1223126

Office of River Protection, State of Washington Department of Ecology
Tank Waste Retrieval Work Plan/Functions and Requirements Change Notice
(Per Hanford Federal Facility Agreement and Consent Order Section 9.3)

1. Document Title and Number: RPP-22520, Rev. 7, 241-C-101 and 241-C-105 Tanks Waste Retrieval Work Plan		
2. Minor Field Change: (Section 12.4 HFFACO Action Plan) ☐ Yes: (WRPS Signature Only – Attach signed form to Primary Document for record purposes) x No: Proceed to Box 3	**3.** Document Issue Date: 03/21/12 **4.** Document Modification Notice Date: 1/22/14	**5.** Notice Number: 2014-01
6. Do proposed changes require schedule changes? (Would this extend completion of retrieval beyond 12 months from date of initiation?) ☐ Yes x No	**7.** Do proposed changes include specific additions, deletions, or modification to scope and/or requirements which affect the overall intent of the plan? ☐ Yes x No	**8.** (Check only one box) ☐ Significant Modification (Check if the answer to question in either section 6 or 7 is "yes". Significant modifications require revision of the primary document.) Minor Modification x Requires modification of the document x Can be accomplished with Modification Notice.

9. Description and Justification of Change:

Change Description: A change is needed to provide a less conservative and better estimate of the concentrations of NO_2, Cr, and Tc-99 in AN-106 supernate. Changes are also made to update the groundwater monitoring program references.

Justifications:

- Pgs 4-3 to 4-5: Deleted out of date groundwater monitoring information and included new references.
- Pg 4-10: Updated moisture logging procedure references.
- Pg 7-9: Updated references to groundwater concentration calculations and deleted previous explanation of conservatism.
- Pgs 9-2 to 9-10: Updated references.
- Pg B-1 to B-8: Updated groundwater risk plots and concentrations.

See the attached redline strikeout pages.

RECEIVED
FEB 20 2014
EDMC

WMA-C

Office of River Protection, State of Washington Department of Ecology
Tank Waste Retrieval Work Plan/Functions and Requirements Change Notice
(Per Hanford Federal Facility Agreement and Consent Order Section 9.3)

10. Impact of Change:

The changes provide current information for the groundwater program and more accurate estimates of the supernate concentration that will be used in C-105 retrieval. The updated information will allow for a better determination of the risk associated with the retrieval actions.

11. Additional Requirements and/or Provisions

Approvals

Washington River Protection Solutions, LLC.	Office of River Protection	State of Wash., Dept. of Ecology
☐ Provisional Approval[2] Date	☐ Provisional Approval[2] Date	☐ Provisional Approval[2] Date
☒ Final Approval Date 2/7/14	☒ Final Approval Date 2/11/14	☒ Final Approval Date 2/11/14

Notes

1 - For use by Ecology to identify any additional information needed to make a decision regarding the request for modifications. In addition, Ecology will identify actions, if any, regarding the modification request that DOE may take pending Ecology's final decision

2 – Provisional approval allows DOE and it's contractors to take specific actions identified in section 11, prior to final approval of this modification.

4.1.2 Groundwater Monitoring

Identify the number and location of groundwater monitoring wells associated with the Waste Management Areas (WMA). Summarize current groundwater monitoring activities.

~~Groundwater monitoring at WMA C was begun in 1990 using four RCRA groundwater monitoring wells constructed in 1989 (299-E27-12, 299-27-13, 299-E27-14 and 299-E27-15). The groundwater beneath the C tank farm has been monitored since 2001 in accordance with the RCRA groundwater monitoring plan established in 2001 (PNNL-13024, *RCRA Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area C at the Hanford Site*). Figure 4-2 provides a plan view of the C tank farm and the surrounding RCRA groundwater monitoring wells. There are nine groundwater monitoring wells surrounding the C tank farm (four new wells constructed in 2003). Since June 2002, groundwater sampling for the groundwater wells 299-E-27-7, 299-E-27-12, 299-E-27-13, 299-E-27-14, and 299-E-27-15 has been performed on a quarterly basis (PNNL-13024, ICN-1). Since December 2003, new groundwater monitoring wells 299-E-27-4, 299-E-27-21, 299-E-27-22, and 299-E-27-23 have also been sampled on a quarterly basis.~~ Additional monitoring wells have added since 1989. A current list of the WMA C groundwater monitoring wells can be found in DOE/RL-2009-77. The wells are sampled quarterly to meet prior agreements made with Ecology. Quarterly samples are analyzed at a minimum for anions, cyanide, inductively coupled plasma metals, gross beta, technetium, and total uranium, and a low-level gamma scan is performed. Sampling is conducted in accordance with DOE/RL-2009-77 and DOE/RL-2001-49.

The quarterly groundwater monitoring that is currently performed is adequate for the purpose of supplementary data collection during waste retrieval. Ecology is provided quarterly groundwater monitoring sample results in the quarterly and annual groundwater monitoring reports. These reports are issued by the groundwater project.

If a leak is detected during retrieval, groundwater monitoring frequency will be reevaluated in accordance with the regulatory requirements in WAC 173-303, "Dangerous Waste Regulations."

4.1.2.1 Use of Groundwater Monitoring for Retrieval Process Control.

(1) Evaluate the use of appropriately located existing groundwater monitoring wells for retrieval process control.

Based on the limitations of flow transport calculations and the time required for a retrieval leak to show up in groundwater samples, groundwater monitoring data will not be used for retrieval process control, but is available, for background reference information only, through the site groundwater monitoring program.

4.1.2.2 Groundwater Sampling Prior to and Following Retrieval.

(2) Ensure that appropriately located existing groundwater monitoring wells will be sampled within a two month period prior to and following the retrieval (quarterly sampling satisfies this requirement).

~~PNNL-13024, ICN-5, requires q~~Quarterly groundwater sampling is performed for the C-farm groundwater monitoring wells. In accordance with 04-TPD-083, "*Agreement on Content of Tank Waste Retrieval Work Plans*" (04-TPD-083 – letter), it was agreed to in writing by ORP, Ecology, and the tank farm contractor that quarterly groundwater sampling satisfies the TWRWP outline requirement C.1.b.(2) (this wording is in italics at the start of Section 4.1.2.2) to take groundwater samples within a 2-month period prior to and following retrieval.

4.1.3 Existing Tank Level Monitoring Equipment and Activities

Identify existing level measurement instrumentation in the subject tank and receiver tank. Identify ongoing tank level monitoring activities.

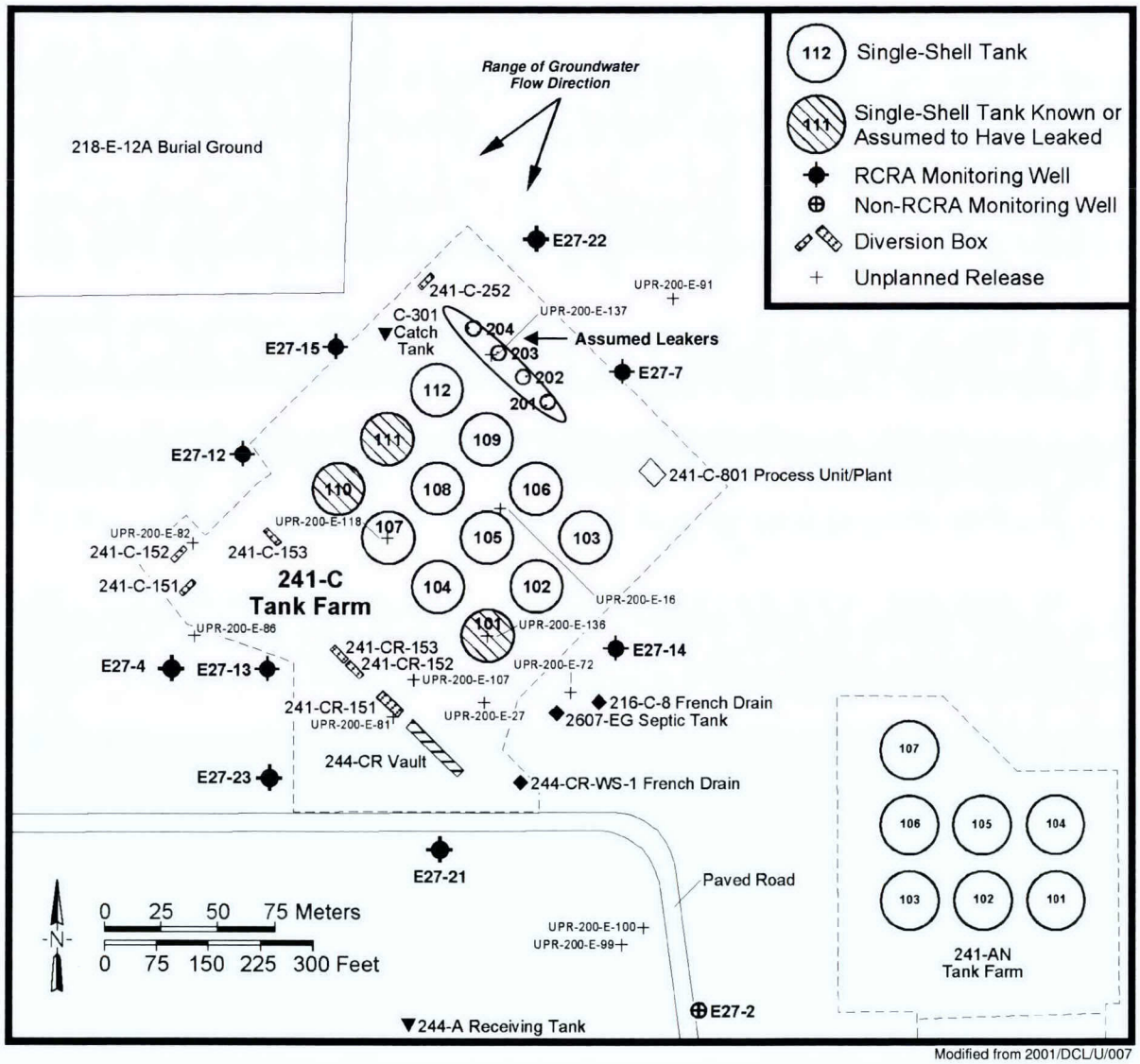
Tanks C-101 and C-105 currently have operable ENRAF level gauges installed. The receiver DSTs currently have the same type of level gauge installed. The receiver DSTs annulus have leak detection devices installed such as conductivity gauges, Enraf level gauges or similar instruments for detection of leaks from the primary tank liner.

The waste levels in tanks C-101 and C-105 while in storage mode are monitored for intrusion on a quarterly basis using an ENRAF level gauge (OSD-T-151-00031). The basis for in-tank leak detection and intrusion monitoring is provided in RPP-9937, *Single-Shell Tank System Leak Detection and Monitoring Functions and Requirements Document*.

The primary level monitoring in the receiver DST is performed as described in OSD-T-151-00031. The annulus leak detector instruments provide indication of tank leaks as described in OSD-T-151-00031.

Level monitoring for the tank receiving the exhauster condensate, if not C-101 or C-105 during their retrieval, will be performed as specified in the applicable Ecology approved TWRWP for that tank.

Figure 4-2. Waste Management Area C and Regulated Structures.*^



Modified from 2001/DCL/U/007

* Adapted from Figure B.18 in PNNL-14548, 2004, *Hanford Site Groundwater Monitoring for Fiscal Year 2003*.

^The most current list of groundwater monitoring wells can be found in DOE/RL-2009-77

gamma data in a single log run can result in a significant reduction in the cost of monitoring activities when compared to obtaining separate neutron and gamma logs. The RMS also provides for electronic data recording. When implemented, the RMS may be substituted for the handheld moisture gauge and may also be used in place of truck-mounted logging systems. Drywells with very high gamma activity may still require the use of the high rate logging system that is part of the SGLS, but it is possible that a high rate detector can be developed for the RMS. Development of the RMS is complete but as of late 2011 it is not yet available for deployment. It is anticipated that the RMS will have a measurement range from background up to 100,000 pCi/g ^{137}Cs and 0 to 25 vol% moisture content.

The SGLS logging system was used to establish baseline conditions in 1995-2000. This logging system is based on a liquid nitrogen cooled high purity germanium detector, which provides excellent gamma energy resolution for identification and quantification of individual radionuclides from background levels (method detection limit about 0.1 pCi/g ^{137}Cs under typical conditions) up to about 10,000 pCi/g ^{137}Cs. A high rate detector with internal and external shields is available to extend the measurement range to about 10^9 pCi/g ^{137}Cs.

The SGLS truck can also be used to operate a neutron moisture logging system, which measures in situ vadose zone moisture over the range of 0 to about 25 vol% moisture content. The neutron moisture logging system uses a similar source-detector relationship as the handheld moisture gauge.

It takes about one shift of operation to obtain moisture logging data from all the drywells around a tank with the hand-held moisture probe. It takes about one shift of operation to obtain RAS data from one drywell.

The handheld moisture gauge will be deployed by qualified personnel in accordance with TO-320-022, *Operate Model 503DR M1 HP-2 or M1 HP-3 Hydroprobe Neutron Moisture ~~Detection~~Gauge* or TO-320-060, *Operate Model 503DR M1 HP-4 Hydroprobe Neutron Moisture Gauge.*

The logging systems will be deployed by qualified personnel in accordance with the applicable procedures for that equipment.

The results from drywell monitoring, as well as a summary and analysis of this monitoring, including tools used, calibration, boreholes logged, depth of logging, frequency, logging rate, and data analysis will be submitted to Ecology within the retrieval data report in accordance with Appendix I of the HFFACO.

4.2.1.2. Leak Detection Using SST Liquid Level Measurement. SST level measurement data are normally limited during periods when active retrieval operations are not being performed due to the strategy of minimizing liquid in the tank. In addition, because of the dished bottoms of the tanks and the location of the level instrumentation near the side in the C-100 series SSTs, waste levels cannot be measured below approximately 12,000 gal. However, should conditions exist where a continuous liquid surface measurement is available (e.g., a pump fail prior to removing as much liquid as practical from the tank and replacement of the pump cannot occur immediately) this measurement could provide an additional means of leak detection superior to

7.1.1.2. Potential Retrieval Leak Inventories. This document presents much of the risk data assuming an 8,000-gal. retrieval leak volume. This quantity is used only as a point of reference, and for consistency and comparison with the volume assumed in the WMA C Closure Plan (RPP-13774, Appendix C) risk assessment. The choice of the reference volume is arbitrary and does not affect how the risk values would be used in the event of a retrieval leak. The 8,000 gal. is a hypothetical volume that represents neither an anticipated leak volume nor a leak detection limit. The WRS design and operational strategy for tanks C-101 and C-105 are designed to minimize the leak potential from the tank structure during waste retrieval. If a leak is detected, however, the risk graphs provided in Appendices A and B will allow the leak impacts to be estimated regardless of leak volume.

The retrieval leak impact graphs provided in the appendices were generated by applying Equation 7-1 over a range of hypothetical retrieval leak inventories for each indicator contaminant (RPP-22521 Rev. 5 and ~~6~~7). Because potential retrieval leak volumes are uncertain, the inventory range was selected to encompass a small leak on the low end and a large leak on the high end. Points of reference were added to the graphs to show the estimated current tank inventory and the estimated inventory associated with a hypothetical 8,000-gal. retrieval supernate leak. The 8,000-gal. volume was used only for information purposes to provide a point of reference on the graphs.

The indicator contaminant concentrations in RPP-22521, Rev. 5 are high estimates that are intended to be bounding. These bounding estimates were initially used for both C-101 and C-105 prior to installation of the retrieval equipment. Close to the startup of C-101 retrieval, RPP-22521 was revised so that less bounding and more accurate estimates would be available. Appendix A (C-101) is based RPP-22521, Rev. 6A and Appendix B (C-105) is based on RPP-22521, Rev. ~~5~~7.

~~An explanation of the bounding assumptions that apply to C-105 and Appendix B are as follows. Prior to retrieval a decant of the DST is conducted reducing the volume of supernate. The estimated volume of water that will be used in the retrieval is not added to the supernate volume thereby minimizing the estimated supernate volume and increasing the estimated concentration. It was assumed that the DST will not be decanted prior to retrieving C-101 and C-105, so all of the mass from SSTs retrieved into the DST prior to C-101 and C-105 remains in the DST supernate. Further, it is assumed that the salt cake shown by the BBI in the DST dissolves increasing the concentration of contaminants.~~

Development of the tank-specific inventories shown as points of reference on the graphs for the individual tanks is discussed in the appendices. Current inventory values were taken from the BBI by downloading from the Tank Waste Information Network System (TWINS) database. Hypothetical retrieval leak inventory values were calculated from the best available published data source.

Baumhardt, R. J., 1989, *Single-Shell Tank Leak Volumes*, Letter to Mr. R. E. Gerton, Richland Operations Office, U.S. Department of Energy, Correspondence number 8901823B R1, May 17, 1989, Westinghouse Hanford Company, Richland, Washington.

Chapter 70.105 RCW, "Hazardous Waste Management Act," *Revised Code of Washington*, as amended.

Consent Decree No. 08-5085-FVS, United States District Court Eastern District of Washington, October 25, 2010

DOE, 2003, *Dangerous Waste Permit Application—Single-Shell Tank System*, Rev. 8, U.S. Department of Energy, Washington, D.C.

DOE O 435.1, 2001, *Radioactive Waste Management*, U.S. Department of Energy, Washington, D.C.

DOE/ORP-2000-24, 2001, *Hanford Immobilized Low-Activity Waste Performance Assessment: 2001 Version*, Rev. 0, U.S. Department of Energy, Office of River Protection, Richland, Washington.

DOE/ORP-2003-02, 2003, *Inventory and Source Term Data Package*, Rev. 0, U.S. Department of Energy, Office of River Protection, Richland, Washington.

DOE/ORP-2003-11, 2003, *Preliminary Performance Assessment for Waste Management Area C at the Hanford Site, Washington*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

DOE/ORP-2005-01, 2005, *Initial Single-Shell Tank System Performance Assessment for The Hanford Site*, U.S. Department of Energy, Office of River Protection, Richland, Washington.

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

DOE/RL-97-69, 1998, *Hanford Immobilized Low-Activity Tank Waste Performance Assessment*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington, March 1998.

DOE/RL-2001-49, *Groundwater Sampling and Analysis Plan for the 200-BP-5 Operable Unit*, Latest Revision, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2009-77, *Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area C*, Latest Revision, U.S. Department of Energy, Richland Operations, Office, Richland, Washington.

HNF-EP-0182, 2011, *Waste Tank Summary Report for Month Ending September 30, 2011*, Rev. 282, Washington River Protection Solutions, LLC, Richland, Washington.

HNF-IP-1266, , *Tank Farms Operations Administrative Controls*, Washington River Protection Solutions, LLC., Latest Revision Richland, Washington.

HNF-SD-WM-DQO-001, 2010, *Data Quality Objectives for Tank Farms Waste Compatibility Program*, Rev. 17, Washington River Protection Solutions, LLC, Richland, Washington.

HNF-SD-WM-OCD-015, *Tank Farm Waste Transfer Compatibility Program*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

HNF-SD-WM-TI-707, 2004, *Exposure Scenarios and Unit Dose Factors for the Hanford Tank Waste Performance Assessment*, Rev. 4, CH2M HILL Hanford Group, Inc., Richland, Washington.

HNF-SD-WM-TSR-006, *Tank Farms Technical Safety Requirements*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

Lyon, J. J., 2004, Letter to Mr. Roy J. Schepens Office of River Protection, United States Department of Energy, July 22, Re: *Letter from R. Schepens, USDOE, to M. Wilson, Ecology, dated May 10, 2004, "Use of Double Shell Tank 241-AN-106 Supernate for Waste Retrieval from Single-Shell Tanks (SST) 241-C-103 and 241-C-105*", Washington State Department of Ecology, Nuclear Waste Program, Richland, Washington.

OSD-T-151-00007, *Operating Specifications for the Double-Shell Storage Tanks*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

OSD-T-151-00013, *Operating Specifications for Single-Shell Waste Storage Tanks*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

OSD-T-151-00031, *Operating Specifications for Tank Farm Leak Detection and Single-Shell Tank Intrusion Detection*, Latest Revision, Washington River Protection Solutions, LLC., Richland, Washington.

OSWER 9938.4-03, 1994, *Waste Analysis at Facilities That Generate, Treat, Store and Dispose of Hazardous Waste*, U.S. Environmental Protection Agency, Washington, D.C.

PNNL-13024, 2001, *RCRA Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area C at the Hanford Site*, Pacific Northwest National Laboratory, Richland, Washington.

~~PNNL-13024, ICN-1 2002, *RCRA Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area C at the Hanford Site*, Pacific Northwest National Laboratory, Richland, Washington.~~

~~PNNL-13024, ICN 5 2007, *RCRA Groundwater Monitoring Plan for Single-Shell Tank Waste Management Area C at the Hanford Site*, Pacific Northwest National Laboratory, Richland, Washington.~~

PNNL-13895, 2003, *Hanford Contaminant Distribution Coefficient Database and Users Guide*, Rev 1, Pacific Northwest National Laboratory, Richland, Washington.

PNNL-14548, 2004, *Hanford Site Groundwater Monitoring for Fiscal Year 2003*, Pacific Northwest National Laboratory, Richland, Washington.

Resource Conservation and Recovery Act of 1976, Public Law 94 580, 90 Stat. 2795, 42 USC 901 et seq.

RHO-CD-896, 1980, *Review of Classification of Nine Hanford Single-Shell "Questionable Integrity" Tanks*, Rev. 0, Rockwell Hanford Operations, Richland, Washington.

RPP-5482, 2000, *Time Deployment Study for Annulus Pumping*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-7625, 2004, *Best Basis Inventory Process Requirements*, Rev. 5, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-7825, 2003, *Single-Shell Tank S-112 Full Scale Saltcake Waste Retrieval Technology Demonstration Functions and Requirements*, Rev. 2A, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-8144, 2004, *Level 2 Specification for the Tank 241-C-101 Waste Retrieval System*, Rev. 3, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-9937, 2008, *Single-Shell Tank System Leak Detection and Monitoring Functions and Requirements Document.*, Rev. 3, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-10413, 2003, *Tank S-112 Saltcake Waste Retrieval Demonstration Project Leak Detection, Monitoring, and Mitigation Strategy*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-10435, 2002, *Single-Shell Tank System Integrity Assessment Report*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-10901, 2004, *S-102 Initial Waste Retrieval Functions and Requirements*, Rev. 1C, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-12711, *Temporary Waste Transfer Line Management Program Plan*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-13033, *Tank Farms Documented Safety Analysis*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-22491, *Industrial Hygiene Vapor Technical Basis*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-22521, *Tanks C-101, C-105, C-110, and C-111 Long-Term Human Health Risk Calculations to Support Tank Waste Retrieval Work Plan*, Rev.5, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-22521, *Tanks C-101, C-102, C-105, C-110, and C-111 Long-Term Human Health Risk Calculations to Support Tank Waste Retrieval Work Plans*, Rev.6A, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-22521, *Tanks C-101, C-102, C-105, C-110, and C-111 Long-Term Human Health Risk Calculations to Support Tank Waste Retrieval Work Plans*, Rev.7, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-23403, 2009, *Single-Shell Tank Component Closure Data Quality Objectives*, Rev. 4, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-23405, 2004, *Tank Farm Vadose Zone Contamination: Volume Estimates for Risk Assessments*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland , Washington.

RPP-23405, 2008, *Tank Farm Vadose Zone Contamination: Volume Estimates for Risk Assessments*, Rev. 3, CH2M HILL Hanford Group, Inc., Richland , Washington.

RPP-27869, *Building Emergency Plan for Tank Farms*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-29002, ~~2006~~2012, *Double-Shell Tank Waste Analysis Plan*, Rev 0, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-30121, 2006, *Tank 241-S-102 High-Resolution Resistivity Leak Detection and Monitoring Test Report,* Rev 0-A, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-32477, *High Resolution Resistivity Leak Detection Data Processing and Evaluation Methods and Requirements*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

RPP-32681, 2007, *Process to Estimate Tank Farm Vadose Zone Inventories*, Rev 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-33116, *241-C-110 Tank Waste Retrieval Work Plan*, Latest Revision, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-50910, 2011, *Single-Shell Tank Waste Retrieval Limit of Technology Definition for Modified Sluicing*, Rev. 0, Washington River Protection Solutions, LLC., Richland, Washington.

TFC-ENG-CHEM-P-47, *Single-Shell Tank Retrieval Completion Evaluation*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

TFC-ENG-STD-26, *Dilution and Flushing Requirements*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

TFC-ESHQ-ENV_FS-C-01, *Environmental Notification*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

TFC-ESHQ-ENV-STD-03, *Air-Quality Radioactive Emissions*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

TFC-ESHQ-ENV-STD-04, *Air Quality Program, Non-Radioactive Emissions*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

TFC-OPS-MAINT-C-01, *Tank Farm Contractor Work Control*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

TFC-OPS-OPER-C-24, *Occurrence Reporting and Processing of Operations Information*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

TFC-OPS-WM-C-10, *Contaminated Equipment Management Practices*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

TFC-PLN-07, *Dangerous Waste Training Plan*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

TFC-PLN-34, *Industrial Hygiene Exposure Assesment Strategy*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

TO-320-022, *Operate Model 503DR M1 HP-2 or M1 HP-3 Hydroprobe Neutron Moisture ~~Detection~~Gauge*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

TO-320-060, *Operate Model 503DR M1 HP-4 Hydroprobe Neutron Moisture Gauge*, Latest Revision, Washington River Protection Solutions, LLC, Richland, Washington.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 173-400, "General Regulation for Air Pollution Sources," *Washington Administrative Code*, as amended.

WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," *Washington Administrative Code*, as amended.

WAC 246-247, "Radiation Air Emissions Program," *Washington Administrative Code*, as amended.

B1.0 TANK C-105 PRE-RETRIEVAL RISK ASSESSMENT RESULTS

This appendix provides tank-specific pre-retrieval risk assessment results for 241-C-105 (tank C-105). The information presented was developed using the methodology described in Section 7.0. Groundwater pathway impacts are presented in Section B2.0. Inadvertent intruder impacts are presented in Section B3.0.

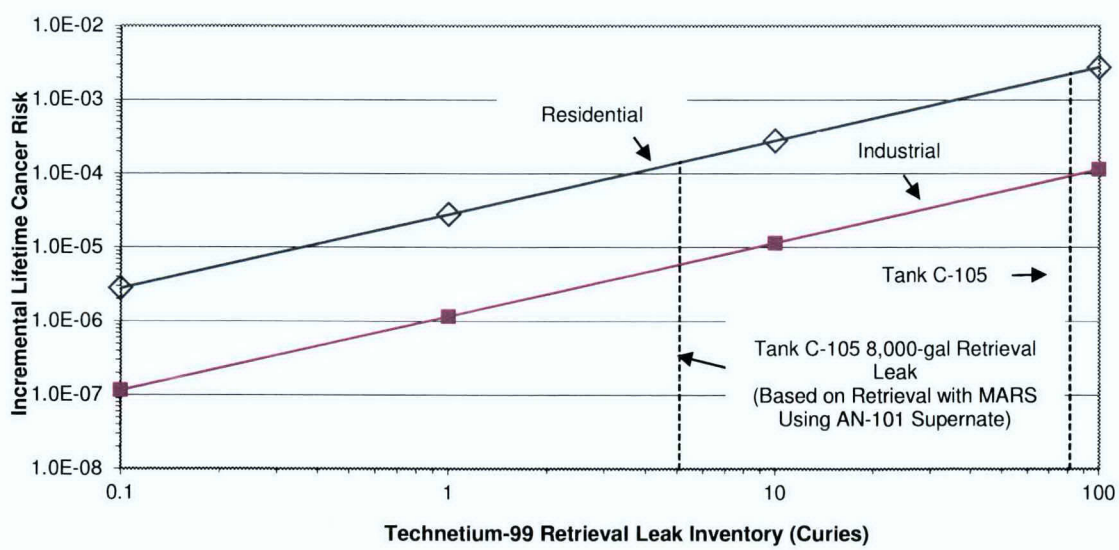
B2.0 GROUNDWATER PATHWAY IMPACTS

The groundwater pathway evaluation involved the development of a set of graphical tools to provide a basis for making informed decisions in the event a leak is detected or unexpected retrieval conditions arise during waste retrieval operations. This section provides and discusses the retrieval leak impact graphs generated for tank C-105. The methodology used to generate the graphs is described in Section 7.1.1. Calculation detail for the graphs is provided in RPP-22521, *Tanks C-101, C-102, C-105, C-110, and C-111 Long-Term Human Health Risk Calculations to Support Tank Waste Retrieval Work Plans*.

B2.1 RETRIEVAL LEAK IMPACT GRAPHS

Figures B-1 through B-3 provide the tank C-105 waste retrieval leak impact graphs for the three indicator contaminants (technetium-99, hexavalent chromium, and nitrite) identified in Section 7.1.1.1.

Figure B-1. Tank C-105 Technetium-99 Risk Plot.



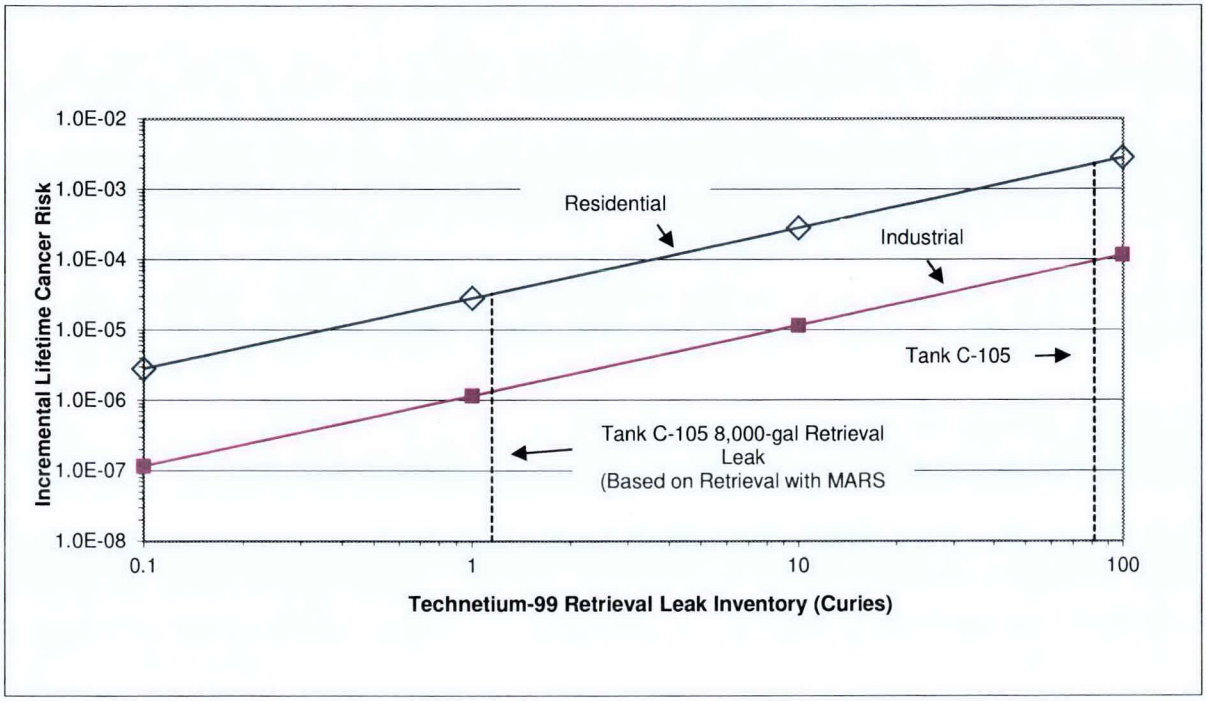
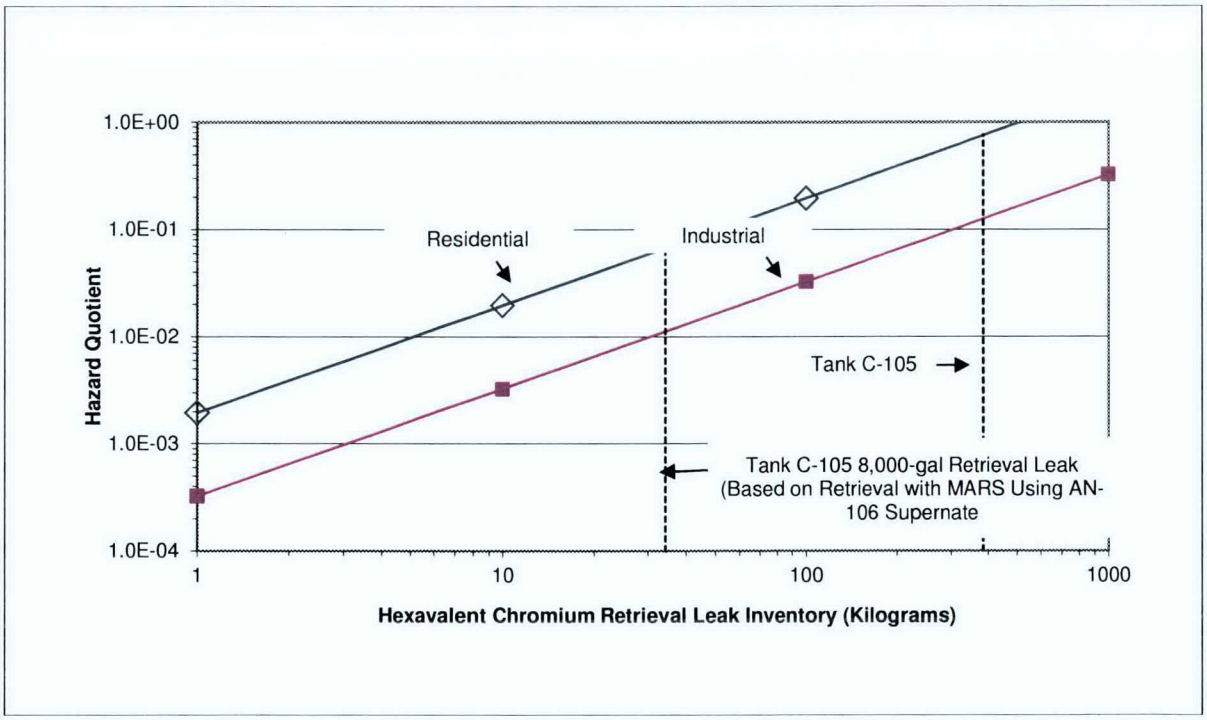


Figure B-2. Tank C-105 Hexavalent Chromium Hazard Quotient Plot.



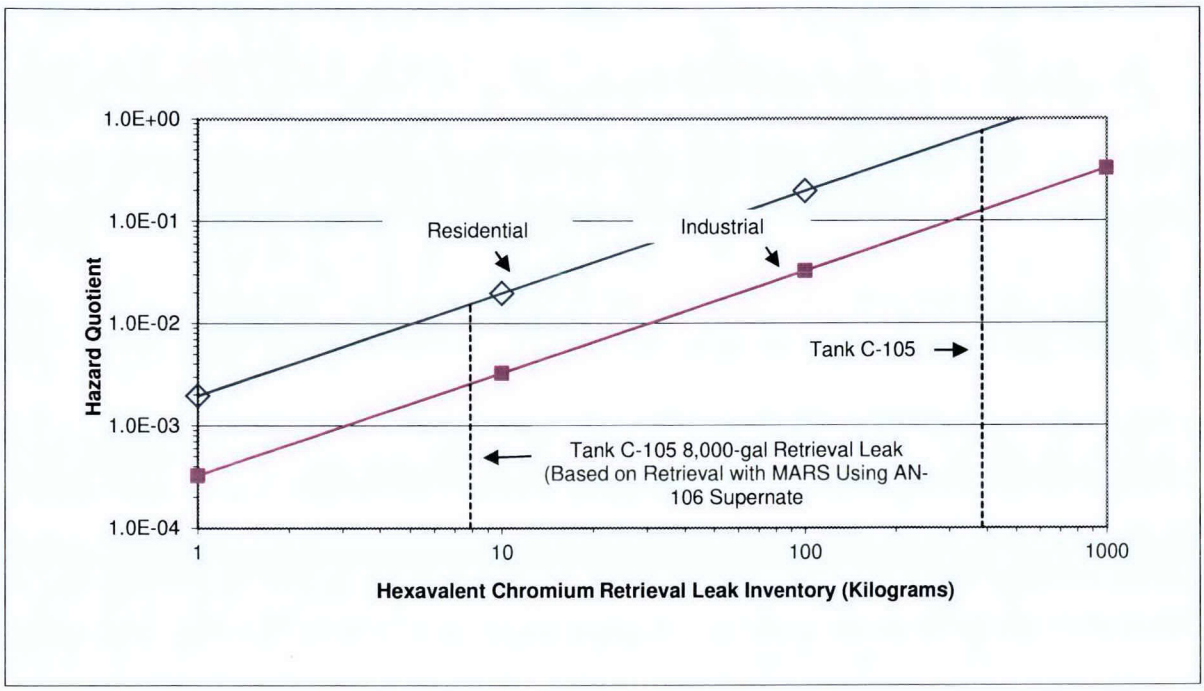
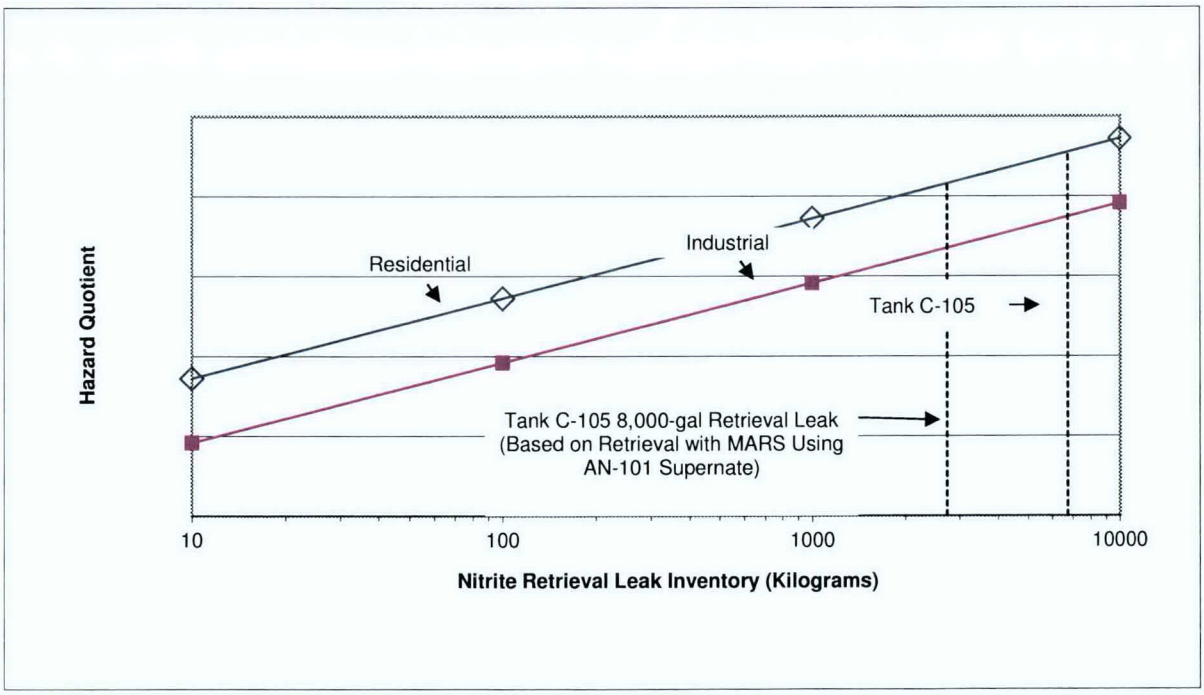


Figure B-3. Tank C-105 Nitrite Hazard Quotient Plot.



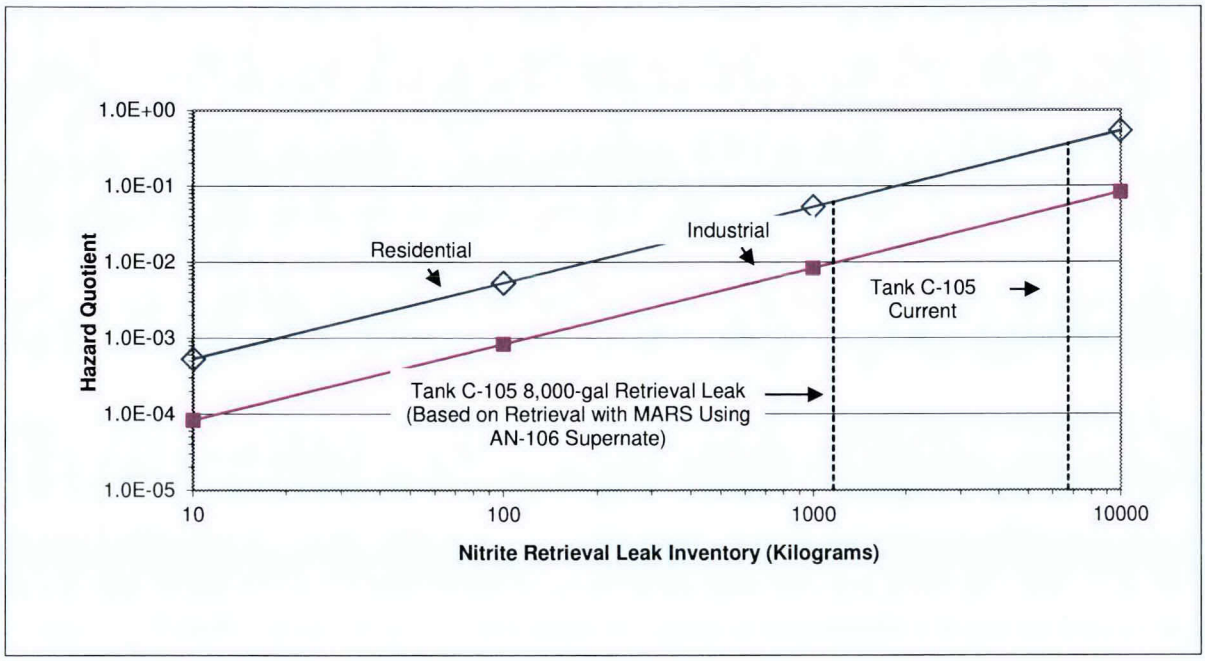


Figure B-1 shows the peak groundwater pathway incremental lifetime cancer risk (ILCR) from technetium-99 as a function of the amount of technetium-99 leaked from tank C-105 during waste retrieval. Figures B-2 and B-3 show the peak groundwater pathway hazard quotient (HQ) from hexavalent chromium and nitrite, respectively, as a function of the amount of hexavalent chromium and nitrite leaked from tank C-105 during waste retrieval.

The ILCR and HQ values shown on the graphs were based on the predicted peak groundwater concentrations at the waste management area (WMA) C downgradient fenceline. As discussed in Section 7.1.1.3, the projected arrival time of the peaks is approximately the year 2082 based on the supporting contaminant transport analysis in RPP-13774, *Single-Shell Tank System Closure Plan*. The graphs provide a retrieval leak risk picture for tank C-105 but do not include contributions from other WMA C sources. Projected impacts from other WMA C sources are discussed in Section 7.1.3.

Two sloped lines representing the industrial and residential scenarios were plotted on each graph. The data points for these lines were calculated as described in Section 7.1.1 over a range of technetium-99, hexavalent chromium, and nitrite values. Because potential retrieval leak volumes are uncertain, the inventory range was selected to encompass a small leak on the low end and a large leak on the high end.

Vertical dashed lines were added to each graph as points of reference to show the estimated current tank C-105 inventory and the inventory associated with a potential 8,000 gal. retrieval leak. The 8,000-gal. volume was a hypothetical volume used only as a point of reference and for consistency with previous analyses. It was not intended to represent anticipated retrieval leak volumes or leak detection limits for tank C-105.

In the event a leak is detected during waste retrieval, the leak monitoring system would be used to estimate the leak volume. The potential human health impacts from the leak could then be

evaluated from the leak volume and estimated contaminant concentrations in the leak along with the graphs shown in Figures B-1 through B-3. Using the graphs, the impacts from leak inventories greater or lesser than those shown for the 8,000-gal. reference volume can be estimated rapidly by extrapolating from the impacts shown for the reference volume.

B2.2 INVENTORY

The reference lines shown in Figures B-1 through B-3 to indicate current inventory and retrieval leak inventory were developed from the best available data and information. Current inventories were taken from the best-basis inventory (BBI) by downloading from the Tank Waste Information Network System (TWINS) database (http://twinsweb.pnl.gov/twins.htm). Retrieval leak inventories were calculated by multiplying the hypothetical retrieval leak volume (8,000 gal.) by the estimated retrieval leak fluid concentration. Waste was assumed to be retrieved from tank C-105 with the ~~mobile retrieval system (MRS)~~mobile arm retrieval system-vacuum (MARS-V) using ~~water~~supernate. The retrieval leak fluid concentrations for this retrieval scenario were developed using data from RPP-~~21753~~22521~~, *C-Farm 100 Series Tanks, Retrieval Process Flowsheet Description*. The RPP-21753 flowsheet description provides representative contaminant concentrations for the fluids inside the SST, the MRS batch vessel, and the double-shell tank (DST) receiver tank during retrieval with the MRS. Retrieval leak inventories were developed for the representative SST fluid concentrations for RPP-21753 (Table B-1)~~.

Table B-1. Tank C-105 Retrieval Leak Inventory Estimate.

Contaminant	Leak Fluid Concentration *	Inventory in 8,000-gal. Retrieval Leak
Technetium-99	~~1.68~~3.79E-~~04~~-05 Ci/L	~~5.09~~1.15E+00 Ci
Hexavalent Chromium	~~1.13E~~2.60-~~03~~-04 kg/L	~~3.42~~7.87E+~~01~~-00 kg
Nitrite	~~9.03~~3.83E-02 kg/L	~~2.73~~1.16E+03 kg

* Appendix ~~D~~E & F, ~~Table D-3~~ from RPP-~~21753~~22521 Rev. 7, ~~2005,~~ *Tanks C-101, C-102, C-105, C-110, and C-111 Long-Term Human Health Risk Calculations to Support Tank Waste Retrieval Work Plans~~C-Farm 100 Series Tanks, Retrieval Process Flowsheet Description.~~*

B2.3 SUMMARY OF IMPACTS FROM HYPOTHETICAL 8,000-GALLON RETRIEVAL LEAK

The technetium-99 inventory associated with a hypothetical 8,000 gal. retrieval leak from tank C-105 was estimated to be approximately ~~5.09~~1.15 curies (RPP-22521). As shown in Figure B-1, this corresponds to an ILCR of approximately ~~5.90~~1.33 × 10^{-6} for the industrial scenario and ~~13.44~~24 × 10^{-4}~~-5~~ for the residential scenario. The peak technetium-99 groundwater concentration at the WMA C fenceline from this retrieval leak would be approximately ~~427~~96.4 pCi/L.

The hexavalent chromium inventory associated with a hypothetical 8,000 gal. retrieval leak from tank C-105 was estimated to be approximately ~~34.2~~7.87 kg (RPP-22521). As shown in Figure B-2, this corresponds to an HQ of approximately ~~1.12~~2.57 × 10^{-2}~~-3~~ for the industrial scenario and ~~6.73~~1.55 × 10^{-2} for the residential scenario. The peak hexavalent chromium groundwater

concentration at the WMA C fenceline from this retrieval leak would be approximately ~~2.87~~6.61 $\times 10^{-34}$ mg/L.

The nitrite inventory associated with an 8,000 gal. retrieval leak from tank C-105 was estimated to be approximately ~~2730~~1160 kg (RPP-22521). As shown in Figure B-3, this corresponds to an HQ of approximately ~~2.27~~9.63 $\times 10^{-2}$-^{3} for the industrial scenario and ~~1.46~~6.20 $\times 10^{-1}$-^{2} for the residential scenario. The peak nitrite groundwater concentration at the WMA C fenceline from this retrieval leak would be approximately ~~2.30~~9.74 $\times 10^{-1}$-^{2} mg/L.

B2.4 EXAMPLE CALCULATION

To illustrate the calculation method used for the retrieval leak impact graphs, the following example is provided. The example uses the industrial scenario ILCR result of 1.~~84~~33 $\times 10^{-6}$. Using Equation 7-1 from Section 7.1.1, the industrial scenario ILCR was calculated as the product of the technetium-99 inventory (Table B-1), the technetium-99 retrieval leak unit groundwater concentration factor (Table 7-2), and the technetium-99 industrial scenario unit risk factor (Table 7-3), as follows:

$$\text{ILCR} = (\cancel{5.09}1.15 \text{ Ci}) \cdot (8.4 \times 10^{1} \text{ pCi/L per Ci}) \cdot (1.38 \times 10^{-8} \text{ ILCR per pCi/L}) = \cancel{5.90}1.33 \times 10^{-6}$$

Complete calculation details are provided in RPP-22521.

B3.0 INADVERTENT INTRUDER IMPACTS

The starting inventories for the tank C-105 intruder calculation were the estimated radionuclide inventories remaining in the tank following retrieval to the Ecology et al. (1989), *Hanford Federal Facility Agreement and Consent Order* (HFFACO) interim retrieval goal of 360 ft^3 (2,700 gal.) of residual waste. These inventories were taken from RPP-15317, *241-C Waste Management Area Inventory Data Package* and are based on the selective phase removal inventory estimation method. Inventories for all 46 radionuclides reported in the BBI are provided in RPP-15317 and were used in the calculation (RPP-22521). Inventories for the subset of BBI radionuclides that were shown in DOE/ORP-2003-11, *Preliminary Performance Assessment for Waste Management Area C at the Hanford Site, Washington* to dominate intruder doses at 500 years after closure are shown in Table B-2.

Table B-3. Tank C-105 Intruder Dose

Radionuclide	Well Driller (mrem EDE)	Suburban Resident with a Garden (mrem/yr EDE)	Rural Farmer with a Dairy Cow (mrem/yr EDE)
Strontium-90	0.000	0.008	0.001
Technetium-99	0.000	0.044	0.001
Tin-126	0.000	0.000	0.000
Cesium-137	0.002	0.003	0.000
Plutonium-239	0.268	1.513	0.068
Plutonium-240	0.039	0.223	0.010
Americium-241	0.107	0.431	0.021
Other Radionuclides	0.002	0.001	0.000
TOTAL	0.418	2.223	0.101

Note: The number of significant digits shown in Table B-3 is not intended to imply a level of accuracy greater than the input values.
EDE = effective dose equivalent.

B4.0 REFERENCES

DOE/ORP-2003-11, 2003, *Preliminary Performance Assessment for Waste Management Area C at the Hanford Site, Washington*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

RPP-13774, 2004, *Single-Shell Tank System Closure Plan*, Rev. 2, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-15317, 2003, *241-C Waste Management Area Inventory Data Package*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-21753, 2005, *C-Farm 100 Series Tanks, Retrieval Process Flowsheet Description*, Rev. 1, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-22521, *Tanks C-101, C-102, C-105, C-110, and C-111 Long-Term Human Health Risk Calculations to Support Tank Waste Retrieval Work Plans*, ~~Latest Revision~~Revision 7, ~~CH2M HILL Hanford Group~~Washington River Protection Solutions, ~~Inc~~LLC., Richland, Washington.