TA-10 ENTERED

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Re: Documents Relating to NMED Accelerator Produced Rad Request

John,

Attached are the following four documents:

1. VCA Plan for SWMUs at TA-33, Nov. 1995, LA-CP-03-0089 (#27);
1. VCA Plan for AOC C-10-001, Radioactively Contaminated Soil, Aug. 1995, LA-CP-03-0090 (#29);
3. Expedited Cleanup Plan for SWMUs 48-002(a) and (b), April 1995, LA-CP-090091 (#28); and,
4. Interim Action Plan for PRS 18-003 (a-d, g), May 1996, LA-CP-03-0092 (#30).

The number in parentheses indicates the number the document was on the list of attachments with our response to the information request sent to NMED.

Finally, these documents have "LA-CP" numbers because they are drafts and not final documents. I have been advised that at this time there is no intention to finalize the attachments and that is why they do not have "LA-UR" numbers.

Beth

Beth

1576

SCANNED

LA-CP-03-0089

*Los Alamos Controlled Publication; distribution is limited.*

*Title:* Voluntary Corrective Action Plan for Solid Waste Management Units at TA-33

*Author(s):* John McCann
Environmental Restoration Project

*Submitted to:* New Mexico Environment Department

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Form 1756c (10/98)

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# Voluntary Corrective Action Plan
## for
## Solid Waste Management Units at TA-33

33-010(a), Canyon-Side Disposal Area
33-010(b), Canyon-Side Disposal Area
33-010(d), Surface Disposal Area
33-010(g), Canyon-Side Disposal Area
33-011(b), General Storage Area

**Field Unit 3**

**Environmental Restoration Project**

November 1995

A Department of Energy
Environmental Cleanup Program

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## FIELD WORK APPROVAL FORM

This form must be completed prior to starting remediation field work for Voluntary Corrective Action (VCA) for SWMUs 33-010(a,b,d,g) and 33-011(b).

I, _____, DOE-LAAO, APPROVE the field work as proposed in the accompanying Voluntary Corrective Action Plan for SWMUs 33-010(a,b,d,g) and 33-011(b).

I, _____, DOE-LAAO, DO NOT APPROVE the field work as proposed in the accompanying Voluntary Corrective Action Plan for SWMUs 33-010(a,b,d,g) and 33-011(b).

The following reasons reflect the decision for disapproval:

Signed: _____ Date:_____

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## 1.0 INTRODUCTION

Solid Waste Management Units (SWMUs) 33-010(a,b,d,g) and 33-011(b) are disposal and storage areas and associated soil located at Technical Area (TA)-33 in Operable Unit (OU) 1122 at Los Alamos National Laboratory (LANL). From 1947 to 1972 TA-33 was used for weapons' experiments employing conventional high explosives (HE), uranium, beryllium, and polonium. The site contains gun-firing areas, firing sites, an office, and a laboratory and shop complex. A tritium facility operated at TA-33 from 1955 to 1990. The National Radio Astronomy Observatory's (NRAO) Very Large Baseline Radiotelescope is currently operational at TA-33.

These SWMUs are considered in one Voluntary Corrective Action (VCA) plan because they are similar in nature and have similar remediation plans. Four SWMUs contain debris that has been disposed over the canyon rim. SWMU 33-011(b) is a storage area containing debris.

The SWMUs addressed in this VCA plan will be implemented by Field Unit 3 Project Leader, Brad Martin. The corrective actions for these SWMUs include screening and removal of debris that will be segregated into hazardous, radioactive, nonhazardous, and nonradioactive wastes. At SWMU 16-010(b), some contaminated soil will be removed incidentally during the removal of small pieces of debris.

## 2.0 SITE TYPE AND DESCRIPTION

Table 2-1 identifies each SWMU to be remediated, its location, its description, and a description of the waste to be remediated.

**TABLE 2-1**

**SWMU DESCRIPTION**

| SWMU NUMBER | SWMU LOCATION | SWMU DESCRIPTION | WASTE DESCRIPTION |
|---|---|---|---|
| 33-010(a) | SE corner of East Site, White Rock Canyon | Canyon-side disposal area | Debris, metal, wood, plastic foam |
| 33-010(b) | SW of TA-33-89, East Site, White Rock Canyon | Canyon-side disposal area | Metal scrap, plastic foam |
| 33-010(d) | N edge of East Site, S rim of Ancho Canyon | Surface disposal area | Debris, foam, glass, concrete, metal scrap |
| 33-010(g) | S and E edge of South Site, North Chaquehui Canyon | Canyon-side disposal area | Debris, metal scrap |
| 33-011(b) | NRAO Site | Storage area | Debris, metal, wood |

Figures 2-1, 2-2, 2-3, and 2-4 are location maps for SWMUs 33-010(a,b,d,g) and 33-011(b) and include RFI Phase I sample locations.

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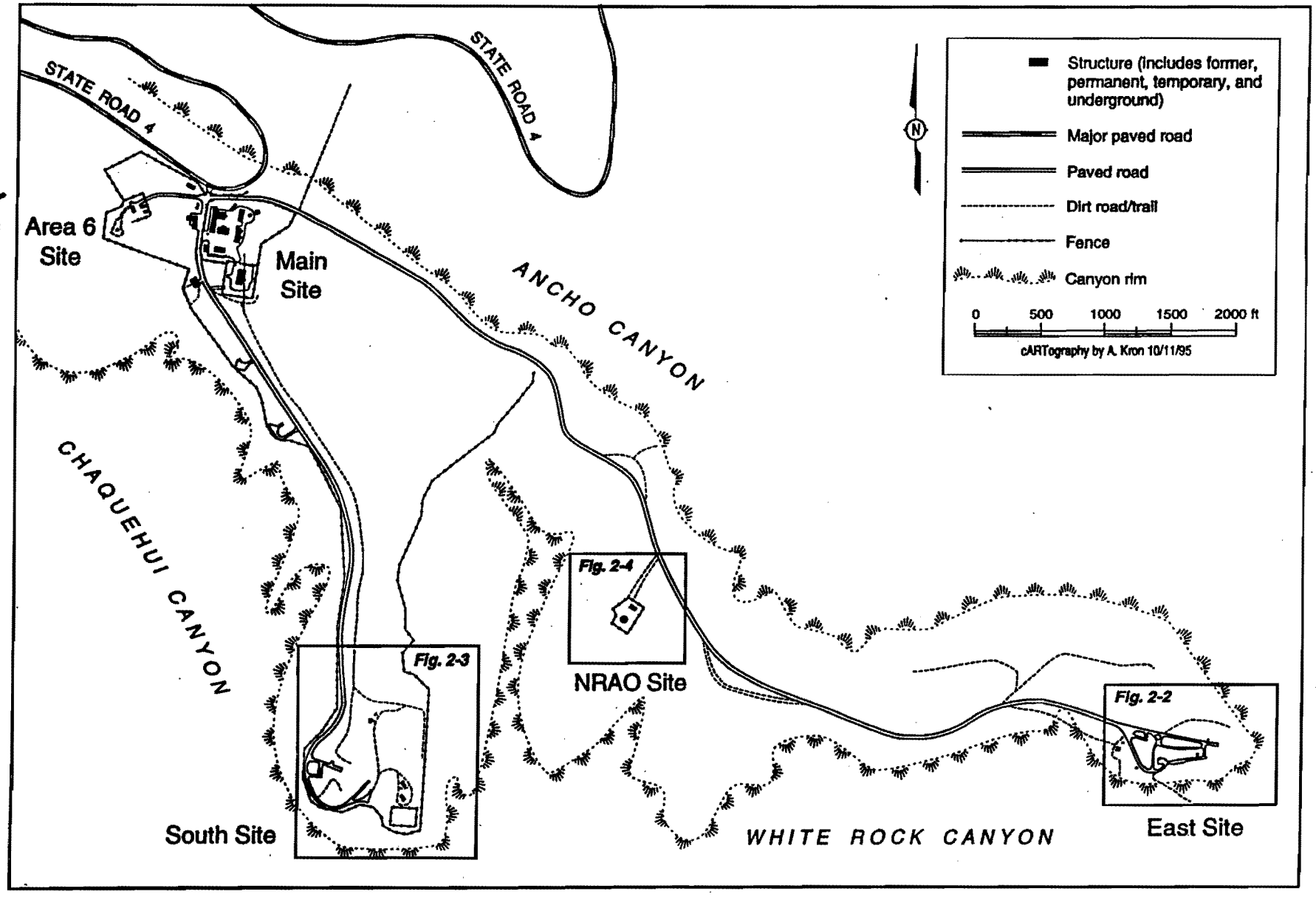


**Fig. 2-1. General Location Map of TA-33.**

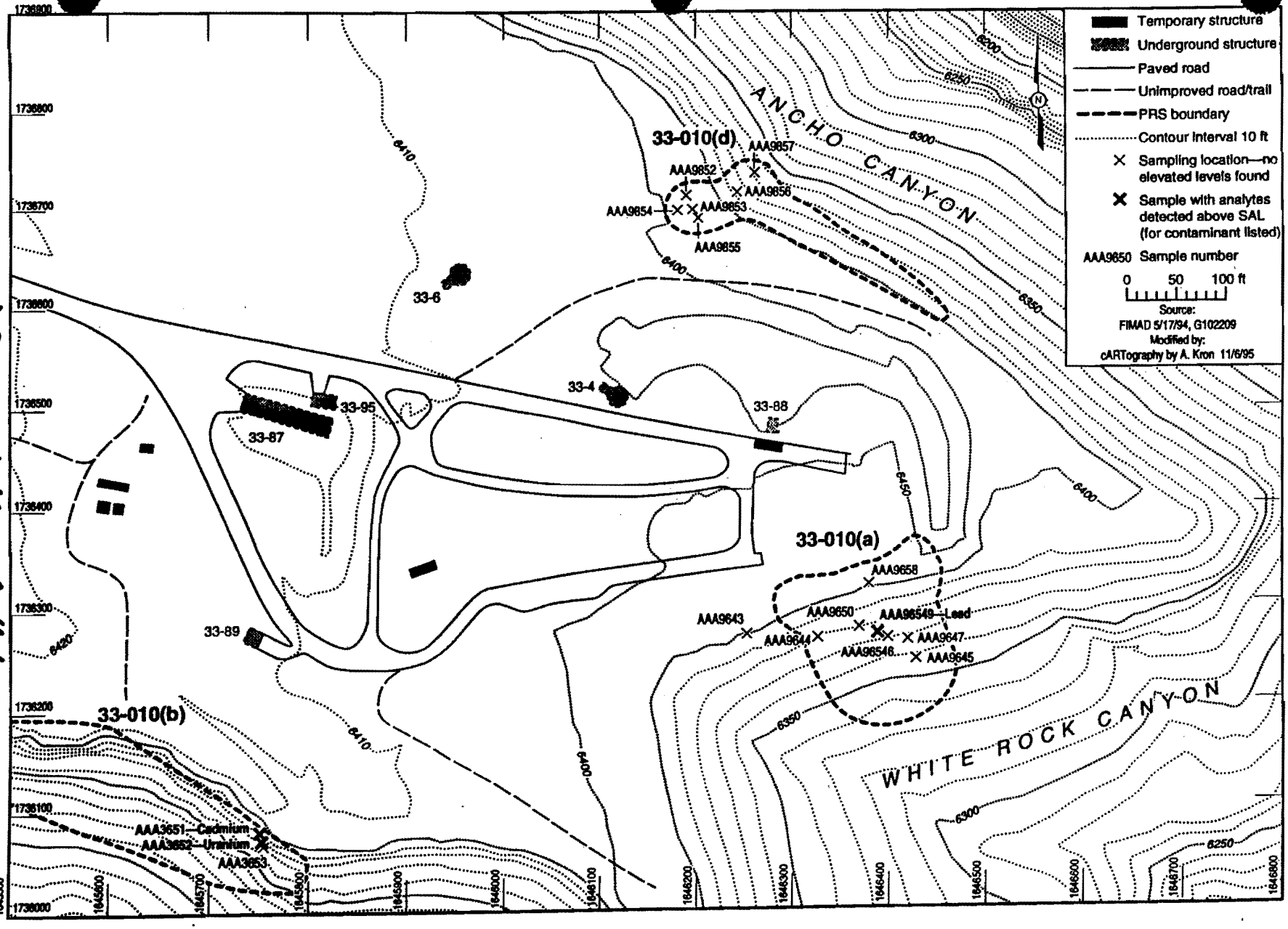


Fig. 2-2. Location map of SWMUs 33-010(a,b,d) at East Site.

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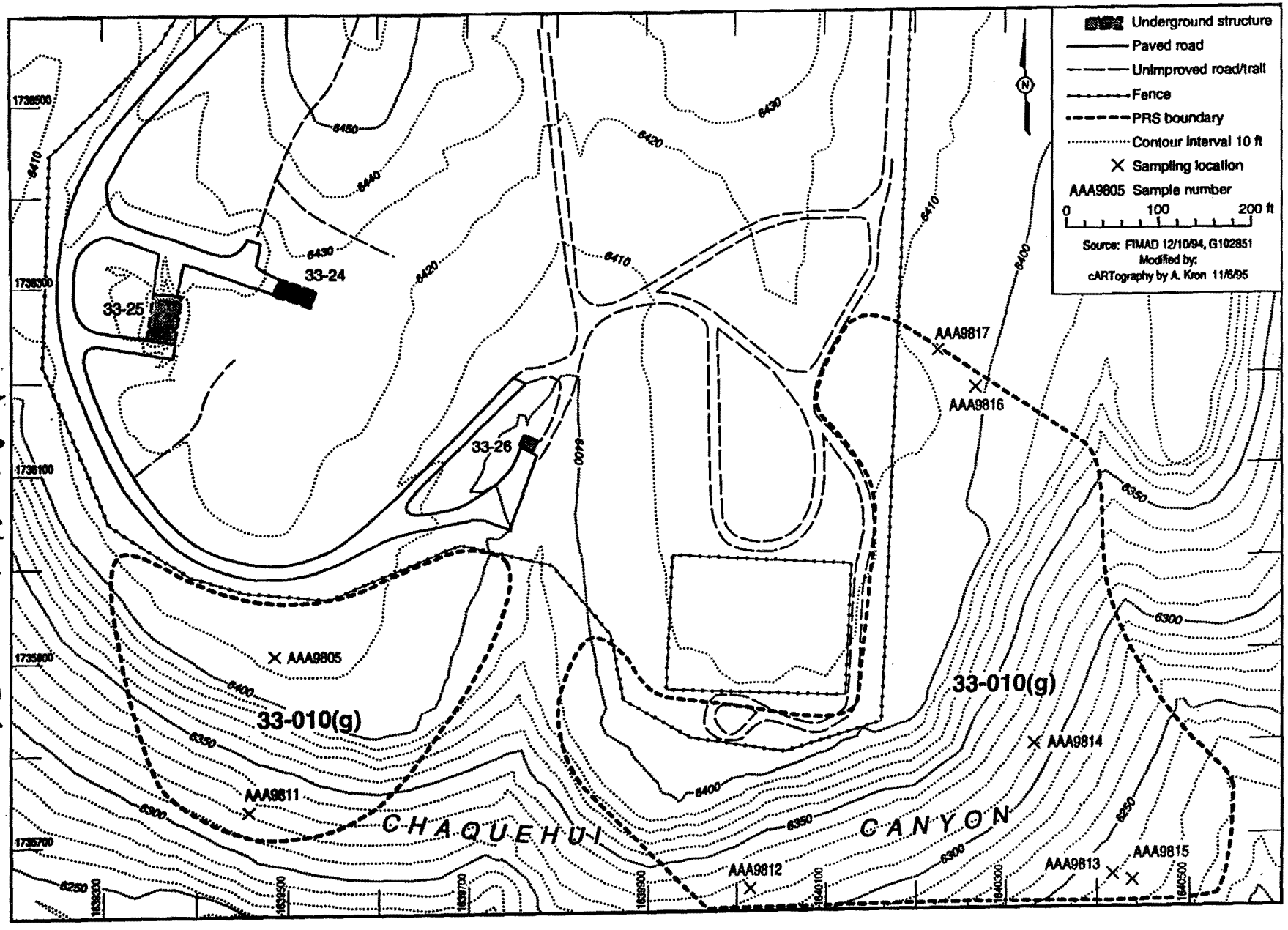


Fig. 2-3. Location map of SWMU 33-010(g) at South Site.

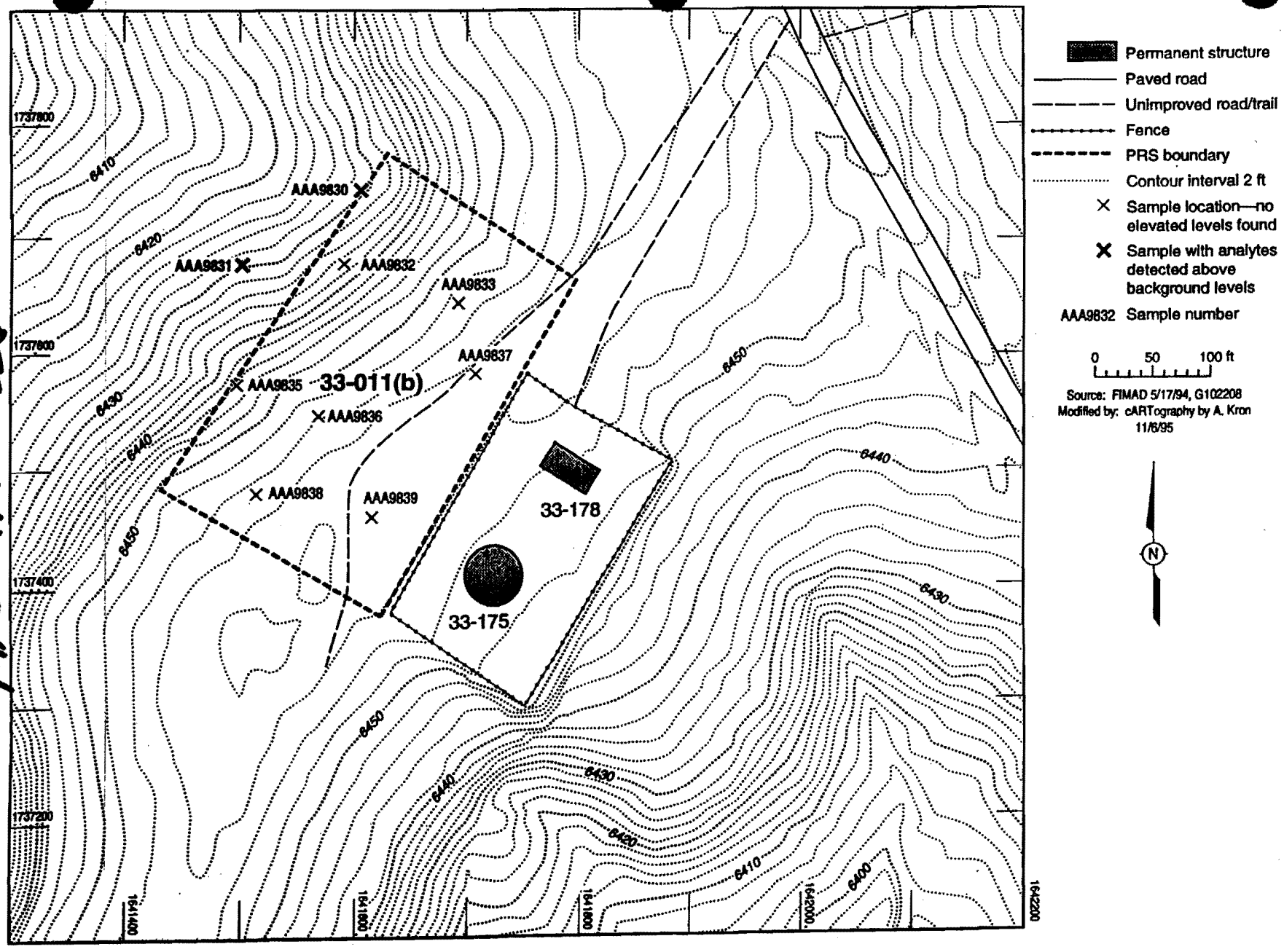


Fig. 2-4. Location map of SWMU 33-011(b) at NRAO Site.

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## 3.0 PROPOSED REMEDY

The general remedy for these sites involves picking up man-made debris and characterizing the debris for segregation into waste categories based on field analyses to detect the presence of metals or radioactivity: hazardous, radioactive, nonhazardous, and nonradioactive. A generic field screening plan is described in Appendix A of this plan.

In lieu of a detailed waste management plan (WMP), each SWMU has been detailed on a characterization strategy form (CSF) included in Appendix B of this plan. The CSF includes a site description, remediation waste description, volume estimate, a characterization strategy, preliminary RCRA determination, and a listing of analyte suites to be characterized. Once waste characterization analyses have been received, the waste profile form (WPF) and chemical waste disposal request (CWDR) will be prepared for shipment of wastes to TA-54 or to an approved off-site Treatment, Storage, and Disposal facility (TSD). All waste will be managed in compliance with the suspected waste type detailed on the CSF. Waste materials confirmed to be nonhazardous or nonradioactive, and not subject to the Toxic Substances Control Act (TSCA), will be disposed of in the proper manner at an industrial landfill.

Remediation of the disposal areas and storage area at TA-33 will involve laborers removing debris with hand tools and transporting (mechanically and/or manually) the debris to a controlled area at the top of the cliff sides. All debris will be analyzed for radioactivity in place. Selected debris will be analyzed for hazardous constituents based on knowledge of process and best judgment. After analyses, large debris will be placed in piles and small debris will be placed into industrial grade bags. The waste will be segregated into the categories discussed above. Hazardous waste will be stored in a satellite storage or less than 90 day storage area. Radioactive waste will be stored in a radioactive material waste holding area. Industrial waste will be stored on site until it is transported to an industrial landfill. Disturbance of existing vegetation will be minimized. All disturbed areas will be regraded to match adjacent contours and reseeded if necessary. The remediation process will be guided by restrictions established in Framework for Reconsidering or Stopping Work on Expedited Cleanups and Voluntary Corrective Actions in Appendix C.

Prior sampling data are available for all the SWMUs in this report. The data are tabulated in Appendix D. Relevant data are summarized within the description of the proposed remedy for each SWMU.

## 3.1 Objectives And Criteria

**Objectives:**

To clean up (remove) industrial debris generated from historical activities at five disposal site PRSs. Debris will be analyzed in the field for hazardous and radioactive constituents for waste characterization purposes. Waste will be separated into four categories: radioactive waste; hazardous waste; mixed waste; and industrial waste.

**Criteria for Collection of Debris:**

Debris from lab operations found within the current PRS boundary will be removed. In addition, debris outside the current boundary of the PRS will be removed if this debris is located in close proximity. The PRS boundary may be expanded to include the entire removal area.

Debris that will not be removed includes:

- natural materials
- debris from overlapping PRSs
- food and beverage containers
- nails, nuts, and bolts (unless above radioactive background)
- wood or concrete (unless above radioactive background)
- foam insulation smaller than approximately 3 inches in diameter (unless above radioactive background)
- debris associated with lab operations, containing no hazardous or radioactive constituents, that could pose safety risks to workers during removal. (Note if any of this type of debris has been found to be hazardous or radioactive elsewhere, then this criterion will be re-visited).

Following the above criteria will assure that clean-up (removal) is complete.



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**Criteria for Waste Characterization Procedures:**

Radioactive Waste Determinations: All industrial debris will be analyzed in place for radioactivity for both waste characterization and health and safety purposes. The ESP-1 and E-600 instruments will be used in accordance with ESH-1 guidance. Background determinations will be made each morning and/or afternoon for the specific location and instrument. Debris which have greater than background activity will be stored as potential radioactive waste until further determinations are made. The waste will be stored in the Radioactive Material Holding Area adjacent to building TA-33-2 at Area 6.

Hazardous Waste Determinations: Acceptable knowledge and best judgment will be used to determine the debris which will be analyzed for hazardous constituents. Debris from experimental devices (such as initiators or unknown devices) and industrial debris suspected to contain hazardous constituents (such as paint cans, metal cuttings, etc.) will be analyzed for metal constituents. This material will be brought to the CRZ and analyzed using the XRF in accordance to the appropriate LANL-ER-SOP. Cans or bottles which contain unknown potentially hazardous liquids will be stored as hazardous waste until further determinations are made. Hazardous waste will be stored in the Satellite Storage Area at the field trailer.

Mixed Waste Determinations: Radioactive waste will be analyzed for hazardous metals to determine the presence of mixed waste. (Note that the potential hazardous waste will have been analyzed for radioactivity in place). Mixed waste is not anticipated, however if it is present, it will be stored in the Satellite Storage Area at the field trailer.

Industrial Waste: Using acceptable knowledge and best judgment, industrial debris and household debris not associated with hazardous materials or processes will not be analyzed for hazardous constituents for waste characterization purposes. The debris will be analyzed for radioactivity. Waste which is neither radioactive nor hazardous will be stored in industrial grade bags and in piles (for the large debris) at the PRS. The waste will be labeled as 'Industrial Waste, Non Hazardous Non Radioactive'.

## 3.2 East Site VCAs

### 3.2.1 SWMU 33-010(a), Canyon-Side Disposal Area

SWMU 33-010(a) is a canyon-side disposal area located on a cliff ledge at East Site (Fig. 2-2). Much of the debris resulted from the initial clearing of the site and consists of dead tree trunks, rocks, and scraped earth. In addition, metal scrap, timbers, plastic foam, and other man-made debris were thrown over the canyon rim at various times. Debris is scattered at the rim and within 15-ft below the rim.

The canyon side just south of the East Site double berm slopes steeply approximately 20-ft into White Rock Canyon, then levels to a more gentle grade to a bench. The steep area contains broken rocks and soil. The eastern end of the site contains dead tree trunks. The remedy for this site is the general remedy described above in section 3.0. Debris from site clearing, such as tree trunks and rocks, will not be removed during the VCA operations.

Preliminary Phase I RFI sampling consisted of five samples collected on the face of the slope and analyzed for metals, uranium, and cesium-137. Three separate samples for SWMU 33-007(a), an overlapping SWMU, were collected within the boundary of SWMU 33-010(a) and analyzed for metals, uranium, cesium-137, semi-volatile organic compounds (SVOCs), and HE. Three samples had uranium well below the screening action level (SAL). Traces of mercury were found in three samples. Lead was found in two samples, one sample contained 989 mg/kg which is above the SAL for lead of 400 mg/kg, yet below the 1 000 mg/kg industrial cleanup level. No other contaminants were found.

SWMU 33-010(a) can be accessed from the top of the canyon by a paved road. The volume of debris that will be removed from the site is estimated to be 10.5 cubic yards.

### 3.2.2 SWMU 33-010(b), Canyon-Side Disposal Area

SWMU 33-010(b) is a canyon-side disposal area on a narrow ledge located below a 30-ft sheer cliff at the southern edge of East Site (Fig. 2-2). The ledge is on bedrock and approximately 10- to 15-ft wide. Below the ledge is a steep pumice slope descending approximately 1 000-ft into White Rock Canyon. Timbers are scattered along the ledge. One large ball, approximately 10-ft in diameter and composed of metal turnings and strapping strips, is the most prominent object in the SWMU. Asbestos boards are also present among the debris. The time frame for deposition of this debris is not known but is presumed to be between the 1950s and 1972.

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Preliminary Phase I RFI sampling consisted of three surface samples taken at the base of the large metal ball and analyzed for metals, uranium, and gamma emitters. All samples contained uranium above LANL background, with one sample containing 762 mg/kg which is above the SAL of 230 mg/kg. All samples contained cadmium above the LANL background, with one sample containing 182 mg/kg which is above the SAL of 38 mg/kg. Nickel, lead, and zinc were detected below SALs.

The proposed remedy for this site follows the general remedy described in section 3.0. Four samples of the metal ball will be removed and screened by LIBS or XRF for cadmium and RAD screened for uranium. If the ball contains one of these metals and contamination could be spread during removal, the surface of the metal ball will be stabilized with spray paint or plastic before removal.

If the samples of the metal ball are found to be contaminated with hazardous or radioactive material, one surface soil sample will be collected near the footprint of the ball and analyzed for cadmium and uranium once the large ball of metal scrap has been removed. Cleanup levels for uranium and cadmium are located in Section 6.0 of this plan.

SWMU 33-010(b) has very difficult access due to its very steep slope and distance (approximately 100-ft) from a maintained road. It also has a fence that may need to be cut and a large drainage ditch which runs along the fence between the road and the SWMU. The volume of debris that will be removed from the site is estimated to be 40 cubic yards.

### 3.2.3 SWMU 33-010(d), Canyon-Side Disposal Area

SWMU 33-010(d) is a surface disposal area on the rim of Ancho canyon at East Site (Fig. 2-2). Debris was dumped in a small drainage leading to the canyon and along the canyon rim. Much of the debris is concrete blocks, including a part of the surface cable holder from the underground TA-33-6 shot chamber. At the top of the drainage are approximately 30 empty unbroken glass specimen vials. Garbage, such as foam chunks and metal cans, lies along the edge of the canyon just below the rim. The proposed remedy for this site follows the general remedy described in section 3.0.

Preliminary Phase I RFI sampling consisted of four surface samples taken on the mesa top amid the debris and two samples taken in the drainage area near the specimen bottles. All six samples were analyzed for metals, uranium, and gamma emitters. Lead was detected in one sample at a level well below SAL. No other contamination was detected.

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SWMU 33-010(d) is accessible from a maintained dirt road located at the top of the sloping site. The volume of debris that will be removed from the site is estimated to be 6.5 cubic yards.

## 3.3 South Site

### SWMU 33-010(g), Canyon-Side Disposal Area

SWMU 33-010(g) is a canyon-side disposal area located on the mesa top and adjacent steep slope at South Site (Fig. 2-3). Some of the debris at this site resulted from initial site clearing and consists of dead tree trunks, rocks, and scraped earth. In addition, metal chunks and other debris were thrown over the canyon rim at various times. Debris is scattered along the rim and within 20-ft below the rim on the steep slope. Three small piles of debris are located on the mesa top near the canyon rim. The proposed remedy for this site will follow the general remedy described in section 3.0. Site clearing debris, such as tree trunks, will not be removed during the VCA process. Before disposal, debris will be visually surveyed by an HE expert for chunks of HE.

Preliminary Phase I RFI sampling consisted of four surface samples taken on the face of the slope. Three additional samples for SWMU 33-006(a), an overlapping SWMU, were collected within the SWMU 33-010(g) boundary. All samples were analyzed for metals, uranium, gamma emitters, and HE. One sample was analyzed for herbicides. One of the samples contained cesium-137 at a level well below the SAL. Trace levels of a propellant were found in two samples on the slope. No other contaminants were found above LANL background.

SWMU 33-010(g) can be accessed by a dirt road located at the top of the cliff and a fence may need to be cut for access to the site. The volume of debris that will be removed from the site is estimated to be six cubic yards.

## 3.4 NRAO Site

### SWMU 33-011(b), Storage Area

SWMU 33-011(b) is located just west of the NRAO fenced complex near the center of TA-33 (Fig. 2-4). The SWMU occupies a 300 x 600-ft area. From the 1950s to the early 1990s, the site was used as material storage for equipment and metals such as tungsten, uranium, and beryllium (Hoard 1990, 02-019). About three-quarters of the site have been scraped and leveled to or near bedrock tuff. The site was cleaned in 1984; however, a few bits of scrap and debris still litter the area (Buhl 1988, 02-038). During a site visit a piece of metal was found with

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a Geiger counter and is expected to be uranium. A small (4-ft x 4-ft x 4-ft) wooden bunker with a periscope exists on the site and will not be removed during this VCA. The proposed remedy for this site follows the general remedy described in section 3.0.

Preliminary Phase I RFI sampling consisted of ten surface samples. Three samples were reanalyzed. The duplicate sample mentioned in the RFI Work Plan for OU 1122 was not collected (LANL 1992, 0784). All samples were analyzed for metals, uranium, and cesium-137. One sample was also analyzed for herbicides. Two samples had cesium-137 at levels well below the SAL. No other contaminants were found.

SWMU 33-011(b) is accessible from a maintained gravel road. The volume of debris that will be removed from the site is estimated to be approximately 6.5 cubic yards.

## 4.0 JUSTIFICATION/RATIONALE

SWMUs 33-010(a,b,d,g) are listed in Table A of the Laboratory's Hazardous and Solid Wastes Amendment (HSWA) permit. These SWMUs will be approached as a VCA for removal from the permit list. SWMU 33-011(b) is not listed in the Laboratory's HSWA permit.

Soils and sediments at each of these PRSs were sampled during a Phase I RFI investigation with the objective of determining if contaminants were present within the PRSs at levels of potential concern. Only at PRS 33-010(b) were contaminants detected in soils at levels of potential concern. Although the Phase I RFI investigation objective was met at each PRS relative to the soils and sediments, debris is also present within each of these PRSs. It was not determined if contaminants were present within the debris. To complete the objectives of the Phase I RFI investigation, this question must be resolved. Therefore, the relevant data quality objective (DQO) for the VCA work is to determine if contaminants on or in the debris are present within the PRSs at levels of concern.

Due to the nature of the debris, this objective is most expeditiously met through removal of the debris from the PRSs. By removal of the debris, any contaminants of potential concern on or in the debris will no longer be present within the PRS.

Because contaminants of potential concern were detected in soils at PRS 33-010(b), an additional DQO for this PRS is to determine if contaminants remain within the PRSs at levels of concern following removal of the debris (including incidental soil removal).

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While the waste materials associated with these sites are of relatively low volume and restricted to well-defined areas, contamination could be spread by wind, rainfall runoff, and possibly foot traffic. The preferred remedy for the cleanup of these sites is obvious and straightforward to implement. Physical site access is not a problem at most of these sites. Access at SWMU 33-010(b) will make cleanup difficult.

## 5.0 ESTIMATED WASTE VOLUMES BY TYPE

Table 5-1 displays each SWMU, the waste types, the waste description, an estimated bulk volume, proposed disposal containers, and the anticipated disposal destination.

**TABLE 5-1**

**ESTIMATED WASTE VOLUMES BY TYPE**

| SWMU NUMBER | WASTE TYPE[a] | WASTE DESCRIPTION | ESTIMATED BULK VOLUME | DISPOSAL CONTAINER TYPE | ANTICIPATED DISPOSAL SITE |
|---|---|---|---|---|---|
| 33-010(a) | Industrial | Debris, wood, plastic | 10 $yd^3$ | Roll-off or dump truck | Industrial landfill |
| 33-010(a) | Haz(b) | Metal | 0.5 $yd^3$ | 55-gallon drum | Off-site hazardous waste facility |
| 33-010(b) | Industrial | Debris, plastic | 24 $yd^3$ | Roll-off or dump truck | Industrial landfill |
| 33-010(b) | Haz(b) | Metal, soil | 14 $yd^3$ | Roll-off | Off-site hazardous waste facility |
| 33-010(b) | Radioactive | Metal, soil | 2 $yd^3$ | 55-gallon drum | TA-54 |
| 33-010(d) | Industrial | Debris, foam concrete, glass, metal | 6 $yd^3$ | Roll-off or dump truck | Industrial landfill |
| 33-010(d) | Haz(b) | Metal, soil | 0.5 $yd^3$ | 55-gallon drum | Off-site hazardous waste facility |
| 33-010(g) | Industrial | Debris, plastic, metal | 6 $yd^3$ | Roll-off or dump truck | Industrial landfill |
| 33-011(b) | Industrial | Debris, wood | 6 $yd^3$ | Roll-off or dump truck | Industrial landfill |
| 33-011(b) | Radioactive | Metal | 0.25 $yd^3$ | 55-gallon drum | TA-54 |

[a] Waste Type: Haz(b) = RCRA Metals

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## 6.0 CLEANUP LEVELS

Identification of the chemicals of potential concern (COPCs) considered for this VCA Plan was based on simple comparisons of Phase I RFI analytical results to background and SAL concentrations. As presented in Appendix D, analytical results from the Phase I RFI sampling indicate that SWMU 33-010(b) is the only site failing a soil screening assessment requiring further evaluation. Inspection of the data indicates that cadmium and uranium are the primary COPCs for soil contamination at the site. Due to the location of this SWMU (close proximity to Bandelier National Monument and on a cliff face), a recreational exposure scenario was chosen as the most likely receptor model for future risk. Current security fencing and lack of receptor activity at the site precludes the estimation of current human exposure.

An exposure unit corresponding to a likely area of receptor activity is traditionally defined in action level derivation calculations. In this case, however, it is more feasible to evaluate exposure within the actual bounds of the contaminated area rather than calculate a fraction of a predefined exposure area corresponding to the contaminated zone. This decision is based on topography of the canyon wall, which inhibits free access to a large continuous area, and the sensitivity of a radiological dose estimate (in the case of uranium) to the true shape and area of the contaminated zone. Potential exposure pathways evaluated for the recreational receptor for this site include ingestion of soil, inhalation of fugitive dust, inhalation of radon, and exposure to external gamma radiation. Dermal exposure was not considered a viable pathway because the only COPCs identified are inorganic metals with little ability to be absorbed through the skin. A summary of the cleanup levels calculated, and the rationale for derivation based on the recreational exposure scenario for each the COPCs identified is provided below.

| CHEMICAL | CLEANUP LEVEL (mg/kg) | RATIONALE |
|---|---|---|
| Cadmium | 170 | Carcinogen - $10^{-6}$ risk level. |
| Total uranium | 4 790 | RESRAD code based on a 15 mrem/yr dose. |

The soil cleanup level for cadmium was calculated based on its potential to act as a human carcinogen at an acceptable level of risk of 1E-06. Based on this approach the cleanup level for cadmium is 170 mg/kg. The equation and assumptions used to calculate the cleanup level for cadmium are presented in Appendix E.

The RESRAD computer code, Version 5.60, was used to calculate cleanup levels based on committed effective dose equivalents for the natural uranium isotopes. Contribution of daughter products is included in the dose estimates for these primary radionuclides. The calculated cleanup level is based on a 15 mrem/yr dose level, which is the annual dose limit proposed in EPA's Radiation Site Cleanup Regulation (40 CFR 196 Proposed Rule). A summary of the RESRAD output file, including all input parameters used in the RESRAD calculations, are provided in Appendix F.

The cleanup level of 4 790 mg/kg total uranium is based on isotopic abundance of natural uranium. These relative abundances are 0.0058%, 0.72%, and 99.28%, by mass, for uranium-234, uranium-235, and uranium-238 respectively. The specific activities of the uranium isotopes are 6.24E+09 pCi/g, 6.24E+09 pCi/g, and 6.24E+09 pCi/g for uranium-234, uranium-235, and uranium-238 respectively. A mass-based cleanup level for total uranium in soil, based on a natural abundance of each isotope, can be calculated according to the following equation:

$$C_t = \frac{1}{\sum_1^i \left\{ F_i / C_i \right\}}$$

Where:

$C_t$ = Cleanup level for mixed isotopes (ppm)

$C_i$ = Cleanup level for isotope i (ppm)

$F_i$ = Fractional amount of isotope i

## 7.0 DESCRIPTION OF CONFIRMATORY SAMPLING

Confirmatory analyses will be done by a fixed laboratory. Both contaminated and uncontaminated materials will be handled and prepared for disposal, storage, or shipment as noted on the completed characterization strategy forms in Appendix B. Confirmatory sampling will not be required at SWMUs 33-010(a,d,g) and 33-011(b) because Phase I analytical results indicated that the soil was not contaminated. Confirmatory soil samples will be collected under the metal ball at SWMU 33-010(b) and analyzed for metals and radioactivity.

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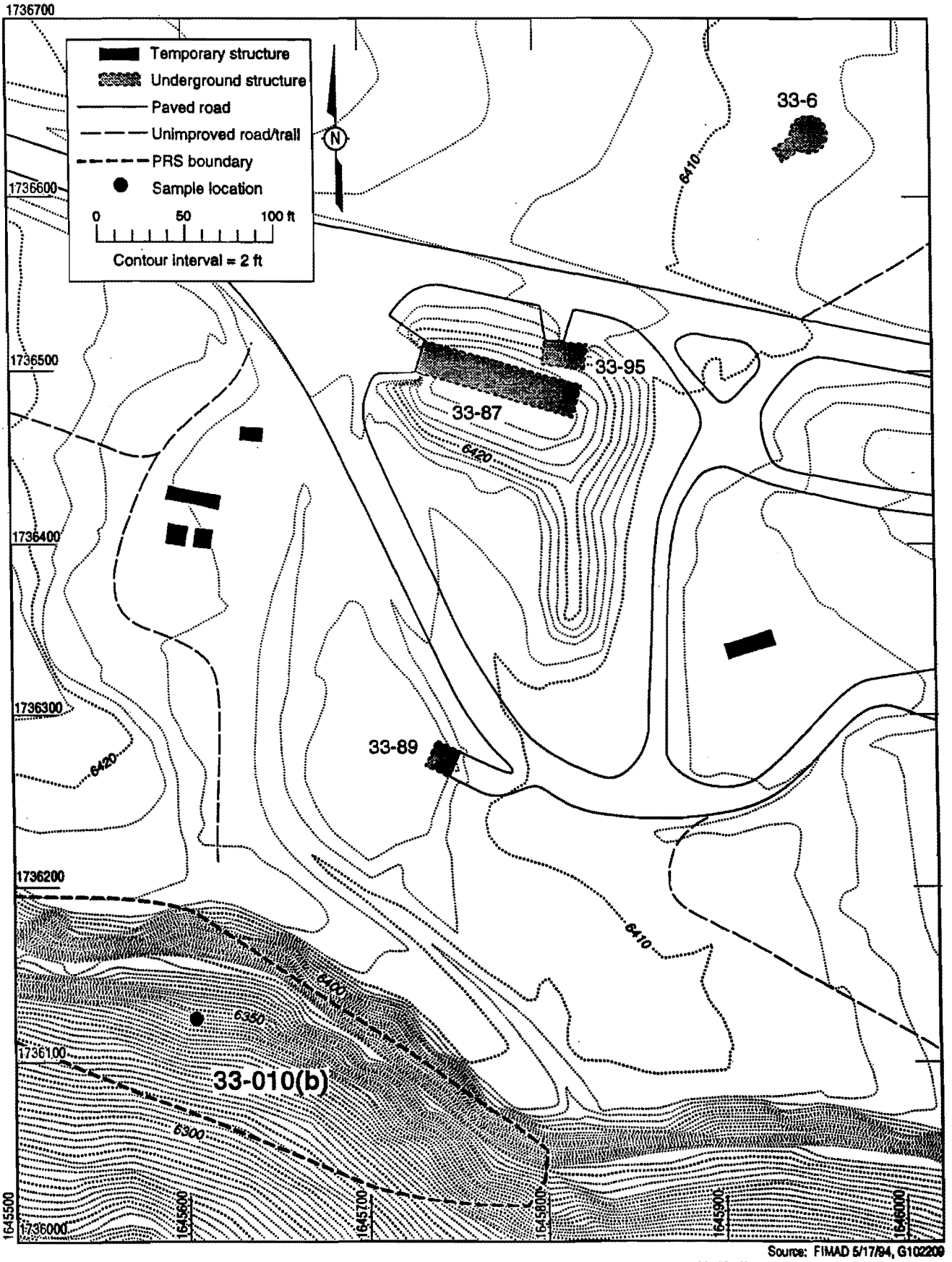


Source: FIMAD 5/17/94, G102209
Modified by: cARTography by A. Kron 10/11/95

**Fig. 7-1. Sampling locations for SWMU 33-010(b).**

## 8.0 ESTIMATED SCHEDULE AND COST TO COMPLETE EACH VCA

Table 8-1 lists each SWMU and details estimated scheduling and costs to be incurred in the implementation of each VCA. Cost estimates include the cost of characterization, confirmatory sampling, and analysis. Cost estimate summaries by SWMU have been included in Appendix G.

**TABLE 8-1**

**ESTIMATED SCHEDULE AND COSTS**

| SWMU NUMBER | START DATE | COMPLETION DATE | ESTIMATED COST |
|---|---|---|---|
| 33-010(a) | 11/2/95 | 11/17/95 | $ 11 700 |
| 33-010(b) | 11/20/95 | 11/30/95 | $ 18 950 |
| 33-010(d) | 11/15/95 | 11/21/95 | $ 11 700 |
| 33-010(g) | 11/7/95 | 11/15/95 | $ 11 700 |
| 33-011(b) | 10/31/95 | 11/8/95 | $ 11 700 |
| | | TOTAL | $ 65 750 |

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## 9.0 REFERENCES

Buhl, T.E., June 28, 1988. "Clean-up of Two Firing Site Areas at TA-33," unpublished draft of a report, Los Alamos National Laboratory, Los Alamos, New Mexico. **(Buhl 1988, 02-038)**

Hoard, D., July 11, 1990. "Conversations with John Dougherty Re TA-33," Los Alamos National Laboratory Memorandum CLS-1/91-304-DH to CLS-1 file from D. Hoard (CLS-1), Los Alamos, New Mexico. **(Hoard 1990, 02-022)**

LANL (Los Alamos National Laboratory), May 1992. "RFI Work Plan for Operable Unit 1122," Los Alamos National Laboratory Report LA-UR-92-925, Los Alamos, New Mexico. **(LANL 1992, 0784)**

# APPENDIX A FIELD SCREENING PROCEDURES

## Field Screening Procedures

This plan outlines the steps to be taken during VCAs at the Laboratory for field screening of debris. Field screening will determine the segregation of debris into waste categories. Details not explicitly stated will be developed in the field and will be implemented as appropriate. All screening will be done by field personnel assigned to the VCA task. Portable hand-held field equipment will be used for radiation and heavy metal screening. Debris will be RAD screened in place prior to removal. Based on knowledge of process and best judgment, select debris will be screened with the XRF for hazardous constituents. The select debris will be screened with the XRF in the contamination reduction zone (CRZ).

Field screening of debris will be used to detect alpha, beta, and gamma radiation; and heavy metals.

In the field screening process, the following steps will be followed, in order, where the chemical of potential concern (COPC) is suspected:

1. Visual Survey
2. Radiation Screening
3. Heavy Metals Screening

The visual survey of each PRS involves a walk around of the site before and during debris removal. The purpose of visually surveying the site before the start of work activities is to identify the work area perimeter and the specific material(s) to be removed. Personnel performing this visual survey will be looking for surface debris, evidence of mounds or piles, flags or stakes from previous surveys or investigations, and any other evidence delineating the site. Visual survey will also be used to select and segregate those pieces of debris that will be screened with the XRF. Conditions that may hamper this activity include rain; regrading, recontouring, or revegetation of the site; discovery of archaeological artifacts; active Laboratory work; vegetation covering the site; and anything else that may inhibit the visual survey.

In addition to the visual survey, radiation screening will be done during the field work activities at each site. Screening equipment to be used will be approved by the Laboratory Health Physics Measurements Group (ESH-4) prior to their utilization. Each site will be surveyed for gross radiation using radiation detectors. Alpha, beta, gamma, and gross radiation detectors may be used. The frequency of debris or soil screening will be done at the discretion of the



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on-site radiation screening personnel (RSP). Personnel will be screened for radiation at the end of the personal decontamination process prior to entering the support zone.

For sites where radioactive contamination is identified as being above background, additional radiation screening will ensure that preliminary information is sufficient and that the waste is consistent with anticipated radiation levels. Soil or debris samples will be collected to determine specific radioisotopes present in the waste. Swipes may also be used to determine radioactive contamination if the overseeing HPT determines this to be an appropriate means of field screening. Personnel will be screened when leaving the regulated area.

XRF or LIBS will be used to screen in the field where heavy metals are COPCs. The field test will be performed during work activities to screen debris and underlying soil and at the end of the removal. Confirmatory samples will be sent to an off-site laboratory, as applicable.

As field work progresses, decisions may be made by the Field Team Leader in conjunction with the Field Team Manager to reduce or increase the frequency of field screening. Field testing is for internal purposes only, and therefore, will not be validated. The field screening identified herein is expected to provide adequate information for waste segregation purposes. Other screening measures may be implemented if additional information is obtained concerning previously unidentified contaminants, or if more appropriate field screening measures are identified.

Samples will be collected for waste characterization by an on-site mobile radiation screening laboratory and mobile chemical screening laboratory. These characterization analyses will provide data for waste management and transportation. Because the mobile labs will have limited capabilities, the samples may be shipped off-site for further analysis.



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# APPENDIX B CHARACTERIZATION STRATEGY FORMS

PENDING FINAL APPROVAL

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# APPENDIX C FRAMEWORK FOR RECONSIDERING OR STOPPING WORK ON

## Expedited Cleanups and Voluntary Corrective Actions

## FRAMEWORK FOR RECONSIDERING OR STOPPING WORK ON EXPEDITED CLEANUPS AND VOLUNTARY CORRECTIVE ACTIONS

During the conduct of expedited cleanups (ECs) or voluntary corrective actions (VCAs), it is important to preplan a framework for understanding when the potential release site (PRS) conceptual model is flawed to the extent that continuing an EC or VCA should be reconsidered. This determination may not be straight forward and may be complicated by factors that are not readily apparent. While pursuing the EC or VCA is important to the ER project success, we must be careful to ensure that the pursuit of a "bean" does not tempt us to ignore emerging problems during the field work. The Field Project Leader (FPL) should reconsider any time information becomes available that indicates the site conceptual model may be off target. Furthermore, if the additional information warrants, work should be stopped.

Several past examples demonstrate the need for reconsideration and stopping criteria:

> Waste type was thought to be solely hazardous, but was in reality "mixed waste".
>
> Volume of waste was thought to be small , but was, in fact, much larger.
>
> Spatial boundaries of the site were thought to be defined, but subsequently were found to be much larger.
>
> Waste was thought to be uncontaminated debris, but upon disposal was determined to be contaminated with radionuclides.

Have we just been unlucky? Probably not. These are classic examples of the old maxim that if something can go wrong, it will. We must, therefore, maximize the opportunity to reconsider or stop work before it becomes a safety hazard, a professional embarrassment, or a bottomless pit for scarce resources, such as budget dollars or site disposal capacity.

If one or more factors change the prevailing site conceptual model, then reconsider the consequences of the change(s) and stop work if the change warrants it. Consider the following as a framework, not as a prescriptive solution to this difficult problem. The examples provided below are not intended to be an exhaustive listing of all possible changes, only an indication of changes frequently encountered.

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When stopping work is determined to be the appropriate action, it is crucial to have a plan that describes 'safe' shutdown for the site EC or VCA operation. "Safe" in this context should consider such things as worker and trespasser safety, safe storage of wastes generated to date, and a shutdown configuration that ensures conditions at the site do not further mobilize contaminants or provide enhanced pathways for off site migration (an appropriate shutdown configuration will be determined in conjunction with appropriate interaction with the New Mexico Environment Department.)

POSSIBLE CRITERIA FOR RECONSIDERING AND/OR STOPPING WORK ON ECs/VCAs

1) **WASTE** - Changes in type, volume, disposal capacity, disposal location, etc. If the composition of waste changes and there is limited capacity for the site waste, such as mixed wastes,

   If the volume of waste begins to grow by more than 50%1 of the initial estimate, or

   If the disposal or treatment capacity for the site waste is not immediately available and would require waste storage for more than 90 days.

   Reconsider the consequences of the change(s) and **Stop**, if the change warrants it.

2) **COST** - Changes in available budget, total cost of project, etc.

   If the budget for site EC or VCA grows by more than 50%1 of the initial estimate,

   If sites are prioritization similarly, those with increasing costs may go down in project priority due to added costs, as the project would accomplish fewer

   EC/VCAs, or

   If continuation will affect the program's ability to take action at sites of equal or greater urgency.

   Reconsider the consequences of the change(s) and **Stop**, if the change warrants it.

3) **LEVEL OF PROBLEM UNDERSTANDING** - Changes in contamination type or level, job difficulty, etc.

   If the waste constituents change and impact the selected treatment/disposal alternatives,

If the extent of contaminant movement or the contaminant transport mechanism affects the overall job difficulty, or

Initial estimates of engineering costs are typically only good within a range of + or 50%. The relationship of waste management volume to waste management cost is usually linear, so that if volume increases 50% then so do costs.

If the impact of continuing the action creates a greater problem (e.g., regulatory, public relations, ecological, etc.) than stopping work.

Reconsider the consequences of the change(s) and **Stop**, if the change warrants it.

4) **RESOURCES** - Changes in knowledge, expertise, equipment, services, etc.

If new or additional site data causes the site problem to change from understood/ Documented historical site data,

If the remediation equipment needed for the changed site problem is unavailable,

If the expertise of available staff does not match the changed site problem, or

* If the sensitivity or analytical detection limits of available analytical methods for the changed site problem does not meet the revised site cleanup requirements.

Reconsider the consequences of the change(s) and **Stop**, if the change warrants it.

5) **SAFETY** - Changes in engineering plan or risk to remedial site worker, LANL worker, or off -site citizen, etc.

If additional site findings suggest a new or greatly increased risk of an acute or chronic nature to remedial site worker, LANL worker, or off-site citizen,

If a change to the remedial engineering plan, such as the depth of excavation, differs from the site safety plan, or

If getting a "bean' by end of the fiscal year appears to compromise safety.

Reconsider the consequences of the continued action(s) and **Stop**, if the finding warrants it.

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6) **"LAUGH" TEST** - Question the appropriateness of what is being done.

If you doubt that your actions are consistent with common sense, or

If you think you are being asked to do something stupid, but in a smarter way.

<u>Reconsider</u> the consequences of the continued action(s) and **Stop**, if the finding warrants it.

**SAMPLE INFORMATION**

**SWMU 33-010(a): Canyonside Disposal**

| NO. | SAMPLE ID | SITE ID | ASSIGNED PRS | TYPE | MATRIX | BEGIN DEPTH (in.) | END DEPTH (in.) | ANALYSES PERFORMED | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | ORGANICS | | | | |
| | | | | | | | | Inorganics | Rad | VOCs[a] | SVOCs[b] | PCBs[c] | HE[d] | Pesticides | Herbicides |
| 1 | AAA9646 | 33-1414 | 33-010(a) | *Surface* | Soil | | | 19258 | 19957 | | | | | | |
| 2 | AAA9647 | 33-1415 | 33-010(a) | *Surface* | Soil | 0 | 6 | 19258 | 19957 | | | | | | |
| 3 | AAA9648 | 33-1416 | 33-010(a) | *Surface* | Soil | 0 | 6 | 19258 | 19957 | | | | | | |
| 4 | AAA9649 | 33-1417 | 33-010(a) | *Surface* | Soil | 0 | 6 | 19258 | 19957 | | | | | | |
| 5 | AAA9650 | 33-1418 | 33-010(a) | *Surface* | Soil | 0 | 6 | 19258 | 19957 | | | | | | |
| 6 | AAA9643 | 33-1392 | 007(a) | *Surface* | Soil | 0 | 6 | 19253 | 19358 | | 17674 | | 17676 | | |
| 7 | AAA9644 | 33-1393 | 007(a) | *Surface* | Soil | 0 | 6 | 19253 | 19358 | | 17674 | | 17676 | | |
| 8 | AAA9645 | 33-1394 | 007(a) | *Surface* | Soil | 0 | 6 | 19253 | 19358 | | 17674 | | 17676 | | |

**RESULTS OF ANALYSES**

**SWMU 33-010(a): Canyonside Disposal**

| NO. | SAMPLE ID | RADIONUCLIDES | | | INORGANICS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Uranium | Cesium-137 | Cobolt-60 | Silver | Arsenic | Barium | Berillium | Cadmium | Chromium | Mercury | Nickel | Lead | Antimony | Selenium | Zinc |
| | | mg/kg | pCi/g | pCi/g | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1 | AAA9646 | 2.75 | 0.093 | 0.012 | <0.76 | <1.1 | 44.1 | <0.45 | <0.35 | 3.3 | <0.02 | 3.2 | 7 | <4.3 | <0.57 | 19 |
| | AAA9646R | NA[f] | NA | NA | <0.76 | 0.8 | 45.5 | 0.43 | <0.35 | 5.1 | *0.03* | <4.1 | 7 | <4.3 | <0.51 | 20 |
| 2 | AAA9647 | 2.87 | 0.101 | -0.007 | <0.8 | <1.3 | 99.3 | <0.86 | <0.37 | 7 | <0.02 | <5.9 | 6 | <4.5 | <0.54 | 30 |
| | AAA9647R | 2.81 | 0.111 | -0.006 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 3 | AAA9648 | *5.46* | 0.175 | -0.009 | <0.78 | <1.7 | 92.7 | <0.88 | 1.4 | 12.8 | *0.42* | <7.2 | *35* | <4.4 | <0.53 | *204* |
| 4 | AAA9649 | *8.34* | 0.093 | -0.016 | <0.76 | <0.83 | 50.5 | <0.5 | <0.35 | 4.1 | *0.13* | <3.3 | *989* | <4.3 | <0.52 | 26 |
| 5 | AAA9650 | 2.8 | 0.071 | -0.008 | <0.76 | <0.55 | 57.5 | <0.48 | <0.35 | 6.1 | <0.09 | <2.8 | *84* | <4.3 | <0.51 | 40 |
| 26 | AAA9643 | 0 | 0.396 | -0.021 | <0.77 | <1.2 | 129 | 0.74 | <0.39 | *34.0* | <0.02 | <8.4 | *24* | 6.1 | <0.52 | 32 |
| | AAA9643R | NA | NA | NA | <0.77 | 1.1 | 141 | <0.77 | 0.64 | *32.4* | <0.02 | 9.1 | *26* | <4.4 | <0.52 | 34 |
| 27 | AAA9644 | 0 | 1.019 | -0.009 | <0.81 | <1.6 | 129 | <0.81 | <0.69 | *22.7* | <0.05 | <7.5 | 18 | <4.6 | <0.55 | 44 |
| 28 | AAA9645 | 0.49 | 0.837 | 0.002 | <0.79 | <1.2 | 78 | <0.88 | <0.43 | 7.4 | <0.02 | <6.2 | 10 | <4.5 | <0.53 | 27 |
| *SALs[g]* | | *230* | *5.1* | *1.1* | *383* | *bkg* | *5 340* | *bkg* | *38* | *210* | *23* | *1 534* | *400* | *31* | *383* | *23 004* |
| *EQLs[h]* | | *1.4* | *1* | *NA* | *2* | *2* | *40* | *1* | *1* | *2* | *0.1* | *8* | *1* | *12* | *1* | *4* |
| *LANL UTLs[i]* | | *5.45* | *1.4* | *NA* | *NA* | *7.82* | *315* | *1.95* | *2.7* | *19.3* | *0.1* | *15.2* | *23.3* | *1* | *1.7* | *50.8* |
| *TA-33 UTLs* | | *4.12* | *2.068* | *NA* | *NA* | *3.77* | *139* | *1.22* | *NA* | *14.6* | *NA* | *11.1* | *25.2* | *0.17* | *0.92* | *57.3* |

***No organics detected***

[a] VOCs = Volatile organic compounds.
[b] SVOCs = Semivolatile organic compounds.
[c] PCBs = Polychlorinated biphenyls.
[d] HE = High explosive.
[e] R = Reanalyzed.
[f] NA = Not applicable.
[g] SALs = Screening action levels.
[h] EQLs = Estimated quantitation limits.
[i] UTLs = Upper tolerance limits.

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**SAMPLE INFORMATION**

**SWMU 33-010(b): Canyonside Disposal**

| NO. | SAMPLE ID | SITE ID | ASSIGNED PRS | TYPE | MATRIX | BEGIN DEPTH (in.) | END DEPTH (in.) | ANALYSES PERFORMED | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | ORGANICS | | | | |
| | | | | | | | | Inorganics | Rad | VOCs[a] | SVOCs[b] | PCBs[c] | HE[d] | Pesticides | Herbicides |
| 1 | AAA9651 | 33-1418 | 33-010(b) | *Surface* | Soil | 0 | 6 | 19258 | 19957 | | | | | | |
| 2 | AAA9652 | 33-1419 | 33-010(b) | *Surface* | Soil | 0 | 6 | 19258 | 19957 | | | | | | |
| 3 | AAA9653 | 33-1420 | 33-010(b) | *Surface* | Soil | 0 | 6 | 19258 | 19957 | | | | | | |

**RESULTS OF ANALYSES**

**SWMU 33-010(b): Canyonside Disposal**

| NO. | SAMPLE ID | RADIONUCLIDES | | | INORGANICS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Uranium | Cesium-137 | Cobalt-60 | Silver | Arsenic | Barium | Beryllium | Cadmium | Chromium | Mercury | Nickel | Lead | Antimony | Selenium | Zinc |
| | | mg/kg | pCi/g | pCi/g | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1 | AAA9651 | *13.26* | 0.77 | -0.013 | <0.76 | <1.8 | 78 | <0.7 | *182* | *43.2* | 0.13 | <3.3 | *83.7* | <4.3 | <0.52 | *402* |
| 2 | AAA9652 | *761.62* | *1.52* | -0.006 | <0.81 | <2.2 | 135 | <0.83 | *53.7* | *34.2* | <0.03 | *.207* | *122* | <4.3 | <0.51 | *222* |
| 3 | AAA9653 | 5.19 | 0.68 | -0.006 | <0.79 | <1.9 | 107 | <0.83 | *5.7* | 6.7 | <0.05 | *429* | 6.9 | <4.6 | <0.55 | 48.9 |
| *SALs[f]* | | *230* | *5.1* | *1.1* | *383* | *bkg* | *5 340* | *bkg* | *38* | *210* | *23* | *1 534* | *400* | *31* | *383* | *23 004* |
| *EQLs[g]* | | *1.4* | *1* | *NA[e]* | *2* | *2* | *40* | *1* | *1* | *2* | *0.1* | *8* | *1* | *12* | *1* | *4* |
| *LANL UTLs[h]* | | *5.45* | *1.4* | *NA* | *NA* | *7.82* | *315* | *1.95* | *2.7* | *19.3* | *0.1* | *15.2* | *23.3* | *1* | *1.7* | *50.8* |
| *TA-33 UTLs* | | *4.12* | *2.068* | *NA* | *NA* | *3.77* | *139* | *1.22* | *NA* | *14.6* | *NA* | *11.1* | *25.2* | *0.17* | *0.92* | *57.3* |

**No organics analyzed**

[a] VOCs = Volatile organic compounds.
[b] SVOCs = Semivolatile organic compounds.
[c] PCBs = Polychlorinated biphenyls.
[d] HE = High explosive.
[e] NA = Not applicable.
[f] SALs = Screening action levels.
[g] EQLs = Estimated quantitation limits.
[h] UTLs = Upper tolerance limits.



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**SAMPLE INFORMATION**

**SWMU 33-010(d): Canyonside Disposal**

| NO. | SAMPLE ID | SITE ID | ASSIGNED PRS | TYPE | MATRIX | BEGIN DEPTH (in.) | END DEPTH (in.) | ANALYSES PERFORMED | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | ORGANICS | | | | |
| | | | | | | | | Inorganics | Rad | VOCs[a] | SVOCs[b] | PCBs[c] | HE[d] | Pesticides | Herbicides |
| 1 | AAA9852 | 33-1422 | 33-010(d) | *Surface* | Surface soil | 0 | 6 | 17843 | 19352 | | | | | | |
| 2 | AAA9853 | 33-1423 | 33-010(d) | *Surface* | Surface soil | 0 | 6 | 17843 | 19352 | | | | | | |
| 3 | AAA9854 | 33-1424 | 33-010(d) | *Surface* | Surface soil | 0 | 6 | 17843 | 19352 | | | | | | |
| 4 | AAA9855 | 33-1425 | 33-010(d) | *Surface* | Surface soil | 0 | 6 | 17843 | 19352 | | | | | | |
| 5 | AAA9856 | 33-1426 | 33-010(d) | *Surface* | Surface soil | 0 | 6 | 17843 | 19352 | | | | | | |
| 6 | AAA9857 | 33-1427 | 33-010(d) | *Surface* | Surface soil | 0 | 6 | 17843 | 19352 | | | | | | |

**RESULTS OF ANALYSES**

**SWMU 33-010(d): Canyonside Disposal**

| NO. | SAMPLE ID | RADIONUCLIDES | | | INORGANICS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Uranium | Cesium-137 | Cobalt-60 | Silver | Arsenic | Barium | Beryllium | Cadmium | Chromium | Mercury | Nickel | Lead | Antimony | Selenium | Zinc |
| | | mg/kg | pCi/g | pCi/g | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1 | AAA9852 | 0.36 | 0.779 | 0.003 | <1 | 1.4 | 110 | 0.4 | 0.4 | 9.2 | NA[e] | 4 | *59* | <0.25 | <0.3 | *77* |
| 2 | AAA9853 | 0.55 | 0.191 | 0.01 | <1 | 1.3 | 68 | 0.09 | 0.4 | 6.8 | NA | 7 | *28* | <0.25 | <0.3 | 36 |
| 3 | AAA9854 | 1.62 | 0.841 | <0.002 | <1 | 0.9 | 63 | 0.3 | <0.4 | 6.3 | NA | <2 | 7 | <0.25 | <0.3 | 45 |
| 4 | AAA9855 | 1.09 | 0.849 | 0.022 | <1 | 1.1 | 95 | 0.6 | 0.4 | 6.8 | NA | 4 | 9 | <0.25 | <0.3 | 29 |
| 5 | AAA9856 | 0.34 | 0.519 | 0.004 | <1 | 1 | 68 | 0.3 | <0.4 | 3.6 | NA | <2 | 4 | <0.25 | <0.3 | 20 |
| 6 | AAA9857 | 0.54 | 0.754 | 0.013 | <1 | 1 | 89 | 0.2 | <0.4 | 4.2 | NA | 2 | 7 | <0.25 | <0.3 | 18 |
| *SALs[f]* | | *230* | *5.1* | *1.1* | *383* | *bkg* | *5 340* | *bkg* | *38* | *210* | *23* | *1 534* | *400* | *31* | *383* | *23 004* |
| *EQLs[g]* | | *1.4* | *1* | *NA* | *2* | *2* | *40* | *1* | *1* | *2* | *0.1* | *8* | *1* | *12* | *1* | *4* |
| *LANL UTLs[h]* | | *5.45* | *1.4* | *NA* | *NA* | *7.82* | *315* | *1.95* | *2.7* | *19.3* | *0.1* | *15.2* | *23.3* | *1* | *1.7* | *50.8* |
| *TA-33 UTLs* | | *4.12* | *2.068* | *NA* | *NA* | *3.77* | *139* | *1.22* | *NA* | *14.6* | *NA* | *11.1* | *25.2* | *0.17* | *0.92* | *57.3* |

**No organics analyzed**

[a] VOCs = Volatile organic compounds.
[b] SVOCs = Semivolatile organic compounds.
[c] PCBs = Polychlorinated biphenyls.
[d] HE = High explosive.
[e] NA = Not applicable.
[f] SALs = Screening action levels.
[g] EQLs = Estimated quantitation limits.
[h] UTLs = Upper tolerance limits.

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**SAMPLE INFORMATION**

**SWMU 33-010(g): Canyonside disposal SE of MDA-K**

| NO. | SAMPLE ID | SITE ID | ASSIGNED PRS | TYPE | MATRIX | BEGIN DEPTH (in.) | END DEPTH (in.) | ANALYSES PERFORMED | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | ORGANICS | | | | | |
| | | | | | | | | Inorganics | Rad | VOCs[a] | SVOCs[b] | PCBs[c] | HE[d] | Pesticides | Herbicides |
| 1 | AAA9814 | 33-1428 | 33-010(g) | canyonside | soil | 0 | 6 | 19283 | 19471 | | | | 17831 | | |
| 2 | AAA9815 | 33-1429 | 33-010(g) | canyonside | | 0 | 6 | 19283 | 19471 | | | | 17831 | | |
| 3 | AAA9816 | 33-1431 | 33-010(g) | rubble pile | | 0 | 6 | 19283 | 19471 | | | | 17831 | | |
| 4 | AAA9817 | 33-1430 | 33-010(g) | drainage | | 0 | 6 | 19283 | 19471 | | | | 17831 | | 17798 |
| 5 | AAA9804 | 33-1345 | 006A-31 | canyonside | | 0 | 6 | 19396 | 19462 | | | | 17732 | | |
| 6 | AAA9812 | 33-1352 | 006A-38 | canyonside | | 0 | 6 | 19283 | 19471 | | | | 17831 | | |
| 7 | AAA9813 | 33-1353 | 006A-39 | canyonside | | 0 | 6 | 19283 | 19471 | | | | 17831 | | |

**RESULTS OF ANALYSES**

**SWMU 33-010(g): Canyonside disposal SE of MDA-K**

| NO. | SAMPLE ID | RADIONUCLIDES | | INORGANICS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Uranium | Cesium-137 | Silver | Arsenic | Barium | Beryllium | Cadmium | Chromium | Mercury | Nickel | Lead | Antimony | Selenium | Zinc |
| | | mg/kg | pCi/g | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1 | AAA9814 | 0.55 | 0.107 | <.78 | <1.1 | 85.6 | 1.5 | <.36 | 4.8 | <.02 | <6.8 | 10.9 | <4.4 | <.53 | 34.3 |
| 2 | AAA9815 | 0.18 | 0.056 | <.84 | <.61 | 53.7 | <.62 | <.39 | 2.8 | <.02 | <5 | 3.3 | <4.8 | <.57 | 19 |
| 3 | AAA9816 | 1.57 | 0.588 | <.75 | <.55 | <24.8 | <.62 | <.34 | 2.3 | *0.56* | <1.3 | 6.4 | <4.3 | <.51 | 32.4 |
| 4 | AAA9817 | 1.16 | 0.244 | <.76 | <.61 | 78.8 | 1.1 | <.35 | 4.2 | <.02 | <6.2 | 6 | <4.3 | <.52 | 30.4 |
| | AAA9817R[e] | 1.27 | NA[f] | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 5 | AAA9804 | 2.33 | 1.12 | <0.76 | <1.6 | 55.9 | <0.91 | <0.51 | 4.4 | <0.02 | <4.5 | 14.7 | <4.3 | <0.51 | 45.8 |
| | AAA9804R | 2.12 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 6 | AAA9812 | 1.35 | *2.085* | <.77 | <.95 | 54.8 | 1.6 | <.52 | 3.4 | <.03 | <4 | 21 | <4.4 | <.52 | *54.2* |
| 7 | AAA9813 | 0.62 | 1.202 | <.82 | <.92 | 74.1 | <1.1 | <.59 | 4.9 | <.02 | <5.7 | 13.7 | <4.7 | <.55 | 43.1 |
| *SALs[g]* | | *230* | *5.1* | *383* | *bkg* | *5 340* | *bkg* | *38* | *210* | *23* | *1 534* | *400* | *31* | *383* | *23 004* |
| *EQLs[h]* | | *1.4* | *1* | *2* | *2* | *40* | *1* | *1* | *2* | *0.1* | *8* | *1* | *12* | *1* | *4* |
| *LANL UTLs[i]* | | *5.45* | *1.4* | *NA* | *7.82* | *315* | *1.95* | *2.7* | *19.3* | *0.1* | *15.2* | *23.3* | *1* | *1.7* | *50.8* |
| *TA-33 UTLs* | | *4.12* | *2.068* | *NA* | *3.77* | *139* | *1.22* | *NA* | *14.6* | *NA* | *11.1* | *25.2* | *0.17* | *0.92* | *57.3* |

| | ORGANICS DETECTED | | | | | |
|---|---|---|---|---|---|---|
| NO. | SAMPLE ID | HE | RESULT | SAL | EQL | UNITS |
| 5 | AAA9804 | Tetryl(methyl-2,4,6-trinitrophenylnitramine) | 0.69 | NC | | mg/kg |
| 7 | AAA9813 | Amino-4,6-dinitrotoluene [2-] | 0.36 | NC | | mg/kg |
| | AAA9813 | Amino-2,6-dinitrotoluene [4-] | 0.36 | NC | | mg/kg |

[a] VOCs = Volatile organic compounds.
[b] SVOCs = Semivolatile organic compounds.
[c] PCBs = Polychlorinated biphenyls.
[d] HE = High explosive.
[e] R = Reanalyzed.
[f] NA = Not applicable.
[g] SALs = Screening action levels.
[h] EQLs = Estimated quantitation limits.
[i] UTLs = Upper tolerance limits.





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**SAMPLE INFORMATION**

**SWMU 33-011(b): NRAO Storage Area**

| NO. | SAMPLE ID | SITE ID | ASSIGNED PRS | TYPE | MATRIX | BEGIN DEPTH (in.) | END DEPTH (in.) | ANALYSES PERFORMED | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | ORGANICS | | | | | |
| | | | | | | | | Inorganics | Rad | VOCs[a] | SVOCs[b] | PCBs[c] | HE[d] | Pesticides | Herbicides |
| 1 | AAA9830 | 33-1433 | 33-011(b) | *surface* | soil | 0 | 6 | 19255 | 19417 | | | | | | |
| 2 | AAA9831 | 33-1434 | 33-011(b) | *surface* | soil | 0 | 6 | 19255 | 19417 | | | | | | |
| 3 | AAA9832 | 33-1435 | 33-011(b) | *surface* | soil | 0 | 6 | 19255 | 19417 | | | | | | |
| 4 | AAA9833 | 33-1436 | 33-011(b) | *surface* | soil | 0 | 6 | 19255 | 19417 | | | | | | |
| 5 | AAA9834 | 33-1471 | 33-011(b) | *collocated* | soil | 0 | 6 | 19255 | 19417 | | | | | | |
| 6 | AAA9835 | 33-1437 | 33-011(b) | *surface* | soil | 0 | 6 | 19255 | 19417 | | | | | | 17897 |
| 7 | AAA9836 | 33-1438 | 33-011(b) | *surface* | soil | 0 | 6 | 19255 | 19417 | | | | | | |
| 8 | AAA9837 | 33-1439 | 33-011(b) | *surface* | soil | 0 | 6 | 19255 | 19417 | | | | | | |
| 9 | AAA9838 | 33-1440 | 33-011(b) | *surface* | soil | 0 | 6 | 19255 | 19417 | | | | | | |
| 10 | AAA9839 | 33-1441 | 33-011(b) | *surface* | soil | 0 | 6 | 19255 | 19417 | | | | | | |

**RESULTS OF ANALYSES**

**SWMU 33-011(b): NRAO Storage Area**

| NO. | SAMPLE ID | RADIONUCLIDES | | INORGANICS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Uranium | Cesium-137 | Silver | Arsenic | Barium | Beriliium | Cadmium | Chromium | Mercury | Nickel | Lead | Antimony | Selenium | Zinc |
| | | mg/kg | pCi/g | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1 | AAA9830 | 0.4 | *1.938* | <0.86 | 1.6 | 110 | 0.66 | <.4 | 6.2 | <0.02 | <7 | 10.1 | <4.9 | <0.58 | 34.2 |
| | AAA9830R[e] | NA[f] | NA | <0.86 | <1.8 | 110 | <.71 | 0.48 | 5.6 | <0.02 | 7.5 | 15.5 | <4.9 | <0.58 | 34.2 |
| 2 | AAA9831 | 0.22 | *1.651* | <0.88 | <1.8 | 193 | <0.72 | <0.4 | 4.7 | <.04 | <5.8 | 10.8 | <5 | <0.59 | 28.6 |
| | AAA9831R | 0.32 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 3 | AAA9832 | 0.33 | 0.943 | <0.8 | <1.5 | 99.6 | <0.68 | <0.7 | 4.8 | <0.02 | <4.9 | 11 | <4.5 | <0.54 | 27.9 |
| | AAA9832R | NA | 1.019 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 4 | AAA9833 | 0.41 | 0.906 | <0.78 | <1.6 | 94.9 | <0.66 | <0.51 | 5.6 | <0.02 | <6.8 | 14.6 | <4.4 | <0.52 | 27.8 |
| 5 | AAA9834 | 0.23 | 0.702 | <0.79 | <1.6 | 105 | <0.76 | <0.51 | 6.1 | <0.02 | <7.1 | 14.4 | <4.5 | <0.54 | 30.1 |
| 6 | AAA9835 | 0.41 | 1.271 | <0.76 | <1.3 | 81.1 | <0.63 | <0.45 | 4.5 | <0.02 | <6.2 | 8.5 | <4.3 | <0.52 | 21.8 |
| 7 | AAA9836 | 0.68 | 0.502 | <0.79 | <1 | 92.5 | <0.86 | <0.36 | 5.8 | <0.02 | <7.1 | 8.9 | <4.5 | <0.53 | 25.4 |
| 8 | AAA9837 | 0.49 | 0.04 | <0.75 | <1.4 | 103 | <0.39 | <0.34 | 5.4 | <0.02 | <4.9 | 4.6 | <4.3 | <0.51 | 15.8 |
| 9 | AAA9838 | 0.53 | 1.262 | <0.82 | <1.1 | 84.7 | <0.59 | <0.38 | 4.6 | <0.02 | <4.2 | 13.2 | <4.7 | <0.55 | 31.9 |
| 10 | AAA9839 | 0.49 | 0.081 | <0.76 | <1.3 | 82.5 | <0.9 | <0.35 | 5.4 | <0.02 | <4.6 | 9.5 | <4.3 | <0.52 | 25.7 |
| | *SALs[g]* | *230* | *5.1* | *383* | *bkg* | *5 340* | *bkg* | *38* | *210* | *23* | *1 534* | *400* | *31* | *383* | *23 004* |
| | *EQLs[h]* | *1.4* | *1* | *2* | *2* | *40* | *1* | *1* | *2* | *0.1* | *8* | *1* | *12* | *1* | *4* |
| | *LANL UTLs[i]* | *5.45* | *1.4* | *NA* | *7.62* | *315* | *1.95* | *2.7* | *19.3* | *0.1* | *15.2* | *23.3* | *1* | *1.7* | *50.8* |
| | *TA-33 UTLs* | *4.12* | *2.068* | *NA* | *3.77* | *139* | *1.22* | *NA* | *14.6* | *NA* | *11.1* | *25.2* | *0.17* | *0.92* | *57.3* |

***No Organics Detected***

[a] VOCs = Volatile organic compounds.
[b] SVOCs = Semivolatile organic compounds.
[c] PCBs = Polychlorinated biphenyls.
[d] HE = High explosive.
[e] R = Reanalyzed.
[f] NA = Not applicable.
[g] SALs = Screening action levels.
[h] EQLs = Estimated quantitation limits.
[i] UTLs = Upper tolerance limits.

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## APPENDIX E METHODOLOGIES FOR DEVELOPING SITE-SPECIFIC PRELIMINARY REMEDIAL GOALS TO DEMONSTRATE CLEAN CLOSURE

The following equation was used to derive cleanup levels for carcinogenic compounds in soil for the recreational scenario:

$$C = \frac{TR \times AT \times 365 \ \ days/year}{\left(SF_o \times 10^{-6} \ \ kg/mg \times EF \times IR_{soil}\right) + \left(SF_i \times EF \times IR_{air} \times \left(1/Y\right)\right)}$$

Where:

| PARAMETER | DEFINITION | UNITS | VALUE |
|---|---|---|---|
| C | Cleanup level - chemical concentration in soil | mg/kg | — |
| TR | Target excess individual lifetime cancer risk | unitless | $10^{-6}$ |
| AT | Carcinogenic averaging time | yr | 70 |
| EF | Exposure frequency | days/yr | 28 |
| $SF_o$ | Oral cancer slope factor | $(mg/kg\text{-}day)^{-1}$ | chemical-specific |
| $IR_{soil}$ | Age adjusted soil ingestion factor | mg-yr/kg-day | 93 |
| $SF_i$ | Inhalation cancer slope factor | $(mg/kg\text{-}day)^{-1}$ | chemical-specific |
| $IR_{air}$ | Age adjusted inhalation factor | $m^3$-yr/kg-day | 9.5 |
| Y | Particulate emission factor (PEF) for non-volatiles | $m^3/kg$ | $1.11 \times 10^7$ |

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# APPENDIX F PARAMETERS USED FOR RESRAD CALCULATION OF URANIUM CLEAN UP LEVEL

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Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

| Parameter | Current Value | Default | Parameter Name |
|---|---|---|---|
| Dose conversion factors for inhalation, mrem/pCi: | | | |
| Ac-227+D | 6.720E+00 | 6.720E+00 | DCF2( 1) |
| Pa-231 | 1.280E+00 | 1.280E+00 | DCF2( 2) |
| Pb-210+D | 2.320E-02 | 2.320E-02 | DCF2( 3) |
| Ra-226+D | 8.600E-03 | 8.600E-03 | DCF2( 4) |
| Th-230 | 3.260E-01 | 3.260E-01 | DCF2( 5) |
| U-234 | 1.320E-01 | 1.320E-01 | DCF2( 6) |
| U-235+D | 1.230E-01 | 1.230E-01 | DCF2( 7) |
| U-238+D | 1.180E-01 | 1.180E-01 | DCF2( 8) |
| Dose conversion factors for ingestion, mrem/pCi: | | | |
| Ac-227+D | 1.480E-02 | 1.480E-02 | DCF3( 1) |
| Pa-231 | 1.060E-02 | 1.060E-02 | DCF3( 2) |
| Pb-210+D | 7.270E-03 | 7.270E-03 | DCF3( 3) |
| Ra-226+D | 1.330E-03 | 1.330E-03 | DCF3( 4) |
| Th-230 | 5.480E-04 | 5.480E-04 | DCF3( 5) |
| U-234 | 2.830E-04 | 2.830E-04 | DCF3( 6) |
| U-235+D | 2.670E-04 | 2.670E-04 | DCF3( 7) |
| U-238+D | 2.690E-04 | 2.690E-04 | DCF3( 8) |
| Food transfer factors: | | | |
| Ac-227+D , plant/soil concentration ratio, dimensionless | 2.500E-03 | 2.500E-03 | RTF( 1,1) |
| Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 2.000E-05 | 2.000E-05 | RTF( 1,2) |
| Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 2.000E-05 | 2.000E-05 | RTF( 1,3) |
| Pa-231 , plant/soil concentration ratio, dimensionless | 1.000E-02 | 1.000E-02 | RTF( 2,1) |
| Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 5.000E-03 | 5.000E-03 | RTF( 2,2) |
| Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 5.000E-06 | 5.000E-06 | RTF( 2,3) |
| Pb-210+D , plant/soil concentration ratio, dimensionless | 1.000E-02 | 1.000E-02 | RTF( 3,1) |
| Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-04 | 8.000E-04 | RTF( 3,2) |
| Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 3.000E-04 | 3.000E-04 | RTF( 3,3) |
| Ra-226+D , plant/soil concentration ratio, dimensionless | 4.000E-02 | 4.000E-02 | RTF( 4,1) |
| Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-03 | 1.000E-03 | RTF( 4,2) |
| Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 1.000E-03 | 1.000E-03 | RTF( 4,3) |
| Th-230 , plant/soil concentration ratio, dimensionless | 1.000E-03 | 1.000E-03 | RTF( 5,1) |
| Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 1.000E-04 | 1.000E-04 | RTF( 5,2) |
| Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 5.000E-06 | 5.000E-06 | RTF( 5,3) |
| U-234 , plant/soil concentration ratio, dimensionless | 2.500E-03 | 2.500E-03 | RTF( 6,1) |
| U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.400E-04 | 3.400E-04 | RTF( 6,2) |
| U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 6.000E-04 | 6.000E-04 | RTF( 6,3) |
| U-235+D , plant/soil concentration ratio, dimensionless | 2.500E-03 | 2.500E-03 | RTF( 7,1) |
| U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.400E-04 | 3.400E-04 | RTF( 7,2) |
| U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 6.000E-04 | 6.000E-04 | RTF( 7,3) |

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Dose Conversion Factor (and Related) Parameter Summary (continued)
File: DOSFAC.BIN

| Parameter | Current Value | Default | Parameter Name |
|---|---|---|---|
| U-238+D , plant/soil concentration ratio, dimensionless | 2.500E-03 | 2.500E-03 | RTF( 8,1) |
| U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 3.400E-04 | 3.400E-04 | RTF( 8,2) |
| U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 6.000E-04 | 6.000E-04 | RTF( 8,3) |
| Bioaccumulation factors, fresh water, L/kg: | | | |
| Ac-227+D , fish | 1.500E+01 | 1.500E+01 | BIOFAC( 1,1) |
| Ac-227+D , crustacea and mollusks | 1.000E+03 | 1.000E+03 | BIOFAC( 1,2) |
| Pa-231 , fish | 1.000E+01 | 1.000E+01 | BIOFAC( 2,1) |
| Pa-231 , crustacea and mollusks | 1.100E+02 | 1.100E+02 | BIOFAC( 2,2) |
| Pb-210+D , fish | 3.000E+02 | 3.000E+02 | BIOFAC( 3,1) |
| Pb-210+D , crustacea and mollusks | 1.000E+02 | 1.000E+02 | BIOFAC( 3,2) |
| Ra-226+D , fish | 5.000E+01 | 5.000E+01 | BIOFAC( 4,1) |
| Ra-226+D , crustacea and mollusks | 2.500E+02 | 2.500E+02 | BIOFAC( 4,2) |
| Th-230 , fish | 1.000E+02 | 1.000E+02 | BIOFAC( 5,1) |
| Th-230 , crustacea and mollusks | 5.000E+02 | 5.000E+02 | BIOFAC( 5,2) |
| [illegible]4 , fish | 1.000E+01 | 1.000E+01 | BIOFAC( 6,1) |
| [illegible]34 , crustacea and mollusks | 6.000E+01 | 6.000E+01 | BIOFAC( 6,2) |
| U-235+D , fish | 1.000E+01 | 1.000E+01 | BIOFAC( 7,1) |
| U-235+D , crustacea and mollusks | 6.000E+01 | 6.000E+01 | BIOFAC( 7,2) |
| U-238+D , fish | 1.000E+01 | 1.000E+01 | BIOFAC( 8,1) |
| U-238+D , crustacea and mollusks | 6.000E+01 | 6.000E+01 | BIOFAC( 8,2) |

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## Site-Specific Parameter Summary

| Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|
| Area of contaminated zone (m**2) | 2.500E+02 | 1.000E+04 | --- | AREA |
| Thickness of contaminated zone (m) | 1.000E+00 | 2.000E+00 | --- | THICK0 |
| Length parallel to aquifer flow (m) | 1.800E+01 | 1.000E+02 | --- | LCZPAQ |
| Basic radiation dose limit (mrem/yr) | 1.500E+01 | 3.000E+01 | --- | BRDL |
| Time since placement of material (yr) | 0.000E+00 | 0.000E+00 | --- | TI |
| Times for calculations (yr) | 1.000E-01 | 1.000E+00 | --- | T( 2) |
| Times for calculations (yr) | 1.000E+00 | 3.000E+00 | --- | T( 3) |
| Times for calculations (yr) | 1.000E+01 | 1.000E+01 | --- | T( 4) |
| Times for calculations (yr) | 5.000E+01 | 3.000E+01 | --- | T( 5) |
| Times for calculations (yr) | 1.000E+02 | 1.000E+02 | --- | T( 6) |
| Times for calculations (yr) | 5.000E+02 | 3.000E+02 | --- | T( 7) |
| Times for calculations (yr) | 1.000E+03 | 1.000E+03 | --- | T( 8) |
| Times for calculations (yr) | 5.000E+03 | 0.000E+00 | --- | T( 9) |
| Times for calculations (yr) | 1.000E+04 | 0.000E+00 | --- | T(10) |
| | | | | |
| Initial principal radionuclide (pCi/g): U-234 | 4.100E+02 | 0.000E+00 | --- | S1( 6) |
| Initial principal radionuclide (pCi/g): U-235 | 1.900E+01 | 0.000E+00 | --- | S1( 7) |
| Initial principal radionuclide (pCi/g): U-238 | 3.700E+02 | 0.000E+00 | --- | S1( 8) |
| Concentration in groundwater (pCi/L): U-234 | not used | 0.000E+00 | --- | W1( 6) |
| Concentration in groundwater (pCi/L): U-235 | not used | 0.000E+00 | --- | W1( 7) |
| Concentration in groundwater (pCi/L): U-238 | not used | 0.000E+00 | --- | W1( 8) |
| | | | | |
| Cover depth (m) | 0.000E+00 | 0.000E+00 | --- | COVER0 |
| Density of cover material (g/cm**3) | not used | 1.500E+00 | --- | DENSCV |
| Cover depth erosion rate (m/yr) | not used | 1.000E-03 | --- | VCV |
| Density of contaminated zone (g/cm**3) | 1.600E+00 | 1.500E+00 | --- | DENSCZ |
| Contaminated zone erosion rate (m/yr) | 0.000E+00 | 1.000E-03 | --- | VCZ |
| Contaminated zone total porosity | 4.000E-01 | 4.000E-01 | --- | TPCZ |
| Contaminated zone effective porosity | 2.000E-01 | 2.000E-01 | --- | EPCZ |
| Contaminated zone hydraulic conductivity (m/yr) | 4.400E+02 | 1.000E+01 | --- | HCCZ |
| Contaminated zone b parameter | 4.050E+00 | 5.300E+00 | --- | BCZ |
| Humidity in air (g/cm**3) | not used | 8.000E+00 | --- | HUMID |
| Evapotranspiration coefficient | 9.990E-01 | 5.000E-01 | --- | EVAPTR |
| Precipitation (m/yr) | 4.800E-01 | 1.000E+00 | --- | PRECIP |
| Irrigation (m/yr) | 0.000E+00 | 2.000E-01 | --- | RI |
| Irrigation mode | overhead | overhead | --- | IDITCH |
| Runoff coefficient | 5.000E-01 | 2.000E-01 | --- | RUNOFF |
| Watershed area for nearby stream or pond (m**2) | 1.000E+06 | 1.000E+06 | --- | WAREA |
| Accuracy for water/soil computations | 1.000E-03 | 1.000E-03 | --- | EPS |
| | | | | |
| Density of saturated zone (g/cm**3) | 1.600E+00 | 1.500E+00 | --- | DENSAQ |
| Saturated zone total porosity | 3.000E-01 | 4.000E-01 | --- | TPSZ |
| Saturated zone effective porosity | 3.000E-01 | 2.000E-01 | --- | EPSZ |
| Saturated zone hydraulic conductivity (m/yr) | 1.000E+02 | 1.000E+02 | --- | HCSZ |
| Saturated zone hydraulic gradient | 2.000E-02 | 2.000E-02 | --- | HGWT |
| Saturated zone b parameter | 4.050E+00 | 5.300E+00 | --- | BSZ |
| Water table drop rate (m/yr) | 3.000E-01 | 1.000E-03 | --- | VWT |
| Well pump intake depth (m below water table) | 1.000E+01 | 1.000E+01 | --- | DWIBWT |
| Model: Nondispersion (ND) or Mass-Balance (MB) | ND | ND | --- | MODEL |
| Well pumping rate (m**3/yr) | 2.500E+02 | 2.500E+02 | --- | UW |

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Site-Specific Parameter Summary (continued)

| | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| 5 | Number of unsaturated zone strata | not used | 1 | --- | NS |
| | Unsat. zone 1, thickness (m) | not used | 4.000E+00 | --- | H(1) |
| 5 | Unsat. zone 1, soil density (g/cm**3) | not used | 1.500E+00 | --- | DENSUZ(1) |
| 5 | Unsat. zone 1, total porosity | not used | 4.000E-01 | --- | TPUZ(1) |
| | Unsat. zone 1, effective porosity | not used | 2.000E-01 | --- | EPUZ(1) |
| | Unsat. zone 1, soil-specific b parameter | not used | 5.300E+00 | --- | BUZ(1) |
| 5 | Unsat. zone 1, hydraulic conductivity (m/yr) | not used | 1.000E+01 | --- | HCUZ(1) |
| | | | | | |
| | Unsat. zone 2, thickness (m) | not used | 0.000E+00 | --- | H(2) |
| 5 | Unsat. zone 2, soil density (g/cm**3) | not used | 1.500E+00 | --- | DENSUZ(2) |
| 5 | Unsat. zone 2, total porosity | not used | 4.000E-01 | --- | TPUZ(2) |
| | Unsat. zone 2, effective porosity | not used | 2.000E-01 | --- | EPUZ(2) |
| | Unsat. zone 2, soil-specific b parameter | not used | 5.300E+00 | --- | BUZ(2) |
| 5 | Unsat. zone 2, hydraulic conductivity (m/yr) | not used | 1.000E+01 | --- | HCUZ(2) |
| | | | | | |
| | Distribution coefficients for U-234 | | | | |
| | Contaminated zone (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCC( 6) |
| | Unsaturated zone 1 (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCU( 6,1) |
| | Unsaturated zone 2 (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCU( 6,2) |
| | Saturated zone (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCS( 6) |
| | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 2.996E-06 | ALEACH( 6) |
| | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 6) |
| | | | | | |
| | Distribution coefficients for U-235 | | | | |
| | Contaminated zone (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCC( 7) |
| | Unsaturated zone 1 (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCU( 7,1) |
| | Unsaturated zone 2 (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCU( 7,2) |
| | Saturated zone (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCS( 7) |
| | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 2.996E-06 | ALEACH( 7) |
| | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 7) |
| | | | | | |
| | Distribution coefficients for U-238 | | | | |
| | Contaminated zone (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCC( 8) |
| | Unsaturated zone 1 (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCU( 8,1) |
| | Unsaturated zone 2 (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCU( 8,2) |
| | Saturated zone (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCS( 8) |
| | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 2.996E-06 | ALEACH( 8) |
| | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 8) |
| | | | | | |
| | Distribution coefficients for daughter Ac-227 | | | | |
| | Contaminated zone (cm**3/g) | 2.000E+01 | 2.000E+01 | --- | DCNUCC( 1) |
| | Unsaturated zone 1 (cm**3/g) | 2.000E+01 | 2.000E+01 | --- | DCNUCU( 1,1) |
| | Unsaturated zone 2 (cm**3/g) | 2.000E+01 | 2.000E+01 | --- | DCNUCU( 1,2) |
| | Saturated zone (cm**3/g) | 2.000E+01 | 2.000E+01 | --- | DCNUCS( 1) |
| | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 7.474E-06 | ALEACH( 1) |
| | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 1) |

OFFICIAL USE ONLY

Site-Specific Parameter Summary (continued)

| | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| 6 | Distribution coefficients for daughter Pa-231 | | | | |
| 6 | Contaminated zone (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCC( 2) |
| 6 | Unsaturated zone 1 (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCU( 2,1) |
| 6 | Unsaturated zone 2 (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCU( 2,2) |
| 6 | Saturated zone (cm**3/g) | 5.000E+01 | 5.000E+01 | --- | DCNUCS( 2) |
| 6 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 2.996E-06 | ALEACH( 2) |
| 6 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 2) |
| | | | | | |
| 6 | Distribution coefficients for daughter Pb-210 | | | | |
| 6 | Contaminated zone (cm**3/g) | 1.000E+02 | 1.000E+02 | --- | DCNUCC( 3) |
| 6 | Unsaturated zone 1 (cm**3/g) | 1.000E+02 | 1.000E+02 | --- | DCNUCU( 3,1) |
| 6 | Unsaturated zone 2 (cm**3/g) | 1.000E+02 | 1.000E+02 | --- | DCNUCU( 3,2) |
| 6 | Saturated zone (cm**3/g) | 1.000E+02 | 1.000E+02 | --- | DCNUCS( 3) |
| 6 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 1.499E-06 | ALEACH( 3) |
| 6 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 3) |
| | | | | | |
| | Distribution coefficients for daughter Ra-226 | | | | |
| | Contaminated zone (cm**3/g) | 7.000E+01 | 7.000E+01 | --- | DCNUCC( 4) |
| | Unsaturated zone 1 (cm**3/g) | 7.000E+01 | 7.000E+01 | --- | DCNUCU( 4,1) |
| | Unsaturated zone 2 (cm**3/g) | 7.000E+01 | 7.000E+01 | --- | DCNUCU( 4,2) |
| | Saturated zone (cm**3/g) | 7.000E+01 | 7.000E+01 | --- | DCNUCS( 4) |
| | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 2.141E-06 | ALEACH( 4) |
| | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 4) |
| | | | | | |
| | Distribution coefficients for daughter Th-230 | | | | |
| | Contaminated zone (cm**3/g) | 6.000E+04 | 6.000E+04 | --- | DCNUCC( 5) |
| | Unsaturated zone 1 (cm**3/g) | 6.000E+04 | 6.000E+04 | --- | DCNUCU( 5,1) |
| | Unsaturated zone 2 (cm**3/g) | 6.000E+04 | 6.000E+04 | --- | DCNUCU( 5,2) |
| | Saturated zone (cm**3/g) | 6.000E+04 | 6.000E+04 | --- | DCNUCS( 5) |
| | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 2.500E-09 | ALEACH( 5) |
| | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 5) |
| | | | | | |
| | Inhalation rate (m**3/yr) | 1.840E+04 | 8.400E+03 | --- | INHALR |
| | Mass loading for inhalation (g/m**3) | 1.000E-04 | 2.000E-04 | --- | MLINH |
| | Dilution length for airborne dust, inhalation (m) | 3.000E+00 | 3.000E+00 | --- | LM |
| | Exposure duration | 3.000E+01 | 3.000E+01 | --- | ED |
| | Shielding factor, inhalation | 4.000E-01 | 4.000E-01 | --- | SHF3 |
| | Shielding factor, external gamma | 7.000E-01 | 7.000E-01 | --- | SHF1 |
| | Fraction of time spent indoors | 0.000E+00 | 5.000E-01 | --- | FIND |
| | Fraction of time spent outdoors (on site) | 6.650E-03 | 2.500E-01 | --- | FOTD |
| | Shape factor flag, external gamma | -1.000E+00 | 1.000E+00 | -1 shows non-circular AREA. | FS |

OFFICIAL USE ONLY

Site-Specific Parameter Summary (continued)

| Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|
| Radii of shape factor array (used if FS = -1): | | | | |
| Outer annular radius (m), ring 1: | 1.000E+00 | 5.000E+01 | --- | RAD_SHAPE( 1) |
| Outer annular radius (m), ring 2: | 2.500E+00 | 7.071E+01 | --- | RAD_SHAPE( 2) |
| Outer annular radius (m), ring 3: | 5.000E+00 | 0.000E+00 | --- | RAD_SHAPE( 3) |
| Outer annular radius (m), ring 4: | 1.000E+01 | 0.000E+00 | --- | RAD_SHAPE( 4) |
| Outer annular radius (m), ring 5: | 2.000E+01 | 0.000E+00 | --- | RAD_SHAPE( 5) |
| Outer annular radius (m), ring 6: | 0.000E+00 | 0.000E+00 | --- | RAD_SHAPE( 6) |
| Outer annular radius (m), ring 7: | 0.000E+00 | 0.000E+00 | --- | RAD_SHAPE( 7) |
| Outer annular radius (m), ring 8: | 0.000E+00 | 0.000E+00 | --- | RAD_SHAPE( 8) |
| Outer annular radius (m), ring 9: | 0.000E+00 | 0.000E+00 | --- | RAD_SHAPE( 9) |
| Outer annular radius (m), ring 10: | 0.000E+00 | 0.000E+00 | --- | RAD_SHAPE(10) |
| Outer annular radius (m), ring 11: | 0.000E+00 | 0.000E+00 | --- | RAD_SHAPE(11) |
| Outer annular radius (m), ring 12: | 0.000E+00 | 0.000E+00 | --- | RAD_SHAPE(12) |
| Fractions of annular areas within AREA: | | | | |
| Ring 1 | 1.000E+00 | 1.000E+00 | --- | FRACA( 1) |
| Ring 2 | 1.000E+00 | 2.732E-01 | --- | FRACA( 2) |
| Ring 3 | 1.000E+00 | 0.000E+00 | --- | FRACA( 3) |
| Ring 4 | 7.400E-01 | 0.000E+00 | --- | FRACA( 4) |
| Ring 5 | 0.000E+00 | 0.000E+00 | --- | FRACA( 5) |
| Ring 6 | 0.000E+00 | 0.000E+00 | --- | FRACA( 6) |
| Ring 7 | 0.000E+00 | 0.000E+00 | --- | FRACA( 7) |
| Ring 8 | 0.000E+00 | 0.000E+00 | --- | FRACA( 8) |
| Ring 9 | 0.000E+00 | 0.000E+00 | --- | FRACA( 9) |
| Ring 10 | 0.000E+00 | 0.000E+00 | --- | FRACA(10) |
| Ring 11 | 0.000E+00 | 0.000E+00 | --- | FRACA(11) |
| Ring 12 | 0.000E+00 | 0.000E+00 | --- | FRACA(12) |
| Fruits, vegetables and grain consumption (kg/yr) | not used | 1.600E+02 | --- | DIET(1) |
| Leafy vegetable consumption (kg/yr) | not used | 1.400E+01 | --- | DIET(2) |
| Milk consumption (L/yr) | not used | 9.200E+01 | --- | DIET(3) |
| Meat and poultry consumption (kg/yr) | not used | 6.300E+01 | --- | DIET(4) |
| Fish consumption (kg/yr) | not used | 5.400E+00 | --- | DIET(5) |
| Other seafood consumption (kg/yr) | not used | 9.000E-01 | --- | DIET(6) |
| Soil ingestion rate (g/yr) | 3.650E+01 | 3.650E+01 | --- | SOIL |
| Drinking water intake (L/yr) | not used | 5.100E+02 | --- | DWI |
| Contamination fraction of drinking water | not used | 1.000E+00 | --- | FDW |
| Contamination fraction of household water | 0.000E+00 | 1.000E+00 | --- | FHHW |
| Contamination fraction of livestock water | not used | 1.000E+00 | --- | FLW |
| Contamination fraction of irrigation water | not used | 1.000E+00 | --- | FIRW |
| Contamination fraction of aquatic food | not used | 5.000E-01 | --- | FR9 |
| Contamination fraction of plant food | not used | -1 | --- | FPLANT |
| Contamination fraction of meat | not used | -1 | --- | FMEAT |
| Contamination fraction of milk | not used | -1 | --- | FMILK |
| Livestock fodder intake for meat (kg/day) | not used | 6.800E+01 | --- | LFI5 |
| Livestock fodder intake for milk (kg/day) | not used | 5.500E+01 | --- | LFI6 |
| Livestock water intake for meat (L/day) | not used | 5.000E+01 | --- | LWI5 |
| Livestock water intake for milk (L/day) | not used | 1.600E+02 | --- | LWI6 |
| Livestock soil intake (kg/day) | not used | 5.000E-01 | --- | LSI |
| Mass loading for foliar deposition (g/m**3) | not used | 1.000E-04 | --- | MLFD |

OFFICIAL USE ONLY

Site-Specific Parameter Summary (continued)

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R019 | Depth of soil mixing layer (m) | 1.500E-01 | 1.500E-01 | --- | DM |
| R019 | Depth of roots (m) | not used | 9.000E-01 | --- | DROOT |
| R019 | Drinking water fraction from ground water | 1.000E+00 | 1.000E+00 | --- | FGWDW |
| R019 | Household water fraction from ground water | not used | 1.000E+00 | --- | FGWHH |
| R019 | Livestock water fraction from ground water | 1.000E+00 | 1.000E+00 | --- | FGWLW |
| R019 | Irrigation fraction from ground water | not used | 1.000E+00 | --- | FGWIR |
| | | | | | |
| C14 | C-12 concentration in water (g/cm**3) | not used | 2.000E-05 | --- | C12WTR |
| C14 | C-12 concentration in contaminated soil (g/g) | not used | 3.000E-02 | --- | C12CZ |
| C14 | Fraction of vegetation carbon from soil | not used | 2.000E-02 | --- | CSOIL |
| C14 | Fraction of vegetation carbon from air | not used | 9.800E-01 | --- | CAIR |
| C14 | C-14 evasion layer thickness in soil (m) | not used | 3.000E-01 | --- | DMC |
| C14 | C-14 evasion flux rate from soil (1/sec) | not used | 7.000E-07 | --- | EVSN |
| C14 | C-12 evasion flux rate from soil (1/sec) | not used | 1.000E-10 | --- | REVSN |
| C14 | Fraction of grain in beef cattle feed | not used | 8.000E-01 | --- | AVFG4 |
| C14 | Fraction of grain in milk cow feed | not used | 2.000E-01 | --- | AVFG5 |
| | | | | | |
| STOR | Storage times of contaminated foodstuffs (days): | | | | |
| STOR | Fruits, non-leafy vegetables, and grain | not used | 1.400E+01 | --- | STOR_T(1) |
| STOR | Leafy vegetables | not used | 1.000E+00 | --- | STOR_T(2) |
| STOR | Milk | not used | 1.000E+00 | --- | STOR_T(3) |
| STOR | Meat and poultry | not used | 2.000E+01 | --- | STOR_T(4) |
| STOR | Fish | not used | 7.000E+00 | --- | STOR_T(5) |
| STOR | Crustacea and mollusks | not used | 7.000E+00 | --- | STOR_T(6) |
| STOR | Well water | not used | 1.000E+00 | --- | STOR_T(7) |
| STOR | Surface water | not used | 1.000E+00 | --- | STOR_T(8) |
| STOR | Livestock fodder | not used | 4.500E+01 | --- | STOR_T(9) |
| | | | | | |
| R021 | Thickness of building foundation (m) | not used | 1.500E-01 | --- | FLOOR |
| R021 | Bulk density of building foundation (g/cm**3) | not used | 2.400E+00 | --- | DENSFL |
| R021 | Total porosity of the cover material | not used | 4.000E-01 | --- | TPCV |
| R021 | Total porosity of the building foundation | not used | 1.000E-01 | --- | TPFL |
| R021 | Volumetric water content of the cover material | not used | 5.000E-02 | --- | PH2OCV |
| R021 | Volumetric water content of the foundation | not used | 3.000E-02 | --- | PH2OFL |
| R021 | Diffusion coefficient for radon gas (m/sec): | | | | |
| R021 | in cover material | not used | 2.000E-06 | --- | DIFCV |
| R021 | in foundation material | not used | 3.000E-07 | --- | DIFFL |
| R021 | in contaminated zone soil | 2.000E-06 | 2.000E-06 | --- | DIFCZ |
| R021 | Radon vertical dimension of mixing (m) | 2.000E+00 | 2.000E+00 | --- | HMIX |
| R021 | Average annual wind speed (m/sec) | 3.000E+00 | 2.000E+00 | --- | WIND |
| R021 | Average building air exchange rate (1/hr) | not used | 5.000E-01 | --- | REXG |
| R021 | Height of the building (room) (m) | not used | 2.500E+00 | --- | HRM |
| R021 | Building interior area factor | not used | 0.000E+00 | code computed (time dependent) | FAI |
| R021 | Building depth below ground surface (m) | not used | -1.000E+00 | code computed (time dependent) | DMFL |
| R021 | Emanating power of Rn-222 gas | 2.500E-01 | 2.500E-01 | --- | EMANA(1) |
| R021 | Emanating power of Rn-220 gas | not used | 1.500E-01 | --- | EMANA(2) |

OFFICIAL USE ONLY

Summary of Pathway Selections

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

OFFICIAL USE ONLY

| Contaminated Zone Dimensions | | Initial Soil Concentrations, pCi/g | |
|---|---|---|---|
| Area: | 250.00 square meters | U-234 | 4.100E+02 |
| Thickness: | 1.00 meters | U-235 | 1.900E+01 |
| Cover Depth: | 0.00 meters | U-238 | 3.700E+02 |

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 15 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

| t (years): | 0.000E+00 | 1.000E-01 | 1.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 | 5.000E+03 | 1.000E+04 |
|---|---|---|---|---|---|---|---|---|---|---|
| TDOSE(t): | 1.409E+00 | 1.409E+00 | 1.409E+00 | 1.409E+00 | 1.410E+00 | 1.413E+00 | 1.443E+00 | 1.497E+00 | 2.297E+00 | 3.521E+00 |
| M(t): | 9.391E-02 | 9.391E-02 | 9.391E-02 | 9.393E-02 | 9.402E-02 | 9.419E-02 | 9.617E-02 | 9.983E-02 | 1.531E-01 | 2.347E-01 |

Maximum TDOSE(t): 3.521E+00 mrem/yr at t = 1.000E+04 years

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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

Water Independent Pathways (Inhalation excludes radon)

| Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 9.650E-04 | 0.0007 | 5.566E-01 | 0.3951 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.041E-03 | 0.0050 |
| 8.254E-02 | 0.0586 | 2.404E-02 | 0.0171 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.078E-04 | 0.0002 |
| 2.821E-01 | 0.2003 | 4.490E-01 | 0.3188 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.040E-03 | 0.0043 |
| 3.656E-01 | 0.2596 | 1.030E+00 | 0.7309 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.339E-02 | 0.0095 |

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

Water Dependent Pathways

| Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 5.646E-01 | 0.4008 |
| 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 | 1.069E-01 | 0.0759 |
| [illegible]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 | 7.372E-01 | 0.5233 |
| 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 | 1.409E+00 | 1.0000 |

*All water independent and dependent pathways.

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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-01 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | frac |
| U-234 | 9.651E-04 | 0.0007 | 5.566E-01 | 0.3951 | 6.580E-15 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.041E-03 | 0.0 |
| U-235 | 8.254E-02 | 0.0586 | 2.404E-02 | 0.0171 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.079E-04 | 0.00 |
| U-238 | 2.821E-01 | 0.2003 | 4.490E-01 | 0.3188 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.040E-03 | 0.00 |
| Total | 3.656E-01 | 0.2596 | 1.030E+00 | 0.7309 | 6.580E-15 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.339E-02 | 0.0 |

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-01 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | frac |
| U-234 | 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 | 5.646E-01 | 0. |
| U-235 | 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 | 1.069E-01 | 0. |
| U-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 | 7.372E-01 | 0.523 |
| 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 | 1.409E+00 | 1.000 |

*Sum of all water independent and dependent pathways.

OFFICIAL USE ONLY

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

Water Independent Pathways (Inhalation excludes radon)

| | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| p- | | | | | | | | | | | | | | |
| ide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| | 9.651E-04 | 0.0007 | 5.566E-01 | 0.3951 | 6.579E-13 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.041E-03 | 0.0050 |
| | 9.254E-02 | 0.0586 | 2.404E-02 | 0.0171 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.081E-04 | 0.0002 |
| 8 | 2.821E-01 | 0.2003 | 4.490E-01 | 0.3188 | 6.531E-19 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.040E-03 | 0.0043 |
| | 3.656E-01 | 0.2596 | 1.030E+00 | 0.7309 | 6.579E-13 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.339E-02 | 0.0095 |

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

Water Dependent Pathways

| | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| p- | | | | | | | | | | | | | | |
| de | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| | 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 | 5.646E-01 | 0.4008 |
| | 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 | 1.069E-01 | 0.0759 |
| | 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 | 7.372E-01 | 0.5233 |
| | 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 | 1.409E+00 | 1.0000 |

of all water independent and dependent pathways.

OFFICIAL USE ONLY

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+01 years

Water Independent Pathways (Inhalation excludes radon)

| | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dio- | | | | | | | | | | | | | | |
| clide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 234 | 9.702E-04 | 0.0007 | 5.567E-01 | 0.3951 | 6.570E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.042E-03 | 0.0050 |
| 235 | 8.254E-02 | 0.0586 | 2.413E-02 | 0.0171 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.109E-04 | 0.0002 |
| 238 | 2.821E-01 | 0.2002 | 4.490E-01 | 0.3187 | 5.593E-16 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.040E-03 | 0.0043 |
| tal | 3.656E-01 | 0.2595 | 1.030E+00 | 0.7310 | 6.570E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.339E-02 | 0.0095 |

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+01 years

Water Dependent Pathways

| | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dio- | | | | | | | | | | | | | | |
| clide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 234 | 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 | 5.647E-01 | 0.40 |
| 235 | 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 | 1.070E-01 | 0.07 |
| 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 | 7.372E-01 | 0.5232 |
| tal | 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 | 1.409E+00 | 1.0000 |

m of all water independent and dependent pathways.

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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

Water Independent Pathways (Inhalation excludes radon)

| Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 1.089E-03 | 0.0008 | 5.571E-01 | 0.3950 | 1.633E-09 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.045E-03 | 0.0050 |
| 8.266E-02 | 0.0586 | 2.499E-02 | 0.0177 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.297E-04 | 0.0002 |
| 2.821E-01 | 0.2000 | 4.490E-01 | 0.3184 | 6.960E-14 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.040E-03 | 0.0043 |
| 3.658E-01 | 0.2594 | 1.031E+00 | 0.7311 | 1.633E-09 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.341E-02 | 0.0095 |

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

Water Dependent Pathways

| Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 5.652E-01 | 0.4008 |
| 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 | 1.080E-01 | 0.0766 |
| 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 | 7.372E-01 | 0.5227 |
| 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 | 1.410E+00 | 1.0000 |

all water independent and dependent pathways.

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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

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract |
| U-234 | 1.457E-03 | 0.0010 | 5.575E-01 | 0.3946 | 6.482E-09 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.052E-03 | 0.00 |
| U-235 | 9.287E-02 | 0.0587 | 2.649E-02 | 0.0188 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.587E-04 | 0.00 |
| U-238 | 2.820E-01 | 0.1996 | 4.490E-01 | 0.3178 | 5.537E-13 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.040E-03 | 0.00 |
| Total | 3.664E-01 | 0.2593 | 1.033E+00 | 0.7312 | 6.482E-09 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.345E-02 | 0.00 |

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

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract |
| U-234 | 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 | 5.660E-01 | 0. |
| U-235 | 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 | 1.097E-01 | 0 |
| U-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 | 7.371E-01 | 0.521 |
| 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 | 1.413E+00 | 1.000 |

*Sum of all water independent and dependent pathways.

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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+02 years

Water Independent Pathways (Inhalation excludes radon)

| | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| de | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| | 1.251E-02 | 0.0087 | 5.612E-01 | 0.3890 | 1.528E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.169E-03 | 0.0050 |
| | 8.475E-02 | 0.0587 | 3.954E-02 | 0.0274 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.035E-04 | 0.0004 |
| | 2.817E-01 | 0.1953 | 4.491E-01 | 0.3113 | 6.620E-11 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.040E-03 | 0.0042 |
| | 3.790E-01 | 0.2627 | 1.050E+00 | 0.7277 | 1.529E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.381E-02 | 0.0096 |

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+02 years

Water Dependent Pathways

| | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| | 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 | 5.809E-01 | 0.4027 |
| | [illegible]E+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 | 1.249E-01 | 0.0866 |
| | [illegible]0E+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 | 7.368E-01 | 0.5108 |
| | 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 | 1.443E+00 | 1.0000 |

f all water independent and dependent pathways.

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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

Water Independent Pathways (Inhalation excludes radon)

| | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Radio- | | | | | | | | | | | | | | |
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract |
| U-234 | 4.397E-02 | 0.0294 | 5.659E-01 | 0.3779 | 5.691E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 7.465E-03 | 0.005 |
| U-235 | 8.707E-02 | 0.0581 | 5.570E-02 | 0.0372 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 9.064E-04 | 0.001 |
| U-238 | 2.813E-01 | 0.1879 | 4.491E-01 | 0.2999 | 5.017E-10 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.040E-03 | 0.004 |
| Total | 4.124E-01 | 0.2754 | 1.071E+00 | 0.7150 | 5.696E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.441E-02 | 0.005 |

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

Water Dependent Pathways

| | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Radio- | | | | | | | | | | | | | | |
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract |
| U-234 | 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 | 6.173E-01 | 0 |
| U-235 | 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 | 1.437E-01 | 0.095 |
| U-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 | 7.365E-01 | 0.491 |
| 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 | 1.497E+00 | 1.0000 |

Sum of all water independent and dependent pathways.

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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+03 years

Water Independent Pathways (Inhalation excludes radon)

| | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| de | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| á | ááááááááá | áááááá | ááááááááá | áááááá | ááááááááá | áááááá | ááááááááá | áááááá | ááááááááá | áááááá | ááááááááá | áááááá | ááááááááá | áááááá |
| | 5.586E-01 | 0.2867 | 5.037E-01 | 0.2628 | 8.706E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.291E-02 | 0.0056 |
| | 1.045E-01 | 0.0455 | 1.773E-01 | 0.0772 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.186E-03 | 0.0014 |
| | 2.812E-01 | 0.1224 | 4.497E-01 | 0.1958 | 4.288E-08 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.068E-03 | 0.0026 |
| é | ééééééééé | ééééééé | ééééééééé | ééééééé | ééééééééé | ééééééé | ééééééééé | ééééééé | ééééééééé | ééééééé | ééééééééé | ééééééé | ééééééééé | ééééééé |
| | 1.044E+00 | 0.4546 | 1.231E+00 | 0.5357 | 8.749E-06 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.216E-02 | 0.0096 |

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+03 years

Water Dependent Pathways

| | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| e | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| á | ááááááááá | áááááá | ááááááááá | áááááá | ááááááááá | áááááá | ááááááááá | áááááá | ááááááááá | áááááá | ááááááááá | áááááá | ááááááááá | áááááá |
| | 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 | 1.275E+00 | 0.5551 |
| | 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 | 2.850E-01 | 0.1241 |
| | 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 | 7.370E-01 | 0.3208 |
| éé | ééééééééé | ééééééé | ééééééééé | ééééééé | ééééééééé | ééééééé | ééééééééé | ééééééé | ééééééééé | ééééééé | ééééééééé | ééééééé | ééééééééé | ééééééé |
| | 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 | 2.297E+00 | 1.0000 |

of all water independent and dependent pathways.

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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+04 years

Water Independent Pathways (Inhalation excludes radon)

| | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dio- | | | | | | | | | | | | | | |
| clide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 234 | 1.661E+00 | 0.4717 | 6.487E-01 | 0.1842 | 2.197E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.167E-02 | 0.0062 |
| 235 | 1.236E-01 | 0.0351 | 3.116E-01 | 0.0885 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 5.703E-03 | 0.0016 |
| 238 | 2.917E-01 | 0.0828 | 4.510E-01 | 0.1281 | 2.364E-07 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 6.197E-03 | 0.0018 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| tal | 2.076E+00 | 0.5896 | 1.411E+00 | 0.4008 | 2.221E-05 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.357E-02 | 0.0095 |

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+04 years

Water Dependent Pathways

| | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| io- | | | | | | | | | | | | | | |
| lide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 34 | 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 | 2.331E+00 | 0.66[illegible] |
| 35 | 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 | 4.410E-01 | 0.1252 |
| 38 | 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 | 7.488E-01 | 0.2127 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| al | 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 | 3.521E+00 | 1.0000 |

a of all water independent and dependent pathways.

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Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

| ent | Product (j) | Branch Fraction | DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00 | 1.000E-01 | 1.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 | 5.000E+03 | 1.000E+04 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ) | | | | | | | | | | | | |
| ááááá | áááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá |
| 34 | U-234 | 1.000E+00 | 1.377E-03 | 1.377E-03 | 1.377E-03 | 1.377E-03 | 1.377E-03 | 1.376E-03 | 1.373E-03 | 1.369E-03 | 1.338E-03 | 1.299E-03 |
| 34 | Th-230 | 1.000E+00 | 0.000E+00 | 3.054E-09 | 3.054E-08 | 3.054E-07 | 1.527E-06 | 3.052E-06 | 1.522E-05 | 3.032E-05 | 1.472E-04 | 2.836E-04 |
| 34 | Ra-226 | 1.000E+00 | 0.000E+00 | 1.215E-12 | 1.214E-10 | 1.213E-08 | 3.014E-07 | 1.197E-06 | 2.821E-05 | 1.051E-04 | 1.607E-03 | 4.057E-03 |
| 34 | Pb-210 | 1.000E+00 | 0.000E+00 | 1.459E-17 | 1.433E-14 | 1.337E-11 | 1.269E-09 | 7.632E-09 | 2.859E-07 | 1.136E-06 | 1.827E-05 | 4.638E-05 |
| 34 | ΣDSR(j) | | 1.377E-03 | 1.377E-03 | 1.377E-03 | 1.377E-03 | 1.379E-03 | 1.381E-03 | 1.417E-03 | 1.506E-03 | 3.110E-03 | 5.686E-03 |
| 35* | U-235 | 1.000E+00 | 5.625E-03 | 5.625E-03 | 5.625E-03 | 5.625E-03 | 5.624E-03 | 5.624E-03 | 5.617E-03 | 5.608E-03 | 5.542E-03 | 5.459E-03 |
| 35 | Pa-231 | 1.000E+00 | 0.000E+00 | 3.148E-08 | 3.148E-07 | 3.148E-06 | 1.573E-05 | 3.144E-05 | 1.563E-04 | 3.106E-04 | 1.472E-03 | 2.754E-03 |
| 35 | Ac-227 | 1.000E+00 | 0.000E+00 | 2.739E-10 | 2.713E-08 | 2.472E-06 | 4.297E-05 | 1.201E-04 | 8.004E-04 | 1.643E-03 | 7.987E-03 | 1.500E-02 |
| 35 | ΣDSR(j) | | 5.625E-03 | 5.625E-03 | 5.626E-03 | 5.631E-03 | 5.683E-03 | 5.775E-03 | 6.574E-03 | 7.562E-03 | 1.500E-02 | 2.321E-02 |
| 38 | U-238 | 1.000E+00 | 1.992E-03 | 1.992E-03 | 1.992E-03 | 1.992E-03 | 1.992E-03 | 1.992E-03 | 1.989E-03 | 1.986E-03 | 1.963E-03 | 1.934E-03 |
| 38 | U-234 | 1.000E+00 | 0.000E+00 | 3.896E-10 | 3.896E-09 | 3.896E-08 | 1.948E-07 | 3.894E-07 | 1.944E-06 | 3.879E-06 | 1.906E-05 | 3.728E-05 |
| 38 | Th-230 | 1.000E+00 | 0.000E+00 | 4.320E-16 | 4.321E-14 | 4.320E-12 | 1.080E-10 | 4.318E-10 | 1.077E-08 | 4.295E-08 | 1.049E-06 | 4.072E-06 |
| 38 | Ra-226 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 1.131E-16 | 1.144E-13 | 1.424E-11 | 1.133E-10 | 1.354E-08 | 1.026E-07 | 8.772E-06 | 4.836E-05 |
| 38 | Pb-210 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 7.188E-21 | 9.605E-17 | 4.797E-14 | 6.054E-13 | 1.294E-10 | 1.075E-09 | 9.903E-08 | 5.509E-07 |
| 38 | ΣDSR(j) | | 1.992E-03 | 1.992E-03 | 1.992E-03 | 1.992E-03 | 1.992E-03 | 1.992E-03 | 1.991E-03 | 1.990E-03 | 1.992E-03 | 2.024E-03 |
| ééé | éééééééé | éééééééééé | ééééééééé | ééééééééé | ééééééééé | ééééééééé | ééééééééé | ééééééééé | ééééééééé | ééééééééé | ééééééééé | ééééééééé |

anch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
* DSR includes contributions from associated (half-life μ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

| clide (i) | t= 0.000E+00 | 1.000E-01 | 1.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 | 5.000E+03 | 1.000E+04 |
|---|---|---|---|---|---|---|---|---|---|---|
| ááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá |
| 234 | 1.089E+04 | 1.089E+04 | 1.089E+04 | 1.089E+04 | 1.088E+04 | 1.087E+04 | 1.059E+04 | 9.963E+03 | 4.823E+03 | 2.638E+03 |
| 235 | 2.667E+03 | 2.667E+03 | 2.666E+03 | 2.664E+03 | 2.639E+03 | 2.597E+03 | 2.282E+03 | 1.984E+03 | 1.000E+03 | 6.463E+02 |
| 8 | 7.529E+03 | 7.529E+03 | 7.529E+03 | 7.529E+03 | 7.529E+03 | 7.529E+03 | 7.532E+03 | 7.536E+03 | 7.531E+03 | 7.412E+03 |
| ééé | éééééééééé | éééééééééé | éééééééééé | éééééééééé | éééééééééé | éééééééééé | éééééééééé | éééééééééé | éééééééééé | éééééééééé |

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 = 1.000E+04 years

| clide (i) | Initial pCi/g | tmin (years) | DSR(i,tmin) | G(i,tmin) (pCi/g) | DSR(i,tmax) | G(i,tmax) (pCi/g) |
|---|---|---|---|---|---|---|
| ááá | áááááááááá | ááááááááááááááá | áááááááááá | áááááááááá | áááááááááá | áááááááááá |
| 234 | 4.100E+02 | 1.000E+04 | 5.686E-03 | 2.638E+03 | 5.686E-03 | 2.638E+03 |
| 235 | 1.900E+01 | 1.000E+04 | 2.321E-02 | 6.463E+02 | 2.321E-02 | 6.463E+02 |
| 8 | 3.700E+02 | 1.000E+04 | 2.024E-03 | 7.412E+03 | 2.024E-03 | 7.412E+03 |
| éééé | éééééééééé | éééééééééééééééé | ééééééééé | ééééééééé | ééééééééé | ééééééééé |

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Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

| clide (j) | Parent (i) | BRF(i) | DOSE(j,t), mrem/yr t= 0.000E+00 | 1.000E-01 | 1.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 | 5.000E+03 | 1.000E+04 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 234 | U-234 | 1.000E+00 | 5.646E-01 | 5.646E-01 | 5.646E-01 | 5.646E-01 | 5.644E-01 | 5.643E-01 | 5.630E-01 | 5.613E-01 | 5.484E-01 | 5.327E-01 |
| 234 | U-238 | 1.000E+00 | 0.000E+00 | 1.442E-07 | 1.442E-06 | 1.441E-05 | 7.206E-05 | 1.441E-04 | 7.192E-04 | 1.435E-03 | 7.051E-03 | 1.379E-02 |
| 234 | ΣDOSE(j): | | 5.646E-01 | 5.646E-01 | 5.646E-01 | 5.646E-01 | 5.645E-01 | 5.644E-01 | 5.637E-01 | 5.628E-01 | 5.555E-01 | 5.465E-01 |
| 230 | U-234 | 1.000E+00 | 0.000E+00 | 1.252E-06 | 1.252E-05 | 1.252E-04 | 6.259E-04 | 1.251E-03 | 6.238E-03 | 1.243E-02 | 6.034E-02 | 1.163E-01 |
| 230 | U-238 | 1.000E+00 | 0.000E+00 | 1.598E-13 | 1.599E-11 | 1.599E-09 | 3.995E-08 | 1.598E-07 | 3.985E-06 | 1.589E-05 | 3.880E-04 | 1.507E-03 |
| 230 | ΣDOSE(j): | | 0.000E+00 | 1.252E-06 | 1.252E-05 | 1.252E-04 | 6.260E-04 | 1.252E-03 | 6.242E-03 | 1.245E-02 | 6.073E-02 | 1.178E-01 |
| 226 | U-234 | 1.000E+00 | 0.000E+00 | 4.980E-10 | 4.979E-08 | 4.973E-06 | 1.236E-04 | 4.906E-04 | 1.156E-02 | 4.308E-02 | 6.590E-01 | 1.663E+00 |
| 226 | U-238 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 4.186E-14 | 4.234E-11 | 5.268E-09 | 4.191E-08 | 5.010E-06 | 3.797E-05 | 3.246E-03 | 1.789E-02 |
| 226 | ΣDOSE(j): | | 0.000E+00 | 4.980E-10 | 4.979E-08 | 4.973E-06 | 1.236E-04 | 4.907E-04 | 1.157E-02 | 4.311E-02 | 6.622E-01 | 1.681E+00 |
| 210 | U-234 | 1.000E+00 | 0.000E+00 | 5.982E-15 | 5.876E-12 | 5.483E-09 | 5.201E-07 | 3.129E-06 | 1.172E-04 | 4.656E-04 | 7.493E-03 | 1.902E-02 |
| 210 | U-238 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 2.659E-18 | 3.554E-14 | 1.775E-11 | 2.240E-10 | 4.788E-08 | 3.976E-07 | 3.664E-05 | 2.038E-04 |
| 210 | ΣDOSE(j): | | 0.000E+00 | 5.982E-15 | 5.876E-12 | 5.483E-09 | 5.201E-07 | 3.129E-06 | 1.173E-04 | 4.660E-04 | 7.529E-03 | 1.922E-02 |
| 35 | U-235 | 1.000E+00 | 1.069E-01 | 1.069E-01 | 1.069E-01 | 1.069E-01 | 1.069E-01 | 1.068E-01 | 1.067E-01 | 1.066E-01 | 1.053E-01 | 1.037E-01 |
| 31 | U-235 | 1.000E+00 | 0.000E+00 | 5.981E-07 | 5.981E-06 | 5.980E-05 | 2.989E-04 | 5.973E-04 | 2.970E-03 | 5.901E-03 | 2.796E-02 | 5.232E-02 |
| 27 | U-235 | 1.000E+00 | 0.000E+00 | 5.204E-09 | 5.154E-07 | 4.696E-05 | 8.165E-04 | 2.282E-03 | 1.521E-02 | 3.122E-02 | 1.518E-01 | 2.849E-01 |
| 8 | U-238 | 1.000E+00 | 7.372E-01 | 7.372E-01 | 7.372E-01 | 7.372E-01 | 7.371E-01 | 7.370E-01 | 7.361E-01 | 7.350E-01 | 7.262E-01 | 7.154E-01 |

i) is the branch fraction of the parent nuclide.

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Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

| lide (j) | Parent (i) | BRF(i) | S(j,t), pCi/g t= 0.000E+00 | 1.000E-01 | 1.000E+00 | 1.000E+01 | 5.000E+01 | 1.000E+02 | 5.000E+02 | 1.000E+03 | 5.000E+03 | 1.000E+04 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ááááá | ááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá |
| 234 | U-234 | 1.000E+00 | 4.100E+02 | 4.100E+02 | 4.100E+02 | 4.100E+02 | 4.099E+02 | 4.098E+02 | 4.088E+02 | 4.076E+02 | 3.982E+02 | 3.868E+02 |
| 234 | U-238 | 1.000E+00 | 0.000E+00 | 1.047E-04 | 1.047E-03 | 1.047E-02 | 5.233E-02 | 1.046E-01 | 5.222E-01 | 1.042E+00 | 5.120E+00 | 1.002E+01 |
| 234 | δS(j): | | 4.100E+02 | 4.100E+02 | 4.100E+02 | 4.100E+02 | 4.099E+02 | 4.099E+02 | 4.093E+02 | 4.087E+02 | 4.034E+02 | 3.968E+02 |
| 230 | U-234 | 1.000E+00 | 0.000E+00 | 3.691E-04 | 3.691E-03 | 3.691E-02 | 1.845E-01 | 3.688E-01 | 1.839E+00 | 3.664E+00 | 1.778E+01 | 3.427E+01 |
| -230 | U-238 | 1.000E+00 | 0.000E+00 | 4.711E-11 | 4.712E-09 | 4.711E-07 | 1.178E-05 | 4.709E-05 | 1.174E-03 | 4.684E-03 | 1.143E-01 | 4.440E-01 |
| 230 | δS(j): | | 0.000E+00 | 3.691E-04 | 3.691E-03 | 3.691E-02 | 1.845E-01 | 3.685E-01 | 1.840E+00 | 3.668E+00 | 1.790E+01 | 3.472E+01 |
| -226 | U-234 | 1.000E+00 | 0.000E+00 | 7.995E-09 | 7.993E-07 | 7.983E-05 | 1.984E-03 | 7.876E-03 | 1.857E-01 | 6.915E-01 | 1.058E+01 | 2.670E+01 |
| -226 | U-238 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 6.720E-13 | 6.796E-10 | 8.457E-08 | 6.727E-07 | 8.043E-05 | 6.096E-04 | 5.210E-02 | 2.872E-01 |
| 226 | δS(j): | | 0.000E+00 | 7.995E-09 | 7.993E-07 | 7.983E-05 | 1.984E-03 | 7.877E-03 | 1.857E-01 | 6.921E-01 | 1.063E+01 | 2.699E+01 |
| -210 | U-234 | 1.000E+00 | 0.000E+00 | 8.366E-12 | 8.218E-09 | 7.669E-06 | 7.274E-04 | 4.376E-03 | 1.640E-01 | 6.512E-01 | 1.048E+01 | 2.659E+01 |
| 210 | U-238 | 1.000E+00 | 0.000E+00 | 0.000E+00 | 3.719E-15 | 4.970E-11 | 2.482E-08 | 3.133E-07 | 6.697E-05 | 5.561E-04 | 5.124E-02 | 2.851E-01 |
| 210 | δS(j): | | 0.000E+00 | 8.366E-12 | 8.218E-09 | 7.669E-06 | 7.274E-04 | 4.376E-03 | 1.640E-01 | 6.517E-01 | 1.053E+01 | 2.688E+01 |
| 235 | U-235 | 1.000E+00 | 1.900E+01 | 1.900E+01 | 1.900E+01 | 1.900E+01 | 1.900E+01 | 1.899E+01 | 1.897E+01 | 1.894E+01 | 1.872E+01 | 1.844E+01 |
| -231 | U-235 | 1.000E+00 | 0.000E+00 | 4.015E-05 | 4.015E-04 | 4.015E-03 | 2.006E-02 | 4.010E-02 | 1.994E-01 | 3.961E-01 | 1.877E+00 | 3.512E+00 |
| 2[illegible] | U-235 | 1.000E+00 | 0.000E+00 | 6.396E-08 | 6.335E-06 | 5.773E-04 | 1.004E-02 | 2.805E-02 | 1.869E-01 | 3.838E-01 | 1.865E+00 | 3.502E+00 |
| 238 | U-238 | 1.000E+00 | 3.700E+02 | 3.700E+02 | 3.700E+02 | 3.700E+02 | 3.699E+02 | 3.699E+02 | 3.694E+02 | 3.689E+02 | 3.645E+02 | 3.591E+02 |
| ááá | ááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá | ááááááááá |

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

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## APPENDIX G COST ESTIMATE DETAILED SUMMARY

| VCA | LABOR COST | SUPPLIES | EQUIPMENT | SAMPLE COST | TOTAL ESTIMATED WASTE VOLUMES | DISPOSAL COST | TOTAL |
|---|---|---|---|---|---|---|---|
| 33-010(a) | $ 8 400 | $ 100 | $ 1 200 | NA | 10.5 $yd^3$ | $ 1 921 | $ 11 621 |
| 33-010(b) | $ 8 400 | $ 50 | $ 8 500 | $ 270 | 40 $yd^3$ | $ 30 500 | $ 47 720 |
| 33-010(d) | $ 8 400 | $ 100 | $ 1 200 | NA | 6.5 $yd^3$ | $ 1 490 | $ 11 190 |
| 33-010(g) | $ 8 400 | $ 100 | $ 1 200 | NA | 6 $yd^3$ | $ 570 | $ 10 270 |
| 33-011(b) | $ 8 400 | $ 100 | $ 1 200 | NA | 6.25 $yd^3$ | $ 875 | $ 10 575 |
| TOTAL | $ 42 000 | $ 450 | $ 13 300 | $ 270 | 69.25 $yd^3$ | $ 35 356 | $ 91 376 |

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LA-CP- 03-0090

*Los Alamos Controlled Publication; distribution is limited.*

*Title:* Voluntary Corrective Action Plan for Area of Concern C-10-001, Radioactively-Contaminated Soil

*Author(s):* Terry Rust, Environmental Restoration Project, ERM Program Management Company, and Golder Federal Services, Inc.

*Submitted to:* New Mexico Environment Department

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Form 1756c (10/98)

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# Los Alamos

NATIONAL LABORATORY
**Environmental Restoration Project**
**EM/ER, MS M992**
Los Alamos, New Mexico 87545
(505) 665-4557, FAX 665-4747


Date: August 2, 1995
Refer to: EM/ER:95-388

Mr. Ted Taylor
Los Alamos Area Office
US Department of Energy
Los Alamos, NM 87544

SUBJECT: **FORMAL REVIEW OF THE VOLUNTARY CORRECTIVE ACTION (VCA) WORK PLAN**

Dear Ted:

Enclosed is the copy of VCA plan (C-10-001) proposed for remediation activities to be completed in Fiscal Year 1995. I am submitting this to you for formal review.

Our Field Project Coordinator has seen this plan as it was being developed. Because of our rather tight field season this year, I would appreciate any further comments as soon as possible in order to assist us in meeting our scheduled deadlines. Also enclosed is the field work approval form for this VCA. If you do not have further comments on the plan, please sign the approval form so we can get started on the cleanup of these sites as soon as possible.

If you have any questions, please call Tracy Glatzmaier at 665-2613 or David Bradbury at 665-6208.

Thanks very much for your timely attention to this matter.

Sincerely,

Jorg

Jorg Jansen, Project Manager
Environmental Restoration

JJ/bp

Enclosures: VCA Plan for PRS at TA-10 Rad Contaminated Dirt
Field Work Approval Form

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Cy (w/o enc.):
G. Allen, CST-18, MS E525
D. Bradbury, EM/ER, MS M992
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B. Martin, CST-18, MS E525
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EM/ER File, MS M992
RPF, MS M707

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# LOS ALAMOS NATIONAL LABORATORY
# ENVIRONMENTAL RESTORATION PROJECT
# VOLUNTARY CORRECTIVE ACTION PLAN

for

## AREA OF CONCERN

## C-10-001, RADIOACTIVELY-CONTAMINATED SOIL

Prepared by:
ERM Program Management Company
and Golder Federal Services, Inc.
555 Oppenheimer Drive, Suite 100
Los Alamos, NM 87544

2 August 1995
Rev.1

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# FIELD WORK APPROVAL FORM

This form must be completed prior to starting remediation field work in accordance with Voluntary Corrective Action Plans.

I, _____,DOE-LAAO, Approve the field work as proposed in the accompanying Voluntary Corrective Action Plan for Area of Concern C-10-001, TA-10.

I, _____, DOE-LAAO, DO NOT APPROVE the field work as proposed in the accompanying Voluntary Corrective Action Plan for Area of Concern C-10-001, TA-10.

The following reasons reflect the decision for disapproval:

Signed:_____ Date:_____

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Figure 2, Locations of Proposed New TA-10 SWMUs and AOCs

APPENDIX A, RESRAD OUTPUT FILE


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# Voluntary Corrective Action Plan
# for
# Area of Concern C-10-001

## 1.0 Introduction

This Voluntary Corrective Action (VCA) Plan addresses assessment of the extent of contamination and removal of contaminated soil at Area of Concern (AOC) C-10-001 on Los Alamos County property in Bayo Canyon (Figure 1). The site consists of two small areas of radioactively-contaminated soil and has been selected for voluntary corrective action because the remedy for the contamination is obvious and easily implemented.

## 2.0 Site Type and Description

This VCA addresses two small areas of radioactively-contaminated soil within a larger area of disturbed soil in Bayo Canyon (Figure 2). This area is near a location where materials and soil associated with the firing sites at TA-10, SWMUs 10-001(a-d), were apparently bulldozed and left remaining even after decontamination and decommissioning (D & D) activities were conducted in 1963. The site was discovered during routine shrapnel removal operations in the summer and fall of 1994. Since then, the site has been formally designated as AOC, C-10-001. For each of the contaminated areas, the area on the ground surface with elevated radioactivity, as determined with hand-held radiation screening instruments, comprises approximately 2 ft by 2 ft.

Existing field screening and laboratory analytical data indicate that only strontium-90 contamination is present. A sample was collected for the VCA at a point where the maximum field radiation-screening results (approximately 50,000 counts per minute of beta/gamma radiation) were found. Analytical results for this sample indicate strontium-90 concentration at 3518 pCi/g. Uranium and cesium were detected at levels at or slightly above background. The sample was not analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), or metals because there is no archival information that indicates that these constituents are present.

## 3.0 Proposed Remedy

The proposed VCA addresses only strontium-90 contamination. The assumption is that the postremediation concentration of strontium-90 will need to meet the standards for residential land use. Either a backhoe or hand tools will be used to remove the contaminated soil, depending on the volume of contaminated soil present. Several boreholes will be hand-augered around the area of surface contamination and the soils will be field screened for radiation to estimate the volume of soil to be removed. During the excavation, field screening results will guide the extent of excavation. Results from analyses conducted in the MRAL or from an offsite analytical laboratory will be used to confirm that the remediation goal has been met.

Soil cleanup guidelines for strontium-90 at the VCA site have been calculated using Version 5.60 of the RESRAD code. Soil cleanup guidelines calculated by RESRAD pertain only to areas of 100 $m^2$ or more and are not directly relevant to areas of contamination as small as the VCA site at TA-10. Soil cleanup guidelines for strontium-90 were, therefore, determined using "hot spot" criteria, as described below.

The Manual for Implementing Residual Radioactive Material Guidelines using RESRAD, Version 5.0 (DOE 1993) contains guidance for the evaluation of radionuclide hot spots within a larger area of contamination. RESRAD may be used to calculate soil cleanup guidelines for radionuclides in soil when the assumption that soil contamination is homogenous over an area of 100 $m^2$ or more


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holds true. For smaller areas, such as the TA-10 VCA site, DOE (1993) provides multiplication factors for estimating hot spot criteria using the soil cleanup guidelines calculated by RESRAD. Hot spot criteria may be estimated for areas ranging from <1 $m^2$ to 25 $m^2$.

The soil cleanup guideline is calculated for a residential scenario in Bayo Canyon using Version 5.60 of the RESRAD code. Exposure pathways evaluated include soil ingestion, inhalation of fugitive dust, external gamma exposure, and ingestion of contaminated fruits and vegetables. Average values of fruit and vegetable consumption, and average values of home production of fruits and vegetables, are used in the calculations. These average values are obtained from EPA's Exposure Factors Handbook (EPA 1989, 0304). For the soil cleanup guideline, the contaminated zone is assumed to extend to a depth of 2 m and cover 2 acres. Ingestion of contaminated soil is assumed to occur at a rate of 100 mg/d (EPA 1989, 0304). An annual dose limit of 15 mrem/yr is used in the calculation, based on EPA's proposed rule in 40 CFR 196 ( EPA Radiation Site Cleanup Regulation). A full listing of input parameters used in the RESRAD simulation is available in the RESRAD output file in Appendix A.

The soil cleanup guideline calculated for strontium-90, using the input parameters stated above, is 9.7 pCi/g. This value is the maximum dose at any time and is achieved at time zero (i.e., the soil guideline increases with time). Because of the relatively short half-life of strontium-90 (approximately 28 years), the soil cleanup guideline after 10 years will be 12 pCi/g and after 100 years, 108 pCi/g. Using the multiplication factors provided in DOE (1993), the following hot spot criteria is may be calculated for strontium-90 at time zero. For areas larger than 25 $m^2$, RESRAD soil guidelines may be applied directly.

| hot spot area (m2) | multiplication factor | hot spot criteria (mrem/yr) |
|---|---|---|
| <1 | 10 | 97 |
| 1 - <3 | 6 | 58 |
| 3 - <10 | 3 | 29 |
| 10 - 25 | 2 | 19 |

The RESRAD soil cleanup guidelines and hot spot criteria were calculated assuming that no erosion or leaching phenomena contribute to either loss of strontium-90 over time or deposition of sediment over the hot spot. Although these phenomena would not affect the soil cleanup guideline at time zero, soil cleanup guidelines for future times are likely to be slightly overestimated. The soil cleanup guidelines do not consider exposure to radionuclides in groundwater due to leaching from contaminated soil. Any contribution from this pathway would be minimal due to the limited extent area of the contamination and depth to groundwater at the VCA site at TA-10.

With the current understanding of the extent of contamination at each of the sites, it is anticipated that the cleanup level will be between 58 and 97 pCi/g for the strontium-90.

## 4.0 Justification/Rationale for the Action

Area of Concern, C-10-001, meets key criteria for implementation of the VCA process. The strontium-90 contamination could potentially pose a health risk to present-day recreational users or future residents of Bayo Canyon. However, rather than conduct a detailed risk assessment for the contamination, removal of the contaminated soil is recommended. The site remediation technology for the contaminated area is straightforward. The waste generated as a result of the VCA is not expected to contain RCRA hazardous waste and therefore, no mixed waste is anticipated.


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## 5.0 Estimated Waste Volumes by Type

Waste characterization samples will be collected and analyzed separately from the confirmation samples. Composite samples will be analyzed in the Mobile Radiochemistry Analytical Laboratory (MRAL) for gross beta activity as a proxy for the strontium-90. One composite soil sample per 4 cubic yards of excavated bulk soil will be analyzed for gross beta activity.

Table 5-1 describes each waste type, estimated volume, and anticipated mode of disposal. The volume estimate is based on the assumption that each excavation will be 6 ft in diameter and 4 ft deep. Some allowance is also made for swelling of the volume of removed soil.

| Waste Type | Estimated Volume | Disposal Container | Anticipated Disposal |
|---|---|---|---|
| Radioactively-Contaminated Soil | 9 $yds^3$ | B-25 Box or 55 gal drums | TA-54, Area G |
| Decontamination Wastewater | <55 gal. | 55-gal. drum | TA-50 |
| PPE, misc Exclusion-Zone Trash | <55 gal. | 55-gal. drum | TA-54, Area G |

## 6.0 Description of Confirmatory Sampling

After excavation, confirmatory samples will be collected from the base of the excavation and analyzed either in the MRAL for gross beta radiation as a proxy for strontium-90 or sent to an offsite laboratory for strontium-90 analysis. Both facilities will utilize proportional counting as the analytical method. The number of confirmation samples will depend on the areal extent of the contamination as determined from field screening and on the size of the excavation. It is estimated that three confirmation samples will be taken per excavation. If samples are analyzed in the MRAL, extended count times will be implemented (as compared to the standard 5-minute count time) and possibly sample preparation, such as sample digestion, will be conducted to further reduce detection limits and analytical error. The sample results will be evaluated to confirm that the remediation goals were met.

## 7.0 Estimated Schedule and Cost to Complete the VCA

The cost to complete the VCA at C-10-001 is estimated to be $60,420. This cost estimate includes contractor labor, equipment purchase and rental, and $ 27,253 in excavation services. Costs for five days for the MRAL are not included. Waste disposal costs for the estimated 9 cubic yards of low level radioactive waste (LLW) are not included, because current guidance from the ER Project Office is that there will be no disposal charges for the first 600 cubic meters of LLW waste generated by the ER Project. If excavation services are not required because of limited extent of contamination, then the estimated cost to complete the VCA is $33,167.

Site activities are estimated to require a maximum of seven days to implement. Final report preparation is estimated to require two days.

## 8.0 References

DOE (US Department of Energy), September 1993, Draft Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD, Version 5.0, ANL/EAD/LD-2.

EPA (US Environmental Protection Agency), May 1989, Exposure factors Handbook, EPA/600/8-89/043, Office of Health and Environmental Assessment, Washington, DC. (EPA, 1989, 0304)



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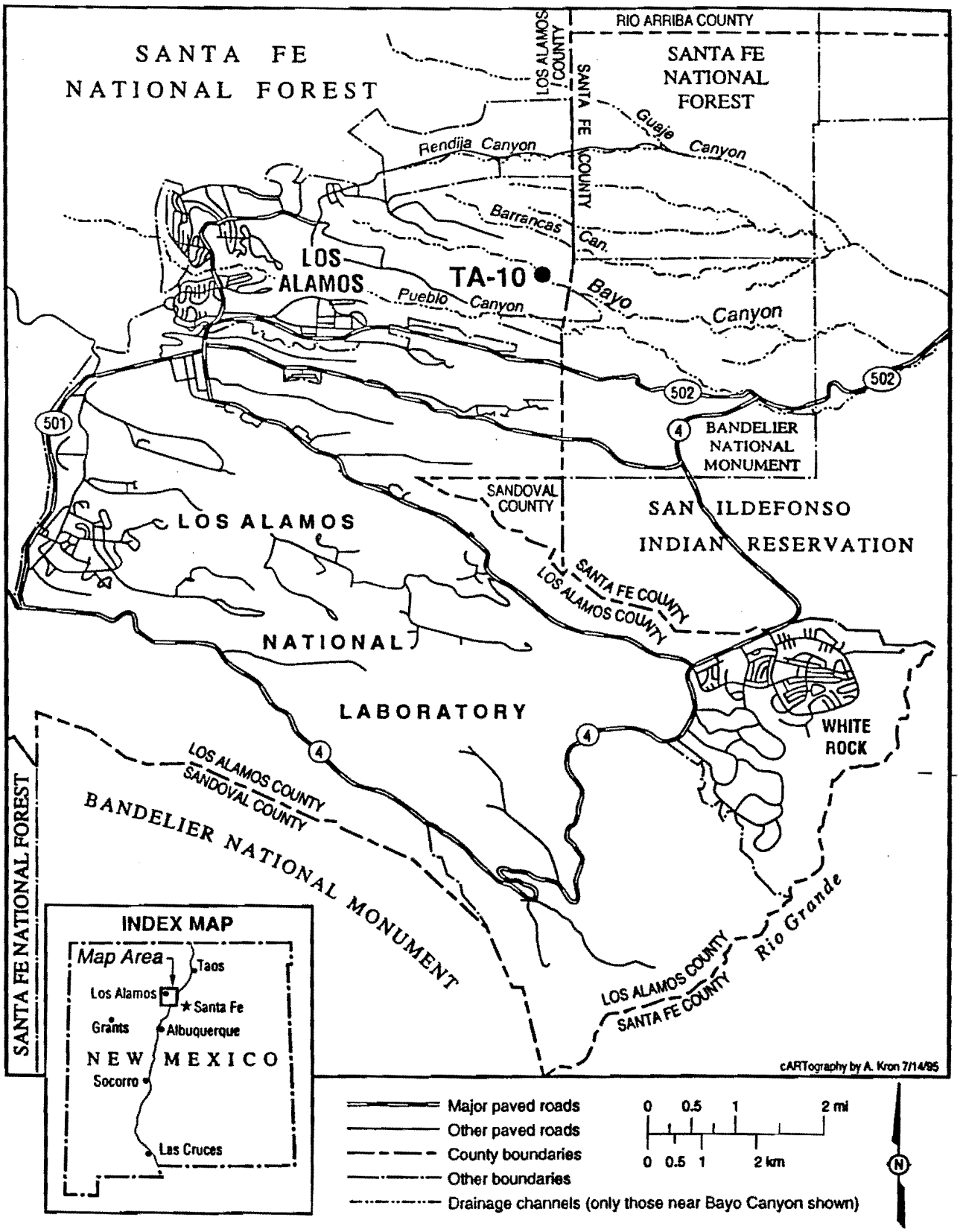


**Figure 1. Regional site map.**

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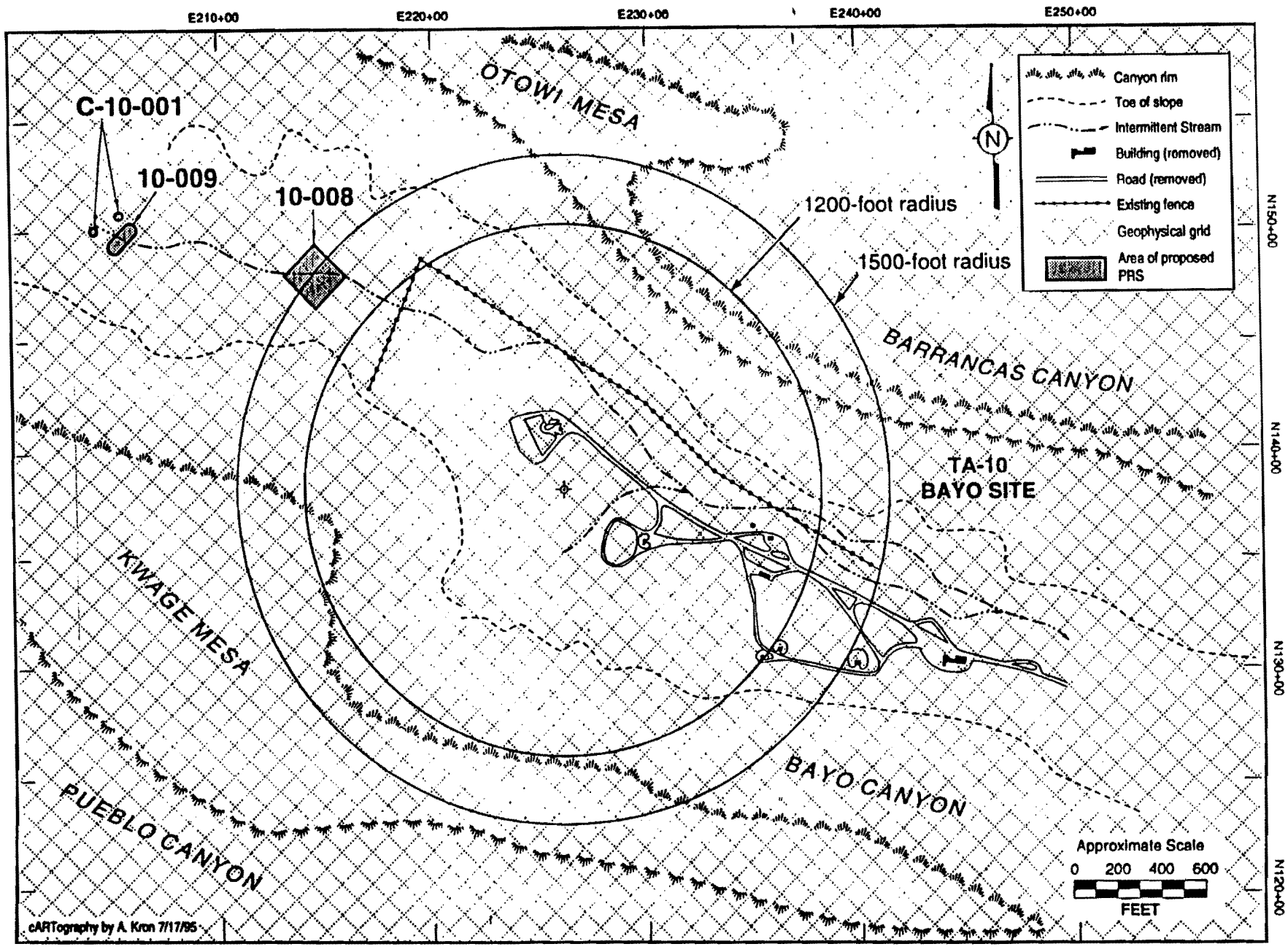


Fig. 2 Locations of proposed new TA-10 SWMUs and AOCs.

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# Appendix A

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# MEMORANDUM

ERM/GOLDER Los Alamos Project Team

**To:** Dave Bradbury

**From:** Danny Katzman DK

**Date:** August 2, 1995

**Regarding: Transmittal of Final VCA Plan for Area of Concern, C-10-001**

---

Please find attached the final VCA plan for Area of Concern, C-10-001 in Bayo Canyon. The plan is being forwarded through ERM/Golder for Field Unit 1. Comments from the Field Unit 1 Technical Team, including Beverly Martin, have been incorporated. Please feel free to contact Beverly martin or myself if you have questions. Thanks for your help.

cc: Beverly Martin

Project File C9588.01-1.4

D. Faulk

J. Williams

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Time = 1.000E-01 ..... 9
Time = 5.000E-01 ..... 10
Time = 1.000E+00 ..... 11
Time = 5.000E+00 ..... 12
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Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

| Menu | Parameter | Current Value | Default | Parameter Name |
|---|---|---|---|---|
| B-1 | Dose conversion factors for inhalation, mrem/pCi: | | | |
| B-1 | Sr-90+D | 1.310E-03 | 1.310E-03 | DCF2( 1) |
| D-1 | Dose conversion factors for ingestion, mrem/pCi: | | | |
| D-1 | Sr-90+D | 1.530E-04 | 1.530E-04 | DCF3( 1) |
| D-34 | Food transfer factors: | | | |
| D-34 | Sr-90+D , plant/soil concentration ratio, dimensionless | 3.000E-01 | 3.000E-01 | RTF( 1,1) |
| D-34 | Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d) | 8.000E-03 | 8.000E-03 | RTF( 1,2) |
| D-34 | Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d) | 2.000E-03 | 2.000E-03 | RTF( 1,3) |
| D-5 | Bioaccumulation factors, fresh water, L/kg: | | | |
| D-5 | Sr-90+D , fish | 6.000E+01 | 6.000E+01 | BIOFAC( 1,1) |
| D-5 | Sr-90+D , crustacea and mollusks | 1.000E+02 | 1.000E+02 | BIOFAC( 1,2) |

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Site-Specific Parameter Summary

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R011 | Area of contaminated zone (m**2) | 4.000E+03 | 1.000E+04 | --- | AREA |
| R011 | Thickness of contaminated zone (m) | 2.000E+00 | 2.000E+00 | --- | THICK0 |
| R011 | Length parallel to aquifer flow (m) | 9.000E+01 | 1.000E+02 | --- | LCZPAQ |
| R011 | Basic radiation dose limit (mrem/yr) | 1.500E+01 | 3.000E+01 | --- | BRDL |
| R011 | Time since placement of material (yr) | 0.000E+00 | 0.000E+00 | --- | TI |
| R011 | Times for calculations (yr) | 1.000E-01 | 1.000E+00 | --- | T( 2) |
| R011 | Times for calculations (yr) | 5.000E-01 | 3.000E+00 | --- | T( 3) |
| R011 | Times for calculations (yr) | 1.000E+00 | 1.000E+01 | --- | T( 4) |
| R011 | Times for calculations (yr) | 5.000E+00 | 3.000E+01 | --- | T( 5) |
| R011 | Times for calculations (yr) | 1.000E+01 | 1.000E+02 | --- | T( 6) |
| R011 | Times for calculations (yr) | 3.000E+01 | 3.000E+02 | --- | T( 7) |
| R011 | Times for calculations (yr) | 1.000E+02 | 1.000E+03 | --- | T( 8) |
| R011 | Times for calculations (yr) | 1.000E+03 | 0.000E+00 | --- | T( 9) |
| R011 | Times for calculations (yr) | 5.000E+03 | 0.000E+00 | --- | T(10) |
| | | | | | |
| R012 | Initial principal radionuclide (pCi/g): Sr-90 | 1.000E+01 | 0.000E+00 | --- | S1( 1) |
| R012 | Concentration in groundwater (pCi/L): Sr-90 | not used | 0.000E+00 | --- | W1( 1) |
| | | | | | |
| R013 | Cover depth (m) | 0.000E+00 | 0.000E+00 | --- | COVER0 |
| R013 | Density of cover material (g/cm**3) | not used | 1.500E+00 | --- | DENSCV |
| R013 | Cover depth erosion rate (m/yr) | not used | 1.000E-03 | --- | VCV |
| R013 | Density of contaminated zone (g/cm**3) | 1.600E+00 | 1.500E+00 | --- | DENSCZ |
| R013 | Contaminated zone erosion rate (m/yr) | 0.000E+00 | 1.000E-03 | --- | VCZ |
| R013 | Contaminated zone total porosity | 4.000E-01 | 4.000E-01 | --- | TPCZ |
| R013 | Contaminated zone effective porosity | 2.000E-01 | 2.000E-01 | --- | EPCZ |
| R013 | Contaminated zone hydraulic conductivity (m/yr) | 4.400E+02 | 1.000E+01 | --- | HCCZ |
| R013 | Contaminated zone b parameter | 4.050E+00 | 5.300E+00 | --- | BCZ |
| R013 | Humidity in air (g/cm**3) | not used | 8.000E+00 | --- | HUMID |
| R013 | Evapotranspiration coefficient | 9.990E-01 | 5.000E-01 | --- | EVAPTR |
| R013 | Precipitation (m/yr) | 4.800E-01 | 1.000E+00 | --- | PRECIP |
| R013 | Irrigation (m/yr) | 0.000E+00 | 2.000E-01 | --- | RI |
| R013 | Irrigation mode | overhead | overhead | --- | IDITCH |
| R013 | Runoff coefficient | 2.000E-01 | 2.000E-01 | --- | RUNOFF |
| R013 | Watershed area for nearby stream or pond (m**2) | 1.000E+06 | 1.000E+06 | --- | WAREA |
| R013 | Accuracy for water/soil computations | 1.000E-03 | 1.000E-03 | --- | EPS |
| | | | | | |
| R014 | Density of saturated zone (g/cm**3) | 1.600E+00 | 1.500E+00 | --- | DENSAQ |
| R014 | Saturated zone total porosity | 3.500E-01 | 4.000E-01 | --- | TPSZ |
| R014 | Saturated zone effective porosity | 3.500E-01 | 2.000E-01 | --- | EPSZ |
| R014 | Saturated zone hydraulic conductivity (m/yr) | 4.500E+03 | 1.000E+02 | --- | HCSZ |
| R014 | Saturated zone hydraulic gradient | 2.700E-02 | 2.000E-02 | --- | HGWT |
| R014 | Saturated zone b parameter | 4.050E+00 | 5.300E+00 | --- | BSZ |
| R014 | Water table drop rate (m/yr) | 3.000E-01 | 1.000E-03 | --- | VWT |
| R014 | Well pump intake depth (m below water table) | 1.000E+01 | 1.000E+01 | --- | DWIBWT |
| R014 | Model: Nondispersion (ND) or Mass-Balance (MB) | ND | ND | --- | MODEL |
| R014 | Well pumping rate (m**3/yr) | 2.500E+02 | 2.500E+02 | --- | UW |
| | | | | | |
| R015 | Number of unsaturated zone strata | 1 | 1 | --- | NS |

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Site-Specific Parameter Summary (continued)

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R015 | Unsat. zone 1, thickness (m) | 2.000E+00 | 4.000E+00 | --- | H(1) |
| R015 | Unsat. zone 1, soil density (g/cm**3) | 1.400E+00 | 1.500E+00 | --- | DENSUZ(1) |
| R015 | Unsat. zone 1, total porosity | 5.000E-01 | 4.000E-01 | --- | TPUZ(1) |
| R015 | Unsat. zone 1, effective porosity | 4.000E-01 | 2.000E-01 | --- | EPUZ(1) |
| R015 | Unsat. zone 1, soil-specific b parameter | 4.050E+00 | 5.300E+00 | --- | BUZ(1) |
| R015 | Unsat. zone 1, hydraulic conductivity (m/yr) | 3.000E+00 | 1.000E+01 | --- | HCUZ(1) |
| | | | | | |
| R016 | Distribution coefficients for Sr-90 | | | | |
| R016 | Contaminated zone (cm**3/g) | 3.000E+01 | 3.000E+01 | --- | DCNUCC( 1) |
| R016 | Unsaturated zone 1 (cm**3/g) | 3.000E+01 | 3.000E+01 | --- | DCNUCU( 1,1) |
| R016 | Saturated zone (cm**3/g) | 3.000E+01 | 3.000E+01 | --- | DCNUCS( 1) |
| R016 | Leach rate (/yr) | 0.000E+00 | 0.000E+00 | 3.990E-06 | ALEACH( 1) |
| R016 | Solubility constant | 0.000E+00 | 0.000E+00 | not used | SOLUBK( 1) |
| | | | | | |
| R017 | Inhalation rate (m**3/yr) | 6.700E+03 | 8.400E+03 | --- | INHALR |
| R017 | Mass loading for inhalation (g/m**3) | 1.000E-04 | 2.000E-04 | --- | MLINH |
| R017 | Dilution length for airborne dust, inhalation (m) | 3.000E+00 | 3.000E+00 | --- | LM |
| R017 | Exposure duration | 3.000E+01 | 3.000E+01 | --- | ED |
| R017 | Shielding factor, inhalation | 4.000E-01 | 4.000E-01 | --- | SHF3 |
| R017 | Shielding factor, external gamma | 7.000E-01 | 7.000E-01 | --- | SHF1 |
| R017 | Fraction of time spent indoors | 6.900E-01 | 5.000E-01 | --- | FIND |
| R017 | Fraction of time spent outdoors (on site) | 8.000E-02 | 2.500E-01 | --- | FOTD |
| R017 | Shape factor flag, external gamma | 1.000E+00 | 1.000E+00 | >0 shows circular AREA. | FS |
| R017 | Radii of shape factor array (used if FS = -1): | | | | |
| R017 | Outer annular radius (m), ring 1: | not used | 5.000E+01 | --- | RAD_SHAPE( 1) |
| R017 | Outer annular radius (m), ring 2: | not used | 7.071E+01 | --- | RAD_SHAPE( 2) |
| R017 | Outer annular radius (m), ring 3: | not used | 0.000E+00 | --- | RAD_SHAPE( 3) |
| R017 | Outer annular radius (m), ring 4: | not used | 0.000E+00 | --- | RAD_SHAPE( 4) |
| R017 | Outer annular radius (m), ring 5: | not used | 0.000E+00 | --- | RAD_SHAPE( 5) |
| R017 | Outer annular radius (m), ring 6: | not used | 0.000E+00 | --- | RAD_SHAPE( 6) |
| R017 | Outer annular radius (m), ring 7: | not used | 0.000E+00 | --- | RAD_SHAPE( 7) |
| R017 | Outer annular radius (m), ring 8: | not used | 0.000E+00 | --- | RAD_SHAPE( 8) |
| R017 | Outer annular radius (m), ring 9: | not used | 0.000E+00 | --- | RAD_SHAPE( 9) |
| R017 | Outer annular radius (m), ring 10: | not used | 0.000E+00 | --- | RAD_SHAPE(10) |
| R017 | Outer annular radius (m), ring 11: | not used | 0.000E+00 | --- | RAD_SHAPE(11) |
| R017 | Outer annular radius (m), ring 12: | not used | 0.000E+00 | --- | RAD_SHAPE(12) |
| | | | | | |
| R017 | Fractions of annular areas within AREA: | | | | |
| R017 | Ring 1 | not used | 1.000E+00 | --- | FRACA( 1) |
| R017 | Ring 2 | not used | 2.732E-01 | --- | FRACA( 2) |
| R017 | Ring 3 | not used | 0.000E+00 | --- | FRACA( 3) |
| R017 | Ring 4 | not used | 0.000E+00 | --- | FRACA( 4) |
| R017 | Ring 5 | not used | 0.000E+00 | --- | FRACA( 5) |
| R017 | Ring 6 | not used | 0.000E+00 | --- | FRACA( 6) |
| R017 | Ring 7 | not used | 0.000E+00 | --- | FRACA( 7) |
| R017 | Ring 8 | not used | 0.000E+00 | --- | FRACA( 8) |
| R017 | Ring 9 | not used | 0.000E+00 | --- | FRACA( 9) |
| R017 | Ring 10 | not used | 0.000E+00 | --- | FRACA(10) |
| R017 | Ring 11 | not used | 0.000E+00 | --- | FRACA(11) |
| R017 | Ring 12 | not used | 0.000E+00 | --- | FRACA(12) |

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Site-Specific Parameter Summary (continued)

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R018 | Fruits, vegetables and grain consumption (kg/yr) | 1.190E+02 | 1.600E+02 | --- | DIET(1) |
| R018 | Leafy vegetable consumption (kg/yr) | 1.400E+01 | 1.400E+01 | --- | DIET(2) |
| R018 | Milk consumption (L/yr) | not used | 9.200E+01 | --- | DIET(3) |
| R018 | Meat and poultry consumption (kg/yr) | not used | 6.300E+01 | --- | DIET(4) |
| R018 | Fish consumption (kg/yr) | not used | 5.400E+00 | --- | DIET(5) |
| R018 | Other seafood consumption (kg/yr) | not used | 9.000E-01 | --- | DIET(6) |
| R018 | Soil ingestion rate (g/yr) | 3.500E+01 | 3.650E+01 | --- | SOIL |
| R018 | Drinking water intake (L/yr) | not used | 5.100E+02 | --- | DWI |
| R018 | Contamination fraction of drinking water | not used | 1.000E+00 | --- | FDW |
| R018 | Contamination fraction of household water | not used | 1.000E+00 | --- | FHHW |
| R018 | Contamination fraction of livestock water | not used | 1.000E+00 | --- | FLW |
| R018 | Contamination fraction of irrigation water | 1.000E+00 | 1.000E+00 | --- | FIRW |
| R018 | Contamination fraction of aquatic food | not used | 5.000E-01 | --- | FR9 |
| R018 | Contamination fraction of plant food | 2.500E-01 | -1 | --- | FPLANT |
| R018 | Contamination fraction of meat | not used | -1 | --- | FMEAT |
| R018 | Contamination fraction of milk | not used | -1 | --- | FMILK |
| | | | | | |
| R019 | Livestock fodder intake for meat (kg/day) | not used | 6.800E+01 | --- | LFI5 |
| R019 | Livestock fodder intake for milk (kg/day) | not used | 5.500E+01 | --- | LFI6 |
| R019 | Livestock water intake for meat (L/day) | not used | 5.000E+01 | --- | LWI5 |
| R019 | Livestock water intake for milk (L/day) | not used | 1.600E+02 | --- | LWI6 |
| R019 | Livestock soil intake (kg/day) | not used | 5.000E-01 | --- | LSI |
| R019 | Mass loading for foliar deposition (g/m**3) | 1.000E-04 | 1.000E-04 | --- | MLFD |
| R019 | Depth of soil mixing layer (m) | 1.500E-01 | 1.500E-01 | --- | DM |
| R019 | Depth of roots (m) | 9.000E-01 | 9.000E-01 | --- | DROOT |
| R019 | Drinking water fraction from ground water | 1.000E+00 | 1.000E+00 | --- | FGWDW |
| R019 | Household water fraction from ground water | not used | 1.000E+00 | --- | FGWHH |
| R019 | Livestock water fraction from ground water | not used | 1.000E+00 | --- | FGWLW |
| R019 | Irrigation fraction from ground water | not used | 1.000E+00 | --- | FGWIR |
| | | | | | |
| C14 | C-12 concentration in water (g/cm**3) | not used | 2.000E-05 | --- | C12WTR |
| C14 | C-12 concentration in contaminated soil (g/g) | not used | 3.000E-02 | --- | C12CZ |
| C14 | Fraction of vegetation carbon from soil | not used | 2.000E-02 | --- | CSOIL |
| C14 | Fraction of vegetation carbon from air | not used | 9.800E-01 | --- | CAIR |
| C14 | C-14 evasion layer thickness in soil (m) | not used | 3.000E-01 | --- | DMC |
| C14 | C-14 evasion flux rate from soil (1/sec) | not used | 7.000E-07 | --- | EVSN |
| C14 | C-12 evasion flux rate from soil (1/sec) | not used | 1.000E-10 | --- | REVSN |
| C14 | Fraction of grain in beef cattle feed | not used | 8.000E-01 | --- | AVFG4 |
| C14 | Fraction of grain in milk cow feed | not used | 2.000E-01 | --- | AVFG5 |
| | | | | | |
| STOR | Storage times of contaminated foodstuffs (days): | | | | |
| STOR | Fruits, non-leafy vegetables, and grain | 1.400E+01 | 1.400E+01 | --- | STOR_T(1) |
| STOR | Leafy vegetables | 1.000E+00 | 1.000E+00 | --- | STOR_T(2) |
| STOR | Milk | not used | 1.000E+00 | --- | STOR_T(3) |
| STOR | Meat and poultry | not used | 2.000E+01 | --- | STOR_T(4) |
| STOR | Fish | not used | 7.000E+00 | --- | STOR_T(5) |
| STOR | Crustacea and mollusks | not used | 7.000E+00 | --- | STOR_T(6) |
| STOR | Well water | 1.000E+00 | 1.000E+00 | --- | STOR_T(7) |
| STOR | Surface water | 1.000E+00 | 1.000E+00 | --- | STOR_T(8) |
| STOR | Livestock fodder | not used | 4.500E+01 | --- | STOR_T(9) |

OFFICIAL USE ONLY

Site-Specific Parameter Summary (continued)

| Menu | Parameter | User Input | Default | Used by RESRAD (If different from user input) | Parameter Name |
|---|---|---|---|---|---|
| R021 | Thickness of building foundation (m) | not used | 1.500E-01 | --- | FLOOR |
| R021 | Bulk density of building foundation (g/cm**3) | not used | 2.400E+00 | --- | DENSFL |
| R021 | Total porosity of the cover material | not used | 4.000E-01 | --- | TPCV |
| R021 | Total porosity of the building foundation | not used | 1.000E-01 | --- | TPFL |
| R021 | Volumetric water content of the cover material | not used | 5.000E-02 | --- | PH2OCV |
| R021 | Volumetric water content of the foundation | not used | 3.000E-02 | --- | PH2OFL |
| R021 | Diffusion coefficient for radon gas (m/sec): | | | | |
| R021 | in cover material | not used | 2.000E-06 | --- | DIFCV |
| R021 | in foundation material | not used | 3.000E-07 | --- | DIFFL |
| R021 | in contaminated zone soil | not used | 2.000E-06 | --- | DIFCZ |
| R021 | Radon vertical dimension of mixing (m) | not used | 2.000E+00 | --- | HMIX |
| R021 | Average annual wind speed (m/sec) | not used | 2.000E+00 | --- | WIND |
| R021 | Average building air exchange rate (1/hr) | not used | 5.000E-01 | --- | REXG |
| R021 | Height of the building (room) (m) | not used | 2.500E+00 | --- | HRM |
| R021 | Building interior area factor | not used | 0.000E+00 | --- | FAI |
| R021 | Building depth below ground surface (m) | not used | -1.000E+00 | --- | DMFL |
| R021 | Emanating power of Rn-222 gas | not used | 2.500E-01 | --- | EMANA(1) |
| R021 | Emanating power of Rn-220 gas | not used | 1.500E-01 | --- | EMANA(2) |

Summary of Pathway Selections

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

OFFICIAL USE ONLY

| Contaminated Zone Dimensions | | Initial Soil Concentrations, pCi/g | |
|---|---|---|---|
| Area: | 4000.00 square meters | Sr-90 | 1.000E+01 |
| Thickness: | 2.00 meters | | |
| Cover Depth: | 0.00 meters | | |

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

| t (years): | 0.000E+00 | 1.000E-01 | 5.000E-01 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 3.000E+01 | 1.000E+02 | 1.000E+03 | 5.000E+03 |
|---|---|---|---|---|---|---|---|---|---|---|
| TDOSE(t): | 1.543E+01 | 1.539E+01 | 1.525E+01 | 1.507E+01 | 1.368E+01 | 1.213E+01 | 7.495E+00 | 1.390E+00 | 5.423E-10 | 0.000E+00 |
| M(t): | 1.029E+00 | 1.026E+00 | 1.016E+00 | 1.004E+00 | 9.121E-01 | 8.087E-01 | 4.997E-01 | 9.267E-02 | 3.616E-11 | 0.000E+00 |

Maximum TDOSE(t): 1.543E+01 mrem/yr at t = 0.000E+00 years

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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

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Sr-90 | 1.384E-01 | 0.0090 | 2.983E-03 | 0.0002 | 0.000E+00 | 0.0000 | 1.525E+01 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.123E-02 | 0.0027 |
| Total | 1.384E-01 | 0.0090 | 2.983E-03 | 0.0002 | 0.000E+00 | 0.0000 | 1.525E+01 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.123E-02 | 0.0027 |

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

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 1.543E+01 | 1.0000 |
| 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 | 1.543E+01 | 1.0000 |

*Sum of all water independent and dependent pathways.

OFFICIAL USE ONLY

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-01 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Sr-90 | 1.381E-01 | 0.0090 | 2.976E-03 | 0.0002 | 0.000E+00 | 0.0000 | 1.521E+01 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.113E-02 | 0.0027 |
| Total | 1.381E-01 | 0.0090 | 2.976E-03 | 0.0002 | 0.000E+00 | 0.0000 | 1.521E+01 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.113E-02 | 0.0027 |

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-01 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 1.539E+01 | 1.0000 |
| 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 | 1.539E+01 | 1.0000 |

*Sum of all water independent and dependent pathways.

OFFICIAL USE ONLY

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

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Sr-90 | 1.368E-01 | 0.0090 | 2.947E-03 | 0.0002 | 0.000E+00 | 0.0000 | 1.507E+01 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.074E-02 | 0.0027 |
| Total | 1.368E-01 | 0.0090 | 2.947E-03 | 0.0002 | 0.000E+00 | 0.0000 | 1.507E+01 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.074E-02 | 0.0027 |

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

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 1.525E+01 | 1.0000 |
| 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 | 1.525E+01 | 1.0000 |

*Sum[illegible] all water independent and dependent pathways.

OFFICIAL USE ONLY

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

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Sr-90 | 1.352E-01 | 0.0090 | 2.912E-03 | 0.0002 | 0.000E+00 | 0.0000 | 1.489E+01 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.025E-02 | 0.0027 |
| Total | 1.352E-01 | 0.0090 | 2.912E-03 | 0.0002 | 0.000E+00 | 0.0000 | 1.489E+01 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 4.025E-02 | 0.0027 |

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

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 1.507E+01 | 1.0000 |
| 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 | 1.507E+01 | 1.0000 |

*Sum of all water independent and dependent pathways.

OFFICIAL USE ONLY

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+00 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Sr-90 | 1.227E-01 | 0.0090 | 2.645E-03 | 0.0002 | 0.000E+00 | 0.0000 | 1.352E+01 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.656E-02 | 0.0027 |
| Total | 1.227E-01 | 0.0090 | 2.645E-03 | 0.0002 | 0.000E+00 | 0.0000 | 1.352E+01 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.656E-02 | 0.0027 |

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+00 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 1.368E+01 | 1.0000 |
| 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 | 1.368E+01 | 1.0000 |

*Sum[illegible] all water independent and dependent pathways.

OFFICIAL USE ONLY

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+01 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Sr-90 | 1.088E-01 | 0.0090 | 3.345E-03 | 0.0002 | 0.000E+00 | 0.0000 | 1.199E+01 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.241E-02 | 0.0027 |
| Total | 1.088E-01 | 0.0090 | 3.345E-03 | 0.0002 | 0.000E+00 | 0.0000 | 1.199E+01 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.241E-02 | 0.0027 |

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+01 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 1.213E+01 | 1.0000 |
| 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 | 1.213E+01 | 1.0000 |

*Sum of all water independent and dependent pathways.

OFFICIAL USE ONLY

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+01 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Sr-90 | 6.724E-02 | 0.0090 | 1.449E-03 | 0.0002 | 0.000E+00 | 0.0000 | 7.407E+00 | 0.9862 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.003E-02 | 0.0027 |
| Total | 6.724E-02 | 0.0090 | 1.449E-03 | 0.0002 | 0.000E+00 | 0.0000 | 7.407E+00 | 0.9862 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 2.003E-02 | 0.0027 |

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+01 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 7.495E+00 | 1.0000 |
| 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 | 7.495E+00 | 1.0000 |

*Sum[illegible] all water independent and dependent pathways.

OFFICIAL USE ONLY

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

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Sr-90 | 1.247E-02 | 0.0090 | 2.687E-04 | 0.0002 | 0.000E+00 | 0.0000 | 1.374E+00 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.714E-03 | 0.0027 |
| Total | 1.247E-02 | 0.0090 | 2.687E-04 | 0.0002 | 0.000E+00 | 0.0000 | 1.374E+00 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.714E-03 | 0.0027 |

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

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 1.390E+00 | 1.0000 |
| 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 | 1.390E+00 | 1.0000 |

*Sum of all water independent and dependent pathways.

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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

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| Sr-90 | 4.865E-12 | 0.0090 | 1.048E-13 | 0.0002 | 0.000E+00 | 0.0000 | 5.359E-10 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.449E-12 | 0.0027 |
| Total | 4.865E-12 | 0.0090 | 1.048E-13 | 0.0002 | 0.000E+00 | 0.0000 | 5.359E-10 | 0.9882 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 1.449E-12 | 0.0027 |

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

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 5.423E-10 | 1.0000 |
| 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 | 5.423E-10 | 1.0000 |

*Su[illegible] all water independent and dependent pathways.

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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+03 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- | Ground | | Inhalation | | Radon | | Plant | | Meat | | Milk | | Soil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 0.000E+00 | 0.0000 |
| 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 | 0.000E+00 | 0.0000 |

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+03 years

Water Dependent Pathways

| Radio- | Water | | Fish | | Radon | | Plant | | Meat | | Milk | | All Pathways* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nuclide | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. | mrem/yr | fract. |
| 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 | 0.000E+00 | 0.0000 |
| 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 | 0.000E+00 | 0.0000 |

*Sum[illegible] all water independent and dependent pathways.

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Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

| Parent (i) | Product (j) | Branch Fraction | DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00 | 1.000E-01 | 5.000E-01 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 3.000E+01 | 1.000E+02 | 1.000E+03 | 5.000E+03 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sr-90 | Sr-90 | 1.000E+00 | 1.543E+00 | 1.539E+00 | 1.525E+00 | 1.507E+00 | 1.368E+00 | 1.213E+00 | 7.495E-01 | 1.390E-01 | 5.423E-11 | 0.000E+00 |

Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life μ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

| Nuclide (i) | t= 0.000E+00 | 1.000E-01 | 5.000E-01 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 3.000E+01 | 1.000E+02 | 1.000E+03 | 5.000E+03 |
|---|---|---|---|---|---|---|---|---|---|---|
| Sr-90 | 9.720E+00 | 9.743E+00 | 9.838E+00 | 9.957E+00 | 1.096E+01 | 1.237E+01 | 2.001E+01 | 1.079E+02 | 2.766E+11 | *1.380E+14 |

*At specific activity limit

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

| Nuclide (i) | Initial pCi/g | tmin (years) | DSR(i,tmin) | G(i,tmin) (pCi/g) | DSR(i,tmax) | G(i,tmax) (pCi/g) |
|---|---|---|---|---|---|---|
| Sr-90 | 1.000E+01 | 0.000E+00 | 1.543E+00 | 9.720E+00 | 1.543E+00 | 9.720E+00 |

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Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

| Nuclide (j) | Parent (i) | BRF(i) | DOSE(j,t), mrem/yr | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t= | 0.000E+00 | 1.000E-01 | 5.000E-01 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 3.000E+01 | 1.000E+02 | 1.000E+03 | 5.000E+03 |
| Sr-90 | Sr-90 | 1.000E+00 | 1.543E+01 | 1.539E+01 | 1.525E+01 | 1.507E+01 | 1.366E+01 | 1.213E+01 | 7.495E+00 | 1.390E+00 | 5.423E-10 | 0.000E+00 |

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

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

| Nuclide (j) | Parent (i) | BRF(i) | S(j,t), pCi/g | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | t= | 0.000E+00 | 1.000E-01 | 5.000E-01 | 1.000E+00 | 5.000E+00 | 1.000E+01 | 3.000E+01 | 1.000E+02 | 1.000E+03 | 5.000E+03 |
| Sr-90 | Sr-90 | 1.000E+00 | 1.000E+01 | 9.976E+00 | 9.880E+00 | 9.762E+00 | 8.866E+00 | 7.861E+00 | 4.857E+00 | 9.007E-01 | 3.514E-10 | 0.000E+00 |

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

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*Author(s):* Gabriela Lopez-Escobedo
Environmental Restoration Project

*Submitted to:* New Mexico Environment Department

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# Los Alamos National Laboratory
# Environmental Restoration Project

# EXPEDITED CLEANUP PLAN

for

# SOLID WASTE MANAGEMENT UNITS 48-002(a) and 48-002(b)

46092.38

April 1995
Revision 1

Environmental
Restoration

20

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**Approvals and Reviews**

This document is based on the most current information available at the time of preparation. In the event changes or modifications are required from those proposed, modifications will be made to incorporate any and all revisions. Subsequent reviews and approvals, consistent with those provided for this revision, will be required. This document has been reviewed for content and approved as reflected by the signatures below:

Document Approved By:

Allyn Pratt, Field Project Leader

24 April 95
Date

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## ACRONYMS

| | |
|---|---|
| AR | administrative requirement |
| CEARP | Comprehensive Environmental Assessment and Response Program |
| CFR | Code of Federal Regulations |
| Chem van | mobile chemical analytical laboratory |
| COC | contaminant of concern |
| CST | Chemical Science and Technology (Division) |
| EC | expedited cleanup |
| EPA | US Environmental Protection Agency |
| ER | Environmental Restoration |
| ES&H | environment, safety, and health |
| HASP | health and safety plan |
| H&S | health and safety |
| Laboratory | Los Alamos National Laboratory |
| ORNL | Oak Ridge National Laboratory |
| PPE | Personal Protective Equipment |
| Rad van | mobile radiological analytical laboratory |
| RCRA | Resource Conservation and Recovery Act |
| RFI | Resource Conservation and Recovery Act facility investigation |
| SAL | screening action level |
| SOP | standard operating procedure |
| SSHASP | Site-Specific Health and Safety Plan |
| SVOC | semivolatile organic compound |
| SWMU | solid waste management unit |
| TA | technical area |
| TCLP | toxicity characteristic leaching procedure |
| TSD | treatment, storage, and disposal |
| USGS | United States Geological Survey |
| VOC | volatile organic compound |
| UTL | upper tolerance limit |
| XRF | x-ray fluorescence |

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## 1.0 INTRODUCTION

This Expedited Cleanup (EC) Plan addresses Solid Waste Management Units (SWMUs) 48-002 (a) and 48-002(b), located in the northwest portion of Los Alamos National Laboratory (the Laboratory), in Los Alamos, New Mexico (Figure 1-1). This EC Plan is being proposed as part of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) process described in the Operable Unit (OU) 1129 RFI Work Plan (LANL 1992, 7666).

SWMUs 48-002(a) and 48-002(b) are included in Table A of the Hazardous and Solid Waste Amendments (HSWA) permit.

SWMUs 48-002(a) and 48-002(b) are former container storage areas located at Technical Area (TA) - 48. Preliminary results from the Phase I RFI sampling efforts indicate that soils within the SWMU boundaries contain elevated levels of metallic mercury and semivolatile organic compounds (SVOCs). These data indicate that this contamination may pose an immediate threat to the environment and possibly to worker safety and may be classified as RCRA hazardous waste.

Activities comprising this EC include the removal of mercury-contaminated soil at the SWMUs. The level of effort required from initial transmittal of the plan to EPA for review, through implementation, to the completion of the final project report is identified in this EC Plan. In the development of this EC Plan, the following assumptions were made:

- The levels of contaminants of concern (COCs) and volumes anticipated are consistent with preliminary data.
- Future land use at the location of these SWMUs will continue to be for industrial purposes.
- Minimal delays in EC operations will be experienced as a result of inclement weather and site access problems. Delays that result from the acquisition and scheduling of heavy equipment and from accepting waste at permitted disposal facilities cannot be anticipated and therefore are not considered within this plan.
- A Site-Specific Health and Safety Plan (SSHASP) and Waste Management Plan will be developed specifically to address COCs identified in this EC Plan. Deviations from the anticipated concentrations and locations of contaminants of concern may necessitate adjustments to both plans.
- Any comments generated by agencies for public review may necessitate adjustments to the scope of this EC Plan. Activities will be performed on a continuous basis during regular business hours, weather permitting, until verification samples indicate that all cleanup levels were met.
- Cost estimates are based on completing the proposed cleanup by removing contaminated soil to a depth of one foot.

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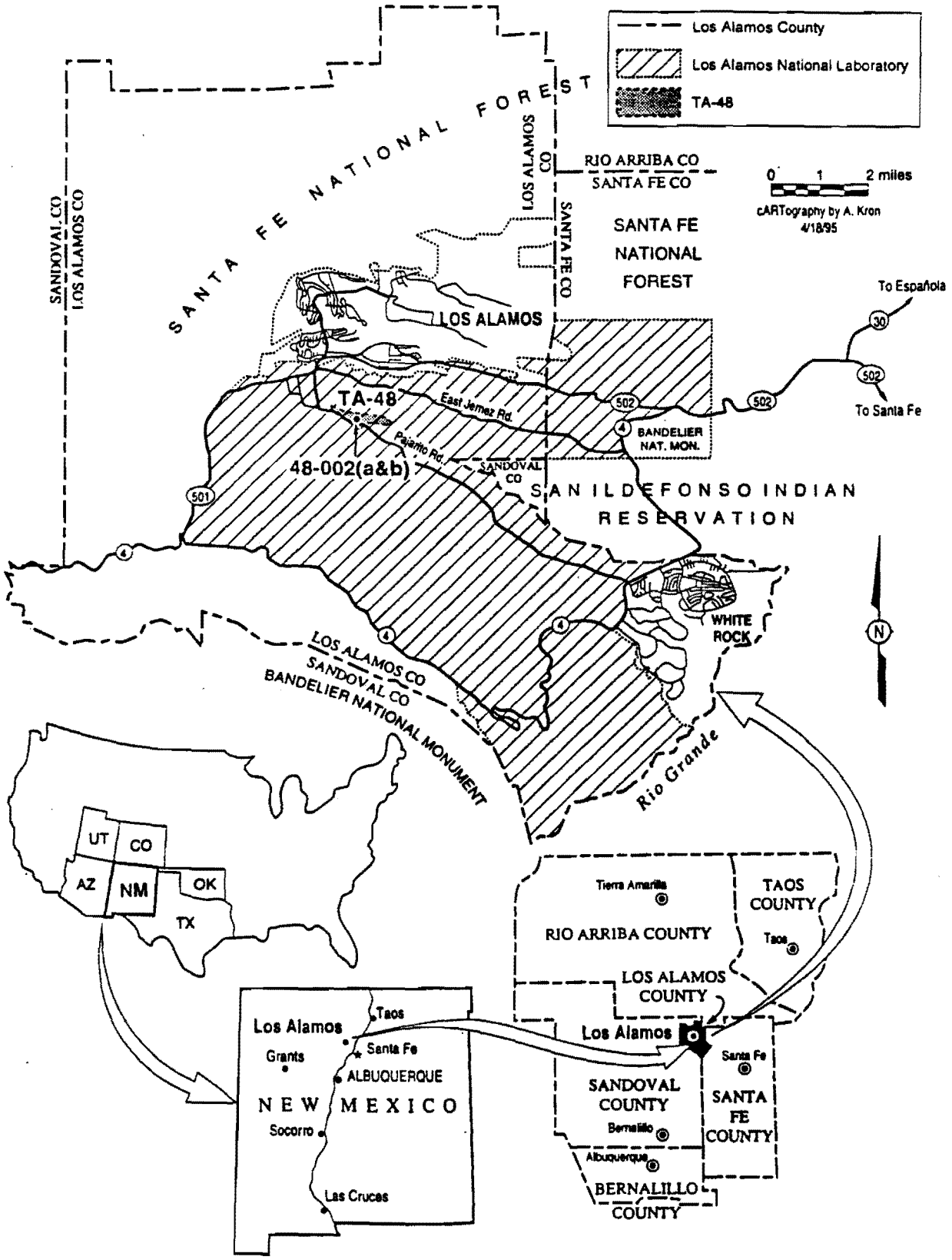


Figure 1-1. Regional location map.

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## 2.0 SITE BACKGROUND AND ENVIRONMENTAL SETTING

### 2.1 Detailed Description of SWMUs 48-002(a) and 48-002(b)

SWMUs 48-002(a) and 48-002(b) are former container storage areas located adjacent to the south side of the Radiochemistry Laboratory, building TA-48-1 (Figure 2-1). The SWMUs have been addressed together during Phase I characterization due to their physical proximity and because preliminary site characterization data indicate the presence of the same suite of COCs. This EC plan continues to address the SWMUs together for these reasons.

Beginning as early as 1976, approximately 200 2-qt. metal flasks, each containing 76 lb. of triple-distilled high-purity mercury, were stored among other "junk" at SWMU 48-002(a) (Garvey 1986, 827; LANL 1990, 7511). The flasks were removed from this location in 1989 (LANL 1990, 7511). Records do not reflect any known releases of hazardous materials, but the flasks were described as "rusting" and sitting in decayed and broken wooden-framed holders (Garvey 1986, 827). No records were found indicating that the site was managed as an active storage area.

SWMU 48-002(b) consisted of an unpaved storage area located at the south end of TA-48-1 where labeled and unlabeled drums were periodically stored (LANL 1990, 7511; DOE 1987, 8663). No records have been located indicating that the area was managed as a formal container storage area. In 1986, a field observation report noted signs of spills at this SWMU, which the observer postulated were due to leaky drums (Perkins 1986, 808; DOE 1987, 8663). In 1989, an internal Laboratory environmental audit report noted only the presence of a long, unlabeled cylinder but omitted any discussion of drums or contamination (LANL 1990, 7511). In 1991, a field activity data log noted that the drums and cylinders previously observed had been removed (Roberson 1991, 884).

The boundaries of SWMUs 48-002(a) and 48-002(b) are generally defined by the physical barriers surrounding the proposed cleanup area. This area is bounded on the north by the wall of building TA-48-1, the east by the concrete retaining wall surrounding the exhaust stack FES-45, and the south by an asphalt road. The western extent of the proposed site, determined from Phase I RFI characterization, is approximately 20 ft. west of the concrete retaining wall. The site measures approximately 220 square ft. and is illustrated in Figure 2-2. The south end of building TA-48-1, where SWMUs 48-002(a) and 48-002(b) are located, is reported to have a basement and perhaps a sub-basement. This feature may be important with regard to potential pathways for contaminant migration (see Section 2.4.1).

#### 2.1.1 Operational History

TA-48 was established in 1957 and is the site of former and current operational structures built to house research work for radiochemistry and nuclear medicine (LANL 1992, 7666). Building TA-48-1 was initially completed in 1957, and in 1963 the alpha wing was added. The alpha wing, located in the northwest end of the building, is used to process high-level alpha and/or beta-gamma emitters. The hot cell facility, which formerly handled irradiated fuel elements from the Rover Program (a nuclear rocket reactor program), is currently used for radiochemical analysis on spallation products from the Clinton P. Anderson Meson Physics Facility. The Nevada Operations Facility is also located within building TA-48-1. Personnel at this facility dissolve samples retrieved from underground shot cavities at the Nevada Test Site and perform radiochemical studies on them.

It is likely that SWMUs 48-002(a) and 48-002(b) were used informally as container storage areas throughout the operational history of the TA-48 facility. No Laboratory records were located to document the intended use of the mercury or the potential source of the SVOCs. Anecdotal information from a former employee indicates that surplus liquid mercury was shipped from Oak Ridge National Laboratory (ORNL) for possible use as shielding for gamma-ray detectors. However, most of the mercury was never used (Balagna, 1995).

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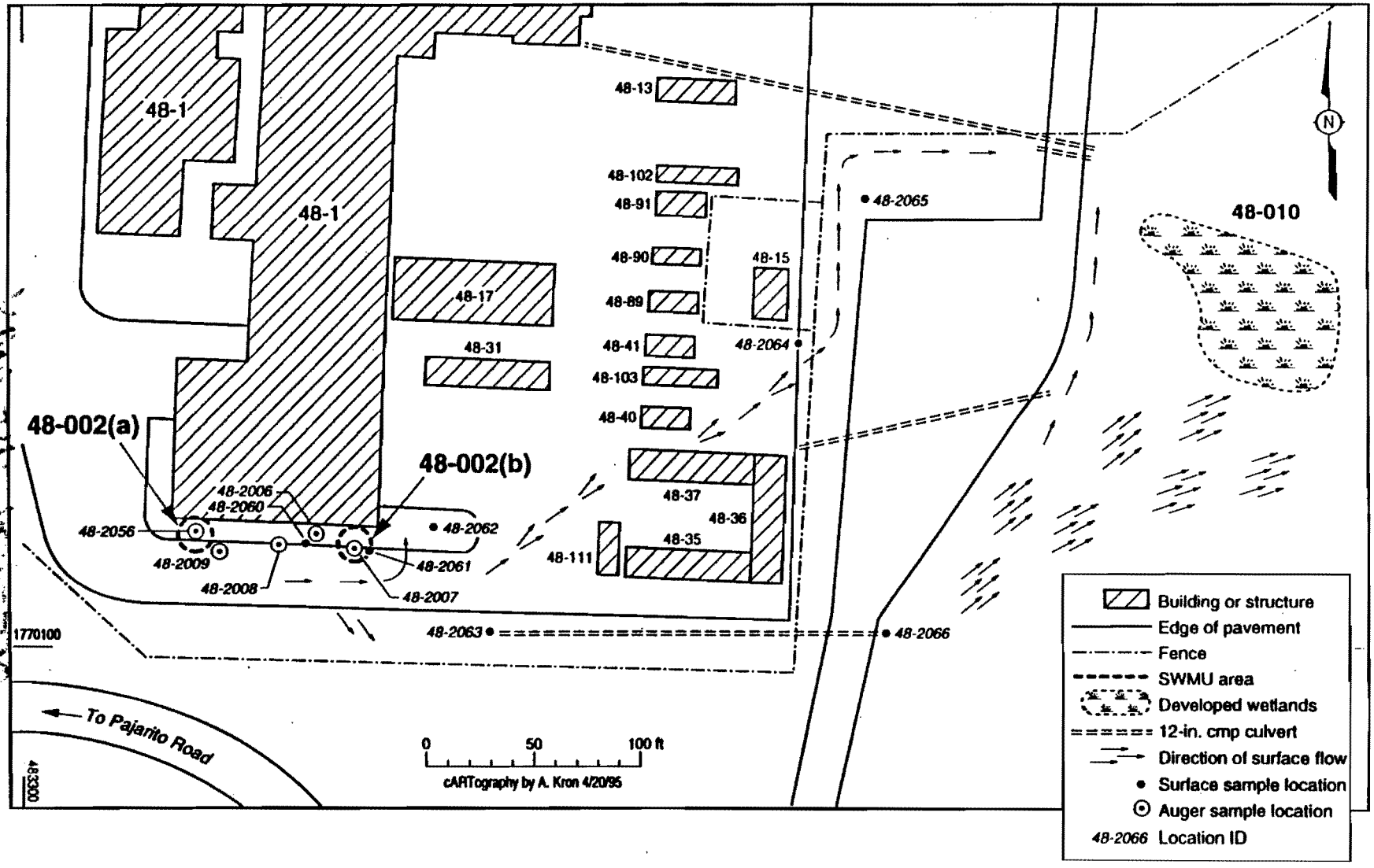


Figure 2-1. Location map for SWMUs 48-002(a) and (b)



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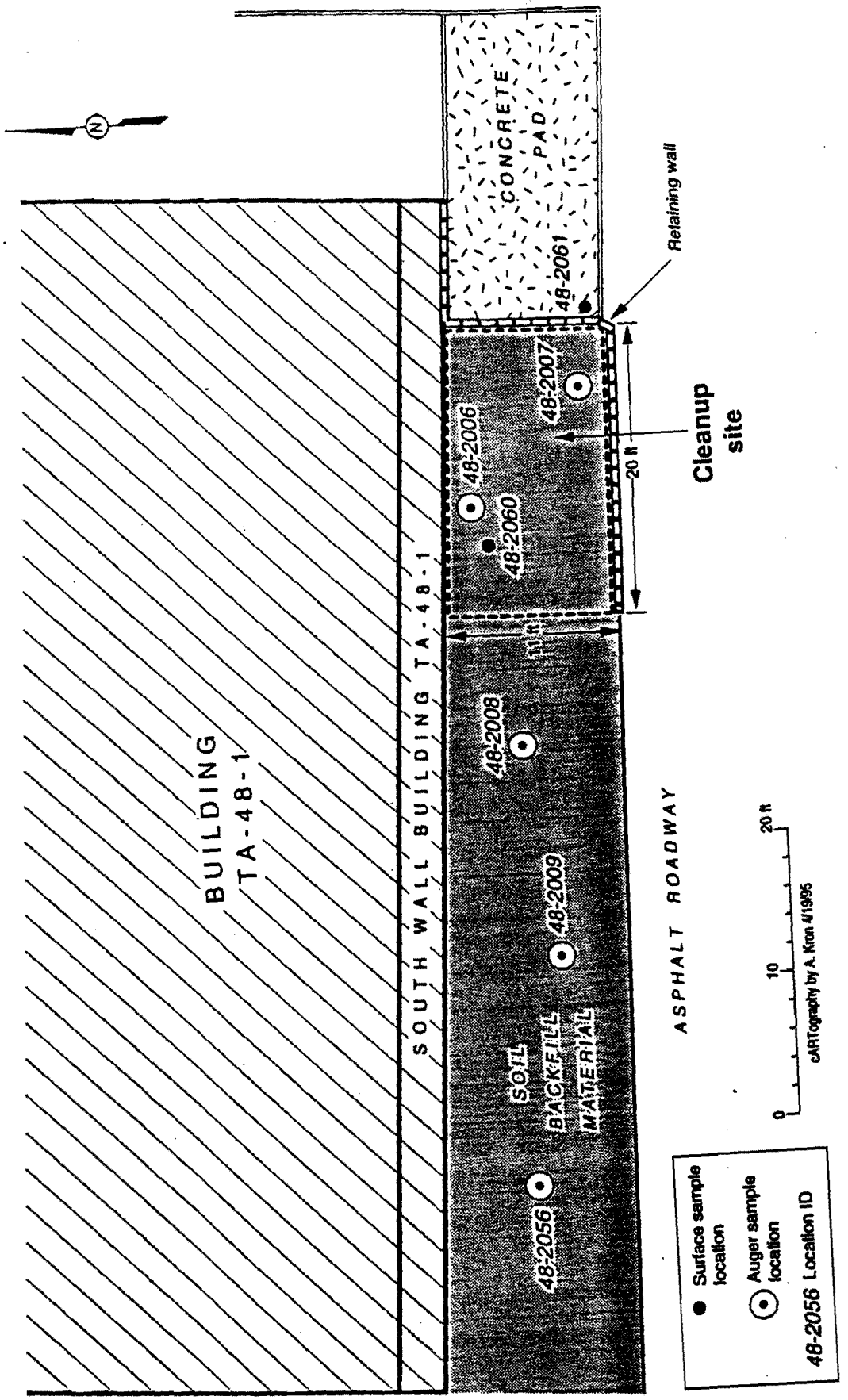


Figure 2-2. Site sketch for SWMUs 48-002(a) and 48-002(b)



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### 2.1.2 Physical Setting

TA-48 lies within the boundaries of the Laboratory (LANL 1992, 7666) and is located north of Pajarito Road at an approximate longitude and latitude of 35:52:00 N and 106:18:20 W (USGS 1984, 21588) (LANL 1992, 7666). It is situated on Mesita del Buey between Mortandad Canyon to the north and Two Mile Canyon to the south (LANL 1992, 7666). Mesita del Buey is underlain by the Bandelier Tuff, composed of ash fall, ash-fall pumice, and rhyolitic tuff. The depth to the soil/tuff interface ranges from approximately 8 to 10 ft. near the building to approximately 3 ft. near the asphalt road. The depth to the main aquifer is approximately 1,000 ft. from the mesa top.

No archeological sites or endangered species exist within the boundary of TA-48 that could be affected during these EC activities (LANL 1992, 7666). A wetland-type area is known to exist approximately 500 ft east of the TA-48 perimeter fence. This area is identified as SWMU 48-010, surface impoundment (LANL 1990, 7511). It consists of an unlined pond that was excavated into the tuff in 1978 to catch noncontact and treated cooling water from TA-48. The perimeter of this pond has developed into a wetland area. The pond discharges to the east into a side canyon of Mortandad Canyon. EC activities at SWMUs 48-002(a) and 48-002(b) are not expected to impact the wetland-type area. SWMU 48-010 has undergone Phase I characterization in accordance the RFI Work Plan for OU 1129, and the results will be reported in a future RFI Report.

## 2.2 Summary of Investigations

Previous investigations at SWMUs 48-002(a) and 48-002(b) include a site evaluation under Phase I of the Comprehensive Environmental Assessment and Response Program (CEARP) and a Phase I Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) under the ER Project.

### 2.2.1 Investigations Prior to the RFI

Prior to designation as SWMUs, the container storage areas were evaluated under Phase I of the CEARP (DOE 1987, 8663). The Phase I CEARP findings were based on a records search, an open literature survey, interviews with current and former Laboratory employees, preliminary assessments, and site inspections. SWMU 48-002(a) was identified as "TA 48-4-CA-A-HW (mercury storage)" in the Phase I draft report. SWMU 48-002(b) was identified as "TA 48-5-CA-A/I-HW/RW/PP (drum storage)."

Under the CEARP the two SWMUs were visited and field observation reports (site inspections) were filed. One report noted the corroding mercury storage flasks, but no further action was recommended at that time. The CEARP Phase I report recommended future action for the drum storage area: "During supplemental Phase I, the extent of residual environmental contamination associated with past drum storage will be determined." However, no further action was taken at either location because the program changed from the DOE CEARP to the Laboratory ER Program.

### 2.2.2 RCRA Field Investigations (RFI)

RCRA facility investigations conducted at the site consisted of two characterization sampling events. Surface and subsurface sampling was conducted at the site in July 1993 and surface soil sampling was conducted downgradient of the site in October 1993.

In July 1993, five boreholes were hand augered at locations 48-2006, -2007, -2008, -2009, and 2056, as shown in Figure 2-1. Borehole 48-2006 was advanced to a depth of 8 ft., boreholes 48-008 and 48-009 were advanced to a depth of 3 ft., borehole 48-2056 was advanced to a depth of 2 ft., and borehole 48-2007 was advanced to a depth of 1 foot. Soil samples from the five boreholes were collected at 1-ft intervals. In addition, one surface soil sample was collected at location 48-2060. During the collection of the surface sample, the soil was noted to be stained, and "beads" of elemental mercury were readily observed in the soil (Stellavato 1993, 45355).

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All of the samples were submitted for analysis of volatile organic compounds (VOCs), SVOCs, metals, and radionuclides; additional samples were collected and field-analyzed for metals using an x-ray fluorescence (XRF) analyzer. A Jerome (Model 431-X) mercury vapor analyzer ("sniffer") was used to monitor the breathing zone and the sampling locations before and during sampling. Readings ranged from barely detectable in the breathing zone to near the Laboratory-imposed H&S action limit at the soil surface at sample location 48-2060.

In October 1993, six additional surface soil samples were collected to evaluate possible mercury migration from the SWMUs. One sample (48-2061) consisted of sediment that had accumulated from wind and/or runoff on a concrete pad associated with TA-48-1. The other five samples (48-2062 through 48-2066) were collected in areas downgradient of the site. All of these soil samples were submitted for mercury analysis.

### 2.2.3 Summary and Evaluation of Results

Annex 6.9 presents a summary of the RFI analytical sampling results reported above detection limits for all RFI samples collected at the site. The detected concentrations, screening action levels (SALs), and upper tolerance limits (UTLs) for background concentrations in soil are also presented for comparison. Based on preliminary review of the monitoring and sampling data, the results are summarized as follows:

- The highest concentration of mercury (62 ppm) in soil was observed near the east end of the south wall of TA-48-1 at a depth of 0.5 ft. (sample number 48-2006). Mercury was detected near the Laboratory SAL (24 ppm) in one sample collected from windblown and/or runoff sediments accumulated on a concrete pad. No mercury was detected in surface soil samples collected from areas downgradient of the SWMUs.

- SVOC concentrations were detected above Laboratory SALs with maximum values provided for benzo{a}anthrac-ene (23.2 ppm); benzo{a}pyrene (22.6 ppm); benzo{b} fluoanth-ene (25.8 ppm); benzo{k}fluoranth-ene (10.7 ppm); dibenzo{a,h}anthrac-ene (2.7 ppm); and ideno{1,2,3-(d)} pyrene (13.7 ppm).

- Thorium-228 was detected at levels slightly above the Laboratory SAL (1.5 pCi/g). The highest values for Thorium-228 (2.27 pCi/g and 2.03 pCi/g) were detected near the east end of the south wall of TA-48-1 at depths of 1 ft to 1.5 ft. Thorium concentrations are within Bandelier Tuff background range of 1.7 pCi/g to 4.0 pCi/g (Crowe, et al., 1978). The values obtained from other locations near the building are relatively consistent throughout the soils. Thorium-228 levels detected during Phase I characterization are well below the levels established to trigger remedial action under 40 CFR 192 (EPA 1994), and well below applicable values for unrestricted release found in DOE Order 5400.5, Radiation Protection of the Public and the Environment.

No identifiable compounds were detected in the VOC analysis. Based on these results, the following assumptions have been made:

- The mercury and SVOC contamination is likely limited to a rectangular area that extends from the east corner of building TA-48-1 for approximately 20 ft along the south wall of the building, and from the wall to approximately 11 ft out toward the asphalt, (Figure 2-2).

- Mercury and SVOC contamination in the soil was generally limited to a depth of approximately 1 foot. Some elemental mercury may have migrated downward between the soil/building interface.

- The reported thorium activity, while slightly above the SAL, is within the range of Laboratory background activity and will not require remediation.

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## 2.3 Types and Volumes of Wastes Present

The nature of the wastes expected to be generated by the proposed cleanup is presented in Table 2-1.

The surface and subsurface soil samples revealed elevated levels of elemental mercury and SVOCs and may be considered RCRA hazardous waste. As described in Section 3.3, contaminated soils within 1 foot of the surface will be excavated and placed directly into drums or bulk storage containers on site prior to transport and disposal by an approved waste facility. Treatment or stabilization of the soils by the waste facility may be necessary before its disposal. The specific nature of this stabilization will be determined by the disposal facility.

Verification sampling will be performed as described in Section 3.5. A small volume of solid and liquid wastes will be generated by this activity. Waste associated with this effort may include disposable sampling equipment, personal protective equipment, and decontamination water. These materials will be handled in accordance with the site-specific Waste Management Plan and treated as potentially hazardous waste pending characterization.

**TABLE 2-1**
**ANTICIPATED WASTE VOLUMES**

| Item | Type | Anticipated Volume |
|---|---|---|
| Sampling waste/PPE | solid - potential hazardous | 1 cu. ft. |
| Contaminated soils | solid- potential hazardous | 200 - 330 cu.ft. |
| Decontamination waste | liquid - potential hazardous | 150 gal. |

## 2.4 Potential Impacts on Public Health and the Environment

Receptors of possible contaminants include animals and humans. Potential exposure routes of receptors include the following:

- Inhalation (especially if the SWMUs are disturbed);
- Ingestion; and
- Skin contact with contaminated soils.

### 2.4.1 Potential Pathways

#### 2.4.1.1 SWMUs in Place

If the contaminated soil is left in place, several mechanisms are available to transport contaminants from their current location. These mechanisms include:

- gravity flow of liquid metallic mercury into, through, or over the soil surface;
- volatilization and transport of vapor phase mercury through air or geologic materials;
- physical agitation of contaminated soil;
- water transport of sorbed mercury on sediment particles or colloids; and
- air or wind transport of mercury attached to airborne particulates.

The following potential pathways are thought to be the most likely to exist for the migration of contaminants from SWMUs 48-002(a) and 48-002(b):

- The field observations from July 1993 (Stellavato 1993, 45355) show that elemental mercury "beads" still exist in the shallow soil. With physical agitation these "beads" may move either downward or laterally from wind, water, or human interaction. Of particular concern is the



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likelihood that mercury has migrated down the interface between the soil and the wall of building TA-48-1. This is inferred from the mercury vapor screening results which showed elevated concentrations of mercury at the soil immediately adjacent to the wall and on the wall.

- Some of the inorganic elemental mercury may attach itself to silt- or clay-sized particles, which can then be mobilized by precipitation and/or wind. While the downward pathway is likely to be very small because of capillary action and soil drying during dry periods, one surface sample (48-2061) indicates that lateral movement via water and/or wind is possible.

#### 2.4.1.2 SWMU Remediation

Potential pathways for contaminant migration during excavation of the soils are generally the same as those described above in Section 2.4.1.1. Some potential exists for sideward migration and airborne transport because of physical agitation of the soils during remediation. Appropriate dust suppression techniques will be followed to minimized this pathway. Little or no potential exists for aqueous transport during remediation because the excavated soils will be placed in 55-gallon drums and covered to prohibit contact with water. Further, the excavated area will be covered with plastic sheeting to prohibit water from entering the excavation.

### 2.4.2 Future Land Use

SWMUs 48-002(a) and 48-002(b) lie entirely on US Department of Energy (DOE)-owned land on Mesita del Buey. In the foreseeable future, the land is anticipated to be used exclusively for Laboratory (industrial) operations.

### 2.4.3 Cleanup Levels

Results from the previous investigations indicate mercury and carcinogenic PAH are contaminants of concern for this EC, and therefore, cleanup levels have been calculated for these compounds. For mercury, the soil cleanup level was set at a concentration that would result in an estimated noncarcinogenic hazard index of one or less for the occupational exposure scenario. The cleanup level for mercury has been calculated at 280 mg/kg (ppm). For carcinogenic PAH, the cleanup level has been calculated for an excess cancer risk due to occupational exposure of 1E-04 (one excess case of cancer in 10,000). This cleanup level is calculated at 80 mg/kg, based on the carcinogenic slope factor for benzo[a]pyrene (BaP). The equation and assumptions used for the calculation of cleanup levels is provided in Annex 6.10. In this case, LANL will adopt a conservative approach of summing all the carcinogenic PAH detected during verification sampling to compare to this level. It should be noted that typically, LANL will start with a cleanup level based on an excess cancer risk of 1E-06. However, this approach was not practical because the calculated cleanup level for BaP (0.75 mg/kg) is well below background at this level of risk (background UTL approximately 12 mg/kg, LANL 1995). However, the cleanup level presented is still within the EPA acceptable risk range of 1E-04 to 1E-06, and remains conservative given that exposure is highly unlikely due to the restricted access of this area. In addition, the maximum observed concentration of PAH (approximately 20 mg/kg) was observed in the first foot of soil, and it is anticipated that PAH contamination will be removed with the mercury-contaminated soil.

Attainment of these cleanup levels will be considered achieved when the upper 95% confidence level of the mean concentration of the constituent remaining in the excavated area, as demonstrated by verification sampling, is equal to or less than the established cleanup levels.

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## 3.0 EXPEDITED CLEANUP

### 3.1 Overview and Rationale

Phase I RFI sampling results indicate that mercury and SVOCs exceeding cleanup levels exist in the backfill material on the south side of building TA-48-1, and the soils may be classified as RCRA hazardous waste. Excavation of mercury- and SVOC-contaminated soils at the site will be conducted to prevent the contaminants from spreading beyond the current area. This action will minimize the potential risk to human health and the environment. Verification samples will be collected to confirm that the mercury and SVOCs have been removed in accordance with this plan.

### 3.2 Permitting, Approval, and Notification Requirements

An excavation permit will be prepared and submitted for approval before execution of this plan.

Documentation will be prepared in accordance with Laboratory Environmental Restoration (ER) Administrative Procedure (AP) LANL-ER-AP-05.1, Rev. 0, Readiness Review for Environmental Restoration Program Field Activities. Key documents to be prepared include a Site-Specific Health and Safety Plan (SSHASP) and a site-specific Waste Management Plan. Personnel training requirements will be specified and will require completion prior to implementation of this EC Plan. Site workers must have received all training for this project as specified in the SSHASP.

#### 3.2.1 DOE Approval

Implementation of this EC will proceed only after DOE approval is documented through receipt of the signed Field Work Approval Form (Annex 6.7).

#### 3.2.2 Regulatory Notification/Permit Modifications

SWMUs 48-002(a) and 48-002(b) are included in Table A of the Hazardous and Solid Waste Amendments (HSWA) permit. Implementation of this EC will require a Class III modification to the Laboratory's RCRA Permit. EPA and the New Mexico Environment Department will be notified of this project, and a request for a permit modification will be submitted.

#### 3.2.3 DOE Approval

The DOE Los Alamos Area Office (DOE/LAAO) will follow normal protocol to evaluate cost, schedule, and technical merit for each EC plan submitted. Implementation of this EC will proceed only after DOE approval is documented through receipt of the signed Field Work Approval Form (Annex 6.7).

### 3.3 Cleanup Activities

The remediation of mercury- and SVOC-contaminated soils at the site will be accomplished using standard industry techniques, and in compliance with standard ER Project standard operating procedures (SOPs).

Prior to excavation, a Health and Safety/field screening walkover will be performed in the proposed cleanup area using a Jerome Mercury Vapor Analyzer to determined areas of high mercury contamination. Any identified "hotspots" and visible contamination within the area to be excavated will be vacuumed using a specially equipped high-powered vacuum fitted with appropriate filtration. The vacuum filtration will include baffles to intercept large material including gravel, a paper pre-filter,

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a HEPA filter, and activated charcoal filter. Waste from the vacuum process will be placed in a 55-gallon drum, located adjacent to the cleanup site.

An initial 1-foot lift of soil will be removed in the proposed cleanup area using either shovels or a backhoe, as required by site conditions. After this lift of soil is removed, the excavated area will inspected for any visible surface contamination that will be removed by vacuum, as outlined above. Confirmatory cleanup samples will be collected on the nodes of a 3 ft. by 3 ft. grid within the excavated area; these samples will be submitted for on-site field laboratory analysis. A mobile Chem van using XRF and gas chromatography will analyze for mercury and SVOC analysis, respectively. The area for subsequent excavation will be determined based on the comparison of the results of the verification sampling to the cleanup criteria.

If necessary, additional excavation in areas that do not meet the cleanup criteria will be performed in 1-foot lifts until field laboratory analytical results indicate that mercury and SVOC concentrations in the soil at the site are below cleanup levels. Excavation equipment will be decontaminated between lifts. This phased cleanup process will continue until the entire site meets the cleanup criteria.

All vacuumed and excavated materials will be managed in 55-gallon drums. Material collected using the vacuum will be segregated from the excavated soil. The soil will be placed in 55-gallon drums to be located at the western boundary of the remediation site. Waste materials will be analyzed for mercury and SVOCs for waste characterization to verify the waste acceptance criteria (WAC) as required by the disposal facility, in accordance with appropriate waste handling and QA/QC procedures.

### 3.4 Waste Management Issues

The laboratory results from Phase I RFI sampling indicate that the contaminated soils may be classified as RCRA hazardous waste. Based on the projected extent of contamination, the maximum total volume of soil to be excavated and removed is estimated to be between 200 and 300 cu. ft.

Other wastes will include personal protective equipment (PPE), sampling wastes, and waste water from equipment decontamination. The volume of PPE is expected to be about one 55-gallon drum. Sampling wastes are expected to be no more than 2 cu. ft., and the decontamination water is expected to have a volume of about 150 gal. These volume estimates are based on past experience with Phase I RFI investigations.

#### 3.4.1 Characterization of Materials for Disposal

Field laboratory analytical results from the confirmatory cleanup samples collected after each lift will be used to determine the gross contamination in the waste soils. After cleanup activities are completed, samples from a representative percentage of the waste containers will be collected and sent to a laboratory and analyzed in accordance with the disposer's WAC and 40 CFR 261 requirements. Waste water generated during equipment decontamination will be sampled and analyzed for mercury and SVOCs.

#### 3.4.2 Treatment, Storage, and Disposal Plans for Waste

The majority of the waste materials generated in this EC will be in the form of mercury and/or SVOC-contaminated soils. These soils, sampling wastes, and PPE wastes will be transported to a permitted treatment, storage, and disposal (TSD) facility for final disposal. Several TSD facilities have Laboratory contracts to treat mercury-contaminated wastes. Laboratory disposal facilities that might be used during this EC include TA-54, Area L for the disposal of nonhazardous and hazardous wastes. Depending on the concentrations of COCs found in the decontamination water, the liquid waste may be sent to the TA-50, Liquid Waste Treatment Plant or to a permitted TSD facility for

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disposal. The waste packaging, labeling, and documentation will comply with the appropriate Administrative Procedure and applicable SOPs.

### 3.5 Verification Plan

Verification samples will be taken to verify that contamination has been removed to the levels specified in Section 2.4.3 A combination of field laboratory analytical techniques and off-site, fixed laboratory analysis will be used to verify results.

The number of samples collected to determine whether a verification unit (in this case the 20 ft. by 11 ft. area of contamination) has achieved the cleanup standard due to excavation is dictated by the sampling frequency needed to achieve statistically defensible data. *Methods for Evaluating the Attainment of Cleanup Standards, Volume 1, Solid Media (EPA 1988)* provides the formulae for calculating the number of random samples needed to determine if the mean concentration remaining in the area after excavation is less than the cleanup goal at a specified level of confidence. The required number of samples is computed using the equation provided in Annex 6.11.

Application of this approach with assumptions as outlined in Annex 6.11 results in a verification sample size of 2 soil samples for laboratory analysis (Table 3-1). The verification sampling approach will include the evaluation of screening data after each cleanup excavation lift is accomplished. If screening data indicate that contaminant concentrations are 50% or less of the cleanup standard with a standard deviation of 25% of the $C_s$, then 2 verification laboratory samples will be obtained. Given the small size of this SWMU, if screening data do not achieve these results, additional soil will be removed until the screening requirements are met. An approach for larger remediated sites would consider the benefit from additional sampling to verify cleanup (i.e., the larger number of samples, the closer the UCL is to the mean) versus the cost of removing additional soil (i.e., reduce the average contaminant concentration).

Results from the laboratory verification samples will be used to calculate the 95% UCL to compare to the cleanup level established for each contaminant. The site cleanup objectives will be obtained when the calculated UCL is less than the established cleanup levels. (USEPA, 1989)

### 3.6 Site Restoration Plan

When sample results confirm that the site has been remediated in accordance with this plan, the excavated area will be returned to the original grade and revegetated if necessary. Backfill material will consist of uncontaminated soil excavated from the site and clean backfill obtained from the Laboratory maintenance contractor.

### 3.7 Acceptance Inspection

The Laboratory proposed an Acceptance Inspection as the mechanism for DOE and EPA to assess the implementation and effectiveness of the EC. A minimum of 14 days' notification will be provided to the agencies before the start of field activities. At this time, a tentative date for the inspection will be agreed upon.

An inspection checklist will be used to document the scope of the inspection and will become part of the EC Final Report. The checklist and the timing of the inspection will be developed by the Laboratory and agreed to by the other agencies. This inspection checklist will contain specific items, criteria, and requirements to be inspected that will constitute acceptance of remediation activities.

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## Table 3-1
## SUMMARY OF VERIFICATION SAMPLES AND ANALYSES FOR SWMUs 48-002(a) and 48-002(b)

| Description | Samples | | | | | | Field Screening | | | | Laboratory Analyses | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Structure | | Surface | | Subsurface | | | | | | | | | | | |
| | Primary | duplicate | primary | duplicate | primary | duplicate | Beta-gamma | Alpha | Organic Vapor | Radiological Smear and Swipe Techniques | Total Uranium | Isotopic plutonium | Metals (SW 6010/7000)* | Mercury | VOCs (SW 8260)* | SVOCs (SW8270)* |
| Soil Samples | | | 2 | 1 | | | x | x | x | | | | | x | | x |
| Equipment Rinsate | 1 | | | | | | x | x | x | | | | | x | | x |

x: All samples
Note: Additional samples may be taken based on field surveys and observations.
*: Applicable EPA SW 846 methods.

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The Acceptance Inspection will be conducted by an independent professional skilled in the appropriate technical discipline. During the Acceptance Inspection, written resolution and an anticipated schedule for completion will be identified for any outstanding items, and documented on the inspection checklist. The Laboratory Field Project Leader (FPL or designee) will be responsible for completing outstanding inspection items and documenting their resolution in the EC Final Report.

Upon completion of remediation activities, the Laboratory will submit a written certification to EPA Region VI, stating that the remedy has been completed in accordance with the EC Plan and Acceptance Inspection Checklist. The certification will be signed by the permitee and by the independent professional conducting the inspection. The certification will accompany the EC Final Report.

### 3.8 Final Report

After field activities are completed and all analytical results from the verification samples obtained a final report on the EC will be prepared. This report will outline the EC process and the "as-left" conditions of the site. A proposed outline for this report is presented as Annex 6.8.



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## 4.0 PROJECT MANAGEMENT

Overall implementation of this expedited cleanup will be managed by Allyn Pratt, the Field Project Leader (FPL). Leslie Sontag will serve as Field Team Leader (FTL) for the EC activities.

### 4.1 Staff and Resource Requirements

Total anticipated costs for the EC is $76,700 as detailed below.

| | |
|---|---|
| **Pre-Field Activities** | |
| Preparation of Waste Management Plan | $1,000 |
| Preparation of Site Health and Safety Plan | 2,500 |
| Field Work Preparation | 2,500 |
| Subtotal | $6,000 |
| **Field Activities** | |
| Geodetic/"mark out" surveys | $3,500 |
| Mercury vacuum/Jerome meter | 2,000 |
| Subcontractor (excavation) | 2,500 |
| Subcontractor (transportation and disposal of waste) | 14,400 |
| Site restoration | 600 |
| Subtotal | $23,000 |
| **Personnel Costs** | |
| Field Team (FTL, SSO, 2 technicians) : $6,600/week x 2 | $13,200 |
| Backhoe Operator : $30/hr x 10 days | 2,500 |
| Subtotal | $15,700 |
| **Analytical Costs** | |
| Rad van (assume shared cost): $1,000/day x 10 days | $10,000 |
| Chem van (assume shared cost): $1,000/day x 10 days | 10,000 |
| Verification sampling: 4 samples x $750 | 3,000 |
| Waste disposal characterization: 3 samples x $1,000 | 3,000 |
| Subtotal | $26,000 |
| **Post-Field Activities** | |
| Acceptance Inspection (including preparation of checklist) | $4,000 |
| Final report | 2,000 |
| Subtotal | $6,000 |
| **TOTAL ESTIMATED COST** | **$76,700** |

### 4.2 Schedule

The proposed EC schedule is shown in Table 4-1. The submittal of this EC Plan to EPA in April 1995 will initiate the 60-day public review/comment period. No sooner than 15 days after the start of this period, a public meeting will be held. Preparation for field work will be conducted concurrent to the public review period. Field work will be initiated within 10 days of agency and public approval or receipt of EPA temporary authorization to proceed. The final report will be submitted to EPA within 14 days of receipt of verification sample results.

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## 4.3 Stakeholder Notifications

Stakeholder notifications are an integral part of the procedure for conducting ECs. ER Project personnel will notify state and local governments, external and internal stakeholders, and individuals on the ER Project mailing list of the availability of the EC plan. The EC plan will be available to the stakeholders at the Laboratory Community Reading Room in Los Alamos; the document repositories at the public libraries in Los Alamos, Española, and Santa Fe; and the San Ildefonso Pueblo Governor's office.

The submission to EPA of this EC plan will trigger publication of a public notice starting a 60-day public comment period.



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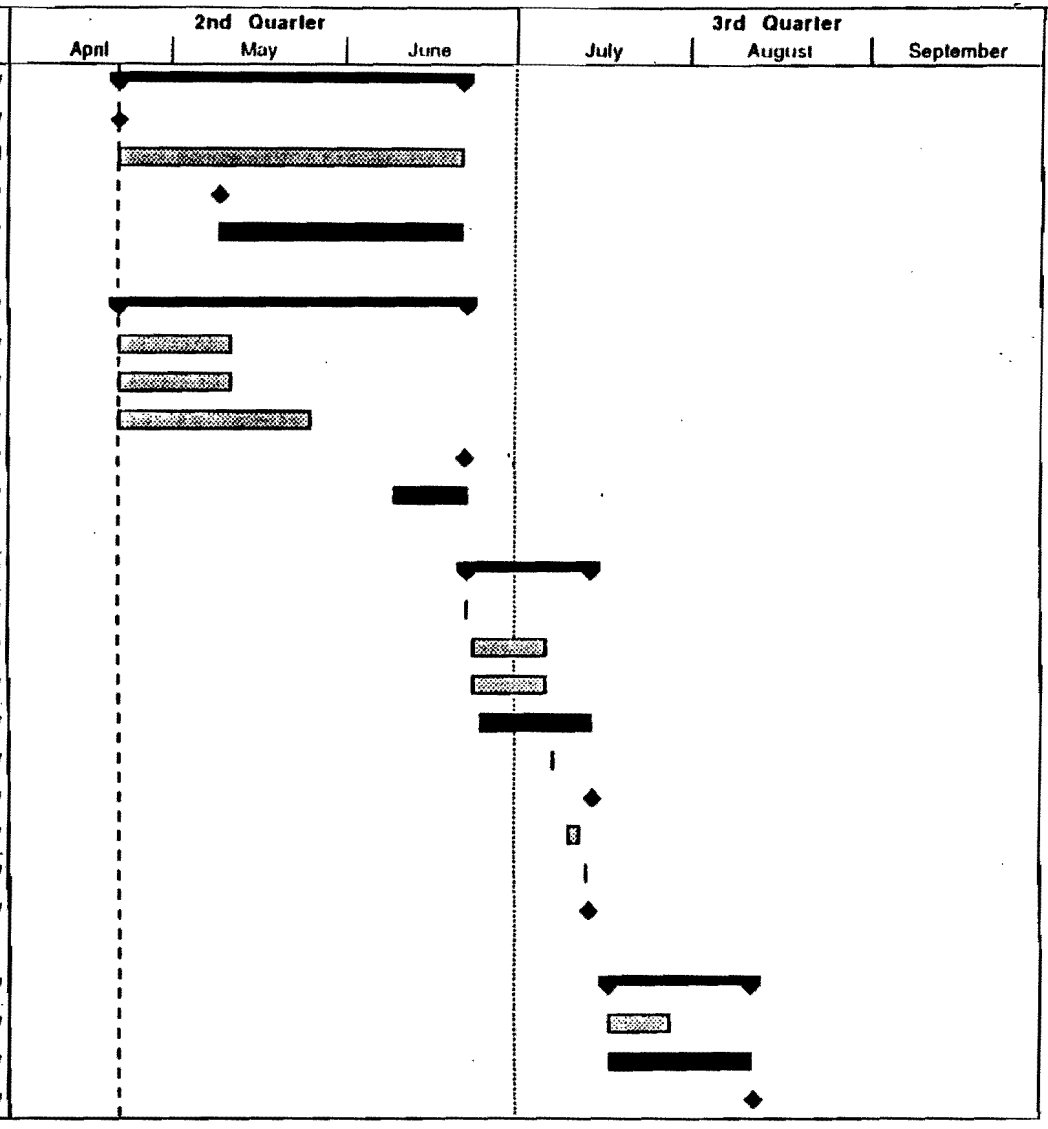
TABLE 4-1 PROPOSED SCHEDULE - SWMUs 48-002(a and b)

| ID | Name | Duration |
|---|---|---|
| 1 | 1.0 PUBLIC ACCEPTANCE | 8.77ew |
| 2 | 1.1 SUBMIT EC PLAN TO EPA | 0w |
| 3 | 1.2 PUBLIC COMMENTS | 44d |
| 4 | 1.3 PUBLIC MEETING | 0ew |
| 5 | 1.4 RESPOND TO PUBLIC COMMENT | 6.4w |
| 6 | | |
| 7 | 2.0 PLANNING | 8.91ew |
| 8 | 2.1 PREPARE/REVISE HEALTH AND SAFETY PLAN | 3w |
| 9 | 2.2 PREPARE/REVISE WASTE MANAGEMENT PLAN | 3w |
| 10 | 2.3 FIELD WORK PLANNING | 5w |
| 11 | 2.4 FIELD WORK APPROVAL FORM SIGNED | 0w |
| 12 | 2.5 14-DAY NOTIFICATION OF FIELD WORK | 2w |
| 13 | | |
| 14 | 3.0 IMPLEMENT EXPEDITED CLEANUP | 3.2ew |
| 15 | 3.1 MOBILIZATION | 0.2w |
| 16 | 3.2 PERFORM CLEANUP | 2w |
| 17 | 3.3 VERIFICATION SAMPLING | 2w |
| 18 | 3.4 VERFICATION ANALYSIS | 3w |
| 19 | 3.5 ACCEPTANCE INSPECTION | 0.2w |
| 20 | 3.6 ANALYSIS COMPLETE | 0w |
| 21 | 3.7 SITE RESTORATION | 0.6w |
| 22 | 3.8 DEMOBILIZATION | 0.2w |
| 23 | 3.9 COMPLETE EC | 0w |
| 24 | | |
| 25 | 4.0 REPORT PREPARATION | 3.63ew |
| 26 | 4.1 VALIDATE SAMPLE DATA | 2w |
| 27 | 4.2 PREPARE FINAL REPORT | 4w |
| 28 | 4.3 SUBMIT REPORT | 0w |




Project: EXPEDITED CLEANUP
Date: 4/21/95

Critical
Noncritical
Progress
Milestone
Summary

Los Alamos National Laboratory

## 5.0 REFERENCES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## 6.0 ANNEXES

### 6.1 Implementation SOPs

See Environmental Restoration Standard Operating Procedures, Volumes I and II, November 17, 1993, Los Alamos National Laboratory.

### 6.2 Quality Assurance Plan

See Quality Program Plan And Quality Assurance Project Plan For Environmental Restoration, February 1995 revision, Los Alamos National Laboratory, Los Alamos, New Mexico.

### 6.3 Site-Specific Health and Safety Plan

See Los Alamos National Laboratory (LANL) ER Project Health and Safety Plan (HASP) (LANL, February 11, 1995).

### 6.4 Records Management Plan

See Installation Work Plan for Environmental Restoration, Revision 4, Chapter IV, Records Management Program Plan.

### 6.5 Public Involvement Plan

See Installation Work Plan for Environmental Restoration, Revision 4, Chapter V, Public Involvement Program Plan.

### 6.6 Waste Management Plan

### 6.7 Field Work Approval Form

### 6.8 Proposed Outline for Expedited Cleanup Final Report

### 6.9 RFI Analytical Results

### 6.10 Risk-Based Cleanup Level Calculations

### 6.11 Verification Plan Calculations



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ANNEX 6.7

FIELD WORK APPROVAL FORM

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**ATTACHMENT 3**
**FIELD WORK APPROVAL FORM**

This form must be completed prior to starting remediation field work in accordance with Voluntary Corrective Action Plans.

I, _____, DOE-LAAO, **Approve** the field work as proposed in the accompanying Voluntary Corrective Action Plan for Potential Release Site _____, TA-___.

I, _____, DOE-LAAO, DO NOT APPROVE the field work as proposed in the accompanying voluntary correction plan for Potential Release Site _____, TA-___.

The following reasons reflect the decision for disapproval:

Signed:_____ Date:_____

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ANNEX 6.8

PROPOSED OUTLINE FOR EXPEDITED CLEANUP REPORT

1.0 SUMMARY OF EXPEDITED CLEANUP

- 1.1 Overview
- 1.2 Expedited Cleanup

2.0 DISCUSSION OF SAMPLING AND ANALYSIS

- 2.1 Verification Sampling and Analysis
  - 2.1.1 Sampling Objectives
  - 2.1.2 QA/QC
  - 2.1.3 Sampling Activities
- 2.2 Site Restoration

3.0 MODIFICATIONS TO THE EC PLAN

4.0 QUANTITIES AND TYPES OF WASTES GENERATED

5.0 OUTSTANDING ITEMS FROM THE ACCEPTANCE INSPECTION

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A ANALYTICAL DATA
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C WASTE STREAM INVENTORY
D PHOTOGRAPHS
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ANNEX 6.9

RFI ANALYTICAL RESULTS

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48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| 48-2006 | 0.0 - 0.5 ft | AAA3753 | Aluminium | 12000 | MG/KG | n/a | 123000 |
| | | | Arsenic | 2.5 | MG/KG | n/a | 11.6 |
| | | | Barium | 120 | MG/KG | 5600 | 1143 |
| | | | Beryllium | 0.81 | MG/KG | n/a | 3.31 |
| | | | Calcium | 2000 | MG/KG | n/a | 54362 |
| | | | Chromium | 8 | MG/KG | n/a | 34.2 |
| | | | Cobalt | 4 | MG/KG | n/a | 51.1 |
| | | | Copper | 4.2 | MG/KG | 3000 | 15.7 |
| | | | Iron | 11000 | MG/KG | n/a | 35586 |
| | | | Lead | 10 | MG/KG | 400 | 39 |
| | | | Lithium | 14 | MG/KG | n/a | n/a |
| | | | Magnesium | 1900 | MG/KG | n/a | 16147 |
| | | | Manganese | 330 | MG/KG | 11000 | 1030 |
| | | | Mercury | 25 | MG/KG | 24 | 0.1 |
| | | | Mercury | 28.8 | MG/KG | 24 | 0.1 |
| | | | Mercury | 36 | MG/KG | 24 | 0.1 |
| | | | Mercury | 40 | MG/KG | 24 | 0.1 |
| | | | Mercury | 41 | MG/KG | 24 | 0.1 |
| | | | Nickel | 7 | MG/KG | 1600 | 26.7 |
| | | | Potassium | 1400 | MG/KG | n/a | 6179 |
| | | | Sodium | 110 | MG/KG | n/a | 1884 |
| | | | Strontium | 20 | MG/KG | 48000 | n/a |
| | | | Vanadium | 16 | MG/KG | 560 | 66 |
| | | | Zinc | 58 | MG/KG | 24000 | 101 |
| 48-2006 | 0.0 - 0.5 ft | AAA4494 | Acenaphthene | 1.1 | MG/KG | 4800 | 3.4 |
| | | | Aluminium | 11000 | MG/KG | n/a | 123000 |
| | | | Anthracene | 2.3 | MG/KG | 24000 | 4.29 * |
| | | | Arsenic | 2.6 | MG/KG | n/a | 11.6 |
| | | | Barium | 100 | MG/KG | 5600 | 1143 |
| | | | Benzo[a]anthracene | 12.5 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 12 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 13.8 | MG/KG | 1 | 12.2 * |
| | | | Benzo[g,h,i]perylene | 4.2 | MG/KG | n/a | 5.9 * |
| | | | Benzo[k]fluoranthene | 3.2 | MG/KG | 1 | 19.4 * |
| | | | Beryllium | 0.72 | MG/KG | n/a | 3.31 |
| | | | Calcium | 1800 | MG/KG | n/a | 54362 |
| | | | Chromium | 7 | MG/KG | n/a | 34.2 |
| | | | Chrysene | 13.6 | MG/KG | 96 | 19.5 |
| | | | Cobalt | 3.4 | MG/KG | n/a | 51.1 |
| | | | Copper | 3.5 | MG/KG | 3000 | 15.7 |
| | | | Dibenzo[a,h]anthracene | 1.6 | MG/KG | 0.1 | 2.9 * |
| | | | Fluoranthene | 20.5 | MG/KG | 3200 | 32.5 * |
| | | | Fluorene | 0.72 | MG/KG | 3200 | 3.3 * |
| | | | Indeno[1,2,3-cd]pyrene | 5.5 | MG/KG | 1 | 6 * |
| | | | Iron | 11000 | MG/KG | n/a | 35586 |
| | | | Lead | 9 | MG/KG | 400 | 39 |
| | | | Lithium | 13 | MG/KG | n/a | n/a |
| | | | Magnesium | 1700 | MG/KG | n/a | 16147 |
| | | | Manganese | 270 | MG/KG | 11000 | 1030 |
| | | | Mercury | 35 | MG/KG | 24 | 0.1 |
| | | | Mercury | 38.1 | MG/KG | 24 | 0.1 |
| | | | Mercury | 47 | MG/KG | 24 | 0.1 |

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48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Mercury | 62 | MG/KG | 24 | 0.1 |
| | | | Nickel | 7 | MG/KG | 1600 | 26.7 |
| | | | Phenanthrene | 13.2 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.0399 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.0308 | PCI/G | 18 | 0.052 |
| | | | Potassium | 1300 | MG/KG | n/a | 6179 |
| | | | Pyrene | 22.6 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Americium-241 | 0.23 | PCI/G | 17 | n/a |
| | | | Radvan Cesium-137 | 3.63 | PCI/G | 4 | 1.4 |
| | | | Radvan Cobalt-60 | 0.11 | PCI/G | 0.9 | n/a |
| | | | Radvan Ruthenium-106 | 0.77 | PCI/G | 14 | n/a |
| | | | Sodium | 87 | MG/KG | n/a | 1884 |
| | | | Strontium | 17 | MG/KG | 48000 | n/a |
| | | | Thorium-228 | 1.19 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 3.88 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 0.97 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 1.13 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.329 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.776 | PCI/G | 59 | 1.9 |
| | | | Vanadium | 15 | MG/KG | 560 | 66 |
| | | | Zinc | 50 | MG/KG | 24000 | 101 |
| 48-2006 | 0.5 - 1.5 ft | AAA4493 | Benzo[a]anthracene | 0.65 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 0.77 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 0.99 | MG/KG | 1 | 12.2 * |
| | | | Carbon disulfide | 0.006 | MG/KG | 7.4 | n/a |
| | | | Chrysene | 0.81 | MG/KG | 96 | 19.5 * |
| | | | Fluoranthene | 1.3 | MG/KG | 3200 | 32.5 * |
| | | | Phenanthrene | 0.82 | MG/KG | n/a | 24.2 * |
| | | | Pyrene | 1.5 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Americium-241 | 0.06 | PCI/G | 17 | n/a |
| | | | Radvan Ruthenium-106 | 0.48 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 2.27 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.04 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 1.02 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.552 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.0029 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.701 | PCI/G | 59 | 1.9 |
| 48-2006 | 1.5 - 3.0 ft | AAA4495 | Acenaphthene | 0.63 | MG/KG | 4800 | 3.4 * |
| | | | Anthracene | 1.1 | MG/KG | 24000 | 4.29 * |
| | | | Benzo[a]anthracene | 5.6 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 6.2 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 6.6 | MG/KG | 1 | 12.2 * |
| | | | Benzo[g,h,i]perylene | 2.2 | MG/KG | 5.9 * | 5.9 * |
| | | | Benzo[k]fluoranthene | 2.9 | MG/KG | 1 | 19.4 * |
| | | | Chrysene | 6 | MG/KG | 96 | 19.5 * |
| | | | Dibenzo[a,h]anthracene | 0.72 | MG/KG | 0.1 | 2.9 * |
| | | | Fluoranthene | 11.4 | MG/KG | 3200 | 32.5 * |
| | | | Fluorene | 0.41 | MG/KG | 3200 | 3.3 * |
| | | | Indeno[1,2,3-cd]pyrene | 2.9 | MG/KG | 1 | 6 * |
| | | | Phenanthrene | 8 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.0095 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.0247 | PCI/G | 18 | 0.052 |

48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Pyrene | 11.7 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Ruthenium-106 | 0.14 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 1.28 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 4.19 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 1.38 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 1.1 | PCI/G | 86 | 2.03 |
| | | | Uranium-238 | 0.892 | PCI/G | 59 | 1.9 |
| 48-2006 | 3.0 - 4.0 ft | AAA3769 | Fluoranthene | 0.44 | MG/KG | 3200 | 32.5 * |
| | | | Plutonium-238 | 0.115 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.0775 | PCI/G | 18 | 0.052 |
| | | | Pyrene | 0.39 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Americium-241 | 0.28 | PCI/G | 17 | n/a |
| | | | Radvan Ruthenium-106 | 4.83 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 1.45 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.05 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 0.487 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.73 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.181 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.807 | PCI/G | 59 | 1.9 |
| 48-2006 | 4.0 - 5.0 ft | AAA3770 | Benzo[a]anthracene | 0.49 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 0.51 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 0.54 | MG/KG | 1 | 12.2 * |
| | | | Chrysene | 0.5 | MG/KG | 96 | 19.5 * |
| | | | Fluoranthene | 1.2 | MG/KG | 3200 | 32.5 * |
| | | | Phenanthrene | 1.1 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-239 | 0.121 | PCI/G | 18 | 0.052 |
| | | | Pyrene | 1.1 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Americium-241 | 0.6 | PCI/G | 17 | n/a |
| | | | Radvan Ruthenium-106 | 1.35 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 1.12 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 3.89 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 1.1 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.453 | PCI/G | 86 | 2.03 |
| | | | Uranium-238 | 0.829 | PCI/G | 59 | 1.9 |
| 48-2006 | 5.0 - 6.0 ft | AAA3771 | Benzo[a]anthracene | 0.47 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 0.6 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 0.68 | MG/KG | 1 | 12.2 * |
| | | | Chrysene | 0.51 | MG/KG | 96 | 19.5 * |
| | | | Fluoranthene | 1.5 | MG/KG | 3200 | 32.5 * |
| | | | Phenanthrene | 1.3 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.0009 | PCI/G | 20 | 0.014 |
| | | | Pyrene | 1.3 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Americium-241 | 0.25 | PCI/G | 17 | n/a |
| | | | Thorium-228 | 0.911 | PCI/G | 1.5 | n/a |
| | | | Thorium-228 | 1.44 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.49 | PCI/G | 5 | n/a |
| | | | Thorium-230 | 2.64 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 0.629 | PCI/G | 5 | 2.68 |
| | | | Thorium-232 | 0.896 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.837 | PCI/G | 86 | 2.03 |
| | | | Uranium-234 | 1.14 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.184 | PCI/G | 18 | 0.088 |

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48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Uranium-235 | 0.189 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.792 | PCI/G | 59 | 1.9 |
| | | | Uranium-238 | 1.01 | PCI/G | 59 | 1.9 |
| 48-2006 | 6.0 - 7.0 ft | AAA3772 | Fluoranthene | 0.81 | MG/KG | 3200 | 32.5 * |
| | | | Phenanthrene | 0.65 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.0727 | PCI/G | 20 | 0.014 |
| | | | Pyrene | 0.65 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Americium-241 | 0.45 | PCI/G | 17 | n/a |
| | | | Radvan Cesium-137 | 3.64 | PCI/G | 4 | n/a |
| | | | Radvan Ruthenium-106 | 0.43 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 1.35 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 2.12 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 1.19 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.645 | PCI/G | 86 | 2.03 |
| | | | Uranium-238 | 0.595 | PCI/G | 59 | 1.9 |
| 48-2006 | 7.0 - 8.0 ft | AAA3773 | Aluminium | 3200 | MG/KG | n/a | 123000 |
| | | | Arsenic | 1.8 | MG/KG | n/a | 11.6 |
| | | | Barium | 34 | MG/KG | 5600 | 1143 |
| | | | Beryllium | 0.46 | MG/KG | n/a | 3.31 |
| | | | Calcium | 1100 | MG/KG | n/a | 54362 |
| | | | Chromium | 3.8 | MG/KG | n/a | 34.2 |
| | | | Cobalt | 1.4 | MG/KG | n/a | 51.1 |
| | | | Copper | 0.82 | MG/KG | 3000 | 15.7 |
| | | | Fluoranthene | 0.78 | MG/KG | 3200 | 32.5 * |
| | | | Iron | 7400 | MG/KG | n/a | 35586 |
| | | | Lead | 4.6 | MG/KG | 400 | 39 |
| | | | Lithium | 5.7 | MG/KG | n/a | n/a |
| | | | Magnesium | 740 | MG/KG | n/a | 16147 |
| | | | Manganese | 240 | MG/KG | 11000 | 1030 |
| | | | Mercury | 1.2 | MG/KG | 24 | 0.1 |
| | | | Mercury | 2 | MG/KG | 24 | 0.1 |
| | | | Mercury | 2.7 | MG/KG | 24 | 0.1 |
| | | | Phenanthrene | 0.7 | MG/KG | n/a | 24.2 * |
| | | | Potassium | 440 | MG/KG | n/a | 6179 |
| | | | Pyrene | 0.72 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Cobalt-60 | 0.12 | PCI/G | 0.9 | n/a |
| | | | Radvan Ruthenium-106 | 1.21 | PCI/G | 14 | n/a |
| | | | Sodium | 73 | MG/KG | n/a | 1884 |
| | | | Strontium | 7.8 | MG/KG | 48000 | n/a |
| | | | Thorium-228 | 1.47 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.22 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 0.455 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 1.02 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.0196 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.811 | PCI/G | 59 | 1.9 |
| | | | Vanadium | 7 | MG/KG | 560 | 66 |
| | | | Zinc | 33 | MG/KG | 24000 | 101 |
| 48-2007 | 0.0 - 0.5 ft | AAA3755 | Radvan Americium-241 | 0.16 | PCI/G | 17 | n/a |
| | | | Radvan Ruthenium-106 | 0.24 | PCI/G | 14 | n/a |
| 48-2007 | 0.0 - 0.5 ft | AAA4496 | Acenaphthene | 2.6 | MG/KG | 4800 | 3.4 * |
| | | | Aluminium | 6400 | MG/KG | n/a | 123000 |
| | | | Americium-241 | 0.035 | PCI/G | 17 | n/a |



OFFICIAL USE ONLY

48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Anthracene | 5.1 | MG/KG | 24000 | 4.29 * |
| | | | Arsenic | 2.2 | MG/KG | n/a | 11.6 |
| | | | Barium | 76 | MG/KG | 5600 | 1143 |
| | | | Benzo[a]anthracene | 23.3 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 22.6 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 25.8 | MG/KG | 1 | 12.2 * |
| | | | Benzo[g,h,i]perylene | 13.3 | MG/KG | n/a | 5.9 * |
| | | | Benzo[k]fluoranthene | 10.7 | MG/KG | 1 | 19.4 * |
| | | | Beryllium | 0.66 | MG/KG | n/a | 3.31 |
| | | | Calcium | 1700 | MG/KG | n/a | 54362 |
| | | | Carbon disulfide | 0.0058 | MG/KG | 7.4 | n/a |
| | | | Chromium | 13 | MG/KG | n/a | 34.2 |
| | | | Chrysene | 26 | MG/KG | 96 | 19.5 * |
| | | | Cobalt | 3 | MG/KG | n/a | 51.1 |
| | | | Copper | 4.1 | MG/KG | 3000 | 15.7 |
| | | | Dibenzofuran | 0.94 | MG/KG | n/a | n/a |
| | | | Dibenzo[a,h]anthracene | 2.7 | MG/KG | 0.1 | 2.9 * |
| | | | Fluoranthene | 0.36 | MG/KG | 3200 | 32.5 * |
| | | | Fluorene | 2.1 | MG/KG | 3200 | 3.3 * |
| | | | Indeno[1,2,3-cd]pyrene | 13.7 | MG/KG | 1 | 6 * |
| | | | Iron | 8000 | MG/KG | n/a | 35586 |
| | | | Lead | 25 | MG/KG | 400 | 39 |
| | | | Lithium | 7.1 | MG/KG | n/a | n/a |
| | | | Magnesium | 1300 | MG/KG | n/a | 16147 |
| | | | Manganese | 250 | MG/KG | 11000 | 1030 |
| | | | Naphthalene | 0.61 | MG/KG | 3200 | 0.66 * |
| | | | Nickel | 10 | MG/KG | 1600 | 26.7 |
| | | | Phenanthrene | 26.2 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.051 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.718 | PCI/G | 18 | 0.052 |
| | | | Potassium | 860 | MG/KG | n/a | 6179 |
| | | | Pyrene | 44.4 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Americium-241 | 0.16 | PCI/G | 17 | n/a |
| | | | Radvan Ruthenium-106 | 0.24 | PCI/G | 14 | n/a |
| | | | Sodium | 64 | MG/KG | n/a | 1884 |
| | | | Strontium | 15 | MG/KG | 48000 | n/a |
| | | | Thorium-228 | 1.718 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.477 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 2.082 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.801 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.024 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.823 | PCI/G | 59 | 1.9 |
| | | | Vanadium | 11 | MG/KG | 560 | 66 |
| | | | Zinc | 40 | MG/KG | 24000 | 101 |
| 48-2007 | 0.5 - 1.0 ft | AAA4497 | Americium-241 | 0 | PCI/G | 17 | n/a |
| | | | Benzo[a]anthracene | 12.3 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 12.9 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 15.9 | MG/KG | 1 | 12.2 * |
| | | | Benzo[g,h,i]perylene | 5.2 | MG/KG | n/a | 5.9 * |
| | | | Benzo[k]fluoranthene | 4.3 | MG/KG | 1 | 19.4 * |
| | | | Cerium-144 | 0.514 | PCI/G | 64 | n/a |
| | | | Cesium-137 | 0.06 | PCI/G | 4 | 1.4 |

OFFICIAL USE ONLY

48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Chrysene | 15.6 | MG/KG | 96 | 19.5 * |
| | | | Cobalt-60 | 0.003 | PCI/G | 0.9 | n/a |
| | | | Fluoranthene | 22.1 | MG/KG | 3200 | 32.5 * |
| | | | Indeno[1,2,3-cd]pyrene | 6 | MG/KG | 1 | 6 * |
| | | | Phenanthrene | 12.4 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.006 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.043 | PCI/G | 18 | 0.052 |
| | | | Pyrene | 23.4 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Americium-241 | 0.31 | PCI/G | 17 | n/a |
| | | | Radvan Cobalt-60 | 0.77 | PCI/G | 0.9 | n/a |
| | | | Radvan Ruthenium-106 | 1.88 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 2.027 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.744 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 2.526 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 1.049 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.032 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.946 | PCI/G | 59 | 1.9 |
| 48-2008 | 0.0 - 0.5 ft | AAA4499 | Acenaphthene | 0.41 | MG/KG | 4800 | 3.4 * |
| | | | Americium-241 | 0.124 | PCI/G | 17 | n/a |
| | | | Anthracene | 0.84 | MG/KG | 24000 | 4.29 * |
| | | | Benzo[a]anthracene | 4.3 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 5.1 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 5.4 | MG/KG | 1 | 12.2 * |
| | | | Benzo[g,h,i]perylene | 2.1 | MG/KG | n/a | 5.9 * |
| | | | Benzo[k]fluoranthene | 2 | MG/KG | 1 | 19.4 * |
| | | | Cerium-144 | 0.346 | PCI/G | 64 | n/a |
| | | | Cesium-137 | 0.151 | PCI/G | 4 | 1.4 |
| | | | Chrysene | 4.6 | MG/KG | 96 | 19.5 * |
| | | | Dibenzo[a,h]anthracene | 0.63 | MG/KG | 0.1 | 2.9 * |
| | | | Fluoranthene | 7.4 | MG/KG | 3200 | 32.5 * |
| | | | Indeno[1,2,3-cd]pyrene | 2.4 | MG/KG | 1 | 6 * |
| | | | Phenanthrene | 4.2 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.009 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.231 | PCI/G | 18 | 0.052 |
| | | | Pyrene | 7.1 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Cesium-137 | 0.72 | PCI/G | 4 | n/a |
| | | | Radvan Cobalt-60 | 0.12 | PCI/G | 0.9 | n/a |
| | | | Radvan Ruthenium-106 | 2.27 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 1.54 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.214 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 1.796 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.729 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.037 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.726 | PCI/G | 59 | 1.9 |
| 48-2008 | 0.5 - 1.5 ft | AAA4500 | Americium-241 | 0.105 | PCI/G | 17 | n/a |
| | | | Anthracene | 0.39 | MG/KG | 24000 | 4.29 * |
| | | | Benzo[a]anthracene | 1.3 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 1.5 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 1.6 | MG/KG | 1 | 12.2 * |
| | | | Benzo[g,h,i]perylene | 0.82 | MG/KG | n/a | 5.9 * |
| | | | Benzo[k]fluoranthene | 0.8 | MG/KG | 1 | 19.4 * |
| | | | Chrysene | 1.6 | MG/KG | 96 | 19.5 |

48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Fluoranthene | 2.7 | MG/KG | 3200 | 32.5 * |
| | | | Indeno[1,2,3-cd]pyrene | 0.88 | MG/KG | 1 | 6 * |
| | | | Phenanthrene | 1.7 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.055 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.826 | PCI/G | 18 | 0.052 |
| | | | Pyrene | 2.7 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Cobalt-60 | 0.07 | PCI/G | 0.9 | n/a |
| | | | Radvan Ruthenium-106 | 0.87 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 1.754 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.29 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 2.064 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.627 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.024 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.638 | PCI/G | 59 | 1.9 |
| 48-2008 | 1.5 - 3.0 ft | AAA3749 | Americium-241 | 0.099 | PCI/G | 17 | n/a |
| | | | Benzo[a]anthracene | 0.45 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 0.47 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 0.58 | MG/KG | 1 | 12.2 * |
| | | | Chrysene | 0.55 | MG/KG | 96 | 19.5 |
| | | | Fluoranthene | 0.86 | MG/KG | 3200 | 32.5 * |
| | | | Phenanthrene | 0.53 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.053 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.436 | PCI/G | 18 | 0.052 |
| | | | Pyrene | 0.89 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Americium-241 | 0.04 | PCI/G | 17 | n/a |
| | | | Radvan Cobalt-60 | 0.19 | PCI/G | 0.9 | n/a |
| | | | Radvan Ruthenium-106 | 1.4 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 1.622 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.159 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 1.902 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.599 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.017 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.625 | PCI/G | 59 | 1.9 |
| 48-2009 | 0.0 - 0.5 ft | AAA3750 | Aluminium | 11000 | MG/KG | n/a | 123000 |
| | | | Americium-241 | 0.003 | PCI/G | 17 | n/a |
| | | | Arsenic | 2.6 | MG/KG | n/a | 11.6 |
| | | | Barium | 100 | MG/KG | 5600 | 1143 |
| | | | Benzo[b]fluoranthene | 0.4 | MG/KG | 1 | 12.2 * |
| | | | Beryllium | 0.77 | MG/KG | n/a | 3.31 |
| | | | Bis(2-ethylhexyl)phthalate | 0.7 | MG/KG | 50 | n/a |
| | | | Calcium | 2200 | MG/KG | n/a | 54362 |
| | | | Chromium | 7.3 | MG/KG | n/a | 34.2 |
| | | | Cobalt | 4.6 | MG/KG | n/a | 51.1 |
| | | | Copper | 3.1 | MG/KG | 3000 | 15.7 |
| | | | Fluoranthene | 0.56 | MG/KG | 3200 | 32.5 * |
| | | | Iron | 11000 | MG/KG | n/a | 35586 |
| | | | Lead | 12 | MG/KG | 400 | 39 |
| | | | Lithium | 12 | MG/KG | n/a | n/a |
| | | | Magnesium | 1800 | MG/KG | n/a | 16147 |
| | | | Manganese | 310 | MG/KG | 11000 | 1030 |
| | | | Nickel | 8 | MG/KG | 1600 | 26.7 |
| | | | Plutonium-238 | 0.005 | PCI/G | 20 | 0.014 |

OFFICIAL USE ONLY

48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Plutonium-239 | 0.34 | PCI/G | 18 | 0.052 |
| | | | Potassium | 1100 | MG/KG | n/a | 6179 |
| | | | Pyrene | 0.58 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Ruthenium-106 | 2.08 | PCI/G | 14 | n/a |
| | | | Sodium | 120 | MG/KG | n/a | 1884 |
| | | | Strontium | 20 | MG/KG | 48000 | n/a |
| | | | Thorium-228 | 1.661 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.37 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 1.962 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.643 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.027 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.61 | PCI/G | 59 | 1.9 |
| | | | Vanadium | 15 | MG/KG | 560 | 66 |
| | | | Zinc | 36 | MG/KG | 24000 | 101 |
| 48-2009 | 0.0 - 0.5 ft | AAA3757 | Radvan Cesium-137 | 0.12 | PCI/G | 4 | n/a |
| | | | Radvan Cobalt-60 | 0.3 | PCI/G | 0.9 | n/a |
| | | | Radvan Ruthenium-106 | 3.57 | PCI/G | 14 | n/a |
| 48-2009 | 0.0 - 0.5 ft | AAA3758 | Benzo[a]pyrene | 0.37 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 0.44 | MG/KG | 1 | 12.2 * |
| | | | Bis(2-ethylhexyl)phthalate | 3.8 | MG/KG | 50 | n/a |
| | | | Chrysene | 0.36 | MG/KG | 96 | 19.5 |
| | | | Fluoranthene | 0.62 | MG/KG | 3200 | 32.5 * |
| | | | Phenanthrene | 0.35 | MG/KG | n/a | 24.2 * |
| | | | Pyrene | 0.74 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Ruthenium-106 | 2.08 | PCI/G | 14 | n/a |
| 48-2009 | 0.5 - 1.5 ft | AAA3751 | Americium-241 | 0.011 | PCI/G | 17 | n/a |
| | | | Benzo[a]anthracene | 0.43 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 0.43 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 0.5 | MG/KG | 1 | 12.2 * |
| | | | Chrysene | 0.4 | MG/KG | 96 | 19.5 |
| | | | Fluoranthene | 1.1 | MG/KG | 3200 | 32.5 * |
| | | | Phenanthrene | 1.1 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-239 | 0.011 | PCI/G | 18 | 0.052 |
| | | | Pyrene | 0.99 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Cesium-137 | 0.32 | PCI/G | 4 | n/a |
| | | | Radvan Cobalt-60 | 0.07 | PCI/G | 0.9 | n/a |
| | | | Radvan Ruthenium-106 | 0.87 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 1.656 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.247 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 1.869 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.543 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.02 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.596 | PCI/G | 59 | 1.9 |
| 48-2009 | 1.5 - 3.0 ft | AAA3752 | Americium-241 | 0.003 | PCI/G | 17 | n/a |
| | | | Fluoranthene | 0.39 | MG/KG | 3200 | 32.5 * |
| | | | Phenanthrene | 0.33 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.002 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.388 | PCI/G | 18 | 0.052 |
| | | | Pyrene | 0.38 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Ruthenium-106 | 1.3 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 1.619 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.174 | PCI/G | 5 | n/a |

48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Thorium-232 | 1.675 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.461 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.016 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.473 | PCI/G | 59 | 1.9 |
| 48-2056 | 0.0 - 0.5 ft | AAA3765 | Aluminium | 6000 | MG/KG | n/a | 123000 |
| | | | Americium-241 | 0.003 | PCI/G | 17 | n/a |
| | | | Arsenic | 1.7 | MG/KG | n/a | 11.6 |
| | | | Barium | 62 | MG/KG | 5600 | 1143 |
| | | | Benzo[a]anthracene | 0.41 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 0.45 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 0.52 | MG/KG | 1 | 12.2 * |
| | | | Beryllium | 0.62 | MG/KG | n/a | 3.31 |
| | | | Bis(2-ethylhexyl)phthalate | 0.37 | MG/KG | 50 | n/a |
| | | | Calcium | 1300 | MG/KG | n/a | 54362 |
| | | | Cerium-144 | 0.238 | PCI/G | 64 | n/a |
| | | | Cesium-137 | 0.0645 | PCI/G | 4 | 1.4 |
| | | | Chromium | 5.1 | MG/KG | n/a | 34.2 |
| | | | Chrysene | 0.44 | MG/KG | 96 | 19.5 |
| | | | Cobalt | 2.4 | MG/KG | n/a | 51.1 |
| | | | Cobalt-60 | 0.0454 | PCI/G | 0.9 | n/a |
| | | | Copper | 1.1 | MG/KG | 3000 | 15.7 |
| | | | Fluoranthene | 1.2 | MG/KG | 3200 | 32.5 * |
| | | | Iron | 8000 | MG/KG | n/a | 35586 |
| | | | Lead | 6.1 | MG/KG | 400 | 39 |
| | | | Lithium | 10 | MG/KG | n/a | n/a |
| | | | Magnesium | 1200 | MG/KG | n/a | 16147 |
| | | | Manganese | 270 | MG/KG | 11000 | 1030 |
| | | | Nickel | 5.4 | MG/KG | 1600 | 26.7 |
| | | | Phenanthrene | 1.1 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.005 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.014 | PCI/G | 18 | 0.052 |
| | | | Potassium | 760 | MG/KG | n/a | 6179 |
| | | | Pyrene | 1.1 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Cobalt-60 | 0.88 | PCI/G | 0.9 | n/a |
| | | | Radvan Ruthenium-106 | 1.11 | PCI/G | 14 | n/a |
| | | | Sodium | 79 | MG/KG | n/a | 1884 |
| | | | Strontium | 11 | MG/KG | 48000 | n/a |
| | | | Thorium-228 | 1.579 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.163 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 1.86 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.66 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.027 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.671 | PCI/G | 59 | 1.9 |
| | | | Vanadium | 9.6 | MG/KG | 560 | 66 |
| | | | Zinc | 34 | MG/KG | 24000 | 101 |
| 48-2056 | 0.5 - 1.5 ft | AAA3766 | Americium-241 | 0.008 | PCI/G | 17 | n/a |
| | | | Benzo[a]anthracene | 0.39 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 0.49 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 0.57 | MG/KG | 1 | 12.2 * |
| | | | Cerium-144 | 0.114 | PCI/G | 64 | n/a |
| | | | Cesium-137 | 0.0788 | PCI/G | 4 | 1.4 |
| | | | Chrysene | 0.5 | MG/KG | 96 | 19.5 |

OFFICIAL USE ONLY

48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Cobalt-60 | 0.0027 | PCI/G | 0.9 | n/a |
| | | | Fluoranthene | 0.81 | MG/KG | 3200 | 32.5 * |
| | | | Phenanthrene | 0.5 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.016 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.032 | PCI/G | 18 | 0.052 |
| | | | Pyrene | 0.83 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Americium-241 | 0.24 | PCI/G | 17 | n/a |
| | | | Radvan Ruthenium-106 | 0.82 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 1.836 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.155 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 1.973 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.672 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.021 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.772 | PCI/G | 59 | 1.9 |
| 48-2056 | 1.5 - 2.0 ft | AAA3767 | Americium-241 | 0.009 | PCI/G | 17 | n/a |
| | | | Cerium-144 | 0.246 | PCI/G | 64 | n/a |
| | | | Cesium-137 | 0.0924 | PCI/G | 4 | 1.4 |
| | | | Cobalt-60 | 0.0404 | PCI/G | 0.9 | n/a |
| | | | Fluoranthene | 0.6 | MG/KG | 3200 | 32.5 * |
| | | | Phenanthrene | 0.57 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.078 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.084 | PCI/G | 18 | 0.052 |
| | | | Pyrene | 0.56 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Americium-241 | 0.3 | PCI/G | 17 | n/a |
| | | | Radvan Cobalt-60 | 0.23 | PCI/G | 0.9 | n/a |
| | | | Ruthenium-106 | 0.0506 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 1.414 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.046 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 1.732 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.618 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.024 | PCI/G | 18 | 0.088 |
| | | | Uranium-238 | 0.628 | PCI/G | 59 | 1.9 |
| 48-2060 | 0.0 - 0.5 ft | AAA3775 | Americium-241 | 0.009 | PCI/G | 17 | n/a |
| | | | Benzo[a]anthracene | 14.2 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 14.5 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 18.5 | MG/KG | 1 | 12.2 * |
| | | | Benzo[g,h,i]perylene | 5.2 | MG/KG | n/a | 5.9 * |
| | | | Benzo[k]fluoranthene | 5 | MG/KG | 1 | 19.4 * |
| | | | Chrysene | 17.1 | MG/KG | 96 | 19.5 |
| | | | Fluoranthene | 27.2 | MG/KG | 3200 | 32.5 * |
| | | | Indeno[1,2,3-cd]pyrene | 5.7 | MG/KG | 1 | 6 * |
| | | | Phenanthrene | 18.2 | MG/KG | n/a | 24.2 * |
| | | | Plutonium-238 | 0.002 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.045 | PCI/G | 18 | 0.052 |
| | | | Pyrene | 29.4 | MG/KG | 2400 | 12.8 * |
| | | | Radvan Americium-241 | 0.17 | PCI/G | 17 | n/a |
| | | | Radvan Ruthenium-106 | 1.01 | PCI/G | 14 | n/a |
| | | | Thorium-228 | 1.617 | PCI/G | 1.5 | n/a |
| | | | Thorium-230 | 1.3 | PCI/G | 5 | n/a |
| | | | Thorium-232 | 1.759 | PCI/G | 5 | 2.68 |
| | | | Uranium-234 | 0.547 | PCI/G | 86 | 2.03 |
| | | | Uranium-235 | 0.017 | PCI/G | 18 | 0.088 |

48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Uranium-238 | 0.608 | PCI/G | 59 | 1.9 |
| 48-2061 | | AAA3787 | Mercury | 23 | MG/KG | 24 | 0.1 |
| | | | Mercury | 24 | MG/KG | 24 | 0.1 |
| | | | Mercury | 27 | MG/KG | 24 | 0.1 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| **XRF Results** | | | | | | | |
| 48-2006 | 0.0 - 0.5 ft | AAA4494 | Barium | 514 | PPM | 5600 | 1143 |
| | | | Calcium | 0.59 | % | n/a | 54362 |
| | | | Chromium | 15 | PPM | n/a | 34.2 |
| | | | Copper | 12 | PPM | 3000 | 15.7 |
| | | | Iron | 1.8 | % | n/a | 35586 |
| | | | Lead | 25 | PPM | 400 | 39 |
| | | | Manganese | 440 | PPM | 11000 | 1030 |
| | | | Mercury | 32 | PPM | 24 | 0.1 |
| | | | Potassium | 2.67 | % | n/a | 6179 |
| | | | Thorium | 20 | PPM | n/a | n/a |
| | | | Titanium | 2239 | PPM | n/a | n/a |
| | | | Zinc | 53 | PPM | 24000 | 101 |
| 48-2006 | 0.5 - 1.5 ft | AAA4493 | Barium | 393 | PPM | 5600 | 1143 |
| | | | Barium | 445 | PPM | 5600 | 1143 |
| | | | Calcium | 0.58 | % | n/a | 54362 |
| | | | Calcium | 0.58 | % | n/a | 54362 |
| | | | Chromium | 11 | PPM | n/a | 34.2 |
| | | | Chromium | 12 | PPM | n/a | 34.2 |
| | | | Copper | 12 | PPM | 3000 | 15.7 |
| | | | Iron | 1.81 | % | n/a | 35586 |
| | | | Iron | 1.87 | % | n/a | 35586 |
| | | | Lead | 22 | PPM | 400 | 39 |
| | | | Lead | 29 | PPM | 400 | 39 |
| | | | Manganese | 401 | PPM | 11000 | 1030 |
| | | | Manganese | 424 | PPM | 11000 | 1030 |
| | | | Mercury | 10 | PPM | 24 | 0.1 |
| | | | Nickel | 16 | PPM | 1600 | 26.7 |
| | | | Potassium | 2.83 | % | n/a | 6179 |
| | | | Potassium | 2.87 | % | n/a | 6179 |
| | | | Thorium | 15 | PPM | n/a | n/a |
| | | | Thorium | 17 | PPM | n/a | n/a |
| | | | Titanium | 2211 | PPM | n/a | n/a |
| | | | Titanium | 2212 | PPM | n/a | n/a |
| | | | Zinc | 44 | PPM | 24000 | 101 |
| | | | Zinc | 46 | PPM | 24000 | 101 |
| 48-2006 | 1.5 - 3.0 ft | AAA4495 | Barium | 331 | PPM | 5600 | 1143 |
| | | | Calcium | 0.48 | % | n/a | 54362 |
| | | | Chromium | 12 | PPM | n/a | 34.2 |
| | | | Iron | 1.57 | % | n/a | 35586 |
| | | | Lead | 28 | PPM | 400 | 39 |
| | | | Manganese | 362 | PPM | 11000 | 1030 |
| | | | Mercury | 190 | PPM | 24 | 0.1 |
| | | | Potassium | 3.13 | % | n/a | 6179 |
| | | | Thorium | 20 | PPM | n/a | n/a |

OFFICIAL USE ONLY

48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Titanium | 1575 | PPM | n/a | n/a |
| | | | Zinc | 44 | PPM | 24000 | 101 |
| 48-2006 | 3.0 - 4.0 ft | AAA3769 | Barium | 417 | PPM | 5600 | 1143 |
| | | | Calcium | 0.52 | % | n/a | 54362 |
| | | | Iron | 1.59 | % | n/a | 35586 |
| | | | Lead | 26 | PPM | 400 | 39 |
| | | | Manganese | 318 | PPM | 11000 | 1030 |
| | | | Potassium | 3.05 | % | n/a | 6179 |
| | | | Thorium | 16 | PPM | n/a | n/a |
| | | | Titanium | 1610 | PPM | n/a | n/a |
| | | | Zinc | 44 | PPM | 24000 | 101 |
| 48-2006 | 4.0 - 5.0 ft | AAA3770 | Barium | 345 | PPM | 5600 | 1143 |
| | | | Calcium | 0.51 | % | n/a | 54362 |
| | | | Iron | 1.52 | % | n/a | 35586 |
| | | | Lead | 26 | PPM | 400 | 39 |
| | | | Manganese | 304 | PPM | 11000 | 1030 |
| | | | Potassium | 3.11 | % | n/a | 6179 |
| | | | Thorium | 17 | PPM | n/a | n/a |
| | | | Titanium | 1475 | PPM | n/a | n/a |
| | | | Zinc | 38 | PPM | 24000 | 101 |
| 48-2006 | 5.0 - 6.0 ft | AAA3771 | Barium | 363 | PPM | 5600 | 1143 |
| | | | Calcium | 0.49 | % | n/a | 54362 |
| | | | Chromium | 11 | PPM | n/a | 34.2 |
| | | | Copper | 12 | PPM | 3000 | 15.7 |
| | | | Iron | 1.56 | % | n/a | 35586 |
| | | | Lead | 27 | PPM | 400 | 39 |
| | | | Manganese | 323 | PPM | 11000 | 1030 |
| | | | Potassium | 3.08 | % | n/a | 6179 |
| | | | Thorium | 16 | PPM | n/a | n/a |
| | | | Titanium | 1504 | PPM | n/a | n/a |
| | | | Zinc | 45 | PPM | 24000 | 101 |
| 48-2006 | 6.0 - 7.0 ft | AAA3772 | Barium | 298 | PPM | 5600 | 1143 |
| | | | Calcium | 0.46 | % | n/a | 54362 |
| | | | Iron | 1.49 | % | n/a | 35586 |
| | | | Lead | 20 | PPM | 400 | 39 |
| | | | Manganese | 292 | PPM | 11000 | 1030 |
| | | | Potassium | 3.07 | % | n/a | 6179 |
| | | | Thorium | 11 | PPM | n/a | n/a |
| | | | Titanium | 1307 | PPM | n/a | n/a |
| | | | Zinc | 41 | PPM | 24000 | 101 |
| 48-2006 | 7.0 - 8.0 ft | AAA3773 | Barium | 243 | PPM | 5600 | 1143 |
| | | | Calcium | 0.35 | % | n/a | 54362 |
| | | | Iron | 1.38 | % | n/a | 35586 |
| | | | Lead | 23 | PPM | 400 | 39 |
| | | | Manganese | 314 | PPM | 11000 | 1030 |
| | | | Nickel | 17 | PPM | 1600 | 26.7 |
| | | | Potassium | 3.19 | % | n/a | 6179 |
| | | | Thorium | 23 | PPM | n/a | n/a |
| | | | Titanium | 1016 | PPM | n/a | n/a |
| | | | Zinc | 42 | PPM | 24000 | 101 |
| 48-2007 | 0.0 - 0.5 ft | AAA4496 | Barium | 460 | PPM | 5600 | 1143 |
| | | | Calcium | 0.61 | % | n/a | 54362 |

48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Chromium | 14 | PPM | n/a | 34.2 |
| | | | Copper | 18 | PPM | 3000 | 15.7 |
| | | | Iron | 1.83 | % | n/a | 35586 |
| | | | Lead | 40 | PPM | 400 | 39 |
| | | | Manganese | 533 | PPM | 11000 | 1030 |
| | | | Potassium | 2.97 | % | n/a | 6179 |
| | | | Thorium | 15 | PPM | n/a | n/a |
| | | | Titanium | 2134 | PPM | n/a | n/a |
| | | | Zinc | 59 | PPM | 24000 | 101 |
| 48-2007 | 0.5 - 1.0 ft | AAA4497 | Barium | 409 | PPM | 5600 | 1143 |
| | | | Calcium | 0.53 | % | n/a | 54362 |
| | | | Iron | 1.62 | % | n/a | 35586 |
| | | | Lead | 30 | PPM | 400 | 39 |
| | | | Manganese | 429 | PPM | 11000 | 1030 |
| | | | Potassium | 2.88 | % | n/a | 6179 |
| | | | Thorium | 16 | PPM | n/a | n/a |
| | | | Titanium | 1662 | PPM | n/a | n/a |
| | | | Zinc | 45 | PPM | 24000 | 101 |
| 48-2008 | 0.0 - 0.5 ft | AAA4499 | Barium | 417 | PPM | 5600 | 1143 |
| | | | Barium | 421 | PPM | 5600 | 1143 |
| | | | Calcium | 0.59 | % | n/a | 54362 |
| | | | Calcium | 0.59 | % | n/a | 54362 |
| | | | Copper | 10 | PPM | 3000 | 15.7 |
| | | | Iron | 1.66 | % | n/a | 35586 |
| | | | Iron | 1.67 | % | n/a | 35586 |
| | | | Lead | 29 | PPM | 400 | 39 |
| | | | Lead | 33 | PPM | 400 | 39 |
| | | | Manganese | 354 | PPM | 11000 | 1030 |
| | | | Manganese | 372 | PPM | 11000 | 1030 |
| | | | Potassium | 2.92 | % | n/a | 6179 |
| | | | Potassium | 2.97 | % | n/a | 6179 |
| | | | Thorium | 12 | PPM | n/a | n/a |
| | | | Thorium | 12 | PPM | n/a | n/a |
| | | | Titanium | 1856 | PPM | n/a | n/a |
| | | | Titanium | 1859 | PPM | n/a | n/a |
| | | | Zinc | 41 | PPM | 24000 | 101 |
| | | | Zinc | 43 | PPM | 24000 | 101 |
| 48-2008 | 0.5 - 1.5 ft | AAA4500 | Barium | 445 | PPM | 5600 | 1143 |
| | | | Calcium | 0.62 | % | n/a | 54362 |
| | | | Chromium | 11 | PPM | n/a | 34.2 |
| | | | Iron | 1.81 | % | n/a | 35586 |
| | | | Lead | 27 | PPM | 400 | 39 |
| | | | Manganese | 385 | PPM | 11000 | 1030 |
| | | | Potassium | 2.86 | % | n/a | 6179 |
| | | | Thorium | 18 | PPM | n/a | n/a |
| | | | Titanium | 2183 | PPM | n/a | n/a |
| | | | Zinc | 46 | PPM | 24000 | 101 |
| 48-2008 | 1.5 - 3.0 ft | AAA3749 | Barium | 351 | PPM | 5600 | 1143 |
| | | | Calcium | 0.48 | % | n/a | 54362 |
| | | | Chromium | 10 | PPM | n/a | 34.2 |
| | | | Iron | 1.46 | % | n/a | 35586 |
| | | | Lead | 24 | PPM | 400 | 39 |

OFFICIAL USE ONLY

48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Manganese | 378 | PPM | 11000 | 1030 |
| | | | Potassium | 2.99 | % | n/a | 6179 |
| | | | Thorium | 14 | PPM | n/a | n/a |
| | | | Titanium | 1536 | PPM | n/a | n/a |
| | | | Zinc | 39 | PPM | 24000 | 101 |
| 48-2009 | 0.0 - 0.5 ft | AAA3750 | Barium | 461 | PPM | 5600 | 1143 |
| | | | Calcium | 0.54 | % | n/a | 54362 |
| | | | Chromium | 17 | PPM | n/a | 34.2 |
| | | | Iron | 1.77 | % | n/a | 35586 |
| | | | Lead | 20 | PPM | 400 | 39 |
| | | | Manganese | 431 | PPM | 11000 | 1030 |
| | | | Mercury | 31 | PPM | 24 | 0.1 |
| | | | Nickel | 17 | PPM | 1600 | 26.7 |
| | | | Potassium | 2.7 | % | n/a | 6179 |
| | | | Titanium | 2150 | PPM | n/a | n/a |
| | | | Zinc | 44 | PPM | 24000 | 101 |
| 48-2009 | 0.5 - 1.5 ft | AAA3751 | Barium | 379 | PPM | 5600 | 1143 |
| | | | Calcium | 0.49 | % | n/a | 54362 |
| | | | Iron | 1.54 | % | n/a | 35586 |
| | | | Lead | 24 | PPM | 400 | 39 |
| | | | Manganese | 388 | PPM | 11000 | 1030 |
| | | | Potassium | 2.99 | % | n/a | 6179 |
| | | | Thorium | 16 | PPM | n/a | n/a |
| | | | Titanium | 1639 | PPM | n/a | n/a |
| | | | Zinc | 42 | PPM | 24000 | 101 |
| 48-2009 | 0.5 - 1.5 ft | AAA3759 | Barium | 348 | PPM | 5600 | 1143 |
| | | | Calcium | 0.5 | % | n/a | 54362 |
| | | | Iron | 1.59 | % | n/a | 35586 |
| | | | Lead | 20 | PPM | 400 | 39 |
| | | | Manganese | 368 | PPM | 11000 | 1030 |
| | | | Potassium | 2.95 | % | n/a | 6179 |
| | | | Thorium | 10 | PPM | n/a | n/a |
| | | | Titanium | 1795 | PPM | n/a | n/a |
| | | | Zinc | 39 | PPM | 24000 | 101 |
| 48-2009 | 1.5 - 3.0 ft | AAA3752 | Barium | 386 | PPM | 5600 | 1143 |
| | | | Calcium | 0.5 | % | n/a | 54362 |
| | | | Chromium | 13 | PPM | n/a | 34.2 |
| | | | Copper | 10 | PPM | 3000 | 15.7 |
| | | | Iron | 1.55 | % | n/a | 35586 |
| | | | Lead | 26 | PPM | 400 | 39 |
| | | | Manganese | 378 | PPM | 11000 | 1030 |
| | | | Potassium | 2.97 | % | n/a | 6179 |
| | | | Thorium | 20 | PPM | n/a | n/a |
| | | | Titanium | 1669 | PPM | n/a | n/a |
| | | | Zinc | 38 | PPM | 24000 | 101 |
| 48-2056 | 0.0 - 0.5 ft | AAA3765 | Barium | 256 | PPM | 5600 | 1143 |
| | | | Calcium | 0.41 | % | n/a | 54362 |
| | | | Iron | 1.7 | % | n/a | 35586 |
| | | | Lead | 21 | PPM | 400 | 39 |
| | | | Manganese | 370 | PPM | 11000 | 1030 |
| | | | Potassium | 2.94 | % | n/a | 6179 |
| | | | Thorium | 17 | PPM | n/a | n/a |



OFFICIAL USE ONLY

48-002(a/b) Detects

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Titanium | 1662 | PPM | n/a | n/a |
| | | | Zinc | 43 | PPM | 24000 | 101 |
| 48-2056 | 0.5 - 1.5 ft | AAA3766 | Barium | 308 | PPM | 5600 | 1143 |
| | | | Calcium | 0.41 | % | n/a | 54362 |
| | | | Iron | 1.4 | % | n/a | 35586 |
| | | | Lead | 19 | PPM | 400 | 39 |
| | | | Manganese | 344 | PPM | 11000 | 1030 |
| | | | Mercury | 12 | PPM | 24 | 0.1 |
| | | | Potassium | 3.03 | % | n/a | 6179 |
| | | | Thorium | 12 | PPM | n/a | n/a |
| | | | Titanium | 1361 | PPM | n/a | n/a |
| | | | Zinc | 40 | PPM | 24000 | 101 |
| 48-2056 | 1.5 - 2.0 ft | AAA3767 | Barium | 353 | PPM | 5600 | 1143 |
| | | | Calcium | 0.51 | % | n/a | 54362 |
| | | | Chromium | 12 | PPM | n/a | 34.2 |
| | | | Copper | 15 | PPM | 3000 | 15.7 |
| | | | Iron | 1.53 | % | n/a | 35586 |
| | | | Lead | 21 | PPM | 400 | 39 |
| | | | Manganese | 371 | PPM | 11000 | 1030 |
| | | | Potassium | 3.06 | % | n/a | 6179 |
| | | | Thorium | 14 | PPM | n/a | n/a |
| | | | Titanium | 1504 | PPM | n/a | n/a |
| | | | Zinc | 40 | PPM | 24000 | 101 |
| 48-2060 | 0.0 - 0.5 ft | AAA3775 | Arsenic | 36 | PPM | n/a | 11.6 |
| | | | Barium | 135 | PPM | 5600 | 1143 |
| | | | Calcium | 0.57 | % | n/a | 54362 |
| | | | Chromium | 17 | PPM | n/a | 34.2 |
| | | | Copper | 31 | PPM | 3000 | 15.7 |
| | | | Iron | 1.48 | % | n/a | 35586 |
| | | | Lead | 18 | PPM | 400 | 39 |
| | | | Manganese | 352 | PPM | 11000 | 1030 |
| | | | Mercury | 50110 | PPM | 24 | 0.1 |
| | | | Potassium | 2.48 | % | n/a | 6179 |
| | | | Thorium | 57 | PPM | n/a | n/a |
| | | | Titanium | 2080 | PPM | n/a | n/a |

* UTL value is taken from the Assessments Council position paper "Interim Guidance for Evaluating PAHs in Soil"

OFFICIAL USE ONLY

48-002(a/b) Detects above SAL and/or UTL

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| 48-2006 | 0.0 - 0.5 ft | AAA3753 | Mercury | 25 | MG/KG | 24 | 0.1 |
| | | | Mercury | 28.8 | MG/KG | 24 | 0.1 |
| | | | Mercury | 36 | MG/KG | 24 | 0.1 |
| | | | Mercury | 40 | MG/KG | 24 | 0.1 |
| | | | Mercury | 41 | MG/KG | 24 | 0.1 |
| 48-2006 | 0.0 - 0.5 ft | AAA4494 | Benzo[a]anthracene | 12.5 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 12 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 13.8 | MG/KG | 1 | 12.2 * |
| | | | Benzo[k]fluoranthene | 3.2 | MG/KG | 1 | 19.4 * |
| | | | Radvan Cesium-137 | 3.63 | PCI/G | 4 | 1.4 |
| | | | Dibenzo[a,h]anthracene | 1.6 | MG/KG | 0.1 | 2.9 * |
| | | | Indeno[1,2,3-cd]pyrene | 5.5 | MG/KG | 1 | 6 * |
| | | | Mercury | 35 | MG/KG | 24 | 0.1 |
| | | | Mercury | 38.1 | MG/KG | 24 | 0.1 |
| | | | Mercury | 47 | MG/KG | 24 | 0.1 |
| | | | Mercury | 62 | MG/KG | 24 | 0.1 |
| | | | Plutonium-238 | 0.0399 | PCI/G | 20 | 0.014 |
| 48-2006 | 0.5 - 1.5 ft | AAA4493 | Uranium-235 | 0.329 | PCI/G | 18 | 0.088 |
| | | | Benzo[a]pyrene | 0.77 | MG/KG | 0.1 | 12.1 * |
| 48-2006 | 1.5 - 3.0 ft | AAA4495 | Thorium-228 | 2.27 | PCI/G | 1.5 | n/a |
| | | | Benzo[a]anthracene | 5.6 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 6.2 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 6.6 | MG/KG | 1 | 12.2 * |
| | | | Benzo[k]fluoranthene | 2.9 | MG/KG | 1 | 19.4 * |
| | | | Dibenzo[a,h]anthracene | 0.72 | MG/KG | 0.1 | 2.9 * |
| 48-2006 | 3.0 - 4.0 ft | AAA3769 | Indeno[1,2,3-cd]pyrene | 2.9 | MG/KG | 1 | 6 * |
| | | | Benzo[a]pyrene | 0.51 | MG/KG | 0.1 | 12.1 * |
| 48-2006 | 5.0 - 6.0 ft | AAA3771 | Plutonium-239 | 0.121 | PCI/G | 18 | 0.052 |
| | | | Benzo[a]pyrene | 0.6 | MG/KG | 0.1 | 12.1 * |
| | | | Uranium-235 | 0.184 | PCI/G | 18 | 0.088 |
| 48-2006 | 6.0 - 7.0 ft | AAA3772 | Uranium-235 | 0.189 | PCI/G | 18 | 0.088 |
| 48-2006 | 7.0 - 8.0 ft | AAA3773 | Plutonium-238 | 0.0727 | PCI/G | 20 | 0.014 |
| | | | Mercury | 1.2 | MG/KG | 24 | 0.1 |
| | | | Mercury | 2 | MG/KG | 24 | 0.1 |
| 48-2007 | 0.0 - 0.5 ft | AAA4496 | Mercury | 2.7 | MG/KG | 24 | 0.1 |
| | | | Benzo[a]anthracene | 23.3 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 22.6 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 25.8 | MG/KG | 1 | 12.2 * |
| | | | Benzo[k]fluoranthene | 10.7 | MG/KG | 1 | 19.4 * |
| | | | Dibenzo[a,h]anthracene | 2.7 | MG/KG | 0.1 | 2.9 * |
| | | | Indeno[1,2,3-cd]pyrene | 13.7 | MG/KG | 1 | 6 * |
| | | | Plutonium-238 | 0.051 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.718 | PCI/G | 18 | 0.052 |
| 48-2007 | 0.5 - 1.0 ft | AAA4497 | Thorium-228 | 1.718 | PCI/G | 1.5 | n/a |
| | | | Benzo[a]anthracene | 12.3 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 12.9 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 15.9 | MG/KG | 1 | 12.2 * |
| | | | Benzo[k]fluoranthene | 4.3 | MG/KG | 1 | 19.4 * |
| | | | Indeno[1,2,3-cd]pyrene | 6 | MG/KG | 1 | 6 * |
| 48-2008 | 0.0 - 0.5 ft | AAA4499 | Thorium-228 | 2.027 | PCI/G | 1.5 | n/a |
| | | | Benzo[a]anthracene | 4.3 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 5.1 | MG/KG | 0.1 | 12.1 * |



OFFICIAL USE ONLY

48-002(a/b) Detects above SAL and/or UTL

| Location ID | Depth of sample | Sample ID | Analyte | Results | Units | SAL | UTL |
|---|---|---|---|---|---|---|---|
| | | | Benzo[b]fluoranthene | 5.4 | MG/KG | 1 | 12.2 * |
| | | | Benzo[k]fluoranthene | 2 | MG/KG | 1 | 19.4 * |
| | | | Dibenzo[a,h]anthracene | 0.63 | MG/KG | 0.1 | 2.9 * |
| | | | Indeno[1,2,3-cd]pyrene | 2.4 | MG/KG | 1 | 6 * |
| | | | Plutonium-239 | 0.231 | PCI/G | 18 | 0.052 |
| 48-2008 | 0.5 - 1.5 ft | AAA4500 | Thorium-228 | 1.54 | PCI/G | 1.5 | n/a |
| | | | Benzo[a]anthracene | 1.3 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 1.5 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 1.6 | MG/KG | 1 | 12.2 * |
| | | | Plutonium-238 | 0.055 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.826 | PCI/G | 18 | 0.052 |
| 48-2008 | 1.5 - 3.0 ft | AAA3749 | Thorium-228 | 1.754 | PCI/G | 1.5 | n/a |
| | | | Benzo[a]pyrene | 0.47 | MG/KG | 0.1 | 12.1 * |
| | | | Plutonium-238 | 0.053 | PCI/G | 20 | 0.014 |
| | | | Plutonium-239 | 0.436 | PCI/G | 18 | 0.052 |
| 48-2009 | 0.0 - 0.5 ft | AAA3750 | Thorium-228 | 1.622 | PCI/G | 1.5 | n/a |
| | | | Plutonium-239 | 0.34 | PCI/G | 18 | 0.052 |
| 48-2009 | 0.0 - 0.5 ft | AAA3758 | Thorium-228 | 1.661 | PCI/G | 1.5 | n/a |
| 48-2009 | 0.5 - 1.5 ft | AAA3751 | Benzo[a]pyrene | 0.37 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[a]pyrene | 0.43 | MG/KG | 0.1 | 12.1 * |
| 48-2009 | 1.5 - 3.0 ft | AAA3752 | Thorium-228 | 1.656 | PCI/G | 1.5 | n/a |
| | | | Plutonium-239 | 0.388 | PCI/G | 18 | 0.052 |
| 48-2056 | 0.0 - 0.5 ft | AAA3765 | Thorium-228 | 1.619 | PCI/G | 1.5 | n/a |
| | | | Benzo[a]pyrene | 0.45 | MG/KG | 0.1 | 12.1 * |
| 48-2056 | 0.5 - 1.5 ft | AAA3766 | Thorium-228 | 1.579 | PCI/G | 1.5 | n/a |
| | | | Benzo[a]pyrene | 0.49 | MG/KG | 0.1 | 12.1 * |
| | | | Plutonium-238 | 0.016 | PCI/G | 20 | 0.014 |
| 48-2056 | 1.5 - 2.0 ft | AAA3767 | Thorium-228 | 1.836 | PCI/G | 1.5 | n/a |
| | | | Plutonium-238 | 0.078 | PCI/G | 20 | 0.014 |
| 48-2060 | 0.0 - 0.5 ft | AAA3775 | Plutonium-239 | 0.084 | PCI/G | 18 | 0.052 |
| | | | Benzo[a]anthracene | 14.2 | MG/KG | 1 | 12.4 * |
| | | | Benzo[a]pyrene | 14.5 | MG/KG | 0.1 | 12.1 * |
| | | | Benzo[b]fluoranthene | 18.5 | MG/KG | 1 | 12.2 * |
| | | | Benzo[k]fluoranthene | 5 | MG/KG | 1 | 19.4 * |
| | | | Indeno[1,2,3-cd]pyrene | 5.7 | MG/KG | 1 | 6 * |
| 48-2061 | | AAA3787 | Thorium-228 | 1.617 | PCI/G | 1.5 | n/a |
| | | | Mercury | 27 | MG/KG | 24 | 0.1 |
| | | | | | | | |
| **XRF Results** | | | | | | | |
| 48-2006 | 0.0 - 0.5 ft | AAA4494 | Mercury | 32 | PPM | 24 | 0.1 |
| 48-2006 | 0.5 - 1.5 ft | AAA4493 | Mercury | 10 | PPM | 24 | 0.1 |
| 48-2006 | 1.5 - 3.0 ft | AAA4495 | Mercury | 190 | PPM | 24 | 0.1 |
| 48-2007 | 0.0 - 0.5 ft | AAA4496 | Copper | 18 | PPM | 3000 | 15.7 |
| | | | Lead | 40 | PPM | 400 | 39 |
| 48-2009 | 0.0 - 0.5 ft | AAA3750 | Mercury | 31 | PPM | 24 | 0.1 |
| 48-2056 | 0.5 - 1.5 ft | AAA3766 | Mercury | 12 | PPM | 24 | 0.1 |
| 48-2060 | 0.0 - 0.5 ft | AAA3775 | Arsenic | 36 | PPM | n/a | 11.6 |
| | | | Copper | 31 | PPM | 3000 | 15.7 |
| | | | Mercury | 50110 | PPM | 24 | 0.1 |

* UTL value is taken from the Assessments Council position paper "Interim Guidance for Evaluating PAHs in Soil"

OFFICIAL USE ONLY

ANNEX 6.10

RISK-BASED CLEANUP LEVEL CALCULATIONS

| Chemical | EPA Cancer Class | Risk Range | | | Cleanup Level mg/kg Occupational Scenario Carcinogenic Range | | | Noncarc. |
|---|---|---|---|---|---|---|---|---|
| Arsenic | A | 1.00E-04 | - | 1.00E-06 | 250 | - | 2 | 613 |
| Barium | D | | | | | | | 7,530 |
| Cadmium | B1 | 1.00E-04 | - | 1.00E-06 | 2,523 | - | 25 | 2,044 |
| Chromium VI | A | 1.00E-04 | - | 1.00E-06 | 378 | - | 4 | 10,220 |
| Copper | | | | | | | | 75,628 |
| Manganese | | | | | | | | 793 |
| Mercury | D | | | | | | | 279 |
| Nickel | A | | | | | | | 40,880 |
| Silver | D | | | | | | | 10,220 |
| Thallium | | | | | | | | 164 |
| Vanadium | | | | | | | | 14,308 |
| Zinc | D | | | | | | | 613,200 |
| Benzene | A | 1.00E-04 | - | 1.00E-06 | 277 | - | 3 | |
| cis-1,2-Dichloroethene | | | | | | | | 20,440 |
| Methylene Chloride | B2 | 1.00E-04 | - | 1.00E-06 | 2,508 | - | 25 | 11,545 |
| Tetrachlorethene | B-C | 1.00E-04 | - | 1.00E-06 | 3,088 | - | 31 | 20,440 |
| 1,1,1-Trichloroethane | D | | | | | | | 7,259 |
| Trichloroethene | B-C | 1.00E-04 | - | 1.00E-06 | 1,347 | - | 13 | |
| Benzo[a]pyrene | B2 | 1.00E-04 | - | 1.00E-06 | 78 | - | 1 | |
| PCBs | B2 | 1.00E-04 | - | 1.00E-06 | 74 | - | 1 | |
| 2,4-DNT | B2 | 1.00E-04 | - | 1.00E-06 | 842 | - | 8 | 4,088 |
| 2,6-DNT | B2 | 1.00E-04 | - | 1.00E-06 | 842 | - | 8 | 2,044 |
| HMX | | | | | | | | 102,200 |
| PETN | | | | | | | | 40,880 |
| RDX | C | 1.00E-04 | - | 1.00E-06 | 5,203 | - | 52 | 6,132 |
| TNT | C | 1.00E-04 | - | 1.00E-06 | 19,077 | - | 191 | 1,022 |

OFFICIAL USE ONLY

**Residential PRGs are based on the following assumptions:**

| | |
|---|---|
| Carcinogenic averaging time (years) = | 70 |
| Non carcinogenic Averaging time (years) = | 30 |
| Exposure frequency (days/year) = | 350 |
| Age adjusted soil ingestion factor (mg-yr/kg-day) = | 114 |
| Age adjusted inhalation factor ($m^3$-yr/kg-day) = | 13 |

$$C = \frac{TR \times AT \times 365\ days/year}{(SF_o \times 10^{-6}\ kg/mg \times EF \times IF_{soil}) + [SF_i \times EF \times IF_{air} \times (1/Y)]}$$

$$C = \frac{THI \times AT \times 365\ days/year}{((1/RfD_o) \times 10^{-6}\ kg/mg \times EF \times IF_{soil}) + [(1/RfD_i) \times EF \times IF_{air} \times (1/Y)]}$$

**Occupational PRGs are based on the following assumptions:**

| | |
|---|---|
| Adult body weight (kg) = | 70 |
| Carcinogenic averaging time (years) = | 70 |
| Non carcinogenic Averaging time (years) = | 25 |
| Exposure frequency (days/year) = | 250 |
| Exposure duration (years) = | 25 |
| Soil ingestion rate (mg/day) = | 50 |
| Workday inhalation rate ($m^3$/day) = | 20 |
| Particualte emission factor ($m^3$/kg) = | 1.11E+07 |

$$C = \frac{TR \times BW \times AT \times 365\ days/year}{EF \times ED \times [(SF_o \times 10^{-6}\ kg/mg \times IF_{soil}) + (SF_i \times IF_{air} \times (1/Y))]}$$

$$C = \frac{THI \times BW \times AT \times 365\ days/year}{EF \times ED \times [((1/RfDo) \times 10^{-6}\ kg/mg \times IR_{soil}) + ((1/RfDi) \times IR_{air} \times (1/Y))]}$$

**Recreational PRGs are based on the following assumptions:**

| | |
|---|---|
| Carcinogenic averaging time (years) = | 70 |
| Non carcinogenic Averaging time (years) = | 20 |
| Exposure frequency (days/year) = | 28 |
| Age adjusted soil ingestion factor (mg-yr/kg-day) = | 93 |
| Age adjusted inhalation factor ($m^3$-yr/kg-day) = | 9.5 |

$$C = \frac{TR \times AT \times 365\ days/year}{(SF_o \times 10^{-6}\ kg/mg \times EF \times IF_{soil}) + [SF_i \times EF \times IF_{air} \times (1/Y)]}$$

$$C = \frac{THI \times AT \times 365\ days/year}{((1/RfD_o) \times 10^{-6}\ kg/mg \times EF \times IF_{soil}) + [(1/RfD_i) \times EF \times IF_{air} \times (1/Y)]}$$

Y = VF for volatiles; PEF for nonvolatiles

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| Chemical | EPA Cancer Class | Carcinogenic Slope Factors (kg-day/mg) Oral | Carcinogenic Slope Factors (kg-day/mg) Inhalation | Chronic RfDs (mg/kg-day) Oral | Chronic RfDs (mg/kg-day) Inhalation | VF $m^3/kg$ |
|---|---|---|---|---|---|---|
| | | | | | | |
| Arsenic | A | 1.75 | 15 | 0.0003 | | |
| Barium | D | | | 0.07 | 0.00014 | |
| Cadmium | B1 | | 6.3 | 0.001 | | |
| Chromium VI | A | | 42 | 0.005 | | |
| Copper | | | | 0.037 | | |
| Manganese | | | | 0.14 | 0.000014 | |
| Mercury | D | | | 0.0003 | 0.00009 | |
| Nickel | A | | | 0.02 | | |
| Silver | D | | | 0.005 | | |
| Thallium | | | | 0.00008 | | |
| Vanadium | | | | 0.007 | | |
| Zinc | D | | | 0.3 | | |
| | | | | | | |
| Benzene | A | 0.029 | 0.029 | | | 5700 |
| cis-1,2-Dichloroethene | | | | 0.01 | | 4600 |
| Methylene Chloride | B2 | 0.0075 | 0.0016 | 0.06 | 0.86 | 2900 |
| Tetrachlorethene | B-C | 0.052 | 0.002 | 0.01 | | 6000 |
| 1,1,1-Trichloroethane | D | | | 0.09 | 0.29 | 5100 |
| Trichloroethene | B-C | 0.011 | 0.006 | | | 5800 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Benzo[a]pyrene | B2 | 7.3 | | | | |
| PCBs | B2 | 7.7 | | | | |
| | | | | | | |
| 2,4-DNT | B2 | 0.68 | | 0.002 | | |
| 2,6-DNT | B2 | 0.68 | | 0.001 | | |
| HMX | | | | 0.05 | | |
| PETN | | | | 0.02 | | |
| RDX | C | 0.11 | | 0.003 | | |
| TNT | C | 0.03 | | 0.0005 | | |

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ANNEX 6.11

VERIFICATION PLAN CALCULATIONS

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Verification Plan

The number of samples to be taken to determine whether a confirmation unit (in this case the 20 by 11 foot area of contamination) has achieved the cleanup standard due to excavation is dictated by the sampling frequency needed to achieve statistically defensible data. *Methods for Evaluating the Attainment of Cleanup Standards, Volume 1, Solid Media (EPA 1988)* provides the formulae for calculating the number of random samples needed to determine if the mean concentration remaining in the area after excavation is less than the cleanup goal at a specified level of confidence. The required number of samples is computed using the following equation:

$$n_d = \frac{\left(z_{1-\beta} + z_{1-\alpha}\right)^2}{\tau^2} \quad where \quad \tau = \frac{(C_s - \mu_1)}{\sigma}$$

The required number of samples is computed using the following parameters and assumptions:

| Parameter | Assumption | Value |
|---|---|---|
| $\alpha$ | alpha - the desired false positive rate | 0.05 |
| $\beta$ | beta - the desired false negative rate | 0.2 |
| $\tau$ | tau - an expression of relative difference | calculated |
| $C_s$ | cleanup standard for the sample area | for Hg = 280 mg/kg<br>for PAH = 80 mg/kg |
| $\mu_1$ | the mean concentration where the site should be declared clean with a high probability | assume 50% of $C_s$ |
| $\sigma$ | the estimate of the standard deviation of the individual contaminant concentrations within the CU | assume a coefficient of variation of 50% which is 50% of $\mu_1$ or 25% of $C_s$ |

Application of this approach with assumptions as outlined results in a confirmatory sample size of 2 soil samples for laboratory analysis. The confirmatory sampling approach will include the evaluation of screening data after each cleanup excavation lift is accomplished. If screening data indicate that contaminant concentrations are 50% or less of the cleanup standard with a standard deviation of 25% of the $C_s$, the 2 confirmatory

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laboratory samples will be obtained. Given the small size of this SWMU, if screening data do not achieve these results, additional soil will be removed until the screening requirements are met. An approach for larger remediated sites would consider the benefit from additional sampling to verify cleanup (i.e., the larger number of samples, the closer the UCL is to the mean) versus the cost of removing additional soil (i.e., reduce the average contaminant concentration).

Results from the 2 laboratory confirmatory samples will be used to calculate the 95% UCL to compare to the cleanup level established for each contaminant. The site cleanup objectives will be obtained when the calculated UCL is less than the established cleanup levels.

REFERENCE

0794 EPA (US Environmental Protection Agency), February 1989. "Methods for Evaluating the Attainment of Cleanup Standards," Volume 1: Soils and Solid Media, EPA 230/02-89-042, National Technical Information Service, Springfield, Virginia. (EPA 1989, 0794) Verified

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*Submitted to:* New Mexico Environment Department

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Form 1756c (10/98)

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# Interim Action Plan for

## Potential Release Sites 18-003(a-d, g)

Field Unit 2

Environmental Restoration Project

May 1996

A Department of Energy Environmental Cleanup Program

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**Appendix A - Waste Characterization Data**

**Appendix B - Interim Action Approval Form**


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## 1.0 Rationale and Objective of Interim Action

The proposed interim action (IA) is a best management practice (BMP) that includes removal of the source of contamination to prevent further discharge to the environment or sanitary sewer. One industrial waste collection tank [PRS 18-003(a)] and four septic tanks [PRSs 18-003(b, c, d, and g)] at technical area (TA) 18 will be pumped free of sludge and liquid and will be decontaminated. The wastes, expected to be RCRA mixed waste and nonhazardous radioactive waste, will be managed appropriately.

In the RFI Report (Environmental Restoration Project 1995, 1283), these sites were proposed for an expedited cleanup. This interim action is consistent with, and contributes to, the final remedy for these sites.

### 1.1 Release Potential/Health and Environmental Risks

Floor drains in the TA-18 facilities, which formerly drained to the septic tanks, have been sealed. The sinks, showers, and sanitary facilities, however, are still physically connected to the septic tanks and their associated drainfields. Currently, the restrooms have been locked and the water service has been shut off. However, there is a continuing potential for release of hazardous constituents in the tanks. Removal of the contents will eliminate the potential for discharge of RCRA contaminants to the environment.

The integrity of the tanks themselves is apparently good and is sufficient to maintain tank water levels during the interval between sampling events. Nevertheless, the release of presently contained effluent, now known to contain radioactive or mixed waste, could result in increased health and environmental risks. PRS 18-003(g) contains trace quantities of RCRA-regulated constituents. Although this PRS does not discharge to the environment via a drainfield, the PRS is included in this IA because its discharge is routed via the site sanitary sewer system to the TA-46 Sanitary Wastewater System Consolidation (SWSC) treatment plant.

This cleanup is an IA only. It is not a final solution for potential soil and/or groundwater contamination at the septic systems. Further issues need to be resolved, including possible plugging of the waste lines, removal or backfilling of the tanks, and the relationship between the drainfields and the shallow alluvial aquifer at the site.

### 1.2 Regulatory Drivers

This IA is being conducted in compliance with the corrective action program as required by the Hazardous and Solid Waste Amendments (HSWA) module of the LANL RCRA permit. All of the PRSs included in this IA are listed in the permit.

### 1.3 Impact on Regulatory Compliance, Cost, and Schedule

This IA will not adversely impact regulatory compliance at the site. Instead, it will enhance compliance by removing the source of contamination to prevent further release. This IA is included in the 1996 baseline and schedule.

## 2.0 Site Description and Characterization Data

A description of the site location, environmental setting, history, geology, and the PRSs are included in the OU 1093 work plan (LANL 1993, 1085). The 1995 RFI report for OU 1093 (Environmental Restoration Project 1995, 1283) includes the results of the sampling conducted during the site investigation. Because the RFI report and its addendum discuss in detail the chemicals of potential

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concern (COPCs) and the degree of risk to human health and the environment regarding contamination found at these PRSs, only a synopsis is presented in this IA plan. See Figure 2-1 for PRS locations.

## 2.1 Site Description and Proximity to Stream Channels/Aquifers

TA-18 is located in Pajarito Canyon and its tributary, Three Mile Canyon, which joins Pajarito Canyon at the southwest corner of TA-18 (Figure 2-1). Small intermittent creeks in each canyon join at TA-18 and flow eastward down the length of Pajarito Canyon, through White Rock to the Rio Grande. Seasonal flow in the creeks is maintained by springs in Three Mile Canyon and by perched groundwater in the shallow alluvial aquifer found in both canyons. The main source of water is runoff from upstream and from local summer thunderstorms. The Y-shaped site consists of a main complex of buildings and three outlying nuclear criticality facilities, one to the northwest in Pajarito Canyon, another in Three Mile Canyon, and a third southeast of the main complex. Each facility has a septic tank and associated drainfield. The tanks have not been used for several years. The drainfields are within a few tens of yards of the creeks. Depth to groundwater is generally several feet below the clay tile pipes of the drainfields.

## 2.2 Operational/Contamination History

PRS 18-003(a) is a concrete pit containing a removable steel catch tank. It has been used since 1947 to collect industrial wastewater from Building TA-18-23, a critical assembly building in the northwest part of TA-18. Solvents were used in the building, and uranium and plutonium are currently used in small fission experiments. Historically, the catch tank was emptied periodically. Any overflow from the catch tank would, however, enter the building's sanitary sewer line downstream from the septic tank. Because such discharge would reach the drainfield, water service to the building has been shut off and the catch tank's overflow line has been plugged. However, the concrete pit is open at the bottom, leaving a pathway to the soil for any leaks or spills from the tank.

PRS 18-003(b) is an abandoned sanitary septic system, placed in service in 1947, that serves a restroom in Building TA-18-23. The PRS consists of sewer lines, a septic tank, and a drainfield. Although water service to the building has been shut off and the doors to the restroom have been locked, the sewer lines have not been plugged. Solvents and beryllium were used in the building, and uranium and plutonium are currently used in small fission experiments.

PRS 18-003(c) is an abandoned sanitary septic system, placed in service in 1952, that serves a restroom in Building TA-18-32, the critical assembly building in the southwest part of TA-18. The PRS consists of sewer lines, a septic tank, a drainfield, and an outfall at the creek flowing from Three Mile Canyon. Although water service to the building has been shut off and the doors to the restroom locked, the sewer lines have not been plugged. Solvents and beryllium were used in the building, and uranium and plutonium are currently used in small fission experiments.

PRS 18-003(d) is an abandoned sanitary septic system, placed in service in 1960, that serves the restroom in Building TA-18-116. This PRS consists of sewer lines, a septic tank, and a drainfield. Although all sanitary facilities have been removed from Building TA-18-116, the sewer lines have not been plugged. Solvents and beryllium were used in the building, and uranium and plutonium are currently used in small fission experiments.

PRS 18-003(g) is a concrete septic tank that dates from 1943. This PRS serves the remainder of Building TA-18-1. Originally this PRS was a shop/lab/office with a restroom and a photolab. The building was demolished in 1968, except for the high bay, which is currently used as a work area for mechanical assembly. Inflow to the septic tank is only from the high bay's restroom, added in 1968. The tank has always functioned as a settling pit, originally with an outfall near the creek in Pajarito Canyon and later possibly connected to PRS 18-003(e) (septic tank and drainfield). When the septic tank associated with PRS 18-003(e) was abandoned in 1969, its input lines and the line from PRS 18-003(g) were connected to the site sewer system that routed effluent eastward to sanitary sewage lagoons in Pajarito Canyon.

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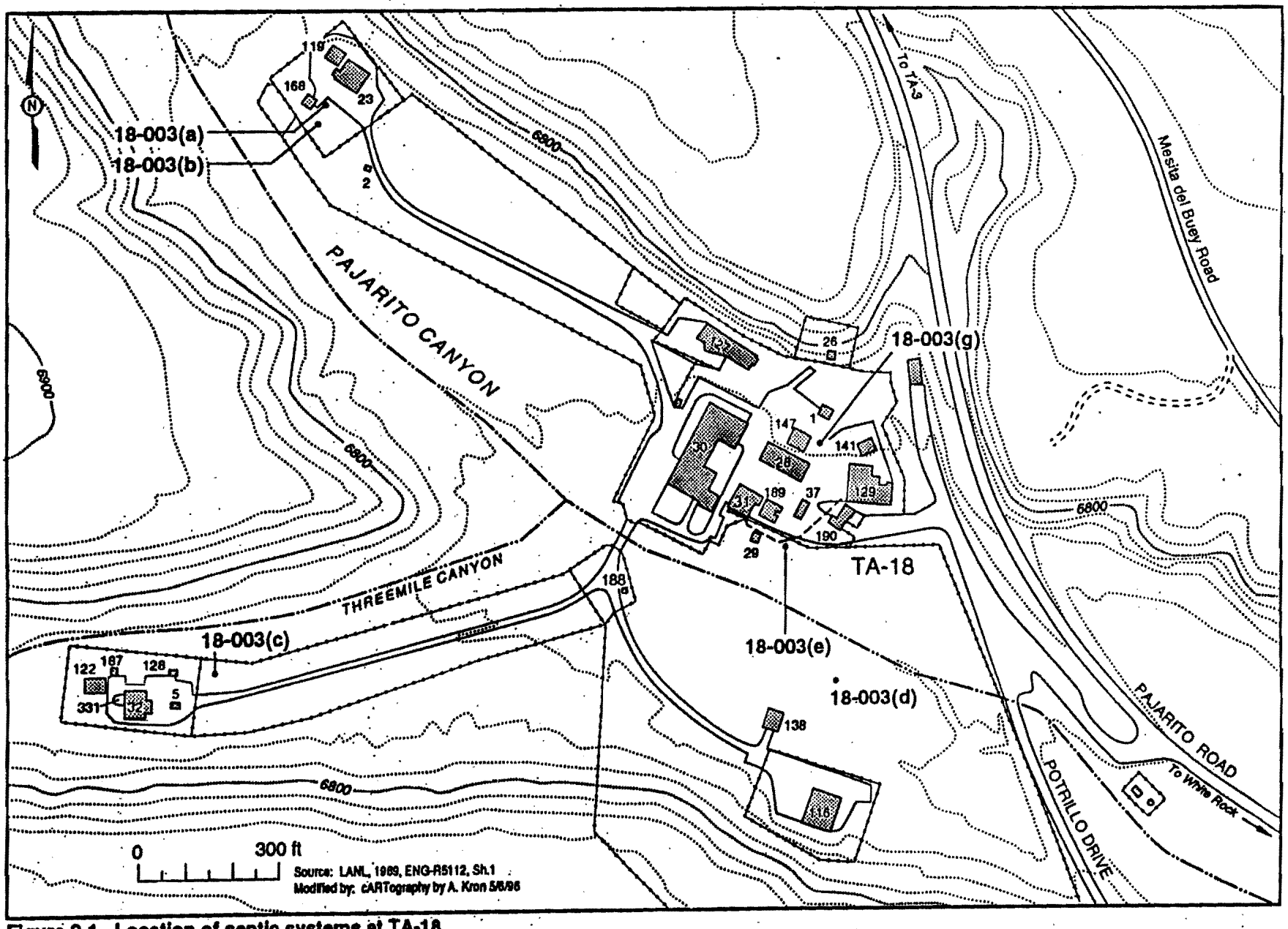


Figure 2-1. Location of septic systems at TA-18.

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This site-wide system is now connected to the TA-46 treatment plant. The septic tank remains full to the outlet pipe and contains about 550 gallons of sewage.

### 2.3 RFI Information/Other Decision Data

Sampling of the liquid and sludge contents of the five tanks was first conducted during the 1993 site characterization. Results of the sampling are presented in the RFI report and its addendum. Because of preliminary indications of mixed waste, confirmatory sampling and more extensive analyses were done in 1996 to further characterize the waste in order to meet the stringent waste acceptance criteria of the treatment, storage, and disposal facility (TSDF) of Envirocare of Utah, Inc. The 1996 waste characterization data are summarized in Appendix A.

## 3.0 Interim Action

The field activities associated with this IA include the following:

- Setting up a RCRA less-than-90-day storage area.
- Setting up spill control measures.
- Removal, containerization, and stabilization of tank contents.
- Pressure-rinse of the tank interiors.

Liquids from the decontamination of the tank interiors and field equipment will be segregated and containerized. In-field stabilization of the tank liquids and the decontamination liquids will occur if these liquids are not accepted by the TA-50 Radioactive Liquid Waste Treatment Facility.

The outside surface of the catch tank at PRS 18-003(a) will be swiped to determine if alpha contamination is present, indicating that an overflow may have occurred. In addition, the gravel bottom of the pit will be sampled for contamination.

## 4.0 Monitoring and Confirmatory Activities

Not applicable

## 5.0 Maintenance and Inspection

Not applicable

## 6.0 Waste Management

Wastes generated at the five PRSs will be managed according to LANL-ER-AP-05.3, Management of Environmental Restoration Waste (or its replacement SOPs, due in May 1996) and LANL-ER-SOP-10.07, Field Monitoring for Surface and Volume Radioactivity Levels (LANL, 0875).

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## 6.1 Waste Volumes and Characteristics

Based on depth measurements in the five tanks, the quantities (in gallons) and types of wastes that will be generated by this IA are shown in Table 6-1. The volume of personal protective equipment (PPE) and sampling/waste management equipment, which is estimated to be less than two 55-gallon drums, is not shown.

**TABLE 6-1**
**WASTE VOLUMES GENERATED BY INTERIM ACTION**

| PRS Number | Liquid Waste (gal) | Returned Decon Liquid (gal) | Sludge Waste (gal) | Decon Liquid (gal) | Treatability Study Waste (gal) |
|---|---|---|---|---|---|
| 18-003(a) | 24 | 2 | 4 | 110[1] | 2 |
| 18-003(b) | 213 | 2 | 23 | 200[2] | 2 |
| 18-003(c) | 208 | 2 | 25 | 200 | |
| 18-003(d) | 188 | 2 | 8 | 200 | |
| 18-003(g) | 700 | 2 | 1 | 200 | |

[1]Triple rinse of PRS 18-003(a) at 30 gal/rinse plus decon of PPE and pump equipment at 20 gallons.

[2]Triple rinse of PRSs 18-003(a-d and g) at 60 gal/rinse plus decon of PPE and sampling equipment at 20 gal/tank.

## 6.2 Mixed Waste Treatment and Disposal

Table 6-2 shows the proposed disposition of the various waste types generated. Liquids, sludges, and slurries sent offsite for disposal will be stabilized before shipment. All waste will be characterized in accordance with an approved Waste Characterization Strategy Form.

Analytical results indicate that the liquid portion of PRS 18-003(c) is nonhazardous, radioactive waste. All other tank wastes (liquids and sludge) contain RCRA-regulated constituents. Only the liquid and sludge portions of the waste from PRS 18-003 and the sludge portion of the waste from PRS 18-003(b) will require treatment to meet the RCRA Land Disposal Restriction (LDR) treatment standards. As discussed below, the liquid portions of PRSs 18-003(b, c, and d) may be disposed of as nonhazardous, radioactive waste.

**Tank Contents**

Because of the presence of F-listed constituents, the liquids from PRSs 18-003(b, c, and d) would normally be classified as mixed waste. Under certain conditions, however, wastewater containing specified F-listed constituents are not defined as hazardous waste. According to 40 CFR 261.3(a)(2)(iv)(A) and (B), this exclusion applies (1) if the generator can demonstrate that the mixture consists of a wastewater the discharge of which is subject to regulation under the Clean Water Act and (2) maximum concentrations of the F-listed constituents (measured at the headworks of the wastewater treatment facility) are adhered to. A determination by ESH-19 regarding the use of this exclusion is pending. If it is determined that this exclusion cannot be used, these liquids will be stabilized and disposed of at Envirocare. If it is determined that this exclusion can be used, the liquids will be pumped into a pump truck using a 2-inch peristaltic pumping device. While the liquids are pumped, care will be taken to prevent disturbing the sludge layer, and pumping will cease if the sludge layer is disturbed. If

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**TABLE 6-2**
**PROPOSED DISPOSAL STRATEGY FOR**
**WASTE TYPES GENERATED BY INTERIM ACTION**

| PRS Number | Matrix | Type | Volume (gal) | RCRA Treatment | Disposal |
|---|---|---|---|---|---|
| 18-003(a) | Liquid[1] | Nonhazardous, Radioactive[2] | 80 | None | TA-50 RLWTF |
| 18-003(a) | Solid | Mixed | 50 | Onsite | Envirocare |
| 18-003(b) | Liquid | Nonhazardous, radioactive[2] | 302 | None | TA-50 RLWTF |
| 18-003(b) | Solid | Mixed | 171 | Onsite | Envirocare |
| 18-003(c) | Liquid | Nonhazardous, radioactive[2] | 298 | None | TA-50 RLWTF |
| 18-003(c) | Solid | Mixed | 137 | None | Envirocare |
| 18-003(d) | Liquid | Nonhazardous, radioactive[2] | 283 | None | TA-50 RLWTF |
| 18-003(d) | Solid | Mixed | 115 | None | Envirocare |
| 18-003(g) | Solid[3] | Mixed | 903 | None | Envirocare |
| PPE | Solid | Mixed | 110 | None | Envirocare |

[1]Tank and sampling/waste management equipment decontamination fluids only.

[2]Waste classification is based upon the final disposition of the waste. Before discharge at the headworks of the TA-50 RLWTF, these liquids will be managed as mixed waste.

[3]Includes solidified liquids, sludges, and decontamination liquids from PRS 18-003(g).

required by TA-50, the liquids will be filtered. The liquids will be transported to the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) and disposed of as nonhazardous, radioactive waste. The sludge portion of the waste from PRSs 18-003(c and d) and both the liquid and sludge portions of the waste from PRS 18-003(g) will be pumped into DOT-certified containers and will be segregated by PRS. These wastes will be stabilized and disposed of as mixed waste at Envirocare.

The liquid and sludge portions of the waste from PRS 18-003(a) and the sludge portion of the waste from PRS 18-003(b) will require treatment to meet the LDR standards. These wastes will be pumped into DOT-certified 55-gallon drums and segregated by PRS to be treated to meet the LDR treatment standards. After treatment, these wastes will be analyzed and disposed of as mixed waste at Envirocare.

**Decontamination Liquids**

After the waste is removed, the catch basin and septic tanks will be decontaminated by high pressure rinsing (three rinses). The first rinse will be added to the sludge that was removed from that PRS. These wastes will be treated and/or stabilized along with the sludges, as described previously.

Pending a final determination regarding the use of the aforementioned RCRA wastewater exemption, the second and third rinses, as well as the liquids used to decontaminate the PPE and sampling/waste management equipment, will be disposed of as either nonhazardous, radioactive waste at the TA-50 RLWTF or stabilized and sent to Envirocare for disposal as mixed waste. More than three rinses may be necessary to achieve effective decontamination.

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## PPE and Sampling/Waste Management Equipment

PPE and sampling/waste management equipment will be managed in accordance with an approved Waste Characterization Strategy Form. Efforts will be made during waste removal and tank decontamination to minimize the generation of radioactive, hazardous, or mixed waste. These items will be decontaminated after use and screened for radioactivity. If the items cannot be completely decontaminated, they will be managed as either radioactive or RCRA mixed waste.

## Onsite Treatment

In-drum organic solidification is proposed for the liquid and sludge portions of waste from PRS 18-003(a) and for the sludge portion of the waste from PRS 18-003(b). (Waste volumes to be generated are too small to be treated by Envirocare.) Several polymers capable of chemically and/or physically binding the organic constituents known to be present are available commercially. Either onsite tests using surrogate waste or treatability studies conducted at an offsite commercial facility will determine the appropriate ratio of wastes to solidifying agent(s). Results of this testing will be used to complete the waste analysis plan that will be submitted to the New Mexico Environment Department (NMED) in accordance with 20 NMAC 4.1, Section 40 CFR 268.7(a)(4). Wastes generated from the onsite tests or treatability study will be added to the waste from PRSs 18-003(a and b) as appropriate.

Contractual arrangements with Envirocare are being done via an existing contract for waste disposal with DOE/Oak Ridge National Laboratory or with a new one being developed by the DOE Albuquerque Operations Office. A DOE Exemption Package is being prepared for offsite shipment of low-level mixed waste. When completed, this exemption package will be provided to the DOE Los Alamos Area Office for their review and approval.

# 7.0 Schedule and Cost

## 7.1 Estimated Interim Action Costs

Waste removal, tank decontamination, waste containerization and storage, onsite treatment, post-treatment waste characterization, waste shipment, and disposal will involve LANL groups and offsite contractors with whom negotiations have not yet been completed. Costs are, therefore, only estimates (see Table 7-1).

**TABLE 7-1**
**ESTIMATED COST FOR TANK DECONTAMINATION AND WASTE MANAGEMENT**

| Activity | Estimated Cost |
|---|---|
| Waste Treatment | $ 6,000 |
| Waste Disposal | $ 64,000 |
| Sample Analysis | $ 6,000 |
| Equipment and Materials | $ 11,500 |
| Waste Transportation | $ 3,000 |
| Personnel | $ 38,500 |
| Total | $129,000 |

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## 7.2 Interim Action Schedule

All of the PRSs are located within secured areas at TA-18. Waste removal and tank decontamination are scheduled to begin May 15, 1996. The proposed IA schedule may be impacted by on-going facility operations. Wastes requiring treatment to RCRA LDR treatment standards are expected to be successfully completed within 90 calendar days. The time interval from waste generation to offsite shipment is estimated at 76 days. Timelines showing significant milestones follow.

**Generator Treatment Schedule**

| Day | Milestone |
|---|---|
| 1 | Waste Generation |
| 14 | Treatability Study Complete |
| 21 | Waste Analysis Plan (WAP) Complete |
| 28 | WAP Submission to NMED |
| 58 | NMED WAP review period complete |
| 65 | Waste Treatment Complete |
| 75 | Verification Analysis Received |
| 76 | LANL Waste Profile/Disposal Request Submission |
| 85 | Waste Transported to TA-54 |

**Waste Disposal Schedule**

| Day | Milestone |
|---|---|
| 1 | LANL Waste Profile Forms Approved |
| 10 | Envirocare Waste Profile Form Submission |
| 15 | Waste Generation Complete |
| 45 | Receive Envirocare Waste Acceptance Authorization |
| 48 | Preshipment Sample Submission |
| 60 | Receive DOE Offsite Disposal Authorization |
| 65 | LANL Shipping Manifests Complete |
| 66 | Submit 10-Day Notification to Ship |
| 76 | Ship Waste |

## 8.0 References


Environmental Restoration Project, October 1995. "RFI Report for Potential Release Sites 18-002(a-c), 18-003(a-h), 18-004(a,b), 18-005(a), 18-008, 18-010(b-f), 18-011, 18-012(a-c), 18-013, 27-002 (located in former Operable Unit 1093), Field Unit 2," Los Alamos National Laboratory Report LA-UR-95-3833, ER ID No. 52183, Los Alamos, New Mexico. (Environmental Restoration Project 1995, 1283)

LANL (Los Alamos National Laboratory). "Los Alamos National Laboratory Environmental Restoration Program Standard Operating Procedures," Los Alamos National Laboratory report, Los Alamos, New Mexico. (LANL, 0875)

LANL (Los Alamos National Laboratory), May 1993. "RFI Work Plan for Operable Unit 1093," Los Alamos National Laboratory Report LA-UR-93-422, Los Alamos, New Mexico. (LANL 1993, 1085)



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# APPENDIX A

# WASTE CHARACTERIZATION DATA

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Table A-1
Comparison of Concentrations with Regulatory Levels
for PRS 18-003(a)
March 1996 Sampling

| atrix/ ample umber/ stimated olume | Preliminary Regulatory Status | Needs Treatment: Exceeds LDR Standards | RCRA Constituents/ Radionuclides Due to DOE Operations | Maximum Concentration | Preliminary RCRA Waste Codes | TC Regulatory Levels | LDR Treatment Standards Wastewaters (based on total analyses) | LDR Treatment Standards Non-Wastewaters (based on total analyses) |
|---|---|---|---|---|---|---|---|---|
| quid<br>218-96-001<br>l gallons | Mixed Waste | NO | Methylene chloride | Total: .0815 mg/L | F001/F002 | NA | .089 mg/L | 30 mg/kg |
| | | YES | Tetrachloroethylene | Total: .159 mg/L | F001/F002 | 0.7 mg/L | .056 mg/L | 6.0 mg/kg |
| | | YES | Trichloroethylene | Total: 49.2 mg/L | F001/F002 | 0.5 mg/L | .054 mg/L | 6.0 mg/kg |
| | | NO | Total Cresols (m-,p-,o- isomers) | Total: .076 mg/L | F004 | 200.0 mg/L | .88 mg/L | 11.2 mg/kg |
| | | NA | Plutonium-239/240[a] | 0.2 pCi/L | NA | NA | NA | NA |
| | | NA | Strontium-90 | 8.3 pCi/L | NA | NA | NA | NA |
| | | NA | Thorium-228 | 0.2 pCi/L | NA | NA | NA | NA |
| | | NA | Thorium-230 | 0.4 pCi/L | NA | NA | NA | NA |
| | | NA | Tritium | 360 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-233/234[a] | 2130 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-235 | 65.6 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-238 | 5.4 pCi/L | NA | NA | NA | NA |
| ludge<br>218-96-002<br>gallons | Mixed Waste | NO | Tetrachloroethylene | TCLP: .702 mg/L<br>Total: 2.0[b] mg/L | F001/F002 | 0.7 mg/L | .056 mg/L | 6.0 mg/kg |
| | | YES | Trichloroethylene | TCLP: 221.0 mg/L<br>Total: 409.8[b] mg/L | F001/F002 | 0.5 mg/L | .054 mg/L | 6.0 mg/kg |
| | | NA | Americium-241 | 3.5 pCi/G | NA | NA | NA | NA |
| | | NA | Cesium-137 | 1.7 pCi/G | NA | NA | NA | NA |

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Table A-1 (continued)
PRS 18-003(a)

ORIGINAL RECORD

| Matrix/ Sample Number/ Estimated Volume | Preliminary Regulatory Status | Needs Treatment: Exceeds LDR Standards | RCRA Constituents/ Radionuclides Due to DOE Operations | Maximum Concentration | Preliminary RCRA Waste Codes | TC Regulatory Levels | LDR Treatment Standards Wastewaters (based on total analyses) | LDR Treatment Standards Non-Wastewaters (based on total analyses) |
|---|---|---|---|---|---|---|---|---|
| Sludge<br><br>0218-96-0002<br><br>4 gallons | Mixed Waste | NA | Cobalt-57 | 2.6 pCi/G | NA | NA | NA | NA |
| | | NA | Cobalt-60 | 0.6 pCi/G | NA | NA | NA | NA |
| | | NA | Europium-152 | 0.7 pCi/G | NA | NA | NA | NA |
| | | NA | Lead-212 | 0.4 pCi/G | NA | NA | NA | NA |
| | | NA | Mercury-203 | 0.7 pCi/G | NA | NA | NA | NA |
| | | NA | Plutonium-238 | 0.6 pCi/G | NA | NA | NA | NA |
| | | NA | Plutonium-239/240[a] | 9.1 pCi/G | NA | NA | NA | NA |
| | | NA | Potassium-40 | 1.1 pCi/G | NA | NA | NA | NA |
| | | NA | Protactinium-234M | 13.2 pCi/G | NA | NA | NA | NA |
| | | NA | Strontium-90 | 4.8 pCi/G | NA | NA | NA | NA |
| | | NA | Technicium-99 | 9.6 pCi/G | NA | NA | NA | NA |
| | | NA | Thallium-208 | 0.1 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-228 | 2.8 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-230 | 11 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-232 | 0.9 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-233/234[a] | 63,800 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-235 | 2,730 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-238 | 327 pCi/G | NA | NA | NA | NA |

a - The analytical laboratory could not distinguish between these isotopes without knowing the original isotopic ratios. The generator does not know the original isotopic ratios that was in the plutonium and uranium that was used at the site.
b - Data are from the 1993 sampling: the March 1996 sample was inadvertently not analyzed for VOCs.

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**Tab[illegible]-2**
**Comparison of Concentra[illegible] with Regulatory Levels**
**for PRS 18-003(b)**
**March 1996 Sampling**

| Matrix/ Sample Number/ Estimated Volume | Preliminary Regulatory Status | Needs Treatment: Exceeds LDR Standards | RCRA Constituents/ Radionuclides Due to DOE Operations | Maximum Concentration | Preliminary RCRA Waste Codes | TC Reg. Levels | LDR Treatment Standards Wastewaters (based on total analyses) | LDR Treatment Standards Non-Wastewaters (based on total analyses) |
|---|---|---|---|---|---|---|---|---|
| Liquid<br>0218-96-0003<br>213 gallons | Mixed Waste | NO | Trichloroethylene | Total: .00616 mg/L | F001/F002 | 0.5 mg/L | .054 mg/L | 6.0 mg/kg |
| | | NA | Plutonium-239/240[a] | 0.4 pCi/L | NA | NA | NA | NA |
| | | NA | Potassium-40 | 93.3 pCi/L | NA | NA | NA | NA |
| | | NA | Strontium-90 | 0.9 pCi/L | NA | NA | NA | NA |
| | | NA | Thorium-230 | 0.2 pCi/L | NA | NA | NA | NA |
| | | NA | Tritium | 280 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-233/234[a] | 1190 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-235 | 42.2 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-238 | 5.4 pCi/L | NA | NA | NA | NA |
| Sludge<br>0218-96-0004<br>23 gallons | Mixed Waste | NO | Tetrachloroethylene | TCLP: .709 mg/L<br>Total: ND | F001/F002 | 0.7 mg/L | .056 mg/L | 6.0 mg/kg |
| | | YES | Trichloroethylene | TCLP: 166.0 mg/L<br>Total: .0038 mg/kg | F001/F002 | 0.5 mg/L | .054 mg/L | 6.0 mg/kg |
| | | NA | Actinium-228 | 0.1 pCi/G | NA | NA | NA | NA |
| | | NA | Bismuth-214 | 0.1 pCi/G | NA | NA | NA | NA |
| | | NA | Cesium-137 | 0.4 pCi/G | NA | NA | NA | NA |
| | | NA | Cobalt-57 | 0.05 pCi/G | NA | NA | NA | NA |
| | | NA | Iodine-129 | 0.2 pCi/G | NA | NA | NA | NA |
| | | NA | Plutonium-238 | 0.003 pCi/G | NA | NA | NA | NA |
| | | NA | Plutonium-239/240[a] | 0.7 pCi/G | NA | NA | NA | NA |
| | | NA | Potassium-40 | 1.4 pCi/G | NA | NA | NA | NA |

[illegible] Use Only

| Matrix/ Sample Number/ Estimated Volume | Preliminary Regulatory Status | Needs Treatment: Exceeds LDR Standards | RCRA Constituents/ Radionuclides Due to DOE Operations | Maximum Concentration | Preliminary RCRA Waste Codes | TC Reg. Levels | LDR Treatment Standards Wastewaters (based on total analyses) | LDR Treatment Standards Non-Wastewaters (based on total analyses) |
|---|---|---|---|---|---|---|---|---|
| Sludge<br><br>0218-96-0004<br><br>23 gallons | Mixed Waste | NA | Radium-226 | 0.1 pCi/G | NA | NA | NA | NA |
| | | NA | Strontium-90 | 1.9 pCi/G | NA | NA | NA | NA |
| | | NA | Strontium-95 | 0.04 pCi/G | NA | NA | NA | NA |
| | | NA | Thallium-208 | 0.07 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-228 | 1.4 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-230 | 1.1 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-232 | 1.3 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-233/234[a] | 1020 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-235 | 43.6 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-238 | 8.4 pCi/G | NA | NA | NA | NA |

- The analytical laboratory could not distinguish between these isotopes without knowing the original isotopic ratios. The generator does not know the original isotopic atios that was in the plutonium and uranium that was used at the site.

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Tab[illegible]3

**Comparison of Concentrations with Regulatory Levels for PRS 18-003(c) March 199[illegible] Sampling**

| Matrix/ Sample Number/ Estimated Volume | Preliminary Regulatory Status | Needs Treatment: Exceeds LDR Standards | RCRA/TSCA Constituents and Radionuclides Due to DOE Operations | Maximum Concentration | Preliminary RCRA Waste Codes | TC Reg. Levels | LDR Treatment Standards Wastewaters (based on total analyses) | LDR Treatment Standards Non-Wastewaters (based on total analyses) |
|---|---|---|---|---|---|---|---|---|
| Liquid<br>0218-96-0005<br>208 gallons | Low-Level Radioactive Waste | NA | PCB-1254 | Total: .00307 mg/L | NA | NA | NA | NA |
| | | NA | Plutonium-239/240[a] | 0.3 pCi/L | NA | NA | NA | NA |
| | | NA | Strontium-90 | 1.8 pCi/L | NA | NA | NA | NA |
| | | NA | Thorium-230 | 0.2 pCi/L | NA | NA | NA | NA |
| | | NA | Tritium | 289 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-233/234[a] | 548 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-235 | 15.6 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-238 | 5.5 pCi/L | NA | NA | NA | NA |
| Sludge<br>0218-96-0006<br>25 gallons | Mixed Waste | NO | Methylene Chloride | Total: .0018 mg/L | F001/F002 | NA | 0.089 mg/L | 30 mg/kg |
| | | NO | Methyl Ethyl Ketone | TCLP: ND<br>Total: .0053 mg/kg | F005 | 200.0 mg/L | 0.28 mg/L | 36 mg/kg |
| | | NA | Actinium-228 | 0.6 pCi/G | NA | NA | NA | NA |
| | | NA | Americium-241 | 2.0 pCi/G | NA | NA | NA | NA |
| | | NA | Bismuth-211 | 0.4 pCi/G | NA | NA | NA | NA |
| | | NA | Bismuth-212 | 0.5 pCi/G | NA | NA | NA | NA |
| | | NA | Cesium-137 | 5.8 pCi/G | NA | NA | NA | NA |
| | | NA | Cobalt-57 | 0.8 pCi/G | NA | NA | NA | NA |
| | | NA | Europium-152 | 0.3 pCi/G | NA | NA | NA | NA |
| | | NA | Lead-212 | 0.8 pCi/G | NA | NA | NA | NA |
| | | NA | Lead-214 | 0.2 pCi/G | NA | NA | NA | NA |

[illegible] USE ONLY

| Matrix/ Sample Number/ Estimated Volume | Preliminary Regulatory Status | Needs Treatment: Exceeds LDR Standards | RCRA/TSCA Constituents and Radionuclides Due to DOE Operations | Maximum Concentration | Preliminary RCRA Waste Codes | TC Reg. Levels | LDR Treatment Standards Wastewaters (based on total analyses) | LDR Treatment Standards Non-Wastewaters (based on total analyses) |
|---|---|---|---|---|---|---|---|---|
| Sludge<br><br>0218-96-0006<br><br>25 gallons | Mixed Waste | NA | Mercury-203 | 0.2 pCi/G | NA | NA | NA | NA |
| | | NA | Plutonium-238 | 0.1 pCi/G | NA | NA | NA | NA |
| | | NA | Plutonium-239/240[a] | 7.2 pCi/G | NA | NA | NA | NA |
| | | NA | Potassium-40 | 1.9 pCi/G | NA | NA | NA | NA |
| | | NA | Proactinium-234M | 27 pCi/G | NA | NA | NA | NA |
| | | NA | Radium-226 | 0.2 pCi/G | NA | NA | NA | NA |
| | | NA | Strontium-90 | 28 pCi/G | NA | NA | NA | NA |
| | | NA | Thallium-208 | 0.2 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-228 | 3.6 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-230 | 5.2 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-232 | 3.6 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-234 | 15.5 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-233/234[a] | 9680 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-235 | 259 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-238 | 97.9 pCi/G | NA | NA | NA | NA |

a - The analytical laboratory could not distinguish between these isotopes without knowing the original isotopic ratios. The generator does not know the original isotopic ratios that was in the plutonium and uranium that was used at the site.

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**Table**
**Comparison of Concentrations with Regulatory Levels**
**for PRS 18-003(d)**
**March 1996 Sampling**

| Matrix/ Sample Number/ Estimated Volume | Preliminary Regulatory Status | Needs Treatment: Exceeds LDR Standards | RCRA Constituents/ Radionuclides Due to DOE Operations | Maximum Concentration | Preliminary RCRA Waste Codes | TC Reg. Levels | LDR Treatment Standards Wastewaters (based on total analyses) | LDR Treatment Standards Non-Wastewaters (based on total analyses) |
|---|---|---|---|---|---|---|---|---|
| Liquid<br>0218-96-0007<br>188 gallons | Mixed Waste | NO | 1,1,1-Trichloroethane | Total: .0138 mg/L | F001/F002 | NA | 0.054 mg/L | 6.0 mg/kg |
| | | NO | Methylene Chloride | Total: .00207 mg/L | F001/F002 | NA | 0.089 mg/L | 30 mg/kg |
| | | NO | Trichloroethylene | Total: .00272 | F001/F002 | 0.5 mg/L | 0.054 mg/L | 6.0 mg/kg |
| | | NA | Plutonium-239/240[a] | 0.2 pCi/L | NA | NA | NA | NA |
| | | NA | Thorium-230 | 0.1 pCi/L | NA | NA | NA | NA |
| | | NA | Tritium | 287 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-233/234[a] | 23.9 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-235 | 1.1 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-238 | 0.2 pCi/L | NA | NA | NA | NA |
| Sludge<br>0218-96-0008<br>8 gallons | Mixed Waste | NO | 1,1,1-Trichloroethane | Total: .092 mg/kg | F001/F002 | NA | 0.054 mg/L | 6.0 mg/kg |
| | | NO | Toluene | Total: .784 mg/kg | F005 | NA | 0.80 mg/L | 10 mg/kg |
| | | NO | Trichloroethylene | TCLP: ND<br>Total: .030 mg/kg | F001/F002 | 0.5 mg/L | 0.054 mg/L | 6.0 mg/kg |
| | | NO | Methyl Ethyl Ketone | TCLP: .0262 mg/L<br>Total: ND | F005 | 200.0 mg/L | 0.28 mg/L | 36 mg/kg |
| | | NA | Cesium-137 | 0.1 pCi/G | NA | NA | NA | NA |
| | | NA | Plutonium-238 | 0.1 pCi/G | NA | NA | NA | NA |
| | | NA | Plutonium-239/240[a] | 0.5 pCi/G | NA | NA | NA | NA |
| | | NA | Radium-224 | 0.6 pCi/G | NA | NA | NA | NA |
| | | NA | Strontium-90 | 8.4 pCi/G | NA | NA | NA | NA |

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Table A-4 (continued)
PRS 18-003(d)

| Matrix/ Sample Number/ Estimated Volume | Preliminary Regulatory Status | Needs Treatment: Exceeds LDR Standards | RCRA Constituents/ Radionuclides Due to DOE Operations | Maximum Concentration | Preliminary RCRA Waste Codes | TC Reg. Levels | LDR Treatment Standards Wastewaters (based on total analyses) | LDR Treatment Standards Non-Wastewaters (based on total analyses) |
|---|---|---|---|---|---|---|---|---|
| Sludge | Mixed Waste | NA | Thorium-228 | 1.1 pCi/G | NA | NA | NA | NA |
| )218-96- | | NA | Thorium-230 | 1.4 pCi/G | NA | NA | NA | NA |
| )008 | | NA | Thorium-232 | 1 pCi/G | NA | NA | NA | NA |
| 3 gallons | | NA | Uranium-233/234[a] | 182 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-235 | 6.1 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-238 | 0.8 pCi/G | NA | NA | NA | NA |

The analytical laboratory could not distinguish between these isotopes without knowing the original isotopic ratios. The generator does not know the original isotopic ios that was in the plutonium and uranium that was used at the site.

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**Table**
**Comparison of Concentratio[illegible]th Regulatory Levels**
**for PRS 18-003(g)**
**March 1996 Sampling**

| atrix/ mple umber/ timated olume | Preliminary Regulatory Status | Needs Treatment: Exceeds LDR Standards | RCRA Constituents/ Radionuclides Due to DOE Operations | Maximum Concentration | Preliminary RCRA Waste Codes | TC Reg. Levels | LDR Treatment Standards Wastewaters (based on total analyses) | LDR Treatment Standards Non-Wastewaters (based on total analyses) |
|---|---|---|---|---|---|---|---|---|
| quid | Mixed Waste | NO | Benzene | Total: .00271 mg/L | F005 | 0.5 mg/L | 0.14 mg/L | 10 mg/kg |
| 18-96- 09 | | NO | Trichloroethylene | Total: .00842 mg/L | F001/F002 | 0.5 mg/L | 0.054 mg/L | 6.0 mg/kg |
| | | NA | Strontium-90 | 2.3 pCi/L | NA | NA | NA | NA |
| 0 gallons | | NA | Thorium-230 | 0.1 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-233/234[a] | 5.2 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-235 | 0.2 pCi/L | NA | NA | NA | NA |
| | | NA | Uranium-238 | 0.7 pCi/L | NA | NA | NA | NA |
| ludge | Mixed Waste | NO | Total Cresols (m-,p-,o-isomers) | TCLP: .151 mg/L Total: ND | F004 | 200.0 mg/L | 0.88 mg/L | 11.2 mg/kg |
| 218-96- 010 | | NA | Plutonium-238 | 0.05 pCi/G | NA | NA | NA | NA |
| | | NA | Plutonium-239/240[a] | 0.2 pCi/G | NA | NA | NA | NA |
| ickness as too in to easure | | NA | Potassium-40 | 0.8 pCi/G | NA | NA | NA | NA |
| | | NA | Strontium-90 | 1.3 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-228 | 0.4 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-230 | 0.4 pCi/G | NA | NA | NA | NA |
| | | NA | Thorium-232 | 0.4 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-233/234[a] | 6.2 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-235 | 0.2 pCi/G | NA | NA | NA | NA |
| | | NA | Uranium-238 | 1.5 pCi/G | NA | NA | NA | NA |

The analytical laboratory could not distinguish between these isotopes without knowing the original isotopic ratios. The generator does not know the original isotopic ios that was in the plutonium and uranium that was used at the site.

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# APPENDIX B

# INTERIM ACTION APPROVAL FORM

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INTERIM ACTION APPROVAL FORM

I, Theodore J. Taylor DOE-LAAO **APPROVE** the interim action as proposed in this Interim Action Plan for PRSs 18-003 (a,b,c,d,g).

I,_____ DOE-LAAO **DO NOT APPROVE** the interim action as proposed in this Interim Action Plan for PRSs 18-003 (a,b,c,d,g).

The following reasons reflect the basis for this disapproval.

Signed: [signature] Date: 5/23/96

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