Performance Assessment for the Waste Management Area C at the Hanford Site in Southeast Washington – 17515

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ABSTRACT

An initial performance assessment (PA) of Single-Shell Tank (SST) Waste Management Area C (WMA C) located at the U.S. Department of Energy's (DOE) Hanford Site in southeastern Washington has been completed to satisfy the requirements of the Hanford Federal Facility Agreement and Consent Order (HFFACO), as well as other Federal requirements and State-approved closure plans and permits. The WMA C PA assesses the fate, transport, and impacts of radionuclides within residual wastes left in tanks and ancillary equipment and facilities in their assumed closed configuration, and the subsequent risks to humans into the far future. This PA focused on radiological impacts has been developed to meet the requirements for a closure authorization under DOE O 435.1 that includes a waste incidental to reprocessing determination for residual wastes remaining in tanks, ancillary equipment, and facilities.

PA results indicate that the performance objectives and measures for the all-pathways dose, the air pathway dose, the radon flux, and groundwater protection are met for both the 1,000-year compliance time period (2020 to 3020) and the post-compliance period (3020 to 12020). The peak dose for the all-pathways analysis in the 1,000-year compliance period is associated with the air pathway, with the peak dose of 4×10^{-5} mSv/yr dominated by tritium resulting from upward gaseous diffusive flux from the residual waste. The peak dose within the sensitivity/uncertainty analysis time period (1,000 to 10,000 years after closure) occurs at about 1,500 years after closure, and results primarily from a peak in ^{99}Tc groundwater concentration at 100 m downgradient of the facility. The peak total dose within the sensitivity/uncertainty analysis time period is 0.001 mSv/yr. For all of the sensitivity analyses and uncertainty analyses evaluated, the disposal system also met the performance objectives. In the uncertainty analysis performed with the system level model based on GoldSim©[a], the highest calculated groundwater dose in the compliance period was about 7×10^{-4} mSv/yr, and the highest calculated peak dose in the sensitivity/uncertainty analysis period was 0.025 mSv/yr.

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[a] *GoldSim© simulation software is copyrighted by GoldSim Technology Group LLC of Issaquah, Washington (see http://www.goldsim.com).*

Doses associated with hypothetical inadvertent human intrusion were calculated for all sources in WMA C and compared to the acute and chronic performance measures in DOE O 435.1. The calculated doses for acute and chronic exposure scenario from potential intrusion into a waste transfer pipeline remain below the DOE O 435.1 performance measure for the time period evaluated beyond 100 years after closure. Acute exposure from drilling into the waste yielded a dose of about 0.36 mSv after the assumed 100–year institutional control period, well below the 5 mSv performance measure for acute exposure. Chronic exposure to waste from drill cuttings in a rural pasture scenario resulted in a dose of about 0.08 mSv/yr after the assumed 100–year institutional control period, well below the 1 mSv/yr performance measure for chronic exposure.

INTRODUCTION

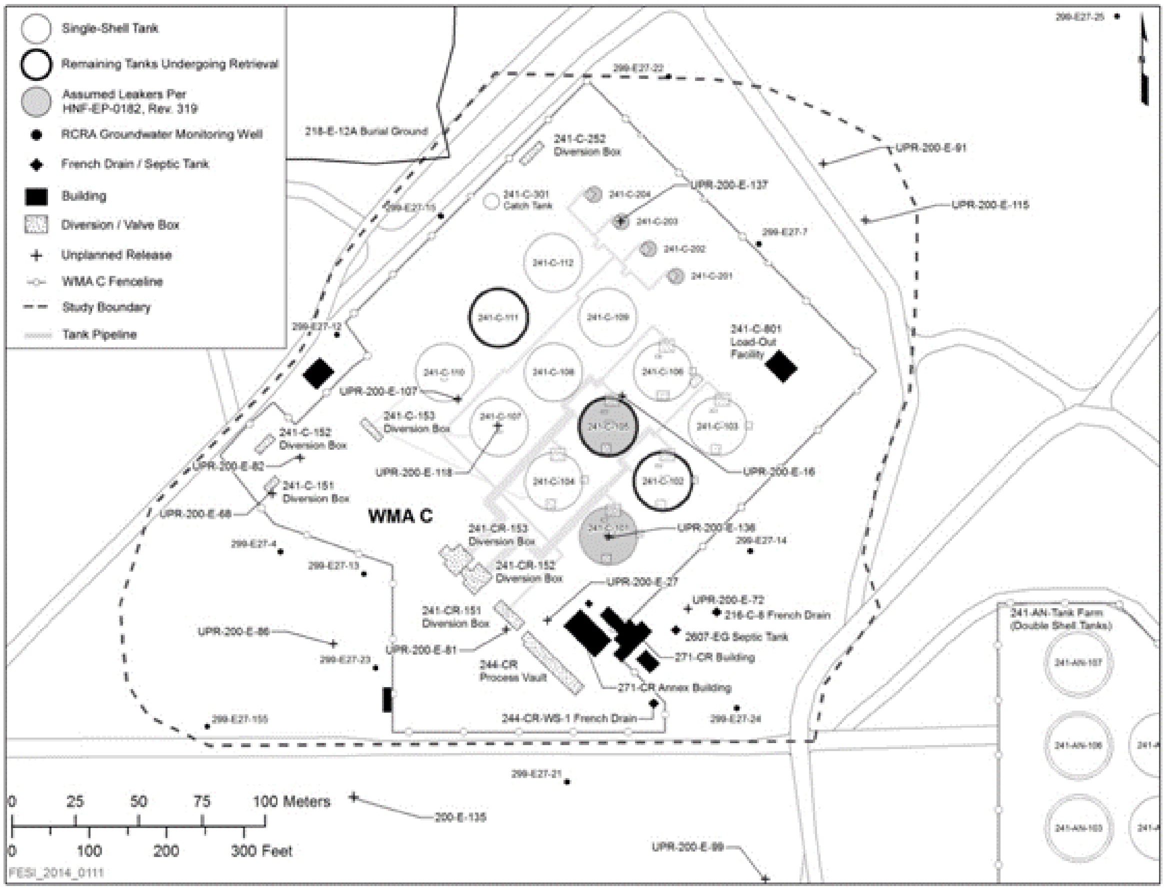
Waste Management Area C is one of seven WMAs (A-AX, B-BX-BY, C, S-SX, T, TX-TY, and U) containing 149 SSTs built from 1943 to 1964. In general, the WMA C boundary is represented by the fence line surrounding 241-C Tank Farm (Fig. 1). Waste Management Area C contains 12 100-series SSTs and 4 200-series SSTs that were constructed in 1943 to 1944 along with associated ancillary equipment (i.e., diversion boxes, pipes). It was placed in service in 1946, and used to store and transfer waste until mid-1980. Additional ancillary equipment (CR-Vault and CR diversion boxes) were added in the early 1950s.
A comprehensive PA [1] meeting the requirements of DOE O 435.1 [2] for WMA C was released in October 2016.

During its operational history, a number of confirmed or suspected waste release events have occurred at WMA C. These included suspected tank leaks and known unplanned releases from waste transfer lines and systems.

Pumping of liquid waste in preparation for removing the tanks from service began in 1976. Currently, the pumpable liquid wastes have been removed from the 241-C Farm tanks and all tanks have been stabilized on an interim basis. Since 2003, there has been a concerted effort to retrieve the waste from the SSTs within WMA C. As of September 2015, waste retrieval has been completed for 15 of the 16 tanks. Retrieval is underway for SST C-105 [3]. The retrieval status will continue to evolve concurrent with the development of the PA in fiscal year 2017.

Fig. 2 illustrates the closure concept for WMA C following tank waste retrieval. Surface facilities will be removed and retrieved SSTs and accessible ancillary equipment with significant void spaces will be filled with grout. Waste transfer pipelines are also expected to be left in place. An engineered surface cover system will be placed over the tank farms and will be monitoring using existing wells.

Fig. 3 shows various pathways of possible exposure evaluated in the PA. The major pathways for contamination entering the environment are the groundwater pathway, the air pathway, and an inadvertent intruder pathway (through drill cuttings brought to the surface). The most important exposure pathway for hydrologic transport is groundwater used for drinking water, irrigation, livestock


Single-Shell Tank
Remaining Tanks Undergoing Retrieval
Assumed Leakers Per HNF-EP-0182, Rev. 319
RCRA Groundwater Monitoring Well
French Drain / Septic Tank
Building
Diversion / Valve Box
Unplanned Release
WMA C Fenceline
Study Boundary
Tank Pipeline
WMA C
218-E-12A Burial Ground
241-C-252 Diversion Box
241-C-301 Catch Tank
241-C-801 Load-Out Facility
241-C-153 Diversion Box
241-C-152 Diversion Box
241-C-151 Diversion Box
241-CR-153 Diversion Box
241-CR-152 Diversion Box
241-CR-151 Diversion Box
244-CR Process Vault
216-C-8 French Drain
2607-EG Septic Tank
271-CR Building
271-CR Annex Building
244-CR-WS-1 French Drain
241-AN-Tank Farm (Double Shell Tanks)
0 25 50 75 100 Meters
0 100 200 300 Feet
FESI_2014_0111

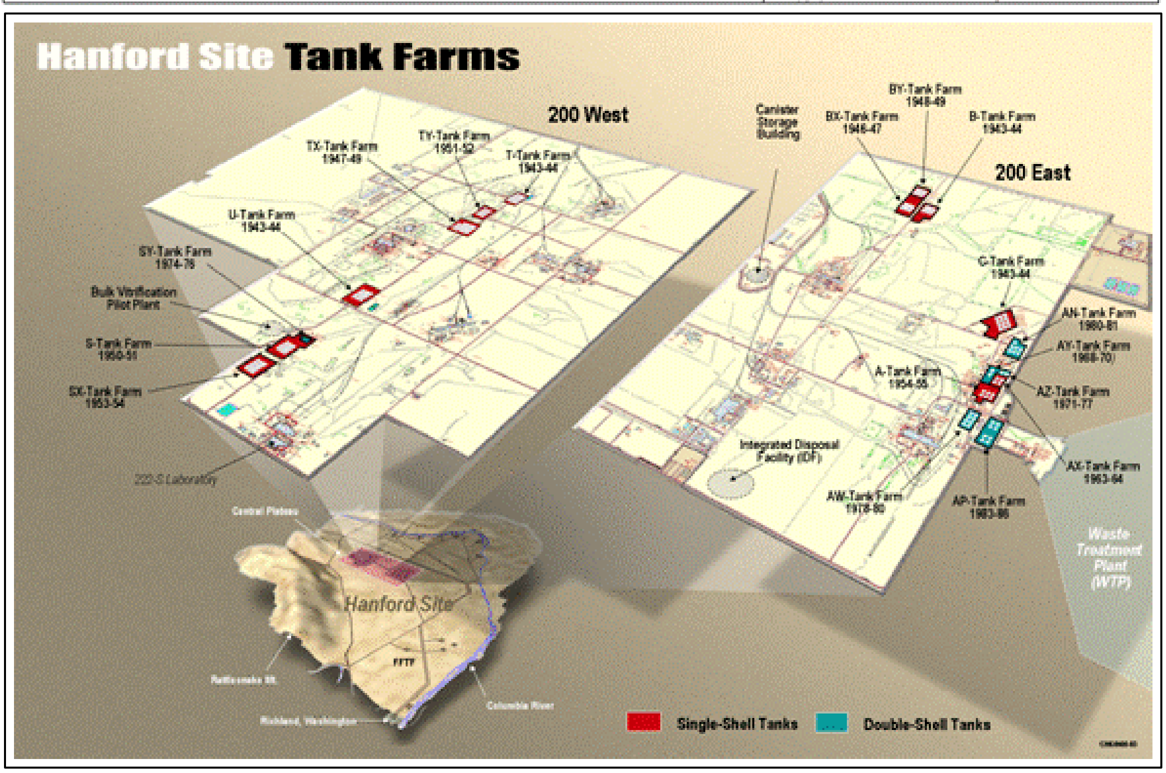

Hanford Site Tank Farms
200 West
200 East
TX-Tank Farm 1947-49
TY-Tank Farm 1951-52
T-Tank Farm 1943-44
U-Tank Farm 1943-44
SY-Tank Farm 1974-76
Bulk Vitrification Pilot Plant
S-Tank Farm 1950-51
SX-Tank Farm 1953-54
222-S Laboratory
Canister Storage Building
BY-Tank Farm 1948-49
BX-Tank Farm 1946-47
B-Tank Farm 1943-44
C-Tank Farm 1943-44
AN-Tank Farm 1980-81
AY-Tank Farm 1968-70
A-Tank Farm 1954-55
AZ-Tank Farm 1971-77
Integrated Disposal Facility (IDF)
AW-Tank Farm 1978-80
AP-Tank Farm 1983-86
AX-Tank Farm 1963-64
Waste Treatment Plant (WTP)
Hanford Site
Single-Shell Tanks
Double-Shell Tanks

Fig. 1. Location of Waste Management Area C in Relation to Hanford Site.[3]

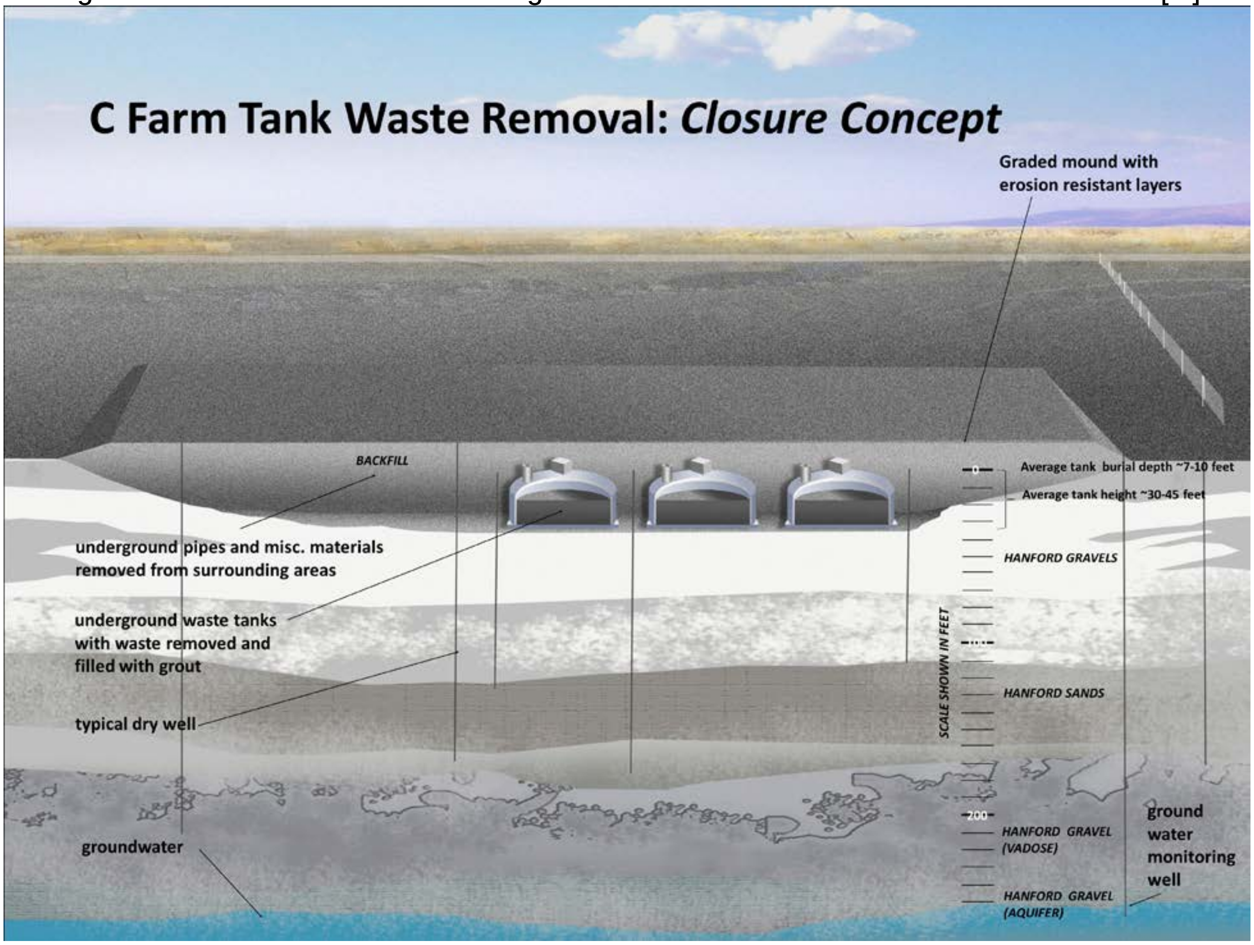


Fig. 2. Conceptual Model of Closure of WMA C.

watering, and biotic transport. Under the groundwater pathway, it is assumed that moisture from rain and snowfall enters the subsurface, contacts waste, and carries dissolved contaminants through the thick heterogeneous vadose zone to the unconfined aquifer. During the compliance and post-compliance periods, a receptor is assumed to reside 100 m (328 ft) downgradient from the southeastern edge of the WMA fence line.

BACKGROUND

The WMA C PA methodology includes deterministic calculations of the estimated impacts from the proposed closure action. Impacts are calculated with the numerical models and a set of inputs and assumptions, referred to as a base case, identified in the PA model development process. This base case provides the expected estimate for how the system may perform given the most current information available. It is assumed that this case will provide a reasonable estimate of the expected performance. Uncertainty and sensitivity analyses using a system-level model based on the GoldSim Software [4] were also performed to understand the importance of key input parameters on transport behavior and dose.

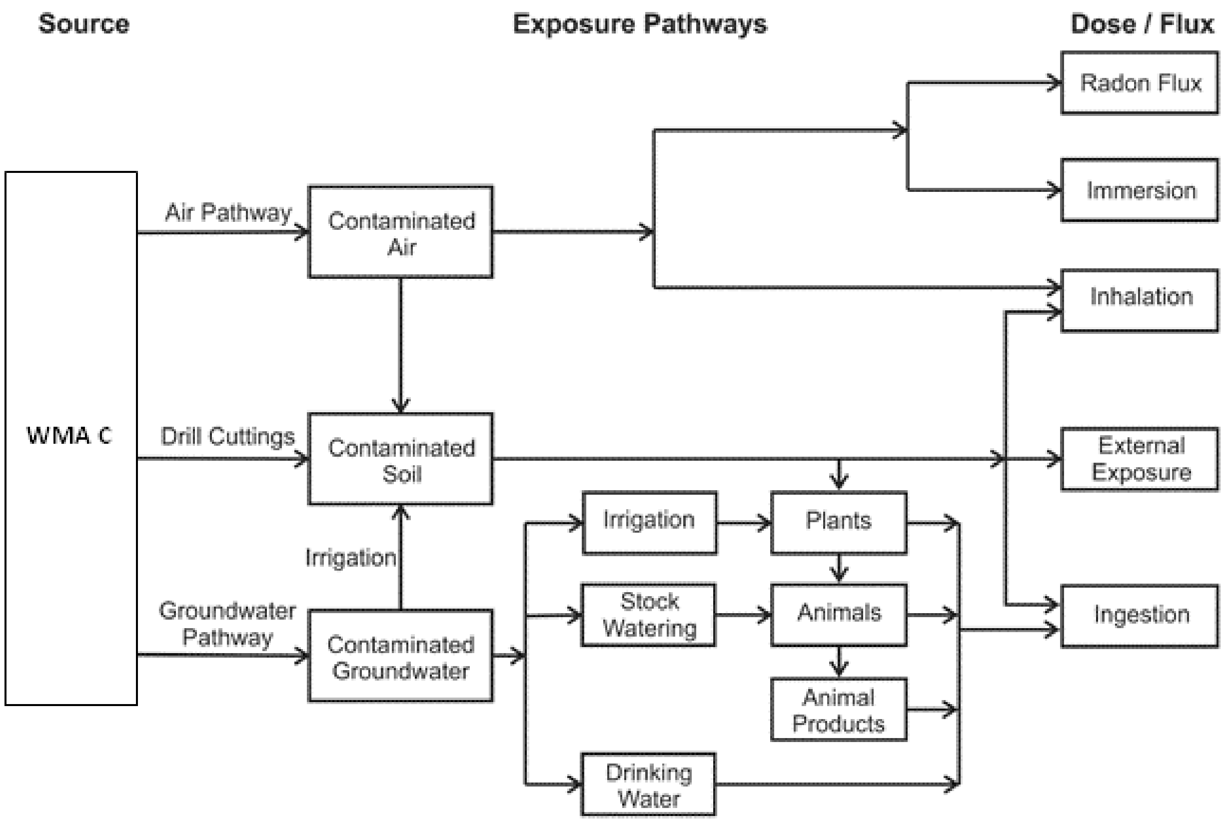


Fig. 3. Overview of the Analysis of Performance for the WMA C PA.

The source term for the base case analysis considers key radionuclides present in residual waste left in tanks and ancillary equipment within WMA C at closure. The inventory used in the source term model includes the current disposed inventory (as of September 2014) for ten of the 100-series tanks and three 200-series tanks where retrieval has been completed. A forecasted inventory for the three remaining 100-series tanks and ancillary equipment were developed using process knowledge and engineering judgment. A total of 46 radionuclides are evaluated in the WMA C PA. A summary of inventories for selected key radionuclides (Tc-99, Se-79, I-129, and U-238) adapted from inventory estimates made for the tanks and ancillary equipment [5] are provided in Table I.

The closed WMA C conceptual model is composed of manmade as well as natural components (Fig. 4). The manmade components of the system that influence contaminant migration include a closure surface barrier, the tank farm and ancillary equipment infrastructure, and the distribution of waste in the subsurface. The natural components of the system that influence contaminant migration are the several underlying, nearly-horizontal stratigraphic layers within the vadose zone and the unconfined aquifer.

TABLE I. Summary of Estimated Inventories for Selected Key Radionuclides for SSTs, Ancillary Equipment, and Pipelines in the Closed WMA C

	Tc-99 (GBq)	Se-79 (GBq)	I-129 (GBq)	U-238 (GBq)
Single-Shell Tanks	5.37E+02	9.10E-01	2.62E+00	8.58E+01
Ancillary Equipment	3.81E+00	1.07E-01	2.15E-02	2.32E+01
Pipelines	2.08E+00	5.85E-02	1.17E-02	1.27E+01
Total	5.44E+02	1.08E+00	2.66E+00	1.22E+02

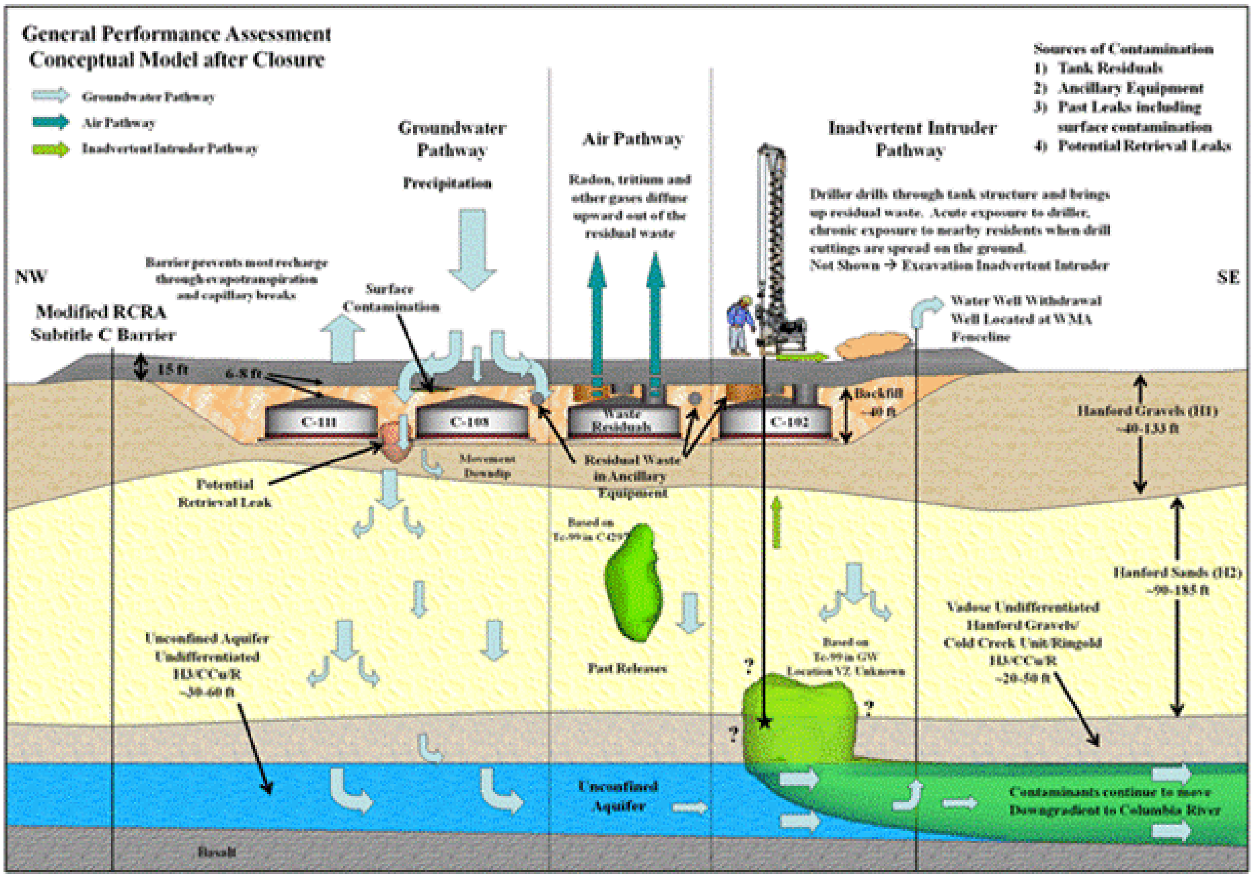


Fig. 4. Schematic Conceptual Representation of the WMA C Site and Various Pathways.

The PA modeling considered reduction of net infiltration from the presence of an engineered cover (surface barrier) over WMA C. The surface barrier is assumed to remain intact and allow only negligible amounts of net infiltration for the first 500 years (i.e., 2020 to 2520), coinciding with an estimated 500-year barrier design life, which includes a 100-year institutional control time period.

Net infiltration (recharge) estimates for each of the time periods [6] is presented in Table II. The recharge rates can vary spatially within each time period depending upon the type of vegetation or state of engineered barrier.

TABLE II. Timeline considered for representing the evolution of WMA C

Phase	Conditions	Time frame (yrs)	Recharge on Surface (mm/yr)			
			Natural Vegetation	Tank Farm Disturbed Surface	Non-Tank Farm Disturbed Surface	Surface Barrier
Pre-Operations	Before Construction of WMA C	Prior 1944	3.5	Not present	Not present	Not present
Operations	Current Conditions During Operations at WMA C	1944-2020	3.5	100	22/63	Not present
First 100 years Post-Closure	Post-Closure During Institutional Control Period	2020-2120	3.5	Not present	3.5	0.5
Early Post-Closure (100 to 500 years)	Post-Institutional Control Period to End of 500-yr Barrier Design Life	2120-2420	3.5	Not present	3.5	0.5
Late Post-Closure (after 500 years)	Post-Barrier Design Life	2420-12020	3.5	Not present	3.5	3.5

Based on the conceptual models for different pathways, numerical models were developed to estimate the contaminant concentrations within water, air, or soil as a function of time. A three-dimensional flow and transport model was developed using the Subsurface Transport Over Multiple Phases code developed by Pacific Northwest National Laboratory [7] to evaluate the impact to the environment from the groundwater pathway. The model assumed that infiltration of moisture from precipitation eventually enters the facility. However, most of the moisture is diverted around WMA C during operations and for the first 500 years after closure. Contaminants, based on their relative inventories associated with different tanks and ancillary equipment, are released into the vadose zone by contact with recharge water. The infiltrating moisture, along with contaminants, travels through the vadose zone with the contaminant transport times influenced by the equilibrium sorption characteristics (determined by the distribution coefficient [K_d]).

In the base case, a diffusion-controlled release from the grouted tanks and advection-controlled release from the pipelines along with equilibrium sorption-desorption processes (i.e., K_d control) were implemented. In this case, the residual waste layer is conceptualized to be located at the top of the grout at the bottom of each tank. The combined minimum thickness of concrete and grout layer under the residual waste is 20.3 cm (~8 inches). This is considered to be a physical barrier to release of contaminants to the underlying vadose zone. While the grout/concrete layer is intact, only diffusive transport of contaminants across this layer is considered. When this layer is degraded, both advective and diffusive transport to the vadose zone can occur.

The diffusion coefficients of contaminant through the grout/concrete layer are derived from laboratory leaching experiments [8,9] that range from 10^{-9} to 10^{-14} cm^2/s. For the purpose of the PA base case calculations, the experimental median value of 3×10^{-8} cm^2/s (4.65×10^{-7} $in.^2/s$) is chosen as the best estimate for the effective diffusion coefficient in concrete. This value is applied to all species diffusing through the concrete. The diffusive area considered is taken to be the base area of the structure being modeled (tank or CR-vault). For the pipelines, the area is based on the assessed area of the tank farm where pipelines are generally present. It is currently defined by a square of length of 164 m and covers the majority of the WMA C area.

PERFORMANCE ASSESSMENT RESULTS

Groundwater Transport Results

Fig. 5 presents an example of the spatial distribution of Tc-99 estimated from an inventory release of 543.9 GBq (14.7 Ci) within all waste residual with and without pipelines at the end of 1,000 years of simulation in the base case. In this case, the technetium travels unretarded through the vadose zone and the saturated zone but does reach the underlying unconfined aquifer below the site within the 1,000-year compliance period.

Fig. 6 presents the groundwater breakthrough curves of selected radionuclide (Tc-99, I-129, and U-238) releases from all SSTs and ancillary equipment over the 10,000-year simulation period at the points of calculation (100 m [328 ft] downgradient of WMA C). Only Tc-99, which moves unretarded through the vadose zone and groundwater, shows breakthrough at the points of calculation. I-129 and U-238 with an assumed K_d value greater than zero (K_d = 0.2 and 0.6 mL/g for sand-dominated units, respectively) begin to arrive at the points of calculation later in the 10,000-year period of analysis. Tc-99 reaches a peak value of about 1.1 bq/L at about 1,500 years after closure, whereas the peak value for I-129 of 1.5×10^{-4} bq/L occurs at about 6,000 year after closure. The peak value for U-238 of 6.3×10^{-4} bq/L is reached at the end of the 10,000-year period of analysis. The timing of these peaks of each of the constituents also reflect about the assumed mobility of Tc-99 (K_d = 1.0 mL/g), I-129 (K_d = 3.0 mL/g) and U-238 (K_d = 2,000 mL/g) in the diffusion-controlled releases through the concrete and grout at the bottom of each SST. Results for these key constituents of concern are below their respective drinking water standards. [10]

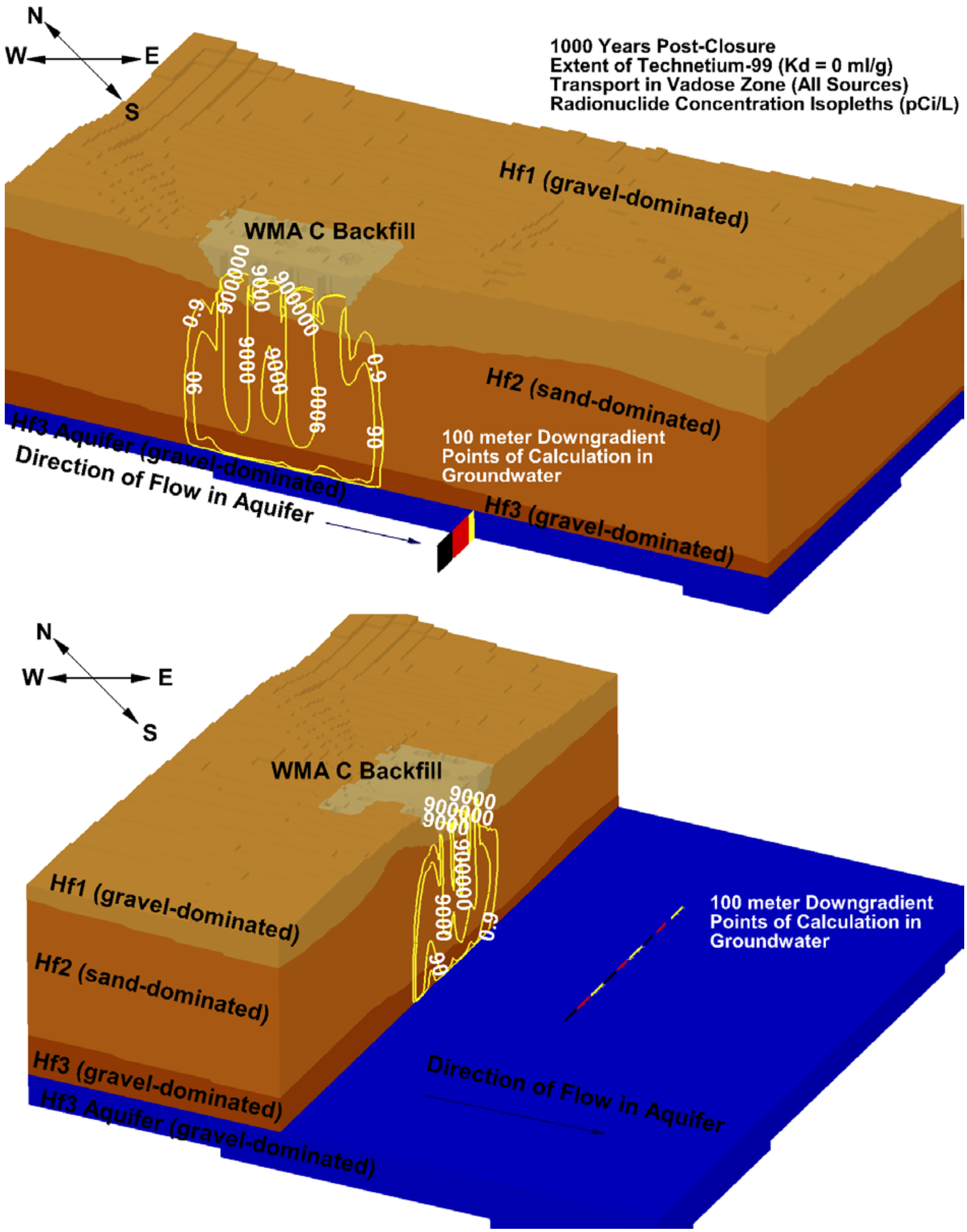


Fig. 5. Extent of Transport of the Most Mobile Radionuclides Such as Technetium-99 (K_d = 0 mL/g) in the Vadose Zone at the End of the 1,000-year

Compliance Period for an Inventory Release of 543.6 GBq (14.7 Ci) from All Residuals (See Inventory Breakdown in Table I). Note: 1 Ci/L = 37 GBq/L.

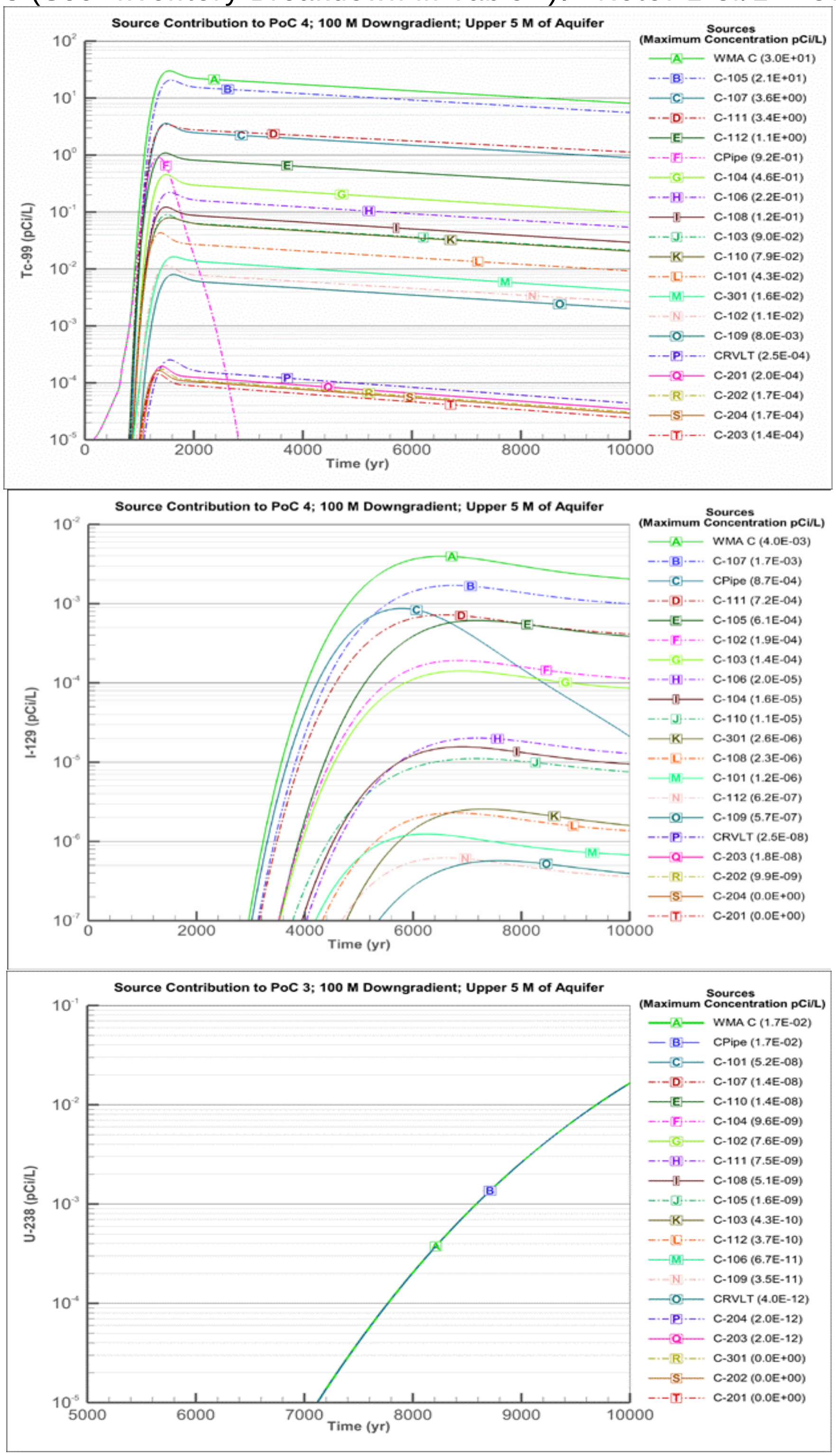


Fig. 6. Maximum Predicted Groundwater Concentration for Selected Radionuclides (Tc-99, I-129, and U-238) at 100 m (328 ft) Downgradient from WMA C Through the End of the Post-Closure Period. (Note: 1 pCi/L = 0.037 Bq/L)

Besides the base case, several other additional sensitivity cases are being conducted to evaluate the effect of changes in key parameter values in the PA analysis. These include selected cases that examine the effect of:

- The timing of potential future tank degradation on contaminant releases and resulting groundwater impacts
- Alternative time-varying recharge rates on the arrival of groundwater breakthrough curves downgradient of WMA C
- Increases in estimated residual inventories on the magnitude of predicted concentrations downgradient of WMA C.

Air Pathways Results

Under the atmospheric pathway, for a limited number of radionuclides that can partition into the gas phase from dissolved phase (e.g., C-14, H-3, and I-129), a conservative one-dimensional model is performed to estimate diffusive release from WMA C into the atmosphere across the modified RCRA [11]-compliant closure cover (Fig. 4). The concentration in air at the point of calculation is negligibly small for all three radionuclides. The concentration of tritium is highest (1.5×10^{-4} bq/L) at the start of the closure period but declines quickly due to short half-life. The concentrations of C-14 and I-129 remain negligibly small throughout the simulated time frame. The atmospheric pathway dose calculations are also negligibly small.

The radon flux at the surface of the WMA C facility is estimated for every source term separately. The highest flux occurs from C-301 tank source with a peak value of 7.4×10^{-6} bq/m^2/sec within the 1,000-year compliance period; and peak value of 2.6×10^{-4} bq/m^2/sec within the 10,000-year period of analysis These values are both much lower compared to the 0.74 bq/m^2/sec performance objective. Tank C-301 has one of the highest initial concentrations of Ra-226 and U-234 due to combination of higher inventory and smaller residual volume compared to other tanks and ancillary equipment. Additionally, because the cross-sectional area of the C-301 tank is small (similar to the 200-series tanks), it leads to high diffusive flux per unit surface area.

All-Pathways Dose Results

The peak dose for the all-pathways analysis in the 1,000-year compliance period is associated with the air pathway, with the peak dose of 4×10^{-5} mSv/yr dominated by tritium resulting from upward gaseous diffusive flux from the residual waste. The peak dose within the sensitivity/uncertainty analysis time period (1,000 to 10,000 years after closure) occurs at about 1,500 years after closure, and results primarily from a peak in Tc-99 groundwater concentration at 100 m downgradient of the facility. The peak total dose within the sensitivity/uncertainty analysis time period is 0.001 mSv/yr. For all of the sensitivity analyses and uncertainty analyses evaluated, the disposal system also met the performance objectives. In the uncertainty analysis performed with the system-level model based on GoldSim©[b], the highest calculated groundwater dose in the compliance period was about 7 x 10^{-4} mSv/yr, and the highest calculated peak dose in the sensitivity/uncertainty analysis period was 0.025 mSv/yr.

Inadvertent Intruder Results

Under the inadvertent intruder scenarios evaluated, it is assumed that a well is drilled to the underlying water tables, encountering the residual wastes left in the closed WMA C on the way. For tanks and some of the ancillary equipment (i.e., C-301 catch tank or CR-Vault), the well is drilled through the grout-filled tanks or grout-filled ancillary equipment before encountering the residual wastes and continuing on through the sediments between the tank and ancillary equipment and the underlying water table. For the pipelines which are not assumed to be grouted at closure, the well is drilled through the pipelines encountering residual wastes before going through the sediments below the pipelines on the way to the underlying water table. Contamination associated with the residual wastes is then brought to the surface as part of the drill cuttings where it can cause human exposure (Fig. 4). Exposure to this contamination is evaluated using an acute well drilling and three chronic inadvertent intruder (commercial farm, rural pasture, and suburban garden) scenarios. Although the likelihood of an inadvertent intrusion at WMA C is very small in the foreseeable future, for the purpose of compliance calculations, passive and active institutional controls are assumed to be ineffective in preventing temporary intrusion after 100 years following closure. In other words, loss of institutional controls is assumed after 100 years following closure and peak dose is evaluated assuming inadvertent intrusion occurs immediately after the loss of institutional controls.

A summary of intruder results at 100 and 500 years post-closure for all inadvertent human intrusion exposure scenarios and sources in WMA C is provided in Table III. Acute exposure scenario dose plots for tanks C-111 and C-112 are presented in Fig. 7 as examples while chronic scenario dose plots for tanks C-111 and C-112 are presented in Fig. 8 to show the general dose trends for the various scenarios analyzed. The results from tanks C-111 and C-112 are presented because examination of the tank inventories shows that the highest concentrations of Cs-137 and Sr-90 (the main contributors to intrusion doses) are found in these tanks.

Evaluation of the results presented in Table III show that doses from the well driller scenario are well below the 5 mSv performance objective for acute exposure at 100 years post-closure time. Results also show that doses from all the chronic scenarios are also well below the 1 mSv/yr performance objective for chronic

[b] GoldSim© simulation software is copyrighted by GoldSim Technology Group LLC of Issaquah, Washington (see http://www.goldsim.com).

exposure at 100 years post-closure. The largest acute dose (0.36 mSv) comes from drilling into a waste transfer pipeline at 100 years post-closure. Of the chronic scenarios, the maximum calculated dose (0.082 mSv/yr) is realized from the chronic rural scenario, also at 100 years post-closure.

TABLE III. Summary of Base Case Doses for the Hypothetical Inadvertent Human Intruder Exposure Scenarios in Waste Management Area C after Closure

Source	Well Driller Acute Dose (mSv)	Commercial Farm Chronic Dose (mSv/yr)	Rural Pasture Chronic Dose (mSv/yr)	Suburban Garden Chronic Dose (mSv/yr)
241-C-101	1.24E-02	2.17E-05	1.44E-03	3.22E-03
241-C-102	4.59E-02	8.09E-05	5.37E-03	1.20E-02
241-C-103	4.09E-03	7.25E-06	6.14E-04	1.10E-03
241-C-104	5.77E-03	1.10E-05	1.21E-03	1.70E-03
241-C-105	3.80E-02	6.69E-05	7.18E-03	1.23E-02
241-C-106	3.47E-02	8.75E-05	8.93E-03	9.57E-03
241-C-107	1.49E-01	2.66E-04	1.82E-02	3.90E-02
241-C-108	5.80E-04	1.05E-06	1.09E-04	1.71E-04
241-C-109	3.10E-04	5.57E-07	7.63E-05	9.33E-05
241-C-110	8.24E-04	1.78E-06	1.99E-04	2.44E-04
241-C-111	7.47E-02	1.32E-04	1.40E-02	2.13E-02
241-C-112	3.48E-03	6.10E-06	9.17E-04	1.41E-03
241-C-201	1.45E-01	2.52E-04	1.58E-02	3.75E-02
241-C-202	1.28E-01	2.22E-04	1.39E-02	3.32E-02
241-C-203	4.61E-03	8.51E-06	7.25E-04	1.26E-03
241-C-204	5.60E-04	1.77E-06	2.97E-04	2.49E-04
241-C-301	2.12E-01	**3.86E-04**	2.69E-02	**5.57E-02**
CR-VAULT	3.91E-02	7.10E-05	4.96E-03	1.03E-02
Pipeline*	**3.60E-01**	1.13E-05	**8.21E-02**	3.92E-02

Note: Peak dose calculated at 500 years for all sources except for pipeline, which is reported at 100 years after closure.
*Maximum dose at 100 years after closure.
The peak dose for each scenario is shown in **bold**.

The key radionuclides contributing to the calculated maximum acute and chronic doses over time are depicted in Figure 7 and 8. For the acute well driller scenario, the dose driver is Cs-137 within the first 200 to 300 years after closure, with secondary contributions from Pu-239 and Sr-90. Plutonium-239 provides the majority of the dose after 200 years with a secondary contribution from Am-241. In the chronic rural pasture scenario, Sr-90 is the main contributor to the dose in the first 300 to 400 years after closure with secondary contributions for Cs-137 and Pu-239. After about 400 years post-closure, Pu-239 is the main contributor to dose.

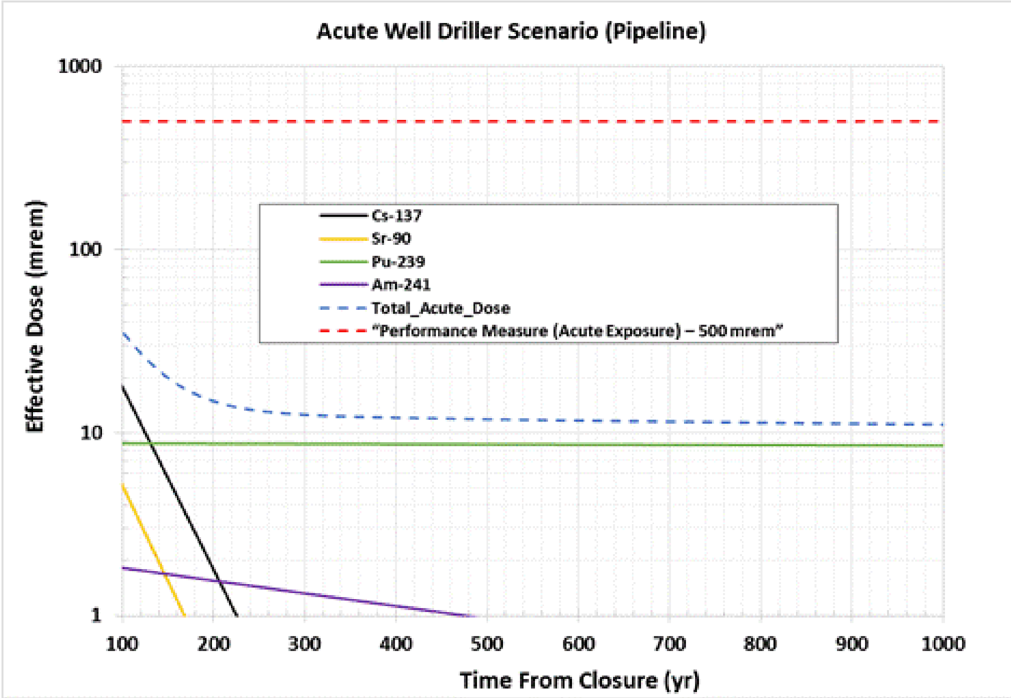


Fig. 7. Effective Dose to the Intruder versus Time of Intrusion into a Pipeline after Site Closure for Acute Well Driller Scenario (Note: 1 mrem = 0.01 mSv).

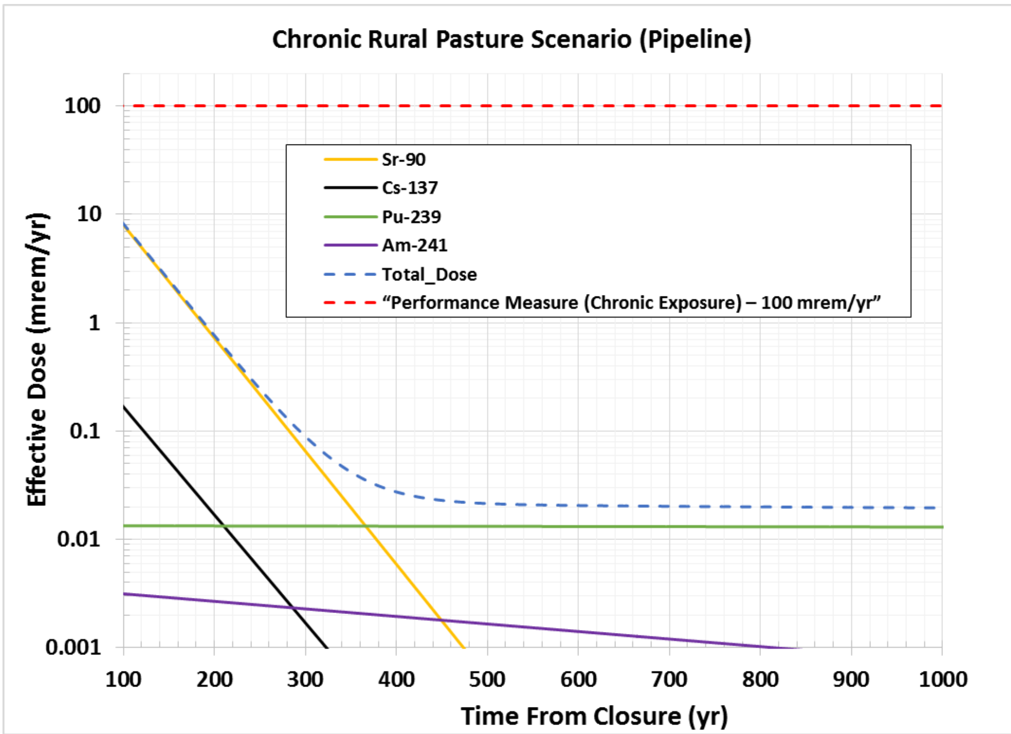


Fig. 8. Effective Dose to the Intruder versus Time of Intrusion into a Pipeline after Site Closure for the Chronic Rural Pasture Scenario (Note: 1 mrem = 0.01 mSv).

CONCLUSIONS

Results of the initial analyses for the groundwater pathway conducted so far show that the proposed closure of WMA C tanks and ancillary equipment is expected to be well below the performance objectives during the 1,000-year post-closure period of compliance. In the base case, none of the major risk drivers (Tc-99, Se-79, I-129, and uranium isotopes) from WMA C reach groundwater within the compliance period (1,000 years post-closure) with any appreciable concentration. The peak time for Tc-99 occurs around 1,500 years after closure. The delay in Tc-99 peak is attributed to the retardation (from sorption) within the grout/concrete layer at the base of the tank. The uranium breakthrough time at the point of calculation is significantly delayed (> 4,000 years after closure) due to additional sorption in the natural system. The uranium breakthrough from pipeline source occurs earlier due to advection-dominated releases, while the breakthrough times from the tank sources is delayed beyond 8,000 years due to diffusive releases from the tank residuals. The peak times for uranium occur beyond the simulated timeframe.

For air pathway analysis of the base case inventory, the contribution from air pathway is negligibly small with only three potential volatiles – tritium (H-3), C-14, and I-129 – present in the residual inventory. Due to small concentrations and their relative fractionation from the dissolved phase to the gas phase, the concentrations of these constituents at the point of calculation remain negligible, leading to negligible dose (4×10^{-5} mSv/yr). Diffusive gas-phase release of radon is calculated separately from each source and evaluated above the source area (e.g., tank area). The radon flux varies among the sources analyzed but remains negligibly small. The peak flux resulting from C-301 tank over the 10,000 period of analysis (i.e. 2.6E-04 bq/m^2/sec) is much less than the 0.74 bq/m^2/sec performance objective.

For the hypothetical inadvertent intruder analyses, one acute and three chronic scenarios were considered. Calculations were performed using the base case inventory for each source separately. The effective dose resulting from the acute well driller intrusion into a waste transfer pipeline provided the highest dose of 0.36 mSv but met the 5 mSv performance measure for acute exposure during the post-institutional control period. The effective dose resulting from the chronic rural scenario (0.082 mSv/yr) was found to be the highest among the chronic scenarios analyzed and also did not exceed the 1 mSv/yr performance measure for chronic exposure following loss of institutional control.

This initial evaluation of performance of a closed WMA C has used actual and projected estimates of volumes and inventories for selected tanks based on either Hanford Tank Waste Operations Simulator or best-basis inventory estimates. At the time this analysis was performed, calculations were not able to account for:

- Final inventories for wastes left in three retrieved SSTs (C-101, C-107 and C-112) that will be developed from waste residual sampling and analyses

- Final volumes and inventories for waste left in three SSTs (C-102, C-105 and C-111) that are in the process of being retrieved

- Final volumes and inventories for waste left in the CR-vault tanks, the C-301 catch tank, and other ancillary equipment where retrieval has not been initiated.

Based on progress to date with unretrieved tanks, it is anticipated that final volumes for the unretrieved tanks may be different than final volumes assumed in the base analyses presented in this analysis. This analysis did evaluate an additional sensitivity case that examined, as bounding inventory case, the volume and concentration for waste remaining in these three unretrieved tanks based on the best-basis inventory at the time that this information was finalized for the first version of the PA.

Eventually, once retrieval of these SSTs and other ancillary equipment has been completed and final inventories have been estimated based on waste residual sampling and analysis, the impacts from these final volumes and inventories will need to be evaluated. Analysis of final closure volumes and inventories will be evaluated as they become available in subsequent revisions of this PA.

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