CVP-2006-00004
Rev. 0
For Approval 0074057

Cleanup Verification Package/ Clean Closure Report for the Soil Column of the 116-N-1 Crib and Trench

Prepared for the U.S. Department of Energy by Washington Closure Hanford

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EXECUTIVE SUMMARY

This cleanup verification package/clean closure report documents completion of remedial action for the 116-N-1 Crib and Trench. The 116-N-1 Crib and Trench are also referred to as the 1301-N Liquid Waste Disposal Facility or the 1301-N Crib and Trench. They comprise a *Resource Conservation and Recovery Act of 1976*-permitted waste treatment, storage, and disposal unit. The 116-N-1 site is located within the 100-NR-1 Operable Unit in the 100 Areas of the Hanford Site in southeastern Washington State. The 116-N-1 Crib began operation in 1963 and was used for the disposal of N Reactor cooling water. The 116-N-1 Trench was added in 1965 to enhance percolation capacity with both facilities operating in tandem after 1965. In 1985, the 116-N-3 Crib became the primary liquid disposal facility for the N Reactor, and the 116-N-1 Crib and Trench were taken out of service.

Site excavation and waste disposal are complete, and the exposed surfaces have been sampled and analyzed to verify attainment of the remedial action goals. Results of the sampling, laboratory analyses, and data evaluations for the 116-N-1 site indicate that remedial action objectives and goals for direct exposure, protection of groundwater, and protection of the Columbia River have been met (see Table ES-1).

The site meets cleanup standards and has been reclassified as "interim closed out" in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) and the Waste Site Reclassification Guideline TPA-MP-14 (RL-TPA-90-0001) (DOE-RL 1998). This does not preclude or supersede closure compliance conditions included in the *Resource Conservation and Recovery Act of 1976* permit. A copy of the waste site reclassification form is included as Attachment ES-1.

Table ES-1. Summary of Cleanup Verification Results for the 116-N-1 Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?	Ref.
Direct Exposure – Radionuclides	1. Attain 15 mrem/yr dose rate above background over 1,000 years.	1. Maximum dose rate calculated by RESRAD is 3.35 mrem/yr for all pathways.	Yes	a
Direct Exposure – Nonradionuclides	1. Attain individual COC RAGs.	1. All individual COC concentrations are below the RAGs.	Yes	b
Meet Nonradionuclide Risk Requirements	1. Hazard quotient of <1 for noncarcinogens.	1. Individual hazard quotients for the 116-N-1 site are less than 1.	Yes	b
	2. Cumulative hazard quotient of <1 for noncarcinogens.	2. Cumulative hazard quotients for the 116-N-1 site are less than 1.		b
	3. Excess cancer risk of <1 x 10^{-6} for individual carcinogens.	3. There are no nonradionuclide carcinogens for the 116-N-1 site.		b
	4. Attain a total excess cancer risk of <1 x 10^{-5} for carcinogens.	4. There are no nonradionuclide carcinogens for the 116-N-1 site.		b
Groundwater/ River Protection – Radionuclides	1. Attain single COC groundwater and river protection RAGs.	1,2. With the exception of tritium, RESRAD modeling predicts that contaminants from the shallow and deep zone do not reach groundwater within 1,000 years. Tritium is predicted to reach groundwater within 1,000 years but at concentrations below the RAGs. Therefore, all groundwater and river protection RAGs have been attained.	Yes	a
	2. Attain National Primary Drinking Water Standards: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.			
	3. Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L maximum contaminant level or 1/25th of the derived concentration guide for DOE Order 5400.5.	3. None of the alpha-emitting radionuclides are predicted to reach groundwater within 1,000 years.		
	4. Meet total uranium standard of 21.2 pCi/L.[d]	4. Uranium was not identified as a COC for this site.	NA	
Groundwater/ River Protection – Nonradionuclides	1. Attain individual nonradionuclide groundwater and river cleanup requirements.	1. Residual hexavalent chromium concentrations are not predicted to leach to groundwater or the Columbia River at concentrations exceeding the applicable water quality criteria.	Yes	a,b

Table ES-1. Summary of Cleanup Verification Results for the 116-N-1 Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?	Ref.
Other supporting Information	1. Sample location design (Appendix C).			c

NOTE: This table reflects an assessment of the site as a whole (i.e., combined crib/trench, overburden, and landfill bridge). The combined crib/trench, overburden, and landfill bridge were also assessed against the RAGs individually. Individual calculation briefs were also completed for the combined crib/trench, overburden, and landfill bridge. The combined crib/trench, overburden, and landfill bridge each met all of the RAGs listed above on an individual basis. Calculations are included in Appendix C.

[a] *116-N-1 Combined Trench and Crib RESRAD Calculation*, 0100N-CA-V0088, Rev. 1, Washington Closure Hanford, Richland, Washington.

[b] *116-N-1 Combined Trench and Crib Cleanup Verification 95% UCL Calculation*, 0100N-CA-V0087, Rev. 1, Washington Closure Hanford, Richland, Washington.

[c] *Shallow and Deep Zone Sample Design for the 116-N-1 Trench and Crib*, 0100N-CA-V0085, Rev. 0, Washington Closure Hanford, Richland, Washington; *Cleanup Verification Sampling of Overburden from the 116-N-1 Trench*, 0100N-CA-V0070, Rev. 0, Bechtel Hanford, Inc., Richland, Washington; *116-N-1 Trench Landfill Backfill Concurrence Checklist*, Figure, CCN 0559995 (BHI 2004).

[d] Based on the isotopic distribution of uranium in the 100 Areas, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001c).

COC = contaminant of concern
NA = not applicable
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose model)

Attachment ES-1
Waste Site Reclassification Form

Date Submitted: 5/10/06 **Originator:** R. A. Carlson **Phone:** 948-6650	**Operable Unit(s):** 100-NR-1 **Waste Site ID:** 116-N-1 Crib and Trench **Type of Reclassification Action:** Rejected ☐ Closed Out ☐ Interim Closed Out ☒ No Action ☐	**Control Number:** 2006-018 **Lead Agency:** Ecology

This form documents agreement among the parties listed below authorizing classification of the subject unit as rejected, closed out, or no action and authorizing backfill of the site, if appropriate. Final removal from the National Priorities List (NPL) of no action or closed-out sites will occur at a future date.

Description of current waste site condition:

Remedial action at the 116-N-1 site has been performed in accordance with remedial action objectives and goals established by the U.S. Environmental Protection Agency and the Washington State Department of Ecology (Ecology), in concurrence with the U.S. Department of Energy, Richland Operations Office. The selected remedial action involves (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility at the 200 Areas of the Hanford Site, and (3) backfilling the site with clean soil to adjacent grade elevations. The *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) excavation and disposal actions have been completed; completion of closure for the *Resource Conservation and Recovery Act of 1976 (RCRA)* treatment, storage, and disposal (TSD) unit is pending.

After this waste site is backfilled, a Certification of Closure shall be prepared for this site by an independent professional engineer and shall be submitted to Ecology. A Certification of Closure Acceptance Letter signed by Ecology shall be issued for the reclassification control number for this waste site to complete the RCRA TSD closure requirements.

Basis for reclassification:

The 116-N-1 Trench and Crib have been remediated to meet the closure performance/cleanup standards specified in the *100-NR-1 Interim Remedial Action Record of Decision* (Interim Action ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington, and DOE/RL-96-39, Rev. 1, *100-NR-1 Treatment, Storage, and Disposal Units Corrective Measures Study/Closure Plan*. Remedial action was performed to protect for direct exposure from shallow zone soils (i.e., surface to 4.6 m [15 ft] deep) and to protect groundwater and the Columbia River. The basis for reclassification is described in detail in the *Cleanup Verification Package/Clean Closure Report for the Soil Column of the 116-N-1 Crib and Trench* (CVP-2006-00004), Washington Closure Hanford, Richland, Washington.

The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soils are required. The *Explanation of Significant Difference for the 100-NR-1 Operable Unit Treatment, Storage and Disposal Interim Action Record of Decision and 100-NR-1/100-NR-2 Operable Unit Interim Action Record of Decision*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington, documents the balancing factors analysis that concluded to allow evaluation of residual contamination in the deep zone for protection of groundwater and the river without irrigation. Therefore, institutional controls to prevent irrigation are required. Institutional controls will be implemented in accordance with DOE/RL-2001-41, *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions*. Consistent with the rural-residential exposure scenario specified in the Interim Action ROD, it is assumed that contaminated groundwater would not be used for drinking, irrigation, or any other use for the time period specified in the ROD.

K. D. Bazzell DOE Project Manager	Signature	Date
J. Price Ecology Project Manager	Signature	Date
NA EPA Project Manager	Signature	Date

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ACRONYMS AND ABBREVIATIONS

CMS	corrective measures study
COC	contaminant of concern
CP	closure plan
CVP	cleanup verification package
DOE-RL	U.S. Department of Energy, Richland Operations Office
DQA	data quality assessment
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ESD	Explanation of Significant Difference
MTCA	Model Toxics Control Act
RAG	remedial action goal
RDR/RAWP	Remedial Design Report/Remedial Action Work Plan
RESRAD	RESidual RADioactivity dose assessment model
ROD	Record of Decision
SAP	sampling and analysis plan
UCL	upper confidence limit
WAC	*Washington Administrative Code*

1.0 INTRODUCTION

The purpose of this cleanup verification package (CVP)/clean closure report is to document that the 116-N-1 Crib and Trench site (herein referred to as the 116-N-1 site) was remediated in accordance with the *100-NR-1 Interim Remedial Action Record of Decision* (ROD) (EPA 2000); the *Explanation of Significant Difference for the 100-NR-1 Operable Unit Treatment, Storage, and Disposal Interim Action Record of Decision and 100-NR-1/100-NR-2 Operable Unit Interim Action Record of Decision* (100-NR-1 ESD) (EPA 2003); and the *100-NR-1 Treatment, Storage, and Disposal Units Corrective Measures Study/Closure Plan* (CMS/CP) (DOE-RL 2002a). Remedial action objectives and goals for the 116-N-1 site were established by the Washington State Department of Ecology and the U.S. Department of Energy, Richland Operations Office, in concurrence with the U.S. Environmental Protection Agency (EPA). These goals and objectives are documented in the ROD (EPA 2000), the CMS/CP (DOE-RL 2002a), and the *Remedial Design Report/Remedial Action Work Plan for the 100-NR-1 Treatment, Storage, and Disposal Units* (100-NR-1 RDR/RAWP) (DOE-RL 2001).

The ROD (EPA 2000) and the CMS/CP (DOE-RL 2002a) provide the U.S. Department of Energy, Richland Operations Office the authority, guidance, and objectives to conduct this remedial action. The remedies specified in the ROD and the CMS/CP and conducted for the 116-N-1 site were excavation and disposal of contaminated materials at the Environmental Restoration Disposal Facility (ERDF) and backfilling the site with clean soil to average adjacent grade elevations. Excavation was driven by remedial action objectives for direct exposure, protection of groundwater, and protection of the Columbia River. For the respective points of compliance, remedial action goals (RAGs), summarized in Table 1, were established for the radionuclide and nonradionuclide contaminants of concern (COCs). Waste site COCs were identified in the *Sampling and Analysis Plan for the 100-NR-1 Treatment, Storage, and Disposal Units During Remediation and Closeout* (100-NR-1 SAP) (DOE-RL 2002b) and are listed in Table 1. Soil cleanup levels were established in the interim action ROD (EPA 2000) based on a limited ecological risk assessment. Although not required by the ROD, a comparison against ecological risk screening levels has been made for the COCs for this site as identified in the SAP (or other relevant documentation). None of the COC concentrations exceeded screening values. A baseline risk assessment for the river corridor portion of the Hanford Site began in 2004 and includes a more complete quantitative ecological risk assessment. The baseline risk assessment will be used to support the final closeout for this site.

2.0 SITE DESCRIPTION AND SUPPORTING INFORMATION

The 116-N-1 site is located in the 100-NR-1 Operable Unit of the 100-N Area (Figure 1). This site consists of the 1301-N Crib and the zig-zag-shaped 1301-N Trench that was used for disposal of 100-N Reactor cooling water and other radioactive liquid wastes

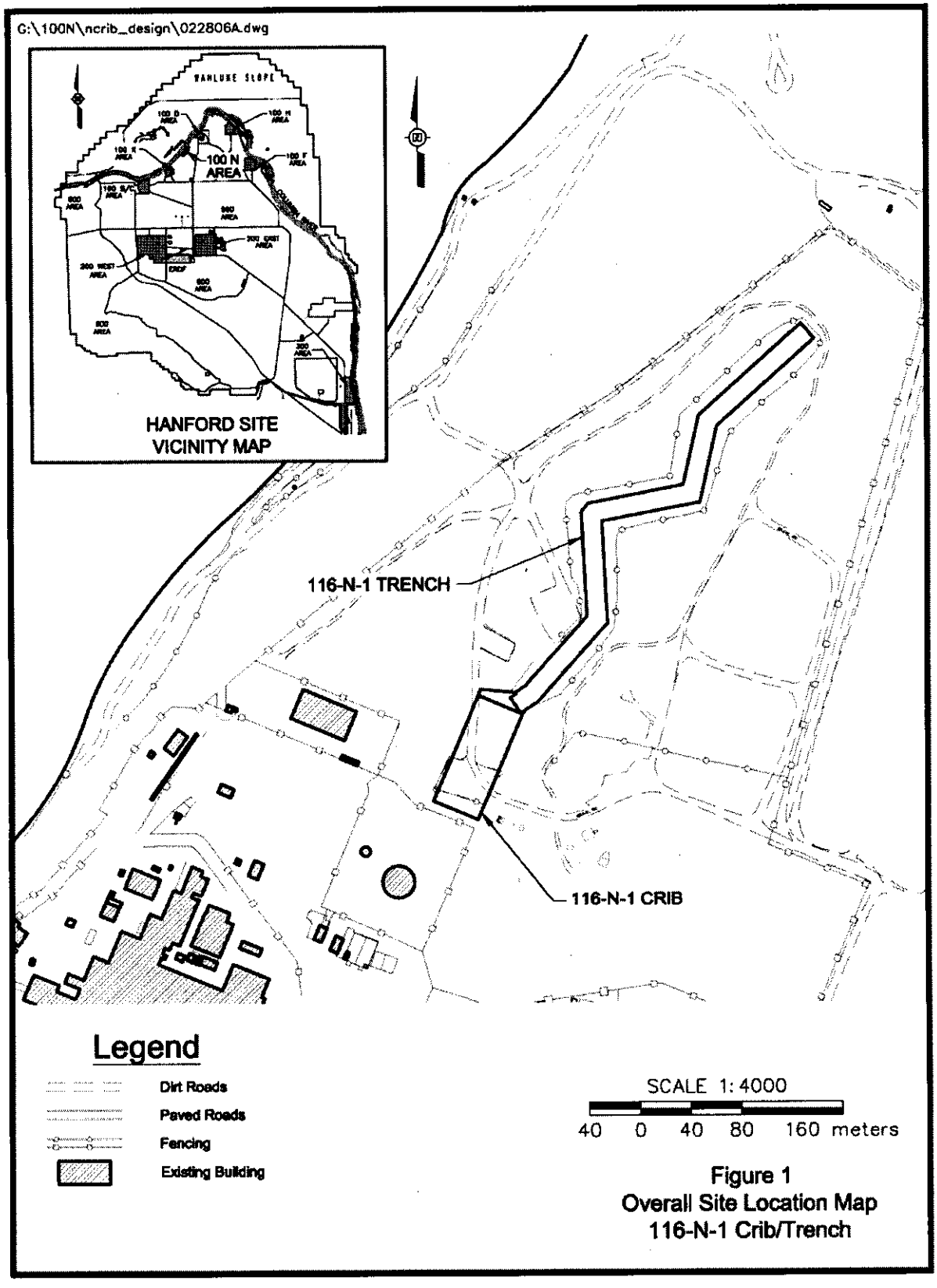
generated by various N Reactor operations. The crib began operation in 1963 and the trench was added in 1965 to enhance percolation capacity, with both facilities operating

Table 1. Summary of Remedial Action Goals.

COCs	Direct Exposure Cleanup Levels/RAG	Groundwater Protection Cleanup Levels/RAG (pCi/L)	Columbia River Protection Cleanup Levels/RAG (pCi/L)
Radionuclides			
Strontium-90[a]	15 mrem/yr (cumulative)[b]	8[c]	8[c]
Americium-241		1.2[d]	1.2[d]
Plutonium-239/240			
Nickel-63		4 mrem/yr (cumulative)[d]	4 mrem/yr (cumulative)[d]
Cesium-137			
Cobalt-60			
Europium-154			
Europium-155			
Tritium (H-3)[a]		20,000[c]	20,000[c]
COCs	**Direct Exposure RAGs (mg/kg)**	**Soil RAGs for Groundwater Protection (mg/kg)**	**Soil RAGs for Columbia River Protection (mg/kg)**
Nonradionuclides			
Chromium (total)	80,000	18.5[e]	18.5[e]
Hexavalent chromium	2.1[f] 400[g]	4.8[g]	2[g]
Mercury	24	0.33[e]	0.33[e]
Nitrate	113,000[h]	4,400[h]	4,400[h]

[a] Strontium-90 and tritium also contribute to the 4 mrem/yr (cumulative) RAG for groundwater and river protection.
[b] Lookup values that correspond to the 15 mrem/yr dose rate are based on a generic site model and are presented in the *Remedial Design Report/Remedial Action Work Plan for the 100-NR-1 Treatment, Storage, and Disposal Units* (100-NR-1 RDR/RAWP) (DOE-RL 2001).
[c] Promulgated groundwater protection standard.
[d] Lookup values based on individual radionuclide 4 mrem/yr dose rate equivalent for beta and gamma emitters per National Drinking water standards as presented in the 100-NR-1 RDR/RAWP (DOE-RL 2001). Alpha emitters must meet drinking water standards based on the more conservative of the 15 pCi/L maximum contaminant level or 1/25th of the derived concentration guide per DOE Order 5400.5.
[e] The "100 times groundwater cleanup" and/or "100 times dilution attenuation factor (DAF) times surface water protection" soil values were less than Hanford Site soil background concentrations; therefore, background values are used as the soil RAG.
[f] Value represents the calculated cleanup level based on the inhalation exposure pathway per WAC 173-340-750(3).
[g] Cleanup levels presented in the 100-NR-1 RDR/RAWP.
[h] Cleanup levels presented in the 100-NR-1 RDR/RAWP. Values shown are expressed as nitrate. To obtain cleanup levels for nitrates as nitrogen, divide the nitrate RAGs by 4.4.
COC = contaminant of concern
RAG = remedial action goal

Figure 1. Hanford Site Map and Location of the 116-N-1 Waste Site.



in tandem after 1965. In 1985, the 116-N-3 Crib became the primary liquid disposal facility for the N Reactor and the 116-N-1 Crib and Trench were taken out of service.

The crib area is approximately 88 m (289 ft) long by 38 m (125 ft) wide with the base of the crib approximately 1.5 m (5 ft) below the level of the surrounding grade. A sloped soil and gravel embankment formed the walls of the crib. The crib was originally excavated to a depth of about 4.6 m (15 ft) below the level of surrounding grade. The crib was backfilled at various times with boulders and cobbles to control the spread of contamination. The three distinct layers of backfill were (1) the lowest layer, which was 0.9 m (3 ft) thick and consisted of large boulders; (2) the middle layer, which was 0.6 m (2 ft) thick and composed of smaller boulders; and (3) the upper layer, which was 1.2 to 1.5 m (4 to 5 ft) thick and consisted of cobble-sized material.

The 116-N-1 Trench is 490 m (1,608 ft) long by 15 m (49 ft) wide at the top, with sloped sidewalls. Water spilled over a weir box in the dike (that was located on the north side of the crib) and into the trench. Wooden poles laid across the trench were used to support wire screening to keep birds out. In early 1982, pre-cast concrete panels were installed to cover the entire trench as a further step to minimize wildlife intrusion and airborne contamination.

3.0 REMEDIAL ACTION FIELD ACTIVITIES

3.1 EXCAVATION AND DISPOSAL

Remedial/corrective action at the 116-N-1 site began in April 2002. Excavation of the site involved removing the overburden materials, debris, the contaminated and uncontaminated structure, and underlying contaminated soil. Based on field screening (discussed in Section 3.2), overburden materials identified as potentially clean were placed in stockpiles for potential use as backfill. A landfill bridge was constructed over a portion of the 116-N-1 Trench in 2004 using clean overburden to provide a temporary road for access to both sides of the trench. The land bridge excavation and overburden were sampled prior to backfill to verify that the excavation and the overburden material met the cleanup criteria. Approximately 8 m (26.2 ft) of piping was also removed between the crib and the 1315-N valve station during excavation of the sidewall of the crib. Closeout of this segment of piping was addressed using the verification sampling for the crib. The contamination within the boundaries of the UPR-100-N-31 waste site was also removed but the waste site is not proposed to be interim closed out because of contaminant plumes that impacted active facilities and cannot be excavated until the active facilities are closed or relocated. Contaminated materials were disposed of at the ERDF.

Figure 2. Pre-Remediation Topographic Plan for the 116-N-1 Waste Site.

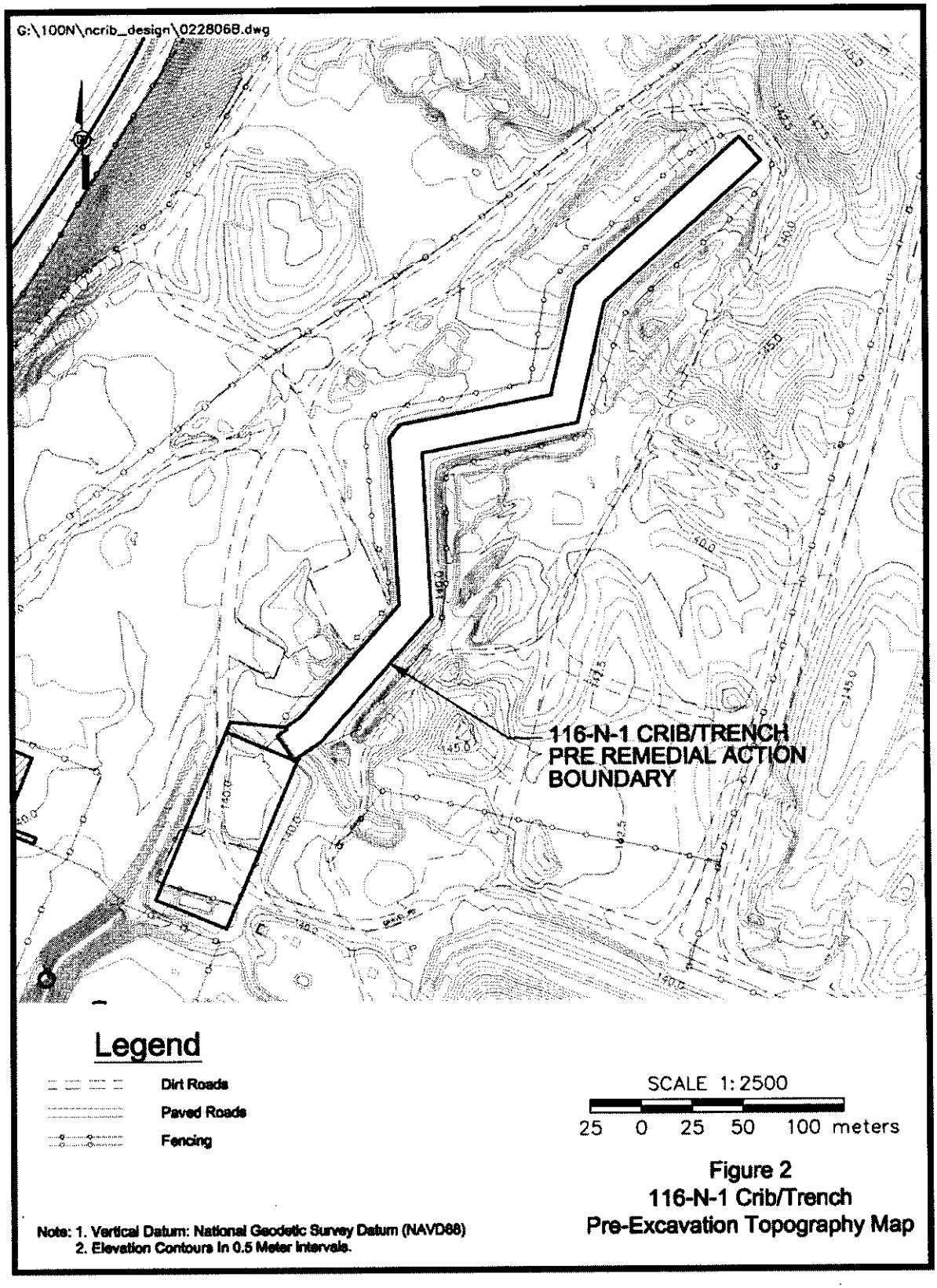
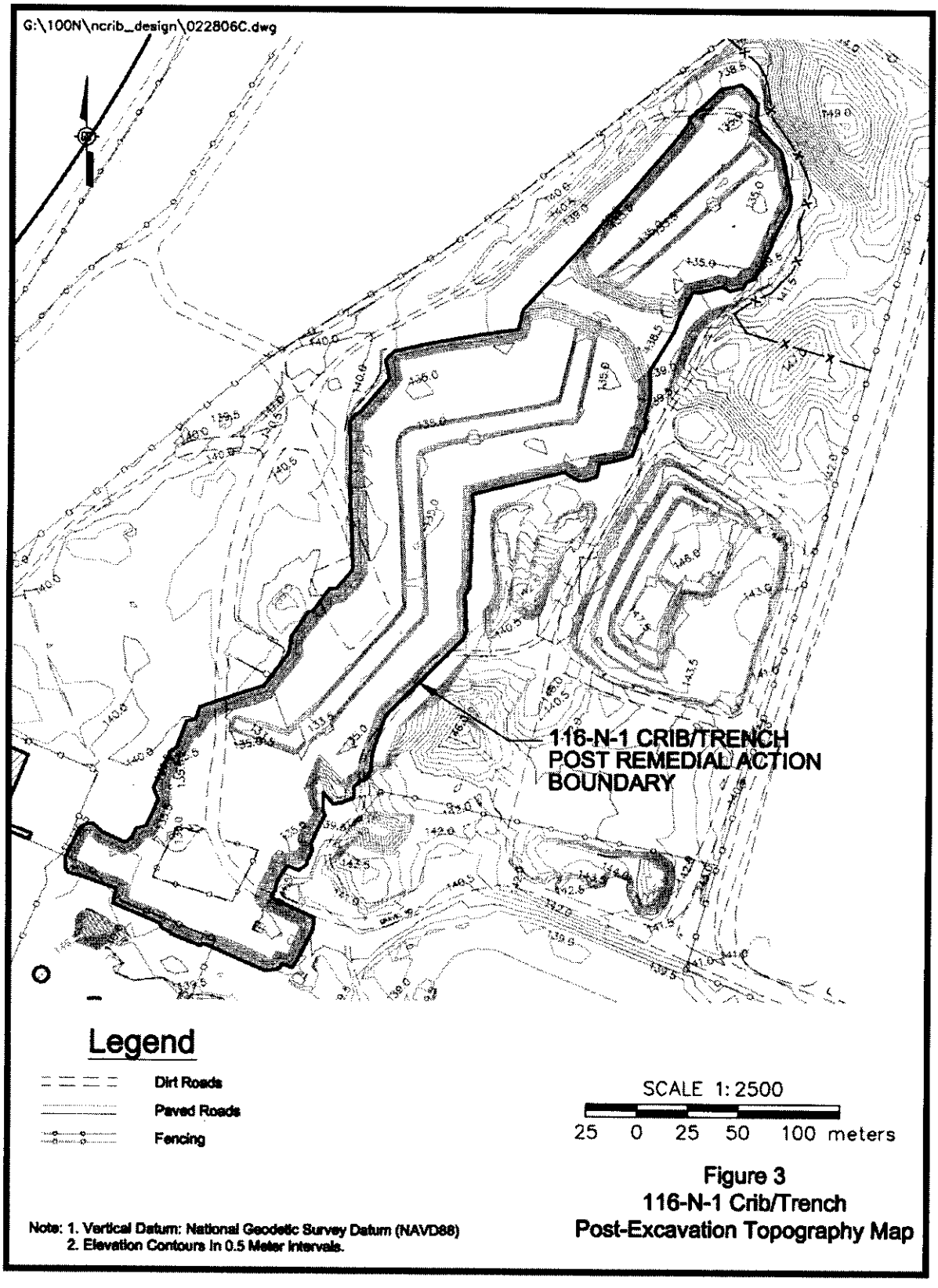


Figure 3. Post-Remediation Topographic Plan for the 116-N-1 Waste Site.



In October 2005, the excavation was completed. Pre- and post-remediation topographic maps for the waste site are shown in Figures 2 and 3. At the conclusion of the excavation activities, the elevation of the bottom of the trench excavation and crib excavation were at 6.5 m (21.3 ft) and 4.5 m (14.8 ft) below ground surface, respectively. In Figure 3, the post-remediation boundary is represented by the bold border. The excavation for the entire 116-N-1 site was approximately 36,011 m^2 (387,619 ft^2) in area. As specified in the ROD (EPA 2000) and CMS/CP (DOE-RL 2002a), soils were removed beneath the crib and trench to a minimum of 1.5 m (5 ft) below the engineered structures. Approximately 333,528 metric tons (367,652.9 US tons) of material from the site was disposed of at the ERDF.

3.2 FIELD SCREENING AND VARIANCE SAMPLING

Field screening was conducted during final stages of site remedial action. Field screening was used to guide the excavation, to quickly assess the presence and level of contamination, and to assess when remediation was complete. Field screening for the 116-N-1 site included using a radiological data mapping system survey, hand-held beta and gamma detectors, gamma energy analyses, and a laser-assisted ranging and data system. Although it was not required, the laser-assisted ranging and data system was used for screening the overburden piles as well. The hand-held detectors were used to screen excavated waste material and to screen for excavation wall and floor hot spots. Gamma energy analysis was used to support waste characterization and to corroborate the radiological mapping survey and hand-held detector data.

As specified in the 100-NR-1 SAP (DOE-RL 2002b) the 116-N-1 Crib and Trench were considered analogous to the 116-N-3 Crib and Trench. Therefore, the results of the variance sampling for the 116-N-3 site were used to determine the number of verification samples for the 116-N-1 site. The results of the 116-N-3 variance sampling (BHI 2002b) indicated that the number of verification samples to be taken was less than the default number of 10; therefore, 10 final verification soil samples were collected from each of the crib and trench shallow zone and deep zone decision units for a total of 40 verification samples.

3.3 CLEANUP VERIFICATION SAMPLING AND ANALYSIS

The division of the site excavation into shallow and deep zone decision units, as shown on the sample design figures on pages C-101 and C-102, is a function of the applicable RAGs. The direct exposure, groundwater protection, and river protection RAGs are applicable to soils within 4.6 m (15 ft) of the ground surface. This soil is referred to as the shallow zone. The overburden is a separate shallow zone decision unit. The groundwater protection and river protection RAGs are applicable to soils greater than 4.6 m (15 ft) below the ground surface. This soil is referred to as the deep zone. The 116-N-1 site consisted of both a shallow and deep zone decision unit. The site was excavated to a depth of approximately 6.5 m (21.3 ft) for the trench and 4.5 m (14.8 ft) for the crib. The shallow zone for the crib and trench consisted of the excavation

sidewalls to a depth of 4.6 m (15 ft), and the deep zone consisted of the excavation sidewalls below 4.6 m (15 ft) together with the floor of the excavation. All deep zone samples were collected below 4.6 m (15 ft).

As described in Section 3.2, the required number of samples for the trench, crib, and overburden shallow zone decision units was less than the default number of 10 randomly selected discrete samples specified in the 100-NR-1 SAP (DOE-RL 2002b). Therefore, the default number of 10 samples was collected from each noted shallow zone decision unit (excluding the quality assurance/quality control samples). As specified in the 100-NR-1 SAP (DOE-RL 2002b), 10 randomly selected samples were also collected from each of the trench and crib deep zones (i.e., below 4.6 m [15 ft]) in addition to quality assurance/quality control samples. For the land bridge area, four judgmental samples from the shallow zone and one judgmental sample from the deep zone were collected from the excavation prior to backfilling to create the land bridge. The sample design calculations for the 116-N-1 site are documented in the sample area and location calculation briefs included in Appendix C.

Final cleanup verification samples were collected on November 8, 2005 through November 10, 2005 for the combined 116-N-1 Crib and Trench area. Verification sampling of overburden was performed on December 1, 2003. Verification soil samples of the land bridge area were collected on August 3, 2003 and October 19, 2004. The final verification samples were submitted to offsite laboratories for analysis using approved EPA analytical methods, as required per the 100-NR-1 SAP (DOE-RL 2002b).

4.0 CLEANUP VERIFICATION DATA EVALUATION

This section presents the evaluation and modeling of the 116-N-1 cleanup verification data for comparison with the data quality criteria and RAGs.

4.1 DATA QUALITY ASSESSMENT PROCESS

A data quality assessment (DQA) is performed to compare the verification sampling approach and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 116-N-1 site determined that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. All analytical data were found to be acceptable for decision-making purposes. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in the Hanford Environmental Information System and are summarized in Appendix A. The detailed DQA is presented in Appendix B.

4.2 CONTAMINANTS OF CONCERN 95% UPPER CONFIDENCE LIMIT

The primary statistical calculation to support cleanup verification is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. The 95% UCL values for each COC are computed for each decision unit (e.g., for the shallow and deep zones and overburden). Prior to calculating the 95% UCL, the individual sample results are reviewed and, as appropriate, adjusted per the 100-NR-1 SAP (DOE-RL 2002b). This process is summarized below.

Appendix C shows the 95% UCL calculation brief for the combined 116-N-1 Crib and Trench. Individual 95% UCL calculation briefs were also completed for overburden and for the land bridge. Each of these calculation briefs went through the cleanup verification calculation brief approval process and is archived in the Washington Closure Hanford project files.

Verification sampling summary statistics (95% UCL values) are listed in Table 2. Individual sample cleanup verification results are presented in Appendix A.

- **Radionuclides:** The laboratory-reported value is used in the calculation of the 95% UCL. In cases where the laboratory does not report a value for data qualified with a "U" (i.e., less than the detection limit), half of the minimum detectable activity is used in the calculation of the 95% UCL.

- **Nonradionuclides:** For data flagged with a "U" (i.e., less than detection), a value equal to one-half the practical quantitation limit is used in the calculation of the 95% UCL, consistent with Washington State Department of Ecology regulations (WAC 173-340-740[7][g]).

For nonradionuclides, if greater than half of the sample results for a given COC are below detection, then the statistical value is set equal to the maximum concentration detected (i.e., versus computing a 95% UCL).

Statistical calculations are presented in the *116-N-1 Combined Crib and Trench Cleanup Verification 95% UCL Calculation, 116-N-1 Overburden Verification 95% UCL Calculation,* and *116-N-1 Trench Landbridge Cleanup Verification 95% UCL Calculation* calculation briefs (Appendix C). The columns on the left side of Table 2 are the 95% UCL statistical values before subtraction of background, if appropriate. The columns on the right side of the table present statistical values adjusted for background, when background values exist; it is these values that constitute the cleanup verification data set and are used for RESidual RADioactivity (RESRAD) modeling. For the shallow and deep zone, only the background values for the uranium isotopes are subtracted from

Table 2. 116-N-1 Cleanup Verification Data. (2 Pages)

COCs	95% UCL Statistical Values					Hanford Site Background[a]	Cleanup Verification Data Set[b]				
	Combined Crib/Trench		Land Bridge		Overburden		Combined Crib/Trench		Land Bridge		Overburden
	Shallow Zone	Deep Zone	Shallow Zone	Deep Zone[c]			Shallow Zone	Deep Zone	Shallow Zone	Deep Zone	
Radionuclides (pCi/g)[d]											
Americium-241	0.55	35	0.12 (ND)	629	0.042 (ND)	NA	0.55	35	0.12 (ND)	629	0.042 (ND)
Cobalt-60	0.121	310	0.21	9,460	0.55	0.008	0.121	310	0.21	9,460	0.542
Cesium-137	0.36	5,100	0.59	96,500	1.2	1.1	0.36	5,100	0.59	96,500	0.1
Europium-154	0.071 (ND)	7.3	0.079 (ND)	92.8	0.022 (ND)	0.033	0.071 (ND)	7.3	0.079 (ND)	92.8	0 (<BG)
Europium-155	0.069 (ND)	1.9	0.062 (ND)	21 (ND)	0.0017 (ND)	0.054	0.069 (ND)	1.9	0.062 (ND)	21 (ND)	0 (<BG)
Tritium (H-3)	NC	16	NC	-3.66 (ND)	NC	NA	NC	16	NC	-3.66 (ND)	NC
Nickel-63	0.97 (ND)	170	0.154 (ND)	2,370	2.87	NA	0.97 (ND)	170	0.154 (ND)	2,370	2.87
Plutonium 239/240	0.026 (ND)	41	0.072 (ND)	700	0.0027 (ND)	0.025	0.026 (ND)	41	0.072 (ND)	700	0 (<BG)
Strontium-90	0.18	931	0.19	2,150	0.1	0.18	0.18	931	0.19	2,150	0 (<BG)

Table 2. 116-N-1 Cleanup Verification Data. (2 Pages)

COCs	95% UCL Statistical Values					Hanford Site Background[a]	Cleanup Verification Data Set[b]				
	Combined Crib/Trench		Land Bridge		Overburden		Combined Crib/Trench		Land Bridge		Overburden
	Shallow Zone	Deep Zone	Shallow Zone	Deep Zone[c]			Shallow Zone	Deep Zone	Shallow Zone	Deep Zone	
Nonradionuclides (mg/kg)[d]											
Chromium (total)	NC	14	NC	9.1	13.2	18.5	NC	14	NC	9.1	13.2
Hexavalent chromium	NC	2.96	NC	0.4 (ND)	0.35	NA	NC	2.96	NC	0.4 (ND)	0.35
Mercury	0.02 (ND)	NC	0.02 (ND)	NC	0.02 (ND)	0.33	0.02 (ND)	NC	0.02 (ND)	NC	0.02 (ND)
Nitrate	17	68	1	1.7	52	52	17	68	1	1.7	52

[a] Represents the 90th percentile of the lognormal distribution (DOE-RL 1995, DOE-RL 1996).
[b] The statistical value above background is used as the input value for RESidual RADioactivity (RESRAD) modeling. For overburden, background is subtracted from all radionuclides. Refer to Appendix C for additional details on determination of statistical values.
[c] Only one sample was collected in the deep zone for the land bridge. The value presented is the sample result and not a 95% UCL value.
[d] Laboratory data including the minimum detectable activity or practical quantitation limit for the individual cleanup verification samples are included in Appendix A and the 95% UCL calculation brief.

BG = background
COC = contaminant of concern
NA = not available
NC = not a COC for this zone
ND = not detected
UCL = upper confidence limit

the statistical values. For overburden, background is subtracted from the statistical value for all radionuclides when background values are available.

4.3 SITE-SPECIFIC CLEANUP VERIFICATION MODEL

The summary of statistical values presented in Table 2 were evaluated and used to develop site-specific cleanup verification models. The 116-N-1 cleanup verification models as described in the 100-NR-1 RDR/RAWP (DOE-RL 2001) comprise three depth intervals: (1) the shallow zone and overburden, (2) the contaminated deep zone, and (3) the uncontaminated vadose (deep) zone. Based on the assumption that residual contaminant levels in the deep zone data set extend uniformly to groundwater (as discussed in the 100-NR-1 RDR/RAWP [DOE-RL 2001]), residual activities of americium-241, cobalt-60, cesium-137, nickel-63, plutonium-239, plutonium-240, and strontium-90 would result in groundwater concentrations that exceeded the groundwater RAGs. Because the assumption that the deep zone contaminant concentrations extend uniformly to groundwater is too conservative in the case of these contaminants, the three-layer model (based on boreholes 199-N-107A and 199-N-108A) was applied to the 116-N-1 site. The development and application of this model is discussed in *100-N Remedial Action Project, 100-NR-1 Subsurface Contaminant Layers* (BHI 2001b) and *116-N-1 RESRAD Evaluation of Groundwater Protection* (BHI 2003). In addition, the 100-NR-1 ESD (EPA 2003) removed the 76 cm (30 in.) of irrigation assumption from the modeling for the 116-N-1 waste site based on a balancing factor evaluation and implementation of institutional controls prohibiting irrigation.

4.4 RESRAD MODELING

The individual radionuclide cleanup verification statistical values (Table 2) were entered into the RESRAD computer code, Version 6.3 (ANL 2005), to estimate the dose rate and to estimate the impact on groundwater and the river from residual COC concentrations. The direct radiation exposure dose rate to the resident living in his or her basement (rural-residential scenario) was conservatively estimated by substituting (for analysis purposes) a case where the resident is standing on level ground with the soil containing concentrations representative of residual (i.e., post-cleanup) shallow zone soils. This is conservative because it ignores the potential shielding effects of concrete basement walls and any clean backfill between residual soils and the basement walls.

The RESRAD modeling methodologies, results, input values, and the site-specific cleanup verification model are included in the RESRAD calculation brief (Appendix C). The drinking water dose rate calculations based on the RESRAD estimated groundwater radionuclide concentrations are shown in the comparison to drinking water standards calculation brief (Appendix C). Specific results from the calculations are discussed in the RAG evaluation section (Section 5.0).

5.0 EVALUATION OF REMEDIAL ACTION GOAL ATTAINMENT

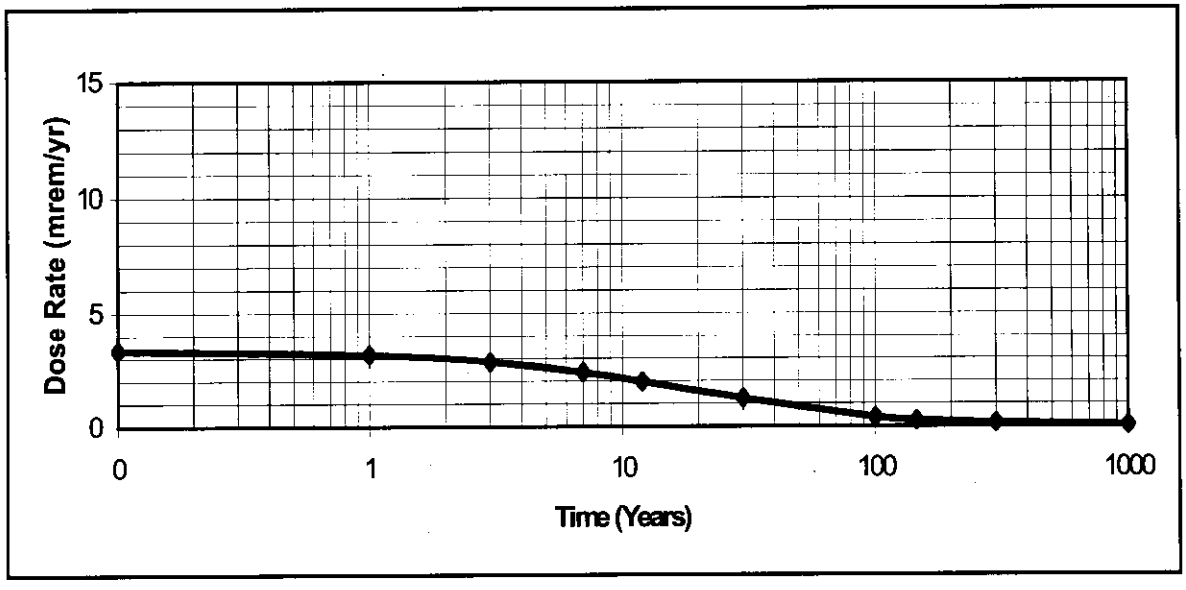
This section demonstrates that remedial actions at the 116-N-1 site meet the applicable RAGs. Sections 5.1, 5.2, and 5.3 address attainment of direct exposure RAGs, groundwater protection RAGs, and Columbia River protection RAGs, respectively. Section 5.4 documents application of the WAC 173-340 (Model Toxics Control Act [MTCA] Cleanup Regulation) three-part test to the shallow and deep zones. This test is required for nonradionuclide COCs only and is based on the most restrictive RAG for each zone.

5.1 DIRECT EXPOSURE SOIL REMEDIAL ACTION GOALS ATTAINED

5.1.1 Radionuclides

The results of the RESRAD dose rate estimates for the 116-N-1 site combined crib and trench shallow and deep zone all-pathways scenarios are presented in Figure 4.

Figure 4. Combined Crib and Trench Shallow and Deep Zone Dose Rate Estimates for the 116-N-1 Site (All Radionuclides, All Pathways).



These dose rates represent the dose contributions from soils at relevant time periods. The dose is largest at present (year 2006), 3.35 mrem/yr, and decreases to 5.09×10^{-02} in 1,000 years. The estimated dose rate in the year 2018 from the site is 1.97 mrem/yr.

The RESRAD modeling for the 116-N-1 site overburden was performed in 2004 and indicated the dose rate estimate to be largest in year 2004 at 8.17 mrem/yr, and decreasing to 4.93 x 10^{-03} mrem/yr in 1,000 years. The estimated dose rate in the year 2018 from the overburden is 2.92 mrem/yr.

The RESRAD modeling for the 116-N-1 site trench land bridge was performed in 2004 and indicated the dose rate estimate to be largest in year 2004 at 4.39 mrem/yr, and decreasing to 4.31 x 10^{-07} mrem/yr in 1,000 years. The estimated dose rate in the year 2018 from the overburden is 2.03 mrem/yr.

5.1.2 Nonradionuclides

5.1.2.1 Direct Comparison to RAGs. Table 3 compares the cleanup verification statistical values presented in Table 2 to the direct exposure RAGs/cleanup levels presented in Table 1. No verification values exceeded the direct exposure RAGs.

Table 3. Attainment of Nonradionuclide Direct Exposure Standards.

Nonradionuclides	Direct Exposure RAG (mg/kg)	Shallow Zone Statistical Value (mg/kg)	Overburden Statistical Value (mg/kg)	Land Bridge Statistical Value (mg/kg)	Direct Exposure RAGs Attained?[a]
Mercury	24	0.02	0.02	0.02	Yes
Nitrate	113,000	17	52.0	1.0	Yes

[a]Criterion is comparison to the cleanup criteria (RAGs) as provided in the RDR/RAWP (DOE-RL 2001).

5.1.2.2 Noncarcinogenic Hazard Quotient RAG Attained. For noncarcinogenic COCs, WAC 173-340 (MTCA Cleanup Regulation) specifies the evaluation of the hazard quotient, which is given as daily intake divided by a reference dose. For cleanup actions under the ROD (EPA 2000), a comparable conservative approach is used to demonstrate attainment of the noncarcinogenic risk requirements.

The COCs with noncarcinogenic effects at this site are mercury and nitrate. The sum of the individual COC quotients for the shallow zone soils is below the limit of 1.0. Therefore, the noncarcinogenic risk requirements have been attained. This is shown in the 95% UCL calculation brief (Appendix C).

5.1.2.3 Carcinogenic Risk RAG Attained. For individual nonradionuclide carcinogenic COCs, the WAC 173-340 Method B cleanup limits are based on an incremental cancer risk of 1 x 10^{-6}. For nonradionuclide carcinogenic COCs, the total excess cancer risk must be less than 1 x 10^{-5} (EPA et al. 1998).

There are no nonradionuclide carcinogenic COCs for the shallow zone. Therefore, the carcinogenic risk standards have been attained.

5.2 GROUNDWATER REMEDIAL ACTION GOALS ATTAINED

5.2.1 Radionuclides

The estimated groundwater concentrations for all of the radionuclide COCs contributed by the site soils are shown in the RESRAD calculation brief (Appendix C). Table 4 shows the total peak concentration predicted for each radionuclide COC and provides the individual RAGs for comparison. No COC is predicted to exceed the RAGs; therefore, the RAGs are attained.

Table 4. Estimated Peak Radionuclide Groundwater Concentrations (Summing Shallow and Deep Zone Impacts) Compared to RAGs. (2 Pages)

Radionuclide	Peak Concentration (pCi/L)	RAG (pCi/L)	RAGS Attained? (Yes/No)
116-N-1 Site			
Americium-241	[a]	1.2[c]	Yes
Cobalt-60	[a]	100[b]	Yes
Cesium-137	[a]	60[b]	Yes
Europium-154	[a]	60[b]	Yes
Europium-155	[a]	600[b]	Yes
Tritium (H-3)	1.52	20,000[e]	Yes
Nickel-63	[a]	50[b]	Yes
Plutonium-239/240	[a]	1.2[c]	Yes
Strontium-90	[a]	8[e]	Yes
Overburden Soil			
Americium-241	[a]	15[c]	Yes
Cobalt-60	[a]	100[b]	Yes
Cesium-137	[a]	60[b]	Yes
Europium-154	[a]	60[b]	Yes
Europium-155	[a]	600[b]	Yes
Tritium	[d]	20,000[e]	Yes
Nickel-63	[a]	50[b]	Yes
Plutonium-239/240	[a]	15[c]	Yes
Strontium-90	[a]	8[e]	Yes[f]
Landbridge Soil			
Americium-241	[a]	15[c]	Yes
Cobalt-60	[a]	100[b]	Yes
Cesium-137	[a]	60[b]	Yes
Europium-154	[a]	60[b]	Yes
Europium-155	[a]	600[b]	Yes
Tritium	[d]	20,000[e]	Yes
Nickel-63	[a]	50[b]	Yes

Table 4. Estimated Peak Radionuclide Groundwater Concentrations (Summing Shallow and Deep Zone Impacts) Compared to RAGs. (2 Pages)

Radionuclide	Peak Concentration (pCi/L)	RAG (pCi/L)	RAGS Attained? (Yes/No)
Plutonium-239/240	[a]	15[c]	Yes
Strontium-90	[a]	8[e]	Yes

[a]Based on RESRAD modeling, these radionuclides do not reach groundwater in 1,000 years.
[b]Lookup value corresponding to a dose rate of 4 mrem/yr.
[c]Alpha emitters must meet drinking water standards based on the more stringent of the 15 pCi/L maximum contaminant level or 1/25th of the derived concentration guide per DOE Order 5400.5.
[d]The tritium 95% UCL statistical value was negative and therefore was not input into RESRAD.
[e]U.S. Environmental Protection Agency drinking water promulgated RAG (40 CFR 141.55).
[f]The 100-NR-1 ESD (EPA 2003) documents the balancing factors analysis that concluded to allow evaluation of residual contamination in the deep zone for protection of groundwater and the river without irrigation. Therefore, institutional controls to prevent irrigation are required.

5.2.2 Nonradionuclides

Table 5 illustrates the comparison of cleanup verification statistical values to the groundwater protection RAGs. The listed RAGs are based on background or the "100 times groundwater cleanup rule." The results of meeting the listed RAGs demonstrate that the groundwater protection RAG has been attained.

5.3 COLUMBIA RIVER REMEDIAL ACTION GOALS ATTAINED

5.3.1 Radionuclides

The river protection RAGs for radionuclides are identical to the groundwater protection RAGs. The RESRAD modeling results were compared to the groundwater protection RAGs in Table 5.

With the exception of tritium, the results indicated that radionuclides are not predicted to reach groundwater (and, by extension, not predicted to reach the Columbia River). No radionuclide reaches groundwater at levels above 4 mrem/yr; therefore, the Columbia River protection RAGs have been attained. Tritium is predicted to reach groundwater within 1,000 years but at concentrations below the RAG.

Table 5. Attainment of Nonradionuclide Remedial Action Goals for Protection of Groundwater and the Columbia River. (2 Pages)

Nonradionuclides	Soil RAG for Groundwater Protection (mg/kg)	Soil RAG for Columbia River Protection (mg/kg)	Statistical Cleanup Verification Data Value (mg/kg)	Groundwater and/or River Protection RAGs Exceeded?	RAGs Attained? (Yes/No)
Combined Crib and Trench Shallow Zone					
Chromium (total)	Not a shallow zone COC				
Hexavalent chromium	Not a shallow zone COC				
Mercury	0.33	0.33	0.02	No	Yes
Nitrate	4,400[a]	4,400[a]	17	No	Yes
Combined Crib and Trench Deep Zone					
Chromium (total)	18.5	18.5	14	No	Yes
Hexavalent chromium	4.8	2	2.96	Yes	Yes[b]
Mercury	Not a deep zone COC				
Nitrate	4,400[a]	4,400[a]	68	No	Yes
Overburden					
Chromium (total)	18.5	18.5	13.2	No	Yes
Hexavalent chromium	4.8	2	0.35	No	Yes
Mercury	0.33	0.33	0.02	No	Yes
Nitrate	4,400[a]	4,400[a]	52	No	Yes
Land Bridge Shallow Zone					
Chromium (total)	Not a shallow zone COC				
Hexavalent chromium	Not a shallow zone COC				
Mercury	0.33	0.33	0.02	No	Yes
Nitrate	4,400[a]	4,400[a]	1	No	Yes
Land Bridge Deep Zone					
Chromium (total)	18.5	18.5	9.1	No	Yes
Hexavalent chromium	4.8	2	0.4	No	Yes
Mercury	Not a deep zone COC				
Nitrate	4,400[a]	4,400[a]	1.7	No	Yes

[a] Cleanup verification samples were analyzed for nitrates as nitrogen. The values presented are expressed as nitrate rather than as nitrogen. To obtain the cleanup level for nitrate as nitrogen divide the nitrate RAGs by 4.4.
[b] Based on the 100-D, 100-F, and 100-H Area hexavalent chromium leach studies, groundwater and surface water quality criteria will not be exceeded where hexavalent chromium concentrations in soil are less than 5.7 mg/kg.
COC = contaminant of concern
RAG = remedial action goal

5.3.2 Nonradionuclides

Table 5 illustrates the comparison of cleanup verification statistical values to the Columbia River protection RAGs. The table shows that the residual concentration (statistical value) of all nonradionuclide COCs for the site is less than the listed river protection soil RAGs with the exception of hexavalent chromium in the deep zone. However, based upon agreement among the Tri-Parties cited in Section E.5 of the 100 Area RDR/RAWP (DOE-RL 2005) and "Hexavalent Chromium Issues at 100D/DR Project" (BHI 2000b), hexavalent chromium leach test results are used to compare residual soil concentrations to hexavalent chromium concentrations in leach test soils that did not produce leachate that exceeded the groundwater and river water quality criteria. If residual soil concentrations are below the hexavalent chromium concentrations that produced leachate exceeding water quality criteria, the site is determined to be protective of groundwater and the river.

Results and application of the hexavalent chromium leach tests are presented in CVPs for the 100-D, 100-F, and 100-H Areas (BHI 2000a, BHI 2002a, and BHI 2001a, respectively). Leach tests in the 100-D Area indicated that soils with hexavalent chromium concentrations below 6.1 mg/kg would not produce leachate that exceeded the Columbia River protection criteria of 20 µg/L (surface water quality criteria of 10 µg/L times the dilution attenuation factor of 2). Likewise, 100-F Area soils with hexavalent chromium concentrations below 7.2 µg/L and 100-H Area soils with hexavalent chromium concentrations below 5.7 µg/L are shown to meet Columbia River protection criteria.

Therefore, using the simple and conservative approach of comparing the residual soil concentration of hexavalent chromium to the soil concentrations used in leach testing, and comparing the leachate concentrations from the leach tests to the surface water hexavalent chromium cleanup level, this indicates that remaining hexavalent chromium in deep zone soil at the 116-N-1 site is protective of the river. That is, the highest cited hexavalent chromium soil concentration (2.96 mg/kg) is less than the 100-D, 100-F, and 100-H Area soil concentration levels that produced a leachate that did not exceed the Columbia River protection criteria of 20 µg/L.

The results listed in Table 5 demonstrate that the Columbia River protection RAGs have been attained for this site.

5.4 WAC 173-340 THREE-PART TEST FOR NONRADIONUCLIDES

Sections 5.1, 5.2, and 5.3 looked separately at compliance with direct exposure RAGs, groundwater protection RAGs, and Columbia River protection RAGs. Section 5.4 documents application of the WAC 173-340-740(7)(e) three-part test for nonradionuclides using the most restrictive RAGs applicable to each decision unit (i.e., shallow zone, overburden, and deep zone). The most restrictive RAG is defined as the lowest of the direct exposure, groundwater protection, and river protection RAGs. The direct exposure, groundwater protection, and river protection RAGs are applicable to the

shallow zone and overburden. Groundwater and river protection RAGs are applicable to the deep zone. The WAC 173-340 three-part test consists of the following criteria: (1) the cleanup verification statistical value must be less than the cleanup level, (2) no single detection can exceed two times the cleanup criteria, and (3) the percentage of samples exceeding the cleanup criteria must be less than 10%.

Table 6 summarizes the results of the WAC 173-340 (MTCA Cleanup Regulation) three-part test (WAC 173-340-740(7)) for the shallow and deep zone sample data sets. For each nonradionuclide COC, the table lists the most restrictive applicable RAG (selected from the RAGs in Table 1), the maximum detected value, the total number of samples collected, and the number of samples exceeding the most restrictive RAG. The final column of the table describes the result of applying the three WAC 173-340 (MTCA Cleanup Regulation) criteria using the values listed in the preceding columns.

Table 6 shows that all nonradionuclide COCs pass the WAC 173-340 (MTCA Cleanup Regulation) three-part test.

Table 6. Application of the WAC 173-340 (MTCA Cleanup Regulation) Three-Part Test. (2 Pages)

Nonradionuclides	Most Stringent Applicable RAG (mg/kg)	Statistical Value (mg/kg)[a]	Maximum Detected (mg/kg)[b]	Total Number of Samples[c]	Percent Exceeding Most Stringent Applicable RAG[d]	RAGs Attained?
Combined Crib and Trench Shallow Zone						
Chromium (total)	Not a shallow zone COC					
Hexavalent chromium	Not a shallow zone COC					
Mercury	0.33	0.02[e]	0.02[e]	22	0	Yes
Nitrate	4,400[f]	17	27.1	22	0	Yes
Combined Crib and Trench Deep Zone						
Chromium (total)	18.5	14	31.7	22	14%	Yes[g]
Hexavalent chromium	2	2.96	2.96	22	14%	Yes[h]
Mercury	Not a deep zone COC					
Nitrate	4,400[f]	68	102	22	0	Yes
Overburden						
Chromium (total)	18.5	13.2	15.6	11	0	Yes
Hexavalent chromium	2	0.35	0.35	11	0	Yes
Mercury	0.33	0.02[e]	0.02[e]	11	0	Yes

Table 6. Application of the WAC 173-340 (MTCA Cleanup Regulation) Three-Part Test. (2 Pages)

Nonradionuclides	Most Stringent Applicable RAG (mg/kg)	Statistical Value (mg/kg)[a]	Maximum Detected (mg/kg)[b]	Total Number of Samples[c]	Percent Exceeding Most Stringent Applicable RAG[d]	RAGs Attained?
Nitrate	4,400[f]	52	24	11	0	Yes
Land Bridge Shallow Zone						
Chromium (total)	Not a shallow zone COC					
Hexavalent chromium	Not a shallow zone COC					
Mercury	0.33	0.02[e]	0.02[e]	4	0	Yes
Nitrate	4,400[f]	1	1.1	4	0	Yes
Land Bridge Deep Zone						
Chromium (total)	18.5	9.1	9.1	1	0	Yes
Hexavalent chromium	2	0.4 (ND)	0.4 (ND)	1	0	Yes
Mercury	Not a deep zone COC					
Nitrate	4,400[f]	1.7	1.7	1	0	Yes

[a] Criterion is comparison to the cleanup RAG.
[b] Criterion is no single detection can exceed two times the cleanup criteria.
[c] The total number of samples includes field duplicate samples, which are included in the evaluation as separate samples.
[d] Criterion is the percentage of samples exceeding the cleanup criteria must be less than 10%.
[e] This value is the practical quantitation limit (PQL) for this analyte. Analyte concentrations for this test were below detection limits of this method.
[f] Cleanup verification samples were analyzed for nitrates as nitrogen. The values presented in this table are expressed as nitrate rather than nitrogen. To obtain cleanup levels for nitrate as nitrogen divide the nitrate RAGs by 4.4.
[g] The deep zone total chromium data set does not meet the 10% Criteria (footnote d). However, because total chromium has a Kd value of 200 mL/g, an evaluation based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005) shows that total chromium will not reach groundwater (and therefore the Columbia River) within 1,000 years.
[h] Since the deep zone hexavalent chromium data set did not meet the 10% criteria (note d), protection for the deep zone hexavalent chromium is demonstrated based on the 100 Area leach study results discussed in Section 5.3.2.
COC = contaminant of concern
ND = Not detected. Analyte concentration is below detection limits of the method and/or instruments used.
RAG = remedial action goal

6.0 RADIONUCLIDE RISK INFORMATION

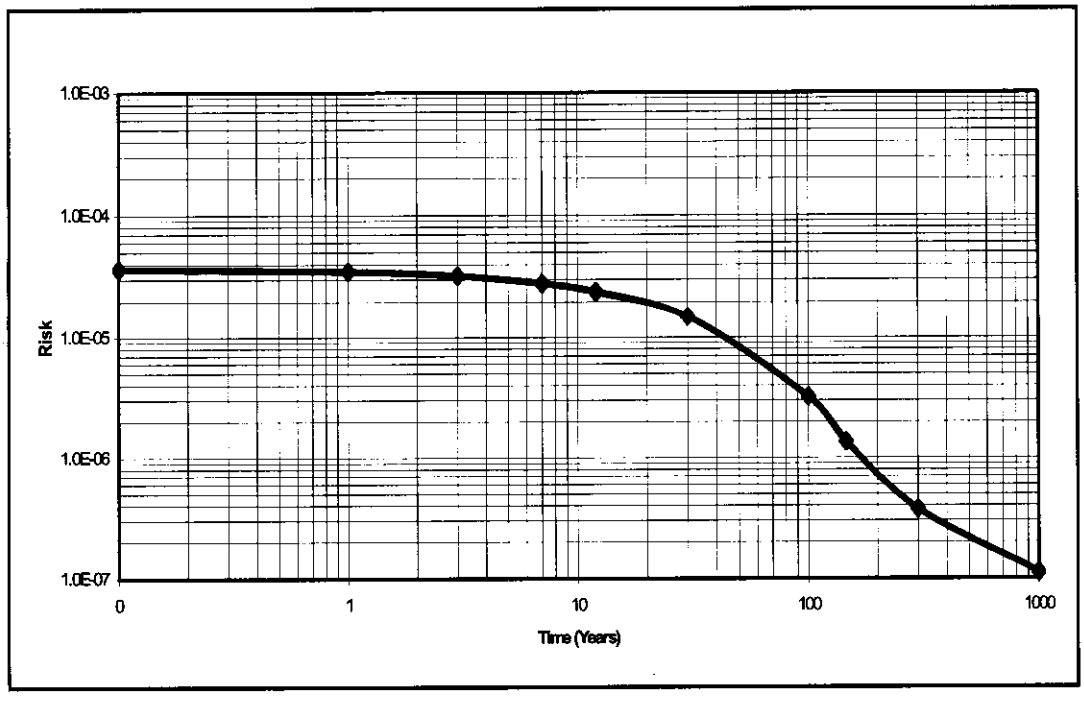
The radionuclide RAG for direct exposure is derived from the ROD (EPA 2000) and is expressed in terms of an allowable radiation dose rate above background (i.e., 15 mrem/yr). The RAG evaluation (Section 5.0) involved using the RESRAD model to estimate total annual radiation dose rates for 1,000 years for comparison to

the RAG. Radiation presents a carcinogenic risk, and the RESRAD model also calculates the excess lifetime cancer risk associated with the estimated radiation dose rates using the EPA's Health Effects Assessment Summary Tables (update dated April 16, 2001, "Update of Radionuclide Carcinogenicity Slope Factors," available on the Internet at www.epa.gov/radiation/heast). The "National Oil and Hazardous Substances Pollution Contingency Plan" (40 *Code of Federal Regulations* 300) presents a target range for residual risk of 10^{-4} to 10^{-6}. Figure 5 illustrates excess lifetime cancer risk as estimated using the RESRAD model. Because of radioactive decay, the risk decreases over time. The estimated risk is largest, 3.66×10^{-5} from the site, at present (year 2006), and decreases to 1.12×10^{-7} in 1,000 years. The estimated risk in the year 2018 is 2.4×10^{-5}.

For the 116-N-1 site overburden, the risk was estimated to be largest in 2004 at 7.70×10^{-5} and decreases to 1.07×10^{-8} 1,000 years later. The estimated risk in the year 2018 is 3.85×10^{-5}.

For the 116-N-1 site trench landbridge, the risk was estimated to be largest in 2004 at 4.72×10^{-7} and decreases to 1.91×10^{-11} 1,000 years later. The estimated risk in the year 2018 is 2.75×10^{-5}.

Figure 5. RESRAD Analysis – Radionuclide Excess Cancer Risk, All Pathways (Shallow and Deep Zones).



7.0 STATEMENT OF PROTECTIVENESS

This CVP/clean closure report demonstrates that remedial action at the 116-N-1 site has achieved the remedial action objectives and corresponding RAGs established in the approved Interim Action ROD (EPA 2000) and 100-NR-1 RDR/RAWP (DOE-RL 2001). Only the soils of the 116-N-1 overburden, shallow zone, and the deep zone layer immediately in contact with the shallow zone have been sampled, analyzed, and modeled for groundwater protection in this CVP. The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soils are required. The 100-NR-1 ESD (EPA 2003), documents the balancing factors analysis that concluded to allow evaluation of residual contamination in the deep zone for protection of groundwater and the river without irrigation. Therefore, institutional controls to prevent irrigation are required. Institutional controls will be implemented in accordance with DOE/RL-2001-41, *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions*. Consistent with the rural-residential exposure scenario specified in the *100-NR-1 Interim Remedial Action Record of Decision* (ROD), it is assumed that contaminated groundwater would not be used for drinking, irrigation, or any other use for the time period specified in the ROD.

8.0 REFERENCES

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APPENDIX A

SUMMARY OF VERIFICATION SOIL SAMPLING AND ANALYTICAL RESULTS

Table A-1. Combined Crib and Trench Shallow Zone Cleanup Verification Data. (Sheet 1 of 2)

Sample Point	HEIS Number	Sample Date	Am-241			Cs-137			Co-60			Eu-154			Eu-155		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Trench SZ-01	J10FB0	11/9/2005	6.00E-02	U	2.30E-01	1.95E-01		4.6E-02	1.11E-01		4.5E-02	1.2E-01	U	1.2E-01	9.4E-02	U	9.4E-02
Trench SZ-08	J10FB7	11/8/2005	7.1E-02	U	5.4E-01	6.86E-01		6.3E-02	7.7E-02		4.4E-02	1.7E-01	U	1.7E-01	1.8E-01	U	1.8E-01
Trench SZ-09	J10FB8	11/8/2005	-4.5E-02	U	3.5E-01	8.31E-01		6.4E-02	1.64E-01		6.4E-02	1.6E-01	U	1.6E-01	1.3E-01	U	1.3E-01
Trench SZ-02	J10FB1	11/8/2005	9.0E-02	U	1.7E-01	3.77E-01		3.2E-02	4.1E-02	U	4.1E-02	1.3E-01	U	1.3E-01	1.4E-01	U	1.4E-01
Trench SZ-10	J10FB9	11/8/2005	-8.1E-02	U	6.2E-01	4.27E-01		5.3E-02	1.98E-01		4.6E-02	1.3E-01	U	1.3E-01	1.4E-01	U	1.4E-01
Trench SZ-03	J10FB2	11/8/2005	6.0E-02	U	4.6E-01	6.4E-02		2.7E-02	2.7E-02	U	2.7E-02	8.4E-02	U	8.4E-02	9.2E-02	U	9.2E-02
Trench SZ-04	J10FB3	11/8/2005	1.7E-02	U	1.6E-01	1.05E-01		3.1E-02	4.1E-02	U	4.1E-02	1.4E-01	U	1.4E-01	7.4E-02	U	7.4E-02
Trench SZ-07	J10FB6	11/8/2005	3.99E+00		3.9E-01	8.28E-01		4.1E-02	8.5E-02	U	8.5E-02	1.2E-01	U	1.2E-01	7.2E-02	U	7.2E-02
Trench SZ-06	J10FB5	11/8/2005	-3.4E-02	U	2.6E-01	3.49E-01		4.0E-02	5.5E-02		3.7E-02	1.1E-01	U	1.1E-01	1.3E-01	U	1.3E-01
Trench SZ-05	J10FB4	11/8/2005	5.6E-02	U	2.2E-01	3.7E-02	U	3.7E-02	4.2E-02	U	4.2E-02	1.4E-01	U	1.4E-01	7.2E-02	U	7.2E-02
Duplicate of J10FB4	J10FC2	11/8/2005	-7.3E-02	U	5.6E-01	4.2E-02	U	4.2E-02	4.5E-02	U	4.5E-02	1.6E-01	U	1.6E-01	1.4E-01	U	1.4E-01
Split of J10FB4	J10FC5	11/8/2005	8.0E-02	U	2.17E-01	1.38E-01		1.83E-02	2.38E-02	U	2.47E-02	5.98E-03	U	6.55E-02	5.24E-02	U	4.82E-02
Equipment Blank	J10FC3	11/8/2005	-4.8E-02	U	3.7E-01	3.E-02	U	3.E-02	3.3E-02	U	3.3E-02	1.E-01	U	1.E-01	1.3E-01	U	1.3E-01
Crib SZ-01	J10F90	11/8/2005	3.1E-02	U	2.4E-01	4.79E-01		4.3E-02	5.14E-01		3.8E-02	1.1E-01	U	1.1E-01	1.2E-01	U	1.2E-01
Crib SZ-02	J10F91	11/8/2005	-3.5E-02	U	2.7E-01	3.5E-02	U	3.5E-02	2.3E-02	U	2.3E-02	7.4E-02	U	7.4E-02	8.6E-02	U	8.6E-02
Crib SZ-03	J10F92	11/8/2005	9.6E-02	U	2.5E-01	4.0E-02	U	4.0E-02	4.7E-02	U	4.7E-02	1.5E-01	U	1.5E-01	8.2E-02	U	8.2E-02
Crib SZ-04	J10F93	11/8/2005	2.5E-02	U	1.9E-01	6.4E-02	U	6.4E-02	1.3E-01	U	1.3E-01	1.5E-01	U	1.5E-01	2.5E-01	U	2.5E-01
Crib SZ-05	J10F94	11/8/2005	1.85E-01	U	4.7E-01	1.54E-01		4.0E-02	5.1E-02	U	5.1E-02	1.7E-01	U	1.7E-01	1.1E-01	U	1.1E-01
Duplicate of J10F94	J10FC0	11/8/2005	6.3E-02	U	2.4E-01	9.6E-02		4.4E-02	4.5E-02	U	4.5E-02	1.5E-01	U	1.5E-01	1.6E-01	U	1.6E-01
Split of J10F94	J10FC4	11/8/2005	7.02E-02	U	3.26E-01	4.65E-02		1.78E-02	3.67E-03	U	1.85E-02	-2.30E-02	U	5.56E-02	6.63E-02	U	4.90E-02
Equipment Blank	J10FC1	11/8/2005	6.20E-02	U	4.8E-01	2.5E-02	U	2.5E-02	2.9E-02	U	2.9E-02	8.8E-02	U	8.8E-02	6.4E-02	U	6.4E-02
Crib SZ-06	J10F95	11/8/2005	7.1E-02	U	2.7E-01	3.3E-02	U	3.3E-02	3.2E-02	U	3.2E-02	1.0E-01	U	1.0E-01	1.1E-01	U	1.1E-01
Crib SZ-07	J10F96	11/8/2005	3.7E-02	U	2.9E-01	3.3E-02	U	3.3E-02	3.5E-02	U	3.5E-02	1.2E-01	U	1.2E-01	1.3E-01	U	1.3E-01
Crib SZ-08	J10F97	11/8/2005	-4.9E-02	U	1.9E-01	7.2E-02		3.1E-02	4.6E-02	U	4.6E-02	1.2E-01	U	1.2E-01	6.7E-02	U	6.7E-02
Crib SZ-09	J10F98	11/8/2005	5.0E-02	U	3.8E-01	1.96E-01		5.1E-02	1.18E-01		4.9E-02	1.5E-01	U	1.5E-01	1.7E-01	U	1.7E-01
Crib SZ-10	J10F99	11/8/2005	2.5E-02	U	1.9E-01	4.06E-01		7.3E-02	7.3E-02	U	7.3E-02	1.9E-01	U	1.9E-01	1.3E-01	U	1.3E-01

NOTE: The following acronyms and abbreviations apply to all tables in this appendix.
HEIS = Hanford Environmental Information system PQL = practical quantitation limit J = estimated
MDA = minimum detectable activity Q = qualifier U = undetected D = diluted

Table A-1. Combined Crib and Trench Shallow Zone Cleanup Verification Data. (Sheet 2 of 2)

Sample Point	HEIS Number	Sample Date	Ni-63			Pu-239/240			Sr-90			Nitrate			Hg		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Trench SZ-01	J10FB0	11/9/2005	1.47E+00	UJ	2.6E+00	7.4E-02	U	1.9E-01	1.4E-02	U	6.5E-01	1.6E+00		2.1E-01	1.7E-02	U	1.7E-02
Trench SZ-08	J10FB7	11/8/2005	2.84E+00	UJ	3.7E+00	2.3E-02	U	1.7E-01	6.5E-02	U	2.5E-01	1.05E+00		2.2E-01	1.6E-02	U	1.6E-02
Trench SZ-09	J10FB8	11/8/2005	1.13E+00	UJ	2.3E+00	0	U	1.4E-01	6.7E-02	U	2.7E-01	5.74E+00		2.1E-01	1.6E-02	U	1.6E-02
Trench SZ-02	J10FB1	11/8/2005	4.63E-01	UJ	3.0E+00	4.7E-02	U	1.8E-01	1.35E-01	U	2.6E-01	3.38E-01		2.E-01	1.5E-02	U	1.5E-02
Trench SZ-10	J10FB9	11/8/2005	1.68E+00	UJ	2.7E+00	3.6E-02	U	1.4E-01	1.51E-01	U	2.5E-01	2.23E+00		2.2E-01	1.8E-02	U	1.8E-02
Trench SZ-03	J10FB2	11/8/2005	4.39E-01	UJ	3.7E+00	0	U	2.0E-01	9.5E-02	U	2.4E-01	1.84E+00		2.1E-01	1.6E-02	U	1.6E-02
Trench SZ-04	J10FB3	11/8/2005	6.11E-01	UJ	3.6E+00	0	U	1.8E-01	1.06E-01	U	2.4E-01	5.01E-01		2.E-01	1.6E-02	U	1.6E-02
Trench SZ-07	J10FB6	11/8/2005	1.16E+00	UJ	3.8E+00	0	U	1.8E-01	1.49E-01	U	2.5E-01	1.72E+01		4.3E-01	1.8E-02	U	1.8E-02
Trench SZ-06	J10FB5	11/8/2005	2.57E+00	UJ	3.0E+00	0	U	2.0E-01	-2.7E-02	U	3.0E-01	8.93E-01		2.1E-01	1.8E-02	U	1.8E-02
Trench SZ-05	J10FB4	11/8/2005	1.16E-01	UJ	2.3E+00	0	U	1.9E-01	9.0E-03	U	2.6E-01	1.39E+00		2.E-01	1.5E-02	U	1.5E-02
Duplicate of J10FB4	J10FC2	11/8/2005	4.75E-01	UJ	3.1E+00	0	U	2.1E-01	-3.1E-02	U	2.8E-01	1.7E+00		2.E-01	1.5E-02	U	1.5E-02
Split of J10FB4	J10FC5	11/8/2005	2.04E+00	U	6.95E+00	-2.34E-03	U	9.76E-02	1.34E-02	U	9.08E-02	3.6E+00		5.1E-01	1.E-02	B	8.00E-03
Equipment Blank	J10FC3	11/8/2005	2.2E+00	U	2.3E+00	0	U	2.2E-01	5.9E-02	U	2.9E-01	1.98E-01	U	2.E-01	1.50E-02	U	1.5E-02
Crib SZ-01	J10F90	11/8/2005	8.4E-01	UJ	4.1E+00	3.4E-02	U	2.6E-01	1.1E-01	U	2.5E-01	2.71E+01		1.1E+00	1.7E-02	U	1.7E-02
Crib SZ-02	J10F91	11/8/2005	-1.81E-01	UJ	3.0E+00	0	U	3.9E-01	-3.6E-02	U	2.8E-01	6.84E-01		2.E-01	1.6E-02	U	1.6E-02
Crib SZ-03	J10F92	11/8/2005	-5.2E-01	UJ	3.3E+00	2.5E-02	U	1.9E-01	-1.8E-02	U	2.2E-01	5.64E+00		2.1E-01	1.7E-02	U	1.7E-02
Crib SZ-04	J10F93	11/8/2005	6.99E-01	UJ	3.4E+00	3.7E-02	U	2.8E-01	6.38E-01		2.2E-01	7.78E+00		2.1E-01	1.8E-02	U	1.8E-02
Crib SZ-05	J10F94	11/8/2005	-7.94E-01	UJ	3.7E+00	0	U	2.5E-01	4.93E-01		2.2E-01	7.14E+00		2.1E-01	1.8E-02	U	1.8E-02
Duplicate of J10F94	J10FC0	11/8/2005	-2.15E+00	UJ	3.8E+00	0	U	8.8E-02	5.9E-01		1.9E-01	6.6E+00		2.2E-01	1.6E-02	U	1.6E-02
Split of J10F94	J10FC4	11/8/2005	2.75E+00	U	6.24E+00	-1.90E-03	U	7.94E-02	4.5E-01	U	9.79E-02	1.28E+01		2.2E+00	7.9E-03	U	8.E-03
Equipment Blank	J10FC1	11/8/2005	5.54E-01	U	3.3E+00	0	U	9.7E-02	1.7E-02	U	2.5E-01	1.96E-01	U	2.E-01	1.4E-02	U	1.4E-02
Crib SZ-06	J10F95	11/8/2005	7.8E-02	U	3.3E+00	1.9E-02	U	1.5E-01	1.41E-01	U	2.5E-01	7.27E+00		2.1E-01	1.5E-02	U	1.5E-02
Crib SZ-07	J10F96	11/8/2005	-1.07E+00	U	3.4E+00	0.E+00	U	9.9E-02	2.E-03	U	2.5E-01	1.74E+01		4.2E-01	1.3E-02	U	1.3E-02
Crib SZ-08	J10F97	11/8/2005	1.2E-01	U	3.3E+00	0.E+00	U	9.6E-02	3.4E-02	U	2.4E-01	3.02E+00		2.E-01	1.4E-02	U	1.4E-02
Crib SZ-09	J10F98	11/8/2005	8.53E-01	U	3.6E+00	4.5E-02	U	1.7E-01	9.3E-02	U	2.0E-01	1.09E+01		2.E-01	1.5E-02	U	1.5E-02
Crib SZ-10	J10F99	11/8/2005	-6.96E-01	U	3.2E+00	1.8E-02	U	1.4E-01	1.04E-01	U	2.1E-01	6.39E+00		2.3E-01	2.0E-02	U	2.E-02

Table A-2. Combined Crib and Trench Deep Zone Cleanup Verification Data. (Sheet 1 of 3)

Sample Point	HEIS Number	Sample Date	Am-241			Cs-137			Co-60			Eu-154			Eu-155		
			pCi/g	Q	PQL	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Trench DZ-02	J10FF1	11/9/2005	7.29E+00		5.2E-01	1.10E+03		2.2E+00	4.5E+00	U	4.5E+00	2.5E+00	U	2.5E+00	3.0E+00	U	3.0E+00
Trench DZ-01	J10FF0	11/9/2005	6.32E+01		4.0E-01	4.61E+03		4.6E+00	7.33E+02		2.2E+00	8.84E+00		4.2E+00	5.1E+00	U	5.1E+00
Trench DZ-03	J10FF2	11/9/2005	1.49E+02		4.7E-01	1.31E+04		6.5E+00	1.23E+03		3.2E+00	2.36E+01		6.9E+00	9.8E+00	U	9.8E+00
Trench DZ-04	J10FF3	11/10/2005	7.92E+01		3.1E-01	1.06E+04		4.0E+00	6.90E+02		8.3E-01	2.3E+01		2.8E+00	6.2E+00	U	6.2E+00
Trench DZ-05	J10FF4	11/10/2005	1.07E+00		2.3E-01	3.19E+02		6.9E-01	8.0E+00		2.3E-01	5.7E-01	U	5.7E-01	1.4E+00	U	1.4E+00
Duplicate of J10FF4	J10FC9	11/10/2005	1.1E+00		4.4E-01	3.36E+02		3.9E-01	9.34E+00		1.4E-01	3.7E-01	U	3.7E-01	1.1E+00	U	1.1E+00
Split of J10FF4	J10FH1	11/10/2005	1.66E+00		1.6E+00	3.52E+02		1.11E-01	1.08E+01		4.6E-02	3.33E-01	U	1.63E-01	1.38E-01	U	3.31E-01
Trench DZ-06	J10FF5	11/10/2005	4.58E+01		5.6E-01	4.11E+03		2.4E+00	2.89E+02		9.9E-01	7.25E+00		2.5E+00	4.2E+00	U	4.2E+00
Trench DZ-07	J10FF6	11/10/2005	7.38E+00		3.0E-01	3.84E+03		2.8E+00	5.98E+01		5.0E-01	2.45E+00		1.2E+00	3.8E+00	U	3.8E+00
Trench DZ-08	J10FF7	11/10/2005	1.53E-01	U	5.8E-01	2.99E+00		1.2E-01	1.7E-01	U	1.7E-01	3.2E-01	U	3.2E-01	3.0E-01	U	3.0E-01
Trench DZ-09	J10FF8	11/10/2005	5.15E+01		5.7E-01	2.16E+04		8.1E+00	5.77E+02		2.4E+00	1.82E+01		5.8E+00	1.2E+01	U	1.2E+01
Trench DZ-10	J10FF9	11/10/2005	1.03E+00		3.9E-01	9.47E+01		4.2E-01	1.43E+01		1.4E-01	6.3E-01	U	6.3E-01	6.1E-01	U	6.1E-01
Crib DZ-01	J10FD0	11/9/2005	1.4E+00		2.8E-01	8.65E+01		1.7E-01	6.55E+00		7.7E-02	3.1E-01	U	3.1E-01	5.6E-01	U	5.6E-01
Crib DZ-02	J10FD1	11/9/2005	2.3E+00		3.1E-01	3.14E+02		3.0E-01	1.05E+01		9.7E-02	2.6E-01	U	2.6E-01	1.0E+00	U	1.0E+00
Crib DZ-03	J10FD2	11/9/2005	3.81E+00		2.4E-01	3.10E-02	U	3.1E-02	3.5E-02	U	3.5E-02	8.9E-02	U	8.9E-02	6.0E-02	U	6.0E-02
Crib DZ-04	J10FD3	11/9/2005	3.72E+00		3.9E-01	2.18E+01		1.8E-01	1.47E+01		1.1E-01	2.9E-01	U	2.9E-01	4.4E-01	U	4.4E-01
Crib DZ-05	J10FD4	11/9/2005	2.66E+00		4.0E-01	3.45E+02		3.5E-01	2.45E+01		1.6E-01	4.5E-01	U	4.5E-01	7.9E-01	U	7.9E-01
Duplicate of J10FD4	J10FC8	11/9/2005	2.21E+00		3.8E-01	3.75E+02		3.3E-01	2.62E+01		1.3E-01	6.35E-01		3.2E-01	9.9E-01	U	9.9E-01
Split of J10FD4	J10FH0	11/9/2005	3.68E+00	U	1.66E+00	3.8E+02		1.18E-01	2.8E+01		4.73E-02	7.36E-01	U	1.85E-01	-1.83E-01	U	3.9E-01
Crib DZ-06	J10FD5	11/9/2005	3.57E+00		2.5E-01	4.28E+02		3.4E-01	2.65E+01		1.3E-01	1.78E+00		3.7E-01	1.0E+00	U	1.0E+00
Crib DZ-07	J10FD6	11/9/2005	1.06E+00		3.1E-01	1.1E+01		4.0E-02	2.02E+01		3.1E-02	2.21E-01		6.1E-02	1.14E-01		1.1E-01
Crib DZ-08	J10FD7	11/9/2005	3.12E-01	U	3.4E-01	5.6E+01		9.8E-02	2.14E+00		4.2E-02	1.1E-01	U	1.1E-01	3.3E-01	U	3.3E-01
Crib DZ-09	J10FD8	11/9/2005	0	U	4.3E-01	1.34E+01		2.5E-02	6.66E-01		2.1E-02	5.9E-02	U	5.9E-02	5.9E-02	U	5.9E-02
Crib DZ-10	J10FD9	11/9/2005	1.98E-01	U	3.0E-01	9.84E+01		1.9E-01	1.18E+01		9.9E-02	2.8E-01	U	2.8E-01	3.8E-01	U	3.8E-01

Table A-2. Combined Crib and Trench Deep Zone Cleanup Verification Data. (Sheet 2 of 3)

Sample Point	HEIS Number	Sample Date	Tritium			Ni-63			Pu-239/240			Sr-90		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Trench DZ-02	J10FF1	11/9/2005	6.16E+00		2.2E+00	4.37E+01		3.9E+00	9.98E+00		2.4E-01	6.55E+01		8.1E-01
Trench DZ-01	J10FF0	11/9/2005	2.04E+01		2.3E+00	2.87E+02		3.6E+00	8.04E+01		1.9E-01	5.58E+02		1.1E+00
Trench DZ-03	J10FF2	11/9/2005	3.03E+01		2.2E+00	7.88E+02		4.4E+00	1.54E+02		1.7E-01	1.26E+03		1.8E+00
Trench DZ-04	J10FF3	11/10/2005	5.11E+01		2.2E+00	3.18E+02		4.1E+00	7.81E+01		1.8E-01	2.11E+03		1.8E+00
Trench DZ-05	J10FF4	11/10/2005	8.8E+00		2.2E+00	2.25E+00	U	4.0E+00	9.97E-01		2.2E-01	2.37E+02		7.1E-01
Duplicate of J10FF4	J10FC9	11/10/2005	1.3E+01		2.7E+00	2.46E+00	U	3.9E+00	9.08E-01		2.2E-01	2.46E+02		1.1E+00
Split of J10FF4	J10FH1	11/10/2005	-6.33E-01	U	1.98E+00	4.44E-01	U	6.73E+00	3.25E+00	U	7.86E-01	3.40E+02		1.1E+00
Trench DZ-06	J10FF5	11/10/2005	1.68E+01		2.3E+00	2.25E+02		3.9E+00	5.14E+01		2.0E-01	1.47E+03		1.9E+00
Trench DZ-07	J10FF6	11/10/2005	2.3E+01		2.2E+00	2.85E+01		4.1E+00	7.62E+00		2.2E-01	2.02E+03		1.8E+00
Trench DZ-08	J10FF7	11/10/2005	2.41E+00		2.2E+00	1.67E+00	U	3.8E+00	8.2E-02	U	2.1E-01	8.09E+01		6.9E-01
Trench DZ-09	J10FF8	11/10/2005	3.27E+01		2.7E+00	1.94E+02		3.8E+00	1.01E+02		1.5E-01	1.75E+03		1.2E+00
Trench DZ-10	J10FF9	11/10/2005	3.27E+00		2.2E+00	6.5E+00		4.0E+00	1.1E+00		2.0E-01	1.17E+01		4.4E-01
Crib DZ-01	J10FD0	11/9/2005	3.23E-01	U	2.1E+00	6.87E+00		4.1E+00	1.69E+00		2.2E-01	2.86E+02		2.8E-01
Crib DZ-02	J10FD1	11/9/2005	3.11E+00		2.3E+00	1.38E+01		4.5E+00	2.49E+00		1.5E-01	9.12E+02		3.1E-01
Crib DZ-03	J10FD2	11/9/2005	2.4E+00		2.2E+00	1.7E+01		4.0E+00	4.28E+00		1.6E-01	1.80E+02		2.7E-01
Crib DZ-04	J10FD3	11/9/2005	1.04E+00	U	2.2E+00	9.41E+00		5.0E+00	3.81E+00		1.4E-01	1.23E+02		2.9E-01
Crib DZ-05	J10FD4	11/9/2005	5.83E+00		2.1E+00	3.47E+01		3.5E+00	3.74E+00		1.4E-01	1.50E+03		2.7E-01
Duplicate of J10FD4	J10FC8	11/9/2005	6.5E+00		2.1E+00	3.08E+01		3.9E+00	3.42E+00		1.7E-01	1.56E+03		2.8E-01
Split of J10FD4	J10FH0	11/9/2005	1.7E+00	U	1.8E+00	5.83E+01		3.25E+01	1.13E+01	U	1.7E+00	1.32E+03		1.77E+01
Crib DZ-06	J10FD5	11/9/2005	2.14E+00		2.1E+00	1.09E+01		5.2E+00	3.76E+00		1.5E-01	5.79E+01		2.8E-01
Crib DZ-07	J10FD6	11/9/2005	1.55E+00	U	2.2E+00	1.0E+01		5.6E+00	1.11E+00		1.9E-01	1.10E+02		2.7E-01
Crib DZ-08	J10FD7	11/9/2005	2.59E-01	U	2.1E+00	4.75E+00		3.2E+00	6.8E-01		1.5E-01	7.21E+01		3.1E-01
Crib DZ-09	J10FD8	11/9/2005	9.39E-01	U	2.1E+00	2.36E+00	U	5.6E+00	4.0E-02	U	1.5E-01	4.93E+01		3.5E-01
Crib DZ-10	J10FD9	11/9/2005	1.31E+00	U	2.2E+00	2.44E+00	U	4.2E+00	3.16E-01		1.4E-01	2.62E+02		2.9E-01

Table A-2. Combined Crib and Trench Deep Zone Cleanup Verification Data. (Sheet 3 of 3)

Sample Point	HEIS Number	Sample Date	Nitrate			Chromium			Hexavalent Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Trench DZ-02	J10FF1	11/9/2005	2.62E+00		2.3E-01	1.33E+01		5.8E-01	2.34E-01	U	2.3E-01
Trench DZ-01	J10FF0	11/9/2005	1.85E+01	D	1.E+00	1.26E+01		5.2E-01	2.09E-01	U	2.1E-01
Trench DZ-03	J10FF2	11/9/2005	2.12E-01	U	2.1E-01	7.9E+00		5.2E-01	2.13E-01	U	2.1E-01
Trench DZ-04	J10FF3	11/10/2005	1.34E+00		2.1E-01	1.41E+01		5.3E-01	2.12E-01	U	2.1E-01
Trench DZ-05	J10FF4	11/10/2005	1.95E+00		2.1E-01	7.6E+00		5.3E-01	2.86E-01		2.2E-01
Duplicate of J10FF4	J10FC9	11/10/2005	1.52E+00		2.1E-01	8.2E+00		5.2E-01	2.13E-01	U	2.1E-01
Split of J10FF4	J10FH1	11/10/2005	4.8E+00		5.1E-01	6.2E+00		7.5E-01	1.50E-01	U	1.5E-01
Trench DZ-06	J10FF5	11/10/2005	2.02E-01	U	2.E-01	6.4E+00		5.2E-01	2.4E-01		2.1E-01
Trench DZ-07	J10FF6	11/10/2005	4.29E+00		2.1E-01	9.E+00		5.3E-01	2.11E-01	U	2.1E-01
Trench DZ-08	J10FF7	11/10/2005	1.02E+02	D	2.1E+00	5.5E+00		5.3E-01	2.15E-01	U	2.2E-01
Trench DZ-09	J10FF8	11/10/2005	5.83E+01	D	2.3E+00	3.17E+01		5.8E-01	2.52E+00		2.3E-01
Trench DZ-10	J10FF9	11/10/2005	3.32E-01		2.1E-01	1.15E+01		5.4E-01	2.17E-01	U	2.2E-01
Crib DZ-01	J10FD0	11/9/2005	1.14E+00		2.E-01	4.5E+00		5.3E-01	2.09E-01	U	2.1E-01
Crib DZ-02	J10FD1	11/9/2005	1.02E+00		2.1E-01	1.23E+01		5.3E-01	1.03E+00		2.1E-01
Crib DZ-03	J10FD2	11/9/2005	3.44E-01		2.1E-01	5.3E+00		5.3E-01	2.10E-01	U	2.1E-01
Crib DZ-04	J10FD3	11/9/2005	2.07E-01	U	2.1E-01	5.8E+00		5.3E-01	2.11E-01	U	2.1E-01
Crib DZ-05	J10FD4	11/9/2005	1.22E+00		2.2E-01	2.21E+01		5.4E-01	2.96E+00		2.2E-01
Duplicate of J10FD4	J10FC8	11/9/2005	1.48E+00		2.1E-01	1.74E+01		5.2E-01	2.77E+00		2.1E-01
Split of J10FD4	J10FH0	11/9/2005	2.6E+00		5.1E-01	2.22E+01		7.5E-01	1.5E-01	U	1.5E-01
Crib DZ-06	J10FD5	11/9/2005	2.52E+00		2.1E-01	8.6E+00		5.2E-01	2.11E-01	U	2.1E-01
Crib DZ-07	J10FD6	11/9/2005	5.52E+00		2.1E-01	4.8E+00		5.2E-01	2.09E-01	U	2.1E-01
Crib DZ-08	J10FD7	11/9/2005	3.89E-01		2.1E-01	5.7E+00		5.3E-01	2.11E-01	U	2.1E-01
Crib DZ-09	J10FD8	11/9/2005	5.57E+00		2.3E-01	1.41E+01		5.8E-01	2.31E-01	U	2.3E-01
Crib DZ-10	J10FD9	11/9/2005	3.99E+00		2.3E-01	1.9E+01		5.6E-01	7.8E-01		2.3E-01

Table A-3. Overburden Cleanup Verification Data.

Sample Point	HEIS Number	Sample Date	Am-241			Cs-137			Co-60			Eu-154			Eu-155			Ni-63		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
OB-01	J015L1	12/1/2003	2.9E-02	U	1.1E-01	4.8E-01		2.7E-02	3.8E-02	U	3.8E-02	7.5E-02	U	7.5E-02	8.1E-02	U	8.1E-02	7.61E-01	U	2.1E+00
Duplicate of J015L1	J015M1	12/1/2003	4.3E-02	U	1.1E-01	5.2E-01		4.5E-02	1.3E-01		4.1E-02	1.2E-01	U	1.2E-01	1.2E-01	U	1.2E-01	3.64E-01	U	2.1E+00
Split of J015L1	J015M3	12/1/2003	6.6E-02	U	1.8E-01	5.8E-01		1.7E-02	1.3E-01		1.7E-02	-1.9E-02	U	5.5E-02	5.0E-02	U	4.8E-02	7.7E-01	U	6.4E+00
OB-02	J015L2	12/1/2003	-6.0E-02	U	1.2E-01	1.4E-01		2.9E-02	2.9E-02	U	2.9E-02	9.1E-02	U	9.1E-02	8.5E-02	U	8.5E-02	1.26E+00	U	2.1E+00
OB-03	J015L3	12/1/2003	1.5E-02	U	1.1E-01	1.3E+00		3.1E-02	2.4E-01		3.0E-02	8.5E-02	U	8.5E-02	6.3E-02	U	6.3E-02	1.91E+00	U	2.1E+00
OB-04	J015L4	12/1/2003	0.0E+00	U	1.3E-01	4.5E-01		2.8E-02	4.4E-02		2.9E-02	8.5E-02	U	8.5E-02	1.2E-01	U	1.2E-01	7.00E+00		2.0E+00
OB-05	J015L5	12/1/2003	4.7E-02	U	1.2E-01	3.6E+00		4.6E-02	2.5E-01		3.7E-02	1.2E-01	U	1.2E-01	1.4E-01	U	1.4E-01	2.42E-01	U	2.1E+00
OB-06	J015L6	12/1/2003	8.8E-02	U	1.1E-01	1.0E+00		3.8E-02	2.9E-01		3.7E-02	1.1E-01	U	1.1E-01	7.8E-02	U	7.8E-02	9.84E-01	U	2.2E+00
OB-07	J015L7	12/1/2003	1.4E-02	U	1.1E-01	5.1E-01		2.6E-02	3.1E-01		3.3E-02	8.1E-02	U	8.1E-02	6.5E-02	U	6.5E-02	3.81E+00		2.2E+00
OB-08	J015L8	12/1/2003	4.3E-02	U	1.1E-01	5.5E+00		7.1E-02	1.6E+00		4.4E-02	1.4E-01	U	1.4E-01	1.5E-01	U	1.5E-01	1.17E+00	U	2.2E+00
OB-09	J015L9	12/1/2003	3.4E-02	U	1.3E-01	2.3E-01		3.7E-02	3.5E-01		3.8E-02	1.1E-01	U	1.1E-01	7.1E-02	U	7.1E-02	4.22E-01	U	2.1E+00
OB-10	J015M0	12/1/2003	0.0E+00	U	1.3E-01	1.9E-01		2.8E-02	4.1E-02	U	4.1E-02	8.9E-02	U	8.9E-02	7.8E-02	U	7.8E-02	2.92E-01	U	2.1E+00

Sample Point	HEIS Number	Sample Date	Pu-239/240			Sr-total			Tritium			Nitrate			Mercury			Cr-total			Cr+6		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
OB-01	J015L1	12/1/2003	0.0E+00	U	2.8E-01	1.E-01	U	2.E-01	-7.6E-02	U	2.7E-01	2.3E+01		2.0E+00	1.E-02	U	1.E-02	1.56E+01		7.2E-01	2.2E-01	U	2.2E-01
Duplicate of J015L1	J015M1	12/1/2003	3.8E-02	U	2.9E-01	3.E-01		2.E-01	-4.0E-02	U	2.6E-01	2.4E+01		1.0E+00	1.E-02	U	1.E-02	1.36E+01		8.1E-01	2.6E-01		2.2E-01
Split of J015L1	J015M3	12/1/2003	0.0E+00	U	1.0E-01	1.1E+00		8.4E-01	5.1E-02		3.0E-02	2.7E+00		6.0E-02	1.8E-02	U	1.8E-02	1.1E+01		6.2E-02	3.5E-01	U	3.5E-01
OB-02	J015L2	12/1/2003	0.0E+00	U	2.8E-01	2.E-03	U	2.E-01	6.0E-02	U	2.6E-01	2.9E+00		1.9E-01	2.E-02	U	2.E-02	1.12E+01		7.9E-01	2.4E-01		2.1E-01
OB-03	J015L3	12/1/2003	0.0E+00	U	2.6E-01	2.E-01		2.E-01	5.0E-03	U	2.7E-01	1.7E+01		2.0E+00	1.E-02	U	1.E-02	1.31E+01		7.2E-01	2.2E-01	U	2.2E-01
OB-04	J015L4	12/1/2003	0.0E+00	U	2.6E-01	3.E-02	U	2.E-01	-6.9E-02	U	2.2E-01	4.9E-01		1.9E-01	1.E-02	U	1.E-02	7.80E+00		5.9E-01	3.5E-01		2.1E-01
OB-05	J015L5	12/1/2003	0.0E+00	U	2.1E-01	2.E-01		2.E-01	-1.0E-02	U	2.8E-01	8.6E+00		9.9E-01	2.E-02	U	2.E-02	1.33E+01		8.2E-01	2.2E-01	U	2.2E-01
OB-06	J015L6	12/1/2003	0.0E+00	U	2.9E-01	7.E-02	U	2.E-01	-7.9E-02	U	2.3E-01	8.6E+00		1.1E+00	2.E-02	U	2.E-02	1.09E+01		8.5E-01	2.2E-01	U	2.2E-01
OB-07	J015L7	12/1/2003	4.1E-02	U	3.2E-01	9.E-02	U	2.E-01	5.0E-03	U	2.4E-01	2.2E+00		1.9E-01	2.E-02	U	2.E-02	1.39E+01		7.6E-01	2.2E-01	U	2.2E-01
OB-08	J015L8	12/1/2003	6.2E-02	U	2.4E-01	1.E-01	U	2.E-01	-6.9E-02	U	2.6E-01	2.4E+01		1.1E+00	1.E-02	U	1.E-02	1.06E+01		7.9E-01	2.3E-01	U	2.3E-01
OB-09	J015L9	12/1/2003	3.6E-02	U	2.8E-01	5.E-02	U	2.E-01	-6.7E-02	U	2.7E-01	5.2E+00		1.9E-01	1.E-02	U	1.E-02	1.35E+01		8.4E-01	2.2E-01	U	2.2E-01
OB-10	J015M0	12/1/2003	0.0E+00	U	2.2E-01	-1.E-02	U	2.E-01	2.0E-02	U	2.6E-01	2.3E+00		2.0E-01	2.E-02	U	2.E-02	1.06E+01		8.2E-01	2.3E-01		2.2E-01

Table A-3. Land Bridge Shallow Zone Cleanup Verification Data.

Sample Point	HEIS Number	Sample Date	Am-241			Cs-137			Co-60			Eu-154			Eu-155			Ni-63			Pu-239/240		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
XW-1	J00WM8	8/13/2003	-3.2E-02	U	1.2E-01	3.6E-02	U	3.6E-02	3.5E-02	U	3.5E-02	1.1E-01	U	1.1E-01	8.3E-02	U	8.3E-02	3.65E-01	U	2.2E+00	5.E-02	U	3.4E-01
F01	J01Y88	10/19/2004	3.1E-02	U	2.3E-01	1.1E-01		6.3E-02	1.1E-01	U	1.1E-01	1.7E-01	U	1.7E-01	1.4E-01	U	1.4E-01	-1.06E-01	U	3.5E+00	9.E-02	U	1.7E-01
F02	J01Y89	10/19/2004	1.6E-01	U	2.4E-01	1.3E-01		2.1E-02	2.8E-01		2.2E-02	5.9E-02	U	5.9E-02	6.4E-02	U	6.4E-02	-1.84E+00	U	3.5E+00	2.E-02	U	1.8E-01
F03	J01Y90	10/19/2004	6.6E-02	U	2.5E-01	8.5E-01		4.5E-02	1.2E-01		4.2E-02	1.4E-01	U	1.4E-01	9.9E-02	U	9.9E-02	-3.22E+00	U	3.5E+00	-2.E-02	U	1.5E-01

Sample Point	HEIS Number	Sample Date	Sr-90			Tritium			Mercury			Nitrate		
			pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL
XW-1	J00WM8	8/13/2003	-3.2E-02	U	2.6E-01	-3.E-03	U	3.E-01	1.E-02	U	1.E-02	1.8E-01	U	2.E-01
F01	J01Y88	10/19/2004	-1.5E-02	U	2.9E-01	5.E-02	U	3.E-01	2.E-02	U	2.E-02	1.1E+00		2.E-01
F02	J01Y89	10/19/2004	1.4E-02	U	2.9E-01	1.E-01	U	3.E-01	2.E-02	U	2.E-02	6.9E-01		2.E-01
F03	J01Y90	10/19/2004	3.0E-01		2.5E-01	-8.E-02	U	3.E-01	2.E-02	U	2.E-02	8.3E-01		2.E-01

Table A-4. Land Bridge Deep Zone Cleanup Verification Data.

Sample Point	HEIS Number	Sample Date	Am-241			Cs-137			Co-60			Eu-154			Eu-155			Ni-63		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
XF-1	J00WN0	8/13/2003	6.29E+02		6.1E+00	9.6500E+04		3.1E+01	9.460E+03		1.5E+01	9.28E+01		2.4E+01	2.1E+01	U	2.1E+01	2.370E+03		5.2E+01

Sample Point	HEIS Number	Sample Date	Pu-239/240			Sr-90			Tritium			Cr			Cr+6			Nitrate		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
XF-1	J00WN0	8/13/2003	7.00E+02		2.6E+00	2.150E+03		1.9E+01	-3.66E+00	U	2.2E+01	9.1E+00	C	1.E-01	4.E-01	U	4.E-01	1.7E+00		2.E-01

APPENDIX B

DATA QUALITY ASSESSMENT

APPENDIX B

DATA QUALITY ASSESSMENT

B1.1 OVERVIEW

This data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications (DOE-RL 2001, 2002). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process. The DQA includes the review of the field logbook information (BHI 2003, 2005) to verify sample location, date, and time. The DQA involves the scientific and statistical evaluation of the data to determine if they are of the right type, quality, and quantity to support their intended use (i.e., closeout decisions [EPA 2000]).

This DQA was performed in accordance with WCH-EE-01, *Environmental Investigations Procedures.* Specific data quality objectives for the site are found in the *Sampling and Analysis Plan for the 100-NR-1 Treatment, Storage, and Disposal Units During Remediation and Closeout* (SAP) (DOE-RL 2002). The DQA is based on the guidelines presented in *Guidance for Data Quality Assessment* (EPA 2000). Statistical tests used in this DQA were performed as specified in the SAP (DOE-RL 2002) and the *Remedial Design Report/Remedial Action Work Plan for the 100-NR-1 Treatment, Storage, and Disposal Units* (DOE-RL 2001).

Prior to performing statistical tests, the field logbooks (BHI 2003, 2005), sample designs (Appendix C), and the analytical data are evaluated. A portion of the cleanup verification data are validated for compliance with quality assurance project plan requirements (DOE-RL 2002). Data evaluation is performed to determine if the laboratory carried out all steps required by the SAP and the laboratory contract governing the conduct of analysis and reporting of the data. This evaluation also examines the available laboratory data to determine if an analyte is present or absent in a sample and the degree of overall uncertainty associated with that determination. Data validation is done in accordance with validation procedures (BHI 2000a, 2000b) as part of data evaluation. After data evaluation and validation, the appropriate statistical test is performed on the adjusted raw analytical data (see calculation briefs in Appendix C) to determine statistical values for each contaminant.

The DQA for the 116-N-1 site determined that the data are of the right type, quality, and quantity to support site cleanup verification decisions within specified error tolerances. All analytical data were found to be acceptable for decision-making purposes. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. Additional quality requirements of the quality assurance (QA) project plan included data acquisition requirements. The cleanup verification sample analytical data are stored in the Hanford Environmental Information System (HEIS) and are summarized in Appendix A.

The following subsections describe the DQA results for the 116-N-1 site, including formal data validation, supplementary data evaluation, and field QA/quality control (QC) program results. The statistical evaluation of the data is provided in the calculation brief excerpts included in Appendix C.

B1.2 LABORATORY QUALITY MEASURES

All verification samples are subject to laboratory-specific QA requirements, including instrument procurement, maintenance, calibration, and operation. Additional laboratory requirements for internal QC checks are performed as appropriate for the analytical method at a rate of 1 per sample delivery group (SDG), or 1 in 20, whichever is more frequent. Laboratory internal QC checks include the following:

- Laboratory Contamination. Each analytical batch contains a laboratory (method) blank (material of similar composition as the samples with known/minimal contamination of the analytes of interest) carried through the complete analytical process. The method blank is used to evaluate false-positive results in samples due to contamination during handling at the laboratory.

- Analytical Accuracy. For most analyses, a known quantity of representative analytes of interest (matrix spike [MS]) is added to a separate aliquot of a sample from the analytical batch. The recovery percentage of the added MS is used to evaluate analytical accuracy. For analyses not amenable to MS techniques (e.g., gamma energy analysis) or where analytical recovery is corrected via internal standards (e.g., alpha spectral analyses), accuracy is evaluated from recovery of the QC reference sample (e.g., laboratory control spike or blank spike sample).

- Analytical Precision. Separate aliquots removed from the same sample container (replicate samples) are analyzed for each analytical batch. The replicate sample results (evaluated as relative percent differences [RPDs]) are used to assess analytical precision.

- QC reference samples. A QC reference sample is prepared from an independent standard at a concentration other than that used for calibration, but within the calibration range. Reference samples provide an independent check on analytical technique and methodology.

Laboratories are also subject to periodic and random assessments of the laboratory performance, systems, and overall program. These assessments are performed by the Washington Closure Hanford QA group to ensure that the laboratories are performing to meet laboratory contract requirements.

B1.3 DATA VALIDATION

After sampling was completed, all of the fixed-base laboratory data from one SDG, K0118, were validated by third-party validation to Level C per WCH-EE-01, *Environmental Investigations Procedures*, Procedure 2.5, "Data Package Validation Process." Level C validation procedures are specified in *Data Validation Procedure for Radiochemical Analysis* (BHI 2000b) and *Data Validation Procedure for Chemical Analysis* (BHI 2000a).

Under the Level C validation procedure, the following items were reviewed, as appropriate, for each analytical method (Tech Law 2006a, 2006b, 2006c):

- Sample holding times
- Method blanks
- MS recovery
- Surrogate recovery
- MS/MS duplicate results
- Sample replicates
- Associated batch laboratory control sample results
- Data package completeness
- Achievement of required (or contractual) detection limits (RDLs).

Data flagged as estimated (i.e., "J") indicate that the associated concentration is an estimate but that the data may be used for decision-making purposes. Data flagged as below detection limits (i.e., "U") indicate the contaminant was analyzed for but not detected and the concentration is below the minimum detectable activity (MDA) for radionuclides or the practical quantitation limit (PQL) (i.e., reporting limit) for nonradionuclides. For nonradionuclides, nondetects are reported as the PQL. For radionuclides, nondetects report the actual value obtained from analysis (positive or negative but less than the MDA) except for limited analyses where no value can be calculated. In these cases, the MDA is reported. This situation is applicable for sample results that are below detection limits. All other validated results are considered to be accurate within the standard errors associated with the methods.

The adequacy of laboratory QA/QC was evaluated for precision, accuracy, completeness, and target detection limits (TDLs) pursuant to the SAP (DOE-RL 2002). In the data validation it was reported that, of the data given formal validation, the laboratory met the standards for performance for precision (±30%), accuracy (±30%), and completeness (>90%). Comparison of the contract required detection limit (CRDL) (also known as the RDL) with the respective MDA or PQL is discussed in Section B1.4. The validated SDG K0118 contains 23 samples. A summary of deficiencies noted during validation of SDG K0118 follows.

B.1.3.1 Radiochemistry

The DQA noted no major deficiencies. Minor deficiencies noted during validation include the following:

- All holding times were acceptable.
- All preparation blank results were acceptable.
- Two equipment (field) blanks (J10FC1, J10FC3) were submitted with SDG K0118. No contaminants of concern (COCs) were detected in the equipment blanks.
- All MS recovery results were acceptable, except for the nickel-63 result. Nickel-63 was not included in the MSs. Because of the lack of MS analysis, all nickel-63 results in SDG K0118 were qualified as estimates and flagged "J."
- All laboratory duplicate results were acceptable.
- Two sets of field duplicates samples (J10FC0/J10F94 and J10FC2/J10FB4) were submitted in SDG K0118. If both sample and replicate activities (or concentrations in nonradiochemistry analyses) are greater than five times the CRDL and the RPD is less than the QC limit (30%), no qualification is required. All field duplicate results were acceptable.
- Reported analytical detection levels for undetected analytes are compared against the RDLs to ensure that laboratory detection levels meet the required criteria. Forty-one COCs exceeded the RDL. Under the Washington Closure Hanford statement of work, no qualification is required. Elevated cesium-137 levels caused the nondetected analyte quantitation limits to increase.
- The completion percentage was 100%. Data package completeness is based on the percentage of data determined to be valid (i.e., not rejected).

B.1.3.2 Inorganics

The DQA noted no major deficiencies. Observations noted during validation, including minor deficiencies, are as follows:

- All holding times were acceptable.
- All preparation blank results were acceptable.
- Two equipment (field) blanks (J10FC1, J10FC3) were submitted with SDG K0118. No COCs were detected in the equipment blanks.
- All MS recovery results were acceptable.

- All laboratory duplicate results were acceptable.
- Two sets of field duplicates samples (J10FC0/J10F94 and J10FC2/J10FB4) were submitted in SDG K0118. All field duplicate results were acceptable.
- Reported analytical detection levels are compared against the RDLs to ensure that laboratory detection levels meet the required criteria. All analytes met the RDL.
- The completion percentage was 100%. Data package completeness is based on the percentage of data determined to be valid (i.e., not rejected).

B.1.3.3 Wet Chemistry

The DQA noted no major or minor deficiencies. The following items are noted in the validation report:

- All holding times were acceptable.
- All preparation blank results were acceptable.
- Two equipment (field) blanks (J10FC1, J10FC3) were submitted with SDG K0118. No analytes were detected in the equipment blanks.
- All accuracy results were acceptable.
- All laboratory duplicate results were acceptable.
- Two sets of field duplicates samples (J10FC0/J10F94 and J10FC2/J10FB4) were submitted in SDG K0118. All field duplicate results were acceptable.
- Reported analytical detection levels are compared against the required quantitation limit to ensure that laboratory detection levels meet the required criteria. All analytes met the required quantitation limit.
- The completion percentage was 100%. Data package completeness is based on the percentage of data determined to be valid (i.e., not rejected).

B1.3 LABORATORY DATA EVALUATION

The formal data validation described in the previous section included evaluation of only one SDG (SDG K0118); however, DQA is required for all SDGs. Therefore, supplementary data evaluation was performed on the remaining SDGs. The following paragraphs include the results of the data evaluation of all SDGs.

To ensure adequate data quality, DQA investigators reviewed the objectives in the SAP (DOE-RL 2002) to determine the context for assessing the data. The context for

assessing the data includes evaluating the sample data using the statistical methodology of the SAP (included in the calculation brief excerpts in Appendix C) and a comparison of analytical results to the PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters as specified in the SAP (DOE-RL 2002). This section summarizes the results of the PARCC parameter comparison and presents an evaluation of the affected data.

- RDL Comparison: Reported analytical detection levels were compared to the RDLs (also referred to as CRDLs). When detected results are obtained, evaluation of detection limits is not performed. The data validation and supplemental data evaluation noted any analyses in which the detection limit (MDA or PQL) was above the RDLs for nondetected analytes.

  The reported MDA or PQL was above the RDL for the following COCs:

  - Americium-241: 0 of 25 nondetect results
  - Cesium-137: 0 of 8 nondetect results
  - Cobalt-60: 6 of 18 nondetect results
  - Europium-154: 30 of 35 nondetect results
  - Europium-155: 33 of 43 nondetect results
  - Nickel-63: 0 of 27 nondetect results
  - Plutonium-239/240: 0 of 24 nondetect results
  - Strontium-90: 0 of 19 nondetect results
  - Nitrate: 0 of 3 nondetect results
  - Mercury: 0 of 22 nondetect results.
  - Total chromium: 0 of 0 nondetect results
  - Hexavalent chromium: 0 of 15 nondetect results

The elevated MDAs observed for cobalt-60, europium-154, and europium-155 were the result of "dead time" in the detection method caused by elevated levels of cesium-137 that lowered the analytical sensitivity to these analytes.

Because all of the reported values for the MDAs and the PQLs for the nondetects for these COCs were less than the applicable remedial action goals (RAGs), the associated data are of sufficient quality for decision-making purposes (DOE-RL 2002).

All other nondetected analyses of COCs had detection limits below the RDL.

Precision and Accuracy Evaluation: Analytical accuracy and precision were evaluated by examination of the percent recovery and RPD between the main and duplicate samples, between the main and split samples, and between the main and the Washington State Department of Ecology (Ecology) split samples. Only the COCs detected at five times the detection limit (or greater) are used for data analysis with regards to accuracy and precision. The calculation of RPDs is included in the 95% upper confidence limit calculation briefs presented in Appendix C.

The RPDs for laboratory duplicates were within acceptable limits for all COCs.

The RPD for the laboratory splits were within acceptable limits for all COCs, except as follows:

- For the crib shallow zone analysis of the split samples, nitrate had an RPD of 56.8%.
- For the trench deep zone analysis of the split samples, strontium had an RPD of 35.7%.
- For the overburden (shallow zone) analysis of the split samples, total chromium had an RPD of 37.3%.

The RPD for the Ecology splits were within the acceptable limits for all COCs, except as follows:

- For the trench shallow zone analysis of the split samples, nitrate had an RPD of 60.6%.
- For the crib deep zone analysis of the split samples, strontium-90 had an RPD of 69.1%.
- For the trench deep zone analysis of the split samples, strontium-90, chromium (total), and nitrate had RPDs of 43.4%, 44.1%, and 90.7% respectively.

Also for americium-241 the laboratories generally use two analytical methods. The two methods include gamma spectroscopy identified in HEIS with the "GAMMA_GS" method name and an americium isotopic method identified in HEIS with the "AMCMISO_IE_PLATE_AEA" method name. When an americium-241 analysis is requested for a site in conjunction with a gamma-emitting radionuclide analysis, results from both methods are provided by the laboratory for americium-241. Both methods are equally suitable for analysis of americium-241. The results of the isotopic americium method were used for cleanup verification. Results from both methods are consistent and indicate very low levels of americium-241.

B1.4 FIELD QA/QC

Field QA/QC measures were used to assess potential sources of error and cross-contamination of soil samples that could bias results. Field QA/QC samples are summarized in Table B-1. All main and QA/QC sample results are presented in Appendix A.

Table B-1. Summary of Field Quality Control Samples.

Sample Area	Main Sample	Equipment Blank	Duplicate	Split	Ecology Split
Crib shallow zone	J10F94	J10FC1	J10FC0	J10FC4	NA
	J10F91	NA	NA	NA	WDOE-SZC-02
	J10F93	NA	NA	NA	WDOE-SZC-04
	J10F96	NA	NA	NA	WDOE-SZC-07
Trench shallow zone	J10FB4	J10FC3	J10FC2	J10FC5	NA
	J10FB0	NA	NA	NA	WDOE-SZT-01
	J10FB3	NA	NA	NA	WDOE-SZT-04
	J10FB6	NA	NA	NA	WDOE-SZT-07
Crib deep zone	J10FD4	NA	J10FC8	J10FH0	WDOE-DZC-05
	J10FD0	NA	NA	NA	WDOE-DZC-01
	J10FD9	NA	NA	NA	WDOE-DZC-10
Trench deep zone	J10FF4	NA	J10FC9	J10FH1	NA
	J10FF1	NA	NA	NA	WDOE-DZT-02
	J10FF6	NA	NA	NA	WDOE-DZT-07
	J10FF9	NA	NA	NA	WDOE-DZT-10
Land bridge shallow zone	J00WM8	NA	NA	NA	N1T-XW-1
	J01Y88	NA	NA	NA	WDOE-CSA-F01
	J01Y89	NA	NA	NA	WDOE-CSA-F02
	J01Y90	NA	NA	NA	WDOE-CSA-F03
Land bridge deep zone	J00WN0	NA	NA	NA	NA
Overburden	J015L1	NA	J015M1	JO15M3	N1-0B-01
	J015L2	NA	NA	NA	N1-0B-02
	J015L3	NA	NA	NA	N1-0B-03
	J015L4	NA	NA	NA	N1-0B-04
	J015L5	NA	NA	NA	N1-0B-05
	J015L6	NA	NA	NA	N1-0B-06
	J015L7	NA	NA	NA	N1-0B-07
	J105L8	NA	NA	NA	N1-0B-08
	J105L9	NA	NA	NA	N1-0B-09
	J105M0	NA	NA	NA	N1-0B-10

Ecology = Washington State Department of Ecology
NA = not applicable

B1.5.1 Equipment Blank Samples

Equipment blank samples were collected as part of the QA/QC measures for the 116-N-1 Crib, trench, land bridge and overburden. The blank sample results for this site were less than detection for all COCs.

B1.5.2 Field Duplicate Samples

Duplicate samples were collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the duplicate samples for each COC. Only analytes with values above five times the TDLs for both the main and duplicate samples are compared.

For field duplicate samples (J10FC0, J10FC8, J10FC2, J10FC9 and J015M1), none of the RPDs were greater than the control limit of 30%.

B1.5.3 Field Split Samples

Split samples were collected to provide a relative measure of the degree of variability in the sampling, sample handling, and analytical techniques used by commercial laboratories. The field main and split samples are evaluated by computing the RPD of the split samples for each COC to determine the usability of the verification data. The U.S. Environmental Protection Agency Contract Laboratory Program duplicate sample comparison methodology, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 1994), is used as an initial test of the data from the splits. The calculation of RPDs was made for analytes with determined concentrations above five times the TDLs or CRDL for both the main and split sample. Where the calculation of RPDs was not appropriate, the data has been evaluated and will be commented on in the following sections as needed.

For field split samples (J10FH0, J10FH1, J10FC4, J10FC5, and J015M1) two of the RPDs were greater than the control limit of +/-30%. J10FC4 exceeded this limit for nitrate in the crib shallow zone. J10FH1 exceeded the limit for strontium-90 for the trench deep zone. All other split RPDs were within the +/-30% range.

Field QA/QC sample results tend to suggest a degree of heterogeneity. Even distribution of the contaminants throughout the matrix is not likely to occur in nature and is difficult to achieve in prepared standard materials. Difficulty in producing truly homogeneous mixtures of soils is well known, and the lack of homogenous samples often times results in high RPDs. It is likely that more essentially inert material (e.g., larger size rocks or cobble) was present in one sample. As all values for nitrate were significantly below the RAGs by a larger amount than the potential heterogeneity in the samples, this does not effect the useability of the data. The RPD (35.7%) for strontium-90 was only slightly above 30% as is to be expected with the higher residual levels of

this COC in the deep zone. The 95% upper confidence limit value for strontium-90 in the deep zone is acceptable for the intended use of the data.

B1.5.4 Regulator Split Samples

In addition to the field split samples described above, Ecology split samples were collected for the 116-N-1 crib, trench, land bridge, and overburden.

The crib had Ecology splits for samples J10F91, J10F93, J10F96, J10FD4, J10FD0, and J10FD9. They were WDOE-SZC-02, WDOE-SZC-04, WDOE-SCZ-07, WDOE-DZC-05, WDOE-DZC-01, and WDOE-DZC-10, respectively.

The trench had Ecology splits for samples J10FB0, J10FB3, J10FB6, J10FF1, J10FF6, and J10FF9. They were WDOE-SZT-01, WDOE-SZT-04, WDOE-SZT-07, WDOE-DZT-02, WDOE-DZT-07, and WDOE-DZT-10, respectively.

The land bridge had Ecology splits for samples J00WM8, J01Y88, J01Y89, and J01J90. They were N1T-XW-1, WDOE-CSA-F01, WDOE-CSA-F02, and WDOE-CSA-F03, respectively.

The overburden had Ecology splits for samples J015L1, J015L2, J015L3, J015L4, J015L5, J015L6, J015L7, J015L8, J015L9, and J015M0. They were N1-OB-01, N1-OB-02, N1-OB-03, N1-OB-04, N1-OB-05, N1-OB-06, N1-OB-07, N1-OB-08, N1-OB-09, and N1-OB-10, respectively.

The U.S. Environmental Protection Agency Contract Laboratory Program duplicate sample comparison methodology, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 1994), is used as an initial test of the data from the splits. Three criteria are described in these guidelines:

1. If **both** main and split results are below detection, no further analysis is required.

2. If **both** main and split results are greater than five times the TDL, the RPD was computed. This RPD is compared to +/-35%. Where the calculation of RPDs was not appropriate, the data has been evaluated and commented on as needed.

3. If **either** the main or split result is greater than five times the TDL, then the difference is computed. This difference is compared to two times the TDL.

For Ecology splits, five of the RPDs were greater than the control of +/-35%:

- WDOE-DZC-10 and WDOE-DZT-07 exceeded the RPD for strontium-90 in the crib deep zone and the trench deep zone, respectively. The RPDs for strontium-90 for the other 10 Ecology split samples were acceptable.

- WDOE-DZT-10 exceeded the RPD for chromium in the trench deep zone.

- WDOE-SZT-07 and WDOE-DZT-10 exceeded the RPD for nitrate in the trench shallow zone and trench deep zone, respectively. The RPDs for nitrate for the other 10 Ecology splits samples were acceptable.

Field QA/QC sample results tend to suggest a degree of heterogeneity. Even distribution of the contaminants throughout the matrix is not likely to occur in nature and is difficult to achieve in prepared standard materials. Difficulty in producing truly homogeneous mixtures of soils is well known, and the lack of homogenous samples often times results in high RPDs. It is likely that more essentially inert material (e.g., larger size rocks or cobble) was present in one sample. As all values for nitrate were significantly below the RAGs by a larger amount than the potential heterogeneity in the samples, this does not effect the usability of the data. The RPDs for these two samples (43.4% and 69.1%) for strontium-90 are to be expected with the higher residual levels of this COC in the deep zone. The 95% upper confidence limit value for strontium-90 in the deep zone is acceptable for the intended use of the data. The RPDs for chromium were only exceeded in 1 sample (44.1%), and the other 11 sample RPDs were acceptable for chromium. Considering the heterogeneity of the sample, this single RPD exceeding the criteria does not effect the useability of the data.

B1.6 SUITABILITY OF DATA

The conclusion of the DQA is that the data are of the right type, quality, and quantity to support the intended use. Detection limits, precision, accuracy, and SDG completeness were analyzed to determine if any analytical results should be rejected as a result of QA/QC deficiencies. All COC analytical data were found to be acceptable for decision-making purposes, and the raw data are acceptable for calculating the required statistical values.

B2.0 REFERENCES

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APPENDIX C

RESRAD INPUT PARAMETERS AND CALCULATION BRIEF EXCERPTS

RESRAD INPUT PARAMETERS FOR THE 116-N-1 COMBINED CRIB AND TRENCH SHALLOW ZONE

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Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Eu-154	2.860E-04	2.860E-04	DCF2(5)
B-1	Eu-155	4.140E-05	4.140E-05	DCF2(6)
B-1	Ni-63	6.290E-06	6.290E-06	DCF2(7)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(8)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(9)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(10)
B-1	Pu-240	4.290E-01	4.290E-01	DCF2(11)
B-1	Ra-228+D	5.080E-03	5.080E-03	DCF2(12)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(13)
B-1	Th-228+D	3.450E-01	3.450E-01	DCF2(14)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(15)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(16)
B-1	U-233	1.350E-01	1.350E-01	DCF2(17)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(18)
B-1	U-236	1.250E-01	1.250E-01	DCF2(19)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Eu-154	9.550E-06	9.550E-06	DCF3(5)
D-1	Eu-155	1.530E-06	1.530E-06	DCF3(6)
D-1	Ni-63	5.770E-07	5.770E-07	DCF3(7)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(8)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(9)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(10)
D-1	Pu-240	3.540E-03	3.540E-03	DCF3(11)
D-1	Ra-228+D	1.440E-03	1.440E-03	DCF3(12)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(13)
D-1	Th-228+D	8.080E-04	8.080E-04	DCF3(14)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(15)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(16)
D-1	U-233	2.890E-04	2.890E-04	DCF3(17)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(18)
D-1	U-236	2.690E-04	2.690E-04	DCF3(19)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)

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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(3,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(3,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-34				
D-34	Eu-155 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,2)
D-34	Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,3)
D-34				
D-34	Ni-63 , plant/soil concentration ratio, dimensionless	5.000E-02	5.000E-02	RTF(7,1)
D-34	Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(7,2)
D-34	Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-02	2.000E-02	RTF(7,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(8,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(8,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(9,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(9,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(10,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(10,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(10,3)
D-34				
D-34	Pu-240 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
D-34	Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
D-34	Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(11,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(12,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(12,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(12,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(13,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(13,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(13,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(14,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(14,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(14,3)
D-34				

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Dose Conversion Factor (and Related) Parameter Summary (continued)
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Menu	Parameter	Current Value	Default	Parameter Name
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(15,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(15,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(15,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(16,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(16,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(16,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(17,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(17,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(17,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(18,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(18,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(18,3)
D-34				
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(19,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(19,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(19,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(3,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Eu-155 , fish	5.000E+01	5.000E+01	BIOFAC(6,1)
D-5	Eu-155 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	Ni-63 , fish	1.000E+02	1.000E+02	BIOFAC(7,1)
D-5	Ni-63 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(7,2)
D-5				
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(8,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(9,2)
D-5				
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(10,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(10,2)

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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
D-5	Pu-240 , fish	3.000E+01	3.000E+01	BIOFAC(11,1)
D-5	Pu-240 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(11,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(12,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(12,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(13,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(13,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(14,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(14,2)
D-5				
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(15,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(15,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(16,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(16,2)
D-5				
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(17,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(17,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(18,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(18,2)
D-5				
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(19,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(19,2)

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Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	3.601E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	4.600E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.200E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	2.500E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	7.000E+00	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.200E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	3.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.460E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	3.000E+02	0.000E+00	---	T(9)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	5.500E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Co-60	1.210E-01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	3.600E-01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Sr-90	1.800E-01	0.000E+00	---	S1(13)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(13)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	2.000E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	7.600E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	2.000E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ

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O Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R014	Water table drop rate (m/yr)	0.000E+00	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	1.790E+01	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	2.000E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	3.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.500E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.500E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.050E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	1.500E+01	3.000E+01	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	1.500E+01	3.000E+01	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	1.500E+01	3.000E+01	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.743E-04	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.316E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Eu-154				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Eu-155				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for daughter Ni-63				
R016	Contaminated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.884E-04	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.373E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter Pu-240				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.239E-04	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.448E-07	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.448E-07	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.088E-03	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R016	Distribution coefficients for daughter U-236				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(19)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(19,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(19)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(19)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(19)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.100E+01	FMEAT

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R018	Contamination fraction of milk	-1	-1	0.100E+01	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R198	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R198	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R198	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R198	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R198	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R198	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R198	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R198	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R198	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R198	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R198	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R198	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R198	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R198	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R198	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R198	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)

1RESRAD, Version 6.30 T½ Limit = 0.5 year 02/23/2006 13:41 Page 12
Summary : 116-N-1 RESRAD Evaluation of Combined Crib and Trench
File : 116-N-1_RESRAD_Shallow_Zone.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	64	---	---	NPTS
TITL	Maximum number of integration points for dose	5	---	---	LYMAX
TITL	Maximum number of integration points for risk	17	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

RESRAD INPUT PARAMETERS FOR THE 116-N-1 COMBINED CRIB AND TRENCH DEEP ZONE

1RESRAD, Version 6.30 T« Limit = 0.5 year 02/23/2006 12:48 Page 1
Summary : 116-N-1 Combined Crib and Trench Deep Zone RESRAD Evaluation
File : 116-N-1_RESRAD_Deep_Zone.RAD

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File : 116-N-1_RESRAD_Deep_Zone.RAD

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Eu-154	2.860E-04	2.860E-04	DCF2(5)
B-1	Eu-155	4.140E-05	4.140E-05	DCF2(6)
B-1	H-3	6.400E-08	6.400E-08	DCF2(7)
B-1	Ni-63	6.290E-06	6.290E-06	DCF2(8)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(9)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(10)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(11)
B-1	Pu-240	4.290E-01	4.290E-01	DCF2(12)
B-1	Ra-228+D	5.080E-03	5.080E-03	DCF2(13)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(14)
B-1	Th-228+D	3.450E-01	3.450E-01	DCF2(15)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(16)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(17)
B-1	U-233	1.350E-01	1.350E-01	DCF2(18)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(19)
B-1	U-236	1.250E-01	1.250E-01	DCF2(20)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Eu-154	9.550E-06	9.550E-06	DCF3(5)
D-1	Eu-155	1.530E-06	1.530E-06	DCF3(6)
D-1	H-3	6.400E-08	6.400E-08	DCF3(7)
D-1	Ni-63	5.770E-07	5.770E-07	DCF3(8)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(9)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(10)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(11)
D-1	Pu-240	3.540E-03	3.540E-03	DCF3(12)
D-1	Ra-228+D	1.440E-03	1.440E-03	DCF3(13)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(14)
D-1	Th-228+D	8.080E-04	8.080E-04	DCF3(15)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(16)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(17)
D-1	U-233	2.890E-04	2.890E-04	DCF3(18)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(19)
D-1	U-236	2.690E-04	2.690E-04	DCF3(20)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				

1RESRAD, Version 6.30 T« Limit = 0.5 year 02/23/2006 12:48 Page 3
Summary : 116-N-1 Combined Crib and Trench Deep Zone RESRAD Evaluation
File : 116-N-1_RESRAD_Deep_Zone.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(3,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(3,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-34				
D-34	Eu-155 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,2)
D-34	Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,3)
D-34				
D-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(7,1)
D-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(7,2)
D-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(7,3)
D-34				
D-34	Ni-63 , plant/soil concentration ratio, dimensionless	5.000E-02	5.000E-02	RTF(8,1)
D-34	Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(8,2)
D-34	Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-02	2.000E-02	RTF(8,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(9,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(9,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(10,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(10,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(10,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(11,3)
D-34				
D-34	Pu-240 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(12,1)
D-34	Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(12,2)
D-34	Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(12,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(13,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(13,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(13,3)
D-34				

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Summary : 116-N-1 Combined Crib and Trench Deep Zone RESRAD Evaluation
File : 116-N-1_RESRAD_Deep_Zone.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(14,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(14,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(14,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(15,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(15,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(15,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(16,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(16,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(16,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(17,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(17,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(17,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(18,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(18,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(18,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(19,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(19,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(19,3)
D-34				
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(20,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(20,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(20,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(3,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Eu-155 , fish	5.000E+01	5.000E+01	BIOFAC(6,1)
D-5	Eu-155 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC(7,1)
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(7,2)
D-5				

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Summary : 116-N-1 Combined Crib and Trench Deep Zone RESRAD Evaluation
File : 116-N-1_RESRAD_Deep_Zone.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
D-5	Ni-63 , fish	1.000E+02	1.000E+02	BIOFAC(8,1)
D-5	Ni-63 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(8,2)
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(9,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(9,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(10,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(10,2)
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(11,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(11,2)
D-5	Pu-240 , fish	3.000E+01	3.000E+01	BIOFAC(12,1)
D-5	Pu-240 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(12,2)
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(13,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(13,2)
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(14,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(14,2)
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(15,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(15,2)
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(16,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(16,2)
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(17,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(17,2)
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(18,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(18,2)
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(19,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(19,2)
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(20,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(20,2)

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Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	3.601E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.010E+01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.200E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	4.000E+00	2.500E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	7.000E+00	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.200E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	3.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.460E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	3.000E+02	0.000E+00	---	T(9)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	3.540E+01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Co-60	3.130E+02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	5.140E+03	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Eu-154	7.310E+00	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Eu-155	1.910E+00	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): H-3	1.600E+01	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): Ni-63	1.710E+02	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): Pu-239	3.340E+01	0.000E+00	---	S1(11)
R012	Initial principal radionuclide (pCi/g): Pu-240	8.000E+00	0.000E+00	---	S1(12)
R012	Initial principal radionuclide (pCi/g): Sr-90	9.310E+02	0.000E+00	---	S1(14)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Eu-154	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Eu-155	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): Ni-63	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(11)
R012	Concentration in groundwater (pCi/L): Pu-240	not used	0.000E+00	---	W1(12)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(14)
R013	Cover depth (m)	4.600E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	2.000E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	2.900E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	0.000E+00	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	7.800E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	2.000E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	3.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.500E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.500E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.050E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.138E-05	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.138E-05	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Eu-154				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Eu-155				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for H-3				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.562E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for Ni-63				
R016	Contaminated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.893E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for Pu-240				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	1.500E+01	3.000E+01	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	1.500E+01	3.000E+01	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	1.500E+01	3.000E+01	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.771E-05	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.834E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.214E-06	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.138E-05	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.696E-06	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for daughter Th-232				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.684E-04	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(19)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(19,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(19)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.684E-04	ALEACH(19)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(19)
R016	Distribution coefficients for daughter U-236				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(20)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(20,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(20)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.684E-04	ALEACH(20)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(20)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.100E+01	FMEAT
R018	Contamination fraction of milk	-1	-1	0.100E+01	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)

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Summary : 116-N-1 Combined Crib and Trench Deep Zone RESRAD Evaluation
File : 116-N-1_RESRAD_Deep_Zone.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Number of graphical time points	64	---	---	NPTS
TITL	Maximum number of integration points for dose	5	---	---	LYMAX
TITL	Maximum number of integration points for risk	17	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

RESRAD INPUT PARAMETERS FOR THE 116-N-1 EVALUATION OF OVERBURDEN FOR BACKFILL

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Summary : 116-N-1 RESRAD Evaluation of Overburden for Backfill
File : 116-N-1_Overburden_RESRAD_Calc_Brief.RAD

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Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Eu-154	2.860E-04	2.860E-04	DCF2(5)
B-1	Eu-155	4.140E-05	4.140E-05	DCF2(6)
B-1	Ni-63	6.290E-06	6.290E-06	DCF2(7)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(8)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(9)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(10)
B-1	Pu-240	4.290E-01	4.290E-01	DCF2(11)
B-1	Ra-228+D	5.080E-03	5.080E-03	DCF2(12)
B-1	Th-228+D	3.450E-01	3.450E-01	DCF2(13)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(14)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(15)
B-1	U-233	1.350E-01	1.350E-01	DCF2(16)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(17)
B-1	U-236	1.250E-01	1.250E-01	DCF2(18)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Eu-154	9.550E-06	9.550E-06	DCF3(5)
D-1	Eu-155	1.530E-06	1.530E-06	DCF3(6)
D-1	Ni-63	5.770E-07	5.770E-07	DCF3(7)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(8)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(9)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(10)
D-1	Pu-240	3.540E-03	3.540E-03	DCF3(11)
D-1	Ra-228+D	1.440E-03	1.440E-03	DCF3(12)
D-1	Th-228+D	8.080E-04	8.080E-04	DCF3(13)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(14)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(15)
D-1	U-233	2.890E-04	2.890E-04	DCF3(16)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(17)
D-1	U-236	2.690E-04	2.690E-04	DCF3(18)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)
D-34				

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Summary : 116-N-1 RESRAD Evaluation of Overburden for Backfill
File : 116-N-1_Overburden_RESRAD_Calc_Brief.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(3,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(3,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-34				
D-34	Eu-155 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,2)
D-34	Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,3)
D-34				
D-34	Ni-63 , plant/soil concentration ratio, dimensionless	5.000E-02	5.000E-02	RTF(7,1)
D-34	Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(7,2)
D-34	Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-02	2.000E-02	RTF(7,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(8,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(8,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(9,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(9,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(10,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(10,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(10,3)
D-34				
D-34	Pu-240 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
D-34	Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
D-34	Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(11,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(12,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(12,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(12,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(13,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(13,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(13,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(14,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(14,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(14,3)
D-34				

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Summary : 116-N-1 RESRAD Evaluation of Overburden for Backfill
File : 116-N-1_Overburden_RESRAD_Calc_Brief.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: NEAST 2001 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(15,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(15,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(15,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(16,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(16,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(17,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(17,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(17,3)
D-34				
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(18,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(18,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(18,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(3,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Eu-155 , fish	5.000E+01	5.000E+01	BIOFAC(6,1)
D-5	Eu-155 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	Ni-63 , fish	1.000E+02	1.000E+02	BIOFAC(7,1)
D-5	Ni-63 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(7,2)
D-5				
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(8,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(9,2)
D-5				
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(10,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(10,2)
D-5				
D-5	Pu-240 , fish	3.000E+01	3.000E+01	BIOFAC(11,1)
D-5	Pu-240 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(11,2)
D-5				

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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(12,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(12,2)
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(13,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(13,2)
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(14,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(14,2)
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(15,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(15,2)
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(16,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(16,2)
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(17,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(17,2)
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(18,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(18,2)

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.240E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	4.600E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.200E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	2.500E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	7.600E+00	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.400E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	4.200E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.370E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	3.000E+02	0.000E+00	---	T(9)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	4.200E-02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Co-60	5.500E-01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.200E+00	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Eu-154	2.200E-02	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Eu-155	1.700E-03	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Ni-63	2.870E+00	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): Pu-239	2.200E-03	0.000E+00	---	S1(10)
R012	Initial principal radionuclide (pCi/g): Pu-240	5.000E-04	0.000E+00	---	S1(11)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Eu-154	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Eu-155	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Ni-63	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(10)
R012	Concentration in groundwater (pCi/L): Pu-240	not used	0.000E+00	---	W1(11)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	2.000E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	7.600E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R014	Density of saturated zone (g/cm**3)	2.000E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	0.000E+00	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	1.790E+01	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	2.000E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	3.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.500E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.500E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.050E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Eu-154				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Eu-155				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Ni-63				
R016	Contaminated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.884E-04	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for Pu-240				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.316E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.373E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.239E-04	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.448E-07	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for daughter Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.448E-07	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.088E-03	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for daughter U-236				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.620E+00	FMEAT

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R018	Contamination fraction of milk	-1	-1	0.620E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)

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Summary : 116-N-1 RESRAD Evaluation of Overburden for Backfill
File : 116-N-1_Overburden_RESRAD_Calc_Brief.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	1	---	---	LYMAX
TITL	Maximum number of integration points for risk	5	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

RESRAD INPUT PARAMETERS FOR THE 116-N-1 TRENCH LANDBRIDGE SHALLOW ZONE

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File : 116-N-1_Backfill_RESRAD_Shallow.RAD

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Eu-154	2.860E-04	2.860E-04	DCF2(5)
B-1	Eu-155	4.140E-05	4.140E-05	DCF2(6)
B-1	Ni-63	6.290E-06	6.290E-06	DCF2(7)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(8)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(9)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(10)
B-1	Pu-240	4.290E-01	4.290E-01	DCF2(11)
B-1	Ra-228+D	5.080E-03	5.080E-03	DCF2(12)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(13)
B-1	Th-228+D	3.450E-01	3.450E-01	DCF2(14)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(15)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(16)
B-1	U-233	1.350E-01	1.350E-01	DCF2(17)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(18)
B-1	U-236	1.250E-01	1.250E-01	DCF2(19)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Eu-154	9.550E-06	9.550E-06	DCF3(5)
D-1	Eu-155	1.530E-06	1.530E-06	DCF3(6)
D-1	Ni-63	5.770E-07	5.770E-07	DCF3(7)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(8)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(9)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(10)
D-1	Pu-240	3.540E-03	3.540E-03	DCF3(11)
D-1	Ra-228+D	1.440E-03	1.440E-03	DCF3(12)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(13)
D-1	Th-228+D	8.080E-04	8.080E-04	DCF3(14)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(15)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(16)
D-1	U-233	2.890E-04	2.890E-04	DCF3(17)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(18)
D-1	U-236	2.690E-04	2.690E-04	DCF3(19)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)

1RESRAD, Version 6.22 T½ Limit = 0.5 year 12/03/2004 14:10 Page 3
Summary : 116-N-1 RESRAD Evaluation of Land Bridge for Backfill Concurrence
File : 116-N-1_Backfill_RESRAD_Shallow.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(3,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(3,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-34				
D-34	Eu-155 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,2)
D-34	Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,3)
D-34				
D-34	Ni-63 , plant/soil concentration ratio, dimensionless	5.000E-02	5.000E-02	RTF(7,1)
D-34	Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(7,2)
D-34	Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-02	2.000E-02	RTF(7,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(8,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(8,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(9,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(9,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(10,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(10,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(10,3)
D-34				
D-34	Pu-240 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
D-34	Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
D-34	Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(11,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(12,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(12,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(12,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(13,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(13,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(13,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(14,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(14,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(14,3)
D-34				

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File : 116-N-1_Backfill_RESRAD_Shallow.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(15,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(15,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(15,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(16,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(16,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(16,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(17,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(17,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(17,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(18,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(18,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(18,3)
D-34				
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(19,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(19,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(19,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(3,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Eu-155 , fish	5.000E+01	5.000E+01	BIOFAC(6,1)
D-5	Eu-155 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	Ni-63 , fish	1.000E+02	1.000E+02	BIOFAC(7,1)
D-5	Ni-63 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(7,2)
D-5				
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(8,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(9,2)
D-5				
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(10,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(10,2)

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Summary : 116-N-1 RESRAD Evaluation of Land Bridge for Backfill Concurrence
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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
D-5	Pu-240 , fish	3.000E+01	3.000E+01	BIOFAC(11,1)
D-5	Pu-240 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(11,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(12,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(12,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(13,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(13,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(14,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(14,2)
D-5				
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(15,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(15,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(16,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(16,2)
D-5				
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(17,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(17,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(18,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(18,2)
D-5				
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(19,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(19,2)

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Summary : 116-N-1 RESRAD Evaluation of Land Bridge for Backfill Concurrence
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Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.240E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	4.600E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.200E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	2.500E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	7.600E+00	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.400E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	4.200E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.370E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	3.000E+02	0.000E+00	---	T(9)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Co-60	2.100E-01	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	5.900E-01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Ni-63	1.540E-01	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): Sr-90	1.900E-01	0.000E+00	---	S1(13)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Ni-63	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(13)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	2.000E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	7.600E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	2.000E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ

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Summary : 116-N-1 RESRAD Evaluation of Land Bridge for Backfill Concurrence
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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Water table drop rate (m/yr)	0.000E+00	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	1.790E+01	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	2.000E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	3.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.500E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.500E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.050E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Ni-63				
R016	Contaminated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.884E-04	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	1.500E+01	3.000E+01	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	1.500E+01	3.000E+01	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	1.500E+01	3.000E+01	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.743E-04	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.316E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for daughter Eu-154				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Eu-155				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.373E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter Pu-240				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.239E-04	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.448E-07	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.341E-05	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.448E-07	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.088E-03	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R016	Distribution coefficients for daughter U-236				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(19)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(19,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(19)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.733E-04	ALEACH(19)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(19)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.620E+00	FMEAT

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Summary : 116-N-1 RESRAD Evaluation of Land Bridge for Backfill Concurrence
File : 116-N-1_Backfill_RESRAD_Shallow.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Contamination fraction of milk	-1	-1	0.620E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	1	---	---	LYMAX
TITL	Maximum number of integration points for risk	5	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

RESRAD INPUT PARAMETERS FOR THE 116-N-1 TRENCH LANDBRIDGE DEEP ZONE

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Summary : 116-N-1 Backfill Concurrence Deep Zone
File : 116-N-1_Backfill_RESRAD_DeepZone.RAD

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Summary : 116-N-1 Backfill Concurrence Deep Zone
File : 116-N-1_Backfill_RESRAD_DeepZone.RAD

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Eu-154	2.860E-04	2.860E-04	DCF2(5)
B-1	Eu-155	4.140E-05	4.140E-05	DCF2(6)
B-1	H-3	6.400E-08	6.400E-08	DCF2(7)
B-1	Ni-63	6.290E-06	6.290E-06	DCF2(8)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(9)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(10)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(11)
B-1	Pu-240	4.290E-01	4.290E-01	DCF2(12)
B-1	Ra-228+D	5.080E-03	5.080E-03	DCF2(13)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(14)
B-1	Th-228+D	3.450E-01	3.450E-01	DCF2(15)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(16)
B-1	Th-232	1.640E+00	1.640E+00	DCF2(17)
B-1	U-233	1.350E-01	1.350E-01	DCF2(18)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(19)
B-1	U-236	1.250E-01	1.250E-01	DCF2(20)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Eu-154	9.550E-06	9.550E-06	DCF3(5)
D-1	Eu-155	1.530E-06	1.530E-06	DCF3(6)
D-1	H-3	6.400E-08	6.400E-08	DCF3(7)
D-1	Ni-63	5.770E-07	5.770E-07	DCF3(8)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(9)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(10)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(11)
D-1	Pu-240	3.540E-03	3.540E-03	DCF3(12)
D-1	Ra-228+D	1.440E-03	1.440E-03	DCF3(13)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(14)
D-1	Th-228+D	8.080E-04	8.080E-04	DCF3(15)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(16)
D-1	Th-232	2.730E-03	2.730E-03	DCF3(17)
D-1	U-233	2.890E-04	2.890E-04	DCF3(18)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(19)
D-1	U-236	2.690E-04	2.690E-04	DCF3(20)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				

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Summary : 116-N-1 Backfill Concurrence Deep Zone
File : 116-N-1_Backfill_RESRAD_DeepZone.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(3,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(3,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(5,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(5,3)
D-34				
D-34	Eu-155 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(6,2)
D-34	Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,3)
D-34				
D-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(7,1)
D-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(7,2)
D-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(7,3)
D-34				
D-34	Ni-63 , plant/soil concentration ratio, dimensionless	5.000E-02	5.000E-02	RTF(8,1)
D-34	Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(8,2)
D-34	Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-02	2.000E-02	RTF(8,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(9,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(9,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(10,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(10,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(10,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(11,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(11,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(11,3)
D-34				
D-34	Pu-240 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(12,1)
D-34	Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(12,2)
D-34	Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(12,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(13,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(13,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(13,3)
D-34				

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Summary : 116-N-1 Backfill Concurrence Deep Zone
File : 116-N-1_Backfill_RESRAD_DeepZone.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(14,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(14,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(14,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(15,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(15,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(15,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(16,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(16,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(16,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(17,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(17,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(17,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(18,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(18,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(18,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(19,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(19,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(19,3)
D-34				
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(20,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(20,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(20,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(3,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Eu-155 , fish	5.000E+01	5.000E+01	BIOFAC(6,1)
D-5	Eu-155 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC(7,1)
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(7,2)
D-5				

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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: HEAST 2001 Morbidity

Menu	Parameter	Current Value	Default	Parameter Name
D-5	Ni-63 , fish	1.000E+02	1.000E+02	BIOFAC(8,1)
D-5	Ni-63 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(8,2)
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(9,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(9,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(10,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(10,2)
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(11,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(11,2)
D-5	Pu-240 , fish	3.000E+01	3.000E+01	BIOFAC(12,1)
D-5	Pu-240 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(12,2)
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(13,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(13,2)
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(14,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(14,2)
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(15,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(15,2)
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(16,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(16,2)
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(17,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(17,2)
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(18,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(18,2)
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(19,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(19,2)
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(20,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(20,2)

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Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.240E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.010E+01	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	1.200E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	4.000E+00	2.500E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	7.600E+00	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.400E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	4.200E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.370E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	3.000E+02	0.000E+00	---	T(9)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	6.290E+02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Co-60	9.460E+03	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	9.650E+04	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Eu-154	9.280E+01	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Ni-63	2.370E+03	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): Pu-239	5.649E+02	0.000E+00	---	S1(11)
R012	Initial principal radionuclide (pCi/g): Pu-240	1.351E+02	0.000E+00	---	S1(12)
R012	Initial principal radionuclide (pCi/g): Sr-90	2.150E+03	0.000E+00	---	S1(14)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Eu-154	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Ni-63	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(11)
R012	Concentration in groundwater (pCi/L): Pu-240	not used	0.000E+00	---	W1(12)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(14)
R013	Cover depth (m)	4.600E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	1.500E+00	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	2.000E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Density of saturated zone (g/cm**3)	2.900E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	0.000E+00	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	7.800E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	2.000E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	3.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.500E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.500E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.050E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.138E-05	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	5.000E+01	1.000E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.138E-05	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Eu-154				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	8.249E+02	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	8.249E+02	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.913E-07	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Ni-63				
R016	Contaminated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	3.000E+01	1.000E+03	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.893E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for Pu-240				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	1.500E+01	3.000E+01	---	DCNUCC(14)
R016	Unsaturated zone 1 (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCU(14,1)
R016	Saturated zone (cm**3/g)	1.500E+01	3.000E+01	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.771E-05	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.834E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Eu-155				
R016	Contaminated zone (cm**3/g)	2.000E+02	-1.000E+00	8.249E+02	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	2.000E+02	-1.000E+00	8.249E+02	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.913E-07	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for daughter H-3				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.562E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.214E-06	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.138E-05	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	1.000E+02	7.000E+01	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.696E-06	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.505E-09	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for daughter Th-232				
R016	Contaminated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	2.000E+02	6.000E+04	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.850E-06	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.138E-05	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)

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Summary : 116-N-1 Backfill Concurrence Deep Zone
File : 116-N-1_Backfill_RESRAD_DeepZone.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(19)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(19,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(19)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.684E-04	ALEACH(19)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(19)
R016	Distribution coefficients for daughter U-236				
R016	Contaminated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCC(20)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(20,1)
R016	Saturated zone (cm**3/g)	2.000E+00	5.000E+01	---	DCNUCS(20)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.684E-04	ALEACH(20)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(20)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)

1RESRAD, Version 6.22 T½ Limit = 0.5 year 12/03/2004 13:38 Page 11
Summary : 116-N-1 Backfill Concurrence Deep Zone
File : 116-N-1_Backfill_RESRAD_DeepZone.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	5.400E+00	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.620E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.620E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL

1RESRAD, Version 6.22 T½ Limit = 0.5 year 12/03/2004 13:38 Page 12
Summary : 116-N-1 Backfill Concurrence Deep Zone
File : 116-N-1_Backfill_RESRAD_DeepZone.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	not used	8.894E+01	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DHFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	1	---	---	LYMAX
TITL	Maximum number of integration points for risk	5	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

CALCULATION BRIEF EXCERPTS

DISCLAIMER FOR CALCULATIONS

The calculations that are provided in the following appendix have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents in the administrative record.

CALCULATION BRIEFS

The following calculation briefs have been prepared in accordance with WCH-DE-01, *Design Engineering Procedures Manual*, EDPI-4.37-01, "Project Calculations," Washington Closure Hanford, Richland, Washington.

116-N-1 Combined Crib and Trench Cleanup Verification 95% UCL Calculation, Calculation No. 0100N-CA-V0087, Rev. 1, Washington Closure Hanford, Richland, Washington.

116-N-1 Combined Crib and Trench Cleanup Verification RESRAD Calculation, Calculation No. 0100N-CA-V0088, Rev. 1, Washington Closure Hanford, Richland, Washington.

Shallow and Deep Zone Sample Design for the 116-N-1 Trench and Crib, Calculation No. 0100N-CA-V0085, Rev. 0, Washington Closure Hanford, Richland, Washington.

116-N-1 Overburden Verification 95% UCL Calculation, Calculation No. 0100N-CA-V0076, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

116-N-1 Evaluation of Overburden for Backfill, Calculation No. 0100N-CA-V0077, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Cleanup Verification Sampling of Overburden from the 116-N-1 Trench, Calculation No. 0100N-CA-V0070, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

116-N-1 Trench Landbridge Cleanup Verification 95% UCL Calculation, Calculation No. 0100N-CA-V0078, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

116-N-1 Trench Landbridge RESRAD Calculation, Calculation No. 0100N-CA-V0079, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

NOTE: The calculation briefs referenced in this appendix are kept in the active Environmental Restoration Contractor project files and are available upon request. When the project is completed, the files will be stored in a U.S. Department of Energy, Richland Operations Office repository. Only excerpts of the calculation briefs are included in this appendix.

CALCULATION COVER SHEET

Project Title:	100-NR-1 TSD Site Remedial Action Project	**Job No.**	14655
Area	100-N		
Discipline	Environmental	***Calc. No.**	0100N-CA-V0087
Subject	116-N-1 Combined Crib and Trench Cleanup Verification 95% UCL Calculation		
Computer Program	Excel	**Program No.**	Excel 2003

The attached calculations have been generated to document compliance with established cleanup levels. These documents should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation [X] **Preliminary** [ ] **Superseded** [ ] **Voided** [ ]

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 9 Total = 10	*Approved* *2/27/2006* W. S. Thompson	*Approved* *2/27/2006* J.M. Capron	*Approved* *2/27/2006* T.M. Blakley	*Approved* *2/27/2006* S.E. Parnell	*2/27/2006*
1	Cover = 1 Sheets = 9 Total = 10	3/29/06 W. S. Thompson	3/29/06 J.M. Capron	3/29/06 T.M. Blakley	S.E. Parnell	3/29/06

SUMMARY OF REVISIONS

1	Cover page replaced for convenience. Page 2: Removed "**" notation in line 17 for hexavalent chromium. Page 3: Added footnotes b and c to address Ecology comments. Changed "NA" to "NO" for 3-Part test entries for nitrate. Edited text for 3 part compliance for nitrate and mercury to incorporate Ecology comments. Page 5: Added footnotes b and c to address Ecology comments. Page 6: Corrected data entered in lines 24 through 43 for chromium in the deep zone. Corrected entries for statistical parameters in lines 27 through 32.

* Obtain calc no. from DIS

DE01437.03 (12/09/2004)

Washington Closure Hanford — **CALCULATION SHEET**

Originator W. S. Thompson — Date 02/27/06 — Calc. No. 0100N-CA-V0087 — Rev. No. 0
Project 100-NR-1 TSD Site Remedial Action Project — Job No. 14655 — Checked J.M. Capron — Date 2/27/06
Subject 116-N-1 Combined Crib and Trench Cleanup Verification 95% UCL Calculation — Sheet No. 1 of 9

Purpose:
Calculate the 95% upper confidence limit (UCL) to evaluate compliance with cleanup standards for the subject site. Also, calculate the carcinogenic risk for applicable nonradionuclide analytes, perform the *Washington Administrative Code* (WAC) 173-340 (Model Toxics Control Act [MTCA]) 3-part test, if required, and calculate the relative percent difference (RPD) for each contaminant of concern (COC).

Table of Contents:
Sheets 1 to 2 - Calculation Sheets Summary
Sheet 3 - Calculation Sheet Shallow Zone Verification
Sheet 4 to 5 - Calculation Sheets Deep Zone Verification
Sheet 6 - Ecology Software (MTCAStat) Results
Sheet 7 - Calculation Sheet Split-Duplicate Analysis
Sheet 8 to 9 - Calculation Sheets WDOE Splits

Given/References:
1) Sample Results.
2) All lookup values and remedial action goals (RAGs) are taken from DOE-RL (2001b), Ecology (1996) and DOE-RL(2001a).
3) DOE-RL, 2001a, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, DOE/RL-92-24, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) DOE-RL, 2001b, *Remedial Design Report/Remedial Action Work Plan (RDR/RAWP) for the 100 Area Treatment, Storage, and Disposal Units*, DOE/RL-2000-16, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
5) DOE-RL, 2002, *Sampling and Analysis Plan (SAP) for the 100-NR-1Treatment, Storage, and Disposal Units During Remediation and Closeout*, DOE/RL-2000-07, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
6) Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Publication #92-54, Washington State Department of Ecology, Olympia, Washington.
7) Ecology, 1993, *Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-Detection Limit or Below-PQL Values (Censored Data Sets)*, Publication #92-54, Washington State Department of Ecology, Olympia, Washington.
8) Ecology, 1996, Model Toxics Control Act Cleanup Levels and Risk Calculations (CLARC II), Publication #94-145, Washington State Department of Ecology, Olympia, Washington.
9) EPA, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013, U.S. Environmental Protection Agency, Washington, D.C.
10) WAC 173-340, 1996, "Model Toxics Control Act--Cleanup," *Washington Administrative Code*.

Solution:
Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 2001). Use data from the attached worksheets to calculate the 95% UCL for each analyte, hazard quotients, excess carcinogenic risk, perform the WAC 173-340 3-part test for nonradionuclides, and calculate the RPD for each COC in the primary-duplicate and primary-split sample pairs.

Calculation Description:
The subject calculations were performed on data from soil verification samples from waste site 116-N-1 Trench and Crib. The data were entered into an EXCEL 2003 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2001) is documented by this calculation. Split and duplicate RPD results are used in evaluation of data quality and are presented in the cleanup verification package (CVP) for this site.

Methodology:
For nonradioactive analytes with <50% of the data below detection limits and all radionuclide analytes, the statistical value calculated to evaluate the effectiveness of cleanup is the 95% UCL. For nonradioactive analytes with >50% of the data below detection limits, the maximum value for the data set is used instead of the 95% UCL. All nonradionuclide data reported as being below detection limits are set to ½ the detection limit value for calculation of the statistics (Ecology 1993). For radionuclide data, calculation of the statistics was done on the reported value. In cases where the laboratory does not report a value below the minimal detectable activity (MDA), half of the MDA is used in the calculation. For the statistical evaluation of primary-duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above.

For nonradionuclides, the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data and the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets ($n < 10$) and all radionuclide data sets, the calculations are performed assuming nonparametric distribution, so no test for distribution is performed. For nonradionuclide data sets of ten or greater, distributional testing is done using Ecology's MTCAStat software (Ecology 1993).

The estimated hazard quotient (for shallow zone nonradionuclide COCs) is determined by dividing the statistical value (derived in this calculation) by the WAC 173-340 non-carcinogenic cleanup limit. The excess nonradionuclide carcinogenic risk is determined by dividing the statistical value by the WAC 173-340 carcinogenic cleanup limit and then multiplying by 10^{-6}. For data sets where all values are below detection, neither of these calculations are required.

The WAC 173-340-740(7)(a) 3-part test is performed for nonradionuclide analytes only and determines if:
1) the 95% UCL value exceeds the most stringent cleanup limit for each nonradionuclide COC,
2) greater than 10% of the raw data exceed the most stringent cleanup limit for each nonradionuclide COC,
3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each nonradionuclide COC.

The RPD is calculated when both the primary value and either the duplicate or split values are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method, listed in Table II-1 of the SAP (DOE-RL 2002). The RPD calculations use the following formula:
RPD =[|M-S|/((M+S)/2)]*100

where, M = Main Sample Value S = Split (or duplicate) Sample Value

For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than +/- 30% indicates the data compare favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. Additional discussion as necessary is provided in the data quality assessment section of the applicable CVP.

If regulator split comparison is required, an additional parameter is evaluated. A control limit of +/- 2 times the TDL shall be used if either the main or regulator split value is less than 5 times the TDL and above detection. In the case where only one result is greater than 5 times the TDL and the other is below, the +/- 2 times the TDL criteria applies. Therefore, the following calculation is performed as part of the evaluation for these two cases involving regulator split data: difference = main - regulator split. If the difference is greater than +/- 2 times the TDL, then further investigation regarding the usability of the data is performed and presented in the applicable CVP data quality assessment section.

Washington Closure Hanford

CALCULATION SHEET

Originator W. S. Thompson Date 03/29/06 Calc. No. 0100N-CA-V0087
Project 100-NR-1 TSD Site Remedial Action Project Job No. 14655 Checked J.M. Capron
Subject 116-N-1 Combined Crib and Trench Cleanup Verification 95% UCL Calculation

Rev. No. 1
Date 03/29/06
Sheet No. 2 of 9

Summary (continued)

Results:

The results presented in the summary tables that follow are for use in RESidual RADioactivity dose/risk analysis and the CVP for this site.

Results Summary

Analyte	Shallow Zone Result	Shallow Zone Qualifier	Deep Zone Result	Deep Zone Qualifier	Units
Americium-241	5.5E-01		3.5E+01 *		pCi/g
Cesium-137	3.6E-01		5.1E+03 **		pCi/g
Cobalt-60	1.21E-01		3.1E+02 **		pCi/g
Europium-154	7.1E-02	U	7.3E+00 *		pCi/g
Europium-155	6.9E-02	U	1.9E+00 *		pCi/g
Tritium	Not a shallow zone COC		1.5E+01		pCi/g
Nickel-63	9.7E-01	U	1.7E+02 **		pCi/g
Plutonium-239/240	2.6E-02	U	4.1E+01 *		pCi/g
Strontium-90	1.6E-01		9.31E+02 **		pCi/g
Chromium	Not a shallow zone COC		1.4E+01 *		mg/kg
Hexavalent chromium	Not a shallow zone COC		2.96E+00		mg/kg
Nitrate	1.7E+01		6.8E+01	D	mg/kg
Mercury	2.0E-02	U	Not a deep zone COC		mg/kg

WAC 173-340 Evaluation (Shallow Zone)

3-Part Test:

95% UCL > Cleanup Limit? NA

> 10% above Cleanup Limit? NA

Any sample > 2x Cleanup Limit? NA

Risk Estimate:

Nonrad noncarcinogenic index sum:

Nonrad carcinogenic risk:

WAC 173-340 Evaluation (Deep Zone)

* Per the ROR/RAWP (DOE-RL 2001) the contaminant will not reach groundwater within a 1,000-year time frame.

**The contaminant will be evaluated for groundwater and river protection via RESRAD.

D = diluted

NA = not applicable

U= undetected

Relative Percent Difference Results* QA/QC Analysis**

Analyte	Crib Shallow Zone Duplicate Analysis**	Crib Shallow Zone Split Analysis**	Crib Deep Zone Duplicate Analysis**	Crib Deep Zone Split Analysis**	Trench Shallow Zone Duplicate Analysis**	Trench Shallow Zone Split Analysis**	Trench Deep Zone Duplicate Analysis**	Trench Deep Zone Split Analysis**
Americium-241								
Cesium-137			8.3%	9.7%			5.2%	9.8%
Cobalt-60			6.7%	13.3%			15.5%	29.8%
Europium-154								
Europium-155								
Tritium	Not a shallow zone COC				Not a shallow zone COC			
Nickel-63								
Plutonium-239/240								
Strontium-90			3.9%	12.8%			3.7%	35.7%
Chromium	Not a shallow zone COC		23.8%	0.5%	Not a shallow zone COC		7.6%	20.3%
Hexavalent Chromium	Not a shallow zone COC		6.6%		Not a shallow zone COC			
Nitrate	7.9%	58.8%						
Mercury			Not a deep zone COC				Not a deep zone COC	

*A blank cell indicates that RPD evaluation was not required.

**The significance of the reported RPD values, including values greater than 30%, is addressed within the Data Quality Assessment for the CVP for this site.

QA/QC = quality assurance/quality control

RPD = relative percent difference

Regulator Split Samples

Relative Percent Difference Results* QA/QC Analysis**

Analyte	Shallow Zone Crib WDOE-02C-02	Shallow Zone Crib WDOE-02C-04	Shallow Zone Crib WDOE-02C-07	Shallow Zone Trench WDOE-02T-01	Shallow Zone Trench WDOE-02T-04	Shallow Zone Trench WDOE-02T-07	Deep Zone Crib WDOE-02C-01	Deep Zone Crib WDOE-02C-05	Deep Zone Crib WDOE-02C-08	Deep Zone Trench WDOE-02T-02	Deep Zone Trench WDOE-02T-07	Deep Zone Trench WDOE-02T10
Americium-241										1.5%		
Cesium-137						4.9%	9.4%	22.2%	14.7%	16.7%	29.9%	18.5%
Cobalt-60							17.1%	27.2%	8.9%		28.4%	10.3%
Europium-154											23.4%	
Europium-155												
Tritium	Not a shallow zone COC											
Nickel-63												
Plutonium-239/240										7.0%		
Strontium-90							23.4%	69.1%	1.1%	0.8%	43.4%	
Chromium	Not a shallow zone COC						4.3%	20.4%	5.4%	29.3%	25.0%	44.1%
Hexavalent Chromium	Not a shallow zone COC						NA	NA	NA	NA	NA	NA
Nitrate		12.3%	14.8%			60.6%			9.8%			90.7%
Mercury							Not a deep zone COC					

*A blank cell indicates that RPD evaluation was not required.

**The significance of the reported RPD values, including values greater than 35%, is addressed within the Data Quality Assessment for the CVP for this site.

COC = contaminant of concern

NA = not applicable

QA/QC = quality assurance/quality control

RPD = relative percent difference

CALCULATION SHEET

Washington Closure Hanford

Originator W. S. Thompson
Project 100-NR-1 TBD Site Remedial Action Project
Subject 116-N-1 Combined Crib and Trench Cleanup Verification 95% UCL Calculation

Date 3/29/06
Job No. 14855

Calc. No. 01000-CA-V0067
Checked J.M. Capron

Rev. No. 1
Date 3/29/06
Sheet No. 3 of 8

1 Shallow Zone Sample Data

	Sampling Area	HEIS Number	Sample Date	Americium-241 pCi/g	Q	MDA	Cesium-137 pCi/g	Q	MDA	Cobalt-60 pCi/g	Q	MDA
4	Trench 82-01	J10F80	11/4/2005	6.0E-02	U	2.70E-01	1.84E-01		4.8E-02	1.11E-01		4.5E-02
5	Trench 82-04	J10F87	11/4/2005	7.1E-02	U	5.4E-01	6.86E-01		8.5E-02	7.7E-02		4.4E-02
6	Trench 82-05	J10F88	11/4/2005	-4.5E-02	U	3.5E-01	8.31E-01		8.4E-02	1.64E-01		4.4E-02
7	Trench 82-06	J10F81	11/4/2005	8.0E-02	U	1.7E-01	3.77E-01		3.2E-02	4.1E-02	U	4.1E-02
8	Trench 82-15	J10F89	11/4/2005	-3.1E-02	U	6.2E-01	4.27E-01		5.3E-02	1.88E-01		4.6E-02
9	Trench 82-03	J10F90	11/4/2005	6.0E-02	U	4.4E-01	8.4E-02		2.7E-02	2.7E-02	U	2.7E-02
10	Trench 82-04	J10F93	11/4/2005	1.7E-02	U	1.6E-01	1.08E-01		2.1E-02	4.1E-02	U	4.1E-02
11	Trench 82-07	J10F94	11/4/2005	3.88E-02		3.6E-01	8.79E-01		4.1E-02	8.6E-02	U	8.5E-02
12	Trench 82-08	J10F96	11/4/2005	8.4E-02	U	2.6E-01	3.49E-01		4.6E-02	5.1E-02		3.7E-02
13	Trench 82-09	J10F84	11/4/2005	6.8E-02	U	2.8E-01	3.7E-02	U	8.7E-02	4.8E-02	U	4.2E-02
14	Duplicate of J10F84	J10FC2	11/4/2005	-7.3E-02	U	8.6E-01	4.2E-02	U	4.2E-02	4.3E-02	U	4.5E-02
15	Crib 82-04	J10F92	11/4/2005	3.1E-02	U	2.4E-01	4.79E-01		4.3E-02	8.14E-01		3.8E-02
16	Crib 82-02	J10F91	11/4/2005	-3.5E-02	U	2.7E-01	3.5E-02	U	3.8E-02	2.3E-02	U	2.3E-02
17	Crib 82-01	J10F82	11/4/2005	9.8E-02	U	2.1E-01	4.0E-02	U	4.0E-02	4.7E-02	U	4.7E-02
18	Crib 82-04	J10F83	11/4/2005	2.3E-02	U	1.9E-01	5.4E-02	U	6.4E-02	1.3E-01	U	1.3E-01
19	Crib 82-06	J10F84	11/4/2005	1.8E-01	U	4.7E-01	1.84E-01		4.0E-02	3.1E-02	U	5.1E-02
20	Duplicate of J10F84	J10FC0	11/4/2005	8.3E-02	U	8.4E-01	8.8E-02		4.4E-02	6.5E-02	U	4.6E-02
21	Crib 82-06	J10F95	11/4/2005	7.1E-02	U	8.1E-01	3.8E-02	U	3.3E-02	5.2E-02	U	2.8E-02
22	Crib 82-07	J10F85	11/4/2005	3.7E-02	U	2.6E-01	7.8E-02	U	3.3E-02	8.5E-02	U	3.0E-02
23	Crib 82-08	J10F97	11/4/2005	-4.9E-02	U	1.9E-01	7.2E-02		3.1E-02	4.6E-02	U	4.6E-02
24	Crib 82-09	J10F98	11/4/2005	5.0E-02	U	3.6E-01	1.8E-01		8.1E-02	1.18E-01		4.6E-02
25	Crib 82-10	J10F99	11/4/2005	2.8E-02	U	1.9E-01	4.0E-01		7.3E-02	7.3E-02	U	7.3E-02

	Sampling Area	Europium-154 pCi/g	Q	MDA	Europium-155 pCi/g	Q	MDA	Nickel-63 pCi/g	Q	MDA
4	Trench 82-01	1.7E-01	U	1.3E-01	9.4E-02	U	9.4E-02	1.47E+00	U	2.4E+00
5	Trench 82-04	1.7E-01	U	1.7E-01	1.8E-01	U	1.8E-01	2.84E+00	U	3.7E+00
6	Trench 82-05	1.6E-01	U	1.6E-01	1.3E-01	U	1.3E-01	1.73E+00	U	2.3E+00
7	Trench 82-06	1.3E-01	U	1.3E-01	1.4E-01	U	1.4E-01	4.83E-01	U	3.0E+00
8	Trench 82-15	1.3E-01	U	1.3E-01	1.4E-01	U	1.4E-01	1.89E+00	U	2.7E+00
9	Trench 82-03	8.4E-02	U	8.4E-02	3.2E-02	U	9.2E-02	4.39E-01	U	3.7E+00
10	Trench 82-04	1.4E-01	U	1.4E-01	7.4E-02	U	7.4E-02	1.17E-01	U	3.8E+00
11	Trench 82-07	1.2E-01	U	1.2E-01	7.7E-02	U	7.7E-02	1.18E+00	U	3.8E+00
12	Trench 82-08	1.1E-01	U	1.1E-01	1.3E-01	U	1.3E-01	2.37E+00	U	3.0E+00
13	Trench 82-09	1.4E-01	U	1.4E-01	7.2E-02	U	7.2E-02	1.19E-01	U	2.3E+00
14	Duplicate of J10F84	1.6E-01	U	1.6E-01	1.4E-01	U	1.4E-01	4.75E-01	U	3.1E+00
15	Crib 82-04	1.1E-01	U	1.1E-01	1.2E-01	U	1.2E-01	8.4E-01	U	4.1E+00
16	Crib 82-02	7.4E-02	U	7.4E-02	6.6E-02	U	6.6E-02	-1.81E-01	U	3.0E+00
17	Crib 82-01	1.6E-01	U	1.6E-01	8.2E-02	U	8.2E-02	-3.2E-01	U	3.3E+00
18	Crib 82-04	2.5E-01	U	1.5E-01	2.5E-01	U	2.5E-01	6.6E-01	U	3.4E+00
19	Crib 82-06	1.7E-01	U	1.7E-01	1.1E-01	U	1.1E-01	-7.94E-01	U	3.7E+00
20	Duplicate of J10F84	1.5E-01	U	1.5E-01	1.8E-01	U	1.8E-01	-2.16E+00	U	3.9E+00
21	Crib 82-06	1.0E-01	U	1.0E-01	1.1E-01	U	1.1E-01	7.9E-02	U	3.3E+00
22	Crib 82-07	1.2E-01	U	1.2E-01	1.3E-01	U	1.3E-01	-1.00E-00	U	3.4E+00
23	Crib 82-08	1.8E-01	U	1.8E-01	6.7E-02	U	6.7E-02	1.3E-01	U	3.3E+00
24	Crib 82-09	1.8E-01	U	1.8E-01	1.7E-01	U	1.7E-01	8.53E-01	U	3.4E+00
25	Crib 82-10	1.9E-01	U	1.9E-01	1.3E-01	U	1.3E-01	-8.98E-01	U	3.2E+00

	Sampling Area	Plutonium-239/240 pCi/g	Q	MDA	Strontium-90 pCi/g	Q	MDA	Nitrate mg/kg	Q	PQL	Mercury mg/kg	Q	PQL
4	Trench 82-01	7.4E-02	U	1.9E-01	1.4E-02	U	5.5E-01	1.6E+00		2.1E-01	1.7E-02	U	1.7E-02
5	Trench 82-04	2.3E-02	U	1.7E-01	6.5E-02	U	2.3E-01	6.05E+00		2.3E-01	1.6E-02	U	1.6E-02
6	Trench 82-05	0	U	1.4E-01	6.7E-02	U	2.7E-01	6.74E+00		2.1E-01	1.8E-02	U	1.8E-02
7	Trench 82-06	4.7E-02	U	1.8E-01	1.35E-01	U	2.8E-01	3.39E-01		2.6E-01	1.5E-02	U	1.5E-02
8	Trench 82-15	3.8E-02	U	1.4E-01	1.61E-01	U	2.5E-01	2.23E+00		2.2E-01	1.6E-02	U	1.6E-02
9	Trench 82-03	0	U	2.0E-01	8.5E-02	U	2.4E-01	1.84E+00		2.1E-01	1.6E-02	U	1.6E-02
10	Trench 82-04	0	U	1.8E-01	1.08E-01	U	2.4E-01	3.61E-01		2.6E-01	1.6E-02	U	1.6E-02
11	Trench 82-07	0	U	1.8E-01	1.49E-01	U	2.5E-01	3.72E-01		4.3E-01	1.8E-02	U	1.8E-02
12	Trench 82-08	0	U	2.0E-01	-2.77E-02	U	3.0E-01	8.83E-01		2.1E-01	1.8E-02	U	1.8E-02
13	Trench 82-09	0	U	1.8E-01	8.0E-03	U	2.9E-01	1.39E+00		2.6E-01	1.5E-02	U	1.5E-02
14	Duplicate of J10F84	0	U	2.1E-01	-3.1E-02	U	2.8E-01	1.7E+00		2.3E-01	1.5E-02	U	1.5E-02
15	Crib 82-04	3.4E-02	U	2.6E-01	1.1E-01	U	2.8E-01	2.77E+00		1.1E+00	1.7E-02	U	1.7E-02
16	Crib 82-02	0	U	5.9E-01	-3.9E-02	U	2.8E-01	5.84E-01		3.2E-01	1.8E-02	U	1.8E-02
17	Crib 82-01	0	U	1.9E-01	-1.9E-02	U	2.2E-01	5.94E+00		2.1E-01	1.7E-02	U	1.7E-02
18	Crib 82-04	3.7E-02	U	2.6E-01	6.39E-01		2.2E-01	7.78E+00		2.1E-01	1.6E-02	U	1.6E-02
19	Crib 82-06	0	U	2.6E-01	4.60E-01		2.2E-01	7.14E+00		2.1E-01	1.8E-02	U	1.8E-02
20	Duplicate of J10F84	0	U	2.6E-02	5.9E-01		1.9E-01	6.6E+00		2.2E-01	1.6E-02	U	1.6E-02
21	Crib 82-06	1.9E-02	U	1.5E-01	1.41E-01	U	2.5E-01	7.27E+00		2.1E-01	1.5E-02	U	1.5E-02
22	Crib 82-07	0.8E-02	U	2.0E-02	2.6E-03	U	2.5E-01	1.74E-01		4.2E-01	1.3E-02	U	1.3E-02
23	Crib 82-08	0.6E-00	U	9.0E-02	3.4E-02	U	2.4E-01	3.09E+00		2.6E-01	1.4E-02	U	1.4E-02
24	Crib 82-09	4.1E-02	U	1.7E-01	9.3E-02	U	2.0E-01	1.09E+01		2.6E-01	1.3E-02	U	1.3E-02
25	Crib 82-10	1.8E-02	U	1.4E-01	1.64E-01	U	2.1E-01	6.39E+00		2.3E-01	2.0E-02	U	2.0E-02

26 Note: Radiological analytical methods use repeatably determined floating calibration curves that are not forced through the origin, therefore, negative values are routinely reported for undetected analytes. This does not diminish the usability of the data.

27 Statistical Computation Input Data

	Sampling Area	HEIS Number	Sample Date	Am-241 pCi/g	Cs-137 pCi/g	Co-60 pCi/g	Eu-154 pCi/g	Eu-155 pCi/g	Ni-63 pCi/g	Pu-239/240 pCi/g	Sr-90 pCi/g	Nitrate mg/kg	Hg mg/kg
30	Trench 82-01	J10F80	11/4/2005	6.0E-02	1.85E-01	1.11E-01	6.0E-02	4.7E-02	1.47E+00	7.4E-02	1.4E-02	1.6E+00	8.5E-03
31	Trench 82-04	J10F87	11/4/2005	7.1E-02	6.86E-01	7.7E-02	8.5E-02	8.0E-02	2.84E+00	2.3E-02	6.5E-02	6.05E+00	8.0E-03
32	Trench 82-05	J10F88	11/4/2005	-4.5E-02	8.31E-01	1.64E-01	8.0E-02	8.5E-02	1.73E+00	0	6.7E-02	6.74E+00	8.0E-03
33	Trench 82-06	J10F81	11/4/2005	8.0E-02	3.77E-01	4.1E-02	4.8E-02	4.1E-02	4.83E-01	4.7E-02	1.35E-01	3.39E-01	7.5E-03
34	Trench 82-15	J10F89	11/4/2005	-3.1E-02	4.27E-01	1.88E-01	6.5E-02	7.0E-02	1.89E+00	3.8E-02	1.61E-01	2.23E+00	8.0E-03
35	Trench 82-03	J10F90	11/4/2005	6.0E-02	8.4E-02	1.4E-02	4.3E-02	4.8E-02	4.39E-01	0	9.5E-02	1.84E+00	8.0E-03
36	Trench 82-04	J10F93	11/4/2005	1.7E-02	1.08E-01	2.1E-02	7.0E-02	3.7E-02	8.11E-01	0	1.0E-01	8.01E-01	8.0E-03
37	Trench 82-07	J10F94	11/4/2005	3.88E-02	8.79E-01	4.3E-02	8.0E-02	3.8E-02	1.18E-02	0	1.46E-01	1.72E-01	8.0E-03
38	Trench 82-08	J10F96	11/4/2005	8.4E-02	3.49E-01	5.3E-02	5.8E-02	6.5E-02	2.37E-00	0	2.7E-02	5.93E-01	8.0E-03
39	Trench 82-09	J10F84/J10FC2	11/4/2005	-6.8E-02	2.0E-02	2.3E-02	7.0E-02	5.3E-02	2.98E-01	0	-1.1E-02	1.6E+00	7.5E-03
40	Crib 82-01	J10F90	11/4/2005	3.1E-02	4.79E-01	8.14E-01	6.8E-02	6.0E-02	8.4E-01	3.4E-02	1.1E-01	2.77E+00	6.5E-03
41	Crib 82-02	J10F91	11/4/2005	-3.5E-02	3.5E-02	1.2E-02	3.7E-02	4.3E-02	-1.81E-01	0	-3.9E-02	5.84E-01	8.0E-03
42	Crib 82-01	J10F82	11/4/2005	9.8E-02	4.0E-02	2.4E-02	7.0E-02	4.1E-02	-3.2E-01	2.5E-02	-1.9E-02	5.94E+00	8.0E-03
43	Crib 82-04	J10F83	11/4/2005	2.3E-02	3.2E-02	6.5E-02	7.5E-02	1.3E-01	6.6E-01	3.7E-02	6.39E-01	7.78E+00	8.0E-03
44	Crib 82-06	J10F84/J10FC0	11/4/2005	1.8E-01	1.3E-01	2.4E-02	8.0E-02	6.8E-02	-1.47E-00	0	5.4E-01	6.6E+00	8.0E-03
45	Crib 82-06	J10F95	11/4/2005	7.1E-02	1.7E-02	1.5E-02	5.0E-02	5.8E-02	7.9E-02	1.9E-02	1.41E-01	7.27E+00	7.5E-03
46	Crib 82-07	J10F85	11/4/2005	3.7E-02	7.8E-02	1.8E-02	8.0E-02	6.0E-02	-1.07E-00	0	2.E-00	1.74E-01	6.5E-03
47	Crib 82-08	J10F97	11/4/2005	-4.9E-02	7.2E-02	2.3E-02	6.0E-02	3.4E-02	1.2E-01	0	3.4E-02	3.09E+00	7.0E-03
48	Crib 82-09	J10F98	11/4/2005	5.0E-02	1.8E-01	1.18E-01	7.5E-02	8.5E-02	8.53E-01	4.1E-02	9.3E-02	1.09E+01	7.5E-03
49	Crib 82-10	J10F99	11/4/2005	2.8E-02	4.0E-01	7.3E-02	1.9E-01	1.3E-01	-8.98E-01	1.8E-02	1.6E-01	6.39E+00	2.0E-02

	Statistical value based on	Am-241	Cs-137	Co-60	Eu-154	Eu-155	Ni-63	Pu-239/240	Sr-90	Nitrate	Hg
50											
51		Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Lognormal distribution is used per MTCA Stat. Land's method is used to determine 95% UCL value.	>50% Below Detection. Default to Maximum Value
52	N	20	20	20	20	20	20	20	20	20	20
53	% < Detection limit	35%	30%	0%	100%	100%	100%	100%	0%	100%	100%
54	mean	2.3E-01	2.6E-01	7.9E-02	6.8E-02	5.10E-02	6.7E-01	1.6E-02	1.2E-01	6.3E+00	8.8E-03
55	st. dev.	8.8E-01	2.7E-01	1.2E-01	1.5E-02	2.2E-02	1.1E+00	2.2E-02	1.7E-01	7.1E+00	8.8E-04
56	Z-statistic	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645
57	95% UCL on mean	3.2E-01	3.9E-01	1.2E-01	7.1E-02	6.8E-02	6.7E-01	2.8E-02	1.8E-01	1.7E-01 a	N/A
58	max value	3.9E-00	8.31E-01	8.14E-01	1.8E-01	2.5E-01	2.8E-00	7.4E-02	6.39E-01	9.77E+01	2.0E-02 U
59	Statistical value	8.8E-01	3.9E-01	1.2E-01	7.1E-02	6.8E-02	6.7E-01	2.8E-02	1.8E-01	1.7E-01	2.0E-02 U
60	Background	NA	NA	NA	NA	NA	NA	NA	NA	NA c	NA c
61	Statistical value above background	5.5E-01	3.9E-01	1.2E-01	7.1E-02	6.8E-02	6.7E-01	2.8E-02	1.8E-01	1.7E-01	2.0E-02 U

Meet Stringent Cleanup Limit for nonradionuclide and RAB type	Protection of groundwater and Columbia River 4400[b]	Protection of groundwater and Columbia River 0.33
WAC 173-340 3-PART Test		
95% UCL > Cleanup Limit?	NO	NA
> 10% above Cleanup Limit?	NO	NA
Any sample > 2X Cleanup Limit?	NO	NA
EXCESS RISK EVALUATION		
WAC 173-340 Non-Carcinogenic Cleanup:	113000	24
Hazard quotient for each nonradionuclide	NA	NA
WAC 173-340 Carcinogenic Cleanup:	NA	NA
Risk for each carcinogenic nonradionuclide	NA	NA
WAC 173-340 3-Part-Test Compliance?	The data set meets the three-part test criteria when compared to the most stringent cleanup limit.	Because mercury was not detected in any of the samples, the 3-part-test and excess risk are not calculated.
Hazard noncarcinogenic index sum:		
Hazard carcinogenic risk:		

62

63 a MTCA Stat determined that the lognormal distribution should be used. The Land's method was used for the 95% UCL value

64 b Cleanup values presented in the 100-NR-1 ROD/RAWP. Values are expressed as nitrate. To obtain cleanup levels for nitrates as nitrogen, divide the nitrate RAGs by 4.4

65 c Background for nitrate is 11.8 mg/kg. Background for mercury is 0.33 mg/kg. Background is not subtracted for nonradionuclides.

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75 HEIS = Hanford Environmental Information System
76 MDA = minimum detectable activity
77 NA = not applicable
78 PQL = practical quantitation level

Q = qualifier
RAG = remedial action goal
U = undetected
WAC = Washington Administrative Code

CALCULATION SHEET

Washington Closure Hanford

Originator W. S. Thompson
Project 100-NR-1 TSD Site Remedial Action Project
Subject 116-N-1 Combined Crib and Trench Cleanup Verification 95% UCL Calculation

Date 2/27/06
Job No. 14655

Calc. No. 0100N-CA-V0087
Checked J.M. Capron

Rev. No. 0
Date 2/27/06
Sheet No. 4 of 9

1 Deep Zone Sample Data

	Sampling Area	HEIS Number	Sample Date	Americium-241 pCi/g	Q	PQL	Cesium-137 pCi/g	Q	MDA	Cobalt-60 pCi/g	Q	MDA	Europium-154 pCi/g	Q	MDA	Europium-155 pCi/g	Q	MDA	Tritium pCi/g	Q	MDA	Nickel-63 pCi/g	Q	MDA	Plutonium-239/240 pCi/g	Q	MDA	Strontium-90 pCi/g	Q	MDA
4	Trench DZ-02	J10FF1	11/9/2005	7.29E+00		5.2E-01	1.10E+03		2.2E+00	4.56E+00	U	4.5E+00	2.5E+00	U	2.5E+00	3.0E+00	U	3.0E+00	6.16E+00		2.2E+00	4.37E+01		3.9E+00	9.96E+00		2.4E-01	6.55E+01		8.1E-01
5	Trench DZ-01	J10FF0	11/9/2005	6.32E+01		4.0E-01	4.61E+03		4.6E+00	7.33E+02		2.2E+00	8.84E+00		4.2E+00	5.1E+00	U	5.1E+00	2.04E+01		2.3E+00	2.87E+02		3.6E+00	8.04E+01		1.9E-01	5.58E+02		1.1E+00
6	Trench DZ-03	J10FF2	11/9/2005	1.49E+02		4.7E-01	1.31E+04		6.5E+00	1.23E+03		3.2E+00	2.36E+01		6.9E+00	9.8E+00	U	9.8E+00	3.03E+01		2.2E+00	7.88E+02		4.4E+00	1.54E+02		1.7E-01	1.26E+03		1.8E+00
7	Trench DZ-04	J10FF3	11/10/2005	7.92E+01		3.1E-01	1.06E+04		4.0E+00	6.90E+02		8.3E-01	2.3E+01		2.8E+00	6.2E+00	U	6.2E+00	5.11E+01		2.2E+00	3.18E+02		4.1E+00	7.81E+01		1.8E-01	2.11E+03		1.8E+00
8	Trench DZ-05	J10FF4	11/10/2005	1.07E+00		2.3E-01	3.19E+02		6.9E-01	8.0E+00		2.3E-01	5.7E-01	U	5.7E-01	1.4E+00	U	1.4E+00	8.8E+00		2.2E+00	2.25E+00	U	4.0E+00	9.97E-01		2.2E-01	2.37E+02		7.1E-01
9	Duplicate of J10FF4	J10FC9	11/10/2005	1.1E+00		4.4E-01	3.36E+02		3.9E-01	9.34E+00		1.4E-01	3.7E-01	U	3.7E-01	1.1E+00	U	1.1E+00	1.3E+01		2.7E+00	2.46E+00	U	3.9E+00	9.06E-01		2.2E-01	2.46E+02		1.1E+00
10	Trench DZ-06	J10FF5	11/10/2005	4.58E+01		5.6E-01	4.11E+03		2.4E+00	2.89E+02		9.9E-01	7.25E+00		2.5E+00	4.2E+00	U	4.2E+00	1.66E+01		2.3E+00	2.25E+02		3.9E+00	5.14E+01		2.0E-01	1.47E+03		1.9E+00
11	Trench DZ-07	J10FF6	11/10/2005	7.38E+00		3.0E-01	3.84E+03		2.8E+00	5.98E+01		5.0E-01	2.45E+00		1.2E+00	3.8E+00	U	3.8E+00	2.3E+01		2.2E+00	2.85E+01		4.1E+00	7.62E+00		2.2E-01	2.02E+03		1.8E+00
12	Trench DZ-08	J10FF7	11/10/2005	1.53E-01	U	5.8E-01	2.99E+00		1.2E-01	1.7E-01	U	1.7E-01	3.2E-01	U	3.2E-01	3.0E-01	U	3.0E-01	2.41E+00		2.2E+00	1.67E+00	U	3.8E+00	8.2E-02	U	2.1E-01	8.09E+01		8.9E-01
13	Trench DZ-09	J10FF8	11/10/2005	5.15E+01		5.7E-01	2.16E+04		6.1E+00	5.77E+02		2.4E+00	1.82E+01		5.8E+00	1.2E+01	U	1.2E+01	3.27E+01		2.7E+00	1.94E+02		3.8E+00	1.01E+02		1.5E-01	1.75E+03		1.2E+00
14	Trench DZ-10	J10FF9	11/10/2005	1.03E+00		3.9E-01	9.47E+01		4.2E-01	1.43E+01		1.4E-01	6.3E-01	U	6.3E-01	6.1E-01	U	6.1E-01	3.27E+00		2.2E+00	6.5E+00		4.0E+00	1.1E+00		2.0E-01	1.17E+01		4.4E-01
15	Crib DZ-01	J10FD0	11/9/2005	1.4E+00		2.8E-01	8.65E+01		1.7E-01	6.55E+00		7.7E-02	3.1E-01	U	3.1E-01	5.6E-01	U	5.6E-01	3.23E-01	U	2.1E+00	6.87E+00		4.1E+00	1.69E+00		2.2E-01	2.86E+02		2.8E-01
16	Crib DZ-02	J10FD1	11/9/2005	2.3E+00		3.1E-01	3.14E+02		3.0E-01	1.05E+01		9.7E-02	2.6E-01	U	2.6E-01	1.0E+00	U	1.0E+00	3.11E+00		2.3E+00	1.38E+01		4.5E+00	2.49E+00		1.5E-01	9.12E+02		3.1E-01
17	Crib DZ-03	J10FD2	11/9/2005	3.81E+00		2.4E-01	3.10E-02	U	3.1E-02	3.5E-02	U	3.5E-02	8.9E-02	U	8.9E-02	6.0E-02	U	6.0E-02	2.4E+00		2.2E+00	1.7E+01		4.0E+00	4.28E+00		1.6E-01	1.80E+02		2.7E-01
18	Crib DZ-04	J10FD3	11/9/2005	3.72E+00		3.9E-01	2.18E+01		1.8E-01	1.47E+01		1.1E-01	2.9E-01	U	2.9E-01	4.4E-01	U	4.4E-01	1.04E+00	U	2.2E+00	9.41E+00		5.0E+00	3.81E+00		1.4E-01	1.23E+02		2.9E-01
19	Crib DZ-05	J10FD4	11/9/2005	2.66E+00		4.0E-01	3.45E+02		3.5E-01	2.45E+01		1.6E-01	4.5E-01	U	4.5E-01	7.9E-01	U	7.9E-01	5.63E+00		2.1E+00	3.47E+01		3.5E+00	3.74E+00		1.4E-01	1.50E+03		2.7E-01
20	Duplicate of J10FD4	J10FC8	11/9/2005	2.21E+00		3.8E-01	3.75E+02		3.3E-01	2.62E+01		1.3E-01	6.35E-01		3.2E-01	9.9E-01	U	9.9E-01	6.5E+00		2.1E+00	3.08E+01		3.9E+00	3.42E+00		1.7E-01	1.56E+03		2.8E-01
21	Crib DZ-06	J10FD5	11/9/2005	3.67E+00		2.5E-01	4.28E+02		3.4E-01	2.65E+01		1.3E-01	1.79E+00		3.7E-01	1.0E+00	U	1.0E+00	2.14E+00		2.1E+00	1.09E+01		5.2E+00	3.78E+00		1.5E-01	5.79E+01		2.8E-01
22	Crib DZ-07	J10FD6	11/9/2005	1.06E+00		3.1E-01	1.1E+01		4.0E-02	2.02E+01		3.1E-02	2.21E-01		6.1E-02	1.14E-01		1.1E-01	1.55E+00	U	2.2E+00	1.0E+01		5.6E+00	1.11E+00		1.9E-01	1.10E+02		2.7E-01
23	Crib DZ-08	J10FD7	11/9/2005	3.12E-01	U	3.4E-01	5.6E+01		9.6E-02	2.14E+00		4.2E-02	1.1E-01	U	1.1E-01	3.3E-01	U	3.3E-01	2.59E-01	U	2.1E+00	4.75E+00		3.2E+00	6.8E-01		1.5E-01	7.21E+01		3.1E-01
24	Crib DZ-09	J10FD8	11/9/2005	0	U	4.3E-01	1.34E+01		2.5E-02	6.66E-01		2.1E-02	5.9E-02	U	5.9E-02	5.9E-02	U	5.9E-02	9.39E-01	U	2.1E+00	2.36E+00	U	5.6E+00	4.0E-02	U	1.5E-01	4.93E+01		3.5E-01
25	Crib DZ-10	J10FD9	11/9/2005	1.98E-01	U	3.0E-01	9.84E+01		1.9E-01	1.18E+01		9.9E-02	2.8E-01	U	2.8E-01	3.8E-01	U	3.8E-01	1.31E+00	U	2.2E+00	2.44E+00	U	4.2E+00	3.16E-01		1.4E-01	2.62E+02		2.9E-01

26 Note: Radiological analytical methods use statistically-determined floating calibration curves that are not forced through the origin; therefore, negative values are routinely reported for undetected analytes. This does not diminish the usability of the data.

27 Statistical Computation Input Data

	Sampling Area	HEIS Number	Sample Date	Am-241 pCi/g	Cs-137 pCi/g	Co-60 pCi/g	Eu-154 pCi/g	Eu-155 pCi/g	H3 pCi/g	Ni-63 pCi/g	Pu-239/240 pCi/g	Sr-90 pCi/g
30	Trench DZ-02	J10FF1	11/9/2005	7.29E+00	1.10E+03	2.25E+00	1.3E+00	1.5E+00	6.16E+00	4.37E+01	9.96E+00	6.55E+01
31	Trench DZ-01	J10FF0	11/9/2005	6.32E+01	4.61E+03	7.33E+02	8.84E+00	2.6E+00	2.04E+01	2.87E+02	8.04E+01	5.58E+02
32	Trench DZ-03	J10FF2	11/9/2005	1.49E+02	1.31E+04	1.23E+03	2.36E+01	4.9E+00	3.03E+01	7.88E+02	1.54E+02	1.26E+03
33	Trench DZ-04	J10FF3	11/10/2005	7.92E+01	1.06E+04	6.90E+02	2.3E+01	3.1E+00	5.11E+01	3.18E+02	7.81E+01	2.11E+03
34	Trench DZ-05	J10FF4/J10FC9	11/10/2005	1.1E+00	3.28E+02	8.7E+00	2.4E-01	6.3E-01	1.1E+01	2.36E+00	9.53E-01	2.42E+02
35	Trench DZ-06	J10FF5	11/10/2005	4.58E+01	4.11E+03	2.89E+02	7.25E+00	2.1E+00	1.66E+01	2.25E+02	5.14E+01	1.47E+03
36	Trench DZ-07	J10FF6	11/10/2005	7.38E+00	3.84E+03	5.98E+01	2.45E+00	1.9E+00	2.3E+01	2.85E+01	7.62E+00	2.02E+03
37	Trench DZ-08	J10FF7	11/10/2005	1.53E-01	2.99E+00	8.5E-02	1.8E-01	1.5E-01	2.41E+00	1.67E+00	8.2E-02	8.09E+01
38	Trench DZ-09	J10FF8	11/10/2005	5.15E+01	2.16E+04	5.77E+02	1.82E+01	6.0E+00	3.27E+01	1.94E+02	1.01E+02	1.75E+03
39	Trench DZ-10	J10FF9	11/10/2005	1.03E+00	9.47E+01	1.43E+01	3.2E-01	3.1E-01	3.27E+00	6.5E+00	1.1E+00	1.17E+01
40	Crib DZ-01	J10FD0	11/10/2005	1.40E+00	8.65E+01	6.55E+00	1.6E-01	2.8E-01	3.23E-01	6.87E+00	1.69E+00	2.86E+02
41	Crib DZ-02	J10FD1	11/9/2005	2.30E+00	3.14E+02	1.05E+01	1.3E-01	5.0E-01	3.11E+00	1.38E+01	2.49E+00	9.12E+02
42	Crib DZ-03	J10FD2	11/9/2005	3.81E+00	1.55E-02	1.8E-02	4.5E-02	3.0E-02	2.4E+00	1.7E+01	4.28E+00	1.80E+02
43	Crib DZ-04	J10FD3	11/9/2005	3.72E+00	2.18E+01	1.47E+01	1.5E-01	2.2E-01	1.04E+00	9.41E+00	3.81E+00	1.23E+02
44	Crib DZ-05	J10FD4/J10FC8	11/9/2005	2.44E+00	3.60E+02	2.54E+01	4.3E-01	4.5E-01	6.2E+00	3.28E+01	3.58E+00	1.53E+03
45	Crib DZ-06	J10FD5	11/9/2005	3.57E+00	4.28E+02	2.65E+01	1.79E+00	5.0E-01	2.14E+00	1.09E+01	3.78E+00	5.79E+01
46	Crib DZ-07	J10FD6	11/9/2005	1.06E+00	1.1E+01	2.02E+01	2.21E-01	1.14E-01	1.55E+00	1.00E+01	1.11E+00	1.10E+02
	Crib DZ-08	J10FD7	11/9/2005	3.12E-01	5.6E+01	2.14E+00	5.6E-02	1.7E-01	2.59E-01	4.75E+00	6.8E-01	7.21E+01
	Crib DZ-09	J10FD8	11/9/2005	0	1.34E+01	6.66E-01	3.0E-02	3.0E-02	9.39E-01	2.36E+00	4.0E-02	4.93E+01
47	Crib DZ-10	J10FD9	11/9/2005	1.98E-01	9.84E+01	1.18E+01	1.4E-01	1.9E-01	1.31E+00	2.44E+00	3.16E-01	2.62E+02

48

49		Am-241	Cs-137	Co-60	Eu-154	Eu-155	H3	Ni-63	Pu-239/240	Sr-90
50	Statistical value based on	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.
51	N	20	20	20	20	20	20	20	20	20
52	% < Detection limit	20%	5%	15%	55%	95%	30%	20%	10%	0%
53	mean	2.1E+01	3.0E+03	1.9E+02	4.4E+00	1.3E+00	1.1E+01	1.0E+02	2.5E+01	6.57E+02
54	st. dev.	3.9E+01	5.7E+03	3.4E+02	7.8E+00	1.7E+00	1.4E+01	1.9E+02	4.4E+01	7.42E+02
55	Z-statistic	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645
56	95% UCL on mean	3.5E+01	5.1E+03	3.1E+02	7.3E+00	1.9E+00	1.6E+01	1.7E+02	4.1E+01	9.31E+02
57	max value	1.49E+02	2.16E+04	1.23E+03	2.36E+01	1.20E+01	5.11E+01	7.88E+02	1.54E+02	2.11E+03
58	Statistical value	3.5E+01	5.1E+03	3.1E+02	7.3E+00	1.9E+00	1.6E+01	1.7E+02	4.1E+01	9.3E+02
59	Background	NA	NA	NA	NA	NA	NA	NA	NA	NA
60	Statistical value above background	3.5E+01	5.1E+03	3.1E+02	7.3E+00	1.9E+00	1.6E+01	1.7E+02	4.1E+01	9.31E+02

61 HEIS = Hanford Environmental Information System
62 MDA = minimum detectable activity
63 NA = not applicable
64 PQL = practical quantitation limit

Q = qualifier
RAG = remedial action goal
U = undetected
WAC = Washington Administrative Code

CVP-2006-00004
Rev. 0
For Approval

CALCULATION SHEET

Washington Closure Hanford

Originator	W. S. Thompson	Date 3/29/06	Calc. No. 0100N-CA-V0067		Rev. No. 1
Project	100-NR-1 TSD Site	Job No. 14655	Checked J.M. Capron		Date 3/29/2006
Subject	116-N-1 Combined Crib and Trench Cleanup Verification 95% UCL Calculation				Sheet No. 5 of 9

1 Deep Zone Sample Data

2	Sampling	HEIS	Sample	Nitrate			Chromium			Hexavalent Chromium		
3	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
4	Trench DZ-02	J10FF1	11/9/2005	2.62E+00		2.3E-01	1.33E+01		5.8E-01	2.34E-01	U	2.3E-01
5	Trench DZ-01	J10FF0	11/9/2005	1.85E+01	D	1.E+00	1.26E+01		5.2E-01	2.09E-01	U	2.1E-01
6	Trench DZ-03	J10FF2	11/9/2005	2.12E-01	U	2.1E-01	7.9E+00		5.2E-01	2.13E-01	U	2.1E-01
7	Trench DZ-04	J10FF3	11/10/2005	1.34E+00		2.1E-01	1.41E+01		5.3E-01	2.12E-01	U	2.1E-01
8	Trench DZ-05	J10FF4	11/10/2005	1.95E+00		2.1E-01	7.6E+00		5.3E-01	2.86E-01		2.2E-01
9	Duplicate of J10FF4	J10FC9	11/10/2005	1.52E+00		2.1E-01	8.2E+00		5.2E-01	2.13E-01	U	2.1E-01
10	Trench DZ-06	J10FF5	11/10/2005	2.02E-01	U	2.E-01	6.4E+00		5.2E-01	2.4E-01		2.1E-01
11	Trench DZ-07	J10FF6	11/10/2005	4.29E+00		2.1E-01	9.E+00		5.3E-01	2.11E-01	U	2.1E-01
12	Trench DZ-08	J10FF7	11/10/2005	1.02E+02	D	2.1E+00	5.5E+00		5.3E-01	2.15E-01	U	2.2E-01
13	Trench DZ-09	J10FF8	11/10/2005	5.83E+01	D	2.3E+00	3.17E+01		5.8E-01	2.52E+00		2.3E-01
14	Trench DZ-10	J10FF9	11/10/2005	3.32E-01		2.1E-01	1.15E+01		5.4E-01	2.17E-01	U	2.2E-01
15	Crib DZ-01	J10FD0	11/9/2005	1.14E+00		2.E-01	4.5E+00		5.3E-01	2.09E-01	U	2.1E-01
16	Crib DZ-02	J10FD1	11/9/2005	1.02E+00		2.1E-01	1.23E+01		5.3E-01	1.03E+00		2.1E-01
17	Crib DZ-03	J10FD2	11/9/2005	3.44E-01		2.1E-01	5.3E+00		5.3E-01	2.10E-01	U	2.1E-01
18	Crib DZ-04	J10FD3	11/9/2005	2.07E-01	U	2.1E-01	5.8E+00		5.3E-01	2.11E-01	U	2.1E-01
19	Crib DZ-05	J10FD4	11/9/2005	1.22E+00		2.2E-01	2.21E+01		5.4E-01	2.96E+00		2.2E-01
20	Duplicate of J10FD4	J10FC8	11/9/2005	1.48E+00		2.1E-01	1.74E+01		5.2E-01	2.77E+00		2.1E-01
21	Crib DZ-06	J10FD5	11/9/2005	2.52E+00		2.1E-01	8.6E+00		5.2E-01	2.11E-01	U	2.1E-01
22	Crib DZ-07	J10FD6	11/9/2005	5.52E+00		2.1E-01	4.8E+00		5.2E-01	2.09E-01	U	2.1E-01
23	Crib DZ-08	J10FD7	11/9/2005	3.89E-01		2.1E-01	5.7E+00		5.3E-01	2.11E-01	U	2.1E-01
24	Crib DZ-09	J10FD8	11/9/2005	5.57E+00		2.3E-01	1.41E+01		5.8E-01	2.31E-01	U	2.3E-01
25	Crib DZ-10	J10FD9	11/9/2005	3.99E+00		2.3E-01	1.9E+01		5.5E-01	7.8E-01		2.3E-01

26

27 Statistical Computation Input Data

28	Sampling	HEIS	Sample	Nitrate			Cr			Cr+6		
29	Area	Number	Date	mg/kg			mg/kg			mg/kg		
30	Trench DZ-02	J10FF1	11/9/2005	2.62E+00			1.33E+01			1.2E-01		
31	Trench DZ-01	J10FF0	11/9/2005	1.85E+01			1.26E+01			1.1E-01		
32	Trench DZ-03	J10FF2	11/9/2005	1.05E-01			7.9E+00			1.1E-01		
33	Trench DZ-04	J10FF3	11/10/2005	1.34E+00			1.41E+01			1.1E-01		
34	Trench DZ-05	J10FF4/J10FC9	11/10/2005	1.74E+00			7.9E+00			1.95E-01		
35	Trench DZ-06	J10FF5	11/10/2005	1.E-01			6.4E+00			2.4E-01		
36	Trench DZ-07	J10FF6	11/10/2005	4.29E+00			9.E+00			1.1E-01		
37	Trench DZ-08	J10FF7	11/10/2005	1.02E+02			5.5E+00			1.1E-01		
38	Trench DZ-09	J10FF8	11/10/2005	5.83E+01			3.17E+01			2.52E+00		
39	Trench DZ-10	J10FF9	11/10/2005	3.32E-01			1.15E+01			1.1E-01		
40	Crib DZ-01	J10FD0	11/10/2005	1.14E+00			4.5E+00			1.1E-01		
41	Crib DZ-02	J10FD1	11/9/2005	1.02E+00			1.23E+01			1.03E+00		
42	Crib DZ-03	J10FD2	11/9/2005	3.44E-01			5.3E+00			1.1E-01		
43	Crib DZ-04	J10FD3	11/9/2005	1.1E-01			5.8E+00			1.1E-01		
44	Crib DZ-05	J10FD4/J10FC8	11/9/2005	1.35E+00			1.98E+01			2.87E+00		
45	Crib DZ-06	J10FD5	11/9/2005	2.52E+00			8.6E+00			1.1E-01		
46	Crib DZ-07	J10FD6	11/9/2005	5.52E+00			4.8E+00			1.1E-01		
47	Crib DZ-08	J10FD7	11/9/2005	3.89E-01			5.7E+00			1.1E-01		
48	Crib DZ-09	J10FD8	11/9/2005	5.57E+00			1.41E+01			1.2E-01		
49	Crib DZ-10	J10FD9	11/9/2005	3.99E+00			1.9E+01			7.8E-01		

50

51		Nitrate			Cr			Cr+6		
52	Statistical value based on	Lognormal distribution is used per MTCAStat. Land's method is used to determine 95% UCL value.			Lognormal distribution is used per MTCAStat. Land's method is used to determine 95% UCL value.			>50% Below Detection. Default to Maximum Value		
53	N	20			20			20		
54	% < Detection limit	15%			0%			70%		
55	mean	1.1E+01			1.1E+01			4.6E-01		
56	st. dev.	2.5E+01			6.7E+00			8.1E-01		
57	Z-statistic	1.645			1.645			1.645		
58	95% UCL on mean	6.8E+01	a		1.4E+01	a		N/A		
59	max value	1.02E+02			3.17E+01			2.96E+00		
60	Statistical value	6.8E+01			1.4E+01			2.96E+00		
61	Background	NA	c		NA	c		NA		
62	Statistical value above background	6.8E+01			1.4E+01			2.96E+00		
63	Most Stringent Cleanup Limit for nonradionuclide and RAG type	4,400		Protection of groundwater and Columbia River [b]	18.5		Protection of Columbia River	2		Protection of Columbia River
64	WAC 173-340 3-PART Test									
65	95% UCL > Cleanup Limit?	NO			NO			YES		
66	> 10% above Cleanup Limit?	NO			YES			YES		
67	Any sample > 2X Cleanup Limit?	NO			NO			NO		

68 a MTCA Stat determined that the lognormal distribution should be used. The Land's method was used for the 95% UCL value.
69 b Cleanup values presented in the 100-NR-1 RDR/RAWP and are expressed as nitrate. To obtain cleanup levels for nitrates as nitrogen, divide the nitrate RAGs by 4.4.
70 c Background for nitrate is 11.8 mg/kg and for chromium is 18.5 mg/kg. Background is not subtracted for nonradionuclides.
71 D = Diluted
72 HEIS = Hanford Environmental Information System
73 NA = not applicable
74 PQL = practical quantitation limit

Ecology Software (MTCAStat) Results

Nitrate 95% UCL Calculation (Shallow Zone)

DATA	ID
1.60E+00	J10FB0
1.05E+00	J10FB7
5.74E+00	J10FB8
3.38E-01	J10FB1
2.23E+00	J10FB9
1.84E+00	J10FB2
5.01E-01	J10FB3
1.72E+01	J10FB6
8.93E-01	J10FB5
1.55E+00	J10FB4/J10FC2
2.71E+01	J10F90
6.84E-01	J10F91
5.64E+00	J10F92
7.78E+00	J10F93
6.87E+00	J10F94/J10FC0
7.27E+00	J10F95
1.74E+01	J10F96
3.02E+00	J10F97
1.09E+01	J10F98
6.39E+00	J10F99

Number of samples	20	Uncensored values	20
Uncensored	20	Mean	6.30
Censored		Lognormal mean	7.29
Detection limit or PQL		Std. devn.	7.07
Method detection limit		Median	4.33
TOTAL	20	Min.	0.34
		Max.	27.1

Lognormal distribution? r-squared is: 0.976
Normal distribution? r-squared is: 0.784
Recommendations:
Use lognormal distribution
UCL (based Land's Method) is 17.3

Nitrate 95% UCL Calculation (Deep Zone)

DATA	ID
2.62E+00	J10FF1
1.85E+01	J10FF0
1.1E-01	J10FF2
1.34E+00	J10FF3
1.74E+00	J10FF4/J10FC9
1.1E-01	J10FF5
4.29E+00	J10FF6
1.02E+02	J10FF7
5.83E+01	J10FF8
3.32E-01	J10FF9
1.14E+00	J10FD0
1.02E+00	J10FD1
3.44E-01	J10FD2
1.1E-01	J10FD3
1.35E+00	8
2.52E+00	J10FD5
5.52E+00	J10FD6
3.89E-01	J10FD7
5.57E+00	J10FD8
3.99E+00	J10FD9

Number of samples	20	Uncensored values	17
Uncensored	17	Mean	10.6
Censored	3	Lognormal mean	11.1
Detection limit or PQL	0.21	Std. devn.	25.2
Method detection limit		Median	1.5
TOTAL	20	Min.	0.11
		Max.	102

Lognormal distribution? r-squared is: 0.959
Normal distribution? r-squared is: 0.441
Recommendations:
Use lognormal distribution
UCL (based on Land's Method) is 67.5

Total Chromium 95% UCL Calculation (Deep Zone)

DATA	ID
1.33E+01	J10FF1
1.26E+01	J10FF0
7.9E+00	J10FF2
1.41E+01	J10FF3
7.9E+00	J10FF4/J10FC9
6.4E+00	J10FF5
9.E+00	J10FF6
5.5E+00	J10FF7
3.17E+01	J10FF8
1.15E+01	J10FF9
4.5E+00	J10FD0
1.23E+01	J10FD1
5.3E+00	J10FD2
5.8E+00	J10FD3
1.98E+01	J10FD4/J10FC8
8.6E+00	J10FD5
4.8E+00	J10FD6
5.7E+00	J10FD7
1.41E+01	J10FD8
1.9E+01	J10FD9

Number of samples	20	Uncensored values	20
Uncensored	20	Mean	11.0
Censored		Lognormal mean	11.0
Detection limit or PQL		Std. devn.	6.7
Method detection limit		Median	8.8
TOTAL	20	Min.	4.5
		Max.	31.7

Lognormal distribution? r-squared is: 0.957
Normal distribution? r-squared is: 0.821
Recommendations:
Use lognormal distribution
UCL (based on Land's Method) is 14.1

Washington Closure Hanford

CALCULATION SHEET

Originator W. S. Thompson
Project 100-NR-1 TSD Site Remedial Action Project
Subject 116-N-1 Combined Crib and Trench Cleanup Verification 95% UCL Calculation

Date 2/27/06
Job No. 14655

Calc. No. 0100N-CA-V0087
Checked J.M. Capron

Rev. No. 0
Date 2/27/06
Sheet No. 7 of 9

Crib Split/Duplicate Analysis:

Sample Point	HEIS Number	Am-241 pCi/g	Q	MDA	Cs-137 pCi/g	Q	MDA	Co-60 pCi/g	Q	MDA	H-3 pCi/g	Q	MDA
Crib Shallow Zone Results:													
SZ-05	J10F94	1.85E-01	U	4.7E-01	1.54E-01		4.0E-02	5.1E-02	U	5.10E-02	Not a Shallow Zone COC		
Duplicate of J10F94	J10FC0	6.3E-02	U	2.4E-01	9.60E-02		4.4E-02	4.5E-02	U	4.50E-02			
Split of J10F94	J10FC4	7.02E-02	U	3.26E-01	4.65E-02		1.78E-02	3.67E-03	U	1.85E-02			
Crib Deep Zone Results:													
DZ-05	J10FD4	2.68E+00		4.E-01	3.46E+02		3.5E-01	2.46E+01		1.6E-01	5.83E+00		2.1E+00
Duplicate of J10FD4	J10FC8	2.21E+00		3.8E-01	3.75E+02		3.3E-01	2.62E+01		1.3E-01	6.6E+00		2.1E+00
Split of J10FD4	J10FH0	5.58E+00	U	1.68E+00	3.8E+02		1.18E-01	2.8E+01		4.73E-02	1.7E+00	U	1.8E+00

Sample Point	HEIS Number	Eu-154 pCi/g	Q	MDA	Eu-155 pCi/g	Q	MDA	Ni-63 pCi/g	Q	MDA	Pu-239/240 pCi/g	Q	MDA
Crib Shallow Zone Results:													
SZ-05	J10F94	1.7E-01	U	1.7E-01	1.1E-02	U	1.1E-02	-7.94E-01	U	3.7E+00	0	U	2.5E-01
Duplicate of J10F94	J10FC0	1.5E-01	U	1.5E-01	1.6E-01	U	1.6E-01	-2.18E+00	U	3.8E+00	0	U	8.8E-02
Split of J10F94	J10FC4	-2.30E-02	U	6.68E-02	8.83E-02	U	4.90E-02	2.75E+00	U	6.24E+00	-1.90E-03	U	7.94E-02
Crib Deep Zone Results:													
DZ-05	J10FD4	4.6E-01	U	4.5E-01	7.9E-01	U	7.9E-01	3.47E+01		3.5E+00	3.74E+00		1.4E-01
Duplicate of J10FD4	J10FC8	6.35E-01		3.2E-01	9.9E-01	U	9.9E-01	3.06E+01		3.9E+00	3.42E+00		1.7E-01
Split of J10FD4	J10FH0	7.36E-01	U	1.66E-01	-1.83E-01	U	3.9E-01	5.83E+01		3.26E+01	1.13E+01	U	1.7E+00

Sample Point	HEIS Number	Sr-90 pCi/g	Q	MDA	Nitrate mg/kg	Q	PQL	Hg mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Hexavalent Chromium mg/kg	Q	PQL
Crib Shallow Zone Results:																
SZ-05	J10F94	4.93E-01		2.2E-01	7.14E+00		2.2E-01	1.8E-02	U	1.5E-02	Not a shallow zone COC			Not a shallow zone COC		
Duplicate of J10F94	J10FC0	5.9E-01		1.9E-01	6.6E+00		2.1E-01	1.8E-02	U	1.5E-02						
Split of J10F94	J10FC4	4.5E-01	U	9.79E-02	1.28E+01		2.2E+00	7.9E-03	U	8.E-03						
Crib Deep Zone Results:																
DZ-05	J10FD4	1.50E+03		2.7E-01	1.22E+00		2.2E-01	Not a deep zone COC			2.21E+01		6.4E-01	2.96E+00		2.2E-01
Duplicate of J10FD4	J10FC8	1.56E+03		2.8E-01	1.48E+00		2.1E-01				1.74E+01		6.2E-01	2.77E+00		2.1E-01
Split of J10FD4	J10FH0	1.32E+03		1.77E+01	2.5E+00		5.1E-01				2.22E+01		7.6E-01	1.5E-01	U	1.5E-01

Crib Shallow Zone Analysis:

		(TDL)	1	0.1	0.05	400	0.1	0.1	30	1	1	0.75	0.2	1	0.5
Duplicate Analysis	Both>MDA?		No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	Not a Shallow Zone COC	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Not a shallow zone COC	Not a shallow zone COC
	Both >5xCRDL?			No-Stop (acceptable)							No-Stop (acceptable)	Yes (calc RPD)			
	RPD											7.80%			
Split Analysis	Both>MDA?		No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	Not a Shallow Zone COC	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Not a shallow zone COC	Not a shallow zone COC
	Both >5xTDL?			No-Stop (acceptable)							No-Stop (acceptable)	Yes (calc RPD)			
	RPD											56.77%			

Crib Deep Zone Analysis:

		(TDL)	1	0.1	0.05	400	0.1	0.1	30	1	1	0.75	0.001	0.01	0.5
Duplicate Analysis	Both>MDA?		Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Not a deep zone COC	Yes (continue)	Yes (continue)
	Both >5xTDL?		No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)			No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)		Yes (calc RPD)	Yes (calc RPD)
	RPD			8.33%	8.71%						3.92%			23.80%	6.63%
Split Analysis	Both>MDA?		Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Not a deep zone COC	Yes (continue)	No-Stop (acceptable)
	Both >5xTDL?		No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)				No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)		Yes (calc RPD)	
	RPD			9.68%	13.33%						12.77%			0.45%	

Trench Split/Duplicate Analysis:

Sample Point	HEIS Number	Am-241 pCi/g	Q	MDA	Cs-137 pCi/g	Q	MDA	Co-60 pCi/g	Q	MDA	H-3 pCi/g	Q	MDA
Trench Shallow Zone													
SZ-05	J10FB4	5.8E-02	U	2.2E-01	3.7E-02	U	3.7E-02	4.2E-02	U	4.2E-02	Not a Shallow Zone COC		
Duplicate of J10FB4	J10FC2	-7.3E-03	U	5.6E-01	4.2E-02	U	4.2E-02	4.6E-02	U	4.6E-02			
Split of J10FB4	J10FC6	8.0E-03	U	2.17E-01	1.36E-01		1.83E-02	2.38E-02	U	2.47E-02			
Trench Deep Zone Results:													
DZ-05	J10FF4	1.07E+00		2.3E-01	9.19E+02		6.9E-01	8.6E+00		2.3E-01	8.8E+00		2.20E+00
Duplicate of J10FF4	J10FC9	1.1E+00		4.4E-01	3.36E+02		3.9E-01	9.34E+00		1.4E-01	1.3E+01		2.70E+00
Split of J10FF4	J10FH1	1.66E+00		1.6E+00	3.52E+02		1.11E-01	1.08E+01		4.6E-02	-6.33E-01	U	1.98E+00

Sample Point	HEIS Number	Eu-154 pCi/g	Q	MDA	Eu-155 pCi/g	Q	MDA	Ni-63 pCi/g	Q	MDA	Pu-239/240 pCi/g	Q	MDA
Trench Shallow Zone													
SZ-05	J10FB4	1.4E-01	U	1.4E-01	7.2E-02	U	7.2E-02	1.19E-01	U	2.3E+00	0	U	1.9E-01
Duplicate of J10FB4	J10FC2	1.6E-01	U	1.6E-01	1.4E-01	U	1.4E-01	4.75E-01	U	3.1E+00	0	U	2.1E-01
Split of J10FB4	J10FC6	5.96E-03	U	6.50E-02	5.24E-02	U	4.62E-02	2.04E+00	U	6.95E+00	-2.34E-03	U	9.76E-02
Trench Deep Zone Results:													
DZ-05	J10FF4	5.7E-01	U	5.7E-01	1.4E+00	U	1.4E+00	2.25E+00	U	4.0E+00	9.97E-01		2.2E-01
Duplicate of J10FF4	J10FC9	3.7E-01	U	3.7E-01	1.1E+00	U	1.1E+00	2.46E+00	U	3.9E+00	9.08E-01		2.2E-01
Split of J10FF4	J10FH1	3.33E-01	U	1.93E-01	1.39E-01	U	3.31E-01	4.44E-01	U	6.73E+00	3.26E+00	U	7.89E-01

Sample Point	HEIS Number	Sr-90 pCi/g	Q	MDA	Nitrate mg/kg	Q	PQL	Hg mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Hexavalent Chromium mg/kg	Q	PQL
Trench Shallow Zone																
SZ-05	J10FB4	9.E-03	U	2.8E-01	1.39E+00		2.E-01	1.5E-02	U	1.50E-02	Not a shallow zone COC			Not a shallow zone COC		
Duplicate of J10FB4	J10FC2	-3.1E-02	U	2.8E-01	1.7E+00		2.E-01	1.5E-02	U	1.50E-02						
Split of J10FB4	J10FC6	1.34E-02	U	9.08E-02	3.6E+00		5.1E-01	1.E-02	B	8.00E-03						
Trench Deep Zone Results:																
DZ-05	J10FF4	2.37E+02		7.1E-01	1.66E+00		2.1E-01	Not a deep zone COC			7.8E+00		5.3E-01	2.86E-01		2.2E-01
Duplicate of J10FF4	J10FC9	2.46E+02		1.1E+00	1.52E+00		2.1E-01				6.2E+00		5.2E-01	2.13E-01	U	2.1E-01
Split of J10FF4	J10FH1	3.40E+02		1.1E+00	4.8E+00		5.1E-01				6.2E+00		7.5E-01	1.50E-01	U	1.5E-01

Trench Shallow Zone Analysis:

		(TDL)	1	0.1	0.05	400	0.1	0.1	30	1	1	0.75	0.2	1	0.5
Duplicate Analysis	Both>MDA?		No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Not a Shallow Zone COC	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both >5xTDL?											No-Stop (acceptable)			
	RPD														
Split Analysis	Both>MDA?		No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Not a Shallow Zone COC	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both >5xTDL?											No-Stop (acceptable)			
	RPD														

Trench Deep Zone Analysis:

		(TDL)	1	0.1	0.05	400	0.1	0.1	30	1	1	0.75	0.001	0.01	0.5
Duplicate Analysis	Both>MDA?		Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Not a deep zone COC	Yes (continue)	Not a deep zone COC
	Both >5xTDL?		No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)				No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)		Yes (calc RPD)	
	RPD			5.19%	15.46%						3.73%			7.56%	
Split Analysis	Both>MDA?		Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Not a deep zone COC	Yes (continue)	Not a deep zone COC
	Both >5xTDL?		No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)					No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)		Yes (calc RPD)	
	RPD			9.94%	29.79%						35.70%			20.29%	

COC = contaminant of concern
MDA = minumum detectable activity
RPD = relative percent difference
TDL = target detection limit

Washington Closure Hanford

CALCULATION SHEET

Originator W. S. Thompson
Project 100-NR-1 TSD Site Remedial Action Project
Subject 116-N-1 Combined Crib and Trench Cleanup Verification 95% UCL Calculation

Date 2/27/06
Job No. 14655

Calc. No. 0100N-CA-V0067
Checked J.M. Capron

Rev. No. 0
Date 2/27/06
Sheet No. 8 of 9

WDOE Splits

Crib (Shallow Zone) WDOE Split Analysis:

Sample Point	HEIS Number	Am-241 pCi/g	Q	MDA	Cs-137 pCi/g	Q	MDA	Co-60 pCi/g	Q	MDA	H-3 pCi/g	Q	MDA	Eu-154 pCi/g	Q	MDA	Eu-155 pCi/g	Q	MDA	Ni-63 pCi/g	Q	MDA	Pu-239/240 pCi/g	Q	MDA	Sr-90 pCi/g	Q	MDA	Nitrate mg/kg	Q	PQL	Hg mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Hexavalent Chromium mg/kg	Q	PQL
Split of BZ-02 Sample																																								
BZ-02	J10F91	-3.5E-02	U	2.7E-01	3.5E-02	U	3.5E-02	2.3E-02	U	2.3E-02	No Split Analysis			7.4E-02	U	7.4E-02	8.6E-02	U	8.6E-02	-1.81E-01	U	3.6E+00	0	U	3.9E-01	-3.6E-02	U	2.8E-01	6.84E-01		2.2E-01	1.8E-02	U	1.6E-02	No Split Analysis			No Split Analysis		
WDOE Split of J10F91	WDOE-SZC-02	-6.E-02	U	1.9E-01	7.6E-02	U	2.E-01	7.E-02	U	2.1E-01	2.E-03	U	3.1E-02	-3.2E-01	U	1.03E+00	4.E-02	U	2.7E-01	-1.E-01	U	3.2E+00	1.30E-02	U	1.6E-02	1.15E-01	U	1.68E-01	2.1E+00	U	2.1E+00	3.5E-02	U	3.5E-02	3.9E+00		1.0E+00	No Split Analysis		
Split of BZ-04 Sample																																								
BZ-04	J10F93	2.5E-02	U	1.9E-01	6.4E-02	U	6.4E-02	1.3E-01	U	1.3E-01	No Split Analysis			1.5E-01	U	1.5E-01	2.5E-01	U	2.5E-01	5.99E-01	U	3.4E+00	3.7E-02	U	2.8E-01	6.39E-01		2.2E-01	7.78E+00		2.1E-01	1.6E-02	U	1.6E-02	No Split Analysis			No Split Analysis		
WDOE Split of J10F93	WDOE-SZC-04	-2.0E-02	U	2.2E-01	1.4E-01	U	2.1E-01	-1.E-02	U	2.7E-01	4.68E-01	LT	4.E-02	-3.9E-01	U	1.66E+00	7.0E-02	U	3.E-01	-1.3E+00	U	3.4E+00	6.E-03	U	8.E-03	6.2E-01		1.9E-01	8.9E+00		2.2E+00	3.8E-02	U	3.9E-02	1.3E+01		1.1E+00	No Split Analysis		
Split of BZ-07 Sample																																								
BZ-07	J10F96	3.7E-02	U	2.9E-01	3.3E-02	U	3.3E-02	3.5E-02	U	3.5E-02	No Split Analysis			1.2E-01	U	1.2E-01	1.3E-01	U	1.3E-01	-1.07E+00	U	3.4E+00	0	U	9.9E-02	2.E-03	U	2.5E-01	1.74E+01		4.2E-01	1.3E-02	U	1.3E-02	No Split Analysis			No Split Analysis		
WDOE Split of J10F96	WDOE-SZC-07	-9.E-02	U	2.7E-01	-8.E-02	U	3.2E-01	0	U	2.5E-01	7.5E-01	LT	4.E-02	-2.7E-01	U	1.64E+00	-6.E-02	U	3.8E-01	-1.4E+00	U	3.3E+00	-4.E-03	U	2.6E-02	1.84E+00	Y1	1.5E-01	1.5E+01		2.2E+00	3.6E-02	U	3.6E-02	1.4E+01		1.1E+00	No Split Analysis		

WDOE Analysis (BZ-02):

(TDL)		1			0.1			0.05			400			0.1			0.1			30			1			1			0.75			0.2			1			0.5		
Split Analysis	Both> MDA?	No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No Split Analysis			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No Split Analysis			No Split Analysis		
	Both >5xTDL?																																							
	RPD																																							

WDOE Analysis (BZ-04):

(TDL)		1			0.1			0.05			400			0.1			0.1			30			1			1			0.75			0.2			1			0.5		
Split Analysis	Both> MDA?	No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No Split Analysis			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			Yes (continue)			Yes (continue)			No-Stop (acceptable)			No Split Analysis			No Split Analysis		
	Both >5xTDL?																										No-Stop (acceptable)			Yes (calc RPD)											
	RPD																													12.36%											

WDOE Analysis (BZ-07):

(TDL)		1			0.1			0.05			400			0.1			0.1			30			1			1			0.75			0.2			1			0.5		
Split Analysis	Both> MDA?	No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No Split Analysis			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			Yes (continue)			No-Stop (acceptable)			No Split Analysis			No Split Analysis		
	Both >5xTDL?																													Yes (calc RPD)											
	RPD																													14.81%											

Crib (Deep Zone) WDOE Split Analysis:

Sample Point	HEIS Number	Am-241 pCi/g	Q	MDA	Cs-137 pCi/g	Q	MDA	Co-60 pCi/g	Q	MDA	H-3 pCi/g	Q	MDA	Eu-154 pCi/g	Q	MDA	Eu-155 pCi/g	Q	MDA	Ni-63 pCi/g	Q	MDA	Pu-239/240 pCi/g	Q	MDA	Sr-90 pCi/g	Q	MDA	Nitrate mg/kg	Q	PQL	Hg mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Hexavalent Chromium mg/kg	Q	PQL
Split of DZ-01 Sample																																								
DZ-01	J01F00	1.4E+00		2.9E-01	8.85E+01		1.7E-01	6.56E+00		7.7E-02	3.23E-01	U	2.1E+00	3.1E-01	U	3.1E-01	5.6E-01	U	5.6E-01	6.87E+00		4.1E+00	1.69E+00		2.2E-01	2.85E+02		2.8E-01	1.1E+00		2.1E-01	No Split Analysis			4.5E+00		6.3E-01	2.09E-01	U	2.1E-01
WDOE Split of J10F00	WDOE-DZC-01	4.1E-01	U	6.1E-01	7.87E+01		4.E-01	5.53E+00		2.3E-01	3.E-02	U	3.E-02	8.E-01	U	1.8E+00	-4.E-02	U	6.3E-01	-3.E-01	U	3.3E+00	4.4E-01		2.8E-02	2.26E+02		0	2.1E+00	U	2.1E+00	3.5E-02	U	3.5E-02	4.7E+00		1.E+00	No Split Analysis		
Split of DZ-05 Sample																																								
DZ-05	J10F04	2.7E+00		4.E-01	3.45E+02		3.5E-01	2.46E+01		1.6E-01	5.63E+00		2.1E+00	4.5E-01	U	4.5E-01	7.9E-01	U	7.9E-01	3.47E+01		3.5E+00	3.74E+00		1.4E-01	1.5E+03		2.7E-01	1.22E+00		2.2E-01	No Split Analysis			2.21E+01		5.4E-01	2.96E+00		2.2E-01
WDOE Split of J10F04	WDOE-DZC-05	8.0E-01	U	8.8E-01	4.31E+02	M 3	1.E+00	3.22E+01		4.E-01	3.46E-01	U	3.1E-02	-6.E-01	U	4.8E+00	5.E-01	U	1.9E+00	1.E-01	U	3.5E+00	9.3E-01		1.E-02	7.3E+02		0	2.1E+00	U	2.1E+00	3.5E-02	U	3.5E-02	1.9E+01		1.E+00	No Split Analysis		
Split of DZ-10 Sample																																								
DZ-10	J10F08	1.86E-01	U	3.E-01	9.64E+01		1.9E-01	1.18E+01		9.9E-02	1.91E+00	U	2.2E+00	2.8E-01	U	2.8E-01	3.8E-01	U	3.8E-01	2.44E+00	U	4.2E+00	3.18E-01		1.4E-01	2.62E+02		2.9E-01	3.89E+00		2.3E-01	No Split Analysis			1.9E+01		5.6E-01	7.8E-01		2.3E-01
WDOE Split of J10F08	WDOE-DZC10	-6.E-02	U, G	7.E-01	1.14E+02	G	0	1.28E+01	G	3.E-01	1.53E-01	U	4.3E-02	1.3E+00	U, G	2.8E+00	1.1E-01	U, G	8.0E-01	-3.E-01	U	3.1E+00	3.71E-01		8.E-03	2.65E+02		0	4.4E+00		2.3E+00	3.8E-02	U	3.8E-02	1.8E+01		1.1E+00	No Split Analysis		

WDOE Analysis (DZ-01):

(TDL)		1			0.1			0.05			400			0.1			0.1			30			1			1			0.75			0.001			0.01			0.5		
Split Analysis	Both> MDA?	No-Stop (acceptable)			Yes (continue)			Yes (continue)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			Yes (continue)			Yes (continue)			No-Stop (acceptable)			No Split Analysis			Yes (continue)			No Split Analysis		
	Both >5xTDL?				Yes (calc RPD)			Yes (calc RPD)															No-Stop (acceptable)			Yes (calc RPD)									Yes (calc RPD)					
	RPD				9.44%			17.07%																		23.44%									4.35%					

WDOE Analysis (DZ-05):

(TDL)		1			0.1			0.05			400			0.1			0.1			30			1			1			0.75			0.001			0.01			0.5		
Split Analysis	Both> MDA?	No-Stop (acceptable)			Yes (continue)			Yes (continue)			Yes (continue)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			Yes (continue)			Yes (continue)			No-Stop (acceptable)			No Split Analysis			Yes (continue)			No Split Analysis		
	Both >5xTDL?				Yes (calc RPD)			Yes (calc RPD)			No-Stop (acceptable)												No-Stop (acceptable)			Yes (calc RPD)									Yes (calc RPD)					
	RPD				22.16%			27.16%																		69.06%									20.45%					

WDOE Analysis (DZ-10):

(TDL)		1			0.1			0.05			400			0.1			0.1			30			1			1			0.75			0.001			0.01			0.5		
Split Analysis	Both> MDA?	No-Stop (acceptable)			Yes (continue)			Yes (continue)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			No-Stop (acceptable)			Yes (continue)			Yes (continue)			Yes (continue)			No Split Analysis			Yes (continue)			No Split Analysis		
	Both >5xTDL?				Yes (calc RPD)			Yes (calc RPD)															No-Stop (acceptable)			Yes (calc RPD)			Yes (calc RPD)						Yes (calc RPD)					
	RPD				14.69%			5.91%																		1.14%			9.77%						5.41%					

COC = contaminant of concern
MDA = minumum detectable activity
Q = Qualifiers
RPD = relative percent difference
TDL = target detection limit

Qualifiers: G = Sample density differs by more than 15% of laboratory control sample density.
LT = Result is less than requested MDA, greater than sample specific MDA.
M3 = The requested MDA was not met, but the reported activity I greater than the reported MDA

CVP-2006-00004
Rev. 0
For Approval

Washington Closure Hanford

CALCULATION SHEET

Originator W. S. Thompson
Project 100-NR-1 TSD Site Remedial Action Project
Subject 116-N-1 Combined Crib and Trench Cleanup Verification 95% UCL Calculation

Date 2/27/06
Job No. 14855

Calc. No. 0100N-CA-V0087
Checked J.M. Capron

Rev. No. 0
Date 2/27/06
Sheet No. 9 of 9

1 WDOE Splits
2 Trench (Shallow Zone) WDOE Split Analysis:

Sample Point	HEIS Number	Am-241 pCi/g	Q	MDA	Cs-137 pCi/g	Q	MDA	Co-60 pCi/g	Q	MDA	H-3 pCi/g	Q	MDA	Eu-154 pCi/g	Q	MDA	Eu-155 pCi/g	Q	MDA	Ni-63 pCi/g	Q	MDA	Pu-239/240 pCi/g	Q	MDA	Sr-90 pCi/g	Q	MDA	Nitrate mg/kg	Q	PQL	Hg mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Hexavalent Chromium mg/kg	Q	PQL
Split of SZ-01 Sample																																								
SZ-01	J10FB0	6.6E-02	U	2.3E-01	1.95E-01		4.6E-02	1.11E-01		4.6E-02	No Split Analysis			1.2E-01	U	1.2E-01	9.4E-02	U	9.4E-02	1.47E+00	U	2.8E+00	7.4E-02	U	1.9E-01	1.4E-02	U	6.5E-01	1.8E+00		2.1E-01	1.7E-02	U	1.7E-02	No Split Analysis			No Split Analysis		
WDOE Split of J10FB0	WDOE-SZT-01	-3.5E-02	U, G	1.84E-01	2.2E-01	U, G	2.2E-01	3.E-02	U, G	2.1E-01	7.E-03	U	3.6E-02	3.E-02	U, G	1.08E+00	1.E-01	U, G	2.5E-01	-1.E-01	U	3.3E+00	1.6E-03	U	1.9E-02	1.37E-01	U	1.67E-01	2.1E+00	U	2.1E+00	3.5E-02	U	3.5E-02	7.4E+00		1.1E+00	No Split Analysis		
Split of SZ-04 Sample																																								
SZ-04	J10FB3	1.7E-02	U	1.8E-01	1.05E-01		3.1E-02	4.1E-02	U	4.1E-02	No Split Analysis			1.4E-01	U	1.4E-01	7.4E-02	U	7.4E-02	8.11E-01	U	3.6E+00	0	U	1.8E-01	1.06E-01	U	2.4E-01	5.01E-01		2.0E-01	1.6E-02	U	1.6E-02	No Split Analysis			No Split Analysis		
WDOE Split of J10FB3	WDOE-SZT-04	5.E-02	U	2.1E-01	1.1E-01	U	1.8E-01	0	U	2.E-01	9.E-03	U	3.5E-02	-4.4E-01	U	1.6E+00	7.E-02	U	3.6E-01	-6.E-01	U	3.6E+00	1.E-03	U	1.9E-02	6.7E-02	U	1.62E-01	2.1E+00	U	2.1E+00	3.5E-02	U	3.5E-02	4.4E+00		1.1E+00	No Split Analysis		
Split of SZ-07 Sample																																								
SZ-07	J10FB6	3.99E+00		3.9E-01	8.26E-01		4.1E-02	8.5E-02	U	8.5E-02	No Split Analysis			1.2E-01	U	1.2E-01	7.2E-02	U	7.2E-02	1.16E+00	U	3.6E+00	0	U	1.8E-01	1.48E-01	U	2.5E-01	1.72E+01		4.3E-01	1.8E-02	U	1.8E-02	No Split Analysis			No Split Analysis		
WDOE Split of J10FB6	WDOE-SZT-07	-2.E-02	U	2.1E-01	8.7E-01		1.8E-01	0	U	2.5E-01	1.2E-02	U	4.E-02	0	U	1.06E+00	1.3E-01	U	2.7E-01	-4.E-01	U	3.3E+00	3.E-03	U	8.E-03	1.24E-01	U	1.48E-01	9.2E+00		2.1E+00	3.6E-02	U	3.6E-02	9.6E+00		1.1E+00	No Split Analysis		

15 WDOE Analysis (SZ-01):

		Am-241	Cs-137	Co-60	H-3	Eu-154	Eu-155	Ni-63	Pu-239/240	Sr-90	Nitrate	Hg	Chromium	Hexavalent Chromium
(TDL)		1	0.1	0.05	400	0.1	0.1	30	1	1	0.75	0.2	1	0.5
Split Analysis	Both> MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No Split Analysis	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No Split Analysis	No Split Analysis
	Both >5xTDL?													
	RPD													

21 WDOE Analysis (SZ-04):

		Am-241	Cs-137	Co-60	H-3	Eu-154	Eu-155	Ni-63	Pu-239/240	Sr-90	Nitrate	Hg	Chromium	Hexavalent Chromium
(TDL)		1	0.1	0.05	400	0.1	0.1	30	1	1	0.75	0.2	1	0.5
Split Analysis	Both> MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No Split Analysis	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No Split Analysis	No Split Analysis
	Both >5xTDL?													
	RPD													

27 WDOE Analysis (SZ-07):

		Am-241	Cs-137	Co-60	H-3	Eu-154	Eu-155	Ni-63	Pu-239/240	Sr-90	Nitrate	Hg	Chromium	Hexavalent Chromium
(TDL)		1	0.1	0.05	400	0.1	0.1	30	1	1	0.75	0.2	1	0.5
Split Analysis	Both> MDA?	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	No Split Analysis	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	No Split Analysis	No Split Analysis
	Both >5xTDL?		Yes (calc RPD)								Yes (calc RPD)			
	RPD		4.95%								60.61%			

33 Trench (Deep Zone) WDOE Split Analysis:

Sample Point	HEIS Number	Am-241 pCi/g	Q	MDA	Cs-137 pCi/g	Q	MDA	Co-60 pCi/g	Q	MDA	H-3 pCi/g	Q	MDA	Eu-154 pCi/g	Q	MDA	Eu-155 pCi/g	Q	MDA	Ni-63 pCi/g	Q	MDA	Pu-239/240 pCi/g	Q	MDA	Sr-90 pCi/g	Q	MDA	Nitrate mg/kg	Q	PQL	Hg mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Hexavalent Chromium mg/kg	Q	PQL
Split of DZ-02 Sample																																								
DZ-02	J10FF1	7.29E+00		5.2E-01	1.1E+03		2.2E+00	4.50E+00	U	4.5E+00	6.19E+00		2.2E+00	2.5E+00	U	2.5E+00	3.0E+00	U	3.E+00	4.37E+01		3.9E+00	9.98E+00		2.4E-01	8.60E+01		8.1E-01	2.62E+00		2.3E-01	No Split Analysis			1.33E+01		5.8E-01	2.34E-01	U	2.3E-01
WDOE Split of J10FF1	WDOE-DZT-02	7.4E+00		1.7E+00	1.3E+03	M 3	0	2.57E+02		1.5E+00	2.E-02	U	5.2E-02	-1.6E+00	U	1.25E+01	1.6E+00	U	2.9E+00	9.9E+00	LT	3.2E+00	1.07E+01		0	6.5E+01		0	3.3E+00		2.3E+00	3.9E-02	U	3.9E-02	9.8E+00		1.2E+00	No Split Analysis		
Split of DZ-07 Sample																																								
DZ-07	J10FF8	7.38E+00		3.E-01	3.84E+03		2.8E+00	5.98E+01		5.E-01	2.3E+01		2.2E+00	2.46E+00		1.2E+00	3.8E+00	U	3.8E+00	2.86E+01		4.1E+00	7.62E+00		2.2E-01	2.02E+03		1.8E+00	4.29E+00		2.1E-01	No Split Analysis			8.6E+00		5.3E-01	2.11E-01	U	2.1E-01
WDOE Split of J10FF8	WDOE-DZT-07	1.5E+00	U	2.4E+00	5.19E+03	M 3	0	7.80E+01		5.6E-01	6.5E-01	LT	3.E-02	3.1E+00	U	5.E+00	-2.7E+00	U	4.5E+00	1.05E+01		3.6E+00	3.09E+00		1.6-02	1.3E+03		0	3.2E+00		2.1E+00	3.4E-02	U	3.4E-02	7.E+00		1.E+00	No Split Analysis		
Split of DZ-10 Sample																																								
DZ-10	J10FF9	1.09E+00		3.9E-01	9.47E+01		4.2E-01	1.43E+01		1.4E-01	3.27E+00		2.2E+00	6.3E-01	U	6.3E-01	8.1E-01	U	8.1E-01	8.8E+00		4.E+00	6.5E+00		4.E+00	1.1E+00		2.0E-01	1.17E+01		4.4E-01	No Split Analysis			1.16E+01		5.4E-01	2.17E-01	U	2.2E-01
WDOE Split of J10FF9	WDOE-DZT10	-6.E-02	U, G	7.5-01	1.14E+02	G	0	1.28E+01	G	3.E-01	1.53E-01	U	4.3E-02	1.3E+00	U, G	2.6E+00	1.1E-01	U, G	9.9E-01	1.1E+00	U	3.3E+00	3.71E-01		6.E-03	2.85E+02		0	4.4E+00		2.3E+00	3.9E-02	U	3.9E-02	1.8E+01		1.1E+00	No Split Analysis		

46 WDOE Analysis (DZ-02):

		Am-241	Cs-137	Co-60	H-3	Eu-154	Eu-155	Ni-63	Pu-239/240	Sr-90	Nitrate	Hg	Chromium	Hexavalent Chromium
(TDL)		1	0.1	0.05	400	0.1	0.1	30	1	1	0.75	0.001	0.01	0.5
Split Analysis	Both> MDA?	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No Split Analysis	Yes (continue)	No Split Analysis
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)					No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)		Yes (calc RPD)	
	RPD	1.50%	18.67%						6.96%	0.77%			29.31%	

52 WDOE Analysis (DZ-07):

		Am-241	Cs-137	Co-60	H-3	Eu-154	Eu-155	Ni-63	Pu-239/240	Sr-90	Nitrate	Hg	Chromium	Hexavalent Chromium
(TDL)		1	0.1	0.05	400	0.1	0.1	30	1	1	0.75	0.001	0.01	0.5
Split Analysis	Both> MDA?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No Split Analysis	Yes (continue)	No Split Analysis
	Both >5xTDL?		Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)		No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)		Yes (calc RPD)	
	RPD		29.90%	26.42%		23.42%				43.37%			25.00%	

58 WDOE Analysis (DZ-10):

		Am-241	Cs-137	Co-60	H-3	Eu-154	Eu-155	Ni-63	Pu-239/240	Sr-90	Nitrate	Hg	Chromium	Hexavalent Chromium
(TDL)		1	0.1	0.05	400	0.1	0.1	30	1	1	0.75	0.001	0.01	0.5
Split Analysis	Both> MDA?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	No Split Analysis	Yes (continue)	No Split Analysis
	Both >5xTDL?		Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)				No-Stop (acceptable)*	No-Stop (acceptable)	Yes (calc RPD)		Yes (calc RPD)	
	RPD		18.50%	10.29%							90.68%		44.07%	

83 * The difference between the main and the split sample exceeds 2 times the TDL.

54 COC = contaminant of concern
55 MDA = minimum detectable activity
56 Q = Qualifiers
57 RPD = relative percent difference
58 TDL = target detection limit

Qualifiers: G = Sample density differs by more than 15% of laboratory control sample density.
LT = Result is less than requested MDA, greater than sample specific MDA.
M3 = The requested MDA was not met, but the reported activity | greater than the reported MDA.

CVP-2006-00004
Rev. 0
For Approval

CALCULATION COVER SHEET

Project Title 100-NR-1 TSD Site **Job No.** 14655
Area 100-N Area
Discipline Environmental ***Calc. No.** 100N-CA-V0088
Subject 116-N-1 Combined Crib and Trench Cleanup Verification RESRAD Calculation
Computer Program RESRAD **Program No.** Version 6.30

The attached calculations have been generated to document compliance with established cleanup levels.
These documents should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐ **Voided** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover – 1 pg Summary – 5 pg Attm. 1 - 1 pg Attm. 2 - 25 pg Attm. 3 - 44 pg Attm. 4 - 21 pg Attm. 5 - 28 pg Attm. 6 - 44 pg Attm. 7 - 21 pg Total – 190 pg	S. W. Clark *Approved* *2/27/2006*	M. W. Perrott *Approved* *2/27/2006*	T. M. Blakley *Approved* *2/27/2006*	S. E. Parnell *Approved* *2/27/2006*	*Approved* *2/27/2006*
1	No Change	S. W. Clark 3/29/06	M. W. Perrott 3/29/06	T. M. Blakley 3/29/06	S. E. Parnell	3/29/06

SUMMARY OF REVISION

1	It was necessary to revise this calculation brief in response to comments from Washington Department of Ecology to (1) Correct a typographical error in the cobalt-60 soil activity in Table 3 on page 3 (the correct activity is 310 pCi/g that was used in the calculations) and (2) Add to the Conclusions on page 4 the fact that in addition to cobalt-60 the major contributors to radionuclide dose include cesium-137 in the direct exposure pathway and strontium-90 in the plant ingestion pathway. Changes are indicated by change bars in the right margin of the affected pages.

*Obtain Calc. No. from DIS

DE01-437.03 (12/09/2004)

Washington Closure Hanford . CALCULATION SHEET

Originator:	S. W. Clark	Date:	3/27/06	Calc. No.:	100N-CA-V0088	Rev.:	0 1
Project:	100-NR-1 TSD Site	Job No:	14655	Checked:	M. W. Perrott	Date:	3/29/06
Subject:	116-N-1 Combined Crib and Trench Cleanup Verification RESRAD Calculation					Sheet No. 1 of 5	

PURPOSE:

Calculate the predicted soil and groundwater concentrations, dose, and risk contributions from radionuclide contaminants in shallow zone and deep zone soil for the combined crib and trench at the 116-N-1 remediation site.

GIVEN/REFERENCES:

1) Cleanup verification data from *116-N-1 Combined Crib and Trench Cleanup Verification 95% UCL Calculation*, Calculation No. 0100N-CA-V0087, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
2) *Remedial Design Report/Remedial Action Work Plan for the 100-NR-1 Treatment, Storage, and Disposal Units* (RDR/RAWP), DOE/RL-2000-16, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, WA.
3) Radioactive and nonradioactive contaminants of concern from the *100-NR-1 Treatment, Storage, and Disposal Units During Remediation and Closeout Sampling and Analysis Plan* (100-NR-1 SAP), DOE/RL-2000-07, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. For the purpose of these RESRAD calculations, the radioactive contaminants of concern (COCs) are americium-241, cesium-137, cobalt-60, europium-154, europium-155, tritium, nickel-63, plutonium-239/240, and strontium-90. The nonradionuclide contaminants of concern are nitrate, total chromium, hexavalent chromium, nitrate, and mercury. Concentrations of all nonradionuclide contaminants are below the remedial action goals per the RDR/RAWP and they are not considered further.
4) RESidual RADioactivity (RESRAD) computer code, version 6.30, to calculate compliance with residual radioactivity guidelines, developed for the U.S. Department of Energy by the Environmental Assessment Division of Argonne National Laboratory, Argonne, Illinois.
5) *116-N-1 RESRAD Evaluation of Groundwater Protection*, Calc. No. 100N-CA-V0066, January, 2003, Bechtel Hanford, Inc., Richland, Washington.
6) Relative individual Pu-239 and Pu-240 activities were calculated from the reported Pu-239/240 results per *Ratios of Plutonium Isotopes at 100 Areas Remedial Action Sites*, Calculation No. 0100B-CA-V0013, Bechtel Hanford, Inc., Richland, Washington.

SOLUTION:

1) RESRAD runs were performed for the residual contamination in shallow zone and deep zone for the combined crib and trench at the 116-N-1 site. Table 1 shows the elevations (NGVD88) and dimensions of the relevant soil horizons. The ground surface elevation for excavation backfill is 140.0 m. The average groundwater elevation beneath the site is 117.5 m. The average elevation of the excavation floor is 133.5 m. Attachment 1 shows the dimensions of each soil horizon and the contaminant pathways considered for dose, risk, and groundwater protection. Input factors for the RESRAD run are shown in the "Summary" section of the RESRAD "Part I: Mixture Sums and Single Radionuclide Guidelines" printouts in the Attachments to this Calculation Summary.

2) The year where the peak dose (or concentration) occurs in the groundwater from each individual COC was examined by a preliminary RESRAD modeling run. This year was then added for all horizons for the final RESRAD runs. For the groundwater (well water) the peak year was year 146 for tritium (H-3). The 146-year time period was included in all of the RESRAD runs. Year 12 was also added, corresponding to 2018, the date of the 30-year site cleanup schedule of the *Hanford Federal Facility Agreement and Consent Order*.

Table 1. Waste Site Dimensions for RESRAD Modeling

Parameter	Units	Shallow Zone	Deep Zone	Comments
Contaminated Zone Dimensions				
Cover Depth	m	0	4.6	
Area of Contaminated Zone (CZ)	m^2	36,011	36,011	Total Waste Site Area
Length Parallel to Aquifer Flow	m	120	120	Based on Site Dimensions
Elevations of Vadose Zone Horizons				
Elevation: Surface	m	140.0	140.0	NAVD88
Elevation: Bottom of Excavation	m	133.5	133.5	NAVD88
Elevation: Groundwater	m	117.5	117.5	NAVD88
Thickness: Contaminated Zone	m	4.6	10.1	
Thickness: Unsaturated Zone	m	17.9	7.8	Calc. No. 100N-CA-V0066

METHODOLOGY:

1) Pu-239/240 Conversion: The relative individual Pu-239 and Pu-240 activities were calculated from the combined Pu-239/240 results reported. The calculations were performed in accordance with calculation brief No. 0100B-CA-V0013. The relative activities for Pu-239 and Pu-240 were calculated by multiplying the cleanup verification value for Pu-239/240 by 0.807 and 0.193, respectively. Table 2 shows the results from this calculation.

Table 2. Conversion of Pu-239/240 to Relative Pu-239 and Pu-240 Activities

Source of Radionuclide Data	Pu-239/240 Activity (pCi/g)	Pu-239, (pCi/g) (0.807 multiplier)	Pu-240, (pCi/g) (0.193 multiplier)
Shallow Zone	0.026 U	0.021 U	0.005 U
Deep Zone	41	33	8.0

2) Runs of RESRAD Version 6.30 were completed for the shallow and deep zones using the radionuclide concentrations shown in Table 3. RESRAD numerical output reports for dose, risk, and concentration for the shallow and deep zones are presented in the Attachments to this Calculation Summary.

Washington Closure Hanford . CALCULATION SHEET

Originator:	S. W. Clark	Date:	3/29/06	Calc. No.:	100N-CA-V0088	Rev.:	0
Project:	100-NR-1 TSD Site	Job No:	14655	Checked:	M. W. Perrott	Date:	3/29/06
Subject:	116-N-1 Combined Crib and Trench Cleanup Verification RESRAD Calculation					Sheet No. 3 of 5	

Table 3. 116-N-1 Shallow and Deep Zone Radionuclide Soil Concentrations

Radionuclide COCs	Shallow Zone Radionuclide Soil Activity, pCi/g	Deep Zone Radionuclide Soil Activity, pCi/g
Am-241	0.55	35
Co-60	0.121	310
Cs-137	0.36	5,100
Eu-154	0.071 U[a]	7.3
Eu-155	0.069 U[a]	1.9
H-3 (tritium)	NA	16
Ni-63	0.97 U[a]	170
Pu-239	0.21 U[a]	33
Pu-240	0.005 U[a]	8
Sr-90	0.18	931

[a] U = undetected. Value was not input into RESRAD because the radionuclide was undetected in soil samples.
[b] RESRAD does not accept negative values. When results are negative, zero is used as the input value.
NA = Not analyzed; not a shallow zone contaminant of concern

RESULTS:

1) **Radionuclide "All Pathways" Dose Rate:** The "all pathways" (maximum) dose rates are shown in Table 4. The maximum dose rate of 3.35 mrem/yr from the combined shallow zone and deep zone occurs at year zero (2006).

Table 4. All Pathways Dose Rate (mrem/yr)

Vadose Zone Horizon	"All Pathways" Dose Contributions in mrem/yr at Each Time Slice (yr)									
	0	1	3	7	12	30	100	146	300	1000
Shallow Zone	3.35E+00	3.16E+00	2.85E+00	2.38E+00	1.97E+00	1.24E+00	4.03E-01	2.66E-01	1.61E-01	5.09E-02
Deep Zone	9.12E-21	8.09E-21	6.37E-21	3.94E-21	2.17E-21	2.52E-22	2.04E-25	7.67E-05	6.70E-09	2.45E-27
Total	3.35E+00	3.16E+00	2.85E+00	2.38E+00	1.97E+00	1.24E+00	4.03E-01	2.66E-01	1.61E-01	5.09E-02

2) **Radionuclide Excess Cancer Risk:** The radionuclide excess cancer risk results are shown on Table 5. The maximum risk (3.66×10^{-5}) occurs at year zero (2006).

Table 5. Radionuclide Excess Cancer Risk

Vadose Zone Horizon	Excess Cancer Risk at Each Time Slice (yr)									
	0	1	3	7	12	30	100	146	300	1000
Shallow Zone	3.66E-05	3.51E-05	3.24E-05	2.80E-05	2.40E-05	1.50E-05	3.20E-06	1.36E-06	3.74E-07	1.12E-07
Deep Zone	6.02E-26	5.34E-26	4.20E-26	2.60E-26	1.43E-26	1.65E-27	2.60E-30	1.97E-09	1.72E-13	1.53E-27
Total	3.66E-05	3.51E-05	3.24E-05	2.80E-05	2.40E-05	1.50E-05	3.20E-06	1.36E-06	3.74E-07	1.12E-07

3) **Radionuclide Groundwater Protection:** The radionuclide concentrations in groundwater due to shallow zone and deep zone soil concentrations were calculated by the RESRAD model and summarized in Table 6. Only tritium (H-3) of the radionuclide contaminants of concern were calculated to reach groundwater in the 1,000 years of the RESRAD modeling runs at concentrations much below the drinking water remedial action goal (RAG) of 20,000. Therefore there is no need to do a comparison to drinking water standards (MCL) calculation brief for the 116-N-1 Combined Crib and Trench.

Table 6. RESRAD Calculated Groundwater (Well Water) Concentrations.

Radio-nuclide	Groundwater Concentration in pCi/L at Each Time Slice (yr)										RAG pCi/L
	0	1	3	7	12	30	100	146	300	1000	
Am-241	0	0	0	0	0	0	0	0	0	0	1.2
Co-60	0	0	0	0	0	0	0	0	0	0	100
Cs-137	0	0	0	0	0	0	0	0	0	0	60
Eu-154	0	0	0	0	0	0	0	0	0	0	60
Eu-155	0	0	0	0	0	0	0	0	0	0	600
H-3	0	0	0	0	0	0	0	1.52E+00	1.325E-04	4.709E-23	20,000
Ni-63	0	0	0	0	0	0	0	0	0	0	50
Pu-239	0	0	0	0	0	0	0	0	0	0	1.6
Pu-240	0	0	0	0	0	0	0	0	0	0	1.2
Sr-90	0	0	0	0	0	0	0	0	0	0	8

CONCLUSIONS:

- The "all pathways" (maximum) dose rates are shown in Table 4. The combined maximum all-pathways dose rate for the shallow and deep zones is 3.35 mrem/yr which occurs at year zero (2006).

- The dominant pathway for the dose rate is direct external exposure.

- The primary radionuclides contributing to the dose rate are cobalt-60 and cesium-137 in the direct exposure pathway and strontium-90 in the plant ingestion pathway.

- None of the site COCs are projected to exceed remedial action goals (RAGs).

- The radionuclide excess lifetime cancer risk results are shown in Table 5. The maximum combined shallow and deep zone excess lifetime cancer risk (3.66×10^{-5}) occurs at year zero (2006).

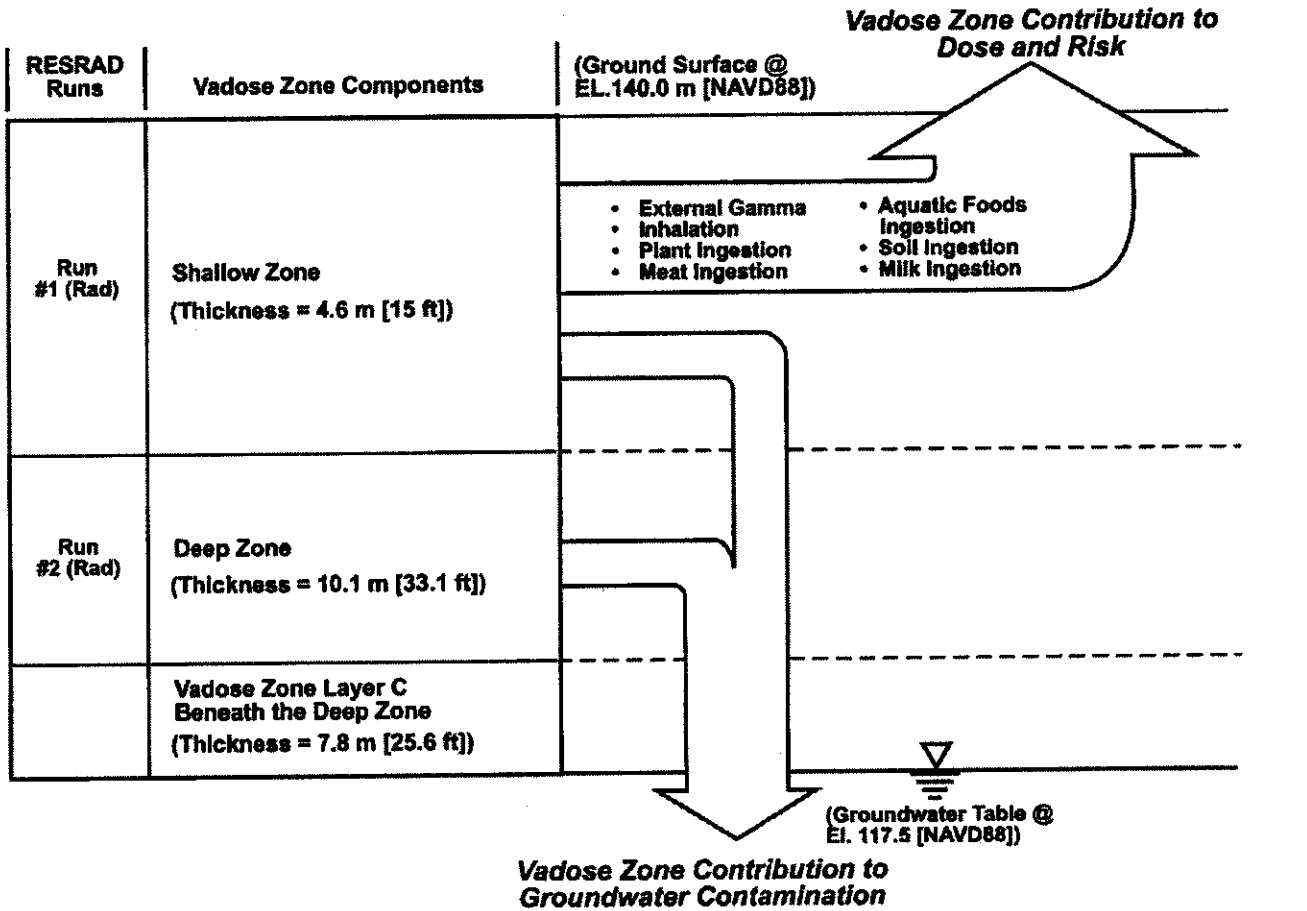
- Only tritium (H-3) of the radionuclide contaminants of concern is predicted to reach groundwater in the 1,000 years of the RESRAD model run at concentrations much below the RAG. Therefore there is no need to do a comparison to drinking water standards (MCL) calculation brief for the 116-N-1 Combined Crib and Trench.

ATTACHMENTS:

1. Graphic showing 116-N-1 Vadose Zone Model (1 page)
2. RESRAD Output: 116-N-1 Evaluation of Shallow Zone for Combined Crib and Trench; Part I: Mixture Sums and Single Radionuclide Guidelines (25 pages)
3. RESRAD Output: 116-N-1 Evaluation of Shallow Zone for Combined Crib and Trench; Part III: Intake Quantities and Health Risk Factors (44 pages)
4. RESRAD Output: 116-N-1 Evaluation of Shallow Zone for Combined Crib and Trench; Part IV: Concentration of Radionuclides (21 pages)
5. RESRAD Output: 116-N-1 Evaluation of Deep Zone for Combined Crib and Trench; Part I: Mixture Sums and Single Radionuclide Guidelines (28 pages)
6. RESRAD Output: 116-N-1 Evaluation of Deep Zone for Combined Crib and Trench; Part III: Intake Quantities and Health Risk Factors (44 pages)
7. RESRAD Output: 116-N-1 Evaluation of Deep Zone for Combined Crib and Trench; Part IV: Concentration of Radionuclides (21 pages)

ATTACHMENT 1

116-N-1 Trench Cleanup Verification Model



Attachment 1 Sheet No. 1 of 1
Originator S.W. Clark Date 3/27/06
Chk'd By M.W. Perrott Date 2/22/06
Calc. No. 0100N-CA-V0068 Rev. No. 0

CALCULATION COVER SHEET

Project Title 100-NR-1 TSD Sites Remediation **Job No.** 14655

Area 100-N

Discipline Environmental ***Calc. No.** 0100N-CA-V0085

Subject Shallow and Deep Zone Sample Design for the 116-N-1 Trench and Crib

Computer Program Visual Sample Plan **Program No.** Version 4.0a

The attached calculations have been generated to document compliance with established cleanup levels. These documents should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐ **Voided** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 sheet Calculations = 3 Attachments = 2 Total= 6	W. S. Thompson 11/9/05	R. B. Kerkow 11/9/05	R. T. Moore 11/10/05	J. D. Pancher	11/10/05

SUMMARY OF REVISION

*Obtain Calc. No. from DIS

DE01437.03 (12/09/2004)

CALCULATION SHEET

Originator W. S. Thompson **Date** 11/09/05 **Calc. No.** 0100N-CA-V0085 **Rev. No.** 0

Project 100-NR-1 TSD Remediation **Job No.** 14655 **Checked** R. B. Kerkow **Date** 11/9/05

Subject Shallow and Deep Zone Sample Design for the 116-N-1 Trench and Crib **Sheet No.** Page 1 of 3

PURPOSE:

Provide documentation to support the calculation of coordinates of locations of cleanup verification samples for the shallow and deep zone of the 116-N-1 Crib and Trench per the requirements of the *Sampling and Analysis Plan for the 100-NR-1 Treatment, Storage, and Disposal Units During Remediation and Closeout* (DOE/RL 2000).

GIVEN/REFERENCES:

1) DOE-RL, 2000, *Sampling and Analysis Plan for the 100-NR-1 Treatment, Storage, and Disposal Units During Remediation and Closeout*, DOE/RL-2000-07, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) Gilbert, R. O., J. E. Wilson, R. F. O'Brien, D. K. Carlson, D. J. Bates, B. A. Pulsipher, C. A. McKinstry, 2002, *Version 2.0 Visual Sample Plan (VSP): Models and Code Verification*, PNNL-3991, Pacific Northwest National Laboratory, Richland, Washington.

3) Visual Sampling Plan, a site map-based user-interface computer software program that may be downloaded at http://etd.pnl.gov:2080/DQO/software/vsp/vspbeta.html.

REQUIREMENTS:

Sections 3.2.2.5, 3.2.2.6, 3.2.2.7, and 3.2.2.8 of the DOE-RL (2000), Rev. 1, require the following:

- 10 samples to be collected from each of the shallow and deep zones of the 116-N-1 Trench
- 10 samples to be collected from each of the shallow and deep zones of the 116-N-1 Crib
- A simple random sampling design.

CALCULATIONS:

Coordinates of verification sampling locations were calculated using Visual Sampling Plan (VSP) computer software. Verification samples were placed in the sample areas by using the regular simple random sampling algorithm (Gilbert et al. 2002) that is consistent with the procedure outlined in Section A.1 of Appendix A of DOE-RL (2000). Using this method, each sample is placed according to the following algorithm without regard to existing samples:

1. The sample point coordinates are calculated using the following equations:

$$X=X_{min}+(X_{max}-X_{min})*RND \qquad \text{(Eq.1)}$$

$$Y=Y_{min}+(Y_{max}-Y_{min})*RND \qquad \text{(Eq.2)}$$

CALCULATION SHEET

Originator W. S. Thompson **Date** 11/09/05 **Calc. No.** 0100N-CA-V0085 **Rev. No.** 0
Project 100-NR-1 TSD Remediation **Job No.** 14655 **Checked** R. B. Kerkow **Date** 11/9/05
Subject Shallow and Deep Zone Sample Design for the 116-N-1 Trench and Crib **Sheet No.** Page 2 of 3

Where RND is the next unused random number between 0 and 1 in a sequence of random numbers that VSP generates using a pseudo-random number generator (Gilbert et al. 2002).

The sample location (X,Y) is checked in VSP to ensure it lies inside the sample area. If it does, a new sample point is added at the location. If not, another random location is tried.

The VSP continues to generate the next random coordinate (X,Y).

RESULTS:

The following tables provide the 10 shallow zone sample locations for the crib and the trench that fell within the sample area shown on Attachment A.

Shallow Zone Crib Sample Locations		
Sample Number	Washington State Plane Coordinates	
	Easting	Northing
SZC-01	571455	149758
SZC-02	571444	149740
SZC-03	571426	149676
SZC-04	571439	149669
SZC-05	571464	149660
SZC-06	571481	149651
SZC-07	571509	149652
SZC-08	571519	149666
SZC-09	571500	149690
SZC-10	571516	149708

Shallow Zone Trench Sample Locations		
Sample Number	Washington State Plane Coordinates	
	Easting	Northing
SZT-01	571711	150070
SZT-02	571615	149954
SZT-03	571559	149947
SZT-04	571539	149841
SZT-05	571548	149746
SZT-06	571568	149786
SZT-07	571597	149874
SZT-08	571658	149891
SZT-09	571681	149919
SZT-10	571740	149995

CALCULATION SHEET

Originator W. S. Thompson **Date** 11/09/05 **Calc. No.** 0100N-CA-V0085 **Rev. No.** 0

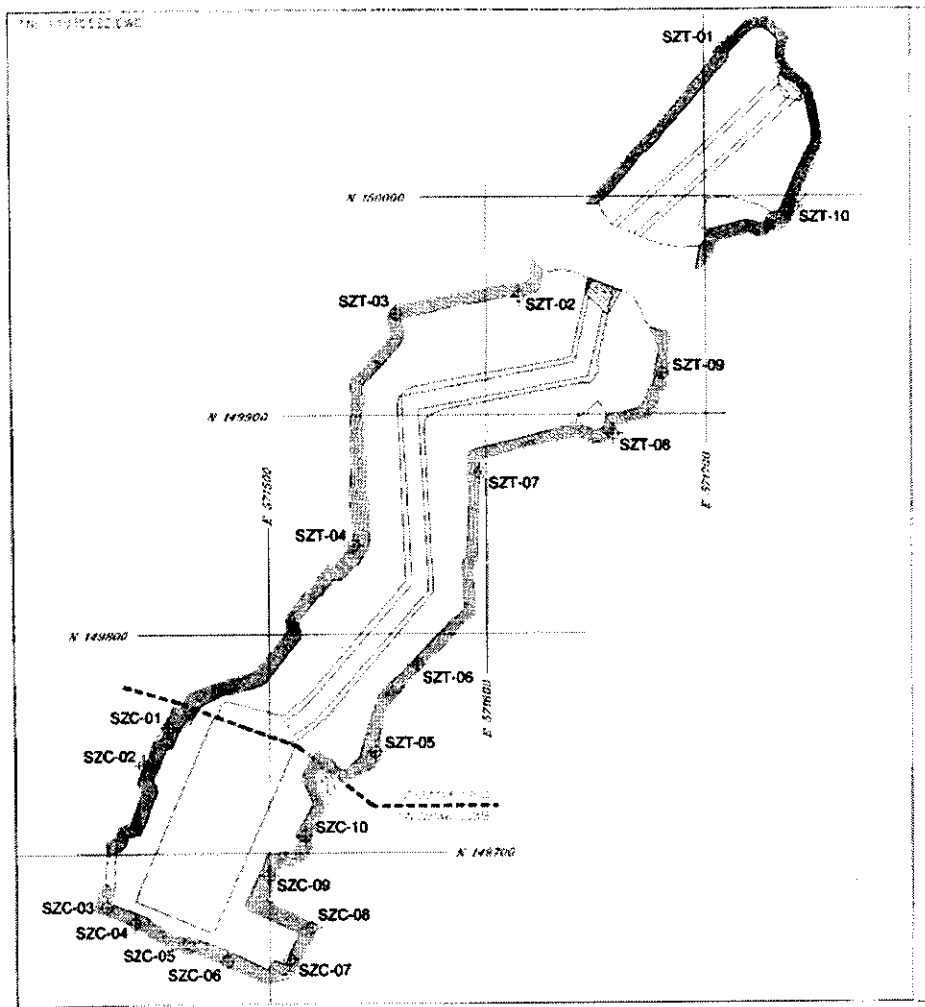
Project 100-NR-1 TSD Remediation **Job No.** 14655 **Checked** R. B. Kerkow RBK **Date** 11/9/05

Subject Shallow and Deep Zone Sample Design for the 116-N-1 Trench and Crib **Sheet No.** Page 3 of 3

The following tables provide the 10 deep zone sample locations for the crib and the trench that fell within the sample area shown on Attachment B.

Deep Zone Crib Sample Locations		
Sample Number	Washington State Plane Coordinates	
	Easting	Northing
DZC-01	571508	149741
DZC-02	571487	149737
DZC-03	571458	149744
DZC-04	571470	149731
DZC-05	571478	149716
DZC-06	571507	149705
DZC-07	571454	149700
DZC-08	571489	149671
DZC-09	571489	149656
DZC-10	571440	149681

Deep Zone Trench Sample Locations		
Sample Number	Washington State Plane Coordinates	
	Easting	Northing
DZT-01	571723	150045
DZT-02	571723	150016
DZT-03	571692	150007
DZT-04	571651	149945
DZT-05	571658	149936
DZT-06	571635	149923
DZT-07	571574	149896
DZT-08	571578	149848
DZT-09	571559	149819
DZT-10	571531	149802



SCALE 1:2000

20 0 20 40 80 meters

A

W.S. Thompson

R.B. Kerkow Rev.

0100N-CA-V008s

Sheet No. 1 of 1

Date 11/9/05

Date 11/9/05

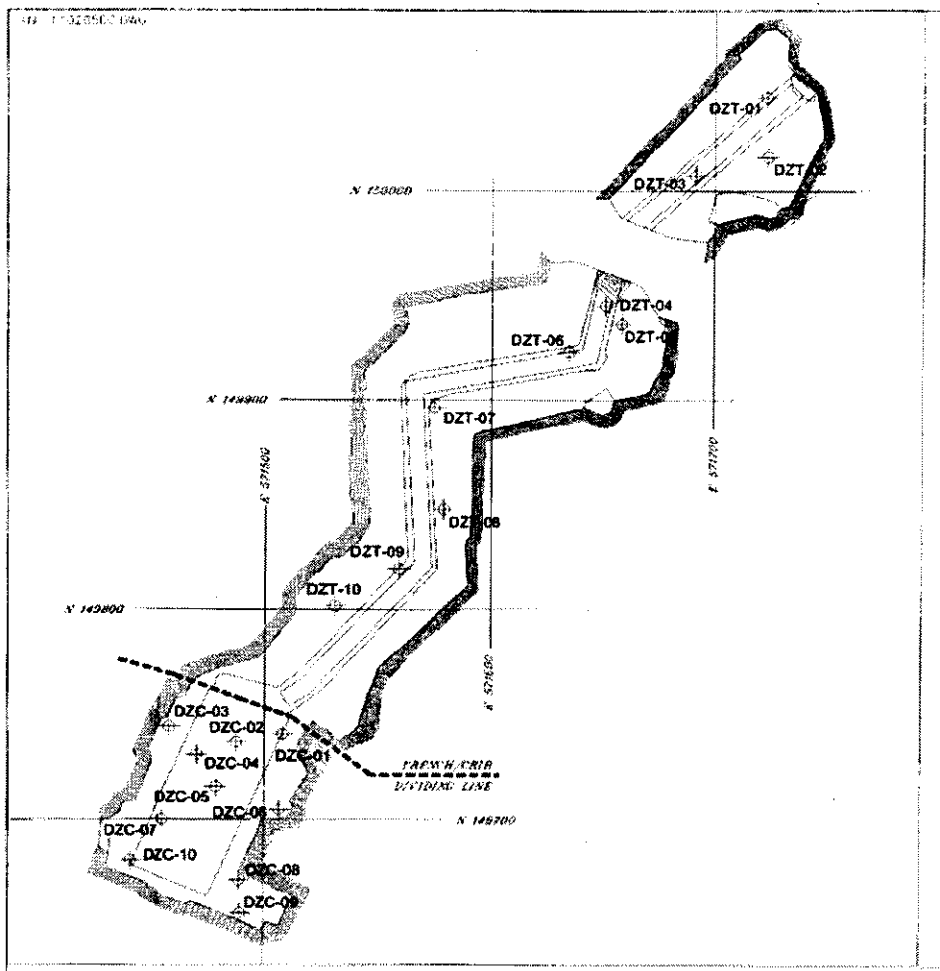
Rev. No. 0

Sample Number	Rounded Washington State Plane Coordinates	
	Easting	Northing
SZT-01	571711	150070
SZT-02	571815	149954
SZT-03	571559	149947
SZT-04	571539	149841
SZT-05	571548	149746
SZT-06	571568	149786
SZT-07	571597	149874
SZT-08	571658	149891
SZT-09	571681	149919
SZT-10	571740	149995
SZC-01	571455	149758
SZC-02	571444	149740
SZC-03	571426	149676
SZC-04	571439	149669
SZC-05	571464	149660
SZC-06	571481	149651
SZC-07	571509	149652
SZC-08	571519	149666
SZC-09	571500	149690
SZC-10	571516	149708

SZT: Shallow Zone Trench
SZC: Shallow Zone Crib

U.S. DEPARTMENT OF ENERGY
DOE RICHLAND OPERATIONS OFFICE
RIVER CORRIDOR CLOSURE CONTRACT

100 N AREA
116-N-1 TRENCH AND CRIB
SHALLOW ZONE SAMPLE DESIGN



SCALE 1:2000
20 0 20 40 80 meters

Attachment B
Drawn W.S. Thompson
Checked R.B. Kerzow
Calc. No. 0100N-CA-V0085
Sheet No. 1 of 1
Date 11/9/05
Date 11/9/05
Rev. No. 0

Sample Number	Rounded Washington State Plane Coordinates	
	Easting	Northing
DZT-01	571723	150045
DZT-02	571723	150016
DZT-03	571692	150007
DZT-04	571651	149945
DZT-05	571658	149936
DZT-06	571635	149923
DZT-07	571574	149896
DZT-08	571578	149846
DZT-09	571559	149819
DZT-10	571531	149802
DZC-01	571508	149741
DZC-02	571487	149737
DZC-03	571458	149744
DZC-04	571470	149731
DZC-05	571478	149716
DZC-06	571507	149705
DZC-07	571454	149700
DZC-08	571489	149671
DZC-09	571489	149656
DZC-10	571440	149681

DZT: Deep Zone Trench
DZC: Deep Zone Crib

U.S. DEPARTMENT OF ENERGY
DOE RICHLAND OPERATIONS OFFICE
RIVER CORRIDOR CLOSURE CONTRACT

100 N AREA
116-N-1 TRENCH AND CRIB
DEEP ZONE SAMPLE DESIGN

CALCULATION COVER SHEET

Project Title:	100-NR-1 TSD Sites Remedial Action Project	**Job No.**	22192
Area	100 N		
Discipline	Environmental	***Calc. No.**	0100N-CA-V0076
Subject	116-N-1 Overburden Cleanup Verification 95% UCL Calculation		
Computer Program	Excel	**Program No.**	Excel 97

The attached calculations have been generated to document compliance with established cleanup levels.
These documents should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 6 Total = 7	W. J. Adam 5/5/04 W. J. Adam	JB Miley 5-6-04 T. B. Miley K. Anselm 5/5/04 K. A. Anselm	SW Callison 5-6-04 S. W. Callison	S. E. Parnell 5/6/04 S. E. Parnell	5/6/04

SUMMARY OF REVISIONS

* Obtain calc no. from DIS

Dec-02

DE01-437.03

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator W. J. Adam
Project 100-NR-1 TSD Sites Remedial Action Project
Date 05/05/04
Job No. 22192
Calc. No. 0100N-CA-V0076
Checked K. A. Anselm
Checked T. B. Miley
Rev. No. 0
Date 05/05/04
Date
Sheet No. 1 of 6

Subject 116-N-1 Overburden Cleanup Verification 95% UCL Calculation

Purpose:
Calculate the 95% upper confidence limit (UCL) to evaluate compliance with cleanup standards for the subject site. Also, calculate the carcinogenic risk for applicable nonradionuclide analytes, perform the *Washington Administrative Code* (WAC) 173-340-740(7)(e) Model Toxics Control Act (MTCA) 3-part test, if required (all nonradionuclide analytes), and calculate the relative percent difference (RPD) for each contaminant of concern (COC).

Table of Contents:
Calculation Sheet Summary, Sheets 1 to 2
Calculation Sheet Shallow Zone, Sheet 3
Ecology Software (MTCAStat) Shallow Zone Nitrate, Sheet 4
Ecology Software (MTCAStat) Shallow Zone Cr-total, Sheet 5
Calculation Sheet Split-Dup Analysis, Sheet 6

Given/References:
1) Sample Results
2) Lookup values and remedial action goals (RAGs) are taken from the Remedial Design Report/Remedial Action Work Plan (RDR/RAWP) (DOE-RL 2001) unless otherwise specified.
3) DOE-RL, 2001, *Remedial Design Report/Remedial Action Work Plan for the 100-NR-1 Treatment, Storage, and Disposal Units*, DOE/RL-2000-18, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) DOE-RL, 2002, *Sampling and Analysis Plan for the 100-NR-1 Treatment, Storage, and Disposal Units During Remediation and Closeout*, DOE/RL-2000-07, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
5) Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
6) Ecology, 1993, *Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets)*, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
7) Ecology, 2001, *Cleanup Levels and Risk Calculations Under the Model Toxic Control Act Cleanup Regulations (CLARC Version 3.1)*, Publication #94-145, Updated November 2001, Washington State Department of Ecology, Olympia, Washington.
8) EPA, 1994, *WSEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013, U.S. Environmental Protection Agency, Washington, D.C.

Solution:
Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993) and below. Use data from attached worksheets to calculate the 95% UCL for each analyte, the carcinogenic risk, perform the WAC 173-340-740(7)(e) 3-part test for nonradionuclides, and the RPD calculations for each COC.

Calculation Description:
The subject calculations were performed on data from soil verification samples from the subject waste site. The data were entered into an EXCEL 97 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulas within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2001) is documented by this calculation. Split and duplicate RPD results are used in evaluation of data quality and are presented in the Cleanup Verification Package (CVP) for this site.

Methodology:
The statistical value calculated to evaluate the effectiveness of cleanup was the 95% UCL. For nonradioactive analytes with > 50% of the data below detection limits, the maximum value for the sample data was used instead of the 95% UCL. All nonradionuclide (e.g., metals) data reported as being below detection limits were set to ½ the detection limit value for calculation of the statistics (Ecology 1993). For radionuclide data, calculation of the statistics was done on the reported value. In cases where the laboratory does not report a value below the minimal detectable activity (MDA), half of the MDA is used in the calculation.

For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above.

For nonradionuclides, the WAC 173-340-740(7)(e) statistical guidance suggests that a test for distributional form be performed on the data and the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets (n < 10) and all radionuclide data sets, the calculations are performed assuming nonparametric distribution, and no test for distribution is performed. For nonradionuclide data sets of ten or greater, distributional testing is done using Ecology's MTCAStat software (Ecology 1993).

The estimated hazard quotient (for applicable nonradionuclide COCs) is determined by dividing the statistical value (derived in the calculation) by the WAC 173-340 Method B non-carcinogenic cleanup limit. The nonradionuclide carcinogenic risk, above background, is determined by dividing the statistical value by the WAC 173-340 Method B carcinogenic cleanup limit and then multiplying by 10^6. For data sets where all values are below detection, neither of these calculations are required. For noncarcinogenic nonradionuclide COCs, only the estimated fraction of risk computation must be performed.

The WAC 173-340-740(7)(e) 3-part test is performed for nonradionuclide analytes only and determines if:
1) the statistical value exceeds the most stringent cleanup limit for each nonradionuclide COC,
2) greater than 10% of the raw data exceed the most stringent cleanup limit for each nonradionuclide COC,
3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each nonradionuclide COC.

The RPD is performed when both the main value and either the duplicate or split values are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method. These detection limit requirements are located in Table 2-1 of the SAP (DOE-RL 2002). The RPD calculations use the following formula:

$$RPD = \{ |M-S|/((M+S)/2)\}*100$$

where: M = Main Sample Value S = Split (or duplicate) Sample Value

For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than +/- 30% indicates the data compare favorably. For regulatory splits, a threshold of +/- 35% is used (EPA 1994). If the RPD is greater than +/- 30% (or +/- 35% for regulatory split data), further investigation regarding the usability of the data is performed. Additional discussion as necessary is provided in the data quality assessment section of the applicable CVP.

If regulator split comparison is required, an additional parameter is evaluated. A control limit of +/- 2 times the TDL shall be used if either the main or regulator split value is less than 5 times the TDL and above detection. In the case where only one result is greater than five times the TDL and the other is below, the +/- 2 times the TDL criteria applies. Therefore, the following calculation is performed as part of the evaluation for these two cases involving regulator split data: difference = main - regulator split.

If the difference is greater than +/- 2 times the TDL, then further investigation regarding the usability of the data is performed and presented in the applicable CVP data quality assessment.

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator W. J. Adam
Project 100-NR-1 TSD Sites Remedial Action Project
Date 05/05/04
Job No. 22192
Calc. No. 0100N-CA-V0076
Checked K. A. Anselm
Checked T. B. Miley
Rev. No. 0
Date 05/05/04
Date 5-6-04
Sheet No. 2 of 5

Subject 116-N-1 Overburden Cleanup Verification 95% UCL Calculation

Results:
The results presented in the summary tables that follow are for use in RESRAD dose/risk analysis and the CVP for this site.

Result Summary - Shallow Zone (Overburden)			
Am-241	4.2E-02	U	pCi/g
Cs-137	1.2E+00		pCi/g
Co-60	5.5E-01		pCi/g
Eu-154	2.2E-02	U	pCi/g
Eu-155	1.7E-03	U	pCi/g
Ni-63	2.87E+00		pCi/g
Pu-239/240	2.7E-03	U	pCi/g
Sr-total	0 (< BG)		pCi/g
Tritium	-1.1E-03	U	pCi/g
Nitrate	5.2E+01		mg/kg
Mercury	2.E-02	U	mg/kg
Cr-total	1.32E+01		mg/kg
Cr+6	3.5E-01		mg/kg

WAC 173-340-740(7)(e) Evaluation

WAC 3-Part Test:

95% UCL > Cleanup Limit?	NO
> 10% above Cleanup Limit?	NO
Any sample > 2x Cleanup Limit?	NO

Risk Estimate:

Nonrad noncarcinogenic index sum:	9E-04
Nonrad carcinogenic risk:	2E-07

Relative Percent Difference (RPD) Results - QA/QC Analysis
Shallow Zone (Overburden)*

Analyte	Duplicate Analysis	Split Analysis	Regulatory Split Analysis (OB-01)	Regulatory Split Analysis (OB-05)	Regulatory Split Analysis (OB-10)
Am-241					
Cs-137				20.1%	
Co-60					
Eu-154					
Eu-155					
Ni-63					
Pu-239/240					
Sr-total					
Tritium					
Nitrate	2.1%		3.0%	8.5%	
Mercury					
Cr-total	13.7%	37.3%			
Cr+6					

* A blank cell indicates that RPD evaluation was not required.

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator W. J. Adam — Date 05/05/04
Project 100-NR-1 TSD Site Remedial Action Project — Job No. 22192
Subject 100-N-1 Overburden Cleanup Verification 95% UCL Computation

Calc. No. 0100N-CA-V0076 — Rev. No. 0
Checked R. A. Ainsworth — Date 05/05/04
Checked T. B. Miley — Date 5-6-04
Sheet No. 1 of 6

1. Shallow Zone (Overburden) Sample Data

Sampling Area	HEIS Number	Sample Date	Am-241 pCi/g	Q	MDA	Cs-137 pCi/g	Q	MDA	Co-60 pCi/g	Q	MDA	Eu-154 pCi/g	Q	MDA	Eu-155 pCi/g	Q	MDA	Ni-63 pCi/g	Q	MDA	Pu-239/240 pCi/g	Q	MDA	Sr-total pCi/g	Q	MDA	Tritium pCi/g	Q	MDA	Nitrate mg/kg	Q	PQL	Mercury mg/kg	Q	PQL	Cr-total mg/kg	Q	PQL	Cr6 mg/kg	Q	PQL
4	C8-01	J015L1	12/1/2003		2.9E-02	U	1.1E-01	4.9E-01		2.7E-02	3.8E-02	U	3.9E-02	7.5E-02	U	7.1E-02	6.1E-02	U	6.1E-02	7.61E-01	U	2.1E-00	0.0E+00	U	7.3E-01	1.6E-01	U	2.6E-01	-7.6E-02	U	2.7E-01	2.3E-01		1.0E+00	1.1E-02	U	1.1E-02	1.50E+01		7.2E-01	2.2E-01	U	2.2E-01
Duplicate of																																										
5	J015L1	J015M1	12/1/2003		4.3E-02	U	1.1E-01	5.7E-01		4.9E-02	1.3E-01		4.1E-02	1.2E-01	U	1.3E-01	1.2E-01	U	1.3E-01	3.64E-01	U	2.1E+00	3.8E-02	U	2.9E-01	3.6E-01		2.6E-01	-4.0E-02	U	2.6E-01	2.4E+01		1.0E+00	1.1E-02	U	1.1E-02	1.39E+01		8.1E-01	2.4E-01		2.1E-01
6	C8-02	J015L2	12/1/2003		6.0E-02	U	1.8E-01	1.4E-01		2.9E-02	2.5E-02	U	2.8E-02	9.1E-02	U	9.1E-02	8.5E-02	U	8.5E-02	1.28E+00	U	2.1E+00	0.0E+00	U	2.8E-01	2.6E-01	U	2.6E-01	6.0E-02	U	2.6E-01	2.9E+00		1.0E+01	2.2E-02	U	2.2E-02	1.12E+01		7.3E-01	2.4E-01		2.1E-01
7	C8-03	J015L3	12/1/2003		1.5E-02		1.1E-01	1.3E-00		3.1E-02	2.4E-01		3.0E-02	6.5E-02	U	6.5E-02	6.3E-02	U	6.3E-02	1.91E+00	U	2.1E+00	6.0E+00	U	2.6E-01	2.6E-01		2.6E-01	6.9E-01	U	2.7E-01	1.7E+01		8.0E+00	1.1E-02	U	1.1E-02	1.11E+01		7.2E-01	2.2E-01	U	2.2E-01
8	C8-04	J015L4	12/1/2003		6.0E+00	U	1.2E-01	4.3E-02		8.8E-02	4.4E-02		2.9E-02	9.9E-02	U	9.8E-02	1.2E-01	U	1.2E-01	7.00E+00		2.0E+00	0.0E+00	U	2.4E-01	2.6E-02	U	2.7E-01	4.9E-02	U	2.2E-01	4.9E-01		1.9E-01	1.1E-02	U	1.1E-02	7.80E+00		5.9E-01	3.5E-01		2.1E-01
9	C8-05	J015L5	12/1/2003		4.7E-02	U	1.2E-01	3.9E+00		4.9E-02	3.9E-01		3.7E-02	1.0E-01	U	1.0E-01	1.4E-01	U	1.4E-01	2.48E-01	U	2.1E+00	0.0E+00	U	2.1E-01	2.6E-01		2.6E-01	-1.0E-02	U	2.6E-01	8.6E+00		9.9E-01	2.1E-02	U	2.1E-02	1.33E+01		8.2E-01	2.2E-01	U	2.2E-01
10	C8-06	J015L6	12/1/2003		8.9E-02	U	1.1E-01	1.0E+00		5.8E-02	2.9E-01		3.7E-02	1.1E-01	U	1.1E-01	7.8E-02	U	7.8E-02	3.94E-01	U	2.2E+00	0.0E+00	U	2.8E-01	7.5E-02	U	2.3E-01	7.9E-02	U	2.3E-01	8.8E+00		1.1E+00	3.6E-02	U	3.6E-02	1.09E+01		8.5E-01	2.2E-01	U	2.2E-01
11	C8-07	J015L7	12/1/2003		1.4E-02	U	1.1E-01	3.1E-01		2.8E-02	3.1E-01		3.5E-02	8.1E-02	U	8.1E-02	6.5E-02	U	6.5E-02	2.81E+00		2.2E+00	4.1E-02	U	3.2E-01	8.6E-02	U	2.6E-01	5.0E-03	U	2.4E-01	2.2E+00		1.5E+00	2.8E-02	U	2.8E-02	1.39E+01		7.9E-01	2.2E-01	U	2.2E-01
12	C8-08	J015L8	12/1/2003		4.3E-02	U	1.1E-01	5.5E-00		7.1E-02	1.4E+00		4.4E-02	1.4E-01		1.4E-01	1.5E-01	U	1.5E-01	1.17E+00	U	2.2E+00	5.2E+00	U	2.4E-01	1.6E-01	U	2.6E-01	-4.9E-02	U	2.6E-01	2.4E+01		1.1E+00	1.1E-02	U	1.1E-02	1.05E+01		7.9E-01	2.3E-01	U	2.3E-01
13	C8-09	J015L9	12/1/2003		3.4E-02	U	1.3E-01	2.3E-01		3.1E-02	3.9E-01		3.9E-02	1.1E-01	U	1.1E-01	7.1E-02	U	7.1E-02	4.22E-01	U	2.1E+00	3.6E-02	U	2.9E-01	5.6E-02	U	2.6E-01	-5.7E-02	U	2.7E-01	5.2E-00		1.9E-01	1.6E-02	U	1.6E-02	1.30E+01		8.4E-01	2.2E-01	U	2.2E-01
14	C8-10	J015M0	12/1/2003		0.0E+00	U	1.3E-01	1.9E-01		2.8E-02	7.1E-02	U	4.1E-02	8.8E-02	U	8.8E-02	7.8E-02	U	7.8E-02	2.98E-01	U	2.1E+00	0.0E+00	U	2.2E-01	1.1E-02	U	2.6E-01	2.0E-02	U	2.6E-01	2.3E+00		3.0E-01	2.6E-02	U	2.6E-02	1.04E+01		8.2E-01	2.2E-01		2.2E-01

15

16. Statistical Computation Input Data

Sampling Area	HEIS Number	Sample Date	Am-241 pCi/g	Cs-137 pCi/g	Co-60 pCi/g	Eu-154 pCi/g	Eu-155 pCi/g	Ni-63 pCi/g	Pu-239/240 pCi/g	Sr-total pCi/g	Tritium pCi/g	Nitrate mg/kg	Mercury mg/kg	Cr-total mg/kg	Cr6 mg/kg
17		J015L1													
18	C8-01	J015M1	2.9E-02	5.0E-01	7.5E-02	4.9E-02	5.0E-02	1.63E-01	1.9E-02	2.6E-01	-5.8E-02	2.4E+01	5.6E-03	1.40E+01	1.9E-01
19		J015L2													
20	C8-02	J015L3	4.0E-02	1.4E-01	1.9E-02	4.6E-02	2.3E-02	1.28E+00	0.0E+00	2.6E-01	6.0E-02	2.9E+00	1.8E-02	1.12E+01	2.4E-01
21	C8-03	J015L4	1.5E-02	1.3E-00	2.4E-01	4.3E-02	3.2E-02	1.91E+00	0.0E+00	2.6E-01	5.0E-03	1.7E+01	5.6E-03	1.11E+01	1.1E-01
22	C8-04	J015L5	6.0E+00	4.3E-01	4.4E-02	4.3E-02	5.0E-02	7.00E+00	0.0E+00	2.6E-01	4.9E-02	4.9E-01	9.6E-03	7.80E+00	3.5E-01
23	C8-05	J015L6	4.7E-02	3.9E+00	3.9E-01	1.0E-01	1.4E-01	2.48E-01	0.0E+00	2.6E-01	-1.0E-02	8.6E+00	2.1E-02	1.33E+01	1.1E-01
24	C8-06	J015L7	8.9E-02	1.0E+00	2.9E-01	1.1E-01	7.8E-02	3.94E-01	0.0E+00	2.6E-01	7.9E-02	8.8E+00	3.6E-02	1.09E+01	2.2E-01
25	C8-07	J015L8	1.4E-02	3.1E-01	3.1E-01	8.1E-02	6.5E-02	2.81E+00	4.1E-02	2.6E-01	5.0E-03	2.2E+00	2.8E-02	1.39E+01	2.2E-01
26	C8-08	J015L9	4.3E-02	5.5E-00	1.4E+00	1.4E-01	1.5E-01	1.17E+00	5.2E+00	2.6E-01	-4.9E-02	2.4E+01	1.1E-02	1.05E+01	2.3E-01
27	C8-09	J015L0	3.4E-02	2.3E-01	3.9E-01	1.1E-01	7.1E-02	4.22E-01	3.6E-02	2.6E-01	-5.7E-02	5.2E+00	1.6E-02	1.30E+01	2.2E-01
28	C8-10	J015M0	0.0E+00	1.9E-01	2.1E-02	8.8E-02	7.8E-02	2.98E-01	0.0E+00	2.6E-01	2.0E-02	2.3E+00	2.6E-02	1.04E+01	2.2E-01
29															

30 Statistical Computations

	Am-241	Cs-137	Co-60	Eu-154	Eu-155	Ni-63	Pu-239/240	Sr-total	Tritium	Nitrate	Mercury	Cr-total	Cr6
31 Statistical value based on	Radionuclide data set. Use nonparametric z-statistic	Radionuclide data set. Use nonparametric z-statistic	Radionuclide data set. Use nonparametric z-statistic	Radionuclide data set. Use nonparametric z-statistic	Radionuclide data set. Use nonparametric z-statistic	Radionuclide data set. Use nonparametric z-statistic	Radionuclide data set. Use nonparametric z-statistic	Radionuclide data set. Use nonparametric z-statistic	Radionuclide data set. Use nonparametric z-statistic	Large data set (n ≥ 10), use MTCASat lognormal distribution	>50% below detection. Default to maximum value	Large data set (n ≥ 10), use MTCASat normal distribution	>50% below detection. Default to maximum value
32													
33 N	10	10	10	10	10	10	10	10	10	10	10	10	10
34 % < Detection limit	100%	0%	30%	100%	100%	80%	100%	70%	100%	0%	100%	0%	40%
35 mean	2.2E-02	1.5E-00	3.2E-01	5.0E-02	4.8E-02	1.77E+00	1.6E-02	2.6E-01	2.6E-02	9.4E+00	8.5E-03	1.20E+01	1.7E-01
36 st. dev.	3.3E-02	1.8E+00	4.0E-01	9.4E-03	1.8E-02	1.12E+00	2.3E-02	0.0E+00	4.8E-02	8.8E-00	3.5E-03	8.09E+00	6.3E-02
37 Z statistic	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645
38 95% UCL on mean	4.2E-02	2.3E+00	5.4E-01	5.5E-02	5.8E-02	2.87E+00	2.8E-02	1.1E-01	1.1E-01	3.7E+01	5.8E-03	1.70E+01	3.1E-01
39 max value	8.9E-02	5.2E+00	1.6E+00	1.4E-01	1.5E-01	7.00E+00	5.2E-02	1.5E-01	6.0E-02	2.4E+01	2.6E-02	1.54E+01	3.9E-01
40 Statistical value	4.2E-02	2.3E+00	5.5E-01	5.5E-02	5.8E-02	2.87E+00	2.8E-02	1.1E-01	1.1E-01	3.2E+01	5.8E-03	1.30E+01	3.1E-01
41 Background	NA	1.1	0.008	0.053	0.054	NA	0.005	0.18	NA	NA	NA	NA	NA
42 Statistical value above background	4.2E-02	1.2E+00	5.5E-01	2.2E-02	1.7E-02	2.87E+00	2.7E-02	0.(-.90)	-1.1E-01	3.2E+01	2.5E-03	1.30E+01	3.5E-01
43 Lookup Value - 10 times/yr for rad	41.6	6.1	1.4	9.1	12.1	4031	23.3	3.7	24.1	NA	NA	NA	NA
44 Most Stringent Cleanup Limit for nonradionuclide and RAG type										150 GW Protection	Background - GW/River Protection 0.33	Background - GW/River Protection 18.5	River Protection 2
45 WAC 173-340 G-PART TEST													
46 95% UCL < Cleanup Limit?										NO	NA	NO	NO
47 > 10% above Cleanup Limit?										NO	NA	NO	NO
48 Any Sample > 2X Cleanup Limit?										NO	NA	NO	NO
49 EXCESS RISK EVALUATION													
50 WAC 173-340 Non-Carcinogenic Cleanup										8,000	24	80,000	600
51 Hazard quotient for each nonradionuclide										NA	NA	NA	8.E-04
52 WAC 173-340 Carcinogenic Cleanup										NA	NA	NA	3.1
53 Excess risk for each carcinogenic radionuclide										NA	NA	NA	2.E-07
54													
55 WAC 173-340 Compliant?	YES									Because the statistical value is equal to the Hanford Site background (59 mg/kg), excess risk is not calculated	Because mercury was not detected in any of the samples, the 3-part test and excess risk are not calculated	Because the statistical value is less than Hanford Site background, excess risk is not calculated	
56 Nonca-d nonradionuclide index sum	8.E-04												
57 Overall carcinogenic risk	2.E-07												

58 BG = background
59 GW = groundwater
60 RAG = remedial action goal

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator W. J. Adam
Project 100-NR-1 TSD Sites Remedial Action Project
Subject 116-N-1 Overburden Cleanup Verification 95% UCL Calculation

Date 05/05/04
Job No. 22192

Calc. No. 0100N-CA-V0076
Checked K. A. Anselm
Checked T. B. Miley

Rev. No. 0
Date 05/05/04
Date 5-6-04
Sheet No. 4 of 6

Ecology Software (MTCAStat)
Shallow Zone Nitrate 95% UCL Calculation

	DATA
1	2.4E+01
2	2.9E+00
3	1.7E+01
4	4.9E-01
5	8.6E+00
6	8.6E+00
7	2.2E+00
8	2.4E+01
9	5.2E+00
10	2.3E+00

Number of samples		Uncensored values	
Uncensored	10	Mean	9.41
Censored		Lognormal mean	11.81
Detection limit or PQL		Std. devn	8.806302289
Method detection limit		Median	6.9
TOTAL	10	Min	0.49
		Max	23.9

Lognormal distribution? r-squared is 0.940
Normal distribution? r-squared is 0.880

Recommendations
Use lognormal distribution.

UCL (Land's method) is 52.136432072512 9

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator W. J. Adam
Project 100-NR-1 TSD Sites Remedial Action Project
Subject 116-N-1 Overburden Cleanup Verification 95% UCL Calculation

Date 05/05/04
Job No. 22192

Calc. No. 0100N-CA-V0076
Checked K. A. Anselm
Checked T. B. Miley

Rev. No. 0
Date 05/05/04
Date 5-6-04
Sheet No. 5 of 6

	DATA
1	1.46E+01
2	1.12E+01
3	1.31E+01
4	7.60E+00
5	1.33E+01
6	1.09E+01
7	1.39E+01
8	1.08E+01
9	1.35E+01
10	1.06E+01

Ecology Software (MTCAStat)
Shallow Zone Cr-total 95% UCL Calculation

Number of samples		Uncensored values	
Uncensored	10	Mean	11.95
Censored		Lognormal mean	11.98
Detection limit or POL		Std. dev.	2.079129091
Method detection limit		Median	12.15
TOTAL	10	Min	7.6
		Max	14.6

Lognormal distribution? r-squared is 0.879
Normal distribution? r-squared is 0.918

Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 13.1551578114504

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator W. J. Adam
Project 100-NR-1 TSD Steps Homogeneity Action Project
Subject 116-N-1 Overburden Cleanup Verification 95% UCL Calculation

Date 05/05/04
Job No. 29182

Calc. No. 6130N-CA-V0076
Checked K. A. Anderson
Checked T. S. Miley

Rev. No. 0
Date 04/29/04
Date 5.1.04
Sheet 8 of 8

1 Split Dup Analysis
2 Shallow Zone (Overburden) Results:

Sampling Area	HEIS Number	Am-241 pCi/g	Q	MDA	Cs-137 pCi/g	Q	MDA	Co-60 pCi/g	Q	MDA	Eu-154 pCi/g	Q	MDA	Eu-155 pCi/g	Q	MDA	Ni-63 pCi/g	Q	MDA	Pu-239/240 pCi/g	Q	MDA
OB-01	J015L1	2.9E-02	U	1.1E-01	4.8E-01		2.7E-02	3.8E-02	U	3.8E-02	7.7E-02	U	7.6E-02	8.1E-02	U	8.1E-02	7.0E-01	U	2.1E+00	0.5E+00	U	2.8E-01
Duplicate of J015L1	J015M1	4.3E-02	U	1.1E-01	5.2E-01		4.5E-02	1.3E-01		4.1E-02	1.2E-01	U	1.2E-01	1.2E-01	U	1.2E-01	8.0E-01	U	2.1E+00	8.8E-02	U	2.9E-01
Split of J015L1	J015M3	9.6E-02	U	1.8E-01	5.8E-01		1.7E-02	1.3E-01		1.7E-02	1.0E-02	U	5.6E-02	5.0E-02	U	4.8E-02	7.7E-01	U	6.4E+00	0.0E+00	U	1.0E-01
Regulatory Split	N1-OB-01	1.5E-02	U	1.6E-02	5.8E-01	G	9.0E-02	7.4E-02	UG	1.0E-01	-1.0E-02	UG	5.2E-01	1.0E-02	UG	2.4E-01	7.0E-01	U	4.9E+00	8.0E-03	U	2.9E-02
OB-05	J015K5	4.7E-02	U	1.2E-01	3.6E+00		4.6E-02	2.5E-01		3.7E-02	1.2E-01	U	1.2E-01	1.4E-01	U	1.4E-01	2.4E-01	U	2.1E-00	0.0E+00	U	2.1E-01
Regulatory Split	N1-OB-05	1.0E-03	U	2.2E-02	4.4E+00		1.0E-01	2.8E-01		1.1E-01	3.0E-02	U	5.3E-01	9.0E-02	U	2.5E-01	-1.1E+00	U	5.1E+00	1.8E-02	LT	1.0E-02
OB-10	J015M0	0.0E+00	U	1.3E-01	1.9E-01		2.9E-02	4.1E-02	U	4.1E-02	8.8E-02	U	8.8E-02	7.8E-02	U	7.8E-02	2.9E-01	U	2.1E-00	0.0E+00	U	2.2E-01
Regulatory Split	N1-OB-10	1.5E-02	U	1.7E-02	1.7E-01	LT	8.8E-02	-9.0E-03	U	1.4E-01	1.8E-01	U	6.7E-01	2.0E-02	U	2.4E-01	1.4E+00	U	5.1E+00	0.0E-02		2.7E-02

Sampling Area	HEIS Number	Sr-total pCi/g	Q	MDA	Tritium pCi/g	Q	MDA	Nitrate mg/kg	Q	PQL	Mercury mg/kg	Q	PQL	Cr-total mg/kg	Q	PQL	Cr+6 mg/kg	Q	PQL
OB-01	J015L1	1.1E-01	U	2.0E-01	-7.8E-02	U	2.7E-01	2.3E+01		2.0E+00	1.0E-02	U	1.0E-02	1.8E+01		2.0E-01	2.2E-01	U	2.2E-01
Duplicate of J015L1	J015M1	3.0E-01		2.3E-01	-4.0E-02	U	2.8E-01	2.4E+01		1.0E+00	1.0E-02	U	1.0E-02	1.4E+01		8.1E-01	2.6E-01		2.2E-01
Split of J015L1	J015M3	1.1E+00		8.4E-01	5.1E-02		3.0E-02	2.7E+00		9.0E-02	1.8E-02	U	1.8E-02	1.1E+01		4.2E-02	8.5E-01	U	3.9E-01
Regulatory Split	N1-OB-01	Not Analyzed			Not Analyzed			2.1E+01		2.2E+00	1.1E-01	UN	1.1E-01	Not Analyzed			Not Analyzed		
OB-05	J015K5	2.3E-01		1.8E-01	-1.0E-02	U	2.9E-01	9.6E+00		8.9E-01	2.0E-02	U	2.0E-02	1.3E+01		9.2E-01	2.2E-01	U	2.2E-01
Regulatory Split	N1-OB-05	Not Analyzed			Not Analyzed			7.9E+00		2.2E+00	1.1E-01	U	1.1E-01	Not Analyzed			Not Analyzed		
OB-10	J015M0	-1.0E-02	U	2.2E-01	2.0E-02	U	3.6E-01	2.5E+00		2.0E-01	2.0E-02	U	2.0E-02	1.1E+01		8.7E-01	2.2E-01		2.2E-01
Regulatory Split	N1-OB-10	Not Analyzed			Not Analyzed			2.4E+00		2.2E+00	1.1E-01	U	1.1E-01	Not Analyzed			Not Analyzed		

16 Shallow Zone (Overburden) Analysis:

	(TDL)		1	0.1	0.05	0.1	0.1	30	1	1	4.0	0.75	0.2	1	0.5
Duplicate Analysis	Both > MDA?		No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No Stop (acceptable)	No Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)
	Both >5xTDL?			No-Stop (acceptable)								Yes (note RPD)		Yes (note RPD)	
	RPD											2.12%		13.70%	
Split Analysis	Both > MDA?		No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)
	Both >5xTDL?			No-Stop (acceptable)								No Stop (acceptable)		Yes (note RPD)	
	RPD													37.26%	
Regulatory Split Analysis (OB-01)	Both > MDA?		No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Not Analyzed	Not Analyzed	Yes (continue)	No-Stop (acceptable)	Not Analyzed	Not Analyzed
	Both >5xTDL?			No-Stop (acceptable)								Yes (note RPD)			
	RPD											2.98%			
Regulatory Split Analysis (OB-05)	Both > MDA?		No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No Stop (acceptable)	No Stop (acceptable)	Not Analyzed	Not Analyzed	Yes (continue)	No-Stop (acceptable)	Not Analyzed	Not Analyzed
	Both >5xTDL?			Yes (note RPD)	No-Stop (acceptable)							Yes (note RPD)			
	RPD			20.19%								6.40%			
Regulatory Split Analysis (OB-10)	Both > MDA?		No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No Stop (acceptable)	No Stop (acceptable)	Not Analyzed	Not Analyzed	Yes (continue)	No-Stop (acceptable)	Not Analyzed	Not Analyzed
	Both >5xTDL?			No-Stop (acceptable)								No Stop (acceptable)			
	RPD														

27 N = Spikes sample recovery not within control limits.
28 G = Sample density differs by more than 10% of UCS density
29 LT = Result is less than reportable minimum detectable concentration (MDC), greater than sample specific MDC.

MSUCL 116-N-1 Rev SPlit Dup Analysis

CVP-2006-00004
Rev. 0
For Approval

CALCULATION COVER SHEET

Project Title 100-NR-1 TSD Sites Remedial Action Project **Job No.** 22192
Area 100-N Area
Discipline Environmental ***Calc. No.** 100N-CA-V0077
Subject 116-N-1 Evaluation of Overburden for Backfill
Computer Program RESRAD **Program No.** Version 6.21

The attached calculations have been generated to document compliance with established cleanup levels.
These documents should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover – 1 pg Summary – 4 pg Attm. 1 - 1 pg Attm. 2 - 27 pg Attm. 3 - 44 pg Attm. 4 - 21 pg Total – 98 pg	S. W. Clark S.W. Clark 5/7/04	W. J. Adam W.J. Adam 5/7/04	S. W. Callison SW. Call 5-7-04	J. D. Fancher J.D. Fancher S. E. Parnell S.E. Parnell 5/13/04	5/13/04

SUMMARY OF REVISION

*Obtain Calc. No. from DIS

November 2002

DE01-437.03

Bechtel Hanford, Inc. CALCULATION SHEET

Originator:	S. W. Clark	Date:	5/7/04	Calc. No.:	100N-CA-V0077	Rev.:	0
Project:	100-NR-1 Remedial Action	Job No:	22192	Checked:	W. J. Adam	Date:	5/7/04
Subject:	116-N-1 RESRAD Evaluation of Overburden for Backfill					Sheet No.	1 of 4

PURPOSE:

Calculate the soil and groundwater concentrations, dose, and risk contributions from radionuclide contaminants in stockpiled overburden soil at the 116-N-1 remediation site.

GIVEN/REFERENCES:

1) Cleanup verification data from *116-N-1 Overburden Cleanup Verification 95% UCL Calculation*, Calculation No. 0100N-CA-V0077, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
2) *Remedial Design Report/Remedial Action Work Plan for the 100-NR-1 Treatment, Storage, and Disposal Units* (RDR/RAWP), DOE/RL-2000-16, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, WA.
3) Radioactive and nonradioactive contaminants of concern from the *100-NR-1 Treatment, Storage, and Disposal Units During Remediation and Closeout Sampling and Analysis Plan* (100-NR-1 SAP), DOE/RL-2000-07, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. For the purpose of these RESRAD calculations, the radioactive contaminants of concern (COCs) are americium-241, cesium-137, cobalt-60, europium-154, europium-155, tritium, nickel-63, plutonium-239/240, and strontium-90. The nonradionuclide contaminants of concern are nitrate, total chromium, hexavalent chromium, and mercury. Concentrations of all nonradionuclide contaminants are below the remedial action goals per the RDR/RAWP and they are not considered further.
4) RESidual RADioactivity (RESRAD) computer code, version 6.21, to calculate compliance with residual radioactivity guidelines, developed for the U.S. Department of Energy by the Environmental Assessment Division of Argonne National Laboratory, Argonne, Illinois.
5) *116-N-1 RESRAD Evaluation of Groundwater Protection*, Calc. No. 100N-CA-V0066, January, 2003, Bechtel Hanford, Inc., Richland, Washington.
6) *Hanford Federal Facility Agreement and Consent Order*, 1998, 2 vols. as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

SOLUTION:

1) A single RESRAD run was performed for the overburden to be used for backfill in the 116-N-1 Trench. Table 1 shows the elevations (NGVD88) and dimensions of the relevant soil horizons. The ground surface elevation for excavation backfill is 140.0 m. The average groundwater elevation beneath the site is 117.5 m. The average elevation of the excavation floor is 135.4 m. Attachment 1 shows the dimensions of each soil horizon and the contaminant pathways considered for dose, risk, and groundwater protection. Input factors for the RESRAD run are shown in the "Summary" section of the RESRAD "Part I: Mixture Sums and Single Radionuclide Guidelines" printouts in the Attachments to this Calculation Summary.

Bechtel Hanford, Inc. CALCULATION SHEET

Originator:	S. W. Clark	Date:	5/7/04	Calc. No.:	100N-CA-V0077	Rev.:	0
Project:	100-NR-1 Remedial Action	Job No:	22192	Checked:	W. J. Adam. WJA	Date:	5/7/04
Subject:	116-N-1 RESRAD Evaluation of Overburden for Backfill					Sheet No. 2 of 4	

2) The year where the peak dose (or concentration) occurs in the groundwater from each individual COC was examined by a preliminary run assuming there was no vadose zone between the overburden and the saturated zone. This year was then added for all horizons for the final RESRAD runs. For the groundwater (well water) the peak years were year 7.6 for cobalt-60, year 42 for cesium-137 and strontium-90, and year 137 for nickel-63. The 7.6, 42, and 137-year time periods were included in all of the RESRAD runs. Year 14 was also added, corresponding to 2018, the date of the 30-year site cleanup schedule of the *Hanford Federal Facility Agreement and Consent Order*.

Table 1. Waste Site Dimensions for RESRAD Modeling

Parameter	Units	Value	Comments
Cover Depth	m	0	
Area of Contaminated Zone (CZ)	m^2	12,400	
Length Parallel to Aquifer Flow			
Based on Site Dimensions	m	120	
Elevations of Vadose Zone Horizons			
Elevation: Surface	m	140.0	NAVD88
Elevation: Bottom of Excavation	m	135.4	NAVD88
Elevation: Groundwater	m	117.5	NAVD88
Thickness: Contaminated Zone	m	4.6	Thickness of shallow zone to be backfilled
Thickness: Unsaturated Zone	m	17.9	

METHODOLOGY:

1) Pu-239/240 Conversion: The relative individual Pu-239 and Pu-240 activities were calculated from the combined Pu-239/240 results reported. The calculations were performed in accordance with calculation brief No. 0100B-CA-V0013. The relative activities for Pu-239 and Pu-240 were calculated by multiplying the cleanup verification value for Pu-239/240 by 0.807 and 0.193, respectively. Table 2 shows the results from this calculation.

Table 2. Conversion of Pu-239/240 to Relative Pu-239 and Pu-240 Activities

Vadose Zone Horizon	Pu-239/240 Activity (pCi/g)	Pu-239, (pCi/g) (0.807 multiplier)	Pu-240, (pCi/g) (0.193 multiplier)
Overburden	2.7E-03	2.2E-03	5E-04

2) Runs of RESRAD Version 6.21 were completed for the overburden using the radionuclide concentrations shown in Table 2. RESRAD numerical output reports for dose, risk, and concentration for the overburden to be placed in the shallow zone are presented in the Attachments to this Calculation Summary.

Bechtel Hanford, Inc. CALCULATION SHEET

Originator:	S. W. Clark	Date: 5/7/04	Calc. No.:	100N-CA-V0077		Rev.:	0
Project:	100-NR-1 Remedial Action	Job No: 22192	Checked:	W. J. Adam		Date:	5/7/04
Subject:	116-N-1 RESRAD Evaluation of Overburden for Backfill					Sheet No. 3 of 4	

Table 3. 116-N-1 Overburden Radionuclide Soil Concentrations

Radionuclide COCs	Radionuclide Activity, pCi/g
Am-241	4.2E-02
Co-60	5.5E-01
Cs-137	1.2E+00
Eu-154	2.2E-02
Eu-155	1.7E-03
H-3 (tritium)	-1.1E-03 [b]
Ni-63	2.87E+00
Pu-239	2.2E-03
Pu-240	5E-04
Sr-90	0 (<BG) [a]

[a] Value was not input into RESRAD because the concentration is below Hanford site background.
[b] RESRAD does not accept negative values. When results are negative, zero is used as the input value.

RESULTS:

1) **Radionuclide "All Pathways" Dose Rate:** The "all pathways" (maximum) dose rates are shown in Table 3. The maximum dose rate of 8.17 mrem/yr from the overburden occurs at year 0 (the present).

Table 3. All Pathways[a] Dose Rate (mrem/yr)

Vadose Zone Horizon	"All Pathways" Dose Contributions in mrem/yr at Each Time Slice (yr)									
	0	1	3	7.6	14	42	100	137	300	1000
Overburden	8.17E+00	7.45E+00	6.25E+00	4.37E+00	2.92E+00	1.11E+00	2.99E-01	1.38E-01	1.73E-02	4.93E-03

2) **Radionuclide Excess Cancer Risk:** The radionuclide excess cancer risk results are shown on Table 4. The maximum risk (7.70×10^{-5}) occurs at year 0 (the present).

Table 4. Radionuclide Excess Cancer Risk

Vadose Zone Horizon	Excess Cancer Risk at Each Time Slice (yr)									
	0	1	3	7.6	14	42	100	137	300	1000
Overburden	7.70E-05	7.22E-05	6.39E-05	5.02E-05	3.85E-05	1.78E-05	4.78E-06	2.14E-06	1.39E-07	1.07E-08

3) **Radionuclide Groundwater Protection:** The radionuclide concentrations in groundwater due to overburden soil concentrations were calculated by the RESRAD model and summarized in Table 5. None of the radionuclide contaminants of concern were calculated to reach groundwater in the 1,000 years of the RESRAD model.

Bechtel Hanford, Inc. CALCULATION SHEET

Originator:	S. W. Clark	Date:	5/5/04	Calc. No.:	100N-CA-V0077	Rev.:	0
Project:	100-NR-1 Remedial Action	Job No:	22192	Checked:	W. J. Adam	Date:	5/7/04
Subject:	116-N-1 RESRAD Evaluation of Overburden for Backfill					Sheet No.	4 of 4

Table 5. RESRAD Calculated Groundwater (Well Water) Concentrations.

Radio-nuclide	Groundwater Concentration in pCi/L at Each Time Slice (yr)										RAG pCi/L
	0	1	3	7.6	16	42	100	137	300	1000	
Am-241	0	0	0	0	0	0	0	0	0	0	15
Co-60	0	0	0	0	0	0	0	0	0	0	100
Cs-137	0	0	0	0	0	0	0	0	0	0	60
H-3	0	0	0	0	0	0	0	0	0	0	20,000
Eu-154	0	0	0	0	0	0	0	0	0	0	60
Eu-155	0	0	0	0	0	0	0	0	0	0	600
Ni-63	0	0	0	0	0	0	0	0	0	0	50
Pu-239	0	0	0	0	0	0	0	0	0	0	15
Pu-240	0	0	0	0	0	0	0	0	0	0	15
Sr-90	0	0	0	0	0	0	0	0	0	0	8

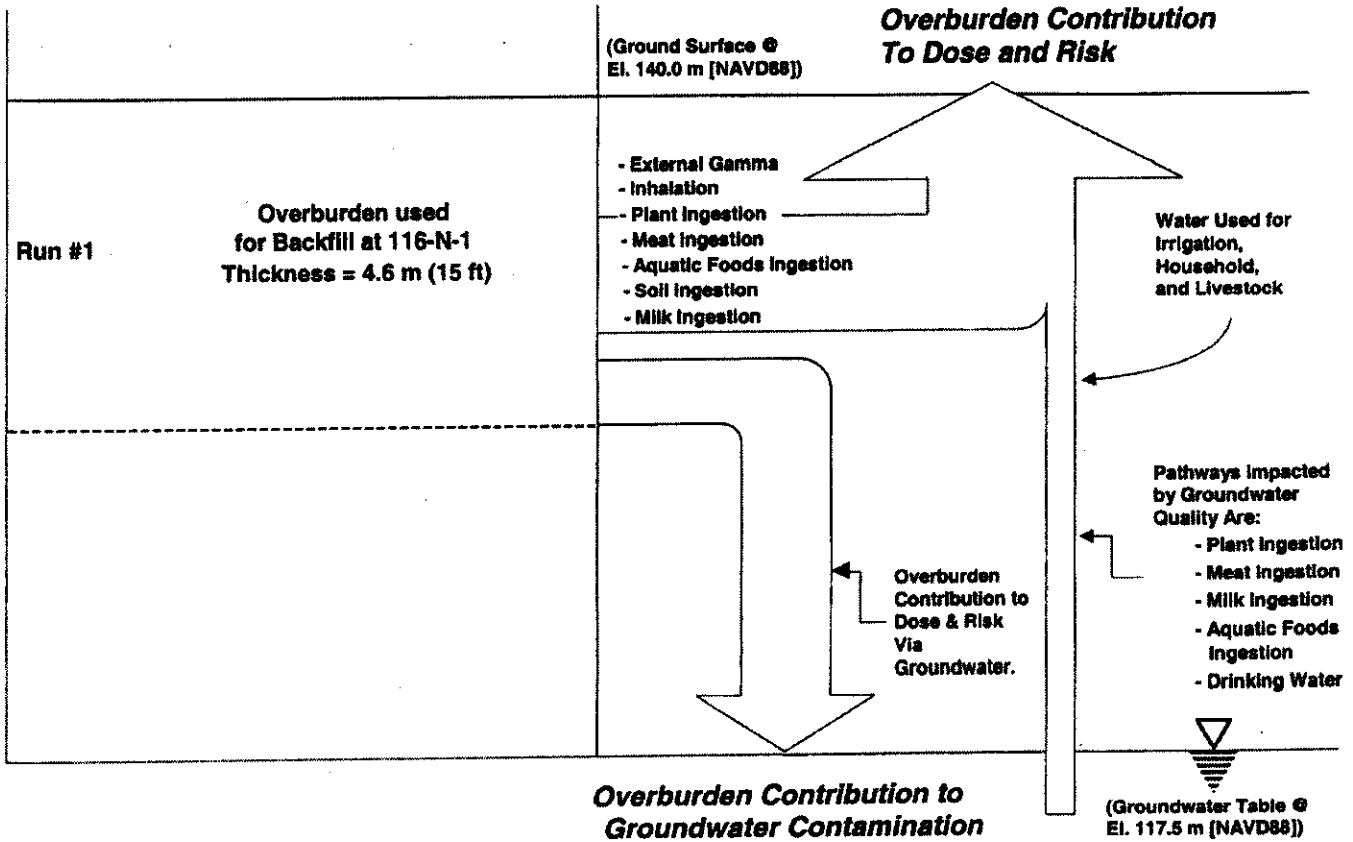
CONCLUSIONS:

- No overburden soil contaminant at 116-N-1 is predicted to reach groundwater with irrigation.
- The results indicate that the maximum dose rate above background from overburden is 8.17 mrem/yr and would occur at present (year 2004). The maximum dose rate is primarily due to direct gamma radiation exposure from cobalt-60.
- The dose rate decreases to 4.93×10^{-3} mrem/yr for the overburden in 1,000 years.
- The calculated total dose rate in 2018 from the overburden is 2.92 mrem/yr. The 2018 date corresponds to the 30-year site cleanup schedule of the *Hanford Federal Facility Agreement and Consent Order*.
- Total dose rates are never predicted to exceed the direct exposure RAG of 15 mrem/yr above background.

ATTACHMENTS:

1. Graphic showing 116-N-1 Overburden and Vadose Zone Model (1 page)
2. RESRAD Output: 116-N-1 Evaluation of Overburden for Backfill, Part I: Mixture Sums and Single Radionuclide Guidelines (27 pages)
3. RESRAD Output: 116-N-1 Evaluation of Overburden for Backfill, Part III: Intake Quantities and Health Risk Factors (44 pages)
4. RESRAD Output: 116-N-1 Evaluation of Overburden for Backfill, Part IV: Concentration of Radionuclides (21 pages)

116-N-1 Evaluation of Overburden for Backfill.



Attachment 1 Sheet No. 1 of 1
Originator S. W. Clark Date 5/7/04
Chk'd By W. J. Adam Date 5/4/04
Calc. No. 0100N-CA-V0077 Rev. No. 0

ATTACHMENT 1

CVP-2006-00004
Rev. 0
For Approval

CALCULATION COVER SHEET

Project Title 100 Area Remediation **Job No.** 22192
Area 100-N

Discipline Environmental Engineering ***Calc. No.** 0100N-CA-V0070

Subject Cleanup Verification Sampling of Overburden from the 116-N-1 Trench

Computer Program Microsoft Excel **Program No.** Office 97 Version

Committed Calculation X **Preliminary** **Superseded**

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 sheet Calculations = 5 sheets Attach A = 1 sheet Attach B = 1 sheet Attach C = 1 sheet Total = 9 sheets	K.E. Cook 12/2/03 K.E. Cook	J.D. Ludowise 12-2-03 J.D. Ludowise	J.D. Fancher 12-3-03 J.D. Fancher	S. E. Parnell 1/8/04 S. E. Parnell	1/8/04

SUMMARY OF REVISIONS

* Obtain Calc. No. from DIS

BHI-DE-01, EDPI-4.37-01, DE01437.03

Bechtel Hanford, Inc. **CALCULATION**

Originator K.E. Cook KEC **Date** 12/2/03 **Calc. No.** 0100N-CA-V0070 **Rev. No.** 0
Project 100 Area Remediation **Job No.** 22192 **Checked** J.D. Ludowise JL **Date** 12-2-03
Subject Cleanup Verification Sampling of Overburden from the 116-N-1 Trench **Sheet No.** 1 of 5

1. Purpose

Calculate the coordinates of cleanup verification samples for the overburden stockpile associated with the 116-N-1 Trench per the requirements of the *Sampling and Analysis Plan for the 100-NR-1 Treatment, Storage, and Disposal Units During Remediation and Closeout (DOE/RL, 2000).*

2. Results Summary

Based on this Calculation, ten sample locations are identified for the Shallow Zone (See Attachments).

Contents

Sheet No.	Title	Topic/Contents
	Cover	Cover
1 of 5	Calculation Sheet 1	Purpose, Results Summary, and Contents
2 of 5	Calculation Sheet 2	Requirements, Given/Assumed Information, References, and Calculations
3 of 5	Calculation Sheet 3	Calculations (Continued)
4 of 5	Calculation Sheet 4	Calculations (Continued), Figure 1.
5 of 5	Calculation Sheet 5	Calculations (Continued)

Attachments

Number of Sheets	Attachments	Topic/Contents
1	Attachment A	Sample Locations in Trench Space Coordinates
1	Attachment B	Sample Locations in Washington State Plane Coordinates
1	Attachment C	Map of Waste Site With Sample Locations

Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator K.E. Cook KEC **Date** 12/2/03 **Calc. No.** 0100N-CA-V0070 **Rev. No.** 0

Project 100 Area Remediation **Job No.** 22192 **Checked** J.D. Ludowise JL **Date** 12-2-03

Subject Cleanup Verification Sampling of Overburden from the 116-N-1 Trench **Sheet No.** 2 of 5

3. Requirements

Section 3.2.3.1 of the *Sampling and Analysis Plan for the 100-NR-1 Treatment, Storage, and Disposal Units During Remediation and Closeout* (DOE-RL 2000) requires the following:

- Use the number of sampling locations determined from previous variance calculations (use worst case results).
- Use randomly determined sample locations.

4. Given/Assumed Information

Previous variance calculations have determined that 10 samples are to be collected (0100N-CA-V0049).

The coordinates of the corners of a rectangle that encloses the overburden stock pile (design rectangle):

	Washington State Plane Coordinates (meters)	
	Easting	Northing
SE	571,782.34	149,764.14
NE	571,782.34	149,907.29
NW	571,624.78	149,907.29
SW	571,624.78	149,764.14

Field measurements should be accurate to within 1 meter.

5. References

Stewart, J., 1991, *Calculus*, 2 ed., Brooks/Cole Publishing Co., Pacific Grove, California.

DOE-RL, 2000, *Sampling and Analysis Plan for the 100-NR-1 Treatment, Storage, and Disposal Units During Remediation and Closeout, DOE/RL-2000-07, Rev. 1*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

6. Calculations

Coordinates of sampling locations can be calculated by using the procedure outlined in Section A.1 of Appendix A of DOE-RL (2000):

1. Generate a set of coordinates (X,Y) using the following equations:

$$X = X_{min} + (X_{max} - X_{min}) * RND \quad \text{(Eq. 1)}$$

$$Y = Y_{min} + (Y_{max} - Y_{min}) * RND \quad \text{(Eq. 2)}$$

where RND is the next unused random number between 0 and 1 in a sequence of random numbers (Attachment C).

2. If (X,Y) is located outside the sample area, return to step 1 to generate another random coordinate; Otherwise go to step 3.

Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator K.E. Cook KEC **Date** 12/2/03 **Calc. No.** 0100N-CA-V0070 **Rev. No.** 0

Project 100 Area Remediation **Job No.** 22192 **Checked** J.D. Ludowise JDL **Date** 12-2-03

Subject Cleanup Verification Sampling of Overburden from the 116-N-1 Trench **Sheet No.** 3 of 5

6. Calculations (Continued)

3. Define (X_i, Y_i) using the following steps:
   a. Round X to the nearest unit that can be located easily in the field; set this to X_i.
   b. Round Y to the nearest unit that can be located easily in the field; set this to Y_i.

4. Continue to generate the next random coordinate (X_i, Y_i).

The sampling coordinates are calculated with respect to a stockpile coordinate system described as follows:

- The origin of the stockpile coordinates is established as the north eastern most corner of the design rectangle at Washington State Plane Coordinates E571782.34, N149907.29
- The X-axis parallels the long axis of the design rectangle
- The Y-axis parallels the short axis of the design rectangle

The design rectangle for the overburden stockpile associated with 116-N-1 is shown on Figure 1.

The stockpile space coordinates of the 4 corners of the design rectangle are calculated from the Washington State Plane Coordinates using the Pythagorean Theorem. Results are shown in Table 1.

Table 1. Coordinates of design rectangle

Washington State Plane Coordinates (meters)		Stock Pile Space Coordinates (meters)	
Easting	Northing	X	Y
571,782.34	149,764.14	0.00	143.15
571,782.34	149,907.29	0.00	0.00
571,624.78	149,907.29	157.56	0.00
571,624.78	149,764.14	157.56	143.15

The minimum and maximum X values are:

X_{min} 0.00
X_{max} 157.56

The minimum and maximum Y values are:

Y_{min} 0.00
Y_{max} 143.15

Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator K.E. Cook KEC **Date** 12/2/03 **Calc. No.** 0100N-CA-V0070 **Rev. No.** 0

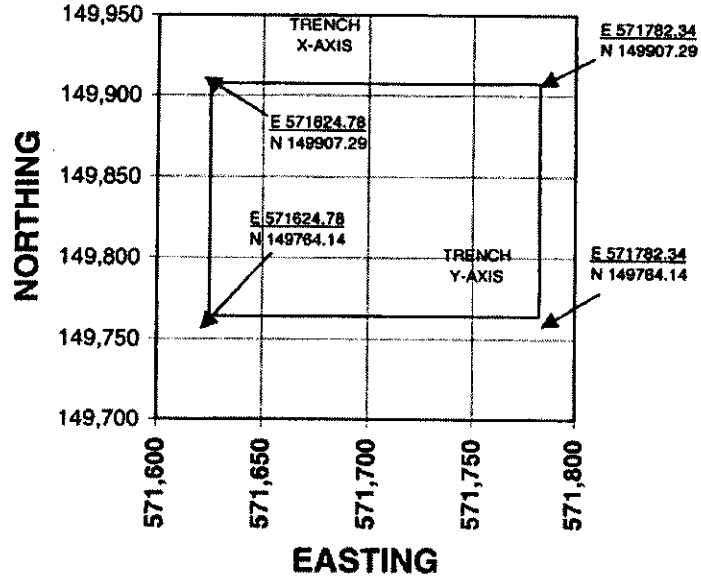
Project 100 Area Remediation **Job No.** 22192 **Checked** J.D. Ludowise JL **Date** 12-2-03

Subject Cleanup Verification Sampling of Overburden from the 116-N-1 Trench **Sheet No.** 4 of 5

6. Calculations (Continued).

FIGURE 1. 116-N-1 Overburden Stockpile

(NOT TO SCALE)



Bechtel Hanford, Inc. **CALCULATION SHEET**

Originator K.E. Cook KEC **Date** 12/2/03 **Calc. No.** 0100N-CA-V0070 **Rev. No.** 0

Project 100 Area Remediation **Job No.** 22192 **Checked** J.D. Ludowise JL **Date** 12-2-03

Subject Cleanup Verification Sampling of Overburden from the 116-N-1 Trench **Sheet No.** 5 of 5

6. Calculations (Continued).

The coordinates in Attachment ~~E~~ A 12/2 KEC need to be converted to Washington State Plane Coordinates. This conversion is normally accomplished by rotating the X-Y axes into the Washington State Plane Coordinates. In this case the site lies directly on the Northing/Easting grid lines and requires no rotation. The formulas and discussion are maintained in the body of the calculation for continuity with previous calculations.

If x and y are the Easting and Northing values, respectively, and X and Y are the stockpile space coordinates, then the formulas for conversion are provided in Appendix E of Stewart (1991):

$$x = X\cos(\alpha) - Y\sin(\alpha) \quad \text{(Eq. 3)}$$

$$y = X\sin(\alpha) + Y\cos(\alpha) \quad \text{(Eq. 4)}$$

where α is the angle of rotation as shown in Figure 1.

α is calculated from the formula:

$$\alpha = \arctan[(y_2-y_1)/(x_2-x_1)]$$

Using the coordinates of the northeast and northwest corners of the design rectangle,

$$\alpha = \arctan[(y_2-y_1)/(x_2-x_1)]$$
$$= \arctan[(149{,}907.29 - 149{,}907.29) / (571{,}624.78 - 571{,}782.34)]$$
$$= 0.00 \text{ radians or } 0.00 \text{ degrees}$$

Because the origin of the stockpile coordinate system and the Washington State Plane Coordinate system are not the same point, equations 3 and 4 need to be adjusted by this difference:

$$x = X_0 + X\cos(\alpha) - Y\sin(\alpha) \quad \text{(Eq. 5)}$$

$$y = Y_0 + X\sin(\alpha) + Y\cos(\alpha) \quad \text{(Eq. 6)}$$

where X_0 and Y_0 are the Washington State Plane Coordinates of the origin of the stockpile space coordinate system, 571,782.34 and 149,907.29 meters, respectively. The results, using equations 5 and 6 are shown in Attachment B.

Sampling Locations in ~~Trench Space~~ Coordinates
OVERBURDEN
12/2 KEC

Attachment A	
Originator: K.E. Cook KEC	Date: 12/2/03
Checked: J.D. Ludowise JL	Date: 12-2-03
Calc. No.: 0100N-CA-V0070	
Rev.: 0	Sheet No.: 1 of 1

The values for X_i and Y_i are calculated using Equations 1 and 2. The Microsoft Excel (R) RAND() function was used to calculate values for RND.

Sample No.	Random Number = RAND()		Stockpile Space Coordinates, Rounded to the Nearest Meter	
	For Calculating X Coordinate	For Calculating Y Coordinate	X	Y
1	0.1070	0.6605	17	95
2	0.9996	0.0540	158	8
3	0.8631	0.6291	136	90
4	0.4467	0.5462	70	78
5	0.3688	0.9244	58	132
6	0.5354	0.8499	84	122
7	0.2760	0.7177	43	103
8	0.2523	0.4338	40	62
9	0.2026	0.7797	32	112
10	0.7264	0.4136	115	59
11	0.8314	0.9301	131	133
12	0.4757	0.5627	75	81
13	0.1515	0.0789	24	11
14	0.1370	0.9755	22	140
15	0.4646	0.0992	73	14
16	0.7149	0.8644	113	124
17	0.2601	0.0702	41	10
18	0.7348	0.9665	116	138
19	0.4483	0.6859	71	98
20	0.0657	0.8856	10	127
21	0.0780	0.8162	12	117
22	0.7082	0.7344	112	105
23	0.0590	0.4980	9	71
24	0.1572	0.0330	25	5
25	0.8285	0.7446	131	107
26	0.0093	0.8495	1	122
27	0.5623	0.6499	89	93
28	0.2333	0.3269	37	47
29	0.9556	0.0326	151	5
30	0.1120	0.6309	18	90
31	0.5151	0.1941	81	28
32	0.8160	0.2516	129	36
33	0.5226	0.7233	82	104
34	0.2689	0.6244	42	89
35	0.8697	0.3895	137	56
36	0.5632	0.1347	89	19
37	0.8589	0.1854	135	27
38	0.3009	0.4522	47	65
39	0.1780	0.2668	28	38
40	0.1967	0.7019	31	100
41	0.8699	0.7456	137	107
42	0.8121	0.4038	128	58
43	0.1881	0.9605	30	137
44	0.4046	0.4311	64	62
45	0.4107	0.2917	65	42
46	0.3572	0.8095	56	116
47	0.7777	0.7146	123	102
48	0.5874	0.7073	93	101
49	0.2809	0.9415	44	135
50	0.0138	0.3259	2	47

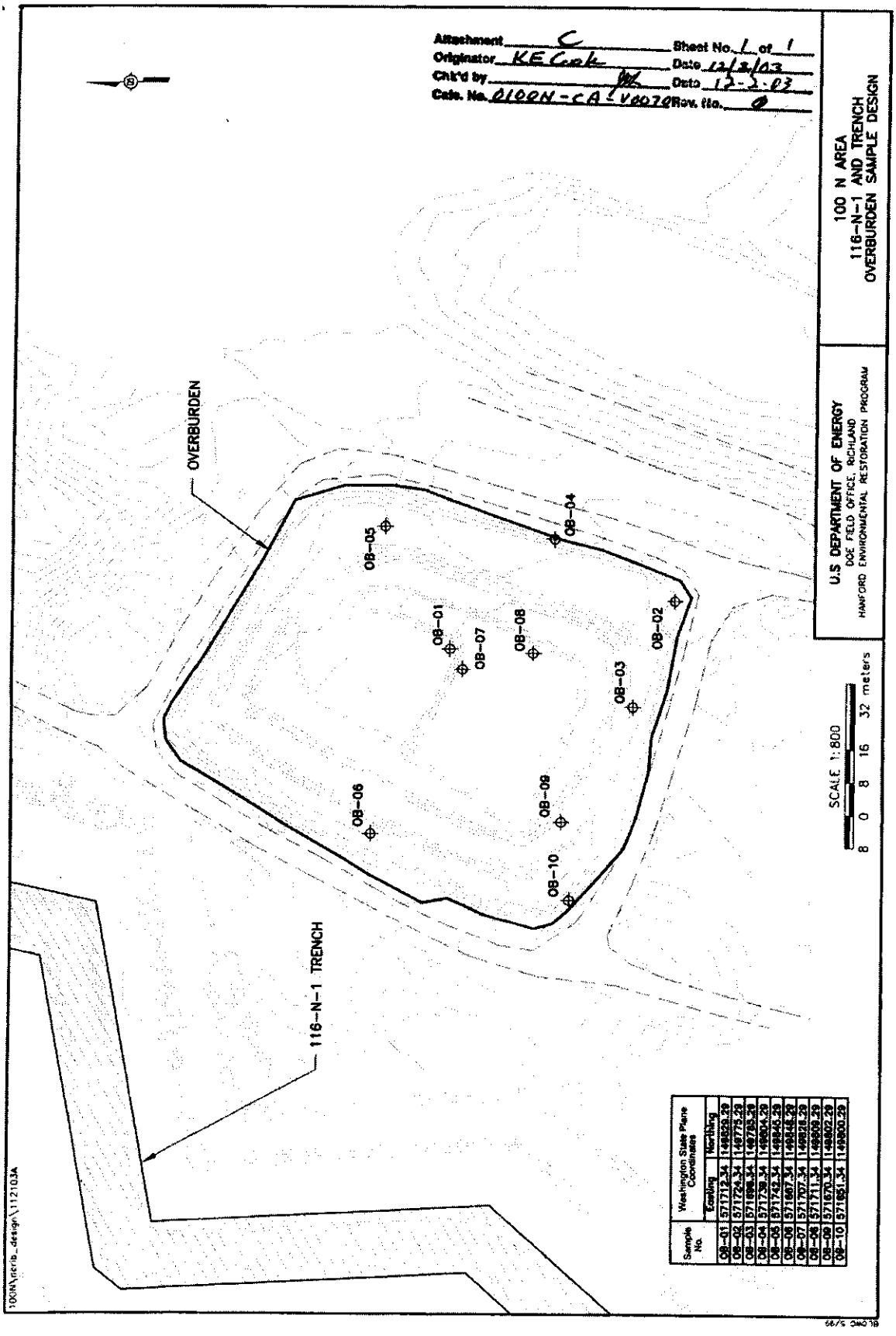
Sample Locations in Washington State Plane Coordinates

Attachment B	
Originator: K.E. Cook KEC	Date: 12/2/03
Checked: J.D. Ludowise JL	Date: 12-2-03
Calc. No.: 0100N-CA-V0070	
Rev.: 0	Sheet No.: 1 of 1

The following table represents the first 10 sample locations for the Overburden Stockpile as shown on Attachment C.

Overburden Stockpile

Sample No.	Sample No. from Attachment A	Trench Space Coordinates, Rounded to the Nearest Meter		Washington State Plane Coordinates		Rounded Washington State Plane Coordinates	
		X	Y	Easting	Northing	Easting	Northing
OB-01	4	70	78	571,712.34	149,829.29	571,712	149,829
OB-02	5	58	132	571,724.34	149,775.29	571,724	149,775
OB-03	6	84	122	571,698.34	149,785.29	571,698	149,785
OB-04	7	43	103	571,739.34	149,804.29	571,739	149,804
OB-05	8	40	62	571,742.34	149,845.29	571,742	149,845
OB-06	10	115	59	571,667.34	149,848.29	571,667	149,848
OB-07	12	75	81	571,707.34	149,826.29	571,707	149,826
OB-08	19	71	98	571,711.34	149,808.29	571,711	149,809
OB-09	22	112	105	571,670.34	149,802.29	571,670	149,802
OB-10	25	131	107	571,651.34	149,800.29	571,651	149,800



Sample No.	Washington State Plane Coordinates	
	Easting	Northing
OB-01	571712.34	149829.29
OB-02	571724.34	149775.29
OB-03	571696.34	149785.29
OB-04	571738.34	149804.29
OB-05	571742.34	149845.29
OB-06	571667.34	149848.29
OB-07	571707.34	149828.29
OB-08	571711.34	149809.29
OB-09	571670.34	149802.29
OB-10	571651.34	149800.29

CALCULATION COVER SHEET

Project Title:	100-NR-1 TSD Sites Remedial Action Project	**Job No.**	22192
Area	100 N		
Discipline	Environmental	***Calc. No.**	0100N-CA-V0078
Subject	116-N-1 Trench Landbridge Cleanup Verification 95% UCL Calculation		
Computer Program	Excel	**Program No.**	Excel 97

The attached calculations have been generated to document compliance with established cleanup levels.
These documents should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 5 Total = 6	K.A. Anselm 12/6/04 K. A. Anselm	J.E. Thomson 12/6/04 J. E. Thomson	K Cook 12/6/04 K. E. Cook	S E Parnell 12/6/04 S. E. Parnell	12/6/04

SUMMARY OF REVISIONS

* Obtain calc no. from DIS

Dec-02

DE01-437.03

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator K. A. Anselm
Date 12/06/04
Calc. No. 0100N-CA-V0078
Rev. No. 0
Project 100-NR-1 TSD Sites Remedial Action Project
Job No. 22192
Checked J. E. Thomson
Date 12/16/04
Subject 118-N-1 Trench Landbridge Cleanup Verification 95% UCL Calculation
Sheet No. 1 of 5

Summary

Purpose:
Calculate the 95% upper confidence limit (UCL) to evaluate compliance with cleanup standards for the subject site. Also, calculate the carcinogenic risk for applicable nonradionuclide analytes, perform the *Washington Administrative Code* (WAC) 173-340-740(7)(e) Model Toxics Control Act (MTCA) 3-part test, if required (all nonradionuclide analytes), and calculate the relative percent difference (RPD) for each contaminant of concern (COC).

Table of Contents:
Sheet 1: Summary
Sheet 2: Summary (continued)
Sheet 3: Calculation Sheet Shallow Zone
Sheet 4: Calculation Sheet Deep Zone
Sheet 5: Calculation Sheet Split-Dup Analysis

Given/References:
1) Sample Results
2) Lookup values and remedial action goals (RAGs) are taken from the Remedial Design Report/Remedial Action Work Plan (RDR/RAWP) (DOE-RL 2001) unless otherwise specified.
3) DOE-RL, 2001, *Remedial Design Report/Remedial Action Work Plan for the 100-NR-1 Treatment, Storage, and Disposal Units*, DOE/RL-2000-16, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) DOE-RL, 2002, *Sampling and Analysis Plan for the 100-NR-1 Treatment, Storage, and Disposal Units During Remediation and Closeout*, DOE/RL-2000-07, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
5) Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
6) Ecology, 1993, *Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets)*, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
7) EPA, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013, U.S. Environmental Protection Agency, Washington, D.C.

Solution:
Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993) and below. Use data from attached worksheets to calculate the 95% UCL for each analyte, the carcinogenic risk, perform the WAC 173-340-740(7)(e) 3-part test for nonradionuclides, and the RPD calculations for each COC.

Calculation Description:
The subject calculations were performed on data from soil verification samples from the subject waste site. The data were entered into an EXCEL 97 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulas within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2001) is documented by this calculation. Split and duplicate RPD results are used in evaluation of data quality and are presented in the Cleanup Verification Package (CVP) for this site. Duplicate samples were not collected; therefore, the RPD calculations are based on the regulatory split laboratory results.

Methodology:
The statistical value calculated to evaluate the effectiveness of cleanup was the 95% UCL. For nonradioactive analytes with > 50% of the data below detection limits, the maximum value for the sample data was used instead of the 95% UCL. All nonradionuclide (e.g., metals) data reported as being below detection limits were set to ½ the detection limit value for calculation of the statistics (Ecology 1993). For radionuclide data, calculation of the statistics was done on the reported value. In cases where the laboratory does not report a value below the minimal detectable activity (MDA), half of the MDA is used in the calculation.

For nonradionuclides, the WAC 173-340-740(7)(e) statistical guidance suggests that a test for distributional form be performed on the data and the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets (n < 10) and all radionuclide data sets, the calculations are performed assuming nonparametric distribution, and no test for distribution is performed. For nonradionuclide data sets of ten or greater, distributional testing is done using Ecology's MTCAStat software (Ecology 1993).

The estimated hazard quotient (for applicable nonradionuclide COCs) is determined by dividing the statistical value (derived in this calculation) by the WAC 173-340 Method B non-carcinogenic cleanup limit. The nonradionuclide carcinogenic risk, above background, is determined by dividing the statistical value by the WAC 173-340 Method B carcinogenic cleanup limit and then multiplying by 10^{-6}. For data sets where all values are below detection, neither of these calculations are required.

The WAC 173-340-740(7)(e) 3-part test is performed for nonradionuclide analytes only and determines if:
1) the statistical value exceeds the most stringent cleanup limit for each nonradionuclide COC,
2) greater than 10% of the raw data exceed the most stringent cleanup limit for each nonradionuclide COC,
3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each nonradionuclide COC.

The RPD is performed when both the main value and either the duplicate or split values are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method. These detection limit requirements are located in Table 2-1 of the SAP (DOE-RL 2002). The RPD calculations use the following formula:
RPD =[|M-S|/((M+S)/2)]*100

where, M = Main Sample Value S = Split (or duplicate) Sample Value

For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than +/- 30% indicates the data compare favorably. For regulatory splits, a threshold of +/- 35% is used (EPA 1994). If the RPD is greater than +/- 30% (or +/- 35% for regulatory split data), further investigation regarding the usability of the data is performed. Additional discussion as necessary is provided in the data quality assessment section of the applicable CVP.

If regulator split comparison is required, an additional parameter is evaluated. A control limit of +/- 2 times the TDL shall be used if either the main or regulator split value is less than 5 times the TDL and above detection. In the case where only one result is greater than five times the TDL and the other is below, the +/- 2 times the TDL criteria applies. Therefore, the following calculation is performed as part of the evaluation for these two cases involving regulator split data: difference = main - regulator split.

If the difference is greater than +/- 2 times the TDL, then further investigation regarding the usability of the data is performed and presented in the applicable CVP data quality assessment.

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator K. A. Anselm KAA
Project 100-NR-1 TSD Sites Remedial Action Project
Subject 116-N-1 Trench Landbridge Cleanup Verification 95% UCL Calculation

Date 12/06/04
Job No. 22192

Calc. No. 0100N-CA-V0078
Checked J. E. Thomson

Rev. No. 0
Date 12/6/04
Sheet No. 2 of 5

Summary

Results:

The results presented in the summary tables that follow are for use in RESRAD dose/risk analysis and the CVP for this site.

Result Summary - Shallow Zone			
Analyte	Result	Qualifier	Units
Am-241	1.2E-01	U	pCi/g
Cs-137	5.9E-01		pCi/g
Co-60	2.1E-01		pCi/g
Eu-154	7.9E-02	U	pCi/g
Eu-155	6.2E-02	U	pCi/g
Ni-63	1.34E-01	U	pCi/g
Pu-239/240	7.2E-02	U	pCi/g
Total Beta Radiostrontium	1.9E-01		pCi/g
Tritium	8.E-02	U	pCi/g
Mercury	2.E-02	U	mg/kg
Nitrate as Nitrogen	1.0E+00		mg/kg

WAC 173-340-740(7)(e) Evaluation

WAC 3-Part Test:

95% UCL > Cleanup Limit?	NA
> 10% above Cleanup Limit?	NA
Any sample > 2x Cleanup Limit?	NA

Risk Estimate:

Nonrad noncarcinogenic index sum:	NA
Nonrad carcinogenic risk:	NA

Result Summary - Deep Zone			
Analyte	Result	Qualifier	Units
Am-241*	6.29E+02		pCi/g
Cs-137**	9.6500E+04		pCi/g
Co-60**	9.460E+03		pCi/g
Eu-154*	9.28E+01		pCi/g
Eu-155*	2.1E+01	U	pCi/g
Ni-63**	2.370E+03		pCi/g
Pu-239/240*	7.00E+02		pCi/g
Total Beta Radiostrontium**	2.150E+03		pCi/g
Tritium	-3.66E+00	U	pCi/g
Cr	9.1E+00	C	mg/kg
Cr+6	4.E-01	U	mg/kg
Nitrate as Nitrogen	1.7E+00		mg/kg

* For the RDR/RAWP (DOE-RL 2001) the contaminant will not reach groundwater within a 1,000-year time frame.

** The contaminant will be evaluated for groundwater and river protection via RESRAD.

C = blank contamination

NA = not applicable

U = undetected

Relative Percent Difference (RPD) Results - QA/QC Analysis Shallow Zone*			
Analyte	Regulatory Split Analysis (F01)	Regulatory Split Analysis (F02)	Regulatory Split Analysis (F03)
Am-241			
Cs-137			1.5%
Co-60		17.6%	
Eu-154			
Eu-155			
Ni-63			
Pu-239/240			
Total Beta Radiostrontium			
Tritium			
Mercury			
Nitrate as Nitrogen			

* A blank cell indicates that RPD evaluation was not required.

CALCULATION SHEET

Bechtel Hanford, Inc.

Originator: K. A. Arsem — Date: 12-08-04 — Calc. No. 0100N-CA-V0079 — Rev. No. 0

Project: 100-NR-1 TSD Site Remedial Action Project — Job No. 22192 — Checked: J. E. Thomson — Date: 12/16/04

Subject: 116-N-1 Trench Landbridge Cleanup Verification 95% UCL Calculation — Sheet No. 3 of 5

1 Shutdown Zone Sample Data

Sampling Area	HEIS Number	Sample Date	Am-241 pCi/g	Q	MDA	Cs-137 pCi/g	Q	MDA	Co-60 pCi/g	Q	MDA	Eu-154 pCi/g	Q	MDA	Eu-155 pCi/g	Q	MDA
XR-1	J00WM6	9/13/2003	-3.2E-02	U	1.2E-01	2.8E-02	U	3.8E-02	3.3E-02	U	3.3E-02	1.1E-01	U	1.1E-01	6.3E-02	U	6.3E-02
F01	J01Y98	10/19/2004	3.1E-02	U	2.3E-01	1.1E-01		4.3E-02	1.1E-01	U	1.1E-01	1.7E-01	U	1.7E-01	1.4E-01	U	1.4E-01
F02	J01Y99	10/19/2004	1.8E-01	U	2.4E-01	1.3E-01		2.1E-02	2.8E-01		7.2E-02	5.9E-02	U	5.9E-02	6.4E-02	U	6.4E-02
F03	J01Y00	10/19/2004	8.9E-02	U	2.5E-01	8.5E-01		4.5E-02	1.2E-01		4.7E-02	1.4E-01	U	1.4E-01	9.8E-02	U	9.8E-02

Sampling Area	HEIS Number	Sample Date	Ni-63 pCi/g	Q	MDA	Pu-239/240 pCi/g	Q	MDA	Total Beta Radioactivity pCi/g	Q	MDA	Tritium pCi/g	Q	MDA	Mercury mg/kg	Q	POL	Nitrate as Nitrogen mg/kg	Q	POL
XR-1	J00WM6	9/13/2003	3.9E-01	U	2.7E-00	5.E-02	U	5.4E-01	-3.2E-02	U	2.9E-01	3.E-03	U	3.E-01	1.E-02	U	1.E-02	1.8E-01	U	2.7E-01
F01	J01Y98	10/19/2004	-1.09E-01	U	3.9E-00	9.E-02	U	1.7E-01	-1.5E-02	U	3.9E-01	3.E-02	U	3.9E-01	2.E-02	U	2.E-02	1.1E-02		2.E-01
F02	J01Y99	10/19/2004	-1.64E-00	U	3.9E-00	3.E-02	U	1.9E-01	1.4E-02	U	2.9E-01	1.E-03	U	3.E-01	2.E-02	U	2.E-02	6.9E-01		3.E-01
F03	J01Y00	10/19/2004	-3.22E-00	U	3.9E-00	2.E-02	U	1.5E-01	3.9E-01		2.9E-01	2.E-02	U	3.E-01	2.E-02	U	2.E-02	8.3E-01		2.E-01

9 Statistical Computation Input Data

Sampling Area	HEIS Number	Sample Date	Am-241 pCi/g	Cs-137 pCi/g	Co-60 pCi/g	Eu-154 pCi/g	Eu-155 pCi/g	Ni-63 pCi/g	Pu-239/240 pCi/g	Total Beta Radioactivity pCi/g	Tritium pCi/g	Mercury mg/kg	Nitrate as Nitrogen mg/kg
XR-1	J00WM6	9/13/2003	-3.2E-02	1.8E-02	1.8E-02	5.5E-02	6.2E-02	3.8E-01	5.E-02	-3.2E-02	3.E-03	5.E-03	9.0E-02
F01	J01Y98	10/19/2004	3.1E-02	1.1E-01	5.5E-02	8.5E-02	7.9E-02	-1.09E-01	9.E-02	-1.5E-02	3.E-02	8.E-03	1.1E-00
F02	J01Y99	10/19/2004	1.8E-01	1.3E-01	2.8E-01	3.0E-02	3.2E-02	-1.64E-00	2.E-02	1.4E-02	1.E-03	8.E-03	6.9E-01
F03	J01Y00	10/19/2004	8.9E-02	8.5E-01	1.2E-01	7.0E-02	5.9E-02	-3.22E-00	2.E-02	3.9E-01	2.E-02	8.E-03	8.3E-01

17 Statistical Computations

	Am-241	Cs-137	Co-60	Eu-154	Eu-155	Ni-63	Pu-239/240	Total Beta Radioactivity	Tritium	Mercury	Nitrate as Nitrogen
	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	>50% below detection. Default to maximum value.	Small data set. Use nonparametric z-statistic.
Statistical value based on											
N	4	4	4	4	4	4	4	4	4	4	4
% < Detection limit	100%	25%	50%	100%	100%	100%	100%	75%	100%	100%	25%
mean	5.9E-02	3.7E-01	1.2E-01	5.0E-02	4.8E-02	-1.23E-00	3.E-02	6.6E-02	3.E-03	7.E-03	9.9E-01
st. dev.	7.9E-02	3.8E-01	1.1E-01	2.4E-02	1.6E-02	1.66E-00	5.E-02	1.6E-01	8.E-03	2.E-03	4.3E-01
Z-statistic	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645
95% UCL on mean	1.2E-01	5.9E-01	2.1E-01	7.9E-02	6.2E-02	1.54E-01	7.E-02	1.8E-01	8.E-02	9.E-03	1.0E+00
max value	1.8E-01	8.5E-01	2.8E-01	1.7E-01	1.4E-01	3.06E-01	9.E-02	3.0E-01	1.E-01	2.E-02	1.1E+00
Statistical value	1.2E-01	5.9E-01	2.1E-01	7.9E-02	6.2E-02	1.54E-01	7.E-02	1.9E-01	8.E-02	2.E-02	1.0E+00
Background	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Statistical value above background	1.2E-01	5.9E-01	2.1E-01	7.9E-02	6.2E-02	1.54E-01	7.E-02	1.9E-01	8.E-02	2.E-02	1.0E+00
Lookup Value - 10 mrem/yr for cell	41.6	6.1	1.4	3.1	127	4031	23.5	3.7	241	NA	NA

Most Stringent Cleanup Limit for nonradionuclide and RAG type			0.33 Background/ GW/River Protection	4400 GW/River Protection
30 WAC 173-340 3-PART TEST				
33 95% UCL > Cleanup Limit?			NA	NA
34 > 10% above Cleanup Limit?			NA	NA
35 Any sample > 2X Cleanup Limit?			NA	NA
36 EXCESS RISK EVALUATION				
37 WAC 173-340 Non-Carcinogenic Cleanup:			24	8,000
38 Hazard quotient for each nonradionuclide:			NA	NA
39 WAC 173-340 Carcinogenic Cleanup:			NA	NA
40 Excess risk for each carcinogenic nonradionuclide:			NA	NA
42 WAC 173-340 Compliance?	NA		Because mercury was not detected in any of the samples, the 3-part test and excess risk are not calculated	Because the statistical value is less than the Hanford Site background (52 mg/kg), the 3-part test and excess risk are not calculated
43 Hanford noncarcinogenic index sum:	NA			
44 Hanford carcinogenic risk:	NA			

45 BG = background
46 GW = groundwater
47 NA = not applicable
48 Q = qualifier
49 RAG = remedial action goal
50 U = undetected

CALCULATION SHEET

Bechtel Hanford, Inc.

Originator K. A. Amstein — Date 12/06/04
Project 100-BR-1 TSD Sites Remedial Action Project — Job No. 32190
Subject 1/8-N-1 Trench Landfill Site Cleanup Verification Min UCL Calculation

Calc. No. 0100N-CA-V0078
Checked J. E. Thomson
Checked 12/13/04

Rev. No. 0
Date 12/13/04
Sheet No. 4 of 5

1 Deep 24mm Sample Data (sample listed for reporting purposes only)

Sampling Area	HEIS Number	Sample Date	Am-241* pCi/g	Q	MDA	Co-137** pCi/g	Q	MDA	Co-60** pCi/g	Q	MDA	Eu-154* pCi/g	Q	MDA	Eu-155* pCi/g	Q	MDA	Ni-63** pCi/g	Q	MDA	Pu-239/240* pCi/g	Q	MDA	Total Beta Radioactivity** pCi/g	Q	MDA	Tritium pCi/g	Q	MDA	Cr mg/kg	Q	PQL	Cr-6 mg/kg	Q	PQL	Nitrate as Nitrogen mg/kg	Q	PQL
XF-1	J00W/N0	8/13/2003	6.28E+02		6.1E+00	9.6500E+04		3.1E+01	9.460E+03		1.5E+01	9.28E+01		2.4E+01	1.1E+01	U	2.1E+01	2.370E+03		5.2E+01	7.00E+02		2.8E+00	2.150E+03		1.8E+01	-3.94E+00	U	2.2E+01	9.1E+00	C	1.5E-01	4.E-01	U	4.E-01	1.7E+00		2.E-01

2
3
4
5
6 Statistical Computation Input Data

Sampling Area	HEIS Number	Sample Date	Am-241* pCi/g	Co-137** pCi/g	Co-60** pCi/g	Eu-154* pCi/g	Eu-155* pCi/g	Ni-63** pCi/g	Pu-239/240* pCi/g	Total Beta Radioactivity** pCi/g	Tritium pCi/g	Cr mg/kg	Cr-6 mg/kg	Nitrate as Nitrogen mg/kg
XF-1	J00W/N0	8/13/2003	6.28E+02	9.6500E+04	9.460E+03	9.28E+01	1.1E+01	2.370E+03	7.00E+02	2.150E+03	-3.94E+00	9.1E+00	2.E-01	1.7E+00

10
11 Statistical Computations

	Am-241*	Co-137**	Co-60**	Eu-154*	Eu-155*	Ni-63**	Pu-239/240*	Total Beta Radioactivity**	Tritium	Cr	Cr-6	Nitrate as Nitrogen
12	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Radionuclide data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic	Small data set. Use nonparametric z-statistic	Small data set. Use nonparametric z-statistic.
13 Statistical value based on												
14 N	1	1	1	1	1	1	1	1	1	1	1	1
15 % < Detection limit	0%	0%	0%	0%	100%	0%	0%	0%	100%	0%	100%	0%
16 mean	6.28E+02	9.6500E+04	9.460E+03	9.28E+01	1.1E+01	2.370E+03	7.00E+02	2.150E+03	-3.94E+00	9.1E+00	2.E-01	1.7E+00
17 st. dev.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
18 z value	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645	1.645
19 95% UCL on mean	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
20 min value	6.28E+02	9.6500E+04	9.460E+03	9.28E+01	1.1E+01	2.370E+03	7.00E+02	2.150E+03	-3.94E+00	9.1E+00	4.E-01	1.7E+00
21 Statistical value	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.E-01	NA
22 Background	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
23 Statistical value above background	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.E-01	NA
24 Lookup Value - 15 mrem/yr fed rad	NV	NV	NV	NV	NV	NV	NV	NV	2000	NA	NA	NA
25 Most Stringent Cleanup Limit for nonradionuclides and RAG Dam										16.5 BG	2 River Protection	4400 GW/River Protection
26 WAC 173-340 SUMMARY TEST												
27 95% UCL > Cleanup Limit?										NA	NA	NA
28 > 10% above Cleanup Limit?										NA	NA	NA
29 Any sample > 2X Cleanup Limit?										NA	NA	NA
30 EXCESS RISK EVALUATION												
31 WAC 173-340 Non-Carcinogenic Cleanup										8,000	480	24
32 Hazard quotient for each nonradionuclide										NA	NA	NA
33 WAC 173-340 Carcinogenic Cleanup										NA	2.1	NA
34 Excess risk for each carcinogenic nonradionuclide										NA	NA	NA
35										Because chromium is less than the Hanford Site background (16.5 mg/kg), the 3-part test and excess risk are not calculated.	Because hexavalent chromium was not detected, the 3-part test and excess risk are not calculated.	Because the result is less than the Hanford Site background (57 mg/kg), the 3-part test and excess risk are not calculated.
36 WAC 173-340 Compliance?	NA											
37 Hazard noncarcinogenic index sum:	NA											
38 Hazard carcinogenic risk:	NA											

39 * Per the RDR/RAWP (DOE/RL 2001) the contaminant will not reach groundwater within a 1,000-year time frame
40 ** The contaminant will be evaluated for GW and river protection via RESRAD
41 BG = background
42 C = blank contamination
43 GW = groundwater
44 NA = not applicable
45 NV = no value
46 Q = qualifier
47 RAG = remedial action goal
48 U = undetected

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator K. A. Anselm
Project 100-NR-1 TSD Sites Remedial Action Project
Subject 116-N-1 Trench Landbridge Cleanup Verification 95% UCL Calculation

Date 12/06/04
Job No. 22192

Calc. No. 0100N-CA-V0078
Checked J. E. Thomson

Rev. No. 0
Date 12/6/04
Sheet 5 of 5

1 Split-Dup Analysis (Duplicates were not collected. The analysis is for regulatory splits only.)
2 Shallow Zone Results:

3	Sampling Area	HEIS Number	Am-241			Cs-137			Co-60			Eu-154			Eu-156			Ni-63			Pu-239/240			Total Beta Radiostrontium			Tritium			Mercury			Nitrate as Nitrogen		
4			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	POL	mg/kg	Q	POL
5		F01	3.E-02	U	2.3E-01	1.E-01		6.3E-02	1.1E-01	U	1.1E-01	2.E-01	U	1.7E-01	1.E-01	U	1.4E-01	-1.E-01	U	3.5E+00	9.E-02	U	2.E-01	-1.5E-02	U	2.9E-01	5.E-02	U	3.E-01	1.7E-02	U	1.7E-02	1.1E+00		2.0E-01
6	Regulator Split	CSA-F01	-3.E-03	U	2.7E-02	5.E-03	U,G	1.2E-01	1.3E-01	G,TI	1.0E-01	1.E-01	U,G	6.3E-01	-2.E-02	U,G	3.2E-01	7.E-01	Y1,U	3.4E+00	5.E-03	U	1.E-02	Not Analyzed			Not Analyzed			3.8E-02	U	3.8E-02	2.2E+00	U	2.2E+00
7		F02	7.E-01	U	2.4E-01	1.E-01		2.1E-02	2.8E-01		2.2E-02	6.E-02	U	5.9E-02	6.E-02	U	6.4E-02	-2.E+00	U	3.5E+00	2.E-02	U	2.E-01	1.4E-02	U	2.9E-01	1.E-01	U	3.E-01	1.8E-02	U	1.8E-02	6.9E-01		2.0E-01
8	Regulatory Split	CSA-F02	1.E-02	U	2.5E-02	2.E-01	U,G	1.9E-01	3.3E-01	G	1.6E-01	-2.E-01	U,G	7.8E-01	-1.E-01	U,G	3.5E-01	2.E-01	Y1,U	3.2E+00	2.E-02	U	2.E-02	Not Analyzed			Not Analyzed			3.8E-02	U	3.8E-02	2.2E+00	U	2.2E+00
9		F03	7.E-02	U	2.5E-01	6.E-01		4.5E-02	1.2E-01		4.2E-02	1.E-01	U	1.4E-01	1.E-01	U	9.9E-02	-3.E+00	U	3.5E+00	-2.E-02	U	2.E-01	3.0E-01		2.5E-01	-8.E-02	U	3.E-01	1.8E-02	U	1.8E-02	8.3E-01		2.1E-01
10	Regulatory Split	CSA-F03	4.E-03	U	2.9E-02	9.E-01		1.1E-01	1.8E-01		8.9E-02	2.E-01	U	4.7E-01	1.E-02	U	2.2E-01	-2.E-01	U	3.1E+00	1.E-02	U	2.E-02	Not Analyzed			Not Analyzed			3.8E-02	U	3.8E-02	2.1E+00	U	2.1E+00

11
12 Shallow Zone Analysis:

13	(TDL)		1	0.1	0.05	0.1	0.1	30	1	1	400	0.2	0.75
14	Regulatory Split Analysis (CSA-F01)	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Not Analyzed	Not Analyzed	No-Stop (acceptable)	No-Stop (acceptable)
15		Both >5xTDL?											
16		RPD											
17	Regulatory Split Analysis (CSA-F02)	Both > MDA?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Not Analyzed	Not Analyzed	No-Stop (acceptable)	No-Stop (acceptable)
18		Both >5xTDL?			Yes (calc RPD)								
19		RPD			17.82%								
20	Regulatory Split Analysis (CSA-F03)	Both > MDA?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Not Analyzed	Not Analyzed	No-Stop (acceptable)	No-Stop (acceptable)
21		Both >5xTDL?		Yes (calc RPD)	No-Stop (acceptable)								
22		RPD		1.52%									

23 G = Sample density differs by more than 15% of LCS density
24 MDA = minimal detectable activity
25 RPD = relative percent difference
26 TDL = target detection limit
27 TI = Nuclide identification is tentative
28 U = undetected
29 Y1 = Chemical yield is in control at 100-110%. Quantitative yield is assumed

95%UCL 116-N-1 Trench Landbridge cleanSplit-Dup Analysis

CVP-2006-00004
Rev. 0
For Approval

CALCULATION COVER SHEET

Project Title 100-NR-1 TSD Sites Remedial Action Project **Job No.** 22192
Area 100-N Area
Discipline Environmental ***Calc. No.** 100N-CA-V0079
Subject 116-N-1 Trench Landbridge RESRAD Calculation
Computer Program RESRAD **Program No.** Version 6.22

The attached calculations have been generated to document compliance with established cleanup levels.
These documents should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ **Preliminary** ☐ **Superseded** ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover – 1 pg Summary – 5 pg Attm. 1 - 1 pg Attm. 2 - 25 pg Attm. 3 - 44 pg Attm. 4 - 21 pg Attm. 5 - 28 pg Attm. 6 - 44 pg Attm. 7 - 21 pg Total – 190 pg	S. W. Clark S.W. Clark 12/6/04	J. E. Thomson J.E. Thomson 12/6/04	K. E. Cook KE Cook 12/6/04	S. E. Parnell S.E. Parnell	12/6/04

SUMMARY OF REVISION

*Obtain Calc. No. from DIS

November 2002

DE01-437.03

Bechtel Hanford, Inc. CALCULATION SHEET

Originator:	S. W. Clark	Date:	12/6/04	Calc. No.:	100N-CA-V0079	Rev.:	0
Project:	100-NR-1 Remedial Action	Job No:	22192	Checked:	J. E. Thomson	Date:	12/6/04
Subject:	116-N-1 Trench Landbridge RESRAD Calculation					Sheet No. 1 of 5	

PURPOSE:

Calculate the predicted soil and groundwater concentrations, dose, and risk contributions from radionuclide contaminants in shallow zone and deep zone soil at the location of a land bridge proposed to cross the 116-N-1 remediation site.

GIVEN/REFERENCES:

1) Cleanup verification data from *116-N-1 Trench Landbridge Cleanup Verification 95% UCL Calculation*, Calculation No. 0100N-CA-V0078, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
2) *Remedial Design Report/Remedial Action Work Plan for the 100-NR-1 Treatment, Storage, and Disposal Units* (RDR/RAWP), DOE/RL-2000-16, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, WA.
3) Radioactive and nonradioactive contaminants of concern from the *100-NR-1 Treatment, Storage, and Disposal Units During Remediation and Closeout Sampling and Analysis Plan* (100-NR-1 SAP), DOE/RL-2000-07, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. For the purpose of these RESRAD calculations, the radioactive contaminants of concern (COCs) are americium-241, cesium-137, cobalt-60, europium-154, europium-155, tritium, nickel-63, plutonium-239/240, and strontium-90. The nonradionuclide contaminants of concern are nitrate, total chromium, hexavalent chromium, and mercury. Concentrations of all nonradionuclide contaminants are below the remedial action goals per the RDR/RAWP and they are not considered further.
4) RESidual RADioactivity (RESRAD) computer code, version 6.22, to calculate compliance with residual radioactivity guidelines, developed for the U.S. Department of Energy by the Environmental Assessment Division of Argonne National Laboratory, Argonne, Illinois.
5) *116-N-1 RESRAD Evaluation of Groundwater Protection*, Calc. No. 100N-CA-V0066, January, 2003, Bechtel Hanford, Inc., Richland, Washington.

SOLUTION:

1) RESRAD runs were performed for the residual contamination in shallow zone and deep zone at the site of the land bridge proposed to cross the 116-N-1 Trench. Table 1 shows the elevations (NGVD88) and dimensions of the relevant soil horizons. The ground surface elevation for excavation backfill is 140.0 m. The average groundwater elevation beneath the site is 117.5 m. The average elevation of the excavation floor is 135.4 m. Attachment 1 shows the dimensions of each soil horizon and the contaminant pathways considered for dose, risk, and groundwater protection. Input factors for the RESRAD run are shown in the "Summary" section of the RESRAD "Part I: Mixture Sums and Single Radionuclide Guidelines" printouts in the Attachments to this Calculation Summary.

2) The year where the peak dose (or concentration) occurs in the groundwater from each individual COC was examined by a preliminary RESRAD modeling run. This year was then added for all horizons for the final RESRAD runs. For the groundwater (well water) the peak years were year 7.6 for cobalt-60, year 42 for cesium-137 and strontium-90, and year 137 for nickel-63. The 7.6, 42, and 137-year time periods were included in all of the RESRAD runs. Year 14 was also added, corresponding to 2018, the date of the 30-year site cleanup schedule of the *Hanford Federal Facility Agreement and Consent Order*.

Table 1. Waste Site Dimensions for RESRAD Modeling

Parameter	Units	Shallow Zone	Deep Zone	Comments
Contaminated Zone Dimensions				
Cover Depth	m	0	4.6	
Area of Contaminated Zone (CZ)	m^2	12,400	12,400	
Length Parallel to Aquifer Flow	m	120	120	Based on Site Dimensions
Elevations of Vadose Zone Horizons				
Elevation: Surface	m	140.0	140.0	NAVD88
Elevation: Bottom of Excavation	m	135.4	135.4	NAVD88
Elevation: Groundwater	m	117.5	117.5	NAVD88
Thickness: Contaminated Zone	m	4.6	10.1	
Thickness: Unsaturated Zone	m	17.9	7.8	Calc. No. 100N-CA-V0066

METHODOLOGY:

1) Pu-239/240 Conversion: The relative individual Pu-239 and Pu-240 activities were calculated from the combined Pu-239/240 results reported. The calculations were performed in accordance with calculation brief No. 0100B-CA-V0013. The relative activities for Pu-239 and Pu-240 were calculated by multiplying the cleanup verification value for Pu-239/240 by 0.807 and 0.193, respectively. Table 2 shows the results from this calculation.

Table 2. Conversion of Pu-239/240 to Relative Pu-239 and Pu-240 Activities

Source of Radionuclide Data	Pu-239/240 Activity (pCi/g)	Pu-239, (pCi/g) (0.807 multiplier)	Pu-240, (pCi/g) (0.193 multiplier)
Shallow Zone	0.072 U	0.058 U	0.014 U
Deep Zone	700	564.9	135.1

2) Runs of RESRAD Version 6.22 were completed for the shallow and deep zones using the radionuclide concentrations shown in Table 3. RESRAD numerical output reports for dose, risk, and concentration for the shallow and deep zones are presented in the Attachments to this Calculation Summary.

Bechtel Hanford, Inc. CALCULATION SHEET

Originator:	S. W. Clark	Date:	12/6/04	Calc. No.:	100N-CA-V0079	Rev.:	0
Project:	100-NR-1 Remedial Action	Job No:	22192	Checked:	J. E. Thomson	Date:	12/6/04
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Table 3. 116-N-1 Shallow and Deep Zone Radionuclide Soil Concentrations

Radionuclide COCs	Shallow Zone Radionuclide Soil Activity, pCi/g	Deep Zone Radionuclide Soil Activity, pCi/g
Am-241	1.2E-01 U[a]	6.29E+02
Co-60	2.1E-01	9.6500E+04
Cs-137	5.9E-01	9.460E+03
Eu-154	7.9E-02 U[a]	9.28E+01
Eu-155	6.2E-02 U[a]	2.1E+01 U[a]
H-3 (tritium)	8.E-02 U[a]	-3.66E+00 U[b]
Ni-63	1.54E-01 U[a]	2.370E+03
Pu-239	5.8E-02 U[a]	5.65E+02
Pu-240	1.4E-02 U[a]	1.35E+02
Sr-90	1.9E-01	2.150E+03

[a] U = undetected. Value was not input into RESRAD because the radionuclide was undetected in soil samples.
[b] RESRAD does not accept negative values. When results are negative, zero is used as the input value.

RESULTS:

1) **Radionuclide "All Pathways" Dose Rate:** The "all pathways" (maximum) dose rates are shown in Table 4. The maximum dose rate of 4.39 mrem/yr from the combined shallow zone and deep zone occurs at year zero (2004).

Table 4. All Pathways Dose Rate (mrem/yr)

Vadose Zone Horizon	"All Pathways" Dose Contributions in mrem/yr at Each Time Slice (yr)									
	0	1	3	7.6	14	42	100	137	300	1000
Shallow Zone	4.39E+00	4.09E+00	3.57E+00	2.73E+00	2.03E+00	8.91E-01	2.23E-01	9.31E-02	2.04E-03	4.31E-07
Deep Zone	2.92E-19	2.59E-19	2.04E-19	1.18E-19	5.47E-20	1.92E-21	4.54E-24	1.88E-24	4.36E-25	1.25E-27
Total	4.39E+00	4.09E+00	3.57E+00	2.73E+00	2.03E+00	8.91E-01	2.23E-01	9.31E-02	2.04E-03	4.31E-07

2) **Radionuclide Excess Cancer Risk:** The radionuclide excess cancer risk results are shown on Table 5. The maximum risk (4.72×10^{-5}) occurs at year zero (2004).

Table 5. Radionuclide Excess Cancer Risk

Vadose Zone Horizon	Excess Cancer Risk at Each Time Slice (yr)									
	0	1	3	7.6	14	42	100	137	300	1000
Shallow Zone	4.72E-05	4.50E-05	4.10E-05	3.41E-05	2.75E-05	1.33E-05	3.36E-06	1.41E-06	3.33E-08	1.91E-11
Deep Zone	1.82E-24	1.62E-24	1.27E-24	7.34E-25	3.41E-25	1.21E-26	5.41E-29	3.65E-29	0	0
Total	4.72E-05	4.50E-05	4.10E-05	3.41E-05	2.75E-05	1.33E-05	3.36E-06	1.41E-06	3.33E-08	1.91E-11

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3) **Radionuclide Groundwater Protection:** The radionuclide concentrations in groundwater due to shallow zone and deep zone soil concentrations were calculated by the RESRAD model and summarized in Table 6. None of the radionuclide contaminants of concern were calculated to reach groundwater in the 1,000 years of the RESRAD modeling runs. Therefore there is no need to do a comparison to drinking water standards (MCL) calculation brief for the 116-N-1 Trench Landbridge.

Table 6. RESRAD Calculated Groundwater (Well Water) Concentrations.

Radio-nuclide	Groundwater Concentration in pCi/L at Each Time Slice (yr)										RAG pCi/L
	0	1	3	7.6	14	42	100	137	300	1000	
Am-241	0	0	0	0	0	0	0	0	0	0	1.2
Co-60	0	0	0	0	0	0	0	0	0	0	100
Cs-137	0	0	0	0	0	0	0	0	0	0	60
Eu-154	0	0	0	0	0	0	0	0	0	0	60
Eu-155	0	0	0	0	0	0	0	0	0	0	600
H-3	0	0	0	0	0	0	0	0	0	0	20,000
Ni-63	0	0	0	0	0	0	0	0	0	0	50
Pu-239	0	0	0	0	0	0	0	0	0	0	1.6
Pu-240	0	0	0	0	0	0	0	0	0	0	1.2
Sr-90	0	0	0	0	0	0	0	0	0	0	8

CONCLUSIONS:

- The "all pathways" (maximum) dose rates are shown in Table 4. The combined maximum all-pathways dose rate for the shallow and deep zones is 4.39 mrem/yr which occurs at year zero (2004).
- The dominant pathway for the dose rate is direct external exposure.
- The primary radionuclide contributing to the direct exposure pathway is cobalt-60.
- None of the site COCs are projected to exceed remedial action goals (RAGs).
- The radionuclide excess lifetime cancer risk results are shown in Table 5. The maximum combined shallow and deep zone excess lifetime cancer risk (4.72×10^{-5}) occurs at year zero (2004).
- None of the radionuclide contaminants of concern are predicted to reach groundwater in the 1,000 years of the RESRAD model run. Therefore there is no need to do a comparison to drinking water standards (MCL) calculation brief for the 116-N-1 Trench Landbridge.

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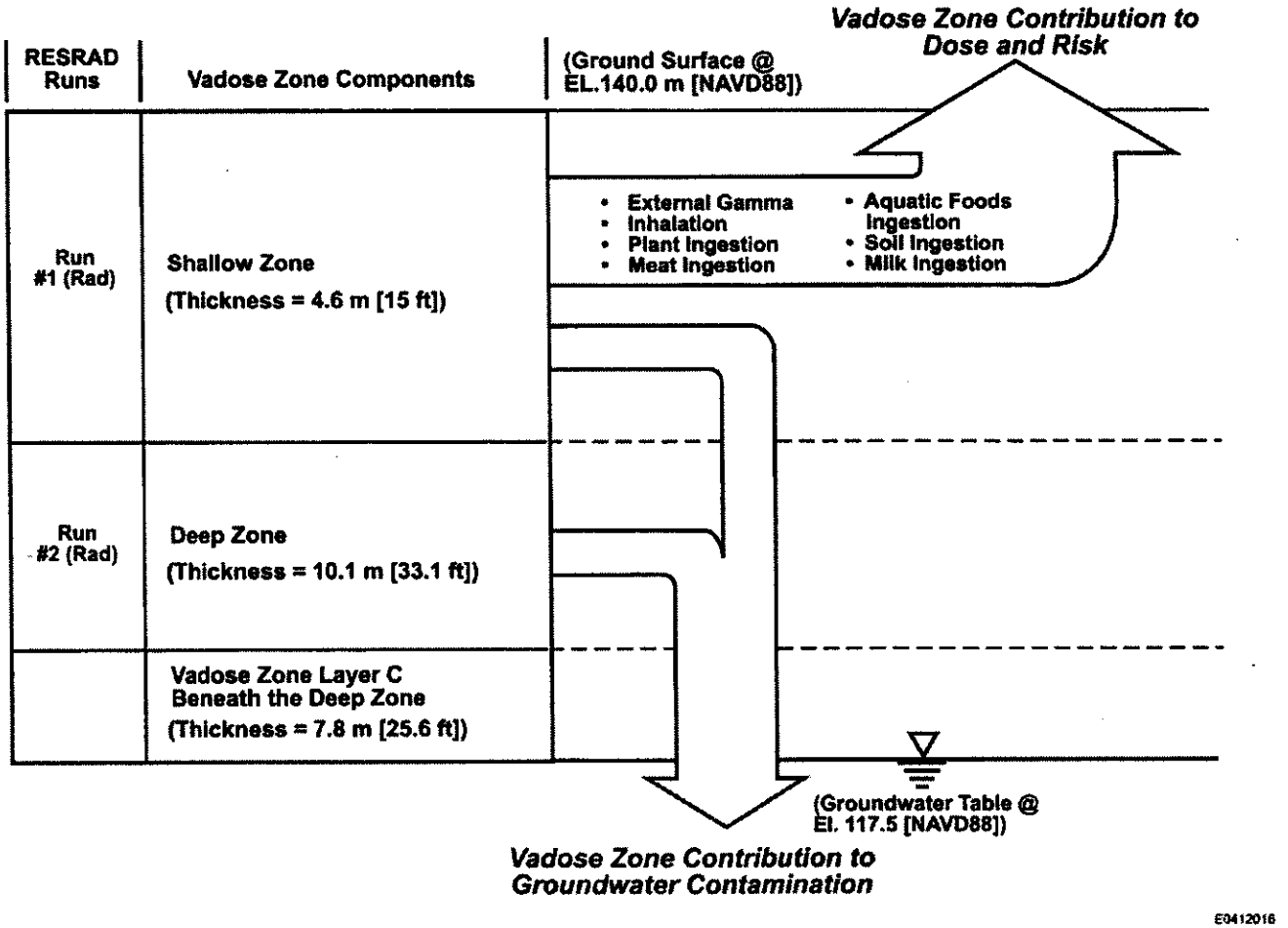
ATTACHMENTS:

1. Graphic showing 116-N-1 Vadose Zone Model (1 page)
2. RESRAD Output: 116-N-1 Evaluation of Shallow Zone for Backfill; Part I: Mixture Sums and Single Radionuclide Guidelines (25 pages)
3. RESRAD Output: 116-N-1 Evaluation of Shallow Zone for Backfill; Part III: Intake Quantities and Health Risk Factors (44 pages)
4. RESRAD Output: 116-N-1 Evaluation of Shallow Zone for Backfill; Part IV: Concentration of Radionuclides (21 pages)
5. RESRAD Output: 116-N-1 Evaluation of Deep Zone for Backfill; Part I: Mixture Sums and Single Radionuclide Guidelines (28 pages)
6. RESRAD Output: 116-N-1 Evaluation of Deep Zone for Backfill; Part III: Intake Quantities and Health Risk Factors (44 pages)
7. RESRAD Output: 116-N-1 Evaluation of Deep Zone for Backfill; Part IV: Concentration of Radionuclides (21 pages)

ATTACHMENT 1

116-N-1 Trench Cleanup Verification Model



Attachment 1 Sheet No. 1 of 1
Originator S. W. Clark Date 12/6/04
Chk'd By J.E. Thomson Date 12/10/04
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