environmental restoration project

A Department of Energy
Environmental Cleanup Program

LA-UR-02-2218
April 2002
ER2002-0253

Voluntary

Corrective Measures Plan for Solid Waste Management Unit 21-011(k) at Technical Area 21

Los Alamos
NATIONAL LABORATORY
Los Alamos, NM 87545

Prepared by the MDA Focus Area

EXECUTIVE SUMMARY

This Voluntary Corrective Measure (VCM) Plan presents the approach for remediation of Solid Waste Management Unit (SWMU) 21-011(k) located within Technical Area (TA) 21 at Los Alamos National Laboratory (LANL or the Laboratory).

SWMU 21-011(k) consists of an inactive NPDES-permitted outfall for treated industrial wastewater from the former wastewater treatment plants (Building 21-35 and 21-157) at TA-21. This includes a 4-in. cast iron drainline and an associated outfall ditch that channeled wastewater to the south rim of DP Canyon and down the north-facing slope of DP Canyon. The effluent was process wastewater generated from the purification of plutonium and contained a variety of radioactive and chemical constituents. SWMU 21-011(k) received industrial effluent from the wastewater treatment plant in Building 21-35 from 1952 until 1967; it received industrial effluent from the wastewater treatment plant in Building 21–257 (that replaced the treatment plant at Building 21-35) from 1967 until the early 1990s when the outfall was left in place.

SWMU 21-011(k) was investigated in 1988 by DOE and by the Laboratory's ER Project in 1992 and 1993. Results of these investigations indicated the presence of significant radionuclide contamination. An interim action (IA) was performed in 1996. Objectives of the IA were to: 1) divert storm water away from the outfall area, and 2) remove a portion of the radionuclide source term from the hillside by excavating and removing the most highly contaminated soils. Approximately 390 yd^3 of radioactively contaminated soil was removed from the site and disposed of at the Laboratory's low-level radioactive waste landfill at TA-54 Area G. Post-excavation radiation survey and soil sampling showed a reduction in gross alpha count levels from greater than 500,000 counts per minute (cpm) to 100,000 cpm. Finally, the IA Completion Report called for the development of a voluntary corrective measure (VCM) to effect a final remedy at the site.

In November 2000, an extensive in situ gamma spectrometry survey was conducted over the entire site, followed by the collection of 48 surface and subsurface soil, tuff and/or sediment samples from eleven locations in March 2001. Twenty-six of the samples were analyzed for waste characterization purposes. The entire data set was used to confirm the location of remaining hotspots in SWMU 21-011(k) and establish a correlation between cesium-137 concentrations, the primary radionuclide at the site, and other radionuclide concentrations in the soil.

Review of the data from the November 2000 and March 2001 sampling events indicate the following:

- the remaining potential contaminants of concern are radionuclides, primarily the relatively short-lived cesium-137 and americium-241;
- none of the contaminated material at the site would be considered hazardous waste upon generation;
- several inorganic chemicals were detected just above background values and will be included in human health and ecological screening assessments to be performed as part of the VCM Completion Report; and
    - completion of the VCM will meet a dose limit of 15 mrem/yr.

The objectives of this VCM are to:

- control the radionuclide contaminant source remaining on the hillside;
- reduce the potential dose associated with the contaminated material; and
    - prevent future contaminant migration.

The Laboratory's ER Project will conduct the following activities to achieve these objectives:

- excavate and dispose of the outfall drainline;
- excavate and solidify contaminated tuff and sediment from hot spots;
- place solidified material in a stabilization cell to be excavated near the center of the SWMU;
- restore the site by placing and compacting approximately 4000 yds^3 of clean fill as a cover over the entire site;
- install storm water run on and runoff controls; and
    - conduct routine site inspections and radiation surveys to ensure the integrity of the remedy.

As the details of this VCM Plan are presented in the body of this document, the following should be kept in mind:

- The site is located on the hillside above DP Canyon where the average slope is 21%-- too steep and impractical for a building site given the abundance of more desirable sites at the Laboratory,
- The planned land use for this site is industrial, with the site under DOE control for at least the next 100 years, although easy access makes the trail user land use scenario more practical, and
- The principle radionuclides contributing to trail user-exposure are cesium-137 (~78% of the dose, half-life 30.17 y) and americium-241 (~13% of the dose, half-life 432.7 y). Over the next 100 years, radioactive decay alone will cause dose rates to decline to 26% of current levels under the recreational trail user scenario assuming pre-remediation average site concentrations.

Table of Contents

APPENDICES

List of Figures

1.0 INTRODUCTION

This VCM Plan presents the approach for remediating SWMU 21-011(k) located at TA-21, at Los Alamos National Laboratory (Figures 1.0-1 and 1.0-2). SWMU 21-011(k) is an inactive outfall, drainline, and outfall ditch and is listed in Module VIII of the Laboratory's Hazardous Waste Facility Permit (EPA 1990, 01585.2).

The purpose and scope, regulatory history, and rationale for the proposed corrective measure are presented in Section 1. Section 2 presents the site description and operational history, previous field investigations, and results of previous investigations for this SWMU. The basis for cleanup levels and bench scale testing are discussed in Section 3. Section 4 includes the conceptual model, and discussions of characterization and confirmation sampling, cleanup activities, and site restoration. Section 5 presents the estimated types and volumes of waste and the method of management and disposal. Section 6 discusses the proposed schedule and uncertainties. References are listed in Section 7. Appendices are as follows: Appendix A includes acronyms and abbreviations; Appendix B includes the VCM checklist; Appendix C includes the ER Project Standard Operating Procedure 2.01, "Surface Water Site Assessments"; Appendix D includes the ecological checklist, Appendix E includes the estimated costs; Appendix F.1 includes radiological data analysis; Appendix F.2 provides RESidual RADioactivity (RESRAD) inputs and results.

1.1 Purpose and Scope

The objectives of this corrective measure are source reduction/control, dose reduction, and prevention of contaminant migration. To meet these objectives, the Laboratory's Environmental Restoration (ER) Project will conduct the following activities: staged solidification of approximately 500 yd^3 of contaminated soil; reburial of the solidified soil within the SWMU boundary; engineered site restoration; removal of a drainline extending from the wastewater treatment tanks to an outfall that discharges just below the canyon rim at SWMU 21-011(k); and long-term monitoring . In addition, the DOE requires that corrective measures strive to reduce radiation levels to "As Low As Reasonably Achievable" (ALARA) and this VCM incorporates the principle of ALARA (DOE 1990, 58980.1). ALARA features include: isolating radioactive materials from the environment, removal of areas with elevated radioactivity (Figure 1.1-1), and avoidance of risk related to offsite transportation of radioactive materials.

The chemicals of potential concern (COPC) at SWMU 21-011(k) are cesium-137, strontium-90, americium-241 and plutonium-239. The current average dose across the site to a recreational trail user is 7 mrem/yr as shown in Figure 1.1-2. The graph shows that exposure from these radionuclides is dramatically reduced over a 100- to 200-year time period due to radioactive decay. While the site, on average, meets the 15 mrem/yr dose limit for a recreational trail user scenario, there are some areas that exceed the dose limit. Soil from these areas will be removed and solidified. As part of the corrective measure, the engineered restoration will reduce exposure to a trail user below the 15 mrem/yr dose limit over the entire site as is consistent with ALARA. A figure illustrating dose reduction from the corrective action is provided in Appendix F.2.

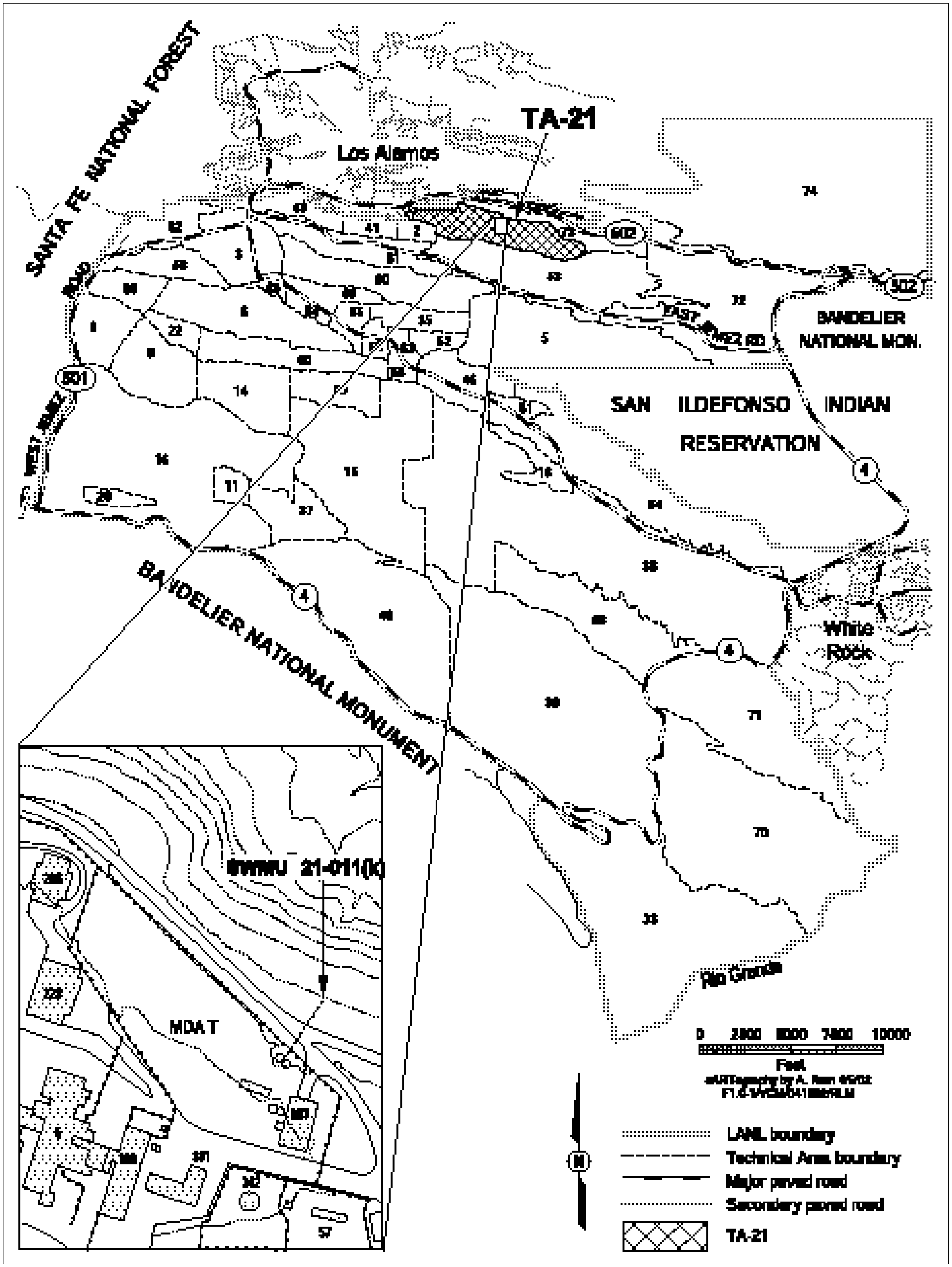


Figure 1.0-1. Location of TA-21 with respect to Laboratory Technical areas and surrounding land holdings.

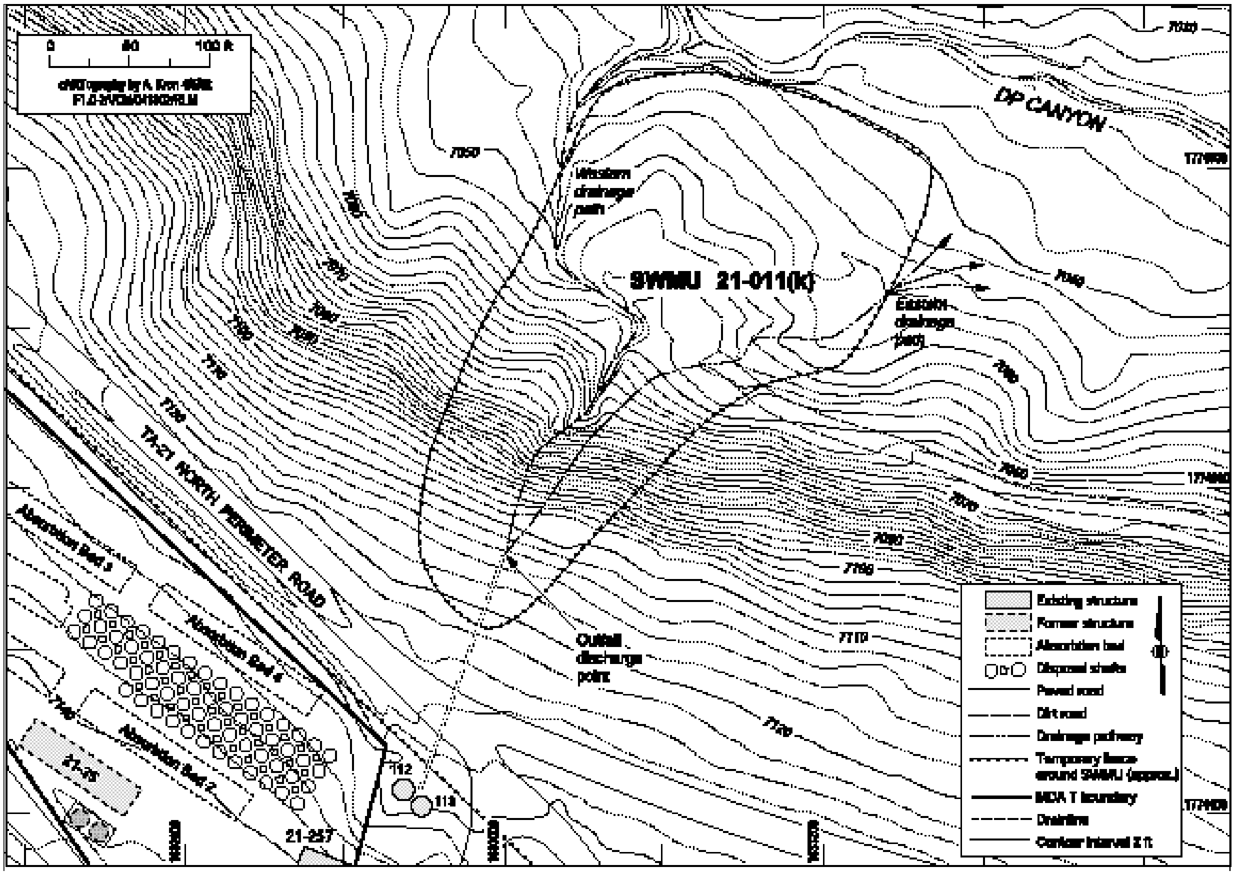


Figure 1.0-2. Location of SWMU 21-011(k) within Laboratory Technical Area 21.

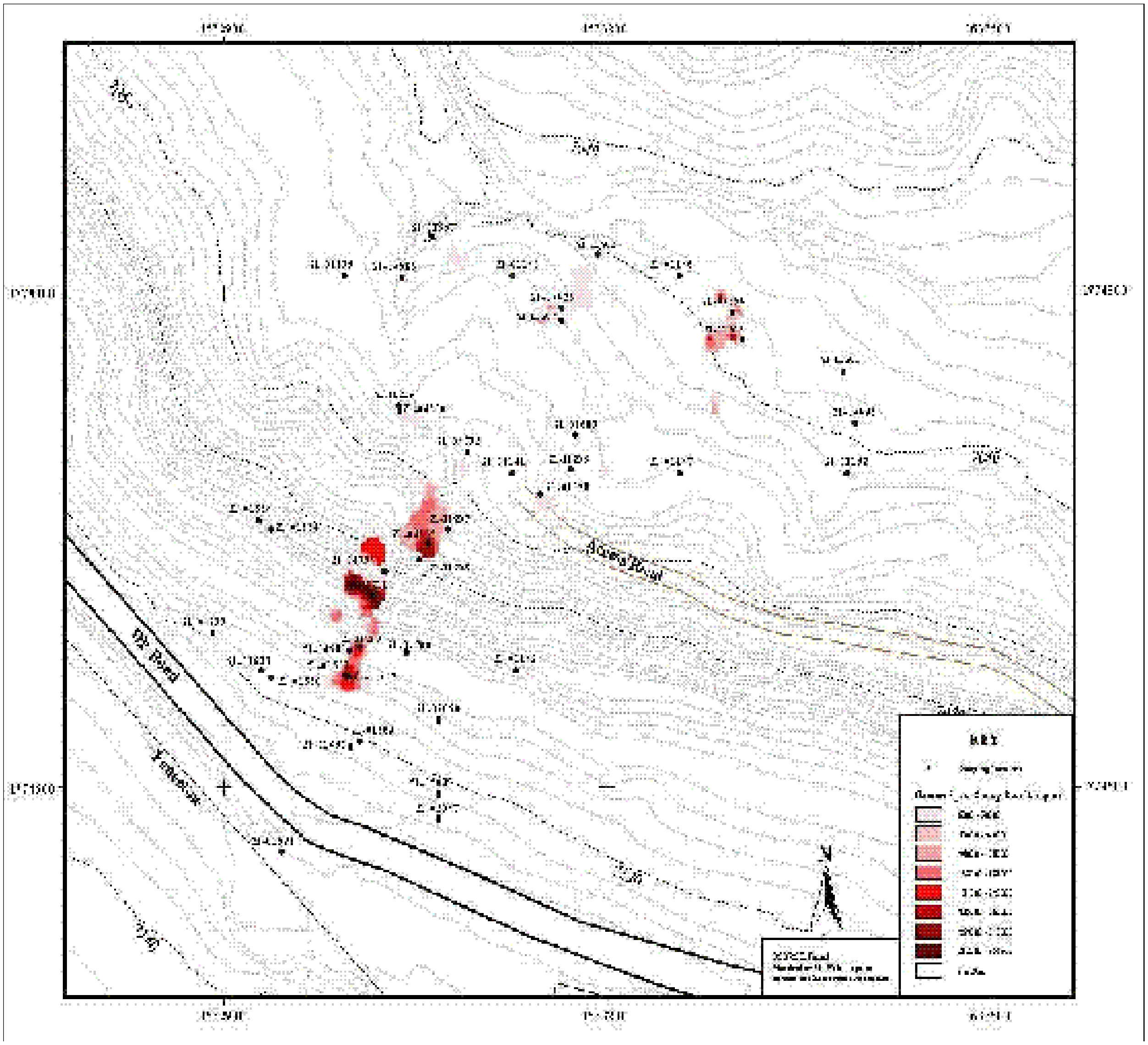


Figure 1.1-1. Areas of elevated activity at SWMU 21-011(k) to be removed and stabilized

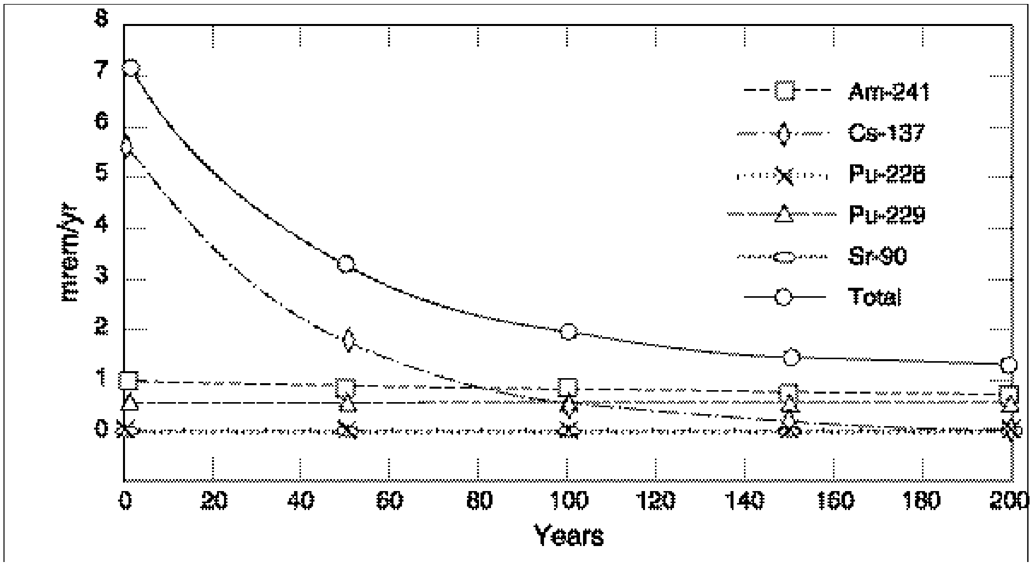


Figure 1.1-2 Dose vs time for trail user scenario at SWMU 21-011(k).

1.2 Regulatory History

The regulatory activities conducted at SWMU 21-011(k) are summarized in Table 1.2-1.

Table 1.2-1
Regulatory Activity for SWMU 21-011(k)

Date	Activity	Document
1988	DOE Reconnaissance Sampling	1994 TA-21 OU RFI Phase Report 1C (LANL 1994, 31591.1)
1992-93	RFI Site Characterization	1994 Addendum to TA-21 Phase Reports 1B and 1C (LANL 1994, 52350.1)
1996/1997	Interim Action	1996 Interim Action Plan for PRS 21-011(k) (LANL 1996, 54790.2); 1997 Interim Action Report for PRS 21-011(k) (LANL 1997, 55648.2)
2001	LANL proposes soil stabilization/solidification to DOE and NMED	Communication Record (LANL 2001, 70217)

1.3 Rationale for Proposed Corrective Measure

SWMU 21-011(k) is located on the north side of DP Mesa on a hillside that leads to DP Canyon. The most northern extent of the slope's toe is within the high water table of the DP Canyon streambed. SWMU 21-011(k) has been identified as the primary source of radionuclide contamination in sediments in the LA Canyon watershed (LANL 1999, 63915). Approximately one-third of a curie of cesium has been identified in the LA Canyon watershed and exists within DP Canyon and LA Canyon. The source of that inventory is SWMU 21-011(k). The existing radionuclide inventory in surface soils, tuff and sediment at the site is one-fourth of a curie of cesium. Because of the site's high potential for erosion (erosion matrix score of 72 out of 100, Appendix C), there is the potential for radionuclides from the site to increase the radionuclide inventory in the LA Canyon watershed. Therefore, remediation of the site is considered a priority by the Laboratory, DOE and the New Mexico Environment Department (NMED).

SWMU 21-011(k) is located on DOE property and will remain under institutional control for at least the next 100 years. Land use for TA-21 is, and will continue to be, industrial under DOE ownership and control. However, the SWMU 21-011(k) site is not a typical industrial site as it is located on a steep hillside that slopes to the bottom of a canyon. Although there are no future plans by Los Alamos County to develop any hiking trails in the canyon, the area is accessible to LANL employees and potentially to the public. Consequently, the trail user scenario is proposed (communication record to NMED, 8/14/01, 70217) and used to screen soil and sediment areas with potentially elevated radionuclide activity exceeding acceptable human health and ecological risk levels.

The proposed VCM activities include the excavation, solidification and reburial of as much as 500 yd^3 of contaminated soil, tuff and sediment; engineered site restoration; and long-term monitoring. In addition, the drainline from Tanks 21-112 and 21-113 to the SWMU boundary will be removed. Soil solidification and reburial is proposed for SWMU 21-011(k) to stabilize elevated concentrations of radionuclides in the soil, sediment, and tuff. Bench-scale solidification testing, using tuff and sediment from SWMU 21-011(k), verified that this technology can be successfully implemented at the site (LANL 2002, 72638). Site restoration will include the placement of a compacted soil layer over the stabilized/solidified material and soil over other areas to accommodate revegetation. The soil layer over the solidified material will provide additional shielding and protection of the stabilized material. The soil layer is designed to provide freeze/thaw protection and a minimum of four feet of cover over the solidified material for the service life of the engineered soil layer. This approach is a cost-effective and proactive remedial alternative, and is preferred over no action, fencing of the site, and excavation and disposal of contaminated material at Area G at TA-54. This VCM approach was developed to protect LANL employees and the public, and to minimize the amount of waste generated. The estimated cost savings of onsite stabilization compared to transportation and disposal at Area G is expected to be approximately $2 million because onsite stabilization eliminates the costs associated with coordination and implementation of transporting low level radiologically contaminated waste over public roadways, through public areas, and disposal at Area G.

2.0 PREVIOUS SITE CHARACTERIZATION AT SWMU 21-011(K)

2.1 Site Description and Operational History

SWMU 21-011(k) was the National Pollution Discharge Elimination System (NPDES)-permitted outfall (NPDES outfall no. EPA050050) for treated industrial wastewater from buildings 21-35 and 21–257, the former industrial wastewater treatment plants (WWTPs) at TA-21. The SWMU consists of a drainline from two industrial wastewater treatment tanks (21-112 and 21-113) that discharged to an outfall ditch, which channeled wastewater to the canyon rim, and down the hillside toward DP Canyon. The ditch is no longer visible; however, a 4-inch cast iron drainline is located approximately 55 feet north of the TA-21 perimeter road in the area where the outfall ditch would have ended. A gently sloping, rocky surface extends from the outfall pipe approximately 30 ft to the canyon rim.

TA-21 is the former plutonium processing facility at LANL. TA-21 began plutonium operations in 1945 and ceased operations in 1978. The first industrial WWTP, 21-35, was activated in 1952 and operated until 1967 when the new industrial WWTP, 21-257, came on line. Both facilities treated wastes from DP West and DP East consisting of liquids remaining after plutonium extraction and processing of radioactive materials for nuclear weapons and aeronautical research projects. The treatment process mixed the raw waste with lime, ferric sulfate, and coagulant aids. The waste was then pumped to a flocculator and on to a settling tank. Settled effluent was pumped through a pressure filter and sampled to verify adequate treatment. If the effluent was determined to be adequately treated, it was pumped to two final holding tanks (21-112 and 21-113). From the tanks, the effluent was piped northeast toward DP Canyon and discharged on the north side of DP Mesa to what is now SWMU 21-011(k). This effluent contained a variety of radioactive and chemical constituents. Discharges of treated industrial wastewater to the outfall were discontinued in the early 1990's. However, approximately 55 gal of partially treated radioactive wastewater was released from holding tank 21-113 in January 2001. The released wastewater was absorbed into the ground within 50 ft of the outfall. Screening of samples from the tank indicated that the water contained radiation levels below those currently within SWMU 21-011(k) (LANL 2001, 72667). Building 21-257 is no longer used for pretreatment of wastewater. The outfall line was permanently plugged as part of the release response (LANL 2001, 72667).

2.2 Previous Field Investigations

SWMU 21-011(k) was sampled during a 1988 DOE Headquarters Environmental Survey of the Laboratory (DOE 1988, 15363). In 1992, SWMU 21-011(k) was characterized as described in the TA-21 Operable Unit (OU) RFI Work Plan with a radiological field survey and collection of soil samples (LANL 1991, 07528.1). Additional characterization consisting of a radiological survey and collection of soil samples was conducted in 1993 due to the elevated radioactivity levels and missed holding times for organic chemicals encountered in the 1992 sampling effort (Figure 2.2-1) (LANL 1994, 52350.1).

2.2.1 1996 Interim Action Soil Removal

In 1996, an IA Plan was prepared (LANL 1996, 54790.2). The IA was conducted in 1996 and 1997 and reported on in the interim action report for Potential Release Site 21-011(k) (LANL 1997, 55648.2).

The IA had two objectives:

- remove a significant portion of the source term from the areas of the outfall exhibiting the greatest levels of radioactivity and,
- install storm water control measures as a best management practice (BMP) to slow the migration of contaminated soil and sediment into the main channel of DP Canyon.

Approximately 390 yd^3 of soil were removed from SWMU 21-011(k) in the 1996 IA (Figure 2.2-2). The results of a post-excavation radiological survey indicated that the soil activity was reduced from greater than 500,000 counts per minute (cpm) to less than 100,000 cpm over the entire upper drainage area. A correlation between cesium-137 concentrations and gross gamma activity was prepared to guide excavation activities during the IA. The 100,000 cpm is equivalent to between 400 and 500 pCi cesium-137/g.

Ten surface samples (from 0 to 6 in.) were collected after removal of 390 yd^3 of soil from areas of highest concentrations in the outfall area (Figure 2.2-2). The samples were analyzed for isotopic plutonium, strontium-90, and by gamma spectroscopy (which includes cesium-137 and americium-241). Analytical results for the ten surface confirmation samples are presented in Table 2.2-1. Analytical results are compared to background or fallout values as presented in "Inorganic and Radionuclide Background Data for Soils, Canyon Sediments and Bandelier Tuff at Los Alamos National Laboratory," (Ryti et al. 1998, 59730.2). Results are also compared to risk-based screening action levels (SAL) that are protective of human health. The SALs used in these comparisons are values presented in "Derivation and Use of Radionuclide Screening Action Levels," (LANL 2001, 69683.1) Americium-241, cesium-137, plutonium-239, and strontium-90 exceeded their respective background values and their respective SALs, as shown in Table 2.2-1.

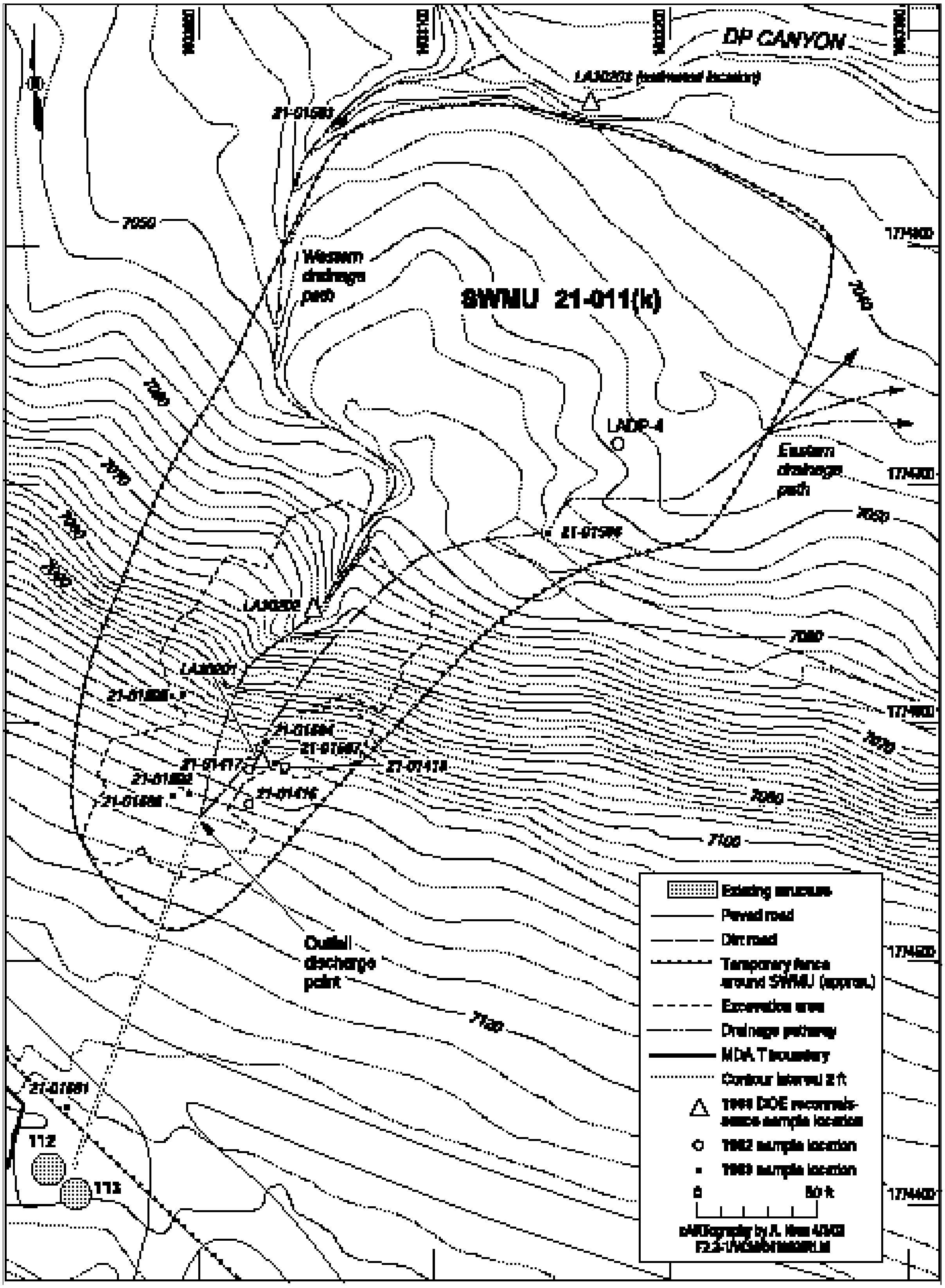


Figure 2.2-1 1988, 1992, and 1993 sampling locations at SWMU 21-011(k)

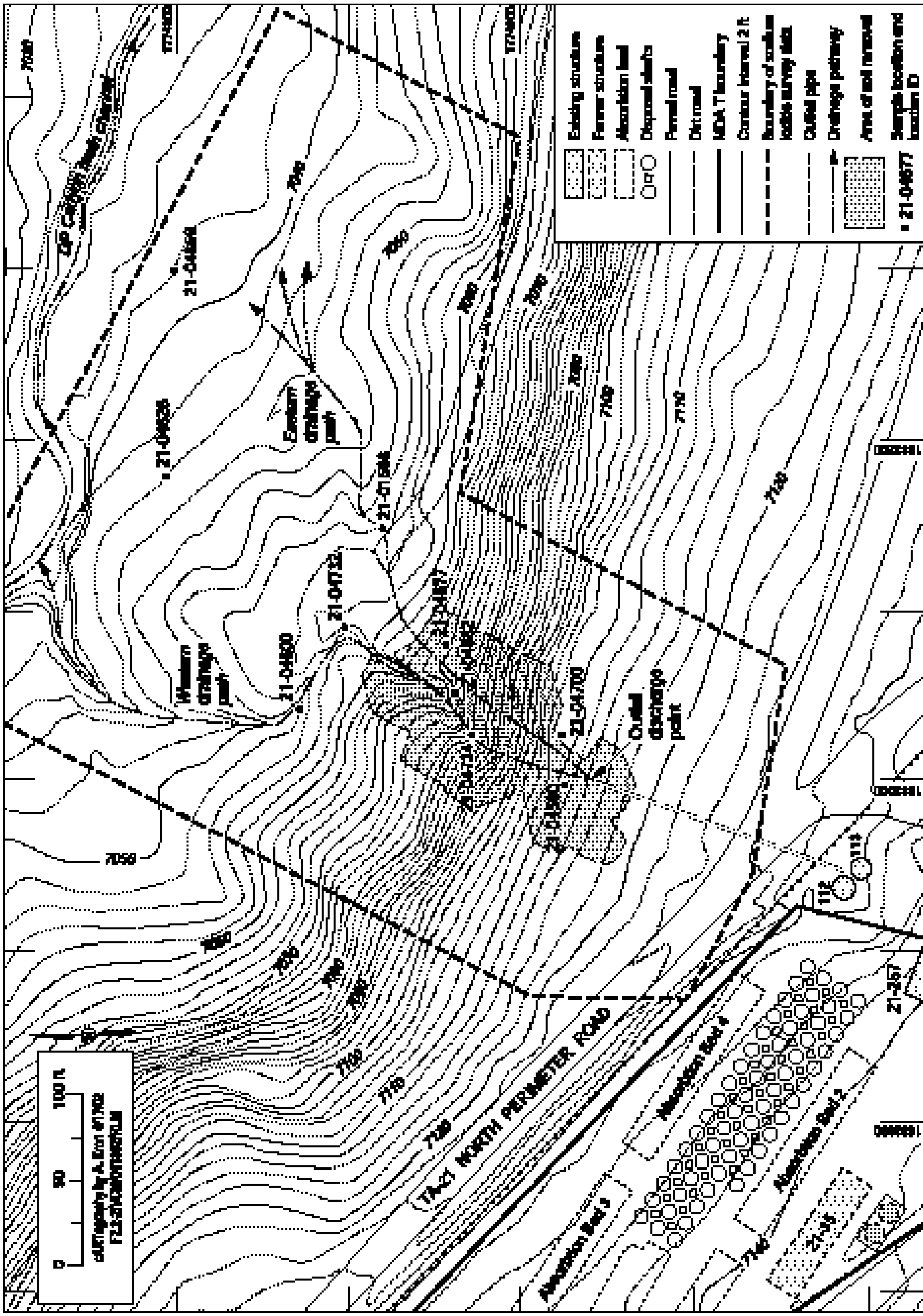


Figure 2.2-2. 1996 interim action soil removal confirmation samples and area of soil removal

Table 2.2-1
1996 Interim Action Confirmation Sample results

Sample ID	Location ID	Depth (ft)	Media	Americium -241 (pCi/g)	Cesium -137 (pCi/g)	Plutonium -238 (pCi/g)	Plutonium -239 (pCi/g)	Strontium-90 (pCi/g)
Soil Fallout Value[a]				**0.013**	**1.65**	**0.023**	**0.054**	**1.31**
SAL				**39**	**5.3**	**49**	**44**	**5.7**
0121-96-0801	21-04734	0-0.5	Soil	10.6	351	0.7838	20.2883	74
0121-96-0802	21-04682	0-0.5	Soil	32.3	621	5.2973	45.959	240
0121-96-0803	21-04600	0-0.5	Soil	125	72.1	7.0991	25.1351	30.7
0121-96-0804	21-04677	0-0.5	Soil	10.5	85.3	1.223	8.72973	33.8
0121-96-0805	21-01598	0-0.5	Soil	0.281	7.05	0.0969	0.79054	1.4
0121-96-0806	21-04732	0-0.5	Soil	2.06	19.7	0.2365	1.8333	7.1
0121-96-0807	21-04700	0-0.5	Soil	601	66.5	27.8919	75.1532	63
0121-96-0808	21-04580	0-0.5	Soil	20.2	877	1.0045	50.95	219
0121-96-0809	21-04856	0-0.5	Soil	2.9	327	0.964	6.2252	24.9
0121-96-0810	21-04626	0-0.5	Soil	14.3	222	4.8694	23.7568	60

[a] Fallout values for soil (Ryti and Longmire 1998, 59730.2)

2.2.2 2000 Chemrad and in Situ Surveys and 2001 Pre-VCM Waste Characterization Sampling.

A walkover gross gamma survey of SWMU 21-011(k) was performed by Chemrad in July 2000. Review of the resulting maps (Figure 2.2-3) showed that the nature and extent of radionuclide contamination at the site had been defined with reasonable confidence and clearly identified hot spots. An in situ gamma survey was conducted at the site in November 2000 to gather more detailed information about the nature and extent (including depth profiles of the radionuclide contamination at the site).

During the in situ gamma surface radiation survey, 650 locations were measured for gross gamma radiation. Approximately 77% of these values were below 50,000 counts per minute (CPM). Approximately 91% of the measurements taken were below 100,000 CPM and 100% of the measurements were below 400,000 CPM. In March 2001, eleven in situ gamma survey locations were selected with concurrence from NMED (LANL 2001, 70217) to conduct depth profiling of the primary radionuclides at the site and to complete waste characterization activities prior to the planned VCM. Two locations with in situ gamma survey results in the low range were chosen for waste characterization sample collection, in addition to four locations exhibiting mid-range survey results, and five locations exhibiting high range survey results. The guidance established for waste characterization sample collection specified that a minimum of one discrete sample was to be collected from each auger hole location. If no elevated radioactivity was detected, then the discrete sample would be collected from the bottom of the auger hole. Two discrete samples were to be collected from any auger hole advanced to a depth of 5 feet or deeper with sample collection intervals based on field screening results and/or the bottom of the hole. Samples submitted for VOC analyses were to be collected from the depth intervals with the highest radioactivity screening results and/or the bottom of the auger hole and not from the top six-inch sample interval. A composite sample, also for waste characterization purposes, was then to be collected from the remaining core at each of the 11 locations.

Waste characterization sample summaries are shown in Table 2.2-2. Field screening data were used to develop an instrument correlation curve (correlating counts with cesium activity levels – See Appendix F), which was presented to NMED in May 2001. The gross gamma survey map and waste sample locations are shown in Figures 2.2-3 and 2.2-4.

Table 2.2-2
2001 Waste Characterization Sample Summaries

Survey ID	Location ID	Depth (ft)	Sample ID	Date/Time	Analytical Suites	Sample Type
256 (Low)	21-11201	0-1	256-0		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		1-2	MD21-01-0021	3/6/01 10:05	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		2-3	256-2		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		3-4	256-3		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		4-5	MD21-01-0023	3/6/01 10:30	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete

Table 2.2-3 presents sample results for the one inorganic chemical, mercury, detected above background. Because mercury has no actual background in soil, the required laboratory detection limit of 0.1 mg/kg is the nominal background value. Mercury was detected at one sample location (21-11210, 0.16 mg/kg) at a concentration essentially the same as background and at one sample location in a composite sample (21-11211, 1.8 mg/kg) above the background value (0.1 mg/kg). Mercury was not detected above the SAL (23 mg/kg). The SALs used in these comparisons are derived based on the approach in the human health screening methodology document (LANL 2002, 72639), which is based on guidance in NMED (2000, 68554.1) and EPA (2001, 71466). Two downgradient samples from sample location 21-11211 (locations 21-11208 and 21-11207) had no detects of mercury.

Table 2.2-4 presents sample results for organic chemicals. The analytical results for sample location MD21-0034 were suspect because no organics were detected in samples directly above or below this sample. Therefore, additional samples (MD21-01-0519, 0520, and 0521) were collected from three depths at the same location in October 2001. The analytical results in Table 2.2-3 show organic chemicals were detected sporadically and at low concentrations and were estimated (J) because the reported values were lower than the reporting limits but above method detection limits. No organic chemecals were detected above SAL. The results also confirmed that the VOCs detected in sample MD21-01-0034 were an anomaly.

Table 2.2-3
2001 Waste Characterization Sample Summaries

Survey ID	Location ID	Depth (ft)	Sample ID	Date/Time	Analytical Suites	Sample Type
		0-5	MD21-01-0024	3/6/01 9:55	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Waste Composite
352 (Mid)	21-11202	0-1	MD21-01-0025	3/6/01 11:11	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs(Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		1-2	352-1		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		2-3	352-2		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		3-4	352-3		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		4-5	MD21-01-0022	3/6/01 12:33	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		0-5	MD21-01-0026	3/6/01 12:20	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Waste Composite
67 (Low)	21-11203	0-1	67-0		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		1-2	MD21-01-0027	3/7/01 9:31	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		2-3	67-2		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		3-4	67-3		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		4-5	MD21-01-0029	3/7/01 9:44	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		0-5	MD21-01-0028	3/7/01 9:36	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Waste Composite
331 (Mid)	21-11204	0-1	331-0		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		1-2	331-1		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		2-3	MD21-01-0030	3/7/01 10:18	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete

Table 2.2-3

Survey ID	Location ID	Depth (ft)	Sample ID	Date/Time	Analytical Suites	Sample Type
		3-4	331-3		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		4-5	MD21-01-0031	3/7/01 10:27	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		0-5	MD21-01-0032	3/7/01 10:23	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Waste Composite
122 (Mid)	21-11205	0-1	122-1		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		1-2	MD21-01-0033	3/7/01 12:29	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		2-3	122-2		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		3-4	122-3		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		4-5	MD21-01-0034	3/7/01 12:57	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		0-5	MD21-01-0035	3/7/01 12:38	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Waste Composite
496 (Mid)	21-11206	0-1	MD21-01-0036	3/8/01 10:30	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		1-2	496-1		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		2-3	496-2		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		3-4	496-3		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		4-5	MD21-01-0037	3/8/01 10:52	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		0-5	MD21-01-0038	3/8/01 22:44	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Waste Composite

Table 2.2-3

Survey ID	Location ID	Depth (ft)	Sample ID	Date/Time	Analytical Suites	Sample Type
547 (High)	21-11207	0-1	MD21-01-0039	3/8/01 11:41	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		1-1.5	547-1		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		0-1.5	MD21-01-0040	3/8/01 11:41	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Waste Composite
554 (High)	21-11208	0-1	554-0		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		1-2	MD21-01-0041	3/8/01 13:09	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		2-3	554-2		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		3-4	554-3		Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Field Screening
		4-5	MD21-01-0042	3/8/01 13:49	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Discrete
		0-5	MD21-01-0043	3/8/01 13:49	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Waste Composite
595 (High)	21-11209	0-1	MD21-01-0044	3/9/01 9:35	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs(Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Waste Composite
583 (High)	21-11210	0-1	MD21-01-0045	3/9/01 9:55	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Waste Composite
564 (High)	21-11211	0-1	MD21-01-0069	3/9/01 10:20	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, TCLP Metals, TCLP VOCs, TCLP SVOCs, Pesticides, PCBs, VOCs (Encore), Gross alpha/beta, Gross gamma, Cesium-137, Americium-241	Waste Composite
			MD21-01-0046	3/12/01 10:30	Perchlorate, Gamma Spec, Isotopic Plutonium, Sr-90, TAL Metals, Pesticides, PCBs, VOCs	Field QC
			MD21-01-0047	3/6/01 8:30	VOCs	Field QC

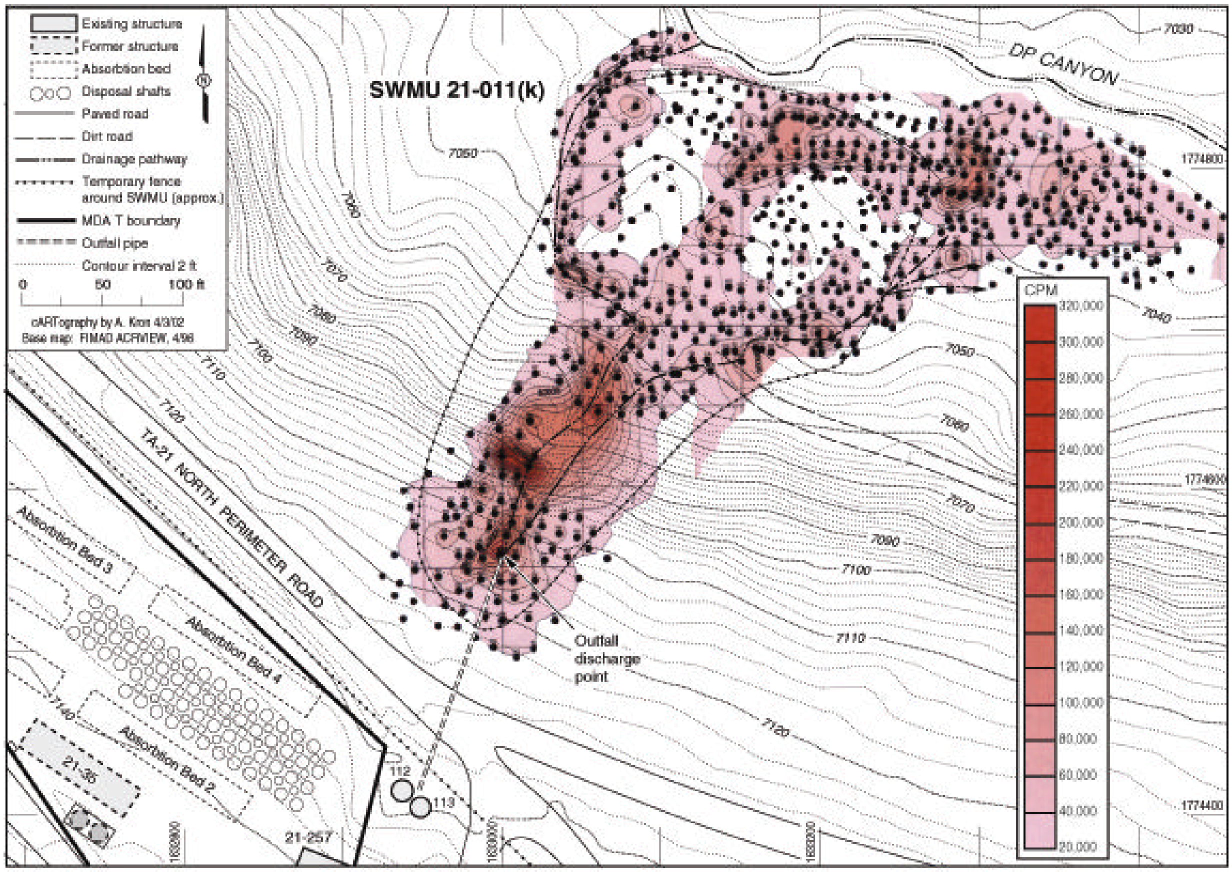


Figure 2.2-3 Gross gamma radiation levels above background at SWMU 21-011(k)

Table 2.2-3
2001 Pre-VCM Characterization Sample Inorganic Chemical Concentrations

Sample ID	Location ID	Depth Interval (ft)	Mercury (mg/kg)
Soil Background[a]			**0.1**
	SAL		**23**
MD21-01-0027	21-11203	1-2	0.0078 (J)[b]
MD21-01-0030	21-11204	2-3	0.0081 (J)
MD21-01-0044	21-11209	0-1	0.14 (J)
MD21-01-0045	21-11210	0-1	0.16
MD21-01-0069	21-11211	0-1	1.8

a Based on required laboratory detection limit for mercury (Ryti et al. 1998, 59730.2)

b "J" Indicates estimated value between the method detection limit (MDL) and the practical quantitation limit (PQL).

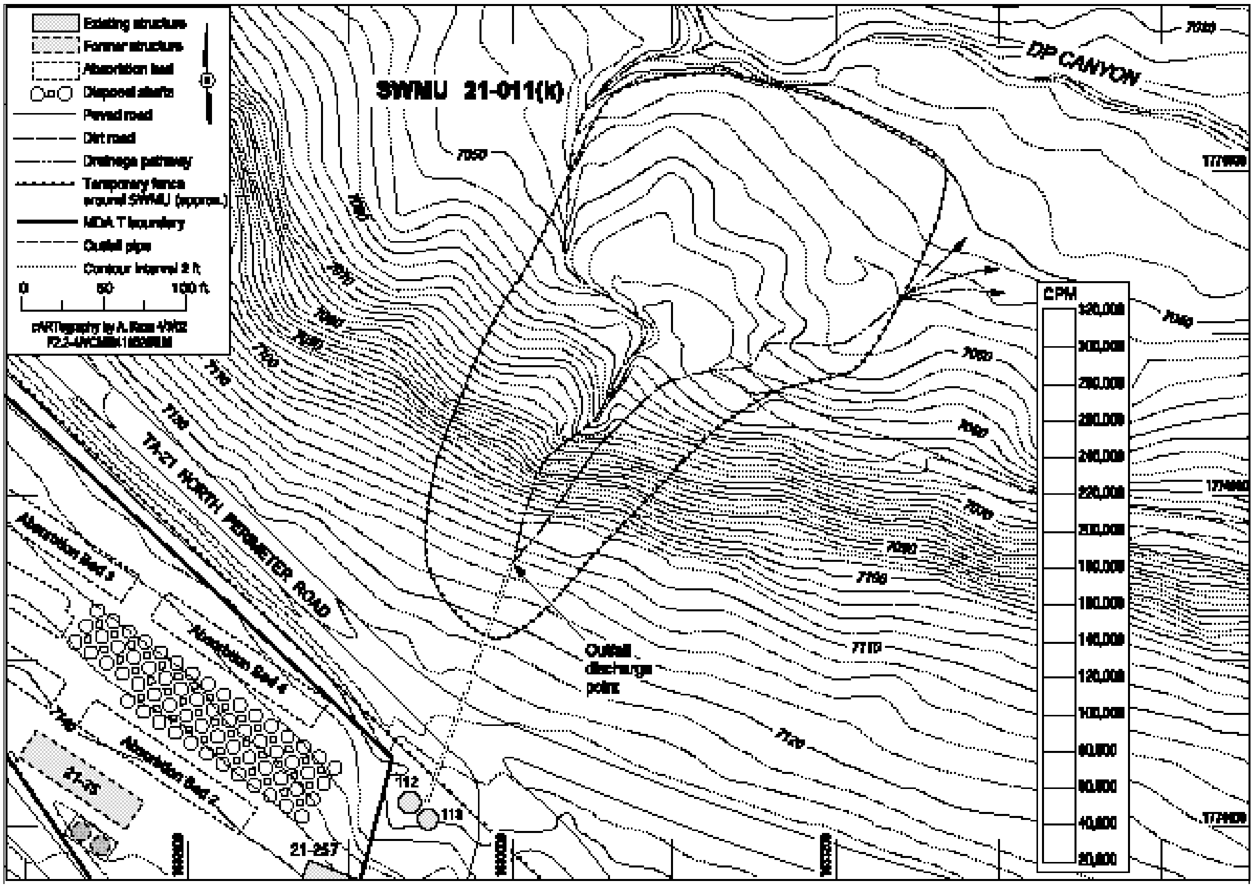


Figure 2.2-4 Pre-VCM Waste Characterization sampling locations

Table 2.2-4
2001 Pre-VCM Characterization Sample Organic Chemical Concentrations

Sample ID	Location Id	DeptH Interval	4,4'-DDT (mg/kg)	Acetone (mg/kg)	Methylene chloride (mg/kg)	4-Isopropyltoluene [1](mg/kg)	2-Hexanone[2] (mg/kg)	Trichloroethylene (mg/kg)	4-methyl-2-pentane (mg/kg)	Toluene (mg/kg)
SAL			1.7	1600	8.9	160	7300		3.6	180
MD21-01-0025	21-11202	0-1 ft	0.00044 (J)	- [a]	-	-	-	-	-	-
MD21-01-0022	21-11202	4-5 ft	-	0.013 (J)	-	0.0073	-	-	-	-
MD21-01-0033	21-11205	1-2 ft	0.00057 (J)	-	-	-	-	-	-	-
MD21-01-0034	21-11205	4-5 ft	-	0.050	0.072	0.026	-	-	-	-
MD21-01-0036	21-11206	0-1 ft	0.00039 (J)	-	-	-	-	-	-	-
MD21-01-0039	21-11207	0-1 ft	-	-	0.0076	-	-	-	-	-
MD21-01-0041	21-11208	1-2 ft	-	-	0.0082	-	-	-	-	-
MD21-01-0042	21-11208	4-5 ft	-	-	0.0092	-	-	-	-	-
MD21-01-0044	21-11209	0-1 ft	0.00069 (J)	-	-	-	-	-	-	-
MD21-01-0045	21-11210	0-1 ft	0.00051 J	-	-	-	0.026 (J)	-	-	-
MD21-01-0069	21-11211	0-1 ft	0.00088 J	0.021 (J)	-	-	-	-	-	-
MD21-01-0519	21-11205	0-1 ft	-	-	-	-	-	-	-	-
MD21-01-0520	21-11205	4-5 ft	-	-	-	-	-	-	-	-
MD21-01-0521	21-11205	1-2 ft	-	-	-	-	-	1.8(J)	-	1.0(J)

[1]isopropylbenzene was used as a surrogate for isopropyltoluene (EPA 2000, 68410)

[2] methyl ethyl ketone used as a surrogate for 2-hexanone (EPA 2000, 68410)

[3] "-" denotes not detected.

[4] "J" denotes estimated value between the MDL and PQL

Table 2.2-5 presents the radionuclide values greater than fallout values for americium-241, cesium-137, plutonium-239, and strontium-90. Of these radionuclides, cesium-137, plutonium-239, and strontium-90 were detected at concentrations greater than their respective SALs. Cesium-137 was detected above its SAL in ten samples, strontium-90 was detected above its SAL in eight samples, and plutonium-239 was detected above its SAL in two samples.

Table 2.2-5
2001 Pre-VCM Waste Characterization Sample
Radionuclide Concentrations above Background/Fallout

Sample ID	Location ID	Depth (ft)	Cesium-137 (pCi/g)	Strontium-90 (pCi/g)	Plutonium-239 (pCi/g)	Americium-241 (pCi/g)	Plutonium-238 (pCi/g)
Fallout Soil Valuea			**1.65**	**1.31**	**0.054**	**0.013**	**0.023**
SAL			**5.3**	**5.7**	**44**	**39**	**49**
MD21-01-0021	21-11201	1-2	1.43	1.7	0.122	-[b]	0.034
MD21-01-0022	21-11202	4-5	1.67	-	0.094	-	-
MD21-01-0025	21-11202	0-1	40.5	7.1	1.93	2.2	0.293
MD21-01-0027	21-11203	1-2	8.7	2.56	0.37	-	0.31
MD21-01-0029	21-11203	4-5	1.03	-	0.036	-	0.048
MD21-01-0030	21-11204	2-3	2.6	0.9	0.111	-	0.074
MD21-01-0033	21-11205	1-2	150	26.1	13.2	13.7	0.63
MD21-01-0034	21-11205	4-5	3.78	1.02	1.01	6.9	0.21
MD21-01-0036	21-11206	0-1	29	3.75	1.18	-	0.122
MD21-01-0037	21-11206	4-5	1.52	0.51	0.118	-	-
MD21-01-0039	21-11207	0-1	109	30.8	11.3	7.9	0.74
MD21-01-0041	21-11208	1-2	445	132	20.5	19	1.64
MD21-01-0042	21-11208	4-5	56.7	15.8	4.33	21	1.2
MD21-01-0044	21-11209	0-1	246	103	32.6	14.9	0.8
MD21-01-0045	21-11210	0-1 ft	343	83	51.2	22.3	0.95
MD21-01-0069	21-11211	0-1 ft	690	268	59.2	32.5	1.02

[a] Based on values in soil only (Ryti and Longmire 1998, 59730.2)
[b] "-" denotes not detected

Summary

The 1996 post-IA sample data, the 2000 Chemrad and in situ gamma survey data, and the 2001 pre-VCM waste characterization data confirm that radionuclides are the COPCs driving risk at the site, and identified areas with elevated activities that will be addressed during this VCM. The data show a clear boundary between the northern edge of SWMU 21-011(k) and the DP Canyon stream channel and confirm that radionuclides have not migrated to the channel since the completion of the 1996 IA.

3.0 BASIS FOR CLEANUP LEVELS

The land use scenario considered most appropriate for derivation of cleanup levels is recreational trail use. The dose-based radiological cleanup levels for the trail user scenario are derived using RESRAD, as shown in Appendix F.2. Development of this scenario leads to the dose-based single soil radionuclide guidelines (SSRG) provided in Table 3.0-1.

Table 3.0-1
SSRGS derived For the recreational trail user scenario

Radionuclide	SSRG (pCi/g)
Americium-241	427
Cesium-137	294
Plutonium-238	496
Plutonium-239	447
Strontium-90	8,288

Because SWMU 21-011(k) has a mixture of radionuclides present at the site, the SSRGs do not apply independently. To account for the mixture of radionuclides at the site and uncertainty inherent in the estimates, a decision was made to reduce the SSRG for cesium-137 to a target level of 150 pCi/gm. This target level meets the goal for cesium-137 as well as the other radionuclide COPCs because of the collocation within the SWMU.

Areas of elevated activity are present on site however, where the sum of ratios may approach or exceed unity. These areas are the focus of the corrective measure. Soil will be removed from these locations with the goal of meeting the target levels. In addition, an elevated activity criterion in DOE Order 5400.5 (Chapter 4, section 4.A.1) must be satisfied once these areas have been remediated (DOE 1990, 58980.1). The DOE Order 5400.5 criterion is listed in the Appendix A glossary and is further discussed in Appendix F.

The areas of elevated concentrations were identified based on 1999 and 2001 analytical data and 2000 gamma surveys. These results were used to generate volume estimates that are presented in Appendix F1.

Based on a preliminary assessment of potential impacts to site ecology, corrective measures for protection of human health will also be protective of ecological receptors. A complete Ecological Screening Assessment will be presented in the VCM Completion Report.

4.0 PROPOSED CORRECTIVE MEASURE

4.1 Conceptual Model

SWMU 21-011(k) is an outfall where industrial wastewater was discharged from holding tanks 21-112 and 21-113 onto the north side of DP Mesa. The wastewater liquids remaining after the plutonium extraction contained a variety of radioactive and chemical constituents. The COPCs in the effluent would have been largely in solution, but because of their geochemical characteristics, most of these would have adsorbed onto sediment particles or organic colloids (Langmuir 1997, 56037).

COPCs in effluent that infiltrated into the colluvial slope would have preferentially adsorbed to organic matter in the soil and finer-grained particles because of their greater surface area and, in the case of clay minerals and solid organic matter, their high-cation exchange capacity. COPCs in effluent that infiltrated into the toe of the slope would have encountered mainly coarse-grained sediment. Adsorption of significant amounts of the radionuclides may have been onto small amounts of other components within the coarse-grained sediment (e.g., organic matter, iron oxide coatings on larger grains, or clay particles adhered to larger grains).

During the period of effluent releases, contaminant inventories would have built up incrementally. Later development of a gully on the slope below SWMU 21-011(k) allowed erosion of some of the contaminated sediments into the DP Canyon channel (LANL 1999, 63915).

The surface water, air, and mass wasting transport pathways do not contribute significantly to current contaminant transport. The site is currently protected by stormwater run-on controls such that the only water contacting the contaminated soil is rain or snow falling directly on the SWMU. Therefore, contaminant transport via stormwater or snowmelt runoff and infiltration has been controlled by BMPs. The SWMU is vegetated and portions of it covered with plant litter, thereby minimizing any contaminant transport via wind and fugitive dust. Contaminant transport via mass wasting is not likely because the slope is quite stable with no new evidence of erosion since the stormwater run-on controls were installed in 1996 and upgraded in 1999.

There are two complete pathways for potential human contact. The first is direct radiation from gamma emitting COPCs such as cesium-137. The second is direct contact with contaminated soil.

The ecological conceptual site model and rationale are presented in Part C of the ecological scoping checklist in Appendix D. The ecological model depicts the potential transport and exposure pathways of significance to terrestrial receptors. In general, exposure pathways to terrestrial receptors can occur through air (inhalation or deposition of particulates), surface soil (root uptake and rain splash on plants, food web transport via plants and/or animals, incidental ingestion of soil/sediment, dermal contact with soil/sediment, and external radiation), and surface water (root uptake and rain splash on plants, food web transport to plants and animals, incidental ingestion of soil/sediment/surface water, dermal contact with soil/sediment, and external radiation from soil/sediment). The Canyons Focus Area will address the stream channel as part of the evaluation of sediment and surface and alluvial ground water in DP Canyon.

4.2 Supplemental Sampling

A target maximum activity level has been calculated for cesium-137 of 150 pCi/g. The derivation of this target level is in Appendix F.1. The discussions that follow in all parts of section 4.3 Surveys and Sampling describe screening and sampling for confirmation of field instrument accuracy and for planning excavation activities in greater detail in the western drainage.

4.3 Surveys and Sampling

Gross gamma surveys will be performed in the field to guide the excavation of materials with elevated activities at the site. This will be supplemented by screening for cesium-137 in an on-site trailer using single-channel or multi-channel analysis with a sodium iodide scintillation detector. Due to the variation of instrument efficiencies it will be necessary to collect samples for fixed laboratory analysis to validate the screening measurements for cesium-137. In the western drainage, a PG-2 analyzer will be used to screen and guide excavation, as described in Section 4.3.2.

4.3.1 Radiological Sampling

Gross gamma measurements and cesium-137 measurements made in the on-site trailer during the VCM will guide excavation in all areas to be remediated except for the drainage in the western portion of the site. A total of six soil or tuff samples will be collected from areas of the site that have count rates less than the 150,000 cpm level as defined in the gross gamma survey map prepared in FY01 (Figure 2.2-3). The samples will be chosen in this manner to ensure accuracy of the screening within the range of activities from background to roughly 150 pCi/g cesium-137. Samples will be screened in the field with a gamma screening instrument to insure a range of observed count rates are collected. Accuracy at higher soil activity levels is not needed since the soil and tuff will be excavated and solidified. All six samples will be submitted to American Radiation Services (ARS) for gamma spectrometry and gross alpha, beta and gamma radiation screening for Department of Transportation (DOT) shipping purposes and for fixed lab gamma spectrometry. The samples used for DOT shipping purposes will be returned to the site and used as benchmarks for the validation of on-site measurements. This sampling event will take place two months prior to removal and stabilization activities to ensure that data are available when needed. Good correlations could not be documented for plutonium-239 or americium-241 from the FY01 gross gamma survey in the western drainage using gamma spectrometry or gross gamma (Appendix F.1). Therefore, americium-241 screening in an on-site trailer will occur using a single channel analyzer with an Eberline PG-2 sodium iodide detector. Activity levels for plutonium-238/239 are below the SSRG (447 pCi/g) required for the recreational trail user scenario and, therefore, do not need to be correlated to the field instruments.

4.3.2 Western Drainage Pre-Excavation Screening

There is a lack of data throughout the western drainage to accurately identify areas to be excavated. Of the five sample locations with analytical data, two are essentially co-located. Only one sample, 21-11205, (Figure 2.2-3) has data at depth sufficient for volume characterization. As part of the pre-excavation radiological characterization described in Section 4.3.1, samples will be collected from up to nine locations and sampled every foot until auger refusal or a total depth of 5 ft is reached. The samples will be screened with an Eberline PG-2/single channel analyzer in the field trailer to identify areas of elevated activity in sediments in the drainage. Aliquots of the samples will also be sent to ARS for gamma spectroscopy, and to the fixed laboratory for analysis of gamma spectroscopy (includes cesium-137 and americium-241) and additional analyses of isotopic plutonium and strontium-90. This sampling event will take place two months prior to removal and stabilization activities to ensure the data are available when needed to identify areas to be excavated.

4.4 Technology Evaluation/Literature Search

In December 2001, Argonne National Laboratory's Environmental Assessment Division (ANL-EAD) evaluated potential remediation technologies for the treatment of soils with elevated levels of cesium-137 and strontium-90 in support of the VCM at SWMU 211-011(k). The VCM requires that the mobility of the radionuclides of concern be reduced, the site be returned to a condition safe for potential human recreational use, and that it be acceptable from an ecological risk evaluation perspective.

The technology evaluation for SWMU 21-011(k) considered only those remedial technologies that have demonstrated an ability to separate, concentrate or immobilize radionuclide constituents in a soil matrix. In addition, the maturity of the potential remedial technology was also considered.

The data and supporting information for the technology evaluation were obtained from the following sources:

- Federal Remediation Technologies Round Table (FRTR) Remediation Technologies Screening Matrix, www.frtr.gov/matrix2/top_page.html,
- ANL-U.S. DOE TechCon Data Base,
- Internet searches, and
- ANL-DOE personnel.

After a review of the FRTR Remediation Technologies Screening Matrix and a search of the sources listed above, five remedial technologies with the potential of treating the radionuclides of concern in a soil matrix were identified. These technologies include the following:

- Stabilization/solidification
- Electrokinetic separation
- Chemical extraction
- Phytoremediation
- Soil washing

Stabilization/solidification was rated the highest of all the potential remedial technologies evaluated for radionuclides in a soil matrix. Stabilization/solidification remedial technologies immobilize radionuclides by physically enclosing or chemically binding within the soil matrix. This i

s a mature technology with demonstrated success with radionuclides. The long-term performance and durability of the stabilized soil can be predicted on the basis of currently available models.

Electrokinetic separation was listed in the FRTR Remediation Technologies Screening Matrix as having the potential to remove radionuclides from a soil matrix. In many cases, radionuclides act as heavy metals. Electrokinetic separation technologies employ a DC current between electrodes that mobilizes metal ions towards and causes them to deposit or plate onto, the electrodes. This technology is not applicable to SWMU 21-011(k) for two reasons. First, cesium-137 ions would migrate to the electrodes, but unlike heavy metals, would not plate to the electrode. This would create areas of localized concentrations of cesium-137 that would have to be removed. Second, for this technology to succeed, constant soil moisture would have to be maintained, which would be difficult to achieve in an arid environment. Electrokinetic separation was removed from consideration for these reasons.

Chemical extraction was listed in the FRTR Remediation Technologies Screening Matrix as having the potential to remove radionuclides from a soil matrix. This separation technology utilizes either a solvent or acid to extract heavy metals from soils sediments or sludge. This technology tends to be equipment intensive and creates residual waste streams that must be managed. Given the small quantity of material to be treated at SWMU 21-011(k) and the limited track record of this technology on radionuclide-containing soils, this technology was removed from consideration.

Phytoremediation has been successfully employed to treat soils contaminated with radionuclides on both a pilot and full-scale basis. It has been demonstrated that several species of plants bioaccumulate cesium-137 and strontium-90. Successful deployment of a phytoremediation system depends largely on soil characteristics. Generally, the lower the clay content of the soils, the greater the bioavailability of cesium for plant uptake. This remedial approach has two potential disadvantages. First, the biomass would have to be continually harvested until the site cleanup criteria are met, and secondly, the biomass disposal may be problematic because of the radioactive contamination. Phytoremediation was removed from consideration because of these two disadvantages.

Soil washing was evaluated for SWMU 21-011(k) because it has been successfully employed to remove heavy metals from contaminated soils. However, cesium presents a particular challenge to this technology because of its nature to bind tightly to soils. The ability of this technology to effectively and economically remove cesium from soil has not been demonstrated on a full-scale basis. Given the uncertainty of this technology to effectively remove cesium, this technology was removed from consideration.

4.4.1 Solidification Bench Scale Study

Bench-scale (laboratory-scale) testing to develop a soil solidification grout mix for the tuff and soil (including sediment) material was performed to identify the most appropriate grout formulation for long-term solidification and on-site burial of the materials.

Solidification grout mix testing was performed on soil and tuff samples collected from 8 locations and a range of activity levels at the site (Figure 4.4-1). Six soil samples and four tuff samples were collected for use in the bench scale testing. Five of the six soil samples were composited together at the laboratory for mix-design testing, as were the four tuff samples. Compositing of the soil samples and compositing of the tuff samples was performed to achieve a more representative material for the mix-design testing. The remaining soil sample, which had much higher levels of radionuclides, was used alone as a most-conservative sample for mix-design testing. An additional 60/40 mixture of tuff was tested using extra soil and tuff composites to determine if mixing of the soils during field operations would be an option and if it would improve the properties of the final stabilized material.

A total of eight reagent mixtures were tested on composite samples of tuff, soil, and a 60/40 mixture of soil and tuff. Reagents added to the soil, tuff, or 60/40 mixture were Portland cement, sodium bentonite, and sodium silicate in different proportions. The reagents and mixtures are similar to those used at other similar stabilization projects within the DOE complex. Results of the testing indicate the 60/40 soil and tuff mixture combined with 10 percent (by weight) Portland cement and 3 percent (by weight) sodium bentonite consistently performed better than any of the other mixtures tested (LANL 2002, 72638).

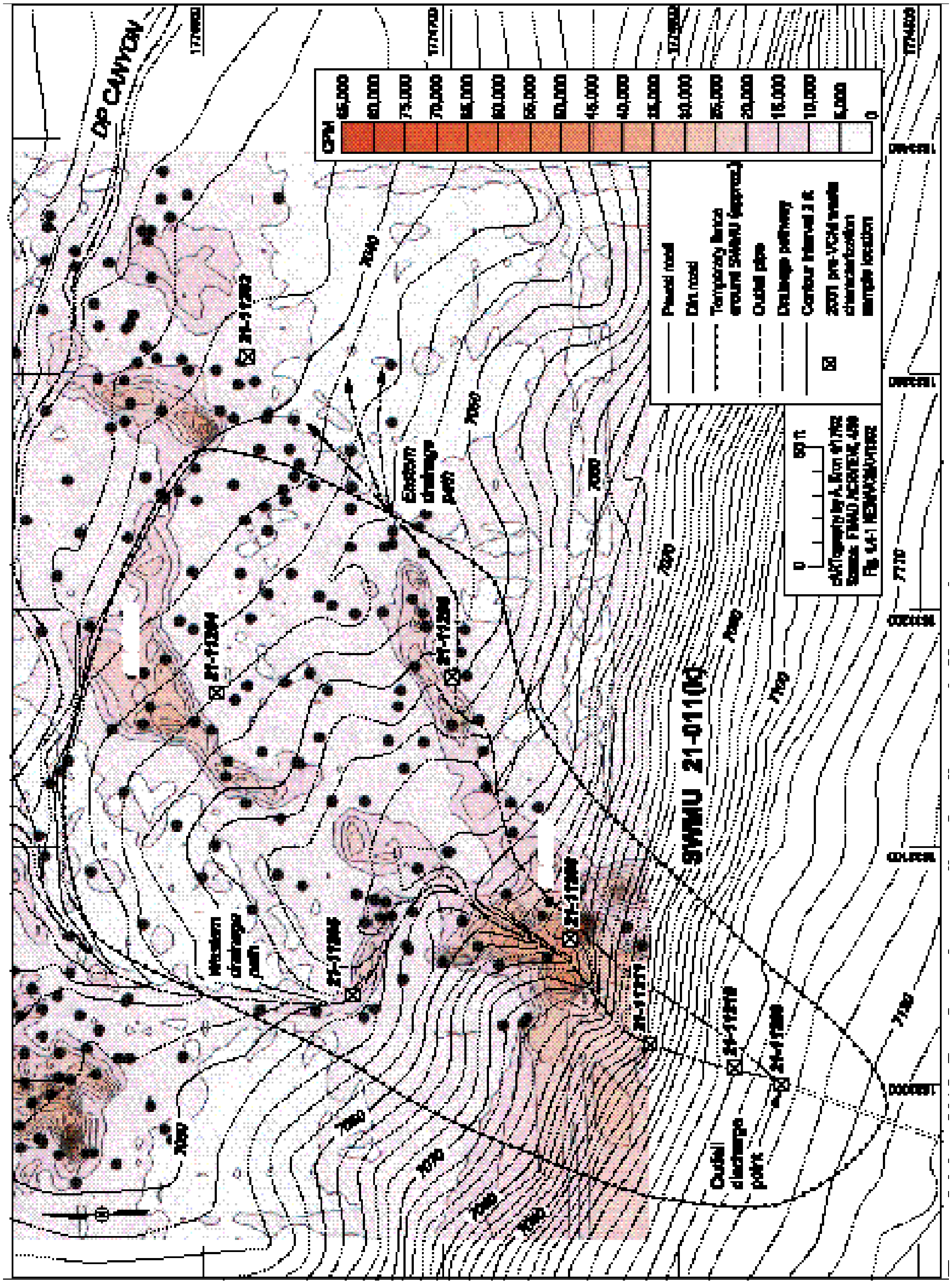


Figure 4.4-1. 2001 bench scale sampling locations and Chemrad survey

4.4.2 Remedial Approach

Following the readiness review, mobilization and site preparation activities will commence. Mobilization activities will include the delivery of site trailers, materials, and heavy equipment. Site preparation activities will include: set-up of site trailers; clearing and grubbing of all excavation areas and the process area; survey and staking of excavation areas, the process area, stabilization cell, etc.; construction of site support zones and process area; installation of sanitary facilities; tree removal and chipping; improvement and extension of existing haul road; fence removal; installation of temporary fencing; installation of erosion control measures; and the installation of two air monitoring stations.

The drainline from the two treatment tanks (Tanks 21-112 and 21-113) to the outfall ditch at the southern end of the SWMU will be removed (Figure 4.4-2). This 4-in. diameter, cast iron section of drainline extends 80 ft from the south side of the North Perimeter Road to a discharge point just below the canyon rim. The soil above the pipe will be excavated, the pipe will be removed, and the excavated trench will be backfilled following collection of verification samples as described in Section 5.

Concurrent with the drainline removal, the process area will be prepared east of the access road. A pugmill will be set-up in this area The pugmill is the mechanical mixing device that will be used to combine the soil, tuff and reagents into a homogeneous grout mass to be placed in the onsite excavation. The process area will also provide space for stockpiles of soil and a load out area for loader and dump truck operation. The pugmill (Rapidmix 400) will provide thorough, high-speed, high-shear mixing. This plant is designed to generate very little dust during operation.

Construction of a below-grade stabilization cell for burial of the solidified materials will proceed concurrently with the excavation and solidification of soil/sediment, and tuff with elevated activity. The stabilization cell will be located near the center of the site (Figure 4.4-3). The west end of the stabilization cell will have a ramp built at a 5:1 slope (Figure 4.4-4) to allow truck and equipment access for the placement of slidified material.

Areas of elevated activity to be excavated will be surveyed and staked. As these areas are excavated, real-time radiological screening combined with real time mapping of gross gamma radiation will be used to determine whether enough media has been removed to achieve the established clean-up levels. Excavated soil/sediment and tuff will be staged at the process area. Confirmation sampling will then be conducted, prior to installation of the cover, in accordance with Section 5.0 Confirmation Surveys and Sampling.

Contaminated soil/sediment and tuff will be composited at a ratio of 60/40 respectively. Contaminated material from the composite stockpile will then be sized for processing in the pugmill. Solidification reagents (cement and bentonite) will be loaded into the reagent bins of the pugmill. A water truck will provide water to the site for filling the pugmill water tanks. Composite material will be loaded into the pugmill using a loader. The pugmill is completely automated and will be adjusted to batch proportions of reagents, water, and contaminated composite material in accordance with the mix design. The maximum solidification rate will be 20 yd^3 per hour or 120 yd^3 per day. QA samples will be collected from the material exiting the pugmill. Specific testing parameters to verify solidification requirements will be detailed in the Construction Quality Control Plan and the results will be documented in the VLM Completion Report.

ESH-17 will operate two high-volume air samplers during onsite activities and will monitor appropriate air quality parameters.

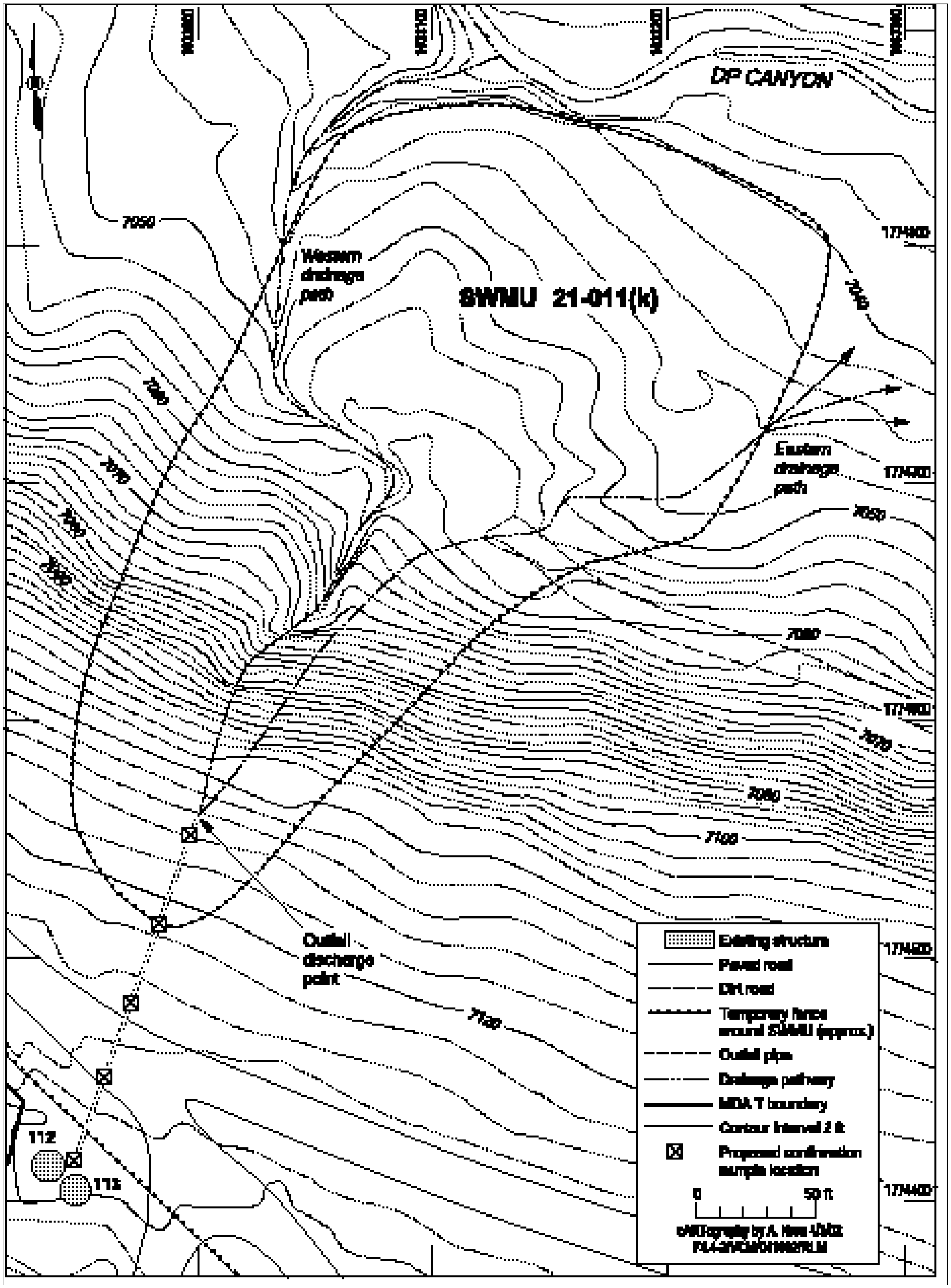


Figure 4.4-2 Outfall pipe to be removed and proposed confirmation sampling locations.

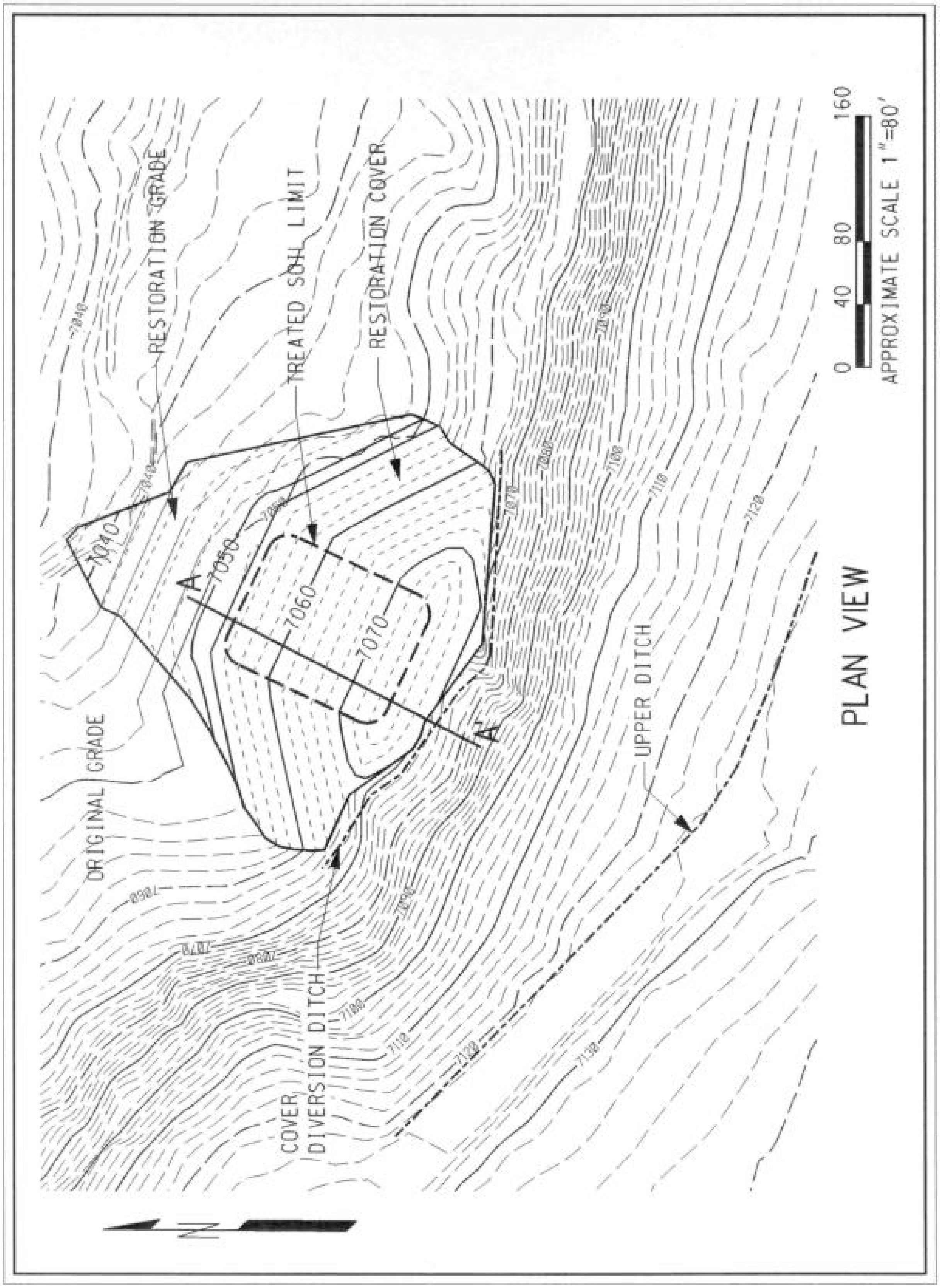


Figure 4.4-3 Location of stabilization cell

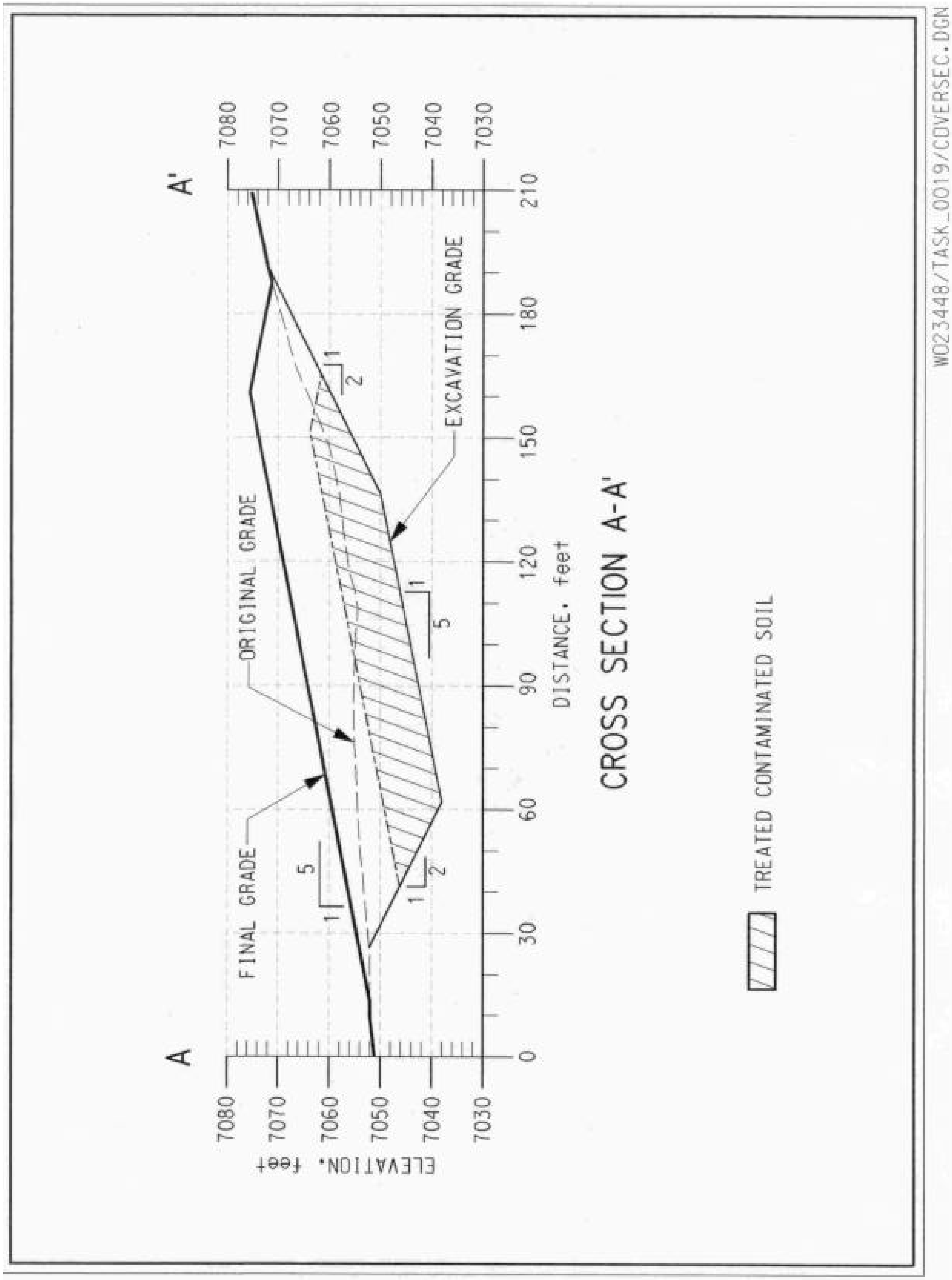


Figure 4.4-4 West end of stabilization cell with ramp

A small dump truck will be used to transfer the solidified material from the process area to the stabilization cell for placement. Solidified material will be spread across the bottom of the cell in lifts and compacted.

Following excavation and treatment activities, project personnel will decontaminate the pugmill and all earth-moving equipment. Residual media adhering to equipment will be removed using dry decontamination methods including the use of wire brushes and scrapers (WGII SOP 1.08 Rev 1). If necessary, final equipment decontamination will be performed on a temporary wash pad with a high-density polyethylene (HDPE) liner. Cleaning solutions and wash water will be recycled or collected for proper disposal. All parts of the equipment, including the undercarriage, wheels, tracks, chassis, and cab will be thoroughly cleaned. Air filters on equipment operating in the exclusion zone will be considered contaminated and will be removed and replaced before equipment leaves the site. A high-pressure sprayer along with long handled brushes and rods will be used to effectively remove contaminated material from equipment. Equipment will be surveyed by Environmental Safety and Health (ESH)-1 Radiological Control Technicians (RCT) prior to being released from the site.

4.4.3 Site Restoration

Upon completion of removal and solidification activities, site restoration will be implemented. This will involve the clearing and grubbing of areas where soil is to be placed, preparing the subgrade for placement of additional soil cover, import and placement of approximately 4000 yd^3 of soil on the hillside, and revegetation of the site. This includes areas excavated in earlier soil removal activities and all areas excavated during this corrective measure.

Approximately 4,000 yd^3 of borrow material will be transported to the site for placement. Borrow material will be placed in lifts and compacted. All grades will be finished in conformance with the lines and grade on the plans. Permanent run-on controls will be installed at the south end of the site and above the solidified material to limit erosion from the site. The permanent run-on controls will consist of water diversion ditches, one located at the top of the slope to prevent surface water from running onto the slope, and one located directly above the solidified material to prevent any surface water from draining onto the site.

Once grading is complete, revegetation activities will commence. Revegetation activities will conform to project specifications to be prepared by a landscape architect licensed in the state of New Mexico. Following revegetation of the disturbed areas, mulch from clearing and grubbing activities will be applied to the site.

Seeded areas will be maintained until a well-developed vegetative cover is established.

5.0 CONFIRMATION SURVEYS AND SAMPLING

5.1 Confirmation Sampling Below SWMU 21-011(k) Outfall Pipe

At a minimum, five locations will be sampled below the outfall line leading to SWMU 21-011(k). Samples will be collected from two depths (0 to 12 in. and 24 to 36 in. below the bottom of the removed pipe). Samples will be analyzed by gamma spectroscopy (Cs-137 and Am-241), and for strontium-90 and isotopic plutonium at a fixed laboratory and screened for gross alpha, beta and gamma radiation for DOT shipping purposes. One sample location each will be located at the joint nearest the north and south ends of the removed line. The remaining three sample locations will be distributed along the length of the line. Gamma screening will be conducted along the length of the line. Sample locations may be biased to areas of elevated gamma radiation identified during the screening or sample locations added as appropriate.

Much of the line to be removed is beneath the roadbed leading to the TSTA facility. Since this is the sole access road to this operating nuclear facility, only the above samples will be collected. The need to remove any contaminated soils beneath the outfall pipe or additional sampling required to define nature and extent of contamination will be determined after review of the fixed laboratory analytical results and in coordination with the TSTA facility.

5.2 Confirmation Surveys and Sampling of Soil Removal Areas

After the elevated activity areas have been remediated but before restoration occurs, verification samples will be collected at a rate of at least one per 25 yd^2 of remediated areas. At least one surface sample will be collected from each discrete remediated area, even if it is much smaller than 25 yd^2. A minimum of one sample per 500 yd^2 of areas not requiring remediation will be collected at random. Verification samples will be screened in the on-site trailer and then sent to a fixed lab for further characterization. Fixed lab analysis will be performed by gamma spectroscopy (Cs-137 and Am-241), strontium-90 and isotopic plutonium.

A walkover gross gamma survey of the entire SWMU prior to restoration will be performed to obtain count rates across the site at a rate of at least 1 per yd^2 of affected area. This survey is to include all affected areas as well as the particular locations where verification samples were collected.

The data quality objective for the walkover survey is that the standard deviation of the count rate data should not exceed 2% of the count rate for locations where the cesium-137 activity is estimated to be 150 pCi/g. This data quality objective will ensure that the gross gamma data will be precise enough to be useful for decision making at locations where soil concentrations could possibly approach the target level.

After the cover is placed and compacted on top of the stabilized soil, a verification survey will be conducted to confirm the shielding action of the cover. The confirmation screening survey will consist of a walkover gross gamma survey. Locations of detections above the target concentration of 150 pCi/g will be sampled for gamma spectrometry in the field counting trailer.

Data from both surveys will be used to derive radionuclide concentrations to demonstrate that the site meets target levels and that the DOE 5400.5 elevated activity criterion is satisfied. Attainment of these objectives will be documented in the VCM Completion Report for SWMU 21-011(k).

5.3 Long-Term Monitoring

A thermoluminescent dosimeter (TLD) survey will be conducted annually as part of an ongoing monitoring program at the site. TLDs are routinely used to monitor personnel exposure and can be used for stationary monitoring points. Approximately 30 TLD badges will be obtained from ESH-17 and placed onsite for one year. Sample locations will be chosen to represent the anticipated range of gamma radiation levels on site. Proposed sample locations and data quality objectives will be detailed in the execution plan which will be developed for the site activities.

Routine inspections of the engineered site restoration and BMPs will be conducted on a frequency to be proposed in the VCM Completion Report. Periodic radiation surveys may also be conducted to ensure the design specifications of the corrective measure are being met.

Annual inspections of the restored areas will consist of a yearly inspection for the first five years after which the inspection requirements will be reviewed. A formal site inspection program will be initiated following site restoration to ensure long-term cover integrity. Inspections will be performed quarterly for the first three years and bi-annually thereafter. The vegetative cover will be inspected for vegetation loss, signs of improper surface drainage, and erosion, including sheet flow, rill, and channelized gully erosion. Areas of the vegetative cover that exhibit a loss of greater than six square feet or repetitive voids greater than two square feet amounting to more than 10 percent of any area will be reseeded. Stormwater controls will be examined to ensure run-on is prevented and diverted away from the site. The cover will also be inspected for excessive differential settlement and subsidence. Depressions will be filled with cover soil and reseeded. Site postings will be inspected to ensure that they prevent unauthorized disturbance of the stabilized material.

6.0 WASTE MANAGEMENT

6.1 Estimated Types and Volumes of Waste

Five separate waste streams are anticipated from this VCM. The waste streams, expected waste types, and volumes are summarized in Table 6.1-1. Waste stream descriptions, including the principal components of the waste and any uncertainties in volume calculations, are described in the paragraphs that follow.

Table 6.1-1
Waste Streams, Types, and Volumes at SWMU 21-011(k)

Waste Stream	Waste Type/Form	Anticipated Volume
Contact waste (PPE, plastic sheeting, disposable sampling supplies, dry decontamination waste, etc.)	Low-level radioactive waste; solid, compactible	30 yd3 (precompacted)
Decontamination solutions	Low-level radioactive waste; liquid	1,000 gallons
Vegetation (brush, small-diameter trees, scrub oak)	Low-level radioactive waste; solid	40 yd3
Metal pipe	Low-level radioactive waste; solid, noncompactible	5 yd3
Municipal refuse, uncontaminated trash and debris (cardboard, paper, plastic, etc.)	Municipal solid waste (MSW); solid	25 yd3

Contact waste. This waste stream will include various types of disposable debris including personal protective equipment (gloves, booties, filter cartridges); plastic sheeting (e.g., liners, tarps and contamination control covers), sampling supplies such as plastic scoops, plastic bags, jars, and filters; and dry decontamination waste. These wastes have the potential to be become contaminated through direct contact with contaminated environmental media. Characterization of this waste will be determined through soil contaminant concentrations and from direct radiological surveys. The volume of contact waste will be kept to a minimum by decontaminating any reusable items that come into contact with the contaminated environmental media.

Decontamination solutions. This waste stream will consist of liquids generated from on-site decontamination of process equipment; tools; excavation equipment, vehicles; sampling equipment; and personnel. The volume of decontamination solutions will be minimized through the use of “dry” techniques and by reusing any in-process wastewater in the soil stabilization process.

Decontamination solutions will be characterized through direct sampling in order to demonstrate compliance with Waste Acceptance Criteria (WAC) at the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF).

Vegetation. Brush, small trees, and scrub oak will be cleared from the site during site preparation activities. This material will be screened for radiological activity and used, as appropriate, as restoration material.

Metal pipe. A 4-inch diameter, cast iron drainline from the two wastewater treatment tanks will be removed and packaged as low-level radioactive waste. This waste stream will be characterized by survey of direct and removable contamination on the drainline. All surveys will be performed by a qualified RCT.

Municipal refuse. This waste stream will include miscellaneous uncontaminated cardboard, plastic, and paper generated during the project. Administrative controls will be established to minimize the introduction of items (e.g., packaging materials) into the exclusion zone and/or radiological control areas. As much as practicable, plastic sheeting (e.g., tarps, liners, and contamination control covers) and reusable supplies will be decontaminated, surveyed and released by a qualified RCT. All recyclable materials will be segregated from this waste stream prior to disposal.

6.2 Method of Management and Disposal

This section describes the planned methods of managing the waste from the time of generation to final disposal.

Contact waste. This waste will be collected in 55-gallon plastic bags and deposited into metal collection boxes (approx. 90 cu ft capacity) for interim storage. The metal boxes will remain in an onsite radioactive waste staging area located until filled and prepared for transport. The contact waste will then be shipped to the low-level waste (LLW) Compaction Facility at TA-54 Area G for disposal.

Decontamination solutions. Wastewater from the onsite decontamination pad will be pumped into plastic tuff tanks (330-gal capacity) and stored in secondary containment within a liquid radioactive waste staging area. Liquid waste samples will be collected and composited for characterization purposes. Radioactively contaminated liquids will be transported in the tuff tanks to the TA-50 RLWTF for disposal.

Vegetation. This waste stream will be cleared from the site, loaded into 20 yd^3 roll-off containers and staged in a radioactive waste storage area. The vegetation will be transported to TA-54, Area G for disposal.

Metal pipe. The cast iron drainline will be placed into a lined roll-off container and staged in an onsite radioactive waste storage area. This waste stream will be disposed at TA-54, Area G.

Municipal refuse. Uncontaminated trash will be collected daily in plastic drum liners and staged onsite in a solid waste storage area. This waste will be disposed at the Los Alamos County Landfill.

7.0 PROPOSED SCHEDULE AND UNCERTAINTIES

The fieldwork portion for this VCM is expected to begin on July 1, 2002 and is anticipated to end by September 24, 2002 (Table 7.0-1). Ten working days have been allotted for a site readiness review, training, and mobilizing. Ten working days have been allotted for site preparation activities. Twenty-five working days have been scheduled for excavation of contaminated material, treatment, and confirmation sampling. Fifty working days have been allotted for waste disposal activities. Ten working days have been allotted for site restoration activities. Demobilization activities are schedule to take 7 working days. The VCM Completion Report will be prepared and submitted to the NMED Hazardous Waste Bureau (HWB) in March 2003.

Table 7.0-1
VCM Field Work Schedule

Activity	Workday Duration	Start	Finish
Readiness review/mobilization	10 days	July 1, 2002	July 12, 2002
Site Preparation	10 days	July 15, 2002	July 26, 2002
Excavation, treatment, and confirmation sampling	25 days	July 29, 2002	August 30, 2002
Waste management/disposal	50 days	July 15, 2002	September 20, 2002
Site restoration	10 days	September 2, 2002	September 13, 2002
Demobilization	7 days	September 16, 2002	September 24, 2002
Approximate Working Days	62 days	July 1, 2002	September 24, 2002

8.0 REFERENCES

The following list includes all references cited in this appendix. Parenthetical information following each reference provides the author, publication date, and the ER identification (ID) number. This information also is included in the citations in the text. ER ID numbers are assigned by the Laboratory's ER Project to track records associated with the Project. These numbers can be used to locate copies of the actual documents at the ER Project's Records Processing Facility and, where applicable, with the ER Project reference library titled "Reference Set for Material Disposal Areas, Technical Area 54."

Copies of the reference library are maintained at the NMED Hazardous Waste Bureau; the DOE Los Alamos Area Office; United States Environmental Protection Agency, Region 6; and the ER Project Material Disposal Areas Focus Area. This library is a living collection of documents that was developed to ensure that the administrative authority has all the necessary material to review the decisions and actions proposed in this document. However, documents previously submitted to the administrative authority are not included.

DOE (US Department of Energy) 1988. "DOE Headquarters Environmental Survey of Los Alamos National Laboratory." (DOE 1988, 15363)

DOE (US Department of Energy)1990. "Radiation Protection of the Public and Environment," DOE Order 5400.5. (DOE 1990, 58980.1)

EPA (US Environmental Protection Agency), April 10, 1990. "Region 6 Hazardous Waste Permit (Hazardous and Solid Waste Amendments)," Permit NM0890010515. (EPA 1990, 01585.2)

EPA (US Environmental Protection Agency), September 1, 2000. "EPA Region 6 Human Health Medium-Specific Screening Levels, US EPA Region 6." (EPA 2000, 68410.1)

Langmuir, D., 1997. *Aqueous Environmental Geochemistry*, Prentice-Hall, Inc., Upper Saddle River, New Jersey. (Langmuir 1997, 56037)

LANL (Los Alamos National Laboratory), May 1991. “TA-21 Operable Unit RFI Work Plan for Environmental Restoration”, Los Alamos National Laboratory report LA-UR-91-962, Los Alamos, New Mexico. (LANL 1991, 07528.1)

LANL (Los Alamos National Laboratory), February 28, 1994. “Phase Report 1C, TA-21 Operable Unit RCRA Facility Investigation, Outfalls Investigation,” Los Alamos National Laboratory report LA-UR-94-228, Los Alamos, New Mexico. (LANL 1994, 31591.1)

LANL (Los Alamos National Laboratory), 1994. “Phase Report Addendum 1B & 1C Operable Unit 1106 RCRA Facility Investigation Phase Report,” Los Alamos National Laboratory report LA-UR-94-4360, Los Alamos, New Mexico. (LANL 1994, 52350.1)

LANL (Los Alamos National Laboratory), September 1, 1996. “Interim Action Plan for Potential Release Site 21-011(K) Discharge System Field Unit 1, September 1996,” Los Alamos National Laboratory report LA-UR-96-1609, Los Alamos, New Mexico. (LANL 1996, 54790.2)

LANL (Los Alamos National Laboratory), 1997. “Interim Action Report for Potential Release Site 21-011(k) Discharge System Field Unit 1, April 1997,” Los Alamos National Laboratory report, Los Alamos, New Mexico. (LANL 1997, 55648.2)

LANL (Los Alamos National Laboratory), August 26, 1999. “Evaluation of Sediment and Alluvial Groundwater in DP Canyon, Reaches DP-1, DP-2, DP-3, and DP-4,” Los Alamos National Laboratory document LA-UR-99-4238, Los Alamos, New Mexico. (LANL 1999, 63915)

LANL (Los Alamos National Laboratory), December 1, 1999. “Screening Level Ecological Risk Assessment Methods,” Rev.1, Los Alamos National Laboratory report LA-UR-99-1405, prepared by R. Ryti, E. Kelly, M. Hooten, G. Gonzales, and L. Soholt, ER Project A3 Focus Area, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 1999, 64783.1)

LANL (Los Alamos National Laboratory), January, 2001. “Release/Discharge Notification,” Los Alamos National Laboratory document, Permit Number NM0028355, Los Alamos, New Mexico. (LANL 2001, 72667)

LANL, March 2001. “Derivation and Use of Radionuclide Screening Action Levels, LANL Environmental Restoration Project,” Los Alamos National Laboratory report LA-UR-01-990, Los Alamos, New Mexico. (LANL 2001, 69683.1)

LANL (Los Alamos National Laboratory), October 2001. Environmental Restoration Project Communication Record, Los Alamos, New Mexico. (LANL 2001, 70217)

LANL (Los Alamos National Laboratory), March 2002. “ECORISK Database (Release 1.4), ER package #186,” Environmental Restoration Project, Los Alamos, New Mexico. (LANL 2002, 72802)

LANL (Los Alamos National Laboratory), April 2002. “Human Health Risk-Based Screening Methodology,” Los Alamos National Laboratory report LA-UR-02-1563, Los Alamos, New Mexico. (LANL 2002, 72639)

LANL (Los Alamos National Laboratory), March 2002. “Stabilization of the Contaminated Tuff and Sediment at the Los Alamos National Laboratory,” prepared by IT Corporation for the Environmental Restoration Project, Los Alamos, New Mexico. (LANL 2002, 72638)

NMED (New Mexico Environment Department), December 18, 2000. "Technical Background Document for Development of Soil Screening Levels (Volume I Soil Screening Guidance Technical Background Document)," New Mexico Environment Department Hazardous Waste Bureau and Ground Water Quality Bureau Voluntary Remediation Program, Santa Fe, New Mexico. (NMED 2000, 68554.1)

Ryti, R., and P. Longmire, September 22, 1998. "Inorganic and Radionuclide Background Data for Soils, Canyon Sediments, and Bandelier Tuff at Los Alamos National Laboratory," Los Alamos National Laboratory report LA-UR-98-4847, Los Alamos, New Mexico. (Ryti and Longmire 1998, 59730)

Appendix A

List of Acronyms and Glossary

APPENDIX A LIST OF ACRONYMS AND GLOSSARY

BMP	best management practice
COPC	chemical of potential concern
DOE	US Department of Energy
EPA	US Environmental Protection Agency
ER	environmental restoration
ESL	ecological screening level
ESH	environment, safety, and health
FIMAD	Facility for Information Management, Analysis, and Display
HSWA	Hazardous and Solid Waste Act
HWB	Hazardous Waste Bureau
IA	interim action
LANL	Los Alamos National Laboratory
LLW	low-level waste
MDA	material disposal area
NMED	New Mexico Environment Department (New Mexico Environmental Improvement Division before 1991)
NPDES	National pollutant discharge elimination system
OU	operable unit
PCB	polychlorinated biphenyl
PPE	personal protective equipment
RCRA	resource Conservation and Recovery Act
RFI	RCRA facility investigation
RLW	radioactive liquid waste
RLWTF	radioactive liquid waste treatment facility
SALs	screening action levels
SOP	standard operating procedure
SVOC	semivolatile organic compound

SWSC	sanitary wastewater system consolidation
SWMU	solid waste management unit
TA	technical area
TAL	target analyte list (EPA)
TCLP	toxicity characteristic leaching procedure
T & E	threatened and endangered
TSD	treatment, storage, disposal
VCA	voluntary corrective action
VCM	voluntary corrective measure
VOC	volatile organic compound
VCP	vitrified clay pipe
WAC	waste acceptance criteria
WWTP	wastewater treatment plants

Glossary

Baseline Risk Assessment—Anthropogenic concentrations of a given chemical in the soil associated with Laboratory and/or commercial activities or processes that may not be related to source material(s) or a release(s) from within a potential release site. Examples of baseline levels are nuclear fallout and organic chemicals associated with urban activities.

Department of Energy (DOE)—Federal agency that sponsors energy research and regulates nuclear materials for weapons production.

DOE ORDER 5400.5, HOT SPOTS—"If the average concentration in any surface or below-surface area less than or equal to 25 m^2 exceeds the limit or guideline by a factor of $(100/A)^{0.5}$ [where A is the area of the region in which concentrations area elevated]. Limits for "hot-spots" shall also be developed and applied. Procedures for calculating these hot-spot limits, which depend on the extent of the elevated local concentrations, are given in DOE/CH-8901. In addition, reasonable efforts shall be made to remove any source of radionuclide that exceeds 30 times the appropriate limit for soil, irrespective of the average concentration in the soil."

Environmental Protection Agency (EPA)—Federal agency responsible for enforcing environmental laws. While state regulatory agencies may be authorized to administer some of this responsibility, the EPA retains oversight authority to ensure protection of human health and the environment.

Groundwater—Water in a subsurface saturated zone; water beneath the regional water table.

Evapotranspiration—The combined *discharge* of water from the earth's surface to the atmosphere by evaporation from lakes, streams, and soil surfaces, and by transpiration from plants.

Medium—Any media capable of *absorbing* or *transporting* constituents. Examples of media include *tuffs*, soils and *sediments* derived from these *tuffs*, surface water, *soil water*, *groundwater*, air, structural surfaces, and debris.

Operable Unit—At the Laboratory, one of 24 areas originally established for administering the ER Project. Set up as groups of *potential release sites*, the OUs were aggregated based on geographic proximity for the purpose of planning and conducting *RCRA facility assessments* and *RCRA facility investigations*. As the project matured, it became apparent that 24 were too many to allow efficient communication and to ensure consistency in approach. Therefore, in 1994, the 24 OUs were reduced to six administrative "field units."

Potential Release Site—Refers to potentially contaminated sites at the Laboratory that are identified either as *solid waste management units (SWMUs)* or *areas of concern* (AOCs). SWMU refers to *SWMUs* and AOCs collectively.

RCRA facility investigation (RFI)—The investigation that determines if a release has occurred and the nature and extent of the contamination at a hazardous waste facility. The RFI is generally equivalent to the remedial investigation portion of the Comprehensive Environment Response, Compensation, and Liability Act (CERCLA) process.

Resource Conservation and Recovery Act (RCRA)—The Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976. (40 CFR 270.2)

Solid Waste Management Unit— Any discernible unit at which *solid wastes* have been placed at any time, irrespective of whether the unit was intended for the management of *solid or hazardous waste*. Such units include any area at a facility at which *solid wastes* have been routinely and systematically *released*. This definition includes regulated units (i.e., landfills, surface impoundments, waste piles, and land *treatment* units) but does not include passive leakage or one-time spills from production areas and units in which wastes have not been managed (e.g., product storage areas).

Radionuclide— A nuclide (species of atom) that exhibits radioactivity.

Remediation—The process of reducing the concentration of a contaminant (or contaminants) in air, water, or soil media to a level that poses an acceptable risk to human health and the environment; the act of restoring a contaminated area to a usable condition based on specified standards.

Runoff—The portion of the precipitation on a drainage area that is discharged from the area either by sheet flow or adjacent stream channels.

Run-on—Surface water flowing onto an area as a result of runoff occurring higher up the slope.

Site characterization—Defining the pathways and methods of migration of the hazardous waste or constituents, including the media affected, the extent, direction and speed of the contaminants, complicating factors influencing movement, concentration profiles, etc. (U.S. Environmental Protection Agency, May 1994. "RCRA Corrective Action Plan, Final," Publication EPA-520/R-94/004, Office of Solid Waste and Emergency Response, Washington, DC)

Solid waste management unit (SWMU)—Any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility at which solid wastes have been routinely and systematically released. This definition includes regulated units (i.e., landfills, surface impoundments, waste piles, and land treatment units) but does not include passive leakage or one-time spills from production areas and units in which wastes have not been managed (e.g., product storage areas).

Standard operating procedure (SOP)—A document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps, and is officially approved as the method for performing certain routine or repetitive tasks.

Target analyte—An element, chemical, or parameter, the concentration, mass, or magnitude of which is designed to be quantified by use of a particular test method.

Technical area (TA)—The Laboratory established technical areas as administrative units for all its operations. There are currently 49 active TAs spread over 43 square miles.

Topography—The physical configuration of the land surface in an area.

Treatment—Any method, technique, or process, including elementary neutralization, designed to change the physical, *chemical*, or biological character or composition of any *hazardous waste* so as to neutralize such waste; recover energy or material resources from the waste; or so as to render such waste nonhazardous or less hazardous; safer to *transport*, store, or dispose of; or amenable for recovery or storage; or reduced in volume.

Tuff—A compacted deposit of volcanic ash and dust that contains rock and mineral fragments accumulated during an eruption.

Vadose zone—The unsaturated zone. Portion of the subsurface above the regional water table in which pores are not fully saturated.

Appendix B

VCM Checklist and Fact Sheet

Accelerated Corrective Action (ACA) Checklist and Field Work Authorization Form

PRS Number: 21-011(k) ☒ HSWA ☐ Non-HSWA

Yes	No	
X		Fact sheet describing planned activities is complete and attached to checklist.
X		COPC(s) for human health risk (HH), ecological risk (ECO), or other requirements are known or will be determined during accelerated site characterization.
X		Nature and extent of contamination is defined or accelerated site characterization is planned as part of this action to define nature and extent and to guide cleanup.
X		Cleanup levels/preliminary remediation goals (PRGs) are appropriate.
X		Remedy is obvious.
X		Time for removal is less than six months.
X		Remedy is final.
X		Land use assumptions are straightforward.
X		Treatment, Storage, and Disposal (TSD) Facilities are available for waste type and volume.
X		Cleanup cost is reasonable for the planned action and meets accelerated decision logic criterion for decision to proceed with ACA.
X		Briefing for NMED is required.

Explain criteria not checked above:

Los Alamos
Environmental Restoration Project

Accelerated Corrective Action (ACA) Checklist and Field Work Authorization Form

Page 2 of 2

PRS Number: 21-011(k) ☒ HSWA ☐ Non-HSWA

Upon reviewing the Accelerated Corrective Action Fact Sheet and the criteria checklist above, the appropriate Accelerated Corrective Action approach for the PRS(s) is (check one): ☐ VCA ☒ VCM

Signatures of the Representative for UC-Laboratory, DOE-LAAO, and NMED-HRMB:

UC: John Hopkins, MDA Focus Area Leader ____________ (Print Name and Title, then Sign) ____________ (Date)

DOE: Woody Woodworth, LAAO ____________ (Print Name and Title, then Sign) ____________ (Date)

NMED: Vicki Maranville, NMED-HWB ____________ (Print Name and Title, then Sign) ____________ (Date)

The undersigned have reviewed the final plan and believe that it fully satisfies the appropriate Accelerated Corrective Action Approach.

Signatures of the Representative for UC-LANL and DOE-LAAO

UC: ____________ (Print Name and Title, then Sign) ____________ (Date)

DOE: ____________ (Print Name and Title, then Sign) ____________ (Date)

Action	Date	Correspondence ID
VCA or VCM plan submitted to NMED		
NOD or RSI received from NMED		
Laboratory response to NOD or RSI		
NMED approval of VCA or VCM plan		

After reviewing the VCA or VCM plan for the site(s) listed above and believing that the ACA process and VCA or VCM criteria have been met, I authorize the fieldwork to proceed.

DOE ER Program Manager ____________ (Signature) ____________ (Date)

Los Alamos
Environmental Restoration Project

Voluntary Corrective Measure Fact Sheet for PRS 21-011(k)
Confirmation Sampling and Removal of Residual Contamination

SRS: 21-011(k) = 67
Erosion Matrix Score: 21-011(k) = 72

OPERATIONAL HISTORY

Potential Release Site (PRS) 21-011(k) was the national pollutant discharge elimination system (NPDES)-permitted outfall (NPDES outfall no. EPA050050) for treated industrial wastewater from Buildings TA-21-35 and -257, the former industrial wastewater treatment plants (WWTP) at TA-21, and is listed in Module VIII of the Laboratory's Hazardous Waste Facility Permit. The PRS consists of a drain line from two wastewater treatment tanks that discharged to an outfall ditch, which channeled wastewater to the canyon rim, and down the hillside toward DP Canyon. The ditch is no longer visible; however, a 4-inch cast iron drain line is located approximately 55 feet north of the TA-21 perimeter road in the area where the outfall ditch would have ended. A gently sloping, rocky surface extends from the outfall pipe approximately 30 feet to the canyon rim.

TA-21,the former plutonium processing facility at LANL, began plutonium operations in 1945 and ceased operations in 1978. The first WWTP, TA-21-35 was activated in 1952 and operated until 1967 when the new WWTP, TA-21-257, came on line. Both facilities treated wastes from DP West and DP East consisting of liquids remaining after plutonium extraction and processing of radioactive materials for nuclear weapons and space rocket research projects. The treatment process mixed the raw waste with lime, ferric sulfate, and coagulant aids. The waste was then pumped to a flocculator and onto a settling tank. Settled effluent was pumped through a pressure filter and sampled to verify treatment. If the effluent was determined to be adequately treated, it was pumped to two final effluent holding tanks (tanks TA-21-112 and TA-21-113). From tanks TA-21-112 and TA-21-113, the wastewater was piped northeast toward DP Canyon and discharged on the north side of DP Mesa (Fig. 1.0-1). This wastewater contained a variety of radioactive and chemical constituents. Discharges of treated wastewater to the outfall were discontinued in the early 1990's; however, Building TA-21-257 is still used for pretreatment of wastewater prior to discharge to the TA-50 waste line.

Previous Investigations and Contaminants of Potential Concern

PRS 21-011(k) was investigated in 1988 by DOE and by the ER Project in 1992 and 1993 and reported on in 1995 in the Final Draft for the OU 1106 Addendum to Phase 1B, 1C Report (LANL 1995, 52350). The initial radiation survey and soil sampling performed at PRS 21-011(k) in FY92 indicated the presence of radionuclide contamination. Additional soil sampling and a radiation survey were performed during the FY93 field season to further define the extent of contamination found in FY92.

An interim action (IA) plan was prepared in 1996 (LANL 1996, 01-0042). The IA was implemented during 1996 and 1997 and described in the *Interim Action Report for TA-21, Potential Release Site 21-011(k)*, submitted to NMED on April 10, 1997 (LANL 1997, 55648). The objectives of the IA were to remove a portion of the radionuclide source term from the outfall area of the PRS and install storm water control measures as a best management practice (BMP). Soil excavated from PRS 21-011(k) during the 1996 IA (390 cubic yards) was characterized in the field and transported to TA-54, MDA G for disposal. Storm water controls were installed in 1997 and upgraded in August 1999. The controls are routinely inspected and maintained by LANL ESH-18 representatives.

The COPCs for this PRS include americium-241, cesium-137, plutonium-238 and -239, and strontium-90. Although analytical results from the 1988, 1992 and 1993 investigations did not identify non-radioactive, RCRA-regulated organic and inorganic chemicals as COPCs, waste characterization samples and a percentage of confirmation samples will be submitted for analysis of metals, SVOCs, and radionuclides. VOCs are not anticipated to be present at the surface because they were not detected when 390 cubic yards of soil were excavated during the IA in 1996. However, VOCs will be included in the analytical suite for a percentage of post excavation confirmation samples and waste characterization samples.

VCM Rationale

SWMU 21-011(k) is located on the north side of DP mesa on a hillside that leads to DP Canyon. The most northern extent of the slope's toe is within the high water table of the DP Canyon streambed. SWMU 21-011(k) has been identified as the primary source of radionuclide contamination in sediments in DP Canyon (LANL 1999, 63915). The existing radionuclide inventory in surface soils and sediment at the site is approximately four times greater than the inventory in the sediments in DP Canyon. Because of the site's high potential for erosion (erosion matrix score of 72 out of 100, Appendix C), there is the potential for radionuclides from the site to increase the radionuclide inventory in DP Canyon. Therefore, remediation of the site is considered a priority for both LANL and the New Mexico Environment Department (NMED).

SWMU 21-011(k) is located on DOE property that will remain under institutional control for at least the next 100 years. Land use for TA-21 is, and will continue to be, industrial under DOE ownership and control. However, the SWMU 21-011(k) site is not a typical industrial site as it is located on a steep hillside that slopes to the bottom of a canyon. Consequently, the more realistic trail user scenario is proposed for screening soil and sediment areas with potentially elevated radionuclide activity exceeding acceptable human health and ecological risk levels.

VCM Implementation

The Laboratory's ER Project will conduct the following activities to achieve the project objectives. The 4-inch cast iron drain line that delivered the contaminating industrial effluent to the site will be excavated and disposed. A disposal cell will be excavated, below grade, and within the SWMU boundary where solidified wastes will be placed for reburial. Contaminated soils/tuff will be excavated from "hot spots" and stockpiled for solidification. Excavation and removal of contaminated material will continue until residual concentrations, averaged over 1 yd^2, do not exceed 150 pCi/g cesium-137 or 170 pCi/g americium-241 based on on-site gamma screening. The stockpiled contaminated material will be solidified, i.e., the contaminated material will be processed in a twin-shaft pugmill mixer with Portland cement, bentonite, and water, then moved and placed as a batch block of solidified material within the disposal cell. Samples will be taken from the block of material to ensure structural integrity. An estimated volume of 800 yd^3 of material will be stabilized. Upon completion, the process equipment will be decontaminated and returned to the vendor.

Post excavation sampling and radiation surveys will be conducted to ensure that the DOE 5400.5 elevated activity criterion has been achieved. After confirmation sampling, site restoration will be performed to include re-contouring all excavated areas and placing and compacting ~4000 yd^3 of clean borrow soils over the disposal cell and across the site. Following grading, placement, and compaction of clean soils, the site will be reseeded.

Anticipated Waste Types and Volumes

Three separate waste streams are anticipated from this VCA as presented in the following table.

Waste Stream	Waste Type	Anticipated Volume
Radionuclide-contaminated soil and tuff	Solid — LLW	2,000 yd^3
Radionuclide-contaminated decon water from heavy equipment	Liquid — LLW	250 gallons
PPE, plastic sheeting, disposable sampling equipment, and soil samples	Solid — LLW	10 yd^3

Estimated Cost

Based on current resource estimates, all waste generated during this VCA is expected to be disposed of at TA-54 as LLW at a cost of approximately $1.2 million for waste disposal only. However, final disposal options will be re-evaluated during the VCA implementation planning process. With anticipated subcontractor costs and analytical costs the total estimated cost of this VCA is approximately $2.2 million.

Schedule

The field work portion of this VCA is expected to begin in mid-FY01 and take approximately three months to complete. The fieldwork includes soil and tuff removal, confirmatory sample collection and analysis, waste management, and site restoration.

Reference List of Past Plans, Reports, etc.

Environmental Restoration Project, August 1999. “Evaluation of Sediment and Alluvial Groundwater in DP Canyon,” Los Alamos National Laboratory report LA-UR-99-4238, Los Alamos, New Mexico. (Environmental Restoration Project 1999, 63915)

LANL (Los Alamos National Laboratory), May 1991. "RFI Work Plan for Operable Unit 1106, Section 15.4," Los Alamos National Laboratory Report LA-UR-91-962, Los Alamos, New Mexico. (LANL 1991, 07529)

LANL (Los Alamos National Laboratory), January 1995. “Final Draft for the OU 1106 Addendum to Phase 1B, 1C Report, TA-21,” Los Alamos National Laboratory report LA-UR-94-4360, Los Alamos, New Mexico. (LANL 1995, 52350)

LANL (Los Alamos National Laboratory), 1996. “Interim Action Plan for TA-21: PRS 21-011(k),” Los Alamos National Laboratory report LA-UR-96-1609, Los Alamos, New Mexico. (LANL 1996, 54790.2)

LANL (Los Alamos National Laboratory), April 1997. “Interim Action Report for Potential Release Site 21-011(k) Discharge System,” Los Alamos National Laboratory report, Los Alamos, New Mexico. (LANL 1997, 55648.2)

Appendix C

Standard Operating Procedure 2.0

Appendix D

Ecological Scoping Checklist

APPENDIX D ECOLOGICAL SCOPING CHECKLIST

Part A—Scoping Meeting Documentation

Site ID	SWMU 21-011(k)
Form of site releases (solid, liquid, vapor). Describe all relevant known or suspected mechanisms of release (spills, dumping, material disposal, outfall, explosive testing, etc.) and describe potential areas of release. Reference locations on a map as appropriate.	Site was a former outfall associated with two 12,700 gal. effluent-holding tanks (TA-21-112 and TA-21-113) that discharged treated effluent from an industrial liquid waste treatment facility into DP Canyon via 21-011(k) outfall. Releases at the outfall were to the surface. The discharge flowed down the slope and eventually into the DP Canyon drainage, which is not part of this SWMU.
List of Primary Impacted Media **(Indicate all that apply.)**	**Surface soil – XX –** impacted by discharges at the outfall. **Surface water/sediment – X –** potentially impacted from the discharge into the canyon; sediment in bottom of canyon and possibly surface water including ephemeral stream channel in bottom of canyon. **Subsurface –** **Groundwater – XX –** alluvial groundwater impacted by discharges at the outfall. **Other, explain –**
FIMAD vegetation class based on Arcview vegetation coverage **(Indicate all that apply.)**	**Water – XX –** An ephemeral stream channel exists in the bottom of DP Canyon below the SWMU and flows eastward. It is located approximately 100 to 200 yards from outfall. **Bare Ground/Unvegetated – XX –** There are few areas of bare ground between vegetated areas. These areas are either exposed tuff or dirt often covered with pine needles and other plant litter. **Spruce/fir/aspen/mixed conifer –** **Ponderosa pine – XX-** Primary vegetation community; also ground cover of grasses and shrubs. **Piñon juniper/juniper savannah –** **Grassland/shrubland – XX –** in the bottom of DP Canyon, below the SWMU, with small patches of bare ground. **Developed –.**
Is T&E Habitat Present? **If applicable, list species known or suspected to use the site for breeding or foraging.**	The site is on the border of the core habitat for the Mexican spotted owl and peregrine falcon. This site is within an area that the owl may be assumed to forage with a moderate to low frequency.
Provide list of Neighboring/ Contiguous/ Up-gradient sites, include a brief summary of COPCs and form of releases for relevant sites and reference map as appropriate. **(Use information to evaluate need to aggregate sites for screening.)**	Neighboring/Contiguous/Up-gradient from SWMU 21-011(k) are: 21-001, 21-011(a), 21-019(g), 21-011(h), 21-011(j), 21-011(i), 21-011(e), 21-011(d), 21-011(g), 21-010(e), 21-011(f), 21-016(a), 21-010(f), 21-010(a), 21-010(c), 21-011(c), 21-028(a), 21-016(b), 21-010(b), 21-016(c), 21-010(h), and 21-010(g). The majority of the contamination contributing to SWMU 21-011(k) would have come from SWMUs 21-011(g) and (f), two 12,700 gal. effluent-holding tanks (TA-21-112 and TA-21-113) that discharged treated effluent from an industrial liquid waste treatment facility into DP Canyon. Additionally, SWMUs 21-016(a-c) (MDA T) where liquid radioactive waste was disposed is upgradient from SWMU 21-011(k).
Surface Water Erosion Potential Information **Summarize information from SOP 2.01, including the run-off subscore (maximum of 46); terminal point of surface water transport; slope; and surface water runon sources.**	The Erosion Matrix score for this SWMU is 72, with a score of 46 for runoff [visible evidence of runoff discharging (5.0), runoff terminates in a drainage/wetland (19.0), and runoff in a gully (22.0)] and a score of 0.0 for run-on (natural drainages onto site) scores. The score also reflects it is within the canyon floodplain, but not watercourse (13.0), ground cover is 25-75% (6.5), and slope is >10-30%. (6.5). Potential exists for soil erosion at this site. The runoff terminates in DP Canyon.

Part B—Site Visit Documentation

Site ID	SWMU 21-011(k)
Date of Site Visit	10/26/2000
Site Visit Conducted by	Rich Mirenda, Linda Causey, Jayne Jones

Receptor Information:

Estimate cover	Relative vegetative cover (high, medium, low, none) = high Relative wetland cover (high, medium, low, none) = none Relative structures/asphalt, etc. cover (high, medium, low, none) = none
Field notes on the FIMAD vegetation class to assist in ground-truthing the Arcview information	Site visit confirms that this SWMU is a combination of open areas and ponderosa pine. In some places the tuff is on the surface, in others it is several inches below the surface. Ground cover consists of grasses, shrubs, and young trees. As one goes from DP Road to the mesa top edge of DP Canyon, the vegetation increases and older ponderosa pine predominates. The ground is also covered with pin needles and litter from other plants.
Field notes on T&E Habitat, if applicable. Consider the need for a site visit by a T&E subject matter expert to support the use of the site by T&E receptors.	Site provides good to excellent habitat for foraging. While there is generally no habitat for nesting for T&E species, there are a few nearby dead trees that would make for excellent nesting of birds. The Mexican spotted owl and the peregrine falcon may forage in DP Canyon (Koch 1999, 63599)
Are ecological receptors present at the site? **(yes/no/uncertain)** **Describe the general types of receptors present at the site (terrestrial and aquatic), and make notes on the quality of habitat present at the site.**	Yes. Terrestrial receptors are present in and around the SWMU. Various songbirds were observed in the trees and circling raptors were observed. There was evidence of burrowing was observed in this area. Bear tracks were seen in the dry stream bed. Other large mammals such as deer, elk, coyotes and raccoons would be in the area. Plant life is abundant and healthy. No aquatic receptors are present in the canyon reach below the SWMU.

Contaminant Transport Information:

Surface water transport **Field notes on the erosion potential, including a discussion of the terminal point of surface water transport (if applicable).**	Previously, the runoff flowed into a man-made (3 to 4 ft deep) gully and into DP Canyon. Runoff flow to this gully has been diverted during the 1996 Interim Action in order to prevent contaminants from being moved via water. The surface water runoff has now been diverted into DP Canyon via a drainage to the east and another to the far west of the site. Rain water that falls directly on the outfall portion of the SWMU would flow into DP Canyon via sheet flow. The terminal point of surface water transport is the intermittent stream channel in the bottom of DP Canyon. There is evidence of erosion into the canyon.
Are there any off-site transport pathways (surface water, air, or groundwater)? **(yes/no/uncertain)** **Provide explanation**	Surface water transport is the primary off-site transport pathway. Air transport via particulates or fugitive dust would be a possibility due to surface contamination, however, there are no barren patches of ground that would be subjected to wind, there is ground cover and plant litter covering the dirt, and the area is protected from wind by trees. Ground water is a viable pathway because the alluvial aquifer is less than 5 ft from ground surface and it is suspected to be the source for DP Spring.

Interim action needed to limit off-site transport? **(yes/no/uncertain)** **Provide explanation/ recommendation to project lead for IA SMDP.**	An Interim Action has already occurred at this SWMU. Contaminated soil has been removed and runoff has been diverted from the contaminated west drainage and from the surface of the SWMU.

Ecological Effects Information:

Physical Disturbance **(Provide list of major types of disturbances, including erosion and construction activities, review historical aerial photos where appropriate.)**	The physical disturbances are the west drainage which shows signs of past remedial activities and BMPs.
Are there obvious ecological effects? **(yes/no/uncertain)** **Provide explanation and apparent cause (e.g., contamination, physical disturbance, other).**	No. The area from the top of the mesa to the stream channel in the canyon bottom appear to be no different from the surrounding area.
Interim action needed to limit apparent ecological effects? **(yes/no/uncertain)** **Provide explanation and recommendations to mitigate apparent exposure pathways to project lead for IA SMDP.**	No. Current data does not support the implementation of an interim action at this SWMU. An Interim Action was implemented in 1996.

No Exposure/Transport Pathways:

If there are no complete exposure pathways to ecological receptors onsite and no transport pathways to offsite receptors, the remainder of the checklist should not be completed. Stop here and provide additional explanation/justification for proposing an ecological No Further Action recommendation (if needed). At a minimum, the potential for future transport should include likelihood that future construction activities could make contamination more available for exposure or transport. Not applicable.

Adequacy of Site Characterization:

Do existing or proposed data provide information on the nature, rate and extent of contamination? **(yes/no/uncertain)** **Provide explanation** **(Consider if the maximum value was captured by existing sample data.)**	**Nature –** Yes, full suite samples from past sampling adequately defines the nature of contamination. **Rate –** Yes, aerial photographs show that gamma shine starts in DP Canyon at SWMU 21-011(k) and continues down canyon, and sampling down stream of SWMU 21-011(k) in the canyon has been done by the Canyons Focus Area. **Extent –** Yes. Sampling has been conducted laterally vertically and downstream which is not part of this SWMU.
Do existing or proposed data for the site address potential transport pathways of site contamination? **(yes/no/uncertain)** **Provide explanation** **(Consider if other sites should**	Yes. The sampling proposed in the VCM will address the major potential transport pathway, i.e., surface water runoff down the drainage and into DP Canyon.

aggregated to characterize potential ecological risk.)	

Part C—Ecological Pathways Conceptual Exposure Model

Question A:

Could soil contaminants reach receptors via vapors?

- **Volatility of the hazardous substance (volatile chemicals generally have Henry's Law constant >10^{-5} atm-me/mol and molecular weight <200 g/mol).**

Answer (likely/unlikely/uncertain): unlikely

Provide explanation: No volatile organic chemicals were detected in the samples collected before 2001. In the 2001 samples volatile organic chemicals (acetone, methylene chloride, 4-isopropyltoluene, 2-hexanone, and trichloroethene) were detected sporadically and in concentrations in the low part per billion range. One sample location (21-11205) was re-sampled and the volatile organic chemicals were not detected. Therefore, it is very possible that the volatile organic chemicals were analytical laboratory contaminants.

Question B:

Could the soil contaminants reach receptors through fugitive dust carried in air?

- **Soil contamination would have to be on the actual surface of the soil to become available for dust.**
- **In the case of dust exposures to burrowing animals, the contamination would have to occur in the depth interval where these burrows occur.**

Answer (likely/unlikely/uncertain): likely

Provide explanation: Soil contamination is on the surface of the soil and is available to become dust where there are bare areas. However, most of the ground is covered with pine needles and litter from the overstory so fugitive dust would be rare or unlikely to occur. However, there is evidence of burrowing animals and they would have to burrow through the contamination at the surface.

Question C:

Can contaminated soil be transported to aquatic ecological communities (use SOP 2.01 run-off score and terminal point of surface water runoff to help answer this question)?

- **If the SOP 2.01 run-off score* for each SWMU included in the site is equal to zero, this suggests that erosion at the site is not a transport pathway. (* Note that the runoff score is not the entire erosion potential score, rather it is a subtotal of this score with a maximum value of 46 points).**
- **If erosion is a transport pathway, evaluate the terminal point to see if aquatic receptors could be affected by contamination from this site.**

Answer (likely/unlikely/uncertain): Unlikely

Provide explanation: The major off-site transport pathway is surface water runoff into DP Canyon. However, there are no aquatic ecosystems in this reach of the canyon that would receive this runoff.

<u>Question D:</u>

Is contaminated groundwater potentially available to biological receptors through seeps or springs or shallow groundwater?

- **Known or suspected presence of contaminants in groundwater.**
- **The potential for contaminants to migrate via groundwater and discharge into habitats and/or surface waters.**
- **Contaminants may be taken up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (~1 m depth).**
- **Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.**

Answer (likely/unlikely/uncertain): Likely

Provide explanation: Alluvial water is close to the surface in the canyon, which is not part of the SWMU. Alluvia wells LAUZ-1 [located on the eastern edge of SWMU 21-011(k) next to the stream bed] and LAUZ-2 [located approximately 250 ft downgradient from LAUZ-1] encountered alluvial water at approximately 4.5 ft below the surface. The saturated zone at the time was approximately 3.5 ft thick. This alluvial water is thought to be a source for DP Spring. This spring flows from the south-facing slope of DP Canyon, approximately 3,000 ft downstream to the east from SWMU 21-011(k). The shallow alluvial water on site can discharge into the ephemeral stream at the canyon bottom. Contaminants are available to be taken up by terrestrial plants with roots in contact with the alluvial water. Terrestrial wildlife receptors can contact this alluvial water when it surfaces into the ephemeral stream at the bottom of DP Canyon. There are no seeps or springs up canyon from the SWMU.

<u>Question E:</u>

Is infiltration/percolation from contaminated subsurface material a viable transport and exposure pathway?

- **Suspected ability of contaminants to migrate to groundwater.**
- **The potential for contaminants to migrate via groundwater and discharge into habitats and/or surface waters.**
- **Contaminants may be taken up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (~1 m depth).**
- **Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.**

Answer (likely/unlikely/uncertain): Likely

Provide explanation: Plutonium-239/240, strontium-90, tritium, uranium-234, and uranium -235 are present in SWMU 21-011(k) soil. Plutonium-239/240, strontium-90, and uranium-234 have been observed in alluvial groundwater from LAUZ-1 and LAUZ-2 to DP Spring. Tritium and uranium-235 were detected in the alluvial groundwater from LAUZ-1 and LAUZ-2 (LANL 1999, 63915).

<u>Question F:</u>

Might erosion or mass wasting events be a potential release mechanism for contaminants from subsurface materials or perched aquifers to the surface?

- **This question is only applicable to release sites located on or near the mesa edge.**
- **Consider the erodability of surficial material and the geologic processes of canyon/mesa edges.**

Answer (likely/unlikely/uncertain): Likely

Provide explanation: While the slope is well vegetated, there is evidence of erosion. Mass wasting is not considered a potential release mechanism because the slope appears stable and vegetated.

Question G:

Could airborne contaminants interact with receptors through respiration of vapors?

- **Contaminants must be present as volatiles in the air.**
- **Consider the importance of inhalation of vapors for burrowing animals.**
- **Foliar uptake of organic vapors is typically not a significant exposure pathway.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 0

Terrestrial Animals: 0

Provide explanation: No volatile organics are expected to be present.

Question H:

Could airborne contaminants interact with plants through deposition of particulates or with animals through inhalation of fugitive dust?

- **Contaminants must be present as particulates in the air or as dust for this exposure pathway to be complete.**
- **Exposure via inhalation of fugitive dust is particularly applicable to ground-dwelling species that would be exposed to dust disturbed by their foraging or burrowing activities or by wind movement.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 0

Terrestrial Animals: 2

Provide explanation: Although there is contamination on the surface, the ground is well covered with pine needles and litter from the established vegetation. However, there is evidence of burrowing animals.

Question I:

Could contaminants interact with plants through root uptake or rain splash from surficial soils?

- **Contaminants in bulk soil may partition into soil solution, making them available to roots.**
- **Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces by rain striking contaminated soils (i.e., rain splash).**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 3

Provide explanation: This is a complete pathway. The shallow nature of the contamination makes it available to roots. However, due to the ground cover rain splash is not a complete pathway.

<u>**Question J:**</u>

Could contaminants interact with receptors through food web transport from surficial soils?

- **The chemicals may bioaccumulate in animals.**
- **Animals may ingest contaminated food items.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 3

Provide explanation: The COPEC strontium-90, which is structurally similar to calcium, is incorporated into the body as bones and teeth. Isotopic uranium is a bioaccumulator. DDT and mercury were detected sporadically and at low concentrations.

<u>**Question K:**</u>

Could contaminants interact with receptors via incidental ingestion of surficial soils?

- **Incidental ingestion of contaminated soil could occur while animals grub for food resident in the soil, feed on plant matter covered with contaminated soil or while grooming themselves clean of soil.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 3

Provide explanation: This could be a major pathway because of the surficial nature of the contamination.

<u>**Question L:**</u>

Could contaminants interact with receptors through dermal contact with surficial soils?

- **Significant exposure via dermal contact would generally be limited to organic contaminants that are lipophilic and can cross epidermal barriers.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 1

Provide explanation: Most suspected COPCs are not lipophilic. No organic chemicals were detected. However, the dermal pathway is a possible complete pathway for some receptors.

Question M:

Could contaminants interact with plants or animals through external irradiation?

- **External irradiation effects are most relevant for gamma emitting radionuclides.**
- **Burial of contamination attenuates radiological exposure.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 3

Terrestrial Animals: 3

Provide explanation: Cesium 137, a gamma emitter, is a COPEC at this SWMU and the contamination is surficial.

Stream Channel

Question N:

Could contaminants interact with plants through direct uptake from water and sediment or sediment rain splash?

- **Contaminants may be taken-up by terrestrial plants whose roots are in contact with surface waters.**
- **Terrestrial plants may be exposed to particulates deposited on leaf and stem surfaces by rain striking contaminated sediments (i.e., rain splash) in an area that is only periodically inundated with water.**
- **Contaminants in sediment may partition into soil solution, making them available to roots.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 2

Provide explanation: The contamination is surficial in nature and the alluvial ground water is close to the surface. Therefore, roots could directly uptake contaminants from alluvial ground water or sediment. Rain splash is, however, a very minor consideration because of the ground cover and plant litter on the ground surface.

Question O:

Could contaminants interact with receptors through food web transport from water and sediment?

- **The chemicals may bioconcentrate in food items.**
- **Animals may ingest contaminated food items.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 2

Provide explanation: PCBs are not present at the site. DDT was detected sporadically, in the low part per billion levels, and the concentrations were qualified as estimated. Mercury was detected once, slightly above background. However, terrestrial animals could ingest the strontium-90 (that is preferentially taken up by plants), and isotopic uranium (a bioaccumulator).

Question P:

Could contaminants interact with receptors via ingestion of water and suspended sediments?

- **If sediments are present in an area that is only periodically inundated with water, terrestrial receptors may incidentally ingest sediments.**
- **Terrestrial receptors may ingest water-borne contaminants if contaminated surface waters are used as a drinking water source.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 2

Provide explanation: Although there are no aquatic systems present on the site or in the canyon below the SWMU, there is evidence that the contaminants have moved down horizontally slope and, once in the stream bed, down stream from the SWMU. This movement is due to water transporting contaminants either in a soluble form or on particulates. Terrestrial animals could have access to this water for drinking, if only for the period of rainwater or snow melt flow.

Question Q:

Could contaminants interact with receptors through dermal contact with water and sediment?

- **If sediments are present in an area that is only periodically inundated with water, terrestrial species may be dermally exposed during dry periods.**
- **Terrestrial organisms may be dermally exposed to water-borne contaminants as a result of wading or swimming in contaminated waters.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Animals: 1

Provide explanation: Although there are no aquatic systems present on the site or in the canyon reach below the SWMU, there is evidence that the contaminants have moved horizontally down slope and, once in the stream bed, down stream from the SWMU. This movement is due to water transporting contaminants either in a soluble form or on particulates. Terrestrial animals could have access to this water for drinking and wading, if only for the period of rainwater or snow melt flow. During times of dryness, the terrestrial species may be dermally exposed to contaminants in the dry gully and stream bed.

<u>Question R:</u>

Could contaminants interact with plants or animals through external irradiation?

- **External irradiation effects are most relevant for gamma emitting radionuclides.**
- **Burial of contamination attenuates radiological exposure.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Terrestrial Plants: 2

Terrestrial Animals: 2

Provide explanation: Cesium 137 is a COPEC at this SWMU and the contamination is surficial.

<u>Question S:</u>

Could contaminants bioconcentrate in free floating aquatic, attached aquatic plants, or emergent vegetation?

- **Aquatic plants are in direct contact with water.**
- **Contaminants in sediment may partition into pore water, making them available to submerged roots.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Plants/Emergent Vegetation: 0

Provide explanation: There are no aquatic systems present on site or in the canyon below the SWMU.

<u>Question T:</u>

Could contaminants bioconcentrate in sedimentary or water column organisms?

- **Aquatic receptors may actively or incidentally ingest sediment while foraging.**
- **Aquatic receptors may be directly exposed to contaminated sediments or may be exposed to contaminants through osmotic exchange, respiration, or ventilation of sediment pore waters.**
- **Aquatic receptors may be exposed through osmotic exchange, respiration, or ventilation of surface waters.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Animals: 0

Provide explanation: There are no aquatic systems present on site or in the canyon below the SWMU.

<u>Question U:</u>

Could contaminants bioaccumulate in sedimentary or water column organisms?

- **Lipophilic organic contaminants and some metals may concentrate in an organism's tissues**
- **Ingestion of contaminated food items may result in contaminant bioaccumulation through the food web.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Animals: 0

Provide explanation: There are no aquatic systems present on site or in the canyon below the SWMU.

Question V:

Could contaminants interact with aquatic plants or animals through external irradiation?

- **External irradiation effects are most relevant for gamma emitting radionuclides.**
- **The water column acts to absorb radiation, thus external irradiation is typically more important for sediment dwelling organisms.**

Provide quantification of exposure pathway (0=no pathway, 1=unlikely pathway, 2=minor pathway, 3=major pathway):

Aquatic Plants: 0

Aquatic Animals: 0

Provide explanation: There are no aquatic systems present on site or in the canyon below the SWMU.

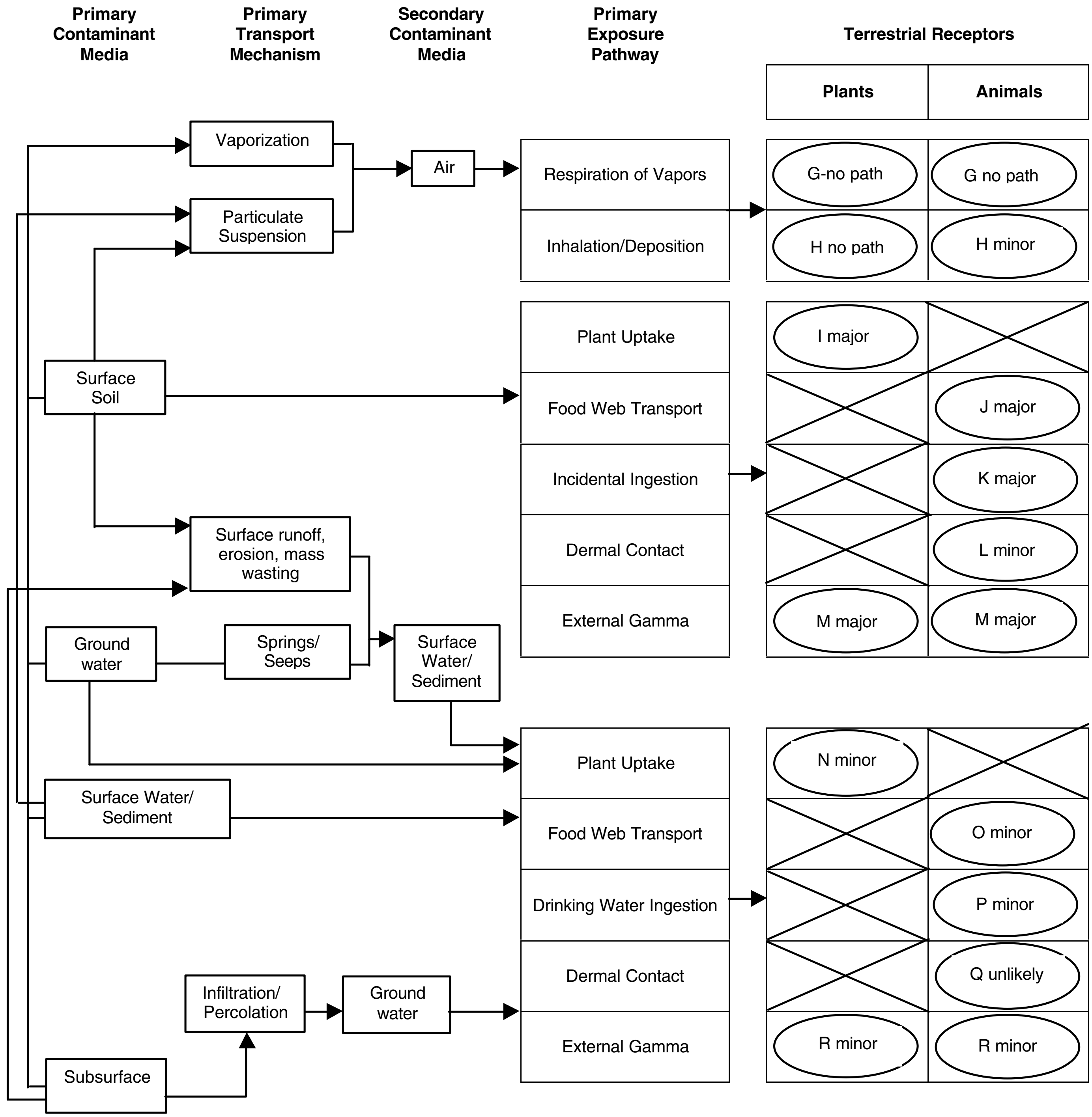
REFERENCES

Koch, S., July 15, 1999. "Memorandum to Greg McDermott: Review of Potential Release Sites for Threatened and Endangered Species Habitat for the Purpose of Ecological Screening/Risk Assessment," Los Alamos National Laboratory Memorandum ESH-20/Ecol-98-0732, Los Alamos, New Mexico. (Koch 1999, 63599)

LANL, August 26, 1999. Evaluation of Sediment and Alluvial Groundwater in DP Canyon, Reaches DP-1, DP-2, DP-3, and DP-4. LA-UR-99-4238. (LANL 1999, 63915)

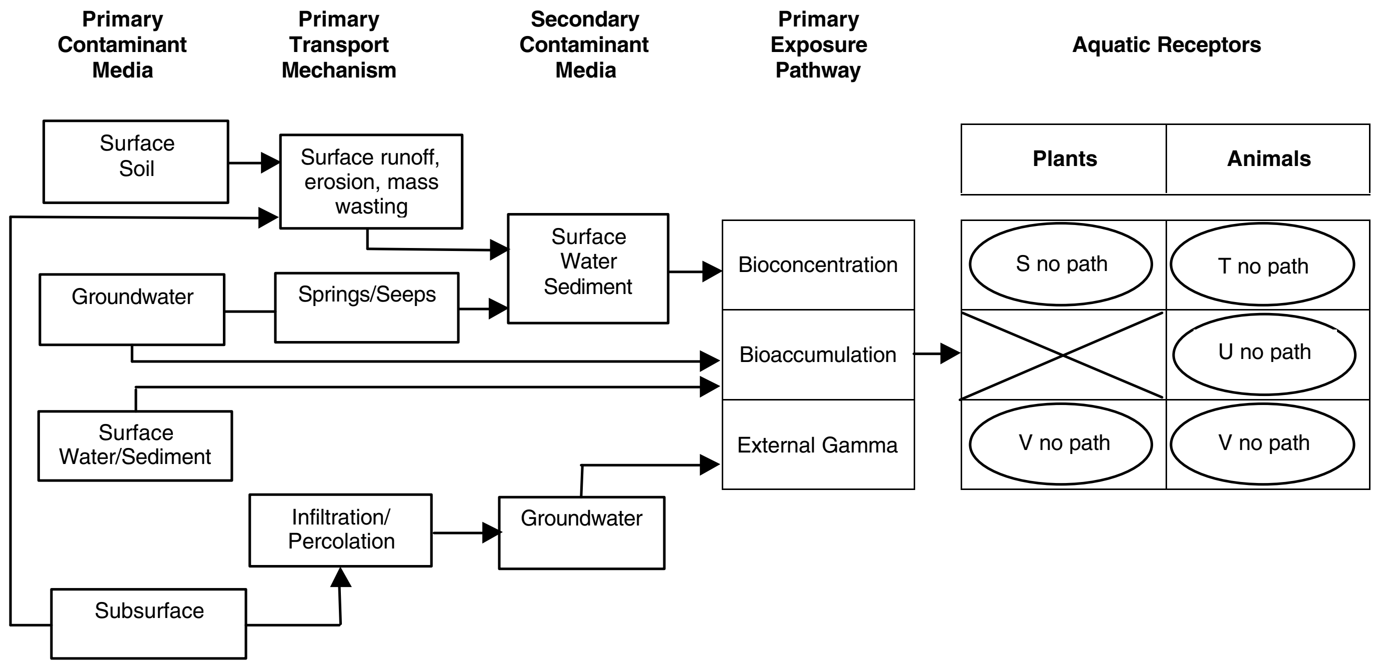
NOTE:
Letters in circles refer to questions on the Scoping Checklist

Ecological Scoping Checklist
Terrestrial Receptors
Ecological Pathways Conceptual Exposure Model



NOTE:
Letters in circles refer to questions on the Scoping Checklist

Ecological Scoping Checklist
Aquatic Receptors
Ecological Pathways Conceptual Exposure Model



Signatures and certifications:

Checklist completed by (provide name, organization and phone number):

Name (printed): ____________________

Name (signature): ____________________

Organization: ____________________

Phone number: ____________________

Date Completed: __/__/____

Verification by a member of ER Project Ecological Risk Task Team (provide name, organization and phone number):

Name (printed): ____________________

Name (signature): ____________________

Organization: ____________________

Phone number: ____________________

Appendix E

Estimated Costs

APPENDIX E ESTIMATED COSTS

ESTIMATED COST

Estimated Cost

Based on current resource estimates, all waste generated during this VCA is expected to be disposed of at TA-54 as LLW at a cost of approximately $1.2 million for waste disposal only. However, final disposal options will be re-evaluated during the VCA implementation planning process. With anticipated subcontractor costs and analytical costs the total estimated cost of this VCA is approximately $2.2 million.

Schedule

The field work portion of this VCA is expected to begin in mid-FY01 and take approximately three months to complete. The fieldwork includes soil and tuff removal, confirmatory sample collection and analysis, waste management, and site restoration.

Appendix F

Data Analysis

APPENDIX F DATA ANALYSIS

F1. Data Analysis

Fixed Laboratory Data Used to Establish Correlations

This section provides correlations among fixed laboratory data that were used to determine target cesium-137 and americium-241 concentrations for soil, sediment and tuff removal under this VCM. Removal to these levels, as estimated by field measurements, makes it likely that the residual contamination levels will not exceed the target level, as defined in Appendix F-2 of this VCM Plan or the hot spot criteria given in DOE Order 5400.5, Chapter 4 (4)(a)(1). The data included in this analysis include results of verification samples that were collected after the 1996 Interim Action and during the 2001 waste characterization sampling. The pooled 1996 verification and 2001 surface characterization data are provided in Table F1-1. This pooled dataset was used to establish correlations among fixed laboratory results since the isotopic ratios are not dependent walkover survey count rate. Zero values in Table F1-1 represent non-detects. For samples where there is no entry in the table for a given analyte, the result is not available.

All rank correlations and linear regressions were performed using a commercially available Excel spreadsheet add-in, Analyse-It 1.62, which is distributed by Analyse It Software, Ltd.

The correlations and forecast errors provided in this section are not used in a quantitative way in this VCM Plan, but their values were taken into consideration in arriving at the proposed target cesium-137 and americium-241 concentrations,[1] as estimated by field measurements, that would be removed.

Cesium-137 and Strontium-90 Correlation

The correlation between cesium-137 and strontium-90 was characterized by both rank and parametric methods in order to be able to estimate strontium-90 concentrations from cesium-137 measurements.

The combined cesium-137 and strontium-90 dataset exhibits a strong rank correlation, with a Spearman rank correlation statistic of 0.94. This means that the cesium-137 and strontium-90 concentrations exhibit a strong tendency to go up and down together.

A linear regression was performed with the full dataset, with cesium-137 chosen as the independent variable and strontium-90 the dependent variable based on the 32 post IA and characterization samples collected in 1996 and 2001. This provided the line for obtaining the best estimate of strontium-90 concentration from cesium-137 data:

Term	Coefficient	SE	p
Intercept	-1.3330	5.3886	0.8063
Slope	0.3027	0.0198	<0.0001

---

[1] Cs-137 target: 150 pCi/g.

Table F1-1
Pooled 1996 Verification and 2001 Waste Characterization Data for 21-011(k)

Sample ID	Strontium-90 pCi/g	Plutonium-238 pCi/g	Plutonium-239 pCi/g	Americium-241 pCi/g	Cesium-137 pCi/g	Total Plutonium pCi/g
21-01-0021	1.7	0.034	0.122	0	1.43	0.156
21-01-0022	0	0	0.094	0	1.67	0.094
21-01-0025	7.1	0.293	1.93	2.2	40.5	2.223
21-01-0027	2.56	0.31	0.37	0	8.7	0.68
21-01-0029	0	0.048	0.036	0	1.03	0.084
21-01-0030	0.9	0.074	0.111	0	2.6	0.185
21-01-0033	26.1	0.63	13.2	13.7	150	13.83
21-01-0034	1.02	0.21	1.01	6.9	3.78	1.22
21-01-0036	3.75	0.122	1.18	0	29	1.302
21-01-0037	0.51	0	0.118	0	1.52	0.118
21-01-0039	30.8	0.74	11.3	7.9	109	12.04
21-01-0041	132	1.64	20.5	19	445	22.14
MD21-01-0025	7.1	0.293	1.93	2.2	40.5	2.223
MD21-01-0036	3.75	0.122	1.18	0	29	1.302
MD21-01-0039	30.8	0.74	11.3	7.9	109	12.04
MD21-01-0040	10.5	0.22	3.07	5.1	59.5	3.29
MD21-01-0044	103	0.8	32.6	14.9	246	33.4
MD21-01-0045	83	0.95	51.2	22.3	343	52.15
MD21-01-0069	268	1.02	59.2	32.5	690	60.22
0121-96-0301	0	0	0	0.307	0	0
0121-96-0302	0	0	0	25.3	15.7	0
0121-96-0303	0	0	0	0.93	9.39	0
0121-96-0801	74		20.088	10.6	351	20.088
0121-96-0802	240		45.959	32.3	621	45.959
0121-96-0804	33.8		8.73	10.5	85.3	8.73
0121-96-0805	1.4	0.0969	0.79054	0.281	7.05	0.88744
0121-96-0806	7.1	0.2365	1.8333	2.06	19.7	2.0698
0121-96-0808	219		50.95	20.2	877	50.95
0121-96-0809	24.9	0.964	6.2252	2.9	327	7.1892
0121-96-0810	60	4.8694	23.7568	14.3	222	28.6262
0121-96-0807	63		75.153	601	66.5	75.153
0121-96-0803	30.7	7.0991	25.1351	125	72.1	32.2342

The cesium-137 : strontium-90 linear regression report is provided in Exhibit F1.A. The coefficient of determination statistic, R^2, for this linear fit was 0.89. The value of the intercept (-1.333) was small compared to the SSRG for strontium-90 provided in section F2 of this report, 8,288 pCi/g. In addition the intercept has a large p-value in comparison to the slope. Both of these factors indicate that the intercept is not important to describing the relationship between cesium-137 and strontium-90 concentrations so it can be ignored.

The standard error on this fit was 25 pCi/g strontium-90. The maximum value of the forecast error over the range of the regression was 29.1 pCi/g.[2] The two-sided 95% upper confidence limit to be used for forecasting is approximately:

60 pCi/g strontium-90 + 0.3027 * cesium-137 pCi/g.

To illustrate with an example:

- the best estimate of the strontium-90 concentration in a soil is 3 pCi/g if the concentration of cesium-137 concentration is 10 pCi/g (3 = 0.3027 * 10)
- the concentration of strontium-90 in a soil sample is not likely to exceed 63 pCi/g if the concentration of cesium-137 is 10 pCi/g (63 = 60 + (0.3027 * 10).

Cesium-137 and Americium-241 Correlation

This section provides the basis for estimating americium-241 concentrations from cesium-137 concentrations. There are two distinct patterns of americium-241 to cesium-137 ratios on-site. A high ratio is associated with the western drainage on the western boundary of the site. There is not enough data to establish a reliable correlation of americium-241 to cesium-137 activity in the western drainage.

A lower ratio is typical of the remainder of the site. The following correlation does not apply to the western drainage. Of the 32 post IA and characterization surface samples, 29 do not appear to be associated with the western drainage.

The correlation between cesium-137 and americium-241 for the 29 surface samples was characterized by both rank and parametric methods. The cesium-137 and americium-241 dataset exhibits a rank correlation, with a Spearman rank correlation statistic of 0.88 which is a measure of the tendency of cesium-137 and americum-241 concentrations to go up and down together.

A linear regression was performed for 29 samples that did not appear to be associated with the western drainage. These 29 samples were a subset of the 32 post IA samples collected in 1996 and 2001. This provided a line for obtaining the best estimate of americium-241 concentration from cesium-137 data:

Term	Coefficient	SE	p
Intercept	1.9746	1.1365	0.0937
Slope	0.0355	0.0040	<0.0001

[2] The forecast error is SE * (1 + 1/n + ((XF – Average of X)^2/ (Σ(Xi – Average of X)^2))^2)^0.5. SE is the standard error of the regression and XF is the cesium-137 concentration from which a strontium-90 value will be forecast (Salvatore, 1982).

The cesium-137 and americium-241 linear regression report is provided in Exhibit F1.B. This exhibit also depicts the data graphically.

The coefficient of determination statistic, R^2, for this linear fit was 0.75. The value of the intercept (1.97) is small compared to the SSRG for americium-241 provided in section F2 of this report, 427 pCi/g. In addition the intercept has a large p-value in comparison to the slope. Both of the factors indicate that the intercept is not important to describing the relationship between cesium-137 and americium-241 concentrations, and it can be ignored when making estimates of americium-241 concentration based on cesium-137 concentration data.

The standard error on this fit was 5.0 pCi/g americium-241, and the maximum value of the forecast error was 5.79 pCi/g americium-241. The two-sided 95% upper confidence limit to be used for forecasting is approximately:

12 pCi/g americium-241 + 0.0355 * cesium-137 pCi/g.

To illustrate with an example:

- the best estimate of the americium-241 concentration in a soil is 3.6 pCi/g if the concentration of cesium-137 concentration is 100 pCi/g (3.6 = 0.0355 * 100)
- the concentration of americium-241 in a soil sample is not likely to exceed 15.6 pCi/g if the concentration of cesium-137 is 100 pCi/g (15.6 = 12 + (0.0355*100).

Cesium-137 and Total Plutonium Correlation

Plutonium cannot be detected by gamma measurements at the concentrations present at the site. This section provides a suitable alternative means of estimating plutonium concentrations from cesium-137 data.

There are two distinct patterns of total plutonium to cesium-137 ratios on-site. A high ratio is associated with the western drainage. There is not enough data to establish a reliable correlation of total plutonium to cesium-137 activity in the western drainage.

A lower ratio is typical of the remainder of the site. The following discussion does not apply to the western drainage.

The correlation between cesium-137 and total plutonium was characterized by both rank and parametric methods. The 3 sample locations judged to be effected by the western drainage were excluded from the evaluation. This left 29 surface samples that had been collected since the 1996 IA.

The cesium-137 and total plutonium data exhibits a Spearman rank correlation statistic of 0.95, which means that their concentrations exhibit a strong tendency to go up and down together.

A linear regression of was performed for 29 data points that did not appear to be associated with the western drainage, with cesium-137 chosen as the independent variable and total plutonium the dependent variable. This provided the line for obtaining the best estimate of total plutonium concentration from cesium-137 concentration data:

Term	Coefficient	SE	p
Intercept	1.4997	1.8813	0.4323
Slope	0.0703	0.0066	<0.0001

The cesium-137 and total plutonium linear regression report is provided in Exhibit F1.C. These exhibits also depict the data graphically.

The coefficient of determination statistic, R^2, for this linear fit was 0.81. The value of the intercept (1.4997) is small compared to the SSRG for plutonium-239 provided in section F2 of this report, 447 pCi/g. In addition the intercept has a large p-value in comparison to the slope. Both of the factors indicate that the intercept is not important to describing the relationship between cesium-137 and total plutonium concentrations, and it can be ignored.

The standard error on this fit was 8.2 pCi/g total plutonium. The maximum value of the forecast error over the range of the regression was 9.6 pCi/g. The two-sided 95% upper confidence limit to be used for forecasting is approximately:

20 pCi/g total plutonium + 0.0703 * cesium-137 pCi/g.

To illustrate with an example:

- the best estimate of the total plutonium concentration in a soil is 7 pCi/g if the concentration of cesium-137 concentration is 100 pCi/g (7 = 0.0703 * 100)
- the concentration of plutonium in a soil sample is not likely to exceed 27 pCi/g if the concentration of cesium-137 is 100 pCi/g (27 = 20 + (0.0703*100).

Estimating Soil Cesium-137 Concentrations From 2001 Gross Gamma Survey Data

This section provides a means of estimating cesium-137 concentrations from the 2001 gross gamma survey. This survey has also been referred to as an in situ gamma survey since it was performed using a SAM-935 multichannel analyzer.

Portions of the site deviate from ideal conditions for soil concentration estimation from count rate data. In particular, portions of the site present a seriously folded or buckled geometry instead of the idealized planar geometry. This is a probable contributor to the “noise” that is present in correlations between gross gamma count rate and cesium-137 concentration. It is expected that removal of areas of elevated activity will reduce this uncertainty.

During 2001, the following data (Table F1-2) was collected to correlate the gross gamma count rate for the SAM 935 multi-channel analyzer system to cesium-137 soil concentrations.

Table F1-2
Data Used to Correlate Gross Gamma to Cesium-137 Using the SAM 935 Analyzer

KCPM*	Cesium-137 (pCi/gm)	KCPM*	Cesium-137 (pCi/gm)
31.254	3.87	110.772	115.5
38.058	6.33	207.9	214.51
74.364	30.68	231.	175.4
84.588	6.62	264.	193.54
91.968	13.28	355.	448.73
95.97	29.6		

* KCPM = kilo counts per minute

The data point having the highest count rate was rejected because of concern that system dead time may have biased the result and because it corresponds to a higher count rate than is necessary for field use. A linear regression was performed for the remaining 10 data points given in this section. Count rate (KCPM) was chosen as the independent variable and cesium-137 the dependent variable.

Term	Coefficient	SE	p
Intercept	-41.9352	19.9759	0.0690
Slope	0.9815	0.1372	<0.0001

The intercept was retained in the fit because its absolute value was judged to be significant in comparison to the SSRG value, 294 pCi/g, which is derived for cesium-137 in Appendix F.2 of this document.

The coefficient of determination statistic, R^2, for this linear fit was 0.86. The standard error on this fit was 33.7 pCi/g cesium-137. The largest value of the forecast error over the range of the distribution was 40 pCi/g.

The line recommended for the best estimate of the cesium-137 concentration from count rate is:

0.9815 * KCPM -41.9 pCi/g cesium-137.

The one-sided 95% upper confidence limit to be used for forecasting cesium-137 concentration from gross gamma count rate is approximately:

(91 - 41.9) pCi/g cesium-137 + 0.9815 * KCPM, or

49 pCi/g cesium-137 + 0.9815 * KCPM. The cesium-137 vs. count rate linear regression data is provided in Exhibit F1.D.

The larger than expected magnitude of intercept suggests that gross gamma field measurements are of more use in finding areas of elevated activity than they are for estimating soil concentrations.

Best Estimates of Contaminant Concentrations Based on 2001 Walkover Gross Gamma Measurements

Best estimates of the radionuclides co-located with cesium-137 are derived from gross gamma count rate (CR) data as follows:

Concentration A =

[{(pCi/g cesium-137 / KCPM)* CR} – 41.9 pCi/g] * Slope A/cesium-137

This is illustrated using strontium-90 as a specific example:

Concentration strontium-90 =

[{(0.9815 pCi/g / KCPM) * CR} – 41.9 pCi/g] * 0.3027 pCi Sr90/pCi cesium-137.

At a count rate of 100 KCPM the best estimate of strontium-90 is 17.03 pCi/g.

Concentration americium-241=

[{(0.9815 pCi/g / KCPM) * CR – 41.9 pCi/g] * 0.0355 pCi americium-241/pCi cesium-137.

Concentration total plutonium (TPU)=

[{(0.9815 pCi/g / KCPM) * CR – 41.9 pCi/g] * 0.0703 pCi TPU/pCi cesium-137.

Table F1- 3 summarizes the gross gamma count rates obtained with the SAM 935 multi-channel analyzer system and the corresponding best estimate radionuclide concentrations. It is anticipated that gross gamma count rates will be somewhat different if a different, gross gamma measurement system is used. The columns of Table F1-3 that are concerned with americium-241 and total plutonium do not apply to the western drainage on the west end of SWMU 21-011(k).

Correlation of American Radiation Services (ARS) Cesium-137 Results with 662 KeV Region of Interest Count Rate Data in Marinelli Geometry.

During 2001, data was collected to establish a correlation between count rate in the 662 KeV region of interest in Marinelli geometry and cesium-137 concentration. A good correlation of the two was obtained, Figure F1-1.

It is anticipated that the background and detector efficiency will be somewhat different if a different, but similar, system is used. In addition, the detection efficiency will be affected if a 500-ml wide mouth Nalgene jar is used as the source geometry. Use of the Marinelli geometry is not recommended because it presents a poor geometry for americium-241 screening with a single channel analyzer/PG-2.

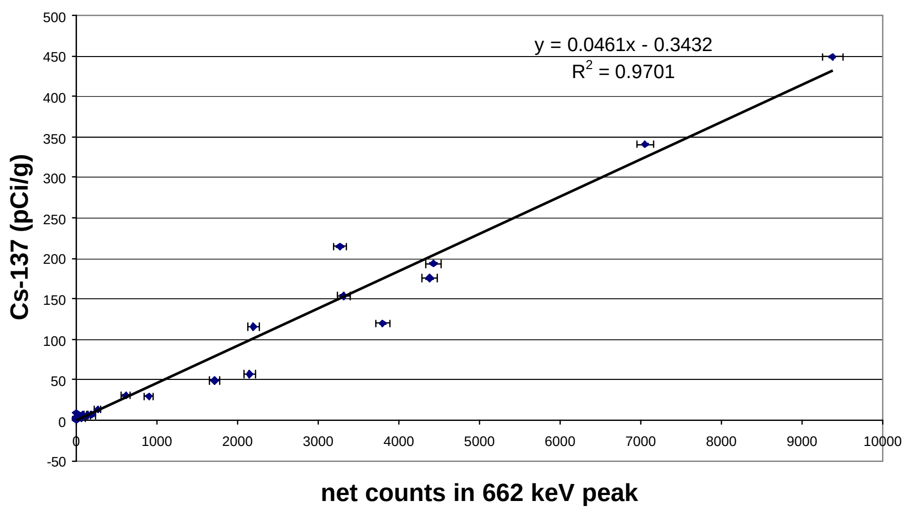


Figure F1-1. Correlation between net counts in 662 KeV region of interest and cesium-137 concentration

Estimated Volumes of Soil to be Removed

This section explains how the soil volumes to be removed were estimated.

It was assumed that the removal volume of contaminated soil located in the western drainage is based on the removal of americium-241. Fort his analysis, the soil volume is assumed to be 100 yd^3.

The following discussion is presented in terms of gross gamma count rate with the SAM 935 multi-channel analyzer with a 2x2-inch sodium iodide scintillation detector. The system to be used during removal could be more or less sensitive. A correlation will be performed between these count rates and the count rates on the system actually used during the removal. The count rates given in this section would be adjusted accordingly.

Removal of soil from other parts of the site would be based on cesium-137 concentration. The cesium-137 concentration would be based on gross gamma count rates using a SAM 935 multi-channel analyzer (or equivalent) or a ratemeter/scaler with a 2x2 inch sodium iodide scintillation detector.

The aerial extent of soil removal was based on count rate data obtained during the 2001 in situ gross gamma walkover survey. ArcView GIS software was used to estimate the aerial extent for the following count rates: 100 KCPM (nominal 56. pCi/g cesium-137), 125 KCPM (nominal 81 pCi/g cesium-137), 150 KCPM (nominal 105. pCi/g cesium-137), 175 KCPM (nominal 130 pCi/g cesium-137), 200 KCPM (nominal 154 pCi/g cesium-137), 225 KCPM (nominal 179 pCi/g cesium-137) and 250 KCPM (nominal 203 pCi/g cesium-137). Aerial extent estimates are provided in Figure F1-2.

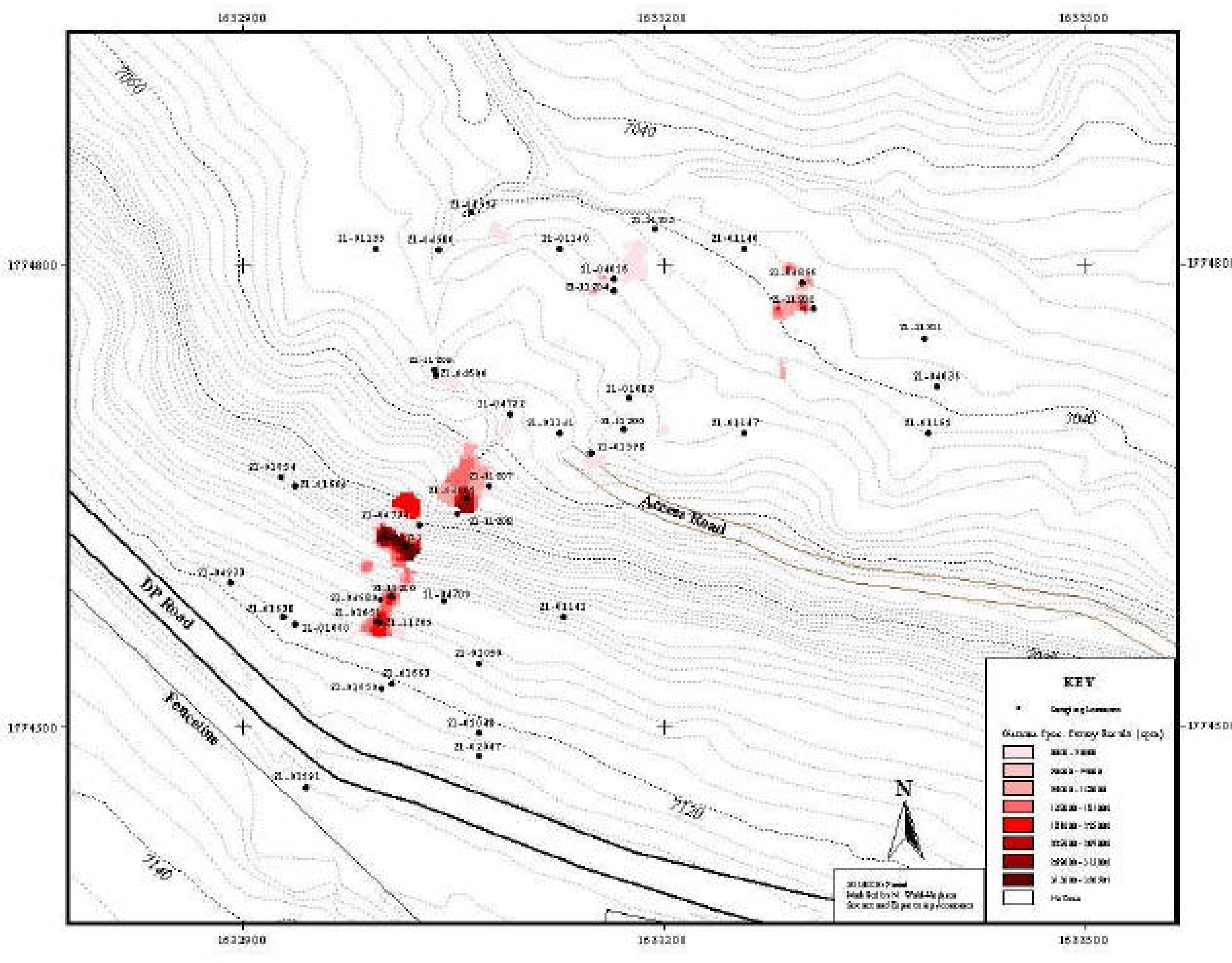


Figure F1-2. SAM 935 Gross Gamma Count rates at 21-011(k)

The distribution with depth was also characterized during 2001. This data is presented in Figure F1-3. It is assumed for estimation purposes that removal from areas of elevated contamination occurs to a depth of 24 inches. This would be sufficient to reduce concentrations by a factor of 4 on average based on the exponential constant presented in Figure F1-3.

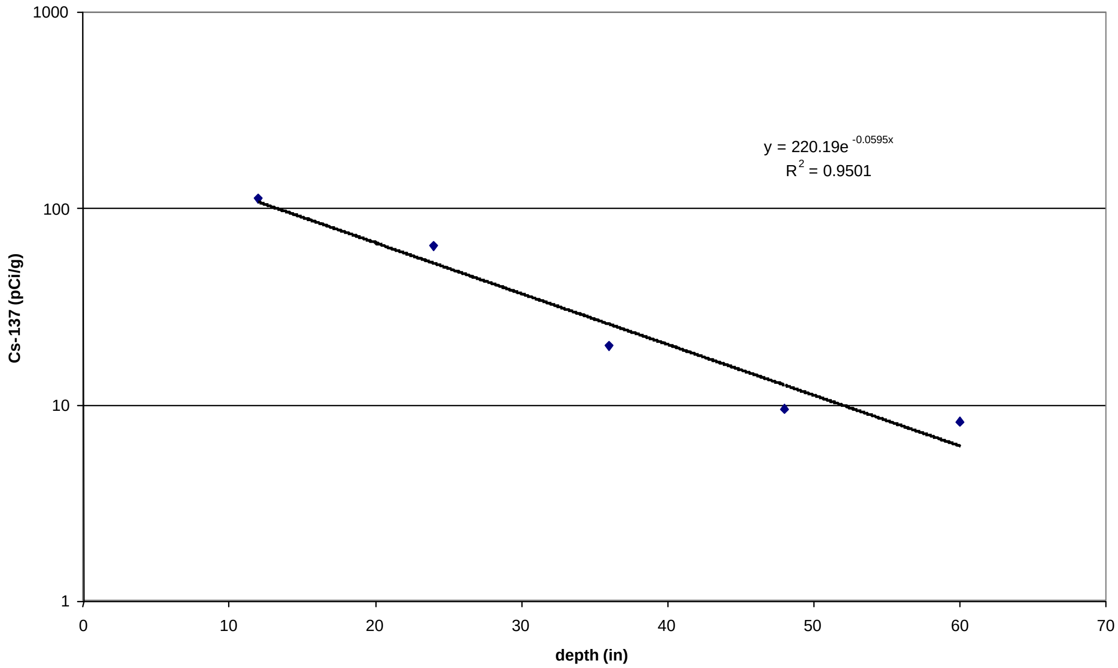


Figure F1-3. Correlation of cesium-137 concentration with depth

The estimated volumes of soil that would be removed for various count rates are depicted in Figure F1-4.

It is proposed that surface soils be removed from areas having cesium-137 soil concentrations in excess of 150 pCi/g, as estimated from screening results, (200 KCPM per the 2001 gross gamma survey). Removal of these areas is consistent with DOE's 5400.5 "As Low as Reasonably Achievable" policy since:

- some of these elevated activity areas would already meet the DOE hot spot criteria if it was rigorously applied, even if a cover were absent, and
- placement of restoration backfill and cover materials over contaminated further reduces dose.

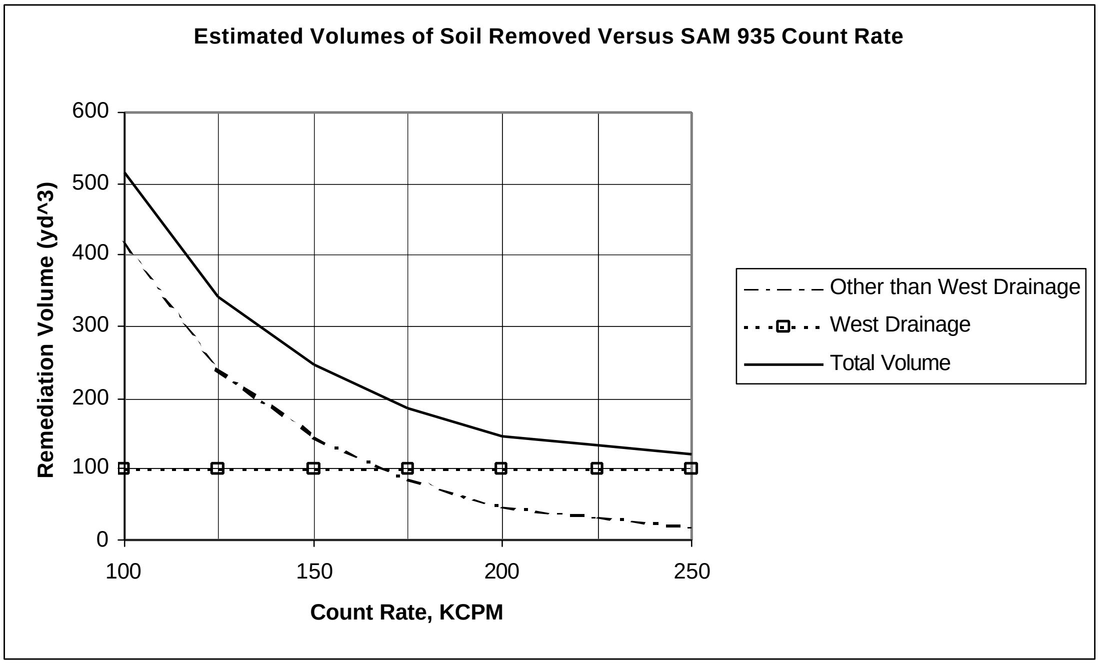


Figure F1-4. Soil Volume estimates.

Table F1-3
Relationship Among of SAM-935 Gross Gamma Count Rate and Best Estimates of Radionuclide Concentrations

Count rate, KCPM	Cesium-137, Best Estimate, pCi/g	Strontium-90, Best Estimate, pCi/g	Americium-241 Best Estimate, pCi/g	Total Plutonium Best Estimate, pCi/g
50	7.2	2.2	0.3	0.5
60	17.0	5.1	0.6	1.2
70	26.8	8.1	1.0	1.9
80	36.6	11.1	1.3	2.6
90	46.4	14.1	1.6	3.3
100	56.3	17.0	2.0	4.0
110	66.1	20.0	2.3	4.6
120	75.9	23.0	2.7	5.3
130	85.7	25.9	3.0	6.0
140	95.5	28.9	3.4	6.7
150	105.3	31.9	3.7	7.4
160	115.1	34.9	4.1	8.1
170	125.0	37.8	4.4	8.8
180	134.8	40.8	4.8	9.5
190	144.6	43.8	5.1	10.2
200	154.4	46.7	5.5	10.9
210	164.2	49.7	5.8	11.5
220	174.0	52.7	6.2	12.2
230	183.8	55.6	6.5	12.9
240	193.7	58.6	6.9	13.6

analysed with: Analyse-it + General 1.62

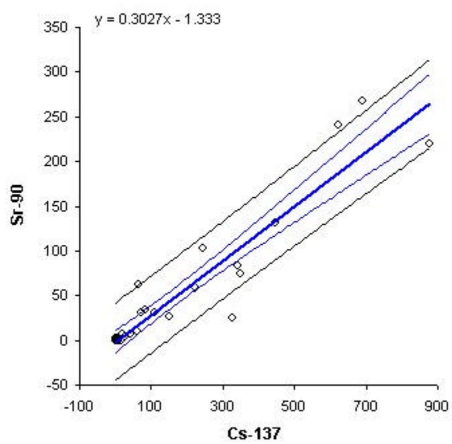
Test	**Linear regression** 2001 Data TA21-011(k) Sr-90 v Cs-137		
Performed by	Rick Haaker	Date	19 March 2002

n	32

R^2	0.89
Adjusted R^2	0.88
SE	24.9661

Term	Coefficient	SE	p	90% CI of Coefficient
Intercept	-1.3330	5.3886	0.8063	-10.4788 to 7.8129
Slope	0.3027	0.0198	<0.0001	0.2691 to 0.3364

Source of variation	SSq	DF	MSq	F	p
Due to regression	145033.310	1	145033.310	232.68	<0.0001
About regression	18699.210	30	623.307		
Total	163732.520	31			



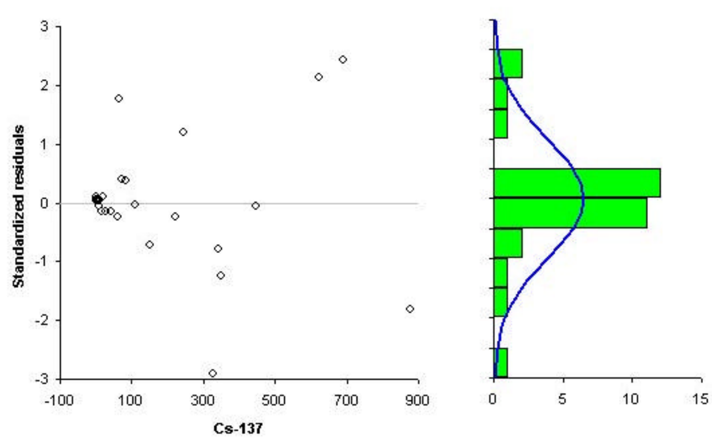


Exhibit F1.A: Correlation of Strontium-90 to Cesium-137 Data

analysed with: Analyse-it + General 1.62

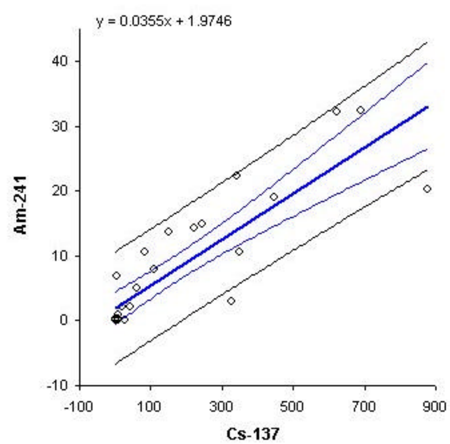
Test	Linear regression 2001 Data TA21-011(k) Am-241 v Cs-137		
Performed by	Rick Haaker	Date	20 March 2002

n	29

R^2	0.75
Adjusted R^2	0.74
SE	4.9626

Term	Coefficient	SE	p	90% CI of Coefficient
Intercept	1.9746	1.1365	0.0937	0.0388 to 3.9104
Slope	0.0355	0.0040	<0.0001	0.0287 to 0.0423

Source of variation	SSq	DF	MSq	F	p
Due to regression	1951.575	1	1951.575	79.24	<0.0001
About regression	664.944	27	24.628		
Total	2616.519	28			



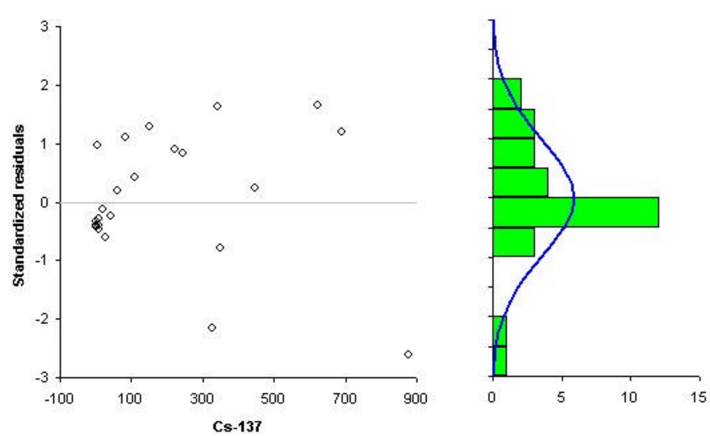


Exhibit F1.B: Correlation of Americium-241 to Cesium-137 Data

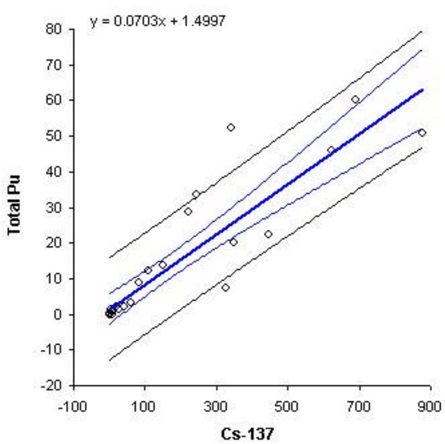
analysed with: Analyse-it + General 1.62

Test	**Linear regression** 2001 Data TA21-011(k) Total Pu v Cs-137
Performed by	Rick Haaker
Date	20 March 2002

n	29
R^2	0.81
Adjusted R^2	0.80
SE	8.2147

Term	Coefficient	SE	p	90% CI of Coefficient
Intercept	1.4997	1.8813	0.4323	-1.7046 to 4.7041
Slope	0.0703	0.0066	<0.0001	0.0591 to 0.0816

Source of variation	SSq	DF	MSq	F	p
Due to regression	7637.817	1	7637.817	113.19	<0.0001
About regression	1821.975	27	67.481		
Total	9459.791	28			



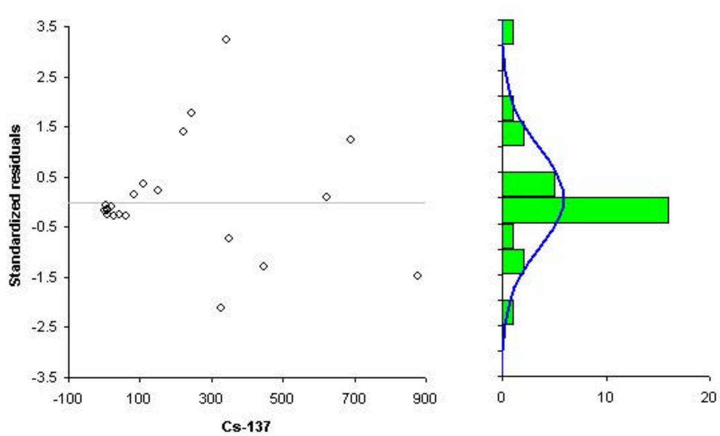


Exhibit F1.C: Correlation of Total Plutonium to Cesium-137 Data

analysed with: Analyse-it + General 1.62

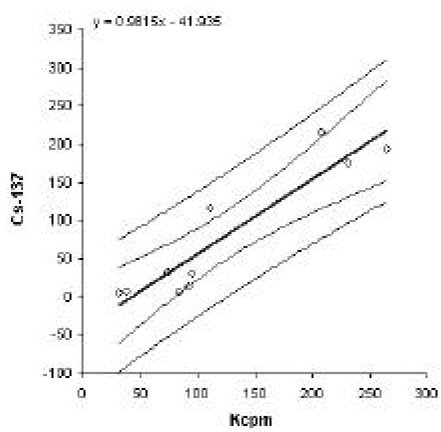
Test	**Linear regression** Data from Table 10, FSR report Cs-137 v Kcpm		
Performed by	Rick Haaker	Date	13 February 2002

n	10

R^2	0.86
Adjusted R^2	0.85
SE	33.7299

Term	Coefficient	SE	p	95% CI of Coefficient
Intercept	-41.9352	19.9759	0.0690	-87.9998 to 4.1294
Slope	0.9815	0.1372	<0.0001	0.6652 to 1.2978

Source of variation	SSq	DF	MSq	F	p
Due to regression	58264.479	1	58264.479	51.21	<0.0001
About regression	9101.669	8	1137.709		
Total	67366.149	9			



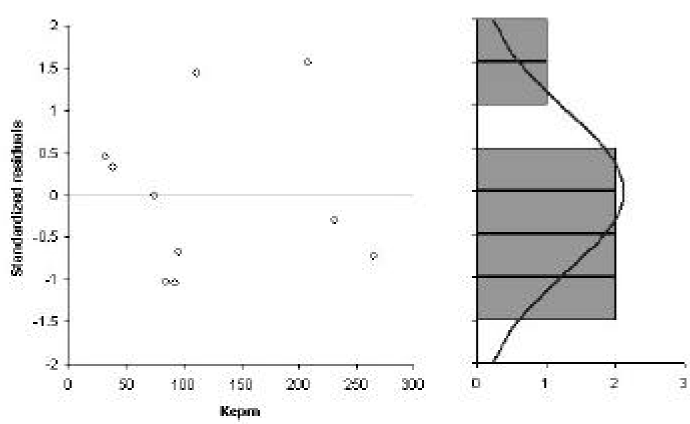


Exhibit F1.D: Correlation of Cesium-137 to SAM 935 Count Rate Data

F.2 RESRAD INPUTS, RESULTS, SINGLE RADIONUCLIDE SOIL GUIDELINES

RESRAD 6.1 was used to calculate dose estimates from a recreational trail user (Yu et al., 2001).

Recreational Trail User Scenario

The recreational trail user scenario represents an individual who regularly walks on the site. The person visits the site 140 times per year and stays for a period of one-hour per visit; this corresponds to a value for the *fraction of time spent outdoors (onsite)* parameter (FOTD) 0.016.[3]

The soil ingestion rate while on-site is assumed to be 67 mg/h; [4] this corresponds to ingestion of 9,392 mg/y of on-site soil per year.[5] The RESRAD *soil ingestion rate* parameter (SOIL) was set to 587 g/y to obtain this desired soil ingestion rate.

Table F2-1
Parameters for Derivation of Single Radionuclide Soil Guidelines (SSRG) Under the Recreational Trail User Scenario Without Cover

Parameter	Value Used	Explanation
Pathways Active	External Gamma Inhalation (w/o radon) Soil Ingestion	These are the active pathways for the pathway described
Area of contaminated zone (AREA)	10,000 m^2	This is a conservative estimate of the area affected at SWMU 21-011(k).
Thickness of contaminated zone (THICKO)	2 m	(LANL 2001)
Fraction of time spent outdoors (onsite) (FOTD)	0.016 y/y	ESH-20 recommended value that corresponds to hiking on-site for 140 hours per year.
Soil ingestion rate (SOIL)	587 g/y	ESH-20 recommended value that corresponds to 67 mg/h while on-site.
Inhalation rate (INHAL)	14,000 m^3/y	ESH-20 recommended value that corresponds to 1.6 m^3/h while onsite.
Mass loading for inhalation (INHALR)	2.0 E-5 g/m^3	(LANL 2001)
Density of contaminated zone (DENSCZ)	1.5 g/cm^3	ESH-20 recommended value. RESRAD default.
Humidity in Air (HUMID)	5.55 g/m^3	(LANL 2001)
Annual average wind speed (WIND)	3 m/s	(LANL 2001)
Evapotranspiration coefficient (EVAPTR)	0.999 unitless	(LANL 2001)
Precipitation (PRECIP)	0.35 m/y	(LANL 2001)
Irrigation (RI)	0.0 m/y	(LANL 2001)
Basic radiation dose limit (BRDL)	15 mrem/y	(LANL 2001)

---

[3] FOTD = 0.016 = 140 h/y / (24 h/d * 365 d/y)

[4] mg/h onsite = SOIL * 1000 mg/g / (365 d/y * 24 h/d) = 587 * 1000 / (365 * 24) = 67

[5] mg/y onsite = SOIL * 1000 mg/g * FOTD = 587 * 1000 * 0.016 = 9392

Recreational Trail User Single Soil Radionuclide Guidelines

The SSRG for a given radionuclide represents the site average soil concentration that corresponds to the dose criterion, which is 15 mrem/y. The SSRGs for SWMU 21-011(k) listed in Table F2-2 were calculated using RESRAD 6.1 based on the parameters listed in Table F2-1.

Table F2-2
SSRGs Derived Under the Recreational Trail User Scenario

Radionuclide	SSRG (pCi/g)
Americium-241	427
Cesium-137	294
Plutonium-238	496
Plutonium-239	447
Strontium-90	8,288

Since there is a mixture of radionuclides present at the site, the SSRGs do not apply independently. To account for the mixture of radionuclides at the site and uncertainty inherent in the estimates, a decision was made to reduce the SSRG for cesium-137 to a target level of 150 pCi/gm. This target level meets the goal for cesium-137 as well as the other radionuclide COPCs because of the collocation within the SWMU.

Figure F2-1 is a dose versus time plot produced by RESRAD 6.1 for the recreational trail user without a cover. This figure illustrates several important points regarding SWMU 21-011(k). The present day dose to a hypothetical recreational trail user is less than one-half the typical dose criterion of 15 mrem/y. The present day dose rate is mostly due to short-lived radioactive materials (cesium-137), and the dose rate will decline to less-than 2 mrem/y within 200 years. The proposed corrective measure removes local areas of elevated contamination and converts the highest activity material into a form that resists migration for a time period that allows the concentrations of short-lived cesium-137 and strontium-90 to decay to insignificant levels. Figure F2-2 is a dose versus time plot for the recreational trail user with a cover.

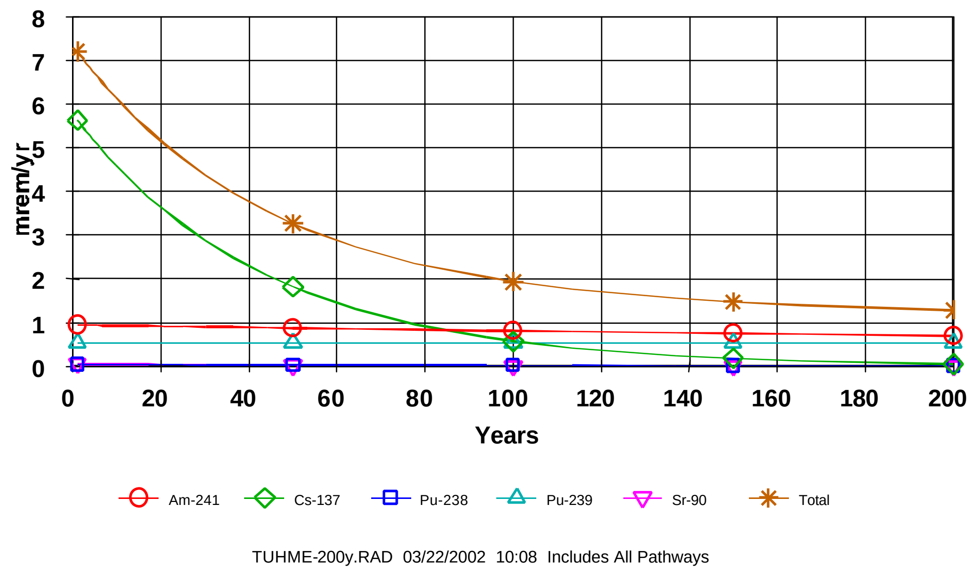


Figure F2-1. RESRAD 6.1 plot of dose versus time for the recreational trail user scenario without cover.

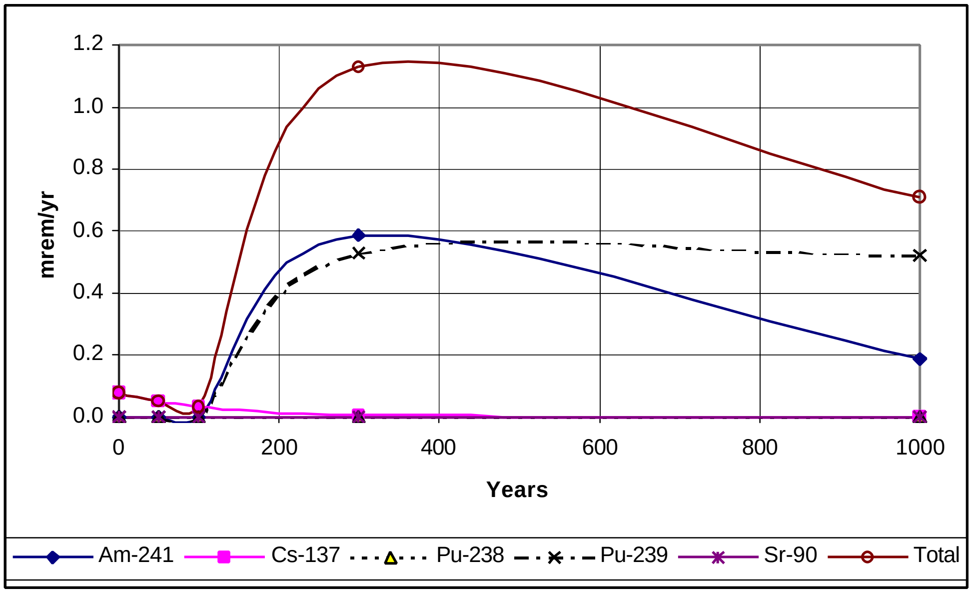


Figure F2-2. RESRAD 6.1 plot of dose versus time for the recreational trail user scenario with a 0.3 m soil cover.

Comparison of the RESRAD simulations in Figures F2-1 and F2-2 shows that the addition of 0.3 m of cover would reduce the maximum dose to a recreational trail user from 7.3 mrem/y to 1.1 mrem/year based on present day average concentrations. The cover over the disposal cell will be much thicker than 0.3 m, so the percent dose reduction would be even greater for that part of the site.

REFERENCES

Yu, C, A.J. Zielen, J.J. Cheng, D. J. LePoire, E. Gnanapragasam, S, Kamboj, J. Arnish, A. Wallo III, W. A. Williams, and H Peterson, 2001. User's Manual for RESRAD Version 6, ANL/EAD-4, Argonne National Laboratories, Argonne, IL. (Yu et.al 2001, 71420)

Salvatore, D, 1982. *Theory and Problems in Statistics and Econometrics*, Schaum's Outline Series, McGraw-Hill Book Company, New York, NY. (Salvatore 1982, 72707)

LANL, 2001. "Derivation and Use of Radionuclide Screening Action Levels," Los Alamos National Laboratory report LA-UR-01-990, Los Alamos, New Mexico. (LANL 2001, 69683.1)

Exhibit F2.1. RESRAD Summary Report for the Recreational Trail User Scenario Without Cover.

1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 1
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Table of Contents
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
Part I: Mixture Sums and Single Radionuclide Guidelines
ÍÍ

1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 2
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Mortality
0 ³ ³ Current ³ ³ Parameter
Menu ³ Parameter ³ Value ³ Default ³ Name
ÄÄÄÄÄÅÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄ
B-1 ³ Dose conversion factors for inhalation, mrem/pCi: ³ ³ ³
B-1 ³ Ac-227+D ³ 6.720E+00 ³ 6.720E+00 ³ DCF2(1)
B-1 ³ Am-241 ³ 4.440E-01 ³ 4.440E-01 ³ DCF2(2)
B-1 ³ Cs-137+D ³ 3.190E-05 ³ 3.190E-05 ³ DCF2(3)
B-1 ³ H-3 ³ 6.400E-08 ³ 6.400E-08 ³ DCF2(4)
B-1 ³ Np-237+D ³ 5.400E-01 ³ 5.400E-01 ³ DCF2(5)
B-1 ³ Pa-231 ³ 1.280E+00 ³ 1.280E+00 ³ DCF2(6)
B-1 ³ Pb-210+D ³ 2.320E-02 ³ 2.320E-02 ³ DCF2(7)
B-1 ³ Pu-238 ³ 3.920E-01 ³ 3.920E-01 ³ DCF2(8)
B-1 ³ Pu-239 ³ 4.290E-01 ³ 4.290E-01 ³ DCF2(9)
B-1 ³ Ra-226+D ³ 8.600E-03 ³ 8.600E-03 ³ DCF2(10)
B-1 ³ Sr-90+D ³ 1.310E-03 ³ 1.310E-03 ³ DCF2(11)
B-1 ³ Th-229+D ³ 2.160E+00 ³ 2.160E+00 ³ DCF2(12)
B-1 ³ Th-230 ³ 3.260E-01 ³ 3.260E-01 ³ DCF2(13)
B-1 ³ U-233 ³ 1.350E-01 ³ 1.350E-01 ³ DCF2(14)
B-1 ³ U-234 ³ 1.320E-01 ³ 1.320E-01 ³ DCF2(15)

B-1 ³ U-235+D ³ 1.230E-01 ³ 1.230E-01 ³ DCF2(16)
B-1 ³ U-238+D ³ 1.180E-01 ³ 1.180E-01 ³ DCF2(17)
³ ³ ³ ³
D-1 ³ Dose conversion factors for ingestion, mrem/pCi: ³ ³ ³
D-1 ³ Ac-227+D ³ 1.480E-02 ³ 1.480E-02 ³ DCF3(1)
D-1 ³ Am-241 ³ 3.640E-03 ³ 3.640E-03 ³ DCF3(2)
D-1 ³ Cs-137+D ³ 5.000E-05 ³ 5.000E-05 ³ DCF3(3)
D-1 ³ H-3 ³ 6.400E-08 ³ 6.400E-08 ³ DCF3(4)
D-1 ³ Np-237+D ³ 4.440E-03 ³ 4.440E-03 ³ DCF3(5)
D-1 ³ Pa-231 ³ 1.060E-02 ³ 1.060E-02 ³ DCF3(6)
D-1 ³ Pb-210+D ³ 7.270E-03 ³ 7.270E-03 ³ DCF3(7)
D-1 ³ Pu-238 ³ 3.200E-03 ³ 3.200E-03 ³ DCF3(8)
D-1 ³ Pu-239 ³ 3.540E-03 ³ 3.540E-03 ³ DCF3(9)
D-1 ³ Ra-226+D ³ 1.330E-03 ³ 1.330E-03 ³ DCF3(10)
D-1 ³ Sr-90+D ³ 1.530E-04 ³ 1.530E-04 ³ DCF3(11)
D-1 ³ Th-229+D ³ 4.030E-03 ³ 4.030E-03 ³ DCF3(12)
D-1 ³ Th-230 ³ 5.480E-04 ³ 5.480E-04 ³ DCF3(13)
D-1 ³ U-233 ³ 2.890E-04 ³ 2.890E-04 ³ DCF3(14)
D-1 ³ U-234 ³ 2.830E-04 ³ 2.830E-04 ³ DCF3(15)
D-1 ³ U-235+D ³ 2.670E-04 ³ 2.670E-04 ³ DCF3(16)
D-1 ³ U-238+D ³ 2.690E-04 ³ 2.690E-04 ³ DCF3(17)
³ ³ ³ ³
D-34 ³ Food transfer factors: ³ ³ ³
D-34 ³ Ac-227+D , plant/soil concentration ratio, dimensionless ³ 2.500E-03 ³ 2.500E-03 ³ RTF(1,1)
D-34 ³ Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 2.000E-05 ³ 2.000E-05 ³ RTF(1,2)
D-34 ³ Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 2.000E-05 ³ 2.000E-05 ³ RTF(1,3)
D-34 ³ ³ ³ ³
D-34 ³ Am-241 , plant/soil concentration ratio, dimensionless ³ 1.000E-03 ³ 1.000E-03 ³ RTF(2,1)
D-34 ³ Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 5.000E-05 ³ 5.000E-05 ³ RTF(2,2)
D-34 ³ Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 2.000E-06 ³ 2.000E-06 ³ RTF(2,3)
D-34 ³ ³ ³ ³
D-34 ³ Cs-137+D , plant/soil concentration ratio, dimensionless ³ 4.000E-02 ³ 4.000E-02 ³ RTF(3,1)
D-34 ³ Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 3.000E-02 ³ 3.000E-02 ³ RTF(3,2)
D-34 ³ Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 8.000E-03 ³ 8.000E-03 ³ RTF(3,3)
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 3
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality
0 ³ ³ Current ³ ³ Parameter
Menu ³ Parameter ³ Value ³ Default ³ Name
ÄÄÄÄÄÅÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄ
D-34 ³ H-3 , plant/soil concentration ratio, dimensionless ³ 4.800E+00 ³ 4.800E+00 ³ RTF(4,1)
D-34 ³ H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.200E-02 ³ 1.200E-02 ³ RTF(4,2)
D-34 ³ H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 1.000E-02 ³ 1.000E-02 ³ RTF(4,3)
D-34 ³ ³ ³ ³
D-34 ³ Np-237+D , plant/soil concentration ratio, dimensionless ³ 2.000E-02 ³ 2.000E-02 ³ RTF(5,1)
D-34 ³ Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.000E-03 ³ 1.000E-03 ³ RTF(5,2)

D-34 ³ Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 5.000E-06 ³ 5.000E-06 ³ RTF(5,3)
D-34 ³ ³ ³ ³
D-34 ³ Pa-231 , plant/soil concentration ratio, dimensionless ³ 1.000E-02 ³ 1.000E-02 ³ RTF(6,1)
D-34 ³ Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 5.000E-03 ³ 5.000E-03 ³ RTF(6,2)
D-34 ³ Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 5.000E-06 ³ 5.000E-06 ³ RTF(6,3)
D-34 ³ ³ ³ ³
D-34 ³ Pb-210+D , plant/soil concentration ratio, dimensionless ³ 1.000E-02 ³ 1.000E-02 ³ RTF(7,1)
D-34 ³ Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 8.000E-04 ³ 8.000E-04 ³ RTF(7,2)
D-34 ³ Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 3.000E-04 ³ 3.000E-04 ³ RTF(7,3)
D-34 ³ ³ ³ ³
D-34 ³ Pu-238 , plant/soil concentration ratio, dimensionless ³ 1.000E-03 ³ 1.000E-03 ³ RTF(8,1)
D-34 ³ Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.000E-04 ³ 1.000E-04 ³ RTF(8,2)
D-34 ³ Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 1.000E-06 ³ 1.000E-06 ³ RTF(8,3)
D-34 ³ ³ ³ ³
D-34 ³ Pu-239 , plant/soil concentration ratio, dimensionless ³ 1.000E-03 ³ 1.000E-03 ³ RTF(9,1)
D-34 ³ Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.000E-04 ³ 1.000E-04 ³ RTF(9,2)
D-34 ³ Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 1.000E-06 ³ 1.000E-06 ³ RTF(9,3)
D-34 ³ ³ ³ ³
D-34 ³ Ra-226+D , plant/soil concentration ratio, dimensionless ³ 4.000E-02 ³ 4.000E-02 ³ RTF(10,1)
D-34 ³ Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.000E-03 ³ 1.000E-03 ³ RTF(10,2)
D-34 ³ Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 1.000E-03 ³ 1.000E-03 ³ RTF(10,3)
D-34 ³ ³ ³ ³
D-34 ³ Sr-90+D , plant/soil concentration ratio, dimensionless ³ 3.000E-01 ³ 3.000E-01 ³ RTF(11,1)
D-34 ³ Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 8.000E-03 ³ 8.000E-03 ³ RTF(11,2)
D-34 ³ Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 2.000E-03 ³ 2.000E-03 ³ RTF(11,3)
D-34 ³ ³ ³ ³
D-34 ³ Th-229+D , plant/soil concentration ratio, dimensionless ³ 1.000E-03 ³ 1.000E-03 ³ RTF(12,1)
D-34 ³ Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.000E-04 ³ 1.000E-04 ³ RTF(12,2)
D-34 ³ Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 5.000E-06 ³ 5.000E-06 ³ RTF(12,3)
D-34 ³ ³ ³ ³
D-34 ³ Th-230 , plant/soil concentration ratio, dimensionless ³ 1.000E-03 ³ 1.000E-03 ³ RTF(13,1)
D-34 ³ Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.000E-04 ³ 1.000E-04 ³ RTF(13,2)
D-34 ³ Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 5.000E-06 ³ 5.000E-06 ³ RTF(13,3)
D-34 ³ ³ ³ ³
D-34 ³ U-233 , plant/soil concentration ratio, dimensionless ³ 2.500E-03 ³ 2.500E-03 ³ RTF(14,1)
D-34 ³ U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 3.400E-04 ³ 3.400E-04 ³ RTF(14,2)
D-34 ³ U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 6.000E-04 ³ 6.000E-04 ³ RTF(14,3)
D-34 ³ ³ ³ ³
D-34 ³ U-234 , plant/soil concentration ratio, dimensionless ³ 2.500E-03 ³ 2.500E-03 ³ RTF(15,1)
D-34 ³ U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 3.400E-04 ³ 3.400E-04 ³ RTF(15,2)
D-34 ³ U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 6.000E-04 ³ 6.000E-04 ³ RTF(15,3)
D-34 ³ ³ ³ ³
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 4
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality

0 ³ ³ Current ³ ³ Parameter
Menu ³ Parameter ³ Value ³ Default ³ Name
ÄÄÄÄÄÅÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄ
D-34 ³ U-235+D , plant/soil concentration ratio, dimensionless ³ 2.500E-03 ³ 2.500E-03 ³ RTF(16,1)
D-34 ³ U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 3.400E-04 ³ 3.400E-04 ³ RTF(16,2)
D-34 ³ U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 6.000E-04 ³ 6.000E-04 ³ RTF(16,3)
D-34 ³ ³ ³ ³
D-34 ³ U-238+D , plant/soil concentration ratio, dimensionless ³ 2.500E-03 ³ 2.500E-03 ³ RTF(17,1)
D-34 ³ U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 3.400E-04 ³ 3.400E-04 ³ RTF(17,2)
D-34 ³ U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 6.000E-04 ³ 6.000E-04 ³ RTF(17,3)
³ ³ ³ ³
D-5 ³ Bioaccumulation factors, fresh water, L/kg: ³ ³ ³
D-5 ³ Ac-227+D , fish ³ 1.500E+01 ³ 1.500E+01 ³ BIOFAC(1,1)
D-5 ³ Ac-227+D , crustacea and mollusks ³ 1.000E+03 ³ 1.000E+03 ³ BIOFAC(1,2)
D-5 ³ ³ ³ ³
D-5 ³ Am-241 , fish ³ 3.000E+01 ³ 3.000E+01 ³ BIOFAC(2,1)
D-5 ³ Am-241 , crustacea and mollusks ³ 1.000E+03 ³ 1.000E+03 ³ BIOFAC(2,2)
D-5 ³ ³ ³ ³
D-5 ³ Cs-137+D , fish ³ 2.000E+03 ³ 2.000E+03 ³ BIOFAC(3,1)
D-5 ³ Cs-137+D , crustacea and mollusks ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(3,2)
D-5 ³ ³ ³ ³
D-5 ³ H-3 , fish ³ 1.000E+00 ³ 1.000E+00 ³ BIOFAC(4,1)
D-5 ³ H-3 , crustacea and mollusks ³ 1.000E+00 ³ 1.000E+00 ³ BIOFAC(4,2)
D-5 ³ ³ ³ ³
D-5 ³ Np-237+D , fish ³ 3.000E+01 ³ 3.000E+01 ³ BIOFAC(5,1)
D-5 ³ Np-237+D , crustacea and mollusks ³ 4.000E+02 ³ 4.000E+02 ³ BIOFAC(5,2)
D-5 ³ ³ ³ ³
D-5 ³ Pa-231 , fish ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(6,1)
D-5 ³ Pa-231 , crustacea and mollusks ³ 1.100E+02 ³ 1.100E+02 ³ BIOFAC(6,2)
D-5 ³ ³ ³ ³
D-5 ³ Pb-210+D , fish ³ 3.000E+02 ³ 3.000E+02 ³ BIOFAC(7,1)
D-5 ³ Pb-210+D , crustacea and mollusks ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(7,2)
D-5 ³ ³ ³ ³
D-5 ³ Pu-238 , fish ³ 3.000E+01 ³ 3.000E+01 ³ BIOFAC(8,1)
D-5 ³ Pu-238 , crustacea and mollusks ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(8,2)
D-5 ³ ³ ³ ³
D-5 ³ Pu-239 , fish ³ 3.000E+01 ³ 3.000E+01 ³ BIOFAC(9,1)
D-5 ³ Pu-239 , crustacea and mollusks ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(9,2)
D-5 ³ ³ ³ ³
D-5 ³ Ra-226+D , fish ³ 5.000E+01 ³ 5.000E+01 ³ BIOFAC(10,1)
D-5 ³ Ra-226+D , crustacea and mollusks ³ 2.500E+02 ³ 2.500E+02 ³ BIOFAC(10,2)
D-5 ³ ³ ³ ³
D-5 ³ Sr-90+D , fish ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(11,1)
D-5 ³ Sr-90+D , crustacea and mollusks ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(11,2)
D-5 ³ ³ ³ ³
D-5 ³ Th-229+D , fish ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(12,1)
D-5 ³ Th-229+D , crustacea and mollusks ³ 5.000E+02 ³ 5.000E+02 ³ BIOFAC(12,2)
D-5 ³ ³ ³ ³
D-5 ³ Th-230 , fish ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(13,1)

D-5 ³ Th-230 , crustacea and mollusks ³ 5.000E+02 ³ 5.000E+02 ³ BIOFAC(13,2)
D-5 ³ ³ ³ ³
D-5 ³ U-233 , fish ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(14,1)
D-5 ³ U-233 , crustacea and mollusks ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(14,2)
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 5
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality
0 ³ ³ Current ³ ³ Parameter
Menu ³ Parameter ³ Value ³ Default ³ Name
ÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
D-5 ³ U-234 , fish ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(15,1)
D-5 ³ U-234 , crustacea and mollusks ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(15,2)
D-5 ³ ³ ³ ³
D-5 ³ U-235+D , fish ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(16,1)
D-5 ³ U-235+D , crustacea and mollusks ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(16,2)
D-5 ³ ³ ³ ³
D-5 ³ U-238+D , fish ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(17,1)
D-5 ³ U-238+D , crustacea and mollusks ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(17,2)
ÍÍÍÍÏÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 6
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Site-Specific Parameter Summary
0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter
Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name
ÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄ
R011 ³ Area of contaminated zone (m**2) ³ 1.000E+04 ³ 1.000E+04 ³ --- ³ AREA
R011 ³ Thickness of contaminated zone (m) ³ 2.000E+00 ³ 2.000E+00 ³ --- ³ THICK0
R011 ³ Length parallel to aquifer flow (m) ³ not used ³ 1.000E+02 ³ --- ³ LCZPAQ
R011 ³ Basic radiation dose limit (mrem/yr) ³ 1.500E+01 ³ 2.500E+01 ³ --- ³ BRDL
R011 ³ Time since placement of material (yr) ³ 0.000E+00 ³ 0.000E+00 ³ --- ³ TI
R011 ³ Times for calculations (yr) ³ 1.000E+00 ³ 1.000E+00 ³ --- ³ T(2)
R011 ³ Times for calculations (yr) ³ 5.000E+01 ³ 3.000E+00 ³ --- ³ T(3)
R011 ³ Times for calculations (yr) ³ 1.000E+02 ³ 1.000E+01 ³ --- ³ T(4)
R011 ³ Times for calculations (yr) ³ 1.500E+02 ³ 3.000E+01 ³ --- ³ T(5)
R011 ³ Times for calculations (yr) ³ 2.000E+02 ³ 1.000E+02 ³ --- ³ T(6)
R011 ³ Times for calculations (yr) ³ not used ³ 3.000E+02 ³ --- ³ T(7)
R011 ³ Times for calculations (yr) ³ not used ³ 1.000E+03 ³ --- ³ T(8)
R011 ³ Times for calculations (yr) ³ not used ³ 0.000E+00 ³ --- ³ T(9)
R011 ³ Times for calculations (yr) ³ not used ³ 0.000E+00 ³ --- ³ T(10)
³ ³ ³ ³ ³
R012 ³ Initial principal radionuclide (pCi/g): Am-241 ³ 2.700E+01 ³ 0.000E+00 ³ --- ³ S1(2)
R012 ³ Initial principal radionuclide (pCi/g): Cs-137 ³ 1.130E+02 ³ 0.000E+00 ³ --- ³ S1(3)
R012 ³ Initial principal radionuclide (pCi/g): Pu-238 ³ 1.000E+00 ³ 0.000E+00 ³ --- ³ S1(8)
R012 ³ Initial principal radionuclide (pCi/g): Pu-239 ³ 1.600E+01 ³ 0.000E+00 ³ --- ³ S1(9)

R012 ³ Initial principal radionuclide (pCi/g): Sr-90 ³ 3.300E+01 ³ 0.000E+00 ³ --- ³ S1(11)
R012 ³ Concentration in groundwater (pCi/L): Am-241 ³ not used ³ 0.000E+00 ³ --- ³ W1(2)
R012 ³ Concentration in groundwater (pCi/L): Cs-137 ³ not used ³ 0.000E+00 ³ --- ³ W1(3)
R012 ³ Concentration in groundwater (pCi/L): Pu-238 ³ not used ³ 0.000E+00 ³ --- ³ W1(8)
R012 ³ Concentration in groundwater (pCi/L): Pu-239 ³ not used ³ 0.000E+00 ³ --- ³ W1(9)
R012 ³ Concentration in groundwater (pCi/L): Sr-90 ³ not used ³ 0.000E+00 ³ --- ³ W1(11)
³ ³ ³ ³ ³
R013 ³ Cover depth (m) ³ 0.000E+00 ³ 0.000E+00 ³ --- ³ COVER0
R013 ³ Density of cover material (g/cm**3) ³ not used ³ 1.500E+00 ³ --- ³ DENSCV
R013 ³ Cover depth erosion rate (m/yr) ³ not used ³ 1.000E-03 ³ --- ³ VCV
R013 ³ Density of contaminated zone (g/cm**3) ³ 1.500E+00 ³ 1.500E+00 ³ --- ³ DENSCZ
R013 ³ Contaminated zone erosion rate (m/yr) ³ 1.000E-03 ³ 1.000E-03 ³ --- ³ VCZ
R013 ³ Contaminated zone total porosity ³ 4.000E-01 ³ 4.000E-01 ³ --- ³ TPCZ
R013 ³ Contaminated zone field capacity ³ 2.000E-01 ³ 2.000E-01 ³ --- ³ FCCZ
R013 ³ Contaminated zone hydraulic conductivity (m/yr) ³ 1.000E+01 ³ 1.000E+01 ³ --- ³ HCCZ
R013 ³ Contaminated zone b parameter ³ 5.300E+00 ³ 5.300E+00 ³ --- ³ BCZ
R013 ³ Average annual wind speed (m/sec) ³ 3.000E+00 ³ 2.000E+00 ³ --- ³ WIND
R013 ³ Humidity in air (g/m**3) ³ 5.500E+00 ³ 8.000E+00 ³ --- ³ HUMID
R013 ³ Evapotranspiration coefficient ³ 9.990E-01 ³ 5.000E-01 ³ --- ³ EVAPTR
R013 ³ Precipitation (m/yr) ³ 3.500E-01 ³ 1.000E+00 ³ --- ³ PRECIP
R013 ³ Irrigation (m/yr) ³ 0.000E+00 ³ 2.000E-01 ³ --- ³ RI
R013 ³ Irrigation mode ³ overhead ³ overhead ³ --- ³ IDITCH
R013 ³ Runoff coefficient ³ 2.000E-01 ³ 2.000E-01 ³ --- ³ RUNOFF
R013 ³ Watershed area for nearby stream or pond (m**2) ³ not used ³ 1.000E+06 ³ --- ³ WAREA
R013 ³ Accuracy for water/soil computations ³ not used ³ 1.000E-03 ³ --- ³ EPS
³ ³ ³ ³ ³
R014 ³ Density of saturated zone (g/cm**3) ³ not used ³ 1.500E+00 ³ --- ³ DENSAQ
R014 ³ Saturated zone total porosity ³ not used ³ 4.000E-01 ³ --- ³ TPSZ
R014 ³ Saturated zone effective porosity ³ not used ³ 2.000E-01 ³ --- ³ EPSZ
R014 ³ Saturated zone field capacity ³ not used ³ 2.000E-01 ³ --- ³ FCSZ
R014 ³ Saturated zone hydraulic conductivity (m/yr) ³ not used ³ 1.000E+02 ³ --- ³ HCSZ
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 7
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Site-Specific Parameter Summary (continued)
0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter
Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄ
R014 ³ Saturated zone hydraulic gradient ³ not used ³ 2.000E-02 ³ --- ³ HGWT
R014 ³ Saturated zone b parameter ³ not used ³ 5.300E+00 ³ --- ³ BSZ
R014 ³ Water table drop rate (m/yr) ³ not used ³ 1.000E-03 ³ --- ³ VWT
R014 ³ Well pump intake depth (m below water table) ³ not used ³ 1.000E+01 ³ --- ³ DWIBWT
R014 ³ Model: Nondispersion (ND) or Mass-Balance (MB) ³ not used ³ ND ³ --- ³ MODEL
R014 ³ Well pumping rate (m**3/yr) ³ not used ³ 2.500E+02 ³ --- ³ UW
³ ³ ³ ³ ³
R015 ³ Number of unsaturated zone strata ³ not used ³ 1 ³ --- ³ NS
R015 ³ Unsat. zone 1, thickness (m) ³ not used ³ 4.000E+00 ³ --- ³ H(1)
R015 ³ Unsat. zone 1, soil density (g/cm**3) ³ not used ³ 1.500E+00 ³ --- ³ DENSUZ(1)

R015 ³ Unsat. zone 1, total porosity ³ not used ³ 4.000E-01 ³ --- ³ TPUZ(1)
R015 ³ Unsat. zone 1, effective porosity ³ not used ³ 2.000E-01 ³ --- ³ EPUZ(1)
R015 ³ Unsat. zone 1, field capacity ³ not used ³ 2.000E-01 ³ --- ³ FCUZ(1)
R015 ³ Unsat. zone 1, soil-specific b parameter ³ not used ³ 5.300E+00 ³ --- ³ BUZ(1)
R015 ³ Unsat. zone 1, hydraulic conductivity (m/yr) ³ not used ³ 1.000E+01 ³ --- ³ HCUZ(1)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for Am-241 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 2.000E+01 ³ 2.000E+01 ³ --- ³ DCNUCC(2)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 2.000E+01 ³ --- ³ DCNUCU(2,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 2.000E+01 ³ --- ³ DCNUCS(2)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 4.636E-06 ³ ALEACH(2)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(2)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for Cs-137 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 1.000E+03 ³ 1.000E+03 ³ --- ³ DCNUCC(3)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 1.000E+03 ³ --- ³ DCNUCU(3,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 1.000E+03 ³ --- ³ DCNUCS(3)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 9.332E-08 ³ ALEACH(3)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(3)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for Pu-238 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 2.000E+03 ³ 2.000E+03 ³ --- ³ DCNUCC(8)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 2.000E+03 ³ --- ³ DCNUCU(8,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 2.000E+03 ³ --- ³ DCNUCS(8)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 4.666E-08 ³ ALEACH(8)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(8)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for Pu-239 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 2.000E+03 ³ 2.000E+03 ³ --- ³ DCNUCC(9)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 2.000E+03 ³ --- ³ DCNUCU(9,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 2.000E+03 ³ --- ³ DCNUCS(9)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 4.666E-08 ³ ALEACH(9)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(9)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for Sr-90 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 3.000E+01 ³ 3.000E+01 ³ --- ³ DCNUCC(11)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 3.000E+01 ³ --- ³ DCNUCU(11,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 3.000E+01 ³ --- ³ DCNUCS(11)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 3.097E-06 ³ ALEACH(11)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(11)
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 8
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Site-Specific Parameter Summary (continued)
0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter
Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name
ÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄ
R016 ³ Distribution coefficients for daughter Ac-227 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³ 2.000E+01 ³ 2.000E+01 ³ --- ³ DCNUCC(1)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 2.000E+01 ³ --- ³ DCNUCU(1,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 2.000E+01 ³ --- ³ DCNUCS(1)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 4.636E-06 ³ ALEACH(1)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(1)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for daughter H-3 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 0.000E+00 ³ 0.000E+00 ³ --- ³ DCNUCC(4)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 0.000E+00 ³ --- ³ DCNUCU(4,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 0.000E+00 ³ --- ³ DCNUCS(4)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 7.000E-04 ³ ALEACH(4)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(4)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for daughter Np-237 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³-1.000E+00 ³-1.000E+00 ³ 2.574E+02 ³ DCNUCC(5)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³-1.000E+00 ³ --- ³ DCNUCU(5,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³-1.000E+00 ³ --- ³ DCNUCS(5)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 3.624E-07 ³ ALEACH(5)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(5)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for daughter Pa-231 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 5.000E+01 ³ 5.000E+01 ³ --- ³ DCNUCC(6)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCU(6,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCS(6)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.862E-06 ³ ALEACH(6)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(6)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for daughter Pb-210 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 1.000E+02 ³ 1.000E+02 ³ --- ³ DCNUCC(7)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 1.000E+02 ³ --- ³ DCNUCU(7,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 1.000E+02 ³ --- ³ DCNUCS(7)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 9.321E-07 ³ ALEACH(7)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(7)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for daughter Ra-226 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 7.000E+01 ³ 7.000E+01 ³ --- ³ DCNUCC(10)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 7.000E+01 ³ --- ³ DCNUCU(10,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 7.000E+01 ³ --- ³ DCNUCS(10)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.331E-06 ³ ALEACH(10)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(10)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for daughter Th-229 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 6.000E+04 ³ 6.000E+04 ³ --- ³ DCNUCC(12)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 6.000E+04 ³ --- ³ DCNUCU(12,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 6.000E+04 ³ --- ³ DCNUCS(12)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.556E-09 ³ ALEACH(12)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(12)
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 9
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y.RAD

Site-Specific Parameter Summary (continued)
0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter
Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name
ÄÄÄÄÄÅÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄ
R016 ³ Distribution coefficients for daughter Th-230 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 6.000E+04 ³ 6.000E+04 ³ --- ³ DCNUCC(13)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 6.000E+04 ³ --- ³ DCNUCU(13,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 6.000E+04 ³ --- ³ DCNUCS(13)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.556E-09 ³ ALEACH(13)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(13)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for daughter U-233 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 5.000E+01 ³ 5.000E+01 ³ --- ³ DCNUCC(14)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCU(14,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCS(14)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.862E-06 ³ ALEACH(14)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(14)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for daughter U-234 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 5.000E+01 ³ 5.000E+01 ³ --- ³ DCNUCC(15)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCU(15,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCS(15)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.862E-06 ³ ALEACH(15)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(15)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for daughter U-235 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 5.000E+01 ³ 5.000E+01 ³ --- ³ DCNUCC(16)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCU(16,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCS(16)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.862E-06 ³ ALEACH(16)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(16)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for daughter U-238 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 5.000E+01 ³ 5.000E+01 ³ --- ³ DCNUCC(17)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCU(17,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCS(17)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.862E-06 ³ ALEACH(17)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(17)
³ ³ ³ ³ ³
R017 ³ Inhalation rate (m**3/yr) ³ 1.400E+04 ³ 8.400E+03 ³ --- ³ INHALR
R017 ³ Mass loading for inhalation (g/m**3) ³ 2.000E-05 ³ 1.000E-04 ³ --- ³ MLINH
R017 ³ Exposure duration ³ 3.000E+01 ³ 3.000E+01 ³ --- ³ ED
R017 ³ Shielding factor, inhalation ³ 4.000E-01 ³ 4.000E-01 ³ --- ³ SHF3
R017 ³ Shielding factor, external gamma ³ 7.000E-01 ³ 7.000E-01 ³ --- ³ SHF1
R017 ³ Fraction of time spent indoors ³ 0.000E+00 ³ 5.000E-01 ³ --- ³ FIND
R017 ³ Fraction of time spent outdoors (on site) ³ 1.600E-02 ³ 2.500E-01 ³ --- ³ FOTD
R017 ³ Shape factor flag, external gamma ³ 1.000E+00 ³ 1.000E+00 ³ >0 shows circular AREA. ³ FS

1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 10
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Site-Specific Parameter Summary (continued)
0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter
Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name
ÄÄÄÄÄÅÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄ
R017 ³ Radii of shape factor array (used if FS = -1): ³ ³ ³ ³
R017 ³ Outer annular radius (m), ring 1: ³ not used ³ 5.000E+01 ³ --- ³ RAD_SHAPE(1)
R017 ³ Outer annular radius (m), ring 2: ³ not used ³ 7.071E+01 ³ --- ³ RAD_SHAPE(2)
R017 ³ Outer annular radius (m), ring 3: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(3)
R017 ³ Outer annular radius (m), ring 4: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(4)
R017 ³ Outer annular radius (m), ring 5: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(5)
R017 ³ Outer annular radius (m), ring 6: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(6)
R017 ³ Outer annular radius (m), ring 7: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(7)
R017 ³ Outer annular radius (m), ring 8: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(8)
R017 ³ Outer annular radius (m), ring 9: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(9)
R017 ³ Outer annular radius (m), ring 10: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(10)
R017 ³ Outer annular radius (m), ring 11: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(11)
R017 ³ Outer annular radius (m), ring 12: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(12)
³ ³ ³ ³ ³
R017 ³ Fractions of annular areas within AREA: ³ ³ ³ ³
R017 ³ Ring 1 ³ not used ³ 1.000E+00 ³ --- ³ FRACA(1)
R017 ³ Ring 2 ³ not used ³ 2.732E-01 ³ --- ³ FRACA(2)
R017 ³ Ring 3 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(3)
R017 ³ Ring 4 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(4)
R017 ³ Ring 5 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(5)
R017 ³ Ring 6 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(6)
R017 ³ Ring 7 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(7)
R017 ³ Ring 8 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(8)
R017 ³ Ring 9 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(9)
R017 ³ Ring 10 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(10)
R017 ³ Ring 11 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(11)
R017 ³ Ring 12 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(12)
³ ³ ³ ³ ³
R018 ³ Fruits, vegetables and grain consumption (kg/yr) ³ not used ³ 1.600E+02 ³ --- ³ DIET(1)
R018 ³ Leafy vegetable consumption (kg/yr) ³ not used ³ 1.400E+01 ³ --- ³ DIET(2)
R018 ³ Milk consumption (L/yr) ³ not used ³ 9.200E+01 ³ --- ³ DIET(3)
R018 ³ Meat and poultry consumption (kg/yr) ³ not used ³ 6.300E+01 ³ --- ³ DIET(4)
R018 ³ Fish consumption (kg/yr) ³ not used ³ 5.400E+00 ³ --- ³ DIET(5)
R018 ³ Other seafood consumption (kg/yr) ³ not used ³ 9.000E-01 ³ --- ³ DIET(6)
R018 ³ Soil ingestion rate (g/yr) ³ 5.870E+02 ³ 3.650E+01 ³ --- ³ SOIL
R018 ³ Drinking water intake (L/yr) ³ not used ³ 5.100E+02 ³ --- ³ DWI
R018 ³ Contamination fraction of drinking water ³ not used ³ 1.000E+00 ³ --- ³ FDW
R018 ³ Contamination fraction of household water ³ not used ³ 1.000E+00 ³ --- ³ FHHW
R018 ³ Contamination fraction of livestock water ³ not used ³ 1.000E+00 ³ --- ³ FLW
R018 ³ Contamination fraction of irrigation water ³ not used ³ 1.000E+00 ³ --- ³ FIRW
R018 ³ Contamination fraction of aquatic food ³ not used ³ 5.000E-01 ³ --- ³ FR9

R018 ³ Contamination fraction of plant food ³ not used ³-1 ³ --- ³ FPLANT
R018 ³ Contamination fraction of meat ³ not used ³-1 ³ --- ³ FMEAT
R018 ³ Contamination fraction of milk ³ not used ³-1 ³ --- ³ FMILK
³ ³ ³ ³ ³
R019 ³ Livestock fodder intake for meat (kg/day) ³ not used ³ 6.800E+01 ³ --- ³ LFI5
R019 ³ Livestock fodder intake for milk (kg/day) ³ not used ³ 5.500E+01 ³ --- ³ LFI6
R019 ³ Livestock water intake for meat (L/day) ³ not used ³ 5.000E+01 ³ --- ³ LWI5
R019 ³ Livestock water intake for milk (L/day) ³ not used ³ 1.600E+02 ³ --- ³ LWI6
R019 ³ Livestock soil intake (kg/day) ³ not used ³ 5.000E-01 ³ --- ³ LSI
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 11
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Site-Specific Parameter Summary (continued)
0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter
Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name
ÄÄÄÄÄÅÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄ
R019 ³ Mass loading for foliar deposition (g/m**3) ³ not used ³ 1.000E-04 ³ --- ³ MLFD
R019 ³ Depth of soil mixing layer (m) ³ 1.500E-01 ³ 1.500E-01 ³ --- ³ DM
R019 ³ Depth of roots (m) ³ not used ³ 9.000E-01 ³ --- ³ DROOT
R019 ³ Drinking water fraction from ground water ³ not used ³ 1.000E+00 ³ --- ³ FGWDW
R019 ³ Household water fraction from ground water ³ not used ³ 1.000E+00 ³ --- ³ FGWHH
R019 ³ Livestock water fraction from ground water ³ not used ³ 1.000E+00 ³ --- ³ FGWLW
R019 ³ Irrigation fraction from ground water ³ not used ³ 1.000E+00 ³ --- ³ FGWIR
³ ³ ³ ³ ³
R19B ³ Wet weight crop yield for Non-Leafy (kg/m**2) ³ not used ³ 7.000E-01 ³ --- ³ YV(1)
R19B ³ Wet weight crop yield for Leafy (kg/m**2) ³ not used ³ 1.500E+00 ³ --- ³ YV(2)
R19B ³ Wet weight crop yield for Fodder (kg/m**2) ³ not used ³ 1.100E+00 ³ --- ³ YV(3)
R19B ³ Growing Season for Non-Leafy (years) ³ not used ³ 1.700E-01 ³ --- ³ TE(1)
R19B ³ Growing Season for Leafy (years) ³ not used ³ 2.500E-01 ³ --- ³ TE(2)
R19B ³ Growing Season for Fodder (years) ³ not used ³ 8.000E-02 ³ --- ³ TE(3)
R19B ³ Translocation Factor for Non-Leafy ³ not used ³ 1.000E-01 ³ --- ³ TIV(1)
R19B ³ Translocation Factor for Leafy ³ not used ³ 1.000E+00 ³ --- ³ TIV(2)
R19B ³ Translocation Factor for Fodder ³ not used ³ 1.000E+00 ³ --- ³ TIV(3)
R19B ³ Dry Foliar Interception Fraction for Non-Leafy ³ not used ³ 2.500E-01 ³ --- ³ RDRY(1)
R19B ³ Dry Foliar Interception Fraction for Leafy ³ not used ³ 2.500E-01 ³ --- ³ RDRY(2)
R19B ³ Dry Foliar Interception Fraction for Fodder ³ not used ³ 2.500E-01 ³ --- ³ RDRY(3)
R19B ³ Wet Foliar Interception Fraction for Non-Leafy ³ not used ³ 2.500E-01 ³ --- ³ RWET(1)
R19B ³ Wet Foliar Interception Fraction for Leafy ³ not used ³ 2.500E-01 ³ --- ³ RWET(2)
R19B ³ Wet Foliar Interception Fraction for Fodder ³ not used ³ 2.500E-01 ³ --- ³ RWET(3)
R19B ³ Weathering Removal Constant for Vegetation ³ not used ³ 2.000E+01 ³ --- ³ WLAM
³ ³ ³ ³ ³
C14 ³ C-12 concentration in water (g/cm**3) ³ not used ³ 2.000E-05 ³ --- ³ C12WTR
C14 ³ C-12 concentration in contaminated soil (g/g) ³ not used ³ 3.000E-02 ³ --- ³ C12CZ
C14 ³ Fraction of vegetation carbon from soil ³ not used ³ 2.000E-02 ³ --- ³ CSOIL
C14 ³ Fraction of vegetation carbon from air ³ not used ³ 9.800E-01 ³ --- ³ CAIR
C14 ³ C-14 evasion layer thickness in soil (m) ³ not used ³ 3.000E-01 ³ --- ³ DMC
C14 ³ C-14 evasion flux rate from soil (1/sec) ³ not used ³ 7.000E-07 ³ --- ³ EVSN
C14 ³ C-12 evasion flux rate from soil (1/sec) ³ not used ³ 1.000E-10 ³ --- ³ REVSN

C14 ³ Fraction of grain in beef cattle feed ³ not used ³ 8.000E-01 ³ --- ³ AVFG4
C14 ³ Fraction of grain in milk cow feed ³ not used ³ 2.000E-01 ³ --- ³ AVFG5
C14 ³ DCF correction factor for gaseous forms of C14 ³ not used ³ 8.894E+01 ³ --- ³ CO2F
³ ³ ³ ³ ³
STOR ³ Storage times of contaminated foodstuffs (days): ³ ³ ³ ³
STOR ³ Fruits, non-leafy vegetables, and grain ³ 1.400E+01 ³ 1.400E+01 ³ --- ³ STOR_T(1)
STOR ³ Leafy vegetables ³ 1.000E+00 ³ 1.000E+00 ³ --- ³ STOR_T(2)
STOR ³ Milk ³ 1.000E+00 ³ 1.000E+00 ³ --- ³ STOR_T(3)
STOR ³ Meat and poultry ³ 2.000E+01 ³ 2.000E+01 ³ --- ³ STOR_T(4)
STOR ³ Fish ³ 7.000E+00 ³ 7.000E+00 ³ --- ³ STOR_T(5)
STOR ³ Crustacea and mollusks ³ 7.000E+00 ³ 7.000E+00 ³ --- ³ STOR_T(6)
STOR ³ Well water ³ 1.000E+00 ³ 1.000E+00 ³ --- ³ STOR_T(7)
STOR ³ Surface water ³ 1.000E+00 ³ 1.000E+00 ³ --- ³ STOR_T(8)
STOR ³ Livestock fodder ³ 4.500E+01 ³ 4.500E+01 ³ --- ³ STOR_T(9)
³ ³ ³ ³ ³
R021 ³ Thickness of building foundation (m) ³ not used ³ 1.500E-01 ³ --- ³ FLOOR1
R021 ³ Bulk density of building foundation (g/cm**3) ³ not used ³ 2.400E+00 ³ --- ³ DENSFL
R021 ³ Total porosity of the cover material ³ not used ³ 4.000E-01 ³ --- ³ TPCV
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 12
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Site-Specific Parameter Summary (continued)
0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter
Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name
ÄÄÄÄÄÅÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄ
R021 ³ Total porosity of the building foundation ³ not used ³ 1.000E-01 ³ --- ³ TPFL
R021 ³ Volumetric water content of the cover material ³ not used ³ 5.000E-02 ³ --- ³ PH2OCV
R021 ³ Volumetric water content of the foundation ³ not used ³ 3.000E-02 ³ --- ³ PH2OFL
R021 ³ Diffusion coefficient for radon gas (m/sec): ³ ³ ³ ³
R021 ³ in cover material ³ not used ³ 2.000E-06 ³ --- ³ DIFCV
R021 ³ in foundation material ³ not used ³ 3.000E-07 ³ --- ³ DIFFL
R021 ³ in contaminated zone soil ³ not used ³ 2.000E-06 ³ --- ³ DIFCZ
R021 ³ Radon vertical dimension of mixing (m) ³ not used ³ 2.000E+00 ³ --- ³ HMIX
R021 ³ Average building air exchange rate (1/hr) ³ not used ³ 5.000E-01 ³ --- ³ REXG
R021 ³ Height of the building (room) (m) ³ not used ³ 2.500E+00 ³ --- ³ HRM
R021 ³ Building interior area factor ³ not used ³ 0.000E+00 ³ --- ³ FAI
R021 ³ Building depth below ground surface (m) ³ not used ³-1.000E+00 ³ --- ³ DMFL
R021 ³ Emanating power of Rn-222 gas ³ not used ³ 2.500E-01 ³ --- ³ EMANA(1)
R021 ³ Emanating power of Rn-220 gas ³ not used ³ 1.500E-01 ³ --- ³ EMANA(2)
³ ³ ³ ³ ³
TITL ³ Number of graphical time points ³ 32 ³ --- ³ --- ³ NPTS
TITL ³ Maximum number of integration points for dose ³ 17 ³ --- ³ --- ³ LYMAX
TITL ³ Maximum number of integration points for risk ³ 257 ³ --- ³ --- ³ KYMAX
ÍÍÍÍÍÏÍÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÏÍÍÍÍÍÍ

Summary of Pathway Selections

Pathway ³ User Selection
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
1 -- external gamma ³ active
2 -- inhalation (w/o radon)³ active
3 -- plant ingestion ³ suppressed
4 -- meat ingestion ³ suppressed
5 -- milk ingestion ³ suppressed
6 -- aquatic foods ³ suppressed
7 -- drinking water ³ suppressed
8 -- soil ingestion ³ active
9 -- radon ³ suppressed
Find peak pathway doses ³ suppressed
ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 13
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Contaminated Zone Dimensions Initial Soil Concentrations, pCi/g
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
Area: 10000.00 square meters Am-241 2.700E+01
Thickness: 2.00 meters Cs-137 1.130E+02
Cover Depth: 0.00 meters Pu-238 1.000E+00
Pu-239 1.600E+01
Sr-90 3.300E+01
0
Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 1.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)
ÄÄÄ
t (years): 0.000E+00 1.000E+00 5.000E+01 1.000E+02 1.500E+02 2.000E+02
TDOSE(t): 7.332E+00 7.197E+00 3.263E+00 1.933E+00 1.470E+00 1.285E+00
M(t): 4.888E-01 4.798E-01 2.175E-01 1.289E-01 9.802E-02 8.564E-02
0Maximum TDOSE(t): 7.332E+00 mrem/yr at t = 0.000E+00 years
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 14
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)
0 Ground Inhalation Radon Plant Meat Milk Soil
Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.
ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
Am-241 1.831E-02 0.0025 7.902E-03 0.0011 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 9.223E-01 0.1258
Cs-137 5.705E+00 0.7780 2.351E-06 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.246E-02 0.0072

Pu-238 2.383E-06 0.0000 2.576E-04 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.994E-02 0.0041

Pu-239 7.252E-05 0.0000 4.528E-03 0.0006 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.320E-01 0.0726

Sr-90 1.284E-02 0.0018 2.818E-05 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 4.686E-02 0.0064

ííííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí

Total 5.736E+00 0.7823 1.272E-02 0.0017 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.584E+00 0.2160

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 9.485E-01 0.1294

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.757E+00 0.7852

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.020E-02 0.0041

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.366E-01 0.0732

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.972E-02 0.0081

ííííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 7.332E+00 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 15

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground Inhalation Radon Plant Meat Milk Soil

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 1.828E-02 0.0025 7.889E-03 0.0011 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 9.208E-01 0.1279

Cs-137 5.574E+00 0.7745 2.297E-06 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.126E-02 0.0071

Pu-238 2.364E-06 0.0000 2.555E-04 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.970E-02 0.0041

Pu-239 7.252E-05 0.0000 4.528E-03 0.0006 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.319E-01 0.0739

Sr-90 1.253E-02 0.0017 2.752E-05 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 4.576E-02 0.0064

ííííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí

Total 5.605E+00 0.7788 1.270E-02 0.0018 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.579E+00 0.2195

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 9.470E-01 0.1316

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.626E+00 0.7816

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.996E-02 0.0042

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.365E-01 0.0745

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.832E-02 0.0081

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 7.197E+00 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 16

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground Inhalation Radon Plant Meat Milk Soil

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 1.690E-02 0.0052 7.291E-03 0.0022 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 8.511E-01 0.2608

Cs-137 1.797E+00 0.5507 7.404E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.652E-02 0.0051

Pu-238 1.606E-06 0.0000 1.735E-04 0.0001 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.017E-02 0.0062

Pu-239 7.242E-05 0.0000 4.521E-03 0.0014 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.312E-01 0.1628

Sr-90 3.904E-03 0.0012 8.570E-06 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.425E-02 0.0044

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 1.818E+00 0.5571 1.200E-02 0.0037 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.433E+00 0.4392

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 8.752E-01 0.2682

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.813E+00 0.5558

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.034E-02 0.0062

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.358E-01 0.1642

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.816E-02 0.0056

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.263E+00 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 17

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground Inhalation Radon Plant Meat Milk Soil

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 1.560E-02 0.0081 6.728E-03 0.0035 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 7.853E-01 0.4063

Cs-137 5.660E-01 0.2928 2.332E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.204E-03 0.0027

Pu-238 1.083E-06 0.0000 1.169E-04 0.0001 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.359E-02 0.0070

Pu-239 7.233E-05 0.0000 4.515E-03 0.0023 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.304E-01 0.2744

Sr-90 1.187E-03 0.0006 2.606E-06 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 4.334E-03 0.0022

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 5.828E-01 0.3015 1.136E-02 0.0059 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.339E+00 0.6926

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 8.076E-01 0.4178

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.712E-01 0.2955

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.370E-02 0.0071

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.350E-01 0.2768

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.524E-03 0.0029

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.933E+00 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 18

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.500E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground Inhalation Radon Plant Meat Milk Soil

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 1.440E-02 0.0098 6.208E-03 0.0042 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 7.246E-01 0.4929

Cs-137 1.783E-01 0.1212 7.346E-08 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.639E-03 0.0011

Pu-238 7.310E-07 0.0000 7.877E-05 0.0001 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 9.153E-03 0.0062

Pu-239 7.223E-05 0.0000 4.508E-03 0.0031 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.297E-01 0.3602

Sr-90 3.611E-04 0.0002 7.927E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.318E-03 0.0009

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 1.931E-01 0.1313 1.080E-02 0.0073 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.266E+00 0.8613

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.500E+02 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 7.453E-01 0.5069

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.799E-01 0.1224

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 9.233E-03 0.0063

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.342E-01 0.3634

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.680E-03 0.0011

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.470E+00 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 19

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 2.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground Inhalation Radon Plant Meat Milk Soil

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 1.330E-02 0.0103 5.729E-03 0.0045 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 6.687E-01 0.5205

Cs-137 5.615E-02 0.0437 2.314E-08 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.163E-04 0.0004

Pu-238 4.944E-07 0.0000 5.308E-05 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 6.167E-03 0.0048

Pu-239 7.214E-05 0.0001 4.502E-03 0.0035 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.289E-01 0.4117

Sr-90 1.098E-04 0.0001 2.411E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 4.009E-04 0.0003

ííííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí

Total 6.963E-02 0.0542 1.028E-02 0.0080 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.205E+00 0.9378

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 2.000E+02 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 6.877E-01 0.5354

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.667E-02 0.0441

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 6.220E-03 0.0048

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.335E-01 0.4153

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.109E-04 0.0004

ííííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí ííííííííí íííííí

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.285E+00 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 20

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y.RAD

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated
0Parent Product Branch DSR(j,t) (mrem/yr)/(pCi/g)
(i) (j) Fraction* t= 0.000E+00 1.000E+00 5.000E+01 1.000E+02 1.500E+02 2.000E+02
ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ
Am-241 Am-241 1.000E+00 3.513E-02 3.507E-02 3.242E-02 2.991E-02 2.760E-02 2.547E-02
Am-241 Np-237 1.000E+00 9.506E-09 2.850E-08 9.227E-07 1.765E-06 2.543E-06 3.260E-06
Am-241 U-233 1.000E+00 6.666E-16 4.664E-15 4.966E-12 1.916E-11 4.185E-11 7.240E-11
Am-241 Th-229 1.000E+00 3.538E-19 5.305E-18 1.785E-13 1.377E-12 4.530E-12 1.049E-11
Am-241 äDSR(j) 3.513E-02 3.507E-02 3.242E-02 2.991E-02 2.760E-02 2.547E-02
0Cs-137 Cs-137 1.000E+00 5.095E-02 4.978E-02 1.605E-02 5.055E-03 1.592E-03 5.015E-04
0Pu-238 Pu-238 1.000E+00 3.020E-02 2.996E-02 2.034E-02 1.370E-02 9.232E-03 6.220E-03
Pu-238 U-234 1.000E+00 3.890E-09 1.163E-08 3.248E-07 5.408E-07 6.863E-07 7.843E-07
Pu-238 Th-230 1.000E+00 2.284E-14 1.595E-13 1.539E-10 5.410E-10 1.085E-09 1.734E-09
Pu-238 Ra-226 1.000E+00 8.336E-17 1.248E-15 3.882E-11 2.779E-10 8.518E-10 1.847E-09
Pu-238 Pb-210 1.000E+00 1.946E-19 5.992E-18 4.400E-12 5.020E-11 1.907E-10 4.678E-10
Pu-238 äDSR(j) 3.020E-02 2.996E-02 2.034E-02 1.370E-02 9.233E-03 6.220E-03
0Pu-239 Pu-239 1.000E+00 3.353E-02 3.353E-02 3.349E-02 3.344E-02 3.339E-02 3.334E-02
Pu-239 U-235 1.000E+00 6.953E-12 2.086E-11 7.017E-10 1.395E-09 2.088E-09 2.780E-09
Pu-239 Pa-231 1.000E+00 3.588E-16 2.511E-15 2.742E-12 1.085E-11 2.431E-11 4.311E-11
Pu-239 Ac-227 1.000E+00 4.776E-18 7.116E-17 1.730E-12 1.027E-11 2.739E-11 5.341E-11
Pu-239 äDSR(j) 3.353E-02 3.353E-02 3.349E-02 3.344E-02 3.339E-02 3.334E-02
0Sr-90 Sr-90 1.000E+00 1.810E-03 1.767E-03 5.504E-04 1.674E-04 5.091E-05 1.548E-05
ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ
*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ó 0.5 yr) daughters.
0
Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.500E+01 mrem/yr
0Nuclide
(i) t= 0.000E+00 1.000E+00 5.000E+01 1.000E+02 1.500E+02 2.000E+02
ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ
Am-241 4.270E+02 4.277E+02 4.627E+02 5.015E+02 5.434E+02 5.889E+02
Cs-137 2.944E+02 3.013E+02 9.347E+02 2.968E+03 9.422E+03 2.991E+04
Pu-238 4.968E+02 5.007E+02 7.374E+02 1.095E+03 1.625E+03 2.411E+03
Pu-239 4.473E+02 4.473E+02 4.479E+02 4.486E+02 4.492E+02 4.499E+02
Sr-90 8.288E+03 8.488E+03 2.725E+04 8.961E+04 2.946E+05 9.688E+05
ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 21
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years
0Nuclide Initial tmin DSR(i,tmin) G(i,tmin) DSR(i,tmax) G(i,tmax)

(i) (pCi/g) (years) (pCi/g) (pCi/g)
ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ
Am-241 2.700E+01 0.000E+00 3.513E-02 4.270E+02 3.513E-02 4.270E+02
Cs-137 1.130E+02 0.000E+00 5.095E-02 2.944E+02 5.095E-02 2.944E+02
Pu-238 1.000E+00 0.000E+00 3.020E-02 4.968E+02 3.020E-02 4.968E+02
Pu-239 1.600E+01 0.000E+00 3.353E-02 4.473E+02 3.353E-02 4.473E+02
Sr-90 3.300E+01 0.000E+00 1.810E-03 8.288E+03 1.810E-03 8.288E+03
ííííííí ííííííííí íííííííííííííííí ííííííííí ííííííííí ííííííííí ííííííííí

1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 22
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated
0Nuclide Parent BRF(i) DOSE(j,t), mrem/yr
(j) (i) t= 0.000E+00 1.000E+00 5.000E+01 1.000E+02 1.500E+02 2.000E+02
ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ
Am-241 Am-241 1.000E+00 9.485E-01 9.470E-01 8.752E-01 8.076E-01 7.452E-01 6.876E-01
0Np-237 Am-241 1.000E+00 2.567E-07 7.695E-07 2.491E-05 4.766E-05 6.865E-05 8.802E-05
0U-233 Am-241 1.000E+00 1.800E-14 1.259E-13 1.341E-10 5.172E-10 1.130E-09 1.955E-09
0Th-229 Am-241 1.000E+00 9.553E-18 1.432E-16 4.819E-12 3.719E-11 1.223E-10 2.833E-10
0Cs-137 Cs-137 1.000E+00 5.757E+00 5.626E+00 1.813E+00 5.712E-01 1.799E-01 5.667E-02
0Pu-238 Pu-238 1.000E+00 3.020E-02 2.996E-02 2.034E-02 1.370E-02 9.232E-03 6.220E-03
0U-234 Pu-238 1.000E+00 3.890E-09 1.163E-08 3.248E-07 5.408E-07 6.863E-07 7.843E-07
0Th-230 Pu-238 1.000E+00 2.284E-14 1.595E-13 1.539E-10 5.410E-10 1.085E-09 1.734E-09
0Ra-226 Pu-238 1.000E+00 8.336E-17 1.248E-15 3.882E-11 2.779E-10 8.518E-10 1.847E-09
0Pb-210 Pu-238 1.000E+00 1.946E-19 5.992E-18 4.400E-12 5.020E-11 1.907E-10 4.678E-10
0Pu-239 Pu-239 1.000E+00 5.366E-01 5.365E-01 5.358E-01 5.350E-01 5.342E-01 5.335E-01
0U-235 Pu-239 1.000E+00 1.112E-10 3.337E-10 1.123E-08 2.233E-08 3.341E-08 4.447E-08
0Pa-231 Pu-239 1.000E+00 5.740E-15 4.018E-14 4.388E-11 1.736E-10 3.890E-10 6.898E-10
0Ac-227 Pu-239 1.000E+00 7.642E-17 1.139E-15 2.768E-11 1.644E-10 4.382E-10 8.545E-10
0Sr-90 Sr-90 1.000E+00 5.972E-02 5.832E-02 1.816E-02 5.524E-03 1.680E-03 5.109E-04
ííííííí ííííííí ííííííííí ííííííííí ííííííííí ííííííííí ííííííííí ííííííííí ííííííííí
BRF(i) is the branch fraction of the parent nuclide.
1RESRAD, Version 6.1 T« Limit = 0.5 year 03/22/2002 10:08 Page 23
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y.RAD

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated
0Nuclide Parent BRF(i) S(j,t), pCi/g
(j) (i) t= 0.000E+00 1.000E+00 5.000E+01 1.000E+02 1.500E+02 2.000E+02
ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ
Am-241 Am-241 1.000E+00 2.700E+01 2.696E+01 2.491E+01 2.299E+01 2.121E+01 1.957E+01
0Np-237 Am-241 1.000E+00 0.000E+00 8.738E-06 4.201E-04 8.078E-04 1.165E-03 1.496E-03
0U-233 Am-241 1.000E+00 0.000E+00 1.911E-11 4.654E-08 1.813E-07 3.975E-07 6.887E-07
0Th-229 Am-241 1.000E+00 0.000E+00 6.017E-16 7.366E-11 5.770E-10 1.907E-09 4.429E-09
0Cs-137 Cs-137 1.000E+00 1.130E+02 1.104E+02 3.559E+01 1.121E+01 3.531E+00 1.112E+00

0Pu-238 Pu-238 1.000E+00 1.000E+00 9.921E-01 6.737E-01 4.538E-01 3.057E-01 2.060E-01

0U-234 Pu-238 1.000E+00 0.000E+00 2.824E-06 1.171E-04 1.959E-04 2.490E-04 2.848E-04

0Th-230 Pu-238 1.000E+00 0.000E+00 1.273E-11 2.808E-08 9.966E-08 2.005E-07 3.211E-07

0Ra-226 Pu-238 1.000E+00 0.000E+00 1.839E-15 2.081E-10 1.512E-09 4.657E-09 1.012E-08

0Pb-210 Pu-238 1.000E+00 0.000E+00 1.421E-17 6.203E-11 7.216E-10 2.759E-09 6.789E-09

0Pu-239 Pu-239 1.000E+00 1.600E+01 1.600E+01 1.598E+01 1.595E+01 1.593E+01 1.591E+01

0U-235 Pu-239 1.000E+00 0.000E+00 1.576E-08 7.873E-07 1.573E-06 2.358E-06 3.142E-06

0Pa-231 Pu-239 1.000E+00 0.000E+00 1.667E-13 4.164E-10 1.664E-09 3.741E-09 6.644E-09

0Ac-227 Pu-239 1.000E+00 0.000E+00 1.755E-15 1.550E-10 9.336E-10 2.500E-09 4.886E-09

0Sr-90 Sr-90 1.000E+00 3.300E+01 3.222E+01 1.004E+01 3.052E+00 9.283E-01 2.823E-01

ííííííí ííííííí ííííííííí ííííííííí ííííííííí ííííííííí ííííííííí ííííííííí ííííííííí

BRF(i) is the branch fraction of the parent nuclide.

0RESCALC.EXE execution time = 1.04 seconds

Exhibit F2.2. RESRAD Summary Report for the Recreational Trail User Scenario With Cover.

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 1
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y+0-3meterCover.RAD

Table of Contents
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
Part I: Mixture Sums and Single Radionuclide Guidelines
ÍÍÍ

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 2
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y+0-3meterCover.RAD

Dose Conversion Factor (and Related) Parameter Summary
File: FGR 13 Mortality
0 ³ ³ Current ³ ³ Parameter
Menu ³ Parameter ³ Value ³ Default ³ Name

ÄÄÄÄÄÅÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄ
ÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
B-1 ³ Dose conversion factors for inhalation, mrem/pCi: ³ ³ ³
B-1 ³ Ac-227+D ³ 6.720E+00 ³ 6.720E+00 ³ DCF2(1)
B-1 ³ Am-241 ³ 4.440E-01 ³ 4.440E-01 ³ DCF2(2)
B-1 ³ Cs-137+D ³ 3.190E-05 ³ 3.190E-05 ³ DCF2(3)
B-1 ³ H-3 ³ 6.400E-08 ³ 6.400E-08 ³ DCF2(4)
B-1 ³ Np-237+D ³ 5.400E-01 ³ 5.400E-01 ³ DCF2(5)
B-1 ³ Pa-231 ³ 1.280E+00 ³ 1.280E+00 ³ DCF2(6)
B-1 ³ Pb-210+D ³ 2.320E-02 ³ 2.320E-02 ³ DCF2(7)
B-1 ³ Pu-238 ³ 3.920E-01 ³ 3.920E-01 ³ DCF2(8)
B-1 ³ Pu-239 ³ 4.290E-01 ³ 4.290E-01 ³ DCF2(9)
B-1 ³ Ra-226+D ³ 8.600E-03 ³ 8.600E-03 ³ DCF2(10)
B-1 ³ Sr-90+D ³ 1.310E-03 ³ 1.310E-03 ³ DCF2(11)
B-1 ³ Th-229+D ³ 2.160E+00 ³ 2.160E+00 ³ DCF2(12)
B-1 ³ Th-230 ³ 3.260E-01 ³ 3.260E-01 ³ DCF2(13)

B-1 ³ U-233 ³ 1.350E-01 ³ 1.350E-01 ³ DCF2(14)
B-1 ³ U-234 ³ 1.320E-01 ³ 1.320E-01 ³ DCF2(15)
B-1 ³ U-235+D ³ 1.230E-01 ³ 1.230E-01 ³ DCF2(16)
B-1 ³ U-238+D ³ 1.180E-01 ³ 1.180E-01 ³ DCF2(17)
³ ³ ³ ³
D-1 ³ Dose conversion factors for ingestion, mrem/pCi: ³ ³ ³
D-1 ³ Ac-227+D ³ 1.480E-02 ³ 1.480E-02 ³ DCF3(1)
D-1 ³ Am-241 ³ 3.640E-03 ³ 3.640E-03 ³ DCF3(2)
D-1 ³ Cs-137+D ³ 5.000E-05 ³ 5.000E-05 ³ DCF3(3)
D-1 ³ H-3 ³ 6.400E-08 ³ 6.400E-08 ³ DCF3(4)
D-1 ³ Np-237+D ³ 4.440E-03 ³ 4.440E-03 ³ DCF3(5)
D-1 ³ Pa-231 ³ 1.060E-02 ³ 1.060E-02 ³ DCF3(6)
D-1 ³ Pb-210+D ³ 7.270E-03 ³ 7.270E-03 ³ DCF3(7)
D-1 ³ Pu-238 ³ 3.200E-03 ³ 3.200E-03 ³ DCF3(8)
D-1 ³ Pu-239 ³ 3.540E-03 ³ 3.540E-03 ³ DCF3(9)
D-1 ³ Ra-226+D ³ 1.330E-03 ³ 1.330E-03 ³ DCF3(10)
D-1 ³ Sr-90+D ³ 1.530E-04 ³ 1.530E-04 ³ DCF3(11)
D-1 ³ Th-229+D ³ 4.030E-03 ³ 4.030E-03 ³ DCF3(12)
D-1 ³ Th-230 ³ 5.480E-04 ³ 5.480E-04 ³ DCF3(13)
D-1 ³ U-233 ³ 2.890E-04 ³ 2.890E-04 ³ DCF3(14)
D-1 ³ U-234 ³ 2.830E-04 ³ 2.830E-04 ³ DCF3(15)
D-1 ³ U-235+D ³ 2.670E-04 ³ 2.670E-04 ³ DCF3(16)
D-1 ³ U-238+D ³ 2.690E-04 ³ 2.690E-04 ³ DCF3(17)
³ ³ ³ ³
D-34 ³ Food transfer factors: ³ ³ ³
D-34 ³ Ac-227+D , plant/soil concentration ratio, dimensionless ³ 2.500E-03 ³ 2.500E-03 ³ RTF(1,1)
D-34 ³ Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 2.000E-05 ³ 2.000E-05 ³ RTF(1,2)
D-34 ³ Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 2.000E-05 ³ 2.000E-05 ³ RTF(1,3)
D-34 ³ ³ ³ ³
D-34 ³ Am-241 , plant/soil concentration ratio, dimensionless ³ 1.000E-03 ³ 1.000E-03 ³ RTF(2,1)
D-34 ³ Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 5.000E-05 ³ 5.000E-05 ³ RTF(2,2)
D-34 ³ Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 2.000E-06 ³ 2.000E-06 ³ RTF(2,3)
D-34 ³ ³ ³ ³
D-34 ³ Cs-137+D , plant/soil concentration ratio, dimensionless ³ 4.000E-02 ³ 4.000E-02 ³ RTF(3,1)
D-34 ³ Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 3.000E-02 ³ 3.000E-02 ³ RTF(3,2)
D-34 ³ Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 8.000E-03 ³ 8.000E-03 ³ RTF(3,3)
1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 3
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y+0-3meterCover.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality
0 ³ ³ Current ³ ³ Parameter
Menu ³ Parameter ³ Value ³ Default ³ Name

ÄÄÄÄÄÅÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄ
ÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
D-34 ³ H-3 , plant/soil concentration ratio, dimensionless ³ 4.800E+00 ³ 4.800E+00 ³ RTF(4,1)
D-34 ³ H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.200E-02 ³ 1.200E-02 ³ RTF(4,2)

D-34 ³ H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 1.000E-02 ³ 1.000E-02 ³ RTF(4,3)
D-34 ³ ³ ³ ³
D-34 ³ Np-237+D , plant/soil concentration ratio, dimensionless ³ 2.000E-02 ³ 2.000E-02 ³ RTF(5,1)
D-34 ³ Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.000E-03 ³ 1.000E-03 ³ RTF(5,2)
D-34 ³ Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 5.000E-06 ³ 5.000E-06 ³ RTF(5,3)
D-34 ³ ³ ³ ³
D-34 ³ Pa-231 , plant/soil concentration ratio, dimensionless ³ 1.000E-02 ³ 1.000E-02 ³ RTF(6,1)
D-34 ³ Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 5.000E-03 ³ 5.000E-03 ³ RTF(6,2)
D-34 ³ Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 5.000E-06 ³ 5.000E-06 ³ RTF(6,3)
D-34 ³ ³ ³ ³
D-34 ³ Pb-210+D , plant/soil concentration ratio, dimensionless ³ 1.000E-02 ³ 1.000E-02 ³ RTF(7,1)
D-34 ³ Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 8.000E-04 ³ 8.000E-04 ³ RTF(7,2)
D-34 ³ Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 3.000E-04 ³ 3.000E-04 ³ RTF(7,3)
D-34 ³ ³ ³ ³
D-34 ³ Pu-238 , plant/soil concentration ratio, dimensionless ³ 1.000E-03 ³ 1.000E-03 ³ RTF(8,1)
D-34 ³ Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.000E-04 ³ 1.000E-04 ³ RTF(8,2)
D-34 ³ Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 1.000E-06 ³ 1.000E-06 ³ RTF(8,3)
D-34 ³ ³ ³ ³
D-34 ³ Pu-239 , plant/soil concentration ratio, dimensionless ³ 1.000E-03 ³ 1.000E-03 ³ RTF(9,1)
D-34 ³ Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.000E-04 ³ 1.000E-04 ³ RTF(9,2)
D-34 ³ Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 1.000E-06 ³ 1.000E-06 ³ RTF(9,3)
D-34 ³ ³ ³ ³
D-34 ³ Ra-226+D , plant/soil concentration ratio, dimensionless ³ 4.000E-02 ³ 4.000E-02 ³ RTF(10,1)
D-34 ³ Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.000E-03 ³ 1.000E-03 ³ RTF(10,2)
D-34 ³ Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 1.000E-03 ³ 1.000E-03 ³ RTF(10,3)
D-34 ³ ³ ³ ³
D-34 ³ Sr-90+D , plant/soil concentration ratio, dimensionless ³ 3.000E-01 ³ 3.000E-01 ³ RTF(11,1)
D-34 ³ Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 8.000E-03 ³ 8.000E-03 ³ RTF(11,2)
D-34 ³ Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 2.000E-03 ³ 2.000E-03 ³ RTF(11,3)
D-34 ³ ³ ³ ³
D-34 ³ Th-229+D , plant/soil concentration ratio, dimensionless ³ 1.000E-03 ³ 1.000E-03 ³ RTF(12,1)
D-34 ³ Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.000E-04 ³ 1.000E-04 ³ RTF(12,2)
D-34 ³ Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 5.000E-06 ³ 5.000E-06 ³ RTF(12,3)
D-34 ³ ³ ³ ³
D-34 ³ Th-230 , plant/soil concentration ratio, dimensionless ³ 1.000E-03 ³ 1.000E-03 ³ RTF(13,1)
D-34 ³ Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 1.000E-04 ³ 1.000E-04 ³ RTF(13,2)
D-34 ³ Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 5.000E-06 ³ 5.000E-06 ³ RTF(13,3)
D-34 ³ ³ ³ ³
D-34 ³ U-233 , plant/soil concentration ratio, dimensionless ³ 2.500E-03 ³ 2.500E-03 ³ RTF(14,1)
D-34 ³ U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 3.400E-04 ³ 3.400E-04 ³ RTF(14,2)
D-34 ³ U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 6.000E-04 ³ 6.000E-04 ³ RTF(14,3)
D-34 ³ ³ ³ ³
D-34 ³ U-234 , plant/soil concentration ratio, dimensionless ³ 2.500E-03 ³ 2.500E-03 ³ RTF(15,1)
D-34 ³ U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 3.400E-04 ³ 3.400E-04 ³ RTF(15,2)
D-34 ³ U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 6.000E-04 ³ 6.000E-04 ³ RTF(15,3)
D-34 ³ ³ ³ ³
1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 4
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y+0-3meterCover.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality
0 ³ ³ Current ³ ³ Parameter
Menu ³ Parameter ³ Value ³ Default ³ Name

ÄÄÄÄÄÅÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄ ÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

D-34 ³ U-235+D , plant/soil concentration ratio, dimensionless ³ 2.500E-03 ³ 2.500E-03 ³ RTF(16,1)
D-34 ³ U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 3.400E-04 ³ 3.400E-04 ³ RTF(16,2)
D-34 ³ U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 6.000E-04 ³ 6.000E-04 ³ RTF(16,3)
D-34 ³ ³ ³ ³
D-34 ³ U-238+D , plant/soil concentration ratio, dimensionless ³ 2.500E-03 ³ 2.500E-03 ³ RTF(17,1)
D-34 ³ U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) ³ 3.400E-04 ³ 3.400E-04 ³ RTF(17,2)
D-34 ³ U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) ³ 6.000E-04 ³ 6.000E-04 ³ RTF(17,3)
³ ³ ³ ³
D-5 ³ Bioaccumulation factors, fresh water, L/kg: ³ ³ ³
D-5 ³ Ac-227+D , fish ³ 1.500E+01 ³ 1.500E+01 ³ BIOFAC(1,1)
D-5 ³ Ac-227+D , crustacea and mollusks ³ 1.000E+03 ³ 1.000E+03 ³ BIOFAC(1,2)
D-5 ³ ³ ³ ³
D-5 ³ Am-241 , fish ³ 3.000E+01 ³ 3.000E+01 ³ BIOFAC(2,1)
D-5 ³ Am-241 , crustacea and mollusks ³ 1.000E+03 ³ 1.000E+03 ³ BIOFAC(2,2)
D-5 ³ ³ ³ ³
D-5 ³ Cs-137+D , fish ³ 2.000E+03 ³ 2.000E+03 ³ BIOFAC(3,1)
D-5 ³ Cs-137+D , crustacea and mollusks ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(3,2)
D-5 ³ ³ ³ ³
D-5 ³ H-3 , fish ³ 1.000E+00 ³ 1.000E+00 ³ BIOFAC(4,1)
D-5 ³ H-3 , crustacea and mollusks ³ 1.000E+00 ³ 1.000E+00 ³ BIOFAC(4,2)
D-5 ³ ³ ³ ³
D-5 ³ Np-237+D , fish ³ 3.000E+01 ³ 3.000E+01 ³ BIOFAC(5,1)
D-5 ³ Np-237+D , crustacea and mollusks ³ 4.000E+02 ³ 4.000E+02 ³ BIOFAC(5,2)
D-5 ³ ³ ³ ³
D-5 ³ Pa-231 , fish ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(6,1)
D-5 ³ Pa-231 , crustacea and mollusks ³ 1.100E+02 ³ 1.100E+02 ³ BIOFAC(6,2)
D-5 ³ ³ ³ ³
D-5 ³ Pb-210+D , fish ³ 3.000E+02 ³ 3.000E+02 ³ BIOFAC(7,1)
D-5 ³ Pb-210+D , crustacea and mollusks ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(7,2)
D-5 ³ ³ ³ ³
D-5 ³ Pu-238 , fish ³ 3.000E+01 ³ 3.000E+01 ³ BIOFAC(8,1)
D-5 ³ Pu-238 , crustacea and mollusks ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(8,2)
D-5 ³ ³ ³ ³
D-5 ³ Pu-239 , fish ³ 3.000E+01 ³ 3.000E+01 ³ BIOFAC(9,1)
D-5 ³ Pu-239 , crustacea and mollusks ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(9,2)
D-5 ³ ³ ³ ³
D-5 ³ Ra-226+D , fish ³ 5.000E+01 ³ 5.000E+01 ³ BIOFAC(10,1)
D-5 ³ Ra-226+D , crustacea and mollusks ³ 2.500E+02 ³ 2.500E+02 ³ BIOFAC(10,2)
D-5 ³ ³ ³ ³
D-5 ³ Sr-90+D , fish ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(11,1)
D-5 ³ Sr-90+D , crustacea and mollusks ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(11,2)

D-5 ³ ³ ³ ³
D-5 ³ Th-229+D , fish ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(12,1)
D-5 ³ Th-229+D , crustacea and mollusks ³ 5.000E+02 ³ 5.000E+02 ³ BIOFAC(12,2)
D-5 ³ ³ ³ ³
D-5 ³ Th-230 , fish ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(13,1)
D-5 ³ Th-230 , crustacea and mollusks ³ 5.000E+02 ³ 5.000E+02 ³ BIOFAC(13,2)
D-5 ³ ³ ³ ³
D-5 ³ U-233 , fish ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(14,1)
D-5 ³ U-233 , crustacea and mollusks ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(14,2)
1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 5
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y+0-3meterCover.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: FGR 13 Mortality
0 ³ ³ Current ³ ³ Parameter
Menu ³ Parameter ³ Value ³ Default ³ Name

ÄÄÄÄÄÅÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄ
ÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
D-5 ³ U-234 , fish ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(15,1)
D-5 ³ U-234 , crustacea and mollusks ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(15,2)
D-5 ³ ³ ³ ³
D-5 ³ U-235+D , fish ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(16,1)
D-5 ³ U-235+D , crustacea and mollusks ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(16,2)
D-5 ³ ³ ³ ³
D-5 ³ U-238+D , fish ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(17,1)
D-5 ³ U-238+D , crustacea and mollusks ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(17,2)
ÍÍÍÍÏÍÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÏÍÍÍÍÍÍÍÍÍÍÍÍÍ
1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 6
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y+0-3meterCover.RAD

Site-Specific Parameter Summary
0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter
Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name

ÄÄÄÄÄÅÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄ
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
R011 ³ Area of contaminated zone (m**2) ³ 1.000E+04 ³ 1.000E+04 ³ --- ³ AREA
R011 ³ Thickness of contaminated zone (m) ³ 2.000E+00 ³ 2.000E+00 ³ --- ³ THICK0
R011 ³ Length parallel to aquifer flow (m) ³ not used ³ 1.000E+02 ³ --- ³ LCZPAQ
R011 ³ Basic radiation dose limit (mrem/yr) ³ 1.500E+01 ³ 2.500E+01 ³ --- ³ BRDL
R011 ³ Time since placement of material (yr) ³ 0.000E+00 ³ 0.000E+00 ³ --- ³ TI
R011 ³ Times for calculations (yr) ³ 1.000E+00 ³ 1.000E+00 ³ --- ³ T(2)
R011 ³ Times for calculations (yr) ³ 5.000E+01 ³ 3.000E+00 ³ --- ³ T(3)
R011 ³ Times for calculations (yr) ³ 1.000E+02 ³ 1.000E+01 ³ --- ³ T(4)
R011 ³ Times for calculations (yr) ³ 3.000E+02 ³ 3.000E+01 ³ --- ³ T(5)
R011 ³ Times for calculations (yr) ³ 1.000E+03 ³ 1.000E+02 ³ --- ³ T(6)
R011 ³ Times for calculations (yr) ³ not used ³ 3.000E+02 ³ --- ³ T(7)

R011 ³ Times for calculations (yr) ³ not used ³ 1.000E+03 ³ --- ³ T(8)
R011 ³ Times for calculations (yr) ³ not used ³ 0.000E+00 ³ --- ³ T(9)
R011 ³ Times for calculations (yr) ³ not used ³ 0.000E+00 ³ --- ³ T(10)
³ ³ ³ ³ ³
R012 ³ Initial principal radionuclide (pCi/g): Am-241 ³ 2.700E+01 ³ 0.000E+00 ³ --- ³ S1(2)
R012 ³ Initial principal radionuclide (pCi/g): Cs-137 ³ 1.130E+02 ³ 0.000E+00 ³ --- ³ S1(3)
R012 ³ Initial principal radionuclide (pCi/g): Pu-238 ³ 1.000E+00 ³ 0.000E+00 ³ --- ³ S1(8)
R012 ³ Initial principal radionuclide (pCi/g): Pu-239 ³ 1.600E+01 ³ 0.000E+00 ³ --- ³ S1(9)
R012 ³ Initial principal radionuclide (pCi/g): Sr-90 ³ 3.300E+01 ³ 0.000E+00 ³ --- ³ S1(11)
R012 ³ Concentration in groundwater (pCi/L): Am-241 ³ not used ³ 0.000E+00 ³ --- ³ W1(2)
R012 ³ Concentration in groundwater (pCi/L): Cs-137 ³ not used ³ 0.000E+00 ³ --- ³ W1(3)
R012 ³ Concentration in groundwater (pCi/L): Pu-238 ³ not used ³ 0.000E+00 ³ --- ³ W1(8)
R012 ³ Concentration in groundwater (pCi/L): Pu-239 ³ not used ³ 0.000E+00 ³ --- ³ W1(9)
R012 ³ Concentration in groundwater (pCi/L): Sr-90 ³ not used ³ 0.000E+00 ³ --- ³ W1(11)
³ ³ ³ ³ ³
R013 ³ Cover depth (m) ³ 3.000E-01 ³ 0.000E+00 ³ --- ³ COVER0
R013 ³ Density of cover material (g/cm**3) ³ 1.500E+00 ³ 1.500E+00 ³ --- ³ DENSCV
R013 ³ Cover depth erosion rate (m/yr) ³ 1.000E-03 ³ 1.000E-03 ³ --- ³ VCV
R013 ³ Density of contaminated zone (g/cm**3) ³ 1.500E+00 ³ 1.500E+00 ³ --- ³ DENSCZ
R013 ³ Contaminated zone erosion rate (m/yr) ³ 1.000E-03 ³ 1.000E-03 ³ --- ³ VCZ
R013 ³ Contaminated zone total porosity ³ 4.000E-01 ³ 4.000E-01 ³ --- ³ TPCZ
R013 ³ Contaminated zone field capacity ³ 2.000E-01 ³ 2.000E-01 ³ --- ³ FCCZ
R013 ³ Contaminated zone hydraulic conductivity (m/yr) ³ 1.000E+01 ³ 1.000E+01 ³ --- ³ HCCZ
R013 ³ Contaminated zone b parameter ³ 5.300E+00 ³ 5.300E+00 ³ --- ³ BCZ
R013 ³ Average annual wind speed (m/sec) ³ 3.000E+00 ³ 2.000E+00 ³ --- ³ WIND
R013 ³ Humidity in air (g/m**3) ³ 5.500E+00 ³ 8.000E+00 ³ --- ³ HUMID
R013 ³ Evapotranspiration coefficient ³ 9.990E-01 ³ 5.000E-01 ³ --- ³ EVAPTR
R013 ³ Precipitation (m/yr) ³ 3.500E-01 ³ 1.000E+00 ³ --- ³ PRECIP
R013 ³ Irrigation (m/yr) ³ 0.000E+00 ³ 2.000E-01 ³ --- ³ RI
R013 ³ Irrigation mode ³ overhead ³ overhead ³ --- ³ IDITCH
R013 ³ Runoff coefficient ³ 2.000E-01 ³ 2.000E-01 ³ --- ³ RUNOFF
R013 ³ Watershed area for nearby stream or pond (m**2) ³ not used ³ 1.000E+06 ³ --- ³ WAREA
R013 ³ Accuracy for water/soil computations ³ not used ³ 1.000E-03 ³ --- ³ EPS
³ ³ ³ ³ ³
R014 ³ Density of saturated zone (g/cm**3) ³ not used ³ 1.500E+00 ³ --- ³ DENSAQ
R014 ³ Saturated zone total porosity ³ not used ³ 4.000E-01 ³ --- ³ TPSZ
R014 ³ Saturated zone effective porosity ³ not used ³ 2.000E-01 ³ --- ³ EPSZ
R014 ³ Saturated zone field capacity ³ not used ³ 2.000E-01 ³ --- ³ FCSZ
R014 ³ Saturated zone hydraulic conductivity (m/yr) ³ not used ³ 1.000E+02 ³ --- ³ HCSZ
1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 7
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y+0-3meterCover.RAD

Site-Specific Parameter Summary (continued)
0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter
Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name

ÄÄÄÄÄÅÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄ
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄ

R014 ³ Saturated zone hydraulic gradient ³ not used ³ 2.000E-02 ³ --- ³ HGWT
R014 ³ Saturated zone b parameter ³ not used ³ 5.300E+00 ³ --- ³ BSZ
R014 ³ Water table drop rate (m/yr) ³ not used ³ 1.000E-03 ³ --- ³ VWT
R014 ³ Well pump intake depth (m below water table) ³ not used ³ 1.000E+01 ³ --- ³ DWIBWT
R014 ³ Model: Nondispersion (ND) or Mass-Balance (MB) ³ not used ³ ND ³ --- ³ MODEL
R014 ³ Well pumping rate (m**3/yr) ³ not used ³ 2.500E+02 ³ --- ³ UW
³ ³ ³ ³ ³
R015 ³ Number of unsaturated zone strata ³ not used ³ 1 ³ --- ³ NS
R015 ³ Unsat. zone 1, thickness (m) ³ not used ³ 4.000E+00 ³ --- ³ H(1)
R015 ³ Unsat. zone 1, soil density (g/cm**3) ³ not used ³ 1.500E+00 ³ --- ³ DENSUZ(1)
R015 ³ Unsat. zone 1, total porosity ³ not used ³ 4.000E-01 ³ --- ³ TPUZ(1)
R015 ³ Unsat. zone 1, effective porosity ³ not used ³ 2.000E-01 ³ --- ³ EPUZ(1)
R015 ³ Unsat. zone 1, field capacity ³ not used ³ 2.000E-01 ³ --- ³ FCUZ(1)
R015 ³ Unsat. zone 1, soil-specific b parameter ³ not used ³ 5.300E+00 ³ --- ³ BUZ(1)
R015 ³ Unsat. zone 1, hydraulic conductivity (m/yr) ³ not used ³ 1.000E+01 ³ --- ³ HCUZ(1)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for Am-241 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 2.000E+01 ³ 2.000E+01 ³ --- ³ DCNUCC(2)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 2.000E+01 ³ --- ³ DCNUCU(2,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 2.000E+01 ³ --- ³ DCNUCS(2)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 4.636E-06 ³ ALEACH(2)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(2)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for Cs-137 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 1.000E+03 ³ 1.000E+03 ³ --- ³ DCNUCC(3)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 1.000E+03 ³ --- ³ DCNUCU(3,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 1.000E+03 ³ --- ³ DCNUCS(3)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 9.332E-08 ³ ALEACH(3)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(3)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for Pu-238 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 2.000E+03 ³ 2.000E+03 ³ --- ³ DCNUCC(8)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 2.000E+03 ³ --- ³ DCNUCU(8,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 2.000E+03 ³ --- ³ DCNUCS(8)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 4.666E-08 ³ ALEACH(8)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(8)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for Pu-239 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 2.000E+03 ³ 2.000E+03 ³ --- ³ DCNUCC(9)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 2.000E+03 ³ --- ³ DCNUCU(9,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 2.000E+03 ³ --- ³ DCNUCS(9)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 4.666E-08 ³ ALEACH(9)
R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(9)
³ ³ ³ ³ ³
R016 ³ Distribution coefficients for Sr-90 ³ ³ ³ ³
R016 ³ Contaminated zone (cm**3/g) ³ 3.000E+01 ³ 3.000E+01 ³ --- ³ DCNUCC(11)
R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 3.000E+01 ³ --- ³ DCNUCU(11,1)
R016 ³ Saturated zone (cm**3/g) ³ not used ³ 3.000E+01 ³ --- ³ DCNUCS(11)
R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 3.097E-06 ³ ALEACH(11)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(11)

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 8

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y+0-3meterCover.RAD

Site-Specific Parameter Summary (continued)

0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter

Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name

ÄÄÄÄÄÅÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄ

R016 ³ Distribution coefficients for daughter Ac-227 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³ 2.000E+01 ³ 2.000E+01 ³ --- ³ DCNUCC(1)

R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 2.000E+01 ³ --- ³ DCNUCU(1,1)

R016 ³ Saturated zone (cm**3/g) ³ not used ³ 2.000E+01 ³ --- ³ DCNUCS(1)

R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 4.636E-06 ³ ALEACH(1)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(1)

³ ³ ³ ³ ³

R016 ³ Distribution coefficients for daughter H-3 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³ 0.000E+00 ³ 0.000E+00 ³ --- ³ DCNUCC(4)

R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 0.000E+00 ³ --- ³ DCNUCU(4,1)

R016 ³ Saturated zone (cm**3/g) ³ not used ³ 0.000E+00 ³ --- ³ DCNUCS(4)

R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 7.000E-04 ³ ALEACH(4)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(4)

³ ³ ³ ³ ³

R016 ³ Distribution coefficients for daughter Np-237 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³-1.000E+00 ³-1.000E+00 ³ 2.574E+02 ³ DCNUCC(5)

R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³-1.000E+00 ³ --- ³ DCNUCU(5,1)

R016 ³ Saturated zone (cm**3/g) ³ not used ³-1.000E+00 ³ --- ³ DCNUCS(5)

R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 3.624E-07 ³ ALEACH(5)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(5)

³ ³ ³ ³ ³

R016 ³ Distribution coefficients for daughter Pa-231 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³ 5.000E+01 ³ 5.000E+01 ³ --- ³ DCNUCC(6)

R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCU(6,1)

R016 ³ Saturated zone (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCS(6)

R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.862E-06 ³ ALEACH(6)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(6)

³ ³ ³ ³ ³

R016 ³ Distribution coefficients for daughter Pb-210 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³ 1.000E+02 ³ 1.000E+02 ³ --- ³ DCNUCC(7)

R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 1.000E+02 ³ --- ³ DCNUCU(7,1)

R016 ³ Saturated zone (cm**3/g) ³ not used ³ 1.000E+02 ³ --- ³ DCNUCS(7)

R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 9.321E-07 ³ ALEACH(7)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(7)

³ ³ ³ ³ ³

R016 ³ Distribution coefficients for daughter Ra-226 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³ 7.000E+01 ³ 7.000E+01 ³ --- ³ DCNUCC(10)

R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 7.000E+01 ³ --- ³ DCNUCU(10,1)

R016 ³ Saturated zone (cm**3/g) ³ not used ³ 7.000E+01 ³ --- ³ DCNUCS(10)

R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.331E-06 ³ ALEACH(10)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(10)

³ ³ ³ ³ ³

R016 ³ Distribution coefficients for daughter Th-229 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³ 6.000E+04 ³ 6.000E+04 ³ --- ³ DCNUCC(12)

R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 6.000E+04 ³ --- ³ DCNUCU(12,1)

R016 ³ Saturated zone (cm**3/g) ³ not used ³ 6.000E+04 ³ --- ³ DCNUCS(12)

R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.556E-09 ³ ALEACH(12)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(12)

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 9

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y+0-3meterCover.RAD

Site-Specific Parameter Summary (continued)

0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter

Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name

ÄÄÄÄÄÄÅÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

R016 ³ Distribution coefficients for daughter Th-230 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³ 6.000E+04 ³ 6.000E+04 ³ --- ³ DCNUCC(13)

R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 6.000E+04 ³ --- ³ DCNUCU(13,1)

R016 ³ Saturated zone (cm**3/g) ³ not used ³ 6.000E+04 ³ --- ³ DCNUCS(13)

R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.556E-09 ³ ALEACH(13)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(13)

³ ³ ³ ³ ³

R016 ³ Distribution coefficients for daughter U-233 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³ 5.000E+01 ³ 5.000E+01 ³ --- ³ DCNUCC(14)

R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCU(14,1)

R016 ³ Saturated zone (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCS(14)

R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.862E-06 ³ ALEACH(14)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(14)

³ ³ ³ ³ ³

R016 ³ Distribution coefficients for daughter U-234 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³ 5.000E+01 ³ 5.000E+01 ³ --- ³ DCNUCC(15)

R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCU(15,1)

R016 ³ Saturated zone (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCS(15)

R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.862E-06 ³ ALEACH(15)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(15)

³ ³ ³ ³ ³

R016 ³ Distribution coefficients for daughter U-235 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³ 5.000E+01 ³ 5.000E+01 ³ --- ³ DCNUCC(16)

R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCU(16,1)

R016 ³ Saturated zone (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCS(16)

R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.862E-06 ³ ALEACH(16)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(16)

³ ³ ³ ³ ³

R016 ³ Distribution coefficients for daughter U-238 ³ ³ ³ ³

R016 ³ Contaminated zone (cm**3/g) ³ 5.000E+01 ³ 5.000E+01 ³ --- ³ DCNUCC(17)

R016 ³ Unsaturated zone 1 (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCU(17,1)

R016 ³ Saturated zone (cm**3/g) ³ not used ³ 5.000E+01 ³ --- ³ DCNUCS(17)

R016 ³ Leach rate (/yr) ³ 0.000E+00 ³ 0.000E+00 ³ 1.862E-06 ³ ALEACH(17)

R016 ³ Solubility constant ³ 0.000E+00 ³ 0.000E+00 ³ not used ³ SOLUBK(17)

³ ³ ³ ³ ³

R017 ³ Inhalation rate (m**3/yr) ³ 1.400E+04 ³ 8.400E+03 ³ --- ³ INHALR

R017 ³ Mass loading for inhalation (g/m**3) ³ 2.000E-05 ³ 1.000E-04 ³ --- ³ MLINH

R017 ³ Exposure duration ³ 3.000E+01 ³ 3.000E+01 ³ --- ³ ED

R017 ³ Shielding factor, inhalation ³ 4.000E-01 ³ 4.000E-01 ³ --- ³ SHF3

R017 ³ Shielding factor, external gamma ³ 7.000E-01 ³ 7.000E-01 ³ --- ³ SHF1

R017 ³ Fraction of time spent indoors ³ 0.000E+00 ³ 5.000E-01 ³ --- ³ FIND

R017 ³ Fraction of time spent outdoors (on site) ³ 1.600E-02 ³ 2.500E-01 ³ --- ³ FOTD

R017 ³ Shape factor flag, external gamma ³ 1.000E+00 ³ 1.000E+00 ³ >0 shows circular AREA. ³ FS

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 10

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y+0-3meterCover.RAD

Site-Specific Parameter Summary (continued)

0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter

Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name

ÄÄÄÄÄÅÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄ
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

R017 ³ Radii of shape factor array (used if FS = -1): ³ ³ ³ ³

R017 ³ Outer annular radius (m), ring 1: ³ not used ³ 5.000E+01 ³ --- ³ RAD_SHAPE(1)

R017 ³ Outer annular radius (m), ring 2: ³ not used ³ 7.071E+01 ³ --- ³ RAD_SHAPE(2)

R017 ³ Outer annular radius (m), ring 3: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(3)

R017 ³ Outer annular radius (m), ring 4: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(4)

R017 ³ Outer annular radius (m), ring 5: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(5)

R017 ³ Outer annular radius (m), ring 6: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(6)

R017 ³ Outer annular radius (m), ring 7: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(7)

R017 ³ Outer annular radius (m), ring 8: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(8)

R017 ³ Outer annular radius (m), ring 9: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(9)

R017 ³ Outer annular radius (m), ring 10: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(10)

R017 ³ Outer annular radius (m), ring 11: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(11)

R017 ³ Outer annular radius (m), ring 12: ³ not used ³ 0.000E+00 ³ --- ³ RAD_SHAPE(12)

³ ³ ³ ³ ³

R017 ³ Fractions of annular areas within AREA: ³ ³ ³ ³

R017 ³ Ring 1 ³ not used ³ 1.000E+00 ³ --- ³ FRACA(1)

R017 ³ Ring 2 ³ not used ³ 2.732E-01 ³ --- ³ FRACA(2)

R017 ³ Ring 3 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(3)

R017 ³ Ring 4 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(4)

R017 ³ Ring 5 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(5)

R017 ³ Ring 6 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(6)

R017 ³ Ring 7 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(7)

R017 ³ Ring 8 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(8)

R017 ³ Ring 9 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(9)

R017 ³ Ring 10 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(10)

R017 ³ Ring 11 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(11)

R017 ³ Ring 12 ³ not used ³ 0.000E+00 ³ --- ³ FRACA(12)

³ ³ ³ ³ ³

R018 ³ Fruits, vegetables and grain consumption (kg/yr) ³ not used ³ 1.600E+02 ³ --- ³ DIET(1)

R018 ³ Leafy vegetable consumption (kg/yr) ³ not used ³ 1.400E+01 ³ --- ³ DIET(2)

R018 ³ Milk consumption (L/yr) ³ not used ³ 9.200E+01 ³ --- ³ DIET(3)

R018 ³ Meat and poultry consumption (kg/yr) ³ not used ³ 6.300E+01 ³ --- ³ DIET(4)

R018 ³ Fish consumption (kg/yr) ³ not used ³ 5.400E+00 ³ --- ³ DIET(5)

R018 ³ Other seafood consumption (kg/yr) ³ not used ³ 9.000E-01 ³ --- ³ DIET(6)

R018 ³ Soil ingestion rate (g/yr) ³ 5.870E+02 ³ 3.650E+01 ³ --- ³ SOIL

R018 ³ Drinking water intake (L/yr) ³ not used ³ 5.100E+02 ³ --- ³ DWI

R018 ³ Contamination fraction of drinking water ³ not used ³ 1.000E+00 ³ --- ³ FDW

R018 ³ Contamination fraction of household water ³ not used ³ 1.000E+00 ³ --- ³ FHHW

R018 ³ Contamination fraction of livestock water ³ not used ³ 1.000E+00 ³ --- ³ FLW

R018 ³ Contamination fraction of irrigation water ³ not used ³ 1.000E+00 ³ --- ³ FIRW

R018 ³ Contamination fraction of aquatic food ³ not used ³ 5.000E-01 ³ --- ³ FR9

R018 ³ Contamination fraction of plant food ³ not used ³-1 ³ --- ³ FPLANT

R018 ³ Contamination fraction of meat ³ not used ³-1 ³ --- ³ FMEAT

R018 ³ Contamination fraction of milk ³ not used ³-1 ³ --- ³ FMILK

³ ³ ³ ³ ³

R019 ³ Livestock fodder intake for meat (kg/day) ³ not used ³ 6.800E+01 ³ --- ³ LFI5

R019 ³ Livestock fodder intake for milk (kg/day) ³ not used ³ 5.500E+01 ³ --- ³ LFI6

R019 ³ Livestock water intake for meat (L/day) ³ not used ³ 5.000E+01 ³ --- ³ LWI5

R019 ³ Livestock water intake for milk (L/day) ³ not used ³ 1.600E+02 ³ --- ³ LWI6

R019 ³ Livestock soil intake (kg/day) ³ not used ³ 5.000E-01 ³ --- ³ LSI

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 11

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y+0-3meterCover.RAD

Site-Specific Parameter Summary (continued)

0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter

Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name

ÄÄÄÄÄÅÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄ
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

R019 ³ Mass loading for foliar deposition (g/m**3) ³ not used ³ 1.000E-04 ³ --- ³ MLFD

R019 ³ Depth of soil mixing layer (m) ³ 1.500E-01 ³ 1.500E-01 ³ --- ³ DM

R019 ³ Depth of roots (m) ³ not used ³ 9.000E-01 ³ --- ³ DROOT

R019 ³ Drinking water fraction from ground water ³ not used ³ 1.000E+00 ³ --- ³ FGWDW

R019 ³ Household water fraction from ground water ³ not used ³ 1.000E+00 ³ --- ³ FGWHH

R019 ³ Livestock water fraction from ground water ³ not used ³ 1.000E+00 ³ --- ³ FGWLW

R019 ³ Irrigation fraction from ground water ³ not used ³ 1.000E+00 ³ --- ³ FGWIR

³ ³ ³ ³ ³

R19B ³ Wet weight crop yield for Non-Leafy (kg/m**2) ³ not used ³ 7.000E-01 ³ --- ³ YV(1)

R19B ³ Wet weight crop yield for Leafy (kg/m**2) ³ not used ³ 1.500E+00 ³ --- ³ YV(2)

R19B ³ Wet weight crop yield for Fodder (kg/m**2) ³ not used ³ 1.100E+00 ³ --- ³ YV(3)

R19B ³ Growing Season for Non-Leafy (years) ³ not used ³ 1.700E-01 ³ --- ³ TE(1)

R19B ³ Growing Season for Leafy (years) ³ not used ³ 2.500E-01 ³ --- ³ TE(2)

R19B ³ Growing Season for Fodder (years) ³ not used ³ 8.000E-02 ³ --- ³ TE(3)

R19B ³ Translocation Factor for Non-Leafy ³ not used ³ 1.000E-01 ³ --- ³ TIV(1)
R19B ³ Translocation Factor for Leafy ³ not used ³ 1.000E+00 ³ --- ³ TIV(2)
R19B ³ Translocation Factor for Fodder ³ not used ³ 1.000E+00 ³ --- ³ TIV(3)
R19B ³ Dry Foliar Interception Fraction for Non-Leafy ³ not used ³ 2.500E-01 ³ --- ³ RDRY(1)
R19B ³ Dry Foliar Interception Fraction for Leafy ³ not used ³ 2.500E-01 ³ --- ³ RDRY(2)
R19B ³ Dry Foliar Interception Fraction for Fodder ³ not used ³ 2.500E-01 ³ --- ³ RDRY(3)
R19B ³ Wet Foliar Interception Fraction for Non-Leafy ³ not used ³ 2.500E-01 ³ --- ³ RWET(1)
R19B ³ Wet Foliar Interception Fraction for Leafy ³ not used ³ 2.500E-01 ³ --- ³ RWET(2)
R19B ³ Wet Foliar Interception Fraction for Fodder ³ not used ³ 2.500E-01 ³ --- ³ RWET(3)
R19B ³ Weathering Removal Constant for Vegetation ³ not used ³ 2.000E+01 ³ --- ³ WLAM
³ ³ ³ ³ ³
C14 ³ C-12 concentration in water (g/cm**3) ³ not used ³ 2.000E-05 ³ --- ³ C12WTR
C14 ³ C-12 concentration in contaminated soil (g/g) ³ not used ³ 3.000E-02 ³ --- ³ C12CZ
C14 ³ Fraction of vegetation carbon from soil ³ not used ³ 2.000E-02 ³ --- ³ CSOIL
C14 ³ Fraction of vegetation carbon from air ³ not used ³ 9.800E-01 ³ --- ³ CAIR
C14 ³ C-14 evasion layer thickness in soil (m) ³ not used ³ 3.000E-01 ³ --- ³ DMC
C14 ³ C-14 evasion flux rate from soil (1/sec) ³ not used ³ 7.000E-07 ³ --- ³ EVSN
C14 ³ C-12 evasion flux rate from soil (1/sec) ³ not used ³ 1.000E-10 ³ --- ³ REVSN
C14 ³ Fraction of grain in beef cattle feed ³ not used ³ 8.000E-01 ³ --- ³ AVFG4
C14 ³ Fraction of grain in milk cow feed ³ not used ³ 2.000E-01 ³ --- ³ AVFG5
C14 ³ DCF correction factor for gaseous forms of C14 ³ not used ³ 8.894E+01 ³ --- ³ CO2F
³ ³ ³ ³ ³
STOR ³ Storage times of contaminated foodstuffs (days): ³ ³ ³ ³
STOR ³ Fruits, non-leafy vegetables, and grain ³ 1.400E+01 ³ 1.400E+01 ³ --- ³ STOR_T(1)
STOR ³ Leafy vegetables ³ 1.000E+00 ³ 1.000E+00 ³ --- ³ STOR_T(2)
STOR ³ Milk ³ 1.000E+00 ³ 1.000E+00 ³ --- ³ STOR_T(3)
STOR ³ Meat and poultry ³ 2.000E+01 ³ 2.000E+01 ³ --- ³ STOR_T(4)
STOR ³ Fish ³ 7.000E+00 ³ 7.000E+00 ³ --- ³ STOR_T(5)
STOR ³ Crustacea and mollusks ³ 7.000E+00 ³ 7.000E+00 ³ --- ³ STOR_T(6)
STOR ³ Well water ³ 1.000E+00 ³ 1.000E+00 ³ --- ³ STOR_T(7)
STOR ³ Surface water ³ 1.000E+00 ³ 1.000E+00 ³ --- ³ STOR_T(8)
STOR ³ Livestock fodder ³ 4.500E+01 ³ 4.500E+01 ³ --- ³ STOR_T(9)
³ ³ ³ ³ ³
R021 ³ Thickness of building foundation (m) ³ not used ³ 1.500E-01 ³ --- ³ FLOOR1
R021 ³ Bulk density of building foundation (g/cm**3) ³ not used ³ 2.400E+00 ³ --- ³ DENSFL
R021 ³ Total porosity of the cover material ³ not used ³ 4.000E-01 ³ --- ³ TPCV
1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 12
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y+0-3meterCover.RAD

Site-Specific Parameter Summary (continued)
0 ³ ³ User ³ ³ Used by RESRAD ³ Parameter
Menu ³ Parameter ³ Input ³ Default ³ (If different from user input) ³ Name

ÄÄÄÄÄÅÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄ
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄ
R021 ³ Total porosity of the building foundation ³ not used ³ 1.000E-01 ³ --- ³ TPFL
R021 ³ Volumetric water content of the cover material ³ not used ³ 5.000E-02 ³ --- ³ PH2OCV
R021 ³ Volumetric water content of the foundation ³ not used ³ 3.000E-02 ³ --- ³ PH2OFL

R021 ³ Diffusion coefficient for radon gas (m/sec): ³ ³ ³ ³
R021 ³ in cover material ³ not used ³ 2.000E-06 ³ --- ³ DIFCV
R021 ³ in foundation material ³ not used ³ 3.000E-07 ³ --- ³ DIFFL
R021 ³ in contaminated zone soil ³ not used ³ 2.000E-06 ³ --- ³ DIFCZ
R021 ³ Radon vertical dimension of mixing (m) ³ not used ³ 2.000E+00 ³ --- ³ HMIX
R021 ³ Average building air exchange rate (1/hr) ³ not used ³ 5.000E-01 ³ --- ³ REXG
R021 ³ Height of the building (room) (m) ³ not used ³ 2.500E+00 ³ --- ³ HRM
R021 ³ Building interior area factor ³ not used ³ 0.000E+00 ³ --- ³ FAI
R021 ³ Building depth below ground surface (m) ³ not used ³-1.000E+00 ³ --- ³ DMFL
R021 ³ Emanating power of Rn-222 gas ³ not used ³ 2.500E-01 ³ --- ³ EMANA(1)
R021 ³ Emanating power of Rn-220 gas ³ not used ³ 1.500E-01 ³ --- ³ EMANA(2)
³ ³ ³ ³ ³
TITL ³ Number of graphical time points ³ 32 ³ --- ³ --- ³ NPTS
TITL ³ Maximum number of integration points for dose ³ 17 ³ --- ³ --- ³ LYMAX
TITL ³ Maximum number of integration points for risk ³ 257 ³ --- ³ --- ³ KYMAX
ÍÍ

Summary of Pathway Selections

Pathway ³ User Selection
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
1 -- external gamma ³ active
2 -- inhalation (w/o radon)³ active
3 -- plant ingestion ³ suppressed
4 -- meat ingestion ³ suppressed
5 -- milk ingestion ³ suppressed
6 -- aquatic foods ³ suppressed
7 -- drinking water ³ suppressed
8 -- soil ingestion ³ active
9 -- radon ³ suppressed
Find peak pathway doses ³ suppressed
ÍÍÍ
1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 13
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y+0-3meterCover.RAD

Contaminated Zone Dimensions Initial Soil Concentrations, pCi/g
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
Area: 10000.00 square meters Am-241 2.700E+01
Thickness: 2.00 meters Cs-137 1.130E+02
Cover Depth: 0.30 meters Pu-238 1.000E+00
Pu-239 1.600E+01
Sr-90 3.300E+01
0
Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 1.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

ÄÄÄ

t (years): 0.000E+00 1.000E+00 5.000E+01 1.000E+02 3.000E+02 1.000E+03

TDOSE(t): 7.930E-02 7.860E-02 5.094E-02 3.272E-02 1.126E+00 7.115E-01

M(t): 5.287E-03 5.240E-03 3.396E-03 2.181E-03 7.507E-02 4.743E-02

0Maximum TDOSE(t): 1.126E+00 mrem/yr at t = 300.0 ñ 0.6 years

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground Inhalation Radon Plant Meat Milk Soil

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

Nuclide

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 1.133E-02 0.0101 4.878E-03 0.0043 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.694E-01 0.5056

Cs-137 5.571E-03 0.0049 2.295E-09 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.123E-05 0.0000

Pu-238 2.297E-07 0.0000 2.411E-05 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.799E-03 0.0025

Pu-239 7.195E-05 0.0001 4.489E-03 0.0040 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.274E-01 0.4684

Sr-90 1.016E-05 0.0000 2.230E-08 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.708E-05 0.0000

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 1.699E-02 0.0151 9.391E-03 0.0083 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.100E+00 0.9766

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

Nuclide

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.856E-01 0.5200

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.622E-03 0.0050

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.824E-03 0.0025

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.319E-01 0.4724

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 4.726E-05 0.0000

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.126E+00 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 14

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y+0-3meterCover.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground Inhalation Radon Plant Meat Milk Soil

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 1.262E-08 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Cs-137 7.924E-02 0.9993 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Pu-238 1.072E-10 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Pu-239 1.403E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Sr-90 5.305E-05 0.0007 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 7.930E-02 1.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.262E-08 0.0000

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 7.924E-02 0.9993

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.072E-10 0.0000

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.403E-07 0.0000

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.305E-05 0.0007

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 7.930E-02 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 15

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y+0-3meterCover.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground Inhalation Radon Plant Meat Milk Soil

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 1.377E-08 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Cs-137 7.855E-02 0.9993 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Pu-238 1.095E-10 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Pu-239 1.432E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Sr-90 5.275E-05 0.0007 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 7.860E-02 1.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.377E-08 0.0000

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 7.855E-02 0.9993

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.095E-10 0.0000

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.432E-07 0.0000

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.275E-05 0.0007

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 7.860E-02 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 16

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y+0-3meterCover.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground Inhalation Radon Plant Meat Milk Soil

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 1.883E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Cs-137 5.090E-02 0.9992 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Pu-238 3.160E-10 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Pu-239 3.858E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Sr-90 3.969E-05 0.0008 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 5.094E-02 1.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.883E-07 0.0000

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.090E-02 0.9992

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.160E-10 0.0000

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.858E-07 0.0000

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.969E-05 0.0008

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.094E-02 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 17

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y+0-3meterCover.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground Inhalation Radon Plant Meat Milk Soil

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 1.482E-06 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Cs-137 3.269E-02 0.9990 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Pu-238 9.440E-10 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Pu-239 1.061E-06 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

Sr-90 2.969E-05 0.0009 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 3.272E-02 1.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.482E-06 0.0000

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.269E-02 0.9990

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 9.440E-10 0.0000

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.061E-06 0.0000

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.969E-05 0.0009

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.272E-02 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 18

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y+0-3meterCover.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground Inhalation Radon Plant Meat Milk Soil

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 1.133E-02 0.0101 4.878E-03 0.0043 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.694E-01 0.5056

Cs-137 5.571E-03 0.0049 2.295E-09 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.123E-05 0.0000

Pu-238 2.297E-07 0.0000 2.411E-05 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.799E-03 0.0025

Pu-239 7.195E-05 0.0001 4.489E-03 0.0040 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.274E-01 0.4684

Sr-90 1.016E-05 0.0000 2.230E-08 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 3.708E-05 0.0000

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 1.699E-02 0.0151 9.391E-03 0.0083 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.100E+00 0.9766

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.856E-01 0.5200

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.622E-03 0.0050

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.824E-03 0.0025

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.319E-01 0.4724

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 4.726E-05 0.0000

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.126E+00 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 19

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y+0-3meterCover.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground Inhalation Radon Plant Meat Milk Soil

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 3.737E-03 0.0053 1.584E-03 0.0022 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.848E-01 0.2598

Cs-137 5.270E-10 0.0000 2.172E-16 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 4.846E-12 0.0000

Pu-238 8.398E-08 0.0000 1.272E-07 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.210E-05 0.0000

Pu-239 7.064E-05 0.0001 4.399E-03 0.0062 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.168E-01 0.7264

Sr-90 5.882E-13 0.0000 1.291E-15 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.147E-12 0.0000

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 3.808E-03 0.0054 5.983E-03 0.0084 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 7.017E-01 0.9862

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)

As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

0 Water Dependent Pathways

0 Water Fish Radon Plant Meat Milk All Pathways*

Radio- ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ

Nuclide mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract. mrem/yr fract.

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ

Am-241 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.902E-01 0.2673

Cs-137 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.319E-10 0.0000

Pu-238 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 1.231E-05 0.0000

Pu-239 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 5.213E-01 0.7327

Sr-90 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 2.737E-12 0.0000

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ

Total 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 0.000E+00 0.0000 7.115E-01 1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 20

Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr

File : TUHME-200y+0-3meterCover.RAD

Dose/Source Ratios Summed Over All Pathways

Parent and Progeny Principal Radionuclide Contributions Indicated

0Parent Product Branch DSR(j,t) (mrem/yr)/(pCi/g)

(i) (j) Fraction* t= 0.000E+00 1.000E+00 5.000E+01 1.000E+02 3.000E+02 1.000E+03

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ

Am-241 Am-241 1.000E+00 4.567E-10 4.779E-10 4.408E-09 4.254E-08 2.168E-02 7.033E-03

Am-241 Np-237 1.000E+00 1.054E-11 3.212E-11 2.565E-09 1.235E-08 4.533E-06 9.457E-06

Am-241 U-233 1.000E+00 9.169E-21 6.531E-20 1.928E-16 2.109E-15 1.546E-10 1.248E-09

Am-241 Th-229 1.000E+00 8.169E-22 1.243E-20 9.569E-16 1.723E-14 3.392E-11 9.648E-10

Am-241 äDSR(j) 4.673E-10 5.100E-10 6.973E-09 5.489E-08 2.169E-02 7.043E-03

0Cs-137 Cs-137 1.000E+00 7.013E-04 6.951E-04 4.504E-04 2.893E-04 4.975E-05 4.707E-12

0Pu-238 Pu-238 1.000E+00 1.072E-10 1.095E-10 3.140E-10 9.200E-10 2.823E-03 1.119E-05

Pu-238 U-234 1.000E+00 1.084E-15 3.325E-15 3.858E-13 2.753E-12 8.945E-07 9.829E-07

Pu-238 Th-230 1.000E+00 1.605E-20 1.148E-19 4.366E-16 6.237E-15 3.223E-09 1.510E-08

Pu-238 Ra-226 1.000E+00 1.842E-18 2.788E-17 1.593E-12 2.125E-11 5.293E-09 8.675E-08

Pu-238 Pb-210 1.000E+00 8.119E-26 2.557E-24 6.763E-18 2.866E-16 1.534E-09 3.058E-08

Pu-238 äDSR(j) 1.072E-10 1.095E-10 3.160E-10 9.440E-10 2.824E-03 1.231E-05

0Pu-239 Pu-239 1.000E+00 8.772E-09 8.951E-09 2.411E-08 6.627E-08 3.325E-02 3.258E-02

Pu-239 U-235 1.000E+00 1.129E-14 3.449E-14 3.196E-12 1.789E-11 4.160E-09 1.370E-08

Pu-239 Pa-231 1.000E+00 5.407E-20 3.842E-19 9.824E-16 9.278E-15 9.667E-11 1.058E-09

Pu-239 Ac-227 1.000E+00 4.274E-21 6.464E-20 3.705E-15 5.290E-14 1.323E-10 1.674E-09

Pu-239 äDSR(j) 8.772E-09 8.951E-09 2.411E-08 6.628E-08 3.325E-02 3.258E-02

0Sr-90 Sr-90 1.000E+00 1.608E-06 1.598E-06 1.203E-06 8.996E-07 1.432E-06 8.293E-14

ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).

The DSR includes contributions from associated (half-life ó 0.5 yr) daughters.

0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g

Basic Radiation Dose Limit = 1.500E+01 mrem/yr

0Nuclide

(i) t= 0.000E+00 1.000E+00 5.000E+01 1.000E+02 3.000E+02 1.000E+03

ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ

Am-241 3.210E+10 2.941E+10 2.151E+09 2.733E+08 6.916E+02 2.130E+03

Cs-137 2.139E+04 2.158E+04 3.330E+04 5.185E+04 3.015E+05 3.187E+12
Pu-238 1.400E+11 1.370E+11 4.747E+10 1.589E+10 5.312E+03 1.219E+06
Pu-239 1.710E+09 1.676E+09 6.221E+08 2.263E+08 4.512E+02 4.604E+02
Sr-90 9.330E+06 9.384E+06 1.247E+07 1.667E+07 1.047E+07 *1.365E+14
ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ
*At specific activity limit
1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 21
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y+0-3meterCover.RAD

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 300.0 ñ 0.6 years
0Nuclide Initial tmin DSR(i,tmin) G(i,tmin) DSR(i,tmax) G(i,tmax)
(i) (pCi/g) (years) (pCi/g) (pCi/g)
ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ
Am-241 2.700E+01 300.0 ñ 0.6 2.169E-02 6.916E+02 2.169E-02 6.916E+02
Cs-137 1.130E+02 0.000E+00 7.013E-04 2.139E+04 4.975E-05 3.015E+05
Pu-238 1.000E+00 276.2 ñ 0.6 2.878E-03 5.212E+03 2.824E-03 5.312E+03
Pu-239 1.600E+01 300.0 ñ 0.6 3.325E-02 4.512E+02 3.325E-02 4.512E+02
Sr-90 3.300E+01 190.3 ñ 0.4 4.697E-06 3.193E+06 1.432E-06 1.047E+07
ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ

1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 22
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y+0-3meterCover.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated
0Nuclide Parent BRF(i) DOSE(j,t), mrem/yr
(j) (i) t= 0.000E+00 1.000E+00 5.000E+01 1.000E+02 3.000E+02 1.000E+03
ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ
Am-241 Am-241 1.000E+00 1.233E-08 1.290E-08 1.190E-07 1.149E-06 5.854E-01 1.899E-01
0Np-237 Am-241 1.000E+00 2.846E-10 8.672E-10 6.926E-08 3.333E-07 1.224E-04 2.553E-04
0U-233 Am-241 1.000E+00 2.476E-19 1.763E-18 5.204E-15 5.693E-14 4.175E-09 3.371E-08
0Th-229 Am-241 1.000E+00 2.206E-20 3.356E-19 2.584E-14 4.653E-13 9.159E-10 2.605E-08
0Cs-137 Cs-137 1.000E+00 7.924E-02 7.855E-02 5.090E-02 3.269E-02 5.622E-03 5.319E-10
0Pu-238 Pu-238 1.000E+00 1.072E-10 1.095E-10 3.140E-10 9.200E-10 2.823E-03 1.119E-05
0U-234 Pu-238 1.000E+00 1.084E-15 3.325E-15 3.858E-13 2.753E-12 8.945E-07 9.829E-07
0Th-230 Pu-238 1.000E+00 1.605E-20 1.148E-19 4.366E-16 6.237E-15 3.223E-09 1.510E-08
0Ra-226 Pu-238 1.000E+00 1.842E-18 2.788E-17 1.593E-12 2.125E-11 5.293E-09 8.675E-08
0Pb-210 Pu-238 1.000E+00 8.119E-26 2.557E-24 6.763E-18 2.866E-16 1.534E-09 3.058E-08
0Pu-239 Pu-239 1.000E+00 1.403E-07 1.432E-07 3.858E-07 1.060E-06 5.319E-01 5.213E-01
0U-235 Pu-239 1.000E+00 1.806E-13 5.519E-13 5.114E-11 2.863E-10 6.655E-08 2.192E-07
0Pa-231 Pu-239 1.000E+00 8.652E-19 6.147E-18 1.572E-14 1.485E-13 1.547E-09 1.693E-08
0Ac-227 Pu-239 1.000E+00 6.839E-20 1.034E-18 5.927E-14 8.463E-13 2.117E-09 2.678E-08
0Sr-90 Sr-90 1.000E+00 5.305E-05 5.275E-05 3.969E-05 2.969E-05 4.726E-05 2.737E-12
ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ

BRF(i) is the branch fraction of the parent nuclide.
1RESRAD, Version 6.1 T« Limit = 0.5 year 04/17/2002 05:23 Page 23
Summary : Trail User, Hiker, 140 hrs/yr, 67 mg/hr soil ingestion---21-0011k mean concentr
File : TUHME-200y+0-3meterCover.RAD

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated
0Nuclide Parent BRF(i) S(j,t), pCi/g
(j) (i) t= 0.000E+00 1.000E+00 5.000E+01 1.000E+02 3.000E+02 1.000E+03
ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ
Am-241 Am-241 1.000E+00 2.700E+01 2.696E+01 2.491E+01 2.299E+01 1.667E+01 5.406E+00
0Np-237 Am-241 1.000E+00 0.000E+00 8.738E-06 4.201E-04 8.078E-04 2.081E-03 4.347E-03
0U-233 Am-241 1.000E+00 0.000E+00 1.911E-11 4.654E-08 1.813E-07 1.474E-06 1.192E-05
0Th-229 Am-241 1.000E+00 0.000E+00 6.017E-16 7.366E-11 5.770E-10 1.435E-08 4.097E-07
0Cs-137 Cs-137 1.000E+00 1.130E+02 1.104E+02 3.559E+01 1.121E+01 1.103E-01 1.044E-08
0Pu-238 Pu-238 1.000E+00 1.000E+00 9.921E-01 6.737E-01 4.538E-01 9.348E-02 3.707E-04
0U-234 Pu-238 1.000E+00 0.000E+00 2.824E-06 1.171E-04 1.959E-04 3.250E-04 3.573E-04
0Th-230 Pu-238 1.000E+00 0.000E+00 1.273E-11 2.808E-08 9.966E-08 5.975E-07 2.804E-06
0Ra-226 Pu-238 1.000E+00 0.000E+00 1.839E-15 2.081E-10 1.512E-09 2.908E-08 4.781E-07
0Pb-210 Pu-238 1.000E+00 0.000E+00 1.421E-17 6.203E-11 7.216E-10 2.233E-08 4.467E-07
0Pu-239 Pu-239 1.000E+00 1.600E+01 1.600E+01 1.598E+01 1.595E+01 1.586E+01 1.554E+01
0U-235 Pu-239 1.000E+00 0.000E+00 1.576E-08 7.873E-07 1.573E-06 4.706E-06 1.552E-05
0Pa-231 Pu-239 1.000E+00 0.000E+00 1.667E-13 4.164E-10 1.664E-09 1.492E-08 1.637E-07
0Ac-227 Pu-239 1.000E+00 0.000E+00 1.755E-15 1.550E-10 9.336E-10 1.213E-08 1.538E-07
0Sr-90 Sr-90 1.000E+00 3.300E+01 3.222E+01 1.004E+01 3.052E+00 2.611E-02 1.512E-09
ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ
BRF(i) is the branch fraction of the parent nuclide.
0RESCALC.EXE execution time = 1.76 seconds