boundary	2.92	6.02×10^{-2}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	4.44×10^{-1}	2.81×10^{-4}	1.29×10^{-11}	2.81×10^{-4}
Columbia River nearshore	3.52	3.95×10^{-2}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	3.02×10^{-1}	3.41×10^{-4}	8.11×10^{-12}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	7.52×10^{-5}	5.38×10^{-6}	3.06×10^{-9}	1.74×10^{-16}	3.06×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–165. Waste Management Alternative 3, Disposal Group 3, Base Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.05	3.02	8.83×10^{-5}	3.41×10^{-7}	8.84×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	1.45	1.31×10^{-1}	6.53×10^{-5}	6.79×10^{-7}	6.58×10^{-5}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{1}	9.86×10^{-1}	6.09×10^{-4}	5.90×10^{-7}	6.09×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^{1}	6.72×10^{-1}	7.39×10^{-4}	3.72×10^{-7}	7.39×10^{-4}	5.73×10^{-2}	1.01×10^{-1}	2.86×10^{-6}	3.72×10^{-7}	2.99×10^{-6}
Off Site										
Columbia River	2.80×10^{-4}	3.35×10^{-3}	1.03×10^{-8}	7.98×10^{-12}	1.03×10^{-8}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–166. Waste Management Alternative 3, Disposal Group 3, Option Case, Drinking-Water Well User and Resident Farmer Long-Term Human Health Impact Summary

Location	Receptor									
	Drinking-Water Well User					Resident Farmer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	5.08×10^{-1}	2.78×10^{-1}	1.35×10^{-5}	0.00	1.35×10^{-5}	1.07	2.07	4.14×10^{-5}	8.80×10^{-12}	4.14×10^{-5}
IDF-West	2.87×10^{1}	1.03×10^{-2}	8.59×10^{-4}	0.00	8.59×10^{-4}	6.66×10^{1}	1.17×10^{-2}	2.72×10^{-3}	4.13×10^{-12}	2.72×10^{-3}
River Protection Project Disposal Facility	4.75×10^{-1}	4.39×10^{-1}	1.49×10^{-5}	0.00	1.49×10^{-5}	1.14	1.53	4.77×10^{-5}	1.27×10^{-10}	4.77×10^{-5}
Core Zone Boundary	2.92	3.75×10^{-1}	8.86×10^{-5}	0.00	8.86×10^{-5}	6.84	1.33	2.81×10^{-4}	1.12×10^{-10}	2.81×10^{-4}
Columbia River nearshore	3.52	2.60×10^{-1}	1.07×10^{-4}	0.00	1.07×10^{-4}	8.28	8.40×10^{-1}	3.41×10^{-4}	8.22×10^{-11}	3.41×10^{-4}
Off Site										
Columbia River	N/A	N/A	N/A	N/A	N/A	7.96×10^{-5}	2.02×10^{-5}	3.24×10^{-9}	1.53×10^{-15}	3.24×10^{-9}

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

Table 5–167. Waste Management Alternative 3, Disposal Group 3, Option Case, American Indian Resident Farmer and American Indian Hunter-Gatherer Long-Term Human Health Impact Summary

Location	Receptor									
	American Indian Resident Farmer					American Indian Hunter-Gatherer				
	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk	Dose at Year of Peak Dose (mrem/yr)	Hazard Index at Year of Peak Hazard Index	Rad. Risk at Year of Peak Rad. Risk	Nonrad. Risk at Year of Peak Nonrad. Risk	Total Risk at Year of Peak Total Risk
On Site										
IDF-East	2.05	4.60	8.87×10^{-5}	4.04×10^{-7}	8.89×10^{-5}	N/A	N/A	N/A	N/A	N/A
IDF-West	1.31×10^{2}	1.87×10^{-2}	5.87×10^{-3}	1.89×10^{-7}	5.87×10^{-3}	N/A	N/A	N/A	N/A	N/A
River Protection Project Disposal Facility	2.27	3.24	1.04×10^{-4}	5.82×10^{-6}	1.07×10^{-4}	N/A	N/A	N/A	N/A	N/A
Core Zone Boundary	1.35×10^{1}	2.79	6.09×10^{-4}	5.12×10^{-6}	6.13×10^{-4}	N/A	N/A	N/A	N/A	N/A
Columbia River nearshore	1.63×10^{1}	1.79	7.39×10^{-4}	3.77×10^{-6}	7.40×10^{-4}	5.73×10^{-2}	2.87×10^{-1}	2.86×10^{-6}	3.77×10^{-6}	5.72×10^{-6}
Off Site										
Columbia River	2.98×10^{-4}	1.03×10^{-2}	1.10×10^{-8}	7.02×10^{-11}	1.10×10^{-8}	N/A	N/A	N/A	N/A	N/A

Key: IDF-East=200-East Area Integrated Disposal Facility; IDF-West=200-West Area Integrated Disposal Facility; mrem=millirem; N/A=not applicable; Nonrad.=nonradiological; Rad.=radiological; yr=year.

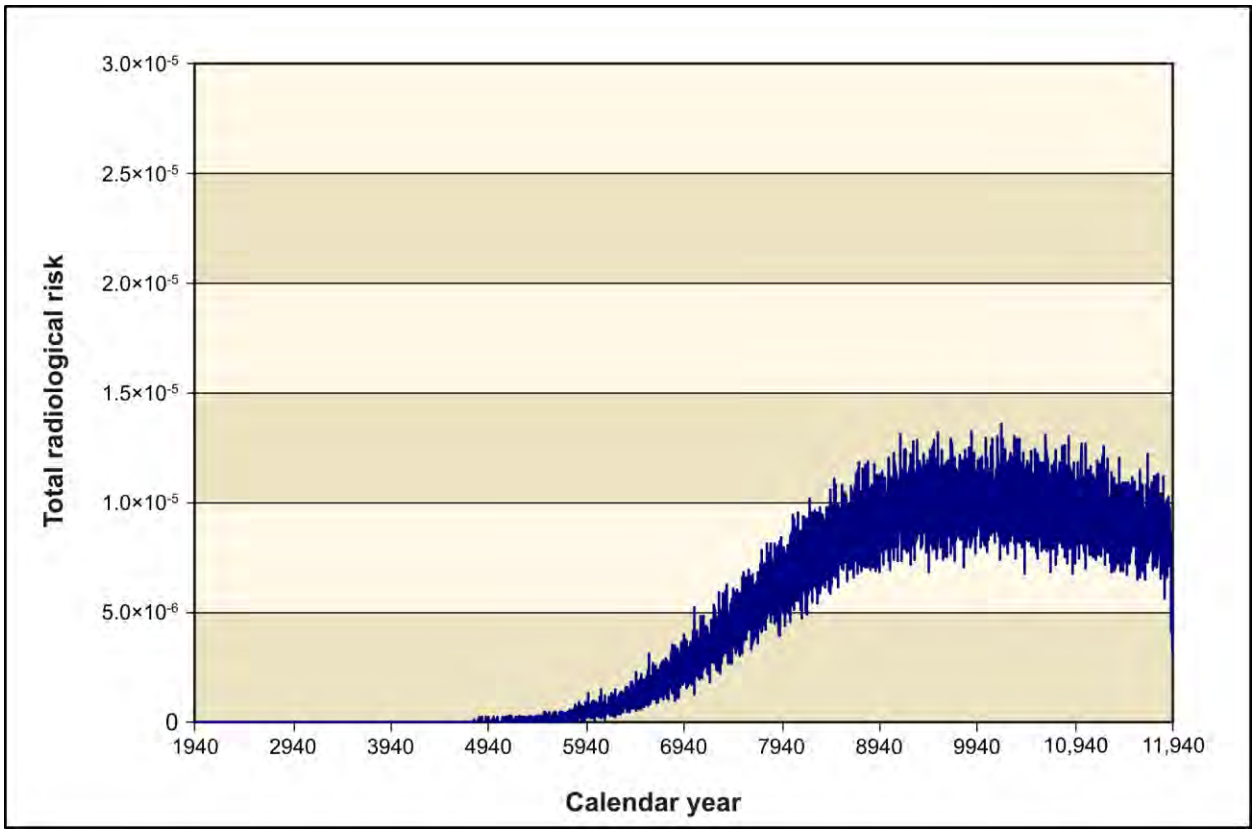


Figure 5–1173. Waste Management Alternative 3, Disposal Group 3, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

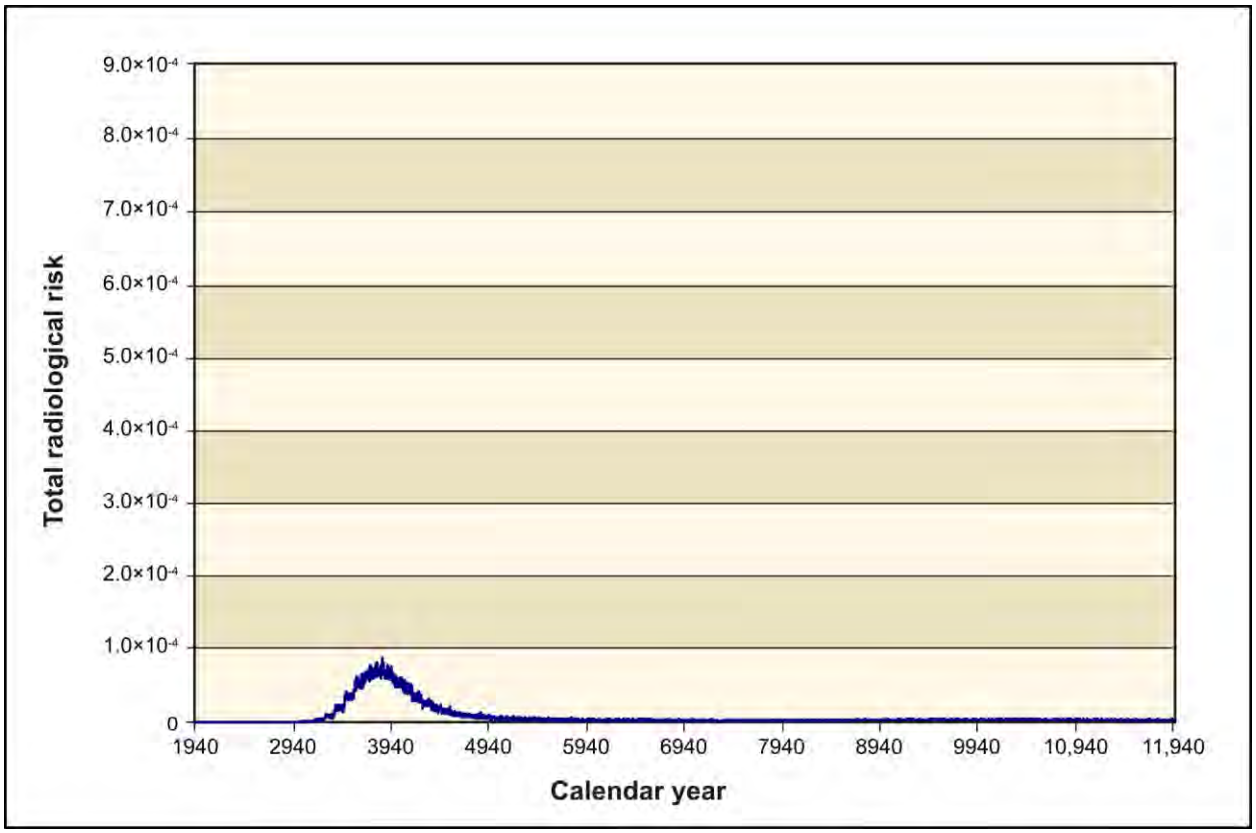


Figure 5–1174. Waste Management Alternative 3, Disposal Group 3, Base Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

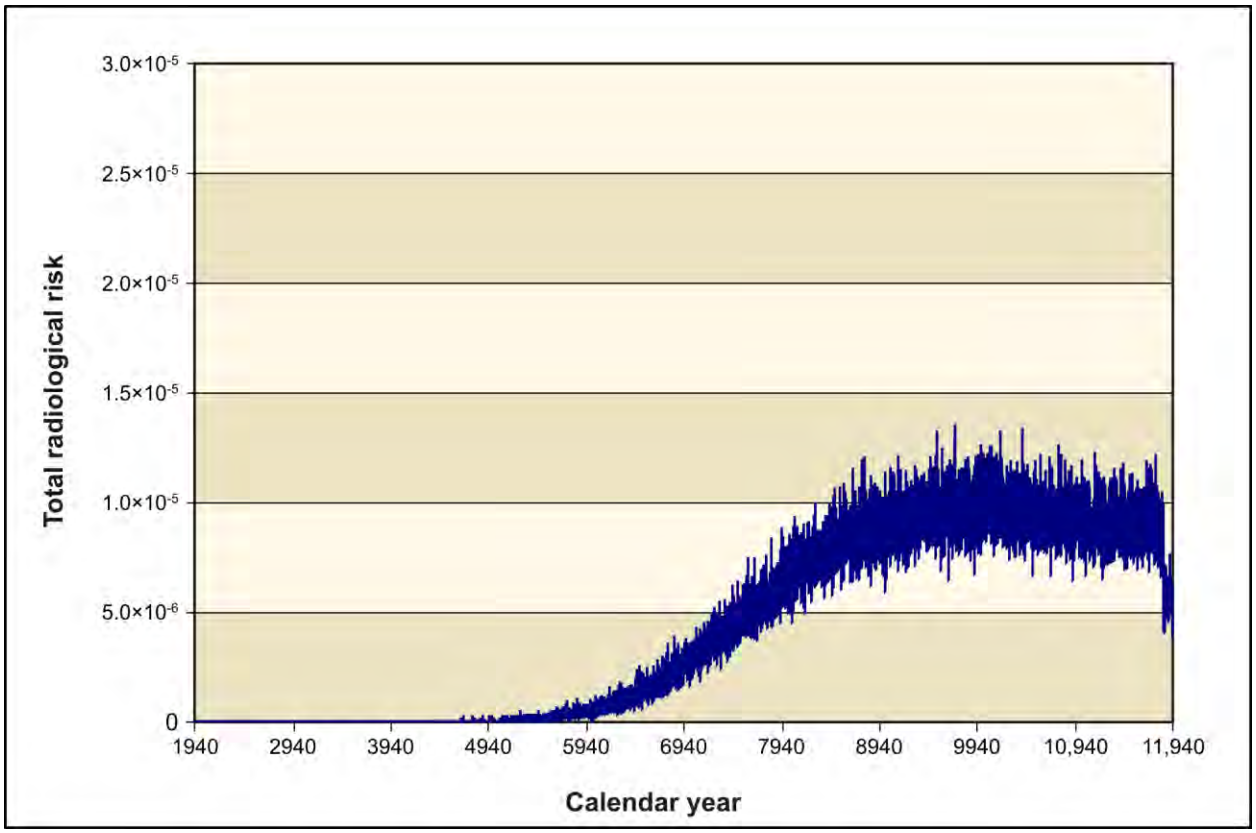


Figure 5–1175. Waste Management Alternative 3, Disposal Group 3, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the 200-East Area Integrated Disposal Facility Barrier

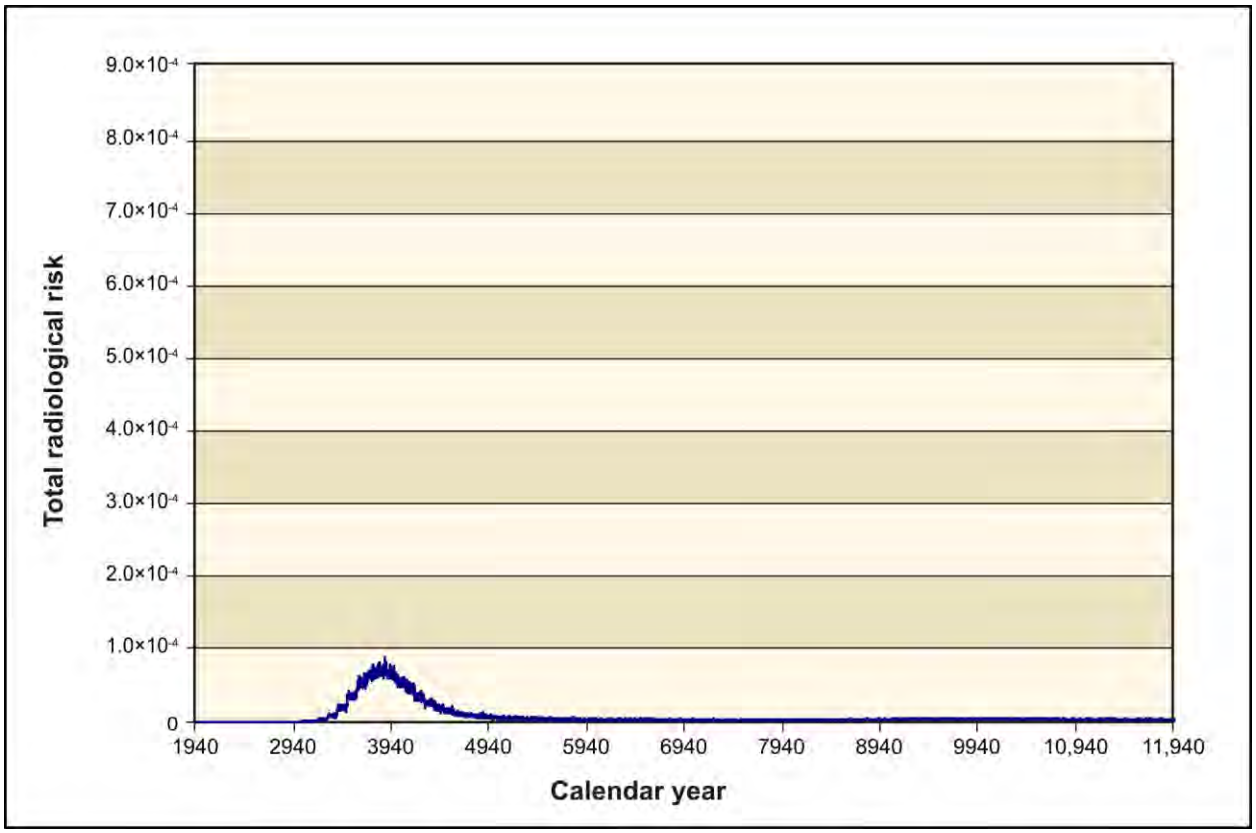


Figure 5–1176. Waste Management Alternative 3, Disposal Group 3, Option Case, Time Series of Radiological Risk for the Drinking-Water Well User at the Core Zone Boundary

5.3.2.4 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:

- 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

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:

- 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; the year of peak dose 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 5–168 and 5–169 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 due 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 for residential agriculture intruders, but is not exceeded for intruder workers. The estimated impacts of intrusion into the rubble, soil and equipment related to tank closure that is disposed of in the RPPDF are presented in Table 5–170. 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 for either type of intruder. 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 5–171 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, but is not exceeded for the intruder worker for any of the four types of waste.

Table 5–168. Doses by Tank Closure Waste Type to an American Indian Engaged in Residential Agriculture Following Well Drilling at an Integrated Disposal Facility

Alternative	Dose (rem per year)								
	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	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]	38.1	0.34	N/A[a]	1.46	0.91
6A, Option Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	1.90	0.34	N/A[a]	1.36	0.039
6B, Base Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	38.1	0.34	N/A[a]	1.46	0.91
6B, Option Case	N/A[a]	N/A[a]	N/A[a]	N/A[a]	1.90	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] Not applicable because 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 5–169. 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	2.7×10^{-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	2.6×10^{-3}	4.4×10^{-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] Not applicable because 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 5–170. 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 per year)
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] Not applicable because the RPPDF would not be constructed under this alternative.
Key: N/A=not applicable; RPPDF=River Protection Project Disposal Facility.

Table 5–171. 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 per year)
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.