Nevada
Environmental
Management
Operations Activity

DOE/NV--1520

National Nuclear Security Administration

Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 415: Project 57 No. 1 Plutonium Dispersion (NTTR), Nevada

Controlled Copy No.: ___
Revision No.: 0

April 2014

UNCLASSIFIED

/s/ Joseph P. Johnston 04/18/2014
Joseph P. Johnston, N-I CO Date

U.S. Department of Energy
National Nuclear Security Administration
Nevada Field Office

Available for sale to the public from:

U.S. Department of Commerce
National Technical Information Service
5301 Shawnee Road
Alexandria, VA 22312
Telephone: 800.553.6847
Fax: 703.605.6900
E-mail: *orders@ntis.gov*
Online Ordering: *http://www.ntis.gov/help/ordermethods.aspx*

Available electronically at *http://www.osti.gov/bridge*

Available for a processing fee to U.S. Department of Energy and its contractors, in paper, from:

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
Phone: 865.576.8401
Fax: 865.576.5728
Email: *reports@adonis.osti.gov*

DOE/NV--1520

STREAMLINED APPROACH FOR ENVIRONMENTAL RESTORATION (SAFER) PLAN FOR CORRECTIVE ACTION UNIT 415: PROJECT 57 NO. 1 PLUTONIUM DISPERSION (NTTR), NEVADA

U.S. Department of Energy, National Nuclear Security Administration
Nevada Field Office
Las Vegas, Nevada

Controlled Copy No.: ___

Revision No.: 0

April 2014

STREAMLINED APPROACH FOR ENVIRONMENTAL RESTORATION (SAFER) PLAN FOR CORRECTIVE ACTION UNIT 415: PROJECT 57 NO. 1 PLUTONIUM DISPERSION (NTTR), NEVADA

Approved by: /s/ Robert F. Boehlecke Date: 4/21/14

Robert F. Boehlecke
Environmental Management Operations Manager

Table of Contents

Table of Contents (Continued)

Table of Contents *(Continued)*

Table of Contents *(Continued)*

List of Figures

List of Tables

Number	Title	Page
2-1	Radionuclide Results above the MDA for COCs in 1998 Soil Samples	12
2-2	Radionuclide Results above the MDA for COCs in 2013 Soil Samples	21
2-3	Radionuclide Results above the MDA for COCs in 2014 Drainage Soil Samples	22
4-1	CAU 415 Closure Activities	41
B.2-1	CSM Description of Elements for Each Release in CAU 415	B-3
B.2-2	Contaminants of Potential Concern	B-8
D.1-1	External Dose Estimates for 1998 and 2013 Soil Samples	D-4
F.1-1	Accuracy Measurements	F-6
F.1-2	Completeness Criterion	F-7
F.1-3	Input Values and Determined Minimum Number of TLD Samples at CAU 415	F-9
F.1-4	Key Assumptions	F-12

List of Acronyms and Abbreviations

Am	Americium
ASTM	ASTM International
BMP	Best management practice
bgs	Below ground surface
CA	Contamination area
CAA	Corrective action alternative
CAI	Corrective action investigation
CAS	Corrective action site
CAU	Corrective action unit
CFR	*Code of Federal Regulations*
Ci	Curie
cm	Centimeter
COC	Contaminant of concern
COPC	Contaminant of potential concern
cpm	Counts per minute
cps	Counts per second
CR	Closure report
CSM	Conceptual site model
°C	Degrees Celsius
DOE	U.S. Department of Energy
dpm/100 cm^2	Disintegrations per minute per 100 square centimeters
DQA	Data quality assessment
DQI	Data quality indicator
DQO	Data quality objective
EPA	U.S. Environmental Protection Agency
FAL	Final action level

List of Acronyms and Abbreviations *(Continued)*

FD	Field duplicate
FFACO	*Federal Facility Agreement and Consent Order*
FIDLER	Field Instrument for the Detection of Low-Energy Radiation
FSR	Field-screening result
ft	Foot
°F	Degrees Fahrenheit
GIS	Geographic Information Systems
GPS	Global Positioning System
GZ	Ground zero
HASL	Health and Safety Laboratory
HCA	High contamination area
HPGe	High-purity germanium
HTH	Hydrologic Test Hole
IDW	Investigation-derived waste
in.	Inch
km/hr	Kilometers per hour
m	Meter
MDA	Minimum detectable activity
mi	Mile
mi^2	Square mile
mph	Miles per hour
mrem/yr	Millirem per year
mrem/IA-yr	Millirem per Industrial Area year
NAC	*Nevada Administrative Code*
NAD	North American Datum
NAEG	Nevada Applied Ecology Group

List of Acronyms and Abbreviations *(Continued)*

NDEP	Nevada Division of Environmental Protection
NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
NNSS	Nevada National Security Site
NTTR	Nevada Test and Training Range
PAL	Preliminary action level
PCB	Polychlorinated biphenyl
pCi/g	Picocuries per gram
PET	Potential evapotranspiration
PPE	Personal protective equipment
Pu	Plutonium
QA	Quality assurance
QAP	*Quality Assurance Plan*
QC	Quality control
r^2	Coefficient of determination or correlation coefficient
RBCA	Risk-Based Corrective Action
RCRA	*Resource Conservation and Recovery Act*
RRMG	Residual radioactive material guidelines
SAFER	Streamlined Approach for Environmental Restoration
TBD	To be determined
TED	Total effective dose
TLD	Thermoluminescent dosimeter
U	Uranium
UR	Use restriction
UTM	Universal Transverse Mercator

Executive Summary

This Streamlined Approach for Environmental Restoration (SAFER) Plan addresses the actions needed to achieve closure for Corrective Action Unit (CAU) 415, Project 57 No. 1 Plutonium Dispersion (NTTR). CAU 415 is located on Range 4808A of the Nevada Test and Training Range (NTTR) and consists of one corrective action site: NAFR-23-02, Pu Contaminated Soil. The CAU 415 site consists of the atmospheric release of radiological contaminants to surface soil from the Project 57 safety experiment conducted in 1957. The safety experiment released plutonium (Pu), uranium (U), and americium (Am) to the surface soil over an area of approximately 1.9 square miles. This area is currently fenced and posted as a radiological contamination area. Vehicles and debris contaminated by the experiment were subsequently buried in a disposal trench within the surface-contaminated, fenced area and are assumed to have released radiological contamination to subsurface soils. Potential source materials in the form of pole-mounted electrical transformers were also identified at the site and will be removed as part of closure activities.

Existing data are sufficient to define the nature and extent of contamination at the site and to recommend closure of CAU 415 using the SAFER process. The selected corrective action for the site is closure in place with use restrictions (URs). This corrective action will leave contamination in place, and will require long-term monitoring and implementation of administrative controls (i.e., URs) to prevent unauthorized future land uses. Because contamination will be left in place, CAU 415 will also require posting for radiological control in accordance with the U.S. Department of Energy (DOE) Occupational Radiation Protection program, governed by 10 *Code of Federal Regulations* 835. If the agreed-upon land use scenario should change from what was evaluated for site closure, the affected area would have to be reevaluated to account for the new land use.

This corrective action was selected by the CAU 415 stakeholders during the development of the data quality objectives. Closure in place of CAU 415 was selected based on the following:

- Closure in place is consistent with the closure method employed at similar safety experiment sites (e.g., CAU 366 Area 11 Plutonium Valley Dispersion Sites, CAU 550 Smoky Contamination Area), with similar contaminant characteristics (e.g., Am, Pu).

- Pu does not readily migrate in the environment. The oxides of Pu, U, and Am are relatively insoluble in water and have a high affinity for soil particles in the desert environment.

- CAU 415 is located in a remote area of Emigrant Valley, Nevada, on Range 4808A of the NTTR. The NTTR is controlled through the use of both physical (i.e., fences), and administrative (e.g., signs, postings) controls; as such, there are no known receptors with routine access to the site.

- The potential risks to workers to remove the contamination at CAU 415 outweigh the risks for closure in place. The clean closure alternative was considered to be impracticable due to the potential physical hazards associated with excavation, removal, and transportation of large volumes of contaminated soil.

Closure in place for CAU 415 includes the following:

1. Determining a corrective action boundary.

2. Establishing administrative controls (e.g., establishing UR boundary, recording boundary in the Geographic Information Systems, posting signs).

3. Removing pole-mounted transformers that potentially contain polychlorinated biphenyls.

4. Implementing best management practices (e.g., placement of a soil cover, installation of monuments/landmarks to identify potential hazards at ground zero).

This SAFER Plan presents the data supporting these closure objectives, defines the corrective action boundary, and establishes the UR boundary for the site. This SAFER Plan identifies decision points developed in cooperation with the Nevada Division of Environmental Protection (NDEP), where the DOE, National Nuclear Security Administration Nevada Field Office will reach consensus with NDEP before finalizing site closure. If the CAU 415 stakeholders determine that additional information is required to confirm site closure, a revised closure strategy will be developed. Otherwise, CAU 415 will be closed in place and the details of closure will be presented in the Closure Report.

This SAFER Plan has been developed in accordance with the *Federal Facility Agreement and Consent Order* that was agreed to by the State of Nevada; DOE, Environmental Management; U.S. Department of Defense; and DOE, Legacy Management.

1.0 Introduction

This Streamlined Approach for Environmental Restoration (SAFER) Plan addresses the actions needed to achieve closure for Corrective Action Unit (CAU) 415, Project 57 No. 1 Plutonium Dispersion (NTTR). CAU 415 is located on Range 4808A of the Nevada Test and Training Range (NTTR) and consists of one corrective action site (CAS): NAFR-23-02, Pu Contaminated Soil.

A SAFER may be performed when the following criteria are met:

- Conceptual corrective actions are clearly identified.
- Uncertainty of the nature, extent, and corrective action is limited to an acceptable level of risk.
- Decision points and criteria for making data quality objective (DQO) decisions are defined.

Existing data are sufficient to define the nature and extent of contamination at the site and to recommend closure of CAU 415 using the SAFER process. As agreed to by the CAU 415 stakeholders, the selected corrective action for CAU 415 is closure in place with use restrictions (URs). Closure in place of CAU 415 was selected based on the following:

- Closure in place is consistent with the closure method employed at similar safety experiment sites (e.g., CAU 366 Area 11 Plutonium Valley Dispersion Sites, CAU 550 Smoky Contamination Area), with similar contaminant characteristics (e.g., plutonium [Pu], americium [Am]).

- Pu does not readily migrate in the environment. The oxides of Pu, uranium (U), and Am are relatively insoluble in water and have a high affinity for soil particles in the desert environment.

- CAU 415 is located in a remote area of Emigrant Valley, Nevada, on Range 4808A of the NTTR. The NTTR is controlled through the use of both physical (i.e., fences), and administrative (e.g., signs, postings) controls; as such, there are no known receptors with routine access to the site.

- The potential risks to workers to remove the contamination at CAU 415 outweigh the risks for closure in place. The clean closure alternative was considered to be impracticable due to the potential physical hazards associated with excavation, removal, and transportation of large volumes of contaminated soil.

This SAFER Plan presents the data supporting closure, defines the corrective action boundary, and establishes the UR boundary for the site. This SAFER Plan identifies decision points developed in cooperation with the Nevada Division of Environmental Protection (NDEP), where the U.S. Department of Energy (DOE), National Nuclear Security Administration Nevada Field Office (NNSA/NFO) will reach consensus with NDEP before finalizing site closure.

This document has been developed in accordance with the *Federal Facility Agreement and Consent Order* (FFACO) (1996 as amended) that was agreed to by the State of Nevada; DOE, Environmental Management; U.S. Department of Defense; and DOE, Legacy Management.

1.1 SAFER Process Description

CAUs that may be closed using the SAFER process have conceptual corrective actions that are clearly identified. Consequently, corrective action alternatives (CAAs) can be chosen before completing a corrective action investigation (CAI), given existing data and anticipated investigation results, for any identified data gaps.

The SAFER process combines elements of the DQO process and the observational approach to plan and conduct closure activities. The DQOs specific to CAU 415 are presented in Appendix B, and are used to identify the problem and define the type and quality of data needed to complete closure of the CAU. The purpose of the investigation phase is to verify the adequacy of existing information used to determine the chosen corrective action and to confirm that closure objectives were met.

Use of the SAFER process allows for technical decisions to be made based on incomplete but sufficient information, and the experience of the stakeholder. Based on a detailed review of existing information, there are sufficient data to close CAU 415 using the SAFER process. Any uncertainties are addressed by documented assumptions that are verified by data evaluation and onsite observations, as necessary. Closure activities may proceed simultaneously with site characterization as sufficient data are gathered to confirm or disprove the assumptions made during selection of the corrective action. If, at any time during the closure process, new information is discovered that indicates that closure activities should be revised, closure activities will be reevaluated as appropriate.

1.2 Summary of Corrective Actions and Closures

The CAU 415 site consists of the atmospheric release of radiological contaminants to soil from the Project 57 safety experiment conducted in 1957. The safety experiment released Pu, U, and Am to the surface soil over an area of approximately 1.9 square miles (mi^2). Vehicles and debris contaminated by the experiment were subsequently buried in a disposal trench within the surface-contaminated area and are assumed to have released radiological contamination to subsurface soils. The selected corrective action for the site is closure in place with URs. This corrective action was selected by the CAU 415 stakeholders during the development of the DQOs. The closure in place of CAU 415 includes (1) determining a corrective action boundary; (2) establishing administrative controls (e.g., establishing UR boundary, recording boundary in the Geographic Information Systems [GIS], posting signs); (3) removing pole-mounted transformers that potentially contain polychlorinated biphenyls (PCBs); and (4) implementing best management practices (BMPs). This SAFER Plan presents the data supporting these closure objectives, and defines both the corrective action boundary and the UR boundary for the site. If the CAU 415 stakeholders determine that additional information is required to confirm site closure, a revised closure strategy will be developed. Otherwise, CAU 415 will be closed in place and the details of closure will be presented in the Closure Report (CR).

The closure decision process for CAU 415 is presented in Figure 1-1. If the closure objectives defined in Section B.3.1 cannot be met, or if any of the following conditions occur, the stakeholders will be consulted and a revised closure strategy will be developed:

- Unsafe conditions or work practices are encountered.
- Conditions outside the scope of work are encountered.
- Elevated levels of additional contaminants of concern (COCs) are found that were not originally identified as being present at the site.
- Unexpected conditions including unexpected waste and/or contamination are encountered.
- Out-of-scope work activities are required due to the detection of other COCs that would require reevaluating a disposal pathway.

1.3 CAU 415 End State

The selected FFACO closure for CAU 415 using the SAFER process is closure in place with URs. Closure in place is a corrective action that leaves some level of contamination in place. This level of contamination may require URs (i.e., access controls) and/or long-term monitoring, but at a minimum requires implementation of administrative controls to prevent unauthorized future land uses

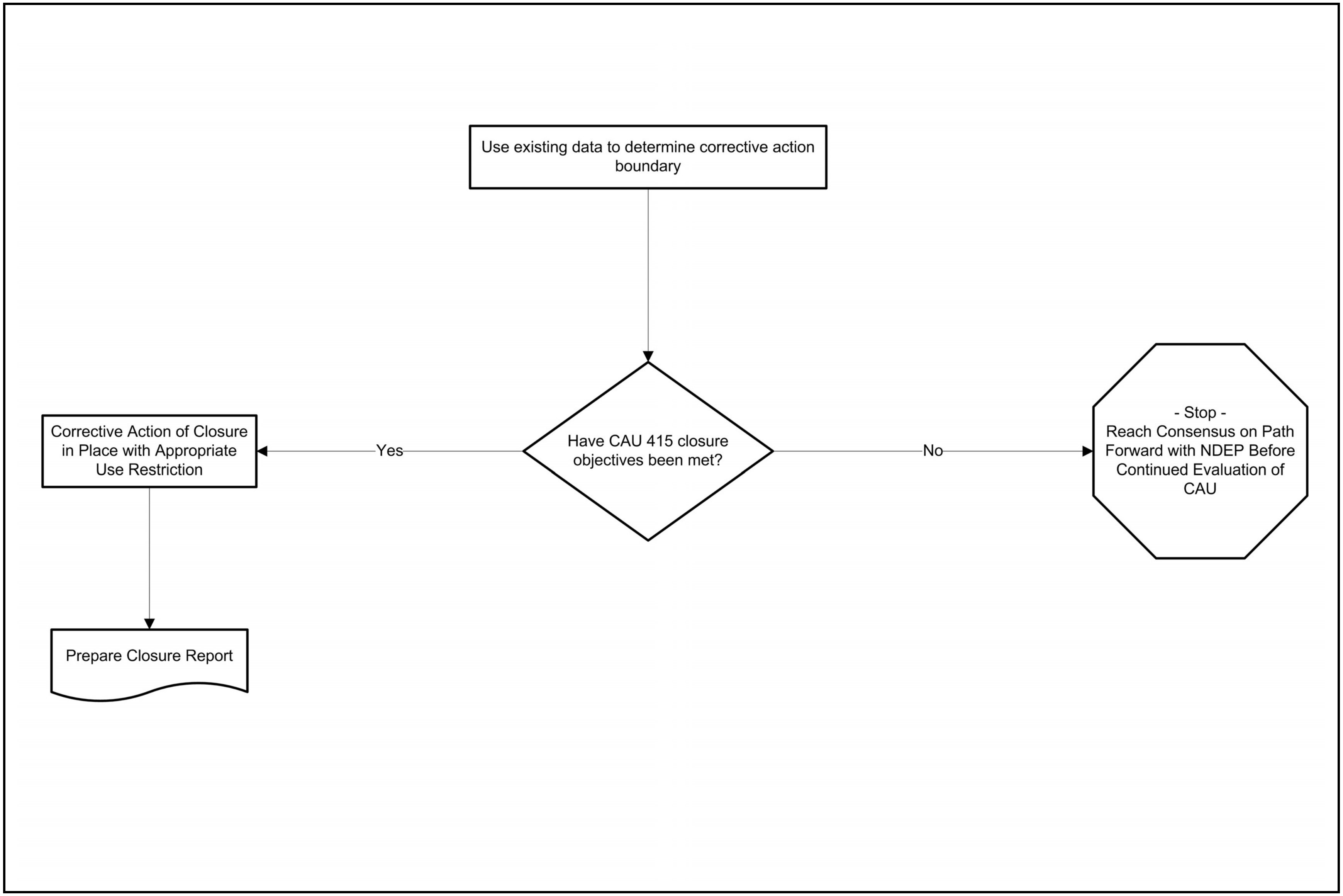


Figure 1-1
CAU 415 Closure Decision Process

(i.e., URs). A site that is closed in place may also require posting for radiological control in accordance with 10 *Code of Federal Regulations* (CFR) 835 regulations (CFR, 2014). For CAU 415, closure in place includes the following:

- Determining extent of contamination exceeding dose-based final action levels (FALs) (25 millirem/Industrial Area-year [mrem/IA-yr]).
- Determining extent of high contamination area (HCA) conditions.
- Removing pole-mounted transformers with potential PCB-containing dielectric fluids.
- Establishing appropriate corrective action boundaries.
- Establishing administrative controls (e.g., establishing a UR boundary, recording boundary in GIS, posting signs).
- Maintaining existing radiologically controlled area boundaries (10 CFR 835, DOE Occupational Radiation Protection Program).
- Performing long-term monitoring, which includes maintaining fencing, signs, and postings.

Although the planned end state for CAU 415 is closure in place, certain additional BMPs will occur independent of the FFACO. BMPs are intended to mitigate certain potential health and safety hazards, provide access to sampling locations, or facilitate future planned activities. As such, NNSA/NFO and the stakeholders have agreed upon construction of a soil cover over the area with the highest levels of contamination, and installation of monuments or landmarks to identify the potential hazards at ground zero (GZ) (see Section 4.2).

After SAFER activities are completed, all final corrective actions, including BMPs, will be documented in a final CR for CAU 415. Future surveillance and inspection requirements will be defined in the CR.

2.0 Unit Description

CAU 415, Project 57 No. 1 Plutonium Dispersion (NTTR), CAS NAFR-23-02, Pu Contaminated Soil, was the location of a safety experiment conducted on April 24, 1957, as part of Operation Plumbbob. CAU 415 is located on Range 4808A of the NTTR. This CAU consists of the atmospheric release of radiological contaminants (Pu, U, and Am) to surface soil from the safety experiment. The radionuclides were dispersed over an area of approximately 1.9 mi^2, which is currently fenced and posted as a radiological contamination area. Vehicles and debris contaminated by the experiment were subsequently buried in a disposal trench within the surface-contaminated, fenced area and are assumed to have released radiological contamination to subsurface soils. Pole-mounted electrical transformers were also identified at the site.

The operational history, process knowledge, and release information for CAU 415 are summarized in this section. This information was obtained through review of historical documents, site photographs, aerial maps, and previous investigation results. Based on this information, assumptions were made to formulate a conceptual site model (CSM) that describes the most probable scenario for the current conditions at the CAU. Additional information on the CSM for CAU 415 is provided in Section 3.2.5.

Because CAU 415 consists of a single CAS, NAFR-23-02, the CAS nomenclature is generally not used in this SAFER Plan. Instead, the CAS is referred to as CAU 415 or the CAU 415 site throughout this document.

2.1 History and Process Knowledge

The Project 57 safety experiment consisted of the detonation of high explosives associated with a nuclear device. The experiment was designed to spread Pu in a defined area to study effective monitoring and decontamination procedures and the biological effects of alpha radiation. The experiment resulted in the radiological posting of approximately 1.9 mi^2 of desert soil and vegetation contaminated with radionuclides (primarily Pu, U, and Am). This contaminated area is currently enclosed by two barbed-wire fences, one located inside the other. The inner, rectangular-shaped fence surrounds GZ, enclosing an area of approximately 0.4 mi^2 and is posted with “Alpha Contamination” radiological control signs. The outer fence is pentagonal in shape and encloses an area of approximately 1.9 mi^2 (Colton, 1993). The outer fence is not posted; however, the entire perimeter of the site at approximately 300 feet (ft) from the outer fence, is posted with "Contamination Area" (CA) radiological control signs. These radiological postings are not part of the FFACO program but are requirements of the DOE Occupational Radiation Protection program, which is discussed in Section 2.2.2.

Historical documents and photographs indicate the burial of four radiologically contaminated vehicles at the site (Figure 2-1) (Author Unknown, 1960). These four vehicles, and a fifth vehicle, were first used at the Project 56 site in Area 11 of the Nevada National Security Site (NNSS) and were later moved and used at the CAU 415 site. All five vehicles were radiologically contaminated and were slated for burial at the CAU 415 site in November 1960. Documentation indicates that on the scheduled day of burial; however, one of the vehicles was missing from the site. The whereabouts and final disposition of this vehicle are unknown. Records indicate that four of the five vehicles and "two piles of miscellaneous contaminated material" were buried within the "double fence which encloses an alpha contaminated area" (Author Unknown, 1960). It is likely that the four vehicles were buried within the inner fence in the vicinity of GZ. Radiological surveys completed in 1991 recorded the presence of a metal beam and two groups of animal cages also located inside the inner fence (Author Unknown, 1991).

2.2 Available Characterization Information

The CAU 415 site has been studied extensively, to include ground-based and aerial radiological surveys, and collection and analysis of soil and vegetation samples. The following subsections discuss the results of previous site investigations used in developing the strategy for more recent site investigation efforts. A summary of a selection of other relevant studies is presented in Section B.4.2 and Appendix C for informational purposes.

2.2.1 Nevada Applied Ecology Group Sampling

In 1974, the Nevada Applied Ecology Group (NAEG) undertook a large soil and vegetation sampling effort at the CAU 415 site. Sample locations were selected based on Field Instrument for the Detection of Low-Energy Radiation (FIDLER) survey results that had been mapped as isopleths (Gilbert et al., 1975). Soil samples were collected from random locations within each isopleth. A total

Figure 2-1
4 Radiologically Contaminated Vehicles
Source: Author Unknown, 1960

of 173 surface soil samples were collected in this effort. As expected, the highest radioactive concentrations were found in the samples from the isopleth surrounding GZ. The maximum FIDLER reading of 943,000 counts per minute (cpm) coincided with the maximum Pu-239/240 result of 266,000 picocuries per gram (pCi/g) in a surface soil sample collected within 50 ft of GZ. These FIDLER survey and soil sample results were considered in developing the investigation strategy for the site investigation conducted in 2013, which is discussed in Section 2.2.4.

2.2.2 Radiological Posting Surveys

The existing radiological postings at CAU 415 are part of the DOE Occupational Radiation Protection program and are based on requirements in 10 CFR 835, "Occupational Radiation Protection" (CFR, 2014). This program is independent of the FFACO and was developed to protect individuals from radiation resulting from DOE activities. The program requires that areas with removable alpha radioactive contamination (i.e., radioactivity that may be removed from a surface) at levels greater than 20 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) or 2,000 dpm/100 cm^2 be posted with CA and HCA signs, respectively. Removable contamination levels have no direct connection to dose rate (i.e., radiation absorbed by a person over a period of time).

Removable contamination levels are determined by a radiological survey (commonly referred to as a "stomp and tromp" survey). These types of surveys are conducted at DOE sites by NNSA/NFO on a periodic basis to determine compliance with 10 CFR 835 requirements.

The three most recent stomp and tromp surveys were conducted at CAU 415 in 2007, 2010, and 2012. The October 2007 survey was conducted to verify the extent of surface contamination and update the radiological postings to meet current regulatory requirements (NSTec, 2007). This survey was conducted at locations near the existing CA boundary, which at the time coincided with the outer fence, and 25 ft out from this boundary around the entire site perimeter. Of the 1,340 survey points, alpha radioactive contamination at activities greater than 20 dpm/100 cm^2 was detected at 7 points near the fence and 16 points at locations 25 ft from the outer fence. As a result, a new perimeter boundary was defined approximately 300 ft from the outer fence. CA warning signs were posted every 200 ft around this new boundary, and "No Access" signs were posted at the access road barricades. The original outer fence was not moved to match the CA boundary; thus, the outer fence does not coincide with the CA postings.

In June 2010, another stomp and tromp survey was conducted at 631 survey locations. None of these locations showed alpha radioactive contamination at levels greater than 20 dpm/100 cm^2; thus, no changes to the boundary or postings were required (NSTec, 2012).

The June 2012 stomp and tromp survey was conducted at the CA boundary established in 2007 and 25 ft out from this boundary around the entire site perimeter. Of the 1,350 survey locations, 1 location on the east side of the site showed elevated removable radiological contamination activity in excess of 20 dpm/100 cm^2. No action was taken to expand the CA boundary at the time. Minor remediation and confirmation surveys at this location are recommended. This would preclude the need to expand the current CA.

2.2.3 1998 Preliminary Site Characterization

The DOE Environmental Restoration program began site investigations at CAU 415 in 1997. As part of this effort, an aerial radiological survey was conducted using a helicopter at an altitude of 50 ft (15 meters [m]) above the ground surface (NNSA/NSO, 2009). This resulted in a circular field of view on the ground approximately 100 ft in diameter. The entire area within the outer fence plus a

3,000-ft (1,000-m) buffer outside the fence was included in the survey. The helicopter flight lines were approximately 75 ft apart. The results of this survey were used to guide the selection of soil sample locations. Eleven soil samples were collected in 1998 from nine sample locations for the purpose of site characterization (Figure 2-2). All of these samples were collected within the inner fence and were analyzed for isotopic Pu, isotopic U, and isotopic Am. The results of these characterization samples that were detected above the minimum detectable activity (MDA) are presented in Table 2-1 (Marty, 2003). The location of the sample with the maximum detected Pu-239/240 (6,620 pCi/g) was approximately 250 ft east of GZ. This was the closest sample location to GZ. Additional soil samples were collected during this effort; however, they were used to determine the physical properties of soil and to support treatability studies. The results of these samples are not presented in this SAFER Plan. FIDLER surveys were planned for the preliminary site characterization effort but were not completed due to instrument failure.

Further investigation at the CAU 415 site (and other DOE sites on NTTR) was suspended by mutual agreement between DOE and NDEP in 1998 because concurrence could not be reached regarding future land use at the sites, a final corrective action level, and the parameters used to determine the corrective action level. Renewed efforts to obtain site closure for CAU 415 were initiated in 2013 with a site investigation, the results of which are presented in the following subsections.

2.2.4 2013/2014 Site Investigation

In December 2013 and April 2014, a site investigation was conducted at CAU 415 to assess current site conditions. The overall objective of the investigation was to obtain site-specific data that could be used to support development of the DQOs and a site closure strategy for CAU 415. The investigation included visual surveys, ground-based radiological surveys, a geophysical survey, placement of thermoluminescent dosimeters (TLDs), and collection of soil samples.

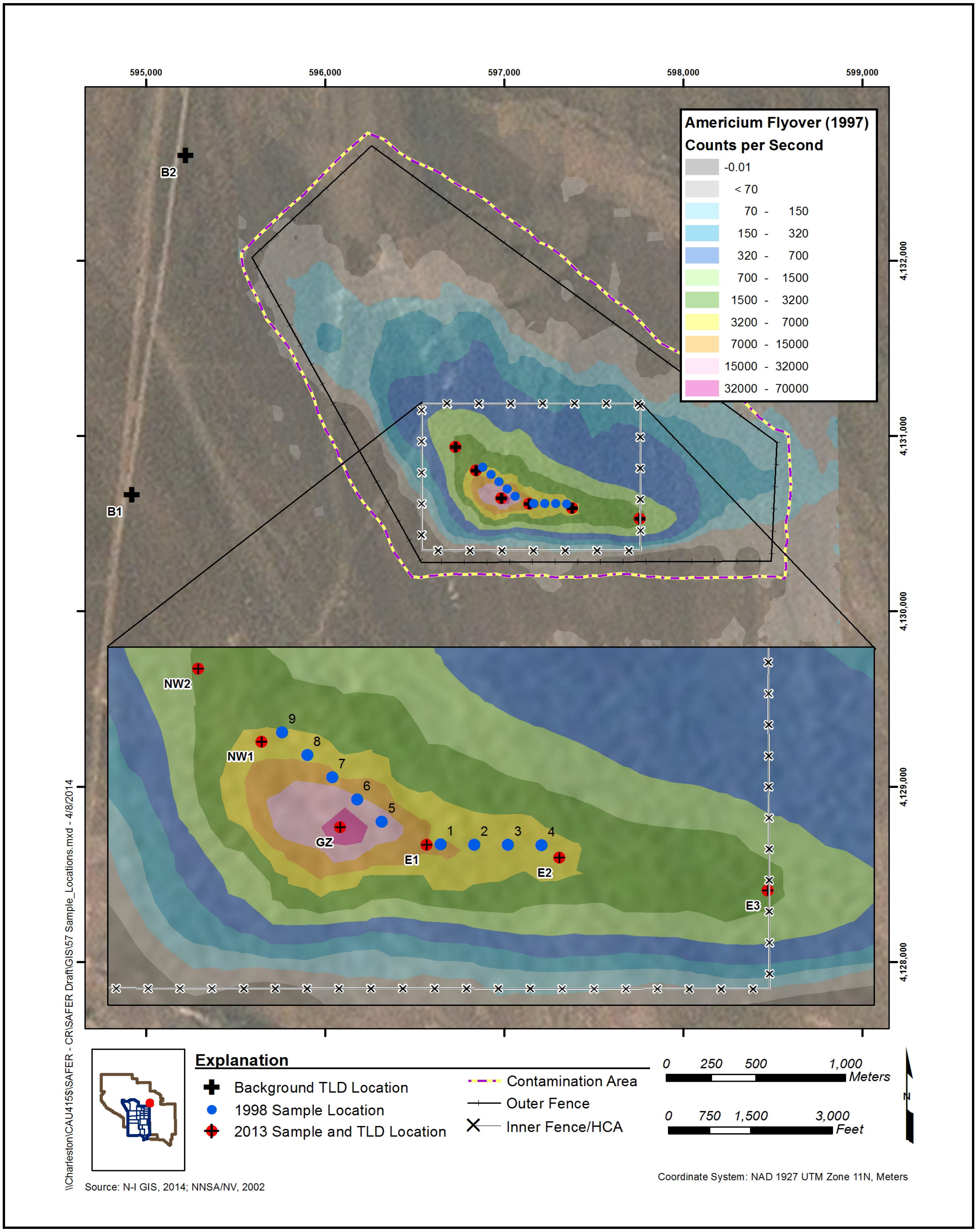


Figure 2-2
1998 and 2013 Soil Sample and TLD Locations

Table 2-1
Radionuclide Results above the MDA for COCs in 1998 Soil Samples[a]

Sample Location	Sample Number	Am-241 (pCi/g)	Pu-238 (pCi/g)	Pu-239/240 (pCi/g)	U-234 (pCi/g)
1	PR57-00013	176 (J)	15.5	1,040	--
2	PR57-00003[b]	263 (J)	27.5 (J)	1,380 (R)	--
	PR57-00014	25.5 (J)	--	239	--
3	PR57-00015	47.8 (J)	4.89	281	--
	PR57-00016 (FD of PR57-00015)	25 (J)	--	117	--
4	PR57-00017	21.2 (J)	2.16	112	--
5	PR57-00018	1,160 (J)	143	6,620	--
6	PR57-00019	303 (J)	40.9	1,710	--
7	PR57-00020	207 (J)	24.4	1,210	1.64 (J)
8	PR57-00021[b]	68.3 (R)	--	420	--
9	PR57-00022	71.9 (J)	6.91	398	--

[a] All samples were analyzed using a HASL-300-equivalent method with modifications (DOE, 1997).
[b] Sample data presented for informational purposes only; data from this sample were not used to support site closure.

HASL = Health and Safety Laboratory
FD = Field duplicate

-- = Not detected.
J = Estimated value.
R = Rejected value.

2.2.4.1 Visual Surveys

Visual surveys at CAU 415 were conducted in conjunction with the radiological surveys, soil sample collection, and TLD placement. The visual surveys were conducted to identify debris and spills (stained soil, distressed vegetation). The visual surveys identified the following:

- A collection of debris at GZ including metal frames with sections of fiberglass sheeting, rubber hoses, two large window vacuum units, one small vacuum unit, wood debris, four 55-gallon metal drums, and a steel beam (Figure 2-3).
- Six pole-mounted transformers: three inside the inner fence, two inside the CA, and one outside the CA. Figures 2-4 and 2-5 show two of the transformers at the site.
- Metal animal cages (Figure 2-6) and concrete pads of various sizes used in the 1957 experiment.

Figure 2-3
Debris at CAU 415 GZ

Figure 2-4
Transformer

Figure 2-5
Transformer Close-Up

Figure 2-6
Animal Cages

- A drainage system, consisting of two natural drainage channels exiting the outer fence at CAU 415 and an associated man-made retention basin. The two drainage channels exit the fenced area at the southwest corner of the site, and both terminate at a large earthen retention basin. The retention basin has earthen berms approximately 3 ft tall on three sides and is built directly adjacent to the dirt road that leads to CAU 415. It is not known when the basin was constructed or for what purpose; however, sediment at the bottom of the basin suggests it has held water in the past (Figure 2-7).

Figure 2-7
Retention Basin Floor

The locations of GZ, the pole-mounted transformers, and the animal cages are presented on Figure 2-8. The drainage system is shown in Figure 2-9.

2.2.4.2 Radiological Surveys

Radiological surveys at the CAU 415 site were conducted using a FIDLER instrument with an attached Global Positioning System (GPS) unit. The objectives of the surveys were to obtain data to confirm and refine the spatial distribution of radiation measurements at the site, to bound the extent of the contamination, and to identify point sources (i.e., debris and/or soil with elevated levels of radioactivity). The results of the 2013 FIDLER survey and 1997 aerial survey are presented in Figure 2-9. The FIDLER survey locations were selected based on the 1997 aerial radiation survey

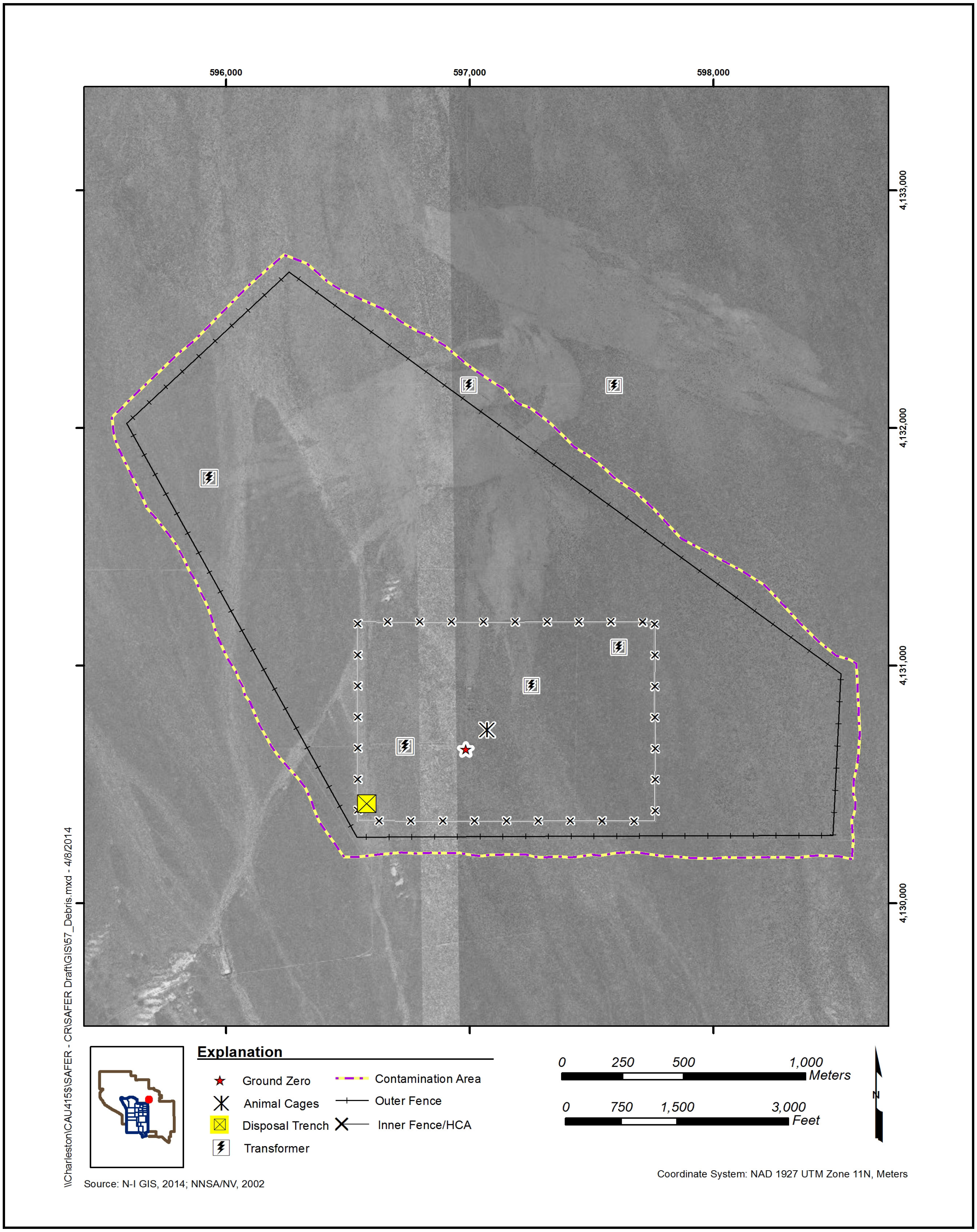


Figure 2-8
Debris and Disposal Trench Locations

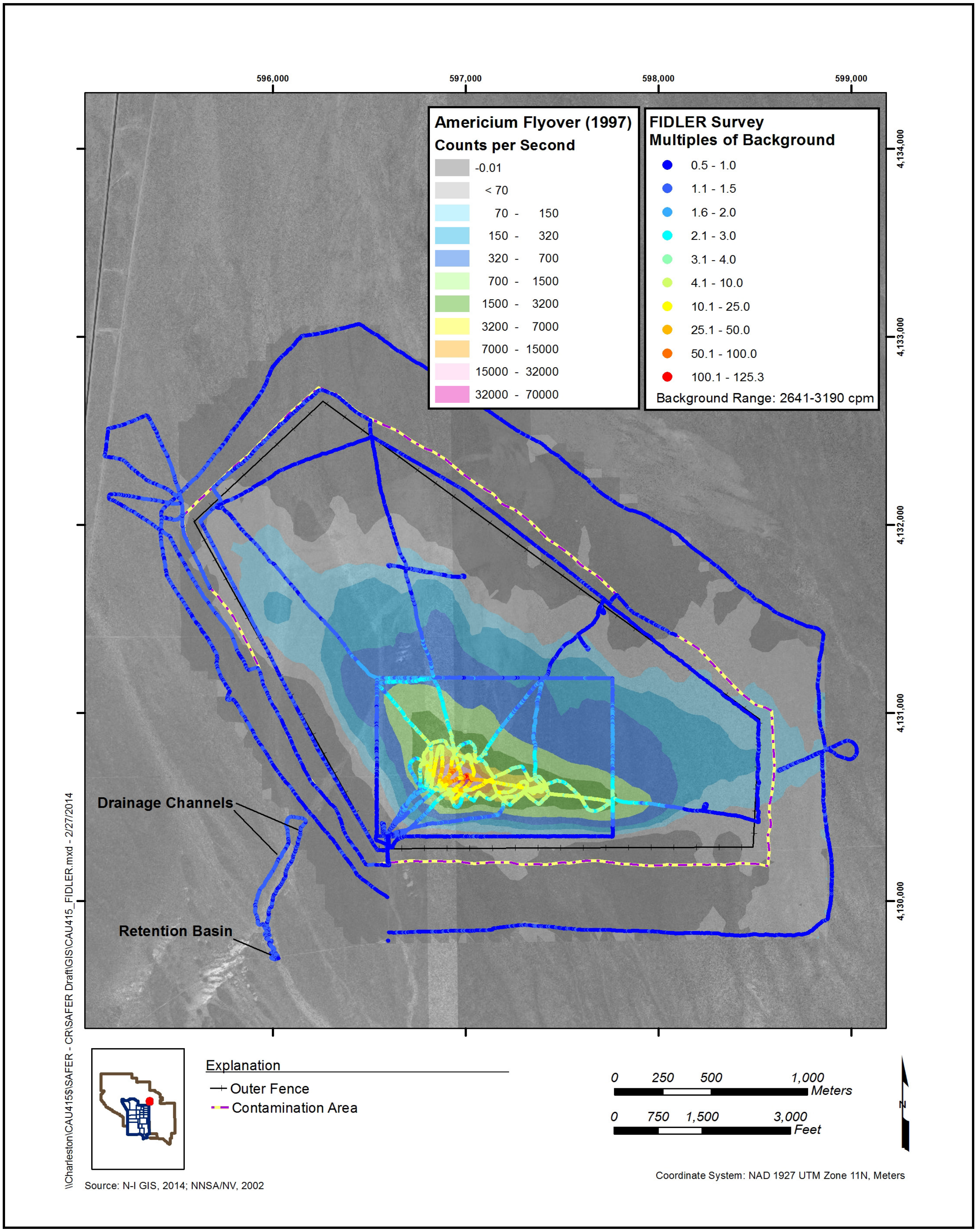


Figure 2-9
2013 FIDLER and 1997 Aerial Survey Results

results, and included transects radiating outward from GZ and a path around the site perimeter. In April 2014, additional FIDLER static readings were collected at each soil sample location in conjunction with TLD retrieval. The purpose of this additional data collection was to supplement the existing FIDLER data in the area of GZ.

Limited removable radioactive contamination surveys were conducted within the inner fence during the investigation. These surveys confirm the presence of HCA conditions within the inner fence.

The drainage system, consisting of two drainage channels exiting the outer fence at CAU 415 and an associated retention basin, was also surveyed with the FIDLER. The objective of this survey was to identify radiological contamination that may have been transported via surface water flow outside the existing outer fence. The drainage features and the results of the FIDLER survey are shown on Figures 2-9 and 2-10. The results of the drainage system survey were consistent with background radiation measurements at the site.

The FIDLER is specially designed to be sensitive for low-energy gamma activity while minimizing the response to higher-energy gamma activity. The FIDLER is an industry-standard device that is used when Pu is the primary contaminant, as is the case at CAU 415. The FIDLER is optimized to detect the gamma activity from Am-241, which is a contaminant associated with, and co-located with, Pu. FIDLER surveys are performed with the detector held at about 12 to 18 inches (in.) above the ground surface while traveling at a speed of about 1 to 2 meters per second. The output of the FIDLER is connected to a GPS unit that supplies submeter position information (at a rate of one point per second) and also logs the output of the FIDLER (at the same rate). The FIDLER records in units of counts per minute. The FIDLER instrument will register a count-rate even when no man-made radionuclides are present in the soil. This response is due to naturally occurring radionuclides that are present in the soils, cosmic rays striking the atmosphere, and varying concentrations of radon in the atmosphere. Because of this response, a brief survey is conducted each day in an area considered not to be affected by man-made radionuclides before starting formal survey efforts. This brief survey is known as a reference, or point survey. The data from the reference survey are processed, and an average value is calculated. The survey file data are processed to present the survey data in terms of multiples of this average reference value and reported in multiples of reference or multiples of background. This serves to “normalize” the data from each day so that they are comparable across

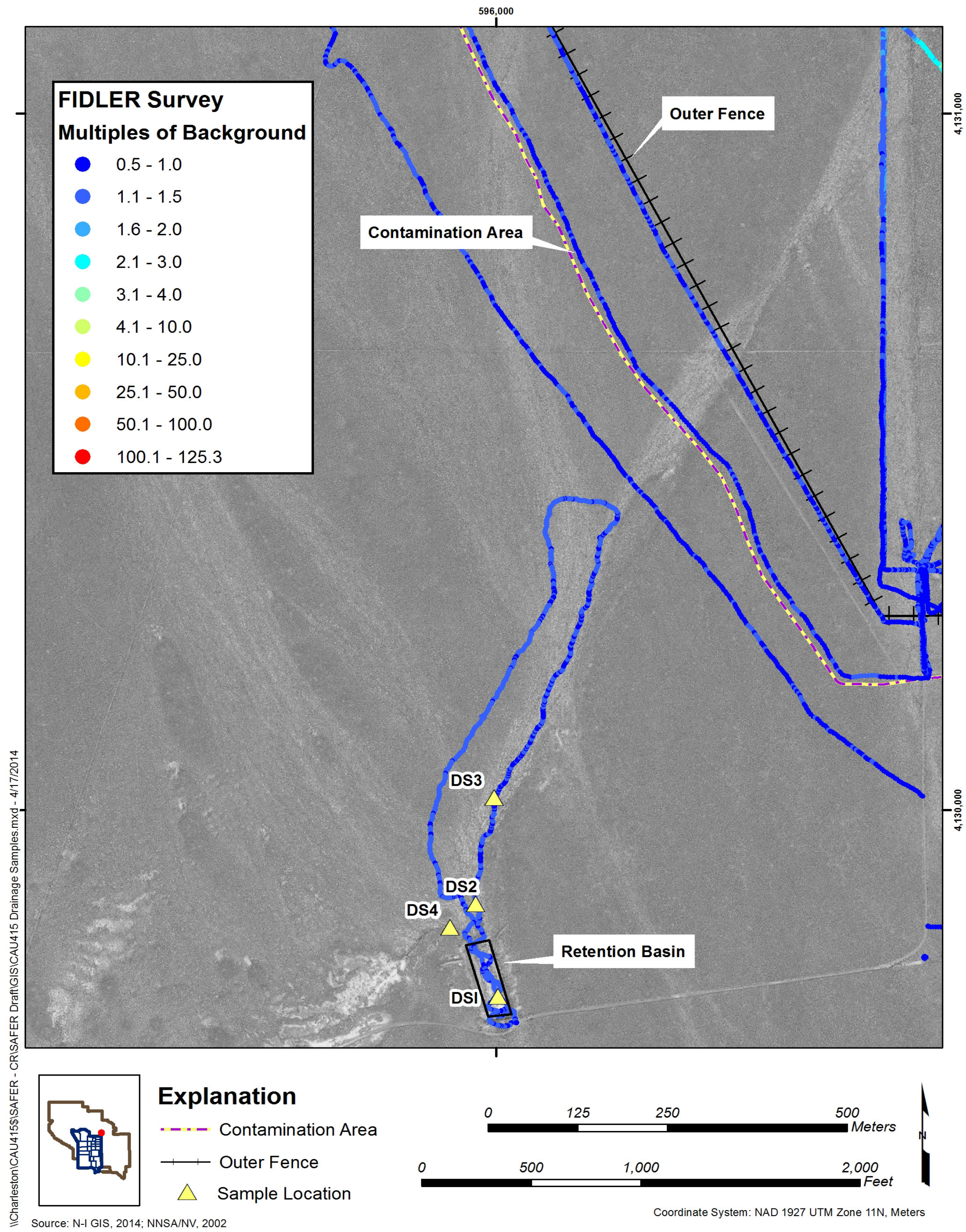


Figure 2-10
Drainage System Sample Locations

locations, seasons, and solar fluctuations. The normalized data are presented in multiples of background.

2.2.4.3 Soil Sampling and TLD Placement

A total of eight grab surface soil samples were collected in 2013 at the CAU 415 site. The sample locations were selected considering the 1997 aerial radiation survey results and the soil sample results from the 1998 site characterization effort. The locations were placed roughly in the same orientation as the 1998 samples along two vectors centered at GZ with one extending outward to the east and one to the northwest (Figure 2-2). At each sample location, FIDLER measurements were used to bias sample locations so that soil samples would be collected at the location of the highest readings in the vicinity of the sample location. Three samples were collected at GZ within 3 ft of one another in a triangular pattern. The purpose of collecting three samples in close proximity to one another at the GZ location was to evaluate the variability of Pu activity within a small area. Widely variable Pu concentrations have been observed at other DOE Soils sites in soil samples collected in close proximity to one another. All soil samples were collected from 0 to 5 centimeters (cm) below ground surface (bgs) and were analyzed for gamma-emitting radionuclides, isotopic Pu, isotopic Am, isotopic U, and Pu-241. Table 2-2 presents the analytical data for the CAU 415 COCs detected above the MDA in the 2013 soil samples.

One TLD was placed at each of the 2013 soil sample locations. Each TLD was placed at a height of 1 m above the ground surface, which is consistent with TLD placement in the NNSS routine environmental monitoring program. TLDs were also placed at two background locations to measure background radiation at the site. The locations of all TLDs placed at CAU 415 are presented in Figure 2-2. The background TLDs measure dose from natural sources in areas unaffected by CAU-related releases. The TLDs were retrieved from the field locations in April 2014 and analyzed by automated TLD readers that are calibrated and maintained by the NNSS contractor. This approach allowed for the use of existing quality control (QC) procedures for TLD processing.

In April 2014, 12 soil samples were collected at varying depths from within the drainage system located southwest of the fenced area at CAU 415. The drainage system was identified as the most likely migration route for surface water exiting the fenced area. The 2013 FIDLER survey of the drainage system did not reveal any areas of elevated radioactivity (Section 2.2.4.2). In addition, the

Table 2-2
Radionuclide Results above the MDA for COCs in 2013 Soil Samples[a]

Sample Location	Sample Number	Am-241 (pCi/g)		Pu-238 (pCi/g)	Pu-239/240 (pCi/g)	Pu-241 (pCi/g)
		Gamma Spectroscopy	Alpha Spectroscopy			
E1	A001	134	129 (J)	14.1	848	253
E2	A002	163	130 (J)	21.8	1,160	386
E3	A003	48.3	45.3 (J)	10.8	456	84.5
NW1	A004	528	399 (J)	63.9	3,950	1,170
NW2	A005	185	168 (J)	22.3	1,460	510
GZ	A006	128,000	14,500	4,470	243,000	127,000 (J)
GZ	A007	83,800	9,600	2,830	188,000	87,600 (J)
GZ	A008	89,700	15,000	4,010	195,000	99,500 (J)

[a] All samples were analyzed using the HASL-300 method with modifications (DOE, 1997).

-- = Not detected.
J = Estimated value.

2012 removable contamination surveys at the CA boundary and 25 ft out from the boundary in the area where the drainage channels exit the CA did not identify contamination above CA posting criteria (see Section 2.2.2). Because no radiologically elevated areas were identified in the drainage system, sample locations were not biased based on radiological measurements, as was done for the 2013 soil samples described above. Instead, the drainage system sample locations were selected at visually discernible sediment accumulation areas within the drainage system features (i.e., retention basin, drainage channels). A total of 12 soil samples (including 1 FD sample) were collected from the four sample locations identified in Figure 2-10. Three samples were collected at each location, with the exception of DS4, at three separate depth intervals: 0 to 10 cm bgs, 10 to 20 cm bgs, and 20 to 30 cm bgs. Refusal at the interface of sediment and native soil was encountered at location DS4 at 20 cm bgs, so the 20-to-30-cm-bgs interval could not be sampled.

Samples were collected at depth in the drainage system to evaluate the potential for the existence of contamination in the subsurface that may have been buried by uncontaminated sediment over time. Each sample depth interval was screened for radioactivity using a hand-held field instrument. These instrument readings were compared to the field-screening levels (FSLs) established at the site to determine whether the radioactivity at depth was greater than that measured on the ground surface. The only sample locations where radioactivity was greater than the FSLs at depth were DS2 and DS4. At DS2, the FSL for beta radiation (4,036 dpm/100 cm^2) was exceeded at all three depth intervals, with the highest reading (4,472 dpm/cm^2) at 20 to 30 cm bgs. The FSL for alpha radiation (66.4 dpm/cm^2) was exceeded at the 10-to-20 and 20-to-30-cm-bgs intervals, with the highest reading (116 dpm/cm^2) at the 20-to-30-cm-bgs interval. Only the beta radiation FSL was exceeded at the two sample intervals at DS4, with the highest (4,241 dpm/100 cm^2) at the 10-to-20-cm-bgs interval.

Each of the drainage samples were analyzed for gamma-emitting radionuclides, isotopic Pu, isotopic Am, isotopic U, and Pu-241. Table 2-3 presents the analytical data for CAU 415 COCs detected above the MDA for these soil samples.

Table 2-3
Radionuclide Results above the MDA for COCs in 2014 Drainage Soil Samples

Sample Location	Sample Number	Sample Depth (cm bgs)	Am-241 (pCi/g)		Pu-238 (pCi/g)	Pu-239/240 (pCi/g)	Pu-241 (pCi/g)
			Gamma Spectroscopy	Alpha Spectroscopy			
DS1	A010	0 - 10	0.388	0.144	--	1.35	--
	A011	10 - 20	--	--	--	0.764	--
	A012	20 - 30	0.507	0.0974	--	0.707	--
DS2	A013	0 - 10	--	--	--	0.116	--
	A014	10 - 20	--	--	--	0.161	--
	A015	20 - 30	--	--	--	0.196	--
	A017 (FD)	0 - 10	--	--	--	0.299	--
DS3	A016	0 - 10	--	--	--	0.136	--
	A018	10 - 20	--	--	--	--	--
	A019	20 - 30	--	--	--	0.0618	--
DS4	A020	0 - 10	--	--	--	--	--
	A021	10 - 20	--	--	--	0.0822	--

-- = Not detected.

2.2.4.4 Geophysical Survey

A geophysical survey was conducted at an area of disturbed soil located just inside the inner fence at the southwest corner of the site (Figure 2-8). An EM31-MK2 ground conductivity meter was used to conduct the survey. Based on a written description of the disposal trench found in historical documentation, it was suspected that the disturbed area was the burial site for the four radiologically contaminated vehicles described in Section 2.1. The results of the survey show a series of four linear anomalies oriented along a line running north to south (see Figure 4-2). The individual anomalies are large, each approximately 2 by 4 m, and oriented northwest to southeast. There is a potential fifth anomaly, of lower strength, immediately south of the four anomalies. The details of the survey are presented in Appendix E. The survey results are consistent with the historical account of the vehicle burial trench. The fifth anomaly could be indicative of the "two piles of miscellaneous contaminated material" that were also reportedly buried in the trench.

3.0 Data Quality Objectives

3.1 Summary of DQO Analysis

This section contains a summary of the DQO process that is presented in Appendix B. The DQO process is a strategic planning approach based on the scientific method that is designed to ensure that the data collected will provide sufficient and reliable information to identify, evaluate, and technically defend the recommendation of viable corrective actions.

The DQO strategy for CAU 415 was developed at a meeting on January 28, 2014. The DQOs were developed to identify data needs, clearly define the intended use of the environmental data, and design a data collection program that will satisfy these purposes. During the DQO discussions for this CAU, the informational inputs or data needs to resolve problem statements and decision statements were documented. As agreed to by the CAU 415 stakeholders, the selected corrective action for CAU 415 is closure in place with URs. The decision was based on the assumption that existing data are sufficient to support closure in place. If it is determined that existing data are not sufficient, the stakeholders will be consulted and a revised closure strategy for CAU 415 will be developed. Otherwise, CAU 415 will be closed in place, and the details of closure will be presented in the CR.

The problem statement for CAU 415 is "Information on the nature and extent of potential contamination needs to be evaluated for the closure of CAU 415."

The primary release source specific to CAU 415 is the safety experiment device. Some of the contamination associated with the release may have been translocated due to mechanical disturbance of the soil (e.g., decontamination activities that were part of the experiment) or due to migration with eroding soil particles (e.g., surface water flow through natural drainages). Other potential release sources include radioactive debris from the test infrastructure that is remaining on the surface or that has been buried in a disposal trench (e.g., contaminated vehicles), and pole-mounted transformers that potentially contain PCB dielectric fluids.

3.1.1 Decision I

The Decision I question is "Does contamination exist at the release site that exceeds FALs?

In order to resolve Decision I, the presence of contamination at levels exceeding the FAL is defined as the condition where the most exposed human receptor (conservatively assumed to be an Industrial Worker) has the potential for exposure to a contaminant exceeding a FAL, to receive a total effective dose (TED) in excess of 25 millirem per year (mrem/yr), or the presence of HCA conditions. Based upon review of the available data, the following has been determined:

- Surface soils in the GZ area of CAU 415 contain COCs that exceed the FALs.
- HCA conditions exist within the inner fence, and the fence line conservatively bounds the area.
- Subsurface soils in the disposal trench are assumed to contain COCs that exceed FALs.
- Visual and radiological (FIDLER) surveys of the drainage system conducted in 2013 did not identify any elevated radiological readings or other biasing factors. Therefore, it is believed that there are no contaminants present above a FAL.
- The pole-mounted transformers located within the CA at CAU 415 potentially contain dielectric fluids with PCBs. Visual inspection of two of the pole-mounted transformers in 2013 did not indicate any evidence of leaks or soil staining in the area below the transformers. However, because the transformers have the potential to release COCs to the soil in excess of a FAL, corrective action (removal of the transformers) is required.

Sufficient information is available from previous investigations to conclude that contamination is present in soil at CAU 415 in concentrations that exceed the radiological FAL. In addition, existing information on removable radioactive contamination at CAU 415 indicate that HCA conditions exist within the inner fence. The Soils Risk-Based Corrective Action (RBCA) document assumes that corrective action is required at areas that exceed HCA criteria (NNSA/NFO, 2014). Because it has been established that the dose-based FAL of 25 mrem/IA-yr is exceeded at the site and the area inside the inner fence meets HCA criteria, Decision I is resolved and corrective action is required. Because it is assumed that COCs above the FAL are present in the subsurface soils at the disposal trench, Decision I for this release is also resolved and corrective action is required.

For the drainage system, it has been determined that no contaminants are present in soil above the FAL; therefore, no further action is required. The pole-mounted transformers are assumed to contain PCBs that could release COCs to the soil in excess of the FALs. A corrective action of removal has been selected for the pole-mounted transformers.

3.1.2 Decision II

The Decision II question for CAU 415 is "Have the CAU 415 closure objectives been met?

The CAU 415 closure objectives are defined as follows:

- For the Pu-contaminated soil, the closure objective is to determine the corrective action boundary (i.e., the area exceeding 25 mrem/IA-yr and the area exceeding HCA conditions).
- For the disposal trench, the closure objective is to determine the extent of the buried contaminated vehicles and debris, defined as the extent of the anomalies detected in the geophysical survey.
- For the drainage system, it has been determined that no contaminants are present in soil above the FAL; therefore, Decision II is not required.
- For the pole-mounted transformers, the closure objective is removal of the transformers.

3.2 Results of the DQO Analysis

3.2.1 Action Level Determination and Basis

The preliminary action levels (PALs) presented in this section are to be used for site screening purposes. They are not necessarily intended to be used as cleanup action levels or FALs. However, they are useful in screening out contaminants that are not present in sufficient concentrations to warrant further evaluation, thereby streamlining the consideration of remedial alternatives. The RBCA process used to establish FALs is described in the Soils RBCA document (NNSA/NFO, 2014). This process conforms with *Nevada Administrative Code* (NAC) 445A.227, which lists the requirements for sites with soil contamination (NAC, 2012a). For the evaluation of corrective actions, NAC 445A.22705 (NAC, 2012b) requires the use of ASTM International (ASTM) Method E1739 (ASTM, 1995) to "conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary." For the evaluation of corrective actions, the FALs are established as the necessary remedial standard.

This RBCA process, summarized in Figure 3-1, defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses:

- **Tier 1 evaluation.** Sample results from source areas (highest concentrations) are compared to action levels based on generic (non-site-specific) conditions (i.e., the PALs established in this SAFER). The FALs may then be established as the Tier 1 action levels, or the FALs may be calculated using a Tier 2 evaluation.

- **Tier 2 evaluation.** Conducted by calculating Tier 2 action levels using site-specific information as inputs to the same or similar methodology used to calculate Tier 1 action levels. The Tier 2 action levels are then compared to individual sample results from reasonable points of exposure (as opposed to the source areas as is done in Tier 1) on a point-by-point basis.

- **Tier 3 evaluation.** Conducted by calculating Tier 3 action levels on the basis of more sophisticated risk analyses using methodologies described in Method E1739 that consider site-, pathway-, and receptor-specific parameters.

This RBCA process includes a provision for conducting an interim remedial action if necessary and appropriate. The decision to conduct an interim action may be made at any time during the investigation and at any level (tier) of analysis. Concurrence of the stakeholders will be obtained before any interim action is implemented. Evaluation of DQO decisions will be based on conditions at the site after any interim actions are completed.

3.2.1.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the U.S. Environmental Protection Agency (EPA) Region 9 Regional Screening Levels for chemical contaminants in industrial soils (EPA, 2014). Background concentrations for *Resource Conservation and Recovery Act* (RCRA) metals will be used instead of screening levels when natural background concentrations exceed the screening level, as is often the case with arsenic on the NNSS. Background is considered the mean plus two standard deviations of the mean for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the Nevada Test and Training Range (NBMG, 1998; Moore, 1999). For detected chemical contaminants of potential concern (COPCs) without established screening levels, the protocol used by the EPA Region 9 in establishing screening levels (or similar) will be used to establish PALs. If used, this process will be documented in the investigation report.

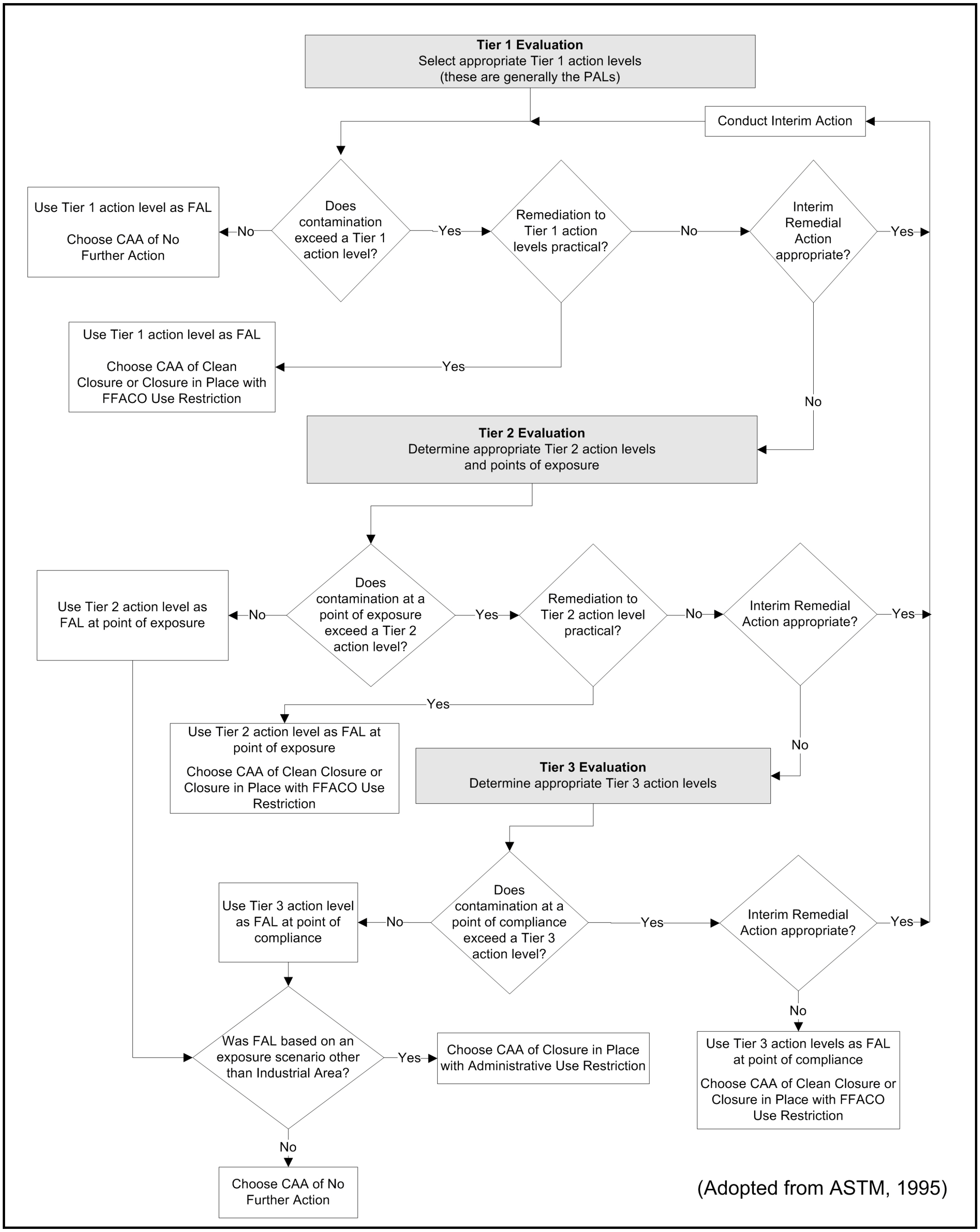


Figure 3-1
RBCA Decision Process

For CAU 415, because no environmental media was identified with the potential for chemical contamination, action levels for chemical constituents were not used in evaluating DQO decisions.

3.2.1.2 Radionuclide PALs

The PAL for radioactive contaminants is a TED of 25 mrem/yr, based upon the Industrial Area scenario. Because the CAU 415 stakeholders agreed to use the Industrial Area land use scenario, the radionuclide PALs were established as the FALs for CAU 415.

The Industrial Area exposure scenario is defined in the Soils RBCA document (NNSA/NFO, 2014). The TED is calculated as the sum of external dose and internal dose. External dose is determined using TLD measurements. Internal dose is determined by comparing analytical results from soil samples to residual radioactive material guidelines (RRMGs) that were established using the RESRAD computer code (Yu et al., 2001). Appendix D provides the RESRAD data used for determination of the internal and total RRMG values for the Industrial Area scenario. RRMGs are radionuclide-specific values for radioactivity in surface soils. The RRMG is the value, in picocuries per gram of surface soil, for a particular radionuclide that would result in an internal dose of 25 mrem/yr to a receptor (under the appropriate exposure scenario) independent of any other radionuclide (assuming that no other radionuclides contribute dose). The RRMGs are presented in the Soils RBCA document (NNSA/NFO, 2014). In the RESRAD calculation, several input parameter values are not specified so that site-specific information can be used. The default and site-specific input parameter values used in the RESRAD calculation of RRMGs for each exposure scenario are listed in the Soils RBCA document.

3.2.2 Hypothesis Test

The baseline condition (i.e., null hypothesis) and alternative condition are as follows:

- **Baseline condition.** The closure objectives (defined in Section 3.1.2) have not been met.
- **Alternative condition.** The closure objectives (defined in Section 3.1.2) have been met.

Sufficient evidence to reject the null hypothesis is as follows:

- The identification of the lateral and vertical extent of COC contamination in media, if present.
- Sufficient information to properly dispose of waste.

3.2.3 Statistical Model

The probabilistic approach was used to establish the extent of areas containing COCs by using a statistical 95 percent confidence in the correlation between TED and radiation survey values (see Appendix D). No sampling of environmental media is anticipated.

3.2.4 Design Description/Option

There are no sampling or other field collection activities planned for CAU 415; therefore, this subsection does not apply.

3.2.5 Conceptual Site Model and Drawing

The CSM describes the most probable scenario for current conditions at each site and defines the assumptions that are the basis for identifying the future land use, contaminant sources, release mechanisms, migration pathways, exposure points, and exposure routes. The CSM was used to develop appropriate sampling strategies and data collection methods. The CSM was developed for CAU 415 using information from the physical setting, potential contaminant sources, release information, historical background information, knowledge from similar sites, and physical and chemical properties of the potentially affected media and COPCs. Figure 3-2 depicts a tabular representation of the conceptual pathways to receptors from CAU 415 sources. Figure 3-3 depicts a graphical representation of the CSM. If evidence of contamination that is not consistent with the presented CSM is identified during investigation activities, the situation will be reviewed; the CSM will be revised; the DQOs will be reassessed; and a recommendation will be made as to how best to proceed. In such cases, stakeholders will be notified and given the opportunity to comment on and/or concur with the recommendation. A detailed discussion of the CSM is presented in Appendix B.

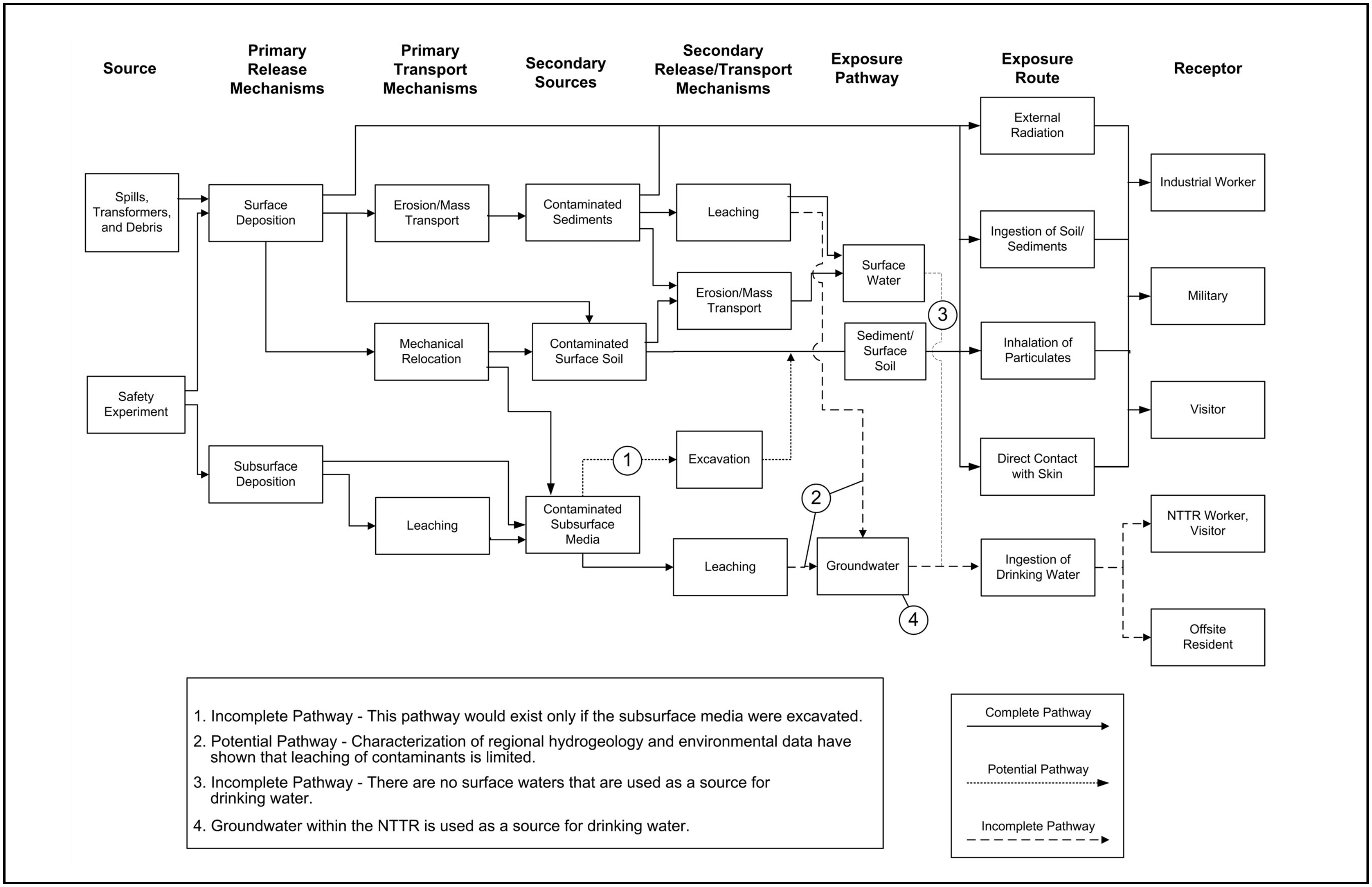


Figure 3-2
Pathways to Receptors

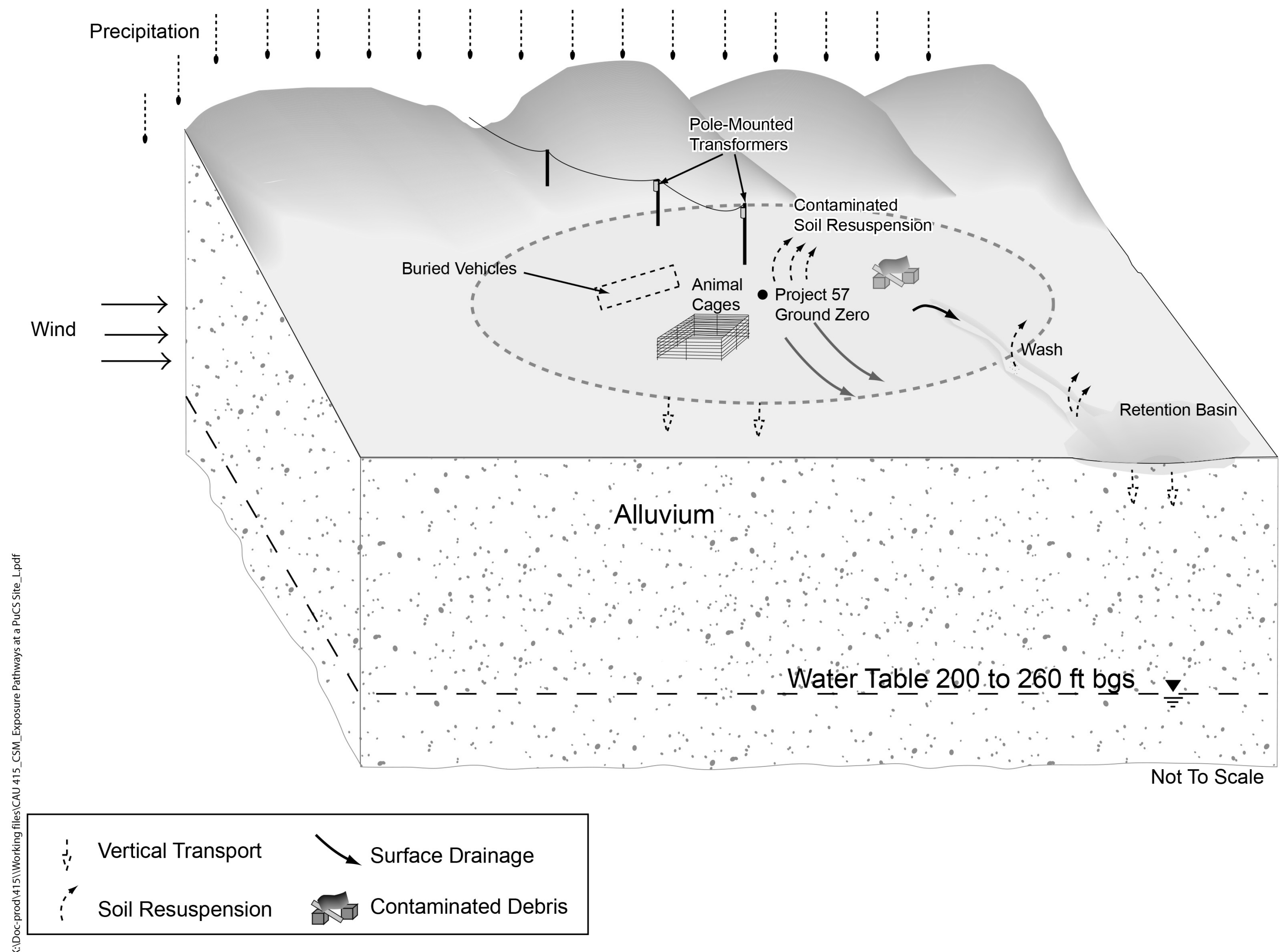


Figure 3-3
CSM for CAU 415

4.0 Field Activities and Closure Objectives

The CAU 415 stakeholders selected a corrective action of closure in place with URs during the DQOs. Therefore, it is anticipated that closure activities will be limited to the removal of the pole-mounted transformers and establishment of URs at CAU 415.

4.1 Contaminants of Potential Concern

The COPCs for CAU 415 are defined as the contaminants reasonably expected at the site that could contribute to a dose or risk exceeding FALs. Based on the nature of the releases identified in Section 2.1 and previous investigation results presented in Section 2.2, the contaminants that could reasonably be suspected to be present at CAU 415 include the isotopes of U, Pu, and Am (from the safety experiment); and PCBs (from the pole-mounted transformers). These COPCs were identified during the planning process through the review of site history, process knowledge, personnel interviews, and past investigation efforts.

4.2 Remediation

The CAU 415 stakeholders selected a corrective action of closure in place with URs for the site during the DQOs. Remediation is not necessary for the implementation of this corrective action and, therefore, is not required at CAU 415.

The closure strategy for CAU 415 under this SAFER process consists of the following:

- Determining whether contaminants exist in environmental media or other debris.
- Determining extent of contamination exceeding FALs.
- Establishing appropriate corrective action boundaries.
- Establishing administrative controls (e.g., establishing a UR boundary, recording boundary in GIS, posting signs).
- Implementing the corrective action of closure in place with URs.

- Completing the following BMPs:
  - Construct a soil cover intended to cover the area with the highest levels of contamination at GZ.
  - Install permanent monuments around the GZ area to identify potential hazards.

The soil cover will be approximately 50 m in diameter and approximately 1.5 m high at the center, which would provide adequate cover over the debris located at GZ. The cover will be constructed with adequate top and side slopes, and compacted to a higher density than surrounding soil to allow for runoff of precipitation on the cover, but also to protect the cover from water erosion. Future maintenance of the soil cover is not anticipated. Monuments will be placed around the perimeter of the soil cover. The monuments are intended to identify the potential subsurface hazards and prevent the potential for future inadvertent intrusive activities.

4.3 Verification

The corrective action of closure in place with URs at CAU 415 was confirmed through an evaluation of existing data and the determination of corrective action boundaries for the site. The evaluation of existing data is summarized in Section 7.0 and presented in detail in Appendix F. The release at CAU 415 presents two types of radiation hazards that were considered in determining the corrective action boundaries: (1) the potential dose to a site worker and (2) the presence of removable radioactive contamination. The Soils RBCA document (NNSA/NFO, 2014) discusses the process for estimating the potential dose to a site worker and the assumptions for addressing removable radioactive contamination.

4.3.1 Radiological Dose

In order to estimate the radiological dose a site worker may receive when performing duties at CAU 415, potential dose was estimated using soil analytical data from the 1998 sampling effort, and soil and TLD data from the 2013 effort. The process for estimating dose is a risk-based approach that combines land use, exposure duration, exposure pathways, and site-specific parameters to estimate the total dose (internal and external) to a human receptor. As agreed to by the stakeholders in the DQOs, the land use scenario to be applied at CAU 415 is industrial use. This scenario assumes continuous industrial use of the site at which a site worker will spend his or her entire career (i.e., 2,000 hours per year for 25 years). This is the most conservative established land use scenario utilized by the Soils Activity and is expected to encompass any foreseeable military land use at the site. The CAU 415 soil sample data from 1998 and 2013 were used to calculate internal dose, and the 2013 TLD data were used to calculate external dose, as described in Appendix D. The sum of these doses result in the estimated TEDs, which are presented for each sampled location in Figure 4-1.

The relationship between TED and FIDLER results is estimated from a simple linear regression of paired calculated TED and radiation survey values for each sample location. These numbered pairs are statistically compared with one another, which results in a solution that represents the average relationship of FIDLER values to TED values. If the strength of this relationship yields a correlation factor (i.e., r^2 value) of 0.8 or greater, the relationship is considered statistically significant and the data may be used with confidence to make DQO decisions. The 25-mrem/IA-yr boundary for CAU 415 was estimated using TED and FIDLER data with an r^2 value of 0.88 (Figure 4-1), indicating the relationship between the TED and FIDLER data is strong. It is therefore concluded that the area within the boundary exceeds the FAL of 25 mrem/IA-yr and requires corrective action. Additional detail on estimating dose and establishing correlations is found in the Soils RBCA document (NNSA/NFO, 2014) and Appendix D.

The subsurface soil at the disposal trench is assumed to exceed the radiological dose FAL. As such, a corrective action boundary around the trench is required to account for the subsurface soil that is assumed to exceed the FAL. This disposal trench boundary is shown in Figure 4-2.

Radiological dose at the drainage system sample locations was estimated using the soil samples collected in 2014 and the RRMGs, as described in Appendix D. Because no TLDs were placed at these sample locations, the external dose component of the TED was calculated in the same manner as described in Appendix D for other sample locations where TLD data were not available (e.g., 1998 soil sample locations). The maximum TED calculated at the drainage system sample locations was 0.8 mrem/IA-yr at the retention basin sample location (DS1) at the 20-to-30-cm-bgs depth interval. Because the maximum TED is well below the FAL of 25 mrem/IA-yr, no corrective action is required at the drainage system. This suggests that contamination is not migrating from the site via surface drainages at levels that could present a radiological dose above action levels.

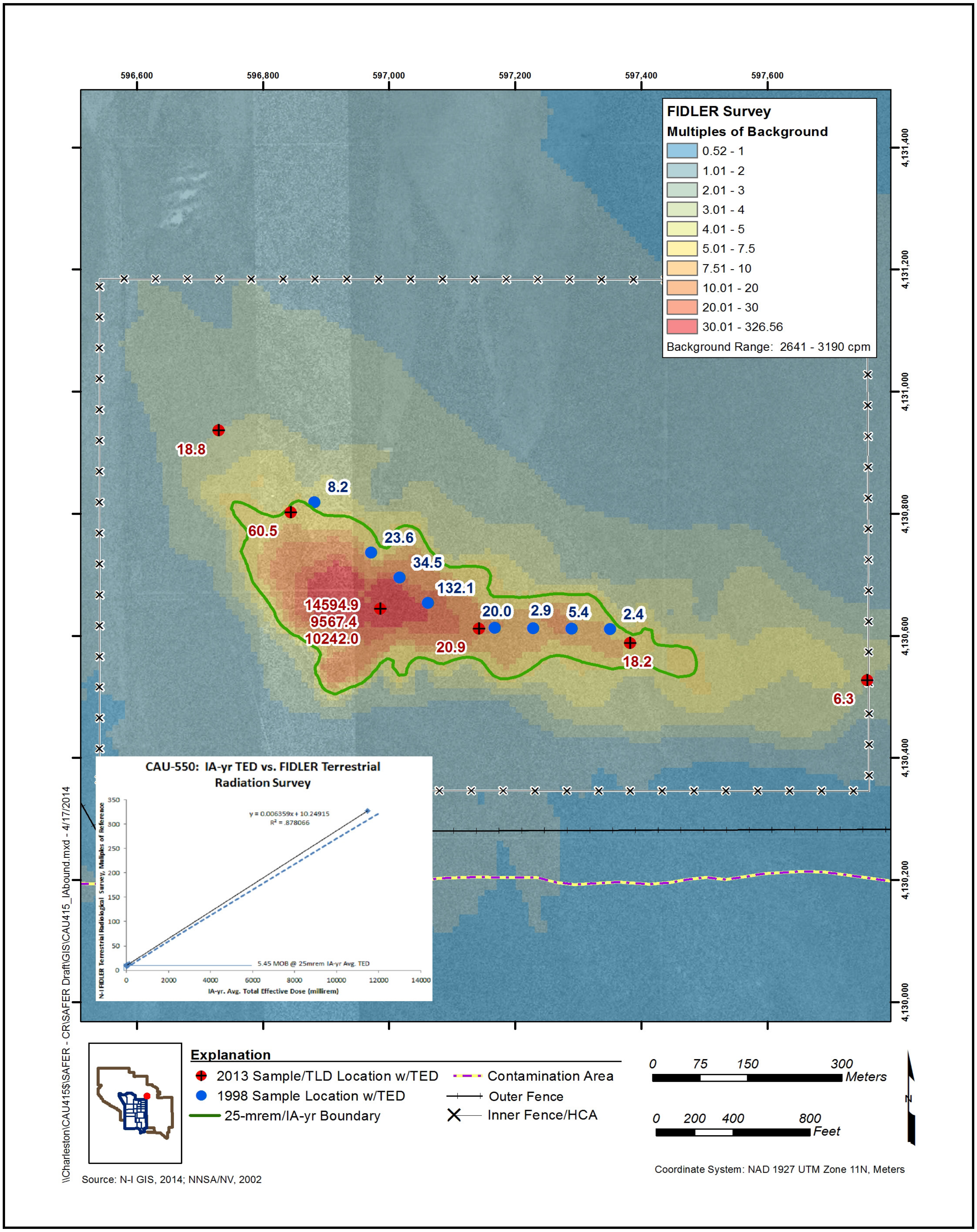


Figure 4-1
TEDs (mrem/IA-yr) and 25-mrem/IA-yr Boundary for CAU 415

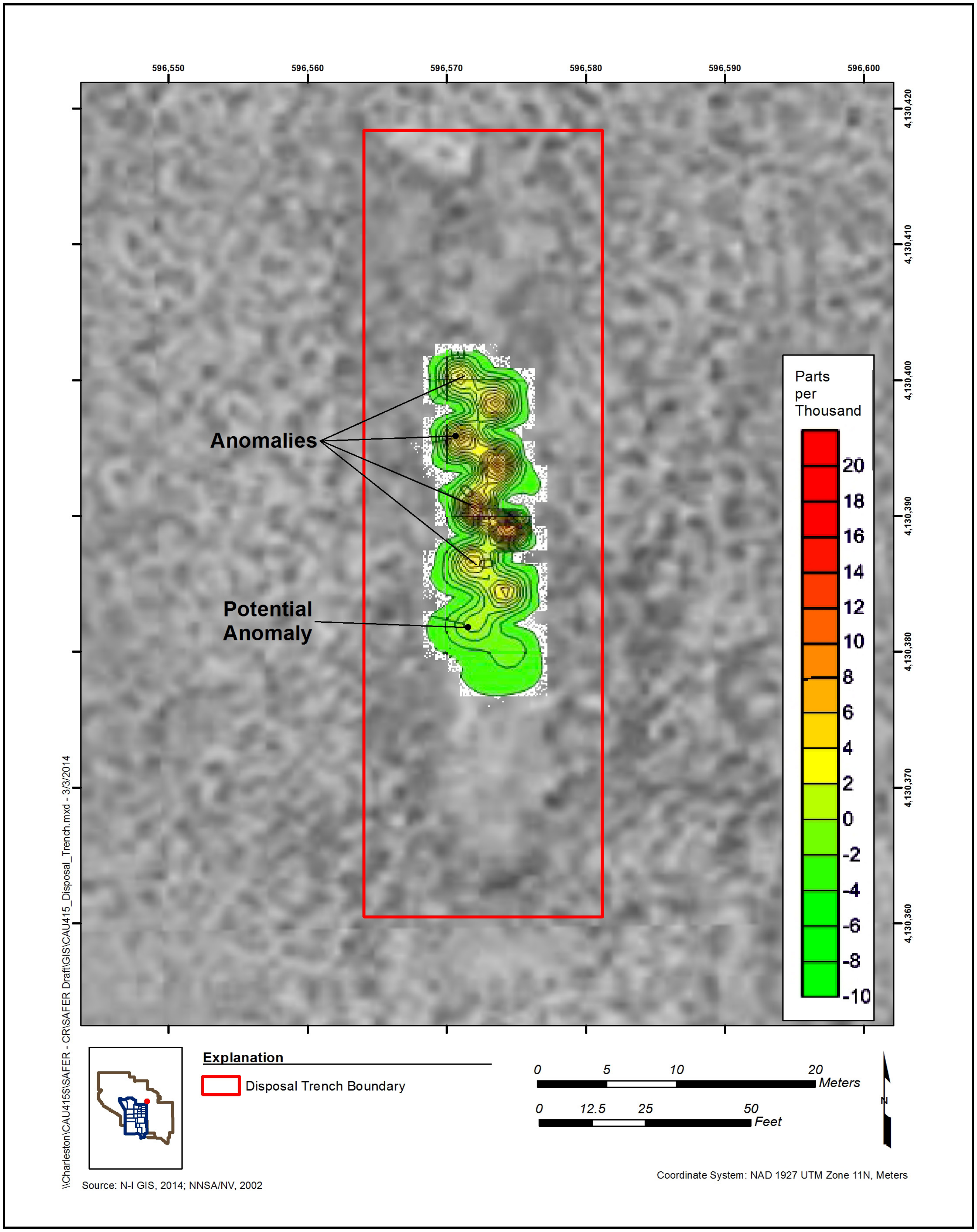


Figure 4-2
Disposal Trench Boundary

4.3.2 Removable Radioactive Contamination

Existing information on removable radioactive contamination at CAU 415 indicates that HCA conditions exist within the inner fence. The Soils RBCA document (NNSA/NFO, 2014) assumes that corrective action is required at areas that exceed HCA criteria. Based on this assumption, the area inside the inner fence meets HCA criteria and requires corrective action. Figure 4-1 presents the HCA boundary.

4.3.3 Corrective Action Boundary and UR Boundary

Three separate boundaries were established for CAU 415 based on radiological dose and removable radioactive contamination. The 25-mrem/IA-yr boundary was established around the land area where surface soil contamination would result in a dose above 25 mrem/IA-yr. The disposal trench boundary was established around the land area where subsurface radiological contamination is assumed to result in a dose above 25 mrem/IA-yr. The HCA boundary was established around the land area where removable radioactive contamination levels are assumed to meet HCA criteria. These three boundaries are shown in Figure 4-3. For practical and logistical reasons, it is desirable to have one corrective action boundary that encompasses all of these radiation hazards. Therefore, the FFACO corrective action boundary for CAU 415 was established at the inner fence, which encompasses the land areas of all three boundaries (i.e., 25 mrem/IA-yr, disposal trench, and HCA). The FFACO corrective action boundary is presented in Figure 4-3.

The UR boundary is the location where administrative controls (e.g., signs) are established to control or restrict activities within the closed site. As a conservative measure, the UR signs for CAU 415 will be posted at the CA boundary, which is the outermost boundary surrounding the site, approximately 300 ft from the outer fence.

4.4 Closure

The selected corrective action for CAU 415 is closure in place with URs. Because this corrective action will leave contamination at the site, post-closure long-term monitoring and the implementation of administrative controls (i.e., URs) to prevent unauthorized future land use is required. Site closure activities at CAU 415 will consist of establishing and recording URs. All URs established at CAU 415 will be entered into the electronic property management system used by the land custodian

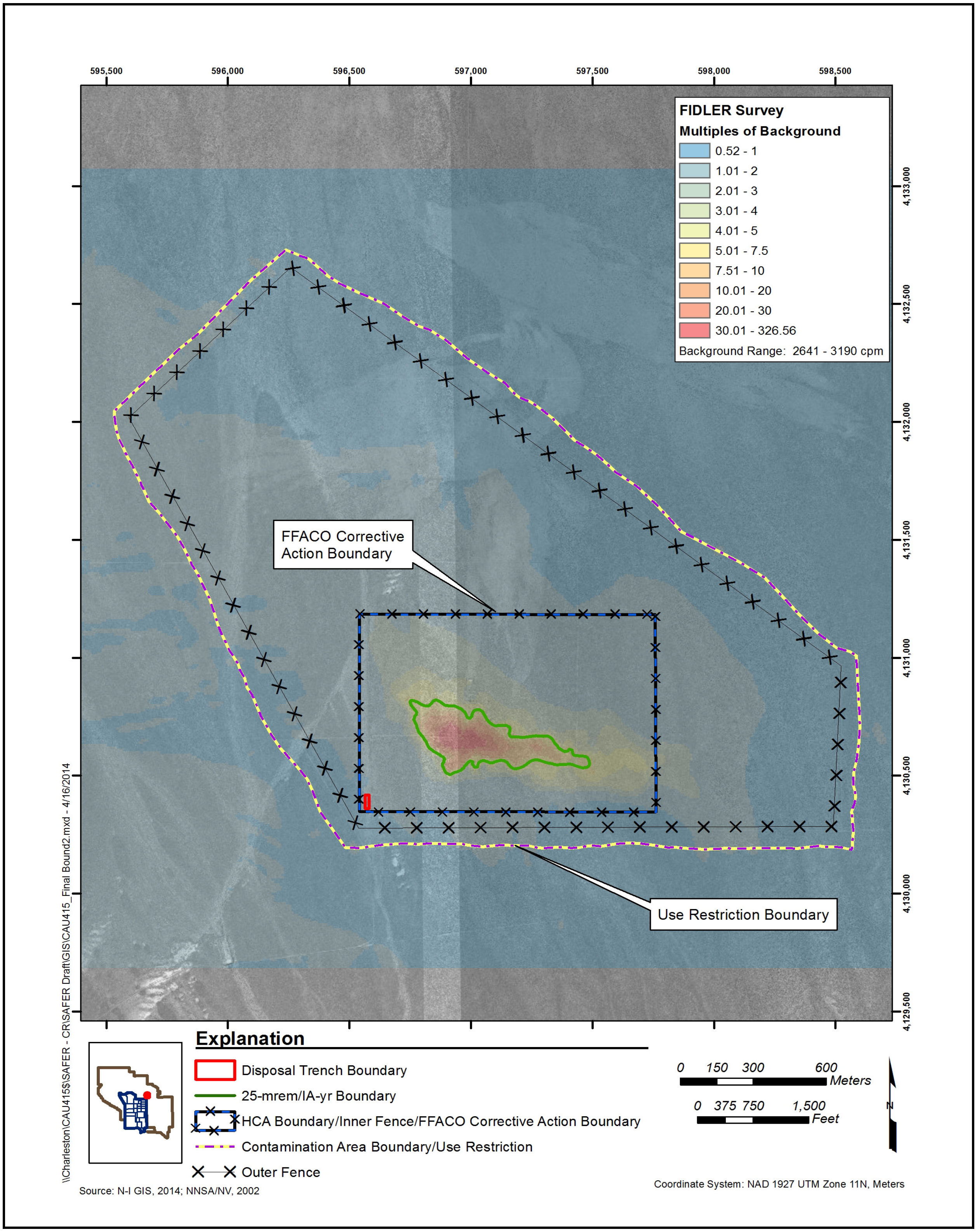


Figure 4-3
FFACO Corrective Action Boundary at CAU 415

for tracking purposes, and UR signs will be posted at the site. Pole-mounted electrical transformers were also identified at the site and will be removed as part of closure activities.

The post-closure monitoring requirements for CAU 415 site closure will be established in the CR. It is anticipated that monitoring will consist of periodic inspections of UR postings and maintenance of fencing and signs, as required. In addition, due to the presence of removable radioactive contamination at the site, separate radiation controls will be implemented as part of the DOE Occupational Radiation Protection program (10 CFR 835) (CFR, 2014). This program is independent of the FFACO and has separate posting (i.e., signage) and inspection requirements (Section 2.2.2).

After site closure activities are completed, the following actions will be implemented:

- All equipment, debris, and materials associated with the CAI will be removed.
- A site inspection will be performed to verify that all restoration activities have been completed.

4.4.1 Changes in Land Use

The closure of CAU 415 under the FFACO means that the selected corrective action has been accepted and approved by NDEP and other stakeholders. The closure of CAU 415 under this SAFER Plan is based on the Industrial Area land use scenario, which was agreed to by the CAU 415 stakeholders in the DQOs. If the agreed-upon land use scenario should change from what was evaluated in this SAFER, the closure of CAU 415 would have to be reevaluated to account for the new land use. In the future, should the land custodian determine that a proposed mission use would not comport with the proposed closure of CAU 415, or that there is a proposed transfer/relinquishment of all or part of the NTTR that will impact CAU 415, then DOE will work with the custodian and NDEP to address and resolve cleanup issues associated with the proposed use or transfer/relinquishment. DOE remains responsible for working with the regulators, as needed to revise or renegotiate any closure agreements, and remains liable for all costs associated with any future negotiation and/or remediation action for CAU 415, consistent with its responsibilities under applicable law.

4.5 Duration

The following is a tentative duration of activities (in calendar days) for SAFER activities:

Table 4-1
CAU 415 Closure Activities

Activity	Duration (days)
Site Mobilization	1
Fieldwork	2
Closure Report	120
Waste Management and Disposal	30

5.0 Reports and Records Availability

Historical information and documents referenced in this plan are retained in the NNSA/NFO activity files in Las Vegas, Nevada. This document is available in the DOE public reading facilities located in Las Vegas and Carson City, Nevada, or by contacting the appropriate DOE Soils Activity Lead.

6.0 Investigation/Remediation Waste Management

Waste generated during the CAU 415 field investigation will be managed in accordance with all applicable DOE orders, federal and state regulations, and agreements and permits between DOE and NDEP. Wastes will be characterized based on these regulations using process knowledge, field-screening results (FSRs), and analytical results from investigation and waste samples. Waste types that may be generated during the CAI include hazardous, low-level radioactive, or mixed wastes; or PCBs.

Disposable sampling equipment and personal protective equipment (PPE) are considered potentially contaminated waste only by virtue of contact with potentially contaminated soil or potentially contaminated debris (e.g., lead). These wastes may be characterized based on associated environmental sample results, waste characterization results, FSRs, or process knowledge.

Chemicals were not known to be used or present at this CAU in a manner that would generate listed hazardous waste; therefore, wastes will be characterized based on their characteristics.

Conservative estimates of total waste contaminant concentrations may be made based on the mass of the waste, the amount of contaminated media contained in the waste, and the maximum concentration of contamination found in the soil.

6.1 Waste Minimization

The CAI will be conducted in a manner that will minimize the generation of wastes using process knowledge, segregation, visual examination, and/or field screening (e.g., radiological survey and swipe results) to avoid cross-contaminating uncontaminated soil or uncontaminated waste that would otherwise be characterized and disposed as sanitary industrial waste. As appropriate, soil and debris will be returned to their original location. To limit unnecessary generation of hazardous or mixed waste, hazardous materials will not be used during the CAI unless required and approved by Environmental Compliance and Health and Safety organizations. Other waste minimization practices will include, as appropriate, avoiding contact with contaminated materials, performing dry decontamination or wet decontamination over source locations, and carefully segregating waste streams.

6.2 Potential Waste Streams

The following waste streams that may be generated during the CAU 415 field investigation:

- Disposable sampling equipment and field-screening waste
- PPE
- Soil
- Debris (e.g., battery, transformers)

The onsite management and ultimate disposition of wastes will be determined based on a determination of the waste type (e.g., low-level, hazardous, mixed), or the combination of waste types. A determination of the waste type will be guided by several factors including, but not limited to, the analytical results of samples either directly or indirectly associated with the waste, historical site knowledge, knowledge of the waste generation process, field observations, field-monitoring results and FSR, and/or radiological survey/swipe results.

6.2.1 Hazardous Waste

Suspected hazardous waste, if generated, will be containerized and managed in waste accumulation areas in accordance with 40 CFR 262.34 (CFR, 2013a).

6.2.2 Polychlorinated Biphenyls

If any type of PCB waste is generated, it will be managed in accordance with 40 CFR 761 (CFR, 2013b) as well as State of Nevada requirements (NAC, 2012b), guidance, and agreements with NNSA/NFO.

6.2.3 Low-Level Radioactive Waste

Low-level radioactive waste, if generated, will be managed in accordance with the contractor-specific waste certification program plan, DOE orders, and the requirements of the current version of the *Nevada National Security Site Waste Acceptance Criteria* (NNSA/NSO, 2012a). Potential radioactive waste containers will be staged and managed at a designated radioactive material area.

6.2.4 Mixed Low-Level Waste

Mixed waste, if generated, will be managed in accordance with the RCRA requirements (CFR, 2013a), agreements between NNSA/NFO and the State of Nevada, and DOE requirements for radioactive waste. Waste characterized as mixed will not be stored for a period of time that exceeds the RCRA requirements unless subject to agreements between NNSA/NFO and the State of Nevada. The mixed waste must be transported via an approved hazardous waste/radioactive waste transporter to the NNSS transuranic waste storage pad for storage pending treatment or disposal.

7.0 QA/QC

7.1 Sample Collection Activities

The CAU 415 stakeholders selected a corrective action of closure in place with URs for the site during the DQOs. Additional sampling is not necessary for the implementation of this corrective action. As such, this section is not applicable.

7.2 Applicable Laboratory/Analytical Data Quality Indicators

As stated in the DQOs (see Appendix B) and in the Soils Quality Assurance Plan (QAP) (NNSA/NSO, 2012b), data used for making DQO decisions will be evaluated for data quality. The Soils QAP defines and establishes data quality criteria that are evaluated in three defined steps:

1. Data Verification
2. Data Validation
3. Data Quality Assessment

Data verification includes an evaluation of all chemical and radiological laboratory data for data quality in accordance with company-specific procedures. The data are reviewed to evaluate the completeness, correctness, and conformance of each dataset. This verification includes a review of sample collection, handling and transfer, and documentation associated with sampling activities.

Data validation was performed on 100 percent of the soil sample data collected in the 1998 and 2013 investigations to determine the analytical quality of the dataset. Data validation criteria was based upon the DQOs and the intended use of the data. Validation includes an evaluation of method and contract compliance, data calculations, QC and calibration verifications, raw data, and data generation methods. Validation may also include qualifying data that may restrict or limit data use. Data validation included an evaluation of the data quality indicator (DQI) criteria for the following:

- Precision
- Accuracy/bias
- Representativeness
- Comparability
- Completeness
- Sensitivity

Data that do not meet the DQI criteria must be evaluated for usability.

A data quality assessment (DQA) was performed on existing soil sample data from the 1998 and 2013 investigations to determine whether the data met the DQO requirements and the performance criteria for the DQIs as defined in the Soils QAP (NNSA/NSO, 2012b). With the exception of two 1998 soil samples for which a portion of the data was rejected, all soil sample data met the performance criteria and are valid for use in resolving DQO decisions for CAU 415. No data from either of the two soil samples were used to support site closure of CAU 415. The details of the DQA are presented in Appendix F.

8.0 References

ASTM, see ASTM International.

ASTM International. 1995 (reapproved 2010). *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, ASTM E1739 - 95(2010)e1. West Conshohocken, PA.

Author Unknown. 1960. Written communication. Subject: "Contaminated Vehicles Area 13." Contains a report, associated letters, and photographs of the burial of four radiologically contaminated vehicles used on the CAU 415 site.

Author Unknown. 1991. Written communication regarding site monitoring/site demarcation checklists and radiation survey reports for Area 13, 12–13 May. Contains a compilation of radiological surveys conducted in 1991 at Project 57 ground zero and the waste burial pit. Includes background radiation survey reports.

CFR, see *Code of Federal Regulations*.

Code of Federal Regulations. 2013a. Title 40 CFR, Parts 260 to 282, "Hazardous Waste Management System." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2013b. Title 40 CFR, Part 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions." Washington, DC: U.S. Government Printing Office.

Code of Federal Regulations. 2014. Title 10 CFR, Part 835, "Occupational Radiation Protection." Washington, DC: U.S. Government Printing Office.

Colton, D.P. 1993. *An In-Situ Radiological Verification Survey of the Area 13 (Project 57) Nuclear Safety Test Site*, NRD-93-319. Las Vegas, NV: EG&G Energy Measurements.

DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency.

FFACO, see *Federal Facility Agreement and Consent Order.*

Federal Facility Agreement and Consent Order. 1996 (as amended March 2010). Agreed to by the State of Nevada; U.S. Department of Energy, Environmental Management; U.S. Department of Defense; and U.S. Department of Energy, Legacy Management. Appendix VI, which contains the Soils Sites Strategy, was last modified May 2011, Revision No. 4.

Gilbert, R.O., L.L. Eberhardt, E.B. Fowler, E.M. Romney, E.H. Essington, and J.E. Kinnear. 1975. "Statistical Analysis of $^{239-240}$Pu and ^{241}Am Contamination of Soil and Vegetation on NAEG Study Sites." In *The Radioecology of Plutonium and Other Transuranics in Desert Environments*, NVO-153. pp. 339–448. M.G. White and P.B. Dunaway eds. Las Vegas, NV: Energy Research & Development Administration, Nevada Applied Ecology Group.

Marty, R.C., Stoller-Navarro Joint Venture. 2003. Letter to M.L. Sanchez (NNSA/NSO) titled "Contract No. DE-AC5203NA99205 Transmittal of Soil Sampling on Project 57," 24 November. Las Vegas, NV.

Moore, J., Science Applications International Corporation. 1999. Memorandum to M. Todd (SAIC) titled "Background Concentrations for NTS and TTR Soil Samples," 3 February. Las Vegas, NV: IT Corporation.

NAC, see *Nevada Administrative Code*.

NBMG, see Nevada Bureau of Mines and Geology.

N-I GIS, see Navarro-Intera Geographic Information Systems.

NNSA/NFO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office.

NNSA/NSO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office.

NNSA/NV, see U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office.

NSTec, see National Security Technologies, LLC.

National Security Technologies, LLC. 2007. *Posting the Contamination Area at Project 57*, WP-P260-027. Prepared by the Radiological Engineering Group. Las Vegas, NV.

National Security Technologies, LLC. 2012. Written communication. Subject: *Project 57 Radiological Survey Results and Recommendations.* Las Vegas, NV.

Navarro-Intera Geographic Information Systems. 2014. ESRI ArcGIS Software.

Nevada Administrative Code. 2012a. NAC 445A.227, "Contamination of Soil: Order by Director for Corrective Action; Factors To Be Considered in Determining Whether Corrective Action Required." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 26 February 2014.

Nevada Administrative Code. 2012b. NAC 445A.22705, "Contamination of Soil: Evaluation of Site by Owner or Operator; Review of Evaluation by Division." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 26 February 2014.

Nevada Bureau of Mines and Geology. 1998. *Mineral and Energy Resource Assessment of the Nellis Air Force Range*, Open-File Report 98-1. Reno, NV.

U.S. Department of Energy. 1997. *The Procedures Manual of the Environmental Measurements Laboratory*, HASL-300. 28th Edition, Vol. 1. February. New York, NY.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. 2002. *Nevada Test Site Orthophoto Site Atlas,* DOE/NV/11718--604. Aerial photos acquired Summer 1998. Prepared by Bechtel Nevada. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2009. Written communication. Subject: "Radiological Data for Select Soils Sub-Project Corrective Action Sites," 30 December. NTS GIS Product ID 20091029-01-P012-R00. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2012a. *Nevada National Security Site Waste Acceptance Criteria*, DOE/NV-325-Rev. 9. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2012b. *Soils Activity Quality Assurance Plan*, Rev. 0, DOE/NV--1478. Las Vegas, NV.

U.S. Environmental Protection Agency. 2014. *Pacific Southwest, Region 9: Regional Screening Levels (Formerly PRGs), Screening Levels for Chemical Contaminants*. As accessed at http://www.epa.gov/region9/superfund/prg on 26 February. Prepared by EPA Office of Superfund and Oak Ridge National Laboratory.

Yu, C., A.J. Zielen, J. J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo, III, W.A. Williams, and H. Peterson. 2001. *User's Manual for RESRAD Version 6,* ANL/EAD-4. Argonne, IL: Argonne National Laboratory, Environmental Assessment Division. (Version 6.5 released in October 2009.)

Appendix A

Activity Organization

A.1.0 Activity Organization

The Soils Activity is managed by the Environmental Management organization within the NNSA/NFO.

The identification of the activity Health and Safety Officer and the Quality Assurance Officer can be found in the appropriate plan. However, personnel are subject to change, and it is suggested that the NNSA/NFO Soils Activity Lead be contacted for further information. The Task Manager will be identified in the FFACO Monthly Activity Report prior to the start of field activities.

Appendix B

Data Quality Objectives

B.1.0 Introduction

The DQO process described in this appendix is a seven-step strategic systematic planning method used to plan data collection activities and define performance criteria for the CAU 415, Project 57 No. 1 Plutonium Dispersion (NTTR) field investigation. The DQOs are designed to ensure that the data provide sufficient and reliable information to identify, evaluate, and technically defend the appropriate corrective actions, to provide sufficient data to implement the corrective actions, and to verify that closure was achieved.

The DQOs, as presented in this appendix, were developed by NDEP, NNSA/NFO, and other stakeholders. The seven steps of the DQO process presented in Sections B.2.0 through B.8.0 were developed in accordance with *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006).

In general, the procedures used in the DQO process provide the following:

- A method to establish performance or acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study.
- Criteria that will be used to establish the final data collection design, such as
  - the nature of the problem that has initiated the study and a conceptual model of the environmental hazard to be investigated;
  - the decisions or estimates that need to be made, and the order of priority for resolving them;
  - the type of data needed; and
  - an analytic approach or decision rule that defines the logic for how the data will be used to draw conclusions from the study findings.
- Acceptable quantitative criteria on the quality and quantity of the data to be collected, relative to the ultimate use of the data.
- A data collection design that will generate data meeting the quantitative and qualitative criteria specified. A data collection design specifies the type, number, location, and physical quantity of samples and data, as well as the QA and QC activities that will ensure that sampling design and measurement errors are managed sufficiently to meet the performance or acceptance criteria specified in the DQOs.

B.2.0 Step 1 - State the Problem

Step 1 of the DQO process defines the problem that requires study, identifies the planning team, and develops a conceptual model of the environmental hazards to be investigated.

The problem statement for CAU 415 is “Information on the nature and extent of potential contamination needs to be evaluated for the closure of CAU 415.”

B.2.1 Planning Team Members

The DQO planning team consists of representatives from NDEP and NNSA/NFO and other stakeholders. The DQO planning team met on January 28, 2014, and conducted the DQO meeting.

B.2.2 Conceptual Site Model

The CSM is used to organize and communicate information about site characteristics. It reflects the best interpretation of available information at a point in time. The CSM is a primary vehicle for communicating assumptions about release mechanisms, potential migration pathways, or specific constraints. It provides a summary of how and where contaminants are expected to move and what impacts such movement may have. It is the basis for assessing how contaminants could reach receptors both in the present and future. The CSM describes the most probable scenario for current conditions at the site and defines the assumptions that are the basis for identifying appropriate sampling strategy and data collection methods. An accurate CSM is important as it serves as the basis for all subsequent inputs and decisions throughout the DQO process.

The CSM was developed for CAU 415 using information from the physical setting, potential contaminant sources, release information, historical background information, knowledge from similar sites, and physical and chemical properties of the potentially affected soil and COPCs.

The CSM consists of the following:

- Potential contaminant releases, including soil subsequently affected
- Release mechanisms (i.e., the conditions associated with the release)

- Potential contaminant source characteristics, including contaminants suspected to be present and contaminant-specific properties
- Site characteristics, including physical, topographical, and meteorological information
- Migration pathways and transport mechanisms that describe the potential for migration and where the contamination may be transported
- The locations of points of exposure where individuals or populations may come in contact with a COC associated with a release
- Routes of exposure where contaminants may enter the receptor

If additional elements are identified during the CAI that are outside the scope of the CSM, the situation will be reviewed and a recommendation will be made as to how to proceed. In such cases, NDEP will be notified and given the opportunity to comment on, or concur with, the recommendation.

Table B.2-1 provides information on CSM elements that will be used throughout the remaining steps of the DQO process. Figure B.2-1 depicts a representation of the conceptual pathways to receptors from CAU 415 sources. Figure B.2-2 depicts a graphical representation of the CSM.

Table B.2-1
CSM Description of Elements for Each Release in CAU 415
(Page 1 of 2)

CAS Identifier	NAFR-23-02
Site Status	Inactive and abandoned
Exposure Scenario	Industrial
Sources of Potential Soil Contamination	Atmospheric deposition of radionuclides from safety test; leaking containers/transformer, and surface and subsurface disposal of discarded contaminated equipment and materials
Location of Contamination/ Release Point	Surface and subsurface soil surrounding and downgradient of GZ and surface and subsurface soil from leaking containers/transformers
Amount Released	Unknown
Affected Media	Surface, shallow subsurface, and subsurface soil; drainage sediments
Potential Contaminants[a]	Pu-239/240, Am-241, U-238, PCBs

Table B.2-1
CSM Description of Elements for Each Release in CAU 415
(Page 2 of 2)

CAS Identifier	NAFR-23-02
Transport Mechanisms	Percolation of precipitation through subsurface media serves as the major driving force for vertical migration of contaminants. Surface water runoff may provide for the transportation of some contaminants within or outside the footprints of the releases. Wind may cause limited resuspension and transport of windborne contaminants.
Migration Pathways	Lateral transport expected to dominate over vertical due to large PET demands and low precipitation amounts. The depth to the uppermost aquifer precludes groundwater as a significant pathway.
Lateral and Vertical Extent of Contamination	Contamination, if present, is expected to be contiguous to the release points. Concentrations are expected to decrease with distance and depth from the source. Lateral and vertical extent of contamination exceeding FALs is assumed to be within the spatial boundaries.
Exposure Pathways	The potential for contamination exposure is limited to industrial workers, and military and emergency services personnel conducting training or response actions. These human receptors may be exposed to COPCs through oral ingestion or inhalation of, or dermal contact (absorption) with soil and/or debris due to inadvertent disturbance of these materials, or irradiation by radioactive materials.

[a]PCBs are potential soil contaminants associated only with the pole-mounted transformers.

PET = Potential evapotranspiration

B.2.2.1 Release Sources

The primary release source specific to CAU 415 is the safety experiment device. Some of the contamination associated with the release may have been translocated due to mechanical disturbance of the soil (e.g., decontamination activities that were part of the experiment) or due to migration with eroding soil particles (e.g., surface water flow through natural drainages). Other potential release sources include radioactive debris from the test infrastructure that is remaining on the surface or that has been buried in a disposal trench (e.g., contaminated vehicles), and pole-mounted transformers that potentially contain PCB dielectric fluids. Additional information on releases specific to each release site is presented in Sections 2.1 and 2.2.4.4.

The most likely locations of the contamination and releases to the environment are the soils directly below or adjacent to the CSM surface and subsurface components (i.e., soils impacted by the atmospheric release, soils impacted by leaking transformers).

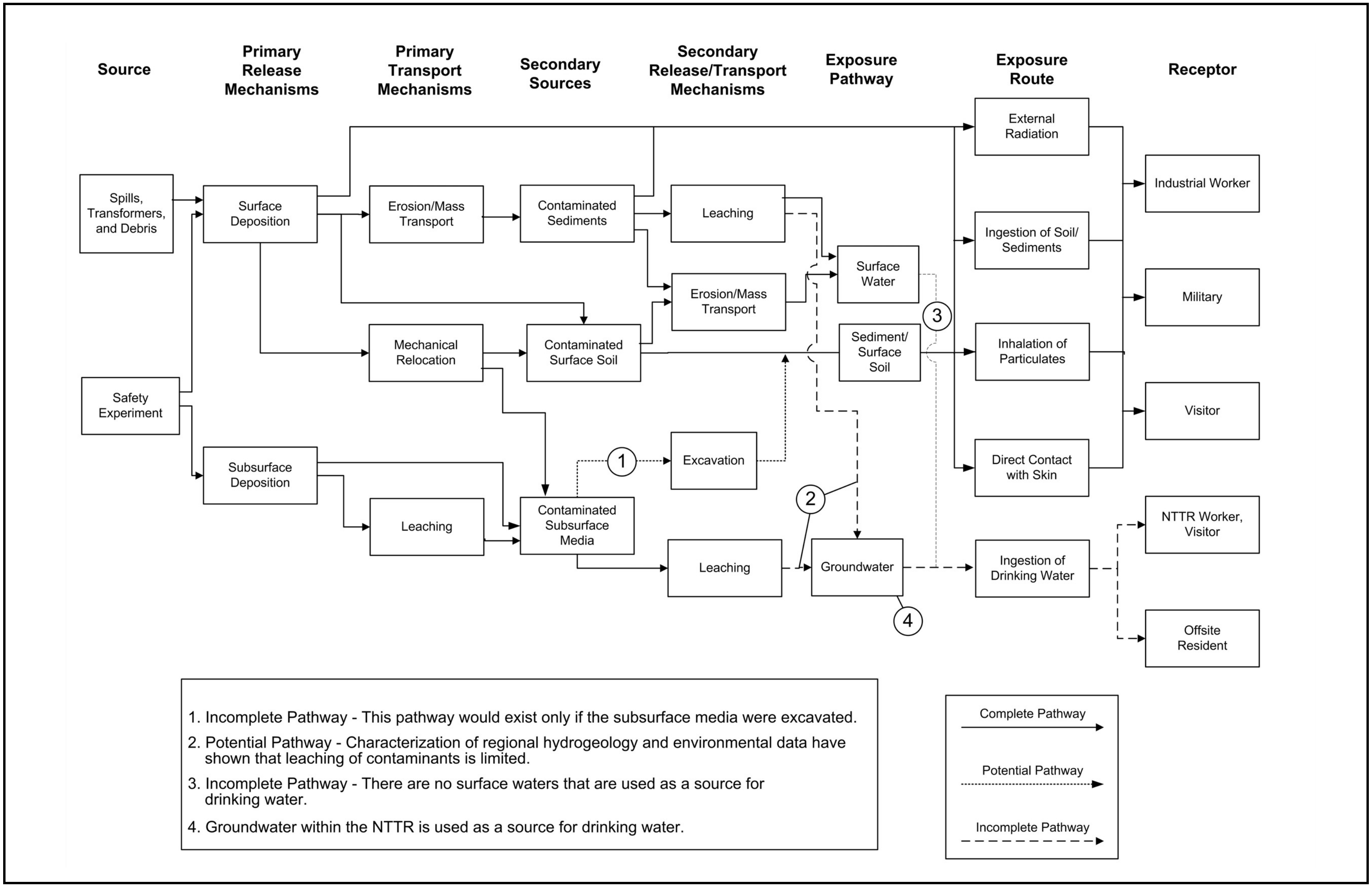


Figure B.2-1
CAU 415 CSM Pathways to Receptors

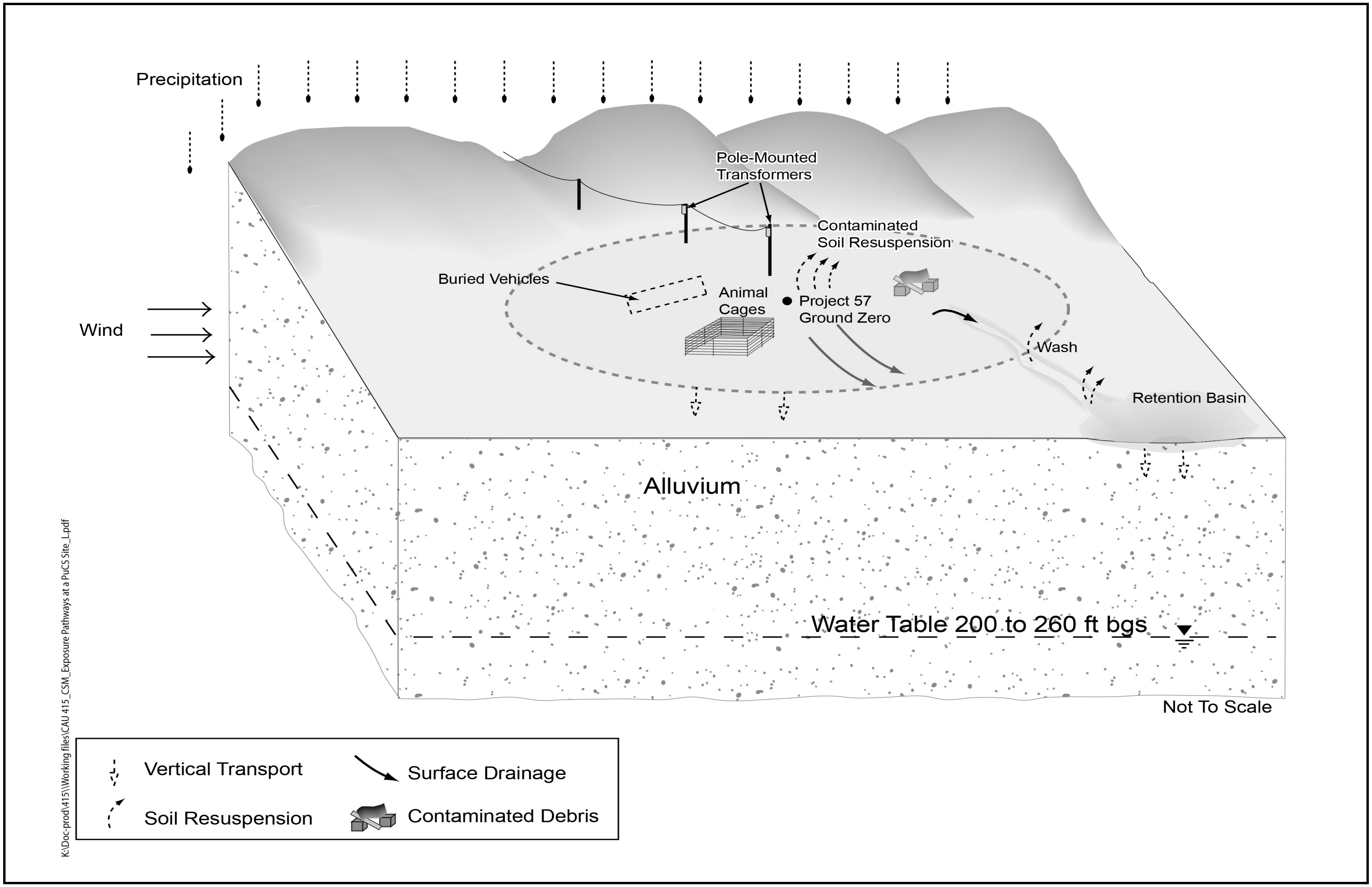


Figure B.2-2
CSM for CAU 415

B.2.2.2 Potential Contaminants

The release-specific COPCs are defined as the contaminants reasonably expected at the site that could contribute to a dose or risk exceeding FALs. Based on the nature of the releases identified in Section 2.1 and previous investigation results presented in Section 2.2, the contaminants listed in Table B.2-2 could reasonably be suspected to be present at CAU 415.

These COPCs were identified during the planning process through the review of site history, process knowledge, personnel interviews, past investigation efforts (where available), and inferred activities associated with the releases (including those that may be discovered during further investigation). Records indicate that during the Project 57 experiment, the only materials known to have been released from the safety experiment were radioactive materials. Pu, U, and Am are the primary contaminants released during the safety experiment and are expected to be found in the soil, on debris (e.g., animal cages), on the buried vehicles, and in the drainages and retention basin. Radionuclide concentrations are expected to decrease with distance from GZ. It is assumed that RCRA constituents are not present at the site at concentrations above regulatory limits based on historical documents and experience at other safety experiment sites. Two transformers were discovered during the 2013 investigation; four others were identified in 2014. The transformers are presently located near the top of power poles. Based on historical use of PCB-containing dielectric fluids in transformers from the 1950s, the transformers potentially contain or once contained PCB dielectric fluids. The COPCs applicable to Decision I for CAU 415 are listed in Table B.2-2.

B.2.2.3 Contaminant Characteristics

Contaminant characteristics include, but are not limited to, solubility, density, and adsorption potential. In general, contaminants with low solubility, high affinity for soil, and high density can be expected to be found relatively close to release points. Based on knowledge of the Project 57 safety experiment and other similar safety experiments conducted on the NNSS, the anticipated primary contaminants in soil at CAU 415 include Pu, Am, and depleted U. The oxides of these radionuclides are relatively insoluble in water and have a high affinity for soil particles in the desert environment.

Table B.2-2
Contaminants of Potential Concern[a]

COPCs	Pu-Contaminated Soil	Disposal Trench	Drainage System	Pole-Mounted Transformers
Organic COPCs				
PCBs	--	--	--	X
Radionuclide COPCs				
U-234	X	X	X	--
U-235/236	X	X	X	--
U-238	X	X	X	--
Pu-238	X	X	X	--
Pu-239/240	X	X	X	--
Pu-241	X	X	X	--
Am-241	X	X	X	--

[a]The COPCs are the contaminants that, based on process knowledge and historical documentation, are likely to be present.

X = COPC associated with this CAU component.
-- = COPC not associated with this CAU component.

PCBs are also relatively immobile if released to the environment. If released to the soil, PCBs are tightly adsorbed to soil particles and do not leach significantly; however biodegradation of PCBs occurs very slowly in the environment.

Based upon conclusions of a contaminant travel time analysis for CAU 415, the radionuclide contaminants at CAU 415 are moderately to highly adsorbed on the valley-fill alluvial materials present at the site (N-I, 2013). Utilizing conservative input parameters based on regional groundwater models, an analysis of contaminant travel time through the subsurface to the water table suggests that the residual radioactive U and Pu contamination on the ground surface at the CAU 415 site will travel 0.76 m and 0.38 m, respectively, over a 1,000-year time period. And, using the highest mobility rate, the U and Pu contamination will not reach the water table for 46,000 years, and 93,000 years, respectively (N-I, 2013).

B.2.2.4 Site Characteristics

Site characteristics are defined by the interaction of physical, topographical, and meteorological attributes and properties. Physical properties include permeability, porosity, hydraulic conductivity, degree of saturation, sorting, chemical composition, and organic content. Topographical and meteorological properties and attributes include slope stability, precipitation frequency and amounts, precipitation runoff pathways, drainage channels and ephemeral streams, and evapotranspiration potential.

The CAU 415 site is situated in the high desert region of south–central Nevada. Meteorological data specific to the CAU 415 site have been collected since 2011 at two meteorological stations located on the east side of the CA fence. Meteorological parameters being measured by these stations include wind direction and speed, air temperature, relative humidity, and precipitation. At present, the available data include approximately one year of monitoring data that may or may not be representative of the typical meteorological conditions at the site. These data indicate that winter is dominated by northerly winds, while the summer season has both northerly and southwest winds. Winds above 19 miles per hour (mph) from both northerly and southwesterly directions during both seasons were noted. Typical of a Great Basin Desert location, the CAU 415 site is exposed to large diurnal temperature ranges with infrequent precipitation events. The total precipitation during the first year of monitoring was less than 3 in.

Additional meteorological data that represent several years of monitoring in a comparable desert environment at Yucca Flat on the NNSS are presented for comparison. These data may be more representative of the typical (or average) meteorological conditions expected to be encountered at CAU 415. Elevations range from about 910 m (3,000 ft) above mean sea level in the south and east, rising to 2,230 m (7,300 ft) in the mesa areas toward the northern and western boundaries. The average annual precipitation at the weather station at Yucca Flat is 7.42 in. (18.8 cm) (French, 1985; Schaeffer, 1968). At Yucca Flat, the average annual daily minimum temperature is 22 degrees Celsius (°C) (72 degrees Fahrenheit [°F]), and the average annual daily maximum is 38 °C (100 °F). Recorded extremes are 43 °C (110 °F) and -26 °C (-15 °F). Temperatures in excess of 38 °C (100 °F) can be expected June through September, while temperatures at or near freezing have been recorded in all months except July and August (DRI, 1988). The average annual wind speed at Yucca Flat is 13 kilometers per hour (km/hr) (8.1 mph), and the prevailing wind direction is from the north, except in May through August, when the winds are primarily from the south–southwest. April is the windiest month, with wind speeds averaging 14 km/hr (9 mph); however, gusts in excess of 80 km/hr (50 mph) have been recorded in every month.

The CAU 415 site is within the Death Valley Groundwater Flow System. Groundwater under the site flows southward toward the Ash Meadows Discharge Area. The depth to groundwater in the area of the CAU 415 site is estimated to be approximately 200 to 260 ft (61 to 79 m) (NNSA/NSO, 2011), and is provided by the depth of the water table at the Stewart 2 (HTH) well, located 1.4 kilometers southwest of the site (N-I, 2013).

No permanent surface waters are associated with the CAU 415 site. Natural drainage for the area is generally from the northwest to the southeast, moving toward the Groom Lake playa. The site drainage patterns observed on aerial photographs of the CAU 415 site suggest that surface runoff may lead from the GZ area to a retention basin, located adjacent to the Stewart 2 (HTH) well, southwest of the fenced area.

B.2.2.5 Migration Pathways and Transport Mechanisms

Migration pathways include the lateral migration of potential contaminants across surface soils/sediments and vertical migration of potential contaminants through subsurface soils. Contaminants present in ephemeral washes are subject to much higher transport rates than contaminants present in other surface areas. These ephemeral washes are generally dry but are subject to infrequent stormwater flows. Stormwater flow events provide an intermittent mechanism for both vertical and lateral transport of contaminants. Contaminated sediments entrained by these stormwater events would be carried by the drainage channel flow to locations where the flowing water loses energy and the sediments drop out. These locations are visually identifiable as sedimentation areas.

Other migration pathways for contamination from the site include windborne material and materials displaced from maintenance activities (e.g., fence repair, road maintenance). Contaminants may also be moved through mechanical disturbance due to maintenance or construction activities at the site. Specifically, this can include activities such as decontamination and demolition of facilities, investigation and resolution of CASs, and disassembly and removal of equipment and support structures.

Migration is influenced by the chemical characteristics of the contaminants (presented in Section B.2.2.3) and the physical characteristics of the vadose zone material (presented in Section B.2.2.4). In general, the radiological contaminants that are reasonably expected to be present at CAU 415 (i.e., Pu, Am, U) have low solubilities and high affinity for soil. The physical characteristics of the vadose zone material generally include medium and high adsorptive capacities; low moisture contents (i.e., available water-holding capacity); and relatively long distances to groundwater (e.g., 200 to 260 ft). Based on these physical and chemical factors, contamination is expected to be found relatively close to release points.

Infiltration and percolation of precipitation serve as a driving force for downward migration of contaminants. However, due to high PET (annual PET at the Area 3 Radioactive Waste Management Site on the NNSS has been estimated at 62.6 in. [Shott et al., 1997]), and limited precipitation for this region (7.42 in. [French, 1985; Schaeffer, 1968]), percolation of infiltrated precipitation does not provide a significant mechanism for vertical migration of contaminants to groundwater (Section B.2.2.3).

Subsurface migration pathways at CAU 415 are expected to be predominately vertical, although spills or leaks at the ground surface may also have limited lateral migration before infiltration. The depth of infiltration will be dependent upon the type, volume, and duration of the discharge; as well as the presence of relatively impermeable layers that could modify vertical or lateral transport pathways, both on the ground surface (e.g., concrete) and in the subsurface (e.g., caliche layers).

B.2.2.6 Exposure Scenarios

Human receptors may be exposed to COPCs through oral ingestion or inhalation of, or dermal contact (absorption) with soil or debris due to inadvertent disturbance of these materials, or external irradiation by radioactive materials. Onsite workers, military personnel, and possibly site visitors may be potential receptors of contaminants from onsite water supply wells. These onsite receptors may be potentially exposed to radionuclides and other hazardous materials in groundwater through oral ingestion, dermal contact, irradiation, or inhalation. Existing monitoring programs of the water supply wells limits the potential for this exposure scenario. The closest well to the CAU 415 site, Stewart 2 (HTH), is a monitoring well and is not a source of drinking water.

The CAU 415 site is in a remote location with controlled access that precludes use as a regularly assigned work area. However, as agreed to by the CAU 415 stakeholders, a conservative land use scenario that assumes an exposure duration of 2,000 hours per year was selected for evaluation of the site. As defined in the Soil RBCA document (NNSA/NFO, 2014), this is the Industrial Use Area exposure scenario that assumes worker exposure to site contaminants for 250 days per year, 8 hours per day for 25 years.

B.3.0 Step 2 - Identify the Goal of the Study

Step 2 of the DQO process states how environmental data will be used in meeting objectives and solving the problem, identifies study questions or decision statement(s), and considers alternative outcomes or actions that can occur upon answering the question(s).

B.3.1 Decision Statements

As agreed to by the CAU 415 stakeholders, the selected corrective action for CAU 415 is closure in place with URs. The decision was based on the assumption that existing data are sufficient to support closure in place. If it is determined that existing data are not sufficient, the stakeholders will be consulted and a revised closure strategy for CAU 415 will be developed. Otherwise, CAU 415 will be closed in place, and the details of closure will be presented in the CR.

For CAU 415, the Decision I statement is as follows:

- “Does contamination exist at the release site that exceeds FALs?”

In order to resolve Decision I, the presence of contamination at levels exceeding the FAL is defined as the condition where the most exposed human receptor (conservatively assumed to be an Industrial Worker) has the potential for exposure to a contaminant exceeding a FAL, to receive a TED in excess of 25 mrem/yr, or the presence of HCA conditions. Based upon review of the available data, the following has been determined:

- Surface soils in the GZ area of CAU 415 contain COCs that exceed the FAL; therefore, Decision I is resolved.
- HCA conditions exist within the inner fence, and the fence line conservatively bounds the area.

The DQO process resulted in the assumption that corrective action is required in the area exhibiting HCA conditions (the area within the inner fence). Figure B.3-1 shows the HCA boundary. Decision I is considered resolved, because HCA conditions are known to exist within the inner fence, and the fence line conservatively bounds the area.

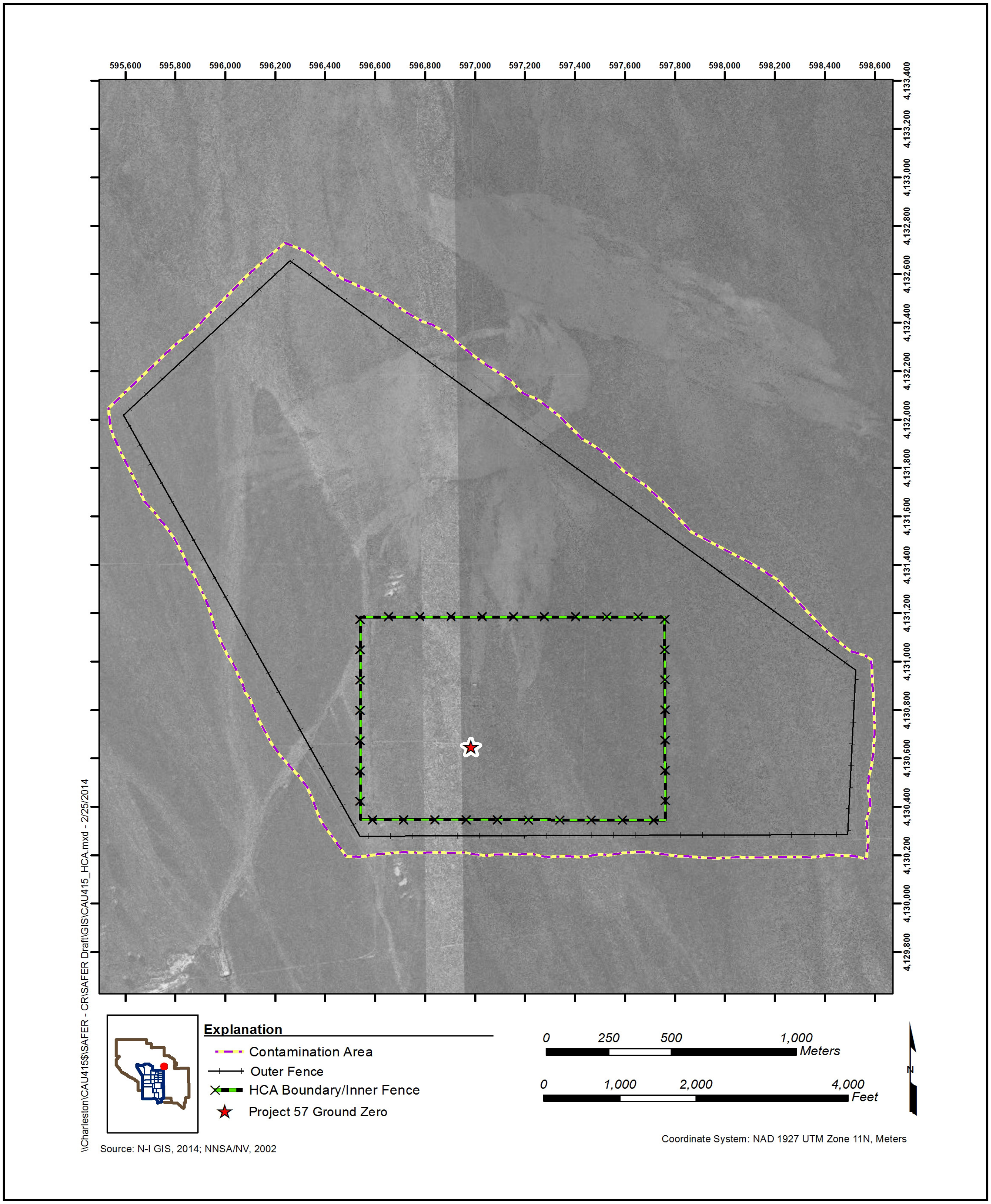


Figure B.3-1
CAU 415 HCA Boundary

- Subsurface soils in the disposal trench are assumed to contain COCs that exceed FALs. Therefore, Decision I is resolved.

- The natural drainages originating from the GZ area and the retention basin were investigated in December 2013. Completion of both a visual survey and radiological (FIDLER) survey did not identify any elevated radiological readings or other biasing factors. Therefore, Decision I is resolved for the drainage system, as there are no contaminants present above a FAL.

- The pole-mounted transformers at CAU 415 potentially contain dielectric fluids with PCBs. Visual inspection of the pole-mounted transformers in 2013 did not indicate any evidence of leaks or soil staining in the area below the transformers. However, because the transformers have the potential to release COCs to the soil in excess of a FAL, corrective action (removal of the transformers) is required.

As information exists that the conditions described above are present, Decision I is resolved; corrective action is required; and Decision II must be resolved.

The Decision II statement is as follows:

- "Have the CAU 415 closure objectives been met?"

The CAU 415 closure objectives are defined as follows:

- For the Pu-contaminated soil, the closure objective is to determine the corrective action boundary (i.e., the area exceeding 25 mrem/IA-yr and the area exceeding HCA conditions).

- For the disposal trench, the closure objective is to determine the lateral extent of the buried contaminated vehicles and debris, defined as the extent of the anomalies detected in the geophysical survey.

- For the drainage system, it has been determined that no contaminants exist above a FAL; therefore, Decision II is not required.

- For the pole-mounted transformers, the closure objective is removal of the transformers.

If sufficient data are not available to meet the closure objectives, then site conditions will be reevaluated, and further consultation with NDEP and the stakeholders is required.

B.3.2 Alternative Actions to the Decisions

This section identifies actions that may be taken to solve the problem depending on the possible outcomes of the investigation.

B.3.2.1 Alternative Actions to Decision I

For the Pu-contaminated soil and the disposal trench, if it is determined that sufficient data are not available to make a corrective action decision, then the stakeholders will be consulted and a revised closure strategy for CAU 415 will be developed. If the available existing data are sufficient, then corrective action is required, and the details of closure will be presented in the CR.

For the drainage system, no FAL is exceeded; further assessment is not required; and no corrective action is necessary.

For the pole-mounted transformers, if contaminants exceeding a FAL are not present, then corrective action is not required. Because it is assumed that contaminants are present, and a FAL is exceeded, the corrective action to remove the transformers will be conducted.

B.3.2.2 Alternative Actions to Decision II

For the Pu-contaminated soil and disposal trench, if the lateral and vertical extent of the area exceeding 25 mrem/yr or HCA conditions have not been defined, then the CAU 415 stakeholders will be consulted and a revised closure strategy will be developed.

For the drainage system, it has been determined that no contaminants exist above a FAL; therefore, Decision II is not required. For the pole-mounted transformers, the corrective action of removal will be conducted; therefore, Decision II is resolved.

If sample analytical results are not sufficient to characterize all generated wastes, then additional waste characterization samples may be collected. If available information is not sufficient to evaluate the potential for migration of COC contamination beyond the corrective action boundary, then additional information may be necessary. If sufficient information is not available to confirm that closure objectives have been met, then further consultation with NNSA/NFO, NDEP, and the stakeholders is required. Otherwise, collection of additional information is not required.

B.4.0 Step 3 - Identify Information Inputs

Step 3 of the DQO process identifies the information needed, determines sources for information, and identifies sampling and analysis methods that will allow reliable comparisons with FALs.

B.4.1 Information Needs

Sufficient information exists to determine that corrective action is required for the following release components:

1. Soils in the GZ area of CAU 415 are present that exceed the FALs.
2. HCA conditions are present within the inner fenced area of the site. Therefore, an HCA boundary has been conservatively established at the inner fence.
3. Based on process and historical information, buried contamination is assumed to exceed the FALs in the disposal trench.
4. The pole-mounted transformers are assumed to contain PCBs exceeding a FAL.

Investigation of the drainages originating from the CAU 415 GZ did not identify any elevated radiological readings or other biasing factors. Therefore, no corrective action is necessary for the drainage system.

Decision II will be resolved using the following methods:

- For the Pu-contaminated soil, the 25 mrem/IA-yr boundary will be established through the correlation of TED at sample locations and radiation survey results. A boundary will then be established at the radiation survey isopleth that corresponds to the 25-mrem/yr FAL. An HCA boundary has been conservatively established at the inner fence that bound the area with known HCA conditions.
- For the disposal trench, buried contamination is assumed to exceed the FALs. The extent of contamination will be determined using the results of the geophysical survey that delineate the extent of the buried anomalies.
- For the pole-mounted transformers, the transformers will be removed, therefore resolving Decision II.

For investigation-derived waste (IDW) and potential remediation wastes (if generated), samples of the waste or environmental media must provide sufficient information to characterize the wastes for disposal. If additional information is needed to confirm that closure objectives have been met, then further consultation with NNSA/NFO, NDEP and the stakeholders is required.

B.4.2 Sources of Information

Previous investigation data—including aerial and ground-based surveys, soil sampling, and TLD data—provide valuable information to evaluate Decision I and II. This information includes the following:

- ***Ground-Based Radiological Surveys***. Multiple ground-based radiological surveys have been conducted at the CAU 415 site since completion of the test in 1957.
  - Loose, unbound survey forms were found in the historical records for surveys conducted in December 1964 (Author Unknown, 1964); May 1970 (Author Unknown, 1970); May 1991 (Author Unknown, 1991); August 1992 (REECo, 1992); and September 1996 (BN, 1996). These surveys targeted the fenced area around CAU 415 GZ.
  - In May 1993, an *in situ* survey was conducted in support of a soil sampling effort (Colton, 1993). The presence of Am-241 was detected at 91 of the 93 locations, ranging in activity from 1 to 543,700 pCi/g.
  - In December 2013, a ground-based radiological survey was conducted in support of site investigation activities at the CAU 415 site. The survey consisted of a GPS-assisted continuous scanning survey using a FIDLER instrument. The survey included transects along radials from the GZ outward to beyond the CA fence line.
- ***Aerial Radiological Surveys***. Aerial radiological surveys were conducted in 1977 (Fritzsche, 1979) and 1997 (NNSA/NSO, 2009). The surveys were conducted using helicopters that flew at an altitude of 100 ft (30 m) (1979 survey) and 50 ft (15 m) (1997 survey) above the ground surface. The 1997 Am survey results are presented in Figure 2-2.
- ***Soil Sampling and TLD Results.*** Analytical data were collected from soil sampling events conducted in 1998 and 2013 at CAU 415. In addition to the soil samples collected during the 2013 site investigation, TLDs were placed at each sample location to calculate external dose.

B.5.0 Step 4 - Define the Boundaries of the Study

Step 4 of the DQO process defines the target population of interest and its relevant spatial boundaries, specifies temporal and other practical constraints associated with sample/data collection, and defines the sampling units on which decisions or estimates will be made.

B.5.1 Target Populations of Interest

The population of interest to resolve Decision I (Does contamination exist at the release site that exceeds FALs?) for the Pu-contaminated soil is any location within the site that is contaminated with any contaminant above a FAL. For the disposal trench, it is the presence of buried radiological contamination. The population of interest for the drainage system is any sedimentation area within the drainage system that is contaminated with any contaminant above a FAL. For the pole-mounted transformers, the population of interest is the transformers that are assumed to contain PCBs that, if released, could cause soil to exceed the FALs. As information exists that all of these conditions are present, Decision I is resolved.

The populations of interest to resolve Decision II (Have the CAU 415 closure objectives been met?) are as follows:

- For the Pu-contaminated soil, it is the set of locations bounding contamination exceeding a FAL in lateral and vertical directions.
- For the disposal trench, it is the lateral extent of the buried radiologically contaminated vehicles and debris.
- For the drainage system, it is the extent of the sedimentation area.
- For the pole-mounted transformers, it is the extent of the area contaminated above the FALs.
- For IDW and remediation wastes, the population of interest is the data required to characterize the waste for disposal.

B.5.2 Spatial Boundaries

Spatial boundaries are the maximum lateral and vertical extent of expected contamination that can be supported by the CSM. For CAU 415 the maximum vertical extent is expected to be 15 ft, and the lateral extent is expected to be 2 miles (mi). Although it is estimated that 95 percent of the Pu from the safety test is located within the top 5 cm of soil (Essington et al., 1976), the maximum vertical extent of contamination is based upon the depth of the vehicle burial in the disposal trench, which is estimated at 15 ft. The lateral boundary of contamination is based upon the extent of detectable activity measured by the 1997 aerial radiological survey of the CAU 415 site (NNSA/NSO, 2009). The extent of the radioactivity measured by the aerial radiological survey extends to the east and to the northwest approximately 2 to 3 mi. The lateral boundary also encompasses the entire area within the present CA. The Decision II spatial boundaries are summarized as follows:

- **Vertical.** 15 ft bgs
- **Lateral.** 2 mi from GZ

COCs found beyond these boundaries may indicate a flaw in the CSM and may require reevaluation of the CSM before the investigation can continue.

B.5.3 Practical Constraints

Practical constraints (e.g., activities by other organizations, utilities, important cultural resources, threatened or endangered animals and plants, unstable or steep terrain, and/or access restrictions) may prevent the ability to investigate this site. Practical constraints that have been identified specific to CAU 415 include military activities at or near the site that will preclude access to the site.

B.5.4 Define the Sampling Units

The scale of decision making refers to the smallest, most appropriate area or volume for which decisions will be made. The scale of decision making in Decision I is the contamination associated with a specific release or CAU component. The presence of a COC associated with a release will cause the determination that the release requires further evaluation. The scale of decision making for Decision II is defined as a contiguous area containing a COC originating from a release. Resolution of Decision II requires this contiguous area to be bounded laterally and vertically.

B.6.0 Step 5 - Develop the Analytic Approach

Step 5 of the DQO process specifies appropriate population parameters for making decisions, defines action levels, and generates an "If … then … else" decision rule that defines the conditions under which possible alternative actions will be chosen. This step also specifies the parameters that characterize the population of interest, specifies the FALs, and confirms that the analytical detection limits are capable of detecting FALs.

B.6.1 Population Parameters

Population parameters are the parameters that will be compared to action levels.

Decision I. For the Pu-contaminated soil, the population parameter is the calculated TED from each location or the presence of HCA conditions. For the disposal trench, the population parameter is TED in the subsurface soil in the trench, which is assumed to exceed the FAL. For the drainage system, the population parameter is the calculated TED from each location. For the transformers, the population parameter is dielectric fluids containing contaminants that, if released, could cause future soil contamination at levels exceeding a FAL.

Decision II. For the Pu-contaminated soil, the population parameters include (1) for radiological dose, the correlation value (r^2 value) resulting from the relationship of the calculated TED with the radiological survey results; and (2) for removable contamination, the area that meets HCA conditions. For the disposal trench, the population parameter is geophysical survey results. For the transformers, the population parameter is the area of soil that exceeds the FAL.

B.6.2 Preliminary Action Levels

The PALs presented in this section are to be used for site screening purposes. They are not necessarily intended to be used as cleanup action levels or FALs. However, they are useful in screening out contaminants that are not present in sufficient concentrations to warrant further evaluation and, therefore, streamline the consideration of remedial alternatives.

The FALs will be established using the RBCA process described in the Soils RBCA document (NNSA/NFO, 2014). This process conforms with NAC 445A.227, which lists the requirements for sites with soil contamination (NAC, 2012a). For the evaluation of corrective actions, NAC 445A.22705 (NAC, 2012b) requires the use of ASTM Method E1739 (ASTM, 1995) to "conduct an evaluation of the site, based on the risk it poses to public health and the environment, to determine the necessary remediation standards or to establish that corrective action is not necessary." For the evaluation of corrective actions, the FALs are established as the necessary remedial standard. The RBCA process as described in the Soils RBCA document defines three tiers (or levels) of evaluation involving increasingly sophisticated analyses.

The comparison of laboratory results to FALs and the evaluation of potential corrective actions will be included in the investigation report. The FALs will be defined (along with the basis for their definition) in the CR.

B.6.2.1 Chemical PALs

Except as noted herein, the chemical PALs are defined as the Region 9 Regional Screening Levels for chemical contaminants in industrial soils (EPA, 2013). Background concentrations for RCRA metals will be used instead of screening levels when natural background concentrations exceed the screening level (e.g., arsenic on the NNSS). Background is considered the average concentration plus two standard deviations of the average concentration for sediment samples collected by the Nevada Bureau of Mines and Geology throughout the NTTR (formerly the Nellis Air Force Range) (NBMG, 1998; Moore, 1999). For detected chemical COPCs without established screening levels, the protocol used by EPA Region 9 in establishing screening levels (or similar) will be used to establish PALs. If used, this process will be documented in the CR. Because no environmental media was identified with the potential for chemical contamination, action levels for chemical constituents were not used in evaluating DQO decisions.

B.6.2.2 Radionuclide PALs

The PAL for radioactive contaminants is a TED of 25 mrem/yr, based upon the Industrial Area exposure scenario. Because the CAU 415 stakeholders agreed to use an Industrial Area land use scenario, the radionuclide PALs were established as the FALs for CAU 415. The Industrial Area exposure scenario is defined in the Soils RBCA document (NNSA/NFO, 2014).

The TED is calculated as the sum of external dose and internal dose. External dose is determined directly from TLD measurements. Internal dose is determined by comparing analytical results from soil samples to RRMGs that were established using the RESRAD computer code (Yu et al., 2001). The RRMGs are radionuclide-specific values for radioactivity in surface soils. The RRMG is the value, in picocuries per gram of surface soil, for a particular radionuclide that would result in an internal dose of 25 mrem/yr to a receptor (under the appropriate exposure scenario) independent of any other radionuclide (assuming that no other radionuclides contribute dose). In the RESRAD calculation, several input parameters are not specified so that site-specific information can be used. The default and site-specific input parameters used in the RESRAD calculation of RRMGs for each exposure scenario and the RRMG values are presented in the Soils RBCA document (NNSA/NFO, 2014).

B.6.3 Decision Rules

Decision I Rules

- If the radiological dose or removable contamination levels are inconsistent with the CSM or extend beyond the spatial boundaries identified in the DQOs, then work will be suspended and the closure strategy will be reconsidered.
- For the Pu-contaminated soil and the disposal trench, if the radiological dose exceeds the FAL or HCA conditions exist, then corrective action is required, else no further action.
- For the drainage system, if the radiological dose exceeds the FAL, then corrective action is required, else no further action.
- If debris is present that contains contaminants that, if released, have the potential to cause future soil contamination at levels exceeding a FAL, then a corrective action is required, else no further action.

Decision II Rules

- For the Pu-contaminated soil, drainage system, and transformers, if available information is adequate to determine the extent of radiological dose above the FAL and the extent of HCA conditions, then the corrective action boundary can be established, else further consultation with NDEP and the stakeholders is required.

- For the disposal trench, if the geophysical survey results define the lateral extent of the buried contaminated vehicles and debris, then close in place with URs, else further consultation with NDEP and the stakeholders is required.

- If sufficient information is not available to determine potential remediation waste types and evaluate the feasibility of remediation alternatives, additional waste characterization samples may be collected, else no further investigation will be necessary.

B.7.0 Step 6 - Specify Performance or Acceptance Criteria

Step 6 of the DQO process defines the decision hypotheses, specifies controls against false rejection and false acceptance decision errors, examines consequences of making incorrect decisions from the test, and places acceptable limits on the likelihood of making decision errors.

B.7.1 Decision Hypotheses

The baseline condition (i.e., null hypothesis) and alternative condition for Decision I are as follows:

- **Baseline condition.** The baseline condition assumes COCs are present exceeding a FAL. For the Pu-contaminated soil component, sufficient information exists to determine the presence of dose exceeding a FAL and the presence of HCA conditions. For the disposal trench component, it is assumed that the buried contaminated vehicles and debris exceed a FAL based upon historical information. For the pole-mounted transformers, it is assumed the transformers contain a COC exceeding a FAL. Decision I has been resolved for all three release components.

- **Alternative condition.** Decision I has been resolved for all three release components. Therefore, there is no alternative condition to consider.

The baseline condition (i.e., null hypothesis) and alternative condition for Decision II are as follows:

- **Baseline condition.** The extent of a COC has not been defined; therefore, CAU 415 closure objectives have not been met.

- **Alternative condition.** The extent of a COC has been defined; therefore, CAU 415 closure objectives have been met.

Decisions and/or criteria have false-negative or false-positive errors associated with their determination. The impact of these decision errors and the methods that will be used to control these errors are discussed in the following subsections. In general terms, confidence in DQO decisions will be established qualitatively by the following:

- Developing a CSM (based on process knowledge) that is agreed to by stakeholder participants during the DQO process.

- Testing the validity of the CSM based on investigation results.

- Evaluating the quality of data based on DQI parameters.

B.7.2 False-Negative Decision Error

The false-negative decision error would mean deciding that a COC is not present when it actually is (Decision I), or deciding that the extent of a COC has been defined when it has not (Decision II). In both cases, the potential consequence is an increased risk to human health and environment.

The false-negative decision error (where consequences are more severe) for CAU 415 is controlled by the following criteria:

- *For Pu-contaminated soil and the drainage system*:
  - For Decision I, having a high degree of confidence that the data will identify a COC if present anywhere within the release.
  - Having a high degree of confidence that the analyses conducted were sufficient to detect any COCs present in the samples.
  - Having a high degree of confidence that the dataset is of sufficient quality and completeness.
  - For Decision II, having a high degree of confidence that the data identify the extent of COCs.
  - Using an established methodology for calculating TED (NNSA/NFO, 2014).
- *For the disposal trench and the pole-mounted transformers*:
  - For Decision I, conservative assumptions are being made to assume the presence of COCs that exceed the FAL.
  - For Decision II for the disposal trench, having a high degree of confidence that the physical extent of the geophysical anomalies bounds the COC contamination. For the pole-mounted transformers, having a high degree of confidence that the extent of the COC contamination in soil was identified.

B.7.3 False-Positive Decision Error

The false-positive decision error would mean deciding that a COC is present when it is not, or a COC is unbounded when it is not, resulting in increased costs, overly conservative corrective action boundaries, or implementation of unnecessary administrative or engineering controls.

For the Pu-contaminated soil and the drainage system, false-positive results could be due to overly conservative estimates for the calculation of TED to determine corrective action boundaries and/or inaccurate inputs.

To control against false-positive error, the following actions will be implemented:

- TED will be determined based on available historical and recent site investigation data.
- Readily accepted, established, and approved procedures will be used to calculate TED and determine the corrective action boundary for CAU 415.

For the disposal trench, false-positive results would mean that the assumed contamination in the disposal trench is either not present at all or present to a lesser extent than identified with the geophysical survey. To control against false-positive error, a thorough instrument check was performed before and after the geophysical survey. The operator who conducted the survey was trained and qualified to conduct the geophysical survey, and there is high confidence that the instrument used to conduct the survey was capable of detecting buried metallic objects in the trench. A false-positive decision error would have little to no impact to environmental risk.

For the pole-mounted transformers, false-positive results would mean that the transformers were incorrectly identified as containing a contaminant (i.e., PCBs) exceeding a FAL. Because the transformers are assumed to contain PCB-dielectric fluid and will be removed, there is no additional environmental risk.

B.8.0 Step 7 - Develop the Plan for Obtaining Data

Step 7 of the DQO process selects and documents a design that will produce data that exceeds performance or acceptance criteria. In order to resolve Step 7 of the DQO process, the following actions will be implemented:

- Existing available information will be evaluated to resolve DQO decisions for the Pu-contaminated soil and the disposal trench components.
- The corrective action of removal will be implemented for the pole-mounted transformers.

Section B.8.1 contains information about gathering and evaluating the necessary existing data to resolve DQO decisions for the Pu-contaminated soil and the disposal trench components. Section B.8.2.2 contains general information regarding the pole-mounted transformers. All debris is evaluated against the criteria listed in the Soils RBCA document (NNSA/NFO, 2014) to determine the need for corrective action. For the pole-mounted transformers, the corrective action of removal will be conducted. Visual survey of the pole-mounted transformers did not indicate any biasing factors indicating the presence of COCs in surface soils.

B.8.1 Decision I

B.8.1.1 Pu-Contaminated Soil and Disposal Trench

The objective of the CAI for the Pu-contaminated soil is as follows:

1. Compile and evaluate current relevant data to determine the radiation survey isopleth that correlates to the 25-mrem/yr boundary, based upon the Industrial Area exposure scenario.
2. Define the corrective action boundary that bounds the area exceeding HCA criteria.

The objective of the CAI for the disposal trench component is as follows:

1. Define the extent of the anomalies detected in the geophysical survey of the trench to bound the extent of COC contamination exceeding the FAL.

The relevant data for determination of the Industrial Area, HCA, and disposal trench boundaries will come from the following sources:

- Aerial radiation surveys
- Ground-based radiological surveys
- Analytical data
- TLD data
- Historical and technical data from the Safety Experiment Program
- Geophysical survey

After data gathering and compilation, the data are evaluated for quality. If existing data and/or data quality are found to be insufficient, then further consultation with NDEP and the stakeholders is required. A DQA was conducted for CAU 415 and is presented in Appendix F. This assessment concluded that soil and TLD data are acceptable for use in making DQO decisions for CAU 415.

Figure B.8-1 shows the TEDs at sample locations from the 1998 and 2013 investigation activities at CAU 415.

B.8.1.2 Pole-Mounted Transformers

The pole-mounted transformers are assumed to contain dielectric fluids with PCBs and will be removed from the poles and sampled for waste disposition. See Figure 2-8 for the location of the transformers at CAU 415. Because visible soil staining or other biasing factors are not present, no soil sampling is required.

B.8.1.3 Drainage System

The natural drainages originating from the GZ area and the retention basin were investigated in December 2013. Completion of both a visual survey and radiological (FIDLER) survey did not identify any elevated radiological readings or other biasing factors. Therefore, Decision I is resolved for the drainage system, as there are no contaminants present above a FAL

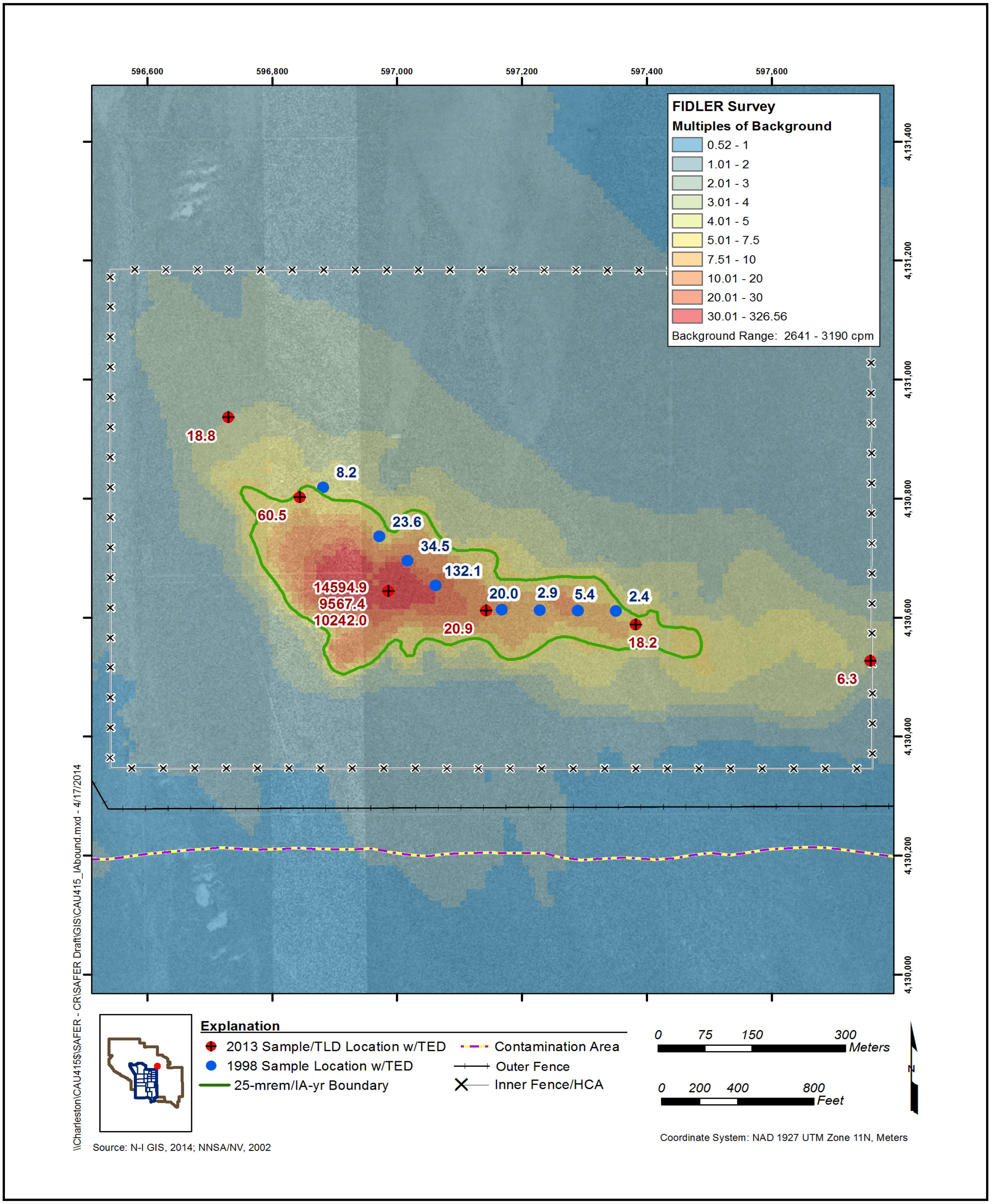


Figure B.8-1
CAU 415 TED (mrem/IA-yr)

B.8.2 Decision II

B.8.2.1 Pu-Contaminated Soil and Disposal Trench

To meet the DQI of representativeness for Decision II for the Pu-contaminated soil release, data must be sufficient to determine the corrective action boundary for the area exceeding 25 mrem/IA-yr and the area exceeding HCA conditions. Decision II for the burial trench is based upon the geophysical data required to determine the extent of the anomalies.

B.8.2.2 Pole-Mounted Transformers

For the pole-mounted transformers, Decision II is unnecessary, following the corrective action of removal of the potentially PCB-containing transformers.

B.8.2.3 Drainage System

For the drainage system, it has been determined that no contaminants exist above a FAL; therefore, Decision II is not required.

B.9.0 References

ASTM, see ASTM International.

ASTM International. 1995 (reapproved 2010). *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, ASTM E1739 - 95(2010)e1. West Conshohocken, PA.

Author Unknown. 1964. Written communication regarding site demarcation surveys on NNSS, Valley Road, the Project 57 GZ inner fence area, the decontamination area, and the waste burial pit. No radiation survey data are attached.

Author Unknown. 1970. Written communication regarding Area 13 alpha survey maps and coordinates. Contains a compilation of radiological survey sketches from May 1970, presenting the layout of the Project 57 GZ inner fence area, the decontamination area, and the waste burial pit. No radiation survey data are attached.

Author Unknown. 1991. Written communication regarding site monitoring/site demarcation checklists and radiation survey reports for Area 13, 12–13 May. Contains a compilation of radiological surveys conducted in 1991 at Project 57 ground zero and the waste burial pit. Includes background radiation survey reports.

BN, see Bechtel Nevada.

Bechtel Nevada. 1996. Written communication regarding site demarcation surveys at the Project 57 ground zero area. Contains a one-page radiation survey record with readings from the outer perimeter fence.

Colton, D.P. 1993. *An In-Situ Radiological Verification Survey of the Area 13 (Project 57) Nuclear Safety Test Site*, NRD-93-319. Las Vegas, NV: EG&G Energy Measurements.

DRI, see Desert Research Institute.

Desert Research Institute. 1988. *CERCLA Preliminary Assessment of DOE's Nevada Operations Office Nuclear Weapons Testing Areas, Volumes I and II*. April. Las Vegas, NV.

EPA, see U.S. Environmental Protection Agency.

Essington, E.H., R.O. Gilbert, L.L. Eberhardt, and E.B. Fowler. 1976. "Plutonium, Americium, and Uranium Concentrations in Nevada Test Soil Profiles." In *Transuranic Nuclides in the Environment*, IAEA-SM-199/76:157-173. Vienna, Austria: International Atomic Energy Agency.

French, R.H. 1985. *Daily, Seasonal, and Annual Precipitation at the Nevada Test Site, Nevada (Preliminary)*, DOE/NV/10384--01; Publication #45042. Las Vegas, NV: Desert Research Institute.

Fritzsche, A.E. 1979. *An Aerial Radiological Survey of Area 13 Nevada Test Site*, EGG-1183-1752. Prepared for the U.S. Department of Energy, Nevada Operations Office. Las Vegas, NV: EG&G Energy Measurements Group.

Moore, J., Science Applications International Corporation. 1999. Memorandum to M. Todd (SAIC) titled "Background Concentrations for NTS and TTR Soil Samples," 3 February. Las Vegas, NV: IT Corporation.

NAC, see *Nevada Administrative Code*.

NBMG, see Nevada Bureau of Mines and Geology.

N-I, see Navarro-Intera, LLC.

N-I GIS, see Navarro-Intera Geographic Information Systems.

NNSA/NFO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office.

NNSA/NSO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office.

NNSA/NV, see U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office.

Navarro-Intera, LLC. 2013. *Water and Solute Travel Time Analysis for Soils Corrective Action Units 375, 411, 412, 413, 414, and 415,* N-I/28091--076. Rev. 0. Las Vegas, NV.

Navarro-Intera Geographic Information Systems. 2014. ESRI ArcGIS Software.

Nevada Administrative Code. 2012a. NAC 445A.227, "Contamination of Soil: Order by Director for Corrective Action; Factors To Be Considered in Determining Whether Corrective Action Required." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 26 February 2014.

Nevada Administrative Code. 2012b. NAC 445A.22705, "Contamination of Soil: Evaluation of Site by Owner or Operator; Review of Evaluation by Division." Carson City, NV. As accessed at http://www.leg.state.nv.us/nac on 26 February 2014.

Nevada Bureau of Mines and Geology. 1998. *Mineral and Energy Resource Assessment of the Nellis Air Force Range*, Open-File Report 98-1. Reno, NV.

REECo, see Reynolds Electrical & Engineering Co., Inc.

Reynolds Electrical & Engineering Co., Inc. 1992. Written communication regarding Area 13 site demarcation surveys of Project 57 ground zero area, decontamination area, and waste burial pit. Includes background radiation survey reports.

Schaeffer, J.R. 1968. *Climatology of Tonopah Test Range, 1967*, SC-M-68-522. Albuquerque, NM: Sandia National Laboratories.

Shott, G.J., V. Yucel, M.J. Sully, L.E. Barker, S.E. Rawlinson, and B.A. Moore. 1997. *Performance Assessment/Composite Analysis for the Area 3 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada*, Rev. 2.0. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office. 2002. *Nevada Test Site Orthophoto Site Atlas,* DOE/NV/11718--604. Aerial photos acquired Summer 1998. Prepared by Bechtel Nevada. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2009. Written communication. Subject: "Radiological Data for Select Soils Sub-Project Corrective Action Sites," 30 December. NTS GIS Product ID 20091029-01-P012-R00. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2011. Written communication. Subject: "The Underground Test Area Borehole Index." Las Vegas, NV.

U.S. Environmental Protection Agency. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, EPA/240/B-06/001. Washington, DC: Office of Environmental Information.

U.S. Environmental Protection Agency. 2013. *Pacific Southwest, Region 9: Regional Screening Levels (Formerly PRGs), Screening Levels for Chemical Contaminants*. As accessed at http://www.epa.gov/region9/superfund/prg on 26 February. Prepared by EPA Office of Superfund and Oak Ridge National Laboratory.

Yu, C., A.J. Zielen, J. J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo, III, W.A. Williams, and H. Peterson. 2001. *User's Manual for RESRAD Version 6,* ANL/EAD-4. Argonne, IL: Argonne National Laboratory, Environmental Assessment Division. (Version 6.5 released in October 2009.)

Appendix C

Summary of Select Previous Studies at CAU 415

C.1.0 Previous Studies

The following is an annotated list of records, by year, relating to the historical operations and potential contamination at the CAU 415 site. This list of records is not a comprehensive list of all documents associated with the Project 57 experiment or referenced in this SAFER.

1957

- *Test Director's Report on Operation Plumbbob* (Johnson, 1957). This report provides a summary of the approach, objectives, and conclusions of the four experimental programs (Programs 71–74) of Project 57. The report notes that not all data have yet been processed at the time of its writing. Only a small portion of this large report is dedicated to Project 57 (pp. 51–54).

1958

- *Operation Plumbbob - Preliminary Report, Summary Report, Test Group 57* (Shreve, 1958). This report provides a detailed account of the genesis of Project 57, the objectives of each of the four experimental programs, and the results to date. Also includes limited information on the long-term and anniversary studies for each experimental program.
- *Plumbbob On-Site Rad-Safety Report* (REECo, 1958). This report summarizes the pre- and post-test radiation safety support provided to the Project 57 test. Details the layout of the decontamination building, including a schematic, and describes the decontamination area (e.g., parking areas, hot water supply). Provides fairly detailed account of the pre- and post-test handling of the fallout trays placed for the experimental programs. Also includes a detailed accounting of personnel and equipment decontamination activities conducted in support of the test. Only a small portion of this large report is dedicated to Project 57 (pp. 14–25).

1961

- *Surface Alpha Monitoring as a Method of Measuring Plutonium Fallout; Operation Plumbbob* (Butler and Miller, 1961). This report provides the detailed results of the surface alpha monitoring program (Program 74) associated with the Project 57 test.
- *Biomedical and Aerosol Studies Associated with a Field Release of Plutonium; Operation Plumbbob* (Wilson et al., 1961). This report provides the detailed results of the animal studies program (Program 72) associated with the Project 57 test. Limited information on the decontamination of study animals and the disposal of animal remains is provided. The report also provides the results of the air sampling program conducted in conjunction with the animal studies.

- *Monitoring and Decontamination Techniques for Plutonium Fallout on Large Area Surfaces; Operation Plumbbob* (Dick and Baker, 1961). This report is a detailed discussion of the results of Program 73, which included studies on Pu decontamination techniques and monitoring methodologies. The report discusses the effectiveness of land-surface and hard-surface Pu decontamination methods and available air and soil sampling techniques. The results of associated anniversary studies (1 and 2 years after the test) are also presented.

1975

- "Physical and Chemical Characteristics of Plutonium in Existing Contaminated Soils and Sediments" (Tamura, 1975a). This analysis concluded that site soils are high in sand and low in clays. The highest level of Pu occurs in the medium silt fraction; however, the highest contributor to total Pu was the coarse silt fraction. This was due to the fact that there was usually twice as much coarse silt as there was medium silt in the collected samples. This study suggested that Pu in silts is probably present as an oxide and as a polymeric form in clay.

- "Characterization of Plutonium in Surface Soils from Area 13 of the Nevada Test Site" (Tamura, 1975b). This document summarizes the results of nine surface soil samples (0 to 5 cm) taken from the CAU 415 site in Area 13. Particle size separation was performed, and each particle size fraction from seven of the samples was analyzed for Pu. The course silt fraction was determined to contain the highest percentage of Pu in the soil. Results were compared to similar studies conducted at the Oak Ridge National Laboratory and Mound Laboratory for comparative purposes.

- "Feasibility and Alternate Procedures for Decontamination and Post Treatment Management of Pu-Contaminated Areas in Nevada" (Wallace and Romney, 1975). Seventeen years after the Project 57 experiment, the site was revisited to evaluate vegetative recovery and compare soil surface conditions. The results show that the plowed and scraped areas had recovered well with an estimated 25 percent of vegetation coverage when compared to adjacent nondisturbed areas. Areas treated with road oil appeared approximately the same as untreated areas except for some remaining oil residue.

1976

- "Plutonium, Americium, and Uranium Concentrations in Nevada Test Soil Profiles" (Essington et al., 1976). This report provides a summary of soil profile samples collected by the NAEG from five nuclear safety test sites on the NNSS and NTTR (Double Tracks; Clean Slate 1, 2, and 3; Project 57; GMX; and Area 11). The profile samples were analyzed for Pu, Am, and in some cases U. The samples were collected in order to estimate the depth of radionuclide penetration and level of contamination at specific sampling depths. Results indicated that approximately 95 percent of the Pu from the safety experiments examined is located in the top 5 cm of soil.

1977

- "Revised Total Amounts of ^{239,240}Pu in Surface Soil at Safety-Shot Sites" (Gilbert, 1977). This report provides corrected estimates of Pu-239/240 in surface soils (0 to 5 cm) for 10 safety shot sites on the NNSS, Tonopah Test Range, and NTTR, including the Project 57 site. The adjustments were the result of using more accurate estimates for the sizes of Am activity strata than originally reported. Based on ground-based radiation surveys using a FIDLER, the estimated inventory of Pu-239/240 remaining in the surface soil (0 to 5 cm depth [0 to 2 in.]) at the site is 46 + 9 curies (Ci) covering a 4,017,000-square-meter (993-acre) area.

1979

- *An Aerial Radiological Survey of Area 13 Nevada Test Site* (Fritzsche, 1979). Using information from the 1977 aerial radiation survey, the total inventory of Am-241 at the site was estimated at 9.6 Ci. This estimate was then used to calculate the Pu-239/240 inventory. Assuming that most of the Am-241 was on the surface, the total inventory of Pu-239/240 was estimated at 62.1 Ci.

1980

- "Estimates of Amounts of Soil Removal for Cleanup of Transuranics at NAEG Offsite Safety-Shot Sites" (Kinnison and Gilbert, 1980). In 1980, available data were used to estimate the amount of soil removal necessary to achieve a remediation action level of 160 pCi/g of Pu. It was determined that roughly 198,000 tons of the top 6 in. of soil would need to be removed from an area covering 269 acres. This equates to a soil volume of roughly 210,000 cubic yards.

1982

- *Safety Experiments November 1955 – March 1958* (Massie and Gravitis, 1982). This report provides an overview of the four Project 57 experimental programs, and includes the various personnel and organizations involved. This report also summarizes the radiological safety support for the project.

- "Redox Reactions Involving Chromium, Plutonium, and Manganese in Soils" (Amacher and Baker, 1982). Available data from the soil and plant studies suggest that Pu shows little dispersion and low bioavailability.

1987

- "Soil Investigations for the Nevada Applied Ecology Group: A Historical Review and Current Status" (Essington, 1987). This report provides a brief historical review of soil studies conducted by the NAEG at several safety and nuclear experiment sites, including the CAU 415 site. The document discusses the collection of soil, vegetation, and animal samples; resuspension studies; vertical soil profiles; determination of Pu ratios; and radiation surveys using a FIDLER. Based on soil profiles, it was estimated that better than 90 percent of the Pu-239/240 was concentrated in the top 5 cm (2 in.) of soil. This is consistent with other findings on the NNSS (Friesen, 1992; Misra et al., 1993).

1993

- *An In-Situ Radiological Verification Survey of the Area 13 (Project 57) Nuclear Safety Test Site* (Colton, 1993). This document reports the results of the *in situ* radiation survey of 93 locations at the CAU 415 site using a high-purity germanium (HPGe) detector. The purpose of the *in situ* survey was to estimate the concentrations of Am-241 and Pu-239 in soil, and target the collection of soil samples for further research. The HPGe survey was conducted as a supplement to a FIDLER presurvey conducted in March 1993. The presence of Am-241 was detected at 91 of the 93 locations, ranging in concentrations from 1 to 543,700 pCi/g. The gamma-energy spectra acquired at the two highest FIDLER-detected activity locations revealed the presence of Pu-239, exhibiting an HPGe-estimated soil concentration of approximately 1,319,000 and 205,000 pCi/g, respectively. As a result of the *in situ* survey, approximately 10 tons of soil (40 drums) was collected to support the Plutonium-Contaminated Soil Cleanup Demonstration Project.

2001

- “Measurements of Plutonium and Americium in Soil Samples from Project 57 Using the Suspended Soil Particle Sizing System (SSPSS)” (Shafer et al., 2001). This study was performed on soil samples from the CAU 415 site to determine Pu and Am activities in relation to soil particle size. This study concluded that the mean activity of Pu and Am on aerodynamically separated samples increased as the particle size increased.

2007

- *Posting the Contamination Area at Project 57* (NSTec, 2007). In October 2007, a ground-based radiation survey was conducted at CAU 415 to verify the extent of surface contamination and update the radiological postings to meet current regulatory requirements. This effort was completed as part of the DOE Occupational Radiation Protection program governed by 10 CFR 835 (CFR, 2014). The survey identified surface contamination on the ground surface outside the outer fence. As a result, a new perimeter boundary was defined approximately 300 ft from the outer fence. CA warning signs were posted every 200 ft around this new boundary, and “No Access” signs were posted at the access road barricades.

2012

- *Project 57 Radiological Survey Results and Recommendations* (NSTec, 2012). This draft paper presents the results of a ground-based radiation survey conducted at CAU 415 in 2012. This effort was completed as part of the DOE Occupational Radiation Protection program governed by 10 CFR 835 (CFR, 2014). The survey locations were at the CA boundary (approximately 300 ft out from the existing outer fence) and 25 ft out from the boundary around the entire site perimeter. Of the 1,350 survey locations, 1 location on the east side of the site had elevated removable radiological contamination in excess of CA levels. The paper recommends that the soil at this elevated location be removed, rather than expanding the CA boundary.

C.2.0 References

Amacher, M.D., and D.E. Baker. 1982. "Redox Reaction Involving Chromium, Plutonium, and Manganese in Soils." In *The Radioecology of Transuranics and Other Radionuclides in Desert Ecosystems*, NVO-224. pp. 137–143. December. W.A. Howard, P.B. Dunaway, and R.G. Fuller eds. Las Vegas, NV: U.S. Department of Energy, Nevada Operations Office.

Butler, R.E., and H.M. Miller. 1961. *Surface Alpha Monitoring as a Method of Measuring Plutonium Fallout; Operation Plumbbob*, WT-1513. Albuquerque, NM: Sandia Corporation.

CFR, see *Code of Federal Regulations*.

Code of Federal Regulations. 2014. Title 10 CFR, Part 835, "Occupational Radiation Protection." Washington, DC: U.S. Government Printing Office.

Colton, D.P. 1993. *An In-Situ Radiological Verification Survey of the Area 13 (Project 57) Nuclear Safety Test Site*, NRD-93-319. Las Vegas, NV: EG&G Energy Measurements.

Dick, J.L., and G.P. Baker, Jr. 1961. *Monitoring and Decontamination Techniques for Plutonium Fallout on Large Area Surfaces; Operation Plumbbob*, WT-1512. January. Albuquerque, NM: Sandia Corporation.

Essington, E.H. 1987. "Soil Investigations for the Nevada Applied Ecology Group: A Historical Review and Current Status." In *The Dynamics of Transuranics and Other Radionuclides in Natural Environments*, NVO-272. Nevada Applied Ecology Group. pp. 197–259. September. W.A. Howard and R.G. Fuller eds. Las Vegas, NV: U.S. Department of Energy, Nevada Operations Office.

Essington, E.H., R.O. Gilbert, L.L. Eberhardt, and E.B. Fowler. 1976. "Plutonium, Americium, and Uranium Concentrations in Nevada Test Soil Profiles." In *Transuranic Nuclides in the Environment*, IAEA-SM-199/76:157-173. Vienna, Austria: International Atomic Energy Agency.

Friesen, H.N. 1992. *Summary of the Nevada Applied Ecology Group and Correlative Programs*, DOE/NV-357, UC-700. Prepared for the U.S. Department of Energy, Nevada Operations Office. Las Vegas, NV.

Fritzsche, A.E. 1979. *An Aerial Radiological Survey of Area 13 Nevada Test Site*, EGG-1183-1752. Prepared for the U.S. Department of Energy, Nevada Operations Office. Las Vegas, NV: EG&G Energy Measurements Group.

Gilbert, R.O. 1977. “Revised Total Amounts of ^{239,240}Pu in Surface Soil at Safety-Shot Sites.” In *Transuranics in Desert Ecosystems*, NVO-181. Nevada Applied Ecology Group. pp. 423–429. November. M.G. White, P.B. Dunaway, and D.L. Wireman eds. Las Vegas, NV: U.S. Department of Energy, Nevada Operations Office.

Johnson, G.W. 1957. *Test Director's Report on Operation Plumbbob,* UCRL-5166. 15 November Livermore, CA: University of California Radiation Laboratory.

Kinnison, R.R., and R.O. Gilbert. 1980. “Estimates of Amounts of Soil Removal for Cleanup of Transuranics at NAEG Offsite Safety-Shot Sites.” In *The Radioecology of Transuranics and Other Radionuclides in Desert Ecosystems*, NVO-224 (DE86001243). pp. 89–96.

Massie, J., and I. Gravitis. 1982. *Safety Experiments November 1955 – March 1958*, DNA 6030F.2. August. Prepared for the U.S. Department of Defense. Washington, DC: Defense Nuclear Agency.

Misra, M., C. Neve, and A. Raichur. 1993. “Characterization and Physical Separation of Radionuclides from Contaminated Soils.” In *Proceedings of the Soil Decon '93: Technology Targeting Radionuclides and Heavy Metals*. Gatlinburg, TN, 16–17 June.

NSTec, see National Security Technologies, LLC.

National Security Technologies, LLC. 2007. *Posting the Contamination Area at Project 57*, WP-P260-027. Prepared by the Radiological Engineering Group. Las Vegas, NV.

National Security Technologies, LLC. 2012. Written communication. Subject: *Project 57 Radiological Survey Results and Recommendations.* Las Vegas, NV.

REECo, see Reynolds Electrical & Engineering Co., Inc.

Reynolds Electrical & Engineering Co., Inc. 1958. *Plumbbob On-Site Rad-Safety Report*, OTO-57-2. 15 July. Mercury, NV.

Shafer, D.S., J.L. Bowen, and R. Gonzalez. 2001. “Measurements of Plutonium and Americium in Soil Samples from Project 57 Using the Suspended Soil Particle Sizing System (SSPSS),” Publication No. 45182. May. Las Vegas, NV.

Shreve, J.D. 1958. *Operation Plumbbob - Preliminary Report, Summary Report, Test Group 57*. Albuquerque, NM: Sandia Corporation.

Tamura, T. 1975a. “Physical and Chemical Characteristic of Plutonium in Existing Contaminated Soils and Sediments,” CONF-751105--4. Presented at the IAEA International Symposium on Transuranium Nuclides in the Environment, San Francisco, California, 17 November.

Tamura, T. 1975b. "Characterization of Plutonium in Surface Soils from Area 13 of the Nevada Test Site." In *The Radioecology of Plutonium and Other Transuranics in Desert Environments*, NVO-153. pp. 27–41. July. M.G. White and P.B. Dunaway eds. Las Vegas, NV: U.S. Atomic Energy Commission, Nevada Operations Office.

Wallace, A., and E.M. Romney. 1975. "Feasibility and Alternate Procedures for Decontamination and Post Treatment Management of Pu-Contaminated Areas in Nevada." In *The Radioecology of Plutonium and Other Transuranics in Desert Environments*, NVO-153. Nevada Applied Ecology Group. pp. 251–337. Las Vegas, NV: Energy Research and Development Administration.

Wilson, R.H., R.G. Thomas, and J.N. Stannard. 1961. *Biomedical and Aerosol Studies Associated with a Field Release of Plutonium; Operation Plumbbob*, WT-1511. Albuquerque, NM: Sandia Corporation.

Appendix D

Dose Calculations and Establishment of a Corrective Action Boundary

D.1.0 Dose Calculations

Soil and TLD data are used to calculate a TED that could potentially be received by a human receptor at the site. The following subsections discuss the process for evaluating the soil and TLD data in terms of dose, so the data may be compared directly to the dose-based radiological FAL.

D.1.1 Internal Dose Estimates

Internal dose was estimated using the radionuclide analytical results from soil samples and the corresponding RRMG (NNSA/NFO, 2014). The internal dose RRMG concentration for a particular radionuclide is that concentration in surface soil that would cause an internal dose to a receptor of 25 mrem/yr under the appropriate exposure scenario, independent of any other radionuclide and assuming that no other radionuclides contribute dose. The internal dose RRMG for each detected radionuclide (in pCi/g of soil) was derived using RESRAD computer code (Yu et al., 2001) under the appropriate exposure scenario (NNSA/NFO, 2014). The RESRAD data have been included in Attachment D-1.

The total internal dose corresponding to each surface soil sample was calculated by adding the dose contribution from each radionuclide. It was necessary to infer the Pu activities in the soil samples, rather than rely on the isotopic Pu values in order to address a potential bias inherent to the isotopic analytical method. Pu activity in soil can only be adequately quantified using alpha spectroscopy (i.e., isotopic analysis). This analytical method uses a very small volume of soil (1 to 2 grams) that represents a fraction of the original soil sample. Am and Pu isotopes may be present in soil in the form of small particles that may or may not be captured in a small soil sample of 1 to 2 grams. Because individual particles of these radionuclides can make a significant impact on analytical results (i.e., bias the results high or low), small volume soil samples taken from the same site can produce analytical results that are very different. However, the Am and Pu isotopes are co-located (e.g., Am-241 is a daughter product of Pu-241), and the relative concentrations between different samples from the same site (i.e., the ratio of Am to Pu isotope concentrations) should be equal. Based on process knowledge and demonstrated by analytical results from previously sampled Soils sites, the ratios between Am and Pu isotopes in soil contamination from any given source is expected to be the same throughout the contaminant plume at any given time. Therefore, if the ratios are known and one of these isotopic concentrations is known, the concentrations of the other isotopes can be estimated. Am-241 is reported by the gamma spectroscopy method as well as the isotopic Am method. Because the gamma spectroscopy measurement is based on a much larger volume of soil (usually 1 liter), the probability of the result being representative of the sampled site is much improved. Thus, inferred Pu values were calculated using the gamma spectroscopy Am-241 results and the ratios of Pu isotopes to Am-241.

For each soil sample (i.e., all 1998 and 2013 soil samples), the radionuclide-specific analytical result was divided by its corresponding internal dose RRMG to yield a fraction of the 25-mrem/yr dose and then multiplied by 25 to yield an internal dose estimate in mrem/yr at that sample location, in accordance with the following formula:

Internal Dose (mrem/yr) = [Analytical result (pCi/g)/Internal Dose RRMG (pCi/g)] x 25 mrem/yr

The internal doses for all radionuclides detected in a soil sample were then summed to yield an internal dose for that sample.

D.1.2 External Dose Calculations

The TLDs placed at CAU 415 contain four individual elements. External dose at each TLD location was determined using the readings from TLD elements 2, 3, and 4; data from element 1 are not relevant to the determination of the external dose for the purpose of the CAU 415 investigation. Each of the elements is considered to be a separate, independent measurement of external dose. The 95 percent UCL of the average of these measurements was calculated as the external dose for each TLD location. Estimates of external dose at the CAU 415 site are net values (i.e., background radiation dose has been subtracted from the raw result). The background dose at CAU 415 was determined to be the average of the background TLD results from locations B01 and B02.

Eight TLDs, including two background TLDs, were deployed at CAU 415 in December 2013. All of the TLDs, with the exception of the single TLD at the GZ sample location, were retrieved in April 2014. The decision not to retrieve the GZ TLD was made to keep worker exposure as low as reasonably achievable, because the GZ area is an HCA where removable contamination is easily transferred to site workers. The lack of TLD data from the GZ sample location did not impact any

DQO decisions because the GZ area requires corrective action based on estimated internal dose alone (i.e., internal dose at GZ is greater than 25 mrem/IA-yr).

Table D.1-1 lists the 95 percent UCL of the average for the five 2013 soil sample locations, which were used in the calculation of TED at these sample locations. For surface soil sample locations where TLD data were not available (i.e., all 1998 sample locations and 2013 GZ location), external dose was initially estimated using the RRMGs in the following formula:

External Dose (mrem/yr) = [Analytical result (pCi/g)/TED RRMG (pCi/g)] x 25 mrem/yr

Experience at other Soils Activity sites has shown that external dose calculated using the RRMGs generally underestimates external dose. To account for this underestimation, an additional measure of conservatism was applied to the CAU 415 data. External dose was first calculated for all sample locations (1998 and 2013) using the above formula. Table D.1-1 lists the RRMG-derived external dose estimates for each sample location. Figure 2-2 shows the sample locations referenced in the table. For the five 2013 sample locations with direct TLD measurements, each measurement was compared to the calculated RRMG-derived external doses for that sample location. This comparison revealed that external dose was underestimated in four of the five TLDs. One of these four measurements (NW2) was 17 times less than the RRMG-derived external dose estimate, and the fifth TLD measurement (E1) was 6 times greater than the RRMG-derived external dose estimate. These two measurements were used in the calculation of TED at the E1 and NW2 sample locations, but were considered outliers when determining the ratio to be applied to the sample locations without TLD data. Thus, the average of the ratio of the RRMG-derived external dose and the actual TLD reading from the three remaining sample locations (E2, E3, and NW1) was applied to the 1998 and GZ sample locations to estimate external dose at these locations. This resulted in an estimated TLD-equivalent external dose at each of the soil sample locations where direct TLD measurements were not available. In each case, application of this ratio increased the estimated external dose, incorporating additional conservatism into the dose calculations. This TLD-equivalent external dose was then used in the calculation of TED at each sample location without TLD data.

Table D.1-1
External Dose Estimates for 1998 and 2013 Soil Samples

Sample Location	RRMG - Derived External Dose (mrem/IA-yr)	TLD - External Dose (mrem/IA-yr)	Estimated TLD Equivalent External Dose (mrem/IA-yr)
1	1.3	--	2.2
2	0.2	--	0.3
3	0.4	--	0.6
4	0.2	--	0.3
5	8.8	--	14.8
6	2.3	--	3.9
7	1.6	--	2.6
9	0.5	--	0.9
E1[a]	1.2	7.3	--
E2	1.6	1.7	--
E3	0.6	1.4	--
NW1	4.3	7.1	--
NW2[a]	1.7	0.1	--
GZ	987.0	--	1,646.1
	653.5	--	1,090.0
	700.1	--	1,167.7

[a]The TLD-external dose measurement from this sample location was determined to be an outlier and was not used to determine the average of the ratio applied to the 1998 and GZ sample locations to calculate a TLD-equivalent external dose.

-- = Not applicable.

D.1.2.1 Total Effective Dose

The calculated TED is the sum of the internal dose and the external dose for each sample location. For grab soil sample locations where a TLD was not deployed (i.e., all 1998 sample locations and 2013 GZ location), TED was calculated as the sum of the estimated external dose (TLD-equivalent external dose) and the single internal dose estimate. For grab soil sample locations where a TLD sample was placed (i.e., five 2013 sample locations), TED was calculated as the sum of the 95 percent UCL of the external dose and the single internal dose estimate.

The calculated TED is an estimate of the true (unknown) TED. It is uncertain how well the calculated TED represents the true TED. If a calculated TED were directly compared to the FAL, any significant difference between the true TED and the measured TED could lead to decision errors. Soil samples at CAU 415 were collected from locations of higher radioactivity surrounding GZ. Samples from these biased locations will produce TED results that are higher than from adjacent locations of lower radioactivity within the exposure area that is being characterized for dose. This will conservatively overestimate the true TED of the exposure area and protect against false-negative decision errors.

D.2.0 Establishing a Corrective Action Boundary

The establishment of corrective action boundaries is based on an assumed relationship between dose (TED) and a response measured on radiation survey instruments (e.g., FIDLER, aerial survey systems). As detailed in the Soil RBCA document (NNSA/NFO, 2014), the extent of a corrective action boundary is defined as the area that encompasses radiation survey isopleths with a value that corresponds to a TED of 25 mrem/yr. Due to some uncertainty in defining the extent of corrective action boundaries, conservative estimates are used to protect against a false-negative decision error (the potential for a receptor to receive a dose exceeding the 25-mrem/yr FAL outside the defined boundary). As has been shown at each previously investigated Soils Activity site, this relationship is linear and shows a distinct and positive relationship between TED and radiation survey values (i.e., increasing doses result in a corresponding increase in radiation survey instrument readings). Therefore, it is assumed that there exists a true linear relationship between true TED and emissions of radioactivity for each release. This relationship is assumed to be a function of the mixture of radioisotopes present at the release site and the ability of the radiation survey instrument to detect the particular mixture of radiation emanating from the contaminants. This relationship is estimated by regressing a linear relationship from estimates of TED (from soil and TLD samples) that are paired with radiation survey readings from several sampling locations. Multiple types of radiation surveys (e.g., FIDLER, aerial) may be used to determine the radiation survey type that best correlates with the particular mixture of radioisotopes present at the release site.

For CAU 415, the best correlation was derived using the FIDLER data collected in 2013/2014 and the calculated TEDs. The relationship between TED and FIDLER results was estimated from a simple linear regression of paired calculated TED and radiation survey values for each sample location. A numbered pair (FIDLER value, TED) was generated at each sample location. These numbered pairs were statistically compared with one another, which resulted in a solution that represents the average relationship of FIDLER values to TED values. If the strength of this relationship yields a correlation factor (i.e., r^2 value) of 0.8 or greater, the relationship is considered statistically significant and the data may be used with confidence to make DQO decisions.

The TED values used in the correlation are the calculated TED for judgmental samples from biased sample locations (Section D.1.0). The values from the radiation surveys are based on either direct instrument readings at the TED location or on interpolated values from the survey. To protect against a Decision II false-negative decision error (the potential for a receptor to receive a dose exceeding the 25-mrem/yr FAL outside the defined boundary), the Soils Activity uses a conservative estimate of the radiation survey value corresponding to 25 mrem/yr. This is accomplished using the uncertainty of how well the calculated relationship between TED and emitted radiation (i.e., the regression) represents the assumed true relationship. This uncertainty includes the uncertainty of how well the calculated TED represents true TED and the uncertainty of how well the radiation survey instrument readings represent emitted radioactivity. This uncertainty is addressed by establishing a 95 percent lower confidence limit of this relationship to conservatively estimate the FIDLER survey value that would correspond to the FAL of 25-mrem/IA-yr. Based on this lower confidence limit, the FIDLER survey value corresponding to the FAL is 5.45 multiples of background. Therefore, the FIDLER survey isopleth at 5.45 multiples of background was used to define the 25-mrem/IA-yr boundary for CAU 415 (Figure 4-1).

Some of the values in the relationship of FIDLER values to TED values are higher than the average, and some are lower. Therefore, when the 25-mrem/IA-yr boundary is created, it is not uncommon to show a small number of lower TED values within the boundary and/or a small number of comparatively higher TED values outside the boundary. For example, a TED value of 18.8 mrem/IA-yr is shown outside the 25-mrem/IA-yr boundary northwest of GZ in Figure 4-1. This value is greater than several of the TED values within the boundary. This is a result of the statistical relationship established between the TED and FIDLER data.

D.3.0 References

NNSA/NFO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475-Rev. 1. Las Vegas, NV.

Yu, C., A.J. Zielen, J. J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, J. Arnish, A. Wallo, III, W.A. Williams, and H. Peterson. 2001. *User's Manual for RESRAD Version 6,* ANL/EAD-4. Argonne, IL: Argonne National Laboratory, Environmental Assessment Division. (Version 6.5 released in October 2009.)

Attachment D-1

RESRAD Data

Industrial Area TED
(36 Pages)
Industrial Area Internal Dose
(36 Pages)

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-225 (Source: FGR 12)	6.371E-02	6.371E-02	DCF1(1)
A-1	Ac-227 (Source: FGR 12)	4.951E-04	4.951E-04	DCF1(2)
A-1	Ac-228 (Source: FGR 12)	5.978E+00	5.978E+00	DCF1(3)
A-1	Ag-108 (Source: FGR 12)	1.143E-01	1.143E-01	DCF1(4)
A-1	Ag-108m (Source: FGR 12)	9.640E+00	9.640E+00	DCF1(5)
A-1	Al-26 (Source: FGR 12)	1.741E+01	1.741E+01	DCF1(6)
A-1	Am-241 (Source: FGR 12)	4.372E-02	4.372E-02	DCF1(7)
A-1	Am-243 (Source: FGR 12)	1.420E-01	1.420E-01	DCF1(8)
A-1	At-217 (Source: FGR 12)	1.773E-03	1.773E-03	DCF1(9)
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(10)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(11)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(12)
A-1	Bi-211 (Source: FGR 12)	2.559E-01	2.559E-01	DCF1(13)
A-1	Bi-212 (Source: FGR 12)	1.171E+00	1.171E+00	DCF1(14)
A-1	Bi-213 (Source: FGR 12)	7.660E-01	7.660E-01	DCF1(15)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(16)
A-1	Cm-243 (Source: FGR 12)	5.829E-01	5.829E-01	DCF1(17)
A-1	Cm-244 (Source: FGR 12)	1.259E-04	1.259E-04	DCF1(18)
A-1	Co-60 (Source: FGR 12)	1.622E+01	1.622E+01	DCF1(19)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(20)
A-1	Eu-152 (Source: FGR 12)	7.006E+00	7.006E+00	DCF1(21)
A-1	Eu-154 (Source: FGR 12)	7.678E+00	7.678E+00	DCF1(22)
A-1	Eu-155 (Source: FGR 12)	1.822E-01	1.822E-01	DCF1(23)
A-1	Fr-221 (Source: FGR 12)	1.536E-01	1.536E-01	DCF1(24)
A-1	Fr-223 (Source: FGR 12)	1.980E-01	1.980E-01	DCF1(25)
A-1	Gd-152 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(26)
A-1	Nb-94 (Source: FGR 12)	9.677E+00	9.677E+00	DCF1(27)
A-1	Np-237 (Source: FGR 12)	7.790E-02	7.790E-02	DCF1(28)
A-1	Np-239 (Source: FGR 12)	7.529E-01	7.529E-01	DCF1(29)
A-1	Pa-231 (Source: FGR 12)	1.906E-01	1.906E-01	DCF1(30)
A-1	Pa-233 (Source: FGR 12)	1.020E+00	1.020E+00	DCF1(31)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(32)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(33)
A-1	Pb-209 (Source: FGR 12)	7.734E-04	7.734E-04	DCF1(34)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(35)
A-1	Pb-211 (Source: FGR 12)	3.064E-01	3.064E-01	DCF1(36)
A-1	Pb-212 (Source: FGR 12)	7.043E-01	7.043E-01	DCF1(37)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(38)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(39)
A-1	Po-211 (Source: FGR 12)	4.764E-02	4.764E-02	DCF1(40)
A-1	Po-212 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(41)
A-1	Po-213 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(42)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(43)
A-1	Po-215 (Source: FGR 12)	1.016E-03	1.016E-03	DCF1(44)
A-1	Po-216 (Source: FGR 12)	1.042E-04	1.042E-04	DCF1(45)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(46)
A-1	Pu-238 (Source: FGR 12)	1.513E-04	1.513E-04	DCF1(47)
A-1	Pu-239 (Source: FGR 12)	2.952E-04	2.952E-04	DCF1(48)
A-1	Pu-240 (Source: FGR 12)	1.467E-04	1.467E-04	DCF1(49)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	Pu-241 (Source: FGR 12)	5.904E-06	5.904E-06	DCF1(50)
A-1	Ra-223 (Source: FGR 12)	6.034E-01	6.034E-01	DCF1(51)
A-1	Ra-224 (Source: FGR 12)	5.119E-02	5.119E-02	DCF1(52)
A-1	Ra-225 (Source: FGR 12)	1.102E-02	1.102E-02	DCF1(53)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(54)
A-1	Ra-228 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(55)
A-1	Rn-219 (Source: FGR 12)	3.083E-01	3.083E-01	DCF1(56)
A-1	Rn-220 (Source: FGR 12)	2.298E-03	2.298E-03	DCF1(57)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(58)
A-1	Sr-90 (Source: FGR 12)	7.043E-04	7.043E-04	DCF1(59)
A-1	Tc-99 (Source: FGR 12)	1.255E-04	1.255E-04	DCF1(60)
A-1	Th-227 (Source: FGR 12)	5.212E-01	5.212E-01	DCF1(61)
A-1	Th-228 (Source: FGR 12)	7.940E-03	7.940E-03	DCF1(62)
A-1	Th-229 (Source: FGR 12)	3.213E-01	3.213E-01	DCF1(63)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(64)
A-1	Th-231 (Source: FGR 12)	3.643E-02	3.643E-02	DCF1(65)
A-1	Th-232 (Source: FGR 12)	5.212E-04	5.212E-04	DCF1(66)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(67)
A-1	Tl-207 (Source: FGR 12)	1.980E-02	1.980E-02	DCF1(68)
A-1	Tl-208 (Source: FGR 12)	2.298E+01	2.298E+01	DCF1(69)
A-1	Tl-209 (Source: FGR 12)	1.293E+01	1.293E+01	DCF1(70)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(71)
A-1	U-233 (Source: FGR 12)	1.397E-03	1.397E-03	DCF1(72)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(73)
A-1	U-235 (Source: FGR 12)	7.211E-01	7.211E-01	DCF1(74)
A-1	U-236 (Source: FGR 12)	2.148E-04	2.148E-04	DCF1(75)
A-1	U-237 (Source: FGR 12)	5.306E-01	5.306E-01	DCF1(76)
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(77)
A-1	Y-90 (Source: FGR 12)	2.391E-02	2.391E-02	DCF1(78)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	2.109E+00	2.035E+00	DCF2(1)
B-1	Ag-108m+D	1.370E-04	1.369E-04	DCF2(2)
B-1	Al-26	7.400E-05	7.400E-05	DCF2(3)
B-1	Am-241	3.550E-01	3.552E-01	DCF2(4)
B-1	Am-243+D	3.550E-01	3.552E-01	DCF2(5)
B-1	Cm-243	2.550E-01	2.553E-01	DCF2(6)
B-1	Cm-244	2.110E-01	2.109E-01	DCF2(8)
B-1	Co-60	1.150E-04	1.147E-04	DCF2(11)
B-1	Cs-137+D	1.440E-04	1.443E-04	DCF2(12)
B-1	Eu-152	1.550E-04	1.554E-04	DCF2(13)
B-1	Eu-154	1.960E-04	1.961E-04	DCF2(15)
B-1	Eu-155	2.550E-05	2.553E-05	DCF2(16)
B-1	Gd-152	7.030E-02	7.030E-02	DCF2(17)
B-1	Nb-94	1.810E-04	1.813E-04	DCF2(18)
B-1	Np-237+D	1.850E-01	1.850E-01	DCF2(19)
B-1	Pa-231	5.180E-01	5.180E-01	DCF2(20)
B-1	Pb-210+D	3.694E-02	2.072E-02	DCF2(21)
B-1	Pu-238	4.070E-01	4.070E-01	DCF2(22)
B-1	Pu-239	4.440E-01	4.440E-01	DCF2(24)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
B-1	Pu-240	4.440E-01	4.440E-01	DCF2(25)
B-1	Pu-241	8.510E-03	8.510E-03	DCF2(27)
B-1	Pu-241+D	8.517E-03	8.510E-03	DCF2(28)
B-1	Ra-226+D	3.531E-02	3.515E-02	DCF2(29)
B-1	Ra-228+D	5.929E-02	5.920E-02	DCF2(30)
B-1	Sr-90+D	5.976E-04	5.920E-04	DCF2(31)
B-1	Tc-99	4.810E-05	4.810E-05	DCF2(32)
B-1	Th-228+D	1.614E-01	1.480E-01	DCF2(33)
B-1	Th-229+D	9.481E-01	8.880E-01	DCF2(34)
B-1	Th-230	3.700E-01	3.700E-01	DCF2(35)
B-1	Th-232	4.070E-01	4.070E-01	DCF2(36)
B-1	U-233	3.550E-02	3.552E-02	DCF2(37)
B-1	U-234	3.480E-02	3.478E-02	DCF2(38)
B-1	U-235+D	3.150E-02	3.145E-02	DCF2(39)
B-1	U-236	3.220E-02	3.219E-02	DCF2(40)
B-1	U-238	2.960E-02	2.960E-02	DCF2(41)
B-1	U-238+D	2.963E-02	2.960E-02	DCF2(42)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	4.473E-03	4.070E-03	DCF3(1)
D-1	Ag-108m+D	8.510E-06	8.510E-06	DCF3(2)
D-1	Al-26	1.300E-05	1.295E-05	DCF3(3)
D-1	Am-241	7.400E-04	7.400E-04	DCF3(4)
D-1	Am-243+D	7.430E-04	7.400E-04	DCF3(5)
D-1	Cm-243	5.550E-04	5.550E-04	DCF3(6)
D-1	Cm-244	4.440E-04	4.440E-04	DCF3(8)
D-1	Co-60	1.260E-05	1.258E-05	DCF3(11)
D-1	Cs-137+D	4.810E-05	4.810E-05	DCF3(12)
D-1	Eu-152	5.180E-06	5.180E-06	DCF3(13)
D-1	Eu-154	7.400E-06	7.400E-06	DCF3(15)
D-1	Eu-155	1.180E-06	1.184E-06	DCF3(16)
D-1	Gd-152	1.520E-04	1.517E-04	DCF3(17)
D-1	Nb-94	6.290E-06	6.290E-06	DCF3(18)
D-1	Np-237+D	4.102E-04	4.070E-04	DCF3(19)
D-1	Pa-231	2.630E-03	2.627E-03	DCF3(20)
D-1	Pb-210+D	6.995E-03	2.553E-03	DCF3(21)
D-1	Pu-238	8.510E-04	8.510E-04	DCF3(22)
D-1	Pu-239	9.250E-04	9.250E-04	DCF3(24)
D-1	Pu-240	9.250E-04	9.250E-04	DCF3(25)
D-1	Pu-241	1.780E-05	1.776E-05	DCF3(27)
D-1	Pu-241+D	2.061E-05	1.776E-05	DCF3(28)
D-1	Ra-226+D	1.041E-03	1.036E-03	DCF3(29)
D-1	Ra-228+D	2.552E-03	2.553E-03	DCF3(30)
D-1	Sr-90+D	1.140E-04	1.036E-04	DCF3(31)
D-1	Tc-99	2.370E-06	2.368E-06	DCF3(32)
D-1	Th-228+D	5.302E-04	2.664E-04	DCF3(33)
D-1	Th-229+D	2.266E-03	1.813E-03	DCF3(34)
D-1	Th-230	7.770E-04	7.770E-04	DCF3(35)
D-1	Th-232	8.510E-04	8.510E-04	DCF3(36)
D-1	U-233	1.890E-04	1.887E-04	DCF3(37)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-1	U-234	1.810E-04	1.813E-04	DCF3(38)
D-1	U-235+D	1.753E-04	1.739E-04	DCF3(39)
D-1	U-236	1.740E-04	1.739E-04	DCF3(40)
D-1	U-238	1.670E-04	1.665E-04	DCF3(41)
D-1	U-238+D	1.796E-04	1.665E-04	DCF3(42)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Ag-108m+D , plant/soil concentration ratio, dimensionless	1.500E-01	1.500E-01	RTF(2,1)
D-34	Ag-108m+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-03	3.000E-03	RTF(2,2)
D-34	Ag-108m+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.500E-02	2.500E-02	RTF(2,3)
D-34				
D-34	Al-26 , plant/soil concentration ratio, dimensionless	4.000E-03	4.000E-03	RTF(3,1)
D-34	Al-26 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-04	5.000E-04	RTF(3,2)
D-34	Al-26 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-04	2.000E-04	RTF(3,3)
D-34				
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(4,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(4,3)
D-34				
D-34	Am-243+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Am-243+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(5,2)
D-34	Am-243+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(5,3)
D-34				
D-34	Cm-243 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Cm-243 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,2)
D-34	Cm-243 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(6,3)
D-34				
D-34	Cm-244 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Cm-244 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(8,2)
D-34	Cm-244 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(8,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(11,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(11,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(11,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(12,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(12,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(12,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(13,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(13,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(13,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(15,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(15,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(15,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Eu-155 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(16,2)
D-34	Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(16,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(17,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(17,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(17,3)
D-34				
D-34	Nb-94 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(18,1)
D-34	Nb-94 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-07	3.000E-07	RTF(18,2)
D-34	Nb-94 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(18,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(19,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(19,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(19,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(20,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(20,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(20,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(21,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(21,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(21,3)
D-34				
D-34	Pu-238 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(22,1)
D-34	Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(22,2)
D-34	Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(22,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(24,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(24,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(24,3)
D-34				
D-34	Pu-240 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(25,1)
D-34	Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(25,2)
D-34	Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(25,3)
D-34				
D-34	Pu-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(27,1)
D-34	Pu-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(27,2)
D-34	Pu-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(27,3)
D-34				
D-34	Pu-241+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(28,1)
D-34	Pu-241+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(28,2)
D-34	Pu-241+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(28,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(29,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(29,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(29,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(30,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(30,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(30,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(31,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(31,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(31,3)
D-34				
D-34	Tc-99 , plant/soil concentration ratio, dimensionless	5.000E+00	5.000E+00	RTF(32,1)
D-34	Tc-99 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(32,2)
D-34	Tc-99 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(32,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(33,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(33,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(33,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(34,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(34,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(34,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(35,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(35,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(35,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(36,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(36,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(36,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(37,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(37,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(37,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(38,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(38,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(38,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(39,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(39,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(39,3)
D-34				
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(40,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(40,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(40,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(41,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(41,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(41,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(42,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(42,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(42,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Ag-108m+D , fish	5.000E+00	5.000E+00	BIOFAC(2,1)
D-5	Ag-108m+D , crustacea and mollusks	7.700E+02	7.700E+02	BIOFAC(2,2)
D-5				
D-5	Al-26 , fish	5.000E+02	5.000E+02	BIOFAC(3,1)
D-5	Al-26 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(3,2)
D-5				
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(4,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(4,2)
D-5				
D-5	Am-243+D , fish	3.000E+01	3.000E+01	BIOFAC(5,1)
D-5	Am-243+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Cm-243 , fish	3.000E+01	3.000E+01	BIOFAC(6,1)
D-5	Cm-243 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	Cm-244 , fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Cm-244 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(8,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(11,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(11,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(12,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(12,2)
D-5				
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(13,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(13,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(15,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(15,2)
D-5				
D-5	Eu-155 , fish	5.000E+01	5.000E+01	BIOFAC(16,1)
D-5	Eu-155 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(16,2)
D-5				
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(17,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(17,2)
D-5				
D-5	Nb-94 , fish	3.000E+02	3.000E+02	BIOFAC(18,1)
D-5	Nb-94 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(18,2)
D-5				
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(19,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(19,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(20,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(20,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(21,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(21,2)
D-5				
D-5	Pu-238 , fish	3.000E+01	3.000E+01	BIOFAC(22,1)
D-5	Pu-238 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(22,2)
D-5				
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(24,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(24,2)
D-5				
D-5	Pu-240 , fish	3.000E+01	3.000E+01	BIOFAC(25,1)
D-5	Pu-240 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(25,2)
D-5				
D-5	Pu-241 , fish	3.000E+01	3.000E+01	BIOFAC(27,1)
D-5	Pu-241 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(27,2)
D-5				
D-5	Pu-241+D , fish	3.000E+01	3.000E+01	BIOFAC(28,1)
D-5	Pu-241+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(28,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(29,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(29,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(30,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(30,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(31,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(31,2)
D-5				
D-5	Tc-99 , fish	2.000E+01	2.000E+01	BIOFAC(32,1)
D-5	Tc-99 , crustacea and mollusks	5.000E+00	5.000E+00	BIOFAC(32,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(33,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(33,2)
D-5				
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(34,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(34,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(35,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(35,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(36,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(36,2)
D-5				
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(37,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(37,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(38,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(38,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(39,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(39,2)
D-5				
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(40,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(40,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(41,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(41,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(42,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(42,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

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)	1.000E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	5.000E-02	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	5.000E-01	1.000E+00	---	T(2)
R011	Times for calculations (yr)	not used	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Ag-108m	1.000E+02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Al-26	1.000E+02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Am-241	1.000E+02	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Am-243	1.000E+02	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Cm-243	1.000E+02	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Cm-244	1.000E+02	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): Co-60	1.000E+02	0.000E+00	---	S1(11)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.000E+02	0.000E+00	---	S1(12)
R012	Initial principal radionuclide (pCi/g): Eu-152	1.000E+02	0.000E+00	---	S1(13)
R012	Initial principal radionuclide (pCi/g): Eu-154	1.000E+02	0.000E+00	---	S1(15)
R012	Initial principal radionuclide (pCi/g): Eu-155	1.000E+02	0.000E+00	---	S1(16)
R012	Initial principal radionuclide (pCi/g): Nb-94	1.000E+02	0.000E+00	---	S1(18)
R012	Initial principal radionuclide (pCi/g): Np-237	1.000E+02	0.000E+00	---	S1(19)
R012	Initial principal radionuclide (pCi/g): Pu-238	1.000E+02	0.000E+00	---	S1(22)
R012	Initial principal radionuclide (pCi/g): Pu-239	1.000E+02	0.000E+00	---	S1(24)
R012	Initial principal radionuclide (pCi/g): Pu-240	1.000E+02	0.000E+00	---	S1(25)
R012	Initial principal radionuclide (pCi/g): Pu-241	1.000E+02	0.000E+00	---	S1(27)
R012	Initial principal radionuclide (pCi/g): Sr-90	1.000E+02	0.000E+00	---	S1(31)
R012	Initial principal radionuclide (pCi/g): Tc-99	1.000E+02	0.000E+00	---	S1(32)
R012	Initial principal radionuclide (pCi/g): Th-232	1.000E+02	0.000E+00	---	S1(36)
R012	Initial principal radionuclide (pCi/g): U-233	1.000E+02	0.000E+00	---	S1(37)
R012	Initial principal radionuclide (pCi/g): U-234	1.000E+02	0.000E+00	---	S1(38)
R012	Initial principal radionuclide (pCi/g): U-235	1.000E+02	0.000E+00	---	S1(39)
R012	Initial principal radionuclide (pCi/g): U-238	1.000E+02	0.000E+00	---	S1(41)
R012	Concentration in groundwater (pCi/L): Ag-108m	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Al-26	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Am-243	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Cm-243	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Cm-244	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(11)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(12)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(13)
R012	Concentration in groundwater (pCi/L): Eu-154	not used	0.000E+00	---	W1(15)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R012	Concentration in groundwater (pCi/L): Eu-155	not used	0.000E+00	---	W1(16)
R012	Concentration in groundwater (pCi/L): Nb-94	not used	0.000E+00	---	W1(18)
R012	Concentration in groundwater (pCi/L): Np-237	not used	0.000E+00	---	W1(19)
R012	Concentration in groundwater (pCi/L): Pu-238	not used	0.000E+00	---	W1(22)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(24)
R012	Concentration in groundwater (pCi/L): Pu-240	not used	0.000E+00	---	W1(25)
R012	Concentration in groundwater (pCi/L): Pu-241	not used	0.000E+00	---	W1(27)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(31)
R012	Concentration in groundwater (pCi/L): Tc-99	not used	0.000E+00	---	W1(32)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(36)
R012	Concentration in groundwater (pCi/L): U-233	not used	0.000E+00	---	W1(37)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(38)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(39)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(41)
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)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.300E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.090E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.900E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.850E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.800E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.230E-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	4.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS

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)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ag-108m				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.476E-01	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Al-26				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.476E-01	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.775E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Am-243				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.775E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Cm-243				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	1.378E+03	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.428E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Cm-244				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	1.378E+03	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.428E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.968E-05	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.278E-06	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.385E-05	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for Eu-154				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.385E-05	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for Eu-155				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.385E-05	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for Nb-94				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.476E-01	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R016	Distribution coefficients for Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(19)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(19,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(19)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.641E-05	ALEACH(19)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(19)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Pu-238				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(22)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(22,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(22)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.839E-06	ALEACH(22)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(22)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(24)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(24,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(24)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.839E-06	ALEACH(24)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(24)
R016	Distribution coefficients for Pu-240				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(25)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(25,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(25)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.839E-06	ALEACH(25)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(25)
R016	Distribution coefficients for Pu-241				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(27)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(27,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(27)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.839E-06	ALEACH(27)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(27)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(31)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(31,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(31)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.531E-04	ALEACH(31)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(31)
R016	Distribution coefficients for Tc-99				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(32)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(32,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(32)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.476E-01	ALEACH(32)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(32)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(36)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(36,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(36)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.280E-07	ALEACH(36)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(36)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(37)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(37,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(37)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.926E-04	ALEACH(37)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(37)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(38)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(38,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(38)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.926E-04	ALEACH(38)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(38)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(39)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(39,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(39)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.926E-04	ALEACH(39)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(39)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(41)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(41,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(41)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.926E-04	ALEACH(41)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(41)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.775E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.385E-05	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(20)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(20,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(20)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.926E-04	ALEACH(20)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(20)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(21)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(21,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(21)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.965E-04	ALEACH(21)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(21)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(29)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(29,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(29)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.806E-04	ALEACH(29)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(29)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(30)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(30,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(30)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.806E-04	ALEACH(30)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(30)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(33)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(33,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(33)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.280E-07	ALEACH(33)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(33)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(34)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(34,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(34)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.280E-07	ALEACH(34)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(34)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(35)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(35,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(35)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.280E-07	ALEACH(35)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(35)
R016	Distribution coefficients for daughter U-236				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(40)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(40,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(40)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.926E-04	ALEACH(40)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(40)
R017	Inhalation rate (m**3/yr)	6.734E+03	8.400E+03	---	INHALR

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Mass loading for inhalation (g/m**3)	1.100E-05	1.000E-04	---	MLINH
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	1.521E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	7.600E-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)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	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)	2.430E+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	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Contamination fraction of milk	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)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	5.000E-02	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	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
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	1024	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

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	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions

Area:	1000.00 square meters
Thickness:	0.05 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g

Ag-108m	1.000E+02
Al-26	1.000E+02
Am-241	1.000E+02
Am-243	1.000E+02
Cm-243	1.000E+02
Cm-244	1.000E+02
Co-60	1.000E+02
Cs-137	1.000E+02
Eu-152	1.000E+02
Eu-154	1.000E+02
Eu-155	1.000E+02
Nb-94	1.000E+02
Np-237	1.000E+02
Pu-238	1.000E+02
Pu-239	1.000E+02
Pu-240	1.000E+02
Pu-241	1.000E+02
Sr-90	1.000E+02
Tc-99	1.000E+02
Th-232	1.000E+02
U-233	1.000E+02
U-234	1.000E+02
U-235	1.000E+02
U-238	1.000E+02

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	5.000E-01
TDOSE(t):	6.151E+02	5.859E+02
M(t):	2.461E+01	2.344E+01

Maximum TDOSE(t): 6.151E+02 mrem/yr at t = 0.000E+00 years

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	frac
Ag-108m	8.269E+01	0.1344	2.596E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.374E-03	0.00
Al-26	1.280E+02	0.2081	1.406E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.699E-03	0.00
Am-241	7.021E-01	0.0011	7.245E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.096E-01	0.00
Am-243	1.074E+01	0.0175	7.251E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.116E-01	0.00
Cm-243	6.507E+00	0.0106	5.148E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.039E-01	0.00
Cm-244	2.230E-03	0.0000	4.231E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.415E-01	0.00
Co-60	1.222E+02	0.1986	2.202E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.544E-03	0.00
Cs-137	3.069E+01	0.0499	2.909E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.636E-02	0.00
Eu-152	5.853E+01	0.0951	3.087E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.798E-03	0.00
Eu-154	6.270E+01	0.1019	3.852E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.944E-03	0.00
Eu-155	2.329E+00	0.0038	4.863E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.104E-04	0.00
Nb-94	7.962E+01	0.1294	3.439E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.241E-03	0.00
Np-237	1.171E+01	0.0190	3.781E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.274E-01	0.00
Pu-238	2.524E-03	0.0000	8.284E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.698E-01	0.00
Pu-239	3.588E-03	0.0000	9.073E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.127E-01	0.00
Pu-240	2.459E-03	0.0000	9.073E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.127E-01	0.00
Pu-241	7.813E-04	0.0000	1.755E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.956E-03	0.00
Sr-90	2.550E-01	0.0004	1.206E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.242E-02	0.00
Tc-99	1.678E-03	0.0000	9.138E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.221E-03	0.00
Th-232	3.452E+00	0.0056	8.409E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.555E-01	0.00
U-233	1.713E-02	0.0000	7.262E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.048E-01	0.00
U-234	5.801E-03	0.0000	7.110E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.003E-01	0.00
U-235	8.699E+00	0.0141	6.437E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.714E-02	0.00
U-238	1.475E+00	0.0024	6.054E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.953E-02	0.00
Total	6.103E+02	0.9922	6.539E-01	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.175E+00	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 = 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	frac
Ag-108m	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.270E+01	0.13
Al-26	0.000E+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	1.280E+02	0.20
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.184E+00	0.00
Am-243	0.000E+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	1.123E+01	0.01
Cm-243	0.000E+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	6.863E+00	0.01
Cm-244	0.000E+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	2.860E-01	0.00
Co-60	0.000E+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	1.222E+02	0.19
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.071E+01	0.04
Eu-152	0.000E+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	5.853E+01	0.09
Eu-154	0.000E+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	6.270E+01	0.10
Eu-155	0.000E+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	2.330E+00	0.00
Nb-94	0.000E+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	7.962E+01	0.12
Np-237	0.000E+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	1.198E+01	0.01
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.552E-01	0.00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.070E-01	0.00
Pu-240	0.000E+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	6.059E-01	0.00
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.249E-02	0.00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.175E-01	0.00
Tc-99	0.000E+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	2.908E-03	0.00
Th-232	0.000E+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	4.092E+00	0.00
U-233	0.000E+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	1.292E-01	0.00
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	1.132E-01	0.00
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	8.802E+00	0.01
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	1.581E+00	0.00
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	6.151E+02	1.00

*Sum of all water independent and dependent pathways.

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	frac
Ag-108m	7.660E+01	0.1307	2.405E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.051E-03	0.00
Al-26	1.189E+02	0.2029	1.306E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.223E-03	0.00
Am-241	7.011E-01	0.0012	7.236E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.091E-01	0.00
Am-243	1.074E+01	0.0183	7.247E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.114E-01	0.00
Cm-243	6.428E+00	0.0110	5.086E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.003E-01	0.00
Cm-244	2.188E-03	0.0000	4.151E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.369E-01	0.00
Co-60	1.144E+02	0.1953	2.062E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.128E-03	0.00
Cs-137	3.034E+01	0.0518	2.876E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.605E-02	0.00
Eu-152	5.702E+01	0.0973	3.007E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.726E-03	0.00
Eu-154	6.028E+01	0.1029	3.703E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.792E-03	0.00
Eu-155	2.172E+00	0.0037	4.535E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.692E-04	0.00
Nb-94	7.395E+01	0.1262	3.194E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.011E-03	0.00
Np-237	1.171E+01	0.0200	3.781E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.274E-01	0.00
Pu-238	2.514E-03	0.0000	8.252E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.680E-01	0.00
Pu-239	3.588E-03	0.0000	9.073E-02	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.127E-01	0.00
Pu-240	2.459E-03	0.0000	9.072E-02	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.127E-01	0.00
Pu-241	1.319E-03	0.0000	1.771E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.004E-02	0.00
Sr-90	2.519E-01	0.0004	1.192E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.166E-02	0.00
Tc-99	1.558E-03	0.0000	8.488E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.134E-03	0.00
Th-232	7.282E+00	0.0124	8.519E-02	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.373E-01	0.00
U-233	1.789E-02	0.0000	7.270E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.048E-01	0.00
U-234	5.800E-03	0.0000	7.109E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.003E-01	0.00
U-235	8.697E+00	0.0148	6.437E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.714E-02	0.00
U-238	1.475E+00	0.0025	6.052E-03	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.951E-02	0.00
Total	5.810E+02	0.9916	6.531E-01	0.0011	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.243E+00	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 = 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	frac
Ag-108m	0.000E+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	7.661E+01	0.13
Al-26	0.000E+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	1.189E+02	0.20
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.183E+00	0.00
Am-243	0.000E+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	1.122E+01	0.01
Cm-243	0.000E+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	6.780E+00	0.01
Cm-244	0.000E+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	2.806E-01	0.00
Co-60	0.000E+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	1.144E+02	0.19
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.036E+01	0.05
Eu-152	0.000E+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	5.703E+01	0.09
Eu-154	0.000E+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	6.028E+01	0.10
Eu-155	0.000E+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	2.172E+00	0.00
Nb-94	0.000E+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	7.396E+01	0.12
Np-237	0.000E+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	1.197E+01	0.02
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.530E-01	0.00
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.070E-01	0.00
Pu-240	0.000E+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	6.058E-01	0.00
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.313E-02	0.00
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.136E-01	0.00
Tc-99	0.000E+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	2.701E-03	0.00
Th-232	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.004E+00	0.01
U-233	0.000E+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	1.300E-01	0.00
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	1.132E-01	0.00
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	8.801E+00	0.01
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	1.581E+00	0.00
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	5.859E+02	1.00

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways

Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years 0.000E+00	(mrem/yr)/(pCi/g) 5.000E-01
Ag-108m+D	Ag-108m+D	1.000E+00	8.270E-01	7.661E-01
Al-26	Al-26	1.000E+00	1.280E+00	1.189E+00
Am-241	Am-241	1.000E+00	1.184E-02	1.183E-02
Am-241	Np-237+D	1.000E+00	1.938E-08	3.873E-08
Am-241	U-233	1.000E+00	3.028E-16	9.838E-16
Am-241	Th-229+D	1.000E+00	9.869E-19	4.933E-18
Am-241	∑DSR(j)		1.184E-02	1.183E-02
Am-243+D	Am-243+D	1.000E+00	1.123E-01	1.122E-01
Am-243+D	Pu-239	1.000E+00	8.739E-08	1.747E-07
Am-243+D	U-235+D	1.000E+00	4.161E-16	1.352E-15
Am-243+D	Pa-231	1.000E+00	8.818E-22	4.408E-21
Am-243+D	Ac-227+D	1.000E+00	3.788E-23	2.856E-22
Am-243+D	∑DSR(j)		1.123E-01	1.122E-01
Cm-243	Cm-243	2.400E-03	1.647E-04	1.627E-04
Cm-243	Am-243+D	2.400E-03	1.256E-08	2.498E-08
Cm-243	Pu-239	2.400E-03	6.527E-15	2.114E-14
Cm-243	U-235+D	2.400E-03	2.334E-23	1.164E-22
Cm-243	Pa-231	2.400E-03	3.960E-29	2.988E-28
Cm-243	Ac-227+D	2.400E-03	1.420E-30	1.608E-29
Cm-243	∑DSR(j)		1.647E-04	1.627E-04
Cm-243	Cm-243	9.976E-01	6.846E-02	6.763E-02
Cm-243	Pu-239	9.976E-01	8.651E-08	1.721E-07
Cm-243	U-235+D	9.976E-01	4.127E-16	1.337E-15
Cm-243	Pa-231	9.976E-01	8.756E-22	4.367E-21
Cm-243	Ac-227+D	9.976E-01	3.765E-23	2.833E-22
Cm-243	∑DSR(j)		6.846E-02	6.763E-02
Cm-244	Cm-244	1.350E-06	3.861E-09	3.788E-09
Cm-244	Cm-244	4.950E-08	1.416E-10	1.389E-10
Cm-244	Pu-240	4.950E-08	1.570E-14	3.115E-14
Cm-244	∑DSR(j)		1.416E-10	1.389E-10
Cm-244	Cm-244	1.000E+00	2.860E-03	2.806E-03
Cm-244	Pu-240	1.000E+00	3.172E-07	6.293E-07
Cm-244	U-236	1.000E+00	5.506E-16	1.780E-15
Cm-244	Th-232	1.000E+00	3.601E-26	1.793E-25
Cm-244	Ra-228+D	1.000E+00	7.918E-26	5.908E-25
Cm-244	Th-228+D	1.000E+00	6.796E-27	7.452E-26
Cm-244	∑DSR(j)		2.860E-03	2.806E-03

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	5.000E-01
Co-60	Co-60	1.000E+00	1.222E+00	1.144E+00
Cs-137+D	Cs-137+D	1.000E+00	3.071E-01	3.036E-01
Eu-152	Eu-152	7.208E-01	4.219E-01	4.110E-01
Eu-152	Eu-152	2.792E-01	1.634E-01	1.592E-01
Eu-152	Gd-152	2.792E-01	8.684E-19	1.718E-18
Eu-152	∑DSR(j)		1.634E-01	1.592E-01
Eu-154	Eu-154	1.000E+00	6.270E-01	6.028E-01
Eu-155	Eu-155	1.000E+00	2.330E-02	2.172E-02
Nb-94	Nb-94	1.000E+00	7.962E-01	7.396E-01
Np-237+D	Np-237+D	1.000E+00	1.198E-01	1.197E-01
Np-237+D	U-233	1.000E+00	2.807E-09	5.613E-09
Np-237+D	Th-229+D	1.000E+00	1.219E-11	3.963E-11
Np-237+D	∑DSR(j)		1.198E-01	1.197E-01
Pu-238	Pu-238	1.840E-09	1.022E-11	1.018E-11
Pu-238	Pu-238	1.000E+00	5.552E-03	5.530E-03
Pu-238	U-234	1.000E+00	1.601E-09	3.196E-09
Pu-238	Th-230	1.000E+00	2.219E-14	7.203E-14
Pu-238	Ra-226+D	1.000E+00	4.236E-16	2.116E-15
Pu-238	Pb-210+D	1.000E+00	1.129E-19	8.507E-19
Pu-238	∑DSR(j)		5.552E-03	5.530E-03
Pu-239	Pu-239	1.000E+00	6.070E-03	6.070E-03
Pu-239	U-235+D	1.000E+00	4.335E-11	8.669E-11
Pu-239	Pa-231	1.000E+00	1.225E-16	3.980E-16
Pu-239	Ac-227+D	1.000E+00	6.569E-18	3.273E-17
Pu-239	∑DSR(j)		6.070E-03	6.070E-03
Pu-240	Pu-240	4.950E-08	2.999E-10	2.999E-10
Pu-240	Pu-240	1.000E+00	6.059E-03	6.058E-03
Pu-240	U-236	1.000E+00	1.573E-11	3.145E-11
Pu-240	Th-232	1.000E+00	1.369E-21	4.448E-21
Pu-240	Ra-228+D	1.000E+00	3.742E-21	1.848E-20
Pu-240	Th-228+D	1.000E+00	3.822E-22	2.779E-21
Pu-240	∑DSR(j)		6.059E-03	6.058E-03

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	5.000E-01
Pu-241	Pu-241	1.000E+00	1.140E-04	1.113E-04
Pu-241	Am-241	1.000E+00	9.349E-06	1.850E-05
Pu-241	Np-237+D	1.000E+00	1.024E-11	3.305E-11
Pu-241	U-233	1.000E+00	1.203E-19	5.983E-19
Pu-241	Th-229+D	1.000E+00	3.141E-22	2.365E-21
Pu-241	∑DSR(j)		1.234E-04	1.298E-04
Pu-241+D	Pu-241+D	2.450E-05	1.528E-06	1.492E-06
Pu-241+D	Np-237+D	2.450E-05	4.676E-13	9.260E-13
Pu-241+D	U-233	2.450E-05	7.336E-21	2.369E-20
Pu-241+D	Th-229+D	2.450E-05	2.396E-23	1.192E-22
Pu-241+D	∑DSR(j)		1.528E-06	1.492E-06
Sr-90+D	Sr-90+D	1.000E+00	3.175E-03	3.136E-03
Tc-99	Tc-99	1.000E+00	2.908E-05	2.701E-05
Th-232	Th-232	1.000E+00	5.624E-03	5.624E-03
Th-232	Ra-228+D	1.000E+00	3.026E-02	5.905E-02
Th-232	Th-228+D	1.000E+00	5.032E-03	1.536E-02
Th-232	∑DSR(j)		4.092E-02	8.004E-02
U-233	U-233	1.000E+00	1.284E-03	1.283E-03
U-233	Th-229+D	1.000E+00	8.365E-06	1.673E-05
U-233	∑DSR(j)		1.292E-03	1.300E-03
U-234	U-234	1.000E+00	1.132E-03	1.132E-03
U-234	Th-230	1.000E+00	2.352E-08	4.705E-08
U-234	Ra-226+D	1.000E+00	5.987E-10	1.945E-09
U-234	Pb-210+D	1.000E+00	1.991E-13	9.923E-13
U-234	∑DSR(j)		1.132E-03	1.132E-03
U-235+D	U-235+D	1.000E+00	8.802E-02	8.800E-02
U-235+D	Pa-231	1.000E+00	3.731E-07	7.460E-07
U-235+D	Ac-227+D	1.000E+00	2.664E-08	8.618E-08
U-235+D	∑DSR(j)		8.802E-02	8.801E-02
U-238	U-238	5.400E-05	5.421E-08	5.420E-08
U-238+D	U-238+D	9.999E-01	1.581E-02	1.581E-02
U-238+D	U-234	9.999E-01	1.605E-09	3.209E-09
U-238+D	Th-230	9.999E-01	2.223E-14	7.223E-14
U-238+D	Ra-226+D	9.999E-01	4.243E-16	2.121E-15
U-238+D	Pb-210+D	9.999E-01	1.130E-19	8.523E-19
U-238+D	∑DSR(j)		1.581E-02	1.581E-02

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	5.000E-01
Ag-108m	3.023E+01	3.263E+01
Al-26	1.953E+01	2.103E+01
Am-241	2.111E+03	2.114E+03
Am-243	2.226E+02	2.228E+02
Cm-243	3.643E+02	3.688E+02
Cm-244	8.741E+03	8.909E+03
Co-60	2.046E+01	2.185E+01
Cs-137	8.139E+01	8.234E+01
Eu-152	4.271E+01	4.384E+01
Eu-154	3.987E+01	4.147E+01
Eu-155	1.073E+03	1.151E+03
Nb-94	3.140E+01	3.380E+01
Np-237	2.088E+02	2.088E+02
Pu-238	4.503E+03	4.521E+03
Pu-239	4.118E+03	4.119E+03
Pu-240	4.126E+03	4.127E+03
Pu-241	2.001E+05	1.904E+05
Sr-90	7.874E+03	7.971E+03
Tc-99	8.597E+05	9.255E+05
Th-232	6.109E+02	3.123E+02
U-233	1.935E+04	1.923E+04
U-234	2.208E+04	2.209E+04
U-235	2.840E+02	2.841E+02
U-238	1.581E+03	1.582E+03

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)
Ag-108m	1.000E+02	0.000E+00	8.270E-01	3.023E+01	8.270E-01	3.023E+01
Al-26	1.000E+02	0.000E+00	1.280E+00	1.953E+01	1.280E+00	1.953E+01
Am-241	1.000E+02	0.000E+00	1.184E-02	2.111E+03	1.184E-02	2.111E+03
Am-243	1.000E+02	0.000E+00	1.123E-01	2.226E+02	1.123E-01	2.226E+02
Cm-243	1.000E+02	0.000E+00	6.863E-02	3.643E+02	6.863E-02	3.643E+02
Cm-244	1.000E+02	0.000E+00	2.860E-03	8.741E+03	2.860E-03	8.741E+03
Co-60	1.000E+02	0.000E+00	1.222E+00	2.046E+01	1.222E+00	2.046E+01
Cs-137	1.000E+02	0.000E+00	3.071E-01	8.139E+01	3.071E-01	8.139E+01
Eu-152	1.000E+02	0.000E+00	5.853E-01	4.271E+01	5.853E-01	4.271E+01
Eu-154	1.000E+02	0.000E+00	6.270E-01	3.987E+01	6.270E-01	3.987E+01
Eu-155	1.000E+02	0.000E+00	2.330E-02	1.073E+03	2.330E-02	1.073E+03
Nb-94	1.000E+02	0.000E+00	7.962E-01	3.140E+01	7.962E-01	3.140E+01
Np-237	1.000E+02	0.000E+00	1.198E-01	2.088E+02	1.198E-01	2.088E+02
Pu-238	1.000E+02	0.000E+00	5.552E-03	4.503E+03	5.552E-03	4.503E+03
Pu-239	1.000E+02	0.000E+00	6.070E-03	4.118E+03	6.070E-03	4.118E+03
Pu-240	1.000E+02	0.000E+00	6.059E-03	4.126E+03	6.059E-03	4.126E+03
Pu-241	1.000E+02	5.000E-01	1.313E-04	1.904E+05	1.249E-04	2.001E+05
Sr-90	1.000E+02	0.000E+00	3.175E-03	7.874E+03	3.175E-03	7.874E+03
Tc-99	1.000E+02	0.000E+00	2.908E-05	8.597E+05	2.908E-05	8.597E+05
Th-232	1.000E+02	5.000E-01	8.004E-02	3.123E+02	4.092E-02	6.109E+02
U-233	1.000E+02	5.000E-01	1.300E-03	1.923E+04	1.292E-03	1.935E+04
U-234	1.000E+02	0.000E+00	1.132E-03	2.208E+04	1.132E-03	2.208E+04
U-235	1.000E+02	0.000E+00	8.802E-02	2.840E+02	8.802E-02	2.840E+02
U-238	1.000E+02	0.000E+00	1.581E-02	1.581E+03	1.581E-02	1.581E+03

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	5.000E-01
Ag-108m	Ag-108m	1.000E+00	8.270E+01	7.661E+01
Al-26	Al-26	1.000E+00	1.280E+02	1.189E+02
Am-241	Am-241	1.000E+00	1.184E+00	1.183E+00
Am-241	Pu-241	1.000E+00	9.349E-04	1.850E-03
Am-241	∑DOSE(j)		1.185E+00	1.184E+00
Np-237	Am-241	1.000E+00	1.938E-06	3.873E-06
Np-237	Np-237	1.000E+00	1.198E+01	1.197E+01
Np-237	Pu-241	1.000E+00	1.024E-09	3.305E-09
Np-237	Pu-241	2.450E-05	4.676E-11	9.260E-11
Np-237	∑DOSE(j)		1.198E+01	1.197E+01
U-233	Am-241	1.000E+00	3.028E-14	9.838E-14
U-233	Np-237	1.000E+00	2.807E-07	5.613E-07
U-233	Pu-241	1.000E+00	1.203E-17	5.983E-17
U-233	Pu-241	2.450E-05	7.336E-19	2.369E-18
U-233	U-233	1.000E+00	1.284E-01	1.283E-01
U-233	∑DOSE(j)		1.284E-01	1.283E-01
Th-229	Am-241	1.000E+00	9.869E-17	4.933E-16
Th-229	Np-237	1.000E+00	1.219E-09	3.963E-09
Th-229	Pu-241	1.000E+00	3.141E-20	2.365E-19
Th-229	Pu-241	2.450E-05	2.396E-21	1.192E-20
Th-229	U-233	1.000E+00	8.365E-04	1.673E-03
Th-229	∑DOSE(j)		8.365E-04	1.673E-03
Am-243	Am-243	1.000E+00	1.123E+01	1.122E+01
Am-243	Cm-243	2.400E-03	1.256E-06	2.498E-06
Am-243	∑DOSE(j)		1.123E+01	1.122E+01
Pu-239	Am-243	1.000E+00	8.739E-06	1.747E-05
Pu-239	Cm-243	2.400E-03	6.527E-13	2.114E-12
Pu-239	Cm-243	9.976E-01	8.651E-06	1.721E-05
Pu-239	Pu-239	1.000E+00	6.070E-01	6.070E-01
Pu-239	∑DOSE(j)		6.070E-01	6.070E-01
U-235	Am-243	1.000E+00	4.161E-14	1.352E-13
U-235	Cm-243	2.400E-03	2.334E-21	1.164E-20
U-235	Cm-243	9.976E-01	4.127E-14	1.337E-13
U-235	Pu-239	1.000E+00	4.335E-09	8.669E-09
U-235	U-235	1.000E+00	8.802E+00	8.800E+00
U-235	∑DOSE(j)		8.802E+00	8.800E+00
Pa-231	Am-243	1.000E+00	8.818E-20	4.408E-19
Pa-231	Cm-243	2.400E-03	3.960E-27	2.988E-26
Pa-231	Cm-243	9.976E-01	8.756E-20	4.367E-19
Pa-231	Pu-239	1.000E+00	1.225E-14	3.980E-14

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	5.000E-01
Pa-231	U-235	1.000E+00	3.731E-05	7.460E-05
Pa-231	∑DOSE(j)		3.731E-05	7.460E-05
Ac-227	Am-243	1.000E+00	3.788E-21	2.856E-20
Ac-227	Cm-243	2.400E-03	1.247E-28	1.579E-27
Ac-227	Cm-243	9.976E-01	3.765E-21	2.833E-20
Ac-227	Pu-239	1.000E+00	6.569E-16	3.273E-15
Ac-227	U-235	1.000E+00	2.664E-06	8.618E-06
Ac-227	∑DOSE(j)		2.664E-06	8.618E-06
Cm-243	Cm-243	2.400E-03	1.647E-02	1.627E-02
Cm-243	Cm-243	9.976E-01	6.846E+00	6.763E+00
Cm-243	∑DOSE(j)		6.863E+00	6.780E+00
Cm-244	Cm-244	1.350E-06	3.861E-07	3.788E-07
Cm-244	Cm-244	4.950E-08	1.416E-08	1.389E-08
Cm-244	∑DOSE(j)		4.002E-07	3.926E-07
Pu-240	Cm-244	4.950E-08	1.570E-12	3.115E-12
Pu-240	Pu-240	4.950E-08	2.999E-08	2.999E-08
Pu-240	∑DOSE(j)		2.999E-08	2.999E-08
Cm-244	Cm-244	1.000E+00	2.860E-01	2.806E-01
Pu-240	Cm-244	1.000E+00	3.172E-05	6.293E-05
U-236	Cm-244	1.000E+00	5.506E-14	1.780E-13
U-236	Pu-240	1.000E+00	1.573E-09	3.145E-09
U-236	∑DOSE(j)		1.573E-09	3.145E-09
Th-232	Cm-244	1.000E+00	3.601E-24	1.793E-23
Th-232	Pu-240	1.000E+00	1.369E-19	4.448E-19
Th-232	Th-232	1.000E+00	5.624E-01	5.624E-01
Th-232	∑DOSE(j)		5.624E-01	5.624E-01
Ra-228	Cm-244	1.000E+00	7.918E-24	5.908E-23
Ra-228	Pu-240	1.000E+00	3.742E-19	1.848E-18
Ra-228	Th-232	1.000E+00	3.026E+00	5.905E+00
Ra-228	∑DOSE(j)		3.026E+00	5.905E+00
Th-228	Cm-244	1.000E+00	6.796E-25	7.452E-24
Th-228	Pu-240	1.000E+00	3.822E-20	2.779E-19
Th-228	Th-232	1.000E+00	5.032E-01	1.536E+00
Th-228	∑DOSE(j)		5.032E-01	1.536E+00
Co-60	Co-60	1.000E+00	1.222E+02	1.144E+02
Cs-137	Cs-137	1.000E+00	3.071E+01	3.036E+01

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	5.000E-01
Eu-152	Eu-152	7.208E-01	4.219E+01	4.110E+01
Eu-152	Eu-152	2.792E-01	1.634E+01	1.592E+01
Eu-152	∑DOSE(j)		5.853E+01	5.703E+01
Gd-152	Eu-152	2.792E-01	8.684E-17	1.718E-16
Eu-154	Eu-154	1.000E+00	6.270E+01	6.028E+01
Eu-155	Eu-155	1.000E+00	2.330E+00	2.172E+00
Nb-94	Nb-94	1.000E+00	7.962E+01	7.396E+01
Pu-238	Pu-238	1.840E-09	1.022E-09	1.018E-09
Pu-238	Pu-238	1.000E+00	5.552E-01	5.530E-01
Pu-238	∑DOSE(j)		5.552E-01	5.530E-01
U-234	Pu-238	1.000E+00	1.601E-07	3.196E-07
U-234	U-234	1.000E+00	1.132E-01	1.132E-01
U-234	U-238	9.999E-01	1.605E-07	3.209E-07
U-234	∑DOSE(j)		1.132E-01	1.132E-01
Th-230	Pu-238	1.000E+00	2.219E-12	7.203E-12
Th-230	U-234	1.000E+00	2.352E-06	4.705E-06
Th-230	U-238	9.999E-01	2.223E-12	7.223E-12
Th-230	∑DOSE(j)		2.352E-06	4.705E-06
Ra-226	Pu-238	1.000E+00	4.236E-14	2.116E-13
Ra-226	U-234	1.000E+00	5.987E-08	1.945E-07
Ra-226	U-238	9.999E-01	4.243E-14	2.121E-13
Ra-226	∑DOSE(j)		5.987E-08	1.945E-07
Pb-210	Pu-238	1.000E+00	1.129E-17	8.507E-17
Pb-210	U-234	1.000E+00	1.991E-11	9.923E-11
Pb-210	U-238	9.999E-01	1.130E-17	8.523E-17
Pb-210	∑DOSE(j)		1.991E-11	9.923E-11
Pu-240	Pu-240	1.000E+00	6.059E-01	6.058E-01
Pu-241	Pu-241	1.000E+00	1.140E-02	1.113E-02
Pu-241	Pu-241	2.450E-05	1.528E-04	1.492E-04
Pu-241	∑DOSE(j)		1.156E-02	1.128E-02
Sr-90	Sr-90	1.000E+00	3.175E-01	3.136E-01
Tc-99	Tc-99	1.000E+00	2.908E-03	2.701E-03
U-238	U-238	5.400E-05	5.421E-06	5.420E-06
U-238	U-238	9.999E-01	1.581E+00	1.581E+00
U-238	∑DOSE(j)		1.581E+00	1.581E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	5.000E-01
Ag-108m	Ag-108m	1.000E+00	1.000E+02	9.263E+01
Al-26	Al-26	1.000E+00	1.000E+02	9.289E+01
Am-241	Am-241	1.000E+00	1.000E+02	9.987E+01
Am-241	Pu-241	1.000E+00	0.000E+00	7.918E-02
Am-241	∑S(j):		1.000E+02	9.995E+01
Np-237	Am-241	1.000E+00	0.000E+00	1.618E-05
Np-237	Np-237	1.000E+00	1.000E+02	1.000E+02
Np-237	Pu-241	1.000E+00	0.000E+00	6.438E-09
Np-237	Pu-241	2.450E-05	0.000E+00	3.920E-10
Np-237	∑S(j):		1.000E+02	1.000E+02
U-233	Am-241	1.000E+00	0.000E+00	1.770E-11
U-233	Np-237	1.000E+00	0.000E+00	2.186E-04
U-233	Pu-241	1.000E+00	0.000E+00	4.702E-15
U-233	Pu-241	2.450E-05	0.000E+00	4.303E-16
U-233	U-233	1.000E+00	1.000E+02	9.998E+01
U-233	∑S(j):		1.000E+02	9.998E+01
Th-229	Am-241	1.000E+00	0.000E+00	2.786E-16
Th-229	Np-237	1.000E+00	0.000E+00	5.162E-09
Th-229	Pu-241	1.000E+00	0.000E+00	5.558E-20
Th-229	Pu-241	2.450E-05	0.000E+00	6.786E-21
Th-229	U-233	1.000E+00	0.000E+00	4.721E-03
Th-229	∑S(j):		0.000E+00	4.721E-03
Am-243	Am-243	1.000E+00	1.000E+02	9.995E+01
Am-243	Cm-243	2.400E-03	0.000E+00	1.120E-05
Am-243	∑S(j):		1.000E+02	9.995E+01
Pu-239	Am-243	1.000E+00	0.000E+00	1.440E-03
Pu-239	Cm-243	2.400E-03	0.000E+00	8.081E-11
Pu-239	Cm-243	9.976E-01	0.000E+00	1.428E-03
Pu-239	Pu-239	1.000E+00	1.000E+02	1.000E+02
Pu-239	∑S(j):		1.000E+02	1.000E+02
U-235	Am-243	1.000E+00	0.000E+00	3.545E-13
U-235	Cm-243	2.400E-03	0.000E+00	1.328E-20
U-235	Cm-243	9.976E-01	0.000E+00	3.523E-13
U-235	Pu-239	1.000E+00	0.000E+00	4.924E-08
U-235	U-235	1.000E+00	1.000E+02	9.998E+01
U-235	∑S(j):		1.000E+02	9.998E+01
Pa-231	Am-243	1.000E+00	0.000E+00	1.250E-18
Pa-231	Cm-243	2.400E-03	0.000E+00	3.514E-26
Pa-231	Cm-243	9.976E-01	0.000E+00	1.244E-18
Pa-231	Pu-239	1.000E+00	0.000E+00	2.604E-13

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	5.000E-01
Pa-231	U-235	1.000E+00	0.000E+00	1.058E-03
Pa-231	∑S(j):		0.000E+00	1.058E-03
Ac-227	Am-243	1.000E+00	0.000E+00	4.959E-21
Ac-227	Cm-243	2.400E-03	0.000E+00	1.116E-28
Ac-227	Cm-243	9.976E-01	0.000E+00	4.935E-21
Ac-227	Pu-239	1.000E+00	0.000E+00	1.376E-15
Ac-227	U-235	1.000E+00	0.000E+00	8.373E-06
Ac-227	∑S(j):		0.000E+00	8.373E-06
Cm-243	Cm-243	2.400E-03	2.400E-01	2.371E-01
Cm-243	Cm-243	9.976E-01	9.976E+01	9.855E+01
Cm-243	∑S(j):		1.000E+02	9.879E+01
Cm-244	Cm-244	1.350E-06	1.350E-04	1.324E-04
Cm-244	Cm-244	4.950E-08	4.950E-06	4.856E-06
Cm-244	∑S(j):		1.400E-04	1.373E-04
Pu-240	Cm-244	4.950E-08	0.000E+00	2.599E-10
Pu-240	Pu-240	4.950E-08	4.950E-06	4.950E-06
Pu-240	∑S(j):		4.950E-06	4.950E-06
Cm-244	Cm-244	1.000E+00	1.000E+02	9.810E+01
Pu-240	Cm-244	1.000E+00	0.000E+00	5.251E-03
U-236	Cm-244	1.000E+00	0.000E+00	3.898E-11
U-236	Pu-240	1.000E+00	0.000E+00	1.480E-06
U-236	∑S(j):		0.000E+00	1.480E-06
Th-232	Cm-244	1.000E+00	0.000E+00	3.211E-22
Th-232	Pu-240	1.000E+00	0.000E+00	1.825E-17
Th-232	Th-232	1.000E+00	1.000E+02	1.000E+02
Th-232	∑S(j):		1.000E+02	1.000E+02
Ra-228	Cm-244	1.000E+00	0.000E+00	4.785E-24
Ra-228	Pu-240	1.000E+00	0.000E+00	3.613E-19
Ra-228	Th-232	1.000E+00	0.000E+00	5.849E+00
Ra-228	∑S(j):		0.000E+00	5.849E+00
Th-228	Cm-244	1.000E+00	0.000E+00	1.687E-25
Th-228	Pu-240	1.000E+00	0.000E+00	1.583E-20
Th-228	Th-232	1.000E+00	0.000E+00	5.041E-01
Th-228	∑S(j):		0.000E+00	5.041E-01
Co-60	Co-60	1.000E+00	1.000E+02	9.364E+01
Cs-137	Cs-137	1.000E+00	1.000E+02	9.885E+01

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	5.000E-01
Eu-152	Eu-152	7.208E-01	7.208E+01	7.023E+01
Eu-152	Eu-152	2.792E-01	2.792E+01	2.720E+01
Eu-152	∑S(j):		1.000E+02	9.743E+01
Gd-152	Eu-152	2.792E-01	0.000E+00	8.844E-14
Eu-154	Eu-154	1.000E+00	1.000E+02	9.614E+01
Eu-155	Eu-155	1.000E+00	1.000E+02	9.325E+01
Nb-94	Nb-94	1.000E+00	1.000E+02	9.288E+01
Pu-238	Pu-238	1.840E-09	1.840E-07	1.833E-07
Pu-238	Pu-238	1.000E+00	1.000E+02	9.961E+01
Pu-238	∑S(j):		1.000E+02	9.961E+01
U-234	Pu-238	1.000E+00	0.000E+00	1.415E-04
U-234	U-234	1.000E+00	1.000E+02	9.998E+01
U-234	U-238	9.999E-01	0.000E+00	1.417E-04
U-234	∑S(j):		1.000E+02	9.998E+01
Th-230	Pu-238	1.000E+00	0.000E+00	3.186E-10
Th-230	U-234	1.000E+00	0.000E+00	4.501E-04
Th-230	U-238	9.999E-01	0.000E+00	3.189E-10
Th-230	∑S(j):		0.000E+00	4.501E-04
Ra-226	Pu-238	1.000E+00	0.000E+00	2.301E-14
Ra-226	U-234	1.000E+00	0.000E+00	4.874E-08
Ra-226	U-238	9.999E-01	0.000E+00	2.303E-14
Ra-226	∑S(j):		0.000E+00	4.874E-08
Pb-210	Pu-238	1.000E+00	0.000E+00	8.913E-17
Pb-210	U-234	1.000E+00	0.000E+00	2.515E-10
Pb-210	U-238	9.999E-01	0.000E+00	8.919E-17
Pb-210	∑S(j):		0.000E+00	2.515E-10
Pu-240	Pu-240	1.000E+00	1.000E+02	9.999E+01
Pu-241	Pu-241	1.000E+00	1.000E+02	9.762E+01
Pu-241	Pu-241	2.450E-05	2.450E-03	2.392E-03
Pu-241	∑S(j):		1.000E+02	9.762E+01
Sr-90	Sr-90	1.000E+00	1.000E+02	9.878E+01
Tc-99	Tc-99	1.000E+00	1.000E+02	9.289E+01
U-238	U-238	5.400E-05	5.400E-03	5.399E-03
U-238	U-238	9.999E-01	9.999E+01	9.997E+01
U-238	∑S(j):		1.000E+02	9.998E+01

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time = 193.15 seconds

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-225 (Source: FGR 12)	6.371E-02	6.371E-02	DCF1(1)
A-1	Ac-227 (Source: FGR 12)	4.951E-04	4.951E-04	DCF1(2)
A-1	Ac-228 (Source: FGR 12)	5.978E+00	5.978E+00	DCF1(3)
A-1	Ag-108 (Source: FGR 12)	1.143E-01	1.143E-01	DCF1(4)
A-1	Ag-108m (Source: FGR 12)	9.640E+00	9.640E+00	DCF1(5)
A-1	Al-26 (Source: FGR 12)	1.741E+01	1.741E+01	DCF1(6)
A-1	Am-241 (Source: FGR 12)	4.372E-02	4.372E-02	DCF1(7)
A-1	Am-243 (Source: FGR 12)	1.420E-01	1.420E-01	DCF1(8)
A-1	At-217 (Source: FGR 12)	1.773E-03	1.773E-03	DCF1(9)
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(10)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(11)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(12)
A-1	Bi-211 (Source: FGR 12)	2.559E-01	2.559E-01	DCF1(13)
A-1	Bi-212 (Source: FGR 12)	1.171E+00	1.171E+00	DCF1(14)
A-1	Bi-213 (Source: FGR 12)	7.660E-01	7.660E-01	DCF1(15)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(16)
A-1	Cm-243 (Source: FGR 12)	5.829E-01	5.829E-01	DCF1(17)
A-1	Cm-244 (Source: FGR 12)	1.259E-04	1.259E-04	DCF1(18)
A-1	Co-60 (Source: FGR 12)	1.622E+01	1.622E+01	DCF1(19)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(20)
A-1	Eu-152 (Source: FGR 12)	7.006E+00	7.006E+00	DCF1(21)
A-1	Eu-154 (Source: FGR 12)	7.678E+00	7.678E+00	DCF1(22)
A-1	Eu-155 (Source: FGR 12)	1.822E-01	1.822E-01	DCF1(23)
A-1	Fr-221 (Source: FGR 12)	1.536E-01	1.536E-01	DCF1(24)
A-1	Fr-223 (Source: FGR 12)	1.980E-01	1.980E-01	DCF1(25)
A-1	Gd-152 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(26)
A-1	Nb-94 (Source: FGR 12)	9.677E+00	9.677E+00	DCF1(27)
A-1	Np-237 (Source: FGR 12)	7.790E-02	7.790E-02	DCF1(28)
A-1	Np-239 (Source: FGR 12)	7.529E-01	7.529E-01	DCF1(29)
A-1	Pa-231 (Source: FGR 12)	1.906E-01	1.906E-01	DCF1(30)
A-1	Pa-233 (Source: FGR 12)	1.020E+00	1.020E+00	DCF1(31)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(32)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(33)
A-1	Pb-209 (Source: FGR 12)	7.734E-04	7.734E-04	DCF1(34)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(35)
A-1	Pb-211 (Source: FGR 12)	3.064E-01	3.064E-01	DCF1(36)
A-1	Pb-212 (Source: FGR 12)	7.043E-01	7.043E-01	DCF1(37)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(38)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(39)
A-1	Po-211 (Source: FGR 12)	4.764E-02	4.764E-02	DCF1(40)
A-1	Po-212 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(41)
A-1	Po-213 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(42)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(43)
A-1	Po-215 (Source: FGR 12)	1.016E-03	1.016E-03	DCF1(44)
A-1	Po-216 (Source: FGR 12)	1.042E-04	1.042E-04	DCF1(45)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(46)
A-1	Pu-238 (Source: FGR 12)	1.513E-04	1.513E-04	DCF1(47)
A-1	Pu-239 (Source: FGR 12)	2.952E-04	2.952E-04	DCF1(48)
A-1	Pu-240 (Source: FGR 12)	1.467E-04	1.467E-04	DCF1(49)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	Pu-241 (Source: FGR 12)	5.904E-06	5.904E-06	DCF1(50)
A-1	Ra-223 (Source: FGR 12)	6.034E-01	6.034E-01	DCF1(51)
A-1	Ra-224 (Source: FGR 12)	5.119E-02	5.119E-02	DCF1(52)
A-1	Ra-225 (Source: FGR 12)	1.102E-02	1.102E-02	DCF1(53)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(54)
A-1	Ra-228 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(55)
A-1	Rn-219 (Source: FGR 12)	3.083E-01	3.083E-01	DCF1(56)
A-1	Rn-220 (Source: FGR 12)	2.298E-03	2.298E-03	DCF1(57)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(58)
A-1	Sr-90 (Source: FGR 12)	7.043E-04	7.043E-04	DCF1(59)
A-1	Tc-99 (Source: FGR 12)	1.255E-04	1.255E-04	DCF1(60)
A-1	Th-227 (Source: FGR 12)	5.212E-01	5.212E-01	DCF1(61)
A-1	Th-228 (Source: FGR 12)	7.940E-03	7.940E-03	DCF1(62)
A-1	Th-229 (Source: FGR 12)	3.213E-01	3.213E-01	DCF1(63)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(64)
A-1	Th-231 (Source: FGR 12)	3.643E-02	3.643E-02	DCF1(65)
A-1	Th-232 (Source: FGR 12)	5.212E-04	5.212E-04	DCF1(66)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(67)
A-1	Tl-207 (Source: FGR 12)	1.980E-02	1.980E-02	DCF1(68)
A-1	Tl-208 (Source: FGR 12)	2.298E+01	2.298E+01	DCF1(69)
A-1	Tl-209 (Source: FGR 12)	1.293E+01	1.293E+01	DCF1(70)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(71)
A-1	U-233 (Source: FGR 12)	1.397E-03	1.397E-03	DCF1(72)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(73)
A-1	U-235 (Source: FGR 12)	7.211E-01	7.211E-01	DCF1(74)
A-1	U-236 (Source: FGR 12)	2.148E-04	2.148E-04	DCF1(75)
A-1	U-237 (Source: FGR 12)	5.306E-01	5.306E-01	DCF1(76)
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(77)
A-1	Y-90 (Source: FGR 12)	2.391E-02	2.391E-02	DCF1(78)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	2.109E+00	2.035E+00	DCF2(1)
B-1	Ag-108m+D	1.370E-04	1.369E-04	DCF2(2)
B-1	Al-26	7.400E-05	7.400E-05	DCF2(3)
B-1	Am-241	3.550E-01	3.552E-01	DCF2(4)
B-1	Am-243+D	3.550E-01	3.552E-01	DCF2(5)
B-1	Cm-243	2.550E-01	2.553E-01	DCF2(6)
B-1	Cm-244	2.110E-01	2.109E-01	DCF2(8)
B-1	Co-60	1.150E-04	1.147E-04	DCF2(11)
B-1	Cs-137+D	1.440E-04	1.443E-04	DCF2(12)
B-1	Eu-152	1.550E-04	1.554E-04	DCF2(13)
B-1	Eu-154	1.960E-04	1.961E-04	DCF2(15)
B-1	Eu-155	2.550E-05	2.553E-05	DCF2(16)
B-1	Gd-152	7.030E-02	7.030E-02	DCF2(17)
B-1	Nb-94	1.810E-04	1.813E-04	DCF2(18)
B-1	Np-237+D	1.850E-01	1.850E-01	DCF2(19)
B-1	Pa-231	5.180E-01	5.180E-01	DCF2(20)
B-1	Pb-210+D	3.694E-02	2.072E-02	DCF2(21)
B-1	Pu-238	4.070E-01	4.070E-01	DCF2(22)
B-1	Pu-239	4.440E-01	4.440E-01	DCF2(24)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
B-1	Pu-240	4.440E-01	4.440E-01	DCF2(25)
B-1	Pu-241	8.510E-03	8.510E-03	DCF2(27)
B-1	Pu-241+D	8.517E-03	8.510E-03	DCF2(28)
B-1	Ra-226+D	3.531E-02	3.515E-02	DCF2(29)
B-1	Ra-228+D	5.929E-02	5.920E-02	DCF2(30)
B-1	Sr-90+D	5.976E-04	5.920E-04	DCF2(31)
B-1	Tc-99	4.810E-05	4.810E-05	DCF2(32)
B-1	Th-228+D	1.614E-01	1.480E-01	DCF2(33)
B-1	Th-229+D	9.481E-01	8.880E-01	DCF2(34)
B-1	Th-230	3.700E-01	3.700E-01	DCF2(35)
B-1	Th-232	4.070E-01	4.070E-01	DCF2(36)
B-1	U-233	3.550E-02	3.552E-02	DCF2(37)
B-1	U-234	3.480E-02	3.478E-02	DCF2(38)
B-1	U-235+D	3.150E-02	3.145E-02	DCF2(39)
B-1	U-236	3.220E-02	3.219E-02	DCF2(40)
B-1	U-238	2.960E-02	2.960E-02	DCF2(41)
B-1	U-238+D	2.963E-02	2.960E-02	DCF2(42)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	4.473E-03	4.070E-03	DCF3(1)
D-1	Ag-108m+D	8.510E-06	8.510E-06	DCF3(2)
D-1	Al-26	1.300E-05	1.295E-05	DCF3(3)
D-1	Am-241	7.400E-04	7.400E-04	DCF3(4)
D-1	Am-243+D	7.430E-04	7.400E-04	DCF3(5)
D-1	Cm-243	5.550E-04	5.550E-04	DCF3(6)
D-1	Cm-244	4.440E-04	4.440E-04	DCF3(8)
D-1	Co-60	1.260E-05	1.258E-05	DCF3(11)
D-1	Cs-137+D	4.810E-05	4.810E-05	DCF3(12)
D-1	Eu-152	5.180E-06	5.180E-06	DCF3(13)
D-1	Eu-154	7.400E-06	7.400E-06	DCF3(15)
D-1	Eu-155	1.180E-06	1.184E-06	DCF3(16)
D-1	Gd-152	1.520E-04	1.517E-04	DCF3(17)
D-1	Nb-94	6.290E-06	6.290E-06	DCF3(18)
D-1	Np-237+D	4.102E-04	4.070E-04	DCF3(19)
D-1	Pa-231	2.630E-03	2.627E-03	DCF3(20)
D-1	Pb-210+D	6.995E-03	2.553E-03	DCF3(21)
D-1	Pu-238	8.510E-04	8.510E-04	DCF3(22)
D-1	Pu-239	9.250E-04	9.250E-04	DCF3(24)
D-1	Pu-240	9.250E-04	9.250E-04	DCF3(25)
D-1	Pu-241	1.780E-05	1.776E-05	DCF3(27)
D-1	Pu-241+D	2.061E-05	1.776E-05	DCF3(28)
D-1	Ra-226+D	1.041E-03	1.036E-03	DCF3(29)
D-1	Ra-228+D	2.552E-03	2.553E-03	DCF3(30)
D-1	Sr-90+D	1.140E-04	1.036E-04	DCF3(31)
D-1	Tc-99	2.370E-06	2.368E-06	DCF3(32)
D-1	Th-228+D	5.302E-04	2.664E-04	DCF3(33)
D-1	Th-229+D	2.266E-03	1.813E-03	DCF3(34)
D-1	Th-230	7.770E-04	7.770E-04	DCF3(35)
D-1	Th-232	8.510E-04	8.510E-04	DCF3(36)
D-1	U-233	1.890E-04	1.887E-04	DCF3(37)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-1	U-234	1.810E-04	1.813E-04	DCF3(38)
D-1	U-235+D	1.753E-04	1.739E-04	DCF3(39)
D-1	U-236	1.740E-04	1.739E-04	DCF3(40)
D-1	U-238	1.670E-04	1.665E-04	DCF3(41)
D-1	U-238+D	1.796E-04	1.665E-04	DCF3(42)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Ag-108m+D , plant/soil concentration ratio, dimensionless	1.500E-01	1.500E-01	RTF(2,1)
D-34	Ag-108m+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-03	3.000E-03	RTF(2,2)
D-34	Ag-108m+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.500E-02	2.500E-02	RTF(2,3)
D-34				
D-34	Al-26 , plant/soil concentration ratio, dimensionless	4.000E-03	4.000E-03	RTF(3,1)
D-34	Al-26 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-04	5.000E-04	RTF(3,2)
D-34	Al-26 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-04	2.000E-04	RTF(3,3)
D-34				
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(4,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(4,3)
D-34				
D-34	Am-243+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Am-243+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(5,2)
D-34	Am-243+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(5,3)
D-34				
D-34	Cm-243 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Cm-243 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(6,2)
D-34	Cm-243 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(6,3)
D-34				
D-34	Cm-244 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Cm-244 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(8,2)
D-34	Cm-244 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(8,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(11,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(11,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(11,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(12,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(12,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(12,3)
D-34				
D-34	Eu-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(13,1)
D-34	Eu-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(13,2)
D-34	Eu-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(13,3)
D-34				
D-34	Eu-154 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(15,1)
D-34	Eu-154 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(15,2)
D-34	Eu-154 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(15,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Eu-155 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	Eu-155 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(16,2)
D-34	Eu-155 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-05	5.000E-05	RTF(16,3)
D-34				
D-34	Gd-152 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(17,1)
D-34	Gd-152 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-03	2.000E-03	RTF(17,2)
D-34	Gd-152 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(17,3)
D-34				
D-34	Nb-94 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(18,1)
D-34	Nb-94 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-07	3.000E-07	RTF(18,2)
D-34	Nb-94 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(18,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(19,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(19,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(19,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(20,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(20,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(20,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(21,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(21,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(21,3)
D-34				
D-34	Pu-238 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(22,1)
D-34	Pu-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(22,2)
D-34	Pu-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(22,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(24,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(24,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(24,3)
D-34				
D-34	Pu-240 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(25,1)
D-34	Pu-240 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(25,2)
D-34	Pu-240 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(25,3)
D-34				
D-34	Pu-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(27,1)
D-34	Pu-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(27,2)
D-34	Pu-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(27,3)
D-34				
D-34	Pu-241+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(28,1)
D-34	Pu-241+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(28,2)
D-34	Pu-241+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(28,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(29,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(29,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(29,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(30,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(30,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(30,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(31,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(31,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(31,3)
D-34				
D-34	Tc-99 , plant/soil concentration ratio, dimensionless	5.000E+00	5.000E+00	RTF(32,1)
D-34	Tc-99 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(32,2)
D-34	Tc-99 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(32,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(33,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(33,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(33,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(34,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(34,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(34,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(35,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(35,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(35,3)
D-34				
D-34	Th-232 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(36,1)
D-34	Th-232 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(36,2)
D-34	Th-232 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(36,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(37,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(37,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(37,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(38,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(38,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(38,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(39,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(39,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(39,3)
D-34				
D-34	U-236 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(40,1)
D-34	U-236 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(40,2)
D-34	U-236 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(40,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(41,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(41,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(41,3)
D-34				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(42,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(42,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(42,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Ag-108m+D , fish	5.000E+00	5.000E+00	BIOFAC(2,1)
D-5	Ag-108m+D , crustacea and mollusks	7.700E+02	7.700E+02	BIOFAC(2,2)
D-5				
D-5	Al-26 , fish	5.000E+02	5.000E+02	BIOFAC(3,1)
D-5	Al-26 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(3,2)
D-5				
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(4,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(4,2)
D-5				
D-5	Am-243+D , fish	3.000E+01	3.000E+01	BIOFAC(5,1)
D-5	Am-243+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(5,2)
D-5				
D-5	Cm-243 , fish	3.000E+01	3.000E+01	BIOFAC(6,1)
D-5	Cm-243 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				
D-5	Cm-244 , fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Cm-244 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(8,2)
D-5				
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(11,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(11,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(12,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(12,2)
D-5				
D-5	Eu-152 , fish	5.000E+01	5.000E+01	BIOFAC(13,1)
D-5	Eu-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(13,2)
D-5				
D-5	Eu-154 , fish	5.000E+01	5.000E+01	BIOFAC(15,1)
D-5	Eu-154 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(15,2)
D-5				
D-5	Eu-155 , fish	5.000E+01	5.000E+01	BIOFAC(16,1)
D-5	Eu-155 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(16,2)
D-5				
D-5	Gd-152 , fish	2.500E+01	2.500E+01	BIOFAC(17,1)
D-5	Gd-152 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(17,2)
D-5				
D-5	Nb-94 , fish	3.000E+02	3.000E+02	BIOFAC(18,1)
D-5	Nb-94 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(18,2)
D-5				
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(19,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(19,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(20,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(20,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(21,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(21,2)
D-5				
D-5	Pu-238 , fish	3.000E+01	3.000E+01	BIOFAC(22,1)
D-5	Pu-238 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(22,2)
D-5				
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(24,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(24,2)
D-5				
D-5	Pu-240 , fish	3.000E+01	3.000E+01	BIOFAC(25,1)
D-5	Pu-240 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(25,2)
D-5				
D-5	Pu-241 , fish	3.000E+01	3.000E+01	BIOFAC(27,1)
D-5	Pu-241 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(27,2)
D-5				
D-5	Pu-241+D , fish	3.000E+01	3.000E+01	BIOFAC(28,1)
D-5	Pu-241+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(28,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(29,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(29,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(30,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(30,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(31,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(31,2)
D-5				
D-5	Tc-99 , fish	2.000E+01	2.000E+01	BIOFAC(32,1)
D-5	Tc-99 , crustacea and mollusks	5.000E+00	5.000E+00	BIOFAC(32,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(33,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(33,2)
D-5				
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(34,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(34,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(35,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(35,2)
D-5				
D-5	Th-232 , fish	1.000E+02	1.000E+02	BIOFAC(36,1)
D-5	Th-232 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(36,2)
D-5				
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(37,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(37,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(38,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(38,2)

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & ICRP 72 (Adult)

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(39,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(39,2)
D-5				
D-5	U-236 , fish	1.000E+01	1.000E+01	BIOFAC(40,1)
D-5	U-236 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(40,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(41,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(41,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(42,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(42,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

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)	1.000E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	5.000E-02	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	5.000E-01	1.000E+00	---	T(2)
R011	Times for calculations (yr)	not used	3.000E+00	---	T(3)
R011	Times for calculations (yr)	not used	1.000E+01	---	T(4)
R011	Times for calculations (yr)	not used	3.000E+01	---	T(5)
R011	Times for calculations (yr)	not used	1.000E+02	---	T(6)
R011	Times for calculations (yr)	not used	3.000E+02	---	T(7)
R011	Times for calculations (yr)	not used	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Ag-108m	1.000E+02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Al-26	1.000E+02	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Am-241	1.000E+02	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Am-243	1.000E+02	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Cm-243	1.000E+02	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): Cm-244	1.000E+02	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): Co-60	1.000E+02	0.000E+00	---	S1(11)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.000E+02	0.000E+00	---	S1(12)
R012	Initial principal radionuclide (pCi/g): Eu-152	1.000E+02	0.000E+00	---	S1(13)
R012	Initial principal radionuclide (pCi/g): Eu-154	1.000E+02	0.000E+00	---	S1(15)
R012	Initial principal radionuclide (pCi/g): Eu-155	1.000E+02	0.000E+00	---	S1(16)
R012	Initial principal radionuclide (pCi/g): Nb-94	1.000E+02	0.000E+00	---	S1(18)
R012	Initial principal radionuclide (pCi/g): Np-237	1.000E+02	0.000E+00	---	S1(19)
R012	Initial principal radionuclide (pCi/g): Pu-238	1.000E+02	0.000E+00	---	S1(22)
R012	Initial principal radionuclide (pCi/g): Pu-239	1.000E+02	0.000E+00	---	S1(24)
R012	Initial principal radionuclide (pCi/g): Pu-240	1.000E+02	0.000E+00	---	S1(25)
R012	Initial principal radionuclide (pCi/g): Pu-241	1.000E+02	0.000E+00	---	S1(27)
R012	Initial principal radionuclide (pCi/g): Sr-90	1.000E+02	0.000E+00	---	S1(31)
R012	Initial principal radionuclide (pCi/g): Tc-99	1.000E+02	0.000E+00	---	S1(32)
R012	Initial principal radionuclide (pCi/g): Th-232	1.000E+02	0.000E+00	---	S1(36)
R012	Initial principal radionuclide (pCi/g): U-233	1.000E+02	0.000E+00	---	S1(37)
R012	Initial principal radionuclide (pCi/g): U-234	1.000E+02	0.000E+00	---	S1(38)
R012	Initial principal radionuclide (pCi/g): U-235	1.000E+02	0.000E+00	---	S1(39)
R012	Initial principal radionuclide (pCi/g): U-238	1.000E+02	0.000E+00	---	S1(41)
R012	Concentration in groundwater (pCi/L): Ag-108m	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Al-26	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Am-243	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Cm-243	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): Cm-244	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---	W1(11)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(12)
R012	Concentration in groundwater (pCi/L): Eu-152	not used	0.000E+00	---	W1(13)
R012	Concentration in groundwater (pCi/L): Eu-154	not used	0.000E+00	---	W1(15)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R012	Concentration in groundwater (pCi/L): Eu-155	not used	0.000E+00	---	W1(16)
R012	Concentration in groundwater (pCi/L): Nb-94	not used	0.000E+00	---	W1(18)
R012	Concentration in groundwater (pCi/L): Np-237	not used	0.000E+00	---	W1(19)
R012	Concentration in groundwater (pCi/L): Pu-238	not used	0.000E+00	---	W1(22)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(24)
R012	Concentration in groundwater (pCi/L): Pu-240	not used	0.000E+00	---	W1(25)
R012	Concentration in groundwater (pCi/L): Pu-241	not used	0.000E+00	---	W1(27)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(31)
R012	Concentration in groundwater (pCi/L): Tc-99	not used	0.000E+00	---	W1(32)
R012	Concentration in groundwater (pCi/L): Th-232	not used	0.000E+00	---	W1(36)
R012	Concentration in groundwater (pCi/L): U-233	not used	0.000E+00	---	W1(37)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(38)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(39)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(41)
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)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.300E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.090E+03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.900E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.850E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.800E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.230E-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	4.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS

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)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ag-108m				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.476E-01	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Al-26				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.476E-01	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.775E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Am-243				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.775E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Cm-243				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	1.378E+03	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.428E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for Cm-244				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	1.378E+03	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.428E-05	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Co-60				
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+03	---	DCNUCU(11,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+03	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.968E-05	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	4.600E+03	4.600E+03	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	not used	4.600E+03	---	DCNUCU(12,1)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.278E-06	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for Eu-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(13,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.385E-05	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for Eu-154				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(15)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(15,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.385E-05	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R016	Distribution coefficients for Eu-155				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(16)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(16,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.385E-05	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for Nb-94				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(18)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(18,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.476E-01	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R016	Distribution coefficients for Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(19)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(19,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(19)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.641E-05	ALEACH(19)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(19)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Pu-238				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(22)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(22,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(22)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.839E-06	ALEACH(22)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(22)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(24)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(24,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(24)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.839E-06	ALEACH(24)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(24)
R016	Distribution coefficients for Pu-240				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(25)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(25,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(25)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.839E-06	ALEACH(25)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(25)
R016	Distribution coefficients for Pu-241				
R016	Contaminated zone (cm**3/g)	2.000E+03	2.000E+03	---	DCNUCC(27)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(27,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(27)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.839E-06	ALEACH(27)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(27)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	3.000E+01	3.000E+01	---	DCNUCC(31)
R016	Unsaturated zone 1 (cm**3/g)	not used	3.000E+01	---	DCNUCU(31,1)
R016	Saturated zone (cm**3/g)	not used	3.000E+01	---	DCNUCS(31)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.531E-04	ALEACH(31)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(31)
R016	Distribution coefficients for Tc-99				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(32)
R016	Unsaturated zone 1 (cm**3/g)	not used	0.000E+00	---	DCNUCU(32,1)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(32)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.476E-01	ALEACH(32)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(32)
R016	Distribution coefficients for Th-232				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(36)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(36,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(36)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.280E-07	ALEACH(36)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(36)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(37)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(37,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(37)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.926E-04	ALEACH(37)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(37)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(38)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(38,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(38)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.926E-04	ALEACH(38)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(38)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(39)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(39,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(39)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.926E-04	ALEACH(39)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(39)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(41)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(41,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(41)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.926E-04	ALEACH(41)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(41)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.775E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Gd-152				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	8.249E+02	DCNUCC(17)
R016	Unsaturated zone 1 (cm**3/g)	not used	-1.000E+00	---	DCNUCU(17,1)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.385E-05	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(20)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(20,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(20)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.926E-04	ALEACH(20)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(20)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(21)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(21,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(21)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.965E-04	ALEACH(21)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(21)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(29)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(29,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(29)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.806E-04	ALEACH(29)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(29)
R016	Distribution coefficients for daughter Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(30)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(30,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(30)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.806E-04	ALEACH(30)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(30)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(33)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(33,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(33)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.280E-07	ALEACH(33)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(33)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(34)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(34,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(34)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.280E-07	ALEACH(34)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(34)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(35)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(35,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(35)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.280E-07	ALEACH(35)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(35)
R016	Distribution coefficients for daughter U-236				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(40)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(40,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(40)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.926E-04	ALEACH(40)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(40)
R017	Inhalation rate (m**3/yr)	6.734E+03	8.400E+03	---	INHALR

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Mass loading for inhalation (g/m**3)	1.100E-05	1.000E-04	---	MLINH
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	1.000E+00	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	1.521E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	7.600E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	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)	2.430E+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	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Contamination fraction of milk	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)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	5.000E-02	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	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
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	1024	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	suppressed
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	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions

Area:	1000.00 square meters
Thickness:	0.05 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g

Ag-108m	1.000E+02
Al-26	1.000E+02
Am-241	1.000E+02
Am-243	1.000E+02
Cm-243	1.000E+02
Cm-244	1.000E+02
Co-60	1.000E+02
Cs-137	1.000E+02
Eu-152	1.000E+02
Eu-154	1.000E+02
Eu-155	1.000E+02
Nb-94	1.000E+02
Np-237	1.000E+02
Pu-238	1.000E+02
Pu-239	1.000E+02
Pu-240	1.000E+02
Pu-241	1.000E+02
Sr-90	1.000E+02
Tc-99	1.000E+02
Th-232	1.000E+02
U-233	1.000E+02
U-234	1.000E+02
U-235	1.000E+02
U-238	1.000E+02

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	5.000E-01
TDOSE(t):	4.829E+00	4.896E+00
M(t):	1.931E-01	1.958E-01

Maximum TDOSE(t): 4.896E+00 mrem/yr at t = 5.000E-01 years

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.
Ag-108m	0.000E+00	0.0000	2.596E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.374E-03	0.0009
Al-26	0.000E+00	0.0000	1.406E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.699E-03	0.0014
Am-241	0.000E+00	0.0000	7.245E-02	0.0150	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.096E-01	0.0848
Am-243	0.000E+00	0.0000	7.251E-02	0.0150	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.116E-01	0.0852
Cm-243	0.000E+00	0.0000	5.148E-02	0.0107	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.039E-01	0.0629
Cm-244	0.000E+00	0.0000	4.231E-02	0.0088	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.415E-01	0.0500
Co-60	0.000E+00	0.0000	2.202E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.544E-03	0.0014
Cs-137	0.000E+00	0.0000	2.909E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.636E-02	0.0055
Eu-152	0.000E+00	0.0000	3.087E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.798E-03	0.0006
Eu-154	0.000E+00	0.0000	3.852E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.944E-03	0.0008
Eu-155	0.000E+00	0.0000	4.863E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.104E-04	0.0001
Nb-94	0.000E+00	0.0000	3.439E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.241E-03	0.0007
Np-237	0.000E+00	0.0000	3.781E-02	0.0078	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.274E-01	0.0471
Pu-238	0.000E+00	0.0000	8.284E-02	0.0172	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.698E-01	0.0973
Pu-239	0.000E+00	0.0000	9.073E-02	0.0188	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.127E-01	0.1062
Pu-240	0.000E+00	0.0000	9.073E-02	0.0188	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.127E-01	0.1062
Pu-241	0.000E+00	0.0000	1.755E-03	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.956E-03	0.0021
Sr-90	0.000E+00	0.0000	1.206E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.242E-02	0.0129
Tc-99	0.000E+00	0.0000	9.138E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.221E-03	0.0003
Th-232	0.000E+00	0.0000	8.409E-02	0.0174	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.555E-01	0.1150
U-233	0.000E+00	0.0000	7.262E-03	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.048E-01	0.0217
U-234	0.000E+00	0.0000	7.110E-03	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.003E-01	0.0208
U-235	0.000E+00	0.0000	6.437E-03	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.714E-02	0.0201
U-238	0.000E+00	0.0000	6.054E-03	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.953E-02	0.0206
Total	0.000E+00	0.0000	6.539E-01	0.1354	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.175E+00	0.8646

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.
Ag-108m	0.000E+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	4.400E-03	0.0009
Al-26	0.000E+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	6.713E-03	0.0014
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.821E-01	0.0998
Am-243	0.000E+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	4.841E-01	0.1003
Cm-243	0.000E+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	3.554E-01	0.0736
Cm-244	0.000E+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	2.838E-01	0.0588
Co-60	0.000E+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	6.566E-03	0.0014
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.638E-02	0.0055
Eu-152	0.000E+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	2.829E-03	0.0006
Eu-154	0.000E+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	3.983E-03	0.0008
Eu-155	0.000E+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	6.153E-04	0.0001
Nb-94	0.000E+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	3.276E-03	0.0007
Np-237	0.000E+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	2.652E-01	0.0549
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.527E-01	0.1145
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.034E-01	0.1250
Pu-240	0.000E+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	6.034E-01	0.1250
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.171E-02	0.0024
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	6.254E-02	0.0130
Tc-99	0.000E+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	1.230E-03	0.0003
Th-232	0.000E+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	6.396E-01	0.1325
U-233	0.000E+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	1.121E-01	0.0232
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	1.074E-01	0.0222
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	1.036E-01	0.0215
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	1.056E-01	0.0219
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	4.829E+00	1.0000

*Sum of all water independent and dependent pathways.

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.
Ag-108m	0.000E+00	0.0000	2.405E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.051E-03	0.0008
Al-26	0.000E+00	0.0000	1.306E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.223E-03	0.0013
Am-241	0.000E+00	0.0000	7.236E-02	0.0148	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.091E-01	0.0836
Am-243	0.000E+00	0.0000	7.247E-02	0.0148	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.114E-01	0.0840
Cm-243	0.000E+00	0.0000	5.086E-02	0.0104	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.003E-01	0.0613
Cm-244	0.000E+00	0.0000	4.151E-02	0.0085	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.369E-01	0.0484
Co-60	0.000E+00	0.0000	2.062E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.128E-03	0.0013
Cs-137	0.000E+00	0.0000	2.876E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.605E-02	0.0053
Eu-152	0.000E+00	0.0000	3.007E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.726E-03	0.0006
Eu-154	0.000E+00	0.0000	3.703E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.792E-03	0.0008
Eu-155	0.000E+00	0.0000	4.535E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.692E-04	0.0001
Nb-94	0.000E+00	0.0000	3.194E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.011E-03	0.0006
Np-237	0.000E+00	0.0000	3.781E-02	0.0077	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.274E-01	0.0464
Pu-238	0.000E+00	0.0000	8.252E-02	0.0169	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.680E-01	0.0956
Pu-239	0.000E+00	0.0000	9.073E-02	0.0185	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.127E-01	0.1047
Pu-240	0.000E+00	0.0000	9.072E-02	0.0185	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.127E-01	0.1047
Pu-241	0.000E+00	0.0000	1.771E-03	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.004E-02	0.0021
Sr-90	0.000E+00	0.0000	1.192E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.166E-02	0.0126
Tc-99	0.000E+00	0.0000	8.488E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.134E-03	0.0002
Th-232	0.000E+00	0.0000	8.519E-02	0.0174	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.373E-01	0.1302
U-233	0.000E+00	0.0000	7.270E-03	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.048E-01	0.0214
U-234	0.000E+00	0.0000	7.109E-03	0.0015	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.003E-01	0.0205
U-235	0.000E+00	0.0000	6.437E-03	0.0013	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.714E-02	0.0198
U-238	0.000E+00	0.0000	6.052E-03	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.951E-02	0.0203
Total	0.000E+00	0.0000	6.531E-01	0.1334	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.243E+00	0.8666

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.
Ag-108m	0.000E+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	4.076E-03	0.0008
Al-26	0.000E+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	6.236E-03	0.0013
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.815E-01	0.0983
Am-243	0.000E+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	4.839E-01	0.0988
Cm-243	0.000E+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	3.511E-01	0.0717
Cm-244	0.000E+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	2.784E-01	0.0569
Co-60	0.000E+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	6.148E-03	0.0013
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.608E-02	0.0053
Eu-152	0.000E+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	2.756E-03	0.0006
Eu-154	0.000E+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	3.829E-03	0.0008
Eu-155	0.000E+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	5.737E-04	0.0001
Nb-94	0.000E+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	3.043E-03	0.0006
Np-237	0.000E+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	2.652E-01	0.0542
Pu-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.505E-01	0.1124
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.034E-01	0.1232
Pu-240	0.000E+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	6.034E-01	0.1232
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.181E-02	0.0024
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	6.178E-02	0.0126
Tc-99	0.000E+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	1.143E-03	0.0002
Th-232	0.000E+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	7.225E-01	0.1476
U-233	0.000E+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	1.121E-01	0.0229
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	1.074E-01	0.0219
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	1.036E-01	0.0212
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	1.056E-01	0.0216
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	4.896E+00	1.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways

Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	5.000E-01
Ag-108m+D	Ag-108m+D	1.000E+00	4.400E-05	4.076E-05
Al-26	Al-26	1.000E+00	6.713E-05	6.236E-05
Am-241	Am-241	1.000E+00	4.821E-03	4.815E-03
Am-241	Np-237+D	1.000E+00	4.291E-10	8.577E-10
Am-241	U-233	1.000E+00	2.642E-16	8.584E-16
Am-241	Th-229+D	1.000E+00	8.074E-20	4.036E-19
Am-241	∑DSR(j)		4.821E-03	4.815E-03
Am-243+D	Am-243+D	1.000E+00	4.841E-03	4.838E-03
Am-243+D	Pu-239	1.000E+00	8.687E-08	1.737E-07
Am-243+D	U-235+D	1.000E+00	4.895E-18	1.591E-17
Am-243+D	Pa-231	1.000E+00	3.909E-22	1.954E-21
Am-243+D	Ac-227+D	1.000E+00	4.608E-24	3.474E-23
Am-243+D	∑DSR(j)		4.841E-03	4.839E-03
Cm-243	Cm-243	2.400E-03	8.529E-06	8.426E-06
Cm-243	Am-243+D	2.400E-03	5.413E-10	1.077E-09
Cm-243	Pu-239	2.400E-03	6.489E-15	2.102E-14
Cm-243	U-235+D	2.400E-03	2.746E-25	1.369E-24
Cm-243	Pa-231	2.400E-03	1.755E-29	1.324E-28
Cm-243	Ac-227+D	2.400E-03	1.727E-31	1.956E-30
Cm-243	∑DSR(j)		8.530E-06	8.427E-06
Cm-243	Cm-243	9.976E-01	3.545E-03	3.503E-03
Cm-243	Pu-239	9.976E-01	8.600E-08	1.711E-07
Cm-243	U-235+D	9.976E-01	4.855E-18	1.573E-17
Cm-243	Pa-231	9.976E-01	3.881E-22	1.936E-21
Cm-243	Ac-227+D	9.976E-01	4.579E-24	3.446E-23
Cm-243	∑DSR(j)		3.546E-03	3.503E-03
Cm-244	Cm-244	1.350E-06	3.831E-09	3.758E-09
Cm-244	Cm-244	4.950E-08	1.405E-10	1.378E-10
Cm-244	Pu-240	4.950E-08	1.564E-14	3.102E-14
Cm-244	∑DSR(j)		1.405E-10	1.378E-10
Cm-244	Cm-244	1.000E+00	2.838E-03	2.784E-03
Cm-244	Pu-240	1.000E+00	3.159E-07	6.267E-07
Cm-244	U-236	1.000E+00	5.338E-16	1.726E-15
Cm-244	Th-232	1.000E+00	3.553E-26	1.769E-25
Cm-244	Ra-228+D	1.000E+00	2.161E-27	1.613E-26
Cm-244	Th-228+D	1.000E+00	2.854E-29	3.129E-28
Cm-244	∑DSR(j)		2.838E-03	2.784E-03

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	5.000E-01
Co-60	Co-60	1.000E+00	6.566E-05	6.148E-05
Cs-137+D	Cs-137+D	1.000E+00	2.638E-04	2.608E-04
Eu-152	Eu-152	7.208E-01	2.039E-05	1.987E-05
Eu-152	Eu-152	2.792E-01	7.898E-06	7.695E-06
Eu-152	Gd-152	2.792E-01	8.684E-19	1.718E-18
Eu-152	∑DSR(j)		7.898E-06	7.695E-06
Eu-154	Eu-154	1.000E+00	3.983E-05	3.829E-05
Eu-155	Eu-155	1.000E+00	6.153E-06	5.737E-06
Nb-94	Nb-94	1.000E+00	3.276E-05	3.043E-05
Np-237+D	Np-237+D	1.000E+00	2.652E-03	2.652E-03
Np-237+D	U-233	1.000E+00	2.449E-09	4.897E-09
Np-237+D	Th-229+D	1.000E+00	9.976E-13	3.242E-12
Np-237+D	∑DSR(j)		2.652E-03	2.652E-03
Pu-238	Pu-238	1.840E-09	1.017E-11	1.013E-11
Pu-238	Pu-238	1.000E+00	5.527E-03	5.505E-03
Pu-238	U-234	1.000E+00	1.519E-09	3.032E-09
Pu-238	Th-230	1.000E+00	2.149E-14	6.976E-14
Pu-238	Ra-226+D	1.000E+00	2.686E-18	1.342E-17
Pu-238	Pb-210+D	1.000E+00	1.105E-19	8.329E-19
Pu-238	∑DSR(j)		5.527E-03	5.505E-03
Pu-239	Pu-239	1.000E+00	6.034E-03	6.034E-03
Pu-239	U-235+D	1.000E+00	5.100E-13	1.020E-12
Pu-239	Pa-231	1.000E+00	5.429E-17	1.764E-16
Pu-239	Ac-227+D	1.000E+00	7.990E-19	3.981E-18
Pu-239	∑DSR(j)		6.034E-03	6.034E-03
Pu-240	Pu-240	4.950E-08	2.987E-10	2.987E-10
Pu-240	Pu-240	1.000E+00	6.034E-03	6.034E-03
Pu-240	U-236	1.000E+00	1.525E-11	3.049E-11
Pu-240	Th-232	1.000E+00	1.350E-21	4.389E-21
Pu-240	Ra-228+D	1.000E+00	1.021E-22	5.045E-22
Pu-240	Th-228+D	1.000E+00	1.605E-24	1.167E-23
Pu-240	∑DSR(j)		6.034E-03	6.034E-03

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	5.000E-01
Pu-241	Pu-241	1.000E+00	1.133E-04	1.106E-04
Pu-241	Am-241	1.000E+00	3.806E-06	7.533E-06
Pu-241	Np-237+D	1.000E+00	2.267E-13	7.318E-13
Pu-241	U-233	1.000E+00	1.049E-19	5.220E-19
Pu-241	Th-229+D	1.000E+00	2.570E-23	1.935E-22
Pu-241	∑DSR(j)		1.171E-04	1.181E-04
Pu-241+D	Pu-241+D	2.450E-05	3.149E-09	3.074E-09
Pu-241+D	Np-237+D	2.450E-05	1.035E-14	2.050E-14
Pu-241+D	U-233	2.450E-05	6.401E-21	2.067E-20
Pu-241+D	Th-229+D	2.450E-05	1.960E-24	9.753E-24
Pu-241+D	∑DSR(j)		3.149E-09	3.074E-09
Sr-90+D	Sr-90+D	1.000E+00	6.254E-04	6.178E-04
Tc-99	Tc-99	1.000E+00	1.230E-05	1.143E-05
Th-232	Th-232	1.000E+00	5.549E-03	5.549E-03
Th-232	Ra-228+D	1.000E+00	8.261E-04	1.612E-03
Th-232	Th-228+D	1.000E+00	2.113E-05	6.452E-05
Th-232	∑DSR(j)		6.396E-03	7.225E-03
U-233	U-233	1.000E+00	1.120E-03	1.120E-03
U-233	Th-229+D	1.000E+00	6.844E-07	1.369E-06
U-233	∑DSR(j)		1.121E-03	1.121E-03
U-234	U-234	1.000E+00	1.074E-03	1.074E-03
U-234	Th-230	1.000E+00	2.278E-08	4.557E-08
U-234	Ra-226+D	1.000E+00	3.796E-12	1.233E-11
U-234	Pb-210+D	1.000E+00	1.949E-13	9.715E-13
U-234	∑DSR(j)		1.074E-03	1.074E-03
U-235+D	U-235+D	1.000E+00	1.036E-03	1.035E-03
U-235+D	Pa-231	1.000E+00	1.654E-07	3.307E-07
U-235+D	Ac-227+D	1.000E+00	3.240E-09	1.048E-08
U-235+D	∑DSR(j)		1.036E-03	1.036E-03
U-238	U-238	5.400E-05	5.324E-08	5.323E-08
U-238+D	U-238+D	9.999E-01	1.056E-03	1.056E-03
U-238+D	U-234	9.999E-01	1.522E-09	3.044E-09
U-238+D	Th-230	9.999E-01	2.153E-14	6.996E-14
U-238+D	Ra-226+D	9.999E-01	2.690E-18	1.345E-17
U-238+D	Pb-210+D	9.999E-01	1.107E-19	8.344E-19
U-238+D	∑DSR(j)		1.056E-03	1.056E-03

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	5.000E-01
Ag-108m	5.682E+05	6.134E+05
Al-26	3.724E+05	4.009E+05
Am-241	5.186E+03	5.192E+03
Am-243	5.164E+03	5.167E+03
Cm-243	7.034E+03	7.120E+03
Cm-244	8.809E+03	8.979E+03
Co-60	3.807E+05	4.066E+05
Cs-137	9.475E+04	9.585E+04
Eu-152	8.838E+05	9.071E+05
Eu-154	6.277E+05	6.529E+05
Eu-155	4.063E+06	4.357E+06
Nb-94	7.632E+05	8.217E+05
Np-237	9.428E+03	9.428E+03
Pu-238	4.523E+03	4.541E+03
Pu-239	4.143E+03	4.143E+03
Pu-240	4.143E+03	4.143E+03
Pu-241	2.135E+05	2.116E+05
Sr-90	3.998E+04	4.047E+04
Tc-99	2.032E+06	2.187E+06
Th-232	3.909E+03	3.460E+03
U-233	2.231E+04	2.230E+04
U-234	2.327E+04	2.328E+04
U-235	2.414E+04	2.414E+04
U-238	2.368E+04	2.368E+04

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 = 5.000E-01 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ag-108m	1.000E+02	0.000E+00	4.400E-05	5.682E+05	4.076E-05	6.134E+05
Al-26	1.000E+02	0.000E+00	6.713E-05	3.724E+05	6.236E-05	4.009E+05
Am-241	1.000E+02	0.000E+00	4.821E-03	5.186E+03	4.815E-03	5.192E+03
Am-243	1.000E+02	0.000E+00	4.841E-03	5.164E+03	4.839E-03	5.167E+03
Cm-243	1.000E+02	0.000E+00	3.554E-03	7.034E+03	3.511E-03	7.120E+03
Cm-244	1.000E+02	0.000E+00	2.838E-03	8.809E+03	2.784E-03	8.979E+03
Co-60	1.000E+02	0.000E+00	6.566E-05	3.807E+05	6.148E-05	4.066E+05
Cs-137	1.000E+02	0.000E+00	2.638E-04	9.475E+04	2.608E-04	9.585E+04
Eu-152	1.000E+02	0.000E+00	2.829E-05	8.838E+05	2.756E-05	9.071E+05
Eu-154	1.000E+02	0.000E+00	3.983E-05	6.277E+05	3.829E-05	6.529E+05
Eu-155	1.000E+02	0.000E+00	6.153E-06	4.063E+06	5.737E-06	4.357E+06
Nb-94	1.000E+02	0.000E+00	3.276E-05	7.632E+05	3.043E-05	8.217E+05
Np-237	1.000E+02	0.000E+00	2.652E-03	9.428E+03	2.652E-03	9.428E+03
Pu-238	1.000E+02	0.000E+00	5.527E-03	4.523E+03	5.505E-03	4.541E+03
Pu-239	1.000E+02	0.000E+00	6.034E-03	4.143E+03	6.034E-03	4.143E+03
Pu-240	1.000E+02	0.000E+00	6.034E-03	4.143E+03	6.034E-03	4.143E+03
Pu-241	1.000E+02	5.000E-01	1.181E-04	2.116E+05	1.181E-04	2.116E+05
Sr-90	1.000E+02	0.000E+00	6.254E-04	3.998E+04	6.178E-04	4.047E+04
Tc-99	1.000E+02	0.000E+00	1.230E-05	2.032E+06	1.143E-05	2.187E+06
Th-232	1.000E+02	5.000E-01	7.225E-03	3.460E+03	7.225E-03	3.460E+03
U-233	1.000E+02	5.000E-01	1.121E-03	2.230E+04	1.121E-03	2.230E+04
U-234	1.000E+02	0.000E+00	1.074E-03	2.327E+04	1.074E-03	2.328E+04
U-235	1.000E+02	0.000E+00	1.036E-03	2.414E+04	1.036E-03	2.414E+04
U-238	1.000E+02	0.000E+00	1.056E-03	2.368E+04	1.056E-03	2.368E+04

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	5.000E-01
Ag-108m	Ag-108m	1.000E+00	4.400E-03	4.076E-03
Al-26	Al-26	1.000E+00	6.713E-03	6.236E-03
Am-241	Am-241	1.000E+00	4.821E-01	4.815E-01
Am-241	Pu-241	1.000E+00	3.806E-04	7.533E-04
Am-241	∑DOSE(j)		4.825E-01	4.822E-01
Np-237	Am-241	1.000E+00	4.291E-08	8.577E-08
Np-237	Np-237	1.000E+00	2.652E-01	2.652E-01
Np-237	Pu-241	1.000E+00	2.267E-11	7.318E-11
Np-237	Pu-241	2.450E-05	1.035E-12	2.050E-12
Np-237	∑DOSE(j)		2.652E-01	2.652E-01
U-233	Am-241	1.000E+00	2.642E-14	8.584E-14
U-233	Np-237	1.000E+00	2.449E-07	4.897E-07
U-233	Pu-241	1.000E+00	1.049E-17	5.220E-17
U-233	Pu-241	2.450E-05	6.401E-19	2.067E-18
U-233	U-233	1.000E+00	1.120E-01	1.120E-01
U-233	∑DOSE(j)		1.120E-01	1.120E-01
Th-229	Am-241	1.000E+00	8.074E-18	4.036E-17
Th-229	Np-237	1.000E+00	9.976E-11	3.242E-10
Th-229	Pu-241	1.000E+00	2.570E-21	1.935E-20
Th-229	Pu-241	2.450E-05	1.960E-22	9.753E-22
Th-229	U-233	1.000E+00	6.844E-05	1.369E-04
Th-229	∑DOSE(j)		6.844E-05	1.369E-04
Am-243	Am-243	1.000E+00	4.841E-01	4.838E-01
Am-243	Cm-243	2.400E-03	5.413E-08	1.077E-07
Am-243	∑DOSE(j)		4.841E-01	4.838E-01
Pu-239	Am-243	1.000E+00	8.687E-06	1.737E-05
Pu-239	Cm-243	2.400E-03	6.489E-13	2.102E-12
Pu-239	Cm-243	9.976E-01	8.600E-06	1.711E-05
Pu-239	Pu-239	1.000E+00	6.034E-01	6.034E-01
Pu-239	∑DOSE(j)		6.035E-01	6.035E-01
U-235	Am-243	1.000E+00	4.895E-16	1.591E-15
U-235	Cm-243	2.400E-03	2.746E-23	1.369E-22
U-235	Cm-243	9.976E-01	4.855E-16	1.573E-15
U-235	Pu-239	1.000E+00	5.100E-11	1.020E-10
U-235	U-235	1.000E+00	1.036E-01	1.035E-01
U-235	∑DOSE(j)		1.036E-01	1.035E-01
Pa-231	Am-243	1.000E+00	3.909E-20	1.954E-19
Pa-231	Cm-243	2.400E-03	1.755E-27	1.324E-26
Pa-231	Cm-243	9.976E-01	3.881E-20	1.936E-19
Pa-231	Pu-239	1.000E+00	5.429E-15	1.764E-14

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	5.000E-01
Pa-231	U-235	1.000E+00	1.654E-05	3.307E-05
Pa-231	∑DOSE(j)		1.654E-05	3.307E-05
Ac-227	Am-243	1.000E+00	4.608E-22	3.474E-21
Ac-227	Cm-243	2.400E-03	0.000E+00	1.666E-28
Ac-227	Cm-243	9.976E-01	4.579E-22	3.446E-21
Ac-227	Pu-239	1.000E+00	7.990E-17	3.981E-16
Ac-227	U-235	1.000E+00	3.240E-07	1.048E-06
Ac-227	∑DOSE(j)		3.240E-07	1.048E-06
Cm-243	Cm-243	2.400E-03	8.529E-04	8.426E-04
Cm-243	Cm-243	9.976E-01	3.545E-01	3.503E-01
Cm-243	∑DOSE(j)		3.554E-01	3.511E-01
Cm-244	Cm-244	1.350E-06	3.831E-07	3.758E-07
Cm-244	Cm-244	4.950E-08	1.405E-08	1.378E-08
Cm-244	∑DOSE(j)		3.971E-07	3.896E-07
Pu-240	Cm-244	4.950E-08	1.564E-12	3.102E-12
Pu-240	Pu-240	4.950E-08	2.987E-08	2.987E-08
Pu-240	∑DOSE(j)		2.987E-08	2.987E-08
Cm-244	Cm-244	1.000E+00	2.838E-01	2.784E-01
Pu-240	Cm-244	1.000E+00	3.159E-05	6.267E-05
U-236	Cm-244	1.000E+00	5.338E-14	1.726E-13
U-236	Pu-240	1.000E+00	1.525E-09	3.049E-09
U-236	∑DOSE(j)		1.525E-09	3.049E-09
Th-232	Cm-244	1.000E+00	3.553E-24	1.769E-23
Th-232	Pu-240	1.000E+00	1.350E-19	4.389E-19
Th-232	Th-232	1.000E+00	5.549E-01	5.549E-01
Th-232	∑DOSE(j)		5.549E-01	5.549E-01
Ra-228	Cm-244	1.000E+00	2.161E-25	1.613E-24
Ra-228	Pu-240	1.000E+00	1.021E-20	5.045E-20
Ra-228	Th-232	1.000E+00	8.261E-02	1.612E-01
Ra-228	∑DOSE(j)		8.261E-02	1.612E-01
Th-228	Cm-244	1.000E+00	2.854E-27	3.129E-26
Th-228	Pu-240	1.000E+00	1.605E-22	1.167E-21
Th-228	Th-232	1.000E+00	2.113E-03	6.452E-03
Th-228	∑DOSE(j)		2.113E-03	6.452E-03
Co-60	Co-60	1.000E+00	6.566E-03	6.148E-03
Cs-137	Cs-137	1.000E+00	2.638E-02	2.608E-02

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	5.000E-01
Eu-152	Eu-152	7.208E-01	2.039E-03	1.987E-03
Eu-152	Eu-152	2.792E-01	7.898E-04	7.695E-04
Eu-152	∑DOSE(j)		2.829E-03	2.756E-03
Gd-152	Eu-152	2.792E-01	8.684E-17	1.718E-16
Eu-154	Eu-154	1.000E+00	3.983E-03	3.829E-03
Eu-155	Eu-155	1.000E+00	6.153E-04	5.737E-04
Nb-94	Nb-94	1.000E+00	3.276E-03	3.043E-03
Pu-238	Pu-238	1.840E-09	1.017E-09	1.013E-09
Pu-238	Pu-238	1.000E+00	5.527E-01	5.505E-01
Pu-238	∑DOSE(j)		5.527E-01	5.505E-01
U-234	Pu-238	1.000E+00	1.519E-07	3.032E-07
U-234	U-234	1.000E+00	1.074E-01	1.074E-01
U-234	U-238	9.999E-01	1.522E-07	3.044E-07
U-234	∑DOSE(j)		1.074E-01	1.074E-01
Th-230	Pu-238	1.000E+00	2.149E-12	6.976E-12
Th-230	U-234	1.000E+00	2.278E-06	4.557E-06
Th-230	U-238	9.999E-01	2.153E-12	6.996E-12
Th-230	∑DOSE(j)		2.278E-06	4.557E-06
Ra-226	Pu-238	1.000E+00	2.686E-16	1.342E-15
Ra-226	U-234	1.000E+00	3.796E-10	1.233E-09
Ra-226	U-238	9.999E-01	2.690E-16	1.345E-15
Ra-226	∑DOSE(j)		3.796E-10	1.233E-09
Pb-210	Pu-238	1.000E+00	1.105E-17	8.329E-17
Pb-210	U-234	1.000E+00	1.949E-11	9.715E-11
Pb-210	U-238	9.999E-01	1.107E-17	8.344E-17
Pb-210	∑DOSE(j)		1.949E-11	9.715E-11
Pu-240	Pu-240	1.000E+00	6.034E-01	6.034E-01
Pu-241	Pu-241	1.000E+00	1.133E-02	1.106E-02
Pu-241	Pu-241	2.450E-05	3.149E-07	3.074E-07
Pu-241	∑DOSE(j)		1.133E-02	1.106E-02
Sr-90	Sr-90	1.000E+00	6.254E-02	6.178E-02
Tc-99	Tc-99	1.000E+00	1.230E-03	1.143E-03
U-238	U-238	5.400E-05	5.324E-06	5.323E-06
U-238	U-238	9.999E-01	1.056E-01	1.056E-01
U-238	∑DOSE(j)		1.056E-01	1.056E-01

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	5.000E-01
Ag-108m	Ag-108m	1.000E+00	1.000E+02	9.263E+01
Al-26	Al-26	1.000E+00	1.000E+02	9.289E+01
Am-241	Am-241	1.000E+00	1.000E+02	9.987E+01
Am-241	Pu-241	1.000E+00	0.000E+00	7.918E-02
Am-241	∑S(j):		1.000E+02	9.995E+01
Np-237	Am-241	1.000E+00	0.000E+00	1.618E-05
Np-237	Np-237	1.000E+00	1.000E+02	1.000E+02
Np-237	Pu-241	1.000E+00	0.000E+00	6.438E-09
Np-237	Pu-241	2.450E-05	0.000E+00	3.920E-10
Np-237	∑S(j):		1.000E+02	1.000E+02
U-233	Am-241	1.000E+00	0.000E+00	1.770E-11
U-233	Np-237	1.000E+00	0.000E+00	2.186E-04
U-233	Pu-241	1.000E+00	0.000E+00	4.702E-15
U-233	Pu-241	2.450E-05	0.000E+00	4.303E-16
U-233	U-233	1.000E+00	1.000E+02	9.998E+01
U-233	∑S(j):		1.000E+02	9.998E+01
Th-229	Am-241	1.000E+00	0.000E+00	2.786E-16
Th-229	Np-237	1.000E+00	0.000E+00	5.162E-09
Th-229	Pu-241	1.000E+00	0.000E+00	5.558E-20
Th-229	Pu-241	2.450E-05	0.000E+00	6.786E-21
Th-229	U-233	1.000E+00	0.000E+00	4.721E-03
Th-229	∑S(j):		0.000E+00	4.721E-03
Am-243	Am-243	1.000E+00	1.000E+02	9.995E+01
Am-243	Cm-243	2.400E-03	0.000E+00	1.120E-05
Am-243	∑S(j):		1.000E+02	9.995E+01
Pu-239	Am-243	1.000E+00	0.000E+00	1.440E-03
Pu-239	Cm-243	2.400E-03	0.000E+00	8.081E-11
Pu-239	Cm-243	9.976E-01	0.000E+00	1.428E-03
Pu-239	Pu-239	1.000E+00	1.000E+02	1.000E+02
Pu-239	∑S(j):		1.000E+02	1.000E+02
U-235	Am-243	1.000E+00	0.000E+00	3.545E-13
U-235	Cm-243	2.400E-03	0.000E+00	1.328E-20
U-235	Cm-243	9.976E-01	0.000E+00	3.523E-13
U-235	Pu-239	1.000E+00	0.000E+00	4.924E-08
U-235	U-235	1.000E+00	1.000E+02	9.998E+01
U-235	∑S(j):		1.000E+02	9.998E+01
Pa-231	Am-243	1.000E+00	0.000E+00	1.250E-18
Pa-231	Cm-243	2.400E-03	0.000E+00	3.514E-26
Pa-231	Cm-243	9.976E-01	0.000E+00	1.244E-18
Pa-231	Pu-239	1.000E+00	0.000E+00	2.604E-13

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	5.000E-01
Pa-231	U-235	1.000E+00	0.000E+00	1.058E-03
Pa-231	∑S(j):		0.000E+00	1.058E-03
Ac-227	Am-243	1.000E+00	0.000E+00	4.959E-21
Ac-227	Cm-243	2.400E-03	0.000E+00	1.116E-28
Ac-227	Cm-243	9.976E-01	0.000E+00	4.935E-21
Ac-227	Pu-239	1.000E+00	0.000E+00	1.376E-15
Ac-227	U-235	1.000E+00	0.000E+00	8.373E-06
Ac-227	∑S(j):		0.000E+00	8.373E-06
Cm-243	Cm-243	2.400E-03	2.400E-01	2.371E-01
Cm-243	Cm-243	9.976E-01	9.976E+01	9.855E+01
Cm-243	∑S(j):		1.000E+02	9.879E+01
Cm-244	Cm-244	1.350E-06	1.350E-04	1.324E-04
Cm-244	Cm-244	4.950E-08	4.950E-06	4.856E-06
Cm-244	∑S(j):		1.400E-04	1.373E-04
Pu-240	Cm-244	4.950E-08	0.000E+00	2.599E-10
Pu-240	Pu-240	4.950E-08	4.950E-06	4.950E-06
Pu-240	∑S(j):		4.950E-06	4.950E-06
Cm-244	Cm-244	1.000E+00	1.000E+02	9.810E+01
Pu-240	Cm-244	1.000E+00	0.000E+00	5.251E-03
U-236	Cm-244	1.000E+00	0.000E+00	3.898E-11
U-236	Pu-240	1.000E+00	0.000E+00	1.480E-06
U-236	∑S(j):		0.000E+00	1.480E-06
Th-232	Cm-244	1.000E+00	0.000E+00	3.211E-22
Th-232	Pu-240	1.000E+00	0.000E+00	1.825E-17
Th-232	Th-232	1.000E+00	1.000E+02	1.000E+02
Th-232	∑S(j):		1.000E+02	1.000E+02
Ra-228	Cm-244	1.000E+00	0.000E+00	4.785E-24
Ra-228	Pu-240	1.000E+00	0.000E+00	3.613E-19
Ra-228	Th-232	1.000E+00	0.000E+00	5.849E+00
Ra-228	∑S(j):		0.000E+00	5.849E+00
Th-228	Cm-244	1.000E+00	0.000E+00	1.687E-25
Th-228	Pu-240	1.000E+00	0.000E+00	1.583E-20
Th-228	Th-232	1.000E+00	0.000E+00	5.041E-01
Th-228	∑S(j):		0.000E+00	5.041E-01
Co-60	Co-60	1.000E+00	1.000E+02	9.364E+01
Cs-137	Cs-137	1.000E+00	1.000E+02	9.885E+01

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	5.000E-01
Eu-152	Eu-152	7.208E-01	7.208E+01	7.023E+01
Eu-152	Eu-152	2.792E-01	2.792E+01	2.720E+01
Eu-152	∑S(j):		1.000E+02	9.743E+01
Gd-152	Eu-152	2.792E-01	0.000E+00	8.844E-14
Eu-154	Eu-154	1.000E+00	1.000E+02	9.614E+01
Eu-155	Eu-155	1.000E+00	1.000E+02	9.325E+01
Nb-94	Nb-94	1.000E+00	1.000E+02	9.288E+01
Pu-238	Pu-238	1.840E-09	1.840E-07	1.833E-07
Pu-238	Pu-238	1.000E+00	1.000E+02	9.961E+01
Pu-238	∑S(j):		1.000E+02	9.961E+01
U-234	Pu-238	1.000E+00	0.000E+00	1.415E-04
U-234	U-234	1.000E+00	1.000E+02	9.998E+01
U-234	U-238	9.999E-01	0.000E+00	1.417E-04
U-234	∑S(j):		1.000E+02	9.998E+01
Th-230	Pu-238	1.000E+00	0.000E+00	3.186E-10
Th-230	U-234	1.000E+00	0.000E+00	4.501E-04
Th-230	U-238	9.999E-01	0.000E+00	3.189E-10
Th-230	∑S(j):		0.000E+00	4.501E-04
Ra-226	Pu-238	1.000E+00	0.000E+00	2.301E-14
Ra-226	U-234	1.000E+00	0.000E+00	4.874E-08
Ra-226	U-238	9.999E-01	0.000E+00	2.303E-14
Ra-226	∑S(j):		0.000E+00	4.874E-08
Pb-210	Pu-238	1.000E+00	0.000E+00	8.913E-17
Pb-210	U-234	1.000E+00	0.000E+00	2.515E-10
Pb-210	U-238	9.999E-01	0.000E+00	8.919E-17
Pb-210	∑S(j):		0.000E+00	2.515E-10
Pu-240	Pu-240	1.000E+00	1.000E+02	9.999E+01
Pu-241	Pu-241	1.000E+00	1.000E+02	9.762E+01
Pu-241	Pu-241	2.450E-05	2.450E-03	2.392E-03
Pu-241	∑S(j):		1.000E+02	9.762E+01
Sr-90	Sr-90	1.000E+00	1.000E+02	9.878E+01
Tc-99	Tc-99	1.000E+00	1.000E+02	9.289E+01
U-238	U-238	5.400E-05	5.400E-03	5.399E-03
U-238	U-238	9.999E-01	9.999E+01	9.997E+01
U-238	∑S(j):		1.000E+02	9.998E+01

THF(i) is the thread fraction of the parent nuclide.

UNCONTROLLED When Printed

RESCALC.EXE execution time = 178.68 seconds

Appendix E

Geophysical Survey of Disposal Trench

(10 Pages)

January 31, 2014

Technical Memorandum: Conduct of Geophysical Survey at Corrective Action Unit 415

Introduction

A geophysical survey was conducted at Corrective Action Unit (CAU) 415 on December 22, 2013. The area surveyed is generally flat with the exception of a shallow (not more than 2 feet deep) depression and low (not more than 2 feet height) mound which adjoin, are linear, and oriented in a general north-south direction. The depression is to the south of the mound. The vegetation consists of low desert scrub and grasses. There was no metallic debris noted on the surface in the area surveyed. The objective of the survey was to determine whether or not there are any buried metallic materials at this location.

Equipment Used

An EM31-MK2 ground conductivity meter was used to conduct the survey. The EM31-MK2 provides measurement of apparent conductivity and magnetic susceptibility to an effective depth of 6 m. The instrument was manufactured by Geonics Limited of Mississauga, Ontario, Canada.

Figure 1 shows an EM31-MK2 in use on a survey. A transmitter coil located at one end induces circular eddy current loops in the earth. Under certain conditions, the magnitude of any one of these current loops is directly proportional to the terrain conductivity in the vicinity of that loop. Each one of the current loops generates a magnetic field which is proportional to the value of the current flowing within that loop. A part of the magnetic field from each loop is intercepted by the receiver coil on the opposite end of the instrument and results in an output voltage which is linearly related to the terrain conductivity.

An Archer 14802 Field personal computer (PC) with integrated Hemisphere XF101 global positioning system (GPS) receiver from Juniper Systems, Inc. of Logan, Utah was used to collect the data produced by the EM31-MK2A. The data was reduced using the DAT31MK2 software provided by Geonics. This software allows the user to reduce the "raw" data files saved in the data-logger to files containing the UTM coordinates of the data points, in meters, and the response values (quadrature-phase and in-phase) generated by the EM31-MK2. All location data was converted to the project standard UTM11 NAD 27 coordinate system using ArcMap Version 10 by esri (esri, 2012). The EM31-MK2 response data, matched to the UTM11 NAD27 coordinates, was then imported into Version 11 of the Surfer program by Golden Software of Golden, CO

(Golden Software, 2013) for contouring and visualization. In addition, ArcMap was used to plot the individual data points on an aerial photo of the site.

General Information Regarding the EM31-MK2 Instrument Response Data

The strength of the EM31-MK2 instrument response is relative. It is a function of the ability of the field generated by the coils to excite a response in an object. The instrument response is affected by the size of the object, its conductivity and iron content, and the distance of the object from the coils (i.e. depth of burial). As such, a small piece of highly ferrous material at ground surface would yield a stronger response than a larger non-ferrous but conductive object also on the surface. In addition, the same piece of highly ferrous material will yield a stronger instrument response on the surface than it will if buried and, is consequently, further from the coils.

The data-logger and Hemisphere XF101 GPS unit recorded the EM31-MK2 survey data while the GPS unit was in motion during the conduct of the surveys. The coordinates of the corners of the area surveyed were recorded with the same unit. Although it is not generally the case, differences between a location surveyed with the GPS unit in motion as compared to being held stationary may be different by as much as a few meters due to the difference in the manner with which the GPS data was collected (i.e. stationary versus in motion) and the number of satellites available at the time the location is recorded. The EM31-MK2 survey data was collected in Universal Transverse Mercator (UTM) 11 North World Geodetic System (WGS) 84 coordinates, in meters. As noted above, this data was converted to the project standard of UTM 11 NAD 27 coordinates, in meters, prior to use.

Conduct of the Geophysical Survey

The survey was conducted December 22, 2013. The area surveyed was approximately 25 m east to west, approximately 60 m north to south, and generally centered on the depression/trench. The survey was walked in an east-west pattern. Each traverse was generally parallel to and approximately two to three meters from the previous traverse. Table 1 shows the survey file collected. Table 2 shows the coordinates of the corner markers used to delineate the survey area. The corner marker data shown in Table 2 were surveyed-in using the Archer Field PC/GPS tool and were saved in the file *points.dbf*. The points in the file for the “mid trench” and “open end” were not actually taken in the depression but to the west of it and do not indicate the physical location of the trench. Those points are not shown in Table 2.

Both the quadrature-phase and in-phase signals were recorded. The quadrature-phase component gives the ground conductivity. The in-phase component is more sensitive to the presence of large metallic objects. The instrument was carried as shown in Figure 1.

Table 1 Summary of Data Files Collected		
Raw Data Filename	**Date**	**Comment**
122208A.r31	12/22/2013	Survey completed.

Table 2 Individual Points Surveyed			
Location Coordinates UTM 11 NAD 27 (m)		**Label**	**Description**
East	**North**		
596,578.0	4,130,419.5	ne corner	northeast corner of the area surveyed
596,556.4	4,130,417.6	nw corner	northwest corner of the area surveyed
596,566.6	4,130,355.6	sw corner	southwest corner of the area surveyed
596,579.6	4,130,355.7	se corner	southeast corner of the area surveyed

Survey Results

Figure 2 is a plot of the EM31-MK2 in-phase data superimposed over an aerial photo of the survey area. Close examination shows a faint outline of the depression and mound. The in-phase value in parts per thousand (ppt) at each data-point is represented by a color. As each data-point is shown, the path walked to conduct the survey is clear. In addition to the data-points, the locations of the markers placed at the corners of the area surveyed are shown.

Figure 2 shows that for the majority of the area surveyed, the in-phase values were less than 0 ppt. The points showing values greater than 0 ppt are all located in the area of the shallow mound.

Figure 3 shows the same data contoured. Reference to the figure shows four anomalies along a north-south line. The individual anomalies are oriented northwest to southeast. Although it is difficult to discern the outlines of the objects causing the anomalies, dimensions of around 2 m (6 ft) wide by 4 m (13 ft) long should be generally accurate. A potential anomaly is also indicated on the figure. This anomaly could be due to lesser amounts of metal than gives rise to the anomalies described above or could simply be due to disturbance of the soil.

Figure 4 shows that for the majority of the area surveyed, the quadrature-phase values were less than 22.2 millimhos per meter (mmhos/m). The points showing values greater than 22.2 mmhos/m are all located in the area of the shallow mound.

Figure 5 shows the same data contoured. Reference to the figure shows that with the quadrature-phase data, the northernmost anomaly is relatively less pronounced and the possible anomaly to the south is relatively more pronounced as compared to the in-phase data.

Conclusions

An EM31-MK2 ground conductivity meter was used to conduct the survey. The results of the survey are shown in Figures 2 through 5. Of particular interest with regard to the detection of metal in the subsurface, are Figures 2 and 3 showing the in-phase data. These figures reveal the presence of a series of four linear anomalies oriented along a line running north-south. The individual anomalies are large, each approximately 2 by 4 m, and oriented northwest to southeast. There is a potential fifth anomaly, of lower strength, immediately south of the anomalies described above. Other than the metal causing the anomalies described above, there do not appear to be any significant amounts of metal in the subsurface of the area surveyed (i.e. no other landfills).

Figure 1 Photo of the EM31-MK2 in Use (Geonics, 2012)

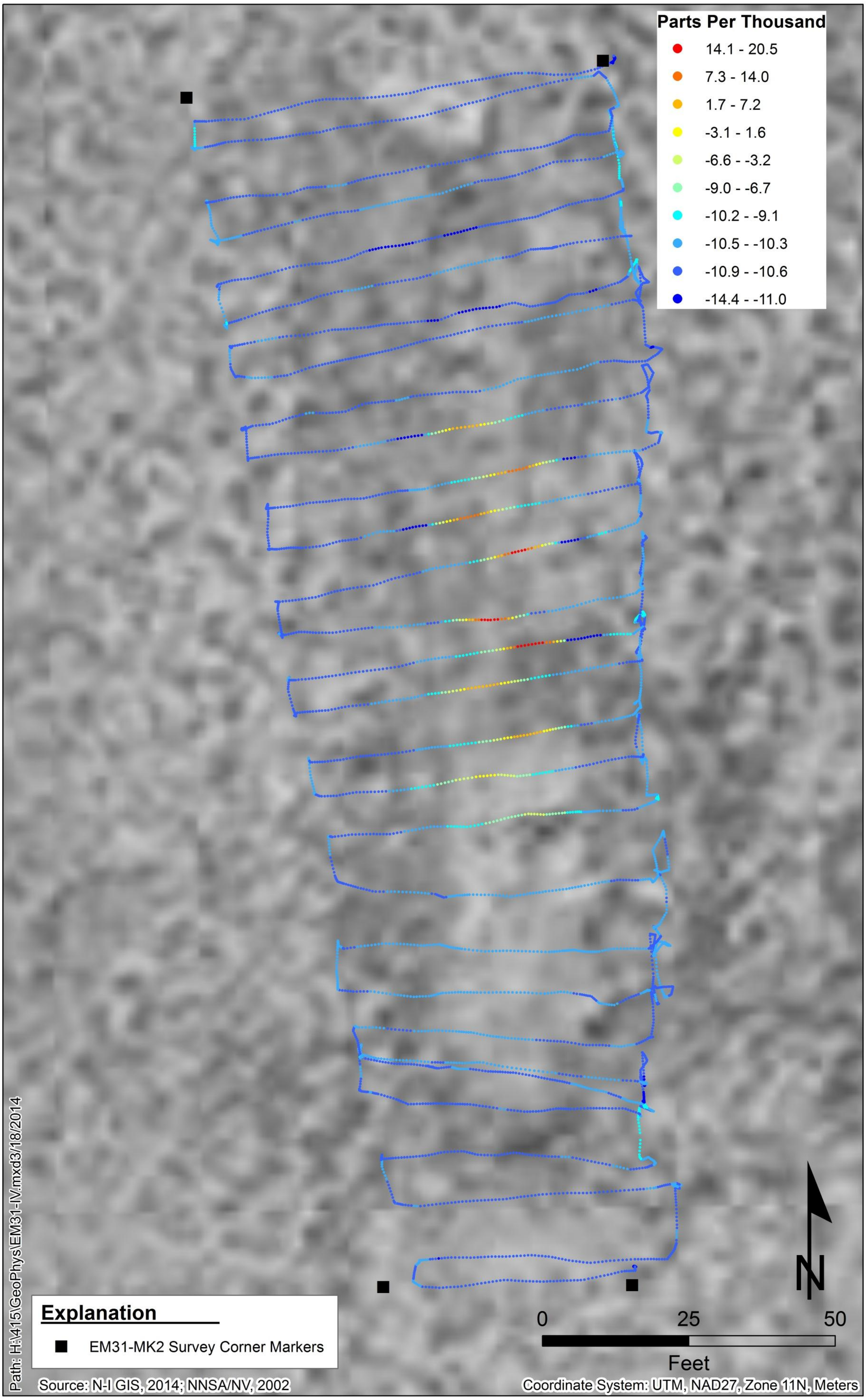
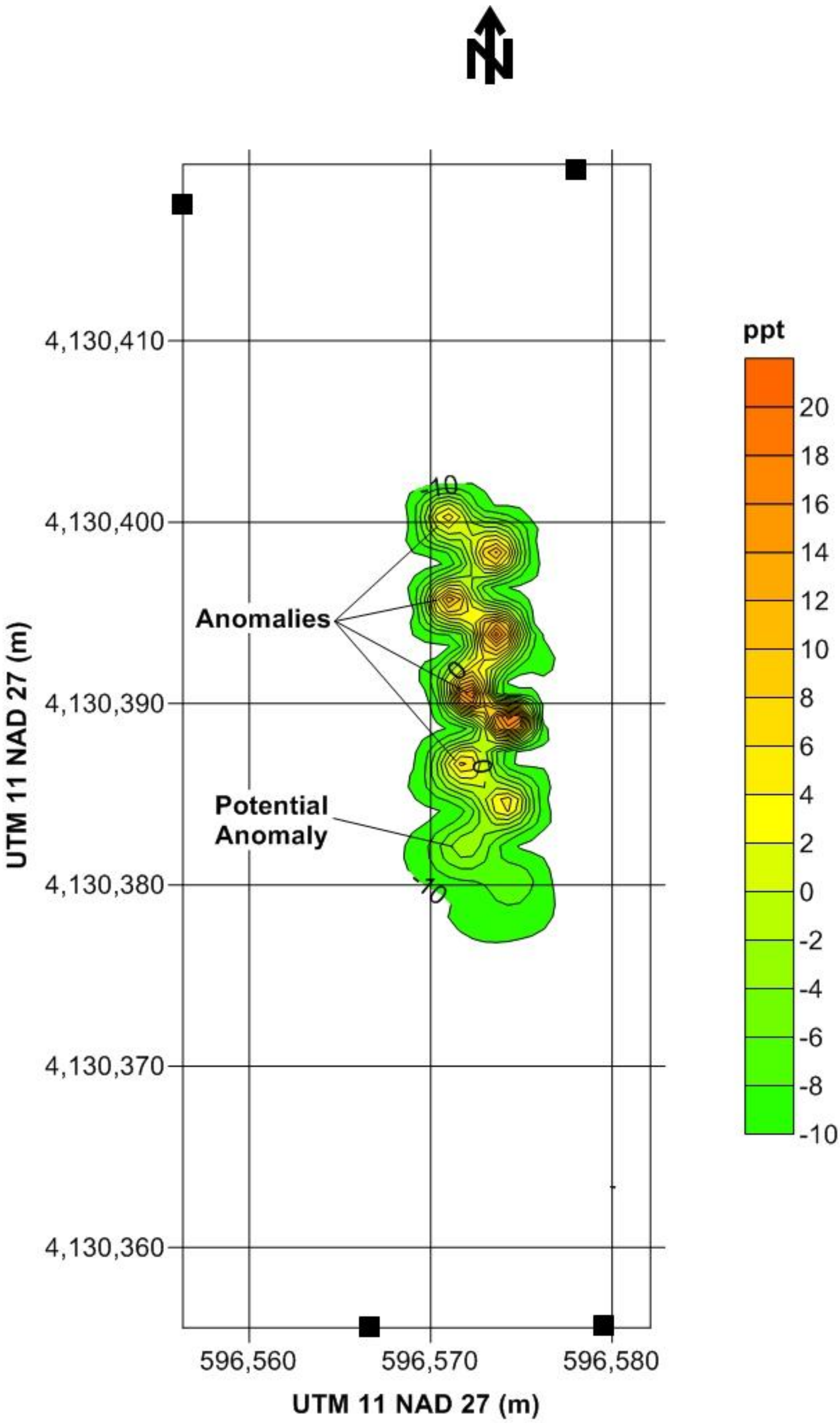


Figure 2 In-Phase Data from the EM31-MK2 Survey Showing Values Recorded at Individual Data-points



Explanation

■ **EM31-MK2 Survey Corner Markers**

ppt - parts per thousand

Figure 3 In-Phase Data from the EM31-MK2 Survey Showing Kriged and Contoured Values

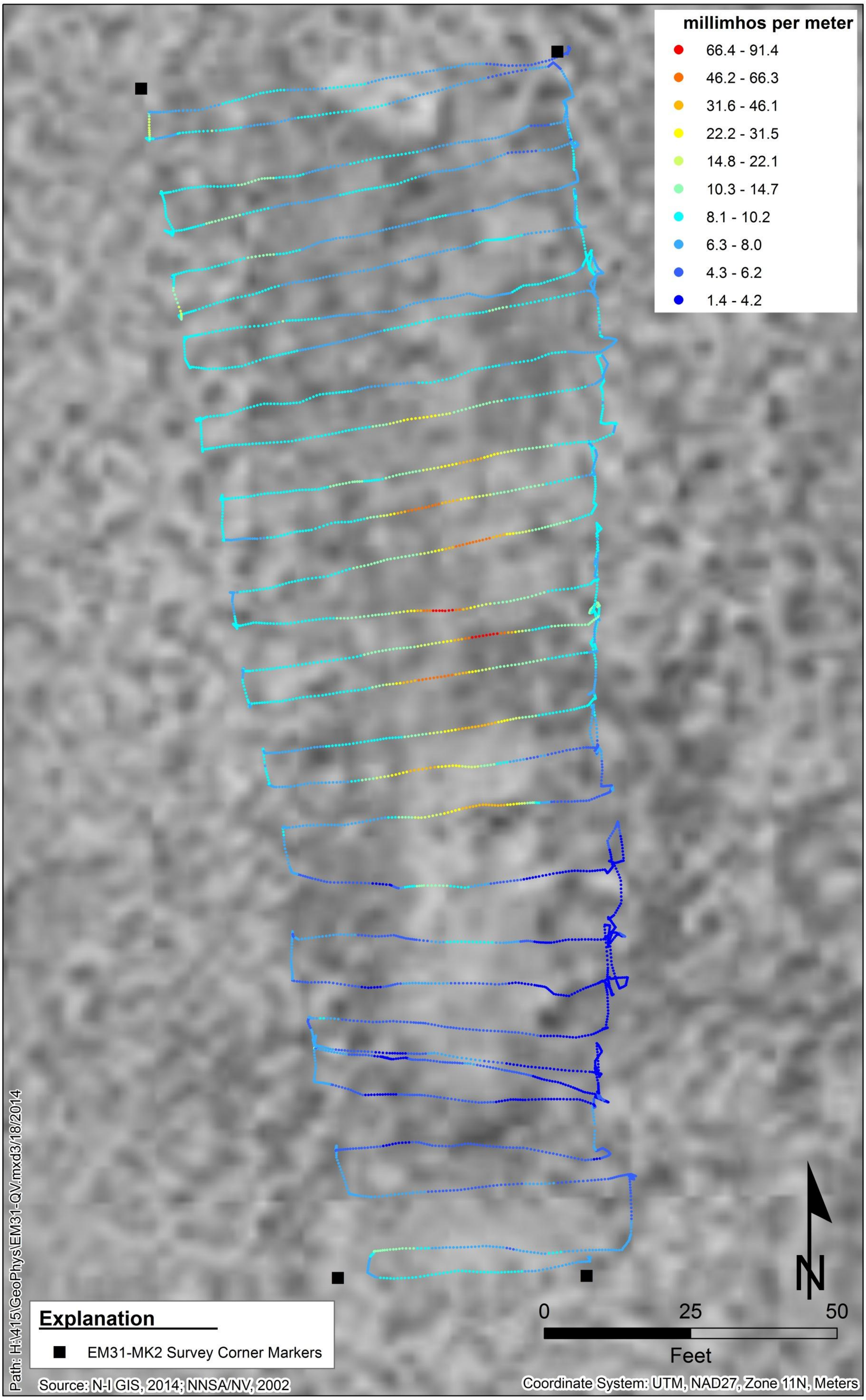
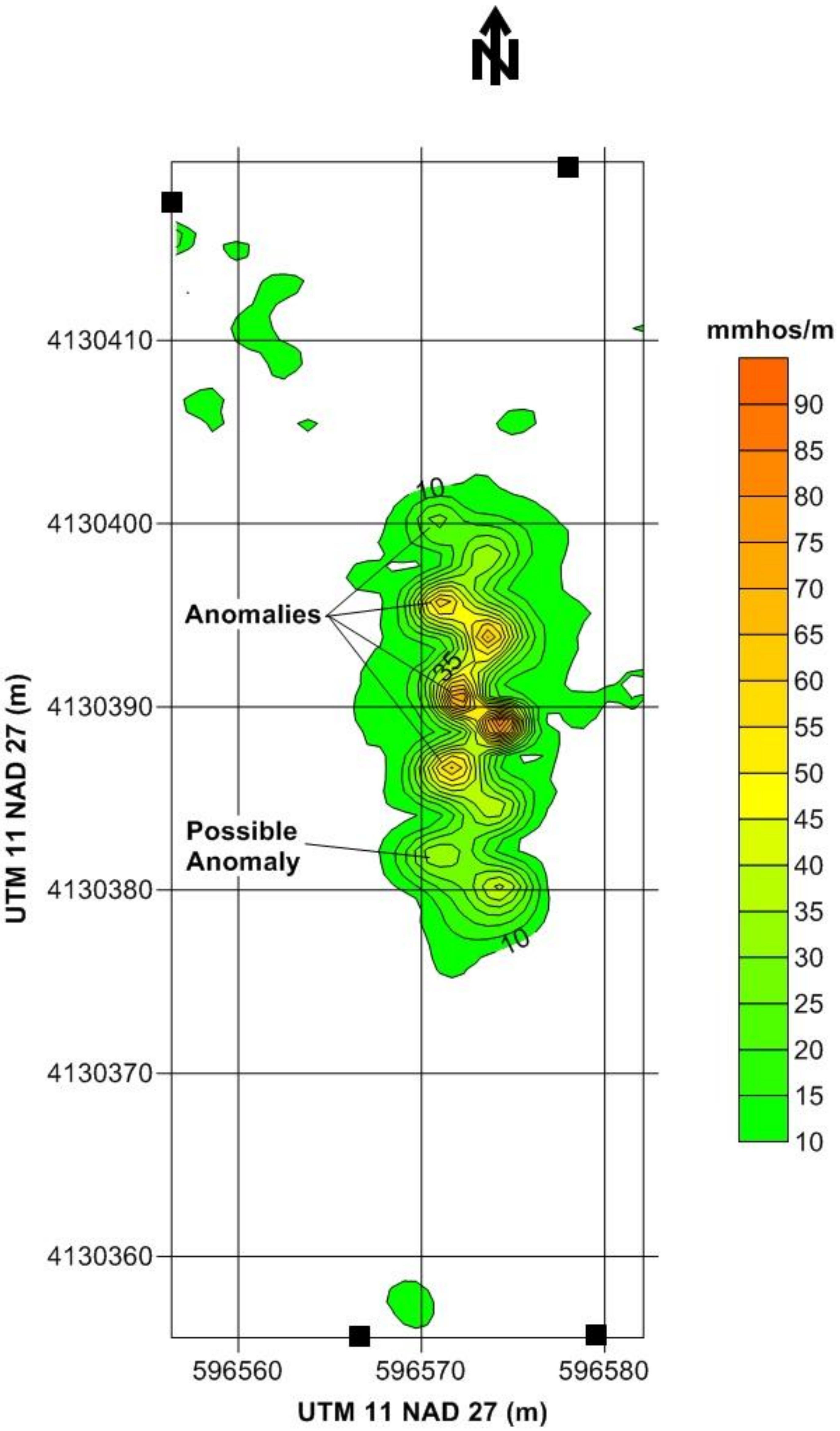


Figure 4 Quadrature-Phase Data from the EM31-MK2 Survey Showing Values Recorded at Individual Data-points



Explanation

■ **Em31-MK2 Survey Corner Markers**

mmhos/m - millimhos/meter

Figure 5 Quadrature-Phase Data from the EM31-MK2 Survey Showing Kriged and Contoured Values

References

esri, 2012. ArcMap Version 10. :
http://www.esri.com/software/arcgis

Geonics, 2012. Website address: http://geonics.com/

Golden Software, 2013. Surfer Version 11. :
http://www.goldensoftware.com/products/surfer/surfer.shtml

MALA Geoscience, 2011. MALA Easy Locator Operating Manual version 2.2 (19-001011), MALA Geoscience USA, Inc. Charleston, SC

Appendix F

Data Assessment

F.1.0 Data Assessment

The DQA process is the scientific evaluation of investigation results to determine whether the DQO criteria established for CAU 415 were met and whether DQO decisions can be resolved at the desired level of confidence. The DQOs were developed by the CAU 415 stakeholders under the assumption that existing data were sufficient to make DQO decisions and the collection of additional samples was not required. Therefore, the investigation results evaluated in this DQA include the soil sample data from 1998 and 2013, and the TLD data from 2013.

The DQO process ensures that the right type, quality, and quantity of data will be available to support the resolution of those decisions at an appropriate level of confidence. Using both the DQO and DQA processes helps to ensure that DQO decisions are sound and defensible. The DQA involves five steps that begin with a review of the DQOs and end with an answer to the DQO decisions. These steps are briefly summarized as follows:

1. *Review DQOs and Sampling Design.* Review the DQO process to provide context for analyzing the data. State the primary statistical hypotheses; confirm the limits on decision errors for committing false-negative (Type I) or false-positive (Type II) decision errors; and review any special features, potential problems, or deviations to the sampling design.

2. *Conduct a Preliminary Data Review.* Perform a preliminary data review by reviewing QA reports and inspecting the data both numerically and graphically, validating and verifying the data to ensure that the measurement systems performed in accordance with the criteria specified, and using the validated dataset to determine whether the quality of the data is satisfactory.

3. *Select the Test.* Select the test based on the population of interest, population parameter, and hypotheses. Identify the key underlying assumptions that could cause a change in one of the DQO decisions.

4. *Verify the Assumptions.* Perform tests of assumptions. If data are missing or are censored, determine the impact on DQO decision error.

5. *Draw Conclusions from the Data.* Perform the calculations required for the test.

F.1.1 Review DQOs and Sampling Design

This section contains a review of the DQO process presented in Appendix B. The DQO decisions are presented with the DQO provisions to limit false-negative or false-positive decision errors.

F.1.1.1 Decision I

The Decision I question is "Does contamination exist at the release site that exceeds FALs?" The FALs for CAU 415 are defined in Section B.6.2.

Decision I Rules

- If the radiological dose or removable contamination levels are inconsistent with the CSM or extend beyond the spatial boundaries identified in the DQOs, then work will be suspended and the closure strategy will be reconsidered.
- For the Pu-contaminated soil and the disposal trench, if the radiological dose exceeds the FAL or HCA conditions exist, then corrective action is required, else no further action.
- For the drainage system, if the radiological dose exceeds the FAL, then corrective action is required, else no further action.
- If debris is present that contain contaminants that, if released, have the potential to cause future soil contamination at levels exceeding a FAL, then a corrective action is required, else no further action.

Population Parameters

For Pu-contaminated soil, the population parameter is the calculated TED from each location or the presence of HCA conditions. For the disposal trench, the population parameter is TED in the subsurface soil in the trench, which is assumed to exceed the FAL. For the drainage system, the population parameter is the calculated TED from each location. For the transformers, the population parameter is oil containing contaminants that, if released, could cause future soil contamination at levels exceeding a FAL.

F.1.1.2 Decision II

The Decision II statement is as follows:

- “Have the CAU 415 closure objectives been met?”

The CAU 415 closure objectives are defined as follows:

- For the Pu-contaminated soil, the closure objective is to determine the corrective action boundary (i.e., the area exceeding 25 mrem/IA-yr and the area exceeding HCA conditions).
- For the disposal trench, the closure objective is to determine the lateral extent of the buried contaminated vehicles and debris, defined as the extent of the anomalies detected in the geophysical survey.
- For the pole-mounted transformers, the closure objective is removal of the transformers.

Decision II Rules

- For the Pu-contaminated soil, drainage system, and transformers, if available information is adequate to determine the extent of radiological dose above the FAL and the extent of HCA conditions, then the corrective action boundary can be established, else further consultation with NDEP and the stakeholders is required.
- For the disposal trench, if the geophysical survey results define the lateral extent of the buried contaminated vehicles and debris, then close in place with URs, else further consultation with NDEP and the stakeholders is required.
- If sufficient information is not available to determine potential remediation waste types and evaluate the feasibility of remediation alternatives, additional waste characterization samples may be collected, else no further investigation will be necessary.

Population Parameters

For Pu-contaminated soil, the population parameters include (1) for radiological dose, the correlation value (i.e., r^2 value) resulting from the relationship of the calculated TED with the radiological survey results and (2) for removable contamination. the area that meets HCA conditions. For the disposal trench, the population parameter is geophysical survey results. For the transformers, the population parameter is the area of soil that exceeds the FAL.

F.1.1.3 DQO Provisions To Limit False-Negative Decision Error

The false-negative decision error would mean deciding that a COC is not present when it actually is (Decision I), or deciding that the extent of a COC has been defined when it has not (Decision II). In both cases, the potential consequence is an increased risk to human health and environment.

The false-negative decision error is controlled by the following criteria:

For Pu-contaminated soil and the drainage system:

1. For Decision I, having a high degree of confidence that the data will identify a COC if present anywhere within the release.
2. Having a high degree of confidence that the analyses conducted were sufficient to detect any COCs present in the samples.
3. Having a high degree of confidence that the dataset is of sufficient quality and completeness.
4. For Decision II, having a high degree of confidence that the data identify the extent of COCs.

For the disposal trench and the pole-mounted transformers, Decision I is resolved because conservative assumptions were made to assume the presence of COCs that exceed the FAL.

1. For Decision II for the disposal trench, having a high degree of confidence that the physical extent of the geophysical anomalies bounds the COC contamination.
2. For Decision II for the pole-mounted transformers, having a high degree of confidence that the extent of the COC contamination in soil was identified.

Criterion 1

To resolve Decision I, existing sample data were evaluated for the following criteria:

- Samples must be collected in areas most likely to contain a COC (judgmental sampling).
- The analytical suite selected must be sufficient to identify any COCs present in the samples.

Existing soil sample data from 1998 and 2013, and TLD data from 2013 were collected from sample locations that were biased using 1997 aerial radiation survey results. The biased sampling design for these investigations is detailed in Section F.1.1.5.

Criterion 2

All soil samples were analyzed for gamma spectroscopy, isotopic Am, isotopic U, and isotopic Pu; the soils samples collected in 2013 were also analyzed for Pu-241. All soil samples were analyzed using the HASL-300 analytical method with modifications (DOE, 1997), or an equivalent method.

Sample results were assessed against the acceptance criterion for the DQI of sensitivity as defined in the Soils QAP (NNSA/NSO, 2012). This criterion is that analytical detection limits are less than their corresponding Industrial Area internal dose RRMGs. All of the analytical result detection limits for every radionuclide were less than their corresponding RRMGs; therefore, the DQI for sensitivity has been met, and the dataset is determined acceptable for the DQI of sensitivity.

Criterion 3

To satisfy this criterion, the entire dataset, as well as individual sample results, were assessed against the acceptance criteria for the DQIs of precision, accuracy, representativeness, comparability, and completeness, as defined in the Soils QAP (NNSA/NSO, 2012).

Precision

The precision rate for all analyzed constituents was 100 percent, which meets the 80 percent acceptance criteria defined in the Soils QAP (NNSA/NSO, 2012). Therefore, the dataset is determined to be acceptable for the DQI of precision.

Accuracy

As shown in Table F.1-1, the Soils QAP criterion of 80 percent accuracy was met for all analyzed constituents (NNSA/NSO, 2012). Thus, the dataset is determined to be acceptable for the DQI of accuracy.

Representativeness

The sample design employed in the 1998 and 2013 investigations resulted in the selection of sample locations that generated data representative of the population parameters that were the most likely locations to contain contamination and bound COCs. The sampling locations identified in the Criterion 1a discussion meet this criterion.

Table F.1-1
Accuracy Measurements

Constituent	Analyses	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
U-235	Uranium	1	31	96.8
Pu-239/240	Plutonium	1	31	96.8
Pu-241	Plutonium	3	20	85

At CAU 415, Pu may be present as a contaminant in soil in the form of small particles. As the soil sample volumes used for the analysis of isotopic Pu are small (e.g., 1 to 2 grams), the presence or absence of a particle of Pu in a particular sample can make a significant difference in the calculated dose results. To ensure that sample results are more representative of the Pu isotope concentrations in the area to which a receptor is exposed, concentrations of Pu isotopes are inferred from Am results from a much larger, and therefore more representative, sample volume (e.g., 1 liter). This practice is justified by the process knowledge that contamination from any given source is expected to have the same Am to Pu isotope ratios as the source material. This ratio is established based on the isotopic Am and isotopic Pu analytical results from the location that contains the maximum concentration of Pu. The gamma spectrometry analysis reports an Am concentration from a 1-liter sample that is then used to infer concentrations of Pu isotopes based on these ratios. This provides Pu concentrations that are more representative of the area.

Based on the methodical selection of sample locations and the use of Am and Pu concentrations that are more representative of the sampled area, the existing analytical data from 1998 and 2013 are considered representative of the population parameters. Therefore, the dataset is determined to be acceptable for the DQI of representativeness.

Comparability

Field sampling conducted in the 1998 and 2013 investigations was performed and documented in accordance with approved procedures that are comparable to standard industry practices. Approved analytical methods and procedures per DOE were used to analyze, report, and validate the data. These are comparable to other methods used not only in industry and government practices, but most importantly are comparable to other investigations conducted for the NNSS. Also, standard, approved field and analytical methods ensured that data were appropriate for comparison to the FALs, as established in this SAFER Plan. Therefore, CAU 415 datasets are considered comparable to other datasets generated using these same standardized DOE procedures, thereby meeting DQO requirements. Therefore, the dataset is determined to be acceptable for the DQI of comparability.

Completeness

The Soils QAP defines acceptable criteria for completeness to be that the dataset is sufficiently complete to be able to make the DQO decisions. This is evaluated as 80 percent of analytes having valid results. As indicated in Table F.1-2, this criteria was met for all CAU 415 data. Rejected data were not used in the resolution of DQO decisions. Two soil samples from the 1998 investigation (PR57-00003 and PR57-00021) had a portion of their analytical results rejected; none of the data from these two samples were used to make DQO decisions for CAU 415. The dataset for CAU 415 has met the general completeness criteria as sufficient information is available to make the DQO decisions.

Table F.1-2
Completeness Criterion

Constituent	Analyses	Number of Measurements Qualified	Number of Measurements Performed	Percent within Criteria
Am-241	Americium	1	31	96.8
	Gamma	1	20	95
Pu-239/240	Plutonium	1	31	96.8
U-235	Uranium	1	31	96.8

Control of the false-negative decision error for the probabilistic samples (i.e. TLDs) was accomplished by ensuring the following:

- A sufficient sample size was collected.
- A false rejection rate of 0.05 was used in calculating the 95 percent UCLs and minimum sample size.

The minimum sample size (n) was calculated for each TLD location using the following EPA sample size formula (EPA, 2006):

$$n = \frac{s^2(z_{.95} + z_{.80})^2}{(\mu - C)^2} + \frac{z^2_{.95}}{2}$$

where

s = standard deviation
$z_{.95}$ = z score associated with the false-negative rate of 5 percent
$z_{.80}$ = z score associated with the false-positive rate of 20 percent
μ = dose level where false-positive decision is not acceptable (12.5 mrem/yr)
C = FAL (25 mrem/yr)

The use of this formula requires the input of basic statistical values associated with the TLD data. Data from a minimum of three samples are required to calculate these statistical values and, as such, the least possible number of samples required to apply the formula is three. Therefore, in instances where the formula resulted in a value less than three, three is adopted as the minimum number of samples required. The results of the minimum sample size calculations and the number of samples collected are presented in Table F.1-3. As shown in the table, the minimum number of TLD samples was met for each TLD sample location. The minimum sample size calculations were conducted based on the following parameters:

- A false rejection rate of 0.05
- A false acceptance rate of 0.20
- The maximum acceptable gray region set to one-half the FAL (12.5 mrem/yr)
- The calculated standard deviation

Criterion 4

The false-negative decision error is controlled by using accepted, established, and approved procedures to calculate TED and determine the corrective action boundary. The methodology employed is detailed in the Soils RBCA document (NNSA/NFO, 2014), which is approved by NDEP.

Table F.1-3
Input Values and Determined Minimum Number of TLD Samples at CAU 415

TLD Location	TLD Serial Number	Standard Deviation	Minimum Sample Size	TLD Samples Collected
E3	1854	0.9	3	3
E2	5033	0.9	3	3
E1	4887	1.7	3	3
NW1	4948	2.2	3	3
NW2	3362	1.3	3	3
GZ[a]	4809	--	--	--

[a]TLD at GZ was not retrieved from CAU 415, so no data are available.

-- = Not applicable.

Criterion 5

To determine confidence in the geophysical survey data used to bound the disposal trench, an evaluation of the survey instrument, the resulting data, and the qualifications of the instrument operator was performed. The EM31-MK2 earth conductivity meter by Geonics Limited sets an industry standard for the detection of buried conductive objects. Daily instrument checks conducted both before and after the geophysical survey showed the instrument to be operating properly. The operator of the equipment received training specific to use of the equipment before undertaking the survey. In addition, the operator was provided written instructions to follow and had the operator's manual in the field. Thus, there is high confidence that the instrument used was able to detect buried metal at the disposal trench; the instrument was operating properly; and the operator was trained in the correct operation of the instrument. Therefore, the data obtained by the geophysical survey are acceptable for use in making DQO decisions for CAU 415.

Criterion 6

To resolve Decision II, a thorough visual inspection was conducted at the base of the transformers identified in 2013. The soil at the base of each pole was inspected for soil staining, discoloration, and distressed vegetation, which would be suggestive of a release of COCs from the transformers.

F.1.1.4 DQO Provisions To Limit False-Positive Decision Error

The false-positive decision error would mean deciding that a COC is present when it is not, or the extent of a COC is unbounded when it is not, resulting in increased costs, overly conservative corrective action boundaries, or implementation of unnecessary administrative or engineering controls. False-positive results could be due to overly conservative estimates for the calculation of TED to determine corrective action boundaries and/or inaccurate inputs.

For Pu-contaminated soil and the drainage system, the false-positive decision error was controlled as follows:

- *Using only validated existing data to determine TED.* The potential for a false-positive analytical result is assessed during the data validation process and appropriate qualifications are applied to the data when applicable. There were no data qualifications that would indicate a potential false-positive analytical result.

- *Using readily accepted, established, and approved procedures to calculate TED and determine the corrective action boundary for CAU 415.* The methodology employed is detailed in the Soils RBCA document, which is approved by the NDEP (NNSA/NFO, 2014).

For the disposal trench and transformers, the false-positive decision error was controlled as follows:

- For the disposal trench, false-positive results would mean that the assumed contamination in the disposal trench is either not present at all or present to a lesser extent than identified with the geophysical survey. To control against false-positive error, a thorough instrument check was performed before and after the geophysical survey. The operator who conducted the survey was trained and qualified to conduct the geophysical survey, and there is high confidence that the instrument used to conduct the survey was capable of detecting buried metallic objects in the trench. A false-positive decision error would have little to no impact to environmental risk.

- For the pole-mounted transformers, false-positive results would mean that the transformers were incorrectly identified as containing a contaminant (i.e., PCBs) exceeding a FAL. Because the transformers are assumed to contain PCB-dielectric fluid and will be removed, there is no additional environmental risk.

F.1.1.5 Sampling Design

The DQOs were developed by the CAU 415 stakeholders under the assumption that existing data were sufficient to make DQO decisions and the collection of additional samples was not required. As a result, the investigation data evaluated in this DQA include the existing soil sample data from 1998 and 2013 and the TLD data from 2013. Both of these investigation events were designed using a biased (judgmental) sampling approach that targeted areas of elevated radiation around GZ. The 1998 sample locations were placed along two vectors centered at GZ with one extending outward to the east and one to the northwest. These vectors coincided with the distribution of radiological contamination as shown in the 1997 aerial radiation survey (Figure 2-2). The 2013 soil sample and TLD locations were placed in a similar orientation (i.e., along two vectors centered on GZ). A total of 11 and 8 grab surface soil samples were collected in the 1998 and 2013 investigations, respectively.

F.1.2 Conduct a Preliminary Data Review

A preliminary data review was conducted by reviewing QA reports and inspecting the data. The contract analytical laboratories generate a QA nonconformance report when data quality does not meet contractual requirements. All data received from the analytical laboratories met contractual requirements, and a QA nonconformance report was not generated. Soil data from 1998 and 2013 were validated and verified to ensure that the measurement systems performed in accordance with the criteria specified in the Soils QAP (NNSA/NSO, 2012). The validated dataset quality was found to be satisfactory.

F.1.3 Select the Test and Identify Key Assumptions

The test for making DQO decisions for radiological contamination was the comparison of the TED to the FAL of 25 mrem/IA-yr and the identification of HCA conditions. The key assumptions that could impact a DQO decision are listed in Table F.1-4.

F.1.4 Verify the Assumptions

Existing data support the key assumptions identified in the CAU 415 DQOs and Table F.1-4. All data support the CSM, and no revisions to the CSM is necessary.

Table F.1-4
Key Assumptions

Exposure Scenario	Industrial Area
Affected Media	Surface, shallow subsurface, and subsurface soil; drainage sediments
Location of Contamination/Release Points	Surface and subsurface soil surrounding and downgradient of GZ and surface and subsurface soil from leaking containers/transformers.
Transport Mechanisms	Percolation of precipitation through subsurface media serves as the major driving force for vertical migration of contaminants. Surface water runoff may provide for the transportation of some contaminants within or outside the footprints of the releases. WInd may cause limited resuspension and transport of windborne contaminants.
Preferential Pathways	Lateral transport is expected to dominate over vertical due to large PET demands and low precipitation amounts. The depth to the uppermost aquifer precludes groundwater as a significant pathway.
Lateral and Vertical Extent of Contamination	Contamination is expected to be contiguous to the release points. Concentrations are expected to decrease with distance and depth from the source. Lateral and vertical extent of contamination exceeding FALs is assumed to be within the spatial boundaries.
Groundwater Impacts	None.
Future Land Use	Military activities.
Other DQO Assumptions	Subsurface soils in the disposal trench are assumed to contain radiological COCs that exceed FAL; the pole-mounted transformers are assumed to contain PCBs that could release COCs to the soil in excess of a FAL

F.1.4.1 Other DQO Commitments

It was assumed during the DQOs that the pole-mounted transformers contain dielectric fluids with PCBs that, if released to the soil, could cause the soil to exceed the FAL. The SAFER committed to removal of the transformers as part of site closure.

F.1.5 Draw Conclusions from the Data

The following subsections resolve the two DQO decisions for CAU 415.

F.1.5.1 Decision Rules for Both Decision I and II

Decision rule. If the radiological dose or removable contamination levels are inconsistent with the CSM or extend beyond the spatial boundaries identified in the DQOs, then work will be suspended and the closure strategy will be reconsidered.

- **Result.** The COC contamination was found to be consistent with the CSM and does not extend beyond the spatial boundaries.

F.1.5.2 Decision Rules for Decision I

Decision rule. For Pu-contaminated soil and the disposal trench, if the radiological dose exceeds the FAL or HCA conditions exist, then corrective action is required, else no further action.

- **Result.** Existing data indicate that the Pu-contaminated surface soil at CAU 415 contains COCs that exceed the radiological FAL and meet HCA conditions; thus, Decision II needs to be resolved. Because COCs were assumed to be present in the subsurface soil in the disposal trench, Decision II needs to be resolved.

Decision rule. For the drainage system, if the radiological dose exceeds the FAL, then corrective action is required, else no further action.

- **Result.** No COCs were identified in the drainage system; thus, no further action is required.

Decision rule. If debris is present that contains contaminants that, if released, have the potential to cause future soil contamination at levels exceeding a FAL, then a corrective action is required, else no further action.

- **Result.** Pole-mounted transformers identified at the site are assumed to contain PCBs with the potential to cause future soil contamination at levels exceeding a FAL. A corrective action of removal was selected for the transformers.

F.1.5.3 Decision Rules for Decision II

Decision rule. For the Pu-contaminated soil, drainage system, and transformers, if available information is adequate to determine the extent of radiological dose above the FAL and the extent of HCA conditions, then the corrective action boundary can be established, else further consultation with NDEP and the stakeholders is required.

- **Result.** The closure objective for the Pu-contaminated surface soil contamination was to determine the corrective action boundary (i.e., the area exceeding 25 mrem/IA-yr and the area exceeding HCA conditions). The correlation of the TED and the radiation survey data resulted in a correlation value (r^2) of 0.88, which meets the 0.8 criteria in the Soils QAP (NNSA/NSO, 2012). This correlation was used to establish the corrective action boundary for radiological dose. Existing information on removable radioactive contamination indicates that HCA conditions exist within the inner fence. The corrective action boundary for removable radioactive contamination was established at the inner fence. A single corrective action boundary that encompasses the radiological dose boundary, the HCA boundary, and the disposal trench extent (see text below), was established at CAU 415. Thus, Decision II is resolved.

- **Result.** For the drainage system, no COCs were identified; thus, Decision II is not applicable.
- **Result.** The closure objective for the pole-mounted transformers was removal of the transformers. Decision II will be considered resolved when the transformers are removed during site closure.

Decision rule. For the disposal trench, if the geophysical survey results define the lateral extent of the buried contaminated vehicles and debris, then close in place with URs, else further consultation with NDEP and the stakeholders is required.

- **Result.** The closure objective for the disposal trench was to determine the lateral extent of the buried contaminated vehicles and debris. This was accomplished through completion of a geophysical survey that identified the lateral extent of the trench; thus, Decision II is resolved.

Decision rule. If sufficient information is not available to determine potential remediation waste types and evaluate the feasibility of remediation alternatives, additional waste characterization samples may be collected, else no further action.

- **Result.** Valid analytical data were obtained to adequately characterize CAU 415 waste and evaluate alternatives. Thus, Decision II is resolved, and no further action is required.

F.2.0 References

DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency.

NNSA/NFO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office.

NNSA/NSO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office.

U.S. Department of Energy. 1997. *The Procedures Manual of the Environmental Measurements Laboratory*, HASL-300. 28th Edition, Vol. 1. February. New York, NY.

U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office. 2014. *Soils Risk-Based Corrective Action Evaluation Process*, Rev. 1, DOE/NV--1475- Rev. 1. Las Vegas, NV.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office. 2012. *Soils Activity Quality Assurance Plan*, Rev. 0, DOE/NV--1478. Las Vegas, NV.

U.S. Environmental Protection Agency. 2006. *Data Quality Assessment: Statistical Methods for Practitioners,* EPA QA/G-9S, EPA/240/B-06/003. Washington, DC: Office of Environmental Information.

Appendix G

Nevada Division of Environmental Protection Comments

(4 Pages)

Nevada Environmental Management Operations Activity
DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 415: Project 57 No. 1 Plutonium Dispersion (NTTR), Nevada	**2. Document Date:**	3/1/2014
3. Revision Number:	0	**4. Originator/Organization:**	Navarro-INTERA
5. Responsible NNSA/NSO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Jeff MacDougall, NDEP, 702-486-2850, ext 233	**9. Reviewer's Signature:**	

10. Comment Number/Locatio	11. Type*	12. Comment	13. Comment Response	14. Accept
1.) Page ES-2, 3rd paragraph, list item 4	Suggested	Providing an example or two of a best management practice would be worthwhile.	The following statement was added to the end of list item # 4 on page ES-2, "(e.g., placement of a soil cover, installation of monuments/landmarks to identify potential hazards at ground zero)".	
2.) Page 3, 2nd paragraph	Mandatory	Identify specific contingencies built into the process in the event that new information is identified...	Page 3, 2nd paragraph of Section 1.2 implies there are multiple contingencies built into the closure decision process for CAU 415, which is misleading. The 2nd paragraph was revised to clarify that the stakeholders will be consulted if closure objectives cannot be met, as follows: Deleted, "Contingencies are built into the ......should be revised. In addition to the decision points, work may be.......unexpected conditions occur:". Replaced with "If the closure objectives defined in Section B.3.1 cannot be met, or if any of the following conditions occur, the stakeholders will be consulted and a revised closure strategy will be developed."	

Nevada Environmental Management Operations Activity
DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 415: Project 57 No. 1 Plutonium Dispersion (NTTR), Nevada	**2. Document Date:**	3/1/2014
3. Revision Number:	0	**4. Originator/Organization:**	Navarro-INTERA
5. Responsible NNSA/NSO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Jeff MacDougall, NDEP, 702-486-2850, ext 233	**9. Reviewer's Signature:**	

10. Comment Number/Locatio	11. Type*	12. Comment	13. Comment Response	14. Accept
3.) Page 26, section 3.2.2	Suggested	Sentence fragments...consider using complete sentences for the bullet points discussing the baseline and alternative conditions.	The bullets on page 26, section 3.2.2 have been revised as follows: • **Baseline condition**. The closure objectives (defined in Section 3.1.2) have not been met. • **Alternative condition**. The closure objectives (defined in Section 3.1.2) have been met.	

Nevada Environmental Management Operations Activity
DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 415: Project 57 No. 1 Plutonium Dispersion (NTTR), Nevada	**2. Document Date:**	3/1/2014
3. Revision Number:	0	**4. Originator/Organization:**	Navarro-INTERA
5. Responsible NNSA/NSO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Jeff MacDougall, NDEP, 702-486-2850, ext 233	**9. Reviewer's Signature:**	

10. Comment Number/Locatio	11. Type*	12. Comment	13. Comment Response	14. Accept
4.) Page 32, 1st and 2nd paragraphs	Suggested	There are redundancies contained in the latter portion of the first paragraph and the beginning of the second paragraph. Consider re-writing to consolidate ideas and discussion.	In order to eliminate redundancies associated with the 1st and 2nd paragraphs in Section 4.3.1, the following revisions were completed: 1. Deleted the last 5 sentences of the 1st paragraph, beginning with "This figure also presents..."; and ending with "...the FAL of 25 mrem/IA-yr and requires corrective action." 2. Replaced the 2nd paragraph with the following: "The relationship between TED and FIDLER results is estimated from a simple linear regression of paired calculated TED and radiation survey values for each sample location. These numbered pairs are statistically compared with one another, which results in a solution that represents the average relationship of FIDLER values to TED values. If the strength of this relationship yields a correlation factor (i.e., r^2value) of 0.8 or greater, the relationship is considered statistically significant and the data may be used with confidence to make DQO decisions. The 25-mrem/IA-yr boundary for CAU 415 was estimated using TED and FIDLER data with an r^2 value of 0.88 (Figure 4-1), indicating the relationship between the TED and FIDLER data is strong. It is therefore concluded that the area within the boundary exceeds the FAL of 25 mrem/IA-yr and requires corrective action. Additional detail on estimating dose and establishing correlations is found in the Soils RBCA document (NNSA/NFO, 2014) and Appendix D."	

Nevada Environmental Management Operations Activity
DOCUMENT REVIEW SHEET

1. Document Title/Number:	Draft Streamlined Approach for Environmental Restoration (SAFER) Plan for Corrective Action Unit 415: Project 57 No. 1 Plutonium Dispersion (NTTR), Nevada	**2. Document Date:**	3/1/2014
3. Revision Number:	0	**4. Originator/Organization:**	Navarro-INTERA
5. Responsible NNSA/NSO Activity Lead:	Tiffany A. Lantow	**6. Date Comments Due:**	
7. Review Criteria:	Full		
8. Reviewer/Organization/Phone No:	Jeff MacDougall, NDEP, 702-486-2850, ext 233	**9. Reviewer's Signature:**	

10. Comment Number/Locatio	11. Type*	12. Comment	13. Comment Response	14. Accept
5.) Page 37, 3rd paragraph	Suggested	Bullet points read awkwardly...consider re-writing, such as "All equipment, debris, and materials associated with the CAI will be removed."	Revised the bullet items on page 37, at the end of Section 4.4 as follows: • All equipment, debris, and materials associated with the CAI will be removed. • A site inspection will be performed to verify that all restoration activities have been completed.	

Library Distribution List

	Copies
U.S. Department of Energy Office of Scientific and Technical Information P.O. Box 62 Oak Ridge, TN 37831-0062	1 (Uncontrolled, electronic copy)
Southern Nevada Public Reading Facility c/o Nuclear Testing Archive P.O. Box 98521, M/S 400 Las Vegas, NV 89193-8521	2 (Uncontrolled, electronic copies)
Manager, Northern Nevada FFACO Public Reading Facility c/o Nevada State Library & Archives 100 N. Stewart Street Carson City, NV 89701-4285	1 (Uncontrolled, electronic copy)