DOE/EIS-0286D2

Revised Draft Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement Richland, Washington

Volume II Appendixes A through O

U.S. Department of Energy
Richland Operations Office
Richland, Washington

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Cover Photographs:

1. Hanford workers preparing to retrieve and repackage TRU waste drums
2. Drums of transuranic waste in a retrievable storage trench
3. A partial aerial view of Hanford's Low Level Burial Grounds
4. Waste Receiving and Processing Facility inspection and repackaging glove boxes
5. Hanford's Mixed Low-Level Waste disposal facility
6. Placing TRU waste into a TRUPACT shipping container for shipment to the Waste Isolation Pilot Plant

RESPONSIBLE AGENCY: **COVER SHEET**

U.S. Department of Energy, Richland Operations Office

TITLE:

Revised Draft Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement, Richland, Benton County, Washington (DOE/EIS-0286D2)

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ABSTRACT:

The revised draft of the Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement (HSW EIS) provides environmental and technical information concerning U.S. Department of Energy (DOE) proposed waste management practices at the Hanford Site. DOE issued the Notice of Intent to prepare the EIS on October 27, 1997, and held public meetings during the scoping period that extended through January 30, 1998. The HSW EIS updates analyses of environmental consequences from previous documents and provides evaluations for activities that may be implemented consistent with the Waste Management Programmatic Environmental Impact Statement (WM PEIS) Records of Decision (RODs). Waste types considered in the HSW EIS include operational low-level radioactive waste (LLW), mixed low-level waste (MLLW), immobilized low-activity waste (ILAW), and transuranic (TRU) waste. MLLW contains chemically hazardous components in addition to radionuclides. In April 2002, DOE issued the first draft of the HSW EIS. During the public comment period that started in May 2002, DOE received a large number of comments from regulators, area tribes, stakeholders, and the public. The revised draft of the HSW EIS was prepared to address these public comments and add the ILAW scope. Alternatives for management of these wastes at the Hanford Site, including the alternative of No Action, are analyzed in detail. The LLW, MLLW, and TRU waste alternatives are evaluated for a range of waste volumes, representing quantities of waste that could be managed at the Hanford Site. A single maximum forecast volume is evaluated for ILAW waste. The No Action Alternative considers continuation of ongoing waste management practices at the Hanford Site and ceasing some operations when the limits of existing capabilities are reached. The No Action Alternative provides for continued storage of some waste types. The other alternatives evaluate waste management practices including treatment and disposal of most wastes. The potential environmental consequences of the alternatives are generally similar. The major differences occur with respect to the consequences of disposal versus continued storage and with respect to the range of waste volumes managed under the alternatives. The revised draft HSW EIS is being issued for public review and comment, after which DOE will prepare the final EIS. Dates, times, and locations for public meetings will be announced in the *Federal Register* and local media. The RODs will be published in the *Federal Register* no sooner than 30 days after publication of the Environmental Protection Agency Notice of Availability of the final EIS. DOE's preferred alternative is to dispose of LLW, MLLW, and ILAW in a single, lined facility on Hanford's Central Plateau; treat MLLW using a combination of onsite and offsite facilities; and certify TRU waste using a combination of existing and upgraded facilities onsite.

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Appendix A

Public Scoping and Review Comments and DOE Responses

The Council on Environmental Quality (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) (42 USC 4321) state “there shall be an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action. This process shall be termed scoping” (40 CFR 1501.7). The principal purpose of scoping is to determine the “range of actions, alternatives, and impacts to be considered in an Environmental Impact Statement (EIS)” (40 CFR 1508.25).

This appendix presents a summary of the scoping comments and responses for the 1) *Immobilized Low-Activity Waste Disposal Supplemental Environmental Impact Statement* (ILAW SEIS) in Part 1, and 2) the *Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement* (HSW EIS) in Part 2, because the former ILAW SEIS has been merged with this revised HSW EIS.

Part 1—Public Scoping Comments and Responses for the ILAW SEIS

Following the Notice of Intent (67 FR 45104) to prepare the ILAW SEIS, the U.S. Department of Energy (DOE) held a scoping meeting in Richland, Washington, on August 20, 2002. During scoping, meetings were held with tribal nations, organizations, and agencies; written comments were received from nine of those entities.

The scoping comments and questions centered on several major themes:

- requests for technical information and clarification
- ILAW disposal alternatives
- long-term performance, mitigation, and stewardship
- ILAW waste form and treatment alternatives
- cumulative impacts
- regulatory, and NEPA issues
- waste classification, definition of ILAW and high-level waste (HLW)
- other impacts and analyses
- relationship to this HSW EIS and other NEPA documents
- public involvement process
- relationship to current DOE cleanup plans
- opposition to disposal or storage of ILAW at Hanford.

After the end of scoping for the ILAW disposal SEIS, DOE decided to combine that SEIS with this revised draft HSW EIS. The HSW EIS now provides the NEPA review for ILAW disposal in addition to Hanford Solid Waste Program operations evaluated in the first draft HSW EIS. Individuals, organizations, and agencies commenting on the scoping phase of the ILAW SEIS are listed in Table A.1. The scoping comments and questions regarding the ILAW disposal SEIS and DOE responses to those comments are summarized in Table A.2.

Table A.1. Individuals, Organizations, and Agencies that Commented on the Scoping Phase of the ILAW SEIS

Name	Organization
Public Scoping Meeting, Richland – August 20, 2002	
Allyn Boldt	Private citizen
Don Clark	Private citizen
Gordon Rogers	Private citizen
Dick Schmidt	Private citizen
Seattle Briefing – August 22, 2002	
Tom Carpenter	Government Accountability Project, West Coast Office
Ashley Evans	Government Accountability Project, West Coast Office
Clare Gilbert	Government Accountability Project, West Coast Office
Dave Johnson	Private citizen
Hyun Lee	Heart of America Northwest
Ruth Yarrow	Private citizen
Portland Briefing – September 3, 2002	
Doug Huston	Oregon Office of Energy
Doug Riggs	Private citizen
Written Comments	
Tom Carpenter, Ashley Evans, Clare Gilbert	Government Accountability Project, West Coast Office –August 26, 2002
Suzanne Dahl and Michael Wilson	Washington State Department of Ecology – August 23, 2002
Glenn Eades	The Mountaineers, president – August 12, 2002
Paige Knight	Hanford Watch – August 15, 2002
Doug Huston and Ken Niles	Oregon Office of Energy – August 30, 2002
Hyun S. Lee	Heart of America – August 26, 2002
Richard Tripp	Private citizen
Harry Smiskin	Confederated Tribes and Bands of the Yakama Nation, administrator – September 26, 2002
Gordon Smith	Private citizen – August 11, 2002

Table A.2. ILAW Disposal SEIS – Public Scoping Comments and Responses

<table>
<tr><th>Name or Organization</th><th>Comment/Statement/Question/Concern</th><th>Response</th></tr>
<tr><td colspan="3">1. Technical/General</td></tr>
<tr><td>Richard K. Tripp, 8806 W. Grande Ronde Ave., Kennewick, WA 99336-1091, letter</td><td>ILAW trenches should be fenced in with permanent signs attached to them identifying the trenches. Should be maintained and replaced when needed over a very long time.</td><td rowspan="8">A number of technical comments across a range of topics were received during the scoping meetings, including institutional controls (fences and signs), waste inventories, waste disposal approaches, etc. The U.S. Department of Energy (DOE) has considered these comments and the HSW EIS addresses these issues, as appropriate.

The evaluations of immobilized low-activity waste (ILAW) disposal incorporates the latest available and referenceable data (e.g., best basis inventory, current waste loading plans, ILAW Performance Assessment, etc.). It includes the disposal of all ILAW from tank waste treatment.

DOE recently announced its intent to prepare a follow-on EIS (Environmental Impact Statement for Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single-Shell Tanks at the Hanford Site, Richland, Washington [DOE/EIS-0356]) to the Tank Waste Remediation System (TWRS) EIS for retrieval, treatment, and disposal of Hanford tank waste, and for closure of 149 single-shell tanks (68 FR 1052). That EIS would evaluate alternative treatment processes for some tank waste and disposal of low-activity waste forms other than the vitrified ILAW considered in this HSW EIS.</td></tr>
<tr><td>Richard K. Tripp, 8806 W. Grande Ronde Ave., Kennewick, WA 99336-1091, letter</td><td>Will leachate be contained in such a way to prevent it from percolating up to the surface? Is the only thing between the leachate and the air the earth closure cap?</td></tr>
<tr><td>Public scoping meeting in Richland, August 20, 2002, Questions and concerns</td><td>The volume of the ILAW</td></tr>
<tr><td>Public scoping meeting in Richland, August 20, 2002, Public comments</td><td>Dick Schmidt, Office of Sustainable Development for the City of Portland, Oregon - Proposes using cathode ray tubes from computer monitors and televisions as frit for making the glass rather than mining natural resources and therefore reducing the unavoidable adverse impacts and potential irreversible and irretrievable commitment of resources.</td></tr>
<tr><td>Public scoping meeting in Richland, August 20, 2002, Public comments</td><td>Allyn Boldt, retired Hanford worker and Kennewick resident – Address all of the waste and not just Phase I.</td></tr>
<tr><td>Public scoping meeting in Richland, August 20, 2002, Public comments</td><td>Allyn Boldt, retired Hanford worker and Kennewick resident – Use the 2002 Best Bases Inventory.</td></tr>
<tr><td>Public scoping meeting in Richland, August 20, 2002, Public comments</td><td>Allyn Boldt, retired Hanford worker and Kennewick resident – Don't base analysis in the SEIS on the SA3 because the SA3 data is out of date.</td></tr>
<tr><td>Seattle briefing, August 22, 2002</td><td>Clare Gilbert asked for clarification between storage and disposal.</td></tr>
</table>

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
Seattle briefing, August 22, 2002	Tom Carpenter wanted to know what fraction of the waste was ILAW.	
Seattle briefing, August 22, 2002	Hyun Lee commented on the carbon tetra chloride and solid wastes that are already in the ground in the 200 West Area and is concerned about placing additional ILAW in the ground.	
Seattle briefing, August 22, 2002	Tom Carpenter wanted to know what the curie difference in the LAW would be when it is vitrified compared to 500 years from now.	
Seattle briefing, August 22, 2002	Tom Carpenter wanted to know who has jurisdiction over the MUSTs.	
Seattle briefing, August 22, 2002	Hyun Lee requested a chart or matrix be made that shows where ILAW fits in the tank farm and WTP operations, including a time line.	
Seattle briefing, August 22, 2002	Dave Johnson asked about chemical constituents in the waste.	
Seattle briefing, August 22, 2002	Ruth Yarrow requested that curies be shown as well as volume when discussing tank waste.	
Portland briefing, September 3, 2002	Doug Riggs asked what is the half-life of LAW?	
Portland briefing, September 3, 2002	Doug Huston asked what the radiation per canister would be.	
Paige Knight, Hanford Watch, letter, August 15, 2002	Please include the kinds and longevity of radionuclides and chemicals.	
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	There have been major new discoveries at the Hanford Site since 1997 (when the TWRS EIS was issued) which affect greatly the plan to dispose of vitrified tank waste in the 200 Area burial grounds. These include the discovery of technetium-99 seeping into the groundwater from tank leaks.	
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	DOE must analyze the possibility that in order to vitrify the tank waste, the waste loading would have to be reduced to extremely low levels. This could increase greatly the volume of vitrified waste disposed of at Hanford.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	The possibility of terrorist attacks on the trenches housing the low-activity waste must be considered in the SEIS.	
Oregon Office of Energy, Formal comments, August 30, 2002	This SEIS should present the long-range plan showing key actions and annual progress anticipated for this project along with the funding requirements for this project for the duration of the tank waste treatment schedule. The budgeting information should include monitoring costs and be presented in FY2003 dollars, as escalated dollars, and as net present value dollars to provide a clear analysis of future costs.	
The Mountaineers, Glenn Eades, President, letter, August 12, 2002	Issues and Concerns: Illegal practices by increasing contractor "self assessment" and reducing federal oversight for safety and health.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
2. Opposed to Onsite Storage or Disposal of Solid Waste at Hanford		
Gordon Smith 8029 Meridian N. Seattle, WA 98103 letter, August 11, 2002	No more storage of any sort on this site on the edge of the Columbia River ecosystem.	DOE acknowledges that there is some opposition to onsite storage/disposal of ILAW, but is proceeding based on decisions derived from environmental impact analysis conducted under the Final Tank Waste Remediation System Environmental Impact Statement (TWRS EIS; DOE 1996). After consultation with the U.S. Nuclear Regulatory Commission (NRC), DOE determined that LAW is appropriate for disposal at Hanford (see HSW EIS Section 1). The HSW EIS evaluates waste management options for the disposal of ILAW at Hanford. The HSW EIS considers a No Action Alternative that evaluates retrievable disposal of ILAW in vaults. The EIS also considers other alternatives for disposal of ILAW (see HSW EIS Section 3).
Seattle briefing, August 22, 2002	Tom Carpenter was concerned that LAW was still HLW and as long as DOE did not dispose of it on site it would be ok.	
Seattle briefing, August 22, 2002	Tom Carpenter said he had no problem with long-term storage of the ILAW but was not in agreement with disposal of ILAW on the Hanford Site. ORP should keep their options open for ILAW storage versus disposal.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
3. Immobilized Low-Activity Waste Form and Treatment Alternatives		
Gordon Smith 8029 Meridian N. Seattle, WA 98103 letter, August 11, 2002	Strongly favors cullet size vitrification because it is easier and safer to process.	The TWRS EIS evaluated waste treatment options and decided it was feasible to vitrify tank waste. DOE has published a Notice of Intent (68 FR 1052) regarding the Tank Waste Retrieval and Closure EIS to evaluate alternative waste forms and supplemental treatment technologies This HSW EIS focuses on the disposal of vitrified ILAW forms (cullet and monolithic forms). For the purposes of analysis in this EIS the treated waste form is assumed to be glass. The EIS provides explanation of the technical, environmental, and financial criteria, uncertainties, and cumulative impacts for the alternatives associated with the proposed action and related alternatives for disposal of ILAW and melters evaluated in the EIS.
Public scoping meeting in Richland, August 20, 2002, Questions and concerns	Will there be a statement in the SEIS about a future alternative waste treatment?	
Public scoping meeting in Richland, August 20, 2002, Questions and concerns	We should only address glass in the SEIS and not make any statement about the future.	
Public scoping meeting in Richland, August 20, 2002, Public comments	Allyn Boldt, retired Hanford worker and Kennewick resident – Keep the option for cullet or monolith in the SEIS in case the monolith form becomes a handling problem during production.	
Seattle briefing, August 22, 2002	Ashley Evans inquired about the practicality of vitrifying tank waste and whether it was technically achievable.	
Seattle briefing, August 22, 2002	Ruth Yarrow was concerned about Jessie Roberson's statement about vitrifying 10% of the waste and using other technologies to stabilize the remaining 90%.	
Portland briefing, September 3, 2002	Doug Riggs stated he was glad that the SEIS continues with the intent to treat the low-activity waste by turning it into glass. He believes it is beneficial that DOE remains open to considering other options to supplemental vitrification if it meets the current standards for treatment and disposal. The presentation explained why the monolith form is proposed and this makes sense. Doug Riggs requested that the draft SEIS include clear explanations on the technical, environmental, and financial criteria for the alternatives.	
Portland briefing, September 3, 2002	Doug Riggs asked if the SEIS covered waste forms other than glass ILAW, and believes this should be clarified in the executive summary.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
Washington State Department of Ecology, Formal Comments, August 3, 2002	The analysis of the waste to be disposed must include the disposal of both the vitrified waste and the melters in which the vitrified waste was processed. The analysis cannot consider other waste forms now under consideration within the DOE because Ecology has not agreed that they are appropriate for land disposal of the wastes.	
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	The tank waste should be discussed in terms of its radiological properties and components, rather than in vague production terms such as 'high-level and "low-activity" waste. If the DOE is now defining "high-level" waste as cesium-137, strontium-90, plutonium, and other transuranics, it should discuss the waste in these specific terms. DOE should rely on scientifically accurate and comprehensive inventories of the contents of the tanks and discuss the waste in these terms. If DOE continues to use the irrelevant production terms, it should explain why it is doing so.	
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	In the past year the Bush administration and DOE's Jessie Roberson have publicly stated that they plan to vitrify only 10% of the waste currently stored in Hanford's HLW tanks. Yet DOE-Richland asserts that it will vitrify 100% of the tank waste. This discrepancy within DOE's policies must be addressed in a new EIS that considers the TWRS EIS (and SEIS) in light of the Bush administration's vision of 'accelerated cleanup.'	
The Mountaineers, Glenn Eades, President, letter, August 12, 2002	Issues and Concerns: Grouting the tank waste prior to appropriate NEPA documentation.	
Public scoping meeting in Richland, August 20, 2002, Public comments	Allyn Boldt, retired Hanford worker and Kennewick resident – We've given up privatization (Phase I demonstration, Phase II production) so the SEIS should reflect what we are doing now.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	In the cumulative impacts analysis, DOE must consider each of the following: The accelerated cleanup plan: Cumulative impact analysis must also consider how DOE's accelerated cleanup plan to vitrify only 10% of the tank waste is being factored into the proposed action. If it is not being factored in, then DOE must explain why not, and whether they will reissue a new EIS if the plan comes to fruition.	
The Mountaineers, Glenn Eades, President, letter, August 12, 2002	Issues and Concerns: The Bush administration's goal to eliminate vitrification of 75% of the tank waste.	
Heart of America Northwest, formal comments, submitted by Hyun S. Lee, August 26, 2002	There have been drastic new changes in factual circumstances that require DOE to consider conducting a new environmental impacts statement. There have been changes in the factual circumstances since the 1996 TWRS EIS ROD which selected the Phased Implementation alternative and decided to privatize the project. Since the issuance of the ROD, DOE has terminated contracts with Lockheed Martin Advanced Environmental Systems and British Nuclear Fuel, Inc. and has awarded the contract to a new contractor altogether. Furthermore, DOE is considering departing from the Tri-Party Agreement milestone requirements and leaving 75% of Hanford's liquid high-level wastes in the tanks forever.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	DOE has stated that it does not yet have complete characterization data for the contents of the Hanford single-and double-shell tanks. What statistical methods has DOE utilized to determine the uncertainty of the inventory in each tank being considered in the SEIS? Does DOE's inventory analysis rely primarily on recent sampling data or on historical production data? Is the level of uncertainty in the inventory for the tanks similar, or does the uncertainty vary widely between tanks? The SEIS must include a detailed description of the record developed to date on tank content inventory, and its sufficiency. Is further characterization planned? This information should be provided in detail in the SEIS.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
4. Hanford Solid Waste Disposal Alternatives		
Public scoping meeting in Richland, August 20, 2002, Questions and concerns	Should the SEIS address alternative kinds of trenches, such as ERDF, for example?	This HSW EIS evaluates a reasonable range of ILAW disposal facility alternatives for accomplishing the proposed action, including disposal in dedicated facilities or with other waste types (see HSW EIS Sections 2 and 3). It addresses various locations (including a new disposal facility in 200 East Area, 200 West Area, the Environmental Restoration and Disposal Facility, or existing Low Level Burial Grounds). It discusses various options for liners and disposal facility covers (see HSW EIS Section 2 and Appendix D). The alternatives and disposal facilities described are assumed to meet and comply with applicable regulatory requirements as described in the EIS. The EIS describes the related analysis of long-term performance (including environmental impacts) and estimates impacts over those time periods (see HSW EIS Sections 5.3 and 5.11). The EIS also describes administrative controls and procedures followed, including waste inspection verification in accordance with established waste acceptance criteria. DOE also plans to evaluate a reasonable range of alternatives for accomplishing the proposed actions for tank closure and tank waste vitrification under the Tank Waste Retrieval and Closure EIS.
Public scoping meeting in Richland, August 20, 2002, Public comments	Gordon Rogers, Pasco resident – Recommends using trenches to dispose of LAW other than the LAW from the vit plant.	
Seattle briefing, August 22, 2002	Hyun Lee asked how ILAW would be stored with the solid waste.	
Seattle briefing, August 22, 2002	Ruth Yarrow asked why we were evaluating ILAW trenches located in the 200 West Area with a modified RCRA barrier.	
Portland briefing, September 3, 2002	Doug Riggs said the draft should be upfront where the SEIS meets initial protections and clear if it does not. A clear and effective executive summary is critical. The differences and benefits that the various barriers provide should be explained.	
Portland briefing, September 3, 2002	Doug Huston stated the collection system is not a long-term protection system and asked if the original TWRS EIS looked at a trench option.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
Heart of America Northwest, formal comments, submitted by Hyun S. Lee, August 26, 2002	DOE has suggested that the ILAW wastes in question in this SEIS may be disposed of in the same facilities as LLW considered in the HSWEIS. DOE must consider the long history of waste mismanagement at Hanford's LLBG where offsite generators have mislabeled, mischaracterized, and mispackaged shipments of radioactive waste sent to Hanford for disposal. Heart of America Northwest has documented that offsite generators have disposed of mixed waste in the LLW-only burial grounds. Disposal of highly radioactive waste in a facility where there has been a long history of waste mismanagement would have potentially catastrophic consequences. These factors must be considered before moving forward with the disposal of ILAW in the same facilities as LLW.	
Heart of America Northwest, formal comments, submitted by Hyun S. Lee, August 26, 2002	DOE must consider the full range of reasonable alternatives, including meeting Tri Party Agreement milestone requirements to empty tanks and complete vitrification of tank wastes by 2028.	
Oregon Office of Energy, Formal comments, August 30, 2002	A clear explanation of the reason for changing the proposed ILAW disposal method from the belowground vaults to trenches needs to be presented in this EIS. Additionally, although we recognize this is a supplemental EIS, we recommend that DOE consider and analyze and include in this SEIS all other reasonable ILAW disposal options.	
Washington State Department of Ecology, Formal Comments, August 23, 2002	This SEIS should address all the land-based disposal facilities required for disposing of all ILAW generated by the Hanford Waste Treatment Plant. It should identify the total number of trenches required, their proposed locations, and the impacts of such uses of the land.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
Washington State Department of Ecology, Formal Comments, August 23, 2002	All disposal facilities must be assumed to meet the requirements of the Washington Dangerous Waste Regulations (WAC Chapter 173, Part 303) for land-based disposal facilities. Ecology is not entertaining petitions to delist the dangerous waste constituents, or listed wastes in the LAW, or considering any delisting before the waste form is generated.	
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	Is the primary authority for tank waste disposal the Washington Dangerous Waste Regulations (WAC Chapter 173 Part 303)?	
Paige Knight, Hanford Watch, letter, August 15, 2002	Please offer real alternatives that truly permanently protect the environment since the assumption has changed from storage to permanent disposal.	
Paige Knight, Hanford Watch, letter, August 15, 2002	Offer more long-term protection of waste trenches than an impermanent, short-lived plastic caps.	
Paige Knight, Hanford Watch, letter, August 15, 2002	We need a full range of alternatives with all impacts addressed to the environment.	
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	The reason for DOE's proposed changes to the TWRS EIS (from retrievable storage in concrete vaults to disposal in trenches) should be explained in the SEIS.	
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	A new EIS and/or the Supplemental EIS must include as alternatives: 1) storage of waste, 2) disposal of waste, and 3) the Tri-Party Agreement milestone of emptying tanks and completing vitrification by 2028.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
5. Relationship to HSW EIS and Other NEPA Documents		
Public scoping meeting in Richland, August 20, 2002, Public comments	Gordon Rogers, Pasco resident – Integrate this SEIS with the Solid Waste EIS and make sure all the waste forms are covered.	DOE has incorporated the ILAW SEIS into this HSW EIS, which adopts the Industrial-Exclusive designations relative to land-use decisions set forth under the Hanford Comprehensive Land-Use Plan EIS ROD (64 FR 61615).
Portland briefing, September 3, 2002	Doug Huston advised that the tank SEIS be communicated clearly so it does not become confused with the Hanford solid waste EIS.	
Heart of America Northwest, formal comments, submitted by Hyun S. Lee, August 26, 2002	DOE must consider public comments submitted during the Hanford site solid waste environmental impact statement. These comments reflect the concerns of the Citizens of the Pacific Northwest about future land disposal of radioactive waste at the Hanford Nuclear Reservation. Disposal of the ILAW in question in trenches with a volume of 200,000 m^3 each (potentially containing 81,000 waste monoliths) will impact alternatives considered in the HSWEIS.	
Oregon Office of Energy, Formal comments, August 30, 2002	An analysis of the compatibility of this SEIS's various options with the Hanford Comprehensive Land Use Plan should be included.	

Table A.2. (contd)

<table>
<tr><th>Name or Organization</th><th>Comment/Statement/Question/Concern</th><th>Response</th></tr>
<tr><td colspan="3">6. Classification and Definition of ILAW and High-Level Waste</td></tr>
<tr><td>Public scoping meeting in Richland, August 20, 2002, Questions and concerns</td><td>Definition of low-activity waste</td><td rowspan="2">This HSW EIS only addresses disposal of the ILAW component of the tank waste. For the purposes of the HSW EIS, DOE assumes that previous designations of ILAW remain valid. The wastes described and defined in the HSW EIS are also classified consistent with the TWRS EIS.

Waste retrieval, separations, treatment, storage, and disposal of high-level waste, as well as closure of the tank farms and WTP will be addressed in the Tank Waste Retrieval and Closure EIS that is currently being prepared by the Office of River Protection (ORP). Reclassification of tank waste as TRU waste is not being considered as part of this HSW EIS.</td></tr>
<tr><td>Seattle briefing,
August 22, 2002</td><td>Tom Carpenter asked if DOE should still go ahead with ILAW disposal with the court challenge pending on tank waste classification.</td></tr>
</table>

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	DOE must consider the possibility that the federal courts may rule that “low-activity waste” is still “high-level waste” under the *Nuclear Waste Policy Act*. DOE has attempted to bypass laws applicable to high-level waste, such as the Nuclear Waste Policy Act, by reclassifying high-level waste as low-activity waste. DOE defines low-activity waste as “The waste that remains after separating from HLW as much of the radioactivity as is practicable that when solidified may be disposed of as low-level waste in a near surface facility” (TWRS EIS, GL-13, Volume One). However, HLW is defined by the Nuclear Regulatory Commission and the Nuclear Waste Policy Act by its source as “material resulting from reprocessing.” DOE ignores this when defining “low activity waste.” Similarly, in DOE Order 435.1, DOE grants itself permission to reclassify HLW as “incidental waste.” DOE’s attempts to reclassify high-level waste as something other than high-level waste are being challenged in U.S. District Court by public interest organizations, indigenous tribes, and the states of Washington and Idaho. The lawsuit recently survived DOE’s Motion for Summary Decision, and presumably will be ruled upon in the near future. The TWRS Supplemental EIS must consider that the court may rule in favor of the plaintiffs and find that “low-activity waste” is still “high-level waste,” subject to the Nuclear Waste Policy Act.	
The Mountaineers, Glenn Eades, President, letter, August 12, 2002	Issues and Concerns: Illegitimate reclassification of wastes at Hanford to mixed low-level or TRU.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	Are the contents of the Hanford single-shell tanks classified as high-level waste? Are the contents of any single-shell tanks, in whole or in part, classified as waste other than high-level waste? If so, the procedure for classification of the wastes in each of the 149 single-shell tanks must be explicitly described in the SEIS, along with the statutes that govern the disposal of such waste.	
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	Are the contents of the Hanford double-shell tanks classified as high-level waste? Are the contents of any double-shell tanks, in whole or in part, classified as waste other than high-level waste? If so, the procedure for classification of the wastes in each of the 28 double-shell tanks must be explicitly described in the SEIS, along with the statutes that govern the disposal of such waste.	
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	Does the *Nuclear Waste Policy Act* govern disposal of the entire contents of all Hanford singe-shell tanks? Does the *Nuclear Waste Policy Act* govern disposal of the entire contents of all Hanford double-shell tanks? The SEIS must clearly describe the authority (or authorities) upon which DOE relies in making decisions for 1) removal of waste from tanks, 2) pretreatment of waste, and 3) final disposal of tank waste.	
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	Under what authority may DOE dispose of any Hanford single- or double-shell tank waste in near-surface trenches? What is the legal and technical process by which DOE determines such disposal to be legally compliant, including the process for classifying the tank waste and analyzing the waste to ensure that it meets the classification criteria? A logic diagram in the SEIS for waste classification would allow for a clear analysis of this important issue.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
7. Cumulative Impacts		
Seattle briefing, August 22, 2002	Tom Carpenter would like the SEIS to include cumulative impacts and update them since the TWRS EIS, which was released in 1996. New knowledge needs to be factored into the SEIS.	This HSW EIS has absorbed the scope of the former ILAW SEIS. The EIS addresses the cumulative environmental impacts from ILAW and other Hanford solid wastes handled during past, present, and reasonably foreseeable future solid waste management activities at Hanford Site (see HSW EIS Section 5.14 and Appendix L). Alternatives considered in this EIS would not preclude retrieval of ILAW, although some alternatives for combined disposal could make retrieval more difficult; however, the impacts of retrieval are not specifically evaluated. If DOE were to decide to retrieve ILAW at some later date, additional environmental review may be required.
Heart of America Northwest, formal comments, submitted by Hyun S. Lee, August 26, 2002	DOE must consider the cumulative environmental impacts disposal of the ILAW in trenches in the 200 Area will have. 40 CFR 1508.25 is not adequate to merely consider the impacts of this proposed action to the environment as though it were taking place in a vacuum or sterile environment. This proposed action will result in the disposal of 1,840,000 Ci of radiation being disposed of in the 200 Area. The NEPA regulations require the agency to consider the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR 1508.7). DOE must consider what the addition of 1,840,000 Ci of radiation will be to the already existing contamination at Hanford.	
Heart of America Northwest, formal comments, submitted by Hyun S. Lee, August 26, 2002	DOE must consider the cumulative, significant impact the proposed disposal of ILAW in the 200 Area will have to the environment (adding 1,840,000 Ci of radiation) in conjunction with the addition of 70,000 truckloads of LLW and mixed waste considered in the Hanford Site solid waste EIS. These cumulative impacts must be analyzed before any decision can be made.	
Oregon Office of Energy, Formal comments, August 30, 2002	The SEIS represents a connected action with respect to the SWEIS, and therefore needs to look at the cumulative impact of adding this waste to those wastes analyzed in the SWEIS, as well as all other current and planned disposal activities.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
Washington State Department of Ecology, Formal Comments, August 23, 2002	The ILAW SEIS must be coordinated with the Hanford solid waste EIS, which addresses other land-based disposal facilities on Hanford's Central Plateau. Included in the coordinated effort must be an analysis that addresses the cumulative effects of all of the land-based dangerous waste disposal facilities on the plateau. That cumulative effect must include the overall impact of land use for those facilities.	
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	<u>In the cumulative impacts analysis, DOE must consider each of the following: Interplay of HSW EIS and tank waste SEIS</u>: The cumulative impact analysis must analyze the impact of adding almost 2,000,000 Ci of highly radioactive waste to a site slated to house an additional 70,000 truckloads of waste, as proposed recently in the Hanford solid waste EIS. The cumulative effects on both the HSW EIS and the tank waste SEIS must be analyzed.	
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	<u>In the cumulative impacts analysis, DOE must consider each of the following: The tank waste cumulative impacts analysis must be tailored to both the 200 West and East Areas</u>: The disposal of 2,000,000 Ci will affect the 200 West and 200 East Areas differently, given their differing current conditions. Also, because the *National Environmental Policy Act* requires consideration of both the current condition and foreseeable future actions at site of proposed action, the cumulative analysis should include the effects of the HSW EIS on both sites (40 CFR 1508.25 and 1508.7).	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	In the cumulative impacts analysis, DOE must consider each of the following: Effect of retrieval on low-activity waste in shared trench: DOE has indicated that the tank waste could be buried in the trenches that contain (or would under the HSW EIS) low-level waste. DOE also has indicated that the disposal of tank waste might not be permanent and that the waste might be retrieved someday. The new EIS/SEIS must consider how such retrieval would affect the LLW in the shared trench. DOE must also consider the possibility that some mixed low-level waste was inadvertently disposed of in the low-level waste trenches, and the associated risks of putting high-level waste or low-activity waste near mixed low-level waste.	
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	DOE must consider the cumulative impacts of its tank waste treatment and disposal program along with the impacts of all other waste and land use planning for Hanford.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
8. Regulatory and Legal NEPA Issues		
Seattle briefing, August 22, 2002	Tom Carpenter said that rather than preparing an SEIS, ORP should prepare a new EIS to evaluate the environmental impacts of disposing of the ILAW in trenches.	DOE considered the need for a new EIS but determined that inclusion of a NEPA analysis for the ILAW disposal in this HSW EIS (merging scopes) would be sufficient to respond to comments. Because of the added scope, the EIS includes new information and alternatives for disposal of ILAW at Hanford and DOE has decided to issue a second draft HSW EIS for public comment. DOE has consulted with the various tribes and stakeholders during the preparation of the EIS. DOE recently announced its intent to prepare a follow-on EIS (Environmental Impact Statement for Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single-Shell Tanks at the Hanford Site, Richland, Washington [DOE/EIS-0356]) to the TWRS EIS for retrieval, treatment, and disposal of Hanford tank waste, and for closure of 149 single-shell tanks (68 FR 1052). That EIS would evaluate alternative treatment processes for some tank waste and disposal of low-activity waste forms other than the vitrified ILAW considered in this HSW EIS.
Portland briefing, September 3, 2002	Doug Huston asked about delegation of authority for the tank farm Supplemental EIS. He felt this was a good idea for streamlining the decision-making process.	
Heart of America Northwest, formal comments, submitted by Hyun S. Lee, August 26, 2002	DOE must consider conducting a completely new environmental impact statement, not merely a supplement to the 1996 environmental impact statement. Since the ROD was issued on the 1996 TWRS EIS there has been significant new information that would have substantively impacted decision-makers' decisions such as the discovery that the Hanford tanks were leaking into the groundwater. This SEIS is examining a substantive change in policy from temporary retrievable storage of ILAW (1,840,000 Ci of radiation) to actual permanent disposal at Hanford. This is a major change that requires in-depth examination.	
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	The magnitude of the proposed changes since the 1997 TWRS EIS warrants an entirely new EIS rather than a supplement to the earlier EIS.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
9. Native American Treaty Rights/Tribal Concerns		
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	DOE's planning must include specific measures it will take to fulfill its enforceable trust obligations to the Yakama Nation. Such measures should be described in the SEIS.	This HSW EIS addresses impacts on Treaty rights and discusses DOE's relationship with Native Americans (see Section 6). DOE interacts and consults regularly and directly with the Native American tribes in the vicinity of Hanford Site. DOE will continue to do so during the NEPA process for this EIS and for the Tank Waste Retrieval and Closure EIS. In addition, DOE agreed to a Yakama Nation request to participate in the preparation of the HSW EIS; however, the Yakama Nation subsequently withdrew.
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	DOE's planning must include specific measures it will take to ensure compliance with the Treaty of 1855 between the United States and the Yakama Nation. Such measures should be described in the SEIS.	
Portland briefing, September 3, 2002	Doug Riggs asked what are the tribal issues or comments thus far.	
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	Specifically, by what means and at what decision points will DOE consult with the Yakama Nation on the matters addressed in the SEIS? The planning for tank waste retrieval, treatment, and disposal all affect the near-term and long-term health and safety of Yakama Nation tribal members. In addition, the SEIS considers actions which may have extremely long-term impacts on Treaty rights as well as trust resources, and which are of great concern to the Yakama Nation. The scope of the SEIS should address in detail how DOE will integrate its planning efforts with its consultation obligations to the Yakama Nation to address these matters.	

Table A.2. (contd)

<table>
<tr><th>Name or Organization</th><th>Comment/Statement/Question/Concern</th><th>Response</th></tr>
<tr><td colspan="3">10. Long-Term Performance, Mitigation Measures, and Stewardship</td></tr>
<tr><td>Seattle briefing, August 22, 2002</td><td>Tom Carpenter inquired how long the monolith would perform.</td><td rowspan="8">This HSW EIS evaluates the environmental impacts of various disposal facilities and considers various mitigation measures. Long-term performance is evaluated over 10,000 years for trenches and vaults (as in the TWRS EIS preferred alternative). Assumptions used in modeling are discussed in Section 5.3 and Appendix G. Mitigation measures and stewardship are addressed in Section 5.18.

Performance Assessments (PAs) for disposal will be prepared for proposed new and expanded disposal facilities as part of the DOE approval process under DOE Order 435.1 (DOE 2001b). PAs evaluate long-term impacts of disposal of specific wastes in proposed disposal facilities. PAs are re-evaluated regularly to assure that facilities continue to meet the long-term limits.</td></tr>
<tr><td>Seattle briefing, August 22, 2002</td><td>Ruth Yarrow asked if vaults were safer than trenches. .</td></tr>
<tr><td>Seattle briefing, August 22, 2002</td><td>Dave Johnson suggested that we evaluate the impacts of a potential ice age that could occur in 60,000 years.</td></tr>
<tr><td>Portland briefing, September 3, 2002</td><td>Doug Riggs asked why the concrete vaults are not as beneficial as trenches and if the trenches have a better flow or drainage system.</td></tr>
<tr><td>Portland briefing, September 3, 2002</td><td>Doug Huston stated that it appears you have less barriers without a vault compared to a trench and the reasons need to be explained in the draft. Doug Huston stated that “not taking credit” confuses the public and the draft should explain and document why the trenches are seen as better than vaults.</td></tr>
<tr><td>Oregon Office of Energy, Formal comments, August 30, 2002</td><td>A performance assessment for each alternative should be included in the EIS along with a description of the maintenance and monitoring programs required for each alternative. This discussion should include a detailed description of how these alternatives will be monitored for leakage. We are particularly concerned that this monitoring plan be able to detect leakage as early as possible.</td></tr>
<tr><td>Oregon Office of Energy, Formal comments, August 30, 2002</td><td>This SEIS must discuss in detail mitigation plans and schedules for each alternative.</td></tr>
<tr><td>Washington State Department of Ecology, Formal Comments, August 23, 2002</td><td>The ILAW SEIS must evaluate the requirements, probable success or failure, and potential costs of long-term stewardship activities associated with each of the alternatives.</td></tr>
</table>

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	The TWRS EIS called for retrievable storage, as opposed to disposal. The new proposal for changing from storage to disposal has vast repercussions, none of which were contemplated in the original EIS and all of which warrant extensive review and consideration.	
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	The TWRS SEIS must consider future scenarios. For example, many scientists believe that the vitrified glass will last only 500 years before breaking down and releasing its radioactive contents into the environment. The SEIS must examine what will occur if this prediction is realized.	
Tom Carpenter, Ashley Evans, and Clare Gilbert, Government Accountability Project, West Coast Office, August 26, 2002	Additionally, the SEIS should consider the effects of global warming, climate change, and the possibility of ice age in the next several hundred to one thousand years. These global changes pose the risk of altered burial ground composition and temperature changes leading to the release of radioactive materials.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
11. Public Involvement		
Seattle briefing, August 22, 2002	Clare Gilbert wanted to know if DOE was going to respond to comments.	This HSW EIS considers all comments received on the ILAW SEIS scoping and the first draft HSW EIS. Summary level responses to scoping comments are provided in this appendix and responses to public comments received on the first draft HSW EIS appear in Volume III of this revised draft HSW EIS. DOE recognizes the need for a clear summary and has revised it accordingly.
Portland briefing, September 3, 2002	Both Doug Huston and Doug Riggs were emphatic that the executive summary be reader friendly, clear, and well supported with appropriate data on key questions that the public will have. They recommended that they or someone from their organization have a chance to review the executive summary to ensure the right issues are addressed upfront and the information is written in a public friendly style.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
12. Other Impacts and Analyses		
Public scoping meeting in Richland, August 20, 2002, Public comments	Don Clark, retired Hanford worker, Richland resident– Include relative risk and cost in the SEIS.	This HSW EIS evaluates the environmental impacts (e.g., risk, land use, irreversible and irretrievable commitment of resources, cost, transportation, ecology, etc.) for the various ILAW disposal alternatives.
Portland briefing, September 3, 2002	Doug Huston handed out copies of the Oregon of Office of Energy's comments on the SEIS. Doug Huston explained that the size and number of caps and the material required to make them could have an impact on the environment, and asked if there will be enough material onsite to generate the barriers.	
Oregon Office of Energy, Formal comments, August 30, 2002	The SEIS will need to specify potential sources of borrow material for the daily cover and capping material in order to accurately assess costs and mitigation requirements. Other ongoing activities and the HSW EIS depend on onsite borrow areas that may not contain adequate reserves. If adequate volumes cannot be identified, then the development of new borrow sources would have to be evaluated for impacts.	
Washington State Department of Ecology, Formal Comments, August 23, 2002	The SEIS should address risks and transport mechanisms associated with each of the disposal sites described.	
Paige Knight, Hanford Watch, letter, August 15, 2002	One of the values of the Hanford Advisory Board is to do no more harm to the land.	

Table A.2. (contd)

Name or Organization	Comment/Statement/Question/Concern	Response
13. Out of Scope		
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	The President and Congress have selected Yucca Mountain in Nevada as the site of the first national high-level waste repository. How does DOE integrate its defense high-level waste disposal plans for Hanford with those of the Yucca Mountain Project? How did DOE arrive at the 10% figure for allocation of repository space for combined defense high-level waste and DOE spent nuclear fuel, while the allocation reserved for commercial spent fuel is 90%? Can the total contents of Hanford's tanks be disposed of in the Yucca Mountain repository? The SEIS scope must include a description of how the DOE repository waste allocation decisions (i.e., space for commercial spent fuel vs. DOE defense high-level waste and DOE spent fuel) affect Hanford tank retrieval, treatment, and disposal planning.	Integration of HLW disposal plans across DOE sites was addressed in the Yucca Mountain EIS. The analysis in this HSW EIS focuses only on disposal on the Hanford Site of the ILAW component of the waste retrieved from the tanks. Discussion of management of HLW at Hanford will be addressed in the Tank Waste Retrieval and Closure EIS.
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	DOE has stated that it intends to maximize the "loading" of the high-level waste canisters designed for disposal in a geologic repository. The SEIS must describe in detail the factors which permit and hinder "loading" of the canisters. The criteria for loading should be described in detail in the SEIS, and the technical basis for such loading.	
Confederated Tribes and Bands of the Yakama Nation, Harry Smiskin, administrator, letter, September 26, 2002	The Hanford Tank Waste Remediation System EIS Record of Decision states that an Environmental Impact Statement will be developed prior to the disposal of any Hanford tank waste. Does this statement apply to planned closure actions for tank C-106 and other tanks being planned for closure in the near future?	

Part 2—Public Scoping Comments and Responses for the HSW EIS

The Notice of Intent (NOI) to prepare the HSW EIS was published in the Federal Register (FR) on October 27, 1997, (62 FR 55615) in accordance with 40 CFR 1501.7, 40 CFR 1508.22, and 10 CFR 1021.311. The NOI announced the schedule for the public scoping process and summarized the alternatives and environmental consequences to be considered in the EIS. Two scoping meetings were held in Richland, Washington, on November 12, 1997, followed by a meeting in Pendleton, Oregon, on November 13, 1997. Originally scheduled from October 27, 1997, to December 11, 1997, the comment period was extended by DOE through January 30, 1998 in response to a request from the State of Oregon. The notice of extension appeared in the December 11, 1997, *Federal Register* (62 FR 65254).

In Part 2 of this appendix, comments received by DOE during the scoping period are summarized and grouped into categories corresponding with the topics that were considered in preparing the HSW EIS. The comments are shown in italic typeface, and have been reproduced as accurately as possible with only minor grammatical corrections incorporated. Responses from DOE and the manner in which the comments were addressed in preparing this EIS follow each category. Persons and agency representatives who provided comments are listed in Table A.3.

Table A.3. Individuals, Organizations, and Agencies Commenting on the Scoping Phase of the HSW EIS

Name	Organization
Written Comments	
Barry C. Bede[a]	U.S. Ecology
Mary Lou Blazek & Dirk Dunning[a]	Oregon Department of Energy
Dirk Dunning	Oregon Department of Energy
Tim Heffernan	Gaian Technologies
Jay McConnaughey	State of Washington, Department of Fish and Wildlife
Vince Panesko[a]	Pacific Rim Enterprise Center
Sam Volpentest	Tri-City Industrial Development Council (TRIDEC)
Mike Wilson	Washington State Department of Ecology
Public Scoping Meeting Comments	
Barry C. Bede[a]	U.S. Ecology
Dirk Dunning[a]	Oregon Department of Energy
Dirk Dunning[a]	Private Citizen
Vince Panesko[a]	Pacific Rim Enterprise Center
(a) These individuals submitted written as well as oral comments.	

A.1 DOE Programmatic/Nationwide Analysis

This category contains comments related to coordination of the HSW EIS with other DOE nationwide initiatives, programs, and NEPA documents.

A.1.1 Coordination with Other Federal Reports, Environmental Impact, and DOE Policy Statements

- *The Notice of Intent (NOI) states that the Solid Waste Programmatic EIS (SW PEIS) will be coordinated with Records of Decisions (ROD) for the Waste Management Programmatic EIS (WM PEIS) and other DOE EIS that affect waste management at the Hanford Site. The NOI also states that the analysis in the SW PEIS of transuranic waste (TRU) waste management will be consistent with the forthcoming ROD for the Waste Isolation Pilot Plant (WIPP) Disposal Phase Final Supplemental EIS. The NOI also states that the goals of the 2006 Plan will be incorporated into the action alternatives evaluated for the SW PEIS. Given these three statements in the NOI, the scope of the SWP EIS must specifically include these three topics. These topics must be clearly addressed so that readers will have no difficulty verifying that the NOI statements have been fulfilled.*

- *In the NOI, there are some statements that the EIS will be coordinated with various RODs and other HSW EIS that affect waste management at the Hanford Site. The NOI also says it will be consistent with the forthcoming ROD on WIPP. It also says the goals of the 2006 Plan will be incorporated into the action alternatives. What my comment is… that these other documents, the RODs for the Waste Management EIS (WM EIS) will be clearly identified and their impact on this HSW EIS will be clearly recognized and stated.*

- *The recent site contractors conceptual study of waste shipment, processing, and packaging for disposal alternatives should be carefully evaluated and utilized when appropriate to achieve the most economical strategy for the ultimate disposal of these wastes*.

  (Note: This comment also addresses issues discussed under Section A.2, Alternatives and Activities Analyzed in the HSW EIS.)

- *Ten years ago, or a little over that, DOE entered into a consent order agreement in regard to a lawsuit in Washington, D.C., about doing a PEIS on all DOE operations. Resulting out of that, DOE splintered that requirement into a bunch of fractions. One of those was a Waste Management EIS (WM EIS) and Environmental Restoration EIS (ER EIS). The WM PEIS is only the waste management portion. The environmental restoration (ER) portion was excluded from analysis. And one of the things that I heard in the question and answer session was that this HSW EIS would also look at ER waste. And I would like to suggest to you that absent the analysis of the ER portion of the PEIS, this HSW EIS has no basis to do so. In addition, the Contractors Report, which came out in association with the focus on 2006 Plan was a report, which was not prepared in compliance with the National Environmental Policy Act (NEPA). It was not done under a Federal Advisory Committee Act process. And as such I believe it has no legal basis to be used in any decision making by DOE.*

(Note: This comment also addresses issues discussed under Section A.3, Waste Types and Volumes.)

- *The Contractors Report is clearly referenced and portions of it are included as recommendations within the national 2006 Plan. I believe as a consequence of that the 2006 Plan also fails to meet the requirements under the NEPA and under the Federal Advisory Committee Act to be able to be used for decision making. And as a consequence, this SW EIS should consider neither of those in any way as the HSW EIS is performed.*

Response to Comments on Programmatic Coordination Issues

DOE recognizes the numerous relationships that exist between the HSW EIS and other ongoing and historic DOE activities. This revised draft HSW EIS strives for consistency with existing decisions and, at the same time, provides DOE and other stakeholders with an updated analysis of Hanford Solid Waste Program operations and alternatives for implementing future activities. Every effort has been made to coordinate with, and tier from, DOE programmatic NEPA documents and decisions, such as the Waste Management Programmatic Environmental Impact Statement (WM PEIS, DOE 1997b; 63 FR 3629, 63 FR 41810, 64 FR 46661, 65 FR 10061) and the Waste Isolation Pilot Plant Supplemental Environmental Impact Statement II (WIPP SEIS II, DOE 1997c; 63 FR 3623).

A nationwide integration team authored the Site Contractors Study (DOE 1997a). The goal of that study was to identify opportunities for increasing the efficiency of DOE waste management operations by coordinating and maximizing the use of existing facilities across the DOE complex. Options considered in other DOE nationwide and Hanford Site initiatives are included in this HSW EIS to the extent that they are consistent with previous NEPA decisions. Some of those initiatives include the Hanford Federal Facility Agreement and Consent Order (Ecology et al. 1989), also known as the Tri-Party Agreement (TPA); remediation activities conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC 9601); the Hanford Groundwater/Vadose Zone Integration Project (DOE-RL 1999a, b; DOE-RL 2000), and the DOE complex 2006 Plan. In general, those initiatives deal with methods and schedules for implementing decisions that result from programmatic NEPA documents. Specific studies of various ways to meet DOE waste management objectives are not decision documents, and need not be subject to NEPA review at the conceptual stage. Any activities proposed in those conceptual and planning documents that are incorporated into the HSW EIS alternatives will undergo the appropriate NEPA process and public review as part of preparing this document and a subsequent ROD. Relationships between NEPA documents and other studies are addressed in this HSW EIS.

Environmental restoration waste is generally not within the scope of the HSW EIS. However, it will be evaluated using the CERCLA process, which provides for assessment of environmental consequences and public review in a manner similar to the NEPA process.

A.1.2 Nationwide Impact Comparisons and Equity Issues

- *The SW EIS must be part of a systematic, complex-wide examination of trade-offs between candidate sites for receipt of additional solid waste…In comments on the PEIS and in other forums, Ecology has noted a critical missing element in DOE's decision-making process for selecting sites for waste treatment, storage, or disposal within the DOE complex. The PEIS is sufficient for making conceptual decisions on whether various waste streams should be centrally, regionally, or decentrally managed and disposed. Site-specific analyses are appropriate for understanding the impacts of those decisions on a given site. Missing is a meaningful comparison of environmental impacts between the candidate sites… To satisfy this need, the SW EIS must be one of several site-specific EIS each addressing a candidate site.*

- *Of special note, both the SW EIS and DOE's broader programmatic decision-making process should consider equity among the sites in both alternative development and impact analysis.*

  (Note: This comment also addresses issues discussed under Section A.2, Alternatives and Activities Analyzed in the HSW EIS.)

- *The transfer of wastes between sites where significant economies of processing and disposal costs and the avoidance of the duplication of needed facilities and programs should be fully considered. In inter-site transfers of wastes between sites, i.e., DOE Richland Operations Office (DOE-RL) and Idaho National Engineering and Environmental Laboratory (INEEL), a reasonable equity balance between the sites should be maintained.*

  (Note: This comment also addresses issues discussed under Section A.2, Alternatives and Activities Analyzed in the HSW EIS.)

- *The mixed waste issue must be addressed on a nation-wide basis, including the shipment of wastes between sites to achieve the most economical waste processing and disposal.*

  (Note: This comment also addresses issues discussed under Section A.2, Alternatives and Activities Analyzed in the HSW EIS.)

- *Managing wastes using primarily cost considerations has been largely responsible for the magnitude of DOE's existing complex-wide cleanup problem. It is time to begin selecting the best disposal sites based on technical and social considerations rather than on economic or other secondary factors.*

  (Note: This comment also addresses issues discussed under the Section A.2, Alternatives and Activities Analyzed in the HSW EIS.)

Response to Comments on Nationwide Analysis

In 1989, DOE established the U.S. Department of Energy Office of Environmental Management (EM) in an effort to coordinate cleanup and waste management activities at DOE facilities. Before this, DOE had focused on managing its waste through individual site-specific programs. As more sites have come into compliance with regulations and urgent needs have been addressed, DOE has been able to focus on a more unified nationwide vision. This vision is reflected in the Final WM PEIS, which presents a nationwide strategy to treat, store, and dispose of radioactive and hazardous waste in a safe, responsible, and efficient manner.

To increase efficiency across the complex, DOE established an Environmental Management Integration initiative. The underlying strategy of the initiative is to increase the efficiency in DOE waste management operations by eliminating the need for redundant facilities, applying site lessons learned across the nation, and using available waste management capabilities across program boundaries. These efforts illustrate a DOE movement towards examining and implementing cleanup and remediation actions from a nationwide perspective.

DOE nationwide waste management impacts have been evaluated in the WM PEIS and in various site-specific NEPA documents. The DOE considered a range of factors, including scientific, technical, economic, and equity issues in making decisions in the WM PEIS RODs (63 FR 3629, 63 FR 41810, 64 FR 46661, 65 FR 10061). The HSW EIS analyzes alternatives for implementing the WM PEIS RODs at Hanford.

A.2 Alternatives and Activities Analyzed in the HSW EIS

This category contains comments related to the proposed alternatives and waste management activities analyzed in the revised HSW EIS.

A.2.1 Alternative Options

A.2.1.1 Shipment of Offsite Waste to Hanford

- *Any costs related to the processing and disposal of wastes from other sites, which are shipped to Hanford, must be funded by HQ or the originating site as an addition to the Hanford cleanup budget. This supplemental funding must be on a full-cost recovery basis including appropriate site overhead and infrastructure costs.*

- *Normally any wastes shipped to Hanford from other sites for processing should be returned to the originating site or to the end disposal location for final disposal. In some cases, it may be appropriate to dispose of the processed wastes at Hanford if suitable facilities are not available elsewhere within the DOE complex. The shipment of additional offsite waste (over and above that which is already in the Hanford baseline) to Hanford for direct disposal may be done only under the following conditions:*

- *It does not increase the amount of land required to be set aside for Hanford's own waste.*

- *The waste meets the acceptance and disposal criteria as currently specified which assures environmental and public safety.*

- *It reduces the cost or accelerates the disposal, of Hanford's own waste.*

- *Accompanying incremental funding is provided for treatment, storage, and/or disposal of the waste.*

- *Any waste shipments to Hanford for processing, interim storage, or disposal must not interfere with or delay any Hanford Site cleanup activities.*

- *As DOE is well aware, there is a significant risk that DOE's proposed actions for handling the immense amounts of other wastes on the Hanford Site are not assured…. Under these circumstances, it is inappropriate for DOE to consider the importation of any waste to Hanford until the cleanup of Hanford wastes is both assured and complete.*

- *The current plans within things such as the 2006 Plan and other documents discuss perhaps leaving a large majority of the tank waste at Hanford buried in-place, rather than retrieving it. If these decisions are made, as the Contractors Report points out, they are recommending increasing the legal exposure limits in order to allow that to occur…As a consequence, bringing any additional waste to Hanford would cause it also to be a part of that exceedence of the legal limit, and as a consequence, it would be unacceptable under the law to do so.*

(Note: This comment also addresses issues discussed under Section A.1, Programmatic/Complex-Wide Analysis.)

Response to Comments on Shipment of Offsite Waste to Hanford

DOE nationwide waste management impacts have been evaluated in the WM PEIS and in various site-specific NEPA documents. The DOE considered a range of factors, including scientific, technical, economic, and equity issues in making decisions in the WM PEIS RODs (63 FR 3629, 63 FR 41810, 64 FR 46661, 65 FR 10061). The HSW EIS analyzes alternatives for implementing the WM PEIS RODs at Hanford.

Hanford waste management services currently used by offsite DOE waste generators are supported in part by fees charged to those generators. The U.S. Department of Energy Richland Operations Office will request funding adequate to meet cleanup goals, including TPA milestones. However, funding for Hanford Site cleanup and other DOE activities is ultimately determined by Congress.

Any waste received for processing or disposal at Hanford would meet the site waste acceptance criteria (FH 2002). Most offsite waste is expected to be in ready-to-dispose form. Disposal and treatment of offsite waste at Hanford could facilitate the cleanup and closure of other DOE facilities in the short term, which would reduce or eliminate the costs associated with operating those facilities. Reducing the long-term costs of operating those facilities may ultimately make additional funding available to Hanford and other major DOE sites for management of more complex waste streams.

Land-use impacts at Hanford are evaluated in the HSW EIS.

The consequences of alternatives considered in the HSW EIS are evaluated with respect to their cumulative impacts with other past, present, and reasonably foreseeable activities at the Hanford Site.

A.2.1.2 Use of Commercial or Offsite Disposal Facilities

- *U.S. Ecology encourages the DOE-RL to include, in the Hanford Site SW EIS scope and alternatives, the potential use of the commercial low-level radioactive waste (LLW) site located between 200 East and 200 West on the Hanford Reservation to dispose of DOE LLW…U.S. Ecology offers the use of its site as a viable alternative to expansion or reconfiguration of the existing Hanford LLW burial site. All LLW identified in the recent NOI (with the exception of Greater Than Class C Waste) has previously been and in the future can be disposed of at the U.S. Ecology site.*

- *Evaluation of the use of the commercial site in the HSW EIS would clearly demonstrate Hanford Operation's commitment to be fiscally responsible, economically conscience, administratively efficient and environmentally protective in considering LLW disposal options.*

- *Immediate closure of the Hanford LLW burial grounds also should be evaluated. Waste currently at the burial grounds was disposed of using operating procedures significantly different from those at the U.S. Ecology site. Possible relocation of this waste to the commercial site should be assessed for its potential environmental impact in the HSW EIS scope. Similar attention should be given to the environmental impact of direct receipt of offsite DOE laboratory LLW at the U.S. Ecology site.*

- *We (U.S. Ecology) believe that the alternatives you have selected are basically very, very broad alternatives, and that under the possible alternative of minimizing waste, that the consideration of using commercial facilities (in particular U.S. Ecology) for the disposal of LLW should be considered.*

- *The proposed HSW EIS should evaluate not only the impacts of ongoing and past activities at Hanford but should also seriously consider the relative impacts of utilizing existing offsite disposal alternatives… Any consideration of further onsite waste disposal should be secondary to a consideration of offsite alternatives. Unless onsite disposal can be clearly demonstrated to be preferable on environmental, social and economic grounds, offsite disposal should be prioritized.*

Response to Comments on the Use of Commercial or Offsite Disposal Facilities

This revised draft HSW EIS considers the option of sending some LLW to a commercial disposal site, such as the U.S. Ecology site at Hanford. Potential benefits to this action, such as avoiding the need to develop new waste disposal facilities and disruption of sensitive habitats, are noted. However, because waste sent to U.S. Ecology would be disposed of in proximity to the DOE Low Level Burial Grounds (LLBGs), the impacts of this option would be similar to other onsite disposal alternatives and are not evaluated in detail.

Some waste that may be generated at Hanford and at other DOE facilities would not be suitable for disposal at commercial facilities under existing permits and regulations. Nor would it be cost-effective or environmentally beneficial to relocate LLW that was disposed of in the LLBG after 1970, because regulations governing disposal of DOE waste have historically been similar to those for commercial facilities. (Waste that was disposed of at the Hanford Site prior to 1970 will be evaluated under the CERCLA process and remediated as necessary.) Therefore, the Hanford Site would need to maintain its waste management operations and infrastructure to provide for disposition of wastes that are not suitable for commercial disposal, as well as to prepare the existing disposal facilities for final closure.

The WM PEIS ROD for LLW and MLLW identified the Hanford Site as a regional site for disposal of LLW, and for treatment and disposal of MLLW, from onsite and offsite DOE generators (65 FR 10061). The WM PEIS ROD for TRU waste specified that DOE sites, with few exceptions, would be responsible for preparing and certifying TRU waste at the site where it was generated for eventual disposal at the WIPP (63 FR 3629). These decisions also specified the Hanford Site would manage LLW, MLLW, and TRU waste generated at Hanford. Use of commercial facilities for treatment or disposal of some Hanford waste would be consistent with the WM PEIS decisions, to the extent that such use is more cost-effective than developing similar capabilities at Hanford. However, use of other DOE sites for disposal of Hanford LLW or MLLW would generally be inconsistent with the WM PEIS decisions, which considered the environmental consequences associated with management of radioactive and hazardous waste across the DOE complex.

A.2.1.3 Alternative Actions and Emerging Technologies

- *At one time solid waste containing plutonium at Hanford was incinerated to recover the plutonium from the ash. Incineration routinely achieved greater than 95% volume reduction of the waste form. Such a volume reduction would significantly reduce the life cycle costs of subsequent storage and permanent disposal. The cost saved in permanent disposal space is a savings, which will accrue for decades or longer. An ash product may be more amenable to treatments that meet land ban requirements. Therefore, I recommend that incineration be considered as an alternative for all waste types.*

- *One option being considered by another DOE program at Hanford is to fill unused canyon facilities with solid nuclear waste prior to entombment. This alternative should be considered for at least the GTC3 waste. The alternative of putting new solid waste into the canyons should be considered as opposed to contaminating new soil.*

- *The caissons contain remote-handled waste. The radiation levels are so high that recovery actions may put workers at an unacceptable risk. Consider an alternative for adding a fixant to the caissons (perhaps filling the caisson with a liquid that sets up into a solid).*

Response to Comments on Alternative Actions and Emerging Technologies

Thermal treatment of some MLLW streams is being considered in the HSW EIS action alternatives. Both MLLW and TRU waste would be treated as required by regulation, or to meet disposal facility acceptance criteria. However, the environmental consequences of constructing and operating new treatment facilities, the cost of treatment, and the relative advantages of reducing waste volume may not be justified for other types of waste. Consistent with the WM PEIS ROD for LLW, waste will be treated as required to prepare it for transportation and disposal (65 FR 10061). Minimal treatment involves stabilization and packaging of LLW, including solidification of liquid and particulate waste. Additional volume reduction measures, such as compaction, thermal treatments, or size reduction, could be employed at the discretion of individual waste generators. However, DOE decided not to pursue LLW volume reduction as a nationwide policy because the projected benefits would not be justified by the cost, environmental impacts, and potential health risk to workers from constructing and operating facilities to provide those capabilities (65 FR 10061).

An ongoing CERCLA study is considering the use of the major canyon facilities for disposal of some waste types that are included in the HSW EIS. As currently envisioned, higher hazard waste such as Category 3 LLW would be placed inside the canyons and other wastes (Category 1 LLW, for example) would be placed above and outside the canyon. The entire facility would then be covered with a layer of soil and capped. The HSW EIS evaluation of LLW disposal in the LLBGs would bound the impacts of disposal in the canyon facilities.

DOE previously decided to retrieve TRU waste stored in the 200 Area LLBGs, including waste in the caissons, as a result of analyses in the Hanford Defense Waste EIS (HDW EIS)(DOE 1987; 53 FR 12449). The HSW EIS evaluates processing and certification of TRU waste, but additional analysis of retrieval activities has been deferred. LLW within caissons, including remote-handled (RH) LLW, would not be retrieved.

A.2.2 Recommended Alternative Analyses

- *As scoping for this HSW EIS is occurring in advance of decisions on the PEIS, in accordance with NEPA this HSW EIS must also examine and consider all reasonable alternatives to the proposed TSD at Hanford. These alternatives should include analysis of similar options at sites from which waste is proposed to be shipped, as well as separate treatment, storage and disposal at sites with no transport of waste.*

  (Note: This comment also addresses issues discussed under Section A.1, Programmatic/Complex-Wide Analysis.)

- *The SW EIS must examine the full range of alternative management and disposal options. In developing and examining options, the HSW EIS should emphasize the following: waste minimization, treatment, avoidance of impacts, and support of cleanup activities. As the alternatives are analyzed, the HSW EIS should be particularly sensitive to impacts on: land use, cleanup schedules, transportation, habitat and compliance with cleanup laws.*

(Note: This comment also addresses issues discussed under Section A.4, Environmental Consequences and Analysis Methods.)

- *Closure of these waste streams (Low Level Burial Grounds [LLBG] and Mixed Low-Level Radioactive Waste [MLLW] trenches) will involve some type of barrier requiring geological resources. The geological resources needed may include: soil, sand, gravel and basalt…Washington Department of Fish and Wildlife (WDFW) requests that a NEPA analysis (EIS) occur to evaluate the environmental impacts related to closure activities for waste streams of the Solid Waste program, the Tank Waste Remediation System (TWRS) program, and the ER program requiring geological resources.*

Response to Comments on Alternative Analyses

Consequences of managing radioactive, hazardous, and mixed waste were evaluated in the WM PEIS, the WIPP SEIS II, and a number of site-specific NEPA documents. The WM PEIS decisions, issued since the HSW EIS scoping period ended, specified that the Hanford Site would be available to treat MLLW and dispose of LLW and MLLW from both offsite and onsite generators. Hanford would also process TRU waste for disposal at WIPP as a result of those decisions. The HSW EIS analyzes the impacts at Hanford from implementing those programmatic decisions. Impacts at other potential waste generator and management sites have been evaluated in the programmatic documents, as well as in other site-specific NEPA analyses, and are not duplicated in this HSW EIS.

Consequences of solid waste program activities at Hanford are evaluated for all applicable resources as required under NEPA, including land use, geological resources, ecological resources, and traffic and transportation. Waste minimization and pollution prevention are also discussed.

The cumulative impacts of waste management activities that are the subject of the HSW EIS are considered in addition to those from other past, present, and reasonably foreseeable activities at Hanford. Hanford Site needs for geologic resources have been addressed in other NEPA documents (DOE 1999, 2001a). As part of commitments made in the *Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (DOE 1999) the Hanford Site is developing a plan for managing geologic resources that may be required for sitewide programs and activities.

A.3 Waste Types and Volumes

This category contains comments related to the types of waste and the waste volumes from Hanford and other DOE generators evaluated in the HSW EIS.

- *The WM PEIS needs to make it clear that pre-1970 waste containing plutonium and buried in cardboard boxes does not fall within the scope of this WM PEIS. The WM PEIS needs to provide a simple and crystal clear explanation as to why the pre-1970 waste is not within its scope. The explanation needs to provide a simple overview of the NEPA process, which is applicable to the pre-1970 burial grounds. Since the pre-1970 burial grounds are within close proximity to post-1970 TRU* *burial grounds, the WM PEIS needs to address consistencies and inconsistencies which may exist between the results of the NEPA process for the two different types of burial grounds.*

- *I would recommend that the scope of this HSW EIS address the pre-1970 TRU and clearly explain why it's not within the jurisdiction of this HSW EIS...*

- *It is essential that decisions regarding both onsite and offsite waste management and disposal be made with a full understanding of what is currently on site. The SW EIS must establish a detailed (baseline) solid waste inventory. That will require a rigorous assessment of the types and volumes of solid waste that has been previously disposed at Hanford and what is currently waiting disposal. Added to that must be the anticipated onsite solid waste stream including pre-1990 wastes. Offsite wastes currently being received for disposal should not be included in a Hanford baseline. DOE should not assume these current relationships would automatically continue.*

  The solid waste baseline must then be combined with a sitewide waste inventory to create a Hanford Site baseline. This sitewide estimate must include other present and future Hanford Site waste streams such as remedial wastes and low and high activity tank wastes. It also must include residual contamination following planned cleanup activities.

  (Note: This comment also addresses issues discussed under Section A.2, Alternatives and Activities Analyzed in the HSW EIS.)

- *The amount of waste and its content (at Hanford) is very poorly and inadequately understood. At Hanford there is according to papers released by the Secretary of Energy, Hazel O'Leary, last year, 1.522 metric tons of plutonium unaccounted for. DOE is not convinced all of that ever actually existed. They are confidant that at least 400 kilograms really does exist and that they don't know where it is but are fairly certain it didn't leave Hanford. As a consequence, that material is likely in the facilities at Hanford or in disposal somewhere on the Hanford Site in unknown conditions. Those materials pose a sizable risk, which must be accounted for in the analysis under the SW EIS.*

- *Liquid wastes from other sites can only be shipped to Hanford for treatment (and disposal of the residual solid waste) if it can be safely shipped, handled, and treated. No liquids shall be directly disposed.*

- *We believe that DOE should break this HSW EIS into two separate pieces. One HSW EIS should deal with the onsite waste. The other HSW EIS should deal with offsite wastes. The lack of specific information on the quantity or character of offsite wastes necessitates this.*

- *To aid in the comparison between candidate sites and in the analysis of impacts at Hanford, the SW EIS must examine the incremental impacts of any offsite wastes that may be sent to Hanford for treatment or disposal. Hanford's solid waste baselines are essential to this examination so decision makers, state, local, and tribal officials and the public know what is already present at Hanford.*

Response to Comments on Waste Types and Volumes

The HSW EIS describes the existing and anticipated waste types and volumes included within its scope, as well as an explanation of waste types specifically excluded from analysis. Several waste types, including high-level radioactive waste, immobilized low-activity tank waste, spent nuclear fuel, hazardous waste, and waste from environmental remediation activities (including pre-1970 buried waste), are outside the scope of the HSW EIS, either because they have been evaluated in other NEPA documents, or are being addressed under the CERCLA process. The CERCLA process provides for analysis of environmental impacts in a manner that is generally consistent with the requirements of NEPA. Therefore, facilities that will be evaluated under CERCLA cleanup projects, such as pre-1970 waste in the inactive LLBG, are not included in the HSW EIS.

DOE recognizes the importance of examining the combined impacts from all waste storage, treatment, and disposal activities on the Hanford Site. The Groundwater/Vadose Zone Integration Program (DOE-RL 1999a, b; DOE-RL 2000) has undertaken an extensive task to quantify the radioactive and hazardous materials that may remain at the Hanford Site. Impacts from the management of these waste types are also included in the analyses of cumulative impacts in the HSW EIS to the extent that information is available.

DOE has very tight controls on the accounting of nuclear material because of safeguards and security. When the material is technically or economically unrecoverable and intentionally sent to waste, it is referred to as "normal operating losses." The 1,522 kg (3355 lb) of plutonium in waste at Hanford is accounted for as follows:

- high-level waste in the tank farms - 455 kg (1003 lb)
- solid waste in the burial grounds - 875 kg (1929 lb)
- waste in cribs, trenches, and ponds - 192 kg (423 lb)
- total - 1,522 kg (3355 lb).

The amount of plutonium in normal operating losses is consistent with the amounts reported in waste. For example, the normal operating loss of 192 kg (423 lb) in cribs, trenches, and ponds is consistent with the inventory of 190 kg (420 lb) (rounded) of plutonium that has been reported for TRU contaminated soil under the Hanford Environmental Restoration Program.

The Hanford Solid Waste Program primarily manages solid operational radioactive and hazardous waste, and generally does not receive liquid waste. Liquids are treated and converted to a solid waste form before receipt by the Solid Waste Program for disposal. The Hanford Site *Solid Waste Acceptance Criteria* (HSSWAC) document requires stabilization or use of sorbents with waste containing free liquids in the LLBGs (FH 2002).

The HSW EIS considers the consequences of managing most solid radioactive and hazardous operational waste that has been, or will be, received at Hanford. This assessment uses the best available information on previously disposed waste and forecast receipts. For the purposes of analysis in this EIS, a range of forecast LLW and MLLW volumes was evaluated to encompass the uncertainties in quantities of waste that might ultimately be received at Hanford under the WM PEIS RODs. The Lower Bound waste volume considered in this EIS was obtained from the Hanford Solid Waste Integrated Forecast Technical (SWIFT) report (Barcot 1999), which includes forecast waste receipts from onsite programs where applicable, as well as small quantities of waste that Hanford is obligated to receive under existing agreements with offsite generators. Additional offsite waste that could come to Hanford under the WM PEIS RODs is included in an Upper Bound waste volume, so the incremental impacts of that waste can be clearly evaluated. The volume of TRU waste is based on a recently updated forecast (Barcot 2002) to incorporate a single maximum volume only, because the Hanford Site is not expected to receive substantial quantities of TRU waste from offsite DOE generators. The basis for quantities of each waste type evaluated is discussed in the HSW EIS.

A.4 Environmental Consequences and Analysis Methods

This category contains comments related to the types of environmental consequences evaluated in the HSW EIS and the methods used to analyze environmental impacts.

- *We are concerned about the risk assessment proposed by DOE. As the SX tank farm expert panel pointed out in their final report - none of the existing site or national vadose zone and groundwater models adequately predict the fate and transport of radioactive and hazardous waste through the soils at Hanford… Any model used must include a good assessment of the uncertainty of the calculations. It also must include a numerical estimate of the uncertainty of the model itself due to invalid assumptions, and model errors. This can only be achieved by validating the models against real world data. This validation must not use data that was used in the creation of the models.*

- *I think it is absolutely vital that all of the cumulative impacts from the site need to be addressed to great degree, and that needs to be with not just the best data available, but accurate data about the transport of radioactive and hazardous materials under the Hanford Site. To date that data does not exist. The most recent data released as part of the SX tank farm expert panel report indicates that previous data was wholly inadequate and inaccurate…*

- *The SW EIS proposed to do a comprehensive assessment of the cumulative risk…. We support a comprehensive assessment, but question whether adequate tools or data exist to perform such an assessment.*

- *To properly analyze the impacts, this HSW EIS should analyze impacts to every community effected by transport from every site waste is shipped. It should analyze the risks from disposal of these wastes in combination with all of the other risks already at Hanford… The scoping of this HSW EIS should be extended to allow affected communities along potential transport routes to have input into the framing of the HSW EIS.*

  (Note: This comment also addresses issues discussed under Section A.2, Alternatives and Activities Analyzed in the HSW EIS.)

- *Any interstate transportation of wastes is an issue, which must be carefully evaluated to ensure an adequate degree of public and environmental safety is maintained.*

- *An extensive stand of a big sagebrush/spiny hopsage plant community can be found there (central Plateau, of the Hanford Site). This plant community has been identified by WDFW as Priority Shrub Steppe Habitat…The expansion of the LLBG and MLLW trenches and any other new facilities related to this action could impact Priority Shrub Steppe Habitat of the Central Plateau if not wisely sited. We are requesting the following site selection processes occur for new facilities, expansions of reconfigurations…1) Avoid shrub steppe habitat by utilizing existing disturbed areas…2) Focus within the 200 East and 200 West fence line, excluding the 200 West expansion area…. etc.*

  (Note: This comment also addresses issues discussed under Section A.2, Alternatives and Activities Analyzed in the HSW EIS.)

- *The burial grounds are located in the vicinity of several facilities including T cribs, Z cribs, T-Tank Farms, 242-T Evaporator, 231-Z, 234-5, covered T-ditches, covered ditches from Z plant to U pond, covered U pond, covered ditches to S ponds and covered S ponds. The cleanup criteria, which may be addressed in the SW PEIS, should be consistent with the criteria used for the cleanup of the surrounding facilities. DOE needs to avoid spending millions of dollars to cleanup a burial ground when a nearby site may be left in place with a larger radionuclide inventory than the burial ground.*

  (Note: This comment also addresses issues discussed under Section A.2, Alternatives and Activities Analyzed in the HSW EIS.)

Response to Comments on Environmental Consequences and Analysis Methods

Hanford Site groundwater and vadose zone models have been incorporated into a sitewide model as part of the Groundwater/Vadose Zone Integration Project (DOE-RL 1999a, b; DOE-RL 2000). This sitewide simulation capability, known as the System Assessment Capability (SAC), has been designed as a stochastic capability with an option to perform deterministic simulations. It uses the groundwater model of the Hanford Site produced and supported by the Groundwater Monitoring Program. Currently, the groundwater portion of this model implements a fully three-dimensional conceptual model of the unconfined aquifer. This model has been inverse calibrated to Hanford Site water table measurements from 1944 to the present, and uses knowledge of geohydrologic units and field measurements of hydraulic conductivity to condition the model calibration. Future revisions of the SAC will incorporate inverse calibrated alternate conceptual models of the aquifer. However, at present, uncertainty in groundwater contaminant migration and fate is represented by the uncertainty in contaminant mobility as reflected in uncertainties in linear sorption isotherm model parameters (for example, distribution coefficients for various contaminants). At the time of preparation, the HSW EIS cumulative impacts evaluation used the best information available from the Groundwater/Vadose Zone Integration Project (DOE-RL 1999a, b; DOE-RL 2000) and from the Hanford Site Composite Analysis (Kincaid et al. 1998). The HSW EIS provides a conservative analysis commensurate with the purpose of the document, which is to bound and compare the consequences of the alternatives.

The consequences of transporting waste between DOE sites were evaluated in the WM PEIS (DOE 1997b) and the WIPP SEIS II (DOE 1997c). Analysis of onsite transportation is included in the HSW EIS, as needed, to address alternatives involving onsite and inter-site transportation of waste. However, the HSW EIS does not re-evaluate transportation between DOE sites that was addressed in previous nationwide NEPA analyses.

The consequences of constructing new facilities that may be needed to implement various alternatives are evaluated in the HSW EIS, including ecological impacts on sensitive plant and animal communities.

Cleanup criteria for various facilities surrounding the active LLBG are outside the scope of the HSW EIS. Cleanup criteria for environmental restoration facilities would be defined and evaluated during remedial actions conducted under the CERCLA process. Soil contamination in the 200 Areas has been evaluated in a number of recent studies (Simpson et al. 2001; Coony 2002). However, environmental remediation activities are regulated separately from the routine waste disposal operations considered in the HSW EIS. Criteria for disposal of LLW and MLLW in the LLBGs (FH 2002) were established to comply with existing regulations, which generally result in risks similar to those used as criteria for remediation activities.

A.5 Public Involvement and Government Agency Consultations

This category contains comments related to public involvement and coordination of the HSW EIS decisions with other government agencies and stakeholders.

- *Information about this HSW EIS was inadequate for the public to understand the potential scope and ramifications. We formally request DOE extend the public comment period on this HSW EIS until January 30, 1998.*

- *In addition, the HSW EIS should seek input from the Yakama, Umatilla, and other affected Native American communities. Their aboriginal lands have been impacted and they have the greatest personal stake in the outcomes selected for Hanford.*

- *Full public disclosure of hearings must be held on any proposed inter-site transfer of waste for processing, interim storage or disposal.*

(Note: This comment also addresses issues discussed under Section A.4, Environmental Consequences and Analysis Methods.)

Response to Comments on Public Involvement and Government Agency Consultation

The scoping comment period was extended beyond the required 30 days as requested. In addition to the HSW EIS public meetings, numerous briefings were provided to tribal organizations, state agencies, the Hanford Advisory Board, and other organizations upon request. Information regarding the HSW EIS was also available at the National Dialog Meetings held in conjunction with publication of the final WM PEIS.

At their request, the Yakama Nation was invited to participate in preparation of the HSW EIS. Comments were also requested from other Tribal Nations, but none offered comments on the scope of the HSW EIS. They had an opportunity to review the first draft HSW EIS and provide input during the comment period following its publication. Their input on this revised draft HSW EIS will also be considered in preparing the final HSW EIS and a subsequent ROD.

Inter-site transport of waste between DOE sites was evaluated in the WM PEIS and WIPP SEIS II (discussed under responses in Section A.4). During preparation of those documents, extensive public input was obtained from communities potentially affected by transportation activities. Additional consultation with emergency planning organizations in potentially affected communities would take place as actual waste shipments are planned.

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Appendix B

Detailed Alternative Descriptions, Assumptions, Waste Volumes, and Waste Stream Flowsheets

B.1 Introduction

This appendix contains four sets of information. The first set identifies waste streams by waste stream number. Basic information on the waste streams and facilities is contained in Section 2 of this environmental impact statement (EIS). The second set of information is a listing by waste type of processing assumptions for each waste stream. The third set of information is the volume of each waste stream expected to be received annually for each waste type. The fourth set of information is detailed flowsheets showing the disposition pathway for each waste stream for each alternative. For the presentation of waste volume numbers, the volumes have been rounded to the nearest whole cubic meter. It should be recognized that for some numbers, the number of significant figures exceeds the accuracy of the information. Occasional differences may be noted in the unit digit due to rounding.

B.2 Waste Stream Numbers

Figure B.1 is the same as Figure 2.1 (see Section 2 of Volume I) but includes the waste stream numbers that were used during the development of the HSW EIS to track individual waste streams. For each waste stream, a number is shown in the figure, such as (#2), and was the identification number assigned to that stream. This is the alphanumeric designation by which each waste stream was initially identified in the development of this EIS. Streams #7, #16, and #19 were dropped from consideration as separate waste streams in the EIS during its development. Stream #7, composed of greater than Class C Wastes (an NRC category no longer applicable to Hanford waste), was combined with Stream #3. Stream 16, composed of contaminated equipment and materials for decontamination, was eliminated from the scope of the EIS, and Stream #19, greater than Category 3 (GTC3) and transuranic (TRU) waste in the Low Level Burial Grounds (LLBGs), was combined with stream #20 when subsequent analyses determined these wastes to be low-level waste (LLW). It can also be noted that two waste streams were subdivided to allow more detailed analysis (#10 and #13).

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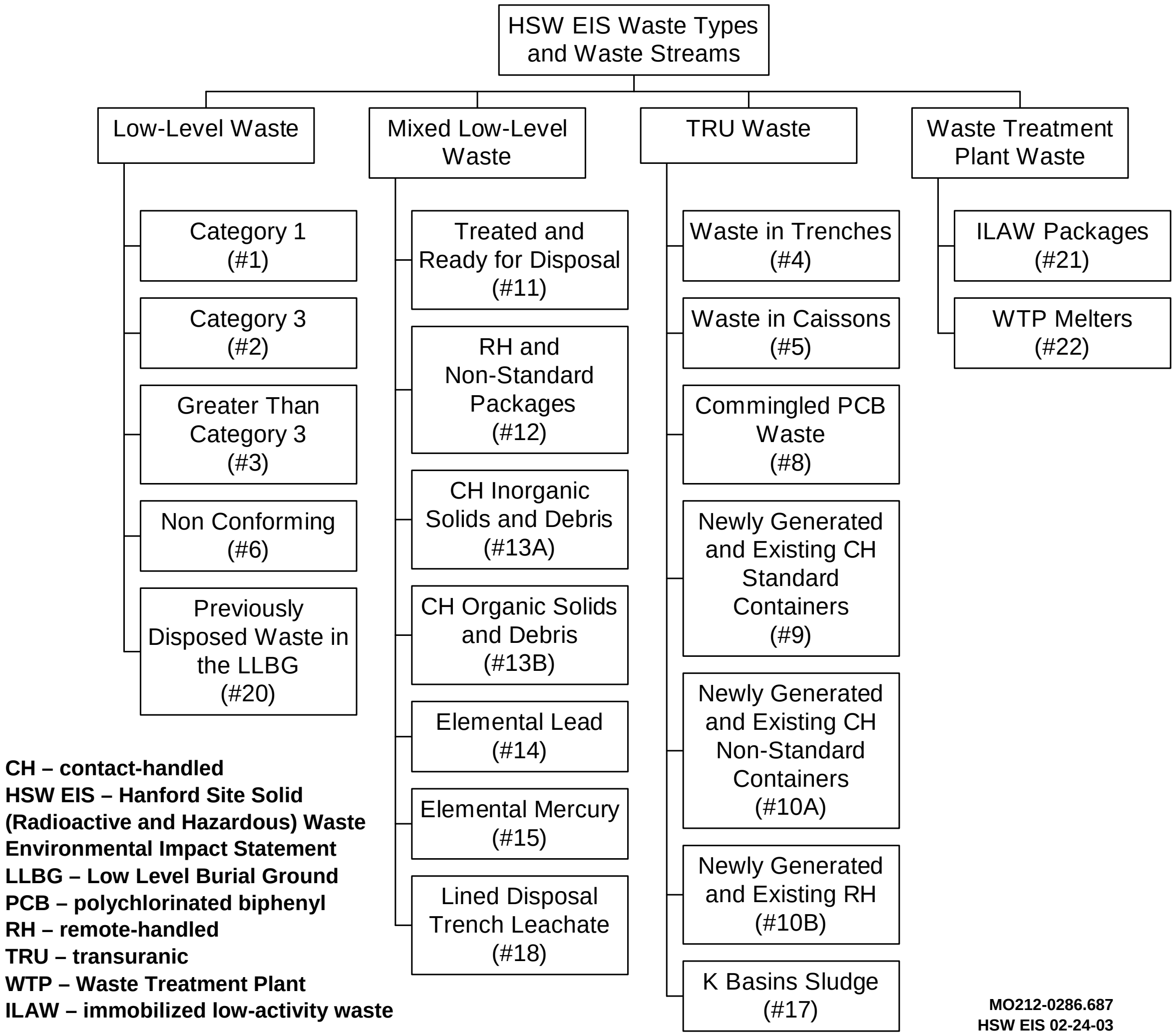


Figure B.1. Waste Types and Waste Streams Considered in the HSW EIS

(See text for discussion of waste streams #7, #16, and #19 that are not included in this diagram.)

B.3 HSW EIS Waste Processing Assumptions

Planning for the management of LLW, MLLW, TRU waste, and WTP waste at the Hanford Site has been ongoing for several years and has been documented in Anderson and Konynenbelt (1995), Sederburg (1997), and the Hanford Waste Management Strategic Plan (DOE-RL 2001). These documents formed the bases for the waste processing assumptions used to develop annual and life-cycle waste flows through facilities for each alternative. These assumptions specify the processing requirements for a particular waste stream, how much waste is sent, when the waste is sent, and what happens to the waste as it is processed. It should be noted that these assumptions were developed for the first draft of the EIS and cover the time period 2002 through 2046. Although the first year covered by these assumptions has passed, the environmental impacts would not change significantly by removing the information associated with 2002.

The assumptions for management of LLW, MLLW, TRU waste, and WTP wastes are contained in Tables B.1 through B.4. These assumptions describe how the waste is processed but do not necessarily specify the facilities at which the waste is managed. The facilities may change depending on the alternative. Information about facilities used in each alternative is contained in Section 3.3 of this EIS (Section 3, Volume I).

Table B.1. Assumptions for Management of Low-Level Waste

Stream Number	Description	Assumptions
NA	General Comments	All waste received after 2032 is assumed to be verified and packaged for disposal. Disposal activities such as Repackage into HICs and In-Trench Grouting will continue through 2046.
1	Category 1 LLW	The majority of Cat 1 LLW will be sent directly to disposal. Disposal of RH Cat 1 LLW results in a 3 to 1 volume increase due to handling criteria. A 5% fraction of the CH Cat 1 LLW in drums and boxes will be selected for verification at WRAP. Large boxes are assumed to be verified at the generating facility. Of the waste selected for verification, 10% is assumed to require glovebox processing. Drums will be processed in WRAP; boxes in the T Plant Complex. Drum processing results in a 60% volume decrease due mainly to compaction. Boxes would not be compacted and therefore processing results in a 50% volume increase. 175 m^3 of CH MLLW is assumed to be reclassified as CH Cat 1 LLW and disposed of in FY 2002 (80 m^3) and FY 2003 (95 m^3). These volumes have been included in the disposal estimates.
2	Category 3 LLW	Cat 3 LLW requires either Repackaging in HICs or In-Trench Grouting to provide additional stabilization prior to disposal. These options are considered equally viable for CH waste and rather than limit the amount of waste that can be sent to either option, the impacts will be analyzed assuming 100% of the CH Cat 3 LLW will undergo each operation. It is assumed that In-Trench Grouting would not be appropriate for RH Cat 3 LLW. Repackaging in HICs and Trench Grouting are assumed to result in a 3 to 1 increase for CH waste and a 5 to 1 increase for RH waste. A 5% fraction of the CH Cat 3 LLW in drums and boxes will be selected for verification at WRAP. Large boxes are assumed to be verified at the generating facility. Of the waste selected for verification, 10% is assumed to require glovebox processing. Drums will be processed in WRAP; boxes in the T-Plant Complex. Drum processing results in a 60% volume decrease due mainly to compaction. Boxes would not be compacted and therefore processing results in a 50% volume increase.
3	GTC3	This waste stream would be managed in a manner similar to the Cat 3 LLW.
6	Non-Conforming LLW	Non-Conforming LLW currently stored in CWC will be treated in 2008, which is assumed to double the waste volume. The treated waste will be sent directly to disposal.
20	Previously Disposed of Waste in the LLBGs	The current inventory of waste disposed of in the LLBGs is assumed to remain in the LLBGs.

Table B.2. Assumptions for Management of Mixed Low-Level Waste

Stream Number	Description	Assumptions
NA	General Comments	All waste received after 2032 is assumed to be treated, verified, and packaged for disposal.
11	Treated and Ready for Disposal	A 10% fraction of the CH MLLW currently stored or received in a form suitable for disposal will be sent to WRAP for verification. Of the current inventory selected for verification, 20% is assumed to be verified each year from FY 2002 to FY 2006. Newly generated waste will be verified in the year it is received. 20% of the current inventory will be disposed of each year from FY 2002 to FY 2006. Newly generated waste will be disposed in the year it is received. 175 m^3 of currently stored MLLW is expected to be reclassified as LLW and disposed in the LLBGs in FY 2002 (80 m^3) and FY 2003 (95 m^3). Existing MLLW Trench capacity is assumed to be 22,900 m^3 of CH waste per trench. One cubic meter of RH waste is assumed to displace 5.725 m^3 of CH waste.
12	RH & Non-Standard Packages	RH & Non-Standard Packages will be treated beginning in 2016. The processing rate will be a constant quantity (171 m^3/yr) sufficient to process all waste by 2032.
13A	CH Inorganic Solids and Debris	10% of the waste will be verified at WRAP. Inventory waste will be verified over a 5-year period at a constant rate starting in 2002; newly generated waste and waste returning from Commercial Treatment Facilities will be verified in the year received or treated. CH Inorganic Solids and Debris will undergo non-thermal treatment beginning in 2003. The treatment rates will be a constant quantity (813 m^3/yr) sufficient to reduce the storage inventory to zero by 2012. (Note: At the time these assumptions were developed, the target was to reduce the CH MLLW inventory to zero by 2014; however, a constant treatment rate through 2014 results in a negative inventory for this waste stream. Therefore, the rate has been set to reduce the inventory to zero in 2012.) After 2012, wastes will be treated as generated. Treatment is assumed to double the waste volume for disposal.

Table B.2. (contd)

Stream Number	Description	Assumptions
13B	CH Organic Solids and Debris	10% of the waste will be verified at WRAP. Inventory waste will be verified over a 5-year period at a constant rate starting in 2002; newly generated waste and waste returning from Commercial Treatment Facilities will be verified in the year received or treated. CH Organic Solids and Debris will undergo thermal treatment beginning in 2003. The treatment rates will be a constant quantity (417 m^3/yr) sufficient to reduce the storage inventory to zero by 2014. After 2014, wastes will be treated as generated. Treatment is not expected to change the waste volume for disposal. (Note: The Hanford Site has an existing contract for thermal treatment requiring 120 m^3 of waste to be treated each year from 2003 to 2005. In all alternatives, this contract is assumed to be fulfilled.)
14	Elemental Lead	Elemental Lead will undergo non-thermal treatment beginning in 2003. The treatment rates will be a constant quantity (46 m^3/yr) sufficient to reduce the storage inventory to zero by 2014. After 2014, wastes will be treated as generated. Treatment is assumed to double the waste volume for disposal.
15	Elemental Mercury	Elemental Mercury will undergo non-thermal treatment beginning in 2003. The treatment rates will be a constant quantity (2 m^3/yr) sufficient to reduce the storage inventory to zero by 2014. After 2014, wastes will be treated as generated. Treatment is assumed to result in a 15 to 1 increase in the waste volume for disposal.
18	MLLW Trench Leachate	Leachate from the MLLW trenches will be collected and sent to the Effluent Treatment Facility for treatment and disposal through 2025. After 2025, pulse driers will be used to treat the leachate.

Table B.3. Assumptions for Management of Transuranic Waste

Stream Number	Description	Assumptions
NA	General Comments	All waste received after 2032 is assumed to be verified, certified, and packaged for shipment.
4	Waste in Trenches	TRU waste retrievably stored in the LLBG trenches is assumed to be retrieved from the LLBGs. Waste in drums will be moved to CWC for storage while waste in boxes and RH waste will be sent directly to the treatment facility as capacity becomes available. All waste will be shipped to WIPP for disposal. **Retrieval** Waste retrieval was analyzed as part of the Hanford Defense Waste EIS (DOE 1987) and is not reanalyzed in this HSW EIS; however, some assumptions were made regarding retrieval to estimate subsequent storage, processing, and disposition impacts. From 2002 to 2006, the retrieval rate is assumed to be 732 m^3 per year. From 2007 to 2014, the rate will increase to 1,361 m^3 per year. Although some boxes and RH waste are likely to be encountered throughout the retrieval efforts, to simplify the analysis it has been assumed that all CH drums are retrieved followed by all CH boxes and finally RH waste. CH drums will be moved to CWC for storage prior to processing. CH boxes and RH waste is assumed to be overpacked and stored in the retrieval trench until processing capacity is available. During retrieval the contents of the CH drums will be determined to be either LLW or TRU waste. 50% of this waste is expected to be reclassified as LLW and remain in the trench as disposed waste. **Processing** Retrievably stored CH drums will be processed at a rate (338 m^3/yr) sufficient to work off the inventory by the startup of processing of non-standard TRU wastes in 2013. Drum processing will result in a LLW Cat 1 volume equal to 10% of the TRU volume. RH and non-standard TRU waste processing is expected to reduce the volume of TRU by approximately 10% and generate volumes of LLW and MLLW roughly 30% and 2% of the original volume respectively. A portion (approximately 30%) of the LLW generated during RH waste processing is assumed to be LLW Cat 3. RH and non-standard TRU waste will be processed starting in 2015 and waste in 2013 respectively. The processing rate will be a constant quantity (366 m^3/yr CH and 10 m^3/yr RH) sufficient to process all waste by 2032. A ramp up in capacity of one-third the first year and two-thirds the second was assumed for CH processing. No ramp up is assumed for RH as the facility will have experience with RH waste from processing the K Basins Sludge. **Shipment to WIPP** Waste is assumed to be shipped to WIPP in the year it is processed.

Table B.3. (contd)

Stream Number	Description	Assumptions
5	Waste in Caissons	TRU waste retrievably stored in Caissons is assumed to be retrieved and shipped directly to the processing facility. **Retrieval** Waste retrieval was analyzed in the Hanford Defense Waste EIS (DOE 1987) and is not reanalyzed in this HSW EIS; however, some assumptions were made regarding retrieval to estimate subsequent storage, processing, and disposition impacts. Caisson retrieval is assumed to occur from 2015 to 2018 at a rate of 6 m^3 per year. **Processing** Caisson wastes will be processed immediately after retrieval at a constant rate from 2015 to 2018. Processing will result in a 2 to 1 volume increase. **Shipment to WIPP** Waste is assumed to be shipped to WIPP in the year it is processed.
8	Commingled PCB Waste	Commingled PCB waste will be processed beginning in 2013. The processing rate will be a constant quantity (5 m^3/yr) sufficient to process all waste by 2032 with a ramp up in capacity of 1/3 the first year and 2/3 the second. Waste is assumed to be shipped to WIPP in the year it is processed.
9	Newly Generated and Existing CH Standard Containers	CH TRU waste in drums and SWBs will be stored in CWC awaiting certification and shipment to WIPP. Newly generated and existing drums in above ground storage will be processed at a constant rate through 2032 (197 m^3 NDE/NDA and 25 m^3 glovebox). SWBs will be processed as generated through 2007 (average 250 m^3/yr). After 2007, the rate will be constant at 801 m^3/yr. This rate will result in all TRU waste in SWBs being shipped to WIPP by 2032. 5% of drums assayed are assumed to be reclassified as LLW. 10% of newly generated drums and 35% of existing drums will require glovebox processing. Glovebox processing will result in a 10% volume increase. Waste is assumed to be shipped to WIPP in the year it is processed.
10A	Newly Generated and Existing CH Non-Standard Containers	CH waste in non-standard containers will be processed beginning in 2013. The processing rate will be a constant quantity (57 m^3/yr) sufficient to process all waste by 2032 with a ramp up in capacity of one-third the first year and two-thirds the second. Processing will result in a 5% increase in the volume of TRU and generate a volume of LLW equal to 20% of the original waste volume. Waste is assumed to be shipped to WIPP in the year it is processed.
10B	Newly Generated and Existing RH	RH waste will be processed beginning in 2015. The processing rate will be a constant quantity (121 m^3/yr) sufficient to process all waste by 2032. No ramp up is assumed as the facility will have experience with RH waste from processing the K Basins Sludge. Processing will result in a 5% increase in the volume of TRU and generate a volume of LLW equal to 20% of the original waste volume. Waste is assumed to be shipped to WIPP in the year it is processed.
17	K Basins Sludge	K Basins Sludge wastes will be treated in 2013 and 2014. One-third of the waste will be treated in 2013 and two-thirds in 2014. Processing will result in a 3 to 1 volume increase. Waste is assumed to be shipped to WIPP in the year it is processed.

Table B.4. Assumptions for Management of Waste Treatment Plant Wastes

Stream Number	Description	Assumptions
21	Immobilized Low-Activity Waste	ILAW will be disposed of in the year it is received.
22	WTP Melters	WTP Melters will be disposed of in the year they are received.

B.4 Waste Volumes

Tables B.5 through B.14 summarize the waste volumes to be managed by waste stream under each of the alternatives for LLW, MLLW, TRU waste, and WTP wastes, respectively. Section 2.1 in the body of the EIS can be consulted for text descriptions of each waste stream, and Appendix C contains additional information regarding the development of the waste volumes.

Table B.5. Low-Level Waste Hanford Only Volumes (m^3)[a, b]

Stream Number	Stream Name	Inventory/ Disposed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012-2046	Total
1	LLW Cat 1	18,944	2,410	2,486	3,241	3,107	3,120	3,117	3,872	4,611	3,827	3,902	36,156	88,792
2	LLW Cat 3	2,773	546	547	573	561	551	534	534	349	345	1,513	30,782	39,607
3	GTC3	<1												<1
6	Non-Conforming	299	0	0	0	0	0	0	0	0	0	0	0	299
20	Previously Disposed	283,067	Not Applicable											283,067

(a) To obtain cubic yards, multiply by 1.308.
(b) Rounded to the nearest cubic meter in this table for calculational convenience; significant figures are not meant to indicate the accuracy of the numbers.

Table B.6. Low-Level Waste Lower Bound Volumes (m^3)[a, b]

Stream Number	Stream Name	Inventory/ Disposed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012-2046	Total
1	LLW Cat 1	18,944	3,429	4,290	4,181	3,770	4,241	3,493	4,241	4,998	4,196	4,275	47,825	107,883
2	LLW Cat 3	2,773	1,048	769	727	676	568	559	552	366	362	1,530	31,403	41,334
3	GTC3	<1												<1
6	Non-Conforming	299	0	0	0	0	0	0	0	0	0	0	0	299
20	Previously Disposed	283,067	Not Applicable											283,067

(a) To obtain cubic yards, multiply by 1.308.
(b) Rounded to the nearest cubic meter in this table for calculational convenience; significant figures are not meant to indicate the accuracy of the numbers.

Table B.7. Low-Level Waste Upper Bound Volumes (m^3)[a, b]

Stream Number	Stream Name	Inventory/ Disposed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012-2046	Total
1	LLW Cat 1	18,944	3,429	4,290	24,103	23,692	24,163	23,415	24,163	7,409	6,591	7,882	119,048	287,130
2	LLW Cat 3	2,773	1,048	769	2,905	2,854	2,747	2,737	2,730	630	624	1,925	39,190	60,933
3	GTC3	<1												<1
6	Non-Conforming	299	0	0	0	0	0	0	0	0	0	0	0	299
20	Previously Disposed	283,067	Not Applicable											283,067

(a) To obtain cubic yards, multiply by 1.308.
(b) Rounded to the nearest cubic meter in this table for calculational convenience; significant figures are not meant to indicate the accuracy of the numbers.

Table B.8. Mixed Low-Level Waste Hanford Only Volumes (m^3)[a, b]

Stream Number	Stream Name	Inventory/ Disposed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012-2046	Total
11	Treated & Ready for Disposal	2,112	704	142	691	1,183	863	1,111	1,612	2,164	2,136	2,613	12,726	28,054
12	RH & Non-Standard	65	175	136	127	111	97	43	56	112	118	123	1,743	2,906
13A	CH Inorganic Solids & Debris	3,172	402	416	440	426	377	329	368	385	381	688	12,724	20,108
13B	CH Organic Solids & Debris	2,553	235	196	249	190	187	160	171	201	190	153	2,241	6,727
14	Elemental Lead	445	9	9	10	10	11	8	9	10	9	6	65	600
15	Elemental Mercury	13	0	0	0	0	1	1	1	1	1	1	1	20
18	MLLW Leachate	Dependent on alternative chosen												

(a) To obtain cubic yards, multiply by 1.308.
(b) Rounded to the nearest cubic meter in this table for calculational convenience; significant figures are not meant to indicate the accuracy of the numbers.

Table B.9. Mixed Low-Level Waste Lower Bound Volumes (m^3)[a, b]

Stream Number	Stream Name	Inventory/ Disposed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012-2046	Total
11	Treated & Ready for Disposal	2,112	704	142	691	1,183	863	1,111	1,612	2,164	2,136	2,613	12,754	28,082
12	RH & Non-Standard	65	175	136	127	111	97	43	56	112	118	123	1,743	2,904
13A	CH Inorganic Solids & Debris	3,172	403	417	441	426	377	329	368	385	381	688	12,724	20,111
13B	CH Organic Solids & Debris	2,553	237	198	251	192	189	162	173	203	192	155	2,284	6,790
14	Elemental Lead	445	14	10	11	10	11	8	9	10	9	6	65	608
15	Elemental Mercury	13	0	0	0	0	1	1	1	1	1	1	1	21
18	MLLW Leachate	Dependent on alternative chosen												

(a) To obtain cubic yards, multiply by 1.308.
(b) Rounded to the nearest cubic meter in this table for calculational convenience; significant figures are not meant to indicate the accuracy of the numbers.

Table B.10. Mixed Low-Level Waste Upper Bound Volumes (m^3)[a, b]

Stream Number	Stream Name	Inventory/ Disposed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012-2046	Total
11	Treated & Ready for Disposal	2,112	704	142	20,190	20,683	20,363	20,610	21,112	3,685	3,441	3,920	51,457	168,419
12	RH & Non-Standard	65	175	136	127	111	97	43	56	112	118	123	1,743	2,904
13A	CH Inorganic Solids & Debris	3,172	403	417	441	426	377	329	368	385	381	688	12,724	20,111
13B	CH Organic Solids & Debris	2,553	237	198	251	192	189	162	173	203	192	155	2,284	6,790
14	Elemental Lead	445	14	10	11	10	11	8	9	10	9	6	65	608
15	Elemental Mercury	13	0	0	0	0	1	1	1	1	1	1	1	21
18	MLLW Leachate	Dependent on alternative chosen												

(a) To obtain cubic yards, multiply by 1.308.
(b) Rounded to the nearest cubic meter in this table for calculational convenience; significant figures are not meant to indicate the accuracy of the numbers.

Table B.11. Transuranic Waste Hanford Only Volumes (m^3)[a, b]

Stream Number	Stream Name	Inventory/ Disposed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012-2046	Total
4	Waste from Trenches	14,552	0	0	0	0	0	0	0	0	0	0	0	14,552
5	Waste from Caissons	23	0	0	0	0	0	0	0	0	0	0	0	23
8	Commingled PCB Waste	80	15	0	0	0	0	0	0	0	0	0	0	95
9	CH Standard Containers	849	414	424	587	486	752	896	1,519	1,518	1,503	1,438	17,334	27,719
10A	CH Non-Standard Containers	585	0	0	0	0	0	0	0	0	0	0	492	1,077
10B	RH Waste	46	250	130	130	131	130	64	72	72	180	158	794	2,157
17	K Basins Sludge	0	0	64	70	6	0	0	0	0	0	0	0	139

(a) To obtain cubic yards, multiply by 1.308.
(b) Rounded to nearest cubic meter in this table for calculational convenience; significant figures are not meant to indicate the accuracy of the numbers.

Table B.12. Transuranic Waste Lower Bound Volumes (m^3)[a, b]

Stream Number	Stream Name	Inventory/ Disposed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012-2046	Total
4	Waste from Trenches	14,552	0	0	0	0	0	0	0	0	0	0	0	14,552
5	Waste from Caissons	23	0	0	0	0	0	0	0	0	0	0	0	23
8	Commingled PCB Waste	80	15	0	0	0	0	0	0	0	0	0	0	95
9	CH Standard Containers	849	418	428	587	486	752	896	1,519	1,518	1,503	1,438	17,334	27,727
10A	CH Non-Standard Containers	585	0	0	0	0	0	0	0	0	0	0	492	1,077
10B	RH Waste	46	270	144	130	131	130	64	72	72	180	158	794	2,191
17	K Basins Sludge	0	0	64	70	6	0	0	0	0	0	0	0	139

(a) To obtain cubic yards, multiply by 1.308.
(b) Rounded to nearest cubic meter in this table for calculational convenience; significant figures are not meant to indicate the accuracy of the numbers.

Table B.13. Transuranic Waste Upper Bound Volumes (m^3)[a, b]

Stream Number	Stream Name	Inventory/ Disposed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012-2046	Total
4	Waste from Trenches	14,552	0	0	0	0	0	0	0	0	0	0	0	14,552
5	Waste from Caissons	23	0	0	0	0	0	0	0	0	0	0	0	23
8	Commingled PCB Waste	80	15	0	0	0	0	0	0	0	0	0	0	95
9	CH Standard Containers	849	418	428	821	720	986	1,130	1,753	1,518	1,503	1,438	17,334	28,897
10A	CH Non-Standard Containers	585	0	0	56	56	56	56	56	0	0	0	492	1,357
10B	RH Waste	46	270	144	140	141	140	74	82	72	180	158	794	2,241
17	K Basins Sludge	0	0	64	70	6	0	0	0	0	0	0	0	139

(a) To obtain cubic yards, multiply by 1.308.
(b) Rounded to nearest cubic meter in this table for calculational convenience; significant figures are not meant to indicate the accuracy of the numbers.

Table B.14. Waste Treatment Plant Waste Volumes (m^3)[a, b]

Stream Number	Stream Name	Inventory/ Disposed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012-2046	Total
21	ILAW Packages	0	0	0	0	0	0	0	1,673	3,345	3,345	3,345	199,292	211,000
22	WTP Melters	0	0	0	0	0	0	0	0	175	350	350	5,950	6,825

(a) To obtain cubic yards, multiply by 1.308.
(b) Rounded to nearest cubic meter in this table for calculational convenience; significant figures are not meant to indicate the accuracy of the numbers.

B.5 Radionuclide Inventories

Tables B.15 through B.23 contain the inventory of radionuclides in each of the major waste types or waste streams that are of major interest for migration calculations.

Table B.15. Inventory of Long-Lived Mobile Radionuclides in HSW for the Various Alternative Groups, Ci

LLW Previously Buried in Various Locations - Additive to All Alternative Groups												
Radionuclide	**Pre-1970 LLW**		**Total**	**1970-1988 LLW**		**Total**	**1989-1995 LLW**		**Total**	**Area Totals**		**Total**
	200 E	**200 W**		**200 E**	**200 W**		**200 E**	**200 W**		**200 E**	**200 W**	
C-14	0	0	0	2.2E+2	3.9E+2	6.1E+2	5.1E+0	9.3E+0	1.4E+1	2.2E+2	4.0E+2	6.2E+2
Tc-99	5.2E-1	1.3E-1	6.5E-1	0	0	0	1.4E-1	4.7E-1	6.1E-1	6.6E-1	6.0E-1	1.3E+0
Grouted Tc-99	0	0	0	0	0	0	0	0	0	0	0	0
I-129	1.2E-3	1.7E-4	1.4E-3	1.9E-2	1.8E-3	2.0E-2	9.5E-5	3.1E-2	3.1E-2	2.0E-2	3.3E-2	5.3E-2
Grouted I-129	0	0	0	0	0	0	0	0	0	0	0	0
U-233	1.0E+1	0	1.0E+1	0	0	0	2.1E-5	6.5E-2	6.5E-2	1.0E+1	6.5E-2	1.0E+1
U-234	3.7E-1	1.4E+0	1.8E+0	3.1E-2	3.9E+1	3.9E+1	1.9E-3	5.8E+0	5.8E+0	4.0E-1	4.7E+1	4.7E+1
U-235	1.1E-2	4.4E-2	5.5E-2	2.6E-3	3.3E+0	3.3E+0	4.3E-4	1.3E+0	1.3E+0	1.4E-2	4.7E+0	4.7E+0
U-236	7.5E-3	3.0E-2	3.7E-2	0	0	0	1.9E-6	5.8E-3	5.8E-3	7.5E-3	3.5E-2	4.3E-2
U-238	2.7E-1	1.1E+0	1.3E+0	6.3E-2	2.8E+1	2.8E+1	1.9E-2	6.0E+1	6.0E+1	3.5E-1	9.0E+1	9.0E+1
Sum U-23x[(a)]	1.1E+1	2.6E+0	1.4E+1	9.6E-2	7.1E+1	7.1E+1	2.2E-2	6.7E+1	6.8E+1	1.1E+1	1.4E+2	1.5E+2

(a) Doses per unit activity for the listed uranium isotopes are sufficiently similar that it is often convenient to employ only the total uranium in some calculations. For that reason, the sum of the activity of individual uranium isotopes is also given in this and following inventory tabulations.

Table B.16. Inventory of Long-Lived Mobile Radionuclides in HSW for Alternative Group A, Ci (Sheet 1 of 4)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group A - LLW and MLLW in deeper/wider trenches in 200E and 200W; melters and ILAW near PUREX												
	Category 1 LLW						**Category 3 LLW**					
	1996 to 2007			**2008 to 2046**			**1996 to 2007**			**2008 to 2046**		
Radionuclide	**200 E**	**200 W**	**Total**	**200 E**	**200 W**	**Total**	**200 E**	**200 W**	**Total**	**200 E**	**200 W**	**Total**
Hanford Only Waste Volume[(a)]												
C-14	0	3.3E+0	3.3E+0	0	1.3E+1	1.3E+1	0	1.5E-1	1.5E-1	0	4.4E-1	4.4E-1
Tc-99	0	3.0E-1	3.0E-1	0	1.1E+0	1.1E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	0	3.2E+3	3.2E+3
I-129	0	2.6E-3	2.6E-3	0	3.0E-3	3.0E-3	0	3.4E-7	3.4E-7	0	2.0E-6	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0
U-233	0	1.0E-1	1.0E-1	0	3.7E-1	3.7E-1	0	9.8E-2	9.8E-2	0	3.0E-1	3.0E-1
U-234	0	1.7E-1	1.7E-1	0	6.1E-1	6.1E-1	0	1.2E+2	1.2E+2	0	3.7E+2	3.7E+2
U-235	0	3.6E-2	3.6E-2	0	1.3E-1	1.3E-1	0	3.5E+0	3.5E+0	0	1.1E+1	1.1E+1
U-236	0	4.0E-3	4.0E-3	0	1.5E-2	1.5E-2	0	1.6E+1	1.6E+1	0	4.8E+1	4.8E+1
U-238	0	4.1E-1	4.1E-1	0	1.5E+0	1.5E+0	0	2.0E+2	2.0E+2	0	6.0E+2	6.0E+2
Sum of U-23x	0	7.2E-1	7.2E-1	0	2.6E+0	2.6E+0	0	3.4E+2	3.4E+2	0	1.0E+3	1.0E+3
Lower Bound Waste Volume												
C-14	0	4.1E+0	4.1E+0	0	1.6E+1	1.6E+1	0	1.5E-1	1.5E-1	0	4.6E-1	4.6E-1
Tc-99	0	3.7E-1	3.7E-1	0	1.3E+0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	0	3.2E+3	3.2E+3
I-129	0	3.2E-3	3.2E-3	0	3.7E-3	3.7E-3	0	3.5E-7	3.5E-7	0	2.0E-6	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0
U-233	0	1.3E-1	1.3E-1	0	4.5E-1	4.5E-1	0	1.0E-1	1.0E-1	0	3.1E-1	3.1E-1
U-234	0	2.1E-1	2.1E-1	0	7.5E-1	7.5E-1	0	1.3E+2	1.3E+2	0	3.9E+2	3.9E+2
U-235	0	4.3E-2	4.3E-2	0	1.6E-1	1.6E-1	0	3.7E+0	3.7E+0	0	1.1E+1	1.1E+1
U-236	0	4.9E-3	4.9E-3	0	1.8E-2	1.8E-2	0	1.7E+1	1.7E+1	0	5.0E+1	5.0E+1
U-238	0	5.0E-1	5.0E-1	0	1.8E+0	1.8E+0	0	2.1E+2	2.1E+2	0	6.2E+2	6.2E+2
Sum of U-23x	0	8.8E-1	8.8E-1	0	3.2E+0	3.2E+0	0	3.6E+2	3.6E+2	0	1.1E+3	1.1E+3

Table B.16. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group A - LLW and MLLW in deeper/wider trenches in 200E and 200W; melters and ILAW near PUREX												
	Category 1 LLW						Category 3 LLW					
	1996 to 2007			2008 to 2046			1996 to 2007			2008 to 2046		
Radionuclide	**200 E**	**200 W**	**Total**	**200 E**	**200 W**	**Total**	**200 E**	**200 W**	**Total**	**200 E**	**200 W**	**Total**
Upper Bound Waste Volume												
C-14	0	5.2E+0	5.2E+0	0	1.6E+1	1.6E+1	0	3.5E-1	3.5E-1	0	1.5E+2	1.5E+2
Tc-99	0	4.0E-1	4.0E-1	0	1.3E+0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0.0E+0	0	0	0.0E+0	0	0	7.2E+1	7.2E+1	0	3.2E+3	3.2E+3
I-129	0	3.2E-3	3.2E-3	0	3.7E-3	3.7E-3	0	3.5E-7	3.5E-7	0	2.0E-6	2.0E-6
Grouted I-129	0		0	0		0	0	0	0	0	5.0E+0	5.0E+0
U-233	0	1.3E-1	1.3E-1	0	4.5E-1	4.5E-1	0	2.3E-1	2.3E-1	0	1.8E-1	1.8E-1
U-234	0	9.0E-1	9.0E-1	0	9.2E-1	9.2E-1	0	2.9E+2	2.9E+2	0	3.1E+2	3.1E+2
U-235	0	8.9E-2	8.9E-2	0	1.7E-1	1.7E-1	0	8.4E+0	8.4E+0	0	1.2E+1	1.2E+1
U-236	0	4.9E-3	4.9E-3	0	1.8E-2	1.8E-2	0	3.8E+1	3.8E+1	0	2.9E+1	2.9E+1
U-238	0	1.7E+0	1.7E+0	0	2.1E+0	2.1E+0	0	4.7E+2	4.7E+2	0	5.0E+2	5.0E+2
Sum of U-23x	0	2.8E+0	2.8E+0	0	3.6E+0	3.6E+0	0	8.1E+2	8.1E+2	0	8.6E+2	8.6E+2

(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.

Table B.16. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046
Alternative Group A - LLW and MLLW in deeper/wider trenches in 200E and 200W; melters and ILAW near PUREX

Radionuclide	MLLW						Melter MLLW	ILAW (vitrified)	Area Totals Segregated		Total Segregated	Total HSW
	1996 to 2007			2008 to 2046								
	200 E	200 W	Total	200 E	200 W	Total	Near PUREX	Near PUREX	200 E	200 W		
Hanford Only Waste Volume[(a)]												
C-14	0	1.5E+0	1.5E+0	4.3E+0	0	4.3E+0	0	0	4.3E+0	1.8E+1	2.2E+1	6.4E+2
Tc-99	0	3.4E+0	3.4E+0	8.3E+0	0	8.3E+0	0	2.6E+4	2.6E+4	4.8E+0	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	1.6E+2	0	1.6E+2	3.9E+1	0	2.0E+2	3.3E+3	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	1.0E-1	0	1.0E-1	0	2.2E+1	2.2E+1	4.1E-2	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	1.3E+2	8.7E-1	1.3E+2	1.4E+2
U-234	0	5.4E+0	5.4E+0	1.6E+1	0	1.6E+1	4.6E-1	4.4E+1	6.1E+1	5.0E+2	5.6E+2	6.1E+2
U-235	0	8.7E-2	8.7E-2	2.6E-1	0	2.6E-1	1.9E-2	1.8E+0	2.1E+0	1.4E+1	1.7E+1	2.1E+1
U-236	0	1.0E-1	1.0E-1	3.0E-1	0	3.0E-1	1.7E-2	1.4E+0	1.7E+0	6.4E+1	6.6E+1	6.6E+1
U-238	0	1.4E+0	1.4E+0	4.0E+0	0	4.0E+0	4.1E-1	4.8E+1	5.3E+1	8.0E+2	8.5E+2	9.4E+2
Sum of U-23x	0	7.0E+0	7.0E+0	2.1E+1	0	2.1E+1	1.8E+0	2.3E+2	2.5E+2	1.4E+3	1.6E+3	1.8E+3
Lower Bound Waste Volume												
C-14	0	1.5E+0	1.5E+0	4.3E+0	0	4.3E+0	0	0	4.3E+0	2.2E+1	2.6E+1	6.5E+2
Tc-99	0	3.4E+0	3.4E+0	8.4E+0	0	8.4E+0	0	2.6E+4	2.6E+4	5.1E+0	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	1.6E+2	0	1.6E+2	3.9E+1	0	2.0E+2	3.3E+3	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	1.0E-1	0	1.0E-1	0	2.2E+1	2.2E+1	4.2E-2	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	1.3E+2	9.9E-1	1.3E+2	1.4E+2
U-234	0	5.5E+0	5.5E+0	1.6E+1	0	1.6E+1	4.6E-1	4.4E+1	6.1E+1	5.2E+2	5.9E+2	6.3E+2
U-235	0	8.7E-2	8.7E-2	2.6E-1	0	2.6E-1	1.9E-2	1.8E+0	2.1E+0	1.5E+1	1.7E+1	2.2E+1
U-236	0	1.0E-1	1.0E-1	3.0E-1	0	3.0E-1	1.7E-2	1.4E+0	1.7E+0	6.7E+1	6.9E+1	6.9E+1
U-238	0	1.4E+0	1.4E+0	4.0E+0	0	4.0E+0	4.1E-1	4.8E+1	5.3E+1	8.3E+2	8.9E+2	9.8E+2
Sum of U-23x	0	7.0E+0	7.0E+0	2.1E+1	0	2.1E+1	1.8E+0	2.3E+2	2.5E+2	1.4E+3	1.7E+3	1.8E+3

Table B.16. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046
Alternative Group A - LLW and MLLW in deeper/wider trenches in 200E and 200W; melters and ILAW near PUREX

Radionuclide	MLLW 1996 to 2007 200 E	MLLW 1996 to 2007 200 W	MLLW 1996 to 2007 Total	MLLW 2008 to 2046 200 E	MLLW 2008 to 2046 200 W	MLLW 2008 to 2046 Total	Melter MLLW Near PUREX	ILAW (vitrified) Near PUREX	Area Totals Segregated 200 E	Area Totals Segregated 200 W	Total Segregated	Total HSW
Upper Bound Waste Volume												
C-14	1.6E+0	1.1E+0	2.7E+0	5.7E+0	0	5.7E+0	0	0	7.3E+0	1.7E+2	1.7E+2	8.0E+2
Tc-99	1.4E+0	2.1E+0	3.5E+0	8.3E+0	0	8.3E+0	0	2.6E+4	2.6E+4	3.8E+0	2.6E+4	2.6E+4
Grouted Tc-99	1.2E+2	6.0E+1	1.8E+2	3.3E+2	0	3.3E+2	3.9E+1	0	5.0E+2	3.4E+3	3.9E+3	3.9E+3
I-129	1.7E-2	1.7E-2	3.4E-2	1.1E-1	0	1.1E-1	0	2.2E+1	2.2E+1	2.4E-2	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0	5.0E+0
U-233	2.2E-3	2.2E-3	4.4E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	1.3E+2	9.9E-1	1.3E+2	1.4E+2
U-234	2.3E+2	1.1E+2	3.3E+2	3.4E+2	0	3.4E+2	4.6E-1	4.4E+1	6.1E+2	7.2E+2	1.3E+3	1.4E+3
U-235	1.0E+1	4.8E+0	1.5E+1	1.5E+1	0	1.5E+1	1.9E-2	1.8E+0	2.6E+1	2.5E+1	5.2E+1	5.7E+1
U-236	4.9E-2	4.9E-2	9.7E-2	3.1E-1	0	3.1E-1	1.7E-2	1.4E+0	1.8E+0	6.7E+1	6.9E+1	6.9E+1
U-238	2.3E+2	1.1E+2	3.5E+2	3.4E+2	0	3.4E+2	4.1E-1	4.8E+1	6.3E+2	1.1E+3	1.7E+3	1.8E+3
Sum of U-23x	4.7E+2	2.3E+2	6.9E+2	7.0E+2	0	7.0E+2	1.8E+0	2.3E+2	1.4E+3	1.9E+3	3.3E+3	3.4E+3

(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.

Table B.17. Inventory of Long-Lived Mobile Radionuclides in HSW for Alternative Group B, Ci (Sheet 1 of 4)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group B - LLW and MLLW in conventional trenches in 200E and 200W; melters in 200E; and ILAW in 200W												
Radionuclide	Category 1 LLW						Category 3 LLW					
	1996 to 2007			2008 to 2046			1996 to 2007			2008 to 2046		
	200 E	200 W	Total	200 E	200 W	Total	200 E	200 W	Total	200 E	200 W	Total
Hanford Only Waste Volume[(a)]												
C-14	1.2E-1	3.2E+0	3.3E+0	4.8E-1	1.2E+1	1.3E+1	5.6E-3	1.4E-1	1.5E-1	1.7E-2	4.3E-1	4.4E-1
Tc-99	1.1E-2	2.9E-1	3.0E-1	4.1E-2	1.0E+0	1.1E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	2.7E+0	6.9E+1	7.2E+1	1.2E+2	3.1E+3	3.2E+3
I-129	9.8E-5	2.5E-3	2.6E-3	1.1E-4	2.9E-3	3.0E-3	1.3E-8	3.3E-7	3.4E-7	7.4E-8	1.9E-6	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0
U-233	3.9E-3	9.8E-2	1.0E-1	1.4E-2	3.6E-1	3.7E-1	3.7E-3	9.4E-2	9.8E-2	1.1E-2	2.9E-1	3.0E-1
U-234	6.4E-3	1.6E-1	1.7E-1	2.3E-2	5.9E-1	6.1E-1	4.7E+0	1.2E+2	1.2E+2	1.4E+1	3.6E+2	3.7E+2
U-235	1.3E-3	3.4E-2	3.6E-2	4.8E-3	1.2E-1	1.3E-1	1.3E-1	3.4E+0	3.5E+0	4.0E-1	1.0E+1	1.1E+1
U-236	1.5E-4	3.9E-3	4.0E-3	5.5E-4	1.4E-2	1.5E-2	6.0E-1	1.5E+1	1.6E+1	1.8E+0	4.6E+1	4.8E+1
U-238	1.5E-2	3.9E-1	4.1E-1	5.5E-2	1.4E+0	1.5E+0	7.5E+0	1.9E+2	2.0E+2	2.2E+1	5.8E+2	6.0E+2
Sum of U-23x	2.7E-2	6.9E-1	7.2E-1	9.7E-2	2.5E+0	2.6E+0	1.3E+1	3.3E+2	3.4E+2	3.9E+1	9.9E+2	1.0E+3
Lower Bound Waste Volume												
C-14	1.5E-1	3.9E+0	4.1E+0	5.9E-1	1.5E+1	1.6E+1	5.8E-3	1.5E-1	1.5E-1	1.7E-2	4.5E-1	4.6E-1
Tc-99	1.4E-2	3.5E-1	3.7E-1	5.0E-2	1.3E+0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	2.7E+0	6.9E+1	7.2E+1	1.2E+2	3.1E+3	3.2E+3
I-129	1.2E-4	3.1E-3	3.2E-3	1.4E-4	3.5E-3	3.7E-3	1.3E-8	3.4E-7	3.5E-7	7.7E-8	2.0E-6	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0
U-233	4.7E-3	1.2E-1	1.2E-1	1.7E-2	4.4E-1	4.5E-1	3.8E-3	9.8E-2	1.0E-1	1.2E-2	3.0E-1	3.1E-1
U-234	7.8E-3	2.0E-1	2.1E-1	2.8E-2	7.2E-1	7.5E-1	4.9E+0	1.2E+2	1.3E+2	1.5E+1	3.7E+2	3.9E+2
U-235	1.6E-3	4.2E-2	4.3E-2	5.9E-3	1.5E-1	1.6E-1	1.4E-1	3.6E+0	3.7E+0	4.2E-1	1.1E+1	1.1E+1
U-236	1.9E-4	4.7E-3	4.9E-3	6.7E-4	1.7E-2	1.8E-2	6.3E-1	1.6E+1	1.7E+1	1.9E+0	4.8E+1	5.0E+1
U-238	1.9E-2	4.8E-1	4.9E-1	6.7E-2	1.7E+0	1.8E+0	7.8E+0	2.0E+2	2.1E+2	2.3E+1	6.0E+2	6.2E+2
Sum of U-23x	3.3E-2	8.4E-1	8.7E-1	1.2E-1	3.0E+0	3.2E+0	1.3E+1	3.4E+2	3.6E+2	4.0E+1	1.0E+3	1.1E+3

Table B.17. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group B - LLW and MLLW in conventional trenches in 200E and 200W; melters in 200E; and ILAW in 200W												
Radionuclide	**Category 1 LLW**						**Category 3 LLW**					
	1996 to 2007			**2008 to 2046**			**1996 to 2007**			**2008 to 2046**		
	200 E	**200 W**	**Total**	**200 E**	**200 W**	**Total**	**200 E**	**200 W**	**Total**	**200 E**	**200 W**	**Total**
Upper Bound Waste Volume												
C-14	7.2E-1	4.5E+0	5.2E+0	2.2E+0	1.4E+1	1.6E+1	1.3E-2	3.4E-1	3.5E-1	5.5E+0	1.4E+2	1.4E+2
Tc-99	5.5E-2	3.4E-1	4.0E-1	1.8E-1	1.2E+0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0.0E+0	0.0E+0	0	0.0E+0	0.0E+0	0	2.7E+0	6.9E+1	7.2E+1	1.2E+2	3.1E+3	3.2E+3
I-129	4.4E-4	2.8E-3	3.2E-3	5.1E-4	3.2E-3	3.7E-3	1.3E-8	3.4E-7	3.5E-7	7.7E-8	2.0E-6	2.0E-6
Grouted I-129			0			0	0	0	0	0	5.0E+0	5.0E+0
U-233	1.7E-2	1.1E-1	1.3E-1	6.2E-2	3.9E-1	4.5E-1	8.7E-3	2.2E-1	2.3E-1	6.8E-3	1.7E-1	1.8E-1
U-234	1.3E-1	7.8E-1	9.0E-1	1.3E-1	7.9E-1	9.2E-1	1.1E+1	2.8E+2	2.9E+2	1.2E+1	3.0E+2	3.1E+2
U-235	1.2E-2	7.6E-2	8.9E-2	2.3E-2	1.5E-1	1.7E-1	3.2E-1	8.1E+0	8.4E+0	4.5E-1	1.2E+1	1.2E+1
U-236	6.8E-4	4.2E-3	4.9E-3	2.5E-3	1.5E-2	1.8E-2	1.4E+0	3.7E+1	3.8E+1	1.1E+0	2.8E+1	2.9E+1
U-238	2.3E-1	1.4E+0	1.7E+0	2.9E-1	1.8E+0	2.1E+0	1.8E+1	4.5E+2	4.7E+2	1.9E+1	4.9E+2	5.0E+2
Sum of U-23x	3.8E-1	2.4E+0	2.8E+0	5.0E-1	3.1E+0	3.6E+0	3.1E+1	7.8E+2	8.1E+2	3.2E+1	8.2E+2	8.6E+2
(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.												

Table B.17. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group B - LLW and MLLW in conventional trenches in 200E and 200W; melters in 200E; and ILAW in 200W												
	MLLW						Melter MLLW	ILAW (vitrified)	Area Totals			
	1996 to 2007			2008 to future					Segregated			
Radionuclide	200 E	200 W	Total	200 E	200 W	Total	200 E	200W	200 E	200 W	Total Segregated	Total HSW
Hanford Only Waste Volume[(a)]												
C-14	0	1.5E+0	1.5E+0	4.3E+0	0	4.3E+0	0	0	4.9E+0	1.8E+1	2.2E+1	6.4E+2
Tc-99	0	3.4E+0	3.4E+0	8.3E+0	0	8.3E+0	0	2.6E+4	8.4E+0	2.6E+4	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	1.6E+2	0	1.6E+2	3.9E+1	0	3.2E+2	3.2E+3	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	1.0E-1	0	1.0E-1	0	2.2E+1	1.0E-1	2.2E+1	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	9.0E-1	1.3E+2	1.3E+2	1.4E+2
U-234	0	5.4E+0	5.4E+0	1.6E+1	0	1.6E+1	4.6E-1	4.4E+1	3.5E+1	5.3E+2	5.6E+2	6.1E+2
U-235	0	8.7E-2	8.7E-2	2.6E-1	0	2.6E-1	1.9E-2	1.8E+0	8.2E-1	1.6E+1	1.7E+1	2.1E+1
U-236	0	1.0E-1	1.0E-1	3.0E-1	0	3.0E-1	1.7E-2	1.4E+0	2.7E+0	6.3E+1	6.6E+1	6.6E+1
U-238	0	1.4E+0	1.4E+0	4.0E+0	0	4.0E+0	4.1E-1	4.8E+1	3.4E+1	8.2E+2	8.5E+2	9.4E+2
Sum of U-23x	0	7.0E+0	7.0E+0	2.1E+1	0	2.1E+1	1.8E+0	2.3E+2	7.4E+1	1.6E+3	1.6E+3	1.8E+3
Lower Bound Waste Volume												
C-14	0	1.5E+0	1.5E+0	4.3E+0	0	4.3E+0	0	0	5.1E+0	2.1E+1	2.6E+1	6.5E+2
Tc-99	0	3.4E+0	3.4E+0	8.4E+0	0	8.4E+0	0	2.6E+4	8.4E+0	2.6E+4	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	1.6E+2	0	1.6E+2	3.9E+1	0	3.2E+2	3.2E+3	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	1.0E-1	0	1.0E-1	0	2.2E+1	1.0E-1	2.2E+1	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	9.0E-1	1.3E+2	1.3E+2	1.4E+2
U-234	0	5.5E+0	5.5E+0	1.6E+1	0	1.6E+1	4.6E-1	4.4E+1	3.6E+1	5.5E+2	5.8E+2	6.3E+2
U-235	0	8.7E-2	8.7E-2	2.6E-1	0	2.6E-1	1.9E-2	1.8E+0	8.4E-1	1.6E+1	1.7E+1	2.2E+1
U-236	0	1.0E-1	1.0E-1	3.0E-1	0	3.0E-1	1.7E-2	1.4E+0	2.8E+0	6.6E+1	6.9E+1	6.9E+1
U-238	0	1.4E+0	1.4E+0	4.0E+0	0	4.0E+0	4.1E-1	4.8E+1	3.6E+1	8.5E+2	8.9E+2	9.8E+2
Sum of U-23x	0	7.0E+0	7.0E+0	2.1E+1	0	2.1E+1	1.8E+0	2.3E+2	7.6E+1	1.6E+3	1.7E+3	1.8E+3

Table B.17. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group B - LLW and MLLW in conventional trenches in 200E and 200W; melters in 200E; and ILAW in 200W												
	MLLW						Melter MLLW	ILAW (vitrified)	Area Totals			
	1996 to 2007			2008 to future					Segregated			
Radionuclide	200 E	200 W	Total	200 E	200 W	Total	200 E	200W	200 E	200 W	Total Segregated	Total HSW
Upper Bound Waste Volume												
C-14	1.6E+0	1.1E+0	2.7E+0	5.7E+0	0	5.7E+0	0	0	1.6E+1	1.6E+2	1.7E+2	8.0E+2
Tc-99	1.4E+0	2.1E+0	3.5E+0	8.3E+0	0	8.3E+0	0	2.6E+4	9.9E+0	2.6E+4	2.6E+4	2.6E+4
Grouted Tc-99	1.2E+2	6.0E+1	1.8E+2	3.3E+2	0	3.3E+2	3.9E+1	0	6.2E+2	3.2E+3	3.9E+3	3.9E+3
I-129	1.7E-2	1.7E-2	3.4E-2	1.1E-1	0	1.1E-1	0	2.2E+1	1.2E-1	2.2E+1	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0	5.0E+0
U-233	2.2E-3	2.2E-3	4.4E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	9.6E-1	1.3E+2	1.3E+2	1.4E+2
U-234	2.3E+2	1.1E+2	3.3E+2	3.4E+2	0	3.4E+2	4.6E-1	4.4E+1	5.9E+2	7.4E+2	1.3E+3	1.4E+3
U-235	1.0E+1	4.8E+0	1.5E+1	1.5E+1	0	1.5E+1	1.9E-2	1.8E+0	2.5E+1	2.6E+1	5.2E+1	5.7E+1
U-236	4.9E-2	4.9E-2	9.7E-2	3.1E-1	0	3.1E-1	1.7E-2	1.4E+0	2.9E+0	6.6E+1	6.9E+1	6.9E+1
U-238	2.3E+2	1.1E+2	3.5E+2	3.4E+2	0	3.4E+2	4.1E-1	4.8E+1	6.1E+2	1.1E+3	1.7E+3	1.8E+3
Sum of U-23x	4.7E+2	2.3E+2	6.9E+2	7.0E+2	0	7.0E+2	1.8E+0	2.3E+2	1.2E+3	2.1E+3	3.3E+3	3.4E+3

(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.

Table B.18. Inventory of Long-Lived Mobile Radionuclides in HSW for Alternative Group C, Ci (Sheet 1 of 4)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group C - Single expandable trenches: LLW in 200W, MLLW in 200E, and ILAW near PUREX; melters also near PUREX												
Radionuclide	**Category 1 LLW**						**Category 3 LLW**					
	1996 to 2007			**2008 to 2046**			**1996 to 2007**			**2008 to 2046**		
	200 E	**200 W**	**Total**	**200 E**	**200 W**	**Total**	**200 E**	**200 W**	**Total**	**200 E**	**200 W**	**Total**
Hanford Only Waste Volume[(a)]												
C-14	0	3.3E+0	3.3E+0	0	1.3E+1	1.3E+1	0	1.5E-1	1.5E-1	0	4.4E-1	4.4E-1
Tc-99	0	3.0E-1	3.0E-1	0	1.1E+0	1.1E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	0	3.2E+3	3.2E+3
I-129	0	2.6E-3	2.6E-3	0	3.0E-3	3.0E-3	0	3.4E-7	3.4E-7	0	2.0E-6	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0
U-233	0	1.0E-1	1.0E-1	0	3.7E-1	3.7E-1	0	9.8E-2	9.8E-2	0	3.0E-1	3.0E-1
U-234	0	1.7E-1	1.7E-1	0	6.1E-1	6.1E-1	0	1.2E+2	1.2E+2	0	3.7E+2	3.7E+2
U-235	0	3.6E-2	3.6E-2	0	1.3E-1	1.3E-1	0	3.5E+0	3.5E+0	0	1.1E+1	1.1E+1
U-236	0	4.0E-3	4.0E-3	0	1.5E-2	1.5E-2	0	1.6E+1	1.6E+1	0	4.8E+1	4.8E+1
U-238	0	4.1E-1	4.1E-1	0	1.5E+0	1.5E+0	0	2.0E+2	2.0E+2	0	6.0E+2	6.0E+2
Sum of U-23x	0	7.2E-1	7.2E-1	0	2.6E+0	2.6E+0	0	3.4E+2	3.4E+2	0	1.0E+3	1.0E+3
Lower Bound Waste Volume												
C-14	0	4.1E+0	4.1E+0	0	1.6E+1	1.6E+1	0	1.5E-1	1.5E-1	0	4.6E-1	4.6E-1
Tc-99	0	3.7E-1	3.7E-1	0	1.3E+0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	0	3.2E+3	3.2E+3
I-129	0	3.2E-3	3.2E-3	0	3.7E-3	3.7E-3	0	3.5E-7	3.5E-7	0	2.0E-6	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0
U-233	0	1.3E-1	1.3E-1	0	4.5E-1	4.5E-1	0	1.0E-1	1.0E-1	0	3.1E-1	3.1E-1
U-234	0	2.1E-1	2.1E-1	0	7.5E-1	7.5E-1	0	1.3E+2	1.3E+2	0	3.9E+2	3.9E+2
U-235	0	4.3E-2	4.3E-2	0	1.6E-1	1.6E-1	0	3.7E+0	3.7E+0	0	1.1E+1	1.1E+1
U-236	0	4.9E-3	4.9E-3	0	1.8E-2	1.8E-2	0	1.7E+1	1.7E+1	0	5.0E+1	5.0E+1
U-238	0	5.0E-1	5.0E-1	0	1.8E+0	1.8E+0	0	2.1E+2	2.1E+2	0	6.2E+2	6.2E+2
Sum of U-23x	0	8.8E-1	8.8E-1	0	3.2E+0	3.2E+0	0	3.6E+2	3.6E+2	0	1.1E+3	1.1E+3

Table B.18. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group C - Single expandable trenches: LLW in 200W, MLLW in 200E, and ILAW near PUREX; melters also near PUREX												
Radionuclide	Category 1 LLW						Category 3 LLW					
	1996 to 2007			2008 to 2046			1996 to 2007			2008 to 2046		
	200 E	200 W	Total	200 E	200 W	Total	200 E	200 W	Total	200 E	200 W	Total
Upper Bound Waste Volume												
C-14	0	5.2E+0	5.2E+0	0	1.6E+1	1.6E+1	0	3.5E-1	3.5E-1	0	1.5E+2	1.5E+2
Tc-99	0	4.0E-1	4.0E-1	0	1.3E+0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0.0E+0	0	0	0.0E+0	0	0	7.2E+1	7.2E+1	0	3.2E+3	3.2E+3
I-129	0	3.2E-3	3.2E-3	0	3.7E-3	3.7E-3	0	3.5E-7	3.5E-7	0	2.0E-6	2.0E-6
Grouted I-129	0		0	0		0	0	0	0	0	5.0E+0	5.0E+0
U-233	0	1.3E-1	1.3E-1	0	4.5E-1	4.5E-1	0	2.3E-1	2.3E-1	0	1.8E-1	1.8E-1
U-234	0	9.0E-1	9.0E-1	0	9.2E-1	9.2E-1	0	2.9E+2	2.9E+2	0	3.1E+2	3.1E+2
U-235	0	8.9E-2	8.9E-2	0	1.7E-1	1.7E-1	0	8.4E+0	8.4E+0	0	1.2E+1	1.2E+1
U-236	0	4.9E-3	4.9E-3	0	1.8E-2	1.8E-2	0	3.8E+1	3.8E+1	0	2.9E+1	2.9E+1
U-238	0	1.7E+0	1.7E+0	0	2.1E+0	2.1E+0	0	4.7E+2	4.7E+2	0	5.0E+2	5.0E+2
Sum of U-23x	0	2.8E+0	2.8E+0	0	3.6E+0	3.6E+0	0	8.1E+2	8.1E+2	0	8.6E+2	8.6E+2

(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.

Table B.18. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group C - Single expandable trenches: LLW in 200W, MLLW in 200E, and ILAW near PUREX; melters also near PUREX												
	MLLW						Melter MLLW	ILAW (vitrified)	Area Totals			
	1996 to 2007			2008 to 2046					Segregated			
Radionuclide	200 E	200 W	Total	200 E	200 W	Total	Near PUREX	Near PUREX	200 E	200 W	Total Segregated	Total HSW
Hanford Only Waste Volume[(a)]												
C-14	0	1.5E+0	1.5E+0	4.3E+0	0	4.3E+0	0	0	4.3E+0	1.8E+1	2.2E+1	6.4E+2
Tc-99	0	3.4E+0	3.4E+0	8.3E+0	0	8.3E+0	0	2.6E+4	2.6E+4	4.8E+0	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	1.6E+2	0	1.6E+2	3.9E+1	0	2.0E+2	3.3E+3	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	1.0E-1	0	1.0E-1	0	2.2E+1	2.2E+1	4.1E-2	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	1.3E+2	8.7E-1	1.3E+2	1.4E+2
U-234	0	5.4E+0	5.4E+0	1.6E+1	0	1.6E+1	4.6E-1	4.4E+1	6.1E+1	5.0E+2	5.6E+2	6.1E+2
U-235	0	8.7E-2	8.7E-2	2.6E-1	0	2.6E-1	1.9E-2	1.8E+0	2.1E+0	1.4E+1	1.7E+1	2.1E+1
U-236	0	1.0E-1	1.0E-1	3.0E-1	0	3.0E-1	1.7E-2	1.4E+0	1.7E+0	6.4E+1	6.6E+1	6.6E+1
U-238	0	1.4E+0	1.4E+0	4.0E+0	0	4.0E+0	4.1E-1	4.8E+1	5.3E+1	8.0E+2	8.5E+2	9.4E+2
Sum of U-23x	0	7.0E+0	7.0E+0	2.1E+1	0	2.1E+1	1.8E+0	2.3E+2	2.5E+2	1.4E+3	1.6E+3	1.8E+3
Lower Bound Waste Volume												
C-14	0	1.5E+0	1.5E+0	4.3E+0	0	4.3E+0	0	0	4.3E+0	2.2E+1	2.6E+1	6.5E+2
Tc-99	0	3.4E+0	3.4E+0	8.4E+0	0	8.4E+0	0	2.6E+4	2.6E+4	5.1E+0	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	1.6E+2	0	1.6E+2	3.9E+1	0	2.0E+2	3.3E+3	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	1.0E-1	0	1.0E-1	0	2.2E+1	2.2E+1	4.2E-2	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	1.3E+2	9.9E-1	1.3E+2	1.4E+2
U-234	0	5.5E+0	5.5E+0	1.6E+1	0	1.6E+1	4.6E-1	4.4E+1	6.1E+1	5.2E+2	5.9E+2	6.3E+2
U-235	0	8.7E-2	8.7E-2	2.6E-1	0	2.6E-1	1.9E-2	1.8E+0	2.1E+0	1.5E+1	1.7E+1	2.2E+1
U-236	0	1.0E-1	1.0E-1	3.0E-1	0	3.0E-1	1.7E-2	1.4E+0	1.7E+0	6.7E+1	6.9E+1	6.9E+1
U-238	0	1.4E+0	1.4E+0	4.0E+0	0	4.0E+0	4.1E-1	4.8E+1	5.3E+1	8.3E+2	8.9E+2	9.8E+2
Sum of U-23x	0	7.0E+0	7.0E+0	2.1E+1	0.0E+0	2.1E+1	1.8E+0	2.3E+2	2.5E+2	1.4E+3	1.7E+3	1.8E+3

Table B.18. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group C - Single expandable trenches: LLW in 200W, MLLW in 200E, and ILAW near PUREX; melters also near PUREX												
	MLLW						Melter MLLW	ILAW (vitrified)	Area Totals			
	1996 to 2007			2008 to 2046					Segregated			
Radionuclide	200 E	200 W	Total	200 E	200 W	Total	Near PUREX	Near PUREX	200 E	200 W	Total Segregated	Total HSW
Upper Bound Waste Volume												
C-14	1.6E+0	1.1E+0	2.7E+0	5.7E+0	0	5.7E+0	0	0	7.3E+0	1.7E+2	1.7E+2	8.0E+2
Tc-99	1.4E+0	2.1E+0	3.5E+0	8.3E+0	0	8.3E+0	0	2.6E+4	2.6E+4	3.8E+0	2.6E+4	2.6E+4
Grouted Tc-99	1.2E+2	6.0E+1	1.8E+2	3.3E+2	0	3.3E+2	3.9E+1	0	5.0E+2	3.4E+3	3.9E+3	3.9E+3
I-129	1.7E-2	1.7E-2	3.4E-2	1.1E-1	0	1.1E-1	0	2.2E+1	2.2E+1	2.4E-2	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0	5.0E+0
U-233	2.2E-3	2.2E-3	4.4E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	1.3E+2	9.9E-1	1.3E+2	1.4E+2
U-234	2.3E+2	1.1E+2	3.3E+2	3.4E+2	0	3.4E+2	4.6E-1	4.4E+1	6.1E+2	7.2E+2	1.3E+3	1.4E+3
U-235	1.0E+1	4.8E+0	1.5E+1	1.5E+1	0	1.5E+1	1.9E-2	1.8E+0	2.6E+1	2.5E+1	5.2E+1	5.7E+1
U-236	4.9E-2	4.9E-2	9.7E-2	3.1E-1	0	3.1E-1	1.7E-2	1.4E+0	1.8E+0	6.7E+1	6.9E+1	6.9E+1
U-238	2.3E+2	1.1E+2	3.5E+2	3.4E+2	0	3.4E+2	4.1E-1	4.8E+1	6.3E+2	1.1E+3	1.7E+3	1.8E+3
Sum of U-23x	4.7E+2	2.3E+2	6.9E+2	7.0E+2	0	7.0E+2	1.8E+0	2.3E+2	1.4E+3	1.9E+3	3.3E+3	3.4E+3
(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.												

Table B.19. Inventory of Long-Lived Mobile Radionuclides in HSW for Alternative Groups D_1 and D_2, Ci (Sheet 1 of 4)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046
Alternative Group D_1. LLW, MLLW, ILAW, and melters in a Lined Modular Facility near PUREX
Alternative Group D_2. LLW, MLLW, ILAW, and melters in a Lined Modular Facility in 200E LLBGs

	Category 1 LLW						Category 3 LLW					
	1996 to 2007			2008 to 2046			1996 to 2007			2008 to 2046		
Radionuclide	200 E	200 W	Total	Near PUREX	200 W	Total	200 E	200 W	Total	Near PUREX	200 W	Total
Hanford Only Waste Volume[(a)]												
C-14	0	3.3E+0	3.3E+0	1.3E+1	0	1.3E+1	0	1.5E-1	1.5E-1	4.4E-1	0	4.4E-1
Tc-99	0	3.0E-1	3.0E-1	1.1E+0	0	1.1E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	3.2E+3	0	3.2E+3
I-129	0	2.6E-3	2.6E-3	3.0E-3	0	3.0E-3	0	3.4E-7	3.4E-7	2.0E-6	0	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	0	5.0E+0
U-233	0	1.0E-1	1.0E-1	3.7E-1	0	3.7E-1	0	9.8E-2	9.8E-2	3.0E-1	0	3.0E-1
U-234	0	1.7E-1	1.7E-1	6.1E-1	0	6.1E-1	0	1.2E+2	1.2E+2	3.7E+2	0	3.7E+2
U-235	0	3.6E-2	3.6E-2	1.3E-1	0	1.3E-1	0	3.5E+0	3.5E+0	1.1E+1	0	1.1E+1
U-236	0	4.0E-3	4.0E-3	1.5E-2	0	1.5E-2	0	1.6E+1	1.6E+1	4.8E+1	0	4.8E+1
U-238	0	4.1E-1	4.1E-1	1.5E+0	0	1.5E+0	0	2.0E+2	2.0E+2	6.0E+2	0	6.0E+2
Sum of U-23x	0	7.2E-1	7.2E-1	2.6E+0	0	2.6E+0	0	3.4E+2	3.4E+2	1.0E+3	0	1.0E+3
Lower Bound Waste Volume												
C-14	0	4.1E+0	4.1E+0	1.6E+1	0	1.6E+1	0	1.5E-1	1.5E-1	4.6E-1	0	4.6E-1
Tc-99	0	3.7E-1	3.7E-1	1.3E+0	0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	3.2E+3	0	3.2E+3
I-129	0	3.2E-3	3.2E-3	3.7E-3	0	3.7E-3	0	3.5E-7	3.5E-7	2.0E-6	0	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	0	5.0E+0
U-233	0	1.3E-1	1.3E-1	4.5E-1	0	4.5E-1	0	1.0E-1	1.0E-1	3.1E-1	0	3.1E-1
U-234	0	2.1E-1	2.1E-1	7.5E-1	0	7.5E-1	0	1.3E+2	1.3E+2	3.9E+2	0	3.9E+2
U-235	0	4.3E-2	4.3E-2	1.6E-1	0	1.6E-1	0	3.7E+0	3.7E+0	1.1E+1	0	1.1E+1
U-236	0	4.9E-3	4.9E-3	1.8E-2	0	1.8E-2	0	1.7E+1	1.7E+1	5.0E+1	0	5.0E+1
U-238	0	5.0E-1	5.0E-1	1.8E+0	0	1.8E+0	0	2.1E+2	2.1E+2	6.2E+2	0	6.2E+2
Sum of U-23x	0	8.8E-1	8.8E-1	3.2E+0	0	3.2E+0	0	3.6E+2	3.6E+2	1.1E+3	0	1.1E+3

Table B.19. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group D_1. LLW, MLLW, ILAW, and melters in a Lined Modular Facility near PUREX Alternative Group D_2. LLW, MLLW, ILAW, and melters in a Lined Modular Facility in 200E LLBGs												
	Category 1 LLW						**Category 3 LLW**					
	1996 to 2007			**2008 to 2046**			**1996 to 2007**			**2008 to 2046**		
Radionuclide	**200 E**	**200 W**	**Total**	**Near PUREX**	**200 W**	**Total**	**200 E**	**200 W**	**Total**	**Near PUREX**	**200 W**	**Total**
Upper Bound Waste Volume												
C-14	0	5.2E+0	5.2E+0	1.6E+1	0	1.6E+1	0	3.5E-1	3.5E-1	1.5E+2	0	1.5E+2
Tc-99	0	4.0E-1	4.0E-1	1.3E+0	0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0.0E+0	0	0.0E+0	0	0	0	7.2E+1	7.2E+1	3.2E+3	0	3.2E+3
I-129	0	3.2E-3	3.2E-3	3.7E-3	0	3.7E-3	0	3.5E-7	3.5E-7	2.0E-6	0	2.0E-6
Grouted I-129	0		0		0	0	0	0	0	5.0E+0	0	5.0E+0
U-233	0	1.3E-1	1.3E-1	4.5E-1	0	4.5E-1	0	2.3E-1	2.3E-1	1.8E-1	0	1.8E-1
U-234	0	9.0E-1	9.0E-1	9.2E-1	0	9.2E-1	0	2.9E+2	2.9E+2	3.1E+2	0	3.1E+2
U-235	0	8.9E-2	8.9E-2	1.7E-1	0	1.7E-1	0	8.4E+0	8.4E+0	1.2E+1	0	1.2E+1
U-236	0	4.9E-3	4.9E-3	1.8E-2	0	1.8E-2	0	3.8E+1	3.8E+1	2.9E+1	0	2.9E+1
U-238	0	1.7E+0	1.7E+0	2.1E+0	0	2.1E+0	0	4.7E+2	4.7E+2	5.0E+2	0	5.0E+2
Sum of U-23x	0	2.8E+0	2.8E+0	3.6E+0	0	3.6E+0	0	8.1E+2	8.1E+2	8.6E+2	0	8.6E+2

(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.

Table B.19. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group D_1 - LLW, MLLW, ILAW, and melters in a Lined Modular Facility near PUREX Alternative Group D_2 - LLW, MLLW, ILAW, and melters in a Lined Modular Facility in 200E LLBGs												
	MLLW						Melter MLLW	ILAW (vitrified)	Area Totals			
	1996 to 2007			2008 to 2046					Segregated			
Radionuclide	200 E	200 W	Total	200 E	200 W	Total	200 E	200 E	200 E	200 W	Total Segregated	Total HSW
Hanford Only Waste Volume(a)												
C-14	0	1.5E+0	1.5E+0	4.3E+0	0	4.3E+0	0	0	1.8E+1	4.9E+0	2.2E+1	6.4E+2
Tc-99	0	3.4E+0	3.4E+0	8.3E+0	0	8.3E+0	0	2.6E+4	2.6E+4	3.7E+0	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	1.6E+2	0	1.6E+2	3.9E+1	0	3.4E+3	7.7E+1	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	1.0E-1	0	1.0E-1	0	2.2E+1	2.2E+1	3.8E-2	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	5.0E+0	0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	1.3E+2	2.1E-1	1.3E+2	1.4E+2
U-234	0	5.4E+0	5.4E+0	1.6E+1	0	1.6E+1	4.6E-1	4.4E+1	4.3E+2	1.3E+2	5.6E+2	6.1E+2
U-235	0	8.7E-2	8.7E-2	2.6E-1	0	2.6E-1	1.9E-2	1.8E+0	1.3E+1	3.7E+0	1.7E+1	2.1E+1
U-236	0	1.0E-1	1.0E-1	3.0E-1	0	3.0E-1	1.7E-2	1.4E+0	5.0E+1	1.6E+1	6.6E+1	6.6E+1
U-238	0	1.4E+0	1.4E+0	4.0E+0	0	4.0E+0	4.1E-1	4.8E+1	6.5E+2	2.0E+2	8.5E+2	9.4E+2
Sum of U-23x	0	7.0E+0	7.0E+0	2.1E+1	0	2.1E+1	1.8E+0	2.3E+2	1.3E+3	3.5E+2	1.6E+3	1.8E+3
Lower Bound Waste Volume												
C-14	0	1.5E+0	1.5E+0	4.3E+0	0	4.3E+0	0	0	2.0E+1	5.7E+0	2.6E+1	6.5E+2
Tc-99	0	3.4E+0	3.4E+0	8.4E+0	0	8.4E+0	0	2.6E+4	2.6E+4	3.8E+0	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	1.6E+2	0	1.6E+2	3.9E+1	0	3.4E+3	7.7E+1	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	1.0E-1	0	1.0E-1	0	2.2E+1	2.2E+1	3.8E-2	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	5.0E+0	0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	1.3E+2	2.3E-1	1.3E+2	1.4E+2
U-234	0	5.5E+0	5.5E+0	1.6E+1	0	1.6E+1	4.6E-1	4.4E+1	4.5E+2	1.3E+2	5.9E+2	6.3E+2
U-235	0	8.7E-2	8.7E-2	2.6E-1	0	2.6E-1	1.9E-2	1.8E+0	1.3E+1	3.8E+0	1.7E+1	2.2E+1
U-236	0	1.0E-1	1.0E-1	3.0E-1	0	3.0E-1	1.7E-2	1.4E+0	5.2E+1	1.7E+1	6.9E+1	6.9E+1
U-238	0	1.4E+0	1.4E+0	4.0E+0	0	4.0E+0	4.1E-1	4.8E+1	6.8E+2	2.1E+2	8.9E+2	9.8E+2
Sum of U-23x	0	7.0E+0	7.0E+0	2.1E+1	0	2.1E+1	1.8E+0	2.3E+2	1.3E+3	3.6E+2	1.7E+3	1.8E+3

Table B.19. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group D_1 - LLW, MLLW, ILAW, and melters in a Lined Modular Facility near PUREX Alternative Group D_2 - LLW, MLLW, ILAW, and melters in a Lined Modular Facility in 200E LLBGs												
	MLLW						Melter MLLW	ILAW (vitrified)	Area Totals Segregated		Total Segregated	Total HSW
	1996 to 2007			2008 to 2046								
Radionuclide	200 E	200 W	Total	200 E	200 W	Total	200 E	200 E	200 E	200 W		
Upper Bound Waste Volume												
C-14	1.6E+0	1.1E+0	2.7E+0	5.7E+0	0	5.7E+0	0	0	1.7E+2	6.7E+0	1.7E+2	8.0E+2
Tc-99	1.4E+0	2.1E+0	3.5E+0	8.3E+0	0	8.3E+0	0	2.6E+4	2.6E+4	2.5E+0	2.6E+4	2.6E+4
Grouted Tc-99	1.2E+2	6.0E+1	1.8E+2	3.3E+2	0	3.3E+2	3.9E+1	0	3.7E+3	1.3E+2	3.9E+3	3.9E+3
I-129	1.7E-2	1.7E-2	3.4E-2	1.1E-1	0	1.1E-1	0	2.2E+1	2.2E+1	2.0E-2	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	5.0E+0	0	5.0E+0	5.0E+0
U-233	2.2E-3	2.2E-3	4.4E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	1.3E+2	3.6E-1	1.3E+2	1.4E+2
U-234	2.3E+2	1.1E+2	3.3E+2	3.4E+2	0	3.4E+2	4.6E-1	4.4E+1	9.2E+2	4.0E+2	1.3E+3	1.4E+3
U-235	1.0E+1	4.8E+0	1.5E+1	1.5E+1	0	1.5E+1	1.9E-2	1.8E+0	3.9E+1	1.3E+1	5.2E+1	5.7E+1
U-236	4.9E-2	4.9E-2	9.7E-2	3.1E-1	0	3.1E-1	1.7E-2	1.4E+0	3.1E+1	3.8E+1	6.9E+1	6.9E+1
U-238	2.3E+2	1.1E+2	3.5E+2	3.4E+2	0	3.4E+2	4.1E-1	4.8E+1	1.1E+3	5.9E+2	1.7E+3	1.8E+3
Sum of U-23x	4.7E+2	2.3E+2	6.9E+2	7.0E+2	0	7.0E+2	1.8E+0	2.3E+2	2.3E+3	1.0E+3	3.3E+3	3.4E+3
(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.												

Table B.20. Inventory of Long-Lived Mobile Radionuclides in HSW for Alternative Group D_3, Ci (Sheet 1 of 4)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046
Alternative Group D_3 - A Lined Modular Facility for LLW, MLLW, ILAW, and melters at ERDF

Radionuclide	Category 1 LLW						Category 3 LLW					
	1996 to 2007			2008 to 2046			1996 to 2007			2008 to 2046		
	200 E	200 W	Total	200 E	ERDF	Total	200 E	200 W	Total	200 E	ERDF	Total
Hanford Only Waste Volume[(a)]												
C-14	0	3.3E+0	3.3E+0	0	1.3E+1	1.3E+1	0	1.5E-1	1.5E-1	0	4.4E-1	4.4E-1
Tc-99	0	3.0E-1	3.0E-1	0	1.1E+0	1.1E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	0	3.2E+3	3.2E+3
I-129	0	2.6E-3	2.6E-3	0	3.0E-3	3.0E-3	0	3.4E-7	3.4E-7	0	2.0E-6	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0
U-233	0	1.0E-1	1.0E-1	0	3.7E-1	3.7E-1	0	9.8E-2	9.8E-2	0	3.0E-1	3.0E-1
U-234	0	1.7E-1	1.7E-1	0	6.1E-1	6.1E-1	0	1.2E+2	1.2E+2	0	3.7E+2	3.7E+2
U-235	0	3.6E-2	3.6E-2	0	1.3E-1	1.3E-1	0	3.5E+0	3.5E+0	0	1.1E+1	1.1E+1
U-236	0	4.0E-3	4.0E-3	0	1.5E-2	1.5E-2	0	1.6E+1	1.6E+1	0	4.8E+1	4.8E+1
U-238	0	4.1E-1	4.1E-1	0	1.5E+0	1.5E+0	0	2.0E+2	2.0E+2	0	6.0E+2	6.0E+2
Sum of U-23x	0	7.2E-1	7.2E-1	0	2.6E+0	2.6E+0	0	3.4E+2	3.4E+2	0	1.0E+3	1.0E+3
Lower Bound Waste Volume												
C-14	0	4.1E+0	4.1E+0	0	1.6E+1	1.6E+1	0	1.5E-1	1.5E-1	0	4.6E-1	4.6E-1
Tc-99	0	3.7E-1	3.7E-1	0	1.3E+0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	0	3.2E+3	3.2E+3
I-129	0	3.2E-3	3.2E-3	0	3.7E-3	3.7E-3	0	3.5E-7	3.5E-7	0	2.0E-6	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0
U-233	0	1.3E-1	1.3E-1	0	4.5E-1	4.5E-1	0	1.0E-1	1.0E-1	0	3.1E-1	3.1E-1
U-234	0	2.1E-1	2.1E-1	0	7.5E-1	7.5E-1	0	1.3E+2	1.3E+2	0	3.9E+2	3.9E+2
U-235	0	4.3E-2	4.3E-2	0	1.6E-1	1.6E-1	0	3.7E+0	3.7E+0	0	1.1E+1	1.1E+1
U-236	0	4.9E-3	4.9E-3	0	1.8E-2	1.8E-2	0	1.7E+1	1.7E+1	0	5.0E+1	5.0E+1
U-238	0	5.0E-1	5.0E-1	0	1.8E+0	1.8E+0	0	2.1E+2	2.1E+2	0	6.2E+2	6.2E+2
Sum of U-23x	0	8.8E-1	8.8E-1	0	3.2E+0	3.2E+0	0	3.6E+2	3.6E+2	0	1.1E+3	1.1E+3

Table B.20. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046
Alternative Group D_3 - A Lined Modular Facility for LLW, MLLW, ILAW, and melters at ERDF

Radionuclide	Category 1 LLW						Category 3 LLW					
	1996 to 2007			2008 to 2046			1996 to 2007			2008 to 2046		
	200 E	200 W	Total	200 E	ERDF	Total	200 E	200 W	Total	200 E	ERDF	Total
Upper Bound Waste Volume												
C-14	0	5.2E+0	5.2E+0	0	1.6E+1	1.6E+1	0	3.5E-1	3.5E-1	0	1.5E+2	1.5E+2
Tc-99	0	4.0E-1	4.0E-1	0	1.3E+0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	0	3.2E+3	3.2E+3
I-129	0	3.2E-3	3.2E-3	0	3.7E-3	3.7E-3	0	3.5E-7	3.5E-7	0	2.0E-6	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0
U-233	0	1.3E-1	1.3E-1	0	4.5E-1	4.5E-1	0	2.3E-1	2.3E-1	0	1.8E-1	1.8E-1
U-234	0	9.0E-1	9.0E-1	0	9.2E-1	9.2E-1	0	2.9E+2	2.9E+2	0	3.1E+2	3.1E+2
U-235	0	8.9E-2	8.9E-2	0	1.7E-1	1.7E-1	0	8.4E+0	8.4E+0	0	1.2E+1	1.2E+1
U-236	0	4.9E-3	4.9E-3	0	1.8E-2	1.8E-2	0	3.8E+1	3.8E+1	0	2.9E+1	2.9E+1
U-238	0	1.7E+0	1.7E+0	0	2.1E+0	2.1E+0	0	4.7E+2	4.7E+2	0	5.0E+2	5.0E+2
Sum of U-23x	0	2.8E+0	2.8E+0	0	3.6E+0	3.6E+0	0	8.1E+2	8.1E+2	0	8.6E+2	8.6E+2

(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.

Table B.20. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046
Alternative Group D_3 - A Lined Modular Facility for LLW, MLLW, ILAW, and melters at ERDF

Radionuclide	MLLW						Melter MLLW	ILAW (vitrified)	Area Totals		Total Segregated	Total HSW
	1996 to 2007			2008 to 2046					Segregated			
	200 E	200 W	Total	200 E	ERDF	Total	ERDF	ERDF	200 E	200 W		
Hanford Only Waste Volume[a]												
C-14	0	1.5E+0	1.5E+0	0	4.3E+0	4.3E+0	0	0	0	2.2E+1	2.2E+1	6.4E+2
Tc-99	0	3.4E+0	3.4E+0	0	8.3E+0	8.3E+0	0	2.6E+4	0	2.6E+4	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	0	1.6E+2	1.6E+2	3.9E+1	0	0	3.5E+3	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	0	1.0E-1	1.0E-1	0	2.2E+1	0	2.2E+1	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	0	1.4E-2	1.4E-2	8.5E-1	1.3E+2	0	1.3E+2	1.3E+2	1.4E+2
U-234	0	5.4E+0	5.4E+0	0	1.6E+1	1.6E+1	4.6E-1	4.4E+1	0	5.6E+2	5.6E+2	6.1E+2
U-235	0	8.7E-2	8.7E-2	0	2.6E-1	2.6E-1	1.9E-2	1.8E+0	0	1.7E+1	1.7E+1	2.1E+1
U-236	0	1.0E-1	1.0E-1	0	3.0E-1	3.0E-1	1.7E-2	1.4E+0	0	6.6E+1	6.6E+1	6.6E+1
U-238	0	1.4E+0	1.4E+0	0	4.0E+0	4.0E+0	4.1E-1	4.8E+1	0	8.5E+2	8.5E+2	9.4E+2
Sum of U-23x	0	7.0E+0	7.0E+0	0	2.1E+1	2.1E+1	1.8E+0	2.3E+2	0	1.6E+3	1.6E+3	1.8E+3
Lower Bound Waste Volume												
C-14	0	1.5E+0	1.5E+0	0	4.3E+0	4.3E+0	0	0	0	2.6E+1	2.6E+1	6.5E+2
Tc-99	0	3.4E+0	3.4E+0	0	8.4E+0	8.4E+0	0	2.6E+4	0	2.6E+4	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	0	1.6E+2	1.6E+2	3.9E+1	0	0	3.5E+3	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	0	1.0E-1	1.0E-1	0	2.2E+1	0	2.2E+1	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	0	1.4E-2	1.4E-2	8.5E-1	1.3E+2	0	1.3E+2	1.3E+2	1.4E+2
U-234	0	5.5E+0	5.5E+0	0	1.6E+1	1.6E+1	4.6E-1	4.4E+1	0	5.9E+2	5.9E+2	6.3E+2
U-235	0	8.7E-2	8.7E-2	0	2.6E-1	2.6E-1	1.9E-2	1.8E+0	0	1.7E+1	1.7E+1	2.2E+1
U-236	0	1.0E-1	1.0E-1	0	3.0E-1	3.0E-1	1.7E-2	1.4E+0	0	6.9E+1	6.9E+1	6.9E+1
U-238	0	1.4E+0	1.4E+0	0	4.0E+0	4.0E+0	4.1E-1	4.8E+1	0	8.9E+2	8.9E+2	9.8E+2
Sum of U-23x	0	7.0E+0	7.0E+0	0	2.1E+1	2.1E+1	1.8E+0	2.3E+2	0	1.7E+3	1.7E+3	1.8E+3

Table B.20. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group D_3 - A Lined Modular Facility for LLW, MLLW, ILAW, and melters at ERDF													
	MLLW						**Melter MLLW**	**ILAW (vitrified)**	**Area Totals**				
	1996 to 2007			**2008 to 2046**					**Segregated**				
Radionuclide	**200 E**	**200 W**	**Total**	**200 E**	**ERDF**	**Total**	**ERDF**	**ERDF**	**200 E**	**200 W**	**Total Segregated**	**Total HSW**
Upper Bound Waste Volume												
C-14	1.6E+0	1.1E+0	2.7E+0	0	5.7E+0	5.7E+0	0	0	1.6E+0	1.7E+2	1.7E+2	8.0E+2
Tc-99	1.4E+0	2.1E+0	3.5E+0	0	8.3E+0	8.3E+0	0	2.6E+4	1.4E+0	2.6E+4	2.6E+4	2.6E+4
Grouted Tc-99	1.2E+2	6.0E+1	1.8E+2	0	3.3E+2	3.3E+2	3.9E+1	0	1.2E+2	3.7E+3	3.9E+3	3.9E+3
I-129	1.7E-2	1.7E-2	3.4E-2	0	1.1E-1	1.1E-1	0	2.2E+1	1.7E-2	2.2E+1	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0	5.0E+0
U-233	2.2E-3	2.2E-3	4.4E-3	0	1.4E-2	1.4E-2	8.5E-1	1.3E+2	2.2E-3	1.3E+2	1.3E+2	1.4E+2
U-234	2.3E+2	1.1E+2	3.3E+2	0	3.4E+2	3.4E+2	4.6E-1	4.4E+1	2.3E+2	1.1E+3	1.3E+3	1.4E+3
U-235	1.0E+1	4.8E+0	1.5E+1	0	1.5E+1	1.5E+1	1.9E-2	1.8E+0	1.0E+1	4.2E+1	5.2E+1	5.7E+1
U-236	4.9E-2	4.9E-2	9.7E-2	0	3.1E-1	3.1E-1	1.7E-2	1.4E+0	4.9E-2	6.9E+1	6.9E+1	6.9E+1
U-238	2.3E+2	1.1E+2	3.5E+2	0	3.4E+2	3.4E+2	4.1E-1	4.8E+1	2.3E+2	1.5E+3	1.7E+3	1.8E+3
Sum of U-23x	4.7E+2	2.3E+2	6.9E+2	0	7.0E+2	7.0E+2	1.8E+0	2.3E+2	4.7E+2	2.8E+3	3.3E+3	3.4E+3
(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.												

Table B.21. Inventory of Long-Lived Mobile Radionuclides in HSW for Alternative Groups E_1 and E_2, Ci (Sheet 1 of 4)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046
Alternative Group E_1 - Lined Modular Facilities for LLW and MLLW in 200E LLBGs, and for melters and ILAW at ERDF
Alternative Group E_2 - Lined Modular Facilities for LLW and MLLW near PUREX, and for melters and ILAW at ERDF

Radionuclide	Category 1 LLW						Category 3 LLW					
	1996 to 2007			2008 to 2046			1996 to 2007			2008 to 2046		
	200 E	200 W	Total	Near PUREX	200 W	Total	200 E	200 W	Total	Near PUREX	200 W	Total
Hanford Only Waste Volume[(a)]												
C-14	0	3.3E+0	3.3E+0	1.3E+1	0	1.3E+1	0	1.5E-1	1.5E-1	4.4E-1	0	4.4E-1
Tc-99	0	3.0E-1	3.0E-1	1.1E+0	0	1.1E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	3.2E+3	0	3.2E+3
I-129	0	2.6E-3	2.6E-3	3.0E-3	0	3.0E-3	0	3.4E-7	3.4E-7	2.0E-6	0	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	0	5.0E+0
U-233	0	1.0E-1	1.0E-1	3.7E-1	0	3.7E-1	0	9.8E-2	9.8E-2	3.0E-1	0	3.0E-1
U-234	0	1.7E-1	1.7E-1	6.1E-1	0	6.1E-1	0	1.2E+2	1.2E+2	3.7E+2	0	3.7E+2
U-235	0	3.6E-2	3.6E-2	1.3E-1	0	1.3E-1	0	3.5E+0	3.5E+0	1.1E+1	0	1.1E+1
U-236	0	4.0E-3	4.0E-3	1.5E-2	0	1.5E-2	0	1.6E+1	1.6E+1	4.8E+1	0	4.8E+1
U-238	0	4.1E-1	4.1E-1	1.5E+0	0	1.5E+0	0	2.0E+2	2.0E+2	6.0E+2	0	6.0E+2
Sum of U-23x	0	7.2E-1	7.2E-1	2.6E+0	0	2.6E+0	0	3.4E+2	3.4E+2	1.0E+3	0	1.0E+3
Lower Bound Waste Volume												
C-14	0	4.1E+0	4.1E+0	1.6E+1	0	1.6E+1	0	1.5E-1	1.5E-1	4.6E-1	0	4.6E-1
Tc-99	0	3.7E-1	3.7E-1	1.3E+0	0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	3.2E+3	0	3.2E+3
I-129	0	3.2E-3	3.2E-3	3.7E-3	0	3.7E-3	0	3.5E-7	3.5E-7	2.0E-6	0	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	0	5.0E+0
U-233	0	1.3E-1	1.3E-1	4.5E-1	0	4.5E-1	0	1.0E-1	1.0E-1	3.1E-1	0	3.1E-1
U-234	0	2.1E-1	2.1E-1	7.5E-1	0	7.5E-1	0	1.3E+2	1.3E+2	3.9E+2	0	3.9E+2
U-235	0	4.3E-2	4.3E-2	1.6E-1	0	1.6E-1	0	3.7E+0	3.7E+0	1.1E+1	0	1.1E+1
U-236	0	4.9E-3	4.9E-3	1.8E-2	0	1.8E-2	0	1.7E+1	1.7E+1	5.0E+1	0	5.0E+1
U-238	0	5.0E-1	5.0E-1	1.8E+0	0	1.8E+0	0	2.1E+2	2.1E+2	6.2E+2	0	6.2E+2
Sum of U-23x	0	8.8E-1	8.8E-1	3.2E+0	0	3.2E+0	0	3.6E+2	3.6E+2	1.1E+3	0	1.1E+3

Table B.21. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group E_1 - Lined Modular Facilities for LLW and MLLW in 200E LLBGs, and for melters and ILAW at ERDF Alternative Group E_2 - Lined Modular Facilities for LLW and MLLW near PUREX, and for melters and ILAW at ERDF												
	Category 1 LLW						**Category 3 LLW**					
	1996 to 2007			**2008 to 2046**			**1996 to 2007**			**2008 to 2046**		
Radionuclide	**200 E**	**200 W**	**Total**	**Near PUREX**	**200 W**	**Total**	**200 E**	**200 W**	**Total**	**Near PUREX**	**200 W**	**Total**
Upper Bound Waste Volume												
C-14	0	5.2E+0	5.2E+0	1.6E+1	0	1.6E+1	0	3.5E-1	3.5E-1	1.5E+2	0	1.5E+2
Tc-99	0	4.0E-1	4.0E-1	1.3E+0	0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0.0E+0	0	0.0E+0	0	0	0	7.2E+1	7.2E+1	3.2E+3	0	3.2E+3
I-129	0	3.2E-3	3.2E-3	3.7E-3	0	3.7E-3	0	3.5E-7	3.5E-7	2.0E-6	0	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	5.0E+0	0	5.0E+0
U-233	0	1.3E-1	1.3E-1	4.5E-1	0	4.5E-1	0	2.3E-1	2.3E-1	1.8E-1	0	1.8E-1
U-234	0	9.0E-1	9.0E-1	9.2E-1	0	9.2E-1	0	2.9E+2	2.9E+2	3.1E+2	0	3.1E+2
U-235	0	8.9E-2	8.9E-2	1.7E-1	0	1.7E-1	0	8.4E+0	8.4E+0	1.2E+1	0	1.2E+1
U-236	0	4.9E-3	4.9E-3	1.8E-2	0	1.8E-2	0	3.8E+1	3.8E+1	2.9E+1	0	2.9E+1
U-238	0	1.7E+0	1.7E+0	2.1E+0	0	2.1E+0	0	4.7E+2	4.7E+2	5.0E+2	0	5.0E+2
Sum of U-23x	0	2.8E+0	2.8E+0	3.6E+0	0	3.6E+0	0	8.1E+2	8.1E+2	8.6E+2	0	8.6E+2

(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.

Table B.21. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group E_1 - Lined Modular Facilities for LLW and MLLW in 200E LLBGs, and for melters and ILAW at ERDF Alternative Group E_2 - Lined Modular Facilities for LLW and MLLW near PUREX, and for melters and ILAW at ERDF												
Radionuclide	**MLLW**						**Melter MLLW**	**ILAW (vitrified)**	**Area Totals Segregated**			
	1996 to 2007			**2008 to 2046**								
	200 E	**200 W**	**Total**	**Near PUREX**	**200 W**	**Total**	**ERDF**	**ERDF**	**200 E**	**200 W**	**Total Segregated**	**Total HSW**
Hanford Only Waste Volume[(a)]												
C-14	0	1.5E+0	1.5E+0	4.3E+0	0	4.3E+0	0	0	1.8E+1	4.9E+0	2.2E+1	6.4E+2
Tc-99	0	3.4E+0	3.4E+0	8.3E+0	0	8.3E+0	0	2.6E+4	9.4E+0	2.6E+4	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	1.6E+2	0	1.6E+2	3.9E+1	0	3.4E+3	1.2E+2	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	1.0E-1	0	1.0E-1	0	2.2E+1	1.1E-1	2.2E+1	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	5.0E+0	0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	6.8E-1	1.3E+2	1.3E+2	1.4E+2
U-234	0	5.4E+0	5.4E+0	1.6E+1	0	1.6E+1	4.6E-1	4.4E+1	3.9E+2	1.7E+2	5.6E+2	6.1E+2
U-235	0	8.7E-2	8.7E-2	2.6E-1	0	2.6E-1	1.9E-2	1.8E+0	1.1E+1	5.5E+0	1.7E+1	2.1E+1
U-236	0	1.0E-1	1.0E-1	3.0E-1	0	3.0E-1	1.7E-2	1.4E+0	4.9E+1	1.8E+1	6.6E+1	6.6E+1
U-238	0	1.4E+0	1.4E+0	4.0E+0	0	4.0E+0	4.1E-1	4.8E+1	6.0E+2	2.5E+2	8.5E+2	9.4E+2
Sum of U-23x	0	7.0E+0	7.0E+0	2.1E+1	0	2.1E+1	1.8E+0	2.3E+2	1.1E+3	5.8E+2	1.6E+3	1.8E+3
Lower Bound Waste Volume												
C-14	0	1.5E+0	1.5E+0	4.3E+0	0	4.3E+0	0	0	2.0E+1	5.7E+0	2.6E+1	6.5E+2
Tc-99	0	3.4E+0	3.4E+0	8.4E+0	0	8.4E+0	0	2.6E+4	9.7E+0	2.6E+4	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	1.6E+2	0	1.6E+2	3.9E+1	0	3.4E+3	1.2E+2	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	1.0E-1	0	1.0E-1	0	2.2E+1	1.1E-1	2.2E+1	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	5.0E+0	0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	7.8E-1	1.3E+2	1.3E+2	1.4E+2
U-234	0	5.5E+0	5.5E+0	1.6E+1	0	1.6E+1	4.6E-1	4.4E+1	4.1E+2	1.8E+2	5.9E+2	6.3E+2
U-235	0	8.7E-2	8.7E-2	2.6E-1	0	2.6E-1	1.9E-2	1.8E+0	1.2E+1	5.6E+0	1.7E+1	2.2E+1
U-236	0	1.0E-1	1.0E-1	3.0E-1	0	3.0E-1	1.7E-2	1.4E+0	5.1E+1	1.8E+1	6.9E+1	6.9E+1
U-238	0	1.4E+0	1.4E+0	4.0E+0	0	4.0E+0	4.1E-1	4.8E+1	6.3E+2	2.6E+2	8.9E+2	9.8E+2
Sum of U-23x	0	7.0E+0	7.0E+0	2.1E+1	0	2.1E+1	1.8E+0	2.3E+2	1.1E+3	5.9E+2	1.7E+3	1.8E+3

Table B.21. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group E_1 - Lined Modular Facilities for LLW and MLLW in 200E LLBGs, and for melters and ILAW at ERDF Alternative Group E_2 - Lined Modular Facilities for LLW and MLLW near PUREX, and for melters and ILAW at ERDF												
	MLLW						Melter MLLW	ILAW (vitrified)	Area Totals			
	1996 to 2007			2008 to 2046					Segregated			
Radionuclide	200 E	200 W	Total	Near PUREX	200 W	Total	ERDF	ERDF	200 E	200 W	Total Segregated	Total HSW
Upper Bound Waste Volume												
C-14	1.6E+0	1.1E+0	2.7E+0	5.7E+0	0	5.7E+0	0	0	1.7E+2	6.7E+0	1.7E+2	8.0E+2
Tc-99	1.4E+0	2.1E+0	3.5E+0	8.3E+0	0	8.3E+0	0	2.6E+4	1.1E+1	2.6E+4	2.6E+4	2.6E+4
Grouted Tc-99	1.2E+2	6.0E+1	1.8E+2	3.3E+2	0	3.3E+2	3.9E+1	0	3.7E+3	1.7E+2	3.9E+3	3.9E+3
I-129	1.7E-2	1.7E-2	3.4E-2	1.1E-1	0	1.1E-1	0	2.2E+1	1.3E-1	2.2E+1	2.2E+1	2.2E+1
Grouted I-129	0	0	0	0	0	0	0	0	5.0E+0	0	5.0E+0	5.0E+0
U-233	2.2E-3	2.2E-3	4.4E-3	1.4E-2	0	1.4E-2	8.5E-1	1.3E+2	6.5E-1	1.3E+2	1.3E+2	1.4E+2
U-234	2.3E+2	1.1E+2	3.3E+2	3.4E+2	0	3.4E+2	4.6E-1	4.4E+1	8.8E+2	4.5E+2	1.3E+3	1.4E+3
U-235	1.0E+1	4.8E+0	1.5E+1	1.5E+1	0	1.5E+1	1.9E-2	1.8E+0	3.7E+1	1.5E+1	5.2E+1	5.7E+1
U-236	4.9E-2	4.9E-2	9.7E-2	3.1E-1	0	3.1E-1	1.7E-2	1.4E+0	2.9E+1	4.0E+1	6.9E+1	6.9E+1
U-238	2.3E+2	1.1E+2	3.5E+2	3.4E+2	0	3.4E+2	4.1E-1	4.8E+1	1.1E+3	6.3E+2	1.7E+3	1.8E+3
Sum of U-23x	4.7E+2	2.3E+2	6.9E+2	7.0E+2	0	7.0E+2	1.8E+0	2.3E+2	2.0E+3	1.3E+3	3.3E+3	3.4E+3

(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.

Table B.22. Inventory of Long-Lived Mobile Radionuclides in HSW for Alternative Group E_3, Ci (Sheet 1 of 4)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group E_3 - Lined Modular Facilities for LLW and MLLW at ERDF, and for melters and ILAW near PUREX												
Radionuclide	**Category 1 LLW**						**Category 3 LLW**					
	1996 to 2007			**2008 to 2046**			**1996 to 2007**			**2008 to 2046**		
	200 E	**200 W**	**Total**	**200 E**	**ERDF**	**Total**	**200 E**	**200 W**	**Total**	**200 E**	**ERDF**	**Total**
Hanford Only Waste Volume[(a)]												
C-14	0	3.3E+0	3.3E+0	0	1.3E+1	1.3E+1	0	1.5E-1	1.5E-1	0	4.4E-1	4.4E-1
Tc-99	0	3.0E-1	3.0E-1	0	1.1E+0	1.1E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	0	3.2E+3	3.2E+3
I-129	0	2.6E-3	2.6E-3	0	3.0E-3	3.0E-3	0	3.4E-7	3.4E-7	0	2.0E-6	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0
U-233	0	1.0E-1	1.0E-1	0	3.7E-1	3.7E-1	0	9.8E-2	9.8E-2	0	3.0E-1	3.0E-1
U-234	0	1.7E-1	1.7E-1	0	6.1E-1	6.1E-1	0	1.2E+2	1.2E+2	0	3.7E+2	3.7E+2
U-235	0	3.6E-2	3.6E-2	0	1.3E-1	1.3E-1	0	3.5E+0	3.5E+0	0	1.1E+1	1.1E+1
U-236	0	4.0E-3	4.0E-3	0	1.5E-2	1.5E-2	0	1.6E+1	1.6E+1	0	4.8E+1	4.8E+1
U-238	0	4.1E-1	4.1E-1	0	1.5E+0	1.5E+0	0	2.0E+2	2.0E+2	0	6.0E+2	6.0E+2
Sum of U-23x	0	7.2E-1	7.2E-1	0	2.6E+0	2.6E+0	0	3.4E+2	3.4E+2	0	1.0E+3	1.0E+3
Lower Bound Waste Volume												
C-14	0	4.1E+0	4.1E+0	0	1.6E+1	1.6E+1	0	1.5E-1	1.5E-1	0	4.6E-1	4.6E-1
Tc-99	0	3.7E-1	3.7E-1	0	1.3E+0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	0	3.2E+3	3.2E+3
I-129	0	3.2E-3	3.2E-3	0	3.7E-3	3.7E-3	0	3.5E-7	3.5E-7	0	2.0E-6	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0
U-233	0	1.3E-1	1.3E-1	0	4.5E-1	4.5E-1	0	1.0E-1	1.0E-1	0	3.1E-1	3.1E-1
U-234	0	2.1E-1	2.1E-1	0	7.5E-1	7.5E-1	0	1.3E+2	1.3E+2	0	3.9E+2	3.9E+2
U-235	0	4.3E-2	4.3E-2	0	1.6E-1	1.6E-1	0	3.7E+0	3.7E+0	0	1.1E+1	1.1E+1
U-236	0	4.9E-3	4.9E-3	0	1.8E-2	1.8E-2	0	1.7E+1	1.7E+1	0	5.0E+1	5.0E+1
U-238	0	5.0E-1	5.0E-1	0	1.8E+0	1.8E+0	0	2.1E+2	2.1E+2	0	6.2E+2	6.2E+2
Sum of U-23x	0	8.8E-1	8.8E-1	0	3.2E+0	3.2E+0	0	3.6E+2	3.6E+2	0	1.1E+3	1.1E+3

Table B.22. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046 Alternative Group E_3 - Lined Modular Facilities for LLW and MLLW at ERDF, and for melters and ILAW near PUREX												
Radionuclide	**Category 1 LLW**						**Category 3 LLW**					
	1996 to 2007			**2008 to 2046**			**1996 to 2007**			**2008 to 2046**		
	200 E	**200 W**	**Total**	**200 E**	**ERDF**	**Total**	**200 E**	**200 W**	**Total**	**200 E**	**ERDF**	**Total**
Upper Bound Waste Volume												
C-14	0	5.2E+0	5.2E+0	0	1.6E+1	1.6E+1	0	3.5E-1	3.5E-1	0	1.5E+2	1.5E+2
Tc-99	0	4.0E-1	4.0E-1	0	1.3E+0	1.3E+0	0	0	0	0	0	0
Grouted Tc-99	0	0	0	0	0	0	0	7.2E+1	7.2E+1	0	3.2E+3	3.2E+3
I-129	0	3.2E-3	3.2E-3	0	3.7E-3	3.7E-3	0	3.5E-7	3.5E-7	0	2.0E-6	2.0E-6
Grouted I-129	0	0	0	0	0	0	0	0	0	0	5.0E+0	5.0E+0
U-233	0	1.3E-1	1.3E-1	0	4.5E-1	4.5E-1	0	2.3E-1	2.3E-1	0	1.8E-1	1.8E-1
U-234	0	9.0E-1	9.0E-1	0	9.2E-1	9.2E-1	0	2.9E+2	2.9E+2	0	3.1E+2	3.1E+2
U-235	0	8.9E-2	8.9E-2	0	1.7E-1	1.7E-1	0	8.4E+0	8.4E+0	0	1.2E+1	1.2E+1
U-236	0	4.9E-3	4.9E-3	0	1.8E-2	1.8E-2	0	3.8E+1	3.8E+1	0	2.9E+1	2.9E+1
U-238	0	1.7E+0	1.7E+0	0	2.1E+0	2.1E+0	0	4.7E+2	4.7E+2	0	5.0E+2	5.0E+2
Sum of U-23x	0	2.8E+0	2.8E+0	0	3.6E+0	3.6E+0	0	8.1E+2	8.1E+2	0	8.6E+2	8.6E+2
(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.												

Table B.22. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046
Alternative Group E_3 - Lined Modular Facilities for LLW and MLLW at ERDF, and for melters and ILAW near PUREX

Radionuclide	MLLW						Melter	ILAW (vitrified)	Area Totals		Total Segregated	Total HSW
	1996 to 2007			2008 to future					Segregated			
	200 E	200 W	Total	200 E	ERDF	Total	Near PUREX	Near PUREX	200 E	200 W		
Hanford Only Waste Volume[(a)]												
C-14	0	1.5E+0	1.5E+0	0	4.3E+0	4.3E+0	0	0	0	2.2E+1	2.2E+1	6.4E+2
Tc-99	0	3.4E+0	3.4E+0	0	8.3E+0	8.3E+0	0	2.6E+4	2.6E+4	1.3E+1	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	0	1.6E+2	1.6E+2	3.9E+1	0	3.9E+1	3.5E+3	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	0	1.0E-1	1.0E-1	0	2.2E+1	2.2E+1	1.4E-1	2.2E+1	2.2E+1
Grouted I-129									0	5.0E+0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	0	1.4E-2	1.4E-2	8.5E-1	1.3E+2	1.3E+2	8.9E-1	1.3E+2	1.4E+2
U-234	0	5.4E+0	5.4E+0	0	1.6E+1	1.6E+1	4.6E-1	4.4E+1	4.5E+1	5.2E+2	5.6E+2	6.1E+2
U-235	0	8.7E-2	8.7E-2	0	2.6E-1	2.6E-1	1.9E-2	1.8E+0	1.8E+0	1.5E+1	1.7E+1	2.1E+1
U-236	0	1.0E-1	1.0E-1	0	3.0E-1	3.0E-1	1.7E-2	1.4E+0	1.4E+0	6.5E+1	6.6E+1	6.6E+1
U-238	0	1.4E+0	1.4E+0	0	4.0E+0	4.0E+0	4.1E-1	4.8E+1	4.9E+1	8.0E+2	8.5E+2	9.4E+2
Sum of U-23x	0	7.0E+0	7.0E+0	0	2.1E+1	2.1E+1	1.8E+0	2.3E+2	2.3E+2	1.4E+3	1.6E+3	1.8E+3
Lower Bound Waste Volume												
C-14	0	1.5E+0	1.5E+0	0	4.3E+0	4.3E+0	0	0	0	2.6E+1	2.6E+1	6.5E+2
Tc-99	0	3.4E+0	3.4E+0	0	8.4E+0	8.4E+0	0	2.6E+4	2.6E+4	1.3E+1	2.6E+4	2.6E+4
Grouted Tc-99	0	4.9E+0	4.9E+0	0	1.6E+2	1.6E+2	3.9E+1	0	3.9E+1	3.5E+3	3.5E+3	3.5E+3
I-129	0	3.5E-2	3.5E-2	0	1.0E-1	1.0E-1	0	2.2E+1	2.2E+1	1.5E-1	2.2E+1	2.2E+1
Grouted I-129	0	0							0	5.0E+0	5.0E+0	5.0E+0
U-233	0	4.6E-3	4.6E-3	0	1.4E-2	1.4E-2	8.5E-1	1.3E+2	1.3E+2	1.0E+0	1.3E+2	1.4E+2
U-234	0	5.5E+0	5.5E+0	0	1.6E+1	1.6E+1	4.6E-1	4.4E+1	4.5E+1	5.4E+2	5.9E+2	6.3E+2
U-235	0	8.7E-2	8.7E-2	0	2.6E-1	2.6E-1	1.9E-2	1.8E+0	1.8E+0	1.5E+1	1.7E+1	2.2E+1
U-236	0	1.0E-1	1.0E-1	0	3.0E-1	3.0E-1	1.7E-2	1.4E+0	1.4E+0	6.7E+1	6.9E+1	6.9E+1
U-238	0	1.4E+0	1.4E+0	0	4.0E+0	4.0E+0	4.1E-1	4.8E+1	4.9E+1	8.4E+2	8.9E+2	9.8E+2
Sum of U-23x	0	7.0E+0	7.0E+0	0	2.1E+1	2.1E+1	1.8E+0	2.3E+2	2.3E+2	1.5E+3	1.7E+3	1.8E+3

Table B.22. (contd)

Disposition of Segregated Wastes in Various Forms and Locations as of 2046
Alternative Group E_3 - Lined Modular Facilities for LLW and MLLW at ERDF, and for melters and ILAW near PUREX

Radionuclide	MLLW						Melter	ILAW (vitrified)	Area Totals		Total Segregated	Total HSW
	1996 to 2007			2008 to future					Segregated			
	200 E	200 W	Total	200 E	ERDF	Total	Near PUREX	Near PUREX	200 E	200 W		
Upper Bound Waste Volume												
C-14	1.6E+0	1.1E+0	2.7E+0	0	5.7E+0	5.7E+0	0	0	1.6E+0	1.7E+2	1.7E+2	8.0E+2
Tc-99	1.4E+0	2.1E+0	3.5E+0	0	8.3E+0	8.3E+0	0	2.6E+4	2.6E+4	1.2E+1	2.6E+4	2.6E+4
Grouted Tc-99	1.2E+2	6.0E+1	1.8E+2	0	3.3E+2	3.3E+2	3.9E+1	0	1.6E+2	3.7E+3	3.9E+3	3.9E+3
I-129	1.7E-2	1.7E-2	3.4E-2	0	1.1E-1	1.1E-1	0	2.2E+1	2.2E+1	1.3E-1	2.2E+1	2.2E+1
Grouted I-129	0	0							0	5.0E+0	5.0E+0	5.0E+0
U-233	2.2E-3	2.2E-3	4.4E-3	0	1.4E-2	1.4E-2	8.5E-1	1.3E+2	1.3E+2	1.0E+0	1.3E+2	1.4E+2
U-234	2.3E+2	1.1E+2	3.3E+2	0	3.4E+2	3.4E+2	4.6E-1	4.4E+1	2.7E+2	1.1E+3	1.3E+3	1.4E+3
U-235	1.0E+1	4.8E+0	1.5E+1	0	1.5E+1	1.5E+1	1.9E-2	1.8E+0	1.2E+1	4.0E+1	5.2E+1	5.7E+1
U-236	4.9E-2	4.9E-2	9.7E-2	0	3.1E-1	3.1E-1	1.7E-2	1.4E+0	1.5E+0	6.7E+1	6.9E+1	6.9E+1
U-238	2.3E+2	1.1E+2	3.5E+2	0	3.4E+2	3.4E+2	4.1E-1	4.8E+1	2.8E+2	1.4E+3	1.7E+3	1.8E+3
Sum of U-23x	4.7E+2	2.3E+2	6.9E+2	0	7.0E+2	7.0E+2	1.8E+0	2.3E+2	7.0E+2	2.6E+3	3.3E+3	3.4E+3

(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.

Table B.23. Inventory of Long-Lived Mobile Radionuclides in HSW for the No Action Alternative, Ci

Disposition of Segregated Wastes in Various Forms and Locations as of 2046
No Action Alternative - LLW in conventional design trenches (conforming LLW only) and MLLW in existing trenches only; remainder of LLW and MLLW stored at CWC; melters stored on concrete pads at CWC; ILAW disposed of in concrete vaults near PUREX

Radionuclide	Category 1 LLW 1996 to 2046			Category 3 LLW 1996 to 2046			MLLW 1996-2046	ILAW (vitrified)	Area Totals Segregated		Total Segregated	In Storage	Total HSW
	200 E	200 W	Total	200 E	200 W	Total	200 W	Near PUREX	200 E	200 W			
Hanford Only Volume[(a)]													
C-14	5.9E-1	1.5E+1	1.6E+1	2.2E-2	5.7E-1	5.9E-1	7.5E-1	0	6.1E-1	1.7E+1	1.7E+1	5.3E+0	6.4E+2
Tc-99	5.0E-2	1.3E+0	1.3E+0	0	0	0	9.6E-1	2.6E+4	2.6E+4	2.3E+0	2.6E+4	1.1E+1	2.6E+4
Grouted Tc-99	0	0	0	1.3E+2	3.2E+3	3.3E+3	3.3E+0	0	1.3E+2	3.2E+3	3.3E+3	2.0E+2	3.5E+3
I-129	2.0E-4	5.2E-3	5.4E-3	8.6E-8	2.2E-6	2.3E-6	1.8E-2	2.2E+1	2.2E+1	2.3E-2	2.2E+1	1.2E-1	2.2E+1
Grouted I-129	0	0	0	0	5.0E+0	5.0E+0	0	0	0	5.0E+0	5.0E+0	0	5.0E+0
U-233	1.8E-2	4.6E-1	4.7E-1	1.5E-2	3.8E-1	3.9E-1	2.5E-3	1.3E+2	1.3E+2	8.4E-1	1.3E+2	8.7E-1	1.4E+2
U-234	2.9E-2	7.5E-1	7.8E-1	1.9E+1	4.8E+2	5.0E+2	2.8E+0	4.4E+1	6.3E+1	4.8E+2	5.4E+2	2.0E+1	6.1E+2
U-235	6.2E-3	1.6E-1	1.6E-1	5.3E-1	1.4E+1	1.4E+1	4.5E-2	1.8E+0	2.3E+0	1.4E+1	1.6E+1	3.5E-1	2.1E+1
U-236	7.0E-4	1.8E-2	1.9E-2	2.4E+0	6.2E+1	6.4E+1	5.2E-2	1.4E+0	3.8E+0	6.2E+1	6.6E+1	4.5E-1	6.6E+1
U-238	7.0E-2	1.8E+0	1.9E+0	3.0E+1	7.7E+2	8.0E+2	7.0E-1	4.8E+1	7.8E+1	7.7E+2	8.5E+2	5.8E+0	9.4E+2
Sum of U-23x	1.2E-1	3.2E+0	3.3E+0	5.2E+1	1.3E+3	1.4E+3	3.6E+0	2.3E+2	2.8E+2	1.3E+3	1.6E+3	2.7E+1	1.8E+3
Lower Bound Waste Volume													
C-14	7.2E-1	1.9E+1	1.9E+1	2.3E-2	5.9E-1	6.1E-1	7.5E-1	0	7.4E-1	2.0E+1	2.1E+1	5.4E+0	6.5E+2
Tc-99	6.1E-2	1.6E+0	1.6E+0	0	0	0	9.7E-1	2.6E+4	2.6E+4	2.5E+0	2.6E+4	1.1E+1	2.6E+4
Grouted Tc-99	0	0	0	1.3E+2	3.2E+3	3.3E+3	3.4E+0	0	1.3E+2	3.2E+3	3.3E+3	2.0E+2	3.5E+3
I-129	2.5E-4	6.4E-3	6.6E-3	9.0E-8	2.3E-6	2.4E-6	1.8E-2	2.2E+1	2.2E+1	2.4E-2	2.2E+1	1.2E-1	2.2E+1
Grouted I-129	0	0	0	0	5.0E+0	5.0E+0	0	0	0	5.0E+0	5.0E+0	0	5.0E+0
U-233	2.2E-2	5.6E-1	5.8E-1	1.5E-2	4.0E-1	4.1E-1	2.5E-3	1.3E+2	1.3E+2	9.5E-1	1.3E+2	8.7E-1	1.4E+2
U-234	3.6E-2	9.2E-1	9.5E-1	1.9E+1	5.0E+2	5.2E+2	2.8E+0	4.4E+1	6.4E+1	5.0E+2	5.7E+2	2.0E+1	6.3E+2
U-235	7.5E-3	1.9E-1	2.0E-1	5.6E-1	1.4E+1	1.5E+1	4.5E-2	1.8E+0	2.4E+0	1.4E+1	1.7E+1	3.5E-1	2.2E+1
U-236	8.5E-4	2.2E-2	2.3E-2	2.5E+0	6.4E+1	6.7E+1	5.2E-2	1.4E+0	3.9E+0	6.4E+1	6.8E+1	4.6E-1	6.9E+1
U-238	8.6E-2	2.2E+0	2.3E+0	3.1E+1	8.0E+2	8.3E+2	7.0E-1	4.8E+1	8.0E+1	8.0E+2	8.8E+2	5.9E+0	9.8E+2
Sum of U-23x	1.5E-1	3.9E+0	4.0E+0	5.4E+1	1.4E+3	1.4E+3	3.6E+0	2.3E+2	2.8E+2	1.4E+3	1.7E+3	2.7E+1	1.8E+3

(a) For same locations: 0.82% of Lower Bound Volume [LBV] Cat 1 LLW; 0.96% of LBV Cat 3 LLW [except Tc-99 & I-129 same as LBV]; 0.996% of MLLW LBV.

B.6 Waste Stream Flowsheets

Detailed information about how each waste steam will be managed is provided in the balance of this appendix, in flowsheets that identify the facilities to be used and the volumes of waste that would pass through that facility over the period of analysis (through 2046). The flowsheets are organized first by alternative group, then by waste type, and finally by waste stream. Each flowsheet lists the three sets of waste volumes analyzed: Hanford Only, Lower Bound, and Upper Bound. The Hanford Only waste volumes are presented in bold type, the Lower Bound waste volumes in normal font, and the Upper Bound waste volumes in italics. An index to the flowsheets is shown in Table B.24. This table provides the page numbers for the flowsheet diagrams by alternative group and waste type.

Table B.24. Identification of Flowsheets

Alternative Group	Waste Type	Page Numbers
Group A	LLW	B.49 to B.51
	MLLW	B.51 to B.54
	TRU Waste	B.54 to B.57
	WTP Waste	B.58
Group B	LLW	B.59 to B.61
	MLLW	B.61 to B.64
	TRU Waste	B.64 to B.67
	WTP Waste	B.68
Group C	LLW	B.69 to B.71
	MLLW	B.71 to B.74
	TRU Waste	B.74 to B.77
	WTP Waste	B.78
Groups D & E	LLW	B.80 to B.82
	MLLW	B.82 to B.85
	TRU Waste	B.85 to B.88
	WTP Waste	B.89
No Action Group	LLW	B.90 to B.92
	MLLW	B.92 to B.95
	TRU Waste	B.95 to B.98
	WTP Waste	B.99

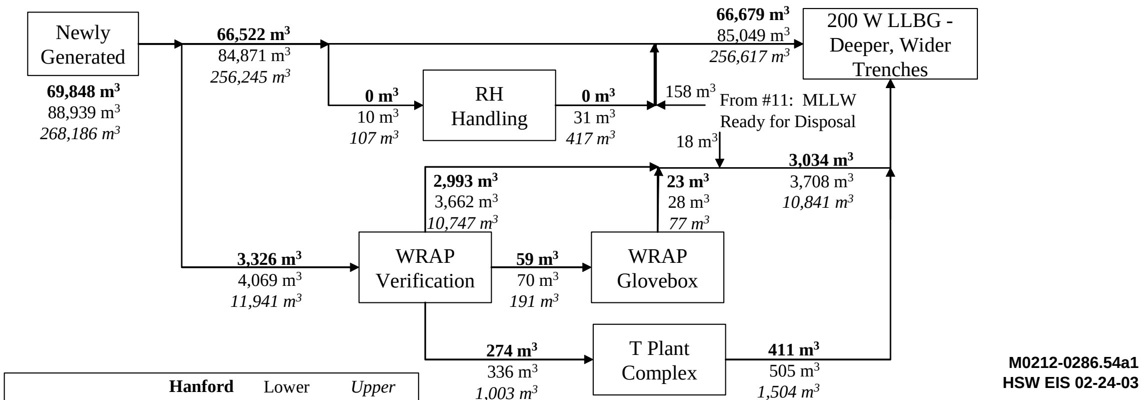
*Acronyms, Abbreviations, and Terms for the Waste Flow Diagrams

CH	contact-handled
CWC	Central Waste Complex
ERDF	Environmental Restoration Disposal Facility
FY	fiscal year
HIC	high-integrity container
ILAW	Immobilized Low-Activity Waste
LLBG	Low Level Burial Grounds
LLW	low-level waste
MLLW	mixed low-level waste
MW	mixed waste
PCB	polychlorinated biphenyl
PUREX	Plutonium Uranium Extraction Plant
RH	remote-handled
TRU	transuranic
WIPP	Waste Isolation Pilot Plant
WRAP	Waste Receiving and Processing Facility
WTP	Waste Treatment Plant

Disposed of FY99-01	Volume of waste disposed of from FY 1999 to FY 2001
Initial Inventory	Volume of waste managed by the Waste Management Program as of 9/30/2001
Receipts	Volume of waste expected to be received from FY 2002 to FY 2046
Waste Stream Total	Total volume of a waste stream to be managed, i.e., the sum of Disposed of FY99-01, Initial Inventory, and Receipts
Total Verification	Life-cycle volume of waste that will undergo verification in a Waste Management facility
Total Stabilized	Life-cycle volume of waste stabilized via in-trench grouting or placement in HICs
Total Treatment	Life-cycle volume of waste treated to meet disposal requirements
Total Processed	Life-cycle volume of waste processed to meet shipment and/or disposal requirements
Total Disposal	Life-cycle volume of waste disposed of at the Hanford Site or shipped offsite for final disposition
Ending Inventory	Total volume of waste remaining in storage at the Hanford Site at the end of FY 2046

Alternative Group A

Stream 1
LLW Category 1



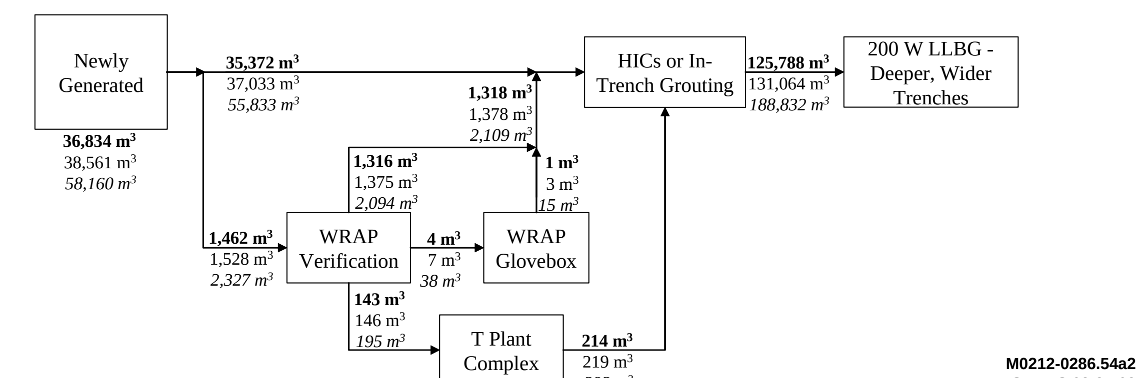
	Hanford Only	Lower Bound	*Upper Bound*
Disposed FY99-01:	**18,944 m^3**	18,944 m^3	*18,944 m^3*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**69,848 m^3**	88,939 m^3	*268,186 m^3*
Waste Stream Total:	**88,792 m^3**	107,883 m^3	*287,130 m^3*
Total Verification:	**3,326 m^3**	4,069 m^3	*11,941 m^3*
Total Disposal:	**89,069 m^3**	108,205 m^3	*287,906 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

Notes: Both lined and unlined trenches have been analyzed as part of this alternative.

Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

Alternative Group A

Stream 2
LLW Category 3



	Hanford Only	Lower Bound	*Upper Bound*
Disposed FY99-01:	**2,773 m^3**	2,773 m^3	*2,773 m^3*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**36,834 m^3**	38,561 m^3	*58,160 m^3*
Waste Stream Total:	**39,607 m^3**	41,334 m^3	*60,933 m^3*
Total Verification:	**1,462 m^3**	1,528 m^3	*2,327 m^3*
Total Stabilized:	**36,903 m^3**	38,630 m^3	*58,234 m^3*
Total Disposal:	**128,561 m^3**	133,837 m^3	*191,605 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

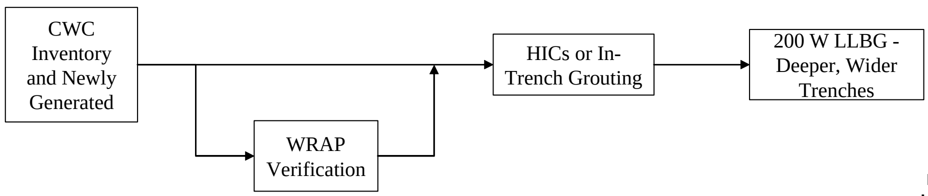
Notes: Both lined and unlined trenches have been analyzed as part of this alternative.

Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group A

Stream 3
Greater Than Category 3 Waste



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HSW EIS 02-24-03

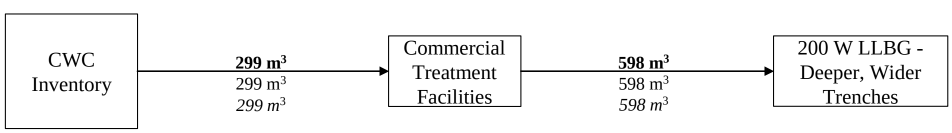
	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**<1 m^3**	<1 m^3	*<1 m^3*
Receipts:	**0 m^3**	0 m^3	*0 m^3*
Waste Stream Total:	**<1 m^3**	<1 m^3	*<1 m^3*
Total Stabilized:	**<1 m^3**	<1 m^3	*<1 m^3*
Total Disposal:	**<1 m^3**	<1 m^3	*<1 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

Notes: Both lined and unlined trenches have been analyzed as part of this alternative.

Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

Alternative Group A

Stream 6
LLW – Non-Conforming



M0212-0286.54a4
HSW EIS 02-24-03

	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**299 m^3**	299 m^3	*299 m^3*
Receipts:	**0 m^3**	0 m^3	*0 m^3*
Waste Stream Total:	**299 m^3**	299 m^3	*299 m^3*
Total Treatment:	**299 m^3**	299 m^3	*299 m^3*
Total Disposal:	**598 m^3**	598 m^3	*598 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

Notes: Both lined and unlined trenches have been analyzed as part of this alternative.

Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group A

Stream 20

LLW – Previously Disposed of

	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**283,067 m³**	283,067 m³	*283,067 m³*
Receipts:	**0 m³**	0 m³	*0 m³*
Waste Stream Total:	**283,067 m³**	283,067 m³	*283,067 m³*
Total Treatment:	**0 m³**	0 m³	*0 m³*
Total Disposal:	**283,067 m³**	283,067 m³	*283,067 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

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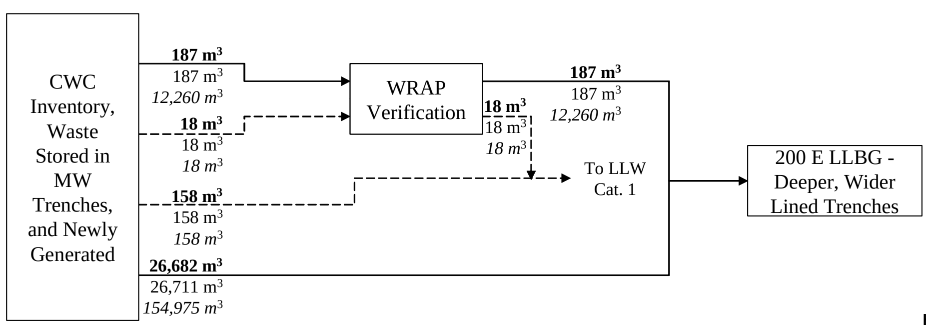
HSW EIS 02-24-03

Alternative Group A

Stream 11

MLLW Treated and Ready for Disposal



M0212-0286.54a6
HSW EIS 02-24-03

	Hanford Only	Lower Bound	*Upper Bound*
Disposed FY99-01:	**1,010 m³**	1,010 m³	*1,010 m³*
Initial Inventory:	**1,102 m³**	1,102 m³	*1,102 m³*
Receipts:	**25,942 m³**	25,970 m³	*166,307m³*
Waste Stream Total:	**28,054 m³**	28,082 m³	*168,419m³*
Total Treatment:	**0 m³**	0 m³	*0 m³*
Total Disposal:	**27,879 m³**	27,907 m³	*168,244 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

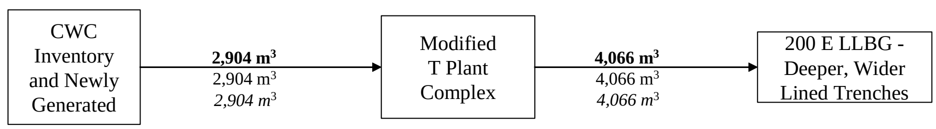
Notes: Dashed lines represent waste managed as MLLW expected to be reclassified as LLW.

Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group A

Stream 12
RH and Non-Standard Packages



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**65 m³**	65 m³	*65 m³*
Receipts:	**2,839 m³**	2,839 m³	*2,839 m³*
Waste Stream Total:	**2,904 m³**	2,904 m³	*2,904 m³*
Total Treatment:	**2,904 m³**	2,904 m³	*2,904 m³*
Total Disposal:	**4,066 m³**	4,066 m³	*4,066 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

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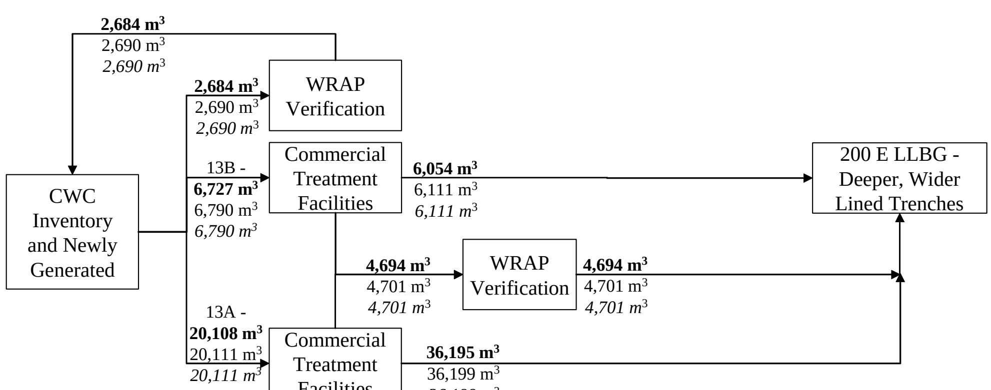
HSW EIS 02-24-03

Alternative Group A

Stream 13A – CH Inorganic Solids and Debris
Stream 13B – CH Organic Solids and Debris



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**5,725 m³**	5,725 m³	*5,725 m³*
Receipts:	**21,110 m³**	21,175 m³	*21,175 m³*
Waste Stream Total:	**26,835 m³**	26,901 m³	*26,901 m³*
Total Treatment:	**26,835 m³**	26,901 m³	*26,901 m³*
Total Disposal:	**46,944 m³**	47,011 m³	*47,011 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

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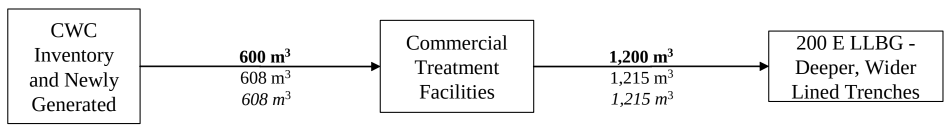
HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group A

Stream 14
Elemental Lead



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**445 m^3**	445 m^3	*445 m^3*
Receipts:	**155 m^3**	163 m^3	*163 m^3*
Waste Stream Total:	**600 m^3**	608 m^3	*608 m^3*
Total Treatment:	**600 m^3**	608 m^3	*608 m^3*
Total Disposal:	**1,200 m^3**	1,215 m^3	*1,215 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

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HSW EIS 02-24-03

Alternative Group A

Stream 15
Elemental Mercury

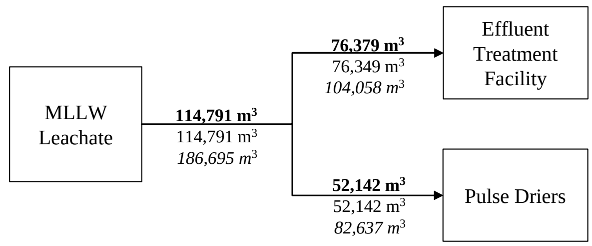
	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**13 m^3**	13 m^3	*13 m^3*
Receipts:	**8 m^3**	8 m^3	*8 m^3*
Waste Stream Total:	**21 m^3**	21 m^3	*21 m^3*
Total Treatment:	**21 m^3**	21 m^3	*21 m^3*
Total Disposal:	**312 m^3**	312 m^3	*312 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a10
HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group A

Stream 18
MLLW Trench Leachate

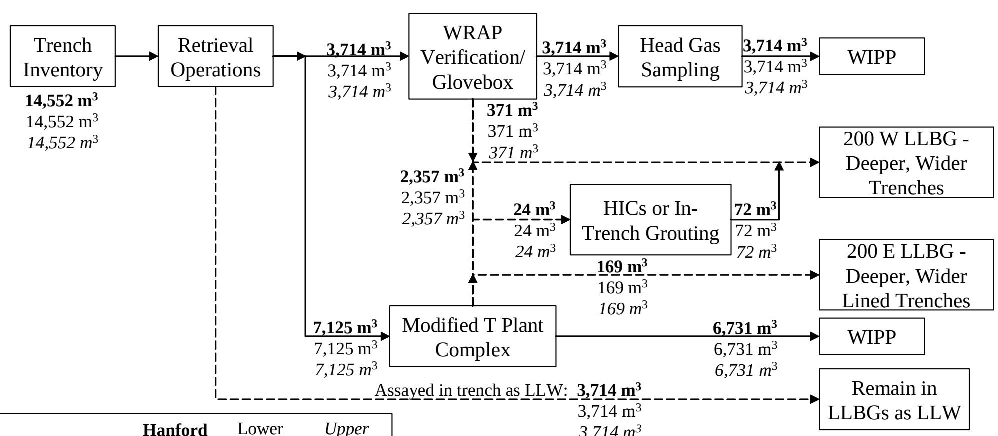


	Hanford Only	Lower Bound	Upper Bound
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Total Generation:	**114,791 m^3**	114,791 m^3	*186,695 m^3*
Waste Stream Total:	**114,791 m^3**	114,791 m^3	*186,695 m^3*
Total Treatment/ Disposal:	**114,791 m^3**	114,791 m^3	*186,695 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a11
HSW EIS 02-24-03

Alternative Group A

Stream 4
TRU - Waste from Trenches



	Hanford Only	Lower Bound	Upper Bound
Initial Inventory:	**14,552 m^3**	14,552 m^3	*14,552 m^3*
Receipts:	**0 m^3**	0 m^3	*0 m^3*
Waste Stream Total:	**14,552 m^3**	14,552 m^3	*14,552 m^3*
Total Processed:	**10,938 m^3**	10,938 m^3	*10,938 m^3*
Total Disposal:	**10,185 m^3**	10,185 m^3	*10,185 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

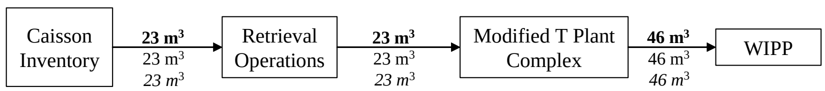
Note: Both lined and unlined trenches have been analyzed for LLW disposal as part of this alternative.

M0212-0286.54a12
HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group A

Stream 5
TRU - Waste from Caissons

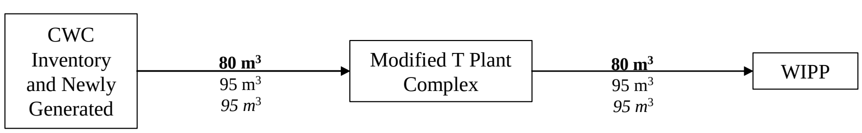


	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**23 m^3**	23 m^3	*23 m^3*
Receipts:	**0 m^3**	0 m^3	*0 m^3*
Waste Stream Total:	**23 m^3**	23 m^3	*23 m^3*
Total Processed:	**23 m^3**	23 m^3	*23 m^3*
Total Disposal:	**46 m^3**	46 m^3	*46 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a13
HSW EIS 02-24-03

Alternative Group A

Stream 8
TRU - Commingled PCB Waste

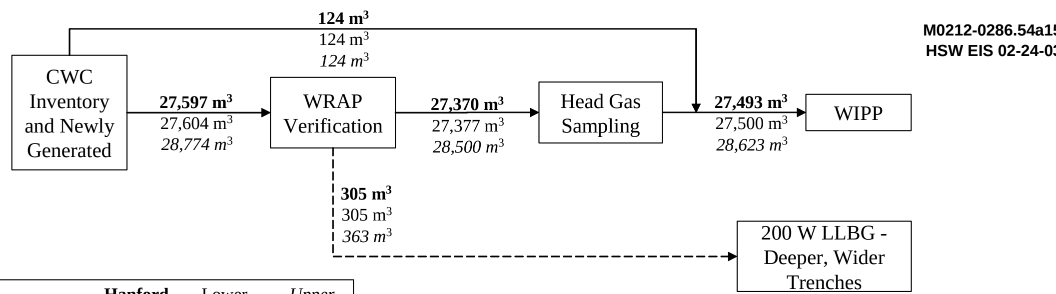


	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**80 m^3**	80 m^3	*80 m^3*
Receipts:	**0 m^3**	15 m^3	*15 m^3*
Waste Stream Total:	**80 m^3**	95 m^3	*95 m^3*
Total Processed:	**80 m^3**	95 m^3	*95 m^3*
Total Disposal:	**80 m^3**	95 m^3	*95 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a14
HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group A
Stream 9
TRU – Newly Generated and Existing CH Standard Containers



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**849 m^3**	849 m^3	*849 m^3*
Receipts:	**26,870 m^3**	26,878 m^3	*28,048 m^3*
Waste Stream Total:	**27,719 m^3**	27,727 m^3	*28,897 m^3*
Total Processed:	**27,597 m^3**	27,604 m^3	*28,774 m^3*
Total Disposal:	**27,493 m^3**	27,500 m^3	*28,623 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

Notes: Both lined and unlined trenches have been analyzed for LLW disposal as part of this alternative.

It is assumed that WIPP or another offsite disposal facility will be available after 2032.

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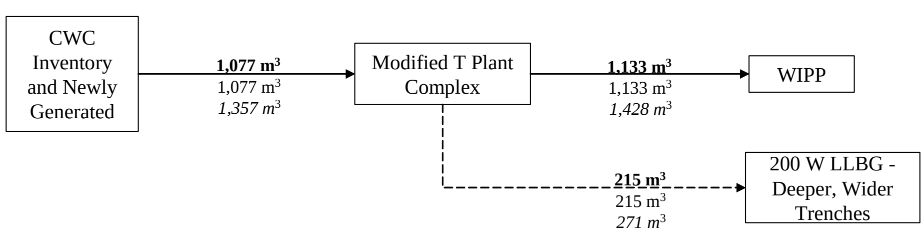
Alternative Group A
Stream 10A
TRU – Newly Generated and Existing CH Non-Standard Containers



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**585 m^3**	585 m^3	*585 m^3*
Receipts:	**492 m^3**	492 m^3	*772 m^3*
Waste Stream Total:	**1,077 m^3**	1,077 m^3	*1,357 m^3*
Total Processed:	**1,077 m^3**	1,077 m^3	*1,357 m^3*
Total Disposal:	**1,133 m^3**	1,133 m^3	*1,428 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

Note: Both lined and unlined trenches have been analyzed for LLW disposal as part of this alternative.

M0212-0286.54a16
HSW EIS 02-24-03

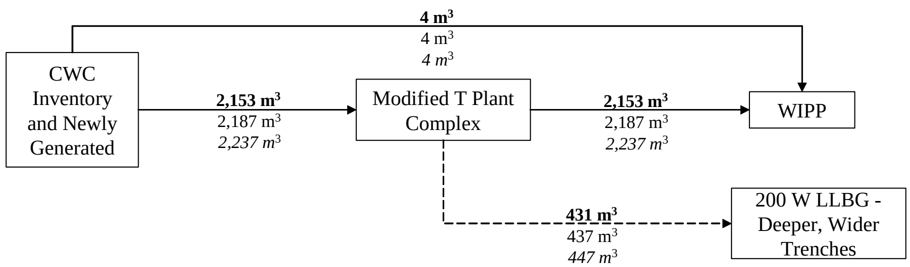
2

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group A

Stream 10B

TRU – Newly Generated and Existing RH Waste



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**46 m^3**	46 m^3	*46 m^3*
Receipts:	**2,112 m^3**	2,145 m^3	*2,196 m^3*
Waste Stream Total:	**2,157 m^3**	2,191 m^3	*2,241 m^3*
Total Processed:	**2,153 m^3**	2,187 m^3	*2,237 m^3*
Total Disposal:	**2,157 m^3**	2,191 m^3	*2,241 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a17
HSW EIS 02-24-03

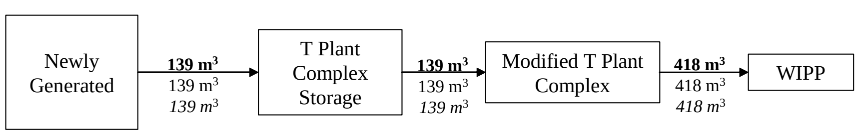
Notes: Both lined and unlined trenches have been analyzed for LLW disposal as part of this alternative.

It is assumed that WIPP or another offsite disposal facility will be available after 2032.

Alternative Group A

Stream 17

TRU – K Basins Sludge



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**139 m^3**	139 m^3	*139 m^3*
Waste Stream Total:	**139 m^3**	139 m^3	*139 m^3*
Total Processed:	**139 m^3**	139 m^3	*139 m^3*
Total Disposal:	**418 m^3**	418 m^3	*418 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

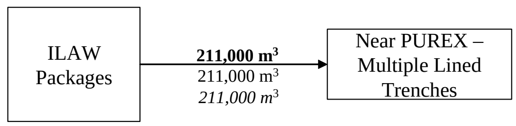
M0212-0286.54a18
HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group A

Stream 21

WTP Wastes – ILAW Packages



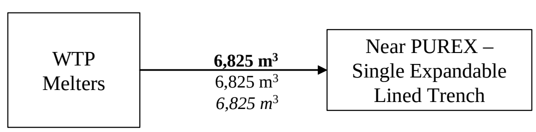
	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**211,000 m^3**	211,000 m^3	*211,000 m^3*
Waste Stream Total:	**211,000 m^3**	211,000 m^3	*211,000 m^3*
Total Processed:	**0 m^3**	0 m^3	*0 m^3*
Total Disposal:	**211,000 m^3**	211,000 m^3	*211,000 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a19
R1 HSW EIS 02-24-03

Alternative Group A

Stream 22

WTP Wastes –WTP Melters



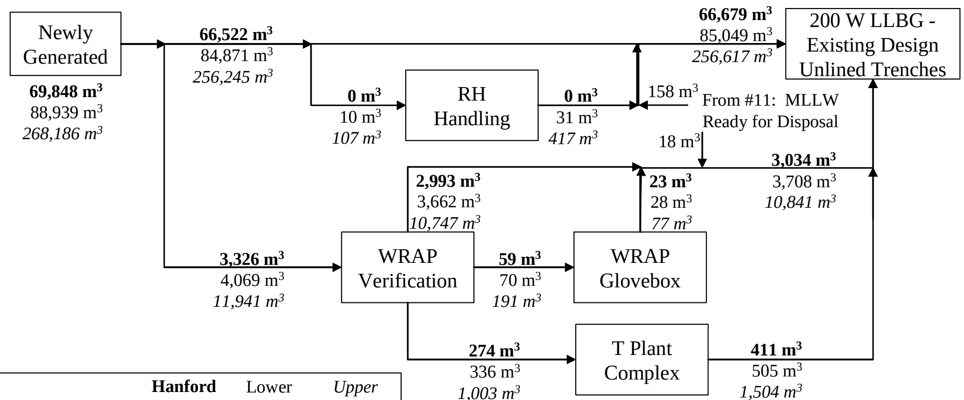
	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**6,825 m^3**	6,825 m^3	*6,825 m^3*
Waste Stream Total:	**6,825 m^3**	6,825 m^3	*6,825 m^3*
Total Processed:	**0 m^3**	0 m^3	*0 m^3*
Total Disposal:	**6,825 m^3**	6,825 m^3	*6,825 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a20
R1 HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group B

Stream 1
LLW Category 1



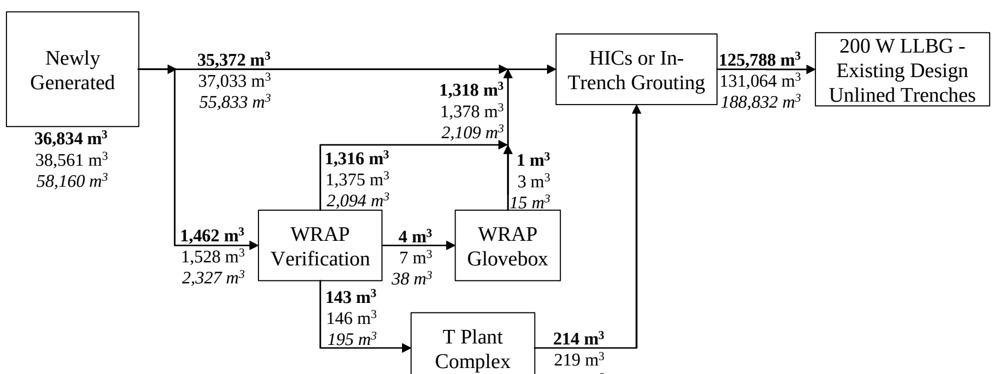
	Hanford Only	Lower Bound	*Upper Bound*
Disposed FY99-01:	**18,944 m³**	18,944 m³	*18,944 m³*
Initial Inventory:	**0 m³**	0 m³	*0 m³*
Receipts:	**69,848 m³**	88,939 m³	*268,186 m³*
Waste Stream Total:	**88,792 m³**	107,883 m³	*287,130 m³*
Total Verification:	**3,326 m³**	4,069 m³	*11,941 m³*
Total Disposal:	**89,069 m³**	108,205 m³	*287,906 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

Note: Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

M0212-0286.54a21
HSW EIS 02-24-03

Alternative Group B

Stream 2
LLW Category 3



	Hanford Only	Lower Bound	*Upper Bound*
Disposed FY99-01:	**2,773 m³**	2,773 m³	*2,773 m³*
Initial Inventory:	**0 m³**	0 m³	*0 m³*
Receipts:	**36,834 m³**	38,561 m³	*58,160 m³*
Waste Stream Total:	**39,607 m³**	41,334 m³	*60,933 m³*
Total Verification:	**1,462 m³**	1,528 m³	*2,327 m³*
Total Stabilized:	**36,903 m³**	38,630 m³	*58,234 m³*
Total Disposal:	**128,561 m³**	133,837 m³	*191,605 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

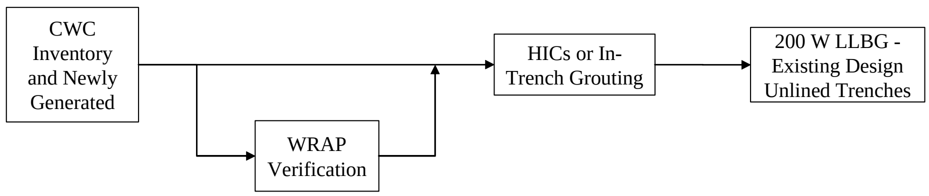
Note: Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

M0212-0286.54a22
HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group B

Stream 3
Greater Than Category 3 Waste

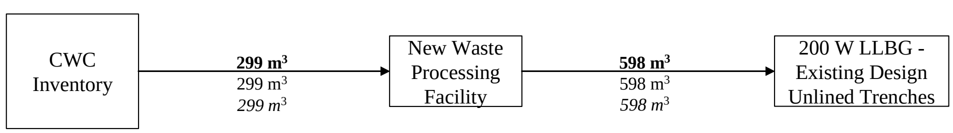


	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**<1 m³**	<1 m³	*<1 m³*
Receipts:	**0 m³**	0 m³	*0 m³*
Waste Stream Total:	**<1 m³**	<1 m³	*<1 m³*
Total Stabilized:	**<1 m³**	<1 m³	*<1 m³*
Total Disposal:	**<1 m³**	<1 m³	*<1 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

M0212-0286.54a23
HSW EIS 02-24-03

Alternative Group B

Stream 6
LLW – Non-Conforming



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**299 m³**	299 m³	*299 m³*
Receipts:	**0 m³**	0 m³	*0 m³*
Waste Stream Total:	**299 m³**	299 m³	*299 m³*
Total Treatment:	**299 m³**	299 m³	*299 m³*
Total Disposal:	**598 m³**	598 m³	*598 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

M0212-0286.54a24
R1 HSW EIS 02-24-03

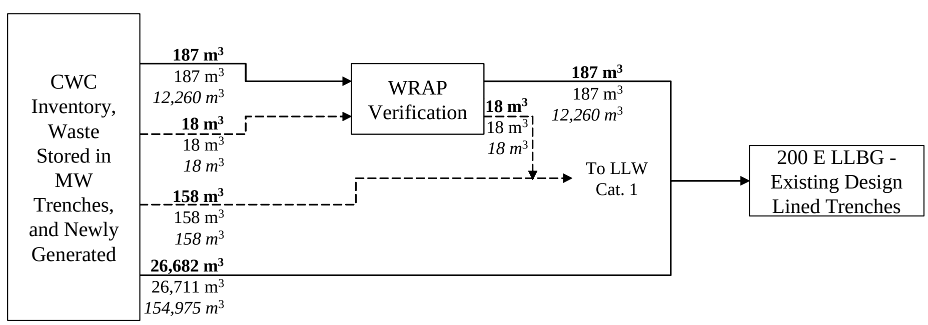
*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group B
Stream 20
LLW – Previously Disposed of

	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**283,067 m³**	283,067 m³	*283,067 m³*
Receipts:	**0 m³**	0 m³	*0 m³*
Waste Stream Total:	**283,067 m³**	283,067 m³	*283,067 m³*
Total Treatment:	**0 m³**	0 m³	*0 m³*
Total Disposal:	**283,067 m³**	283,067 m³	*283,067 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

M0212-0286.54a25
HSW EIS 02-24-03

Alternative Group B
Stream 11
MLLW Treated and Ready for Disposal



M0212-0286.54a26
HSW EIS 02-24-03

	Hanford Only	Lower Bound	*Upper Bound*
Disposed FY99-01:	**1,010 m³**	1,010 m³	*1,010 m³*
Initial Inventory:	**1,102 m³**	1,102 m³	*1,102 m³*
Receipts:	**25,942 m³**	25,970 m³	*166,307m³*
Waste Stream Total:	**28,054 m³**	28,082 m³	*168,419m³*
Total Treatment:	**0 m³**	0 m³	*0 m³*
Total Disposal:	**27,879 m³**	27,907 m³	*168,244 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

Notes: Dashed lines represent waste managed as MLLW expected to be reclassified as LLW.

Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group B

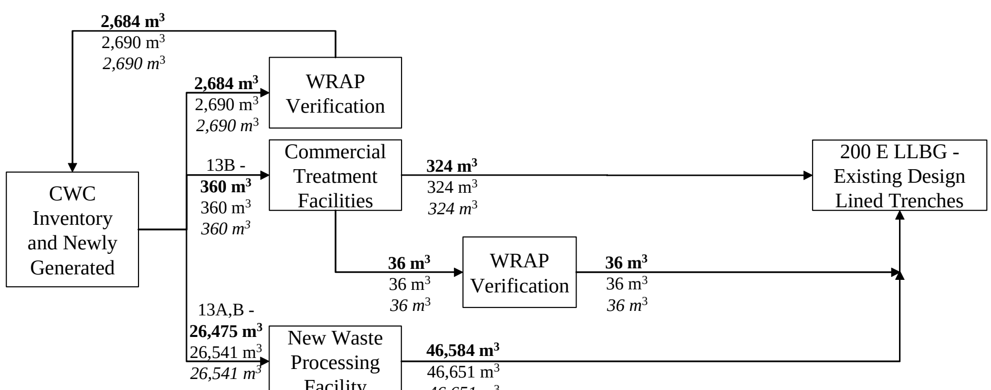
Stream 12
RH and Non-Standard Packages

	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**65 m^3**	65 m^3	*65 m^3*
Receipts:	**2,839 m^3**	2,839 m^3	*2,839 m^3*
Waste Stream Total:	**2,904 m^3**	2,904 m^3	*2,904 m^3*
Total Treatment:	**2,904 m^3**	2,904 m^3	*2,904 m^3*
Total Disposal:	**4,066 m^3**	4,066 m^3	*4,066 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a27
R1 HSW EIS 02-24-03

Alternative Group B

Stream 13A – CH Inorganic Solids and Debris
Stream 13B – CH Organic Solids and Debris

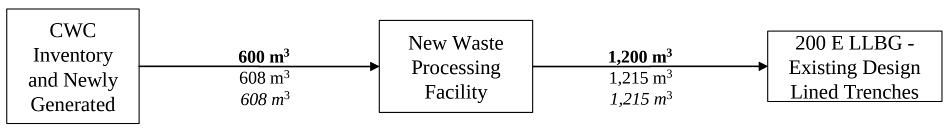


	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**5,725 m^3**	5,725 m^3	*5,725 m^3*
Receipts:	**21,110 m^3**	21,175 m^3	*21,175 m^3*
Waste Stream Total:	**26,835 m^3**	26,901 m^3	*26,901 m^3*
Total Treatment:	**26,835 m^3**	26,901 m^3	*26,901 m^3*
Total Disposal:	**46,944 m^3**	47,011 m^3	*47,011 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a28
R1 HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

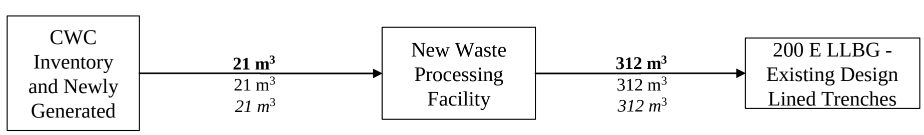
Alternative Group B
Stream 14
Elemental Lead



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**445 m^3**	445 m^3	*445 m^3*
Receipts:	**155 m^3**	163 m^3	*163 m^3*
Waste Stream Total:	**600 m^3**	608 m^3	*608 m^3*
Total Treatment:	**600 m^3**	608 m^3	*608 m^3*
Total Disposal:	**1,200 m^3**	1,215 m^3	*1,215 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a29
R1 HSW EIS 02-24-03

Alternative Group B
Stream 15
Elemental Mercury



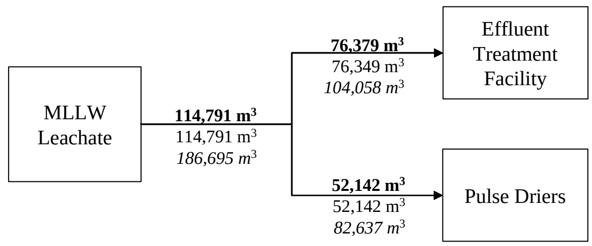
	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**13 m^3**	13 m^3	*13 m^3*
Receipts:	**8 m^3**	8 m^3	*8 m^3*
Waste Stream Total:	**21 m^3**	21 m^3	*21 m^3*
Total Treatment:	**21 m^3**	21 m^3	*21 m^3*
Total Disposal:	**312 m^3**	312 m^3	*312 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a30
R1 HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group B

Stream 18
MLLW Trench Leachate

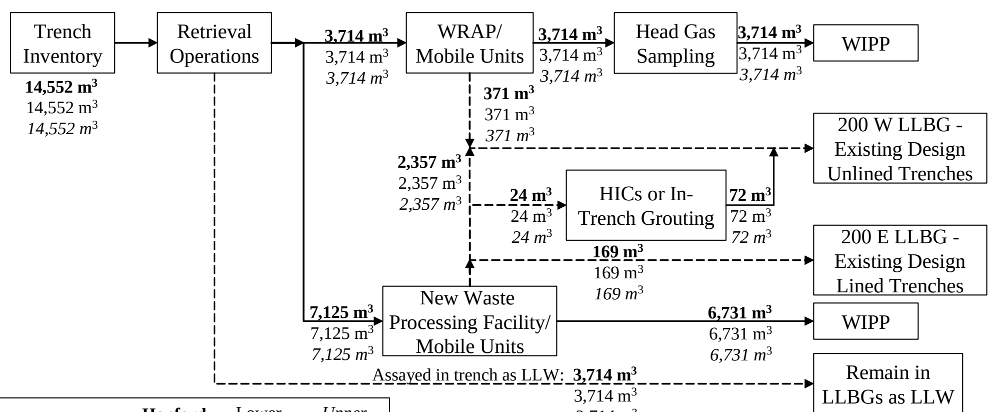


	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m³**	0 m³	*0 m³*
Total Generation:	**114,791 m³**	114,791 m³	*186,695 m³*
Waste Stream Total:	**114,791 m³**	114,791 m³	*186,695 m³*
Total Treatment/ Disposal:	**114,791 m³**	114,791 m³	*186,695 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

M0212-0286.54a65
HSW EIS 02-24-03

Alternative Group B

Stream 4
TRU - Waste from Trenches



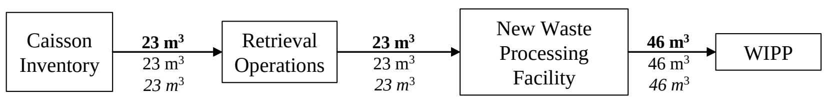
	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**14,552 m³**	14,552 m³	*14,552 m³*
Receipts:	**0 m³**	0 m³	*0 m³*
Waste Stream Total:	**14,552 m³**	14,552 m³	*14,552 m³*
Total Processed:	**10,938 m³**	10,938 m³	*10,938 m³*
Total Disposal:	**10,185 m³**	10,185 m³	*10,185 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

M0212-0286.54a31
R2 HSW EIS 03-27-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group B

Stream 5
TRU - Waste from Caissons



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**23 m^3**	23 m^3	*23 m^3*
Receipts:	**0 m^3**	0 m^3	*0 m^3*
Waste Stream Total:	**23 m^3**	23 m^3	*23 m^3*
Total Processed:	**23 m^3**	23 m^3	*23 m^3*
Total Disposal:	**46 m^3**	46 m^3	*46 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a32
R1 HSW EIS 02-24-03

Alternative Group B

Stream 8
TRU - Commingled PCB Waste

	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**80 m^3**	80 m^3	*80 m^3*
Receipts:	**0 m^3**	15 m^3	*15 m^3*
Waste Stream Total:	**80 m^3**	95 m^3	*95 m^3*
Total Processed:	**80 m^3**	95 m^3	*95 m^3*
Total Disposal:	**80 m^3**	95 m^3	*95 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

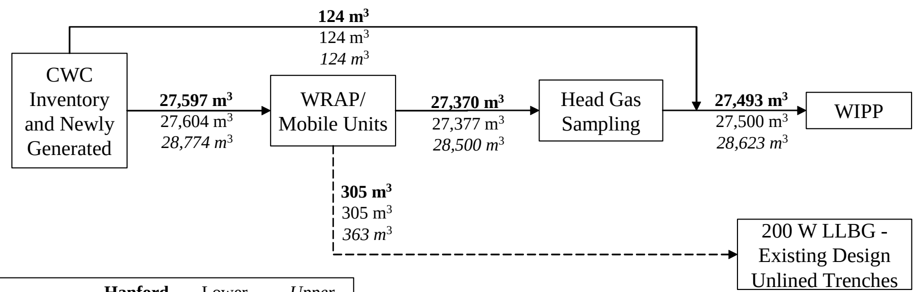
M0212-0286.54a66
R1 HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group B

Stream 9

TRU – Newly Generated and Existing CH Standard Containers



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**849 m^3**	849 m^3	*849 m^3*
Receipts:	**26,870 m^3**	26,878 m^3	*28,048 m^3*
Waste Stream Total:	**27,719 m^3**	27,727 m^3	*28,897 m^3*
Total Processed:	**27,597 m^3**	27,604 m^3	*28,774 m^3*
Total Disposal:	**27,493 m^3**	27,500 m^3	*28,623 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

Note: It is assumed that WIPP or another offsite disposal facility will be available after 2032.

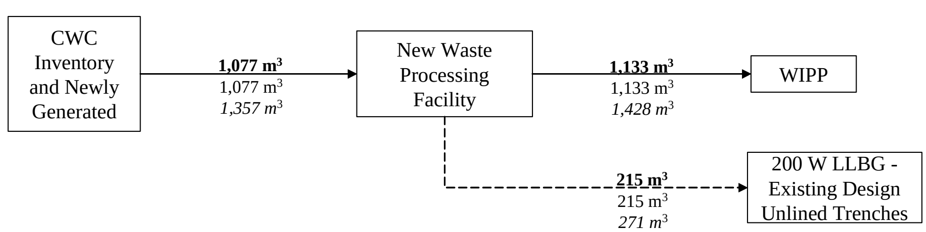
M0212-0286.54a33
HSW EIS 02-24-03

1

Alternative Group B

Stream 10A

TRU – Newly Generated and Existing CH Non-Standard Containers



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**585 m^3**	585 m^3	*585 m^3*
Receipts:	**492 m^3**	492 m^3	*772 m^3*
Waste Stream Total:	**1,077 m^3**	1,077 m^3	*1,357 m^3*
Total Processed:	**1,077 m^3**	1,077 m^3	*1,357 m^3*
Total Disposal:	**1,133 m^3**	1,133 m^3	*1,428 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

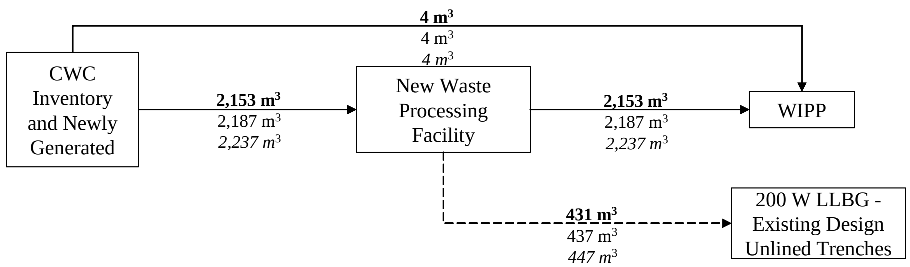
M0212-0286.54a34
R1 HSW EIS 02-24-03

2

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group B

Stream 10B
TRU – Newly Generated and Existing RH Waste



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**46 m^3**	46 m^3	*46 m^3*
Receipts:	**2,112 m^3**	2,145 m^3	*2,196 m^3*
Waste Stream Total:	**2,157 m^3**	2,191 m^3	*2,241 m^3*
Total Processed:	**2,153 m^3**	2,187 m^3	*2,237 m^3*
Total Disposal:	**2,157 m^3**	2,191 m^3	*2,241 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

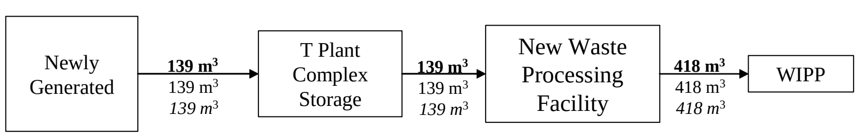
Note: It is assumed that WIPP or another offsite disposal facility will be available after 2032.

M0212-0286.54a35
R1 HSW EIS 02-24-03

1

Alternative Group B

Stream 17
TRU – K Basins Sludge



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**139 m^3**	139 m^3	*139 m^3*
Waste Stream Total:	**139 m^3**	139 m^3	*139 m^3*
Total Processed:	**139 m^3**	139 m^3	*139 m^3*
Total Disposal:	**418 m^3**	418 m^3	*418 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

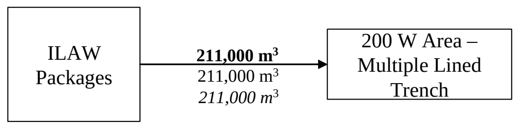
M0212-0286.54a36
R1 HSW EI S 02-24-03

2

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group B

Stream 21
WTP Wastes – ILAW Packages

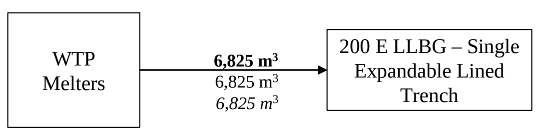


	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**211,000 m^3**	211,000 m^3	*211,000 m^3*
Waste Stream Total:	**211,000 m^3**	211,000 m^3	*211,000 m^3*
Total Processed:	**0 m^3**	0 m^3	*0 m^3*
Total Disposal:	**211,000 m^3**	211,000 m^3	*211,000 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a37
R1 HSW EIS 02-24-03

Alternative Group B

Stream 22
WTP Wastes –WTP Melters

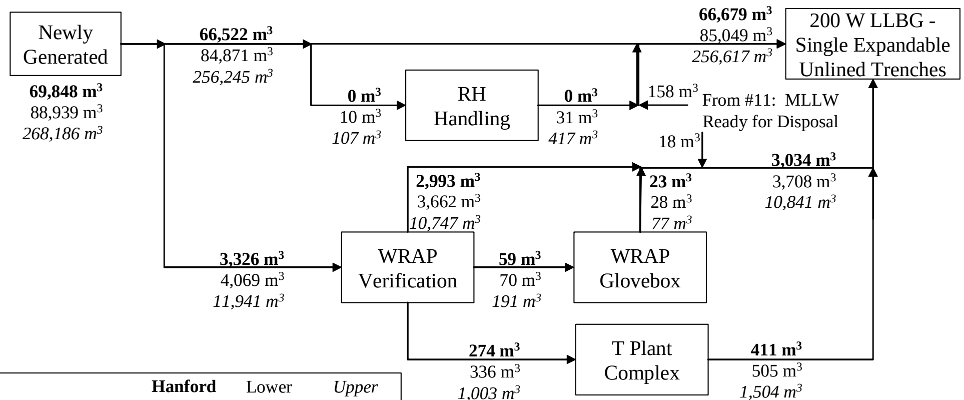


	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**6,825 m^3**	6,825 m^3	*6,825 m^3*
Waste Stream Total:	**6,825 m^3**	6,825 m^3	*6,825 m^3*
Total Processed:	**0 m^3**	0 m^3	*0 m^3*
Total Disposal:	**6,825 m^3**	6,825 m^3	*6,825 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a38
R1 HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group C
Stream 1
LLW Category 1



	Hanford Only	Lower Bound	*Upper Bound*
Disposed FY99-01:	**18,944 m³**	18,944 m³	*18,944 m³*
Initial Inventory:	**0 m³**	0 m³	*0 m³*
Receipts:	**69,848 m³**	88,939 m³	*268,186 m³*
Waste Stream Total:	**88,792 m³**	107,883 m³	*287,130 m³*
Total Verification:	**3,326 m³**	4,069 m³	*11,941 m³*
Total Disposal:	**89,069 m³**	108,205 m³	*287,906 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

Note: Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

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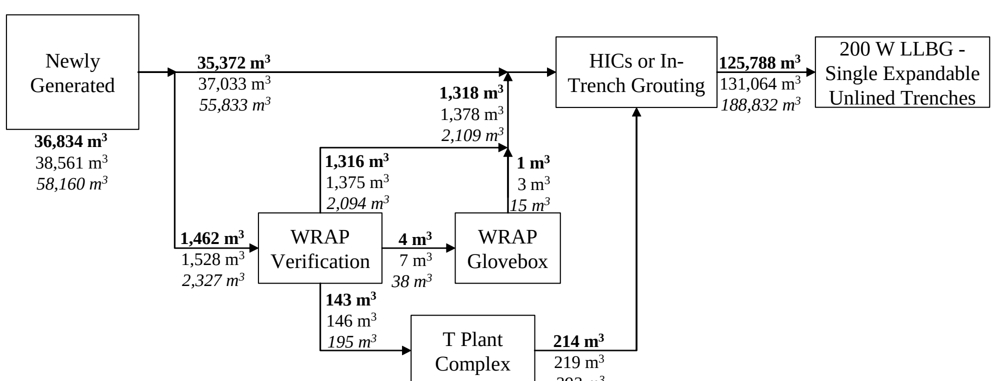
1

Alternative Group C
Stream 2
LLW Category 3



	Hanford Only	Lower Bound	*Upper Bound*
Disposed FY99-01:	**2,773 m³**	2,773 m³	*2,773 m³*
Initial Inventory:	**0 m³**	0 m³	*0 m³*
Receipts:	**36,834 m³**	38,561 m³	*58,160 m³*
Waste Stream Total:	**39,607 m³**	41,334 m³	*60,933 m³*
Total Verification:	**1,462 m³**	1,528 m³	*2,327 m³*
Total Stabilized:	**36,903 m³**	38,630 m³	*58,234 m³*
Total Disposal:	**128,561 m³**	133,837 m³	*191,605 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

Note: Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

M0212-0286.54a40
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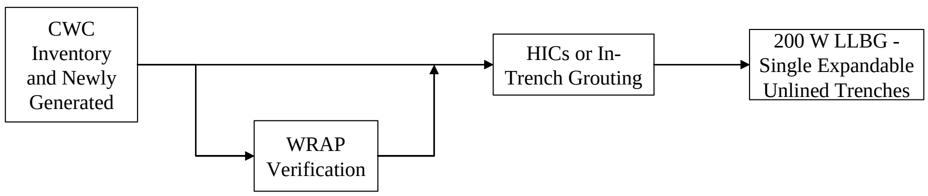
2

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group C

Stream 3
Greater Than Category 3 Waste



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**<1 m^3**	<1 m^3	*<1 m^3*
Receipts:	**0 m^3**	0 m^3	*0 m^3*
Waste Stream Total:	**<1 m^3**	<1 m^3	*<1 m^3*
Total Stabilized:	**<1 m^3**	<1 m^3	*<1 m^3*
Total Disposal:	**<1 m^3**	<1 m^3	*<1 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

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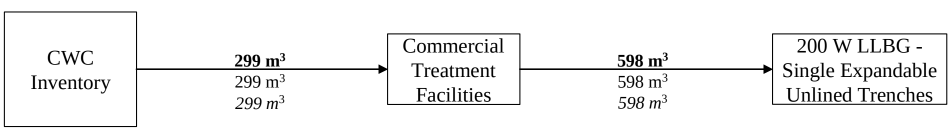
Alternative Group C

Stream 6
LLW – Non-Conforming



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**299 m^3**	299 m^3	*299 m^3*
Receipts:	**0 m^3**	0 m^3	*0 m^3*
Waste Stream Total:	**299 m^3**	299 m^3	*299 m^3*
Total Treatment:	**299 m^3**	299 m^3	*299 m^3*
Total Disposal:	**598 m^3**	598 m^3	*598 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

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*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group C

Stream 20
LLW – Previously Disposed of

	Hanford Only	Lower Bound	Upper Bound
Initial Inventory:	**283,067 m^3**	283,067 m^3	*283,067 m^3*
Receipts:	**0 m^3**	0 m^3	*0 m^3*
Waste Stream Total:	**283,067 m^3**	283,067 m^3	*283,067 m^3*
Total Treatment:	**0 m^3**	0 m^3	*0 m^3*
Total Disposal:	**283,067 m^3**	283,067 m^3	*283,067 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

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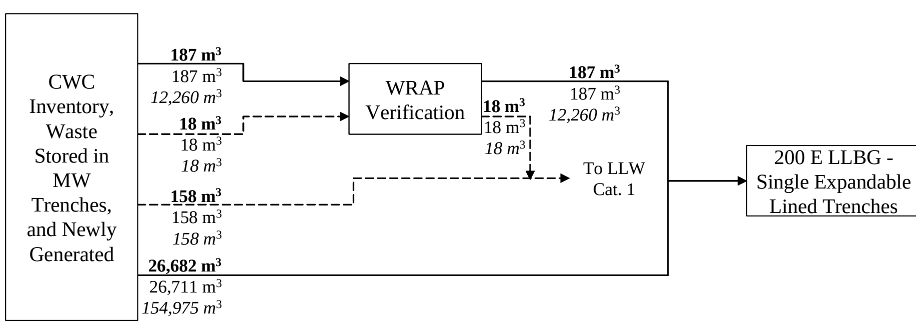
Alternative Group C

Stream 11
MLLW Treated and Ready for Disposal



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	Hanford Only	Lower Bound	Upper Bound
Disposed FY99-01:	**1,010 m^3**	1,010 m^3	*1,010 m^3*
Initial Inventory:	**1,102 m^3**	1,102 m^3	*1,102 m^3*
Receipts:	**25,942 m^3**	25,970 m^3	*166,307m^3*
Waste Stream Total:	**28,054 m^3**	28,082 m^3	*168,419m^3*
Total Treatment:	**0 m^3**	0 m^3	*0 m^3*
Total Disposal:	**27,879 m^3**	27,907 m^3	*168,244 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

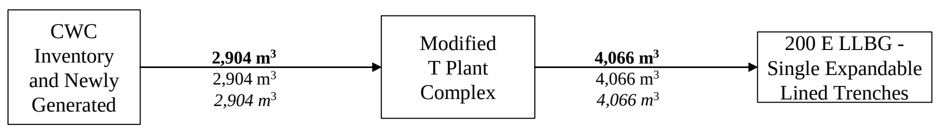
Notes: Dashed lines represent waste managed as MLLW expected to be reclassified as LLW.

Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group C

Stream 12
RH and Non-Standard Packages



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**65 m^3**	65 m^3	*65 m^3*
Receipts:	**2,839 m^3**	2,839 m^3	*2,839 m^3*
Waste Stream Total:	**2,904 m^3**	2,904 m^3	*2,904 m^3*
Total Treatment:	**2,904 m^3**	2,904 m^3	*2,904 m^3*
Total Disposal:	**4,066 m^3**	4,066 m^3	*4,066 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

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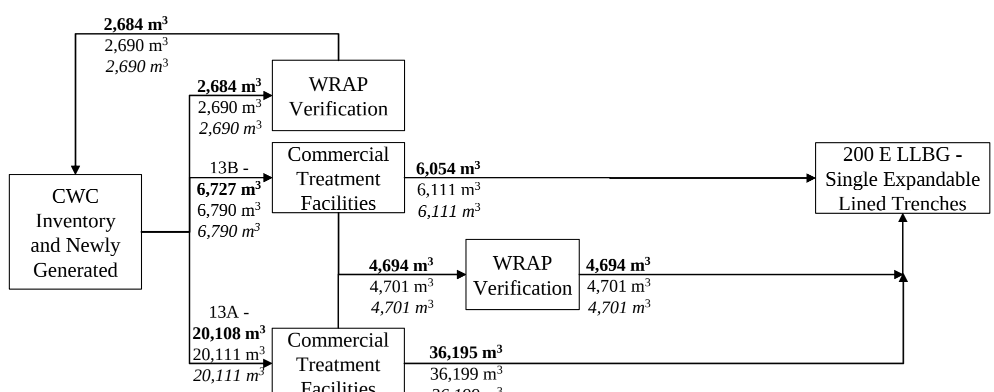
Alternative Group C

Stream 13A – CH Inorganic Solids and Debris
Stream 13B – CH Organic Solids and Debris



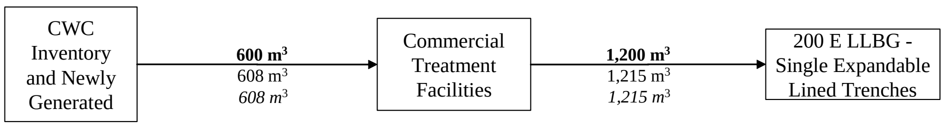
	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**5,725 m^3**	5,725 m^3	*5,725 m^3*
Receipts:	**21,110 m^3**	21,175 m^3	*21,175 m^3*
Waste Stream Total:	**26,835 m^3**	26,901 m^3	*26,901 m^3*
Total Treatment:	**26,835 m^3**	26,901 m^3	*26,901 m^3*
Total Disposal:	**46,944 m^3**	47,011 m^3	*47,011 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a46
HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group C

Stream 14
Elemental Lead



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**445 m^3**	445 m^3	*445 m^3*
Receipts:	**155 m^3**	163 m^3	*163 m^3*
Waste Stream Total:	**600 m^3**	608 m^3	*608 m^3*
Total Treatment:	**600 m^3**	608 m^3	*608 m^3*
Total Disposal:	**1,200 m^3**	1,215 m^3	*1,215 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

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Alternative Group C

Stream 15
Elemental Mercury

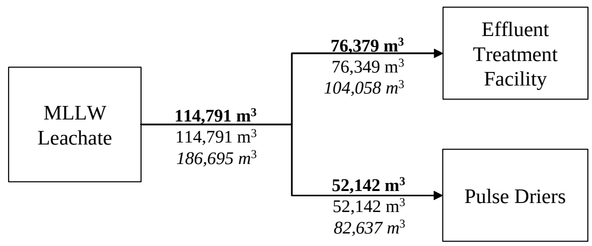
	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**13 m^3**	13 m^3	*13 m^3*
Receipts:	**8 m^3**	8 m^3	*8 m^3*
Waste Stream Total:	**21 m^3**	21 m^3	*21 m^3*
Total Treatment:	**21 m^3**	21 m^3	*21 m^3*
Total Disposal:	**312 m^3**	312 m^3	*312 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a48
HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group C

Stream 18
MLLW Trench Leachate



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Total Generation:	**114,791 m^3**	114,791 m^3	*186,695 m^3*
Waste Stream Total:	**114,791 m^3**	114,791 m^3	*186,695 m^3*
Total Treatment/ Disposal:	**114,791 m^3**	114,791 m^3	*186,695 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a49
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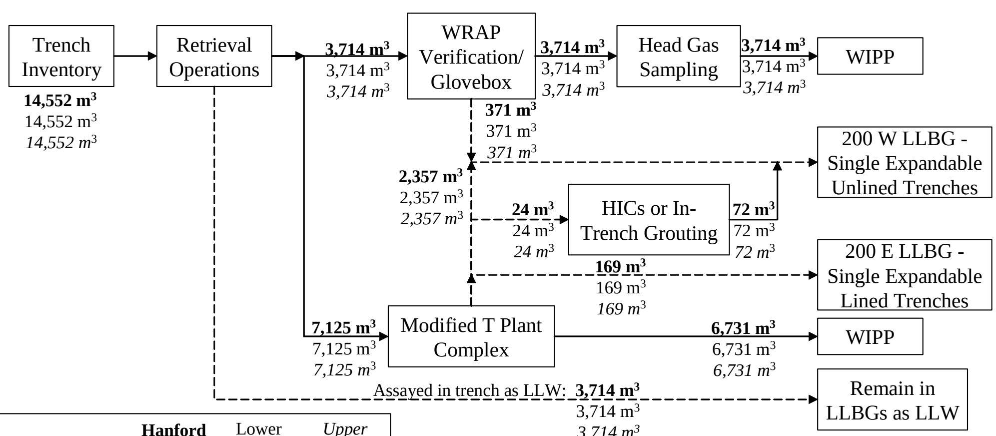
Alternative Group C

Stream 4
TRU - Waste from Trenches



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**14,552 m^3**	14,552 m^3	*14,552 m^3*
Receipts:	**0 m^3**	0 m^3	*0 m^3*
Waste Stream Total:	**14,552 m^3**	14,552 m^3	*14,552 m^3*
Total Processed:	**10,938 m^3**	10,938 m^3	*10,938 m^3*
Total Disposal:	**10,185 m^3**	10,185 m^3	*10,185 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a50
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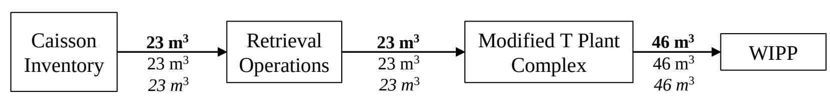
*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group C

Stream 5
TRU - Waste from Caissons



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**23 m^3**	23 m^3	*23 m^3*
Receipts:	**0 m^3**	0 m^3	*0 m^3*
Waste Stream Total:	**23 m^3**	23 m^3	*23 m^3*
Total Processed:	**23 m^3**	23 m^3	*23 m^3*
Total Disposal:	**46 m^3**	46 m^3	*46 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

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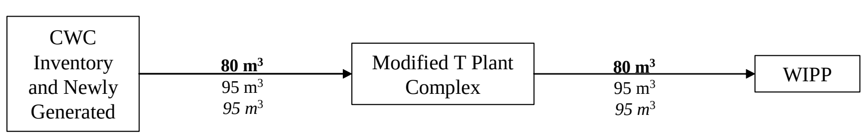
Alternative Group C

Stream 8
TRU - Commingled PCB Waste



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**80 m^3**	80 m^3	*80 m^3*
Receipts:	**0 m^3**	15 m^3	*15 m^3*
Waste Stream Total:	**80 m^3**	95 m^3	*95 m^3*
Total Processed:	**80 m^3**	95 m^3	*95 m^3*
Total Disposal:	**80 m^3**	95 m^3	*95 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a52
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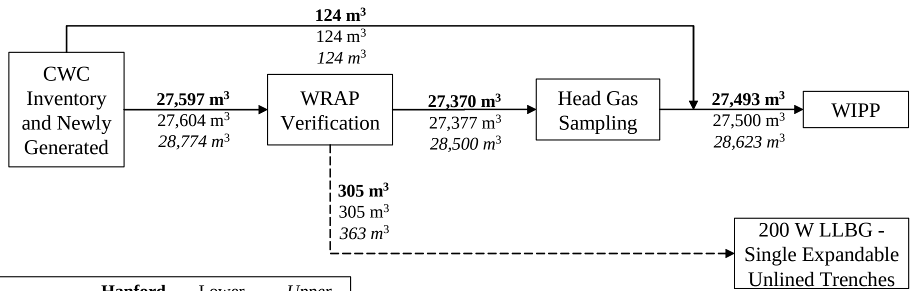
*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group C

Stream 9

TRU – Newly Generated and Existing CH Standard Containers



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**849 m³**	849 m³	*849 m³*
Receipts:	**26,870 m³**	26,878 m³	*28,048 m³*
Waste Stream Total:	**27,719 m³**	27,727 m³	*28,897 m³*
Total Processed:	**27,597 m³**	27,604 m³	*28,774 m³*
Total Disposal:	**27,493 m³**	27,500 m³	*28,623 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

Note: It is assumed that WIPP or another offsite disposal facility will be available after 2032.

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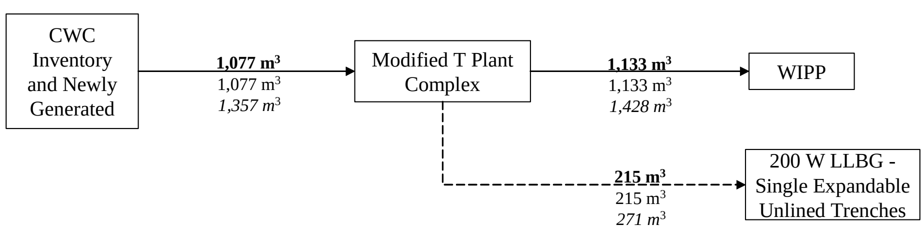
1

Alternative Group C

Stream 10A

TRU – Newly Generated and Existing CH Non-Standard Containers



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**585 m³**	585 m³	*585 m³*
Receipts:	**492 m³**	492 m³	*772 m³*
Waste Stream Total:	**1,077 m³**	1,077 m³	*1,357 m³*
Total Processed:	**1,077 m³**	1,077 m³	*1,357 m³*
Total Disposal:	**1,133 m³**	1,133 m³	*1,428 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

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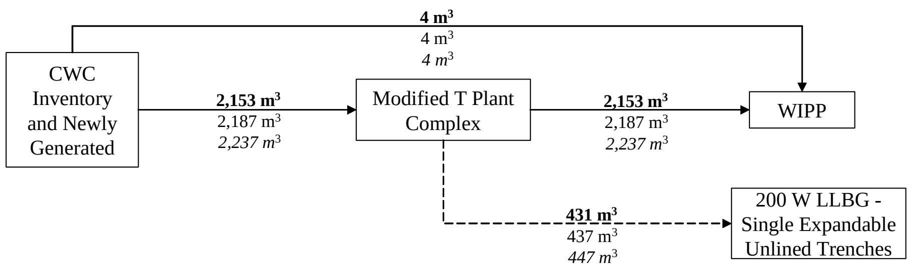
2

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group C
Stream 10B
TRU – Newly Generated and Existing RH Waste



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**46 m^3**	46 m^3	*46 m^3*
Receipts:	**2,112 m^3**	2,145 m^3	*2,196 m^3*
Waste Stream Total:	**2,157 m^3**	2,191 m^3	*2,241 m^3*
Total Processed:	**2,153 m^3**	2,187 m^3	*2,237 m^3*
Total Disposal:	**2,157 m^3**	2,191 m^3	*2,241 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

Note: It is assumed that WIPP or another offsite disposal facility will be available after 2032.

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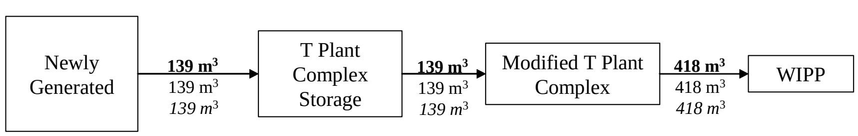
Alternative Group C
Stream 17
TRU – K Basins Sludge



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**139 m^3**	139 m^3	*139 m^3*
Waste Stream Total:	**139 m^3**	139 m^3	*139 m^3*
Total Processed:	**139 m^3**	139 m^3	*139 m^3*
Total Disposal:	**418 m^3**	418 m^3	*418 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

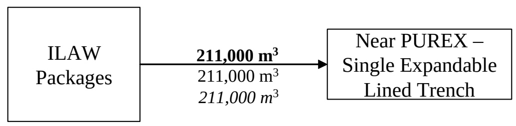
M0212-0286.54a56
HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Group C

Stream 21

WTP Wastes – ILAW Packages



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**211,000 m^3**	211,000 m^3	*211,000 m^3*
Waste Stream Total:	**211,000 m^3**	211,000 m^3	*211,000 m^3*
Total Processed:	**0 m^3**	0 m^3	*0 m^3*
Total Disposal:	**211,000 m^3**	211,000 m^3	*211,000 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

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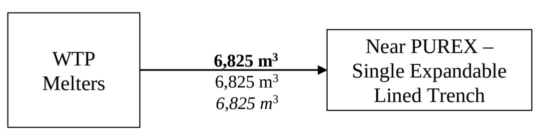
Alternative Group C

Stream 22

WTP Wastes –WTP Melters



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**6,825 m^3**	6,825 m^3	*6,825 m^3*
Waste Stream Total:	**6,825 m^3**	6,825 m^3	*6,825 m^3*
Total Processed:	**0 m^3**	0 m^3	*0 m^3*
Total Disposal:	**6,825 m^3**	6,825 m^3	*6,825 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.54a58
R1 HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

The waste flow diagrams for Alternative Groups D and E have been combined for simplification. The primary difference between these alternative groups is that Group D assumes a single modular combined-use facility for LLW, MLLW, and WTP wastes disposal whereas Group E assumes two modular combined-use facilities, one for LLW and MLLW disposal and one for disposal of WTP wastes. The subalternatives within each group are also represented by these diagrams. The primary differences among the subalternatives are the locations for the disposal facilities. Table B.25 has been provided as an aid for reviewing these flow diagrams. This table provides a matrix of the disposal options by waste type for each subalternative in Groups D and E.

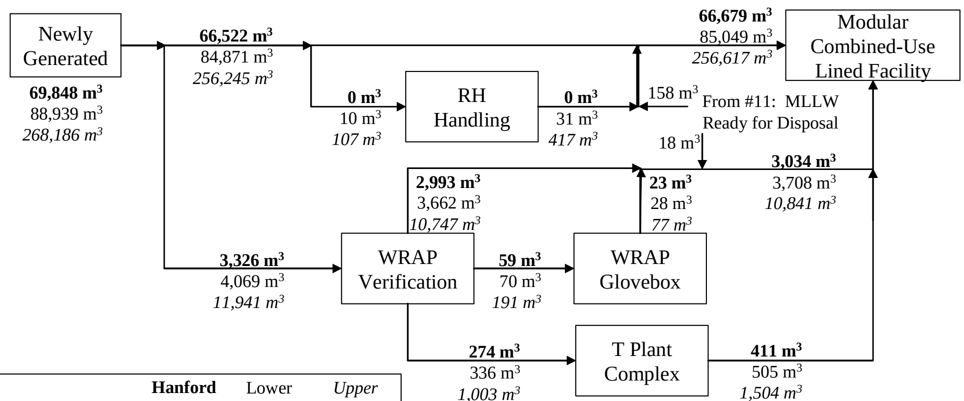
Table B.25. Matrix of Disposal Options for Alternative Groups D and E

	Alternative Group D			**Alternative Group E**		
	1	**2**	**3**	**1**	**2**	**3**
LLW	Near PUREX	200 E LLBG	ERDF	200 E LLBG	Near PUREX	ERDF
MLLW	Near PUREX	200 E LLBG	ERDF	200 E LLBG	Near PUREX	ERDF
ILAW Packages	Near PUREX	200 E LLBG	ERDF	ERDF	ERDF	Near PUREX
WTP Melters	Near PUREX	200 E LLBG	ERDF	ERDF	ERDF	Near PUREX

Alternative Groups D & E

Stream 1

LLW Category 1



	Hanford Only	Lower Bound	*Upper Bound*
Disposed FY99-01:	**18,944 m³**	18,944 m³	*18,944 m³*
Initial Inventory:	**0 m³**	0 m³	*0 m³*
Receipts:	**69,848 m³**	88,939 m³	*268,186 m³*
Waste Stream Total:	**88,792 m³**	107,883 m³	*287,130 m³*
Total Verification:	**3,326 m³**	4,069 m³	*11,941 m³*
Total Disposal:	**89,069 m³**	108,205 m³	*287,906 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

Note: Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

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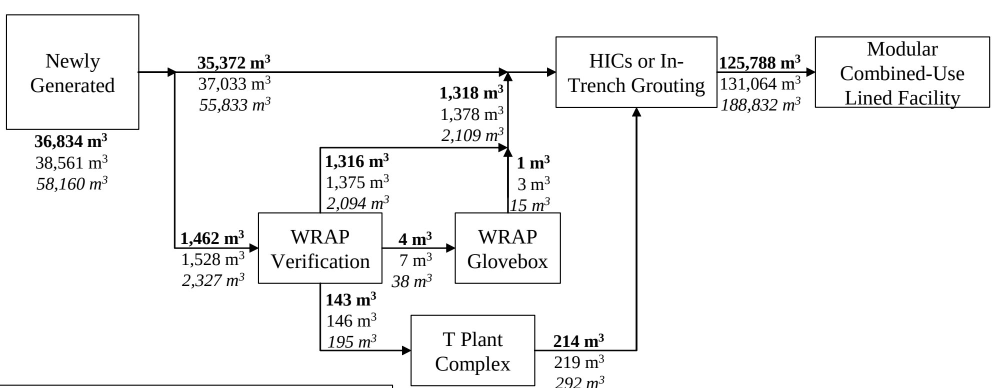
Alternative Groups D & E

Stream 2

LLW Category 3



	Hanford Only	Lower Bound	*Upper Bound*
Disposed FY99-01:	**2,773 m³**	2,773 m³	*2,773 m³*
Initial Inventory:	**0 m³**	0 m³	*0 m³*
Receipts:	**36,834 m³**	38,561 m³	*58,160 m³*
Waste Stream Total:	**39,607 m³**	41,334 m³	*60,933 m³*
Total Verification:	**1,462 m³**	1,528 m³	*2,327 m³*
Total Stabilized:	**36,903 m³**	38,630 m³	*58,234 m³*
Total Disposal:	**128,561 m³**	133,837 m³	*191,605 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

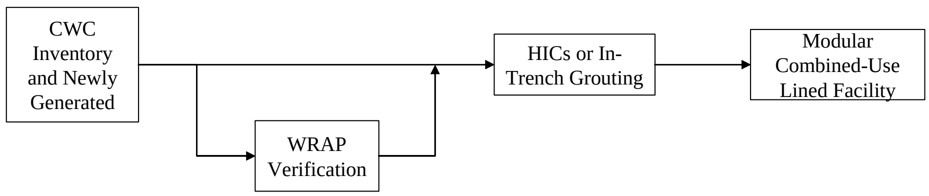
Note: Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

M0212-0286.55a2
HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Groups D & E

Stream 3
Greater Than Category 3 Waste

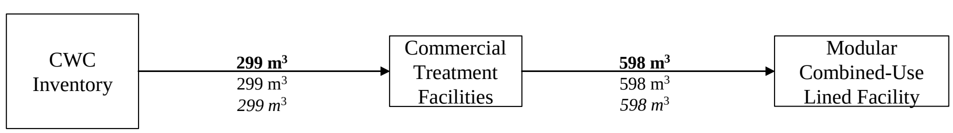


	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**<1 m³**	<1 m³	*<1 m³*
Receipts:	**0 m³**	0 m³	*0 m³*
Waste Stream Total:	**<1 m³**	<1 m³	*<1 m³*
Total Stabilized:	**<1 m³**	<1 m³	*<1 m³*
Total Disposal:	**<1 m³**	<1 m³	*<1 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

M0212-0286.55a3
R1 HSW EIS 02-24-03

Alternative Groups D & E

Stream 6
LLW – Non-Conforming



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**299 m³**	299 m³	*299 m³*
Receipts:	**0 m³**	0 m³	*0 m³*
Waste Stream Total:	**299 m³**	299 m³	*299 m³*
Total Treatment:	**299 m³**	299 m³	*299 m³*
Total Disposal:	**598 m³**	598 m³	*598 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

M0212-0286.55a4
R1 HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Groups D & E

Stream 20

LLW – Previously Disposed of

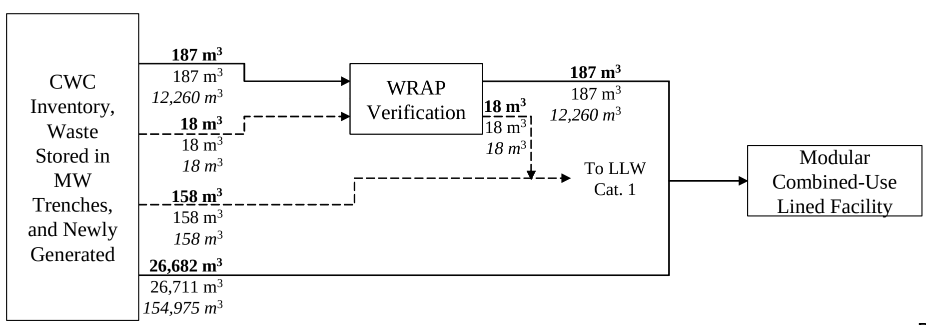
	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**283,067 m³**	283,067 m³	*283,067 m³*
Receipts:	**0 m³**	0 m³	*0 m³*
Waste Stream Total:	**283,067 m³**	283,067 m³	*283,067 m³*
Total Treatment:	**0 m³**	0 m³	*0 m³*
Total Disposal:	**283,067 m³**	283,067 m³	*283,067 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

M0212-0286.55a5
HSW EIS 02-24-03

Alternative Groups D & E

Stream 11

MLLW Treated and Ready for Disposal



M0212-0286.55a6
R1 HSW EIS 02-24-03

	Hanford Only	Lower Bound	*Upper Bound*
Disposed FY99-01:	**1,010 m³**	1,010 m³	*1,010 m³*
Initial Inventory:	**1,102 m³**	1,102 m³	*1,102 m³*
Receipts:	**25,942 m³**	25,970 m³	*166,307m³*
Waste Stream Total:	**28,054 m³**	28,082 m³	*168,419m³*
Total Treatment:	**0 m³**	0 m³	*0 m³*
Total Disposal:	**27,879 m³**	27,907 m³	*168,244 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

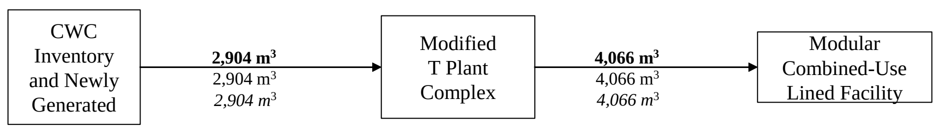
Notes: Dashed lines represent waste managed as MLLW expected to be reclassified as LLW.

Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Groups D & E

Stream 12
RH and Non-Standard Packages

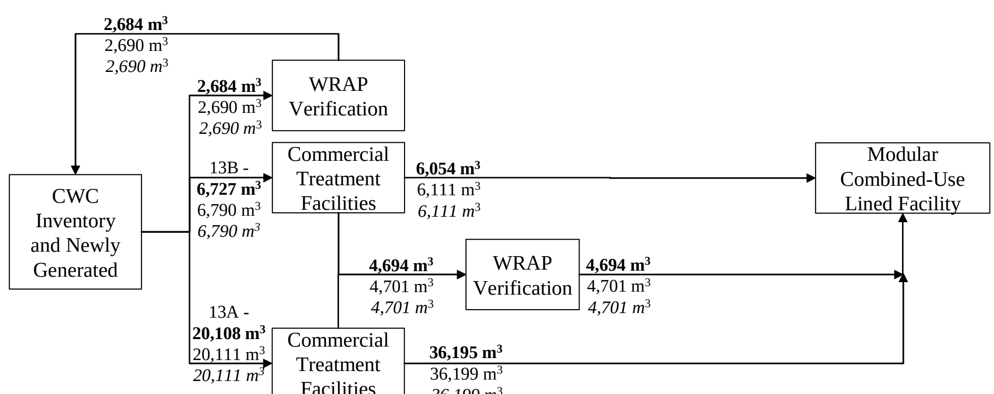


	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**65 m^3**	65 m^3	*65 m^3*
Receipts:	**2,839 m^3**	2,839 m^3	*2,839 m^3*
Waste Stream Total:	**2,904 m^3**	2,904 m^3	*2,904 m^3*
Total Treatment:	**2,904 m^3**	2,904 m^3	*2,904 m^3*
Total Disposal:	**4,066 m^3**	4,066 m^3	*4,066 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.55a7
R1 HSW EIS 02-24-03

Alternative Groups D & E

Stream 13A – CH Inorganic Solids and Debris
Stream 13B – CH Organic Solids and Debris



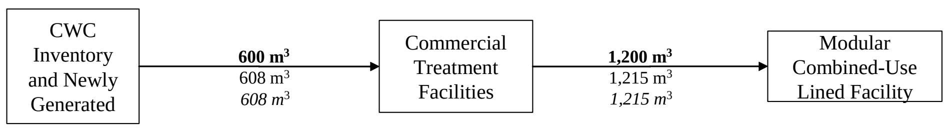
	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**5,725 m^3**	5,725 m^3	*5,725 m^3*
Receipts:	**21,110 m^3**	21,175 m^3	*21,175 m^3*
Waste Stream Total:	**26,835 m^3**	26,901 m^3	*26,901 m^3*
Total Treatment:	**26,835 m^3**	26,901 m^3	*26,901 m^3*
Total Disposal:	**46,944 m^3**	47,011 m^3	*47,011 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.55a8
R1 HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Groups D & E

Stream 14
Elemental Lead



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**445 m^3**	445 m^3	*445 m^3*
Receipts:	**155 m^3**	163 m^3	*163 m^3*
Waste Stream Total:	**600 m^3**	608 m^3	*608 m^3*
Total Treatment:	**600 m^3**	608 m^3	*608 m^3*
Total Disposal:	**1,200 m^3**	1,215 m^3	*1,215 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.55a9
R1 HSW EIS 02-24-03

Alternative Groups D & E

Stream 15
Elemental Mercury

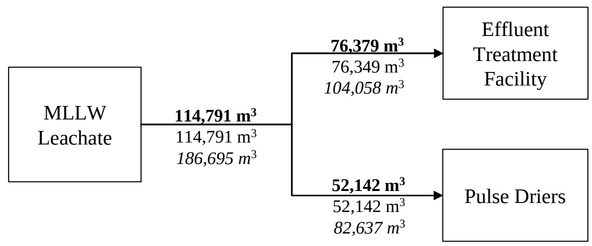
	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**13 m^3**	13 m^3	*13 m^3*
Receipts:	**8 m^3**	8 m^3	*8 m^3*
Waste Stream Total:	**21 m^3**	21 m^3	*21 m^3*
Total Treatment:	**21 m^3**	21 m^3	*21 m^3*
Total Disposal:	**312 m^3**	312 m^3	*312 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.55a10
R1 HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Groups D & E

Stream 18
MLLW Trench Leachate

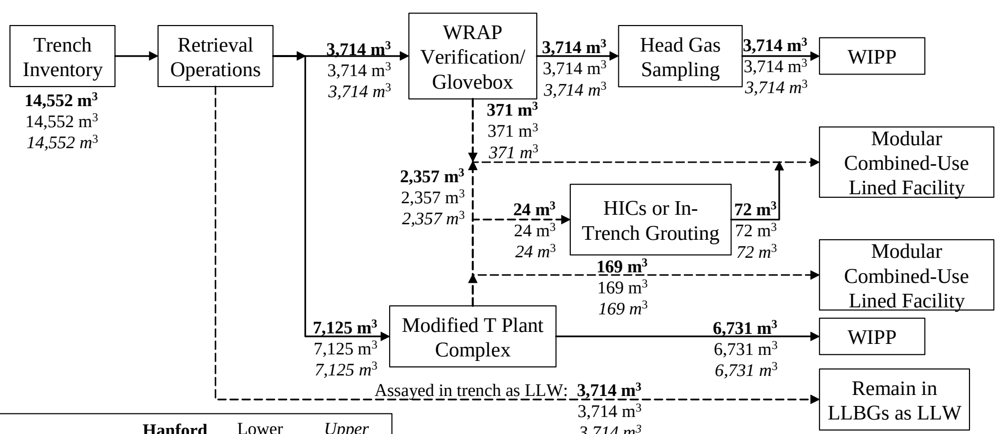


	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m³**	0 m³	*0 m³*
Total Generation:	**114,791 m³**	114,791 m³	*186,695 m³*
Waste Stream Total:	**114,791 m³**	114,791 m³	*186,695 m³*
Total Treatment/ Disposal:	**114,791 m³**	114,791 m³	*186,695 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

M0212-0286.55a11
HSW EIS 02-24-03

Alternative Groups D & E

Stream 4
TRU - Waste from Trenches



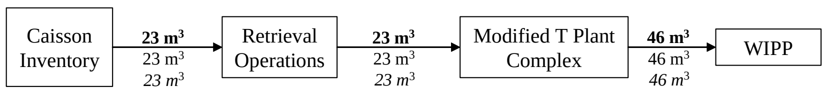
	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**14,552 m³**	14,552 m³	*14,552 m³*
Receipts:	**0 m³**	0 m³	*0 m³*
Waste Stream Total:	**14,552 m³**	14,552 m³	*14,552 m³*
Total Processed:	**10,938 m³**	10,938 m³	*10,938 m³*
Total Disposal:	**10,185 m³**	10,185 m³	*10,185 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

M0212-0286.55a12
R1 HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Groups D & E

Stream 5
TRU - Waste from Caissons

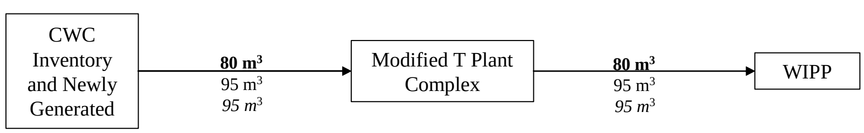


	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**23 m^3**	23 m^3	*23 m^3*
Receipts:	**0 m^3**	0 m^3	*0 m^3*
Waste Stream Total:	**23 m^3**	23 m^3	*23 m^3*
Total Processed:	**23 m^3**	23 m^3	*23 m^3*
Total Disposal:	**46 m^3**	46 m^3	*46 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

M0212-0286.55a13
HSW EIS 02-24-03

Alternative Groups D & E

Stream 8
TRU - Commingled PCB Waste



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**80 m^3**	80 m^3	*80 m^3*
Receipts:	**0 m^3**	15 m^3	*15 m^3*
Waste Stream Total:	**80 m^3**	95 m^3	*95 m^3*
Total Processed:	**80 m^3**	95 m^3	*95 m^3*
Total Disposal:	**80 m^3**	95 m^3	*95 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

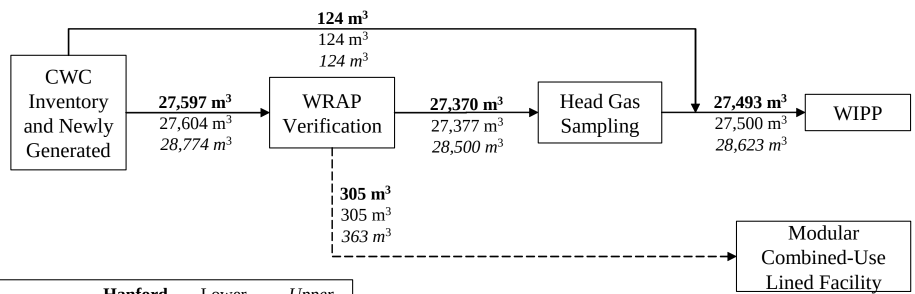
M0212-0286.55a14
HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Groups D & E

Stream 9

TRU – Newly Generated and Existing CH Standard Containers



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**849 m^3**	849 m^3	*849 m^3*
Receipts:	**26,870 m^3**	26,878 m^3	*28,048 m^3*
Waste Stream Total:	**27,719 m^3**	27,727 m^3	*28,897 m^3*
Total Processed:	**27,597 m^3**	27,604 m^3	*28,774 m^3*
Total Disposal:	**27,493 m^3**	27,500 m^3	*28,623 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

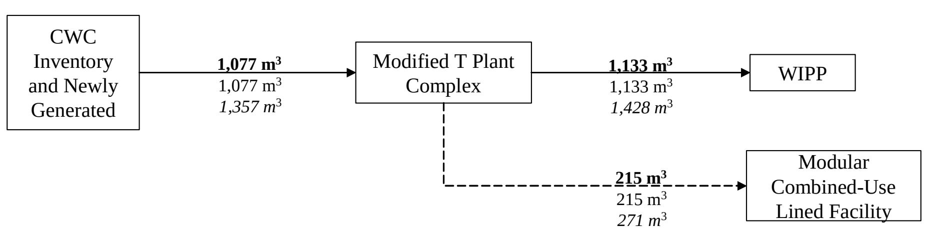
Note: It is assumed that WIPP or another offsite disposal facility will be available after 2032.

M0212-0286.55a15
R1 HSW EIS 02-24-03

Alternative Groups D & E

Stream 10A

TRU – Newly Generated and Existing CH Non-Standard Containers



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**585 m^3**	585 m^3	*585 m^3*
Receipts:	**492 m^3**	492 m^3	*772 m^3*
Waste Stream Total:	**1,077 m^3**	1,077 m^3	*1,357 m^3*
Total Processed:	**1,077 m^3**	1,077 m^3	*1,357 m^3*
Total Disposal:	**1,133 m^3**	1,133 m^3	*1,428 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

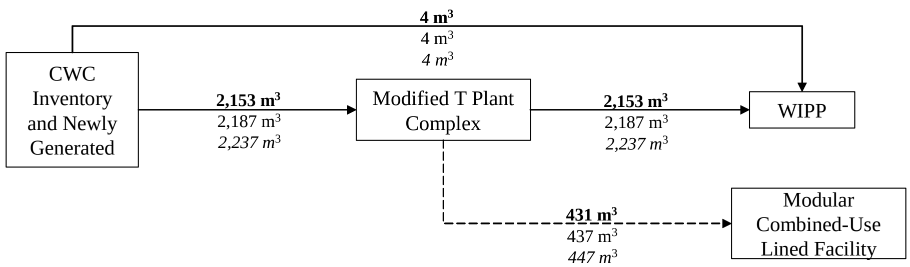
M0212-0286.55a16
R1 HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Groups D & E

Stream 10B

TRU – Newly Generated and Existing RH Waste



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**46 m³**	46 m³	*46 m³*
Receipts:	**2,112 m³**	2,145 m³	*2,196 m³*
Waste Stream Total:	**2,157 m³**	2,191 m³	*2,241 m³*
Total Processed:	**2,153 m³**	2,187 m³	*2,237 m³*
Total Disposal:	**2,157 m³**	2,191 m³	*2,241 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

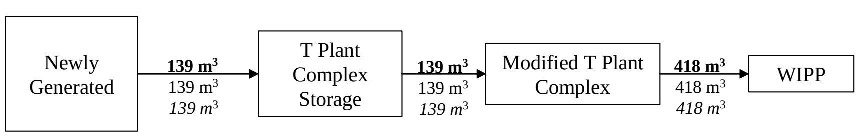
Note: It is assumed that WIPP or another offsite disposal facility will be available after 2032.

M0212-0286.55a17
R1 HSW EIS 02-24-03

Alternative Groups D & E

Stream 17

TRU – K Basins Sludge



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m³**	0 m³	*0 m³*
Receipts:	**139 m³**	139 m³	*139 m³*
Waste Stream Total:	**139 m³**	139 m³	*139 m³*
Total Processed:	**139 m³**	139 m³	*139 m³*
Total Disposal:	**418 m³**	418 m³	*418 m³*
Ending Inventory:	**0 m³**	0 m³	*0 m³*

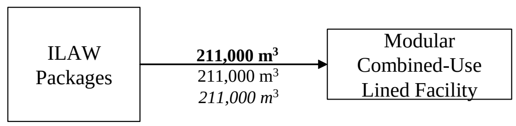
M0212-0286.55a18
HSW EIS 02-24-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

Alternative Groups D & E

Stream 21

WTP Wastes – ILAW Packages



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**211,000 m^3**	211,000 m^3	*211,000 m^3*
Waste Stream Total:	**211,000 m^3**	211,000 m^3	*211,000 m^3*
Total Processed:	**0 m^3**	0 m^3	*0 m^3*
Total Disposal:	**211,000 m^3**	211,000 m^3	*211,000 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

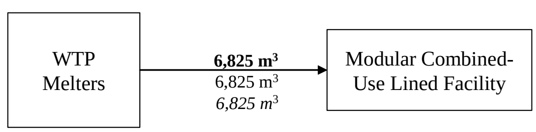
M0212-0286.55a19
R1 HSW EIS 02-24-03

1

Alternative Groups D & E

Stream 22

WTP Wastes – WTP Melters



	Hanford Only	Lower Bound	*Upper Bound*
Initial Inventory:	**0 m^3**	0 m^3	*0 m^3*
Receipts:	**6,825 m^3**	6,825 m^3	*6,825 m^3*
Waste Stream Total:	**6,825 m^3**	6,825 m^3	*6,825 m^3*
Total Processed:	**0 m^3**	0 m^3	*0 m^3*
Total Disposal:	**6,825 m^3**	6,825 m^3	*6,825 m^3*
Ending Inventory:	**0 m^3**	0 m^3	*0 m^3*

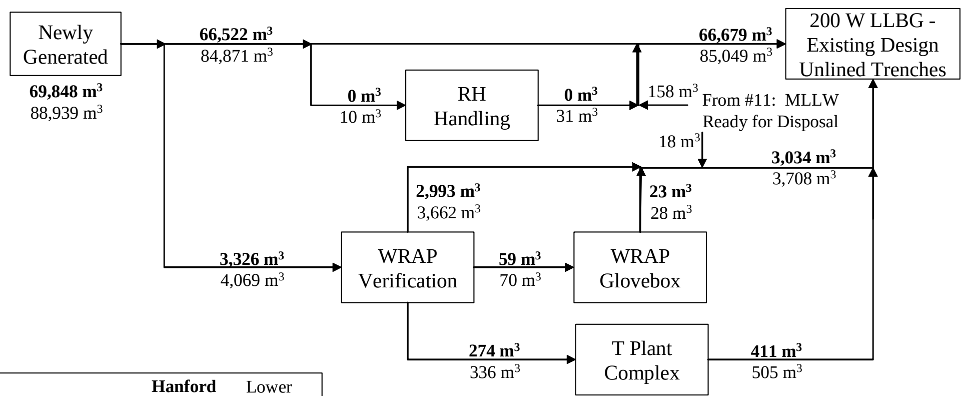
M0212-0286.55a20
R1 HSW EIS 02-24-03

2

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

No Action Alternative Group

Stream 1
LLW Category 1



	Hanford Only	Lower Bound
Disposed FY99-01:	**18,944 m³**	18,944 m³
Initial Inventory:	**0 m³**	0 m³
Receipts:	**69,848 m³**	88,939 m³
Waste Stream Total:	**88,792 m³**	107,883 m³
Total Verification:	**3,326 m³**	4,069 m³
Total Disposal:	**89,069 m³**	108,205 m³
Ending Inventory:	**0 m³**	0 m³

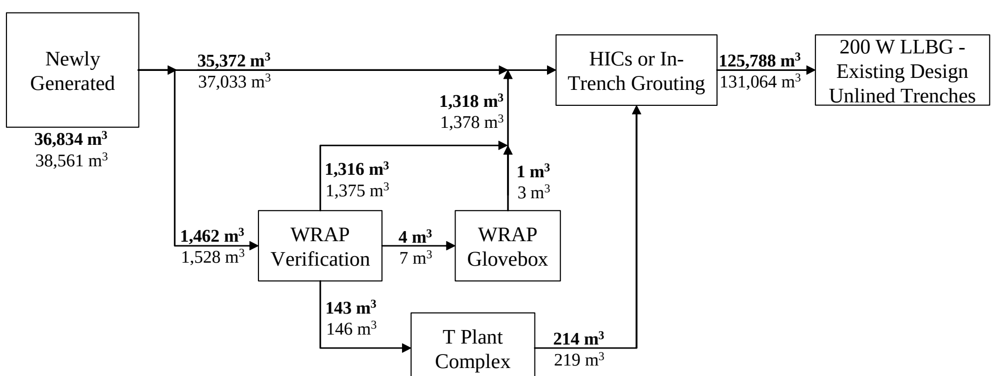
Note: Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

M0212-0286.55a21
HSW EIS 02-24-03

1

No Action Alternative Group

Stream 2
LLW Category 3



	Hanford Only	Lower Bound
Disposed FY99-01:	**2,773 m³**	2,773 m³
Initial Inventory:	**0 m³**	0 m³
Receipts:	**36,834 m³**	38,561 m³
Waste Stream Total:	**39,607 m³**	41,334 m³
Total Verification:	**1,462 m³**	1,528 m³
Total Stabilized:	**36,903 m³**	38,630 m³
Total Disposal:	**128,561 m³**	133,837 m³
Ending Inventory:	**0 m³**	0 m³

Note: Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

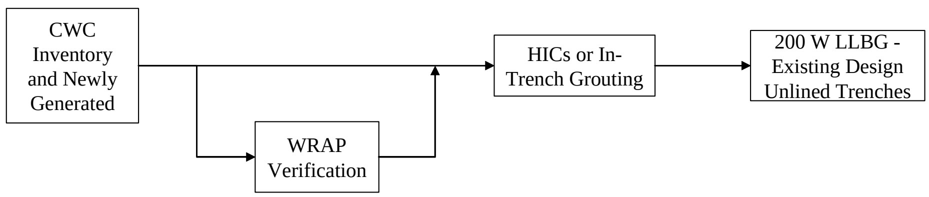
M0212-0286.55a22
HSW EIS 02-24-03

2

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

No Action Alternative Group

Stream 3
Greater Than Category 3 Waste

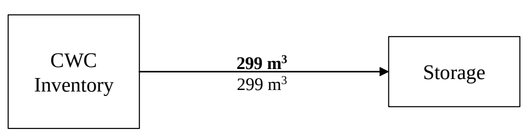


	Hanford Only	Lower Bound
Initial Inventory:	**<1 m³**	<1 m³
Receipts:	**0 m³**	0 m³
Waste Stream Total:	**<1 m³**	<1 m³
Total Stabilized:	**<1 m³**	<1 m³
Total Disposal:	**<1 m³**	<1 m³
Ending Inventory:	**0 m³**	0 m³

M0212-0286.55a23
HSW EIS 02-24-03

No Action Alternative Group

Stream 6
LLW – Non-Conforming



	Hanford Only	Lower Bound
Initial Inventory:	**299 m³**	299 m³
Receipts:	**0 m³**	0 m³
Waste Stream Total:	**299 m³**	299 m³
Total Treatment:	**299 m³**	299 m³
Total Disposal:	**0 m³**	0 m³
Ending Inventory:	**299 m³**	299 m³

M0212-0286.55a24
R1 HSW EIS 03-27-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

No Action Alternative Group

Stream 20

LLW – Previously Disposed of

	Hanford Only	Lower Bound
Initial Inventory:	**283,067 m³**	283,067 m³
Receipts:	**0 m³**	0 m³
Waste Stream Total:	**283,067 m³**	283,067 m³
Total Treatment:	**0 m³**	0 m³
Total Disposal:	**283,067 m³**	283,067 m³
Ending Inventory:	**0 m³**	0 m³

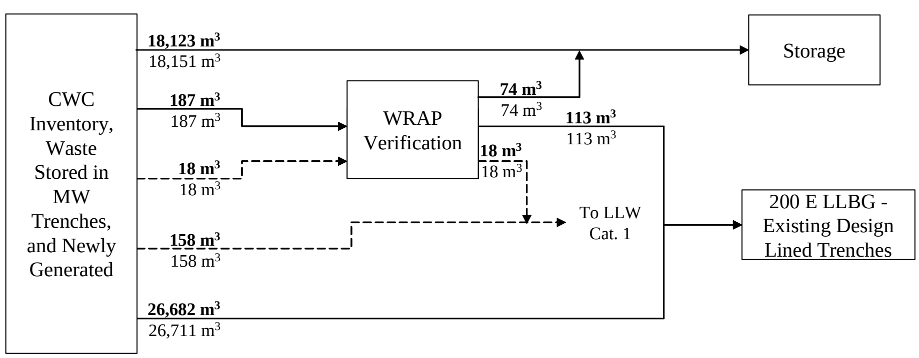
M0212-0286.55a25
HSW EIS 02-24-03

1

No Action Alternative Group

Stream 11

MLLW Treated and Ready for Disposal



M0212-0286.55a26
R1 HSW EIS 03-27-03

	Hanford Only	Lower Bound
Disposed FY99-01:	**1,010 m³**	1,010 m³
Initial Inventory:	**1,102 m³**	1,102 m³
Receipts:	**25,942 m³**	25,970 m³
Waste Stream Total:	**28,054 m³**	28,082 m³
Total Treatment:	**0 m³**	0 m³
Total Disposal:	**9,683 m³**	9,683 m³
Ending Inventory:	**18,196 m³**	18,225 m³

Notes: Dashed lines represent waste managed as MLLW expected to be reclassified as LLW.

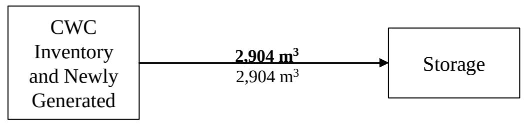
Waste disposed from FY99 to FY01 is not shown in the diagram but is included in the summary of Total Disposal.

2

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

No Action Alternative Group

Stream 12
RH and Non-Standard Packages

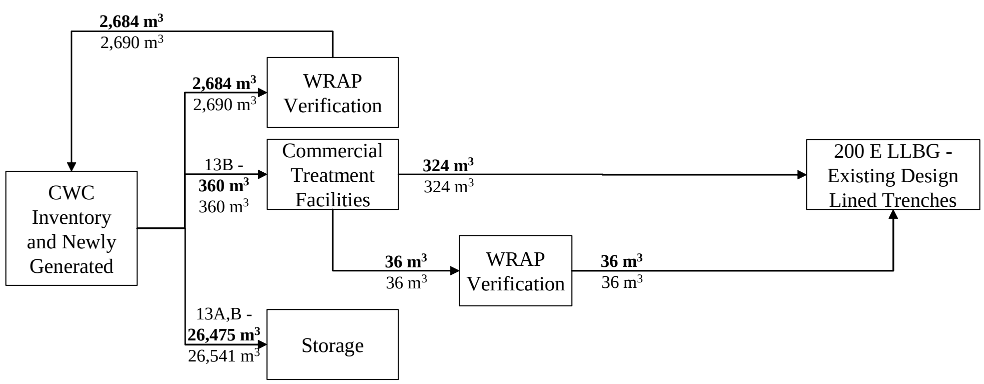


	Hanford Only	Lower Bound
Initial Inventory:	**65 m³**	65 m³
Receipts:	**2,839 m³**	2,839 m³
Waste Stream Total:	**2,904 m³**	2,904 m³
Total Treatment:	**0 m³**	0 m³
Total Disposal:	**0 m³**	0 m³
Ending Inventory:	**2,904 m³**	2,904 m³

M0212-0286.55a27
R1 HSW EIS 03-27-03

No Action Alternative Group

Stream 13A – CH Inorganic Solids and Debris
Stream 13B – CH Organic Solids and Debris



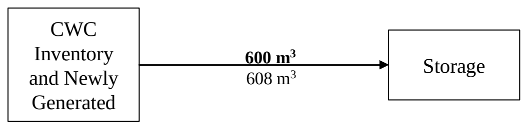
	Hanford Only	Lower Bound
Initial Inventory:	**5,725 m³**	5,725 m³
Receipts:	**21,110 m³**	21,175 m³
Waste Stream Total:	**26,835 m³**	26,901 m³
Total Treatment:	**360 m³**	360 m³
Total Disposal:	**360 m³**	360 m³
Ending Inventory:	**26,475 m³**	26,541 m³

M0212-0286.55a28
R1 HSW EIS 03-27-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

No Action Alternative Group

Stream 14
Elemental Lead

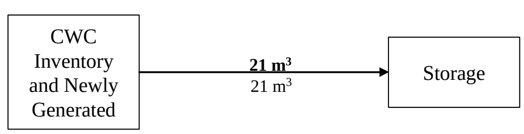


	Hanford Only	Lower Bound
Initial Inventory:	**445 m³**	445 m³
Receipts:	**155 m³**	163 m³
Waste Stream Total:	**600 m³**	608 m³
Total Treatment:	**0 m³**	0 m³
Total Disposal:	**0 m³**	0 m³
Ending Inventory:	**608 m³**	608 m³

M0212-0286.55a29
R1 HSW EIS 03-27-03

No Action Alternative Group

Stream 15
Elemental Mercury

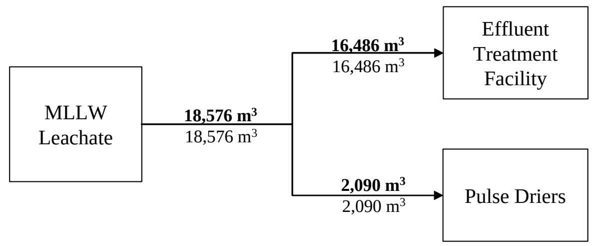


	Hanford Only	Lower Bound
Initial Inventory:	**13 m³**	13 m³
Receipts:	**8 m³**	8 m³
Waste Stream Total:	**21 m³**	21 m³
Total Treatment:	**0 m³**	0 m³
Total Disposal:	**0 m³**	0 m³
Ending Inventory:	**21 m³**	21 m³

M0212-0286.55a30
R1 HSW EIS 03-27-03

No Action Alternative Group

Stream 18
MLLW Trench Leachate

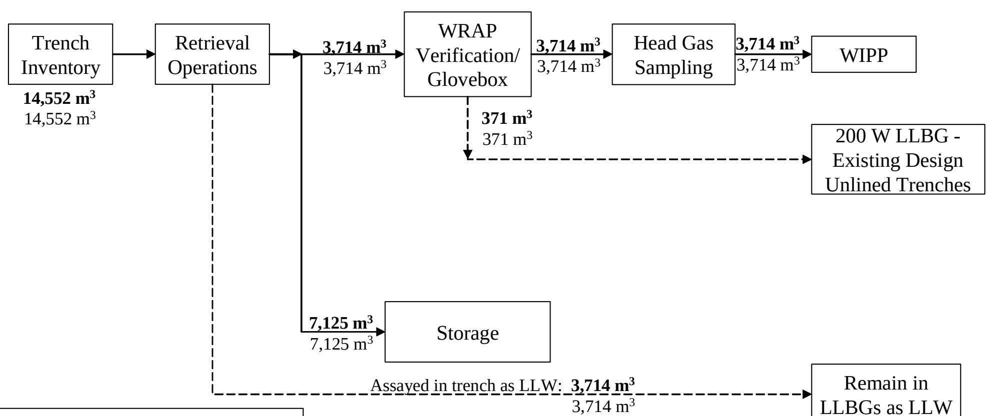


	Hanford Only	Lower Bound
Initial Inventory:	**0 m³**	0 m³
Total Generation:	**18,576 m³**	18,576 m³
Waste Stream Total:	**18,576 m³**	18,576 m³
Total Treatment/ Disposal:	**18,576 m³**	18,576 m³
Ending Inventory:	**0 m³**	0 m³

M0212-0286.55a31
HSW EIS 02-24-03

No Action Alternative Group

Stream 4
TRU - Waste from Trenches



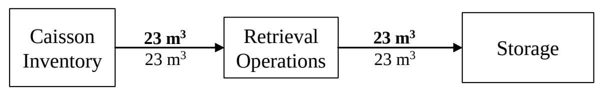
	Hanford Only	Lower Bound
Initial Inventory:	**14,552 m³**	14,552 m³
Receipts:	**0 m³**	0 m³
Waste Stream Total:	**14,552 m³**	14,552 m³
Total Processed:	**10,938 m³**	10,938 m³
Total Disposal:	**10,185 m³**	10,185 m³
Ending Inventory:	**0 m³**	0 m³

M0212-0286.55a32
R1 HSW EIS 03-27-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

No Action Alternative Group

Stream 5
TRU - Waste from Caissons

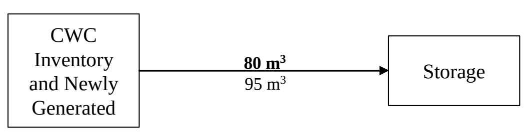


	Hanford Only	Lower Bound
Initial Inventory:	**23 m^3**	23 m^3
Receipts:	**0 m^3**	0 m^3
Waste Stream Total:	**23 m^3**	23 m^3
Total Processed:	**0 m^3**	0 m^3
Total Disposal:	**0 m^3**	0 m^3
Ending Inventory:	**23 m^3**	23 m^3

M0212-0286.55a33
R1 HSW EIS 03-27-03

No Action Alternative Group

Stream 8
TRU - Commingled PCB Waste



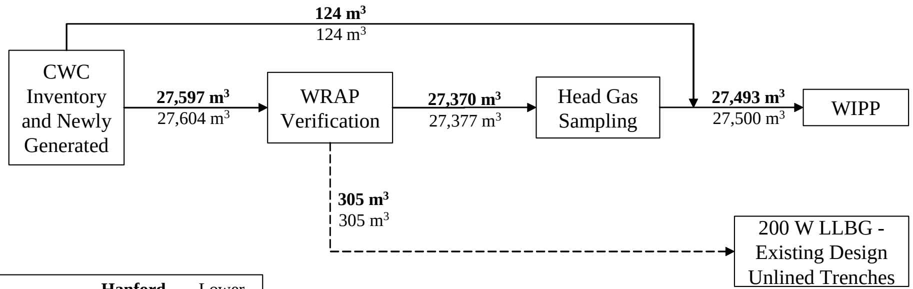
	Hanford Only	Lower Bound
Initial Inventory:	**80 m^3**	80 m^3
Receipts:	**0 m^3**	15 m^3
Waste Stream Total:	**80 m^3**	95 m^3
Total Processed:	**80 m^3**	95 m^3
Total Disposal:	**80 m^3**	95 m^3
Ending Inventory:	**0 m^3**	0 m^3

M0212-0286.55a34
R1 HSW EIS 03-27-03

No Action Alternative Group

Stream 9

TRU – Newly Generated and Existing CH Standard Containers



	Hanford Only	Lower Bound
Initial Inventory:	**849 m^3**	849 m^3
Receipts:	**26,870 m^3**	26,878 m^3
Waste Stream Total:	**27,719 m^3**	27,727 m^3
Total Processed:	**27,597 m^3**	27,604 m^3
Total Disposal:	**27,493 m^3**	27,500 m^3
Ending Inventory:	**0 m^3**	0 m^3

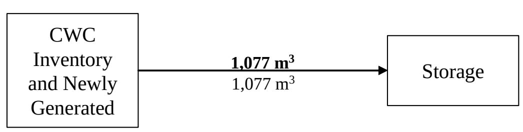
Note: It is assumed that WIPP or another offsite disposal facility will be available after 2032.

M0212-0286.55a35
HSW EIS 02-24-03

No Action Alternative Group

Stream 10A

TRU – Newly Generated and Existing CH Non-Standard Containers



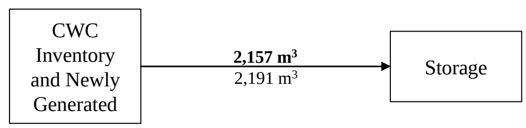
	Hanford Only	Lower Bound
Initial Inventory:	**585 m^3**	585 m^3
Receipts:	**492 m^3**	492 m^3
Waste Stream Total:	**1,077 m^3**	1,077 m^3
Total Processed:	**0 m^3**	0 m^3
Total Disposal:	**0 m^3**	0 m^3
Ending Inventory:	**1,077 m^3**	1,077 m^3

M0212-0286.55a36
R1 HSW EIS 03-27 -03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

No Action Alternative Group

Stream 10B
TRU – Newly Generated and Existing RH Waste

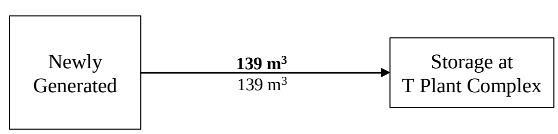


	Hanford Only	Lower Bound
Initial Inventory:	**46 m^3**	46 m^3
Receipts:	**2,112 m^3**	2,145 m^3
Waste Stream Total:	**2,157 m^3**	2,191 m^3
Total Processed:	**0 m^3**	0 m^3
Total Disposal:	**0 m^3**	0 m^3
Ending Inventory:	**2,157 m^3**	2,191 m^3

M0212-0286.55a37
R1 HSW EIS 03-27-03

No Action Alternative Group

Stream 17
TRU – K Basins Sludge

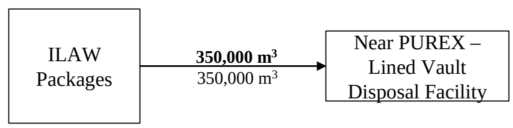


	Hanford Only	Lower Bound
Initial Inventory:	**0 m^3**	0 m^3
Receipts:	**139 m^3**	139 m^3
Waste Stream Total:	**139 m^3**	139 m^3
Total Processed:	**0 m^3**	0 m^3
Total Disposal:	**0 m^3**	0 m^3
Ending Inventory:	**139 m^3**	139 m^3

M0212-0286.55a38
R1 HSW EIS 03-27-03

No Action Alternative Group

Stream 21
WTP Wastes – ILAW Packages

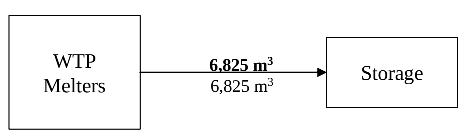


	Hanford Only	Lower Bound
Initial Inventory:	**0 m^3**	0 m^3
Receipts:	**350,000 m^3**	350,000 m^3
Waste Stream Total:	**350,000 m^3**	350,000 m^3
Total Processed:	**0 m^3**	0 m^3
Total Disposal:	**350,000 m^3**	350,000 m^3
Ending Inventory:	**0 m^3**	0 m^3

M0212-0286.55a39
R1 HSW EIS 02-24-03

No Action Alternative Group

Stream 22
WTP Wastes –WTP Melters



	Hanford Only	Lower Bound
Initial Inventory:	**0 m^3**	0 m^3
Receipts:	**6,825 m^3**	6,825 m^3
Waste Stream Total:	**6,825 m^3**	6,825 m^3
Total Processed:	**0 m^3**	0 m^3
Total Disposal:	**0 m^3**	0 m^3
Ending Inventory:	**6,825 m^3**	6,825 m^3

M0212-0286.55a40
R2 HSW EIS 03-27-03

*For definitions of acronyms, abbreviations, and terms, see list at the beginning of these flow diagrams.

B.7 References

Anderson, G. S., and H. S. Konynenbelt. 1995. *1995 Baseline Solid Waste Management System Description*. PNL-10743, Pacific Northwest Laboratory, Richland, Washington.

DOE. 1987. *Final Environmental Impact Statement for Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes*. DOE/EIS-0113, U.S. Department of Energy, Washington D.C.

DOE-RL. 2001. *2001 Hanford Waste Management Strategic Plan*. DOE/RL-2001-15, U. S. Department of Energy, Richland, Washington.

Sederburg, J. P. 1997. *Waste Management Project Technical Baseline Description*. HNF-SD-WM-RPT-288, U.S. Department of Energy (DOE), Richland, Washington.

Appendix C

Description of Waste Volumes for the Hanford Site Solid (Radioactive and Hazardous) Waste Program EIS

The waste volumes used in the Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement (HSW EIS) are based on analysis of the waste type options considered in the following sources: the Solid Waste Integrated Forecast Technical (SWIFT) Report (Barcot 1999, 2002), the Solid Waste Information and Tracking System (SWITS) (FH 2003), the Waste Management Programmatic Environmental Impact Statement (WM PEIS) (DOE 1997), Accelerating Cleanup: Paths to Closure (ACPC) (DOE 1998), the Transuranic Waste Performance Management Plan (DOE 2002), Tank Waste Remediation System (TWRS) EIS, and Conceptual Design Report Immobilized Low-Activity Waste Disposal Facility, Project W-520 (Burbank 2001). These sources are believed to include all low-level waste (LLW), mixed low-level waste (MLLW), and transuranic (TRU) waste that potentially could be shipped to Hanford for processing or disposal. In addition, a review of potential offsite waste receipts was conducted by the U.S. Department of Energy Richland Operations Office (DOE-RL) to determine lower and upper bound cases of offsite receipts.

Throughout the development of the HSW EIS, the waste volumes have been periodically reviewed to ensure the volumes used for analysis are representative of the latest available information. A comparison to the most recent versions of the SWIFT Report and the Integrated Planning, Accountability and Budgeting System (IPABS) (https://ipabs-is.em.doe.gov/ipabs/) showed that the LLW and MLLW volumes developed in fiscal year (FY) 1999 and FY 2000 were only slightly different than the most up-to-date information and that these volumes could continue to be used. Estimates for TRU waste, however, had increased substantially from previous estimates. Therefore, updated information was obtained from the SWIFT Report (Barcot 2002) to more accurately reflect the currently projected quantity of waste to be managed. In addition, recent planning by DOE to accelerate disposal of TRU waste has recommended the creation of a western hub to certify TRU waste from small-quantity sites for shipment to the Waste Isolation Pilot Plant (WIPP).

The HSW EIS used three different sets of volume data to assess the environmental impacts associated with 1) managing only wastes currently existing at Hanford or expected to be generated by Hanford activities and 2) receiving and managing waste from other DOE sites. The first set of data is defined as the Hanford Only volume and includes the following:

- Existing waste either previously disposed of or in storage as of October 1, 2001, according to the SWITS database version 01.01.00.

- Forecasted LLW and MLLW from onsite generators as defined in the 1999 SWIFT Report (Barcot 1999).

- Forecasted TRU waste from onsite generators as defined in the 2002 SWIFT Report (Barcot 2002).

- Estimates of immobilized low-activity waste (ILAW) and melters generated by the Waste Treatment Plant (WTP). ILAW estimates were obtained from the TWRS EIS (DOE and Ecology 1996) and RPP-7908. Estimates for melters were obtained from an Interface Control Document (ICD) (BNFL 1999) prepared under a contract to privatize the vitrification of high-level tank waste. These estimates were later reviewed against current plans for a DOE-owned facility to ensure the numbers contained in the ICD provided a bounding analysis.

The second set of data is referred to as the Lower Bound volume. This data set includes all waste included in the Hanford Only case as well as wastes from offsite generators approved for shipment to Hanford. Estimates for future receipts of LLW and MLLW from offsite generators were obtained from the 1999 SWIFT report while estimates for future TRU waste receipts were obtained from the 2002 SWIFT report.

The third set of data is defined as the Upper Bound volume and includes the Lower Bound volume as well as future offsite waste not reported in the SWIFT Report, but that may be managed at the Hanford Site. These potential additional offsite volumes were identified in the ACPC and the Transuranic Waste Performance Management Plan and reviewed by DOE-RL. The following section presents the three sets of volumes obtained from the sources mentioned above and describes the methodology for determining the appropriate volumes for the Upper Bound.

C.1 Volume Identification, Review, and Selection Methodology

As mentioned above, the waste volumes analyzed in the HSW EIS were obtained from a variety of sources. The criteria and assumptions used to develop the data in these sources varied depending when the data were developed and on the intended use of the data. For example, the data contained in the WM PEIS represent a 20-year period whereas the ACPC data represent the full life cycle of each site. In addition, the sources did not necessarily indicate where waste from a particular site would be dispositioned. Therefore, the sources were evaluated to determine the most appropriate data to use for each site. The data sources were reviewed using the following criteria:

- currency of the data (for example, which reference was the most recent)

- estimate duration (for example, was the forecast for the full life cycle or 20 years)

- previous shipments to Hanford (for example, did the waste generator have an established shipping agreement)

- previous shipments to Nevada Test Site (NTS) (for example, if the generator already shipped to NTS, it was likely that future shipments would continue to go to NTS).

Final selection of offsite forecast waste volume data was determined by a DOE-RL review. This review consisted of discussions with other DOE sites and DOE Headquarters to verify the amount of waste to be disposed of and to determine the likelihood of waste volumes being sent to Hanford. Unless alternate disposition pathways were clearly the preferred option, waste volumes were included in the Upper Bound volume to ensure a bounding assessment. Table C.1 contains a comparison of the various volume sources and the results of the DOE-RL review. The total waste volumes resulting from the DOE-RL review were used in the HSW EIS analyses.

Sections C.2 through C.5 delineate the volumes by waste type that are used in the HSW EIS and the assumptions used in developing the volumes.

Table C.1. Comparison of Waste Management Programmatic Environmental Impact Statement, Accelerated Cleanup: Paths to Closure, and HSW EIS Waste Volumes (m^3)

Waste Type	Reporting/Generating Site	WM PEIS 20 Yrs	WM PEIS to 2050	ACPC Disposition Maps	HSW EIS		
					Hanford Only	Lower Bound	Upper Bound
LLW	Ames Laboratory (Ames, Iowa)	34	86	97		75	75
	Argonne National Laboratory-East	4,455	10,394	12,960		11,366	11,366
	Battelle Columbus Laboratory	9,192	9,192	1,478		774	774
	Bettis Atomic Power Laboratory					549	549
	Bettis Atomic Power Shipyards					1	1
	Brookhaven National Laboratory	23,179	30,934	1,090		1,574	14,894
	Energy Technology Engineering Center	3,401	3,401	2,355		1,428	1,428
	Fermi National Accelerator Laboratory			1,490		1,627	1,627
	Fernald Environmental Management Project	83,591	83,591				0
	General Atomics	337	337	704		0	0
	General Electric Vallencitos	20	20				20
	Grand Junction Projects Office	55	55				55
	Hanford Site[(a)]	148,530	230,924	98,760	411,765	411,765	411,765
	Idaho National Engineering and Environmental Laboratory	6,419	24,860	50,873			6,419
	Inhalation Toxicology Research Institute	670	1,693	2,344			670
	Knolls Atomic Power Shipyards					356	356
	Los Alamos National Laboratory	25,235	73,045				0
	Lawrence Berkeley National Laboratory	209	348	434		174	174
	Laboratory for Energy-Related Health Research/University of California at Davis	1,996		7,421		0	0
	Lawrence Livermore National Laboratory	10,975	27,310				10,975
	Massachusetts Institute of Technology/Bates Linear Accelerator Center			39		11	11
	Mound Plant	64,177	64,177				0
	Oak Ridge National Laboratory	78,883	202,219	259,830			78,883
	Paducah Gaseous Diffusion Plant	4,379	4,379			46	46

Table C.1. (contd)

Waste Type	Reporting/Generating Site	WM PEIS 20 Yrs	WM PEIS to 2050	ACPC Disposition Maps	HSW EIS		
					Hanford Only	Lower Bound	Upper Bound
LLW (contd)	Pantex Facility	1,205	1,329	1,198			1,205
	Portsmouth Gaseous Diffusion Plant	2,031	2,031			0	0
	Princeton Plasma Physics Laboratory	688	1,480	2,572		2,081	2,081
	Rocky Flats Plant	65,033	65,033	396			65,033
	Sandia National Laboratories	2,748	4,193	5,745			2,748
	Separations Process Research Unit	8,220	8,220				8,220
	Stanford Linear Accelerator Center			774		756	756
	West Valley Nuclear Services	11,297	11,297				11,297
LLW Total		556,959	860,540	450,560	411,765	432,582	631,427
MLLW	Battelle Columbus Laboratory			9		<1	<1
	Energy Technology Engineering Center	1,365	1,365				1,365
	Hanford Site	69,225	99,074	72,217	58,414	58,414	58,414
	Idaho National Engineering and Environmental Laboratory			196			196
	Knolls Atomic Power Laboratory					6	6
	Los Alamos National Laboratory	3,373	3,373				3,373
	Oak Ridge National Laboratory	25,462	55,323	68,625			55,323
	Paducah Gaseous Diffusion Plant	2,672	2,681	1,730			2,681
	Pearl Harbor Naval Shipyard					<1	<1
	Portsmouth Gaseous Diffusion Plant	2,933	2,933				2,933
	Princeton Plasma Physics Laboratory			2		91	91
	Puget Sound Naval Shipyard					3	3
	Rocky Flats Plant (SWIFT Maximum = 63,040)	68,144	68,146	67,934			68,144
	Sandia National Laboratories	158	160				159
	Savannah River Site	4,085	6,134	3,191			6,134
	West Valley Nuclear Services	26	26				26
MLLW Total		177,443	239,215	213,904	58,414	58,515	198,852
TRU[b]	Battelle Columbus Laboratory					28	28
	Energy Technology Engineering Center					19	19
	Framatome ANP					9	9
	Hanford Site				45,748	45,748	45,748
	Missouri University Research Reactor					2	2
	Transuranic Waste PMP Small-Quantity Sites						1,500
TRU Total					45,748	45,805	47,305
WTP Wastes	Immobilized Low-Activity Waste[c]				211,000	211,000	211,000
	Melters				6,825	6,825	6,825
WTP Total					217,825	217,825	217,825

(a) HSW EIS volumes for LLW include 283,067 m^3 of previously disposed waste.
(b) WM PEIS did not report TRU waste volumes for these sites.
(c) The No Action Alternative assumes a volume of 350,000 m^3.

C.2 Low-Level Waste

The Hanford Only volume includes all inventory and disposed of waste as of October 2001 (i.e., the existing waste in the Low Level Burial Grounds [LLBGs] and in storage) and onsite life-cycle forecasted waste. Table C.2 displays the Hanford Only volume for LLW.

Table C.2. Hanford Only Volume for Low-Level Waste (m^3)

Previously Disposed of	Disposed of FY99-FY01	Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 1999)	Total
283,067	21,717	299	106,681	411,765

The assumptions used for preparing the LLW Hanford Only volume include the following:

- Forecast estimates were included for the years 2002 through 2046.

- Onsite forecasted volumes were obtained from the 1999 version of the SWIFT Report for the time period 2002 through 2046. To ensure data consistency, the forecast volumes in the SWIFT Report were compared to the most current estimates included in the 2002 version. The 2002 forecast for LLW is nearly identical to the 1999 forecast for the same time period. Therefore, updating the volume estimates would not significantly change the environmental impacts and the forecast from 1999 will continue to be used to minimize cost and schedule. The forecast volumes for FY 1999 to FY 2001 were deleted from the analysis, however, because these volumes are accounted for in the volume of waste disposed of or in storage.

- The storage inventory waste volume is current as of October 2001 and was obtained from the SWITS database.

- Estimates for previously disposed of LLW and waste disposed of from FY 1999 to FY 2001 were obtained from the SWITS database.

- All waste will be verified by sampling a fraction of the waste received at the Hanford Site.

The LLW Lower Bound volume includes the Hanford Only volume plus additional forecasted waste from offsite waste generators approved for shipment to the Hanford Site. Table C.3 displays the Lower Bound volume for LLW.

Table C.3. Lower Bound Volume for Low-Level Waste (m^3)

Previously Disposed of	Disposed of FY99-FY01	Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 1999)	Offsite Waste Forecast (Barcot 1999)	Total
283,067	21,717	299	106,681	20,818	432,582

The assumptions used for preparing the Lower Bound LLW volume include the following:

- Forecast estimates were included for the years 2002 through 2046.

- Offsite forecasted waste generators include Ames Laboratory (Ames, Iowa), Argonne National Laboratory-East, Battelle Columbus Laboratory, Bettis Atomic Power Laboratory, Bettis Atomic Power Shipyards, Brookhaven National Laboratory, Energy Technology Engineering Center (also known as Rockwell-Canoga Park), Fermi National Accelerator Laboratory, Knolls Atomic Power Shipyards, Lawrence Berkeley National Laboratory, Laboratory for Energy-Related Health Research/University of California at Davis, Massachusetts Institute of Technology, Princeton Plasma Physics Laboratory, Paducah Gaseous Diffusion Plant, Portsmouth Gaseous Diffusion Plant, and Stanford Linear Accelerator Center. These are approved generators (Bilson 1998).

- Offsite forecasted volumes were obtained from the 1999 version of the SWIFT Report for the time period 2002 through 2046. To ensure data consistency, the forecast volumes in the SWIFT Report were compared to the most current estimates included in the 2002 version. The 2002 forecast for LLW is nearly identical to the 1999 forecast for the same time period. Therefore, updating the volume estimates would not significantly change the environmental impacts and the forecast from 1999 will continue to be used to minimize cost and schedule. The forecast volumes for FY 1999 to FY 2001 were deleted from the analysis, however, because these volumes are accounted for in the volume of waste disposed of or in storage.

The LLW Upper Bound volume includes the Lower Bound volume plus additional forecasted waste from offsite waste generators that may ship to the Hanford Site. The Upper Bound volume is derived from the WM PEIS Option 2 with some variation as described in the following assumption section. Table C.4 displays the Upper Bound volume for LLW.

Table C.4. Upper Bound Volume for Low-Level Waste (m^3)

Previously Disposed of	Disposed of FY99-FY01	Storage Inventory (10/2001)	Onsite Waste Forecast (1999 SWIFT)	Offsite Waste Forecast (1999 SWIFT)	Additional Offsite Waste	Total
283,067	21,717	299	106,681	20,818	198,845	631,427

The assumptions used to arrive at the Upper Bound volume for LLW include the following:

- Potential receipts from offsite generators in addition to the Lower Bound volumes were reviewed by DOE-RL with the following generators to determine the appropriate estimates for analysis: Brookhaven National Laboratory, General Electric Vallecitos, Grand Junction Project Office, Idaho National Engineering and Environmental Laboratory, Inhalation Toxicology Research Institute, Lawrence Livermore National Laboratory, Oak Ridge National Laboratory, Pantex Facility, Rocky Flats Plant, Sandia National Laboratory, Separations Process Research Unit, and West Valley Nuclear Services. The Upper Bound volume includes both the Lower Bound volume estimates and the additional offsite wastes.

- The 1999 SWIFT Report, the WM PEIS Option 2 waste volumes for Hanford and NTS, and the Environmental Management Integration (ACPC) disposition maps (DOE 1998) were used as the bases for the upper bound volume. These volumes were then further refined by DOE-RL and the generating sites to determine the volumes analyzed in the HSW EIS.

- Offsite waste volumes were included through 2046.

C.3 Mixed Low-Level Waste

The Hanford Only volume includes all inventory and disposed of waste as of October 2001 (i.e., the existing waste in the MLLW trenches and in storage) and onsite life-cycle forecasted waste. Table C.5 displays the Hanford Only volume for MLLW.

Table C.5. Hanford Only Volume for Mixed Low-Level Waste (m^3)

MLLW Trench Inventory (10/2001)	Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 1999)	Total
1,010	7,350	50,054	58,414

The assumptions used for preparing the Hanford Only MLLW volume include the following:

- Onsite forecasted volumes were obtained from the 1999 SWIFT Report for the time period 2002 through 2046. To ensure data consistency, the forecast volumes in the 1999 SWIFT Report were compared to the most current estimates included in 2002 Report. The 2002 forecast for MLLW is nearly identical to the 1999 forecast for the same time period. Therefore, updating the volume estimates would not significantly change the environmental impacts and the 1999 estimates will continue to be used to minimize cost and schedule. The forecast volumes for FY 1999 to FY 2001 were deleted from the analysis, however, because these volumes are accounted for in the MLLW trench inventory or in the storage inventory.

- Inventory waste is current as of October 2001 and was obtained from the SWITS database.

- Estimates for waste disposed from FY 1999 to FY 2001 were obtained from the SWITS database.

- Roughly half the onsite forecasted waste will require treatment before disposal at the Hanford Site. Large volumes of long-length contaminated equipment are expected to be received in a form that is treated and ready for disposal.

The Lower Bound volume includes the Hanford Only volume and additional forecasted offsite waste that has an approved site treatment plan. Table C.6 displays the Lower Bound volume for MLLW.

Table C.6. Lower Bound Volume for Mixed Low-Level Waste (m^3)

MLLW Trench Inventory (10/2001)	Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 1999)	Offsite Waste Forecast (Barcot 1999)	Total
1,010	7,350	50,054	101	58,515

The assumptions used for preparing the Lower Bound MLLW volume include the following:

- The following offsite generators forecast waste for shipment to Hanford in accordance with approved site treatment plans: Battelle Columbus Laboratory, Knolls Atomic Power Laboratory, Pearl Harbor Naval Shipyard, Princeton Plasma Physics Laboratory, and Puget Sound Naval Shipyard.

- Offsite forecasted volumes were obtained from the 1999 SWIFT Report for the time period 2002 through 2046. To ensure data consistency, the forecast volumes in the 1999 SWIFT Report were compared to the most current estimates included in 2002 Report. The 2002 forecast for MLLW is nearly identical to the 1999 forecast for the same time period. Therefore, updating the volume estimates would not significantly change the environmental impacts and the 1999 estimates will continue to be used to minimize cost and schedule. The forecast volumes for FY 1999 to FY 2001 were deleted from the analysis, however, because these volumes are accounted for in the MLLW trench inventory or in the storage inventory.

- Some site treatment plans for the offsite generators show the waste will be treated at Hanford and be shipped back to the sites for disposal. However, as the amount of this offsite waste is small compared to the total, this waste is assumed to be disposed of at Hanford.

The Upper Bound volume includes the Lower Bound volume, plus additional forecasted waste from offsite waste generators that are not currently shipping waste to the Hanford Site but may ship in the future as a result of the WM PEIS. Table C.7 displays the Upper Bound volume for MLLW.

Table C.7. Upper Bound Volume for Mixed Low-Level Waste (m^3)

MLLW Trench Inventory (10/2001)	Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 1999)	Offsite Waste Forecast (Barcot 1999)	Additional Offsite Waste	Total
1,010	7,350	50,054	101	140,334	198,852

The assumptions used to arrive at the Upper Bound volume for MLLW are described in the following:

- Additional offsite waste generators as confirmed by DOE-RL include Energy Technology Engineering Center, Idaho National Engineering and Environmental Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Paducah Gaseous Diffusion Plant, Portsmouth Gaseous Diffusion Plant, Rocky Flats Plant, Sandia National Laboratories, Savannah River Site, and the West Valley Nuclear Services.

- Offsite waste volumes represent waste expected through the Hanford life cycle (2046).

- All offsite waste will be disposed of at Hanford.

- Additional waste volumes received from offsite generators are assumed to be received, treated, and ready for disposal and will not require treatment at the Hanford Site.

- Initial estimates for additional offsite waste volumes were based on the life-cycle volume estimates used in Option D of the WM PEIS and the Environmental Management Integration (ACPC) disposition maps (DOE 1998). The estimates included waste to be dispositioned at Hanford or waste with no identified disposition pathway. Waste designated for commercial treatment and disposal was not included. These volumes were then further refined by DOE-RL and the generating sites to determine the volumes analyzed in the HSW EIS.

C.4 Transuranic Waste

The Hanford Only volume includes all inventory waste as of October 2001 (i.e., the existing waste in storage) and onsite life-cycle forecasted waste. Table C.8 displays the Hanford Only volume for TRU waste.

Table C.8. Hanford Only Waste Volumes for Transuranic Waste (m^3)

Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 2002)	Total
16,136	29,613	45,748

The assumptions used to arrive at the Hanford Only case for TRU waste are described in the following list:

- Forecasted volumes were obtained from the 2002 SWIFT Report and collected for the life cycle of the Hanford Site (through 2046). The maximum forecast estimates were used to provide a bounding analysis.

- A comparison of the TRU waste volume estimates developed during FY 1999 and FY 2000 to the 2002 SWIFT Report showed that the expected waste volumes had increased significantly over the development period of the HSW EIS. Therefore, the waste volumes for TRU waste were updated to reflect the current forecast estimates.

- Inventory waste is current as of October 2001 and was obtained from the SWITS database.

- The TRU waste will be processed and certified at the Hanford Site and sent to WIPP.

The Lower Bound volume includes the Hanford Only volume and additional offsite waste included in the 2002 SWIFT Report. Table C.9 displays the Lower Bound volume for TRU waste.

Table C.9. Lower Bound Waste Volumes for Transuranic Waste (m^3)

Storage Inventory (10/2001)	**Onsite Waste Forecast (Barcot 2002)**	**Offsite Waste Forecast (Barcot 2002)**	**Total**
16,136	29,613	57	45,805

The assumptions used to arrive at the Lower Bound case for TRU waste are described in the following:

- Forecasted volumes from offsite generators were obtained from the 2002 SWIFT Report and collected for the life cycle of the Hanford Site (through 2046). The maximum forecast estimates were used to provide a bounding analysis.

- Waste from offsite generators is included for Battelle Columbus Laboratory, Energy Technology Engineering Center (ETEC), Framatome ANP, and Missouri University Research Reactor.

- The TRU waste will be processed and certified at the Hanford Site and sent to WIPP.

The Upper Bound volume includes the Lower Bound volume, plus additional waste from offsite waste generators that may be received in the future if Hanford is selected to receive waste from small-quantity sites as the western hub as part of DOE's efforts to accelerate the disposal of TRU waste (DOE 2002). Table C.10 displays the Upper Bound volume for TRU waste.

Table C.10. Upper Bound Waste Volumes for Transuranic Waste (m^3)

Storage Inventory (10/2001)	Onsite Waste Forecast (Barcot 2002)	Offsite Waste Forecast (Barcot 2002)	Additional Offsite Waste	Total
16,136	29,613	57	1,500	47,305

The following assumptions were used to develop the Upper Bound volume for TRU waste:

- The volume of TRU waste expected to be received from small-quantity sites by the western hub was obtained from the Transuranic Waste Performance Management Plan (DOE 2002). It is assumed the wastes from small quantity sites are in addition to the offsite wastes included in the Lower Bound volume. Decreasing the additional offsite waste volume by the offsite waste included in the Lower Bound would not significantly change the environmental impacts.

C.5 Waste Treatment Plant Wastes

Waste volumes expected from the Waste Treatment Plant are shown in Table C.11. As these wastes will only be generated at Hanford, the Lower Bound and Upper Bound cases are not applicable. The volume of ILAW generated by the WTP, however, may vary depending on the vitrified waste form produced. For the No Action Alternative, ILAW would be produced in a cullet form and packaged in containers for retrievable disposal in vaults as outlined in the TWRS EIS (DOE and Ecology 1996). The EIS analysis assumed 140,000 containers would be required or an equivalent volume of approximately 350,000 m^3. For the Action Alternatives, ILAW was assumed to be in a monolithic form and packaged in 2.6-m^3 containers for disposal in trenches. Approximately 81,000 containers would be required, or an equivalent volume of approximately 211,000 m^3 (Burbank 2001).

Table C.11. Estimated Volumes of WTP Waste Streams through 2046

Waste Streams	No Action (cubic meters)	Action Alternatives (cubic meters)
ILAW	350,000	211,000
WTP Melters	6,825	6,825
Total WTP Waste	356,825	217,825

C.6 References

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Appendix D

Supplemental Information on the Low Level Burial Grounds, Environmental Restoration Disposal Facility, Borrow Pits, Trench Liners, and Disposal Facility Barriers

This appendix contains information on the Low Level Burial Grounds (LLBGs), the Environmental Restoration Disposal Facility (ERDF), the borrow pits used for the closure covers of the LLBGs, liners used in disposal facilities, and barriers that will be placed over the disposal facilities after they are filled.

D.1 Low Level Burial Grounds

The LLBGs are eight separate waste disposal areas located in the 200 Areas. They are regulated under the Atomic Energy Act (AEA) of 1954 (42 USC 2011) and the trenches that contain MLLW are also regulated under Resource Conservation and Recovery Act (RCRA) (42 USC 6901; 40 CFR 261.8), and applicable state laws and regulations (WAC 173-303). The following sections summarize specific information concerning the LLBGs.

D.1.1 200 East Area Burial Grounds

Burial Ground 218-E-12B. Burial Ground 218-E-12B (Figure D.1) is located in the northeast corner of the 200 East Area. It covers approximately 70.1 ha (173.2 ac) and began receiving waste in 1962. Burial Ground 218-E-12B has three trenches containing retrievably stored transuranic (TRU) waste, but contains primarily low-level waste (LLW) generated by facilities in the 200 East Area. Trench 94, a portion of 12B, is reserved for the disposal of U.S. Navy defueled reactor compartments composed of various types of steel and lead shielding. Trench 94 is regulated under the Toxic Substances Control Act (TSCA) (15 USC 2601; 40 CFR 717, 761, and 792) and RCRA because it contains polychlorinated byphenyls (PCBs), and is permitted for the disposal of mixed low-level waste (MLLW).

Burial Ground 218-E-10. Burial Ground 218-E-10 (Figure D.2) is located in the northwest corner of the 200 East Area and is used primarily for LLW disposal, although it also contains MLLW. It began receiving waste in 1960 and covers approximately 36.1 ha (89.2 ac). Waste in this burial ground came from the 200 East and 100 N Areas facilities, and was primarily received in large concrete boxes.

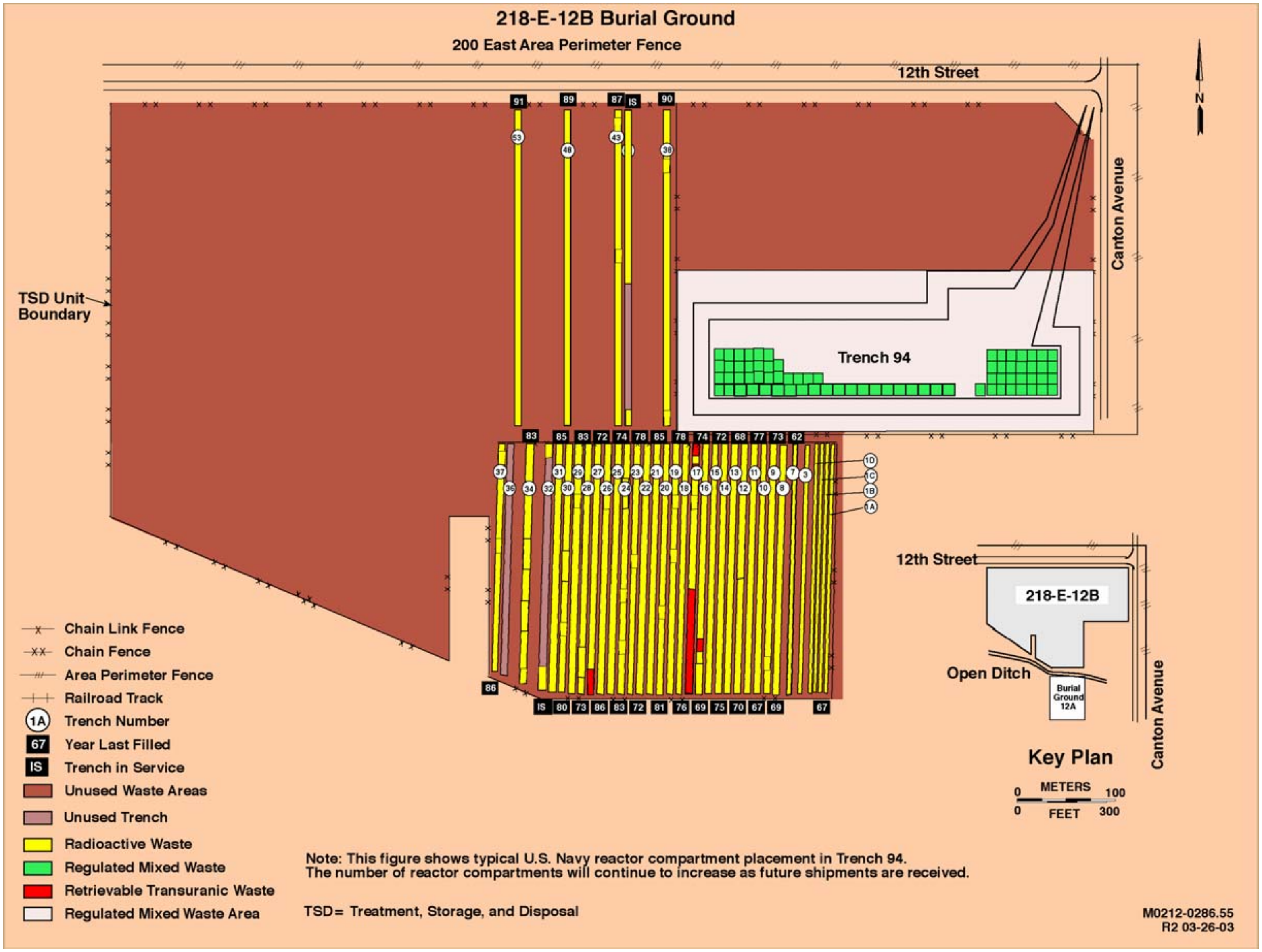

Figure D.1. 218-E-12B Burial Ground

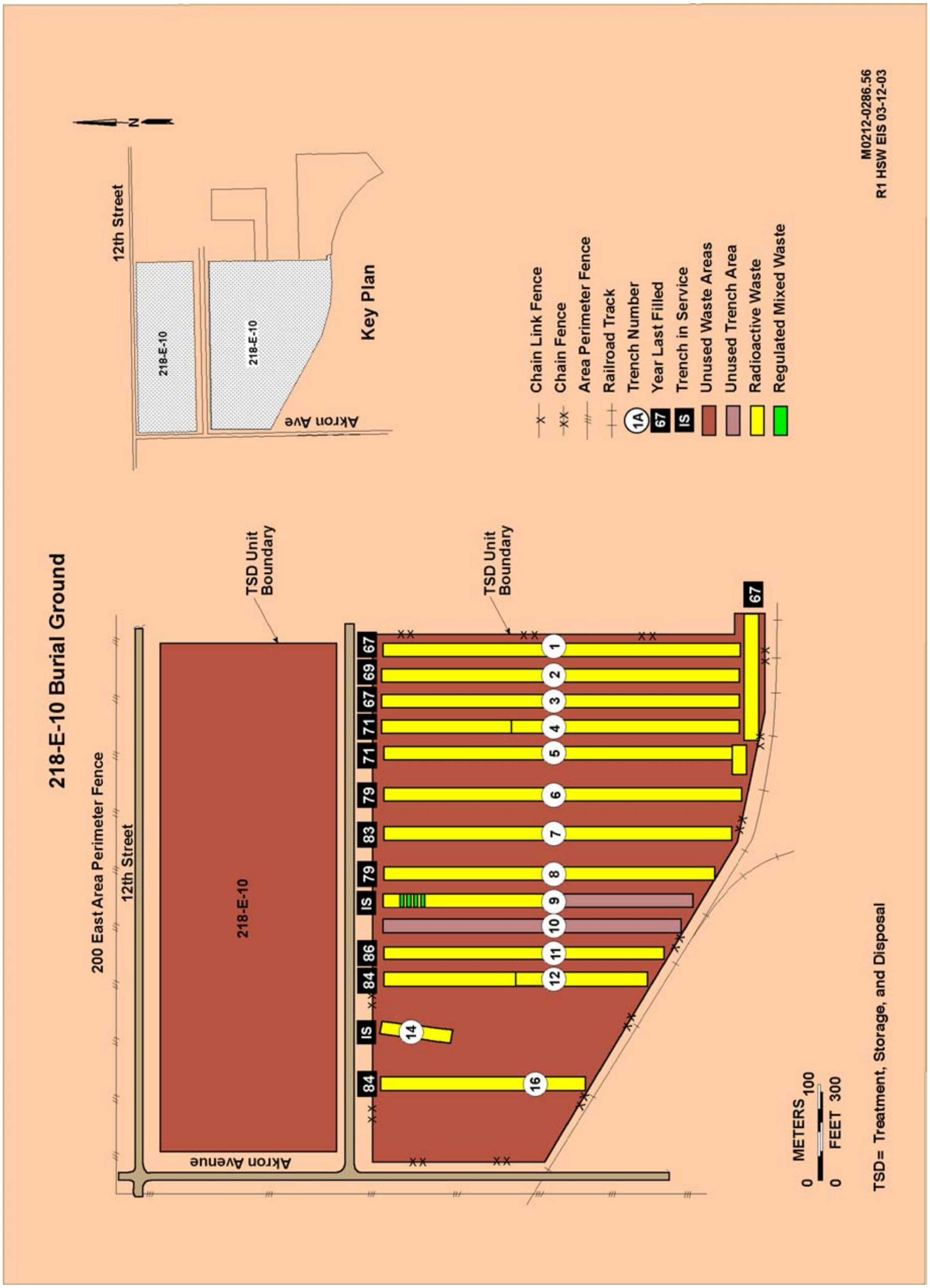

Figure D.2. 218-E-10 Burial Ground

D.1.2 200 West Area Burial Grounds

Burial Ground 218-W-3A. Burial Ground 218-W-3A (Figure D.3) began receiving waste in 1970. Located in the north-central section of 200 West Area, it covers approximately 20.4 ha (50.3 ac). Primarily, it receives LLW, but also contains MLLW, and retrievably stored TRU waste.

Burial Ground 218-W-3AE. Burial Ground 218-W-3AE (Figure D.4) covers approximately 20 ha (49.4 ac) and began receiving waste in 1981. It contains primarily LLW, although MLLW is present. This burial ground includes Trenches 05 and 10 that are wide-bottom stacking trenches, and Trench 26 that was dug with a wide bottom to dispose of LLW railroad cars and large tanks.

Burial Ground 218-W-4B. Burial Ground 218-W-4B (Figure D.5) began receiving wastes in 1968, and is located in the central portion of the 200 West Area. It consists of 14 trenches (one containing 12 caissons, of which 4 caissons contain TRU waste) and covers 3.5 ha (8.6 ac). The trenches in this burial ground contain unsegregated TRU waste and contact-handled (CH) TRU waste stored on an asphalt pad mostly in 55-gal drums. Trench 7 contains one of the earlier designs for retrievably stored TRU waste—the V trench. The concrete V trench stores waste containers on a 45-degree angle and is covered with a metal roof and soil. The TRU waste in Trench 11 contains either remote-handled (RH) or CH wastes. Trench 14 contains caissons that are underground storage structures for the disposal of 3.8-L (1-gal) to 18.9-L (5-gal) cans of RH waste.

Five caissons were planned for TRU waste and from 1970 to 1988 retrievably stored TRU waste was placed in four of them. The caissons have been isolated. One caisson has never been used. Seven caissons containing LLW were filled from 1968 to 1979 and are also found in this burial ground. No additional waste placement is planned for any of these caissons. All the trenches in this burial ground are covered with earth.

Burial Ground 218-W-4C. Burial Ground 218-W-4C (Figure D.6) started receiving waste in 1978. It covers approximately 20 ha (49.4 ac) and mainly receives LLW, although some MLLW and retrievably stored TRU wastes are also present. The most northern trench (Trench NC) contains core barrels from naval bases. Trench 1 contains mostly retrievably stored TRU waste, including drums generated from mining the 216-Z-9 Crib. Trench 4 also contains retrievably stored TRU waste. Trench 7 contains retrievably stored TRU boxes and drums of Test Reactor and Isotope Production General Atomics (TRIGA) fuel waste. Additional retrievably stored TRU wastes in boxes and drums are located in Trenches 19, 20, 24, and 29.

Burial Ground 218-W-5. The 218-W-5 Burial Ground (Figure D.7) began receiving wastes in 1986. It covers approximately 37.2 ha (91.9 ac) (excluding the expansion area) and accepts MLLW and LLW. The 218-W-5 Burial Ground currently contains two permitted MLLW trenches.

Burial Ground 218-W-6. Burial Ground 218-W-6 (Figure D.8) covers approximately 16 ha (39.5 ac). To date, it has not received any waste.

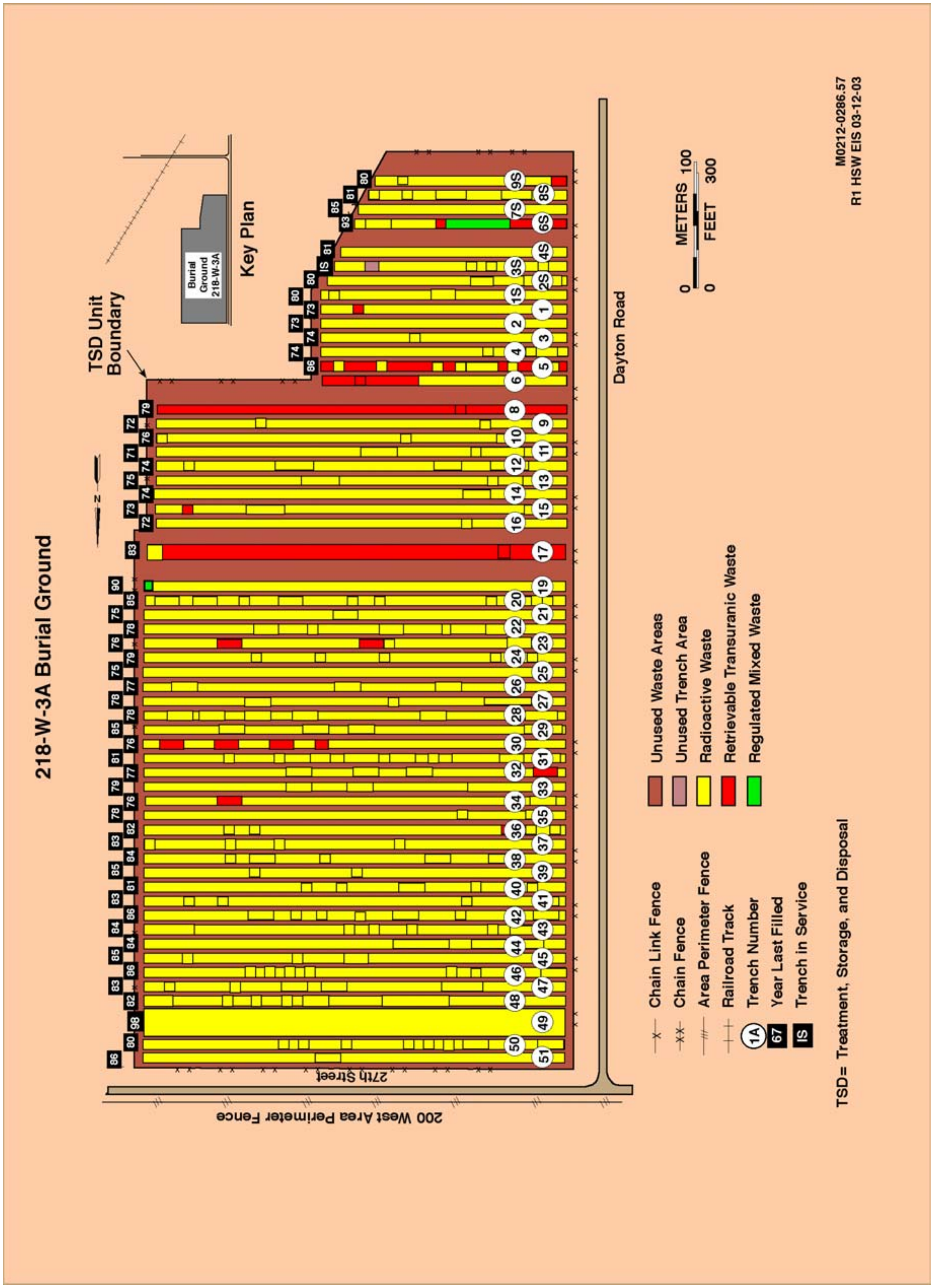

Figure D.3. 218-W-3A Burial Ground

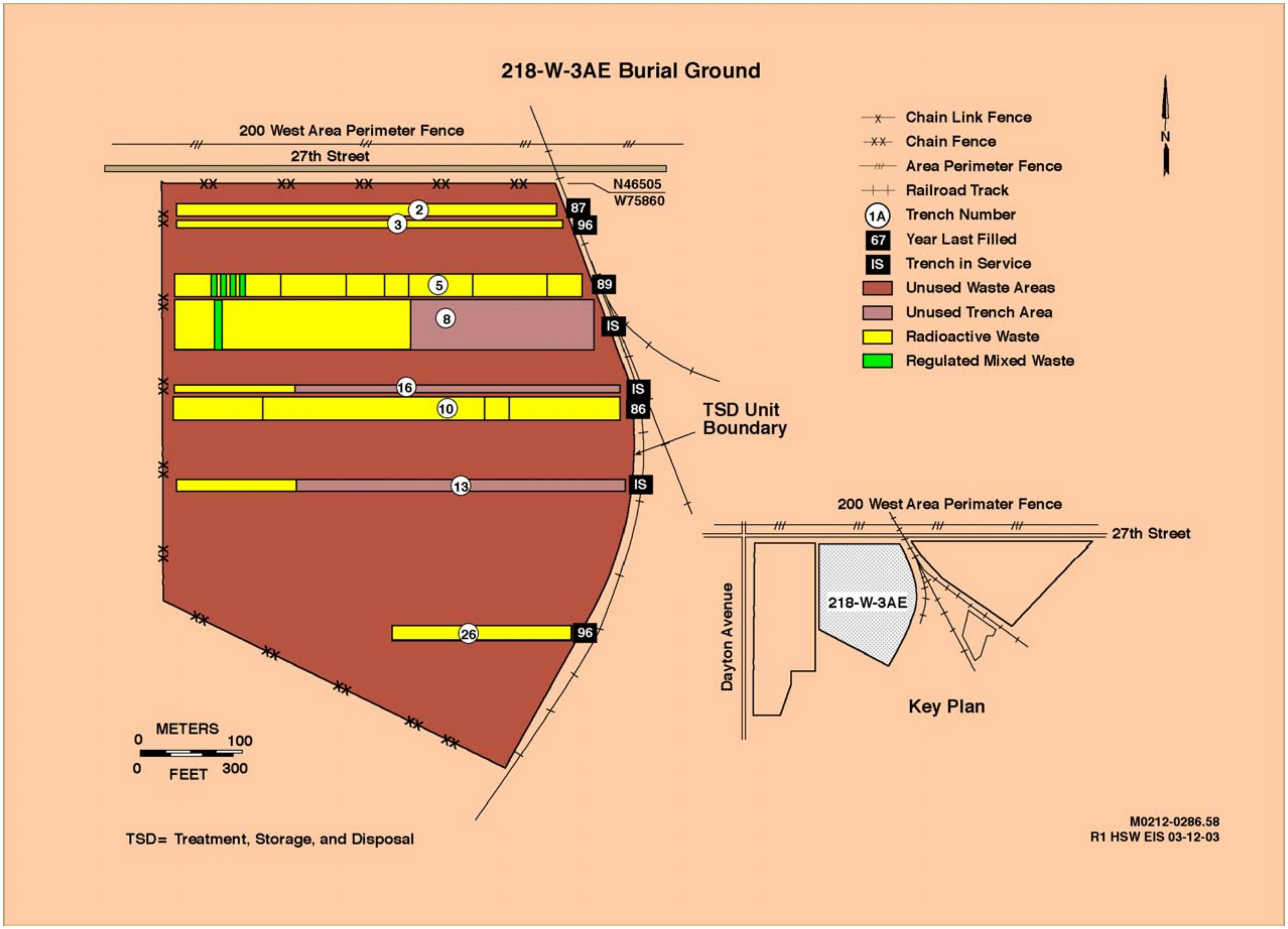

Figure D.4. 218-W-3AE Burial Ground

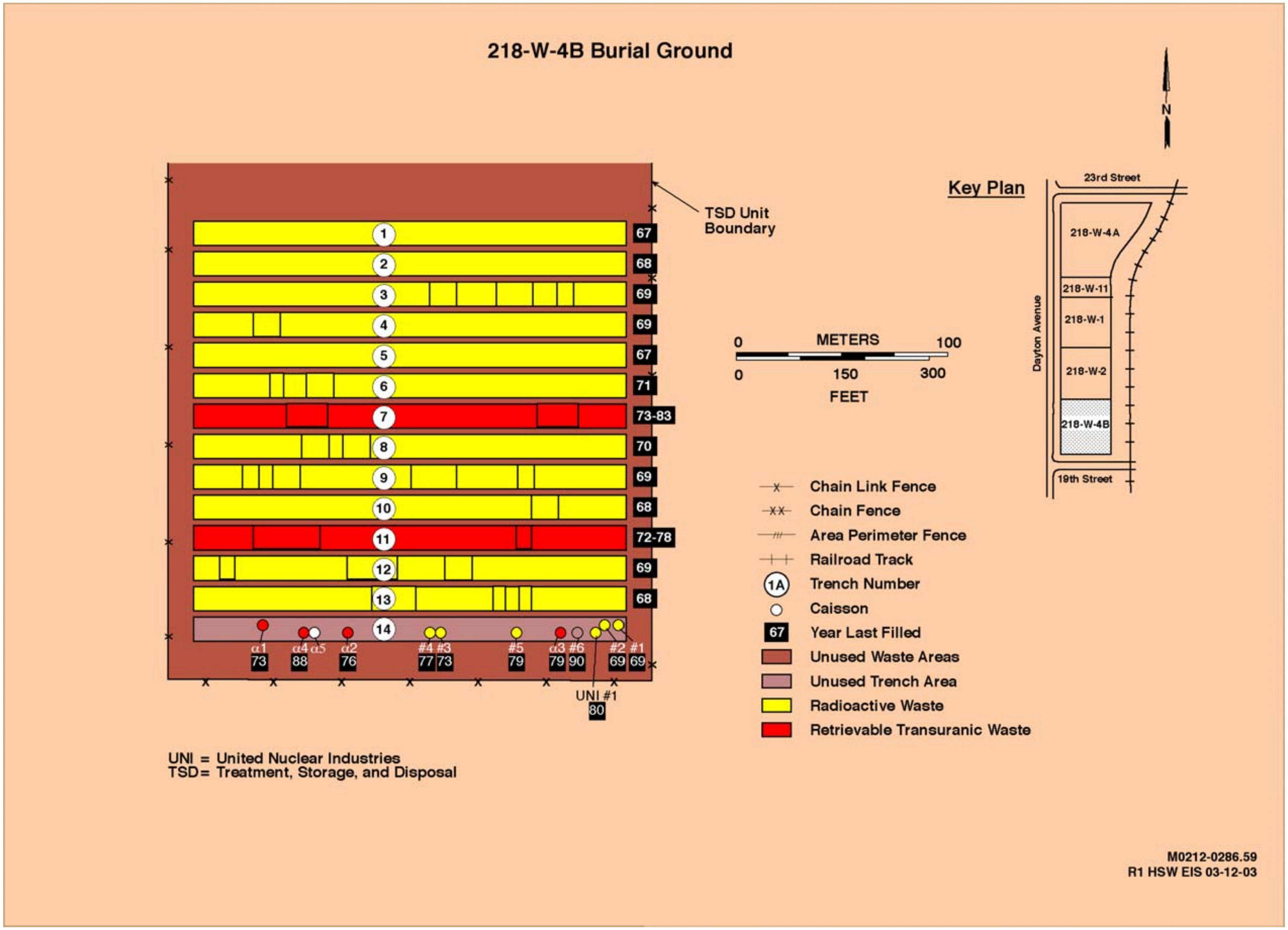

Figure D.5. 218-W-4B Burial Ground

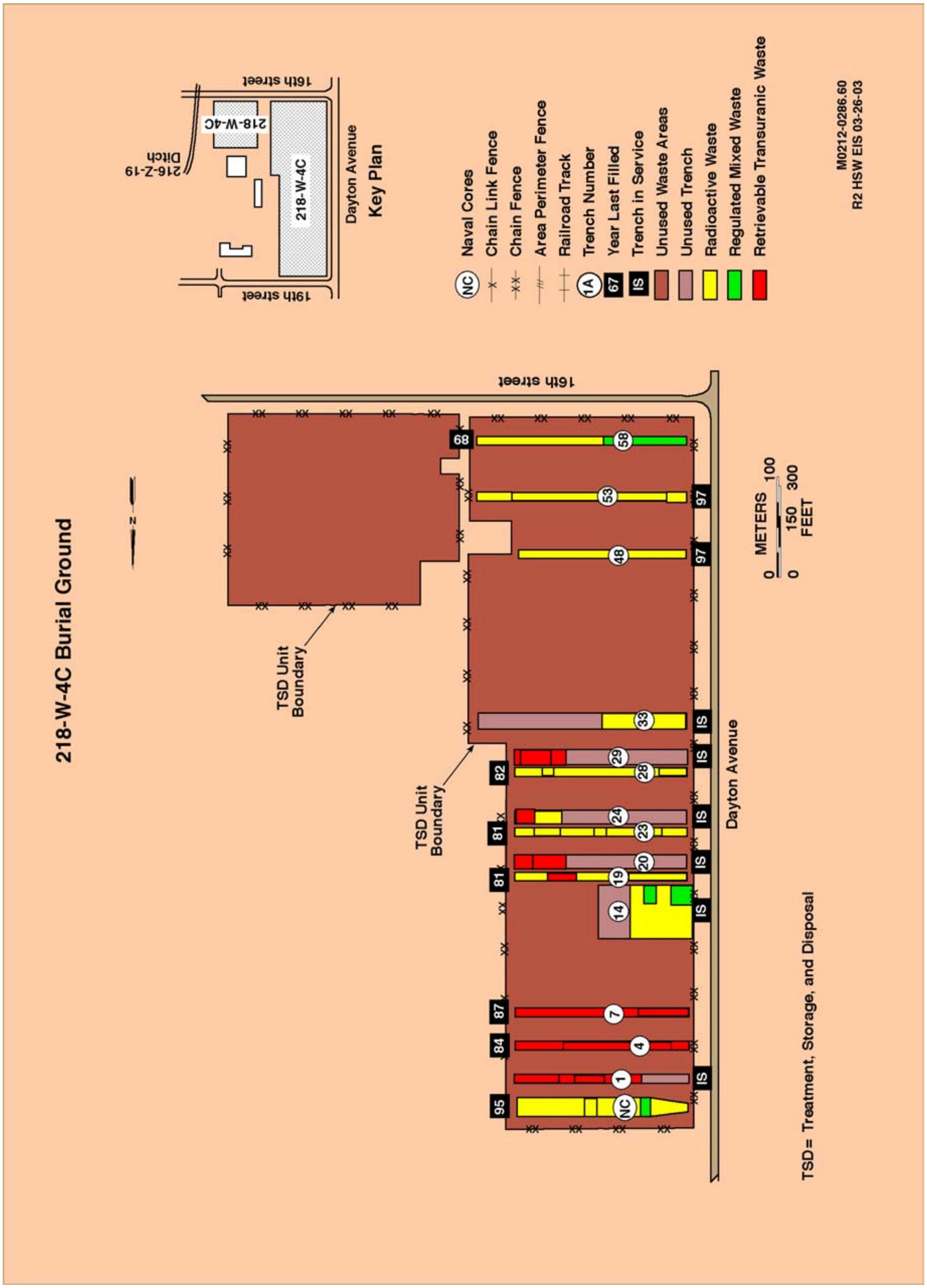

Figure D.6. 218-W-4C Burial Ground

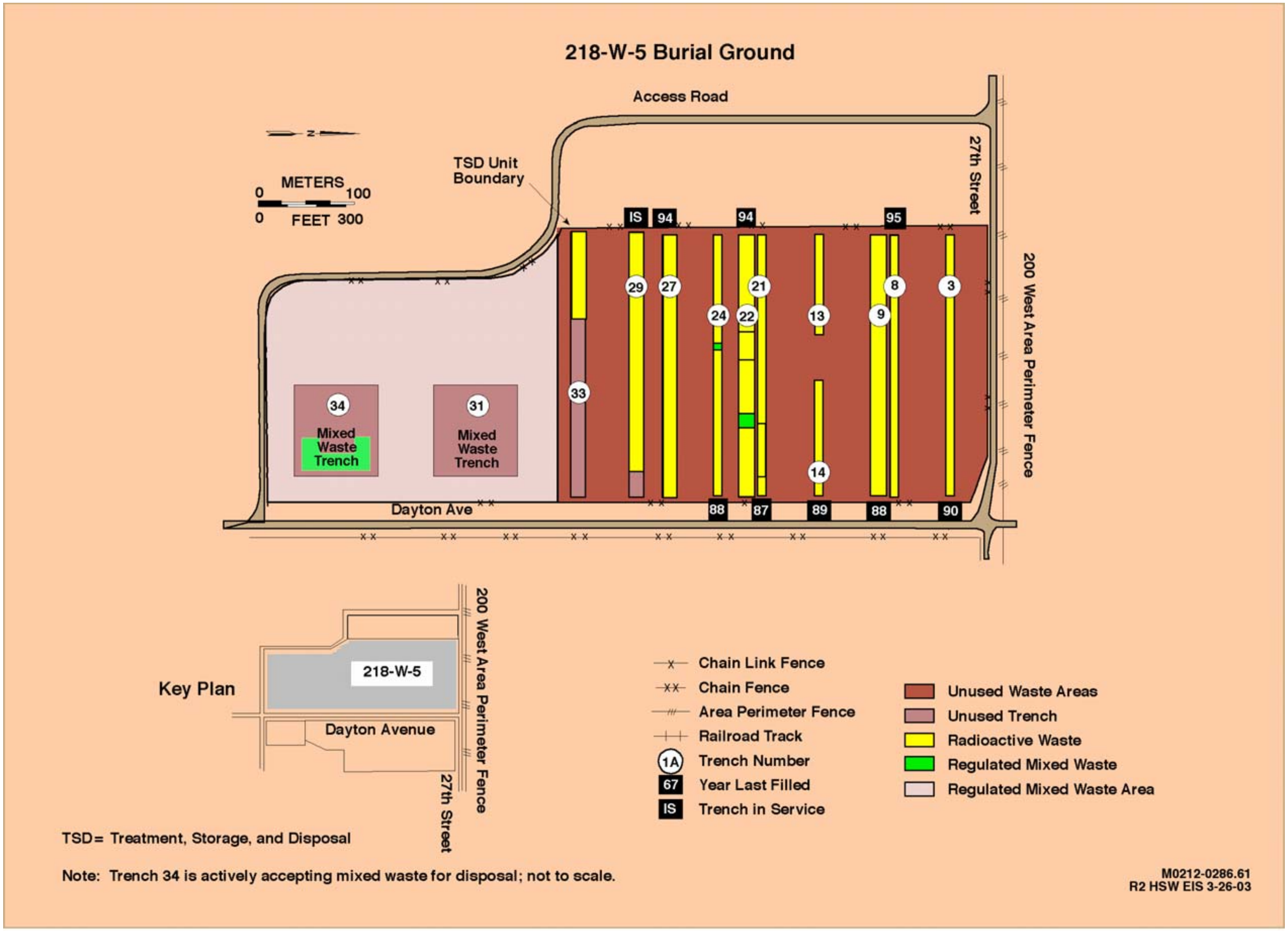

Figure D.7. 218-W-5 Burial Ground

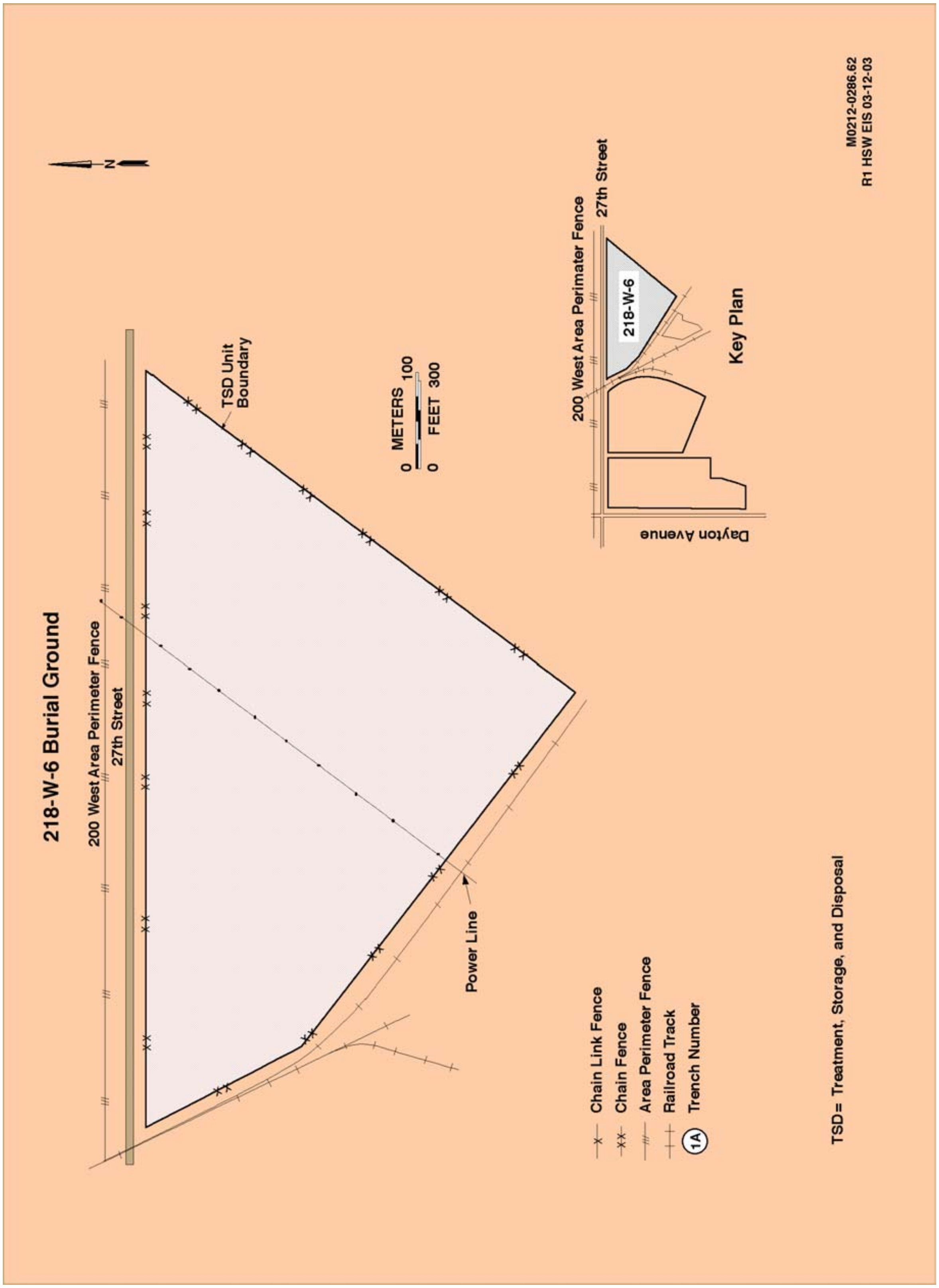

Figure D.8. 218-W-6 Burial Ground

D.2 Environmental Restoration Disposal Facility

ERDF is Hanford's low-level and hazardous waste disposal facility for wastes from CERCLA cleanup activities. It is located on the Central Plateau, as can be noted in Figure 3.2 in Section 3. The facility is composed of a number of cells, as illustrated in Figure D.9. The first two cells were completed in 1996 and are 21 m (70 ft) deep, 152 m (500 ft) long and 152 m (500 ft) wide. Construction of cells 3 and 4 began in 1998 and were ready to begin receiving waste in the spring of 2000. Together, the four cells have a capacity of 4.7 billion kg (5.2 million tons). It is expected that the capacity will be filled in March of 2005 with the current operations. DOE is planning on adding four more cells to ERDF to double its capacity. It is currently planned to have those cells constructed and ready to receive waste in 2005.

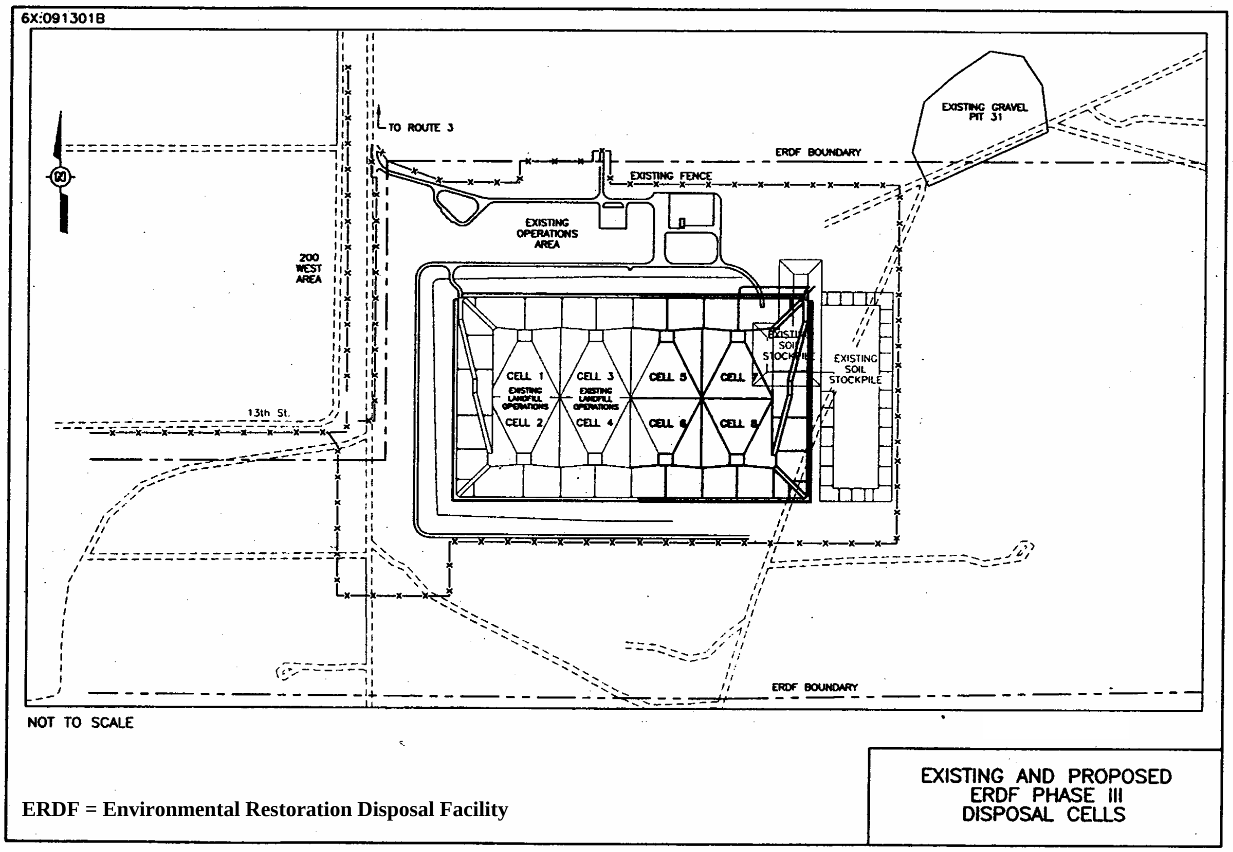

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Figure D.9. Existing and Proposed ERDF Disposal Cells

D.3 Borrow Pit Resource Excavation

Up to approximately 3,700,000 m^3 (approximately 5,000,000 yd^3) of sand, gravel, rock, and silt/loam will be required as a mineral resource for up to 178 ha (440 ac) of regulatory-compliant caps on LLBGs and other disposal facilities addressed in this EIS. It is anticipated that almost all of the onsite resources required for surface capping will come from Area C, shown in Figures D.10 and D.11. The only exception is materials for an asphalt layer, which would be transported from the Tri-Cities.

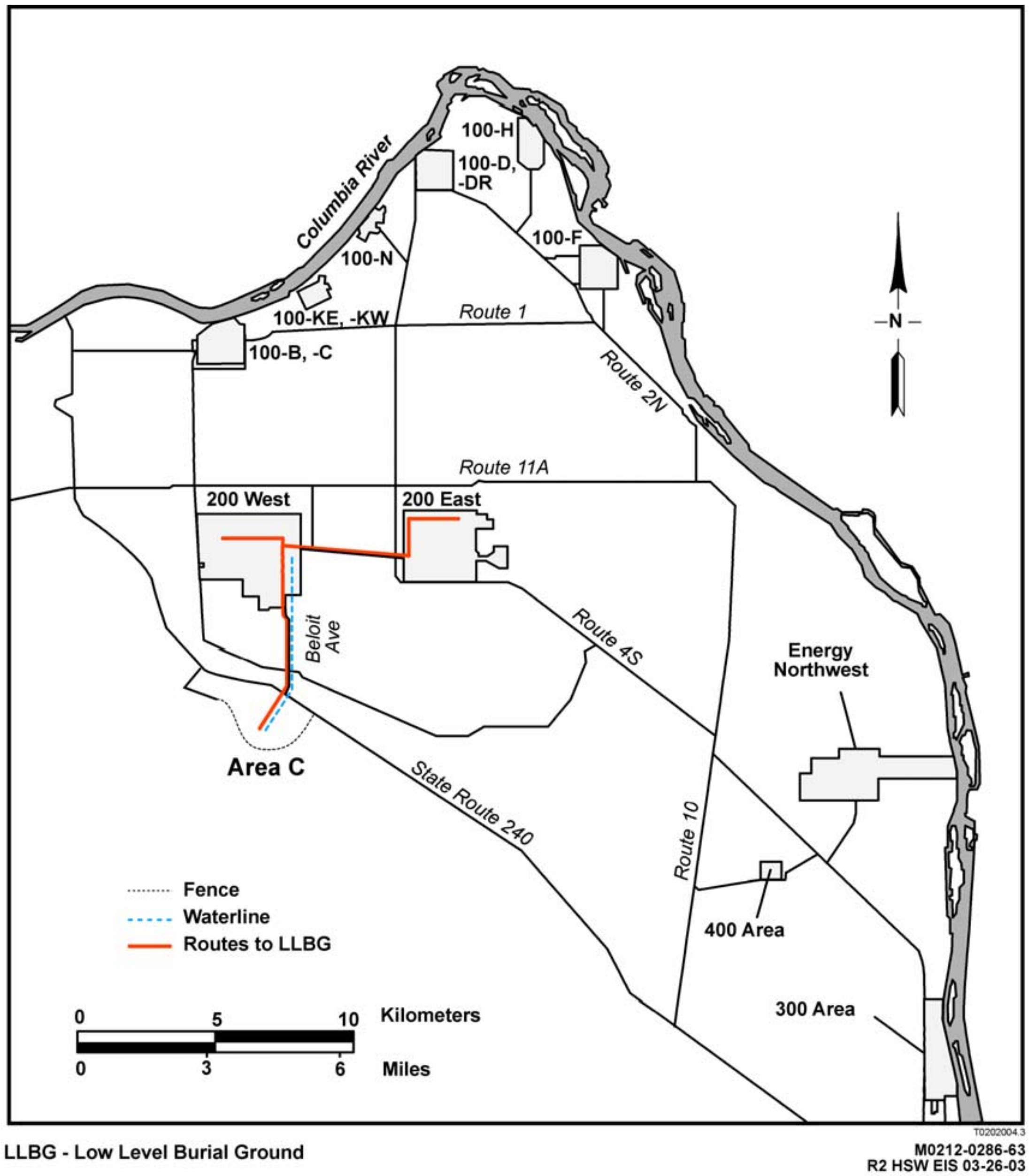

Figure D.10. Area C Location Relative to the 200 East and 200 West Burial Grounds

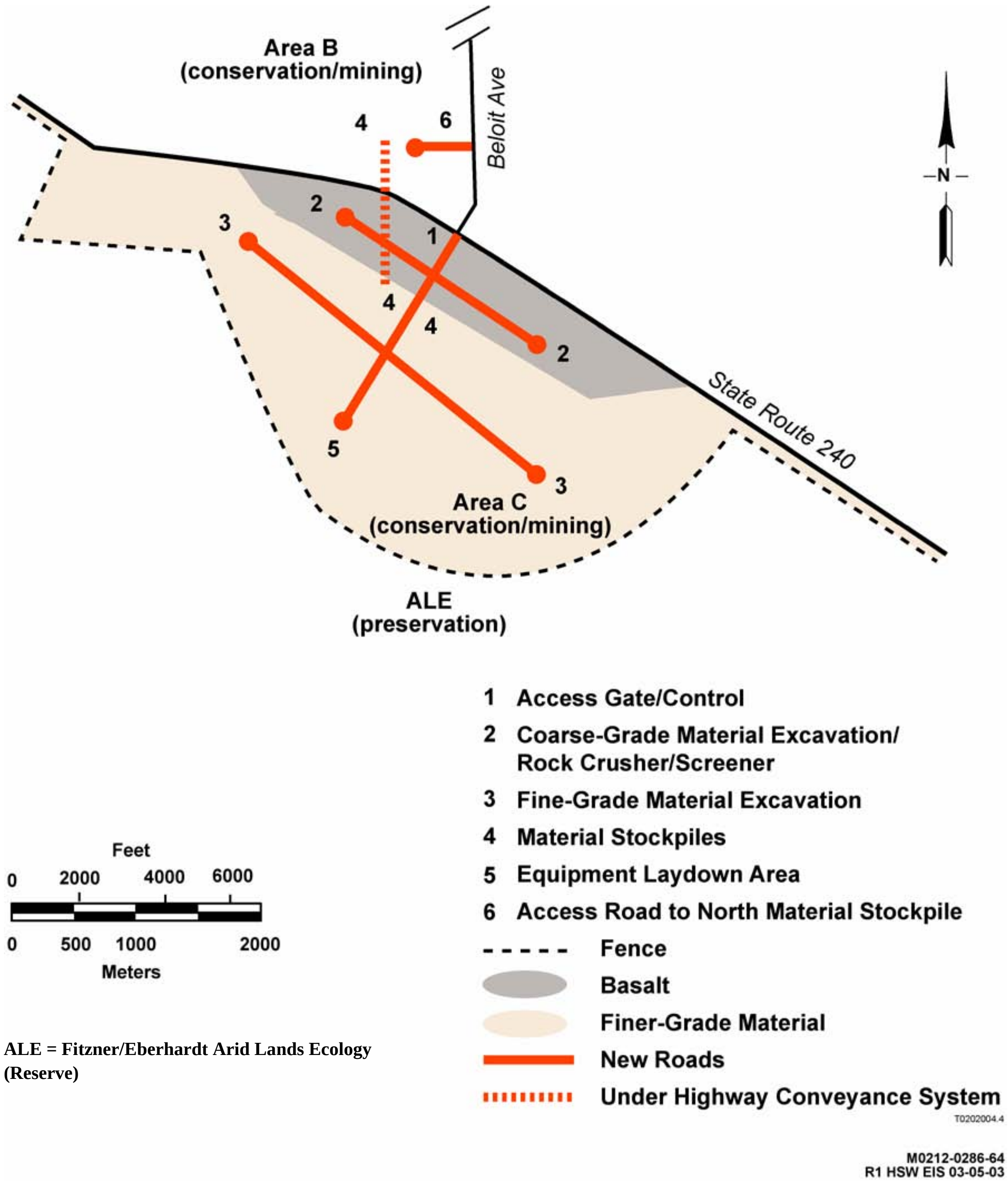

Figure D.11. Borrow Pit Layout in Area C

Although the amount of resource material varies slightly depending upon the alternative chosen, the variance is not large considering that the areas between LLW and MLLW trenches would be required to be covered to minimize contaminant migration from precipitation events. The barrier edges would be extended far enough beyond the waste trenches to preclude reintrusion of precipitation and snowmelt back into the waste zones.

Area C is on the southeast side adjacent to State Route (SR) 240 and is accessed via the Rattlesnake Gate and Beloit Avenue. Area C is a large 926-ha (2287-ac) polygonal area located adjacent to the south side of SR 240 and is centered approximately at the intersection of Beloit Avenue and SR 240. The area is bounded by SR 240 and the Fitzner/Eberhardt Arid Lands Ecology (ALE) Reserve. Area C is not part of the Hanford Reach National Monument. A small portion of the northern portion of Area C has already been used as a borrow pit. It is anticipated that less than 7.5 percent (81 ha [200 ac]) of Area C will be required for capping resource material.

Area C is considered part of the Central Plateau in the *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (HCP EIS) and its use is designated as "conservation (mining)" (DOE 1999). The HCP EIS acknowledges that "mining of onsite geologic materials will be needed to construct surface barriers as required by Hanford Site remediation activities."

The use of Area C as a borrow pit would have the following restrictions required by the Hanford Site procedures and best management practices:

1. A restoration plan would be written to direct how the site would be revegetated and restored.

2. Topsoil would be stripped and stockpiled for use in revegetation.

3. Excavation and bank cuts would be kept a minimum of 152 m (500 ft) from SR 240.

4. Areas prone to wind erosion (for example, active pit faces, haul roads, stockpiles) would be stabilized as needed with ballast or other means, such as routine wetting with water and a stabilization agent.

5. Approximately 8 km (5 mi) of new roads within Area C (see Figure D.10) would be built to expedite traffic and shorten haul roads. It is anticipated that the access road would intersect SR 240 directly across from the intersection of the highway from Beloit Avenue.

6. Immediately following the removal of material from each pit, cut banks would be sloped and the sides of the pits would be shaped with irregular boundaries to avoid straight lines and to more naturally blend with the surrounding terrain.

Borrow operations at Area C would consist of the following:

- **Infrastructure Upgrade** – Water and electricity would be extended from the vicinity of Beloit Avenue and 13th Street, a distance of 6.4 km (4 mi). New gravel roads would be installed within Area C to access the mineral resource, laydown areas, office areas, and resource stockpiles. Modular space would be used for offices, lunchrooms, and showers. A holding tank would be installed to receive sanitary wastewater from trailers. Portable toilets would be provided to all other areas of the site. A contract sanitary waste hauler would service the holding tank and portable toilets at least twice weekly. Site lighting would be provided via fixed lights on poles and portable, rechargeable light stands.

- **Resource Excavation** – Borrow pits would be excavated via a track hoe, scraper, bulldozer, and/or front-end loader and loaded either directly into trucks or onto conveyor systems. Conveyor systems would be used to move the resource to stockpile areas or to load trucks. Conveyor systems would be fitted with crushing, sorting, and screening systems to segregate fines from rock. Basalt would probably be blasted with standard controlled subsurface detonations. A one-shift operation with approximately 20 trucks would require a minimum of 12 years of borrow pit operation.

- **Under Highway Conveyance System** – Part of the conveyor system discussed above would be a more permanent system installed between the access gate and road in Area C and another conservation/mining area north of SR 240 (Area B, shown in Figure D.10). Area B is also an area designated as "conservation (mining)" by the HCP EIS and would be used only as a reservoir for resource material excavated from Area C to minimize the number of truck highway crossings that could be expected during peak capping demand periods; as such, it is only expected to be in use during the latter portion of the LLBG capping mission. The same crew that performed the water and power infrastructure upgrade would be used to install a new approximately 1-m- (36-in-) diameter approximately 24-m- (80-ft-) long culvert under SR 240 (see Figure D.10), using standard horizontal boring techniques used frequently in municipal applications. A screw auger type conveyance system would then be slipped through the culvert to convey resource material from Area C to Area B.

- **Resource Restoration** – Immediately after the mineral resource from a pit is depleted, restoration activities would proceed, including laying backside slopes and eliminating straight lines to match the surrounding environment. Stockpiled topsoil would then be redistributed into the borrow pit and the area replanted with native vegetation. If necessary, water would be sprinkled onto the site to promote seed germination. It is estimated this activity would add an additional 5 percent to the cost and labor of the borrow pit operation.

- **Hauling and Stockpiling** – A fleet of haul trucks would be used to haul resource material to stock-piles (if not directly conveyed) or the LLBGs in both 200 East and 200 West Areas. The numbers of haul trucks would be similar to those associated with hauling contaminated material to the Environ-mental Restoration and Disposal Facility. Haul trucks would be loaded either directly from borrow pit excavations or from stockpiles. Stockpiles would be staged 152 to 305 m (500 to 1,000 ft) from SR 240 in topographically low areas to minimize wind erosion.

- **Dust and Traffic Control** – Traffic and dust control required by Area C operations are important considerations because of the vicinity of SR 240 and potential safety hazards associated with traffic. The following precautions are planned as needed:

  - Haul trucks would be fitted with roll-out tarps. If necessary, an undercarriage and wheel wash-down system would be provided near the point where the trucks cross SR 240 to minimize fugitive dusts.

  - If necessary, a traffic light could also be installed at the intersection, with warning lights on each side of it to warn oncoming traffic.

- As needed, a water truck and soil binder additive system would be employed to continuously wet site gravel roads, queues, stockpiles, and working faces (this practice has proved to be extremely effective at Hanford soil cleanup sites). A sprinkler system might also be used to control dusts.

- Excavation and truck loading activities would be discontinued when winds are excessive.

- The exposed working face of a borrow pit would be limited.

- Stockpile profiles would be minimized wherever possible.

- Haul roads and queues would be rocked.

- Conveyor systems would be fitted with misting systems to minimize fugitive dusts.

Area C was selected for use as a borrow pit because of its proximity to the 200 Area waste disposal facilities, and the borrow pit would be designed to minimize dust and safety hazards.

D.4 Liner Options for Disposal Facilities

Liners in disposal facilities can delay water entering into the vadose zone and eventually into ground water. However, liners have the potential to adversely affect long-term performance by retaining water within the disposal facility around the waste thereby leaching radioactive and hazardous components from the waste. Options for application of liners to waste disposal are described in this section.

Mixed waste disposal facilities are required by RCRA and State regulation to contain a liner underneath the waste, and LLW facilities may also use liners to retain any rain or snow water that has fallen onto the disposal facilities and contacted waste materials. This water, which is called leachate, may contain hazardous and radioactive materials that have been leached from the waste. The leachate must be contained, removed, and treated in facilities designed to meet applicable standards. These standards require that the liner function during the active operational period and for a minimum of 30 years after closure of the disposal facility. Landfill liners are typically constructed of one or more layers of earthen materials (e.g., sand, silt clay, gravel, or cobbles), plastics (e.g., High-Density Polyethylene [HDPE]), or a combination of these materials). The primary objective of a landfill liner is to prevent any leachate from percolating down into the underlying aquifer. The liners that have been used in the existing disposal trenches are described and illustrated in Section 2.2.3.5. Other liner options are described below:

- no liners
- regulatory-compliant liners
- clay liners
- other types of liners.

As discussed in Section 5.3, the normal soils and geologic media would retard migration of most radionuclides and chemicals. Even when liners are part of a disposal facility, no credit is taken for the liner in evaluating the long-term performance of disposal facilities. The EIS analysis assumes no liners for independent LLW disposal facilities, which has been the standard practice for the LLBGs at Hanford where the annual precipitation is low. To ensure that analyses are conservative when evaluating the potential releases from LLW disposal, even in lined facilities, no credit is taken for the liner. Due to long time period of analysis and the relative short expected life of liners (30-100 years) it was conservative to model transport to ground water as if the liner did not exist. Liners effectively minimize transport of contaminants from the disposal facility during operations. However, there is no scientific consensus regarding the lifetime of liners.

The mixed waste trenches, ERDF, and all of the lined disposal facilities evaluated in the HSW EIS alternatives are designed with liners that meet applicable technical standards. The liners are a combination of clay, drainable layers, and thick polymeric liners, as discussed in Section 2.2.3.5.

Some disposal facilities use only a clay liner with its natural ability to retard water flows. Smectite or bentonite-type clays are suitable for this function because they have very low permeability to water and are less subject to geologic modification with time than polymeric liners. However, they can be subject to shrinkage and cracking as the water environment changes.

Another option for minimizing contaminant migration could be the use of a permeable reactive barrier in-lieu of the traditional double-lined system. Disposal facility trench design could optimize the physical and chemical characteristics in a trench bottom in order to maximize artificially created attenuation of radionuclides and hazardous waste components. Disposal site design could optimize the soil adsorption capacity by artificially creating a permeable reactive barrier in the trench bottom by adding such materials as flyash, zeolite clays, various oxides, zero valence metals (e.g., metallic iron), granulated activated carbon, phosphates, lime, and peat. Manipulating trench-bottom material pH could also assist in enhancing specific contaminants' retardation. The type and amount of additives, method of additive installation (e.g., layered adsorbents vs. a homogenous blend of adsorbents), and physical/ chemical manipulations deployed to create an artificial reactive barrier would depend primarily on such factors as waste composition (types and volumes) and climate. Field and laboratory tests have demonstrated that flyash and zeolite clays alone greatly improve the retention of most radionuclides (except the actinides) and hazardous contaminants. Installing such a reactive permeable liner system under a mixed waste trench could provide a long-term solution to waste isolation as opposed to the uncertainty associated with long-term performance of landfill barriers, performance monitoring, and landfill liner systems. A permeable reactive barrier could be substantially lower in cost than a traditional double-lined system due to such factors as lower construction costs and elimination of the need to collect and treat leachate during the operating life cycle of the facility and would provide, with a high level of certainty, the ability to isolate waste for thousands of years.

D.5 Barrier Options

The modified RCRA Subtitle C Barrier was selected for use in this EIS as the reference design barrier for LLW and MLLW disposal facilities and is discussed in Section 2.2.3.6. A focused feasibility study (DOE 1996) was performed to examine engineered barrier options that have broad application and are considered viable from the standpoint of effectiveness, implementability, and cost. The feasibility study evaluated a total of four conceptual barrier designs for different types of waste sites. The Hanford for independent LLW disposal facilities, which has been the standard practice for the LLBGs at Hanford where the annual precipitation is low. To ensure that analyses are conservative when evaluating the potential releases from LLW disposal, even in lined facilities, no credit is taken for the liner. Due to long time period of analysis and the relative short expected life of liners (30-100 years) it was conservative to model transport to ground water as if the liner did not exist. Liners effectively minimize transport of contaminants from the disposal facility during operations. However, there is no scientific consensus regarding the lifetime of liners.

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Barrier, the modified RCRA Subtitle C Barrier, and the modified RCRA Subtitle D Barrier were considered as the baseline designs for the purpose of the evaluation. A fourth barrier design, the standard RCRA Subtitle C Barrier, was also evaluated; it is commonly applied at other waste sites across the country. These four designs provide a range of barrier options to minimize health and environmental risks associated with a site and specific waste categories for design life periods of 1000, 500, 100, or 30 years, respectively. Design criteria for the 500- and 1000-year design life barriers include performance to extend beyond active institutional control and monitoring periods. An alternative approach, which is being considered for commercial radioactive waste disposal, is also discussed below.

D.5.1 Hanford Barrier

The Hanford Barrier was designed for disposal facilities with Greater than Category C (GTCC) LLW, GTCC MLLW, and/or wastes with significant inventories of TRU constituents. This barrier is designed to remain functional for a performance period of 1000 years and to provide the maximum practicable degree of containment and hydrologic protection of the evaluated designs. The Hanford Barrier is composed of nine layers of durable material (excluding the grading fill layer) with a combined thickness of 4.5 m (14.7 ft) (see Figure D.12). The barrier layers are designed to maximize evapotranspiration, and to minimize moisture infiltration and bio-intrusion, considering long-term variations in Hanford Site climate.

The primary structural differences between the Hanford Barrier and other barriers discussed in this report are increased thicknesses of the individual layers within the barrier and the inclusion of a coarse-fractured basalt layer to control bio-intrusion and to limit inadvertent human intrusion.

D.5.2 Standard RCRA Subtitle C Barrier

This barrier design can be used at disposal facilities containing hazardous constituents. This barrier is designed to provide containment and hydrologic protection for a period of 30 years, to include institutional control consisting of monitoring and necessary maintenance. The Standard RCRA Subtitle C Barrier is composed of five primary layers (not counting the grading fill layer) with a combined minimum thickness of 1.65 m (65 in.) (see Figure D.13). The barrier layers are designed to shed surface waters, and only minimally account for moisture retention and evapotranspiration capabilities. Bio-intrusion is mitigated primarily by institutional control, monitoring, and maintenance. However, EPA guidelines suggest using optional surface layer treatments for bio-intrusion considerations.

The Standard RCRA Subtitle C Barrier technology meets EPA's minimum technology guidance (EPA 1989). The Standard RCRA Subtitle C Barrier has limited applications and use at the Hanford Site. Limitations include a design life that may be inadequate for the radioactive waste categories; an anticipated high surveillance and maintenance and operations cost caused by implementation of the low permeability layer design features in an arid climate condition; and maintenance and operations cost caused by surface water runon and runoff control, collection, and discharge facilities.

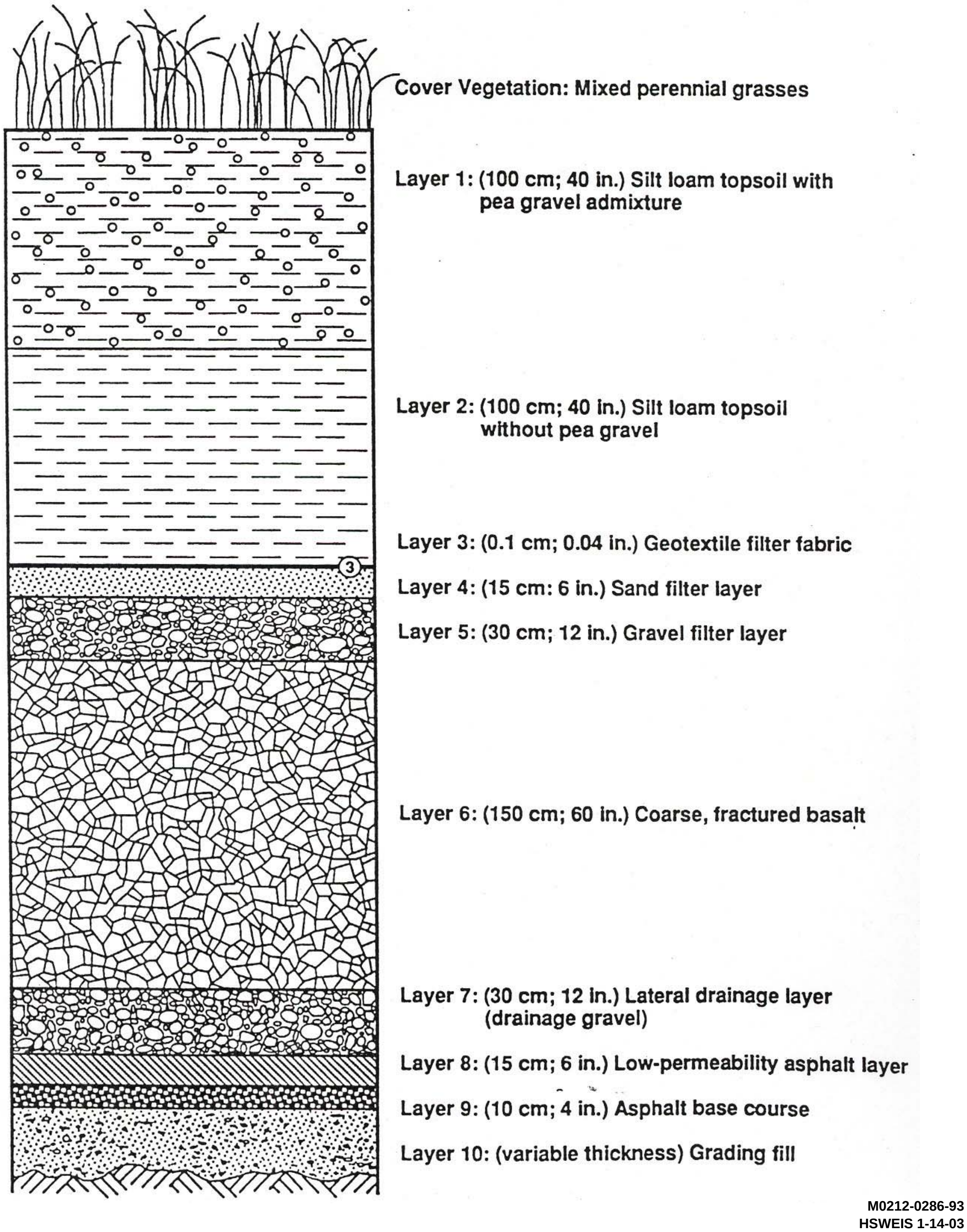

Figure D.12. Hanford Barrier

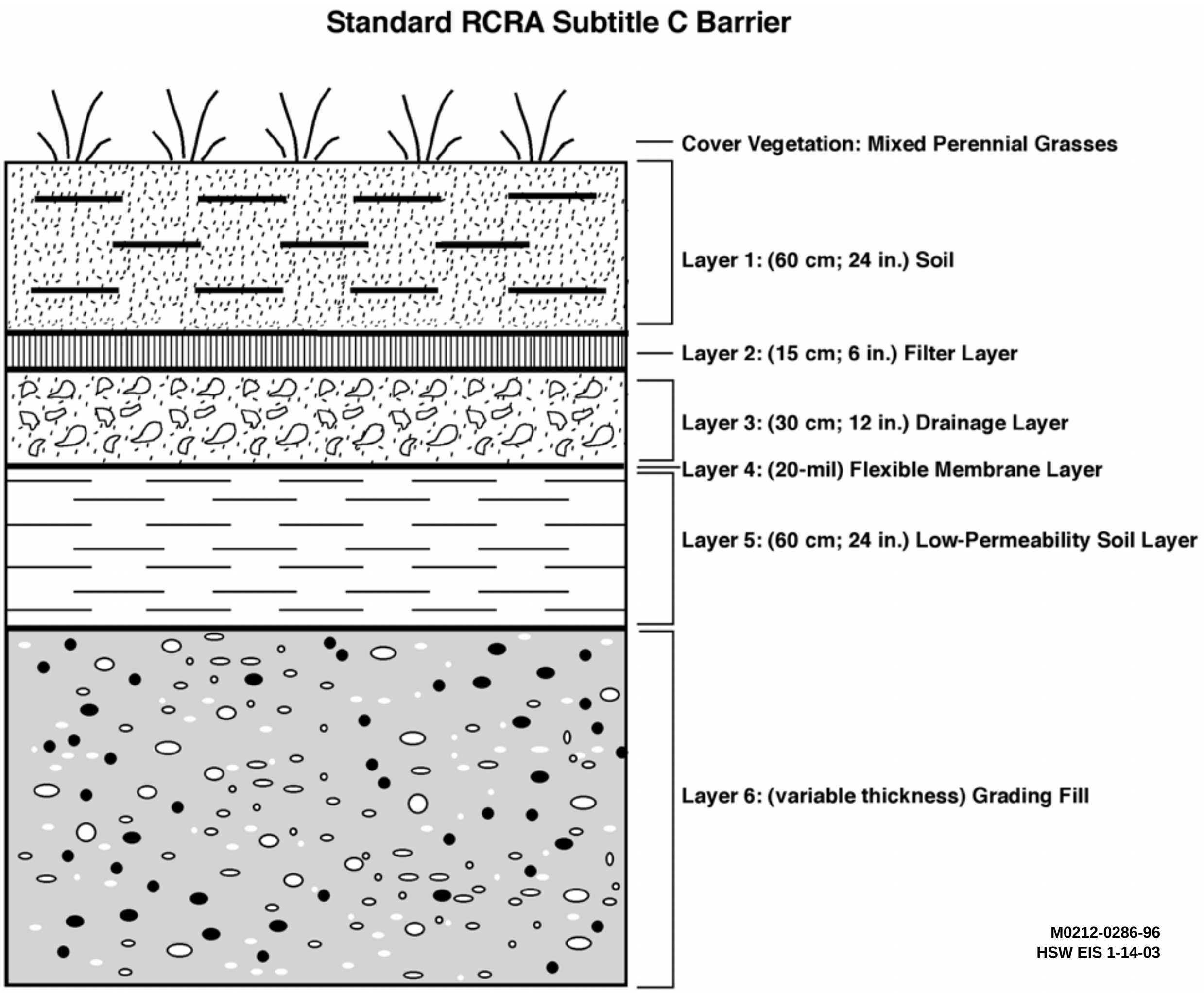

Figure D.13. Standard RCRA Subtitle C Barrier

D.5.3 Modified RCRA Subtitle D Barrier

This barrier is designed for non-radiological and non-hazardous solid waste disposal facilities, as well as Category 1 LLW sites where hazardous constituents are not present. The modified RCRA Subtitle D Barrier as shown in Figure D.14 is composed of four layers of durable material with a combined minimum thickness of 0.90 m (2.9 ft) excluding the grading fill layer. It is designed to provide limited biointrusion and limited hydrologic protection (relative to the Hanford and Modified RCRA Subtitle C barrier designs) for a performance period of 100 years. The performance period is consistent with the radionuclide concentrations and activity limits specified for Cat 1 LLW. The 100-year design life is also consistent with the minimum expected duration of active institutional control.

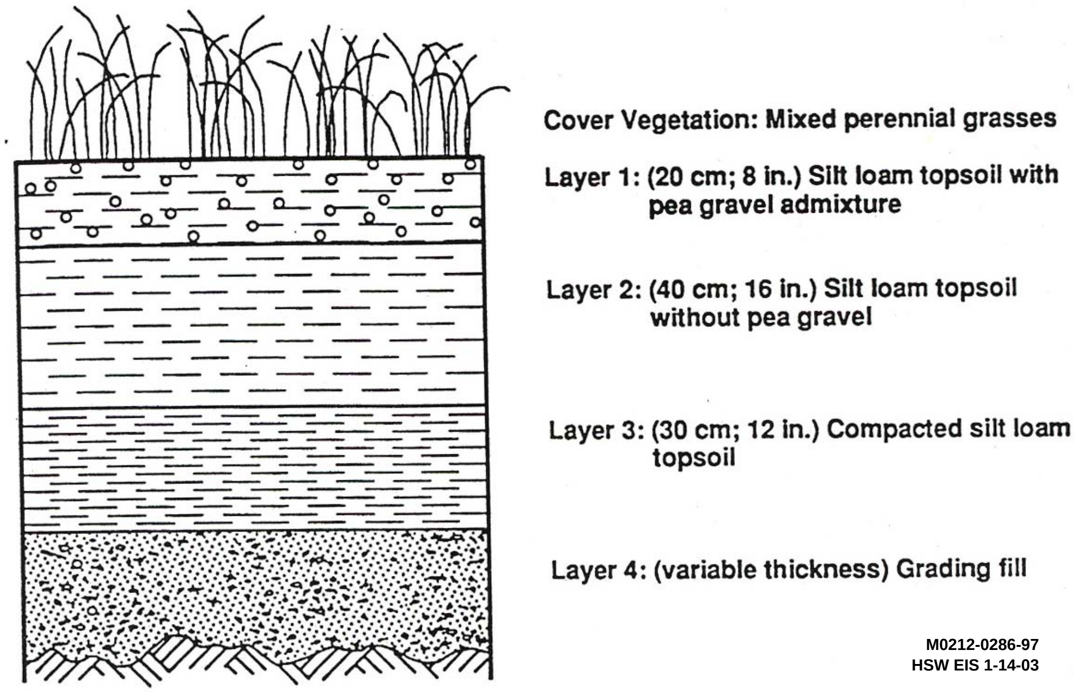

Figure D.14. Modified RCRA Subtitle D Barrier with Bentonite Mix

D.5.4 Conceptual Cover Barrier with Bentonite Mix

This barrier has been evaluated by WDOH (WDOH 1999) for use at the leased commercial disposal facility adjacent to the 200 Areas (the US Ecology Site). The conceptual cover barrier is shown in Figure D.15. Some of the key characteristics of the barrier design are a 4-inch surface layer with 50 percent gravel, 36-inch silt loam layer, and a 12-inch bentonite clay (12 percent) low-permeability barrier.

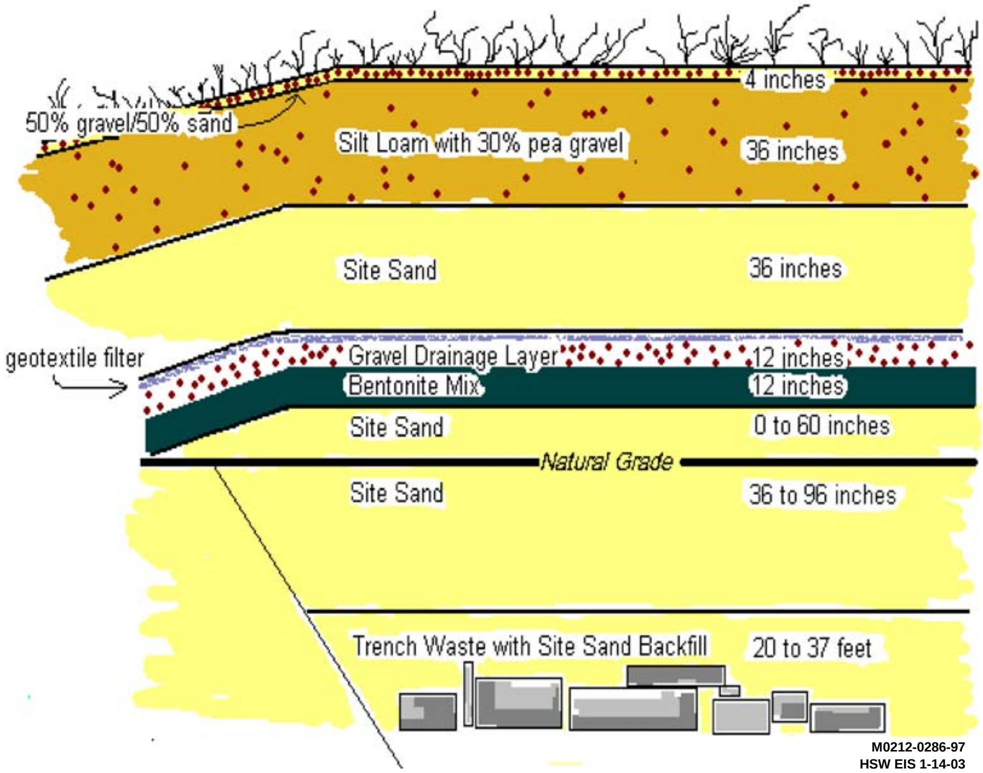

Figure D.15. US Ecology Conceptual Cover Barrier

D.6 References

40 CFR 261. "Identification and Listing of Hazardous Waste." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/40cfr261_01.html.

40 CFR 717. "Records and Reports of Allegations that Chemical Substances Cause Significant Adverse Reactions to Health or the Environment." U.S. Code of Federal Regulations.

40 CFR 761. "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, and Use Prohibitions." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/40cfr761_01.html.

40 CFR 792. "Good Laboratory Practice Standards." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/40cfr792_01.html.

15 USC 2601. Toxic Substance Control Act (TSCA) of 1976. Online at: http://www4.law.cornell.edu/uscode/15/2601.html.

42 USC 2011 et. seq. Atomic Energy Act of 1954. Online at: http://www4.law.cornell.edu/uscode/15/2601.html.

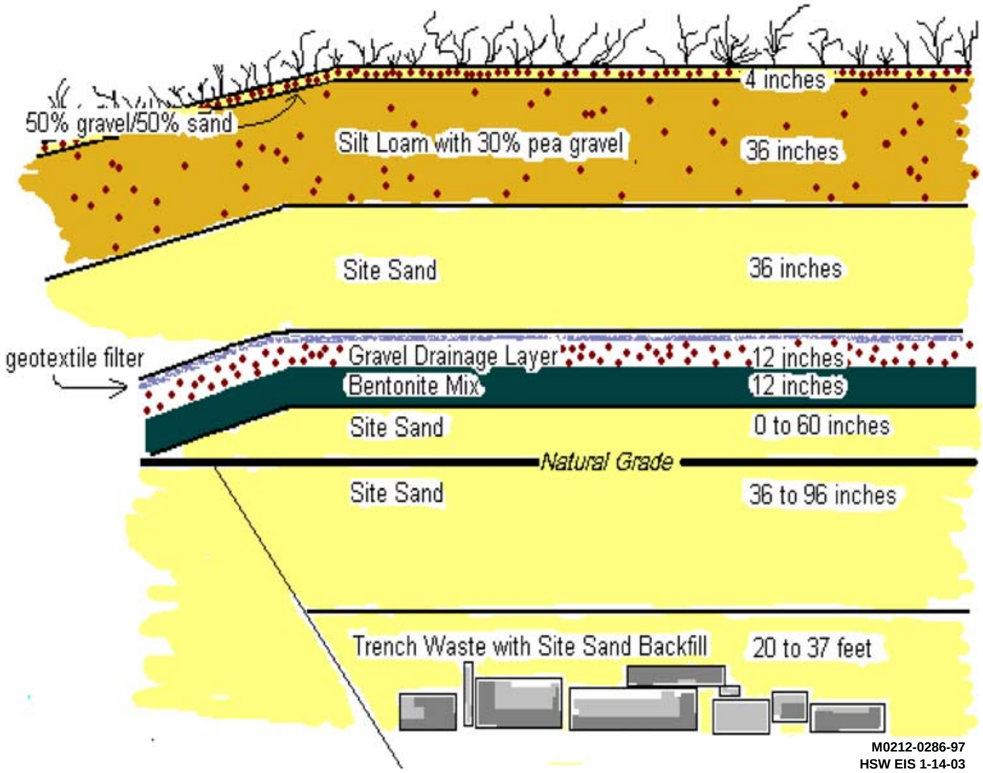

Figure D.15. US Ecology Conceptual Cover Barrier

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15 USC 2601. Toxic Substance Control Act (TSCA) of 1976. Online at: http://www4.law.cornell.edu/uscode/15/2601.html.

42 USC 2011 et. seq. Atomic Energy Act of 1954. Online at: http://www4.law.cornell.edu/uscode/15/2601.html.

42 USC 6901 et seq. Resource Conservation and Recovery Act (RCRA) of 1976. Online at: http://www4.law.cornell.edu/uscode/15/2601.html.

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Appendix E

Air Quality Analysis

This appendix provides information to support the non-radiological air quality impact analysis presented in Section 5.2. This analysis characterizes the routine emission of non-radiological pollutants by most Hanford Solid Waste Program activities, the atmospheric dispersion of these pollutants, and the maximum air quality impacts to the public. The impacts associated with waste transportation activities and the emission of hazardous chemicals and radionuclides are not addressed in Section 5.2 or this appendix. Section 5.8 covers the air quality impacts associated with the transportation of radioactive and hazardous wastes. Section 5.11 and Appendix F report on the potential health impacts associated with the emission of chemicals and radionuclides.

The Clean Air Act authorizes the U.S. Environmental Protection Agency (EPA) to set permissible levels of exposure for selected air pollutants using health-based criteria. These “criteria pollutants” include nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter with aerodynamic diameters of 10 microns or less (PM_{10}), carbon monoxide (CO), lead, and ozone. The maximum permissible exposure levels for these pollutants are set in National Primary and Secondary Ambient Air Quality Standards (40 CFR 50). The standards focus on short-term exposures (1 hr or 3 hr), workday exposures (8 hr), and long-term exposures (24 hr or annual). The standards for some pollutants focus on short-term exposures (for example, CO and ozone), and the standards for other pollutants focus on long-term exposures (for example, PM_{10} and NO_2). Primary standards are established to protect against adverse health effects. Secondary standards protect the public welfare from negative effects such as damage to crops, vegetation, and buildings, as well as decreased visibility. In addition, states and local governments can set additional or more restrictive standards. Washington State has defined such standards for particulate matter and sulfur dioxide. Section 4.2.3 indicates the standards applicable to the Hanford Site.

Carbon monoxide, particulate matter, sulfur dioxide, and nitrogen dioxide are produced from the combustion of fossil fuels. Particulate matter is generated also by the mechanical disturbance of ground materials by earthmoving activities, vehicle traffic over unpaved and paved roadways, and the action of the wind on disturbed soils. Two criteria pollutants, ozone[a] and lead, are not considered in this assessment because the level of their emissions, or that of essential precursor compounds, is negligible.

To estimate maximum air quality impacts from Hanford Solid Waste Program activities, the Industrial Source Complex Short-Term (ISCST3) Dispersion Model (EPA 1995b) was selected for use.

(a) Volatile organic compounds (VOCs), a class of pollutant involved in ozone formation, would have a maximum project emission rate of less than 1 g/s. This release rate would not cause a detectable change in background concentration of this class of pollutants and therefore could not result in any detectable change in ozone concentrations within the local airshed.

The ISCST3 model is approved by the EPA for the calculation of the maximum air quality impacts of criteria pollutants. The model uses a steady-state Gaussian plume algorithm to estimate pollutant concentrations from a wide variety of sources associated with industrial complexes. The model is applicable for either flat or rolling terrain, modeling domains with a radius of 50 km (31 mi) or less from the point of release, and urban or rural environments.

Multiple years of hourly meteorological data from the Hanford Site were used in conducting ISCST3 modeling. These data provided an extended, climatologically representative period of local meteorology for computing atmospheric dispersion conditions. The hourly meteorological data covered a representative 4-yr period (1993 through 1996) and included such parameters as wind transport direction, wind speed, atmospheric stability, mixing depth, and air temperature. All meteorological data were obtained from the Hanford Meteorology Station (HMS). The HMS is located between the 200 West and 200 East Areas; data from this station are representative of meteorological conditions at the Hanford Solid Waste Program work sites in and around the 200 Areas. Area C is located about 6 km (4 mi) south of the HMS and data from the station are also representative of meteorological conditions at this work site. Wind measurements were made at 10 m (33 ft) above ground level on the 122-m (400-ft) tall instrumented tower located adjacent to the HMS. Wind transport directions were reported in the data set using 36 direction sectors (i.e., the sectors are 10 degrees wide). Near-surface air temperature measurements were made at 1.5 m (5 ft) above ground level. Mixing-depth estimates were made using measurements from the HMS Doppler acoustic sodar, the HMS instrumented tower, and other sources of information. Atmospheric stability was computed using the U.S. Nuclear Regulatory Commission (NRC) ?T method (NRC 1972). This methodology uses the wind speed and the difference between temperature measurements at 60 m (200 ft) and 10 m (30 ft) above the ground to estimate the atmospheric stability class.

The ISCST3 model uses meteorological data records to compute the maximum air quality impacts for various federal- and state-defined averaging periods and receptor locations. A Cartesian grid, polar grid, and an array of user-defined receptor points were all used in modeling air quality impacts. This dense network of receptors was used to capture air quality impacts to the public along the Hanford Site boundary, outside the boundary, and at points of public access within the boundaries of the site.

The characterization of pollutant emissions from Hanford Solid Waste Program activities was a critical step in the air quality analysis. Criteria pollutant emissions would come from fugitive dust sources, diesel-fueled engines, and propane-fired equipment. The operation of vehicles and construction equipment would generate both exhaust and fugitive dust emissions. Major pollutant generating activities would include:

- construction or modification of waste-processing facilities (e.g., T Plant, CWC)
- construction of waste-disposal trenches (e.g., LLW, MLLW, ILAW)
- waste-disposal operations
- excavation of backfill and capping material at the borrow pits
- transportation of capping materials from the borrow pit area to the disposal trenches
- backfill and capping activities at the disposal trenches
- leachate drying operations.

To simplify the modeling of air quality impacts, emissions from Hanford Solid Waste Program activities were conservatively assumed to originate from only three source locations. These source locations were situated in the 200 West Area (near the southwestern edge of local project activities), 200 East Area (near the northwestern edge of local project activities), and Area C (at the borrow pit work site near State Route [SR] 240). These source locations were chosen because they represented the project work site in their major operating area that would generate the greatest air quality impacts to the public.

The 200 Area source locations were each represented using a 40 m by 40 m (130 ft by 130 ft) emissions area. The Area C source location was represented using two 40 m by 40 m emission areas. The emission area used to represent borrow pit operations was set on the southwest side of SR 240. The Area C emissions used to represent truck-loading operations was set on the northeast side of the highway. Both emissions areas were conservatively positioned so that they extend between 150 m (490 ft) and 95 m (310 ft) from SR 240. This is less than the 150-m minimum distance specified in project guidelines for conducting activities near SR 240. During Area C operations, most emissions would actually occur at distances between 300 m (980 ft) and 1.6 km (1 mile) from the highway. In modeling emissions from borrow pit operations, 4 diesel-powered vehicles (a scraper, bulldozer, front-end loader, and track hoe) were assumed to be operating at the borrow pit source location. In addition to the diesel exhaust, fugitive dust emissions from equipment operations and the material stockpile were also included in the source term. Detailed information on borrow pit operations is provided in FH (2002).

The coordinates and sizes of all source locations were selected to provide conservative estimates of the maximum potential air quality impacts to the public that would result from activities to be conducted within each area. This included concentrating emissions from multiple activities into one source location, even though these emissions would actually occur at multiple work sites spread over a much larger work area. The transportation of backfill and capping materials was also handled in this manner. Twenty diesel-powered trucks were assumed to be in continuous operation during normal work periods to facilitate the transportation of the materials from Area C to the 200 Areas. Pollutant emissions associated with the operation of the trucks include exhaust emissions and fugitive dust. A conservative assumption was made that all truck emissions would be split between two fixed source locations: Area C and the 200 West Area. This assumption concentrated emissions rather than spreading them across a much broader area or line source, thereby maximizing estimates of air quality impacts.

Another conservative assumption involved not accounting for processes that would chemically decompose pollutants or remove pollutants from the atmosphere via deposition processes. In actuality, chemical decomposition and atmospheric-deposition processes would act to substantially reduce most pollutant concentrations and associated air quality impacts.

Based on ISCST3 model runs for pollutant releases in the 200 East and 200 West Areas, the locations where maximum air quality impacts to the public would occur were determined for various averaging periods. Table E.1 provides estimates of the maximum air quality impact locations and the associated dispersion factors. Multiplying a dispersion factor (s/m^3) by a maximum pollutant release rate ($\mu g/s$) generates an estimate of the maximum air-pollutant concentration ($\mu g/m^3$). For criteria pollutants with ambient air quality standards based on 8-hr or less averaging times, the maximum air quality impacts for emissions from the 200 Areas would occur at points of public access along SR 240. For criteria pollutants with 24-hr and annual standards, the greatest air quality impacts would occur at the Site boundary, the closest point where a member of the public could potentially be located for an extended period of time. Long-term air quality impacts are not computed for SR 240 because this highway passes through federal lands with restricted public access (between the Hanford Site and the Fitzner/Eberhardt Arid Lands Ecology Reserve).

The 200 East and 200 West dispersion-factors indicate that for a unit emission, releases from the 200 West Area would have a slightly greater air quality impact than would emissions from the 200 East Area. As a result, for project activities that could occur in either the 200 East or 200 West Areas, the bounding 200 West dispersion factor was used to estimate air quality impacts. For example, the Lined Modular Facility proposed in Alternative Group D could be sited at locations in or near the 200 East or 200 West Areas, depending on the sub-alternative selected. The 200 West source location was used in the air quality analysis because it generated the greatest air quality impacts.

Table E.1. 200 East and 200 West Area Emissions: Dispersion Factors Used to Determine Maximum Air Quality Impacts to the Public

Area	Averaging Time Period	Maximum Impact Location and Corresponding Public Access	Distance and Direction from Pollutant Release Location to Maximum Public Impact Location [(a)]	Dispersion Factor for Maximum Impact Location (s/m^3)[(b)]
200 East	1 hr	SR 240	8.5 km – SW	8.4E-5
	3 hr	SR 240	9.0 km – SSW	3.3E-5
	8 hr	SR 240	9.0 km – SSW	2.2E-5
	24 hr	Hanford Site boundary	15.3 km – WNW	9.3E-6
	Annual	Hanford Site boundary	13.9 km – WNW	8.9E-8
200 West	1 hr	SR 240	4.0 km – S	1.6E-4
	3 hr	SR 240	4.0 km – S	7.4E-5
	8 hr	SR 240	4.0 km – S	5.1E-5
	24 hr	Hanford Site boundary	8.5 km – WNW	1.6E-5
	Annual	Hanford Site boundary	11.5 km – W	1.5E-7

(a) Distance and direction determined by dispersion modeling. Pollutant-transport direction is reported using 16 compass sectors—starting with North (N) and continuing clockwise with NNE, NE, ENE, E (East), ESE, SE, SSE, S (South), SSW, SW, WSW, W (West), WNW, NW, and NNW.

(b) Values computed by the ISCST3 model. To convert to a concentration estimate ($\mu g/m^3$), a dispersion factor (s/m^3) is multiplied by the actual pollutant release rate ($\mu g/s$).

Table E.2 provides the locations where maximum air quality impacts to the public would occur for releases from the Area C borrow pit. The maximum short-term air quality impacts for emissions from the borrow pit would occur along SR 240, and the maximum long-term air quality impacts would occur at the Site boundary. These impact locations are different from those for 200 Areas.

Hanford Solid Waste Program activities that would be associated with criteria pollutant emissions are shown in the timeline of Tables E.3 through E.8. These timelines show the expected years of various activities. Figure E.1 precedes Tables E.3 through E.8 to provide a key for interpreting the timelines.

Table E.2. Area C Borrow Pit Emissions: Location and Dispersion Factors Used to Determine Maximum Air Quality Impacts

Averaging Time	Maximum Impact Location	Distance from Release to Maximum Public Impact Location[(a)]	Unit Dispersion Factors for Maximum Impact Location (s/m^3)[(b)]
1 hr	SR 240	<150 m NE	3.3E-3
3 hr	SR 240	<150 m NE	2.3E-3
8 hr	SR 240	<150 m NE	1.9E-3
24 hr	Hanford Site Boundary	14.4 km WNW	1.0E-5
Annual	Hanford Site Boundary	13.8 km WNW	9.2E-8

(a) Distance and direction determined by dispersion modeling. Pollutant-transport direction is reported using 16 compass sectors—starting with North (N) and continuing clockwise with NNE, NE, ENE, E (East), ESE, SE, SSE, S (South), SSW, SW, WSW, W (West), WNW, NW, and NNW.

(b) Values computed by the ISCST3 model. To convert to a concentration estimate ($\mu g/m^3$), the dispersion factor (s/m^3) is multiplied by the actual pollutant release rate ($\mu g/s$).

KEY to TIMELINE TABLES E.3-E.8

Column Headings: H=Hanford Only waste volume; L=Lower Bound waste volume; U = Upper Bound waste volume; and N = No Action waste volume that is disposed (as opposed to stored). N/A = activity is not applicable to the alternative; NWPF = new waste processing facility.

CONSTRUCTION

LLW Trench – Number indicates the number of low-level waste (LLW) trenches constructed during that year. The trench design can change by alternative. A fraction of a trench indicates that a less-than-full-sized trench, according to the design considered under the alternative, will be constructed.

MLLW Trench – Number indicates the number of mixed low-level waste (MLLW) trenches constructed during that year. The trench design can change by alternative. A fraction of a trench indicates that a less-than-full-sized trench, according to the design considered under the alternative, will be constructed. The "m" indicates the Phase I melter trench construction. "I" indicates ILAW trench (Alternative Groups A through E) or ILAW vault (No Action) construction. Six ILAW vaults are assumed to be constructed at a time.

CWC Bldgs – Number indicates the number of new Central Waste Complex (CWC) buildings to be constructed. Under the No Action Alternative, the first number indicates the number of CWC buildings constructed to store MLLW, and the second number indicates the number of CWC buildings constructed to store transuranic (TRU) waste. Also under the No Action Alternative, "melter pad construction" indicates the year that a pad would be constructed to store melters.

T Plant Modif – Construction activity associated with T-Plant modification for waste treatment occurs.
NWPF – Construction of the new waste processing facility occurs.
LMF – Lined Modular Facility – also may be called the Lined Modular Trench

CAPPING

LLW – Check marks are the years that the LLW burial grounds will be capped.

MLLW – The number indicates the total number of MLLW trenches capped during that year. The first two trenches to be capped are the existing trenches (MLLW Trenches 31 and 34). The "m" indicates Phase I Melter trench capping. The "I" indicates ILAW trench or vault capping.

OTHER

CWC Propane – The amount of propane required to power vehicles for routine operations at CWC are indicated as increasing or decreasing over time.

MLLW Propane – The number indicates the number of MLLW trenches that require leachate processing by pulse driers.

Figure E.1. Information Key to the Timeline Tables (Tables E.3 – E.8)

Table E.3. Timeline of Alternative Group A Activities Resulting in Criteria Pollutant Emissions

	CONSTRUCTION									CAPPING						OTHER			
	LLW Trench			MLLW/ Melter Trench			ILAW Trench	CWC Bldgs	T Plant Modif	LLW			MLLW/Melter/ ILAW			CWC Propane	MLLW Propane		
	H	L	U	H	L	U		N/A		H	L	U	H	L	U		H	L	U
2000																*			
																|			
																|			
	1	1	1			1										|			
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									✓				1	1		E			
2010							I		✓							A			
			1				I		✓							S			
									✓							E			
							I									O			
2015	1	1					I									P			
																E			
																R			
			1				I						m	m	m	A			
							I									T			
2020																I			
																O			
							I									N			
							I									S			
																|			
2025							I									|			
							I									|	3	3	3
																|	3	3	3
																|	3	3	3
																|	3	3	3
2030																|	3	3	3
																|	3	3	3
													I	I	I	|	3	3	3
													I	I	I	▼	3	3	3
													I	I	I	No ops	3	3	3
2035													I	I	I		3	3	3
													I	I	I		3	3	2
													I	I	I		2	2	1
													I	I	I		2	2	1
													I	I	I		2	2	0
2040													I	I	I		1	1	
													I	I	I		1	1	
													I	I	I		1	1	
										✓	✓	✓	I	I	I		1	1	
										✓	✓	✓	I	I	I		1	1	
2045										✓	✓	✓	I	I	I		1	1	
										✓	✓	✓	I	I	I		1	1	
													1	1	1		1	1	
																	1	1	
																	0	0	
2050																			

Table E.4. Timeline of Alternative Group B Activities Resulting in Criteria Pollutant Emissions

	CONSTRUCTION									CAPPING						OTHER			
	LLW Trench			MLLW/Melter Trench			ILAW Trench	CWC	NWPF	LLW			MLLW/ Melter/ILAW			CWC Propane	MLLW Propane		
	H	L	U	H	L	U		N/A		H	L	U	H	L	U		H	L	U
2000																*			
																|			
	3	3	2													|			
	1	1	4	2	2	3										|			
	1	1	5	2	2	3									1	|			
2005	1	1	5	2	2	3							1	1		D			
			4	1.5	1.5	3	I								1	E			
	2	2	5			3	I								2	C			
			1	m	m	m									2	R			
	1	1	2						✓				1	1	1	E			
2010	1	1	1				I		✓						1	A			
	2	2	2				I		✓				2	2	1	S			
	2	2	3						✓							E			
	2	2	3										1	1	1				
			2				I						1	1	1	O			
2015	1	1	2				I								1	P			
	3	3	3										1	1		E			
	2	2	1												1	R			
			2				I						m	m	m	A			
	3	3	1				I									T			
2020	1	1	2										1	1		I			
	1	1	1												1	O			
	1	1					I									N			
			2				I									S			
	2	2														|			
2025	0.3	0.3					I									|			
	1	1	2				I									|	9	9	15
													1	1		|	**10**	**10**	15
															1	|	10	10	16
																|	10	10	16
2030			1													|	10	10	16
	0.3	0.3	1													|	10	10	16
													I	I	I,1	|	10	10	**17**
			1										I	I	I	|	10	10	**17**
	1	1											I	I	I	▼	10	10	**17**
2035													I	I	I	No ops	10	10	16
													I	I	I		9	9	16
													I	I	I		9	9	15
			1										I	I	I		9	9	13
													I	I	I		9	9	11
2040													I	I	I		8	8	10
													I	I	I		7	7	9
													I	I	I		6	6	8
			1							✓	✓	✓	I	I	I		6	6	8
										✓	✓	✓	I	I	I		5	5	7
2045										✓	✓	✓	I	I	I		4	4	6
										✓	✓	✓	I	I	I		4	4	5
													0.5	0.5	1		3	3	5
																	3	3	4
																	3	3	4
2050																	3	3	4

Table E.5. Timeline of Alternative Group C Activities Resulting in Criteria Pollutant Emissions

	CONSTRUCTION									CAPPING						OTHER			
	LLW Trench			**MLLW/ Melter Trench**			**ILAW**	**CWC Bldgs**	**T Plant Modif**	**LLW**			**MLLW/Melter /ILAW**			**CWC Propane**	**MLLW Propane**		
	H	**L**	**U**	**H**	**L**	**U**		**N/A**		**H**	**L**	**U**	**H**	**L**	**U**		**H**	**L**	**U**
2000																*			
																|			
																|			
																|			
																|			
2005															1	D			
							I						1	1	1	E			
	1	1	1	1	1	1	I									C			
				m	m	m										R			
									✓				1	1		E			
2010							I		✓							A			
							I		✓							S			
									✓							E			
							I									O			
2015							I									P			
																E			
																R			
							I						m	m	m	A			
							I									T			
2020																I			
																O			
							I									N			
							I									S			
																|			
2025							I									|			
							I									|	3	3	3
																|	3	3	3
																|	3	3	3
																|	3	3	3
2030																|	3	3	3
																|	3	3	3
													I	I	I	|	3	3	3
													I	I	I	▼	3	3	3
													I	I	I	No ops	3	3	3
2035													I	I	I		3	3	3
													I	I	I		3	3	2
													I	I	I		2	2	1
													I	I	I		2	2	1
													I	I	I		2	2	0
2040													I	I	I		1	1	
													I	I	I		1	1	
													I	I	I		1	1	
										✓	✓	✓	I	I	I		1	1	
										✓	✓	✓	I	I	I		1	1	
2045										✓	✓	✓	I	I	I		1	1	
										✓	✓	✓	I	I	I		1	1	
													1	1	1		1	1	
																	1	1	
																	0	0	

Table E.6. Timeline of Alternative Group D Activities Resulting in Criteria Pollutant Emissions

	CONSTRUCTION						CAPPING						OTHER			
	LMF (LLW/MLLW modules)			LMF (ILAW and melter modules)	CWC Bldg	T Plant Modif	LMF (LLW/ MLLW modules)			LMF (ILAW and melter modules)			CWC Propane	MLLW Propane		
	H	L	U	H/L/U	N/A		H	L	U	H	L	U		H	L	U
2000													*			
													|			
													|			
													|			
													|			
2005												1	D			
	✓	✓	✓	I						1	1	1	E			
	✓	✓	✓	I									C			
				m									R			
						✓				1	1		E			
2010				I		✓							A			
				I		✓							S			
						✓							E			
				I									O			
2015				I									P			
													E			
													R			
				I						m	m	m	A			
				I									T			
2020													I			
													O			
				I									N			
				I									S			
													|			
2025				I									|			
				I									|	3	3	3
													|	3	3	3
													|	3	3	3
													|	3	3	3
2030													|	3	3	3
													|	3	3	3
										I	I	I	|	3	3	3
										I	I	I	▼	3	3	3
										I	I	I	No ops	3	3	3
2035										I	I	I		3	3	3
										I	I	I		3	3	2
										I	I	I		2	2	1
										I	I	I		2	2	1
										I	I	I		2	2	0
2040										I	I	I		1	1	
										I	I	I		1	1	
										I	I	I		1	1	
							✓	✓	✓	I	I	I		1	1	
							✓	✓	✓	I	I	I		1	1	
2045							✓	✓	✓	I	I	I		1	1	
							✓	✓	✓	I	I	I		1	1	
														1	1	
														1	1	
														0	0	
2050																

Table E.7. Timeline of Alternative Group E Activities Resulting in Criteria Pollutant Emissions

	CONSTRUCTION								CAPPING						OTHER			
	LLW & MLLW Trenches			ILAW and Melter Trenches			CWC Bldg	T Plant Modif	LLW & MLLW			ILAW and Melter			CWC Propane	MLLW Propane		
	H	L	U	H	L	U	N/A		H	L	U	H	L	U		H	L	U
2000															*			
															|			
															|			
															|			
															|			
2005														1	D			
	✓	✓	✓	I	I	I						1	1	1	E			
	✓	✓	✓	Im	Im	Im									C			
															R			
								✓				1	1		E			
2010				I	I	I		✓							A			
				I	I	I		✓							S			
								✓							E			
				I	I	I									O			
2015				I	I	I									P			
															E			
															R			
				I	I	I						m	m	m	A			
				I	I	I									T			
2020															I			
															O			
				I	I	I									N			
				I	I	I									S			
															|			
2025				I	I	I									|			
				I	I	I									|	3	3	3
															|	3	3	3
															|	3	3	3
															|	3	3	3
2030															|	3	3	3
															|	3	3	3
												I	I	I	|	3	3	3
												I	I	I	▼	3	3	3
												I	I	I	No ops	3	3	3
2035												I	I	I		3	3	3
												I	I	I		3	3	2
												I	I	I		2	2	1
												I	I	I		2	2	1
												I	I	I		2	2	1
2040												I	I	I		1	1	1
												I	I	I		1	1	1
												I	I	I		1	1	1
									✓	✓	✓	I	I	I		1	1	1
									✓	✓	✓	I	I	I		1	1	1
2045									✓	✓	✓	I	I	I		1	1	1
									✓	✓	✓	I	I	I		1	1	1
																1	1	1
																1	1	1
																1	1	1
2050																1	1	1

Table E.8. Timeline of No Action Alternative Resulting in Criteria Pollutant Emissions

	CONSTRUCTION							CAPPING			OTHER		
	LLW Trench		MLLW/ Melter Trench		ILAW Vaults	CWC Bldgs LLW+MLLW/TRU	NWPF/T Plant	LLW	MLLW/ melter/ ILAW		CWC Propane	MLLW Propane	
	H	N	N/A	N/A		H & N	N/A	N/A	H	N	H & N	H	N
2000											*		
											|		
	3	3									|		
	1	1			I						I		
	1	1									N		
2005	1	1			I	4/3					C		
					I	4/3					R		
	2	2				4/3			1	1	E		
					I	4/3 & melter pad					A		
	1	1			I	4/3					S		
2010	1	1				4/3			1	1	E		
	2	2			I	4/4							
	2	2			I	4/4					O		
	2	2				4/4					P		
	2	2			I						S		
2015	1	1									|		
	3	3			I						|		
	2	2									▼		
					I				m	m	*		
	3	3									C		
2020	1	1			I						O		
	1	1									N		
	1	1									S		
											T		
	2	2									A		
2025	0.3	0.3									N		
											T	3	3
												3	3
											L	3	3
											E	3	3
2030									I	I	V	3	3
	0.3	0.3							I	I	E	3	3
									I	I	L	3	3
									I	I		3	3
	1	1							I	I	O	3	3
2035									I	I	P	3	3
									I	I	S	3	3
									I	I	|	3	3
									I	I	|	2	2
									I	I	|	2	2
2040									I	I	|	2	2
											|	1	1
											|	1	1
											|	1	1
											|	1	1
2045											▼	1	1
											No ops	1	1
												1	1
												1	1
												0	0
2050													

E.1 Combustion Engine Emissions

For the facilities and operations evaluated in this study, diesel-fueled engines would be used in machines such as backhoes, forklifts, and air compressors. Propane fuel would be used in leachate-treatment equipment beginning in 2026 and for CWC vehicles. Gasoline would be used to fuel construction-support vehicles. However, these would generally be mobile sources and use very small quantities of fuel compared to the program's diesel-powered construction equipment. Therefore, criteria pollutant emissions from gasoline-fueled vehicles were not explicitly evaluated. Criteria pollutant emissions from diesel engines are estimated using the following equation:

$$A_{o,c,a} = F_{o,a} \times E_{c,f} \times D_a \quad \text{(E.1)}$$

where $A_{o,c,a}$ = air concentration of criteria pollutant **c** with an averaging time **a** for operation **o** $\mu g/m^3$
$F_{o,a}$ = fuel-consumption rate for operation **o** and averaging time **a** L/s (or gal/s)
$E_{c,f}$ = generation rate of criteria pollutant **c** for fuel **f** $\mu g/L$ (or μg /gal)
D_a = dispersion factor for averaging time **a**, $\mu g/m^3$ per g/s.

Dispersion factors (D_a) were given in Table E.1 and Table E.2. The generation rates for criteria pollutants ($E_{c,f}$) for diesel fuel and propane are shown in Table E.9. The rates of pollutant generation for diesel fuel for carbon monoxide, nitrogen dioxide, and particulates are based on average values for a variety of heavy-duty construction equipment (EPA 1991). The values for particulates listed in Table E.9 are total suspended particulates but are conservatively assumed to be PM_{10}. Sulfur dioxide emissions are based on the maximum permissible amount of sulfur allowed in diesel fuel (a 500-ppm limit). No credit is taken for the substantial reduction in the sulfur content of diesel fuel (a 15-ppm limit) scheduled to be phased in beginning in June 2006 or a tightening of the emission standards for nitrogen dioxide and particulate matter scheduled to be phased in beginning in 2007 (EPA 2000). The propane-pollutant generation rates presented in Table E.9 are based on a propane industrial boiler (EPA 1996).

Fine material on road surfaces is emitted into the atmosphere as a result of vehicular traffic. The rate of particulate emissions is a function of the weight and the amount of dust on the road surface. Equations for computing the rate of particulate emissions are provided by EPA (1988). Using information on the

Table E.9. Emission Factors for Criteria Pollutants

Criteria Pollutant	Diesel-Fuel Pollutant Generation Rate (μg pollutant/L diesel fuel)	Propane Pollutant Generation Rate (μg pollutant/gal propane)
Carbon monoxide	1.5E+7	1.4E+6
Nitrogen dioxide	3.9E+7	8.6E+6
Particulates	3.5E+6	2.7E+5
Sulfur dioxide	8.2E+5	None

likely dust concentrations on paved roads at Hanford (0.4 g/m^2) and the average weight of the trucks, a rate of PM_{10} emissions at 16 g (0.564 oz) per vehicle mile traveled was conservatively estimated. For a 24-km (15-mi) roundtrip, this equates to a PM_{10} emission rate of 0.067 g/s per truck.

Fuel consumption rates ($F_{o,a}$ of Equation E.1) are shown in Table E.10 for diesel fuel and Table E.11 for propane. The fuel-consumption rates vary according to the averaging time selected. The hourly emission rates consider operation of the equipment over the 1-, 3-, or 8-hr periods. For daily averaging times, the diesel-fueled engines are assumed to run for one shift per day (that is, one-third of a day). Therefore, the emission rates averaged over a day (24 hr) are one-third of the hourly rate. For the propane-fueled leachate treatment equipment that would be operated 24 hr/day, the hourly and daily fuel consumption rates are the same because they run full time, not just one-third of a day as with the diesel engines. Most operations do not occur over the full year. Therefore, the emission rate for annual averaging times was adjusted to the average over a year. In situations in which the operation does in fact occur for a 1-yr period and daily operations are estimated from annual use, the assumption is that operations would occur 250 days/yr (5 days per week and 50 weeks per year).

For operational safety, diesel-fired backup generators would be located at some facilities, such as the T Plant. Pollutant emissions would occur during brief periods when the generators are fired up for testing and maintenance purposes. At Hanford, backup diesel-fired generators are routinely run only once per month for a period of about 30 minutes. As a result of the low frequency and short duration of backup generator operations, the maximum annual air quality impacts to the public from all Hanford Solid Waste program activities should not be affected by the limited testing of diesel-fired generators. Flexibility in scheduling the operation of the generators would prevent emissions from occurring during periods with unfavorable dispersion conditions. As a result, the diesel-fired backup generators would not be in operation under conditions when emissions from other pollutant sources would produce the program's maximum 1-, 3-, 8-, and 24-hr air quality impacts to the public.

E.2 Fugitive Dust

Fugitive dust would be generated during Hanford solid waste activities as a result of various earthmoving activities and truck traffic. The release rate of particulates (with aerodynamic diameters of 30 μm or less) for earthmoving was estimated as 0.27 kg/(m^2-month) (EPA 1995a). This particulate emission rate was based on measurements made during the construction of apartments and shopping centers. The characteristics of the soil in this study are similar to soil conditions found in the 200 Areas. Assuming that the construction activities generating this level of particulate emissions were active 8 hr/day and 30 days/month, the particulate emission rate would amount to 3.1E-4 g/(m^2-s).

Much of the fugitive dust generated by construction activities would be at the larger end of the 30-μm range and would tend to settle rapidly (Seinfeld 1986). Experiments on dust suspension due to construction found that at 50 m (160 ft) downwind of the source, a maximum of 30 percent of the remaining suspended particulates at respirable height were in the PM_{10} range (Grelinger et al. 1988). Based on this factor, only 30 percent of the total suspended particulates were assumed to be emitted as PM_{10}.

Table E.10. Average Diesel-Fuel Consumption Rates

Activity[a]	Diesel-Fuel Use (Liters)	Operation/ Construction Time	Note	Fuel Consumption Rate for Indicated Averaging Time (Liter/second)		
				Hourly	Daily	Annual
LLW Construction						
Alt. Group A – H & L	110,000	40 d	1 trench	0.095	0.032	0.0035
Alt. Group A – U	110,000	40 d	1 trench	0.095	0.032	0.0035
Alt. Group B – H & L	164,000	40 d	3 trenches[b]	0.14	0.047	0.0052
Alt. Group B – U	275,000	40 d	5 trenches[b]	0.24	0.080	0.0087
Alt. Group C – H & L	110,000	40 d	1 trench	0.095	0.032	0.0035
Alt. Group C – U	110,000	40 d	1 trench	0.095	0.032	0.0035
No Action	164,000	40 d	3 trenches[b]	0.14	0.047	0.0052
MLLW Construction						
Alt. Group A – H & L	200,000	1 yr	1.5 ha trench	0.028	0.0093	0.0063
Alt. Group A – U	400,000	1 yr	3.0 ha trench	0.056	0.019	0.013
Alt. Group B – H & L	300,000	28 wk	2x1.25ha trench[b]	0.25[c]	0.084[c]	0.0095
Alt. Group B – U	450,000	28 wk	3x1.25 ha trench[b]	0.38[c]	0.13[c]	0.014
Alt. Group C – H & L	200,000	1 yr	-	0.028	0.0093	0.0063
Alt. Group C – U	400,000	1 yr	-	0.056	0.019	0.013
No Action	150,000	28 wk	1 trench	0.13[c]	0.042[c]	0.0048
LMF Construction						
Alt. Group D – H & L	7,760,000	2 yr	(d)	0.54	0.18	0.12
Alt. Group D – U	7,960,000	2 yr	(d)	0.55	0.18	0.13
Alt. Group E – H & L	420,000	1 yr	(e)	0.058	0.019	0.013
Alt. Group E – U	840,000	1 yr	(e)	0.12	0.039	0.027
Melter & ILAW Construction						
Melter Trench	450,000	40 wk	1 trench[f]	0.31[c]	0.042[c]	0.014
ILAW Trench	7,000,000	2 yr	6 vaults/yr	0.49	0.16	0.11
ILAW Vault	582,000	1 yr		0.081	0.027	0.018
CWC Construction						
No Action – per building	10,600[g]	120 d/bldg	4 bldgs[b] &	0.012[b]	0.0041[b]	0.0027[b]
No Action – melter pad	24,600	50 d	8 bldg/y (2008)	0.017	0.0057	0.00078
LLBG Capping						
All Action Alternatives[h]	912,000	1 yr	2046-2049	0.13	0.042	0.029
MLLW Capping[c]						
Alt. Group A – H & L	145,920	8 wk	1.5 ha trench	0.13	0.042	0.0046
Alt. Group A – U	273,600	15 wk	3 ha trench	0.13	0.042	0.0087
Alt. Group B – H & L	109,440	3 wk	2x1.25ha trench[b]	0.25	0.084	0.0035
Alt. Group B – U	109,440	3 wk	2x1.25ha trench[b]	0.25	0.084	0.0035
Alt. Group C – H & L	145,920	8 wk	-	0.13	0.042	0.0046
Alt. Group C – U	273,600	15 wk	-	0.13	0.042	0.0087
No Action	54,720	3 wk	1.25 ha trench	0.13	0.042	0.0017
Melter and ILAW Capping						
Melter	364,800	20 wk	2018	0.13	0.042	0.012
ILAW Trenches	2,520,000	1 yr	-	0.35	0.12	0.080
ILAW Vault	6,600,000	1 yr	-	0.92	0.31	0.21
LLW Backfilling						
Alt. Group A – H & L	820	1 yr	-	0.016[i]	0.0053[i]	0.000026
Alt. Group A – U	3,210	1 yr	-	0.032[j]	0.011[j]	0.00010
Alt. Group B – H & L	6,780	1 yr	3 trenches[b]	0.048[i]	0.016[i]	0.00021
Alt. Group B – U	11,300	1 yr	5 trenches[b]	0.079[i]	0.026[i]	0.00036

Table E.10. (contd)

Activity[(a)]	Diesel-Fuel Use (Liters)	Operation/ Construction Time	Note	Fuel Consumption Rate for Indicated Averaging Time (Liter/second)		
				Hourly	Daily	Annual
LLW Backfilling (cont.)						
Alt. Group C – H & L	820	1 yr	-	0.016	0.0053	0.000026
Alt. Group C – U	3,210	1 yr	-	0.032	0.011	0.00010
Alt. Group D – H & L	95,920	1 yr	(d)	0.048	0.021	0.0022
Alt. Group D – U	100,000	1 yr	(d)	0.064	0.027	0.0024
Alt. Group E – H & L	2,520	1 yr	(e)	0.016	0.0054	0.000080
Alt. Group E – U	6,610	1 yr	(e)	0.032	0.012	0.00021
No Action	6,780	1 yr	3 trenches[(b)]	0.048[(i)]	0.016[(i)]	0.00021
MLLW Backfilling						
Alt. Group A – H & L[(k)]	1,700	1 yr	2005-8 max years	0.00024	0.000079	0.000054
Alt. Group A – U[(l)]	3,400	1 yr	2004-5 max years	0.00047	0.00016	0.00011
Alt. Group B – H & L[(m)]	6,800	1 yr	2009-10 max years	0.00094	0.00031	0.00022
Alt. Group B – U[(m)]	13,600	1 yr	2007 max year	0.0019	0.00063	0.00043
Alt. Group C – H & L	1,700	1 yr	-	0.00024	0.000079	0.000054
Alt. Group C – U	3,400	1 yr	-	0.00047	0.00016	0.00011
No Action[(n)]	1,700	1 yr	2006-9 max years	0.00024	0.000079	0.000054
Melter and ILAW Backfilling						
Melter[(o)]	25,000	25 wk	-	0.0069	0.0023	0.00079
ILAW Trench and Vault	1,250,000	1 yr	-	0.032[(j)]	0.016[(j)]	0.040
Treatment Facility						
T-plant Modification	1,200,000	4 yr	-	0.042	0.014	0.0095
NWPF Construction	2,900,000	4 yr	-	0.10	0.034	0.023
Borrow Pit						
Utility Extension	27,000	4 wk	Prior to ops	0.047	0.016	0.00086
Borrow operations	5,960,000	12.6 yr	As needed to cap	0.066	0.022	0.015

(a) Waste volume considered – Hanford Only (H), Lower Bound (L), and Upper Bound (U) waste volumes.
(b) Simultaneous construction/activity assumed.
(c) Assumed maximum of eight trucks operating on each trench at one time, except for ILAW capping.
(d) The sum of diesel used for LLW(Alt A), MLLW(Alt A), Melter, and ILAW trenches construction.
(e) The sum of diesel used for Alternative A LLW and MLLW trenches construction.
(f) Assumed consumption for each multiple trench design and for two modules of the single ILAW trench design.
(g) Diesel required per building.
(h) Applies to the LMF under Alternatives D and E.
(i) Assumed maximum of one truck operating on each trench at a time.
(j) Assumed maximum of two trucks operating on each trench at a time.
(k) Other years Alternative A–L: 1000 L/yr 1999-2005 and 1200 L/yr 2008–2046.
(l) Other years Alternative A–U: 1100 L/yr 1999-2004 and 2300 L/yr 2005–2046.
(m) Assumed 6800 L/yr to backfill one current-design trench in one year.
(n) Other year No Action: 1000 L/yr 2000-2006.
(o) Melter trench backfilling could occur over 15 campaigns or all-at-once. All-at-once was assumed for conservatism (that is, highest emission rate of pollutants).

CWC = Central Waste Complex.
ILAW =immobilized low-activity waste.
LLBG = low-level burial ground
LLW = low-level waste.
LMF = Lined Modular Facility.
MLLW = mixed low-level waste.
NWPF = new waste processing facility
Source: FH 2003.

Table E.11. Average Propane Fuel Consumption Rates

Operation/ Alternative (a)	Maximum Propane Use	Operation/ Time of Maximum Use	Note (b)	Fuel Consumption Rate for Indicated Averaging Time (gal/s)		
				Hourly	Daily	Annual
MLLW Leachate Pulse Drier	**Ton/yr**[(c)]					
Alt. Group A – H & L	330	36 d/yr	50 hr/campaign	0.091	0.091	0.0043
Alt. Group A – U	700	71 d/yr	96 hr/campaign	0.19	0.19	0.0091
Alt. Group B – H & L	2650	1 yr	2027; 32 hr/camp per tr	0.067	0.067	0.034
Alt. Group B – U	4505	1 yr	2032; 32 hr/camp per tr	0.13	0.13	0.059
Alt. Group C – H & L	330	36 d/yr	50 hr/campaign	0.091	0.091	0.0043
Alt. Group C – U	700	71 d/yr	96 hr/campaign	0.19	0.19	0.0091
Alt. Group D – H & L	770	78 d/yr	(d)	0.14	0.047	0.010
Alt. Group D – U	1140	113 d/yr	(d)	0.14	0.048	0.015
Alt. Group E – H & L	330	36 d/yr	50 hr/campaign	0.091	0.091	0.0043
Alt. Group E – U	700	71 d/yr	96 hr/campaign	0.19	0.19	0.0091
No Action	530	1 yr	2026-37; 32 hr/camp	0.067	0.067	0.0069
Melter Leachate/Pulse Drier						
Melter	440	42 d/yr	60 hr/campaign	0.13	0.13	0.0057
CWC Vehicles	**Liter/yr**[(e)]					
Alt. Group A – H & L	7600	1 yr	Max year 2002	0.00028	0.000093	0.000064
Alt. Group A – U	7600	1 yr	Max year 2002	0.00028	0.000093	0.000064
Alt. Group B – H & L	7600	1 yr	Max year 2002	0.00028	0.000093	0.000064
Alt. Group B – U	7600	1 yr	Max year 2002	0.00028	0.000093	0.000064
Alt. Group C – H & L	7600	1 yr	Max year 2002	0.00028	0.000093	0.000064
Alt. Group C – U	7600	1 yr	Max year 2002	0.00028	0.000093	0.000064
Alt. Group D – H & L	7600	1 yr	Max year 2002	0.00028	0.000093	0.000064
Alt. Group D – U	7600	1 yr	Max year 2002	0.00028	0.000093	0.000064
Alt. Group E – H & L	7600	1 yr	Max year 2002	0.00028	0.000093	0.000064
Alt. Group E – U	7600	1 yr	Max year 2002	0.00028	0.000093	0.000064
No Action – H & L	32400	1 yr	Max 2014-47	0.0012	0.00040	0.00027

(a) Waste volume considered – Hanford Only (H), Lower Bound (L), and Upper Bound (U) waste volumes.
(b) All campaigns are assumed to be carried out in series over the year, except for Alternative B-U where two campaigns are assumed to occur at a time for hourly and daily fuel-consumption-rate calculations.
(c) Conversion factor for propane = 409.8 gal/ton (Lide 2001).
(d) The sum of propane use for Alternative A and melter.
(e) Conversion factor 1 liter = 0.265 gallons.
Camp per tr = campaign per trench.
CWC = Central Waste Complex.
MLLW = mixed low-level waste.
Source: FH 2003.

All Hanford Solid Waste Program activities would be conducted using dust-suppression techniques; however, no credit is taken for any reduction in PM_{10} emissions as a result of dust-suppression. Dust control during large earthmoving activities would comply with nuisance-dust-emission control requirements. Earthmoving activities would be restricted on days with excessive wind speeds. The use of dust-suppression methods would depend on the soil being excavated, wind speed, and visual observations. Water sprays for dust suppression were found to be very effective in controlling PM_{10} emissions at the Hanford Site (DOE-RL 1996). Monitoring of the effectiveness of water sprays found air-particulate concentrations at the location of earthmoving activity to be under 90 $\mu g/m^3$ (DOE-RL 1996), well within the 24-hr ambient air quality standard for PM_{10} of 150 $\mu g/m^3$. Most values were even lower.

Although not governed by ambient air quality standards, a potential concern for public safety is a short-term, wind-blown dust event at the borrow pit that could limit visibility on SR 240 and cause problems for passing motorists. To guard against this, an aggressive dust-suppression program is planned for this area. This dust-control program would include the following as needed:

- spraying of active work areas with water and a soil adhesive
- rocking of 8 km (5 mi) of project roads and periodic spray with solid adhesive
- covering of materials in truck beds with rollout tarps prior to transport
- other dust-suppression activities would also be considered for implementation when wind speeds are projected to exceed the threshold for significant dust generation.

The estimation of the annual and 24-hr average PM_{10} emission values from earthmoving operations requires an estimate of the area being disturbed by earthmoving equipment. Estimates of the amount of area that would be disturbed by earthmoving activities are presented in Table E.12. The actual area that is actively being disturbed at any given time is estimated on a case-by-case basis. In general, for work sites where operation/construction times exceed a year, 2 percent of the annual disturbed area is assumed to be active at any one time. Work sites where the soil is actively disturbed for shorter periods of time have a correspondingly larger percentage of their total area being disturbed at any given time. For example, consider the 2.2 ha (5.4 ac) that would be disturbed over a period of 40 days for LLW construction activities under Alternative Group A. It was assumed that 2200 m^2 (2630 yd^2), about 10 percent of the total disturbed area, would be actively disturbed at any given moment during this construction activity. Estimates of fugitive dust from material stockpiles are conservatively determined by assuming that the entire stockpile, or an appropriate portion of the stockpile based on its size, is an active construction site.

E.3 Calculating Maximum Air Quality Impacts

The maximum air quality impacts associated with each major project activity were calculated by putting together previous information, including unit dispersion factors (from ISCST3 model runs), fuel-consumption rates, size of disturbed areas, and emission factors. Table E.13 provides the maximum air quality impacts to the public for activities conducted in the 200 Areas under the assumptions noted for each activity in Tables E.10 and E.11. Construction and capping operations at the trenches (LLW, MLLW, and ILAW) and the transportation of capping materials would be substantial sources of pollutants and major contributors to maximum air quality impacts. Table E.14 indicates the maximum air quality impacts to the public from activities in the 200 Area. Table E.15 presents comparable information for Area C activities. Looking at the individual pollutants:

- LLW and ILAW capping would be the largest contributors to PM_{10} air quality impacts. The transportation of capping materials to the trenches and LMF, LLW, and ILAW construction would also represent substantial sources of PM_{10}.

- LMF construction and ILAW capping would generate the largest air quality impacts for SO_2 and CO. LLW and MLLW construction and capping activities (particularly under Alternative Group B) would also represent substantial sources of SO_2 and CO.

- ILAW capping activities (particularly under the No Action Alternative) and LMF construction would produce the largest air quality impact for NO_2.

Table E.12. The Size of Disturbed Areas and Associated Durations for Various Activities/Alternatives

Activity[(a)]	Cumulative Disturbed Area (Hectares)	Duration of Operation/ Construction (Time)	Percentage of Total Area Actively Disturbed	Amount of Area Being Disturbed at Any Given Time (m^2)
LLW Construction				
Alt. Group A – H & L	2.2	40 d	10	2200
Alt. Group A – U	2.2	40 d	10	2200
Alt. Group B – H & L	3 x 0.55	40 d	10	1650
Alt. Group B – U	5 x 0.55	40 d	10	2750
Alt. Group C – H & L	2.2	40 d	10	2200
Alt. Group C – U	2.2	40 d	10	2200
No Action	3 x 0.55	40 d	10	1650
MLLW Construction				
Alt. Group A – H & L	1.50	1 yr	2.0	300
Alt. Group A – U	3.00	1 yr	2.0	600
Alt. Group B – H & L	2 x 0.60	28 wk	3.6	430
Alt. Group B – U	3 x 0.60	28 wk	3.6	640
Alt. Group C – H & L	1.50	1 yr	2.0	300
Alt. Group C – U	3.00	1 yr	2.0	600
No Action	0.60	28 wk	3.3	200
LMF Construction[(b)]				
Alt. Group D – H & L	3.7	2 yr	6.3	2350
Alt. Group D – U	5.2	2 yr	4.8	2500
Alt. Group E – H & L	3.7	2 yr	6.3	2350
Alt. Group E – U	5.2	2 yr	4.8	2500
Melter Construction				
Melter trench	6.0 [(c)]	40 wk	2.5	1500
ILAW Construction				
Alt. Group A – ILAW Trench	26.0	15 yr	1.0	2600
Alt. Group B – ILAW Trench	26.0	15 yr	1.0	2600
Alt. Group C – ILAW Trench	8.0	15 yr	1.0	800
Alt. Group D – ILAW Trench	8.0	15 yr	1.0	800
Alt. Group E – ILAW Trench	8.0	15 yr	1.0	800
No Action – ILAW Vaults	10.0	15 yr	1.0	1000
CWC Construction				
No Action – per building	1.00	1 yr	5.	500
No Action – pad construction	0.100	50 d	20.	200
LLBG Capping				
All Action Alternatives	93.50	4 yr	0.50	4700

Table E.12. (contd)

Activity[a]	Cumulative Disturbed Area (Hectares)	Duration of Operation/ Construction (Time)	Percentage of Total Area Actively Disturbed	Amount of Area Being Disturbed at Any Given Time (m^2)
MLLW Capping				
Alt. Group A – H & L	1.50	8 wk	10	1500
Alt. Group A – U	3.00	15 wk	5	1500
Alt. Group B – H & L	2 x 0.60	3 wk	10	1200
Alt. Group B – U	2 x 0.60	3 wk	10	1200
Alt. Group C – H & L	1.50	8 wk	10	1500
Alt. Group C – U	3.00	15 wk	5	1500
Alt. Group D – H & L	1.50	8 wk	10	1500
Alt. Group D – U	3.00	15 wk	5	1500
Alt. Group E – H & L	1.50	8 wk	10	1500
Alt. Group E – U	3.00	15 wk	5	1500
No Action	0.60	3 wk	10	600
Melter and ILAW Capping				
Melter	6.0	20 wk	3	1800
Alt. Group A – ILAW Trench	26.0	15 yr	1.0	2600
Alt. Group B – ILAW Trench	26.0	15 yr	1.0	2600
Alt. Group C – ILAW Trench	8.0	15 yr	1.0	800
Alt. Group D – ILAW Trench	8.0	15 yr	1.0	800
Alt. Group E – ILAW Trench	8.0	15 yr	1.0	800
No Action – ILAW Vaults	10.0	15 yr	1.0	1000
LLW Backfilling				
Alt. Group A – H & L	0.18	1 yr	2.0	40
Alt. Group A – U	0.71	1 yr	2.0	140
Alt. Group B – H & L	1.50	1 yr	2.0	300
Alt. Group B – U	2.50	1 yr	2.0	500
Alt. Group C – H & L	0.18	1 yr	2.0	40
Alt. Group C – U	0.71	1 yr	2.0	140
Alt. Group D – H & L	0.18	1 yr	2.0	40
Alt. Group D – U	0.71	1 yr	2.0	140
Alt. Group E – H & L	0.18	1 yr	2.0	40
Alt. Group E – U	0.71	1 yr	2.0	140
No Action	1.50	1 yr	2.0	300
MLLW Backfilling[d]				
Alt. Group A – H & L	0.15 max	1 yr	2.0	30
Alt. Group A – U	0.30 max	1 yr	2.0	60
Alt. Group B – H & L	0.60 max	1 yr	2.0	120
Alt. Group B – U	1.20 max	1 yr	2.0	240
Alt. Group C – H & L	0.15 max	1 yr	2.0	30
Alt. Group C – U	0.30 max	1 yr	2.0	60
Alt. Group D – H & L	0.15 max	1 yr	2.0	30
Alt. Group D – U	0.30 max	1 yr	2.0	60
Alt. Group E – H & L	0.15 max	1 yr	2.0	30
Alt. Group E – U	0.30 max	1 yr	2.0	60
No Action	0.15 max	1 yr	2.0	30
Melter	3.50[c]	6 wk	10	3500

Table E.12. (contd)

Activity[(a)]	Cumulative Disturbed Area (Hectares)	Duration of Operation/ Construction (Time)	Percentage of Total Area Actively Disturbed	Amount of Area Being Disturbed at Any Given Time (m^2)
Treatment Facility				
T Plant Modification (Alt A,C,D,E)	3.50	4 yr	1.0	350
NWPF Construction (Alt B)	3.50	4 yr	1.0	350
Borrow Activity				
Borrow operations	81.0	12 yr	0.20	1600

(a) Waste volume considered – Hanford Only (H), Lower Bound (L) and Upper Bound (U) waste volumes.
(b) Without ILAW or melter construction portions.
(c) Includes road construction.
(d) Waste area only; all-at-once backfilling considered to maximize emission rate of particulates.
Source: FH 2003.
NWPF = new waste processing facility

Table E.13. Maximum Air Quality Impacts to the Public from Major Activities with a Source Location in the 200 West or 200 East Areas

Activity[a]	Maximum Air Quality Impacts ($\mu g/m^3$) for the Indicated Averaging Periods[b]								
	PM_{10}[c]		SO_2				CO		NO_2
	24 hr	**Annual**	**1 hr**	**3 hr**	**24 hr**	**Annual**	**1 hr**	**8 hr**	**Annual**
LLW Construction									
Alt. Group A – H&L	12	0.013	12	5.8	0.42	4.3E-4	230	73	0.020
Alt. Group A – U	12	0.013	12	5.8	0.42	4.3E-4	230	73	0.020
Alt. Group B – H&L	11	0.011	18	8.5	0.62	6.4E-4	340	110	0.030
Alt. Group B – U	18	0.018	31	15	1.0	1.1E-3	580	180	0.051
Alt. Group C – H&L	12	0.013	12	5.8	0.42	4.3E-4	230	73	0.020
Alt. Group C – U	12	0.013	12	5.8	0.42	4.3E-4	230	73	0.020
No Action	11	0.011	18	8.5	0.62	6.4E-4	340	110	0.030
MLLW Construction									
Alt. Group A – H&L	2.0	0.017	3.7	1.7	0.12	7.7E-4	67	21	0.037
Alt. Group A – U	3.9	0.034	7.3	3.4	0.25	1.6E-3	130	43	0.076
Alt. Group B – H&L	6.8	0.015	33	15	1.1	1.2E-3	600	190	0.056
Alt. Group B – U	10	0.023	50	23	1.7	1.7E-3	910	290	0.082
Alt. Group C – H&L	1.1	0.010	1.9	0.76	0.071	4.6E-4	35	9.2	0.022
Alt. Group C – U	2.3	0.020	3.9	1.5	0.14	9.5E-4	71	18	0.045
No Action	3.3	0.0074	17	7.9	0.55	5.9E-4	310	99	0.028
LMF Construction									
Alt. Group D – H&L	11	0.070	**71**[b]	**33**[b]	**2.4**[b]	**0.015**[b]	**1300**[b]	**410**[b]	0.70
Alt. Group D – U	11	0.070	**71**[b]	**33**[b]	**2.4**[b]	**0.015**[b]	**1300**[b]	**410**[b]	0.70
Alt. Group E – H&L	1.8	0.014	7.6	3.5	0.25	1.6E-3	140	44	0.076
Alt. Group E – U	3.6	0.028	16	7.3	0.51	3.3E-3	290	92	0.16
Melter & ILAW Construction									
Melter Trench	5.6	0.035	21	8.4	0.32	1.0E-3	390	100	0.049
ILAW Alt. Groups A, B	21	0.17	64	30	2.1	0.014	1200	370	0.64
ILAW portions only Alt. Groups C, D, E	13	0.094	64	30	2.1	0.014	1200	370	0.64
ILAW No Action	3.7	0.032	5.6	2.2	0.21	1.3E-3	100	27	0.062
CWC Construction									
No Action – per bldg	2.6	0.024	1.6	0.73	0.054	3.3E-4	29	9.2	0.016
No Action – melter Pad	1.3	0.0016	2.2	1.0	0.075	9.6E-5	41	13	4.6E-3

NA = "Not Applicable" – There are no SO_2 emissions from the propane used for this activity.
(a) Waste volume considered – Hanford Only (H), Lower Bound (L) and Upper Bound (U) waste volumes.
(b) The maximum air quality impact is indicated with **bold text** for each averaging period.
(c) Includes both fugitive dust and diesel combustion particulates.
(d) See Low Level Burial Ground (LLBG) capping. Lined modular facility (LMF) capping occurs at same rate as the LLBG capping during the maximum year.

Table E.13. (contd)

Activity[a]	Maximum Air Quality Impacts ($\mu g/m^3$) for the Indicated Averaging Periods[b]								
	PM_{10}[c]		SO_2				CO		NO_2
	24 hr	Annual	1 hr	3 hr	24 hr	Annual	1 hr	8 hr	Annual
Transporting Capping Materials									
All Alternatives	24	**0.23**[b]	4.2	1.9	0.42	3.9E-3	130	42	0.081
LLBG Capping									
All Action Alts	**25**[b]	**0.23**[b]	17	7.9	0.55	3.6E-3	310	99	0.17
MLLW Capping									
Alt. Group A – H&L	9.6	0.013	17	7.9	0.55	5.7E-4	310	99	0.027
Alt. Group A – U	9.6	0.024	17	7.9	0.55	1.1E-3	310	99	0.051
Alt. Group B – H&L	10	4.9E-3	33	15	1.1	4.3E-4	600	190	0.020
Alt. Group B – U	10	4.9E-3	33	15	1.1	4.3E-4	600	190	0.020
Alt. Group C – H&L	5.6	7.6E-3	9.0	3.5	0.32	3.4E-4	160	43	0.016
Alt. Group C – U	5.6	0.014	9.0	3.5	0.32	6.3E-4	160	43	0.030
No Action	3.0	1.5E-3	9.0	3.5	0.32	1.2E-4	160	43	5.9E-3
Melter & ILAW Capping									
Melter Trench	6.4	0.022	9.0	3.5	0.32	8.8E-4	160	43	0.042
ILAW Alt. Groups A, B	19	0.16	46	21	1.6	9.8E-3	840	270	0.47
ILAW Alt. Groups C, D, E	11	0.078	46	21	1.6	9.8E-3	840	270	0.47
ILAW No Action	13	0.092	63	25	**2.4**[b]	**0.015**[b]	1200	300	**0.73**[b]
LLW Backfilling									
Alt. Group A – H&L	0.49	1.8E-3	2.1	0.97	0.070	3.2E-6	38	12	1.5E-4
Alt. Group A – U	1.3	6.4E-3	4.2	1.9	0.14	1.2E-5	77	24	5.9E-4
Alt. Group B – H&L	2.3	0.014	6.3	2.9	0.21	2.6E-5	120	37	1.2E-3
Alt. Group B – U	3.9	0.023	10	4.8	0.34	4.4E-5	190	60	2.1E-3
Alt. Group C – H&L	0.49	1.8E-3	2.1	0.97	0.070	3.2E-6	38	12	1.5E-4
Alt. Group C – U	1.3	6.4E-3	4.2	1.9	0.14	1.2E-5	77	24	5.9E-4
Alt. Group D – H&L	1.4	3.0E-3	6.3	2.9	0.28	2.7E-4	120	37	0.013
Alt. Group D – U	2.2	7.6E-3	8.4	3.9	0.35	3.0E-4	150	49	0.014
Alt. Group E – H&L	0.49	1.8E-3	2.1	0.97	0.071	9.8E-6	38	12	4.7E-4
Alt. Group E – U	1.3	6.4E-3	4.2	1.9	0.16	2.6E-5	77	24	1.2E-3
No Action	1.4	8.1E-3	3.3	1.3	0.12	1.5E-5	120	16	7.3E-4

NA = "Not Applicable" – There are no SO_2 emissions from the propane used for this activity.

(a) Waste volume considered – Hanford Only (H), Lower Bound (L) and Upper Bound (U) waste volumes.

(b) The maximum air quality impact is indicated with **bold text** for each averaging period.

(c) Includes both fugitive dust and diesel combustion particulates.

(d) See Low Level Burial Ground (LLBG) capping. Lined modular facility (LMF) capping occurs at same rate as the LLBG capping during the maximum year.

Table E.13. (contd)

Activity[a]	Maximum Air Quality Impacts ($\mu g/m^3$) for the Indicated Averaging Periods[b]								
	PM_{10}[c]		SO_2				CO		NO_2
	24 hr	Annual	1 hr	3 hr	24 hr	Annual	1 hr	8 hr	Annual
MLLW Backfilling									
Alt. Group A – H&L	0.15	1.4E-3	0.031	0.015	1.0E-3	6.6E-6	0.58	0.18	3.2E-4
Alt. Group A – U	0.30	2.8E-3	0.062	0.029	2.1E-3	1.4E-5	1.1	0.36	6.4E-4
Alt. Group B – H&L	0.59	5.5E-3	0.12	0.057	4.1E-3	2.7E-5	2.3	0.72	1.3E-3
Alt. Group B – U	1.2	0.011	0.25	0.12	8.3E-3	5.3E-5	4.6	1.5	2.5E-3
Alt. Group C – H&L	0.086	8.2E-4	0.017	6.5E-3	6.0E-4	3.9E-6	0.3	0.079	1.9E-4
Treatment Plant									
T Plant mod	2.5	0.021	5.5	2.5	0.18	1.2E-3	100	32	0.056
NWPF Const	3.6	0.028	13	6.1	0.45	2.8E-3	240	77	0.13
MLLW Leachate									
Alt. Group A – H&L	0.40	1.8E-4	NA	NA	NA	NA	21	6.7	0.12
Alt. Group A – U	0.83	3.7E-4	NA	NA	NA	NA	44	14	0.25
Alt. Group B – H&L	0.29	1.4E-3	NA	NA	NA	NA	16	5.0	0.087
Alt. Group B – U	0.57	2.4E-3	NA	NA	NA	NA	30	9.6	0.17
Alt. Group C – H&L	0.23	1.0E-4	NA	NA	NA	NA	11	2.9	0.070
Alt. Group C – U	0.48	2.2E-4	NA	NA	NA	NA	23	6.1	0.15
Alt. Group D – H&L	0.20	4.1E-4	NA	NA	NA	NA	32	10	0.18
Alt. Group D – U	0.21	6.1E-4	NA	NA	NA	NA	32	10	0.18
Alt. Group E – H&L	0.40	1.8E-4	NA	NA	NA	NA	21	6.7	0.12
Alt. Group E – U	0.83	3.7E-4	NA	NA	NA	NA	44	14	0.25
No Action	0.29	2.8E-4	NA	NA	NA	NA	16	5.0	0.087
Melter Trench	0.33	1.4E-4	NA	NA	NA	NA	16	4.1	0.10
CWC Vehicles									
Alt. Group A-E	4.0E-4	2.6E-6	NA	NA	NA	NA	0.065	0.021	3.6E-4
No Action	1.7E-3	1.1E-5	NA	NA	NA	NA	0.28	0.089	1.6E-3

NA = "Not Applicable" – There are no SO_2 emissions from the propane used for this activity.
(a) Waste volume considered – Hanford Only (H), Lower Bound (L) and Upper Bound (U) waste volumes.
(b) The maximum air quality impact is indicated with **bold text** for each averaging period.
(c) Includes both fugitive dust and diesel combustion particulates.
(d) See Low Level Burial Ground (LLBG) capping. Lined modular facility (LMF) capping occurs at same rate as the LLBG capping during the maximum year.

Table E.14. Maximum Impacts from Any Single Activity Conducted in the 200 Areas

	PM_{10}		SO_2				CO		NO_2
	24 hr	**Annual**	**1 hr**	**3 hr**	**24 hr**	**Annual**	**1 hr**	**8 hr**	**Annual**
Ambient Air Quality Standard ($\mu g/m^3$)	150	50	1,000	1,300	260	50	40,000	10,000	100
Maximum Impact – single activity ($\mu g/m^3$)	25	0.23	71	33	2.4	0.015	1300	410	0.73
Maximum Impact – single activity (Percent of Standard)	17	0.46	7.1	2.5	0.92	0.030	3.2	4.1	0.73
Activity creating maximum impact[(a)]	a	a, d	b	b	b, c	b, c	b	b	c

Note: All alternatives are considered in selecting the activities with the maximum air quality impacts.
(a) Activities creating maximum impacts:
a. LLBG capping
b. LMF trench construction
c. ILAW vault capping
d. Transportation of capping materials

The maximum air quality impacts from all project emissions in the 200 Areas were obtained by combining the data in Table E.13 with the project-activity scheduling data presented in Tables E.3 through E.8. These estimates are presented in Table 5.4 and Tables 5.6 through 5.10 in Section 5.2.

Operations at the borrow pit and the emissions from the transportation of capping materials are the two largest sources of pollutants in the vicinity of Area C. Both activities would generally occur simultaneously. The maximum air quality impacts from emissions in Area C were obtained by combining the data in Table E.15 with the project-activity scheduling data presented in Tables E.3 through E.8. These estimates are presented in Table 5.5 in Section 5.2.

Table E.15. Maximum Air Quality Impacts to the Public from Activities with an Area C Source Location

	Maximum Air Quality Impacts ($\mu g/m^3$) for the Indicated Averaging Periods								
	PM_{10}		SO_2				CO		NO_2
Activity[(a)]	**24 hr**	**Annual**	**1 hr**	**3 hr**	**24 hr**	**Annual**	**1 hr**	**8 hr**	**Annual**
Utility Extensions									
All Alternatives	0.56	2.8E-4	130	96	0.13	6.5E-05	2300	1300	3.1E-03
Operations									
All Alternatives	5.6	0.049	**180**[(b)]	**140**[(b)]	0.18	1.1E-03	**3300**[(b)]	**1900**[(b)]	**0.054**[(b)]
Propane Emissions									
All Alternatives	0.056	3.8E-04	-	-	-	-	320	180	0.052
Transportation of Capping Materials									
All Alternatives	**15**[(b)]	**0.14**[(b)]	85	65	**0.26**[(b)]	**2.4E-03**[(b)]	2700	1600	0.050

(a) Waste volume considered – Hanford Only (H), Lower Bound (L) and Upper Bound (U) waste volumes.
(b) The maximum air quality impact is indicated with **bold text** for each averaging period.

E.4 Clean Air Act General Conformity Review

DOE guidance suggests a method to formally report how EIS actions relate to the Clean Air Act (CAA) (42 USC 7401), which implements General Conformity Requirements (DOE 2000). The CAA General Conformity Requirements method is, in general, another means to validate the acceptability of the release estimates resulting from an action. The guidance requires that a conformity review be conducted to determine if detailed analyses and reporting would be required for EIS actions to be conducted. It is intended to ensure that actions would not further impair or sustain current excesses of criteria pollutant levels. This review would allow faster implementation of the action once a record of decision or finding of no significant impact is issued. It is important to note that the emissions reported in a conformity review may be narrower than sources considered in an EIS air quality assessment (DOE 2000).

The conformity review process consists of answering four questions (see Table E.16). The DOE (2000) recommends that a conformity review be conducted for each EIS alternative. Normally, a conformity review is not needed for the No Action Alternative (DOE 2000). The results of the conformity review are presented in Table E.16. As a result of the conformity-review process, it has been determined that a Conformity Determination need not be conducted.

Table E.16. Clean Air Act Conformity Review for the Alternatives

Question	All Alternative Groups
1. Are criteria pollutants emitted?	Yes
2. Would criteria pollutant emissions occur in a non-attainment or maintenance area?	No, the Hanford Site is an attainment area.[a]
3. Is the action(s) exempt from the Clean Air Act Conformity Requirements?	No; therefore, the actions are not exempt outright from air quality requirements.
4. What are the estimated emissions and how do they compare to the non-attainment (or maintenance) area threshold emission rates and emission inventory?	The Hanford Site is in an attainment area. Also, the estimated maximum releases do not exceed Clean Air Act Criteria Pollutant standards.

(a) Ecology (2001).

E.5 References

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Appendix F

Methods for Evaluating Impacts on Health from Radionuclides and Chemicals

This appendix describes details of the methodology used to evaluate health impacts for the alternatives considered in the Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement (HSW EIS). Unless otherwise specified, the data used for the analysis are provided in the Technical Information Document prepared by Fluor Hanford (FH 2003), the Solid Waste Information Tracking System (SWITS) database (Anderson and Hagel 1996; Hagel 1999; FH 2003), or the Solid Waste Integrated Forecast Technical (SWIFT) Report (Barcot 1999, 2002).

F.1 Normal Operation Impact Assessment Methods

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

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

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

F.1.1 Pollutant Releases to the Atmosphere

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

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

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

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

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

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

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

Table F.1. Summary of Waste Stream Concentration Tables

Stream No.[a]	Waste Stream Description[b]	Table Number
1	LLW Cat 1	F.2
2	LLW Cat 3	F.3
1 and 2	LLW from Offsite	F.4
2c2	LLW Cat 3 for T Plant Processing from Offsite	F.5
4	TRU-RH Waste in Trenches	F.6
4	TRU-CH Waste in Trenches	F.7
5	TRU-CH Waste in Caissons	F.8
8	TRU Waste Containing PCBs	F.9
9	TRU-RH and -CH Drums and SWBs	F.10
10	TRU-CH Boxes	F.10
10	RH-TRU Waste Boxes	F.11
11	MLLW-Treated Ready for Disposal	F.12
12	MLLW-RH and Large Boxes	F.13
13	MLLW-CH	F.14
14	Elemental Lead	F.15
15	Elemental Mercury	F.16
17	K Basin Sludge	F.17
18	Leachate from MLLW Trenches	F.18

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

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

1. Radioactive materials in sealed packages that remain unopened and have not leaked during the assessment period were not included in the calculation.

2. The release fraction for gaseous material is 1.

3. The release fraction for liquids and particulate solids is 0.001.

4. The release fraction for solids is 1E-06.

5. Credit can be taken for particulate filtration installed between the place of use and the point of release (except for gaseous radionuclides).

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

Constituent	Concentration, Ci/m^3
Americium-241	6.41E-06
Cobalt-60	1.07E-03
Cesium-137	1.01E-04
Iron-55	2.46E-03
Manganese-54	3.29E-03
Nickel-63	8.62E-04
Plutonium-238	2.16E-06
Plutonium-239	3.11E-05
Plutonium-240	7.87E-06
Plutonium-241	2.11E-04
Strontium-90	1.20E-04
Tritium	4.49E+00

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

Constituent	Concentration, Ci/m^3
Americium-241	7.94E-03
Curium-244	1.00E-03
Cesium-137	9.77E+00
Plutonium-238	1.97E-03
Plutonium-239	9.44E-03
Plutonium-240	3.73E-03
Plutonium-241	2.23E-01
Strontium-90	1.24E+01
Tritium	1.62E-03
Uranium-234	1.89E-02
Uranium-235	5.40E-04
Uranium-236	2.44E-03
Uranium-238	3.04E-02

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

Radionuclide	Source Site[(a)] and Waste Stream Concentrations, Ci/m^3											
	BNL	**GE VAL**	**GJPO**	**INEEL**	**ITRI**	**LLNL**	**ORR**	**PNTX**	**RFETS**	**SNL**	**SPRU**	**WV**
Tritium	9.66E-05			6.66E+01	1.73E-02	6.97E-03	8.60E+0	5.81E-04	2.47E-05	1.14E+0	1.45E-04	4.80E-01
Carbon-14				2.31E-03	2.92E-03	1.73E-06	4.30E-05			4.07E-04	1.32E-11	4.07E-04
Cobalt-60	1.41E-06	6.18^{E}-04		8.17E+01			3.21E-02			9.50E-01	7.04E-05	9.50E-01
Nickel-59				4.39E-01			1.41E-07			4.70E-03	8.72E-08	4.70E-03
Nickel-63				1.56E+01			5.76E-01			2.12E-01	3.81E-06	2.12E-01
Strontium-90	3.39E-04	3.14^{E}-03		1.14E-02			2.29E-03		4.74E-11	2.53E-01	4.23E-04	2.53E-01
Technetium-99				1.40E-05			2.56E-07			4.19E-05	9.57E-10	4.19E-05
Cesium-137	5.52E-04	2.18^{E}-03	5.52E-14	2.20E-01			2.17E-01		1.70E-08	1.68E-01	6.80E-04	1.68E-01
Uranium-234	7.52E-08			3.08E-06			1.59E-04	7.36E-06	3.15E-07	1.41E-04	3.61E-06	1.41E-04
Uranium-235	2.66E-08			4.36E-05			7.21E-04	1.26E-06	9.47E-11	7.14E-06	1.67E-07	7.14E-06
Uranium-238	5.76E-08			1.88E-03	5.84E-04	4.96E-04	7.85E-05	7.89E-05	2.68E-07	3.27E-04	1.17E-05	3.27E-04

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

Table F.5. Stream 2c2 – Low-Level Waste Category 3 Offsite Sources for T Plant Processing

Radionuclide	Source Site[(a)] and Waste Stream Concentrations, Ci/m^3											
	BNL	**GE VAL**	**GJPO**	**INEEL**	**ITRI**	**LLNL**	**ORR**	**PNTX**	**RFETS**	**SNL**	**SPRU**	**WV**
Tritium	3.06E-05			2.11E+01	5.48E-03	2.20E-03	2.73E+0	1.84E-04	7.82E-06	3.60E-01	4.57E-05	1.52E-01
Carbon-14				7.32E-04	9.24E-04	5.46E-07	1.36E-05			1.29E-04	4.19E-12	1.29E-04
Cobalt-60	4.47E-07	1.95E-04		2.59E+01			1.01E-02			3.01E-01	2.23E-05	3.01E-01
Nickel-59				1.39E-01			4.47E-08			1.49E-03	2.76E-08	1.49E-03
Nickel-63				4.93E+0			1.82E-01			6.70E-02	1.21E-06	6.70E-02
Strontium-90	1.07E-04	9.93E-04		3.61E-03			7.26E-04		1.50E-11	7.99E-02	1.34E-04	7.99E-02
Technetium-99				4.43E-06			8.10E-08			1.33E-05	3.03E-10	1.33E-05
Cesium-137	1.75E-04	6.89E-04	5.52E-14	6.96E-02			6.85E-02		5.38E-09	5.33E-02	2.15E-04	5.33E-02
Uranium-234	2.38E-08			9.73E-07			5.04E-05	2.32E-06	9.97E-08	4.44E-05	1.14E-06	4.44E-05
Uranium-235	8.41E-09			1.38E-05			2.28E-06	3.98E-07	3.00E-11	2.26E-06	5.29E-08	2.26E-06
Uranium-238	1.82E-08			5.95E-04	1.85E-04	1.57E-04	2.48E-05	2.50E-05	8.47E-08	1.03E-04	3.69E-06	1.03E-04

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

Table F.6. Stream 4 – TRU-RH Waste in Trenches

Constituent	Concentration	Units
Americium-241	6.35E+01	Ci/m^3
Plutonium-238	1.40E+01	Ci/m^3
Plutonium-239	5.51E+01	Ci/m^3
Plutonium-240	3.11E+01	Ci/m^3
Plutonium-241	1.20E+03	Ci/m^3
Beryllium	5.00E-01	kg/m^3
Sodium hydroxide	5.00E-01	kg/m^3
Xylene	4.80E+00	kg/m^3

Table F.7. Stream 4 – TRU-CH Waste in Trenches

Constituent	Concentration, Ci/m^3
Americium-241	2.63E-01
Plutonium-238	1.01E+00
Plutonium-239	5.67E-01
Plutonium-240	2.17E+01

Table F.8. Stream 5 – TRU-CH Waste in Caissons

Constituent	Concentration, Ci/m^3
Americium-241	5.55E+00
Cesium-137	5.06E+01
Cobalt-60	9.11E+00
Plutonium-238	8.98E-01
Plutonium-239	1.30E+01
Plutonium-240	3.26E+00
Plutonium-241	2.69E+01
Plutonium-242	1.26E-03
Strontium-90	4.67E+01
Uranium-233	1.04E-02
Uranium-234	1.30E-03
Uranium-235	3.91E-05
Uranium-238	9.57E-04

Table F.9. Stream 8 – TRU Waste Containing PCBs

Constituent	Concentration	Units
Americium-241	3.17E+00	Ci/m^3
Plutonium-238	7.21E-01	Ci/m^3
Plutonium-239	2.74E+00	Ci/m^3
Plutonium-240	1.54E+00	Ci/m^3
Plutonium-241	5.77E+01	Ci/m^3
Beryllium	5.00E-01	kg/m^3
Polychlorinated biphenyls (PCBs)	1.78E+00	kg/m^3
Sodium hydroxide	5.00E-01	kg/m^3
Xylene	4.80E+00	kg/m^3

Table F.10. Stream 9 – TRU-RH and -CH Drums and SWBs and Stream 10 – TRU-CH Boxes

Constituent	Concentration	Units
Americium-241	3.17E+00	Ci/m^3
Plutonium-238	7.21E-01	Ci/m^3
Plutonium-239	2.74E+00	Ci/m^3
Plutonium-240	1.54E+00	Ci/m^3
Plutonium-241	5.77E+01	Ci/m^3
Acetone	7.72E-04	kg/m^3
Beryllium	5.00E-01	kg/m^3
Carbon tetrachloride	1.33E-01	kg/m^3
Dichloromethane	5.72E-03	kg/m^3
Hydraulic fluid	2.31E-01	kg/m^3
Mercury	4.81E-03	kg/m^3
Sodium hydroxide	5.00E-01	kg/m^3
1,1,1-Trichloroethane	7.86E-04	kg/m^3
Xylene	4.05E-03	kg/m^3

Table F.11. Stream 10 – RH-TRU Waste Boxes

Constituent	Concentration	Units
Cesium-137	7.36E+00	Ci/m^3
Cobalt-60	3.13E-01	Ci/m^3
Iron-55	2.79E+00	Ci/m^3
Strontium-90	2.48E+00	Ci/m^3
Tritium	3.93E-03	Ci/m^3
Acetone	7.72E-04	kg/m^3
Beryllium	5.00E-01	kg/m^3
Carbon tetrachloride	1.33E-01	kg/m^3
Dichloromethane	5.72E-03	kg/m^3
Hydraulic fluid	2.31E-01	kg/m^3
Mercury	4.81E-03	kg/m^3
Sodium hydroxide	5.00E-01	kg/m^3
1,1,1-Trichloroethane	7.86E-04	kg/m^3
Xylene	4.05E-03	kg/m^3

Table F.12. Stream 11 – MLLW-Treated Ready for Disposal

Constituent	Concentration	Units
Americium-241	3.14E-05	Ci/m^3
Cesium-137	3.51E-03	Ci/m^3
Cobalt-60	6.33E-01	Ci/m^3
Curium-244	5.59E-04	Ci/m^3
Iron-55	1.14E-01	Ci/m^3
Neptunium-237	2.41E-06	Ci/m^3
Nickel-63	1.17E+0	Ci/m^3
Plutonium-238	2.91E-04	Ci/m^3
Plutonium-239	1.23E-04	Ci/m^3
Plutonium-240	2.14E-05	Ci/m^3
Plutonium-241	7.44E-04	Ci/m^3
Radium-224	1.68E-02	Ci/m^3
Strontium-90	1.05E-02	Ci/m^3
Tritium	3.93E-03	Ci/m^3

Table F.12. (contd)

Constituent	Concentration	Units
Thorium-228	4.84E-05	Ci/m^3
Thorium-232	1.45E-06	Ci/m^3
Thorium-234	2.45E-02	Ci/m^3
Uranium-234	2.88E-04	Ci/m^3
Uranium-235	4.58E-06	Ci/m^3
Uranium-236	5.38E-06	Ci/m^3
Uranium-238	7.15E-05	Ci/m^3
Acetone	2.05E-01	kg/m^3
Beryllium	5.30E+00	kg/m^3
Bromodichloromethane	1.15E-03	kg/m^3
Carbon tetrachloride	4.18E-01	kg/m^3
Hydraulic fluid	3.63E-01	kg/m^3
Toluene	3.45E-01	kg/m^3
Formic acid	9.42E-01	kg/m^3
Dichloromethane	2.07E-01	kg/m^3
Diesel fuel	1.59E-01	kg/m^3
Methyl ethyl ketone (MEK)	1.60E-01	kg/m^3
Mercury	4.93E-02	kg/m^3
Nitric acid	6.70E+00	kg/m^3
Polychlorinated biphenyls (PCBs)	5.75E-01	kg/m^3
p-Chloroaniline	5.55E-01	kg/m^3
Sodium hydroxide	9.60E+00	kg/m^3
1,1,1-Trichloroethane	7.41 E-01	kg/m^3
Xylene	6.21E-02	kg/m^3

Table F.13. Stream 12 – MLLW-RH, and Large Boxes

Constituent	Concentration	Units
Cesium-137	7.36E+00	Ci/m^3
Cobalt-60	3.13E-01	Ci/m^3
Iron-55	2.79E+00	Ci/m^3
Strontium-90	2.48E+00	Ci/m^3
Tritium	3.93E-03	Ci/m^3
Acetone	2.00E-01	kg/m^3
Beryllium	5.30E+00	kg/m^3
Nitric acid	6.70E+00	kg/m^3
Sodium hydroxide	9.60E+00	kg/m^3
Toluene	1.06E+01	kg/m^3
Xylene	1.00E+00	kg/m^3

Table F.14. Stream 13 –MLLW-CH

Constituent	Concentration	Units
Americium-241	3.14E-05	Ci/m^3
Cesium-137	3.51E-03	Ci/m^3
Cobalt-60	6.33E-01	Ci/m^3
Curium-244	5.59E-04	Ci/m^3
Iron-55	1.14E-01	Ci/m^3
Nickel-63	1.17E+00	Ci/m^3
Neptunium-237	2.41E-06	Ci/m^3
Plutonium-238	2.91E-04	Ci/m^3
Plutonium-239	1.23E-04	Ci/m^3
Plutonium-240	2.14E-05	Ci/m^3
Plutonium-241	7.44E-04	Ci/m^3
Radium-224	1.68E-02	Ci/m^3
Strontium-90	1.05E-02	Ci/m^3
Thorium-228	4.84E-05	Ci/m^3
Thorium-232	1.45E-06	Ci/m^3
Thorium-234	2.45E-02	Ci/m^3

Table F.14. (contd)

Constituent	Concentration	Units
Tritium	3.93E-03	Ci/m^3
Uranium-234	2.88E-04	Ci/m^3
Uranium-235	4.58E-06	Ci/m^3
Uranium-236	5.38E-06	Ci/m^3
Uranium-238	7.15E-05	Ci/m^3
Acetone	2.05E-01	kg/m^3
Beryllium	5.30E+00	kg/m^3
Bromodichloromethane	1.15E-03	kg/m^3
Carbon tetrachloride	4.18E-01	kg/m^3
Dichloromethane	2.07E-01	kg/m^3
Diesel fuel	1.59E-01	kg/m^3
Formic acid	9.42E-01	kg/m^3
Hydraulic fluid	3.63E-01	kg/m^3
Methyl ethyl ketone (MEK)	1.60E-01	kg/m^3
Mercury	4.93E-02	kg/m^3
Nitrate	2.31E-01	kg/m^3
Nitric acid	6.70E+0	kg/m^3
Polychlorinated biphenyls (PCBs)	5.75E-01	kg/m^3
p-Chloroaniline	5.55E-01	kg/m^3
Sodium hydroxide	9.60E+00	kg/m^3
Toluene	3.45E-01	kg/m^3
1,1,1-Trichloroethane	7.41E-01	kg/m^3
Xylene	6.21E-02	kg/m^3

Table F.15. Stream 14 – Elemental Lead

Constituent	Concentration	Units
Americium-241	6.13E-05	Ci/m^3
Cerium-144	3.07E-03	Ci/m^3
Cesium-134	4.68E-05	Ci/m^3
Cesium-137	1.26E-02	Ci/m^3
Cobalt-60	1.24E-03	Ci/m^3
Neptunium-237	9.53E-07	Ci/m^3
Plutonium-238	9.30E-06	Ci/m^3
Plutonium-239	9.48E-05	Ci/m^3
Plutonium-240	4.06E-04	Ci/m^3
Plutonium-241	6.44E-04	Ci/m^3
Radium-224	4.17E-05	Ci/m^3
Radium-226	1.92E-04	Ci/m^3
Ruthenium-106	8.26E-04	Ci/m^3
Strontium-90	8.64E-03	Ci/m^3
Thorium-228	1.93E-03	Ci/m^3
Thorium-232	1.11E-06	Ci/m^3
Tritium	2.13E-05	Ci/m^3
Uranium-234	6.92E-06	Ci/m^3
Uranium-238	1.06E-05	Ci/m^3
Lead	9.80E+02	kg/m^3

Table F.16. Stream 15 – Elemental Mercury

Constituent	Concentration	Units
Americium-241	5.31E-06	Ci/m^3
Cerium-144	4.62E-04	Ci/m^3
Cesium-134	3.69E-06	Ci/m^3
Cesium-137	8.48E-04	Ci/m^3
Cobalt-60	4.60E-05	Ci/m^3
Plutonium-238	5.60E-06	Ci/m^3
Plutonium-239	2.70E-03	Ci/m^3
Plutonium-240	1.06E-05	Ci/m^3
Plutonium-241	4.06E-04	Ci/m^3
Ruthenium-106	1.62E-04	Ci/m^3
Strontium-90	1.18E-04	Ci/m^3
Thorium-232	1.27E-05	Ci/m^3
Tritium	6.98E-07	Ci/m^3
Mercury	1.34E+02	kg/m^3

Table F.17. Stream 17 – K Basin Sludge

Constituent	Concentration	Units
Americium-241	1.56E+01	Ci/m^3
Cesium-134	2.08E-01	Ci/m^3
Cesium-137	2.72E+02	Ci/m^3
Cobalt-60	5.47E-01	Ci/m^3
Neptunium-237	1.63E-03	Ci/m^3
Plutonium –238	2.68E+00	Ci/m^3
Plutonium-239	9.09E+00	Ci/m^3
Plutonium-240	5.02E+00	Ci/m^3
Strontium-90	2.73E+02	Ci/m^3
Technetium-99	4.17E-01	Ci/m^3
Uranium-234	3.39E-02	Ci/m^3
Uranium-235	1.18E-03	Ci/m^3
Uranium-236	3.97E-03	Ci/m^3
Uranium-238	2.53E-02	Ci/m^3
Polychlorinated biphenyls (PCBs)	1.63E-02	kg/m^3

Table F.18. Stream 18 – Leachate from MLLW Trenches

Constituent	Concentration, Ci/m^3
Americium-241	1.44E-11
Cesium-137	3.63E-11
Cobalt-60	6.54E-09
Curium-244	2.57E-10
Iron-55	1.18E-09
Neptunium-237	1.11E-12
Nickel-63	1.21E-08
Plutonium –238	1.34E-10
Plutonium-239	5.66E-11
Plutonium-240	9.84E-12
Plutonium-241	3.42E-10
Radium-224	7.73E-09
Strontium-90	1.09E-10
Thorium-228	2.06E-11
Thorium-232	6.67E-13
Thorium-234	1.13E-08
Tritium	4.06E-11
Uranium-234	1.32E-10
Uranium-235	2.11E-12
Uranium-236	2.47E-12
Uranium-238	3.29E-11

F.1.1.1 Release Fractions for Waste Receiving and Processing Facility

Potential releases from the WRAP have been characterized in the Notice of Construction (NOC) reports for hazardous chemicals (DOE-RL 1993a) and radionuclides (DOE-RL 1993b). Release fractions for radionuclides are based on 40 CFR 61, Appendix D (consistent with WAC 246-247). Releases of particulate solids from the WRAP gloveboxes include a factor of 1E-03, with an additional 5E-07 reduction for double high-efficiency particulate air (HEPA) filtration efficiency. The net release fraction is then 5E-10 for particulate material and 1.0 for volatile radionuclides (such as tritium and carbon-14).

Release fractions for non-radioactive volatile organic compounds (VOCs) were based on the vapor pressure and molecular weight of the chemical (DOE-RL 1993a, Appendix A). The releases were postulated to occur when a container was opened (within a glovebox) and the volatile chemicals were emptied onto a holding pan with a diameter of 0.5 m (1.6 ft). The theoretical vaporization rate from this geometry was used to estimate the release rate over a one-year period. If the theoretical release rate indicated a greater release than the total inventory processed in a year, the chemical was assumed to be totally released (release fraction is 1.0).

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

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

Table F.19. Release Fraction Values for the WRAP

Constituents Type	Form	Release Fraction
Radioactive material	Gases	1.0
	Particulates	5E-10
Chemicals	Gases	1.0
	VOCs[(a)]	0.12 VM/drum amount[(b)]
	Inorganic chemicals	5E-10

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

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

Chemical Name	Waste Stream Description	
	TRU Waste, New and Stored	MLLW
1,1,1-Trichloroethane	1.0	1.0
Acetone	1.0	1.0
Bromodichloromethane	1.0	1.0
Carbon tetrachloride	1.0	1.0
p-chloroaniline	1.0	2.6E-03
Dichloromethane	--	1.0
Diesel fuel	--	3.4E-02
Formic acid	1.0	1.0
Hydraulic fluid	1.1E-04	7.5E-05
Mercury	6.4E-02	6.3E-03
Methyl ethyl ketone (MEK)	1.0	1.0
Polychlorinated biphenyls (PCBs)	4.0E-05	3.0E-05
Toluene	1.0	1.0
Xylene	1.0	1.0

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

F.1.1.2 Release Fractions for the Existing T Plant Complex

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

Table F.21. Airborne Radionuclide Releases from the WRAP

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

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

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

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

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

Operation	Form	Release Fraction	Filter Factor	Net Release Fraction
2706-T Facility	Gases	1E+00	1E+00	1E+00
	Particulates	1E-03	5E-04	5E-07
	Solids	1E-06	5E-04	5E-10

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

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

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

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

(a) PCBs = polychlorinated biphenyls.

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

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

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

Constituent Type	Form	Release Fraction
Radioactive material	Gases	1E+0
	Particulates	5E-10
Chemicals	Gases	1E+00
	VOCs[(a)]	0.12VM/drum amount[(b)]
	Inorganic chemicals	5E-10

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

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

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

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

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

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

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

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

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

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

F.1.1.4 Pulse Drier Operation

The treatment of trench leachate would be performed in the Effluent Treatment Facility until that facility is decommissioned in 2025. Starting in 2026, the plan is to treat leachate using pulse driers installed near the trenches. Releases from drier operations are estimated using a release fraction of 0.001 (40 CFR 61, Appendix D) and a HEPA filtration factor of 5E-04. The net release fraction of 5E-07 is applied to radionuclides in the leachate from the trenches except for tritium and carbon-14, which are assumed to be totally released. The leachate is not expected to contain substantial amounts of volatile hazardous chemicals. The total annual release from leachate treatment using pulse driers is given in Table F.31 for Alternative Groups A and B. Releases for Alternative Groups C and D and for the No Action Alternative are given in Table F.32. Releases for Alternative Group E are expected to be the same as those for Alternative Group D.

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

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

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

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

F.1.2 Release Point Characteristics

The atmospheric transport analysis requires definition of release point characteristics for each facility that has a release to air. The characteristics are presented in Table F.33 for the WRAP, 2706-T facility, the modified T Plant Complex, and pulse driers. Values for the WRAP are taken from the NOC (DOE-RL 2001); for the 2706-T facility from the Interim Safety Analysis for T Plant (Meyer 1998); for the modified T Plant Complex from the NOC (DOE-RL 2000) and Rokkan et al. (2001). Pulse drier characteristics are from the Technical Information Document (FH 2003). For all facilities, the temperature of outside air is set to the annual average value of 12°C (53.6°F).

Table F.33. Release Point Characteristics

Parameter	Units	WRAP and New Waste Processing Facility	2706-T Facility	Modified T Plant Complex	Pulse Driers
Stack height	M	14	8.5	61	5
Exit area	m^2	0.5	0.39	1.8	0.20
Exit velocity	m/s	15.4	15[a]	8.3	1.5
Exit air temperature	°C	32.2	25.6	23.9	74
Height of building	M	7	7.62	25	4.3

(a) The average exit velocity was set to one half the maximum value for the 2706-T facility.

F.1.3 Atmospheric Transport

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

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

The population dose values were estimated from the calculated individual doses by multiplying by a conversion factor relating the population weighted χ/Q value to the χ/Q value at the location of the offsite MEI (7E+04 person-s/m^3). This conversion factor was also used to estimate population health impacts from carcinogenic chemicals. The population distribution (Beck et al. 1991) is given in Table F.36.

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

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

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

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

Table F.35. (contd)

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

Table F.35. (contd)

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

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

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

F.1.4 Exposure Scenarios

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

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

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

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

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

F.1.4.1 Industrial Scenario

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

Table F.37. Industrial Scenario Exposure Pathways

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

Table F.38. Industrial Scenario Parameter Values

Exposure Parameters[(a)]					
Source	**Exposure Pathway**	**Intake Rate**	**Exposure Frequency, d/yr**	**Conversion Factors**	**Other Factors**
Air (with deposition to soil)	Soil ingestion	50 mg/d	146	1E-06 kg/mg	--
	Soil external	8 hr/d	146	--	0.8[(b)]
	Soil dermal absorption	0.2 mg/cm^2/d	146	1E-06 kg/mg	5000 cm^2[(c)]
	Soil suspension –inhalation	20 m^3/d	250	1E-09 kg/μg	50 μg/m^3 [(d)]
	Air inhalation	20 m^3/d	250	--	--

(a) For all cases, the body weight is 70 kg (155 lb). The exposure period is 1 year for annual dose estimates and 20 years for other analyses.
(b) Average shielding factor for external exposure to contaminated soil.
(c) Skin surface area contacted with soil by the worker.
(d) Average particulate loading in air.

F.1.4.2 Resident Gardener Scenario

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

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

Table F.39. Resident Gardener Scenario Exposure Pathways

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

Table F.40. Resident Gardener Scenario Exposure Factors

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

(a) For all cases the body weight is 70 kg (155 lb). The exposure period is for 1-year annual dose estimates and 30 years for other analyses.
(b) Average shielding factor for external exposure to contaminated soil.
(c) Skin surface area contacted with soil by the worker.
(d) Average particulate loading in air.
(e) The sauna or sweat lodge transfer factor (1.9 L/m^3) for VOCs assumes 4 L/d water use in a hemisphere of a 2-m (6.6-ft) diameter with complete suspension of all contaminants.
(f) Ratio of indoor air concentration to water concentration for volatilization from indoor water uses.
(g) Skin surface area contacted during bathing with domestic water.

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

Deposition of airborne activity on soil would result in exposure to individuals who come in contact with the soil, breathe resuspended particles from the soil, or eat foods grown in the soil. The contamination deposited onto soil is modeled as a pollutant concentration per unit area of soil. Some of the soil exposure pathways require concentration to be expressed in units of soil mass (mg/kg or pCi/kg dry soil). For these pathways, the conversion to soil mass is made using the conversion factor 60 kg/m^2 that is based on uniform distribution of the contaminant in the top 4 cm (1.6 in.) of soil having a density of 1.5 g/cm^3. This thickness is representative of the distribution of contaminants in residential soil (such as lawns) for deposition occurring over extended periods (for instance, several years). For agricultural pathways, the conversion is based on uniform distribution in 15 cm (6 in.) of soil (plow layer) with a conversion factor of 225 kg/m^2.

The parameter values for each exposure pathway related to soil as a medium have been presented in the preceding tables for the three exposure scenarios. Notes on the exposure pathways follow.

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

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

Soil Dermal Contact. The dermal contact pathway is evaluated only for chemicals (as recommended in DOE-RL 1995). The individuals are assumed to have one contact event per day (a 12-hour period) with soil adhering to the skin at a surface density of 0.2 mg/cm^2 of skin for the industrial and resident gardener scenarios. The area of skin contacted is assumed to be 5000 cm^2 for all scenarios. The industrial worker is exposed 146 days per year; the resident gardener is exposed 180 days per year.

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

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

Game (Deer). For the resident gardener scenario, the individual is assumed to hunt and kill one deer in the year. The deer becomes contaminated when foraging on plants grown in contaminated soil. The HSRAM scenario applies a hunter success rate of 19 percent for a season. This percentage is appropriate when the exposure duration is many years (30 years for HSRAM), but is not appropriate when considering a one-year period. The annual dose analysis must assume the hunter is successful (a success rate equal to 100 percent for the year of exposure). Also, the HSRAM intake rate for deer meat is based on the amount of animal fat in the consumed meat. Although this assumption may be appropriate for organic chemical pollutants that are lipophilic, it is not generally appropriate for radionuclides. Also, the exposure pathway models for radionuclides evaluate the activity in the edible meat, not fat. The intake rate for deer meat, therefore, must be adjusted to represent the amount of meat ingested. This value is 15 g/day (0.53 oz/d), as calculated and reported for the recreational scenario of the Columbia River Comprehensive Impact Assessment (CRCIA) project (DOE-RL 1998).

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

F.1.4.4 Air Transport Medium

Airborne activity may result in inhalation exposure plus direct transfer to plant surfaces, resulting in intake of contaminated food crops and animal products (from animals that eat contaminated feed crops). The parameter values for each exposure pathway related to air as a medium have been presented in Tables F.36 and F.38 for the two exposure scenarios. Notes on the exposure pathways follow.

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

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

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

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

F.1.4.5 Waterborne Transport Medium

Waterborne activity may result in exposure from domestic water uses and irrigation water uses. Groundwater used to supply drinking water for domestic water for residences can result in exposure via water ingestion, inhalation of volatile chemicals released during showering and washing, and dermal contact during bathing. The parameter values for each exposure pathway related to groundwater as a medium have been presented in Tables F.36 and F.38. Notes on the exposure pathways follow.

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

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

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

The transfer of non-volatile compounds (and most radionuclides) is determined by the amount of water vapor that can be held in the air. Excess water vapor (and associated non-volatile pollutants) would condense and be removed from the air. The estimated transfer factor of 0.3 L/m3 is based on recommendations of Harris and Harper (1997) and is intended to maximize the concentration of non-volatile compounds in the air.

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

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

F.1.5 Soil Accumulation Model

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

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

Table F.41. Volatilization Half Times for Soil

Chemical	Soil Half Time Volatilization (Days)
Acetone	4.00E+02
Bromodichloromethane	3.80E+02
Carbon tetrachloride	1.20E+02
Dichloromethane	5.10E+01
Diesel fuel	8.50E+03
Hydraulic fluid	8.70E+03
Methyl ethyl ketone	8.40E+02
Polychlorinated biphenyls (PCBs)	4.40E+04
p-chloroaniline	1.40E+04
Toluene	2.70E+02
1,1,1 Trichloroethane	2.30E+02
Xylene	2.20E+02
(a) PCBs = polychlorinated biphenyls.	

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

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

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

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

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

Values used for the distribution coefficient were selected to give low leach rate constants (high retention times). This selection would result in a conservative (high) estimate of radiation dose or chemical intake for those exposure pathways that involve accumulation in soil. The parameters for agricultural soil are used for all exposure pathways, as a simplification to the analysis and a further conservatism for the residential exposure pathways. Residential soil would be expected to involve mixing in a smaller depth (represented in Equation F.2 by parameter h). A smaller value for soil depth would result in a faster leach rate and lower equilibrium concentrations. Residential and industrial soils are assumed subject to the same infiltration rate as agricultural lands because of lawn watering.

F.1.5.1 Evaluation of Distribution Coefficient for Organic Chemicals

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

$$K_d = 0.0001 K_{oc} S_d \qquad \text{(F.3)}$$

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

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

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

where the empirical coefficients have units of 1 percent.

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

Table F.42. Soil Classification Composition

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

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

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

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

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

Chemical	K_{oc}	K_d
Beryllium	--[(a)]	1.0E+02
Nitric acid	--	1.0E+01
Sodium nitrate	--	1.0E+01
Sodium hydroxide	--	1.0E+01
1,1,1 trichloroethane	1.52E+02	2.57E+0
Polychlorinated biphenyls	6.10E+05	1.03E+04
p-chloroaniline	4.17E+01	7.04E-01
Carbon tetrachloride	5.02E+02	8.48E+0
Hydraulic fluid	1.40E+04	2.36E+02
Toluene	3.00E+02	5.07E+0
Formic acid	1.8E-01	3.04E-03
Dichloromethane	8.8E+0	1.49E-01
Acetone	5.75E-01	9.7E-02
Methyl ethyl ketone (MEK)	4.5E+0	7.6E-02
Diesel fuels	4.50E+03	7.6E+01
Xylene	2.40E+02	4.05E+0
Mercury	--	8.00E+04
Bromodichloromethane	1.07E+02	1.81E+0

(a) A K_{oc} value is not needed for inorganic chemicals.

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

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

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

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

Analyte Name[(a)]	Distribution Coefficient (mg/g)
Americium	5000
Beryllium	100
Bismuth	900
Cesium	100
Cobalt	100
Curium	1500
Iron	100
Lead	80,000
Manganese	2400
Mercury	80,000
Neptunium	1500
Nickel	2400
Nitrate	10
Nitrite	10
Plutonium	5000
Polonium	1100
Protactinium	3600
Radium	500
Radon	0.1
Sodium hydroxide	10
Strontium	180
Thorium	600,000
Tritium	0.7
Uranium	7
Yttrium	1500

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

F.1.6 Health Impacts

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

For non-carcinogenic chemicals, the health endpoint is the hazard quotient defined by EPA as the average daily intake of a chemical divided by the reference dose (RfD) for that chemical. The hazard quotient is evaluated for both inhalation exposures and ingestion exposures with RfD determined for each route. For carcinogenic chemicals, the health endpoint is the lifetime cancer incidence from the defined total intake.

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

F.1.7 Basis for Radiological Health Consequences

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

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

Table F.45. Summary of Basis for Health Consequences from Radiological Exposures from Federal Guidance Report No. 13 (Eckerman et al. 1999)

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

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

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

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

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

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

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

For radiological accidents discussed in this HSW EIS, the doses estimated for some hypothetical events may be greater than the doses to which the ICRP health effects coefficients were intended to apply.

Depending upon the radionuclides involved and the exposure pathways considered, the LCF risk may be as much as twice that listed in Table F.45 for doses greater than 20 rem but less than a few hundred rem. For doses greater than a few hundred rem, there is a potential for short-term health effects other than cancer and hereditary effects (again, depending upon the radionuclides and exposure pathways associated with a particular accident scenario). For a further discussion of uncertainties see Section 3.5 in Volume I of this EIS.

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

All dose results in this EIS have been estimated using the internal radiation dose conversion factors recommended in Federal Guidance Report (FGR) 11 (Eckerman et al. 1988). As an approximation, radiation risks were estimated using an individual dose-to-risk conversion factor of 0.0006 risk of induction of a latent cancer fatality per rem of dose, as recommended by the Interagency Steering Committee on Radiation Standards (ISCORS). All estimates presented in this EIS are based on exposure of adults.

Radiation doses and risks to children are different than those to adults for the same concentrations of contaminants in the environment, because children generally eat and drink less than adults (except possibly for milk) so their bodies metabolize contaminants differently than adults, and their organs have different masses than adult organs. In addition, children may have different sensitivities than adults to radiation for a given radiation dose. FGR 13 (Eckerman et al. 1999) provides tables of ingestion dose and risk to children for a unit intake of radionuclides that may be used to evaluate the potential differences in dose and risk to children and adults for given groundwater concentrations of radionuclides of interest in this EIS.

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

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

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

Radionuclide	Dose Ratio (Child/Adult)	Risk Ratio (Child/Adult)
C-14	1.4	2.3
Tc-99	6.0	11
I-129	1.4	0.2
U-233	0.88	1.1
U-234	0.87	1.1
U-235	0.90	1.2
U-236	0.87	1.1
U-238	0.88	1.1

F.2 Accident Impact Assessment Methods

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

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

Changes and adjustments to safety document calculations include the following:

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

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

3. The locations of the MEI member of the public and the MEI non-involved worker were changed from those in the safety analyses. For this HSW EIS analysis, the MEI was located at the nearest publicly accessible location on U.S. State Route 240 (generally 3 to 5 km [1.9 to 3.1 mi] distant), and the

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maximally exposed non-involved worker was located 100 m (109 yd) away. For the safety analyses, the MEI member of the public was located at the Hanford Site boundary, typically a distance of 12 km (7.4 mi), and the co-located worker was at the nearest facility, typically a distance of 800 m (872 yd). The difference in the locations of hypothetically exposed individuals is the most important reason for differences in the dose estimates between this HSW EIS and safety analyses.

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

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

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

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

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

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

F.2.1 Adjustment Method

The method for adjusting dose results presented in the safety analyses for the environmental impact analysis is shown in the following equations (Equations 5.5 through 5.8). It is a simple ratio of acute release atmospheric dispersion factors (E/Q) and the calculated doses. The E/Q is a measure of atmospheric dispersion for short-term (acute) atmospheric releases using Gaussian dispersion plume modeling, with units of s/m^3. For a given point or location at some distance from the source, it represents the time-integrated air concentration ($Ci{\cdot}s/m^3$) divided by the total release from the source (Ci). E/Qs are typically used for releases lasting no longer than 8 to 24 hours. The effective dose equivalent (EDE) used in the safety analyses (SA) is equivalent to the TEDE used in the environmental impact analysis.

$$\frac{TEDE_{EIS}}{EDE_{SA}} = \frac{E/Q_{EIS}}{E/Q_{SA}} \qquad \text{(F.5)}$$

or

$$TEDE_{EIS} = EDE_{SA} * \frac{E/Q_{EIS}}{E/Q_{SA}} \quad \text{(F.6)}$$

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

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

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

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

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

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

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

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

F.2.2 Accident Frequency

As part of the safety analysis process, a preliminary hazard analysis was performed to identify potential accident scenarios for each facility. Accident scenarios in each of three frequency categories were selected for further analysis. The accidents selected for evaluation represent what were considered the bounding consequences for the frequency category, although other accidents in the frequency category may also have been analyzed to better represent the range of potential impacts. It is important to note that in this HSW EIS, accident consequences are presented without regard to frequency of occurrence and that estimated frequencies of the accidents were not incorporated into the statement of risk.

F.2.3 Non-Radiological Impact Endpoints

Estimates of consequences of exposure to potentially hazardous chemicals were based on one-hour exposures, consistent with the assumptions of the Emergency Response Planning Guidelines (ERPGs). Also used were TEELs that are interim, temporary, or equivalent exposure limits for chemicals for which official ERPGs have not yet been developed. At its April 1996 meeting in Knoxville, Tennessee, the DOE Subcommittee on Consequence Assessment and Protective Actions (SCAPA) adopted the term TEEL. These exposure limits must be regarded as dynamic; if new concentration limits are issued (for example, ERPG, permissible exposure level, or threshold limit value) or if new or additional toxicity data are found, the TEEL would be revised. At the time of this analysis, TEEL values were provided for over 1,340 additional chemicals. ERPGs adopted through January 1, 2000, are located on the SCAPA Internet Web site (DOE 2002). The most recent TEELs list revision is *ERPGs and TEELs for Chemicals of Concern: Rev 18* (Craig 2001).

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

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

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

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

Temporary Emergency Exposure Limits:

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

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

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

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

F.2.3.1 Impacts from Industrial Accidents

Impacts of potential industrial and occupational accidents were predicted using five-year average statistics for the U.S. DOE Richland Operations Office, reported in Computerized Accident/Incident Reporting System, or CAIRS, for the years 1996 – 2000 (DOE 2001). The baseline statistics, applied separately for construction and operations activities, are presented in Section 4.10. Impacts are presented as the predicted number of total recordable cases, lost workday cases, lost workdays, and fatalities for construction and operation activities, based on the number of worker-years for that activity. A full-time worker is assumed to work 2,000 hours per year.

F.3 Intruder Impact Assessment Methods

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

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

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

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

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

(a) The activity is in activated metal.

F.3.1 Human Intrusion Exposure Scenarios

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

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

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

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

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

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

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

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

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

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

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

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

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

F.3.2 Radiological Analysis

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

The dose-rate-per-unit waste concentration factors change with time because of decay of the parent radionuclide and leaching of radionuclides from the surface soil. The unit dose factors given in Tables F.49 and F.50 for *without soil leaching* are impacted only by radioactive decay and progeny

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

Nuclide	Without Soil Leaching			Dominant Exposure Pathway
	100 yr	300 yr	500 yr	
Tritium	5.11E-06	6.39E-11	7.99E-16	Soil Ing.
Carbon-14	5.13E+0	5.01E+0	4.89E+0	Vegetable
Cobalt-60	6.26E-03	2.37E-14	8.96E-026	External
Nickel-59	1.19E-01	1.18E-01	1.18E-01	External
Nickel-63	7.85E-02	1.97E-02	4.92E-03	Vegetable
Strontium-90	3.00E+01	2.36E-01	1.85E-03	Vegetable
Technetium-99	2.00E+01	1.99E+01	1.99E+01	Vegetable
Iodine-129	5.47E+01	5.47E+01	5.47E+01	Vegetable
Cesium-137	8.45E+01	8.54E-01	8.63E-03	External
Uranium-234	5.25E+01	5.25E+01	5.25E+01	Inhalation
Uranium-235	1.70E+02	1.84E+02	1.98E+02	External
Uranium-236	4.91E+01	4.91E+01	4.91E+01	Inhalation
Uranium-238	8.18E+01	8.18E+01	8.18E+01	Inhalation

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

Nuclide	Without Soil Leaching			Dominant Exposure Pathway
	100 yr	300 yr	500 yr	
Tritium	1.09E-03	1.37E-08	1.71E-13	Soil Ing.
Carbon-14	1.10E+03	1.07E+03	1.05E+03	Vegetable
Cobalt-60	1.34E+0	5.07E-12	1.92E-023	External
Nickel-59	2.53E+03	2.53E+01	2.53E+01	External
Nickel-63	1.68E+01	4.21E+0	1.05E+0	Vegetable
Strontium-90	6.43E+03	5.05E+01	3.96E-01	Vegetable
Technetium-99	4.28E+03	4.27E+03	4.27E+03	Vegetable
Iodine-129	1.17E+04	1.17E+04	1.17E+04	Vegetable
Cesium-137	1.81E+04	1.83E+02	1.85E+0	External
Uranium-234	1.13E+04	1.12E+04	1.12E+04	Inhalation
Uranium-235	3.63E+04	3.94E+04	4.25E+04	External
Uranium-236	1.05E+04	1.05E+04	1.05E+04	Inhalation
Uranium-238	1.75E+04	1.75E+04	1.75E+04	Inhalation

ingrowth. These dose factors generally decrease with time as the parent decays, although progeny ingrowth may cause an increase with time. For example, the uranium-235 dose-rate–per-unit waste concentration factors increase with time because of the ingrowth of protactinium-231. The dose-rate-per-unit waste concentration factors for *with soil leaching* are impacted by decay and leaching and are less than or equal to the corresponding value for no leaching.

F.4 Impacts from Waterborne Pathways

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

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

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

Nuclide	Without Soil Leaching			Dominant Exposure Pathway
	100 yr	300 yr	500 yr	
Tritium	1.09E-03	1.37E-08	1.71E-13	Soil Ing.
Carbon-14	1.10E+03	1.07E+03	1.05E+03	Vegetable
Cobalt-60	1.34E+0	5.07E-12	1.92E-023	External
Nickel-59	2.53E+03	2.53E+01	2.53E+01	External
Nickel-63	1.68E+01	4.21E+0	1.05E+0	Vegetable
Strontium-90	6.43E+03	5.05E+01	3.96E-01	Vegetable
Technetium-99	4.28E+03	4.27E+03	4.27E+03	Vegetable
Iodine-129	1.17E+04	1.17E+04	1.17E+04	Vegetable
Cesium-137	1.81E+04	1.83E+02	1.85E+0	External
Uranium-234	1.13E+04	1.12E+04	1.12E+04	Inhalation
Uranium-235	3.63E+04	3.94E+04	4.25E+04	External
Uranium-236	1.05E+04	1.05E+04	1.05E+04	Inhalation
Uranium-238	1.75E+04	1.75E+04	1.75E+04	Inhalation

ingrowth. These dose factors generally decrease with time as the parent decays, although progeny ingrowth may cause an increase with time. For example, the uranium-235 dose-rate–per-unit waste concentration factors increase with time because of the ingrowth of protactinium-231. The dose-rate-per-unit waste concentration factors for *with soil leaching* are impacted by decay and leaching and are less than or equal to the corresponding value for no leaching.

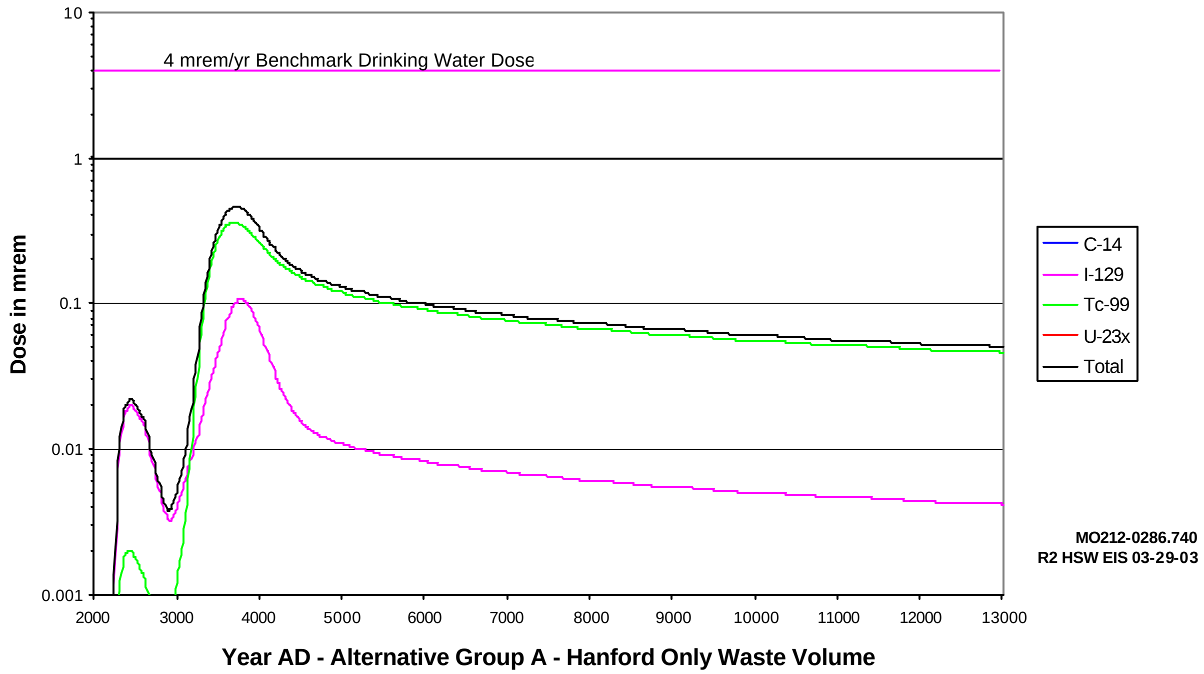
F.4 Impacts from Waterborne Pathways

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

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

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

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



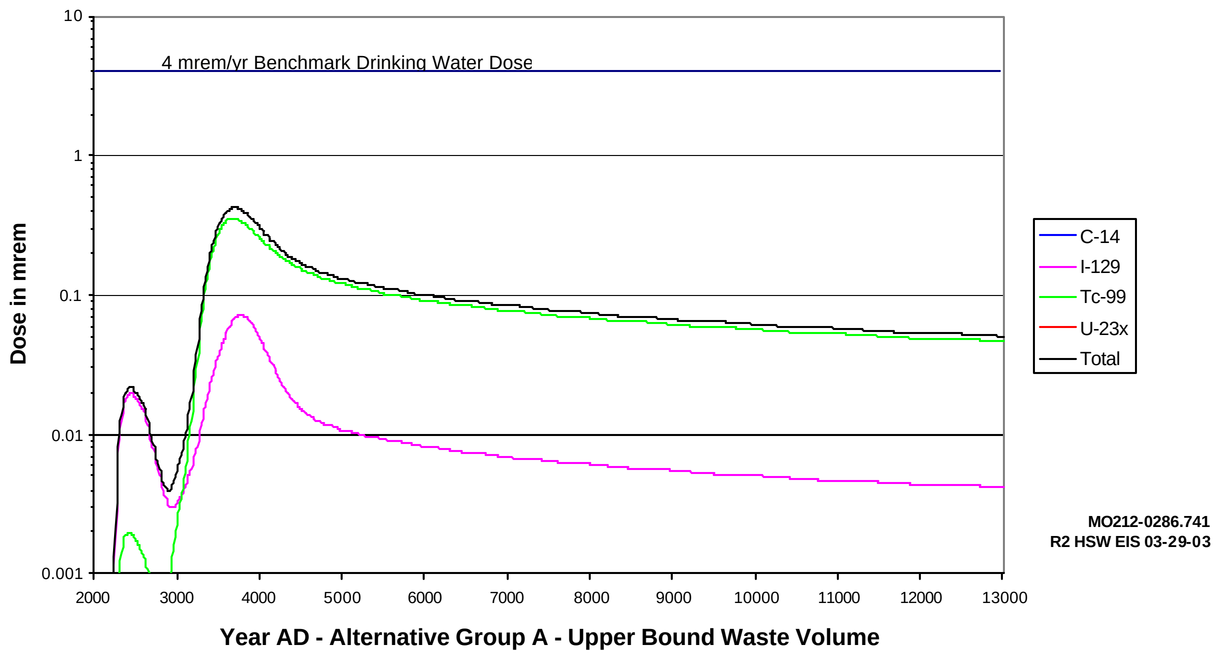
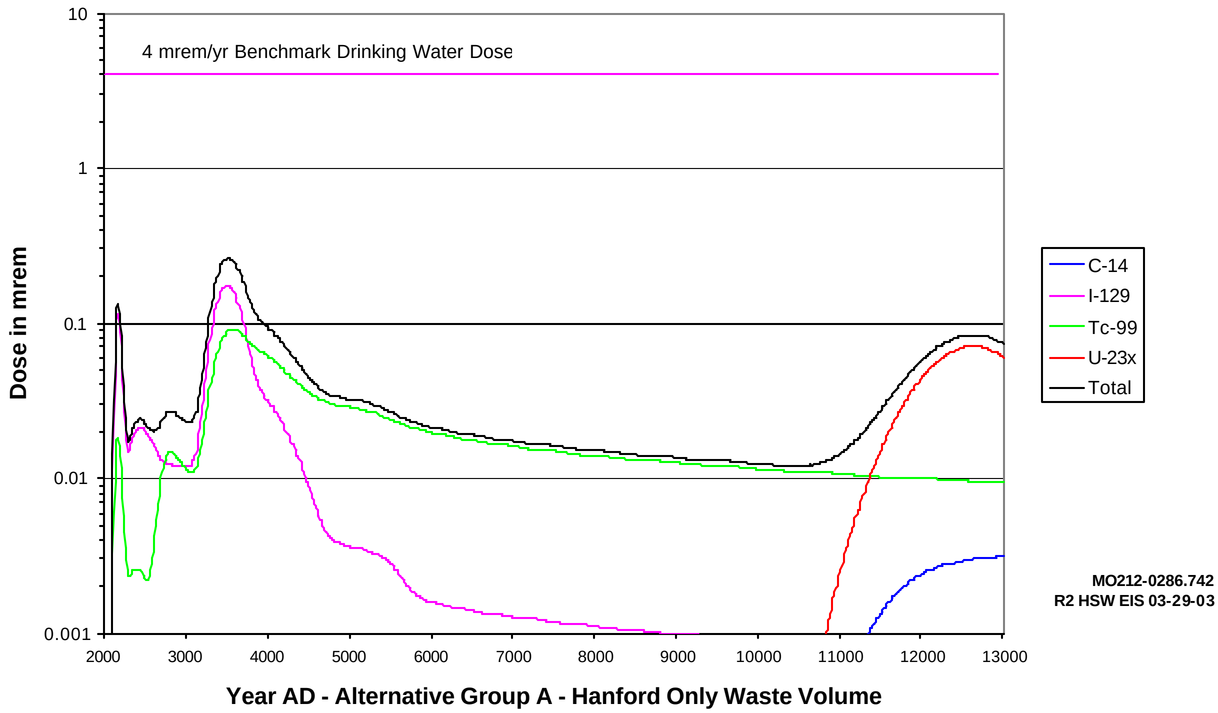


Figure F.1. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from the 200 West Area, Alternative Group A



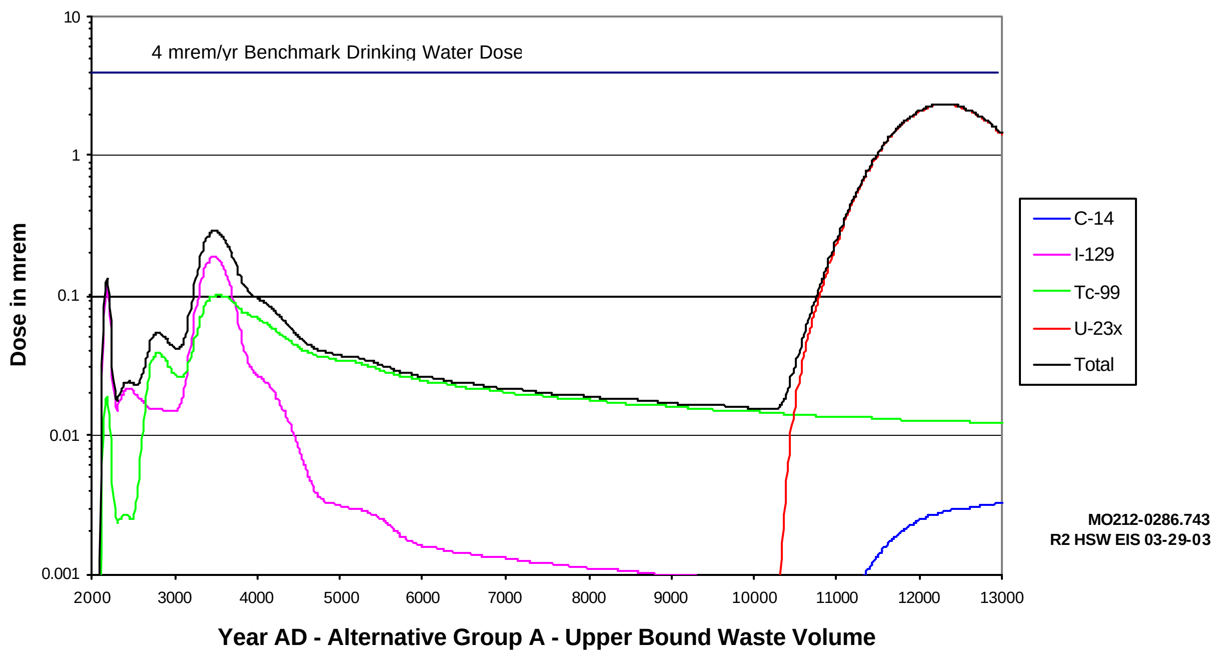
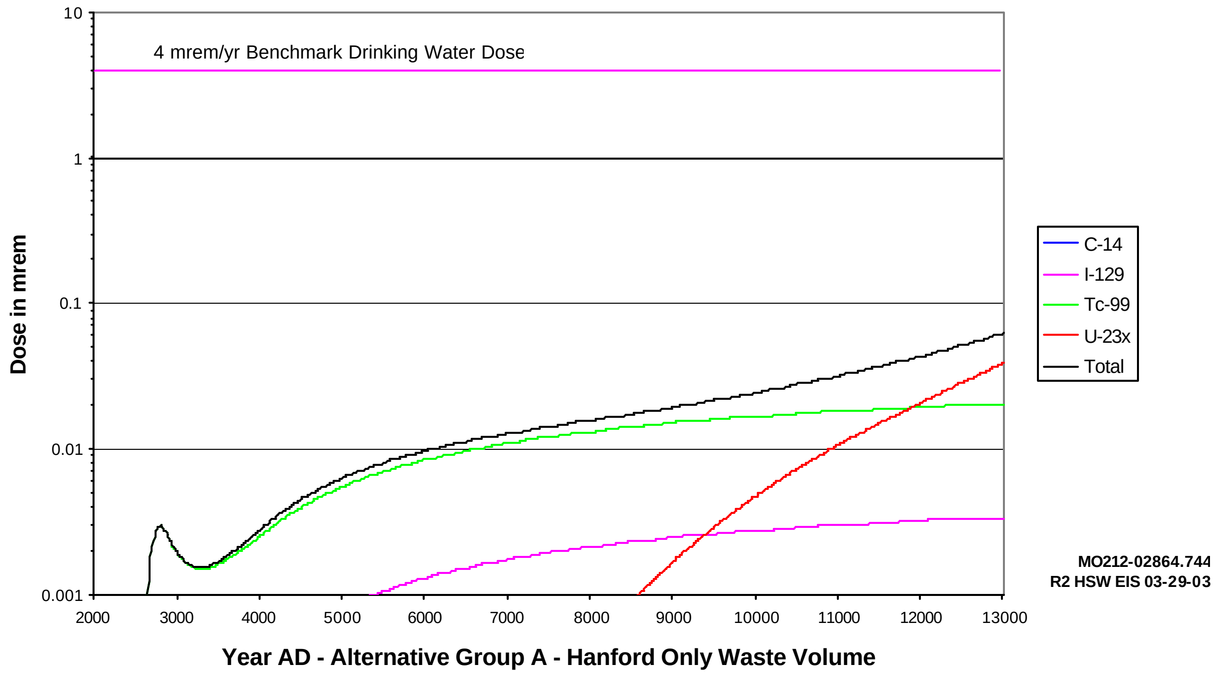


Figure F.2. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Northwest from 200 East Area, Alternative Group A



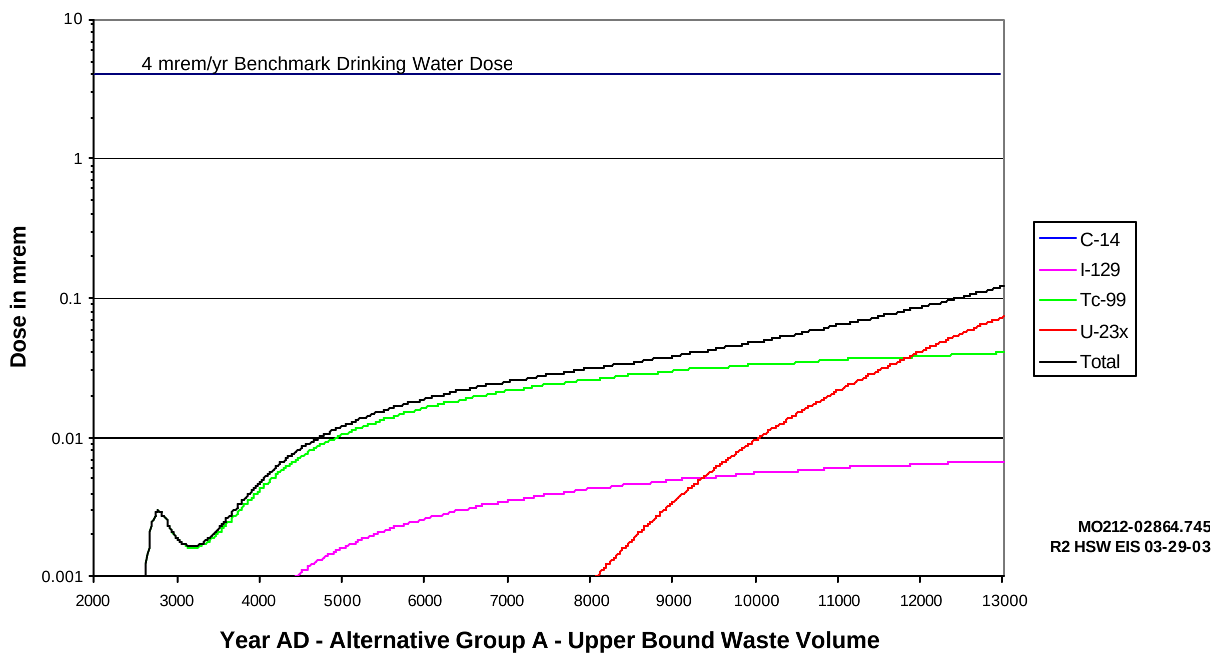
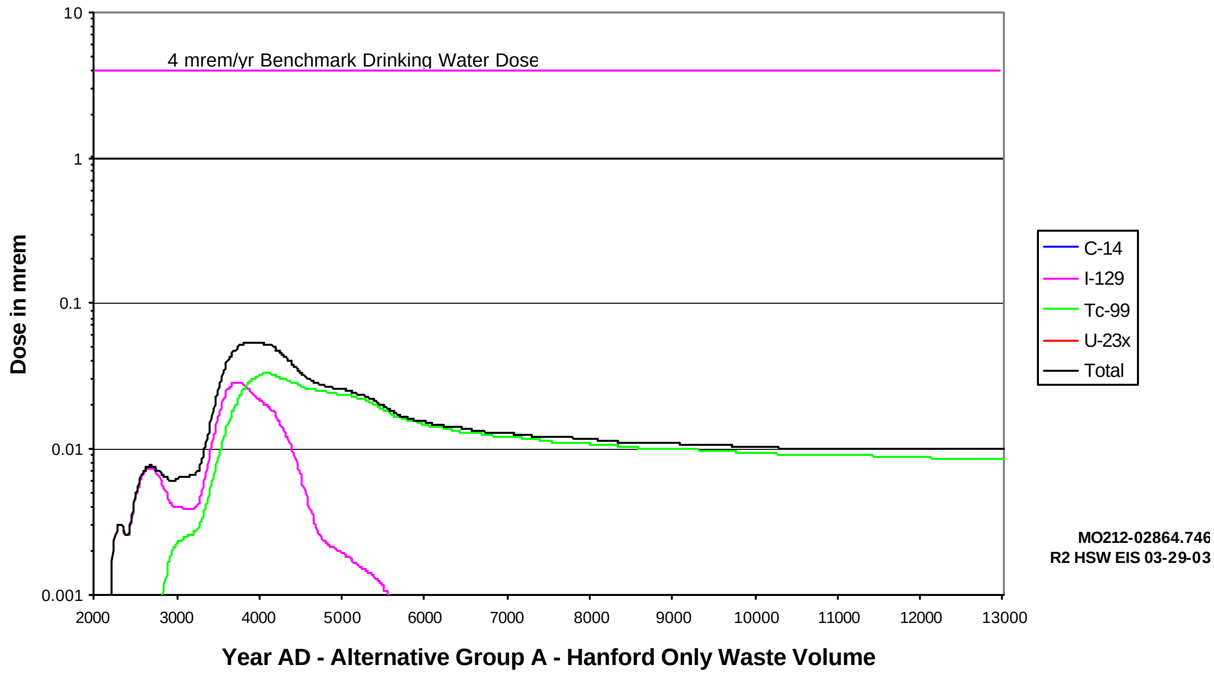


Figure F.3. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Southeast of 200 East Area, Alternative Group A



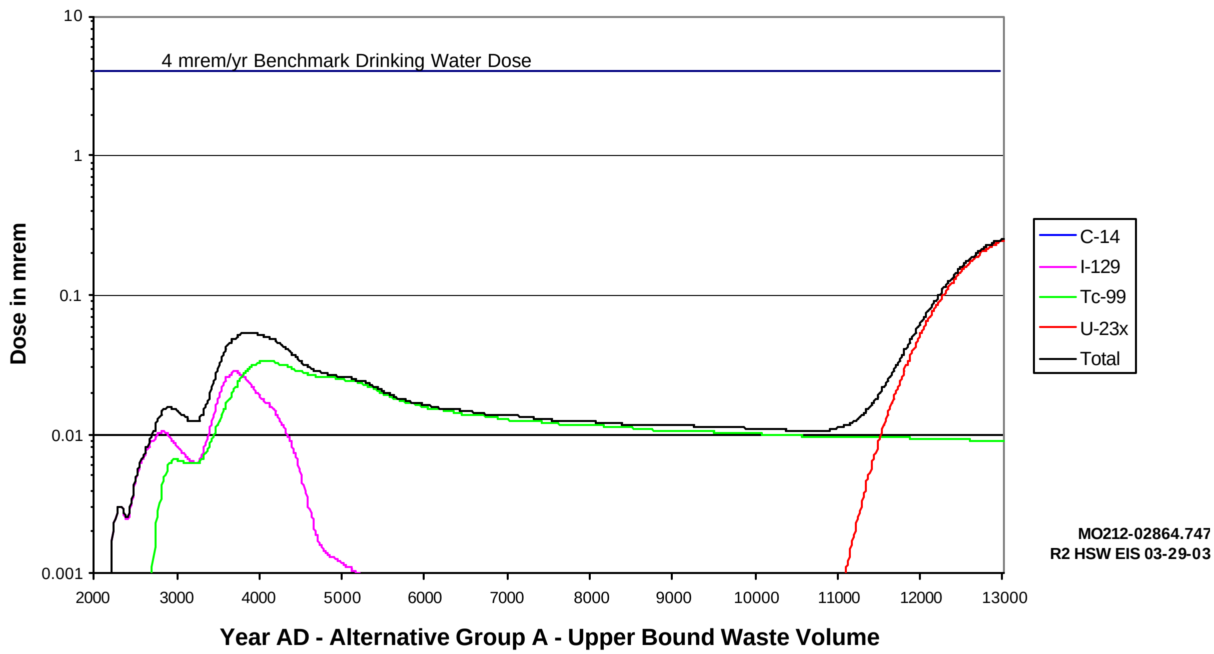
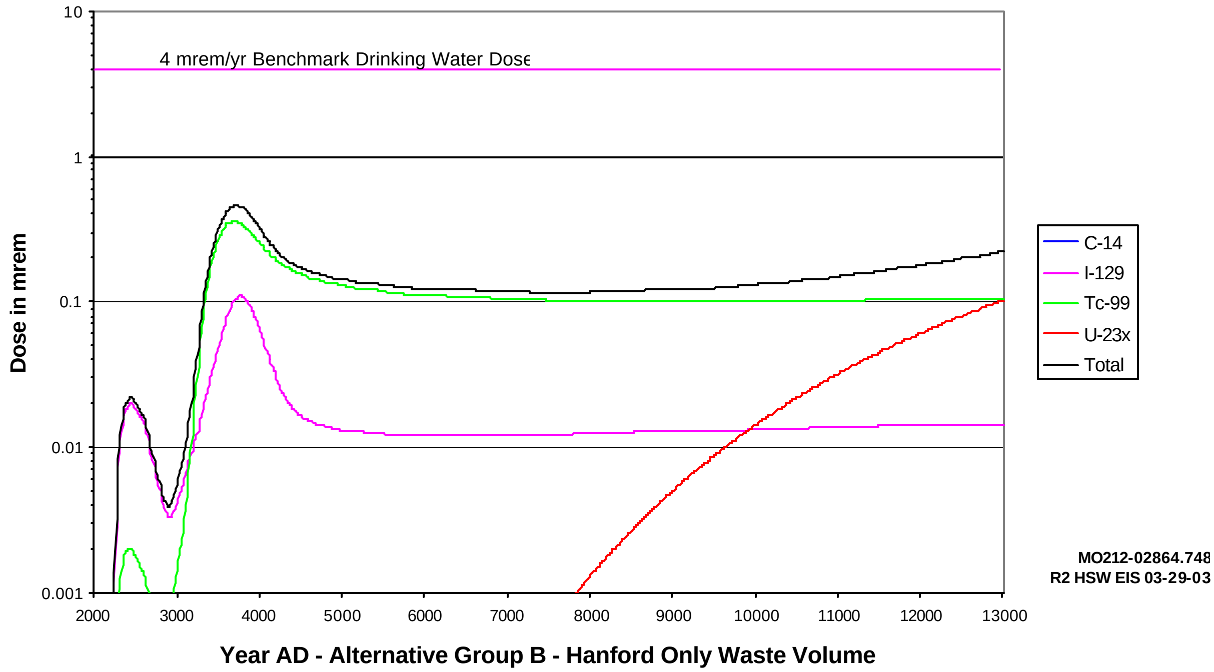


Figure F.4. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River Alternative Group A



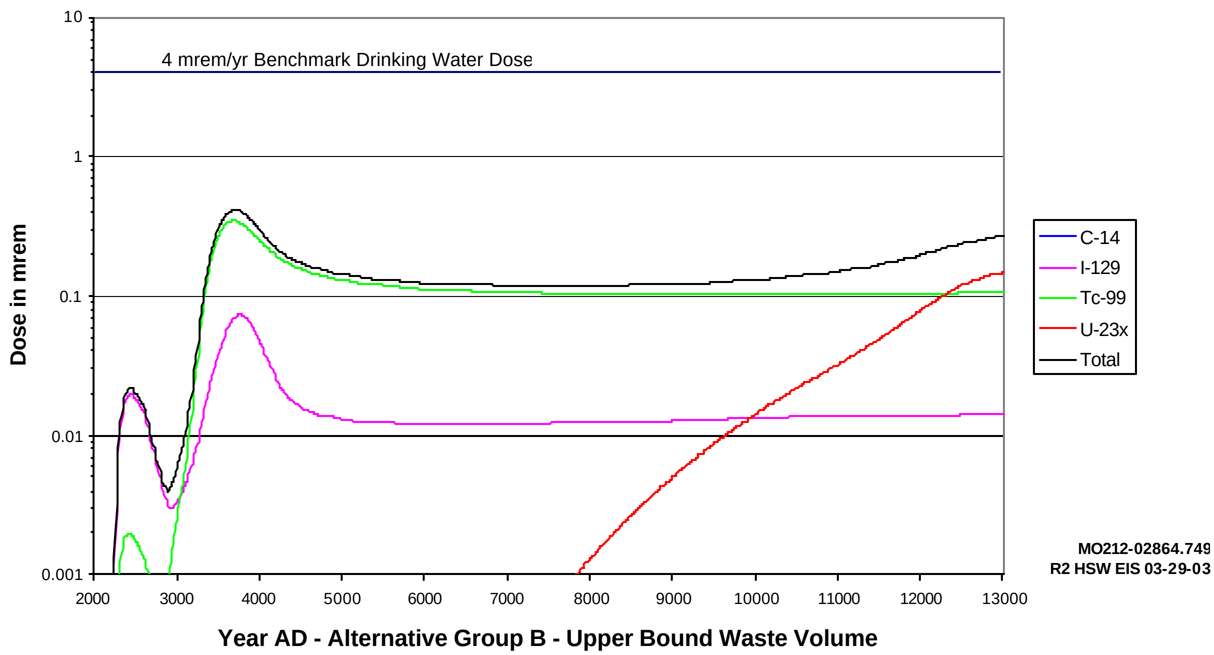
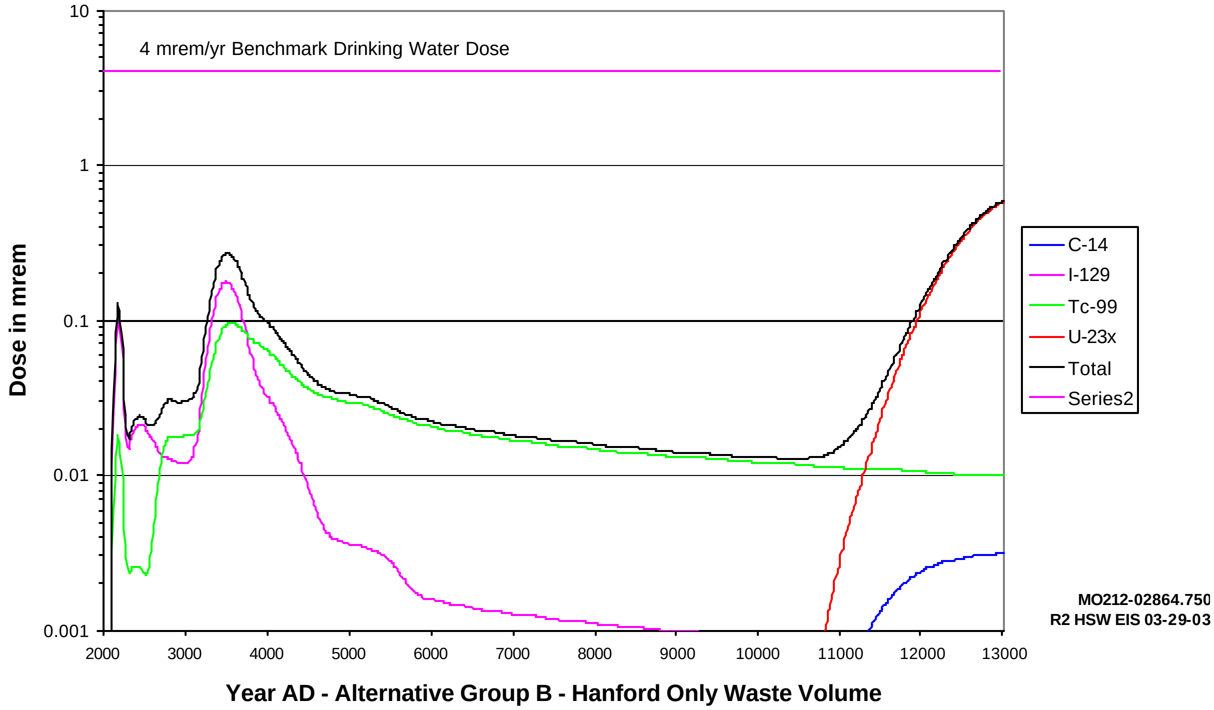


Figure F.5. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from 200 West Area, Alternative Group B



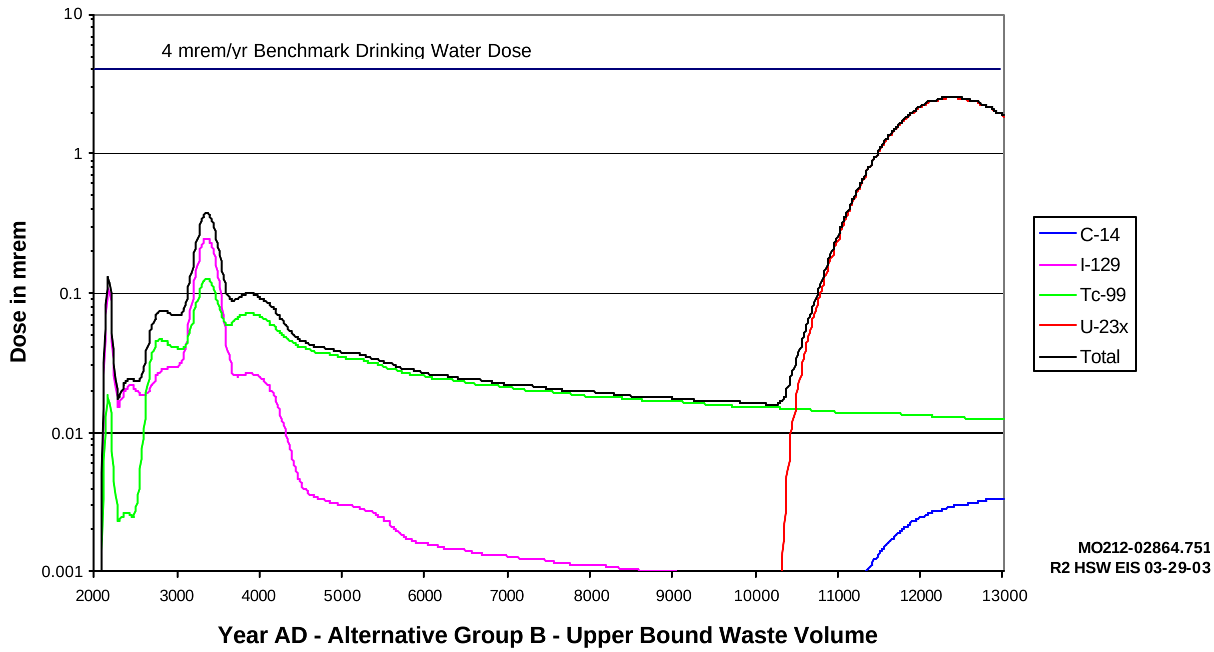
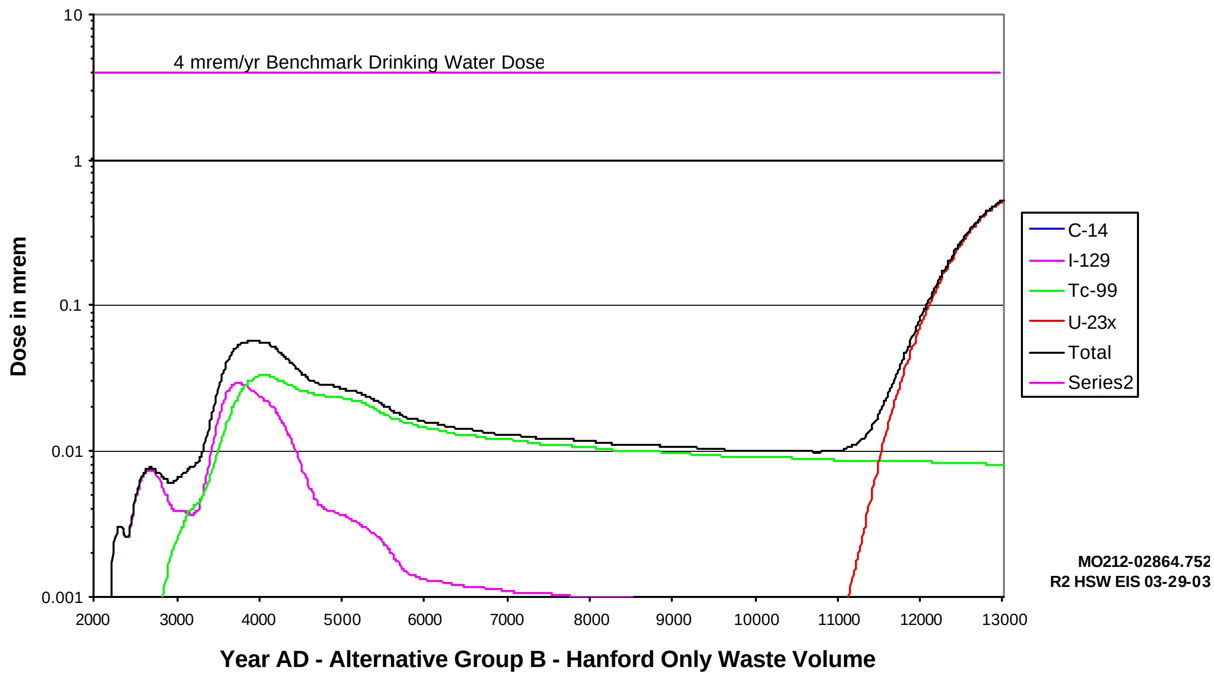


Figure F.6. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Northwest from 200 East Area, Alternative Group B



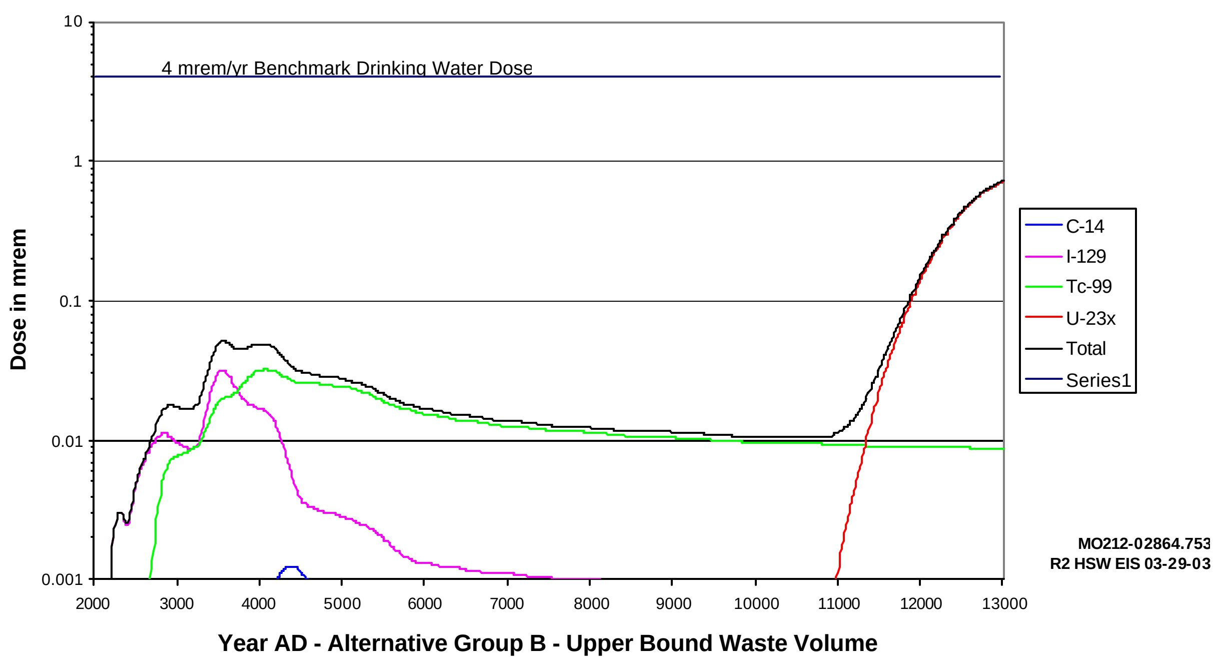
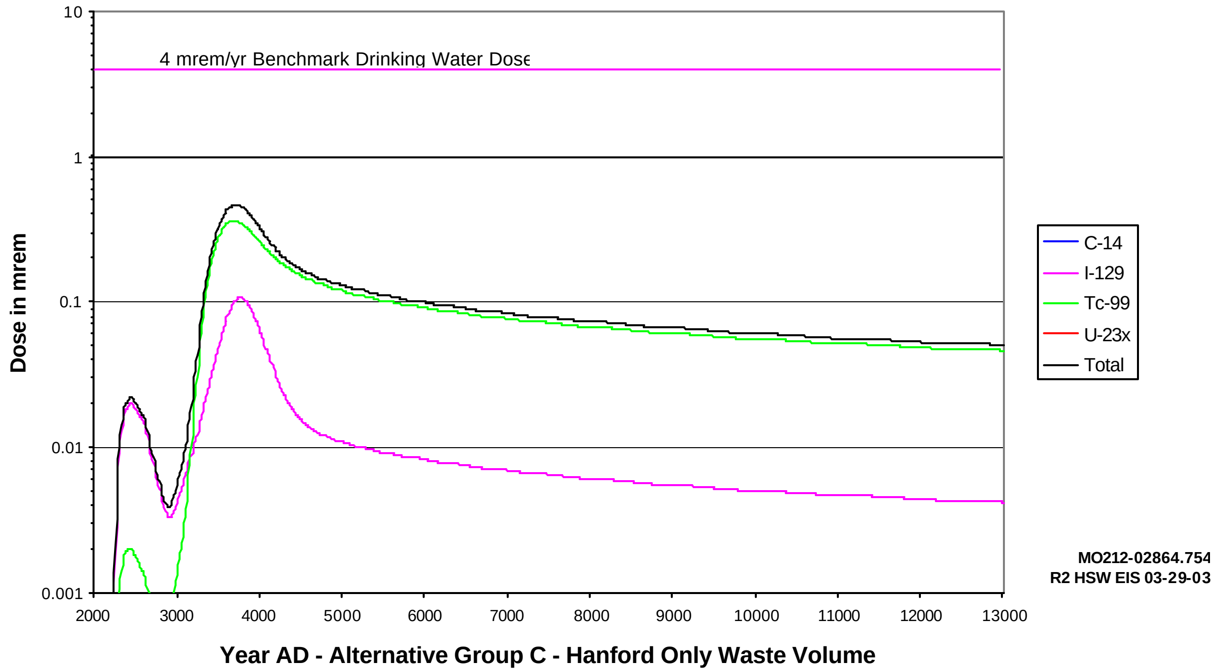


Figure F.7. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group B



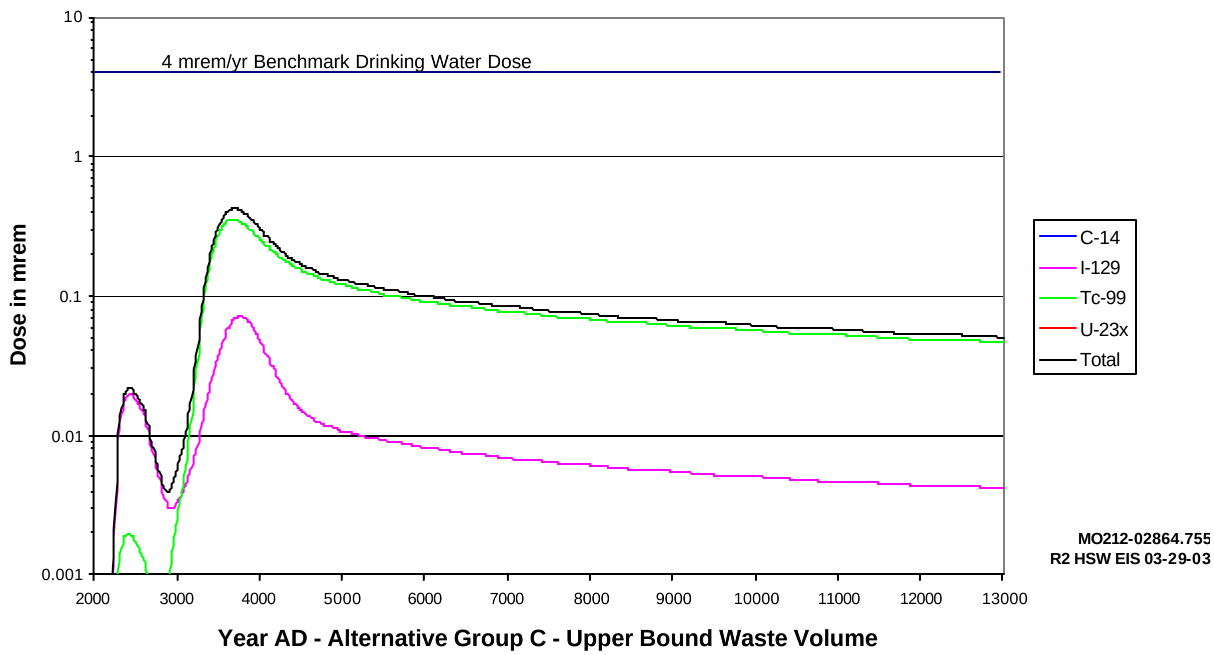
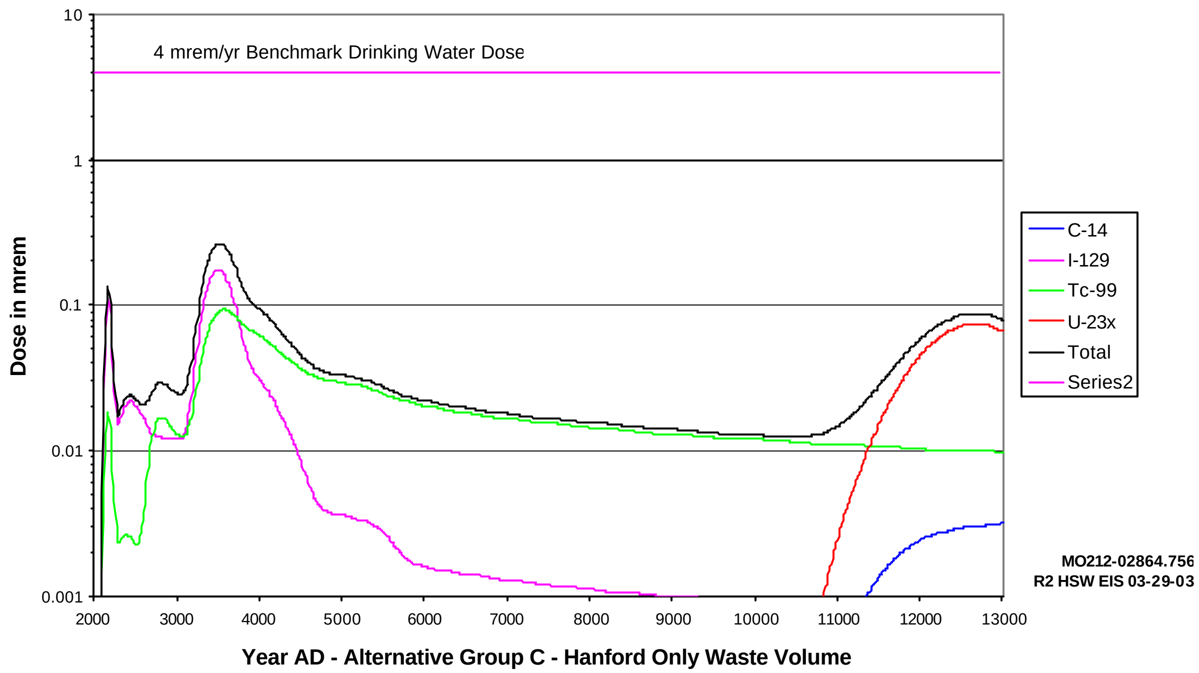


Figure F.8. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from 200 West Area, Alternative Group C



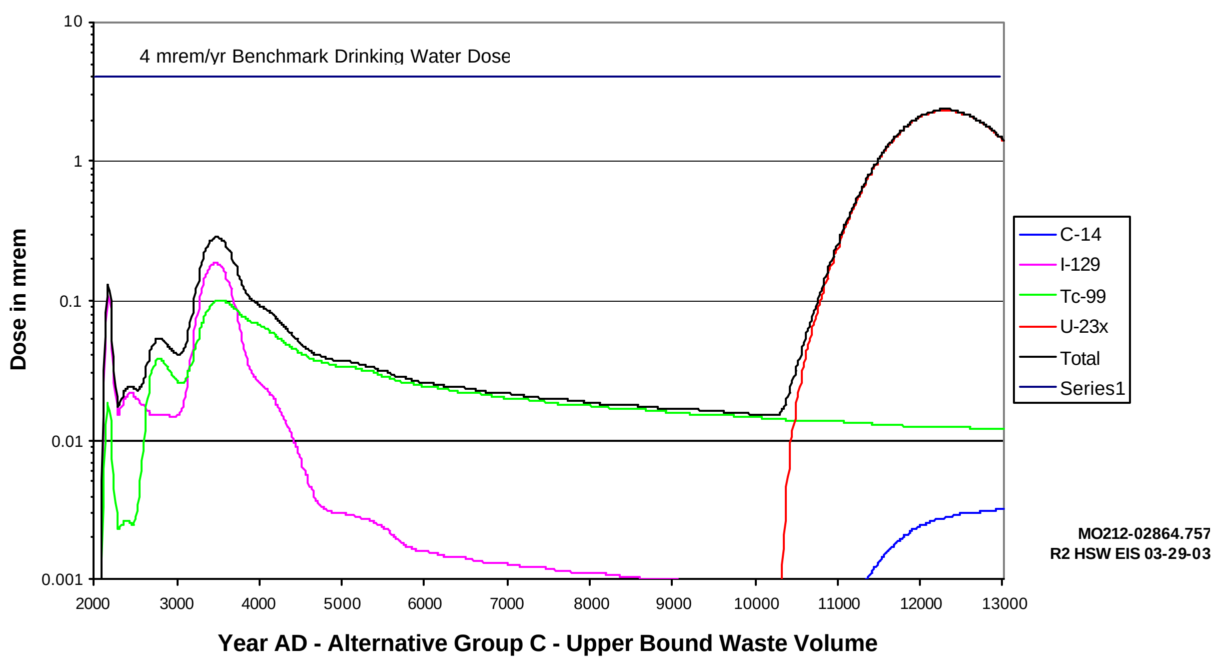
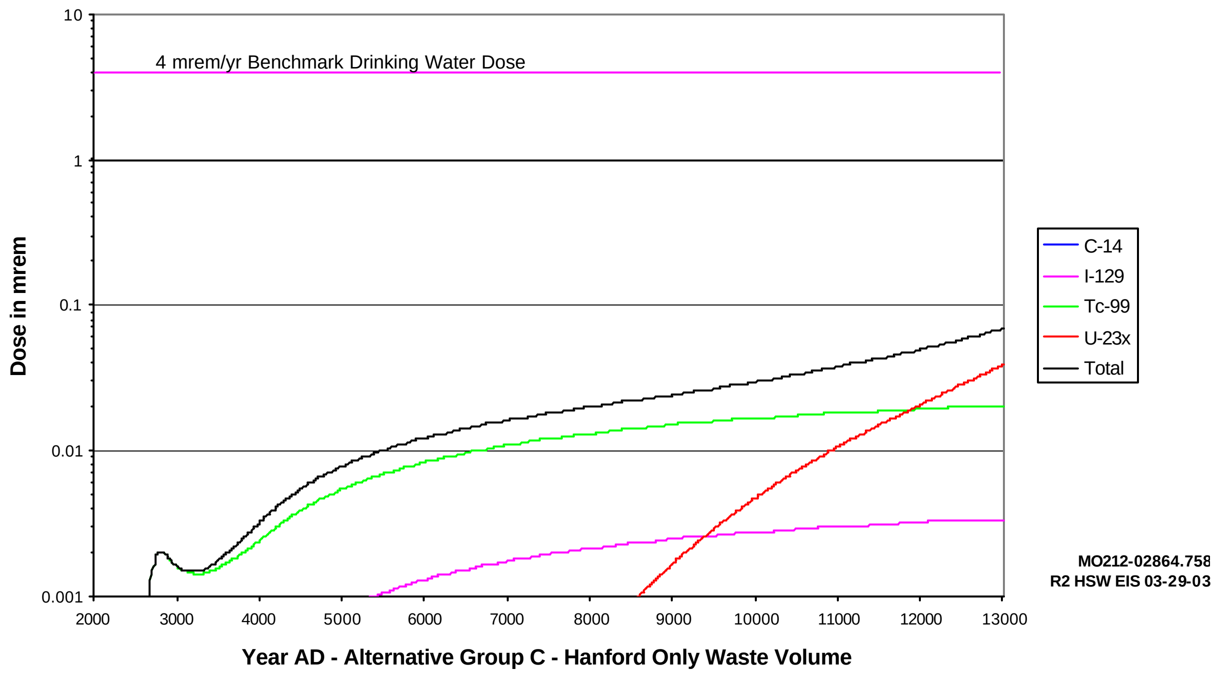


Figure F.9. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Northwest from 200 East Area, Alternative Group C



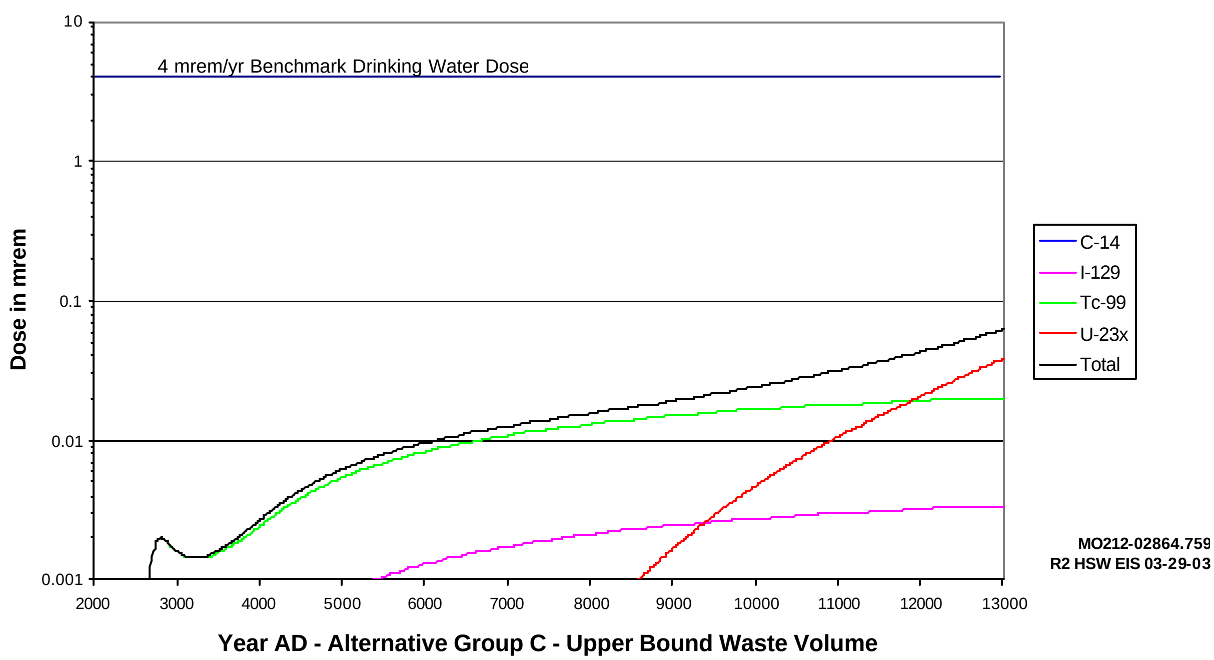


Figure F.10. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Southeast of 200 East Area, Alternative Group C

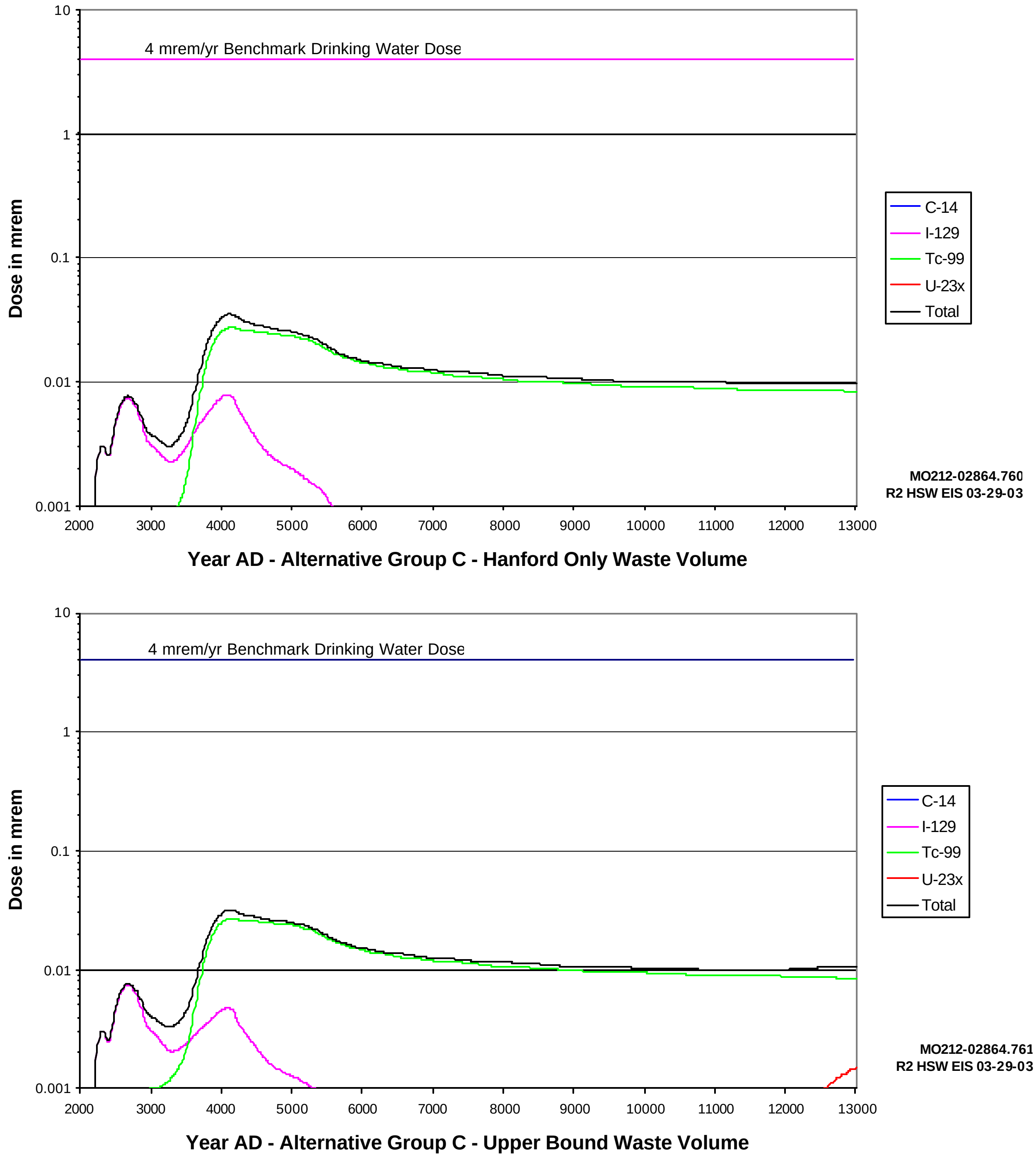
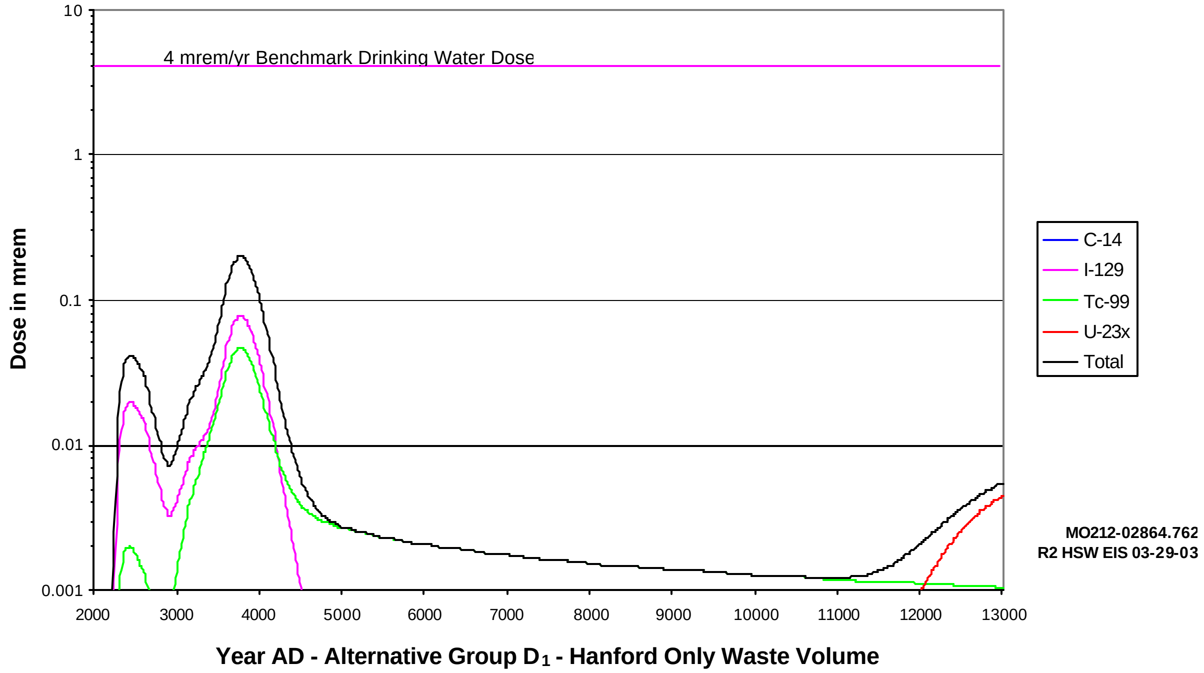


Figure F.11. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group C



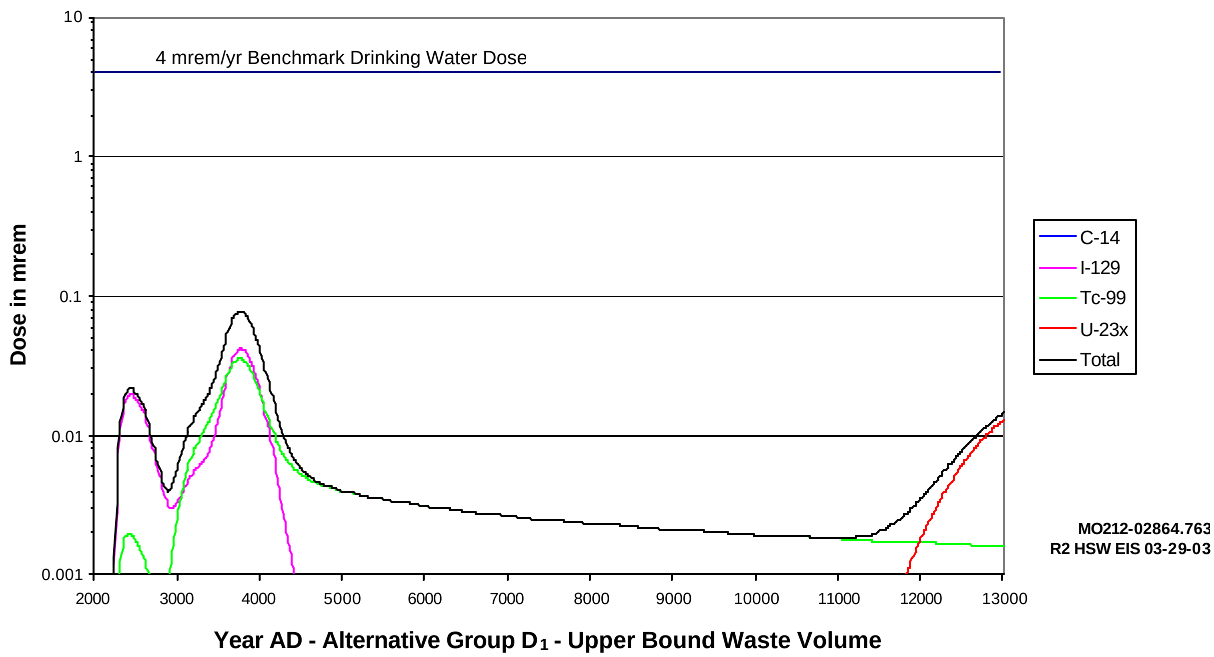
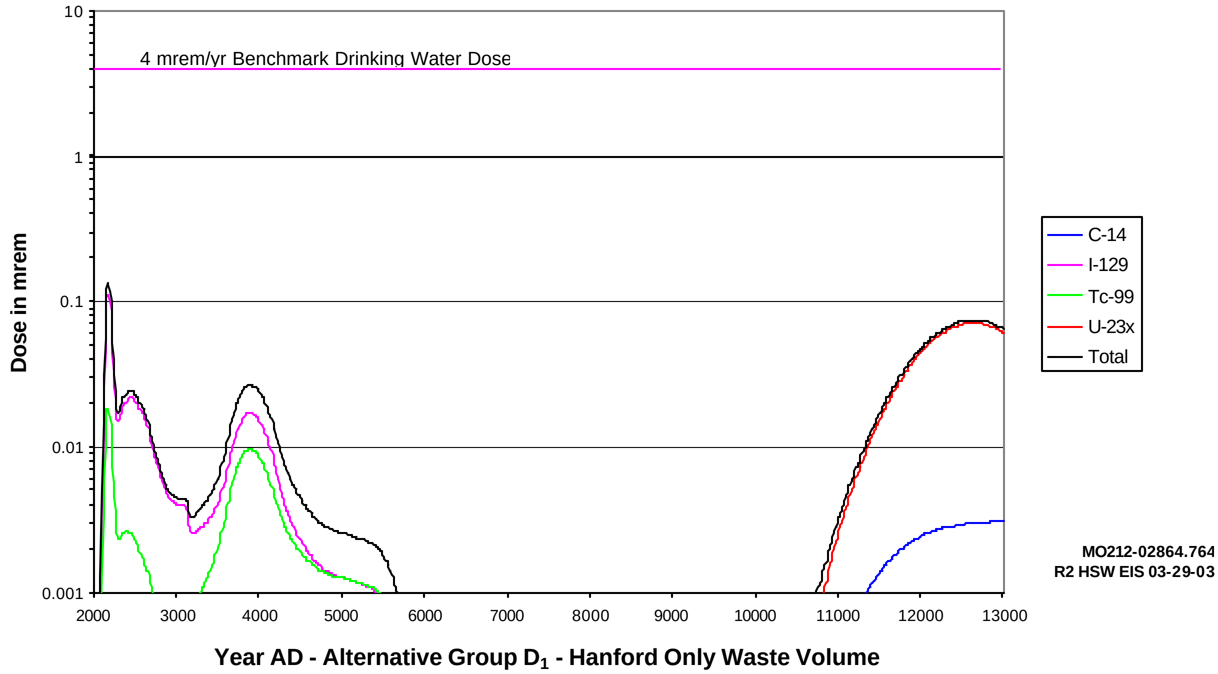


Figure F.12. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from 200 West Area, Alternative Group D_1



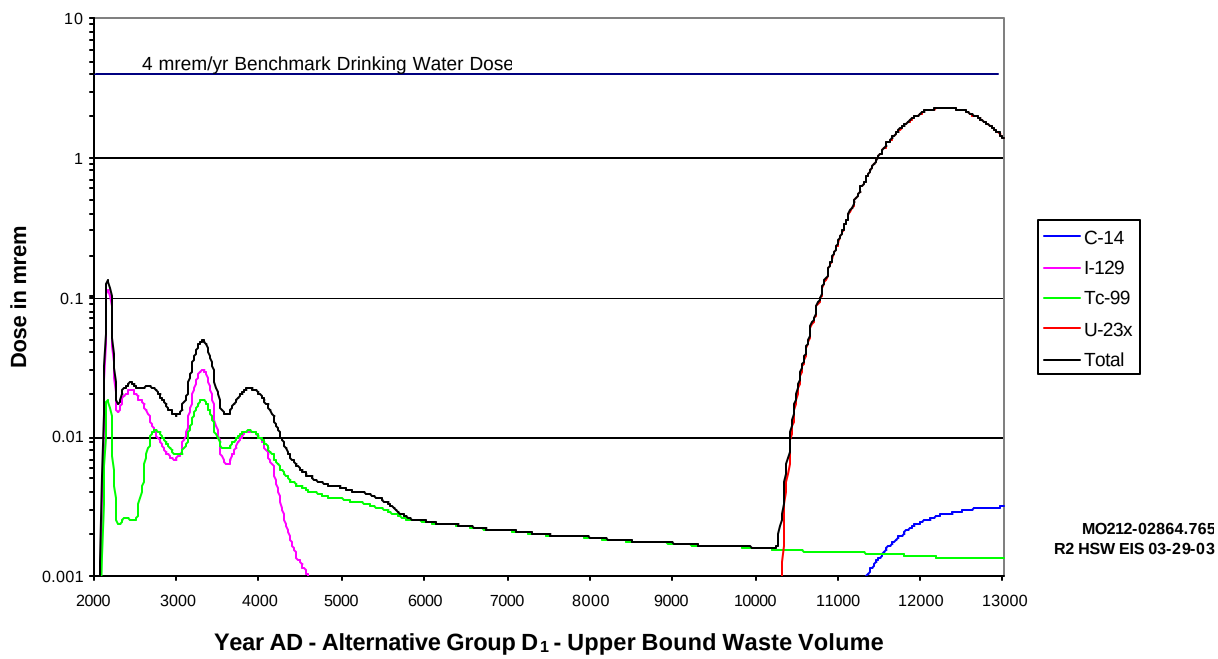
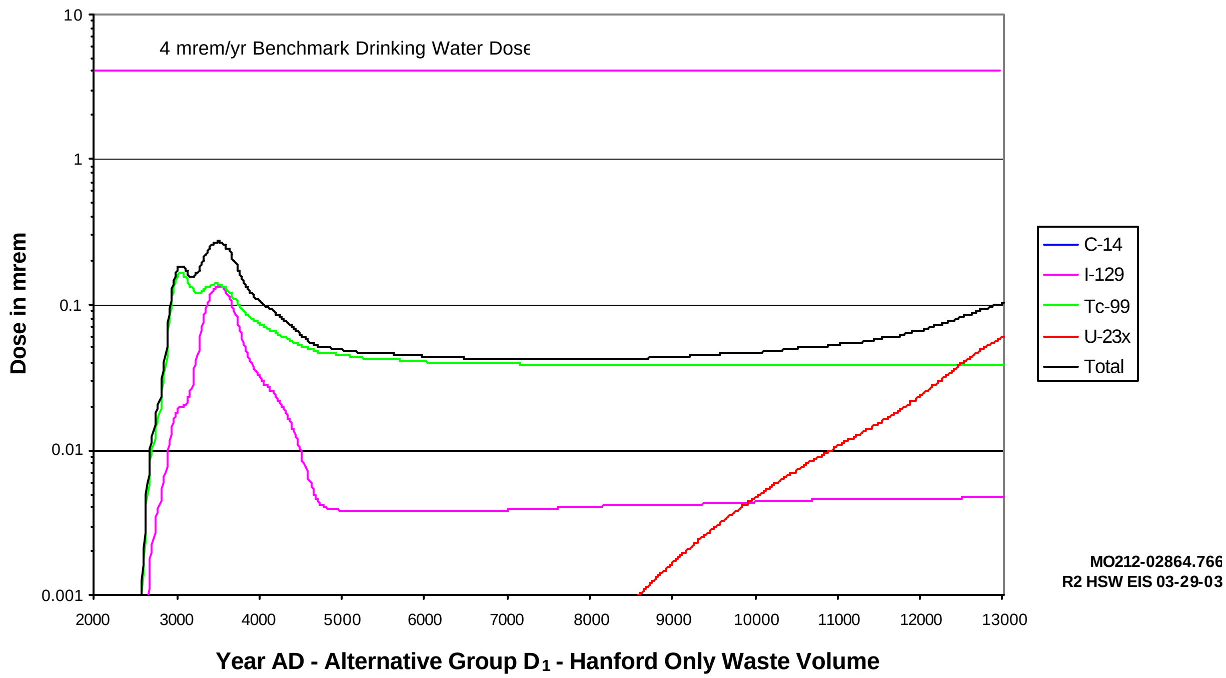


Figure F.13. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Northwest from 200 East Area, Alternative Group D_1



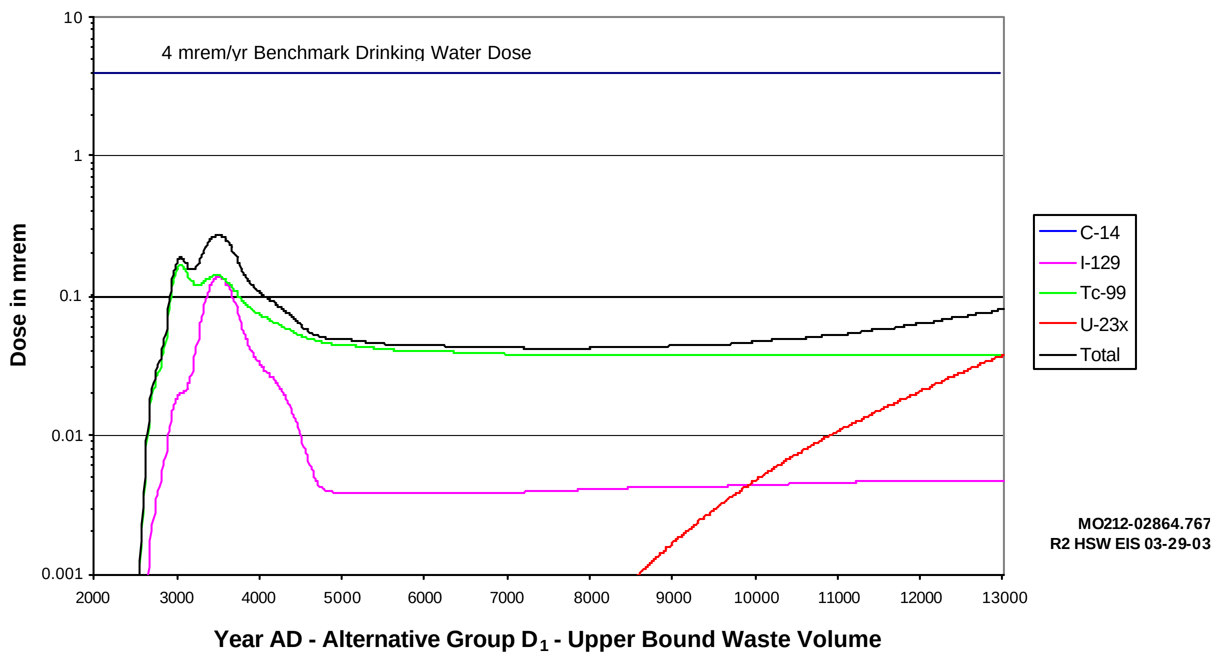
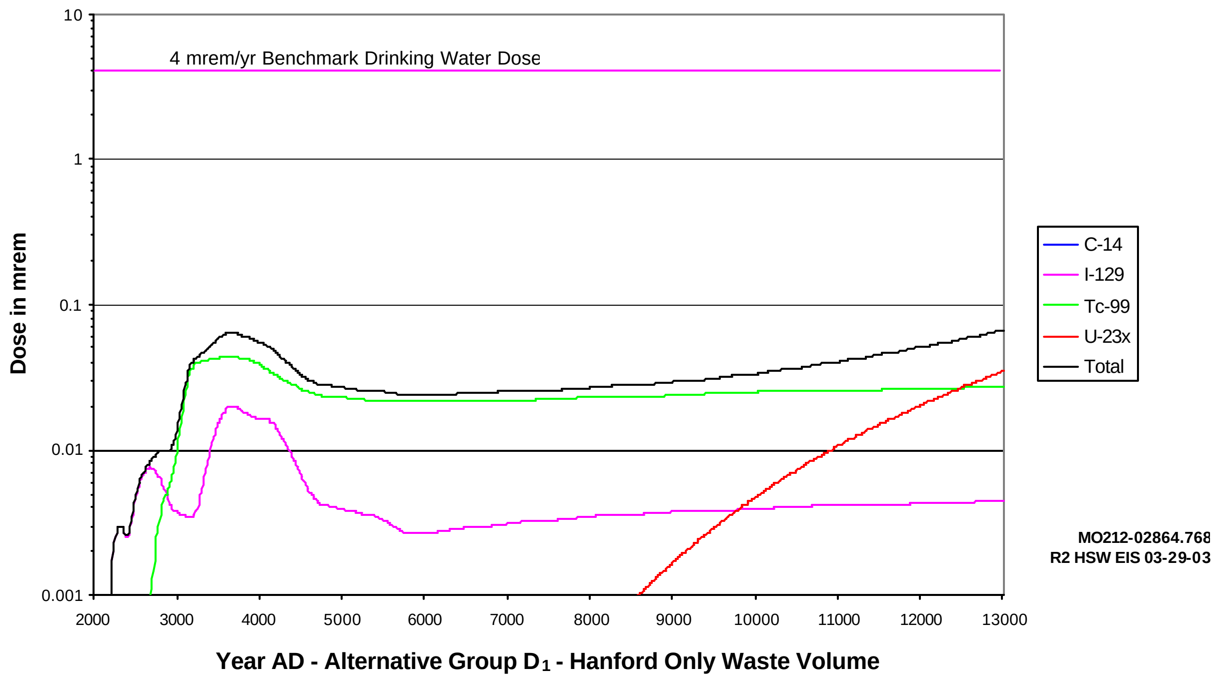


Figure F.14. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Southeast of 200 East Area, Alternative Group D_1



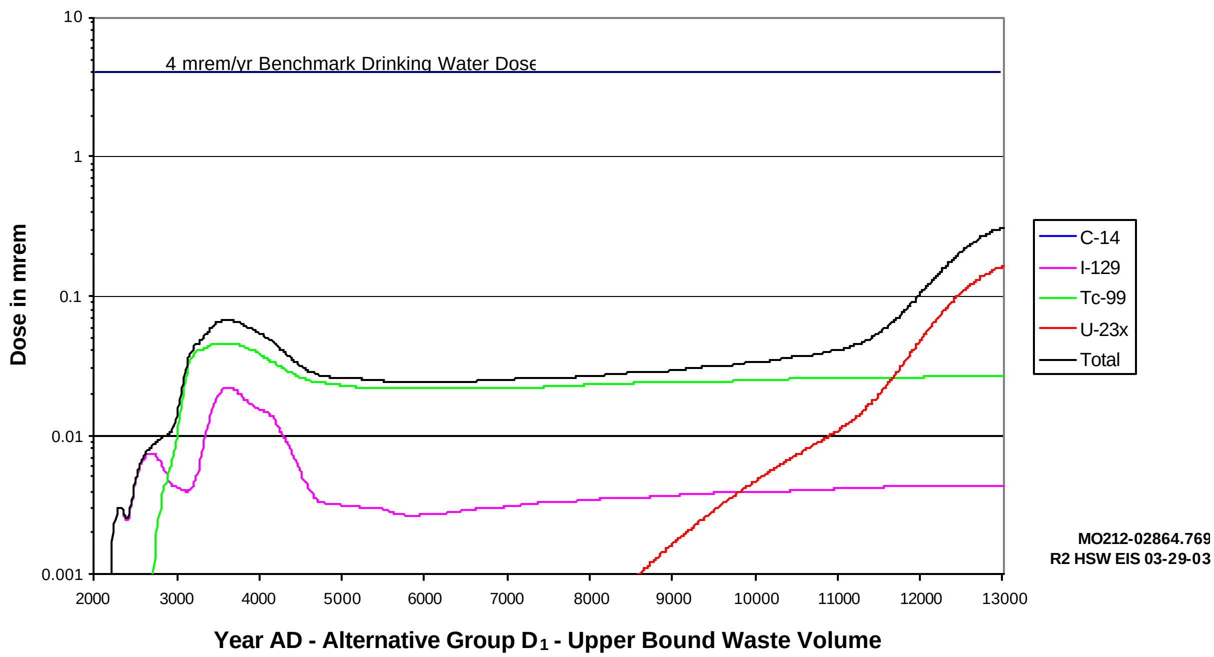
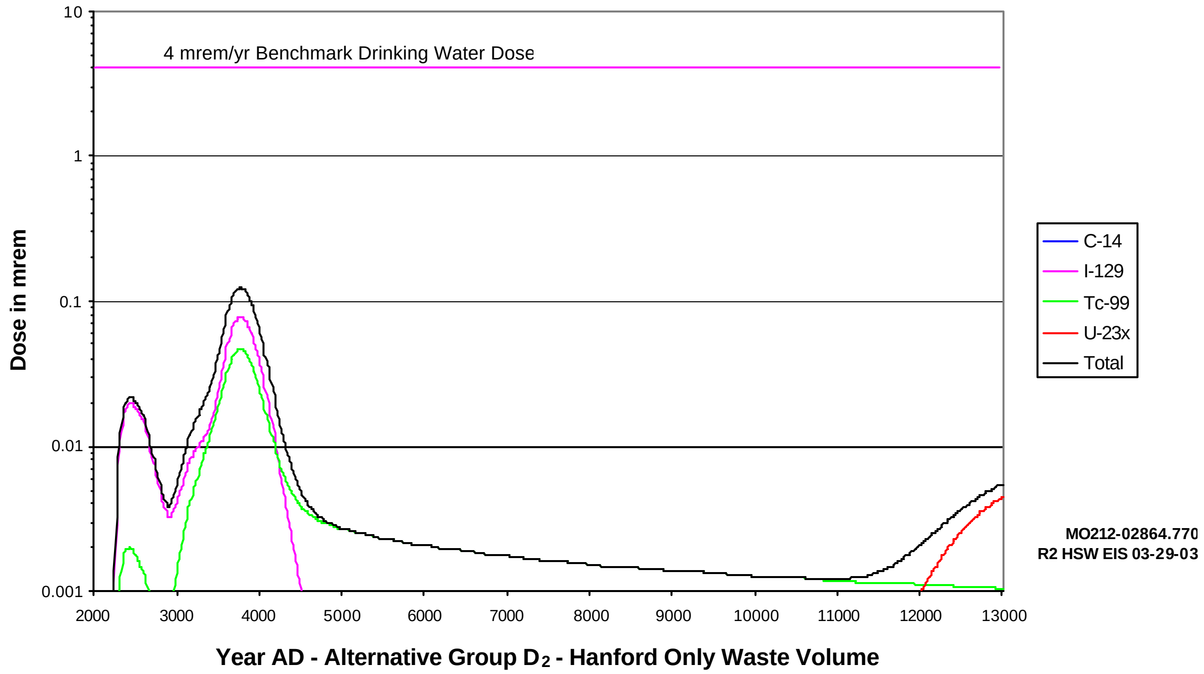


Figure F.15. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group D_1



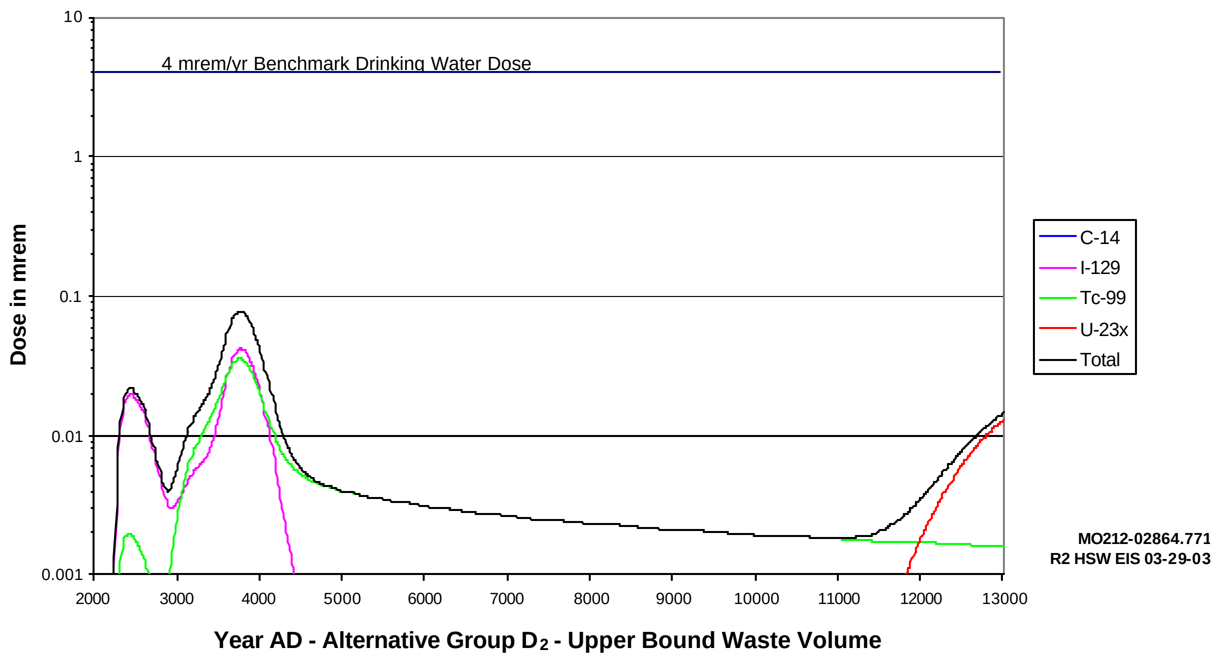
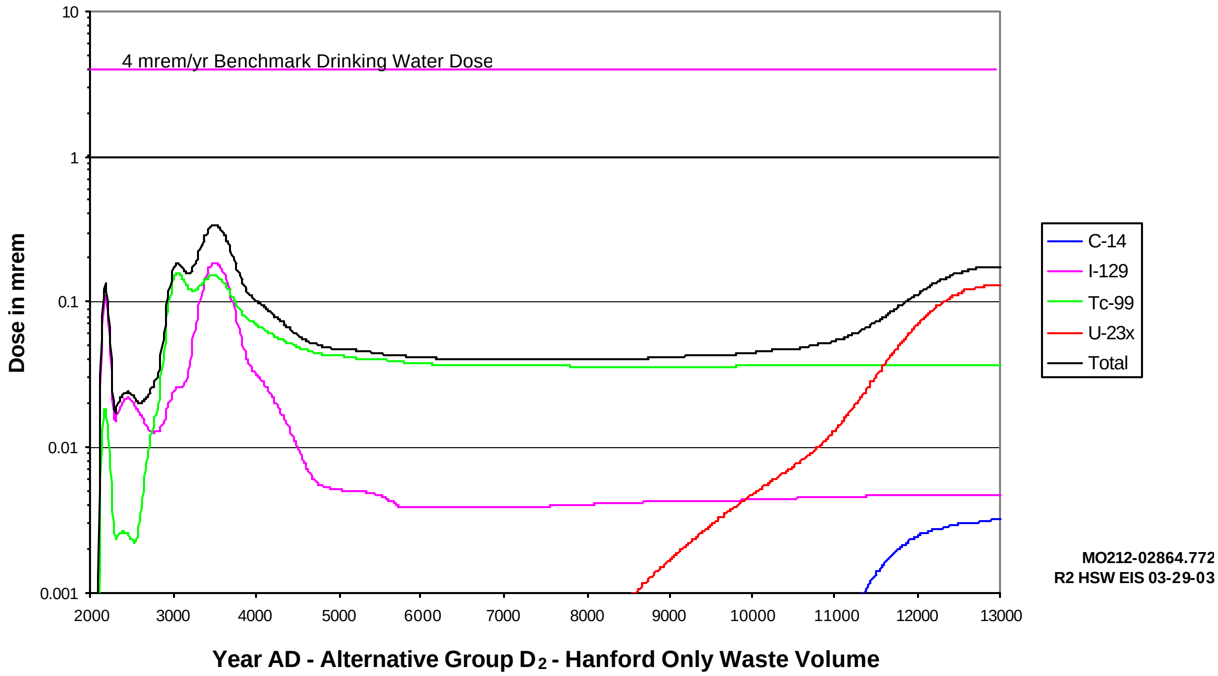


Figure F.16. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from 200 West Area, Alternative Group D_2



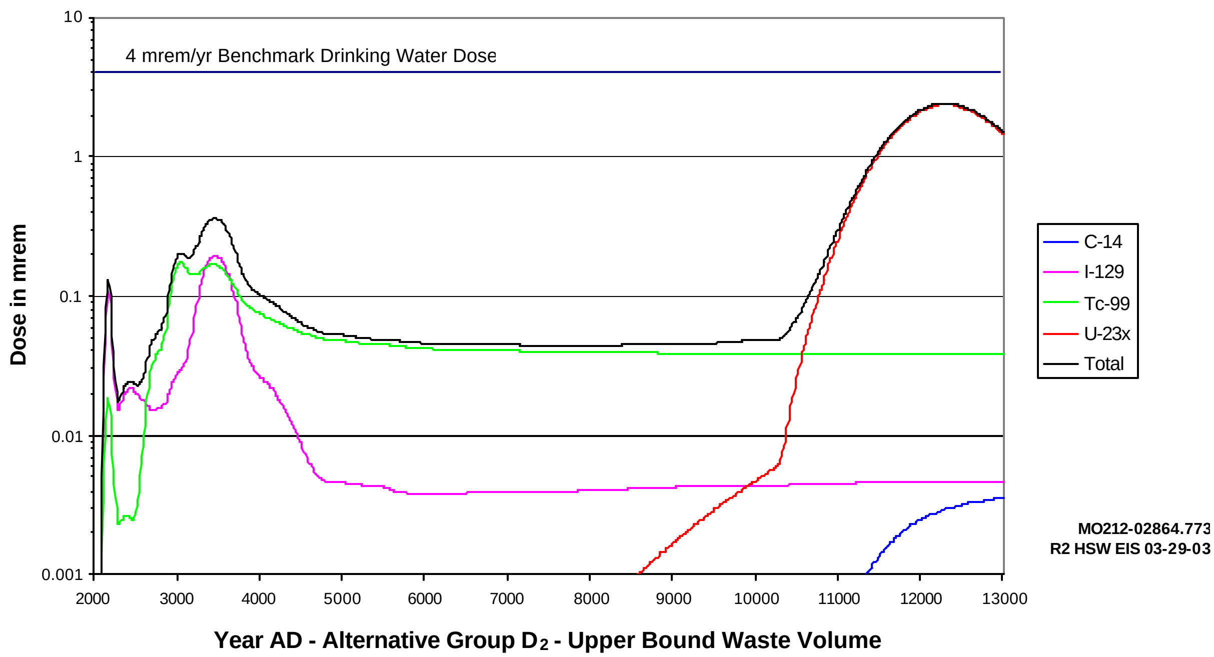
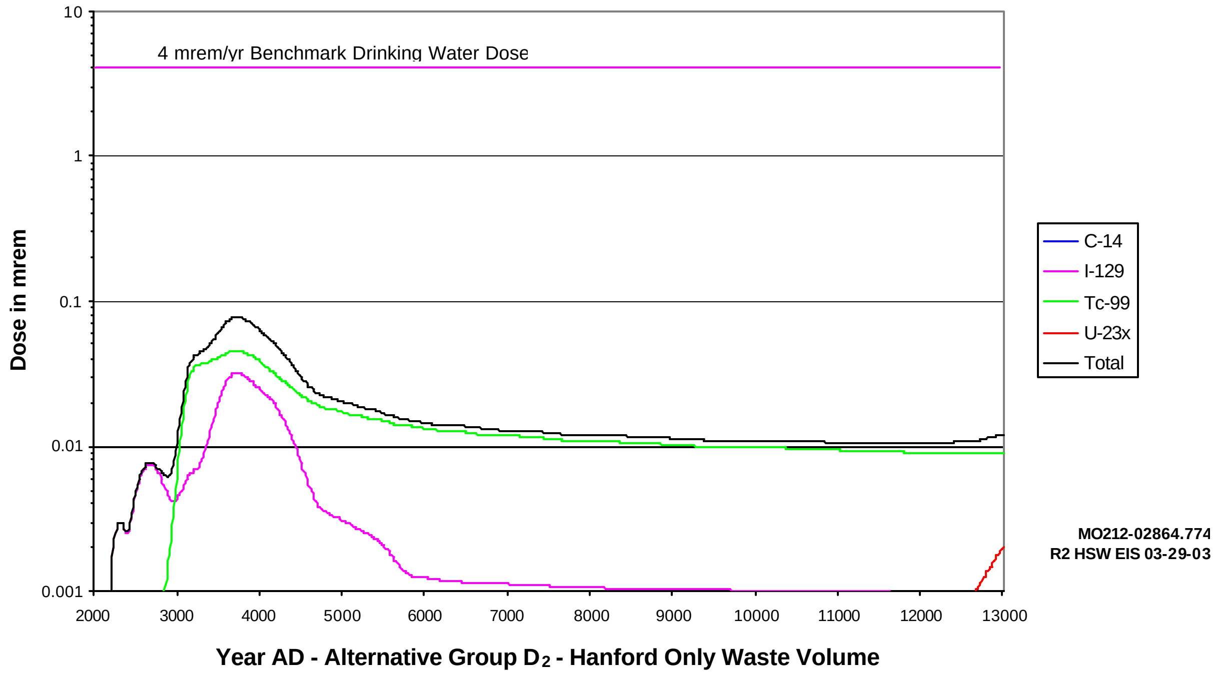


Figure F.17. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Northwest from 200 East Area, Alternative Group D_2



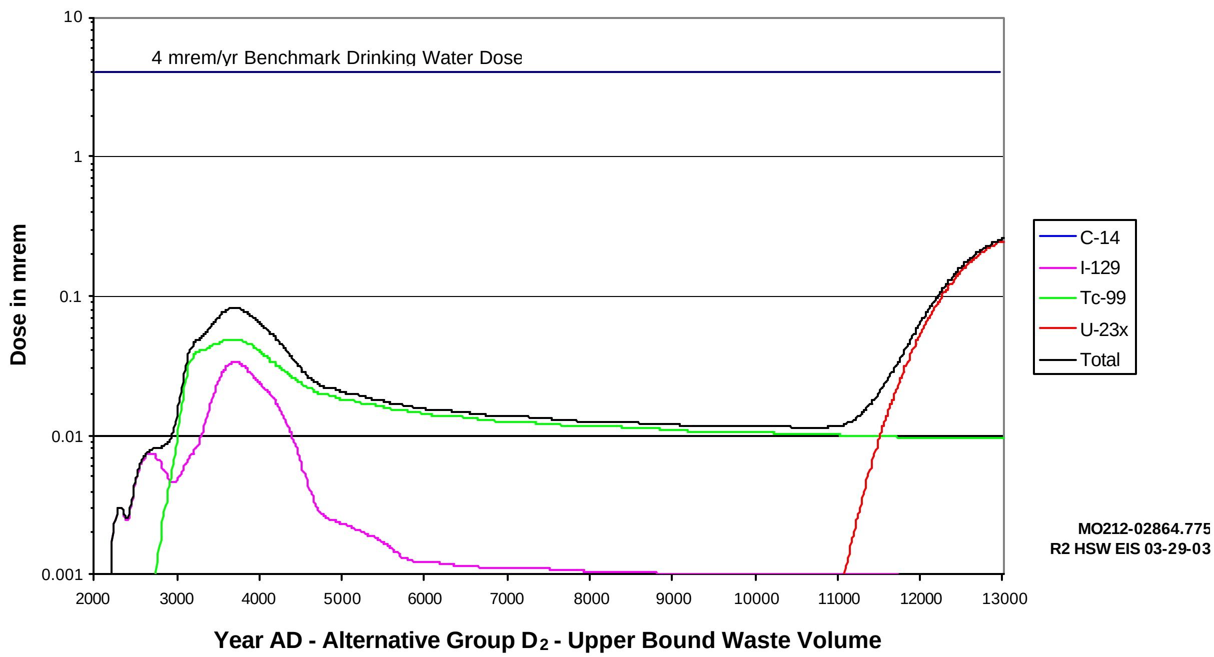
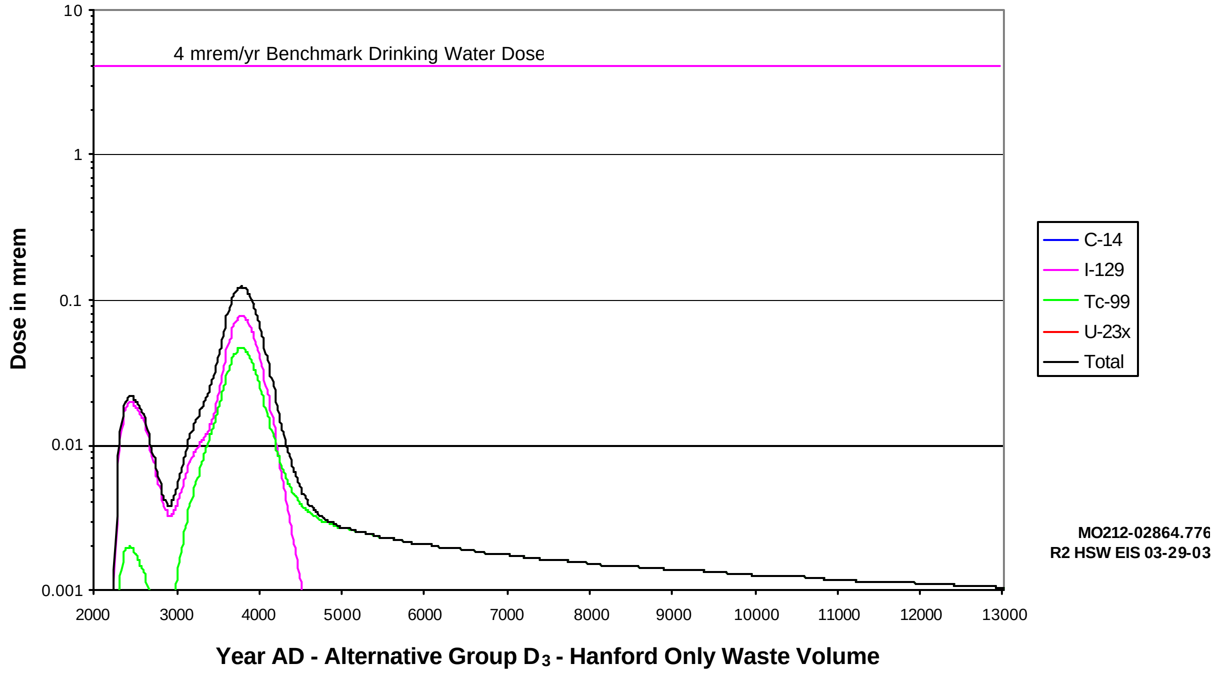


Figure F.18. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group D_2



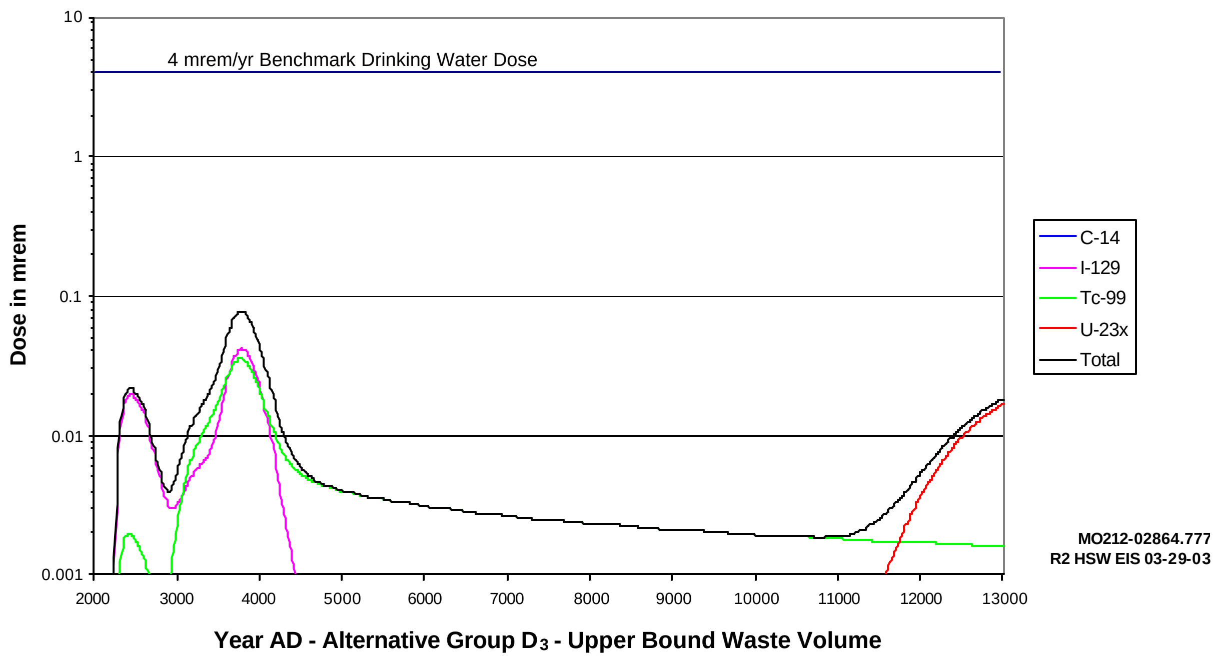
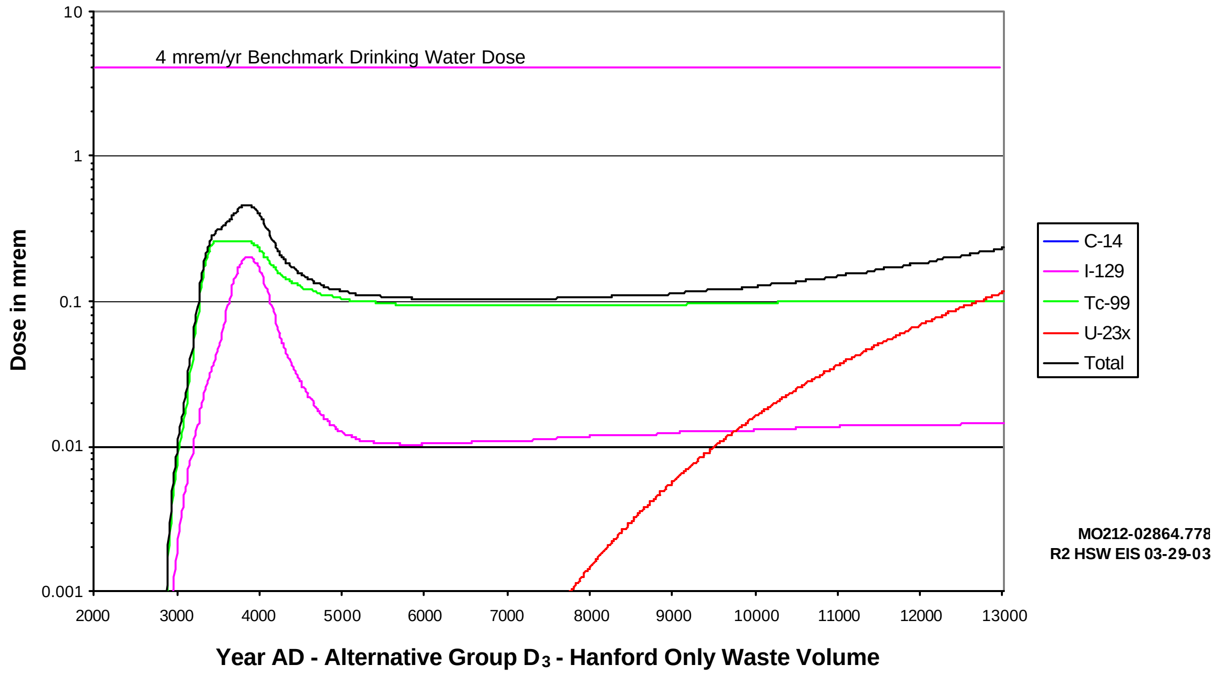


Figure F.19. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from 200 West Area, Alternative Group D_3



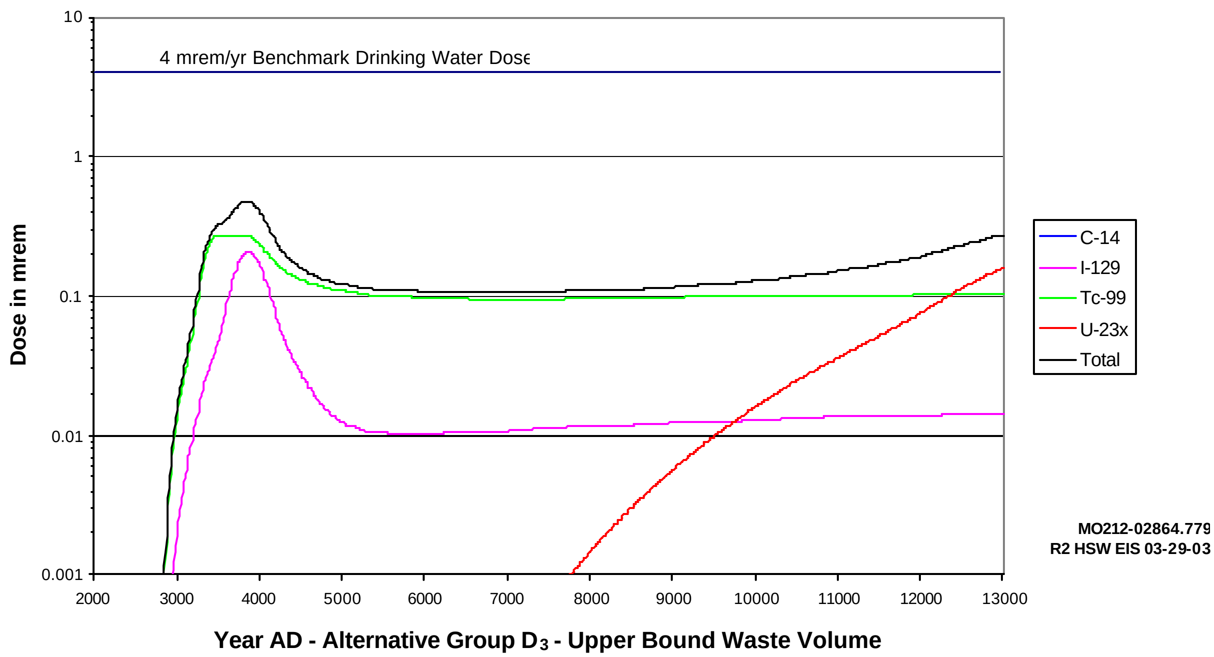


Figure F.20. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from ERDF, Alternative Group D_3

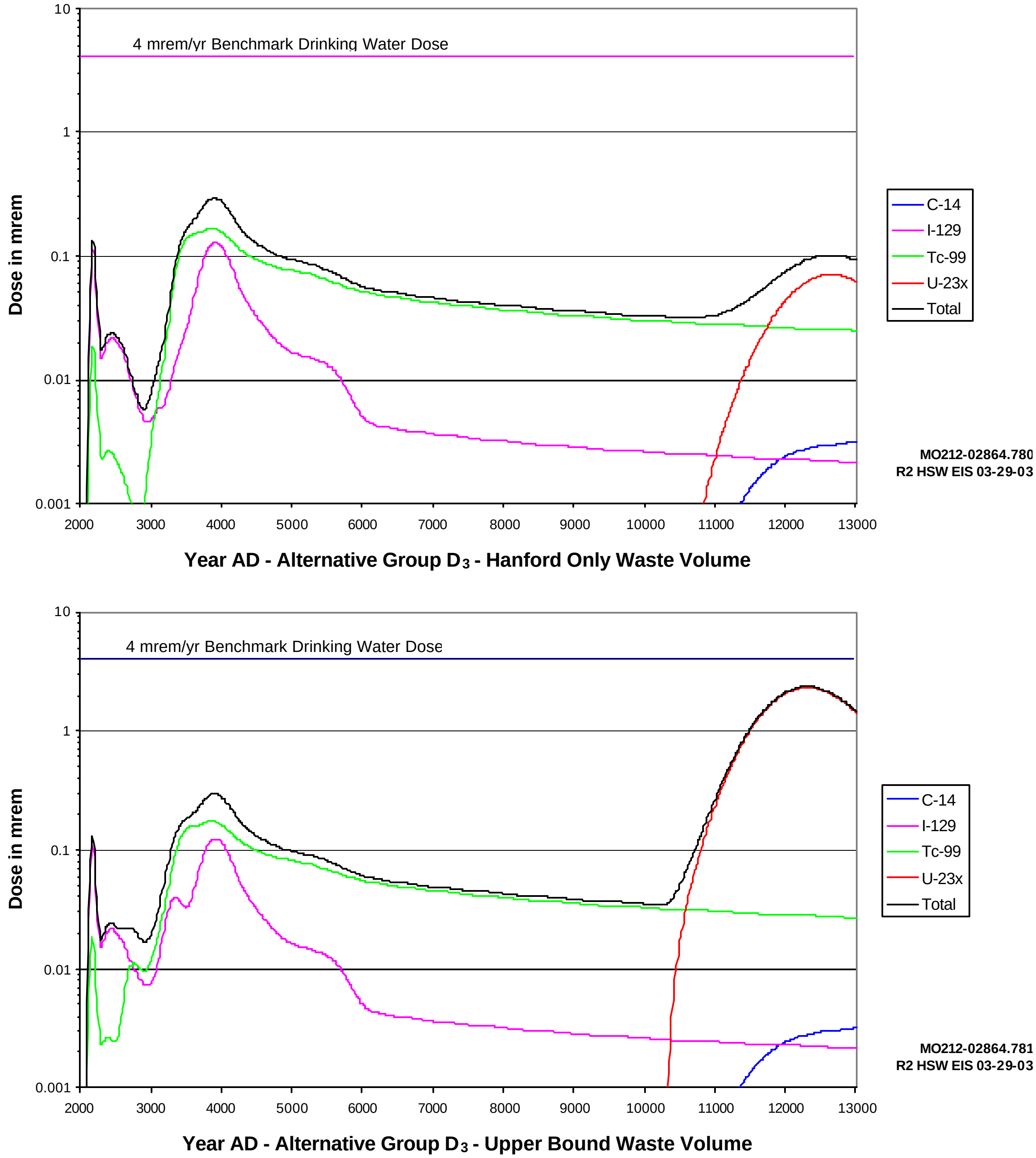
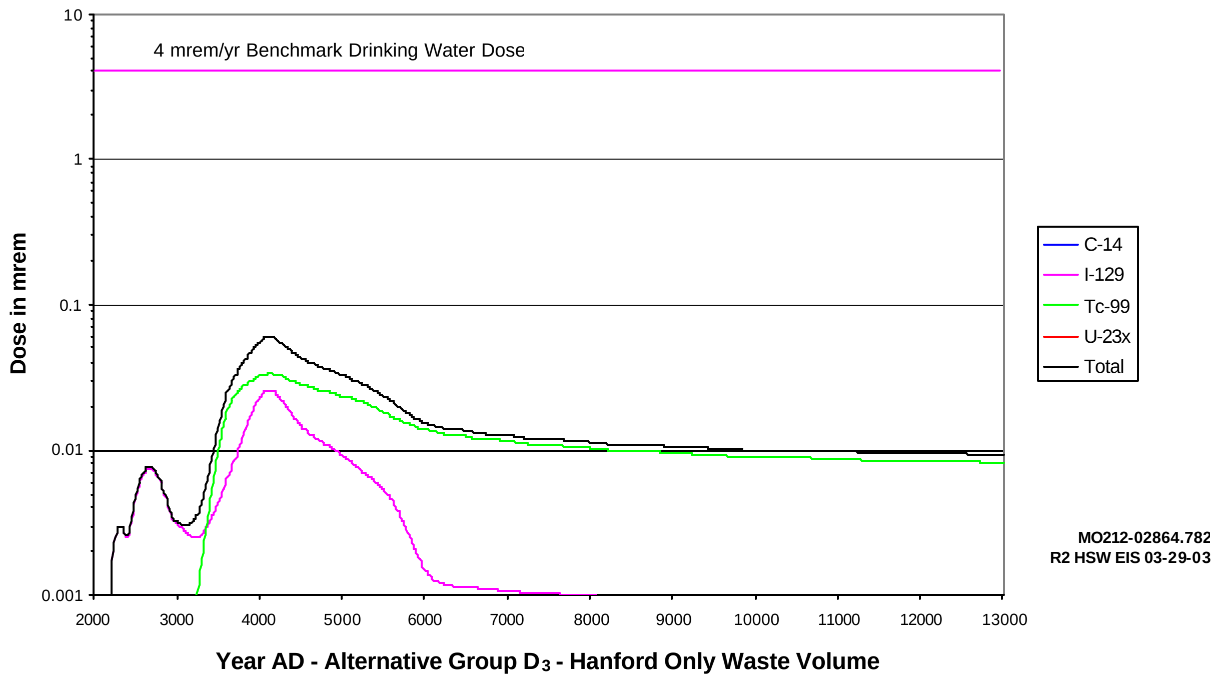


Figure F.21. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Northwest from 200 East Area, Alternative Group D_3



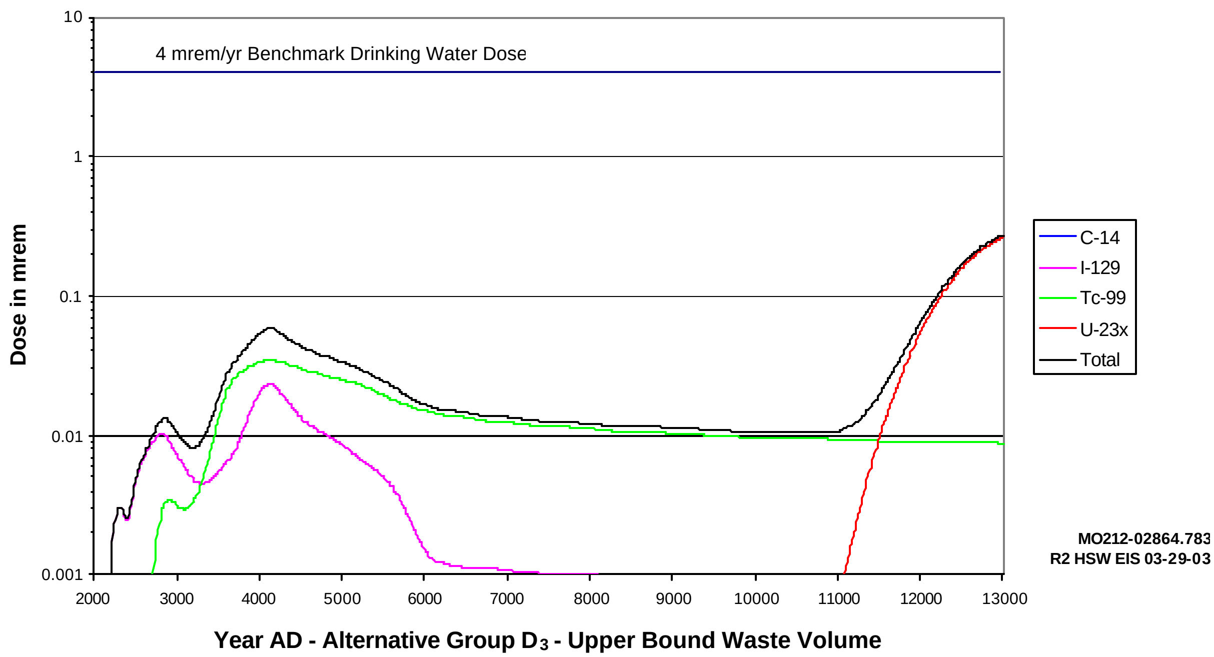


Figure F.22. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group D_3

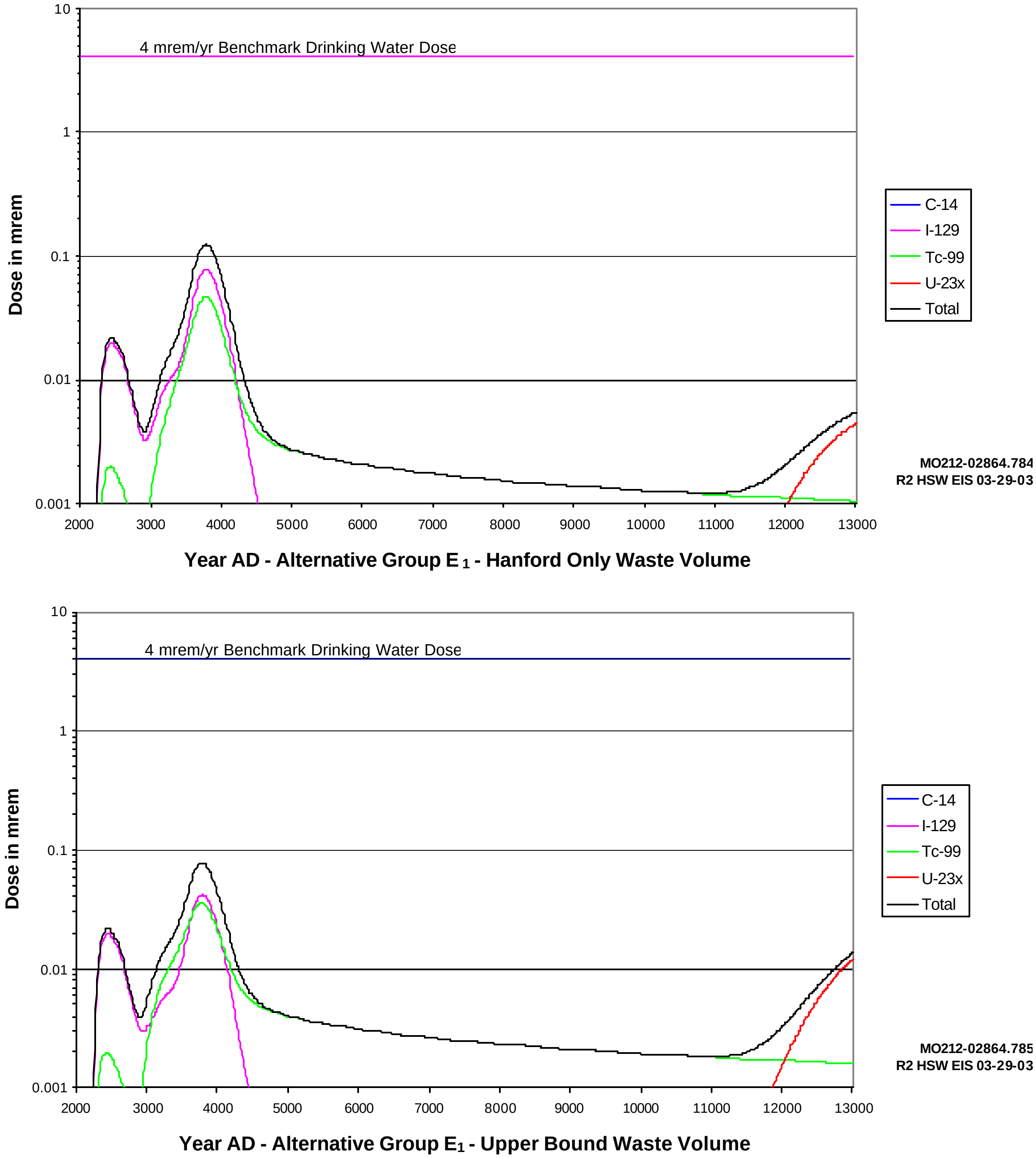
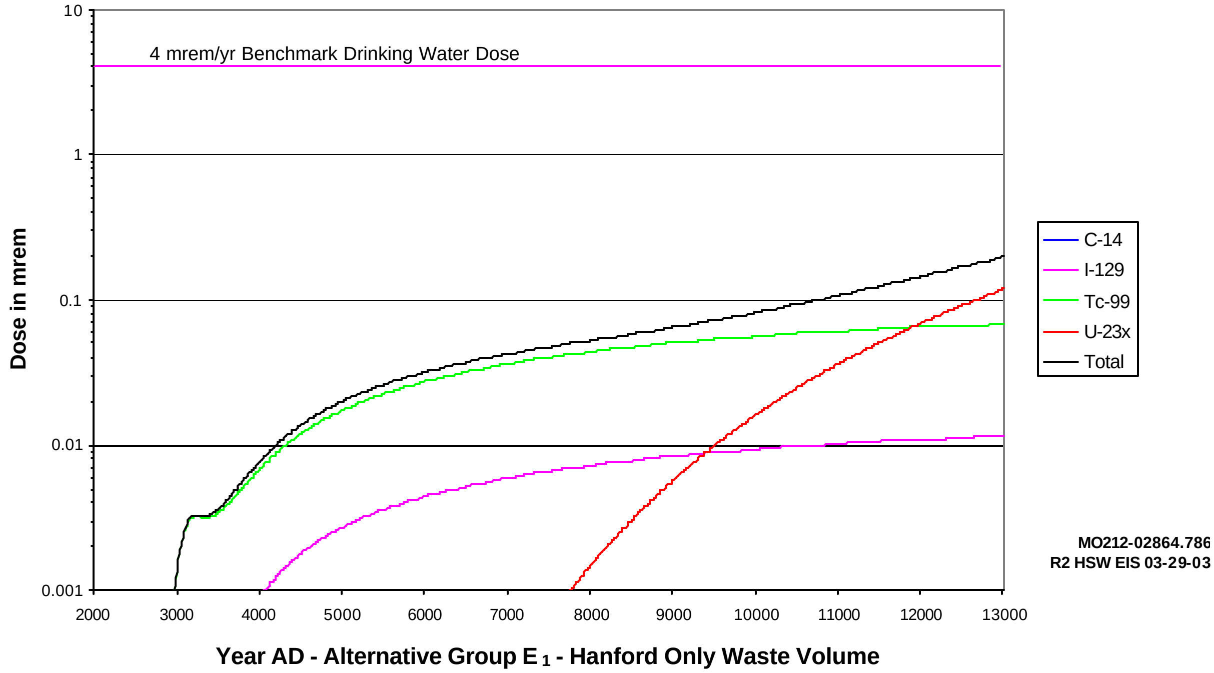


Figure F.23. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from 200 West Area, Alternative Group E_1



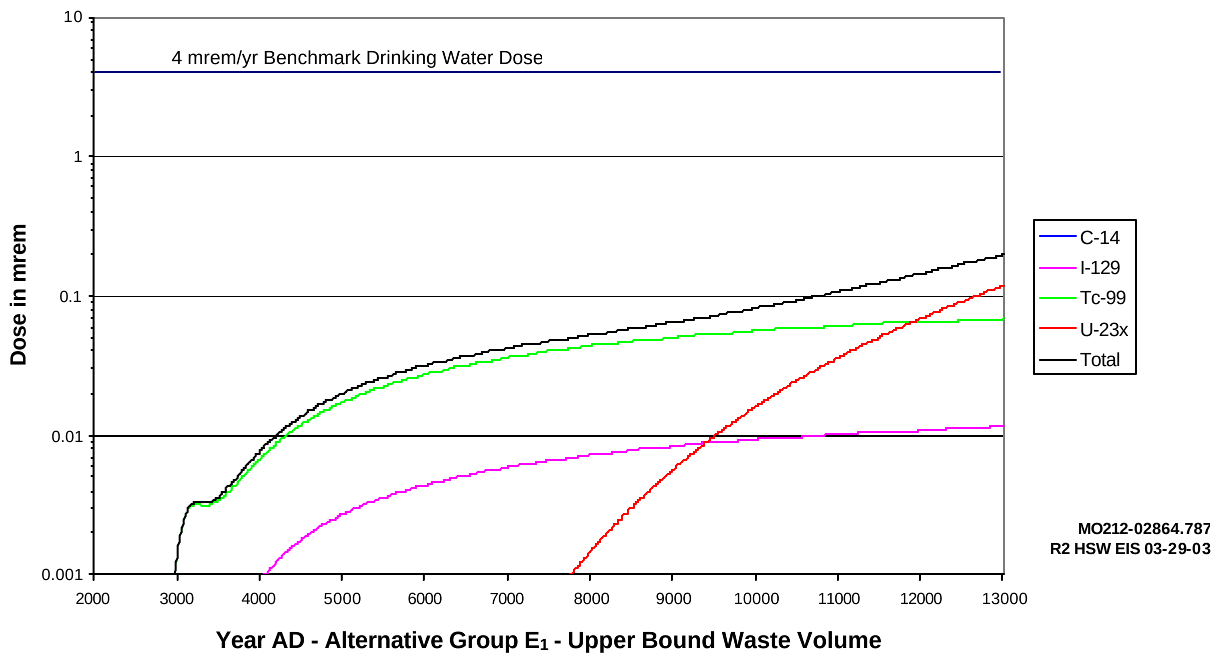
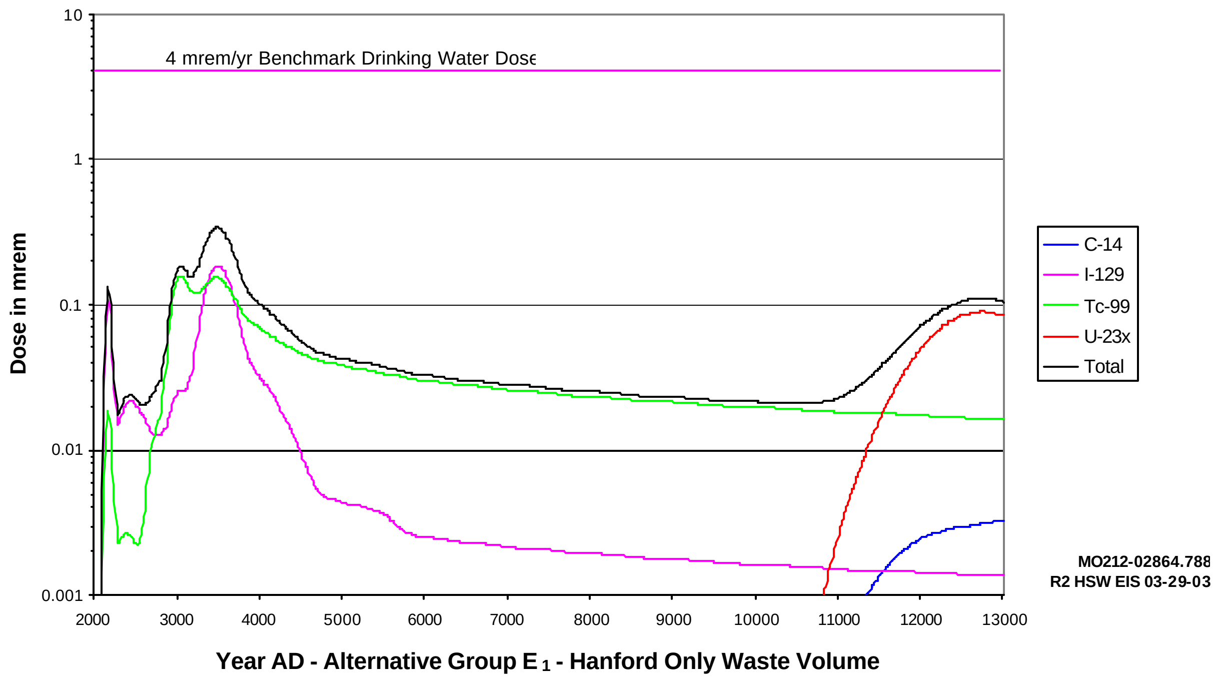


Figure F.24. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from ERDF, Alternative Group E_1



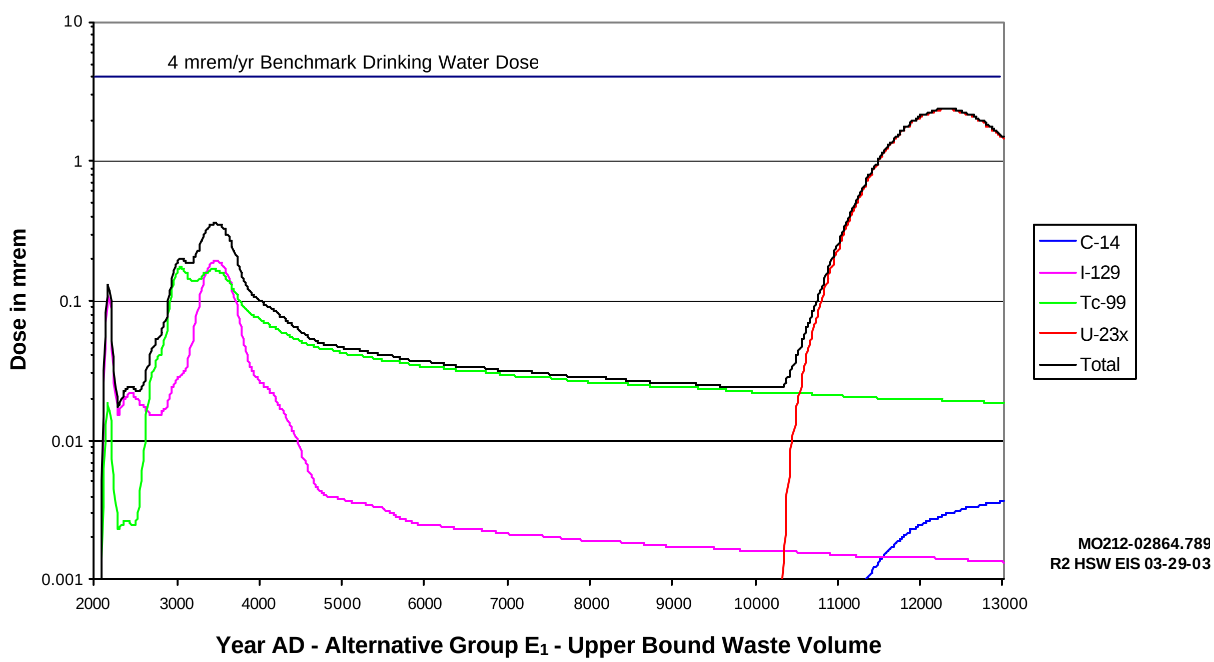
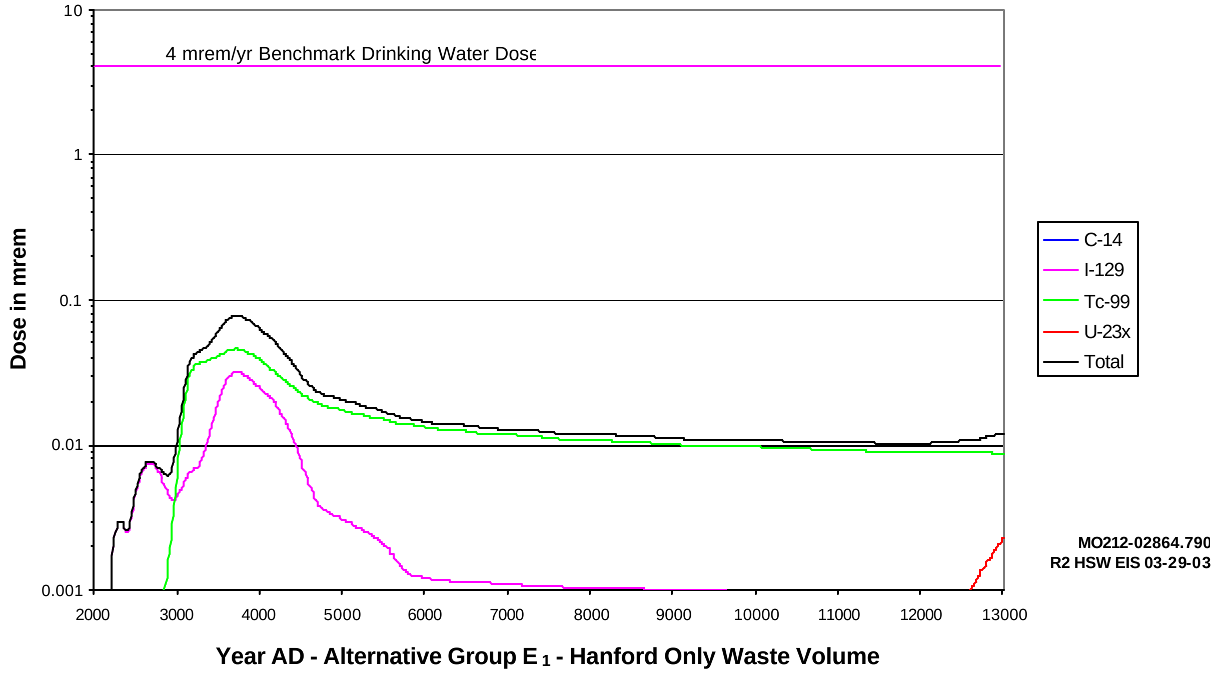


Figure F.25. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Northwest from 200 East Area, Alternative Group E_1



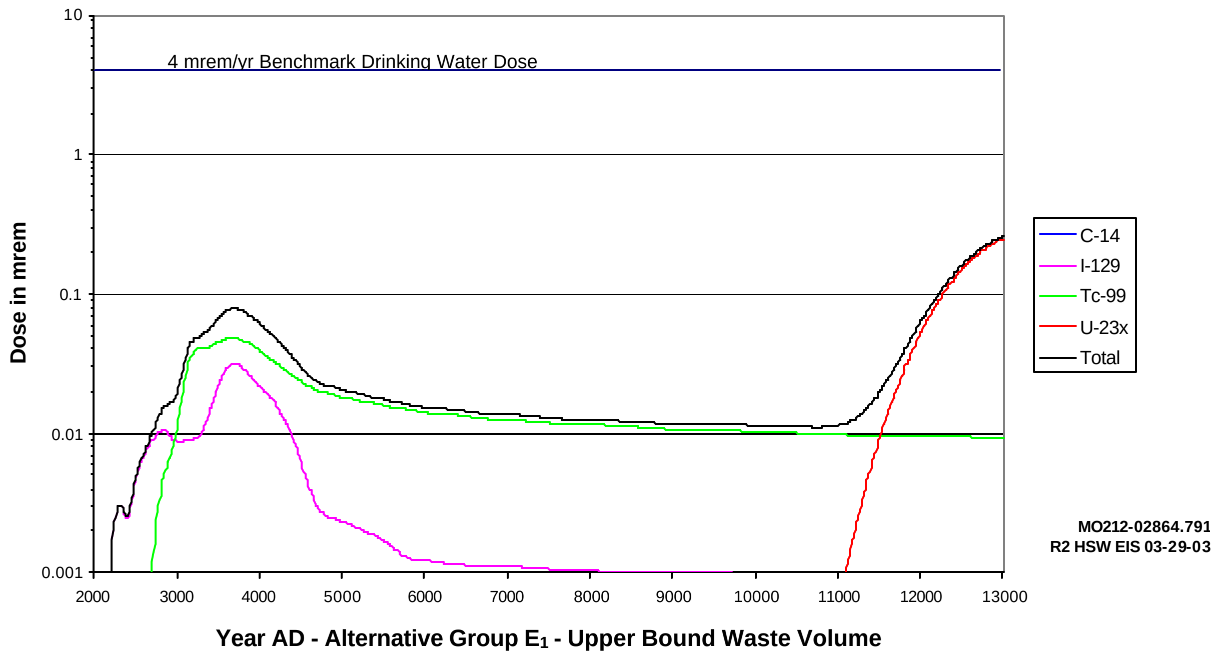
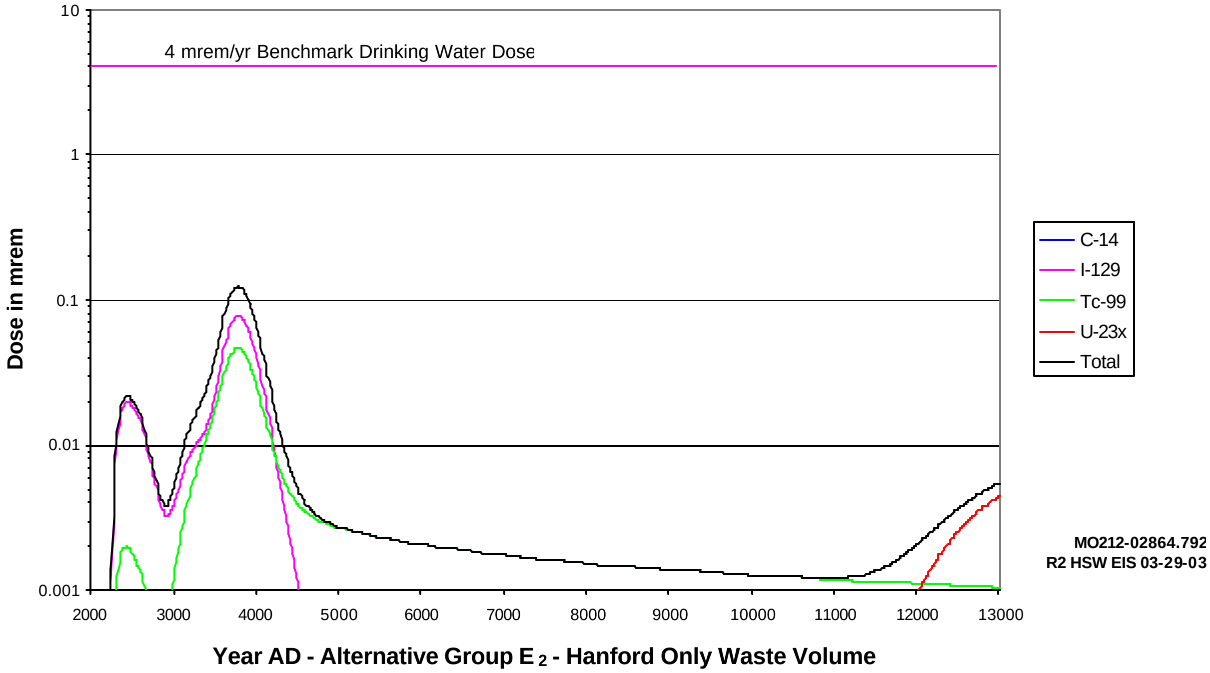


Figure F.26. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group E_1



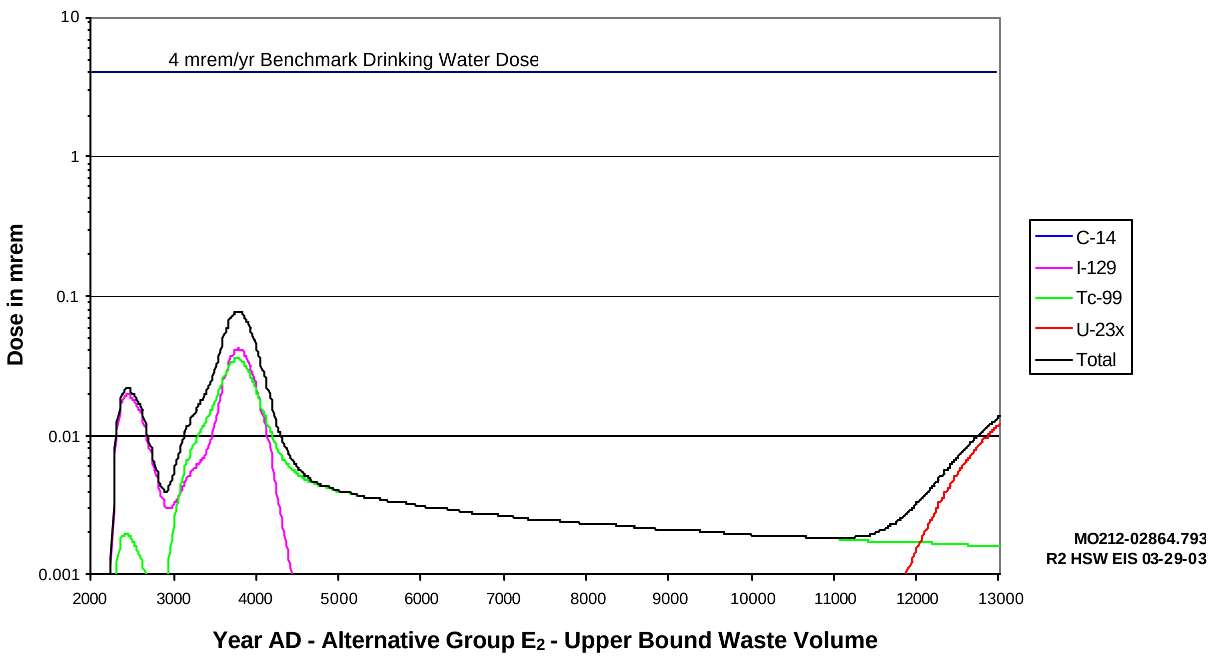
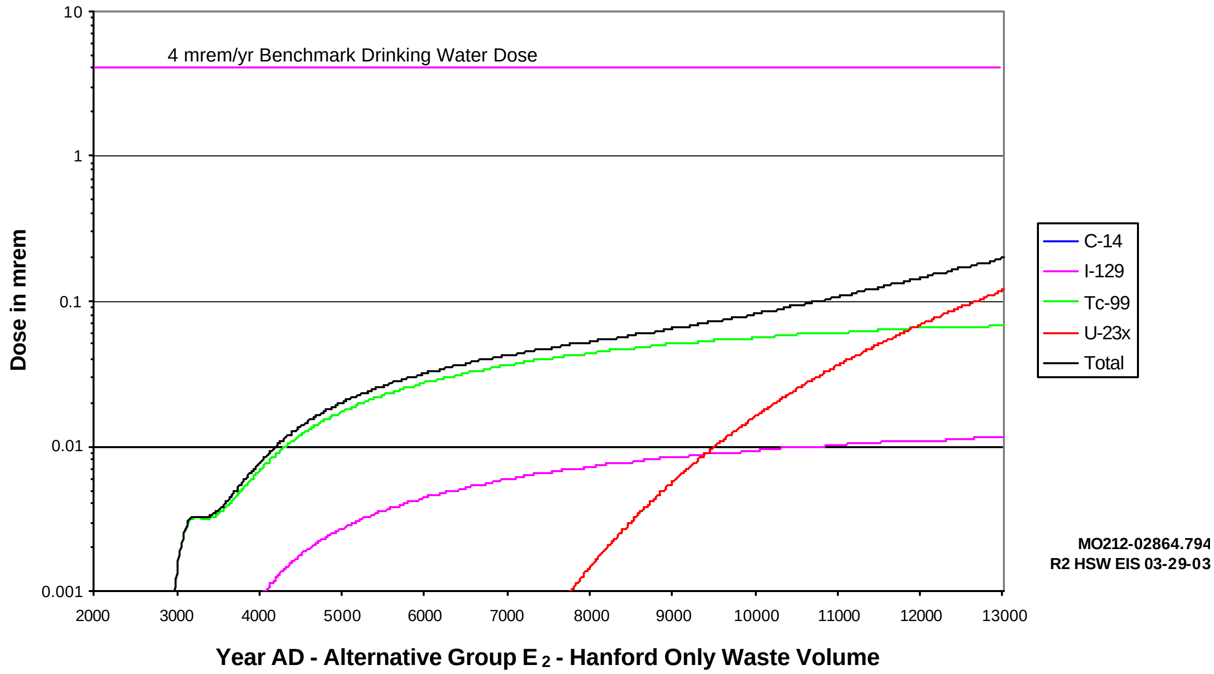


Figure F.27. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from 200 West Area, Alternative Group E_2



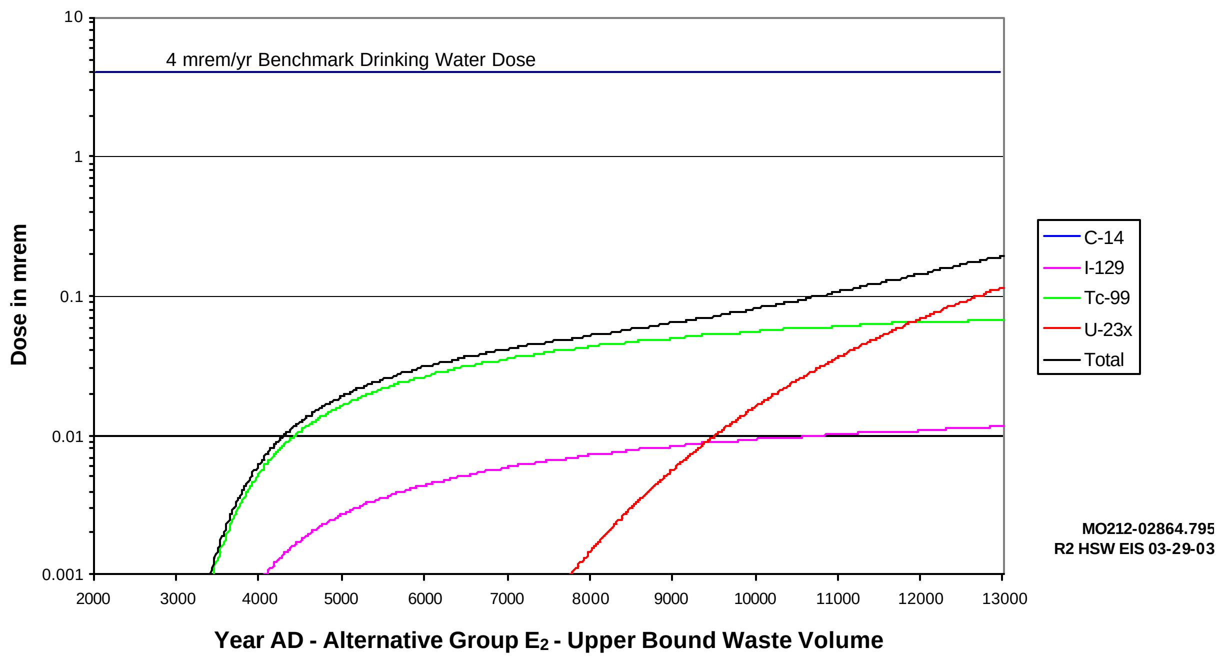
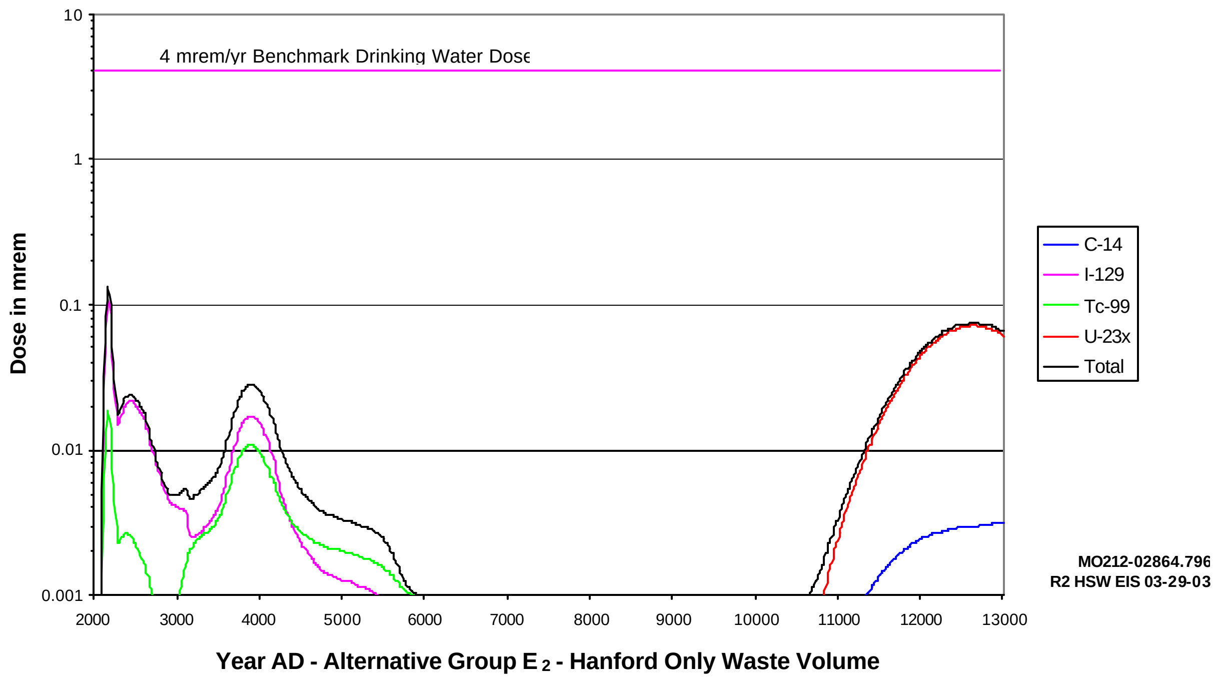


Figure F.28. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from ERDF, Alternative Group E_2



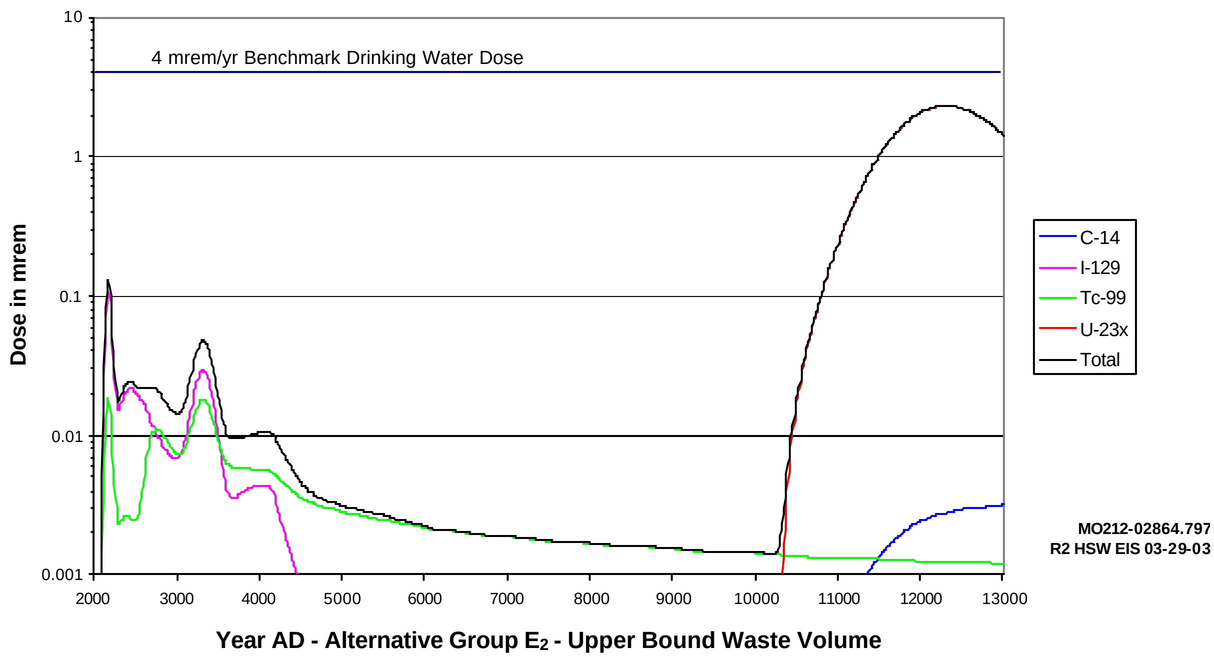
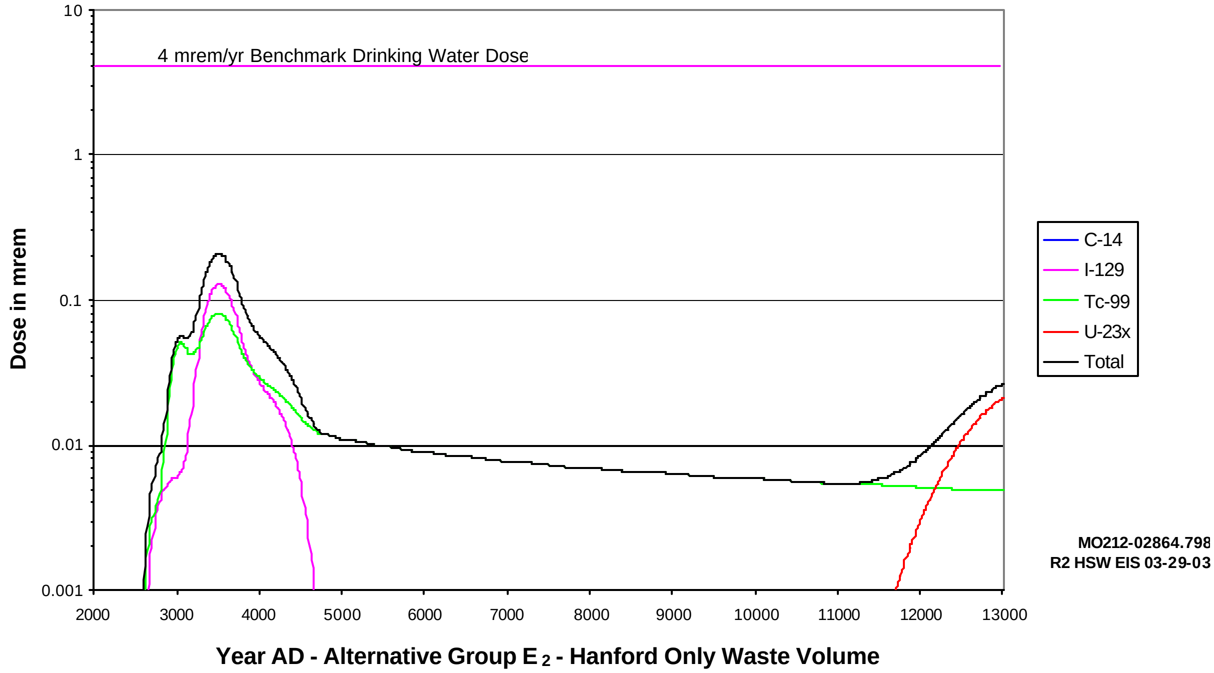


Figure F.29. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Northwest from 200 East Area, Alternative Group E_2



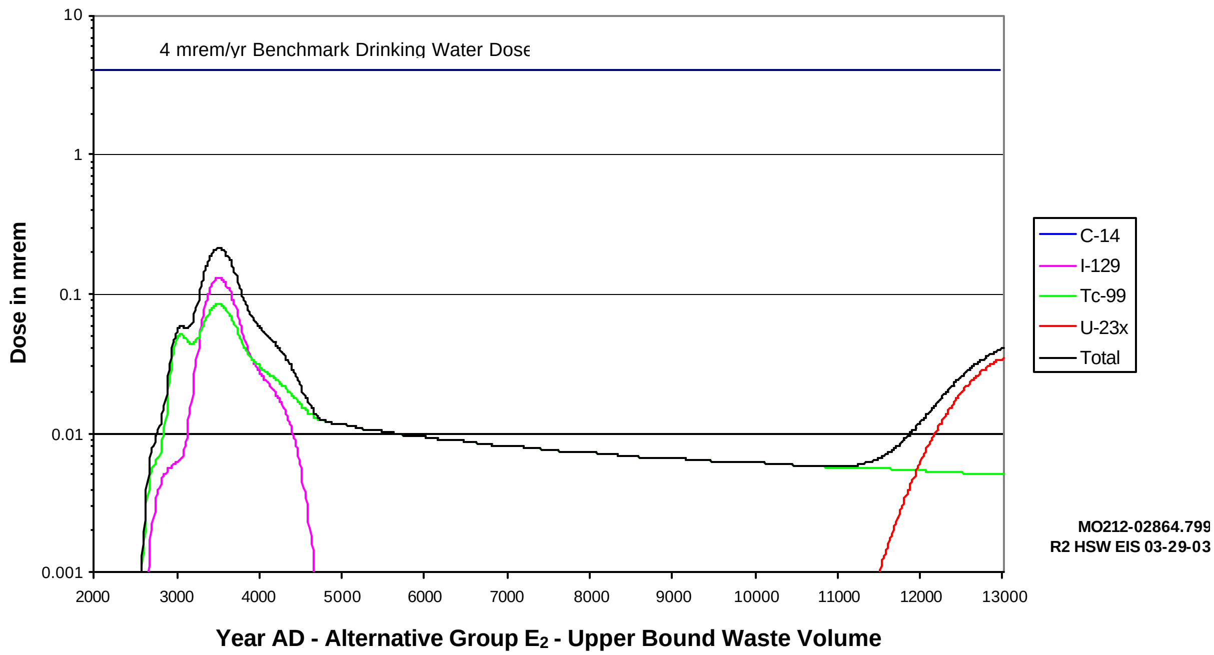


Figure F.30. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Southeast of 200 East Area, Alternative Group E_2

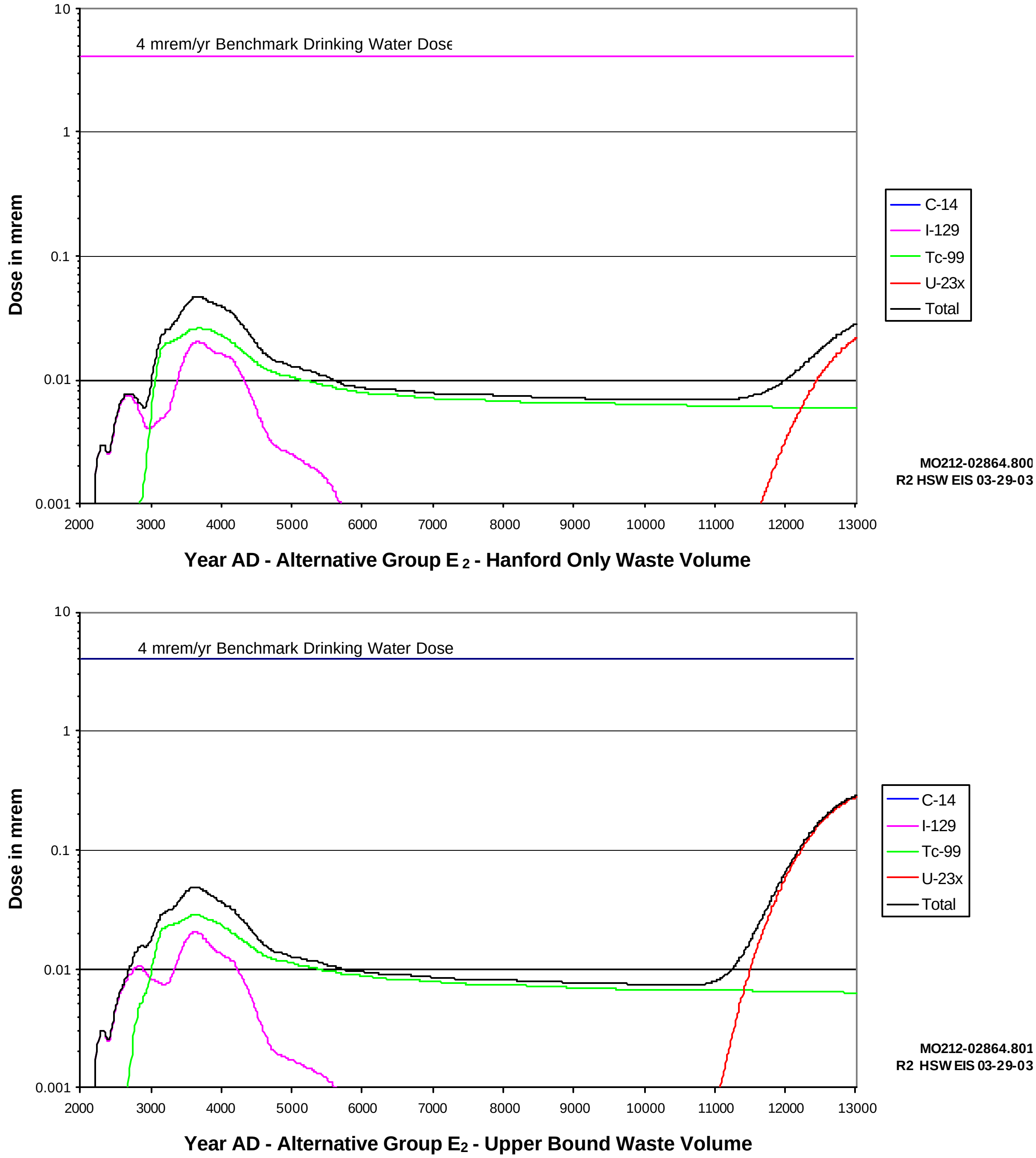
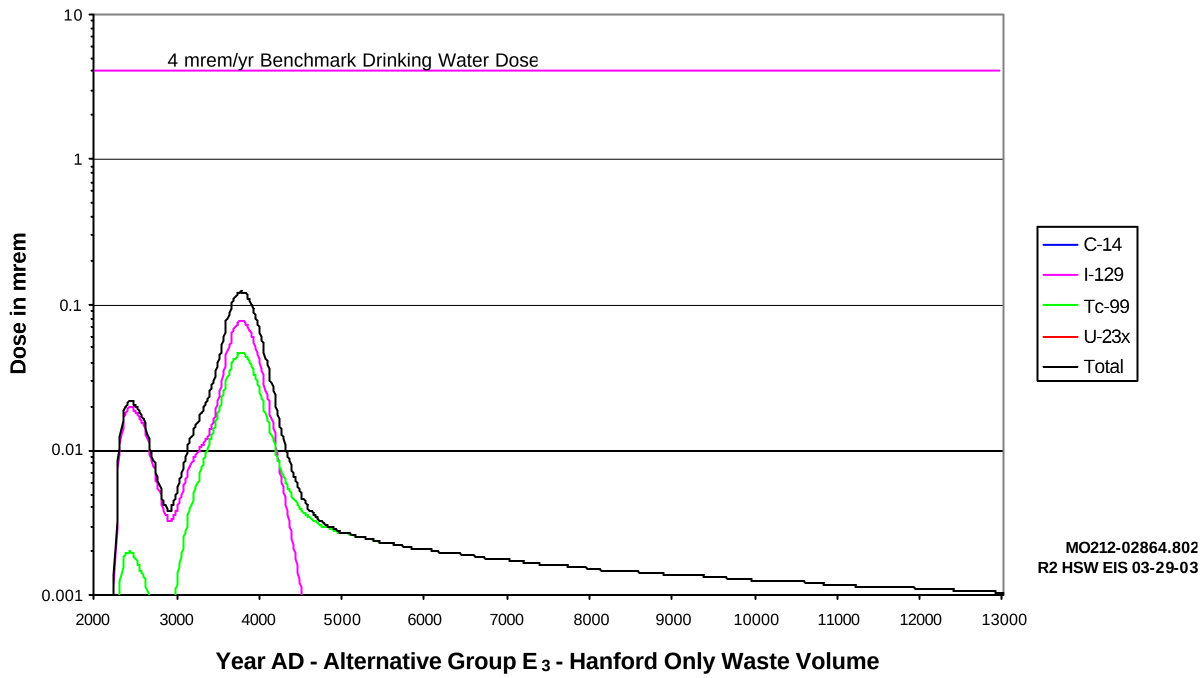


Figure F.31. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group E_2



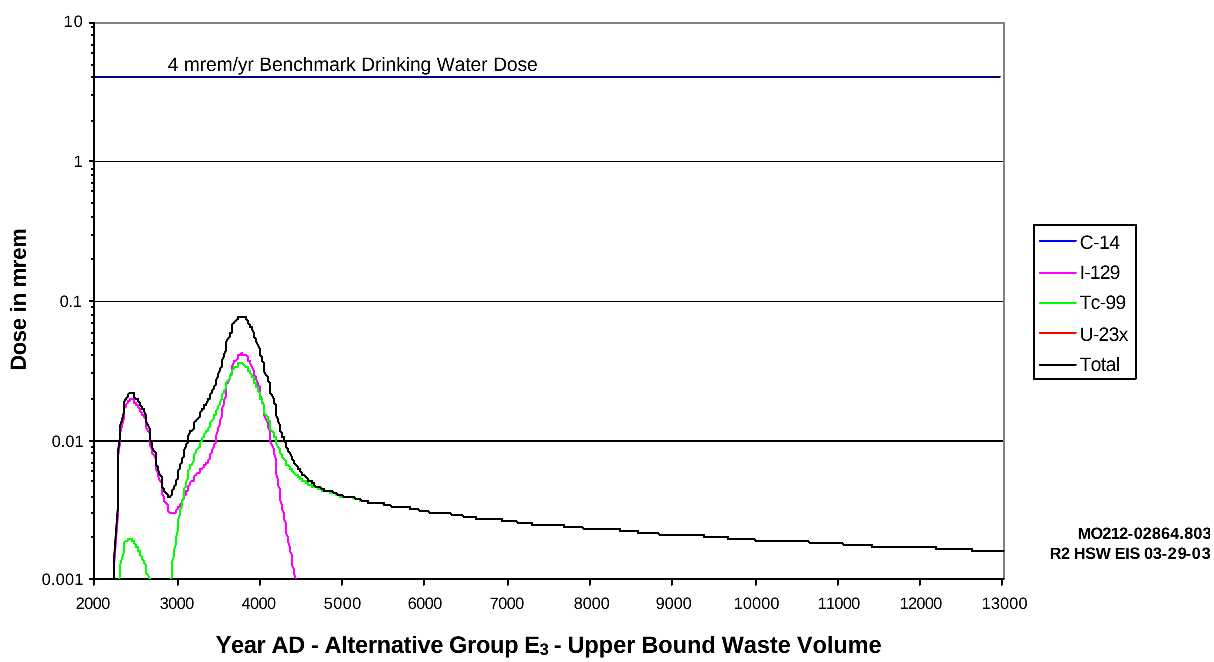
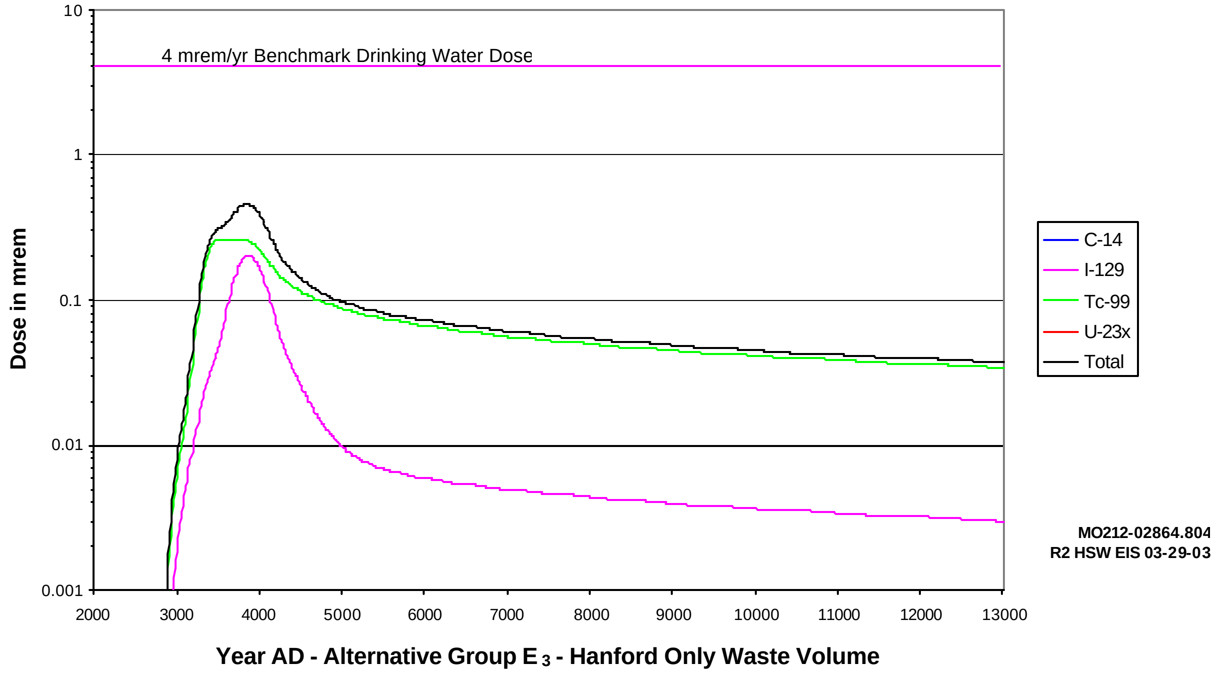


Figure F.32. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from 200 West Area, Alternative Group E_3



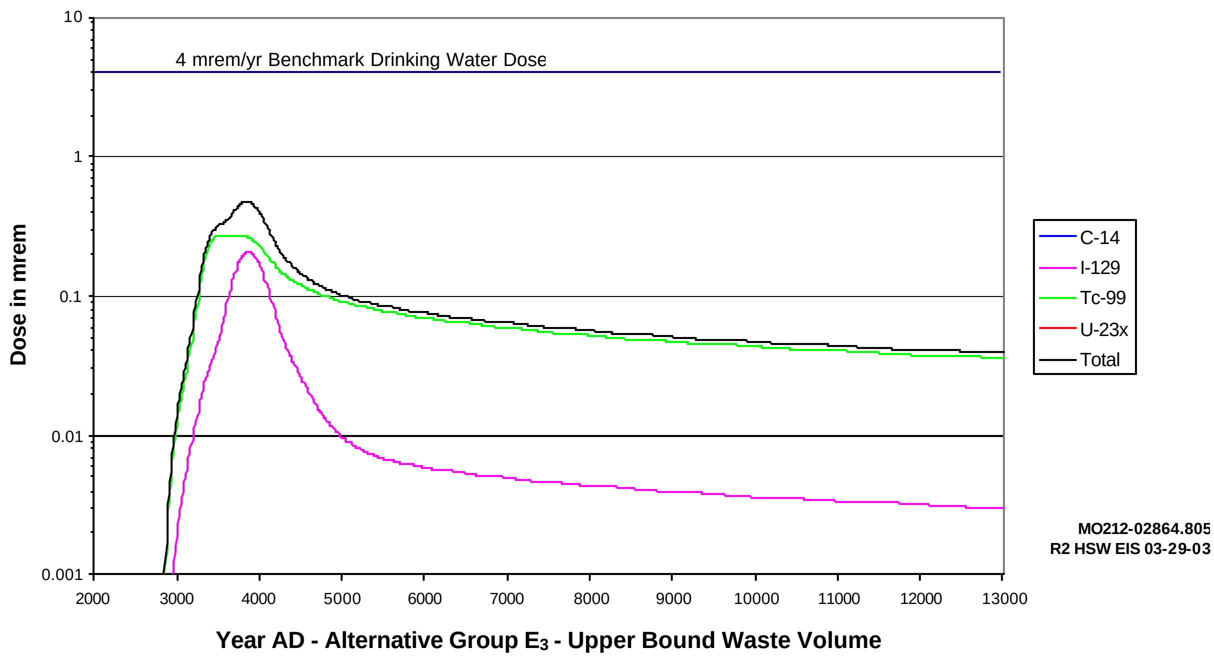
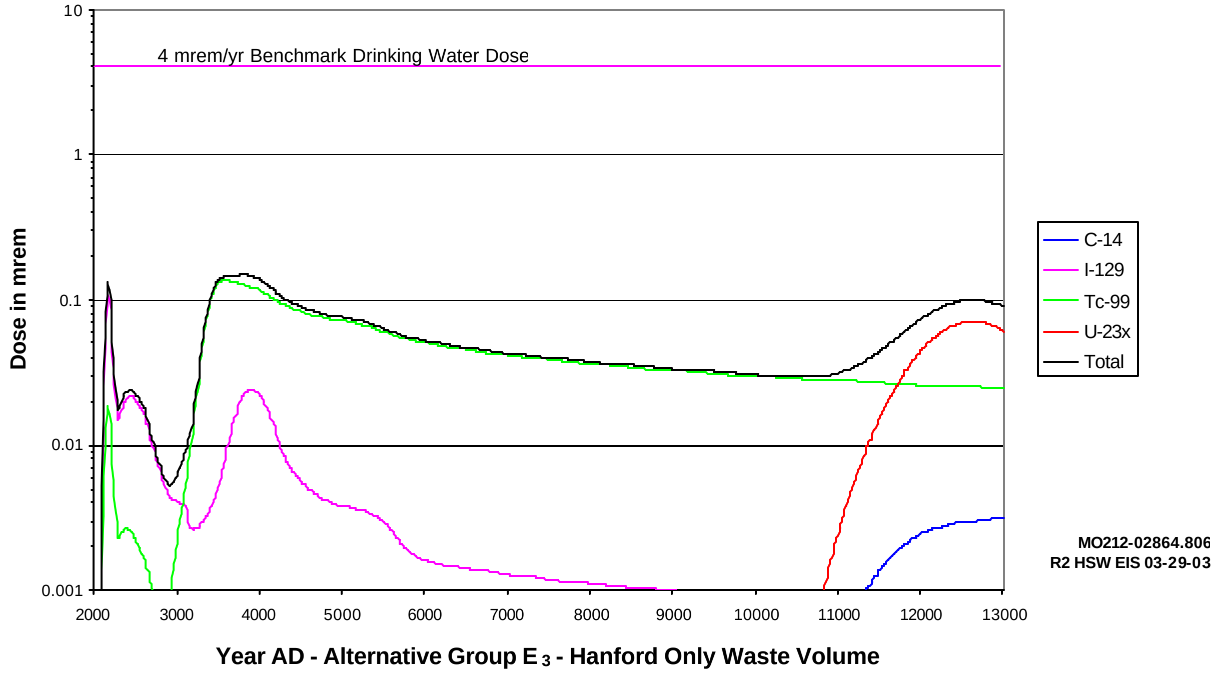


Figure F.33. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from ERDF, Alternative Group E_3



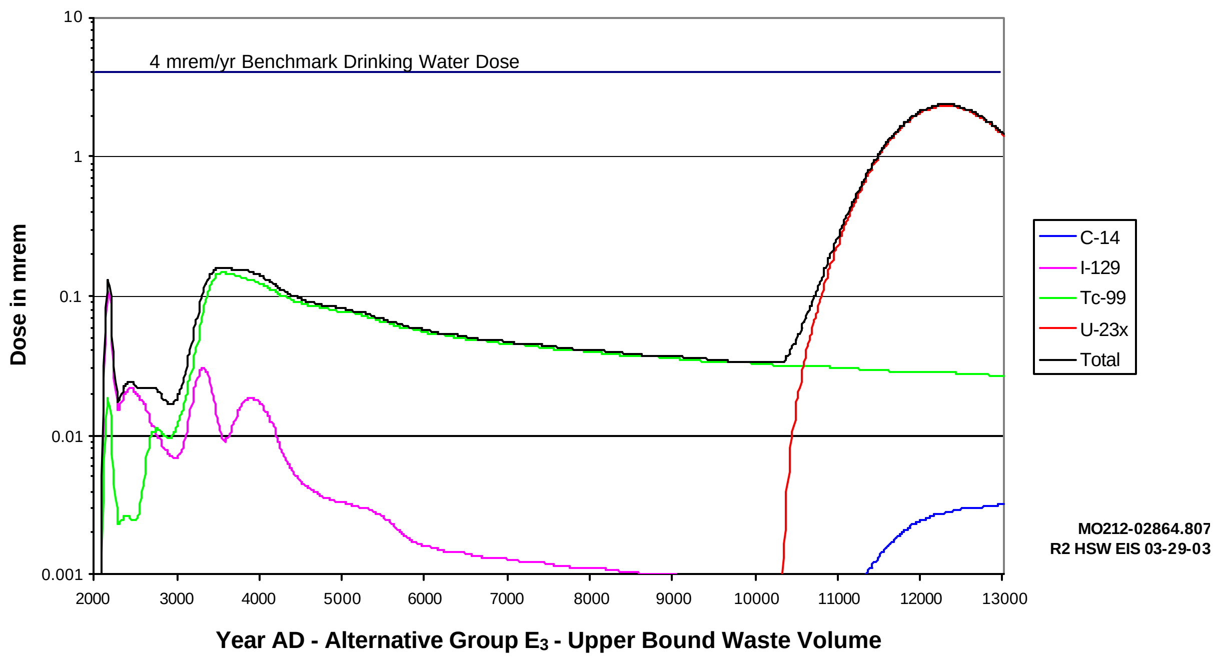


Figure F.34. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Northwest from 200 East Area, Alternative Group E_3

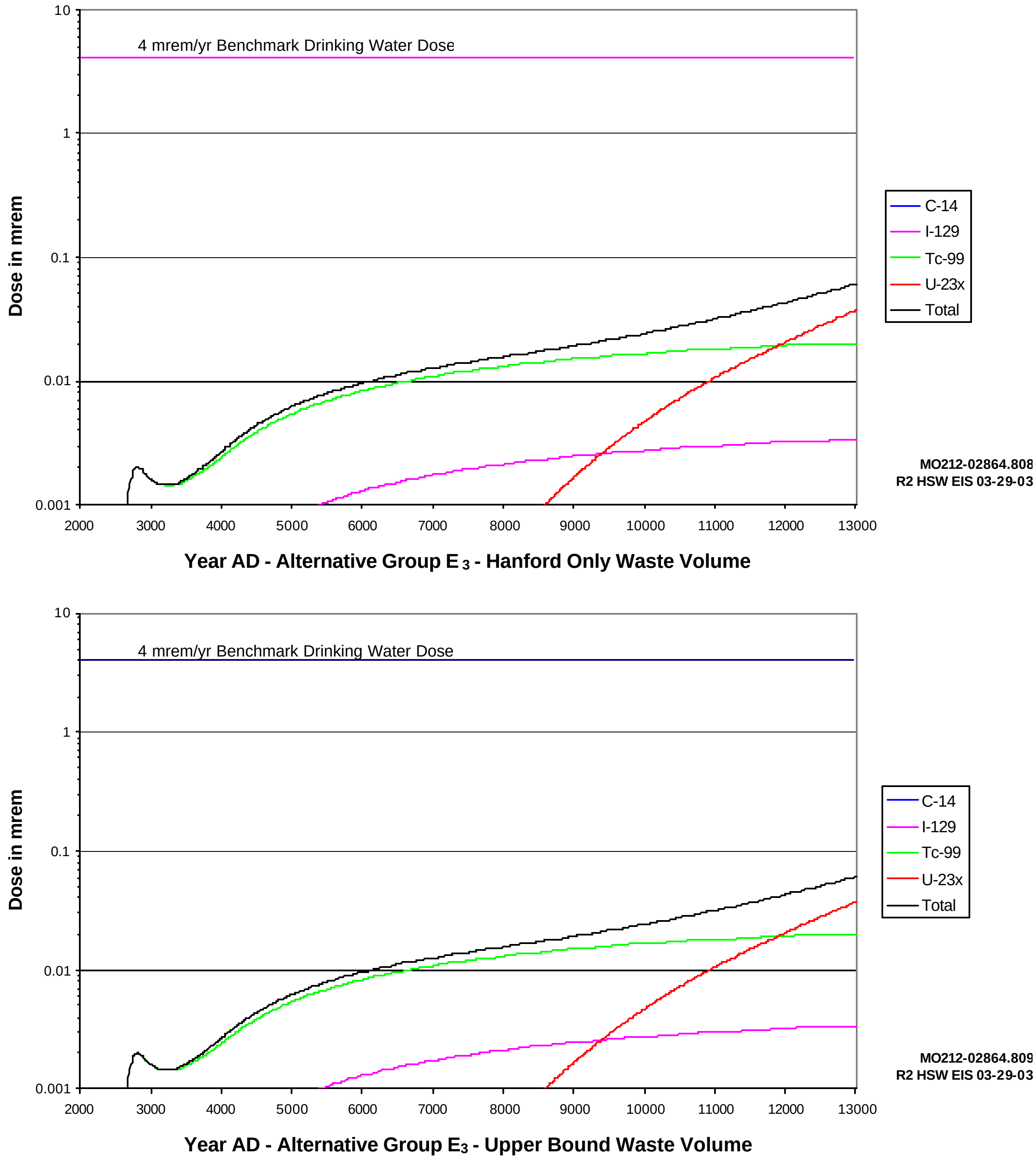


Figure F.35. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Southeast of 200 East Area, Alternative Group E_3

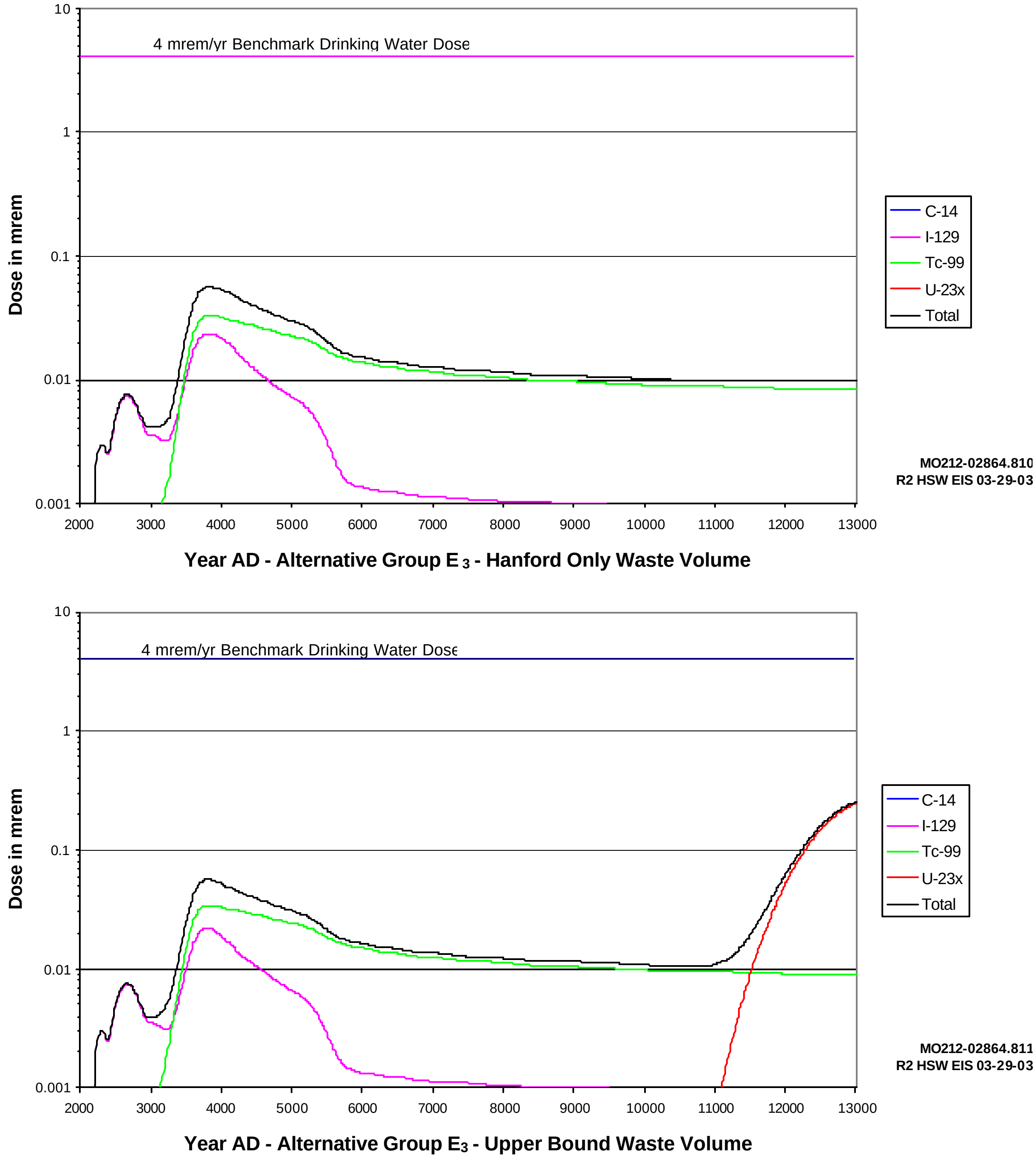


Figure F.36. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, Alternative Group E_3

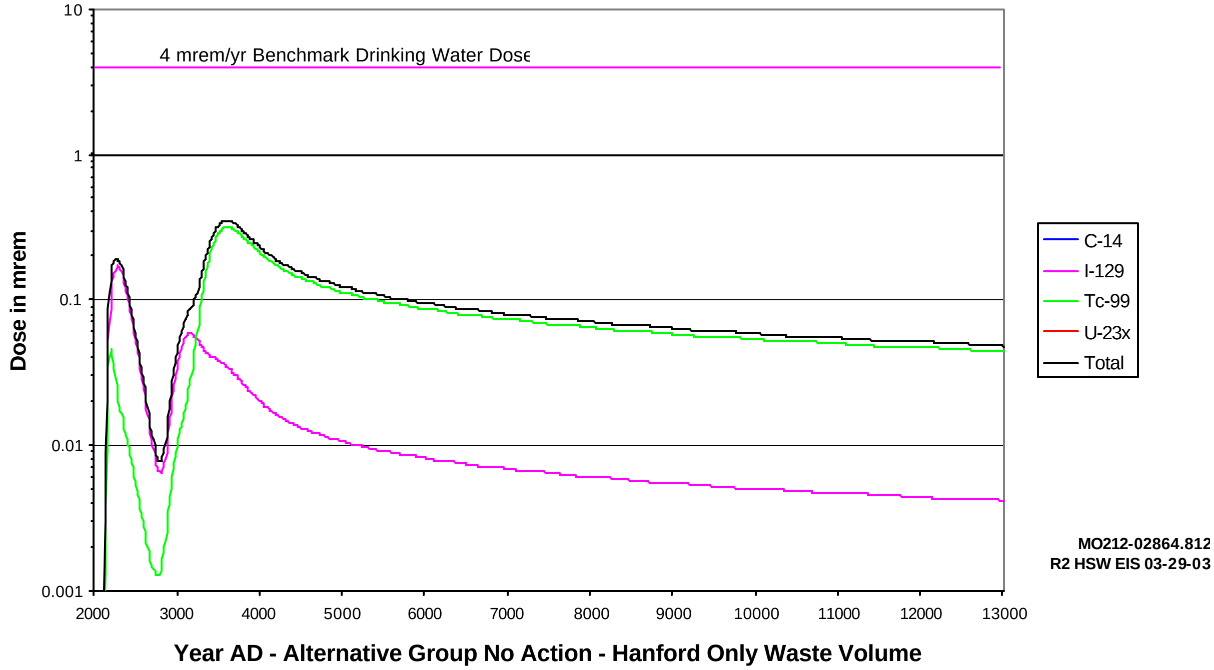


Figure F.37. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient from 200 West Area, No Action Alternative

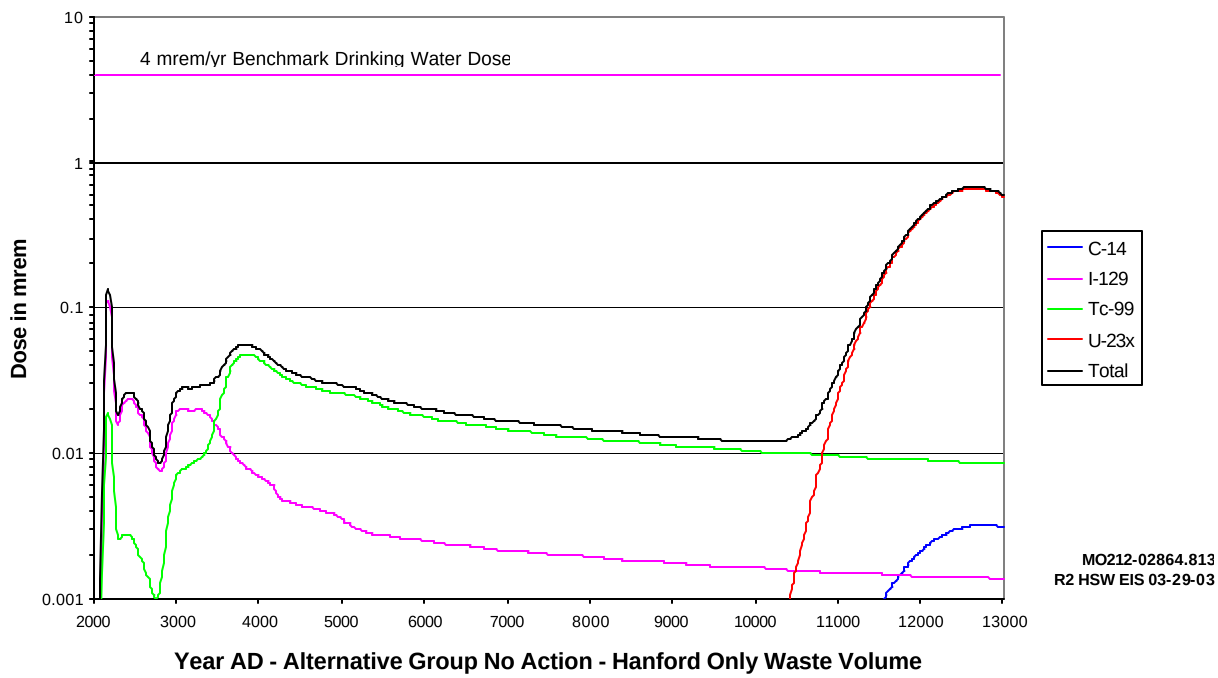


Figure F.38. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well 1 km Down-Gradient Northwest from 200 East Area, No Action Alternative

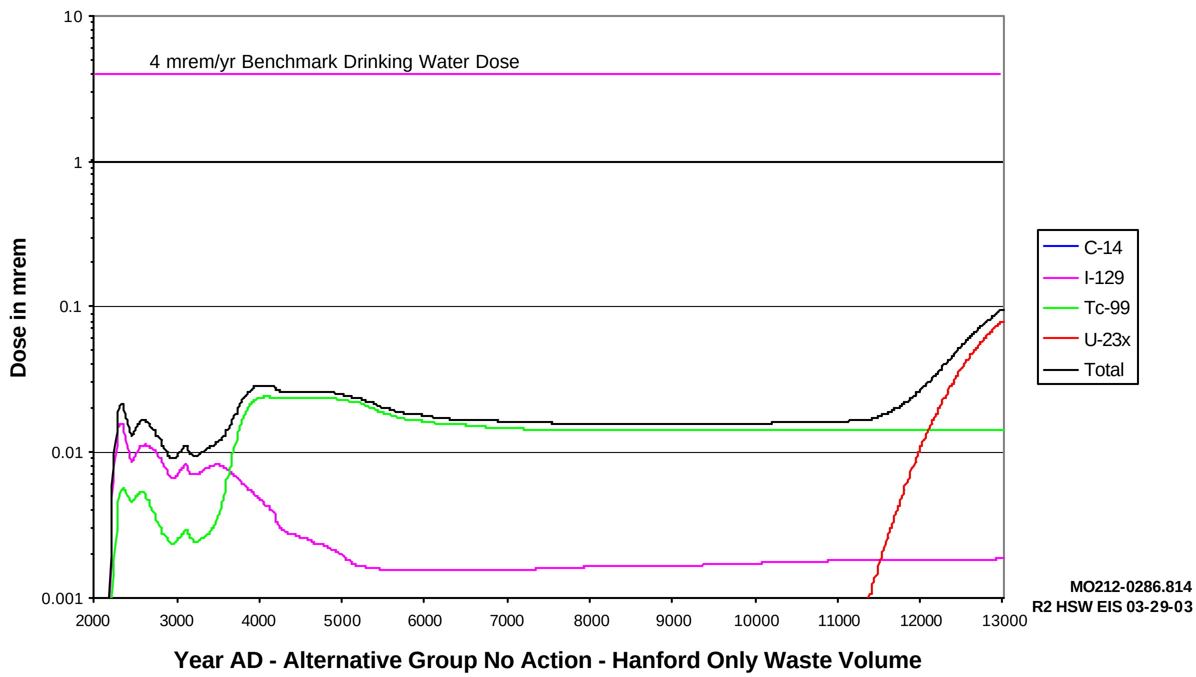


Figure F.39. Annual Drinking Water Dose at Various Times over 10,000 Years in Water from a Well Adjacent to the Columbia River, No Action Alternative

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

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

Radionuclide	Annual Dose Factor by Exposure Scenario (mrem/yr per pCi/L)		
	Drinking Water	Resident Gardener	Resident Gardener with Sauna
C14	1.53E-03	4.09E-02	4.43E-02
Tc99	1.07E-03	3.66E-03	1.74E-02
I129	2.02E-01	6.20E-01	9.06E-01
U233	2.11E-01	2.56E-01	2.22E+02
U234	2.07E-01	2.51E-01	2.17E+02
U235	1.94E-01	2.35E-01	2.02E+02
U236	1.97E-01	2.39E-01	2.06E+02
U238	1.86E-01	2.26E-01	1.94E+02

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

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

Alternative	200 East Area 1-km Point of Analysis			200 West Area 1- km Point of Analysis			Columbia River Point of Analysis		
	Waste Volume			Waste Volume			Waste Volume		
	Hanford	Lower	Upper	Hanford	Lower	Upper	Hanford	Lower	Upper
Group A	F.53	F.54	F.55	F.56	F.57	F.58	F.59	F.60	F.61
Group B	F.62	F.63	F.64	F.65	F.66	F.67	F.68	F.69	F.70
Group C	F.71	F.72	F.73	F.74	F.75	F.76	F.77	F.78	F.79
Group D_1	F.80	F.81	F.82	F.83	F.84	F.85	F.86	F.87	F.88
Group D_2	F.89	F.90	F.91	F.92	F.93	F.94	F.95	F.96	F.97
Group D_3	F.98	F.99	F.100	F.101	F.102	F.103	F.104	F.105	F.106
Group E_1	F.107	F.108	F.109	F.110	F.111	F.112	F.113	F.114	F.115
Group E_2	F.116	F.117	F.118	F.119	F.120	F.121	F.122	F.123	F.124
Group E_3	F.125	F.126	F.127	F.128	F.129	F.130	F.131	F.132	F.133
No Action	F.134	F.135	NA	F.136	F.137	NA	F.138	F.139	NA

NA = not applicable.

Table F.54. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater over 10,000 Years – Alternative Group A, Hanford Only Waste Volume

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	10000	2.6E-04	7.8E-03	4.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	5.8E-06	1.7E-04	1.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	1.6E-05	4.8E-04	2.9E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.9E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2070	9.3E-06	2.8E-04	1.7E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	1.7E-04	5.0E-03	3.0E-06
MLLW	200 East Area	Resident Gardener	1370	7.9E-04	2.4E-02	1.4E-05
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	670	1.0E-05	3.0E-04	1.8E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2070	3.4E-05	1.0E-03	6.2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	7.6E-04	2.3E-02	1.4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1370	2.0E-03	6.1E-02	3.7E-05
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	7.7E-04	2.3E-02	1.4E-05

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

Table F.55. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group A, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[a]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[b]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996– 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.0E-06	2.1E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	2.0E-05	5.9E-04	3.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.9E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2070	1.1E-05	3.4E-04	2.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	1.7E-04	5.0E-03	3.0E-06
MLLW	200 East Area	Resident Gardener	1390	7.9E-04	2.4E-02	1.4E-05
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4.3E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2070	4.2E-05	1.3E-03	7.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	7.6E-04	2.3E-02	1.4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1360	2.0E-03	6.1E-02	3.7E-05
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	7.8E-04	2.3E-02	1.4E-05

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

Table F.56. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group A, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[(a)]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.3E-06	2.2E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1690	1.9E-04	5.7E-03	3.4E-06
	200 East Area	Resident Gardener	10000	2.8E-03	8.3E-02	5.0E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	2.1E-05	6.2E-04	3.7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.9E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1590	5.6E-04	1.7E-02	1.0E-05
	200 East Area	Resident Gardener + Sauna	10000	2.2E+00	6.7E+01	4.0E-02
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	2070	1.1E-05	3.4E-04	2.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	1.7E-04	5.0E-03	3.0E-06
MLLW	200 East Area	Resident Gardener	1360	8.1E-04	2.4E-02	1.5E-05
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	670	1.0E-05	3.0E-04	1.8E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2070	4.2E-05	1.3E-03	7.6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	7.6E-04	2.3E-02	1.4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1360	2.1E-03	6.4E-02	3.8E-05
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	7.7E-04	2.3E-02	1.4E-05

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

Table F.57. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group A, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	2.7E-05	8.2E-04	4.9E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	7.6E-05	2.3E-03	1.4E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1910	4.8E-05	1.5E-03	8.7E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2.1E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1910	1.8E-04	5.4E-03	3.2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.3E-03	1.6E-01	9.6E-05

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

Table F.58. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group A, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.3E-05	1.0E-03	6.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.3E-05	2.8E-03	1.7E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1910	5.9E-05	1.8E-03	1.1E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2.1E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1910	2.2E-04	6.5E-03	3.9E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.3E-03	1.6E-01	9.6E-05

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

Table F.59. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group A, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.4E-05	1.0E-03	6.2E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1690	1.9E-04	5.7E-03	3.4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.8E-05	3.0E-03	1.8E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1690	5.6E-04	1.7E-02	1.0E-05
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1910	5.9E-05	1.8E-03	1.1E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2.1E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1910	2.2E-04	6.6E-03	4.0E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.3E-03	1.6E-01	9.6E-05

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

Table F.60. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group A, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.4E-06	7.2E-05	4.3E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	6.7E-06	2.0E-04	1.2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2260	4.5E-06	1.3E-04	8.1E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	8.2E-05	2.5E-03	1.5E-06
MLLW	200 East Area	Resident Gardener	1580	1.1E-04	3.4E-03	2.0E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	940	1.2E-06	3.7E-05	2.2E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2260	1.7E-05	5.0E-04	3.0E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	3.7E-04	1.1E-02	6.7E-06
MLLW	200 East Area	Resident Gardener + Sauna	1580	2.9E-04	8.7E-03	5.2E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	10000	1.1E-05	3.2E-04	1.9E-07

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

Table F.61. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group A, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[(a)]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.9E-06	8.7E-05	5.2E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	8.1E-06	2.4E-04	1.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	2260	5.5E-06	1.6E-04	8.2E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	8.2E-05	2.5E-03	1.2E-06
MLLW	200 East Area	Resident Gardener	1580	1.1E-04	3.4E-03	1.7E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	940	1.2E-06	3.7E-05	1.8E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2260	2.0E-05	6.1E-04	3.6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	3.7E-04	1.1E-02	6.7E-06
MLLW	200 East Area	Resident Gardener + Sauna	1590	2.9E-04	8.8E-03	5.3E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	10000	1.1E-05	4.6E-04	2.8E-07

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

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

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[(a)]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	2000	3.0E-06	9.1E-05	5.4E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	1.7E-05	5.2E-04	3.1E-07
	200 East Area	Resident Gardener	810	2.8E-05	8.4E-04	5.0E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	8.6E-06	2.6E-04	1.6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	5.2E-05	1.6E-03	9.4E-07
	200 East Area	Resident Gardener + Sauna	810	7.9E-05	2.4E-03	1.4E-06
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	2260	5.5E-06	1.7E-04	9.9E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	8.2E-05	2.5E-03	1.5E-06
MLLW	200 East Area	Resident Gardener	1580	1.1E-04	3.3E-03	2.0E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	940	1.2E-06	3.7E-05	2.2E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2260	2.0E-05	6.1E-04	3.7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	3.7E-04	1.1E-02	6.7E-06
MLLW	200 East Area	Resident Gardener + Sauna	1580	2.9E-04	8.7E-03	5.2E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	10000	1.1E-05	3.2E-04	1.9E-07

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

Table F.63. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group B, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[(a)]	Maximum Annual Dose: Dose rem	Lifetime Dose rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	10000	2.6E-04	7.8E-03	4.7E-06
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1810	5.5E-06	1.7E-04	1.0E-07
	200 East Area	Resident Gardener	1230	8.5E-07	2.5E-05	1.5E-08
LLW Cat 3	200 West Area	Resident Gardener	1450	3.3E-06	1.0E-04	6.0E-08
	200 East Area	Resident Gardener	620	6.0E-06	1.8E-04	1.1E-07
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	1.5E-05	4.6E-04	2.8E-07
	200 East Area	Resident Gardener + Sauna	10000	3.0E-04	9.0E-03	5.4E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.7E-04	2.8E-07
	200 East Area	Resident Gardener + Sauna	620	2.9E-05	8.6E-04	5.2E-07
MLLW	200 West Area	Resident Gardener + Sauna	1420	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1920	9.5E-06	2.8E-04	1.7E-07
	200 East Area	Resident Gardener	1320	1.1E-06	3.2E-05	1.9E-08
LLW Cat 3	200 West Area	Resident Gardener	1450	1.6E-04	4.9E-03	2.9E-06
	200 East Area	Resident Gardener	10000	3.0E-04	9.1E-03	5.4E-06
MLLW	200 East Area	Resident Gardener	1360	8.0E-04	2.4E-02	1.4E-05
Melters	200 East Area	Resident Gardener	680	2.6E-07	7.7E-06	4.6E-09
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1920	3.5E-05	1.1E-03	6.3E-07
	200 East Area	Resident Gardener + Sauna	1320	3.9E-06	1.2E-04	7.0E-08
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	7.3E-04	2.2E-02	1.3E-05
	200 East Area	Resident Gardener + Sauna	10000	2.4E-01	7.3E+00	4.4E-03
MLLW	200 East Area	Resident Gardener + Sauna	1360	2.1E-03	6.2E-02	3.7E-05
Melters	200 East Area	Resident Gardener + Sauna	680	1.2E-06	3.6E-05	2.2E-08

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

Table F.64. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group B, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	6.8E-06	2.0E-04	1.2E-07
	200 East Area	Resident Gardener	1230	1.0E-06	3.1E-05	1.9E-08
LLW Cat 3	200 West Area	Resident Gardener	1450	3.3E-06	1.0E-04	6.0E-08
	200 East Area	Resident Gardener	620	4.2E-07	1.3E-05	7.6E-09
MLLW	200 West Area	Resident Gardener	1810	2.3E-05	6.8E-04	4.1E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	1.9E-05	5.6E-04	3.4E-07
	200 East Area	Resident Gardener + Sauna	10000	3.5E-04	1.0E-02	6.3E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.7E-04	2.8E-07
	200 East Area	Resident Gardener + Sauna	10000	2.3E-06	6.8E-05	4.1E-08
MLLW	200 West Area	Resident Gardener + Sauna	1810	2.0E-04	5.9E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1920	1.2E-05	3.5E-04	2.1E-07
	200 East Area	Resident Gardener	1320	1.3E-06	3.8E-05	2.3E-08
LLW Cat 3	200 West Area	Resident Gardener	1450	1.6E-04	4.9E-03	2.9E-06
	200 East Area	Resident Gardener	10000	3.1E-04	9.3E-03	5.6E-06
MLLW	200 East Area	Resident Gardener	1360	8.0E-04	2.4E-02	1.4E-05
Melters	200 East Area	Resident Gardener	680	2.6E-07	7.7E-06	4.6E-09
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1920	4.3E-05	1.3E-03	7.7E-07
	200 East Area	Resident Gardener + Sauna	10000	7.5E-04	2.2E-02	1.3E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	7.3E-04	2.2E-02	1.3E-05
	200 East Area	Resident Gardener + Sauna	10000	2.5E-01	7.5E+00	4.5E-03
MLLW	200 East Area	Resident Gardener + Sauna	1360	2.1E-03	6.2E-02	3.7E-05
Melters	200 East Area	Resident Gardener + Sauna	680	1.2E-06	3.6E-05	2.2E-08

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

Table F.65. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group B, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1810	6.3E-06	1.9E-04	1.1E-07
	200 East Area	Resident Gardener	1230	3.9E-06	1.2E-04	7.1E-08
LLW Cat 3	200 West Area	Resident Gardener	1450	3.3E-06	1.0E-04	6.0E-08
	200 East Area	Resident Gardener	620	4.4E-07	1.3E-05	7.9E-09
MLLW	200 West Area	Resident Gardener	1810	4.1E-05	1.2E-03	7.4E-07
	200 East Area	Resident Gardener	10000	2.6E-03	7.8E-02	4.7E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	1.8E-05	5.4E-04	3.2E-07
	200 East Area	Resident Gardener + Sauna	10000	5.5E-05	1.6E-03	9.8E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.7E-04	2.8E-07
	200 East Area	Resident Gardener + Sauna	10000	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.2E-04	3.6E-03	2.2E-06
	200 East Area	Resident Gardener + Sauna	10000	2.2E+00	6.7E+01	4.0E-02
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1920	1.0E-05	3.1E-04	1.9E-07
	200 East Area	Resident Gardener	1210	6.1E-06	1.8E-04	1.1E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	1.6E-04	4.9E-03	2.9E-06
	200 East Area	Resident Gardener	10000	3.1E-04	9.4E-03	5.6E-06
MLLW	200 East Area	Resident Gardener	1240	1.0E-03	3.1E-02	1.8E-05
Melters	200 East Area	Resident Gardener	680	2.6E-07	7.7E-06	4.6E-09
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1920	3.9E-05	1.2E-03	7.0E-07
	200 East Area	Resident Gardener + Sauna	1210	2.3E-05	7.0E-04	4.2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	7.3E-04	2.2E-02	1.3E-05
	200 East Area	Resident Gardener + Sauna	10000	2.5E-01	7.6E+00	4.5E-03
MLLW	200 East Area	Resident Gardener + Sauna	1240	2.7E-03	8.0E-02	4.8E-05
Melters	200 East Area	Resident Gardener + Sauna	680	1.2E-06	3.6E-05	2.2E-08

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

Table F.66. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group B, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	2.6E-05	7.9E-04	4.7E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.3E-05	7.0E-04	4.2E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	7.3E-05	2.2E-03	1.3E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.1E-04	3.3E-03	2.0E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1770	5.0E-05	1.5E-03	9.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	1.1E-03	3.4E-02	2.1E-05
ILAW	200 West Area	Resident Gardener	10000	3.1E-04	9.2E-03	5.5E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1770	1.8E-04	5.5E-03	3.3E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.1E-03	1.5E-01	9.2E-05
ILAW	200 West Area	Resident Gardener + Sauna	10000	1.1E-01	3.3E-00	2.0E-03

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

Table F.67. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group B, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.2E-05	9.6E-04	5.8E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.3E-05	7.0E-04	4.2E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	8.9E-05	2.7E-03	1.6E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.1E-04	3.3E-03	2.0E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1770	6.1E-05	1.8E-03	1.1E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.1E-03	3.4E-02	2.1E-05
ILAW	200 West Area	Resident Gardener	10000	3.1E-04	9.2E-03	5.5E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	2.4E-02	7.3E-01	4.4E-04
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.1E-03	1.5E-01	9.2E-05
ILAW	200 West Area	Resident Gardener + Sauna	10000	1.1E-01	3.3E-00	2.0E-03

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

Table F.68. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group B, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.0E-05	8.9E-04	5.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.3E-05	7.0E-04	4.2E-07
MLLW	200 West Area	Resident Gardener	1690	1.9E-04	5.6E-03	3.4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	8.5E-05	2.5E-03	1.5E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.1E-04	3.3E-03	2.0E-06
MLLW	200 West Area	Resident Gardener + Sauna	1690	5.4E-04	1.6E-02	9.7E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1770	5.5E-05	1.6E-03	9.9E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	1.1E-03	3.4E-02	2.1E-05
ILAW	200 West Area	Resident Gardener	10000	3.1E-04	9.2E-03	5.5E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	2.1E-02	6.2E-01	3.7E-04
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.1E-03	1.5E-01	9.2E-05
ILAW	200 West Area	Resident Gardener + Sauna	10000	1.1E-01	3.3E-00	2.0E-03

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

Table F.69 Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group B, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.3E-06	6.9E-05	4.1E-08
	200 East Area	Resident Gardener	1400	1.4E-07	4.3E-06	2.6E-09
LLW Cat 3	200 West Area	Resident Gardener	1710	1.6E-06	4.9E-05	2.9E-08
	200 East Area	Resident Gardener	860	1.4E-06	4.2E-05	2.5E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	6.4E-06	1.9E-04	1.2E-07
	200 East Area	Resident Gardener + Sauna	10000	1.2E-05	3.7E-04	2.2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	7.7E-06	2.3E-04	1.4E-07
	200 East Area	Resident Gardener + Sauna	860	6.7E-06	2.0E-04	1.2E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2110	4.5E-06	1.4E-04	8.2E-08
	200 East Area	Resident Gardener	2330	1.2E-05	3.5E-04	2.1E-07
LLW Cat 3	200 West Area	Resident Gardener	1710	7.9E-05	2.4E-03	1.4E-06
	200 East Area	Resident Gardener	10000	2.9E-04	8.6E-03	5.2E-06
MLLW	200 East Area	Resident Gardener	1980	1.3E-04	3.8E-03	2.3E-06
ILAW	200 West Area	Resident Gardener	10000	1.0E-05	3.0E-04	1.8E-07
Melters	200 East Area	Resident Gardener	940	3.2E-08	9.5E-07	5.7E-10
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2110	1.7E-05	5.0E-04	3.0E-07
	200 East Area	Resident Gardener + Sauna	10000	6.4E-04	1.9E-02	1.2E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	3.6E-04	1.1E-02	6.4E-06
	200 East Area	Resident Gardener + Sauna	10000	2.4E-01	7.3E+00	4.4E-03
MLLW	200 East Area	Resident Gardener + Sauna	1610	3.2E-04	9.5E-03	5.7E-06
ILAW	200 West Area	Resident Gardener + Sauna	10000	2.6E-05	7.8E-02	4.7E-05
Melters	200 East Area	Resident Gardener + Sauna	940	1.5E-07	4.5E-06	2.7E-09

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

Table F.70. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group B, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.8E-06	8.4E-05	5.0E-08
	200 East Area	Resident Gardener	1400	1.7E-07	5.2E-06	3.1E-09
LLW Cat 3	200 West Area	Resident Gardener	1710	1.6E-06	4.9E-05	2.9E-08
	200 East Area	Resident Gardener	860	9.8E-08	2.9E-06	1.8E-09
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	7.8E-06	2.3E-04	1.4E-07
	200 East Area	Resident Gardener + Sauna	10000	1.3E-05	3.9E-04	2.3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	7.7E-06	2.3E-04	1.4E-07
	200 East Area	Resident Gardener + Sauna	860	4.6E-07	1.4E-05	8.4E-09
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2110	5.5E-06	1.7E-04	1.0E-07
	200 East Area	Resident Gardener	2250	1.4E-05	4.2E-04	2.5E-07
LLW Cat 3	200 West Area	Resident Gardener	1710	7.9E-05	2.4E-03	1.4E-06
	200 East Area	Resident Gardener	10000	3.0E-04	8.9E-03	5.3E-06
MLLW	200 East Area	Resident Gardener	1420	1.3E-04	3.8E-03	2.3E-06
ILAW	200 West Area	Resident Gardener	10000	1.0E-05	3.0E-04	1.8E-07
Melters	200 East Area	Resident Gardener	940	3.2E-08	9.5E-07	5.7E-10
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2110	2.0E-05	6.1E-04	3.7E-07
	200 East Area	Resident Gardener + Sauna	10000	7.4E-04	2.2E-02	1.3E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	3.6E-04	1.1E-02	6.4E-06
	200 East Area	Resident Gardener + Sauna	10000	2.5E-01	7.5E+00	4.5E-03
MLLW	200 East Area	Resident Gardener + Sauna	1420	3.3E-04	1.0E-02	6.0E-06
ILAW	200 West Area	Resident Gardener + Sauna	10000	2.6E-05	7.8E-02	4.7E-05
Melters	200 East Area	Resident Gardener + Sauna	940	1.5E-07	4.5E-06	2.7E-09

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

Table F.71. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group B, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.6E-06	7.8E-05	4.7E-08
	200 East Area	Resident Gardener	1400	6.6E-07	2.0E-05	1.2E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.6E-06	4.9E-05	2.9E-08
	200 East Area	Resident Gardener	860	9.8E-08	2.9E-06	1.8E-09
MLLW	200 West Area	Resident Gardener	2000	1.7E-05	5.2E-04	3.1E-07
	200 East Area	Resident Gardener	10000	6.7E-05	2.0E-03	1.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	7.4E-06	2.2E-04	1.3E-07
	200 East Area	Resident Gardener + Sauna	1400	5.3E-05	1.6E-03	9.6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	7.7E-06	2.3E-04	1.4E-07
	200 East Area	Resident Gardener + Sauna	860	6.4E-07	1.9E-05	1.2E-08
MLLW	200 West Area	Resident Gardener + Sauna	2000	5.2E-05	1.6E-03	9.4E-07
	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.1E+00	6.4E-04
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2110	5.0E-06	1.5E-04	9.0E-08
	200 East Area	Resident Gardener	10000	6.1E-06	1.8E-04	1.1E-07
LLW Cat 3	200 West Area	Resident Gardener	1710	7.9E-05	2.4E-03	1.4E-06
	200 East Area	Resident Gardener	10000	3.0E-04	8.9E-03	5.3E-06
MLLW	200 East Area	Resident Gardener	1420	1.3E-04	4.0E-03	2.4E-06
ILAW	200 West Area	Resident Gardener	10000	1.0E-05	3.0E-04	1.8E-07
Melters	200 East Area	Resident Gardener	940	3.2E-08	9.5E-07	5.7E-10
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2110	1.9E-05	5.6E-04	3.3E-07
	200 East Area	Resident Gardener + Sauna	10000	4.0E-03	1.2E-01	7.2E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	3.6E-04	1.1E-02	6.4E-06
	200 East Area	Resident Gardener + Sauna	10000	2.5E-01	7.6E+00	4.5E-03
MLLW	200 East Area	Resident Gardener + Sauna	1420	3.6E-04	1.1E-02	6.5E-06
ILAW	200 West Area	Resident Gardener + Sauna	10000	2.6E-05	7.8E-02	4.7E-05
Melters	200 East Area	Resident Gardener + Sauna	940	1.5E-07	4.5E-06	2.7E-09

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

Table F.72. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group C, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	10000	2.6E-04	7.8E-03	4.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	5.8E-06	1.7E-04	1.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	1.6E-05	4.8E-04	2.9E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.9E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2070	6.3E-06	1.9E-04	1.1E-07
LLW Cat 3	200 West Area	Resident Gardener	1460	1.7E-04	5.0E-03	3.0E-06
MLLW	200 East Area	Resident Gardener	1370	7.9E-04	2.4E-02	1.4E-05
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	680	6.9E-06	2.1E-04	1.2E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2070	3.0E-05	9.0E-04	5.4E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1460	7.6E-04	2.3E-02	1.4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1370	2.0E-03	6.1E-02	3.7E-05
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	8.0E-04	2.4E-02	1.4E-05

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

Table F.73. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group C, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.0E-06	2.1E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	2.0E-05	5.9E-04	3.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.9E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2070	7.7E-06	2.3E-04	1.4E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	1.7E-04	5.0E-03	3.0E-06
MLLW	200 East Area	Resident Gardener	1370	7.9E-04	2.4E-02	1.4E-05
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	680	6.9E-06	2.1E-04	1.2E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2070	3.7E-05	1.1E-03	6.6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	7.6E-04	2.3E-02	1.4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1370	2.0E-03	6.1E-02	3.7E-05
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	8.0E-04	2.4E-02	1.4E-05

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

Table F.74. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group C, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.3E-06	2.2E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	4.1E-05	1.2E-03	7.4E-07
	200 East Area	Resident Gardener	10000	2.8E-03	8.3E-02	5.0E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	2.1E-05	6.2E-04	3.7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.9E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.2E-04	3.6E-03	2.2E-06
	200 East Area	Resident Gardener + Sauna	10000	2.2E+00	6.7E+01	4.0E-02
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2070	7.7E-06	2.3E-04	1.4E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	1.7E-04	5.0E-03	3.0E-06
MLLW	200 East Area	Resident Gardener	1360	8.1E-04	2.4E-02	1.5E-05
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	680	6.9E-06	2.1E-04	1.2E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2070	3.7E-05	1.1E-03	6.6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	7.6E-04	2.3E-02	1.4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1360	2.1E-03	6.4E-02	3.8E-05
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	8.0E-04	2.4E-02	1.4E-05

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

Table F.75. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group C, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[(b)]
			Years Post-2046[(a)]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	2.7E-05	8.2E-04	4.9E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	7.6E-05	2.3E-03	1.4E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1910	4.8E-05	1.5E-03	8.7E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2.1E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1910	1.8E-04	5.4E-03	3.2E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.3E-03	1.6E-01	9.6E-05

(a) The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.

(b) Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of an LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.

(c) Results are not reported for cases that had no inventory reported for the waste.

Table F.76. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group C, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.3E-05	1.0E-03	6.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.3E-05	2.8E-03	1.7E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1910	5.9E-05	1.8E-03	1.1E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2.1E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1910	2.2E-04	6.5E-03	3.9E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.3E-03	1.6E-01	9.6E-05

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

Table F.77. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group C, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.4E-05	1.0E-03	6.2E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1690	1.9E-04	5.7E-03	3.4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.8E-05	3.0E-03	1.8E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	5.9E-04	1.8E-02	1.1E-05
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1910	5.9E-05	1.8E-03	1.1E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2.1E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1910	2.2E-04	6.6E-03	4.0E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.3E-03	1.6E-01	9.6E-05

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

Table F.78. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group C, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.4E-06	7.2E-05	4.3E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	6.7E-06	2.0E-04	1.2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2260	4.5E-06	1.3E-04	8.1E-08
LLW Cat 3	200 West Area	Resident Gardener	1720	7.6E-05	2.3E-03	1.4E-06
MLLW	200 East Area	Resident Gardener	1580	1.1E-04	3.4E-03	2.0E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	820	7.5E-07	2.2E-05	1.3E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2260	1.7E-05	5.0E-04	3.0E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1720	3.6E-04	1.1E-02	6.5E-06
MLLW	200 East Area	Resident Gardener + Sauna	1580	2.9E-04	8.8E-03	5.3E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	10000	1.3E-05	3.9E-04	2.4E-07

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

Table F.79. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group C, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.9E-06	8.7E-05	5.2E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	8.1E-06	2.4E-04	1.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2260	5.5E-06	1.6E-04	8.2E-08
LLW Cat 3	200 West Area	Resident Gardener	1720	7.8E-05	2.3E-03	1.2E-06
MLLW	200 East Area	Resident Gardener	1580	1.1E-04	3.4E-03	1.7E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	1.9E-07
Melters	200 East Area	Resident Gardener	820	7.6E-07	2.3E-05	1.1E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2260	2.0E-05	6.1E-04	3.0E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1720	3.6E-04	1.1E-02	5.4E-06
MLLW	200 East Area	Resident Gardener + Sauna	1580	2.9E-04	8.8E-03	4.4E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	4.9E-05
Melters	200 East Area	Resident Gardener + Sauna	10000	1.3E-05	3.9E-04	2.0E-07

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

Table F.80. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group C, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	3.0E-06	9.1E-05	5.4E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	1.7E-05	5.2E-04	3.1E-07
	200 East Area	Resident Gardener	940	3.9E-06	1.2E-04	7.0E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	8.6E-06	2.6E-04	1.6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	5.2E-05	1.6E-03	9.4E-07
	200 East Area	Resident Gardener + Sauna	940	1.9E-05	5.6E-04	3.3E-07
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2260	5.5E-06	1.7E-04	9.9E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	7.8E-05	2.3E-03	1.4E-06
MLLW	200 East Area	Resident Gardener	1580	1.2E-04	3.6E-03	2.1E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	820	7.5E-07	2.2E-05	1.3E-08
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2260	2.0E-05	6.1E-04	3.7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	3.6E-04	1.1E-02	6.5E-06
MLLW	200 East Area	Resident Gardener + Sauna	1580	3.2E-04	9.7E-03	5.8E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	10000	1.3E-05	3.9E-04	2.4E-07

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

Table F.81. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_1, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	10000	2.6E-04	7.8E-03	4.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	5.8E-06	1.7E-04	1.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	3.5E-05	1.0E-03	6.2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1380	3.4E-05	1.0E-03	6.2E-07
LLW Cat 3	200 East Area	Resident Gardener	620	5.4E-04	1.6E-02	9.7E-06
MLLW	200 East Area	Resident Gardener	1380	5.8E-04	1.7E-02	1.0E-05
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4.3E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10000	4.7E-03	1.4E-01	8.5E-05
LLW Cat 3	200 East Area	Resident Gardener + Sauna	620	2.4E-03	7.3E-02	4.4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1380	1.5E-03	4.5E-02	2.7E-05
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	5.6E-04	1.7E-02	1.0E-05

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

Table F.82. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_1, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.1E-06	2.1E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	3.6E-05	1.1E-03	6.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1380	4.2E-05	1.3E-03	7.6E-07
LLW Cat 3	200 East Area	Resident Gardener	620	5.4E-04	1.6E-02	9.7E-06
MLLW	200 East Area	Resident Gardener	1380	5.8E-04	1.7E-02	1.0E-05
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4.3E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10000	5.5E-01	1.7E+01	1.0E-02
LLW Cat 3	200 East Area	Resident Gardener + Sauna	620	2.4E-03	7.3E-02	4.4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1380	1.5E-03	4.5E-02	2.7E-05
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	5.7E-04	1.7E-02	1.0E-05

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

Table F.83. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_1, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.4E-06	2.2E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	4.1E-05	1.2E-03	7.4E-07
	200 East Area	Resident Gardener	10000	2.8E-03	8.3E-02	5.0E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	7.6E-05	2.3E-03	1.4E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.2E-04	3.6E-03	2.2E-06
	200 East Area	Resident Gardener + Sauna	10000	2.2E+00	6.7E+01	4.0E-02
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1380	4.3E-05	1.3E-03	7.8E-07
LLW Cat 3	200 East Area	Resident Gardener	620	5.5E-04	1.6E-02	9.8E-06
MLLW	200 East Area	Resident Gardener	1380	6.0E-04	1.8E-02	1.1E-05
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4.3E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	1380	1.6E-04	4.7E-03	2.8E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	620	2.4E-03	7.3E-02	4.4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1380	1.6E-03	4.7E-02	2.8E-05
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	5.7E-04	1.7E-02	1.0E-05

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

Table F.84. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_1, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[a]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[b]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1700	2.9E-05	8.6E-04	5.2E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-02	2.2E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.4E-04	4.2E-03	2.5E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05

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

Table F.85. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_1, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.5E-05	1.0E-03	6.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	1.4E-03	4.3E-02	2.6E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.4E-04	4.2E-03	2.5E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05

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

Table F.86. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_1, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.4E-05	1.0E-03	6.2E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	1.9E-04	5.6E-03	3.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.8E-05	3.0E-03	1.8E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	5.3E-04	1.6E-02	9.6E-06

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

Table F.87. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_1, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose Years Post-2046[a]	Maximum Annual Dose Dose, rem	Lifetime Dose, rem	Probability of an LCF[b]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.4E-06	7.2E-05	4.3E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	7.0E-06	2.1E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1510	4.0E-06	1.2E-04	7.3E-08
LLW Cat 3	200 East Area	Resident Gardener	860	1.2E-04	3.6E-03	2.2E-06
MLLW	200 East Area	Resident Gardener	1500	6.8E-05	2.0E-03	1.2E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	10000	1.9E-09	5.6E-08	3.4E-11
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10000	6.3E-05	1.9E-03	1.1E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	820	5.6E-04	1.7E-02	1.0E-05
MLLW	200 East Area	Resident Gardener + Sauna	1500	1.8E-04	5.3E-03	3.2E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	10000	1.6E-06	4.8E-05	2.9E-08

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

Table F.88. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_1, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.9E-06	8.7E-05	5.2E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	8.5E-06	2.6E-04	1.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1510	4.9E-06	1.5E-04	8.9E-08
LLW Cat 3	200 East Area	Resident Gardener	820	6.7E-05	2.0E-03	1.2E-06
MLLW	200 East Area	Resident Gardener	1500	6.8E-05	2.0E-03	1.2E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	850	1.4E-06	4.2E-05	2.5E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10000	7.3E-05	2.2E-03	1.3E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	820	3.0E-04	9.0E-03	5.4E-06
MLLW	200 East Area	Resident Gardener + Sauna	1500	1.8E-04	5.3E-03	3.2E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	10000	1.4E-05	4.1E-04	2.4E-07

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

Table F.89. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_1, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	3.0E-06	9.1E-05	5.4E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	1.7E-05	5.2E-04	3.1E-07
	200 East Area	Resident Gardener	10000	8.1E-05	2.4E-03	1.5E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	8.6E-06	2.6E-04	1.6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	5.2E-05	1.6E-03	9.4E-07
	200 East Area	Resident Gardener + Sauna	10000	7.0E-02	2.1E+00	1.3E-03
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1510	4.9E-06	1.5E-04	8.8E-08
LLW Cat 3	200 East Area	Resident Gardener	820	6.7E-05	2.0E-03	1.2E-06
MLLW	200 East Area	Resident Gardener	1500	7.5E-05	2.3E-03	1.4E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	10000	4.4E-08	1.3E-06	7.9E-10
LLW Cat 1	200 East Area	Resident Gardener + Sauna	1510	1.8E-05	5.4E-04	3.2E-07
LLW Cat 3	200 East Area	Resident Gardener + Sauna	820	3.0E-04	9.0E-03	5.4E-06
MLLW	200 East Area	Resident Gardener + Sauna	1500	2.1E-04	5.8E-03	3.5E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	10000	7.1E-06	2.1E-04	1.3E-07

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

Table F.90. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_2, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	10000	2.6E-04	7.8E-03	4.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	5.8E-06	1.7E-04	1.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	3.5E-05	1.0E-03	6.2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1320	2.8E-05	8.4E-04	5.0E-07
LLW Cat 3	200 East Area	Resident Gardener	620	5.4E-04	1.6E-02	9.7E-06
MLLW	200 East Area	Resident Gardener	1370	7.9E-04	2.4E-02	1.4E-05
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4.3E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10000	7.5E-03	2.3E-01	1.4E-04
LLW Cat 3	200 East Area	Resident Gardener + Sauna	620	2.4E-03	7.3E-02	4.4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1370	2.0E-03	6.1E-02	3.7E-05
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	9.0E-04	2.7E-02	1.6E-05

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

Table F.91. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_2, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[(a)]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.1E-06	2.1E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	3.6E-05	1.1E-03	6.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 East Area	Resident Gardener	1320	3.4E-05	1.0E-03	6.1E-07
LLW Cat 3	200 East Area	Resident Gardener	620	5.4E-04	1.6E-02	9.7E-06
MLLW	200 East Area	Resident Gardener	1370	7.9E-04	2.4E-02	1.4E-05
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4.3E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10000	8.9E-03	2.7E-01	1.6E-04
LLW Cat 3	200 East Area	Resident Gardener + Sauna	620	2.4E-03	7.3E-02	4.4E-05
MLLW	200 East Area	Resident Gardener + Sauna	1370	2.0E-03	6.1E-02	3.7E-05
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	9.0E-04	2.7E-02	1.6E-05

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

Table F.92. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_2, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.4E-06	2.2E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	4.1E-05	1.2E-03	7.4E-07
	200 East Area	Resident Gardener	10000	2.8E-03	8.3E-02	5.0E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	1.1E-04	3.4E-03	2.1E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.2E-04	3.6E-03	2.2E-06
	200 East Area	Resident Gardener + Sauna	10000	2.2E+00	6.7E+01	4.0E-02
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1320	3.6E-05	1.1E-03	6.4E-07
LLW Cat 3	200 East Area	Resident Gardener	620	5.5E-04	1.7E-02	9.9E-06
MLLW	200 East Area	Resident Gardener	1360	8.1E-04	2.4E-02	1.5E-05
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	980	2.4E-06	7.1E-05	4.3E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	1320	1.3E-04	3.8E-03	2.3E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	620	2.5E-03	7.5E-02	4.5E-05
MLLW	200 East Area	Resident Gardener + Sauna	1360	2.1E-03	6.3E-02	3.8E-05
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	8.9E-04	2.7E-02	1.6E-05

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

Table F.93. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_2, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1700	2.9E-05	8.6E-04	5.2E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-02	2.2E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05

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

Table F.94. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_2, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.5E-05	1.0E-03	6.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	1.4E-03	4.3E-02	2.6E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05

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

Table F.95. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_2, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.4E-05	1.0E-03	6.2E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1690	1.9E-04	5.7E-03	3.4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.8E-05	3.0E-03	1.8E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1690	5.6E-04	1.7E-02	1.0E-05

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

Table F.96. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_2, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.4E-06	7.2E-05	4.3E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	7.0E-06	2.1E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1530	7.6E-06	2.3E-04	1.4E-07
LLW Cat 3	200 East Area	Resident Gardener	860	1.3E-04	3.8E-03	2.3E-06
MLLW	200 East Area	Resident Gardener	1580	1.1E-04	3.4E-03	2.0E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	2110	6.5E-08	2.0E-06	1.2E-09
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10000	8.7E-05	2.6E-03	1.6E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	860	5.7E-04	1.7E-02	1.0E-05
MLLW	200 East Area	Resident Gardener + Sauna	1580	2.9E-04	8.8E-03	5.3E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	10000	9.7E-06	2.9E-04	1.8E-07

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

Table F.97. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_2, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.9E-06	8.7E-05	5.2E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	8.5E-06	2.6E-04	1.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1530	9.3E-06	2.8E-04	1.7E-07
LLW Cat 3	200 East Area	Resident Gardener	860	1.3E-04	3.8E-03	2.3E-06
MLLW	200 East Area	Resident Gardener	1580	1.1E-04	3.4E-03	2.0E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	850	1.4E-06	4.2E-05	2.5E-08
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10000	1.1E-04	3.3E-03	2.0E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	860	5.7E-04	1.7E-02	1.0E-05
MLLW	200 East Area	Resident Gardener + Sauna	1580	2.9E-04	8.8E-03	5.3E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	10000	8.1E-06	2.4E-04	1.5E-07

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

Table F.98. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_2, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose Years Post-2046[a]	Maximum Annual Dose Dose, rem	Lifetime Dose, rem	Probability of an LCF[b]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	3.0E-06	9.1E-05	5.4E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2010	1.7E-05	5.2E-04	3.1E-07
	200 East Area	Resident Gardener	10000	8.1E-05	2.4E-03	1.5E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	9.8E-06	2.9E-04	1.8E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2010	5.2E-05	1.6E-03	9.4E-07
	200 East Area	Resident Gardener + Sauna	10000	7.0E-02	2.1E+00	1.3E-03
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 East Area	Resident Gardener	1530	9.3E-06	2.8E-04	1.7E-07
LLW Cat 3	200 East Area	Resident Gardener	860	1.3E-04	3.8E-03	2.3E-06
MLLW	200 East Area	Resident Gardener	1580	1.2E-04	3.6E-03	2.1E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	2110	6.5E-08	2.0E-06	1.2E-09
LLW Cat 1	200 East Area	Resident Gardener + Sauna	10000	1.2E-04	3.5E-03	2.1E-06
LLW Cat 3	200 East Area	Resident Gardener + Sauna	860	5.7E-04	1.7E-02	1.0E-05
MLLW	200 East Area	Resident Gardener + Sauna	1580	3.1E-04	9.4E-03	5.6E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	10000	9.7E-06	2.9E-04	1.8E-07

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

Table F.99. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_3, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	10000	2.6E-04	7.8E-03	4.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	5.8E-06	1.7E-04	1.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	1.6E-05	4.8E-04	2.9E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.9E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1800	2.7E-05	8.2E-04	4.9E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1130	4.8E-04	1.4E-02	8.6E-06
MLLW	200 ERDF Site	Resident Gardener	1790	4.6E-04	1.4E-02	8.3E-06
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
Melters	200 ERDF Site	Resident Gardener	1130	5.3E-06	1.6E-04	9.5E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1800	1.0E-04	3.0E-03	1.8E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1130	2.1E-03	6.4E-02	3.9E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1790	1.2E-03	3.7E-02	2.2E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1130	2.5E-05	7.6E-04	4.5E-07

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

Table F.100. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_3, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[(a)]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.0E-06	2.1E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	2.0E-05	5.9E-04	3.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.9E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1800	3.3E-05	1.0E-03	6.0E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1130	4.8E-04	1.4E-02	8.6E-06
MLLW	200 ERDF Site	Resident Gardener	1790	4.6E-04	1.4E-02	6.9E-06
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
Melters	200 ERDF Site	Resident Gardener	1130	5.3E-06	1.6E-04	9.5E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1800	1.2E-04	3.7E-03	2.2E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1130	2.1E-03	6.4E-02	3.9E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1790	1.2E-03	3.7E-02	2.2E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1130	2.5E-05	7.6E-04	4.5E-07

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

Table F.101. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_3, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.4E-06	2.2E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	4.1E-05	1.2E-03	7.4E-07
	200 East Area	Resident Gardener	10000	2.6E-03	7.8E-02	4.7E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	1.3E-04	4.0E-03	2.4E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.2E-04	3.6E-03	2.2E-06
	200 East Area	Resident Gardener + Sauna	10000	2.2E+00	6.7E+01	4.0E-02
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1800	3.3E-05	1.0E-03	6.0E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1130	4.8E-04	1.4E-02	8.6E-06
MLLW	200 ERDF Site	Resident Gardener	1790	4.8E-04	1.4E-02	8.6E-06
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
Melters	200 ERDF Site	Resident Gardener	1130	5.3E-06	1.6E-04	9.5E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1800	1.3E-04	3.8E-03	2.3E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1130	2.1E-03	6.4E-02	3.9E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1790	1.3E-03	3.8E-02	2.3E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1130	2.5E-05	7.6E-04	4.5E-07

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

Table F.102. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area and 200 ERDF Site Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_3, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	2.7E-05	8.2E-04	4.9E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	7.6E-05	2.3E-03	1.4E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1740	5.0E-05	1.5E-03	9.0E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1070	8.9E-04	2.7E-02	1.6E-05
MLLW	200 ERDF Site	Resident Gardener	1740	8.4E-04	2.5E-02	1.5E-05
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1740	1.9E-04	5.6E-03	3.3E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1070	4.0E-03	1.2E-01	7.2E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1740	2.2E-03	6.7E-02	4.0E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03

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

Table F.103. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area and 200 ERDF Site Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_3, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.3E-05	1.0E-03	6.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.3E-05	2.8E-03	1.7E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1740	6.1E-05	1.8E-03	1.1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1070	8.9E-04	2.7E-02	1.6E-05
MLLW	200 ERDF Site	Resident Gardener	1740	8.4E-04	2.5E-02	1.5E-05
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1740	2.3E-04	6.8E-03	4.1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1070	4.0E-03	1.2E-01	7.2E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1740	2.2E-03	6.5E-02	3.9E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03

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

Table F.104. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area and 200 ERDF Site Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_3, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	4.0E-05	1.2E-03	7.2E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1690	1.9E-04	5.7E-03	3.4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	4.8E-03	1.5E-01	8.7E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1690	5.6E-04	1.7E-02	1.0E-05
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1740	6.1E-05	1.8E-03	1.1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1070	8.9E-04	2.7E-02	1.6E-05
MLLW	200 ERDF Site	Resident Gardener	1740	8.7E-04	2.6E-02	1.6E-05
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	1.0E-02	3.1E-01	1.9E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1070	4.0E-03	1.2E-01	7.2E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1740	2.3E-03	6.8E-02	4.1E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03

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

Table F.105. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_3, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.4E-06	7.2E-05	4.3E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	6.7E-06	2.0E-04	1.2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	2010	4.4E-06	1.3E-04	8.0E-08
LLW Cat 3	200 ERDF Site	Resident Gardener	1420	7.8E-05	2.3E-03	1.4E-06
MLLW	200 ERDF Site	Resident Gardener	2010	7.6E-05	2.3E-03	1.4E-06
ILAW	200 ERDF Site	Resident Gardener	10000	1.2E-05	3.5E-04	2.1E-07
Melters	200 ERDF Site	Resident Gardener	1420	8.7E-07	2.6E-05	1.6E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	2010	1.6E-05	4.9E-04	3.0E-07
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1420	3.5E-04	1.1E-02	6.3E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	2010	2.0E-04	6.0E-03	3.6E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	3.0E-05	9.0E-02	5.4E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1420	4.1E-06	1.2E-04	7.4E-08

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

Table F.106. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_3, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose Years Post-2046[(a)]	Maximum Annual Dose Dose, rem	Lifetime Dose, rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.9E-06	8.7E-05	5.2E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	8.1E-06	2.4E-04	1.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	2010	5.4E-06	1.6E-04	9.8E-08
LLW Cat 3	200 ERDF Site	Resident Gardener	1420	7.8E-05	2.3E-03	1.4E-06
MLLW	200 ERDF Site	Resident Gardener	2010	7.6E-05	2.3E-03	1.4E-06
ILAW	200 ERDF Site	Resident Gardener	10000	1.2E-05	3.5E-04	2.1E-07
Melters	200 ERDF Site	Resident Gardener	1420	8.7E-07	2.6E-05	1.6E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	2010	2.0E-05	6.0E-04	3.6E-07
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1420	3.5E-04	1.1E-02	6.3E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	2010	2.0E-04	6.0E-03	3.6E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	3.0E-05	9.0E-02	5.4E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1420	4.1E-06	1.2E-04	7.4E-08

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

Table F.107. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group D_3, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	3.0E-06	9.1E-05	5.5E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.1E-08
MLLW	200 West Area	Resident Gardener	2000	1.7E-05	5.2E-04	3.1E-07
	200 East Area	Resident Gardener	10000	8.1E-05	2.4E-03	1.5E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	1.4E-05	4.3E-04	2.6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1720	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	5.2E-05	1.6E-03	9.4E-07
	200 East Area	Resident Gardener + Sauna	10000	7.0E-02	2.1E+00	1.3E-03
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	2010	5.4E-06	1.6E-04	9.8E-08
LLW Cat 3	200 ERDF Site	Resident Gardener	1420	7.8E-05	2.3E-03	1.4E-06
MLLW	200 ERDF Site	Resident Gardener	2010	8.0E-05	2.4E-03	1.4E-06
ILAW	200 ERDF Site	Resident Gardener	10000	1.2E-05	3.5E-04	2.1E-07
Melters	200 ERDF Site	Resident Gardener	1420	8.7E-07	2.6E-05	1.6E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	4.2E-03	1.2E-01	7.5E-05
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1420	3.5E-04	1.1E-02	6.3E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	2010	2.2E-04	6.7E-03	4.0E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	3.0E-05	9.0E-02	5.4E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1420	4.1E-06	1.2E-04	7.4E-08

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

Table F.108. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_1, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	10000	2.6E-04	7.8E-03	4.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	5.8E-06	1.7E-04	1.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	3.5E-05	1.0E-03	6.2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1320	2.8E-05	8.4E-04	5.0E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	620	5.4E-04	1.6E-02	9.7E-06
MLLW	200 ERDF Site	Resident Gardener	1370	7.9E-04	2.4E-02	1.4E-05
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
Melters	200 ERDF Site	Resident Gardener	1130	5.3E-06	1.6E-04	9.5E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	7.6E-03	2.3E-01	1.4E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	620	2.4E-03	7.3E-02	4.4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1370	2.0E-03	6.1E-02	3.6E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1130	2.5E-05	7.6E-04	4.5E-07

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

Table F.109. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_1, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.1E-06	2.1E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	3.6E-05	1.1E-03	6.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1320	3.4E-05	1.0E-03	6.1E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	620	5.4E-04	1.6E-02	9.7E-06
MLLW	200 ERDF Site	Resident Gardener	1370	7.9E-04	2.4E-02	1.4E-05
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
Melters	200 ERDF Site	Resident Gardener	1130	5.3E-06	1.6E-04	9.5E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	9.0E-03	2.7E-01	1.6E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	620	2.5E-03	7.4E-02	4.4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1370	2.2E-03	6.5E-02	3.9E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1130	2.5E-05	7.6E-04	4.5E-07

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

Table F.110. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_1, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.3E-06	2.2E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	4.1E-05	1.2E-03	7.4E-07
	200 East Area	Resident Gardener	10000	2.8E-03	8.3E-02	5.0E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	4.3E-05	1.3E-03	7.7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.2E-04	3.6E-03	2.2E-06
	200 East Area	Resident Gardener + Sauna	10000	2.2E+00	6.7E+01	4.0E-02
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1320	3.4E-05	1.0E-03	6.1E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	620	5.4E-04	1.6E-02	9.7E-06
MLLW	200 ERDF Site	Resident Gardener	1370	8.1E-04	2.4E-02	1.5E-05
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
Melters	200 ERDF Site	Resident Gardener	1130	5.3E-06	1.6E-04	9.5E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	1.4E-02	4.3E-01	2.6E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	620	2.4E-03	7.2E-02	4.3E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1370	2.1E-03	6.3E-02	3.8E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1130	2.5E-05	7.6E-04	4.5E-07

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

Table F.111. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area and 200 ERDF Site Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_1, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1700	2.9E-05	8.6E-04	5.2E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	1.3E-03	3.9E-02	2.4E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.4E-04	4.2E-03	2.5E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[c]						
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03

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

Table F.112. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area and 200 ERDF Site Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_1, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.5E-05	1.0E-03	6.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	1.4E-03	4.3E-02	2.6E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[c]						
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03

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

Table F.113. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area and 200 ERDF Site Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_1, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[(a)]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.7E-05	1.1E-03	6.6E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1690	1.9E-04	5.7E-03	3.4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	2.2E-03	6.6E-02	4.0E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1690	5.6E-04	1.7E-02	1.0E-05
Projected New Waste (> 2007)[(c)]						
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03

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

Table F.114. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years –- Alternative Group E_1, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.4E-06	7.2E-05	4.3E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	7.0E-06	2.1E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1530	7.7E-06	2.3E-04	1.4E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	860	1.3E-04	3.8E-03	2.3E-06
MLLW	200 ERDF Site	Resident Gardener	1580	1.1E-04	3.4E-03	2.0E-06
ILAW	200 ERDF Site	Resident Gardener	10000	1.2E-05	3.5E-04	2.1E-07
Melters	200 ERDF Site	Resident Gardener	1420	8.7E-07	2.6E-05	1.6E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	1.4E-04	4.1E-03	2.5E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	860	5.7E-04	1.7E-02	1.0E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1580	2.9E-04	8.8E-03	5.3E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	3.0E-05	9.0E-02	5.4E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1420	4.5E-06	1.3E-04	8.0E-08

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

Table F.115. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_1, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose Years Post-2046[(a)]	Maximum Annual Dose Dose, rem	Lifetime Dose, rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.9E-06	8.7E-05	5.2E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	8.5E-06	2.6E-04	1.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1530	9.3E-06	2.8E-04	1.7E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	860	1.3E-04	3.8E-03	2.3E-06
MLLW	200 ERDF Site	Resident Gardener	1580	1.1E-04	3.4E-03	2.0E-06
ILAW	200 ERDF Site	Resident Gardener	10000	1.2E-05	3.5E-04	2.1E-07
Melters	200 ERDF Site	Resident Gardener	1420	8.7E-07	2.6E-05	1.6E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	1.6E-04	4.8E-03	2.9E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	850	5.7E-04	1.7E-02	1.0E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1580	2.9E-04	8.8E-03	5.3E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	3.0E-05	9.0E-02	5.4E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1420	4.5E-06	1.3E-04	8.0E-08

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

Table F.116. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_1, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	3.0E-06	9.1E-05	5.4E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	1.7E-05	5.2E-04	3.1E-07
	200 East Area	Resident Gardener	10000	8.1E-05	2.4E-03	1.5E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	9.0E-06	2.7E-04	1.6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	5.2E-05	1.6E-03	9.4E-07
	200 East Area	Resident Gardener + Sauna	10000	7.0E-02	2.1E+00	1.3E-03
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1530	9.6E-06	2.9E-04	1.7E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	860	1.3E-04	3.8E-03	2.3E-06
MLLW	200 ERDF Site	Resident Gardener	1570	1.2E-04	3.5E-03	2.1E-06
ILAW	200 ERDF Site	Resident Gardener	10000	1.2E-05	3.5E-04	2.1E-07
Melters	200 ERDF Site	Resident Gardener	1420	8.7E-07	2.6E-05	1.6E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	3.4E-04	1.0E-02	6.1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	860	5.7E-04	1.7E-02	1.0E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1570	3.1E-04	9.4E-03	5.6E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	3.0E-05	9.0E-02	5.4E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1420	4.5E-06	1.3E-04	8.0E-08

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

Table F.117. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_2, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	10000	2.6E-04	7.8E-03	4.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	5.8E-06	1.7E-04	1.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	3.5E-05	1.0E-03	6.2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1380	4.1E-05	1.2E-03	7.3E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	620	1.6E-04	4.8E-03	2.9E-06
MLLW	200 ERDF Site	Resident Gardener	1380	5.7E-04	1.7E-02	1.0E-05
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
Melters	200 ERDF Site	Resident Gardener	1130	5.3E-06	1.6E-04	9.5E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	4.8E-03	1.4E-01	8.7E-05
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	620	7.7E-04	2.3E-02	1.4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1380	1.4E-03	4.3E-02	2.6E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1130	2.5E-05	7.6E-04	4.5E-07

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

Table F.118. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_2, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[a]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[b]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.1E-06	2.1E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	3.6E-05	1.1E-03	6.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1380	4.9E-05	1.5E-03	8.9E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	620	1.6E-04	4.8E-03	2.9E-06
MLLW	200 ERDF Site	Resident Gardener	1380	5.6E-04	1.7E-02	1.0E-05
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
Melters	200 ERDF Site	Resident Gardener	1130	5.3E-06	1.6E-04	9.5E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	5.5E-03	1.7E-01	1.0E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	620	7.7E-04	2.3E-02	1.4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1380	1.4E-03	4.3E-02	2.6E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1130	2.5E-05	7.6E-04	4.5E-07

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

Table F.119. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_2, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[(a)]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.3E-06	2.2E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	10000	1.4E-04	4.3E-03	2.6E-06
	200 East Area	Resident Gardener	1220	1.4E-04	4.3E-03	2.6E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	4.3E-05	1.3E-03	7.7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.7E-05	5.0E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	10000	1.2E-01	3.7E+00	2.2E-03
	200 East Area	Resident Gardener + Sauna	10000	7.0E-02	2.1E+00	1.3E-03
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1380	4.2E-05	1.3E-03	7.6E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	620	1.7E-04	5.0E-03	3.0E-06
MLLW	200 ERDF Site	Resident Gardener	1380	5.7E-04	1.7E-02	1.0E-05
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
Melters	200 ERDF Site	Resident Gardener	1130	5.3E-06	1.6E-04	9.5E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	9.4E-03	2.8E-01	1.7E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	620	8.0E-04	2.4E-02	1.4E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1380	1.4E-03	4.3E-02	2.6E-05
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03
Melters	200 ERDF Site	Resident Gardener + Sauna	1130	2.5E-05	7.6E-04	4.5E-07

The number of years post-2046 in which the maximum annual dose occurs over the 10,000-yr period.

Health impacts are expressed as lifetime risk of fatal cancer from the indicated lifetime radiation dose. The probability of an LCF is the calculated value using the appropriate linear health effects conversion factor. The actual probability cannot be greater than one.

Results are not reported for cases that had no inventory reported for the waste.

Table F.120. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area and 200 ERDF Site Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_2, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose Years Post-2046[a]	Maximum Annual Dose Dose, rem	Lifetime Dose ,rem	Probability of an LCF[b]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1700	2.9E-05	8.6E-04	5.2E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	1.3E-03	3.9E-02	2.4E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[c]						
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03

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

Table F.121. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area and 200 ERDF Site Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_2, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[a]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[b]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.5E-05	1.0E-03	6.3E-07
LLW Cat 3	200 West Area	Resident Gardener	680	1.3E-05	3.8E-04	2.3E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	1.3E-03	4.0E-02	2.4E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[c]						
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03

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

Table F.122. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area and 200 ERDF Site Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_2, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.7E-05	1.1E-03	6.6E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1690	1.9E-04	5.7E-03	3.4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	10000	2.2E-03	6.6E-02	4.0E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.3E-04	3.8E-03	2.3E-06
MLLW	200 West Area	Resident Gardener + Sauna	1690	5.6E-04	1.7E-02	1.0E-05
Projected New Waste (> 2007)[c]						
ILAW	200 ERDF Site	Resident Gardener	10000	3.5E-04	1.0E-02	6.0E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	1.2E-01	3.6E-00	2.2E-03

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

Table F.123. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_2, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.4E-06	7.2E-05	4.3E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	7.0E-06	2.1E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	10000	5.4E-06	1.6E-04	9.8E-08
LLW Cat 3	200 ERDF Site	Resident Gardener	820	6.2E-05	1.9E-03	1.1E-06
MLLW	200 ERDF Site	Resident Gardener	1500	6.7E-05	2.0E-03	1.2E-06
ILAW	200 ERDF Site	Resident Gardener	10000	1.2E-05	3.5E-04	2.1E-07
Melters	200 ERDF Site	Resident Gardener	1420	8.7E-07	2.6E-05	1.6E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	4.7E-03	1.4E-01	8.5E-05
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	820	3.1E-04	9.3E-03	5.6E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	1500	1.7E-04	5.2E-03	3.1E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	3.0E-05	9.0E-02	5.4E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1420	4.1E-06	1.2E-04	7.4E-08

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

Table F.124. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_2, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose Years Post-2046[(a)]	Maximum Annual Dose Dose, rem	Lifetime Dose, rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.9E-06	8.7E-05	5.2E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	8.5E-06	2.6E-04	1.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	10000	5.5E-03	1.7E-01	1.0E-04
LLW Cat 3	200 ERDF Site	Resident Gardener	820	6.7E-05	2.0E-03	1.2E-06
MLLW	200 ERDF Site	Resident Gardener	1500	6.7E-05	2.0E-03	1.2E-06
ILAW	200 ERDF Site	Resident Gardener	10000	1.2E-05	3.5E-04	2.1E-07
Melters	200 ERDF Site	Resident Gardener	1420	8.7E-07	2.6E-05	1.6E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	5.6E-03	1.7E-01	1.0E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	820	3.2E-04	9.7E-03	5.8E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	1500	1.8E-04	5.3E-03	3.2E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	3.0E-05	9.0E-02	5.4E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1420	4.1E-06	1.2E-04	7.4E-08

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

Table F.125. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_2, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[(a)]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	2000	3.0E-06	9.1E-05	5.4E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	1.7E-05	5.2E-04	3.1E-07
	200 East Area	Resident Gardener	10000	8.3E-05	2.5E-03	1.5E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	9.0E-06	2.7E-04	1.6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	5.2E-05	1.6E-03	9.4E-07
	200 East Area	Resident Gardener + Sauna	10000	7.0E-02	2.1E+00	1.3E-03
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	10000	1.1E-05	3.2E-04	1.9E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	820	6.2E-05	1.9E-03	1.1E-06
MLLW	200 ERDF Site	Resident Gardener	1500	7.0E-05	2.1E-03	1.3E-06
ILAW	200 ERDF Site	Resident Gardener	10000	1.2E-05	3.5E-04	1.8E-07
Melters	200 ERDF Site	Resident Gardener	1420	8.7E-07	2.6E-05	1.6E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	10000	9.2E-03	2.8E-01	1.7E-04
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	820	3.0E-04	9.0E-03	5.4E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	10000	3.1E-04	9.2E-03	5.5E-06
ILAW	200 ERDF Site	Resident Gardener + Sauna	10000	3.0E-05	9.0E-02	5.4E-05
Melters	200 ERDF Site	Resident Gardener + Sauna	1420	4.1E-06	1.2E-04	7.4E-08

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

Table F.126. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_3, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	10000	2.6E-04	7.8E-03	4.7E-06
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	5.8E-06	1.7E-04	1.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	1.6E-05	4.8E-04	2.9E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.9E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1800	5.5E-05	1.7E-03	9.9E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1130	4.5E-04	1.4E-02	8.1E-06
MLLW	200 ERDF Site	Resident Gardener	1130	2.1E-05	6.4E-04	3.8E-07
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	680	7.5E-06	2.3E-04	1.4E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1800	1.3E-04	3.9E-03	2.4E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1130	2.1E-03	6.3E-02	3.8E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1130	1.0E-04	3.0E-03	1.8E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	5.6E-04	1.7E-02	1.0E-05

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

Table F.127. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_3, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[(a)]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[(c)]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.0E-06	2.1E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	7.3E-05	2.2E-03	1.3E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	2.0E-05	5.9E-04	3.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.9E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.9E-04	5.8E-03	3.5E-06
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1800	6.7E-05	2.0E-03	1.2E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1130	4.5E-04	1.4E-02	8.2E-06
MLLW	200 ERDF Site	Resident Gardener	1130	2.1E-05	6.4E-04	3.9E-07
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	680	7.5E-06	2.3E-04	1.4E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1800	1.6E-04	4.8E-03	2.9E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1130	2.1E-03	6.3E-02	3.8E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1130	1.0E-04	3.0E-03	1.8E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	5.6E-04	1.7E-02	1.0E-05

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

Table F.128. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_3, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.0E-06	6.1E-05	3.6E-08
	200 East Area	Resident Gardener	10000	7.0E-05	2.1E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.7E-06	2.6E-04	1.6E-07
	200 East Area	Resident Gardener + Sauna	10000	6.1E-02	1.8E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	5.4E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-04	5.8E-07
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	7.9E-08
	200 East Area	Resident Gardener + Sauna	10000	1.2E-03	3.7E-03	2.2E-06
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	1.1E-06
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	3.1E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.2E-03	1.9E-06
	200 East Area	Resident Gardener + Sauna	110	2.7E-02	8.0E-01	4.8E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1810	7.3E-06	2.2E-04	1.3E-07
LLW Cat 3	200 West Area	Resident Gardener	1450	3.5E-06	1.0E-04	6.2E-08
MLLW	200 West Area	Resident Gardener	1810	3.9E-05	1.2E-03	7.1E-07
	200 East Area	Resident Gardener	10000	2.8E-03	8.3E-02	5.0E-05
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1810	2.1E-05	6.2E-04	3.7E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1450	1.6E-05	4.9E-04	3.0E-07
MLLW	200 West Area	Resident Gardener + Sauna	1810	1.1E-04	3.4E-03	2.0E-06
	200 East Area	Resident Gardener + Sauna	10000	2.2E+00	6.7E+01	4.0E-02
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1800	6.8E-05	2.0E-03	1.2E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1130	4.5E-04	1.4E-02	8.1E-06
MLLW	200 ERDF Site	Resident Gardener	1130	4.6E-05	1.4E-03	8.2E-07
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
Melters	200 East Area	Resident Gardener	680	6.9E-06	2.1E-04	1.2E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1800	1.6E-04	4.8E-03	2.9E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1130	2.1E-03	6.3E-02	3.8E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1130	2.2E-04	6.5E-03	3.9E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04
Melters	200 East Area	Resident Gardener + Sauna	10000	5.6E-04	1.7E-02	1.0E-05

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

Table F.129. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area and 200 ERDF Site Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_3, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	2.7E-05	8.2E-04	4.9E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	7.6E-05	2.3E-03	1.4E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1740	5.1E-05	1.5E-03	9.1E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1070	8.9E-04	2.7E-02	1.6E-05
MLLW	200 ERDF Site	Resident Gardener	1070	4.0E-05	1.2E-03	7.3E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1070	1.9E-04	5.6E-03	3.4E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1070	4.0E-03	1.2E-01	7.2E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1070	1.9E-04	5.7E-03	3.4E-06

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

Table F.130. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area and 200 ERDF Site Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_3, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime	Probability of
			Years Post-2046[(a)]	Dose, rem	Dose, rem	an LCF[(b)]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.3E-05	1.0E-03	6.0E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1700	3.4E-04	1.0E-02	6.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.3E-05	2.8E-03	1.7E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1700	9.2E-04	2.8E-02	1.7E-05
Projected New Waste (> 2007)[(c)]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1740	6.2E-05	1.9E-03	1.1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1070	8.9E-04	2.7E-02	1.6E-05
MLLW	200 ERDF Site	Resident Gardener	1070	4.0E-05	1.2E-03	7.3E-07
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1740	2.3E-04	6.8E-03	4.1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1070	4.0E-03	1.2E-01	7.2E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1070	1.9E-04	5.7E-03	3.4E-06

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

Table F.131. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area and 200 ERDF Site Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_3, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	2.2E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	9.1E-07
1970 – 1988	200 West Area	Resident Gardener	290	1.8E-05	5.5E-04	3.3E-07
	200 West Area	Resident Gardener + Sauna	290	2.7E-05	8.1E-04	4.9E-07
1988 – 1995	200 West Area	Resident Gardener	250	3.3E-04	9.9E-03	6.0E-06
	200 West Area	Resident Gardener + Sauna	250	4.8E-04	1.5E-02	8.7E-06
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	1700	3.4E-05	1.0E-03	6.2E-07
LLW Cat 3	200 West Area	Resident Gardener	1230	2.4E-05	7.3E-04	4.4E-07
MLLW	200 West Area	Resident Gardener	1690	1.9E-04	5.7E-03	3.4E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1700	9.8E-05	3.0E-03	1.8E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	1.2E-04	3.5E-03	2.1E-06
MLLW	200 West Area	Resident Gardener + Sauna	1690	5.6E-04	1.7E-02	1.0E-05
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1740	6.2E-05	1.9E-03	1.1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener	1070	9.0E-04	2.7E-02	1.6E-05
MLLW	200 ERDF Site	Resident Gardener	1070	8.6E-05	2.6E-03	1.5E-06
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1740	2.3E-04	6.9E-03	4.1E-06
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1070	4.0E-03	1.2E-01	7.2E-05
MLLW	200 ERDF Site	Resident Gardener + Sauna	1070	4.1E-04	1.2E-02	7.3E-06

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

Table F.132. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_3, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.4E-06	7.2E-05	4.3E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	6.7E-06	2.0E-04	1.2E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1660	4.6E-06	1.4E-04	8.4E-08
LLW Cat 3	200 ERDF Site	Resident Gardener	1520	7.7E-05	2.3E-03	1.4E-06
MLLW	200 ERDF Site	Resident Gardener	1650	7.9E-05	2.4E-03	1.4E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	820	7.5E-07	2.2E-05	1.3E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1660	1.7E-05	5.1E-04	3.1E-07
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1420	3.5E-04	1.1E-02	6.3E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	1650	2.1E-04	6.2E-03	3.7E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	820	3.9E-06	1.2E-04	7.0E-08

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

Table F.133. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_3, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	2.9E-06	8.7E-05	5.2E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	3.0E-05	9.1E-04	5.4E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	8.1E-06	2.4E-04	1.5E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	8.1E-05	2.4E-03	1.5E-06
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1660	5.7E-06	1.7E-04	1.0E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1420	7.8E-05	2.4E-03	1.4E-06
MLLW	200 ERDF Site	Resident Gardener	1650	7.9E-05	2.4E-03	1.4E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	940	1.2E-06	3.7E-05	2.2E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1660	2.1E-05	6.3E-04	3.8E-07
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1420	3.5E-04	1.1E-02	6.3E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	1650	2.1E-04	6.2E-03	3.7E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	940	6.2E-06	1.9E-04	1.1E-07

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

Table F.134. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – Alternative Group E_3, Upper Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose: Years Post-2046[a]	Maximum Annual Dose: Dose, rem	Lifetime Dose, rem	Probability of an LCF[b]
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.4E-08
	200 East Area	Resident Gardener	260	6.6E-06	2.0E-04	1.2E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	5.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	8.2E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	2.2E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	5.2E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	3.3E-08
	200 East Area	Resident Gardener + Sauna	10000	7.4E-05	2.2E-03	1.3E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.1E-05	6.4E-04	3.9E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.5E-08
	200 West Area	Resident Gardener + Sauna	600	3.1E-05	9.4E-04	5.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.5E-05	4.6E-04	2.8E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	2000	3.0E-06	9.1E-05	5.4E-08
LLW Cat 3	200 West Area	Resident Gardener	1710	1.7E-06	5.1E-05	3.0E-08
MLLW	200 West Area	Resident Gardener	2000	1.7E-05	5.2E-04	3.1E-07
	200 East Area	Resident Gardener	10000	8.1E-05	2.4E-03	1.5E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	2000	8.6E-06	2.6E-04	1.6E-07
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1710	8.0E-06	2.4E-04	1.4E-07
MLLW	200 West Area	Resident Gardener + Sauna	2000	5.2E-05	1.6E-03	9.4E-07
	200 East Area	Resident Gardener + Sauna	10000	7.0E-02	2.1E+00	1.3E-03
Projected New Waste (> 2007)[c]						
LLW Cat 1	200 ERDF Site	Resident Gardener	1660	5.7E-06	1.7E-04	1.0E-07
LLW Cat 3	200 ERDF Site	Resident Gardener	1520	7.7E-05	2.3E-03	1.4E-06
MLLW	200 ERDF Site	Resident Gardener	1660	8.3E-05	2.5E-03	1.5E-06
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
Melters	200 East Area	Resident Gardener	820	7.5E-07	2.2E-05	1.3E-08
LLW Cat 1	200 ERDF Site	Resident Gardener + Sauna	1660	2.1E-05	6.3E-04	3.8E-07
LLW Cat 3	200 ERDF Site	Resident Gardener + Sauna	1420	3.5E-04	1.1E-02	6.3E-06
MLLW	200 ERDF Site	Resident Gardener + Sauna	1660	2.3E-04	6.8E-03	4.1E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05
Melters	200 East Area	Resident Gardener + Sauna	820	3.9E-06	1.2E-04	7.0E-08

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

Table F.135. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – No Action Alternative, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.1E-06	6.4E-05	3.2E-08
	200 East Area	Resident Gardener	10000	8.7E-05	2.6E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.8E-06	2.6E-04	1.3E-07
	200 East Area	Resident Gardener + Sauna	10000	7.5E-02	2.3E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	4.5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-03	4.9E-06
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	6.6E-08
	200 East Area	Resident Gardener + Sauna	10000	1.3E-03	3.8E-02	1.9E-05
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	9.4E-07
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	2.6E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.3E-03	1.6E-06
	200 East Area	Resident Gardener + Sauna	110	2.6E-02	7.8E-01	3.9E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	1220	1.9E-05	5.7E-04	3.4E-07
	200 East Area	Resident Gardener	1220	1.9E-05	5.7E-04	3.4E-07
LLW Cat 3	200 West Area	Resident Gardener	680	8.6E-04	2.6E-02	1.5E-05
	200 East Area	Resident Gardener	10000	6.6E-04	2.0E-02	1.2E-05
MLLW	200 West Area	Resident Gardener	1220	3.5E-05	1.1E-03	6.3E-07
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	1220	6.5E-05	1.9E-03	1.2E-06
	200 East Area	Resident Gardener + Sauna	10000	1.6E-03	4.7E-02	2.8E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	680	4.0E-03	1.2E-01	7.1E-05
	200 East Area	Resident Gardener + Sauna	10000	5.7E-01	1.7E+01	1.0E-02
MLLW	200 West Area	Resident Gardener + Sauna	1220	8.0E-05	2.4E-03	1.4E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04

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

Table F.136. Potential Individual Human Health Impacts to a Resident Gardener at the 200 East Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – No Action Alternative, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	350	2.1E-06	6.4E-05	3.2E-08
	200 East Area	Resident Gardener	10000	8.7E-05	2.6E-03	1.3E-06
	200 West Area	Resident Gardener + Sauna	350	8.8E-06	2.6E-04	1.3E-07
	200 East Area	Resident Gardener + Sauna	10000	7.5E-02	2.3E+00	1.1E-03
1970 – 1988	200 West Area	Resident Gardener	420	3.0E-06	9.1E-05	4.5E-08
	200 East Area	Resident Gardener	110	3.2E-04	9.7E-03	4.9E-06
	200 West Area	Resident Gardener + Sauna	420	4.4E-06	1.3E-04	6.6E-08
	200 East Area	Resident Gardener + Sauna	10000	1.3E-03	3.8E-02	1.9E-05
1988 – 1995	200 West Area	Resident Gardener	360	6.2E-05	1.9E-03	9.4E-07
	200 East Area	Resident Gardener	110	1.7E-02	5.2E-01	2.6E-04
	200 West Area	Resident Gardener + Sauna	360	1.1E-04	3.3E-03	1.6E-06
	200 East Area	Resident Gardener + Sauna	110	2.6E-02	7.8E-01	3.9E-04
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	360	2.9E-05	8.8E-04	5.3E-07
	200 East Area	Resident Gardener	110	1.1E-05	3.2E-04	1.9E-07
LLW Cat 3	200 West Area	Resident Gardener	1460	1.7E-04	5.0E-03	3.0E-06
	200 East Area	Resident Gardener	10000	7.1E-04	2.1E-02	1.3E-05
MLLW	200 West Area	Resident Gardener	1220	3.5E-05	1.1E-03	6.4E-07
ILAW	200 East Area	Resident Gardener	10000	1.0E-04	3.0E-03	1.8E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	360	1.0E-04	3.0E-03	1.8E-06
	200 East Area	Resident Gardener + Sauna	10000	1.9E-03	5.8E-02	3.5E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1460	7.4E-04	2.2E-02	1.3E-05
	200 East Area	Resident Gardener + Sauna	10000	5.9E-01	1.8E+01	1.1E-02
MLLW	200 West Area	Resident Gardener + Sauna	1220	8.0E-05	2.4E-03	1.4E-06
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.5E-02	1.0E-00	6.0E-04

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

Table F.137. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – No Action Alternative, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF(b)
			Years Post-2046(a)	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	1.8E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	7.5E-07
1970 – 1988	200 West Area	Resident Gardener	250	2.4E-05	7.3E-04	3.7E-07
	200 West Area	Resident Gardener + Sauna	250	3.6E-05	1.1E-03	5.4E-07
1988 – 1995	200 West Area	Resident Gardener	210	5.2E-04	1.6E-02	7.8E-06
	200 West Area	Resident Gardener + Sauna	210	9.0E-04	2.7E-02	1.4E-05
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	210	2.0E-04	6.0E-03	3.6E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2.1E-05
MLLW	200 West Area	Resident Gardener	1070	2.3E-04	7.0E-03	4.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	210	6.8E-04	2.0E-02	1.2E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.2E-03	1.6E-01	9.4E-05
MLLW	200 West Area	Resident Gardener + Sauna	1070	5.2E-04	1.6E-02	9.4E-06

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

Table F.138. Potential Individual Human Health Impacts to a Resident Gardener at the 200 West Area Point of Analysis from Radionuclides in the Groundwater Over 10,000 Years – No Action Alternative, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	190	1.2E-05	3.6E-04	1.8E-07
	200 West Area	Resident Gardener + Sauna	190	5.0E-05	1.5E-03	7.5E-07
1970 – 1988	200 West Area	Resident Gardener	250	2.4E-05	7.3E-04	3.7E-07
	200 West Area	Resident Gardener + Sauna	250	3.6E-05	1.1E-03	5.4E-07
1988 – 1995	200 West Area	Resident Gardener	210	5.2E-04	1.6E-02	7.8E-06
	200 West Area	Resident Gardener + Sauna	210	9.0E-04	2.7E-02	1.4E-05
Newly Generated Waste (1996 – 2007)						
LLW Cat 1	200 West Area	Resident Gardener	210	2.4E-04	7.3E-03	4.4E-06
LLW Cat 3	200 West Area	Resident Gardener	1230	1.2E-03	3.5E-02	2.1E-05
MLLW	200 West Area	Resident Gardener	1070	2.3E-04	7.0E-03	4.2E-06
LLW Cat 1	200 West Area	Resident Gardener + Sauna	210	8.3E-04	2.5E-02	1.5E-05
LLW Cat 3	200 West Area	Resident Gardener + Sauna	1230	5.2E-03	1.6E-01	9.4E-05
MLLW	200 West Area	Resident Gardener + Sauna	1070	5.2E-04	1.6E-02	9.4E-06

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

Table F.139. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – No Action Alternative, Hanford Only Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.1E-08
	200 East Area	Resident Gardener	260	6.7E-06	2.0E-04	1.0E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	4.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	6.8E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	1.9E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	4.3E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	2.7E-08
	200 East Area	Resident Gardener + Sauna	10000	7.3E-05	2.2E-03	1.1E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.3E-05	7.0E-04	3.5E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.1E-08
	200 West Area	Resident Gardener + Sauna	10000	4.9E-02	1.5E+00	7.3E-04
	200 East Area	Resident Gardener + Sauna	10000	6.5E-04	0.0E+00	0.0E+00
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	600	8.4E-06	2.5E-04	1.5E-07
	200 East Area	Resident Gardener	260	7.7E-07	2.3E-05	1.4E-08
LLW Cat 3	200 West Area	Resident Gardener	930	1.1E-04	3.3E-03	2.0E-06
	200 East Area	Resident Gardener	10000	3.1E-05	9.4E-04	5.6E-07
MLLW	200 West Area	Resident Gardener	1420	1.4E-05	4.3E-04	2.6E-07
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	600	3.0E-05	9.0E-04	5.4E-07
	200 East Area	Resident Gardener + Sauna	10000	9.5E-05	2.8E-03	1.7E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	940	4.9E-04	1.5E-02	8.8E-06
	200 East Area	Resident Gardener + Sauna	10000	2.3E-02	6.9E-01	4.2E-04
MLLW	200 West Area	Resident Gardener + Sauna	1420	3.2E-05	9.7E-04	5.8E-07
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05

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

Table F.140. Potential Individual Human Health Impacts to a Resident Gardener at the Columbia River Well from Radionuclides in the Groundwater Over 10,000 Years – No Action Alternative, Lower Bound Volumes

Waste Category	Source Location	Exposure Scenario	Maximum Annual Dose		Lifetime Dose, rem	Probability of an LCF[b]
			Years Post-2046[a]	Dose, rem		
Previously Disposed Low Level Waste						
Pre-1970	200 West Area	Resident Gardener	530	7.6E-07	2.3E-05	1.1E-08
	200 East Area	Resident Gardener	260	6.7E-06	2.0E-04	1.0E-07
	200 West Area	Resident Gardener + Sauna	530	3.1E-06	9.4E-05	4.7E-08
	200 East Area	Resident Gardener + Sauna	10000	4.5E-03	1.4E-01	6.8E-05
1970 – 1988	200 West Area	Resident Gardener	610	1.2E-06	3.7E-05	1.9E-08
	200 East Area	Resident Gardener	260	2.9E-05	8.7E-04	4.3E-07
	200 West Area	Resident Gardener + Sauna	610	1.8E-06	5.5E-05	2.7E-08
	200 East Area	Resident Gardener + Sauna	10000	7.3E-05	2.2E-03	1.1E-06
1988 – 1995	200 West Area	Resident Gardener	600	2.3E-05	7.0E-04	3.5E-07
	200 East Area	Resident Gardener	260	1.4E-06	4.2E-05	2.1E-08
	200 West Area	Resident Gardener + Sauna	10000	4.9E-02	1.5E+00	7.3E-04
	200 East Area	Resident Gardener + Sauna	10000	2.2E-05	6.5E-04	3.3E-07
Newly Generated Waste (1996 – 2007)[c]						
LLW Cat 1	200 West Area	Resident Gardener	600	1.0E-05	3.1E-04	1.9E-07
	200 East Area	Resident Gardener	260	9.4E-07	2.8E-05	1.7E-08
LLW Cat 3	200 West Area	Resident Gardener	930	1.1E-04	3.3E-03	2.0E-06
	200 East Area	Resident Gardener	10000	2.9E-05	8.6E-04	5.2E-07
MLLW	200 West Area	Resident Gardener	1420	1.4E-05	4.3E-04	2.6E-07
ILAW	200 East Area	Resident Gardener	10000	1.3E-05	3.8E-04	2.3E-07
LLW Cat 1	200 West Area	Resident Gardener + Sauna	600	3.6E-05	1.1E-03	6.6E-07
	200 East Area	Resident Gardener + Sauna	10000	1.1E-04	3.4E-03	2.0E-06
LLW Cat 3	200 West Area	Resident Gardener + Sauna	940	4.9E-04	1.5E-02	8.8E-06
	200 East Area	Resident Gardener + Sauna	10000	2.4E-02	7.2E-01	4.3E-04
MLLW	200 West Area	Resident Gardener + Sauna	1420	3.2E-05	9.7E-04	5.8E-07
ILAW	200 East Area	Resident Gardener + Sauna	10000	3.3E-05	9.8E-02	5.9E-05

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

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Appendix G

Groundwater Quality Impacts

The purpose of this appendix is to describe the analysis used to calculate concentrations of key contaminants that could potentially reach the groundwater from the Low Level Burial Ground (LLBG) areas defined in each of the Hanford Site Solid (Radioactive and Hazardous) Waste Program Environmental Impact Statement (HSW EIS) alternative groups. The analysis also assesses the impacts to accessible surface water resources from contaminated groundwater. Calculated concentrations of key contaminants are compared to drinking water standards as a benchmark against which water aulity may be assessed. These calculations also provide the basis for estimates of potential human health risk and ecological risk for comparison among the alternative groups. Human health and risk consequences are discussed in Section 5.11.

Wastes considered in this assessment include previously disposed of wastes and wastes to be disposed of in the Hanford solid waste (HSW) disposal facilities (for purposes of analysis, year 2007 was assumed to be the date when new disposal facilities would be operational):

- Previously disposed of low-level waste (LLW), which includes:

  - LLW disposed of in LLBGs between 1962 and 1970 (referred to as pre-1970 LLW in this section)

  - LLW disposed of in LLBGs after 1970, but before October 1987 (referred to as 1970-1987 LLW in this section)

  - LLW disposed of in LLBGs after October 1987, but before 1995 (referred to as 1988-1995 LLW in this section)

- Category (Cat) 1 LLW, which includes:

  - Cat 1 LLW disposed of in the LLBGs after 1995 including Cat 1 LLW forecasted to be disposed of through 2007 (referred to as Cat 1 LLW [1996-2007] in this section)

  - Cat 1 LLW disposed of after 2007 including Cat 1 LLW forecasted to be disposed of through 2046 (referred to as Cat 1 LLW disposed of after 2007 in this section). For purposes of analysis, year 2007 was assumed to be the date when new disposal facilities would be operational

- Cat 3 LLW, which includes:

  - Cat 3 and greater than Cat 3 (GTC3) LLW disposed of in the LLBGs after 1995 including Cat 3 LLW forecasted to be disposed of through 2007 (referred to as Cat 3 LLW [1996-2007] in this section)

  - Cat 3 and GTC3 LLW disposed of after 2007 including Cat 3 LLW forecasted to be disposed of through 2046 (referred to as Cat 3 LLW disposed of after 2007 in this section).

- Mixed low-level waste (MLLW), which includes:

  - MLLW disposed of after 1996 including MLLW forecasted to be disposed of through 2007 (referred to as MLLW [1996-2007] in this section)

  - MLLW disposed of after 2007 including MLLW forecasted to be disposed of through 2046 (referred to as MLLW disposed of after 2007 in this section).

- Melters from the tank waste treatment program

- Immobilized low-activity waste (ILAW) from the tank waste treatment program.

Inventories of retrievably stored transuranic (TRU) waste in trenches and caissons located in the LLBGs were not evaluated for their groundwater impacts because the TRU waste will be retrieved and sent to the Waste Isolation Pilot Plant for disposal.

The groundwater exposure pathway analyzed considers the long-term release of contaminants from the variety of LLW and MLLW, analyzed groundwater transport through the vadose zone underlying the potential sources, and lateral transport through the unconfined aquifer immediately underlying the vadose zone to the Columbia River. The LLBGs are all located in the 200 Areas and the physical area of potential groundwater impacts is the unconfined aquifer bounded laterally by the Rattlesnake Hills in the west and southwest, by the Columbia River in the north and east, and by the Yakima River to the south (see Section 4.5, Figure 4.16).

This groundwater assessment was performed using a combination of screening techniques and numerical modeling. The groundwater modeling results predict contaminant concentrations in the groundwater associated with selected alternatives from assumed site closure at 2046 up to 10,000 years after LLBG closure. Although not specifically required by current regulations for LLW management, this assessment examined water quality impacts for up to 10,000 years after the operational period. Current requirements for performance assessment of LLW disposal facilities, as prescribed in DOE Order 435.1, focus on impacts during the first 1000 years after disposal.

Contaminants released from disposal facilities and other sources (for example, tank wastes, canyon facilities, the U.S. Ecology commercial LLW facilities) are included in an assessment of combined impacts in Section 5.14.

G.1 Methodology and Approach

The approach and steps taken to assess potential impacts to the groundwater system are provided in this section. The alternatives considered in this assessment are described in detail in Section 3.3.

The analysis framework of this water quality assessment considers three major elements: source-term release, vadose zone transport, and groundwater transport. In addition, this analysis framework considers the eventual impact of predicted concentration levels in groundwater on the water quality of the Columbia River.

G.1.1 Lines of Analysis

The lines of analysis (LOAs) used in this comparative assessment were located on the Hanford Site along lines approximately 1 km (0.6 mi) down-gradient of aggregate Hanford solid waste (HSW) disposal areas within the 200 East and West Areas, ERDF, and near the Columbia River located down-gradient from all disposal site areas (see Figure G.1). LOAs were selected based on transport results of unit releases at selected HSW disposal site locations. LOAs approximately 1 km (0.6 mi) down-gradient from the overall waste disposal facilities in each area are not meant to represent points of compliance, but rather common locations to facilitate comparison of impacts from broad waste management selections and locations defined for each alternative group.

Predicted constituent concentrations presented for each alternative group from specific water category releases represent maximum concentrations estimated along these LOAs. Because of the variation in the location of the different waste types and category releases for a given alternative group, the estimated maximum concentrations calculated from a specific waste category release may not correspond to the same point on the line analysis for every waste category and alternative group. For the sake of being conservative, however, combined concentration levels presented for each LOA and alternative group reflect the summation of predicted concentration levels regardless of their position on the LOA.

Delineation of waste impacts in the 200 East Area required two different LOAs. One LOA, designated as the 200 East Northwest (NW) LOA, is used to evaluate concentrations in groundwater migrating northwest of the 200 East Area. Another LOA, designated as the 200 East Southeast (SE) LOA, is used to evaluate concentrations in groundwater migrating southeast of the 200 East Area.

G.1.2 Overall Analysis Approach

To estimate the concentration of contaminants in the groundwater, it was necessary to link the results of process models of waste release, transport through the vadose zone, and transport through the groundwater system. Two general approaches are available to link these models. One approach involves simulating a contaminant inventory distribution through each of the three process models. The other approach involves simulating a unit release through each of the three process models and superimposing these results with a specific constituent inventory distribution.

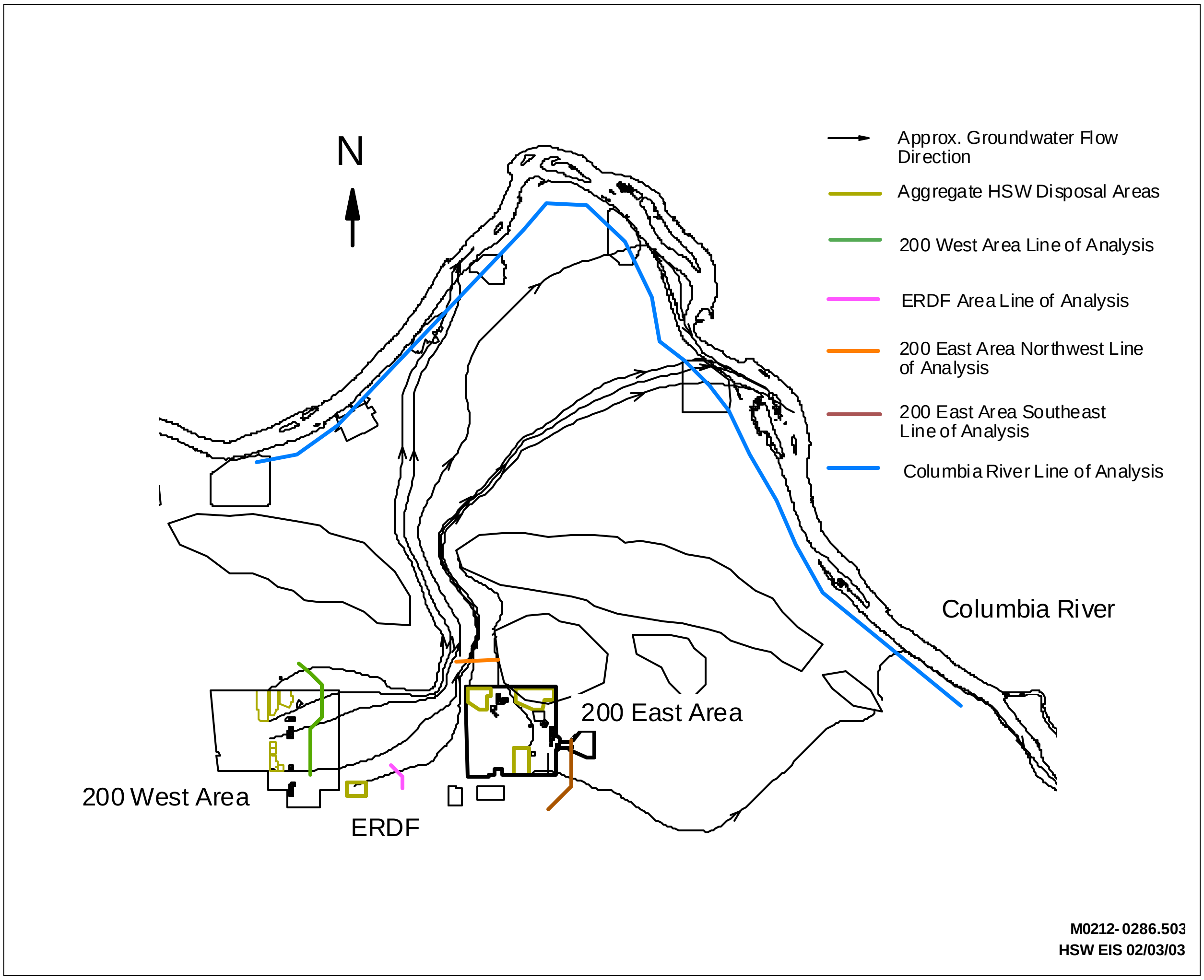


Figure G.1. Lines of Analysis Down-Gradient of Aggregate Hanford Solid Waste Disposal Areas

The first approach requires that each of the calculations be performed sequentially with each simulation representing a unique inventory distribution and parameter set. This approach is preferred when the number of combinations of inventory distributions and parameter sets is small compared to the total number of simulations required.

The second approach involves development of system output or response and, from that, a unit release that can be simulated for each source area, parameter set, and process model. (In this case, the process models include estimating source release, vadose zone flow and transport, and groundwater flow and transport.) Unit releases in each of the process models can be simulated independently. Then, by making the assumption of linearity, the unit release responses from each individual source area, via each of the process models, can be combined or superimposed using the convolution integral approach (Lee 1999). The convolution calculational approach is preferred when the number of combinations of inventory distributions and parameter sets is large, compared to the number of vadose zone and groundwater flow and transport scenarios that need to be simulated. This second approach was selected for this analysis.

The convolution approach and the implicit assumption of linearity provide a reasonable approach in approximating the long-term release of constituents from solid waste disposal facilities for the following reasons:

- The waste zone environment of solid waste sources in HSW disposal facilities has been characterized as a low-organic, low salt, near neutral geochemical environment (Kincaid et al. 1998) and, as such, processes such as non-linear adsorption and other complex chemical reactions are not expected to have a substantial effect on contaminant release and transport through the vadose zone and groundwater water at the scales of interest (that is, down-gradient of the waste facilities to the Columbia River).

- Wastes disposed of in HSW disposal facilities are largely dry solids and do not have any substantial amount of liquids or complex chemical fluids that could enhance migration of constituents to the underlying water table.

- Waste releases are expected to occur over long periods of time and will likely reach the water table when the effect of past artifical discharges has dissipated and the unconfined aquifer returns to more natural conditions. Using estimates of infiltration through the vadose zone to the underlying groundwater that would reflect long-term average rates of natural recharge would appear reasonable.

The convolution approach used also incorporates the process of solubility control that is assumed to be important in the source release for some constituents. The effect of this process is approximated by applying appropriate solubility controls in the source-term release component of the analysis. This approach can be effectively used without disrupting the superposition process. Solubility-controlled release models were used in the calculation of source-term release of the uranium isotopes in each of the alternatives.

In the convolution integral calculational approach, the concentration in the groundwater at a specific location, i, at time, t, ($C_{i,t}$) can be estimated using Equations G.1 and G.2:

$$C_{i,t} = \sum_{s=1}^{n} \mathrm{M}_s \sum_{\mathrm{T}=1}^{t} (\mathrm{f}_{s,\mathrm{T}}\, c_{s,i,t-\mathrm{T}+1}) \qquad \text{(G.1)}$$

$$\mathrm{f}_{s,t} = \sum_{\mathrm{T}=1}^{t} (r_{s,\mathrm{T}}\, f_{s,t-\mathrm{T}+1}) \qquad \text{(G.2)}$$

where $C_{i,t}$ = Concentration at location, i, at time, t

M_s = Inventory at source, s

$c_{s,i,t}$ = Groundwater concentration at *i* based on a unit release from *s* (Coupled Fluid, Energy, and Solute Transport [CFEST] model output)

$r_{s,t}$ = Fractional release of unit inventory in source *s* at time *t* (Release model output)

$f_{s,t}$ = Flux to water table from source, *s*, at time, *t*, based on unit release from *s* (Subsurface Transport Over Multiple Phases [STOMP] model output)

n = number of sources

T = time integration variable.

and where $c_{s,i,t}$ and $f_{s,t}$ are the discrete response functions estimated with the vadose zone and groundwater models based on a unit release. These discrete responses can be quickly combined with Equations G.1 and G.2 (that is, superimposed) in a variety of combinations to estimate system responses to different inventory distributions and parameter sets. (Note that equations G.1 and G.2 are discrete-approximation representations of the classic convolution integral calculational approach used in the calculation of superposition of responses in linear response systems.) The form of equation G.1 was also used to estimate the time-varying flux of a contaminant to the Columbia River by substituting the groundwater concentration based on a unit release from *s* with the calculated flux to the river based on a unit release from *s*. This river flux was combined with average annual river flows in the Columbia River to estimate river concentration levels that provided the basis for human health impacts and ecosystem risk from exposure to Columbia River water.

Impacts from the subsurface transport pathway were analyzed for the LLBGs. The contaminant inventory for the LLBGs was released to the vadose zone according to an appropriate release model. Transport within the vadose zone was estimated with a steady-state, one-dimensional variably saturated vadose zone transport model by assuming a unit release for a range of recharge rates. Travel times for releases of unit mass were defined by arrival of 50 percent of each unit mass. These travel times were used to translate mass releases from the LLBGs into mass releases at the water table in the aquifer. The time-varying mass flux arriving at the water table reflects the entire time history of the mass release from the source area, as well as the calculated travel time in the vadose zone.

Estimates of contaminant release transport from the LLBGs to the groundwater were evaluated. This evaluation was done by first calculating transport of 10-year releases of a unit of dry mass into the unconfined aquifer at the approximate locations of the LLBGs at the water table. These transport calculations were made with a steady-state, three-dimensional saturated groundwater flow and transient transport model. These calculated concentrations, based on a unit release, were then used in the convolution integral calculational method to translate transport of mass releases from the LLW through the vadose zone and the aquifer to specified locations down-gradient from the source areas. The concentrations in the groundwater plumes for each radionuclide were translated into doses using methods described in Appendix F.

The sequence of calculations used in the long-term assessment required estimating the water quality impacts using a suite of process models that estimated source-term release, vadose zone flow and transport, and groundwater flow and transport. The computational framework for these process models and relationship of software elements, which are schematically illustrated in Figure G.2, are as follows:

1. Excel™ workbook

2. Dynamically linked library version of the STOMP code (White and Oostrom 1996; White and Oostrom 1997; and Nichols et al. 1997)

3. Coupled Fluid Energy and Solute Transport (CFEST) code (Gupta 1997)

The concentrations in the groundwater plumes for each radionuclide were translated into human health impacts, which are summarized in Section 5.11 and Appendix F.

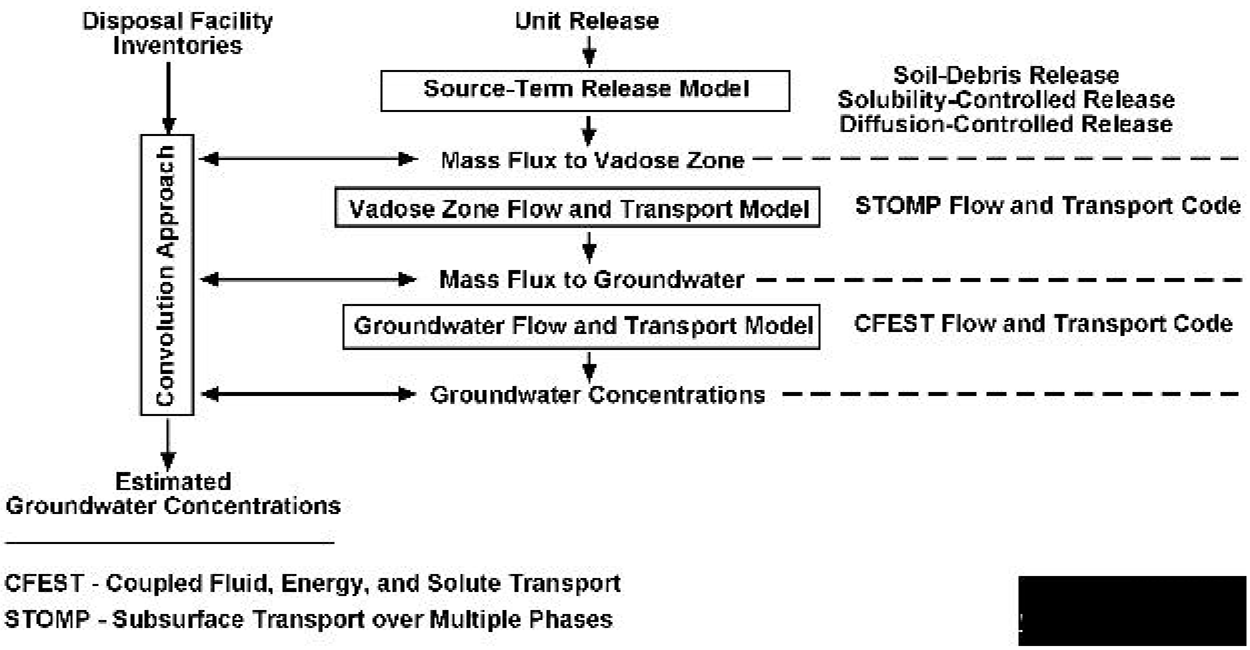


Figure G.2. Schematic Representation of Computational Framework and Codes Used in this HSW EIS

The methodologies for calculating source-term release, vadose zone transport, and groundwater transport are described in the following sections. Assumptions (for example, geometry, initial conditions, boundary conditions, and parameters) for each calculation are identified and discussed. The implementation of each model for each alternative is described.

G.1.3 Source-Term Release

The source-term is the quantification of when and what constituents (by mass or activity) would be released. This source-term includes the water flux into the vadose zone that results from precipitation infiltrating the waste and mass or activity solubilized from dissolution of waste in the LLBGs. This section addresses the approach and methods used for source-term release that involve:

- Grouping of constituents into categories based on their mobility and screening to determine which constituents should be considered in this analysis

- Aggregating potential sources into common source areas

- Developing the contaminant inventories for each source area

- Selecting appropriate source-term release models to calculate mass flux and fluid flux release as a function of time.

G.1.3.1 Constituent Grouping and Screening

The LLBGs contain over 100 radioactive and non-radioactive constituents that potentially could impact groundwater. Screening of these constituents considered a number of aspects that included (1) their potential for dose or risk, (2) their estimated amount of inventory, and (3) their relative mobility in the subsurface system within a 10,000-year period of analysis.

The assessment was the beneficiary of preceding analyses and field observations including the performance assessments for 200 West and 200 East post-1988 burial grounds (Wood et al. 1995, 1996), the remedial investigation and feasibility study of the ERDF (DOE 1994b), the disposal of ILAW originating from the single- and double-shell tanks (Mann et al. 1997) and (Mann et al. 2001), and the Composite Analysis of the 200 Area Plateau (Kincaid et al. 1998). These and other analyses, (for example, environmental impact statements) included development of inventory data and application of screening or significance criteria to identify those radionuclides that could be expected to substantially contribute to either the dose or risk calculated in the respective analysis. Clearly, those radionuclides identified as potentially significant in these published analyses are also expected to be key radionuclides in this assessment.

To establish their relative mobility, the constituents were grouped based on their mobility in the vadose zone and underlying unconfined aquifer. Contaminant mobility classes were used rather than the individual mobility of each contaminant because of the uncertainty involved in determining the mobility of individual constituents. The mobility classes were selected based on relatively narrow ranges of mobility.

Some of the constituents, such as iodine and technetium, would move at the rate of water whether in the vadose zone or underlying groundwater. The movement of other constituents in water, such as americium and cesium, would be slowed or retarded by the process of sorption onto soil and rock. A parameter that is commonly used to represent a measure of this sorption is referred to as the distribution coeefficent or K_d. This parameter is defined as the ratio of the quantity of the solute adsorbed per gram of solid to the amount of solute remaining in solution (Kaplan et al. 1996). Values of K_d for the constituents range from 0 mL/g (in which the contaminant movement in water is not retarded) to more than 40 mL/g (in which the contaminant moves much slower than water).

The LLW inventory constituents were grouped according to estimated or assumed K_d of each constituent. The constituent groups, based on mobility and examples of common constituents, are described in the following text. A summary of all constituents and associated groupings (based on K_d values) is provided in Table G.1. The constituent classes used for modeling include:

- **Mobility Class 1** – Contaminants were modeled as non-sorbing (that is, K_d = 0) and would not be retarded in the soil-water system. Contaminant K_d values in this group ranged from 0 to 0.59 mL/g and include all the isotopes of iodine, technetium, selenium, chlorine, and tritium.

- **Mobility Class 2** – Contaminants were modeled as slightly sorbing (that is, K_d = 0.6) and would be slightly retarded in the soil-water system. Contaminant K_d values in this group ranged from 0.6 to 0.99 mL/g and include all the isotopes of uranium and carbon.

- **Mobility Class 3** – Contaminants were modeled as slightly more sorbing (that is, K_d = 1). Contaminant K_d values in this group ranged from 1 to 9.9 mL/g and include all the isotopes of barium.

- **Mobility Class 4** – Contaminants were modeled as moderately sorbing (that is, K_d = 10). Contaminant K_d values in this group ranged from 10 to 39.9 mL/g and include all the isotopes of neptunium, palladium, protactinium, radium, and strontium.

- **Mobility Class 5** – Contaminants were modeled as strongly sorbing (that is, K_d = 40). Contaminant K_d values in this group were 40 mL/g or greater and include all the isotopes of actinium, americium, cobalt, curium, cesium, iron, europium, gallium, niobium, nickel, lead, plutonium, samarium, tin, thorium, and zirconium.

The constituent listing in Table G.1 was further evaluated using estimates of constituent transport times through the thick vadose zone to the unconfined aquifer during the 10,000-year period of analysis. For purposes of this analysis, the infiltration rate selected was 0.5 cm/yr. This rate was assumed, based on recharge estimates for different site surface conditions by Fayer et al. (1999), to reflect a conservative estimate of infiltration for surface conditions that would be expected to persist at the LLBGs during the post-closure period. Estimates by Fayer et al. (1999) indicate that infiltration rates for surface conditions that have a modified Resource Conservation and Recovery Act (RCRA) Subtitle C cover system would be below the assumed 0.5 cm/yr rate used in this screening analysis.

Based on this assumed infiltration rate and estimated levels of sorption and associated retardation for each of the classes above, estimated travel times of all constituents in Mobility Classes 3, 4, and 5 through the thick vadose zone to the unconfined aquifer beneath the LLBGs were calculated to be well beyond the 10,000-year period of analysis. Thus, all constituents in these classes were eliminated from further consideration.

Table G.1. Constituents Categorized by Mobility (K_d) Classes

Mobility Class 1 (K_d = 0.0 mL/g)				
Constituent	**Best K_d Estimate**	**Range of K_d Estimates**	**Reference**	**Half-Life (years)**
H-3	0	0 – 0.5	Kincaid *et al*. (1998)	1.2E+01
Tc-99	0	0 – 0.6 0 – 0.1	Kincaid *et al*. (1998) Cantrell et al. (2002)	2.1E+05
I-129	0.3	0.2 – 15 0 – 2	Kincaid *et al*. (1998) Cantrell et al. (2002)	1.5E+07
Cl-36	0	0-0.6	Kincaid *et al*. (1998)	3.8E+05
Se-79	0	0 – 0.78	Kincaid *et al*. (1998)	6.5E+05
Mobility Class 2 (K_d = 0.6 mL/g)				
C-14	0.5	0.5 – 1000	Kincaid *et al*. (1998)	5.7E+03
U-232 U-233 U-234 U-235 U-236 U-238	0.6	0.1 – 79.9 0.2 - 4	Kincaid *et al*. (1998) Cantrell et al. (2002)	6.9E+01 1.5E+05 2.4E+05 7.0E+08 2.3E+07 4.5E+09
Mobility Class 3 (K_d = 1.0 mL/g)				
Ba-133	1	N/A	Wood *et al.* (1995)	1.0E+01
Mobility Class 4 (K_d = 10.0 mL/g)				
Np-237	15	2.4-21.9	Kincaid *et al*. (1998)	2.1E+06
Pa-231	15	2.4 – 21.9	Kincaid *et al*. (1998)	3.3E+04
Pd-107	10	N/A	DOE and Ecology (1996)	6.5E+06
Ra-226	20	5 – 173	Kincaid *et al*. (1998)	1.6E+03
Sr-90	20	5 – 173 10 - 20	Kincaid *et al*. (1998) Cantrell et al. (2002)	2.8E+01
Mobility Class 5 (K_d = 40.0 mL/g)				
Ac-227	300	67 – 1330	Kincaid *et al*. (1998)	2.1E.01
Am-241 Am-242m Am-243	300	67 – 1330	Kincaid *et al*. (1998)	4.3E+02 1.5E+02 7.4E+03
Co-60	1200	1200 – 12500	Kincaid *et al*. (1998)	5.3E+00
Cm-243 Cm-244 Cm-245 Cm-246 Cm-248	300	67 – 1330	Kincaid *et al*. (1998)	2.9E+01 1.8E+01 8.4E+03 4.7E+03 3.4E+05
Cs-135 Cs-137	1500	540 – 3180	Kincaid *et al*. (1998)	2.30E+06 3.0E+01
Eu-152	300	67 – 1330	Kincaid *et al*. (1998)	1.3E+01
Gd-152	100	N/A	Wood *et al.* (1996)	1.1E+14
Nb-94	300	50 – 2350	Kincaid *et al*. (1998)	2.0E+04
Ni-63	300	50 – 2350	Kincaid *et al*. (1998)	1.0E+02

Table G.1. (contd)

Constituent	Best K_d Estimate	Range of K_d Estimates	Reference	Half Life (years)
Mobility Class 5 (K_d = 40.0 mL/g) - continued				
Pb-210	2000	13000 – 79000	Kincaid *et al*. (1998)	2.2E+01
Pu-238	200	80 – >1980	Kincaid *et al*. (1998)	8.7E+01
Pu-229				2.4E+04
Pu-240				6.5E+03
Pu-242				3.7E+05
Pu-244				8.1E+07
Th-229	1000	40 – >2000	Kincaid *et al*. (1998)	7.3E+03
Th-230				7.7E+04
Th-232				1.4E+10
Sm-147	100	N/A	Wood *et al.* (1996)	1.1E+11
Sn-126	50	50 – 2350	Kincaid *et al*. (1998)	9.9E+04
Zr-93	1000	40 – >2000	Kincaid *et al*. (1998)	1.5E+06

N/A – Not applicable.

Of the suite of remaining waste constituents, technetium-99 and iodine-129 in Mobility Class 1 and carbon-14 and the uranium isotopes in Mobility Class 2 were considered to be in sufficient quantity and mobile enough to warrant a detailed analysis of groundwater impacts. Although three of the constituents in Mobility Class 1— selenium, chloride, and tritium—are considered very mobile, they were screened out for other factors. Selenium and chloride were not considered in the assessment because the total inventories for both of these constituents were estimated to be less than 1×10^{-2} Ci. Tritium was not evaluated because of its relatively short half-life.

Estimated inventories of hazardous chemical constituents associated with LLW and MLLW disposed of after 1988 being considered under each alternative group would be expected to be found at trace levels. MLLW, which would be expected to contain the majority of hazardous chemical constituents, would undergo predisposal solidification to stabilized waste forms and containment and thermal treatment to remove organic chemical components of the MLLW. This waste treatment would be done to meet current waste acceptance criteria and land disposal restrictions before being disposed of in permitted MLLW facilities. Consequently, groundwater quality impacts from these constituents would not be expected to be substantial.

Analysis of MLLW inventories for this assessment did identify two exceptions that included lead and mercury inventories associated with the projected MLLW that were estimated at 336 kg (741 lb) and 2.5 kg (5.5 lb), respectively. Because of its affinity to be sorbed into Hanford sediments, lead falls within Mobility Class 5 (K_d = 40 mL/g) and would not release to groundwater within the 10,000-year period of interest. The inventory estimated for mercury is assumed to be small enough that it would not release to groundwater in substantial concentrations. Even the most conservative estimates of release would yield estimated groundwater concentrations at levels two orders of magnitude below the current standard of 0.002 mg/L.

LLW disposed of prior to September 1987 may contain hazardous chemical constituents, but no specific requirements existed to account for or report the content of hazardous chemical constituents in this category of LLW. As a consequence, analysis of these constituents and estimated impacts based on the limited amount of information on estimated inventories and waste disposal locations would be subject to uncertainty at this time. These facilities are part of the LLW and MLLW facilities in the LLW Management Areas 1 – 4 that are currently being monitored under RCRA interim status programs. Final evaluation of these facilities under RCRA and/or CERCLA guidelines would eventually require analysis of the impacts of the chemical components of these inventories. Any analysis with information that is currently available would be at best speculative without more detailed inventory characterization information. Such analyses would require a more thorough and detailed characterization of these wastes at some future date.

G.1.3.2 Source Inventories

The sources inventories of key constituents that provided the basis for water quality impacts described in this appendix and Section 5.3 are summarized by alternative group in Appendix B. The inventory associated with the specific constituents for each of alternatives was partitioned between the 200 East and West Areas roughly in proportion to estimated disposal areas in the LLBGs that had already received LLW or will receive newly generated LLW. Estimates of LLBG areas for all the alternatives are summarized in Section 5.1, Table 5.1. Distribution of LLBGs for each waste category assumed in the release modeling, described in the section below, in the HSW disposal site areas by alternative are given in Table G.2. The broad categories considered include previously disposed LLW, newly generated Cat 1 and Cat 3 LLW, and MLLW. The relative percentages of LLBG areas for these three categories provide the basis for the partitioning of LLW volumes and associated constituent inventories. For purposes of this analysis, the greater-than-Cat 3 (GTC3) LLW were considered part of the Cat 3 LLW inventory. Although no specific GTC3 LLW is expected in forecasted wastes, for purposes of this analysis, it was assumed that about 1 m^3 (1.4 yd^3) of GTC3 LLW containing mostly cesium-137 and other non-mobile nuclides would be part of the inventory considered. The inventory of this category is included in the Cat 3 LLW and is not discussed separately.

G.1.3.3 Release Models

Source-release models were selected and used to approximate contaminant releases from the variety of LLW types considered in this analysis. The models considered included a soil-debris release model and a cement release model.

G.1.3.3.1 Soil-Debris Model

In the soil-debris model, LLW is assumed to be mixed with soils. Waste sources included in this model were assumed to be permeable to percolating water. Thus, all surfaces of the waste were assumed to come into contact with percolating water. If contaminant inventories in the source were high enough, leaching of the contaminant through the bottom of the source was controlled by the solubility of the contaminant in soil water. Otherwise, leaching was controlled by partitioning of the radionuclides between aqueous and sorbed phases. The inventory was assumed to be perfectly mixed throughout the

Table G.2. Assumed Distribution of LLBG Areas (ha) of Previously Disposed of LLW, Cat 1 LLW, Cat 3 LLW, MLLW, and Melters in the 200 East and 200 West Areas by Alternative Group

	Previously Disposed of LLW						Category 1 LLW				Category 3 LLW				MLLW				Melters
	1962-1970 LLW		1970-1988 LLW		1988-1995		1996 to 2007		After 2007		1996 to 2007		After 2007		1996 to date and future		After 2007		
Disposal Alternative	200 East	200 West	200 East	200 West	200 East	200 West	200 East	200 West	200 East	200 West	200 East	200 West	200 East	200 West or ERDF	200 East	200 West or ERDF	200 East	200 West or ERDF	200 East or ERDF
A (Lower bound Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7		4.4		39.7		4.4		1.7		1.5	6.0
A (Hanford Only Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7		4.4		39.7		4.4		1.7		1.5	6.0
A (Upper Bound Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7		8.9		39.7		8.9	3.5	1.7		3.0	6.0
B (Lower bound Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7	0.7	16.7		39.7	0.7	16.7		1.7	5.7		6.0
B (Hanford Only Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7	0.7	16.7		39.7	0.7	16.7		1.7	5.7		6.0
B (Upper Bound Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7	4.0	25.1		39.7	1.1	28.0	3.5	1.7	10.2		6.0
C (Lower bound and Hanford Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7		4.4		39.7	0.0	4.4		1.7	1.5		6.0
C (Hanford Only Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7		4.4		39.7	0.0	4.4		1.7	1.5		6.0
C (Upper Bound Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7		8.9		39.7	0.0	8.9	3.5	1.7	3.0		6.0
D1, D2, and D3 (Lower bound Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7	3.0			39.7	3.0			1.7	1.1		6.0
D1, D2, and D3(Hanford Only Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7	3.0			39.7	3.0			1.7	1.1		6.0
D1, D2, and D3 (Upper Bound Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7	6.2			39.7	6.2		3.5	1.7	3.0		6.0
E1, E2, and E3 (Lower Bound Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7	3.0			39.7	3.0			1.7	1.1		6.0
E1, E2, and E3 (Hanford Only Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7	3.0			39.7	3.0			1.7	1.1		6.0
E1, E2, and E3 (Upper Bound Volume)	7.1	2.2	20.9	16.6	19.6	39.7		39.7	6.2			39.7	6.2		3.5	1.7	3.0		6.0
No Action	7.1	2.2	20.9	16.6	19.6	39.7		39.7		39.7		39.7				1.7			

source volume during the entire release period–assuming perfectly mixed conditions reduced the likelihood that solubility would control the release. The mathematical basis of this release model is described in detailed in Appendix D of Kincaid et al. (1998).

The soil-debris model was used to estimate release of all non-grouted contaminants from previously disposed of LLW, Cat 1 LLW, Cat 3 LLW, and MLLW. The key parameter in the use of the soil-debris release model, besides the depth of the waste, is the rate of infiltrating water through the LLBGs. Table G.3 provides a summary of assumed waste depths and infiltration rates used in the soil-debris model for each alternative.

This assessment focuses on the long-term release of contaminants from new LLBGs during the post-closure period. This assumption of minimal leaching and migration prior to site closure is reasonable for the majority of LLW and MLLW being considered. Containment and waste forms used in Cat 1 and Cat 3 LLW would be expected to be sufficient to contain and isolate disposed LLW during the operational period. MLLW facilities, which involve the collection and management of leachate during and following the operational period, are also expected to control the amount of waste leaching during the period of operations. Thus, an infiltration rate of 0.5 cm/yr was used for the Cat 1 LLW, Cat 3 LLW, and MLLW within the No Action Alternative.

Because less rigorous requirements for waste contaminant and content were in effect prior to 1988, contaminants contained in solid LLW disposed of in LLBGs prior to 1988 offer the highest potential for leaching and release into the vadose zone prior to site closure. This analysis evaluated the potential impacts of these earlier disposals by evaluating the effect of higher infiltration rates during the period of operations. The leaching of these categories of LLW prior to site closure has the potential to be influenced by relatively high infiltration rates during and shortly after the disposal period when bare soil conditions persist. Infiltration rates into coarse surface sediments maintained free of vegetation, as would be expected during and shortly after the disposal period, is estimated to be in the order of 5 cm/yr, based on data from a non-vegetated gravel-covered lysimeter study conducted on the Hanford Site (Fayer and Walters 1996; Fayer et al. 1999). Eventually, infiltration through the LLBGs would be expected to be reduced to lower levels as surface cover conditions return to a more natural vegetative state.

For the No Action Alternative, an infiltration rate used in release modeling of the pre-1970 and 1970-1988 LLW was increased to 0.5 cm/yr after the operational period and during the post-closure period. This infiltration rate is a reasonable rate (Fayer and Walters 1996; Fayer et al. 1999) to use in the post-closure period when natural vegetative cover would be expected to persist.

For all LLW and MLLW under all action alternatives, it is assumed that LLBGs would have a long-term surface barrier at site closure that would limit infiltration rates through the disposed wastes. The assumed barrier is a modified RCRA Subtitle C cover system. Recharge from this barrier system is expected to be very low and comparable to long-term recharge estimates for the Hanford Protective Barrier. A recent analysis by Fayer et al. (1999) for the ILAW Disposal Program has estimated a long-term infiltration at 0.01 cm/yr through this type of a system with an established natural (that is, shrub-steppe plant community) cover condition.

Table G.3. Summary of Waste Depth and Infiltration Rates Used in the Soil-Debris Release Model

	Waste Depth (meters)	Infiltration Used in Waste Release Models (cm/yr)							
		Prior to 2046	2046-2546	2547-2646	2647-2746	2747-2846	2847-2976	2947-2946	3046 -12046
	Action Alternatives								
Wastes Disposed of prior to 1995									
Pre-1970	6	5	0.01	0.05	0.1	0.2	0.3	0.4	0.5
1970-1987	6	5	0.01	0.05	0.1	0.2	0.3	0.4	0.5
1988-1995	6	5	0.01	0.05	0.1	0.2	0.3	0.4	0.5
Wastes Disposed of between 1996 and 2007	6	n/a	0.01	0.05	0.1	0.2	0.3	0.4	0.5
Wastes Disposed of after 2007									
Alt Group A	15.6	n/a	0.01	0.05	0.1	0.2	0.3	0.4	0.5
Alt Group B	6	n/a	0.01	0.05	0.1	0.2	0.3	0.4	0.5
Alt Group C	15.6	n/a	0.01	0.05	0.1	0.2	0.3	0.4	0.5
Alt Group D_1	15.6	n/a	0.01	0.05	0.1	0.2	0.3	0.4	0.5
Alt Group D_2	15.6	n/a	0.01	0.05	0.1	0.2	0.3	0.4	0.5
Alt Group D_3	15.6	n/a	0.01	0.05	0.1	0.2	0.3	0.4	0.5
Alt Group E_1	15.6	n/a	0.01	0.05	0.1	0.2	0.3	0.4	0.5
Alt Group E_2	15.6	n/a	0.01	0.05	0.1	0.2	0.3	0.4	0.5
Alt Group E_3	15.6	n/a	0.01	0.05	0.1	0.2	0.3	0.4	0.5
Melter Trench (All Alternatives Groups)	18.6	n/a	0.01	0.05	0.1	0.2	0.3	0.4	0.5
	No Action Alternative								
Wastes Disposed of prior to 1995									
Pre-1970	6	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1970-1987	6	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
1988-1995	6	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Wastes Disposed of after 1996	6	n/a	0.5	0.5	0.5	0.5	0.5	0.5	0.5

N/A = Not applicable.

No guidance is available for specifying barrier performance after its design life. However, an immediate decrease in performance is not expected, and it is likely that this specific barrier will perform as designed far beyond its design life. Without data to understand and predict long-term performance of the specific barrier, a conservative assumption is the performance of the barrier would degrade stepwise after reaching its design life, and until the recharge rate matches the natural recharge rate in the surrounding environment. This approach is based on the assumption that a degraded cover will eventually return back to its natural state and behave like the surrounding environment. The period of degradation was assumed to be the same as the design life. At the time of site closure, all waste disposal facilities are assumed to be covered with the modified RCRA Subtitle C cover system. To approximate the effect of the cover on waste release, the following assumed infiltration rates, as illustrated in Figure G.3, were used in the waste release modeling. For 500 years after site closure, an infiltration rate of 0.01 cm/yr was used to approximate the effect of cover emplacement over the wastes and its impact on reducing infiltration. After 500 years, the cover is assumed to begin to degrade. Between 500 to 1000 years after site closure, infiltration rates were increased linearly from 0.01 cm/yr to 0.5 cm/yr to approximate a 500-year period of cover degradation and a return infiltration rate reflective of natural vegetated surface soil conditions over the wastes. The final rate of 0.5 cm/yr was used for the remaining 9000-year period of analysis.

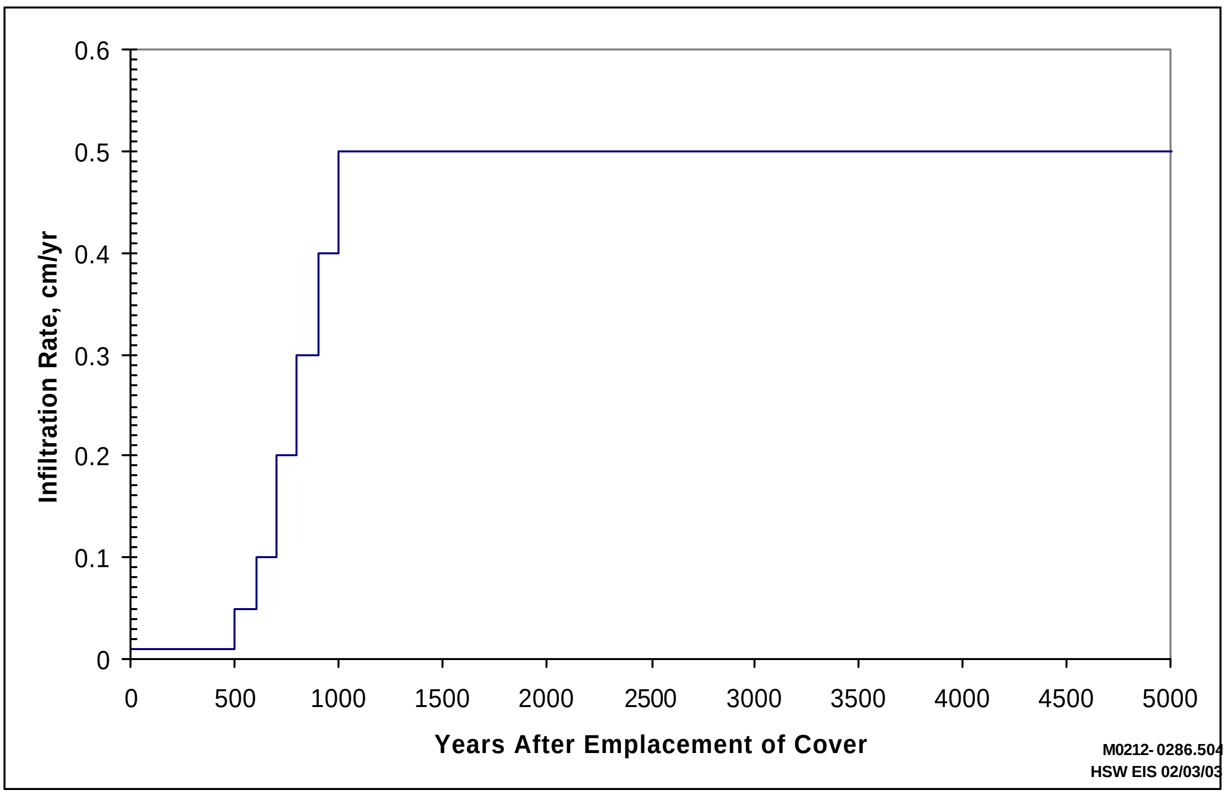


Figure G.3. Changes in Infiltration Rates Assumed in Source-Term Release to Approximate the Modified RCRA Subtitle C Cover System Degradation

A number of the alternatives considered specify the use of liner systems to control waste release during the period of operations. However, no credit for the effect of these liner systems was considered in this long-term analysis. Although the liner systems as described in Section 3.1 might last (that is, contain leachate for removal) for several hundreds of years if properly managed, this analysis assumed that the emplaced liners would fail during the 100-year active institutional control period and would have little effect on the long-term waste release during the 10,000-year period of analysis

In the case of uranium isotope release calculations, sufficient inventories of uranium in a number of LLW categories were estimated with the soil-debris model using solubility controls. For all LLW categories except Cat 3 LLW, a solubility-controlled concentration of 64 mg/L was used for all uranium isotopes. This estimate was developed and described for Hanford-specific conditions in Wood et al. (1996) for use in the performance assessment of solid waste burial grounds in the 200 East Area.

In the Cat 3 LLW, the geochemical environment created by the presence of cement associated with the high-integrity containers (HIC) and the in-trench grouting is expected to reduce the release of uranium at much lower concentration limits. The solubility-controlled concentration used for Cat 3 LLW was 0.23 mg/L, which was based on an estimate (2.34×10^{-4} g/L) developed and described in Wood et al. (1996) for use in the performance assessment of solid waste burial grounds in the 200 East Area.

To account for the expected delay in release of Cat 3 LLW, because it is contained within HICs or grouted in place, the soil-debris release model used a 300-year delay before releases were initiated. This delay is consistent with the estimated 300-year lifetime of LLW containment effectiveness of the HIC or in-trench grouting.

For some categories (Cat 3 LLW and Cat 3 MLLW) in each of the alternatives, LLW containing elevated levels of technetium-99 will be placed in a grout matrix before being placed in the LLBGs. For this type of grouted waste, a release model referred to as the cement-release model was used to approximate the source release. The underlying basis of the cement-release model assumes that (1) the permeability of the grouted waste is much lower than that of the surrounding soil, (2) the permeability of the waste is low enough that advective water flow within the waste form is essentially zero, and (3) the pore space connectivity in the cementitious waste form is sufficiently high enough to allow contaminant mobility within the waste form by diffusion. The mathematical basis of this release model is also described in detailed in Appendix D of Kincaid et al. (1998).

In the cement-release model, percolating water is assumed to move around the grouted waste, and contaminants are leached only from the outer surface. As this occurs, contaminants inside the waste form are assumed to diffuse toward the outer surface. Therefore, overall contaminant release from the source zone is assumed to be controlled by the effective diffusion coefficient of the contaminant in the waste form.

Effect of Organic Hazardous Chemicals on Long-term Water Quality Impacts

The effect of hazardous chemicals, particularly organic chemicals, on enhancing the mobility of normally sorbed or immobile constituents in transport was raised as an important technical issue for solid waste disposal facilities during public review and comment of the first draft HSW EIS. Detailed evaluations of tabulations of metal-organic complex stability constants for organic compounds (Martell 1971; Martell and Smith 1977; Smith and Martell 1982) suggest that most of the stability constants are weak for organics typically contained in LLW and MLLW. The more typical organic compounds found in LLW and MLLW are non-polar and relatively hydrophobic molecules. Organics that fit into this category (that is, carbon tetrachloride, trichloroethane, and other volatile organics) generally cannot form a complex with metals and radionuclides and enhance their mobility. However, such non-polar and/or hydrophobic organic compounds if disposed in large quantities and in high concentration could potentially affect radionuclide and metal migration by creating a reducing zone in the sediments or groundwater especially if biological activity is occurring. Field evidence suggests that this has not occurred to any significant extent at any waste site at Hanford (see Serne and Wood 1990 and references therein). Thus this type of enhanced transport is not expected to be important in affecting field-scale transport of constituents of concern from HSW EIS disposal sites. A small subset of organic compounds, commonly referred to as complexing/chelating agents, do have the ability to enhance the mobility of some normally sorbed or immobile constituents. Some notable examples of such agents include ETDA, HEDTA, DTPA, oxalic acid, and TBP. The ability of these complexing agents to affect the general mobility of normally immobile or sorbed radionuclides and metals is a function of many factors, including:

- The type and amount of organic complexing agent is present
- The stability of the complex and the kinetics of its formation and disassociation back to free molecules
- pH, REDOX and microbiological conditions
- The amount of free liquids or fluids contained within the wastes.

In one instance onsite, the presence of complexing agents (EDTA and/or ferro-ferric-cyanide) in a liquid waste stream discharged to the ground is suspected of enhancing the transport of a cobalt-60 plume from the northern part of the 200 East Area. However, the combination of complexing agents and liquid discharge at this waste site is unique and cannot be interpreted as being representative of expected geochemical or vadose zone flow and transport conditions that would be expected at solid waste burial grounds.

At this time, there is no specific evidence that would support enhanced movement of moderately to strongly sorbed radionuclides or metals (for example. cesium, strontium, europium, uranium, or plutonium) due to the presence of organic complexing agents in solid wastes within LLBGs. In fact, no field-scale evidence has been found at other solid waste LLW sites across North America that would support this hypothesis (Serne et al. 1990 and 1995). Estimated inventories of hazardous chemical constituents and particular organic complexing agents associated with LLW and MLLW disposed of after 1988 are thought to be quite small. MLLW, which would be expected to contain the majority of hazardous chemical constituents, will undergo predisposal solidification to stabilize waste forms and thermal treatment to remove organic chemical components of the MLLW. This waste treatment would be done to meet current waste acceptance criteria and land disposal restrictions before disposal in permitted MLLW facilities. Consequently, the effect of organic complexing agents and groundwater quality impacts from organic chemicals, in general, would not be expected to be substantial for solid wastes.

LLW disposed of prior to September 1987 may potentially contain hazardous chemical constituents and organic complexing agents, but because no specific requirements existed to account for or to report their content, it is difficult to assess impacts. As a consequence, analysis of these constituents and estimated impacts based on the limited amount of information on estimated inventories and waste disposal location would be subject to large uncertainty at this time. These facilities are part of the LLW and MLLW facilities in the LLW Management Areas 1 – 4 that are currently being monitored under RCRA interim status programs. Final evaluation of these facilities under RCRA and/or CERCLA guidelines would eventually require analysis of the impacts of the chemical components of these disposed inventories. Any analysis with information that is currently available would be at best speculative without more detailed inventory characterization information. Such analyses would require a more thorough and detailed characterization of these wastes at some future date or more extensive vadose zone monitoring (that is, extraction of pore fluids underneath the burial grounds). There is no evidence of enhanced mobility of radionuclides or chemicals, which can be traced back to the solid wastes, in groundwater surrounding the monitoring wells that surrounding the LLBGs.

Relation of the HSW-EIS to Current Performance Assessments for LLW and MLLW Disposal

The long-term radiological impacts of solid wastes disposed of in LLBGs in the 200 East and West Areas since October 1987 have been evaluated with two active performance assessments (*Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds* [Wood et al. 1995] and *Performance Assessment for the Disposal of Low-Level Waste in the 200 East Area Burial Grounds* [Wood et al. 1996]). These performance assessments were approved by DOE (Cowan 1996; Frei 1997).
The proposed disposal of immobilized low-activity waste (ILAW) derived from the Tank Waste Treatment Plant in a disposal facility sited southwest of the PUREX Plant within the 200 East Area has also been evaluated using a performance assessment (Mann et al. 2001). This performance assessment was also approved (DOE 2001). Ongoing maintenance for all three of these performance assessments includes continual evaluation and production of annual reports on new data and information on projected disposal inventories, geochemical, and waste form performance data and information and their relevance to current performance assessment results and conclusions

Projected waste inventories, selection of disposal methods, or trench designs that might result from this HSW EIS would be addressed under performance assessment compliance requirements as specified in DOE Order 435.1. Long-term performance assessment of radiological impacts from disposal facilities is a part of several requirements specified under DOE Order 435.1 for Hanford Site low-level waste disposal facilities to ensure the protection of workers, the public, and the environment.

Analysis of the most current baseline disposal practices that use conventional trenches for both solid wastes and ILAW show that for current waste inventory projections, operational waste acceptance criteria and waste acceptance practices continue to be compliant with performance objectives.

Specific values of the effective diffusion coefficient in cement-release model type waste forms for each radionuclide were chosen from the values originally reported by Serne et al. (1989). These values had previously been incorporated into a computer database known as the Multimedia-Modeling Environmental Database Editor (MMEDE) (Warren and Strenge 1994). For the source-term calculation effort of this analysis, the MMEDE database was queried to produce an electronic file of tabulated diffusion coefficients for relevant radionuclides (that was subsequently incorporated into the source-term calculation spreadsheet). This study used diffusion coefficient values as reported in Buck et al. (1997). Diffusion coefficients of 1×10^{-11} and 1×10^{-12} $cm^2\ s^{-1}$ for technetium-99 and iodine-129, respectively, were used. For some radionuclides (for which no specific values were available), the diffusion coefficient was fixed at a reasonable conservatively high default value (5×10^{-8} $cm^2\ s^{-1}$).

G.1.4 Vadose Zone Modeling

Contaminants released from the various LLBGs were transported downward through the vadose zone to the water table. The primary mechanism for transport in the vadose zone was water flow in response to gravitational and capillary forces. After the LLW disposal operations cease, steady-state hydraulic conditions resulting from different surface covers (including re-vegetation) that affect recharge were represented in the model. Recharge directly from precipitation or snowmelt infiltrates into the vadose zone. The recharge rate varies for the assumed surface cover conditions for each of the LLBGs. The data used in the vadose zone model are described in the remainder of this section.

The vadose zone was modeled as a stratified one-dimensional column. In this analysis, it was not appropriate to represent the vadose zone as multidimensional because of the large number of LLBG sites modeled and the limited characterization of the vadose zone. Multidimensional modeling of the vadose zone has been performed for some waste sources and types (Mann et al. 1997; Mann et al. 2001) but was not practical for this analysis for the large number of sites in question. A one-dimensional approach would also be expected to yield results that would be more conservative than those produced with multi-dimensional approaches which consider lateral spreading of infiltration and contaminant transport.

The remainder of this section describes the stratigraphy, hydraulic properties, recharge, and geochemical conditions used in this analysis.

G.1.4.1 Stratigraphy

Because of the large number of sites to be modeled in this assessment, the technical approach used for the vadose zone stratigraphy was similar to the approach used in the Composite Analysis by Kincaid et al. (1998). The stratigraphy used was an approximation that was consistent with the major geologic formations found in the vadose zone beneath the Central Plateau in the areas of question and was based on work documented in Thorne and Chamness (1992), Thorne et al. (1993), and Thorne et al. (1994). In the composite analysis, the stratigraphies for several areas of the 200 East and 200 West Areas were defined as a set of strata consistent with the nearest available well log from 18 well logs (Kincaid et al. 1998). Each of the well logs included location, ground surface elevation, and the thickness of the various major sediment types.

A summary of the geologic well logs used in the composite analysis appears in Table G.4. At each profile location, seven sediment types, and one rock type (basalt) were identified and used to define the stratigraphy. The acronyms of the sediment types provided in Table G.5 are associated with the following sediment types: 200 West Area Hanford Sand (WHS) sediment, 200 West Area Early Palouse (WEP) sediment, 200 West Area Plio Pleistocene (WPP) sediment, 200 West Area Ringold (WR) sediment, 200 East Area Hanford Sand (EHS) sediment, 200 East Area Ringold (ER) sediment, and 200 East Area Hanford Gravel (LEHG or EHG) sediment. East Hanford Gravel sediment type also appears in the table as LEHG, but the same soil moisture characteristics are applied to both. At most, four different sediment types occurred above the basalt at any location. In the vadose zone model, the basalt rock type was regarded as impermeable and was used to define the default bottom of the vadose zone profile. If the water table fell below the top of the basalt, as in the case for LLBGs located in the northern part of the 200 East Area, the vadose zone was still assumed to be limited to the basalt surface.

Two of the composite well logs developed for the composite analysis were selected for use in this assessment based on their proximity to the LLBGs. The specific well logs used to approximate the vadose zone stratigraphy at the LLBGs, which are noted in the first two rows of the table, are 218-E-12b in the 200 East Area and 218-W-5 in the 200 West Area and the ERDF.

G.1.4.2 Hydraulic Properties

Modeling water flow and radionuclide transport through the vadose zone required a description of the relationship among moisture content, pressure head, and unsaturated hydraulic conductivity. These relationships, called soil moisture characteristics, are highly nonlinear. In this analysis, non-hysteretic

Table G.4. Geologic Well Logs for the Vadose Zone Model

Composite Well Log	Surface Elevation (m)	Northing (m)[a]	Easting (m)[b]	Sediment 1[c]	Thickness (m)	Sediment 2	Thickness (m)	Sediment 3	Thickness (m)	Sediment 4[d]	Thickness (m)
218-W-5[e]	224.9	137024	565658	WHS	19	WEP	4	WPP	7	WR	85
218-E-12B[f]	191.9	137238	574643	EHG	10	EHS	6	LEHG	54	ER	0.01
218-E-10	190.7	137468	572924	EHG	10	EHS	6	LEHG	59	ER	0.01
299-E13-20	226.4	134313	573610	EHG	10	EHS	6	LEHG	80	ER	60
299-E19-1	224.1	135086	572820	EHG	10	EHS	6	LEHG	91	ER	51
299-E24-7	218.2	135561	574407	EHG	10	EHS	6	LEHG	60	ER	56
299-E25-2	205.9	136062	575514	EHG	10	EHS	6	LEHG	60	ER	36
299-E26-8	188.8	136687	575522	EHG	10	EHS	6	LEHG	44	ER	14
299-E28-16	214.3	136562	573135	EHG	10	EHS	6	LEHG	71	ER	12
299-E28-22	213.5	136321	574041	EHG	10	EHS	6	LEHG	83	ER	17
299-W6-1	214.1	137510	567214	WHS	14	WPP	4	WR	121		
299-W11-2	217.8	136671	567407	WHS	34	WEP	4	WPP	7	WR	110
299-W14-7	206.6	135655	567034	WHS	38	WPP	2	WR	118		
299-W14-8A	221.0	135688	568013	WHS	47	WEP	5	WPP	5	WR	106
299-W15-15	212.8	135752	566089	WHS	42	WEP	3	WPP	8	WR	100
299-W18-21	203.8	134979	566098	WHS	36	WEP	5	WPP	3	WR	100
299-W21-1	213.1	134397	568141	WHS	53	WEP	8	WPP	8	WR	100
299-W22-24	211.0	134411	567648	WHS	42	WEP	13	WPP	12	WR	104

(a) Refers to north coordinate in Washington State Plane NAD83 coordinate system.
(b) Refers to east coordinate in Washington State Plane NAD83 coordinate system.
(c) Refers to the upper sediment layer.
(d) Refers to the lowest sediment layer simulated.
(e) Composite well log used in analysis of the 200 West Area LLBGs.
(f) Composite well log used in analysis of the 200 East Area LLBGs.
EHS – 200 East Area Hanford Gravel Sediment.
LEHG – Lower 200 East Area Hanford Gravel Sediment.
ER – 200 East Area Ringold Sediment.
WHS – 200 West Area Hanford Sand Sediment.
WPP – 200 West Area Plio-Pleistocene Sediment.
WEP – 200 West Area Lower Palouse Sediment.
WR – 200 West Area Ringold Sediment.

relationships were assumed for Hanford Site soils because few measurements to characterize hysteresis have been made for such soils, and it is believed to be of secondary importance. The hydraulic properties of Hanford Site soils are highly variable, both between the Hanford and Ringold formations and within each of the formations (Khaleel and Freeman 1995). For purposes of this analysis, the values of each of the parameters provided in the table were the values used.

In this analysis, different sediment types were used to define the one-dimensional columns beneath the LLBGs. The hydraulic properties of the sediment types were assumed to be uniform with each sediment layer. Preferential flow paths in the form of wells and clastic dikes were not considered in this analysis because use of one-dimensional models cannot represent their local influence in a three-dimensional environment. The potential influence of preferential flow paths, especially clastic dikes, has been addressed in the performance assessments for the solid waste burial grounds (Wood et al. 1995, 1996) and, more recently, by Ward et al. (1997) for post-1988 LLW. Wood et al. (1995) and Wood et al. (1996) concluded that clastic dikes were insufficiently large and insufficiently continuous to provide a true preferential pathway.

The model of soil hydraulic properties based on the van Genuchten (1980) and Mualem (1976) analytical expressions was used as the basis for the relationships among moisture content, pressure head, and unsaturated hydraulic conductivity. This model has been applied in previous vadose zone studies at the Hanford Site. Parameters for the van Genuchten and Mualem models have been determined by fitting experimental data for Hanford Site sediments to the classic analytic expressions of these models. These results are described in several Hanford Site documents, but the parameters used in this analysis were compiled by Khaleel and Freeman (1995).

For this analysis, unsaturated flow parameters were established for each of the vadose zone sediment types previously defined. Sediment types and the associated unsaturated flow modeling parameters used in this analysis are shown in Table G.5. It should be noted that laboratory-measured moisture retention and saturated conductivity data in Table G.5 have been corrected for the gravel fraction (> 2 mm) present in the bulk sample.

G.1.4.3 Recharge Rates

This assessment focuses on the long-term transport of contaminants from the LLBGs through the underlying vadose zone to the unconfined aquifer after the end of the operational period in 2046. At the Hanford Site, data on the current distribution of soil moisture and contaminants in the vadose zone at the majority of waste sites are inadequate to define long-term conditions for modeling, so simulations were begun at the initiation of LLBG release to the vadose zone assumed to start in 2046. Initial conditions in this analysis were based on expected conditions after the operational period and assumed a steady-state natural recharge condition with no contaminants in the vadose zone. The assumed long-term recharge that will govern the migration of contaminants through the vadose zone to the underlying water table will be controlled by the expected regional surface conditions surrounding the LLBGs dominated by natural vegetation and is conservatively estimated to be in the order of 0.5 cm/year as currently estimated for vegetative surface conditions (Fayer and Walters 1996; Fayer et al. 1999). The net recharge or infiltration rate will vary, representing a range of surface cover conditions from undisturbed surfaces with natural

Table G.5. Sediment Types and Unsaturated Flow Model Parameters Used in the Composite Analysis[(a)]

Sediment Name (Code)	van Genuchten alpha (-)	van Genuchten n (1/cm)	Residual Water Content (cm^3/cm^3)	Saturated Water Content (cm^3/cm^3)	Saturated Hydraulic Conductivity (cm/s)	Bulk Density (g/cm^3)	Gravel %[(b)]
200 East Area Hanford Gravel (EHG)	8.11E-03	1.58	0.0146	0.119	1.76E-03	1.97	41.70
Lower 200 East Area Hanford Gravel (LEHG)	8.11E-03	1.58	0.0146	0.119	1.76E-03	1.97	41.70
200 East Area Hanford Sand (EHS)	1.30E-01	2.10	0.0257	0.337	1.19E-02	1.78	17.30
200 East Area Ringold (ER)	8.19E-03	1.53	0.0262	0.124	3.97E-04	2.04	43.30
200 West Area Hanford Sand (WHS)	1.44E-02	2.20	0.0519	0.382	3.98E-04	1.64	3.60
200 West Area Early Palouse (WEP)	6.27E-03	2.53	0.0300	0.379	9.69E-05	1.68	2.00
200 West Area Plio-Pleistocene (WPP)	1.55E-02	1.78	0.0616	0.337	5.79E-02	1.65	8.40
200 West Area Ringold (WR)	3.14E-02	1.65	0.0236	0.226	5.76E-02	2.04	43.30

(a) Data are from Khaleel and Freeman (1995). A normal distribution was assumed for the parameters “van Genuchten n,” “Residual Water Contents,” and “Saturated Water Content,” and the mean was calculated accordingly. A log-normal distribution was assumed for the parameters “van Genuchten alpha” and “Saturated Hydraulic Conductivity,” and the mean was calculated accordingly. If the sample size was less than 10, the parameters “van Genuchten alpha” and “Saturated Hydraulic Conductivity” were determined using the geometric mean.
(b) Only fine particles were assumed to contribute to sorption of contaminants of concern. The impact of larger particles was corrected using gravel %.

vegetation, to disturbed surfaces maintained free of vegetation, to engineered surface barriers designed for long-term service.

G.1.4.4 Distribution Coefficients

In this analysis, the linear sorption isotherm model was used in transport calculations. This model was selected because it was the only approach for which model parameters (distribution coefficients) were available for the LLBG contaminants. The distribution coefficients (k_d) used for the vadose zone analysis are summarized in Table G.1.

G.1.4.5 Vadose Zone Model Implementation

The vadose zone flow and transport model was implemented with the STOMP code (White and Oostrom 1996; White and Oostrom 1997; Nichols et al. 1997). Implementation of the vadose zone model with a unit release resulted in estimates of the annual contaminant flux to the water table that were used in the convolution integral method for linear superposition described previously.

The STOMP code was developed under the Volatile Organic Compounds (VOC) Arid Demonstration Project through the DOE Office of Technology Development (White and Oostrom 1997). STOMP is based on the numerical solution of the three-dimensional Richards' equation for fluid flow (Richards 1931) and the advection-dispersion equation for contaminant transport. Although STOMP is capable of three-dimensional simulations, it is also designed to be efficient in performing one- and two-dimensional simulations. The code is based on an integral-volume, finite-difference method and is designed to simulate a wide variety of multidimensional, nonlinear, nonisothermal, and multiphase situations. STOMP was selected for this analysis because of computational efficiency and flexibility, its prior application to the Hanford Site vadose zone (Ward et al. 1997), and its thorough documentation (Nichols et al. 1997), (White and Oostrom 1997), and (White and Oostrom 1996).

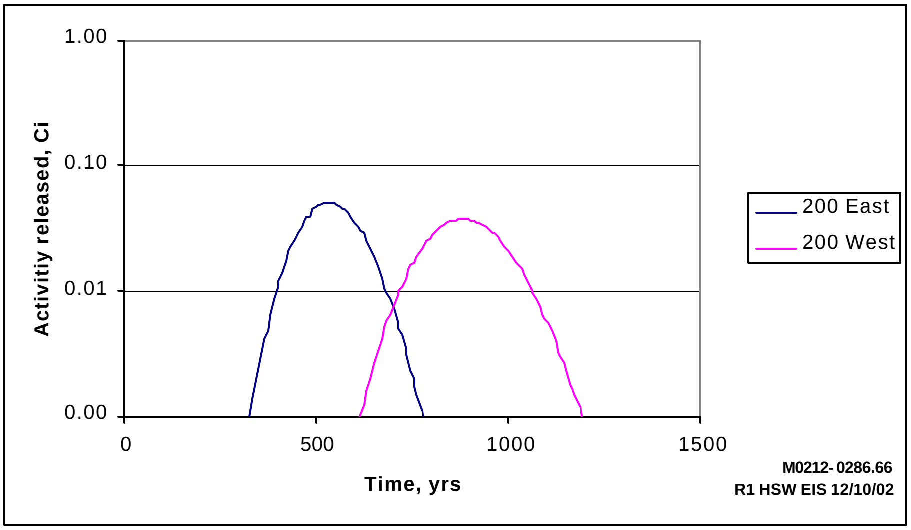
Because of the large number of sites to be modeled in this assessment, the technical approach used for the vadose zone stratigraphy was similar to the approach used in the composite analysis by Kincaid et al. (1998). The stratigraphy used was an approximation that was consistent with the major geologic formations found in the vadose zone beneath the Central Plateau in the areas of question and was based on work documented in Thorne and Chamness (1992), Thorne et al. (1993), and Thorne et al. (1994). A summary of the geologic well logs used in the composite analysis appears in Table G.5. To approximate the vadose zone at the LLBGs in the 200 East and West Areas, two of the composite well logs developed for the composite analysis were selected for use in this assessment based on their proximity to the LLBGs. The specific well logs used to approximate the vadose zone stratigraphy at the LLBGs, which are noted in the first two rows of the table, are 218-E-12b in the 200 East Area and 218-W-5 in the 200 West Area and the ERDF.

Water table elevations for future conditions at the LLBGs were calculated with the groundwater flow model. This information was used in the vadose zone transport calculations to define the bottom of the vadose zone. The elevation of the top of the vadose zone at the LLBGs was calculated from land surface elevations and depth to the bottom of the source, which was tabulated for the LLBG areas.

Results of vadose zone transport of a unit release to the water table for the assumed long-term recharge rate of 0.5 cm/year using assumed soil columns and properties in the 200 East and West Areas is presented in Figure G.4. Average travel times for the releases of unit mass of contaminants within Mobility Class 1, as defined by the arrival of 50 percent of each unit mass, is on the order of 500 to 600 years in the 200 East Area and 800 to 900 years in the 200 West Area.

G.1.5 Groundwater Modeling

Contaminant transport through the saturated unconfined aquifer was simulated with the sitewide groundwater flow and transport model, CFEST model (Cole et al. 2001a) for the 200 East and the 200 West LLBGs.



LLBG - Low-Level Burial Grounds
STOMP - Subsurface Transport Over Multiple Phases

Figure G.4. STOMP Code Results for Releases to the Water Table for a Unit Release from LLBGs for an Assumed Recharge Rate of 0.5 cm/yr

A three-dimensional conceptual model was developed for the unconfined aquifer that included stratigraphy, the upper and lower aquifer boundaries, and a table of material units and corresponding flow and transport parameters. The conceptual model was used to guide the setup of the numerical model. A grid spacing of 375 m (1230 ft) was established for the Hanford Site and overlain onto a site map containing physical features and the LLBGs.

G.1.5.1 Conceptual Model

G.1.5.1.1 Hydrogeologic Framework

Hydrogeologic units defined for use in the model were designated by numbers and are briefly described in Table G.6. More detailed descriptions of the sediments were presented in Section 4.5 of this HSW EIS, and a graphic comparison of the model units taken from Thorne et al. (1993) against the stratigraphic column defined in Lindsey (1995) is shown in Figure G.5.

Although nine hydrogeologic units were defined, only seven (Units 1, 4, 5, 6, 7, 8, and 9) are found below the water table during post-Hanford conditions (Cole et al. 1997). Odd-numbered Ringold model units (5, 7, and 9) are predominantly coarse-grained sediments. Even-numbered Ringold model units (4, 6, and 8) are predominantly fine-grained sediments with low permeability. The Hanford formation

Table G.6. Major Hydrogeologic Units Used in the Sitewide Three-Dimensional Model

Unit Number	Hydrogeologic Unit	Lithologic Description
1	Hanford Formation	Fluvial gravels and coarse sands
2	Palouse Soils	Fine-grained sediments and eolian silts
3	Plio-Pleistocene Unit	Buried soil horizon containing caliche and basaltic gravels
4	Upper Ringold Formation	Fine-grained fluvial/lacustrine sediments
5	Middle Ringold (Units E and C)	Semi-indurated coarse-grained fluvial sediments
6	Middle Ringold (Lower Ringold Mud)	Fine-grained sediments with some interbedded coarse-grained sediments
7	Middle Ringold (Units B and D)	Coarse-grained sediments
8	Lower Mud Sequence (Lower Ringold and part of Basal Ringold Muds)	Lower blue or green clay or mud sequence
9	Basal Ringold (Unit A)	Fluvial sand and gravel
10	Columbia River Basalt	Basalt

combined with the pre-Missoula gravel deposits were designated as Model Unit 1. Model Units 2 and 3 correspond to the early Palouse soil and Plio-Pleistocene deposits, respectively. These units lie above the current water table. The predominantly mud facies of the upper Ringold unit identified by Lindsey (1995) was designated Model Unit 4. However, a difference in the definition of model units was the lower, predominantly sand, portion of the upper Ringold unit described in Lindsey (1995) was grouped with Model Unit 5 that also includes Ringold gravel/sand Units E and C. This action was taken because the predominantly sand portion of the upper Ringold is expected to have hydraulic properties similar to Units E and C. The lower mud unit identified by Lindsey (1995) was designated Model Units 6 and 8. Where they exist, the gravel and sand Units B and D, found within the lower Ringold, were designated Model Unit 7. Gravels of Ringold Unit A were designated Model Unit 9, and the underlying basalt was designated Model Unit 10. However, the basalt was assigned a very low hydraulic conductivity and was essentially impermeable in the model.

The lateral extent and thickness distribution of each hydrogeologic unit were defined based on information from drillers' well logs, geologists' logs, geophysical logs, and an understanding of the geologic environment. These interpreted areal distributions and thicknesses were then integrated into EarthVision™ (Dynamic Graphics, Inc., Alameda, California), a three-dimensional, visualization software package that was used to construct a database of the three-dimensional hydrogeologic framework.

G.1.5.1.2 Recharge and Flow System Boundary Conditions

The past development of the sitewide model considered both natural and artificial recharge to the aquifer. Natural recharge to the unconfined aquifer system occurs from infiltration of (1) runoff from elevated regions along the western boundary of the Hanford Site; (2) spring discharges originating from the basalt-confined aquifer system, also along the western boundary; and (3) precipitation falling across

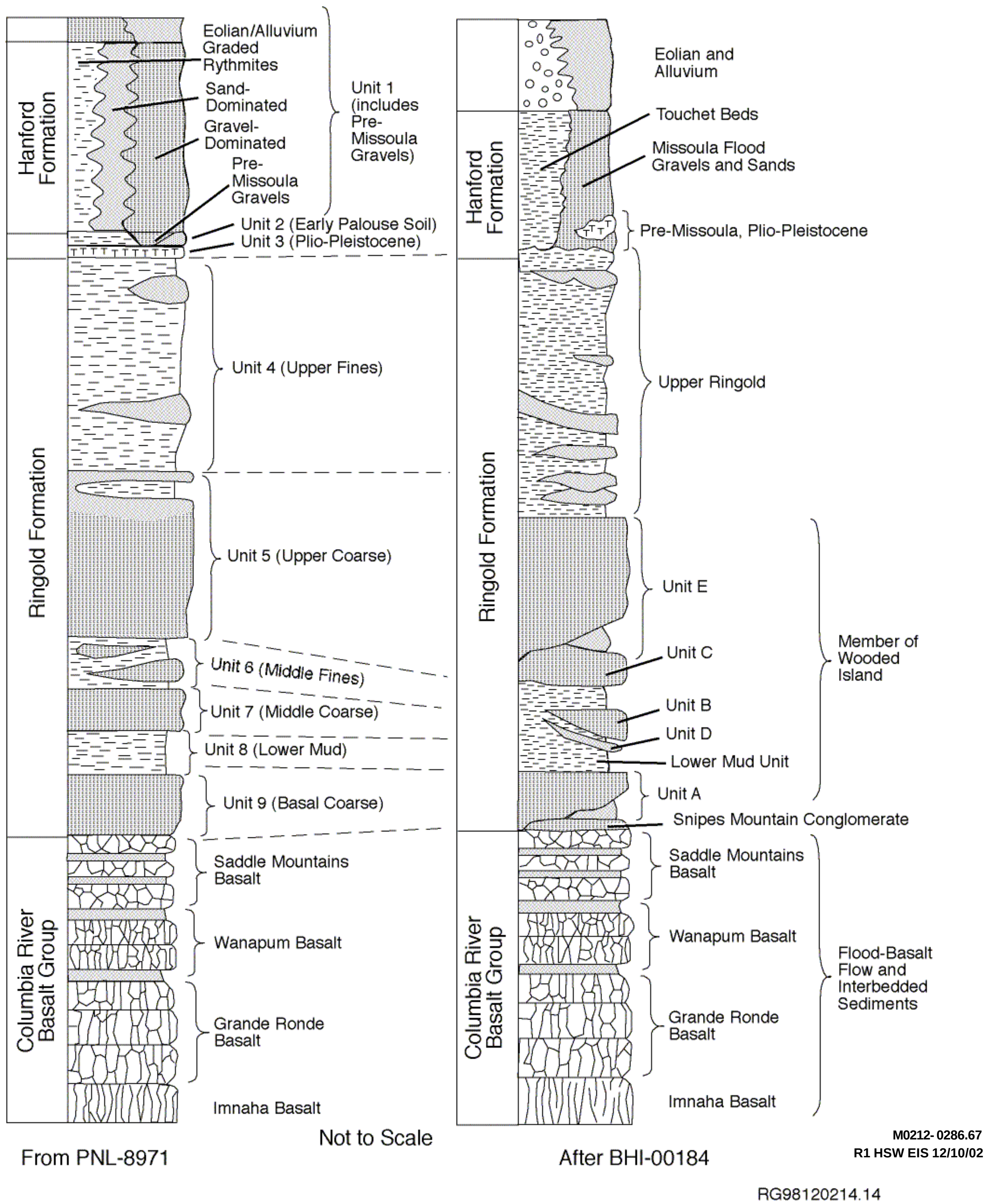


Figure G.5. Comparison of Generalized Hydrogeologic and Geologic Stratigraphy the site. Some recharge also occurs along the Yakima River in the southern portion of the site. Natural recharge from runoff and irrigation in the Cold Creek and Dry Creek Valleys, up-gradient of the site, also provides a source of groundwater inflow. Natural recharge from precipitation on the site is highly variable, both spatially and temporally, and depends on local climate, soil type, and vegetation.

The other source of recharge to the unconfined aquifer has historically come from wastewater disposal. The large volume of artificial recharge from wastewater discharged to disposal facilities on the Hanford Site over the past 60 years has substantially impacted groundwater flow and contaminant transport in the unconfined aquifer system. This volume of artificial recharge decreased significantly in the past 10 years, and the water table has been declining steadily over several years. The unconfined aquifer system eventually will be expected to reach more natural conditions after site closure. Because flow conditions simulated for this assessment focused on conditions that are likely to exist after Hanford Site closure and well into the future, the effect of past and current wastewater discharges on the unconfined aquifer system were not considered in this assessment.

Peripheral boundaries defined for the three-dimensional model are shown in Figure G.6, together with the three-dimensional flow-model grid. The flow system is bounded by the Columbia River on the north and east and by the Yakima River and basalt ridges on the south and west. The Columbia River represents a point of regional discharge for the unconfined aquifer system. The amount of groundwater discharging to the river is a function of local hydraulic gradient between the groundwater elevation adjacent to the river and the river-stage elevation. This hydraulic gradient is highly variable because the river stage is affected by releases from upstream dams.

Because of the regional-scale nature and long-time frame being considered in the current assessment, site-wide flow and transport modeling efforts did not attempt to consider the short-term and local-scale transient effects of the Columbia River system on the unconfined aquifer. However, the long-term effect of the Columbia River as a regional discharge area for the unconfined aquifer system was approximated in the three-dimensional model with a constant-head boundary applied at the uppermost nodes of the model at the approximate locations of the river's left bank and channel midpoint. Nodes representing the thickness of the aquifer below the nodes representing mid-point of the river channel were treated as no-flow boundaries. This boundary condition is used to approximate the location of the groundwater divide that exists beneath the Columbia River where groundwater from the Hanford Site and the other side of the river discharge into the Columbia. The long-term, average river-stage elevations for the Columbia River implemented in the sitewide model were based on results from previous work performed by Walters et al. (1994) for the Columbia River with the CHARIMA river simulation model. The Yakima River was also represented as a specified-head boundary at surface nodes approximating its location. Like the Columbia River, nodes representing the thickness of the aquifer below the Yakima River channel were treated as no-flow boundaries. Short-term fluctuations in the river levels do not influence modeling results.

At Cold Creek and Dry Creek Valleys, the unconfined aquifer system extends westward beyond the boundary of the model. To approximate the groundwater flux entering the modeled area from these valleys, both constant-head and constant-flux boundary conditions were defined. A constant-head boundary condition was specified for Cold Creek Valley for the steady-state model calibration runs. The

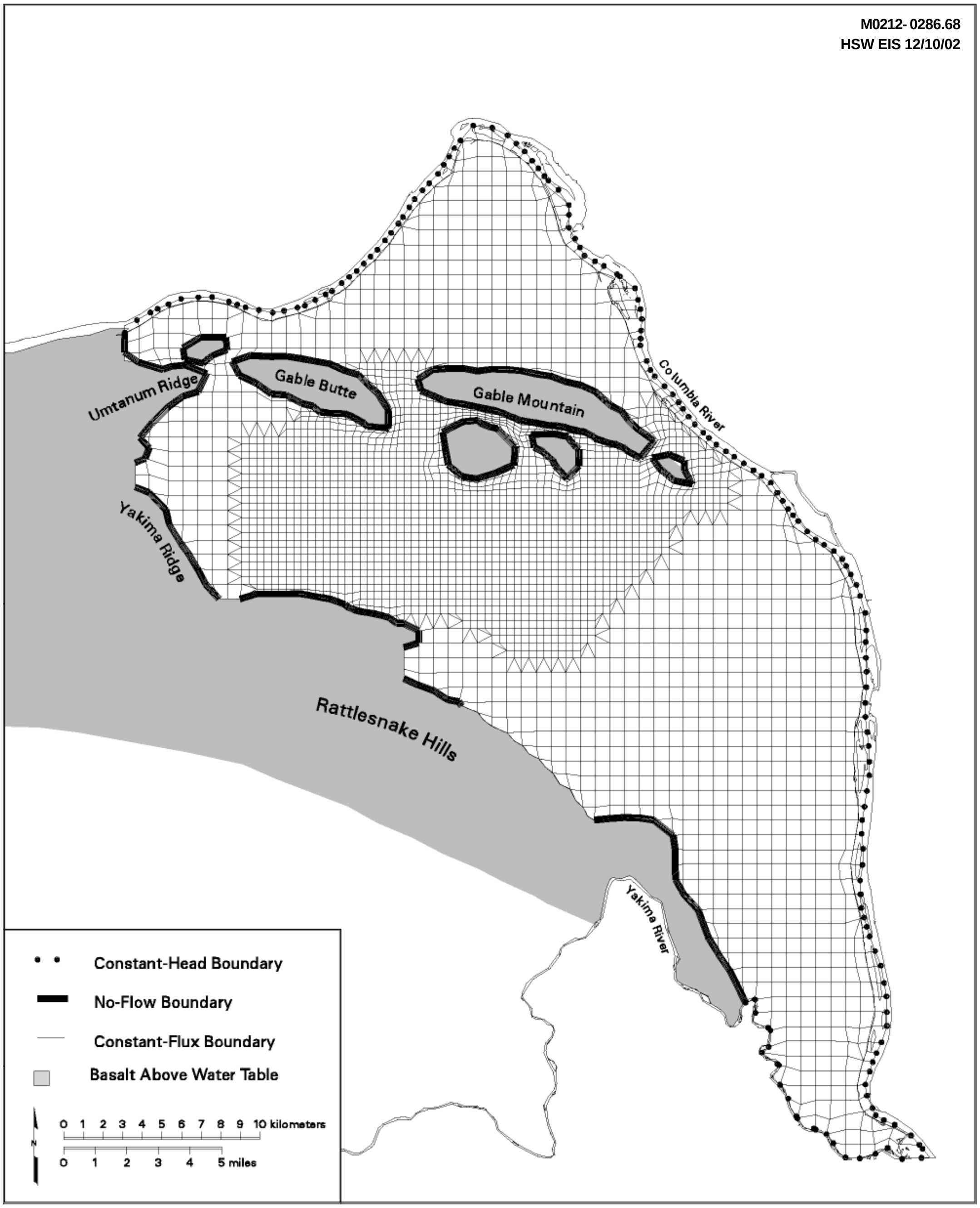


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Figure G.6. Peripheral Boundaries Defined for the Three-Dimensional Model (taken from Cole et al. (1997)

fluxes resulting from the specified-head boundaries in the calibrated steady-state model were then used in the steady-state flow simulation of flow conditions after Hanford Site closure. The constant-flux boundary was used because it better represents the response of the boundary to a declining water table than does a constant-head boundary. Discharges from Dry Creek Valley in the model area, resulting from infiltration of precipitation and spring discharges, are approximated using the same methods.

The basalt underlying the unconfined aquifer sediments represents a lower boundary to the unconfined aquifer system. The potential for interflow (recharge and discharge) between the basalt-confined aquifer system and the unconfined aquifer system is largely unquantified but is postulated to be small relative to the other flow components estimated for the unconfined aquifer system. Therefore, interflow with underlying basalt units was not included in the current three-dimensional model. The basalt was defined in the model as an essentially impermeable unit underlying the sediments.

G.1.5.1.3 Flow and Transport Properties

To model groundwater flow, the distribution of hydraulic properties, including horizontal and vertical hydraulic conductivity, storativity, and specific yield, was needed for each hydrogeologic unit defined in the model. In addition, to simulate movement of contaminant plumes, transport properties were needed, including contaminant-specific distribution coefficients, bulk density, effective porosity, and longitudinal and transverse dispersivities.

In the original model calibration procedure described in Wurstner et al. (1995), measured values of aquifer transmissivity were used in a two-dimensional model with an inverse model-calibration procedure to determine the transmissivity distribution. Hydraulic head conditions for 1979 were used in the inverse calibration because measured hydraulic heads were relatively stable at that time. Details concerning the updated calibration of the two-dimensional model are provided in Cole et al. (1997). The resulting transmissivity distribution for the unconfined aquifer system is shown in Figure G.10.

Hydraulic conductivities were assigned to the three-dimensional model units so that the total aquifer transmissivity from inverse calibration was preserved at every location. The vertical distribution of hydraulic conductivity at each spatial location was determined, based on the transmissivity value and other information, including facies descriptions and hydraulic property values measured for similar facies. A complete description of the seven-step process used to vertically distribute the transmissivity among the model hydrogeologic units is described in Cole et al. (1997).

The current version of the sitewide model relies on a three-dimensional representation of the aquifer system that was calibrated to Hanford Sitewide groundwater monitoring data collected during Hanford operations from 1943 to the present. The calibration procedure and results for this model are described in Cole et al. (2001a). This recent work is part of a broader effort to develop and implement a stochastic uncertainty estimation methodology in future assessments and analyses using the sitewide groundwater model (Cole et al. 2001b). Resulting distribution of hydraulic conductivities from this recent calibration effort is provided in Figures G.8 and G.9.

Information on transport properties used in past modeling studies at the Hanford Site is provided in Wurstner et al. (1995). Estimates of model parameters were developed to account for contaminant dispersion and adsorption in all transport simulations. Specific model parameters examined included longitudinal and transverse dispersivity (D_L and D_T) and contaminant retardation factors (R_f). Calculation

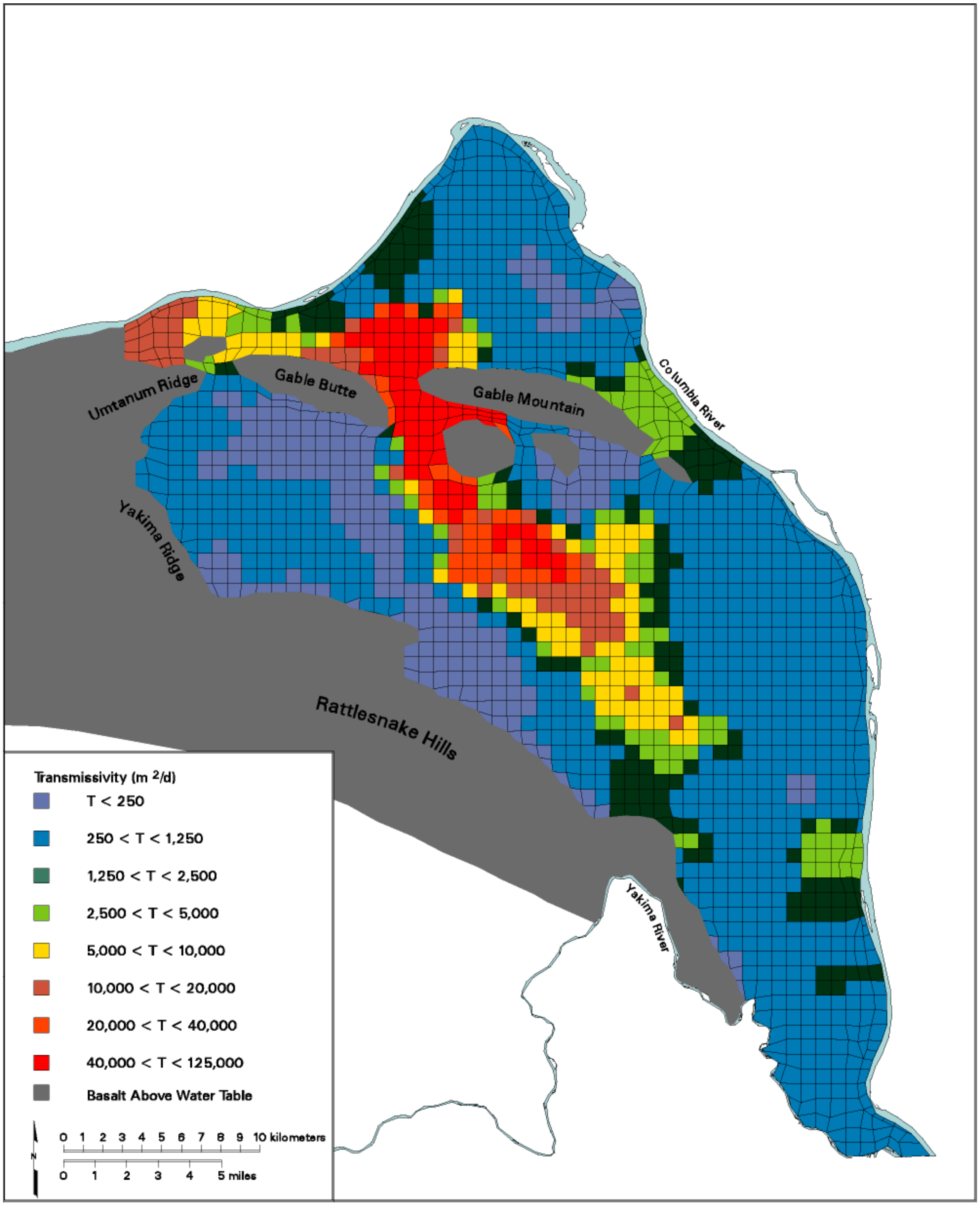

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Figure G.7. Transmissivity Distribution for the Unconfined Aquifer System Based on Two-Dimensional Inverse Model Calibration (after Wurstner et al. 1995)

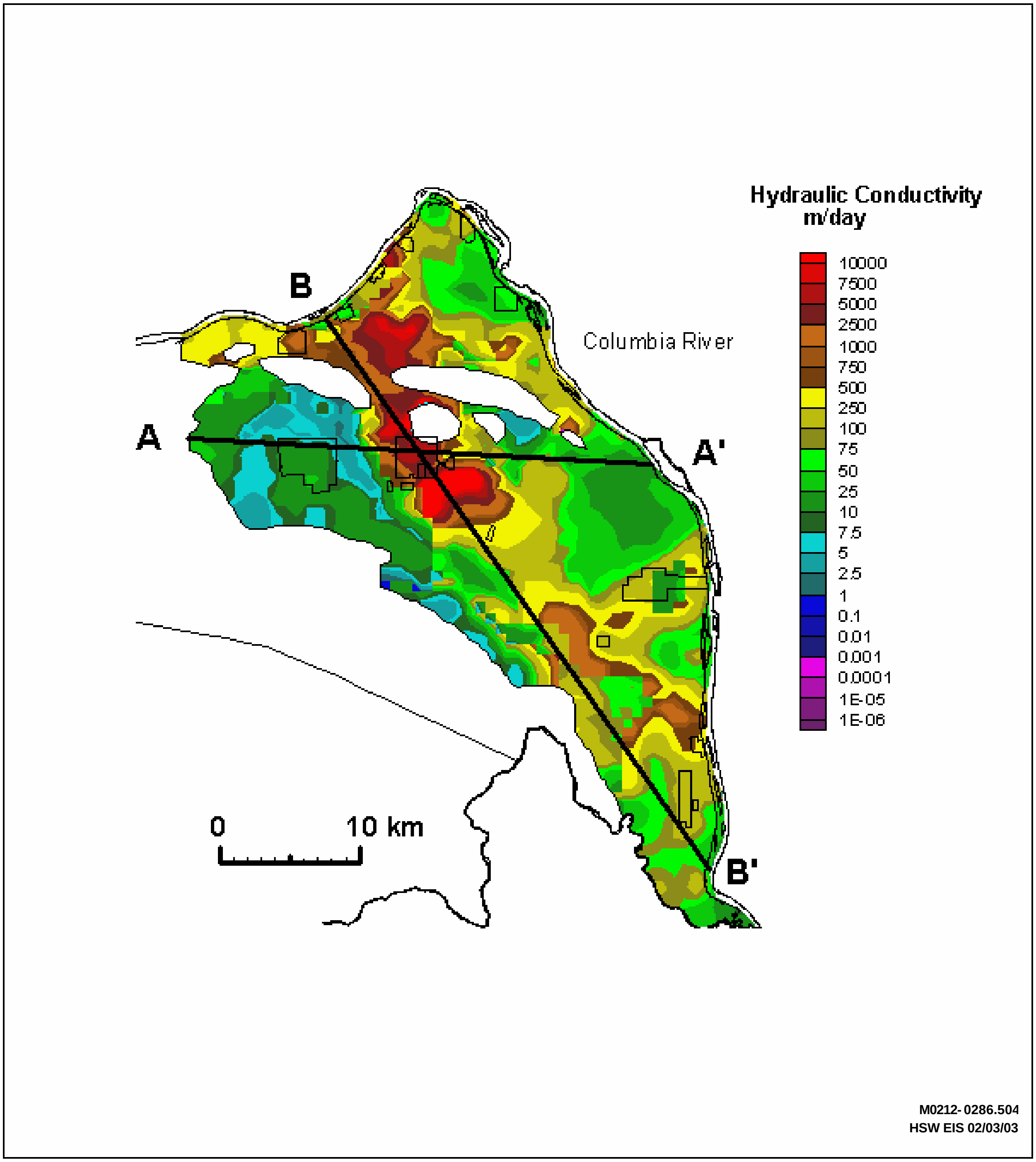

Figure G.8. Distribution of Estimated Hydraulic Conductivities at Water Table from Best-Fit Inverse Calibration of Sitewide Groundwater Model by Cole et al. (2001a)

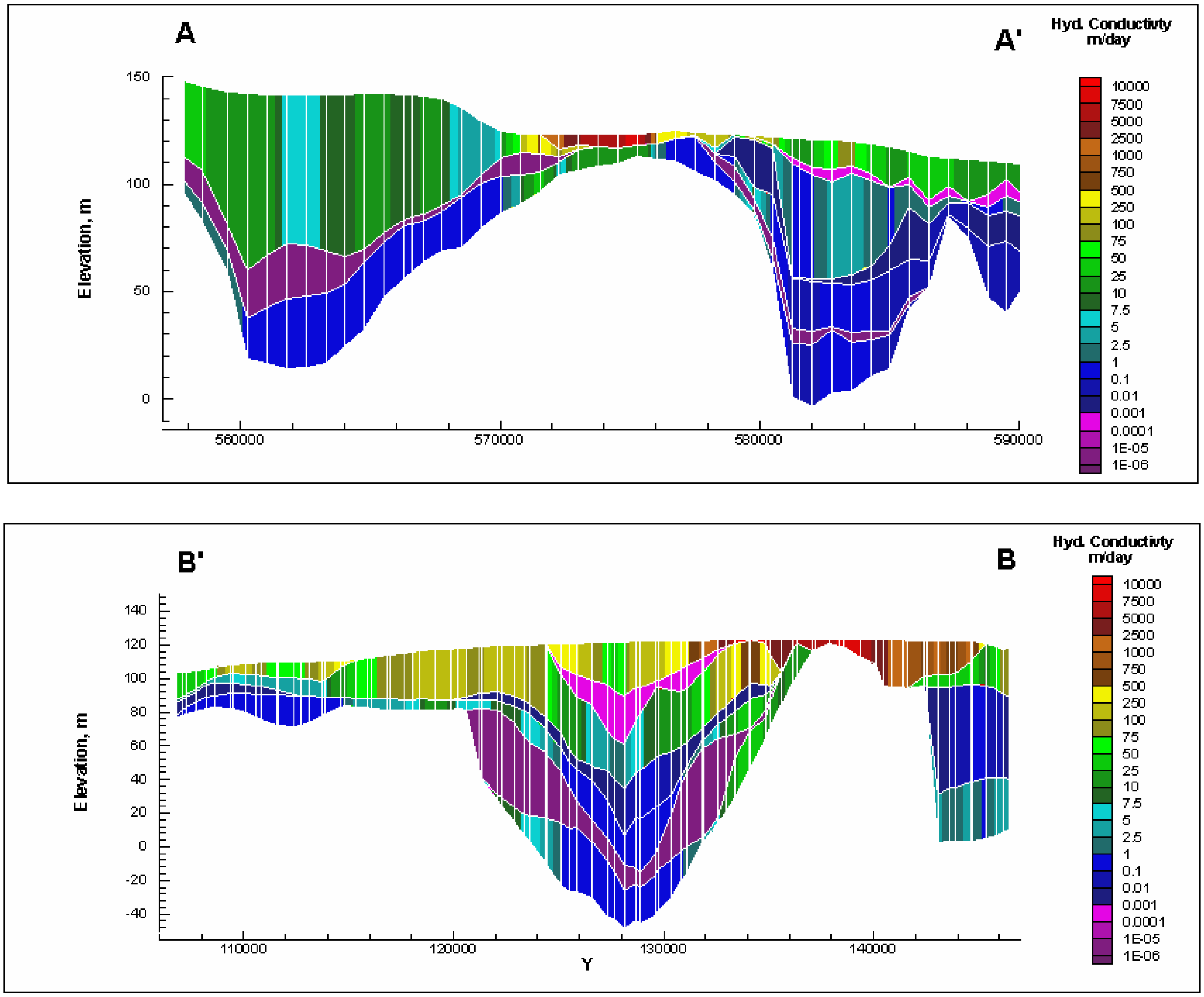

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Figure G.9. Distribution of Estimated Hydraulic Conductivities Along Section Lines A-A' and B-B' from Best-Fit Inverse Calibration of Sitewide Groundwater Model by Cole et al. (2001a)

of effective R_f required estimates of contaminant-specific distribution coefficients, as well as estimates of effective bulk density and porosity of the aquifer materials. The remainder of this section briefly summarizes estimated transport properties.

For this analysis, a longitudinal dispersivity, D_L, of a little less than 100 m (95 m) (310 ft) was selected using this typical approach for estimating longitudinal dispersivity based on the scale of interest. Although transport results produced in this analysis span a range of scales, the key scale of interest is the minimum distance between some of the source areas in the Central Plateau and the location of the buffer zone boundary surrounding this area. For some sources in 200 East Area, the distance of interest is on the order of 1 to 2 kilometers away. Thus, a dispersivity value used in the original analysis was selected to be approximately equal to 10 percent of the minimum travel distance of interest of about 1 km (0.6 mi).

The longtitudinal dispersivity was also consistent to be within the range of recommended grid Peclet numbers (Pe < 4) for acceptable solutions. The 95-m (310-ft) estimate is about one-quarter of the grid spacing in the finest part of the model grid in the Central Plateau where the smallest grid spacing is about 375 m by 375 m (1230 ft x 1230 ft).

The corresponding transverse dispersivity used in the analysis was selected to be consistent with general available regulatory and technical guidance. EPA guidance (Mills et al. 1985) on the subject suggests a 1 to 3 ratio for D_T to D_L. Freeze and Cherry (1979) report that transverse dispersivities used are normally lower than the longitudinal dispersivity by a factor of 5 to 20 (that is, 0.2 to 0.05). Walton (1985) states that reported ratios of D_T to D_L vary from 1 to 24 but that common values are 0.2 and 0.1. Considering this information, a transverse dispersivity, $D_{T,}$ used in Composite Aanalysis simulations was assumed to be about 20 m (65.6 ft), which is approximately 20 percent of the selected longitudinal dispersivity.

The longitudinal dispersivity was also consistent and within the range of recommended grid Peclet numbers (Pe < 4) for acceptable solutions. The 95-m (310-ft) estimate is about one-quarter of the grid spacing in the finest part of the model grid in the Central Plateau where the smallest grid spacing is about 375 m by 375 m (1230 ft x 1230 ft).

In addition to the estimated distribution coefficient, calculation of contaminant-specific retardation factors used in the model requires estimates of the effective bulk density and porosity. For purposes of these calculations, a bulk density of 1.9 g/cm^3 was used for all simulations. The effective porosity was estimated from specific yields obtained from multiple well aquifer tests. These values range from 0.01 to 0.37. Laboratory measurements of porosity that range from 0.19 to 0.41 were available for samples from a few Hanford Site wells and were also considered. The few tracer tests conducted indicate effective porosities ranging from 0.1 to 0.25. Within the model, a porosity value of 0.1 was used for the Ringold Formation (Model Units 4 through 9) and a porosity value of 0.25 was used for the Hanford formation (Model Unit 1). For the expected lower water table conditions during the post-Hanford period, the Early Palouse and Plio-Pleistocene hydrogeologic units (Model Units 2 and 3) only existed above the projected water table and were not considered in the analysis. Values of distribution coefficient, bulk density, effective porosity, and dispersivity used in this analysis are discussed in more detail in Cole et al. (1997).

G.1.5.2 Simulation of Post-Closure Flow Conditions

Past projections of water table conditions after site closure have estimated the impact of Hanford operations ceasing and the resulting changes in artificial discharges that have been used extensively as a part of site waste management practices. Simulations of transient-flow conditions from 1944 through the year 3050 were conducted by Bryce et al. (2002). The three-dimensional model shows an overall decline in the hydraulic head and hydraulic gradient across the entire water table within the modeled region. Results of these simulations suggest that the water table would reach steady state between 100 to 350 years in different areas over the Hanford Site. These results were generally consistent with findings for the similar conditions in earlier modeling by Cole et al. (1997) and Kincaid et al. (1998).

Given the expected long delay of contaminants reaching the water from the LLBGs, the hydrologic framework of all groundwater transport calculations was based on postulated post-Hanford steady-state water table as estimated with the three-dimensional model. These conditions would only reflect estimated boundary condition fluxes (for example, natural recharge and lateral boundary fluxes) and not the effect of past and current wastewater discharges on the unconfined aquifer system.

Flow modeling results also suggest that as water levels drop in the vicinity of central areas in the model where the basalt crops out above the water table, the saturated thickness of the unconfined aquifer will decrease and the aquifer may actually dry out in certain areas. This thinning/drying of the aquifer is predicted to occur in the area just north of the 200 East Area between Gable Butte and the outcrop south of Gable Mountain, and there is the potential of this northern area of the unconfined aquifer becoming hydrologically separated from the area south of Gable Mountain and Gable Butte. Because of the uncertainty in the potential natural recharge and boundary fluxes from up-gradient areas, the potential for movement of contaminants either through the gap or to the east toward the Columbia River is also uncertain. To address this uncertainty, two predicted water tables for these post-Hanford steady-state conditions, as illustrated in Figures G.10 and G.11, were considered.

The first scenario, shown in Figure G.10, estimates flow conditions where basalt sub-crops estimated to be above the water table north of the Central Plateau are consistent with those used in the most recent assessments by Bryce et al. (2002). Under this scenario, the overall flow attributes of the water table surface lead to groundwater flow and transport through the gap between Gable Mountain and Gable Butte from most areas in the 200 East and 200 West Areas. This scenario was the flow condition used in all groundwater flow and transport calculations presented in the following sections.

In the second scenario, shown in Figure G.11, flow conditions are reflective of assumed basalt sub-crops just north of the 200 East Area that are more widespread and effectively cut off the flow and transport from both the 200 East and 200 West Areas to the north through the gap between Gable Mountain and Gable Butte. The overall flow attributes of this water table surface leads to a predominant easterly flow direction from nearly all areas within the 200 East and 200 West Areas. The effect of this scenario on calculated results, while not considered in all results presented in Section G.2, is briefly discussed in the following section and in a discussion of results for Alternative Group A in Section G.2.1.

G.1.5.3 Simulation of Unit Releases

To allow groundwater transport calculations to be used in the convolution approach for linear superposition (See Section G.1.2), a unit release was simulated with the three-dimensional model and the estimated post-Hanford steady-state water table condition. These simulation results are used to relate the effect of known release (1 curie over a 10-year period) to predicted concentrations at various points in the aquifer system. Example results of simulated groundwater concentrations in response to a unit release of a long-lived, mobile (non-sorbing) contaminant over a period of 10 years from MLLW disposal sites in the 200 West and 200 East Areas are illustrated in Figures G.15 and G.16, respectively. These simulations were made using the groundwater conceptual model with a predominant northerly flow pattern out of the Central Plateau.

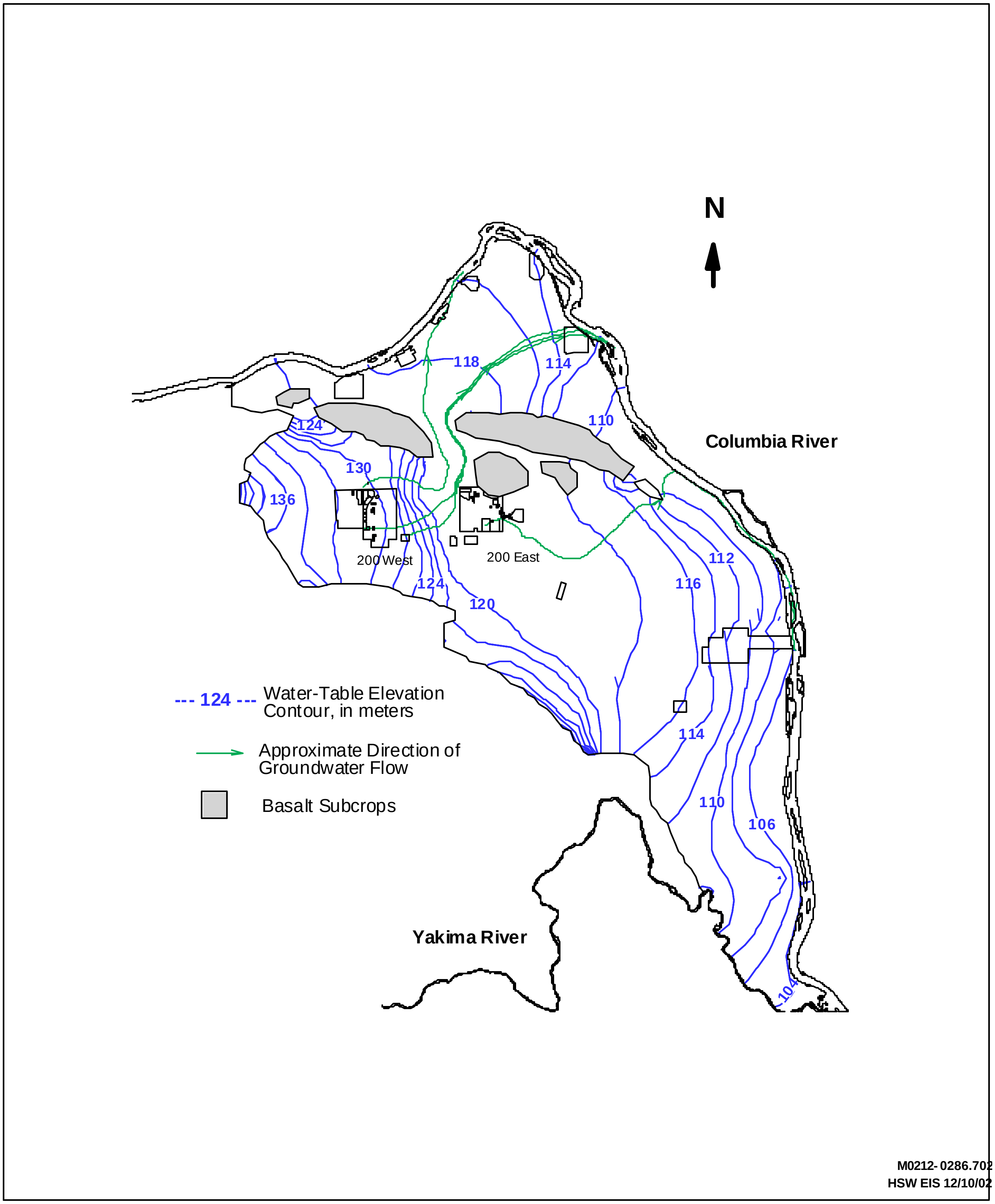

Figure G.10. Predicted Post-Hanford Water Table Conditions (Predominant Northerly Flow)

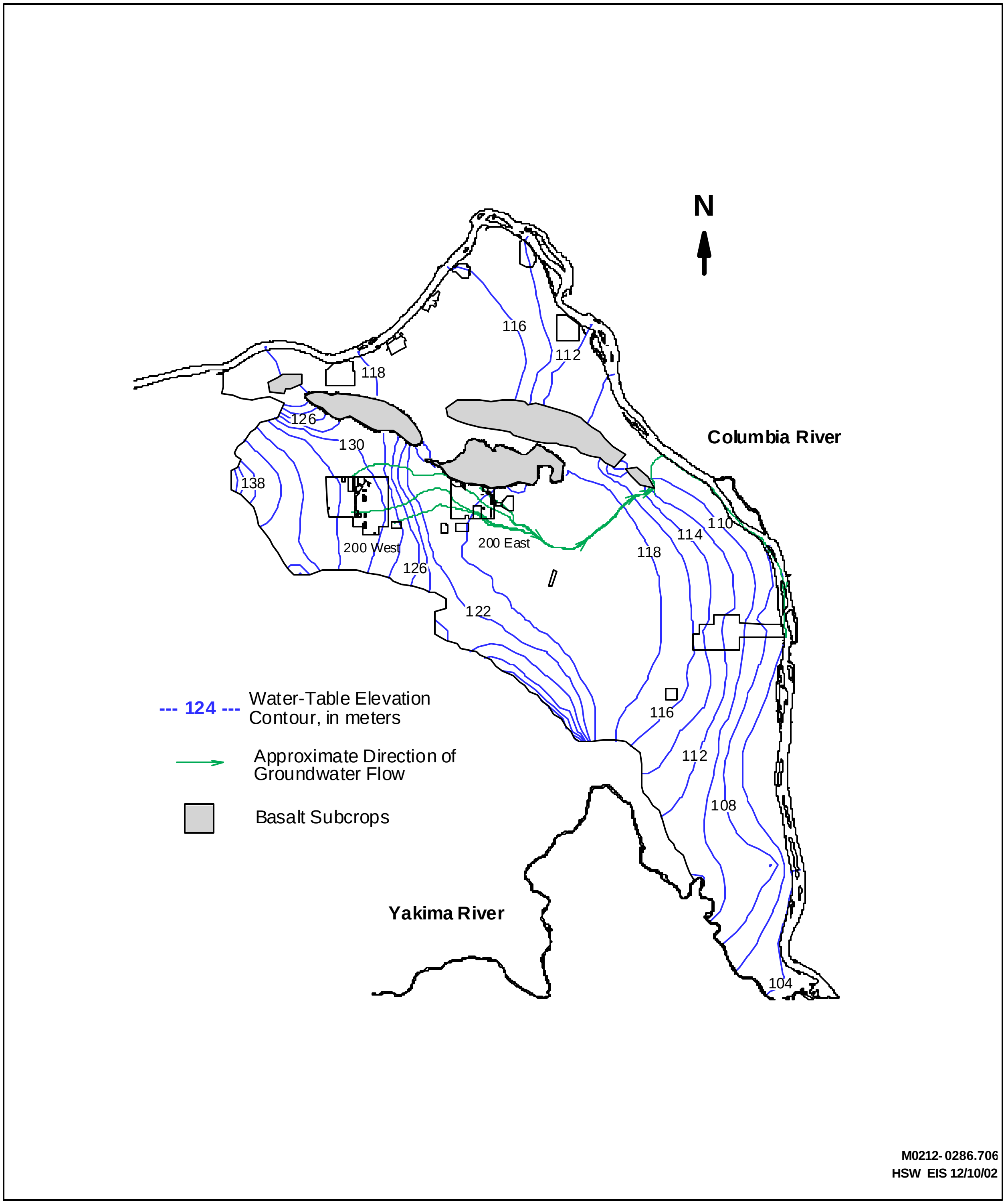

Figure G.11. Predicted Post-Hanford Water Table Conditions (Predominant Easterly Flow)

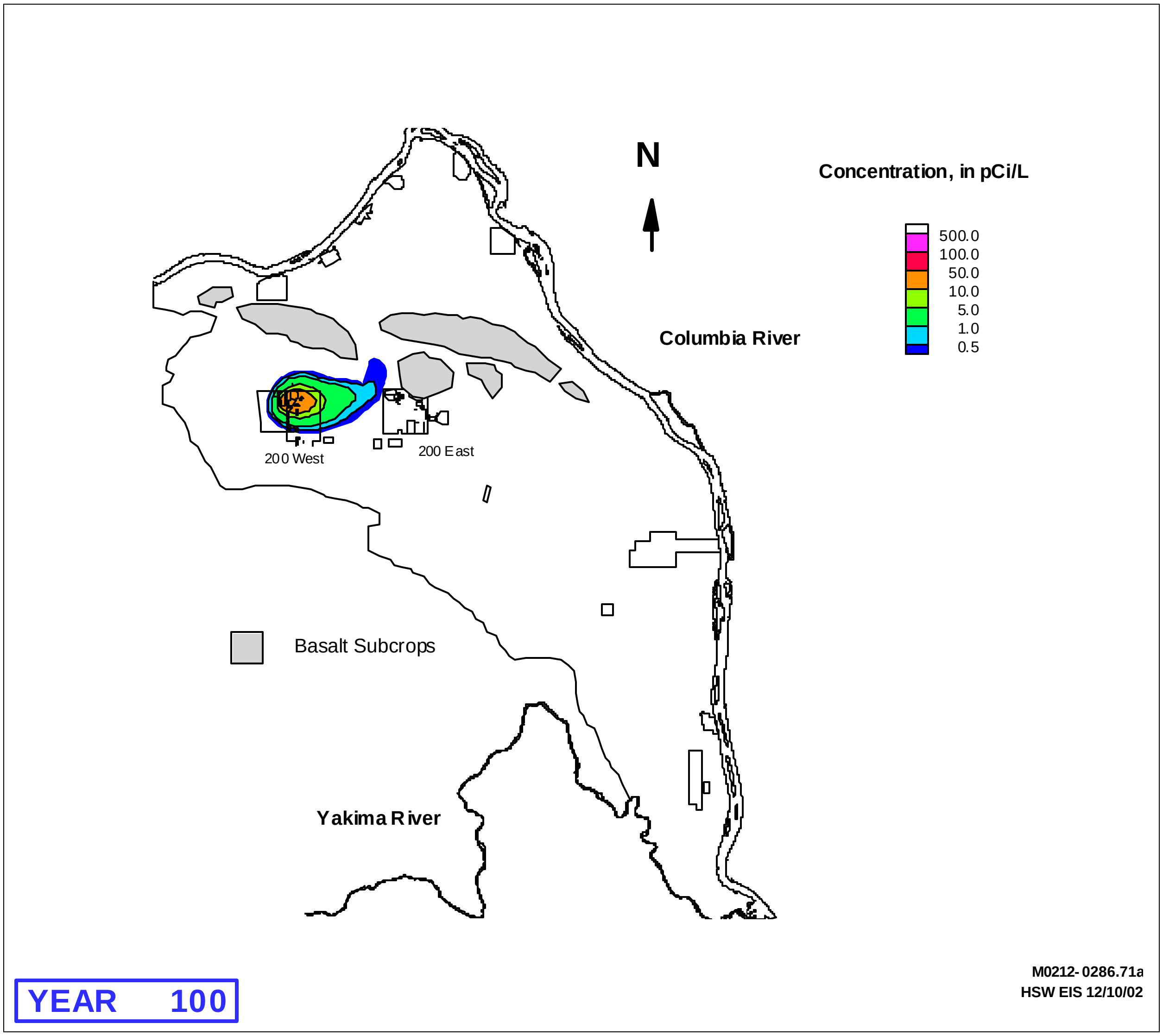

Figure G.12a. Simulated Transport of a 10-Year Unit Release (1 Curie) of a Contaminant Representative of Mobility Class 1[(a)] from MLLW in the 200 West Area at 100 Years After Release Using a Groundwater Model with a Predominant Northerly Flow from the Central Plateau

(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.

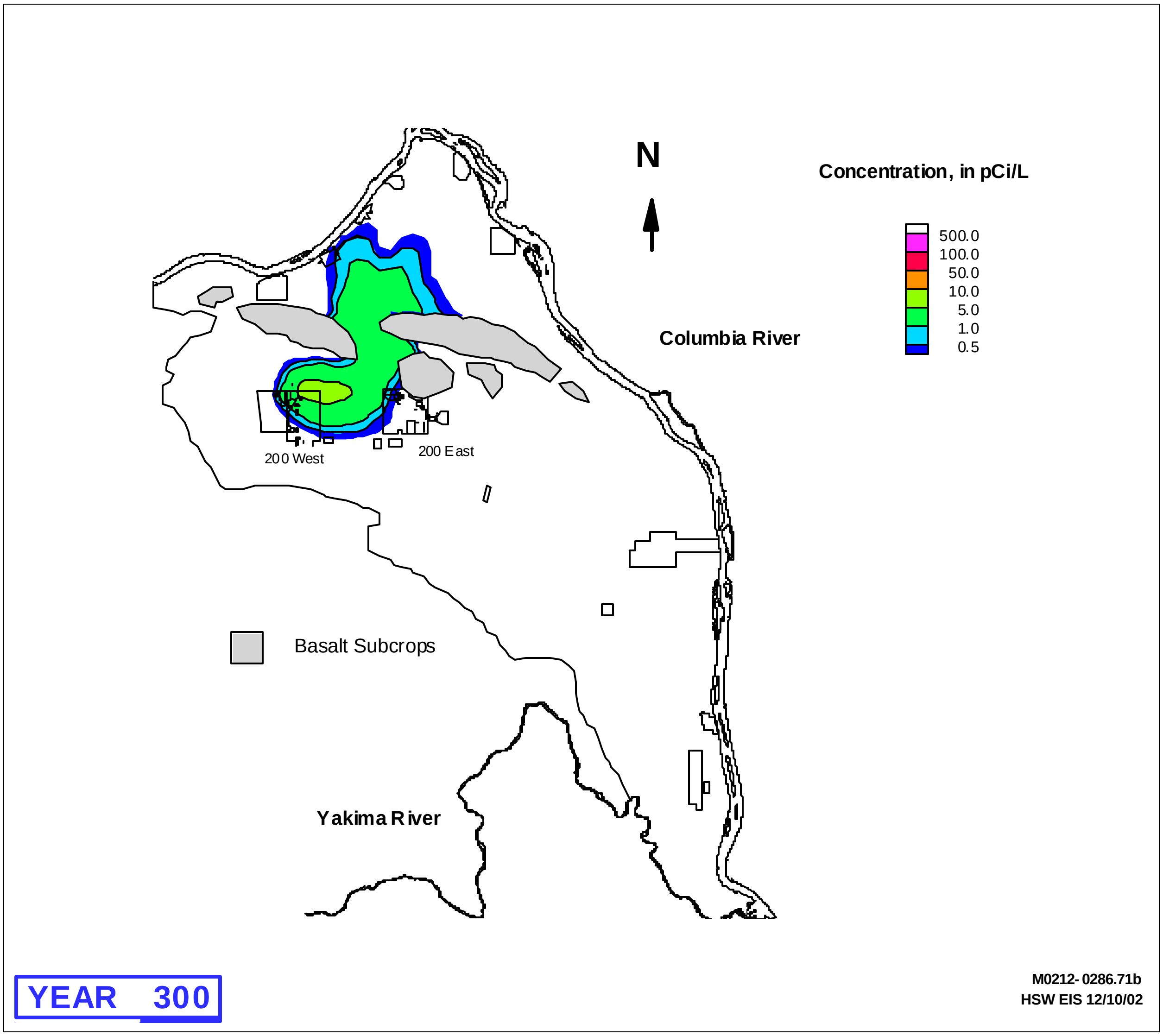

Figure G.12b. Simulated Transport of a 10-Year Unit Release (1 Curie) of a Contaminant Representative of Mobility Class 1[a] from MLLW in the 200 West Area at 300 Years After Release Using a Groundwater Model with a Predominant Northerly Flow from the Central Plateau

(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system.of an unretarded long-lived contaminant. These results provide the basis for the groundwater transport comp onent of the convolution approach described in Section G.1.2.

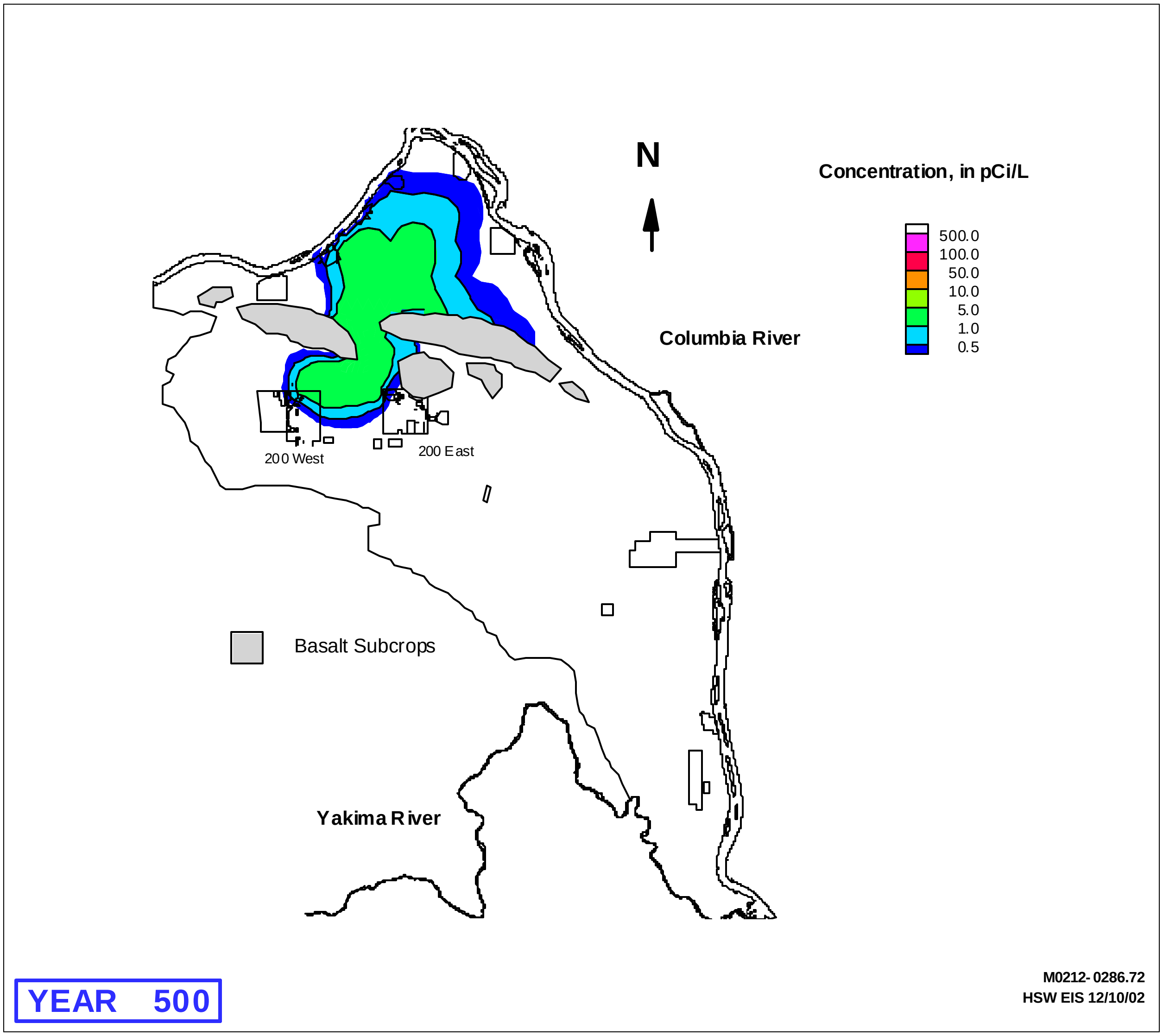

Figure G.12c. Simulated Transport of a 10-Year Unit Release (1 Curie) of a Contaminant Representative of Mobility Class 1[(a)] from MLLW in the 200 West Area at 500 Years After Release Using a Groundwater Model with a Predominant Northerly Flow from the Central Plateau

(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.

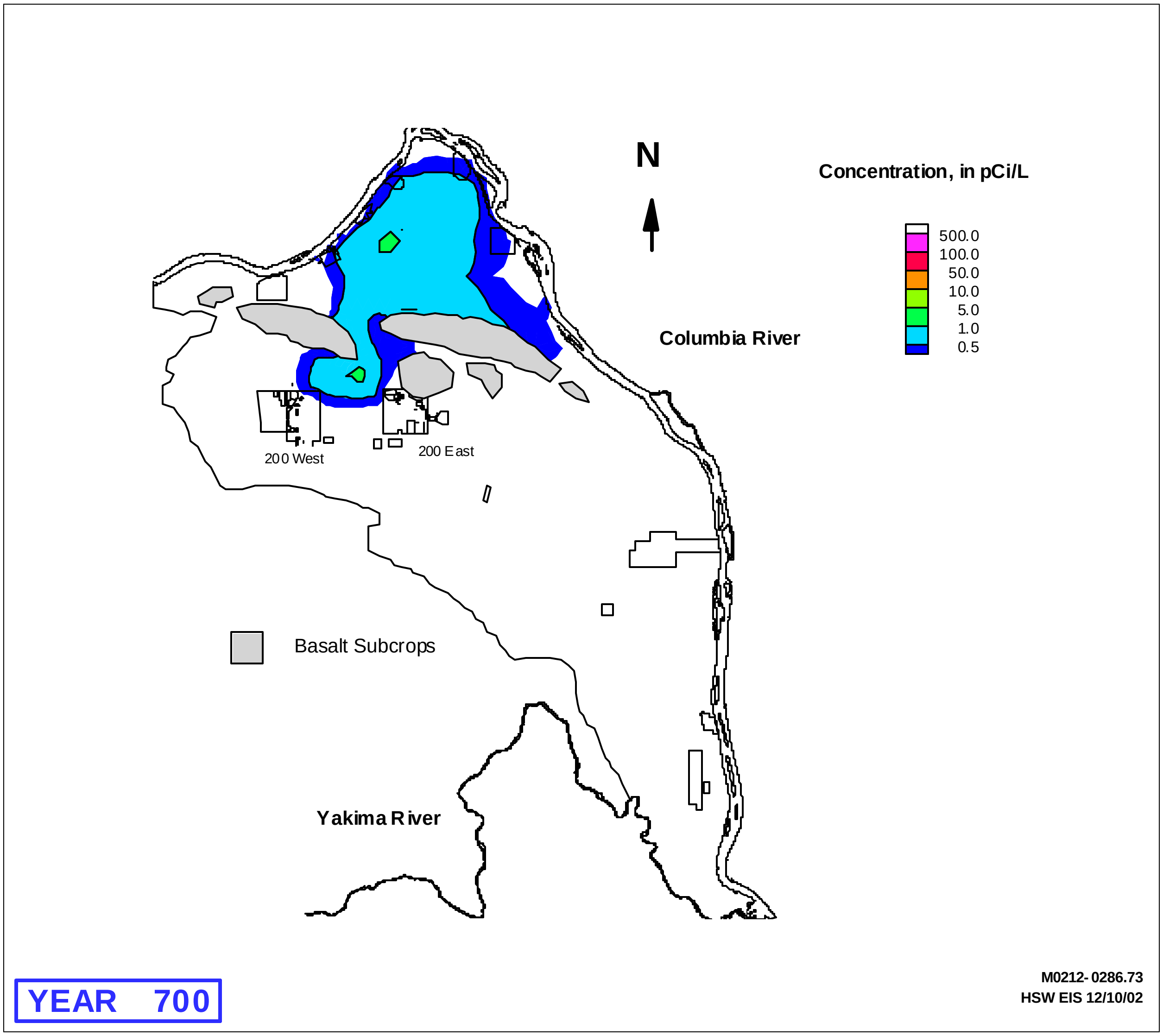

Figure G.12d. Simulated Transport of a 10-Year Unit Release (1 Curie) of a Contaminant Representative of Mobility Class 1[a] from MLLW in the 200 West Area at 700 Years After Release Using a Groundwater Model with a Predominant Northerly Flow from the Central Plateau

(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.

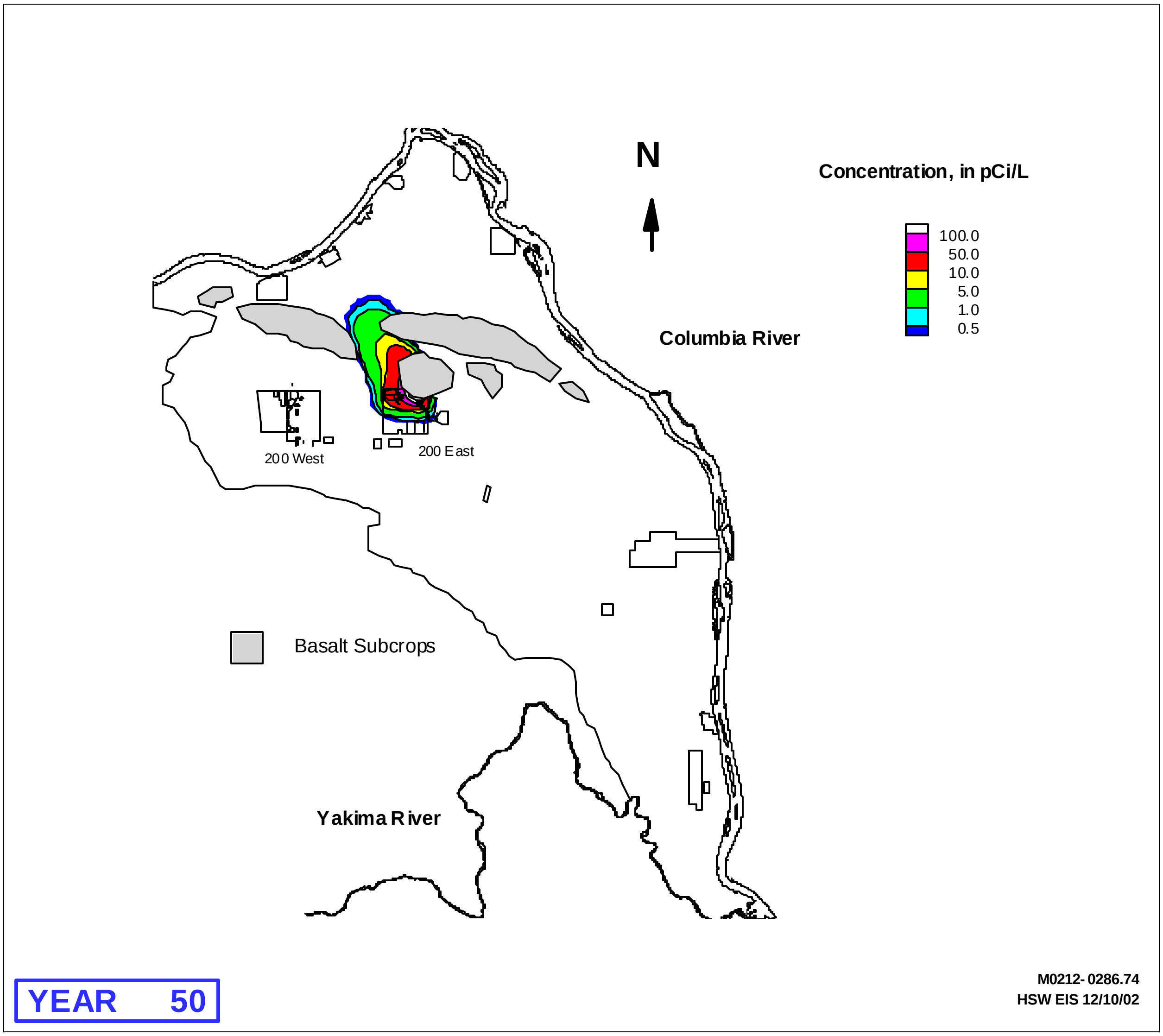

Figure G.13a. Simulated Transport of a 10-Year Unit Release (1 Curie) of a Contaminant Representative of Mobility Class 1[a] from MLLW in the 200 East Area at 50 Years After Release Using a Groundwater Model with a Predominant Northerly Flow from the Central Plateau

(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.

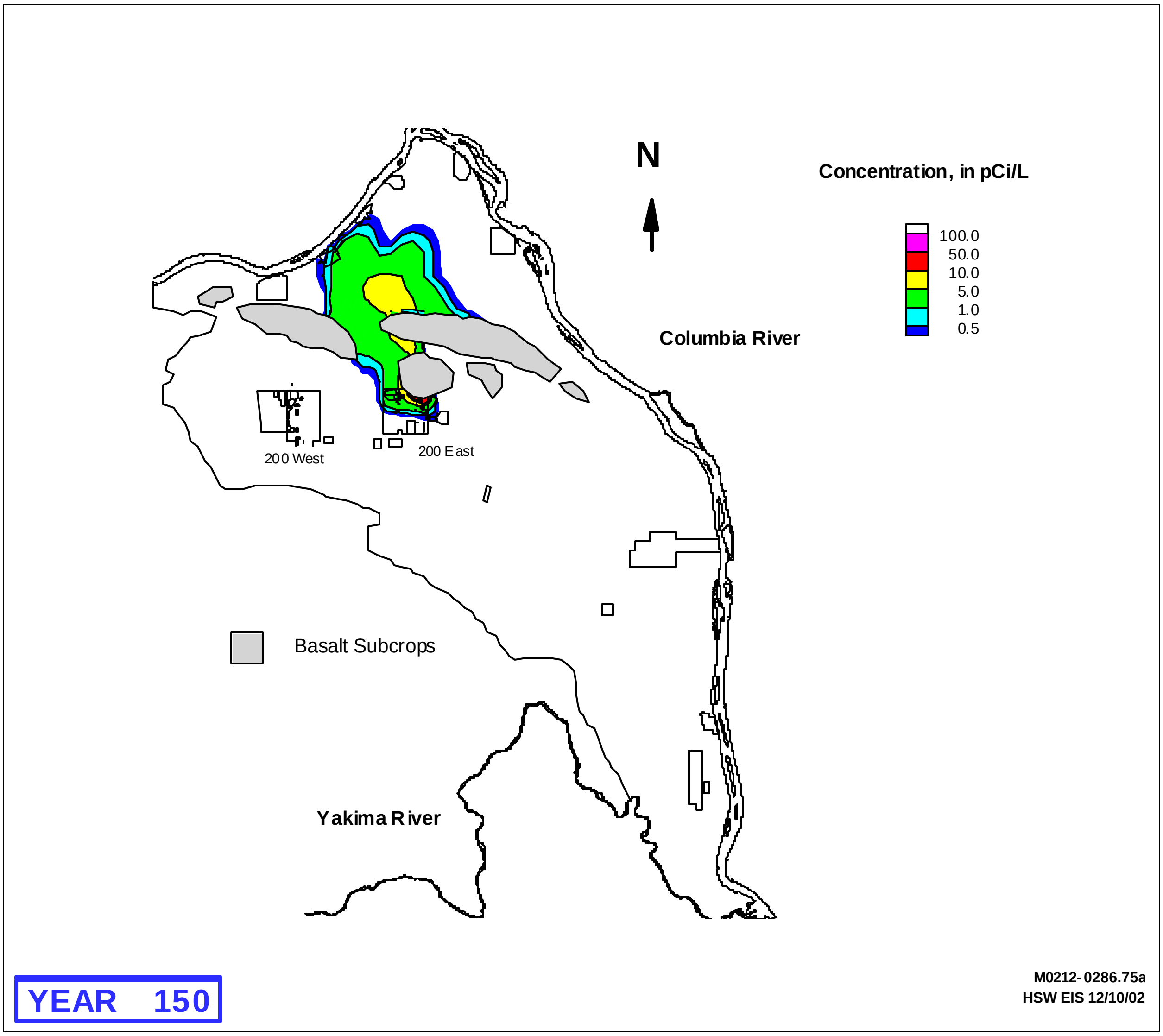

Figure G.13b. Simulated Transport of a 10-Year Unit Release (1 Curie) of a Contaminant Representative of Mobility Class 1[a] from MLLW in the 200 East Area at 150 Years After Release Using a Groundwater Model with a Predominant Northerly Flow from the Central Plateau

(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.

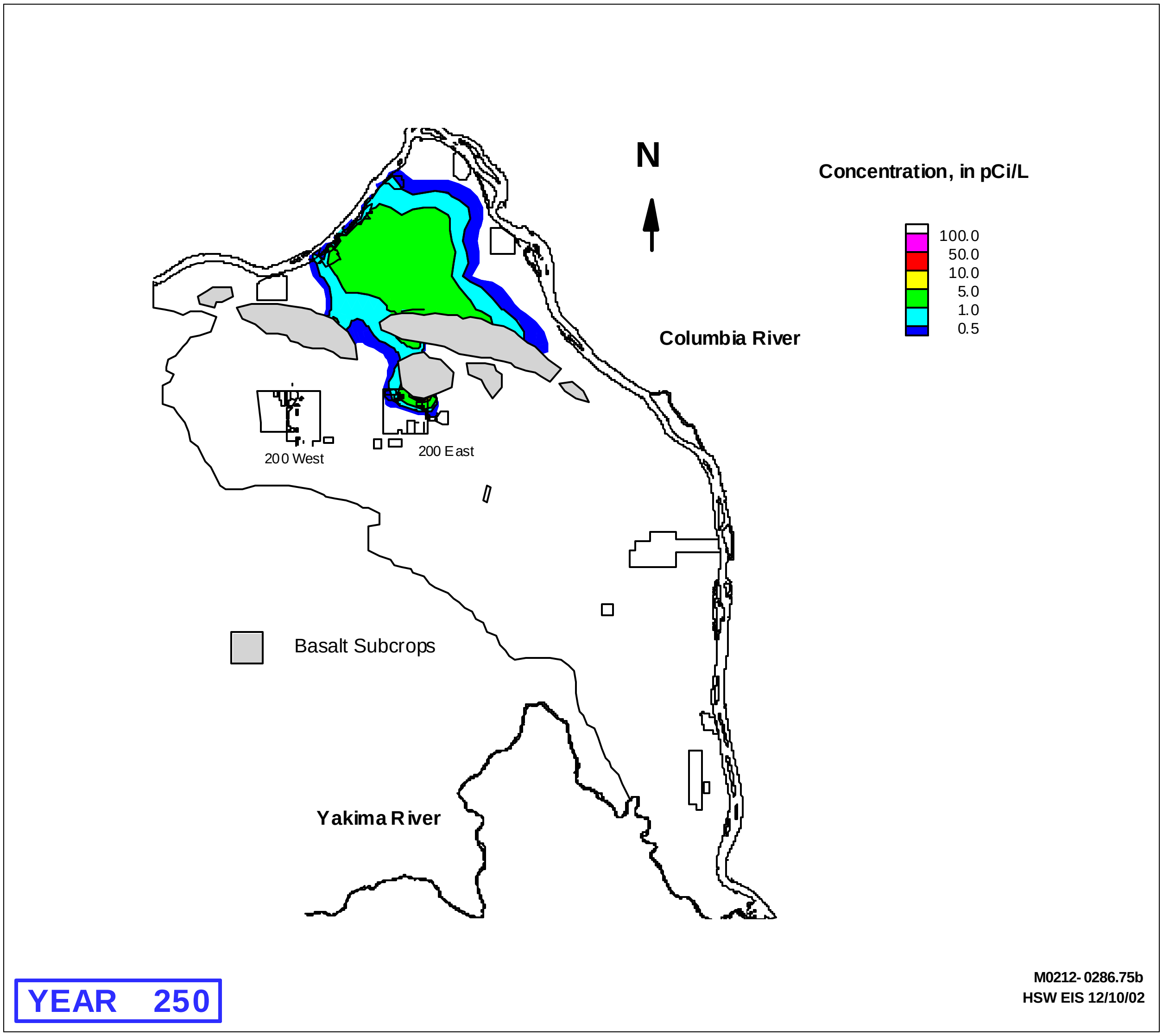

Figure G.13c. Simulated Transport of a 10-Year Unit Release (1 Curie) of of a Contaminant Representative of Group 1[(a)] from MLLW in the 200 East Area at 250 Years After Release Using a Groundwater Model with a Predominant Northerly Flow from the Central Plateau

(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.

The same calculations were also made using the alternative groundwater conceptual model with easterly flow from the 200 East Area. Results of this model at the same MLLW disposal locations in the 200 West and East Areas are illustrated in Figures G.14 and G.15, respectively.

Results of these unit releases were evaluated to identify the maximum concentrations over time for use in the convolution approach along the LOAs down-gradient of the 200 East and West Areas and ERDF HSW disposal areas (See Figure G.6) as appropriate for each alternative group. Because the location of different waste categories within each of the aggregate HSW disposal areas varies as specified for each alternative group, the locations of maximum concentration along the LOAs may not necessarily correspond to the same location for each waste category specified within and across alternative groups. This is particularly true for breakthrough curves developed for LOAs along the Columbia River where the location of maximum concentration varies in time as the simulated plumes migrate north to the Columbia River. The specific calculations presented here were used to evaluate groundwater transport of contaminants in Group 1 (technetium-99 and iodine-129). Similar calculations were made to evaluate groundwater transport of the same Group 1 contaminants and for contaminants in Group 2 (carbon-14 and uranium isotopes) for other waste category locations in the overall convolution approach.

A comparison of unit release breakthrough curves for Group 1 constituents at the 200 East and West Area, ERDF, and Columbia River LOAs for the two alternative groundwater conceptual models are presented in a series of plots in Figures 16 and 17 for all waste categories to illustrate differences in results for the two groundwater conceptual models. Under the first alternative model, impacts from LLW disposed of in the 200 East Area LLBGs are evaluated at the 200 East Area NW LOA. Impacts from LLW disposed of near the PUREX Plant are evaluated at the 200 East Area SE LOA. Under the second alternative, where groundwater flow is toward the east from the 200 Areas, impacts from LLW disposed of in the 200 East Area LLBGs or near the PUREX Plant are evaluated at the 200 East Area SE LOA.

Results of these calculations show very little change in breakthrough curves calculated from 200 West Area and ERDF sources in both models. Peak concentrations of long-lived mobile contaminants (like technetium-99 or iodine-129) released in the 200 West Area and the ERDF would reach the 1-km (0.6-mi) LOAs between 80 and 200 years. Times of peak concentration at the Columbia River in areas north through the gap between Gable Mountain and Gable Butte using the first groundwater conceptual model between 400 and 500 years for sources in the 200 West Area and about 300 years from sources at the ERDF. Concentration levels of the river are slightly lower for the second alternative model. This is consistent with the general plume migration behavior in the second alternative model since a secondary part of plume splits off of the main lobe originating from the 200 West Area and migrates to the east across the 200 East Area, where it eventually discharges into the Columbia River near the Hanford town site.

Peak concentrations of mobile contaminants introduced at the water table beneath HSW disposal sites in the 200 East Area would reach the 1-km (0.6-mi) LOAs within 30 to 50 years and migrate only about 150 to 250 years before reaching the Columbia River north through the gap in the first groundwater model. In the second alternative model, arrival at the 1 km (0.6 mi) LOA is very rapid—within 10 years—and reaches the Columbia River near the Hanford town site within 100 years.

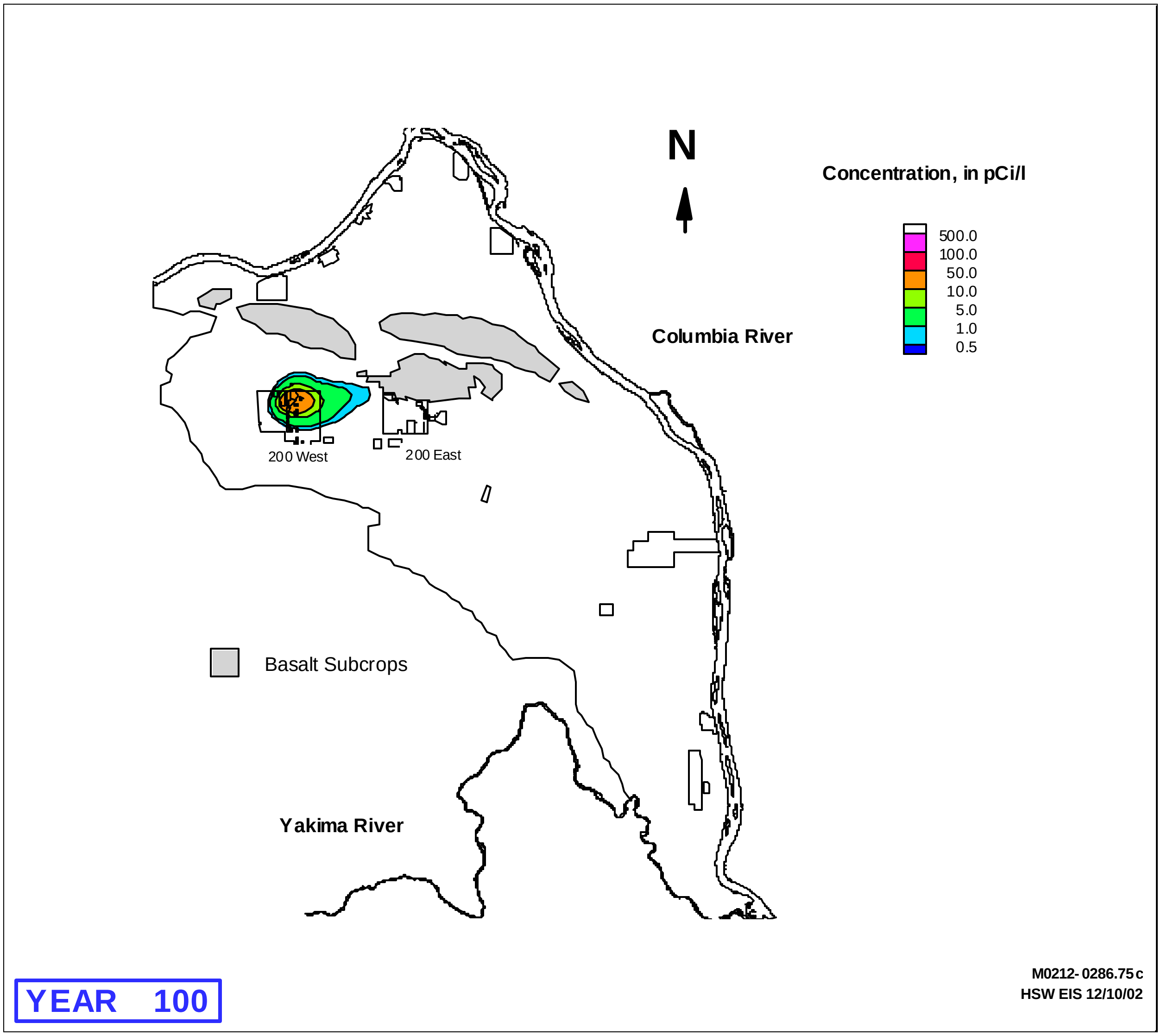

Figure G.14a. Simulated Transport of a 10-Year Unit Release (1 Curie) of a Contaminant Representative of Mobility Class 1[(a)] from MLLW in the 200 West Area at 100 Years After Release Using a Groundwater Model with a Predominant Easterly Flow from the Central Plateau

(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.

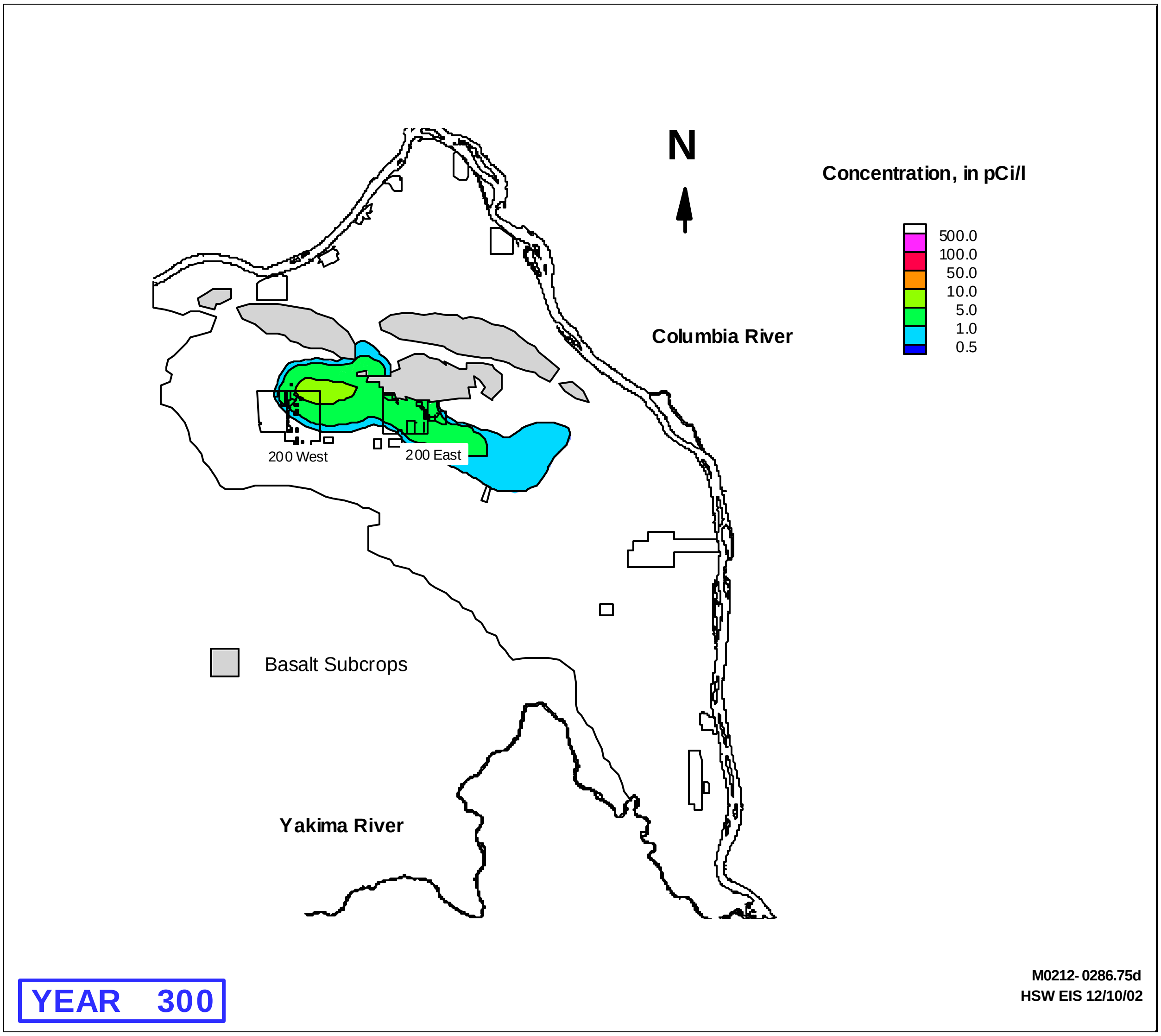

Figure G.14b. Simulated Transport of a 10-Year Unit Release (1 Curie) of a Contaminant Representative of Mobility Class 1[(a)] from MLLW in the 200 West Area at 300 Years After Release Using a Groundwater Model with a Predominant Easterly Flow from the Central Plateau

(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.

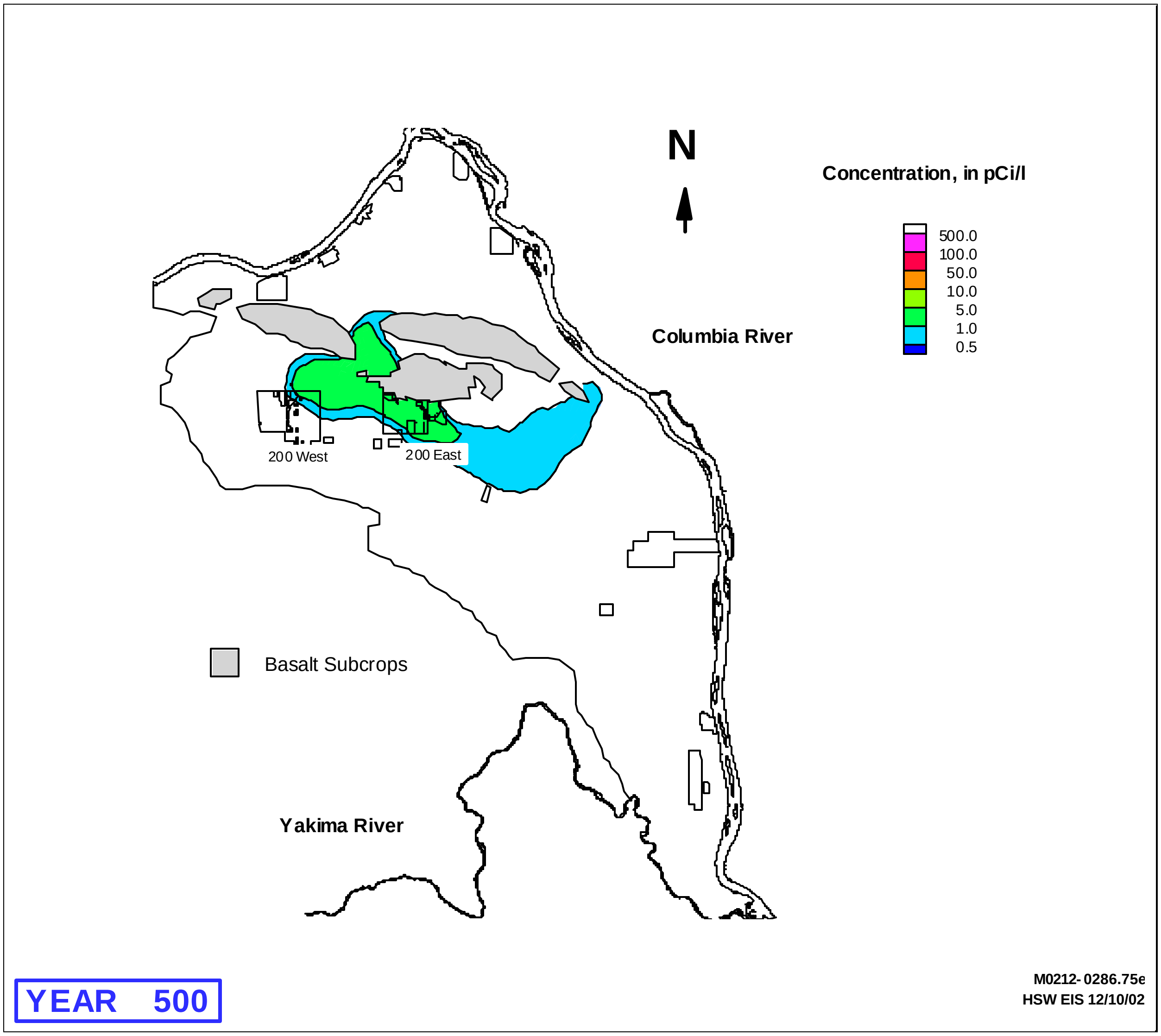

Figure G.14c. Simulated Transport of a 10-Year Unit Release (1 Curie) of a Contaminant Representative of Mobility Class 1[(a)] from MLLW in the 200 West Area at 500 Years After Release Using a Groundwater Model with a Predominant Easterly Flow from the Central Plateau

(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.

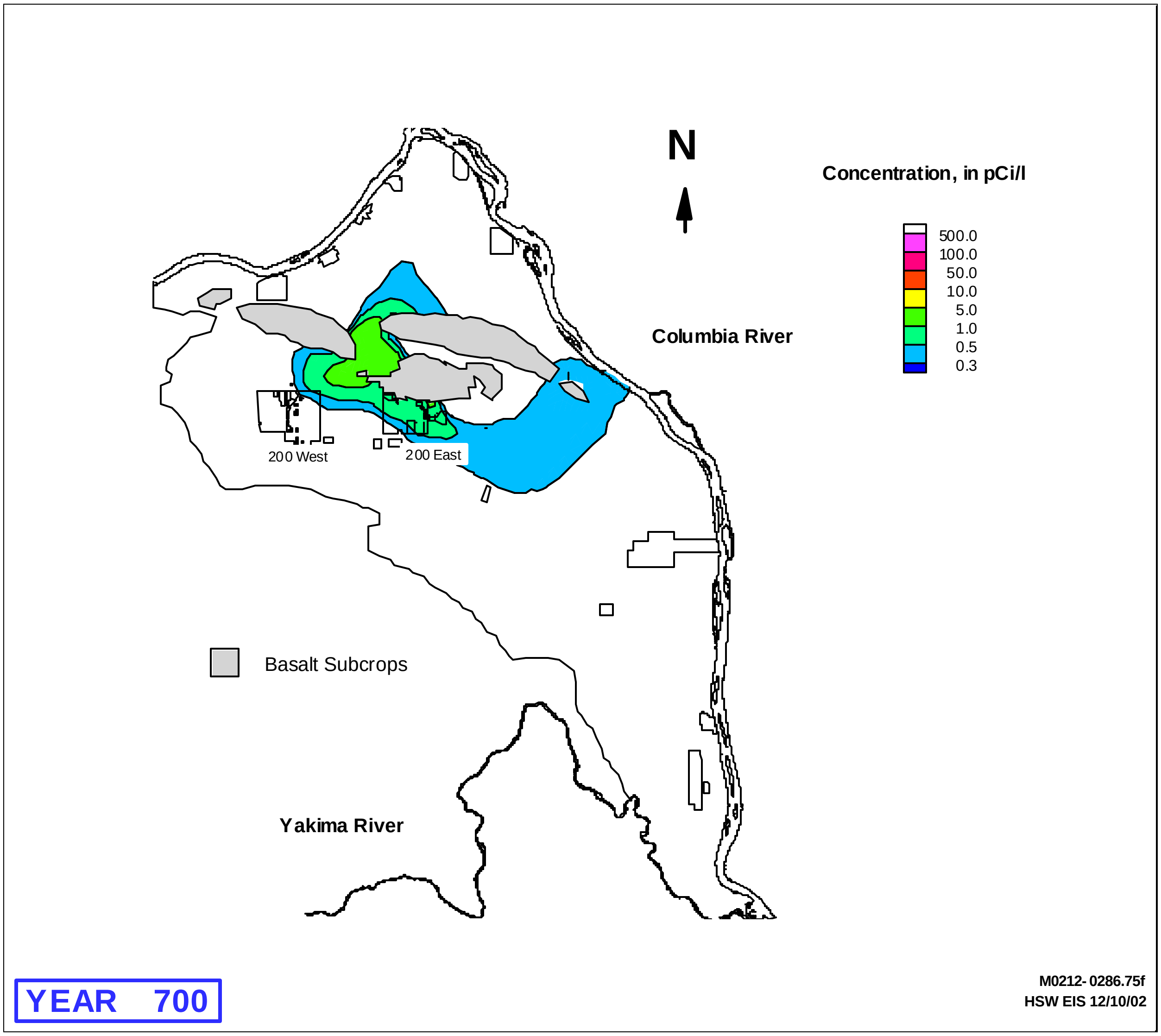

Figure G.14d. Simulated Transport of a 10-Year Unit Release (1 Curie) of a Contaminant Representative of Mobility Class 1[(a)] from MLLW in the 200 West Area at 700 Years After Release Using a Groundwater Model with a Predominant Easterly Flow from the Central Plateau

(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.

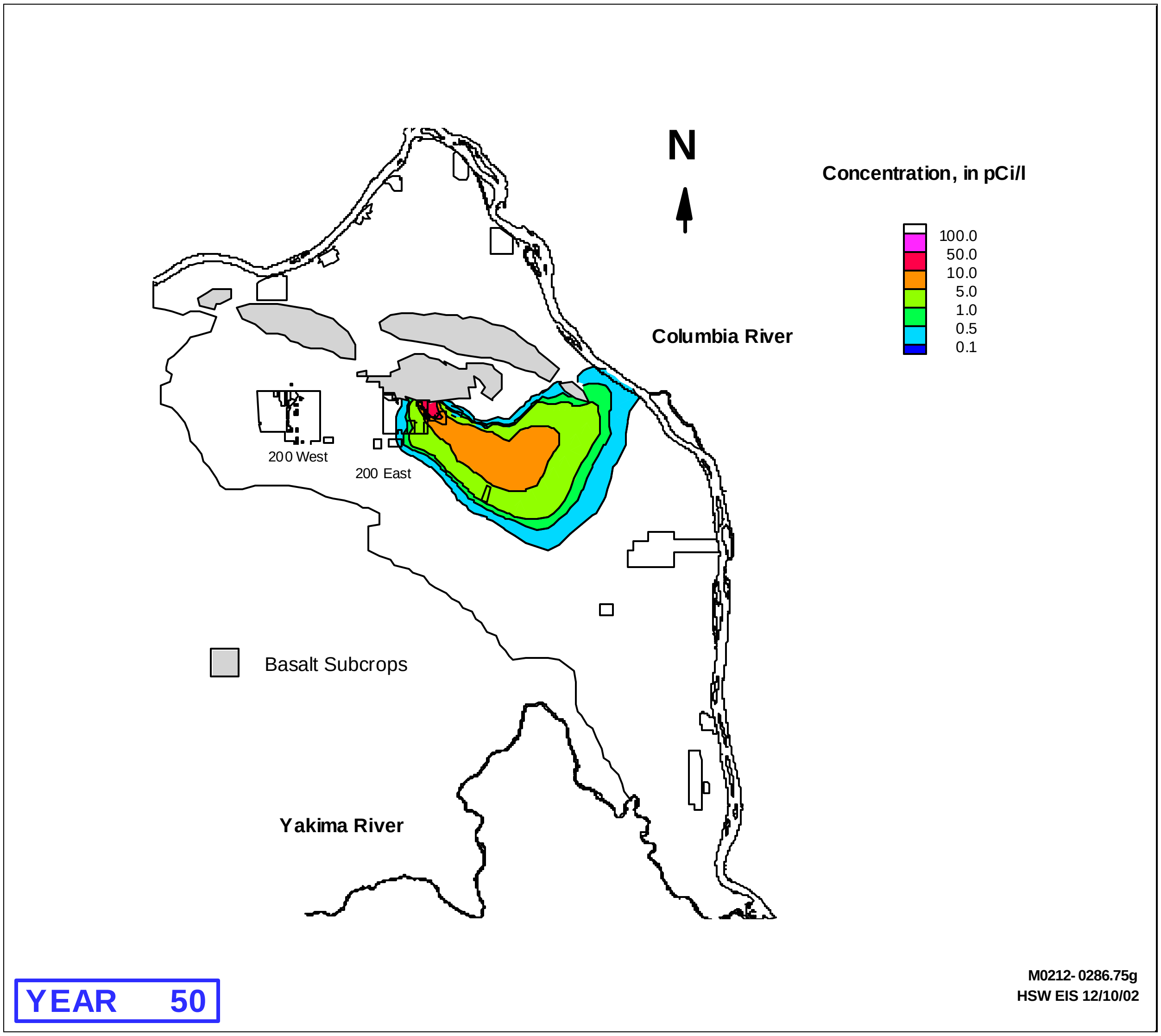

Figure G.15a. Simulated Transport of a 10-Year Unit Release (1 Curie) of of a Contaminant Representative of Mobility Class 1[(a)] from MLLW in the 200 East Area at 50 Years After Release Using a Groundwater Model with a Predominant Easterly Flow from the Central Plateau

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(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.

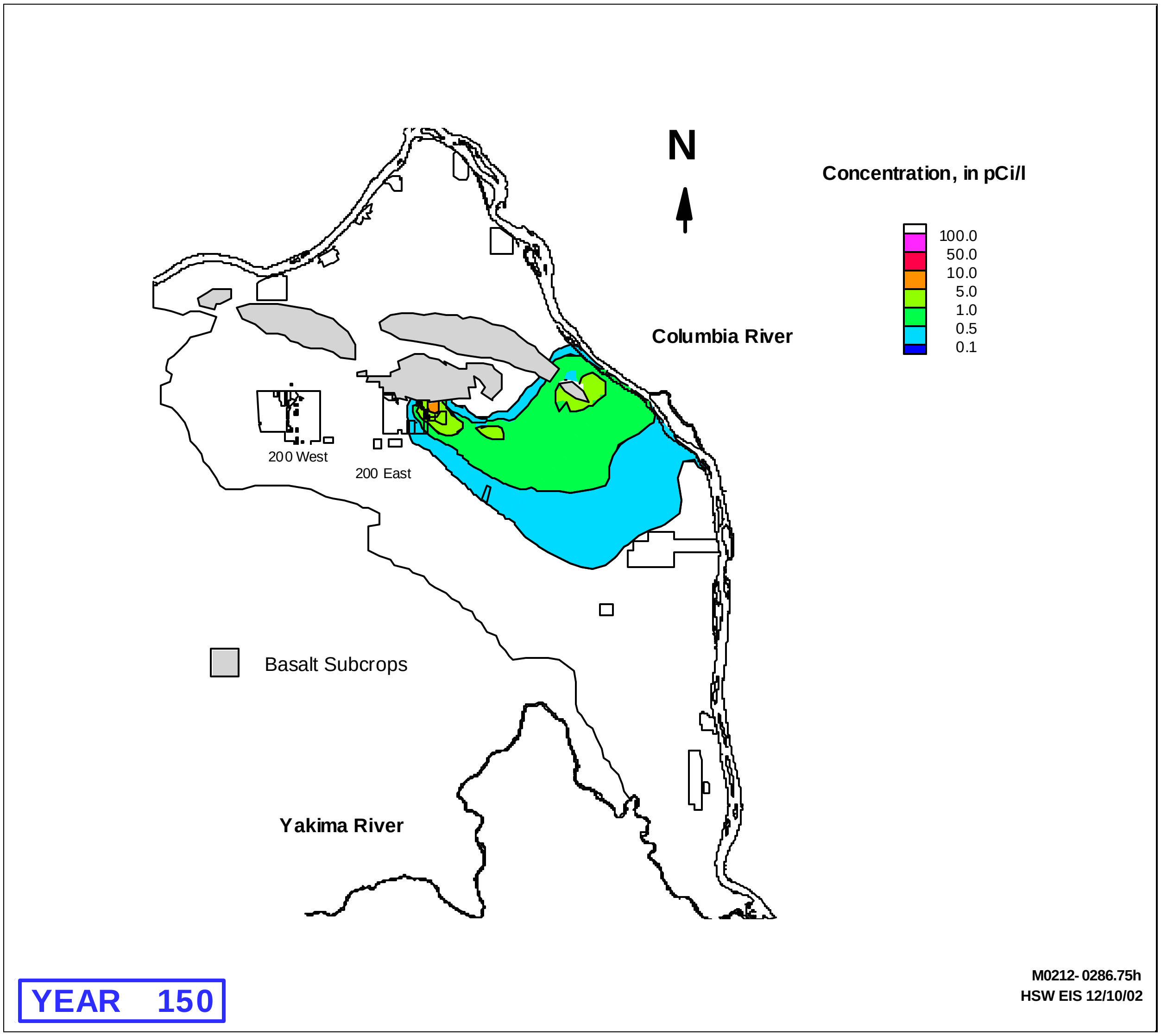

Figure G.15b. Simulated Transport of a 10-Year Unit Release (1 Curie) of of a Contaminant Representative of Mobility Class 1[a] from MLLW in the 200 East Area at 150 Years After Release Using a Groundwater Model with a Predominant Easterly Flow from the Central Plateau

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(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.

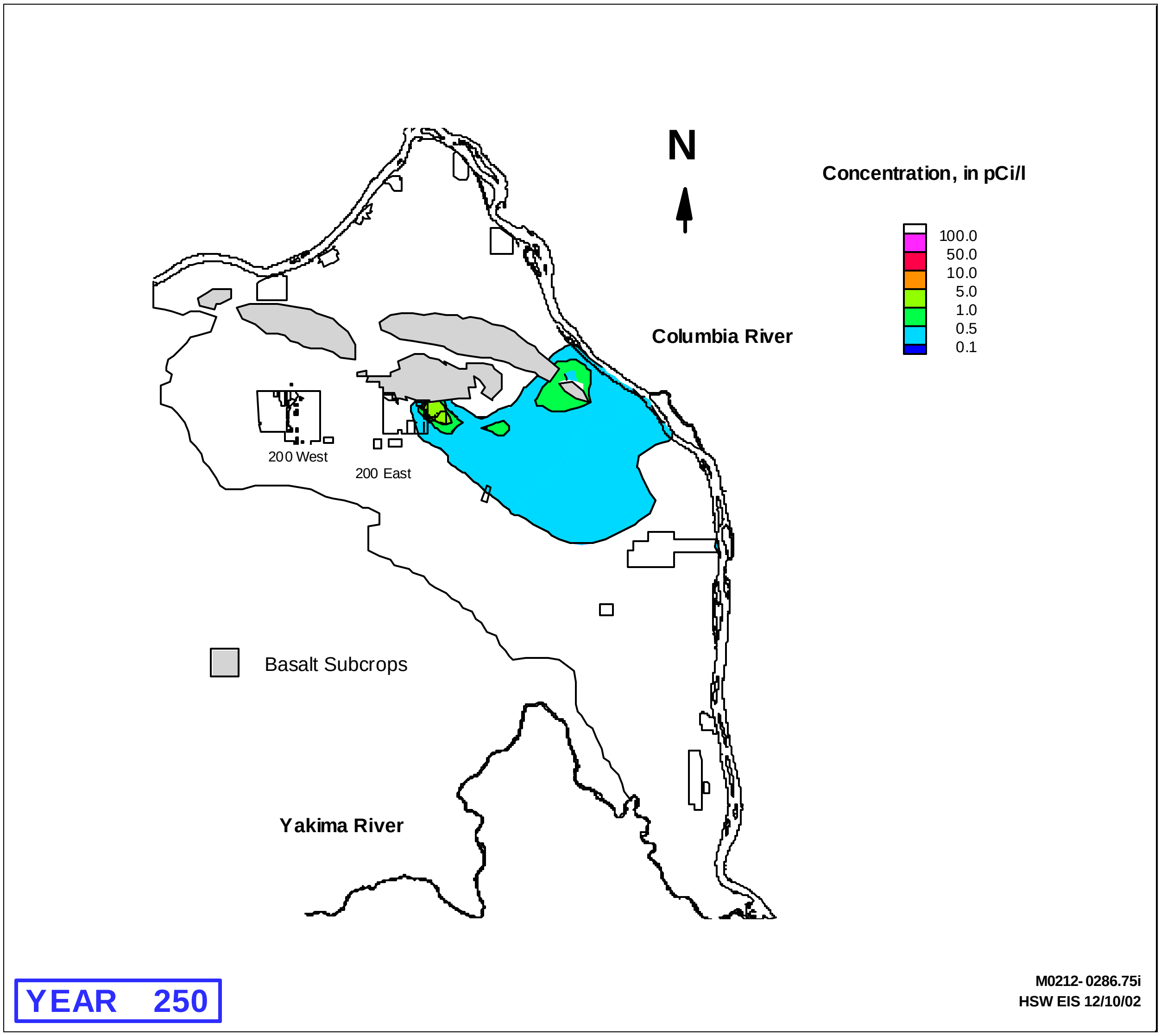

Figure G.15c. Simulated Transport of a 10-Year Unit Release (1 Curie) of of a Contaminant Representative of Mobility Class 1[(a)] from MLLW in the 200 East Area at 250 Years After Release Using a Groundwater Model with a Predominant Easterly Flow from the Central Plateau

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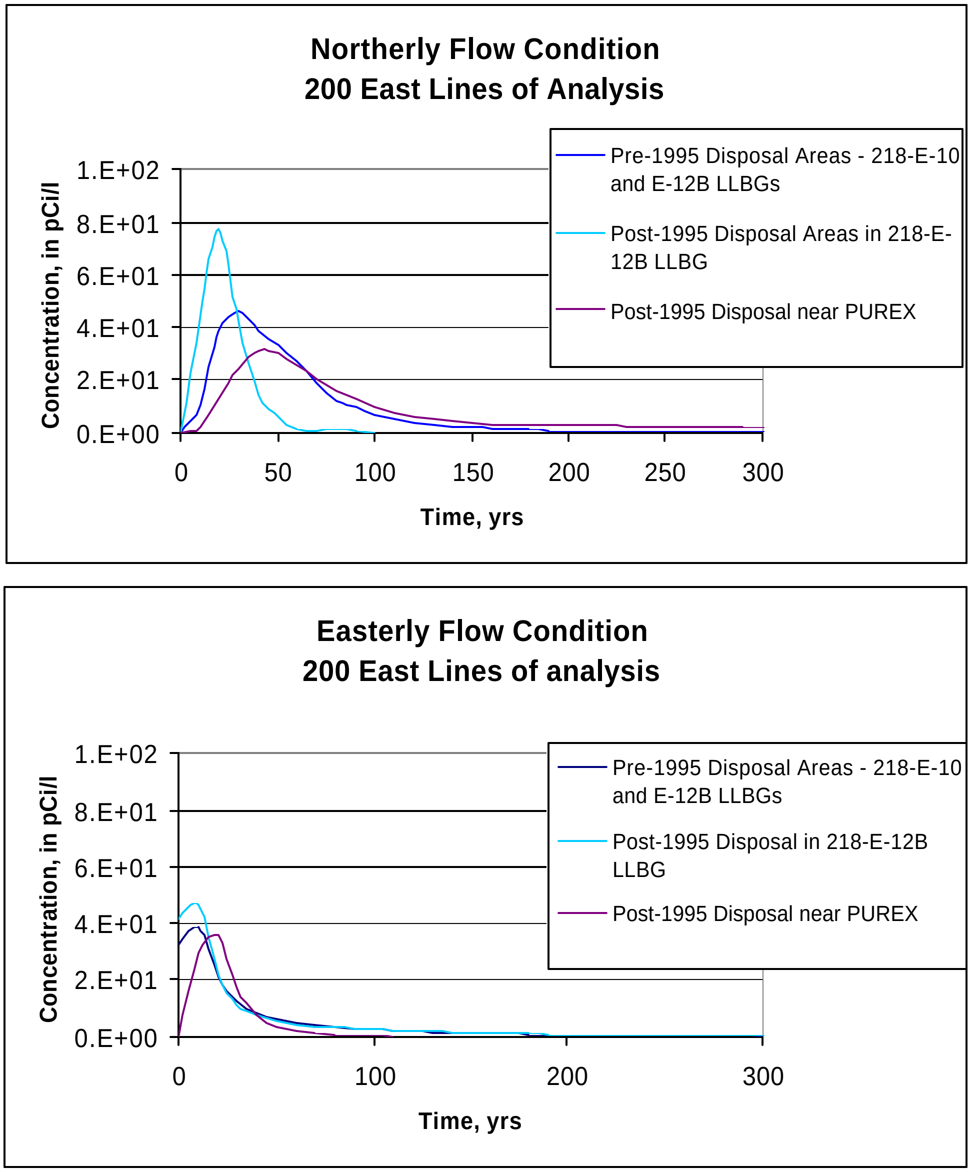
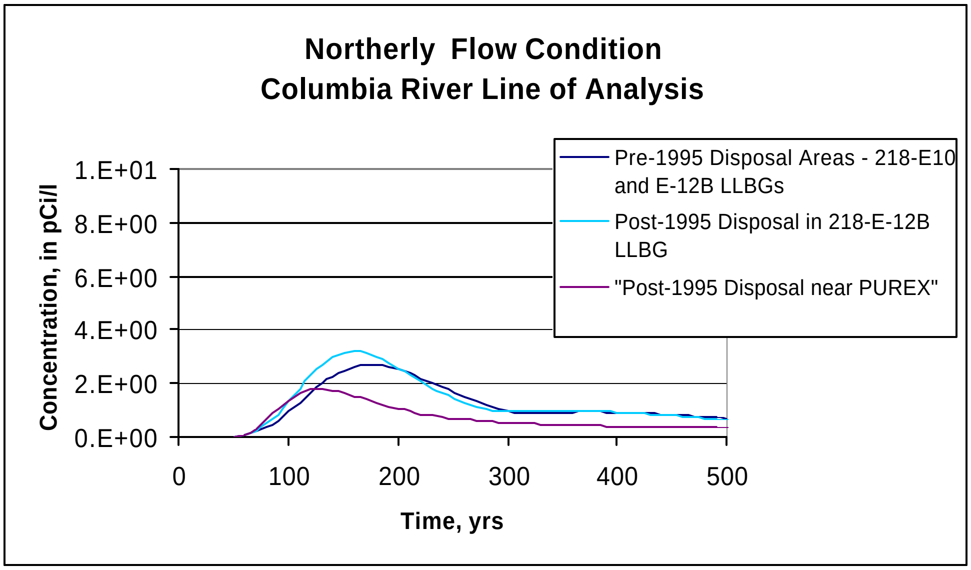
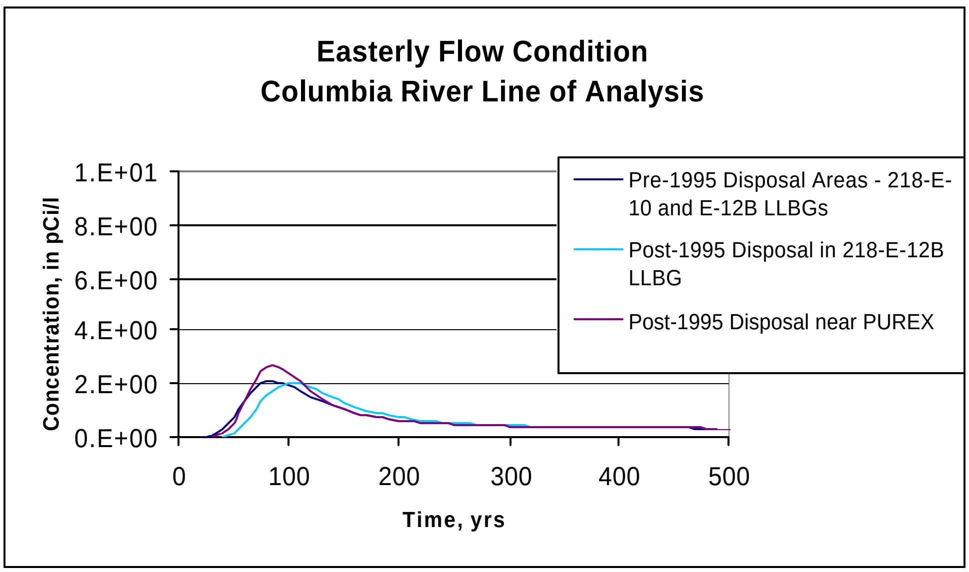
(a) These simulation results relate the effect of a known release (1 curie over a period of 10 years) of a hypothetical, long-lived contaminant in Mobility Class 1 to predicted concentrations at various points in the aquifer system. These results provide the basis for the groundwater transport component of the convolution approach described in Section G.1.2.



M0212- 0286.76a
HSW EIS 12/10/02

Figure G.16a. Comparison of Predicted Concentrations from Unit Releases from the 200 East Area at 200 East LOAs Using Groundwater Models with a Predominant Northerly and Easterly Flow from the Central Plateau





M0212- 0286.76b
HSW EIS 12/10/02

Figure G.16b. Comparison of Predicted Concentrations from Unit Releases from the 200 East Area at Columbia River LOAs Using Groundwater Models with a Predominant Northerly and Easterly Flow from the Central Plateau

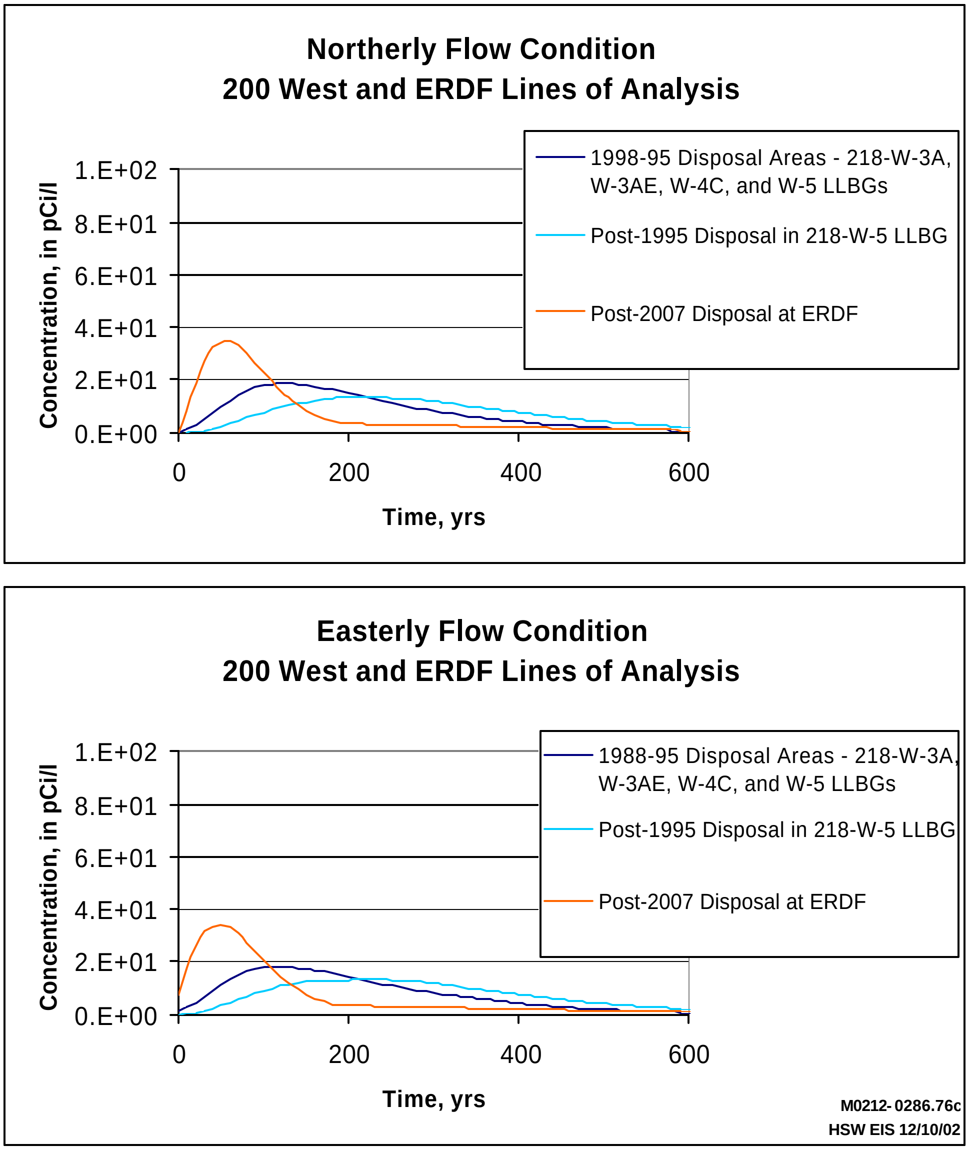


Figure G.17a. Comparison of Predicted Concentrations from Unit Releases from the 200 West Area at the 200 West and ERDF LOAs Using Groundwater Models with a Predominant Northerly and Easterly Flow from the Central Plateau

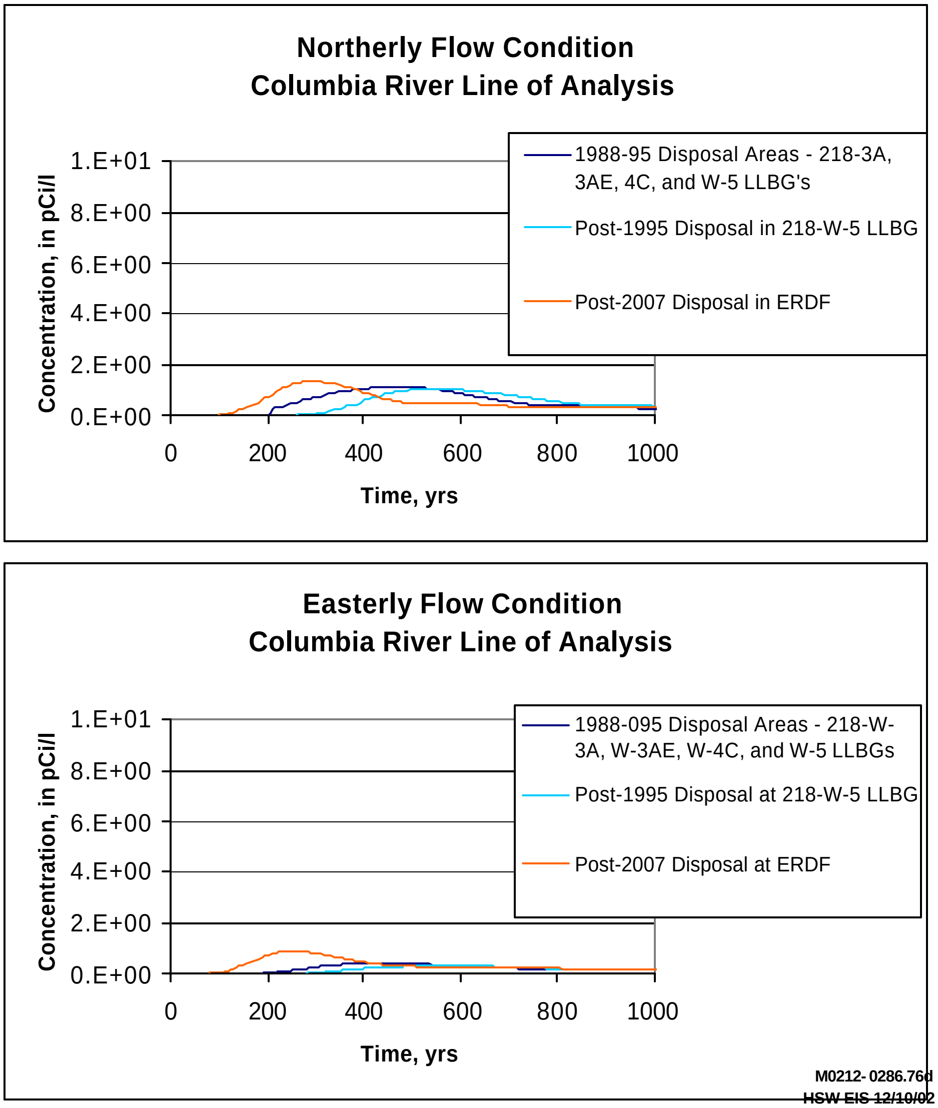


Figure G.17b. Comparison of Predicted Concentrations from Unit Releases from the 200 West Area at the Columbia River LOA Using Groundwater Models with a Predominant Northerly and Easterly Flow from the Central Plateau

Results of these unit releases were evaluated to identify the maximum concentrations over time for use in the convolution approach along the LOAs down-gradient of the 200 East and West Areas and the ERDF HSW disposal areas (See Figure G.1) as appropriate for each alternative group. Because the location of different waste categories within each of the aggregate HSW disposal areas varies as specified for each alternative group, the locations of maximum concentration along the LOAs may not necessarily correspond to the same location for each waste category specified within and across alternative groups. This is particularly true for breakthrough curves developed for LOAs along the Columbia River where the location of maximum concentration varies in time as the simulated plumes migrate north to the Columbia River.

G.2 Water Quality Impact Results

Potential impacts on groundwater are provided in the following sections as peak concentrations of contaminants in well water and the time of occurrence. The alternatives, waste types, and disposal conditions are briefly stated to establish the framework for comparing the results.

G.2.1 Alternative Group A

LLW considered in Alternative Group A includes wastes to be disposed of in several categories:

- Pre-1970 LLW
- 1970-1987 LLW
- 1988-1995 LLW
- 1996-2007 Cat 1 and Cat 3 LLW
- Cat 1 and Cat 3 LLW and MLLW disposed of after 2007 in deeper (18 m) (59 ft) and wider trenches in existing LLBGs 218-E-12B and 218-W-5
- Melters disposed of after 2007 in 21-m (69-ft) deep trenches in LLBG 218-E-12B
- ILAW disposed of after 2007 in a disposal facility near the PUREX Plant.

Results for Alternative Group A are summarized in Tables G.7a, b, c; G.8, G.9, and G.10 and Figures G.18 through G.27. Results for this alternative group include:

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater at the 1-km (0.6-mi) LOAs down-gradient from the waste sites for wastes disposed of prior to 1996 (Table G.7a) and wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.8)
- Predicted peak concentrations of key radionuclides from an LLBG in groundwater along the Columbia River for wastes disposed of prior to 1996 (Table G.7b) and wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.9)
- Predicted peak river fluxes of key radionuclides from an LLBG to the Columbia River for wastes disposed of prior to 1996 (Table G.7c) and wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.10).

Table G.7a. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a 1-km Line of Analysis, All Action Alternatives

Constituent	Benchmark Drinking Water Standard (pCi/L)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)
Pre-1970 LLW				
200 East Area				
C-14	2000	0.00E+00		
Tc-99	900	5.16E-01	1.44E+01	110
Grouted Tc-99	900	0.00E+00	0.00E+00	
I-129	1	1.24E-03	3.47E-02	110
Grouted I-129	1	0.00E+00	0.00E+00	
U-233	(a)	1.03E+01	3.20E-01	10000
U-234	(a)	3.68E-01	1.14E-02	10000
U-235	(a)	1.12E-02	3.48E-04	10000
U-236	(a)	7.53E-03	2.34E-04	10000
U-238	(a)	2.69E-01	8.35E-03	10000
200 West Area	(a)			
C-14	2000	0.00E+00	0.00E+00	
Tc-99	900	1.30E-01	2.71E+00	190
Grouted Tc-99	900	0.00E+00	0.00E+00	
I-129	1	1.70E-04	3.54E-03	190
Grouted I-129	1	0.00E+00	0.00E+00	
U-233	(a)	0.00E+00	0.00E+00	
U-234	(a)	1.45E+00	0.00E+00	10,000
U-235	(a)	4.38E-02	0.00E+00	10,000
U-236	(a)	2.95E-02	0.00E+00	10,000
U-238	(a)	1.06E+00	0.00E+00	10,000
1970-1987 LLW				
200 East Area				
C-14	2000	2.15E+02	4.84E+00	10000
Tc-99	900	0.00E+00		
Grouted Tc-99	900	0.00E+00		
I-129	1	1.87E-02	5.23E-01	110
Grouted I-129	1	0.00E+00		
U-233	(a)	0.00E+00		
U-234	(a)	3.08E-02	1.89E-03	10000
U-235	(a)	2.61E-03	1.60E-04	10000
U-236	(a)	0.00E+00	0.00E+00	10000
U-238	(a)	6.28E-02	3.85E-03	10000
200 West Area				
C-14	2000	3.92E+02	0.00E+00	>10,000
Tc-99	900	0.00E+00		
Grouted Tc-99	900	0.00E+00		
I-129	1	1.77E-03	3.94E-02	250
Grouted I-129	1	0.00E+00		
U-233	(a)	0.00E+00		
U-234	(a)	3.94E+01	0.00E+00	>10,000
U-235	(a)	3.33E+00	0.00E+00	>10,000
U-236	(a)	0.00E+00	0.00E+00	>10,000
U-238	(a)	2.82E+01	0.00E+00	>10,000

Table G.7a. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Inventory (Ci)	Maximum Concentration (pCi/L)	Approximate Peak Arrival Time (yrs)
1988-1995 LLW				
200 East Area				
C-14	2000	5.11E+00	1.15E-01	10000
Tc-99	900	1.39E-01	3.89E+00	110
Grouted Tc-99	900	0.00E+00		
I-129	1	9.45E-05	2.64E-03	110
Grouted I-129	1	0.00E+00		
U-233	(a)	2.09E-05	1.28E-06	10000
U-234	(a)	1.85E-03	1.13E-04	10000
U-235	(a)	4.29E-04	2.63E-05	10000
U-236	(a)	1.85E-06	1.13E-07	10000
U-238	(a)	1.93E-02	1.18E-03	10000
200 West Area				
C-14	2000	9.29E+00	0.00E+00	>10,000
Tc-99	900	4.71E-01	1.18E+01	210
Grouted Tc-99	900	0.00E+00		
I-129	1	3.06E-02	7.70E-01	210
Grouted I-129	1	0.00E+00		
U-233	(a)	6.54E-02	0.00E+00	>10,000
U-234	(a)	5.77E+00	0.00E+00	>10,000
U-235	(a)	1.34E+00	0.00E+00	>10,000
U-236	(a)	5.77E-03	0.00E+00	>10,000
U-238	(a)	6.03E+01	0.00E+00	>10,000

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:
- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Respective results presented for previously disposed of wastes before 1996 for Alternative Group A are only presented once in Tables G.7a, G.7b, and G.7c since these results are the same for all action alternative groups (that is, Alternative Groups A, B, C, D_1, D_2, D_3, E_1, E_2, and E_3).

G.2.1.1 Previously Disposed of Wastes

Constituents released from previously disposed of wastes that have the highest impact on water quality are technetium-99 and iodine-129. Estimated combined technetium-99 and iodine-129 levels at the 200 East Area NW LOA peaked at about 110 years and about 220 years at the 200 West Area LOA. Combined concentration levels of technetium-99 were relatively low (less than 20 pCi/L) down-gradient from both areas and were a small percentage of the benchmark maximum contaminant level (MCL) for technetium-99 (900 pCi/L). The combined concentration level of iodine-129 at the 200 East Area NW LOA was about 60 percent (0.6 pCi/L) of the benchmark MCL. This concentration level resulted from releases of the iodine-129 inventory in 1970-87 LLW. The combined concentration level of iodine-129 at

Table G.7b. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a Line of Analysis Along the Columbia River, All Action Alternatives

Constituent	Benchmark Drinking Water Standard (pCi/L)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)
Pre-1970 LLW				
200 East Area				
C-14	2000	0.00E+00		
Tc-99	900	5.16E-01	1.29E+00	260
Grouted Tc-99	900	0.00E+00	0.00E+00	
I-129	1	1.24E-03	3.09E-03	260
Grouted I-129	1	0.00E+00	0.00E+00	
U-233	(a)	1.03E+01	1.92E-02	10000
U-234	(a)	3.68E-01	6.87E-04	10000
U-235	(a)	1.12E-02	2.09E-05	10000
U-236	(a)	7.53E-03	1.41E-05	10000
U-238	(a)	2.69E-01	5.02E-04	10000
200 West Area	(a)			
C-14	2000	0.00E+00	0.00E+00	
Tc-99	900	1.30E-01	1.69E-01	530
Grouted Tc-99	900	0.00E+00	0.00E+00	
I-129	1	1.70E-04	2.21E-04	530
Grouted I-129	1	0.00E+00	0.00E+00	
U-233	(a)	0.00E+00	0.00E+00	
U-234	(a)	1.45E+00	0.00E+00	10,000
U-235	(a)	4.38E-02	0.00E+00	10,000
U-236	(a)	2.95E-02	0.00E+00	10,000
U-238	(a)	1.06E+00	0.00E+00	10,000
1970-1987 LLW				
200 East Area				
C-14	2000	2.15E+02	2.65E-01	10000
Tc-99	900	0.00E+00	0.00E+00	0
Grouted Tc-99	900	0.00E+00	0.00E+00	0
I-129	1	1.87E-02	4.66E-02	260
Grouted I-129	1	0.00E+00	0.00E+00	0
U-233	(a)	0.00E+00	0.00E+00	0
U-234	(a)	3.08E-02	1.12E-04	10000
U-235	(a)	2.61E-03	9.48E-06	10000
U-236	(a)	0.00E+00	0.00E+00	10000
U-238	(a)	6.28E-02	2.28E-04	10000
200 West Area				
C-14	2000	3.92E+02	0.00E+00	10,000
Tc-99	900	0.00E+00	0.00E+00	
Grouted Tc-99	900	0.00E+00	0.00E+00	
I-129	1	1.77E-03	2.01E-03	610
Grouted I-129	1	0.00E+00	0.00E+00	
U-233	(a)	0.00E+00	0.00E+00	
U-234	(a)	3.94E+01	0.00E+00	10,000
U-235	(a)	3.33E+00	0.00E+00	10,000
U-236	(a)	0.00E+00	0.00E+00	10,000
U-238	(a)	2.82E+01	0.00E+00	10,000

Table G.7b. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)
1988-1995 LLW				
200 East Area				
C-14	2000	5.11E+00	9.11E-04	10000
Tc-99	900	1.39E-01	3.46E-01	260
Grouted Tc-99	900	0.00E+00	0.00E+00	
I-129	1	9.45E-05	2.35E-04	260
Grouted I-129	1	0.00E+00	0.00E+00	
U-233	(a)	2.09E-05	7.59E-08	10000
U-234	(a)	1.85E-03	6.72E-06	10000
U-235	(a)	4.29E-04	1.56E-06	10000
U-236	(a)	1.85E-06	6.72E-09	10000
U-238	(a)	1.93E-02	7.01E-05	10000
200 West Area				
C-14	2000	9.29E+00	0.00E+00	10,000
Tc-99	900	4.71E-01	3.45E-02	600
Grouted Tc-99	900	0.00E+00	0.00E+00	
I-129	1	3.06E-02	3.45E-02	600
Grouted I-129	1	0.00E+00		
U-233	(a)	6.54E-02	0.00E+00	10,000
U-234	(a)	5.77E+00	0.00E+00	10,000
U-235	(a)	1.34E+00	0.00E+00	10,000
U-236	(a)	5.77E-03	0.00E+00	10,000
U-238	(a)	6.03E+01	0.00E+00	10,000

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

the 200 West Area LOA was about 50 percent (0.5 pCi/L) of benchmark MCL. This concentration level also resulted from releases of the iodine-129 inventory in 1970-87 LLW.

Technetium-99 and iodine-129 combined concentrations were well below benchmark MCLs by the time they reached the Columbia River. Overall concentration levels at the Columbia River LOA reached their peaks in about 260 years. Contaminant levels from sources in the 200 West Area reached their peaks along the river LOA between 500 and 600 years.

The combined concentration of carbon-14 and the uranium isotopes were found to peak at about or beyond 10,000 years. Carbon-14 concentrations at all 1-km LOAs were well below the drinking water standard (DWS) of 2000 pCi/L. Combined concentration levels of uranium-238, the dominant uranium isotope, were also well below the benchmark MCLs at the 200 East and West Area LOAs at 10,000 years.

Table G.7c. Predicted Peak River Flux of Key Constituents by Waste Type and Category at a Line of Analysis to the Columbia River, All Action Alternatives

Constituent	Inventory (Ci)	Maximum River Flux (Ci)	Approximate Peak Arrival Time (yrs)
Pre-1970 LLW			
200 East Area			
C-14	0.00E+00		
Tc-99	5.16E-01	9.81E-03	290
Grouted Tc-99	0.00E+00	0.00E+00	
I-129	1.24E-03	2.36E-05	290
Grouted I-129	0.00E+00	0.00E+00	
U-233	1.03E+01	1.29E-04	10,000
U-234	3.68E-01	4.61E-06	10,000
U-235	1.12E-02	1.40E-07	10,000
U-236	7.53E-03	9.43E-08	10,000
U-238	2.69E-01	3.37E-06	10,000
200 West Area			
C-14	0.00E+00	0.00E+00	
Tc-99	1.30E-01	1.68E-03	600
Grouted Tc-99	0.00E+00	0.00E+00	
I-129	1.70E-04	2.20E-06	600
Grouted I-129	0.00E+00	0.00E+00	
U-233	0.00E+00	0.00E+00	
U-234	1.45E+00	0.00E+00	10,000
U-235	4.38E-02	0.00E+00	10,000
U-236	2.95E-02	0.00E+00	10,000
U-238	1.06E+00	0.00E+00	10,000
1970-1987 LLW			
200 East Area			
C-14	2.15E+02	1.76E-03	10000
Tc-99	0.00E+00	0.00E+00	0
Grouted Tc-99	0.00E+00	0.00E+00	0
I-129	1.87E-02	3.54E-04	290
Grouted I-129	0.00E+00	0.00E+00	0
U-233	0.00E+00	0.00E+00	0
U-234	3.08E-02	7.50E-07	10,000
U-235	2.61E-03	6.35E-08	10,000
U-236	0.00E+00	0.00E+00	10,000
U-238	6.28E-02	1.53E-06	10,000
200 West Area			0
C-14	3.92E+02	0.00E+00	10,000
Tc-99	0.00E+00	0.00E+00	
Grouted Tc-99	0.00E+00	0.00E+00	
I-129	1.77E-03	2.07E-05	690
Grouted I-129	0.00E+00	0.00E+00	
U-233	0.00E+00	0.00E+00	
U-234	3.94E+01	0.00E+00	10,000
U-235	3.33E+00	0.00E+00	10,000
U-236	0.00E+00	0.00E+00	10,000
U-238	2.82E+01	0.00E+00	10,000

Table G.7c. (contd)

Constituent	Inventory (Ci)	Maximum River Flux (Ci)	Approximate Peak Arrival Time (yrs)
	1988-1995 LLW		
200 East Area			
C-14	5.11E+00	6.05E-06	10,000
Tc-99	1.39E-01	2.63E-03	290
Grouted Tc-99	0.00E+00	0.00E+00	
I-129	9.45E-05	1.79E-06	290
Grouted I-129	0.00E+00	0.00E+00	
U-233	2.09E-05	5.09E-10	10,000
U-234	1.85E-03	4.50E-08	10,000
U-235	4.29E-04	1.04E-08	10,000
U-236	1.85E-06	4.50E-11	10,000
U-238	1.93E-02	4.70E-07	10,000
200 West Area			
C-14	9.29E+00	0.00E+00	10,000
Tc-99	4.71E-01	0.00E+00	10,000
Grouted Tc-99	0.00E+00	0.00E+00	
I-129	3.06E-02	3.58E-04	670
Grouted I-129	0.00E+00		
U-233	6.54E-02	0.00E+00	10,000
U-234	5.77E+00	0.00E+00	10,000
U-235	1.34E+00	0.00E+00	10,000
U-236	5.77E-03	0.00E+00	10,000
U-238	6.03E+01	0.00E+00	10,000

Combined contaminant flux for technetium-99 and iodine-129 inventories in previously disposed of LLW reaching the Columbia River within the 10,000-year period of analysis were estimated as follows:

- ~95 Ci of technetium-99 (peak loading 0.1 Ci /yr around 520 -530 yrs)

- ~20 Ci of iodine-129 (peak loading 0.06 Ci/yr 260 yrs)

This amount of constituent loading does not adversely affect water quality in the Columbia River.

G.2.1.2 Wastes Disposed of After 1995

Water quality impacts from wastes disposed of after 1995 were also highest for technetium-99 and iodine-129. Technetium-99 levels at the 200 East Area NW LOA were about 8 percent (75 pCi/L) of the benchmark MCL for the Hanford Only waste volume. The source for these elevated levels is from technetium-99 released from MLLW disposed of after 2008. Technetium-99 levels at the 200 West Area LOA were about 33 percent (300 pCi/L) of the benchmark MCL. The source of these impacts was primarily from the technetium-99 releases from Cat 3 LLW disposed of after 2008. Predicted technetium-99 levels were very similar for all volumes but were slightly higher for the Upper Bound volume.

Iodine-129 levels at the 200 East Area NW LOA were about 80 percent of the DWS of 1 pCi/L for the Hanford Only volumes. The main contributor to these concentration levels was MLLW disposed of after 2008. Iodine-129 levels at the 200 West Area LOA were about 40 percent of the DWS of 1 pCi/L for the Hanford Only volume. The main contributor to these concentration levels was MLLW disposed of between 1996 and 2007.

Iodine-129 levels were slightly higher at the 200 East Area NW LOA and slightly lower at the 200 West Area LOA for the Upper Bound volume. This result is reflective of changes in partitioning iodine-129 inventory for the MLLW (1996-2007) waste category between the 200 East and West Areas for the Upper Bound volume.

Technetium-99 and iodine-129 concentrations were well below benchmark MCLs by the time they reached the Columbia River. Overall concentration levels at the Columbia River LOA from sources in the 200 East Area reached their peaks between 1550 and 1600 years. Contaminant levels from sources in the 200 West Area reached their peaks the Columbia River LOA between 1600 and 2100 years.

Concentration levels of carbon-14 and uranium isotopes at the 1-km (0.6-m) LOAs did not reach their peak values until after the 10,000-year period of analysis and were well below benchmark MCLs at 10,000 years.

Combined contaminant flux for technetium-99 and iodine-129 inventories in previously disposed of LLW reaching the Columbia River within the 10,000-year period of analysis were estimated as follows:

- 116 and 121 Ci of technetium-99 for the Hanford Only and Upper Bound volumes, respectively. Peak loading was about 0.04 Ci /yr about 1750 years.

- 0.2 Ci of iodine-129 for Hanford Only and Upper Bound volumes. Peak loading 0.0001 Ci/yr at about 1650 years.

This amount of constituent loading does not adversely affect water quality in the Columbia River.

A qualitative analysis of these results using the alternative groundwater conceptual model described in Sections G.1.3.1 and G.1.3.2 would suggest the following:

- Arrival times and estimated concentration levels at the 1-km (0.6-m) well location down-gradient for LLW and MLLW disposed of in 218-E-12b would be expected to change because these source areas under an easterly flow condition would be closer to an aggregate HSW disposal area boundary and thus be close to the 1-km (0.6-m) well LOA. Changes would be expected to be similar to the earlier rises in concentration levels and slight increases (20 to 30 percent) of concentration levels calculated for unit releases from HSW disposal site areas of the 218-E-12b LLBG. For this alternative, these types of changes would be expected for nearly all LLW and MLLW categories disposed of in the 218-12b LLBG. The most substantial impacts would be for key sources that were identified above, including (1) 1970-87 LLW, (2) MLLW disposed of between 1996 and 2007, and (3) MLLW disposed of after 2007.

- No significant changes would be expected for estimated concentration levels and impacts estimated from HSW disposal areas in the 218-E-10 LLBG in the 200 East Area and all disposal locations in the 200 West Area and the ERDF.

Respective results presented for previously disposed of wastes before 1996 for Alternative Group A are only presented once in Tables G.8a, b, and c since these results are the same for all action alternative groups (that is, Alternative Groups A, B, C, D_1, D_2, D_3, E_1, E_2, and E_3). In addition, because LLW and MLLW disposed of between 1996 and 2007 used conventional trenches with the same assumptions regarding source-term release and vadose zone modeling, the results calculated for Alternative Group A would also apply to all alternatives except the No Action Alternative. Thus, discussion of results for the Alternative Groups B through E will focus on results from LLW and MLLW disposed of after 2007 and not repeat results for LLW and MLLW disposed of between 1996 and 2007 unless the wastes include inventories that are the dominant in a particular HSW disposal area.

G.2.2 Alternative Group B

LLW considered in Alternative Group B includes the same waste considered in Alternative Group A but disposes of Cat 1 and Cat 3 LLW and MLLW in conventional trenches after 2007 in LLBGs 218-E-12b and 218-W-5 and the ILAW disposal facility located just south of the CWC.

Results for Alternative Group B are summarized in Tables G.11, G.12, and G.13 and Figures G.28 through G.33. Results for this alternative group include:

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater at the 1-km (0.6-mi) LOA down-gradient from wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.11)

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater along the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.12)

- Predicted peak river fluxes of key radionuclides from an LLBG to the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.13).

G.2.2.1 Previously Disposed of Wastes

Because of assumptions in the source-term release and vadose zone modeling used for LLW and MLLW previously disposed of between 1996 and 2007 for Alternative Group B, results for this alternative were the same for those waste categories calculated for Alternative Group A. Results for previously disposed of wastes before 1996 for Alternative Group A are presented in Tables G.7a, b, and c in Section G.2.2.

G.2.2.2 Wastes Disposed of After 1995

As expected, results showed slightly higher concentration values of both technetium-99 and iodine-129 from key wastes at all LOAs. Under this alternative group, water quality was most impacted by releases of technetium-99 and iodine-129 from the disposed of LLW and MLLW. Technetium-99 levels at the 200 East Area NW LOA were about 11 and 13 percent (95 and 116 pCi/L) for the Hanford Only and Upper Bound volumes, respectively. The primary source of these elevated levels was from inventories in MLLW disposed of after 2008. These higher concentration levels are generally consistent with the broader surface area of releases associated with the use of conventional trenches under this alternative.

Technetium-99 levels at the 200 West Area LOA were estimated to be about 33 percent (300 pCi/L) of the benchmark MCL of 900 pCi/L for the Hanford Only and Upper Bound volumes at the 1-km LOA. These values are slightly less than levels estimated for Alternative Group A. This would be expected since the source of these impacts was primarily from the technetium-99 inventories in Cat 3 LLW disposed of after 2008. Additionally, the use of conventional trenches under this alternative would result in some of the inventory associated with Cat 1 and Cat 3 LLW disposed of after 2007 being emplaced in the 200 East Area.

Iodine-129 levels at the 200 East Area NW LOA were 110 and 120 percent (1.1 and 1.2 pCi/L) of the benchmark MCL of 1 pCi/L for the Hanford Only volume. The main contributor to these concentration levels was inventories in MLLW disposed of after 2008. Iodine-129 levels at the 200 West Area LOA were about 40 and 20 percent (0.4 and 0.2 pCi/L) of the benchmark MCL for the Hanford Only volume. The main contributor to these concentration levels was inventories in MLLW disposed of between 1996 and 2007.

Iodine-129 levels were slightly higher at the 200 East Area NW LOA and slightly lower at the 200 West Area LOA for the Upper Bound volume. This impact is reflective of changes in the partitioning of iodine-129 inventory for the MLLW (1996-2007) waste category between the 200 East and West Areas for the Upper Bound volume.

Concentration levels of carbon-14 and uranium isotopes at the 1-km (0.6-m) well down-gradient from source areas of projected LLW and MLLW did not reach their peak values until after the 10,000-year period of analysis. Concentration levels for both constituents were well below benchmark MCLs at 10,000 years.

Concentrations of all constituents were well below benchmark MCLs by the time they reached the Columbia River LOA. Overall concentration levels at the Columbia River LOA from sources in the 200 East Area reached their peaks at about 1400 years. Contaminant levels from sources in 200 West Area sources reached their peaks along the river at about 1500 years.

Combined contaminant flux for technetium-99 and iodine-129 inventories in wastes disposed of after 1995 reaching the Columbia River within the 10,000-year period of analysis were estimated as follows:

- 118 and 121 Ci of technetium-99 for the Hanford Only and Upper Bound volumes, respectively. Peak loading was about 0.04 Ci /yr at about 1690 years.

- 0.2 Ci of iodine-129 for Hanford Only and Upper Bound volumes. Peak loading 0.0001 Ci/yr at about 1630 years.

This amount of constituent loading does not adversely affect water quality in the Columbia River.

G.2.3 Alternative Group C

LLW considered in Alternative Group C includes the same wastes considered in Alternative Group A but disposes of Cat 1 and Cat 3 LLW and MLLW in single, lined, expandable trenches after 2007 in LLBGs 218-E-12b and 218-W-5. The melters would be placed in a lined trench and ILAW would be placed in a single, expandable, lined trench near the PUREX Plant.

Results for Alternative Group C are summarized in Tables G.14, G.15, and G.16 and Figures G.34 through G.39. Results for this alternative group include:

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater at the 1-km (0.6 mi) LOA down-gradient from wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.14)

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater along the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and MLLW disposed of in conventional trenches between 1996 and 2007 for Upper Bound volumes (Table G.15)

- Predicted peak river fluxes of key radionuclides from an LLBG to the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.16).

G.2.3.1 Previously Disposed of Wastes

Because of assumptions in the source-term release and vadose zone modeling used for LLW and MLLW previously disposed of between 1996 and 2007 for Alternative Group C, results for this alternative were the same for those waste categories calculated for Alternative Group A. Results for previously disposed of wastes before 1996 for Alternative Group A are presented in Tables G.7a, b, and c in Section G.2.1.

G.2.3.2 Wastes Disposed of After 1995

Because of assumptions in the source-term release and vadose zone modeling used for LLW and MLLW previously disposed of between 1996 and 2007 for Alternative Group C, results for this alternative group were the same for those waste categories calculated for Alternative Group A. Results for LLW and MLLW disposed of after 2007 for this alternative group were essentially the same as the results presented in Tables G.8 through G.10 for Alternative Group A. These results are consistent since the analysis assumption about waste depth and projected land use for waste disposed of after 2007 are the same for both alternative groups.

G.2.4 Alternative Group D_1

LLW considered in Alternative Group D_1 includes the same wastes considered in Alternative Group A but disposes of Cat 1 and Cat 3 LLW and MLLW in a lined modular facility after 2007 near the PUREX Plant. The melter trench and the ILAW disposal facility would also be placed in the same general area.

Results for Alternative Group D_1 are summarized in Tables G.17, G.18, and G.19 and Figures G.40 through G.45. Results for this alternative group include:

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater at the 1-km (0.6 mi) LOA down-gradient from wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.17)

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater along the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.18)

- Predicted peak river fluxes of key radionuclides from an LLBG to the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.19).

G.2.4.1 Previously Disposed of Wastes

Because of assumptions in the source-term release and vadose zone modeling used for LLW and MLLW previously disposed of between 1996 and 2007 for Alternative Group D, results for this alternative were the same for those waste categories calculated for Alternative Group A. Results for previously disposed of wastes before 1996 for Alternative Group A are presented in Tables G.7a, b, and c in Section G.2.1.

G.2.4.2 Wastes Disposed of After 1995

The highest impact for this alternative reflects the emplacement of all wastes disposed of after 2007 in the vicinity of the PUREX Plant. Impacts from LLW and MLLW are dominated by technetium-99 and iodine-129.

Combined concentration levels for technetium-99 were about 18 to 20 percent (167 and 185 pCi/L) of the benchmark MCL at the 200 East Area SE LOA for the Hanford Only and Upper Bound volumes. The primary source for these elevated levels was from inventories in MLLW disposed of after 2008. Two peaks reflect technetium-99 inventories in both Cat 3 LLW and MLLW disposed of after 2008 near the PUREX Plant.

Combined technetium-99 concentration levels at the 200 Area West LOA were about 5 and 3 percent (42 and 31 pCi/L) of the benchmark MCL for the Hanford Only and Upper Bound volumes. These values are slightly less than levels estimated for Alternative Group A. The source of these impacts was primarily from the technetium-99 inventory in MLLW disposed of between 1996 and 2007. Decreased concentrations for the Upper Bound volume reflect the emplacement of some of the MLLW inventory in the 200 East Area.

Combined iodine-129 concentration levels at the 200 East Area SE LOA were about 60 and 70 percent (0.6 and 0.7 pCi/L) of the benchmark MCL for the Hanford Only and Upper Bound volumes. The main contributor to these concentration levels was inventories in MLLW disposed of after 2008.

Combined iodine-129 levels at the 200 West Area LOA were about 40 and 20 percent (0.4 and 0.2 pCi/L) of the benchmark MCL for the for the Hanford Only and Upper Bound volumes. The main contributor to these concentration levels was from inventories in MLLW disposed of between 1996 and 2007. Combined iodine-129 levels were slightly higher at the 200 East Area SE LOA and slightly lower at the 200 West Area LOA for the Upper Bound volume. These results are reflective of changes in partitioning of iodine-129 inventory for the MLLW (1996-2007) waste category between the 200 East and West Areas for the Upper Bound volume.

Combined concentration levels of carbon-14 and uranium isotopes at all LOAs from source areas of projected LLW and MLLW did not reach their peak values until after the 10,000-year period of analysis. Concentration levels for both constituents were well below the benchmark MCLs at 10,000 years.

Technetium-99 and iodine-129 concentrations were well below benchmark MCLs by the time they reached the Columbia River. Overall concentration levels at the Columbia River LOA from sources in the 200 East Area reached their peaks along the river between 1400 and 1500 years. Contaminant levels at the same LOA from sources in the 200 West Area sources reached their peaks between 2100 and 2200 years.

Combined contaminant flux for technetium-99 and iodine-129 inventories in previously disposed of LLW reaching the Columbia River within the 10,000 period of analysis were estimated as follows:

- 101 and 106 Ci of technetium-99 for the Hanford Only and Upper Bound volumes, respectively. Peak loading was about 0.03 Ci /yr at about 14,700 years.

- 0.11 Ci of iodine-129 for Hanford Only and Upper Bound volumes. Peak loading was 0.0001 Ci/.yr at about 1540 years.

This amount of constituent loading does not adversely affect water quality in the Columbia River.

G.2.5 Alternative Group D_2

LLW considered in the Alternative D_2 include the same wastes considered in Alternative Group A but disposes of Cat 1 and Cat 3 LLW and MLLW in a single, lined modular trench after 2007 in

LLBG 218-E-12b. Results for Alternative D_2 are summarized in Tables G.20, G.21 and G.22 and Figures G.46 through G.51. Results for this alternative group include:

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater at the 1-km (0.6-mi) LOA down-gradient from wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.20)

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater along the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.21)

- Predicted peak river fluxes of key radionuclides from an LLBG to the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.22).

G.2.5.1 Previously Disposed of Wastes

Impact results presented for previously disposed of wastes before 1996 for Alternative Group A in Tables G.7a, b, and c also apply to Alternative Group D_2.

G.2.5.2 Wastes Disposed of After 1995

The highest impacts for this alternative reflect emplacement of LLW and MLLW disposed of after 2007 in the 218-E-12b LLBG. These impacts were primarily from technetium-99 and iodine-129.

Combined technetium-99 levels at the 200 East Area NW LOA were about 16 and 19 percent (148 and 169 pCi/L) of the benchmark MCL for the Hanford Only and Upper Bound volumes. The primary source for these elevated levels was from inventories in Cat 3 LLW and MLLW disposed of after 2008.

Combined concentration levels of technetium-99 at the 200 West Area LOA were about 5 and 3 percent (42 and 31 pCi/L) of the benchmark MCL for the Hanford Only and Upper Bound volumes, respectively. These values are slightly less than levels estimated for Alternative Group A. The source of these impacts was primarily from the technetium-99 inventory in MLLW disposed of between 1996 and 2007. Decreased concentrations for the Upper Bound volume reflect the emplacement of some of the MLLW inventory in the 200 East Area.

The highest combined iodine-129 levels at the 200 East Area NW LOAs were about 86 and 95 percent (0.86 and 0.95 pCi/L) of the benchmark MCL for the Hanford Only volume. The main contributor to these concentration levels was inventories in MLLW disposed of after 2008.

The highest combined iodine-129 levels were about 40 and 20 percent (0.4 and 0.2 pCi/L) of the benchmark MCL at the 200 West Area LOA for the Hanford Only volume. The main contributor to these concentration levels was inventories in MLLW disposed of between 1996 and 2007.

The highest iodine-129 levels were slightly higher at the 200 East Area NW LOA and slightly lower at the 200 West Area LOA for the Upper Bound volume, This is reflective of changes in the partitioning of the iodine-129 inventory for the MLLW (1996-2007) waste category between the 200 East and West Areas for the Upper Bound volume.

Concentration levels of carbon-14 and uranium isotopes at the 1-km (0.6-mi) LOA did not reach their peak values until after the 10,000-year period of analysis. Concentration levels for both constituents were well below the benchmark MCLs at 10,000 years.

Technetium-99 and iodine-129 concentrations were well below the benchmark MCLs by the time they reached the Columbia River. Overall concentration levels at the Columbia River LOA from sources in the 200 East Area reached their peaks between 1500 and 1600 years. Contaminant levels from sources in the 200 West Area reached their peaks along the river at about 2000 years.

Combined contaminant flux for technetium-99 and iodine-129 inventories in previously disposed of LLW reaching the Columbia River within the 10,000-year period of analysis were estimated as follows:

- 101 and 106 Ci of technetium-99 for the Hanford Only and Upper Bound volumes, respectively. Peak loading was about 0.03 Ci/yr at about 1520 years.

- 0.11 Ci of iodine-129 for Hanford Only and Upper Bound volumes. Peak loading was 0.0001 Ci/yr at about 1640 years.

This amount of constituent loading does not adversely affect water quality in the Columbia River.

G.2.6 Alternative Group D_3

LLW considered in the Alternative D_3 include the same wastes considered in Alternative Group A but disposes of Cat 1 and Cat 3 LLW and MLLW in a single, lined modular trench after 2007 in ERDF. The melter trench and the ILAW disposal facility would also be placed at ERDF. Results for Alternative Group D_3 are summarized in Tables G.23, G.24, and G.25 and Figures G.52 through G.59. Results for this alternative group include:

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater at the 1 km (0.6 mi) LOA down-gradient from wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.23)

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater along the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.24)

- Predicted peak river fluxes of key radionuclides from an LLBG to the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.25).

G.2.6.1 Previously Disposed of wastes

Impact results presented for previously disposed of wastes before 1996 for Alternative Group A in Tables G.7a, b, and c also apply to Alternative Group D_3.

G.2.6.2 Wastes Disposed of After 1995

The highest water quality impacts for this alternative reflect emplacement of LLW and MLLW disposed of after 2007 at the ERDF. Impacts were primarily from technetium-99 and iodine-129.

No LLW and MLLW were disposed of after 1996 in the 200 East Area for the Hanford Only volumes under this alternative group. Combined technetium-99 levels at the 200 East Area NW LOA were about 2 percent (15.7 pCi/L) of benchmark MCLs for the Upper Bound volume. The primary source for these elevated levels was from inventories in MLLW disposed of between 1996 and 2007.

Combined technetium-99 levels at the 200 West Area LOA were about 5 and 3 percent (42 and 31 pCi/L) of the benchmark MCL for the Hanford Only and Upper Bound volumes. These values are slightly less than levels estimated for Alternative Group A. The source of these impacts was primarily from the technetium-99 inventory in MLLW disposed of between 1996 and 2007. Decreased concentrations for the Upper Bound volume reflect the emplacement of some of the MLLW inventory in the 200 East Area.

Combined technetium-99 levels at the ERDF LOA were about 27 and 28 percent (242 and 253 pCi/L) of benchmark MCLs for the Hanford Only and Upper Bound volumes. The primary source for these elevated levels was from inventories in Cat 3 LLW disposed of after 2008.

No LLW and MLLW were disposed of after 1996 in the 200 East Area for the Hanford Only volume under this alternative group. Combined iodine-129 levels at the 200 East Area NW LOA were about 95 percent (0.95 pCi/L) of the benchmark MCL for the Upper Bound volume. The main contributor to these concentration levels was iodine-129 inventories in MLLW disposed of between 1996 and 2007.

Combined iodine-129 levels at the 200 West Area LOA were 40 and 20 percent (0.4 and 0.2 pCi/L) of the benchmark MCL for the Hanford Only volume. The main contributor to these concentration levels was from inventories in MLLW disposed of between 1996 and 2007.

Combined iodine-129 levels at the 200 West Area LOA were slightly higher at the 200 East Area NW LOA and slightly lower for the Upper Bound volume. This result reflects assumed changes in the partitioning of the iodine-129 inventory for the MLLW (1996-2007) waste category between the 200 East and West Areas for the Upper Bound volume.

Combined iodine-129 levels at the ERDF LOA were 92 and 94 percent (0.92 and 0.94 pCi/L) of the benchmark MCL for the Hanford Only volume. The main contributor to these concentration levels was from inventories in MLLW disposed of after 2008.

Concentration levels of carbon-14 and uranium isotopes at all LOAs down-gradient from source areas of projected LLW and MLLW did not reach their peak values until after the 10,000-year period of analysis. Concentration levels for both constituents were well below benchmark MCLs at 10,000 years.

Combined technetium-99 and iodine-129 concentrations were well below benchmark MCLs by the time they reached the Columbia River. Overall concentration levels from sources in the 200 East Area reached their peaks along the river at about 1400 years. Contaminant levels from sources in the 200 West Area reached their peaks along the river about 2000 years.

Combined contaminant flux for technetium-99 and iodine-129 inventories in previously disposed of LLW reaching the Columbia River within the 10,000-year period of analysis were estimated as follows:

- 122 and 132 Ci of technetium-99 for the Hanford Only and Upper Bound volumes, respectively. Peak loading was about 0.04 Ci /yr between 2000 and 2100 years.

- 0.14 Ci of iodine-129 for Hanford Only and Upper Bound volumes. Peak loading was 0.0001 Ci/yr at about 2100 years.

This amount of constituent loading does not adversely affect water quality in the Columbia River.

G.2.7 Alternative Group E_1

LLW considered in Alternative Group E_1 includes the same wastes considered in Alternative Group A but disposes of Cat 1 and Cat 3 LLW and MLLW in a single, lined modular trench after 2007 in LLBG 218-E-12b. The melter trench and the ILAW disposal facility would be placed at ERDF. Results for Alternative E_1 are summarized in Tables G.26, G.27, and G.28 and Figures G.60 through G.67. Results for this alternative group include:

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater at the 1-km (0.6-mi) LOA down-gradient from wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.26)

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater along the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.27)

- Predicted peak river fluxes of key radionuclides from an LLBG to the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.28).

G.2.7.1 Previously Disposed of Wastes

Impact results presented for previously disposed of wastes before 1996 for Alternative Group A in Tables G.7a, b, c also apply to Alternative Group E_1.

G.2.7.2 Wastes Disposed of After 1995

Impacts for this alternative reflect emplacement of LLW and MLLW disposed of after 2007 in 218-E-12B and the disposal of melters and ILAW at ERDF. Results for LLW and MLLW disposed of after 2007, excluding the melters are identical to results for the same wastes in Alternative D_2. The highest impacts resulted from releases of technetium-99 and iodine-129.

Combined technetium-99 levels at the 200 East Area NW LOA were about 16 and 19 percent (148 and 169 pCi/L) of the benchmark MCL for the Hanford Only and Upper Bound volumes. The primary source of these elevated levels was from inventories in Cat 3 LLW and MLLW disposed of after 2008.

Combined technetium-99 levels at the 200 West Area LOA were about 5 and 3 percent (42 and 31 pCi/L) of the benchmark MCL for the Hanford Only and Upper Bound volumes. These values are slightly less than levels estimated for Alternative Group A. The source of these impacts was primarily from the technetium-99 inventory in MLLW disposed of between 1996 and 2007. Decreased concentrations for the Upper Bound volume reflect the emplacement of some of the MLLW inventory in the 200 East Area.

Combined technetium-99 levels at the ERDF LOA were about 0.3 percent (2.7 pCi/L) of the benchmark MCL for both the Hanford Only and Upper Bound volumes. The primary source for these elevated levels was from inventories in the melters disposed of after 2008.

No LLW and MLLW were disposed of after 1996 in the 200 East Area for the Hanford Only volume under this alternative. Combined iodine-129 levels at the 200 East Area NW LOA were 95 percent (0.95 pCi/L) of the benchmark MCL for the Upper Bound volume. The main contributor to these concentration levels was from inventories in MLLW disposed of between 1996 and 2007.

Combined iodine-129 levels at the 200 West Area LOA were 40 and 20 percent (0.4 and 0.2 pCi/L) of the benchmark MCL for the Hanford Only and Upper Bound volumes. The main contributor to these concentration levels was from inventories in MLLW disposed of between 1996 and 2007.

Combined iodine-129 levels at the 200 West Area LOA were slightly higher at the 200 East Area NW LOA and slightly lower for the Upper Bound volume, which is reflective of changes in the partitioning of the iodine-129 inventory for the MLLW (1996-2007) waste category between the 200 East and West Areas for the Upper Bound volume.

Combined iodine-129 levels were 22 percent (0.22 pCi/L) at the ERDF LOA for the Hanford Only and Upper Bound volume. No iodine-129 inventory was estimated for melters disposed of at ERDF after 2007 for this alternative group.

Concentration levels of carbon-14 and uranium isotopes at the 1-km (0.6-m) well down-gradient from source areas of projected LLW and MLLW did not reach their peak values until after the 10,000-year period of analysis. Concentration levels for both constituents were well below the applicable DWS at 10,000 years.

Technetium-99 and iodine-129 concentrations were well below the DWS by the time they reached the Columbia River. Overall concentration levels at the Columbia River LOA from sources in the 200 East Area reached their peaks along the river at about 1400 years. Contaminant levels from sources in the 200 West Area reached their peaks along the river at about 2000 years.

Combined contaminant flux for technetium-99 and iodine-129 inventories in previously disposed of LLW reaching the Columbia River within the 10,000-year period of analysis were estimated as follows:

- 122 and 132 Ci of technetium-99 for the Hanford Only and Upper Bound volumes, respectively. Peak loading was about 0.04 Ci/yr between 2000 and 2100 years.

- 0.14 Ci of iodine-129 for Hanford Only and Upper Bound volumes. Peak loading was 0.0001 Ci/yr at about 2100 years.

This amount of constituent loading does not adversely affect water quality in the Columbia River.

G.2.8 Alternative Group E_2

LLW considered in Alternative E_2 includes the same wastes considered in Alternative Group A but disposes of Cat 1 and Cat 3 LLW and MLLW in a single-lined modular trench after 2007 near the PUREX Plant. The melter trench and the ILAW disposal facility would be placed at ERDF. Results for Alternative Group E_2 are summarized in Tables G.29, G.30, and G.31 and Figures G.68 through G.75. Results for this alternative group include:

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater at the 1-km (0.6-mi) LOA down-gradient from wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.29)

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater along the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.30)

- Predicted peak river fluxes of key radionuclides from an LLBG to the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.31).

G.2.8.1 Previously Disposed of Wastes

Various results presented for previously disposed of wastes before 1996 for Alternative Group A in Tables G.7a, b, c also apply to Alternative Group E_2.

G.2.8.2 Wastes Disposed of After 1995

Impacts for this alternative group reflect emplacement of LLW and MLLW disposed of after 2007 near the PUREX Plant and the disposal of melters and ILAW at ERDF. Results for LLW and MLLW disposed of after 2007, excluding the melters are identical to results for the same wastes in Alternative Group D_1 (see Section G.2.4). Results for the melters were the same as those calculated for Alternative Group E_1 (see Section G.2.7).

G.2.9 Alternative Group E_3

LLW considered in Alternative Group E_3 include the same wastes considered in Alternative A but disposes of Cat 1 and Cat 3 LLW and MLLW in a single, lined modular trench after 2007 at ERDF. The melter trench and the ILAW disposal facility would be placed near the PUREX Plant. Results for Alternative Group E_3 are summarized in Tables G.32, 33, and G.34 and Figures G.76 through G.83. Results for this alternative group include:

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater at the 1-km (0.6-mi) LOA down-gradient from wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.32)

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater along the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.33)

- Predicted peak river fluxes of key radionuclides from an LLBG to the Columbia River for wastes disposed of after 1996 for Lower Bound, Hanford Only, and Upper Bound volumes (Table G.34).

G.2.9.1 Previously Disposed of Wastes

Various results presented for previously disposed of wastes before 1996 for Alternative Group A in Tables G.7a, b, c also apply to Alternative Group E_3.

G.2.9.2 Wastes Disposed of After 1995

Impacts for this alternative reflect emplacement of LLW and MLLW disposed of after 2007 near the PUREX Plant and the disposal of melter MLLW and ILAW at ERDF. Results for LLW and MLLW disposed of after 2007, excluding the melters, are identical to results for the same wastes in Alternative Group D_3 (see Section G.2.6).

Results for Alternative Group E_3 for combined technetium-99 and iodine-129 concentration levels for Hanford Only and Upper Bound volumes are summarized in Section 5.3, Figures 5.20 and 5.21. Additional information can be found in several tables and figures referenced in Section G.2.9.

Combined technetium-99 levels were slightly less than 2.5 percent (22 pCi/L) of the benchmark MCL at the 200 East Area SE LOA for the Hanford Only volume. The impact for the Hanford Only volume reflects the melter and ILAW disposals near the PUREX Plant. The highest combined iodine-129 levels at the 200 East Area SE LOA were about 0.2 percent (0.2 pCi/L) of the benchmark MCL for the Hanford Only and Upper Bound volumes as a result of the ILAW disposal near the PUREX Plant.

G.2.10 No Action Alternative

LLW considered in the No Action Alternative includes wastes to be disposed of in several categories:

- LLW disposed of prior to 1970
- LLW disposed of after 1970 but before 1988
- LLW disposed of between 1988 and 1995
- Cat 1 LLW disposed of in conventional trenches between 1996 and 2007
- Cat 3 LLW and GTC3 LLW disposed of in conventional trenches between 1996 and 2007
- MLLW disposed of in conventional trenches between 1996 and 2007
- Cat 1 and Cat 3 LLW and MLLW disposed of in conventional trenches in LLBGs 218-E-12b and 218-W-5.

Contaminants considered in the LLW categories include estimated inventories associated with Lower Bound and Hanford Only waste volumes of 220,925 and 190,164 m^3 of LLW, respectively. Contaminants considered in the MLLW category include estimated inventories associated with Lower Bound and Hanford Only waste volumes of 79,502 m^3 and 79,379 m^3 of MLLW, respectively.

Results for the No Action Alternative are summarized in Tables G.35a, b, and c; G.36; G.37; and G.38 and Figures G.84 through G89. Results for the No Action Alternative include:

- Predicted peak concentrations of key radionuclides from an LLBG in groundwater at the 1-km (0.6-mi) LOA down-gradient from the waste sites for LLW disposed of prior to 1996 for the Lower Bound volume (Table G.35a) and LLW and MLLW disposed of between 1996 and 2007 for Lower Bound and Hanford Only volumes (Table G.36)
- Predicted peak concentrations of key radionuclides from an LLBG in groundwater along the Columbia River for wastes disposed of prior to 1996 for the Lower Bound volume (Table G.35b) and between 1996 and 2007 for Lower Bound and Hanford Only volumes (Table G.37)

- Predicted peak river fluxes of key radionuclides from an LLBG to the Columbia River for wastes disposed of prior to 1996 for the Lower Bound volume (Table G.35c) and between 1996 and 2007 for Lower Bound and Hanford Only volumes (Table G.38).

G.2.10.1 Previously Disposed of Wastes

The highest water quality impacts from previously disposed of wastes are related to technetium-99 and iodine-129 releases. Estimated concentrations of technetium-99 and iodine-129 peaked at about 110 years at the 200 East Area NW LOA and about 220 years at the 200 West Area LOA. Combined levels of technetium-99 were less than 2 percent (18 pCi/L) at the 200 East Area NW and West LOAs. Combined levels of iodine-129 at the 200 East Area NW LOA were less than 0.1 percent (0.09 pCi/L) of the benchmark MCL.

Combined levels of iodine-129 at the 200 West Area LOA were about 50 percent (0.5 pCi/L) of the benchmark MCL. This concentration level resulted from releases of the iodine-129 inventory in LLW disposed of between 1970 and 1987.

Carbon-14 and uranium isotopes concentration levels were found to peak at about or beyond 10,000 years. Carbon-14 concentrations were well below the DWS of 2000 pCi/L at the 200 East and West Area LOAs. Concentration levels of uranium-238, the dominant uranium isotope, were also well below the DWS of 30 pCi/L at the 200 East and West Area LOAs at 10,000 years. Uranium-238 concentration levels reached their peak of about 3 pCi/L between 14,000 and 16,000 years at the 200 West Area LOA.

Technetium-99 and iodine-129 concentrations were well below benchmark MCLs by the time they reached the Columbia River. Overall concentration levels from sources in the 200 East Area reached their peaks at the Columbia River LOA at about 260 years. Contaminant levels from sources in the 200 West Area reached their peaks at the Columbia River LOA between 500 and 600 years.

Combined contaminant flux for technetium-99 and iodine-129 inventories in previously disposed of LLW reaching the Columbia River within the 10,000-year period of analysis were estimated as follows:

- ~ 1 Ci of technetium-99 (peak loading at 0.001 Ci /yr between 520 -530 years)

- ~0.5 Ci of iodine-129 (peak loading at 0.001 Ci/yr at around 260 years).

This amount of constituent loading does not adversely affect water quality in the Columbia River.

G.2.10.2 Wastes Disposed of After 1995

The highest water quality impacts from LLW and MLLW disposed of after 1995 resulted from releases of technetium-99 and iodine-129. Combined technetium-99 levels at the 200 East Area NW LOA were about 8 percent (77 pCi/L) of the benchmark MCL for the Hanford Only volume. The primary source for these elevated levels was from inventories in MLLW disposed of after 1995.

Combined technetium-99 levels were about 25 percent (225 pCi/L) of the benchmark MCL at the 200 West Area LOA. The source of these impacts was primarily from the technetium-99 inventory in Cat 3 LLW disposed of after 1995.

Combined iodine-129 levels at the 200 East Area NW LOA were about 96 percent (0.96 pCi/L) of the benchmark MCL of 1 pCi/L for the Hanford Only volume. The main contributor to these concentration levels was from inventories in MLLW disposed of after 1995. The highest iodine-129 levels were about 40 percent (0.4 pCi/L) of the benchmark MCL at the 200 West Area LOA for the Hanford Only volume. The main contributor to these concentration levels was from inventories in MLLW disposed of after 1995.

Concentration levels of carbon-14 and uranium isotopes at the 1-km (0.6-m) LOAs down-gradient from source areas of LLW and MLLW disposed of after 1995 did not reach their peak values until after the 10,000-year period of analysis. Concentration levels for both constituents were well below the benchmark MCL at 10,000 years.

Technetium-99 and iodine-129 concentration levels were well below the benchmark MCL by the time they reached the Columbia River. Overall concentration levels at the Columbia River LOA from sources in the 200 East Area reached their peaks at the Columbia River LOA at 260 years for ungrouted forms of technetium-99 and iodine-129 and at about 850 years for grouted forms of the inventories. Contaminant levels from sources in the 200 West Area reached their peaks along the river between 1660 and 1820 years.

Combined contaminant flux for technetium-99 and iodine-129 inventories in previously disposed of LLW reaching the Columbia River within the 10,000-year period of analysis were estimated as follows:

- 102 Ci of technetium-99 for the Hanford Only volume. Peak loading was about

- 0.03 Ci /yr at about 1820 years.

- 0.07 Ci of iodine-129 for the Hanford Only volume. Peak loading was 0.0001 Ci/yr at about 1660 years.

This amount of constituent loading does not adversely affect water quality in the Columbia River.

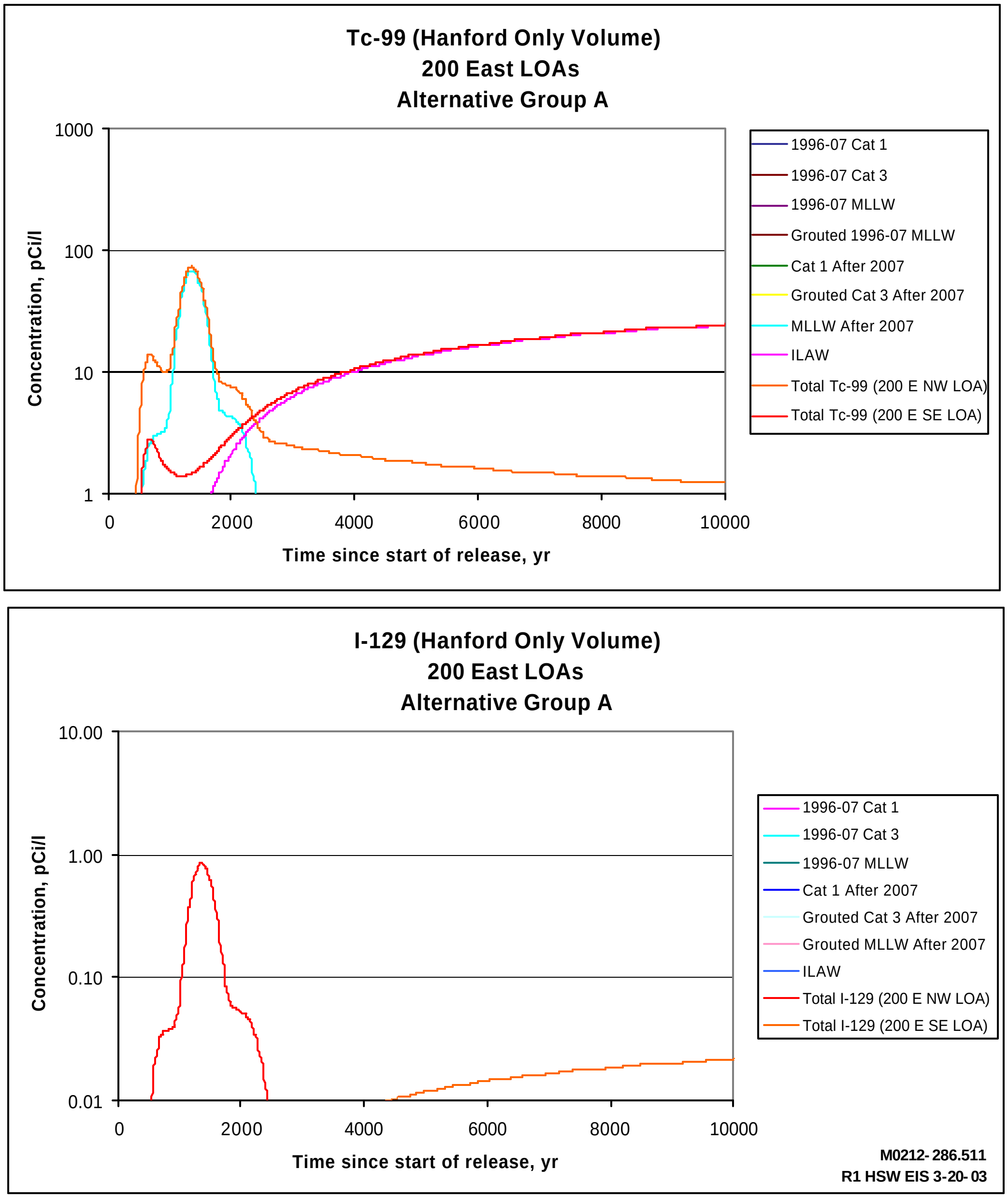


Figure G.18. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group A – Hanford Only Wastes Disposed of After 1995)

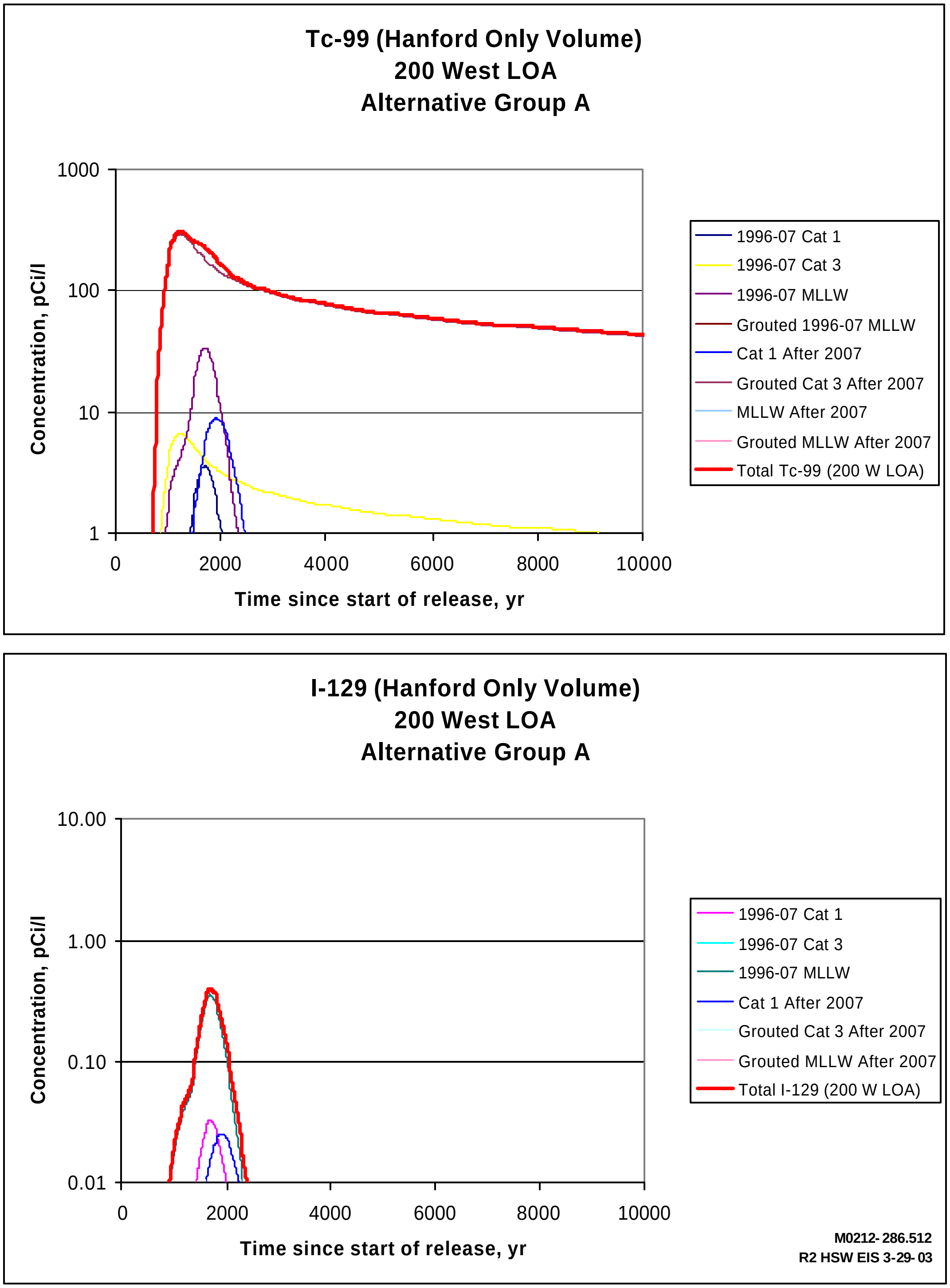
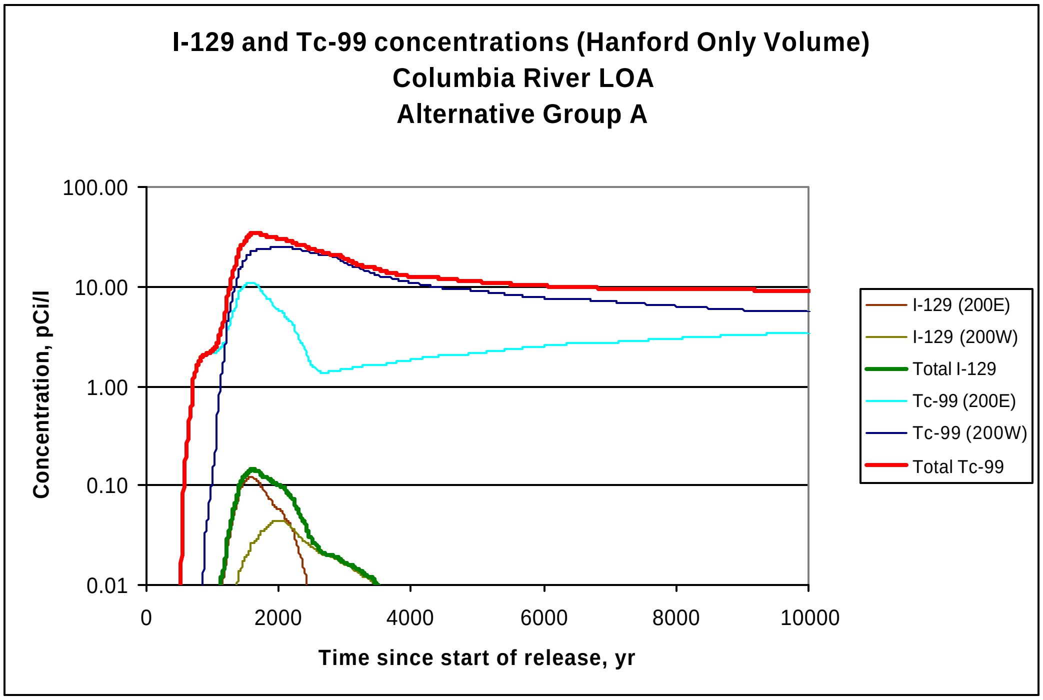


Figure G.19. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 West) (Alternative Group A – Hanford Only Wastes Disposed of After 1995)



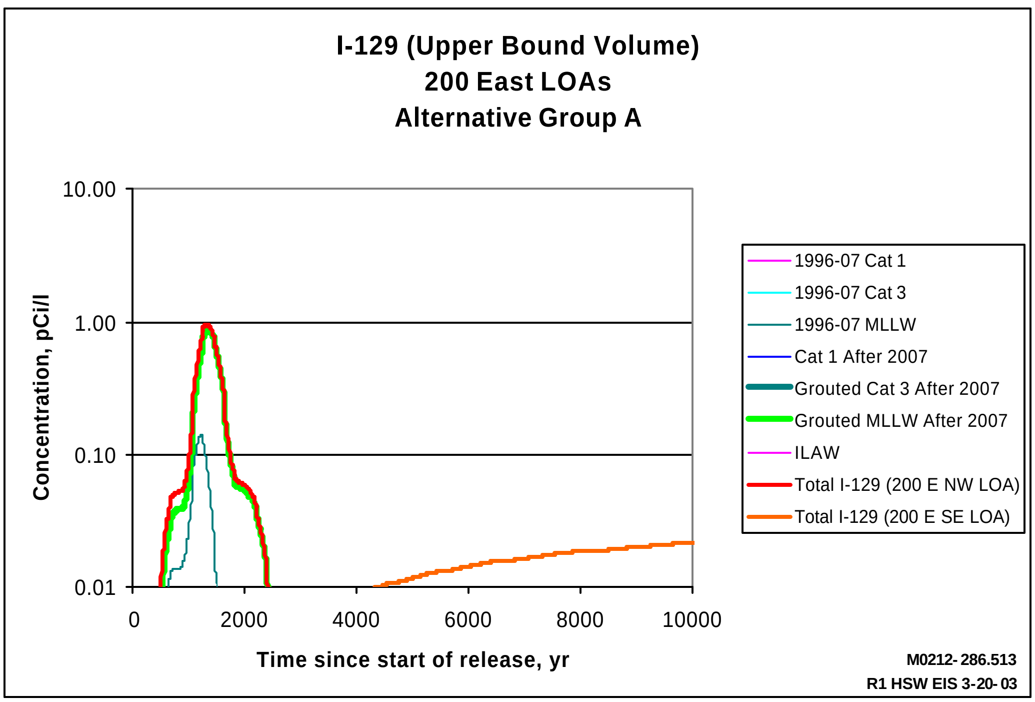


Figure G.20. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River (Alternative Group A – Hanford Only Wastes Disposed of After 1995)

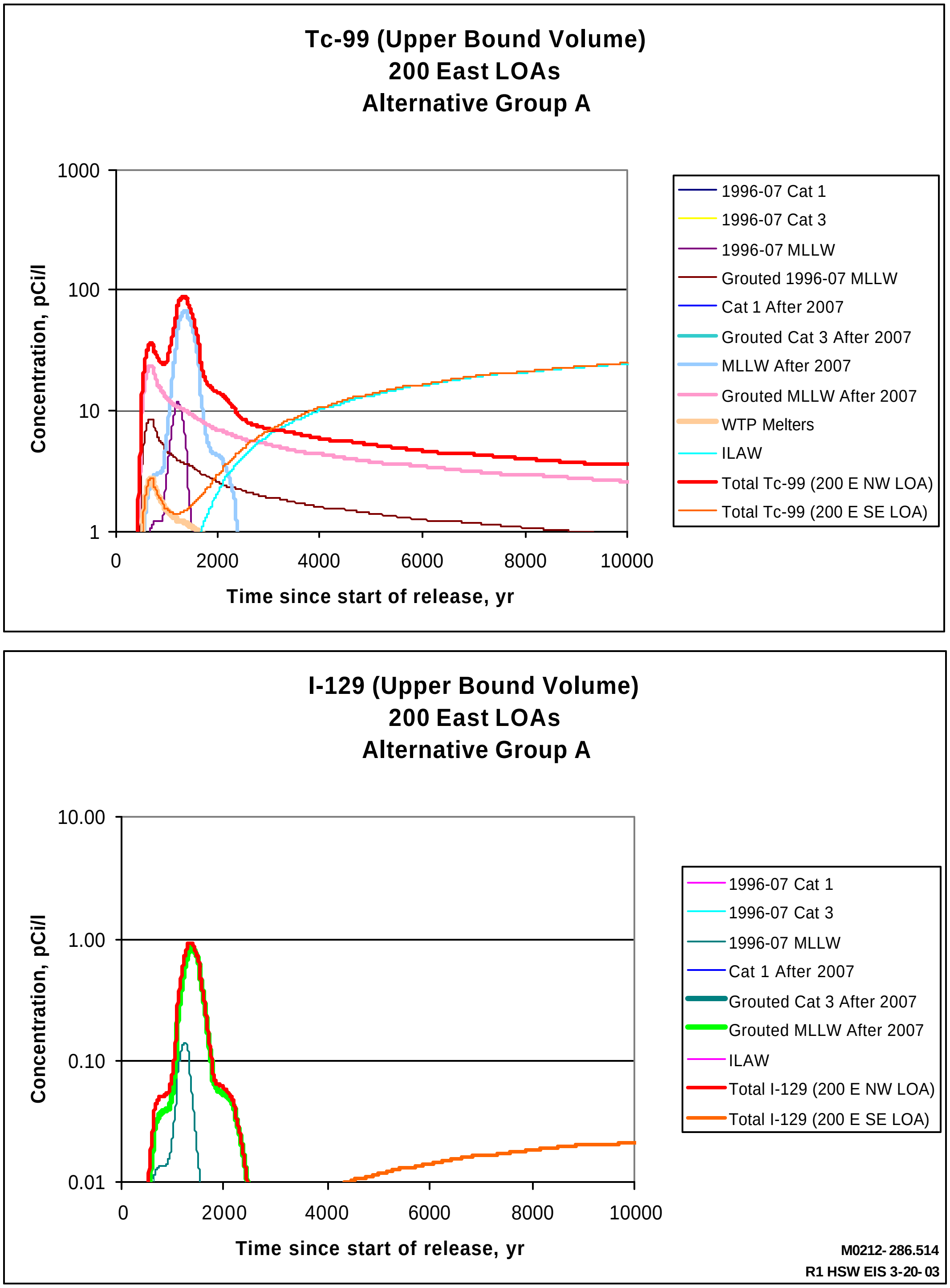


Figure G.21. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group A – Upper Bound Volume Wastes Disposed of After 1995)

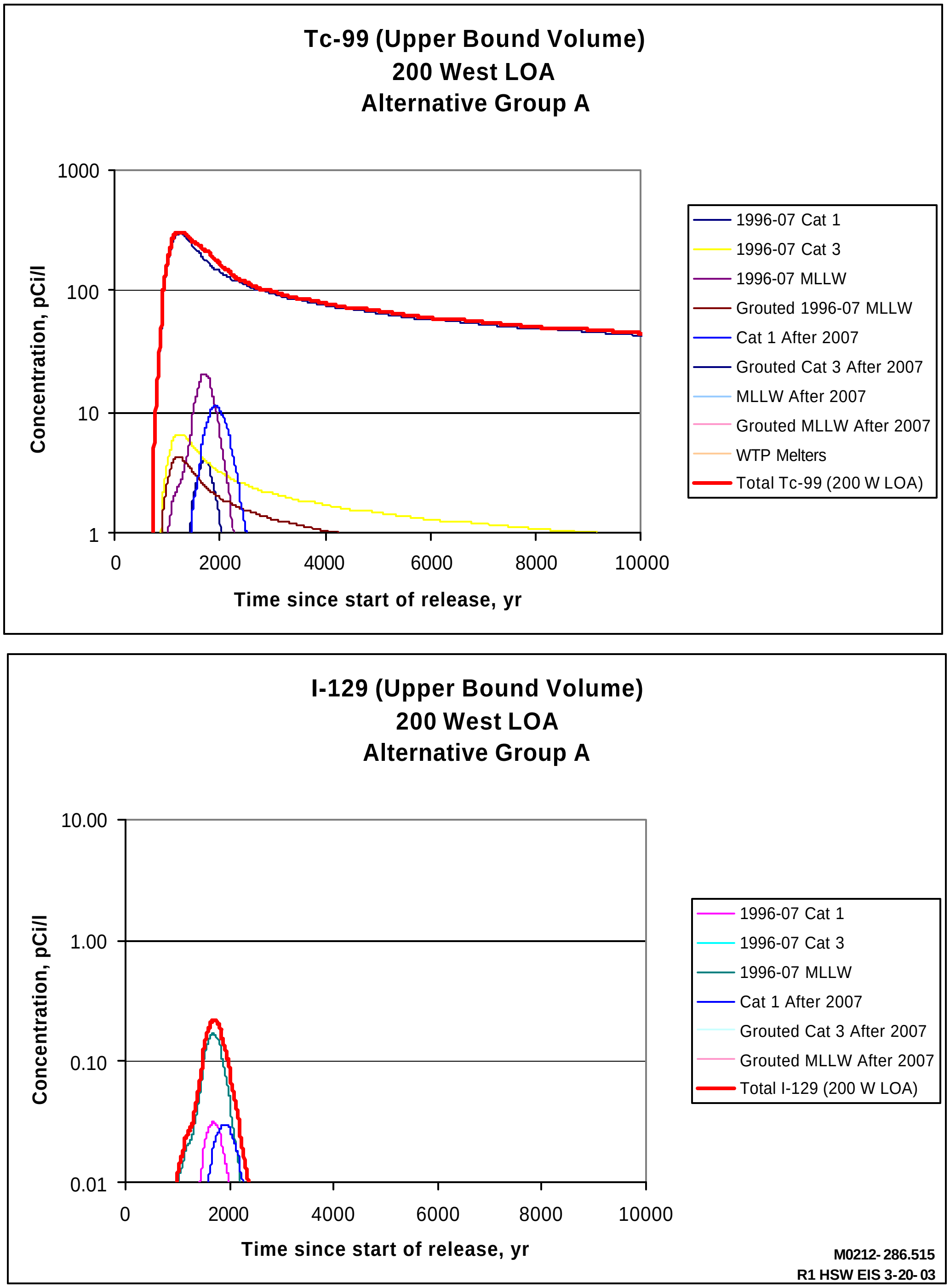
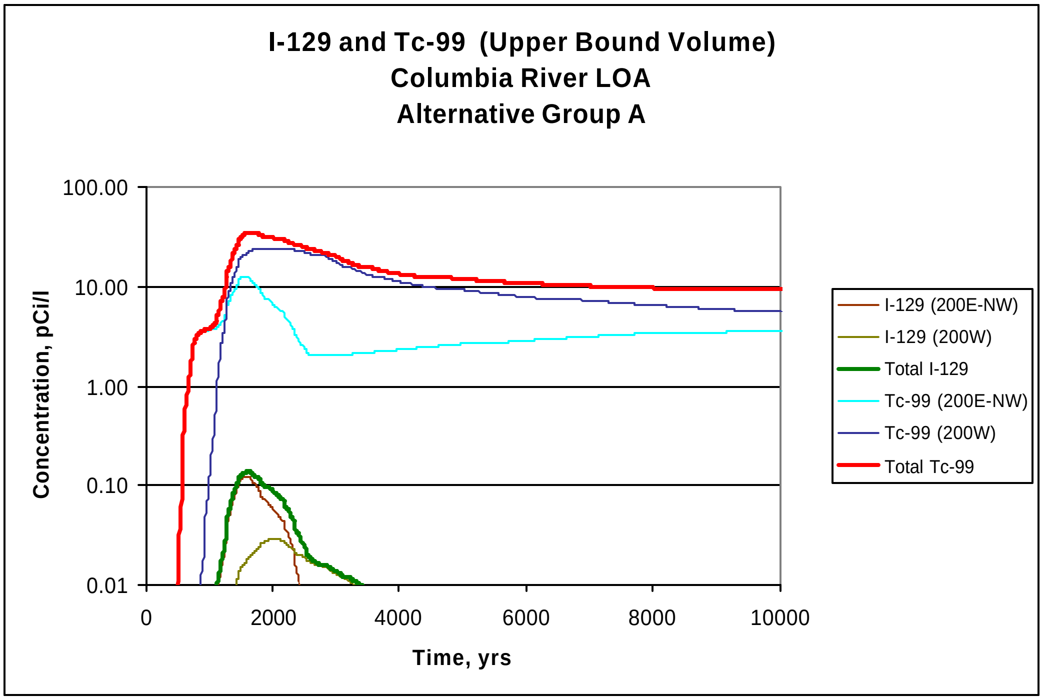


Figure G.22. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 West) (Alternative Group A – Upper Bound Volume Wastes Disposed of After 1995)



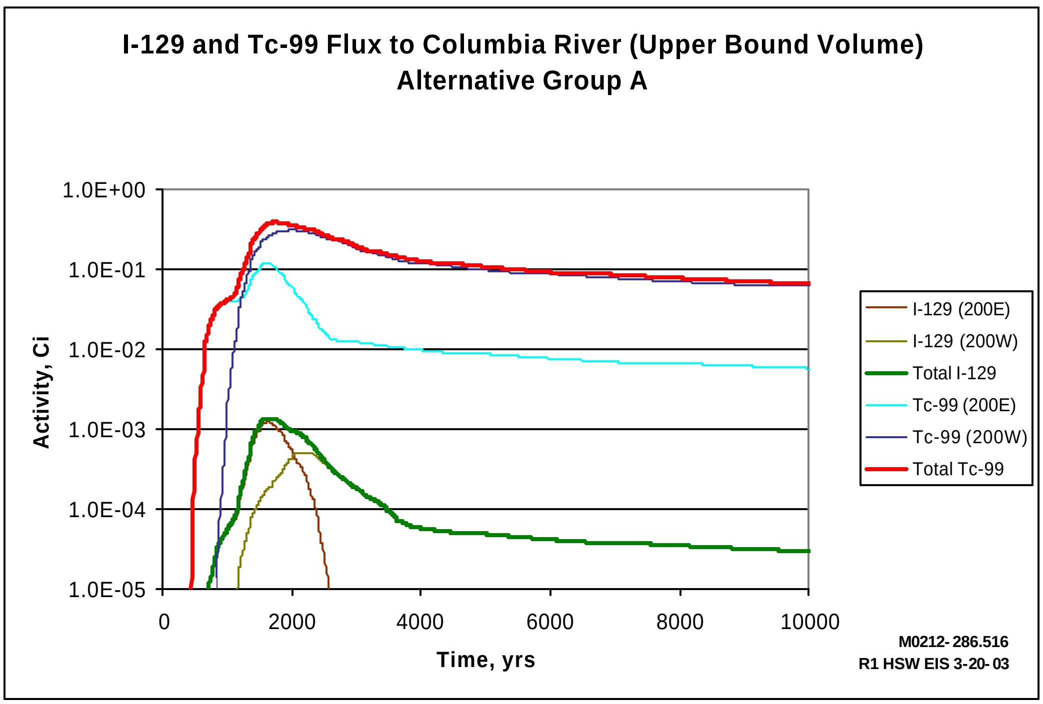
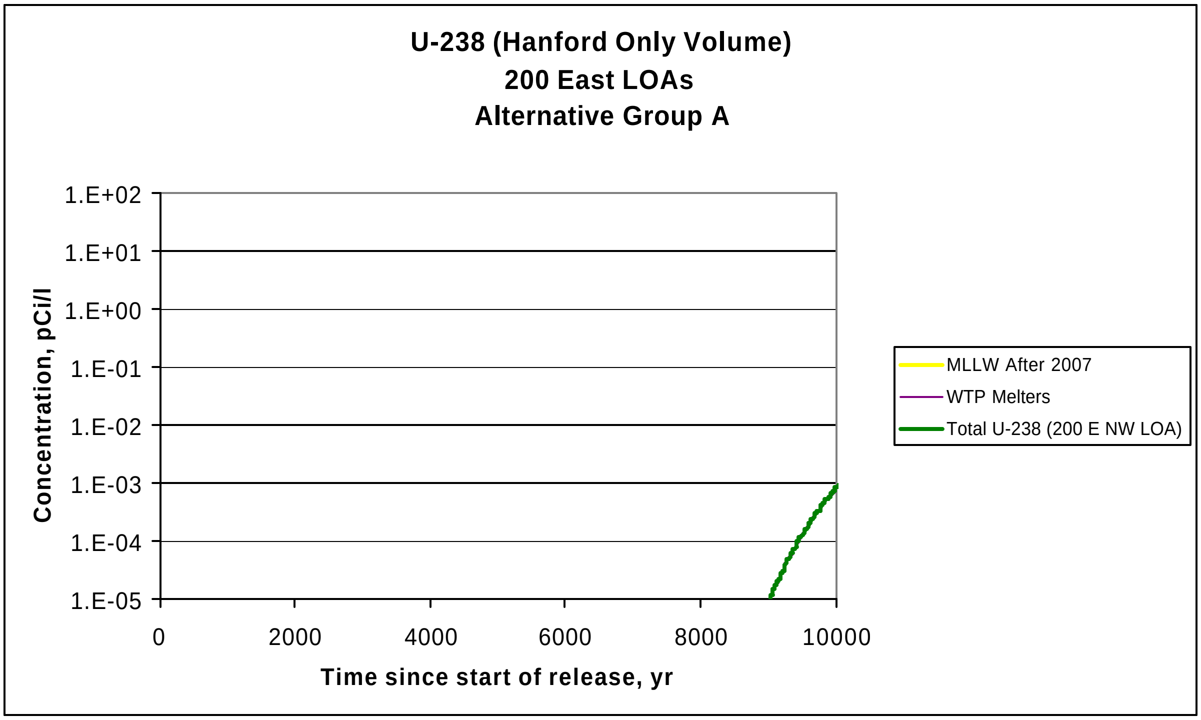


Figure G.23. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River (Alternative Group A – Upper Bound Volume Wastes Disposed of After 1995)



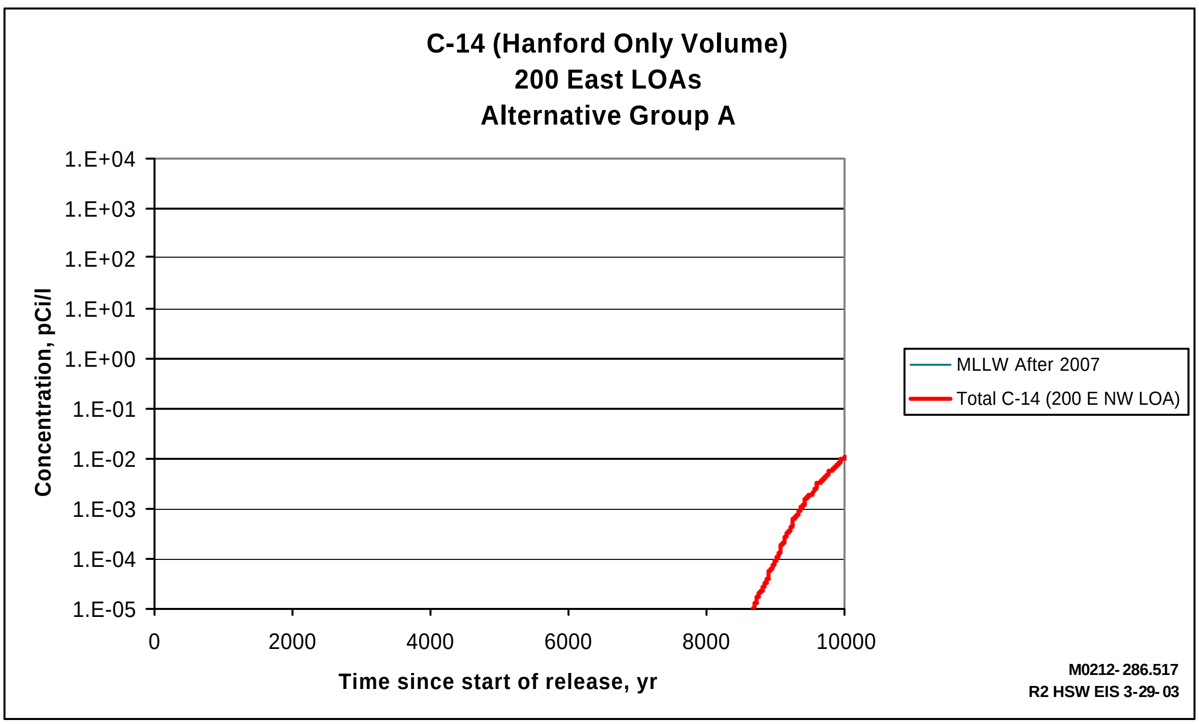


Figure G.24. U-238 and C-14 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group A – Hanford Wastes Disposed of After 1995)

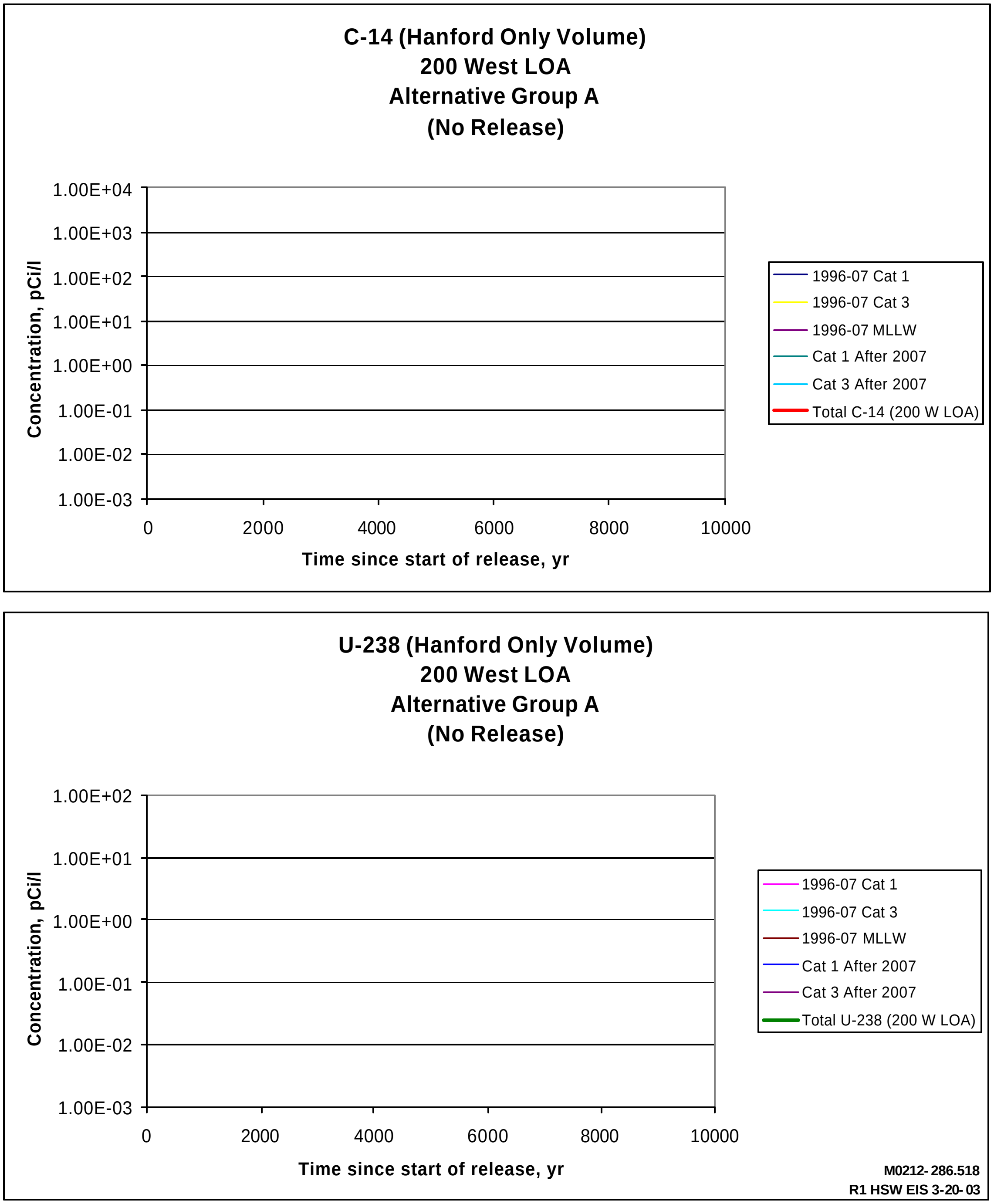


Figure G.25. U-238 and C-14 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group A Hanford Only Wastes Disposed of After 1995)

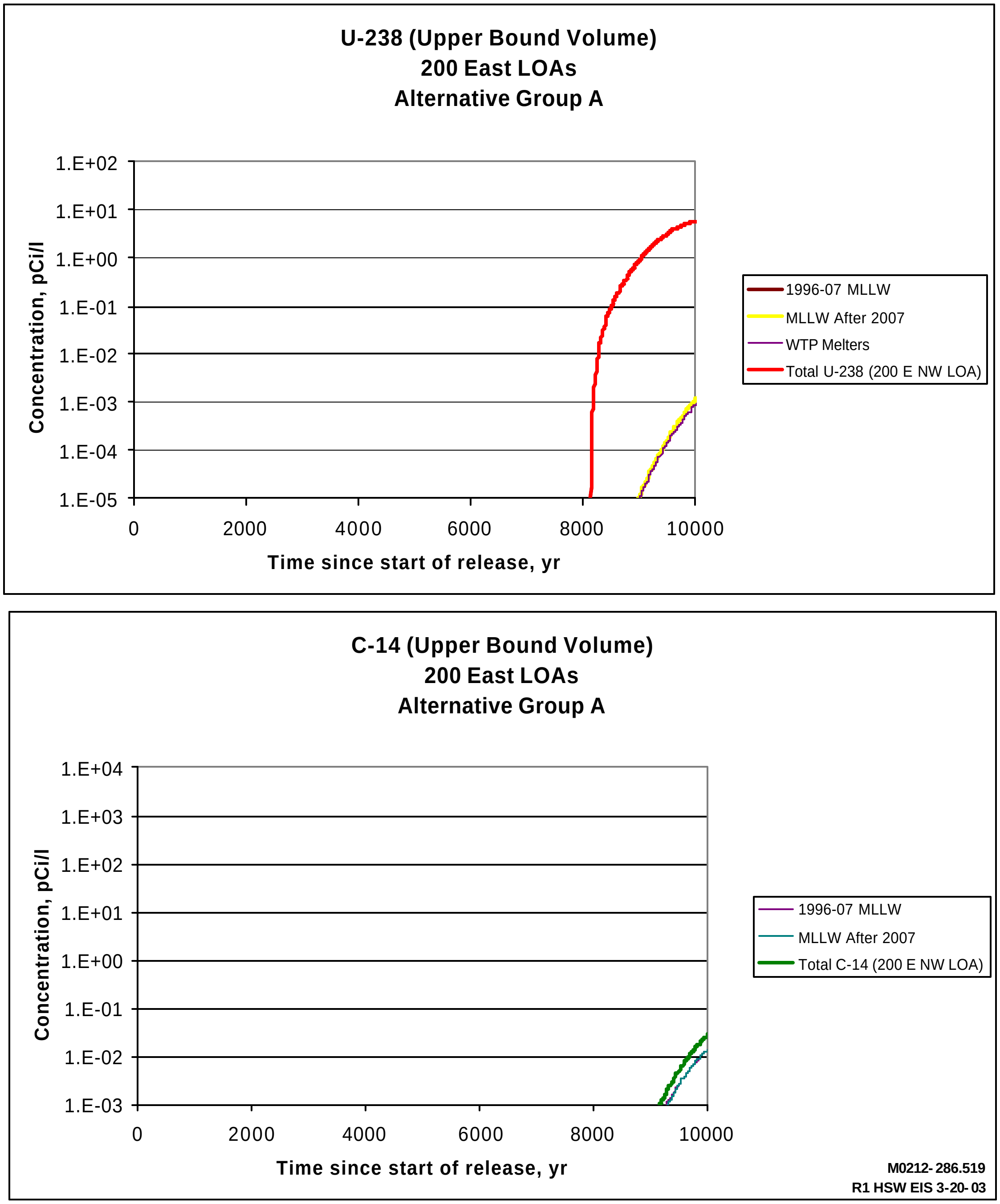
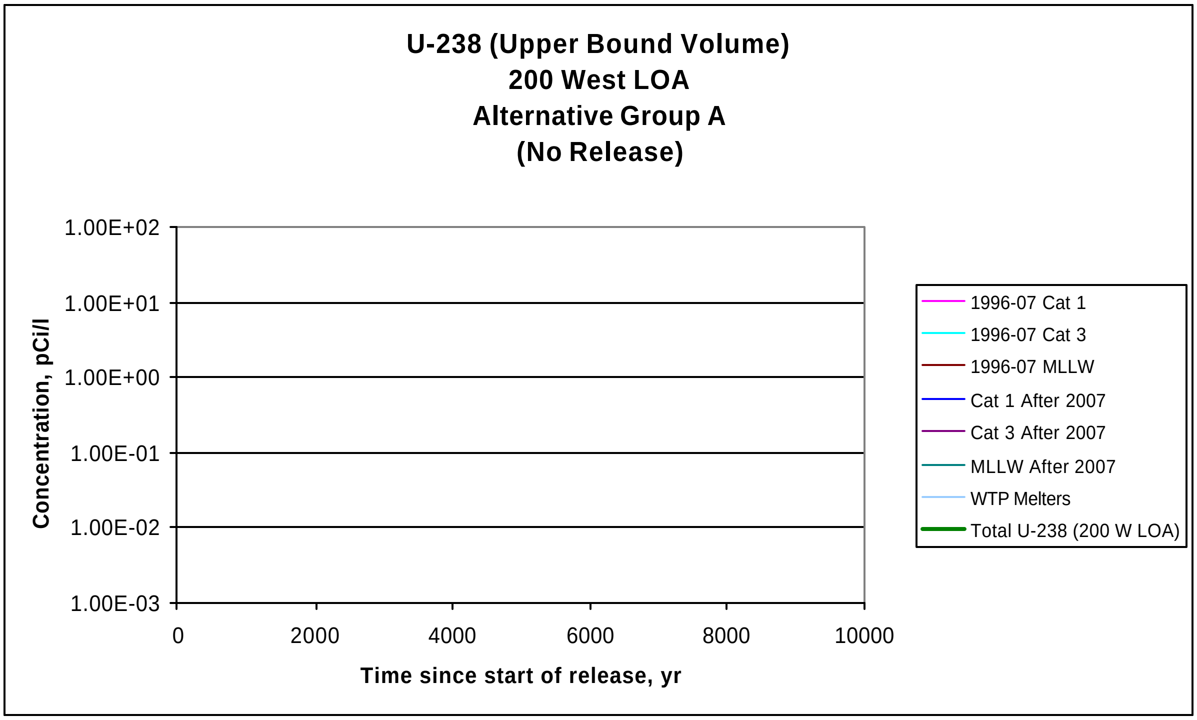


Figure G.26. U-238 and C-14 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group A – Upper Bound Volume Wastes Disposed of After 1995)



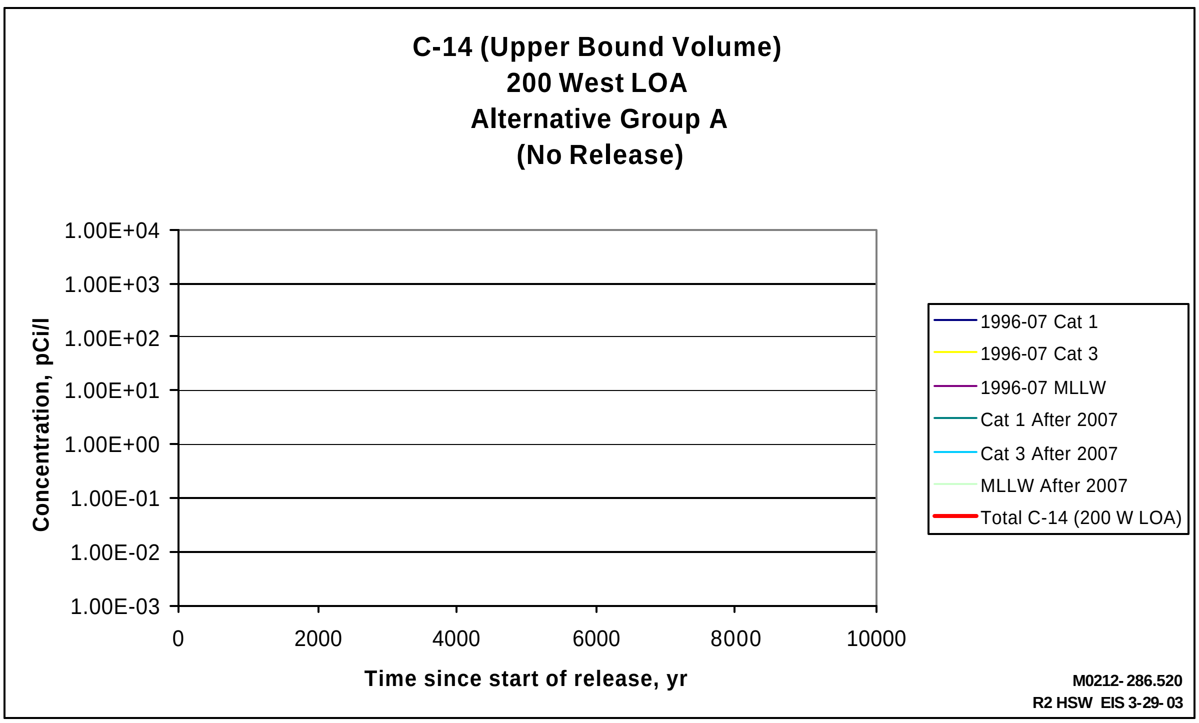


Figure G.27. U-238 and C-14 Concentration Profiles at 1-km Line of Analysis (200 West) (Alternative Group A – Upper Bound Volume Wastes Disposed of After 1995)

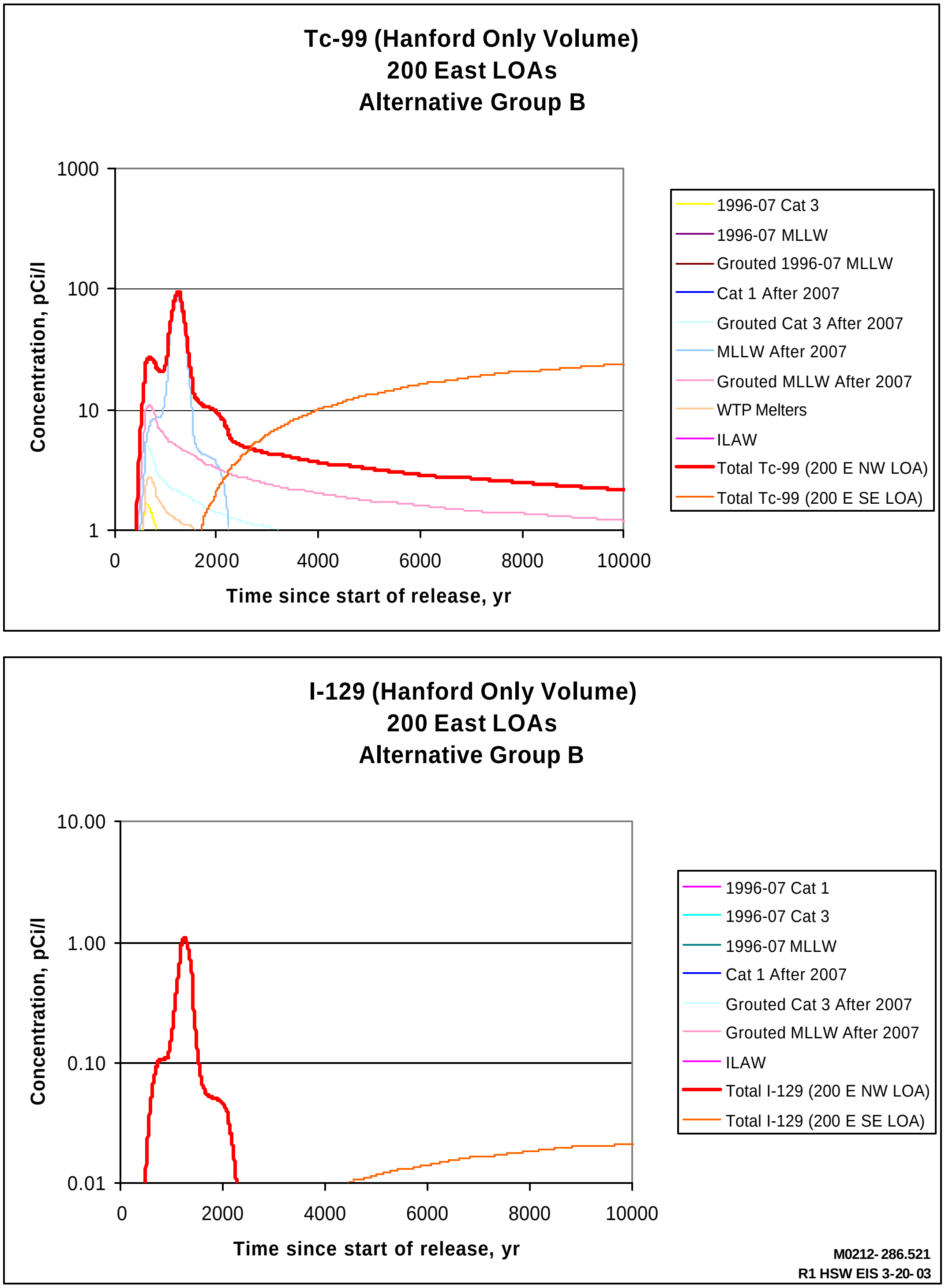
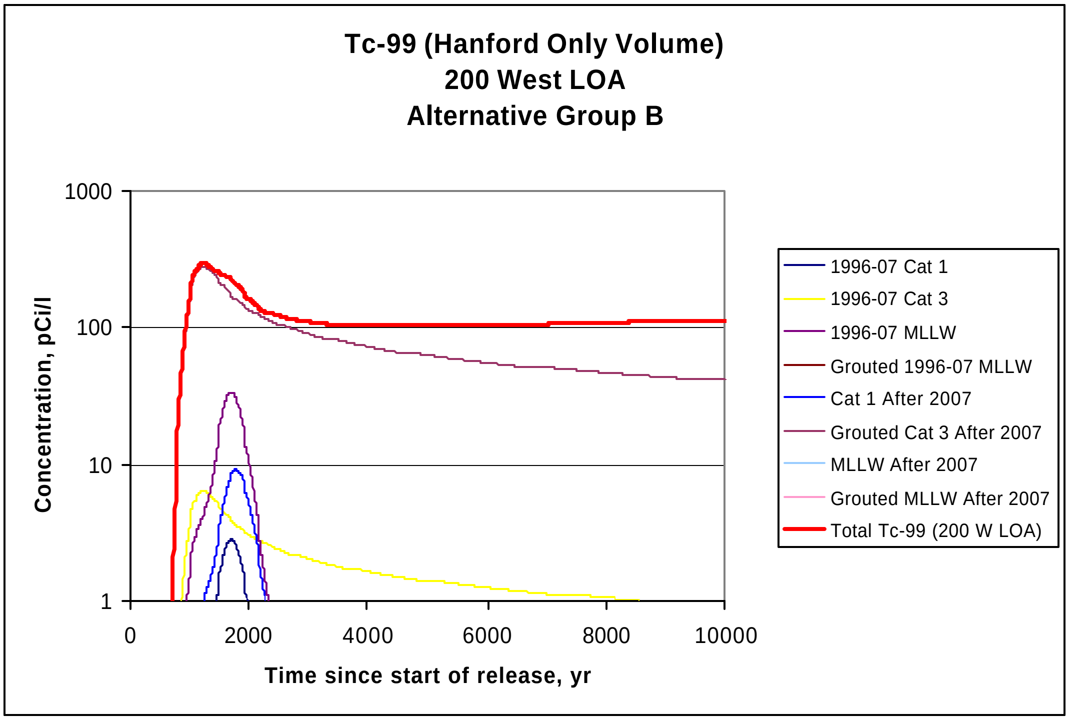


Figure G.28. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group B – Hanford Only Wastes Disposed of After 1995)



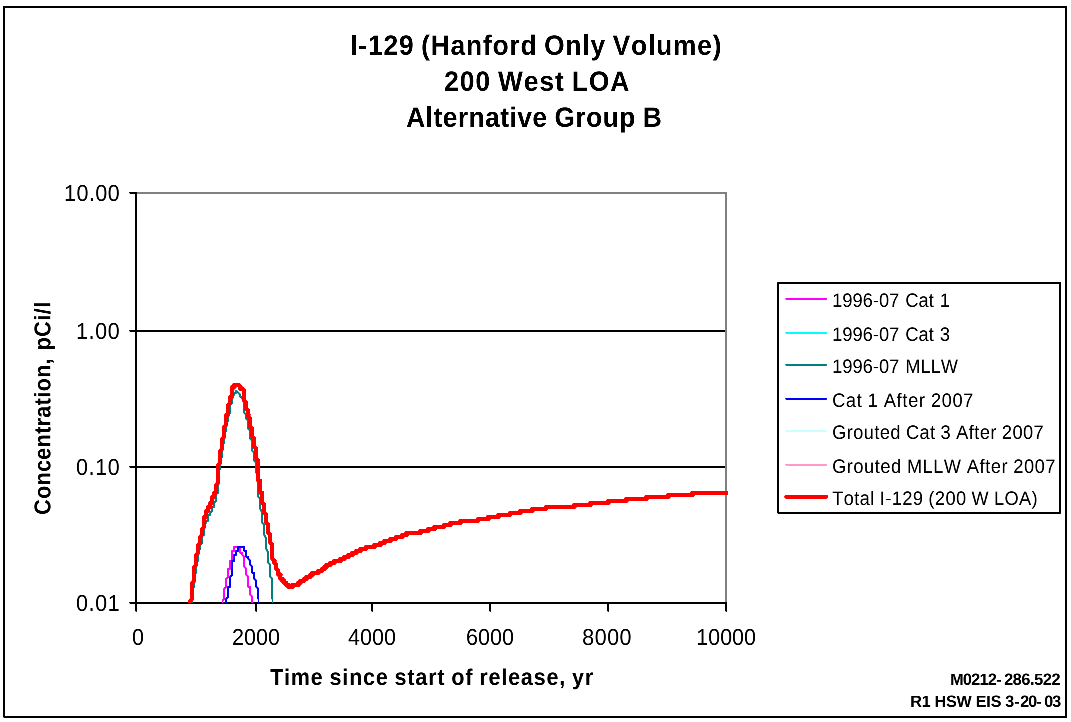


Figure G.29. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 West) (Alternative Group B – Hanford Only Wastes Disposed of After 1995)

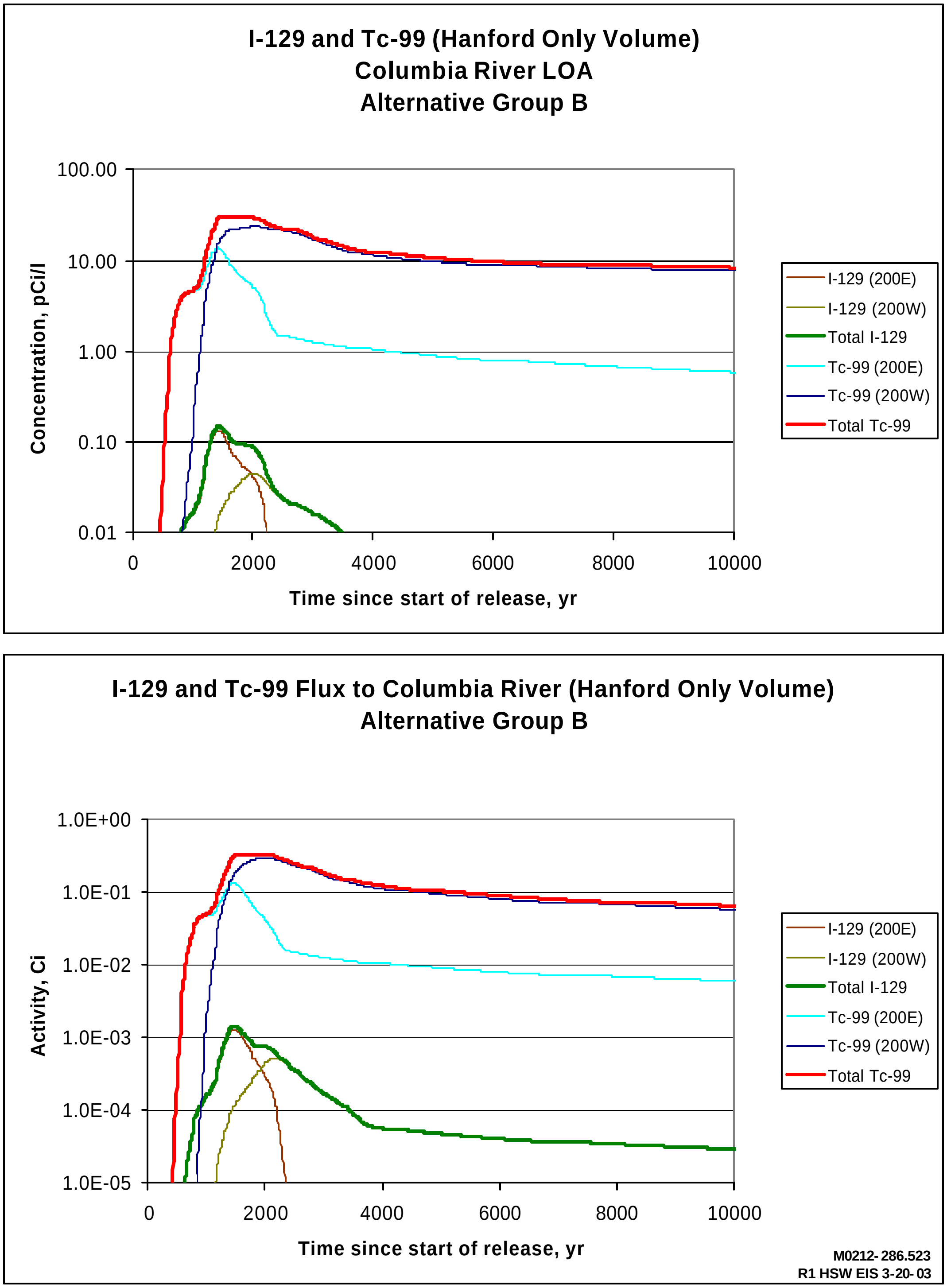


Figure G.30. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River (Alternative Group B – Hanford Only Wastes Disposed of After 1995)

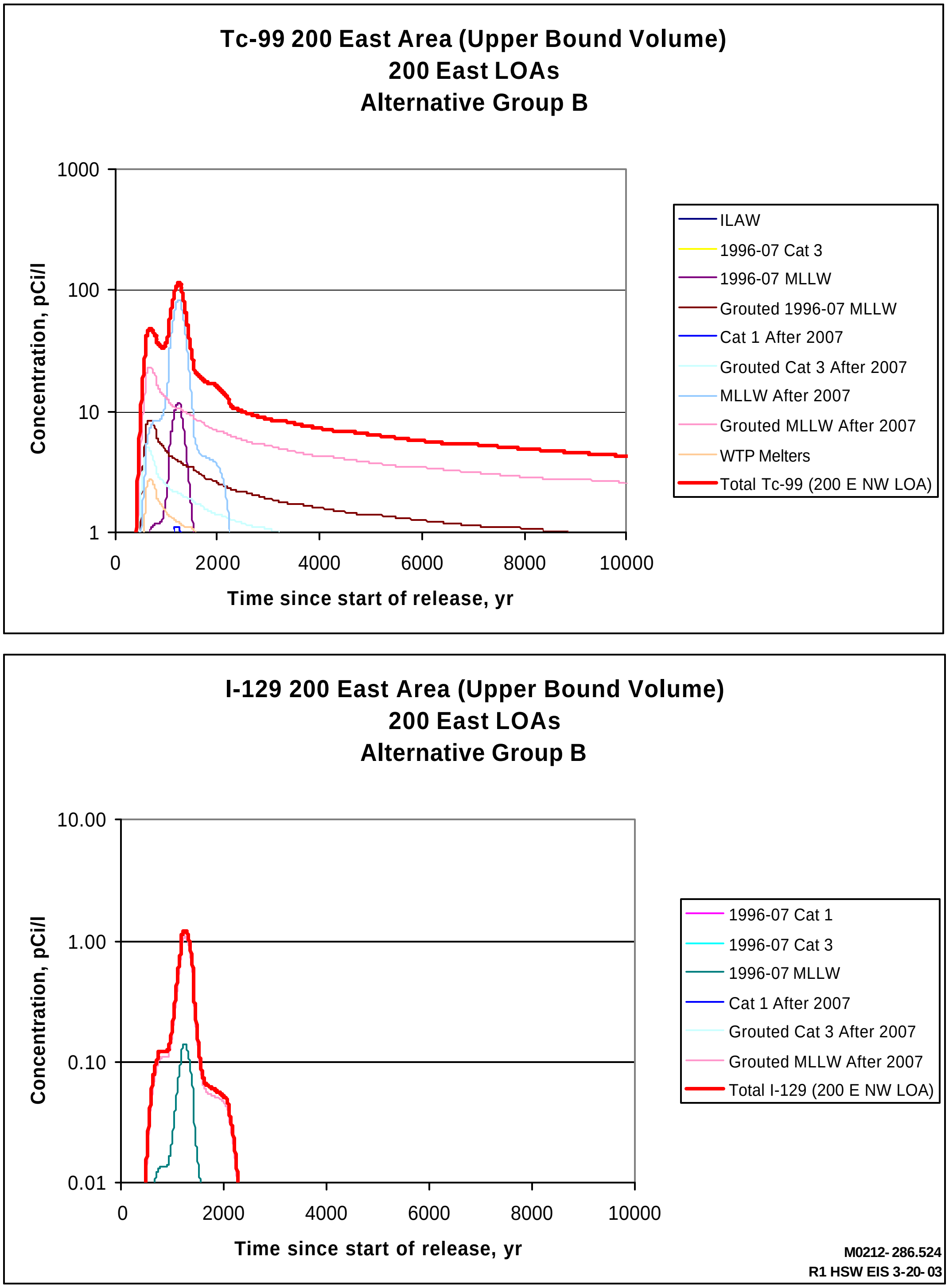


Figure G.31. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group B – Upper Bound Volume Wastes Disposed of After 1995)

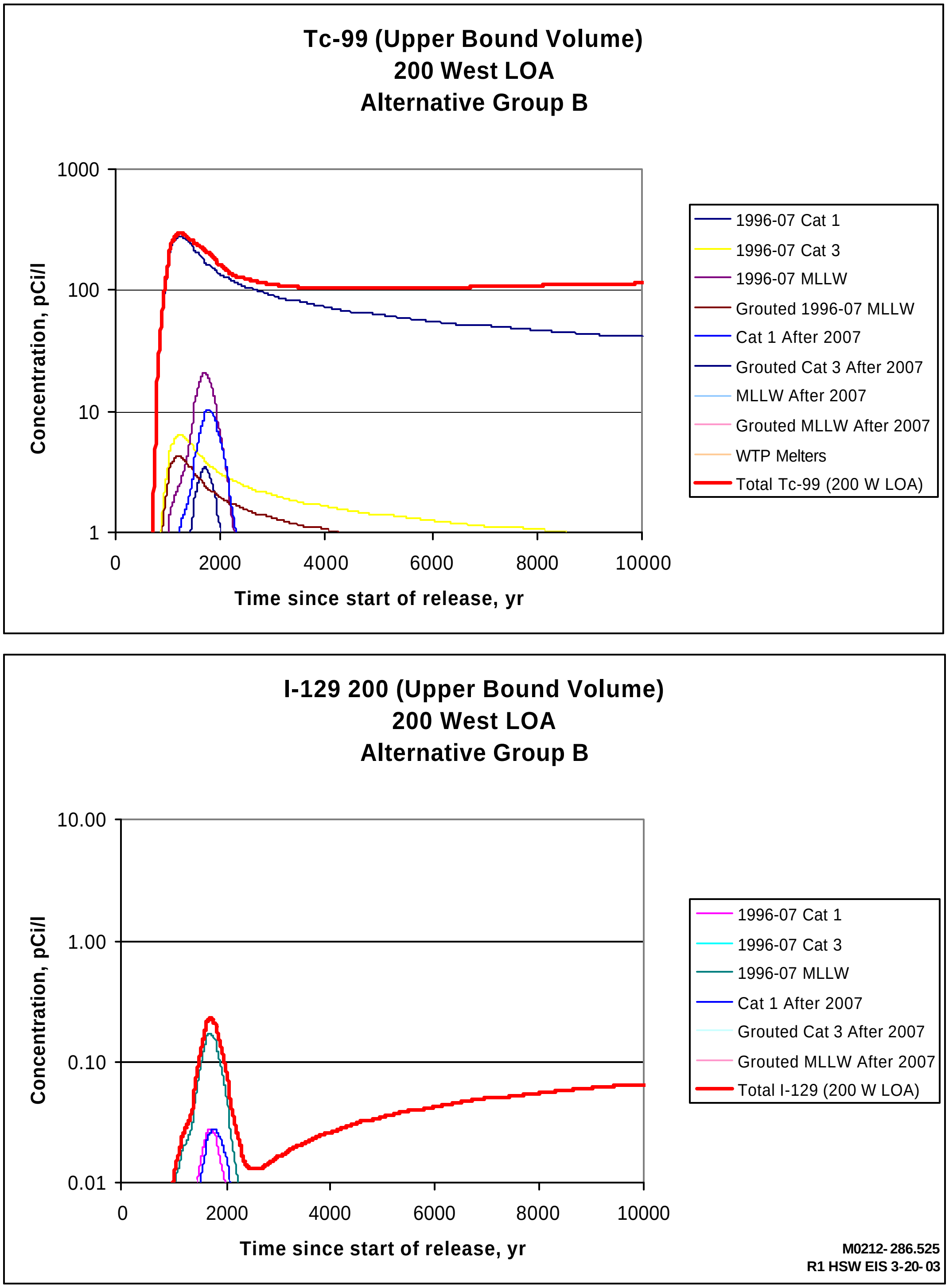


Figure G.32. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 West) (Alternative Group B – Upper Bound Volume Wastes Disposed of After 1995)

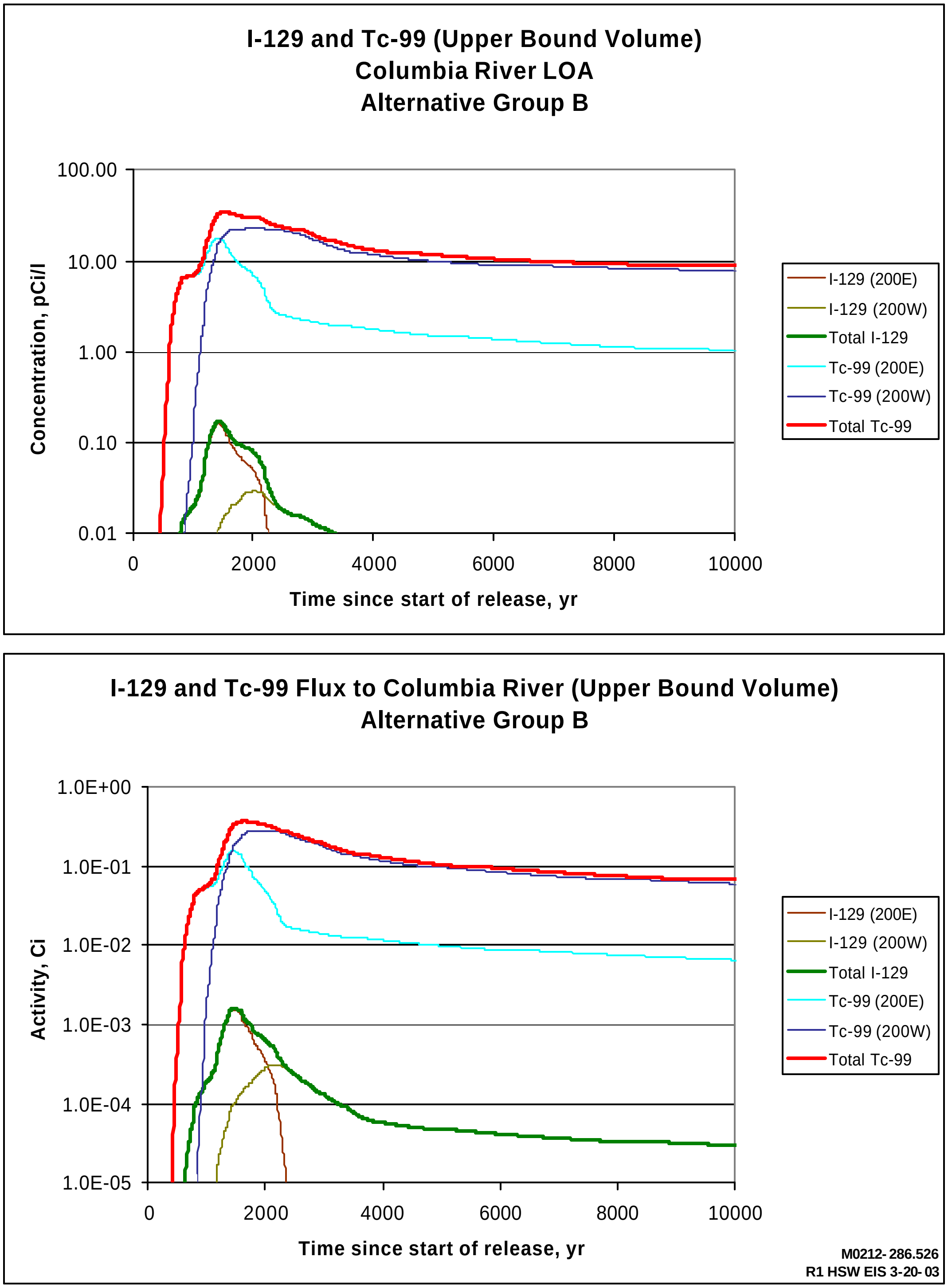
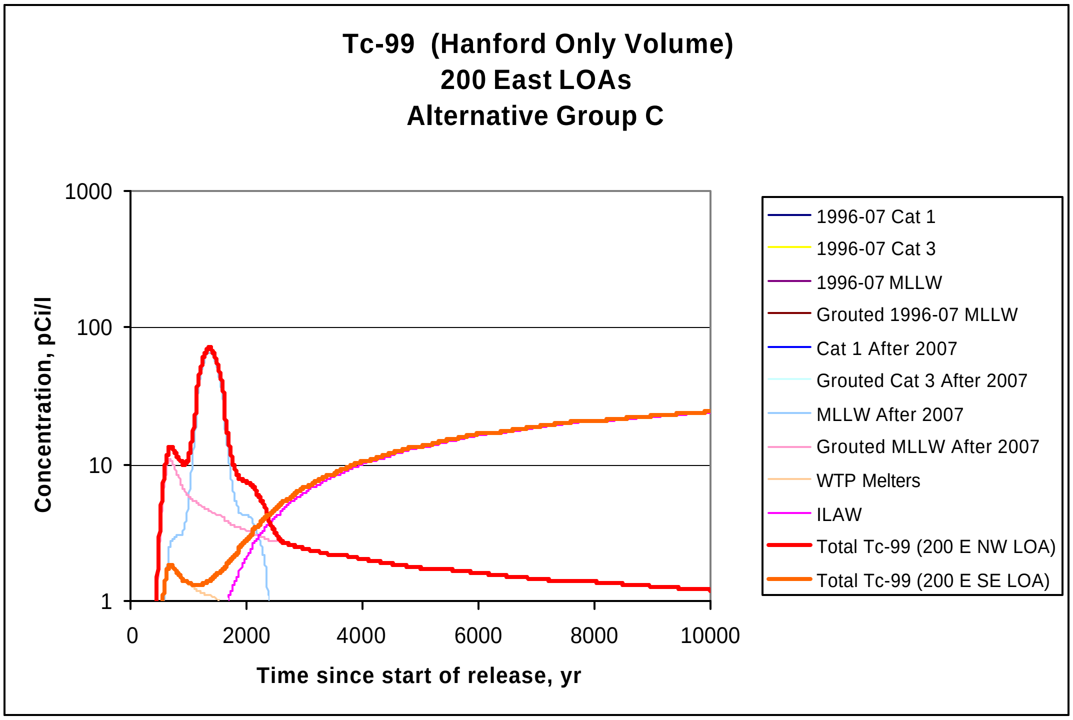


Figure G.33. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River (Alternative Group B – Upper Bound Volume Wastes Disposed of After 1995)



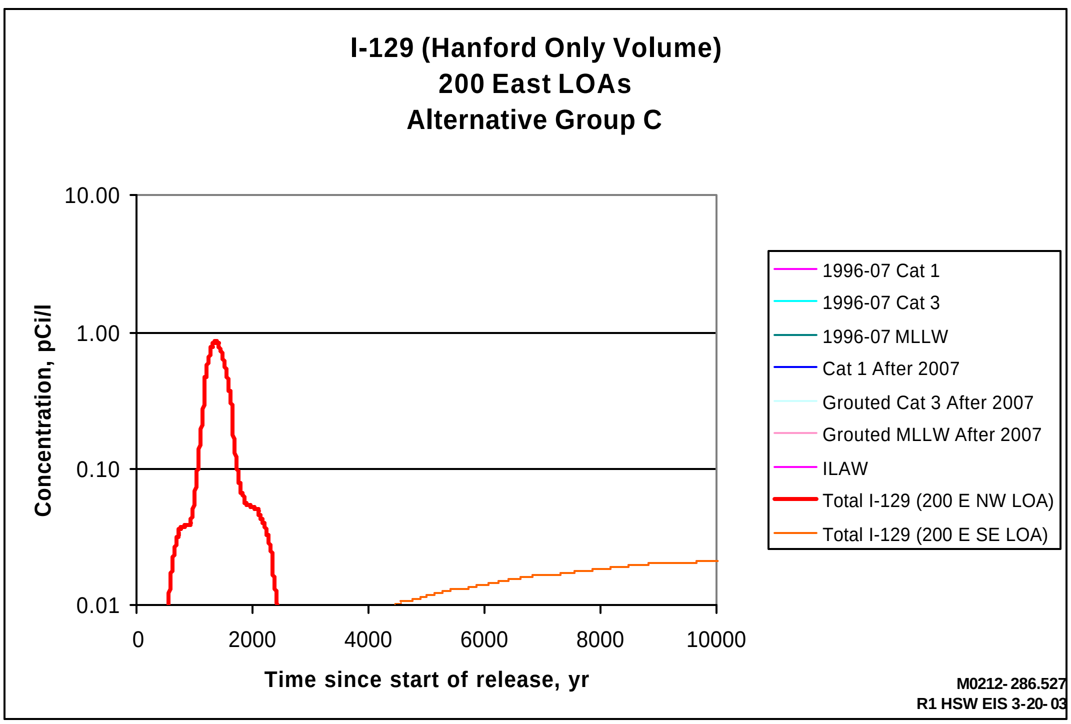
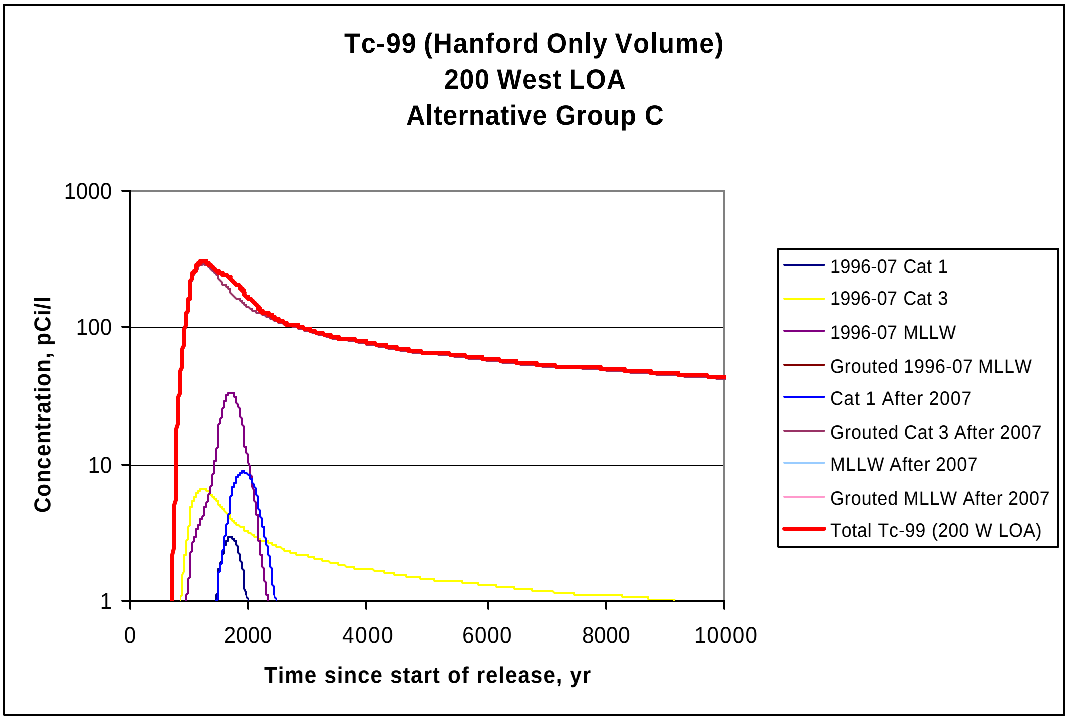


Figure G.34. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group C – Hanford Only Wastes Disposed of After 1995)



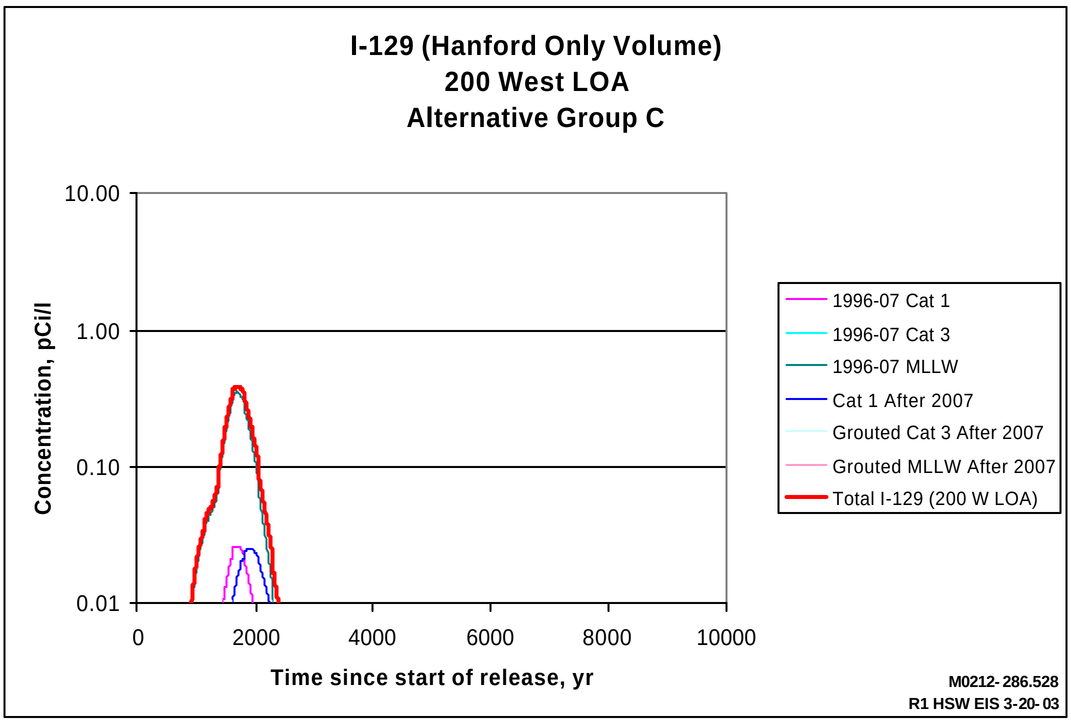
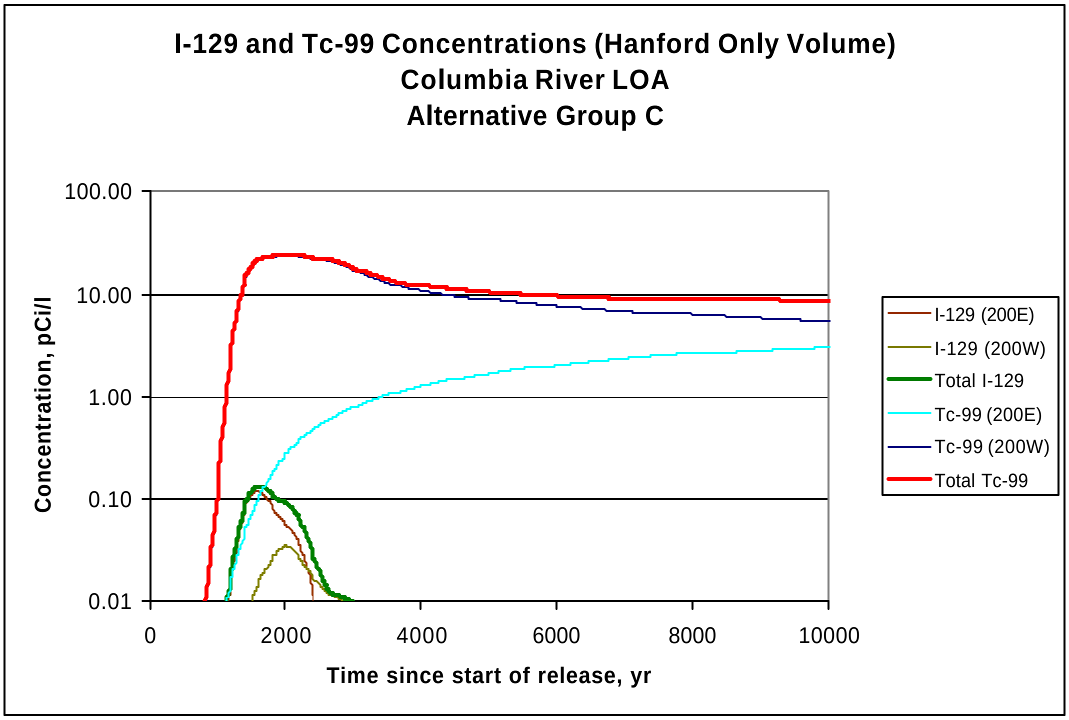


Figure G.35. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 West) (Alternative Group C – Hanford Only Wastes Disposed of After 1995)



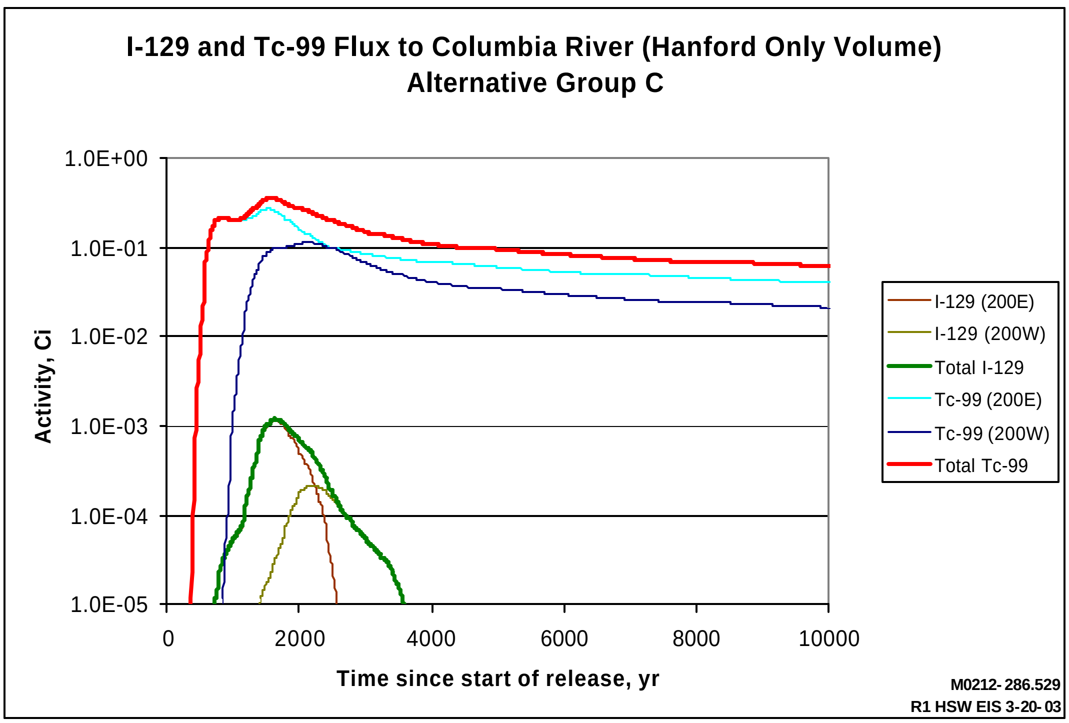


Figure G.36. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River (Alternative Group C – Hanford Only Wastes Disposed of After 1995)

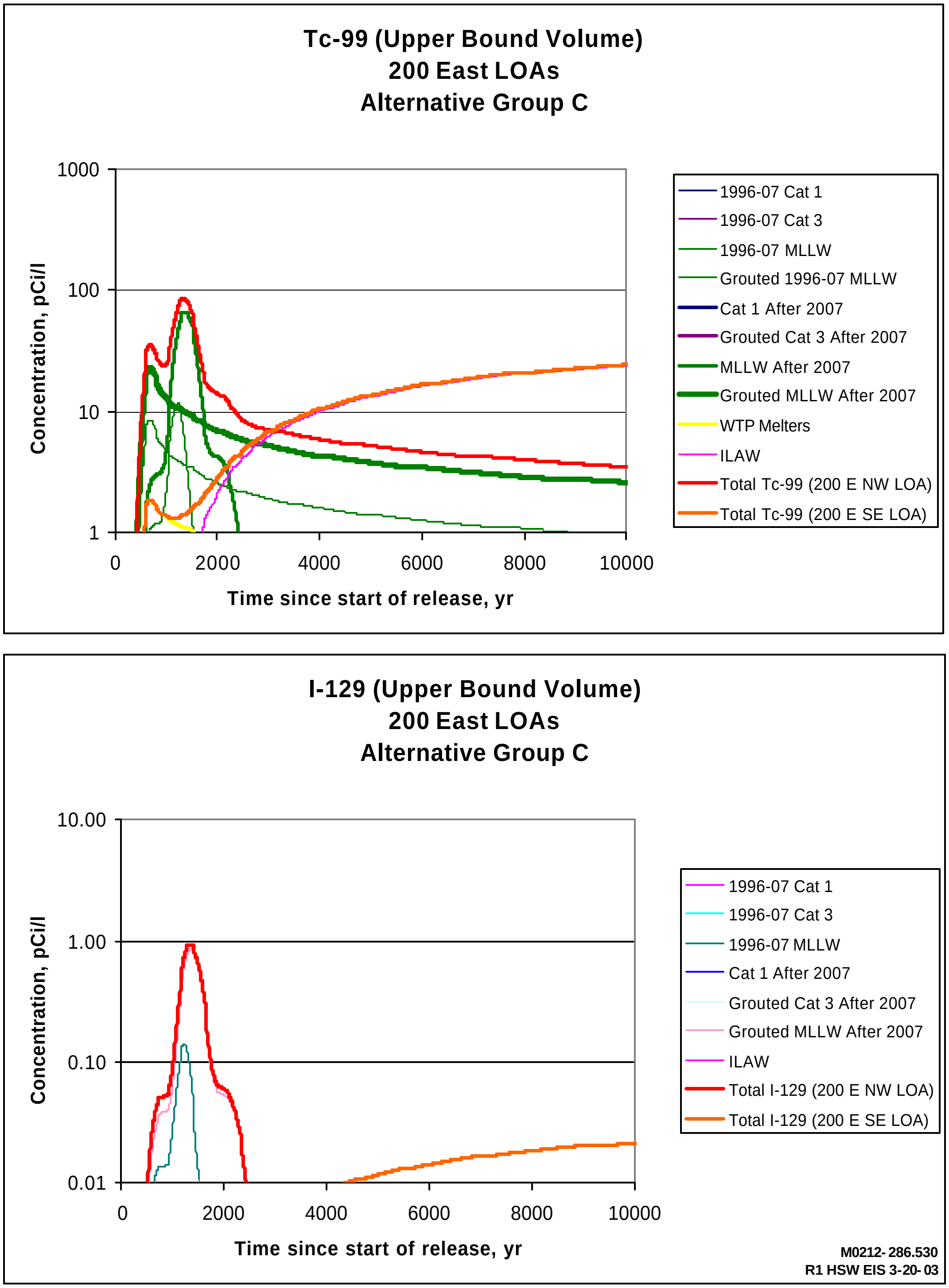


Figure G.37. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group C – Upper Bound Volume Wastes Disposed of After 1995)

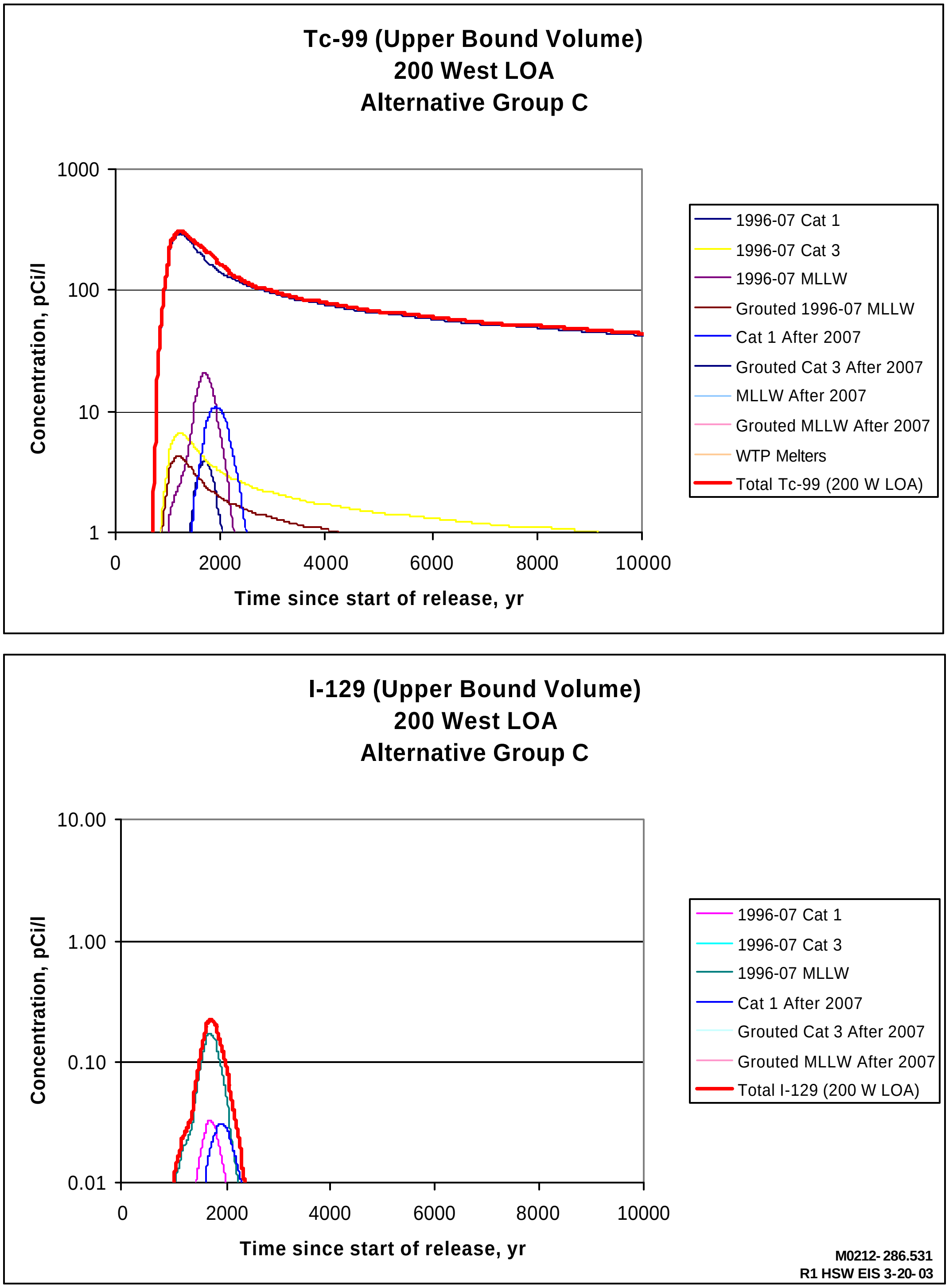


Figure G.38. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 West) (Alternative Group C – Upper Bound Volume Wastes Disposed of After 1995)

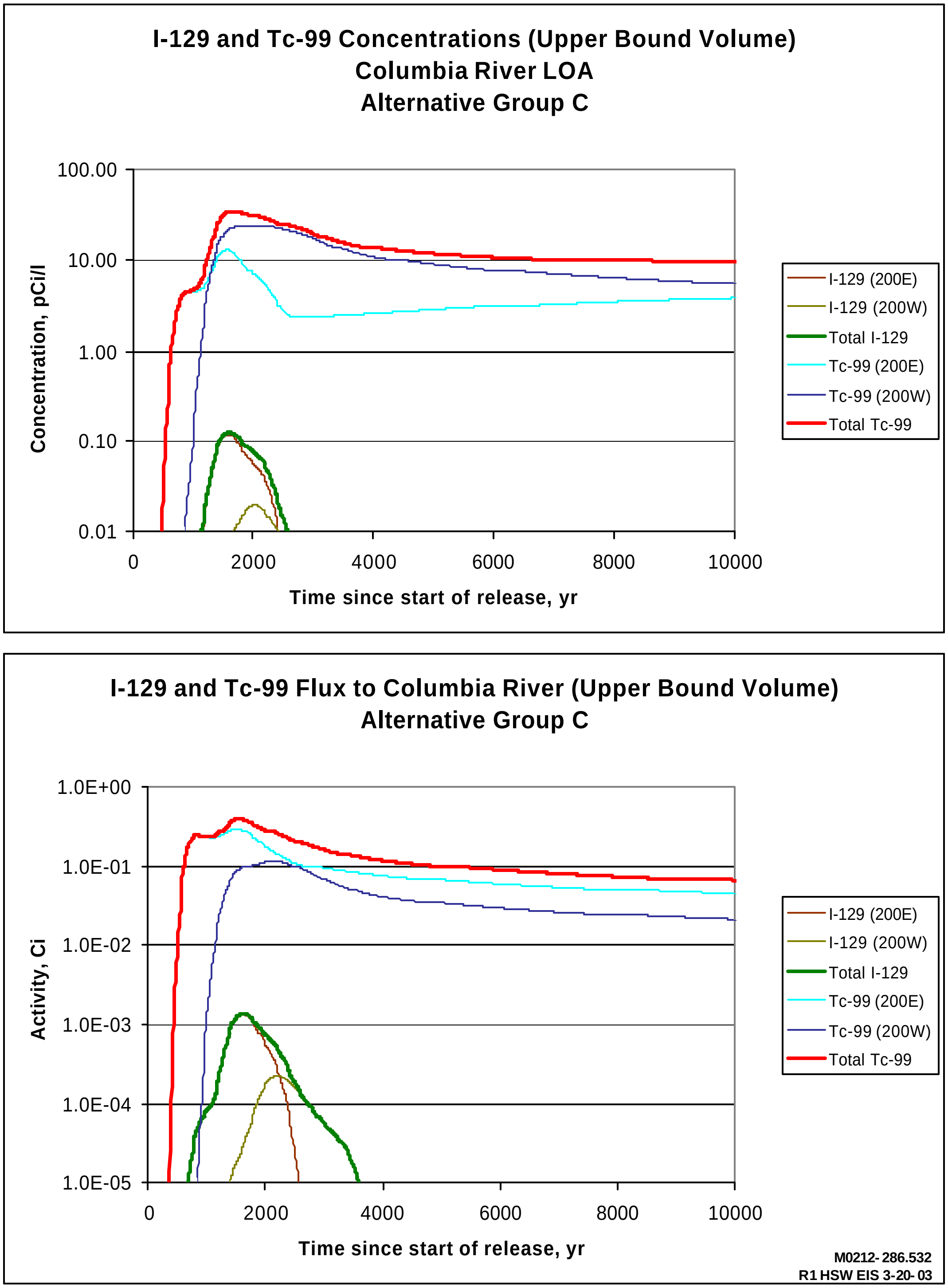


Figure G.39. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River (Alternative Group C – Upper Bound Volume Wastes Disposed of After 1995)

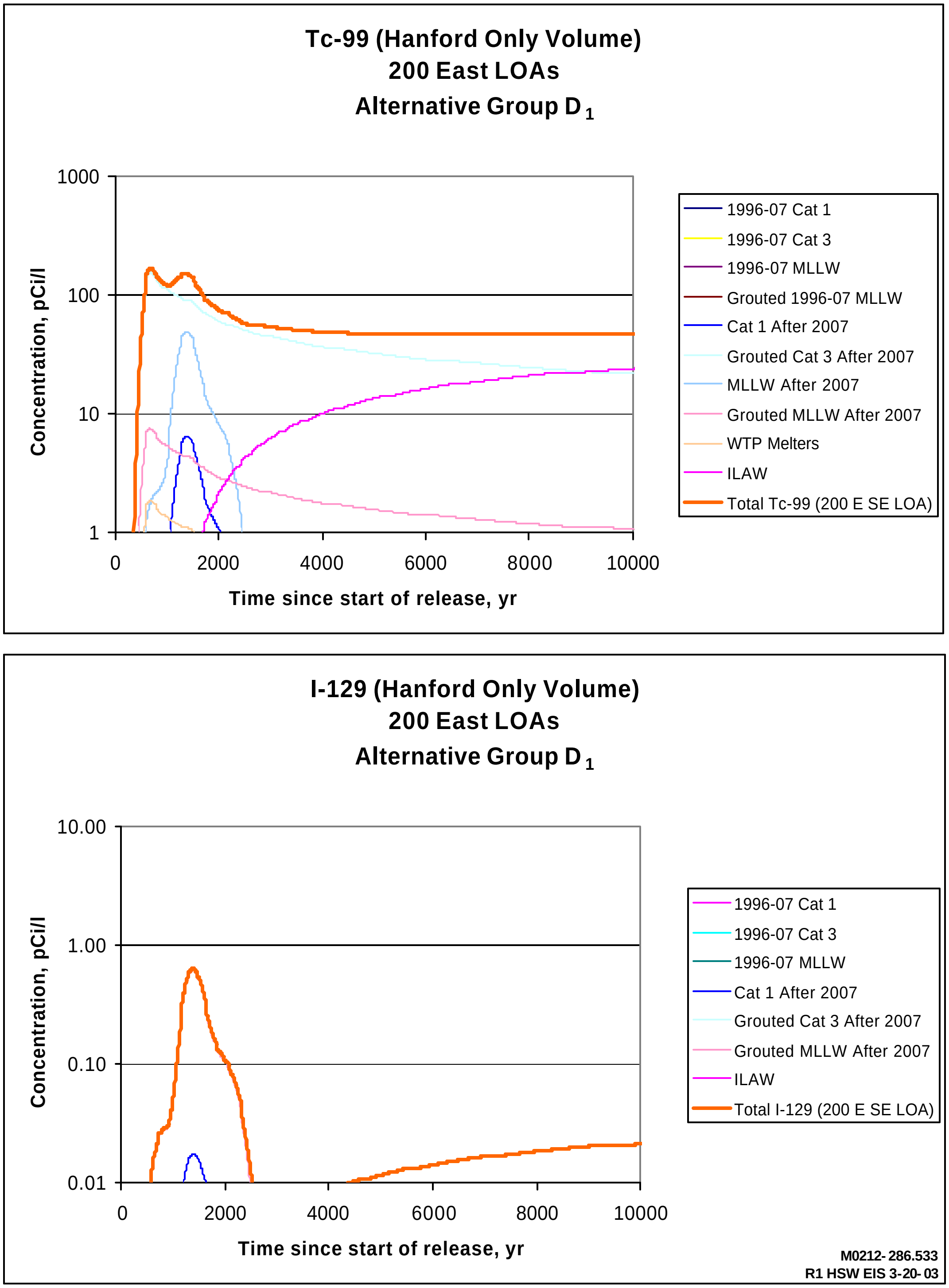


Figure G.40. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group D_1 – Hanford Only Wastes Disposed of After 1995)

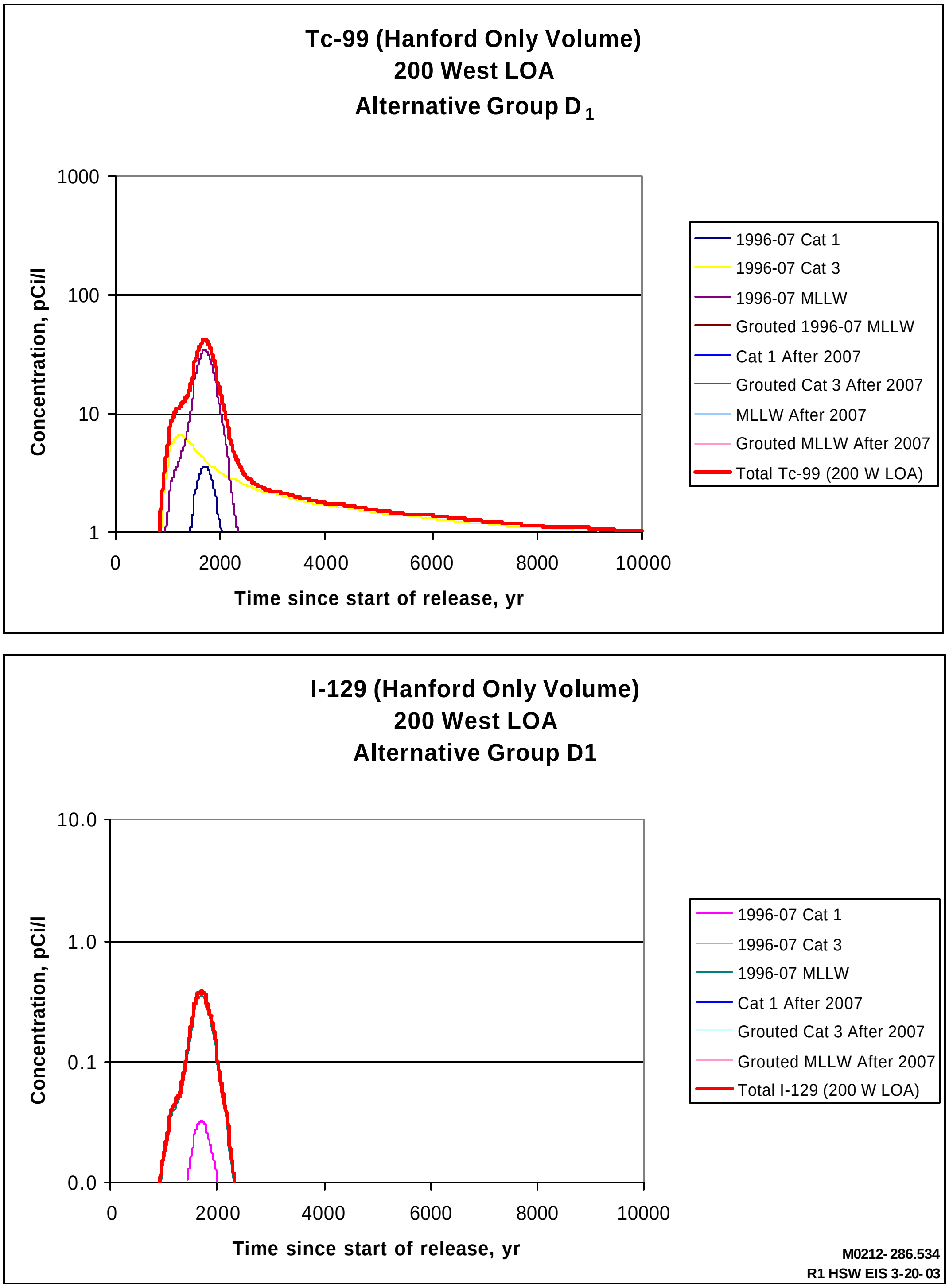
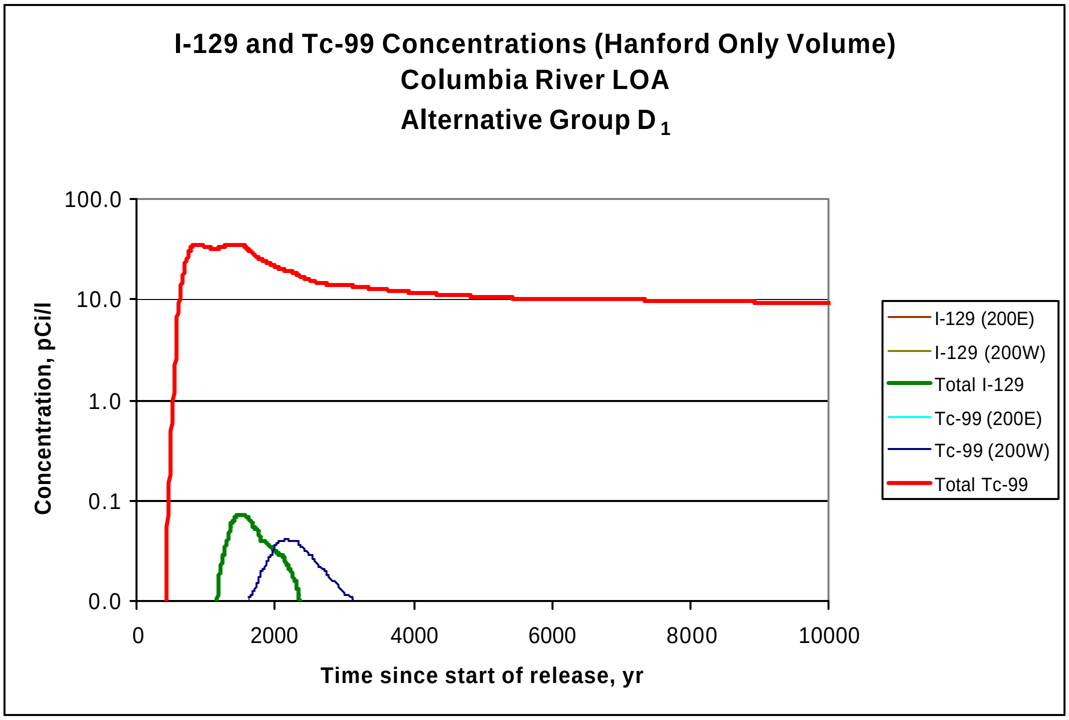


Figure G.41. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 West) (Alternative Group D_1 – Hanford Only Wastes Disposed of After 1995)



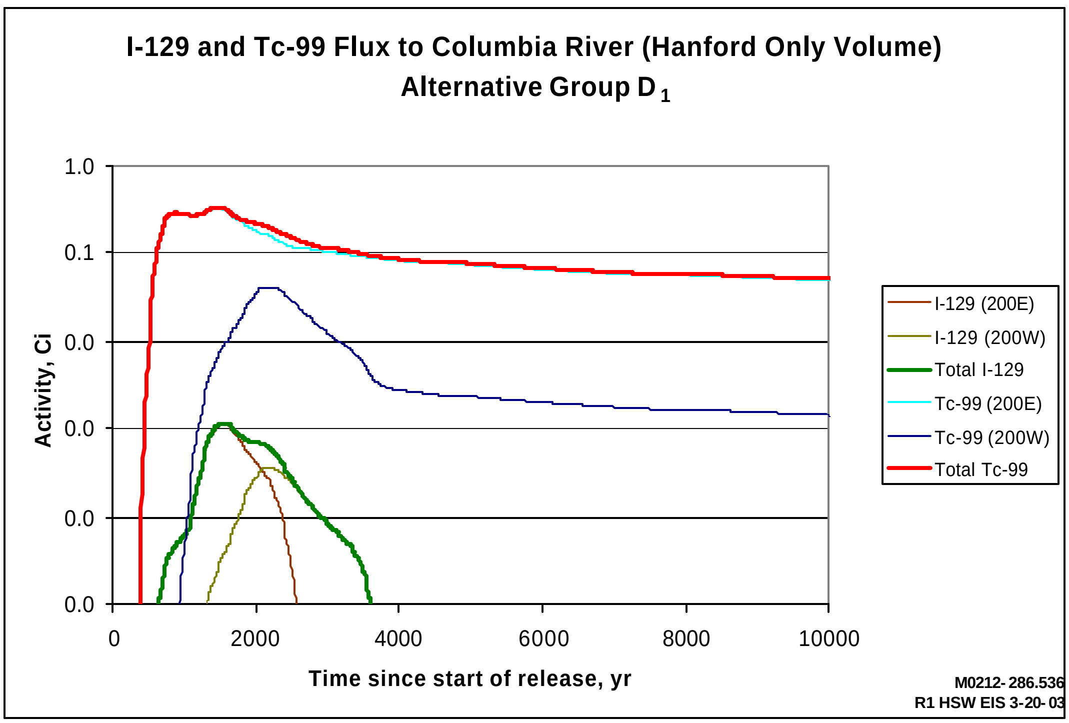


Figure G.42. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River (Alternative Group D_1 – Hanford Only Wastes Disposed of After 1995)

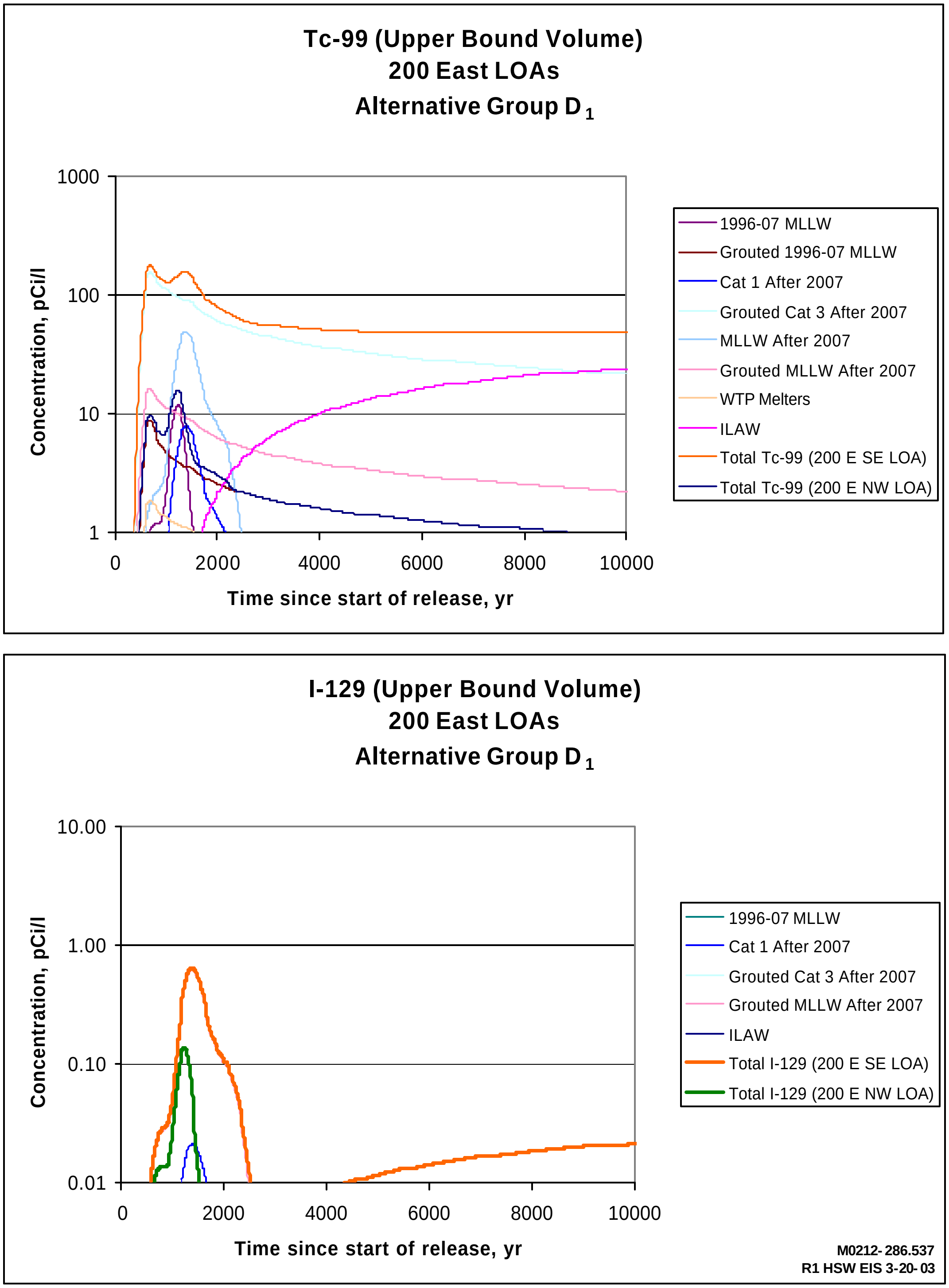


Figure G.43. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group D_1 – Upper Bound Volume Wastes Disposed of After 1995)

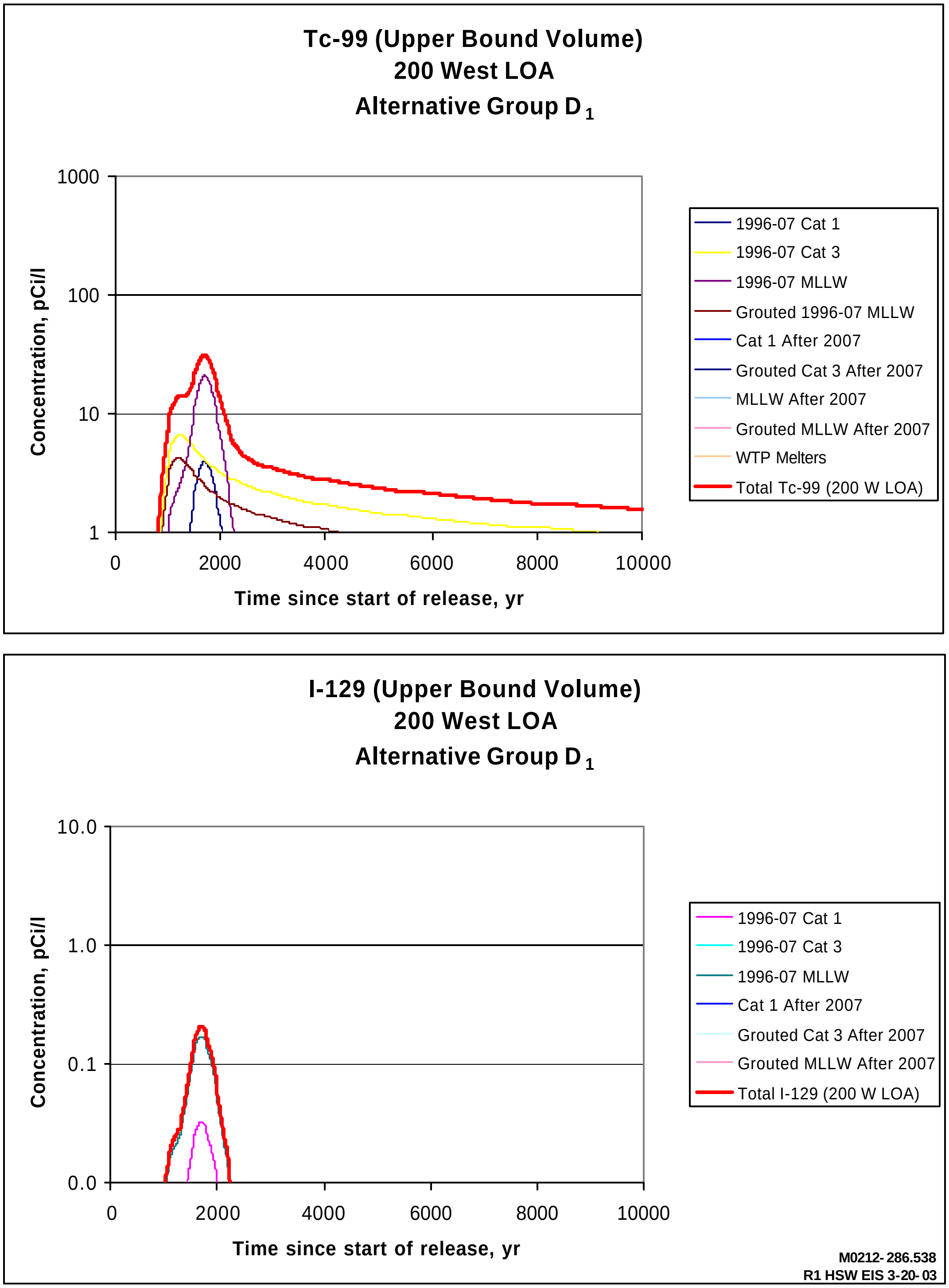
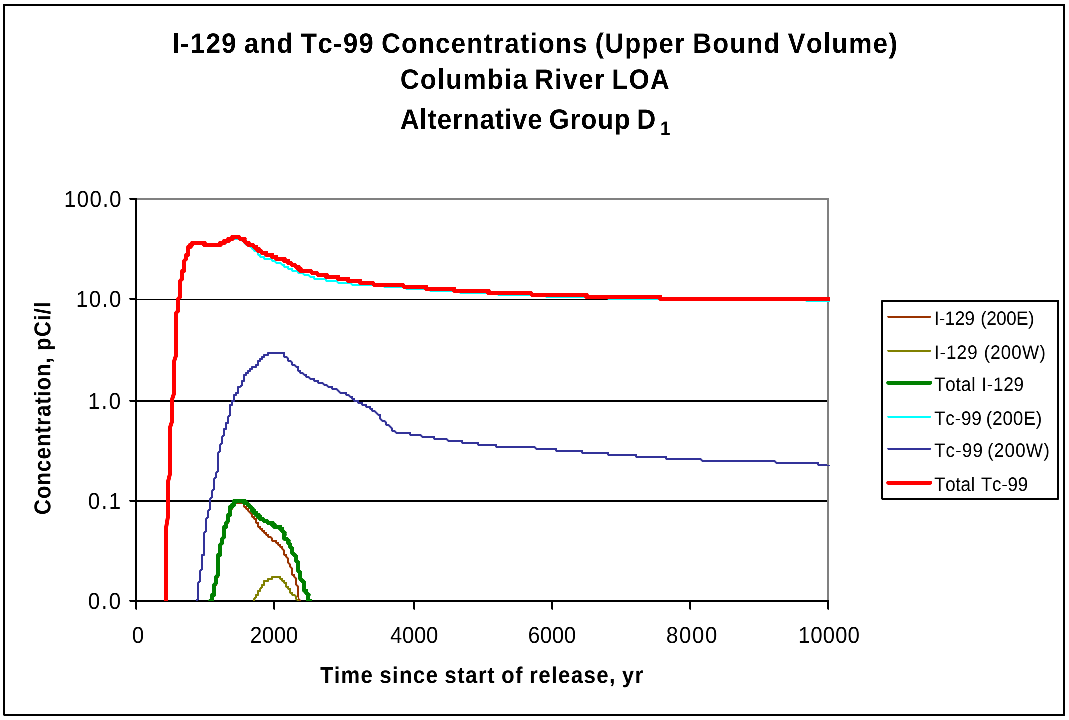


Figure G.44. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 West) (Alternative Group D_1 – Upper Bound Volume Wastes Disposed of After 1995)



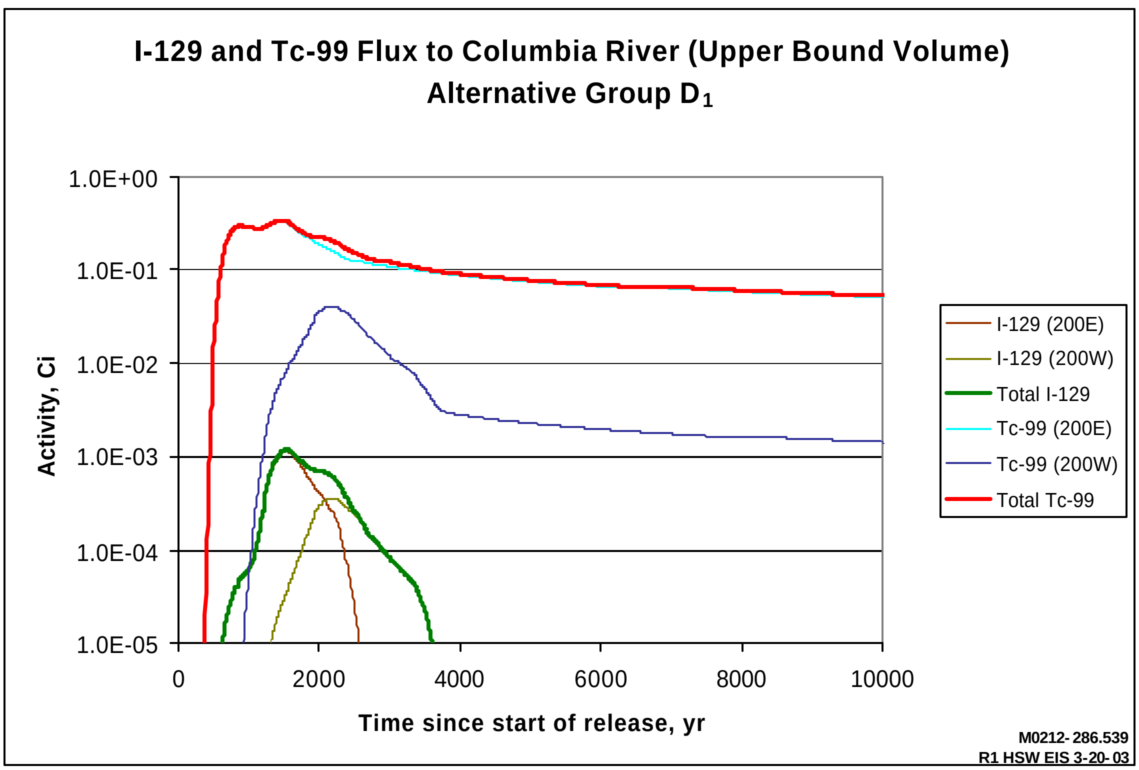


Figure G.45. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River (Alternative Group D_1 – Upper Bound Volume Wastes Disposed of After 1995)

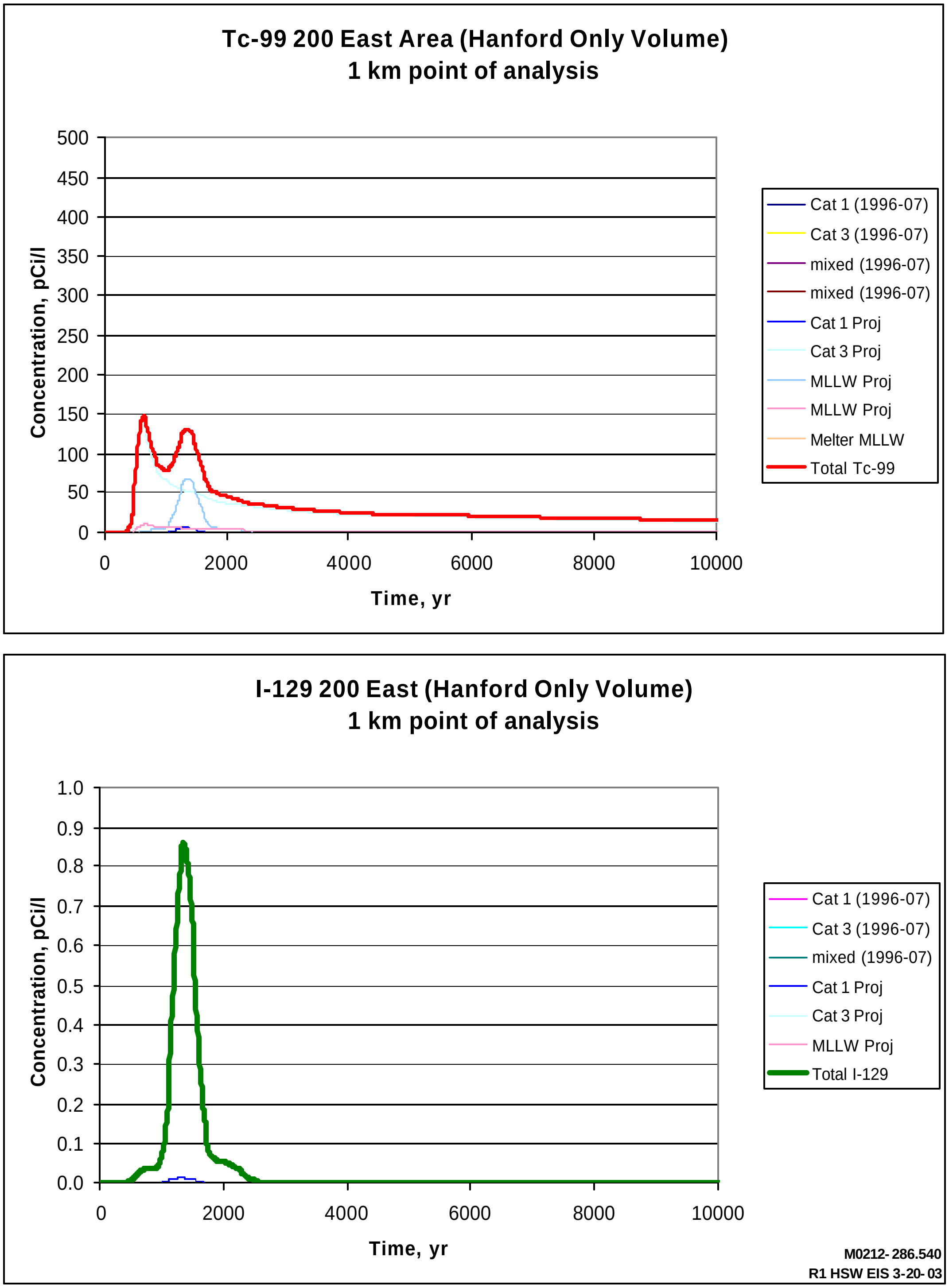


Figure G.46. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group D_2 – Hanford Only Wastes Disposed of After 1995)

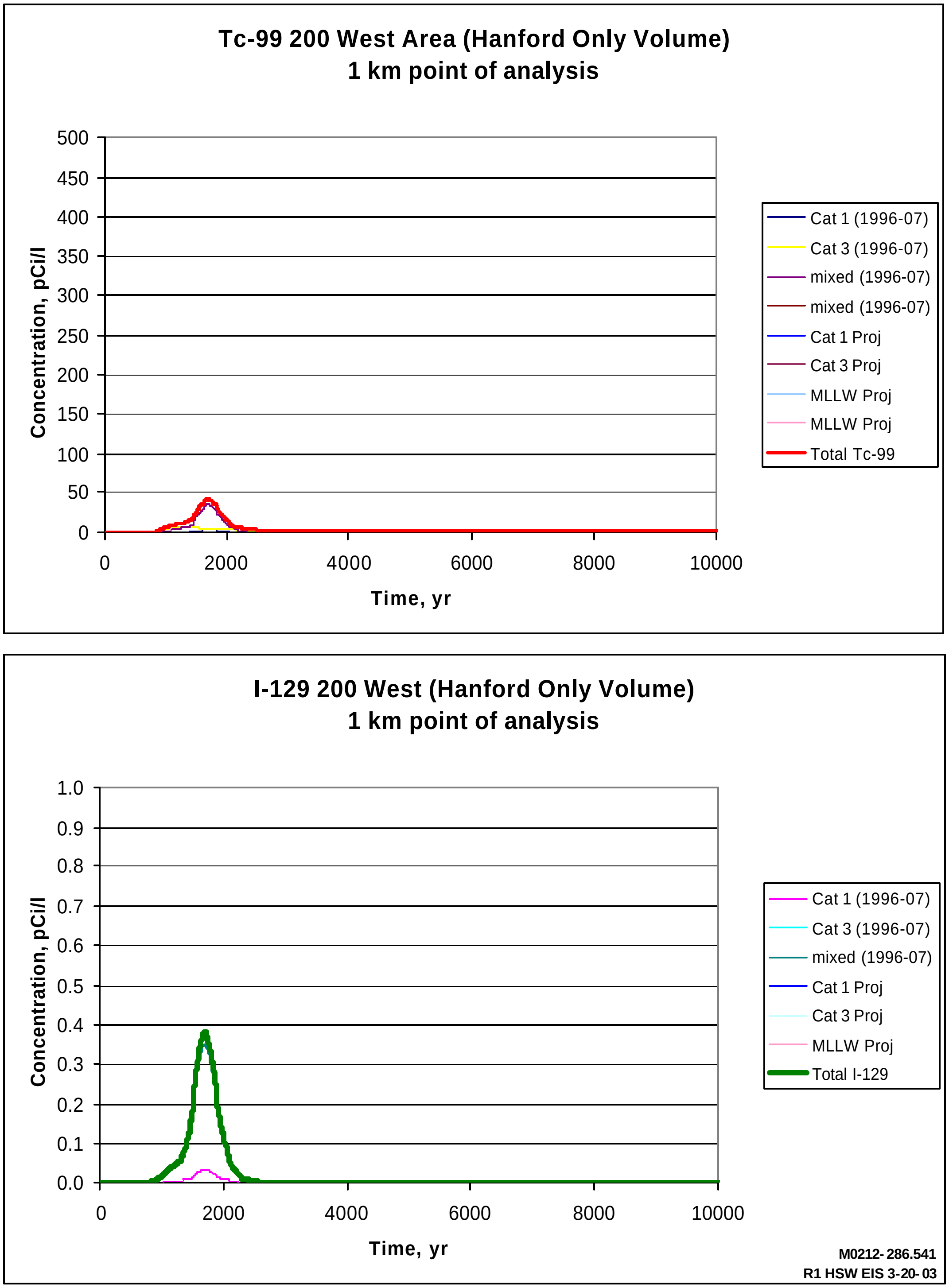


Figure G.47. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 West) (Alternative Group D_2 – Hanford Only Wastes Disposed of After 1995)

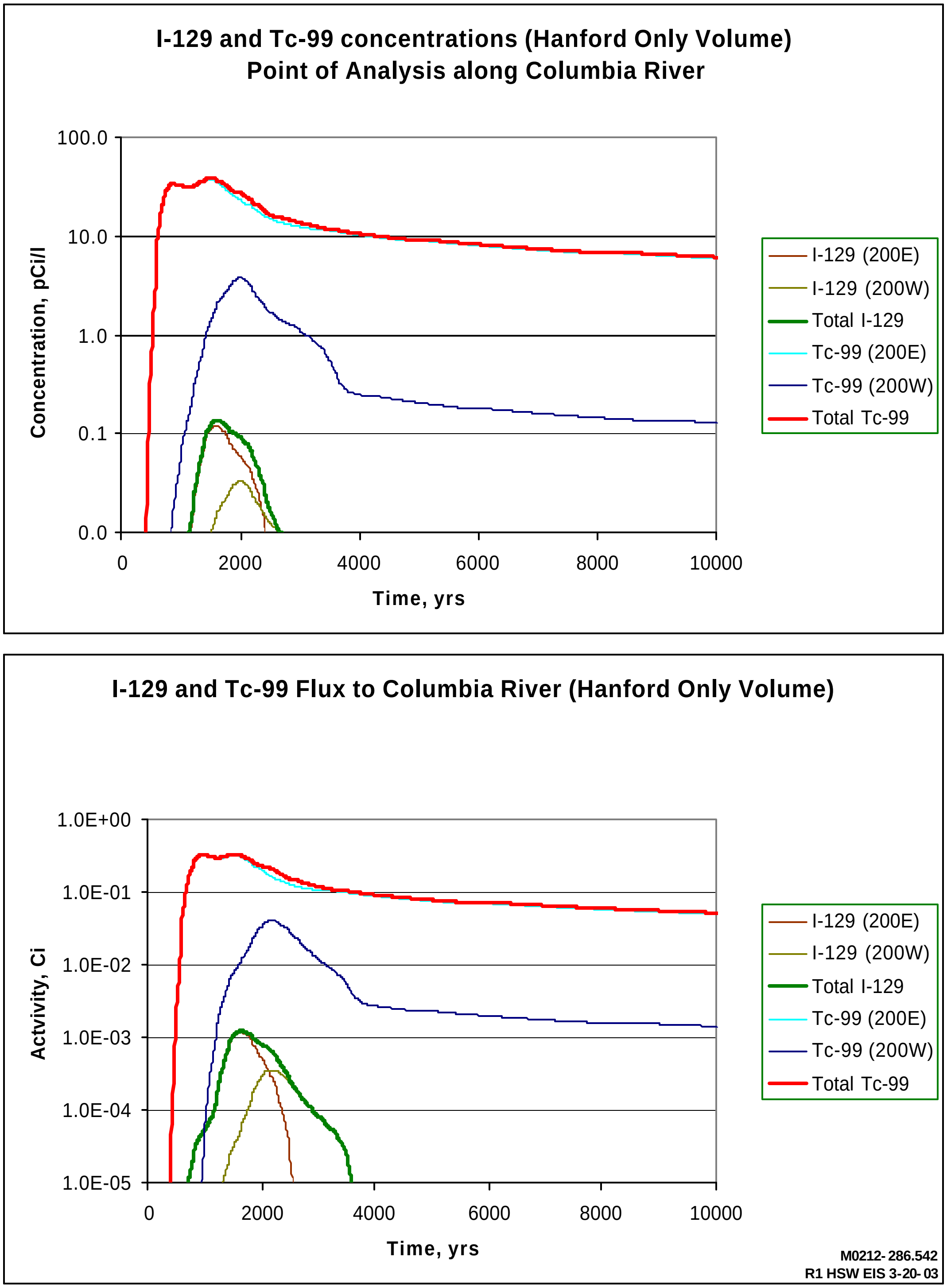


Figure G.48. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River (Alternative Group D_2 – Hanford Only Wastes Disposed of After 1995)

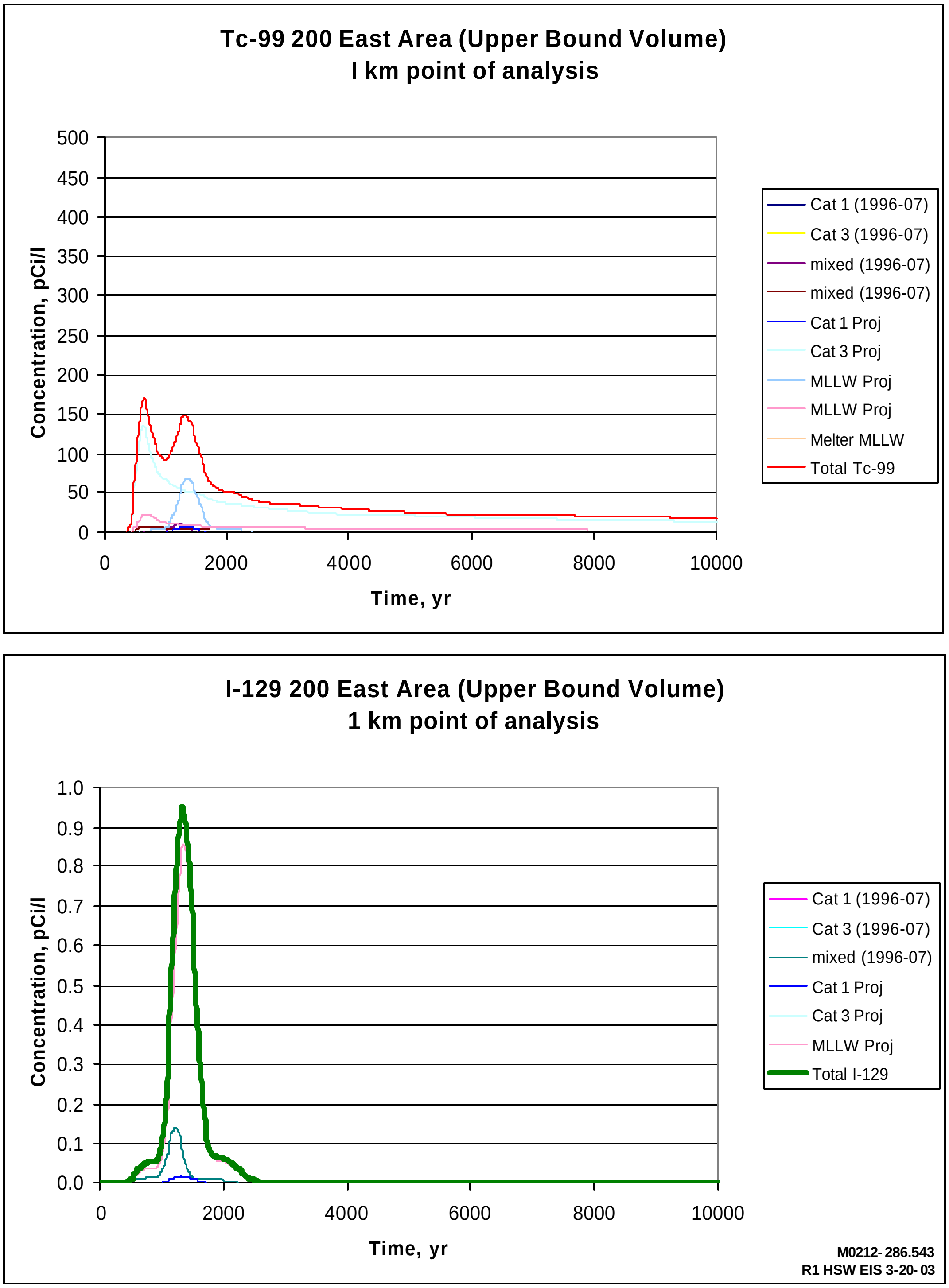


Figure G.49. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group D_2 – Upper Bound Volume Wastes Disposed of After 1995)

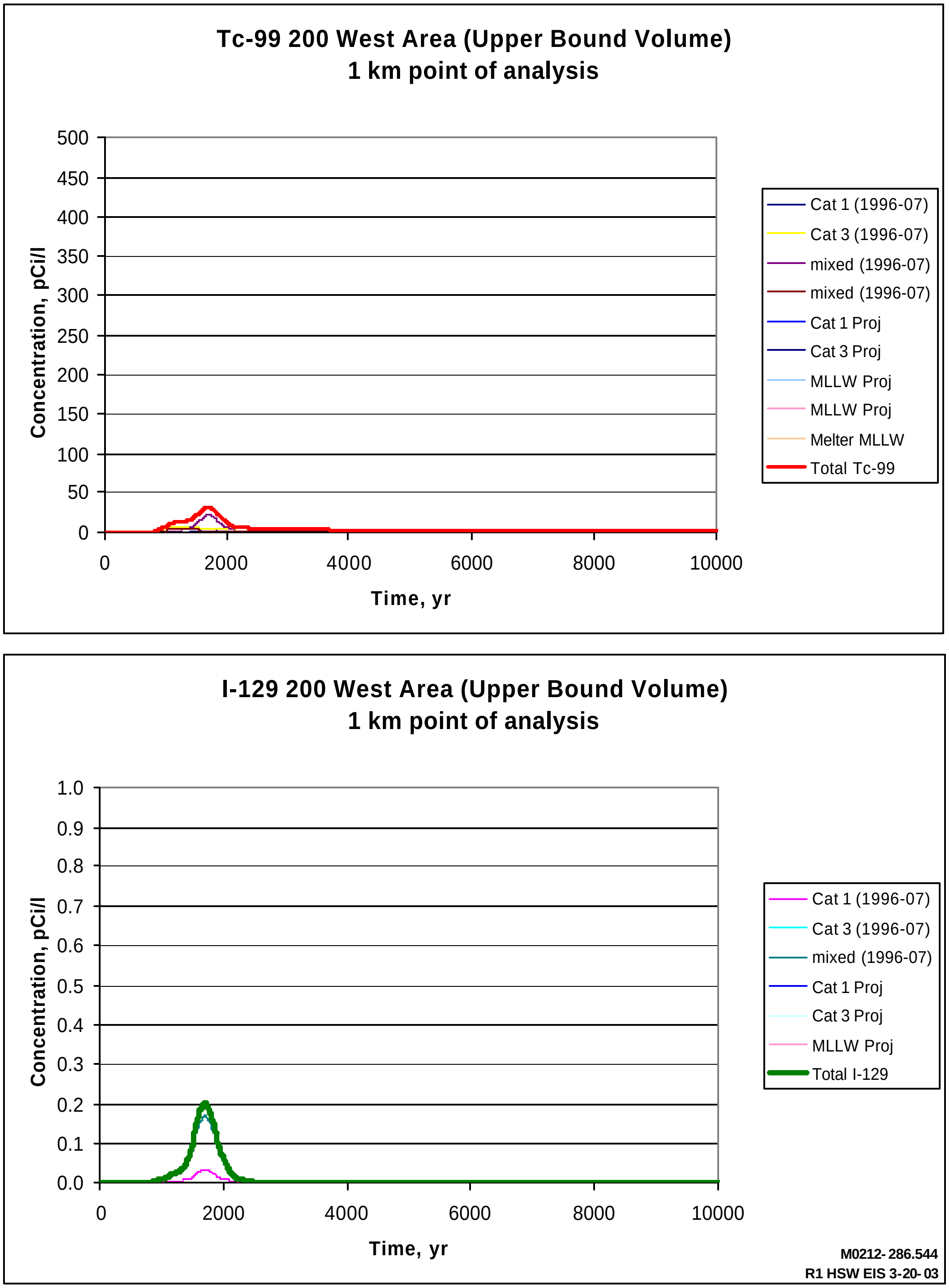


Figure G.50. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 West) (Alternative Group D_2 – Upper Bound Volume Wastes Disposed of After 1995)

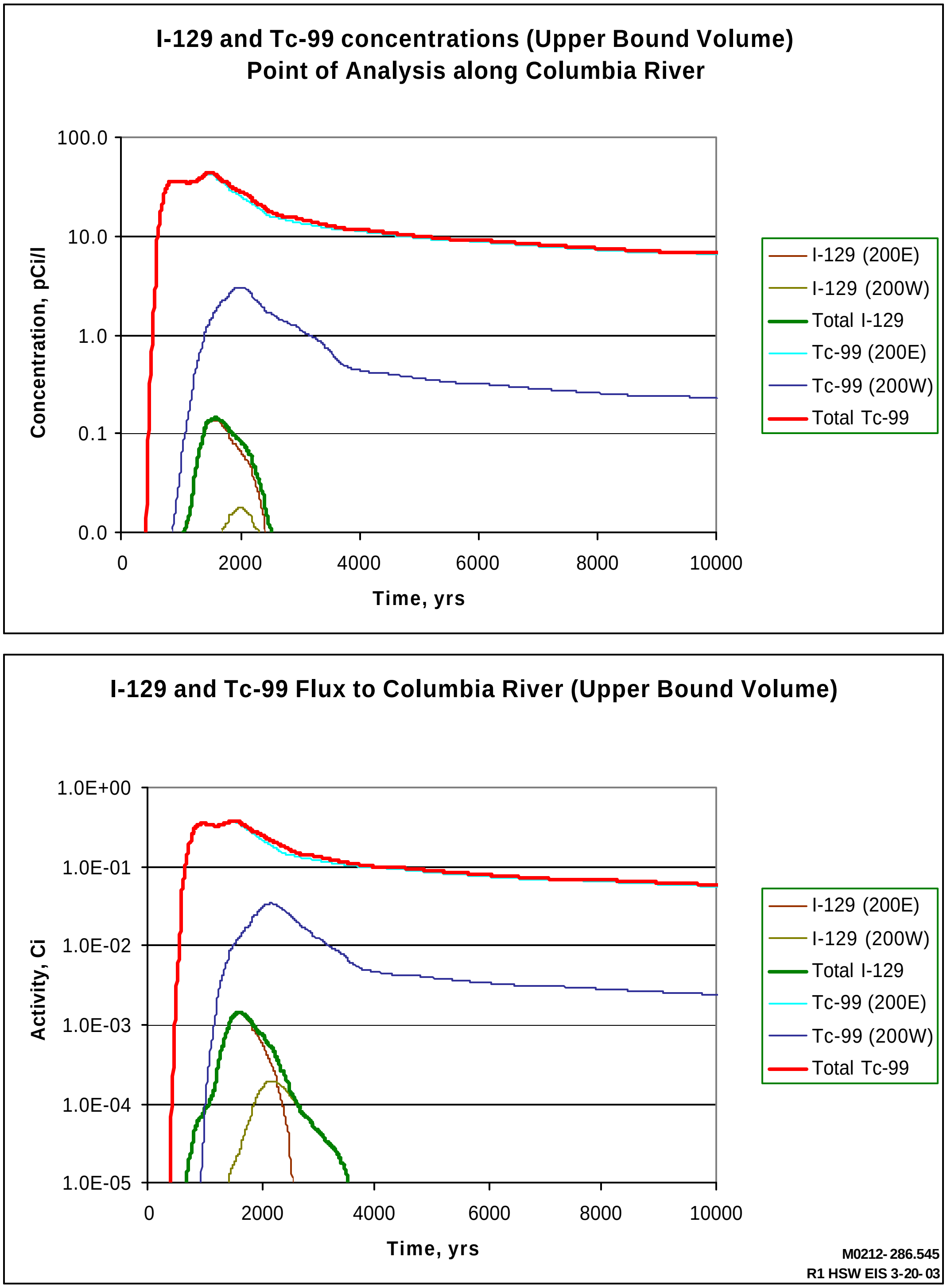


Figure G.51. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River (Alternative Group D_2 – Upper Bound Volume Wastes Disposed of After 1995)

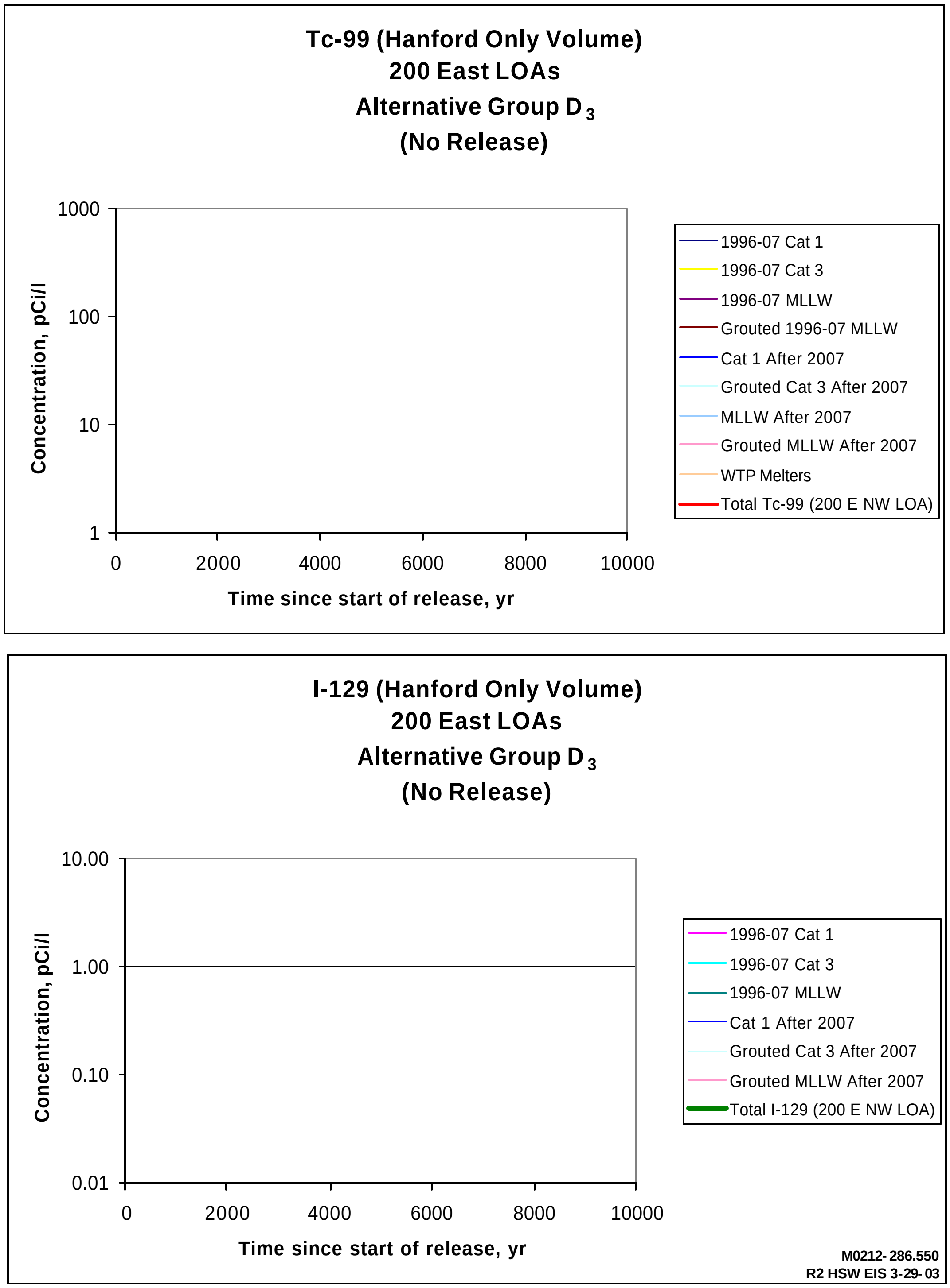


Figure G.52. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 East) (Alternative Group D_3 – Hanford Only Wastes Disposed of After 1995)

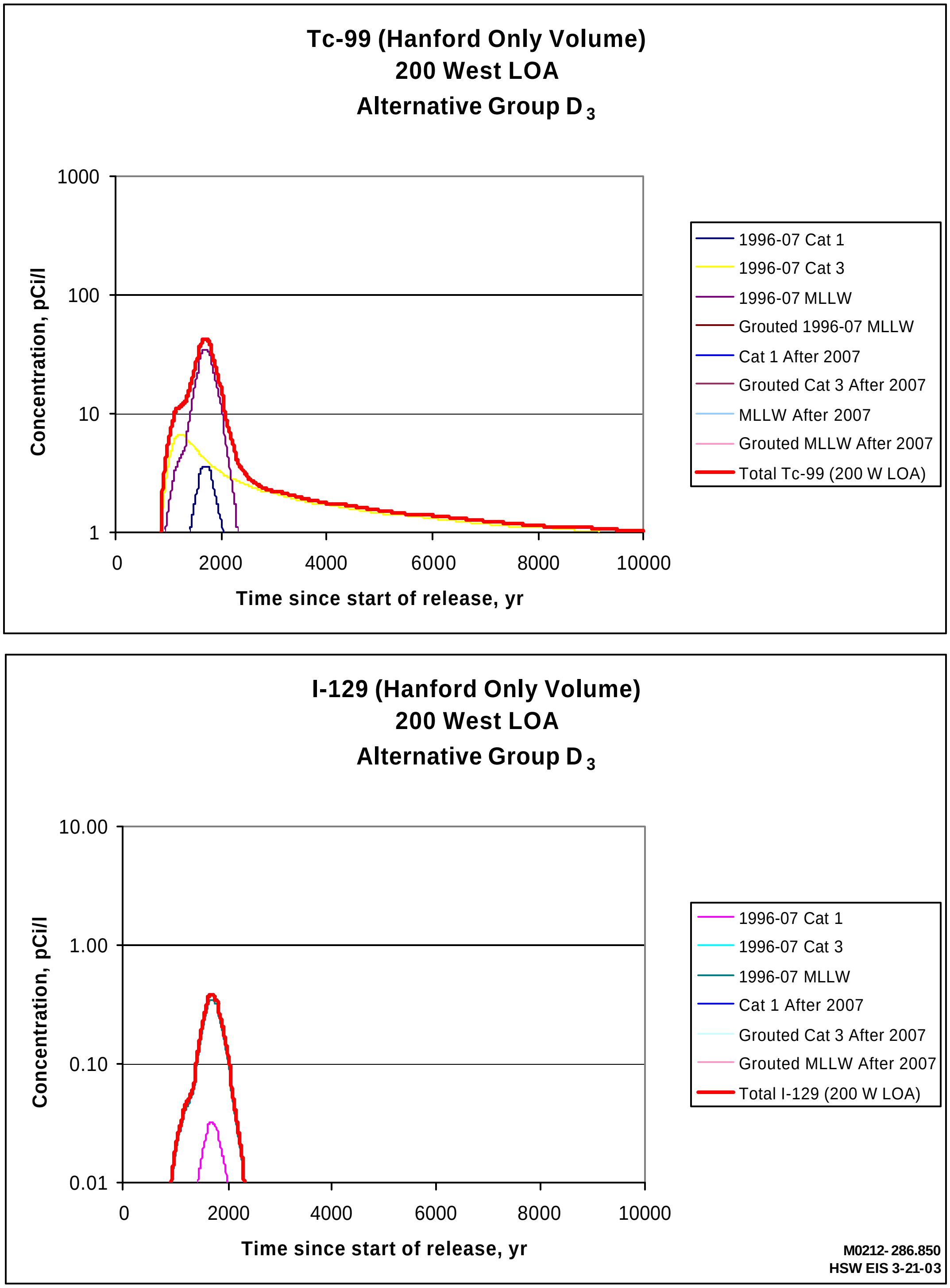


Figure G.53. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 West) (Alternative Group D_3 – Hanford Only Wastes Disposed of After 1995)

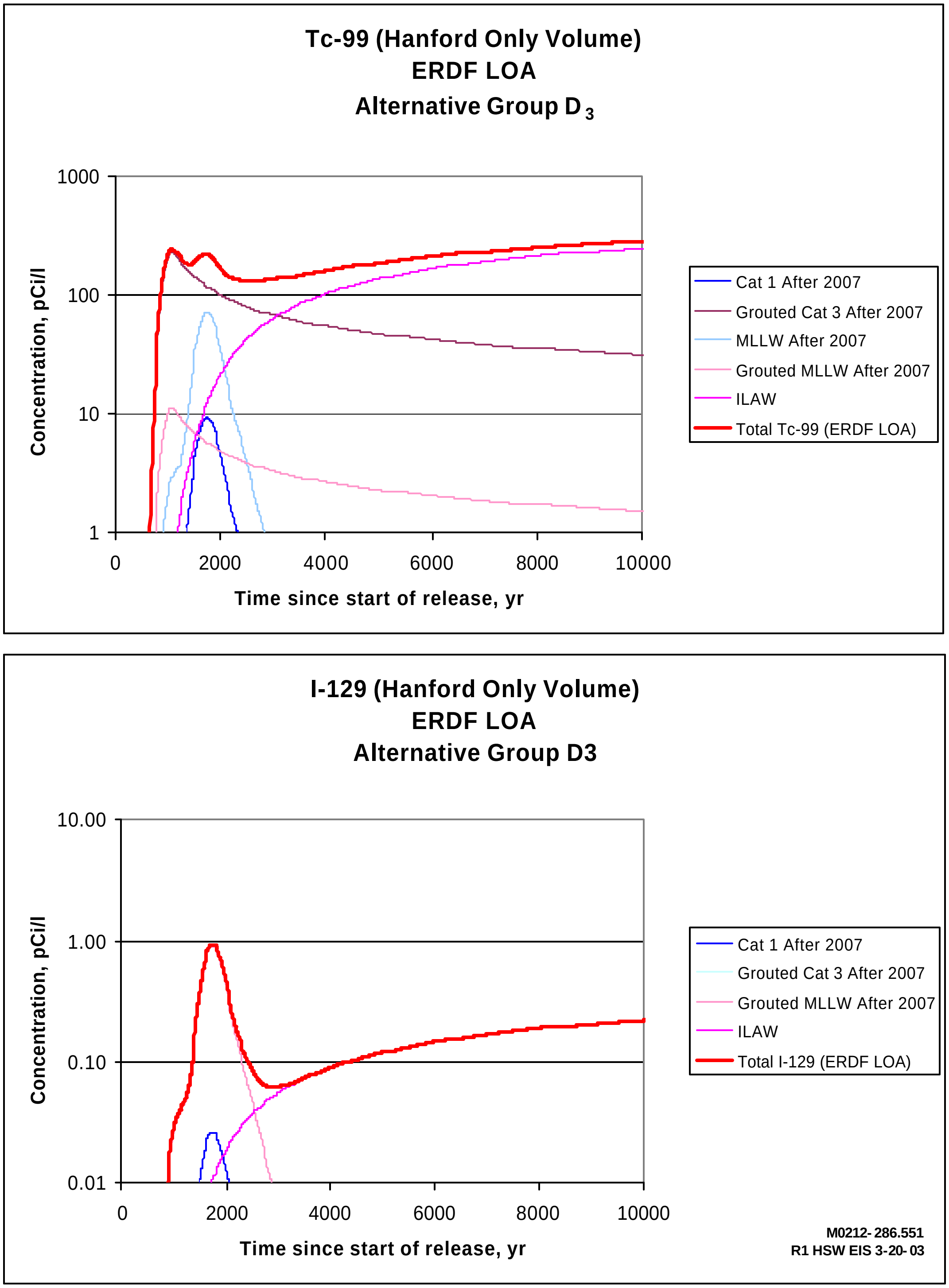
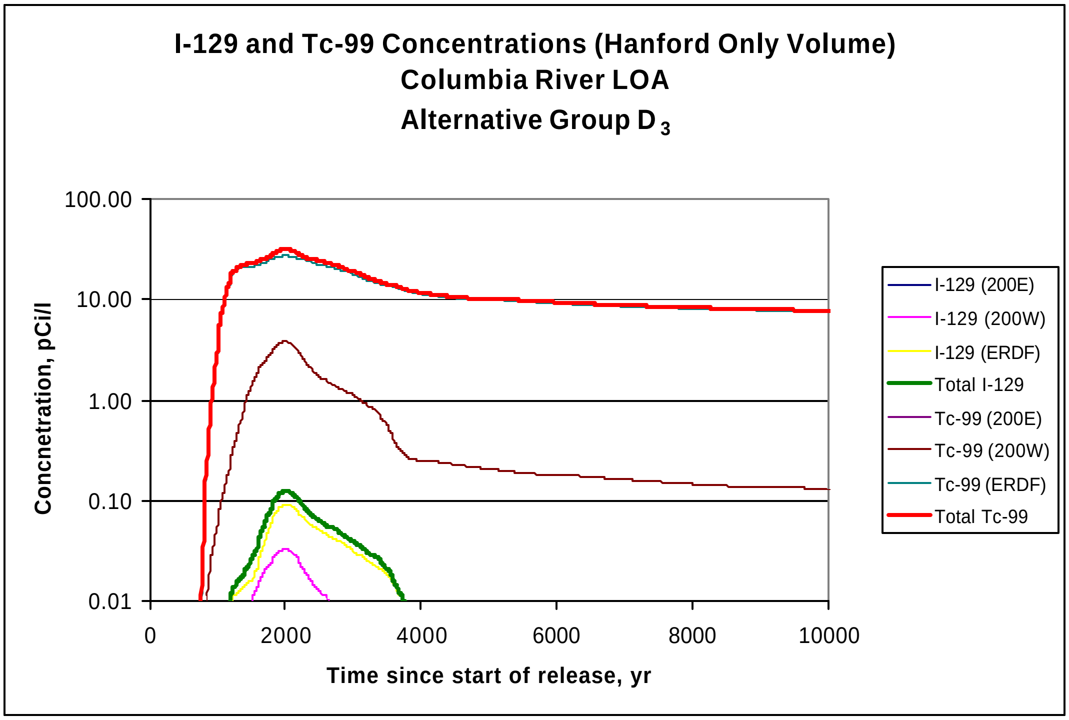


Figure G.54. Tc-99 and I-129 Concentration Profiles at the ERDF LOA (Alternative Group D_3 – Hanford Only Wastes Disposed of After 1995)



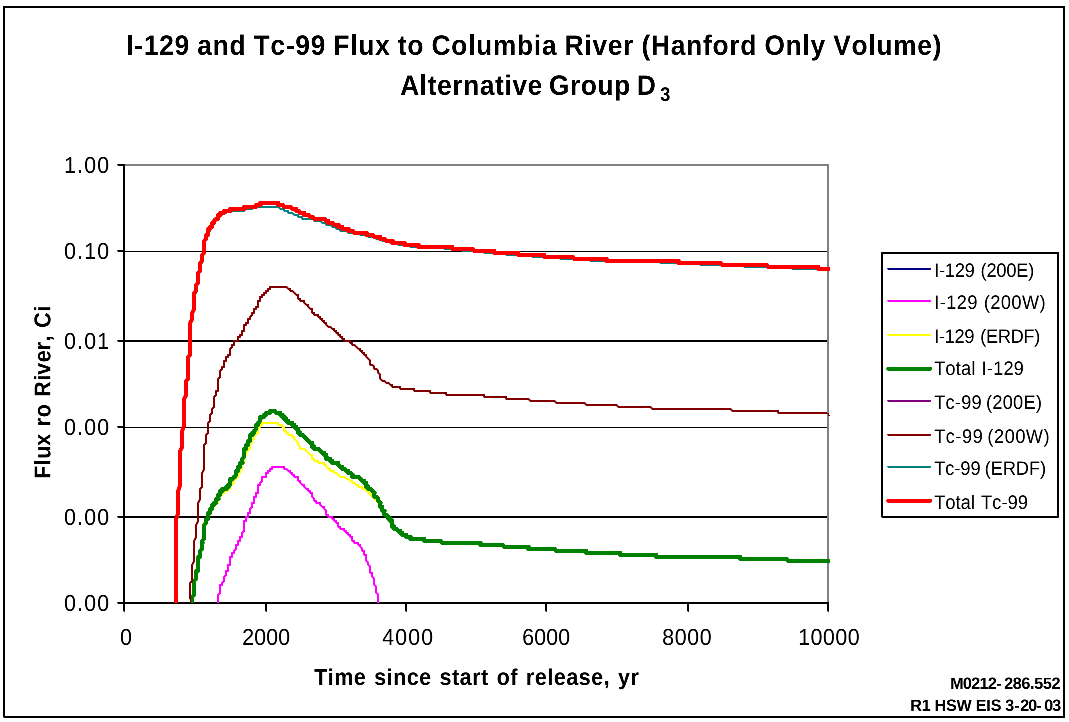
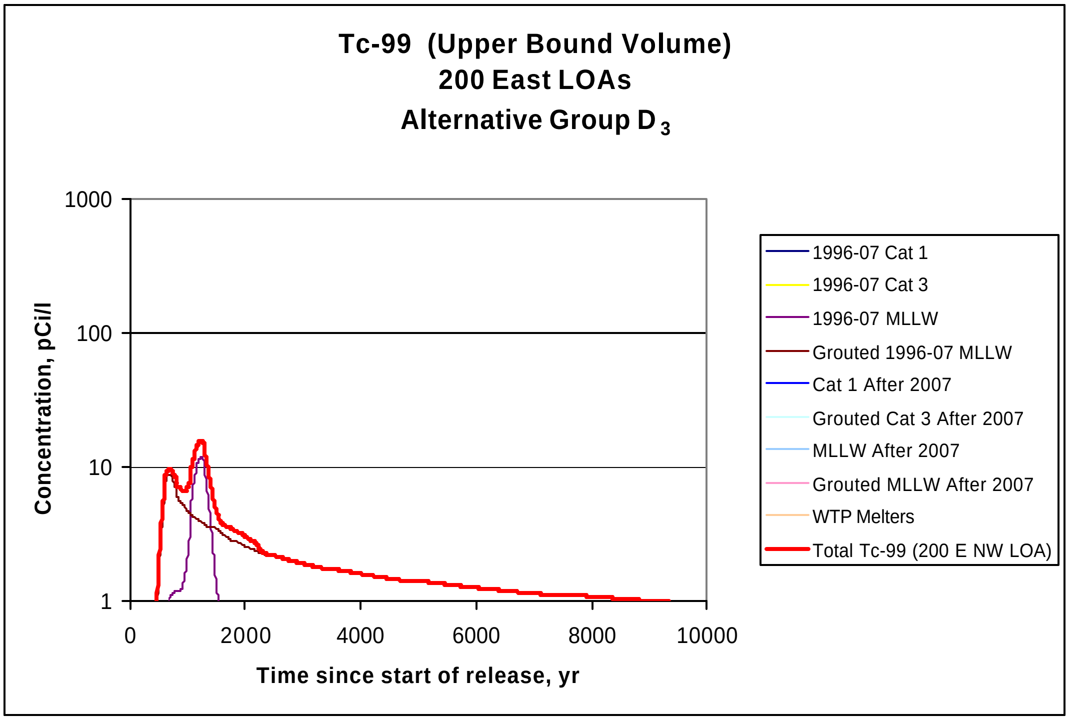


Figure G.55. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River LOA (Alternative Group D_3 – Hanford Only Wastes Disposed of After 1995)



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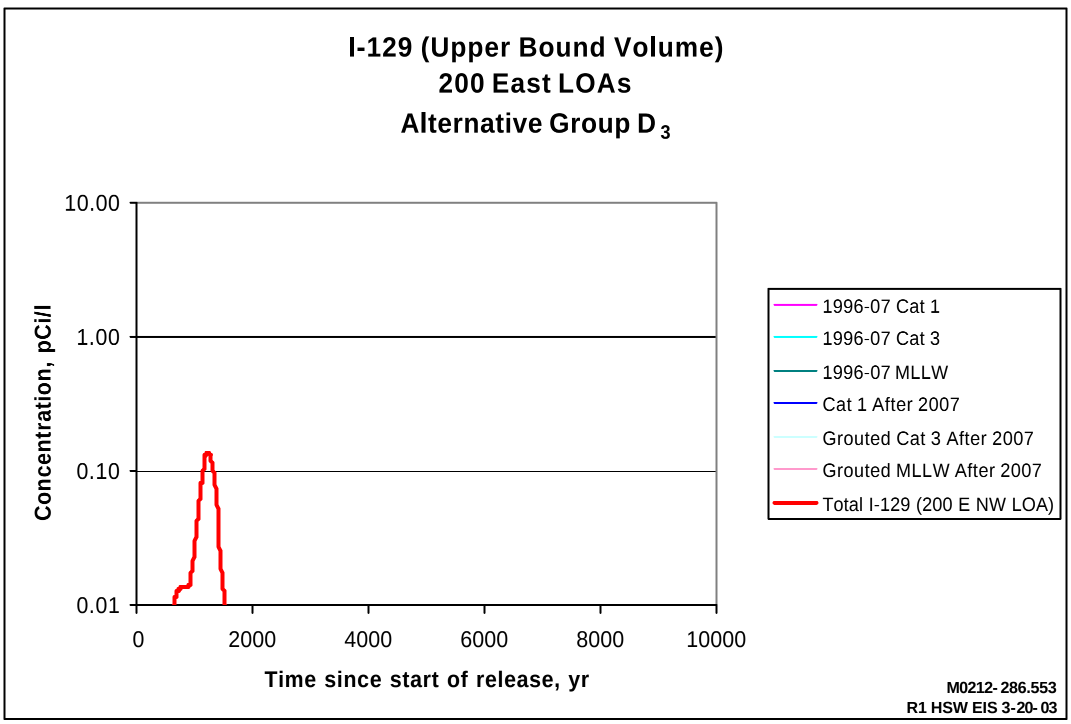


Figure G.56. Tc-99 and I-129 Concentration Profiles at the 200 East LOAs (Alternative Group D_3 – Upper Bound Volume Wastes Disposed of After 1995)

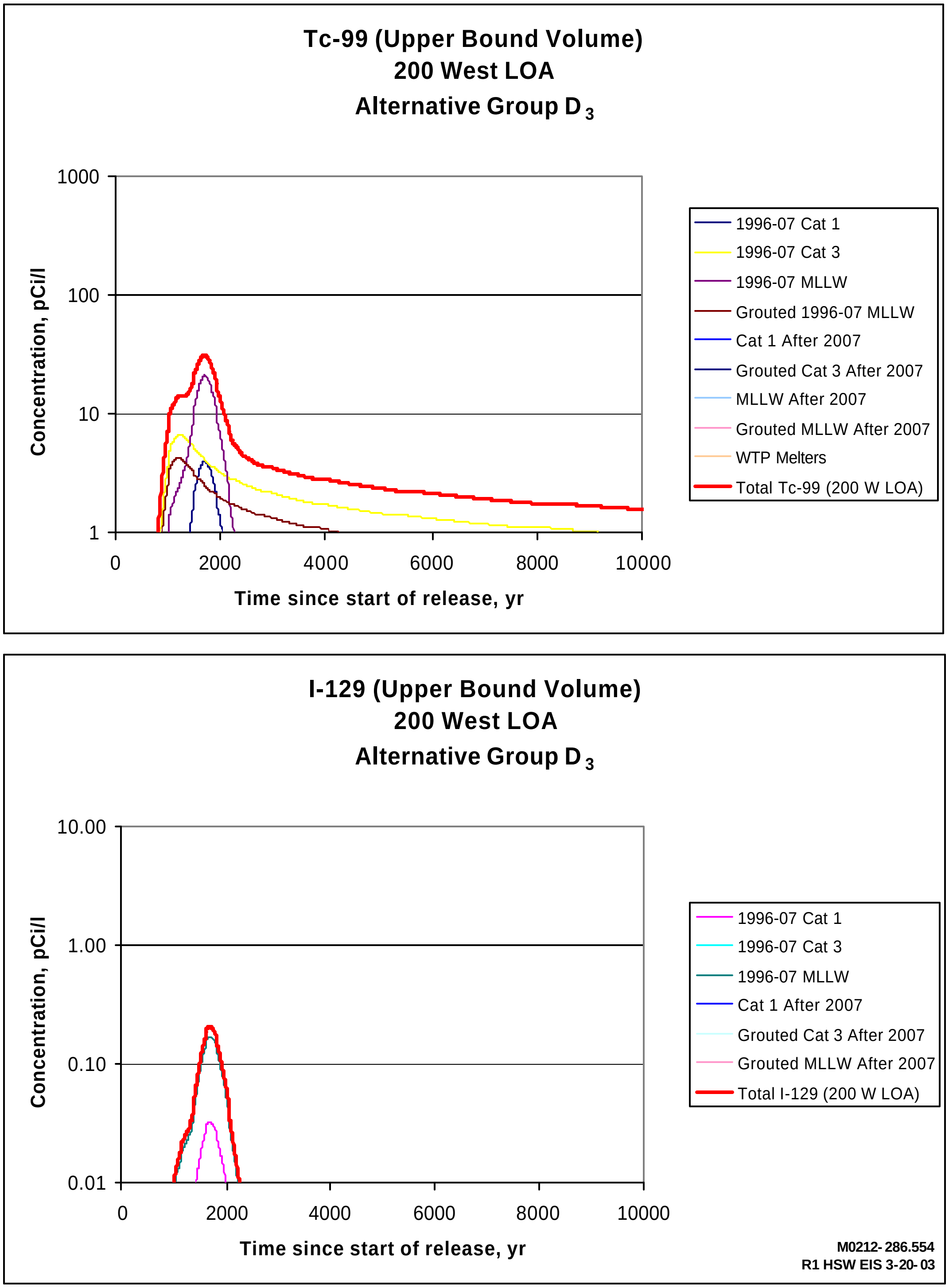


Figure G.57. Tc-99 and I-129 Concentration Profiles at the 200 West LOA (Alternative Group D_3 – Upper Bound Volume Wastes Disposed of After 1995)

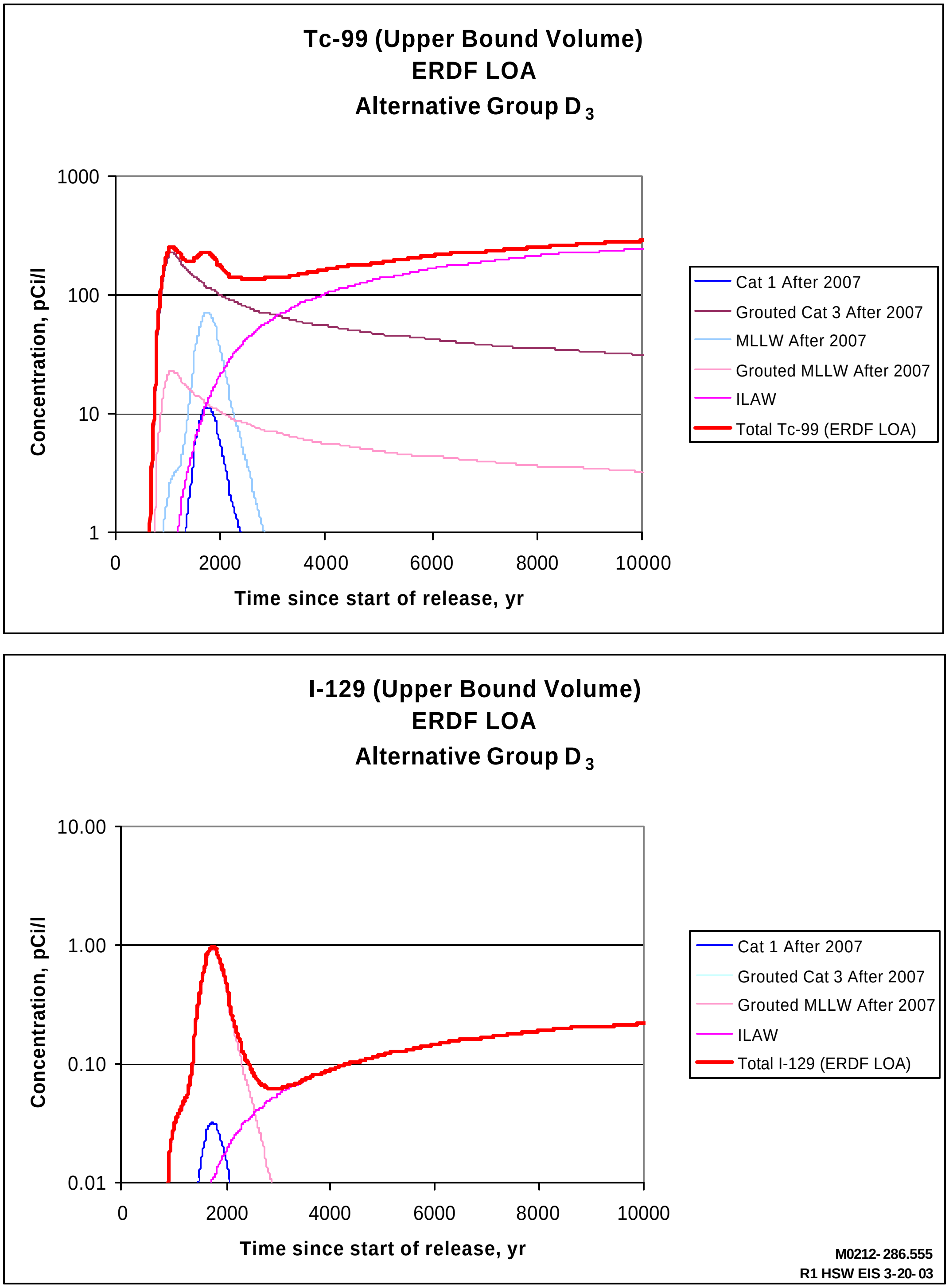


Figure G.58. Tc-99 and I-129 Concentration Profiles at the ERDF LOA (Alternative Group D_3 – Upper Bound Volume Wastes Disposed of After 1995)

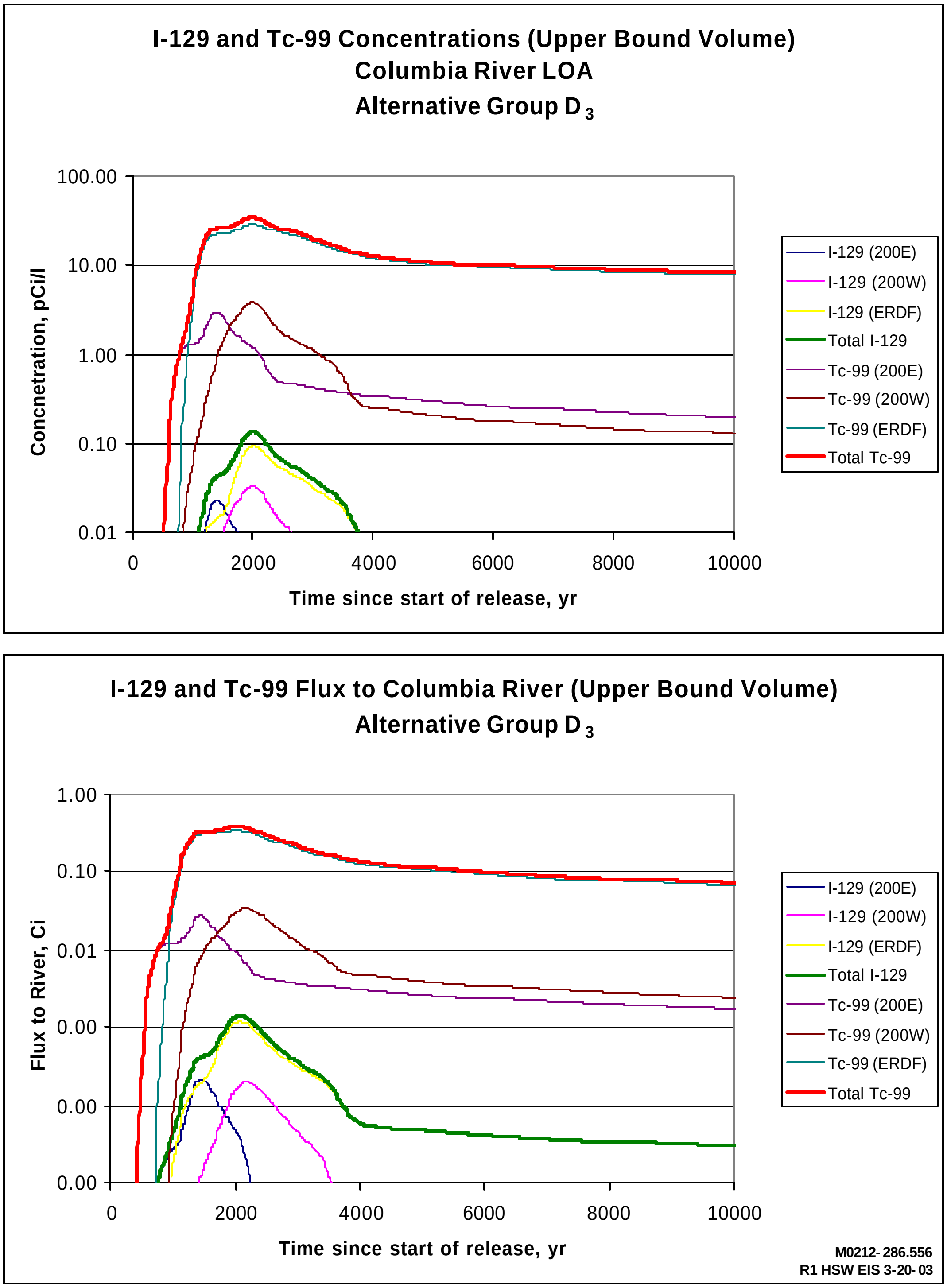


Figure G.59. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River LOA (Alternative Group D_3 – Upper Bound Volume Wastes Disposed of After 1995)

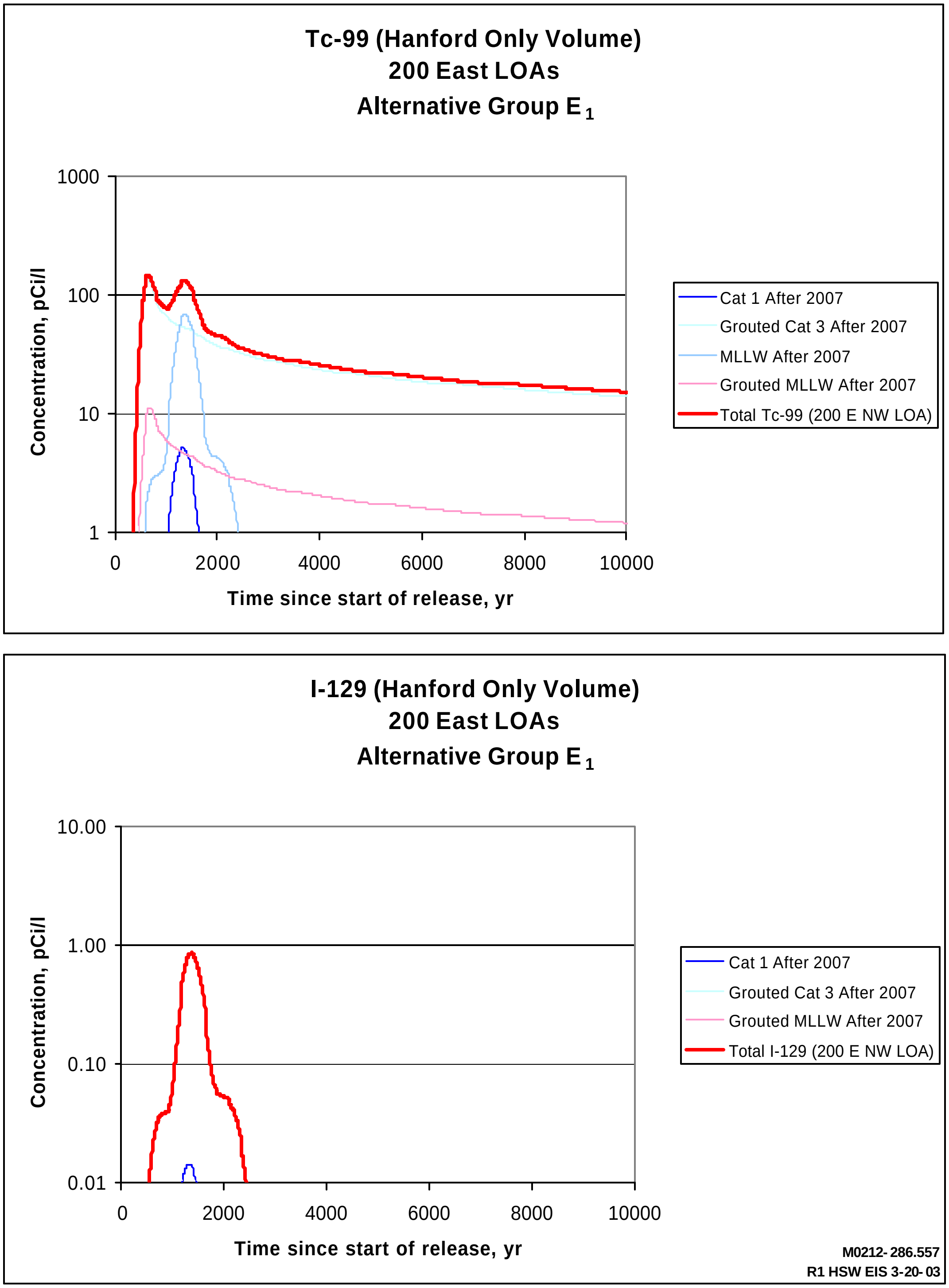
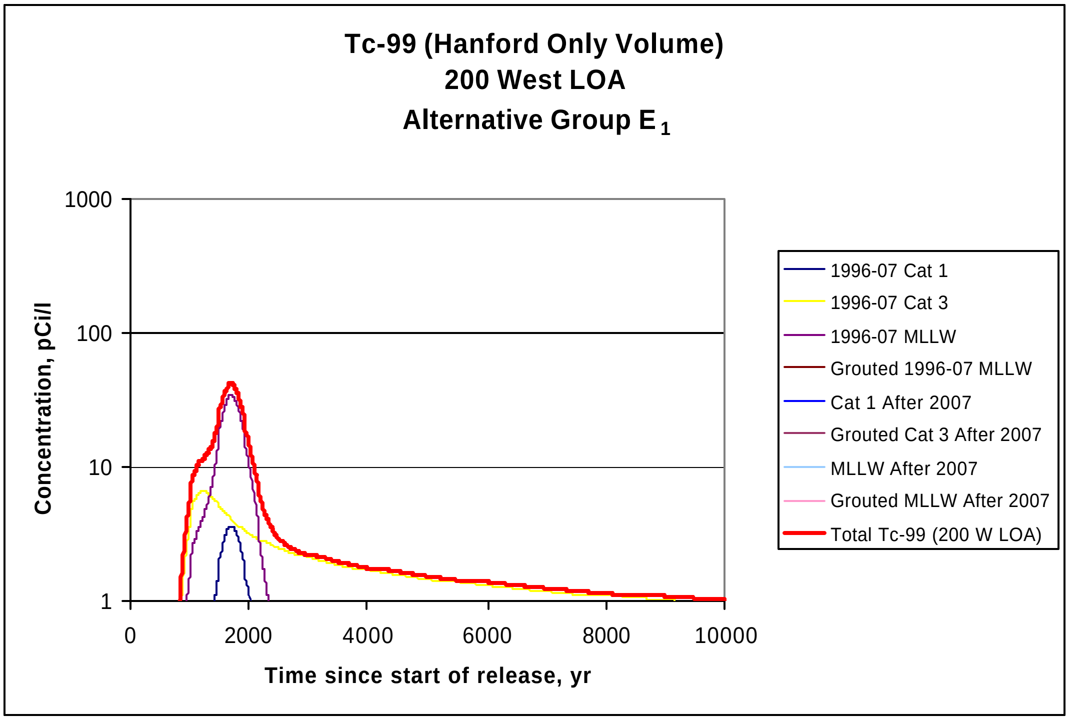


Figure G.60. Tc-99 and I-129 Concentration Profiles at the 200 East LOAs (Alternative Group E_1 – Hanford Only Wastes Disposed of After 1995)



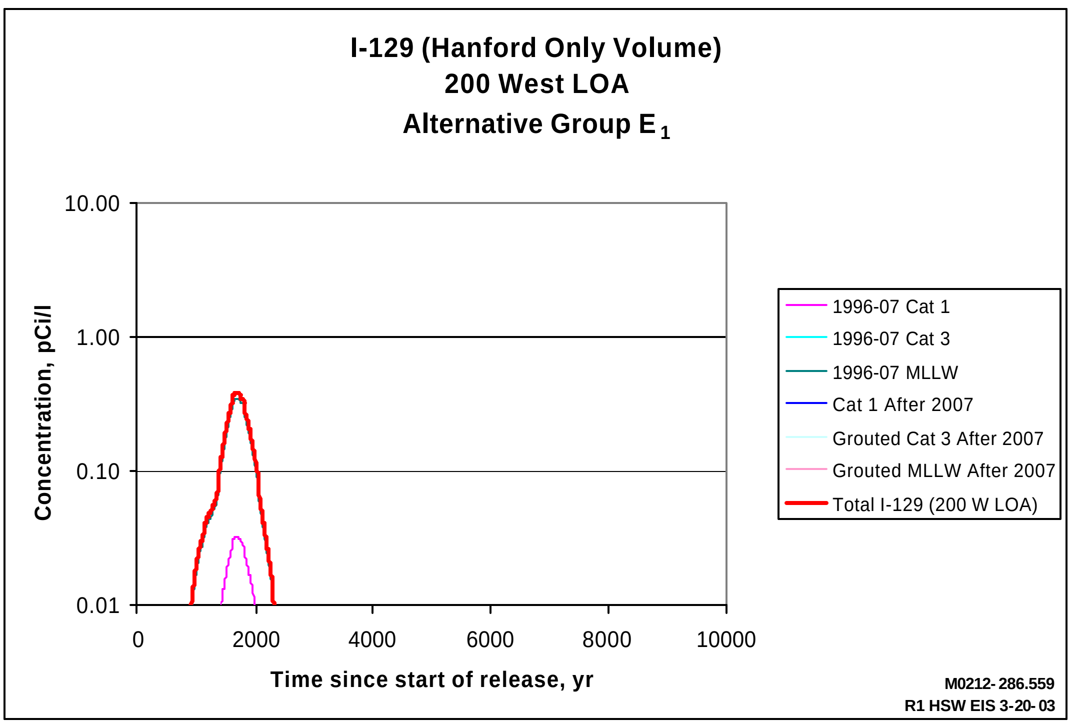


Figure G.61. Tc-99 and I-129 Concentration Profiles at the 200 West LOA (Alternative Group E_1 – Hanford Only Wastes Disposed of After 1995)

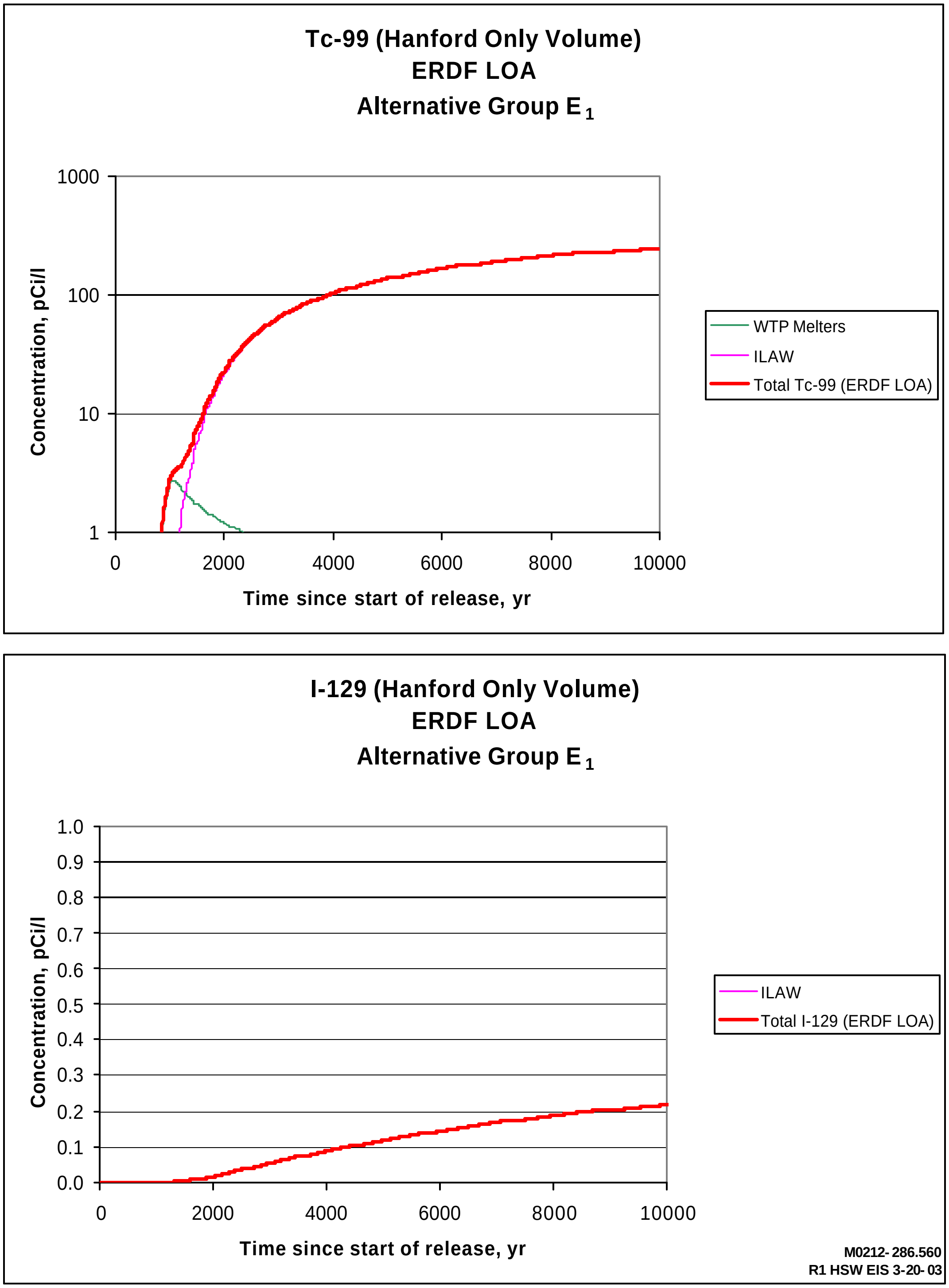
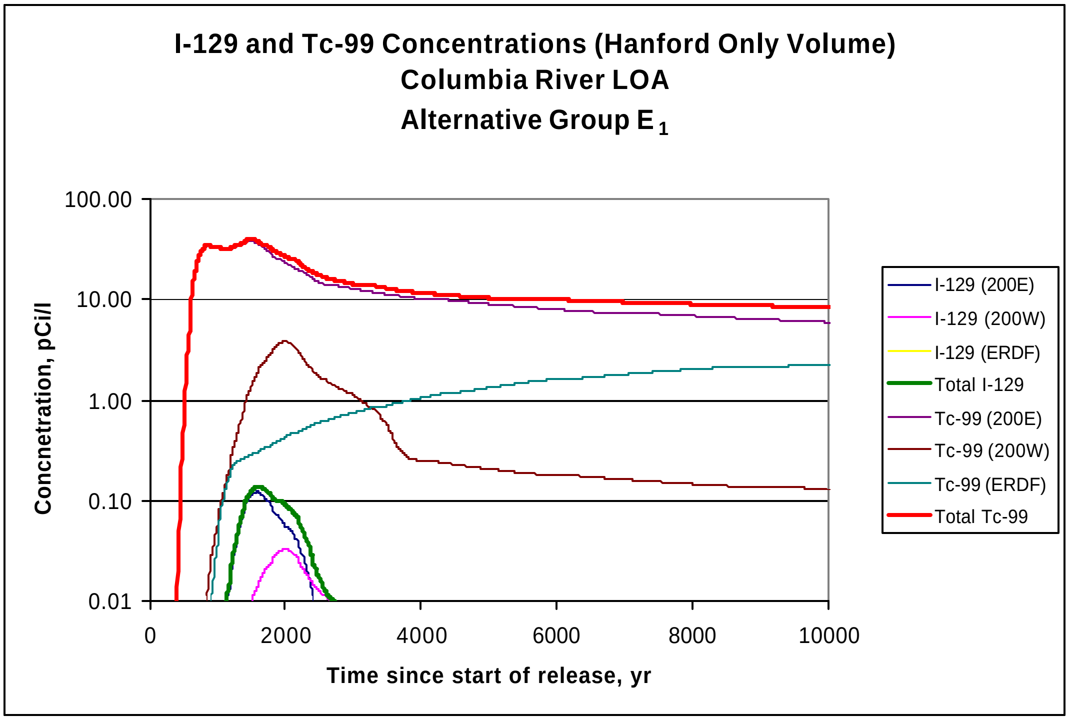


Figure G.62. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (ERDF) (Alternative Group E_1 – Hanford Only Wastes Disposed of After 1995)



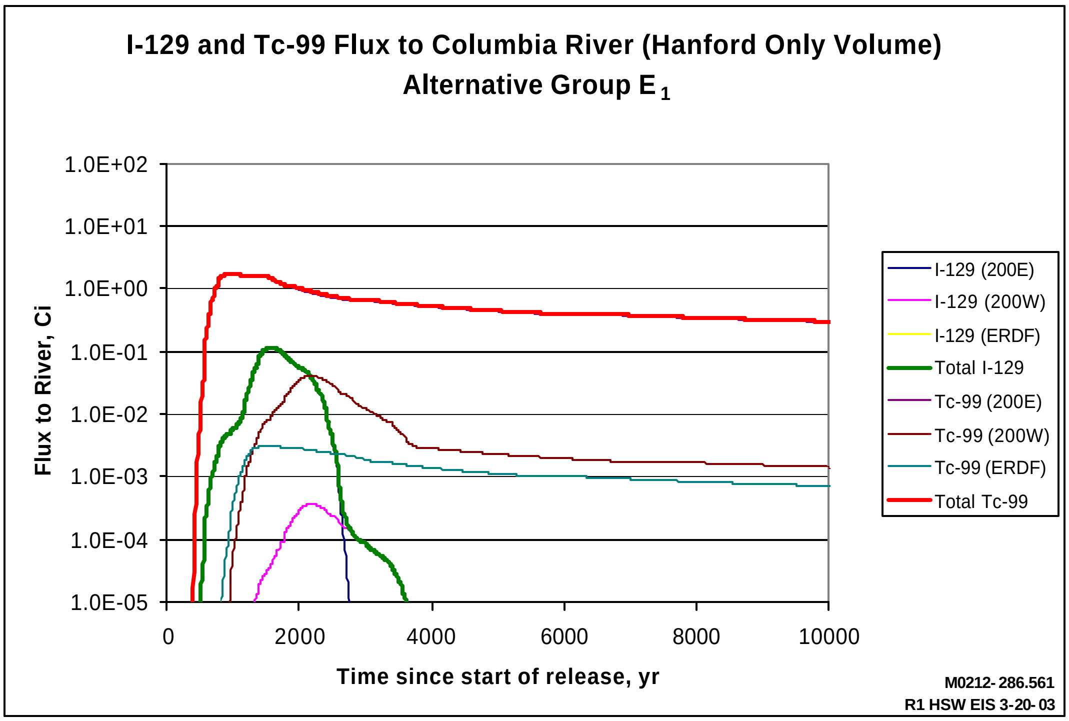
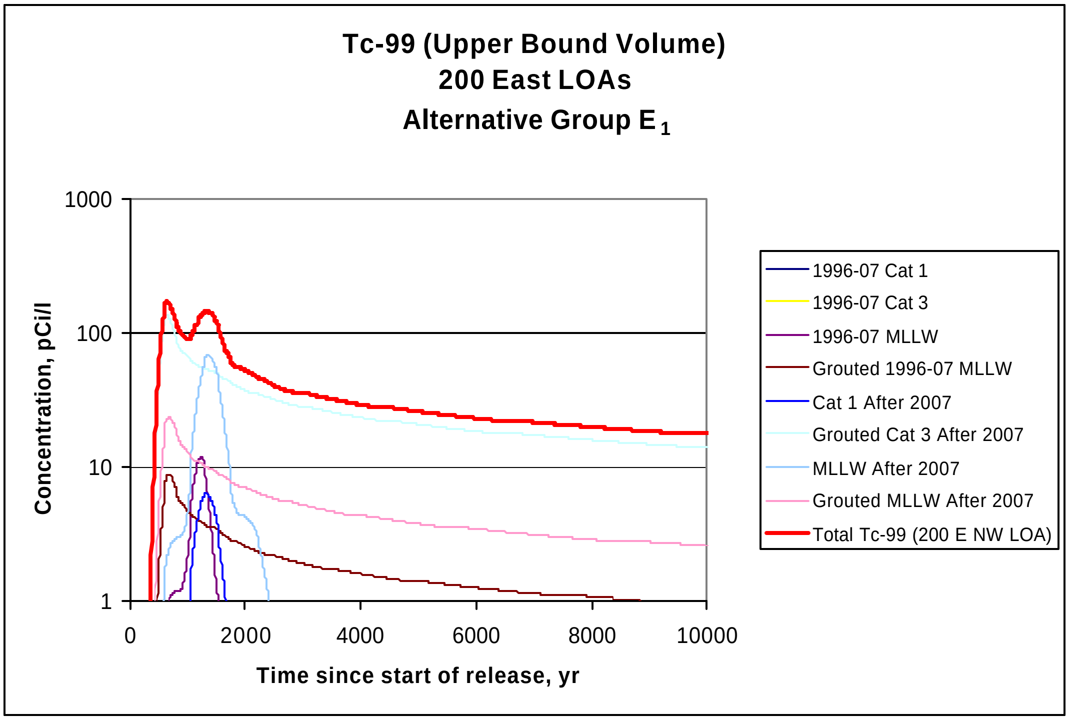


Figure G.63. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River LOA (Alternative Group E_1 – Hanford Only Wastes Disposed of After 1995)



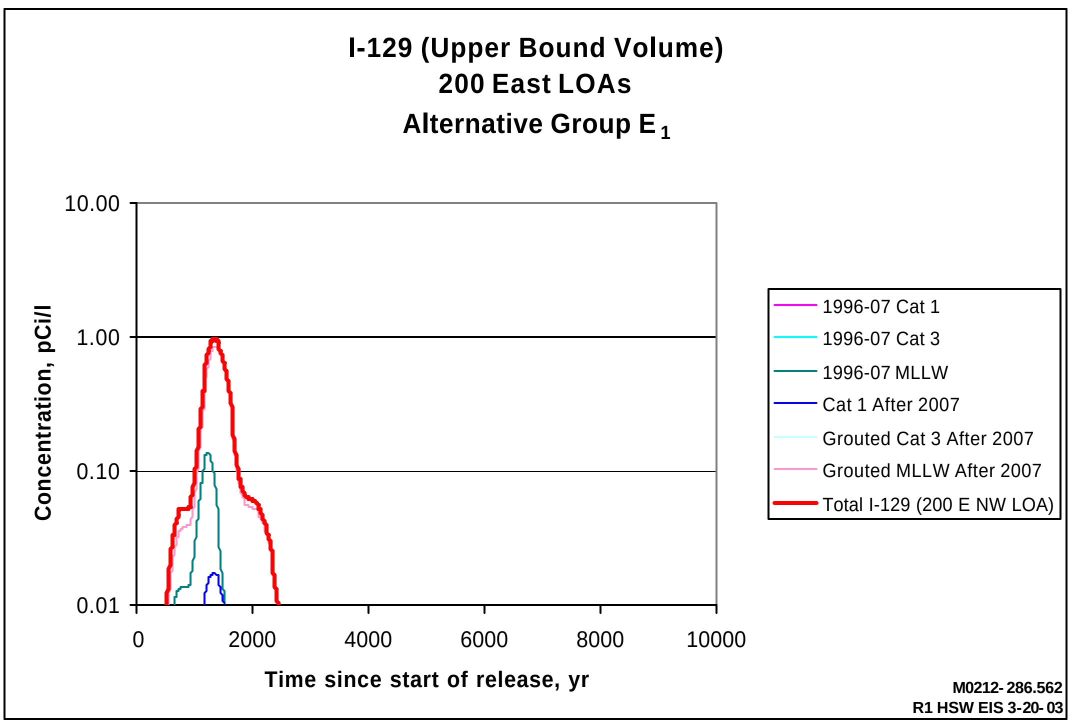
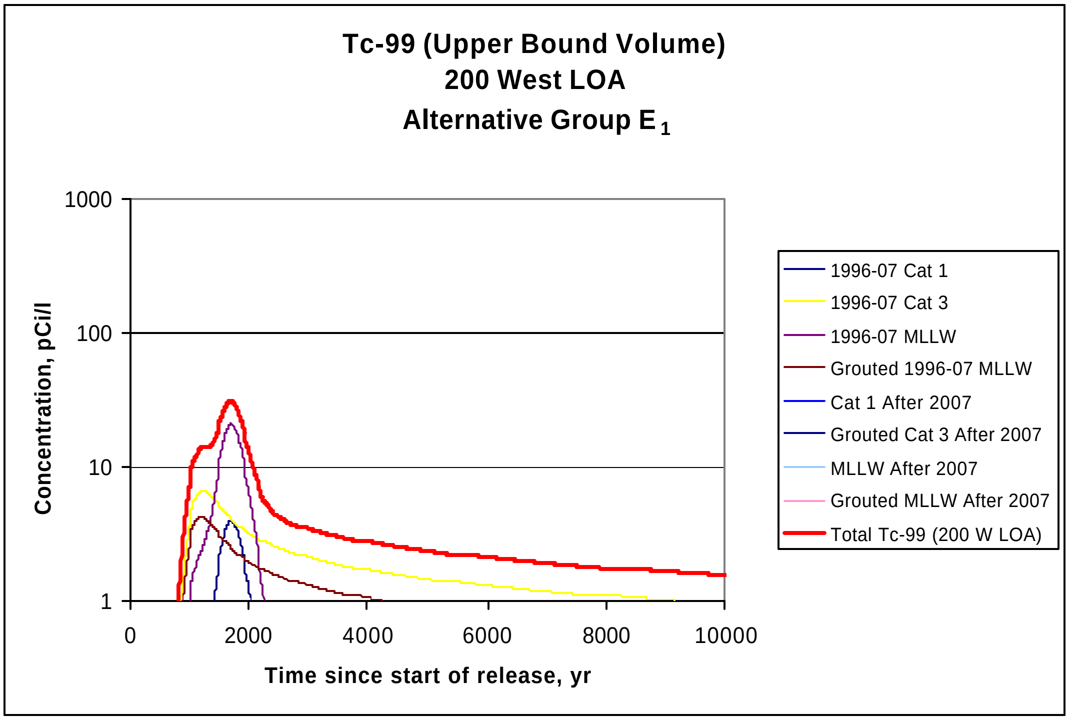


Figure G.64. Tc-99 and I-129 Concentration Profiles at the 200 East LOAs (Alternative Group E_1 – Upper Bound Volume Wastes Disposed of After 1995)



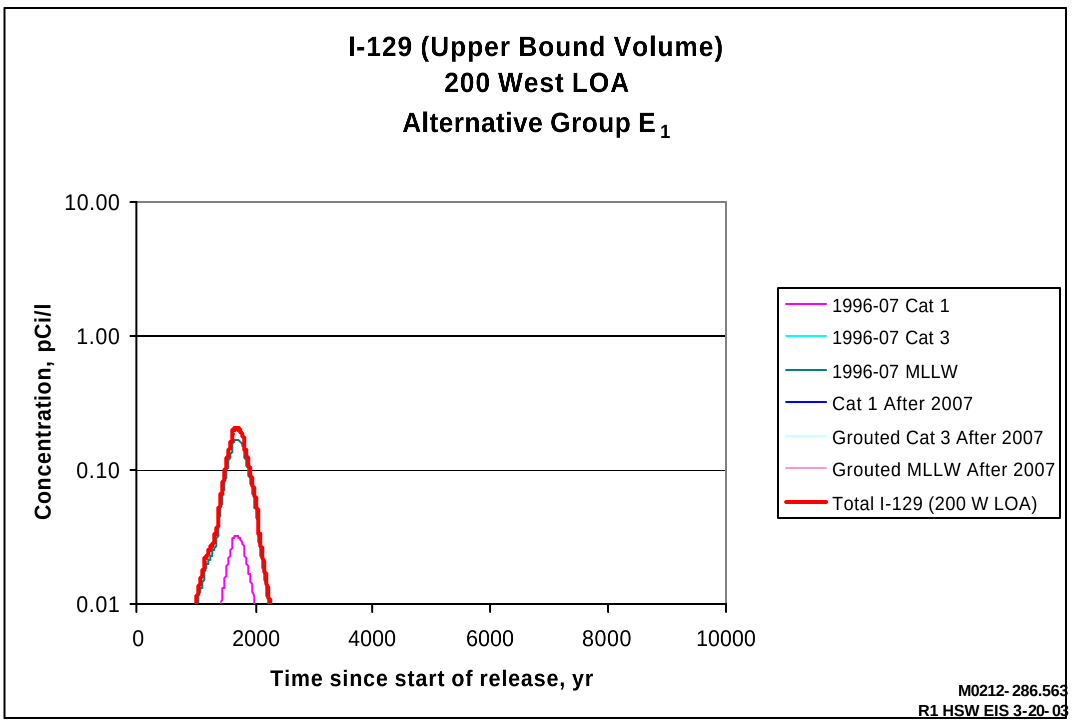
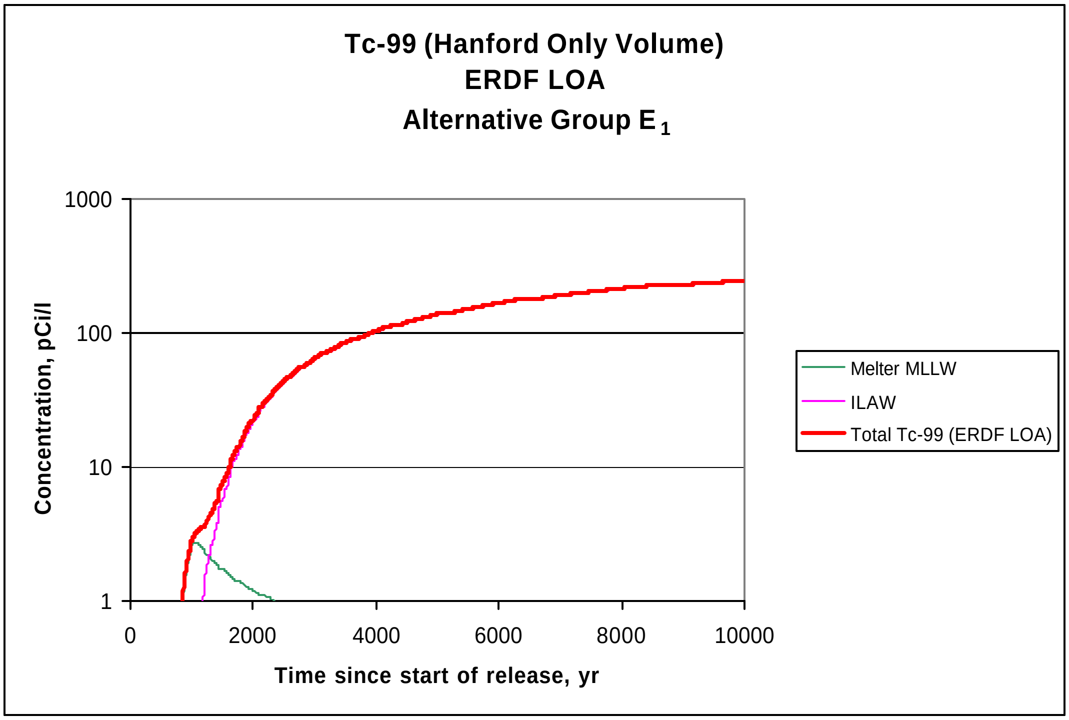


Figure G.65. Tc-99 and I-129 Concentration Profiles at the 200 West LOA (Alternative Group E_1 – Upper Bound Volume Wastes Disposed of After 1995)



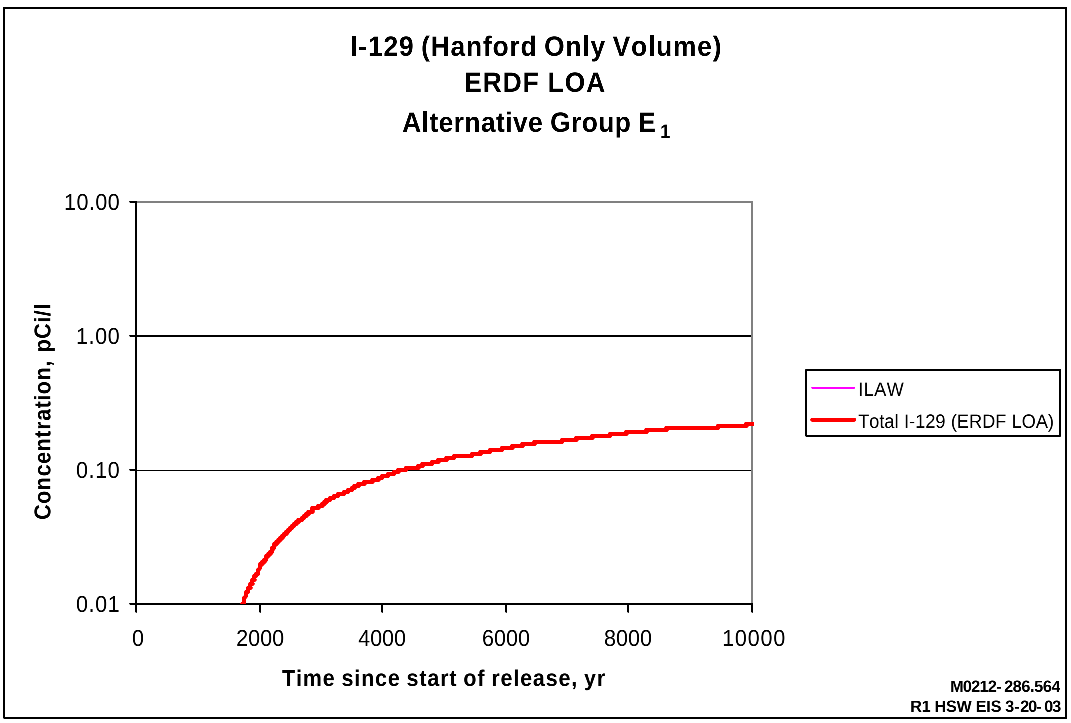
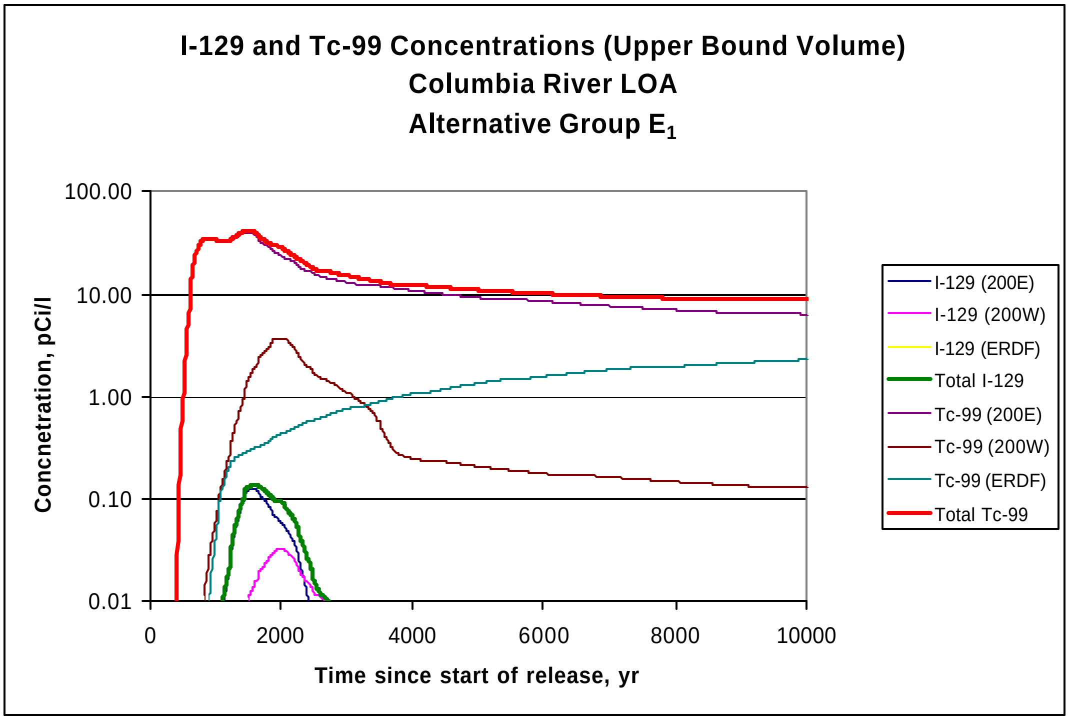


Figure G.66. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (200 ERDF) (Alternative Group E_1 – Upper Bound Volume Wastes Disposed of After 1995)



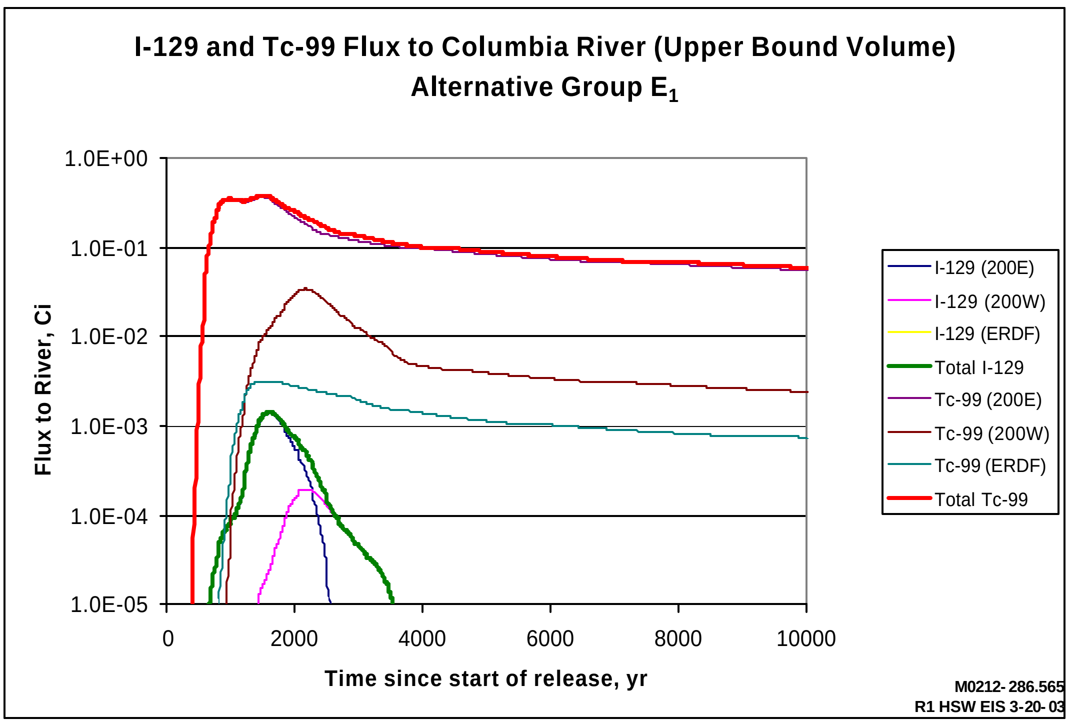


Figure G.67. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River LOA (Alternative Group E_1 – Upper Bound Volume Wastes Disposed of After 1995)

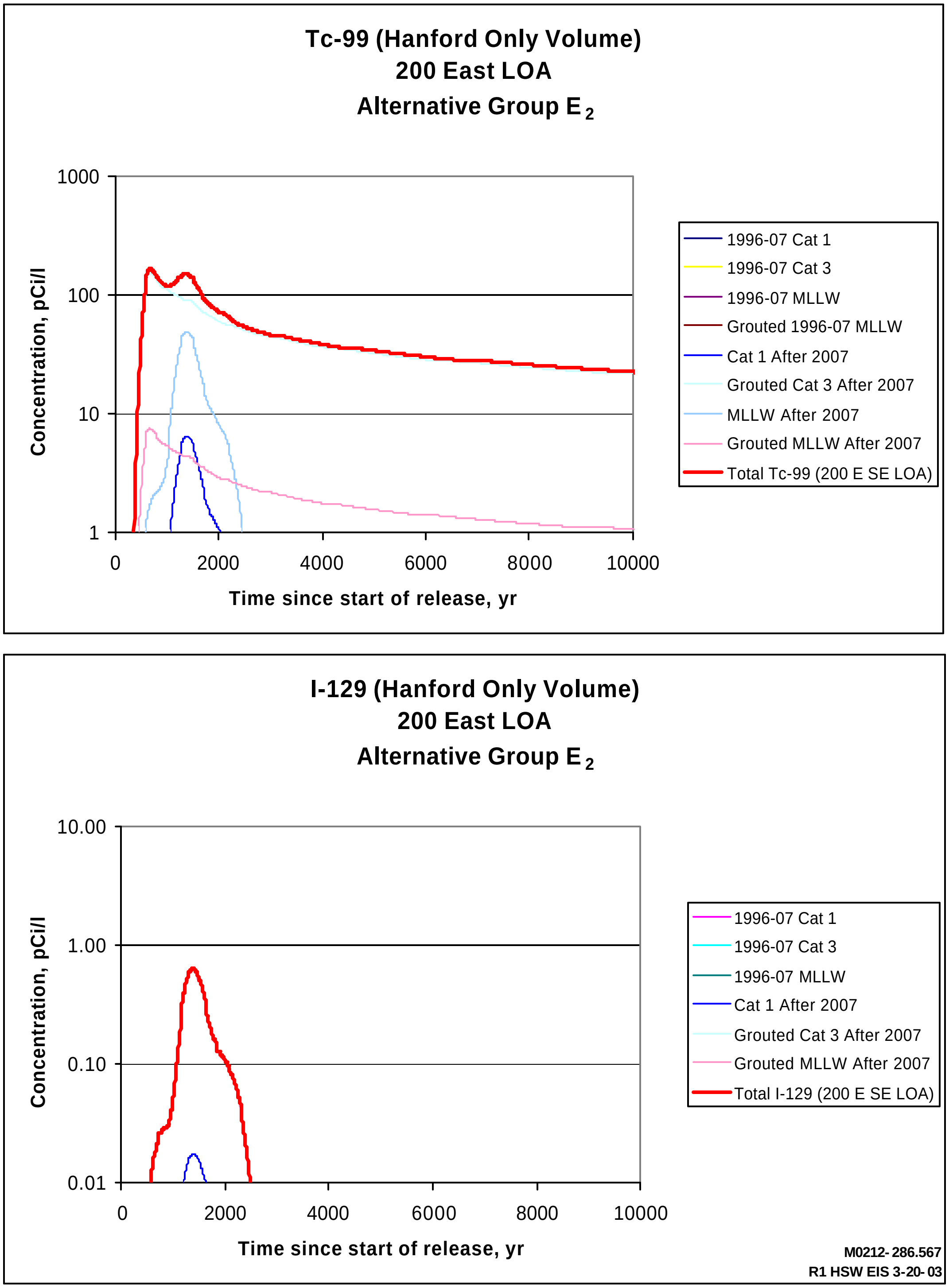


Figure G.68. Tc-99 and I-129 Concentration Profiles at the 200 East LOA (Alternative Group E_2 – Hanford Only Wastes Disposed of After 1995)

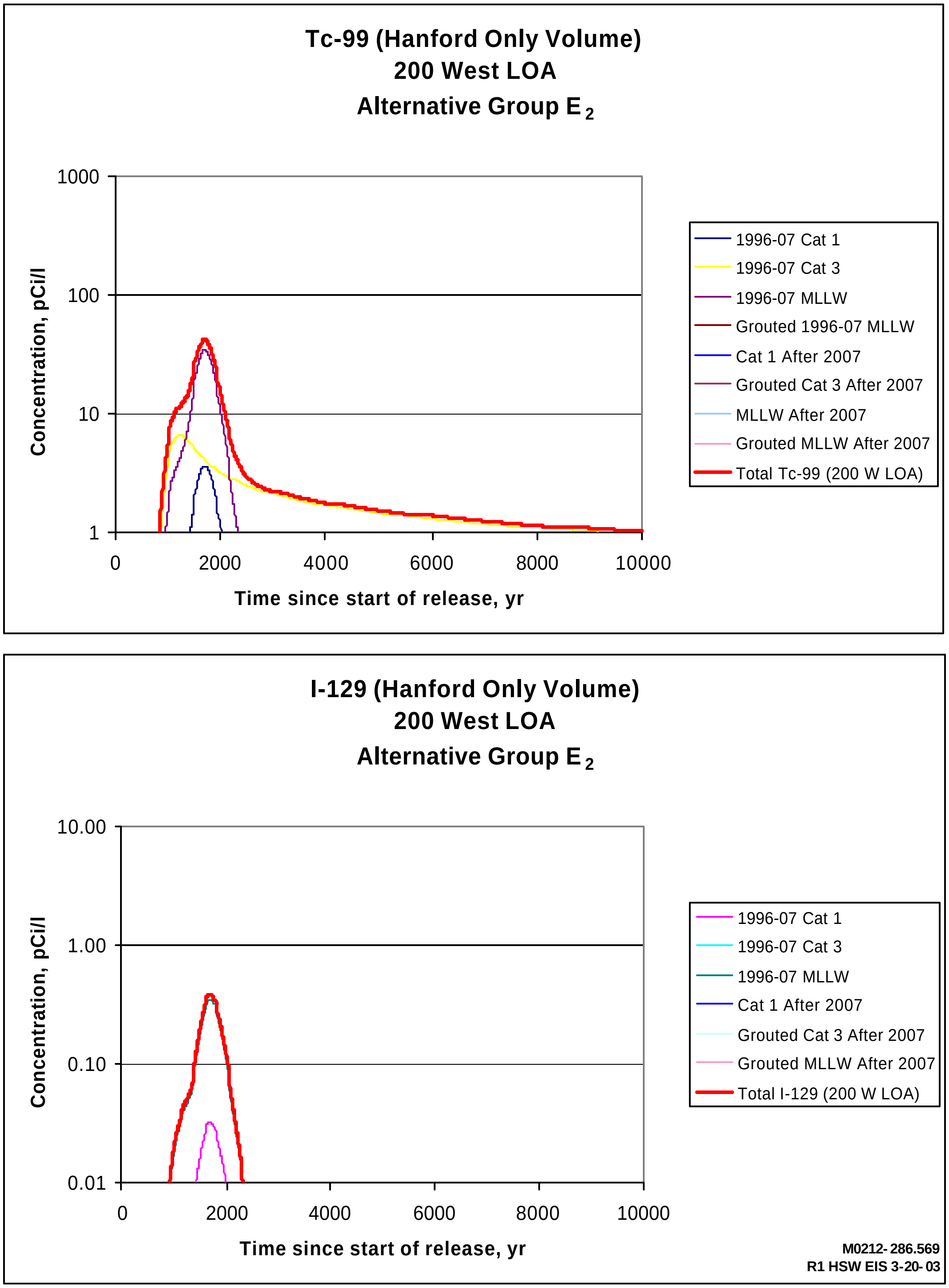


Figure G.69. Tc-99 and I-129 Concentration Profiles at the 200 West LOA (Alternative Group E_2 – Hanford Only Wastes Disposed of After 1995)

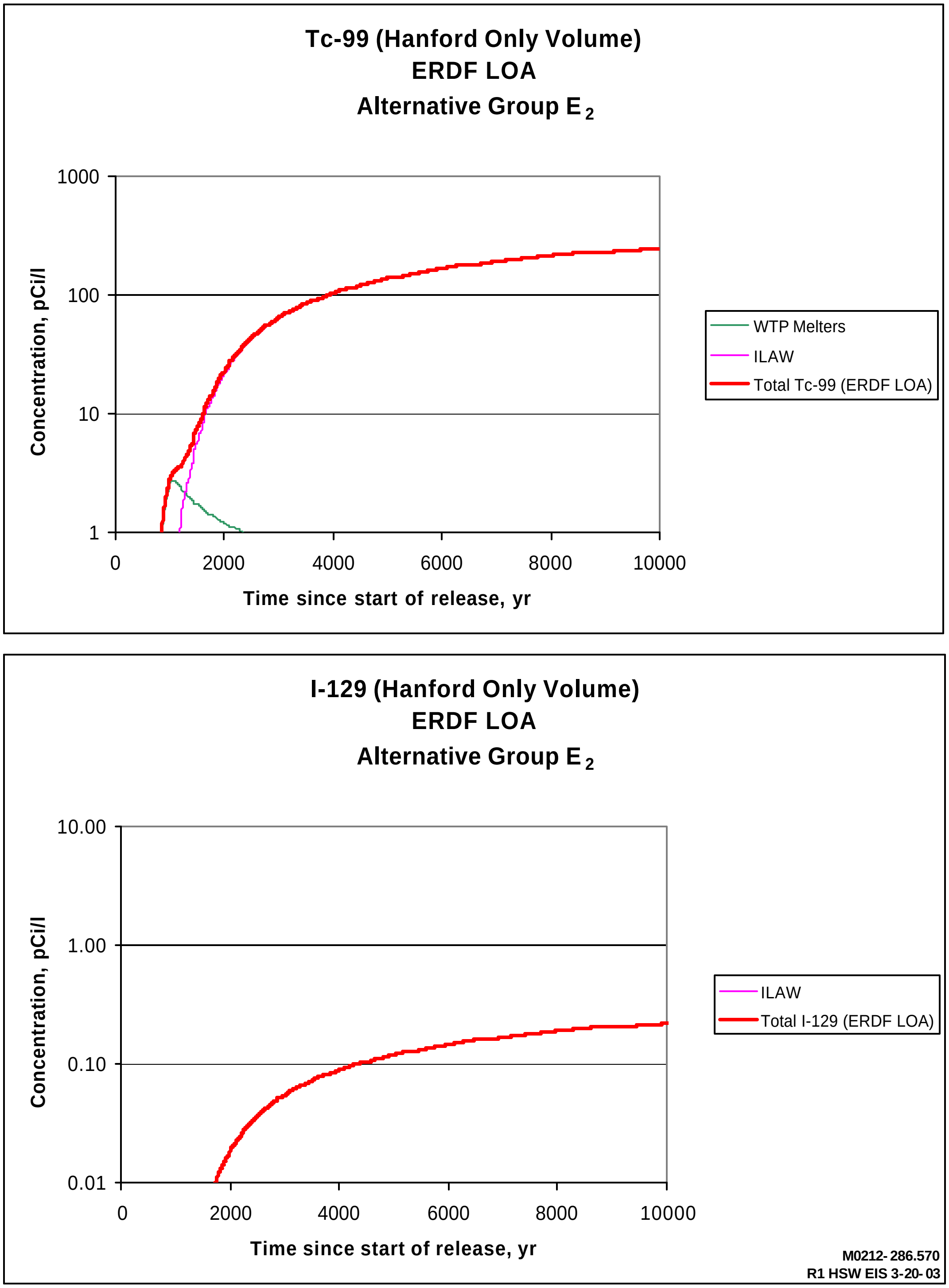


Figure G.70. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (ERDF) (Alternative Group E_2 – Hanford Only Wastes Disposed of After 1995)

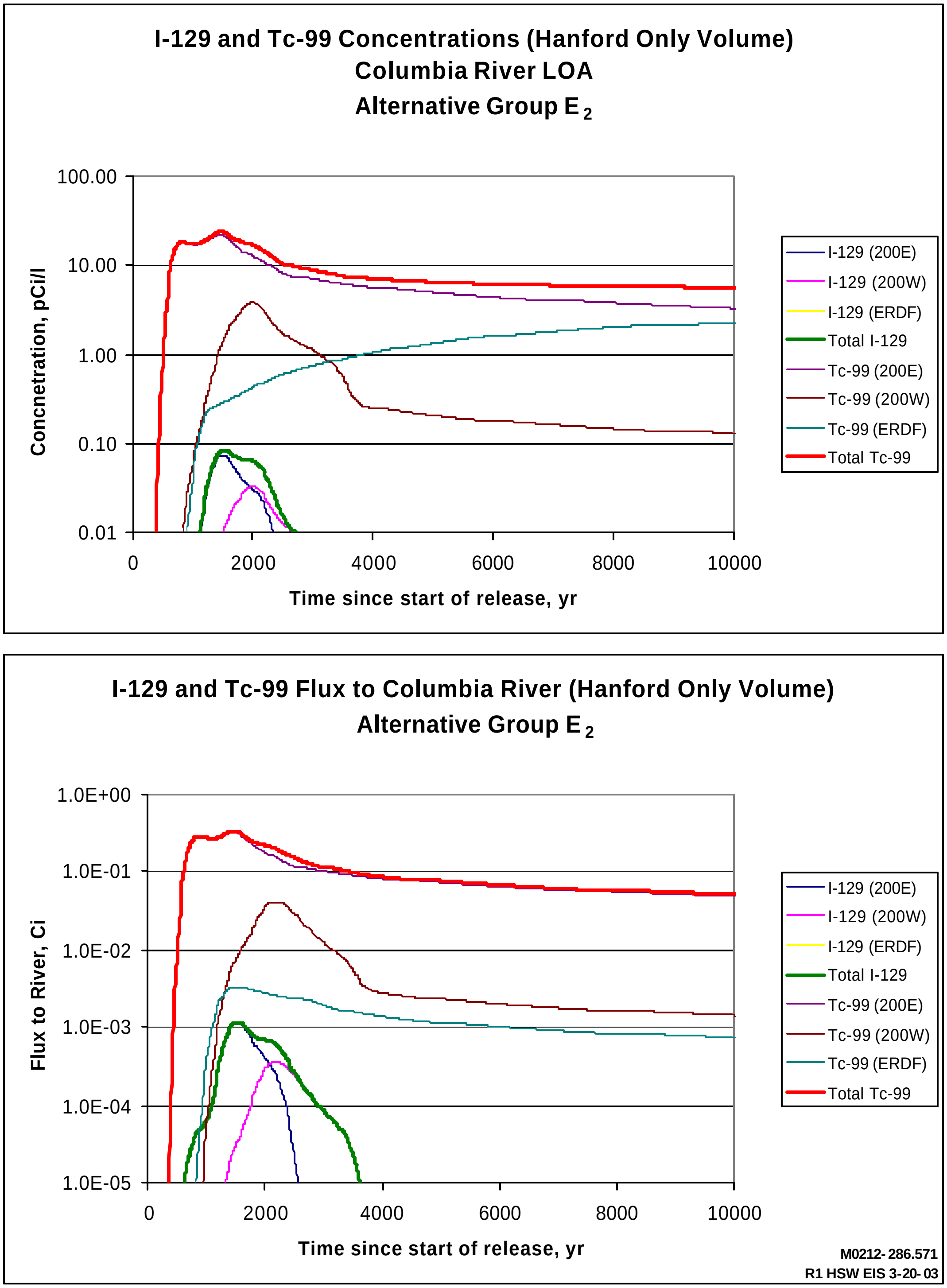


Figure G.71. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River LOA (Alternative Group E_2 – Hanford Only Wastes Disposed of After 1995)

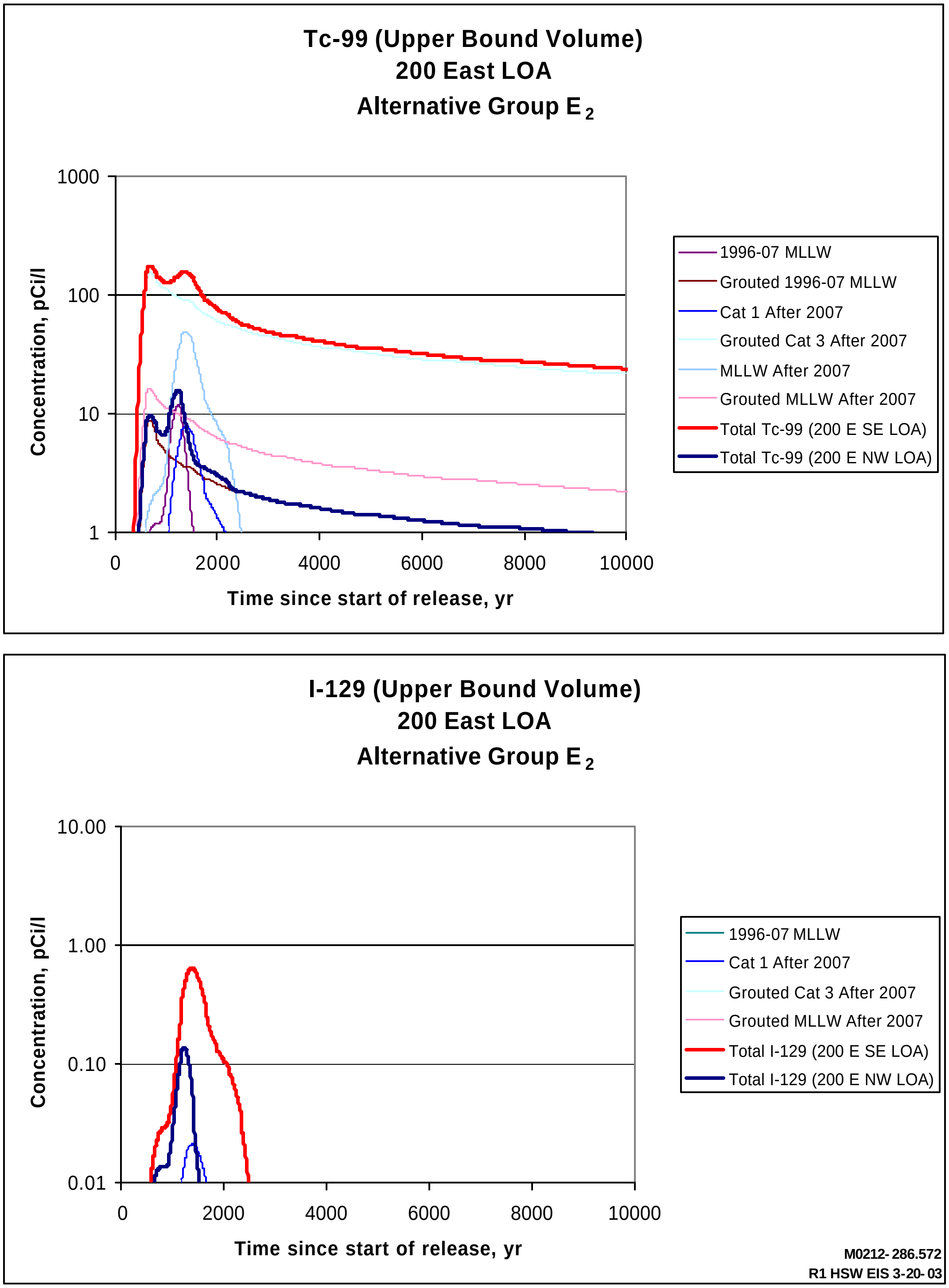
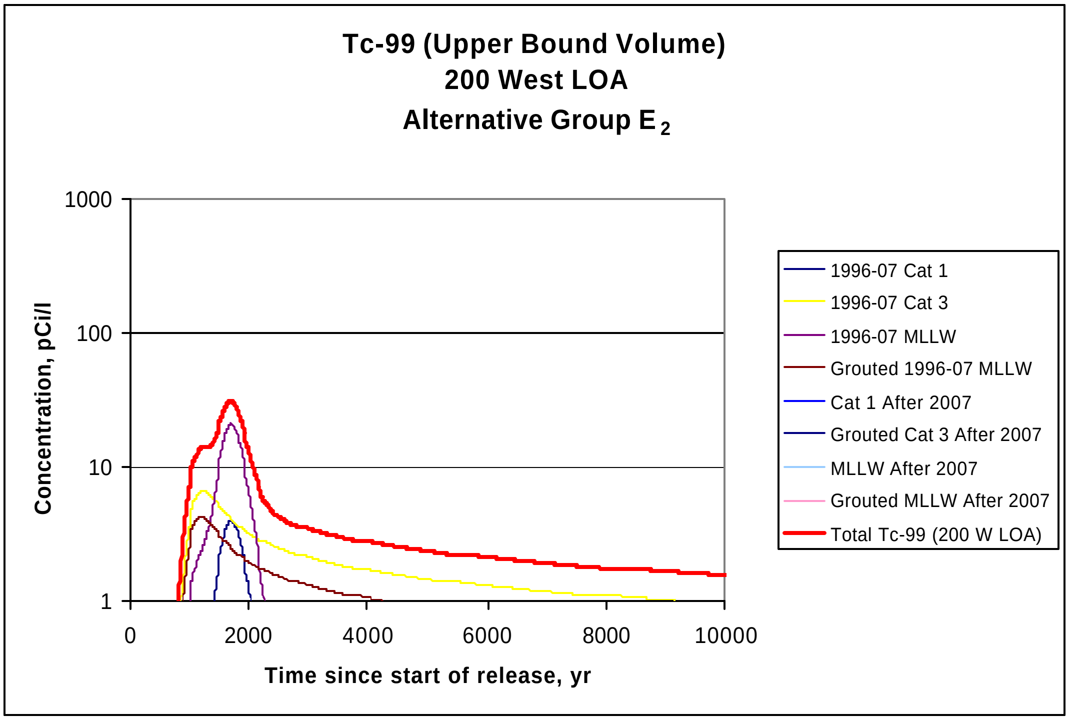


Figure G.72. Tc-99 and I-129 Concentration Profiles at the 200 East LOA (Alternative Group E_2 – Upper Bound Volume Wastes Disposed of After 1995)



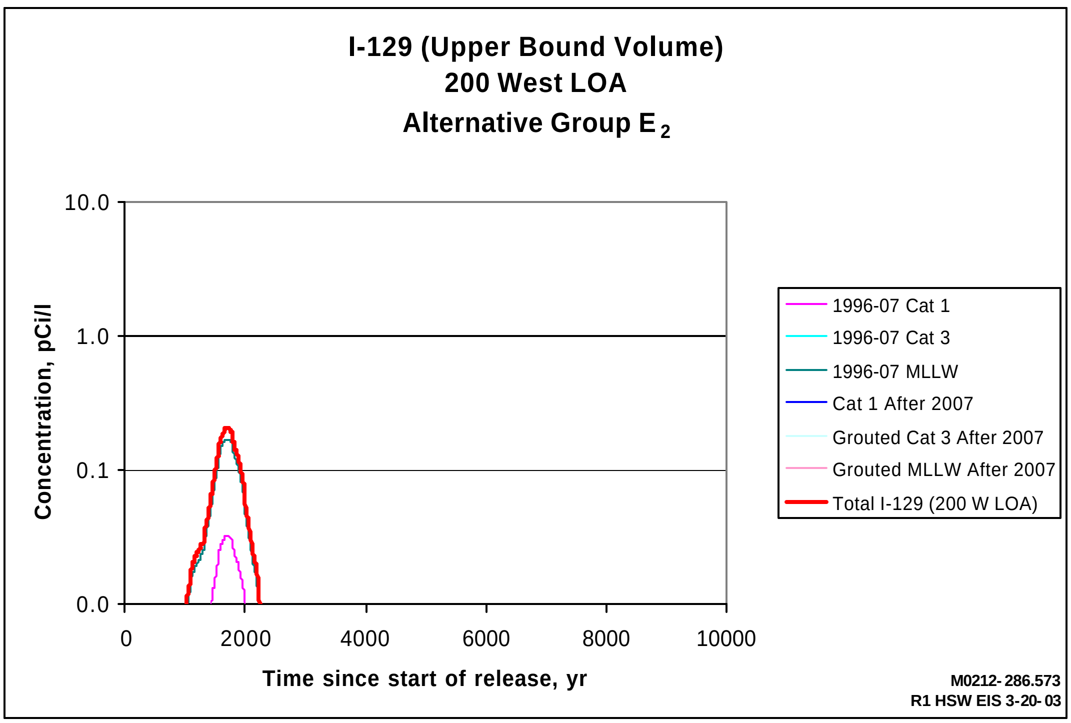
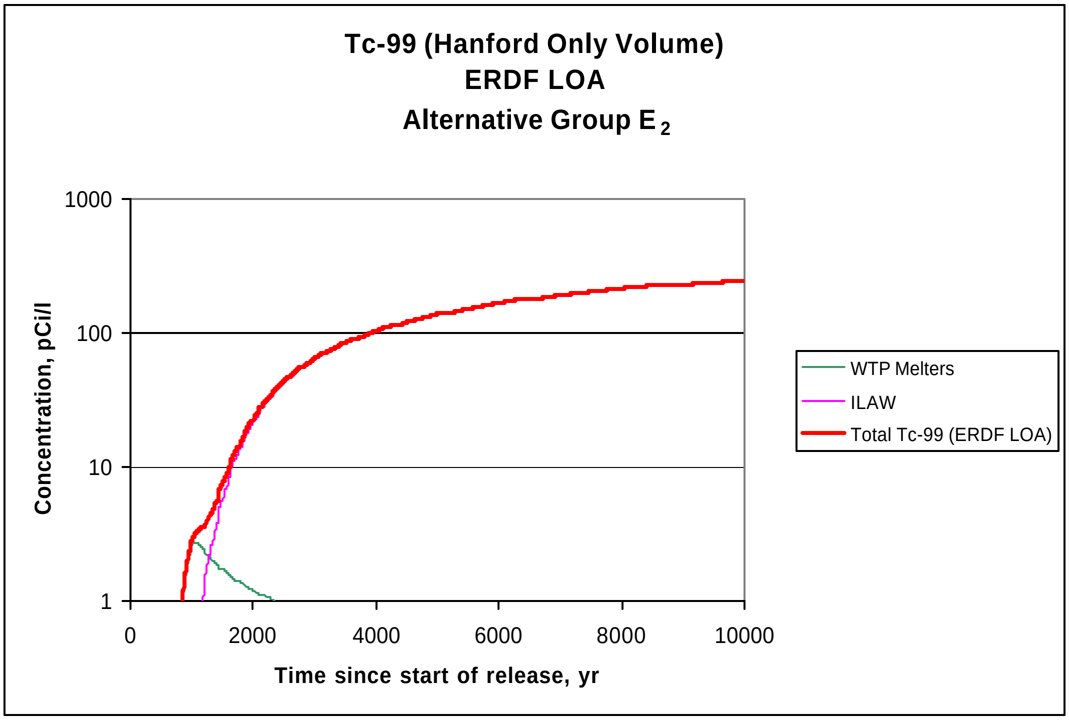


Figure G.73. Tc-99 and I-129 Concentration Profiles at the 200 West LOA (Alternative Group E_2 – Upper Bound Volume Wastes Disposed of After 1995)



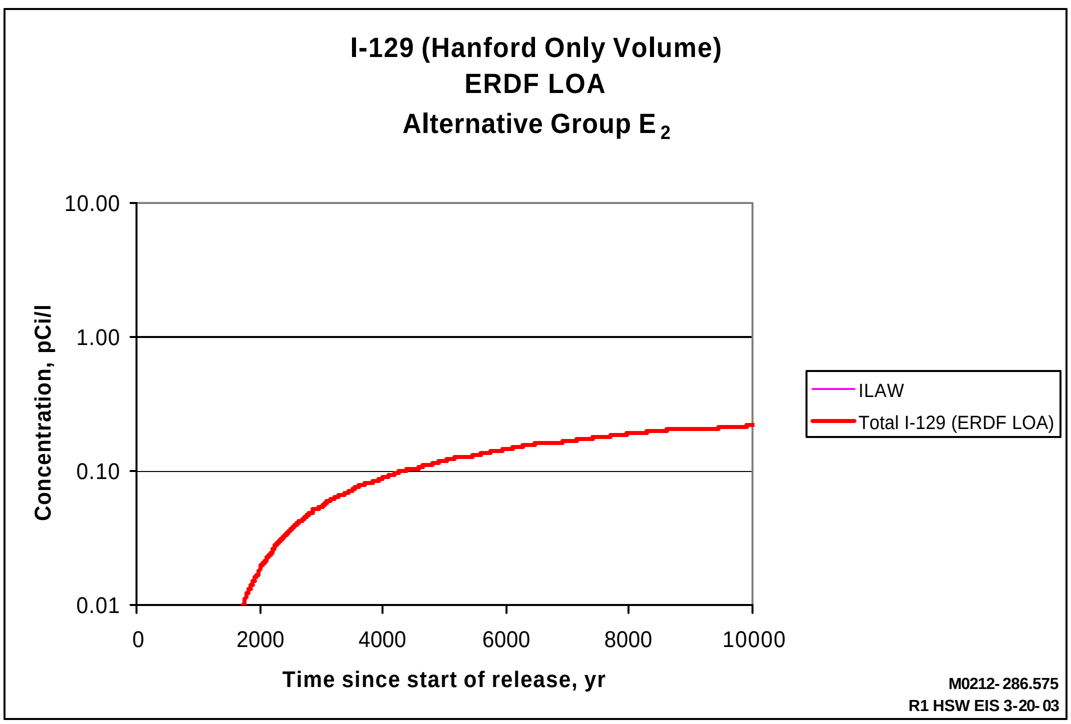


Figure G.74. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (ERDF) (Alternative Group E_2 – Upper Bound Volume Wastes Disposed of After 1995)

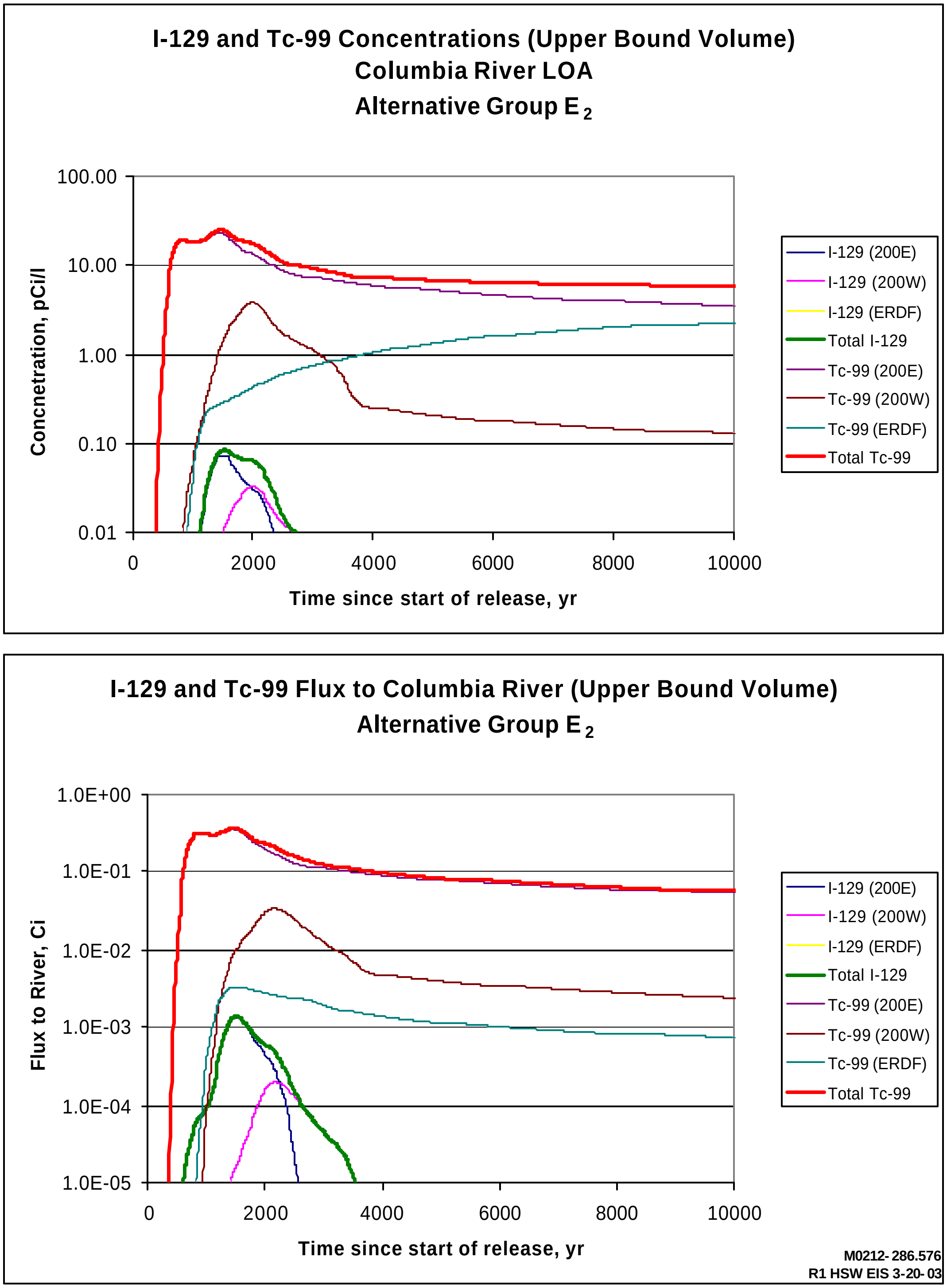
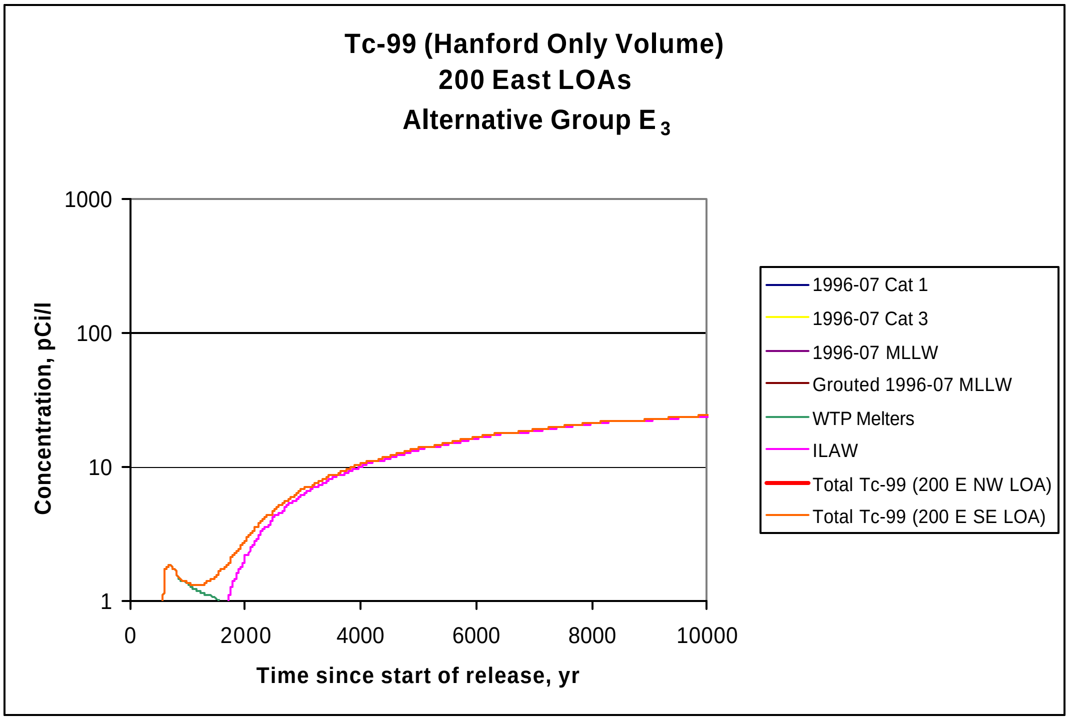


Figure G.75. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River LOA (Alternative Group E_2 – Upper Bound Volume Wastes Disposed of After 1995)



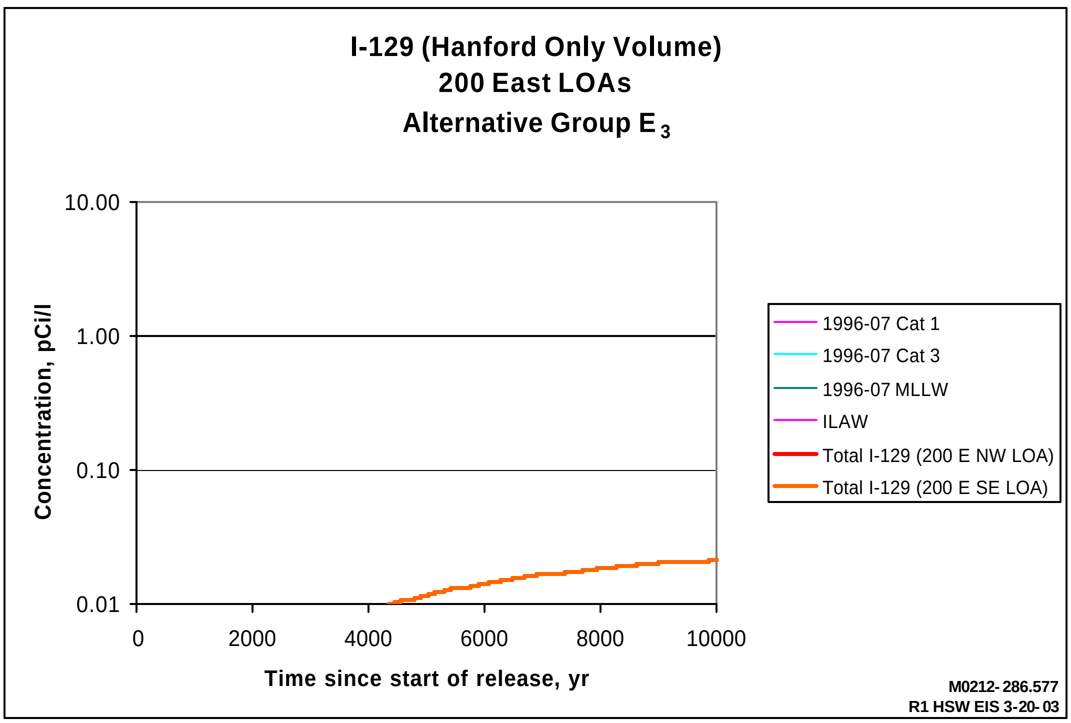
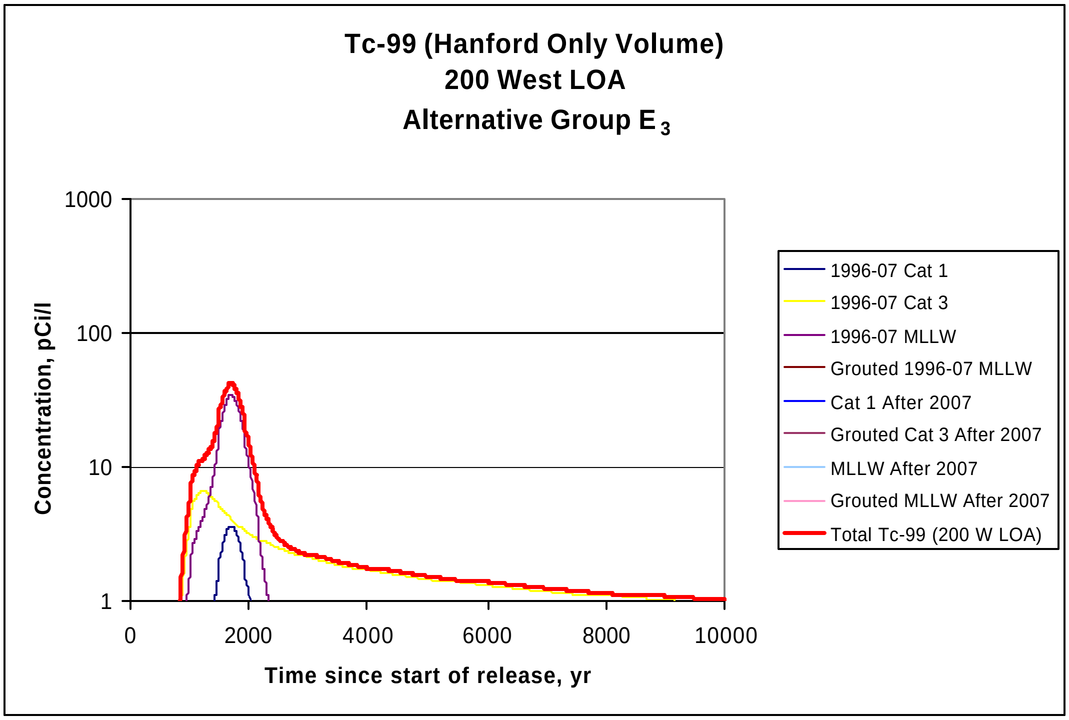


Figure G.76. Tc-99 and I-129 Concentration Profiles at the 200 East LOAs (Alternative Group E_3 – Hanford Only Wastes Disposed of After 1995)



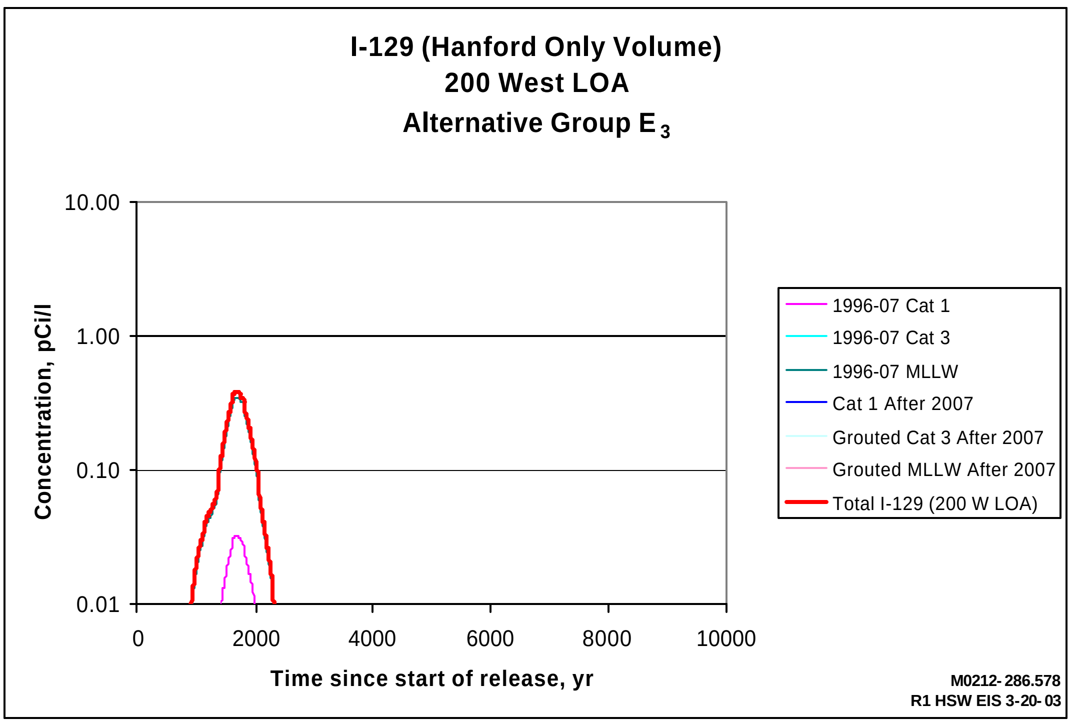


Figure G.77. Tc-99 and I-129 Concentration Profiles at the 200 West LOA
(Alternative Group E_3 – Hanford Only Wastes Disposed of After 1995)

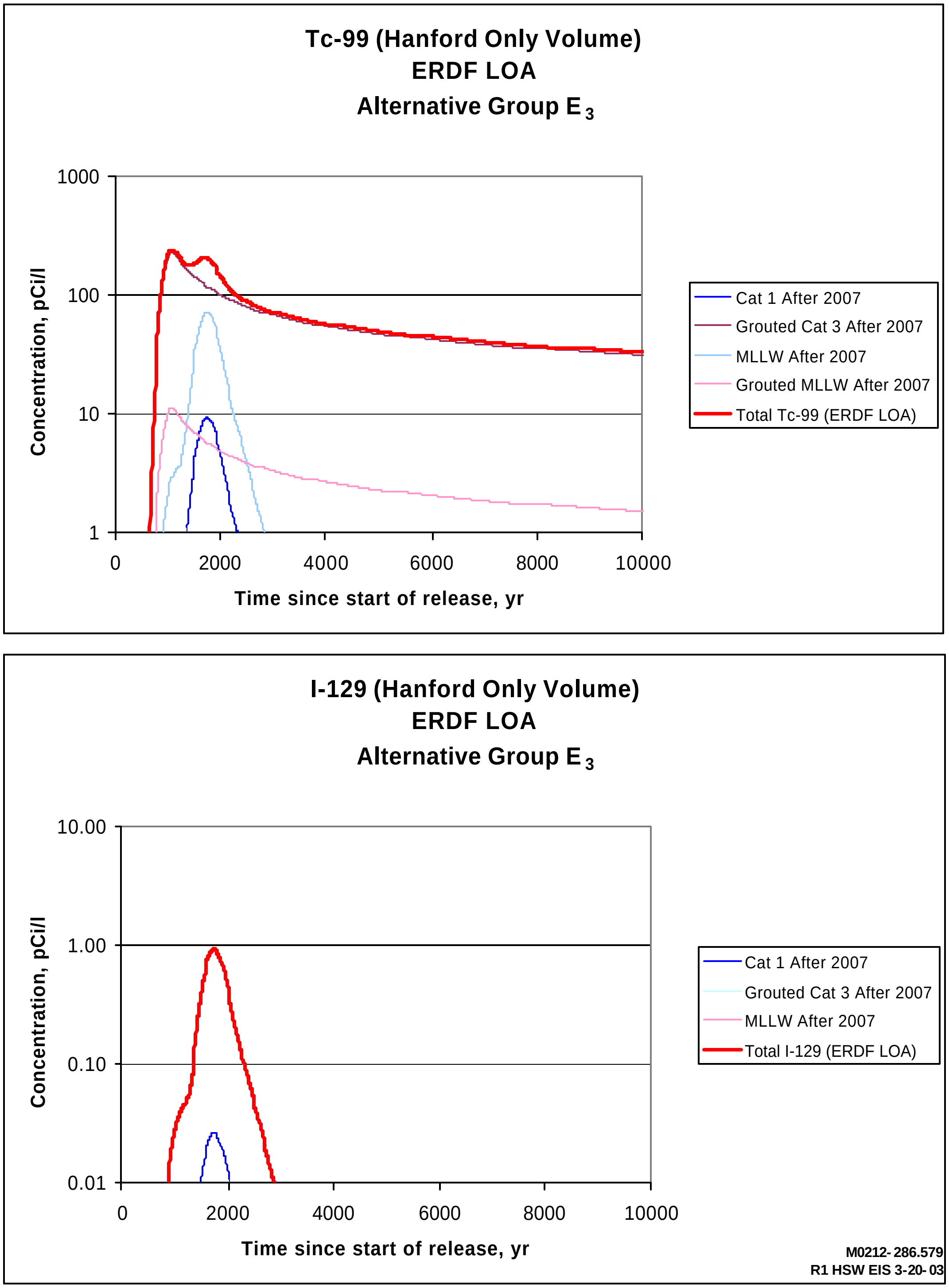


Figure G.78. Tc-99 and I-129 Concentration Profiles at the ERDF LOA (Alternative Group E_3 – Hanford Only Wastes Disposed of After 1995)

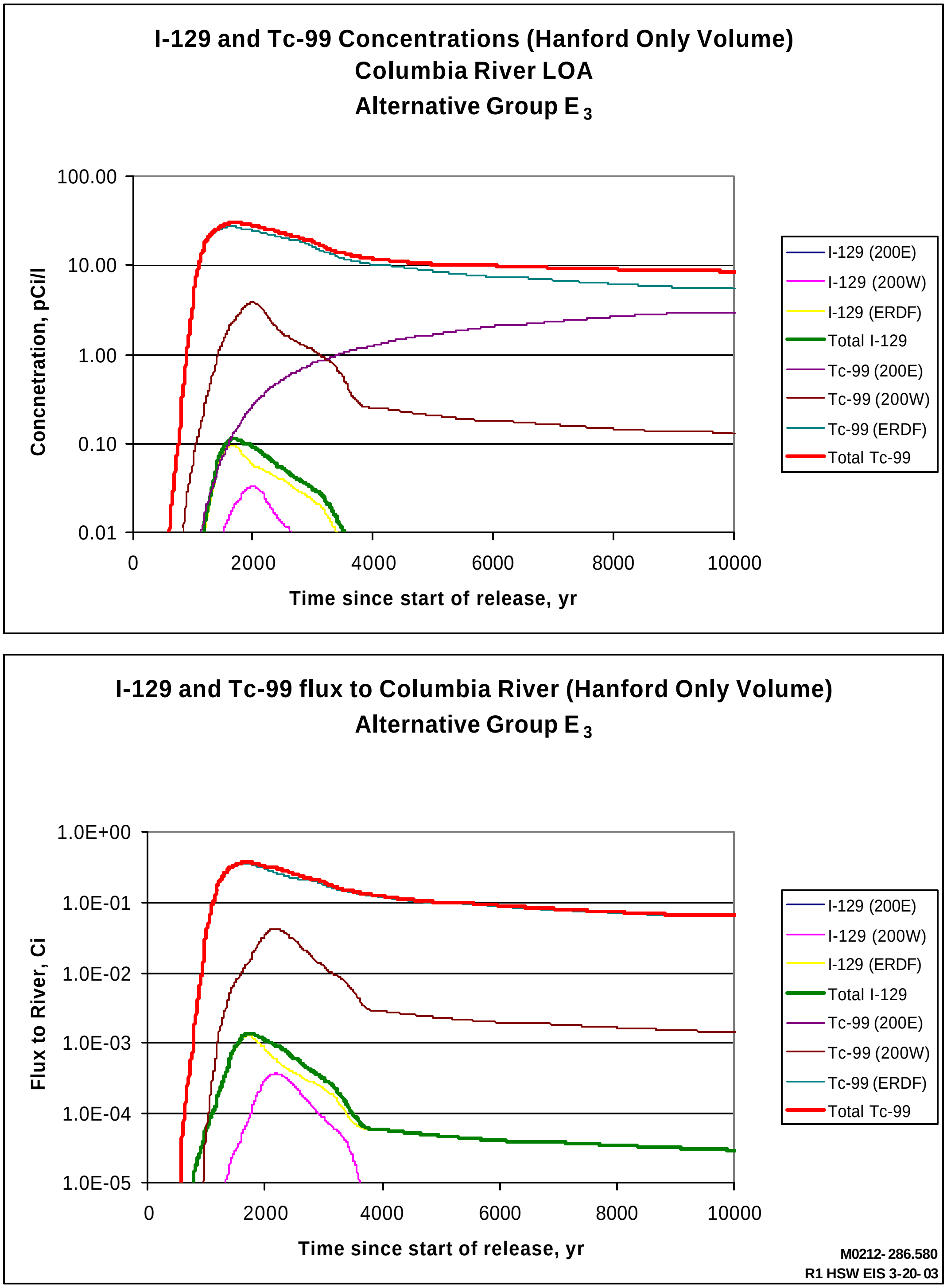
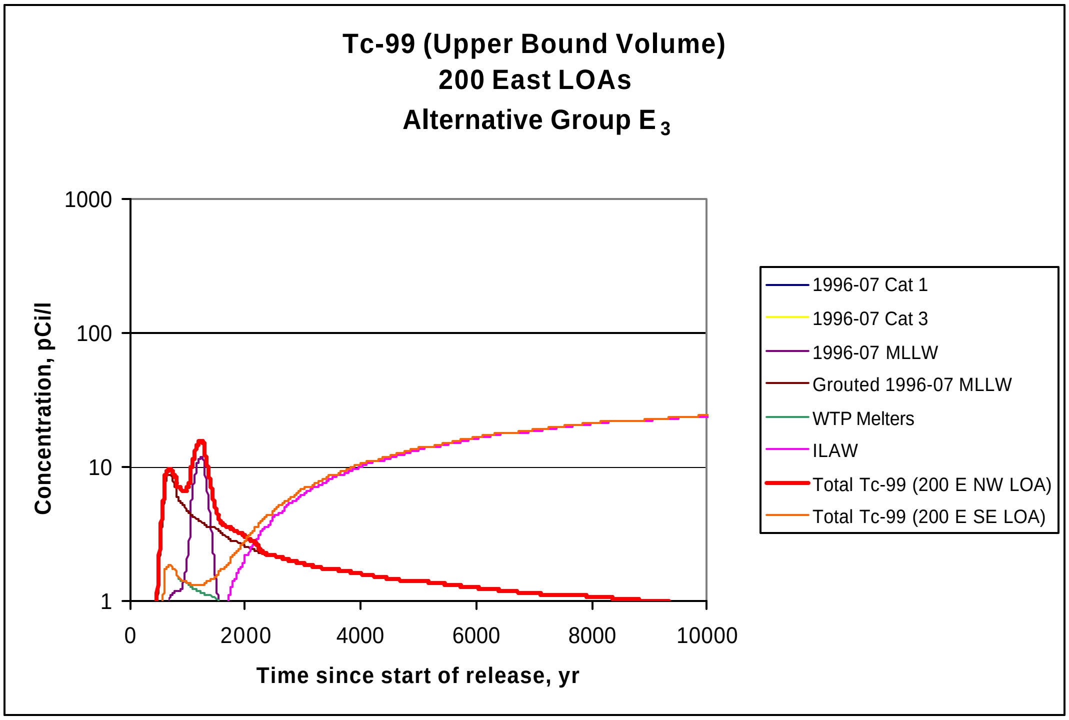


Figure G.79. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River LOA (Alternative Group E_3 – Hanford Only Wastes Disposed of After 1995)



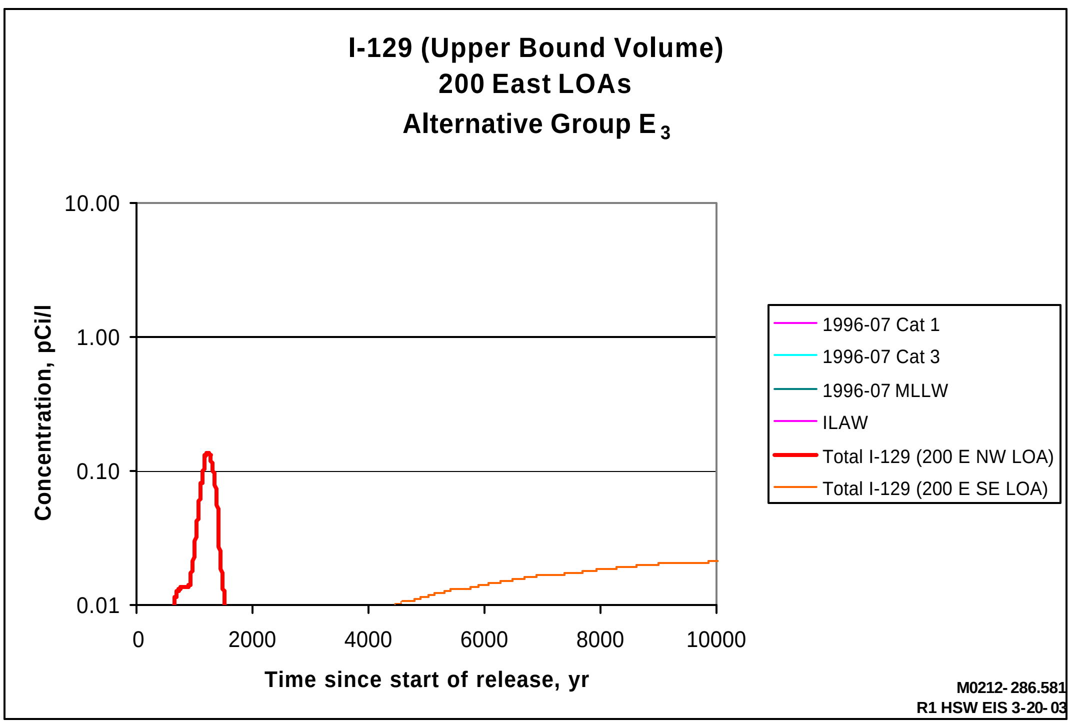


Figure G.80. Tc-99 and I-129 Concentration Profiles at the 200 East LOAs (Alternative Group E_3 – Upper Bound Volume Wastes Disposed of After 1995)

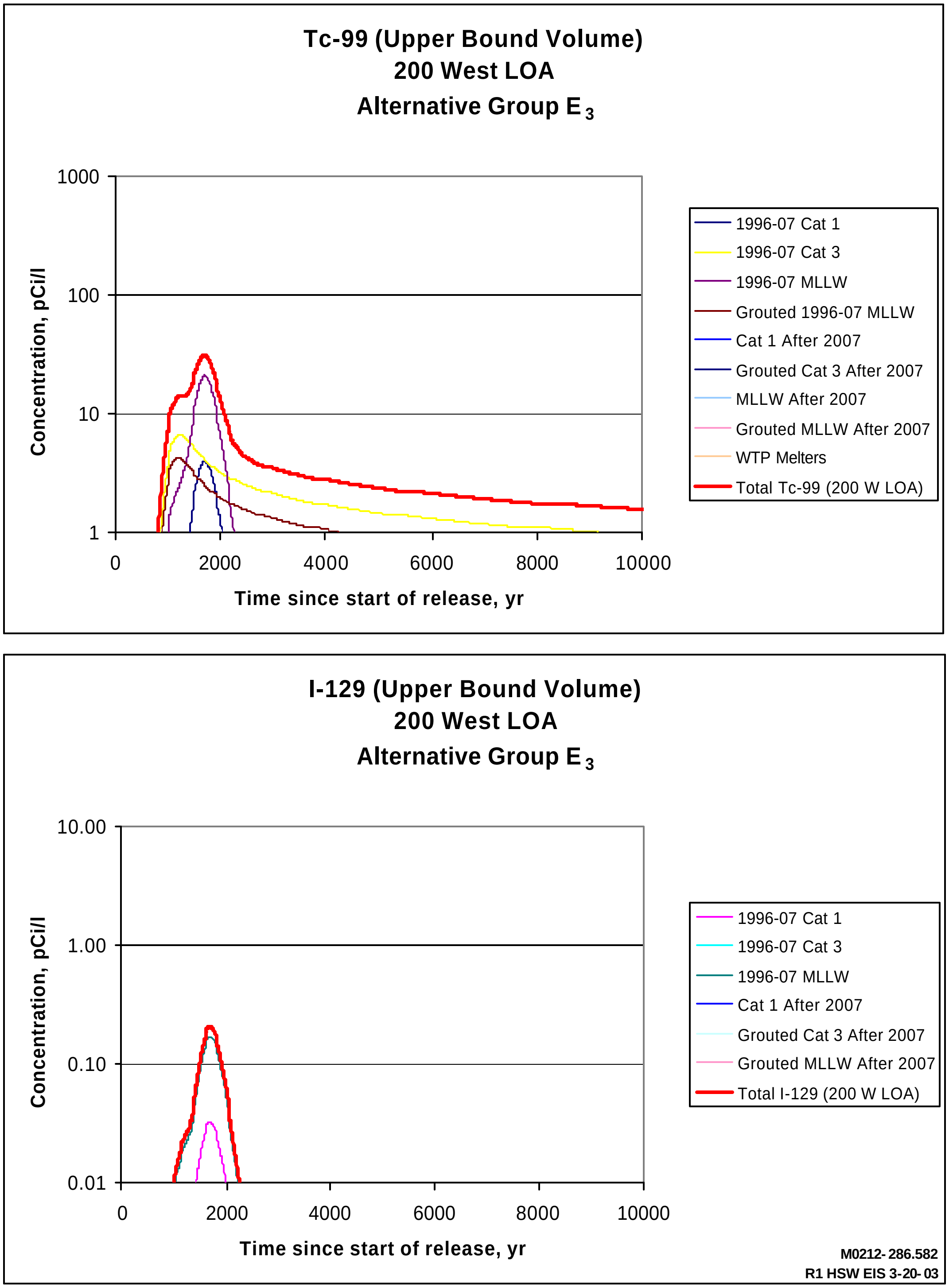
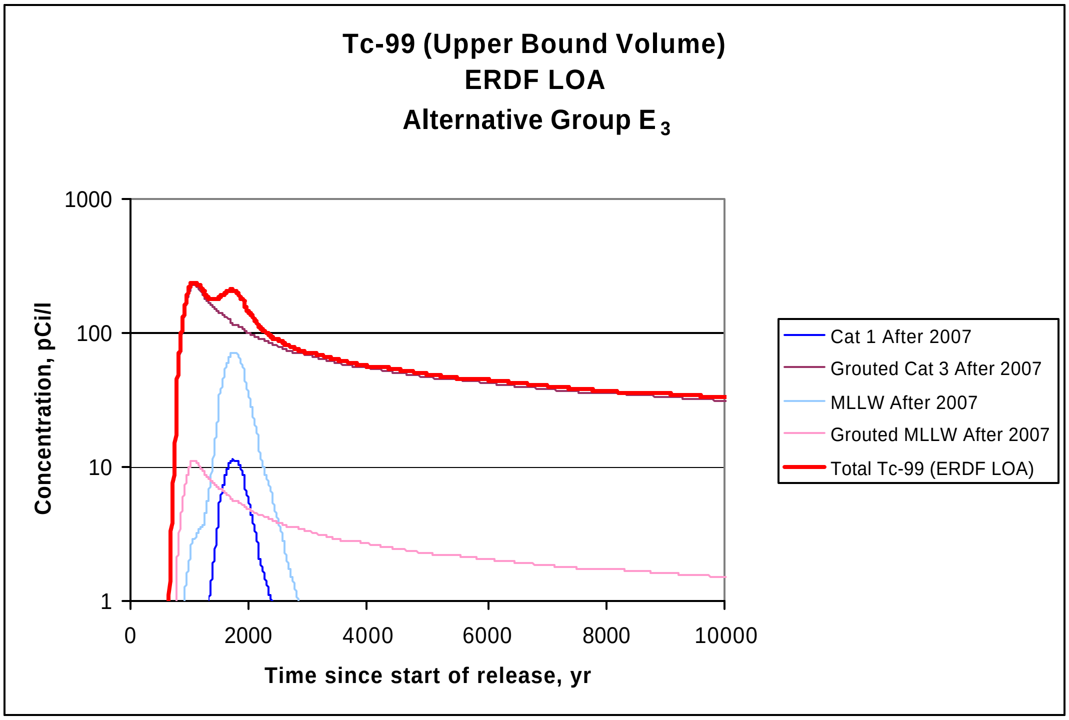


Figure G.81. Tc-99 and I-129 Concentration Profiles at the 200 West LOA (Alternative Group E_3 – Upper Bound Volume Wastes Disposed of After 1995)



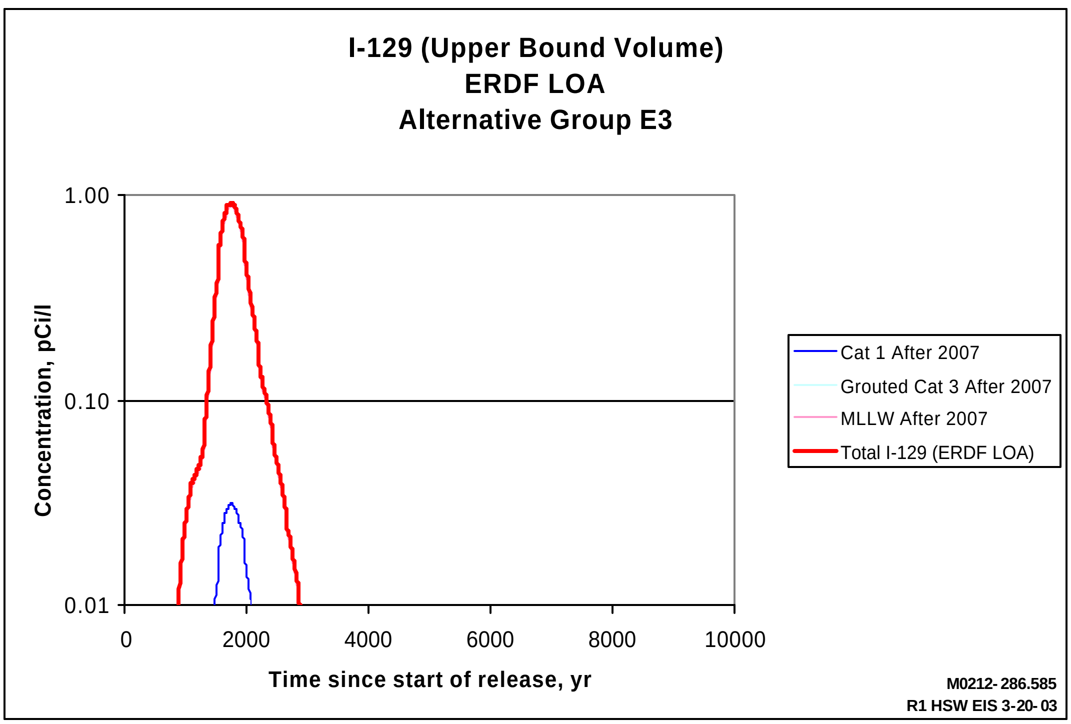
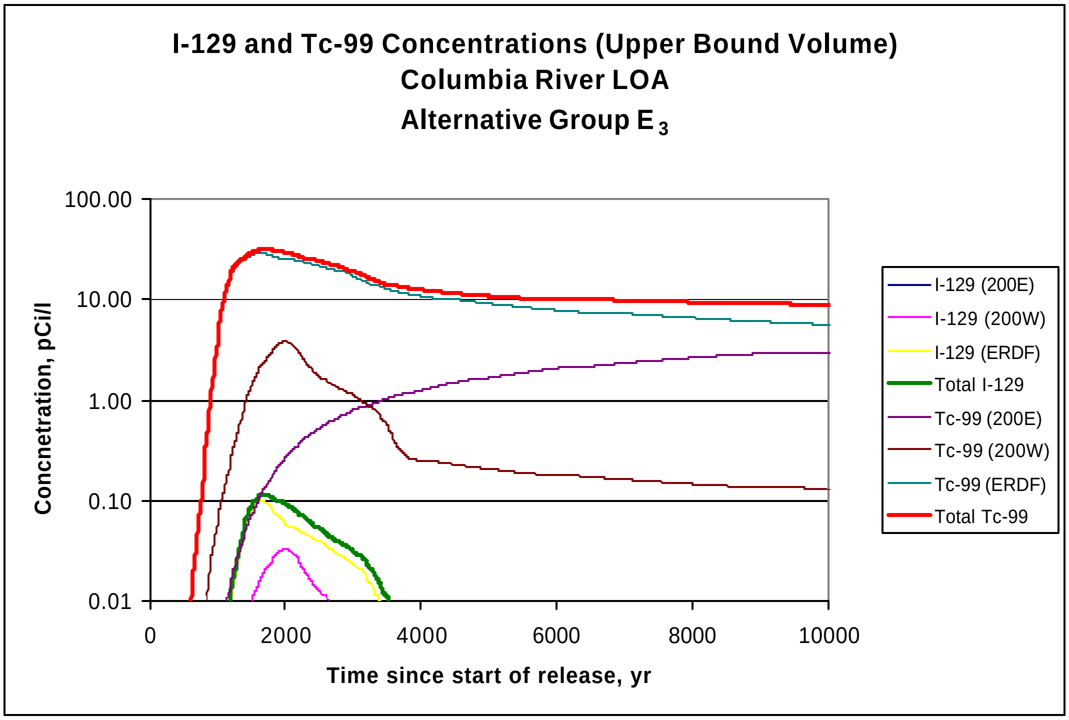


Figure G.82. Tc-99 and I-129 Concentration Profiles at 1-km Line of Analysis (ERDF) (Alternative Group E_3 – Upper Bound Volume Wastes Disposed of After 1995)



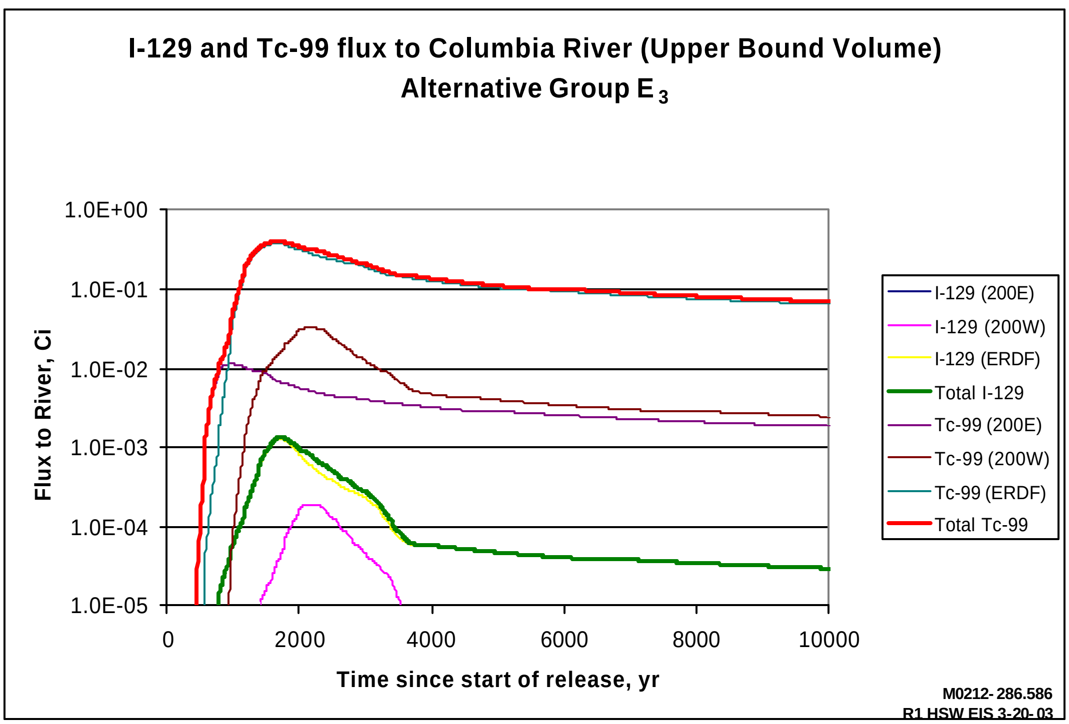
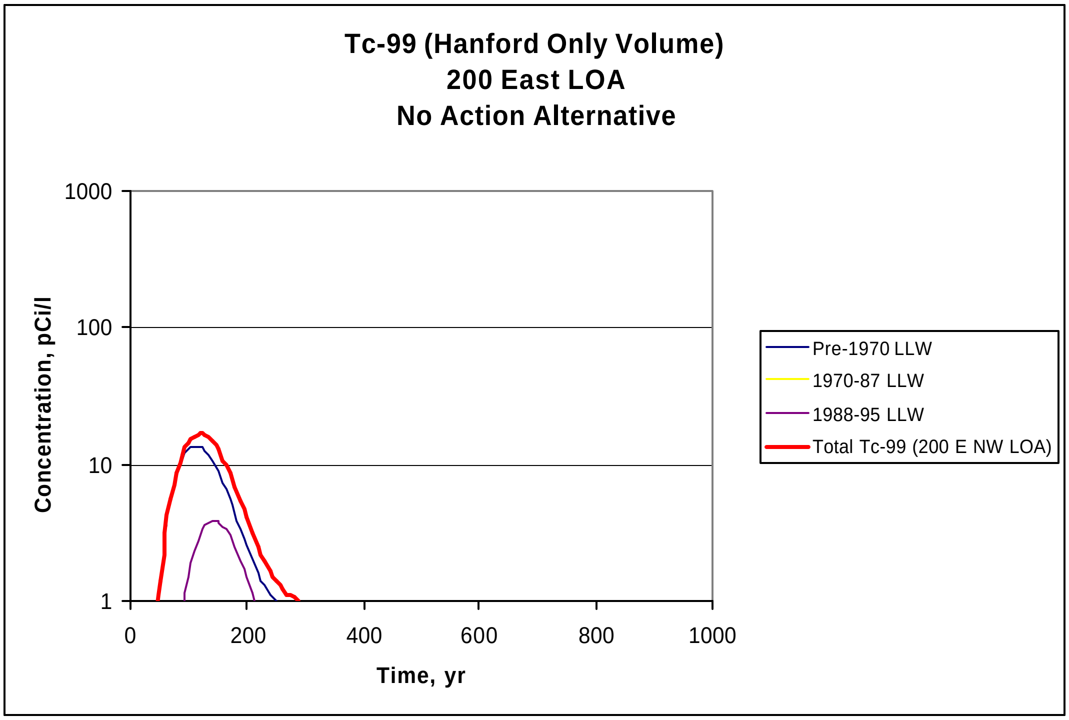


Figure G.83. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River LOA (Alternative Group E_3 – Upper Bound Volume Wastes Disposed of After 1995)



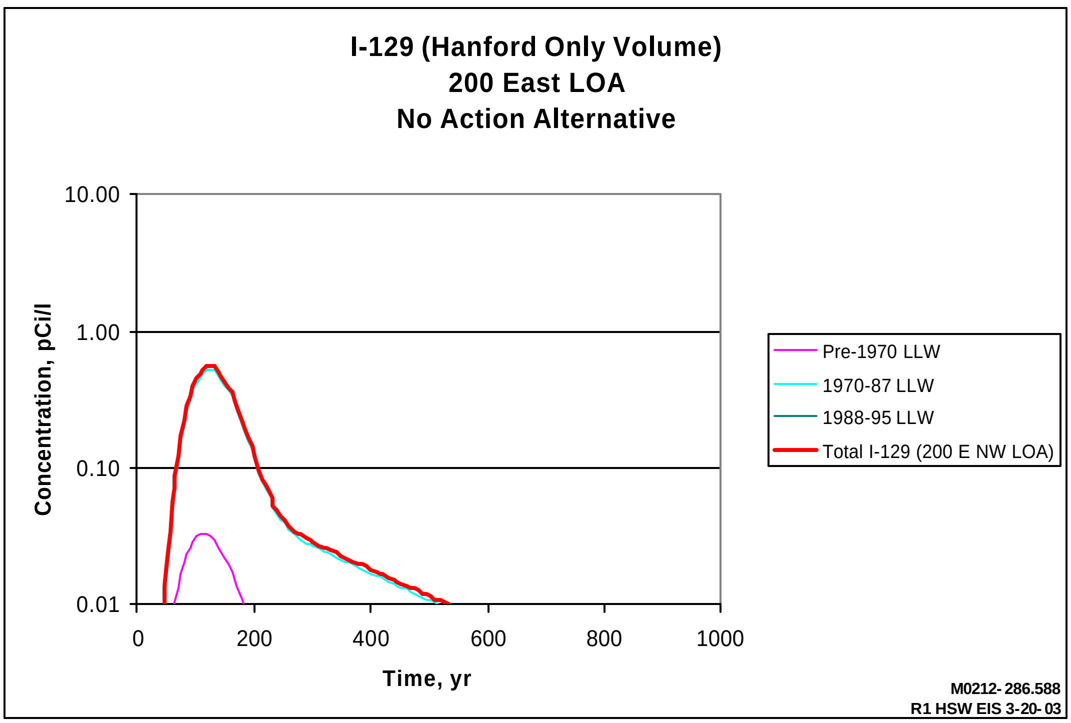


Figure G.84. Tc-99 and I-129 Concentration Profiles at the 200 East LOA (No Action Alternative – Previously Disposed of Wastes)

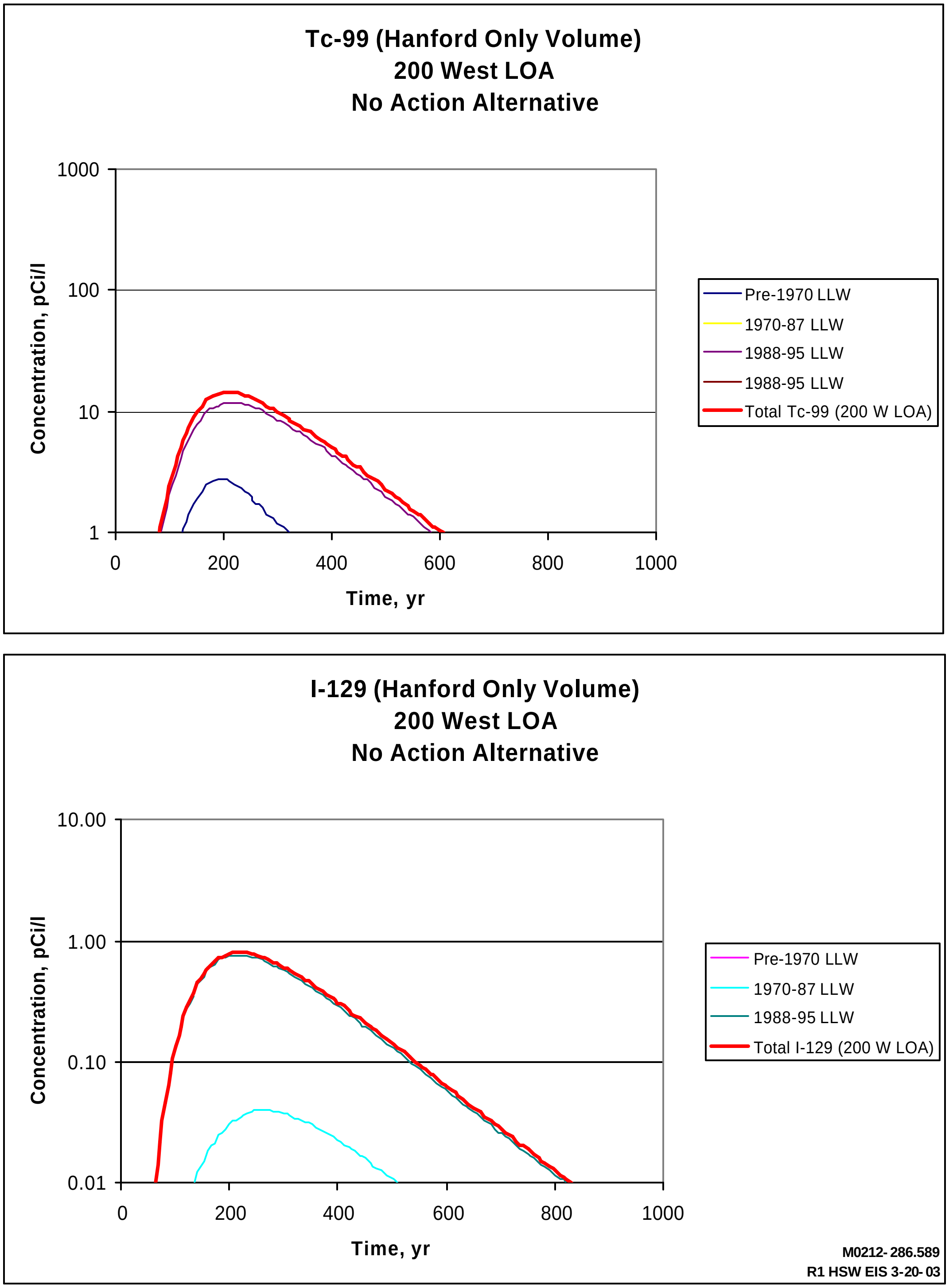


Figure G.85. Tc-99 and I-129 Concentration Profiles at the 200 West LOA (No Action Alternative - Previously Disposed of Wastes)

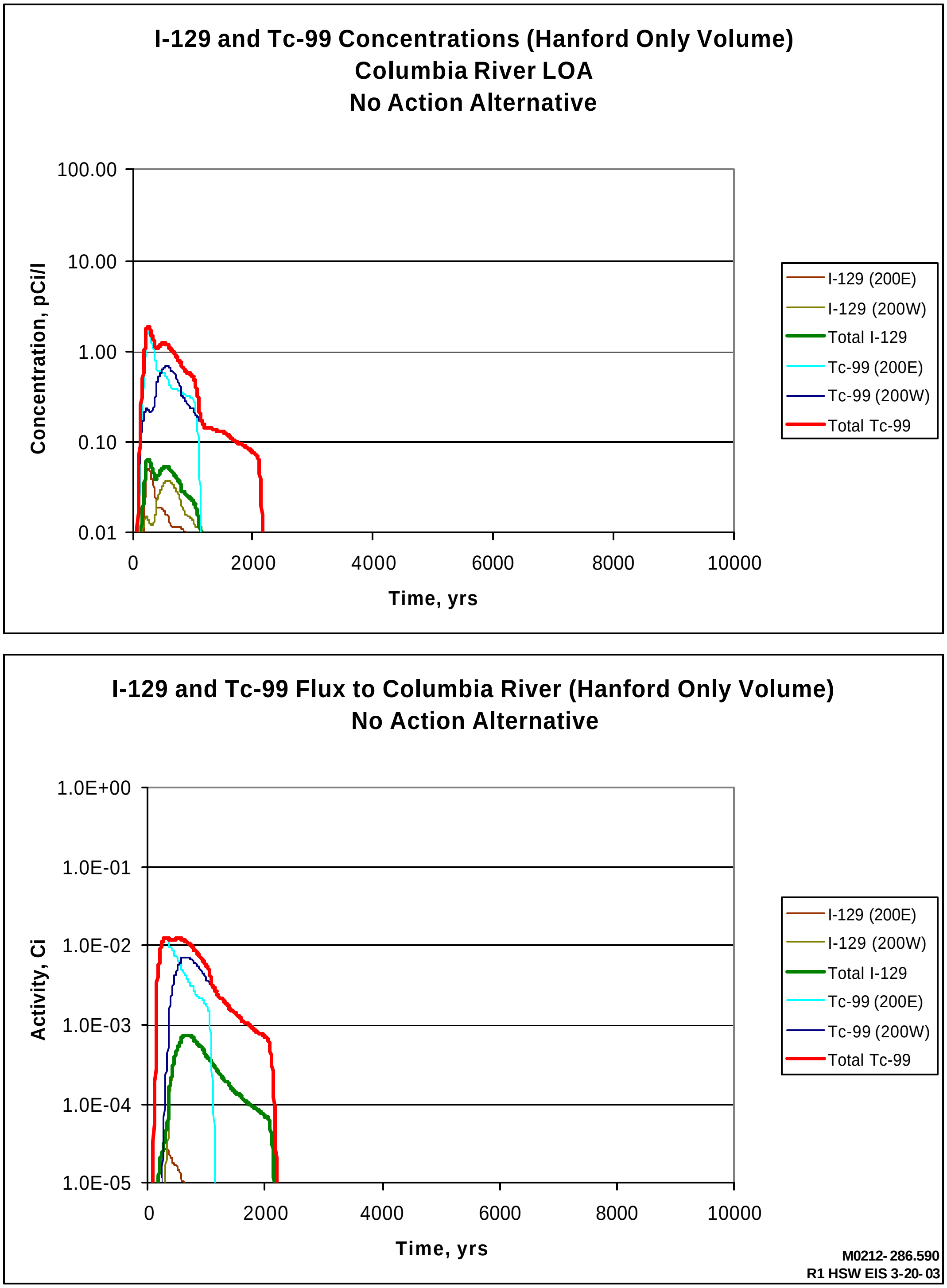
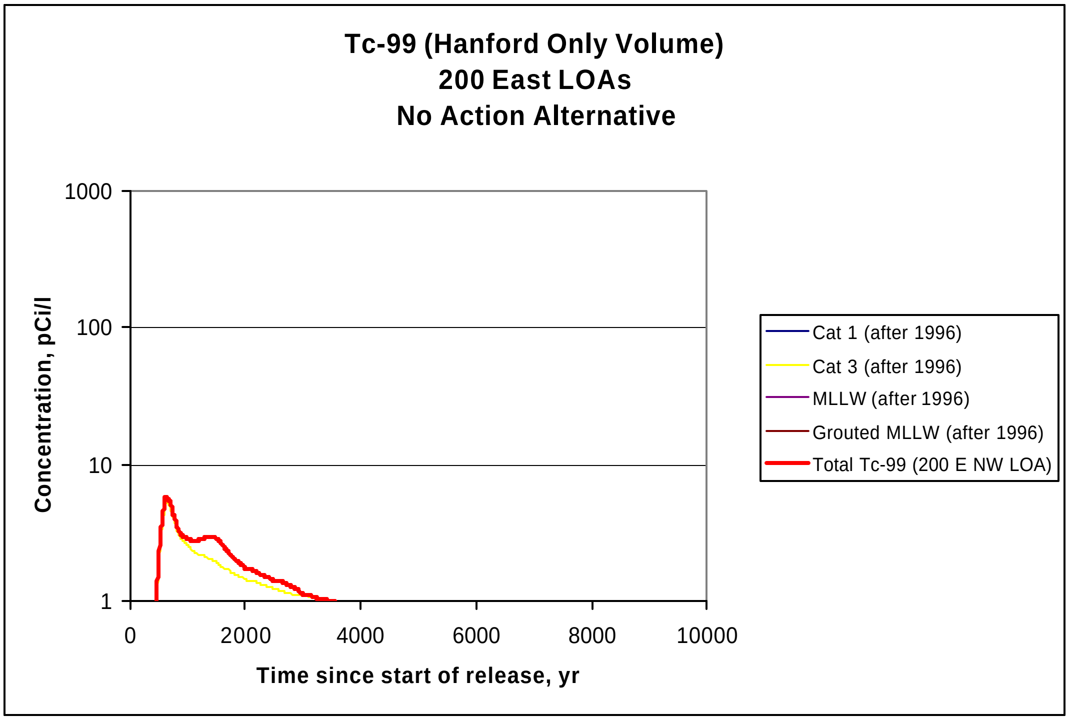


Figure G.86. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River LOA (No Action Alternative - Previously Disposed of Wastes)



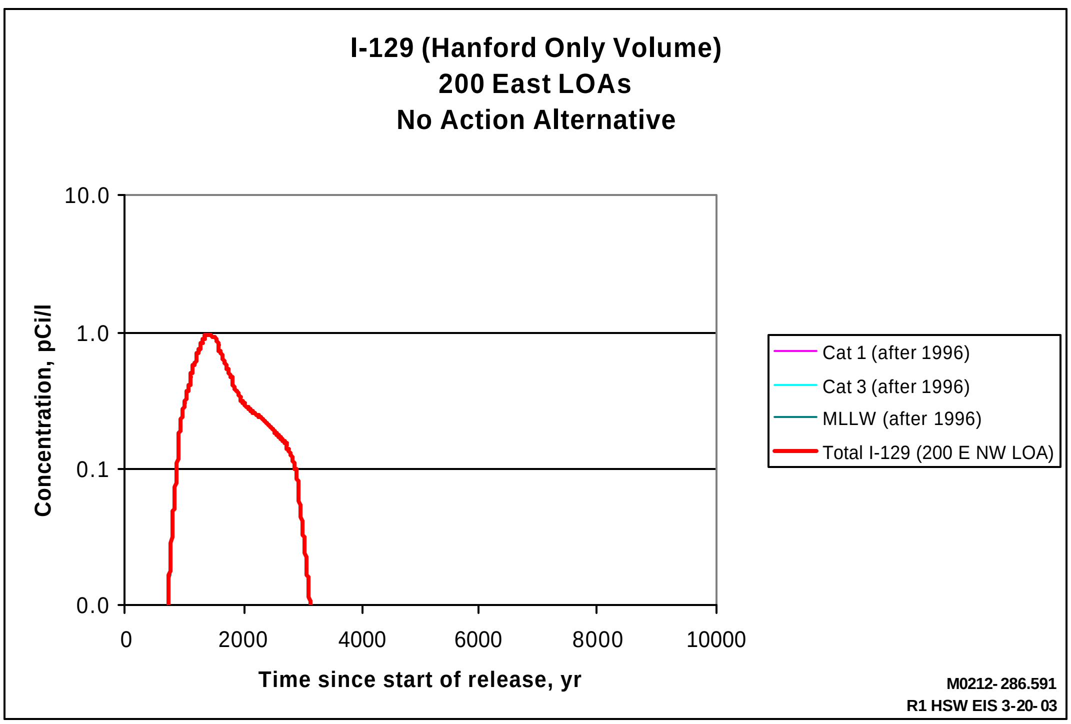


Figure G.87. Tc-99 and I-129 Concentration Profiles at the 200 East LOAs (No Action Alternative – Hanford Only Wastes Disposed of After 1995)

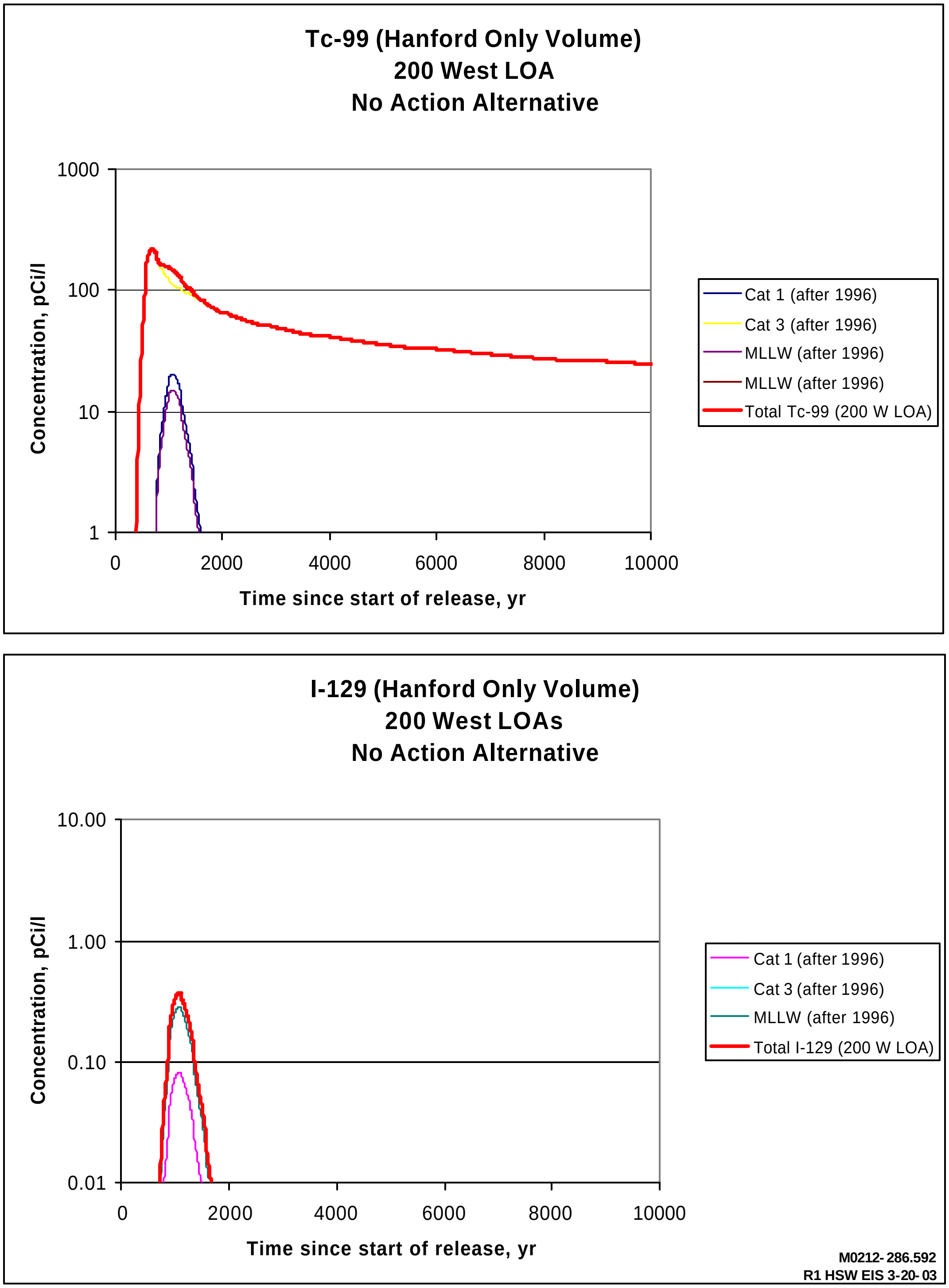


Figure G.88. Tc-99 and I-129 Concentration Profiles at the 200 West LOA (No Action Alternative – Hanford Only Wastes Disposed of After 1995)

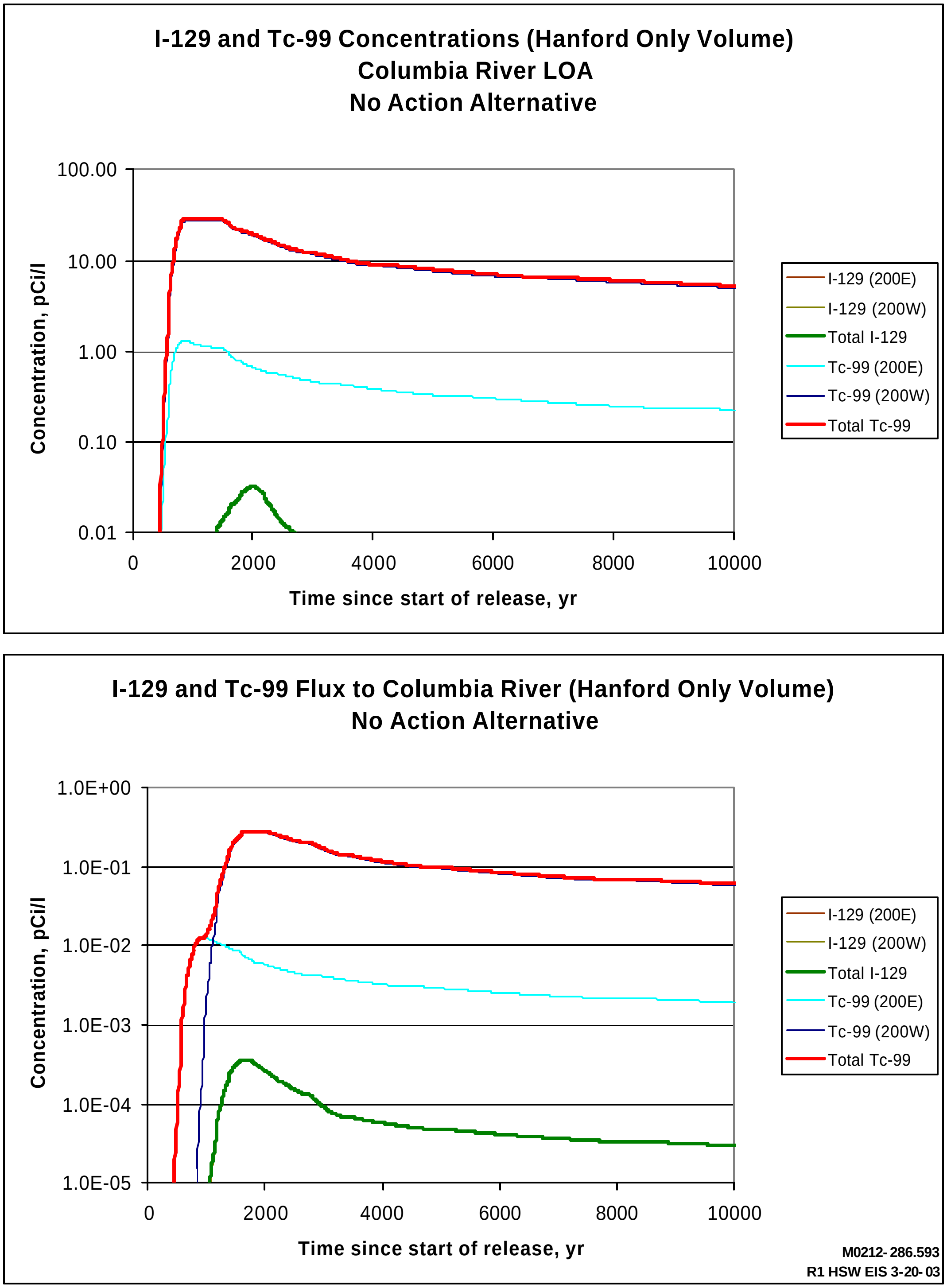


Figure G.89. I-129 and Tc-99 Concentration and River Flux Profiles Along the Columbia River LOA (No Action Alternative – Hanford Only Wastes Disposed of After 1995)

Table G.8. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a 1-km Line of Analysis, Alternative Group A

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area		0.00E+00								
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	3.00E+00	1700	3.66E-01	3.66E+00	1700	3.99E-01	3.99E+00	1700
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.63E-02	1700	3.20E-03	3.20E-02	1700	3.20E-03	3.20E-02	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.03E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000
U-234	(a)	1.70E-01	0.00E+00	>10000	2.07E-01	0.00E+00	>10000	9.01E-01	0.00E+00	>10000
U-235	(a)	3.56E-02	0.00E+00	>10000	4.34E-02	0.00E+00	>10000	8.86E-02	0.00E+00	>10000
U-236	(a)	4.03E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000
U-238	(a)	4.06E-01	0.00E+00	>10000	4.95E-01	0.00E+00	>10000	1.66E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230
I-129	1	3.39E-07	3.39E-06	1700	3.53E-07	3.53E-06	1700	3.53E-07	3.53E-06	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.79E-02	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	2.32E-01	0.00E+00	>10000
U-234	(a)	1.24E+02	0.00E+00	>10000	1.29E+02	0.00E+00	>10000	2.94E+02	0.00E+00	>10000
U-235	(a)	3.54E+00	0.00E+00	>10000	3.69E+00	0.00E+00	>10000	8.39E+00	0.00E+00	>10000
U-236	(a)	1.60E+01	0.00E+00	>10000	1.67E+01	0.00E+00	>10000	3.80E+01	0.00E+00	>10000
U-238	(a)	1.99E+02	0.00E+00	>10000	2.07E+02	0.00E+00	>10000	4.72E+02	0.00E+00	>10000

Table G8. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.27E-02	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.18E+01	1230
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	8.66E+00	680
I-129	1	0.00E+00			0.00E+00			1.68E-02	1.39E-01	1230
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	5.18E-05	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	5.24E+00	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	2.32E-01	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	1.13E-03	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	5.43E+00	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.44E+01	1700	3.44E+00	3.44E+01	1700	2.09E+00	2.09E+01	1700
Grouted Tc-99	900	4.91E+00	3.50E-01	1200	4.92E+00	3.51E-01	1200	5.96E+01	4.25E+00	1200
I-129	1	3.50E-02	3.51E-01	1700	3.51E-02	3.51E-01	1700	1.70E-02	1.70E-01	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.28E+01	0.00E+00	>10000	1.56E+01	0.00E+00	>10000	1.59E+01	0.00E+00	>10000
Tc-99	900	1.08E+00	8.98E+00	1910	1.32E+00	1.09E+01	1910	1.33E+00	1.10E+01	1910
Grouted Tc-99	900	0.00E+00			0.00E+00	0.00E+00		0.00E+00		
I-129	1	3.01E-03	2.50E-02	1910	3.67E-03	3.04E-02	1910	3.67E-03	3.04E-02	1910
Grouted I-129	1	0.00E+00			0.00E+00	0.00E+00		0.00E+00		
U-233	(a)	3.71E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000
U-234	(a)	6.13E-01	0.00E+00	>10000	7.47E-01	0.00E+00	>10000	9.21E-01	0.00E+00	>10000
U-235	(a)	1.29E-01	0.00E+00	>10000	1.57E-01	0.00E+00	>10000	1.68E-01	0.00E+00	>10000
U-236	(a)	1.46E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000
U-238	(a)	1.47E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000	2.08E+00	0.00E+00	>10000

Table G8. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum Concen-tration (pCi/L)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum Concen-tration (pCi/L)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum Concen-tration (pCi/L)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	4.44E-01	0.00E+00	>10000	4.62E-01	0.00E+00	>10000	1.45E+02	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	2.98E+02	1230	3.23E+03	2.98E+02	1230	3.23E+03	2.98E+02	1230
I-129	1	1.96E-06	1.62E-05	1910	2.04E-06	1.62E-05	1910	2.04E-06	1.69E-05	1910
Grouted I-129	1	5.00E+00	1.46E-01	1230	5.00E+00	1.46E-01	1230	5.00E+00	1.46E-01	1230
U-233	(a)	2.98E-01	0.00E+00	>10000	3.10E-01	0.00E+00	>10000	1.80E-01	0.00E+00	>10000
U-234	(a)	3.73E+02	0.00E+00	>10000	3.89E+02	0.00E+00	>10000	3.11E+02	0.00E+00	>10000
U-235	(a)	1.07E+01	0.00E+00	>10000	1.11E+01	0.00E+00	>10000	1.20E+01	0.00E+00	>10000
U-236	(a)	4.82E+01	0.00E+00	>10000	5.02E+01	0.00E+00	>10000	2.89E+01	0.00E+00	>10000
U-238	(a)	5.99E+02	0.00E+00	>10000	6.24E+02	0.00E+00	>10000	5.04E+02	0.00E+00	>10000
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	5.28E+01	10000	4.33E+00	1.01E-02	10000	5.70E+00	1.34E-02	10000
Tc-99	900	8.34E+00	6.79E+01	1370	8.36E+00	6.80E+01	1370	8.27E+00	6.73E+01	1370
Grouted Tc-99	900	1.57E+02	1.10E+01	680	1.57E+02	1.11E+01	680	3.34E+02	2.35E+01	680
I-129	1	1.04E-01	8.44E-01	1370	1.04E-01	8.46E-01	1370	1.05E-01	8.56E-01	1370
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	4.14E-08	10000	1.36E-02	4.15E-08	10000	1.38E-02	4.20E-08	10000
U-234	(a)	1.61E+01	4.91E-05	10000	1.61E+01	4.92E-05	10000	3.40E+02	1.04E-03	10000
U-235	(a)	2.56E-01	7.82E-07	10000	2.57E-01	7.83E-07	10000	1.46E+01	4.46E-05	10000
U-236	(a)	3.01E-01	9.19E-07	10000	3.02E-01	9.20E-07	10000	3.05E-01	9.31E-07	10000
U-238	(a)	4.00E+00	1.22E-05	10000	4.01E+00	1.22E-05	10000	3.44E+02	1.05E-03	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G8. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	2.74E+00	680	3.89E+01	2.74E+00	680	3.89E+01	2.74E+00	680
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	1.74E-03	10000	8.49E-01	1.74E-03	10000	8.49E-01	1.74E-03	10000
U-234	(a)	4.60E-01	9.43E-04	10000	4.60E-01	9.43E-04	10000	4.60E-01	9.43E-04	10000
U-235	(a)	1.90E-02	3.89E-05	10000	1.90E-02	3.89E-05	10000	1.90E-02	3.89E-05	10000
U-236	(a)	1.70E-02	3.48E-05	10000	1.70E-02	3.48E-05	10000	1.70E-02	3.48E-05	10000
U-238	(a)	4.10E-01	8.40E-04	10000	4.10E-01	8.40E-04	10000	4.10E-01	8.40E-04	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 μg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to μg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

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Table G.9. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a Line of Analysis Along the Columbia River, Alternative Group A

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	2.63E-01	2000	3.66E-01	3.21E-01	2000	3.99E-01	3.50E-01	2000
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.30E-03	2000	3.20E-03	2.81E-03	2000	3.20E-03	2.81E-03	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.03E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000
U-234	(a)	1.70E-01	0.00E+00	>10000	2.07E-01	0.00E+00	>10000	9.01E-01	0.00E+00	>10000
U-235	(a)	3.56E-02	0.00E+00	>10000	4.34E-02	0.00E+00	>10000	8.86E-02	0.00E+00	>10000
U-236	(a)	4.03E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000
U-238	(a)	4.06E-01	0.00E+00	>10000	4.95E-01	0.00E+00	>10000	1.66E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	0.00E+00			3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			7.20E+01			0.00E+00		
Grouted Tc-99	900	7.20E+01	4.62E-01	1710	3.53E-07	4.62E-01	1710	7.20E+01	4.62E-01	1710
I-129	1	3.39E-07	2.97E-07	2000	0.00E+00	3.09E-07	2000	3.53E-07	3.09E-07	2000
Grouted I-129	1	0.00E+00			1.02E-01			0.00E+00		
U-233	(a)	9.79E-02	0.00E+00	>10000	1.29E+02	0.00E+00	>10000	2.32E-01	0.00E+00	>10000
U-234	(a)	1.24E+02	0.00E+00	>10000	3.69E+00	0.00E+00	>10000	2.94E+02	0.00E+00	>10000
U-235	(a)	3.54E+00	0.00E+00	>10000	1.67E+01	0.00E+00	>10000	8.39E+00	0.00E+00	>10000
U-236	(a)	1.60E+01	0.00E+00	>10000	2.07E+02	0.00E+00	>10000	3.80E+01	0.00E+00	>10000
U-238	(a)	1.99E+02	0.00E+00	>10000	0.00E+00	0.00E+00	>10000	4.72E+02	0.00E+00	>10000

Table G9. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	**Maximum Concen-tration (pCi/L)**	**Approx. Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum Concen-tration (pCi/L)**	**Approx. Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum Concen-tration (pCi/L)**	**Approx. Peak Arrival Time (yrs)**
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.18E-03	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	2.24E+00	800
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	1.06E+00	940
I-129	1	0.00E+00			0.00E+00			1.68E-02	2.63E-02	800
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	**1.61E-06**	**10000**
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	**1.63E-01**	**10000**
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	**7.21E-03**	**10000**
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	**3.52E-05**	**10000**
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	**1.69E-01**	**10000**
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.01E+00	2000	3.44E+00	3.02E+00	2000	2.09E+00	1.83E+00	2000
Grouted Tc-99	900	4.91E+00	3.36E-02	1620	4.92E+00	3.37E-02	1620	5.96E+01	4.08E-01	1620
I-129	1	3.50E-02	3.07E-02	2000	3.51E-02	3.08E-02	2000	1.70E-02	1.49E-02	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.28E+01	0.00E+00	>10000	1.56E+01	0.00E+00	>10000	1.59E+01	0.00E+00	>10000
Tc-99	900	1.08E+00	8.33E-01	2260	1.32E+00	1.02E+00	2260	1.33E+00	1.02E+00	2260
Grouted Tc-99	900	0.00E+00			0.00E+00	0.00E+00		0.00E+00	0.00E+00	
I-129	1	3.01E-03	2.32E-03	2260	3.67E-03	2.83E-03	2260	3.67E-03	2.83E-03	2260
Grouted I-129	1	0.00E+00			0.00E+00	0.00E+00		0.00E+00	0.00E+00	
U-233	(a)	3.71E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000
U-234	(a)	6.13E-01	0.00E+00	>10000	7.47E-01	0.00E+00	>10000	9.21E-01	0.00E+00	>10000
U-235	(a)	1.29E-01	0.00E+00	>10000	1.57E-01	0.00E+00	>10000	1.68E-01	0.00E+00	>10000
U-236	(a)	1.46E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000
U-238	(a)	1.47E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000	2.08E+00	0.00E+00	>10000

Table G9. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	4.44E-01	0.00E+00	>10000	4.62E-01	0.00E+00	>10000	1.45E+02	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	2.07E+01	1710	3.23E+03	2.07E+01	1710	3.23E+03	2.07E+01	1710
I-129	1	1.96E-06	1.51E-06	2260	2.04E-06	1.57E-06	2260	2.04E-06	1.57E-06	2260
Grouted I-129	1	5.00E+00	1.01E-02	1710	5.00E+00	1.01E-02	1710	5.00E+00	1.01E-02	1710
U-233	(a)	2.98E-01	0.00E+00	>10000	3.10E-01	0.00E+00	>10000	1.80E-01	0.00E+00	>10000
U-234	(a)	3.73E+02	0.00E+00	>10000	3.89E+02	0.00E+00	>10000	3.11E+02	0.00E+00	>10000
U-235	(a)	1.07E+01	0.00E+00	>10000	1.11E+01	0.00E+00	>10000	1.20E+01	0.00E+00	>10000
U-236	(a)	4.82E+01	0.00E+00	>10000	5.02E+01	0.00E+00	>10000	2.89E+01	0.00E+00	>10000
U-238	(a)	5.99E+02	0.00E+00	>10000	6.24E+02	0.00E+00	>10000	5.04E+02	0.00E+00	>10000
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	6.36E-05	10000	4.33E+00	6.38E-05	10000	5.70E+00	8.39E-05	10000
Tc-99	900	8.34E+00	9.43E+00	1590	8.36E+00	9.44E+00	1590	8.27E+00	9.34E+00	1590
Grouted Tc-99	900	1.57E+02	1.35E+00	940	1.57E+02	1.36E+00	940	3.34E+02	2.89E+00	940
I-129	1	1.04E-01	1.17E-01	1590	1.04E-01	1.17E-01	1590	1.05E-01	1.19E-01	1590
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	2.21E-10	10000	1.36E-02	2.22E-10	10000	1.38E-02	2.25E-10	10000
U-234	(a)	1.61E+01	2.63E-07	10000	1.61E+01	2.63E-07	10000	3.40E+02	5.55E-06	10000
U-235	(a)	2.56E-01	4.18E-09	10000	2.57E-01	4.19E-09	10000	1.46E+01	2.39E-07	10000
U-236	(a)	3.01E-01	4.92E-09	10000	3.02E-01	4.93E-09	10000	3.05E-01	4.98E-09	10000
U-238	(a)	4.00E+00	6.53E-08	10000	4.01E+00	6.54E-08	10000	3.44E+02	5.61E-06	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G9. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	3.37E-01	0	3.89E+01	3.37E-01	0	3.89E+01	3.37E-01	0
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	2.16E-05	10000	8.49E-01	2.16E-05	10000	8.49E-01	2.16E-05	10000
U-234	(a)	4.60E-01	1.17E-05	10000	4.60E-01	1.17E-05	10000	4.60E-01	1.17E-05	10000
U-235	(a)	1.90E-02	4.83E-07	10000	1.90E-02	4.83E-07	10000	1.90E-02	4.83E-07	10000
U-236	(a)	1.70E-02	4.32E-07	10000	1.70E-02	4.32E-07	10000	1.70E-02	4.32E-07	10000
U-238	(a)	4.10E-01	1.04E-05	10000	4.10E-01	1.04E-05	10000	4.10E-01	1.04E-05	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
Tc-99	900	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
I-129	1	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-233	(a)	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-234	(a)	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-235	(a)	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-236	(a)	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-238	(a)	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.10. Predicted Peak River Flux of Key Constituents by Waste and Category at a Line of Analysis to the Columbia River, Alternative A

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	3.00E-01	2.85E-03	2180	3.66E-01	3.48E-03	2180	3.99E-01	3.79E-03	2180
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	2.62E-03	2.49E-05	2180	3.20E-03	3.04E-05	2180	3.20E-03	3.04E-05	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.03E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000
U-234	1.70E-01	0.00E+00	>10000	2.07E-01	0.00E+00	>10000	9.01E-01	0.00E+00	>10000
U-235	3.56E-02	0.00E+00	>10000	4.34E-02	0.00E+00	>10000	8.86E-02	0.00E+00	>10000
U-236	4.03E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000
U-238	4.06E-01	0.00E+00	>10000	4.95E-01	0.00E+00	>10000	1.66E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840
I-129	3.39E-07	3.22E-09	2180	3.53E-07	3.35E-09	2180	3.53E-07	3.35E-09	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	9.79E-02	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	2.32E-01	0.00E+00	>10000
U-234	1.24E+02	0.00E+00	>10000	1.29E+02	0.00E+00	>10000	2.94E+02	0.00E+00	>10000
U-235	3.54E+00	0.00E+00	>10000	3.69E+00	0.00E+00	>10000	8.39E+00	0.00E+00	>10000
U-236	1.60E+01	0.00E+00	>10000	1.67E+01	0.00E+00	>10000	3.80E+01	0.00E+00	>10000
U-238	1.99E+02	0.00E+00	>10000	2.07E+02	0.00E+00	>10000	4.72E+02	0.00E+00	>10000

Table G.10. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			1.60E+00	6.81E-07	10000
Tc-99	0.00E+00			0.00E+00			1.43E+00	1.86E-02	1450
Grouted Tc-99	0.00E+00			0.00E+00			1.23E+02	1.01E-02	870
I-129	0.00E+00			0.00E+00			1.68E-02	2.18E-04	1450
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			2.22E-03	1.05E-08	10000
U-234	0.00E+00			0.00E+00			2.25E+02	1.06E-03	10000
U-235	0.00E+00			0.00E+00			9.96E+00	4.71E-05	10000
U-236	0.00E+00			0.00E+00			4.86E-02	2.30E-07	10000
U-238	0.00E+00			0.00E+00			2.33E+02	1.10E-03	10000
200 West Area									
C-14	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	3.43E+00	3.26E-02	2180	3.44E+00	3.27E-02	2180	2.09E+00	1.99E-02	2180
Grouted Tc-99	4.91E+00	4.10E-04	1840	4.92E+00	4.10E-04	1840	5.96E+01	4.97E-03	1840
I-129	3.50E-02	3.33E-04	2180	3.51E-02	3.34E-04	2180	1.70E-02	1.62E-04	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	1.28E+01	0.00E+00	>10000	1.56E+01	0.00E+00	>10000	1.59E+01	0.00E+00	>10000
Tc-99	1.08E+00	1.01E-02	2340	1.32E+00	1.23E-02	2340	1.33E+00	1.24E-02	2340
Grouted Tc-99	0.00E+00			0.00E+00	0.00E+00		0.00E+00	0.00E+00	
I-129	3.01E-03	2.80E-05	2340	3.67E-03	3.41E-05	2340	3.67E-03	3.41E-05	2340
Grouted I-129	0.00E+00			0.00E+00	0.00E+00		0.00E+00	0.00E+00	
U-233	3.71E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000
U-234	6.13E-01	0.00E+00	>10000	7.47E-01	0.00E+00	>10000	9.21E-01	0.00E+00	>10000
U-235	1.29E-01	0.00E+00	>10000	1.57E-01	0.00E+00	>10000	1.68E-01	0.00E+00	>10000
U-236	1.46E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000
U-238	1.47E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000	2.08E+00	0.00E+00	>10000

Table G.10. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	4.44E-01	0.00E+00	>10000	4.62E-01	0.00E+00	>10000	1.45E+02	0.00E+00	>10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.23E+03	2.69E-01	1840	3.23E+03	2.69E-01	1840	3.23E+03	2.69E-01	1840
I-129	1.96E-06	1.82E-08	2340	2.04E-06	1.89E-08	2340	2.04E-06	1.89E-08	2340
Grouted I-129	5.00E+00	1.32E-04	1840	5.00E+00	1.32E-04	1840	5.00E+00	1.32E-04	1840
U-233	2.98E-01	0.00E+00	>10000	3.10E-01	0.00E+00	>10000	1.80E-01	0.00E+00	>10000
U-234	3.73E+02	0.00E+00	>10000	3.89E+02	0.00E+00	>10000	3.11E+02	0.00E+00	>10000
U-235	1.07E+01	0.00E+00	>10000	1.11E+01	0.00E+00	>10000	1.20E+01	0.00E+00	>10000
U-236	4.82E+01	0.00E+00	>10000	5.02E+01	0.00E+00	>10000	2.89E+01	0.00E+00	>10000
U-238	5.99E+02	0.00E+00	>10000	6.24E+02	0.00E+00	>10000	5.04E+02	0.00E+00	>10000
Projected Mixed LLW After 2008									
200 East Area									
C-14	4.32E+00	3.71E-07	10000	4.33E+00	3.72E-07	10000	5.70E+00	4.90E-07	10000
Tc-99	8.34E+00	9.43E-02	1630	8.36E+00	9.45E-02	1630	8.27E+00	9.35E-02	1630
Grouted Tc-99	1.57E+02	1.45E-02	970	1.57E+02	1.45E-02	970	3.34E+02	3.09E-02	970
I-129	1.04E-01	1.17E-03	1630	1.04E-01	1.18E-03	1630	1.05E-01	1.19E-03	1630
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.36E-02	1.30E-12	10000	1.36E-02	1.31E-12	10000	1.38E-02	1.32E-12	10000
U-234	1.61E+01	1.55E-09	10000	1.61E+01	1.55E-09	10000	3.40E+02	3.26E-08	10000
U-235	2.56E-01	2.46E-11	10000	2.57E-01	2.47E-11	10000	1.46E+01	1.41E-09	10000
U-236	3.01E-01	2.89E-11	10000	3.02E-01	2.90E-11	10000	3.05E-01	2.93E-11	10000
U-238	4.00E+00	3.84E-10	10000	4.01E+00	3.85E-10	10000	3.44E+02	3.30E-08	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.10. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.89E+01	3.19E-03	870	3.89E+01	3.19E-03	870	3.89E+01	3.19E-03	870
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	8.49E-01	2.62E-07	10000	8.49E-01	2.62E-07	10000	8.49E-01	2.62E-07	10000
U-234	4.60E-01	1.42E-07	10000	4.60E-01	1.42E-07	10000	4.60E-01	1.42E-07	10000
U-235	1.90E-02	5.86E-09	10000	1.90E-02	5.86E-09	10000	1.90E-02	5.86E-09	10000
U-236	1.70E-02	5.24E-09	10000	1.70E-02	5.24E-09	10000	1.70E-02	5.24E-09	10000
U-238	4.10E-01	1.26E-07	10000	4.10E-01	1.26E-07	10000	4.10E-01	1.26E-07	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.11. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a 1-km Line of Analysis, Alternative Group B

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	1.25E-01	9.91E-04	10000	1.52E-01	1.21E-03	10000	7.20E-01	5.73E-03	10000
Tc-99	900	1.13E-02	9.36E-02	1230	1.38E-02	1.14E-01	1230	5.52E-02	4.56E-01	1230
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	9.84E-05	8.14E-04	1230	1.20E-04	9.92E-04	1230	4.42E-04	3.65E-03	1230
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	3.85E-03	2.08E-04	10000	4.70E-03	2.43E-04	10000	1.73E-02	1.20E-05	10000
U-234	(a)	6.38E-03	3.44E-04	10000	7.78E-03	4.02E-04	10000	1.25E-01	8.68E-05	10000
U-235	(a)	1.34E-03	7.20E-05	10000	1.63E-03	8.42E-05	10000	1.22E-02	8.47E-06	10000
U-236	(a)	1.52E-04	8.17E-06	10000	1.85E-04	9.55E-06	10000	6.80E-04	4.72E-07	10000
U-238	(a)	1.53E-02	8.21E-04	10000	1.86E-02	9.60E-04	10000	2.29E-01	1.59E-04	10000
200 West Area	(a)									
C-14	2000	3.21E+00	0.00E+00	>10000	3.91E+00	0.00E+00	>10000	4.49E+00	0.00E+00	>10000
Tc-99	900	2.89E-01	2.89E+00	1700	3.52E-01	3.52E+00	1700	3.44E-01	3.44E+00	1700
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.53E-03	2.53E-02	1700	3.08E-03	3.08E-02	1700	2.76E-03	2.76E-02	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.84E-02	0.00E+00	>10000	1.20E-01	0.00E+00	>10000	1.08E-01	0.00E+00	>10000
U-234	(a)	1.63E-01	0.00E+00	>10000	1.99E-01	0.00E+00	>10000	7.77E-01	0.00E+00	>10000
U-235	(a)	3.43E-02	0.00E+00	>10000	4.18E-02	0.00E+00	>10000	7.64E-02	0.00E+00	>10000
U-236	(a)	3.88E-03	0.00E+00	>10000	4.73E-03	0.00E+00	>10000	4.24E-03	0.00E+00	>10000
U-238	(a)	3.90E-01	0.00E+00	>10000	4.76E-01	0.00E+00	>10000	1.43E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00	0.00E+00	10000	5.79E-03	4.60E-05	10000	1.32E-02	1.05E-04	10000
Tc-99	900	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	
Grouted Tc-99	900	3.89E+01	1.63E+00	630	2.71E+00	1.14E-01	630	2.71E+00	1.14E-01	630
I-129	1	0.00E+00	0.00E+00	1230	1.33E-08	1.10E-07	1230	1.33E-08	1.10E-07	1230
Grouted I-129	1	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	
U-233	(a)	8.49E-01	6.70E-07	10000	3.83E-03	2.90E-09	10000	8.70E-03	2.32E-08	10000
U-234	(a)	4.60E-01	3.63E-07	10000	4.85E+00	3.67E-06	10000	1.11E+01	2.96E-05	10000
U-235	(a)	1.90E-02	1.50E-08	10000	1.39E-01	1.05E-07	10000	3.15E-01	8.41E-07	10000
U-236	(a)	1.70E-02	1.34E-08	10000	6.27E-01	4.75E-07	10000	1.43E+00	3.82E-06	10000
U-238	(a)	4.10E-01	3.24E-07		7.78E+00	5.89E-06	10000	1.77E+01	4.72E-05	10000
200 West Area										
C-14	2000	1.42E-01	0.00E+00	>10000	1.48E-01	0.00E+00	>10000	3.37E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	6.93E+01	6.40E+00	1230	6.93E+01	6.40E+00	1230	6.93E+01	6.40E+00	1230
I-129	1	3.26E-07	3.27E-06	1700	3.40E-07	3.40E-06	1700	3.40E-07	3.40E-06	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.43E-02	0.00E+00	>10000	9.82E-02	0.00E+00	>10000	2.23E-01	0.00E+00	>10000
U-234	(a)	1.19E+02	0.00E+00	>10000	1.24E+02	0.00E+00	>10000	2.83E+02	0.00E+00	>10000
U-235	(a)	3.41E+00	0.00E+00	>10000	3.55E+00	0.00E+00	>10000	8.07E+00	0.00E+00	>10000
U-236	(a)	1.55E+01	0.00E+00	>10000	1.61E+01	0.00E+00	>10000	3.66E+01	0.00E+00	>10000
U-238	(a)	1.91E+02	0.00E+00	>10000	1.99E+02	0.00E+00	>10000	4.54E+02	0.00E+00	>10000

Table G.11. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.27E-02	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.18E+01	1230
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	8.66E+00	680
I-129	1	0.00E+00			0.00E+00			1.68E-02	1.39E-01	1230
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	5.18E-05	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	5.24E+00	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	2.32E-01	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	1.13E-03	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	5.43E+00	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.44E+01	1700	3.44E+00	3.44E+01	1700	2.09E+00	2.09E+01	1700
Grouted Tc-99	900	4.91E+00	3.50E-01	1200	4.92E+00	3.51E-01	1200	5.96E+01	1.35E+00	1200
I-129	1	3.50E-02	3.51E-01	1700	3.51E-02	3.51E-01	1700	1.70E-02	1.70E-01	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	4.81E-01	3.84E-03	10000	5.86E-01	4.68E-03	10000	2.20E+00	1.76E-02	10000
Tc-99	900	4.08E-02	2.52E-01	1210	4.97E-02	3.08E-01	1210	1.84E-01	1.14E+00	1210
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	1.13E-04	7.01E-04	1210	1.38E-04	8.55E-04	1210	5.07E-04	3.14E-03	1210
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.39E-02	4.48E-04	10000	1.70E-02	5.20E-04	10000	6.24E-02	2.42E-03	10000
U-234	(a)	2.30E-02	7.41E-04	10000	2.81E-02	8.60E-04	10000	1.27E-01	4.93E-03	10000
U-235	(a)	4.84E-03	1.55E-04	10000	5.90E-03	1.81E-04	10000	2.33E-02	9.04E-04	10000
U-236	(a)	5.49E-04	1.76E-05	10000	6.69E-04	2.05E-05	10000	2.46E-03	9.55E-05	10000
U-238	(a)	5.51E-02	1.77E-03	10000	6.72E-02	2.06E-03	10000	2.87E-01	1.11E-02	10000
200 West Area										
C-14	2000	1.23E+01	0.00E+00	>10000	1.50E+01	0.00E+00	>10000	1.37E+01	0.00E+00	>10000
Tc-99	900	1.04E+00	9.25E+00	1770	1.27E+00	1.13E+01	1770	1.15E+00	1.02E+01	1770
Grouted Tc-99	900	0.00E+00			0.00E+00	0.00E+00		0.00E+00		
I-129	1	2.89E-03	2.57E-02	1770	3.53E-03	3.13E-02	1770	3.16E-03	2.81E-02	1770
Grouted I-129	1	0.00E+00			0.00E+00	0.00E+00		0.00E+00		
U-233	(a)	3.57E-01	0.00E+00	>10000	4.35E-01	1.69E-02	10000	3.90E-01	1.25E-02	10000
U-234	(a)	5.90E-01	0.00E+00	>10000	7.19E-01	2.79E-02	10000	7.93E-01	2.55E-02	10000
U-235	(a)	1.24E-01	0.00E+00	>10000	1.51E-01	5.86E-03	10000	1.45E-01	4.66E-03	10000
U-236	(a)	1.40E-02	0.00E+00	>10000	1.71E-02	6.64E-04	10000	1.53E-02	4.92E-04	10000
U-238	(a)	1.41E+00	0.00E+00	>10000	1.72E+00	6.68E-02	10000	1.79E+00	5.75E-02	10000

Table G.11. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	1.66E-02	1.33E-04	10000	1.73E-02	1.38E-04	10000	5.45E+00	8.21E-04	10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	1.21E+02	5.08E+00	630	1.21E+02	5.08E+00	630	1.21E+02	1.19E+00	860
I-129	1	7.35E-08	4.55E-07	1210	7.66E-08	4.74E-07	1210	7.66E-08	1.15E-07	1380
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.11E-02	9.13E-09	10000	1.16E-02	1.06E-08	10000	6.80E-03	1.29E-08	10000
U-234	(a)	1.40E+01	1.15E-05	10000	1.46E+01	1.33E-05	10000	1.17E+01	2.22E-05	10000
U-235	(a)	4.00E-01	3.28E-07	10000	4.17E-01	3.81E-07	10000	4.51E-01	8.56E-07	10000
U-236	(a)	1.81E+00	1.49E-06	10000	1.89E+00	1.73E-06	10000	1.09E+00	2.07E-06	10000
U-238	(a)	2.25E+01	1.84E-05	10000	2.34E+01	2.14E-05	10000	1.89E+01	3.59E-05	10000
200 West Area										
C-14	2000	4.27E-01	0.00E+00	>10000	4.45E-01	0.00E+00	>10000	1.39E+02	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.11E+03	2.87E+02	1230	3.11E+03	2.87E+02	1230	3.11E+03	2.87E+02	1710
I-129	1	1.88E-06	1.67E-05	1770	1.96E-06	1.74E-05	1770	1.96E-06	1.74E-05	2110
Grouted I-129	1	5.00E+00	1.46E-01	1230	5.00E+00	1.46E-01	1230	5.00E+00	1.46E-01	1710
U-233	(a)	2.86E-01	0.00E+00	>10000	2.98E-01	0.00E+00	>10000	1.73E-01	0.00E+00	>10000
U-234	(a)	3.59E+02	0.00E+00	>10000	3.74E+02	0.00E+00	>10000	2.99E+02	0.00E+00	>10000
U-235	(a)	1.03E+01	0.00E+00	>10000	1.07E+01	0.00E+00	>10000	1.15E+01	0.00E+00	>10000
U-236	(a)	4.64E+01	0.00E+00	>10000	4.83E+01	0.00E+00	>10000	2.78E+01	0.00E+00	>10000
U-238	(a)	5.77E+02	0.00E+00	>10000	6.01E+02	0.00E+00	>10000	4.85E+02	0.00E+00	>10000
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	3.22E-02	10000	4.33E+00	3.22E-02	10000	5.70E+00	4.24E-02	10000
Tc-99	900	8.34E+00	8.61E+01	1250	8.36E+00	8.63E+01	1250	8.27E+00	8.53E+01	1250
Grouted Tc-99	900	1.57E+02	1.10E+01	680	1.57E+02	1.11E+01	680	3.34E+02	2.35E+01	680
I-129	1	1.04E-01	1.07E+00	1250	1.04E-01	1.07E+00	1250	1.05E-01	1.09E+00	1250
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	4.14E-08	10000	1.36E-02	4.15E-08	10000	1.38E-02	4.68E-08	10000
U-234	(a)	1.61E+01	4.91E-05	10000	1.61E+01	4.92E-05	10000	3.40E+02	1.15E-03	10000
U-235	(a)	2.56E-01	7.82E-07	10000	2.57E-01	7.83E-07	10000	1.46E+01	4.97E-05	10000
U-236	(a)	3.01E-01	9.19E-07	10000	3.02E-01	9.20E-07	10000	3.05E-01	1.04E-06	10000
U-238	(a)	4.00E+00	1.22E-05	10000	4.01E+00	1.22E-05	10000	3.44E+02	1.17E-03	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G.11. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	2.74E+00	680	3.89E+01	2.74E+00	680	3.89E+01	2.74E+00	680
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	2.51E-06	10000	8.49E-01	2.51E-06	10000	8.49E-01	2.51E-06	10000
U-234	(a)	4.60E-01	1.36E-06	10000	4.60E-01	1.36E-06	10000	4.60E-01	1.36E-06	10000
U-235	(a)	1.90E-02	5.61E-08	10000	1.90E-02	5.61E-08	10000	1.90E-02	5.61E-08	10000
U-236	(a)	1.70E-02	5.02E-08	10000	1.70E-02	5.02E-08	10000	1.70E-02	5.02E-08	10000
U-238	(a)	4.10E-01	1.21E-06	10000	4.10E-01	1.21E-06	10000	4.10E-01	1.21E-06	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.12. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a Line of Analysis Along the Columbia River, Alternative Group B

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	1.25E-01	1.19E-05	10000	1.52E-01	1.45E-05	10000	7.20E-01	6.86E-05	10000
Tc-99	900	1.13E-02	1.58E-02	1400	1.38E-02	1.92E-02	1400	5.52E-02	7.69E-02	1400
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	9.84E-05	1.37E-04	1400	1.20E-04	1.67E-04	1400	4.42E-04	6.16E-04	1400
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	3.85E-03	8.28E-06	10000	4.70E-03	9.06E-06	10000	1.73E-02	1.29E-07	10000
U-234	(a)	6.38E-03	1.37E-05	10000	7.78E-03	1.50E-05	10000	1.25E-01	8.68E-05	10000
U-235	(a)	1.34E-03	2.87E-06	10000	1.63E-03	3.14E-06	10000	1.22E-02	8.47E-06	10000
U-236	(a)	1.52E-04	3.26E-07	10000	1.85E-04	3.56E-07	10000	6.80E-04	4.72E-07	10000
U-238	(a)	1.53E-02	3.28E-05	10000	1.86E-02	3.58E-05	10000	2.29E-01	1.59E-04	10000
200 West Area		0.00E+00							0.00E+00	0.00E+00
C-14	2000	3.21E+00	0.00E+00	>10000	3.91E+00	0.00E+00	>10000	4.49E+00	0.00E+00	>10000
Tc-99	900	2.89E-01	2.53E-01	2000	3.52E-01	3.09E-01	2000	3.44E-01	3.02E-01	2000
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.53E-03	2.21E-03	2000	3.08E-03	2.70E-03	2000	2.76E-03	2.42E-03	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.84E-02	0.00E+00	>10000	1.20E-01	0.00E+00	>10000	1.08E-01	0.00E+00	>10000
U-234	(a)	1.63E-01	0.00E+00	>10000	1.99E-01	0.00E+00	>10000	7.77E-01	0.00E+00	>10000
U-235	(a)	3.43E-02	0.00E+00	>10000	4.18E-02	0.00E+00	>10000	7.64E-02	0.00E+00	>10000
U-236	(a)	3.88E-03	0.00E+00	>10000	4.73E-03	0.00E+00	>10000	4.24E-03	0.00E+00	>10000
U-238	(a)	3.90E-01	0.00E+00	>10000	4.76E-01	0.00E+00	>10000	1.43E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			5.79E-03	5.52E-07	10000	1.32E-02	1.26E-06	10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	3.83E-01	860	2.71E+00	2.67E-02	860	2.71E+00	2.67E-02	860
I-129	1	0.00E+00			1.33E-08	1.85E-08	1400	1.33E-08	1.85E-08	1400
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	2.01E-08	10000	3.83E-03	8.69E-11	10000	8.70E-03	2.49E-10	10000
U-234	(a)	4.60E-01	1.09E-08	10000	4.85E+00	1.10E-07	10000	1.11E+01	3.17E-07	10000
U-235	(a)	1.90E-02	4.49E-10	10000	1.39E-01	3.15E-09	10000	3.15E-01	9.00E-09	10000
U-236	(a)	1.70E-02	4.02E-10	10000	6.27E-01	1.42E-08	10000	1.43E+00	4.09E-08	10000
U-238	(a)	4.10E-01	9.69E-09	10000	7.78E+00	1.77E-07	10000	1.77E+01	5.06E-07	10000
200 West Area										
C-14	2000	1.42E-01	0.00E+00	>10000	1.48E-01	0.00E+00	>10000	3.37E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	6.93E+01	4.45E-01	1710	6.93E+01	4.45E-01	1710	6.93E+01	4.45E-01	1710
I-129	1	3.26E-07	2.86E-07	2000	3.40E-07	2.98E-07	2000	3.40E-07	2.98E-07	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.43E-02	0.00E+00	>10000	9.82E-02	0.00E+00	>10000	2.23E-01	0.00E+00	>10000
U-234	(a)	1.19E+02	0.00E+00	>10000	1.24E+02	0.00E+00	>10000	2.83E+02	0.00E+00	>10000
U-235	(a)	3.41E+00	0.00E+00	>10000	3.55E+00	0.00E+00	>10000	8.07E+00	0.00E+00	>10000
U-236	(a)	1.55E+01	0.00E+00	>10000	1.61E+01	0.00E+00	>10000	3.66E+01	0.00E+00	>10000
U-238	(a)	1.91E+02	0.00E+00	>10000	1.99E+02	0.00E+00	>10000	0.00E+00	0.00E+00	>10000

Table G.12. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.52E-04	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.99E+00	1400
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	1.06E+00	940
I-129	1	0.00E+00			0.00E+00			1.68E-02	2.34E-02	1400
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	0.00E+00	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	0.00E+00	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	0.00E+00	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	0.00E+00	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	0.00E+00	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.01E+00	2000	3.44E+00	3.02E+00	2000	2.09E+00	1.83E+00	2000
Grouted Tc-99	900	4.91E+00	3.36E-02	1620	4.92E+00	3.37E-02	1620	5.96E+01	4.08E-01	1620
I-129	1	3.50E-02	3.07E-02	2000	3.51E-02	3.08E-02	2000	1.70E-02	1.49E-02	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	4.81E-01	7.24E-05	10000	5.86E-01	8.83E-05	10000	2.20E+00	3.31E-04	10000
Tc-99	900	4.08E-02	6.10E-02	1380	4.97E-02	7.44E-02	1380	1.84E-01	2.75E-01	1380
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	1.13E-04	1.69E-04	1380	1.38E-04	2.06E-04	1380	5.07E-04	7.59E-04	1380
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.39E-02	4.48E-04	10000	1.70E-02	5.20E-04	10000	6.24E-02	2.42E-03	10000
U-234	(a)	2.30E-02	7.41E-04	10000	2.81E-02	8.60E-04	10000	1.27E-01	4.93E-03	10000
U-235	(a)	4.84E-03	1.55E-04	10000	5.90E-03	1.81E-04	10000	2.33E-02	9.04E-04	10000
U-236	(a)	5.49E-04	1.76E-05	10000	6.69E-04	2.05E-05	10000	2.46E-03	9.55E-05	10000
U-238	(a)	5.51E-02	1.77E-03	10000	6.72E-02	2.06E-03	10000	2.87E-01	1.11E-02	10000
200 West Area										
C-14	2000	1.23E+01	0.00E+00	>10000	1.50E+01	0.00E+00	>10000	1.37E+01	0.00E+00	>10000
Tc-99	900	1.04E+00	8.44E-01	2110	1.27E+00	1.03E+00	2110	1.15E+00	9.32E-01	2110
Grouted Tc-99	900	0.00E+00			0.00E+00	0.00E+00		0.00E+00		
I-129	1	2.89E-03	2.35E-03	2110	3.53E-03	2.86E-03	2110	3.16E-03	2.56E-03	2110
Grouted I-129	1	0.00E+00			0.00E+00	0.00E+00		0.00E+00		
U-233	(a)	3.57E-01	0.00E+00	>10000	4.35E-01	0.00E+00	>10000	3.90E-01	0.00E+00	>10000
U-234	(a)	5.90E-01	0.00E+00	>10000	7.19E-01	0.00E+00	>10000	7.93E-01	0.00E+00	>10000
U-235	(a)	1.24E-01	0.00E+00	>10000	1.51E-01	0.00E+00	>10000	1.45E-01	0.00E+00	>10000
U-236	(a)	1.40E-02	0.00E+00	>10000	1.71E-02	0.00E+00	>10000	1.53E-02	0.00E+00	>10000
U-238	(a)	1.41E+00	0.00E+00	>10000	1.72E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000

Table G.12. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	1.66E-02	2.50E-06	10000	1.73E-02	2.61E-06		5.45E+00	8.21E-04	10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	1.21E+02	1.19E+00	860	1.21E+02	1.19E+00	860	1.21E+02	1.19E+00	860
I-129	1	7.35E-08	1.10E-07	1380	7.66E-08	2.06E-04		7.66E-08	1.15E-07	1380
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.11E-02	1.49E-10	10000	1.16E-02	1.73E-10	10000	6.80E-03	2.11E-10	10000
U-234	(a)	1.40E+01	1.88E-07	10000	1.46E+01	2.18E-07	10000	1.17E+01	3.63E-07	10000
U-235	(a)	4.00E-01	5.36E-09	10000	4.17E-01	6.23E-09	10000	4.51E-01	1.40E-08	10000
U-236	(a)	1.81E+00	2.43E-08	10000	1.89E+00	2.82E-08	10000	1.09E+00	3.38E-08	10000
U-238	(a)	2.25E+01	3.01E-07	10000	2.34E+01	3.50E-07	10000	1.89E+01	5.87E-07	10000
200 West Area		0.00E+00								
C-14	2000	4.27E-01	0.00E+00	>10000	4.45E-01	0.00E+00	>10000	1.39E+02	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.11E+03	1.99E+01	1710	3.11E+03	1.99E+01	1710	3.11E+03	1.99E+01	1710
I-129	1	1.88E-06	1.52E-06	2110	1.96E-06	1.59E-06	2110	1.96E-06	1.59E-06	2110
Grouted I-129	1	5.00E+00	1.01E-02	1710	5.00E+00	1.01E-02	1710	5.00E+00	1.01E-02	1710
U-233	(a)	2.86E-01	0.00E+00	>10000	2.98E-01	0.00E+00	>10000	1.73E-01	0.00E+00	>10000
U-234	(a)	3.59E+02	0.00E+00	>10000	3.74E+02	0.00E+00	>10000	2.99E+02	0.00E+00	>10000
U-235	(a)	1.03E+01	0.00E+00	>10000	1.07E+01	0.00E+00	>10000	1.15E+01	0.00E+00	>10000
U-236	(a)	4.64E+01	0.00E+00	>10000	4.83E+01	0.00E+00	>10000	2.78E+01	0.00E+00	>10000
U-238	(a)	5.77E+02	0.00E+00	>10000	6.01E+02	0.00E+00	>10000	4.85E+02	0.00E+00	>10000
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	1.86E-04	10000	4.33E+00	1.86E-04	10000	5.70E+00	2.45E-04	10000
Tc-99	900	8.34E+00	1.08E+01	1430	8.36E+00	1.09E+01	1430	8.27E+00	1.07E+01	1430
Grouted Tc-99	900	1.57E+02	1.35E+00	940	1.57E+02	1.36E+00	940	3.34E+02	2.89E+00	940
I-129	1	1.04E-01	1.35E-01	1430	1.04E-01	1.35E-01	1430	1.05E-01	1.37E-01	1430
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	2.21E-10	10000	1.36E-02	2.22E-10	10000	1.38E-02	2.51E-10	10000
U-234	(a)	1.61E+01	2.63E-07	10000	1.61E+01	2.63E-07	10000	3.40E+02	6.18E-06	10000
U-235	(a)	2.56E-01	4.18E-09	10000	2.57E-01	4.19E-09	10000	1.46E+01	2.66E-07	10000
U-236	(a)	3.01E-01	4.92E-09	10000	3.02E-01	4.93E-09	10000	3.05E-01	5.55E-09	10000
U-238	(a)	4.00E+00	6.53E-08	10000	4.01E+00	6.54E-08	10000	3.44E+02	6.25E-06	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G.12. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum Concen-tration (pCi/L)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum Concen-tration (pCi/L)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum Concen-tration (pCi/L)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	3.37E-01	940	3.89E+01	3.37E-01	940	3.89E+01	3.37E-01	940
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	8.49E-01	1.33E-08	10000	8.49E-01	1.33E-08	10000	8.49E-01	1.33E-08	10000
U-234	30	4.60E-01	7.23E-09	10000	4.60E-01	7.23E-09	10000	4.60E-01	7.23E-09	10000
U-235	30	1.90E-02	2.99E-10	10000	1.90E-02	2.99E-10	10000	1.90E-02	2.99E-10	10000
U-236	30	1.70E-02	2.67E-10	10000	1.70E-02	2.67E-10	10000	1.70E-02	2.67E-10	10000
U-238	30	4.10E-01	6.44E-09	10000	4.10E-01	6.44E-09	10000	4.10E-01	6.44E-09	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.13. Predicted Peak River Flux of Key Constituents by Waste and Category at a Line of Analysis to the Columbia River, Alternative Group B

	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
Constituent	**Inventory (Ci)**	**Maximum River Flux (Ci)**	**Approx. Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum River Flux (Ci)**	**Approx. Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum River Flux (Ci)**	**Approx. Peak Arrival Time (yrs)**
1996-2007 Cat 1 LLW									
200 East Area									
C-14	1.25E-01	1.46E-03	690	1.52E-01	1.78E-03	690	7.20E-01	8.44E-03	690
Tc-99	1.13E-02	1.47E-04	1450	1.38E-02	1.79E-04	1450	5.52E-02	7.17E-04	1450
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	9.84E-05	1.28E-06	1450	1.20E-04	1.56E-06	1450	4.42E-04	5.74E-06	1450
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	3.85E-03	4.54E-08	10000	4.70E-03	4.92E-08	10000	1.73E-02	5.78E-10	10000
U-234	6.38E-03	7.52E-08	10000	7.78E-03	8.15E-08	10000	1.25E-01	8.68E-05	10000
U-235	1.34E-03	1.58E-08	10000	1.63E-03	1.71E-08	10000	1.22E-02	8.47E-06	10000
U-236	1.52E-04	1.79E-09	10000	1.85E-04	1.94E-09	10000	6.80E-04	4.72E-07	10000
U-238	1.53E-02	1.80E-07	10000	1.86E-02	1.95E-07	10000	2.29E-01	1.59E-04	10000
200 West Area									
C-14	3.21E+00	0.00E+00	>10000	3.91E+00	0.00E+00	>10000	4.49E+00	0.00E+00	>10000
Tc-99	2.89E-01	0.00E+00	>10000	3.52E-01	0.00E+00	>10000	3.44E-01	0.00E+00	>10000
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	2.53E-03	0.00E+00	>10000	3.08E-03	0.00E+00	>10000	2.76E-03	0.00E+00	>10000
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	9.84E-02	0.00E+00	>10000	1.20E-01	0.00E+00	>10000	1.08E-01	0.00E+00	>10000
U-234	1.63E-01	0.00E+00	>10000	1.99E-01	0.00E+00	>10000	7.77E-01	0.00E+00	>10000
U-235	3.43E-02	0.00E+00	>10000	4.18E-02	0.00E+00	>10000	7.64E-02	0.00E+00	>10000
U-236	3.88E-03	0.00E+00	>10000	4.73E-03	0.00E+00	>10000	4.24E-03	0.00E+00	>10000
U-238	3.90E-01	0.00E+00	>10000	4.76E-01	0.00E+00	>10000	1.43E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW									
200 East Area									
C-14	5.56E-03	6.51E-05	690	5.79E-03	5.79E-03	690	1.32E-02	1.32E-02	690
Tc-99	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	
Grouted Tc-99	2.71E+00	2.51E-04	970	2.71E+00	2.71E+00	970	2.71E+00	2.71E+00	970
I-129	1.28E-08	1.66E-10	1450	1.33E-08	1.33E-08	1450	1.33E-08	1.33E-08	1450
Grouted I-129	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	
U-233	3.68E-03	4.57E-13	10000	3.83E-03	3.83E-03	10000	8.70E-03	8.70E-03	10000
U-234	4.66E+00	5.79E-10	10000	4.85E+00	4.85E+00	10000	1.11E+01	1.11E+01	10000
U-235	1.33E-01	1.66E-11	10000	1.39E-01	1.39E-01	10000	3.15E-01	3.15E-01	10000
U-236	6.02E-01	7.48E-11	10000	6.27E-01	6.27E-01	10000	1.43E+00	1.43E+00	10000
U-238	7.47E+00	9.29E-10	10000	7.78E+00	7.78E+00	10000	1.77E+01	1.77E+01	10000
200 West Area									
C-14	1.42E-01	0.00E+00	>10000	1.48E-01	0.00E+00	>10000	3.37E-01	0.00E+00	>10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	6.93E+01	5.78E-03	1840	6.93E+01	5.78E-03	1840	6.93E+01	5.78E-03	1840
I-129	3.26E-07	0.00E+00	>10000	3.40E-07	0.00E+00	>10000	3.40E-07	0.00E+00	>10000
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	9.43E-02	0.00E+00	>10000	9.82E-02	0.00E+00	>10000	2.23E-01	0.00E+00	>10000
U-234	1.19E+02	0.00E+00	>10000	1.24E+02	0.00E+00	>10000	2.83E+02	0.00E+00	>10000
U-235	3.41E+00	0.00E+00	>10000	3.55E+00	0.00E+00	>10000	8.07E+00	0.00E+00	>10000
U-236	1.55E+01	0.00E+00	>10000	1.61E+01	0.00E+00	>10000	3.66E+01	0.00E+00	>10000
U-238	1.91E+02	0.00E+00	>10000	1.99E+02	0.00E+00	>10000	0.00E+00	0.00E+00	>10000

Table G.13. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			1.60E+00	6.81E-07	10000
Tc-99	0.00E+00			0.00E+00			1.43E+00	1.86E-02	1450
Grouted Tc-99	0.00E+00			0.00E+00			1.23E+02	1.01E-02	870
I-129	0.00E+00			0.00E+00			1.68E-02	2.18E-04	1450
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			2.22E-03	0.00E+00	>10000
U-234	0.00E+00			0.00E+00			2.25E+02	0.00E+00	>10000
U-235	0.00E+00			0.00E+00			9.96E+00	0.00E+00	>10000
U-236	0.00E+00			0.00E+00			4.86E-02	0.00E+00	>10000
U-238	0.00E+00			0.00E+00			2.33E+02	0.00E+00	>10000
200 West Area									
C-14	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	3.43E+00	3.26E-02	2180	3.44E+00	3.27E-02	2180	2.09E+00	1.99E-02	2180
Grouted Tc-99	4.91E+00	4.10E-04	1840	4.92E+00	4.10E-04	1840	5.96E+01	4.97E-03	1840
I-129	3.50E-02	0.00E+00	>10000	3.51E-02	0.00E+00	>10000	1.70E-02	0.00E+00	>10000
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008									
200 East Area									
C-14	4.81E-01	2.05E-07	10000	5.86E-01	2.49E-07	10000	2.20E+00	9.37E-07	10000
Tc-99	4.08E-02	5.29E-04	1450	4.97E-02	6.46E-04	1450	1.84E-01	2.39E-03	1450
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	1.13E-04	1.47E-06	1450	1.38E-04	1.79E-06	1450	5.07E-04	6.59E-06	1450
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.39E-02	4.21E-08	10000	1.70E-02	4.89E-08	10000	6.24E-02	2.83E-07	10000
U-234	2.30E-02	6.96E-08	10000	2.81E-02	8.09E-08	10000	1.27E-01	5.75E-07	10000
U-235	4.84E-03	1.46E-08	10000	5.90E-03	1.70E-08	10000	2.33E-02	1.05E-07	10000
U-236	5.49E-04	1.66E-09	10000	6.69E-04	1.93E-09	10000	2.46E-03	1.11E-08	10000
U-238	5.51E-02	1.66E-07	10000	6.72E-02	1.93E-07	10000	2.87E-01	1.30E-06	10000
200 West Area									
C-14	1.23E+01	0.00E+00	>10000	1.50E+01	0.00E+00	>10000	1.37E+01	0.00E+00	>10000
Tc-99	1.04E+00	9.90E-03	2180	1.27E+00	1.21E-02	2180	1.15E+00	1.09E-02	2180
Grouted Tc-99	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
I-129	2.89E-03	2.75E-05	2180	3.53E-03	3.35E-05	2180	3.16E-03	3.00E-05	2180
Grouted I-129	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-233	3.57E-01	0.00E+00	>10000	4.35E-01	0.00E+00	>10000	3.90E-01	0.00E+00	>10000
U-234	5.90E-01	0.00E+00	>10000	7.19E-01	0.00E+00	>10000	7.93E-01	0.00E+00	>10000
U-235	1.24E-01	0.00E+00	>10000	1.51E-01	0.00E+00	>10000	1.45E-01	0.00E+00	>10000
U-236	1.40E-02	0.00E+00	>10000	1.71E-02	0.00E+00	>10000	1.53E-02	0.00E+00	>10000
U-238	1.41E+00	0.00E+00	>10000	1.72E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000

1 **Table G.13**. (contd)

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Constituent	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum River Flux (Ci)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum River Flux (Ci)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum River Flux (Ci)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008									
200 East Area									
C-14	1.66E-02	1.79E-04	1490	1.73E-02	1.87E-04	1490	5.45E+00	5.88E-02	1490
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	1.21E+02	1.12E-02	970	1.21E+02	1.12E-02	970	1.21E+02	1.12E-02	970
I-129	7.35E-08	3.45E-13	10000	7.66E-08	3.59E-13	10000	7.66E-08	3.59E-13	10000
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.11E-02	3.31E-08	10000	1.16E-02	3.34E-08	10000	6.80E-03	3.07E-08	10000
U-234	1.40E+01	4.16E-05	10000	1.46E+01	4.20E-05	10000	1.17E+01	5.28E-05	10000
U-235	4.00E-01	1.19E-06	10000	4.17E-01	1.20E-06	10000	4.51E-01	2.04E-06	10000
U-236	1.81E+00	5.39E-06	10000	1.89E+00	5.44E-06	10000	1.09E+00	4.92E-06	10000
U-238	2.25E+01	6.67E-05	10000	2.34E+01	6.73E-05	10000	1.89E+01	8.53E-05	10000
200 West Area	0.00E+00								
C-14	4.27E-01	0.00E+00	>10000	4.45E-01	0.00E+00	>10000	1.39E+02	0.00E+00	>10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.11E+03	2.59E-01	1840	3.11E+03	2.59E-01	1840	3.11E+03	2.59E-01	1840
I-129	1.88E-06	1.79E-08	2180	1.96E-06	1.86E-08	2180	1.96E-06	1.86E-08	2180
Grouted I-129	5.00E+00	1.32E-04	1840	5.00E+00	1.32E-04	1840	5.00E+00	1.32E-04	1840
U-233	2.86E-01	0.00E+00	>10000	2.98E-01	0.00E+00	>10000	1.73E-01	0.00E+00	>10000
U-234	3.59E+02	0.00E+00	>10000	3.74E+02	0.00E+00	>10000	2.99E+02	0.00E+00	>10000
U-235	1.03E+01	0.00E+00	>10000	1.07E+01	0.00E+00	>10000	1.15E+01	0.00E+00	>10000
U-236	4.64E+01	0.00E+00	>10000	4.83E+01	0.00E+00	>10000	2.78E+01	0.00E+00	>10000
U-238	5.77E+02	0.00E+00	>10000	6.01E+02	0.00E+00	>10000	4.85E+02	0.00E+00	>10000
Projected Mixed LLW After 2008									
200 East Area									
C-14	4.32E+00	1.08E-06	10000	4.33E+00	1.09E-06	10000	5.70E+00	1.43E-06	10000
Tc-99	8.34E+00	1.04E-01	1480	8.36E+00	1.04E-01	1480	8.27E+00	1.03E-01	1480
Grouted Tc-99	1.57E+02	1.45E-02	970	1.57E+02	1.45E-02	970	3.34E+02	3.09E-02	970
I-129	1.04E-01	1.29E-03	1480	1.04E-01	1.29E-03	1480	1.05E-01	1.31E-03	1480
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.36E-02	2.19E-12	10000	1.36E-02	2.19E-12	10000	1.38E-02	2.48E-12	10000
U-234	1.61E+01	2.60E-09	10000	1.61E+01	2.60E-09	10000	3.40E+02	6.11E-08	10000
U-235	2.56E-01	4.14E-11	10000	2.57E-01	4.15E-11	10000	1.46E+01	2.63E-09	10000
U-236	3.01E-01	4.86E-11	10000	3.02E-01	4.87E-11	10000	3.05E-01	5.49E-11	10000
U-238	4.00E+00	6.46E-10	10000	4.01E+00	6.47E-10	10000	3.44E+02	6.18E-08	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.13. (contd)

Constituent	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum River Flux (Ci)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum River Flux (Ci)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum River Flux (Ci)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Melter Waste									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.89E+01	3.60E-03	970	3.89E+01	3.60E-03	970	3.89E+01	3.60E-03	970
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	8.49E-01	7.84E-11	>10000	8.49E-01	7.84E-11	>10000	8.49E-01	7.84E-11	>10000
U-234	4.60E-01	4.25E-11	>10000	4.60E-01	4.25E-11	>10000	4.60E-01	4.25E-11	>10000
U-235	1.90E-02	1.75E-12	>10000	1.90E-02	1.75E-12	>10000	1.90E-02	1.75E-12	>10000
U-236	1.70E-02	1.57E-12	>10000	1.70E-02	1.57E-12	>10000	1.70E-02	1.57E-12	>10000
U-238	4.10E-01	3.79E-11	>10000	4.10E-01	3.79E-11	>10000	4.10E-01	3.79E-11	>10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.14. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a 1-km Line of Analysis, Alternative Group C

		Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
Constituent	Benchmark Drinking Water Standard **(pCi/L)**	**Inventory (Ci)**	**Maximum Concen-tration (pCi/L)**	**Approx. Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum Concen-tration (pCi/L)**	**Approx. Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum Concen-tration (pCi/L)**	**Approx. Peak Arrival Time (yrs)**
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	4.06E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.66E-01	3.00E+00	1700	3.66E-01	3.66E+00	1700	3.99E-01	3.99E+00	1700
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.20E-03	3.20E-02	1700	3.20E-03	3.20E-02	1700	3.20E-03	3.20E-02	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000
U-234	(a)	2.07E-01	0.00E+00	>10000	2.07E-01	0.00E+00	>10000	9.01E-01	0.00E+00	>10000
U-235	(a)	4.34E-02	0.00E+00	>10000	4.34E-02	0.00E+00	>10000	8.86E-02	0.00E+00	>10000
U-236	(a)	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000
U-238	(a)	4.95E-01	0.00E+00	>10000	4.95E-01	0.00E+00	>10000	1.66E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.54E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230
I-129	1	3.53E-07	3.53E-06	1700	3.53E-07	3.53E-06	1700	3.53E-07	3.53E-06	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	2.32E-01	0.00E+00	>10000
U-234	(a)	1.29E+02	0.00E+00	>10000	1.29E+02	0.00E+00	>10000	2.94E+02	0.00E+00	>10000
U-235	(a)	3.69E+00	0.00E+00	>10000	3.69E+00	0.00E+00	>10000	8.39E+00	0.00E+00	>10000
U-236	(a)	1.67E+01	0.00E+00	>10000	1.67E+01	0.00E+00	>10000	3.80E+01	0.00E+00	>10000
U-238	(a)	2.07E+02	0.00E+00	>10000	2.07E+02	0.00E+00	>10000	4.72E+02	0.00E+00	>10000

Table G.14. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume: Inventory (Ci)	Hanford Only Volume: Maximum Concen-tration (pCi/L)	Hanford Only Volume: Approx. Peak Arrival Time (yrs)	Lower Bound Volume: Inventory (Ci)	Lower Bound Volume: Maximum Concen-tration (pCi/L)	Lower Bound Volume: Approx. Peak Arrival Time (yrs)	Upper Bound Volume: Inventory (Ci)	Upper Bound Volume: Maximum Concen-tration (pCi/L)	Upper Bound Volume: Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.27E-02	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.18E+01	1230
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	8.66E+00	680
I-129	1	0.00E+00			0.00E+00			1.68E-02	1.39E-01	1230
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	5.18E-05	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	5.24E+00	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	2.32E-01	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	1.13E-03	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	5.43E+00	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.44E+00	3.44E+01	1700	3.44E+00	3.44E+01	1700	2.09E+00	2.09E+01	1700
Grouted Tc-99	900	4.92E+00	3.51E-01	1200	4.92E+00	3.51E-01	1200	5.96E+01	4.25E+00	1200
I-129	1	3.51E-02	3.51E-01	1700	3.51E-02	3.51E-01	1700	1.70E-02	1.70E-01	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.60E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.45E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.70E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.56E+01	0.00E+00	>10000	1.56E+01	0.00E+00	>10000	1.59E+01	0.00E+00	>10000
Tc-99	900	1.32E+00	8.98E+00	1910	1.32E+00	1.09E+01	1910	1.33E+00	1.10E+01	1910
Grouted Tc-99	900	0.00E+00			0.00E+00	0.00E+00		0.00E+00		
I-129	1	3.67E-03	2.50E-02	1910	3.67E-03	3.04E-02	1910	3.67E-03	3.04E-02	1910
Grouted I-129	1	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00		
U-233	(a)	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000
U-234	(a)	7.47E-01	0.00E+00	>10000	7.47E-01	0.00E+00	>10000	9.21E-01	0.00E+00	>10000
U-235	(a)	1.57E-01	0.00E+00	>10000	1.57E-01	0.00E+00	>10000	1.68E-01	0.00E+00	>10000
U-236	(a)	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000
U-238	(a)	1.79E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000	2.08E+00	0.00E+00	>10000

Table G.14. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume: Inventory (Ci)	Hanford Only Volume: Maximum Concen-tration (pCi/L)	Hanford Only Volume: Approx. Peak Arrival Time (yrs)	Lower Bound Volume: Inventory (Ci)	Lower Bound Volume: Maximum Concen-tration (pCi/L)	Lower Bound Volume: Approx. Peak Arrival Time (yrs)	Upper Bound Volume: Inventory (Ci)	Upper Bound Volume: Maximum Concen-tration (pCi/L)	Upper Bound Volume: Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	4.62E-01	0.00E+00	>10000	4.62E-01	0.00E+00	>10000	1.45E+02	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	2.98E+02	1230	3.23E+03	2.98E+02	1230	3.23E+03	2.98E+02	1230
I-129	1	2.04E-06	1.69E-05	1910	2.04E-06	1.69E-05	1910	2.04E-06	1.69E-05	1910
Grouted I-129	1	5.00E+00	1.46E-01	1230	5.00E+00	1.46E-01	1230	5.00E+00	1.46E-01	1230
U-233	(a)	3.10E-01	0.00E+00	>10000	3.10E-01	0.00E+00	>10000	1.80E-01	0.00E+00	>10000
U-234	(a)	3.89E+02	0.00E+00	>10000	3.89E+02	0.00E+00	>10000	3.11E+02	0.00E+00	>10000
U-235	(a)	1.11E+01	0.00E+00	>10000	1.11E+01	0.00E+00	>10000	1.20E+01	0.00E+00	>10000
U-236	(a)	5.02E+01	0.00E+00	>10000	5.02E+01	0.00E+00	>10000	2.89E+01	0.00E+00	>10000
U-238	(a)	6.24E+02	0.00E+00	>10000	6.24E+02	0.00E+00	>10000	5.04E+02	0.00E+00	>10000
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.33E+00	1.01E-02	10000	4.33E+00	1.01E-02	10000	5.70E+00	1.34E-02	10000
Tc-99	900	8.36E+00	6.80E+01	1370	8.36E+00	6.80E+01	1370	8.27E+00	6.73E+01	1370
Grouted Tc-99	900	1.57E+02	1.11E+01	680	1.57E+02	1.11E+01	680	3.34E+02	2.35E+01	680
I-129	1	1.04E-01	8.44E-01	1370	1.04E-01	8.46E-01	1370	1.05E-01	8.56E-01	1370
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	4.15E-08	10000	1.36E-02	4.15E-08	10000	1.38E-02	4.20E-08	10000
U-234	(a)	1.61E+01	4.92E-05	10000	1.61E+01	4.92E-05	10000	3.40E+02	1.04E-03	10000
U-235	(a)	2.57E-01	7.83E-07	10000	2.57E-01	7.83E-07	10000	1.46E+01	4.46E-05	10000
U-236	(a)	3.02E-01	9.20E-07	10000	3.02E-01	9.20E-07	10000	3.05E-01	9.31E-07	10000
U-238	(a)	4.01E+00	1.22E-05	10000	4.01E+00	1.22E-05	10000	3.44E+02	1.05E-03	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G.14. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum Concen-tration (pCi/L)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum Concen-tration (pCi/L)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum Concen-tration (pCi/L)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	1.87E+00	680	3.89E+01	1.87E+00	680	3.89E+01	1.87E+00	680
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	1.79E-06	10000	8.49E-01	1.79E-06	10000	8.49E-01	1.79E-06	10000
U-234	(a)	4.60E-01	9.68E-07	10000	4.60E-01	9.68E-07	10000	4.60E-01	9.68E-07	10000
U-235	(a)	1.90E-02	4.00E-08	10000	1.90E-02	4.00E-08	10000	1.90E-02	4.00E-08	10000
U-236	(a)	1.70E-02	3.58E-08	10000	1.70E-02	3.58E-08	10000	1.70E-02	3.58E-08	10000
U-238	(a)	4.10E-01	8.62E-07	10000	4.10E-01	8.62E-07	10000	4.10E-01	8.62E-07	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.15. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a Line of Analysis Along the Columbia River, Alternative Group C

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	2.63E-01	2000	3.66E-01	3.21E-01	2000	3.99E-01	3.50E-01	2000
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.30E-03	2000	3.20E-03	2.81E-03	2000	3.20E-03	2.81E-03	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.03E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000
U-234	(a)	1.70E-01	0.00E+00	>10000	2.07E-01	0.00E+00	>10000	9.01E-01	0.00E+00	>10000
U-235	(a)	3.56E-02	0.00E+00	>10000	4.34E-02	0.00E+00	>10000	8.86E-02	0.00E+00	>10000
U-236	(a)	4.03E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000
U-238	(a)	4.06E-01	0.00E+00	>10000	4.95E-01	0.00E+00	>10000	1.66E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710
I-129	1	3.39E-07	2.97E-07	2000	3.53E-07	3.09E-07	2000	3.53E-07	3.09E-07	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.79E-02	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	2.32E-01	0.00E+00	>10000
U-234	(a)	1.24E+02	0.00E+00	>10000	1.29E+02	0.00E+00	>10000	2.94E+02	0.00E+00	>10000
U-235	(a)	3.54E+00	0.00E+00	>10000	3.69E+00	0.00E+00	>10000	8.39E+00	0.00E+00	>10000
U-236	(a)	1.60E+01	0.00E+00	>10000	1.67E+01	0.00E+00	>10000	3.80E+01	0.00E+00	>10000
U-238	(a)	1.99E+02	0.00E+00	>10000	2.07E+02	0.00E+00	>10000	4.72E+02	0.00E+00	>10000

Table G.15. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.52E-04	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.36E-04	10000
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	1.06E+00	940
I-129	1	0.00E+00			0.00E+00			1.68E-02	1.60E-06	10000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	1.61E-06	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	1.63E-01	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	7.21E-03	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	3.52E-05	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	1.69E-01	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.01E+00	2000	3.44E+00	3.02E+00	2000	2.09E+00	1.83E+00	2000
Grouted Tc-99	900	4.91E+00	3.36E-02	1620	4.92E+00	3.37E-02	1620	5.96E+01	4.08E-01	1620
I-129	1	3.50E-02	3.07E-02	2000	3.51E-02	3.08E-02	2000	1.70E-02	1.49E-02	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.28E+01	0.00E+00	>10000	1.56E+01	0.00E+00	>10000	1.59E+01	0.00E+00	>10000
Tc-99	900	1.08E+00	8.33E-01	2260	1.32E+00	1.02E+00	2260	1.33E+00	1.02E+00	2260
Grouted Tc-99	900	0.00E+00			0.00E+00	0.00E+00		0.00E+00	0.00E+00	
I-129	1	3.01E-03	2.32E-03	2260	3.67E-03	2.83E-03	2260	3.67E-03	2.83E-03	2260
Grouted I-129	1	0.00E+00			0.00E+00	0.00E+00		0.00E+00	0.00E+00	
U-233	(a)	3.71E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000
U-234	(a)	6.13E-01	0.00E+00	>10000	7.47E-01	0.00E+00	>10000	9.21E-01	0.00E+00	>10000
U-235	(a)	1.29E-01	0.00E+00	>10000	1.57E-01	0.00E+00	>10000	1.68E-01	0.00E+00	>10000
U-236	(a)	1.46E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000
U-238	(a)	1.47E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000	2.08E+00	0.00E+00	>10000

Table G.15. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	4.44E-01	0.00E+00	>10000	4.62E-01	0.00E+00	>10000	1.45E+02	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	2.07E+01	1710	3.23E+03	2.07E+01	1710	3.23E+03	2.07E+01	1710
I-129	1	1.96E-06	1.51E-06	2260	2.04E-06	1.57E-06	2260	2.04E-06	1.57E-06	2260
Grouted I-129	1	5.00E+00	1.01E-02	4930	5.00E+00	1.01E-02	4930	5.00E+00	1.01E-02	4930
U-233	(a)	2.98E-01	0.00E+00	>10000	3.10E-01	0.00E+00	>10000	1.80E-01	0.00E+00	>10000
U-234	(a)	3.73E+02	0.00E+00	>10000	3.89E+02	0.00E+00	>10000	3.11E+02	0.00E+00	>10000
U-235	(a)	1.07E+01	0.00E+00	>10000	1.11E+01	0.00E+00	>10000	1.20E+01	0.00E+00	>10000
U-236	(a)	4.82E+01	0.00E+00	>10000	5.02E+01	0.00E+00	>10000	2.89E+01	0.00E+00	>10000
U-238	(a)	5.99E+02	0.00E+00	>10000	6.24E+02	0.00E+00	>10000	5.04E+02	0.00E+00	>10000
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	6.36E-05	10000	4.33E+00	6.38E-05	10000	5.70E+00	8.39E-05	10000
Tc-99	900	8.34E+00	9.43E+00	1590	8.36E+00	9.44E+00	1590	8.27E+00	9.34E+00	1590
Grouted Tc-99	900	1.57E+02	1.35E+00	940	1.57E+02	1.36E+00	940	3.34E+02	2.89E+00	940
I-129	1	1.04E-01	1.17E-01	1590	1.04E-01	1.17E-01	1590	1.05E-01	1.19E-01	1590
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	2.21E-10	10000	1.36E-02	2.22E-10	10000	1.38E-02	2.25E-10	10000
U-234	(a)	1.61E+01	2.63E-07	10000	1.61E+01	2.63E-07	10000	3.40E+02	5.55E-06	10000
U-235	(a)	2.56E-01	4.18E-09	10000	2.57E-01	4.19E-09	10000	1.46E+01	2.39E-07	10000
U-236	(a)	3.01E-01	4.92E-09	10000	3.02E-01	4.93E-09	10000	3.05E-01	4.98E-09	10000
U-238	(a)	4.00E+00	6.53E-08	10000	4.01E+00	6.54E-08	10000	3.44E+02	5.61E-06	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G.15. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	2.03E-01	820	3.89E+01	2.03E-01	820	3.89E+01	2.03E-01	820
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	2.21E-08	10000	8.49E-01	2.21E-08	10000	8.49E-01	2.21E-08	10000
U-234	(a)	4.60E-01	1.20E-08	10000	4.60E-01	1.20E-08	10000	4.60E-01	1.20E-08	10000
U-235	(a)	1.90E-02	4.96E-10	10000	1.90E-02	4.96E-10	10000	1.90E-02	4.96E-10	10000
U-236	(a)	1.70E-02	4.43E-10	10000	1.70E-02	4.43E-10	10000	1.70E-02	4.43E-10	10000
U-238	(a)	4.10E-01	1.07E-08	10000	4.10E-01	1.07E-08	10000	4.10E-01	1.07E-08	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
Tc-99	900	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
I-129	1	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-233	(a)	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-234	(a)	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-235	(a)	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-236	(a)	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-238	(a)	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.16. Predicted Peak River Flux of Key Constituents by Waste and Category at a Line of Analysis to the Columbia River, Alternative Group C

	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
Constituent	**Inventory (Ci)**	**Maximum River Flux (Ci)**	**Approx. Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum River Flux (Ci)**	**Approx. Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum River Flux (Ci)**	**Approx. Peak Arrival Time (yrs)**
1996-2007 Cat 1 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	3.00E-01	2.85E-03	2180	3.66E-01	3.48E-03	2180	3.99E-01	3.79E-03	2180
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	2.62E-03	2.49E-05	2180	3.20E-03	3.04E-05	2180	3.20E-03	3.04E-05	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.03E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000
U-234	1.70E-01	0.00E+00	>10000	2.07E-01	0.00E+00	>10000	9.01E-01	0.00E+00	>10000
U-235	3.56E-02	0.00E+00	>10000	4.34E-02	0.00E+00	>10000	8.86E-02	0.00E+00	>10000
U-236	4.03E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000
U-238	4.06E-01	0.00E+00	>10000	4.95E-01	0.00E+00	>10000	1.66E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	7.20E+01	1.86E-03	1840	7.20E+01	1.86E-03	1840	7.20E+01	1.86E-03	1840
I-129	3.39E-07	3.22E-09	2180	3.53E-07	3.35E-09	2180	3.53E-07	3.35E-09	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	9.79E-02	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	2.32E-01	0.00E+00	>10000
U-234	1.24E+02	0.00E+00	>10000	1.29E+02	0.00E+00	>10000	2.94E+02	0.00E+00	>10000
U-235	3.54E+00	0.00E+00	>10000	3.69E+00	0.00E+00	>10000	8.39E+00	0.00E+00	>10000
U-236	1.60E+01	0.00E+00	>10000	1.67E+01	0.00E+00	>10000	3.80E+01	0.00E+00	>10000
U-238	1.99E+02	0.00E+00	>10000	2.07E+02	0.00E+00	>10000	4.72E+02	0.00E+00	>10000

Table G.16. (contd)

Constituent	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum River Flux (Ci)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum River Flux (Ci)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum River Flux (Ci)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			1.60E+00	6.81E-07	10000
Tc-99	0.00E+00			0.00E+00			1.43E+00	1.86E-02	1450
Grouted Tc-99	0.00E+00			0.00E+00			1.23E+02	1.01E-02	870
I-129	0.00E+00			0.00E+00			1.68E-02	2.18E-04	1450
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			2.22E-03	1.05E-08	10000
U-234	0.00E+00			0.00E+00			2.25E+02	1.06E-03	10000
U-235	0.00E+00			0.00E+00			9.96E+00	4.71E-05	10000
U-236	0.00E+00			0.00E+00			4.86E-02	2.30E-07	10000
U-238	0.00E+00			0.00E+00			2.33E+02	1.10E-03	10000
200 West Area									
C-14	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	3.43E+00	3.26E-02	2180	3.44E+00	3.27E-02	2180	2.09E+00	1.99E-02	2180
Grouted Tc-99	4.91E+00	1.27E-04	1840	4.92E+00	1.27E-04	1840	5.96E+01	1.54E-03	1840
I-129	3.50E-02	3.33E-04	2180	3.51E-02	3.34E-04	2180	1.70E-02	1.62E-04	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	1.28E+01	0.00E+00	>10000	1.56E+01	0.00E+00	>10000	1.59E+01	0.00E+00	>10000
Tc-99	1.08E+00	1.01E-02	2340	1.32E+00	1.23E-02	2340	1.33E+00	1.24E-02	2340
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00	0.00E+00	
I-129	3.01E-03	2.80E-05	2340	3.67E-03	3.41E-05	2340	3.67E-03	3.41E-05	2340
Grouted I-129	0.00E+00			0.00E+00	0.00E+00		0.00E+00	0.00E+00	
U-233	3.71E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000
U-234	6.13E-01	0.00E+00	>10000	7.47E-01	0.00E+00	>10000	9.21E-01	0.00E+00	>10000
U-235	1.29E-01	0.00E+00	>10000	1.57E-01	0.00E+00	>10000	1.68E-01	0.00E+00	>10000
U-236	1.46E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000
U-238	1.47E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000	2.08E+00	0.00E+00	>10000

Table G.16. (contd)

Constituent	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum River Flux (Ci)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum River Flux (Ci)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum River Flux (Ci)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	4.44E-01	0.00E+00	>10000	4.62E-01	0.00E+00	>10000	1.45E+02	0.00E+00	>10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.23E+03	2.69E-01	1840	3.23E+03	2.69E-01	1840	3.23E+03	2.69E-01	1840
I-129	1.96E-06	1.82E-08	2340	2.04E-06	1.89E-08	2340	2.04E-06	1.89E-08	2340
Grouted I-129	5.00E+00	1.32E-04	1840	5.00E+00	1.32E-04	1840	5.00E+00	1.32E-04	1840
U-233	2.98E-01	0.00E+00	>10000	3.10E-01	0.00E+00	>10000	1.80E-01	0.00E+00	>10000
U-234	3.73E+02	0.00E+00	>10000	3.89E+02	0.00E+00	>10000	3.11E+02	0.00E+00	>10000
U-235	1.07E+01	0.00E+00	>10000	1.11E+01	0.00E+00	>10000	1.20E+01	0.00E+00	>10000
U-236	4.82E+01	0.00E+00	>10000	5.02E+01	0.00E+00	>10000	2.89E+01	0.00E+00	>10000
U-238	5.99E+02	0.00E+00	>10000	6.24E+02	0.00E+00	>10000	5.04E+02	0.00E+00	>10000
Projected Mixed LLW After 2008									
200 East Area									
C-14	4.32E+00	3.71E-07	10000	4.33E+00	3.72E-07	10000	5.70E+00	4.90E-07	10000
Tc-99	8.34E+00	9.43E-02	1630	8.36E+00	9.45E-02	1630	8.27E+00	9.35E-02	1630
Grouted Tc-99	1.57E+02	1.28E-02	870	1.57E+02	1.29E-02	870	3.34E+02	2.74E-02	870
I-129	1.04E-01	1.17E-03	1630	1.04E-01	1.18E-03	1630	1.05E-01	1.19E-03	1630
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.36E-02	2.19E-12	10000	1.36E-02	2.19E-12	10000	1.38E-02	2.22E-12	10000
U-234	1.61E+01	2.60E-09	10000	1.61E+01	2.60E-09	10000	3.40E+02	5.49E-08	10000
U-235	2.56E-01	4.14E-11	10000	2.57E-01	4.15E-11	10000	1.46E+01	2.36E-09	10000
U-236	3.01E-01	4.86E-11	10000	3.02E-01	4.87E-11	10000	3.05E-01	4.93E-11	10000
U-238	4.00E+00	6.46E-10	10000	4.01E+00	6.47E-10	10000	3.44E+02	5.55E-08	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.16. (contd)

Constituent	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum River Flux (Ci)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum River Flux (Ci)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum River Flux (Ci)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Melter Waste									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.89E+01	3.19E-03	870	3.89E+01	3.19E-03	870	3.89E+01	3.19E-03	870
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	8.49E-01	2.69E-10	10000	8.49E-01	2.69E-10	10000	8.49E-01	2.69E-10	10000
U-234	4.60E-01	1.46E-10	10000	4.60E-01	1.46E-10	10000	4.60E-01	1.46E-10	10000
U-235	1.90E-02	6.01E-12	10000	1.90E-02	6.01E-12	10000	1.90E-02	6.01E-12	10000
U-236	1.70E-02	5.38E-12	10000	1.70E-02	5.38E-12	10000	1.70E-02	5.38E-12	10000
U-238	4.10E-01	1.30E-10	10000	4.10E-01	1.30E-10	10000	4.10E-01	1.30E-10	10000
200 West Area									
C-14	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
Tc-99	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
I-129	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
Grouted I-129	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-233	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-234	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-235	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-236	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
U-238	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		

Table G.17. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a 1-km Line of Analysis, Alternative Group D_1

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area		0.00E+00								
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	3.00E+00	1700	3.66E-01	3.66E+00	1700	3.99E-01	3.99E+00	1700
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.63E-02	1700	3.20E-03	3.20E-02	1700	3.20E-03	3.20E-02	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.03E-01	8.61E-04	10000	1.25E-01	9.44E-04	10000	1.25E-01	5.31E-04	10000
U-234	(a)	1.70E-01	1.43E-03	10000	2.07E-01	1.56E-03	10000	9.01E-01	3.83E-03	10000
U-235	(a)	3.56E-02	2.99E-04	10000	4.34E-02	3.28E-04	10000	8.86E-02	3.76E-04	10000
U-236	(a)	4.03E-03	3.39E-05	10000	4.92E-03	3.71E-05	10000	4.92E-03	2.09E-05	10000
U-238	(a)	4.06E-01	3.41E-03	10000	4.95E-01	3.74E-03	10000	1.66E+00	7.05E-03	10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230
I-129	1	3.39E-07	3.39E-06	1700	3.53E-07	3.53E-06	1700	3.53E-07	3.53E-06	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.79E-02	3.61E-08	10000	1.02E-01	3.61E-08	10000	2.32E-01	0.00E+00	>10000
U-234	(a)	1.24E+02	4.56E-05	10000	1.29E+02	4.56E-05	10000	2.94E+02	0.00E+00	>10000
U-235	(a)	3.54E+00	1.30E-06	10000	3.69E+00	1.30E-06	10000	8.39E+00	0.00E+00	>10000
U-236	(a)	1.60E+01	5.90E-06	10000	1.67E+01	5.90E-06	10000	3.80E+01	0.00E+00	>10000
U-238	(a)	1.99E+02	7.32E-05	10000	2.07E+02	7.32E-05	10000	0.00E+00	0.00E+00	>10000

Table G.17. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum Concen-tration (pCi/L)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum Concen-tration (pCi/L)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum Concen-tration (pCi/L)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.27E-02	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.18E+01	1230
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	8.66E+00	680
I-129	1	0.00E+00			0.00E+00			1.68E-02	1.39E-01	1230
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	5.18E-05	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	5.24E+00	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	2.32E-01	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	1.13E-03	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	5.43E+00	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.44E+01	1700	3.44E+00	3.44E+01	1700	2.09E+00	2.09E+01	1700
Grouted Tc-99	900	4.91E+00	3.50E-01	1200	4.92E+00	3.51E-01	1200	5.96E+01	4.25E+00	1200
I-129	1	3.50E-02	3.51E-01	1700	3.51E-02	3.51E-01	1700	1.70E-02	1.70E-01	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	1.28E+01	2.01E-02	10000	1.56E+01	2.45E-02	10000	1.59E+01	2.50E-02	10000
Tc-99	900	1.08E+00	6.39E+00	1380	1.32E+00	7.80E+00	1380	1.33E+00	7.86E+00	1380
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.01E-03	1.78E-02	1380	3.67E-03	2.17E-02	1380	3.67E-03	2.17E-02	1380
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	3.71E-01	3.29E-03	10000	4.52E-01	3.88E-03	10000	4.52E-01	0.00E+00	>10000
U-234	(a)	6.13E-01	5.44E-03	10000	7.47E-01	6.41E-03	10000	9.21E-01	0.00E+00	>10000
U-235	(a)	1.29E-01	1.14E-03	10000	1.57E-01	1.35E-03	10000	1.68E-01	0.00E+00	>10000
U-236	(a)	1.46E-02	1.30E-04	10000	1.78E-02	1.53E-04	10000	1.78E-02	0.00E+00	>10000
U-238	(a)	1.47E+00	1.30E-02	10000	1.79E+00	1.54E-02	10000	2.08E+00	0.00E+00	>10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00	0.00E+00		0.00E+00		
U-234	(a)	0.00E+00			0.00E+00	0.00E+00		0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G.17. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	4.44E-01	6.97E-04	10000	4.62E-01	7.26E-04	10000	1.45E+02	2.28E-01	10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	4.81E-02	680	3.23E+03	1.55E+02	680	3.23E+03	4.81E-02	680
I-129	1	1.96E-06	1.16E-05	1380	2.04E-06	1.21E-05	1380	2.04E-06	1.21E-05	1380
Grouted I-129	1	5.00E+00	1.52E-02	680	5.00E+00	7.61E-02	680	5.00E+00	1.52E-02	680
U-233	(a)	1.36E-02	2.56E-08	10000	3.10E-01	2.97E-08	10000	1.80E-01	4.43E-08	10000
U-234	(a)	1.61E+01	3.21E-05	10000	3.89E+02	3.73E-05	10000	3.11E+02	7.65E-05	10000
U-235	(a)	2.56E-01	9.16E-07	10000	1.11E+01	1.06E-06	10000	1.20E+01	2.95E-06	10000
U-236	(a)	3.01E-01	4.14E-06	10000	5.02E+01	4.81E-06	10000	2.89E+01	7.11E-06	10000
U-238	(a)	4.00E+00	5.15E-05	10000	6.24E+02	5.98E-05	10000	5.04E+02	1.24E-04	10000
200 West Area										
C-14	2000	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00		0.00E+00		
Tc-99	900	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00		0.00E+00		
Grouted Tc-99	900	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00		0.00E+00		
I-129	1	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00		0.00E+00		
Grouted I-129	1	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00		0.00E+00		
U-233	(a)	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00		0.00E+00		
U-234	(a)	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00		0.00E+00		
U-235	(a)	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00		0.00E+00		
U-236	(a)	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00		0.00E+00		
U-238	(a)	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00		0.00E+00		
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	6.79E-03	10000	4.33E+00	6.81E-03	10000	5.70E+00	8.96E-03	10000
Tc-99	900	8.34E+00	4.93E+01	1380	8.36E+00	4.94E+01	1380	8.27E+00	4.89E+01	1380
Grouted Tc-99	900	1.57E+02	4.81E-02	680	1.57E+02	4.81E-02	680	3.34E+02	4.81E-02	680
I-129	1	1.04E-01	6.13E-01	1380	1.04E-01	6.14E-01	1380	1.05E-01	6.21E-01	1380
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	2.85E-08	10000	1.36E-02	2.86E-08	10000	1.38E-02	2.90E-08	10000
U-234	(a)	1.61E+01	3.39E-05	10000	1.61E+01	3.39E-05	10000	3.40E+02	7.15E-04	10000
U-235	(a)	2.56E-01	5.39E-07	10000	2.57E-01	5.41E-07	10000	1.46E+01	3.08E-05	10000
U-236	(a)	3.01E-01	6.34E-07	10000	3.02E-01	6.35E-07	10000	3.05E-01	6.42E-07	10000
U-238	(a)	4.00E+00	8.42E-06	10000	4.01E+00	8.43E-06	10000	3.44E+02	7.24E-04	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G.17. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	1.87E+00	680	3.89E+01	1.87E+00	680	3.89E+01	1.87E+00	680
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	1.79E-06	10000	8.49E-01	1.79E-06	10000	8.49E-01	1.79E-06	10000
U-234	(a)	4.60E-01	9.68E-07	10000	4.60E-01	9.68E-07	10000	4.60E-01	9.68E-07	10000
U-235	(a)	1.90E-02	4.00E-08	10000	1.90E-02	4.00E-08	10000	1.90E-02	4.00E-08	10000
U-236	(a)	1.70E-02	3.58E-08	10000	1.70E-02	3.58E-08	10000	1.70E-02	3.58E-08	10000
U-238	(a)	4.10E-01	8.62E-07	10000	4.10E-01	8.62E-07	10000	4.10E-01	8.62E-07	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 μg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to μg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.18. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a Line of Analysis Along the Columbia River, Alternative Group D_1

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concentration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concentration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concentration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	2.63E-01	2000	3.66E-01	3.21E-01	2000	3.99E-01	3.50E-01	2000
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.30E-03	2000	3.20E-03	2.81E-03	2000	3.20E-03	2.81E-03	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.03E-01	2.59E-07	10000	1.25E-01	2.64E-07	10000	1.25E-01	9.13E-08	10000
U-234	(a)	1.70E-01	4.29E-07	10000	2.07E-01	4.38E-07	10000	9.01E-01	6.58E-07	10000
U-235	(a)	3.56E-02	9.00E-08	10000	4.34E-02	9.18E-08	10000	8.86E-02	6.47E-08	10000
U-236	(a)	4.03E-03	1.02E-08	10000	4.92E-03	1.04E-08	10000	4.92E-03	3.59E-09	10000
U-238	(a)	4.06E-01	1.03E-06	10000	4.95E-01	1.05E-06	10000	1.66E+00	1.21E-06	10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710
I-129	1	3.39E-07	2.97E-07	2000	3.53E-07	3.09E-07	2000	3.53E-07	3.09E-07	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.79E-02	2.57E-12	10000	1.02E-01	2.57E-12	10000	2.32E-01	0.00E+00	>10000
U-234	(a)	1.24E+02	3.25E-09	10000	1.29E+02	3.25E-09	10000	2.94E+02	0.00E+00	>10000
U-235	(a)	3.54E+00	9.30E-11	10000	3.69E+00	9.30E-11	10000	8.39E+00	0.00E+00	>10000
U-236	(a)	1.60E+01	4.21E-10	10000	1.67E+01	4.21E-10	10000	3.80E+01	0.00E+00	>10000
U-238	(a)	1.99E+02	5.22E-09	10000	2.07E+02	5.22E-09	10000	4.72E+02	0.00E+00	>10000

Table G.18. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.52E-04	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.99E+00	1400
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	1.06E+00	940
I-129	1	0.00E+00			0.00E+00			1.68E-02	2.34E-02	1400
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	1.61E-06	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	1.63E-01	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	7.21E-03	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	3.52E-05	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	1.69E-01	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.01E+00	2000	3.44E+00	3.02E+00	2000	2.09E+00	1.83E+00	2000
Grouted Tc-99	900	4.91E+00	3.36E-02	1620	4.92E+00	3.37E-02	1620	5.96E+01	4.08E-01	1620
I-129	1	3.50E-02	3.07E-02	2000	3.51E-02	3.08E-02	2000	1.70E-02	1.49E-02	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	1.28E+01	2.96E-04	10000	1.56E+01	3.61E-04	10000	1.59E+01	3.68E-04	10000
Tc-99	900	1.08E+00	7.36E-01	1510	1.32E+00	8.97E-01	1510	1.33E+00	9.04E-01	1510
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.01E-03	2.05E-03	1510	3.67E-03	2.50E-03	1510	3.67E-03	2.50E-03	1510
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	3.71E-01	4.40E-05	10000	4.52E-01	5.12E-05	10000	4.52E-01	8.41E-05	10000
U-234	(a)	6.13E-01	7.27E-05	10000	7.47E-01	8.47E-05	10000	9.21E-01	1.71E-04	10000
U-235	(a)	1.29E-01	1.53E-05	10000	1.57E-01	1.78E-05	10000	1.68E-01	3.13E-05	10000
U-236	(a)	1.46E-02	1.73E-06	10000	1.78E-02	2.02E-06	10000	1.78E-02	3.31E-06	10000
U-238	(a)	1.47E+00	1.74E-04	10000	1.79E+00	2.03E-04	10000	2.08E+00	3.87E-04	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G.18. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	4.44E-01	1.03E-05	10000	4.62E-01	1.07E-05	10000	1.45E+02	3.35E-03	10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	1.69E+01	820	3.23E+03	1.69E+01	820	3.23E+03	1.69E+01	820
I-129	1	1.96E-06	1.33E-06	1510	2.04E-06	1.39E-06	1510	2.04E-06	1.39E-06	1510
Grouted I-129	1	5.00E+00	8.26E-03	820	5.00E+00	8.26E-03	820	5.00E+00	8.26E-03	820
U-233	(a)	2.98E-01	3.17E-10	10000	3.10E-01	3.68E-10	10000	1.80E-01	5.49E-10	10000
U-234	(a)	3.73E+02	3.98E-07	10000	3.89E+02	4.62E-07	10000	3.11E+02	9.49E-07	10000
U-235	(a)	1.07E+01	1.14E-08	10000	1.11E+01	1.32E-08	10000	1.20E+01	3.66E-08	10000
U-236	(a)	4.82E+01	5.13E-08	10000	5.02E+01	5.97E-08	10000	2.89E+01	8.82E-08	10000
U-238	(a)	5.99E+02	6.38E-07	10000	6.24E+02	7.42E-07	10000	5.04E+02	1.54E-06	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	9.99E-05	10000	4.33E+00	1.00E-04	10000	5.70E+00	1.32E-04	10000
Tc-99	900	8.34E+00	5.67E+00	1510	8.36E+00	5.68E+00	1510	8.27E+00	5.62E+00	1510
Grouted Tc-99	900	1.57E+02	8.19E-01	820	1.57E+02	8.21E-01	820	3.34E+02	1.75E+00	820
I-129	1	1.04E-01	7.06E-02	1510	1.04E-01	7.07E-02	1510	1.05E-01	7.15E-02	1510
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	3.54E-10	10000	1.36E-02	3.55E-10	10000	1.38E-02	3.59E-10	10000
U-234	(a)	1.61E+01	4.20E-07	10000	1.61E+01	4.21E-07	10000	3.40E+02	8.87E-06	10000
U-235	(a)	2.56E-01	6.69E-09	10000	2.57E-01	6.70E-09	10000	1.46E+01	3.82E-07	10000
U-236	(a)	3.01E-01	7.86E-09	10000	3.02E-01	7.88E-09	10000	3.05E-01	7.97E-09	10000
U-238	(a)	4.00E+00	1.04E-07	10000	4.01E+00	1.05E-07	10000	3.44E+02	8.97E-06	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G.18. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	2.03E-01	820	3.89E+01	2.03E-01	820	3.89E+01	2.03E-01	820
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	2.21E-08	10000	8.49E-01	2.21E-08	10000	8.49E-01	2.21E-08	10000
U-234	(a)	4.60E-01	1.20E-08	10000	4.60E-01	1.20E-08	10000	4.60E-01	1.20E-08	10000
U-235	(a)	1.90E-02	4.96E-10	10000	1.90E-02	4.96E-10	10000	1.90E-02	4.96E-10	10000
U-236	(a)	1.70E-02	4.43E-10	10000	1.70E-02	4.43E-10	10000	1.70E-02	4.43E-10	10000
U-238	(a)	4.10E-01	1.07E-08	10000	4.10E-01	1.07E-08	10000	4.10E-01	1.07E-08	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.19. Predicted Peak River Flux of Key Constituents by Waste and Category at a Line of Analysis to the Columbia River, Alternative Group D_1

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	3.00E-01	2.85E-03	2180	3.66E-01	3.48E-03	2180	3.99E-01	3.79E-03	2180
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	2.62E-03	2.49E-05	2180	3.20E-03	3.04E-05	2180	3.20E-03	3.04E-05	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.03E-01	2.00E-09	10000	1.25E-01	2.05E-09	10000	1.25E-01	7.25E-10	10000
U-234	1.70E-01	3.32E-09	10000	2.07E-01	3.40E-09	10000	9.01E-01	5.22E-09	10000
U-235	3.56E-02	6.96E-10	10000	4.34E-02	7.12E-10	10000	8.86E-02	5.14E-10	10000
U-236	4.03E-03	7.89E-11	10000	4.92E-03	8.07E-11	10000	4.92E-03	2.85E-11	10000
U-238	4.06E-01	7.93E-09	10000	4.95E-01	8.12E-09	10000	1.66E+00	9.62E-09	10000
1996-2007 Cat 3 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840
I-129	3.39E-07	3.22E-09	2180	3.53E-07	3.35E-09	2180	3.53E-07	3.35E-09	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	9.79E-02	2.03E-14	10000	1.02E-01	2.03E-14	10000	2.32E-01	2.03E-14	10000
U-234	1.24E+02	2.57E-11	10000	1.29E+02	2.57E-11	10000	2.94E+02	2.57E-11	10000
U-235	3.54E+00	7.36E-13	10000	3.69E+00	7.36E-13	10000	8.39E+00	7.34E-13	10000
U-236	1.60E+01	3.33E-12	10000	1.67E+01	3.33E-12	10000	3.80E+01	3.32E-12	10000
U-238	1.99E+02	4.13E-11	10000	2.07E+02	4.13E-11	10000	4.72E+02	4.13E-11	10000

Table G.19. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			1.60E+00	1.52E-02	2180
Tc-99	0.00E+00			0.00E+00			1.43E+00	1.86E-02	1450
Grouted Tc-99	0.00E+00			0.00E+00			1.23E+02	1.14E-02	970
I-129	0.00E+00			0.00E+00			1.68E-02	2.18E-04	1450
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			2.22E-03	1.05E-08	10000
U-234	0.00E+00			0.00E+00			2.25E+02	1.06E-03	10000
U-235	0.00E+00			0.00E+00			9.96E+00	4.71E-05	10000
U-236	0.00E+00			0.00E+00			4.86E-02	2.30E-07	10000
U-238	0.00E+00			0.00E+00			2.33E+02	1.10E-03	10000
200 West Area									
C-14	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	3.43E+00	3.26E-02	2180	3.44E+00	3.27E-02	2180	2.09E+00	1.99E-02	2180
Grouted Tc-99	4.91E+00	4.10E-04	1840	4.92E+00	4.10E-04	1840	5.96E+01	4.97E-03	1840
I-129	3.50E-02	3.33E-04	2180	3.51E-02	3.34E-04	2180	1.70E-02	1.62E-04	2180
Grouted I-129	0.00E+00	0.00E+00	1840	0.00E+00	0.00E+00	1840	0.00E+00	0.00E+00	1840
U-233	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008									
200 East Area									
C-14	1.28E+01	3.60E-06	10000	1.56E+01	4.39E-06	10000	1.59E+01	4.48E-06	10000
Tc-99	1.08E+00	1.15E-02	1530	1.32E+00	1.40E-02	1530	1.33E+00	1.41E-02	1530
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	3.01E-03	3.19E-05	1530	3.67E-03	3.89E-05	1530	3.67E-03	3.89E-05	1530
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	3.71E-01	5.34E-07	10000	4.52E-01	6.22E-07	10000	4.52E-01	1.03E-06	10000
U-234	6.13E-01	8.83E-07	10000	7.47E-01	1.03E-06	10000	9.21E-01	2.10E-06	10000
U-235	1.29E-01	1.86E-07	10000	1.57E-01	2.16E-07	10000	1.68E-01	3.84E-07	10000
U-236	1.46E-02	2.10E-08	10000	1.78E-02	2.45E-08	10000	1.78E-02	4.06E-08	10000
U-238	1.47E+00	2.12E-06	10000	1.79E+00	2.46E-06	10000	2.08E+00	4.75E-06	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.19. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008									
200 East Area									
C-14	4.44E-01	1.25E-07	10000	4.62E-01	1.30E-07	10000	1.45E+02	4.08E-05	10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.23E+03	2.65E-01	870	3.23E+03	2.69E-01	1840	3.23E+03	2.65E-01	870
I-129	1.96E-06	2.07E-08	1530	2.04E-06	2.16E-08	1530	2.04E-06	2.16E-08	1530
Grouted I-129	5.00E+00	1.30E-04	870	5.00E+00	1.32E-04	1840	5.00E+00	1.30E-04	870
U-233	2.98E-01	3.85E-12	10000	3.10E-01	4.47E-12	10000	1.80E-01	1.75E-12	10000
U-234	3.73E+02	4.83E-09	10000	3.89E+02	5.61E-09	10000	3.11E+02	3.02E-09	10000
U-235	1.07E+01	1.38E-10	10000	1.11E+01	1.60E-10	10000	1.20E+01	1.17E-10	10000
U-236	4.82E+01	6.23E-10	10000	5.02E+01	7.24E-10	10000	2.89E+01	2.81E-10	10000
U-238	5.99E+02	7.74E-09	10000	6.24E+02	9.00E-09	10000	5.04E+02	4.90E-09	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
Projected Mixed LLW After 2008									
200 East Area									
C-14	4.32E+00	1.22E-06	10000	4.33E+00	1.22E-06	10000	5.70E+00	1.61E-06	10000
Tc-99	8.34E+00	8.84E-02	1530	8.36E+00	8.85E-02	1530	8.27E+00	8.76E-02	1530
Grouted Tc-99	1.57E+02	1.28E-02	870	1.57E+02	1.29E-02	870	3.34E+02	2.74E-02	870
I-129	1.04E-01	1.10E-03	1530	1.04E-01	1.10E-03	1530	1.05E-01	1.11E-03	1530
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.36E-02	4.29E-12	10000	1.36E-02	4.30E-12	10000	1.38E-02	4.36E-12	10000
U-234	1.61E+01	5.10E-09	10000	1.61E+01	5.11E-09	10000	3.40E+02	1.08E-07	10000
U-235	2.56E-01	8.12E-11	10000	2.57E-01	8.13E-11	10000	1.46E+01	4.63E-09	10000
U-236	3.01E-01	9.54E-11	10000	3.02E-01	9.56E-11	10000	3.05E-01	9.66E-11	10000
U-238	4.00E+00	1.27E-09	10000	4.01E+00	1.27E-09	10000	3.44E+02	1.09E-07	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.19. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.89E+01	3.19E-03	870	3.89E+01	3.19E-03	870	3.89E+01	3.19E-03	870
I-129	0.00E+00		0	0.00E+00		0	0.00E+00		0
Grouted I-129	0.00E+00		0	0.00E+00		0	0.00E+00		0
U-233	8.49E-01	2.69E-10	10000	8.49E-01	2.69E-10	10000	8.49E-01	2.69E-10	10000
U-234	4.60E-01	1.46E-10	10000	4.60E-01	1.46E-10	10000	4.60E-01	1.46E-10	10000
U-235	1.90E-02	6.01E-12	10000	1.90E-02	6.01E-12	10000	1.90E-02	6.01E-12	10000
U-236	1.70E-02	5.38E-12	10000	1.70E-02	5.38E-12	10000	1.70E-02	5.38E-12	10000
U-238	4.10E-01	1.30E-10	10000	4.10E-01	1.30E-10	10000	4.10E-01	1.30E-10	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.20. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a 1-km Line of Analysis, Alternative Group D_2

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	3.00E+00	1700	3.66E-01	3.66E+00	1700	3.99E-01	3.99E+00	1700
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.63E-02	1700	3.20E-03	3.20E-02	1700	3.20E-03	3.20E-02	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.03E-01	8.61E-04	10000	1.25E-01	9.44E-04	10000	1.25E-01	5.31E-04	10000
U-234	(a)	1.70E-01	1.43E-03	10000	2.07E-01	1.56E-03	10000	9.01E-01	3.83E-03	10000
U-235	(a)	3.56E-02	2.99E-04	10000	4.34E-02	3.28E-04	10000	8.86E-02	3.76E-04	10000
U-236	(a)	4.03E-03	3.39E-05	10000	4.92E-03	3.71E-05	10000	4.92E-03	2.09E-05	10000
U-238	(a)	4.06E-01	3.41E-03	10000	4.95E-01	3.74E-03	10000	1.66E+00	7.05E-03	10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230
I-129	1	3.39E-07	3.39E-06	1700	3.53E-07	3.53E-06	1700	3.53E-07	3.53E-06	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.79E-02	3.61E-08	10000	1.02E-01	3.61E-08	10000	2.32E-01	3.60E-08	10000
U-234	(a)	1.24E+02	4.56E-05	10000	1.29E+02	4.56E-05	10000	2.94E+02	4.56E-05	10000
U-235	(a)	3.54E+00	1.30E-06	10000	3.69E+00	1.30E-06	10000	8.39E+00	1.30E-06	10000
U-236	(a)	1.60E+01	5.90E-06	10000	1.67E+01	5.90E-06	10000	3.80E+01	5.89E-06	10000
U-238	(a)	1.99E+02	7.32E-05	10000	2.07E+02	7.32E-05	10000	4.72E+02	7.32E-05	10000

Table G.20. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.27E-02	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.18E+01	1230
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	8.66E+00	680
I-129	1	0.00E+00			0.00E+00			1.68E-02	1.39E-01	1230
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	5.18E-05	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	5.24E+00	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	2.32E-01	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	1.13E-03	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	5.43E+00	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.44E+01	1700	3.44E+00	3.44E+01	1700	2.09E+00	2.09E+01	1700
Grouted Tc-99	900	4.91E+00	3.50E-01	1200	4.92E+00	3.51E-01	1200	5.96E+01	4.25E+00	1200
I-129	1	3.50E-02	3.51E-01	1700	3.51E-02	3.51E-01	1700	1.70E-02	1.70E-01	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	1.28E+01	3.09E-02	10000	1.56E+01	3.76E-02	10000	1.59E+01	3.84E-02	10000
Tc-99	900	1.08E+00	5.17E+00	1320	1.32E+00	6.31E+00	1320	1.33E+00	6.36E+00	1320
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.01E-03	1.44E-02	1320	3.67E-03	1.75E-02	1320	3.67E-03	1.75E-02	1320
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	3.71E-01	5.20E-03	10000	4.52E-01	6.13E-03	10000	4.52E-01	8.62E-03	10000
U-234	(a)	6.13E-01	8.59E-03	10000	7.47E-01	1.01E-02	10000	9.21E-01	1.76E-02	10000
U-235	(a)	1.29E-01	1.81E-03	10000	1.57E-01	2.13E-03	10000	1.68E-01	3.20E-03	10000
U-236	(a)	1.46E-02	2.05E-04	10000	1.78E-02	2.42E-04	10000	1.78E-02	3.39E-04	10000
U-238	(a)	1.47E+00	2.06E-02	10000	1.79E+00	2.43E-02	10000	2.08E+00	3.97E-02	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G.20. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	4.44E-01	1.07E-03	10000	4.62E-01	1.11E-03	10000	1.45E+02	3.50E-01	10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	1.35E+02	630	3.23E+03	1.35E+02	630	3.23E+03	1.35E+02	630
I-129	1	1.96E-06	9.36E-06	1320	2.04E-06	9.75E-06	1320	2.04E-06	9.75E-06	1320
Grouted I-129	1	5.00E+00	6.63E-02	630	5.00E+00	6.63E-02	630	5.00E+00	6.63E-02	630
U-233	(a)	2.98E-01	4.08E-08	10000	3.10E-01	4.74E-08	10000	1.80E-01	7.07E-08	10000
U-234	(a)	3.73E+02	5.12E-05	10000	3.89E+02	5.95E-05	10000	3.11E+02	1.22E-04	10000
U-235	(a)	1.07E+01	1.46E-06	10000	1.11E+01	1.70E-06	10000	1.20E+01	4.71E-06	10000
U-236	(a)	4.82E+01	6.61E-06	10000	5.02E+01	7.68E-06	10000	2.89E+01	1.13E-05	10000
U-238	(a)	5.99E+02	8.21E-05	10000	6.24E+02	9.54E-05	10000	5.04E+02	1.98E-04	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	1.01E-02	10000	4.33E+00	1.01E-02	10000	5.70E+00	1.34E-02	10000
Tc-99	900	8.34E+00	6.79E+01	1370	8.36E+00	6.80E+01	1370	8.27E+00	6.73E+01	1370
Grouted Tc-99	900	1.57E+02	1.10E+01	680	1.57E+02	1.11E+01	680	3.34E+02	2.35E+01	680
I-129	1	1.04E-01	8.44E-01	1370	1.04E-01	8.46E-01	1370	1.05E-01	8.56E-01	1370
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	4.56E-08	10000	1.36E-02	4.57E-08	10000	1.38E-02	4.63E-08	10000
U-234	(a)	1.61E+01	5.41E-05	10000	1.61E+01	5.42E-05	10000	3.40E+02	1.14E-03	10000
U-235	(a)	2.56E-01	8.61E-07	10000	2.57E-01	8.63E-07	10000	1.46E+01	4.91E-05	10000
U-236	(a)	3.01E-01	1.01E-06	10000	3.02E-01	1.01E-06	10000	3.05E-01	1.03E-06	10000
U-238	(a)	4.00E+00	1.34E-05	10000	4.01E+00	1.35E-05	10000	3.44E+02	1.15E-03	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G.20. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume: Inventory (Ci)	Hanford Only Volume: Maximum Concen-tration (pCi/L)	Hanford Only Volume: Approx. Peak Arrival Time (yrs)	Lower Bound Volume: Inventory (Ci)	Lower Bound Volume: Maximum Concen-tration (pCi/L)	Lower Bound Volume: Approx. Peak Arrival Time (yrs)	Upper Bound Volume: Inventory (Ci)	Upper Bound Volume: Maximum Concen-tration (pCi/L)	Upper Bound Volume: Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	2.74E+00	680	3.89E+01	2.74E+00	680	3.89E+01	2.74E+00	680
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	2.51E-06	10000	8.49E-01	2.51E-06	10000	8.49E-01	2.51E-06	10000
U-234	(a)	4.60E-01	1.36E-06	10000	4.60E-01	1.36E-06	10000	4.60E-01	1.36E-06	10000
U-235	(a)	1.90E-02	5.61E-08	10000	1.90E-02	5.61E-08	10000	1.90E-02	5.61E-08	10000
U-236	(a)	1.70E-02	5.02E-08	10000	1.70E-02	5.02E-08	10000	1.70E-02	5.02E-08	10000
U-238	(a)	4.10E-01	1.21E-06	10000	4.10E-01	1.21E-06	10000	4.10E-01	1.21E-06	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.21. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a Line of Analysis Along the Columbia River, Alternative Group D_2

		Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
Constituent	Benchmark Drinking Water Standard (pCi/L)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	2.63E-01	2000	3.66E-01	3.21E-01	2000	3.99E-01	3.50E-01	2000
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.30E-03	2000	3.20E-03	2.81E-03	2000	3.20E-03	2.81E-03	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.03E-01	2.59E-07	10000	1.25E-01	2.64E-07	10000	1.25E-01	2.64E-07	10000
U-234	(a)	1.70E-01	4.29E-07	10000	2.07E-01	4.38E-07	10000	9.01E-01	1.91E-06	10000
U-235	(a)	3.56E-02	9.00E-08	10000	4.34E-02	9.18E-08	10000	8.86E-02	1.87E-07	10000
U-236	(a)	4.03E-03	1.02E-08	10000	4.92E-03	1.04E-08	10000	4.92E-03	1.04E-08	10000
U-238	(a)	4.06E-01	1.03E-06	10000	4.95E-01	1.05E-06	10000	1.66E+00	3.51E-06	10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710
I-129	1	3.39E-07	2.97E-07	2000	3.53E-07	3.09E-07	2000	3.53E-07	3.09E-07	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.79E-02	2.57E-12	10000	1.02E-01	2.57E-12	10000	2.32E-01	5.85E-12	10000
U-234	(a)	1.24E+02	3.25E-09	10000	1.29E+02	3.25E-09	10000	2.94E+02	7.41E-09	10000
U-235	(a)	3.54E+00	9.30E-11	10000	3.69E+00	9.30E-11	10000	8.39E+00	2.11E-10	10000
U-236	(a)	1.60E+01	4.21E-10	10000	1.67E+01	4.21E-10	10000	3.80E+01	9.58E-10	10000
U-238	(a)	1.99E+02	5.22E-09	10000	2.07E+02	5.22E-09	10000	4.72E+02	7.32E-05	10000

Table G.21. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.52E-04	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.99E+00	1400
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	1.06E+00	940
I-129	1	0.00E+00			0.00E+00			1.68E-02	2.34E-02	1400
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	1.61E-06	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	1.63E-01	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	7.21E-03	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	3.52E-05	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	1.69E-01	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.01E+00	2000	3.44E+00	3.02E+00	2000	2.09E+00	1.83E+00	2000
Grouted Tc-99	900	4.91E+00	3.36E-02	1620	4.92E+00	3.37E-02	1620	5.96E+01	4.08E-01	1620
I-129	1	3.50E-02	3.07E-02	2000	3.51E-02	3.08E-02	2000	1.70E-02	1.49E-02	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	1.28E+01	6.49E-04	10000	1.56E+01	7.92E-04	10000	1.59E+01	8.07E-04	10000
Tc-99	900	1.08E+00	1.39E+00	1530	1.32E+00	1.70E+00	1530	1.33E+00	1.71E+00	1530
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.01E-03	3.87E-03	1530	3.67E-03	4.71E-03	1530	3.67E-03	4.71E-03	1530
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	3.71E-01	6.08E-05	10000	4.52E-01	7.08E-05	10000	4.52E-01	3.30E-07	10000
U-234	(a)	6.13E-01	1.00E-04	10000	7.47E-01	1.17E-04	10000	9.21E-01	6.73E-07	10000
U-235	(a)	1.29E-01	2.11E-05	10000	1.57E-01	2.46E-05	10000	1.68E-01	1.23E-07	10000
U-236	(a)	1.46E-02	2.39E-06	10000	1.78E-02	2.79E-06	10000	1.78E-02	1.30E-08	10000
U-238	(a)	1.47E+00	2.41E-04	10000	1.79E+00	2.80E-04	10000	2.08E+00	1.52E-06	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G.21. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	4.44E-01	2.25E-05	10000	4.62E-01	2.34E-05	10000	1.45E+02	7.36E-03	10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	3.18E+01	860	3.23E+03	3.18E+01	860	3.23E+03	3.18E+01	860
I-129	1	1.96E-06	2.52E-06	1530	2.04E-06	2.62E-06	1530	2.04E-06	2.62E-06	1530
Grouted I-129	1	5.00E+00	1.56E-02	860	5.00E+00	1.56E-02	860	5.00E+00	1.56E-02	860
U-233	(a)	2.98E-01	4.37E-10	10000	3.10E-01	5.08E-10	10000	1.80E-01	7.57E-10	10000
U-234	(a)	3.73E+02	5.48E-07	10000	3.89E+02	6.37E-07	10000	3.11E+02	1.31E-06	10000
U-235	(a)	1.07E+01	1.56E-08	10000	1.11E+01	1.82E-08	10000	1.20E+01	5.04E-08	10000
U-236	(a)	4.82E+01	7.08E-08	10000	5.02E+01	8.22E-08	10000	2.89E+01	1.21E-07	10000
U-238	(a)	5.99E+02	8.80E-07	10000	6.24E+02	1.02E-06	10000	5.04E+02	2.12E-06	10000
200 West Area										
C-14	2000	0.00E+00	0.00E+00	0	0.00E+00			0.00E+00	0.00E+00	0
Tc-99	900	0.00E+00	0.00E+00	0	0.00E+00			0.00E+00	0.00E+00	0
Grouted Tc-99	900	0.00E+00	0.00E+00	0	0.00E+00			0.00E+00	0.00E+00	0
I-129	1	0.00E+00	0.00E+00	0	0.00E+00			0.00E+00	0.00E+00	0
Grouted I-129	1	0.00E+00	0.00E+00	0	0.00E+00			0.00E+00	0.00E+00	0
U-233	(a)	0.00E+00	0.00E+00	0	0.00E+00			0.00E+00	0.00E+00	0
U-234	(a)	0.00E+00	0.00E+00	0	0.00E+00			0.00E+00	0.00E+00	0
U-235	(a)	0.00E+00	0.00E+00	0	0.00E+00			0.00E+00	0.00E+00	0
U-236	(a)	0.00E+00	0.00E+00	0	0.00E+00			0.00E+00	0.00E+00	0
U-238	(a)	0.00E+00	0.00E+00	0	0.00E+00			0.00E+00	0.00E+00	0
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	6.36E-05	10000	4.33E+00	6.38E-05	10000	5.70E+00	8.39E-05	10000
Tc-99	900	8.34E+00	9.43E+00	1590	8.36E+00	9.44E+00	1590	8.27E+00	9.34E+00	1590
Grouted Tc-99	900	1.57E+02	1.35E+00	940	1.57E+02	1.36E+00	940	3.34E+02	2.89E+00	940
I-129	1	1.04E-01	1.17E-01	1590	1.04E-01	1.17E-01	1590	1.05E-01	1.19E-01	1590
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	4.88E-10	10000	1.36E-02	4.89E-10	10000	1.38E-02	4.95E-10	10000
U-234	(a)	1.61E+01	5.79E-07	10000	1.61E+01	5.80E-07	10000	3.40E+02	1.22E-05	10000
U-235	(a)	2.56E-01	9.22E-09	10000	2.57E-01	9.24E-09	10000	1.46E+01	5.26E-07	10000
U-236	(a)	3.01E-01	1.08E-08	10000	3.02E-01	1.09E-08	10000	3.05E-01	1.10E-08	10000
U-238	(a)	4.00E+00	1.44E-07	10000	4.01E+00	1.44E-07	10000	3.44E+02	1.24E-05	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

Table G.21. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	3.37E-01	940	3.89E+01	3.37E-01	940	3.89E+01	3.37E-01	940
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	1.33E-08	10000	8.49E-01	1.33E-08	10000	8.49E-01	1.33E-08	10000
U-234	(a)	4.60E-01	7.23E-09	10000	4.60E-01	7.23E-09	10000	4.60E-01	7.23E-09	10000
U-235	(a)	1.90E-02	2.99E-10	10000	1.90E-02	2.99E-10	10000	1.90E-02	2.99E-10	10000
U-236	(a)	1.70E-02	2.67E-10	10000	1.70E-02	2.67E-10	10000	1.70E-02	2.67E-10	10000
U-238	(a)	4.10E-01	6.44E-09	10000	4.10E-01	6.44E-09	10000	4.10E-01	6.44E-09	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.22. Predicted Peak River Flux of Key Constituents by Waste and Category at a Line of Analysis to the Columbia River – Alternative Group D_2

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	3.00E-01	2.85E-03	2180	3.66E-01	3.48E-03	2180	3.99E-01	3.79E-03	2180
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	2.62E-03	2.49E-05	2180	3.20E-03	3.04E-05	2180	3.20E-03	3.04E-05	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.03E-01	2.00E-09	10000	1.25E-01	2.05E-09	10000	1.25E-01	7.25E-10	10000
U-234	1.70E-01	3.32E-09	10000	2.07E-01	3.40E-09	10000	9.01E-01	5.22E-09	10000
U-235	3.56E-02	6.96E-10	10000	4.34E-02	7.12E-10	10000	8.86E-02	5.14E-10	10000
U-236	4.03E-03	7.89E-11	10000	4.92E-03	8.07E-11	10000	4.92E-03	2.85E-11	10000
U-238	4.06E-01	7.93E-09	10000	4.95E-01	8.12E-09	10000	1.66E+00	9.62E-09	10000
1996-2007 Cat 3 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840
I-129	3.39E-07	3.22E-09	2180	3.53E-07	3.35E-09	2180	3.53E-07	3.35E-09	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	9.79E-02	2.03E-14	10000	1.02E-01	2.03E-14	10000	2.32E-01	2.03E-14	10000
U-234	1.24E+02	2.57E-11	10000	1.29E+02	2.57E-11	10000	2.94E+02	2.57E-11	10000
U-235	3.54E+00	7.36E-13	10000	3.69E+00	7.36E-13	10000	8.39E+00	7.34E-13	10000
U-236	1.60E+01	3.33E-12	10000	1.67E+01	3.33E-12	10000	3.80E+01	3.32E-12	10000
U-238	1.99E+02	4.13E-11	10000	2.07E+02	4.13E-11	10000	4.72E+02	4.13E-11	10000

Table G.22. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			1.60E+00	6.81E-07	10000
Tc-99	0.00E+00			0.00E+00			1.43E+00	1.86E-02	1450
Grouted Tc-99	0.00E+00			0.00E+00			1.23E+02	1.01E-02	870
I-129	0.00E+00			0.00E+00			1.68E-02	2.18E-04	1450
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			2.22E-03	1.05E-08	10000
U-234	0.00E+00			0.00E+00			2.25E+02	1.06E-03	10000
U-235	0.00E+00			0.00E+00			9.96E+00	4.71E-05	10000
U-236	0.00E+00			0.00E+00			4.86E-02	2.30E-07	10000
U-238	0.00E+00			0.00E+00			2.33E+02	1.10E-03	10000
200 West Area									
C-14	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	3.43E+00	3.26E-02	2180	3.44E+00	3.27E-02	2180	2.09E+00	1.99E-02	2180
Grouted Tc-99	4.91E+00	4.10E-04	1840	4.92E+00	4.10E-04	1840	5.96E+01	4.97E-03	1840
I-129	3.50E-02	3.33E-04	2180	3.51E-02	3.34E-04	2180	1.70E-02	1.62E-04	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008									
200 East Area									
C-14	1.28E+01	1.86E-06	10000	1.56E+01	2.27E-06	10000	1.59E+01	2.31E-06	10000
Tc-99	1.08E+00	1.27E-02	1600	1.32E+00	1.55E-02	1600	1.33E+00	1.56E-02	1600
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	3.01E-03	3.53E-05	1600	3.67E-03	4.30E-05	1600	3.67E-03	4.30E-05	1600
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	3.71E-01	2.74E-07	10000	4.52E-01	3.18E-07	10000	4.52E-01	5.46E-07	10000
U-234	6.13E-01	4.53E-07	10000	7.47E-01	5.26E-07	10000	9.21E-01	1.11E-06	10000
U-235	1.29E-01	9.51E-08	10000	1.57E-01	1.11E-07	10000	1.68E-01	2.03E-07	10000
U-236	1.46E-02	1.08E-08	10000	1.78E-02	1.25E-08	10000	1.78E-02	2.15E-08	10000
U-238	1.47E+00	1.08E-06	10000	1.79E+00	1.26E-06	10000	2.08E+00	2.51E-06	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
Tc-99	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00	0.00E+00	
I-129	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
Grouted I-129	0.00E+00			0.00E+00			0.00E+00	0.00E+00	
U-233	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
U-234	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
U-235	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
U-236	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
U-238	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0

Table G.22. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008									
200 East Area									
C-14	4.44E-01	6.44E-08	10000	4.62E-01	6.71E-08	10000	1.45E+02	2.11E-05	10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.23E+03	2.99E-01	970	3.23E+03	2.99E-01	970	3.23E+03	2.99E-01	970
I-129	1.96E-06	2.29E-08	1600	2.04E-06	2.39E-08	1600	2.04E-06	2.39E-08	1600
Grouted I-129	5.00E+00	1.46E-04	970	5.00E+00	1.46E-04	970	5.00E+00	1.46E-04	970
U-233	2.98E-01	1.96E-12	10000	3.10E-01	2.28E-12	10000	1.80E-01	3.40E-12	10000
U-234	3.73E+02	2.46E-09	10000	3.89E+02	2.86E-09	10000	3.11E+02	5.87E-09	10000
U-235	1.07E+01	7.02E-11	10000	1.11E+01	8.16E-11	10000	1.20E+01	2.26E-10	10000
U-236	4.82E+01	3.18E-10	10000	5.02E+01	3.69E-10	10000	2.89E+01	5.45E-10	10000
U-238	5.99E+02	3.95E-09	10000	6.24E+02	4.59E-09	10000	5.04E+02	9.51E-09	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
Tc-99	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
I-129	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
Grouted I-129	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
U-233	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
U-234	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
U-235	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
U-236	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
U-238	0.00E+00			0.00E+00			0.00E+00	0.00E+00	0
Projected Mixed LLW After 2008									
200 East Area									
C-14	4.32E+00	3.71E-07	10000	4.33E+00	3.72E-07	10000	5.70E+00	4.90E-07	10000
Tc-99	8.34E+00	9.43E-02	1630	8.36E+00	9.45E-02	1630	8.27E+00	9.35E-02	1630
Grouted Tc-99	1.57E+02	1.45E-02	970	1.57E+02	1.45E-02	970	3.34E+02	3.09E-02	970
I-129	1.04E-01	1.17E-03	1630	1.04E-01	1.18E-03	1630	1.05E-01	1.19E-03	1630
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.36E-02	2.19E-12	10000	1.36E-02	2.19E-12	10000	1.38E-02	2.22E-12	10000
U-234	1.61E+01	2.60E-09	10000	1.61E+01	2.60E-09	10000	3.40E+02	5.49E-08	10000
U-235	2.56E-01	4.14E-11	10000	2.57E-01	4.15E-11	10000	1.46E+01	2.36E-09	10000
U-236	3.01E-01	4.86E-11	10000	3.02E-01	4.87E-11	10000	3.05E-01	4.93E-11	10000
U-238	4.00E+00	6.46E-10	10000	4.01E+00	6.47E-10	10000	3.44E+02	5.55E-08	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.22. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.89E+01	3.60E-03	970	3.89E+01	3.60E-03	970	3.89E+01	3.60E-03	970
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	8.49E-01	7.84E-11	10000	8.49E-01	7.84E-11	10000	8.49E-01	7.84E-11	10000
U-234	4.60E-01	4.25E-11	10000	4.60E-01	4.25E-11	10000	4.60E-01	4.25E-11	10000
U-235	1.90E-02	1.75E-12	10000	1.90E-02	1.75E-12	10000	1.90E-02	1.75E-12	10000
U-236	1.70E-02	1.57E-12	10000	1.70E-02	1.57E-12	10000	1.70E-02	1.57E-12	10000
U-238	4.10E-01	3.79E-11	10000	4.10E-01	3.79E-11	10000	4.10E-01	3.79E-11	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.23. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a 1-km Line of Analysis, Alternative Group D_3

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area		0.00E+00						0.00E+00	0.00E+00	0
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	3.00E+00	1700	3.66E-01	3.66E+00	1700	3.99E-01	3.99E+00	1700
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.63E-02	1700	3.20E-03	3.20E-02	1700	3.20E-03	3.20E-02	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.03E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000
U-234	(a)	1.70E-01	0.00E+00	>10000	2.07E-01	0.00E+00	>10000	9.01E-01	0.00E+00	>10000
U-235	(a)	3.56E-02	0.00E+00	>10000	4.34E-02	0.00E+00	>10000	8.86E-02	0.00E+00	>10000
U-236	(a)	4.03E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000
U-238	(a)	4.06E-01	0.00E+00	>10000	4.95E-01	0.00E+00	>10000	1.66E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230
I-129	1	3.39E-07	3.39E-06	1700	3.53E-07	3.53E-06	1700	3.53E-07	3.53E-06	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.79E-02	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	2.32E-01	0.00E+00	>10000
U-234	(a)	1.24E+02	0.00E+00	>10000	1.29E+02	0.00E+00	>10000	2.94E+02	0.00E+00	>10000
U-235	(a)	3.54E+00	0.00E+00	>10000	3.69E+00	0.00E+00	>10000	8.39E+00	0.00E+00	>10000
U-236	(a)	1.60E+01	0.00E+00	>10000	1.67E+01	0.00E+00	>10000	3.80E+01	0.00E+00	>10000
U-238	(a)	1.99E+02	0.00E+00	>10000	2.07E+02	0.00E+00	>10000	4.72E+02	0.00E+00	>10000

Table G.23. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.27E-02	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.18E+01	1230
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	8.66E+00	680
I-129	1	0.00E+00			0.00E+00			1.68E-02	1.39E-01	1230
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	5.18E-05	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	5.24E+00	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	2.32E-01	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	1.13E-03	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	5.43E+00	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.44E+01	1700	3.44E+00	3.44E+01	1700	2.09E+00	2.09E+01	1700
Grouted Tc-99	900	4.91E+00	3.50E-01	1200	4.92E+00	3.51E-01	1200	5.96E+01	4.25E+00	1200
I-129	1	3.50E-02	3.51E-01	1700	3.51E-02	3.51E-01	1700	1.70E-02	1.70E-01	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.28E+01	0.00E+00	>10000	1.56E+01	0.00E+00	>10000	1.59E+01	0.00E+00	>10000
Tc-99	900	1.08E+00	9.31E+00	1740	1.32E+00	1.14E+01	1740	1.33E+00	1.14E+01	1740
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.01E-03	2.59E-02	1740	3.67E-03	3.16E-02	1740	3.67E-03	3.16E-02	1740
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	3.71E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000
U-234	(a)	6.13E-01	0.00E+00	>10000	7.47E-01	0.00E+00	>10000	9.21E-01	0.00E+00	>10000
U-235	(a)	1.29E-01	0.00E+00	>10000	1.57E-01	0.00E+00	>10000	1.68E-01	0.00E+00	>10000
U-236	(a)	1.46E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000
U-238	(a)	1.47E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000	2.08E+00	0.00E+00	>10000

Table G.23. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area		0.00E+00								
C-14	2000	4.44E-01	0.00E+00	>10000	4.62E-01	0.00E+00	>10000	1.45E+02	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	2.25E+02	1070	3.23E+03	2.25E+02	1070	3.23E+03	2.25E+02	1070
I-129	1	1.96E-06	1.69E-05	1740	2.04E-06	1.76E-05	1740	2.04E-06	1.76E-05	1740
Grouted I-129	1	5.00E+00	1.10E-01	1070	5.00E+00	1.10E-01	1070	5.00E+00	1.10E-01	1070
U-233	(a)	2.98E-01	0.00E+00	>10000	3.10E-01	0.00E+00	>10000	1.80E-01	0.00E+00	>10000
U-234	(a)	3.73E+02	0.00E+00	>10000	3.89E+02	0.00E+00	>10000	3.11E+02	0.00E+00	>10000
U-235	(a)	1.07E+01	0.00E+00	>10000	1.11E+01	0.00E+00	>10000	1.20E+01	0.00E+00	>10000
U-236	(a)	4.82E+01	0.00E+00	>10000	5.02E+01	0.00E+00	>10000	2.89E+01	0.00E+00	>10000
U-238	(a)	5.99E+02	0.00E+00	>10000	6.24E+02	0.00E+00	>10000	5.04E+02	0.00E+00	>10000
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	4.32E+00	0.00E+00	>10000	4.33E+00	0.00E+00	>10000	5.70E+00	0.00E+00	>10000
Tc-99	900	8.34E+00	7.18E+01	1740	8.36E+00	7.19E+01	1740	8.27E+00	7.12E+01	1740
Grouted Tc-99	900	1.57E+02	1.09E+01	1070	1.57E+02	1.09E+01	1070	3.34E+02	2.33E+01	1070
I-129	1	1.04E-01	8.93E-01	1740	1.04E-01	8.95E-01	1740	1.05E-01	9.05E-01	1740
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	0.00E+00	>10000	1.36E-02	0.00E+00	>10000	1.38E-02	4.63E-08	10000
U-234	(a)	1.61E+01	0.00E+00	>10000	1.61E+01	0.00E+00	>10000	3.40E+02	1.14E-03	10000
U-235	(a)	2.56E-01	0.00E+00	>10000	2.57E-01	0.00E+00	>10000	1.46E+01	4.91E-05	10000
U-236	(a)	3.01E-01	0.00E+00	>10000	3.02E-01	0.00E+00	>10000	3.05E-01	1.03E-06	10000
U-238	(a)	4.00E+00	0.00E+00	>10000	4.01E+00	0.00E+00	>10000	3.44E+02	1.15E-03	10000

Table G.23. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum Concen-tration (pCi/L)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum Concen-tration (pCi/L)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum Concen-tration (pCi/L)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	2.71E+00	1070	3.89E+01	2.71E+00	1070	3.89E+01	2.71E+00	1070
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	0.00E+00	>10000	8.49E-01	0.00E+00	>10000	8.49E-01	0.00E+00	>10000
U-234	(a)	4.60E-01	0.00E+00	>10000	4.60E-01	0.00E+00	>10000	4.60E-01	0.00E+00	>10000
U-235	(a)	1.90E-02	0.00E+00	>10000	1.90E-02	0.00E+00	>10000	1.90E-02	0.00E+00	>10000
U-236	(a)	1.70E-02	0.00E+00	>10000	1.70E-02	0.00E+00	>10000	1.70E-02	0.00E+00	>10000
U-238	(a)	4.10E-01	0.00E+00	>10000	4.10E-01	0.00E+00	>10000	4.10E-01	0.00E+00	>10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.24. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a Line of Analysis Along the Columbia River, Alternative Group D_3

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	2.63E-01	2000	3.66E-01	3.21E-01	2000	3.99E-01	3.50E-01	2000
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.30E-03	2000	3.20E-03	2.81E-03	2000	3.20E-03	2.81E-03	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.03E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000
U-234	(a)	1.70E-01	0.00E+00	>10000	2.07E-01	0.00E+00	>10000	9.01E-01	0.00E+00	>10000
U-235	(a)	3.56E-02	0.00E+00	>10000	4.34E-02	0.00E+00	>10000	8.86E-02	0.00E+00	>10000
U-236	(a)	4.03E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000
U-238	(a)	4.06E-01	0.00E+00	>10000	4.95E-01	0.00E+00	>10000	1.66E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710
I-129	1	3.39E-07	2.97E-07	2000	3.53E-07	3.09E-07	2000	3.53E-07	3.09E-07	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.79E-02	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	2.32E-01	0.00E+00	>10000
U-234	(a)	1.24E+02	0.00E+00	>10000	1.29E+02	0.00E+00	>10000	2.94E+02	0.00E+00	>10000
U-235	(a)	3.54E+00	0.00E+00	>10000	3.69E+00	0.00E+00	>10000	8.39E+00	0.00E+00	>10000
U-236	(a)	1.60E+01	0.00E+00	>10000	1.67E+01	0.00E+00	>10000	3.80E+01	0.00E+00	>10000
U-238	(a)	1.99E+02	0.00E+00	>10000	2.07E+02	0.00E+00	>10000	4.72E+02	0.00E+00	>10000

Table G.24. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume: Inventory (Ci)	Hanford Only Volume: Maximum Concen-tration (pCi/L)	Hanford Only Volume: Approx. Peak Arrival Time (yrs)	Lower Bound Volume: Inventory (Ci)	Lower Bound Volume: Maximum Concen-tration (pCi/L)	Lower Bound Volume: Approx. Peak Arrival Time (yrs)	Upper Bound Volume: Inventory (Ci)	Upper Bound Volume: Maximum Concen-tration (pCi/L)	Upper Bound Volume: Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.52E-04	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.99E+00	1400
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	1.06E+00	940
I-129	1	0.00E+00			0.00E+00			1.68E-02	2.34E-02	1400
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	1.61E-06	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	1.63E-01	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	7.21E-03	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	3.52E-05	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	1.69E-01	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.01E+00	2000	3.44E+00	3.02E+00	2000	2.09E+00	1.83E+00	2000
Grouted Tc-99	900	4.91E+00	3.36E-02	1620	4.92E+00	3.37E-02	1620	5.96E+01	4.08E-01	1620
I-129	1	3.50E-02	3.07E-02	2000	3.51E-02	3.08E-02	2000	1.70E-02	1.49E-02	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.28E+01	0.00E+00	>10000	1.56E+01	0.00E+00	>10000	1.59E+01	0.00E+00	>10000
Tc-99	900	1.08E+00	8.26E-01	2010	1.32E+00	1.01E+00	2010	1.33E+00	1.01E+00	2010
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.01E-03	2.30E-03	2010	3.67E-03	2.80E-03	2010	3.67E-03	2.80E-03	2010
Grouted I-129	1	0.00E+00			0.00E+00	0.00E+00		0.00E+00	0.00E+00	
U-233	(a)	3.71E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000
U-234	(a)	6.13E-01	0.00E+00	>10000	7.47E-01	0.00E+00	>10000	9.21E-01	0.00E+00	>10000
U-235	(a)	1.29E-01	0.00E+00	>10000	1.57E-01	0.00E+00	>10000	1.68E-01	0.00E+00	>10000
U-236	(a)	1.46E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000
U-238	(a)	1.47E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000	2.08E+00	0.00E+00	>10000

Table G.24. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume: Inventory (Ci)	Hanford Only Volume: Maximum Concen-tration (pCi/L)	Hanford Only Volume: Approx. Peak Arrival Time (yrs)	Lower Bound Volume: Inventory (Ci)	Lower Bound Volume: Maximum Concen-tration (pCi/L)	Lower Bound Volume: Approx. Peak Arrival Time (yrs)	Upper Bound Volume: Inventory (Ci)	Upper Bound Volume: Maximum Concen-tration (pCi/L)	Upper Bound Volume: Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	4.44E-01	0.00E+00	>10000	4.62E-01	0.00E+00	>10000	1.45E+02	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	1.97E+01	1420	3.23E+03	1.97E+01	1420	3.23E+03	1.97E+01	1420
I-129	1	1.96E-06	1.49E-06	2010	2.04E-06	1.56E-06	2010	2.04E-06	1.56E-06	2010
Grouted I-129	1	5.00E+00	9.65E-03	1420	5.00E+00	9.65E-03	1420	5.00E+00	9.65E-03	1420
U-233	(a)	2.98E-01	0.00E+00	>10000	3.10E-01	0.00E+00	>10000	1.80E-01	0.00E+00	>10000
U-234	(a)	3.73E+02	0.00E+00	>10000	3.89E+02	0.00E+00	>10000	3.11E+02	0.00E+00	>10000
U-235	(a)	1.07E+01	0.00E+00	>10000	1.11E+01	0.00E+00	>10000	1.20E+01	0.00E+00	>10000
U-236	(a)	4.82E+01	0.00E+00	>10000	5.02E+01	0.00E+00	>10000	2.89E+01	0.00E+00	>10000
U-238	(a)	5.99E+02	0.00E+00	>10000	6.24E+02	0.00E+00	>10000	5.04E+02	0.00E+00	>10000
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	4.32E+00	0.00E+00	>10000	4.33E+00	0.00E+00	>10000	5.70E+00	0.00E+00	>10000
Tc-99	900	8.34E+00	6.36E+00	2010	8.36E+00	6.38E+00	2010	8.27E+00	6.31E+00	2010
Grouted Tc-99	900	1.57E+02	9.56E-01	1420	1.57E+02	9.58E-01	1420	3.34E+02	2.04E+00	1420
I-129	1	1.04E-01	7.92E-02	2010	1.04E-01	7.93E-02	2010	1.05E-01	8.02E-02	2010
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	0.00E+00	>10000	1.36E-02	0.00E+00	>10000	1.38E-02	0.00E+00	>10000
U-234	(a)	1.61E+01	0.00E+00	>10000	1.61E+01	0.00E+00	>10000	3.40E+02	0.00E+00	>10000
U-235	(a)	2.56E-01	0.00E+00	>10000	2.57E-01	0.00E+00	>10000	1.46E+01	0.00E+00	>10000
U-236	(a)	3.01E-01	0.00E+00	>10000	3.02E-01	0.00E+00	>10000	3.05E-01	0.00E+00	>10000
U-238	(a)	4.00E+00	0.00E+00	>10000	4.01E+00	0.00E+00	>10000	3.44E+02	0.00E+00	>10000

Table G.24. (contd)

Constituent	Benchnmark Groundwater Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	2.38E-01	1420	3.89E+01	2.38E-01	1420	3.89E+01	3.23E-03	1510
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	0.00E+00	>10000	8.49E-01	0.00E+00	>10000	8.49E-01	0.00E+00	>10000
U-234	(a)	4.60E-01	0.00E+00	>10000	4.60E-01	0.00E+00	>10000	4.60E-01	0.00E+00	>10000
U-235	(a)	1.90E-02	0.00E+00	>10000	1.90E-02	0.00E+00	>10000	1.90E-02	0.00E+00	>10000
U-236	(a)	1.70E-02	0.00E+00	>10000	1.70E-02	0.00E+00	>10000	1.70E-02	0.00E+00	>10000
U-238	(a)	4.10E-01	0.00E+00	>10000	4.10E-01	0.00E+00	>10000	4.10E-01	0.00E+00	>10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.25 Predicted Peak River Flux of Key Constituents by Waste and Category at a Line of Analysis to the Columbia River, Alternative Group D_3

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	3.00E-01	2.85E-03	2180	3.66E-01	3.48E-03	2180	3.99E-01	3.79E-03	2180
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	2.62E-03	2.49E-05	2180	3.20E-03	3.04E-05	2180	3.20E-03	3.04E-05	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.03E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000
U-234	1.70E-01	0.00E+00	>10000	2.07E-01	0.00E+00	>10000	9.01E-01	0.00E+00	>10000
U-235	3.56E-02	0.00E+00	>10000	4.34E-02	0.00E+00	>10000	8.86E-02	0.00E+00	>10000
U-236	4.03E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000
U-238	4.06E-01	0.00E+00	>10000	4.95E-01	0.00E+00	>10000	1.66E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840
I-129	3.39E-07	3.22E-09	2180	3.53E-07	3.35E-09	2180	3.53E-07	3.35E-09	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	9.79E-02	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	2.32E-01	0.00E+00	>10000
U-234	1.24E+02	0.00E+00	>10000	1.29E+02	0.00E+00	>10000	2.94E+02	0.00E+00	>10000
U-235	3.54E+00	0.00E+00	>10000	3.69E+00	0.00E+00	>10000	8.39E+00	0.00E+00	>10000
U-236	1.60E+01	0.00E+00	>10000	1.67E+01	0.00E+00	>10000	3.80E+01	0.00E+00	>10000
U-238	1.99E+02	0.00E+00	>10000	2.07E+02	0.00E+00	>10000	4.72E+02	0.00E+00	>10000

Table G.25. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			1.60E+00	6.81E-07	10000
Tc-99	0.00E+00			0.00E+00			1.43E+00	1.86E-02	1450
Grouted Tc-99	0.00E+00			0.00E+00			1.23E+02	1.01E-02	870
I-129	0.00E+00			0.00E+00			1.68E-02	2.18E-04	1450
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			2.22E-03	0.00E+00	>10000
U-234	0.00E+00			0.00E+00			2.25E+02	0.00E+00	>10000
U-235	0.00E+00			0.00E+00			9.96E+00	0.00E+00	>10000
U-236	0.00E+00			0.00E+00			4.86E-02	0.00E+00	>10000
U-238	0.00E+00			0.00E+00			2.33E+02	0.00E+00	>10000
200 West Area									
C-14	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	3.43E+00	3.26E-02	2180	3.44E+00	3.27E-02	2180	2.09E+00	1.99E-02	2180
Grouted Tc-99	4.91E+00	4.10E-04	1840	4.92E+00	4.10E-04	1840	5.96E+01	4.97E-03	1840
I-129	3.50E-02	3.33E-04	2180	3.51E-02	3.34E-04	2180	1.70E-02	1.62E-04	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	1.28E+01	0.00E+00	>10000	1.56E+01	0.00E+00	>10000	1.59E+01	0.00E+00	>10000
Tc-99	1.08E+00	1.08E-02	2070	1.32E+00	1.31E-02	2070	1.33E+00	1.32E-02	2070
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	3.01E-03	2.99E-05	2070	3.67E-03	3.65E-05	2070	3.67E-03	3.65E-05	2070
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	3.71E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000
U-234	6.13E-01	0.00E+00	>10000	7.47E-01	0.00E+00	>10000	9.21E-01	0.00E+00	>10000
U-235	1.29E-01	0.00E+00	>10000	1.57E-01	0.00E+00	>10000	1.68E-01	0.00E+00	>10000
U-236	1.46E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000
U-238	1.47E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000	2.08E+00	0.00E+00	>10000

Table G.25. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00						0.00E+00		
200 West Area				4.62E-01	0.00E+00	>10000			
C-14	4.44E-01	0.00E+00	>10000	0.00E+00			1.45E+02	0.00E+00	>10000
Tc-99	0.00E+00			3.23E+03	2.67E-01	1510	0.00E+00		
Grouted Tc-99	3.23E+03	2.67E-01	1510	2.04E-06	2.03E-08	2070	3.23E+03	2.67E-01	1510
I-129	1.96E-06	1.95E-08	2070	5.00E+00	1.31E-04	1510	2.04E-06	2.03E-08	2070
Grouted I-129	5.00E+00	1.31E-04	1510	3.10E-01	0.00E+00	>10000	5.00E+00	1.31E-04	1510
U-233	2.98E-01	0.00E+00	>10000	3.89E+02	0.00E+00	>10000	1.80E-01	0.00E+00	>10000
U-234	3.73E+02	0.00E+00	>10000	1.11E+01	0.00E+00	>10000	3.11E+02	0.00E+00	>10000
U-235	1.07E+01	0.00E+00	>10000	5.02E+01	0.00E+00	>10000	1.20E+01	0.00E+00	>10000
U-236	4.82E+01	0.00E+00	>10000	6.24E+02	0.00E+00	>10000	2.89E+01	0.00E+00	>10000
U-238	5.99E+02	0.00E+00	>10000				5.04E+02	0.00E+00	>10000
Projected Mixed LLW After 2008									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	4.32E+00	0.00E+00	>10000	4.33E+00	0.00E+00	>10000	5.70E+00	0.00E+00	>10000
Tc-99	8.34E+00	8.29E-02	2070	8.36E+00	8.30E-02	2070	8.27E+00	8.21E-02	2070
Grouted Tc-99	1.57E+02	1.30E-02	1510	1.57E+02	1.30E-02	1510	3.34E+02	2.77E-02	1510
I-129	1.04E-01	1.03E-03	2070	1.04E-01	1.03E-03	2070	1.05E-01	1.04E-03	2070
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.36E-02	0.00E+00	>10000	1.36E-02	0.00E+00	>10000	1.38E-02	0.00E+00	>10000
U-234	1.61E+01	0.00E+00	>10000	1.61E+01	0.00E+00	>10000	3.40E+02	0.00E+00	>10000
U-235	2.56E-01	0.00E+00	>10000	2.57E-01	0.00E+00	>10000	1.46E+01	0.00E+00	>10000
U-236	3.01E-01	0.00E+00	>10000	3.02E-01	0.00E+00	>10000	3.05E-01	0.00E+00	>10000
U-238	4.00E+00	0.00E+00	>10000	4.01E+00	0.00E+00	>10000	3.44E+02	0.00E+00	>10000

Table G.25. (contd)

Constituent	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum River Flux (Ci/yr)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum River Flux (Ci/yr)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum River Flux (Ci/yr)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Melter Waste									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.89E+01	3.23E-03	1510	3.89E+01	3.23E-03	1510	3.89E+01	3.23E-03	1510
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	8.49E-01	0.00E+00	>10000	8.49E-01	0.00E+00	>10000	8.49E-01	0.00E+00	>10000
U-234	4.60E-01	0.00E+00	>10000	4.60E-01	0.00E+00	>10000	4.60E-01	0.00E+00	>10000
U-235	1.90E-02	0.00E+00	>10000	1.90E-02	0.00E+00	>10000	1.90E-02	0.00E+00	>10000
U-236	1.70E-02	0.00E+00	>10000	1.70E-02	0.00E+00	>10000	1.70E-02	0.00E+00	>10000
U-238	4.10E-01	0.00E+00	>10000	4.10E-01	0.00E+00	>10000	4.10E-01	0.00E+00	>10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.26. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a 1-km Line of Analysis, Alternative Group E_1

Constituent	Benchmark Drinking Water Standard **(pCi/L)**	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	**Maximum Concen-tration (pCi/L)**	**Approx. Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum Concen-tration (pCi/L)**	**Approx. Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum Concen-tration (pCi/L)**	**Approx. Peak Arrival Time (yrs)**
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		
200 West Area		0.00E+00						0.00E+00	0.00E+00	0
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	3.00E+00	1700	3.66E-01	3.66E+00	1700	3.99E-01	3.99E+00	1700
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.63E-02	1700	3.20E-03	3.20E-02	1700	3.20E-03	3.20E-02	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	1.03E-01	8.61E-04	10000	1.25E-01	9.44E-04	10000	1.25E-01	4.65E-04	10000
U-234	30	1.70E-01	1.43E-03	10000	2.07E-01	1.56E-03	10000	9.01E-01	3.35E-03	10000
U-235	30	3.56E-02	2.99E-04	10000	4.34E-02	3.28E-04	10000	8.86E-02	3.30E-04	10000
U-236	30	4.03E-03	3.39E-05	10000	4.92E-03	3.71E-05	10000	4.92E-03	1.83E-05	10000
U-238	30	4.06E-01	3.41E-03	10000	4.95E-01	3.74E-03	10000	1.66E+00	6.18E-03	10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00						0.00E+00		
Grouted I-129	1	0.00E+00						0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230
I-129	1	3.39E-07	3.39E-06	1700	3.53E-07	3.53E-06	1700	3.53E-07	3.53E-06	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	9.79E-02	3.61E-08	10000	1.02E-01	3.61E-08	10000	2.32E-01	3.60E-08	10000
U-234	30	1.24E+02	4.56E-05	10000	1.29E+02	4.56E-05	10000	2.94E+02	4.56E-05	10000
U-235	30	3.54E+00	1.30E-06	10000	3.69E+00	1.30E-06	10000	8.39E+00	1.30E-06	10000
U-236	30	1.60E+01	5.90E-06	10000	1.67E+01	5.90E-06	10000	3.80E+01	5.89E-06	10000
U-238	30	1.99E+02	7.32E-05	10000	2.07E+02	7.32E-05	10000	4.72E+02	7.32E-05	10000

Table G.26. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.27E-02	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.14E-02	10000
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	8.66E+00	680
I-129	1	0.00E+00			0.00E+00			1.68E-02	1.34E-04	10000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			2.22E-03	5.18E-05	10000
U-234	30	0.00E+00			0.00E+00			2.25E+02	5.24E+00	10000
U-235	30	0.00E+00			0.00E+00			9.96E+00	2.32E-01	10000
U-236	30	0.00E+00			0.00E+00			4.86E-02	1.13E-03	10000
U-238	30	0.00E+00			0.00E+00			2.33E+02	5.43E+00	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.44E+01	1700	3.44E+00	3.44E+01	1700	2.09E+00	2.09E+01	1700
Grouted Tc-99	900	4.91E+00	3.50E-01	1200	4.92E+00	3.51E-01	1200	5.96E+01	4.25E+00	1200
I-129	1	3.50E-02	3.51E-01	1700	3.51E-02	3.51E-01	1700	1.70E-02	1.70E-01	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	30	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	30	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	30	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	30	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	1.28E+01	3.09E-02	10000	1.56E+01	3.76E-02	10000	1.59E+01	3.84E-02	10000
Tc-99	900	1.08E+00	5.17E+00	1320	1.32E+00	6.31E+00	1320	1.33E+00	6.36E+00	1320
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.01E-03	1.44E-02	1320	3.67E-03	1.75E-02	1320	3.67E-03	1.75E-02	1320
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	3.71E-01	5.26E-03	10000	4.52E-01	6.22E-03	10000	4.52E-01	8.62E-03	10000
U-234	30	6.13E-01	8.69E-03	10000	7.47E-01	1.03E-02	10000	9.21E-01	1.76E-02	10000
U-235	30	1.29E-01	1.83E-03	10000	1.57E-01	2.16E-03	10000	1.68E-01	3.20E-03	10000
U-236	30	1.46E-02	2.07E-04	10000	1.78E-02	2.45E-04	10000	1.78E-02	3.39E-04	10000
U-238	30	1.47E+00	2.08E-02	10000	1.79E+00	2.46E-02	10000	2.08E+00	3.97E-02	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

Table G.26. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	4.44E-01	1.07E-03	10000	4.62E-01	1.11E-03	10000	1.45E+02	3.50E-01	10000
Tc-99	900	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0
Grouted Tc-99	900	3.23E+03	1.35E+02	630	3.23E+03	1.35E+02	630	3.23E+03	1.35E+02	630
I-129	1	1.96E-06	9.36E-06	1320	2.04E-06	9.75E-06	1320	2.04E-06	9.75E-06	1320
Grouted I-129	1	5.00E+00	6.63E-02	630	5.00E+00	6.63E-02	630	5.00E+00	6.63E-02	630
U-233	30	2.98E-01	4.23E-08	10000	3.10E-01	4.91E-08	10000	1.80E-01	7.32E-08	10000
U-234	30	3.73E+02	5.31E-05	10000	3.89E+02	6.17E-05	10000	3.11E+02	1.27E-04	10000
U-235	30	1.07E+01	1.51E-06	10000	1.11E+01	1.76E-06	10000	1.20E+01	4.88E-06	10000
U-236	30	4.82E+01	6.85E-06	10000	5.02E+01	7.96E-06	10000	2.89E+01	1.18E-05	10000
U-238	30	5.99E+02	8.51E-05	10000	6.24E+02	9.89E-05	10000	5.04E+02	2.05E-04	10000
200 West Area		***0.00E+00***								
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	1.01E-02	10000	4.33E+00	1.01E-02	10000	5.70E+00	1.34E-02	10000
Tc-99	900	8.34E+00	6.79E+01	1370	8.36E+00	6.80E+01	1370	8.27E+00	6.73E+01	1370
Grouted Tc-99	900	1.57E+02	1.10E+01	680	1.57E+02	1.11E+01	680	3.34E+02	2.35E+01	680
I-129	1	1.04E-01	8.44E-01	1370	1.04E-01	8.46E-01	1370	1.05E-01	8.56E-01	1370
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	1.36E-02	4.14E-08	10000	1.36E-02	4.15E-08	10000	1.38E-02	4.20E-08	10000
U-234	30	1.61E+01	4.91E-05	10000	1.61E+01	4.92E-05	10000	3.40E+02	1.04E-03	10000
U-235	30	2.56E-01	7.82E-07	10000	2.57E-01	7.83E-07	10000	1.46E+01	4.46E-05	10000
U-236	30	3.01E-01	9.19E-07	10000	3.02E-01	9.20E-07	10000	3.05E-01	9.31E-07	10000
U-238	30	4.00E+00	1.22E-05	10000	4.01E+00	1.22E-05	10000	3.44E+02	1.05E-03	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

Table G.26. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	2.71E+00	1070	3.89E+01	2.71E+00	1070	3.89E+01	2.71E+00	1070
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	8.49E-01	9.62E-04	10000	8.49E-01	9.62E-04	10000	8.49E-01	9.62E-04	10000
U-234	30	4.60E-01	5.21E-04	10000	4.60E-01	5.21E-04	10000	4.60E-01	5.21E-04	10000
U-235	30	1.90E-02	2.15E-05	10000	1.90E-02	2.15E-05	10000	1.90E-02	2.15E-05	10000
U-236	30	1.70E-02	1.93E-05	10000	1.70E-02	1.93E-05	10000	1.70E-02	1.93E-05	10000
U-238	30	4.10E-01	4.65E-04	10000	4.10E-01	4.65E-04	10000	4.10E-01	4.65E-04	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

Table G.27. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a Line of Analysis Along the Columbia River, Alternative Group E_1

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	2.63E-01	2000	3.66E-01	3.21E-01	2000	3.99E-01	3.50E-01	2000
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.30E-03	2000	3.20E-03	2.81E-03	2000	3.20E-03	2.81E-03	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	1.03E-01	2.59E-07	10000	1.25E-01	2.64E-07	10000	1.25E-01	8.56E-08	10000
U-234	30	1.70E-01	4.29E-07	10000	2.07E-01	4.38E-07	10000	9.01E-01	6.17E-07	10000
U-235	30	3.56E-02	9.00E-08	10000	4.34E-02	9.18E-08	10000	8.86E-02	6.07E-08	10000
U-236	30	4.03E-03	1.02E-08	10000	4.92E-03	1.04E-08	10000	4.92E-03	3.37E-09	10000
U-238	30	4.06E-01	1.03E-06	10000	4.95E-01	1.05E-06	10000	1.66E+00	1.14E-06	10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710
I-129	1	3.39E-07	2.97E-07	2000	3.53E-07	3.09E-07	2000	3.53E-07	3.09E-07	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	9.79E-02	2.57E-12	10000	1.02E-01	2.57E-12	10000	2.32E-01	2.56E-12	10000
U-234	30	1.24E+02	3.25E-09	10000	1.29E+02	3.25E-09	10000	2.94E+02	3.25E-09	10000
U-235	30	3.54E+00	9.30E-11	10000	3.69E+00	9.30E-11	10000	8.39E+00	9.27E-11	10000
U-236	30	1.60E+01	4.21E-10	10000	1.67E+01	4.21E-10	10000	3.80E+01	4.20E-10	10000
U-238	30	1.99E+02	5.22E-09	10000	2.07E+02	5.22E-09	10000	4.72E+02	5.22E-09	10000

Table G.27. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.52E-04	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.99E+00	1400
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	1.06E+00	940
I-129	1	0.00E+00			0.00E+00			1.68E-02	2.34E-02	1400
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			2.22E-03	1.61E-06	10000
U-234	30	0.00E+00			0.00E+00			2.25E+02	1.63E-01	10000
U-235	30	0.00E+00			0.00E+00			9.96E+00	7.21E-03	10000
U-236	30	0.00E+00			0.00E+00			4.86E-02	3.52E-05	10000
U-238	30	0.00E+00			0.00E+00			2.33E+02	1.69E-01	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.01E+00	2000	3.44E+00	3.02E+00	2000	2.09E+00	1.83E+00	2000
Grouted Tc-99	900	4.91E+00	3.36E-02	1620	4.92E+00	3.37E-02	1620	5.96E+01	4.08E-01	1620
I-129	1	3.50E-02	3.07E-02	2000	3.51E-02	3.08E-02	2000	1.70E-02	1.49E-02	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	30	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	30	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	30	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	30	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	1.28E+01	6.49E-04	10000	1.56E+01	7.92E-04	10000	1.59E+01	8.07E-04	10000
Tc-99	900	1.08E+00	1.39E+00	1530	1.32E+00	1.70E+00	1530	1.33E+00	1.71E+00	1530
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.01E-03	3.87E-03	1530	3.67E-03	4.71E-03	1530	3.67E-03	4.71E-03	1530
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	3.71E-01	9.60E-05	10000	4.52E-01	1.12E-04	10000	4.52E-01	1.85E-04	10000
U-234	30	6.13E-01	1.59E-04	10000	7.47E-01	1.85E-04	10000	9.21E-01	3.77E-04	10000
U-235	30	1.29E-01	3.33E-05	10000	1.57E-01	3.88E-05	10000	1.68E-01	6.88E-05	10000
U-236	30	1.46E-02	3.78E-06	10000	1.78E-02	4.40E-06	10000	1.78E-02	7.29E-06	10000
U-238	30	1.47E+00	3.80E-04	10000	1.79E+00	4.43E-04	10000	2.08E+00	8.51E-04	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

Table G.27. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume: Inventory (Ci)	Hanford Only Volume: Maximum Concen-tration (pCi/L)	Hanford Only Volume: Approx. Peak Arrival Time (yrs)	Lower Bound Volume: Inventory (Ci)	Lower Bound Volume: Maximum Concen-tration (pCi/L)	Lower Bound Volume: Approx. Peak Arrival Time (yrs)	Upper Bound Volume: Inventory (Ci)	Upper Bound Volume: Maximum Concen-tration (pCi/L)	Upper Bound Volume: Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	4.44E-01	2.25E-05	10000	4.62E-01	2.34E-05	10000	1.45E+02	7.36E-03	10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	3.18E+01	860	3.23E+03	3.18E+01	860	3.23E+03	3.18E+01	860
I-129	1	1.96E-06	2.52E-06	1530	2.04E-06	2.62E-06	1530	2.04E-06	2.62E-06	1530
Grouted I-129	1	5.00E+00	1.56E-02	850	5.00E+00	1.56E-02	850	5.00E+00	1.56E-02	850
U-233	30	2.98E-01	6.92E-10	10000	3.10E-01	8.04E-10	10000	1.80E-01	1.20E-09	10000
U-234	30	3.73E+02	8.68E-07	10000	3.89E+02	1.01E-06	10000	3.11E+02	2.07E-06	10000
U-235	30	1.07E+01	2.48E-08	10000	1.11E+01	2.88E-08	10000	1.20E+01	7.98E-08	10000
U-236	30	4.82E+01	1.12E-07	10000	5.02E+01	1.30E-07	10000	2.89E+01	1.92E-07	10000
U-238	30	5.99E+02	1.39E-06	10000	6.24E+02	1.62E-06	10000	5.04E+02	3.35E-06	10000
200 West Area		0.00E+00								
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	6.36E-05	10000	4.33E+00	6.38E-05	10000	5.70E+00	8.39E-05	10000
Tc-99	900	8.34E+00	9.43E+00	1590	8.36E+00	9.44E+00	1590	8.27E+00	9.34E+00	1590
Grouted Tc-99	900	1.57E+02	1.35E+00	940	1.57E+02	1.36E+00	940	3.34E+02	2.89E+00	940
I-129	1	1.04E-01	1.17E-01	1590	1.04E-01	1.17E-01	1590	1.05E-01	1.19E-01	1590
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	1.36E-02	2.13E-10	10000	1.36E-02	2.14E-10	10000	1.38E-02	2.17E-10	10000
U-234	30	1.61E+01	2.53E-07	10000	1.61E+01	2.54E-07	10000	3.40E+02	5.34E-06	10000
U-235	30	2.56E-01	4.03E-09	10000	2.57E-01	4.04E-09	10000	1.46E+01	2.30E-07	10000
U-236	30	3.01E-01	4.74E-09	10000	3.02E-01	4.74E-09	10000	3.05E-01	4.80E-09	10000
U-238	30	4.00E+00	6.29E-08	10000	4.01E+00	6.30E-08	10000	3.44E+02	5.40E-06	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

Table G.27. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum Concen-tration (pCi/L)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum Concen-tration (pCi/L)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum Concen-tration (pCi/L)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	2.38E-01	1420	3.89E+01	2.38E-01	1420	3.89E+01	2.38E-01	1420
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	8.49E-01	7.61E-07	10000	8.49E-01	7.61E-07	10000	8.49E-01	7.61E-07	10000
U-234	30	4.60E-01	4.12E-07	10000	4.60E-01	4.12E-07	10000	4.60E-01	4.12E-07	10000
U-235	30	1.90E-02	1.70E-08	10000	1.90E-02	1.70E-08	10000	1.90E-02	1.70E-08	10000
U-236	30	1.70E-02	1.52E-08	10000	1.70E-02	1.52E-08	10000	1.70E-02	1.52E-08	10000
U-238	30	4.10E-01	3.67E-07	10000	4.10E-01	3.67E-07	10000	4.10E-01	3.67E-07	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

Table G.28. Predicted Peak River Flux of Key Constituents by Waste and Category at a Line of Analysis to the Columbia River, Alternative Group E_1

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area	0.00E+00								
C-14	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	3.00E-01	2.85E-03	2180	3.66E-01	3.48E-03	2180	3.99E-01	3.79E-03	2180
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	2.62E-03	2.49E-05	2180	3.20E-03	3.04E-05	2180	3.20E-03	3.04E-05	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.03E-01	2.00E-09	10000	1.25E-01	2.05E-09	10000	1.25E-01	6.72E-10	10000
U-234	1.70E-01	3.32E-09	10000	2.07E-01	3.40E-09	10000	9.01E-01	4.84E-09	10000
U-235	3.56E-02	6.96E-10	10000	4.34E-02	7.12E-10	10000	8.86E-02	4.76E-10	10000
U-236	4.03E-03	7.89E-11	10000	4.92E-03	8.07E-11	10000	4.92E-03	2.64E-11	10000
U-238	4.06E-01	7.93E-09	10000	4.95E-01	8.12E-09	10000	1.66E+00	8.92E-09	10000
1996-2007 Cat 3 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840
I-129	3.39E-07	3.22E-09	2180	3.53E-07	3.35E-09	2180	3.53E-07	3.35E-09	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	9.79E-02	2.03E-14	10000	1.02E-01	2.03E-14	10000	2.32E-01	2.03E-14	10000
U-234	1.24E+02	2.57E-11	10000	1.29E+02	2.57E-11	10000	2.94E+02	2.57E-11	10000
U-235	3.54E+00	7.36E-13	10000	3.69E+00	7.36E-13	10000	8.39E+00	7.34E-13	10000
U-236	1.60E+01	3.33E-12	10000	1.67E+01	3.33E-12	10000	3.80E+01	3.32E-12	10000
U-238	1.99E+02	4.13E-11	10000	2.07E+02	4.13E-11	10000	4.72E+02	4.13E-11	10000

Table G.28. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			1.60E+00	6.81E-07	10000
Tc-99	0.00E+00			0.00E+00			1.43E+00	1.86E-02	1450
Grouted Tc-99	0.00E+00			0.00E+00			1.23E+02	1.14E-02	970
I-129	0.00E+00			0.00E+00			1.68E-02	2.18E-04	1450
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			2.22E-03	1.05E-08	10000
U-234	0.00E+00			0.00E+00			2.25E+02	1.06E-03	10000
U-235	0.00E+00			0.00E+00			9.96E+00	4.71E-05	10000
U-236	0.00E+00			0.00E+00			4.86E-02	2.30E-07	10000
U-238	0.00E+00			0.00E+00			2.33E+02	1.10E-03	10000
200 West Area									
C-14	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	3.43E+00	3.26E-02	2180	3.44E+00	3.27E-02	2180	2.09E+00	1.99E-02	2180
Grouted Tc-99	4.91E+00	4.10E-04	1840	4.92E+00	4.10E-04	1840	5.96E+01	4.97E-03	1840
I-129	3.50E-02	3.33E-04	2180	3.51E-02	3.34E-04	2180	1.70E-02	1.62E-04	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008									
200 East Area									
C-14	1.28E+01	1.86E-06	10000	1.56E+01	2.27E-06	10000	1.59E+01	2.31E-06	10000
Tc-99	1.08E+00	1.27E-02	1600	1.32E+00	1.55E-02	1600	1.33E+00	1.56E-02	1600
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	3.01E-03	3.53E-05	1600	3.67E-03	4.30E-05	1600	3.67E-03	4.30E-05	1600
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	3.71E-01	2.74E-07	10000	4.52E-01	3.18E-07	10000	4.52E-01	5.46E-07	10000
U-234	6.13E-01	4.53E-07	10000	7.47E-01	5.26E-07	10000	9.21E-01	1.11E-06	10000
U-235	1.29E-01	9.51E-08	10000	1.57E-01	1.11E-07	10000	1.68E-01	2.03E-07	10000
U-236	1.46E-02	1.08E-08	10000	1.78E-02	1.25E-08	10000	1.78E-02	2.15E-08	10000
U-238	1.47E+00	1.08E-06	10000	1.79E+00	1.26E-06	10000	2.08E+00	2.51E-06	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.28. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008									
200 East Area									
C-14	4.44E-01	6.44E-08	10000	4.62E-01	6.71E-08	10000	1.45E+02	2.11E-05	10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.23E+03	2.99E-01	970	3.23E+03	2.99E-01	970	3.23E+03	2.99E-01	970
I-129	1.96E-06	2.29E-08	1600	2.04E-06	2.39E-08	1600	2.04E-06	2.39E-08	1600
Grouted I-129	5.00E+00	1.46E-04	970	5.00E+00	1.46E-04	970	5.00E+00	1.46E-04	970
U-233	2.98E-01	1.96E-12	10000	3.10E-01	2.28E-12	10000	1.80E-01	3.40E-12	10000
U-234	3.73E+02	2.46E-09	10000	3.89E+02	2.86E-09	10000	3.11E+02	5.87E-09	10000
U-235	1.07E+01	7.02E-11	10000	1.11E+01	8.16E-11	10000	1.20E+01	2.26E-10	10000
U-236	4.82E+01	3.18E-10	10000	5.02E+01	3.69E-10	10000	2.89E+01	5.45E-10	10000
U-238	5.99E+02	3.95E-09	10000	6.24E+02	4.59E-09	10000	5.04E+02	9.51E-09	10000
200 West Area	0.00E+00								
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
Projected Mixed LLW After 2008									
200 East Area									
C-14	4.32E+00	3.71E-07	10000	4.33E+00	3.72E-07	10000	5.70E+00	4.90E-07	10000
Tc-99	8.34E+00	9.43E-02	1630	8.36E+00	9.45E-02	1630	8.27E+00	9.35E-02	1630
Grouted Tc-99	1.57E+02	1.28E-02	12.46426505	1.57E+02	1.45E-02	970	3.34E+02	3.09E-02	970
I-129	1.04E-01	1.17E-03	1630	1.04E-01	1.18E-03	1630	1.05E-01	1.19E-03	1630
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.36E-02	2.19E-12	10000	1.36E-02	2.19E-12	10000	1.38E-02	2.22E-12	10000
U-234	1.61E+01	2.60E-09	10000	1.61E+01	2.60E-09	10000	3.40E+02	5.49E-08	10000
U-235	2.56E-01	4.14E-11	10000	2.57E-01	4.15E-11	10000	1.46E+01	2.36E-09	10000
U-236	3.01E-01	4.86E-11	10000	3.02E-01	4.87E-11	10000	3.05E-01	4.93E-11	10000
U-238	4.00E+00	6.46E-10	10000	4.01E+00	6.47E-10	10000	3.44E+02	5.55E-08	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.28. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste After 2008									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.89E+01	3.23E-03	1510	3.89E+01	3.23E-03	1510	3.89E+01	3.23E-03	1510
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	8.49E-01	4.92E-09	10000	8.49E-01	4.92E-09	10000	8.49E-01	4.92E-09	10000
U-234	4.60E-01	2.67E-09	10000	4.60E-01	2.67E-09	10000	4.60E-01	2.67E-09	10000
U-235	1.90E-02	1.10E-10	10000	1.90E-02	1.10E-10	10000	1.90E-02	1.10E-10	10000
U-236	1.70E-02	9.86E-11	10000	1.70E-02	9.86E-11	10000	1.70E-02	9.86E-11	10000
U-238	4.10E-01	2.38E-09	10000	4.10E-01	2.38E-09	10000	4.10E-01	2.38E-09	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.29. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a 1-km Line of Analysis, Alternative Group E_2

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		
200 West Area		0.00E+00								
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	3.00E+00	1700	3.66E-01	3.66E+00	1700	3.99E-01	3.99E+00	1700
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.63E-02	1700	3.20E-03	3.20E-02	1700	3.20E-03	3.20E-02	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	1.03E-01	8.61E-04	10000	1.25E-01	9.44E-04	10000	1.25E-01	4.65E-04	10000
U-234	30	1.70E-01	1.43E-03	10000	2.07E-01	1.56E-03	10000	9.01E-01	3.35E-03	10000
U-235	30	3.56E-02	2.99E-04	10000	4.34E-02	3.28E-04	10000	8.86E-02	3.30E-04	10000
U-236	30	4.03E-03	3.39E-05	10000	4.92E-03	3.71E-05	10000	4.92E-03	1.83E-05	10000
U-238	30	4.06E-01	3.41E-03	10000	4.95E-01	3.74E-03	10000	1.66E+00	6.18E-03	10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	6.64E+00	1230	7.20E+01	3.46E+00	680	7.20E+01	6.64E+00	1230
I-129	1	3.39E-07	3.39E-06	1700	3.53E-07	3.53E-06	1700	3.53E-07	3.53E-06	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	9.79E-02	3.61E-08	10000	1.02E-01	3.61E-08	10000	2.32E-01	3.60E-08	10000
U-234	30	1.24E+02	4.56E-05	10000	1.29E+02	4.56E-05	10000	2.94E+02	4.56E-05	10000
U-235	30	3.54E+00	1.30E-06	10000	3.69E+00	1.30E-06	10000	8.39E+00	1.30E-06	10000
U-236	30	1.60E+01	5.90E-06	10000	1.67E+01	5.90E-06	10000	3.80E+01	5.89E-06	10000
U-238	30	1.99E+02	7.32E-05	10000	2.07E+02	7.32E-05	10000	4.72E+02	7.32E-05	10000

Table G.29. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.27E-02	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.18E+01	1230
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	8.66E+00	680
I-129	1	0.00E+00			0.00E+00			1.68E-02	1.39E-01	1230
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			2.22E-03	5.18E-05	10000
U-234	30	0.00E+00			0.00E+00			2.25E+02	5.24E+00	10000
U-235	30	0.00E+00			0.00E+00			9.96E+00	2.32E-01	10000
U-236	30	0.00E+00			0.00E+00			4.86E-02	1.13E-03	10000
U-238	30	0.00E+00			0.00E+00			2.33E+02	5.43E+00	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.44E+01	1700	3.44E+00	3.44E+01	1700	2.09E+00	2.09E+01	1700
Grouted Tc-99	900	4.91E+00	3.50E-01	1200	4.92E+00	3.51E-01	1200	5.96E+01	4.25E+00	1200
I-129	1	3.50E-02	3.51E-01	1700	3.51E-02	3.51E-01	1700	1.70E-02	1.70E-01	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	30	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	30	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	30	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	30	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	1.28E+01	2.01E-02	10000	1.56E+01	2.45E-02	10000	1.59E+01	2.50E-02	10000
Tc-99	900	1.08E+00	6.39E+00	1380	1.32E+00	7.80E+00	1380	1.33E+00	7.86E+00	1380
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.01E-03	1.78E-02	1380	3.67E-03	2.17E-02	1380	3.67E-03	2.17E-02	1380
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	3.71E-01	3.29E-03	10000	4.52E-01	3.88E-03	10000	4.52E-01	5.61E-03	10000
U-234	30	6.13E-01	5.44E-03	10000	7.47E-01	6.41E-03	10000	9.21E-01	1.14E-02	10000
U-235	30	1.29E-01	1.14E-03	10000	1.57E-01	1.35E-03	10000	1.68E-01	2.08E-03	10000
U-236	30	1.46E-02	1.30E-04	10000	1.78E-02	1.53E-04	10000	1.78E-02	2.21E-04	10000
U-238	30	1.47E+00	1.30E-02	10000	1.79E+00	1.54E-02	10000	2.08E+00	2.58E-02	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

Table G.29. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum Concen-tration (pCi/L)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum Concen-tration (pCi/L)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum Concen-tration (pCi/L)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	4.44E-01	6.97E-04	10000	4.62E-01	7.26E-04	10000	1.45E+02	2.28E-01	10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	1.55E+02	680	3.23E+03	1.55E+02	680	3.23E+03	1.55E+02	680
I-129	1	1.96E-06	1.16E-05	1380	2.04E-06	1.21E-05	1380	2.04E-06	1.21E-05	1380
Grouted I-129	1	5.00E+00	7.61E-02	680	5.00E+00	7.61E-02	680	5.00E+00	7.61E-02	680
U-233	30	2.98E-01	2.56E-08	10000	3.10E-01	2.97E-08	10000	1.80E-01	4.43E-08	10000
U-234	30	3.73E+02	3.21E-05	10000	3.89E+02	3.73E-05	10000	3.11E+02	7.65E-05	10000
U-235	30	1.07E+01	9.16E-07	10000	1.11E+01	1.06E-06	10000	1.20E+01	2.95E-06	10000
U-236	30	4.82E+01	4.14E-06	10000	5.02E+01	4.81E-06	10000	2.89E+01	7.11E-06	10000
U-238	30	5.99E+02	5.15E-05	10000	6.24E+02	5.98E-05	10000	5.04E+02	1.24E-04	10000
200 West Area		0.00E+00								
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	6.79E-03	10000	4.33E+00	6.81E-03	10000	5.70E+00	8.96E-03	10000
Tc-99	900	8.34E+00	4.93E+01	1380	8.36E+00	4.94E+01	1380	8.27E+00	4.89E+01	1380
Grouted Tc-99	900	1.57E+02	7.54E+00	680	1.57E+02	7.55E+00	680	3.34E+02	1.61E+01	680
I-129	1	1.04E-01	6.13E-01	1380	1.04E-01	6.14E-01	1380	1.05E-01	6.21E-01	1380
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	1.36E-02	2.85E-08	10000	1.36E-02	2.86E-08	10000	1.38E-02	2.90E-08	10000
U-234	30	1.61E+01	3.39E-05	10000	1.61E+01	3.39E-05	10000	3.40E+02	7.15E-04	10000
U-235	30	2.56E-01	5.39E-07	10000	2.57E-01	5.41E-07	10000	1.46E+01	3.08E-05	10000
U-236	30	3.01E-01	6.34E-07	10000	3.02E-01	6.35E-07	10000	3.05E-01	6.42E-07	10000
U-238	30	4.00E+00	8.42E-06	10000	4.01E+00	8.43E-06	10000	3.44E+02	7.24E-04	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

Table G.29. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum Concen-tration (pCi/L)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum Concen-tration (pCi/L)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum Concen-tration (pCi/L)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	2.71E+00	1070	3.89E+01	2.71E+00	1070	3.89E+01	2.71E+00	1070
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	8.49E-01	9.62E-04	10000	8.49E-01	9.62E-04	10000	8.49E-01	9.62E-04	10000
U-234	30	4.60E-01	5.21E-04	10000	4.60E-01	5.21E-04	10000	4.60E-01	5.21E-04	10000
U-235	30	1.90E-02	2.15E-05	10000	1.90E-02	2.15E-05	10000	1.90E-02	2.15E-05	10000
U-236	30	1.70E-02	1.93E-05	10000	1.70E-02	1.93E-05	10000	1.70E-02	1.93E-05	10000
U-238	30	4.10E-01	4.65E-04	10000	4.10E-01	4.65E-04	10000	4.10E-01	4.65E-04	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

Table G.30. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a Line of Analysis Along the Columbia River, Alternative Group E_2

Constituent	Bendmark Drinking Water Standard (pCi/L)	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum Concentra-tion (pCi/L)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum Concentra-tion (pCi/L)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum Concentra-tion (pCi/L)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		
200 West Area		0.00E+00								
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	2.63E-01	2000	3.66E-01	3.21E-01	2000	3.99E-01	3.50E-01	2000
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.30E-03	2000	3.20E-03	2.81E-03	2000	3.20E-03	2.81E-03	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	1.03E-01	2.59E-07	10000	1.25E-01	2.64E-07	10000	1.25E-01	8.56E-08	10000
U-234	30	1.70E-01	4.29E-07	10000	2.07E-01	4.38E-07	10000	9.01E-01	6.17E-07	10000
U-235	30	3.56E-02	9.00E-08	10000	4.34E-02	9.18E-08	10000	8.86E-02	6.07E-08	10000
U-236	30	4.03E-03	1.02E-08	10000	4.92E-03	1.04E-08	10000	4.92E-03	3.37E-09	10000
U-238	30	4.06E-01	1.03E-06	10000	4.95E-01	1.05E-06	10000	1.66E+00	1.14E-06	10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710
I-129	1	3.39E-07	2.97E-07	2000	3.53E-07	3.09E-07	2000	3.53E-07	3.09E-07	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	9.79E-02	2.57E-12	10000	1.02E-01	2.57E-12	10000	2.32E-01	2.56E-12	10000
U-234	30	1.24E+02	3.25E-09	10000	1.29E+02	3.25E-09	10000	2.94E+02	3.25E-09	10000
U-235	30	3.54E+00	9.30E-11	10000	3.69E+00	9.30E-11	10000	8.39E+00	9.27E-11	10000
U-236	30	1.60E+01	4.21E-10	10000	1.67E+01	4.21E-10	10000	3.80E+01	4.20E-10	10000
U-238	30	1.99E+02	5.22E-09	10000	2.07E+02	5.22E-09	10000	4.72E+02	5.22E-09	10000

Table G.30. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.52E-04	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.99E+00	1400
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	1.06E+00	940
I-129	1	0.00E+00			0.00E+00			1.68E-02	2.34E-02	1400
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			2.22E-03	1.61E-06	10000
U-234	30	0.00E+00			0.00E+00			2.25E+02	1.63E-01	10000
U-235	30	0.00E+00			0.00E+00			9.96E+00	7.21E-03	10000
U-236	30	0.00E+00			0.00E+00			4.86E-02	3.52E-05	10000
U-238	30	0.00E+00			0.00E+00			2.33E+02	1.69E-01	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.01E+00	2000	3.44E+00	3.02E+00	2000	2.09E+00	1.83E+00	2000
Grouted Tc-99	900	4.91E+00	3.36E-02	1620	4.92E+00	3.37E-02	1620	5.96E+01	4.08E-01	1620
I-129	1	3.50E-02	3.07E-02	2000	3.51E-02	3.08E-02	2000	1.70E-02	1.49E-02	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	30	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	30	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	30	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	30	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	1.28E+01	2.96E-04	10000	1.56E+01	3.61E-04	10000	1.59E+01	3.68E-04	10000
Tc-99	900	1.08E+00	7.36E-01	1510	1.32E+00	8.97E-01	1510	1.33E+00	9.04E-01	1510
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.01E-03	2.05E-03	1510	3.67E-03	2.50E-03	1510	3.67E-03	2.50E-03	1510
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	3.71E-01	3.29E-03	10000	4.52E-01	3.88E-03	10000	4.52E-01	5.61E-03	10000
U-234	30	6.13E-01	5.44E-03	10000	7.47E-01	6.41E-03	10000	9.21E-01	1.14E-02	10000
U-235	30	1.29E-01	1.14E-03	10000	1.57E-01	1.35E-03	10000	1.68E-01	2.08E-03	10000
U-236	30	1.46E-02	1.30E-04	10000	1.78E-02	1.53E-04	10000	1.78E-02	2.21E-04	10000
U-238	30	1.47E+00	1.30E-02	10000	1.79E+00	1.54E-02	10000	2.08E+00	2.58E-02	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

Table G.30. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	4.44E-01	1.03E-05	10000	4.62E-01	1.07E-05	10000	1.45E+02	3.35E-03	10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	1.69E+01	820	3.23E+03	1.69E+01	820	3.23E+03	1.69E+01	820
I-129	1	1.96E-06	1.33E-06	1510	2.04E-06	1.39E-06	1510	2.04E-06	1.39E-06	1510
Grouted I-129	1	5.00E+00	0.00E+00	820	5.00E+00	8.26E-03	820	5.00E+00	0.00E+00	820
U-233	30	2.98E-01	2.56E-08	10000	3.10E-01	2.97E-08	10000	1.80E-01	4.43E-08	10000
U-234	30	3.73E+02	3.21E-05	10000	3.89E+02	3.73E-05	10000	3.11E+02	7.65E-05	10000
U-235	30	1.07E+01	9.16E-07	10000	1.11E+01	1.06E-06	10000	1.20E+01	2.95E-06	10000
U-236	30	4.82E+01	4.14E-06	10000	5.02E+01	4.81E-06	10000	2.89E+01	7.11E-06	10000
U-238	30	5.99E+02	5.15E-05	10000	6.24E+02	5.98E-05	10000	5.04E+02	1.24E-04	10000
200 West Area		0.00E+00								
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	4.32E+00	9.99E-05	10000	4.33E+00	1.00E-04	10000	5.70E+00	1.32E-04	10000
Tc-99	900	8.34E+00	5.67E+00	1510	8.36E+00	5.68E+00	1510	8.27E+00	5.62E+00	1510
Grouted Tc-99	900	1.57E+02	8.19E-01	820	1.57E+02	8.21E-01	820	3.34E+02	1.75E+00	820
I-129	1	1.04E-01	7.06E-02	1510	1.04E-01	7.07E-02	1510	1.05E-01	7.15E-02	1510
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	1.36E-02	2.85E-08	10000	1.36E-02	3.55E-10	10000	1.38E-02	2.90E-08	10000
U-234	30	1.61E+01	3.39E-05	10000	1.61E+01	4.21E-07	10000	3.40E+02	7.15E-04	10000
U-235	30	2.56E-01	5.39E-07	10000	2.57E-01	6.70E-09	10000	1.46E+01	3.08E-05	10000
U-236	30	3.01E-01	6.34E-07	10000	3.02E-01	7.88E-09	10000	3.05E-01	6.42E-07	10000
U-238	30	4.00E+00	8.42E-06	10000	4.01E+00	1.05E-07	10000	3.44E+02	7.24E-04	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

Table G.30. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	2.38E-01	1420	3.89E+01	2.38E-01	1420	3.89E+01	2.38E-01	1420
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	8.49E-01	0.00E+00	>10000	8.49E-01	0.00E+00	>10000	8.49E-01	0.00E+00	>10000
U-234	30	4.60E-01	0.00E+00	>10000	4.60E-01	0.00E+00	>10000	4.60E-01	0.00E+00	>10000
U-235	30	1.90E-02	0.00E+00	>10000	1.90E-02	0.00E+00	>10000	1.90E-02	0.00E+00	>10000
U-236	30	1.70E-02	0.00E+00	>10000	1.70E-02	0.00E+00	>10000	1.70E-02	0.00E+00	>10000
U-238	30	4.10E-01	0.00E+00	>10000	4.10E-01	0.00E+00	>10000	4.10E-01	0.00E+00	>10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	30	0.00E+00			0.00E+00			0.00E+00		
U-234	30	0.00E+00			0.00E+00			0.00E+00		
U-235	30	0.00E+00			0.00E+00			0.00E+00		
U-236	30	0.00E+00			0.00E+00			0.00E+00		
U-238	30	0.00E+00			0.00E+00			0.00E+00		

Table G.31. Predicted Peak River Flux of Key Constituents by Waste and Category at a Line of Analysis to the Columbia River, Alternative Group E_2

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	3.00E-01	2.85E-03	2180	3.66E-01	3.48E-03	2180	3.99E-01	3.79E-03	2180
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	2.62E-03	2.49E-05	2180	3.20E-03	3.04E-05	2180	3.20E-03	3.04E-05	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.03E-01	2.00E-09	10000	1.25E-01	2.05E-09	10000	1.25E-01	6.72E-10	10000
U-234	1.70E-01	3.32E-09	10000	2.07E-01	3.40E-09	10000	9.01E-01	4.84E-09	10000
U-235	3.56E-02	6.96E-10	10000	4.34E-02	7.12E-10	10000	8.86E-02	4.76E-10	10000
U-236	4.03E-03	7.89E-11	10000	4.92E-03	8.07E-11	10000	4.92E-03	2.64E-11	10000
U-238	4.06E-01	7.93E-09	10000	4.95E-01	8.12E-09	10000	1.66E+00	8.92E-09	10000
1996-2007 Cat 3 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840
I-129	3.39E-07	3.22E-09	2180	3.53E-07	3.35E-09	2180	3.53E-07	3.35E-09	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	9.79E-02	2.03E-14	10000	1.02E-01	2.03E-14	10000	2.32E-01	2.03E-14	10000
U-234	1.24E+02	2.57E-11	10000	1.29E+02	2.57E-11	10000	2.94E+02	2.57E-11	10000
U-235	3.54E+00	7.36E-13	10000	3.69E+00	7.36E-13	10000	8.39E+00	7.34E-13	10000
U-236	1.60E+01	3.33E-12	10000	1.67E+01	3.33E-12	10000	3.80E+01	3.32E-12	10000
U-238	1.99E+02	4.13E-11	10000	2.07E+02	4.13E-11	10000	4.72E+02	4.13E-11	10000

Table G.31. (contd)

	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
Constituent	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			1.60E+00	6.81E-07	10000
Tc-99	0.00E+00			0.00E+00			1.43E+00	1.86E-02	1450
Grouted Tc-99	0.00E+00			0.00E+00			1.23E+02	1.14E-02	970
I-129	0.00E+00			0.00E+00			1.68E-02	2.18E-04	1450
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			2.22E-03	1.61E-06	10000
U-234	0.00E+00			0.00E+00			2.25E+02	1.63E-01	10000
U-235	0.00E+00			0.00E+00			9.96E+00	7.21E-03	10000
U-236	0.00E+00			0.00E+00			4.86E-02	3.52E-05	10000
U-238	0.00E+00			0.00E+00			2.33E+02	1.69E-01	10000
200 West Area									
C-14	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	3.43E+00	3.26E-02	2180	3.44E+00	3.27E-02	2180	2.09E+00	1.99E-02	2180
Grouted Tc-99	4.91E+00	4.10E-04	1840	4.92E+00	4.10E-04	1840	5.96E+01	4.97E-03	1840
I-129	3.50E-02	3.33E-04	2180	3.51E-02	3.34E-04	2180	1.70E-02	1.62E-04	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008									
200 East Area									
C-14	1.28E+01	3.60E-06	10000	1.56E+01	4.39E-06	10000	1.59E+01	4.48E-06	10000
Tc-99	1.08E+00	1.15E-02	1530	1.32E+00	1.40E-02	1530	1.33E+00	1.41E-02	1530
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	3.01E-03	3.19E-05	1530	3.67E-03	3.89E-05	1530	3.67E-03	3.89E-05	1530
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	3.71E-01	3.29E-03	10000	4.52E-01	3.88E-03	10000	4.52E-01	5.61E-03	10000
U-234	6.13E-01	5.44E-03	10000	7.47E-01	6.41E-03	10000	9.21E-01	1.14E-02	10000
U-235	1.29E-01	1.14E-03	10000	1.57E-01	1.35E-03	10000	1.68E-01	2.08E-03	10000
U-236	1.46E-02	1.30E-04	10000	1.78E-02	1.53E-04	10000	1.78E-02	2.21E-04	10000
U-238	1.47E+00	1.30E-02	10000	1.79E+00	1.54E-02	10000	2.08E+00	2.58E-02	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.31. (contd)

Constituent	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum River Flux (Ci/yr)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum River Flux (Ci/yr)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum River Flux (Ci/yr)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008									
200 East Area									
C-14	4.44E-01	1.25E-07	10000	4.62E-01	1.30E-07	10000	1.45E+02	4.08E-05	10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.23E+03	2.65E-01	870	3.23E+03	2.65E-01	870	3.23E+03	2.65E-01	870
I-129	1.96E-06	2.07E-08	1530	2.04E-06	2.16E-08	1530	2.04E-06	2.16E-08	1530
Grouted I-129	5.00E+00	0.00E+00	870	5.00E+00	1.30E-04	870	5.00E+00	0.00E+00	870
U-233	2.98E-01	2.56E-08	10000	3.10E-01	2.97E-08	10000	1.80E-01	4.43E-08	10000
U-234	3.73E+02	3.21E-05	10000	3.89E+02	3.73E-05	10000	3.11E+02	7.65E-05	10000
U-235	1.07E+01	9.16E-07	10000	1.11E+01	1.06E-06	10000	1.20E+01	2.95E-06	10000
U-236	4.82E+01	4.14E-06	10000	5.02E+01	4.81E-06	10000	2.89E+01	7.11E-06	10000
U-238	5.99E+02	5.15E-05	10000	6.24E+02	5.98E-05	10000	5.04E+02	1.24E-04	10000
200 West Area	0.00E+00								
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00	0.00E+00	0	0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
Projected Mixed LLW After 2008									
200 East Area									
C-14	4.32E+00	1.22E-06	10000	4.33E+00	1.22E-06	10000	5.70E+00	1.61E-06	10000
Tc-99	8.34E+00	8.84E-02	1530	8.36E+00	8.85E-02	1530	8.27E+00	8.76E-02	1530
Grouted Tc-99	1.57E+02	1.28E-02	870	1.57E+02	1.29E-02	870	3.34E+02	2.74E-02	870
I-129	1.04E-01	1.10E-03	1530	1.04E-01	1.10E-03	1530	1.05E-01	1.11E-03	1530
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.36E-02	2.85E-08	10000	1.36E-02	4.30E-12	10000	1.38E-02	2.90E-08	10000
U-234	1.61E+01	3.39E-05	10000	1.61E+01	5.11E-09	10000	3.40E+02	7.15E-04	10000
U-235	2.56E-01	5.39E-07	10000	2.57E-01	8.13E-11	10000	1.46E+01	3.08E-05	10000
U-236	3.01E-01	6.34E-07	10000	3.02E-01	9.56E-11	10000	3.05E-01	6.42E-07	10000
U-238	4.00E+00	8.42E-06	10000	4.01E+00	1.27E-09	10000	3.44E+02	7.24E-04	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.31. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.89E+01	3.23E-03	1510	3.89E+01	3.23E-03	1510	3.89E+01	3.23E-03	1510
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	8.49E-01	0.00E+00	>10000	8.49E-01	0.00E+00	>10000	8.49E-01	0.00E+00	>10000
U-234	4.60E-01	0.00E+00	>10000	4.60E-01	0.00E+00	>10000	4.60E-01	0.00E+00	>10000
U-235	1.90E-02	0.00E+00	>10000	1.90E-02	0.00E+00	>10000	1.90E-02	0.00E+00	>10000
U-236	1.70E-02	0.00E+00	>10000	1.70E-02	0.00E+00	>10000	1.70E-02	0.00E+00	>10000
U-238	4.10E-01	0.00E+00	>10000	4.10E-01	0.00E+00	>10000	4.10E-01	0.00E+00	>10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.32. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a 1-km Line of Analysis, Alternative Group E_3

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	3.00E+00	1700	3.66E-01	3.66E+00	1700	3.99E-01	3.99E+00	1700
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.63E-02	1700	3.20E-03	3.20E-02	1700	3.20E-03	3.20E-02	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.03E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000
U-234	(a)	1.70E-01	0.00E+00	>10000	2.07E-01	0.00E+00	>10000	9.01E-01	0.00E+00	>10000
U-235	(a)	3.56E-02	0.00E+00	>10000	4.34E-02	0.00E+00	>10000	8.86E-02	0.00E+00	>10000
U-236	(a)	4.03E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000
U-238	(a)	4.06E-01	0.00E+00	>10000	4.95E-01	0.00E+00	>10000	1.66E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230	7.20E+01	6.64E+00	1230
I-129	1	3.39E-07	3.39E-06	1700	3.53E-07	3.53E-06	1700	3.53E-07	3.53E-06	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.79E-02	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	2.32E-01	0.00E+00	>10000
U-234	(a)	1.24E+02	0.00E+00	>10000	1.29E+02	0.00E+00	>10000	2.94E+02	0.00E+00	>10000
U-235	(a)	3.54E+00	0.00E+00	>10000	3.69E+00	0.00E+00	>10000	8.39E+00	0.00E+00	>10000
U-236	(a)	1.60E+01	0.00E+00	>10000	1.67E+01	0.00E+00	>10000	3.80E+01	0.00E+00	>10000
U-238	(a)	1.99E+02	0.00E+00	>10000	2.07E+02	0.00E+00	>10000	4.72E+02	0.00E+00	>10000

Table G.32. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.27E-02	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.18E+01	1230
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	8.66E+00	680
I-129	1	0.00E+00			0.00E+00			1.68E-02	1.39E-01	1230
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	5.18E-05	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	5.24E+00	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	2.32E-01	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	1.13E-03	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	5.43E+00	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.44E+01	1700	3.44E+00	3.44E+01	1700	2.09E+00	2.09E+01	1700
Grouted Tc-99	900	4.91E+00	3.50E-01	1200	4.92E+00	3.51E-01	1200	5.96E+01	4.25E+00	1200
I-129	1	3.50E-02	3.51E-01	1700	3.51E-02	3.51E-01	1700	1.70E-02	1.70E-01	1700
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.28E+01	0.00E+00	>10000	1.56E+01	0.00E+00	>10000	1.59E+01	0.00E+00	>10000
Tc-99	900	1.08E+00	9.31E+00	1740	1.32E+00	1.14E+01	1740	1.33E+00	1.14E+01	1740
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.01E-03	2.59E-02	1740	3.67E-03	3.16E-02	1740	3.67E-03	3.16E-02	1740
Grouted I-129	1	0.00E+00			0.00E+00	0.00E+00		0.00E+00		
U-233	(a)	3.71E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000
U-234	(a)	6.13E-01	0.00E+00	>10000	7.47E-01	0.00E+00	>10000	9.21E-01	0.00E+00	>10000
U-235	(a)	1.29E-01	0.00E+00	>10000	1.57E-01	0.00E+00	>10000	1.68E-01	0.00E+00	>10000
U-236	(a)	1.46E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000
U-238	(a)	1.47E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000	2.08E+00	0.00E+00	>10000

Table G.32. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	4.44E-01	5.47E-04	10000	4.62E-01	5.69E-04	10000	1.45E+02	1.79E-01	10000
Tc-99	900	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00		0.00E+00	0.00E+00	0
Grouted Tc-99	900	3.23E+03	2.25E+02	1070	3.23E+03	2.25E+02	1070	3.23E+03	2.25E+02	1070
I-129	1	1.96E-06	1.69E-05	1740	2.04E-06	1.76E-05	1740	2.04E-06	1.76E-05	1740
Grouted I-129	1	5.00E+00	1.10E-01	1070	5.00E+00	1.10E-01	1070	5.00E+00	1.10E-01	1070
U-233	(a)	2.98E-01	0.00E+00	>10000	3.10E-01	0.00E+00	>10000	1.80E-01	0.00E+00	>10000
U-234	(a)	3.73E+02	0.00E+00	>10000	3.89E+02	0.00E+00	>10000	3.11E+02	0.00E+00	>10000
U-235	(a)	1.07E+01	0.00E+00	>10000	1.11E+01	0.00E+00	>10000	1.20E+01	0.00E+00	>10000
U-236	(a)	4.82E+01	0.00E+00	>10000	5.02E+01	0.00E+00	>10000	2.89E+01	0.00E+00	>10000
U-238	(a)	5.99E+02	0.00E+00	>10000	6.24E+02	0.00E+00	>10000	5.04E+02	0.00E+00	>10000
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	4.32E+00	5.33E-03	10000	4.33E+00	5.34E-03	10000	5.70E+00	7.03E-03	10000
Tc-99	900	8.34E+00	7.18E+01	1740	8.36E+00	7.18E+01	1740	8.27E+00	7.12E+01	1740
Grouted Tc-99	900	1.57E+02	1.09E+01	1070	1.57E+02	1.09E+01	1070	3.34E+02	2.33E+01	1070
I-129	1	1.04E-01	8.93E-01	1740	1.04E-01	8.93E-01	1740	1.05E-01	9.05E-01	1740
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	0.00E+00	>10000	1.36E-02	0.00E+00	>10000	1.38E-02	0.00E+00	>10000
U-234	(a)	1.61E+01	0.00E+00	>10000	1.61E+01	0.00E+00	>10000	3.40E+02	0.00E+00	>10000
U-235	(a)	2.56E-01	0.00E+00	>10000	2.57E-01	0.00E+00	>10000	1.46E+01	0.00E+00	>10000
U-236	(a)	3.01E-01	0.00E+00	>10000	3.02E-01	0.00E+00	>10000	3.05E-01	0.00E+00	>10000
U-238	(a)	4.00E+00	0.00E+00	>10000	4.01E+00	0.00E+00	>10000	3.44E+02	0.00E+00	>10000

Table G.32. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	1.87E+00	680	3.89E+01	1.87E+00	680	3.89E+01	1.87E+00	680
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	1.26E-03	10000	8.49E-01	1.26E-03	10000	8.49E-01	1.26E-03	10000
U-234	(a)	4.60E-01	6.82E-04	10000	4.60E-01	6.82E-04	10000	4.60E-01	6.82E-04	10000
U-235	(a)	1.90E-02	2.82E-05	10000	1.90E-02	2.82E-05	10000	1.90E-02	2.82E-05	10000
U-236	(a)	1.70E-02	2.52E-05	10000	1.70E-02	2.52E-05	10000	1.70E-02	2.52E-05	10000
U-238	(a)	4.10E-01	6.08E-04	10000	4.10E-01	6.08E-04	10000	4.10E-01	6.08E-04	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 μg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to μg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.33. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a Line of Analysis Along the Columbia River, Alternative Group E_3

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concentra-tion (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concentra-tion (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concentra-tion (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	900	3.00E-01	2.63E-01	2000	3.66E-01	3.21E-01	2000	3.99E-01	3.50E-01	2000
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	2.62E-03	2.30E-03	2000	3.20E-03	2.81E-03	2000	3.20E-03	2.81E-03	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.03E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000
U-234	(a)	1.70E-01	0.00E+00	>10000	2.07E-01	0.00E+00	>10000	9.01E-01	0.00E+00	>10000
U-235	(a)	3.56E-02	0.00E+00	>10000	4.34E-02	0.00E+00	>10000	8.86E-02	0.00E+00	>10000
U-236	(a)	4.03E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000
U-238	(a)	4.06E-01	0.00E+00	>10000	4.95E-01	0.00E+00	>10000	1.66E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710	7.20E+01	4.62E-01	1710
I-129	1	3.39E-07	2.97E-07	2000	3.53E-07	3.09E-07	2000	3.53E-07	3.09E-07	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	9.79E-02	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	2.32E-01	0.00E+00	>10000
U-234	(a)	1.24E+02	0.00E+00	>10000	1.29E+02	0.00E+00	>10000	2.94E+02	0.00E+00	>10000
U-235	(a)	3.54E+00	0.00E+00	>10000	3.69E+00	0.00E+00	>10000	8.39E+00	0.00E+00	>10000
U-236	(a)	1.60E+01	0.00E+00	>10000	1.67E+01	0.00E+00	>10000	3.80E+01	0.00E+00	>10000
U-238	(a)	1.99E+02	0.00E+00	>10000	2.07E+02	0.00E+00	>10000	4.72E+02	0.00E+00	>10000

Table G.33. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			1.60E+00	1.52E-04	10000
Tc-99	900	0.00E+00			0.00E+00			1.43E+00	1.99E+00	1400
Grouted Tc-99	900	0.00E+00			0.00E+00			1.23E+02	8.41E-01	1620
I-129	1	0.00E+00			0.00E+00			1.68E-02	2.34E-02	1400
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			2.22E-03	1.61E-06	10000
U-234	(a)	0.00E+00			0.00E+00			2.25E+02	1.63E-01	10000
U-235	(a)	0.00E+00			0.00E+00			9.96E+00	7.21E-03	10000
U-236	(a)	0.00E+00			0.00E+00			4.86E-02	3.52E-05	10000
U-238	(a)	0.00E+00			0.00E+00			2.33E+02	1.69E-01	10000
200 West Area										
C-14	2000	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	900	3.43E+00	3.01E+00	2000	3.44E+00	3.02E+00	2000	2.09E+00	1.83E+00	2000
Grouted Tc-99	900	4.91E+00	3.36E-02	1620	4.92E+00	3.37E-02	1620	5.96E+01	4.08E-01	1620
I-129	1	3.50E-02	3.07E-02	2000	3.51E-02	3.08E-02	2000	1.70E-02	1.49E-02	2000
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	(a)	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	(a)	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	(a)	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	(a)	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	1.28E+01	1.38E-05	10000	1.56E+01	1.69E-05	10000	1.59E+01	1.72E-05	10000
Tc-99	900	1.08E+00	8.62E-01	1660	1.32E+00	1.05E+00	1660	1.33E+00	1.06E+00	1660
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	3.01E-03	2.40E-03	1660	3.67E-03	2.92E-03	1660	3.67E-03	2.92E-03	1660
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	3.71E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000
U-234	(a)	6.13E-01	0.00E+00	>10000	7.47E-01	0.00E+00	>10000	9.21E-01	0.00E+00	>10000
U-235	(a)	1.29E-01	0.00E+00	>10000	1.57E-01	0.00E+00	>10000	1.68E-01	0.00E+00	>10000
U-236	(a)	1.46E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000
U-238	(a)	1.47E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000	2.08E+00	0.00E+00	>10000

Table G.33. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum Concen-tration (pCi/L)	Hanford Only Volume Approx. Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum Concen-tration (pCi/L)	Lower Bound Volume Approx. Peak Arrival Time (yrs)	Upper Bound Volume Inventory (Ci)	Upper Bound Volume Maximum Concen-tration (pCi/L)	Upper Bound Volume Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		
200 West Area										
C-14	2000	4.44E-01	4.80E-07	10000	4.62E-01	5.00E-07	10000	1.45E+02	1.57E-04	10000
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.23E+03	1.97E+01	1420	3.23E+03	1.97E+01	1420	3.23E+03	1.97E+01	1420
I-129	1	1.96E-06	1.56E-06	1660	2.04E-06	1.62E-06	1660	2.04E-06	1.62E-06	1660
Grouted I-129	1	5.00E+00	1.01E-02	1700	5.00E+00	1.01E-02	1700	5.00E+00	1.01E-02	1700
U-233	(a)	2.98E-01	0.00E+00	>10000	3.10E-01	0.00E+00	>10000	1.80E-01	0.00E+00	>10000
U-234	(a)	3.73E+02	0.00E+00	>10000	3.89E+02	0.00E+00	>10000	3.11E+02	0.00E+00	>10000
U-235	(a)	1.07E+01	0.00E+00	>10000	1.11E+01	0.00E+00	>10000	1.20E+01	0.00E+00	>10000
U-236	(a)	4.82E+01	0.00E+00	>10000	5.02E+01	0.00E+00	>10000	2.89E+01	0.00E+00	>10000
U-238	(a)	5.99E+02	0.00E+00	>10000	6.24E+02	0.00E+00	>10000	5.04E+02	0.00E+00	>10000
Projected Mixed LLW After 2008										
200 East Area										
C-14	2000	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0
Tc-99	900	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0
Grouted Tc-99	900	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0
I-129	1	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0
Grouted I-129	1	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0
U-233	(a)	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0
U-234	(a)	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0
U-235	(a)	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0
U-236	(a)	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0
U-238	(a)	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0
200 West Area										
C-14	2000	4.32E+00	4.67E-06	10000	4.33E+00	4.68E-06	10000	5.70E+00	6.17E-06	10000
Tc-99	900	8.34E+00	6.64E+00	1660	8.36E+00	6.65E+00	1660	8.27E+00	6.58E+00	1660
Grouted Tc-99	900	1.57E+02	9.56E-01	1420	1.57E+02	9.58E-01	1420	3.34E+02	2.04E+00	1420
I-129	1	1.04E-01	8.26E-02	1660	1.04E-01	8.28E-02	1660	1.05E-01	8.37E-02	1660
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	1.36E-02	0.00E+00	>10000	1.36E-02	0.00E+00	>10000	1.38E-02	0.00E+00	>10000
U-234	(a)	1.61E+01	0.00E+00	>10000	1.61E+01	0.00E+00	>10000	3.40E+02	0.00E+00	>10000
U-235	(a)	2.56E-01	0.00E+00	>10000	2.57E-01	0.00E+00	>10000	1.46E+01	0.00E+00	>10000
U-236	(a)	3.01E-01	0.00E+00	>10000	3.02E-01	0.00E+00	>10000	3.05E-01	0.00E+00	>10000
U-238	(a)	4.00E+00	0.00E+00	>10000	4.01E+00	0.00E+00	>10000	3.44E+02	0.00E+00	>10000

Table G.33. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approx. Peak Arrival Time (yrs)
Projected Melter Waste										
200 East Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	3.89E+01	2.03E-01	820	3.89E+01	2.03E-01	820	3.89E+01	2.03E-01	820
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	8.49E-01	7.61E-07	10000	8.49E-01	7.61E-07	10000	8.49E-01	7.61E-07	10000
U-234	(a)	4.60E-01	4.12E-07	10000	4.60E-01	4.12E-07	10000	4.60E-01	4.12E-07	10000
U-235	(a)	1.90E-02	1.70E-08	10000	1.90E-02	1.70E-08	10000	1.90E-02	1.70E-08	10000
U-236	(a)	1.70E-02	1.52E-08	10000	1.70E-02	1.52E-08	10000	1.70E-02	1.52E-08	10000
U-238	(a)	4.10E-01	3.67E-07	10000	4.10E-01	3.67E-07	10000	4.10E-01	3.67E-07	10000
200 West Area										
C-14	2000	0.00E+00			0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00			0.00E+00		

(a) The benchmark groundwater standard for uranium is 30 μg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to μg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.34. Predicted Peak River Flux of Key Constituents by Waste and Category at a Line of Analysis to the Columbia River, Alternative E_3

	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
Constituent	**Inventory (Ci)**	**Maximum River Flux Ci/yr**	**Approx. Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum River Flux Ci/yr**	**Approx. Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum River Flux Ci/yr**	**Approx. Peak Arrival Time (yrs)**
1996-2007 Cat 1 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	3.33E+00	0.00E+00	>10000	4.06E+00	0.00E+00	>10000	5.21E+00	0.00E+00	>10000
Tc-99	3.00E-01	2.85E-03	2180	3.66E-01	3.48E-03	2180	3.99E-01	3.79E-03	2180
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	2.62E-03	2.49E-05	2180	3.20E-03	3.04E-05	2180	3.20E-03	3.04E-05	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.03E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000	1.25E-01	0.00E+00	>10000
U-234	1.70E-01	0.00E+00	>10000	2.07E-01	0.00E+00	>10000	9.01E-01	0.00E+00	>10000
U-235	3.56E-02	0.00E+00	>10000	4.34E-02	0.00E+00	>10000	8.86E-02	0.00E+00	>10000
U-236	4.03E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000	4.92E-03	0.00E+00	>10000
U-238	4.06E-01	0.00E+00	>10000	4.95E-01	0.00E+00	>10000	1.66E+00	0.00E+00	>10000
1996-2007 Cat 3 LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00	.		0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	1.48E-01	0.00E+00	>10000	1.54E-01	0.00E+00	>10000	3.50E-01	0.00E+00	>10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840	7.20E+01	6.01E-03	1840
I-129	3.39E-07	3.22E-09	2180	3.53E-07	3.35E-09	2180	3.53E-07	3.35E-09	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	9.79E-02	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	2.32E-01	0.00E+00	>10000
U-234	1.24E+02	0.00E+00	>10000	1.29E+02	0.00E+00	>10000	2.94E+02	0.00E+00	>10000
U-235	3.54E+00	0.00E+00	>10000	3.69E+00	0.00E+00	>10000	8.39E+00	0.00E+00	>10000
U-236	1.60E+01	0.00E+00	>10000	1.67E+01	0.00E+00	>10000	3.80E+01	0.00E+00	>10000
U-238	1.99E+02	0.00E+00	>10000	2.07E+02	0.00E+00	>10000	4.72E+02	0.00E+00	>10000

Table G.34. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux Ci/yr	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux Ci/yr	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux Ci/yr	Approx. Peak Arrival Time (yrs)
1996-2007 Mixed LLW									
200 East Area									
C-14	0.00E+00			0.00E+00			1.60E+00	6.81E-07	10000
Tc-99	0.00E+00			0.00E+00			1.43E+00	1.86E-02	1450
Grouted Tc-99	0.00E+00			0.00E+00			1.23E+02	1.14E-02	970
I-129	0.00E+00			0.00E+00			1.68E-02	2.18E-04	1450
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			2.22E-03	1.05E-08	10000
U-234	0.00E+00			0.00E+00			2.25E+02	1.05E-08	10000
U-235	0.00E+00			0.00E+00			9.96E+00	1.06E-03	10000
U-236	0.00E+00			0.00E+00			4.86E-02	4.71E-05	10000
U-238	0.00E+00			0.00E+00			2.33E+02	2.30E-07	10000
200 West Area									
C-14	1.46E+00	0.00E+00	>10000	1.46E+00	0.00E+00	>10000	1.13E+00	0.00E+00	>10000
Tc-99	3.43E+00	3.26E-02	2180	3.44E+00	3.27E-02	2180	2.09E+00	1.99E-02	2180
Grouted Tc-99	4.91E+00	4.10E-04	1840	4.92E+00	4.10E-04	1840	5.96E+01	4.97E-03	1840
I-129	3.50E-02	3.33E-04	2180	3.51E-02	3.34E-04	2180	1.70E-02	1.62E-04	2180
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	4.59E-03	0.00E+00	>10000	4.60E-03	0.00E+00	>10000	2.20E-03	0.00E+00	>10000
U-234	5.44E+00	0.00E+00	>10000	5.45E+00	0.00E+00	>10000	1.09E+02	0.00E+00	>10000
U-235	8.68E-02	0.00E+00	>10000	8.70E-02	0.00E+00	>10000	4.78E+00	0.00E+00	>10000
U-236	1.02E-01	0.00E+00	>10000	1.02E-01	0.00E+00	>10000	4.88E-02	0.00E+00	>10000
U-238	1.36E+00	0.00E+00	>10000	1.36E+00	0.00E+00	>10000	1.12E+02	0.00E+00	>10000
Projected Cat 1 LLW After 2008									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	1.28E+01	8.79E-08	10000	1.56E+01	1.07E-07	10000	1.59E+01	1.09E-07	10000
Tc-99	1.08E+00	1.12E-02	1720	1.32E+00	1.36E-02	1720	1.33E+00	1.37E-02	1720
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	3.01E-03	3.10E-05	1720	3.67E-03	3.79E-05	1720	3.67E-03	3.79E-05	1720
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	3.71E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000	4.52E-01	0.00E+00	>10000
U-234	6.13E-01	0.00E+00	>10000	7.47E-01	0.00E+00	>10000	9.21E-01	0.00E+00	>10000
U-235	1.29E-01	0.00E+00	>10000	1.57E-01	0.00E+00	>10000	1.68E-01	0.00E+00	>10000
U-236	1.46E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000	1.78E-02	0.00E+00	>10000
U-238	1.47E+00	0.00E+00	>10000	1.79E+00	0.00E+00	>10000	2.08E+00	0.00E+00	>10000

Table G.34. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux Ci/yr	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux Ci/yr	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux Ci/yr	Approx. Peak Arrival Time (yrs)
Projected Cat 3 LLW After 2008									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area	0.00E+00								
C-14	4.44E-01	3.05E-09	10000	4.62E-01	3.17E-09	10000	1.45E+02	9.96E-07	10000
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.23E+03	2.67E-01	1510	3.23E+03	2.67E-01	1510	3.23E+03	2.67E-01	1510
I-129	1.96E-06	2.02E-08	1720	2.04E-06	2.10E-08	1720	2.04E-06	2.10E-08	1720
Grouted I-129	5.00E+00	1.31E-04	1510	5.00E+00	1.31E-04	1510	5.00E+00	1.31E-04	1510
U-233	2.98E-01	0.00E+00	>10000	3.10E-01	0.00E+00	>10000	1.80E-01	0.00E+00	>10000
U-234	3.73E+02	0.00E+00	>10000	3.89E+02	0.00E+00	>10000	3.11E+02	0.00E+00	>10000
U-235	1.07E+01	0.00E+00	>10000	1.11E+01	0.00E+00	>10000	1.20E+01	0.00E+00	>10000
U-236	4.82E+01	0.00E+00	>10000	5.02E+01	0.00E+00	>10000	2.89E+01	0.00E+00	>10000
U-238	5.99E+02	0.00E+00	>10000	6.24E+02	0.00E+00	>10000	5.04E+02	0.00E+00	>10000
Projected Mixed LLW After 2008									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		
200 West Area									
C-14	4.32E+00	2.97E-08	10000	4.33E+00	2.97E-08	10000	5.70E+00	3.92E-08	10000
Tc-99	8.34E+00	8.61E-02	1720	8.36E+00	8.62E-02	1720	8.27E+00	8.53E-02	1720
Grouted Tc-99	1.57E+02	1.30E-02	1510	1.57E+02	1.30E-02	1510	3.34E+02	2.77E-02	1510
I-129	1.04E-01	1.07E-03	1720	1.04E-01	1.07E-03	1720	1.05E-01	1.09E-03	1720
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	1.36E-02	0.00E+00	>10000	1.36E-02	0.00E+00	>10000	1.38E-02	0.00E+00	>10000
U-234	1.61E+01	0.00E+00	>10000	1.61E+01	0.00E+00	>10000	3.40E+02	0.00E+00	>10000
U-235	2.56E-01	0.00E+00	>10000	2.57E-01	0.00E+00	>10000	1.46E+01	0.00E+00	>10000
U-236	3.01E-01	0.00E+00	>10000	3.02E-01	0.00E+00	>10000	3.05E-01	0.00E+00	>10000
U-238	4.00E+00	0.00E+00	>10000	4.01E+00	0.00E+00	>10000	3.44E+02	0.00E+00	>10000

Table G.34. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume			Upper Bound Volume		
	Inventory (Ci)	Maximum River Flux Ci/yr	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux Ci/yr	Approx. Peak Arrival Time (yrs)	Inventory (Ci)	Maximum River Flux Ci/yr	Approx. Peak Arrival Time (yrs)
Projected Melter Waste									
200 East Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	3.89E+01	3.19E-03	870	3.89E+01	3.19E-03	870	3.89E+01	3.19E-03	870
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	8.49E-01	1.89E-07	10000	8.49E-01	1.89E-07	10000	8.49E-01	1.89E-07	10000
U-234	4.60E-01	1.03E-07	10000	4.60E-01	1.03E-07	10000	4.60E-01	1.03E-07	10000
U-235	1.90E-02	4.24E-09	10000	1.90E-02	4.24E-09	10000	1.90E-02	4.24E-09	10000
U-236	1.70E-02	3.79E-09	10000	1.70E-02	3.79E-09	10000	1.70E-02	3.79E-09	10000
U-238	4.10E-01	9.14E-08	10000	4.10E-01	9.14E-08	10000	4.10E-01	9.14E-08	10000
200 West Area									
C-14	0.00E+00			0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00			0.00E+00		

Table G.35a. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a 1-km Line of Analysis, No Action Alternative – Lower Bound Waste Volume (Previously Disposed of Wastes)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)
Pre-1970 LLW				
200 East Area				
C-14	2000	0.00E+00		
Tc-99	900	5.16E-01	1.37E+01	110
Grouted Tc-99	900	0.00E+00		
I-129	1	1.24E-03	3.30E-02	110
Grouted I-129	1	0.00E+00		
U-233	(a)	1.03E+01	3.20E-01	10000
U-234	(a)	3.68E-01	1.14E-02	10000
U-235	(a)	1.12E-02	3.48E-04	10000
U-236	(a)	7.53E-03	2.34E-04	10000
U-238	(a)	2.69E-01	8.35E-03	10000
200 West Area	(a)			
C-14	2000	0.00E+00		
Tc-99	900	1.30E-01	2.70E+00	190
Grouted Tc-99	900	0.00E+00		
I-129	1	1.70E-04	3.54E-03	190
Grouted I-129	1	0.00E+00		
U-233	(a)	0.00E+00		
U-234	(a)	1.45E+00	0.00E+00	>10,000
U-235	(a)	4.38E-02	0.00E+00	>10,000
U-236	(a)	2.95E-02	0.00E+00	>10,000
U-238	(a)	1.06E+00	0.00E+00	>10,000
1970-1987 LLW				
200 East Area				
C-14	2000	2.15E+02	4.84E+00	10000
Tc-99	900	0.00E+00		
Grouted Tc-99	900	0.00E+00		
I-129	1	1.87E-02	5.23E-01	110
Grouted I-129	1	0.00E+00		
U-233	(a)	0.00E+00		
U-234	(a)	3.08E-02	1.89E-03	10000
U-235	(a)	2.61E-03	1.60E-04	10000
U-236	(a)	0.00E+00	0.00E+00	10000
U-238	(a)	6.28E-02	3.85E-03	10000
200 West Area				
C-14	2000	3.92E+02	0.00E+00	>10,000
Tc-99	900	0.00E+00		
Grouted Tc-99	900	0.00E+00		
I-129	1	1.77E-03	3.94E-02	250
Grouted I-129	1	0.00E+00		
U-233	(a)	0.00E+00		
U-234	(a)	3.94E+01	0.00E+00	>10,000
U-235	(a)	3.33E+00	0.00E+00	>10,000
U-236	(a)	0.00E+00	0.00E+00	>10,000
U-238	(a)	2.82E+01	0.00E+00	>10,000

Table G.35a. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)
1988-1995 LLW				
200 East Area				
C-14	2000	5.11E+00	1.15E-01	10000
Tc-99	900	1.39E-01	3.89E+00	110
Grouted Tc-99	900	0.00E+00		
I-129	1	9.45E-05	2.64E-03	110
Grouted I-129	1	0.00E+00		
U-233	(a)	2.09E-05	1.28E-06	10000
U-234	(a)	1.85E-03	1.13E-04	10000
U-235	(a)	4.29E-04	2.63E-05	10000
U-236	(a)	1.85E-06	1.13E-07	10000
U-238	(a)	1.93E-02	1.18E-03	10000
200 West Area				
C-14	2000	9.29E+00	0.00E+00	>10,000
Tc-99	900	4.71E-01	1.18E+01	210
Grouted Tc-99	900	0.00E+00		
I-129	1	3.06E-02	7.70E-01	210
Grouted I-129	1	0.00E+00		
U-233	(a)	6.54E-02	0.00E+00	>10,000
U-234	(a)	5.77E+00	0.00E+00	>10,000
U-235	(a)	1.34E+00	0.00E+00	>10,000
U-236	(a)	5.77E-03	0.00E+00	>10,000
U-238	(a)	6.03E+01	0.00E+00	>10,000

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.35b. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a Line of Analysis Along the Columbia River, No Action Alternative – Lower Bound Waste Volume (Previously Disposed of Waste)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)
Pre-1970 LLW				
200 East Area				
C-14	2000	0.00E+00		
Tc-99	900	5.16E-01	1.29E+00	260
Grouted Tc-99	900	0.00E+00		
I-129	1	1.24E-03	3.10E-03	260
Grouted I-129	1	0.00E+00		
U-233	(a)	1.03E+01	1.92E-02	10000
U-234	(a)	3.68E-01	6.87E-04	10000
U-235	(a)	1.12E-02	2.09E-05	10000
U-236	(a)	7.53E-03	1.41E-05	10000
U-238	(a)	2.69E-01	5.02E-04	10000
200 West Area	(a)			
C-14	2000	0.00E+00		
Tc-99	900	1.30E-01	1.69E-01	530
Grouted Tc-99	900	0.00E+00		
I-129	1	1.70E-04	2.21E-04	530
Grouted I-129	1	0.00E+00		
U-233	(a)	0.00E+00		
U-234	(a)	1.45E+00	0.00E+00	>10,000
U-235	(a)	4.38E-02	0.00E+00	>10,000
U-236	(a)	2.95E-02	0.00E+00	>10,000
U-238	(a)	1.06E+00	0.00E+00	>10,000
1970-1987 LLW				
200 East Area				
C-14	2000	2.15E+02	1.58E-01	10000
Tc-99	900	0.00E+00		
Grouted Tc-99	900	0.00E+00		
I-129	1	1.87E-02	4.66E-02	260
Grouted I-129	1	0.00E+00		
U-233	(a)	0.00E+00		
U-234	(a)	3.08E-02	1.12E-04	10000
U-235	(a)	2.61E-03	9.48E-06	10000
U-236	(a)	0.00E+00	0.00E+00	10000
U-238	(a)	6.28E-02	2.28E-04	10000
200 West Area				
C-14	2000	3.92E+02	0.00E+00	>10,000
Tc-99	900	0.00E+00		
Grouted Tc-99	900	0.00E+00		
I-129	1	1.77E-03	2.01E-03	610
Grouted I-129	1	0.00E+00		
U-233	(a)	0.00E+00		
U-234	(a)	3.94E+01	0.00E+00	>10,000
U-235	(a)	3.33E+00	0.00E+00	>10,000
U-236	(a)	0.00E+00	0.00E+00	>10,000
U-238	(a)	2.82E+01	0.00E+00	>10,000

Table G.35b. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)
1988-1995 LLW				
200 East Area				
C-14	2000	5.11E+00	3.77E-03	10000
Tc-99	900	1.39E-01	3.47E-01	260
Grouted Tc-99	900	0.00E+00		
I-129	1	9.45E-05	2.36E-04	260
Grouted I-129	1	0.00E+00		
U-233	(a)	2.09E-05	7.59E-08	10000
U-234	(a)	1.85E-03	6.72E-06	10000
U-235	(a)	4.29E-04	1.56E-06	10000
U-236	(a)	1.85E-06	6.72E-09	10000
U-238	(a)	1.93E-02	7.01E-05	10000
200 West Area				
C-14	2000	9.29E+00	0.00E+00	>10,000
Tc-99	900	4.71E-01	5.32E-01	600
Grouted Tc-99	900	0.00E+00		
I-129	1	3.06E-02	3.46E-02	600
Grouted I-129	1	0.00E+00		
U-233	(a)	6.54E-02	0.00E+00	>10,000
U-234	(a)	5.77E+00	2.13E-02	>10,000
U-235	(a)	1.34E+00	4.96E-03	>10,000
U-236	(a)	5.77E-03	2.13E-05	>10,000
U-238	(a)	6.03E+01	2.23E-01	>10,000

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.35c. Predicted Peak River Flux of Key Constituents by Waste and Category at a Line of Analysis to the Columbia River, No Action Alternative – Lower Bound Waste Volume (Previously Disposed of Waste)

Constituent	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
Pre-1970 LLW			
200 East Area			
C-14	0.00E+00		
Tc-99	5.16E-01	9.81E-03	290
Grouted Tc-99	0.00E+00		
I-129	1.24E-03	2.36E-05	290
Grouted I-129	0.00E+00		
U-233	1.03E+01	1.54E-04	10000
U-234	3.68E-01	5.50E-06	10000
U-235	1.12E-02	1.67E-07	10000
U-236	7.53E-03	1.13E-07	10000
U-238	2.69E-01	4.02E-06	10000
200 West Area			
C-14	0.00E+00		
Tc-99	1.30E-01	1.68E-03	600
Grouted Tc-99	0.00E+00		
I-129	1.70E-04	2.20E-06	600
Grouted I-129	0.00E+00		
U-233	0.00E+00		
U-234	1.45E+00	0.00E+00	>10,000
U-235	4.38E-02	0.00E+00	>10,000
U-236	2.95E-02	0.00E+00	>10,000
U-238	1.06E+00	0.00E+00	>10,000
1970-1987 LLW			
200 East Area			
C-14	2.15E+02	2.55E-03	10000
Tc-99	0.00E+00		
Grouted Tc-99	0.00E+00		
I-129	1.87E-02	3.54E-04	290
Grouted I-129	0.00E+00		
U-233	0.00E+00		
U-234	3.08E-02	4.71E-07	10000
U-235	2.61E-03	3.99E-08	10000
U-236	0.00E+00	0.00E+00	10000
U-238	6.28E-02	9.60E-07	10000
200 West Area			
C-14	3.92E+02	0.00E+00	>10,000
Tc-99	0.00E+00		
Grouted Tc-99	0.00E+00		
I-129	1.77E-03	2.07E-05	690
Grouted I-129	0.00E+00		
U-233	0.00E+00		
U-234	3.94E+01	0.00E+00	>10,000
U-235	3.33E+00	0.00E+00	>10,000
U-236	0.00E+00	0.00E+00	>10,000
U-238	2.82E+01	0.00E+00	>10,000

Table G.35c. (contd)

Constituent	Inventory (Ci)	Maximum River Flux (Ci/yr)	Approx. Peak Arrival Time (yrs)
1988-1995 LLW			
200 East Area			
C-14	5.11E+00	5.08E-05	10000
Tc-99	1.39E-01	2.63E-03	290
Grouted Tc-99	0.00E+00		
I-129	9.45E-05	1.79E-06	290
Grouted I-129	0.00E+00		
U-233	2.09E-05	4.71E-11	10000
U-234	1.85E-03	4.17E-09	10000
U-235	4.29E-04	9.67E-10	10000
U-236	1.85E-06	4.17E-12	10000
U-238	1.93E-02	4.35E-08	10000
200 West Area			
C-14	9.29E+00	0.00E+00	>10,000
Tc-99	4.71E-01	5.51E-03	670
Grouted Tc-99	0.00E+00		
I-129	3.06E-02	3.58E-04	670
Grouted I-129	0.00E+00		
U-233	6.54E-02	0.00E+00	>10,000
U-234	5.77E+00	2.14E+00	>10,000
U-235	1.34E+00	4.97E-01	>10,000
U-236	5.77E-03	2.14E-03	>10,000
U-238	6.03E+01	2.24E+01	>10,000

Table G.36. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a 1-km Line of Analysis, No Action Alternative

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW							
200 East Area							
C-14	2000	5.90E-01	1.33E-02	10000	7.20E-01	1.62E-02	10000
Tc-99	900	5.03E-02	1.41E+00	110	6.14E-02	1.72E+00	110
Grouted Tc-99	900	0.00E+00			0.00E+00		
I-129	1	2.03E-04	5.69E-03	110	2.48E-04	6.93E-03	110
Grouted I-129	1	0.00E+00			0.00E+00		
U-233	(a)	1.78E-02	1.09E-03	10000	2.17E-02	1.33E-03	10000
U-234	(a)	2.94E-02	1.80E-03	10000	3.58E-02	2.19E-03	10000
U-235	(a)	6.16E-03	3.77E-04	10000	7.51E-03	4.60E-04	10000
U-236	(a)	6.99E-04	4.29E-05	10000	8.53E-04	5.23E-05	10000
U-238	(a)	7.03E-02	4.31E-03	10000	8.57E-02	5.25E-03	10000
200 West Area	(a)						
C-14	2000	1.53E+01	0.00E+00	>10,000	1.86E+01	0.00E+00	>10,000
Tc-99	900	1.29E+00	2.02E+01	1070	1.57E+00	2.46E+01	1070
Grouted Tc-99	900	0.00E+00			0.00E+00		
I-129	1	5.22E-03	8.18E-02	1070	6.36E-03	9.98E-02	1070
Grouted I-129	1	0.00E+00			0.00E+00		
U-233	(a)	4.55E-01	0.00E+00	>10,000	5.55E-01	0.00E+00	>10,000
U-234	(a)	7.53E-01	0.00E+00	>10,000	9.18E-01	0.00E+00	>10,000
U-235	(a)	1.57E-01	0.00E+00	>10,000	1.92E-01	0.00E+00	>10,000
U-236	(a)	1.79E-02	0.00E+00	>10,000	2.18E-02	0.00E+00	>10,000
U-238	(a)	1.80E+00	0.00E+00	>10,000	2.19E+00	0.00E+00	>10,000
1996-2007 Cat 3 LLW							
200 East Area							
C-14	2000	2.21E-02	4.97E-04	10000	2.30E-02	5.18E-04	10000
Tc-99	900	0.00E+00			0.00E+00		
Grouted Tc-99	900	1.25E+02	5.24E+00	630	1.25E+02	5.24E+00	630
I-129	1	8.62E-08	9.11E-07	630	8.98E-08	9.49E-07	630
Grouted I-129	1	0.00E+00			0.00E+00		
U-233	(a)	1.48E-02	8.04E-04	10000	1.54E-02	8.37E-04	10000
U-234	(a)	1.86E+01	1.01E+00	10000	1.94E+01	1.05E+00	10000
U-235	(a)	5.34E-01	2.90E-02	10000	5.56E-01	3.02E-02	10000
U-236	(a)	2.41E+00	1.31E-01	10000	2.51E+00	1.36E-01	10000
U-238	(a)	3.00E+01	1.63E+00	10000	3.12E+01	1.70E+00	10000
200 West Area							
C-14	2000	5.67E-01	0.00E+00	>10,000	5.91E-01	0.00E+00	>10,000
Tc-99	900	0.00E+00			0.00E+00		
Grouted Tc-99	900	3.18E+03	2.93E+02	1230	3.18E+03	2.93E+02	1230
I-129	1	2.21E-06	3.46E-05	1070	2.30E-06	3.61E-05	1070
Grouted I-129	1	5.00E+00	1.46E-01	1230	5.00E+00	1.46E-01	1230
U-233	(a)	3.79E-01	0.00E+00	>10,000	3.95E-01	0.00E+00	>10,000
U-234	(a)	4.78E+02	0.00E+00	>10,000	4.98E+02	0.00E+00	>10,000
U-235	(a)	1.36E+01	0.00E+00	>10,000	1.42E+01	0.00E+00	>10,000
U-236	(a)	6.17E+01	0.00E+00	>10,000	6.43E+01	0.00E+00	>10,000
U-238	(a)	7.67E+02	0.00E+00	>10,000	7.99E+02	0.00E+00	>10,000

Table G.36. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)
1996-2007 Mixed LLW							
200 East Area							
C-14	2000	0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00		
200 West Area							
C-14	2000	7.52E-01	0.00E+00	>10,000	7.54E-01	0.00E+00	>10,000
Tc-99	900	9.63E-01	1.51E+01	1070	9.65E-01	1.51E+01	1070
Grouted Tc-99	900	3.34E+00	2.39E-01	1200	3.35E+00	2.39E-01	1200
I-129	1	1.81E-02	2.83E-01	1070	1.81E-02	2.84E-01	1070
Grouted I-129	1	0.00E+00			0.00E+00		
U-233	(a)	2.52E-03	0.00E+00	>10,000	2.53E-03	0.00E+00	>10,000
U-234	(a)	2.80E+00	0.00E+00	>10,000	2.81E+00	0.00E+00	>10,000
U-235	(a)	4.45E-02	0.00E+00	>10,000	4.46E-02	0.00E+00	>10,000
U-236	(a)	5.23E-02	0.00E+00	>10,000	5.24E-02	0.00E+00	>10,000
U-238	(a)	6.96E-01	0.00E+00	>10,000	6.97E-01	0.00E+00	>10,000

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.37. Predicted Peak Concentrations of Key Constituents by Waste Type and Category at a Line of Analysis Along the Columbia River, No Action Alternative

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)
1996-2007 Cat 1 LLW							
200 East Area							
C-14	2000	5.90E-01	4.35E-04	10000	7.20E-01	5.31E-04	10000
Tc-99	900	5.03E-02	7.89E-02	800	6.14E-02	9.62E-02	800
Grouted Tc-99	900	0.00E+00			0.00E+00		
I-129	1	2.03E-04	3.19E-04	800	2.48E-04	3.89E-04	800
Grouted I-129	1	0.00E+00			0.00E+00		
U-233	(a)	1.78E-02	6.46E-05	10000	2.17E-02	7.88E-05	10000
U-234	(a)	2.94E-02	1.07E-04	10000	3.58E-02	1.30E-04	10000
U-235	(a)	6.16E-03	2.24E-05	10000	7.51E-03	2.73E-05	10000
U-236	(a)	6.99E-04	2.54E-06	10000	8.53E-04	3.10E-06	10000
U-238	(a)	7.03E-02	2.55E-04	10000	8.57E-02	3.11E-04	10000
200 West Area	(a)						
C-14	2000	1.53E+01	0.00E+00	>10,000	1.86E+01	0.00E+00	>10,000
Tc-99	900	1.29E+00	1.24E+00	1420	1.57E+00	1.51E+00	1420
Grouted Tc-99	900	0.00E+00			0.00E+00		
I-129	1	5.22E-03	5.03E-03	1420	6.36E-03	6.13E-03	1420
Grouted I-129	1	0.00E+00			0.00E+00		
U-233	(a)	4.55E-01	0.00E+00	>10,000	5.55E-01	0.00E+00	>10,000
U-234	(a)	7.53E-01	0.00E+00	>10,000	9.18E-01	0.00E+00	>10,000
U-235	(a)	1.57E-01	0.00E+00	>10,000	1.92E-01	0.00E+00	>10,000
U-236	(a)	1.79E-02	0.00E+00	>10,000	2.18E-02	0.00E+00	>10,000
U-238	(a)	1.80E+00	0.00E+00	>10,000	2.19E+00	0.00E+00	>10,000
1996-2007 Cat 3 LLW							
200 East Area							
C-14	2000	2.21E-02	1.63E-05	10000	2.30E-02	5.31E-04	10000
Tc-99	900	0.00E+00			0.00E+00	9.62E-02	
Grouted Tc-99	900	1.25E+02	1.23E+00	800	1.25E+02		800
I-129	1	8.62E-08	1.35E-07	800	8.98E-08	3.89E-04	800
Grouted I-129	1	0.00E+00			0.00E+00		
U-233	(a)	1.48E-02	3.26E-05	10000	1.54E-02	7.88E-05	10000
U-234	(a)	1.86E+01	4.11E-02	10000	1.94E+01	1.30E-04	10000
U-235	(a)	5.34E-01	1.18E-03	10000	5.56E-01	2.73E-05	10000
U-236	(a)	2.41E+00	5.31E-03	10000	2.51E+00	3.10E-06	10000
U-238	(a)	3.00E+01	6.60E-02	10000	3.12E+01	3.11E-04	10000
200 West Area							
C-14	2000	5.67E-01	0.00E+00	>10,000	5.91E-01	0.00E+00	>10,000
Tc-99	900	0.00E+00			0.00E+00		
Grouted Tc-99	900	3.18E+03	2.04E+01	1710	3.18E+03	2.04E+01	1710
I-129	1	2.21E-06	2.13E-06	1420	2.30E-06	2.22E-06	1420
Grouted I-129	1	5.00E+00	1.01E-02	1710	5.00E+00	1.01E-02	1710
U-233	(a)	3.79E-01	0.00E+00	>10,000	3.95E-01	0.00E+00	>10,000
U-234	(a)	4.78E+02	0.00E+00	>10,000	4.98E+02	0.00E+00	>10,000
U-235	(a)	1.36E+01	0.00E+00	>10,000	1.42E+01	0.00E+00	>10,000
U-236	(a)	6.17E+01	0.00E+00	>10,000	6.43E+01	0.00E+00	>10,000
U-238	(a)	7.67E+02	0.00E+00	>10,000	7.99E+02	0.00E+00	>10,000

Table G.37. (contd)

Constituent	Benchmark Drinking Water Standard (pCi/L)	Hanford Only Volume			Lower Bound Volume		
		Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)	Inventory (Ci)	Maximum Concen-tration (pCi/L)	Approximate Peak Arrival Time (yrs)
1996-2007 Mixed LLW							
200 East Area							
C-14	2000	0.00E+00			0.00E+00		
Tc-99	900	0.00E+00			0.00E+00		
Grouted Tc-99	900	0.00E+00			0.00E+00		
I-129	1	0.00E+00			0.00E+00		
Grouted I-129	1	0.00E+00			0.00E+00		
U-233	(a)	0.00E+00			0.00E+00		
U-234	(a)	0.00E+00			0.00E+00		
U-235	(a)	0.00E+00			0.00E+00		
U-236	(a)	0.00E+00			0.00E+00		
U-238	(a)	0.00E+00			0.00E+00		
200 West Area							
C-14	2000	7.52E-01	0.00E+00	>10,000	7.54E-01	0.00E+00	>10,000
Tc-99	900	9.63E-01	9.28E-01	1420	9.65E-01	9.30E-01	1420
Grouted Tc-99	900	3.34E+00	2.29E-02	1620	3.35E+00	2.29E-02	1620
I-129	1	1.81E-02	1.74E-02	1420	1.81E-02	1.74E-02	1420
Grouted I-129	1	0.00E+00			0.00E+00		
U-233	(a)	2.52E-03	0.00E+00	>10,000	2.53E-03	0.00E+00	>10,000
U-234	(a)	2.80E+00	0.00E+00	>10,000	2.81E+00	0.00E+00	>10,000
U-235	(a)	4.45E-02	0.00E+00	>10,000	4.46E-02	0.00E+00	>10,000
U-236	(a)	5.23E-02	0.00E+00	>10,000	5.24E-02	0.00E+00	>10,000
U-238	(a)	6.96E-01	0.00E+00	>10,000	6.97E-01	0.00E+00	>10,000

(a) The benchmark groundwater standard for uranium is 30 µg/L expressed as total uranium. To convert isotope specific concentrations from pCi/L to µg/L, use following conversion factors:

- Uranium-233 - 1.05E-04
- Uranium-234 - 1.62E-04
- Uranium-235 - 4.66E-01
- Uranium-236 - 1.58E-02
- Uranium-238 - 3.00E+00.

Table G.38. Predicted Peak River Flux of Key Constituents by Waste Type and Category at a Line of Analysis to the Columbia River, No Action Alternative

	Hanford Only Volume			Lower Bound Volume		
Constituent	**Inventory (Ci)**	**Maximum River Flux (Ci)**	**Approximate Peak Arrival Time (yrs)**	**Inventory (Ci)**	**Maximum River Flux (Ci)**	**Approximate Peak Arrival Time (yrs)**
1996-2007 Cat 1 LLW						
200 East Area						
C-14	5.90E-01	2.34E-06	10000	7.20E-01	2.86E-06	10000
Tc-99	5.03E-02	7.31E-04	850	6.14E-02	8.92E-04	850
Grouted Tc-99	0.00E+00			0.00E+00		
I-129	2.03E-04	2.95E-06	850	2.48E-04	3.60E-06	850
Grouted I-129	0.00E+00			0.00E+00		
U-233	1.78E-02	4.01E-08	10000	2.17E-02	4.89E-08	10000
U-234	2.94E-02	6.62E-08	10000	3.58E-02	8.07E-08	10000
U-235	6.16E-03	1.39E-08	10000	7.51E-03	1.69E-08	10000
U-236	6.99E-04	1.58E-09	10000	8.53E-04	1.92E-09	10000
U-238	7.03E-02	1.58E-07	10000	8.57E-02	1.93E-07	10000
200 West Area						
C-14	1.53E+01	0.00E+00	>10,000	1.86E+01	0.00E+00	>10,000
Tc-99	1.29E+00	1.31E-02	1610	1.57E+00	1.60E-02	1610
Grouted Tc-99	0.00E+00			0.00E+00		
I-129	5.22E-03	5.32E-05	1610	6.36E-03	6.49E-05	1610
Grouted I-129	0.00E+00			0.00E+00		
U-233	4.55E-01	0.00E+00	>10,000	5.55E-01	0.00E+00	>10,000
U-234	7.53E-01	0.00E+00	>10,000	9.18E-01	0.00E+00	>10,000
U-235	1.57E-01	0.00E+00	>10,000	1.92E-01	0.00E+00	>10,000
U-236	1.79E-02	0.00E+00	>10,000	2.18E-02	0.00E+00	>10,000
U-238	1.80E+00	0.00E+00	>10,000	2.19E+00	0.00E+00	>10,000
1996-2007 Cat 3 LLW						
200 East Area						
C-14	2.21E-02	8.77E-08	10000	2.30E-02	9.13E-08	10000
Tc-99	0.00E+00			0.00E+00		
Grouted Tc-99	1.25E+02	1.16E-02	970	1.25E+02	1.16E-02	970
I-129	8.62E-08	1.25E-09	850	8.98E-08	1.30E-09	850
Grouted I-129	0.00E+00			0.00E+00		
U-233	1.48E-02	1.60E-08	10000	1.54E-02	1.66E-08	10000
U-234	1.86E+01	2.01E-05	10000	1.94E+01	2.10E-05	10000
U-235	5.34E-01	5.77E-07	10000	5.56E-01	6.01E-07	10000
U-236	2.41E+00	2.60E-06	10000	2.51E+00	2.71E-06	10000
U-238	3.00E+01	3.24E-05	10000	3.12E+01	3.37E-05	10000
200 West Area						
C-14	5.67E-01	0.00E+00	>10,000	5.91E-01	0.00E+00	>10,000
Tc-99	0.00E+00			0.00E+00		
Grouted Tc-99	3.18E+03	2.65E-01	1840	3.18E+03	2.65E-01	1840
I-129	2.21E-06	2.25E-08	1610	2.30E-06	2.35E-08	1610
Grouted I-129	5.00E+00	1.32E-04	1840	5.00E+00	1.32E-04	1840
U-233	3.79E-01	0.00E+00	>10,000	3.95E-01	0.00E+00	>10,000
U-234	4.78E+02	0.00E+00	>10,000	4.98E+02	0.00E+00	>10,000
U-235	1.36E+01	0.00E+00	>10,000	1.42E+01	0.00E+00	>10,000
U-236	6.17E+01	0.00E+00	>10,000	6.43E+01	0.00E+00	>10,000
U-238	0.00E+00	0.00E+00	>10,000	7.99E+02	0.00E+00	>10,000

Table G.38. (contd)

Constituent	Hanford Only Volume Inventory (Ci)	Hanford Only Volume Maximum River Flux (Ci)	Hanford Only Volume Approximate Peak Arrival Time (yrs)	Lower Bound Volume Inventory (Ci)	Lower Bound Volume Maximum River Flux (Ci)	Lower Bound Volume Approximate Peak Arrival Time (yrs)
1996-2007 Mixed LLW						
200 East Area						
C-14	0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00		
200 West Area						
C-14	7.52E-01	0.00E+00	>10,000	7.54E-01	0.00E+00	>10,000
Tc-99	9.63E-01	9.83E-03	1610	9.65E-01	9.85E-03	1610
Grouted Tc-99	3.34E+00	2.79E-04	1840	3.35E+00	2.79E-04	1840
I-129	1.81E-02	1.84E-04	1610	1.81E-02	1.85E-04	1610
Grouted I-129	0.00E+00			0.00E+00		
U-233	2.52E-03	0.00E+00	>10,000	2.53E-03	0.00E+00	>10,000
U-234	2.80E+00	0.00E+00	>10,000	2.81E+00	0.00E+00	>10,000
U-235	4.45E-02	0.00E+00	>10,000	4.46E-02	0.00E+00	>10,000
U-236	5.23E-02	0.00E+00	>10,000	5.24E-02	0.00E+00	>10,000
U-238	6.96E-01	0.00E+00	>10,000	6.97E-01	0.00E+00	>10,000

G.3 Use of ILAW Performance Assessment Calculations in HSW EIS Long-term Water Quality and Human Health Impacts

Impact results presented for the ILAW disposal facility were based on performance assessment (PA) calculations made for siting the facility in the vicinity of the PUREX Plant, as summarized in Mann et al. (2001). The following section discusses:

- Range of waste form and engineering performance examined to date, as discussed in Mann et al. (2001) including the specific discussion of the case selected for this analysis.

- Additional planned analyses of waste disposal system performance.

- Scaling of ILAW PA results for use in this analysis.

Table G.38. (contd)

Constituent	Hanford Only Volume			Lower Bound Volume		
	Inventory (Ci)	**Maximum River Flux (Ci)**	Approximate Peak Arrival Time **(yrs)**	**Inventory (Ci)**	**Maximum River Flux (Ci)**	**Approximate Peak Arrival Time (yrs)**
1996-2007 Mixed LLW						
200 East Area						
C-14	0.00E+00			0.00E+00		
Tc-99	0.00E+00			0.00E+00		
Grouted Tc-99	0.00E+00			0.00E+00		
I-129	0.00E+00			0.00E+00		
Grouted I-129	0.00E+00			0.00E+00		
U-233	0.00E+00			0.00E+00		
U-234	0.00E+00			0.00E+00		
U-235	0.00E+00			0.00E+00		
U-236	0.00E+00			0.00E+00		
U-238	0.00E+00			0.00E+00		
200 West Area						
C-14	7.52E-01	0.00E+00	>10,000	7.54E-01	0.00E+00	>10,000
Tc-99	9.63E-01	9.83E-03	1610	9.65E-01	9.85E-03	1610
Grouted Tc-99	3.34E+00	2.79E-04	1840	3.35E+00	2.79E-04	1840
I-129	1.81E-02	1.84E-04	1610	1.81E-02	1.85E-04	1610
Grouted I-129	0.00E+00			0.00E+00		
U-233	2.52E-03	0.00E+00	>10,000	2.53E-03	0.00E+00	>10,000
U-234	2.80E+00	0.00E+00	>10,000	2.81E+00	0.00E+00	>10,000
U-235	4.45E-02	0.00E+00	>10,000	4.46E-02	0.00E+00	>10,000
U-236	5.23E-02	0.00E+00	>10,000	5.24E-02	0.00E+00	>10,000
U-238	6.96E-01	0.00E+00	>10,000	6.97E-01	0.00E+00	>10,000

G.3 Use of ILAW Performance Assessment Calculations in HSW EIS Long-term Water Quality and Human Health Impacts

Impact results presented for the ILAW disposal facility were based on performance assessment (PA) calculations made for siting the facility in the vicinity of the PUREX Plant, as summarized in Mann et al. (2001). The following section discusses:

- Range of waste form and engineering performance examined to date, as discussed in Mann et al. (2001) including the specific discussion of the case selected for this analysis.

- Additional planned analyses of waste disposal system performance.

- Scaling of ILAW PA results for use in this analysis.

G.3.1 Range Of Waste Form and Engineering Performance Evaluated in 2001 ILAW PA

The long-term impacts from disposing ILAW was analyzed in the *Hanford Immobilized Low-Activity Waste Performance Assessment: 2001* (Mann et al. 2001), known as 2001 ILAW PA. A wide variety of cases were analyzed. Performance objectives covering air, groundwater, surface water, all-pathways, and inadvertent intrusion were established based on analyzing applicable and relevant regulations. The document concluded that there was a reasonable expectation that long-term public health and safety as well as the environment would be protected from the disposal in dirt trenches of a vitrified product from the Waste Treatment Plant (WTP). This document was reviewed by the Washington State Department of Ecology and approved by DOE headquarters, in accordance with DOE (2001).

The 2001 ILAW PA was built around a base analysis case. This case was designed to include the major features of disposal facility design and performance without going into details that have minimal impact in long-term performance. Important features are the waste composition and facility design.

At the time of writing the 2001 ILAW PA, the reference glasses to be produced by the WTP were not specified. Therefore, the ILAW PA activity used a glass composition (LAWABP1) developed by the Pacific Northwest National Laboratory in the composition envelope within which the WTP was working because of extensive laboratory testing data base for LAWABP1. Subsequent testing of the WTP reference glasses shows that the performance of LAWABP1 is very comparable to the WTP reference glasses. The results of the base analysis case, along with other cases analyzed, are illustrated in Figure G.90 as the curve labeled LAWABP1. Results of this case are also presented in tabular form in Table G.39.

The conceptual designs for the ILAW disposal facility have been evolving with time. The basic design is a set of large, deep trenches in the ground, underlain by plastic sheets. The presence of a surface barrier has remained constant while the width, depth, thickness, and placement of the trenches on the disposal site has changed. An important feature of the current conceptual design is a capillary break that acts as a moisture diverter underneath the surface barrier. As the name implies, this feature, using natural materials, diverts most of the water around and away from the waste forms. This case is labeled the best estimate case in the 2001 ILAW PA and is shown in Figure G.90 and summarized in Table G.39 as the "Enhanced Facility Design."

Although a wide variety of sensitivity cases were run in the 2001 ILAW PA, the ones of most interest here are those addressing various waste form performance. The release of contaminants from a waste form can be quite complex, particularly for those waste forms containing large amounts of sodium waste (such as those containing tank waste). Cases were run to test the sensitivity of the results to models and data used. Cases were also run to determine the effect of various waste forms.

To determine the performance of a lower-quality glass, the 2001 ILAW PA investigated the behavior of HLP-31 glass. This glass releases contaminants at a rate of about 10 times faster than LAWABP1 and, moreover, does not exhibit the common trait of decreased release as the concentration of silic acid (a by-product of glass dissolution) increases. For the conditions expected in the ILAW disposal facility, these

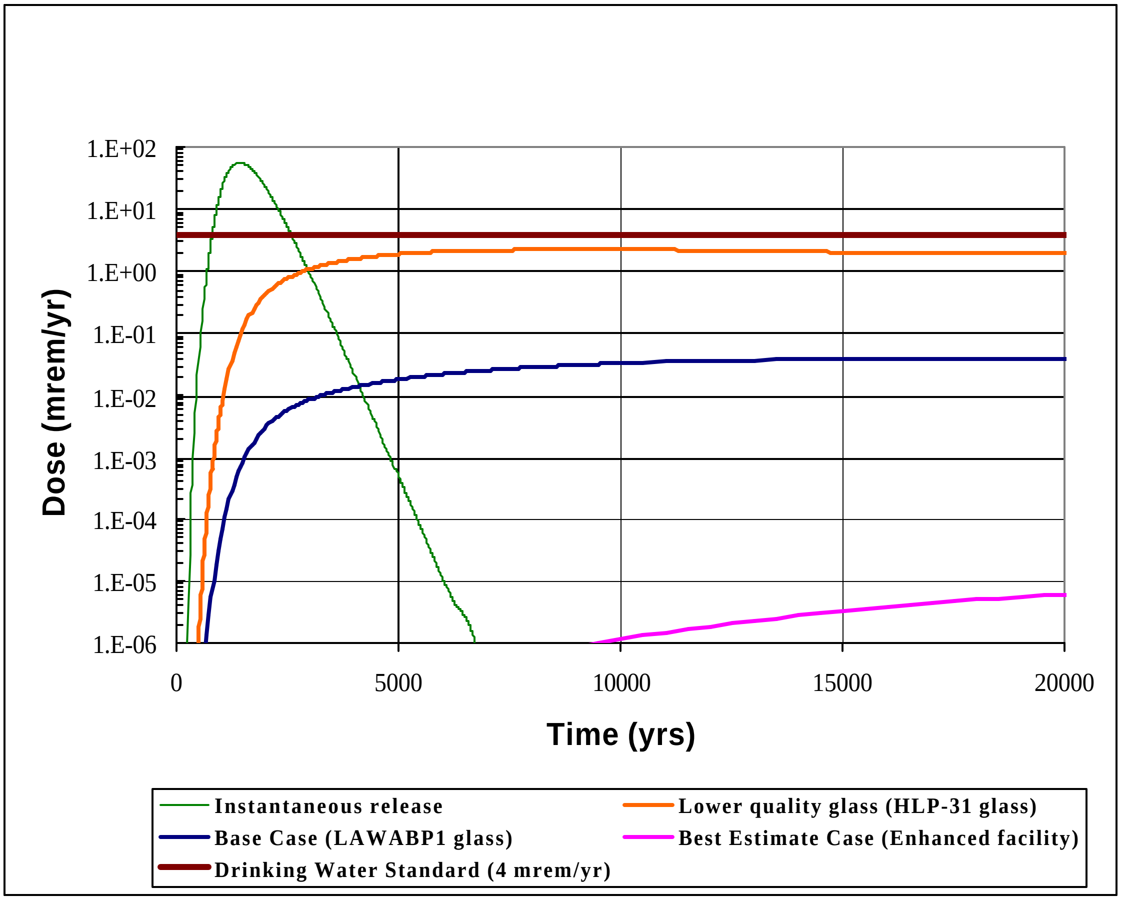

Figure G.90. Drinking Water Dose at a Well 100 Meters Down-Gradient from the ILAW Disposal Facility as a Function of Time for Various ILAW Waste Form Performance and Disposal Facility Parameters

two effects combine to cause the estimated impacts from HLP-31 waste forms to be about a factor of 100 greater than the impacts from the LAWABP1 waste forms. However, as seen from Figure G.90 and in Table G.39, even this higher release is estimated to be below 4 mrem/year, the level used by the U.S. Environmental Protection Agency for public water systems.

To investigate the performance of an extremely poor waste form, the 2001 ILAW PA investigated an extreme release case that assumed that all waste was released instantaneously. Because of the thickness of soil underlying the proposed ILAW disposal facility, the pulse broadens to the shape seen in Figure G.90 and summarized in Table G.39, which is actually quite broad (full width at one-tenth maximum of approximately 2000 years). For such cases, where the time over which release occurs is shorter than the time to travel through the soil to reach groundwater, the plateau-shaped curves of glass are replaced by peaked curves. The estimated drinking water dose for this instantaneous case is greater than 4 mrem/yr.

Table G.39. Drinking Water Doses (mrem/yr) Based on 2001 ILAW PA[a]

Case	@ 1,000 years	@ 10,000 years	Peak (@)
Base Case (LAWABP1 glass) (b)	0.00007	0.034	.040 (98,000 yrs)
Best Estimate Case (Enhanced Facility Design) (c)	---	0.000001	Not calculated
Lower Quality Glass Case (HLP-31 glass)	0.006	2.2	2.3 (9,000)
Extreme Release Case (pulse)	19.7	---	56. (1,400)

(a) Renormalized for increased Tc-99, due to removal from Tc-99 separations process from WTP.
(b) "Base analysis case" of the 2001 ILAW PA.
(c) "Best estimate case" of 2001 ILAW PA.

G.3.2 Additional Planned Analyses of Waste Disposal System Performance

The DOE has announced its plans for an environmental impact statement on the retrieval, treatment, and disposal of the waste being managed in the high-level waste tank farms at the Hanford Site and closure of the 149 single-shell tanks and associated facilities in the HLW tank farms (68 FR 1052). The HLW tanks contain both hazardous and radioactive waste (mixed waste). That document will provide additional analyses of low-activity waste treatment alternatives and disposal system performance.

G.3.3 Specific Scaling of ILAW PA Results for Use in the Analysis

G.3.3.1 Scaling for Estimated Inventory

Under a number of alternatives (Alternative Groups A, C, $D_{1,}$, and E_3) where ILAW disposal is sited near the PUREX facility, results of a sensitivity case in Mann et al. (2001) that analyzed the effect of 25,550 Ci of technetium was used. This case reflected no technetium removal in the separation processes from the Waste Treatment Plant. This technetium-99 inventory (25,550 Ci) is a factor of 4.4 higher than the estimated inventory of technetium-99 (about 5,790 Ci) if technetium-99 removal were considered in the separation process. The resulting scaled technetium-99 concentrations and other constituents from the ILAW PA that were used for those alternative groups where ILAW disposal is sited near the PUREX Plant is provided in Figure G.91.

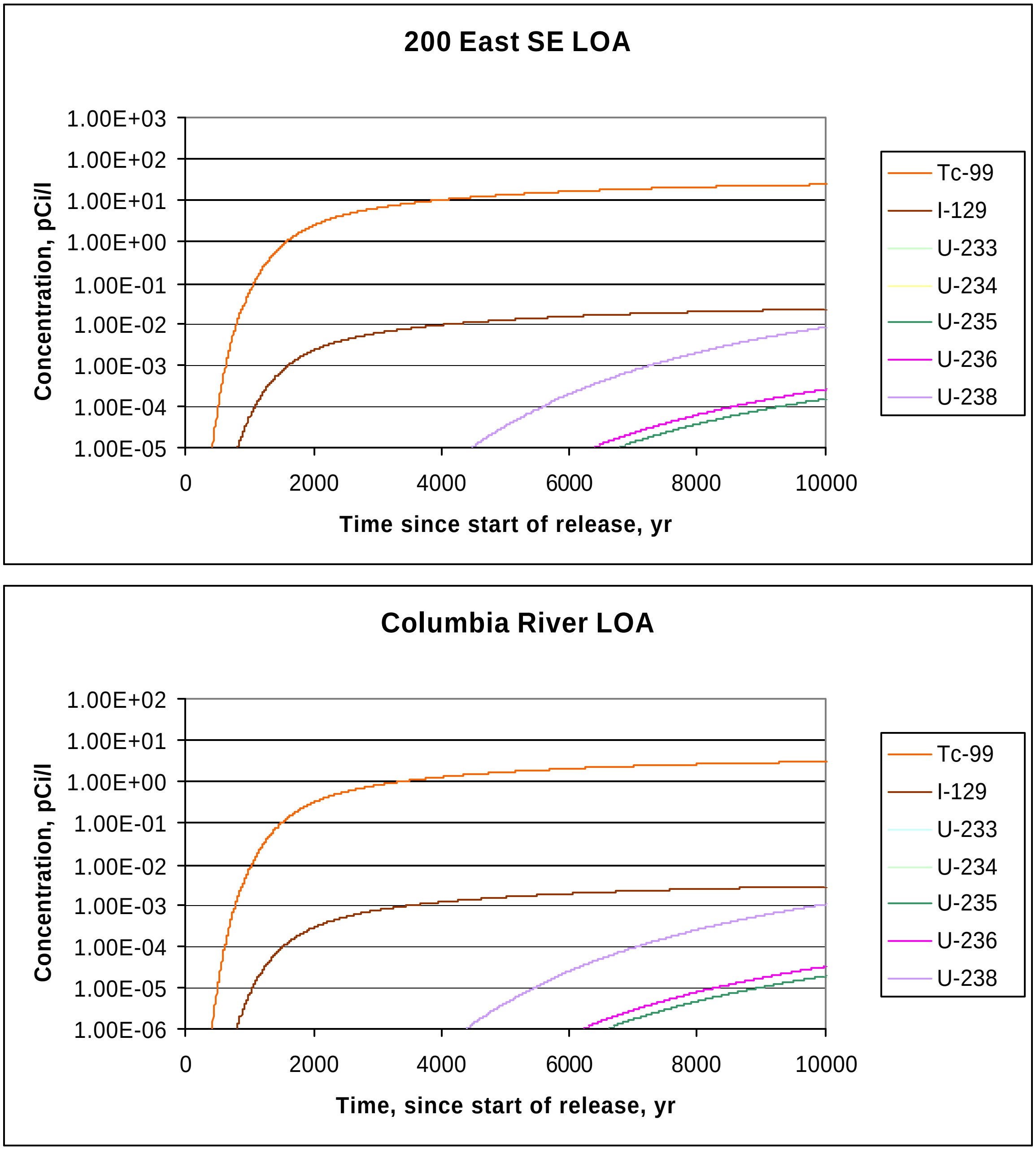

Figure G.91. Scaled Concentrations of Key Constituents that were Used from the ILAW PA at the 200 East Area SE and Columbia River LOAs for Those Alternative Groups where ILAW Disposal was Sited near the PUREX Plant, Alternative Groups A, C, $D_{1,}$ and E_3

G.3.3.2 Scaling for Alternative HSW-EIS Disposal Site Locations

Impact results presented for the ILAW disposal facility were based on performance assessment calculations made for siting the facility in the vicinity of the PUREX Plant, as summarized in DOE/ORP (2001). However, for a few of the alternative groups, the ILAW disposal facility is sited in areas south of the CWC and at ERDF, and the calculated impacts at these alternative sites would be expected to be different because of the change in hydrogeologic conditions and hydraulic properties at these three locations.

For purposes of this analysis, the human health impacts results presented in Appendix F and Section 5.11 for Alternative Group A (where the ILAW disposal facility is sited in an area south of the CWC) and Alternative Groups D_3, E_1, and E_2 (where the ILAW disposal facility is sited in the ERDF area) are based on simple scaling of comparative simulation results of source releases in these areas using the sitewide groundwater flow and transport model. Groundwater concentrations and results of human health impacts summarized in the original performance assessment calculations described in Mann et al. (2002) were based on well intercept factors (WIFs) or dilution factors from a given areal flux of a hypothetical contaminant released to the unconfined aquifer from the ILAW disposal facility (Bergeron and Wurstner 2000). The WIF is defined as the ratio of the concentration at a well location in the aquifer to the concentration of infiltrating water entering the aquifer. These WIFs are being used in conjunction with calculations of released contaminant fluxes through the vadose zone to estimate potential impacts from radiological and hazardous chemical contaminants within the ILAW disposal facility at LOAs.

For the purposes of implementing the limit release calculation, the concentration of a source entering the aquifer of 1 Ci/m^3 was used. The rate of mass flux associated with this concentration is a function of the infiltration rate assumed for the disposal facility covered by the modified RCRA Subtitle C cover system. With a rate of 0.42 cm/yr assumed for the ILAW disposal facility, the resulting solute flux entering the aquifer from each of the disposal concepts is 4.2×10^{-3} $Ci/yr/m^2$. This is the product of the contaminant concentration in the infiltrating water and the infiltration rate.

In the simulations used to support this assessment, the same calculation performed for the base case described in Bergeron and Wurstner (2000) (see Section 6.1.1) using the regional scale model was performed again at the approximate PUREX location and the two alternative areas described in Alternative Group A (south of the CWC) and Alternative Groups D_3, E_1, and E_2 (near ERDF) using the groundwater models in this assessment. The ratio of predicted WIFs at the 1-km (0.6-mi) LOA and along the Columbia River down-gradient from the CWC and ERDF locations to the comparable predicted WIFs from the PUREX locations provided the basis for the scaling of results used in this analysis.

The groundwater model using the extended basalt subcrop conditions north of the 200 East Area and the resultant predominant easterly flow out of the 200 East and West Areas was considered to be most representative of original conditions simulated with the model used by Bergeron and Wurstner (2000) of the two groundwater evaluations in this analysis. This model was the one used in this comparative analysis.

Results of WIFs using an assumed infiltration rate in the source area of 0.42 cm/yr for the three postulated ILAW disposal locations, presented in Figure G.91, suggest that predicted groundwater concentrations and calculated human health impacts would be a factor of about 3 higher and about 3.4 higher at the 1-km (0.6-mi) LOA down-gradient of the HSW disposal site locations (south of CWC and near ERDF, respectively) relative to a comparable location down-gradient from the PUREX location. These higher-predicted concentrations would be consistent with differences in hydrogeology at these two locations relative to conditions found near the PUREX Plant. Near the PUREX Plant, the upper part of the unconfined aquifer is largely composed of very permeable sediments associated with the Hanford formation. Whereas, at the ERDF and CWC locations, the upper part of the unconfined aquifer is made up of less permeable sand and gravel sediments associated with the Ringold sediments.

Results of WIF ratios at LOAs along the Columbia River resulting from releases at these two alternative locations are also presented in Table G.40 The resulting WIF ratio suggests that peak concentrations estimated along the Columbia River from these alternative locations of disposal would have about a factor of 0.8 and 0.9 lower, respectively, than was calculated from releases near the PUREX Plant. The reduction in concentration levels would be consistent with the longer flow path to the Columbia River location.

Table G.40. Well Intercept Factors at Down-Gradient LOAs from the ILAW Disposal Facility Sited near the PUREX Plant and Alternative Locations (South of the CWC under Alternative Group A and near ERDF under Alternative Groups D_3, E_1, and E_2)

	Near PUREX	**South of CWC**	**Near ERDF**
1-km LOA			
WIF	5.1E-04	1.5E-03	1.8E-03
Ratio to WIF to WIF (near PUREX)	1.0	3.0	3.4
Columbia River LOA			
WIF	1.8E-04	1.4E-04	1.6E-04
Ratio to WIF to WIF (near PUREX)	1.0	0.8	0.9

G.4 References

Bergeron, M. P. and S. K. Wurstner. 2000. *Groundwater Transport Calculations Supporting the Immobilized Low-Activity Waste Disposal Facility Performance Assessment*. PNNL-13400, Pacific Northwest National Laboratory, Richland, Washington.

Bryce, R., C.T. Kincaid, P.W. Eslinger, L.F. Morasch. 2002. *An Intial Assessment of Hanford Impacts Performed with the System Assessment Capbility*. PNNL-13027, Pacific Northwest National Laboratory, Richland, Washington.

Appendix H

Traffic and Transportation

This section evaluates the radiological and non-radiological impacts of onsite shipments of LLW, MLLW (including melters), TRU waste, and ILAW to treatment and disposal facilities, offsite shipments of MLLW from Hanford to offsite treatment facilities and back, and the shipment of construction and capping materials. This appendix also presents the impacts of shipments of LLW and MLLW from offsite generators to Hanford treatment and disposal facilities and shipments of TRU waste from Hanford to the Waste Isolation Pilot Plant (WIPP) for disposal. The impacts of shipments of LLW, MLLW, and TRU from offsite generators to Hanford and from Hanford to WIPP are presented for the States of Washington and Oregon. The impacts of shipments of LLW, MLLW, and TRU from offsite generators to Hanford were calculated for the States of Washington and Oregon using methods and data that are consistent with the *Waste Management Programmatic Environmental Impact Statement* (WM-PEIS, DOE 1997a). Estimated impacts of transporting TRU waste to WIPP are scaled from information presented in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b).

Estimates in the environmental impact statement (EIS) of radiological and non-radiological impacts of transporting various types of waste are presented in the following sections. This analysis addresses radiological hazards of waste transported under routine and accident conditions, and chemical hazards of waste transportation accidents, as well as physical hazards (that is, fatalities) projected to occur from traffic accidents involving waste shipments. Health effects from routine vehicular emissions are also quantified. The physical (or non-radiological) hazards and the impacts of routine vehicular emissions are independent of the cargo being transported. Total integrated radiological and non-radiological impacts are calculated. Note that all of the methods used in this appendix to calculate transportation impacts are commonly used in U.S. Department of Energy (DOE) environmental documents. Potential impacts of sabotage or acts of terrorism are also addressed. Finally, the transportation impacts associated with the *Final Waste Management Programmatic Environmental Impact Statement* (WM PEIS, DOE 1997a) are compared to the transportation impacts in this EIS.

H.1 Description of Methods

The methods used in this EIS to calculate the impacts of transporting waste, construction, and capping materials are described in the following section. Section H.1.1 describes the RADTRAN 4 computer code that was used to calculate the radiological routine (or incident-free) doses and accident risks to the public and transport crews associated with the alternatives examined in the EIS. The method used to calculate physical (non-radiological) routine risks is described in Section H.1.2. The method used to calculate non-radiological accident risks is described in Section H.1.3; the method used to calculate the impacts of accidental releases of hazardous chemicals is described in Section H.1.4.

Appendix H

Traffic and Transportation

This section evaluates the radiological and non-radiological impacts of onsite shipments of LLW, MLLW (including melters), TRU waste, and ILAW to treatment and disposal facilities, offsite shipments of MLLW from Hanford to offsite treatment facilities and back, and the shipment of construction and capping materials. This appendix also presents the impacts of shipments of LLW and MLLW from offsite generators to Hanford treatment and disposal facilities and shipments of TRU waste from Hanford to the Waste Isolation Pilot Plant (WIPP) for disposal. The impacts of shipments of LLW, MLLW, and TRU from offsite generators to Hanford and from Hanford to WIPP are presented for the States of Washington and Oregon. The impacts of shipments of LLW, MLLW, and TRU from offsite generators to Hanford were calculated for the States of Washington and Oregon using methods and data that are consistent with the *Waste Management Programmatic Environmental Impact Statement* (WM-PEIS, DOE 1997a). Estimated impacts of transporting TRU waste to WIPP are scaled from information presented in the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (DOE 1997b).

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H.1.1 Radiological Impact Analysis Methodology

RADTRAN 4 (Neuhauser and Kanipe 1992) was used to estimate collective impacts to populations from routine transportation of radioactive material and collective population risks from accidents during transport. RADTRAN 4 is organized into eight models:

- material model
- transportation model
- population distribution models
- material models: isotopic compositions and properties
- accident severity and package behavior models
- meteorological dispersion model
- health-effects model
- economic model.

The code uses these models to calculate the potential population dose from normal (routine or incident-free) transportation and to calculate the risk to the population from user-defined accident scenarios.

Collective Population Doses from Routine (Incident-Free) Transport. The RADTRAN 4 incident-free models calculate doses to people on or near the transportation routes from low-level external radiation emitted from the loaded shipping containers. RADTRAN 4 calculates incident-free doses to the following population groups:

- **Persons along the route (referred to as *off-link population*)**. RADTRAN 4 calculates population doses to all persons living or working within 0.8 km (0.5 mi) on each side of a transportation route.

- **Persons sharing the route (*on-link population*)**. Collective doses are calculated for persons in vehicles sharing the transportation route, traveling in the same or in opposite directions.

- **Persons at stops**. RADTRAN 4 calculates collective doses to persons who may be exposed to a shipment while it is at a stop. For truck shipments to/from offsite locations, stops may be made for refueling, food, or rest. For onsite truck shipments, stop times are set to zero because of the short transport distances.

- **Crew members**. Incident-free doses to truck crew members are calculated.

The total collective population doses are the sum of the doses to the off-link population, on-link population, and persons at stops. Worker doses include the doses to truck crewmembers. Note the population doses resulting from onsite shipments are doses to Hanford Site workers that may be adjacent to or nearby a truck shipment of radioactive waste. Onsite shipments of radioactive waste would not expose a member of the public to any significant radioactive dose rate because Hanford Site access restrictions prevent the shipment from approaching locations where a member of the public could be. One exception would be shipments from the 300 Area or 400 Area to the 200 Areas treatment and disposal facilities. The highway from the 300 Area and 400 Area to the Wye Barricade is publicly accessible, and a member of the public (that is, a non-Hanford worker) could conceivably be on the highway at the time a waste shipment is being transported. However, many shipments of radioactive materials from the 300 Area and 400 Area to the 200 East and 200 West Areas are currently conducted during off-shift hours (for example, nights and weekends) and often require closure of the road between the 300 or 400 Area and the Wye Barricade. Consequently, except for this small potential dose to a non-Hanford worker member of the public, the doses to the public referred to in this appendix from onsite shipments are actually doses to Hanford workers who may be driving to/from or at their work locations as a waste shipment passes by. Doses to the public who are non-Hanford workers are associated with shipments of MLLW to offsite treatment facilities and back, offsite shipments of TRU waste to WIPP, and LLW, MLLW, and TRU shipments from offsite generators through Washington and Oregon to Hanford.

Incident-free doses calculated by RADTRAN 4 are generally based on extrapolating the dose rate emitted from the package as a function of distance from a point source. The public and worker doses are dependent upon parameters, such as population density, shipping distance, exposure distance, exposure duration, stop times, traffic density, and the Transportation Index (TI) of the package or packages. The TI is defined as the highest package dose rate (mrem per hour) that would be received by an individual located at a distance of 1 m (3.3 ft) from the external surface of the package. The values used for this and other parameters are presented in Table H.1.

RADTRAN 4 calculations are performed for each origin/destination pair. Onsite population densities and shipping distances are based on Hanford map distances and occupancies in buildings along the routes. The HIGHWAY computer code (Johnson et al. 1993) was used to determine the population densities and shipping distances in Washington and Oregon for shipments from offsite generators to Hanford.

The shipment origins, destinations, shipping distances, and number of shipments to be transported onsite in the Alternatives are presented later in this Appendix. The capacities of the various onsite shipment types are shown below:

- LLW Category 1 and non-conforming LLW – 7.5 m^3/shipment; Category 3 – 3.4 m^3/shipment

- CH MLLW – 3.4 m^3/shipment RH MLLW – 0.6 m^3/shipment; WTP melters – 175 m^3/shipment (one melter/shipment); elemental lead and mercury – 0.5 m^3/shipment

- TRU Drums – 3.4 m^3/shipment; TRU boxes – 5.7 m^3/shipment

- ILAW – 1 ILAW canister/shipment – 2.6 m^3/shipment.

Radioactive Waste Shipping Regulations and Packaging

The two key federal government agencies responsible for ensuring the safety of transporting radioactive materials are the U.S. Department of Transportation (DOT) and U.S. Nuclear Regulatory Commission (NRC). DOT regulations for the safe transportation of radioactive materials are found in Title 49 of the Code of Federal Regulations (49 CFR). NRC regulations are found in 10 CFR 71. These regulations establish a comprehensive set of requirements that assure appropriate packaging (or shipping container) commensurate with the hazard presented by the shipment is used, vehicle (tractor-trailer, railcar) safety and reliability routes are selected to minimize risk where appropriate, drivers are appropriately trained and accredited, and shipments are manifested and placarded in accordance with the level of hazard.

The most important element of ensuring safety is the packaging or shipping containers used to transport the waste materials. Federal regulations, which DOE must comply with for offsite shipments, establish two types of packagings that will be used for offsite transport of waste materials; Type A and Type B. The levels of radioactivity and the specific radionuclides contained in the wastes determine whether a shipment can be transported in a Type A or Type B package. In general, low hazard (i.e., low radioactive content) shipments are transported in Type A packages and high hazard (high radioactive content) shipments must be transported in Type B containers. Type A packages would be used for most LLW and MLLW shipments. These waste types are characterized by relatively low radiation levels and radionuclide concentrations. Type A packages are required to withstand a series of tests referred to as normal conditions of transport without functional failure. Type A packaging tests include a water spray test, drop test, stacking test, and penetration test. Examples of Type A containers used for transporting LLW and MLLW include 210-L (55-gal.) steel drums, steel boxes, and various sizes of concrete and steel shielded cylindrical containers. Type B packages, on the other hand, are used for radioactive materials that have relatively high radionuclide concentrations and/or relatively high concentrations of transuranic radionuclides, such as plutonium and americium. TRU waste and ILAW canisters would be shipped in Type B packages. Type B packages must withstand a series of hypothetical accident conditions that are designed to simulate severe accidents (including impact, puncture, thermal, and water immersion environments) in addition to the normal conditions of transport. Examples of Type B packages include the massive spent nuclear fuel shipping casks and the TRUPACT container being used to transport TRU wastes to WIPP. Properly designed, manufactured, tested, and maintained packaging systems are the backbone of DOE's transportation safety program.

Table H.1. General RADTRAN 4 Parameters for Onsite Waste Shipments[a]

Parameter	Value
Transport Index (dose rate at 1 m from shipping container, mrem/hr)[b]	1
LLW and MLLW	3
CH TRU Waste	7
RH TRU Waste	0.08[c]
Leachate in 5000-gal tanker truck	14[d]
ILAW	
Number of Truck Crew	2
Average Vehicular Speed (km/hr)	
Rural	88
Suburban	40
Urban	24
Stop Time (hr/km)	NA (No stops for onsite shipments)
Number of People Exposed While Stopped	
Average Exposure Distance at Stops	
Number of People per Vehicle Sharing Route	2
Population Densities (persons/km^2)	Route-specific
One-Way Traffic Count (vehicles/hr)	
Rural	470
Suburban	780
Urban	2800

(a) Source of the parameter values is Neuhauser and Kanipe (1992), except where indicated otherwise.
(b) Source: WM PEIS (DOE 1997a).
(c) Based on preliminary shielding calculations performed using the MICROSHIELD™ Computer Code, Version 5.0 (Grove Engineering 1996).
(d) Based on regulatory maximum external dose rate of 10 mrem/hr at 2 m from the shipping container.

Population density information for onsite shipments was obtained from the Spent Nuclear Fuel Programmatic EIS (DOE 1995). For shipments from unspecified locations to the 200 West Area, it was assumed that the origin of the shipment is the 300 Area, the onsite waste generators farthest from the 200 West Area. These shipments were assumed to travel a one-way distance of 40 km (25 mi) through a region defined by three population densities: 1.6 km (1 mi) through a region defined by the 300 Area population density (660 persons/km^2 or 1700 persons/mi^2); 6.4 km (4 mi) through a region defined by the 200 West Area population density (120 persons/km^2 or 300 persons/mi^2); and 32 km (20 mi) through a region with the 600 Area population density (0.14 persons/km^2 or 0.35 persons/mi^2). This analysis is conservative because most of the onsite personnel will be in buildings located on one side of the road or the other, although the code assumes a uniform population density on both sides of the road. Also, many of the shipments will come from the 200 East and 200 West Areas, a much shorter shipping distance than from the 300 Area. For intra-200 West Area shipments (for example, from the Central Waste Complex

[CWC] to the Waste Receiving and Processing Facility [WRAP] or the T Plant Complex to the Low Level Burial Grounds [LLBGs]), a distance of 1 mile (1.6 km) was assumed, and the 200 West Area population density was used. For shipments from the 200 West Area to offsite treatment facilities, a 48-km (30-mi) shipping distance was used. The shipments were assumed to travel 3.2 km (2 mi) in the 300 Area population density region, 6.4 km (4 mi) in the 200 West Area region, and 38.4 km (24 mi) in the 600 Area. ILAW shipments to a 200 East Area disposal facility were modeled as a 1.6 km (1 mi) shipment, 10 percent of which is through an area defined by a population density of 660 persons/km^2 (1700 persons/mi^2) and 90 percent in an area defined by a population density of 0.14 persons/km^2 (0.35 persons/mi^2). ILAW shipments to a 200 West Area disposal facility were modeled as a 16-km (10-mi) shipment, 10 percent of which is through an area defined by a population density of 660 persons/km^2 (1700 persons/mi^2) and 90 percent in an area defined by a population density of 0.14 persons/km^2 (0.35 persons/mi^2).

Table H-2 presents the shipping data for Alternative Group A, Hanford Only waste volume. The table provides the origin and destination for each shipment, the projected waste volume, and the number of shipments. For Alternative Group A, Lower Bound and Upper Bound volume cases, additional wastes are received from offsite generators. The impacts of the shipments from offsite generators are discussed separately in Section H.5. They are not added to the Hanford Only waste-volume case because the analyses of offsite shipments were conducted only for transport through Washington and Oregon.

Shipping data for Alternative Group B is similar to Group A except for ILAW and MLLW shipments. In Group B, the ILAW disposal facility is assumed to be located in the 200 West Area (was assumed to be located near PUREX in Group A); consequently, the shipping distance for ILAW canisters is longer in Alternative Group B than Group A. For MLLW, wastes that were assumed to be shipped offsite are instead shipped to a new treatment facility assumed to be located in the 200 West Area. This significantly reduces the shipping distances for these wastes in Alternative Group B.

Shipping data for Alternative Group C is similar to Group A. The differences between Group C and A are in the technologies deployed to treat and dispose of the waste. For example, LLW is assumed to be disposed in a single, expandable unlined trench in Group C whereas it is disposed of in deeper, wider, lined trenches in Group A. Both the expandable and deeper, wider, unlined disposal facilities are assumed to be located in the 200 West Area, and therefore there would be only minimal differences in shipping data between the two Alternative Groups. Similarly, MLLW is assumed to be disposed in a single expandable lined trench in Group C and deeper, wider lined trenches in Group A. Because both types of lined-trench disposal facilities are assumed to be located in the 200 East Area, there would be no differences in shipping data.

Alternative Group A also forms the base for Alternative Groups D and E. The main differences between these alternatives and the effects on shipping data are as follows. Treatment of all waste types is identical in all three Groups. The difference between the three Alternative Groups is in the location of disposal facilities for LLW (three locations in or near the 200 East Area in Alternative Group D versus 200 West Area for Group A). Because most of these wastes were assumed to be transported from the 300 Area to 200 Area disposal facilities to bound the impacts, the exact locations of the disposal facilities have little impact on the results.

Table H.2. Shipping Data – Alternative Group A, Hanford Only Waste Volume

Waste Stream	Origin	Destination	Waste Volume, m³	Number of Shipments[(a)]
LLW				
WRAP				
1b - LLW Cat. 1	300 Area	WRAP	3326	443
2c - LLW Cat. 3	300 Area	WRAP	1462	430
T Plant Complex				
1b2 - LLW Cat. 1	WRAP	T-Plant	274	37
2c2 - LLW Cat. 3	WRAP	T-Plant	143	42
Offsite Commercial Facilities	CWC	Comm Treat	299	40
Repackage in HICs or Trench Grouting				
2a - LLW Cat 3 Direct Disposal	300 Area	LLBG	35,372	10,404
2c1 - LLW Cat 3 from WRAP	WRAP	LLBG	1318	388
2c2 - LLW Cat 3 from T Plant	T-Plant	LLBG	214	63
LLBG				
1a - LLW Cat 1 Direct Disposal	300 Area	LLBG	66,522	8870
1a - LLW Cat 1 from stream 11	300 Area	LLBG	158	21
1b1 - LLW Cat 1 from WRAP	WRAP	LLBG	3034	405
1b2 - LLW Cat 1 from T Plant	T-Plant	LLBG	411	55
6 - Non-Conforming LLW	Comm Treat	LLBG	598	80
MLLW				
WRAP				
11 - Wastes ready for disposal	300 Area	WRAP	187	55
13 - Waste verification	CWC	WRAP	2684	789
13 - Post treatment verification	WRAP	CWC	2684	789
MLLW reclassified as LLW	WRAP	LLBG	18	5
Modified T Plant				
12 - RH MLLW	CWC	T-Plant	2839	4732
Commercial Treatment Facilities				
13A - CH Standard (non-thermal)	CWC	Offsite	20,108	2801
13B - CH Standard (thermal)	CWC	ORR	6727	946
14 - Elemental Lead	CWC	Offsite	600	1200
15 - Elemental Mercury	CWC	Offsite	21	42
MW Enhanced Trench Design				
11 - Wastes ready for disposal	300 Area	MW Trench	26,682	7848
22 - WTP Melters	200E Area	MW Trench	3205	18
11 - From WRAP verification	WRAP	MW Trench	187	55
12 - RH MLLW from Modified T Plant	T-Plant	MW Trench	4066	6777
13A - CH Standard (non-thermal)	Offsite	MW Trench	36,195	5602
13B - CH Standard (thermal)	ORR	MW Trench	6054	946
14 - Elemental Lead	Offsite	MW Trench	1200	2400
15 - Elemental Mercury	Offsite	MW Trench	42	84

Table H2. (contd)

Waste Stream	Origin	Destination	Waste Volume, m^3	Number of Shipments[(a)]
TRU				
WRAP				
4A - Retrievably Stored Drums in Trenches	LLBG	WRAP	3714	1092
9 - Drums	300 Area	WRAP	5933	1745
9 - SWBs	300 Area	WRAP	20,937	3673
Storage in T Plant Complex				
#17 - K-Basin Sludge	K-Basin	T-Plant	139	41
WIPP	See Section H.5			
LLBG				
4A - TRU drums assayed in trench as LLW				
4A - Empty containers sent to LLBG for disposal	WRAP	LLBG	371	49
9 - drums assayed in WRAP as LLW	WRAP	LLBG	305	41
10A - Newly generated CH Non-standard	300 Area	CWC	492	145
10B - Newly-generated RH Waste	300 Area	CWC	2112	3520
10 - TRU Waste Processed at T-Plant	T-Plant	LLBG	215	29
ILAW				
Immobilized Low Activity Waste	WTP	200 E Disposal	211,000	97,235

(a) Due to rounding, the number of shipments may not match exactly the result of dividing the volume shipped by the shipment capacity.
RH = remote-handled
CH = contact-handled
LDR = land disposal restriction
WTP = Waste Treatment Plant.
ORR = Oak Ridge Reservation
SWB = Standard Waste Box
NWPF = New Waste Processing Facility

Shipping data for the No Action Alternative is presented in Table H.3. Key differences between the No Action Alternative and the other alternatives are that many waste streams are stored rather than being treated and disposed. This substantially reduces the amount of transportation required to manage solid wastes.

To provide a conservative analysis, waste sent from Hanford for thermal treatment was assumed to go to the Oak Ridge Reservation (ORR). For shipments of waste from Hanford to the ORR for treatment and then back to Hanford for disposal, per-shipment impacts were taken directly from a previous Environmental Assessment (EA) that evaluated the impacts of transporting LLW from the ORR to Hanford (DOE 2001). No adjustments were made to reflect the assumed larger shipping capacities used in the EA (eighty 55-gal drums per shipment in the ORR EA versus 18 drums per shipment assumed in this EIS), except the numbers of shipments were calculated using 18 drums per shipment. Important parameters that remained the same included the radiological inventories, external radiation dose rates, packaging-system release parameters, fractional occurrences of accidents in the various severity categories, and dosimetry parameters. Note that the ORR EA conducted route-specific impact analyses for these

Table H.3. Shipping Data for the No Action Alternative

Waste Stream	Origin	Destination	Volume Shipped, m^3	Number of Shipments[(a)]
LLW				
WRAP				
1b - LLW Cat. 1	300 Area	WRAP	3326	443
2c - LLW Cat. 3	300 Area	WRAP	1462	430
T-Plant Complex				
1b2 - LLW Cat. 1	WRAP	T-Plant	274	37
2c2 - LLW Cat. 3	WRAP	T-Plant	143	42
Repackage in HICs or Trench Grouting				
2a - LLW Cat 3 Direct Disposal	300 Area	LLBG	35,372	10,404
2c1 - LLW Cat 3 from WRAP	WRAP	LLBG	1318	388
2c2 - LLW Cat 3 from T Plant	T-Plant	LLBG	214	63
LLBG				
1a - LLW Cat 1 Direct Disposal	300 Area	LLBG	66,522	8870
1a - LLW Cat 1 from stream 11	300 Area	LLBG	158	21
1b1 - LLW Cat 1 from WRAP	WRAP	LLBG	3034	405
1b2 - LLW Cat 1 from T Plant	T-Plant	LLBG	411	55
MLLW				
WRAP				
11 - Wastes ready for disposal	300 Area	WRAP	187	55
13 - Waste verification	CWC	WRAP	2684	789
13 - Post treatment verification	CWC	WRAP	36	11
MLLW reclassified as LLW	WRAP	LLBG	18	5
Commercial Treatment Facilities				
13B - CH Standard (thermal)	CWC	ORR	360	106
MW Existing Trenches				
11 - Wastes ready for disposal	300 Area	MW Trench	25,942	7630
CH-MLLW	CWC	MW Trench		
RH-MLLW	CWC	MW Trench		
11 - From WRAP verification	WRAP	MW Trench	113	33
13B - CH Standard (thermal)	ORR	MW Trench	360	106
14 - Elemental Lead	300 Area	CWC	155	310
15 - Elemental Mercury	300 Area	CWC	8	16
TRU				
WRAP				
4A - Retrievably Stored Drums in Trenches	LLBG	WRAP	3714	1092
9 - CH - Standard Containers (55-gal drums and SWBs)				
Drums	300 Area	WRAP	5933	1745
SWBs	300 Area	WRAP	20,937	3673
Storage in T Plant Complex				
17 - K-Basin Sludge	K-Basin	T-Plant	139	41
WIPP	Hanford	WIPP	See Section H.5	

Table H3. (contd)

Waste Stream	Origin	Destination	Volume Shipped, m^3	Number of Shipments[(a)]
LLBG				
4A - Empty containers sent to LLBG for disposal	WRAP	LLBG	371	50
9 - drums assayed in WRAP as LLW	WRAP	LLBG	305	41
10A - Newly generated CH Non-standard	300 Area	CWC	492	145
10B - Newly-generated RH Waste	300 Area	CWC	2112	3520

(a) Due to rounding, the number of shipments may not match exactly the result of dividing the volume shipped by the shipment capacity.
RH = remote-handled
CH = contact-handled
LDR = land disposal restriction
WTP = Waste Treatment Plant.
ORR = Oak Ridge Reservation
SWB = Standard Waste Box
NWPF = New Waste Processing Facility

shipments. Also note that the incident-free dose risk to the public and truck crews should be comparable to those calculated here because the external dose rates are assumed to be the same in the ORR EA as they are at Hanford. Radiological accident risks should be slightly higher than those calculated for Hanford because the radionuclide inventories assumed here are for only eighteen 55-gal drums of waste. Those used in the ORR EA assumed eighty 55-gal drums per shipment. Finally, the ORR EA did not estimate the number of accidents projected to occur during the shipments. These impacts were estimated in this EIS by multiplying the estimated non-radiological fatalities due to traffic accidents by the ratio of the mean national accident rate to the mean national fatality rate given by Saricks and Tompkins (1999, Table 4). This ratio amounts to about one fatality per 46 heavy-combination truck accidents. The reader is referred to DOE (2001) for additional information about the ORR shipments. Shipments to non-thermal treatment facilities were assumed to be transported to a facility adjacent to the Hanford Site.

Radiological Accident Risks. RADTRAN 4 performs accident risk assessment by combining the probabilities and consequences of accidents to produce a risk value. RADTRAN 4 considers a spectrum of potential transportation accidents, ranging from those with high frequencies and low consequences (for example, fender benders) to those with low frequencies and high consequences (accidents in which the shipping container is exposed to severe mechanical and thermal conditions).

Accident analysis in RADTRAN 4 is performed using an accident severity and package release model. The user can define up to 20 severity categories for 3 population densities (urban, suburban, and rural), each category increasing in magnitude. Severity categories are related to fire, puncture, crush, and immersion environments created in vehicular accidents. For this study, the eight severity categories defined in NUREG-0170 (NRC 1977) were adopted. Severity Category I represents minor accidents in which the packaging system retains confinement of the cargo (that is, no release). Higher severity categories represent more severe accident conditions with correspondingly higher releases and lower probabilities.

Each severity category has an assigned conditional probability (or the probability, given an accident occurs that it will be of the specified severity). The accident scenarios are further defined by allowing the user to input release fractions and aerosol and respirable fractions for each severity category. These fractions are also a function of the physical-chemical properties of the materials transported. RADTRAN 4 default values for similar generic materials were used in this analysis. For example, Category 1 solid wastes were modeled as a generic small-powder-material form. Using this definition, the Category 1 LLW solids will have an aerosol fraction of 0.10 (that is, 10 percent aerosol-size particles) and a respirable fraction of 0.05 (or 5 percent of the aerosol-size particles are also respirable-size particles). These parameters were used for all onsite shipments of solid materials, including Category 1 LLW, Category 3 LLW, Greater than Class 3 (GTC3) LLW, MLLW, and TRU waste. LLW Category 1 organic liquid wastes were assigned to a generic liquid material form in which the aerosol and respirable fractions are set to 1.0. Table H.4 shows the input parameters used in this analysis of onsite and offsite shipments in 55-gal drums and boxes as well as ILAW canisters. Note that the release fractions used are very conservative for ILAW, which will be transported in a massive steel container that is much less likely to fail in accident conditions than a drum or box shipment. Concentrations of radioactive materials that were used to calculate the per-shipment inventories of each material, taken from the Technical Information Document FH (2003), are shown in Table H.5. Note that only a few streams are presented in Table H.5. Readers are referred to the Technical Information Document (FH 2003) for information on other waste streams.

For accidents that result in a release of radioactive material, RADTRAN 4 assumes the material is dispersed into the environment according to standard Gaussian diffusion models. The code allows the user to choose two different methods for modeling the atmospheric transport of radionuclides after a potential accident. The user can either input Pasquill atmospheric-stability category data or averaged time-integrated concentrations. In this analysis, the default standard cloud option (uses time-integrated concentrations) within RADTRAN 4 was used.

RADTRAN 4 calculates the population dose from the released radioactive material for four exposure pathways. These pathways are

1. external dose from exposure to the passing cloud of radioactive material

2. external dose from radionuclides deposited on the ground by the passing plume

3. internal dose from inhalation of airborne radioactive contaminants

4. internal dose from ingestion of contaminated food.

Standard radionuclide uptake and dosimetry models are incorporated into RADTRAN 4. The computer code combines the accident consequences and frequencies of each severity category, sums over the severity categories, and then integrates over all the shipments. Accident-risk impacts that are provided in the form of a collective population dose (person-rem over the entire shipping campaign) are then converted to population risk using health-effects conversion factors. The dose to risk factors, which

Table H.4. RADTRAN 4 Accident Parameters for Trucks

Accident Rate			
Onsite[a] – Hanford Sitewide Average – 1.14E-7 accidents per mile			
Fractional Occurrence by Severity Category (Conditional Probability Given an Accident Occurs)[a]			
Severity Category			
I	0.55		
II	0.36		
III	0.07		
IV	0.016		
V	0.0028		
VI	0.0011		
VII	8.5E-5		
VIII	1.5E-5		
Fractional Occurrence by Population Zone (Conditional Probability Given an Accident Occurs of the Specified Severity)[a]			
	Rural	**Suburban**	**Urban**
I	0.1	0.1	0.8
II	0.1	0.1	0.8
III	0.3	0.4	0.3
IV	0.3	0.4	0.3
V	0.5	0.3	0.3
VI	0.7	0.2	0.1
VII	0.8	0.1	0.1
VIII	0.9	0.05	0.05
Release Fraction (Fraction of Container Contents Released from Shipment by Severity Category)[b]			
I	0		
II	0.01		
III	0.1		
IV	1		
V	1		
VI	1		
VII	1		
VIII	1		

(a) Data taken from NUREG-0170 (NRC 1977) for Type A shipments (see Text Box on Page H.6).
(b) Source: Green et al. (1996).

Table H.5. Radionuclide Concentrations (Ci/m^3) Used to Calculate Per-Shipment Inventories[a]

Radionuclide	LLW Cat 1	LLW Cat 3	MLLW	TRU Waste	ILAW
Am-241	6.41E-6	7.94E-3	0	3.17E+0	1.1E-1
C-14	7.02E-5	2.25E-5	0	0	0
Cm-244	0	1.00E-3	0	0	1.1E-3
Co-60	1.07E-3	5.27E-2	3.18E-8	0	4.4E-2
Cs-137/Ba-137m	1.01E-4	9.77E+0	1.70E-6	8.17E-2	9.6E+0
Fe-55	2.46E-3	5.24E-2	0	0	0
H-3	4.49E+0	1.62E-3	0	0	0
Mn-54	3.29E-3	7.78E-3	0	0	0
Ni-59	2.60E-4	8.87E-6	0	0	1.8E-3
Ni-63	8.62E-4	8.75E-2	0	0	1.7E-1
Pu-238	2.16E-6	1.97E-3	0	7.21E-1	5.1E-4
Pu-239	3.11E-5	9.44E-3	0	2.74E+0	3.2E-2
Pu-240	7.87E-6	3.73E-3	0	1.54E+0	5.5E-3
Pu-241	2.11E-4	2.23E-1	0	5.77E+1	7.5E-2
Pu-242	1.77E-8	1.70E-6	0	6.25E-5	4.7E-7
Sr-90 / Y-90	1.20E-4	1.24E+1	1.60E-7	6.73E-2	4.7E+1
Tc-99	1.37E-5	9.59E-3	1.17E-3	0	1.6E-2
U-233	0	1.49E-5	0	0	1.4E-3
U-234	0	1.89E-2	0	0	4.6E-4
U-235	0	5.40E-4	1.13E-7	0	1.9E-5
U-236	0	2.44E-3	0	0	1.5E-5
U-238	0	3.04E-2	1.18E-4	0	5.1E-4
(a) Source: FH 2003.					

were taken from the International Commission on Radiological Protection (ICRP) Publication 60 (ICRP 1991), infer 4.0E-4 latent cancer fatalities (LCFs) per person-rem for workers and 5.0E-4 LCF/person-rem for the general public.

H.1.2 Physical (Non-Radiological) Routine Risks

Non-radiological routine impacts consist of fatalities from pollutants, such as diesel exhaust emitted from vehicles. This category of impacts is not related to the radiological characteristics of the cargo.

Spreadsheet calculations were performed using unit-risk factors (fatalities per km of travel) to derive estimates of the non-radiological impacts. The non-radiological impacts were calculated by multiplying the unit risk factors by the total shipping distances for all of the shipments in each shipping option. Non-radiological unit risk factors for incident-free transport were taken from Rao et al. (1982).

H.1.3 Non-Radiological Accident Risks in Transit

The non-radiological accident impacts of traffic accidents associated with the transportation of radioactive waste are assumed to be comparable to the impacts associated with general transportation activities in the United States. A unit factor (fatalities per km or fatalities per mi) is multiplied by the shipping distance to calculate non-radiological impacts from vehicular accidents. The fatalities are due to vehicular impacts with solid objects, rollovers, or collisions and are not related to the radioactive nature of the cargo being transported. For onsite shipments, the fatality data developed by Saricks and Tompkins (1999) for primary highways in the state of Washington was used in the calculations. Separate unit factors were used to develop estimates of the number of accidents involving the shipments and the number of fatalities resulting from the accidents.

H.1.4 Hazardous Chemical Impact Analysis

The impact of accidental releases of hazardous chemicals from the various waste shipments was addressed differently than accidental releases of LLW, MLLW, and TRU waste. A maximum credible accident involving each shipment was postulated. Hazardous chemical release and atmospheric dispersion calculations were then performed to determine the maximum downwind concentration to which an individual would be exposed. The downwind concentrations were compared to safe exposure levels for each chemical (Emergency Response Planning Guidelines [ERPGs] or Temporary Emergency Exposure Limits [TEELs]; see Section H.6) to determine the potential public and worker impacts.

The formula used to estimate the downwind concentrations of hazardous chemicals is

$$Concentration = \frac{Source\ Inventory \times Respirable\ Release\ Fraction \times \frac{E}{Q}}{Release\ Duration}$$

where E/Q is the atmospheric dispersion coefficient.

Hazardous chemical concentrations for the highest-volume waste streams are presented in Table H.5.

Source inventories for each material shipped were taken from the Technical Information Document (FH 2003). Where necessary, adjustments were made to the 55-gal drum inventories in Table H.6 to account for different waste container sizes and shipment capacities. Release duration was assumed in all cases to be 2 hr. Derivations of the remaining variables in the formula are described in the following paragraphs.

Table H.6. Maximum Hazardous Chemical Inventories

Hazardous Constituent	TEEL-2 Value (mg/m^3)[(a)]	Chemical Inventory in Maximum 55-Gallon Drum,[(b)] kg			
		MLLW[(c)]	TRU Waste[(d)]	Elemental Mercury	Elemental Lead
Acetone	8500	20.0	0	0	0.2
Ammonium fluoride	12.5	7.9	0	0	0
Ammonium nitrate	50	7.9	0	0	0
Ammonium sulfate	500	15.6	0	0	0
Beryllium	0.025	5.7	0.2	0	0
Butyl alcohol	50	1.1	0.5	0	0
Carbon tetrachloride	100	36.6	1.0	0	0
Cyclohexane	1300	3.8	0	0	0
Ethanol	3300	20.2	0.2	0	0
Hydrazine	0.8	8.6	0	0	0
Isopropyl alcohol	400	29.1	0	0	0
Lead	0.25	0	0	0	204
Mercury	0.1	0	0	27.6	0
Methanol	1000	39.2	0	0	0
Methyl ethyl ketone (MEK)	0.2	23.8	0	0	0
Methyl isobutyl ketone	500	33.0	0	0	0
Nitric acid	15	61.0	0.2	0	0
Phosphoric acid	500	52.4	0.3	0	0
Potassium hydroxide	2	56.3	0	0	0
Propane	2100	0	0.4	0	0
Sodium Hydroxide	40	76.5	6.0	0	0
Styrene	250	1.6	0	0	0
Sulfuric acid	10	3.3	1.5	0	0
Tetrahydrofuran	2000	3.0	0	0	0
Toluene	300	104.0	0	0	0
Uranium	1	340	0	0	0
Xylene	200	52.0	4.2	0	0

Note: 0 indicates no data was provided in the source document.
(a) Source: Craig (2001).
(b) Source: FH (2003).
(c) The source terms are representative of CH MLLW. RH MLLW had a lower hazardous chemical content.
(d) The source term is representative of suspect TRU waste in trenches. Other TRU waste chemical source terms were lower.

The maximum credible accident postulated here is assumed to involve a severe impact followed by a fire. The impact condition is assumed to break up the waste form and cause the waste container to fail so the contained material has an open pathway to the environment. A fire is then assumed to occur, resulting in additional damage and turning the waste material into an aerosol. The aerosol and respirable fractions, used for the radiological materials (for example, with LLW Category 1), were set equal to 0.1 and 0.05, respectively, and were also used to characterize the released hazardous chemicals. Therefore, a combined respirable release fraction of 0.005 was used in the calculations.

Because an accident could occur anywhere and at any time during a shipment, predicting the population distributions and weather conditions at the time of the accident is not possible. For this analysis, the concentrations of the hazardous materials at the location of the maximally exposed individual were calculated. The maximally exposed individual (MEI) for onsite shipments was assumed to be a Hanford Site worker located 100 m (109 yd) downwind from the accident location for the entire duration of the release. The dose to the MEI for offsite shipments would be similar. Downwind air concentrations are also a function of wind speed and atmospheric stability class. Accident-analysis guidance from the U.S. Nuclear Regulatory Commission (NRC) was used to characterize the weather conditions at the time of the accident. The wind speed was assumed to be 1 m/s, and Pasquill stability class F (stable conditions) was assumed. These are low-probability wind conditions that tend to overestimate typical concentrations of released materials. The atmospheric dispersion coefficient or E/Q was calculated using NRC Regulatory Guide 1.145 (NRC 1982). The atmospheric dispersion coefficient at 100 m (109 yd) under Pasquill stability class F and 1 m/s wind speed was calculated to be 3.5E-2 s/m^3.

The impacts to the maximum exposed individual were determined by comparing the downwind concentrations of each hazardous chemical to safe exposure levels. The primary source of the exposure levels is Craig (2001), *ERPGs and TEELs for Chemicals of Concern, Rev. 18*. The safe exposure level assumed here is the TEEL-2 (Temporary Emergency Exposure Limit - 2), as defined by Craig (2001). The TEEL-2 concentration is defined as the maximum concentration in air below which nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

H.2 Results of Transportation-Impact Analysis

This section presents the results of the transportation-impact analysis in support of the EIS. Separate subsections are presented for results of Alternative Groups A through E and the No Action Alternative. The accident-impact analysis results for hazardous chemicals are presented in Section H.6. All of the impacts provided in the table are in fatalities except for the estimated number of traffic accidents. Fatalities are expressed in latent cancer fatalities (LCFs) for radiological impacts and routine non-radiological emissions. For non-radiological accidents, impacts are expressed in terms of the predicted number of traffic accidents and physical-trauma-induced fatalities resulting from the traffic accidents. Note that many of the entries in the table are expressed as fractional fatalities, for example, 1E-1 or 0.1 fatalities. The whole-number totals are determined by summing over all waste types and then rounding the sums to the nearest whole number.

The maximum credible accident postulated here is assumed to involve a severe impact followed by a fire. The impact condition is assumed to break up the waste form and cause the waste container to fail so the contained material has an open pathway to the environment. A fire is then assumed to occur, resulting in additional damage and turning the waste material into an aerosol. The aerosol and respirable fractions, used for the radiological materials (for example, with LLW Category 1), were set equal to 0.1 and 0.05, respectively, and were also used to characterize the released hazardous chemicals. Therefore, a combined respirable release fraction of 0.005 was used in the calculations.

Because an accident could occur anywhere and at any time during a shipment, predicting the population distributions and weather conditions at the time of the accident is not possible. For this analysis, the concentrations of the hazardous materials at the location of the maximally exposed individual were calculated. The maximally exposed individual (MEI) for onsite shipments was assumed to be a Hanford Site worker located 100 m (109 yd) downwind from the accident location for the entire duration of the release. The dose to the MEI for offsite shipments would be similar. Downwind air concentrations are also a function of wind speed and atmospheric stability class. Accident-analysis guidance from the U.S. Nuclear Regulatory Commission (NRC) was used to characterize the weather conditions at the time of the accident. The wind speed was assumed to be 1 m/s, and Pasquill stability class F (stable conditions) was assumed. These are low-probability wind conditions that tend to overestimate typical concentrations of released materials. The atmospheric dispersion coefficient or E/Q was calculated using NRC Regulatory Guide 1.145 (NRC 1982). The atmospheric dispersion coefficient at 100 m (109 yd) under Pasquill stability class F and 1 m/s wind speed was calculated to be 3.5E-2 s/m^3.

The impacts to the maximum exposed individual were determined by comparing the downwind concentrations of each hazardous chemical to safe exposure levels. The primary source of the exposure levels is Craig (2001), *ERPGs and TEELs for Chemicals of Concern, Rev. 18*. The safe exposure level assumed here is the TEEL-2 (Temporary Emergency Exposure Limit - 2), as defined by Craig (2001). The TEEL-2 concentration is defined as the maximum concentration in air below which nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

H.2 Results of Transportation-Impact Analysis

This section presents the results of the transportation-impact analysis in support of the EIS. Separate subsections are presented for results of Alternative Groups A through E and the No Action Alternative. The accident-impact analysis results for hazardous chemicals are presented in Section H.6. All of the impacts provided in the table are in fatalities except for the estimated number of traffic accidents. Fatalities are expressed in latent cancer fatalities (LCFs) for radiological impacts and routine non-radiological emissions. For non-radiological accidents, impacts are expressed in terms of the predicted number of traffic accidents and physical-trauma-induced fatalities resulting from the traffic accidents. Note that many of the entries in the table are expressed as fractional fatalities, for example, 1E-1 or 0.1 fatalities. The whole-number totals are determined by summing over all waste types and then rounding the sums to the nearest whole number.

H.2.1 Alternative Group A

The transportation impacts for Alternative Group A, Hanford Only volume is presented in Table H.7. The impacts of shipments from offsite generators, which make up the differences between the Hanford Only, Lower Bound, and Upper Bound waste-volume cases, are addressed in Section H.5.

H.2.2 Alternative Group B

Table H.8 presents the impacts of transporting MLLW under Alternative Group B, Hanford Only waste volume. Note that the shipping parameters for transportation of LLW, TRU waste, and ILAW are the same in this alternative as they are in Alternative Group A. Thus, only the MLLW impacts are presented in Table H.8. Also note that the impacts of shipments from offsite generators, which make up the differences between the Hanford Only, Lower Bound, and Upper Bound waste-volume cases, are addressed in Section H.5.

H.2.3 Alternative Group C

The results of the impact analysis for transport of solid waste under the Alternative Group C are the same as those for Alternative Group A because there are no substantial differences in shipping parameters. Treatment and disposal facilities are located in the same areas of the Hanford Site in both alternatives. Since most of these wastes were assumed to be transported from the 300 Area to 200 Area disposal facilities to bound the impacts, the exact locations of the disposal facilities have little impact on the results.

H.2.4 Alternative Group D

The results of the impact analysis for transport of solid waste under the Alternative Group D are the same as those for Alternative Group A because there are no substantial differences in shipping parameters. See Section H.2.3.

H.2.5 Alternative Group E

The results of the impact analysis for transport of solid waste under the Alternative Group E are the same as those for Alternative Group A because there are no substantial differences in shipping parameters. See Section H.2.3.

H.2.6 No Action Alternative

Table H.9 presents the transportation impacts of the No Action Alternative.

Table H.7. Transportation Impacts of Alternative Group A, Hanford Only Waste Volume[(a)], Number of Fatalities

Waste Stream	Radiological Incident-Free LCFs		Radiological Accident LCFs	Non-radiological Accidents		
	Occupational	Non-Occupational		Number of Accidents	Number of Fatalities	Emissions LCFs
LLW						
WRAP						
1b - LLW Cat. 1	6.3E-04	5.3E-04	2.1E-05	4.0E-03	4.4E-04	3.5E-03
2c - LLW Cat. 3	6.1E-04	5.2E-04	7.2E-04	3.9E-03	4.3E-04	3.4E-03
T Plant Complex						
1b2 - LLW Cat. 1	6.0E-06	1.2E-05	8.3E-07	1.3E-05	1.5E-06	1.2E-05
2c2 - LLW Cat. 3	6.9E-06	1.4E-05	3.6E-05	1.5E-05	1.7E-06	1.3E-05
Offsite Commercial Facilities	2.4E-05	4.8E-05	5.3E-10	4.4E-04	4.8E-05	3.8E-04
Repackage in HICs or Trench Grouting						
2a - LLW Cat 3 Direct Disposal	1.5E-02	1.2E-02	1.7E-02	9.5E-02	1.0E-02	8.2E-02
2c1 - LLW Cat 3 from WRAP	6.4E-05	1.3E-04	3.3E-04	1.4E-04	1.6E-05	1.2E-04
2c2 - LLW Cat 3 from T Plant	1.0E-05	2.1E-05	5.4E-05	2.3E-05	2.5E-06	2.0E-05
LLBG						
1a - LLW Cat 1 Direct Disposal	1.3E-02	1.1E-02	4.2E-04	8.1E-02	8.9E-03	7.0E-02
1a - LLW Cat 1 from stream 11	3.0E-05	2.5E-05	9.9E-07	1.9E-04	2.1E-05	1.7E-04
1b1 - LLW Cat 1 from WRAP	6.7E-05	1.4E-04	9.2E-06	1.5E-04	1.6E-05	1.3E-04
1b2 - LLW Cat 1 from T Plant	9.0E-06	1.8E-05	1.2E-06	2.0E-05	2.2E-06	1.7E-05
6 - Non-Conforming LLW	4.8E-05	9.6E-05	1.1E-09	8.7E-04	9.6E-05	7.6E-04
TOTAL LLW	**2.9E-02**	**2.5E-02**	**1.9E-02**	**1.9E-01**	**2.0E-02**	**1.6E-01**
MLLW						
WRAP						
11 - Wastes ready for disposal	7.8E-05	6.6E-05	2.6E-06	5.0E-04	5.5E-05	4.4E-04
13 - Waste verification	1.3E-04	2.6E-04	1.8E-05	2.9E-04	3.2E-05	2.5E-04
13 - Post treatment verification	1.3E-04	2.7E-04	1.8E-05	2.9E-04	3.2E-05	2.5E-04
MLLW reclassified as LLW	8.7E-07	1.8E-06	1.2E-07	1.9E-06	2.1E-07	1.7E-06
Modified T Plant						
12 - RH MLLW	7.8E-04	1.5E-03	1.1E-03	1.7E-03	1.9E-04	1.5E-03
Commercial Treatment Facilities						
13A - CH Standard (non-thermal)	2.3E-01	5.5E-02	2.1E-07	1.2E+01	2.8E-01	1.2E-02
13B - CH Standard (thermal)	7.7E-02	1.9E-02	6.9E-08	3.9E+00	9.5E-02	3.9E-03
14 - Elemental Lead	0	0	0	1.3E-02	1.4E-03	1.1E-02
15 - Elemental Mercury	0	0	0	4.6E-04	5.0E-05	4.0E-04

Table H7. (contd)

Waste Stream	Radiological Incident-Free LCFs		Radiological Accident LCFs	Non-radiological Accidents		
	Occupational	Non-Occupational		Number of Accidents	Number of Fatalities	Emissions LCFs
MW Enhanced Trench Design						
11 - Wastes ready for disposal	1.1E-02	9.4E-03	3.7E-04	7.2E-02	7.8E-03	6.2E-02
22 - WTP Melters	3.0E-05	5.9E-05	4.2E-05	6.7E-06	7.3E-07	5.8E-06
11 - From WRAP verification	9.1E-06	1.8E-05	1.3E-06	2.0E-05	2.2E-06	1.7E-05
12 - RH MLLW from Modified T Plant	1.1E-03	2.2E-03	1.5E-03	2.5E-03	2.7E-04	2.1E-03
13A - CH Standard (non-thermal)	9.2E-03	8.1E-03	3.2E-04	6.1E-02	6.7E-03	5.3E-02
13B - CH Standard (thermal)	7.7E-02	1.9E-02	6.9E-08	3.9E+00	9.5E-02	3.9E-03
14 - Elemental Lead	0	0	0	2.6E-02	2.9E-03	2.3E-02
15 - Elemental Mercury	0	0	0	9.2E-04	1.0E-04	8.0E-04
TOTAL MLLW	**4.1E-01**	**1.1E-01**	**3.4E-03**	**2.0E+01**	**4.9E-01**	**1.7E-01**
TRU						
WRAP						
4A - Retrievably Stored Drums in Trenches	1.8E-04	3.5E-04	3.5E-04	4.0E-04	4.4E-05	3.5E-04
9 - Drums	2.5E-03	2.1E-03	1.2E-03	1.6E-02	1.7E-03	1.4E-02
9 - SWBs	5.2E-03	4.4E-03	2.5E-03	3.3E-02	3.7E-03	2.9E-02
Storage in T Plant Complex						
#17 - K-Basin Sludge	4.9E-05	3.2E-05	2.3E-06	1.1E-04	1.2E-05	9.7E-05
WIPP						
LLBG	**See Section H.5**					
4A - TRU drums assayed in trench as LLW						
4A - Empty containers sent to LLBG for disposal	8.2E-06	1.7E-05	1.1E-06	1.8E-05	2.0E-06	1.6E-05
9 - drums assayed in WRAP as LLW	6.7E-06	1.4E-05	9.3E-07	1.5E-05	1.6E-06	1.3E-05
10A - Newly generated CH Non-standard	2.4E-05	4.7E-05	3.3E-06	5.3E-05	5.8E-06	4.6E-05
10B - Newly-generated RH Waste	5.8E-04	1.1E-03	8.0E-04	1.3E-03	1.4E-04	1.1E-03
10 - TRU Waste Processed at T-Plant	4.7E-06	9.6E-06	6.5E-07	1.0E-05	1.1E-06	9.1E-06
TOTAL TRU WASTE	**8.6E-03**	**8.1E-03**	**4.9E-03**	**5.1E-02**	**5.6E-03**	**4.5E-02**
ILAW						
Immobilized Low Activity Waste	**5.8E-03**	**1.9E-04**	**3.7E-11**	**3.5E-02**	**3.8E-03**	**3.0E-03**
GRAND TOTAL	**4.5E-01**	**1.5E-01**	**2.7E-02**	**2.0E+01**	**5.2E-01**	**3.8E-01**

Table H.8. MLLW[a] Transportation Impacts of Alternative Group B, Hanford Only Waste Volume, Number of Fatalities

Waste Stream	Radiological Impacts, LCFs		Radiological Accidents	Non-Radiological Impacts		
	Occupa-tional	Non-Occupational		Number of Accidents	Accident Fatalities	Emission, LCFs s
MLLW						
WRAP						
11 - Wastes ready for disposal	7.8E-05	6.6E-05	2.6E-06	5.0E-04	5.5E-05	4.4E-04
13 - Waste verification	1.3E-04	2.6E-04	1.8E-05	2.9E-04	3.2E-05	2.5E-04
13 - Post treatment verification	1.3E-04	2.7E-04	1.8E-05	2.9E-04	3.2E-05	2.5E-04
MLLW reclassified as LLW	8.7E-07	1.8E-06	1.2E-07	1.9E-06	2.1E-07	1.7E-06
Modified T Plant						
12 - RH MLLW	7.8E-04	1.5E-03	1.1E-03	1.7E-03	1.9E-04	1.5E-03
Commercial Treatment Facilities						
13A - CH Standard (non-thermal)	1.3E-03	2.5E-03	1.8E-04	2.8E-03	3.1E-04	2.5E-03
13B - CH Standard (thermal)	4.1E-03	1.0E-03	3.7E-09	2.1E-01	5.1E-03	2.1E-04
14 - Elemental Lead	0	0	0	2.7E-04	3.0E-05	2.4E-04
15 - Elemental Mercury	0	0	0	9.6E-06	1.1E-06	8.3E-06
MW Enhanced Trench Design						
11 - Wastes ready for disposal	1.1E-02	9.4E-03	3.7E-04	7.2E-02	7.8E-03	6.2E-02
22 - WTP Melters	3.0E-05	5.9E-05	4.2E-05	6.7E-06	7.3E-07	5.8E-06
11 - From WRAP verification	9.1E-06	1.8E-05	1.3E-06	2.0E-05	2.2E-06	1.7E-05
12 - RH MLLW from Modified T Plant	1.1E-03	2.2E-03	1.5E-03	2.5E-03	2.7E-04	2.1E-03
13A - CH Standard (non-thermal)	2.3E-03	4.4E-03	3.1E-04	5.0E-03	5.5E-04	4.3E-03
13B - CH Standard (thermal)	4.1E-03	1.0E-03	3.7E-09	2.1E-01	5.1E-03	2.1E-04
14 - Elemental Lead	0	0	0	5.5E-04	6.0E-05	4.8E-04
15 - Elemental Mercury	0	0	0	1.4E-04	1.6E-05	1.2E-04
TOTAL MLLW	**2.5E-02**	**2.3E-02**	**3.6E-03**	**5.1E-01**	**2.0E-02**	**7.5E-02**

Table H.9. Transportation Impacts for the No Action Alternative[(a)], Hanford-only Waste Volume, Number of Fatalities

Waste Type	Radiological Incident-Free Impacts, LCFs		Radio-Logical Accidents LCFs	Non-radiological		
	Occupational	Non-Occupational		Number of Accidents	Accident Fatalities	Emissions, LCFs
LLW						
WRAP						
1b - LLW Cat. 1	6.3E-04	5.3E-04	2.1E-05	4.0E-03	4.4E-04	3.5E-03
2c - LLW Cat. 3	6.1E-04	5.2E-04	7.2E-04	3.9E-03	4.3E-04	3.4E-03
T-Plant Complex						
1b2 - LLW Cat. 1	6.0E-06	1.2E-05	8.3E-07	1.3E-05	1.5E-06	1.2E-05
2c2 - LLW Cat. 3	6.9E-06	1.4E-05	3.6E-05	1.5E-05	1.7E-06	1.3E-05
Repackage in HICs or Trench Grouting						
2a - LLW Cat 3 Direct Disposal	1.5E-02	1.2E-02	1.7E-02	9.5E-02	1.0E-02	8.2E-02
2c1 - LLW Cat 3 from WRAP	6.4E-05	1.3E-04	3.3E-04	1.4E-04	1.6E-05	1.2E-04
2c2 - LLW Cat 3 from T Plant	1.0E-05	2.1E-05	5.4E-05	2.3E-05	2.5E-06	2.0E-05
LLBG						
1a - LLW Cat 1 Direct Disposal	1.3E-02	1.1E-02	4.2E-04	8.1E-02	8.9E-03	7.0E-02
1a - LLW Cat 1 from stream 11	3.0E-05	2.5E-05	9.8E-07	1.9E-04	2.1E-05	1.7E-04
1b1 - LLW Cat 1 from WRAP	6.7E-05	1.4E-04	9.2E-06	1.5E-04	1.6E-05	1.3E-04
1b2 - LLW Cat 1 from T Plant	9.0E-06	1.8E-05	1.2E-06	2.0E-05	2.2E-06	1.7E-05
TOTAL LLW	**2.9E-02**	**2.5E-02**	**1.9E-02**	**1.8E-01**	**2.0E-02**	**1.6E-01**
MLLW						
WRAP						
11 - Wastes ready for disposal	7.8E-05	6.6E-05	2.6E-06	5.0E-04	5.5E-05	4.3E-04
13 - Waste verification	1.3E-04	2.6E-04	1.8E-05	2.9E-04	3.2E-05	2.5E-04
13 - Post treatment verification	1.7E-06	3.6E-06	2.4E-07	3.9E-06	4.2E-07	3.4E-06
MLLW reclassified as LLW	8.5E-07	1.7E-06	1.2E-07	1.9E-06	2.1E-07	1.6E-06
Commercial Treatment Facilities						
13B - CH Standard (thermal)	1.3E-02	2.5E-03	9.4E-09	4.5E-01	1.1E-02	4.5E-04
MW Existing Trenches						
11 - Wastes ready for disposal	1.1E-02	9.2E-03	3.6E-04	7.0E-02	7.6E-03	6.0E-02
11 - From WRAP verification	5.5E-06	1.1E-05	7.6E-07	1.2E-05	1.3E-06	1.1E-05
13B - CH Standard (thermal)	1.3E-02	2.5E-03	9.4E-09	4.5E-01	1.1E-02	4.5E-04
14 - Elemental Lead	0	0	0	2.8E-03	3.1E-04	2.5E-03

Table H9. (contd)

Waste Type	Radiological Incident-Free Impacts, LCFs		Radio-Logical Accidents LCFs	Non-radiological		
	Occupational	Non-Occupational		Number of Accidents	Accident Fatalities	Emissions, LCFs
15 - Elemental Mercury	0	0	0	1.5E-04	1.6E-05	1.3E-04
TOTAL MLLW	**3.7E-02**	**1.5E-02**	**3.8E-04**	**9.6E-01**	**2.9E-02**	**6.5E-02**
TRU						
WRAP						
4A - Retrievably Stored Drums in Trenches	1.8E-04	3.5E-04	3.5E-04	4.0E-04	4.4E-05	3.5E-04
9 - CH - Standard Containers (55-gal drums and SWBs)						
Drums	2.5E-03	2.1E-03	1.2E-03	1.6E-02	1.7E-03	1.4E-02
SWBs	5.2E-03	4.4E-03	2.5E-03	3.3E-02	3.7E-03	2.9E-02
Storage in T Plant Complex						
17 - K-Basin Sludge	4.9E-05	3.2E-05	2.3E-06	1.1E-04	1.2E-05	9.7E-05
WIPP	See Section H.5					
LLBG						
4A - Empty containers sent to LLBG for disposal	8.2E-06	1.7E-05	1.1E-06	1.8E-05	2.0E-06	1.6E-05
9 - drums assayed in WRAP as LLW	6.7E-06	1.4E-05	9.3E-07	1.5E-05	1.6E-06	1.3E-05
10A - Newly generated CH Non-standard	2.4E-05	4.7E-05	3.3E-06	5.3E-05	5.8E-06	4.6E-05
10B - Newly-generated RH Waste	5.8E-04	1.1E-03	8.0E-04	1.3E-03	1.4E-04	1.1E-03
TOTAL TRU WASTE	**8.6E-03**	**8.1E-03**	**4.9E-03**	**5.1E-02**	**5.6E-03**	**4.5E-02**
ILAW	Inter-facility transfer					
GRAND TOTAL	**7.5E-02**	**4.7E-02**	**2.4E-02**	**1.2E+00**	**5.5E-02**	**2.7E-01**

H.2.6 Summary of Impacts

Table H.10 summarizes the radiological and non-radiological impacts of each Alternative Group. The results in the table indicate that Alternative Group B results in the lowest transportation impacts of all the alternatives. This is because most MLLW is treated onsite in this alternative so there are fewer offsite shipments of MLLW in Alternative Group B than were projected in the other Alternative Groups. Note that none of the alternatives is projected to result in any radiological fatalities. Only Alternative Group B is projected to result in a non-radiological fatality due to a traffic accident (recall that Group B includes

Table H.10. Summary of Impacts of Shipping Hanford Only Wastes for Each Alternative Group[(a)]

Waste Type	Radiological Impacts, LCFs			Non-Radiological Impacts		
	Occupational	Non-Occupational	Radiological Accidents	Number of Accidents	Accident Fatalities	Emissions, LCFs
Alternative Groups A, C, D, and E[(b)]						
LLW	2.9E-2	2.5E-2	1.9E-2	1.9E-1	2.0E-2	1.6E-1
MLLW	4.1E-1	1.1E-1	3.4E-3	2.0E+1	4.9E-1	1.7E-1
TRU Waste	8.0E-3	6.9E-3	4.1E-3	5.0E-2	5.5E-3	4.3E-2
ILAW	5.8E-3	1.9E-4	3.7E-11	3.5E-2	3.8E-3	3.0E-3
Total	**0** (4.5E-1)	**0** (1.5E-1)	**0** (2.7E-2)	**20** (2.0E+1)	**1** (5.2E-1)	**0** (3.8E-1)
Alternative Group B[(b)]						
LLW	2.9E-2	2.5E-2	1.9E-2	1.9E-1	2.0E-2	1.6E-1
MLLW	2.5E-2	2.3E-2	3.6E-3	5.1E-1	2.0E-2	7.5E-2
TRU Waste	8.0E-3	6.9E-3	4.1E-3	5.0E-2	5.5E-3	4.3E-2
ILAW	5.8E-3	1.9E-4	3.7E-11	3.5E-2	3.8E-3	3.0E-3
Total	**0** (6.9E-2)	**0** (5.6E-2)	**0** (2.7E-2)	**1** (7.8E-1)	**0** (4.9E-2)	**0** (2.8E-1)
No Action Alternative						
LLW	2.9E-2	2.5E-2	1.9E-2	1.8E-1	2.0E-2	1.6E-1
MLLW	3.7E-2	1.5E-2	3.8E-4	9.6E-1	2.9E-2	6.5E-2
TRU Waste	8.6E-3	8.1E-3	4.9E-3	5.1E-2	5.6E-3	4.5E-2
Total[(c)]	**0** (7.5E-2)	**0** (4.7E-2)	**0** (2.4E-2)	**1** (1.2E+0)	**0** (5.5E-2)	**0** (2.7E-1)

Note: Public includes non-involved workers.

(a) Radiological impacts (incident-free and accident) are expressed in units of LCFs. Non-radiological accident impacts are expressed as the expected number of accidents and the resulting physical trauma fatalities. Non-radiological emissions impacts are expressed as LCFs.

(b) The impacts in these areas are for the Hanford Only waste volume case. Impacts are included for shipments of MLLW to offsite treatment facilities and back. The impacts in Washington and Oregon from offsite shipments are presented in Table 5.16.

(c) No transportation impacts are included for transfer of ILAW cullet between the WTP and the adjacent grout vault used for ILAW disposal because of their close proximity.

offsite shipments of MLLW to the ORR for treatment and then return of the treated waste to Hanford). Even so, the differences in impacts among the alternatives are small.

H.3 Impacts of Transporting Construction and Capping Materials

This section evaluates the impacts of transporting materials required to construct new facilities, such as new disposal trenches and treatment facilities, as well as materials required to cap the disposal facilities after they are filled with waste. The quantities of these materials, which include concrete, asphalt, basalt, and concrete, are compiled for each alternative in Section 5.10. This section evaluates the impacts of

Table H.10. Summary of Impacts of Shipping Hanford Only Wastes for Each Alternative Group[(a)]

Waste Type	Radiological Impacts, LCFs			Non-Radiological Impacts		
	Occupational	Non-Occupational	Radiological Accidents	Number of Accidents	Accident Fatalities	Emissions, LCFs
Alternative Groups A, C, D, and E[(b)]						
LLW	2.9E-2	2.5E-2	1.9E-2	1.9E-1	2.0E-2	1.6E-1
MLLW	4.1E-1	1.1E-1	3.4E-3	2.0E+1	4.9E-1	1.7E-1
TRU Waste	8.0E-3	6.9E-3	4.1E-3	5.0E-2	5.5E-3	4.3E-2
ILAW	5.8E-3	1.9E-4	3.7E-11	3.5E-2	3.8E-3	3.0E-3
Total	**0** (4.5E-1)	**0** (1.5E-1)	**0** (2.7E-2)	**20** (2.0E+1)	**1** (5.2E-1)	**0** (3.8E-1)
Alternative Group B[(b)]						
LLW	2.9E-2	2.5E-2	1.9E-2	1.9E-1	2.0E-2	1.6E-1
MLLW	2.5E-2	2.3E-2	3.6E-3	5.1E-1	2.0E-2	7.5E-2
TRU Waste	8.0E-3	6.9E-3	4.1E-3	5.0E-2	5.5E-3	4.3E-2
ILAW	5.8E-3	1.9E-4	3.7E-11	3.5E-2	3.8E-3	3.0E-3
Total	**0** (6.9E-2)	**0** (5.6E-2)	**0** (2.7E-2)	**1** (7.8E-1)	**0** (4.9E-2)	**0** (2.8E-1)
No Action Alternative						
LLW	2.9E-2	2.5E-2	1.9E-2	1.8E-1	2.0E-2	1.6E-1
MLLW	3.7E-2	1.5E-2	3.8E-4	9.6E-1	2.9E-2	6.5E-2
TRU Waste	8.6E-3	8.1E-3	4.9E-3	5.1E-2	5.6E-3	4.5E-2
Total[(c)]	**0** (7.5E-2)	**0** (4.7E-2)	**0** (2.4E-2)	**1** (1.2E+0)	**0** (5.5E-2)	**0** (2.7E-1)

Note: Public includes non-involved workers.
(a) Radiological impacts (incident-free and accident) are expressed in units of LCFs. Non-radiological accident impacts are expressed as the expected number of accidents and the resulting physical trauma fatalities. Non-radiological emissions impacts are expressed as LCFs.
(b) The impacts in these areas are for the Hanford Only waste volume case. Impacts are included for shipments of MLLW to offsite treatment facilities and back. The impacts in Washington and Oregon from offsite shipments are presented in Table 5.16.
(c) No transportation impacts are included for transfer of ILAW cullet between the WTP and the adjacent grout vault used for ILAW disposal because of their close proximity.

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transporting these materials from their points of origin to the appropriate Hanford Site facility. Note that only the non-radiological impacts of transportation accidents are evaluated. No radiological impacts would occur (Rao et al. 1982).

The non-radiological accident impacts of transporting construction materials were calculated by first determining the numbers of shipments of each material. This calculation was done by dividing the total material requirements by the capacity of a typical shipment. Typically, the shipment capacities are limited to about 40,000 lb (18,140 kg) of cargo to ensure that the shipments are below legal-weight truck limits (80,000 lb [36,290 kg] gross vehicle weight in most states). The next step was to determine the total distance traveled by these shipments or the product of the round-trip shipping distance and the number of shipments. Finally, the projected numbers of fatalities were determined by multiplying the travel distances times the accident and fatality rates for heavy-combination truck shipping. The accident rate used in this analysis was 1.75E-7 accidents per truck-km (2.8E-7 accidents per truck-mile), and the fatality rate was 7.5E-9 fatalities per truck-km (1.2E-8 fatalities per truck-mile). These rates are representative of accident and fatality rates on Washington State primary highways, similar to the highways and roadways to be used for most of the shipments. The rates used in this analysis were taken from Saricks and Tompkins (1999).

Table H.11 presents the input data and results of the impact analysis for the transport of construction and capping materials. The table includes the estimated impacts associated with each Alternative Group and waste-volume case. Although accidents are expected to occur, in no case were any fatalities projected to occur associated with the transport of construction and capping materials.

The results in Table H.11 indicate that there are not large differences in impacts among the Alternative Groups. For the Hanford Only waste-volume cases, the projected fatalities ranged from about 0.06 for Alternative Groups C, D, and E to 0.15 fatalities for the No Action Alternative. The impacts of all Alternative Groups except for the No Action Alternative are dominated by transport of asphalt, gravel/sand, silt/loam, and basalt, and bentonite to use as capping materials. The impacts for the No Action Alternative are dominated by the transport of steel and concrete.

H.4 Impacts on Traffic

The potential for adverse impacts on traffic would be limited to those associated with the transport of construction materials from offsite, which would be predominantly 4- to 6-lane highways south of the Hanford Site; traffic congestion would not be expected. The transport of the majority of capping resources would be onsite as material from Area C would be delivered under State Route (SR) 240 by conveyors to a holding area in Area B on the Hanford Site east of SR 240. For a conservative view, the transportation-impact analysis assumed that all transport of capping material is by truck.

H.5 Offsite Transportation Impacts

This section presents the transportation-impact analysis for shipping LLW and MLLW to Hanford from offsite generators and for shipping TRU Waste to WIPP.

transporting these materials from their points of origin to the appropriate Hanford Site facility. Note that only the non-radiological impacts of transportation accidents are evaluated. No radiological impacts would occur (Rao et al. 1982).

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H.5 Offsite Transportation Impacts

This section presents the transportation-impact analysis for shipping LLW and MLLW to Hanford from offsite generators and for shipping TRU Waste to WIPP.

Table H.11. Impacts of Transporting Construction and Backfill Materials

Alternative		Total Material	Shipment Capacity	Total Shipments	Shipment Source	One-way Distance	Total Miles Traveled	Accidents	Fatalities
A	**Hanford Only**								
	Asphalt (1000 m^3)	392	12 m^3	32,667	Offsite	45	2.9E+06	5.1E-01	2.2E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2394	20 m^3	119,700	Area C	15	3.6E+06	6.3E-01	2.7E-02
	Steel (MT)	1720	10 MT	172	Unspecified	1000	3.4E+05	6.0E-02	2.6E-03
	Concrete (1000 m^3)	8	10 m^3	831	Offsite	45	7.5E+04	1.3E-02	5.6E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1000	1.5E+06	2.6E-01	1.1E-02
	TOTAL						8.4E+06	1.5E+00	6.3E-02
	Lower Bound Volume								
	Asphalt (1000 m^3)	394	12 m^3	32,833	Offsite	45	3.0E+06	5.2E-01	2.2E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2405	20 m^3	120,250	Area C	15	3.6E+06	6.3E-01	2.7E-02
	Steel (MT)	1870	10 MT	187	Unspecified	1000	3.7E+05	6.5E-02	2.8E-03
	Concrete (1000 m^3)	10	10 m^3	991	Offsite	45	8.9E+04	1.6E-02	6.7E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1000	1.5E+06	2.6E-01	1.1E-02
	TOTAL						8.5E+06	1.5E+00	6.4E-02
	Upper Bound Volume								
	Asphalt (1000 m^3)	416	12 m^3	34,667	Offsite	45	3.1E+06	5.5E-01	2.3E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2500	20 m^3	125,000	Area C	15	3.8E+06	6.6E-01	2.8E-02
	Steel (MT)	2280	10 MT	228	Unspecified	1000	4.6E+05	8.0E-02	3.4E-03
	Concrete (1000 m^3)	14	10 m^3	1431	Offsite	45	1.3E+05	2.3E-02	9.7E-04
	Bentonite (MT)	18,200	19 MT	958	Wyoming	1000	1.9E+06	3.4E-01	1.4E-02
	TOTAL						9.4E+06	1.6E+00	7.0E-02

Table H.11. (contd)

Alternative		Total Material	Shipment Capacity	Total Shipments	Shipment Source	One-way Distance	Total Miles Traveled	Accidents	Fatalities
B	**Hanford Only**								
	Asphalt (1000 m^3)	438	12 m^3	36,500	Offsite	45	3.3E+06	5.7E-01	2.5E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2552	20 m^3	127,600	Area C	15	3.8E+06	6.7E-01	2.9E-02
	Steel (MT)	1800	10 MT	180	Unspecified	1000	3.6E+05	6.3E-02	2.7E-03
	Concrete (1000 m^3)	10	10 m^3	1021	Offsite	45	9.2E+04	1.6E-02	6.9E-04
	Bentonite (MT)	33,600	19 MT	1768	Wyoming	1000	3.5E+06	6.2E-01	2.7E-02
	TOTAL						1.1E+07	1.9E+00	8.3E-02
	Lower Bound Volume								
	Asphalt (1000 m^3)	444	12 m^3	37,000	Offsite	45	3.3E+06	5.8E-01	2.5E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2593	20 m^3	129,650	Area C	15	3.9E+06	6.8E-01	2.9E-02
	Steel (MT)	1950	10 MT	195	Unspecified	1000	3.9E+05	6.8E-02	2.9E-03
	Concrete (1000 m^3)	12	10 m^3	1231	Offsite	45	1.1E+05	1.9E-02	8.3E-04
	Bentonite (MT)	33,600	19 MT	1768	Wyoming	1000	3.5E+06	6.2E-01	2.7E-02
	TOTAL						1.1E+07	2.0E+00	8.4E-02
	Upper Bound Volume								
	Asphalt (1000 m^3)	498	12 m^3	41,500	Offsite	45	3.7E+06	6.5E-01	2.8E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2827	20 m^3	141,350	Area C	15	4.2E+06	7.4E-01	3.2E-02
	Steel (MT)	2380	10 MT	238	Unspecified	1000	4.8E+05	8.3E-02	3.6E-03
	Concrete (1000 m^3)	16	10 m^3	1631	Offsite	45	1.5E+05	2.6E-02	1.1E-03
	Bentonite (MT)	57,600	19 MT	3032	Wyoming	1000	6.1E+06	1.1E+00	4.5E-02
	TOTAL						1.5E+07	2.6E+00	1.1E-01

Table H.11. (contd)

Alternative		Total Material	Shipment Capacity	Total Shipments	Shipment Source	One-way Distance	Total Miles Traveled	Accidents	Fatalities
C	**Hanford Only**								
	Asphalt (1000 m^3)	372	12 m^3	31,000	Offsite	45	2.8E+06	4.9E-01	2.1E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2174	20 m^3	108,700	Area C	15	3.3E+06	5.7E-01	2.4E-02
	Steel (MT)	1720	10 MT	172	Unspecified	1000	3.4E+05	6.0E-02	2.6E-03
	Concrete (1000 m^3)	8	10 m^3	800	Offsite	45	7.2E+04	1.3E-02	5.4E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1000	1.5E+06	2.6E-01	1.1E-02
	TOTAL						7.9E+06	1.4E+00	5.9E-02
	Lower Bound Volume								
	Asphalt (1000 m^3)	374	12 m^3	31,167	Offsite	45	2.8E+06	4.9E-01	2.1E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2185	20 m^3	109,250	Area C	15	3.3E+06	5.7E-01	2.5E-02
	Steel (MT)	1870	10 MT	187	Unspecified	1000	3.7E+05	6.5E-02	2.8E-03
	Concrete (1000 m^3)	10	10 m^3	960	Offsite	45	8.6E+04	1.5E-02	6.5E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1000	1.5E+06	2.6E-01	1.1E-02
	TOTAL						8.0E+06	1.4E+00	6.0E-02
	Upper Bound Volume								
	Asphalt (1000 m^3)	396	12 m^3	33,000	Offsite	45	3.0E+06	5.2E-01	2.2E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2280	20 m^3	114,000	Area C	15	3.4E+06	6.0E-01	2.6E-02
	Steel (MT)	2280	10 MT	228	Unspecified	1000	4.6E+05	8.0E-02	3.4E-03
	Concrete (1000 m^3)	14	10 m^3	1400	Offsite	45	1.3E+05	2.2E-02	9.5E-04
	Bentonite (MT)	18,200	19 MT	958	Wyoming	1000	1.9E+06	3.4E-01	1.4E-02
	TOTAL						8.9E+06	1.6E+00	6.7E-02

Table H.11. (contd)

Alternative		Total Material	Shipment Capacity	Total Shipments	Shipment Source	One-way Distance	Total Miles Traveled	Accidents	Fatalities
D	**Hanford Only**								
	Asphalt (1000 m^3)	371	12 m^3	30,917	Offsite	45	2.8E+06	4.9E-01	2.1E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2174	20 m^3	108,700	Area C	15	3.3E+06	5.7E-01	2.4E-02
	Steel (MT)	1710	10 MT	171	Unspecified	1000	3.4E+05	6.0E-02	2.6E-03
	Concrete (1000 m^3)	8	10 m^3	800	Offsite	45	7.2E+04	1.3E-02	5.4E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1000	1.5E+06	2.6E-01	1.1E-02
	TOTAL						7.9E+06	1.4E+00	5.9E-02
	Lower Bound Volume								
	Asphalt (1000 m^3)	371	12 m^3	30,917	Offsite	45	2.8E+06	4.9E-01	2.1E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2204	20 m^3	110,200	Area C	15	3.3E+06	5.8E-01	2.5E-02
	Steel (MT)	1870	10 MT	187	Unspecified	1000	3.7E+05	6.5E-02	2.8E-03
	Concrete (1000 m^3)	10	10 m^3	990	Offsite	45	8.9E+04	1.6E-02	6.7E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1000	1.5E+06	2.6E-01	1.1E-02
	TOTAL						8.0E+06	1.4E+00	6.0E-02
	Upper Bound Volume								
	Asphalt (1000 m^3)	383	12 m^3	31,917	Offsite	45	2.9E+06	5.0E-01	2.2E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2331	20 m^3	116,550	Area C	15	3.5E+06	6.1E-01	2.6E-02
	Steel (MT)	2280	10 MT	228	Unspecified	1000	4.6E+05	8.0E-02	3.4E-03
	Concrete (1000 m^3)	14	10 m^3	1400	Offsite	45	1.3E+05	2.2E-02	9.5E-04
	Bentonite (MT)	18,200	19 MT	958	Wyoming	1000	1.9E+06	3.4E-01	1.4E-02
	TOTAL						8.9E+06	1.6E+00	6.7E-02

Table H.11. (contd)

Alternative		Total Material	Shipment Capacity	Total Shipments	Shipment Source	One-way Distance	Total Miles Traveled	Accidents	Fatalities
E	**Hanford Only**								
	Asphalt (1000 m^3)	371	12 m^3	30,917	Offsite	45	2.8E+06	4.9E-01	2.1E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2174	20 m^3	108,700	Area C	15	3.3E+06	5.7E-01	2.4E-02
	Steel (MT)	1710	10 MT	171	Unspecified	1000	3.4E+05	6.0E-02	2.6E-03
	Concrete (1000 m^3)	8	10 m^3	800	Offsite	45	7.2E+04	1.3E-02	5.4E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1000	1.5E+06	2.6E-01	1.1E-02
	TOTAL						7.9E+06	1.4E+00	5.9E-02
	Lower Bound Volume								
	Asphalt (1000 m^3)	371	12 m^3	30,917	Offsite	45	2.8E+06	4.9E-01	2.1E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2185	20 m^3	109,250	Area C	15	3.3E+06	5.7E-01	2.5E-02
	Steel (MT)	1870	10 MT	187	Unspecified	1000	3.7E+05	6.5E-02	2.8E-03
	Concrete (1000 m^3)	10	10 m^3	990	Offsite	45	8.9E+04	1.6E-02	6.7E-04
	Bentonite (MT)	13,900	19 MT	732	Wyoming	1000	1.5E+06	2.6E-01	1.1E-02
	TOTAL						8.0E+06	1.4E+00	6.0E-02
	Upper Bound Volume								
	Asphalt (1000 m^3)	383	12 m^3	31,917	Offsite	45	2.9E+06	5.0E-01	2.2E-02
	Gravel/sand, silt/loam, basalt (1000 m^3)	2280	20 m^3	114,000	Area C	15	3.4E+06	6.0E-01	2.6E-02
	Steel (MT)	2280	10 MT	228	Unspecified	1000	4.6E+05	8.0E-02	3.4E-03
	Concrete (1000 m^3)	14	10 m^3	1400	Offsite	45	1.3E+05	2.2E-02	9.5E-04
	Bentonite (MT)	18,200	19 MT	958	Wyoming	1000	1.9E+06	3.4E-01	1.4E-02
	TOTAL						8.8E+06	1.5E+00	6.6E-02

Table H.11. (contd)

Alternative		Total Material	Shipment Capacity	Total Shipments	Shipment Source	One-way Distance	Total Miles Traveled	Accidents	Fatalities
No Action	**Hanford Only**								
	Asphalt (1000 m^3)	35	12 m^3	2933	Offsite	45	2.6E+05	4.6E-02	2.0E-03
	Gravel/sand, silt/loam, basalt (1000 m^3)	2648	20 m^3	132,405	Area C	15	4.0E+06	7.0E-01	3.0E-02
	Steel (MT)	59,100	10 MT	5910	Unspecified	1000	1.2E+07	2.1E+00	8.9E-02
	Concrete (1000 m^3)	420	10 m^3	42,000	Offsite	45	3.8E+06	6.6E-01	2.8E-02
	Bentonite (MT)	0	19 MT	0	Wyoming	1000	0	0	0
	TOTAL						2.0E+07	3.5E+00	1.5E-01
	Lower Bound Volume								
	Asphalt (1000 m^3)	35	12 m^3	2933	Offsite	45	2.6E+05	4.6E-02	2.0E-03
	Gravel/sand, silt/loam, basalt (1000 m^3)	2648	20 m^3	132,405	Area C	15	4.0E+06	7.0E-01	3.0E-02
	Steel (MT)	59,200	10 MT	5920	Unspecified	1000	1.2E+07	2.1E+00	8.9E-02
	Concrete (1000 m^3)	422	10 m^3	42,200	Offsite	45	3.8E+06	6.6E-01	2.8E-02
	Bentonite (MT)	0	19 MT	0	Wyoming	1000	0	0	0
	TOTAL						2.0E+07	3.5E+00	1.5E-01

H.5.1 Impacts of Transportation of TRU Wastes to WIPP

This section presents the expected radiological and non-radiological impacts of transporting TRU wastes from Hanford to the WIPP in New Mexico. The information presented in this section was taken from the *Waste Isolation Pilot Plant Disposal Phase Final Environmental Impact Statement* (WIPP SEIS-2, DOE 1997b) adjusted to the Hanford TRU waste volumes projected in this EIS. The WIPP SEIS-2 impacts were adjusted to account for waste volumes projected in this EIS. Table H.12 summarizes the results from the WIPP SEIS-2. Note that the impacts are for the entire route between Hanford and WIPP. The following subsections provide the bases for the values in the table followed by a comparison with the HSW-EIS bases and assumptions.

Waste Volume

The waste volume presented in Table H.12 is for the Action Alternative 1 in the WIPP SEIS-2. It includes both the "Basic Inventory" and "Additional Inventory" of TRU waste projected to be shipped from Hanford to WIPP.

Table H.12. Summary of Impacts of Transporting TRU Waste by Truck from Hanford to WIPP[a]

			Radiological Impacts, LCFs[b]			Non-Radiological Impacts		
Waste Type	**Waste Volume, m^3**	**Number of Shipments**	**Routine Occupational**	**Routine Non-Occupational**	**Accident Impacts**	**Number of Accidents**	**Fatalities**	**Vehicle Pollution LCFs**
CH-TRU	120,000	18,729	**0** (2.2E-1)	**2** (1.9E+0)	**0** (4.1E-1)	**40** (3.6E+1)	**3** (3.2E+0)	**0** (1.1E-1)
RH-TRU	43,000	48,807	**0** (2.0E-1)	**5** (4.9E+0)	**0** (6.5E-2)	**90** (9.3E+1)	**8** (8.3E+0)	**0** (2.8E-1)
Total	**163,000**	**67,536**	**0** (4.2E-1)	**7**	**0** (4.7E-1)	**130**	**11**	**0** (3.9E-1)

(a) Impacts are based on information in WIPP SEIS-2 (DOE 1997b). The results presented here may not exactly match the WIPP SEIS-2 estimates due to rounding errors.
(b) LCFs = latent cancer fatalities

Number of Shipments

The numbers of shipments in the WIPP SEIS-2 (DOE 1997b) were calculated by dividing the total volume of CH- and RH-TRU wastes by the capacity of the shipping containers used to transport the two types of TRU waste materials. For CH TRU waste, the shipping capacity was about 6.4 m^3 per shipment (three TRUPACT containers carrying fourteen 55-gal-drum equivalents per container). For RH-TRU wastes, the RH-72B shipping cask was used, which carries about 0.9 m^3 per shipment.

Radiological Routine Exposure Risks

The WIPP SEIS-2 did not provide a breakdown of routine exposures by shipping site. However, the per-shipment routine exposures for shipments from Hanford to WIPP were provided. Therefore, the routine radiological impacts presented in Table H.12 were calculated by multiplying together the per-shipment impacts and number of shipments for both CH- and RH-TRU waste shipments.

Radiological Accident Impacts

WIPP SEIS-2 provided a breakdown on radiological-accident impacts by shipping site so the values in Table H.12 were taken directly from that document.

Non-Radiological Impacts

Similar to the radiological routine impacts, WIPP SEIS-2 provided the per-shipment impacts but not a site-by-site breakdown. Consequently, the results in Table H.12 were calculated by combining the per-shipment impacts and the numbers of shipments.

Impacts for HSW-EIS TRU Waste Volumes

The volumes of TRU waste projected to be shipped from Hanford to WIPP in this EIS are substantially lower than the bounding volumes assumed in WIPP SEIS-2. The CH-TRU waste volume projected to be shipped to WIPP in the HSW EIS is about 38,000 m^3 for Alternative Groups A through E. For the No Action Alternative, the projected CH-TRU waste volume to be shipped to WIPP is about 31,000 m^3. This is about one-third of the CH-TRU waste volume projected in WIPP SEIS-2. Similarly, the RH-TRU waste volume projected to be shipped to WIPP in Alternative Groups A through E is about 2800 m^3, or about one-fifteenth of the WIPP SEIS- projections. The ratios of these values were used to adjust the WIPP SEIS-2 impacts for TRU waste shipments from Hanford to the HSW-EIS TRU waste-volume projections. The results are shown in Table H.13.

H.5.2 Transportation Impacts Within Washington and Oregon of Offsite Shipments

This section calculates the impacts of offsite transportation of solid wastes to and from Hanford. Included are the impacts of transporting LLW and MLLW from offsite generators to Hanford Site treatment and disposal facilities and the impacts of transporting MLLW from Hanford to offsite commercial disposal facilities.

Radiological Routine Exposure and Accident Impact Analysis Parameters

The RADTRAN 4 computer code was used to perform the transportation-impact calculations. For offsite shipments, the key differences in RADTRAN parameters are primarily related to the route characteristics (e.g., shipping distances, travel fractions, and population densities in rural, suburban, and urban population zones). For the purposes of this EIS, two routes through Oregon and Washington are

Table H.13. Impacts of Offsite Transportation of TRU Wastes from Hanford to WIPP Adjusted for HSW-EIS Waste Volume[(a)]

Waste Type	Waste Volume, m^3	Shipments	Radiological Impacts, LCFs			Non-Radiological Impacts		
			Routine Occupational	Routine Non-Occupational	Accidents	Number of Accidents	Fatalities	Vehicle Pollution LCFs
Alternative Groups A, B, C, D, and E								
CH-TRU	40,154[(b)]	6267	7.5E-2	6.3E-1	1.4E-1	1.2E+1	1.1E+0	3.6E-2
RH-TRU	2815	3195	1.3E-2	3.2E-1	4.3E-3	6.1E+0	5.4E-1	1.9E-2
Total	**42,969**	**9462**	**0** (8.8E-2)	**1** (9.5E-1)	**0** (1.4E-1)	**18** (1.8E+1)	**2** (1.6E+0)	**0** (5.5E-2)
No Action								
CH-TRU	32,714[(b)]	5106	6.1E-2	5.1E-1	1.1E-1	9.7E+0	8.7E-1	3.0E-2
RH-TRU	0	0	0	0	0	0	0	0
Total	**32,714**	**5106**	**0** (6.1E-2)	**1** (5.1E-1)	**0** (1.1E-1)	**9** (9.7E+0)	**1** (8.7E-1)	**0** (3.0E-2)

LCF = latent cancer fatality

(a) Intermediate values may not add to totals due to rounding.

(b) Includes Hanford Only waste volumes as well as an additional 1500 m^3 of TRU waste to account for small generator sites included in the *Transuranic Waste Performance Management Plan* (DOE 2002b).

assumed to be used exclusively. The first enters Oregon at approximately Ashland, Oregon, on Interstate 5 and travels north to Portland, Oregon. Near Portland, the shipment takes Interstate 205 to Interstate 84 and then travels up the Columbia River Gorge to Umatilla, Oregon. Near Umatilla, the shipments exit Interstate 84 onto Interstate 82, cross into the State of Washington, and travel to Richland, Washington. Near Richland, the shipment exits onto State Route 240 and travels to the Hanford Site. The second route enters the State of Oregon near Ontario, Oregon, on Interstate 84, and travels to Umatilla, Oregon, where it exits onto Interstate 82 and follows the same path to Hanford described for the first route. Note that both routes enter the State of Washington at the Umatilla, Oregon/Patterson, Washington ports of entry.

The HIGHWAY computer code (Johnson et al. 1993) was used to develop this information for the RADTRAN runs. A summary of the route characteristics for transport in Washington and Oregon are shown in Table H.14.

Table H.14. Route Characteristics for Transport in Washington and Oregon

Route Description	Distance, km	Travel Percentage			Population Density, per sq. km		
		Rural	Suburban	Urban	Rural	Suburban	Urban
Enter OR at Ashland	824	75.8%	20.6%	3.6%	10.4	320.2	2242.4
Enter OR at Ontario	430	90.1%	9.1%	0.8	3.9	400.8	1979.6

Table H.15 summarizes the LLW, MLLW, and TRU waste volumes to be transported from offsite generators to Hanford under the Lower Bound and Upper Bound waste-volume cases and the TRU waste volume to be transported from Hanford to WIPP.

Table H.15. Offsite Shipping Volumes Used for Oregon and Washington Impacts Calculations

Shipment Type	Route	Waste Type	Volume, m^3	Number of Shipments
Lower Bound Case				
LLW to Hanford	Ontario, OR	All LLW	23,281	1412
	Ashland, OR	All LLW	1719	105
MLLW to Hanford	Ontario, OR	All MLLW	99	6
	Ashland, OR	All MLLW	1	1
TRU Waste to Hanford	Ontario, OR	CH TRU	1274	161
	Ashland, OR	CH TRU	286	36
TRU Waste to WIPP	Ontario, OR	CH-TRU	40,154	6267
		RH-TRU	2815	3195
		Total TRU	42,969	9462
Upper Bound Case				
LLW to Hanford	Ontario, OR	All LLW	220,707	13,388
	Ashland, OR	All LLW	16,293	992
MLLW to Hanford	Ontario, OR	All MLLW	138,936	8426
	Ashland, OR	All MLLW	1364	1403
TRU Waste to Hanford	Ontario, OR	CH TRU	1274	161
	Ashland, OR	CH TRU	286	36
TRU Waste to WIPP	Ontario, OR	CH-TRU	40,154	6267
		RH-TRU	2815	3195
		Total TRU	42,969	9462

(a) TRU waste volume shipped to Hanford and from Hanford to WIPP includes 1500 m^3 in addition to Upper Bound and Lower Bound waste volumes.

For comparison purposes, the remaining RADTRAN parameters were assumed to be the same as for onsite shipments. This is a realistic assumption because the shipping containers for onsite shipments are required to meet equivalent packaging and transportation standards as shipping containers for onsite shipments. Table H.16 summarizes these routine exposure parameters used in the RADTRAN calculations. Table H.17 summarizes these accident-analysis parameters used in the RADTRAN calculations.

Non-Radiological Impact Analysis Parameters

Impacts from two potential sources of non-radiological impacts are calculated here, including impacts from traffic accidents (fatalities) and routine emissions of vehicular pollutants (latent cancer fatalities). Both types of impacts were calculated by combining unit rates (i.e., fatalities per km traveled), distance per shipment, and the number of shipments. Unit fatality rates for traffic accidents in Washington and Oregon were taken from Saricks and Tompkins (1999). Oregon traffic-fatality-rate data was incomplete

Table H.16. RADTRAN Routine Exposure Parameters Used in Offsite Transportation-Impact Calculations

Parameter	**Value**[(a)]
Transport Index (Dose rate at 1 m from vehicle, mrem/hr)[(b)]	
- LLW and MLLW	3
- CH TRU Waste	7
- RH TRU Waste	7
Number of Truck Crew	2
Average Vehicular Speed (km/hr)	
- Rural	88
- Suburban	40
- Urban	24
Stopped Time (hr/km)	0.011
Number of People Exposed While Stopped	50
Average Exposure Distance at Stops, m	20
Number of People per Vehicle Sharing Route	2
Population Densities (Persons/km^2)	Route-Specific
One-Way Traffic Count (Vehicles/hr)	
- Rural	470
- Suburban	780
- Urban	2800

(a) Source of the parameter values is Neuhauser and Kanipe (1992), except where indicated otherwise.
(b) Source: WM PEIS (DOE 1997a).

in Saricks and Tompkins (1999), so national average fatality rates, which are about four times higher than the average rates in Washington, were used. The unit fatality rate for vehicular emissions was taken from Rao et al. (1982). Both sets of unit-fatality-rate data are commonly used in EISs.

Analysis Results

The transportation impacts in Washington and Oregon for offsite shipments of LLW, MLLW, and TRU waste are presented in Table H.18. The table includes the impacts in Washington and Oregon for both the Lower Bound and Upper Bound waste-volume cases. Table H.19 presents the impacts by state. The estimates in Table H.19 were calculated by scaling the overall results in Table H.18 by the ratio of the mileages in each state to the total mileage traveled in Washington and Oregon. Note that no fatalities are estimated in Washington and Oregon from the offsite shipments. Also note that, although traffic accidents are expected to occur, no fatalities are estimated to result from the traffic accidents.

Table H.17. RADTRAN 4 Accident Parameters for Trucks

Accident Rate			
State-Specific Values Used			
Fractional Occurrence by Severity Category (Conditional Probability Given an Accident Occurs)[a]			
Severity Category			
I	0.55		
II	0.36		
III	0.07		
IV	0.016		
V	0.0028		
VI	0.0011		
VII	8.5E-5		
VIII	1.5E-5		
Fractional Occurrence by Population Zone (Conditional Probability Given an Accident Occurs of the Specified Severity)[a]			
	Rural	**Suburban**	**Urban**
I	0.1	0.1	0.8
II	0.1	0.1	0.8
III	0.3	0.4	0.3
IV	0.3	0.4	0.3
V	0.5	0.3	0.3
VI	0.7	0.2	0.1
VII	0.8	0.1	0.1
VIII	0.9	0.05	0.05
Release Fraction (Fraction of Container Contents Released from Shipment by Severity Category)[a]			
	Type A (LLW and MLLW)	**Type B (CH- and RH-TRU)[b]**	
I	0	0	
II	0.01	0	
III	0.1	8E-9	
IV	1	2E-7	
V	1	8E-5	
VI	1	2E-4	
VII	1	2E-4	
VIII	1	2E-4	

(a) Data taken from NUREG-0170 (NRC 1977) for Type A shipments. Release fractions are package-type specific whereas the fractional occurrence parameters are independent of package type.

(b) Data taken from WIPP SEIS-2 (DOE 1997b). Includes contributions from impact and thermal release phenomena.

Table H.18. Impacts in Washington and Oregon from Shipments of Solid Waste to Hanford from Offsite Generators and Shipments of TRU Waste to WIPP[(a)]

Shipment	Route	Waste Type	Radiological Impacts, LCFs			Non-Radiological Impacts		
			Occupational	Public	Radiological Accident	Number of Accidents	Accident Fatalities	Emissions, LCFs
Lower Bound Case								
LLW to Hanford	Ontario, OR	LLW	5.1E-3	3.6E-3	5.6E-4	1.0E-1	2.2E-3	9.6E-4
	Ashland, OR	LLW	8.8E-4	5.8E-4	3.6E-4	1.5E-2	3.5E-4	6.1E-4
MLLW to Hanford	Ontario, OR	MLLW	1.1E-2	3.4E-3	2.8E-5	1.8E+0	2.0E-2	8.5E-4
	Ashland, OR	MLLW	8.4E-6	5.5E-6	4.2E-5	1.4E-4	3.3E-6	5.9E-6
TRU Waste to Hanford	Ontario, OR	TRU	6.0E-4	4.2E-4	1.1E-5	1.2E-2	2.5E-4	1.1E-4
	Ashland, OR	TRU	1.7E-3	1.1E-3	1.2E-4	3.0E-2	6.7E-4	1.2E-3
Total – All Offsite Generators		All	1.9E-2	9.1E-3	1.1E-3	2.0E+0	2.4E-2	3.7E-3
TRU to WIPP	Ontario, OR	CH-TRU	1.7E-2	1.6E-2	4.4E-4	4.7E-1	1.0E-2	4.3E-3
		RH-TRU	8.6E-3	1.8E-2	2.2E-4	2.4E-1	5.1E-3	2.2E-3
		Total TRU	2.5E-2	3.4E-2	6.6E-4	7.1E-1	1.5E-2	2.7E-2
GRAND TOTAL	**All waste types, to and from Hanford**		**0** (4.5E-2)	**0** (4.3E-2)	**0** (1.8E-3)	**3** (2.7E+0)	**0** (3.9E-2)	**0** (3.1E-2)
Upper Bound Case								
LLW to Hanford	Ontario, OR	LLW	4.8E-2	3.4E-2	5.3E-3	9.9E-1	2.1E-2	9.1E-3
	Ashland, OR	LLW	8.3E-3	5.5E-3	3.4E-3	1.4E-1	3.3E-3	5.8E-3
MLLW to Hanford	Ontario, OR	MLLW	4.1E-2	2.5E-2	4.0E-2	2.4E+0	3.3E-2	6.5E-3
	Ashland, OR	MLLW	1.2E-2	7.8E-3	5.9E-2	2.0E-1	4.6E-3	8.3E-3
TRU Waste to Hanford	Ontario, OR	TRU	6.0E-4	4.2E-4	1.1E-5	1.2E-2	2.5E-4	1.1E-4
	Ashland	TRU	1.7E-3	1.1E-3	1.2E-4	3.0E-2	6.7E-4	1.2E-3
Total – All Offsite Generators		All	1.1E-1	7.4E-2	1.1E-1	3.8E+0	6.3E-2	3.1E-2
TRU Waste to WIPP	Ontario, OR	CH-TRU	1.7E-2	1.6E-2	4.4E-4	4.7E-1	1.0E-2	4.3E-3
		RH-TRU	8.6E-3	1.8E-2	2.2E-4	2.4E-1	5.1E-3	2.2E-3
		Total TRU	2.5E-2	3.4E-2	6.6E-4	7.1E-1	1.5E-2	2.7E-2
GRAND TOTAL	**All waste types, to and from Hanford**		**0** (1.4E-1)	**0** (1.1E-1)	**0** (1.1E-1)	**5** (4.5E+0)	**0** (7.8E-2)	**0** (5.8E-2)

Note: Public includes non-involved workers.

(a) Radiological impacts (incident-free and accident) are expressed in units of LCFs. Non-radiological accident impacts are expressed as the expected number of accidents and the resulting physical trauma fatalities. Non-radiological emissions impacts are expressed as LCFs.

Table H.19. Impacts in Washington and Oregon by State from Offsite Shipments of Solid Wastes to and from Hanford[a]

Shipment	State	Radiological Impacts, LCFs			Non-Radiological Impacts		
		Occupational	Non-Occupational	Radiological Accident	Number of Accidents	Accident Fatalities	Emissions, LCFs
Lower Bound Waste Volume							
LLW, MLLW, and TRU to Hanford[b]	WA	4.1E-3	1.9E-3	2.2E-4	3.9E-1	5.4E-3	7.9E-4
	OR	1.5E-2	7.2E-3	9.0E-4	1.6E+0	1.8E-2	2.9E-3
TRU Waste to WIPP	WA	4.4E-3	5.9E-3	1.2E-4	1.2E-1	2.6E-3	4.7E-3
	OR	2.1E-2	2.8E-2	5.4E-4	5.9E-1	1.2E-2	2.2E-2
Total - Offsite Shipments	WA	8.6E-3	7.8E-3	3.4E-4	5.2E-1	8.0E-3	5.5E-3
	OR	3.6E-2	3.5E-2	1.4E-3	2.2E+0	3.1E-2	2.5E-2
Grand Total	**WA + OR**	**0** (4.5E-2)	**0** (4.3E-2)	**0** (1.8E-3)	**3** (2.7E+0)	**0** (3.9E-2)	**0** (3.1E-2)
Upper Bound Waste Volume							
LLW, MLLW, and TRU Waste to Hanford[b]	WA	2.1E-2	1.4E-2	2.2E-2	7.3E-1	1.3E-2	6.2E-3
	OR	9.0E-2	6.0E-2	8.6E-2	3.1E+0	5.0E-2	2.5E-2
TRU Waste to WIPP	WA	4.4E-3	5.9E-3	1.2E-4	1.2E-1	2.6E-3	4.7E-3
	OR	2.1E-2	2.8E-2	5.4E-4	5.9E-1	1.2E-2	2.2E-2
Total – Offsite Shipments	WA	2.6E-2	2.0E-2	2.2E-2	8.5E-1	1.5E-2	1.1E-2
	OR	1.1E-1	8.8E-2	8.7E-2	3.6E+0	6.3E-2	4.7E-2
Grand Total	**WA + OR**	**0** (1.4E-1)	**0** (1.1E-1)	**0** (1.1E-1)	**5** (4.5E+0)	**0** (7.8E-2)	**0** (5.8E-2)

Note: Public includes non-involved workers.

(a) Radiological impacts (incident-free and accident) are expressed in units of LCFs. Non-radiological accident impacts are expressed as the expected number of accidents and the resulting physical trauma fatalities. Non-radiological emissions impacts are expressed as LCFs.

(b) MLLW shipments include those from offsite generators to Hanford and those to ORR and back for treatment. TRU waste volumes include 1500 m^3 in addition to the Upper Bound and Lower Bound waste-volume projections to account for small-quantity sites identified in the *Transuranic Waste Performance Management Plan* (DOE 2002b).

H.6 Results of Hazardous Chemical Impact Analysis

Downwind concentrations of hazardous chemicals released from a severe transportation accident are presented in this section. The resulting chemical concentrations are put in perspective by comparing them to safe exposure levels. The methods used are standard facility safety-analysis techniques and are proven methods for assessing potential health effects from accidental releases of hazardous chemical materials.

The hazardous chemical constituents of MLLW and TRU waste to be transported to and on the Hanford Site are shown in Table H.6. The downwind concentrations shown in Table H.20 were calculated assuming a maximum-inventory 55-gal drum is involved in a severe accident and releases

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		Occupational	Non-Occupational	Radiological Accident	Number of Accidents	Accident Fatalities	Emissions, LCFs
Lower Bound Waste Volume							
LLW, MLLW, and TRU to Hanford[b]	WA	4.1E-3	1.9E-3	2.2E-4	3.9E-1	5.4E-3	7.9E-4
	OR	1.5E-2	7.2E-3	9.0E-4	1.6E+0	1.8E-2	2.9E-3
TRU Waste to WIPP	WA	4.4E-3	5.9E-3	1.2E-4	1.2E-1	2.6E-3	4.7E-3
	OR	2.1E-2	2.8E-2	5.4E-4	5.9E-1	1.2E-2	2.2E-2
Total - Offsite Shipments	WA	8.6E-3	7.8E-3	3.4E-4	5.2E-1	8.0E-3	5.5E-3
	OR	3.6E-2	3.5E-2	1.4E-3	2.2E+0	3.1E-2	2.5E-2
Grand Total	**WA + OR**	**0** (4.5E-2)	**0** (4.3E-2)	**0** (1.8E-3)	**3** (2.7E+0)	**0** (3.9E-2)	**0** (3.1E-2)
Upper Bound Waste Volume							
LLW, MLLW, and TRU Waste to Hanford[b]	WA	2.1E-2	1.4E-2	2.2E-2	7.3E-1	1.3E-2	6.2E-3
	OR	9.0E-2	6.0E-2	8.6E-2	3.1E+0	5.0E-2	2.5E-2
TRU Waste to WIPP	WA	4.4E-3	5.9E-3	1.2E-4	1.2E-1	2.6E-3	4.7E-3
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Total – Offsite Shipments	WA	2.6E-2	2.0E-2	2.2E-2	8.5E-1	1.5E-2	1.1E-2
	OR	1.1E-1	8.8E-2	8.7E-2	3.6E+0	6.3E-2	4.7E-2
Grand Total	**WA + OR**	**0** (1.4E-1)	**0** (1.1E-1)	**0** (1.1E-1)	**5** (4.5E+0)	**0** (7.8E-2)	**0** (5.8E-2)

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0.5 percent of the total inventory of each hazardous chemical as respirable particles into the environment. The downwind concentrations are then compared to Temporary Emergency Exposure Limit-2 (TEEL-2) values given by Craig (2001). The TEEL-2 definition follows.

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

TEEL-2 values are used here instead of the more widely accepted Emergency Response Planning Guidelines (ERPGs), because ERPG values do not exist for some of the chemicals listed in Table H.6. TEEL values are interim replacements for the peer-reviewed ERPG values and may be used when ERPG values are not available. ERPG-2 is analogous to TEEL-2 and is defined as follows:

> **ERPG-2**: The maximum concentration in air below which it is believed that nearly all individuals could be exposed *for up to 1 hour* without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

The results of the hazardous-chemical-concentration calculations are shown in Table H.20. The results indicate that downwind concentrations of only four hazardous chemicals would exceed the TEEL-2 guidelines following a severe transportation accident involving a maximum-inventory 55-gal drum. These four chemicals are elemental lead, elemental mercury, methyl ethyl ketone (MEK or 2-butanone), and beryllium. For these four chemicals, the Immediately Dangerous to Life and Health (IDLH) values are provided in the table for additional perspective. IDLH concentrations are defined as follows:

> **IDLH**: The maximum concentration from which, in the event of respirator failure, a person could escape within 30 minutes without a respirator and without experiencing any escape-impairing (for example, severe eye irritation) or irreversible health effects.

The IDLH values are driven by worker safety requirements, as indicated by the language on respirator failure.

The downwind concentrations of all four of the IDLH chemicals are well below their respective IDLH values. Based on these observations, the conclusion is that releases of hazardous chemicals from transportation accidents are unlikely to result in a fatality.

The downwind hazardous chemical concentrations are calculated for a person 100 m (109 yd) away from the release point. This assumption is conservative for a member of the public, either offsite or onsite, who is unlikely to be 100 m (109 yd) from the release point for the entire duration of the release. Furthermore, the maximum hazardous-chemical concentrations (referred to as the maximum drum) have been modeled. This model includes, in the case of MLLW, more than 20 hazardous chemicals. It is extremely unlikely that any single 55-gal drum would contain the maximum concentrations of all 20 or more hazardous chemicals. This information provides additional evidence that results shown in Table H.20 are bounding.

Table H.20. Hazardous Chemical Concentrations 100 m (109 yd) Downwind from Severe Transportation Accidents

Hazardous Constituent	Concentration, mg/m^3					
	TEEL-2 Value[(a)]	MLLW[(b)]	TRU Waste[(b)]	Elemental Mercury	Elemental Lead	Comments[(c)]
Acetone	8500	0.49	0	0	0.004	
Ammonium fluoride	12.5	0.19	0	0	0	
Ammonium nitrate	50	0.19	0	0	0	
Ammonium sulfate	500	0.38	0	0	0	
Beryllium	0.025	0.14	0.0049	0	0	IDLH = 10 mg/m^3
Butyl alcohol	50	0.03	0.012	0	0	
Carbon tetrachloride	100	0.89	0.024	0	0	
Cyclohexane	1300	0.09	0	0	0	
Ethanol	3300	0.49	0.0049	0	0	
Hydrazine	0.8	0.21	0	0	0	
Isopropyl alcohol	400	0.71	0	0	0	
Lead	0.25	0	0	0	5.0	IDLH = 700 mg/m^3
Mercury	0.1	0	0	0.67	0	IDLH = 10 mg/m^3
Methanol	1000	0.95	0	0	0	
Methyl ethyl ketone	0.2	0.58	0	0	0	IDLH = 9000 mg/m^3
Methyl isobutyl ketone	500	0.80	0	0	0	
Nitric acid	15	1.48	0.0049	0	0	
Phosphoric acid	500	1.27	0.0073	0	0	
Potassium hydroxide	2	1.37	0	0	0	
Propane	2100	0	0.0097	0	0	
Sodium hydroxide	40	1.86	0.15	0	0	
Styrene	250	0.04	0	0	0	
Sulfuric acid	10	0.08	0.036	0	0	
Tetrahydrofuran	2000	0.07	0	0	0	
Toluene	300	2.53	0	0	0	
Uranium	1	0.009	0	0	0	
Xylene	200	1.26	0.10	0	0	

(a) Source: Craig (2001).
(b) Inventories bound quantities for either CH or RH waste.
(c) IDLH = Immediately Dangerous to Life and Health. Source: National Institute for Occupational Safety and Health (NIOSH 1990).

H.7 Potential Impacts of Sabotage or Terrorist Attack

This section addresses the environmental impacts associated with potential sabotage or terrorist attacks on shipments of solid waste to and from the Hanford Site. The Nuclear Regulatory Commission (NRC) has established regulations designed specifically to protect the public from potential terrorist attacks on certain types of radioactive material shipments (see 10 CFR 71). These requirements are intended to minimize the possibility of sabotage and facilitate recovery of shipments that could come into control of unauthorized persons. The requirements minimize the impacts of malevolent acts during transport of the most dangerous types of radioactive materials, including spent nuclear fuel and special nuclear materials that could be used to construct nuclear weapons. The NRC rules require, for example, advance route approval, advance arrangements with local law-enforcement agencies along the route, advance notification of states, escort requirements, and onboard communications equipment. These rules apply to offsite shipments in the general-public domain when conditions along transport routes cannot be controlled.

None of the solid waste materials covered by this EIS are required to implement special safeguards and security provisions. In general, the solid waste materials have low radioactivity levels relative to spent nuclear fuel and none qualify as special nuclear material that would require special safeguards and security considerations.

In addition to the physical-protection requirements in 10 CFR 73, the shipping containers themselves provide a measure of protection. Type B accident-resistant packaging systems are required for the most hazardous shipments, such as TRU waste and certain high-quantity LLW and MLLW shipments, as well as ILAW containers. These packaging systems, which are designed to withstand severe mechanical and thermal environments, provide a significant amount of protection from terrorist attacks. Lower hazard materials, including most LLW and MLLW shipments, do not require accident-resistant Type B packages. They are shipped in Type A packages. However, the less hazardous shipments are not attractive terrorist targets because they would not involve a high-profile symbol of the United States nor would a successful attack produce a large number of immediate fatalities. The latter observation is based on the results of an assessment of radioactive releases from a spent nuclear fuel shipping cask subjected to an attack using a high-energy device (Luna et al. 2000). The maximum individual dose from such an event involving a spent-nuclear-fuel shipping cask, which carries orders of magnitude greater radioactive material than typical solid waste shipping containers, was well below that which would cause an immediate radiation-induced fatality.

An additional element to consider is that most of the shipments of radioactive waste covered in this EIS are within Hanford Site boundaries. Hanford is a controlled-access facility that is protected by various security measures, for example, security guards and visual surveillance systems. Onsite shipments of solid waste would be protected by these same systems, which lessens the likelihood of a successful terrorism incident.

To provide some perspective on the potential impacts of a terrorist attack on a shipment of radioactive materials addressed in this EIS, the consequences of the most severe accident (i.e., Severity Category VIII), involving a spent nuclear fuel shipment, modeled in the RADTRAN accident analysis, were determined.

The results indicate that such an attack, if conducted successfully in an urban area, could result in a population dose of about 48,000 person-rem. Such a population dose would result in about 24 excess LCFs in the exposed population. If the attack occurred in a rural area, the consequences would be much lower, approximately 160 person-rem, and 0 excess LCFs. These are conservative estimates because they assume that the attack results in complete loss of containment and interdiction, and other measures that would lessen the impacts are not accounted for. Shipments associated with waste evaluated in this HSW EIS would have lower radionuclide inventories and would be expected to have correspondingly smaller consequences.

Because of the terrorist attacks on September 11, 2001, DOE and other agencies are reviewing the physical-protection requirements for shipments of radioactive materials. Any findings and recommendations from this re-examination would be incorporated into DOE's plans for shipping solid waste materials to, from, and within the Hanford Site.

H.8 Comparison with Waste Management Programmatic Environmental Impact Statement

The *Final Waste Management Programmatic Environmental Impact Statement* (WM PEIS, DOE 1997b) evaluated the nationwide impacts of managing four types of radioactive waste (LLW, MLLW, TRU waste, and high-level waste) and hazardous waste. The purpose of the WM PEIS was to provide part of the basis for DOE decisions on programmatic configurations of sites for waste treatment and disposal activities. A Record of Decision (ROD) on management of LLW and MLLW was issued on February 25, 2000 (65 FR 10061). DOE decided, among other things, to continue onsite disposal of LLW at four DOE sites and to make Hanford and the Nevada Test Site (NTS) available to all DOE sites for disposal of LLW and MLLW. The HSW EIS and WM PEIS analyzed similar configurations for treatment and disposal of LLW and MLLW and used similar methods for calculating transportation impacts. The main difference between the purposes of the HSW EIS and the WM PEIS is that the former seeks a site-specific decision on management of LLW, MLLW, and TRU waste, whereas the latter sought decisions on broader, nationwide configurations of sites for management of these and other radioactive wastes.

Given the similarities in scope and analytical methodologies between the HSW EIS and WM PEIS, it could be asked if the impacts calculated in both documents are comparable. A comparison was made between the transportation impacts calculated in the WM PEIS and HSW EIS in an effort to understand what the differences are, if any. The WM PEIS information was taken from the *Information Package on Pending Low-Level Waste and Mixed Low-Level Waste Disposal Decisions to be made under the Final Waste Management Programmatic Environmental Impact Statement* (DOE 1998) that was developed to support the LLW/MLLW Record of Decision.

This exercise led to the following observations. First, the WM PEIS scope was limited to 20 years whereas the HSW EIS covers the lifecycle of the Hanford Site Solid (Radioactive and Hazardous) Waste Management Program (through 2046). Consequently, the LLW and MLLW volume projections are significantly different, leading to differences in the transportation impacts. In addition, the WM PEIS was published in 1997, so the waste-volume projections are several years older than the waste-volume

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H.9 Effects of Transporting Solid Waste by Rail

The analyses in this appendix assumed that all of the onsite and offsite shipments of solid waste would be conducted using trucks over existing roads. It is possible that some of the shipments of solid waste and construction/capping materials could be transported by rail. Rail shipments generally result in lower impacts than truck shipments. These lower impacts for rail relative to truck shipping are documented in numerous EISs (DOE 2002a, 1997a, 1997b). Generally, rail shipments result in lower impacts than truck shipments for a variety of reasons:

- Rail payload capacity is substantially greater than truck. This results in fewer shipments which, in turn, results in lower transportation impacts.

- There are fewer people sharing a rail line than would be sharing the highway with truck shipments. This is somewhat offset by the lower average speeds for rail shipments, which increases the exposure time relative to truck shipments.

- When a rail shipment stops at a railyard, there are many other railcars that provide shielding between the shipping container and any people. This shielding results in lower radiation dose rates, and thus lower radiation exposures, to bystanders and people living in the vicinity of rail stops relative to truck stops.

- According to recent data in Saricks and Tompkins (1999), fatality rates for truck and rail transport are comparable. For example, the nationwide accident and fatality rates for truck shipments are about 3.2E-7 accidents per truck-km and 1.4E-8 fatalities per truck-km, respectively (see Table 4 of Saricks and Tompkins [1999]). For rail shipments, the comparable nationwide accident rate is about 5.4E-8 accidents per railcar-km and the fatality rate is about 2.1E-8 fatalities per railcar-km (see Table 6 of Saricks and Tompkins [1999]). Although the fatality rate on a per-km basis is higher for rail than for truck shipments, the rail shipments travel fewer miles than truck shipments due to the higher payload capacity of the rail shipments. The higher payloads for rail shipments more than offset the difference in fatality rates, resulting in lower non-radiological accident impacts for rail shipments.

While rail shipments generally result in lower radiological incident-free and non-radiological accident impacts than truck shipments, the impacts of radiological accidents are likely to be higher for rail shipments than truck shipments. Recall that radiological accident impacts are calculated as the product of the frequency of an accident times its consequences. While the probability of a severe accident is comparable between the two modes as discussed above, the consequences of a severe rail accident would be greater due to the higher payload of rail shipments relative to truck shipments; i.e., larger quantities of radioactive materials would be released from a rail shipment than a truck shipment. This leads to generally higher projections used in the HSW EIS. The HSW EIS volumes from offsite generators have been verified with the generator sites and are thought to be more realistic than waste volumes analyzed in the WM PEIS. Finally, some of the data was used in the transportation-impact calculations, for example, transportation-accident statistics, have been updated from previous studies. This has led to small differences in impacts relative to the differences that arise from the waste-volume projections.

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- According to recent data in Saricks and Tompkins (1999), fatality rates for truck and rail transport are comparable. For example, the nationwide accident and fatality rates for truck shipments are about 3.2E-7 accidents per truck-km and 1.4E-8 fatalities per truck-km, respectively (see Table 4 of Saricks and Tompkins [1999]). For rail shipments, the comparable nationwide accident rate is about 5.4E-8 accidents per railcar-km and the fatality rate is about 2.1E-8 fatalities per railcar-km (see Table 6 of Saricks and Tompkins [1999]). Although the fatality rate on a per-km basis is higher for rail than for truck shipments, the rail shipments travel fewer miles than truck shipments due to the higher payload capacity of the rail shipments. The higher payloads for rail shipments more than offset the difference in fatality rates, resulting in lower non-radiological accident impacts for rail shipments.

While rail shipments generally result in lower radiological incident-free and non-radiological accident impacts than truck shipments, the impacts of radiological accidents are likely to be higher for rail shipments than truck shipments. Recall that radiological accident impacts are calculated as the product of the frequency of an accident times its consequences. While the probability of a severe accident is comparable between the two modes as discussed above, the consequences of a severe rail accident would be greater due to the higher payload of rail shipments relative to truck shipments; i.e., larger quantities of radioactive materials would be released from a rail shipment than a truck shipment. This leads to generally higher radiological accident impacts for rail shipments relative to truck shipments. However, a review of the impact estimates in Table H.10 indicates that radiological accident impacts are a small fraction of the radiological incident-free and non-radiological impacts. Therefore, the radiological accident impacts do not contribute substantially to the total impacts.

Although predicted impacts for rail shipments would likely be smaller than for truck shipments, a number of other variables must also be considered. First, general freight rail service is slower than truck shipping, resulting in longer travel times and possibly long stop times in rail yards waiting for train makeup. The longer shipping times for rail shipments may also lead to less efficient use of DOE shipping containers, depending on the waste types transported by rail and the truck/rail mix of the shipping campaigns. Second, not all generator sites, including Hanford, are provided with rail service. In order for these sites to use rail service, they would have to construct new rail lines, rebuild existing lines that have been discontinued, or implement truck/rail intermodal transportation (i.e., deliver truck shipments to a railyard where the shipping containers would be offloaded from the trucks and loaded onto a rail car for subsequent transport; the opposite operation would be required if the receiving site is also not provided with rail service). This could lead to increased costs as well as increased impacts due to the additional handling activities required to offload and reload the containers onto or off of the railcars. Third, if a rail accident involving a derailment were to occur, the rail line could be disabled for a lengthy period of time. Although truck accidents could also involve closure of a highway, there is a greater potential for a detour around a closed highway than around a closed rail line.

There are two types of rail service available for radioactive waste shipments; 1) general freight rail in which the railcars carrying the wastes would be added to an existing train and 2) dedicated rail service in which a train would be made up solely of railcars carrying radioactive wastes to/from Hanford plus locomotives and buffer cars as needed. According to DOE (2002), dedicated rail service offers advantages over general freight rail service in incident-free transport but could lead to higher accident impacts. It was concluded in DOE (2002) that available information does not indicate a clear advantage for the use of either general freight or dedicated train service.

A final point relative to rail shipping is that the HSW management facilities are not currently provided with rail service. Although restarting rail service to the Waste Treatment Plant is currently under consideration, new rail spurs and upgrades to existing rail lines would be needed to reach the HSW treatment facilities. At this time, it is too speculative to assume that rail access to solid waste management facilities on the Hanford Site would be available, and an analysis of rail transport does not appear warranted.

H.10 References

10 CFR 71. “Packaging and Shipping of Radioactive Materials.” U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/10cfr71_01.html.

65 FR 10061. “Record of Decision for the Department of Energy’s Waste Management Program: Treatment and Disposal of Low-Level Waste and Mixed Low-Level Waste; Amendment of the Record of Decision for the Nevada Test Site.” *Federal Register* (February 25, 2000).

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Appendix I

Ecological Resources

Appendix I provides additional information regarding potential impacts to terrestrial and aquatic ecological resources that may result from implementation of Alternative Groups A, B, C, D_1, D_2, D_3, E_1, E_2, and E_3, or the No Action Alternative. Potential impacts to terrestrial resources would occur in the near term, i.e., during waste management operations and under current conditions. These relate primarily to surface disturbance associated with disposal in the Low Level Burial Grounds (LLBGs), the Environmental Restoration and Disposal Facility (ERDF), and in the proposed disposal facility near the PUREX Plant; Area C from which capping materials would be obtained and the associated stockpile area and conveyance road; and construction sites for the additional Central Waste Complex (CWC) facilities and New Waste Processing Facility. Potential impacts to Columbia River riparian and aquatic resources could occur in the long term, i.e., up to 10,000 years following the conclusion of waste management operations. These relate primarily to the eventual migration of radionuclides and other hazardous chemicals through the vadose zone to groundwater and on to the Columbia River.

I.1 Background

The 24 Command Fire, a range fire that occurred in late June–early July 2000 (DOE-RL 2000), burned 163,884 acres on the central part of the Hanford Site and the Fitzner/Eberhardt Arid Lands Ecology (ALE) Reserve (Baker 2000). The 24 Command Fire covered the 200 West Expansion Area, some of which has been identified for construction of the additional CWC facilities and the New Waste Processing Facility; a large area west and south of that location, including Area C; and the southern portion of the corridor between the 200 West Area and 200 East Area, including the ERDF. The 24 Command Fire did not affect the LLBGs in the 200 West Area (although some of these border the 200 West Expansion Area), nor did it reach the 200 East Area.

In general, approximately 85 percent of the burned area experienced severe fire intensity, resulting in complete destruction of all vegetation and organic litter on the soil surface (Baker 2000). In moderately burned areas, there was partial removal of the shrub layer and understory. Many of the severely and moderately burned areas have since been colonized by alien annual weeds, such as Russian thistle (*Salsola kali*) and cheatgrass (*Bromus tectorum*).

The most severely burned areas, particularly west and southwest of the 200 West Area (including the area identified for construction of the additional CWC facilities and the New Waste Processing Facility), were, and continue to be severely eroded by wind (Becker and Sackschewsky 2001a, 2001b; Sackschewsky and Becker 2001). Much of the topsoil and likely much of the buried seed (Baker 2000) have been removed. Plant communities in these areas, particularly the shrub components, may not

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The most severely burned areas, particularly west and southwest of the 200 West Area (including the area identified for construction of the additional CWC facilities and the New Waste Processing Facility), were, and continue to be severely eroded by wind (Becker and Sackschewsky 2001a, 2001b; Sackschewsky and Becker 2001). Much of the topsoil and likely much of the buried seed (Baker 2000) have been removed. Plant communities in these areas, particularly the shrub components, may not recover before project-related surface disturbance because of a lack of buried seed (Baker 2000), relatively long distances to upwind seed sources, continued wind erosion, and competition by weedy species.

In contrast, some of the pre-fire shrub and understory vegetation in the moderately burned areas (including most of Area C and the ERDF) was not removed or is recovering, and these areas have not been affected as severely by wind erosion. These plant communities thus have likely retained more of their buried seed than those that were severely burned; this seed may germinate when conditions are suitable. Consequently, some of these communities are expected to partially or fully recover before project-related disturbance, notwithstanding competition by weedy species.

I.2 Impacts to Terrestrial Resources Resulting from Surface Disturbance

I.2.1 Alternative Group A

LLBGs in the 200 East Area – Impacts to Habitats and Plant Species of Concern. The LLBGs in the 200 East Area are surveyed annually, consistent with the DOE *Ecological Compliance Assessment Management Plan* (ECAMP) (DOE-RL 1995a). The 218-E-10 and 218-E-12B LLBGs have been cleared of most of their original vegetation, greatly increasing their susceptibility to noxious weed invasion.

Noxious weeds on the Hanford Site are managed under the Integrated Pest Management (IPM) program (WHC 1995), and the primary means of control is herbicides. IPM personnel are required to obtain training, licenses, and certifications (WHC 1995) in order to ensure compliance with Washington State Department of Agriculture rules relating to the use of restricted herbicides in ground and aerial applications. Compliance with these rules facilitates effective control of target populations with minimal accidental overspray of and herbicide drift into non-target areas. Herbicide drift is minimized primarily by deploying herbicides under optimal weather conditions (Renne and Wolf 1976) and using drift retardants. Drift retardants increase droplet size, increasing settling rate and thus rendering herbicides less susceptible to drift.

Cheatgrass and Sandberg's bluegrass (*Poa sandbergii*), a native perennial, dominate approximately two-thirds of the 218-E-10 and 218-E-12B LLBGs. Crested wheatgrass (*Agropyron cristatum*), a non-native perennial planted for a variety of purposes including dust suppression and reduction of water infiltration into the vadose zone, dominates the other third (Brandt 1998, 1999; Sackschewsky 2000, 2001, 2002a). The 218-E-10 and 218-E-12B LLBGs receive regular herbicide applications and thus have essentially no habitat value for native broad-leaved species such as big sagebrush (*Artemisia tridentata*). Consequently, continued use of these LLBGs, or new disturbance of the extant plant communities within them, would not result in the loss of any habitats designated by Washington State as priority habitats (DOE-RL 2003). However, native habitats could develop if herbicide spraying ceases.

Two plant species of concern have been observed within the 218-E-10 and 218-E-12B LLBGs. The most notable is Piper's daisy (*Erigeron piperianus*). The State of Washington Natural Heritage Program recover before project-related surface disturbance because of a lack of buried seed (Baker 2000), relatively long distances to upwind seed sources, continued wind erosion, and competition by weedy species.

In contrast, some of the pre-fire shrub and understory vegetation in the moderately burned areas (including most of Area C and the ERDF) was not removed or is recovering, and these areas have not been affected as severely by wind erosion. These plant communities thus have likely retained more of their buried seed than those that were severely burned; this seed may germinate when conditions are suitable. Consequently, some of these communities are expected to partially or fully recover before project-related disturbance, notwithstanding competition by weedy species.

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Two plant species of concern have been observed within the 218-E-10 and 218-E-12B LLBGs. The most notable is Piper’s daisy (*Erigeron piperianus*). The State of Washington Natural Heritage Program

(WHNP) lists Piper's daisy as sensitive (a taxon that is vulnerable or declining and could become endangered or threatened in Washington without active management or removal of threats [WNHP 2002]) (Sackschewsky and Downs 2001). Sensitive species are considered Level III resources (Table I.1) under the *Hanford Site Biological Resources Management Plan* (BRMaP) (DOE-RL 2001). This species was observed within the 218-E-12B and 218-E-10 LLBGs during spring 1999 (Brandt 1999) but not in spring 2000, 2001, or 2002 (Sackschewsky 2000, 2001, 2002a). Piper's daisy populations on these two LLBGs have been reduced or eliminated, likely as a result of regular herbicide applications. However, these populations could regenerate from buried seed, particularly if herbicide spraying ceases.

Table I.1. Hanford Site Biological Resources Management Plan Resource Levels and Their Definitions

Resource Level	Definition
I	Those resources that—because of their recreational, commercial, or ecological role or previous protection status—require at a minimum some level of status monitoring. Mitigation is not normally required.
II	Those resources that—to show compliance with procedural and substantive laws such as NEPA, CERCLA, and the Migratory Bird Treaty Act—require consideration of potential adverse impacts. Mitigation is most often accomplished by avoidance and impact minimization, except in the case of recovering shrub-steppe habitat,[a] for which mitigation via rectification or compensation is recommended.
III	Those resources that—because of their state listing, potential for federal or state listing, unique or significant value for plant, fish, or wildlife species, special administrative designation, or environmental sensitivity—require mitigation. When avoidance and minimization are not possible or are insufficient, mitigation via rectification or compensation is recommended.
IV	Those resources that—because of their federally protected legal status or their regional and national significance—justify preservation and the primary management option. Typically, these cannot be mitigated unless it is by compensation via acquisition and protection of in-kind resources.

(a) Habitat characterized by short-statured, widely spaced, small-leaved shrubs, sometimes aromatic (of, related to, or containing the six-carbon ring typical of the benzene series and related organic groups), with brittle stems and an understory dominated by perennial bunchgrasses.

The other plant species of concern observed within the 218-E-10 and 218-E-12B LLBGs is crouching milkvetch (*Astragalus succumbens*), a Washington State Watch List species (plant taxon that is of concern but is considered to be more abundant and/or less threatened in Washington than previously assumed [WNHP 2002]) (Sackschewsky and Downs 2001). Watch List species are considered Level I resources (Table I.1) under BRMaP (DOE-RL 2001). This species was observed in spring 2000, 2001, and 2002 within Trench 94 in the 218-E-12B LLBG and on the northeast side of the 218-E-10 LLBG (Sackschewsky 2000, 2001, 2002a). Crouching milkvetch is relatively common on the Central Plateau (Sackschewsky and Downs 2001). Therefore, disturbance of those individuals on the 218-E-12B and 218-E-10 LLBGs would not be likely to adversely affect the overall local population.

LLBGs in the 200 West Area – Impacts to Habitats and Plant Species of Concern. The LLBGs in the 200 West Area are surveyed annually consistent with ECAMP (DOE-RL 1995a). The 218-W-3A, 218-W-3AE, 218-W-4B, and 218-W-5 LLBGs in the 200 West Area are sparsely colonized by cheatgrass, Russian thistle, and crested wheatgrass (Brandt 1998, 1999; Sackschewsky 2000, 2001, 2002a). These receive regular herbicide applications and thus have essentially no habitat value for native species. Consequently, continued use of these LLBGs, or new disturbance of the extant plant communities within them, would not result in the loss of any habitats designated by Washington State as priority habitat (DOE-RL 2003). However, native habitats could develop if herbicide spraying ceases.

Most of the developed portion of the 218-W-4C LLBG, bounded on the west by Dayton Avenue and on the north and south by 19th and 16th streets, respectively, is highly disturbed and has a sparse cover of cheatgrass. However, some portions of this LLBG now have relatively thick stands of Indian ricegrass (*Oryzopsis hymenoides*) and needle-and-thread grass (*Stipa comata*) (Brandt 1998, 1999; Sackschewsky 2000, 2001, 2002a), both native perennial species. This developed portion of the 218-W-4C LLBG receives regular herbicide applications and thus has essentially no habitat value for native species. Consequently, continued use of the developed portion of the 218-W-4C LLBG, or new disturbance of the extant plant communities within it, would not result in the loss of any habitats designated by Washington State as priority habitat (DOE-RL 2003). However, native habitats could develop if herbicide spraying ceases.

The undeveloped southeastern portion of the 218-W-4C LLBG, along 16th Street, is dominated by mature sagebrush, with gray and green rabbitbrush (*Chrysothmnus nauseosus*) as minor overstory components. The understory consists primarily of needle-and-thread grass, cheatgrass, and crested wheatgrass. Development of the southeastern portion of the 218-W-4C LLBG would result in the loss of sagebrush steppe (shrub-steppe dominated by sagebrush), considered a priority habitat by the State of Washington (DOE-RL 2003) and a Level III resource under BRMaP (DOE-RL 2001).

One plant species of concern has been observed within some of the 200 West LLBGs—stalked-pod milkvetch (*Astragalus sclerocarpus*), a Washington State Watch List species (Sackschewsky and Downs 2001) and thus a Level I resource (DOE-RL 2001). Stalked-pod milkvetch was observed in spring 1998, 1999, 2000, 2001, and 2002 at the extreme western edge of the 218-W-5 LLBG and within the undeveloped portion of the 218-W-4C LLBG (Brandt 1998, 1999; Sackschewsky 2000, 2001, 2002a). Stalked-pod milkvetch is relatively common on the Central Plateau (Sackschewsky and Downs 2001). Therefore, disturbance of those individuals on the 218-W-5 and 218-W-4C LLBGs would not likely adversely affect the overall local population.

LLBGs in the 200 East and 200 West Areas – Impacts to Wildlife and Wildlife Species of Concern. Wildlife that could be impacted by disturbance of the 200 East and 200 West LLBGs includes the mule deer (*Odocoileus hemionus*), Great Basin pocket mouse (*Perognathus parvus*), side-blotched lizard (*Uta stansburiana*), and several migratory bird species. Ground-nesting birds that have been observed, and that may nest within the 200 East and 200 West LLBGs, include the horned lark (*Eremophila alpestris*), killdeer (*Charadrius vociferous*), long-billed curlew (*Numenius americanus*), and Western meadowlark (*Sturnella neglecta*) (Sackschewsky 2001). Ground disturbance during the nesting season, generally March through July, could destroy eggs and young and temporarily displace nesting individuals into other areas of the Hanford Site. The nests, eggs, and young of migratory birds are protected under the Migratory Bird Treaty Act (MBTA) (16 USC 703-712, as amended). Protection is generally accomplished by conducting ground-disturbing activities outside the nesting season, generally August through February.

Proposed Disposal Facility Near the PUREX Plant in 200 East Area – Impacts to Habitats and Plant Species of Concern. The proposed disposal facility near the PUREX Plant is surveyed annually consistent with ECAMP (DOE-RL 1995a). Unlike the majority of the LLBGs, the original vegetation in the proposed disposal facility near the PUREX Plant has not been cleared. The overstory is dominated by sagebrush (25% cover), with green rabbitbrush (*Chrysothmnus viscidiflorus*) as a minor component. The understory is dominated by cheatgrass and Sandberg's bluegrass. Development of the proposed disposal facility near the PUREX Plant would result in the loss of sagebrush steppe, considered a priority habitat by the State of Washington (DOE-RL 2003) and a Level III resource under BRMaP (DOE-RL 2001). No plant species of concern were observed in the proposed disposal facility near the PUREX Plant during the annual field survey of summer 2002.

Proposed Disposal Facility Near the PUREX Plant in 200 East Area – Impacts to Wildlife and Wildlife Species of Concern. Wildlife that could be affected by disturbance of the proposed disposal facility near the PUREX Plant includes the black-tailed jackrabbit (*Lepus californicus*), mule deer (*Odocoileus hemionus*), coyote (*Canis latrans*), Northern pocket gopher (*Thomomys talpoides*), and several migratory bird species. Shrub- and ground-nesting birds that have been observed and that likely nest within the proposed disposal facility near the PUREX Plant include the sage sparrow (*Amphispiza belli*) and Western meadowlark (*Sturnella neglecta*), respectively. Ground disturbance during the nesting season, generally March through July, could destroy eggs and young and temporarily displace nesting individuals into other areas of the Hanford Site. The nests, eggs, and young of migratory birds are protected under the MBTA. Protection is generally accomplished by conducting ground-disturbing activities outside the nesting season, generally August through February.

Two wildlife species of concern were observed within the proposed disposal facility near the PUREX Plant—the black-tailed jackrabbit and sage sparrow, both Washington State candidate species (species that the Washington Department of Fish and Wildlife will review for possible listing as endangered, threatened, or sensitive [WDFW 2002]). The distribution of the black-tailed jackrabbit (BMNHC 2002) and sage sparrow within Washington is limited mostly to the Columbia Basin. Both species have a strong affinity for sagebrush habitat. Removal of sagebrush within the proposed disposal facility near the PUREX Plant would likely have a minimal impact on populations of these species within the Columbia Basin.

Area C – Impacts to Habitats. Much of the original vegetation in Area C was burned in the 24 Command Fire. Pre-fire plant communities and land cover types in Area C consisted of the following:

- needle-and-thread grass/Indian ricegrass
- big sagebrush/needle-and-thread grass
- bluebunch wheatgrass (*Agropyron spicatum*)/Sandberg's bluegrass
- rabbitbrush (*Chrysothamnus* spp.)/bunchgrass mosaic
- Sandberg's bluegrass/cheatgrass

- big sagebrush/Sandberg's bluegrass/cheatgrass
- abandoned old agricultural fields
- disturbed (inactive borrow pit) (Figure I.1).

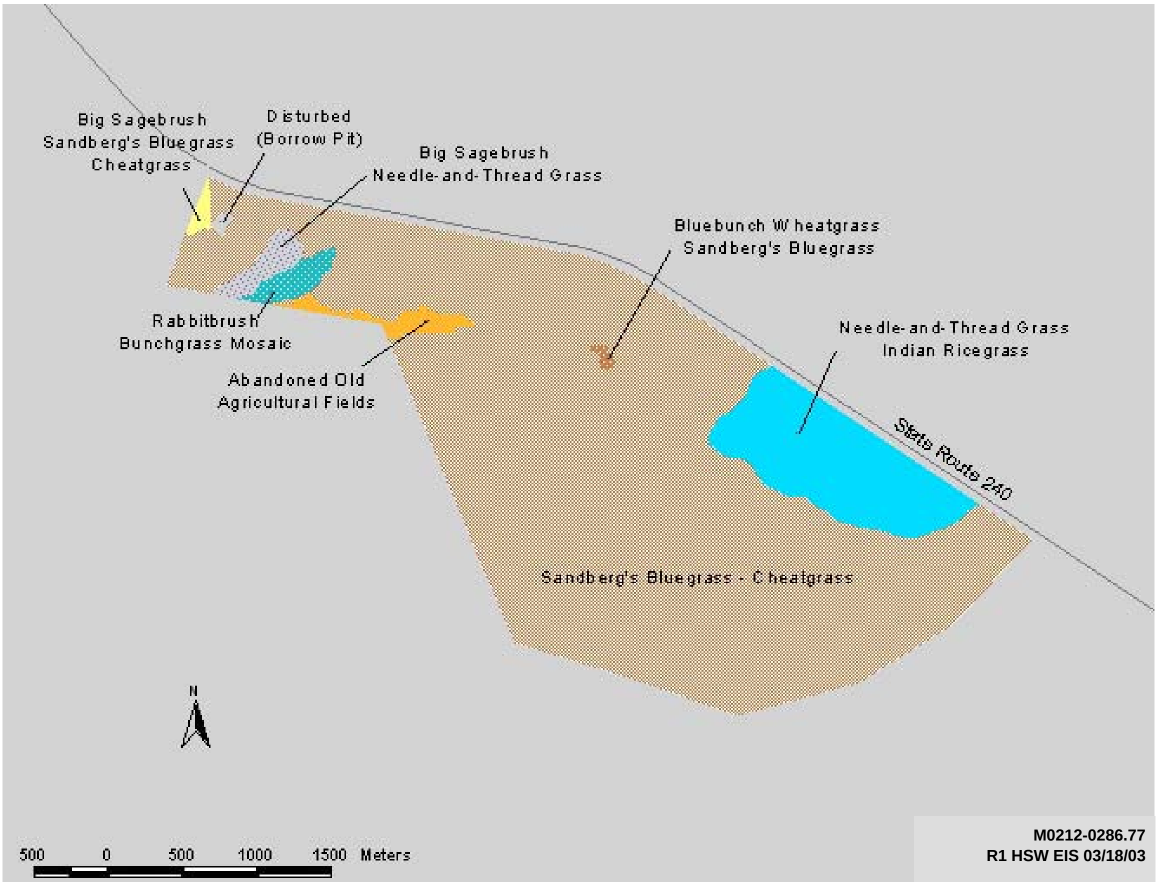

Figure I.1. Plant Communities in Area C Before the 24 Command Fire of June 2000 (Data collected 1994 and 1997 by TNC; 1991 and 1999 by Pacific Northwest National Laboratory [PNNL]. Map created January 2002 by PNNL).

Needle-and-Thread Grass/Indian Ricegrass. The pre-fire needle-and-thread grass/Indian ricegrass community was designated a potential bitterbrush (*Purshia tridentata*)/Indian ricegrass sand dune complex community (Figure I.2) by The Nature Conservancy (TNC) of Washington. A potential plant community is one that, with the passage of time, is projected to dominate an undisturbed site, based on climate and other abiotic factors (Soll and Soper 1996). Thus, development of the potential bitterbrush/ Indian ricegrass community is based on long-term colonization by bitterbrush and eventual domination of the understory by Indian ricegrass.

The pre-fire needle-and-thread grass/Indian ricegrass community was designated an element occurrence of the bitterbrush/Indian ricegrass sand dune complex community type (Figure I.3). An element occurrence of a community type is one that meets the minimum standards set by the WNHP for

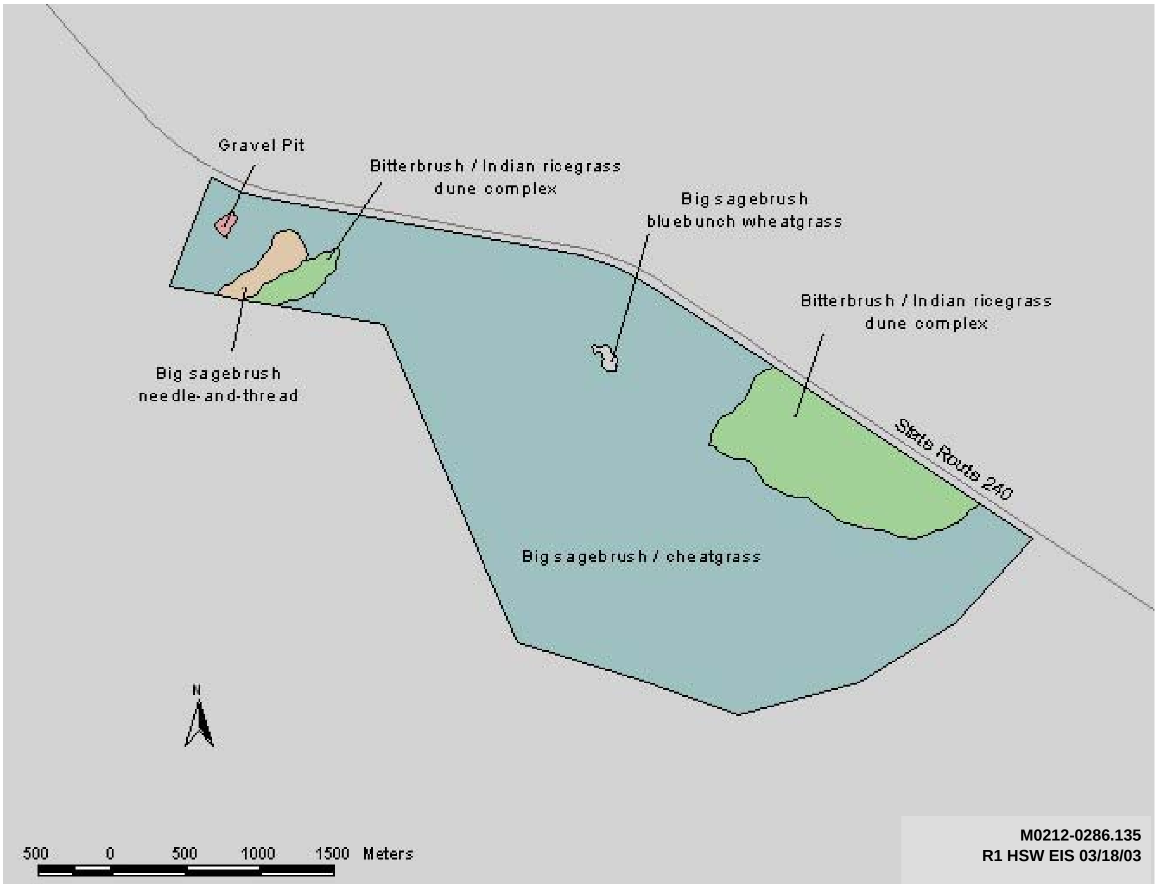

Figure I.2. Potential Plant Communities in Area C (Data collected 1994 and 1997 by TNC; 1991 and 1999 by PNNL. Map created January 2002 by PNNL).

ecological condition, size, and the surrounding landscape. Element occurrences are generally considered to be of significant conservation value from a state and/or regional perspective. More specifically, element occurrences on the Hanford Site may be considered integral to the preservation and sustenance of biodiversity in the Columbia Basin shrub-steppe. Element occurrences are tracked by the WNHP.

Element occurrences are designated Level IV resources (Table I.1) in BRMaP (DOE-RL 2001), the highest level of resource designation at the Hanford Site. Element occurrences, because of their regional significance, justify preservation as the primary management option, and impacts to these should be avoided where possible (DOE-RL 2001).

The dominant plant species in this community, as determined by ocular estimation of percentage ground cover, currently are cheatgrass (50 percent), needle-and-thread grass (15 percent), and Indian ricegrass (10 percent) (Attachment A to this appendix; Sackschewsky 2002d). This needle-and-thread grass/Indian ricegrass community should thus be re-designated cheatgrass/needle-and-thread grass/Indian

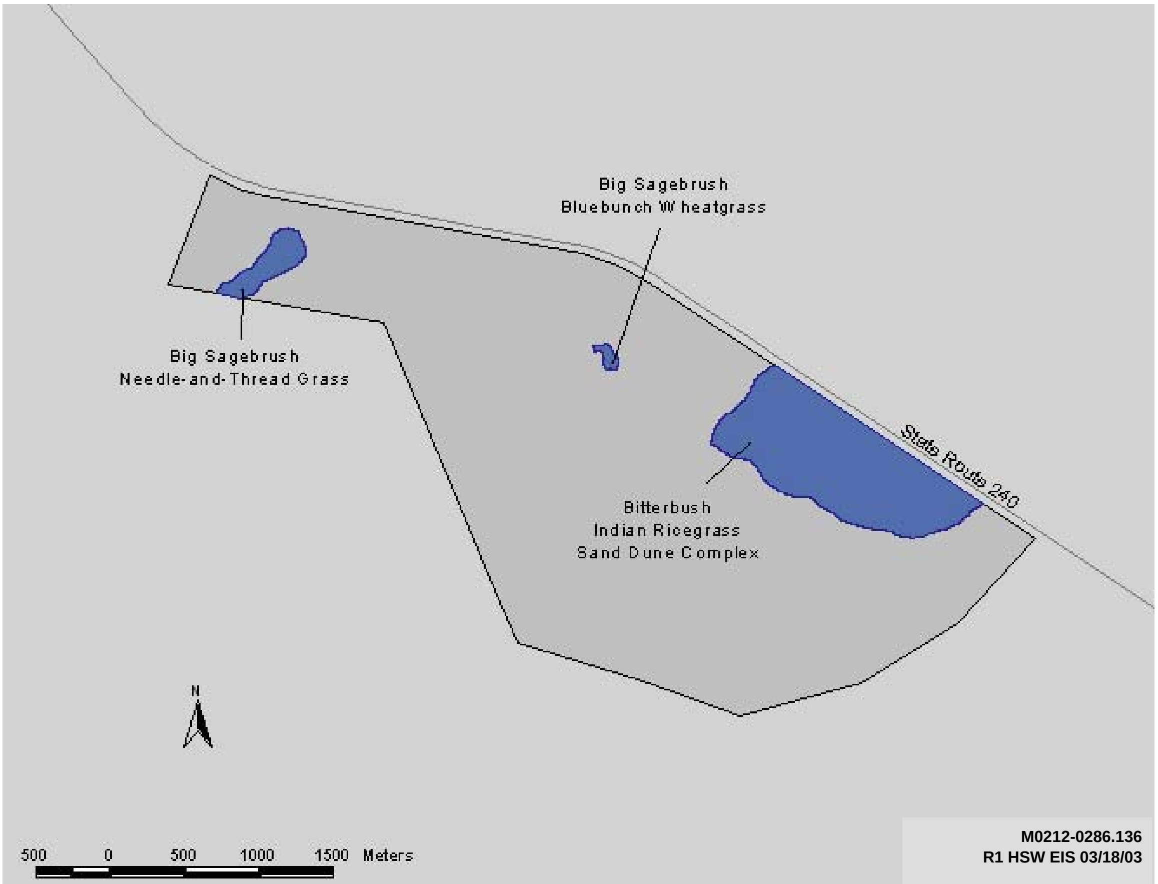

Figure I.3. Element Occurrences of Plant Community Types in Area C (Data collected 1994, 1995, and 1997 by TNC; 1996 by WNHP. Map created January 2002 by PNNL).

ricegrass (Figure I.4). Because bitterbrush is not currently present in this community (Attachment A to this appendix; Sackschewsky 2002d), it appears unlikely that it will become a bitterbrush/Indian ricegrass community prior to the start of new construction.

Big Sagebrush/Needle-and-Thread Grass. No potential (more advanced) community type has been designated by TNC for this pre-fire big sagebrush/needle-and-thread grass community (Figure I.2) (Soll and Soper 1996). This pre-fire community was designated an element occurrence (Figure I.3) (Soll and Soper 1996). However, big sagebrush appears to have been absent in the pre-fire community, based on observations made in the field in February and June 2002 (Sackschewsky 2002c, 2002d; Attachment A to this appendix), during which no burned shrub stumps and virtually no other burned shrub residue (e.g., branches) were observed. Therefore, its designation as an element occurrence may have been erroneous. However, this determination can be made only by the WNHP.

This community is currently much smaller than that defined by TNC (compare Figures I.1, I.2, and I.3 with I.4). The dominant plant species in this community currently are needle-and-thread grass (20 percent) and cheatgrass (20 percent) (Attachment A to this appendix; Sackschewsky 2002d). This big

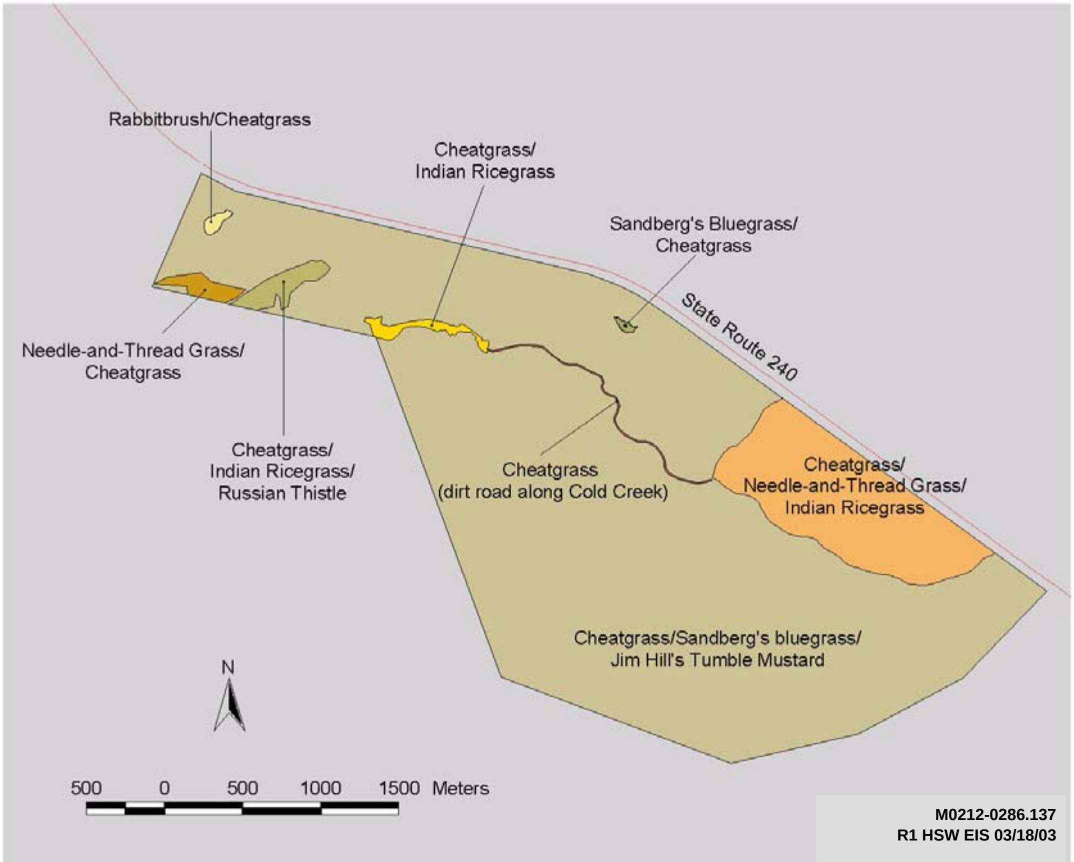

Figure I.4. Plant Communities in Area C After the 24 Command Fire of June 2000 (Data collected June and July 2002 by PNNL. Map created October 2002 by PNNL).

sagebrush/ needle-and-thread grass community should thus be re-designated needle-and-thread grass/cheatgrass (Figure I.4). Because sagebrush is not currently present in this community (Attachment A to this appendix; Sackschewsky 2002d), it appears unlikely that it could become a big sagebrush/needle-and-thread grass community prior to the start of new construction.

Bluebunch Wheatgrass/Sandberg's Bluegrass. The pre-fire bluebunch wheatgrass/Sandberg's bluegrass community, designated a potential big sagebrush/bluebunch wheatgrass community (Figure I.2) by Soll and Soper (1996), was designated an element occurrence of the big sagebrush/bluebunch wheatgrass community (Figure I.3) (Soll and Soper 1996).

The dominant plant species in this community currently are Sandberg's bluegrass (40 percent) and cheatgrass (10 percent). Bluebunch wheatgrass is a minor component of this community, i.e., much less than 1 percent cover (Attachment A to this appendix; Sackschewsky 2002d). This bluebunch wheatgrass/ Sandberg's bluegrass community should thus be re-designated Sandberg's bluegrass/cheatgrass (Figure I.4). The designation of this community as an element occurrence may be erroneous due to the insignificant amount of bluebunch wheatgrass. However, this determination can be made only by the WNHP. Because sagebrush is not currently present in this community (Attachment A to this appendix;

Sackschewsky 2002d), it appears unlikely that it could become a big sagebrush/bluebunch wheatgrass community prior to the start of new construction.

Rabbitbrush/Bunchgrass Mosaic. This pre-fire rabbitbrush/bunchgrass mosaic community has been designated a potential bitterbrush/Indian ricegrass sand dune complex community (Figure I.2) by Soll and Soper (1996).

The dominant plant species in this community currently are cheatgrass (20 percent), Indian ricegrass (10 percent), and Russian thistle (10 percent). Scattered burned and living rabbitbrush were a minor component of this community, i.e., much less than 1 percent cover (Attachment A to this appendix; Sackschewsky 2002d). This community should thus be re-designated cheatgrass/Indian ricegrass/Russian thistle (Figure I.4). Because living rabbitbrush are currently present (Attachment A to this appendix; Sackschewsky 2002d), and given the substantial Indian ricegrass component, this community will likely recover to its pre-fire condition (i.e., rabbitbrush/bunchgrass mosaic community) before the start of new construction.

Sandberg's Bluegrass/Cheatgrass. This area was designated a potential big sagebrush/cheatgrass community (Figure I.2) by Soll and Soper (1996). The dominant plant species in this community, except for the dirt road along Cold Creek, currently are cheatgrass (55 percent), Sandberg's bluegrass (15 percent), and Jim Hill's tumble mustard (*Sisymbrium altissimum*) (10 percent) (Attachment A to this appendix; Sackschewsky 2002d), an alien, annual weed. This community should thus be re-designated cheatgrass/ Sandberg's bluegrass/Jim Hill's tumble mustard (Figure I.4). The dominant plant species along the dirt road along Cold Creek is cheatgrass (50 percent) (Attachment A to this appendix; Sackschewsky 2002d), and should be considered a separate community (Figure I.4).

Widely scattered mature big sagebrush (<1 percent cover in the area of its occurrence [Attachment A to this appendix; Sackschewsky 2002d]), of which approximately 10 percent were alive, were observed in the southeastern portion of this cheatgrass/Sandberg's bluegrass/Jim Hill's tumble mustard community, within approximately 200 m (656 ft) of the border of Area C. This portion of the cheatgrass/Sandberg's bluegrass/Jim Hill's tumble mustard community is thus a Level II resource (Table I.1) under BRMaP (DOE-RL 2001). Seeding from remnant mature sagebrush may enable this portion of the community to become big sagebrush/cheatgrass before the start of new construction. However, because living, mature sagebrush are currently scarce and very limited in distribution, and given the relatively long upwind distance to external seed sources, the potential for sagebrush colonization of the remainder of this community before the start of new construction is expected to be low.

Big Sagebrush/Sandberg's Bluegrass/Cheatgrass. This area was designated a potential big sagebrush/cheatgrass community (Figure I.2) by Soll and Soper (1996). The dominant plant species in this community currently are cheatgrass (55 percent), Sandberg's bluegrass (15 percent), and Jim Hill's tumble mustard (*Sisymbrium altissimum*) (Attachment A to this appendix; Sackschewsky 2002d). This community should thus be re-designated cheatgrass/Sandberg's bluegrass/Jim Hill's tumble mustard (Figure I.4). No evidence was found to indicate that sagebrush had been a component of the pre-fire community, and sagebrush is not currently present in this area (Attachment A to this appendix; Sackschewsky 2002d). Thus, it appears unlikely that this area could become a big sagebrush/cheatgrass community prior to the start of new construction.

Abandoned Old Agricultural Fields. This area was designated a potential big sagebrush/cheatgrass community (Figure I.2) by Soll and Soper (1996). The dominant plant species in this community currently are cheatgrass (20 percent) and Indian ricegrass (10 percent) (Attachment A to this appendix; Sackschewsky 2002d). This community should thus be designated cheatgrass/Indian ricegrass (Figure I.4) because the current designation provides no information on species composition. Because sagebrush is not currently present in this area (Sackschewsky 2002d), it appears unlikely that this area could become a big sagebrush/cheatgrass community prior to the start of new construction.

Disturbed (Inactive Borrow Pit). Based on observations made in the field in February and June 2002 (Sackschewsky 2002c, 2002d), the inactive borrow pit was virtually unaffected by the 24 Command Fire, although vegetation all around it was removed. The dominant plant species in this community currently are gray rabbitbrush (5 percent) and cheatgrass (30 percent). Sagebrush is a minor component, at 1 percent cover (Attachment A to this appendix; Sackschewsky 2002d). This community should thus be designated gray rabbitbrush/cheatgrass (Figure I.4) because the current designation provides no information on species composition. Because the overstory is dominated by rabbitbrush and sagebrush is sub-dominant, this community should be considered a Level II resource under BRMaP (DOE-RL 2001).

Area C – **Impacts to Wildlife**. Wildlife that could be affected by disturbance of Area C include mammals—the badger (*Taxidea taxus*), coyote, elk (*Cervus elaphus*), mule deer, and Northern pocket gopher; birds—the horned lark, lark sparrow (*Chondestes grammacus*), rock wren (*Salpinctes obsoletus*), short-eared owl (*Asio flammeus*), and Western meadowlark; and reptiles—the side-blotched lizard (Attachment A to this appendix; Sackschewsky 2002d).

Of these avian species, those that are ground-nesting and that may nest within Area C include the horned lark and Western meadowlark. Ground disturbance during the nesting season, generally March through July, could destroy eggs and young and temporarily displace nesting individuals into other areas of the Hanford Site. The same temporal restrictions as set forth above in **LLBGs in the 200 East and 200 West Areas – Impacts to Wildlife and Wildlife Species of Concern** (page I.4) apply for conducting ground-disturbing activities outside the nesting season to protect the nests, eggs, and young of these species in this area.

An elk herd of approximately 660 animals uses the ALE Reserve and surrounding private lands (Tiller et al. 2000). After the 24 Command Fire, little vegetation was available on the ALE Reserve. Core use areas during the calving (March–June) and post-calving (July–August) periods in 2000 generally centered along the southern border of the ALE Reserve, largely on private lands in range and agricultural areas (Tiller et al. 2000). However, one of the core areas used by bulls during the calving period centered on State Route 240 and included part of the Hanford Central Plateau southeast of Area C (Tiller et al. 2000). In addition, elk are known to also move extensively north of State Route 240 (SR 240), east and south of Area C, from fall through spring. Although most of these movements onto the Hanford Central Plateau are located east and south of Area C, elk also have been observed using Area C (e.g., during summer 2002 [see Attachment A to this appendix]). Use of Area C appears to be restricted to foraging and loafing. Calving generally occurs at the upper elevations of Rattlesnake Mountain.

Blasting and use of heavy equipment to remove borrow materials from Area C undoubtedly will disturb elk and displace some animals into adjacent areas, particularly if conducted during the winter months. However, because Area C comprises only a small portion of their overall range and is not known to be particularly important for either overwintering or calving, the effect on the population is likely to be minimal.

Blasting and use of heavy equipment to remove borrow materials from Area C undoubtedly will also disturb the other mammalian species listed above and displace some individuals into adjacent areas. However, because Area C is not known to be particularly important for any of these species, the effects on local populations of these are likely to be minimal.

Area C – Impacts to Plant and Wildlife Species of Concern. According to Soll and Soper (1996), there was a rare plant population of an unnamed species located within Area C, although its purported location did not correspond to any of the areas searched by TNC during the rare plant surveys it conducted on the ALE Reserve in the 1990s. In addition, this population was not referenced in the BRMaP (DOE-RL 2001). This discrepancy was resolved during fieldwork conducted in June and July 2002, during which no rare plant population was observed (Sackschewsky 2002d).

The only plant species of concern observed within the Area C plant communities were purple mat (*Nama densum* var. *parviflorum*), crouching milkvetch, and stalked-pod milkvetch (Attachment A to this appendix; Sackschewsky 2002d). Purple mat is a Washington State Review 1 species (plant taxon of potential concern that is in need of additional field work before a status can be assigned [WNHP 2002]). Review 1 species are considered Level II resources under BRMaP (DOE-RL 2001).

Purple mat occurs occasionally throughout central Hanford (Sackschewsky and Downs 2001). Crouching milkvetch and stalked-pod milkvetch are relatively common on the Central Plateau (Sackschewsky and Downs 2001). Consequently, disturbance of the individuals of these three species located in the Area C plant communities would not likely adversely affect the overall local populations. The Area C plant communities (Figure I.4) in which these three species were observed are provided in Table I.2.

No wildlife species of concern were observed in any of the Area C plant communities (Attachment A to this appendix; Sackschewsky 2002d).

Area C Stockpile Area and Conveyance Road – Impacts to Habitats and Wildlife. The area identified for the stockpile area and conveyance road north of SR 240 was severely burned in the 24 Command Fire. This area continues to be severely eroded by wind (Becker and Sackschewsky 2001a; 2001b; Sackschewsky and Becker 2001). Much of the topsoil, and likely much of the buried seed (Baker 2000), has been removed. Because of a lack of buried seed, relatively long distances to external upwind seed sources, continued wind erosion, and competition by weedy species, sagebrush recovery is expected to be minimal before the start of new construction.

Table I.2. Area C Plant Communities in Which Purple Mat, Crouching Milkvetch, and/or Stalked-Pod Milkvetch Were Observed (Attachment A to this appendix; Sackschewsky 2002d)

Plant Community	Species		
	Crouching Milkvetch	**Purple Mat**	**Stalked-Pod Milkvetch**
Cheatgrass/needle-and-thread grass/Indian ricegrass	(a)	X	X
Needle-and-thread grass/cheatgrass	X		
Sandberg's bluegrass/cheatgrass			
Cheatgrass/Indian ricegrass/Russian thistle			X
Cheatgrass/Sandberg's bluegrass/Jim Hill's tumble mustard	X	X	
Cheatgrass	X		
Cheatgrass/Indian ricegrass	X		
Gray rabbitbrush/cheatgrass			X

(a) Blank cells indicate that the species have not been found in the corresponding plant communities.

The dominant plant species in this area currently are Russian thistle (30 percent), cheatgrass (15 percent), and dune scurfpea (*Psoralea lanceolata*) (10 percent) (Attachment A to this appendix; Sackschewsky 2002d).

Wildlife that could be affected by disturbance of the stockpile and conveyance road area include mammals—the black-tailed jackrabbit and coyote—and birds—the horned lark, mourning dove (*Zenaida macroura*), Western kingbird (*Tyrannus verticalis*), and Western meadowlark (Attachment A to this appendix; Sackschewsky 2002d).

Of these avian species, those that are ground-nesting and that may nest within the stockpile and conveyance road area include the horned lark and Western meadowlark. The same temporal restrictions as set forth above apply for conducting ground-disturbing activities outside the nesting season to protect the nests, eggs, and young of these species in this area.

Area C Stockpile Area and Conveyance Road – Impacts to Plant and Wildlife Species of Concern. The only plant species of concern observed within the area identified for the stockpile and conveyance road was stalked-pod milkvetch (Attachment A to this appendix; Sackschewsky 2002d). Because stalked-pod milkvetch is relatively common on the Central Plateau (Sackschewsky and Downs 2001), disturbance of the individuals located within the stockpile and conveyance road area would not likely adversely affect the overall local population.

Only one wildlife species of concern was observed within this area—the black-tailed jackrabbit (Attachment A to this appendix; Sackschewsky 2002d). Because sagebrush recovery in the area identified for the stockpile and conveyance road is expected to be minimal before the start of new construction, the impact of its eventual removal on the black-tailed jackrabbit within the Columbia Basin is likely to be insignificant.

I.2.2 Alternative Group B

LLBGs in the 200 East Area. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Group B. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Group B.

LLBGs in the 200 West Area. Other potential impacts in addition to those described for habitats and plant and animal species under Alternative Group A may occur under Alternative Group B due to disposal in the 218-W-6 LLBG.

Most of the eastern half of the 218-W-6 LLBG has been previously disturbed and replanted to crested wheatgrass (Brandt 1998, 1999; Sackschewsky 2000, 2001, 2002a). The entire western half and a portion of the eastern half (on the northern edge) of the burial ground had not been disturbed prior to late 2001/2002 and consisted of sagebrush, spiny hopsage (*Grayia spinosa*), and Sandberg's bluegrass. However, these areas also were treated with herbicide during late 2001/early 2002 (Sackschewsky 2002a) prior to anticipated mechanical removal of vegetation (Sackschewsky 2002b) for the purpose of fire suppression.

With the exception of the northeastern corner, the eastern half of the 218-W-6 LLBG receives regular herbicide applications and thus has essentially no habitat value for native species. Vegetation on the western half and the northeastern corner of the 218-W-6 LLBG has been removed since the initial herbicide application of late 2001/2002, and these areas will continue to receive herbicide applications on a regular basis. Thus, they also will have essentially no habitat value for native species. Consequently, continued use of the 218-W-6 LLBG, or new disturbance of the extant plant communities within them, would not result in the loss of any habitats designated by Washington State as priority habitat (DOE-RL 2003). However, native habitats could develop if herbicide spraying ceases.

New Waste Processing Facility – Impacts to Habitats and Wildlife. The area identified for construction of the New Waste Processing Facility consisted of mature sagebrush habitat before the 24 Command Fire. The dominant plant species in this area currently is bur ragweed (*Ambrosia acanthacarpa*), a native annual weed (Attachment A to this appendix).

This area was severely burned and continues to be severely eroded by wind (Becker and Sackschewsky 2001a, 2001b; Sackschewsky and Becker 2001). Much of the topsoil and likely much of the buried seed (Baker 2000) have been removed. Because of a lack of buried seed, relatively long distances to external upwind seed sources, continued wind erosion, and competition by weedy species, sagebrush recovery is expected to be minimal within the time frame before the start of new construction.

Wildlife that could be affected by disturbance of the area identified for construction of the New Waste Processing Facility include the coyote (Attachment A to this appendix).

New Waste Processing Facility – Impacts to Plants and Wildlife Species of Concern. The only plant species of concern observed within the area identified for the New Waste Processing Facility was stalked-pod milkvetch (Attachment A to this appendix). Because stalked-pod milkvetch is relatively common on the Central Plateau (Sackschewsky and Downs 2001), disturbance of the individuals located within the stockpile and conveyance road area would not likely adversely affect the overall local population.

No wildlife species of concern were observed in this area (Attachment A to this appendix).

ILAW Disposal Facility – **Impacts to Habitats and Wildlife**. The area identified for construction of the ILAW disposal facility was divided into two areas for the summer 2002 field surveys (Attachment A to this appendix; Sackschewsky 2002d)—the W-5 Expansion Area and the area located north of 16th Street and west of Dayton Avenue. Both areas consisted of mature big sagebrush habitat before the 24 Command Fire.

The dominant plant species in the W-5 Expansion Area currently are Sandberg's bluegrass (20 percent), cheatgrass (15 percent), Indian ricegrass (10 percent), and Russian thistle (10 percent) (Attachment A to this appendix; Sackschewsky 2002d). The dominant plant species in the area located north of 16th Street and west of Dayton Avenue currently is Russian thistle (Attachment A to this appendix; Sackschewsky 2002d).

Wildlife that could be affected by disturbance of the W-5 Expansion Area include mammals—the badger, coyote, Great Basin pocket mouse, and mule deer; and birds—the horned lark, mourning dove, and Western meadowlark (Attachment A to this appendix; Sackschewsky 2002d). Only the coyote and Western meadowlark were observed in the area north of 16th Street and west of Dayton Avenue (Attachment A to this appendix; Sackschewsky 2002d).

Of these avian species, those that are ground-nesting and that may nest within the W-5 Expansion Area and the area located north of 16th Street and west of Dayton Avenue include the horned lark and Western meadowlark. The same temporal restrictions as set forth above apply for conducting ground-disturbing activities outside the nesting season to protect the nests, eggs, and young of these species in these areas.

The W-5 Expansion Area and the area north of 16th Street and west of Dayton Avenue were severely burned and continue to be severely eroded by wind (Becker and Sackschewsky 2001a, 2001b; Sackschewsky and Becker 2001). Much of the topsoil and likely much of the buried seed (Baker 2000) have been removed. Because of a lack of buried seed, relatively long distances to external upwind seed sources, continued wind erosion, and competition by weedy species, sagebrush recovery is expected to be minimal within the time frame before the start of new construction.

ILAW Disposal Facility – **Impacts to Plant and Wildlife Species of Concern**. The only plant species of concern observed in the W-5 Expansion Area were crouching milkvetch, stalked-pod milkvetch, and purple mat (Attachment A to this appendix; Sackschewsky 2002d). Crouching milkvetch and purple mat were the only plant species of concern observed in the area north of 16th Street and west of Dayton Avenue (Attachment A to this appendix; Sackschewsky 2002d). Because purple mat occurs occasionally throughout central Hanford, and crouching milkvetch and stalked-pod milkvetch are relatively common on the Central Plateau (Sackschewsky and Downs 2001), disturbance of the individuals of these three species located in the W-5 Expansion Area and the area north of 16th Street and west of Dayton Avenue would not likely adversely affect the overall local populations.

No wildlife species of concern were observed in the W-5 Expansion Area and the area located north of 16th Street and west of Dayton Avenue (Attachment A to this appendix; Sackschewsky 2002d).

Area C. No other impacts to habitats and species in addition to those described under Alternative Group A are expected to occur under Alternative Group B. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Group B.

Area C Stockpile Area and Conveyance Road. No other impacts to habitats and species in addition to those described under Alternative Group A are expected to occur under Alternative Group B. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Group B.

I.2.3 Alternative Group C

LLBGs in the 200 East Area and 200 West Area. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Group C. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Group C.

Proposed Disposal Facility Near PUREX in 200 East Area. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Group C. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Group C.

Area C. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Group C. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Group C.

Area C Stockpile Area and Conveyance Road. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Group C. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Group C.

I.2.4 Alternative Groups D_1, D_2, and D_3

LLBGs in the 200 East Area and 200 West Area. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Groups D_1, D_2, or D_3. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Groups D_1, D_2, or D_3.

Proposed Disposal Facility Near PUREX in 200 East Area. Proposed disposal near the PUREX Plant occurs only under Alternative Group D_1. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Group D_1. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Group D_1.

ERDF – Impacts to Habitats and Plant Species of Concern. Disposal in the ERDF occurs only under Alternative Group D_3. The majority of the ERDF site has not been completely surveyed. The ERDF site and some of the surrounding area was burned in the 24 Command Fire. The area comprising the ERDF site before the 24 Command Fire generally consisted of mature sagebrush habitat with varying understory components. The dominant understory component over approximately 90 percent of the area was a mix of cheatgrass and Sandberg's bluegrass. The dominant understory component over approximately 10 percent of the area was a mix of cheatgrass and needle-and-thread grass (DOE-RL 1995c).

A winter survey of a previously contemplated ERDF rail line was conducted in 1993. Sections 4 and 5 of the rail line fell within the northern half of the ERDF site (Brandt 1994). The plant species observed within these two sections at that time are provided in Brandt (1994). The dominant overstory species at that time was sagebrush at 25 percent to 50 percent cover, and the dominant understory species was cheatgrass at 50 percent to 75 percent cover. The only observed plant species of concern was the stalked-pod milkvetch.

This field survey covered only a relatively small portion of the ERDF site and was conducted outside the growing season for most herbaceous plants and prior to the 24 Command Fire of June 2000. Consequently, a spring 2003 field survey is planned to completely characterize the current habitat associations and plant species on the ERDF site.

ERDF – Impacts to Wildlife and Wildlife Species of Concern. Wildlife species observed along the previously contemplated ERDF rail line are summarized for the entire line in Brandt (1994). The only evidence of species of concern observed within the ERDF site were inactive nests of the loggerhead shrike (*Lanius ludovicianus*), a Washington State candidate species and a federal species of concern (species whose conservation standing is of concern to the U.S. Fish and Wildlife Service but for which status information still is needed).

This field survey covered only a relatively small portion of the ERDF site, was conducted outside the period of residence of migratory birds and during the period of hibernation of most mammals, and occurred prior to the 24 Command Fire. Consequently, a spring 2003 field survey is planned to completely characterize current wildlife use of the ERDF site.

Area C. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Groups D_1, D_2, or D_3. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Groups D_1, D_2, or D_3.

Area C Stockpile Area and Conveyance Road. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Groups D_1, D_2, or D_3. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Groups D_1, D_2, or D_3.

I.2.5 Alternative Groups E_1, E_2, and E_3

LLBGs in the 200 East Area and 200 West Area. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Groups E_1, E_2, or E_3. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Groups E_1, E_2, or E_3.

Proposed Disposal Facility Near PUREX in 200 East Area. Proposed disposal near the PUREX Plant occurs only under Alternative Groups E_2 and E_3. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Groups E_2 or E_3. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Groups E_2 or E_3.

ERDF. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group D_3 are expected to occur under Alternative Groups E_1, E_2, or E_3. No other field surveys in addition to those described under Alternative Group D_3 would be required under Alternative Groups E_1, E_2, or E_3.

Area C. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Groups E_1, E_2, or E_3. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Groups E_1, E_2, or E_3.

Area C Stockpile Area and Conveyance Road. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under Alternative Groups E_1, E_2, or E_3. No other field surveys in addition to those described under Alternative Group A would be required under Alternative Groups E_1, E_2, or E_3.

I.2.6 No Action Alternative

LLBGs in the 200 East Area and 200 West Area. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under the No Action Alternative. No other field surveys in addition to those described under Alternative Group A would be required under the No Action Alternative.

Proposed Disposal Facility Near PUREX in 200 East Area. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under the No Action Alternative. No other field surveys in addition to those described under Alternative Group A would be required under the No Action Alternative.

Additional CWC Buildings. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group B are expected to occur under the No Action Alternative. No other field surveys in addition to those described under Alternative Group B would be required under the No Action Alternative.

Area C. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under the No Action Alternative. No other field surveys in addition to those described under Alternative Group A would be required under the No Action Alternative.

Area C Stockpile Area and Conveyance Road. No other impacts in addition to those described for habitats and plant and animal species under Alternative Group A are expected to occur under the No Action Alternative. No other field surveys in addition to those described under Alternative Group A would be required under the No Action Alternative.

I.2.7 Mitigation

Most biological resources in the Industrial-Exclusive Area of the 200 Areas Plateau were destroyed or displaced during the 24 Command Fire. However, some habitats and species would be subject to mitigation under existing biological conditions and current mitigation guidelines, as prescribed in BRMaP (DOE-RL 2001) and the *Hanford Site Biological Resources Mitigation Strategy* (BRMiS) (DOE-RL 2003).

This section sets forth what the current mitigation requirements for these habitats/species would be if these were to be disturbed in their current condition under current mitigation guidelines. This is done for the purpose of comparison among the alternative groups because current biological conditions and mitigation guidelines are inappropriate for determining actual mitigation requirements for impacts that would not occur for at least another decade. In the interim, habitats and species assemblages may change (e.g., fire-damaged habitats may recover), as might mitigation guidelines at Hanford. Consequently, actual mitigation requirements will depend on the results of field surveys conducted during the growing season just prior to initiating operations, as well as on the mitigation guidelines in effect at Hanford at that time.

According to BRMaP (DOE-RL 2001), mitigation should be considered for biological resources categorized as Level II and above (Table I.3). The current mitigation requirements for the Level II and above resources described in the preceding sections are discussed below.

Level I Habitat Resources. All habitats described in the preceding sections that were not designated Level II or above are considered Level I resources, and no mitigation is required (Table I.3) (DOE-RL 2001).

Level II Habitat Resources. Mitigation of Level II habitat resources generally is accomplished by avoidance and impact minimization (Table I.3). However, in some cases where Level II resources fall into the category of recovering shrub-steppe habitat, and field surveys of the affected area confirm that

Table I.3. General Classes of Mitigation Actions and Biological Resource Levels of Concern to Which They Apply (DOE-RL 2001)

Class of Mitigation Action	Resource Level[a]			
	I	II	III	IV
Avoidance[b]/Minimization[c]	No	Yes	Yes	Yes
Replacement by Rectification[d]/Compensation[e]	No	No	Yes	Yes[f]

(a) See Table I.1 for resource level definitions.
(b) Avoidance = eliminate all or part of a project or alter the timing, location, or implementation to avoid injury to biological resources of concern.
(c) Minimization = alter project timing, location, or implementation to minimize injury to biological resources of concern.
(d) Rectification = replace biological resources of concern on the site to be disturbed.
(e) Compensation = replace lost biological resources of concern away from the site to be disturbed.
(f) Rectification is probably not possible nor an appropriate means of mitigation at this level; compensatory mitigation can be used but only when it is achieved by acquisition and/or protection of in-kind resources.

sagebrush recovery (defined as sagebrush habitat with immature sagebrush regenerated through natural processes) is well under way, replacement mitigation (rectification or compensation [Table I.3]) is recommended (DOE-RL 2001).

Replacement mitigation for disturbance of the widely scattered mature big sagebrush located in the southeastern portion of the cheatgrass/Sandberg’s bluegrass/Jim Hill’s tumble mustard community in Area C (see Figure I.4) is not recommended. Because no immature sagebrush was observed during the summer 2002 field survey (Sackschewsky 2002d), sagebrush recovery is not currently occurring, by definition. Nonetheless, this habitat would be subject to mitigation via avoidance and impact minimization (Table I.3).

Replacement mitigation for disturbance of the sagebrush habitat within the gray rabbitbrush/ cheatgrass community in Area C (see Figure I.4) is not required. The sagebrush within this community occurs over an area smaller than the current mitigation threshold for the 600 Area (0.5 ha [1.25 ac]) (DOE-RL 2003), and it covers only 1 percent of the area in which it occurs, which is much less than the current mitigation requirement of at least 10 percent cover (DOE-RL 2003). Nonetheless, this habitat would be subject to mitigation via avoidance and impact minimization (Table I.3).

Level III Habitat Resources. Disturbance of 5 ha or more of mature sagebrush habitat is the mitigation threshold in the southern half of the 200 East Area (DOE-RL 2003). Mitigation for disturbance of the mature sagebrush habitat on the site of the proposed disposal facility near PUREX would first be by avoidance and impact minimization. However, when avoidance and impact minimization are not possible or their application still results in adverse residual impacts above 5 ha, as would be the case in construction of the disposal facility, replacement mitigation is required (DOE-RL 2001).

Level IV Habitat Resources. Element occurrences are defined as Level IV resources (see Table I.1) because they are of such high quality (i.e., they show little or no indication of human impact or invasion by non-native species, or they have significant wildlife usage) and/or rarity that they cannot be mitigated unless it is by compensation via the setting aside and protection of in-kind (i.e., similar type and quality) resources (DOE-RL 2001). There are three element occurrences in Area C. Mitigation recommendations for these follow.

The cheatgrass/needle-and-thread grass/Indian ricegrass community (Figure I.4) is an element occurrence of the bitterbrush/Indian ricegrass sand dune complex community type (Figure I.3). Disturbance of the cheatgrass/needle-and-thread grass/Indian ricegrass community would be mitigated via the setting aside and protection of an element occurrence of the bitterbrush/Indian ricegrass sand dune complex community type located away from Area C. The size of the replacement community should approximate that of the lost community, 97 ha (241 ac). Ample element occurrences of this community type currently exist elsewhere in the 600 Area of the Hanford Site to satisfy this size constraint (Figure I.5).

The needle-and-thread grass/cheatgrass community (Figure I.4) is an element occurrence of the sagebrush/needle-and-thread grass community type (Figure I.3). Disturbance of the needle-and-thread grass/ cheatgrass community would be mitigated via the setting aside and protection of an element occurrence of the sagebrush/needle-and-thread grass community type located away from Area C. The size of the replacement community should approximate that of the lost community, 5 ha (12.5 ac). Ample element occurrences of this community type currently exist elsewhere in the 600 Area of the Hanford Site to satisfy this size constraint (Figure I.6).

The Sandberg’s bluegrass/cheatgrass community (Figure I.4) is an element occurrence of the big sagebrush/bluebunch wheatgrass community type (Figure I.3). Disturbance of the Sandberg’s bluegrass/ cheatgrass community would be mitigated via the setting aside and protection of an element occurrence of the big sagebrush/bluebunch wheatgrass community type. The size of the replacement community should approximate that of the lost community, 1.5 ha (4 ac). Element occurrences of this community type within the 600 Area are currently limited to Gable Mountain and the north side of Vernita Quarry (Figure I.7).

Level I Species Resources. Crouching milkvetch (located in the 218-E-10 and 218-E-12B LLBGs in the 200 East Area and in Area C) and stalked-pod milkvetch (located in the 218-W-5 LLBG in the 200 West Area, Area C, the stockpile area and conveyance road area, the area designated for the new processing facility, and ERDF) are considered Watch List species by Washington State, the lowest level of listing for plant species of concern in the state. Watch List species are thus considered Level I resources under BRMaP, for which no mitigation is required (Table I.3) (DOE-RL 2001).

Level II Species Resources. Purple mat (located in Area C) is considered a Washington State Review 1 species. Review 1 species are considered Level II resources under BRMaP, for which mitigation requirements consist of avoidance and impact minimization (Table I.3) (DOE-RL 2001).

Level III Species Resources. Piper’s daisy was formerly present in the 218-E-12B and 218-E-10 LLBGs in the 200 East Area. Mitigation for this species would not currently be required because it is now absent in the areas where it formerly occurred. However, mitigation would be considered if populations were to recover prior to initiating operations. Therefore, the presence/absence of Piper’s

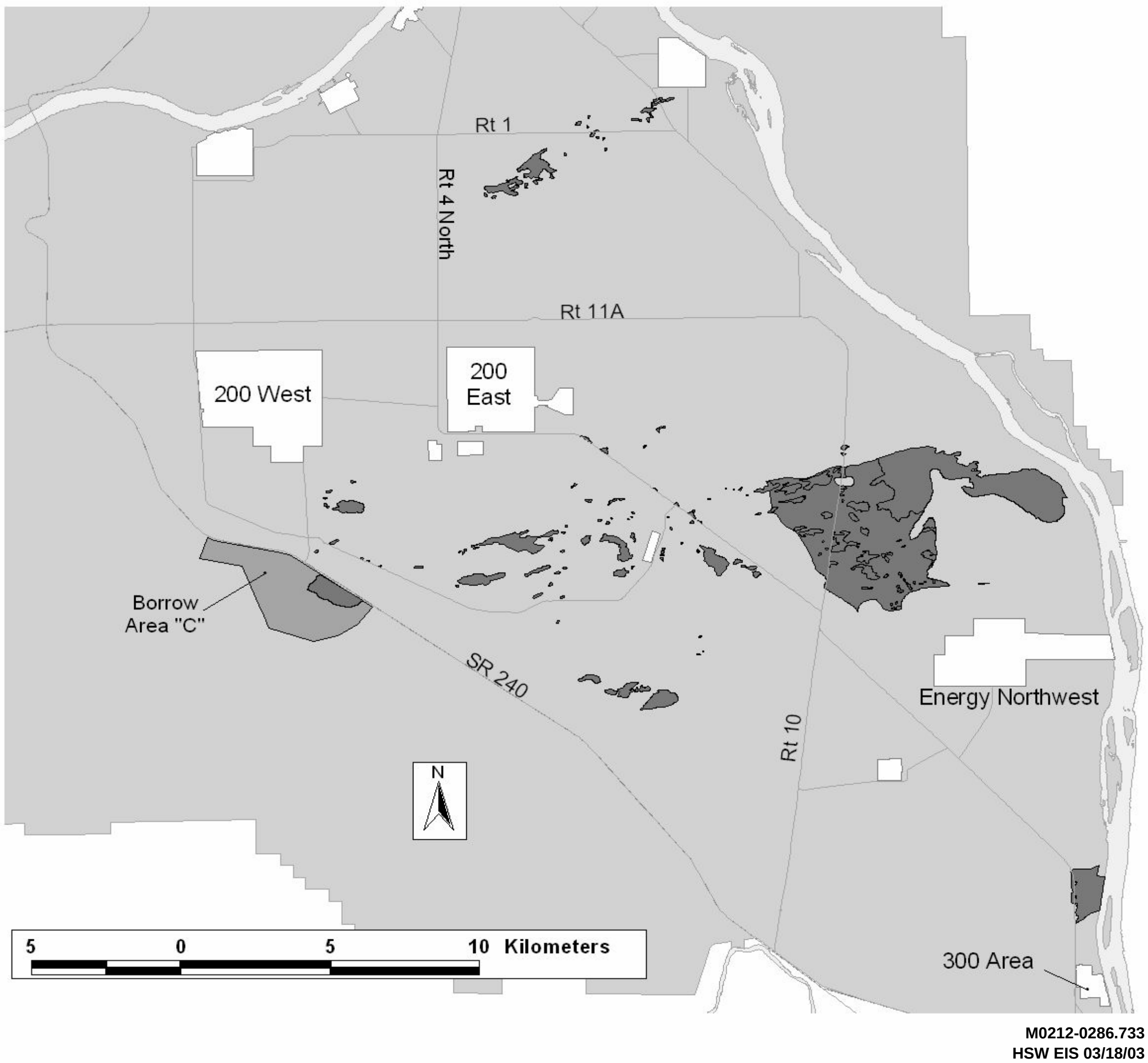

Figure I.5. Element Occurrences of Bitterbrush/Indian Ricegrass Sand Dune Complex Community Type Outside Area C in 600 Area of Hanford Site

daisy populations on the 218-E-12B and 218-E-10 LLBGs should be determined via a field survey during the growing season just prior to initiating operations.

Summary. The habitats and species that are subject to mitigation based on existing conditions and current mitigation guidelines are summarized by alternative group in Table I.4. All habitats/species subject to mitigation, with their associated mitigation actions, occur in each of the alternative groups, with the exception of the mature sagebrush habitat at the site of the proposed disposal facility near PUREX (Table I.4). Consequently, the alternative groups can be differentiated only with respect to mitigation of this habitat.

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

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

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

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

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

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

I.3.1 Assumptions Regarding Contaminants

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

The 10,000 years were divided into two time periods, early and late. An individual risk assessment was performed for each time period within each alternative group. The early time period applies to the radionuclides with a distribution or partition coefficient (K_d) of zero—technetium-99 and iodine-129—whose arrival times at the river well and river are less than 2500 years. The late time period applies to the radionuclides with a K_d greater than zero—carbon-14 and the uranium isotopes—whose arrival times are from 2500 to 10,000 years.

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

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

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

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

I.3.2 Assumptions Regarding Partitioning of Contaminants to Abiotic Media

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

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

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

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

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

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

I.3.3 Ecological Contaminant Exposure Model

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

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

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

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

Table I.6. (contd)

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

Table I.6. (contd)

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

Table I.6. (contd)

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

Table I.6. (contd)

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

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

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

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

Table I.8. Ecological Contaminant Exposure Model Receptors

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

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

Table I.8. (contd)

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

I.3.4 Combined Radiological Toxicity

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

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

Environmental hazard quotients based on total dose from all radiological constituents are provided for the Hanford and Hanford plus background exposure scenarios for the one receptor in Table I.8 that was at maximal risk in each alternative group and time period. These receptors were the mayfly for all alternative groups in the 0- to 2500-year time period (Figure I.8) and Woodhouse's toad tadpole for all alternative groups in the 0- to 10,000-year time period (Figure I.9).

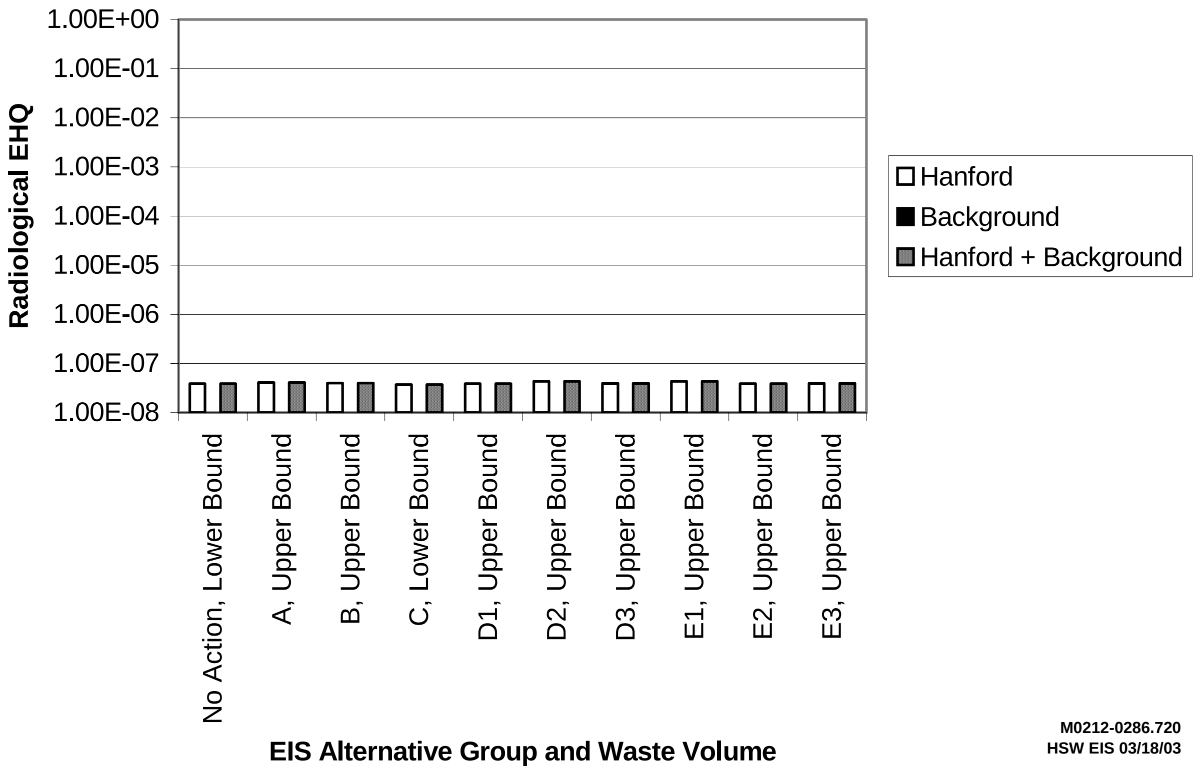

Figure I.8. Mayfly Radiological EHQs for Each Alternative Group in the 0- to 2500-Year Time Period for Background Compared to the Hanford and Hanford Plus Background Scenarios

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

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

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

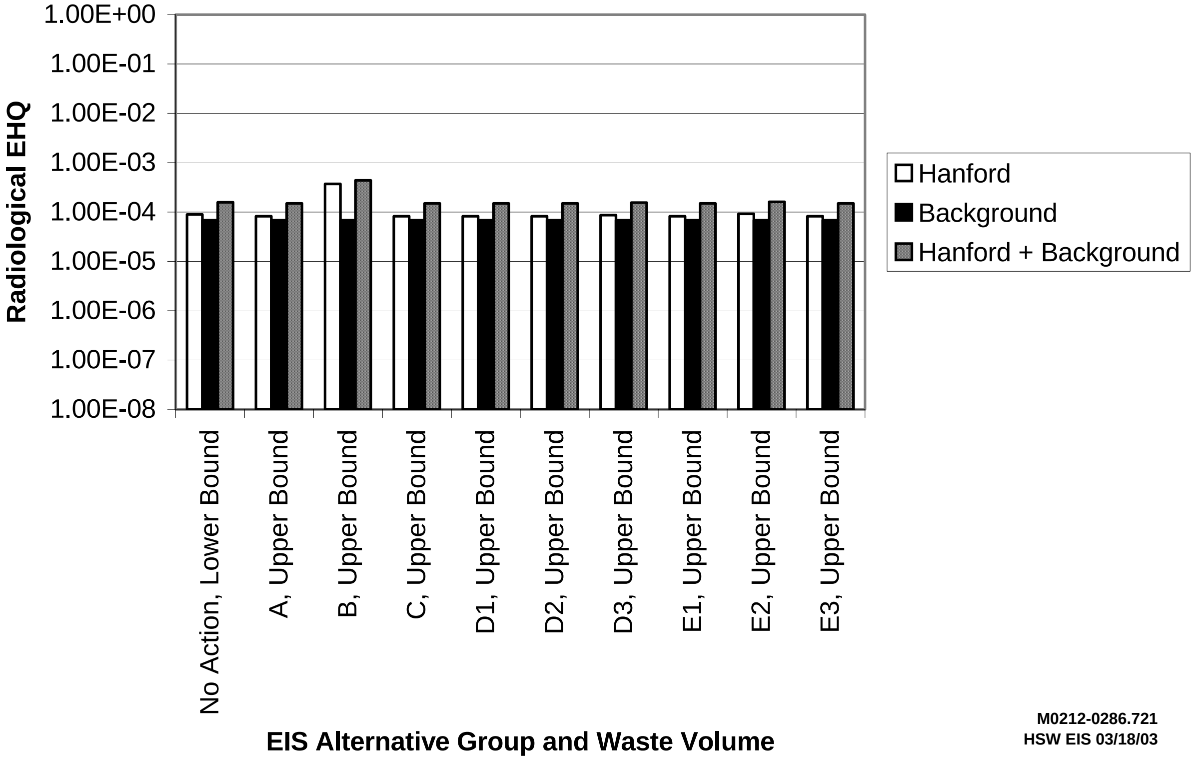

Figure I.9. Woodhouse's Toad Tadpole Radiological EHQs for Each Alternative Group in the 2500- to 10,000-Year Time Period for Background Compared to the Hanford and Hanford Plus Background Scenarios

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

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

I.3.5 Chemical Toxicity of Total Uranium

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

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

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

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

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

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

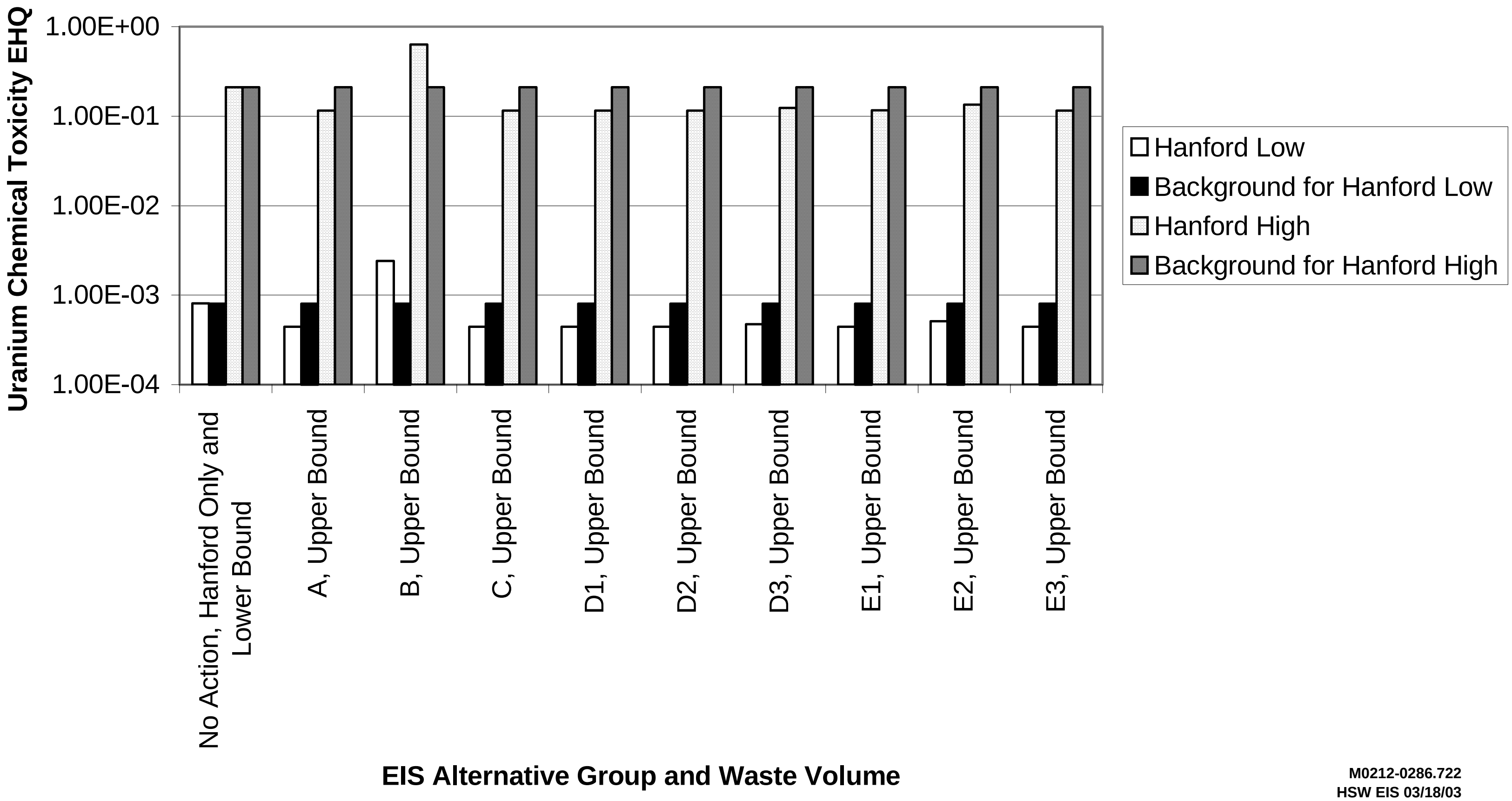

Figure I.10. American Coot Low and High Uranium Chemical Toxicity EHQs for Each Alternative Group in the 2500- to 10,000-Year Time Period for Background and the Hanford Scenario

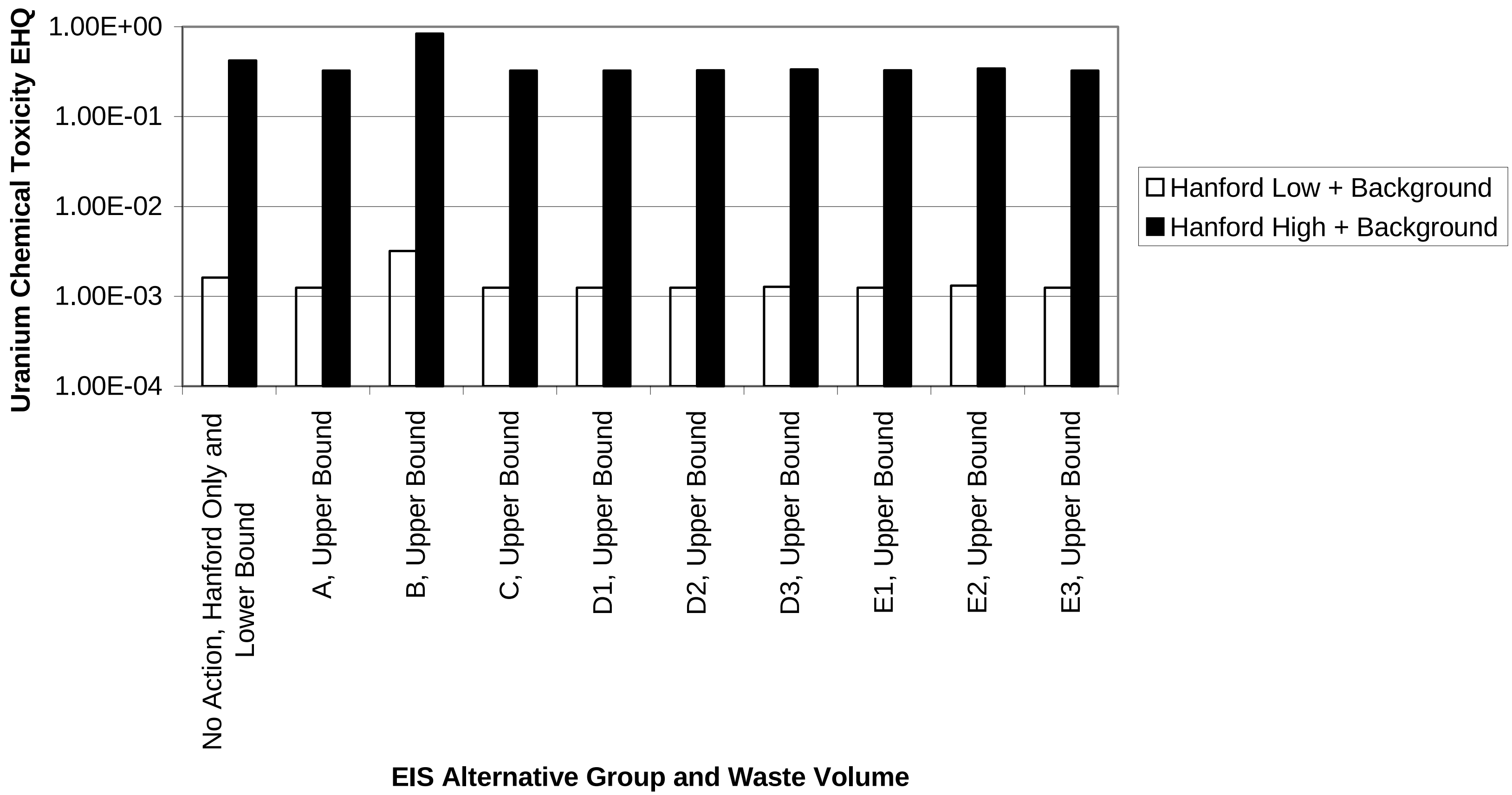

Figure I.11. American Coot Low and High Uranium Chemical Toxicity EHQs for Each Alternative Group in the 2500- to 10,000-Year Time Period for the Hanford Plus Background Scenario

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

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

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

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

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

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

The BCF values used in deriving the equivalent water concentrations were those reported in conjunction with the aquatic toxicity data described below (i.e., 8.87E-03 for the teleost fish [of or belonging to a large group of fishes with bony skeletons] [*Brachydanio rerio*] and 55.67E-03 for the bivalve mollusk [*Corbicula fluminea*] [Labrot et al. 1999]). The teleost fish BCF was used to calculate equivalent water concentrations for fish, lamprey, and the Woodhouse's toad tadpole. The *Corbicula* BCF was used to calculate equivalent water concentrations for crayfish, mayfly, clams, mussels, and the Columbia pebble snail. In addition, more conservative BCFs from the literature (i.e., 50, the upper end of a range of BCFs [2 to 50] for generic fish, and 1000, the upper end of a range of BCFs [100 to 1000] for generic aquatic invertebrates [Fellows et al. 1998]) were similarly used. Because neither the generic nor species-specific BCFs were considered more reliable, the former were used to calculate low EHQs and the latter high EHQs.

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

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

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

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

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

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

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

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

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

I.4 Consultations

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

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

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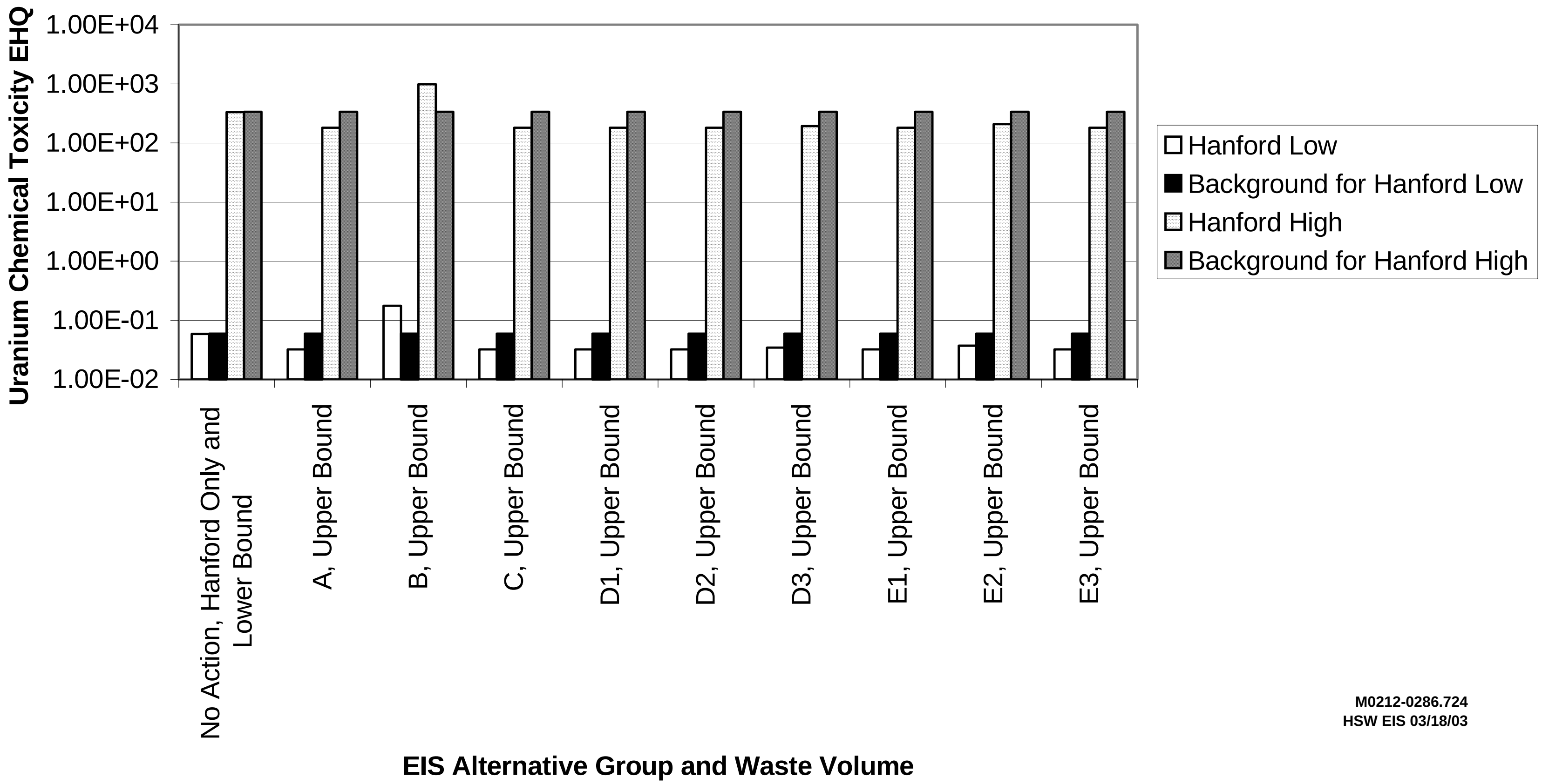

Figure I.12. Woodhouse's Toad Tadpole Low and High Uranium Chemical Toxicity EHQs for Each Alternative Group in the 2500- to 10,000-Year Time Period for Background and the Hanford Scenario

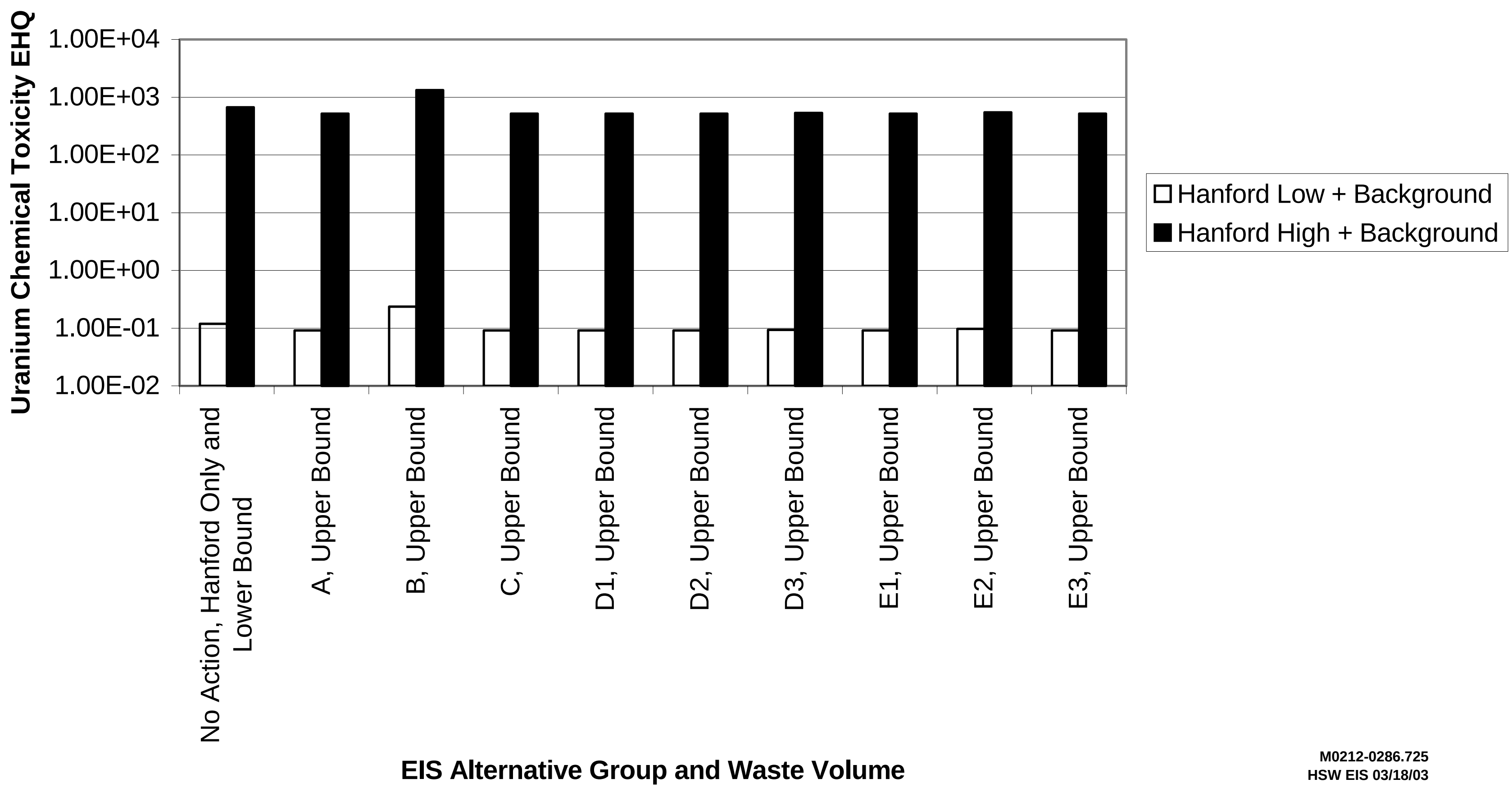

Figure I.13. Woodhouse's Toad Tadpole Low and High Uranium Chemical Toxicity EHQs for Each Alternative Group in the 2500- to 10,000-Year Time Period for the Hanford Plus Background Scenario

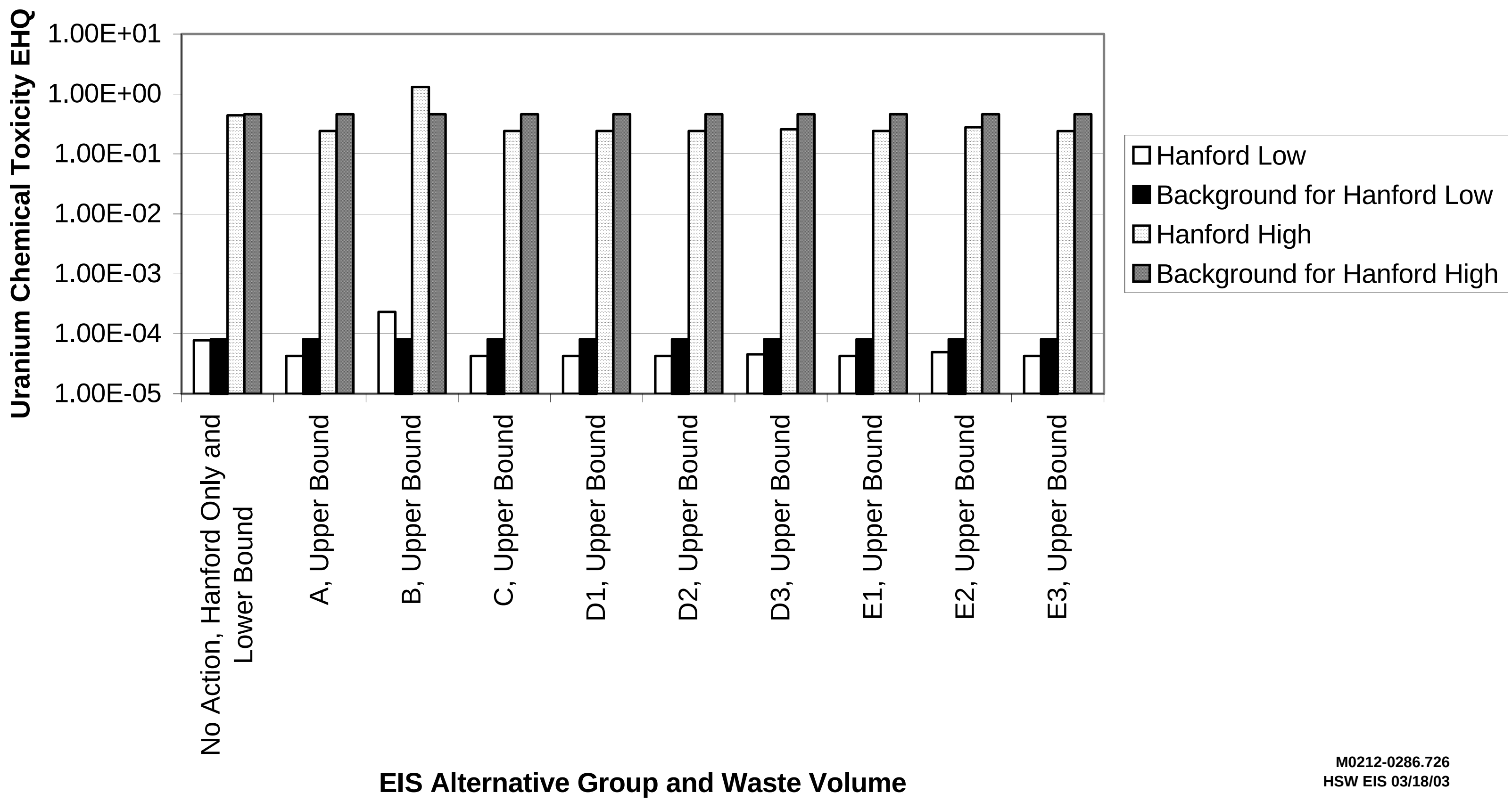

Figure I.14. Carp Low and High Uranium Chemical Toxicity EHQs for Each Alternative Group in the 2500- to 10,000-Year Time Period for Background and the Hanford Scenario

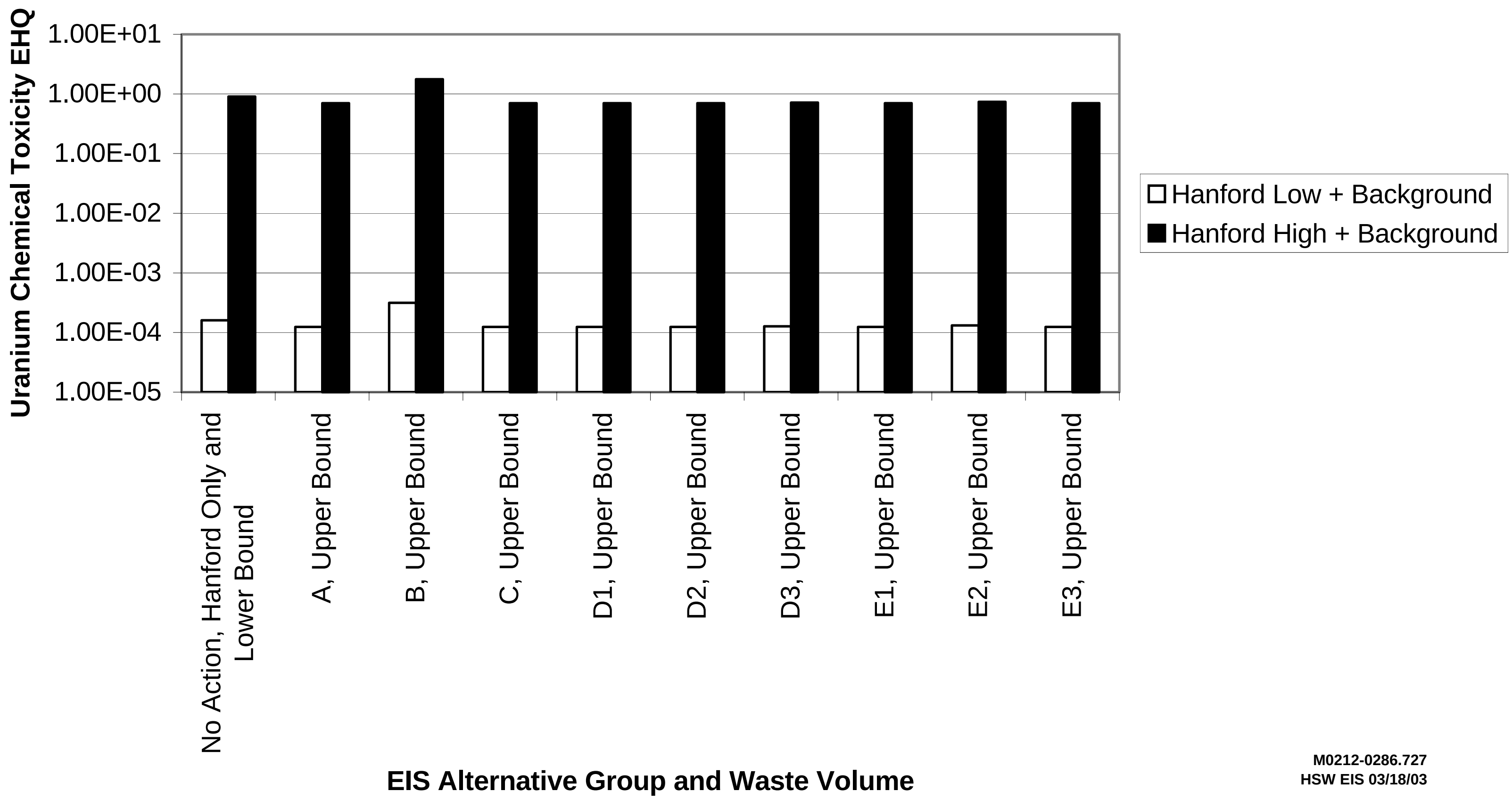

Figure I.15. Carp Low and High Uranium Chemical Toxicity EHQs for Each Alternative Group in the 2500- to 10,000-Year Time Period for the Hanford Plus Background Scenario

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Appendix J

Construction Noise – Method of Assessment

Heavy equipment such as earthmovers and graders may generate higher levels of noise than operational equipment such as exhaust fans or generators. For example, pulse driers produce a noise level of 70 decibels (dB). Diesel-powered earthmoving equipment is inherently noisy and would be used in the construction of trenches and obtaining fill material from the borrow pits in Area C south of State Route 240.

The Washington State Department of Ecology (Ecology) implements rules consistent with federal noise control legislation through Washington Administrative Code (WAC) 173-60. Maximum noise levels are defined for the zoning of the area in accordance with the environmental designation for noise abatement (EDNA). The Hanford Site is classified as a Class C EDNA on the basis of industrial activities. Unoccupied areas also are classified as Class C areas by default because they are neither Class A (residential) nor Class B (commercial). Maximum noise levels are established based on the EDNA classification of the receiving area and the source area (Table J.1). The benchmark for industrial noise levels in the State of Washington is 70 A-weighted decibels (dBA).

Table J.1. Applicable State Noise Limitations Based on Source and Receptor EDNA Designation

Source - Hanford Site	Receptor		
	Class A Residential (dBA)	Class B Commercial (dBA)	Class C Industrial (dBA)
Class C - Day	60	65	70
Night	50	--	--

J.1 Assessment of Noise Impacts

The assessment of noise impacts relies on evaluating critical distances between sources of noise and receptors and a conservative source term that is likely to overestimate impacts.

J.1.1 Critical Distances

Because the 200 Area is isolated, no human residences are likely to be impacted due to the great distances from source to receptor. The nearest residences are farmhouses along Highway 24 on the western perimeter of the Hanford Site (10 km [6.2 mi] from the western border of the 200 West Area). Distances exceed 10 km (6.2 mi) from Area C to these residences. The shortest distance between the western perimeter of the 200 Areas and State Route 240 is about 2 km (1.25 mi).

J.1.2 Source Term

To ensure that noise levels were not underestimated, the noise generated by a diesel locomotive engine was used as a conservative source term for heavy construction equipment. Screening estimates were based on non–A-weighted (pure total sound) adjustments and A-weighted adjustments. For this analysis, each octave band frequency from 63 to 8000 hertz (Hz) was modeled from the 132-dBA locomotive engine source term (Hanson et al. 1991). Noise propagation and attenuation were based on hemispherical spreading, molecular absorption, and anomalous excess attenuation under standard day conditions (EEI 1979). For a 132-dBA source to attenuate to 70 dB, about 43 to 70 dB must be attenuated (adsorbed or dispersed) based on frequency (Table J.2). The distance of attenuation for this source (63 Hz and 8000 Hz), based on reduction to a 70-dBA level, ranged from 40 m to 250 m (130 ft to 820 ft).

The distance of attenuation required for achieving a reduction to 70 dB was taken from tables in EEI (1979). The maximum distance of attenuation to 70 dB was 250 m (820 ft) at 500 and 1000 Hz. Effectively, no frequency would attain a sound pressure level greater that 70 dBA at 250 m (820 ft). The overall noise level at this distance would be dominated by these frequencies. Based on decibel addition, the A-weighted decibel level would approach 75 dB for all octave bands at 250 m (820 ft). The A-weighted decibel level would decrease to 70 dBA at 400 m (1312 ft) and to 67 dBA at 500 m (1640 ft).

Table J.2. Estimated Distances of Attenuation by Octave Band (hertz) for a 132-dBA Diesel Locomotive (conservative surrogate for heavy construction equipment)

Hertz	Correction by frequency (dB @ 30 m)	Corrected Source Term (dB @ 30 m)	Estimated Source Term (dB)	Distance of Attenuation 45 dBA[a]			Distance of Attenuation 70 dBA[b]		
				Attenuated dB	A wt Corrected	Distance (m)	Attenuated dB	A wt Corrected	Distance (m)
63	2.7	98.7	135.7	90.7	64.7	630	65.7	39.7	40
125	5.3	101.3	138.3	93.3	77.3	1700	68.3	52.3	160
250	-6	90	127	82	73	1200	57	48	100
500	-3.3	92.7	129.7	84.7	81.7	1600	59.7	56.7	250
1000	-4.7	91.3	128.3	83.3	83.3	1300	58.3	58.3	250
2000	-9	87	124	79	80	820	54	55	160
4000	-14	82	119	74	75	410	49	50	90
8000	-22.3	73.7	112.7	67.7	66.7	223	42.7	41.7	40

(a) The value of 45 dBA is routinely associated with quiet residential areas and is 5 dB below the level commonly used for a residential nighttime noise standard of 50 dBA. This provides a 5-dBA margin of safety.
(b) The noise standard for industrial zones during daylight hours is 70 dBA (WAC 173-60).

A “region of influence” for heavy equipment would be set at 500 m (1640 ft) for operations in the 200 Areas and at Area C. A 500-m (1640-ft) region of influence would allow for the simultaneous operation of two pieces of heavy equipment such that estimated noise levels would not exceed 70 dBA at 500 m.

J.2 References

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Appendix K

Cultural Resources

K.1 Introduction

This appendix provides details regarding known and potential cultural resources in areas in which the Hanford Solid Waste Program activities, as described in Section 3, may take place. These areas are portions (including Low Level Burial Grounds [LLBGs] and the ILAW disposal area near the PUREX Plant) of the 200 East and 200 West Areas (including the Central Waste Complex [CWC] expansion area), Area C containing borrow pit material, access roads, and a stockpile area north of State Route 240 near the 200 West Area.

Cultural resources reviews, in accordance with the National Historic Preservation Act (16 USC 470), are conducted to ensure that potential impacts to cultural resources and historic properties are considered in advance of Federal undertakings. Copies of letters of consultation (for this Hanford Solid Waste Environmental Impact Statement [HSW EIS]) with the State of Washington Office of Archaeology and Historic Preservation for this EIS are attached.

K.1.1 200 East and 200 West Areas

Since 1987, a total of 42 cultural resources reviews have been conducted for various projects associated with the LLBGs, surrounding areas in the 200 West and 200 East Areas, and mineral source locations (see Table K.1). New reviews are completed when any change in project scope or location occurs. Thus cultural resources reviews would be initiated for project activities associated with alternatives considered in this EIS to determine whether or not the proposed activities associated with waste management operations would have the potential to cause effects on historic properties [36 CFR 800.3(a)(1)].

The only buildings and structures that are eligible for listing in the National Register of Historic Places and have the potential to be affected by projects associated with the Hanford Solid Waste Program activities in the 200 West and 200 East Areas include certain facilities within the T Plant Complex. Modifications of these facilities, as proposed for all alternatives (except Alternative Group B and the No Action Alternative), may require additional cultural resources reviews.

Table K.1. Previously Conducted Cultural Resources Reviews[(a)]

Hanford Cultural Resource Case Number	Title	Activities Reviewed	Cultural Resources
87-200-016	Cultural Resources Survey of the Proposed 200-West 218-W-3A, 218-W-3AE, and 218-W-5 Waste Trenches.	Trench construction in 218 W-5, 218-W-3A, 218-W-3AE.	No archaeological, historic, paleontological, or Native American cultural sites.
87-200-021	Cultural Resources Survey of the Proposed PCB/PU Storage Facility HCRC# 87-200-021 and of the Proposed Hanford Center Waste Complex HCRC# 88-200-005.	200 East and 200 West Areas. Construction of plutonium/ polychlorinated biphenyl storage facility and the steam tie lines and water system upgrade tie lines between areas.	White Bluffs Road.
88-200-005	Cultural Resources Review of the Hanford CWC.	100 ac tract of land bounded on the south by 19th Street, on the east by Dayton Avenue, and on the north by 23rd Street.	White Bluffs Road, 2 isolated finds, and 1 site.
88-600-001	Cultural Resource Review of Barrier Development Program Fine Soil Borrow Pit at McGee Ranch.	McGee Ranch fine soils borrow pit use.	Review not completed numerous archaeological sites.
89-200-005	Cultural Resources Review of the 218-E-12B Special Naval Disposal Trench Expansion.	218-E-12B. Excavation to the west for 80 ft and to a depth of 30 ft below existing ground surface.	No effect on any historic properties.
89-200-006	Cultural Resources Review of the 218-W-2A and 216-T-18 Cleanup.	218-W-2A, 216-T-18, 218 W-3, 218-W-4, borrow area west of 213-W-3.	No known National Register properties.
89-200-008	Cultural Resources Review of the LLBG Permit Application.	218-E-10, 218-12B, 218-W 3A, 218-W-3AE, 218 W-4B, 218-W-4C, 218-W-5, 218-W-6 LLBGs. Maximum depth of excavation: 3 ft.	White Bluffs Road, historic artifacts.
89-200-023	Cultural Resources Review of the Effluent Retention and Treatment Complex (Effluent Retention and Treatment Complex (ERTC).	84.9 ha to develop facilities and a 26 km pipeline corridor to the Columbia River.	White Bluffs Road, 45BN307, HT-89-029, HT-90-002, HT-89-030, HT-89-031, HI-89-016.
91-600-006	Cultural Resources Review of the Privatization Steam Plant.	Gravel Pit 30. 23 acres at northwest corner of the junction between Route 3 and Route 4 South.	HT-99-007 (recorded in 1999).
91-600-012	Cultural Resources Review of the Action Plan for Characterization of McGee Ranch Oil.	McGee Ranch boring and sampling to select and characterize potential borrow locations for fine-textured soils.	Cultural properties present, survey recommended.
93-200-001	Cultural Resources Review of the Environmental Restoration Disposal Facility (ERDF)	A disposal site for waste exhumed during Hanford Site CERCLA and RCRA cleanup actions. Excavations at the site will be extensive and may be up to 12 meters deep.	Four archaeological sites, one paleontologic site, and nine isolated artifacts.

(a) Note that some reviews include areas that are not considered in this HSW EIS, for example the McGee Ranch, which is now within the Hanford Reach National Monument.

1 **Table K.1**. (contd)

Hanford Cultural Resource Case Number	Title	Activities Reviewed	Cultural Resources
93-200-004	Cultural Resources Review of 200-BP-1 Hanford Prototype.	Vernita Basalt Quarry. Total potential volume of McGee Ranch silt - 80,000 yd^3, basalt riprap - 115,000 yd^3, and batch plant - 180,000 yd^3.	No known cultural resources or historic properties in quarry boundary.
93-200-008	Cultural Resources Review of the Transuranic (TRU) Waste Retrieval/Characterization Pilot Program.	LLBG trenches T01, 4C; T04, 4C; T07, 4B; T20, 4C; T24, 4C.	No known cultural resources or historic properties.
93-200-074	Cultural Resources Review of the Solid Waste Retrieval Complex, Phase I (W-113) and Enhanced Radioactive and Mixed waste Storage Facility Project.	200 West Area. Phase I Retrieval complex for retrieving transuranic solid waste including support buildings and facilities. Construction of Phase V Facility for storage of waste containers.	White Bluffs Road, 2 isolated finds, and 1 historic site.
93-200-137	Cultural Resources Review of the W-026, Waste Receiving and Processing 1 Facility (WRAP) Project.	200 West Area. Construction of the WRAP 1 facility in the CWC located southwest of the intersection of 23rd Street and Dayton Avenue.	No known cultural resources or historic properties.
93-200-154	Cultural Resources Review of the CWC and TRU Storage and Assay Facility (TRUSAF) Paving Project.	200 West Area. Paving of 4 gravel and dirt areas.	No known cultural resources or historic properties.
93-600-002	Cultural Resources Review for the Expansion of Gravel Pits 23 and 30 Project.	Gravel Pits 30 and 23 expansion.	No known cultural resources.
94-200-018	Cultural Resources Review of the Geologic Testing of Mixed Waste Trench Project.	218-W-5. Maximum size of excavation: 4 test pits, 17 ft deep.	No known cultural resources or historic properties.
94-200-068	Cultural Resources Review of the 200/Solid Waste/CWC Facility Project.	200 West Area. Service pole holes adjacent to 2403-WB facility. Maximum size of excavation: 2 ft in diameter and 6 ft deep.	No known cultural resources or historic properties.
94-200-077	Cultural Resources Review of the Burial Ground Increase Trench #33 Project.	218-W-4C. Maximum size of excavation: trench enlarged from 6 ft deep to 24 ft deep with base widened to 24 ft.	No known cultural resources or historic properties.
94-200-200	Cultural Resources Review of the Storage of Long Length Radioactive Mixed Waste Project.	200 West Area. 24,000 ft^2 for 2 structures, storage for a crane and rails near the intersection of 19th Street and Dayton Avenue.	No known cultural resources or historic properties.
94-200-097	Cultural Resources Review of the W-236A, Multi-Function Waste Tank Facility, 1994 Project.	Adjacent to Gravel Pit 30. Project modification from previous 93-600-004 cultural review.	HT-99-007 (recorded in 1999).
94-600-001	Cultural Resources Review of the Spent Nuclear Fuel Storage Facility Project.	Survey adjacent to Gravel Pit 30 (northern and eastern boundary).	HI-94-003.

Table K.1. (contd)

Hanford Cultural Resource Case Number	Title	Activities Reviewed	Cultural Resources
94-600-032	Survey Narrative for the Topographic Survey of a portion of the ERDF Project	Topographic survey of project area by 4-wheeled off road vehicles that will drive over the entire area; most of which was previously surveyed for ERDF	No known cultural resources or historic properties.
94-600-034	Cultural Resources Review of the ERDF Project W-296, NE Portion Project	Additional 1.126 km^2 added to the original 11.0 km^2 of area surveyed for ERDF.	Two isolated artifacts: an Army (Camp Hanford era) communication line and round metal can.
95-200-066	Cultural Resources Review of the 218-E-12B Trench 94 Project.	218-E-12B. Excavation in bottom of trench to maximum depth of 3 ft.	No known cultural resources or historic properties.
95-200-124	Cultural Resources Review of Removal of Contaminated Soils in and around 218-W-4B Burial Grounds.	218-W-4B.	No known cultural resources or historic properties.
95-200-065	Cultural Resources Review of the 218-W-4C Trench 14 - High Integrity Containers Project.	218-W-4C. Maximum excavation size: 6 holes 36 inches in diameter and 19 ft deep in bottom of trench.	No known cultural resources or historic properties.
95-200-104	Cultural Resources Review of the Solid Waste Retrieval complex, Enhanced Radioactive and Mixed Waste Storage Facility, Infrastructure Upgrades, and Central Waste Support Complex.	200 West Area. Entire area previously reviewed except for future drain field.	White Bluffs Road, 1 site, 2 isolated finds.
96-200-058	200 Area Block Survey.	Remainder of undisturbed ground within 200 East and West Areas not previously surveyed.	HI-96-002, HI-96-003, HI-96-004, HI 96 005, HI-96-006, HI-96-007, HT-96-002, HT-96-010.
96-200-059	Cultural Resources Review of the 218-W-4C Trench 14 - Culvert Containers.	218-W-4C. Maximum excavation size: 25 ft wide by 25 ft long by 8 ft deep.	No known cultural resources or historic properties.
96-200-076	Cultural Resources Review of the Routine Operation of Grouting in the 200 West Burial Grounds.	218-W-5, 218-W-3A, 218-W-3AE, 218-W-4C. Maximum depth of excavation: up to 8 ft below trench floor.	No known cultural resources or historic properties.
96-200-102	Cultural Resources Review of the Widening and Deepening of Trench 36, 218-E-12B	218-E-12B. Maximum size of excavation: 80 ft wide at top, 20 ft wide at bottom, and 20 ft deep.	No known cultural resources or historic properties.
97-200-023	Cultural Resources Review of the Burial Ground 218-W-5 Trench 33 Expansion.	218-W-5. Maximum size of excavation: trench widening to 40 ft for length of trench (1160 ft), excavation to 20 ft.	No known cultural resources or historic properties.
97-200-062	Cultural Resources Review of the Burial Ground 218-W-5 Trench 34 Rain Curtain.	218-W-5. Maximum size of excavation: 1 to 2 ft deep trenches around Trench 34 and down inner edge of truck ramp.	No known cultural resources or historic properties.

Table K.1. (contd)

Hanford Cultural Resource Case Number	Title	Activities Reviewed	Cultural Resources
98-200-031	Cultural Resources Review of the Subsidence Repair and Maintenance in the Low Level Burial Grounds.	218-E-10, 218-E-12B, 218 W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, 218-W-6.	No known National Register properties.
99-200-008	Cultural Resources Review for Widening Trench 36 218-E-12B Burial Ground.	218-E-12B. Maximum size of excavation: 900 ft long, 16 ft deep, and 25 width added.	No known National Register properties.
01-200-006	Cultural Resources Review for the Storage of K Basin Sludge at the 221-T and the 271-T Facilities	221-T and 271-T Facility upgrades to safety and security systems, 221-T modifications to hot cells.	No effect on facility characteristics that make them eligible for National Register.
02-200-050	Cultural Resources Review of Immobilized Low-Activity Waste (ILAW) Disposal Facility	Low-activity waste to be disposed of in six lined trenches southwest of the PUREX Plant in the 200 East Area.	No effect on historic properties.
02-200-051	Cultural Resources Review of Melter Trench	Disposal of melters into a specifically designed trench in 3 alternative locations in the 200 East Area.	No effect on historic properties.
02-200-054	Cultural Resources Review of Groundwater Well Installation	Four groundwater wells to be installed in several locations in the 200 West Area.	No effect on historic properties.

K.1.2 Central Waste Complex Expansion Area

Under the No Action Alternative, the CWC in the 200 West Area would continue to receive and store newly generated wastes. With existing storage capacity reaching its limit, the CWC would be expanded. Expansion would occur in a 36-ha (89-ac) area south of the existing CWC and a 30-ha (74-ac) area west of the CWC and south 218-W-5 expansion area. Depth of excavation would be 0.9 m (3 ft) for CWC buildings.

Staff of the Hanford Cultural Resources Laboratory (HCRL) conducted a records and literature search that revealed the project area has been previously surveyed for cultural resources. Cultural resources identified within the project area are provided in Table K.2

The cultural resources surveys of the project area concluded that no known historic properties are located within the CWC expansion area.

K.1.3 New Waste Processing Facility

The location of the new waste processing facility that would be constructed, if Alternative Group B were to be implemented, is directly west of WRAP in the 200 West Area. The previous cultural resources surveys conducted in the CWC expansion area concluded that no known historic properties are located within the footprint of the new waste processing facility.

Table K.2. Cultural Resources Identified in Project Area

Survey number/name	Cultural Resources Identified in the Project Area	Eligible to the National Register
HCRC# 88-200-038, Archaeological Survey of the 200 East and 200 West Areas.	HT-88-009, 1920s/1930s can and bottle scatter - possible sheepherder/cowboy camp.	Determined not eligible.
HCRC# 96-200-058, 200 Area Block Survey.	HT-96-002: sparse scatter of cryptocrystalline silica (ccs) flakes and historic debris. HI-96-004: ccs utilized flake. HI-96-005: ccs flake.	Determined not eligible.
HCRC# 95-200-104, Solid Waste Retrieval Complex (Infrastructure).[(a)]	No cultural resources located.	N/A
HCRC# 2000-600-023, White Bluffs Road Survey.	H3-121, White Bluffs Road and associated features.	Determined eligible to the National Register. The section that runs through the 200 West Area and through the project area, however, has been determined to be non-contributing due to lack of physical integrity.
(a) HCRC = Hanford Cultural Resources Case; see Appendix L for details on source.		

K.2 Area C – Borrow Pits, Stockpile Area, and Access Roads

Area C borrow pits would be used for excavation of basalt and fine textured material, such as silt loam, gravel, or sand, for the construction of closure covers to be placed over low-level waste (LLW) trenches in Alternative Groups A through E and MLLW trenches in all alternatives. The HCRL conducted a cultural resources review of the 926-ha (2287-ac) Area C borrow pit in February 2002 (see Figure K.1).

K.2.1 Literature and Record Search – Previous Cultural Resources Surveys

Staff of HCRL conducted a records and literature search that revealed a small section of Area C has been previously surveyed in 1994 for cultural resources (Bard et al. 1994). The survey was conducted in the northwestern portion of Area C. Three isolated finds were recorded in the project area:

ISOLATE NUMBER	DESCRIPTION
HI-94-032	Two white cryptocrystalline silica (css) flakes.
HI-94-036	A historic “fence jack”—a rock pile with remains of a split rail.
HI-94-037	A large historic riveted metal collared cylinder.

Table K.2. Cultural Resources Identified in Project Area

Survey number/name	Cultural Resources Identified in the Project Area	Eligible to the National Register
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HCRC# 2000-600-023, White Bluffs Road Survey.	H3-121, White Bluffs Road and associated features.	Determined eligible to the National Register. The section that runs through the 200 West Area and through the project area, however, has been determined to be non-contributing due to lack of physical integrity.
(a) HCRC = Hanford Cultural Resources Case; see Appendix L for details on source.		

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K.2.1 Literature and Record Search – Previous Cultural Resources Surveys

Staff of HCRL conducted a records and literature search that revealed a small section of Area C has been previously surveyed in 1994 for cultural resources (Bard et al. 1994). The survey was conducted in the northwestern portion of Area C. Three isolated finds were recorded in the project area:

ISOLATE NUMBER	DESCRIPTION
HI-94-032	Two white cryptocrystalline silica (css) flakes.
HI-94-036	A historic “fence jack”—a rock pile with remains of a split rail.
HI-94-037	A large historic riveted metal collared cylinder.

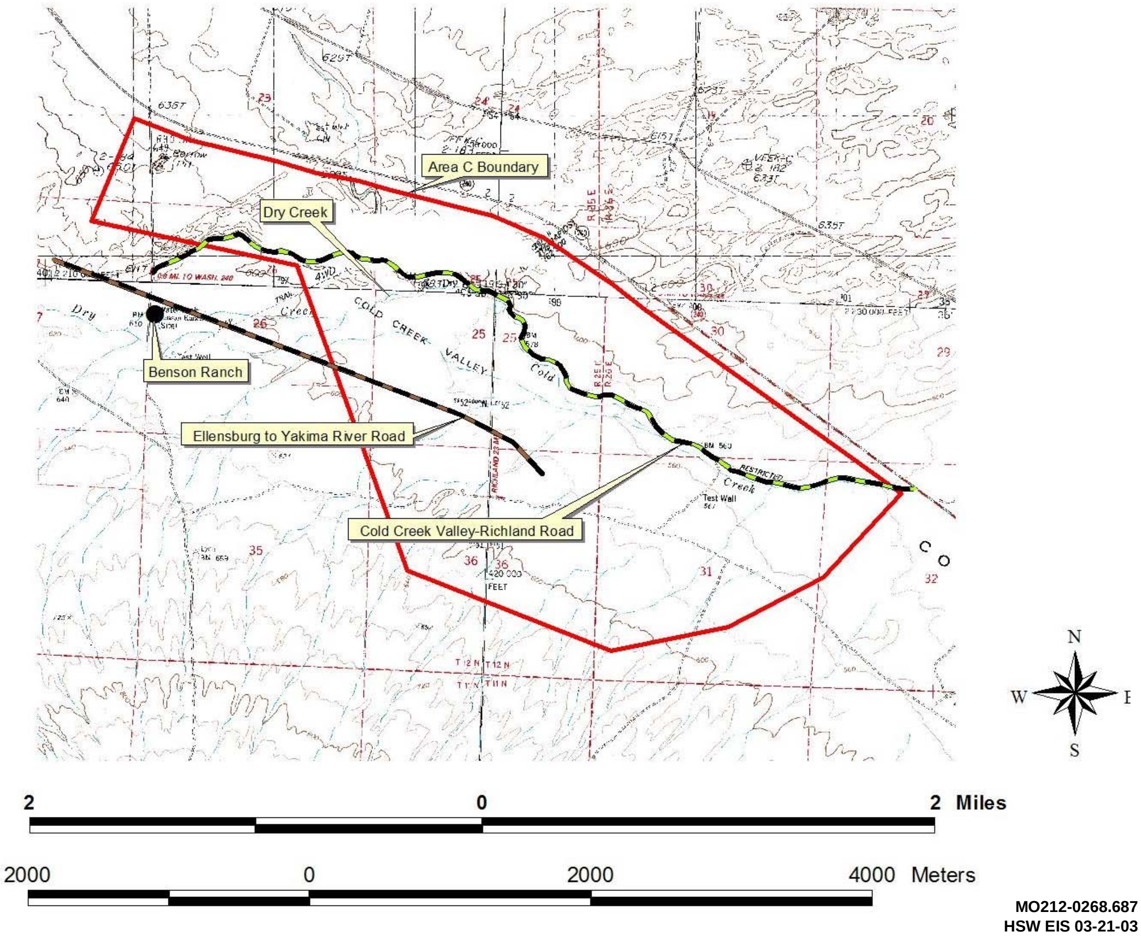

Figure K.1. Area C - Historical Features

A previous cultural resources survey three miles west of the project area resulted in the establishment of the Rattlesnake Springs Archaeological District and listing in the National Register of Historic Places (Fuller 1974). Sites recorded by the survey include evidence of prehistoric activity near Rattlesnake Springs and Dry Creek. The historic White Bluffs Road, which passed through Rattlesnake Springs, was identified in the survey and is listed in the National Register. The road was an important Native American and Euro-American route from Yakima to the town of White Bluffs on the Columbia River and gives evidence to the fact that the Rattlesnake Springs area was a crossroad for Native Americans as well as early Euro-American settlers in the region.

K.2.2 Research Initiatives and Field Reconnaissance

For the purposes of this EIS, a cultural resources survey of Area C is recommended prior to the commencement of excavation activities. HCRL staff has conducted a variety of research initiatives to assess the potential cultural resources impacts the project may have. These activities are summarized below.

- **Historical Research -** During the literature and records search, previous cultural resources investigations, historic maps, land records, and local histories were reviewed. Former residents of the Hanford area were also contacted to see what, if any, historic activity they recalled. Results of this research indicated that portions of Area C, located in the Rattlesnake Flats section of Cold Creek Valley, were used for grazing and ranching from the 1880s to 1943 (see Figure K.1). Irrigation was undertaken at ranches west (Benson Ranch) and south (Snively Ranch) of the project area. Large-scale irrigation efforts for the entire Cold Creek Valley were promoted, but they never reached fruition (Van Arsdol 1972).

  A review of the 1881 General Land Office map of the Cold Creek Valley revealed that the Ellensburg to Yakima River Road traversed the project area in an east-west direction and was possibly used as an Indian trail prior to Euro-American settlement. The 1943 Real Estate maps depict another road connecting Cold Creek Valley with Richland. The road parallels Dry Creek along the northern section of the project area. The maps also note that at the time of the establishment of the Hanford Site, ownership of the project area was divided among the State of Washington, Northern Pacific Railroad, and United States government.

  The Benson Ranch, located on the western boundary of the project area, is an unrecorded archaeological site that is noted on the 1915 U.S. Geological Survey topographic maps. The Benson Ranch obtained its water for irrigation from Rattlesnake Springs in order to grow alfalfa and other crops, and a well-used trail connected the ranch with the springs (Hinds and Rodgers 1991). Rattlesnake Springs was valued by both prehistoric peoples and Euro-American settlers for its year-round water supply and source of plentiful game. Further, Rattlesnake Springs holds prehistoric significance as there is evidence of aboriginal occupation some distance from the Columbia River. Until recently, most prehistoric archaeological investigations of the mid-Columbia Basin have been conducted along major rivers and tributaries. It was noted that surface findings in the vicinity of Rattlesnake Springs indicate possible human presence as far back as 8000 to 10,000 years.

- **Photogrammetry -** Aerial photographs from recent decades were analyzed to determine if historic roads still existed and to see if any additional historic activity could be located. The analysis confirmed the location of roads along with various probable cultural features; however, no major sites, such as farmsteads or military encampments (that is, Camp Hanford's forward positions), were observed. In 1963, the U.S. Army conducted maneuvers, called Operation Braveshield, for several weeks in the Cold Creek Valley. The troops proceeded north to Rattlesnake Springs and followed the Cold Creek drainage to the Yakima Firing Range (DOE-RL 1995). At this point, however, little evidence suggests that Area C was used for Army exercises.

- **Ethnographic Research -** From previous ethnographic interviews conducted by HCRL with local Native Americans, the area has been identified as a travel route for Native Americans between Rattlesnake Springs and the Yakima and Columbia Rivers. The area lies in close proximity to Rattlesnake Mountain, a place considered important by local Native American tribes.

- **Archaeological Research and Field Reconnaissance -** Previous archaeological surveys in the area, limited to only one small survey (Bard et al. 1994), identified minimal presence of archaeological remains from the prehistoric and historic periods. To gain additional perspective on the likelihood that significant archaeological remains are located in Area C, staff conducted a field reconnaissance of high potential areas identified by a predictive model developed by the HCRL for the Hanford Site (see Figure K.2). The model indicated the areas located along the dry beds of Cold Creek and Dry Creek would have a moderately high chance of containing archaeological sites. Four staff members conducted a field reconnaissance, principally along the creeks, their tributaries, and along the dirt road parallel to Dry Creek. Cultural material observed included one cryptocrystalline silica flake, numerous rusted cans and contemporary beer cans, military telephone wire, and barbwire fence lines that run parallel to Dry Creek and the dirt road. If significant archaeological remains are present in Area C, they are most likely buried under wind blown deposition.

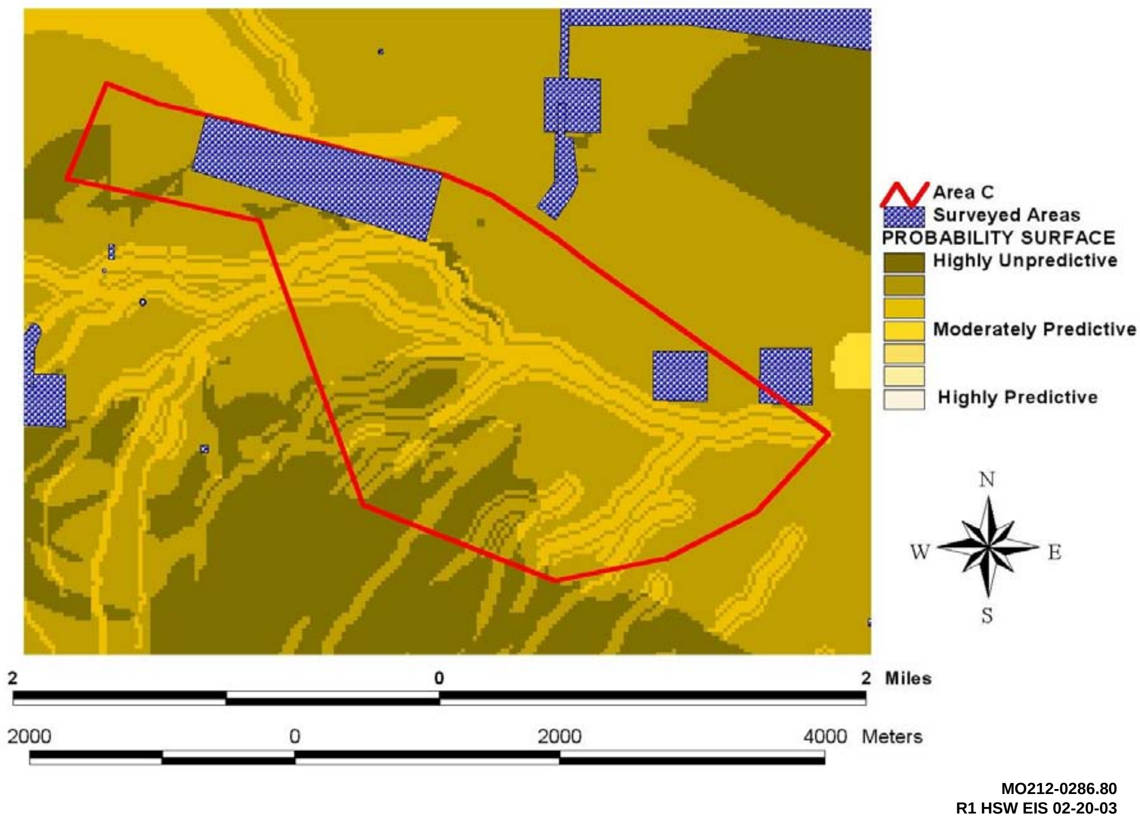

Figure K.2. Area C Predictive Model

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

JAN 24 1994

Ms. Mary M. Thompson
State Historic Preservation Officer
Office of Archaeology and
Historic Preservation
Department of Community Development
111 West 21st Avenue, KL-11
Olympia, Washington 98504-5411

Dear Ms. Thompson:

POTENTIAL HISTORIC PROPERTIES; ENVIRONMENTAL RESTORATION DISPOSAL FACILITY

Enclosed is a survey report and site forms for the Environmental Restoration Disposal Facility (ERDF) facility project at the U.S. Department of Energy, Richland Operations Office's (RL) Hanford Site. A survey in the proposed project area identified one prehistoric isolated artifact (HI-89-016), a cobble tool. Nine isolated artifacts consisting of three prehistoric and six historic items; and five sites, one paleontologic, one with prehistoric and historic/modern components, and three with historic components were also recorded. We believe that Sites HP-93-001, HT-93-080, and HT-93-081 do not meet any of the criteria necessary for listing on the National Register of Historic Places (Register). The research potential of these sites and of all but one of the isolates has been exhausted through recordation and/or collection. Sites HT-93-083 and HT-93-084 by themselves do not retain nationally significant information. However, viewed in a broader historic context, Euro-American ranching in Southeastern Washington, the sites represent part of the greater archaeological record and may be considered regionally or locally significant. However, since these two sites are outside the proposed ERDF boundaries, the proposed project will have no effect on them.

In accordance with CFR 36, 800.4, RL has made a good faith effort to identify historic properties at this proposed location and to evaluate the eligibility of these properties to the Register. A literature and records review and site surveys, where required, have indicated that no historic properties eligible for the Register will be affected by this undertaking.

If any archaeological or additional historical resources are discovered during project activities, work will be halted and your office consulted immediately. Your office will also be consulted if the site boundaries are modified. Therefore, in accordance with CFR 36, 800.4(d), we are providing documentation supporting these findings to your office.

Your signature below will acknowledge receipt of our notification. Please return a signed copy for our records. If you have any questions or are in need of additional information I can be contacted at (509) 376-6354.

Sincerely,

Charles R. Pasternak, Manager
Cultural Resources Program

SID:CRP

Gregory A. Griffith 2/2/94
for Office of Archaeology
and Historic Preservation

Enclosures:
ERDF Site Report & 15 Site Forms

cc w/o encls:
G. V. Last, PNL
M. K. Wright, PNL
D. W. Harvey, PNL
R. H. Engelmann, WHC

012894-10

1

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HSW EIS 02/12/03

STATE OF WASHINGTON
DEPARTMENT OF COMMUNITY DEVELOPMENT
OFFICE OF ARCHAEOLOGY AND HISTORIC PRESERVATION
111 21st Avenue S.W. • P.O. Box 48343 • Olympia, Washington 98504-8343 • (206) 753-4011 • SCAN 234-4011

February 4, 1994

Mr. Charles R. Pasternak, Manager
Cultural Resources Program
Department of Energy
Richland Field Office
P.O. Box 550
Richland, WA 99352

Log: 012894-10-DOE
Re: Cultural Resources Survey for ERDF

Dear Mr. Pasternak:

The Washington State Office of Archaeology and Historic Preservation (OAHP) is in receipt of your letter and documentation regarding the above referenced cultural resources survey in the area proposed for the Environmental Restoration Disposal Facility (ERDF) at the Hanford Reservation. In addition to the survey report, inventory forms were submitted identifying prehistoric and historic sites and one paleontologic site.

OAHP has reviewed the report and the site forms generated by this survey effort. As a result of our review, we agree with your recommendation that sites HT-93-083 and HT-93-084 should remain unevaluated until such time that development of a context on ranching in southeastern Washington can shed more light on the level of significance of these two properties. It is my understanding that these sites will not be affected by the ERDF project. In addition, we concur with your opinion that the remaining sites identified by this survey effort are not eligible for listing in the National Register of Historic Places. Therefore, further contact with OAHP on this project is not necessary. However, in the event the project scope changes or archaeological resources are uncovered during implementation, work should be halted immediately and contact made with OAHP for further consultation.

1

Charles, thank you for the opportunity to comment on this action. Should you have any questions, please feel free to contact me at (206) 753-9116.

Sincerely,

Gregory A. Griffith
Comprehensive Planning Specialist

GAG:aa
Enclosure

cc: Mona Wright

1

M0212-0286.675b
HSW EIS 02/12/03

Department of Energy

Richland Operations Office
P.O. Box 550
Richland, Washington 99352

April 15, 1994

Ms. Mary M. Thompson
State Historic Preservation Officer
Office of Archaeology and Historic Preservation
Department of Community Development
111 West Twenty-first Avenue, KL-11
Olympia, Washington 98504-5411

Dear Ms. Thompson:

CHANGE IN SCOPE: ENVIRONMENTAL RESTORATION DISPOSAL FACILITY (ERDF) - NO KNOWN HISTORIC PROPERTIES

Since your concurrence with our January 24, 1994, findings on February 4, 1994, the scope of the above mentioned proposed project has been modified. In response to a cultural resources review for a topographic survey of the proposed area it was noted that the sites boundaries had been expanded. The U.S. Department of Energy, Richland Operations Office (RL) Cultural Resources Laboratory has completed surveying the additional area. In accordance with 36 CFR 800.4, RL has made a good faith effort to identify historic properties at this proposed location and to evaluate the eligibility of these properties to the Register. A literature and records review and a survey have indicated that no historic properties eligible for the Register will be affected by these undertakings.

If any archaeological or additional historical resources are discovered during project activities, work will be halted and your office consulted immediately. If the scope of the proposed undertakings are revised, your office will also notified immediately. Therefore, in accordance with 36 CFR 800.4(d), we are providing documentation supporting these findings to your office.

M0212-0286.676a
HSW EIS 02/12/03

Your signature below will acknowledge receipt of our notification. Please return a signed copy for our files. If you have any questions or are in need of additional information I can be contacted at (509) 376-6354.

Sincerely,

for Charles R. Pasternak, Manager
Cultural Resources Program
Site Infrastructure Division

SID:CRP

____
Office of Archaeology
and Historic Preservation

Enclosure: HCRC #94-600-032

cc w/o encl:
P. Nickens, PNL file
D. Harvey, PNL
M. Wright, PNL
R. Phillips, PNL
R. Engelmann, WHC
1 J. Van Pelt, CTUIR, w/encl.

M0212-0286.676b
HSW EIS 02/12/03

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

FEB 27 2002

02-RCA-0201

Dr. Allyson Brooks
Office of Archaeology and
Historic Preservation
P. O. Box 48343
Olympia, Washington 95804

Dear Dr. Brooks:

THREE CULTURAL RESOURCE REVIEWS FOR HANFORD SITE SOLID WASTE DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS): 1) USE OF AREA C, HCRC# 2002-600-012; 2) EXPANSION OF THE CENTRAL WASTE COMPLEX, HCRC# 2002-600-012A; and 3) RAIL SPUR TO THE WASTE RECEIVING AND PROCESSING (WRAP) FACILITY, HCRC# 2002-600-12B

Enclosed are three cultural resource reviews completed by the U.S. Department of Energy, Richland Operations Office (RL). These cultural resource reviews are in support of the Hanford Site Solid Waste EIS analysis. The subject projects are located in the 200 West Area and 600 Area of the Hanford Site, Richland, Washington. The results of the records and literature review conducted by staff at the Hanford Cultural Resources Laboratory (HCRL) are described in the attached cultural resource reviews. The results of the reviews indicate the following:

1. USE OF AREA C, HCRC# 2002-600-012 (Enclosure 1)
   Based on the information collected by the field reconnaissance and research, this project may affect historic properties. HCRL is unable to make a final determination of finding for the purposes of compliance with 36CFR 800 until additional work is completed. This area is adjacent to, but not included in, the Hanford Reach National Monument.

2. EXPANSION OF THE CENTRAL WASTE COMPLEX, HCRC# 2002-600-012A (Enclosure 2)
   Based on the information collected during the records and literature search, the expansion of the Central Waste Complex for the Hanford Site Solid Waste Program will have no affect on historic properties.

3. RAIL SPUR TO THE WRAP FACILITY, HCRC# 2002-600-12B (Enclosure 3)
   Based on the information collected during the records and literature search and the cultural resources survey, that there are no historic properties located within the Area of Potential Effect. This project will have no effect to historic properties.

Pursuant to 36CFR 800.2 (4) we are providing documentation to support these findings and to involve your office as a consulting party in the National Historic Preservation Act, Section 106, Review process. If you have any questions or are in need of additional information, please contact Annabelle Rodriguez, of my staff, on (509) 372-0277 within 30 days of the date of this letter.

Sincerely,

Joel Hebdon

Joel Hebdon, Director
Regulatory Compliance and Analysis Division

RCA:ALR

Enclosures

cc:w/encls:
A. Fyall, Benton County
J. Gaston, USFWS
C. Hulse, EBCHS
A. Heriford, HWBP
J. Sonderman, FCHS
P. Vinther, HRA
G. Weisskoph, BRMA

cc w/o encls:
E. L. Prendergast, PNNL
K. Rhoads, PNNL

M0212-0286.135Kb
HSW EIS 01/28/03

This letter, cultural resource review and historic inventory forms have been sent to the following individuals:

Washington State Historic Preservation Officer
Dr. Allyson Brooks

Confederated Tribes of the Umatilla Indian Reservation
Jeff Van Pelt
Armand Minthorn
J. Longenecker (Richland Office)

Confederated Tribes and Bands of the Yakama Nation
Russell Jim

Confederated Tribes of the Colville Reservation
Adeline Fredin

Nez Perce Tribe
Lenora Seelatsee
Rex Buck, Jr.

U.S. Fish and Wildlife Service
Jenna Gaston

B Reactor Museum Association
Gene Weisskoph

Benton County
Adam Fyall

East Benton County Historical Society
Corene Hulse

Franklin County Historical Society
Jaqui Sonderman

Hanford Retirees Association
Paul Vinther

Hanford White Bluffs Pioneers
Annette Heriford

M0212-0286.135Kc
HSW EIS 01/28/03

STATE OF WASHINGTON

OFFICE OF COMMUNITY DEVELOPMENT

Office of Archaeology and Historic Preservation

1063 S. Capitol Way, Suite 106 • PO Box 48343 • Olympia, Washington 98504-8343 • (360) 586-3065 Fax Number (360) 586-3067 • http://www.oahp.wa.gov

March 6, 2002

Mr. Joel Hebdon
Regulatory Compliance & Analysis Division
Richland Operations Office
Department of Energy
PO Box 550
Richland, WA 99352

Re: Solid Waste DEIS
Log No.: 030502-14-DOE
Code: HCRC # 2002-600-012/2002-600-012A/2002-600-012B

Dear Mr. Hebdon;

Thank you for providing a copy of the cultural resources survey assessment of the proposed Site Waste DEIS analysis in the 200 West Area and 600 Area of the Hanford Site. We concur with their professional recommendations and your finding that no cultural resources are in the identified impact area as of this date. We concur with the recommendation that further survey efforts be undertaken in Area C and we look forward to receiving these reports when available.

We would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer in conformance with Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations 36CFR800. Should additional information become available, our assessment may be revised. In the event that archaeological or historic materials are discovered during project activities, work in the immediate vicinity should be discontinued, the area secured, and this office notified.

Thank you for the opportunity to comment and a copy of these comments should be included in subsequent environmental documents.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: robw@cted.wa.gov

M0212-0286.136K
HSW EIS 01/28/03

RECEIVED
MAR 1 2 2002
DOE RL / CCC

STATE OF WASHINGTON

OFFICE OF COMMUNITY DEVELOPMENT

Office of Archaeology and Historic Preservation

1063 S. Capitol Way, Suite 106 • PO Box 48343 • Olympia, Washington 98504-8343 • (360) 586-3064
Fax Number (360) 586-3067 • http://www.oahp.wa.gov

January 31, 2002

Ms. Ellen Prendergast
Cultural and Historic Resources Program
Richland Operations Office
PO Box 550
Richland, WA 99352

Log No.: 013102-10-DOE
Re: Solid Waste EIS Area C
HCRC # 2002-600-012

Dear Ms. Prendergast;

We have reviewed the materials forwarded to our office for the above referenced project concerning the proposed evaluation of Area C as a potential source of fine textured materials for the construction of graded surface barriers over waste sites at the Hanford Site. We concur with your determination of the Area of Potential Effect as illustrated in the attached figures. We look forward to receiving the results of your review and on-site surveys.

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer in compliance with the Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations 36CFR800.4. Should additional information become available, our assessment may be revised, including information regarding historic properties that have not yet been identified. We would also appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer. Should additional information become available, our assessment may be revised. Thank you for the opportunity to comment and we look forward to receiving the reports on the results of your investigations.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: robw@cted.wa.gov

M0212-0286.137K
HSW EIS 01/28/03

Pacific Northwest National Laboratory

Operated by Battelle for the U.S. Department of Energy

February 11, 2002

Preliminary Findings

Mr. Kent McDonald
Fluor Hanford, MSIN H8-44
Richland, Washington 99352

CULTURAL RESOURCES REVIEW FOR SOLID WASTE EIS, AREA C (HCRC#2002-600-012)

Dear Mr. McDonald,

In response to your request received January 25, 2002, staff of the Hanford Cultural Resources Laboratory (HCRL) conducted a cultural resources review of the subject project located in the 600 Area of the Hanford Site, Richland, Washington. As part of the U.S. Department of Energy's (DOE) ongoing efforts to provide for the safe and effective long-term storage of solid waste at Hanford, an area (Area C) measuring 2289 acres is being evaluated as a potential source of fine textured material (silt, loam and basalt) for the construction of graded surface barriers (caps) over waste sites. This project area is located adjacent to the south side of Highway 240 and is centered on the intersection of Beloit Avenue and Highway 240. This area is identified for possible borrow use in the Hanford Site Comprehensive Land Use Plan EIS (DOE 1999).

1. Background

This cultural resources review request is part of the larger Solid Waste project being conducted at the Hanford Site. A Draft Environmental Impact Statement (DEIS) is being prepared and will be available for public comment. As part of that effort, the Hanford Cultural Resources Laboratory has been asked to initiate the NHPA Section 106 process for this third part of that project. The other two parts are comprised of the Expansion of the Central Waste Complex (HCRC# 2002-600-012A) and Rail Spur to the WRAP Facility in 200 West Area (HCRC# 2002-600-012B).

2. Notifications and Public Involvement

On January 30, 2002:

- Per 36 CFR 800, the State Historic Preservation Officer (SHPO), tribes and interested parties were notified of this cultural resources review request and the Area of Potential Effect (APE). The APE is defined as the project area delineated in the attached map.
- Per 34 Stat. 225, 16 U.S.C. 431, the United States Fish and Wildlife Service (USFWS) were notified of this request for cultural resource review.

3. Results of the Identification of Historic Properties Survey (Literature and Records Review)

<u>Previous Work</u>
A records and literature search conducted by HCRL staff during the week of February 4, 2002, revealed that some of the project area has been surveyed for cultural resources. In 1994, a cultural resources survey was conducted in the northwestern portion of the project area (Bard et. al. 1994) (please see attached map for the location of this survey). Three isolated finds were recorded in the project area and are listed in the table on the next page.

M0212-0286.138Ka
HSW EIS 01/28/03

902 Battelle Boulevard • P.O. Box 999 • Richland, WA 99352

Telephone (509) 376-4626 ▪ Email ellen.prendergast@pnl.gov ▪ Fax (509) 376-2210

ISOLATE NUMBER	DESCRIPTION
HI-94-032	Two white CCS flakes
HI-94-036	A historic "fence jack" – a rock pile with remains of a split rail
HI-94-037	A large historic riveted metal collared cylinder

In 1999, a cultural resources survey was conducted by HCRL approximately 3 miles northwest of the project area in the Rattlesnake Springs Archaeological District (HCRC# 99-600-001). David Rice recorded this district in 1968 and later it was listed in the National Register of Historic Places (National Register) in 1974. Sites recorded in the district and by the survey include the White Bluffs Road (3-121), which is also listed in the National Register. The road was an important Indian and Euro-American road from Yakima to the town of White Bluffs on the Columbia River and indicates that the Rattlesnake Springs area was a cross road for Native American prehistoric and ethnographic peoples as well as early Euro-American settlers in the region (Hale 1999).

Research Initiatives and Field Reconnaissance

Although additional work will need to be conducted for the project area prior to excavation, for the purposes of the DEIS, HCRL staff conducted a variety of research initiatives to assess the potential cultural resource impacts that the project may have. These activities are documented in the project files and are summarized below:

- Historical Research – Historic maps, land records, and local histories were reviewed. Former residents of the Hanford area were also contacted to see if they could recall historic activity in the area. Results indicated that portions of Area C were used for grazing and ranching. The Ellensburg to Yakima River Road that dates at least to 1881 traversed the project area east to west, which probably was also used as an Indian trail prior to Euro-American settlement. Benson Ranch located west of the project area is an unrecorded archaeological site which shows up on the 1915 Topographic maps. The 1943 Real Estate maps depict a road connecting Cold Creek Valley with the City of Richland. This road appears to traverse adjacent to Dry Creek.
- Photogrammetry – Aerial photographs from recent decades were analyzed to determine if historic roads still existed and to see if any additional historic activity could be located. The analysis confirmed the location of roads along with various probable cultural features; however, no major sites such as farmsteads or military encampments were observed.
- Ethnographic Research – From previous ethnographic interviews with local Native Americans, we know that ethnohistorically the area was important as a travel route between Rattlesnake Springs and the Yakima River. We also know that the area lies in close proximity to at least two places considered culturally important by local tribes: Rattlesnake Mountain and Goose Egg Hill. Additional interviews will be conducted to better understand the potential that the project could have on religious activities or traditional use areas once the DEIS is released for comment.
- Archaeological Research – Previous archaeological work in the area, limited to the only one small survey (Bard 1994), identified minimal presence of archaeological remains. To gain additional perspective on the likelihood that significant archaeological remains are located in the area, staff conducted two efforts, use of an archaeological predictive model and field reconnaissance of high potential areas identified by the predictive model. The predictive model, recently developed for Hanford, was examined to evaluate the potential of the project area to contain prehistoric sites. The model indicated that the areas located along the dry beds of Cold Creek and Dry Creek would have a moderately high chance of containing

1

archaeological sites. Four staff members conducted a field reconnaissance principally along the creeks, their tributaries, and also along the old road. One tan CCS flake was geo-referenced and is identified in the attached map. Numerous rusted cans and barbwire were also observed.

4. Findings and Actions Required

It is the finding of HCRL that based on the information collected by the field reconnaissance and research, this project may affect historic properties. HCRL is unable to make a final determination of finding for the purposes of compliance with 36CFR 800 until more work is completed. However, we can provide the following preliminary assessment and recommendations:

Preliminary Findings

Historic use of Area C seems to have been centered on sheep and cattle grazing, and travel. Farmsteads (i.e. Benson Ranch) have been identified west of the project area where irrigated water allowed for the cultivation of alfalfa. Ethnohistoric Native American use appears to have been limited to travel. Native American use prior to Euro American contact and extending back as far as 10,000 years probably occurred.

In terms of cultural resource impacts that the Area C excavation may have on Native American spirituality, we do not understand the potential relationships between the project area and Rattlesnake Mountain or Goose Egg Hill well enough to offer an opinion. Those comments will have to come directly from Native Americans during the EIS review process. Since the project area is within the APE of the viewshed from Rattlesnake, we can say that the project may have an indirect effect to the characteristics that contribute to the cultural and religious significance of Rattlesnake Mountain to local tribes. There is a reasonable probability that sites are located within the project boundaries. Any sites, however, are likely to be buried, as the field reconnaissance failed to locate any on the surface. As little is known about the pre-contact use of the Cold Creek Valley, any sites located there would provide an opportunity to gain new knowledge about past life (Criterion D, NHPA). Further, if campsites or village sites are located there, human remains and possible cemeteries may also be located there.

Actions Required

Prior to construction, additional work will be needed to address potential cultural impacts. At a minimum, a standard pedestrian archaeological survey will be needed. Given the likelihood for buried deposits, some methodology will be needed to observe the subsurface. Shovel testing or backhoe testing might be appropriate, as might construction monitoring for cultural resources. Before deciding about further work required, we recommend waiting for cultural resource-related input from Native Americans and other interested parties that will be collected during the DEIS review.

RL's Hanford Cultural Resources Program will submit official documentation of our findings to the SHPO and consulting parties. The SHPO will respond within 30 days of receipt of this letter. No project activities can begin until the SHPO has concurred with our findings stated above.

The workers must be directed to watch for cultural materials (e.g., historic artifacts) during all work activities. If any are encountered, work in the vicinity of the discovery must stop until an HCRL staff member has been notified to assess the significance of the find, and, if necessary, arrange for mitigation of the impacts to the find. HCRL must be notified if any changes to project location or scope are anticipated. This project is a Class 5 case, defined as projects that "Involve Undisturbed Ground." If you have any questions, please call me at 376-4626. Please use the HCRC# above for any future.

Kent McDonald
February 11, 2002
Page 4

Very truly yours,

Ellen Prendergast, M. A.
Research Scientist/Anthropologist
Cultural Resources Project

Concurrence:
D. C. Stapp, Project Manager
Cultural Resources Project

Review and Concurrence:
A. L. Rodriguez
DOE, Richland Operations Office, Hanford Cultural Resources Program

cc: A. L. Rodriguez, A5-58 (2)
Environmental Portal, A3-01
K.R. Welsch, N1-25
File/LB

Kent McDonald
February 11, 2002
Page 5

References

Bard, JC, Robin McClintock, and JB Cox. 1994. "A Cultural Resources Inventory of Proposed Basalt Quarry Sites at the Department of Energy's Hanford Site, Benton County, Washington." CH2M Hill, Inc. Richland, Washington.

Hale, LL. 1999 "Cultural Resources Report Narrative- The Rattlesnake Springs Survey (HCRC#99-600-001)." Prepared for the U. S. Department of Energy, Richland Operations Office, Richland, Washington.

Rice, D.G. 1968. "Archaeological Reconnaissance: Hanford Atomic Works." Washington State University. Pullman, Washington.

M0212-0286.138Kd
HSW EIS 01/28/03

RL-665
(10/00)

REQUEST FOR CULTURAL AND/OR ECOLOGICAL RESOURCES REVIEW FOR THE HANFORD SITE

Review Tracking Number 2002-600-012

ERC Projects (BHI, CH2M Hill)	**All Other Hanford Projects** (PHMC, PNNL, Other)
Direct Form and Cultural Resource Questions To: Tom Marceau Phone 372-9289 Fax 372-9654 MSIN H0-23	Direct All Forms and Cultural Resource Questions To: Ellen Prendergast Phone 376-4626 Fax 373-2958 MSIN K6-75
Direct Form and Ecological Resource Questions To: Ken Gano Phone 372-9316 Fax 372-9654 MSIN H0-23	Direct Ecological Resource Questions To: Mike Sackschewsky Phone 376-2554 Fax 372-3515 MSIN K6-85
Date Sent: 1/25/02	Date Findings Requested By: 2/15/02

Primary Contact: Kent McDonald   Company/Organization: Fluor Hanford

E:mail: kent_m_mcdonald@rl.gov

Telephone: 373-4981   Fax: 372-1441   MSIN: H8-44

Secondary Contact: Ken Hladek   Company/Organization: Fluor Hanford

Telephone: 372-3201   Fax: 372-1441   MSIN: H8-44

Project Name: Solid Waste Environmental Impact Statement

Project Number/COA:

RL Project Manager: Michael Collins

REQUESTOR SHOULD SUBMIT A COPY OF THIS REQUEST TO THE RL PROJECT MANAGER UNDER WHOM THEIR PROJECT FALLS WITHIN 5 DAYS.

Project Description, including Time Period over which proposed action will occur:

Remove silt/loam and/or larger material to be used in constructing closure covers/caps for the Low-Level Burial Grounds. Material removal would likely occur sometime after 2030.

Project Dimensions:

Area C is a large polygonal area located adjacent to the south side of Highway 240 and is centered approximately on the intersection of Beloit Avenue and Highway 240 and is approximately 368 ha (909 ac). Although this area is on the ALE side of Highway 240, it is clearly identified as a possible borrow use area in the Hanford Site comprehensive land-use plan environmental impact statement. Based upon an assumed average thickness of 1.8 m, the volume of material present is 6.6 million cubic meters.

Depth of Excavation(s): Minimum 2 m. May excavate to depth of silt/loam as yet undetermined.

Project Location:

☐ 100 Area ☐ 200 East Area ☐ 200 West Area ☐ 300 Area ☐ 400 Area

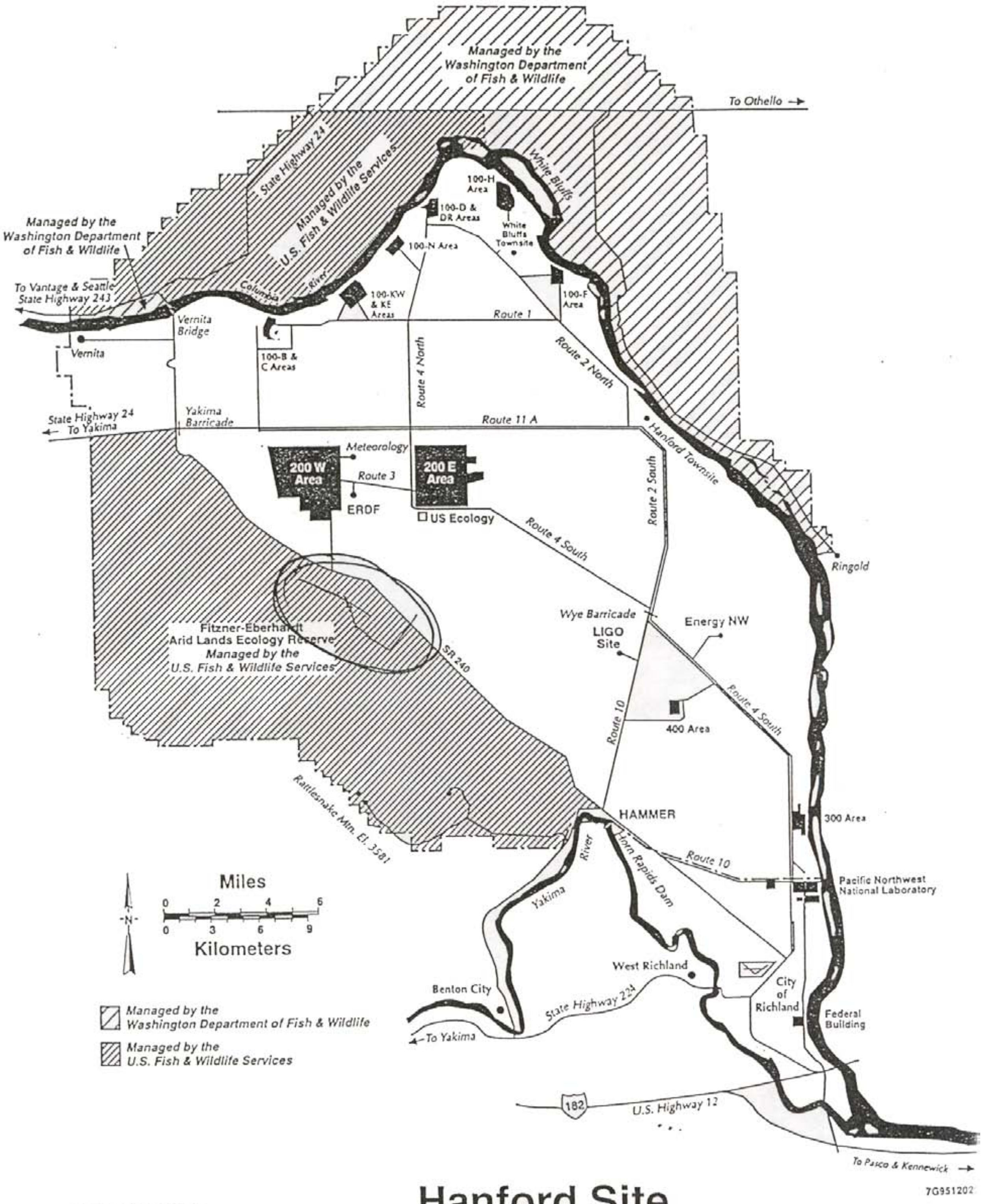
☐ 600 Area ☐ 700 Area ☒ Other: Area C conservation/mining

Township ______ N, Range ______ E   UTM: Easting: ________ Northing: ________

Please also provide the following:
1. Overview map showing project location (or other suitable map to assist in finding the project site)
2. Map or scale drawing showing all excavation areas (including water, sewer, and power lines, etc.), parking, topsoil storage areas, equipment staging areas, access roads, and utility corridors.

Submitted By: K.M McDonald   Telephone: 373-4981

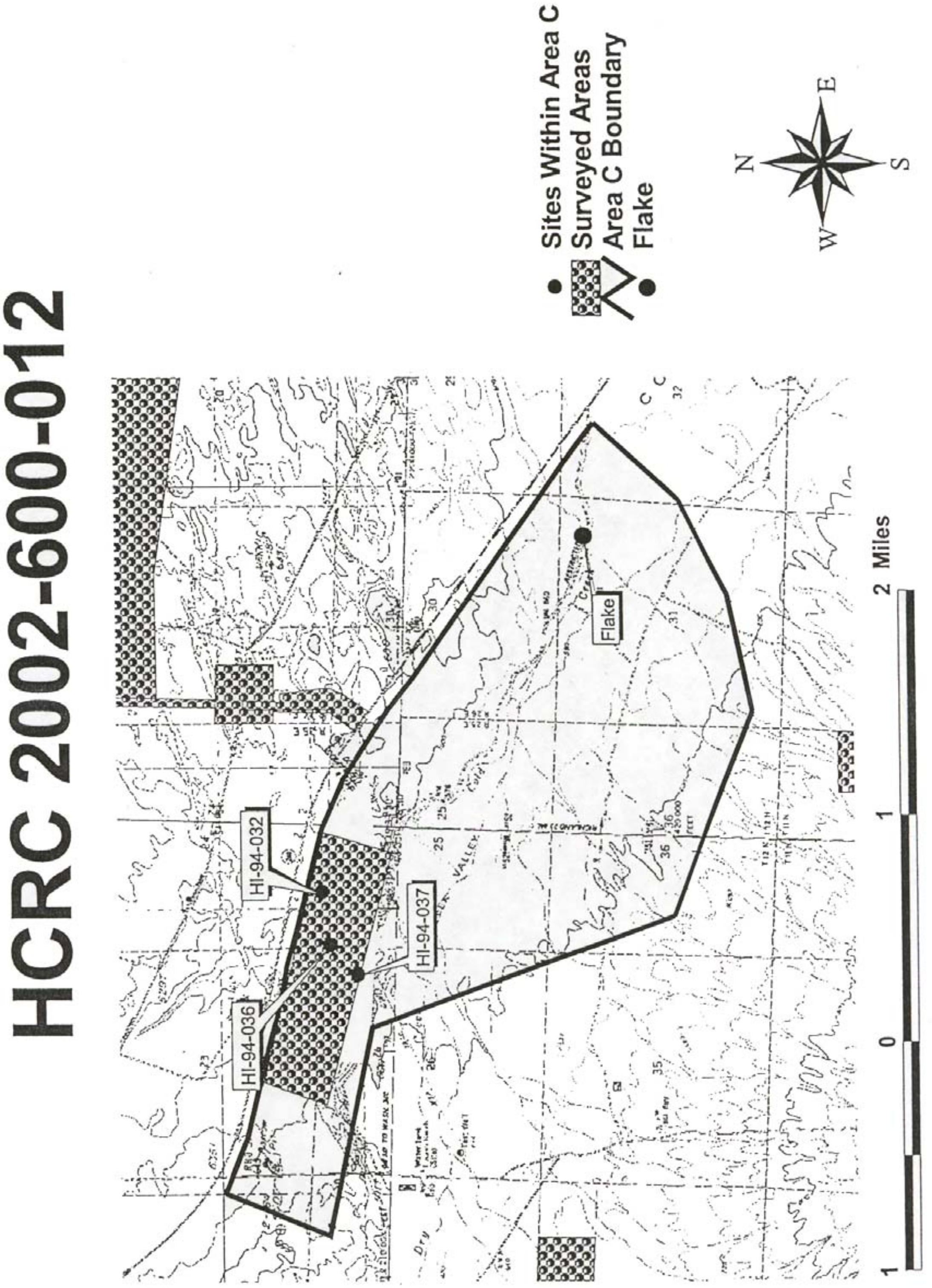
M0212-0286.138Ke
HSW EIS 01/28/03



U.S. Department of Energy
Office of External Affairs
Richland, Washington 99352
(509) 376-7501

Hanford Site
U.S. Department of Energy

M0212-0286.125
HSW EIS 01/21/03



M0212-0286.126
HSW EIS 01/21/03

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

AUG 06 2002

02-RCA-0479

Dr. Allyson Brooks
State Historic Preservation Officer
Office of Archaeology and Historic Preservation
Washington Department of Community,
Trade and Economic Development
P.O. Box 48343
Olympia, Washington 98504

Dear Dr. Brooks:

TRANSMITTAL OF THREE CULTURAL RESOURCE REVIEWS: IMMOBILIZED LOW-ACTIVITY WASTE (ILAW) DISPOSAL FACILITY (HCRC #2002-200-050), MELTER TRENCH (HCRC #2002-200-051), GROUNDWATER WELL INSTALLATION (HCRC #2002-200-054)

Enclosed are three cultural resource reviews completed by the Hanford Cultural Resources Laboratory (HCRL) for the U.S. Department of Energy, Richland Operations Office for the subject projects located on the Hanford Site, Richland, Washington. The results of the records and literature review conducted by HCRL staff are described in the attached cultural resource reviews. The results indicate that the proposed undertaking will have no effect upon historic properties. Pursuant to 36 CFR 800.2 (4), we are providing documentation to support these findings and to involve your office as a consulting party in the NHPA Section 106 Review process.

If you have any questions, please contact Annabelle L. Rodriguez, of my staff, on (509) 372-0277.

Sincerely,

Joel Hebdon

Joel Hebdon, Director
Regulatory Compliance and Analysis Division

RCA:ALR

Enclosures

cc w/o encls:
E. L. Prendergast, PNNL

M0212-0286.139K
HSW EIS 01/28/03

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STATE OF WASHINGTON
OFFICE OF COMMUNITY DEVELOPMENT
Office of Archaeology and Historic Preservation
1063 S. Capitol Way, Suite 106 • PO Box 48343 • Olympia, Washington 98504-8343 • (360) 586-3065 Fax Number (360) 586-3067 • http:www.oahp.wa.gov

August 13, 2002

Mr. Joel Hebdon
Regulatory Compliance & Analysis Division
Richland Operations Office
PO Box 550
Richland, WA 99352

Log No: 081202-14-DOE
Re: Immobilized Low Activity Waste Disposal & Others
HCRC # 2002-200-050/2002-200-051/2002-200-054

Dear Mr. Hebdon;

Thank you for providing a copy of the cultural resources survey assessment by the Pacific Northwest National Laboratory for the proposed Immobilized Low Activity Waste Disposal Facility, the proposed Melter Trench and the proposed Groundwater well Installation at the Hanford site.

We concur with their professional recommendations and your finding of no historic properties effected. We would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer in conformance with Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations 36CFR800. Should additional information become available, our assessment may be revised.

In the event that archaeological or historic materials are discovered during project activities, work in the immediate vicinity should be discontinued, the area secured, and this office notified. Thank you for the opportunity to comment and a copy of these comments should be included in subsequent environmental documents.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: robw@cted.wa.gov

RECEIVED
AUG 16 2002
DOE-RL/RLCC

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M0212-0286.140K
HSW EIS 01/28/03

RL-665 (10/00)

REQUEST FOR CULTURAL AND/OR ECOLOGICAL RESOURCES REVIEW FOR THE HANFORD SITE

Review Tracking Number: 2002-200-050

ERC Projects (BHI, CH2M Hill)	All Other Hanford Projects (PHMC, PNNL, Other)
Direct Form and Cultural Resource Questions To: Tom Marceau, Phone 372-9289 Fax 372-9654 MSIN H0-23	Direct All Forms and Cultural Resource Questions To: Ellen Prendergast, Phone 376-4626 Fax 373-2958 MSIN K6-75
Direct Form and Ecological Resource Questions To: Ken Gano, Phone 372-9316 Fax 372-9654 MSIN H0-23	Direct Ecological Resource Questions To: Mike Sackschewsky, Phone 376-2554 Fax 372-3515 MSIN K6-85

Date Sent: 6/28/02 **Date Findings Requested By:** 7/12/02

Primary Contact: Ted Wooley
Company/Organization: CH2M Hill Hanford Group
E:mail: Theodore_A_Wooley@rl.gov
Telephone: 372-1617 Fax: 509-376-0175 MSIN: R1-51

Secondary Contact: Derek Ballinger
Company/Organization: CH2M Hill Hanford Group
Telephone: 373-3469 Fax: 509-376-0175 MSIN: R1-51

Project Name: ILAW Disposal Facility
Project Number/COA:
RL Project Manager:

REQUESTOR SHOULD SUBMIT A COPY OF THIS REQUEST TO THE RL PROJECT MANAGER UNDER WHOM THEIR PROJECT FALLS WITHIN 5 DAYS.

Project Description, including Time Period over which proposed action will occur:

It has been proposed that immobilized low-activity waste (ILAW) be disposed of in six lined trenches southeast of the PUREX facility in the 200E Area. Each trench will contain three layers of stainless steel ILAW containers separated by 1 m of soil for a total volume of 25 hectare-meters of retrievable disposed waste. The facility is still in the conceptual and design stages but is expected to begin operating in early 2008.

Project Dimensions:

Each trench will be approximately 80 m wide, 260 m long, and 10 m deep.

Depth of Excavation(s): 10 m

Project Location:

☐ 100 Area ☒ 200 East Area ☐ 200 West Area ☐ 300 Area ☐ 400 Area
☐ 600 Area ☐ 700 Area ☐ Other:

Township ______ N, Range ______ E UTM: Easting: ______ Northing: ______

Please also provide the following:
1. Overview map showing project location (or other suitable map to assist in finding the project site)
2. Map or scale drawing showing all excavation areas (including water, sewer, and power lines, etc.), parking, topsoil storage areas, equipment staging areas, access roads, and utility corridors.

Submitted By: Derek Ballinger Telephone: 373-3469

M0212-0286.141K
HSW EIS 01/28/03

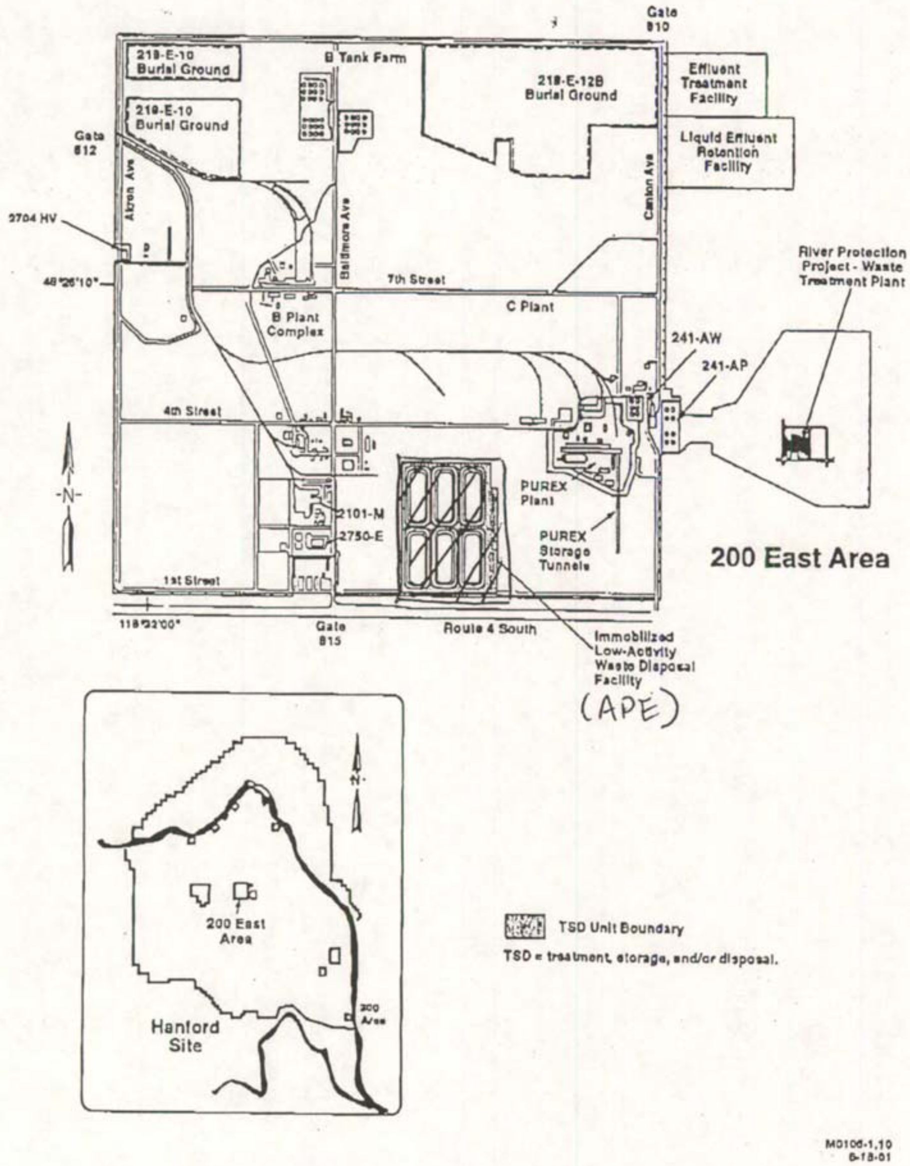

Figure 2-1. Immobilized Low-Activity Waste Disposal Facility Site Plan.

STATE OF WASHINGTON
OFFICE OF COMMUNITY DEVELOPMENT
Office of Archaeology and Historic Preservation
1063 S. Capitol Way, Suite 106 • PO Box 48343 • Olympia, Washington 98504-8343 • (360) 586-3064
Fax Number (360) 586-3067 • http://www.oahp.wa.gov

July 9, 2002

Ms. Annabelle Rodriguez
Cultural and Historic Resources Program
Richland Operations Office
PO Box 550
Richland, WA 99352

Log No.: 070902-10-DOE
Re: ILAW Disposal Facility
HCRC # 2002-200-050

Dear Ms. Rodriguez;

We have reviewed the materials forwarded to our office for the above referenced project concerning the proposed Immobilized low-activity waste (ILAW) to be disposed of in six lined trenches in the 200 East Area of the Hanford Site. We concur with your determination of the Area of Potential Effect as illustrated in the attached figure. We look forward to receiving the results of your review and on-site surveys.

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer in compliance with the Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations 36CFR800.4. Should additional information become available, our assessment may be revised, including information regarding historic properties that have not yet been identified. We would also appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer. Should additional information become available, our assessment may be revised. Thank you for the opportunity to comment and we look forward to receiving the reports on the results of your investigations.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: robw@cted.wa.gov

M0212-0286.142K
HSW EIS 01/28/03

RECEIVED
JUL 15 2002
DOE-RL/RLCC

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

July 9, 2002

No Affect to Historic Properties
30-Day SHPO Review Required

Ted Wooley
CH2M Hill Hanford Group, R1-51
Richland, Washington 99352

Subject: Cultural Resources Review of Immobilized Low-Activity Waste (ILAW) Disposal Facility (HCRC #2002-200-050)

Dear Mr. Wooley,

In response to your request received July 8, 2002, staff of the Hanford Cultural Resources Laboratory (HCRL) conducted a cultural resources review of the subject project. It has been proposed that Immobilized Low-Activity Waste (ILAW) be disposed of in six lined trenches southwest of the PUREX facility in the 200 East Area of the Hanford Site, Richland, Washington. Each trench will contain three layers of stainless steel ILAW containers separated by 1 m of soil for a total volume of 25 hectare-meters of retrievable disposed waste. The ILAW facility is still in the conceptual and design stages but is expected to begin operation in early 2008. Each trench will be approximately 80 m wide, 260 m long, and 10 m deep.

Notifications and Public Involvement
On July 9, 2002:

- Per 36 CFR 800, the State Historic Preservation Officer (SHPO) and Tribes were notified of this cultural resources review request and the Area of Potential Effect (APE). The APE is defined as the project area delineated in the attached map.
- Per 34 Stat. 225, 16 U.S.C. 431, the United States Fish and Wildlife Service (USFWS) were notified of this request for cultural resource review.

Results of the Identification of Historic Properties Survey (Literature and Records Review)
A preliminary records and literature review revealed that the project area was surveyed in the past by HCRC #88-200-028 and two historic isolates were recorded in the vicinity of the project area (HI-88-024 and HI-88-025). In 1994, the project area was surveyed as one of the alternative locations (Area B) for the proposed Tank Waste Remediation Systems Complex (TWRS) by HCRC #94-600-060 and no cultural resources were located. An additional cultural resource review was conducted in 1998 (HCRC #98-200-033) for the ILAW complex for grubbing of the existing surface up to two feet for access roads, creation of three well pads and installation of 3 wells. Cultural resource clearance was given for this project on the basis of previous surveys

902 Battelle Boulevard • P.O. Box 999 • Richland, WA 99352

M0212-0286.143Ka
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Telephone (509) 376-4626 ■ Email ellen.prendergast@pnl.gov ■ Fax (509) 376-2210

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Ted Wooley
July 9, 2002
Page 2

(HCRC #88-200-028 and 94-600-060). An examination of aerial photographs taken in 1987 showed that much of the project area is undisturbed. As few cultural resources have been located within the APE and the vicinity of the APE, this indicates that the project is located in an area of low archaeological sensitivity and the potential for the presence of subsurface archaeological resources is low.

Findings and Actions Required
It is the finding of HCRL that this project will not affect historic properties, as no cultural resources are known to be located within the APE.

RL's Hanford Cultural Resources Program will submit official documentation to the SHPO, Tribes and interested parties of our findings. Pursuant to 36CFR Section 800 affording SHPO, ACHP, and tribes 30 days to comment, these parties have 30 days to respond in receipt of this letter. No project activities can begin until the SHPO has concurred with our findings stated above.

The workers must be directed to watch for cultural materials (e.g., historic artifacts) during all work activities. If any are encountered, work in the vicinity of the discovery must stop until an HCRL historian has been notified to assess the significance of the find, and, if necessary, arrange for mitigation of the impacts to the find. HCRL must be notified if any changes to project location or scope are anticipated. This project is a Class 5 case involving construction in an undisturbed area. If you have any questions, please call me at 376-4626. Please use the HCRC# above for any future correspondence concerning this project.

Very truly yours,

Ellen Prendergast, M. A.
Research Scientist/Anthropologist
Cultural Resources Project

Concurrence: D C Stapp
D. C. Stapp, Project Manager
Cultural Resources Project

Review and Concurrence: Paul F. X. Dunigan Jr.
for A. L. Rodriguez
DOE, Richland Operations Office, Hanford Cultural Resources Program

cc: A. L. Rodriguez, A5-58 (2)
Environmental Portal, A3-01
K.R. Welsch, N1-25
File/LB

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HSW EIS 01/28/03

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RL-665 (10/00)

REQUEST FOR CULTURAL AND/OR ECOLOGICAL RESOURCES REVIEW FOR THE HANFORD SITE

Review Tracking Number: 2002-200-051

ERC Projects (BHI, CH2M Hill)	All Other Hanford Projects (PHMC, PNNL, Other)
Direct Form and Cultural Resource Questions To: Tom Marceau Phone 372-9289 Fax 372-9654 MSIN H0-23	Direct All Forms and Cultural Resource Questions To: Ellen Prendergast Phone 376-4626 Fax 373-2958 MSIN K6-75
Direct Form and Ecological Resource Questions To: Ken Gano Phone 372-9316 Fax 372-9654 MSIN H0-23	Direct Ecological Resource Questions To: Mike Sackschewsky Phone 376-2554 Fax 372-3515 MSIN K6-85

Date Sent: 6/28/02 **Date Findings Requested By:** 7/12/02

Primary Contact: Ted Wooley Company/Organization: CH2M Hill Hanford Group

E-mail: Theodore_A_Wooley@rl.gov

Telephone: 372-1617 Fax: 509-376-0175 MSIN: R1-51

Secondary Contact: Derek Ballinger Company/Organization: CH2M Hill Hanford Group

Telephone: 373-3469 Fax: 509-376-0175 MSIN: R1-51

Project Name: Melter Trench

Project Number/COA:

RL Project Manager:

REQUESTOR SHOULD SUBMIT A COPY OF THIS REQUEST TO THE RL PROJECT MANAGER UNDER WHOM THEIR PROJECT FALLS WITHIN 5 DAYS.

Project Description, including Time Period over which proposed action will occur:

The vitrification plant currently under construction in the Hanford area will use melters that liquify the waste and glass material. It has been proposed that these melters be disposed of after their estimated five-year lifespans into a specially designed trench. This trench will accomodate an estimated volume of 6,825 cubic meters of failed melters and must be operational before 2008.

Project Dimensions:

The melter trench will have a length of 270 m, a width of 120 m, and a depth of 21 m.

Depth of Excavation(s): 21 m

Project Location:

☐ 100 Area ☒ 200 East Area ☐ 200 West Area ☐ 300 Area ☐ 400 Area

☐ 600 Area ☐ 700 Area ☐ Other:

Township ____ N, Range ____ E UTM: Easting: ____ Northing: ____

Please also provide the following:

1. Overview map showing project location (or other suitable map to assist in finding the project site)
2. Map or scale drawing showing all excavation areas (including water, sewer, and power lines, etc.), parking, topsoil storage areas, equipment staging areas, access roads, and utility corridors.

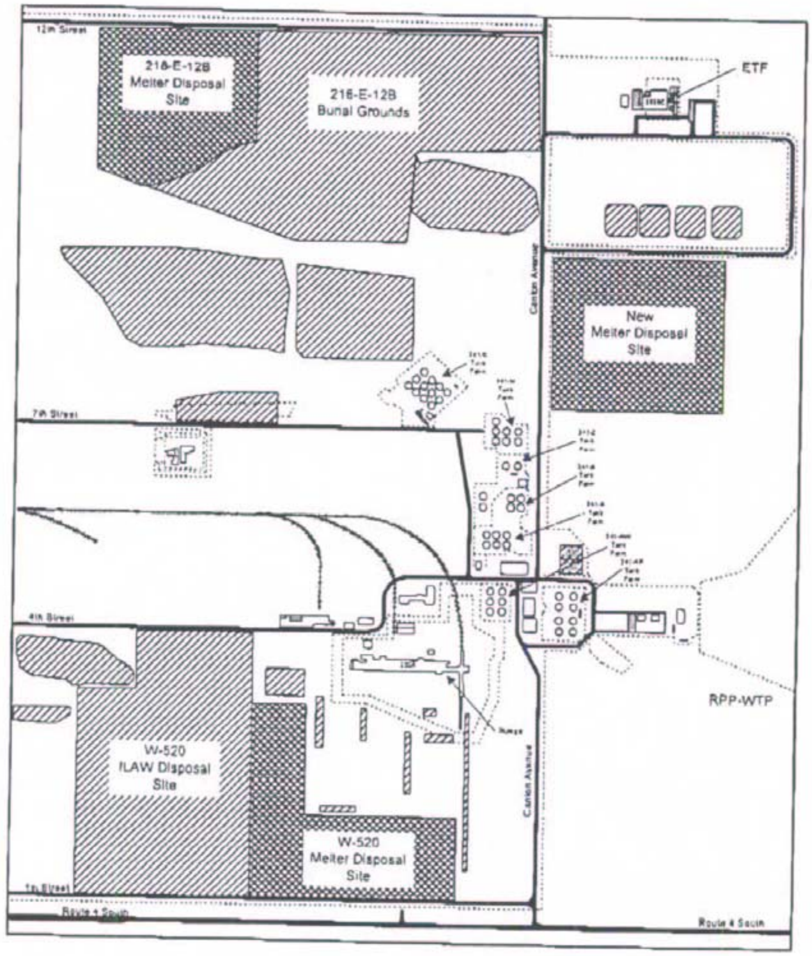
Submitted By: Derek Ballinger Telephone: 373-3469

M0212-0286.143Kc
HSW EIS 01/28/03

4.1.1 Alternative Description

The following describes each disposal site alternative. Figure 4-3 presents the general location of disposal site alternatives, excluding the multiuse burial trench site (Alternative 1C). As discussed in the Alternative 1C description, the multiuse burial trench program is at such an early stage of development that a site has not been selected.

Figure 4-3. Potential Failed Melter Disposal Sites.



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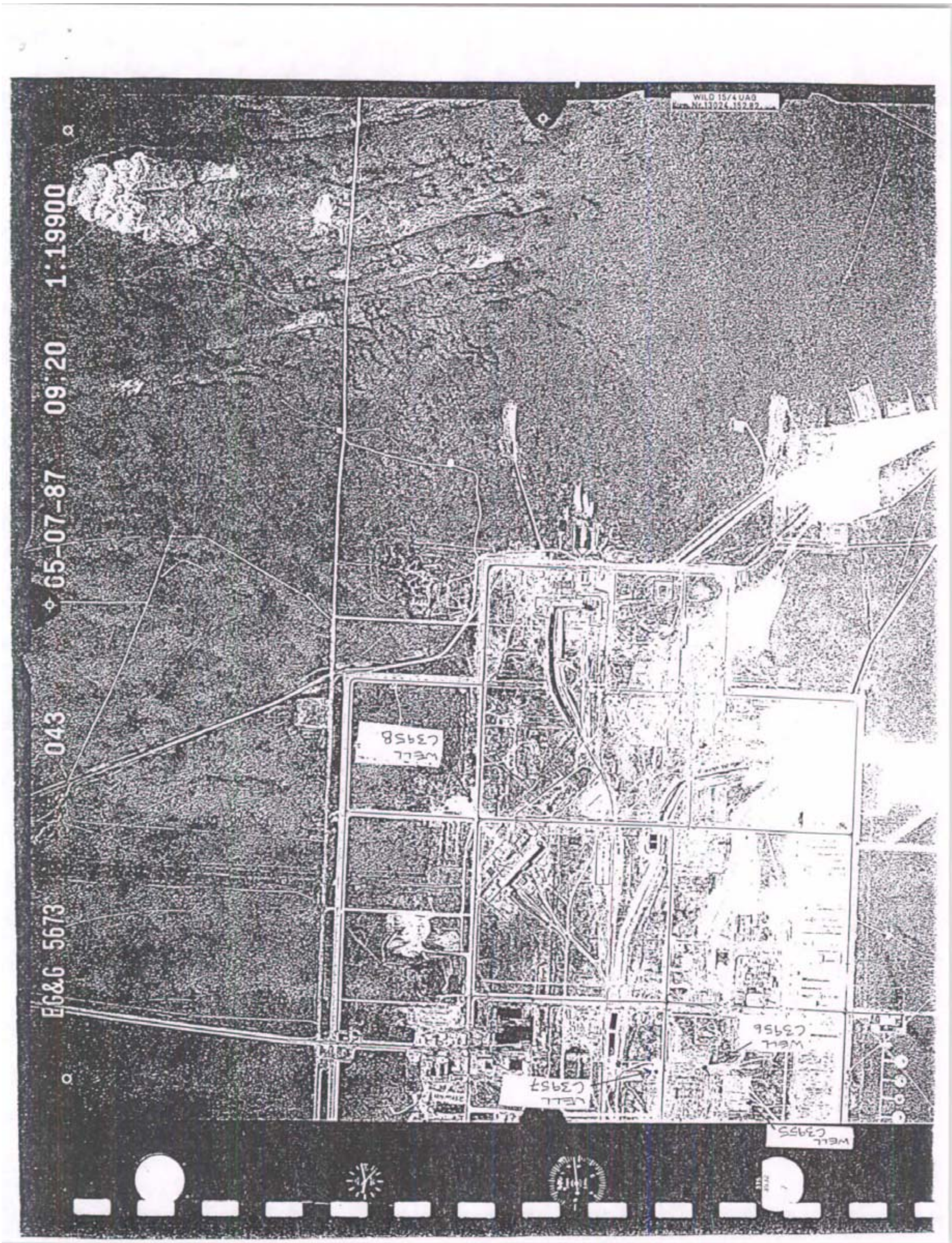

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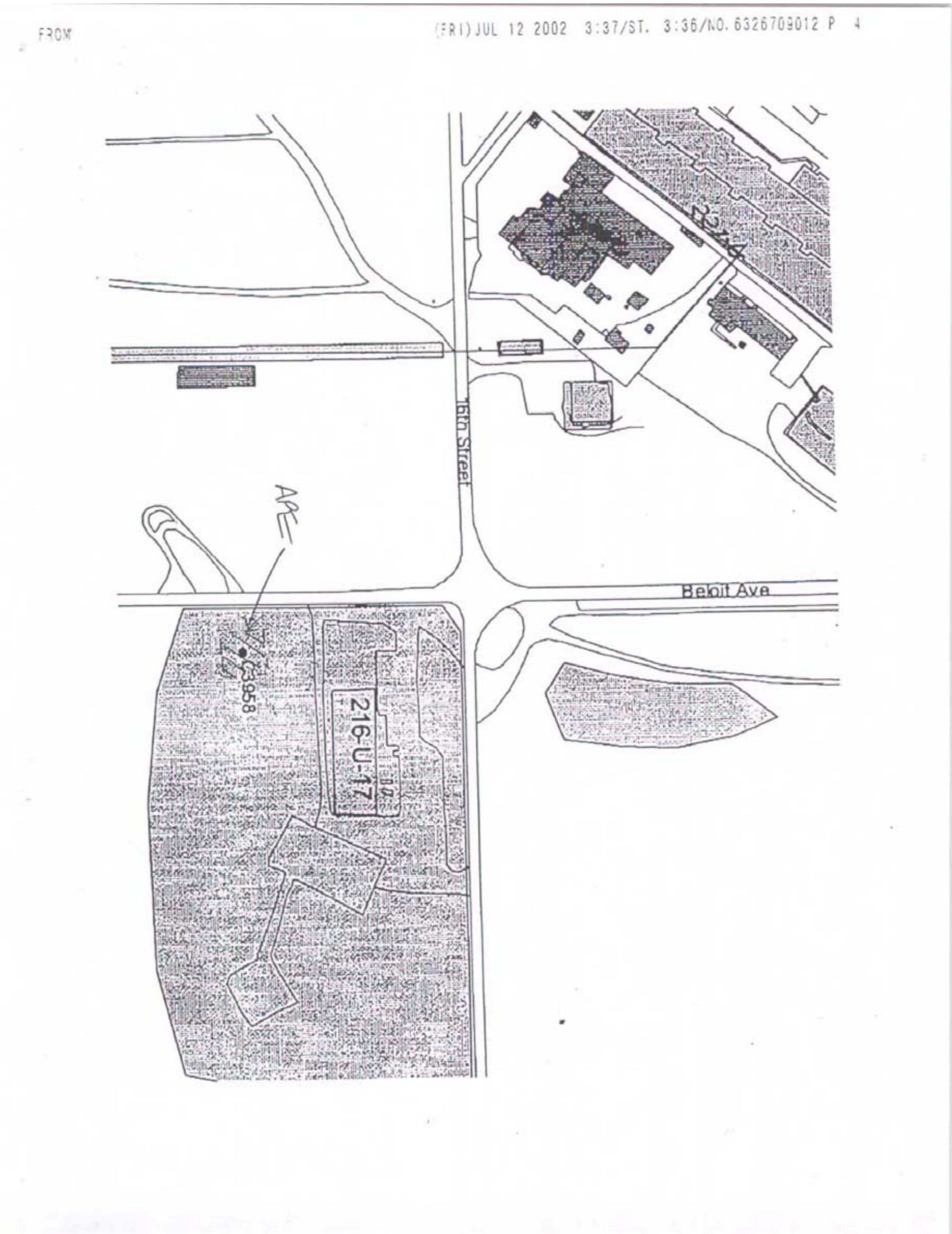
HSW EIS 01/21/03



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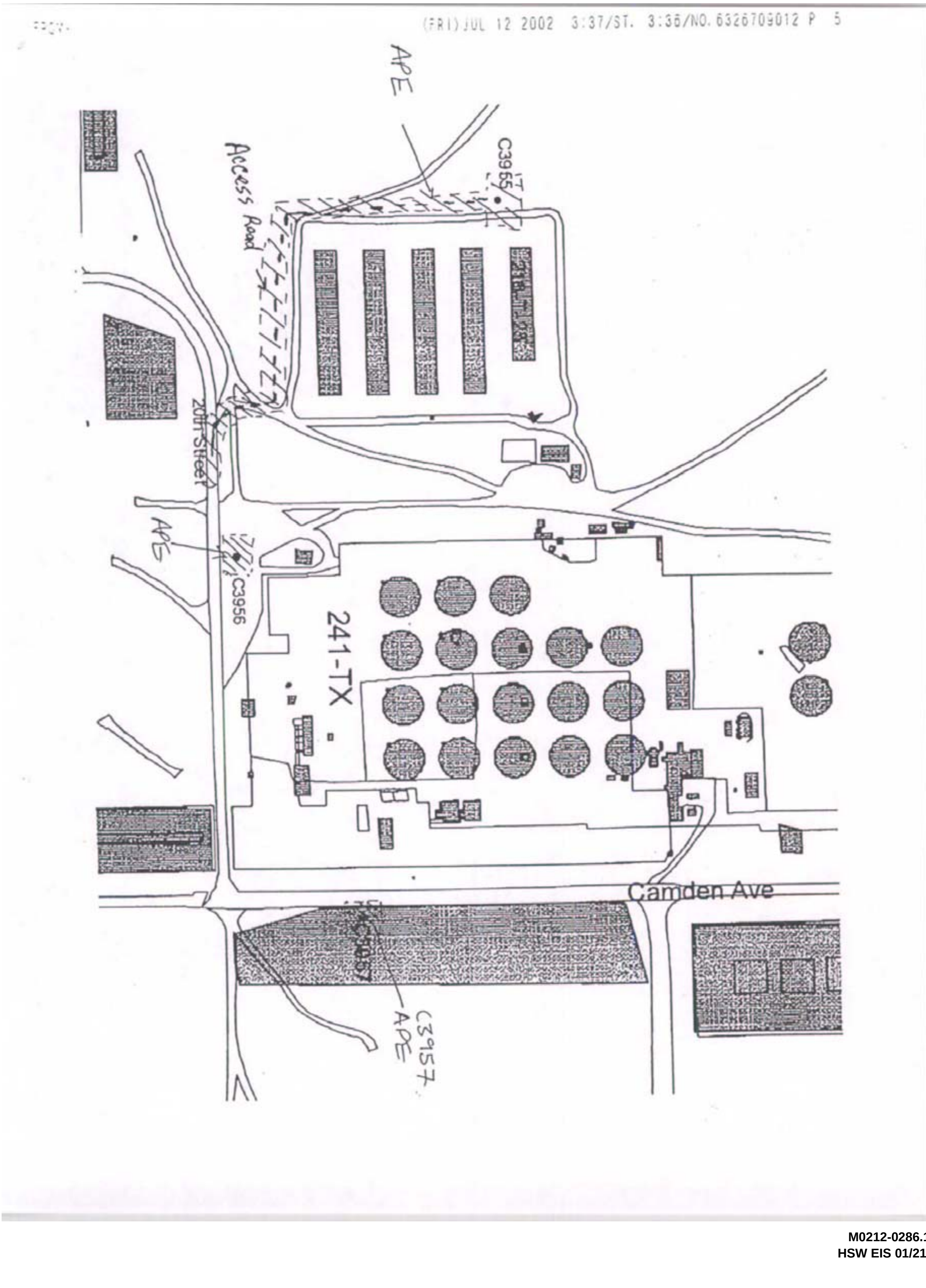

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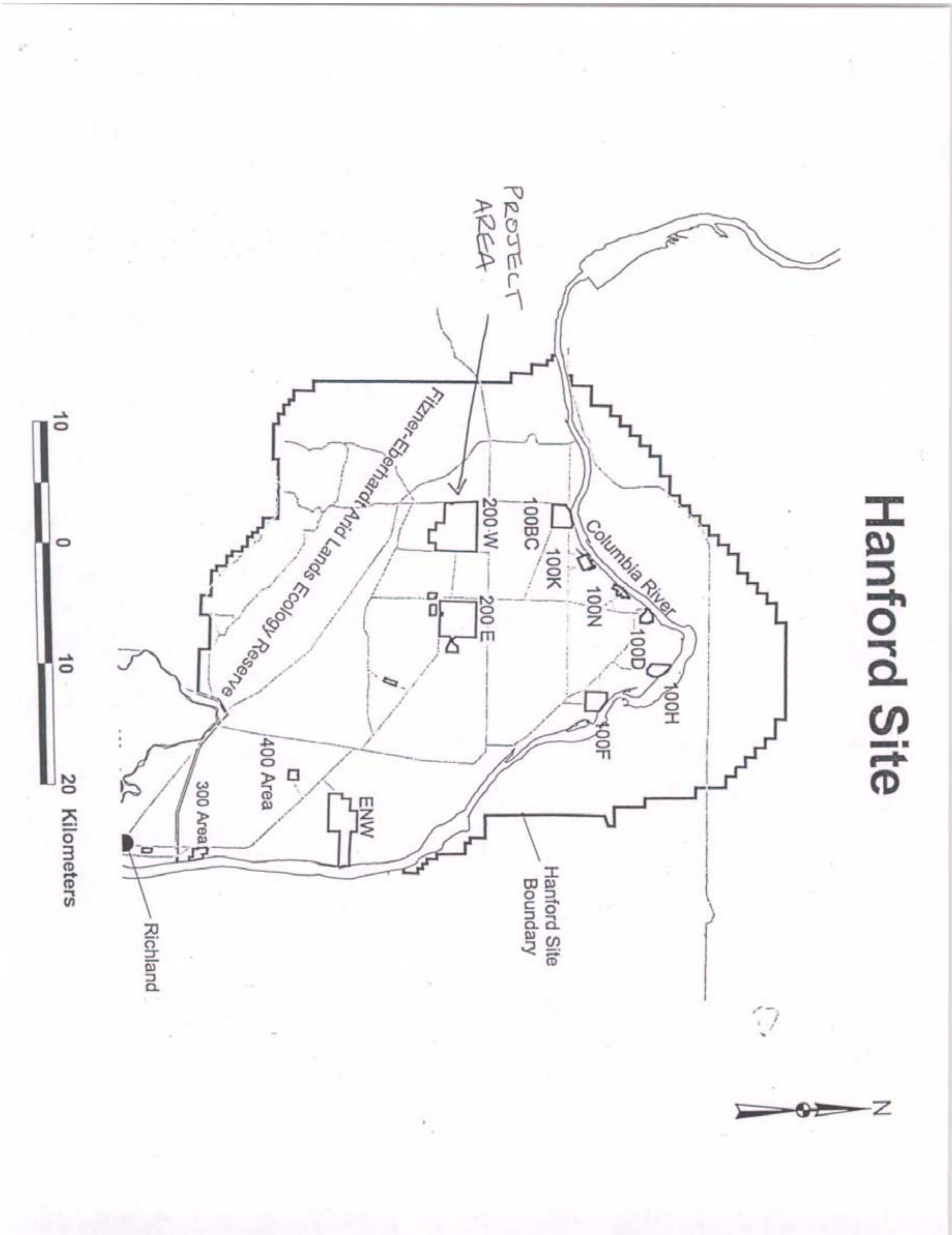
HSW EIS 01/21/03



M0212-0286.132
HSW EIS 01/21/03

Pacific Northwest National Laboratory

Operated by Battelle for the U.S. Department of Energy

July 12, 2002

No Affect to Historic Properties
30 Day SHPO Concurrence Required

Chris Wright
Fluor Hanford
E6-35
Richland, Washington 99352

Subject: Groundwater well installation (HCRC #2002-200-054)

Dear Mr. Wright,

In response to your request received July 11, 2002, staff of the Hanford Cultural Resources Laboratory (HCRL) conducted a cultural resources review of the subject project. This project in located in the 200 West Area of the Hanford Site. Four groundwater wells will be installed in several locations within the 200 West Area (see attached maps). Well C3955 will require a 75 by 75 foot gravel pad and an existing 850 foot dirt road will be graveled over for access. Wells C3956 and C3957 will require only 75 by 75 foot gravel pads. Well C3958 will not require any gravel development areas.

Notifications and Public Involvement
On July 12, 2002:

- Per 36 CFR 800, the State Historic Preservation Officer (SHPO) and Tribes were notified of this cultural resources review request and the Area of Potential Effect (APE). The APE is defined as the project area delineated in the attached map.
- Per 34 Stat. 225, 16 U.S.C. 431, the United States Fish and Wildlife Service (USFWS) were notified of this request for cultural resource review.

Results of the Identification of Historic Properties Survey (Literature and Records Review)

A preliminary records and literature review revealed that the C3958 well location area has been surveyed in the past (HCRC#87-200-032) and no cultural resources were identified. Well C3958 is located in the vicinity of a waste site (216-U-17), the construction of which most likely caused the disturbance visible in aerial photos. The areas around the other three well locations, gravel pads and access road have not been surveyed for cultural resources. However, wells C3955, the proposed access road, and well C3956 are all located in close proximity to a waste site, roads, and tank farm 241-TX. Well C3957 is also located close to a road and in a disturbed area, possibly due to road construction or construction of tank farm 241-TX.

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M0212-0286.144Ka
HSW EIS 01/28/03

Telephone (509) 376-4626 ■ Email ellen.prendergast@pnl.gov ■ Fax (509) 376-2210

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Chris Wright
July 12, 2002
Page 2

archaeological potential. Examination of aerial photographs taken in 1987 shows that all of the well location areas are highly disturbed. Construction of waste sites, tank farm 241-TX, and access roads most likely caused the disturbance visible on the aerial photos (see attached photos).

Findings and Actions Required
It is the finding of HCRL that this project will not affect historic properties, as no cultural resources are known to be located within the APE.

RL's Hanford Cultural Resources Program will submit an official letter of documentation to the SHPO, Tribes and interested parties of our findings. Pursuant to 36CFR Section 800, SHPO and tribes have 30 days to respond in receipt of this letter. No project activities can begin until the SHPO has concurred with our findings stated above.

All workers should be directed to watch for cultural materials (e.g. bones, artifacts) during all work activities. If any are encountered, work in the vicinity of the discovery must stop until an HCRL archaeologist has been notified, assessed the significance of the find, and, if necessary arranged for mitigation of the impacts to the find. The HCRL must be notified if any changes to project location or scope are anticipated. This project is a Class 3 case involving new construction in a disturbed, low sensitivity area. If you have any questions, please call me at 376-4626. Please use the HCRC# above for any future correspondence concerning this project.

Very truly yours,

Ellen Prendergast, M. A.
Research Scientist/Anthropologist
Cultural Resources Project

Concurrence: ____________
D. C. Stapp, Project Manager
Cultural Resources Project

Review and Concurrence: ____________
A. L. Rodriguez
DOE, Richland Operations Office, Hanford Cultural Resources Program

cc: A. L. Rodriguez, A5-58 (2)
Environmental Portal, A3-01
K.R. Welsch, N1-25
File/LB

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HSW EIS 01/28/03

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RL-655

REQUEST FOR CULTURAL AND/OR ECOLOGICAL RESOURCES REVIEW FOR THE HANFORD SITE

Review Tracking Number 2002-200-054

ERC Projects (BHI, CH2M Hill)	**All Other Hanford Projects** (PHMC, PNNL, Other)
Direct Form and Cultural Resource Questions To: Tom Marceau Phone 372-9289 Fax 372-9654 MSIN H0-23	Direct All Forms and Cultural Resource Questions To: Ellen Prendergast Phone 376-4626 Fax 373-2958 MSIN K6-75
Direct Form and Ecological Resource Questions To: Ken Gano Phone 372-9316 Fax 372-9654 MSIN H0-23	Direct Ecological Resource Questions To: Mike Sackschewsky Phone 376-2554 Fax 372-3515 MSIN K6-85

Date Sent: 7/10/02 **Date Findings Requested By: 7/23/02**

Primary Contact: Chris Wright Company/Organization: FH

E:mail:

Telephone: 373-3994 Fax: MSIN E6-35

Secondary Contact: Chris Webb Company/Organization: FH

Telephone: 373-5573 Fax: 373-5871 MSIN: A0-21

Project Name: Groundwater/Vadose

Project Number/COA: 117599

RL Project Manager: KM Thompson

REQUESTOR SHOULD SUBMIT A COPY OF THIS REQUEST TO THE RL PROJECT MANAGER UNDER WHOM THEIR PROJECT FALLS WITHIN 5 DAYS.

Project Description, including Time Period over which proposed action will occur:

Four groundwater wells will be installed in 200 West Area (see attached location sketches). Well C3955 will require a 75 by 75 foot gravel pad and a gravel access road measuring approximately 850 feet long. Wells C3956 and C3957 will require only 75 by 75 foot gravel pads. Well C3958 will not require any gravel development areas.

Project Dimensions:

Depth of Excavation(s): Well depth = Approx. 370 feet deep

Project Location:

100 Area	X 200 West Area	400 Area	700 Area	Other:
200 East Area	300 Area	600 Area		

Township 12 N Range 25 & 26 E UTM: Easting ______ Northing: _______

Please also provide the following:
1. Overview map showing project location (or other suitable map to assist in finding the project site)
2. Map or scale drawing showing all excavation areas (including water, sewer, and power lines, etc.), parking, topsoil storage areas, equipment staging areas, access roads, and utility corridors.

Submitted By: CR Webb Telephone: 373-5573

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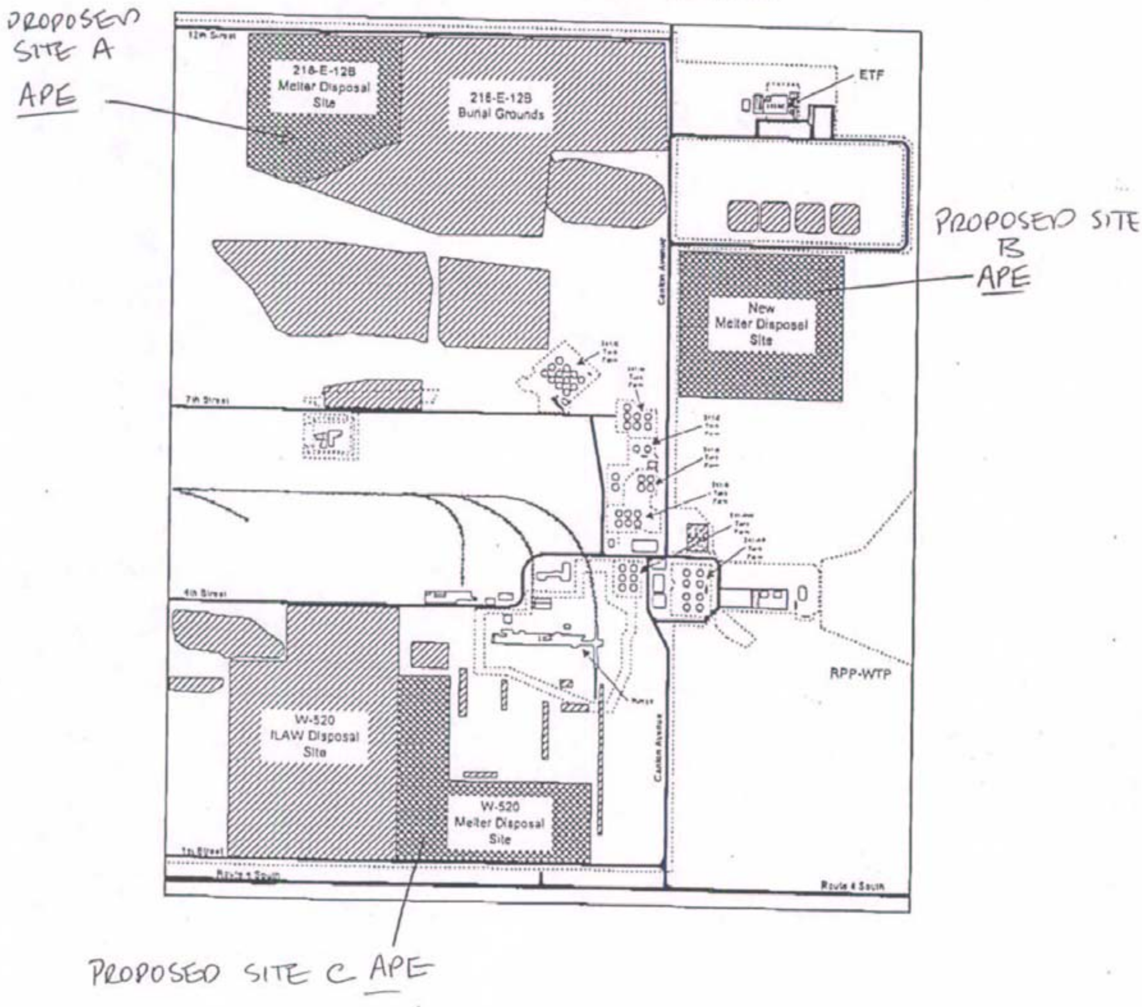
4.1.1 Alternative Description

The following describes each disposal site alternative. Figure 4-3 presents the general location of disposal site alternatives, excluding the multiuse burial trench site (Alternative 1C). As discussed in the Alternative 1C description, the multiuse burial trench program is at such an early stage of development that a site has not been selected.

Figure 4-3. Potential Failed Melter Disposal Sites.



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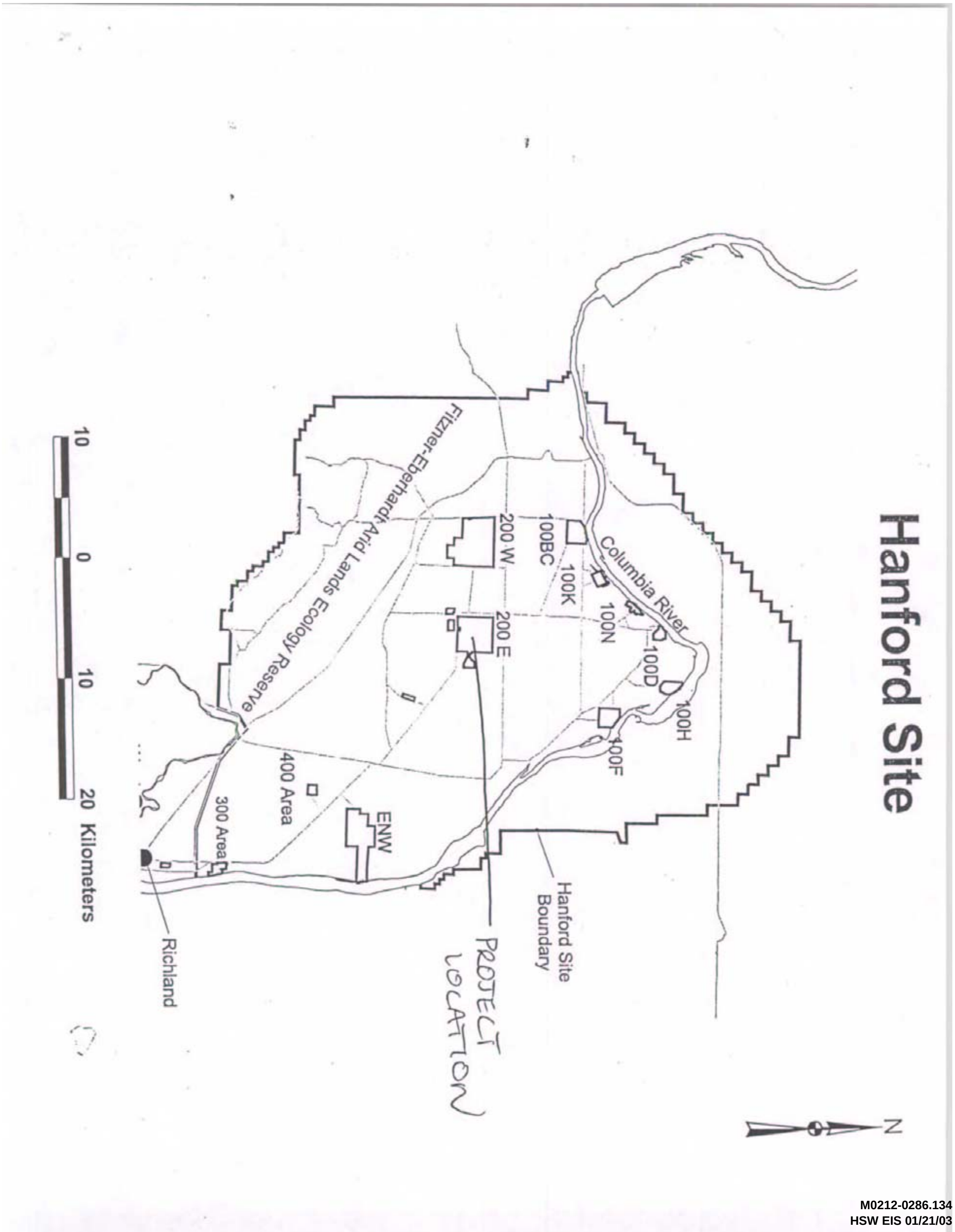
HSW EIS 01/21/03


Hanford Site
Columbia River
100BC
100K
100N
100D
100H
100F
200 W
200 E
Fitzner-Eberhardt Arid Lands Ecology Reserve
400 Area
300 Area
ENW
Hanford Site Boundary
PROJECT LOCATION
Richland
10 0 10 20 Kilometers
N
M0212-0286.134
HSW EIS 01/21/03

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

July 9, 2002

No Affect to Historic Properties
30-Day SHPO Review Required

Ted Wooley
CH2M Hill Hanford Group
R1-51
Richland, Washington 99352

Subject: Cultural Resources Review of Melter Trench (HCRC #2002-200-051)

Dear Mr. Wooley,

In response to your request received July 8, 2002, staff of the Hanford Cultural Resources Laboratory (HCRL) conducted a cultural resources review of the subject project. The Vitrification Plant currently under construction in the 200 East Area of the Hanford area will use melters that liquefy the waste and glass material. It has been proposed that these melters be disposed of after their estimated five-year lifespan into a specially designed trench, located in the 200 East area of the Hanford Site, Richland, Washington. This trench will accommodate an estimated volume of 6,825 cubic meters of failed melters and must be operational before 2008. Three alternative locations for the melter trenches are designated on the attached map. The melter trench itself will have a length of 270 meters, a width of 120 meters, and a depth of 21 meters.

Notifications and Public Involvement
On July 9, 2002:

- Per 36 CFR 800, the State Historic Preservation Officer (SHPO) and Tribes were notified of this cultural resources review request and the Area of Project Effect (APE). The Area of Potential Effect is defined as the project area delineated in the attached map.

- Per 34 Stat. 225, 16 U.S.C. 431, the United States Fish and Wildlife Service (USFWS) were notified of this request for cultural resource review.

Results of the Identification of Historic Properties Survey (Literature and Records Review)

A preliminary records and literature review revealed that only one of the three proposed melter trench locations has been surveyed for cultural resources in the past. Melter trench location C (W-520) was surveyed (HCRC #88-200-038) and two historic isolates recorded (HI-88-024 and HI-88-025). Aerial photographs indicate that melter trench location C is undisturbed. Proposed melter location A (218-E-12B) has not been surveyed. However, a survey conducted to the southeast of proposed melter site A (HCRC #88-200-038) located no

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Telephone (509) 376-4626 ■ Email ellen.prendergast@pnl.gov ■ Fax (509) 376-2210

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HSW EIS 01/28/03

Teed Wooley
July 9, 2002
Page 2

cultural resources. Aerial photographs indicate that melter site A has been disturbed by grubbing and excavation for the 218-E12B Waste Burial ground which lies east of the melter site A. Melter site location B has not been surveyed but cultural resource surveys conducted to the north (HCRC# 89-200-023) and to the west (HCRC #88-200-038) of this proposed melter disposal area did not locate cultural resources. Aerial photographs indicate that melter location B is disturbed by existing water and utility lines.

Findings and Actions Required

Melter Location A and B:

It is the finding of HCRL that this project will not affect historic properties, as the project areas are located in highly disturbed areas and cultural resource surveys conducted in the vicinity of these project areas indicates that the project area is also located in an area where the potential for subsurface archaeological resources is low.

Melter Location C

It is the finding of HCRL that this project will not affect historic properties, as no cultural resources are known to be located within the APE.

RL's Hanford Cultural Resources Program will submit official documentation to the SHPO, Tribes and interested parties of our findings. Pursuant to 36CFR Section 800 affording SHPO, ACHP, and tribes 30 days to comment, these parties have 30 days to respond in receipt of this letter. No project activities can begin until the SHPO has concurred with our findings stated above.

The workers must be directed to watch for cultural materials (e.g., historic artifacts) during all work activities. If any are encountered, work in the vicinity of the discovery must stop until an HCRL historian has been notified to assess the significance of the find, and, if necessary, arrange for mitigation of the impacts to the find. HCRL must be notified if any changes to project location or scope are anticipated. This project is a Class 3 and Class 5 case involving construction in both a disturbed low sensitivity area and construction in an undisturbed area. If you have any questions, please call me at 376-4626. Please use the HCRC# above for any future correspondence concerning this project.

Very truly yours,

Ellen Prendergast, M. A.
Research Scientist/Anthropologist
Cultural Resources Project

Concurrence:
D. C. Stapp, Project Manager
Cultural Resources Project

Review and Concurrence: Paul F. X. Dunigan Jr.
for A. L. Rodriguez
DOE, Richland Operations Office, Hanford Cultural Resources Program

M0212-0286.146Kb
HSW EIS 01/28/03

STATE OF WASHINGTON

OFFICE OF COMMUNITY DEVELOPMENT

Office of Archaeology and Historic Preservation

1063 S. Capitol Way, Suite 106 • PO Box 48343 • Olympia, Washington 98504-8343 • (360) 586-3064
Fax Number (360) 586-3067 • http://www.oahp.wa.gov

July 9, 2002

Ms. Annabelle Rodriguez
Cultural and Historic Resources Program
Richland Operations Office
PO Box 550
Richland, WA 99352

Log No.: 070902-11-DOE
Re: Melter Trench
HCRC # 2002-200-051

Dear Ms. Rodriguez;

We have reviewed the materials forwarded to our office for the above referenced project concerning the proposed construction of trenches for failed melters in the 200 East Area of the Hanford Site. We concur with your determination of the Area of Potential Effect as illustrated in the attached figure. We look forward to receiving the results of your review and on-site surveys.

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer in compliance with the Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations 36CFR800.4. Should additional information become available, our assessment may be revised, including information regarding historic properties that have not yet been identified. We would also appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer. Should additional information become available, our assessment may be revised. Thank you for the opportunity to comment and we look forward to receiving the reports on the results of your investigations.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: robw@cted.wa.gov

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JUL 15 2002
DOE-RL/RLCC

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STATE OF WASHINGTON
OFFICE OF COMMUNITY DEVELOPMENT
Office of Archaeology and Historic Preservation
1063 S. Capitol Way, Suite 106 • PO Box 48343 • Olympia, Washington 98504-8343 • (360) 586-3064
Fax Number (360) 586-3067 • http://www.oahp.wa.gov

July 15, 2002

Ms. Annabelle Rodriguez
Cultural and Historic Resources Program
Richland Operations Office
PO Box 550
Richland, WA 99352

Log No.: 071202-10-DOE
Re: Groundwater Well Installation
HCRC # 2002-200-054

Dear Ms. Rodriguez;

We have reviewed the materials forwarded to our office for the above referenced project concerning the proposed installation of a groundwater well in the 200 Area of the Hanford Site. We concur with your determination of the Area of Potential Effect as illustrated in the attached figure. We look forward to receiving the results of your review and on-site surveys.

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer in compliance with the Section 106 of the National Historic Preservation Act, as amended, and its implementing regulations 36CFR800.4. Should additional information become available, our assessment may be revised, including information regarding historic properties that have not yet been identified. We would also appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer. Should additional information become available, our assessment may be revised. Thank you for the opportunity to comment and we look forward to receiving the reports on the results of your investigations.

Sincerely,

Robert G. Whitlam, Ph.D.
State Archaeologist
(360) 586-3080
email: robw@cted.wa.gov

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JUL 18 2002
DOE-RL/RLCC

M0212-0286.148K
HSW EIS 01/28/03

K.3 References

16 USC 470, et seq., National Historic Preservation Act (NHPA) of 1966. Available URL: http://www4.law.cornell.edu/uscode/16/ch1AschII.html

36 CFR 800. "Protection of Historic Properties." U.S. Code of Federal Regulations. Available URL: http://www.access.gpo.gov/nara/cfr/waisidx_01/36cfr800_01.html

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DOE-RL. 1995. *Ordnance and Explosive Waste Records Search Report*. DOE/RL-94-07. U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Fuller, N. G. 1974. *Rattlesnake Springs Archaeological District—National Register of Historic Places, Inventory-Nomination Form*. U.S. Atomic Energy Commission, Richland Operations Office, Richland, Washington.

Hinds, N. R., and L. E. Rodgers. 1991. *Ecological Perspectives of Land Use History: The Arid Lands Ecology (ALE) Reserve*. PNL-7750, UC-702, prepared for the U.S. Department of Energy, Pacific Northwest Laboratory, Richland, Washington.

Van Arsdol, T. 1972. Desert Boom and Bust – The Story of Irrigation Efforts and Town-Building in Benton County, Washington, 1888-1904. Vancouver, Washington.

Appendix L

System Assessment Capability: A 10,000-Year, Post-Closure Assessment

L.1 Introduction

In late 1997, the U.S. Department of Energy (DOE) established the Groundwater/Vadose Zone Integration Project with Bechtel Hanford, Inc. (BHI), the Hanford Site Environmental Restoration Contractor, as manager. The project transitioned to Fluor Hanford, the Project Hanford Management Contractor, in July 2002, and has been renamed the Groundwater Protection Program. Pacific Northwest National Laboratory (PNNL) is a partner in the project. The mission of the project is to coordinate and integrate projects that characterize, monitor, and clean up contaminants in the groundwater and vadose zone (the soil between the ground surface and the groundwater) beneath the Hanford Site. The Groundwater Protection Project also incorporates other task areas that complement these projects and several that represent accelerated actions leading to earlier site cleanup and closure.

In 1999, under the Integration Project, DOE initiated development of an assessment tool that will enable users to model the movement of contaminants from all waste sites at Hanford through the vadose zone, the groundwater, and the Columbia River and to estimate the impact of contaminants on human health, ecology and the local cultures and economy. This tool is named the System Assessment Capability (SAC).

The approach taken by the SAC is consistent with the methods, characteristics, and controls associated with a composite analysis as described by the Columbia River Comprehensive Impact Assessment (CRCIA) team (DOE-RL 1998). The CRCIA was a study initiated by DOE, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency (EPA) to assess the effects of Hanford-derived materials and contaminants on the Columbia River environment, river-dependent life, and users of river resources. Part I of CRCIA was a study of present-day impacts to the Columbia River from Hanford contaminants. Part II was a suite of requirements for the development of a comprehensive impact assessment for the Columbia River. The two key elements of the SAC approach are 1) ensuring that factors that will dominate the risk are included, and 2) providing an understanding of the uncertainty of the results. Dominant factors were identified through scoping studies and the development of conceptual models for each of the analysis modules used. A stochastic modeling approach was taken to estimate uncertainty in the results. Aspects of uncertainty that could not be included in the calculation were considered in the analysis of the modeling results and discussed in the document presenting initial assessment results (Bryce et al. 2002). The analysis modules included in the SAC parallel those identified by CRCIA and were developed through work group meetings that included regulator and stakeholder participation.

Several key modules were adopted directly from the CRCIA, including the module used to calculate human health impacts (the HUMAN code) and the module used to calculate impacts to ecological species (the ECEM code).

An initial assessment was recently completed with the SAC to demonstrate its functional assessment capability. Future modifications to the tool will be driven by the requirements of specific assessments. Improvements in the results obtained from use of the SAC will be realized as input data are refined through characterization and scientific research. Bryce et al. (2002) reported the results of that assessment, which is the basis for application of the SAC to provide a site-wide perspective of waste disposal and remedial actions in this Hanford Solid Waste Environmental Impact Statement (HSW EIS). Much of the material presented in this appendix has been taken from Bryce et al. (2002).

To simplify the discussion presented in this appendix, the term “SAC” refers to the software package used for this assessment, but it should be noted that the SAC is an evolving and maturing capability.

The initial assessment in fiscal year 2002:

- Modeled the movement of contaminants from 533 locations throughout the Hanford Site representing 890 waste sites through the vadose zone, the groundwater, and the Columbia River.

- Incorporated data on 10 radioactive and chemical contaminants—carbon tetrachloride, cesium-137, chromium, iodine-129, plutonium-239/240, tritium, strontium-90, technetium-99, total uranium (chemical), and uranium (radionuclide).

- Focused on subsurface transport, the Columbia River, and risks to human and ecological health, and the economy and culture.

- Included the geographic region from Rattlesnake Mountain to the Columbia River and from Vernita Bridge to McNary Dam on the Columbia River.

- Included the cleanup actions in Hanford’s cleanup plans and agreements as of October 2000.

- Consisted of a stochastic simulation for the period 1944 to 3050 using 25 realizations, thus providing insight into the median response and an initial look at uncertainty.

- Simulated a 1000-year, post-closure period. Three waste forms known to release after that time were not included—immobilized low-activity waste (ILAW), melters, and naval reactor compartments.

For the waste sites located on the Hanford Central Plateau and their associated contaminant plumes, the findings of the initial assessment parallel those of the composite analysis (Kincaid et al. 1998). The results are also consistent with concentrations in environmental media measured by the Hanford Environmental Surveillance Program (Poston et al. 2002). Both the monitoring results and the assessment reported here indicate that Hanford impacts to the Columbia River have peaked and are now declining.

For the purposes of the HSW EIS, the System Assessment Capability (SAC) is a ‘best available technology’ and, while it remains a tool under development, the SAC Rev. 0 tool is adequate to provide valuable information through quantification of cumulative risks and impacts associated with solid waste disposal at the Hanford Site.

L.1.1 Context of SAC Runs

The principal SAC simulation made in support of the HSW EIS is a series of 25 stochastic simulations run over the period 1944 through 12050 A.D. (that is, a 10,000-year, post-closure period), for the Hanford Site Disposition Baseline (HSDB) scenario. This simulation includes a stochastic representation of inventory, release and transport, and a deterministic representation of exposure and dose. In addition, a median-value input case, based on the median value of each input parameter represented by a distribution in the stochastic model, was simulated.

The HSDB scenario represented in the fiscal year 2002 initial assessment are based on a number of cleanup assumption including waste, debris, and contaminated soil will be removed from the 100 Areas and the remaining soil will meet residential use standards. Similarly, waste, debris, and contaminated soil will be removed from the 300 Areas, but the remaining soil will meet industrial use standards. In this scenario, retrievably stored transuranic (TRU) waste will be recovered, tested to determine waste content, repackaged, and sent offsite for disposal at the Waste Isolation Plant in New Mexico. The waste in Burial Grounds 618-10 and 618-11 will be removed, and the TRU waste will be repackaged and removed from the Hanford Site, while the low-level waste (LLW) will be disposed of in solid waste disposal facilities in the Central Plateau. Ninety-nine percent of the tank waste volume will be recovered from the tanks and a 1 percent residual volume will remain. Losses to the subsurface during waste recovery are assumed to average 30,280 L (8000 gal) per single-shell tank recovered. The recovered tank waste will be separated into low-activity and high-activity fractions. Both waste fractions are assumed to be immobilized. Low-activity waste will be disposed of onsite, while the high-activity fraction will be disposed of in the national repository. All spent fuel also will be stored in a stable configuration for shipment to and disposal in the national repository.

The initial assessment and this analysis assume that, for the duration of the analysis, the future regional and local climate will remain unchanged for the period of the analysis. Furthermore, it is assumed that major engineered structures in the region (for example, the reservoir system on the Columbia River) will remain in place. The recorded climate and environmental response (for example, Columbia River stage and discharge records) since startup of the site operations were used to simulate the period from 1944 to the present. The climate record from 1961 to 1990 was used to represent the future climate. Consequently, the Hanford Site remains a semi-arid, shrub-steppe environment in the simulations. The riparian zone, Columbia River, and river ecosystem are assumed to remain essentially unchanged for the duration of the analysis. Also, the human population will be unchanged and will be based on the current socio-economic setting. Analyses of alternate future climates (for example, global climate change or onset of an ice age and glacial flooding) and potential future events (for example, failure or removal of the reservoir system) are not addressed.

Where the initial assessment addressed the period 1944 through 3050 (that is, essentially a 1000-year, post-closure simulation), simulations for this EIS were carried out over a 10,000-year, post-closure period. Within the SAC, a single transport pathway element, the Columbia River model, is limited to the year 10,000 A.D. in its simulation algorithm, but all other transport pathways (release, vadose zone, groundwater) can execute for the full 10,000-year, post-closure period.

The stochastic simulations supporting the HSW EIS are based on the parameter distributions assembled for the initial assessment. In addition to the environmental pathway and risk/impact model parameters, the inventory and the future disposal and remedial actions assembled for the initial assessment are included. Differences between the inventory used in this extended simulation of the initial assessment and that used in the HSW EIS are described in Section L.2.2.2. Principal differences lie in the methods used to forecast solid waste disposal actions until site closure, both for onsite generators (for example, Waste Treatment Plant contributions) and for offsite generators.

The potential contaminants of greatest concern include technetium-99, iodine-129 and uranium. These contaminants appear in solid waste performance assessments (Wood et al. 1995, Wood 1996) that analyze solid waste disposals in 200 West and 200 East Areas. While the initial application of SAC to the HSW EIS did not include iodine-129, an ability to achieve simulation of iodine-129 is being established. Of necessity, simulation of iodine-129 will include an initial condition for iodine-129 representative of prior releases to the unconfined groundwater, simulation of future releases of iodine-129 per the initial assessment, and superposition of the ILAW contribution to iodine-129 risk and impact. This approach to iodine-129 simulation will include events attributed to past liquid discharges (current groundwater plumes), future solid waste releases, and long-term future releases from immobilized low-activity tank waste. The inventory estimated to exist in the unconfined aquifer, and the estimate of iodine-129 in low-activity tank waste to remain at Hanford will be used in this estimate of the iodine-129 contribution to risk/impact. As in the original 1000-yr initial assessment, simulation of technetium-99 and uranium will use the complete history and forecast of their disposal and begin in 1944 with a clean subsurface environment.

It is unlikely that the plumes from these three classes of release events will superimpose in time. The liquid discharge and unplanned release (e.g., tank leak) sites have created groundwater plumes and will likely continue to release to groundwater during the immediate future. Releases from dry solid waste disposals have some containment (e.g., boxes, drums, plastic bags) and less driving force (e.g., infiltration), and, therefore, they will likely release later than the liquid releases. Finally, the substantially stable and long-term waste forms like vitrified low-activity tank waste will not corrode and release for thousands of years. It is unlikely that peaks from each of these types of release will superimpose in space and time.

L.1.2 Relationship to EIS Calculations

The EIS calculations focus on the impacts associated with alternatives to the disposal of solid waste. The SAC represents a holistic examination of the radioactive and chemical waste legacy of the Hanford Site. For this reason, it can be used to examine the relative risk and impact associated with disposal and remedial action alternatives and the relative role of different segments of Hanford waste—for example, solid waste, past-practice liquid discharges, or tank wastes. Used in this way, the SAC provides an ability to visualize the change in impact associated with various options and wastes. This kind of cumulative impact assessment provides a larger scale site-wide context from which to view the alternatives and influence disposal decisions.

The EIS calculations provide a detailed evaluation of each specific alternative. The SAC is only able, at this time, to present the single case of an extended analysis (e.g., 10,000 yr post closure) of the HSDB. In essence, the SAC provides an estimate of the contribution made to risk and impact from technetium-99 and uranium from other Hanford waste disposal and remedial actions not explicitly considered in the HSW EIS alternatives, and to contrast that with the contribution from solid wastes.

L.2 Methods and Approach

Historically, DOE has used various tools to assess the effects of waste management and cleanup activities on the environment. Assessments have been performed to address a range of questions. Some assessments have focused on individual waste sites or waste types—for example the assessment performed to evaluate the future performance of the glass waste form proposed for isolating low-activity waste currently in tanks (Mann et al. 2001). Others have looked at contaminants from a variety of sources. The Hanford Environmental Dose Reconstruction Project estimated human health impacts from past releases to the atmosphere and river (Farris et al. 1994) during Hanford operations from 1944 to 1972. The Columbia River Comprehensive Impact Assessment (CRCIA) (DOE-RL 1998) examined ecological and human health effects that might result from the 1990 to 1996 distribution of contaminants in the environment in and near the Columbia River. The composite analysis performed in 1997 considered the impact of selected radionuclides from approximately 280 waste sites in the 200 Areas (Kincaid et al. 1998). In 2001, Bergeron et al. (2001) issued an addendum to the composite analysis that considered additional waste sites on the Central Plateau.

The collective impact of all of the waste that will remain at Hanford, however, had not yet been integrated to provide an understanding of the cumulative effects of Hanford activities on the Central Plateau as well as in the river corridor. The SAC was developed to fill this gap and has benefited from the lessons learned in previous assessments.

The initial assessment and this extension to a 10,000-year, post-closure analysis considers solid waste disposals in the Central Plateau as occurring within aggregated solid waste disposal facilities in the northern and southern portions of the 200 West and East Areas. Annual inventories for each disposal facility within a subregion of the site are aggregated to create an annual solid waste inventory for the subregion. The areal footprints of disposal facilities within a subregion are aggregated to create a total solid waste disposal facility areal footprint. Contaminants from the aggregated disposal facility are released to the unconfined aquifer at the centroid coordinates of the aggregated disposal facility. Thus, use of an aggregated representation of solid waste disposal facilities is an approximation in a number of ways. Notably, the inventory actually placed in individual trenches within each disposal facility is represented as distributed over the entire areal footprint of the disposal facility. Hence, the aggregated inventory is distributed over the aggregated areal footprint of all solid waste disposal facilities in a subregion of the site. Because to visualize the change in impact associated with various options and wastes. This kind of cumulative impact assessment provides a larger scale site-wide context from which to view the alternatives and influence disposal decisions.

The EIS calculations provide a detailed evaluation of each specific alternative. The SAC is only able, at this time, to present the single case of an extended analysis (e.g., 10,000 yr post closure) of the HSDB. In essence, the SAC provides an estimate of the contribution made to risk and impact from technetium-99 and uranium from other Hanford waste disposal and remedial actions not explicitly considered in the HSW EIS alternatives, and to contrast that with the contribution from solid wastes.

L.2 Methods and Approach

Historically, DOE has used various tools to assess the effects of waste management and cleanup activities on the environment. Assessments have been performed to address a range of questions. Some assessments have focused on individual waste sites or waste types—for example the assessment performed to evaluate the future performance of the glass waste form proposed for isolating low-activity waste currently in tanks (Mann et al. 2001). Others have looked at contaminants from a variety of sources. The Hanford Environmental Dose Reconstruction Project estimated human health impacts from past releases to the atmosphere and river (Farris et al. 1994) during Hanford operations from 1944 to 1972. The Columbia River Comprehensive Impact Assessment (CRCIA) (DOE-RL 1998) examined ecological and human health effects that might result from the 1990 to 1996 distribution of contaminants in the environment in and near the Columbia River. The composite analysis performed in 1997 considered the impact of selected radionuclides from approximately 280 waste sites in the 200 Areas (Kincaid et al. 1998). In 2001, Bergeron et al. (2001) issued an addendum to the composite analysis that considered additional waste sites on the Central Plateau.

The collective impact of all of the waste that will remain at Hanford, however, had not yet been integrated to provide an understanding of the cumulative effects of Hanford activities on the Central Plateau as well as in the river corridor. The SAC was developed to fill this gap and has benefited from the lessons learned in previous assessments.

The initial assessment and this extension to a 10,000-year, post-closure analysis considers solid waste disposals in the Central Plateau as occurring within aggregated solid waste disposal facilities in the northern and southern portions of the 200 West and East Areas. Annual inventories for each disposal facility within a subregion of the site are aggregated to create an annual solid waste inventory for the subregion. The areal footprints of disposal facilities within a subregion are aggregated to create a total solid waste disposal facility areal footprint. Contaminants from the aggregated disposal facility are released to the unconfined aquifer at the centroid coordinates of the aggregated disposal facility. Thus, use of an aggregated representation of solid waste disposal facilities is an approximation in a number of ways. Notably, the inventory actually placed in individual trenches within each disposal facility is represented as distributed over the entire areal footprint of the disposal facility. Hence, the aggregated inventory is distributed over the aggregated areal footprint of all solid waste disposal facilities in a subregion of the site. Because of the scale of the aggregation (that is, half an operational area), the centroid of the aggregated area and, hence, the point where contaminants are introduced into the aquifer may lie outside an actual solid waste disposal facility.

The waste form used to represent the disposal of low-activity waste is the vitrified waste form described and analyzed in the Immobilized Low-Activity Waste (ILAW) Performance Assessment (PA) (Mann et al. 2001). The ILAW presents a unit release analysis of the waste inventory, contaminant release, and migration in the vadose zone and groundwater. The contribution of the ILAW source to groundwater and surface water impacts can be estimated by scaling (i.e., for inventory and spatial position). These results can then be superimposed onto the groundwater and surface water impacts predicted for all other Hanford waste sources to achieve a cumulative impact projection. For the initial assessment (Bryce et al. 2002), all contaminants were simulated from 1944 forward in time to estimate the distribution of contamination in the environment. For some contaminants, (e.g., tritium), sufficient process knowledge and data existed to complete a history match against tritium field data. For other contaminants, (e.g., technetium-99, uranium, iodine-129) work is underway to improve our understanding of inventory and mobility to enable improved comparisons to field observations from Hanford's groundwater.

L.2.1 Modular Components of SAC

The SAC development task involved assembling software and gathering the data needed to assess the cumulative impact of radioactive and chemical waste at Hanford. Computer codes that were well tested at the Hanford Site were used when possible, and new software was written when necessary to simulate the features and processes that affect the release of contaminants into the environment, transport of contaminants through the environment, and the impact those contaminants have on living systems, cultures, and the local economy. The components were organized to simulate the transport and fate of contaminants from their presence in Hanford waste sites, through their release to the vadose zone, to their movement in the groundwater, and into the Columbia River. Components such as the groundwater model, the ecological impact component, and the human health component were originally developed and tested for previous Hanford assessments.

The elements of the SAC computational tool include:

- **Inventory Module**—develops an inventory of specific waste disposal and storage locations for the period from 1944 to December 2050 based on disposal records, process knowledge, and the results of tank and field samples. December 2050 was used because it had been identified as the date of site closure. However, for the purposes of this EIS, the Hanford closure date is considered to be 2046. Future analyses will use the current closure date. This module identifies the material scheduled for disposal in offsite repositories including high-activity waste (HLW), TRU waste, and spent fuel.

- **Release Module**—simulates the annual release of contaminants to the vadose zone from the variety of waste types in the modeled waste sites. Waste types explicitly modeled include soil debris wastes as solubility limited desorption, cemented waste as diffusion limited, salt cake tank residuals as nitrate salt dissolution, and graphite cores of production reactors as an empirically defined release.

Because they release after the 1000-year period of analysis, waste types not included in the original SAC design included ILAW, melters, and naval reactor compartments. This module also simulates Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial actions that move waste to the Environmental Restoration Disposal Facility (ERDF) trench.

- **Vadose Zone Module**—simulates the flow and transport of contaminants in the vadose zone, which is the unsaturated sediment between the land surface and the unconfined aquifer. Vadose zone simulations utilize a one-dimensional version of the well-established and documented Subsurface Transport Over Multiple Phases (STOMP) code.

- **Groundwater Module**—simulates the flow of water and the transport of contaminants in the unconfined aquifer that underlies Hanford using the three-dimensional, site-wide groundwater model. Groundwater simulations use the Coupled Fluid, Energy, and Solute Transport (CFEST) code.

- **River Module—**simulates river flow and contaminant/sediment transport in the Hanford Reach from Vernita Bridge downstream to McNary Dam. This model simulates background concentrations and background plus the Hanford Site contribution to enable an assessment of the Hanford Site incremental impact to the Columbia River and its ecosystem. The river model is an extension of the Modular Aquatic Simulation System 2D (MASS2) code developed and applied to support studies of the Snake and Columbia Rivers.

- **Riparian Zone Module**—uses river and groundwater information to simulate the concentration of contaminants in seep or spring water and in the wet soil near the shoreline of the river.

- **Risk/Impact Module**—performs risk/impact analysis in four topical areas: human health, ecological health, economic impact, and cultural impact, with economic and cultural impacts being two new impact metrics for Hanford assessments.

The conceptual illustration of SAC (Figure L.1) portrays a linear flow of information. In general, data flows in the initial assessment in the following manner: the Inventory Module provides input to the Release Module, which provides input to the Vadose Zone, Groundwater, and River Modules. The Vadose Zone Module provides input to the Groundwater Module. Finally, both the Groundwater and River Modules provide input to the Risk/Impact Modules. This version of the SAC conceptual model does not allow feedback among modules and does not include either atmospheric or terrestrial ecological pathways and, hence, receptors.

The data used in the initial assessment came from a variety of sources, including environmental monitoring activities on the Hanford Site, Hanford historical records, a waste site information database, and other geohydrologic and physical property databases. The remediation actions included in the assessment are based on the collection of disposal and remedial actions identified in the Tri-Party Agreement that are planned to occur as the Hanford Site moves toward closure.

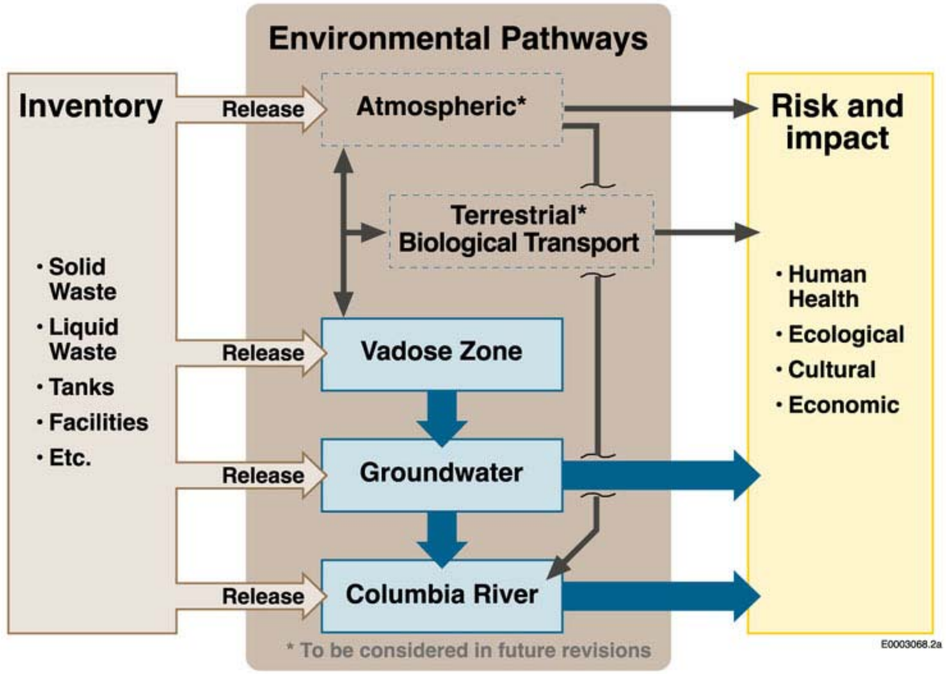

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Figure L.1. Conceptual Model of the System Assessment Capability

L.2.2 Inventory

Inventory consists of the quantity of radiological and chemical constituents used and created at the Hanford Site, and their distribution in individual facilities and waste disposal sites. For the initial assessment, inventory was defined as the volume and concentration of contamination introduced annually to waste disposal sites (for example, the solid waste disposal facilities), facilities (for example, the canyon building), and the environment (for example, the vadose zone via liquid discharge sites, the Columbia River via reactor cooling water retention basins). In the initial assessment, export of contaminants to offsite locations was provided by collecting exports at the conclusion of the analysis. The movement of onsite waste from one location to another is included in the Release Module but is limited to the movement of excavated CERCLA wastes to the ERDF trench. Finally, tank waste moves into the Inventory Module of the initial assessment only after it leaks to the environment, is defined as a tank residual, or is recovered from tanks and processed into waste forms that are disposed of onsite or shipped offsite.

The initial assessment included 533 waste site locations throughout the Hanford Site representing 890 waste sites that were identified for consideration. Each of the 890 sites had a likelihood of containing one or more of the contaminants of interest. Some sites were combined, or aggregated, thus reducing the total to 722 sites for analysis. However, of the 722 sites chosen for analysis, only 533 sites were assigned inventories because some waste disposal and unplanned release inventories were further aggregated. For example, individual disposal ditches and ponds were all identified in the list of 722 sites, but the ditch inventories were assigned to the receptor pond. Accordingly, the inventories for the ditches leading to

Gable Mountain Pond, B Pond, and U Pond were assigned zero inventories. The Inventory Module of the SAC generates annual inventories for the selected contaminants at 533 sites for the period from 1944 through 2050, and each of 25 realizations for the stochastic analysis. For the initial assessment, this represented in excess of 782,000 pieces of non-zero inventory data.

Regarding chemicals in solid waste disposals, as in the case of radionuclides it is unlikely that chemical impacts from liquid discharges and solid waste will superimpose in time. It is believed that the majority of chemicals were either discharged to cribs and trenches, or stored in tanks, as opposed to being disposed as solid waste. When the Hanford Site moved away from liquid discharge of chemicals in the late 1960s and early 1970s, substantial chemical waste streams were routed to tanks, (e.g., carbon tetrachloride). Mixed low-level radioactive waste is currently being stored and will be treated prior to disposal under RCRA and past practice CERCLA guidelines to ensure long-term safety. At this time insufficient data and information are available on the chemical inventories in solid waste disposals to perform a site-wide analysis on the scale of the initial assessment. However, it is not clear that chemicals, other than carbon tetrachloride and perhaps chromium, present as substantial a threat to human health as the key radionuclides, technetium-99, iodine-129, and uranium.

L.2.2.1 Initial Assessment Inventory

Methods used to assemble the annual inventory database for all waste sites are described in an appendix to a Composite Analysis addendum issued in September 2001 (Bergeron et al. 2001, Appendix A). Additional detail on the methods used to merge record data and estimates for the Hanford Site inventory were provided by Coony (2002). The addendum to the Composite Analysis includes a summary of the inventory in each waste site at the close of 2000 and at the assumed time of Hanford Site closure in 2050 (Bergeron et al. 2001). The inventory shown in the initial assessment inventory differs from the summary inventory presented in the addendum; however, the data in the addendum provides a representative picture of the Site inventory.

L.2.2.2 Comparison of HSW EIS and Initial Assessment Inventories

The initial assessment inventory was developed over a period of time, beginning in fiscal year 2000 with final entries completed during the spring of 2002. Some of the data entries date from September 1999, the close of fiscal year 1999. The HSW EIS inventory has been developed over a similar time period, but it reflects changes as recent as the summer of 2002. Table L.1 shows a comparison of the initial assessment (SAC) and the EIS as their respective inventories existed in September 2002. The HSW EIS inventories address only wastes assigned to past, present, and future burial grounds, and therefore, while being more current for solid waste, they are not as complete as those assembled for the initial assessment. Table L.1 and the discussion of inventory differences provide a review of the inventories in the two assessments and indicate the relative inventories treated by a soil debris, cement, or liquid release models.

Table L.1. Comparison of Initial Assessment and HSW EIS Inventories

Summary of Technetium-99, Iodine-129 and Uranium Inventories at the Time of Hanford Site Closure							
		Initial Assessment [a]			HSW EIS[b]		
		Tc-99	I129	U	Tc-99	I129	U
Waste Stream	Type	Ci	Ci	Ci	Ci	Ci	Ci
200 East	Solid waste as soil debris	25.3[c]	0.39[c]	0.12	9.1[c]	0.12[c]	32[d,e]
200 East	Solid waste as cement	0.08	0	0	160[d]	0	0
200 East	Tank leaks/residuals	259	0.35	24.8			
200 East	Liquid/UPR	791	0.40	66.2			
200 East	Total Activity	1075	1.14	91.3			
200 West	Solid waste as soil debris	50.2[c]	0.41[c]	209[f]	5.7[c]	.075[c]	150[f]
200 West	Solid waste as cement	1258[c,g]	64.2[c,g]	1837[f,g]	3300[h]	5[h]	1400[f,h]
200 West	Tank leaks/residuals	327	0.61	13.2			
200 West	Liquid/UPR	40.9	0.10	24.7			
200 West	Total Activity	1712	64.9	1803			
ERDF[i] (600-148)		2.6	0.0017	54.0			
SALDS[j] (600-211)	"soil"	0.310	2.17	0.00133			
Graphite Cores (100 Areas)	"core"	0.012	.000089	0			
ILAW (200 East)	"glass"	5929[g]	0[g]	52.97[g]	25,550[k]	22[k]	230[e,k]
Melters (200 East)	"glass"	37.8	0	1.70	38.9	0	1.8
Naval Reactors (200 East)	"rxcomp"	5.18	1.3E-5	0	6		No data
US Ecology (600 Area)	"soil"	60.7	5.45	11390			
Other 200 Area Remaining Onsite[l]		729[m]	0.065[m]	8.6[m]			
Other Areas Remaining Onsite[l]		13.8	0.0044	33.4			

(a) Initial assessment inventory values are median values from a stochastic simulation of the inventory.
(b) lternate A Lower Bound Waste Volume.
(c) The initial assessment includes technetium-99 and iodine-129 inventories estimated using a fuel-ratio method for fission product inventories not reported on original records or prior estimates. The HSW EIS inventories of technetium-99 and iodine-129 include only reported or record values.
(d) The HSW EIS includes inventories of mixed low-level waste (MLLW) that are included elsewhere in the initial assessment inventory for the SAC (see note "m" below).
(e) The HSW EIS includes an inventory of uranium-233 not included in the initial assessment conducted using the SAC.
(f) The initial assessment includes uranium inventories estimated using somewhat different uranium isotopic ratios and estimation methods than used in the HSW EIS.
(g) The initial assessment includes inventory forecasts obtained from a Hanford Tank Waste Operating System (HTWOS) simulation that used potentially out-of-date factors for secondary waste streams.
(h) The HSW EIS includes inventory forecasts obtained from the Solid Waste Information Forecast Tool (SWIFT) that includes a life-cycle forecast of the composition of secondary waste streams from tank waste.
(i) Environmental Restoration Disposal Facility (ERDF).
(j) State Approved Land Disposal Site (SALDS).
(k) The HSW EIS includes inventory forecasts obtained from the ILAW performance assessment (PA) (Mann et al. 2001) for isotopes, and from a current estimate of technetium-99 that will be routed to low-activity waste disposal.
(l) Does not include waste listed above.
(m) The initial assessment includes inventories of MLLW at the Hanford Site that will be routed though the Radioactive Mixed Waste Storage Facility prior to disposal onsite.

The SAC was applied in the HSW EIS to generate both a stochastic simulation and a median-inputs deterministic simulation. The inventory values reported for the initial assessment in Table L.1 are median values of the stochastic distribution. Thus, a varied inventory is analyzed, and each of the 25 realizations is based on a Latin hypercube selection procedure. For sites not modeled using process knowledge and a stochastic simulator (Simpson et al. 2001), site-specific inventories prior to 1970 are modeled as twenty-fold uncertain; that is, the maximum is approximately 20 times the inventory database value, and the minimum is approximately one-twentieth of the inventory database value. After 1970, the inventories for these sites are modeled as twofold uncertain; that is, the maximum is approximately twice the inventory database value, and the minimum is approximately half the database value.

The inventory analyzed by the site-wide groundwater model and the unit release approach in the HSW EIS was provided by Fluor Hanford. The inventory analyzed using the SAC tool is based on available records and was augmented with estimated inventories for fission products (for example, technetium-99 and iodine-129) and uranium isotopes where they are absent from the record. The augmented values are only estimates and should not be considered record values.

There are differences in the compilations shown in Table L.1. Solid waste deposits in the 200 East and 200 West Areas differ primarily as follows: 1) the initial-assessment technetium-99 and iodine-129 inventories include fuel-ratio estimates of this fission product, 2) the initial-assessment uranium inventories include estimates based on uranium-isotopic ratio methods of estimation that differ from those of the EIS, 3) the HSW EIS uranium inventories include MLLW inventories that are accounted for elsewhere in the initial assessment, and 4) HSW EIS solid waste disposal facility uranium inventories include uranium-233, which was omitted from the initial assessment.

A major difference in inventories in 200 West Area solid waste disposal facility deposits and in ILAW and melter deposits lies in the use of different resources to estimate future disposals and secondary wastes from the processing and solidification of high- and low-activity wastes at Hanford. The initial assessment relied on the Hanford Tank Waste Operation System (HTWOS) model that relied on a suite of potentially out-of-date factors to estimate secondary waste stream composition. The HSW EIS relied on current ILAW and melter inventories. Inventories with the greatest differences are either simulated as cement waste forms that release relatively slowly, (for example, 200 West Area solid waste cement), or are not simulated by the initial assessment, (for example, ILAW and melter waste). A difference of approximately 2000 Ci in technetium-99 exists between the two estimates of secondary technetium-99 wastes. Similarly, a difference of approximately 60 Ci in iodine-129 exists. These differences will be reconciled as projections are updated; however, all of this waste would be disposed of in cement to minimize the hazard. In the analyses undertaken for both the initial assessment and the HSW EIS, the majority of the future uranium inventory is disposed of in cement to minimize the hazard. Finally, because of the original design objectives of the SAC (that is, a 1000-year analysis), the initial assessment does not include the glass release model(s) necessary to forecast the long-term release of the ILAW and melter wastes. Hence, the influence of ILAW and melter inventories is not included in the initial assessment results, or in the extended, that is 10,000-year, initial assessment presented here. Naval reactor compartments are also omitted from SAC analyses at this time. However, for the greatest of these inventories, ILAW, their influence is introduced to the cumulative assessment by superimposing the results of the ILAW PA (Mann et al. 2001) onto the initial assessment result.

In addition to the values indicated in Table L.1 the SAC simulation had 7.15 Ci of iodine-129 in spent fuel and includes an estimated 18.9 Ci of iodine-129 released to the atmosphere during the operation of chemical separation plants. The 64 Ci of iodine-129 in 200 West "solid waste as cement," is almost entirely from HTWOS analysis byproduct streams from vitrification (that is, spent resins, and ILAW and HLW waste streams (not glass)). At the time the initial assessment inventory was assembled, the HTWOS processing fractions had no iodine going to any immobilized waste product (that is, ILAW, melters, or HLW). The median value iodine-129 inventory for the initial assessment had a total of about 103 Ci.

Inventories included in the initial assessment for the commercial low-level radioactive waste disposal site operated by US Ecology at Hanford are based in part on the published State of Washington SEPA Draft EIS (Washington State Department of Health and Washington State Department of Ecology 2000) and the Closure Plan for the site published by US Ecology, Inc. (1996). The State of Washington is now reviewing the inventory for the commercial site during its early years of operation. Hanford staff are in contact with a representative of the State Department of Health, and as soon as an updated inventory is available it will be incorporated into Hanford assessments. Certainly, uranium inventories for the commercial low-level radioactive waste disposal site appear to be relatively high in the initial assessment.

L.2.3 Release

Release is the rate at which radioactive and chemical contaminants find their way into the environment. The SAC Release Module handles liquid releases and releases from solid waste forms. It is important to note that because the initial assessment was originally designed as a 1000-year analysis, several waste forms that will not be released in this period were not analyzed and were not analyzed in this extended 10,000-year, post-closure analysis even though they may be released in the 10,000-year time frame. These waste forms include naval reactor compartments, immobilized low-activity waste, and components of melter systems. Liquid discharges, liquid unplanned releases including tank leaks, and future tank losses are handled as a simple pass-through to the vadose zone or the Columbia River. The solid waste forms are primarily in solid waste disposal facilities including past-practice sites (pre-1988), active sites (post-1988), and the ERDF. Other solid waste includes residual waste in the single-shell tanks, the graphite cores of the retired production reactors, and concrete and cement waste forms associated with caissons, canyon buildings, and grouted waste.

The Release Module applies release models to waste inventory from the Inventory Module and also accounts for site remediation activities (for example, waste movement) as a function of time. The resulting releases to the vadose zone, expressed as time profiles of annual rates, become source terms for the Vadose Zone Module. Radioactive decay is accounted for in all inputs and outputs of the Release Module. The Release Module is implemented as the VADose zone Environmental Release (VADER) computer code.

L.2.3.1 Conceptual Model

Waste containment facilities have a number of features that influence the rate at which contaminants can be released from waste. The waste may be placed in a trench or may reside in a tank. The trench, tank, or other engineered structure may have features that serve as barriers to prevent infiltrating water from making contact with and transporting contaminants from the waste to the vadose zone. Waste inside an engineered structure (for example, a trench) may also be contained in a waste package (for example, a metal drum or high-integrity concrete container). The drum or concrete container acts as an additional barrier that prevents transport of the contaminants from the waste. Major containment materials for Hanford waste are concrete, steel, and bituminous layers and coatings. The stability and permeability of concrete materials change over time, and likewise, time affects the features that dominate water or contaminant migration in containment materials. Surface covers on an engineered system and liners (geomembrane and geosynthetic) and leachate collection systems at the bottom of a system further restrict infiltrating water from transporting contaminants to the vadose zone. Surface covers are particularly important because migration of infiltrating pore water may be limited as long as the cover maintains its integrity. Individual waste sites have one or more of these features. However, none of the waste sites in the initial assessment had all of the features in the conceptual model.

A number of key processes govern how much contaminant at any given time is released from the waste to the infiltrating water. One process is the affinity of contaminants to be retained by the waste (for example, sorption to soil or waste material). Another process is the ability of waste to dissolve and, in some cases, to form new precipitates, thus allowing some contaminants to be released to the infiltrating water while others remain trapped in the precipitated solids. Release from the waste may also be limited by the solubility of the contaminant in the infiltrating water.

Water infiltrating an engineered system may contact and react with fill materials (for example, soil, basalt, or grout), containment materials in various states of degradation, and different types of waste. Reaction with these materials will change the water chemistry and the physical and hydraulic properties over time. The water composition, pH, and redox state at any given time will influence the extent to which these processes influence contaminant release from the waste.

L.2.3.2 Implementation Model

The Release Module accounts for releases that occurred in the early years of Hanford operations, releases that may be expected while the Site is being cleaned up over the next several decades, and future releases that may continue until the entire inventory is released. The Release Module relies on several sources for input. Input from the Inventory Module includes contaminant mass (for chemicals) and activity (for radionuclides) deposits. Some of the release models (that is, soil-debris, cement) require site or waste feature information (that is, site cross-sectional area, site volume, or waste surface area or volume). Recharge rate is an important parameter for the salt cake and soil-debris models. Key process parameters are distribution coefficient (soil-debris model), solubility (soil-debris, C_{sol}, and salt cake models), diffusion coefficient (cement model), and fractional release rate (reactor block model).

To capture uncertainty in the SAC simulations, contaminant inventories and numerical model parameters are expressed in terms of statistical distributions. Each realization of the initial assessment used sample parameter values for randomly distributed variables such as bulk soil density, soil moisture content, sorption or distribution coefficient, salt cake density, and cement diffusion coefficient. Other model parameters were held to constant values over all realizations.

L.2.3.3 Numerical Models Relevant to HSW EIS

Soil-Debris Model

The soil-debris model is used to model contaminant release from unconsolidated wastes mixed with soil. Source zones composed of this waste-form type are permeable to percolating water; thus, all surfaces of the waste come in contact with the percolating water as it passes through the zone in a manner similar to the way infiltrating water passes through natural vadose zone material. The soil-debris model is applied to the release of contaminants from all solid waste disposal facilities, including the ERDF, and the commercial low-level radioactive waste disposal facility operated by US Ecology, Inc.

For the SAC initial assessment, the model used the high-impact values of the distribution coefficient parameter (K_d) associated with the vadose zone nearest the disposal facility. For solid waste disposal facilities, the K_d category used by the soil-debris model is that associated with sites that are low organic, low salts, and near neutral pH. The K_d best-estimate values for this category were 0 mL/g, 0.5 mL/g, and 3 mL/g for technetium-99, iodine-129, and uranium, respectively.

For radionuclides for which no specific solubility values were available, the aqueous solubility was fixed at an arbitrarily high default value ($1x10^{10}$ mg/L) so that the soil-debris model automatically selects algorithms for sorption (K_d) control in these cases (Kincaid et al. 1998). Technetium-99 solubility ($1x10^{10}$ mg/L or $1.7x10^{2}$ Ci/cm^3) was assigned using this approach. Iodine-129 solubility ($1x10^{10}$ mg/L or 1.77×10^{0} Ci/cm^3) was also assigned using this approach. Uranium solubility (86.9 mg/L or $2.95x10^{-11}$ Ci/cm^3) was estimated in Hanford groundwater assuming that the solid controlling uranium solubility was $UO_2 (OH)_2 \cdot H_2O$ (Wood et al. 1995).

In the simulation runs, K_d, θ_w, and ß were treated as stochastic over the 25 realizations, and Q_w and C_{sol} were fixed to a constant value for all analytes except tritium. For tritium, K_d was set to zero over all realizations.

Sites with soil wastes include the ‘118,’ ‘218,’ and ‘618’ sites listed in Bergeron et al (2001).

Analytical Solution for Instantaneous Release—Soil-Debris Model

The rate of loss of contaminant for a given contaminant by the soil-debris model is given by Kincaid et al. (1998) as:

$$dM / dt = - Q_w A C_w$$

where $C_w = C_{sol}$ when the release process is solubility controlled and $C_w = M / (\theta R A h)$ when the release process is desorption-controlled where:

$$R = 1 + (\beta K_d) / \theta$$

Switching régimes is controlled by comparing the remaining mass with the maximum mass M_{max} consistent with an aqueous phase saturated with the contaminant. If M, the mass remaining in the waste form, is larger than the quantity M_{max} where:

$$M_{max} = \theta R C_{sol} A h$$

the release process is considered to be solubility controlled. Otherwise, it is considered desorption controlled.

Coupling the soil-debris model with an aggregated waste site representation leads to a lower calculated waste concentration, a reduced likelihood of a solubility-controlled release, and a greater likelihood of a desorption-controlled release. Because the release occurs over a larger area than really occupied by the waste deposit, the calculated release is a function of a greater amount of infiltrating water contacting the waste. Thus, all contaminants are leached and for mobile contaminants such as technetium-99 that are not solubility controlled, the release is greater for an aggregated site approach.

Definitions

- M_{max} is the maximum amount of contaminant possible in the source zone (in Ci or kg) without a precipitated phase.

- M = M(t) is the current quantity of contaminant contained in the source zone (Ci or kg).

- Q_w is the recharge rate for the site in cm/yr. Q_w can be considered to be constant, or it can be time-dependent based on site climate and remediation activities.

- hA is the surface area of the soil waste form exposed to the release mechanism (cm^2).

- h is the depth of the waste form in the site (cm).

- C_w is a coefficient expressing the effective release of the contaminant (Ci/cm^3 or kg/cm^3).

- C_{sol} expresses aqueous solubility of the contaminant in Ci/cm^3 or kg/cm^3.

- R is either a retardation factor or a soil apportionment factor (unitless) that depends on the following factors:
  - ß Soil bulk density in g/cm^3
  - K_d Sorption factor (cm^3/g)
  - θ Soil volumetric content of water in soil (unitless fraction).

- dM/dt is the rate of loss of contaminant from the source zone (the rate contaminant crosses the soil waste form boundary and enters the environment).

- t is the elapsed time (years) from the beginning of release from containment.

C_{sol} (Solubility) Model

The C_{sol} model is the independently operated solubility-controlled analytical solution component of the soil-debris model. As such, it is applied to the same types of solid wastes that are applied to the soil-debris model. The difference is that the process represented by the C_{sol} model is that of a constant concentration release. The concentration at which a contaminant is released from a waste often is at its solubility limit in some aqueous medium (for example, groundwater or grout leachate) but is not a requirement. This is different from application of the same analytical solution within the soil-debris model in which the model determines the process (solubility controlled vs. sorption controlled) that is the appropriate for application at any time within a simulation. In addition, release is always at what is considered to be the solubility limit of the contaminant in the aqueous media of interest. The analytical solution and key parameters are the same as those described in the previous section for the solubility-controlled analytical solution component of the soil-debris model.

Initial application of this release model within the SAC Release Module was undertaken to provide a comparative evaluation of uranium release from a cemented waste form using three different release models (see Section L.2.3.4).

Assume that a solubility-controlled release was prescribed for several scales of disposal from aggregated areas to individual waste trenches, and that each disposal scale contained the same inventory. The larger the waste site area, the greater the infiltrating water quantity contacting waste, and the greater the mass or curie flux from the waste site and the more rapid the release.

Cement Model

The cement model is generally applied to cementitious waste forms. Knowledge of the total external surface area and the volume of the waste form is required. The ratio of area-to-volume is assumed to be constant—that is, the waste form is assumed not to degrade in terms of shape over the duration of the contaminant release process. In the SAC initial assessment, the cement model was used to simulate release of contaminants from cementitious wastes within selected solid waste disposal facilities. Delay of contaminant release from containerized waste can be accomplished with the current capability by arbitrarily assigning a time of delay. In the SAC initial assessment, however, no credit was taken for container integrity. Plans call for incorporating one or more models into a future revision of the SAC capability that will accommodate delay of release from contained waste based on specific processes (for example, corrosion of metal).

The range in diffusion coefficient values ($1.58x10^{-4}$ cm/y to $1.89x10^{-3}$ cm/y) used in the SAC initial assessment for technetium-99 was obtained from recent laboratory work (Mattigod et al. 2000). The diffusion coefficient for uranium ($3.15x10^{-5}$ cm/y) was obtained from Serne et al. (1992). In the simulations, the diffusion coefficient for technetium-99 was stochastic; for uranium, it was set to a constant for all realizations.

Sites containing cementitious wastes include the '202,' '221,' 224,' and '276' sites listed in Bergeron et al. (2001).

Analytical Solution for Instantaneous Release—Cement Model

The contaminant release mechanism of the cement model is diffusion in the pore water of the solidified waste material to the outer surface of the waste form. The rate of loss of contaminant for a given contaminant is given by Kincaid et al. (1998) as:

$$dM/dt = Mo(A/V)\sqrt{D/_{\pi}t}$$

where:	M_0	=	the original quantity of the contaminant contained in the cement (Ci or kg)
	M	=	current quantity of the contaminant contained in the cement (Ci or kg)
	A	=	the surface area of the cement structure (cm^2)
	V	=	the volume of the cement structure (cm^3)
	D	=	the diffusion coefficient of the contaminant (cm^2/yr)
	t	=	the elapsed time (years) from the beginning of release from containment
	dM/dt	=	the rate of loss of contaminant from the cement waste form
	π	=	3.14159.

Note, the original quantity M_0 can be seen as a function of concentration (kg/cm^3 or Ci/cm^3) and volume (cm^3).

With regard to the scale of the disposal, assuming the aggregated area of an aggregated volume is simply the exterior surface of the volume, the larger the disposal area – the smaller the ratio of area to volume (A/V) in the equation above. Accordingly, if the contaminant mass or curies and the diffusion coefficient are unchanged for multiple scales of waste site, then the larger aggregated site will exhibit a lower release rate.

Containment

The release models implemented in the current version of SAC have no provisions for specifically modeling containment of wastes, such as high-integrity steel containers. The models do have provision for delaying release to a specific start year (that is, the STARTREL argument in the MODELS keyword). The default start year is the year the waste begins to be deposited at the Site. In the initial assessment, STARTREL was set to 1944 throughout the simulation, so for the initial assessment, the release mechanism was active as soon as wastes were deposited.

L.2.3.4 Comparison of Release Model Parameters

A comparison of key source-term release models (that is, soil debris, solubility-controlled, and cement) and values of key parameters used in the SAC analysis, the HSW-EIS analysis (described in Appendix G), and the Solid Waste Burial Ground Performance Assessments (SWBG-PAs) for the 200 West and East Areas (as described by Wood et al. [1995, 1996]) is summarized in Table L.2. The three constituents addressed are technetium-99, iodine-129, and uranium. This summary of parameter values coupled with the release model formulations of the preceding section allow a comparison of relative release characteristics included in the three assessments. The parameter values shown here are somewhat generic and not necessarily related to specific waste streams, and, therefore, could be changed according to specific waste disposal conditions for application in specific wastes and especially for regulatory compliance simulations (that is, a performance assessment for a specific disposal).

There are several key differences in the way these different analysis approaches address selective contaminant releases from the source term. The SAC analysis differs from the other two analyses in the way that uranium is released from LLW. For non-cemented waste, the SAC analysis uses a soil debris model coupled with uranium specific solubility-limits to simulate uranium release. For cemented wastes, the SAC analysis uses a cement (that is, diffusion-controlled) release model to simulate uranium release. In contrast, the release of uranium in HSW-EIS analysis and the SWBG PAs both rely on a solubility-controlled release model with uranium specific solubility limits depending on whether the uranium inventory is contained in non-cemented wastes or in cemented wastes (for example, 64 mg/l for non-cemented wastes and 0.23 mg/l for cemented wastes).

The SAC application of the cement model to technetium-99, iodine-129, and uranium releases assumed a cemented waste and a surface area to volume ratio based on a waste volume that constituted a number of aggregated burial ground sites. In contrast, the HSW-EIS and SWBG-PA analyses rely on a conceptualization of surface area-to-volume (A/V) ratio based on the surface area and volume of individual waste containers (for example, individual steel barrels, boxes, high integrity containers that would contain grouted wastes). As a result, the surface A/V ratio for the SAC source term was up to 10 times lower than those reported for HSW-EIS and SWBG-PA analyses. A lower release of technetium-99, iodine-129, and uranium from the SAC analysis would be expected based on this difference alone. However, when the diffusion coefficient is roughly an order of magnitude higher in the SAC application, the lower A/V ratio is partially offset by the higher diffusion coefficient.

From the formulations of the soil debris model, which is the release model associated with early solid waste disposals at Hanford (that is, pre-1970 wastes), it is apparent that the use of larger aggregated areas as opposed to burial ground, trench, or caisson scales to represent waste, leads to lower initial concentrations of waste but exposes waste to greater infiltration, and, hence leaching. Use of aggregated representations and the soil debris model tends to release waste more rapidly than would occur if simulations were conducted on the burial ground or trench scale.

Table L.2. Comparison of Selected Values of Key Parameters Used in Source Term Release Models for the System Assessment Capability Analysis Described in this Appendix, the HSW EIS Analysis Described in Appendix G, and the Solid Waste Burial Ground Performance Assessments for 200 West and 200 East Areas Described in Wood et al. (1995, 1996).

	System Assessment	HSW EIS	Solid Waste Performance Assessment
Source-Term Release Models			
Soil-Debris Model			
Model or Zone/Parameter	**Data/Statistical Treatment**		
Volumetric Moisture Content (%)	0.0594 ± 0.0310 [(a)] (mean/standard deviation, normal distribution)	0.05	0.05
Bulk Density (g/cm^3)	1.535 ± 0.1085 [(a)] (mean/standard deviation, normal distribution)	1.6	1.5
Waste Thickness (m)	5.349 [(b)] (deterministic)	6	4.5
K_d uranium (mL/g)	Low organic/low salt/near neutral, high impact: (best estimate, min and max) best estimate: 3, min: 0.1, max: 500	Mobility Class (K_d=0.6) covering constituents with K_ds between 0.6 and 0.9999	Mobility Class (K_d=0.0) covering constituents with K_ds between 0.0 and 0.9999
K_d technetium-99 (mL/g)	Low organic/low salt/near neutral, high impact: (best estimate, min and max) best estimate: 0; min: 0; max: 0.1	Mobility Class (K_d=0.0) covering constituents with K_ds between 0.0 and 0.5999	Mobility Class (K_d=0.0) covering constituents with K_ds between 0.0 and 0.9999
K_d iodine-129 (mL/g)	Low organic/low salt/near neutral, high impact: (triangular distribution, mode, min and max) median: 0.5; min: 0; max: 15	Mobility Class (K_d=0.0) covering constituents with K_ds between 0.0 and 0.5999	Mobility Class (K_d=0.0) covering constituents with K_ds between 0.0 and 0.9999
Solubility; uranium (mg/L)	86.9 (2.95 x 10^{-11} Ci/cm^3) [(d)] (deterministic) (non cemented wastes)	none	none
Solubility; technetium-99 (mg/L)	1 x 10^{10} (1.7 x 10^2 Ci/cm^3) [(e)] (deterministic) (non-cemented wastes)	none	none
Solubility; iodine-129 (mg/L)	1 x 10^{10} (1.77 x 10^0 Ci/cm^3) [(e)] deterministic (non-cemented wastes)	none	none
Solubility-Control Model			
Model or Zone/Parameter	**Data/Statistical Treatment**		
Solubility; uranium (mg/L)	86.9 (2.95 x 10^{-11} Ci/cm^3) [(d)] (deterministic) (non cemented wastes)	64 (non-cemented wastes); 0.23 (cemented wastes)	64 (non-cemented wastes); 0.23 (cemented wastes)
Solubility; technetium-99 (mg/L)	1 x 10^{10} (1.7 x 10^2 Ci/cm^3) [(e)] (deterministic) (non cemented wastes)	none	none
Solubility; iodine-129 (mg/L)	1 x 10^{10} (1.77 x 10^0 Ci/cm^3) [(e)] (deterministic) (non cemented wastes)	none	none
Cement Model			
Model or Zone/Parameter	**Statistical Treatment**		
Area to Volume Ratio (m^2/m^3)	0.378 [(k)]	1.55 to 1.93	5.33 [(i)]
Diffusion Coefficient; uranium (cm^2/y)	3.15 x 10^{-5} (1 x 10^{-12} cm^2/s) [(e,f)] (deterministic)	NA	NA
Diffusion Coefficient; technetium-99 (cm^2/y)	(uniform distribution, median, min, max) median: 1.02 x 10^{-3}, min: 1.58 x 10^{-4}, max: 1.89 x 10^{-3} [(g)]	3.15 x 10^{-4}	3.15 x 10^{-5} to 31.5 [(j)]
Diffusion Coefficient (iodine 129) (cm^2/y)	3.5 x 10^{-5} [(g)]	3.15 x 10^{-5}	3.15 x 10^{-5} to 31.5 [(j)]

(a) Values based on statistical treatment of individual data points measured or calculated over a depth ranging from 0- to 20-ft values calculated from bulk density and moisture content data from Fayer et al. (1999).
(b) An average height calculated for burial ground sites based on available height information in the WIDS database.
(c) Based on revision of K_ds in Kincaid et al. (1998) resulting from a recent compilation and evaluation of distribution coefficient data in Hanford sediments (Cantrell et al. 2002).
(d) Estimated solubility in Hanford groundwater assuming solid controlling solubility was $UO_2(OH)_2 \cdot H_2O$ (Wood et al. 1995).
(e) Default value from Table D.2 of Kincaid et al. (1998).
(f) Recommended value (default) for generic grout performance assessment when actual grout-specific data is lacking (Table 6, Serne et al. 1992).
(g) Based on results obtained from Mattigod et al. (2000).
(h) Best estimate K_d values after Cantrell et al. (2002).
(i) Values as low as 1.7 m^2/m^3 have been used in subsequent waste stream specific analyses.
(j) A range of values was considered for an unspecified constituent in the PA analysis (Wood et al. 1995).
(k) Based on all cemented waste placed in aggregate area 218-W@T-6-12 (SAC rev. 0).

L.2.4 Vadose Zone Module

The Vadose Zone Module is designed to simulate the transport and fate of contaminants as they move through the hydrogeologic region that extends from the land surface to the regional water table. Kincaid et al. (2000) identified the STOMP computer code (White and Oostrom 1996) as the code for the Vadose Zone Flow and Transport Module for SAC. Inputs to the Vadose Zone Module come primarily from the inventory and release elements, including recharge, and the mass flux and concentrations of the selected constituents. Other inputs include the effectiveness and timing of remedial actions that might either reduce the mass and/or concentration of contaminants in the vadose zone or that might reduce the flux of deep infiltrating moisture (that is, capping). These inputs include infiltration rates from both natural events (for example, precipitation) and operational activities (for example, excavation or capping). A few major hydro-stratigraphic units that are of uniform thickness and horizontal with homogeneous and isotropic properties were used to represent each site. Hydraulic and geochemical parameters for each hydro-stratigraphic unit are represented by stochastic distributions that reflect the uncertainty in measured properties. Definitions of the hydro-stratigraphy and the associated hydraulic, transport, and geochemical properties of the one-dimensional soil column were based on existing geologic, soil physics, and geochemical databases.

L.2.4.1 Distribution Coefficients (K_ds) for Technetium-99 and Uranium

The SAC initial assessments used K_d values that were assigned to each hydrogeologic unit in a manner similar to that done for the Composite Analysis (Kincaid et. al. 1998). The waste characteristics were assumed to dominate the near-field mobility of the contaminants in the vadose zone. After being in contact with vadose zone sediments and soil water for some distance, the waste undergoes a change in its mobility based on buffering of the contaminant solution by the vadose zone sediments. Thus, distribution coefficients were defined separately for each contaminant in the upper vadose zone (near-field or high-impact zone) and in the lower vadose zone (far-field or intermediate-impact zone) (Kincaid et. al. 1998).

Distribution coefficient zones were defined as either high-impact or intermediate-impact depending on the nature of the contaminant. Zones in which the organic concentration, pH, or salt concentration in the fluids may have affected the K_d values were designated high-impact. Zones in which the acidic or basic nature of the wastes was estimated to have been neutralized by the natural soil were designated intermediate-impact. Kincaid et al. (1998) estimated the depths of this transition zone by examining the peak location of beta/gamma contamination, as presented by Fecht et al. (1977), for 200 Area cribs receiving very acid or high-salt/very basic waste. In general, these transition depths ranged from 10 to 40 m (33 to 130 ft). Given the limited data available on which to base further interpretations on the depths of transition and the desire to simplify the numerical simulations, a slightly different approach was used here. Generally, the hydrogeologic unit into which waste streams were introduced was designated as high-impact regardless of waste stream characteristics. If those hydrogeologic units were thin (for example, less than 10 m), then the hydrogeologic unit immediately below that into which the waste stream was introduced was also designated as high-impact. All other hydrogeologic units lower in the profile were designated intermediate-impact. This approach kept the numerical simulations relatively simple by using the existing number of hydrogeologic units (that is, new layers did not need to be added to make the K_d change where it might have occurred within a single hydrogeologic unit). At the same time, the depths of change, corresponding to the thickness of the hydrogeologic units, are still on the same scale (10s of meters) as those used by Kincaid et al. (1998). A summary of the K_d values used for technetium-99 and uranium is presented in Tables L.3 and L.4, respectively.

L.2.4.2 Vadose Zone Strata and Hydraulic Properties

Of the more than 2600 waste sites at Hanford cataloged in Waste Information Database System (WIDS), a subset of 533 was selected for simulation in the initial assessment. Because of the aggregation of solid waste disposal facilities, unplanned releases, and various liquid discharge sites into fewer global waste sites within operational areas or portions of operational areas, these 533 sites represent 890 waste sites.

Geologic Profiles

Each of these sites were assigned to one of 64 base templates defined on the basis of 1) the type of waste site, 2) its geographic location (that is, area/geology), and 3) the characteristics of the waste stream.

Table L.3. Technetium-99 K_ds in ml/g

<table>
<tr><th rowspan="3">Waste Chemistry</th><th colspan="3">Vadose Zone</th><th rowspan="3">Groundwater</th><th rowspan="3">Reparian Zone</th></tr>
<tr><th rowspan="2">Near-field (High Impact)</th><th colspan="2">Far-Field (Intermediate Impact)</th></tr>
<tr><th>Sand</th><th>Gravel</th></tr>
<tr><td>All</td><td><u>0</u> (0-0.1)</td><td><u>0</u> (0- 0.1)</td><td><u>0</u> (0-0.01)</td><td><u>0</u> (0-0.1)</td><td><u>0</u> (0-0.0001)</td></tr>
<tr><td colspan="6">Values are listed as <u>best</u> (minimum–maximum).</td></tr>
</table>

Table L.4. Uranium K_ds in ml/g

<table>
<tr><th rowspan="3">Waste Chemistry</th><th colspan="3">Vadose Zone</th><th rowspan="3">Groundwater</th><th rowspan="3">Reparian Zone</th></tr>
<tr><th rowspan="2">Near-field (High Impact)</th><th colspan="2">Far-Field (Intermediate Impact)</th></tr>
<tr><th>Sand</th><th>Gravel</th></tr>
<tr><td>High Organic/Very Acidic; Chelates/High Salts; Low Organic/Low Salts/Acidic</td><td><u>0.2</u> (0-4)</td><td rowspan="2"><u>0.8</u> (0.2-4)</td><td rowspan="2"><u>0.08</u> (0.02-0.4)</td><td rowspan="2"><u>0.8</u> (0.2-4)</td><td rowspan="2"><u>0.0008</u> (0.0002-0.0004)</td></tr>
<tr><td>High Organic/Near Neutral; Very High Salt/Very Basic; Low Organic/Low Salt/ Near Neutral</td><td><u>0.8</u> (0.2-4)</td></tr>
<tr><td colspan="6">Values are listed as <u>best</u> (minimum–maximum).</td></tr>
</table>

Generalized hydro-stratigraphic columns were specified for each of the 13 geographic areas. These columns were assembled from existing information including:

- drillers' logs, geologists' logs, and geophysical logs

- published interpretive depths to the top and bottom surfaces of hydrogeologic units

- surface elevations (to convert hydrogeologic unit depths to elevations)

- elevation of the 1944 water table (to define the bottom of the vadose zone prior to waste disposal).

The generalized hydrostratigraphic units used in this study are summarized in Table L.5.

Table L.5. Summary of Hydrogeologic Units Used in This Study

Hydrogeologic Units	Facies/Subunit	Description
Not Applicable	Backfill	Poorly sorted gravel, sand, and silt derived from the Hanford formation and/or Holocene deposits
Holocene	Eolian	Dune sand and silt
Hanford formation	Silt-dominated	Interbedded silt and fine to coarse sand
	Fine sand-dominated	Stratified fine sand with minor pebbles and minor laterally discontinuous silt interbeds
	Coarse sand-dominated	Stratified coarse sand with minor pebbles and minor laterally discontinuous silt interbeds
	Gravelly sand	Cross bedded, interstratified coarse sand with up to 30 wt% very fine pebble to cobble
	Gravel-dominated	Cross bedded, interstratified coarse sand and gravel with greater than 30 wt% very fine pebble to boulder
	Undifferentiated	Undifferentiated sand and gravel with minor discontinuous silt interbeds.
Plio-Pleistocene Unit	Silt/sand dominated	Very fine sand to clayey silt sequence. Interstratified silt to silty very fine sand and clay deposits
	Carbonate rich	Carbonate-rich sequence. Weathered and naturally altered sandy silt to sandy gravel, moderately to strongly cemented with secondary pedogenic calcium carbonate.
Ringold Formation	Fluvial sand (member of Taylor Flat)	Interstratified sand and silt deposits
	Fluvial gravel (member of Wooded Island, subunit E)	Moderate to strongly cemented well-rounded gravel and sand deposits, and interstratified finer-grained deposits.
	Overbank/Lacustrine deposits (lower mud sequence)	Predominantly mud (silt and clay) with well-developed argillic to calcic paleosols.

In general, the depth and thickness of each hydrogeologic layer (strata) for each geographic area were taken from published maps and cross sections. The estimated average strata thickness was used for the generalized columns extending from the surface to the 1944 water table (Kipp and Mudd 1974). Because the sum of the average thickness did not always equal the distance from the land surface to the ground-water, small adjustments were made to the average strata thickness.

Hydraulic Properties

Hydraulic property data were primarily taken from Khaleel and Freeman (1995) as supplemented by Khaleel (1999) and Khaleel et al. (2000). Because this data set is rather limited in regards to the spatial location of samples and the soil types represented, individual stochastic data sets were selected to represent each hydrogeologic strata present in the 13 geographical areas. Care was taken to ensure that the soil classifications for which hydraulic property data was available could be correlated to the sediment facies within each template.

The statistical distributions of van Genuchten model (van Genuchten 1980) parameters, saturated hydraulic conductivity, and bulk density data were taken primarily from Khaleel and Freeman (1995) and Khaleel et al. (2000), and the distributions for longitudinal dispersivity were primarily taken from Ho et al. (1999). Values for residual saturation (S_r) were calculated by dividing the raw residual water content (θ_R) by the raw saturated content (θ_s), as provided by Khaleel and Freeman (1995). Effective porosity is assumed to be equal to the saturated water content (θ_s). Note that all model nodes within a single hydrogeologic unit are assigned the same hydraulic properties for a single realization.

L.2.4.3 Surface Covers

The SAC incorporates recharge estimates into the STOMP model to provide deterministic values that change stepwise as the surface cover changes and to represent the degradation of engineered covers following their design life. The recharge rates (actually, deep drainage rates) used for the SAC were estimated for all surface conditions under consideration for the initial assessments. These conditions included four different barrier designs, degraded barriers, the natural conditions that surround the barriers, and the unique conditions created by human activities (for example, facility construction, gravel-covered tank farms). Recharge estimates were based on the best available data (Fayer and Walters 1995, Fayer et al. 1999, Murphy et al. 1996, Prych 1998).

Barrier Recharge Estimates

Recharge through engineered surface covers was estimated based on the Focused Feasibility Study (FFS) conducted by DOE-RL (DOE-RL 1996). The FFS was conducted to determine the barrier needs at Hanford and to identify a set of barrier designs to meet those needs. Table L.8 identifies the four barrier designs that were proposed. According to the FFS, the modified Resource Conservation and Recovery Act (RCRA) Subtitle C design will be the predominant barrier type. DOE-RL (1996) used the Hydrologic Evaluation of Landfill Performance (HELP) model to simulate the recharge rate through the Hanford Barrier, modified RCRA barriers, and the standard RCRA barriers. The estimates ranged from 0.2 to 0.8 mm/yr., assuming that the annual mean precipitation remained at 160 mm/yr (6.3 in./yr).

Subsequent to the FFS, additional data and model results became available. As a result, the recharge rates for the barriers were updated and are reflected in Table L.6.

No guidance is available for specifying barrier performance after the design life. However, an immediate decrease in performance is not expected, and it is likely that some of these barriers will perform as designed far beyond their design life. Without data to understand and predict that long-term performance, however, an assumption was made that the performance would degrade stepwise after reaching its design life, until the recharge rate matches the rate in the surrounding environment. This approach is based on the assumption that a degraded cover will eventually return to its natural state and will behave like the surrounding environment. A further assumption was that the period of degradation would be the same as the design life. For example, the modified RCRA Subtitle D cover would perform as designed for 100 years and then degrade stepwise in five equal steps over the next 100 years to the point at which recharge rates are equivalent to the rates of the natural surrounding environment.

The schedule and type of engineered cover to be applied to each site was based on the Hanford Disposition Baseline as defined by Kincaid et al. (2000).

Natural (Non-barrier) Recharge Rates

Most of the waste sites at Hanford have not had a surface barrier, and it is assumed that many sites will not have a surface barrier applied prior to Site closure. The effort to estimate recharge in these areas addressed four site conditions:

- undisturbed soil and shrub-steppe vegetation

- undisturbed soil with no vegetation

Table L.6. Barrier Design Lifetimes and Estimated Recharge Rates (actual rates are expected to be less than shown)

DOE-RL Design	Design Life (yr)	Recharge Rate (mm/yr)	Source
Hanford Barrier	1000	0.1	Based on lysimeter data and simulation results (Fayer et al. 1999)
Modified RCRA Subtitle C	500	0.1	Based on lysimeter data and simulation results (Fayer et al. 1999)
Standard RCRA Subtitle C	30	0.1	No data; recommendation is based on presence of geomembrane, 2-ft thick clay admix layer, and short design life
Modified RCRA Subtitle D	100	0.1	Based on simulation results using parameters from Fayer et al. (1999)

- disturbed soil with no vegetation

- disturbed soil with shrub-steppe vegetation.

The Hanford soil map (Hajek 1966) was examined to identify the soil types prevalent in the waste areas. Table L.7 lists the four soil types that dominate the areas being evaluated in the initial assessment and their recharge rates. It was assumed that these soils, in their undisturbed condition, support a shrub-steppe plant community.

For some Hanford activities, the shrub-steppe plant community was often removed while leaving the existing soil type relatively intact. For other activities, the sites were excavated, which removed the existing soil structure, and backfilled with Hanford-formation sand or gravel. Some activities also covered selected surface areas with a layer of gravel (for example, the tank farms). Table L.8 shows the estimated recharge rates for native soils and backfilled sediments without vegetation. Eventually, the disturbed areas may become revegetated and a shrub-steppe plant community re-established. Under these conditions, it is assumed that the estimated recharge rate will return to that equivalent to the pre-Hanford conditions after a period of 100 years.

Summary of Recharge Estimates for the Initial Assessment

The estimated recharge rates for various surface conditions for each of the 13 geographic areas included in the initial assessment are provided in Table L.9. This table presents a brief description of

Table L.7. Estimated Recharge Rates for Predominant Soil Types and Sediments with a Shrub-Step Plant Community

Soil Type	Recharge Rate Estimate (mm/yr)	Description
Ephrata stony loam (Eb)	1.5	No data; used estimate for El, which is a similar soil
Ephrata sandy loam (El)	1.5	Average of two estimates (1.2; 1.8) from deep (> 10 m) chloride data collected from the two boreholes B17 and B18 (Prych 1998)
Burbank loamy sand (Ba)	3.0	Average of three estimates (0.66, 2.8, 5.5) from deep (> 10 m) chloride data collected from the three boreholes B10, B12, and B20 (Prych 1998)
Rupert sand (Rp) inside the 200 East Area	0.9	Average of four estimates (0.16, 0.58, 1.0, and 1.8) from deep (> 10 m) chloride data collected from the four boreholes E24-161, E24-162, B8501, B8502 (Fayer et al. 1999)
Rupert sand (Rp) outside the 200 East Area	4.0	Estimated from chloride data collected from a borehole near the Wye Barricade (Murphy et al. 1996)
Hanford-formation sand	4.0	No data; used estimate for Rupert sand outside the 200 East are

Table L.8. Estimated Recharge Rates for Native Soils and Backfilled Sediments without Vegetation

Soil Type	Recharge Rate Estimate (mm/yr)	Description
Ephrata stony loam (Eb)	17.3	Simulation estimate from Fayer and Walters (1995)
Ephrata sandy loam (El)	17.3	Simulation estimate from Fayer and Walters (1995)
Burbank loamy sand (Ba)	52.5	Simulation estimate from Fayer et al. (1999)
Rupert sand (Rp)	44.3	Simulation estimate from Fayer et al. (1999)
Hanford-formation sand	55.4	8-yr lysimeter record for Hanford sand (Fayer and Walters 1995)
Graveled surface	104	8-yr lysimeter record for graveled surface (Fayer et al. 1999)

each setting and identifies the major soil type that was identified visually for each area using the soil map developed by Hajek (1966). If a substantial secondary soil type was present, that soil type is shown in parentheses. Likewise, its recharge rate is also shown in parentheses. Figure L.2 illustrates how the recharge rates for various surface covers were assumed to change over time, as performance degrades.

The recharge rates estimated for the initial assessment do not account for overland flow from roadways or roofs, water line leaks, or any other anthropogenic additions of water. The rates also do not account for variations within soil types, plant community succession (for example, a takeover by cheatgrass), dune sand deposition, or climate change. Finally, these rates were developed for fairly large geographic areas and may not represent the local recharge rates at specific locations.

L.2.5 Groundwater Module

The Groundwater Module focuses on groundwater that is part of the upper most saturated zone on the Hanford Site. This zone, commonly referred to as the unconfined aquifer, offers a pathway for contaminants released through the vadose zone from past, present, and future site activities to reach the environment accessible to man. Radioactive and hazardous chemicals have been released on the Hanford Site from a variety of sources including ponds, cribs, ditches, injection wells (referred to as reverse wells), surface spills, and tank leaks. Many of these sources have already affected the groundwater, and some may affect it in the future. Once in the groundwater, contaminants move along the pathways of least resistance, from higher to lower potentials, (for example, elevations) where some contaminants may ultimately discharge into the Columbia River.

The goal of the Groundwater Module is to evaluate the transport of contaminants released from the vadose zone to points of regional discharge of groundwater along the Columbia River within the assessment period. Contaminants released to the groundwater form plumes, some of which extend from their source areas to the Columbia River. The Groundwater Module calculates the concentrations of contaminants in the groundwater for direct use in impact and risk calculations.

Table L.9. Recharge estimates for the initial assessment. Substantial secondary soil types and their associated recharge estimates are shown in parentheses.

Area Label	Brief Description	Major (Secondary) Soil Type(s) [(a)]	Recharge Rates Used in the Initial SAC Assessment(s) (mm/yr)			
			Pre- and Post-Hanford (shrub-steppe)	Operations (soil intact, no vegetation)	Operations (soil disturbed, with/without vegetation)	Operations (gravel surface, no vegetation)
C	Reactor along river	Eb (Ba)	1.5 (3.0)	17.3 (52.5)	4.0 / 55.4	104
K	Reactor along river	Eb (El)	1.5 (1.5)	17.3 (17.3)	4.0 / 55.4	104
N	Reactor along river	Eb	1.5	17.3	4.0 / 55.4	104
D	Reactor along river	El	1.5	17.3	4.0 / 55.4	104
H	Reactor along river	Ba	3.0	52.5	4.0 / 55.4	104
F	Reactor along river	Rp (El)	4.0 (1.5)	44.3 (17.3)	4.0 / 55.4	104
R	300 Area	Rp (El)	4.0 (1.5)	44.3 (17.3)	4.0 / 55.4	104
G	200 N Area	El (Ba)	1.5 (3.0)	17.3 (52.5)	4.0 / 55.4	104
T	Northern 200 West Area	Rp (Ba)	4.0 (3.0)	44.3 (52.5)	4.0 / 55.4	104
S	Southern 200 West Area and ERDF	Rp	4.0	44.3	4.0 / 55.4	104
A	Southern 200 East Area	Rp (Ba)	0.9 (3.0)	44.3 (52.5)	4.0 / 55.4	104
B	Northwestern 200 East Area	El	1.5	17.3	4.0 / 55.4	104
E	Eastern 200 East Area	Ba (Rp)	3.0 (0.9)	52.5 (44.3)	4.0 / 55.4	104
Eb = Ephrata stony loam	El = Ephrata sandy loam		Ba = Burbank loamy sand		Rp = Rupert sand	
(a) Note: Only the major soil types were used to represent each aggregate area.						

Information concerning characterization, modeling, and monitoring of the groundwater system, described in DOE-RL (1999), provides the primary basis for the conceptual model and numerical implementation of the Groundwater Module supporting the initial assessment. The groundwater conceptual model is an interpretation or working description of the characteristics and dynamics of the physical hydrogeologic system, and it consolidates Hanford Site data (for example, geologic, hydraulic, transport, and contaminant data) into a set of assumptions and concepts that can be quantitatively evaluated.

The Groundwater Module takes the results of the analyses from the vadose zone technical element in the form of contaminant flux from various waste sources. In addition to the influx from the vadose zone element, the Groundwater Module requires information that defines the physical characteristics of the hydrologic system, transport parameters, and natural and artificial recharge rates. Driving forces, including natural recharge from precipitation and artificial recharge from waste disposal activities, contribute to

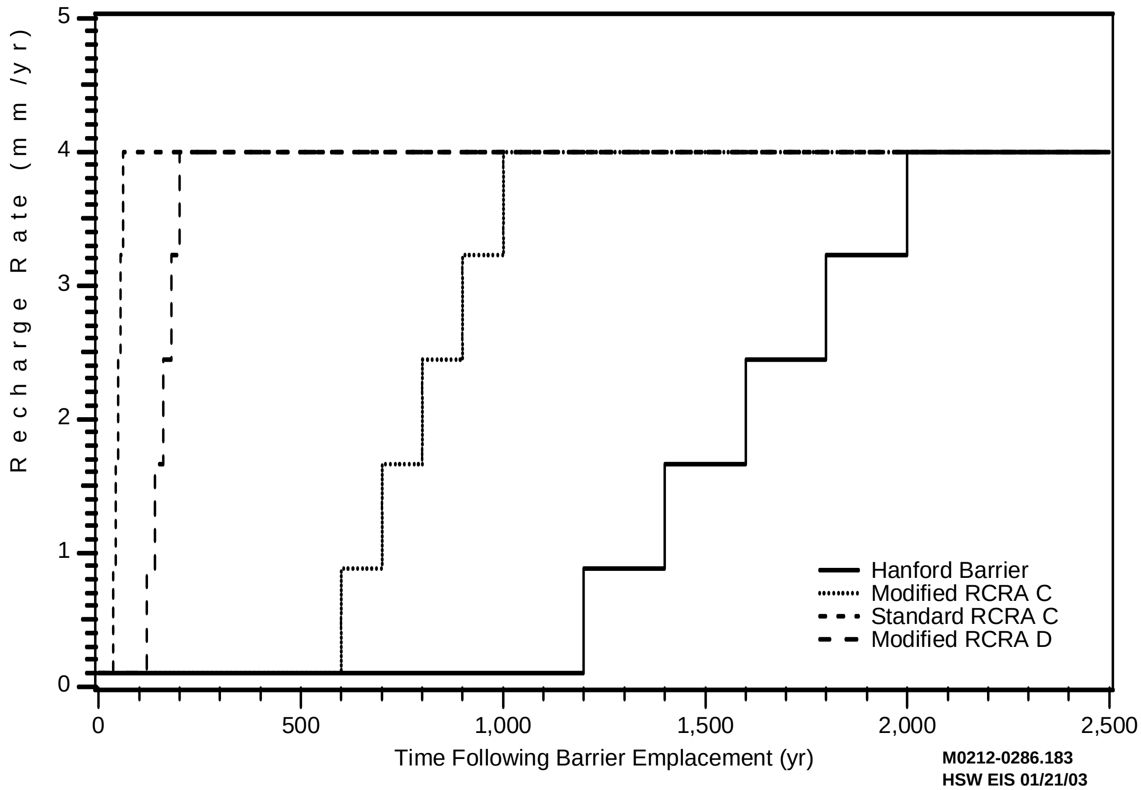

Figure L.2. Recharge Through Covers as a Function of Time

the movement of the contaminants through the vadose zone and into the groundwater of the unconfined aquifer. Several important fate and transport processes, including advection and dispersion, first-order radioactive decay, thermal and chemical interactions with the water and sediment, and contaminant density, may control the fate and transport of the contaminants in the groundwater. For the initial assessment, the thermal and chemical processes considered in the groundwater transport element were limited to assumptions of isothermal conditions, uniform density, and adsorption using the linear sorption isotherm model and, hence, the distribution coefficient, K_d, concept.

The definition of the hydrologic system is based on previous subsurface investigations from which data on the hydrologic units, unit boundaries, hydraulic conductivity, hydraulic heads, storativity, and specific yield were assembled. Transport parameters are based on both site-specific work of previous investigations and published literature values for parameters including effective porosity, dispersivity, contaminant-specific retardation coefficients, and vertical and horizontal anisotropy. The groundwater flow and transport model also requires estimates of natural recharge rates and locations and magnitude of artificial recharge to the hydrologic system, which are available from historic records and direct measurements. Model domain boundaries are established for the flow system based on site-specific knowledge and output data requirements. Boundaries are established along the northern and eastern portion of the Site corresponding to the course of the Columbia River and along the southeastern portion of the model along the course of the Yakima River. Basalt ridgelines and the Cold Creek Valley form the western model domain boundaries. Lower flow boundaries are established between the confined basalt aquifer system and the overlying unconfined aquifer. A complete description of the groundwater conceptual model is provided in Appendix D of DOE-RL (1999).

The conceptual model of the groundwater system used in this assessment is based on nine major hydrogeologic units identified in Thorne and Chamness (1992), Thorne and Newcomer (1992), and Thorne et al. (1993, 1994). Although nine hydrogeologic units were defined, only seven are found in the unconfined aquifer during the period of interest. The Hanford formation combined with the pre-Missoula gravel deposits were designated as model unit 1. Model units 2 and 3 correspond to the early Palouse soil and Plio-Pleistocene deposits, respectively. Odd-numbered Ringold model units (5, 7, and 9) are predominantly coarse-grained sediment. Even-numbered Ringold model units (4, 6, and 8) are predominantly fine-grained sediment with low permeability. The underlying basalt was designated model unit 10. However, the basalt was assigned a very low hydraulic conductivity and was essentially treated as an impermeable unit in the model.

A complete description of the site-wide groundwater flow and transport model used in the current assessment is provided in Cole et al. (2001a). The current Hanford site-wide groundwater model is implemented with the CFEST code (Gupta et al. 1987). The current model has been transient-inverse calibrated to the record of hydraulic head (that is, water-table elevation) measurements from Hanford startup in 1944 to the present.

Simulated flow conditions during the historical period of operations that provided the basis for all transport calculations are described in Cole et al. (2001b). These flow conditions incorporate the effect of large-volume discharges of wastewater to a variety of waste facilities since the inception of the Hanford Site in 1943. These operational discharges have raised the water table, created groundwater mounds, and been the source of local- and regional-scale contaminant plumes under waste management sites and facilities along the Columbia River and in the Central Plateau. Since 1988, the mission of the Hanford Site has changed from weapons material production to environmental restoration. As a result, wastewater discharges have declined substantially, which caused the water table to decline substantially over the past decade. Simulation of future water table decline indicates that the aquifer would return to more natural levels within 150 to 300 years. These results are consistent with previous work on future water table declines described in Cole et al. (1997) and Kincaid et al. (1998).

The SAC has been inverse calibrated to the hydraulic head data, and history matched to the most abundant data, that for tritium the most mobile of radioactive contaminants. Use of the hydraulic head and tritium data sets provide confidence that the underlying liquid release, vadose zone and groundwater models duplicate the essential features of the tritium groundwater plume; extent of tritium contamination, its arrival at the Columbia River, and its decay as a function of time.

Historical field data specific to solid waste disposal facilities are not available. Solid wastes disposed in containers of either cardboard, wood, plastic, or metal construction are not believed to have released from the their containers and contaminated the sediments immediately below the disposal facilities. It may be decades or centuries before contaminants in some solid waste disposal facilities reach the underlying groundwater and are available for detection. Thus, history matching to solid waste releases is not tractable at this time.

L.2.6 River Transport Module

The River Transport Module simulates the Columbia River between the Vernita Bridge and McNary Dam including inputs from groundwater and the Yakima and the Snake Rivers. The contaminants modeled in the river come from three sources:

- those already in the river when water reaches the Vernita Bridge from upstream sources and atmospheric fallout

- contaminant influx from Hanford waste sites through groundwater

- direct discharge to the river from Hanford facilities.

Groundwater and irrigation return discharges to the river along the shore opposite Hanford are not included in the initial assessment.

The MASS2 code provides the basis of the River Transport Module (Richmond et al. 2000). MASS2 is a two-dimensional, depth-averaged hydrodynamics model that provides the capability to simulate the lateral (bank-to-bank) variation of flow and transport of sediments and contaminants. The model incorporates river hydraulics (velocity and water depth), contaminant influx to the river through groundwater and point sources, sediment and contaminant transport, and adsorption/desorption of contaminant to sediments.

The Columbia River is the largest North American River to discharge into the Pacific Ocean. The river originates in Canada and flows south 1953 km (1212 mi) to the Pacific Ocean. The watershed drains a total of 670,000 km^2 (258,620 mi^2) and receives waters from seven states and one Canadian province. Key contributors to the flow are runoff from the Cascade Mountains in Washington and Oregon and from the western slopes of the Rocky Mountains in Idaho, Montana, and British Columbia. Average annual flows below Priest Rapids and The Dalles dams are approximately 3360 m^3/s (120,000 ft^3/s) and 5376 m^3/s (192,000 ft^3/s), respectively. Numerous dams within the United States and Canada regulate flow on the main stem of the Columbia River. Priest Rapids Dam is the nearest dam upstream of the Hanford Site, and McNary Dam is the nearest downstream. The dams on the lower Columbia River greatly increase the water travel times from the upper reaches of the river to the mouth, subsequently reducing the sediment loads discharged downstream. The increased travel times also allow for greater radionuclide deposition and decay.

The Snake, Yakima, and Walla Walla Rivers all contribute suspended sediment to the Columbia River; contributions from the Snake River are the most substantial. Since completion of McNary Dam in 1953, much of the sediment load has been trapped behind the dam. However, at McNary Dam and other Columbia River dams, some of the trapped sediment is resuspended and transported downstream by seasonal high discharges. As expected, much of this material is redeposited behind dams located farther downstream. Within the domain of this model that only extends to McNary Dam, sediment accumulates faster on the Oregon shore than on the Washington shore because sediment input from the Snake and Walla Walla Rivers stays near the shore on the Oregon side. Sediment-monitoring samples taken for the

Hanford Sitewide Surface Environmental Surveillance Project indicated cobble and coarse- and fine-sand bed sediments at sampling locations along the Hanford Site (Blanton et al. 1995). Silt and clay sediment was observed at the McNary Dam sampling site.

The conceptual model used in the initial assessment included the environmental pathways and transport processes that affect contaminant transport in surface water systems. The physical processes include river hydrodynamics and suspended sediment transport, deposition, and resuspension. Because of run-time constraints, suspended and bed sediments were modeled with only the silt-size fraction. The contaminant transport processes include surface water advection and dispersion, sorption and desorption to sediments, decay, and exchange between bed pore water and the overlying surface water. The initial assessment River Transport Module, which is the MASS2 model, included these key features, events, and processes in the mathematical implementation of the conceptual model.

L.2.7 Risk and Impact

The SAC has implemented a suite of impact assessment modules that treat ecological, economic, cultural, and human impacts and include internal stochastic capabilities. An initial assessment of the Hanford Site using these modules is provided in Bryce et al. (2002). The HUMAN code (Eslinger et al. 2002) was used in calculations for this EIS. The human impact model includes exposure pathways from ingestion, inhalation, skin contact, and direct radiation exposure. Relative exposures to these sources depend on individual lifestyles or exposure scenarios.

The human exposure scenarios for the EIS were limited to the ingestion of water. In addition, the ingestion dose factors were selected as deterministic rather than stochastic factors. With these assumptions, annual human dose calculations do not depend on stochastic variables internal to the human exposure model. Thus, all variability in the human doses arises from the variability in the inventory, release, and transport models. The dose factor used for ingestion of technetium-99 was 1.5×10^{-9} rem/pCi and the dose factor used for ingestion of uranium-238 was 2.5×10^{-7} rem/pCi. These values were obtained by converting the values in Table 2.2 of EPA (1988) from Sv/Bq to rem/pCi (the values were multiplied by a factor of 3700).

Intrusion events by man, vegetation, or animals and the potential for terrestrial ecological pathways to be impacted by Hanford Site wastes in shallow earth deposits is an intrusion analysis – not a long-term exposure analysis. Intrusion analyses are part of the site-specific or waste-specific analyses included in remedial investigation / feasibility studies required under CERCLA, and performance assessment required by DOE Order 435.1. Intrusion analyses contribute to our understanding of the waste concentration that can be safely disposed (i.e., at levels less than chronic and acute intruder dose limits), and of the performance necessary in a barrier system to prevent intrusion by man, vegetation, or animals. However, because intrusion exposures are not included in long-term exposure scenarios, such analyses are not included in the site-wide assessment tool, the SAC.

The version of SAC applied to the initial assessment (Bryce et al. 2002) and that applied in the Hanford SW EIS does not include a terrestrial ecological pathway analysis. Essentially, the SAC does not analyze intruder exposure / risk scenarios. Design of the SAC tool was predicated on the assumption that the Hanford Site would be closed following the remediation of all sites, and the further assumption that any contaminants at substantial levels in the subsurface would be covered with a proven infiltration and intrusion barrier. A Modified RCRA Subtitle C barrier has been proposed for waste sites receiving surface barriers on the central plateau. Thus, the long-term exposure scenarios do not include intrusion as a source of contamination.

L.2.8 Uncertainty

The SAC was designed to provide a stochastic simulation capability able to quantify uncertainty through a Monte Carlo analysis. An uncertainty analysis can be completed for the SAC results. The goal of such an uncertainty analysis is to determine the model parameters that contribute the most variability to the performance measures. Results of the stochastic realizations can also be used to reveal the maximum – minimum range of performance measures.

The uncertainty analysis addresses the role of uncertainty as caused by the variation of parameters within the modeling systems. It does not address causes of errors between modeled and observed data. It does not address uncertainty due to the use of different models. In addition, the analysis of uncertainty does not differentiate between uncertainties due to lack of knowledge and uncertainty due to natural variability in the parameters.

The uncertainty analysis can identify controlling sources of variability in the simulation estimates of the performance measure, but not necessarily the source of the overall magnitude of the performance measure. However, the source of the overall magnitude is obtained from direct examination of model results.

The uncertainty analysis technique employed is a step-wise linear regression analysis using the output results and input parameters of an assessment. Because the SAC uses a sequential analysis structure (i.e., analysis progressively treats inventory, release, vadose zone, etc.), a top-down hierarchal analysis is performed to identify first tier quantities (e.g., derived quantities like tritium concentration in groundwater), and associated second tier parameters (e.g., unsaturated hydraulic properties, distribution coefficient) responsible for variability.

The initial assessment (Bryce et al. 2002) demonstrated that a relatively small number of input parameter could determine most of the variability in calculated performance measures. It was observed that when the performance measure is human dose, variability with regard to individual behavior and exposure affects uncertainty in the estimated dose more than variability in inventory, release, or environmental transport of the contaminants.

L.3 Results

Results of the initial assessment for a 10,000-year period conducted using the SAC software are presented below in three sections. Section L.3.1 details the release of contamination to the groundwater from the vadose zone. Section L.3.2 presents the drinking water dose that occurs from a 2-L/d drinking water the Hanford Site would be closed following the remediation of all sites, and the further assumption that any contaminants at substantial levels in the subsurface would be covered with a proven infiltration and intrusion barrier. A Modified RCRA Subtitle C barrier has been proposed for waste sites receiving surface barriers on the central plateau. Thus, the long-term exposure scenarios do not include intrusion as a source of contamination.

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L.3.1 Release to Groundwater Results

Releases to the unconfined aquifer from the vadose zone predicted using the SAC software and data are summarized in this section. Vadose zone releases to the groundwater are aggregated into the following categories for the numerous vadose zone sites simulated:

- Solid waste disposal facilities (only ‘218’ sites)

- Tanks (only ‘241’ sites)

- Liquid discharge (‘216’ sites plus unplanned release sites and the State Approved Land Disposal Site)

- Environmental Restoration Disposal Facility

- Commercial low-level radioactive waste disposal (referred to as the US Ecology site)

- Other sites in 200 East or 200 West Areas not included in the above categories

- All sites not in 200 East or 200 West Areas (that is, 100, 300, 400, and 600 Areas)

For each result, both annual releases and the cumulative of all annual releases (undecayed) are presented. Note, releases from ILAW, melters, and naval reactor compartments are omitted. The stochastic capability of the SAC was employed for these simulations, so the following results are shown in each plot:

- individual stochastic results (25 realizations)

- the median result of the 25 realizations—that is, the realization that resulted in the median cumulative release in the year 12050 A.D. (at the end of the simulation) is emphasized.

- the median-inputs simulation—that is, a separate single-realization simulation with SAC using the median value of all stochastic input variables.

The median result as defined by the cumulative release to the groundwater is highlighted in both the annual release and cumulative release plots. Each new pair of annual and cumulative plots identifies a new median case from the 25 realizations simulated.

The annual release plots have the appearance of being either a series of piecewise constant (stair-step) values or a smooth continuous curve. This is a function of the temporal resolution of both the release model and the vadose zone simulation. Piecewise constant curves result when the release rate is constant over a period of time and the vadose zone model is able to adopt relatively long time steps (for example, hundreds of years). When either the release or vadose zone model use a fine time step to forecast a more variable release, the release to groundwater appears as a smooth and continuous curve. In reality, both curves are a series of piecewise constant values; however, the fine temporal resolution of the more continuous curve give it the smooth appearance.

Figures L.3 through L.10 present the vadose zone release to groundwater results for the sum of all solid waste disposal facilities. Each cumulative plot showing the 25 stochastic realizations provides information on the range of cumulative response as well as the median for solid waste disposals. Cumulative releases to groundwater for solid waste disposed of in the Central Plateau range from approximately 323 to approximately 445 Ci for technetium-99 during the 10,000-year analysis period. However, for uranium the release is nil—none in any realization in the 200 East Area and only 5 of 25 realizations exhibit any release in 200 West Area. The median solutions for both 200 East and 200 West Areas are zero essentially.

Figures L.11 through L.18 present the results for vadose zone releases to groundwater for the sum of all tank sites. Cumulative releases to groundwater for tank waste (that is, past leaks, future losses, and residuals) in the Central Plateau range from approximately 440 to approximately 645 Ci for technetium-99 during the 10,000-year analysis period. As in the case of solid waste, uranium in tank waste does not exhibit substantial release during the 10,000-year period. Only 5 of 25 realizations show uranium release from 200 East Area tank sites, and hence, the median release is zero. For 200 West Area tank sites, the median case predicts release of approximately 1 Ci of uranium to groundwater during the entire 10,000-year period.

Figures L.19 through L.26 present the vadose zone release to groundwater results for the sum of all liquid discharge and unplanned release (UPR) sites and (in the case of 200 West) the SALDS facility. Cumulative releases to groundwater for liquid releases in the Central Plateau range from approximately 735 to approximately 1030 Ci for technetium-99 during the 10,000-year analysis period. The vast majority of this activity is associated with 200 East Area. The liquid release of uranium ranges between approximately 5 and approximately 100 Ci for the Central Plateau with median values of approximately 26 Ci for 200 East Area and approximately 5 Ci for 200 West Area.

Figures L.27 through L.38 present the results for vadose zone releases to groundwater for the sum of all other sites (sites in 200 East and 200 West Areas, excluding solid waste burial ground, tank, liquid discharge, unplanned release, ERDF, and commercial low-level radioactive waste disposal sites) and for the sum of all sites outside the 200 East and 200 West Areas (that is, the 100, 300, 400, and 600 area sites). Cumulative releases to groundwater for all other sites (for example, canyons, tunnels) on the Central Plateau range from approximately 15 to approximately 50 Ci for technetium-99 during the 10,000-year analysis period. The majority of this activity is associated with 200 West Area. Negligible releases of uranium occur from these sites. Cumulative releases to groundwater from sites away from the Central Plateau (for example, river corridor sites with residual contamination) range from approximately 17 to approximately 37 Ci for technetium-99 during the 10,000-year analysis period. The release of uranium from these same sites ranges from approximately 5 to approximately 80 Ci. Note that the river corridor includes several liquid waste disposal trenches that received fuel fabrication waste streams that carried uranium to the vadose zone.

Figures L.39 through L.42 present the results for vadose zone releases to groundwater for the ERDF. Cumulative releases to groundwater from the ERDF range from 0 to approximately 27 Ci for technetium-99 during the 10,000-year analysis period. As in the case of solid waste, uranium in the ERDF does not exhibit significant release during the 10,000-year period. Only 3 of 25 realizations exhibit any release, none before 7000 years post-closure. Hence, the median case shows no uranium release to groundwater.

Figures L.43 through L.46 present the results for vadose zone releases to groundwater for the commercial low-level radioactive waste disposal site operated by US Ecology, Inc. Cumulative releases to groundwater from the US Ecology site range from 0 to approximately 80 Ci for technetium-99 during the 10,000-year analysis period. The annual release curves (Figure L.43) and the cumulative plots (Figure L.44) exhibit substantial variability in the timing of release; however, the peak annual releases appear to vary between only approximately $2x10^{-2}$ and approximately $5x10^{-2}$ Ci/yr after 3000 A.D. As in the case of solid waste and ERDF, uranium in the US Ecology site does not exhibit release to groundwater during the 10,000-year period.

These results indicate that technetium-99 releases from the solid waste disposal facilities to groundwater of may account for approximately 323 to approximately 445 Ci in 10,000 years, and releases of uranium would be negligible. This contrasts with approximately 440 to approximately 645 Ci of technetium-99 from tank sites, approximately 735 to approximately 1030 Ci from liquid releases, approximately 15 to approximately 50 Ci from other sites on the Central Plateau, approximately 17 to approximately 37 Ci from sites away from the plateau, 0 to approximately 27 Ci from ERDF, and 0 to approximately 80 Ci from the US Ecology site. Overall, the comparison is approximately 323 to approximately 445 Ci of technetium-99 from solid waste and approximately 1530 to approximately 2310 Ci of technetium-99 released in 10,000 years from all Hanford Site sources. Thus, the contribution from Hanford solid waste would amount to about 20 percent of the cumulative technetium-99 release from all Hanford sources.

The release of uranium to groundwater from Hanford solid waste is much lower. No realizations showed any release of uranium to groundwater from Hanford solid waste in the 200 East Area, and only 5 of 25 realizations exhibit any release of uranium to groundwater from Hanford solid waste in 200 West Area. Thus, in an average, or median, sense, Hanford solid waste deposits would release no uranium to groundwater over the 10,000-year period of analysis. This result compares to a median release of approximately 84 Ci and a range of release to groundwater from the 25 realizations of between approximately 10 and approximately 300 Ci of uranium for all Hanford wastes. Of the five realizations of non-zero uranium release from Hanford solid waste in the 200 West Area, the range of cumulative release was 0 to approximately 94 Ci. Hence, the contribution to overall uranium release to the water table from Hanford solid waste lies between 0 and approximately 29 Ci, but the majority of realizations show zero release. As a consequence, the contribution from Hanford solid waste would amount to between 0 and 30 percent of the cumulative release from all Hanford sources. The majority of the technetium-99 and uranium release was forecast to occur from past liquid discharge sites (cribs, ponds, trenches) and unplanned releases on the plateau, and from off-plateau or river corridor waste sites.

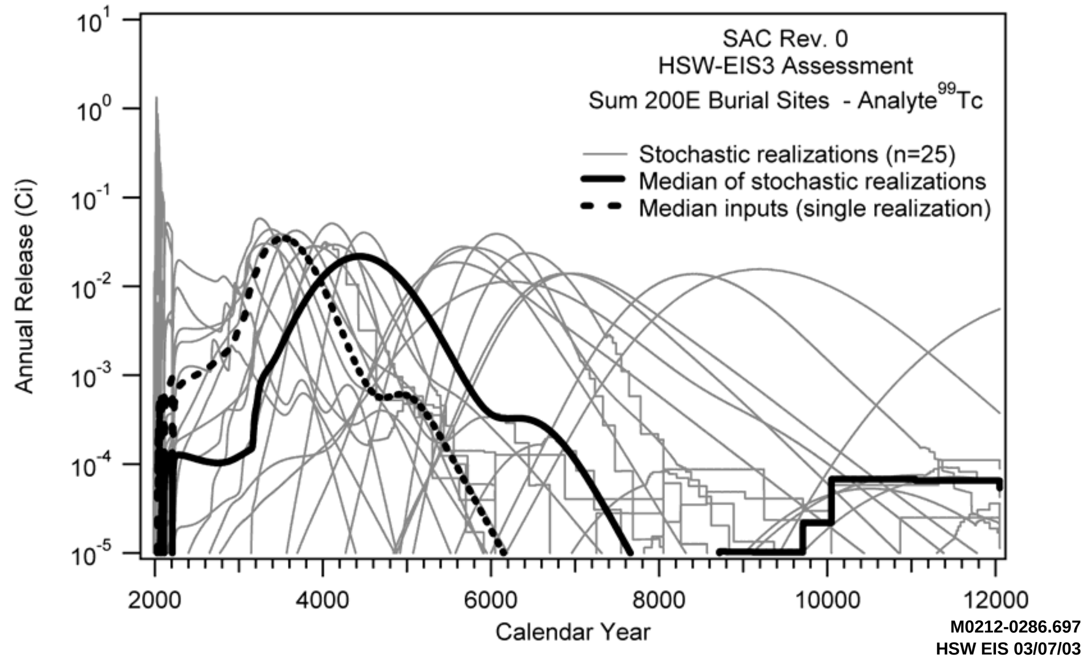

Figure L.3. SAC Results for Annual Vadose Zone Release of Technetium-99 from All Solid Waste Disposal Facilities Sites in the 200 East Area (including all '218' sites except 218-E-14 and 218-E-15, and excluding ILAW)

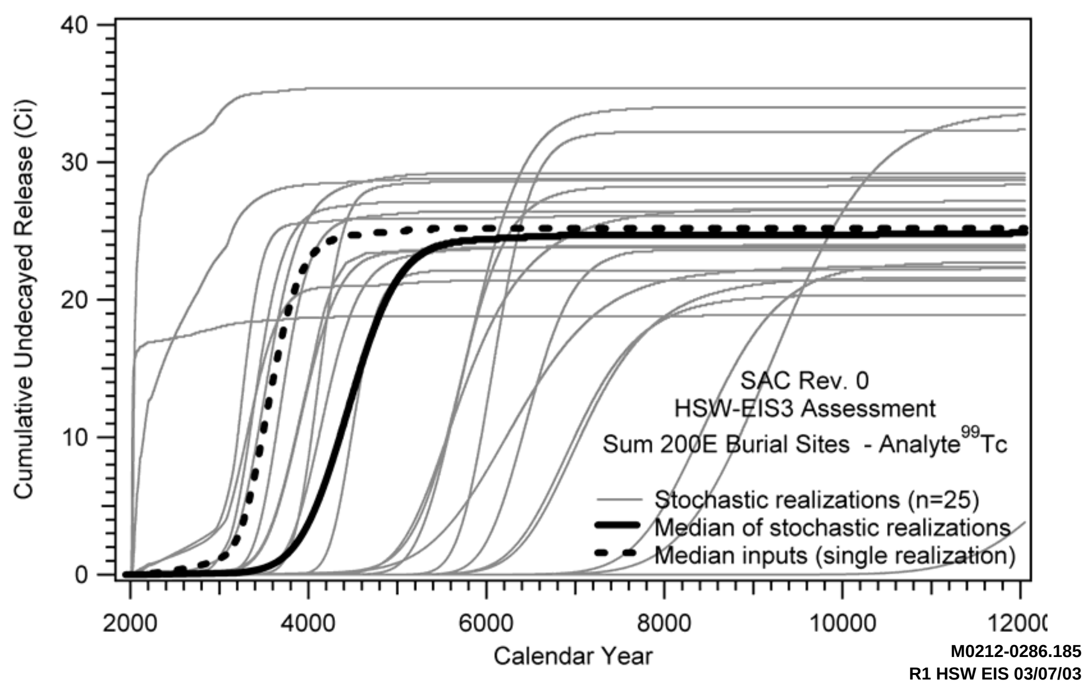

Figure L.4. SAC Results for Cumulative (undecayed) Vadose Zone Release of Technetium-99 from All Solid Waste Disposal Facilities Sites in the 200 East Area (including all '218' sites except 218-E-14 and 218-E-15, and excluding ILAW)

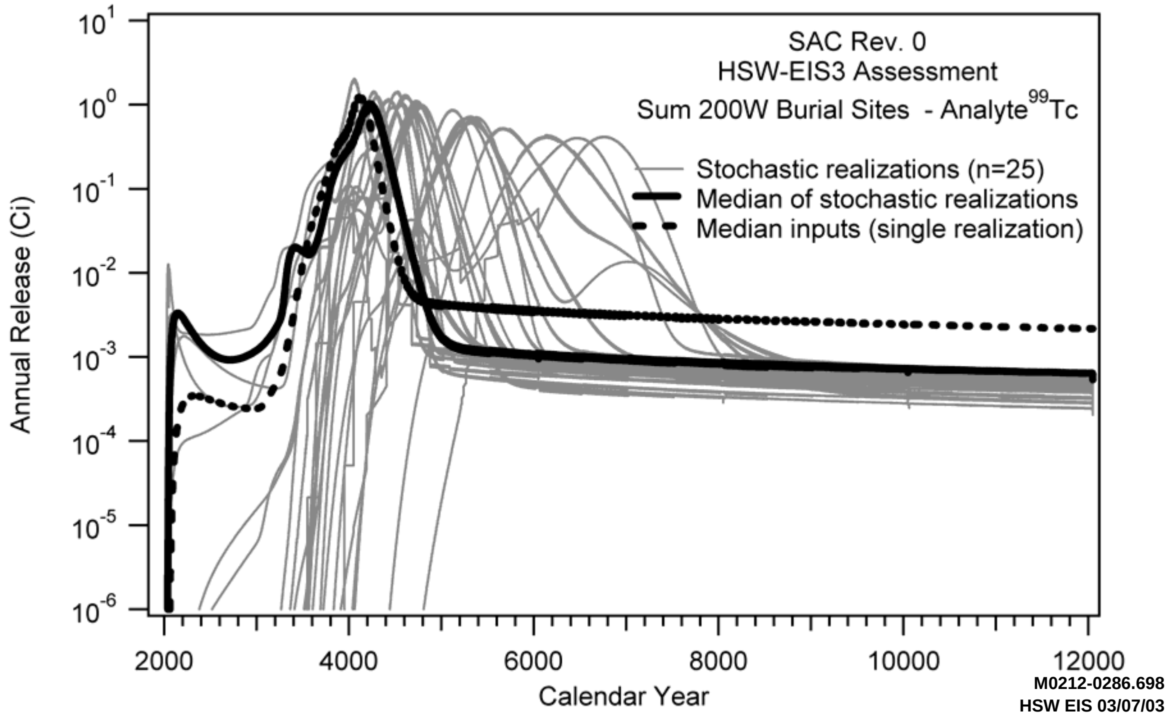

Figure L.5. SAC Results for Annual Vadose Zone Release of Technetium-99 from All Solid Waste Disposal Facilities Sites in the 200 West Area (including all ‘218’ sites)

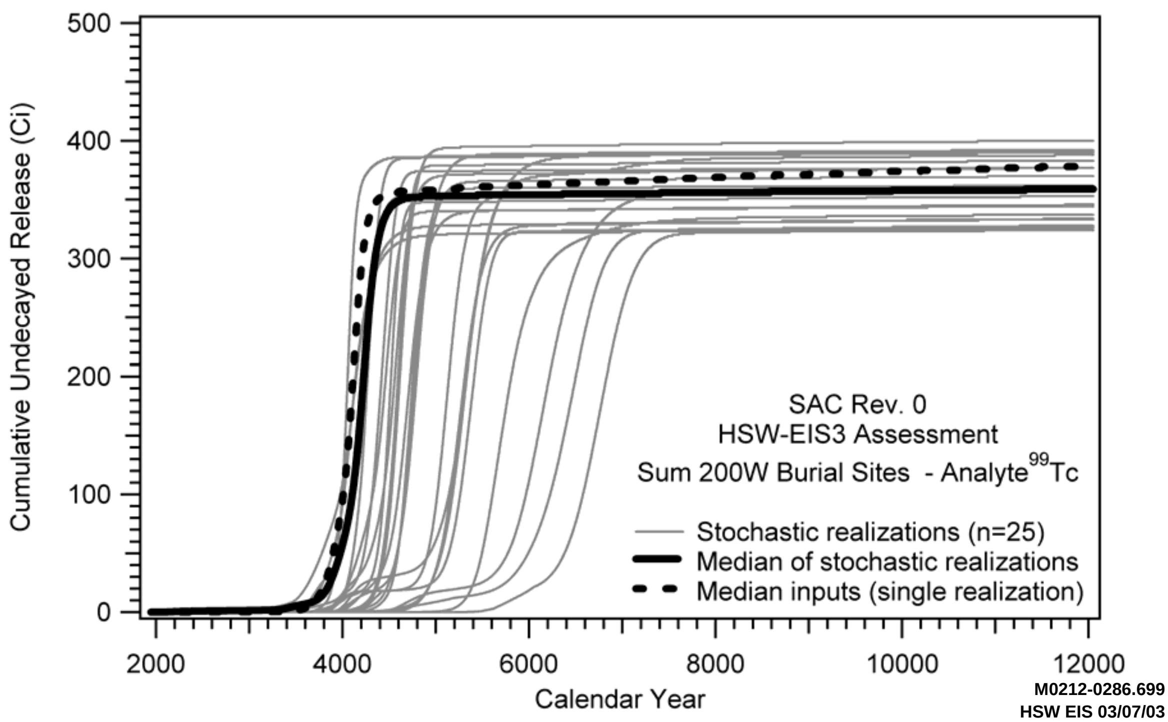

Figure L.6. SAC Results for Cumulative (undecayed) Vadose Zone Release of Technetium-99 from All Solid Waste Disposal Facilities Sites in the 200 West Area (including all ‘218’ sites)

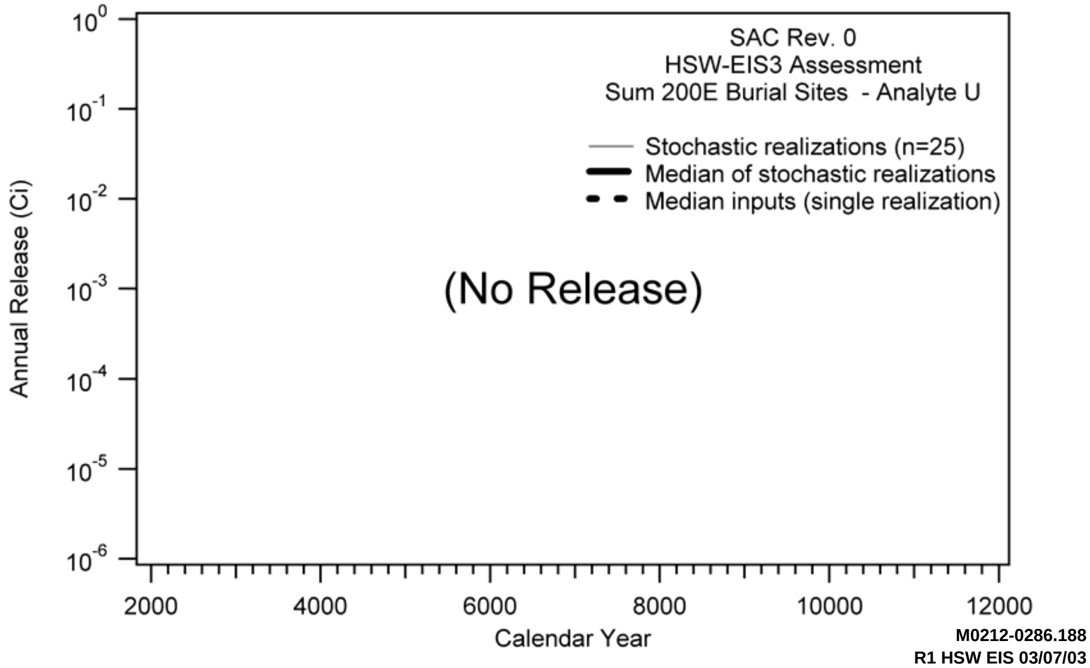

Figure L.7. SAC Results for Annual Vadose Zone Release of Uranium from All Solid Waste Disposal Facilities Sites in the 200 East Area (including all ‘218’ sites except 218-E-14 and 218-E-15, and excluding ILAW)

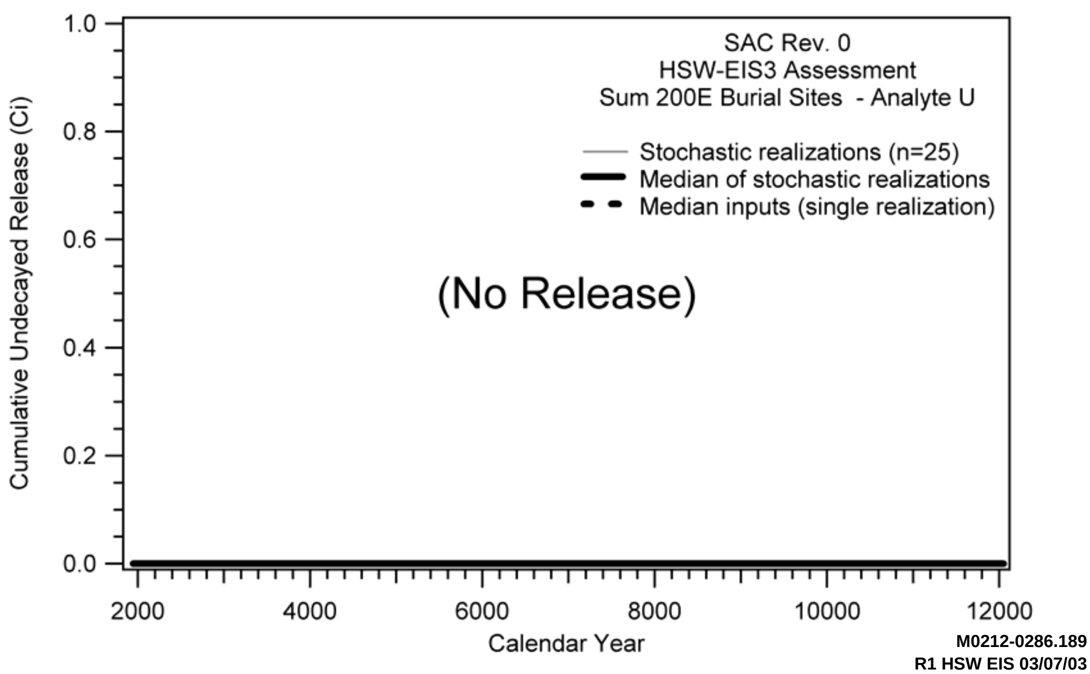

Figure L.8. SAC Results for Cumulative (undecayed) Vadose Zone Release of Uranium from All Solid Waste Disposal Facilities Sites in the 200 East Area (including all ‘218’ sites except 218-E-14 and 218-E-15, and excluding ILAW)

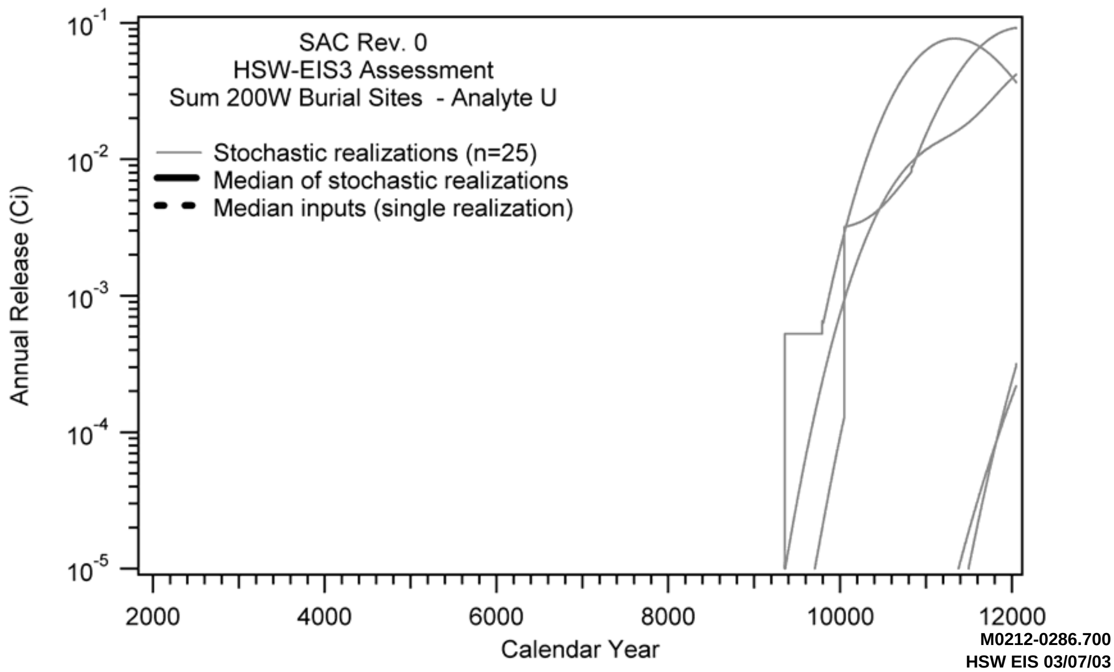

Figure L.9. SAC Results for Annual Vadose Zone Release of Uranium from All Solid Waste Disposal Facilities Sites in the 200 West Area (including all '218' sites)

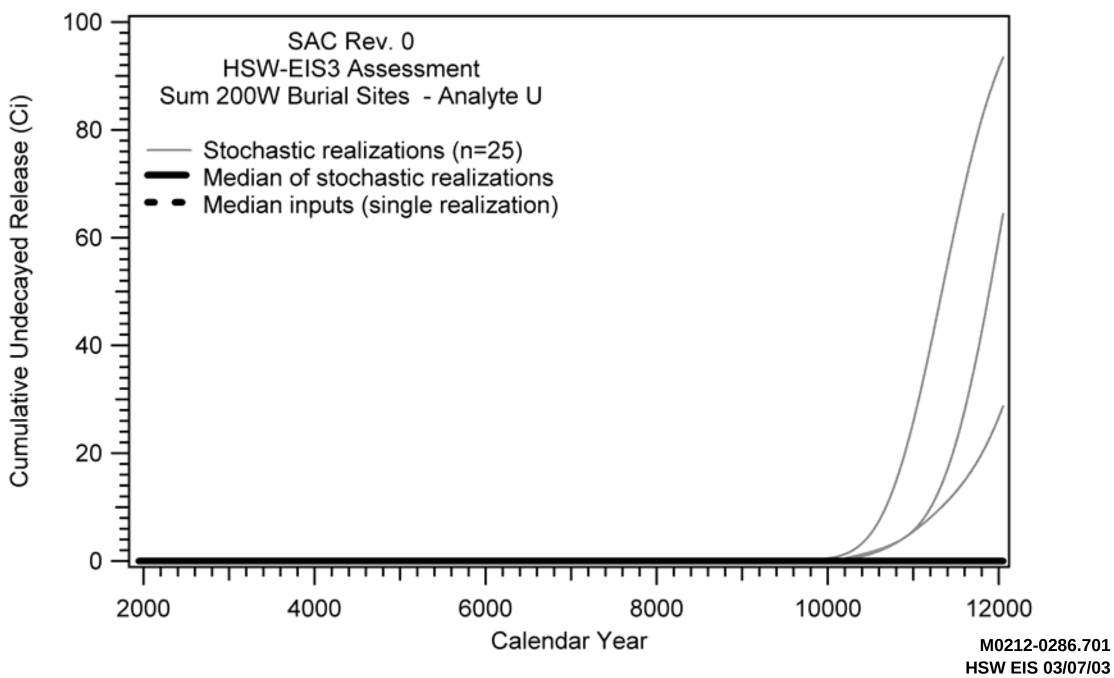

Figure L.10. SAC Results for Cumulative (undecayed) Vadose Zone Release of Uranium from All Solid Waste Disposal Facilities Sites in the 200 West Area (including all '218' sites)

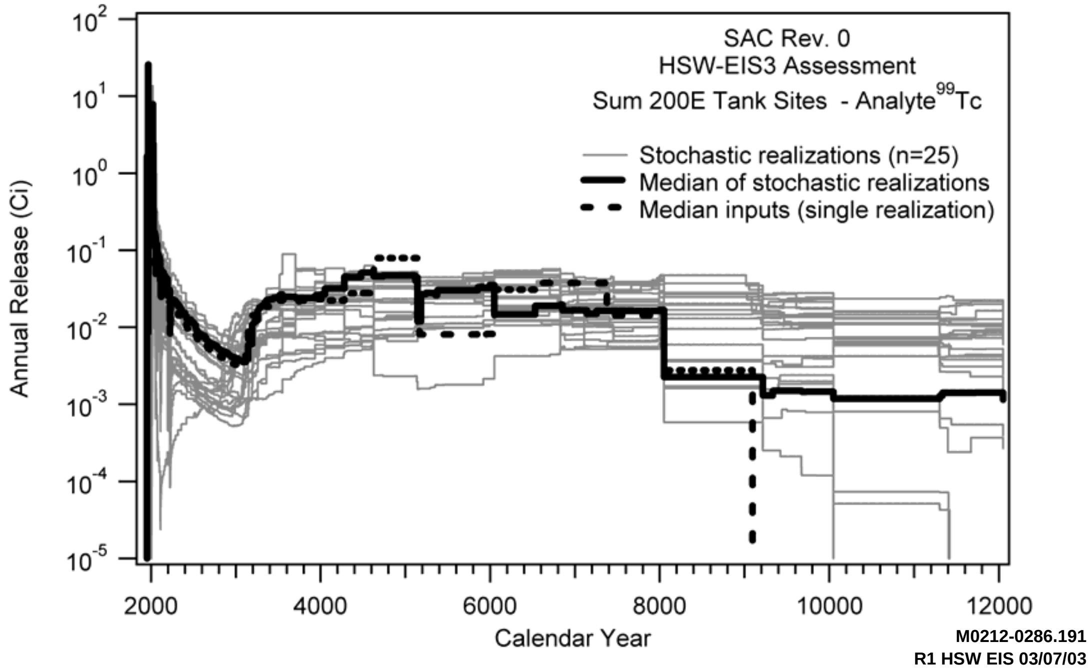

Figure L.11. SAC Results for Annual Vadose Zone Release of Technetium-99 from All Tank Sites in the 200 East Area

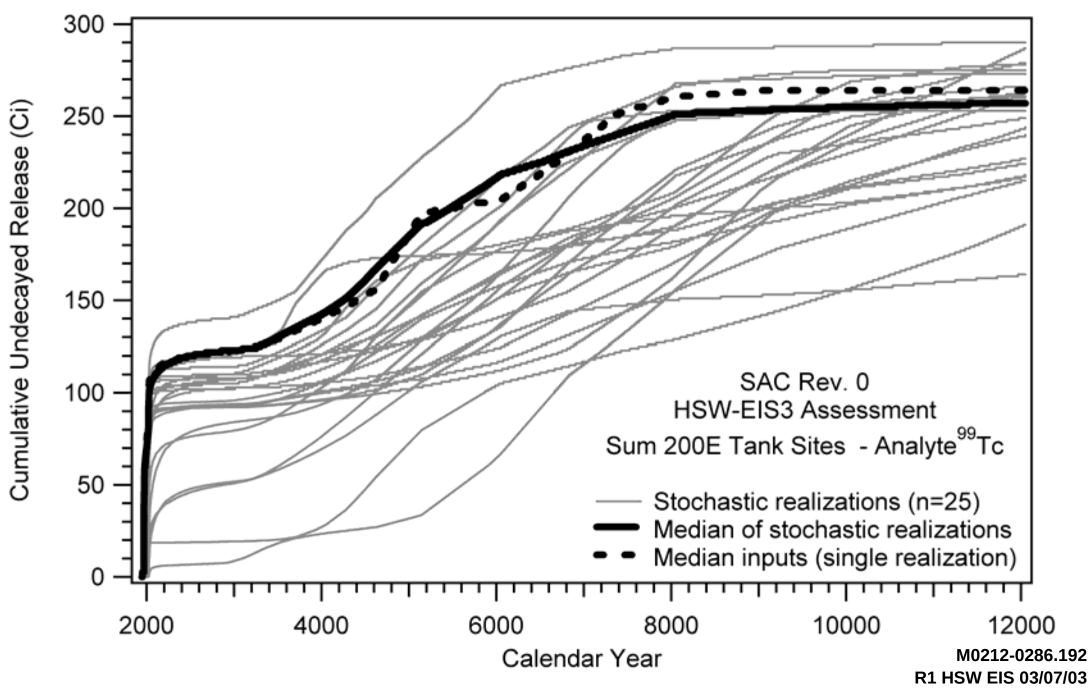

Figure L.12. SAC Results for Cumulative (undecayed) Vadose Zone Release of Technetium-99 from All Tank Sites in the 200 East Area

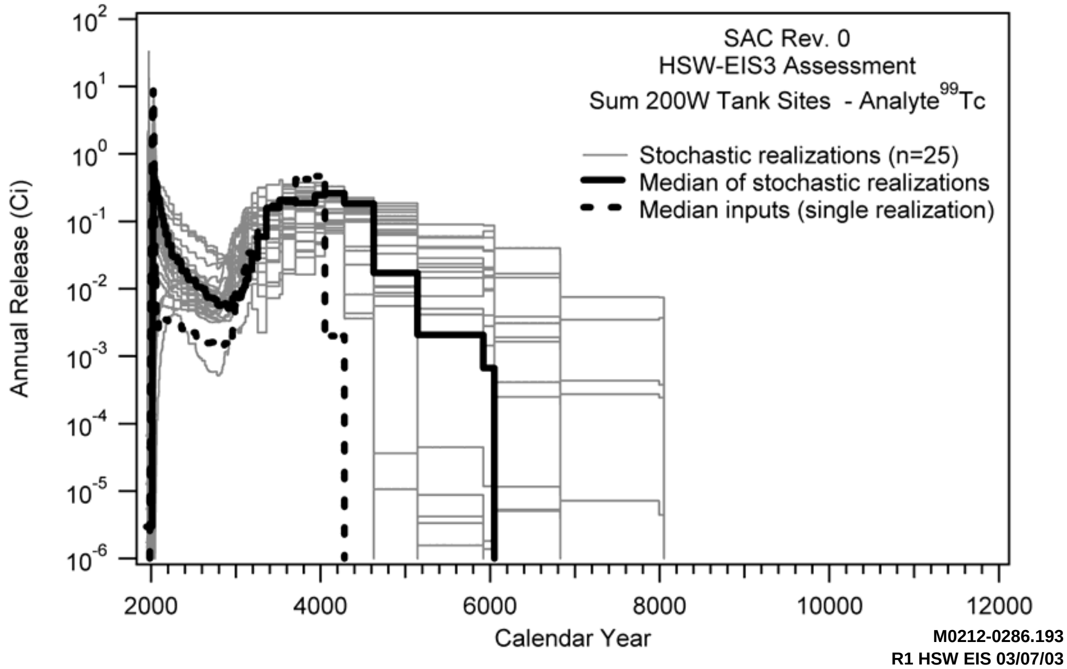

Figure L.13. SAC Results for Annual Vadose Zone Release of Technetium-99 from All Tank Sites in the 200 West Area

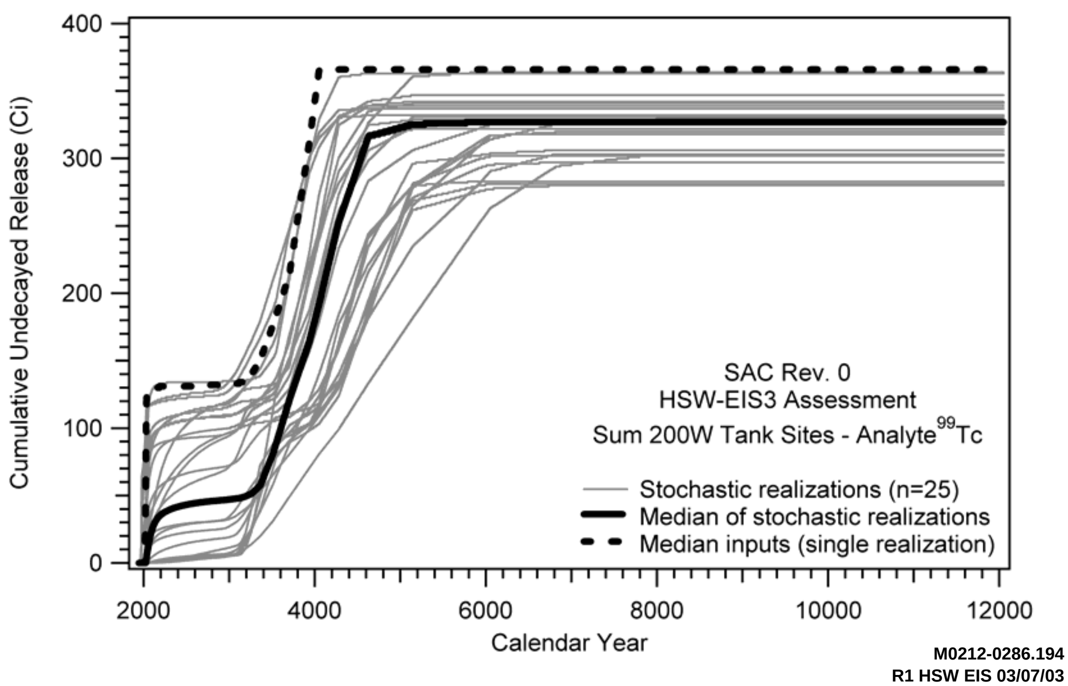

Figure L.14. SAC Results for Cumulative (undecayed) Vadose Zone Release of Technetium-99 from All Tank Sites in the 200 West Area

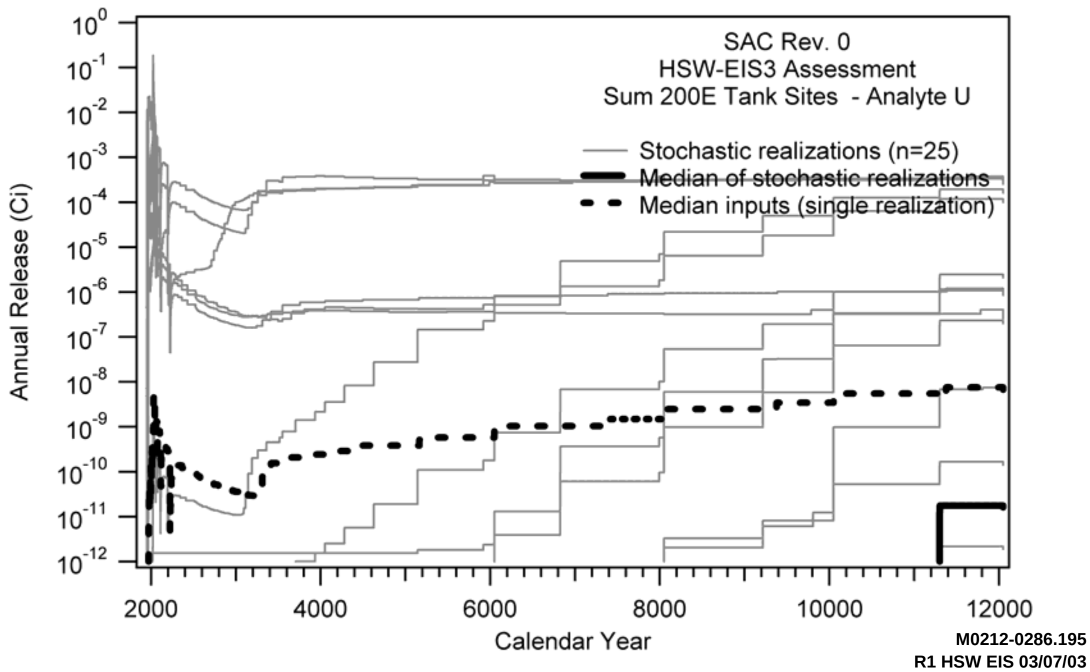

Figure L.15. SAC Results for Annual Vadose Zone Release of Uranium from All Tank Sites in the 200 East Area

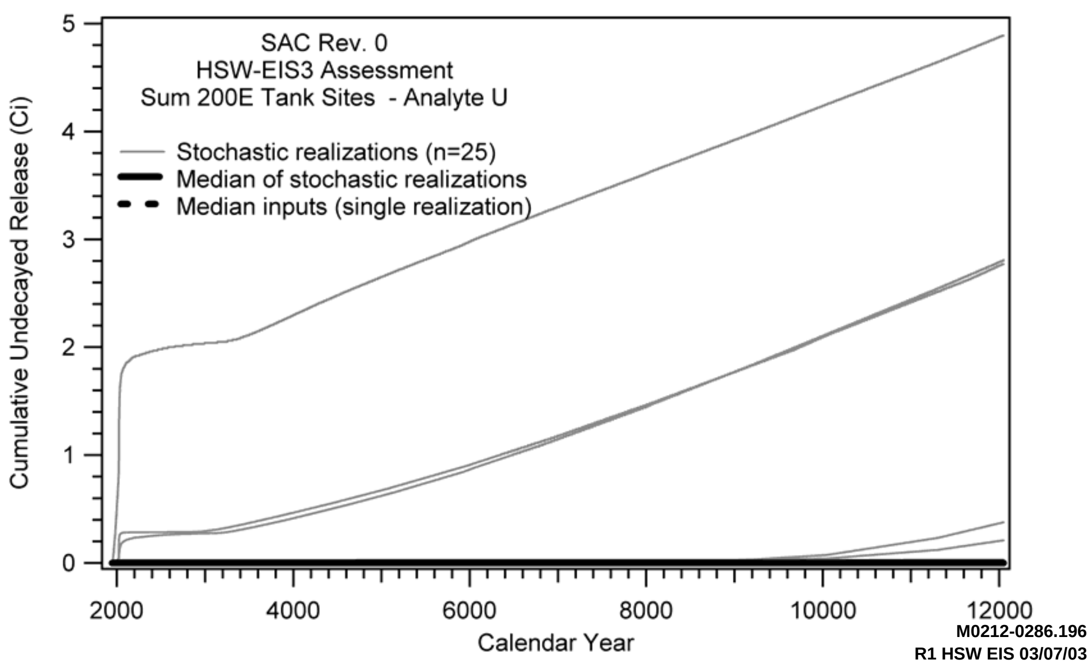

Figure L.16. SAC Results for Cumulative (undecayed) Vadose Zone Release of Uranium from All Tank Sites in the 200 East Area

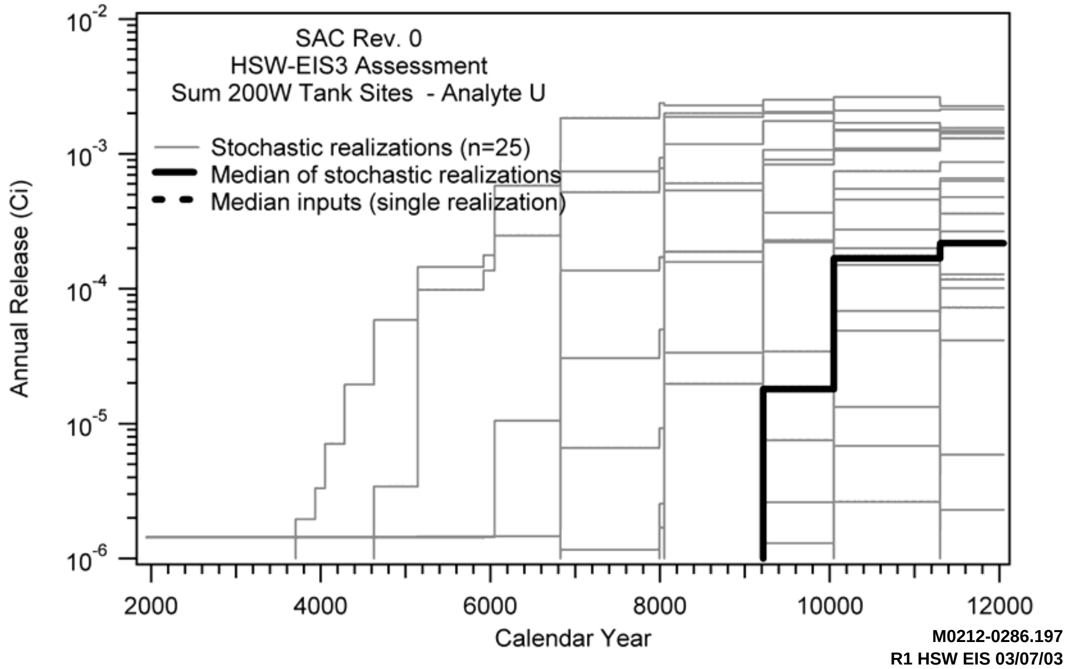

Figure L.17. SAC Results for Annual Vadose Zone Release of Uranium from All Tank Sites in the 200 West Area

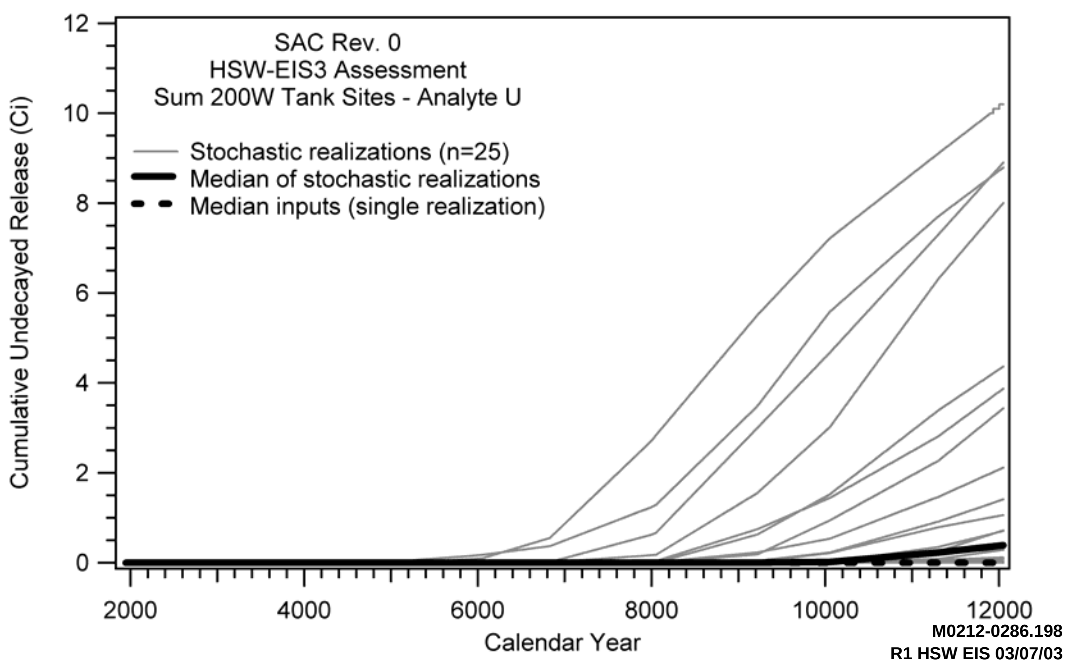

Figure L.18. SAC Results for Cumulative (undecayed) Vadose Zone Release of Uranium from All Tank Sites in the 200 West Area

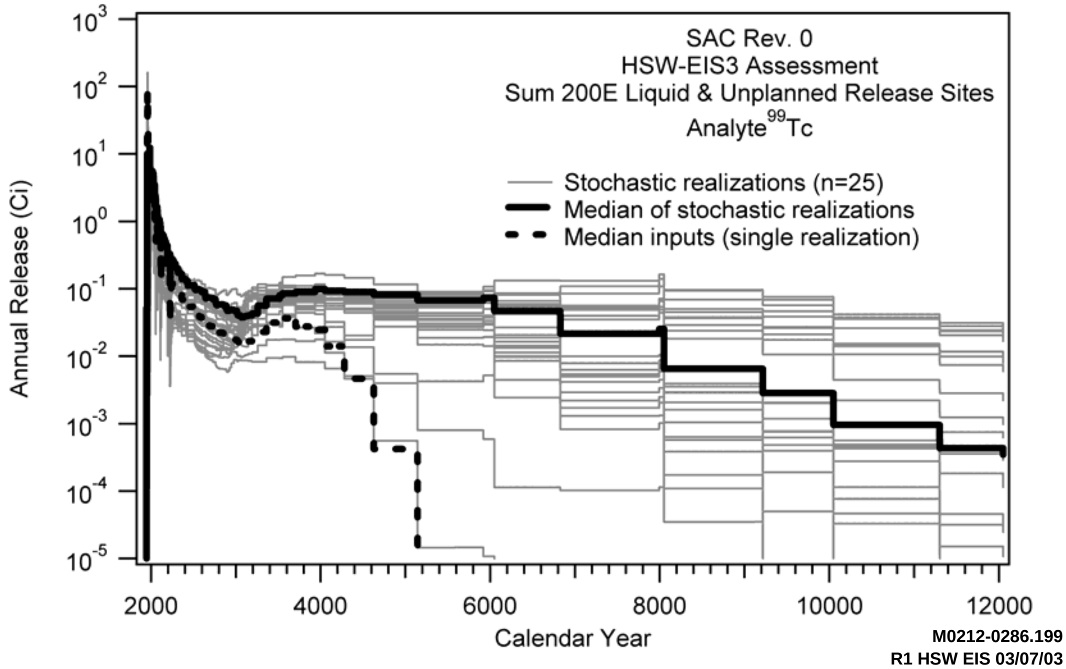

Figure L.19. SAC Results for Annual Vadose Zone Release of Technetium-99 from All Liquid Discharge and Unplanned Release Sites in the 200 East Area

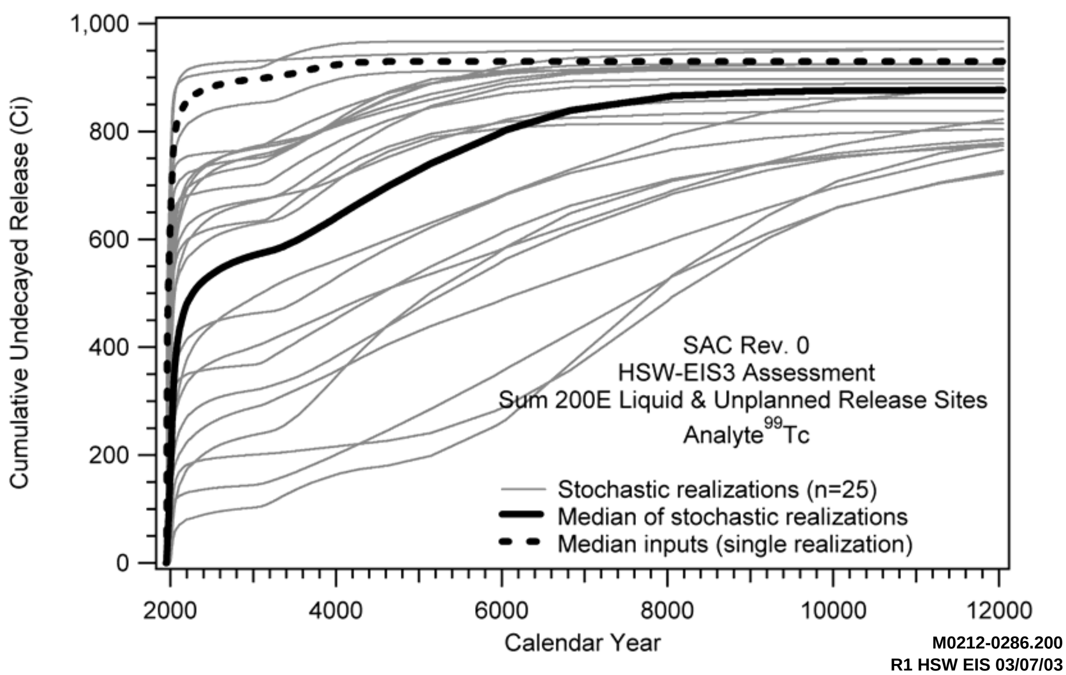

Figure L.20. SAC Results for Cumulative (undecayed) Vadose Zone Release of Technetium-99 from All Liquid Discharge and Unplanned Release Sites in the 200 East Area

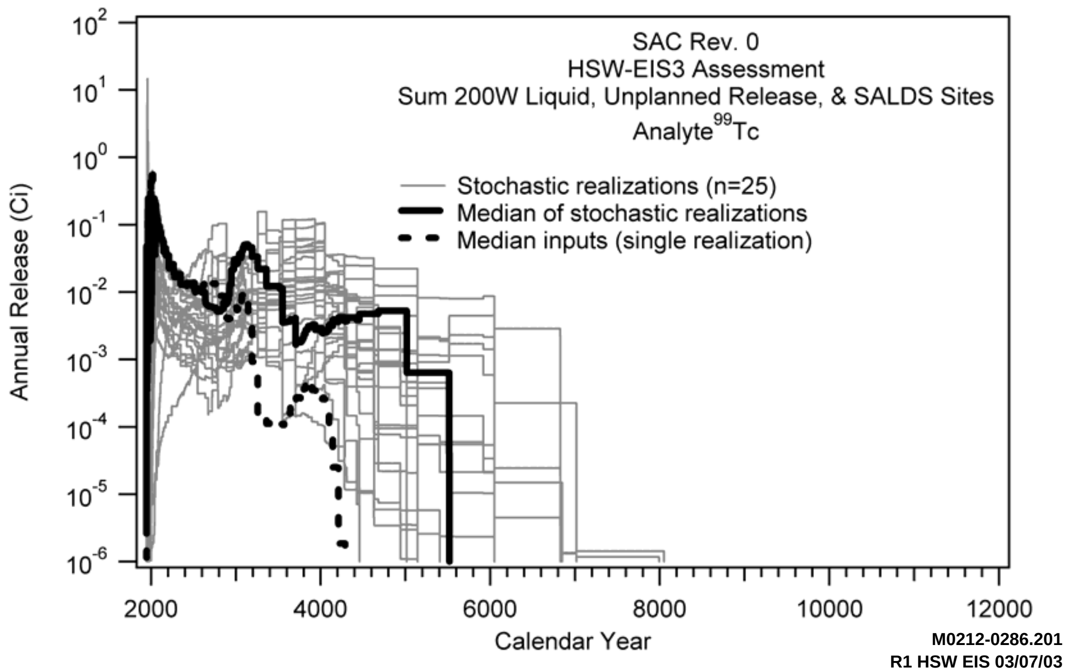

Figure L.21. SAC Results for Annual Vadose Zone Release of Technetium-99 from All Liquid Discharge and Unplanned Release Sites in the 200 West Area Plus SALDS

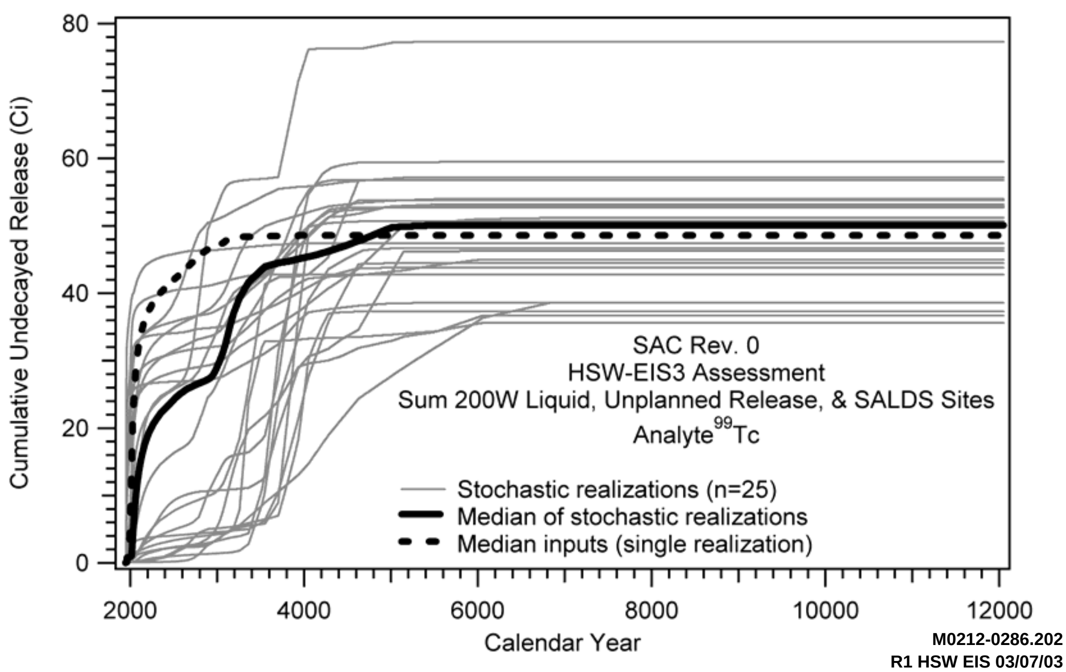

Figure L.22. SAC Results for Cumulative (undecayed) Vadose Zone Release of Technetium-99 from All Liquid Discharge and Unplanned Release Sites in the 200 West Area Plus SALDS

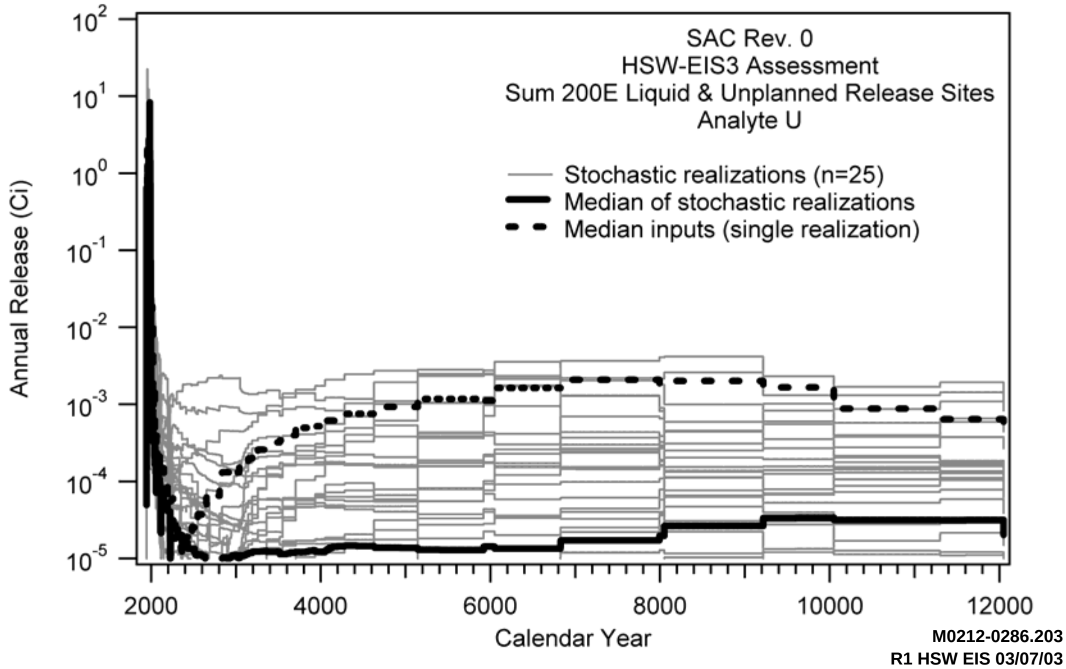

Figure L.23. SAC Results for Annual Vadose Zone Release of Uranium from All Liquid Discharge and Unplanned Release Sites in the 200 East Area

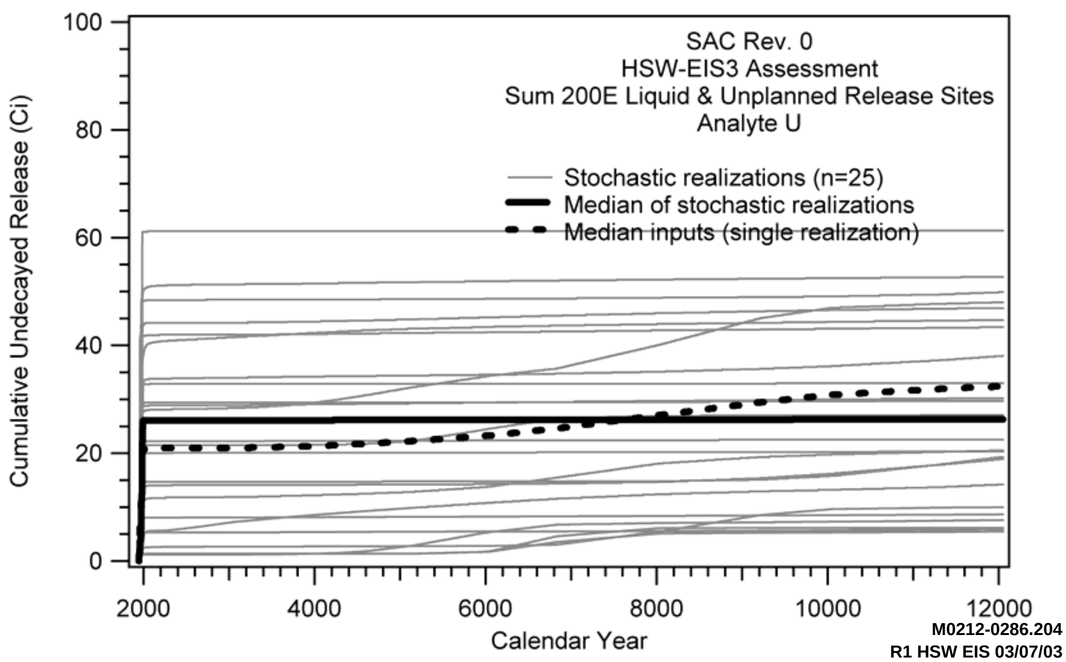

Figure L.24. SAC Results for Cumulative (undecayed) Vadose Zone Release of Uranium from All Liquid Discharge and Unplanned Release Sites in the 200 East Area

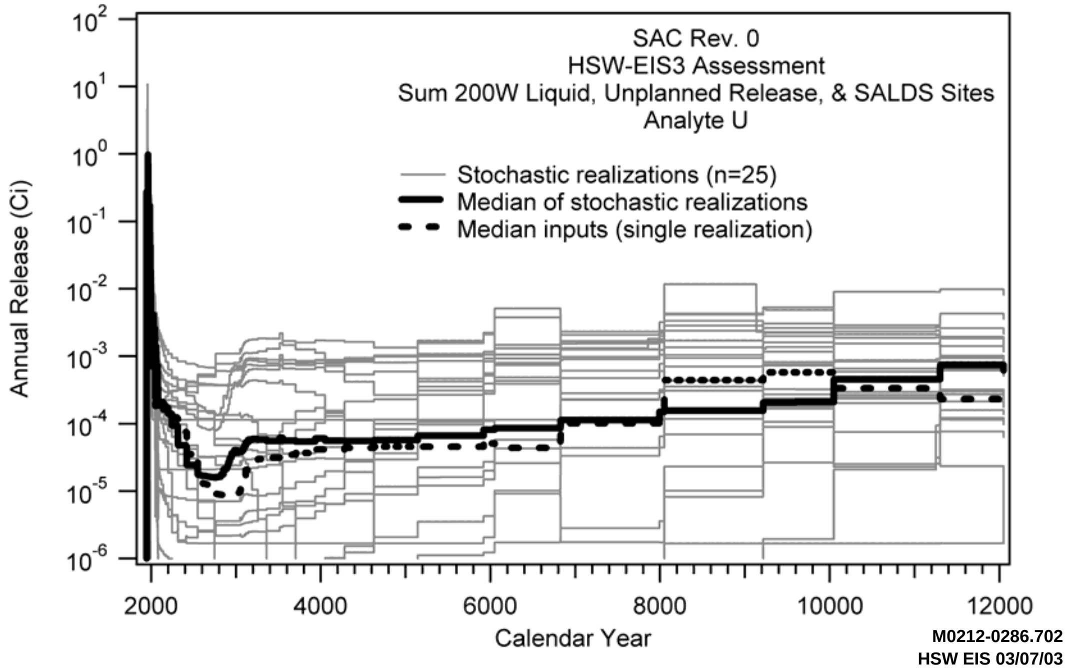

Figure L.25. SAC Results for Annual Vadose Zone Release of Uranium from All Liquid Discharge and Unplanned Release Sites in the 200 West Area Plus SALDS

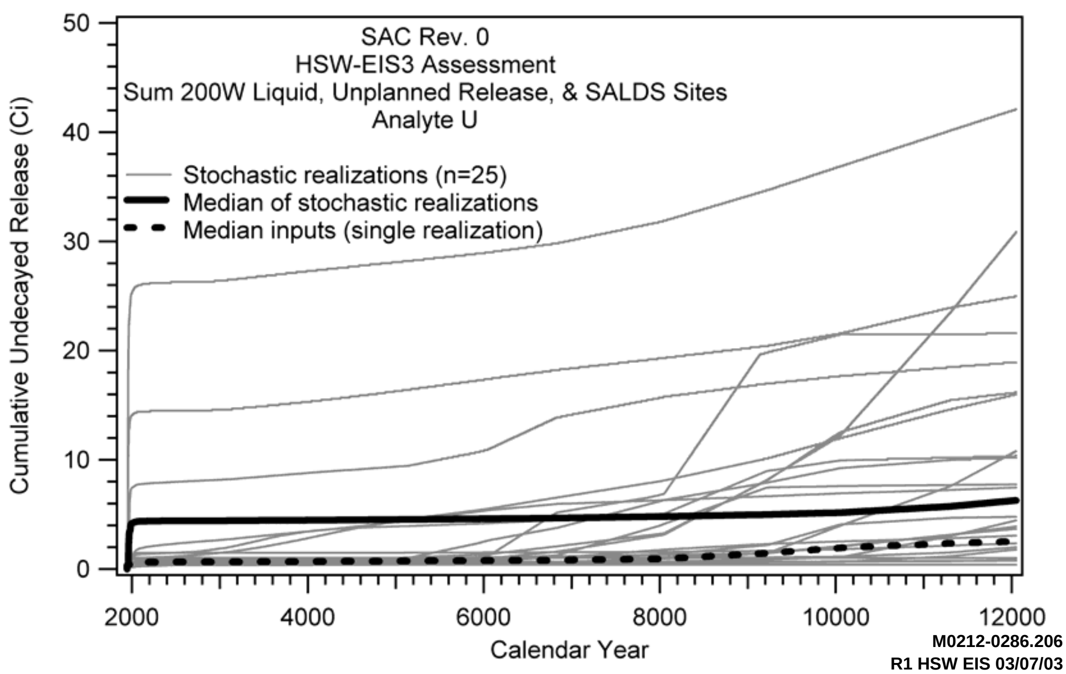

Figure L.26. SAC Results for Cumulative (undecayed) Vadose Zone Release of Uranium from All Liquid Discharge and Unplanned Release Sites in the 200 West Area Plus SALDS

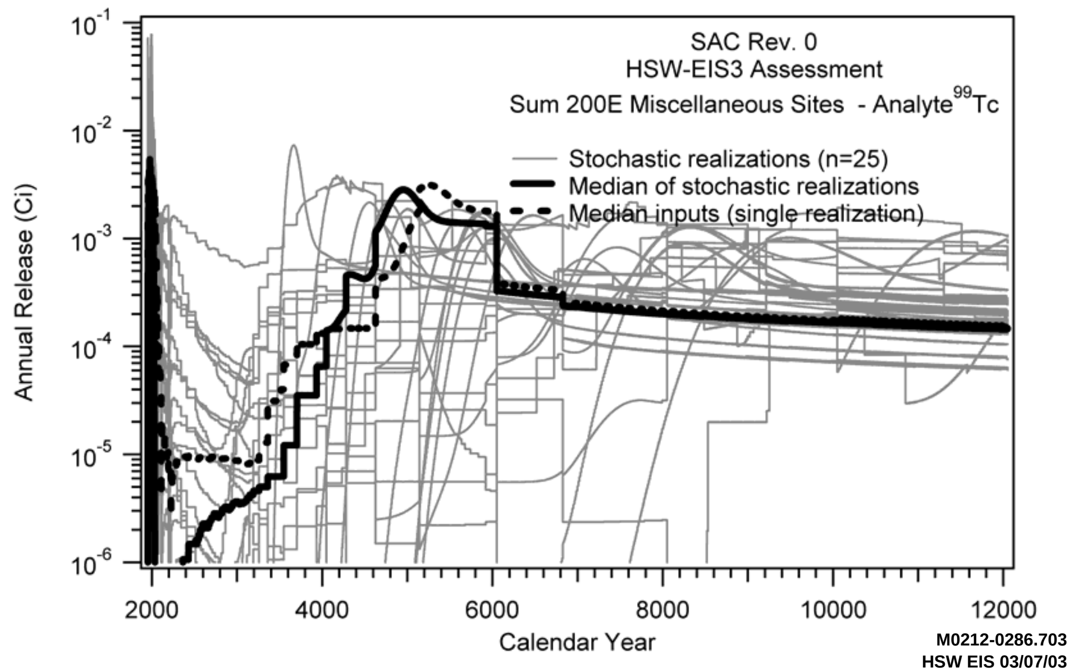

Figure L.27. SAC Results for Annual Vadose Zone Release of Technetium-99 from All Other Sites in the 200 East Area

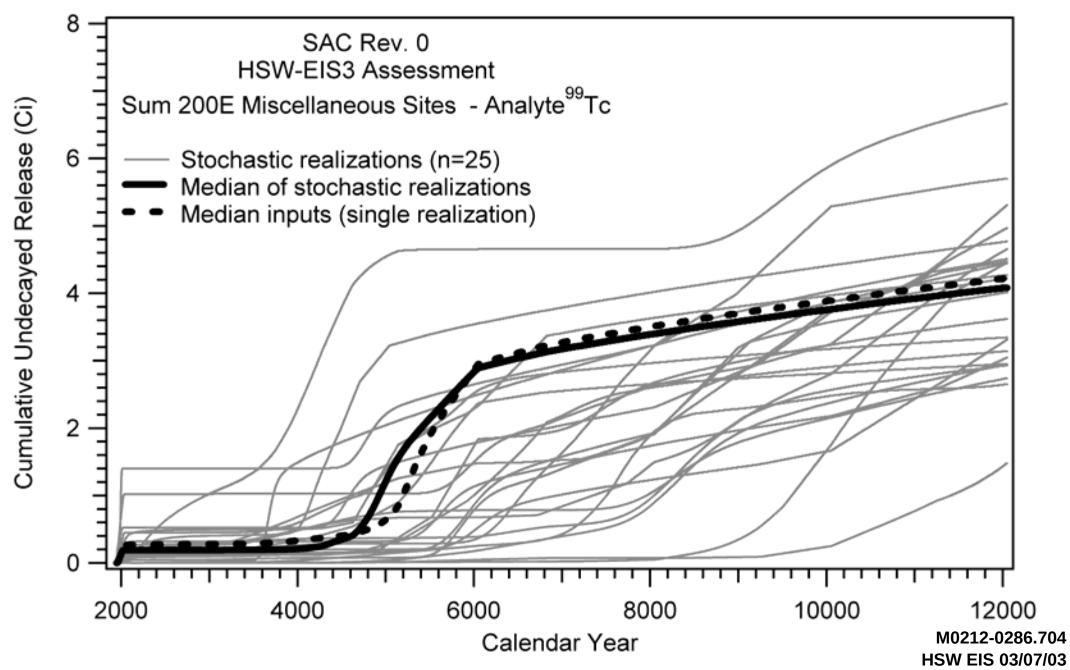

Figure L.28. SAC Results for Cumulative (undecayed) Vadose Zone Release of Technetium-99 from All Other Sites in the 200 East Area

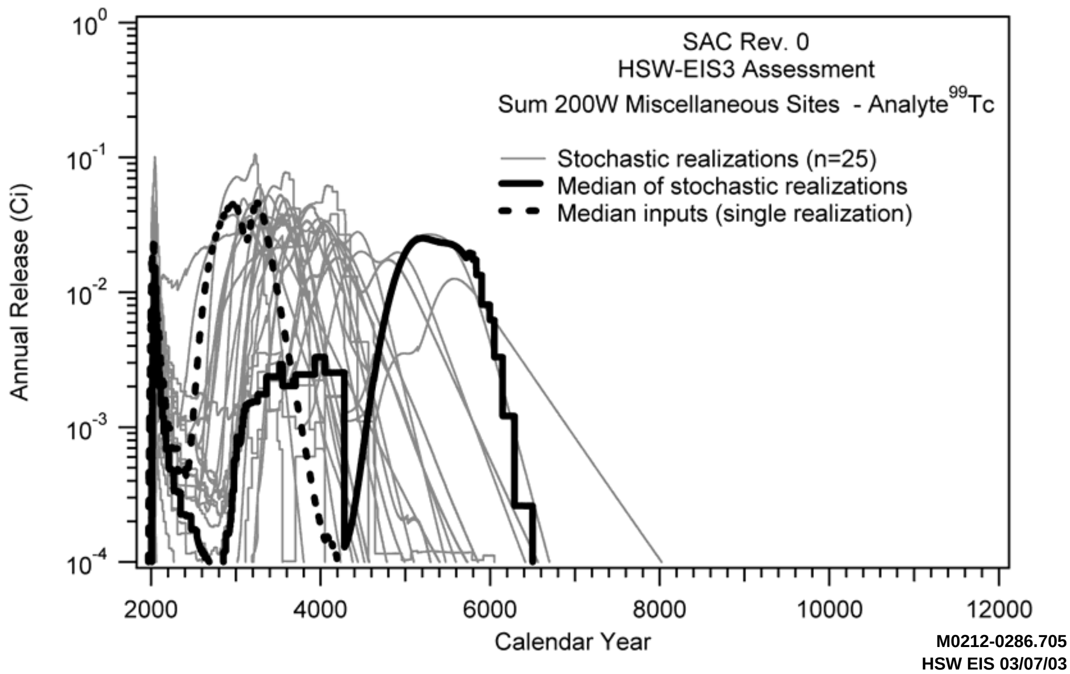

Figure L.29. SAC Results for Annual Vadose Zone Release of Technetium-99 from All Other Sites in the 200 West Area

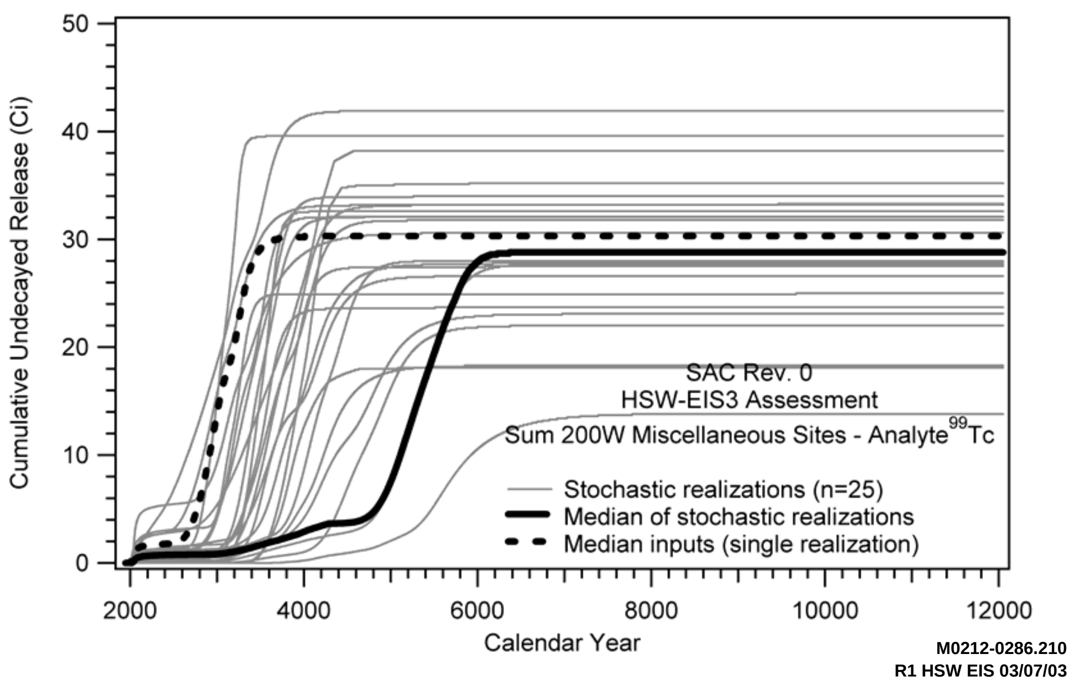

Figure L.30. SAC Results for Cumulative (undecayed) Vadose Zone Release of Technetium-99 from All Other Sites in the 200 West Area

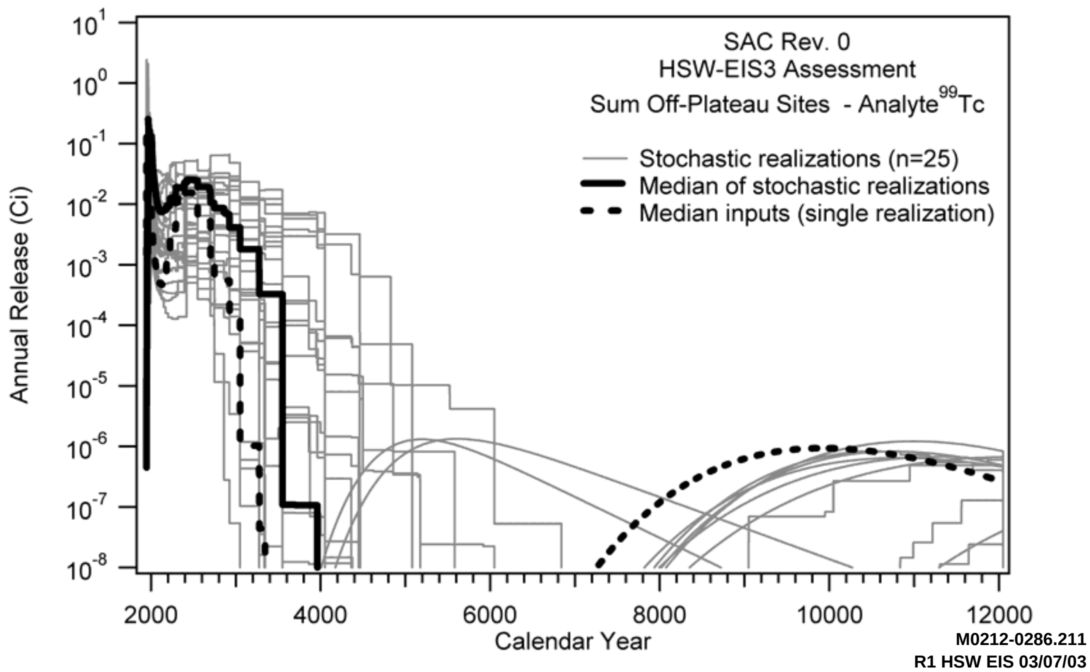

Figure L.31. SAC Results for Annual Vadose Zone Release of Technetium-99 from all Other Sites Outside the 200 East and 200 West Areas

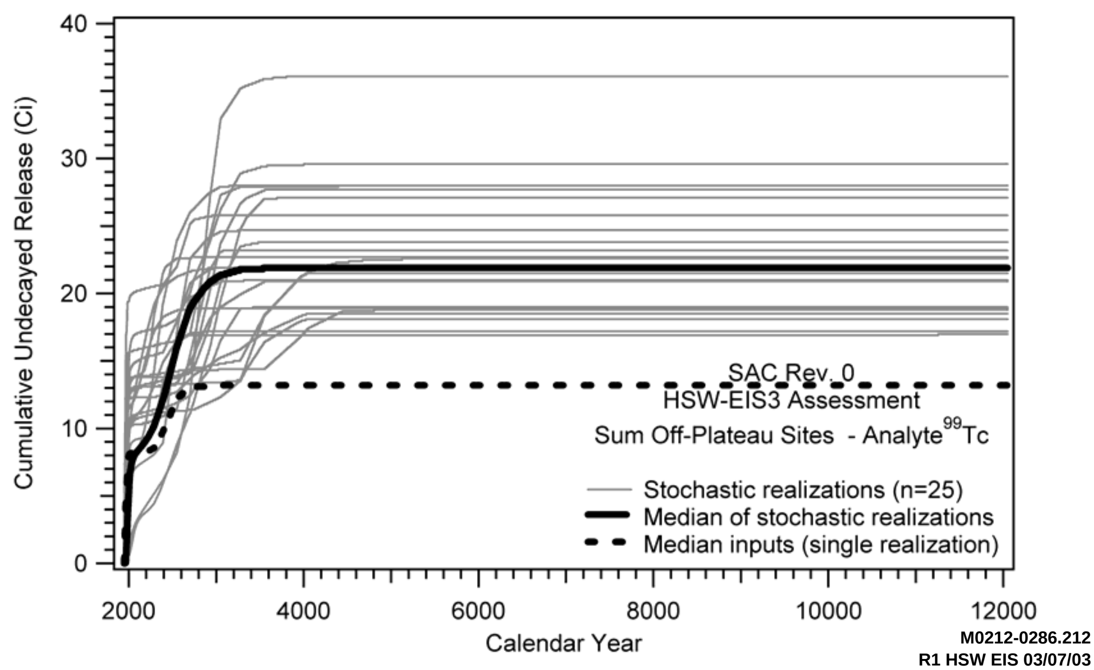

Figure L.32. SAC Results for Cumulative (undecayed) Vadose Zone Release of Technetium-99 from All Other Sites Outside the 200 East and 200 West Areas

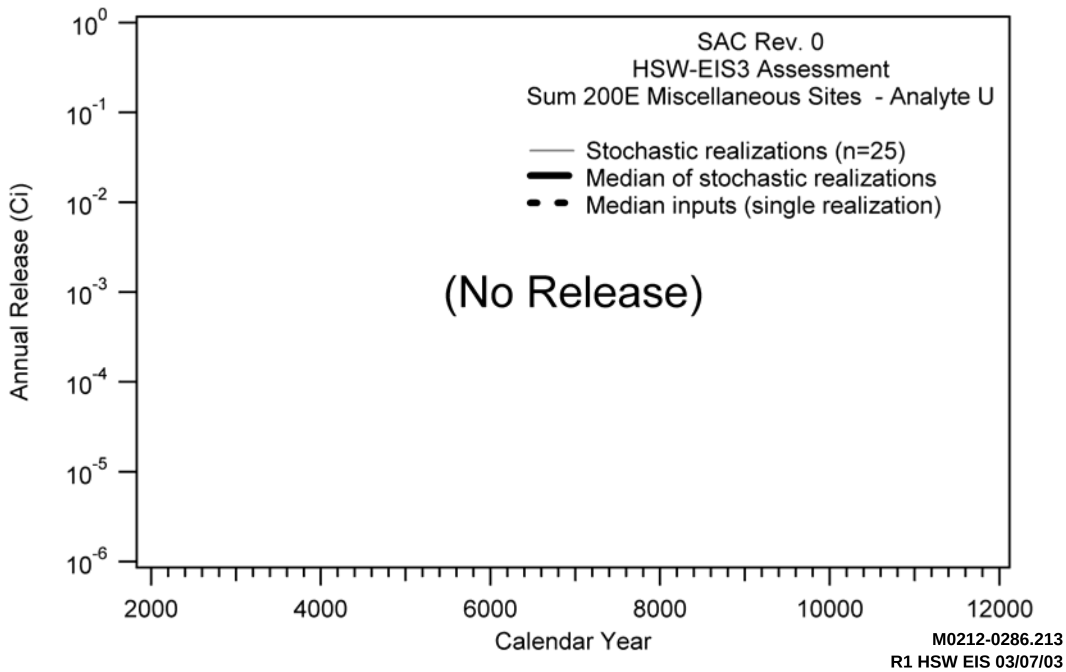

Figure L.33. SAC Results for Annual Vadose Zone Release of Uranium from All Other Sites in the 200 East Area

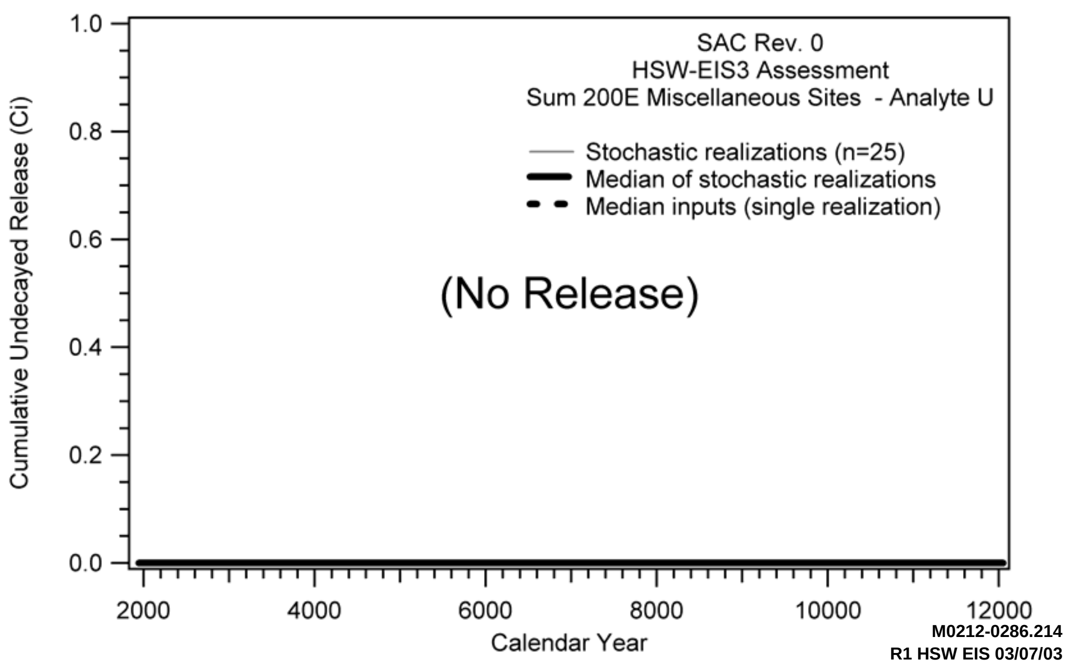

Figure L.34. SAC Results for Cumulative (undecayed) Vadose Zone Release of Uranium from All Other Sites in the 200 East Area

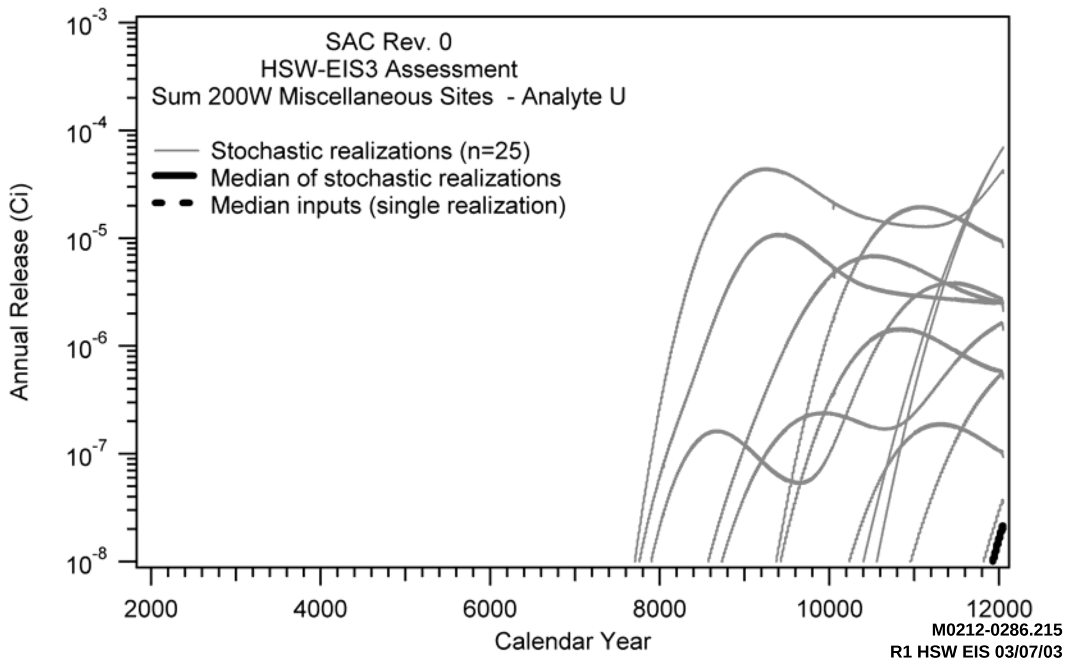

Figure L.35. SAC Results for Annual Vadose Zone Release of Uranium from All Other Sites in the 200 West Area

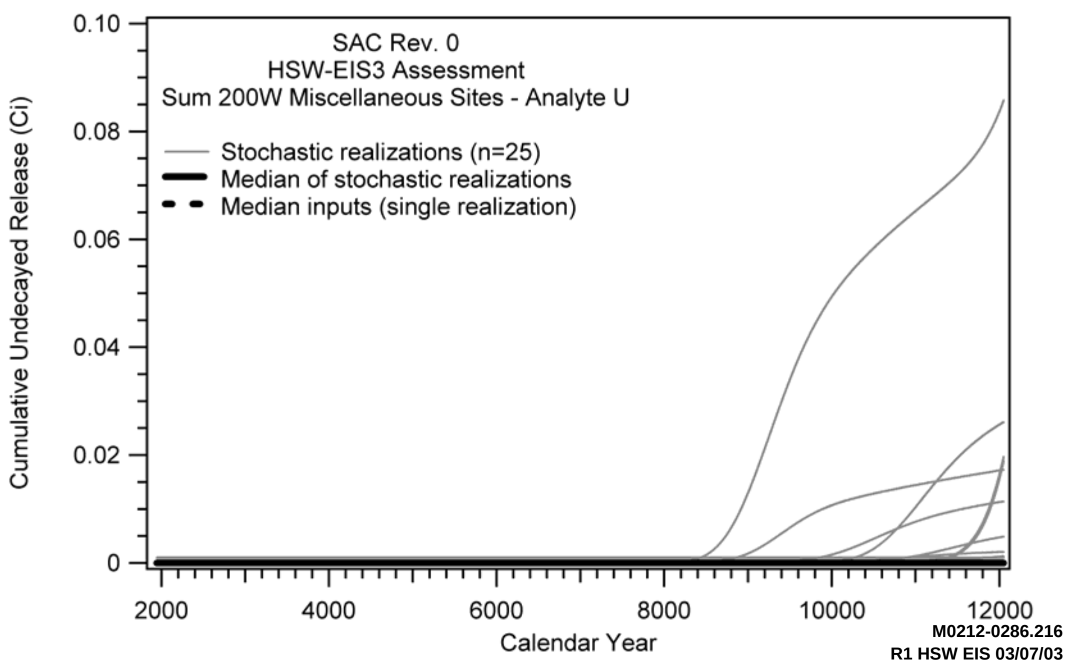

Figure L.36. SAC Results for Cumulative (undecayed) Vadose Zone Release of Uranium from All Other Sites in the 200 West Area

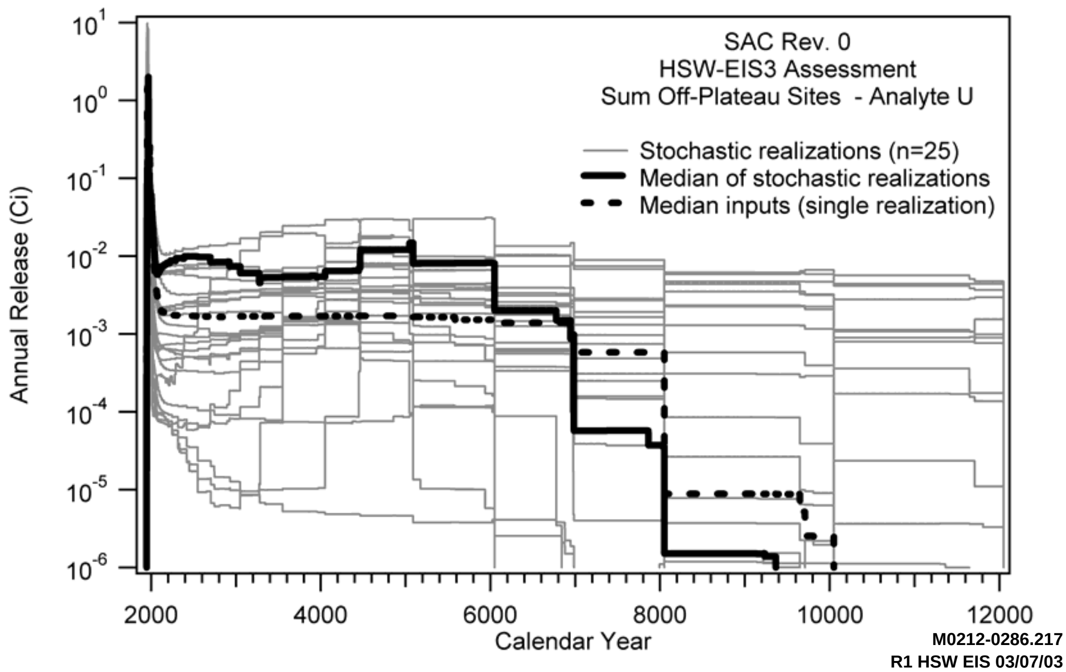

Figure L.37. SAC Results for Annual Vadose Zone Release of Uranium from All Other Sites Outside the 200 East and 200 West Areas

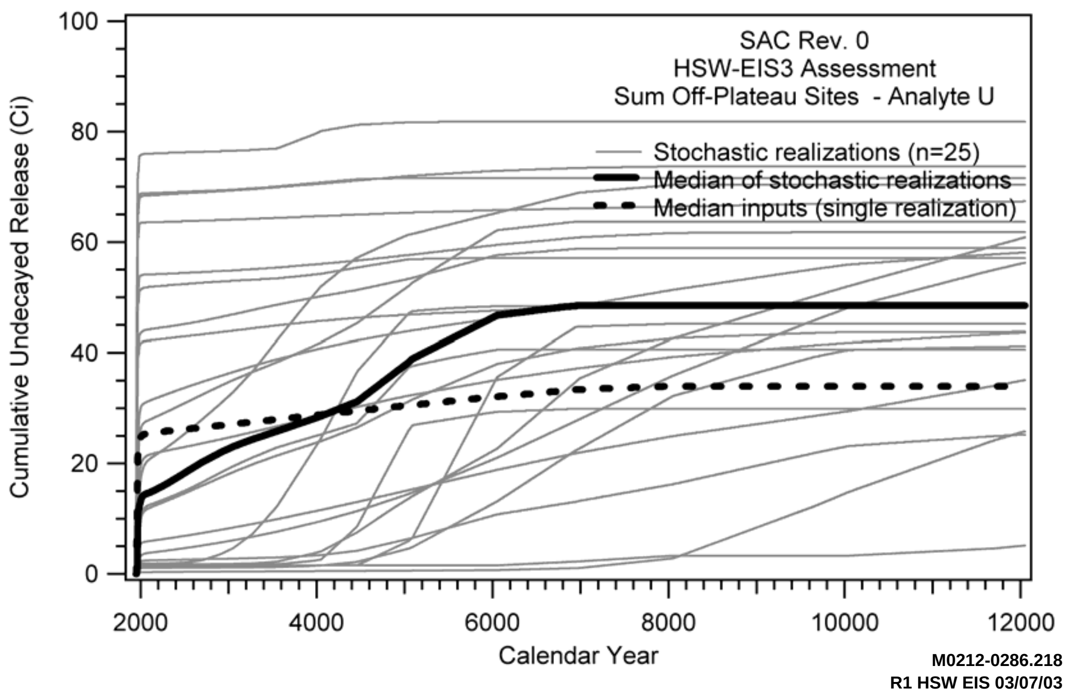

Figure L.38. SAC Results for Cumulative (undecayed) Vadose Zone Release of Uranium from All Other Sites Outside the 200 East and 200 West Areas

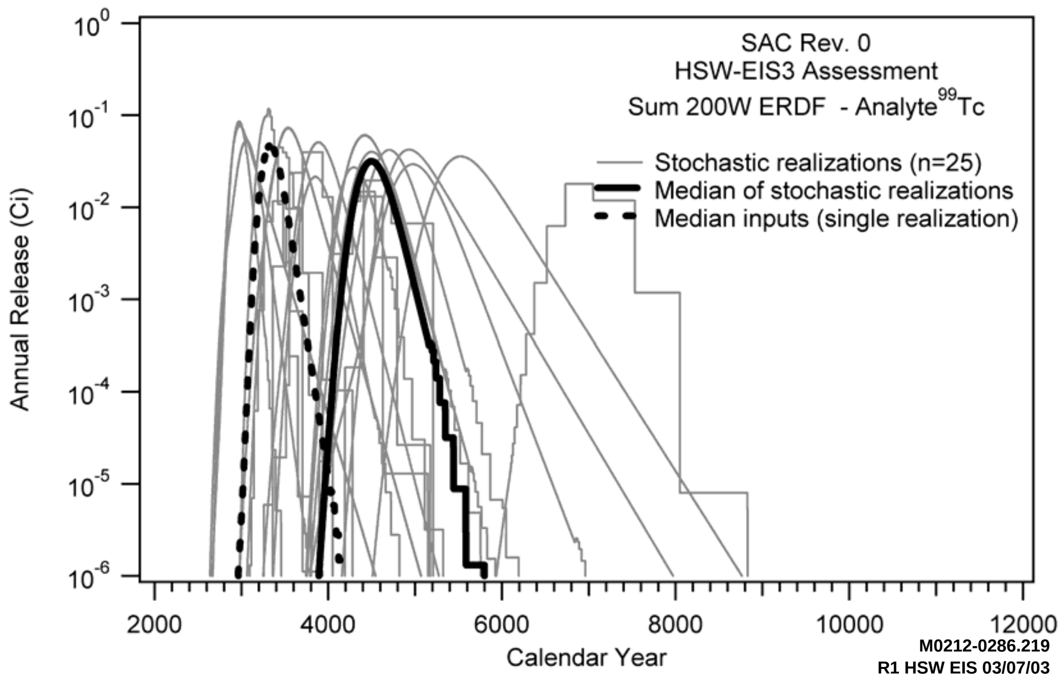

Figure L.39. SAC Results for Annual Vadose Zone Release of Technetium-99 from ERDF

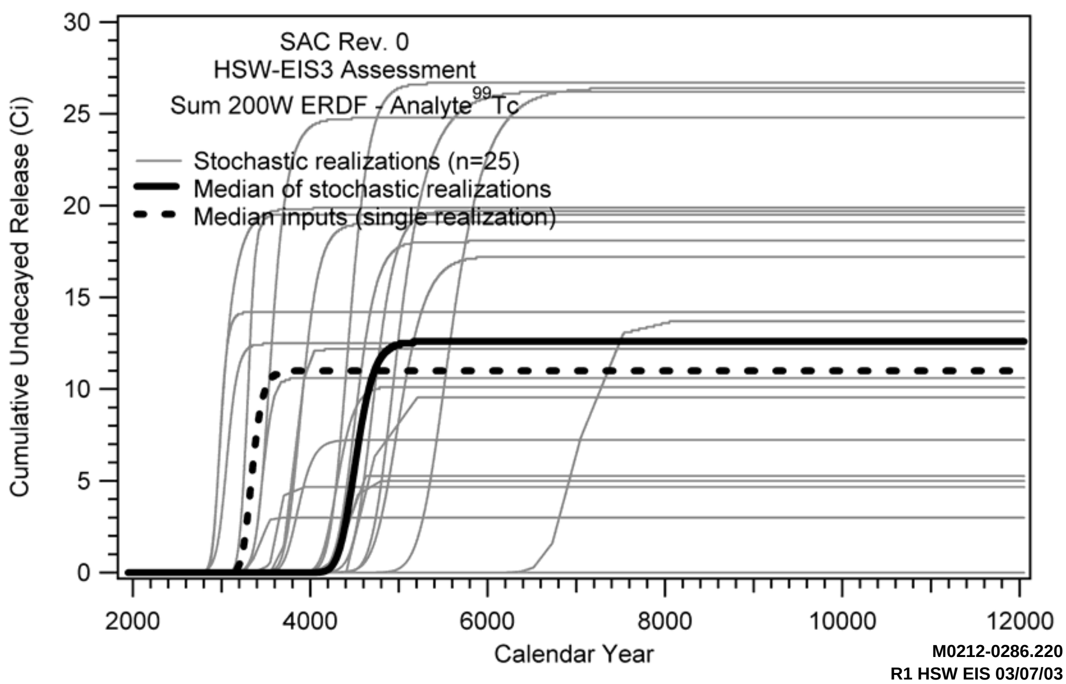

Figure L.40. SAC Results for Cumulative (undecayed) Vadose Zone Release of Technetium-99 from ERDF

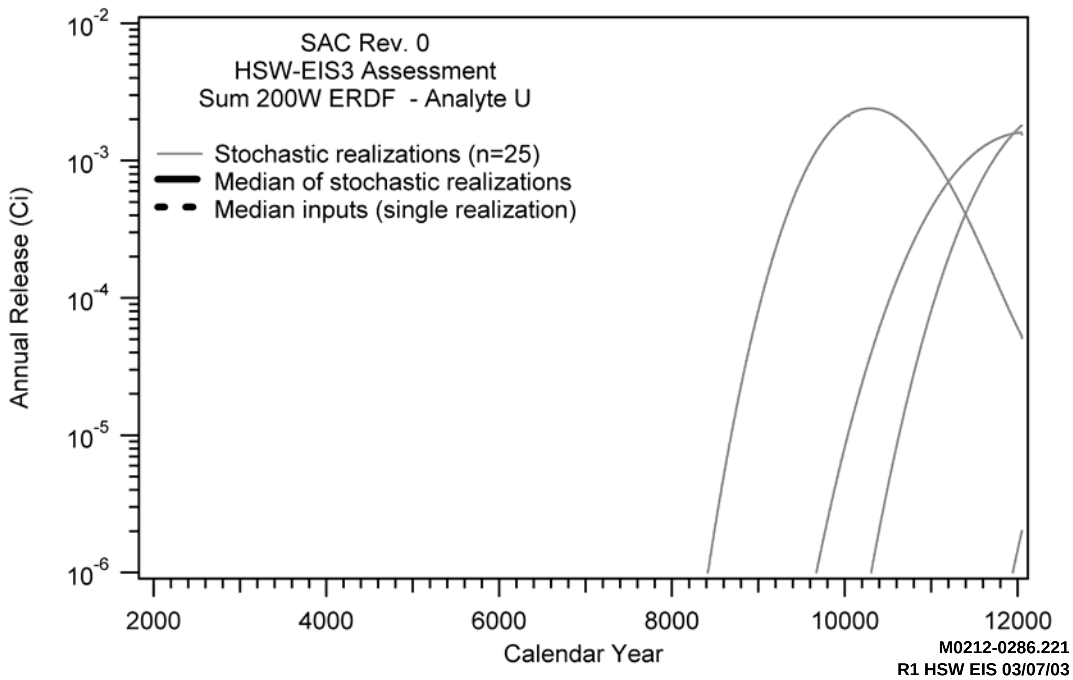

Figure L.41. SAC Results for Annual Vadose Zone Release of Uranium from the ERDF

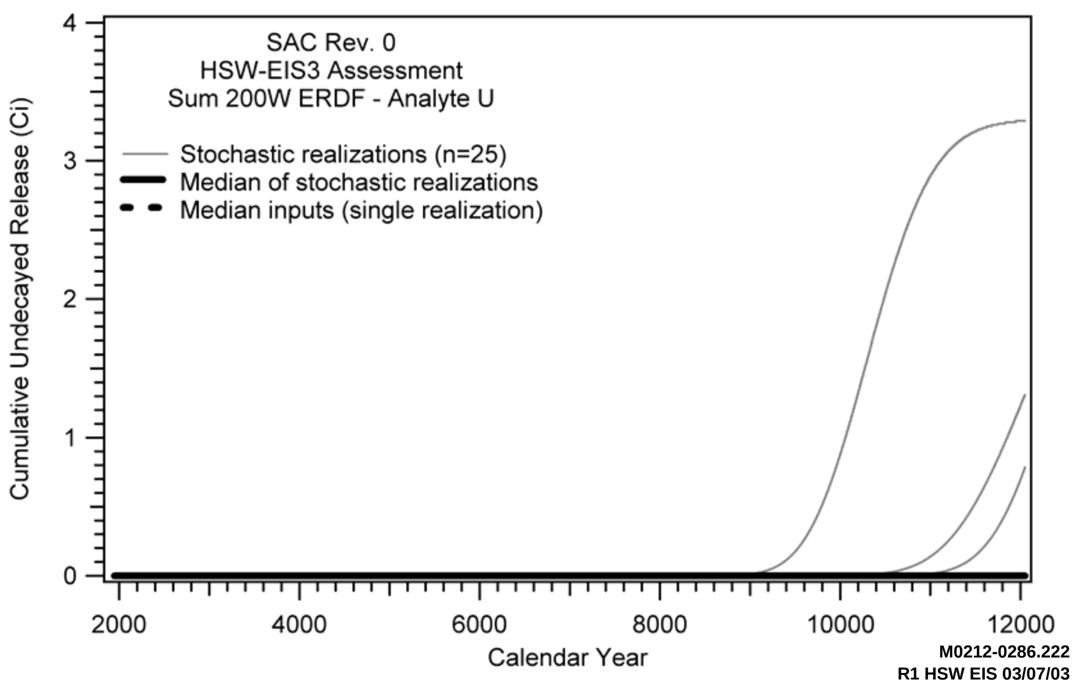

Figure L.42. SAC Results for Cumulative (undecayed) Vadose Zone Release of Uranium from the ERDF

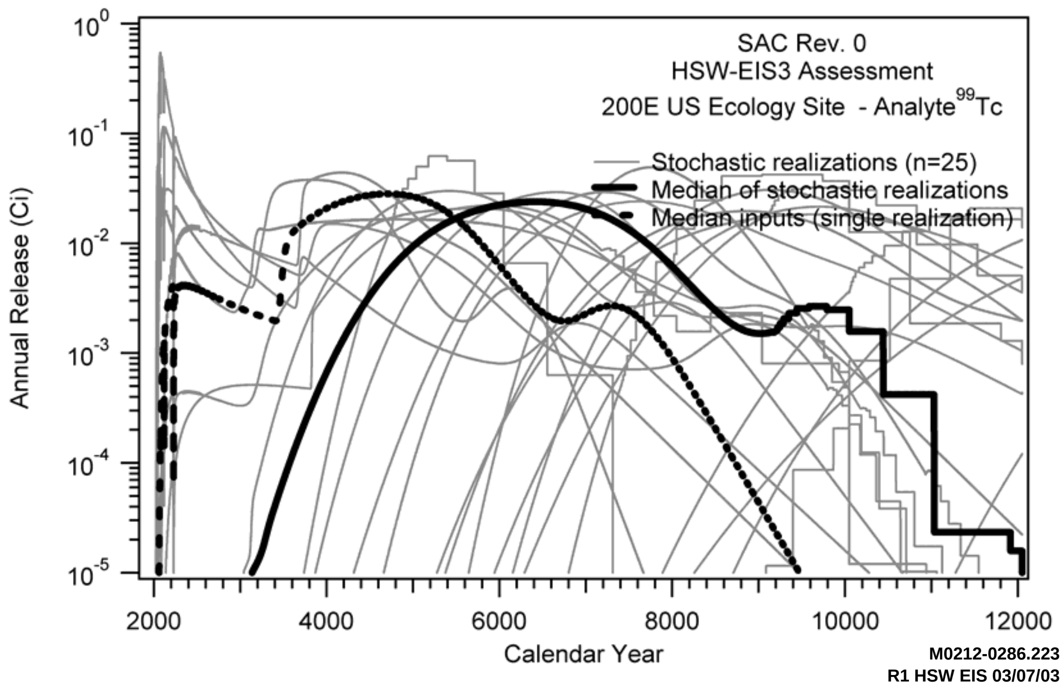

Figure L.43. SAC Results for Annual Vadose Zone Release of Technetium-99 from the Commercial Low-Level Radioactive Waste Disposal (US Ecology, Inc.) Site

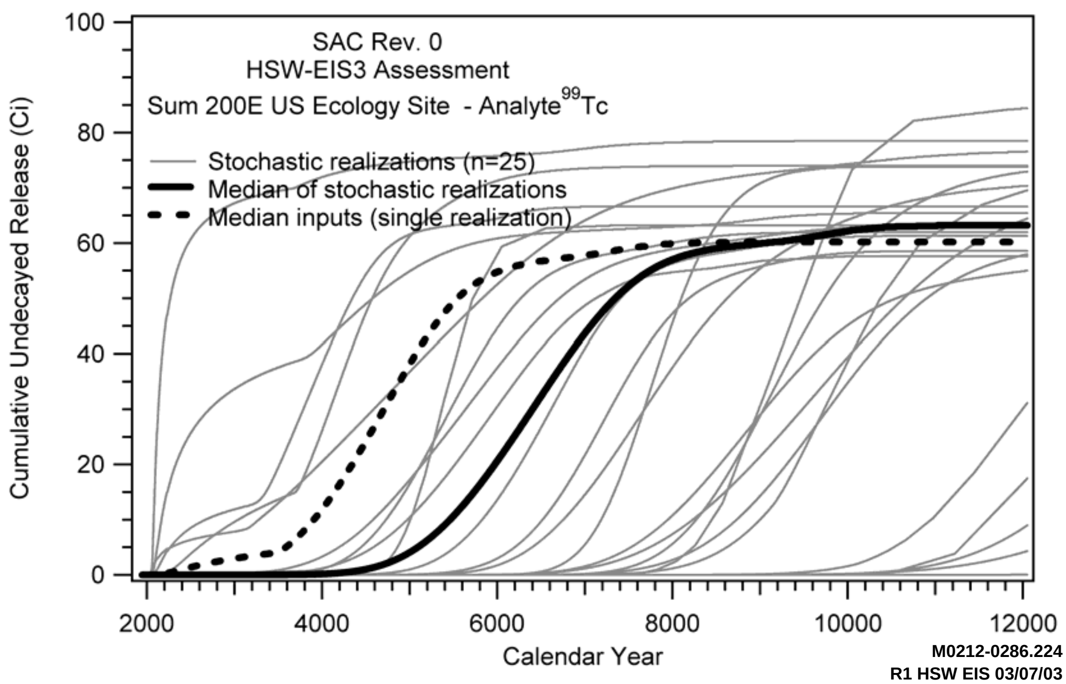

Figure L.44. SAC Results for Cumulative (undecayed) Vadose Zone Release of Technetium-99 from the Commercial Low-Level Radioactive Waste Disposal (US Ecology, Inc.) Site

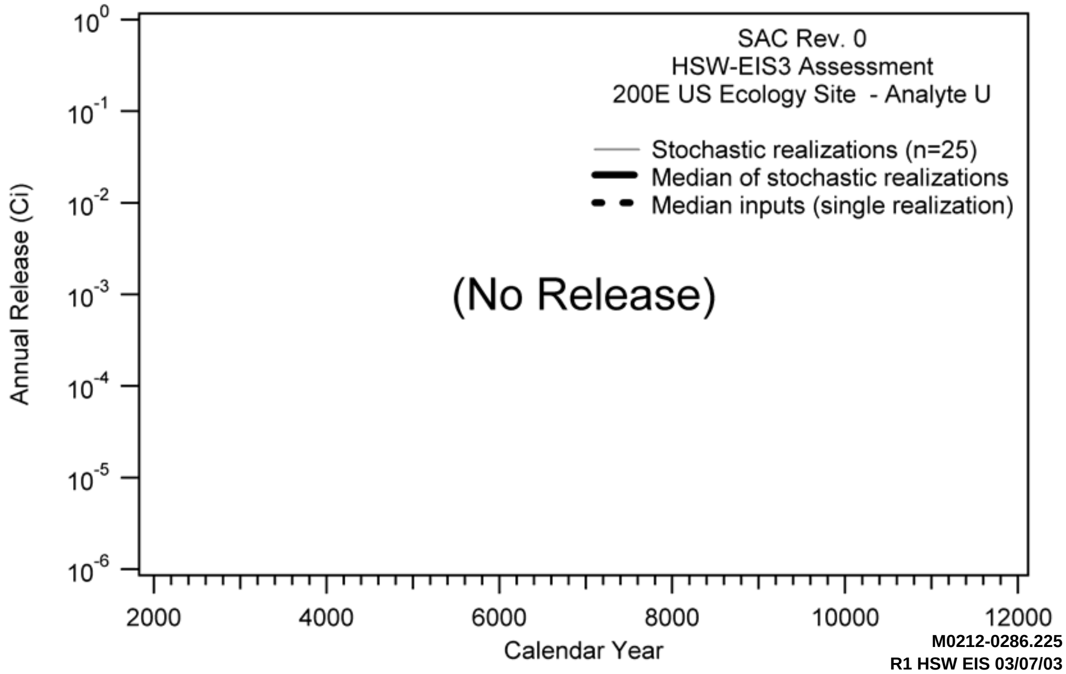

Figure L.45. SAC Results for Annual Vadose Zone Release of Uranium from the Commercial Low-Level Radioactive Waste Disposal (US Ecology, Inc.) Site

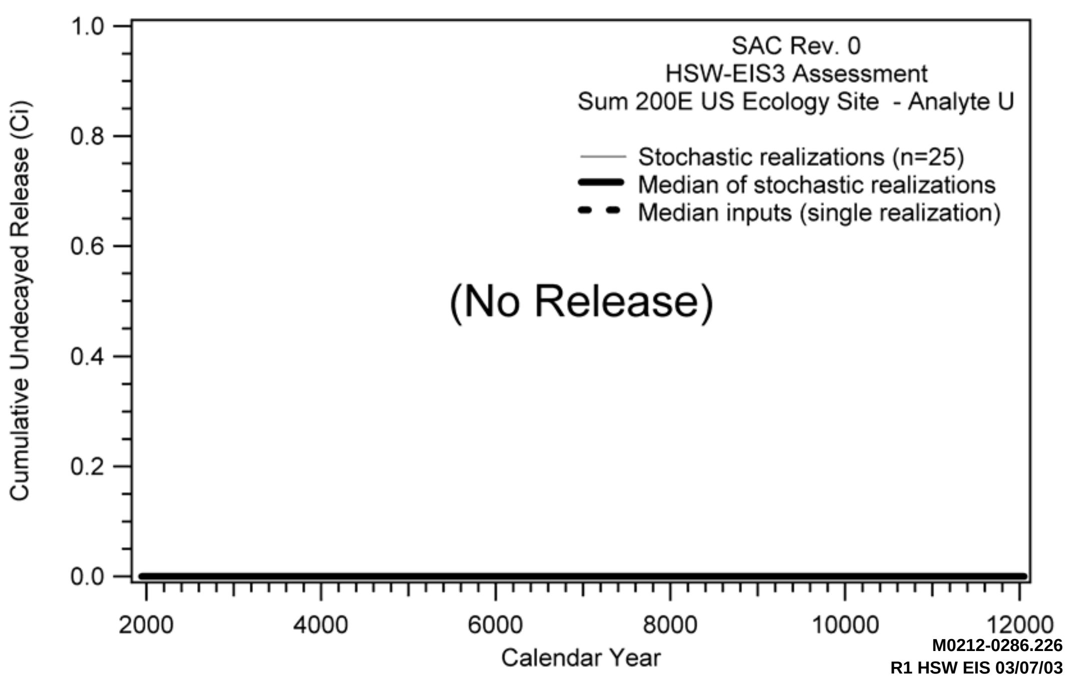

Figure L.46. SAC Results for Cumulative (undecayed) Vadose Zone Release of Uranium from the Commercial Low-Level Radioactive Waste Disposal (US Ecology, Inc.) Site

L.3.2 Drinking Water Dose at Selected 200 East and 200 West Area Locations

Doses to humans calculated using the SAC software and data are summarized in this section. The exposure scenario has an adult human drinking 2 L per day of contaminated groundwater. The stochastic capability of SAC was employed for these simulations, so the following results are shown in each plot in this section:

- Individual stochastic results (25 realizations) are shown in black.

- The median result of the 25 realizations—that is, the realization that resulted in the median integrated cumulative dose in the year 12050 A.D. (at the end of the simulation)—is shown in blue.

- The median-inputs simulation—a separate single-realization simulation with SAC using the median value of all stochastic input variables—is shown in red.

The variability in the stochastic results is due to variability in the inventory, release, and transport of technetium-99 and uranium. The human dose calculations use fixed inputs.

The doses provided in this section are based on all waste at the Hanford Site except the ILAW, melters, and naval reactor compartments. Cumulative releases to groundwater for HSW excluding ILAW disposed of in the Central Plateau range from approximately 323 to approximately 445 Ci for technetium-99 during the 10,000-year analysis period. This compares with a range of release to groundwater between approximately 1530 and 2310 Ci of technetium-99 for all Hanford wastes except ILAW. The contribution from HSW excluding ILAW would amount to about 20 percent of the cumulative release from Hanford sources excluding ILAW. The median release of technetium-99 from HSW excluding ILAW was approximately 390 Ci while the median release for all Hanford sources except ILAW was approximately 2000 Ci. The ILAW cumulative release of technetium-99 for the base case (Mann et al. 2001) considering the full technetium-99 inventory was approximately 86 curies by the end of the 10,000-yr post-closure period. Accordingly the contribution from HSW including ILAW would amount to about 25 percent of the cumulative release from all Hanford sources after 10,000 years.

For uranium, the cumulative releases to groundwater for Hanford solid waste disposed of in the Central Plateau range from 0 to approximately 94 Ci. However of all realizations simulated, no realizations showed any release to groundwater from HSW in the 200 East Area, and only 5 of 25 realizations show any release of uranium to groundwater from HSW in the 200 West Area. Thus, in an average (or median) sense, HSW deposits would release no uranium to groundwater over the 10,000 yr period of analysis. This compares with a median release of approximately 84 Ci and a range of release to groundwater from the 25 realizations of between approximately 10 to 300 Ci of uranium for all Hanford wastes except ILAW. Of the five realizations of non-zero uranium release from HSW in the 200 West Area, the cumulative release ranged from 0 to approximately 90 Ci. The contribution from uranium in Hanford solid waste lies between 0 and 30 percent of the cumulative release from all Hanford sources. However, the median release of uranium from Hanford solid waste was zero while the median release for all Hanford sources (except ILAW) was approximately 84 Ci.

L.3.2.1 Drinking Water Dose at the Northeast Corner of the 200 West Area

The drinking water dose to a human from technetium-99 using groundwater approximately 1 km (0.62 mi) outside the northeast corner of 200 West Area is provided in Figure L.47. The location was chosen to represent the highest doses from the local groundwater plume. The drinking water dose to a human from uranium at the same location is provided in Figure L.48. Neither of these figures included ILAW waste-form impacts explicitly. However, ILAW disposal occurs in the 200 East Area, and existing and future groundwater flow will conduct plumes from ILAW release away from the 200 West Area location shown in these figures. The data for technetium-99 show peaks early and again after approximately 3000 years. Figure L.47 exhibits a peak dose from technetium-99 in the range of 1 to 3 mrem/yr and a median of less than 2 mrem/yr with much lower consequences in the 7000 to 10,000-year time frame (that is, a range of 0.001 to 0.01 mrem/yr and a median less than 0.002 mrem/yr). Figure L.48 exhibits a peak dose from uranium (that is, a range of 0.01 to 0.3 mrem/yr and a median of approximately 0.05 mrem/yr) and considerable variability in later years because of the sorption model for uranium (that is, a range of 0.0001 to 7 mrem/yr and a median of approximately 0.04 mrem/yr).

L.3.2.2 Drinking Water Dose at the Southeast Corner of the 200 East Area

The drinking water dose to a human from technetium-99 using groundwater from approximately 1 km (0.62 mi) outside the southeast corner of 200 East Area is provided in Figure L.49. The location was chosen to represent the highest doses from the local groundwater plume. The drinking water dose to a human from uranium at the same location is provided in Figure L.50. Neither of these figures includes ILAW waste-from impacts. The technetium-99 results show peaks early and again throughout the 10,000-year period. Figure 5.49 exhibits a peak median dose from technetium-99 in the range of 0.3 to 2 mrem/yr during the 10,000-year period. Peaks within all realizations range to 100 mrem/yr. Figure 5.50 exhibits a peak median dose from uranium of less than 1 mrem/yr early with a long-term median value of less than 0.01 mrem/yr. There is considerable variability in later years because of the sorption model for uranium (that is, after 10,000 years, there is a range of approximately 0.001 to 1 mrem/yr, but the median is less than 0/01 mrem/yr).

L.3.2.3 Drinking Water Dose at the Northwest Corner of the 200 East Area

The drinking water dose to a human from technetium-99 using groundwater from approximately 1km (0.62 mi) outside the northwest corner of 200 East Area is provided in Figure L.51. The location was chosen to represent the highest doses from the local groundwater plume. The drinking water dose to a human from uranium at the same location is provided in Figure L.52. These figures exclude the influence of the ILAW waste-form impact. The technetium-99 results show peaks early and again throughout the 10,000-year period. Figure L.51 exhibits a peak median dose from technetium-99 in the range of 0.1 to 3 mrem/yr during the 10,000-year period. Figure 5.52 exhibits a peak median dose from uranium of approximately 3 mrem/yr with a long-term median value of less than 0.01 mrem/yr. There is considerable variability in later years because of the sorption model for uranium (that is, after 10,000 years, there is range of approximately 0.001 to 1 mrem/yr, but the median is less than 0.01 mrem/yr).

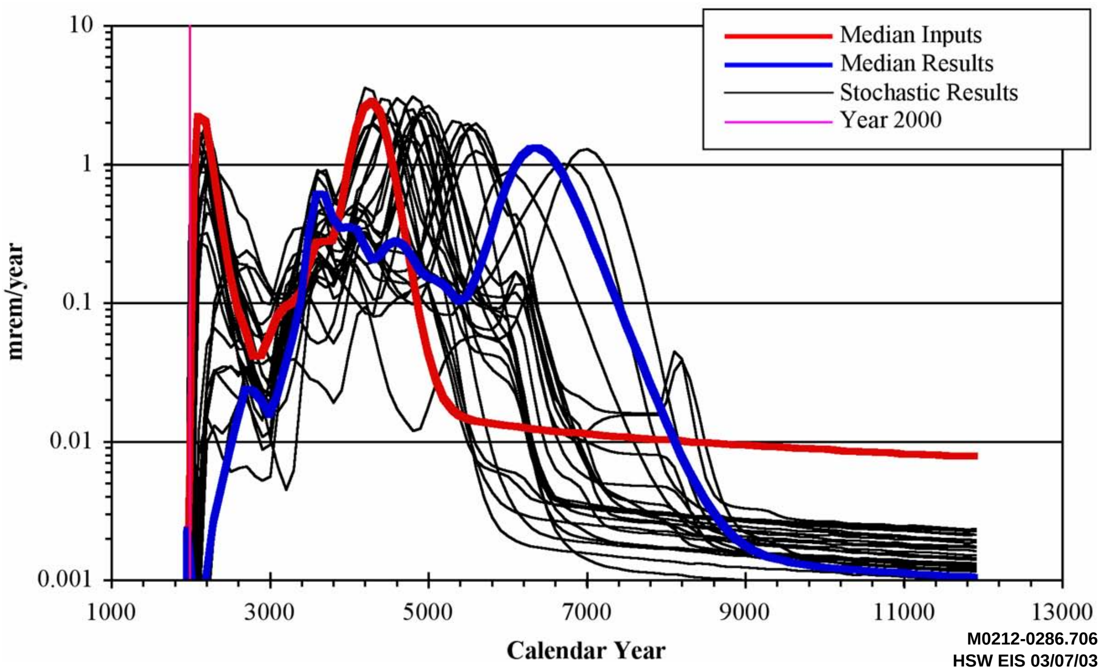

Figure L.47. Annual Drinking Water Dose from Technetium-99 in Groundwater 1 Kilometer Northeast of the 200 West Area

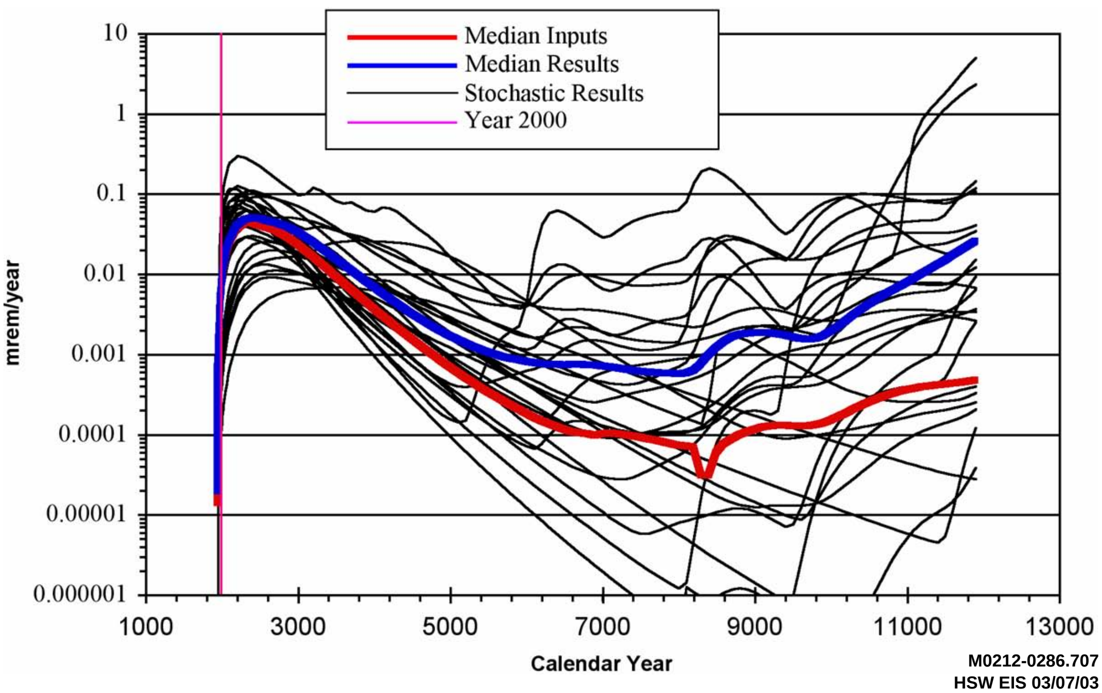

Figure L.48. Annual Drinking Water Dose from Uranium in Groundwater 1 Kilometer Northeast of the 200 West Area

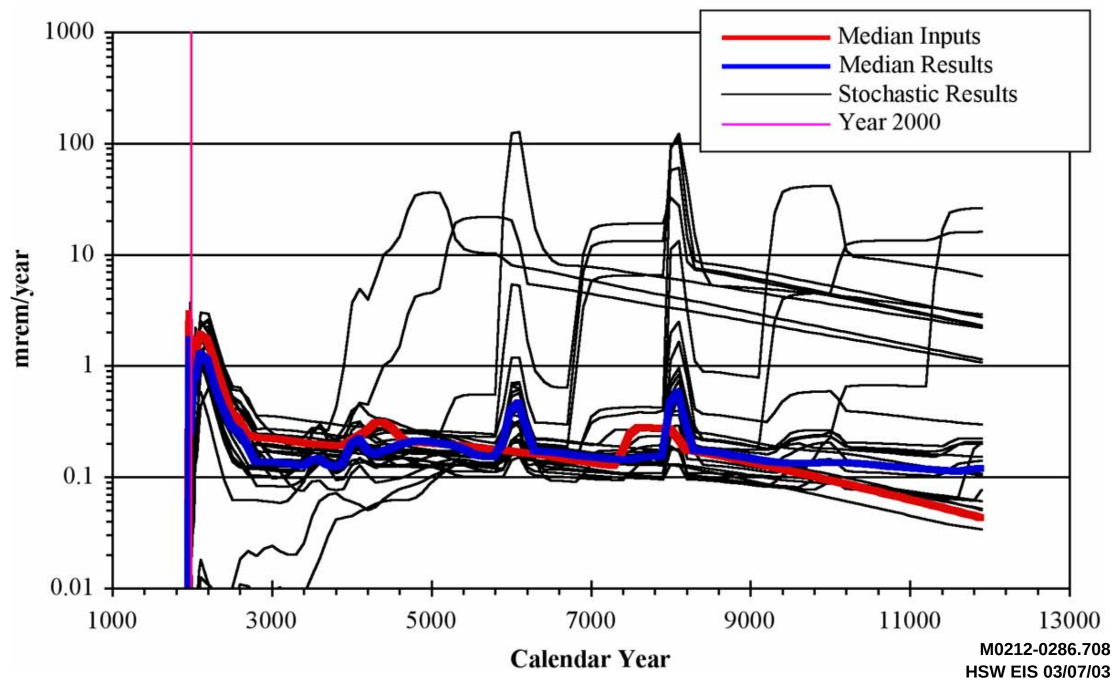

Figure L.49. Drinking Water Dose from Technetium-99 in Groundwater 1 Kilometer Southeast of the 200 East Area from All Hanford Sources Except ILAW, Melters, and Naval Reactors

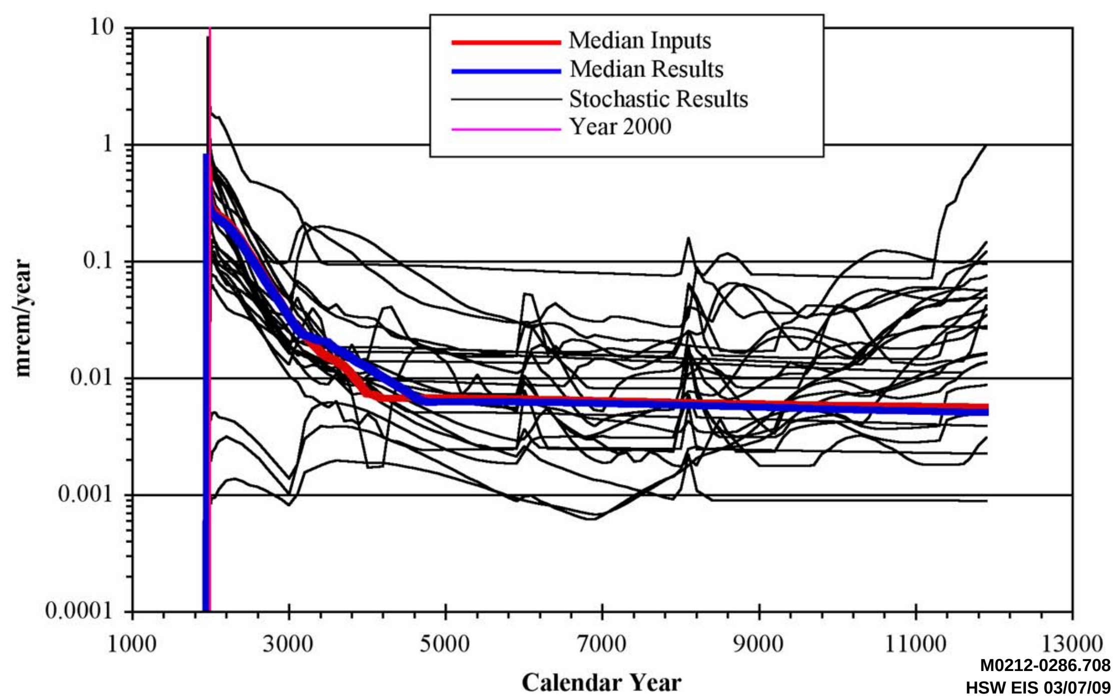

Figure L.50. Drinking Water Dose from Uranium in Groundwater 1 Kilometer Southeast of the 200 East Area from All Hanford Sources Except ILAW, Melters, and Naval Reactors

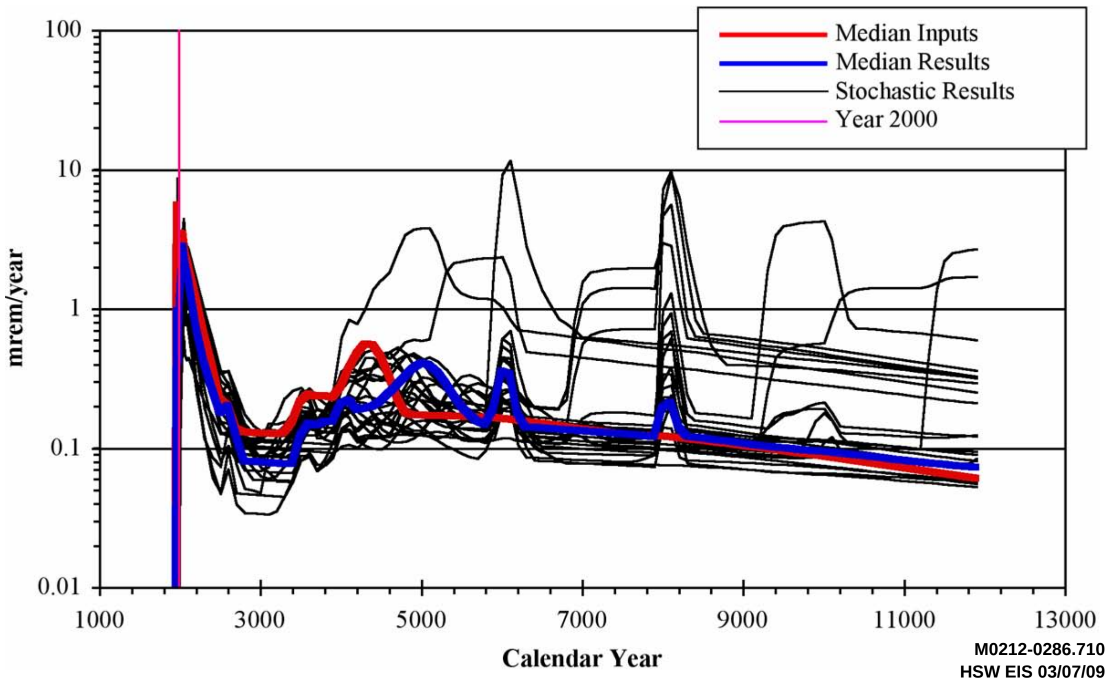

Figure L.51. Drinking Water Dose from Technetium-99 in Groundwater 1 Kilometer Northwest of the 200 East Area from All Hanford Sources Except ILAW, Melters, and Naval Reactors

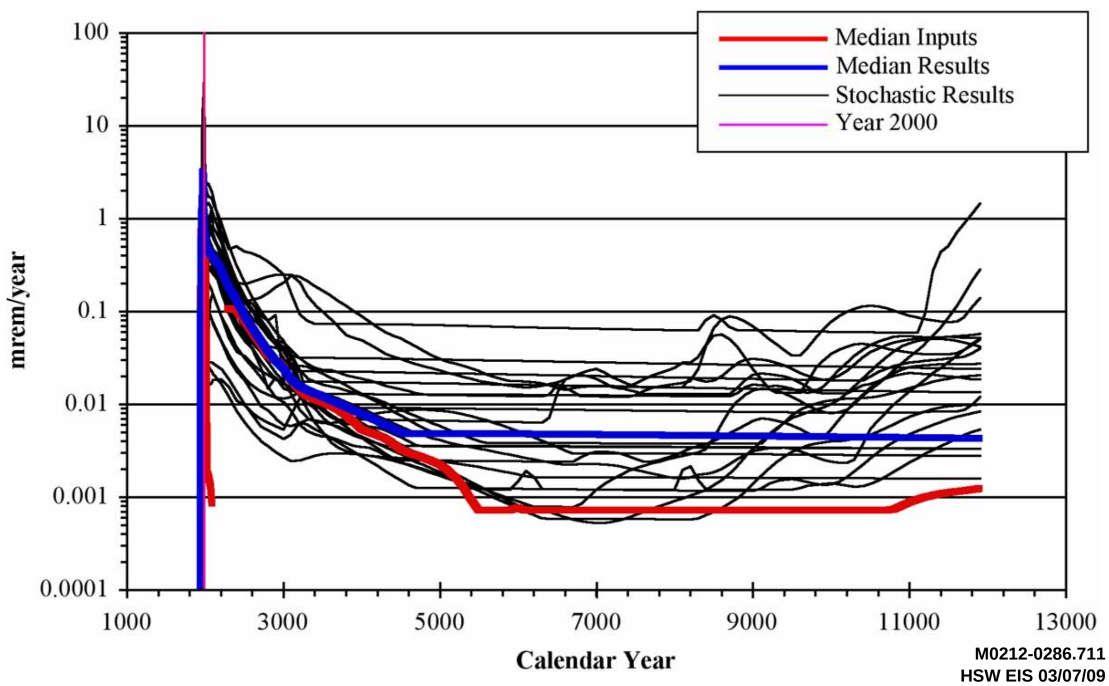

Figure L.52. Drinking Water Dose from Uranium in Groundwater 1 kilometer Northwest of the 200 East Area from All Hanford Sources Except ILAW, Melters, and Naval Reactors

L.3.3 Dose from Columbia River Water at the City of Richland Pumping Station

Annual dose to humans based on consumption of river water is summarized in this section. The exposure scenario has an adult human drinking 2 liters per day of contaminated river water from the modeled near-shore point nearest the City of Richland Pumping Station. The stochastic capability of SAC was employed for these simulations, so the following results are shown in each plot in this section:

- Individual stochastic results (25 realizations) are shown in black.

- The median result of the 25 realizations—that is, the realization that resulted in the median integrated cumulative dose in the year 9900 A.D.—is shown in blue. Although the groundwater simulations continued through the year 12050 A.D., the river simulations were terminated at the year 9900 A.D. due to software design constraints.

- The median-inputs simulation—a separate single-realization simulation with SAC using the median value of all stochastic input variables—is shown in red.

The variability in the stochastic results is due to the inventory, release, and transport of technetium-99 and uranium. The human dose model uses fixed inputs in the calculations. The doses provided in this section are based on all waste at the Hanford site and do not include background concentrations in the river. Thus, the doses are due entirely to Hanford contaminants, with most of the dose due to waste forms other than solid wastes.

L.3.3.1 Drinking Water Dose at the City of Richland Pumping Station

The drinking water dose to a human from technetium-99 using water concentrations calculated near the City of Richland Pumping Station is provided in Figure L.53. This location is downriver from all groundwater plumes of Hanford origin. The maximum estimated annual dose from technetium-99 over all realizations from the year 2000 through 9900 A.D. is less than 0.00008 mrem/yr, while the peak median dose was approximately 0.00004 mrem/yr. The annual drinking water dose to a human from uranium at the same location is provided in Figure L.54. The maximum annual dose from uranium over all realizations from the year 2000 through 12050 A.D. is less than 0.002 mrem/yr, while the peak median dose was approximately 0.00005 mrem/yr.

L.3.4 Annual Drinking Water Dose at Selected 200 East Area and Columbia River Locations from Hanford Sources Including ILAW

The deterministic capability of SAC was employed with results of the ILAW performance assessment (Mann et al. 2001), which were scaled to current inventory estimates to provide an initial estimate of the cumulative impact of all Hanford sources including ILAW. These deterministic results portray the median-inputs case of the initial assessment using SAC and the base case of the ILAW performance assessment (Mann et al. 2001). Essentially, the 2 L/d dose impacts from the ILAW inventories of technetium-99 and uranium reported in the ILAW performance assessment (Mann et al. 2001) are

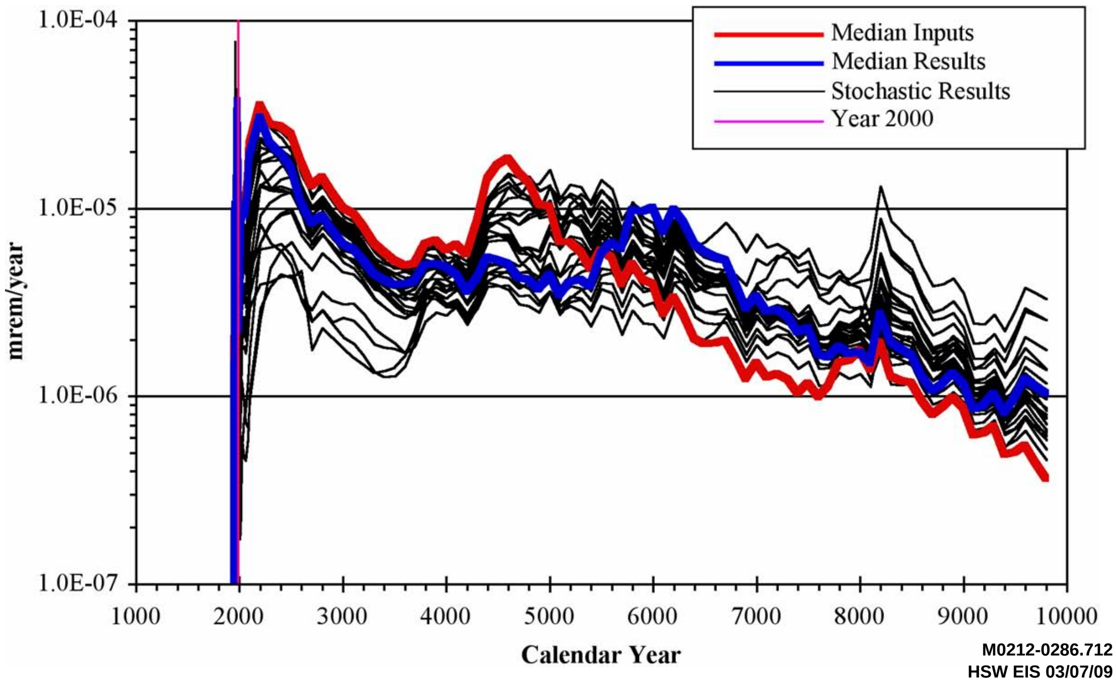

Figure L.53. Drinking Water Dose at the City of Richland Pumping Station from Technetium-99 Due to All Hanford Sources Except ILAW, Melters, and Naval Reactors

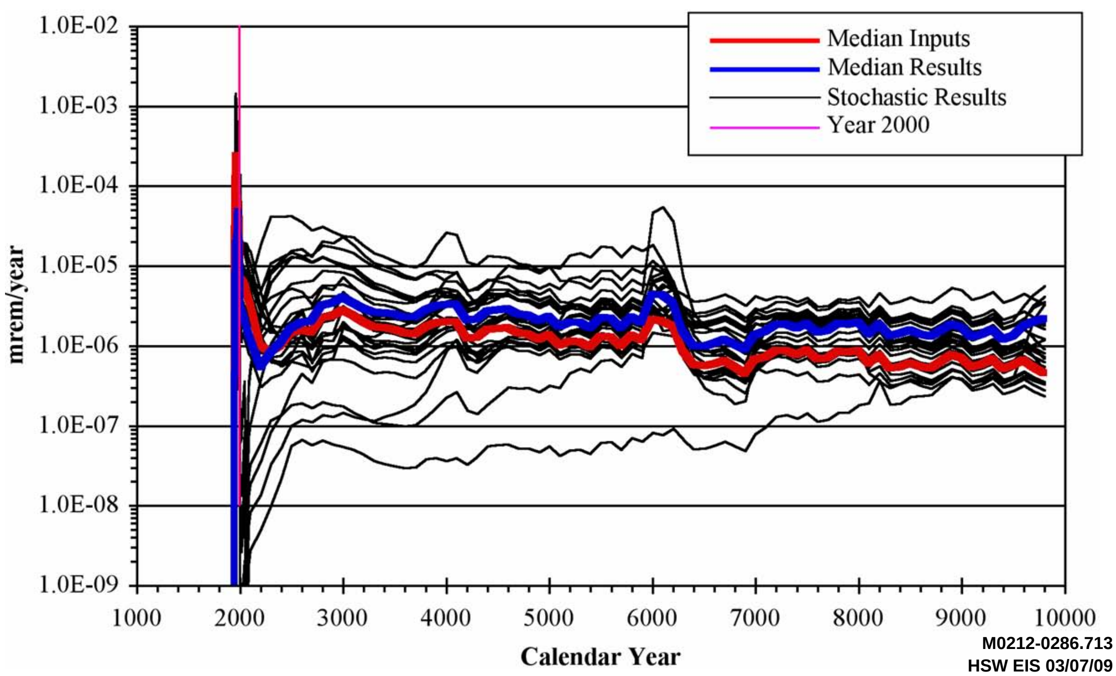

Figure L.54. Drinking Water Dose at the City of Richland Pumping Station from Uranium Due to All Hanford Sources Except ILAW, Melters, and Naval Reactors superimposed on the SAC median-value simulation. A series of three plots show combined SAC and ILAW results at a point 1-km southeast of the 200 East Area and at a point of analysis near the shore of the Columbia River at the City of Richland Pumping Station.

The cumulative impact for all Hanford sources is provided in Figure L.55. This is the annual drinking water dose from a 2 L/d drinking water scenario for technetium-99 at a point of analysis approximately 1 km (0.62 mi) southeast of the 200 East Area. The curve is a composite of the SAC initial assessment result and the base case ILAW result (Mann et al. 2001). To account for the current estimate of 25,500 Ci of technetium-99 in low-activity waste from the single- and double-shell tanks, the ILAW analysis of a 5790 Ci technetium-99 source has been scaled accordingly.

The cumulative result shown in Figure L.55 exhibits an initial peak prior to the year 2000 and a secondary peak in the next two centuries. The secondary peak is approximately 1 mrem/yr and is related to releases from liquid discharge sites in the 200 East Area. Additional, but lower, secondary peaks, 0.03 mrem/yr, appear in approximately 4300 A.D. and 7500 A.D. Releases from solid waste disposal facilities in the 200 West Area are responsible for the earlier of these two secondary peaks. Tank waste residuals releasing from the 200 East Area, modeled as 1 percent residual tank waste volume in a salt cake waste form, are responsible for the last secondary peak.

By the end of the 10,000-year, post-closure period, the cumulative dose from all Hanford sources is approximately 0.06 mrem/yr, of which approximately 0.02 mrem/yr is from ILAW and 0.04 mrem/yr is from all other Hanford sources. Based on uncertainty in the groundwater conceptual model, the ILAW contribution may be four times larger. Thus, the ILAW contribution may be 0.08 mrem/yr and may be comparable to or larger than that for all other Hanford sources. For this alternate conceptual model, the cumulative 2-L/d dose would be approximately 0.12 mrem/yr at 10,000 years post-closure. Note that ILAW release and associated dose impacts play a role in the last several thousand years, and do not substantially alter the secondary peaks described earlier.

A comparison of consequences from consuming 2 L/d of river water with and without the ILAW release of technetium-99 and uranium are provided in Figures L.56 and L.57 for the Columbia River at the City of Richland Pumping Station. Results from the SAC median-input case of the initial assessment and from the ILAW performance assessment base case are shown on each figure. Figure L.56 shows that dose originating from the low-activity waste source containing 25,500 Ci of technetium-99 is approximately equivalent to or slightly greater than the dose originating from all other Hanford wastes. The cumulative dise is 1.0×10^{-6} mrem/yr at 10,000 years post-closure, and this result is five orders-of-magnitude below the dose predicted at the 200 East area location.

The comparison graphic of consequences from uranium is provided in Figure L.57. After 10,000 years post-closure and at the time of greatest ILAW uranium impact, the dose from uranium is estimated to be approximately an order-of-magnitude below that of all other Hanford sources. Combined, the estimated dose is less than 1.0×10^{-6} mrem/yr.

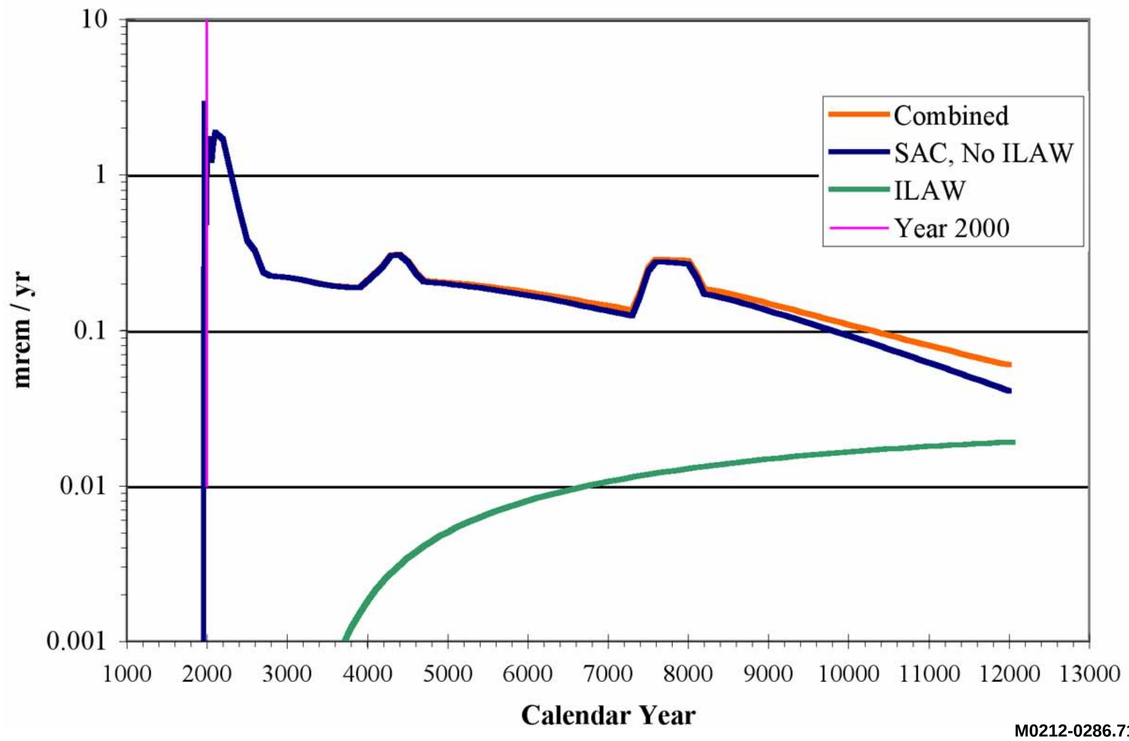

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Figure L.55. Annual Drinking Water Dose from Technetium-99 in Groundwater 1 Kilometer Southeast of the 200 East Area from Hanford Sources Including ILAW

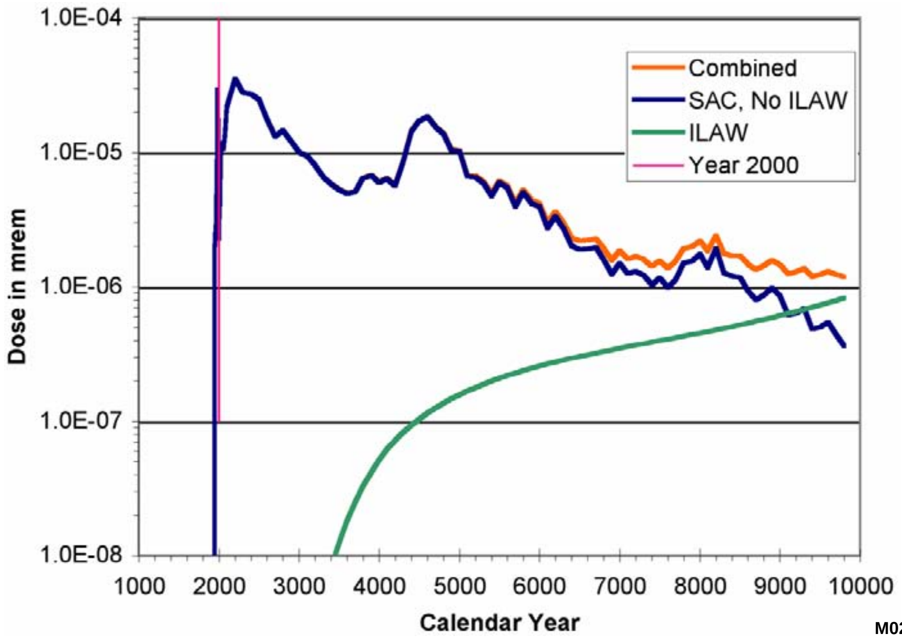

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Figure L.56. Annual Drinking Water Dose from Technetium-99 in the Columbia River at the City of Richland Pumping Station from Hanford Sources Including ILAW

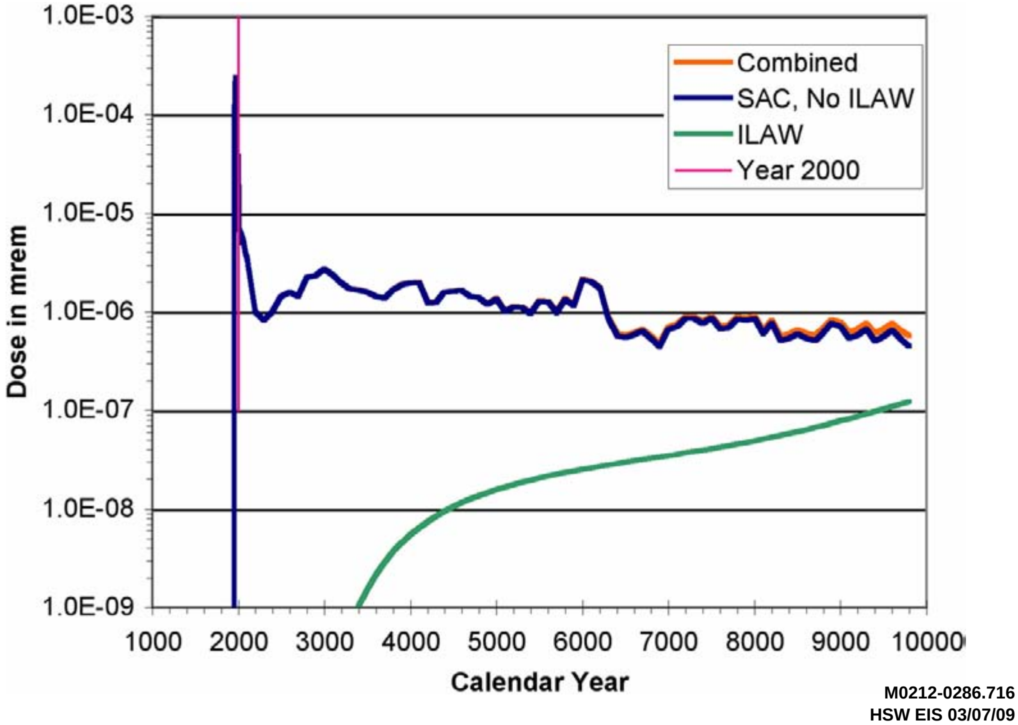

Figure L.57. Annual Drinking Water Dose from Uranium in the Columbia River at the City of Richland Pumping Station from Hanford Sources Including ILAW

The dose from technetium-99 at the City of Richland (Figure L-61) exhibits the secondary peak structure seen in the dose from technetium-99 near the 200 East Area. However, the dose from consumption of river water exhibits a greater variability in both Figures L.56 and L.57 because of the underlying variability associated with Columbia River discharge. Secondary peak structure is greatly subdued in the dose from uranium plot (Figure L.57) because uranium is sorbed onto subsurface sediments and river sediments.

The results are an approximation achieved by superimposing the results of two independently conducted analyses. Nevertheless, the results indicate that the contribution from ILAW, which represents a substantial fraction of the technetium-99 inventory at Hanford, while being equivalent to the initial assessment results does not substantially influence the overall dose prediction made in the initial assessment for all wastes other than ILAW.

L.4 References

Bergeron, M. P., E. J. Freeman, S. K. Wurstner, C.T. Kincaid, F.M. Cooney, D.L. Strenge, R.L Aaberg, and P.W. Eslinger. 2001. *Addendum to Composite Analysis for Low-Level Disposal in the 200 Area Plateau of the Hanford Site*. PNNL-11800, Addendum 1, Pacific Northwest National Laboratory, Richland, Washington.

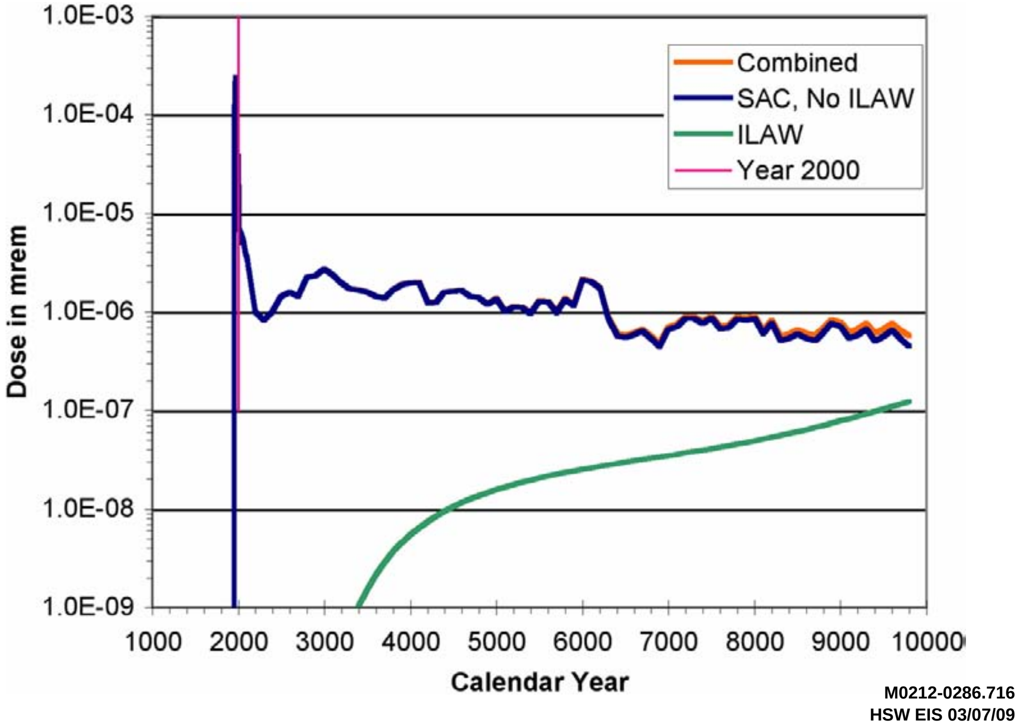

Figure L.57. Annual Drinking Water Dose from Uranium in the Columbia River at the City of Richland Pumping Station from Hanford Sources Including ILAW

The dose from technetium-99 at the City of Richland (Figure L-61) exhibits the secondary peak structure seen in the dose from technetium-99 near the 200 East Area. However, the dose from consumption of river water exhibits a greater variability in both Figures L.56 and L.57 because of the underlying variability associated with Columbia River discharge. Secondary peak structure is greatly subdued in the dose from uranium plot (Figure L.57) because uranium is sorbed onto subsurface sediments and river sediments.

The results are an approximation achieved by superimposing the results of two independently conducted analyses. Nevertheless, the results indicate that the contribution from ILAW, which represents a substantial fraction of the technetium-99 inventory at Hanford, while being equivalent to the initial assessment results does not substantially influence the overall dose prediction made in the initial assessment for all wastes other than ILAW.

L.4 References

Bergeron, M. P., E. J. Freeman, S. K. Wurstner, C.T. Kincaid, F.M. Cooney, D.L. Strenge, R.L Aaberg, and P.W. Eslinger. 2001. *Addendum to Composite Analysis for Low-Level Disposal in the 200 Area Plateau of the Hanford Site*. PNNL-11800, Addendum 1, Pacific Northwest National Laboratory, Richland, Washington.

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Appendix M

Long-Term Impacts Associated with No Further Disposal of HSW at the Hanford Site

M.1 Introduction

Consideration was given to an alternative of No Further Disposal of Hanford solid waste (HSW) at Hanford. This alternative would differ from the No Action Alternative evaluated in this HSW EIS in that future wastes from neither Hanford nor offsite generators would be accepted for disposal under the HSW program. The following waste types underwent an analysis of long-term environmental impacts:

- Pre-1970 through 1995 low-level waste (LLW)
- Category (Cat) 1 and Cat 3 LLW disposed of in the period 1996-2007
- Mixed LLW (MLLW) for the period 1996-2007 that could be disposed of in Trenches 31 and 34 in the 200 West Area with any remaining MLLW stored in the Central Waste Complex (CWC).

M.2 Impacts on Groundwater

Impacts on groundwater are presented in terms of annual dose to an individual drinking 2 liters of water per day from wells located down-gradient from the existing waste disposal facilities. The doses, as a function of time for 10,000 years after site closure, are presented in Figures M.1 – M.3 for the well 1 km down-gradient from the 200 West Area low-level burial grounds (LLBGs), the northwest well 1 km from the 200 East Area LLBGs, and the near-river well. Dose plots are presented for both capped and uncapped LLBGs (MLLW trenches 31 and 34 are capped in both cases). The plot for the No Action Alternative as provided in Section 3.4 is also shown.

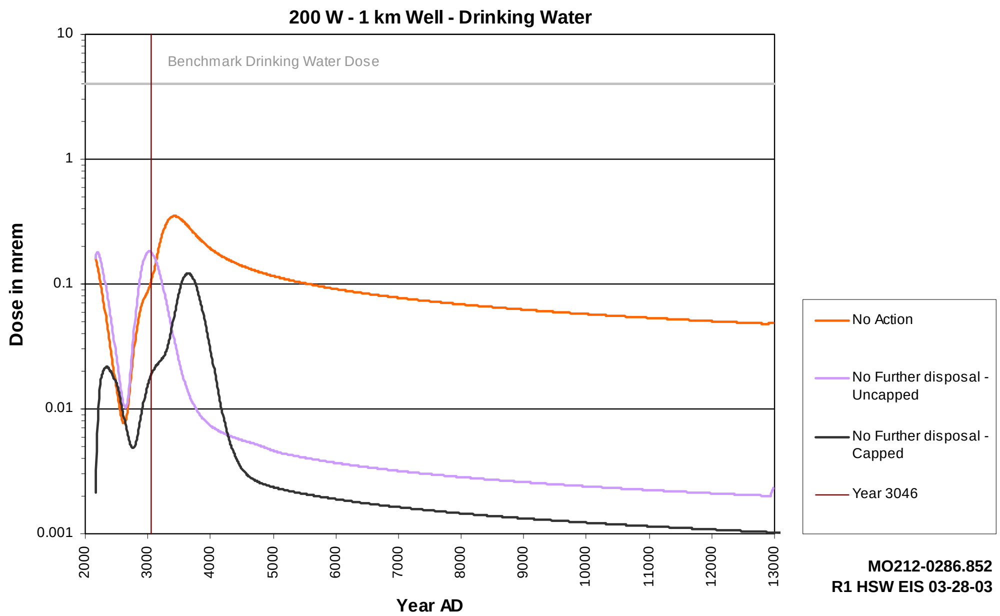

Figure M.1. Annual Dose from Drinking Water Containing Maximum Combined Concentrations of Radionuclides in Groundwater at 1 km Down-Gradient from the 200 West Area as a Function of Calendar Year

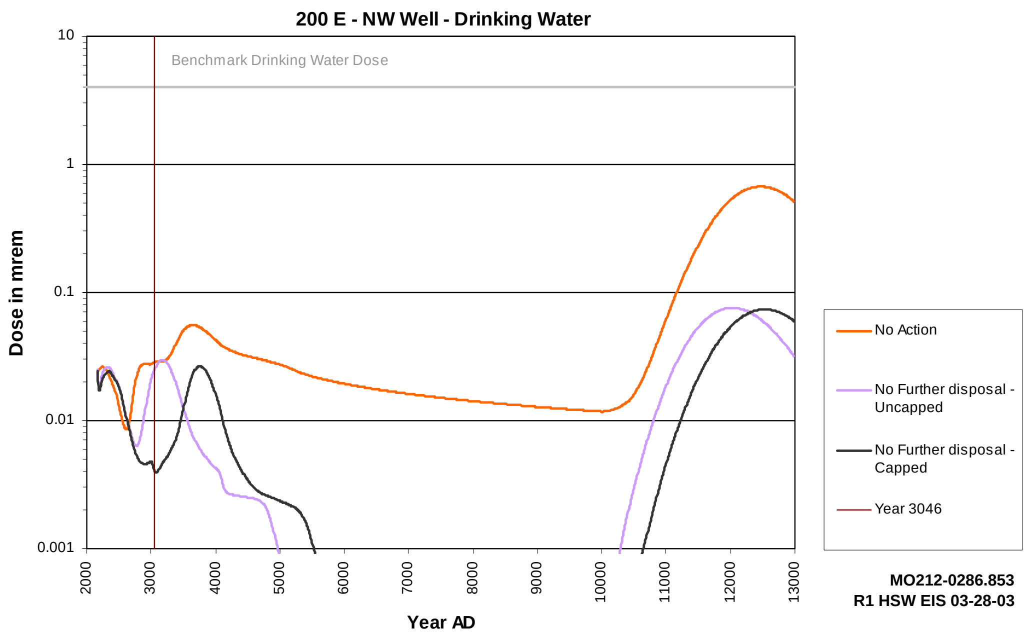

Figure M.2. Annual Dose from Drinking Water Containing Maximum Combined Concentrations of Radionuclides in Groundwater 1 km Down-Gradient Northwest from the 200 East Area as a Function of Calendar Year

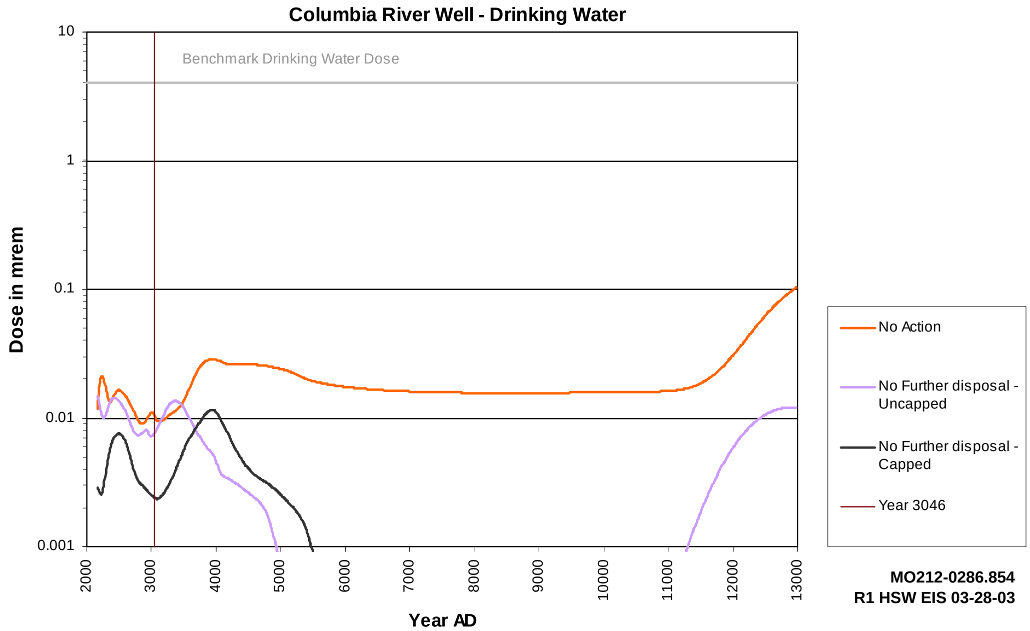

Figure M.3. Annual Dose from Drinking Water Containing Maximum Combined Concentrations of Radionuclides in Groundwater Near the Columbia River as a Function of Calendar Year

As would be expected, the plots for No Further Disposal show lower doses over most of the period of analysis than do the plots for the No Action Alternative. However, the doses are essentially the same in the earlier part of the period of analysis, as the additional inventories of HSW do not contribute. It may also be noted that capping the wastes provides for only a minimal reduction in doses; however, the presence of caps shifts the arrival of contaminants and, consequently, the doses by roughly 600 years.

Impacts on groundwater are also presented in terms of annual dose to the hypothetical resident gardener as a function of time in Figures M.4 – M.6, and to the hypothetical resident gardener with a sauna or sweat lodge scenario in Figures M.7 – M.9.

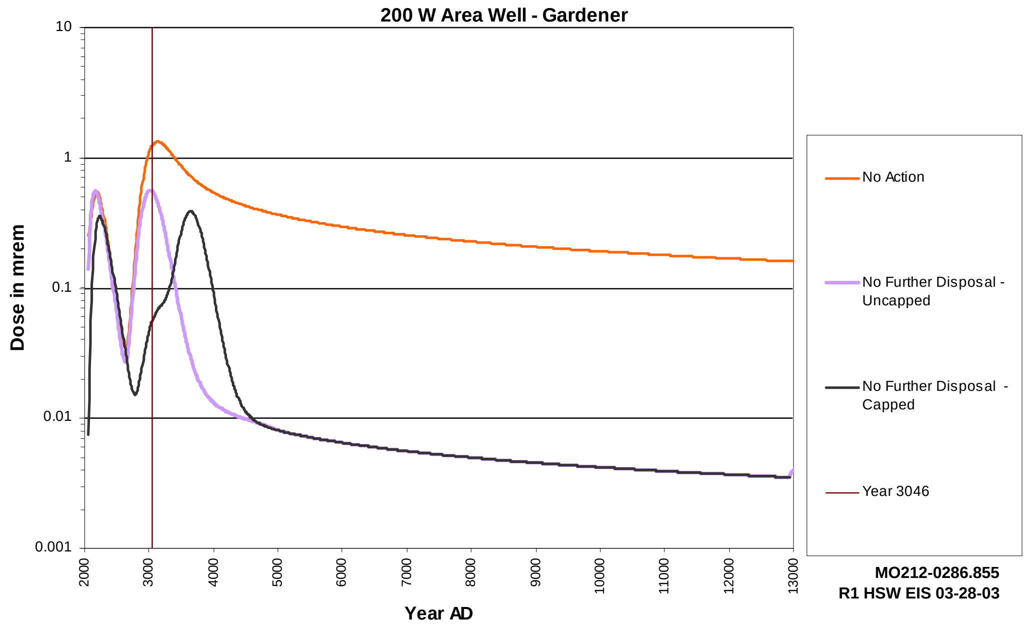

Figure M.4. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well 1 km Down-Gradient from 200 West Area

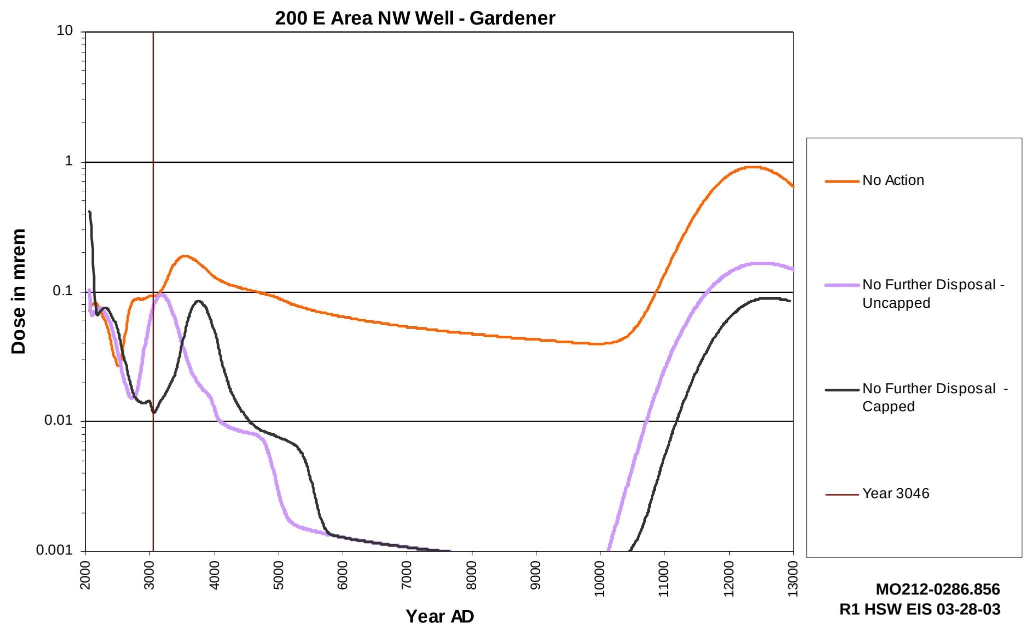

Figure M.5. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well 1 km Down-Gradient Northwest from the 200 East Area

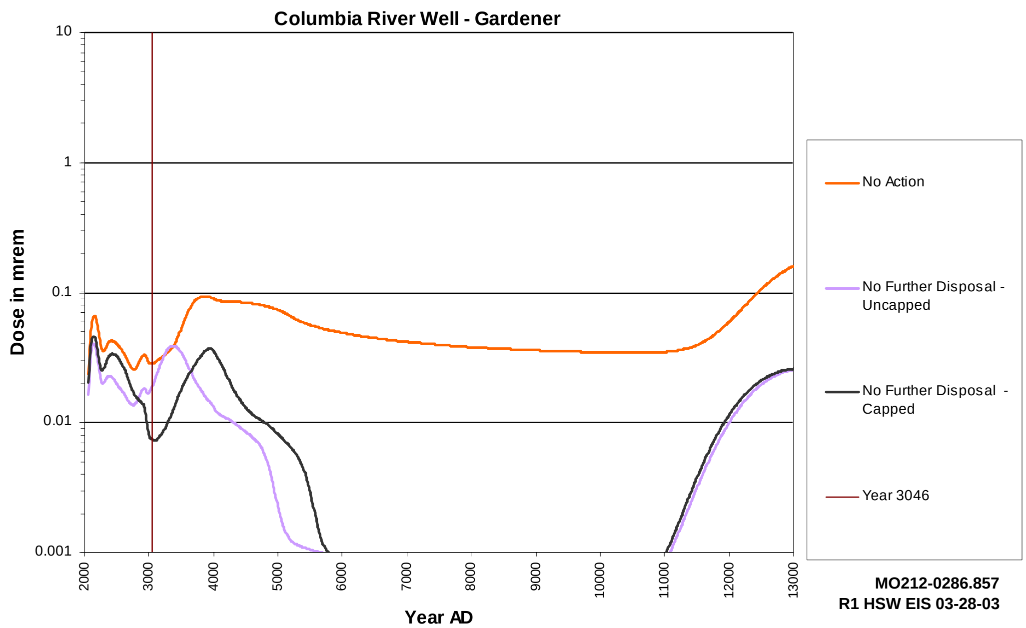

Figure M.6. Annual Dose to a Hypothetical Resident Gardener at Various Times over 10,000 Years Using Water from a Well Adjacent to the Columbia River

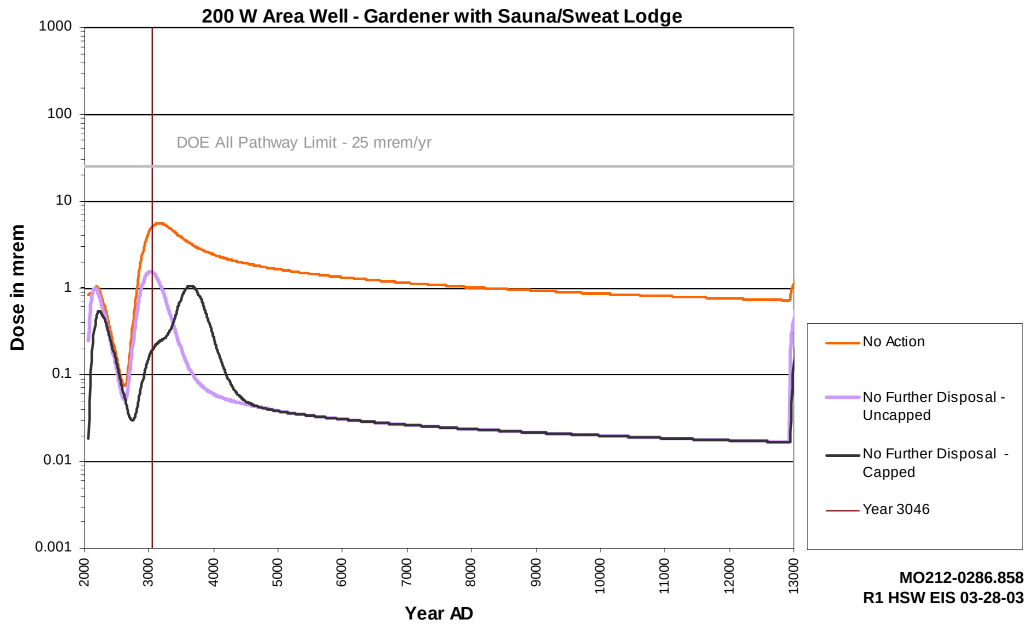

Figure M.7. Annual Dose to a Hypothetical Resident Gardener with a Sauna/Sweat Lodge Scenario at Various Times over 10,000 Years Using Water from a Well Down-Gradient from the 200 West Area

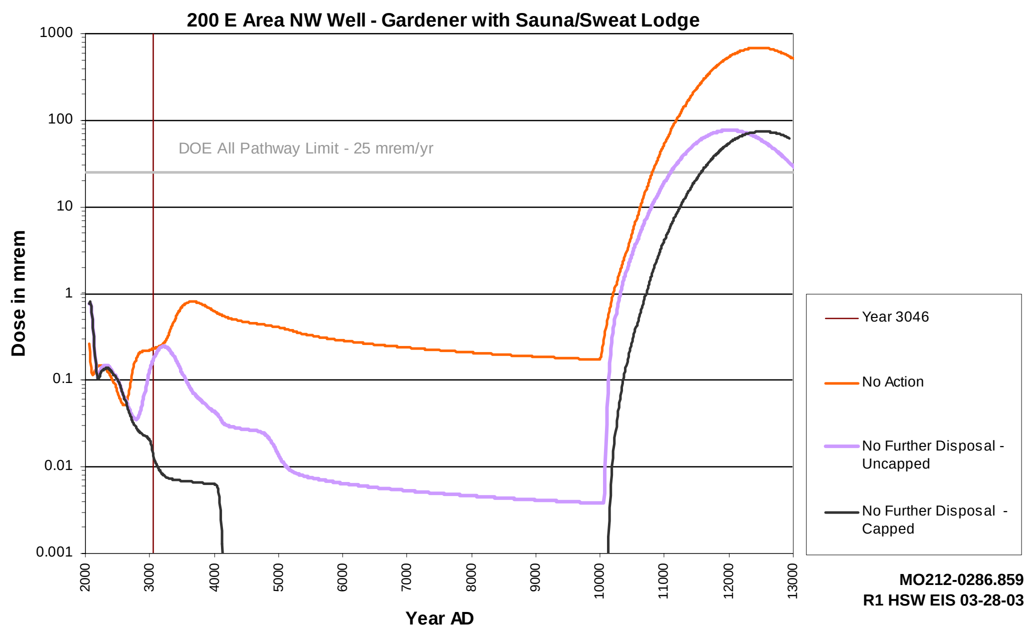

Figure M.8 Annual Dose to a Hypothetical Resident Gardener with a Sauna/Sweat Lodge Scenario at Various Times over 10,000 Years Using Water from a Well Down-Gradient Northwest from the 200 East Area

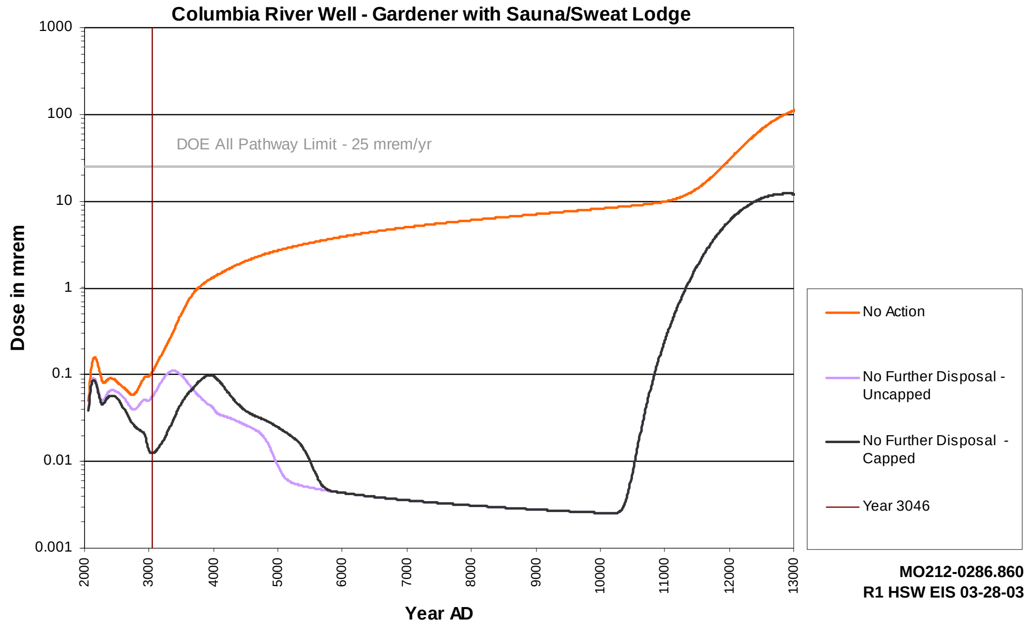

Figure M.9. Annual Dose to a Hypothetical Resident Gardener with a Sauna/Sweat Lodge Scenario at Various Times over 10,000 Years Using Water from a Well Adjacent to the Columbia River

Impacts on groundwater in terms of annual dose to the hypothetical resident gardener are higher than those in terms of drinking water dose, but, in general, follow the same pattern. Again, the pattern is similar in terms of the hypothetical resident gardener with sauna or sweat lodge, but the doses are larger due to the inhalation pathway.

Appendix N

Overview of DOE Nationwide and Hanford Site Waste Management Programs and Initiatives

The following sections describe the U.S. Department of Energy (DOE) national waste management programs, the implementation of those programs at Hanford, and recent initiatives examining strategies to accelerate cleanup activities

N.1 DOE Nationwide Waste Management Programs

DOE nationwide waste management programs fall into two general categories: 1) management of operational waste generated during other research and materials production programs, and 2) environmental restoration programs to clean up and close DOE facilities that no longer have active operations. Management of operational waste has been evaluated in the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (WM PEIS, DOE 1997a) and the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (WIPP SEIS 2, DOE 1997c), as described in Section 1, in Volume I of this HSW EIS. Environmental restoration activities generally fall under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 USC 9601). Under DOE policy (DOE 1994a), the CERCLA process incorporates values and public involvement procedures comparable to those implemented by the National Environmental Policy Act (NEPA, 42 USC 4321). The following sections describe the DOE nationwide activities to manage both operational and environmental restoration wastes and other nuclear materials.

N.1.1 Environmental Management Top-to-Bottom Review

In 2001, DOE reviewed its efforts to clean up 114 sites nationwide that are managed as part of DOE's Environmental Management (EM) Program (DOE 2002b). Cleanup of 74 of those sites is complete, and cleanup efforts at other sites are well underway. However, costs and schedules for the more extensive cleanup efforts, including Hanford, were expected to increase unless there were major changes in the way cleanup work was being managed. That review, referred as the Top-to-Bottom Review, was intended to identify problems and recommend improvements to accelerate cleanup, reduce risks, and reduce costs.

Twelve major issues were identified during the review:

1) Better use of performance-based contracting is needed. Performance-based contracting is the single best opportunity for improving DOE's cleanup efforts. It is now being employed inconsistently. This inconsistency reduces the effectiveness of this contracting approach to reduce risks to workers, the public, and the environment. Better use of performance-based contracting requires improvements by both DOE and its contractors.

2) Waste needs to be managed to reduce risks. The current framework and, in some cases, interpretation of DOE Orders and requirements, laws, regulations, and cleanup agreements create obstacles to achieving cleanup that reduces risks to workers, the public, and the environment as quickly as possible. Waste is often managed and treated based on where it comes from and not on what actual risk it presents to workers, the public, and the environment. Funds are not being spent in proportion to the hazards.

3) Cleanup strategies for accelerating site closure need to be based on national needs. There is no single strategy for closure of DOE sites. There is only a collection of closure strategies for individual sites. This fragmented approach results in costly duplication of effort and assignment of priorities based on local concerns rather than on a national basis.

4) Cleanup agreements need to be improved. Regulatory agreements have often failed to achieve expected reductions in risk or accelerated site closures. In some cases, provisions in these agreements have not focused on the highest risk.

5) Safeguard and security threats need to be reduced. Large quantities of special nuclear materials are stored at several facilities that have no need for those materials. A great deal of combustible and dispersible transuranic waste is also stored at many sites awaiting certification and disposal. These scattered storage configurations are difficult to manage, expensive, and present greater safeguards and security concerns.

6) Long-term stewardship needs to be better considered. Long-term stewardship is necessary for the continued protection of the public and the environment after sites are closed. DOE needs to adequately plan for long-term stewardship at these sites.

7) Breakthrough business processes are needed to accelerate risk reduction. DOE's existing business processes are not structured to address cost and schedule growth. As structured today, the cleanup of DOE's EM sites is expected to cost $220 billion. This cost could increase to over $300 billion unless significant changes are made. With increased cost come further delays in cleanup.

8) Implementation of NEPA requirements needs to better support decision making. The NEPA process as currently implemented for clean up efforts is often time-consuming and costly without providing the sound analysis and rational alternatives needed to support good decision making by DOE.

9) A single program for accelerating clean up of small sites is needed. DOE's EM Program is responsible for the cleanup of several small sites. Cleanup of those sites could be accelerated and life-cycle costs reduced if a single management approach were used to address those cleanup efforts.

10) Packaging and transportation requirements need to better support accelerated risk reduction. Existing packaging and transportation policies and procedures often result in delays in removing materials from sites. This increases costs and delays reduction of risks.

11) Environmental Management Program needs to focus on cleanup. DOE's EM Program manages several activities that do not support accelerated, risk-based clean up. Both budget resources and staff and management attention are not fully applied to clean up and closure of sites.

12) Science and Technology Program needs to focus on cleanup efforts. DOE's Science and Technology Program is not focused on providing the necessary support to DOE's EM Program to accelerate clean up efforts.

N.1.2 DOE Cost Report

In 2002, DOE prepared a life-cycle cost analysis to address the disposal of DOE's LLW (DOE 2002c). Life-cycle disposal costs include those related to transportation, disposal, closure, and long-term stewardship. The report discussed facilities for the disposal of LLW from cleanup actions under CERCLA (e.g., the Environmental Restoration Disposal Facility [ERDF]) as well as facilities used for other LLW disposal (e.g., the LLBGs). The report was prepared to address congressional concerns regarding the cost of LLW disposal, the extent to which DOE fee structures reflect actual life-cycle costs, and the impact of DOE disposal facilities on commercial LLW disposal.

The report concluded the following:

1) Pre-disposal costs offer the greatest opportunity for cost savings.

Pre-disposal costs are those costs associated with getting LLW ready for disposal, packaging LLW, and transporting LLW to a disposal site. Pre-disposal costs vary greatly by individual waste stream. These pre-disposal costs are strongly influenced by specific radioactive constituents in the waste, the physical form of the waste, where the waste is generated, where it is disposed of, and the volume of the waste.

2) DOE facilities used for the disposal of onsite waste from CERCLA cleanup actions offer the least expensive life-cycle disposal costs.

LLW and MLLW from CERCLA cleanup actions tend to be very large volumes of minimally contaminated waste. This waste generally does not require special shielding or packaging to protect people or the environment. Costs can be spread over a greater volume of waste, thereby decreasing the per unit disposal cost of that waste. Disposal typically occurs at the same site as cleanup, thus minimizing transportation costs.

3) Commercial facilities offer the most cost-effective disposal for some DOE waste.

The report noted that commercial disposal facilities sometimes offer the lowest life-cycle disposal costs. This validates existing DOE practices. Commercial disposal facilities have historically been used for the disposal of some DOE LLW (DOE 1997b). Commercial disposal facilities will continue to be used by DOE where they offer cost-effective disposal of DOE LLW.

Envirocare of Utah, Inc. is the commercial site that currently receives the largest volume of DOE LLW. More than 20 DOE sites have disposed of large amounts of waste at the Envirocare site. For example, in September 2000, about 4200 m^3 (150,000 ft^3) of LLW from the DOE Savannah River Site were disposed of at Envirocare (Envirocare 2000c). DOE MLLW is also disposed of at Envirocare. For example, over a five-year period ending in 2000, the DOE-Oak Ridge Reservation shipped over 5600 m^3 (200,000 ft^3) of MLLW to Envirocare for disposal (Envirocare 2000a). Since 1993 Envirocare has received over 56,000 m^3 (2,000,000 ft^3) of DOE mixed and low-level waste for treatment and/or disposal (Envirocare 2000b).

4) DOE disposal facilities offer services that are not commercially available.

Some DOE LLW and MLLW cannot be disposed of at commercial facilities. Commercial disposal facilities operate under State or U.S. Nuclear Regulatory Commission licenses that restrict the sources, quantities, types, and specific characteristics of waste that can be disposed of in those facilities. DOE waste that cannot be disposed of commercially needs to be disposed of in DOE facilities.

5) Comparison of disposal alternatives must consider more than just disposal fees.

DOE LLW disposal sites charge fees to DOE waste generators for the incremental cost of facility operation and maintenance associated with waste disposal. DOE disposal sites are limited in their ability to charge fees to recover past costs (e.g., initial facility construction) that were funded through congressional appropriations. DOE is also precluded from collecting fees to cover future costs (e.g., closure and long-term stewardship) without specific congressional approval.

The way DOE funds disposal does not preclude life-cycle cost considerations being used to determine the most cost-effective disposal site. Given that pre-disposal costs offer a substantial opportunity for cost savings, the cost report concludes that DOE should continue to make disposal decisions based on life-cycle disposal costs rather than on the fees charged to DOE waste generators by DOE disposal sites. This recommendation reinforces existing DOE requirements for considering life-cycle costs, such as those for waste minimization (DOE 2001a), facility management (DOE 1998), and radioactive waste management (DOE 2001b).

N.2 DOE Office of Environmental Management Programs at the Hanford Site

The following sections describe EM activities at Hanford, and relates those activities to the alternatives described in this HSW EIS.

N.2.1 Spent Nuclear Fuel

As part of the defense materials program, spent nuclear fuel (SNF) from Hanford's production reactors was sent to process facilities, such as the Plutonium-Uranium Extraction (PUREX) Facility, to separate plutonium and uranium from the remaining radionuclides in the fuel. Most of the remaining radionuclides were sent to underground tanks in the Hanford 200 Areas for storage as HLW.

When the last processing plant closed in the late 1980s, about 2100 metric tons of unprocessed production reactor SNF remained at the Hanford Site. This SNF represents about one-eighth (1/8) of the curies of radioactivity that exist at Hanford. The SNF has been stored in the K Basins near the Columbia River. The K Basins are water-filled pools that provide shielding and cooling. Water in the K Basins contains small quantities of radioactive materials, and the basins have leaked water to the surrounding soil in the past.

Because of concerns about possible future contamination of the Columbia River, DOE is moving the SNF away from the river to a storage facility in the central Hanford Site. After the SNF is removed from the K Basins, it is dried in the Cold Vacuum Drying Facility and moved to the Canister Storage Building (CSB) in the 200 East Area. About 30 metric tons of SNF stored at other Hanford Site locations will also be sent to the CSB. The SNF would ultimately be sent to the Yucca Mountain repository for disposal.

After removal of the SNF, sludge (dirt and small debris) from the K Basins will be placed into sealed containers and sent to T Plant for storage. The sludge is classified as transuranic waste, which will be treated at Hanford and disposed of at WIPP. Contaminated water in the K Basins will be treated at the Effluent Treatment Facility (ETF), and the solid residues will be disposed of onsite. After the SNF, sludge and water have been removed, the K Basins will be demolished. The resulting debris and any surrounding contaminated soil will be disposed of at the LLBGs or ERDF.

As of January 2003, 957 metric tons of the 2100 metric tons of K Basin SNF had been sent to the CSB. Removal of all the SNF is scheduled for completion by 2004. Removal of the water and sludge, treatment of contaminated waste, and demolition of the K Basins is scheduled for completion by 2007.

N.2.2 High-Level Waste

After SNF was processed, the process waste was sent to underground tanks in the Hanford 200 Areas for storage. This process waste is defined as HLW, which consists of a combination of solids, sludges, and liquids. One hundred seventy-seven HLW tanks were constructed at Hanford and currently contain about 53 million gallons of waste.

Twenty-eight of the 177 Hanford tanks are double-shell tanks. The remaining tanks are single-shell tanks, of which 67 may have leaked more than one million gallons of waste. Liquids are being pumped from the single-shell tanks and transferred to double-shell tanks to prevent leaks from reoccurring. About 2.5 million gallons of liquid have been pumped from 131 single-shell tanks, and DOE plans to pump an additional 500,000 gallons out of the single-shell tanks by 2004.

Cesium and strontium were removed from HLW because of the heat generated during decay of those isotopes, and because of their potential for use in various industrial processes. The separated cesium and strontium were sealed in double-walled steel capsules that are currently stored in a water-filled pool at the Waste Encapsulation and Storage Facility (WESF). High-level tank waste and the cesium and strontium capsules, represent more than three-fourths of the curies of radioactivity that exist at the Hanford Site.

A waste treatment plant (WTP) is currently under construction at Hanford to treat and vitrify the tank waste, a process that will convert it to a stable glass for disposal. In the WTP, the tank waste will be separated into HLW and low-activity waste streams. The HLW glass will be placed into canisters and stored onsite before being sent to Yucca Mountain for disposal. DOE initially planned to store vitrified low-activity waste in concrete vaults in the 200 East Area (DOE and Ecology 1996). Other options for onsite disposal of the immobilized low-activity waste (ILAW) are being evaluated as part of this revised draft HSW EIS. DOE has also announced plans to prepare an EIS for retrieval of the tank waste and closure of the HLW tanks (68 FR 1052).

N.2.3 Environmental Restoration Waste

In 1989, portions of the Hanford Site were placed on the National Priorities List as contaminated sites requiring cleanup action under CERCLA. CERCLA provides the regulatory framework for most cleanup of potentially hazardous materials from past-practices sites, such as old buildings, waste cribs, burial grounds, and other sites that are no longer in use. CERCLA provides a process to address sites where a release, or a threat of release, of hazardous substances has occurred. In the context of CERCLA, remediation of a waste site may consist of removing the hazardous materials and other contaminated materials from the waste site, or it could involve a combination of removal and stabilization of the site to minimize migration of residual hazardous materials to the surrounding environment (for example, by placing a barrier over the waste site to reduce water infiltration and migration of the waste constituents to groundwater).

CERCLA and the National Contingency Plan regulations (40 CFR 300) provide authority for conducting two types of response actions: removal actions and remedial actions. Removal actions are applied to cases that do not require extensive, time-consuming, and costly study and analysis. Removal actions can also be taken to respond to emergencies, address entire operable units, or achieve prompt risk reduction prior to a remedial response. In many instances, it may be reasonable to complete the cleanup entirely using only removal authorities. A major goal of DOE removal actions is to contribute to the efficiency of any subsequent longer-term remedial actions. In cases where there has been a release, or threat of release, the factors outlined in 40 CFR 300.415(b) are considered in determining the appropriateness of taking a removal action.

For remedial actions, DOE conducts a remedial investigation/feasibility study to characterize the hazardous materials associated with each site and to consider potential methods for reducing the risk associated with those materials. The process for evaluating remediation alternatives includes comparing each alternative against nine criteria, including overall protection of human health and the environment, long-term effectiveness, and short-term effectiveness. As noted previously, these criteria address many of the same elements that would be addressed in a NEPA review. Long-term effectiveness considers the magnitude of the residual risk to human health or the environment from untreated waste, or treatment residues, remaining at the conclusion of remediation activities. It also considers the adequacy and reliability of controls needed to manage untreated wastes or treatment residuals. Short-term effectiveness evaluates impacts occurring during remediation, such as risks to the community (for example, from air emissions), risks to workers, and risks to the environment. A public review of the proposed action is included, ultimately leading to a CERCLA Record of Decision (ROD) for completing the remediation process.

Environmental restoration at Hanford involves characterizing and remediating contaminated soil and groundwater; stabilizing contaminated soil; remediating disposal sites; decontaminating, decommissioning, and demolishing former plutonium production buildings, nuclear reactors, and separation plants; maintaining inactive waste sites; transitioning facilities into the Surveillance and Maintenance Program; and mitigating effects to biological and cultural resources from site development and environmental cleanup and restoration activities. Within the Hanford Site, over 1700 waste sites and 500 contaminated facilities have been identified for remediation under CERCLA or a substantially comparable Resource Conservation and Recovery Act (RCRA) past-practices process. DOE has prioritized Hanford cleanup to focus on sites near the Columbia River first, including placing the plutonium production reactors into interim safe storage, demolition of other unneeded facilities, removal of contaminated soil, and remediation of inactive disposal facilities that contain potentially hazardous waste.

Nine plutonium production reactors were constructed at Hanford from 1943 through 1963. These reactors are being placed in interim safe storage , which is the process of demolishing all but the shield walls surrounding the reactor core and putting a new roof over the remaining facilities. The reactors will remain in the interim safe storage state for up to 75 years to allow radiation levels in the reactor cores to decay to more manageable levels. The first reactor interim safe storage project was completed in 1998, work is in progress on four others, and three remain to be started. Alternatives to dismantlement are being considered for B Reactor because of its historic role, including its preservation as a museum.

Most cleanup of the Hanford Central Plateau is planned after completion of the River Corridor activities, although some projects are currently in progress. That phase of the cleanup will include remediation of contaminated soil and inactive disposal facilities and disposition of inactive facilities, including the fuel and plutonium processing buildings. CERCLA sites in the 200 Areas, including burial grounds closed before 1970, are the last sites scheduled for a major characterization effort. DOE has undertaken a project that includes characterization to assess the nature and extent of soil contamination and to select appropriate remedial actions. Decisions regarding remediation would be made as characterization is completed. The framework for the characterization and remediation of 200 Area CERCLA sites is defined in the *200 Areas RI/FS Implementation Plan* (DOE-RL 1999).

The Environmental Restoration Disposal Facility (ERDF) is located in the center of the Hanford Site between the 200 East and 200 West Areas. ERDF is a large-scale disposal facility designed to receive and isolate LLW and MLLW. It is currently authorized by the U.S. Environmental Protection Agency (EPA) to receive only waste from Hanford cleanup activities. ERDF is a RCRA-compliant landfill authorized under CERCLA.

ERDF is designed to provide disposal capacity for projected Hanford cleanup wastes over the next 20 to 30 years. Four disposal cells make up ERDF. The first two cells were constructed beginning in 1995 and began receiving waste in 1996. The cells are each 152 meters (500 feet) square at the bottom, 21 meters (70 feet) deep, and over 304 meters (1,000 feet) wide at the surface. Construction of two additional cells was completed in 2000, and there are plans to construct up to four additional cells. The cells are lined with a RCRA Subtitle C-type liner and have a leachate collection system. An interim cover has been placed over filled portions of the first two cells. After ERDF is filled, a final barrier will be placed over the entire facility to minimize infiltration of rain and release of hazardous constituents from the waste. Capacity of the current four-cell configuration is 10 million tons, which can be expanded as necessary. Currently, ERDF receives about 3,000 tons of waste per day, and is expected to receive about 7 million tons of waste during Hanford cleanup. The facility is monitored regularly and will continue to be monitored after closure to ensure that human health and the environment are protected.

N.2.4 Groundwater Protection

Groundwater beneath the Hanford Site ultimately surfaces at springs near or in the Columbia River, which traverses the northern and eastern parts of the site. Some of the groundwater is contaminated by radionuclides and hazardous chemicals as a result of past liquid disposal practices, leaks, and spills. Past practices that contributed to groundwater contamination have been discontinued, including disposal of untreated liquids to the ground. Programs are underway to clean up and stabilize remaining materials that could present a threat to human health and the environment. Ongoing radioactive and hazardous waste management practices comply with applicable standards, and they are evaluated on a continuing basis to minimize environmental degradation.

DOE conducts an extensive program to monitor groundwater contamination (Poston et al. 2002). In 2001, samples were collected from 735 monitoring wells to determine the distribution and movement of existing radiological and chemical constituents in Hanford Site groundwater and to identify and characterize potential and emerging groundwater contamination problems. Samples were analyzed for approximately 40 different radiological constituents and 290 different chemical constituents. The total area of groundwater contaminant plumes with concentrations exceeding drinking water standards was estimated to be about 208 square kilometers (80 square miles) in 2001. This area, which has decreased by about 1% compared to 2000, occupies approximately 14% of the total area of the Hanford Site. Most of the contaminant plume area, represented by tritium, lies southeast of the 200 East Area extending to the Columbia River.

The most widespread groundwater contaminants are tritium, iodine-129, technetium-99, uranium, strontium-90, carbon tetrachloride, nitrate, and trichloroethene. Plumes of carbon-14, cesium-137, cobalt-60, and plutonium occur in isolated parts of the 100 and 200 Areas. For the last 10 years, DOE has been treating contaminated groundwater plumes in both the 100 and 200 Areas to reduce potential hazards to downstream populations and the environment. Since the pump-and-treat projects began, over 4 billion liters of groundwater have been treated. Nearly 300 kg of chromium, over 6,000 kg of carbon tetrachloride, 20,000 kg of nitrate, 130 kg of uranium, 80 g of technetium-99, and 1.1 Ci of strontium-90 have been removed. An additional 77,000 kg of carbon tetrachloride has been removed from the soil by vapor extraction to prevent future groundwater contamination (Poston et al. 2002).

Groundwater monitoring at Hanford is being addressed under milestones established under the Tri Party Agreement independently of this HSW EIS. DOE and a team of contractors have developed, and are implementing, a sitewide program that integrates all assessment and remediation activities that address key groundwater, vadose zone, and related Columbia River issues. This effort is coordinated by the Groundwater Protection Program to support cleanup and closure decisions for the Hanford Site and protection of the Columbia River. Information developed under that program was used to evaluate long-term impacts of LLW and MLLW disposal in this revised draft HSW EIS. Additional information can be found at http://www.bhi-erc.com/projects/vadose.

N.2.5 Liquid Waste

The 200 Area Liquid Waste Processing Facilities receive, treat, and dispose of liquid effluents from onsite programs and projects. Facilities include the Liquid Effluent Retention Facility (LERF), the 2025E Effluent Treatment Facility (ETF), the 200 Area Treated Effluent Disposal Facility (TEDF), State-Approved Land Disposal Site (SALDS), and the 242-A Evaporator. The 300 Area TEDF processes potentially hazardous wastewater from the 300 Area.

The 242-A Evaporator is a RCRA-permitted facility that concentrates tank waste to reduce the overall volume and storage requirements. The facility has a volume reduction capacity of 270,000 L (70,000 gal) per day. The concentrated waste is returned to the waste tanks, and the process condensate is transferred to the LERF. Since the evaporator was upgraded in 1994 and from its restart through late 2000, its operation has reduced tank waste volume by over 11 million gallons. This treatment activity has provided a savings in tank space equivalent to 12 double-shell tanks.

The LERF is a RCRA-permitted facility that consists of three basins with a usable capacity of about 88 million L (23 million gal). The LERF receives and temporarily stores wastewater from the 242-A Evaporator, groundwater from the site pump-and-treat projects, leachate from onsite solid waste disposal facilities and a variety of generators (including site cleanup activities). From LERF, the water is routed to the ETF for treatment and disposal.

The ETF is a RCRA-permitted treatment process, has a design capacity 216 million L (56 million gal) per year, and removes hazardous and radioactive contaminants other than tritium. The ETF treatment process includes filtration (removal of suspended solids) ultraviolet light/peroxide (destruction of organics), reverse osmosis (removal of dissolved solids), and ion exchange (radioactivity removal). Storage tanks hold the treated effluent for verification of acceptable discharge levels, before the effluent is transferred to the 200 Area TEDF or SALDS.

The 200 Area TEDF is a collection and disposal system for non-hazardous, non-radioactive waste streams. The TEDF includes more than 19 kilometers (12 miles) of polyvinyl chloride pipe up to 36 centimeters (14 inches) in diameter connecting facilities to a second state-permitted land disposal site. The TEDF has a capacity of 13,000 L (3,400 gal) per minute, equivalent to 6.8 billion L (1.8 billion gal) per year. The final disposition of this waste is the SALDS.

The SALDS receives treated and verified liquid process waste from the 200 Area TEDF. The liquid wastes received at SALDS are not considered dangerous, but may contain small quantities of tritium. The facility consists of a gravel bed with a geotextile membrane cover.

The 300 Area TEDF receives the combined wastewater collection for the 300 Area. The facility receives processed wastewater and has the ability to perform characteristic waste treatment under Permit-by-Rule provisions.

N.2.6 Cleanup, Constraints, and Challenges Team (C3T)

In 2001, the DOE, its contractors, the EPA, and the Washington State Department of Ecology started a series of discussions to better identify, characterize, and resolve constraints and barriers to Hanford cleanup (DOE-RL 2002a). These discussions, referred to as the Cleanup, Constraints, and Challenges Team (C3T) process, are designed to be an informal forum where ideas and concepts could be discussed openly. Ideas are developed and evaluated to determine whether they could accelerate cleanup; reduce costs; or protect workers, the public, and the environment. The C3T process is not intended to replace legal or regulatory requirements, or to change formal commitments such as the Tri-Party Agreement (TPA). Some concepts identified during the C3T process might be suitable for implementing immediately. However, most would probably require further planning, changes to existing permits and TPA Milestones, changes to existing contracts, and preparation of additional NEPA reviews.

Seven sub-teams were formed to consider opportunities to accelerate cleanup and reduce cost in the following areas:

1) Cesium/Strontium Capsule Disposition:
   - Develop options that would substitute continued underwater storage of cesium and strontium capsules.
   - Develop options that would substitute vitrifying cesium and strontium prior to final disposal.

2) Tank Retrieval and Closure Demonstration Project:
   - Demonstrate waste retrieval technologies.
   - Demonstrate closure of tanks.

3) ORP (DOE Office of River Protection) Baseline Opportunities (Mission Acceleration Initiatives):
   - Enhance design and operations of the waste treatment plant (WTP).
   - Explore alternate waste treatment technologies including sulfate removal, containerized grout, bulk vitrification, and steam reformation.

4) Integrated Groundwater Protection, Monitoring, Assessment, and Remediation:
- Develop an overall approach for groundwater protection, monitoring, assessment and remediation.
- Explore technologies for removing and immobilizing contaminants.
- Reduce natural and artificial recharge through contaminated areas.
- Minimize duplication and inconsistencies between regulatory requirements for monitoring and well drilling (RCRA, CERCLA, U.S. Atomic Energy Act [AEA]) and comply with standards for protection of human health and the environment.

5) Central Plateau Vision and Strategy:
- Develop an overall approach to cleanup of waste sites on the Central Plateau.
- Develop a strategy for transitioning the Central Plateau to industrial use.

6) Waste Disposal Project Options:
- Consider combined disposal of LLW, MLLW, and ILAW.
- Evaluate the use of canyon buildings for waste disposal.
- Coordinate pre-1970 and post-1970 transuranic waste management activities (retrieval, treatment, disposal).

7) ORP (DOE-Office of River Protection)/RL (DOE-Richland Operations Office) Baseline Integration and Infrastructure Optimization (Site Infrastructure and Services):
- Assess site infrastructure needs (e.g., roads, utilities) as cleanup progresses and the Hanford Site “shrinks.”

N.2.7 Hanford Performance Management Plan (HPMP)

Drawing on recommendations contained in the Top-to-Bottom Review and from ideas emerging from the C3T process (DOE-RL 2002a), the Hanford Performance Management Plan (HPMP) was prepared to accelerate cleanup at Hanford (DOE-RL 2002b). The HPMP describes higher-level strategic initiatives as well as specific goals for completing Hanford cleanup by 2035, which is 35 years earlier than previously planned.

A Hanford map showing the River Corridor, the Central Plateau, and some key features on the Hanford Site is shown in Figure N.1.

With the help of the EPA and the Washington State Department of Ecology, six strategic initiatives were developed:

1) Accelerate Columbia River Corridor Cleanup. Restore the Columbia River Corridor reducing the risk to the river and shrinking Hanford Site operations. Complete remediation of 50 burial grounds, 579 waste sites, 357 excess facilities, and 7 plutonium production reactors by 2012.

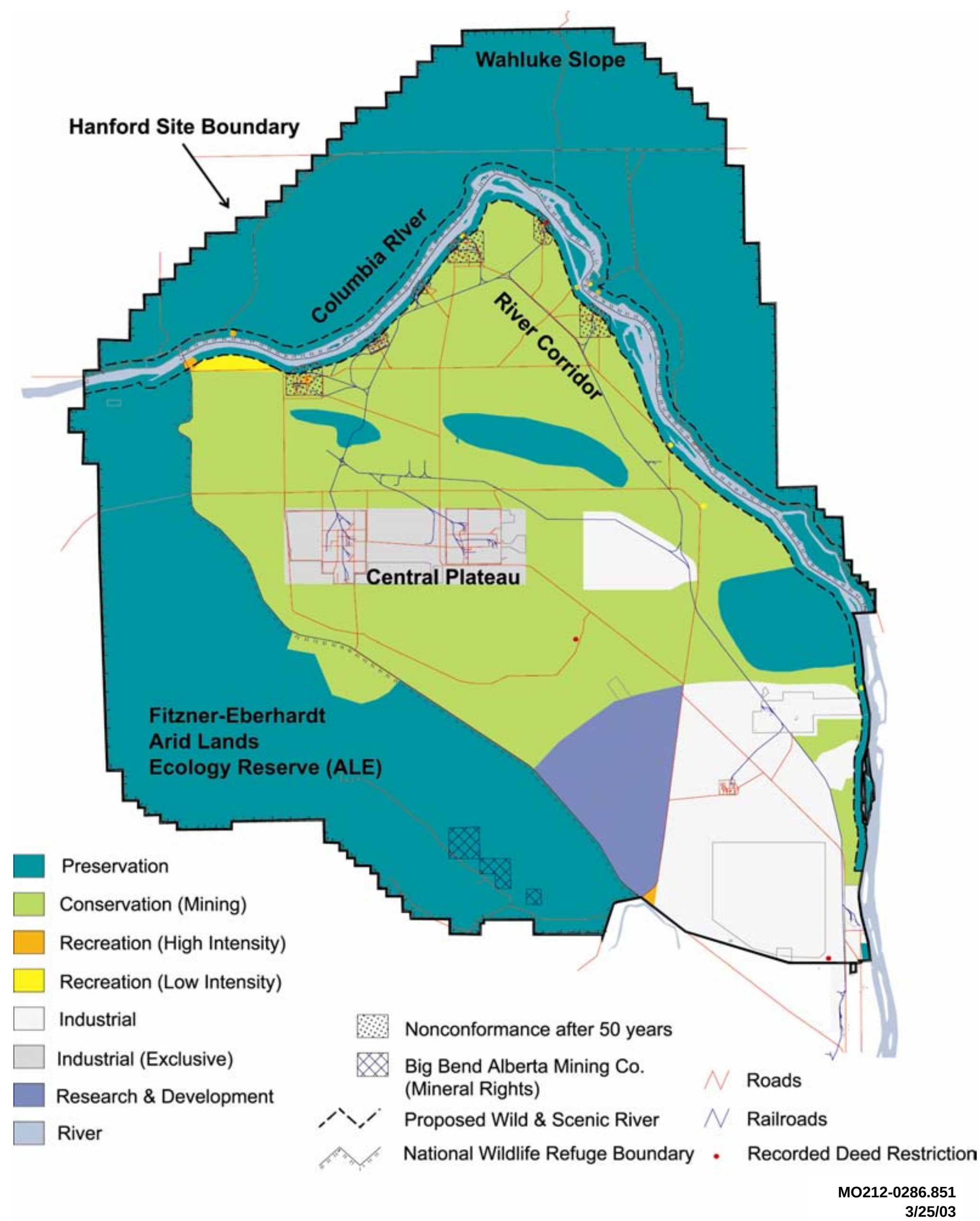

Figure N.1. Hanford's Land-Use Plan

2) Accelerate Tank Waste Treatment. End the tank waste program by 2033. Accelerate tank waste retrieval. Complete tank waste treatment by 2028 by increasing the capacity of the planned Waste Treatment Plant and using supplemental technologies for waste treatment and immobilization. Demonstrate tank closure and start in earnest the process of closing tanks now. Many of the activities related to tank waste are on the "critical path" to site closure, and the site cannot be closed until they are complete.

3) Accelerate Stabilization and De-Inventory of Nuclear Materials. Accelerate the cleanup of Hanford's other urgent risks. Remove K Basins spent nuclear fuel, sludge, debris, and water from the river's edge 10 months early. Stabilize and securely store remaining plutonium nine years sooner. Demolish the Plutonium Finishing Plant (PFP) seven years earlier. Evaluate the benefits of moving 1,936 high-radiation-level cesium and strontium capsules to a secure dry storage facility and seek a path to allow Hanford to directly ship the (unvitrified) capsules to a national geologic repository. This would avoid the risk, time and cost associated with vitrifying the capsules in the Waste Treatment Plant.

4) Accelerate Waste Disposal. Accelerate treatment and disposal of MLLW and retrieval and shipment of TRU waste five to ten years ahead of current plans. Work with other DOE sites to ensure that disposal capability exists to meet their mission and closure schedules.

5) Accelerate Central Plateau Cleanup. Use regional or other waste site grouping strategies to clean up over 900 excess facilities on the Central Plateau (including the five massive plutonium separation and processing facilities commonly referred to as canyons) and more than 800 non-tank-farm waste sites. Use U Plant to demonstrate the ability to combine disposition canyon facilities in place (the Canyon Disposal Initiative) and remediate associated waste sites. With the exception of T Plant, which is required for final processing, disposition of the canyon facilities is expected 14 years early.

6) Accelerate Cleanup and Protection of Hanford Groundwater. Protect groundwater resources. Remove or isolate contaminant sources on the Central Plateau. Remediate sources of contamination outside the Central Plateau core zone. Reduce the conditions that have the potential to drive contaminants into the groundwater. Integrate all site monitoring requirements. Accelerate remediation of high-risk sites by five years.

A list of specific goals and how they compare to previous plans can be found in Table N.1.

Under HPMP initiatives, cleanup of 964 km^2 (511 mi^2) of the Hanford Site's 1158 km^2 (586 mi^2) would be complete by 2012. After that time, cleanup activities would be limited to the Central Plateau. Acceleration is expected to reduce the estimated $90 billion cleanup costs by $30-40 billion.

While all the strategic initiatives affect Hanford as a whole, activities included in Strategic Initiative 4, Accelerate Waste Disposal, are most relevant to the alternatives analyzed in the HSW EIS. Specific goals within that initiative include the following:

- Initiate retrieval of buried, suspect transuranic waste by April 30, 2003.

- Initiate construction of lined MLLW/LLW disposal facilities by April 30, 2005.

- Complete characterization, retrieval, storage, and disposal of 15,000 drum-equivalents of suspect transuranic waste by September 30, 2006.

Table N.1. Hanford Performance Management Plan Acceleration Goals

Cleanup Activity	Previous Plan	Acceleration Goal
Complete Cleanup	2070	2035
Start Tank Closure	2012[a]	2002
Initiate Plutonium Finishing Plant (PFP) Plutonium Deinventory	2009	2003
Establish the Site-Wide Integrated Groundwater Protection Program	NA[b]	2003
Complete First Tank Waste Retrieval and Closure Demonstration	2014[a]	2004
Demonstrate Supplemental Tank Waste Technologies	NA	2004
Complete Plutonium Finishing Plant (PFP) Plutonium Deinventory	2014	2005
Retrieve, Assay, and Disposition 15,000 Drums of Buried Suspect Transuranic Waste	2010	2006
Complete Removal of K Basins Spent Nuclear Fuel, Sludge, Debris, and Water	2007[g]	2006
Move Cesium and Strontium Capsules into Dry Storage	NA	2008[c]
Treat 14,000 m^3 of Mixed Low-Level Waste	2012	2008
Demolish PFP	2016	2009
Achieve Waste Treatment Plant Full Performance	2018	2010
Complete U Plant Regional Closure	2025	2011
Initiate Shipments of Cesium and Strontium Capsules to National Geologic Repository	2040	2012
Complete River Corridor Cleanup	2037	2012[e]
Complete Remediation of High-Risk Sites[e]	2017	2012
Disposition All Contact-Handled Transuranic Waste[d]	2027	2015
Complete Closure of 60 to 140 Single-Shell Tanks[h]	2024	2018
Complete Tank Waste Treatment	2048[f]	2028

(a) The current Tri-Party Agreement target date.
(b) Agencies have recently agreed to establish a new sitewide Integrated Groundwater Protection Program.
(c) The benefits of dry storage and disposal options will be evaluated in FY 2003.
(d) Remote-handled and non-standard transuranic waste will require processing through a modified T Plant or a new facility, alternatives evaluated in this EIS.
(e) Several discrete projects in the River Corridor will not be completed by 2012. The 618-10 and 618-11 Burial Grounds will be completed in 2018. Several facilities in the 300 Area related to the Pacific Northwest National Laboratory will remain operational. The reactor cores will remain in interim safe storage pending final disposition. Ongoing groundwater cleanup, monitoring, and stewardship activities will be required based on final groundwater remedies. The Fast Flux Test Facility is not yet included.
(f) The current DOE projection is 2048. The Tri-Party Agreement date is 2028.
(g) The current Tri-Party Agreement Milestone is July 31, 2007.
(h) The number of tanks depicted here represents a DOE goal and does not represent agreement with the Washington State Department of Ecology.

- Complete risk studies and associated environmental documentation to support decisions about how much of the remaining post-1970 and pre-1970 transuranic waste must be retrieved by September 30, 2006.

- Initiate use of lined MLLW/LLW disposal facilities by September 30, 2007.

- Complete treatment and/or disposal of all stored mixed low-level waste (about 7000 m^3) and newly generated MLLW (forecasted to be about 7000 m^3) by September 30, 2008.

- Complete retrieval of post-1970 suspect, contact-handled transuranic waste from the Low Level Burial Grounds by September 30, 2010.

- Complete certification and shipment of all legacy, contact-handled transuranic waste (about 7500 m^3) to the Waste Isolation Pilot Plant by September 30, 2013.

Some of the acceleration activities described in the HPMP could be implemented immediately. Others could be implemented as a result of reviews performed under this HSW EIS. Some, however, would require further planning, changes to existing permits and TPA Milestones, and preparation of additional NEPA or CERCLA reviews. Implementation of some of the accelerated cleanup proposals is discussed in Volume I, Section 3 of this EIS. However, the plans and schedules associated with many HPMP proposals were not sufficiently well developed for detailed analysis at the time this EIS was prepared. Therefore, the analyses of environmental impacts presented in Section 5 do not necessarily reflect all activities, or the timing of some activities, as described in the HPMP.

N.2.8 Pollution Prevention/Waste Minimization

Pollution prevention is defined as the use of materials, processes, and practices that reduce or eliminate the generation and release of pollutants, contaminants, hazardous substances, and wastes into land, water, and air. Pollution prevention includes practices that reduce the use of hazardous materials, energy, water, and other resources along with practices that protect natural resources through conservation or more efficient use. Within DOE, pollution prevention includes all aspects of source reduction as defined by the EPA, and incorporates waste minimization by expanding beyond the EPA definition of pollution prevention to include recycling.

DOE’s interpretation of pollution prevention is consistent with the definition in the International Organization of Standardization (ISO) Document 14001, *Environmental Management Systems – Specifications with Guidance for Use* (ISO 1996), which includes recycling. DOE’s definition is also consistent with the Council of Environmental Quality’s definition of pollution prevention.

Pollution prevention is achieved through the following:

- equipment or technology selection or modification, process or procedure modification, reformulation or redesign of products, substitution of raw material, waste segregation, and improvements in housekeeping, maintenance, training or inventory control

- increased efficiency in the use of raw materials, energy, water, or other resources

- recycling to reduce the amount of waste and pollutants destined for release, treatment, storage, and disposal.

Pollution prevention is applied to all DOE pollution-generating activities including the following:

- manufacturing and production operations

- facility operations, maintenance, and transportation

- laboratory research

- research, development, and demonstration

- weapons dismantlement

- stabilization, deactivation, and decommissioning

- legacy waste and contaminated site cleanup.

DOE is faced with the challenge of removing and treating wastes already generated from past production and manufacturing operations. Facility and equipment stabilization, deactivation and decommissioning, and weapons dismantlement activities result in significant amounts of wastes that must be handled. Many pollution prevention techniques may not directly apply to wastes that were generated and media that were contaminated by previous practices. However, two techniques, waste segregation and recycling, are used to reduce the amount of such waste that would otherwise require additional treatment and disposal.

Additional waste and pollutants are generated in the process of conducting restoration and dismantlement activities. Pollution prevention is applicable to the generation of secondary waste and is factored into remedial investigations, feasibility studies, design, and execution of all restoration and dismantlement projects. Restoration projects are performed in a manner that reduces or prevents the generation of new waste and pollutants, and reduces the further release and spread of contamination (DOE 1996b).

In 1994, DOE prepared its first pollution prevention plan (DOE 1994b). The latest version of DOE's Pollution Prevention Program is described in *Pollution Prevention Program Plan* (DOE 1996b). This plan is consistent with the requirements and guidance of the following:

- Pollution Prevention Act of 1990 (42 USC 13101)

- Resource Conservation and Recovery Act (42 USC 6901)

- Executive Order 13101, Greening of Government through Waste Prevention, Recycling, and Federal Acquisition (63 FR 49643, September 14, 1998)

- Executive Order 13123, Greening the Government through Efficient Energy Management (64 FR 30851, June 3, 1999)

- Executive Order 13148, Greening the Government through Leadership in Environmental Management (65 FR 24595, April 21, 2000)

- Executive Order 13149, Greening the Government through Federal Fleet and Transportation Efficiency (65 FR 24607, April 21, 2000)

- DOE Order 5400.1, Change 1, *General Environmental Protection Program* (June 29, 1990) (DOE 1990)

- DOE Order 430.2, *In-House Energy Management* (June 13, 2000) (This Order has been replaced by DOE Order 430.2A, *Departmental Energy and Utilities Management*, April 15, 2002) (DOE 1996a)

- DOE Notice 430.3, *Extension of DOE Order 430.2, In-House Energy Management*, (December 13, 2000) (This notice has been replaced by DOE Order 430.2A, *Departmental Energy and Utilities Management*, April 15, 2002) (DOE 1996a)

- DOE Order 435.1, *Radioactive Waste Management* (July 9, 1999) (This Order was supplemented by DOE Order 435.1, Change 1, August 28, 2001) (DOE 1999)

- DOE Manual 435.1, *Radioactive Waste Management Manual* (July 9, 1999) (This manual was supplemented by DOE Manual, Change 1, June 19, 2001) (DOE 2001a)

The *Pollution Prevention Program Plan* outlines specific goals issued by the Secretary of Energy for reducing waste generation from routine operations and for reducing the use and release of toxic chemicals. This plan required that individual operations offices, like the Richland Operations Offices that is responsible for Hanford activities, develop its own goals to help achieve the DOE-wide goals set by the Secretary. The *Pollution Prevention Program Plan* set goals through December 31, 1999. Further goals have since been set for fiscal year (FY) 2005 and 2010.

DOE's generation of all waste types, including LLW, MLLW, and transuranic waste has decreased substantially since 1993. This same trend in the reduction of wastes generated is also occurring at the Hanford Site. The reduction in waste generated by DOE during routine operations and during cleanup/stabilization activities has resulted in cost savings or avoidance of costs amounting to over $120,000,000 in FY 2001. Of that figure, more than $22,000,000 of cost savings and cost avoidance occurred at Hanford (DOE 2002a).

Some examples of waste minimization activities performed at Hanford during FY 2001 are provided below (extracted from DOE-RL 2001).

- Mechanical screening to separate contaminated soil from non-contaminated soil reduced the amount of soil that would have otherwise been sent to ERDF for disposal as LLW by almost 1400 m^3 and saved $192,000.

- Reusing lead from contaminated railcars in the 325 Building reduced the amount of lead that would have otherwise been treated and disposed of as MLLW by 2.1 m^3 and saved about $35,000.

- Upgrading the ion exchange system at the ETF will result in the reduction of the amount of MLLW that will be generated annually by 9.8 m^3 and will save about $38,000 annually.

- Recycling chemicals and gases; fire extinguishers; incandescent, sodium, and mercury vapor lamps; mercury and related equipment; shop towels; and small batteries reduced the amount of material that would have otherwise been treated and disposed of as hazardous waste by 8.5 tons and saved about $190,000.

- Recycling lead acid vehicle batteries reduced the amount of material that would have otherwise been treated and disposed of as hazardous waste by 8.5 tons and saved almost $200,000.

- Replacement of a high-performance liquid chromatograph and other laboratory equipment will result in the reduction of the amount of mixed low-level waste and hazardous waste that will be generated annually by about 0.1 m^3 and will save about $94,000 annually.

- Using slightly contaminated soil for shielding and mixing during remediation activities at the 100-N Crib reduced the amount of soil that would have otherwise been sent to ERDF for disposal as LLW by almost 3600 m^3 and saved about $450,000.

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