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INTERIM MEASURE / INTERIM REMEDIAL ACTION FOR IHSS GROUP 900-11 (903 LIP AREA AND VICINITY, THE WINDBLOWN AREA, AND SURFACE SOIL IN OPERABLE UNIT 1 [881 HILLSIDE])

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

April 26, 2004

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ACRONYMS AND ABBREVIATIONS

AL	Action Level
ALARA	As Low As Reasonably Achievable
Am	Americium
APEN	Air Pollutant Emission Notice
AR	Administrative Record
ARAR	Applicable or Relevant and Appropriate Requirements
BMP	Best Management Practice
CAD/ROD	Corrective Action Decision/Record of Decision
CAQCC	Colorado Air Quality Control Commission
CCR	Colorado Code of Regulations
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, & Liability Act
CFR	Code of Federal Regulations
CID	Cumulative Impacts Document
COC	Contaminant of Concern
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
EDE	Effective Dose Equivalent
EPA	U. S. Environmental Protection Agency
ER	Environmental Restoration
HAP	Hazardous Air Pollutant
HASP	Health and Safety Plan
HRR	Historical Release Report
IA	Industrial Area
IGD	Implementation Guidance Document
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
ISMS	Integrated Safety Management System
IWCP	Integrated Work Control Program
JHA	Job Hazard Analysis
K-H	Kaiser-Hill Company, L.L.C.
LLMW	Low-Level Mixed Waste
LLW	Low-Level Waste
mg/kg	milligrams per kilogram
MOU	memorandum of understanding
mph	miles per hour
mrem	millirem
m/s	meters per second
mSv	milliSievert
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NFAA	No Further Accelerated Action
OSHA	Occupational Safety and Health Administration

OU	Operable Unit
PAC	Potential Area of Concern
pCi	picoCurie
pCi/g	picoCuries per gram
pCi/L	picoCuries per liter
PCOC	Potential Contaminant of Concern
PM	particulate matter
PMJM	Preble's Meadow Jumping Mouse
POC	Point of Compliance
POE	Point of Evaluation
Pu	Plutonium
RAAMP	Radioactive Ambient Air Monitoring Program
RADMS	Remedial Action Decision Management System
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RSAL	Radionuclide Soil Action Level
RSOP	RFCA Standard Operating Protocol
RWP	Radiological Work Permit
SID	South Interceptor Ditch
Site	Rocky Flats Environmental Technology Site
SOR	Sum-of-Ratios
SWD	Soil Water Database
TSP	total suspended particulates
U	Uranium
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOC	volatile organic compound
WRW	Wildlife Refuge Worker

EXECUTIVE SUMMARY

This Interim Measure/Interim Remedial Action (IM/IRA) decision document addresses the Comprehensive Environmental Response and Liability Act (CERCLA) remediation of soil at Individual Hazardous Substance Site (IHSS) Group 900-11 and surface soil in Operable Unit 1 (OU1). Both of these areas are located near the southeast corner of the Industrial Area at the Rocky Flats Environmental Technology Site (RFETS). The OU1 surface soils are addressed in this document because the OU1 Corrective Action Decision/Record of Decision (CAD/ROD) stipulates that surface soil within OU1 will be evaluated in the decision document that addresses the 903 Pad Lip Area (IHSS 155). The 903 Pad Outer Lip Area is the primary subject of the accelerated action proposed in this IM/IRA. In addition, this IM/IRA presents previous and planned actions at other IHSSs and Potential Areas of Concern (PACs) within and in the immediate vicinity of the 903 Pad Lip Area and OU1.

Soil data in the area of concern addressed by this IM/IRA was compared with Soil Action Levels (ALs), as specified in Attachment 5 of the Rocky Flats Cleanup Agreement (RFCA), for radiological, organic and inorganic constituents. The analysis indicates that approximately 23 acres contain radionuclides in soil, from 0 to 0.5 feet deep, that exceed their respective Radionuclide Soil Action Levels (RSALs). This area, located largely within the 903 Pad Lip Area boundary, requires a soil removal action in accordance with the RFCA. Plutonium-239/240 (Pu) is the radionuclide that exceeds its RSAL in the greatest number of sample locations, and thereby dictates that the accelerated action be performed. The RSAL for Pu-239/240 is 50 picoCuries per gram (pCi/g) for soil from 0 to 3 feet deep.

In soil less than 0.5 feet in depth, data indicate multiple locations where the radionuclide Sum-of-Ratios (SOR) exceeds the AL of 1. However, these samples locations are all in the 903 Pad Lip Area that is being addressed for the Pu RSALs, except for one location. The lone exception is a sample location in IHSS 119.1 (in OU1) that has a SOR above 1 and requires removal. For organic or inorganic constituents in the 0 to 0.5 foot depth interval, there are no exceedances of soil ALs in the area of concern.

Sub-surface soil risk screens were applied to several sample results in the area of concern. Six Pu sample locations and three americium (Am) locations were subjected to such a screen. Pu and Am results are subjected to a sub-surface soil risk screen if the sample is collected from more than 3 feet in depth and the result is above the respective RSAL. None of the Pu or Am sub-surface soil risk screen locations require further action. However, it is recognized that these locations, which are within the area defined to have surface soil removed, could potentially require further excavation if confirmation sampling, following the removal of surface soil, indicates removal of the underlying soil is necessary. The other radionuclide with a sample requiring a sub-surface soil risk screen is uranium-235; the screening result for this sample, collected south of the 903 Pad, also indicates no further action is necessary.

For non-radionuclides, sub-surface soil risk screens are conducted if the analyte is below 0.5 feet in depth and is above the respective soil AL. Analysis of metals and organics data indicates one sample location exceedance for chromium and two sample location exceedances for benzo(a)pryrene. Subsurface soil risk screen results for these samples indicate no accelerated action is required at these locations.

Surface water data at RFCA Point-of-Compliance monitoring locations GS31 (below Pond C-2) and GS01 (at Woman Creek and Indiana Street) indicate the water quality has been in compliance with the 0.15 pCi/L RFCA standard for Pu and Am since RFCA sampling was initiated on October 1, 1996. For perspective, the median Pu concentration at GS01 during RFCA monitoring has been approximately 0.002 pCi/L (nearly two orders of magnitude below the RFCA standard). Similarly, air-monitoring data at the RFETS boundary and around the 903 Pad Area also indicates the air quality is well below the respective regulatory compliance levels. Therefore, accelerated action is not required for surface water or air quality compliance.

While RFCA specifies that soil be removed in locations where the RSALs are exceeded, the RFCA Implementation Guidance Document (IGD) also specifies that an IM/IRA include a No Action alternative in the analysis. Therefore, a No Action alternative is included in this IM/IRA and is compared with a soil removal alternative. The soil removal alternative is the option selected for the proposed accelerated action.

The proposed accelerated action consists of excavating and disposing of soil as necessary to comply with the RSALs. The areal extent of the main region to be excavated is determined by a geostatistical analysis technique called kriging. The kriging analysis bounds an area that, if completely excavated, provides a 90 percent degree of confidence that all of the soil above the 50 pCi/g RSAL has been removed. Confirmation sampling will be performed in excavated areas to verify that the soil has been remediated to an activity level below the RSAL.

The initial depth of the excavation, based on sample data, will typically involve approximately the top 6 inches of soil, but will involve less depth in areas where the contamination exceeding the RSAL is confined to shallower depths. Excavation will typically be performed using conventional heavy excavation equipment, though other soil removal techniques, such as vacuum technology, may be used if determined to be appropriate. The excavated soil will be loaded into soil waste containers for disposal at an off-site, licensed low-level radiological soil disposal facility. Engineering controls will be used during the remediation to control soil erosion and its associated impacts to air and surface water quality. Installation of erosion control measures, such as erosion blankets and straw wattles, will be placed after excavation of an area has been completed, generally on a daily basis. Revegetation of the entire disturbed area will also be performed.

Other areas identified for accelerated action in this IM/IRA include IHSS 140 (Hazardous Disposal Area) and PAC-SE-1602 (East Firing Range). These areas, with metals contamination unrelated to the 903 Pad, are the subject of accelerated actions recently agreed upon with the regulatory agencies. IHSS 140, located southeast of the 903 Pad in the Inner Lip area, will be subject to an accelerated action for removing metals in soil that will be conducted concurrently with the removal action for radionuclides in surface soil. The objective of the IHSS 140 action is to locate and remove soil contamination in pits where reactive metal processing was conducted in the 1950s and 1960s. At PAC-SE-1602, the accelerated action involves removing the asphalt, berms, and other fixtures located in the north firing range portion of PAC-SE-1602.

1.0 INTRODUCTION

This Interim Measure/Interim Remedial Action (IM/IRA) Decision Document presents an evaluation of environmental contaminants, remediation alternatives and proposed accelerated actions for four areas at the Rocky Flats Environmental Technology Site (RFETS). These areas, shown in (Figure 1-1), are:

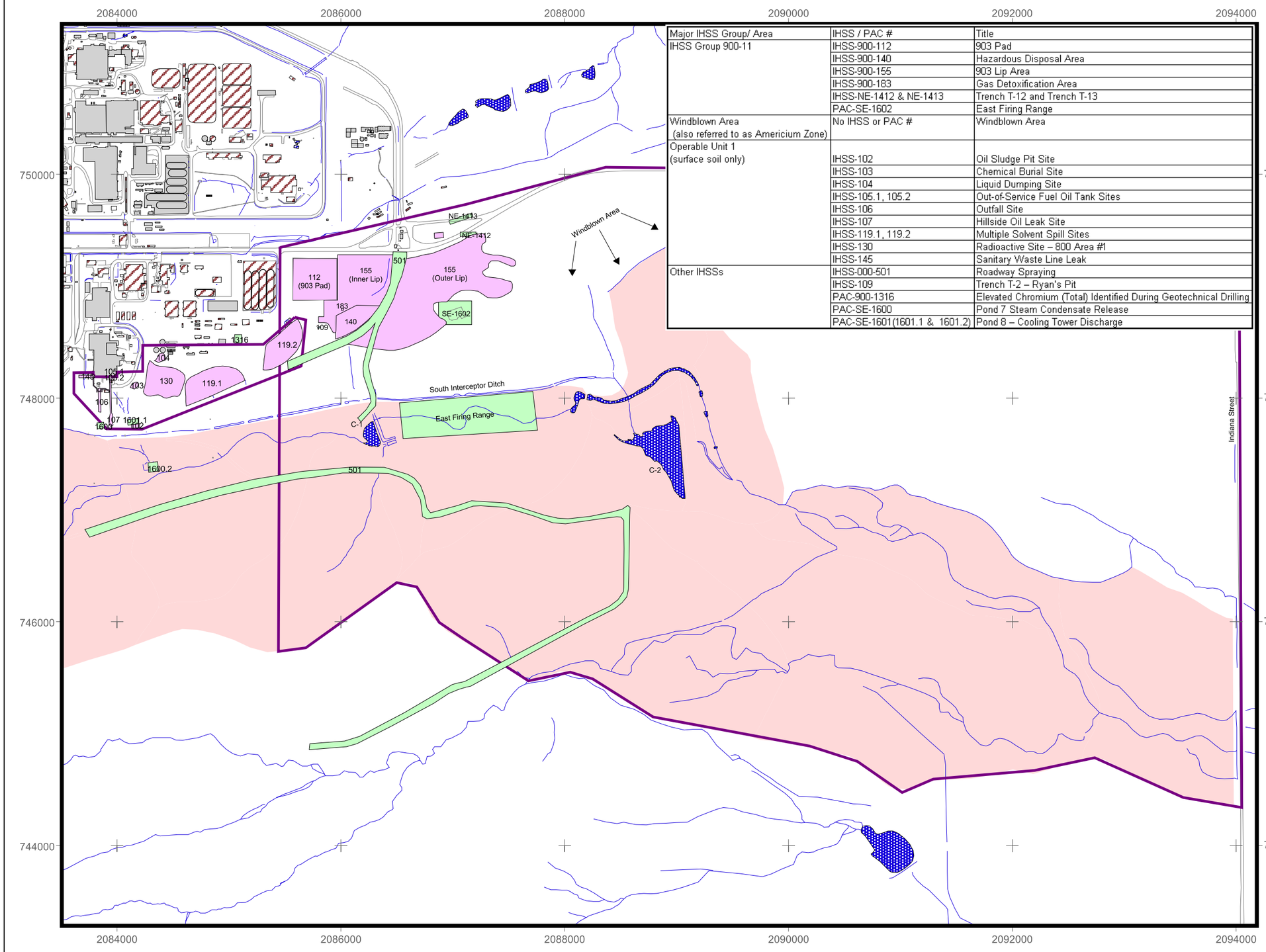
1) Individual Hazardous Substance Site (IHSS) Group 900-11 (903 Lip Area and vicinity);
2) The Windblown Area east of IHSS Group 900-11, also referred to as the Americium Zone;
3) Operable Unit 1 (OU1) (881 hillside area), surface soil only; and
4) Other IHSSs located in the vicinity of OU1.

RFETS is a DOE facility located in northern Jefferson County, Colorado, located approximately 16 miles northwest of Denver, that was formerly used to process and manufacture nuclear weapons components. Currently, the Site is undergoing closure, environmental remediation, and conversion into a National Wildlife Refuge. It is approximately 6,550 acres in size. The developed Industrial Area (IA) is centrally located within RFETS and occupies approximately 400 acres. The Rocky Flats Buffer Zone surrounds the IA and occupies the remaining 6,150 acres.

Accelerated actions are approved by the U.S. Department of Energy (DOE), Colorado Department of Public Health and Environment (CDPHE), and the U.S. Environmental Protection Agency (EPA) under the Rocky Flats Cleanup Agreement (RFCA) (DOE et al., 1996). RFCA is both a cleanup agreement under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and a compliance order on consent under the Resource Conservation and Recovery Act (RCRA) and the Colorado Hazardous Waste Act.

IHSS Group 900-11 is located within the Rocky Flats Buffer Zone southeast of the IA. The Windblown Area is located to the east of IHSS Group 900-11, and OU1 is located on the 881 hillside west of and adjacent to IHSS Group 900-11 (Figure 1-1).

Figure 1-1.
900-11 Area IM/IRA Base Map



Major IHSS Group/ Area	IHSS / PAC #	Title
IHSS Group 900-11	IHSS-900-112	903 Pad
	IHSS-900-140	Hazardous Disposal Area
	IHSS-900-155	903 Lip Area
	IHSS-900-183	Gas Detoxification Area
	IHSS-NE-1412 & NE-1413	Trench T-12 and Trench T-13
	PAC-SE-1602	East Firing Range
Windblown Area (also referred to as Americium Zone)	No IHSS or PAC #	Windblown Area
Operable Unit 1 (surface soil only)	IHSS-102	Oil Sludge Pit Site
	IHSS-103	Chemical Burial Site
	IHSS-104	Liquid Dumping Site
	IHSS-105.1, 105.2	Out-of-Service Fuel Oil Tank Sites
	IHSS-106	Outfall Site
	IHSS-107	Hillside Oil Leak Site
	IHSS-119.1, 119.2	Multiple Solvent Spill Sites
	IHSS-130	Radioactive Site – 800 Area #1
	IHSS-145	Sanitary Waste Line Leak
Other IHSSs	IHSS-000-501	Roadway Spraying
	IHSS-109	Trench T-2 – Ryan's Pit
	PAC-900-1316	Elevated Chromium (Total) Identified During Geotechnical Drilling
	PAC-SE-1600	Pond 7 Steam Condensate Release
	PAC-SE-1601(1601.1 & 1601.2)	Pond 8 – Cooling Tower Discharge

KEY

- IHSS
- Area of Concern
- Paved roads
- Streams
- Lakes
- PAC
- Woman Creek Watershed
- Demolished Building
- Standing Building

N
W E
S

500 0 500 Feet

Scale = 1: 10750

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

Date: 3.23.04

RADMS

Prepared for:

KAISER•HILL COMPANY

File: W:\Projects\Fy2004\900-11_IMIRA\120403\900-11_120403.apr

1.1 SCOPE OF AREAS AND ENVIRONMENTAL MEDIA ADDRESSED

1.1.1 Major Areas, IHSSs, and PACs

Multiple IHSSs and/or Potential Areas of Concern (PACs) make up the area addressed by this decision document. In addition, the Windblown Area is evaluated in this document, despite not being designated as an IHSS, because it contains levels of radionculides in surface soil that are of potential concern to surface water quality. A summary list of the IHSSs and PACs, and their major groupings, is provided in Table 1-1.

Table 1-1. Summary List of Areas, IHSSs, and PACs Addressed in this IM/IRA

Major IHSS Group/ Area	IHSS / PAC #	Title
IHSS Group 900-11	IHSS-900-112	903 Pad (only non-rads in sub-surface analyzed in this IM/IRA)
	IHSS-900-140	Hazardous Disposal Area
	IHSS-900-155	903 Lip Area (Inner and Outer Lip)
	IHSS-900-183	Gas Detoxification Area
	IHSS-NE-1412 & NE-1413	Trench T-12 and Trench T-13
	PAC-SE-1602	East Firing Range
Windblown Area	No IHSS or PAC #	Windblown Area (also referred to as Americium Zone)
Operable Unit 1 (surface soil only)	IHSS-102	Oil Sludge Pit Site
	IHSS-103	Chemical Burial Site
	IHSS-104	Liquid Dumping Site
	IHSS-105.1, 105.2	Out-of-Service Fuel Oil Tank Sites
	IHSS-106	Outfall Site
	IHSS-107	Hillside Oil Leak Site
	IHSS-119.1, 119.2	Multiple Solvent Spill Sites
	IHSS-130	Radioactive Site – 800 Area #1
	IHSS-145	Sanitary Waste Line Leak
Other IHSSs	IHSS-000-501	Roadway Spraying
	IHSS-109	Trench T-2 – Ryan's Pit
	IHSS-900-1316	Elevated Chromium (Total) Identified During Geotechnical Drilling
	PAC-SE-1600	Pond 7 Steam Condensate Releases
	PAC-SE-1601 (1601.1 & 1601.2)	Pond 8 Cooling Tower Dischg. Release

For each of the IHSSs, PACs, and areas listed in Table 1-1, further detail is provided in Section 2.1. Descriptions are provided for each area's history, contaminants or potential contaminants, prior response actions (if any), and the potential need for an accelerated action. All of the IHSSs and PACs listed in Table 1-1 are evaluated to determine if an accelerated action is warranted. Measured environmental data for specific contaminants are compared with their respective RFCA Action Levels. This data evaluation is presented in Section 2.3.

Additional information is presented in Sections 1.1.2 and 1.1.3 about specific environmental media that are addressed, or are not addressed, in this IM/IRA.

1.1.2 Operable Unit 1 - Surface Soil Only

The OU1 Corrective Action Decision/Record of Decision (CAD/ROD) (K-H, 1997a) states that surface soils at OU1 may have been contaminated with windblown low-level radionuclides from the 903 Pad. Therefore, any remaining surface soil contamination in OU1 will be addressed jointly with surface soil contamination at the 903 Pad area (K-H, 1997a). Because this IM/IRA addresses the 903 Pad and Lip Area, it will also address OU1 surface soil in accordance with the CAD/ROD.

1.1.3 Groundwater - Addressed in Groundwater IM/IRA

Contamination of groundwater and potential accelerated actions for groundwater are not addressed in this document. Groundwater contamination and remediation issues will be addressed in the Groundwater IM/IRA document, scheduled to be completed later.

1.2 PROPOSED ACCELERATED ACTION OBJECTIVE AND REGULATORY FRAMEWORK

The primary Remedial Action Objective (RAO) addressed by this document is to remediate soil, as necessary, to comply with applicable RFCA Soil Action Levels. An additional RAO is to maintain compliance with surface water and air quality after the action has been completed (see Section 3.0 for further discussion on RAOs). As noted previously, this IM/IRA addresses soil, surface water, and air, but does not address groundwater, which will be subsequently addressed by the Groundwater IM/IRA.

This IM/IRA document was prepared in accordance with guidelines outlined in Appendix B of the RFCA Implementation Guidance Document (IGD)(DOE, 1999). Other regulatory decision documents also exist that pertain to IHSS Group 900-11, the Windblown Area, and OU1 surface soil. These documents and their relationships are diagrammed in Table 1-2.

Table 1-2. IHSSs, PACs, and Related Regulatory Decision Documents

IHSS/PAC #	Area of IHSS	Media/ contaminant	Relevant Document (Shaded block indicates this IM/IRA)	Status
IHSS Group 900-11				
IHSS 900-112 (903 Pad)	Entire pad	Soil (Rads)	ER-RSOP Routine Soil Removal Notification (K-H, 2003h)	Approved by regulatory agencies (9/17/03)
			Close-Out Report	In preparation (January 2004)
		Soil (non-rads)	900-11 IM/IRA	In public review
			Close-Out Report	To be prepared
		Groundwater (all contam.)	Groundwater IM/IRA	To be prepared
			Close-Out Report	To be prepared
IHSS 900-140 (Hazardous Disposal Area)	Entire area	Soil (Rads)	900-11 IM/IRA	In public review
			Close-Out Report	To be prepared
		All media (Non-rads)	Historical Release Report (1998) – proposed for NFAA (K-H, 1998)	NFAA not approved
IHSS 155 (903 Lip Area)	Inner Lip Area	Soil (Rads)	ER-RSOP Routine Soil Removal Notification (K-H, 2003h)	Approved by regulatory agencies (9/17/03)
			Close-Out Report	To be prepared
		Soil (non-rads)	900-11 IM/IRA	In public review
			Close-Out Report	To be prepared
		Groundwater (all contam.)	Groundwater IM/IRA	To be prepared
			Close-Out Report	To be prepared

Table 1-2 (continued)

IHSS/PAC #	Area of IHSS	Media/ contaminant	Relevant Document (Shaded block indicates this IM/IRA)	Status
IHSS Group 900-11 (continued)				
IHSS 155 (903 Lip Area) (continued)	Outer Lip Area	Soil (all contam.)	900-11 IM/IRA	In public review
			Close-Out Report	To be prepared
		Groundwater (all contam.)	Groundwater IM/IRA	To be prepared
			Close-Out Report	To be prepared
IHSS 900-183 (Gas Detox. Area)	Entire area	Soil (Rads)	900-11 IM/IRA	In public review
			Close-Out Report	To be prepared
		All media (Non-rads)	Historical Release Report (K-H, 2001a) – proposed for NFAA	NFAA approved 2001
PAC SE-1602 (East Firing Range)	Entire area	Soil (Rads)	900-11 IM/IRA	In public review
			Close-Out Report	To be prepared
		All media (Non-rads)	Decision document to be determined; Sampling and Analysis Plan being prepared as of December 2003.	To be prepared
PAC NE 1412 and 1413 (Trenches T-12 and T-13)	Entire area	Surface soil (Pu in 2 locations)	900-11 IM/IRA	In public review
			Close-Out Report	To be prepared
		All media (Non-rads)	Data Summary Report – IHSS Group NE/NW, Sept. 2003 (Kaiser-Hill [K-H], 2003a)	NFAA approved October 7, 2003 (EPA, 2003)

Table 1-2 (continued)

IHSS/PAC #	Area of IHSS	Media/ contaminant	Relevant Document (Shaded block indicates this IM/IRA)	Status
Windblown Area				
Windblown Area (also referred to as Americium Zone) (No IHSS #)	Area south of the East Access Road, east to the RFETS boundary	Surface soil (all contam.)	900-11 IM/IRA	In Public Review
			Close-Out Report	To be prepared
		Groundwater (all contam.)	Groundwater IM/IRA	To be prepared
			Close-Out Report	To be prepared
OU1				
IHSS 102	Entire area	Surface Soil (all contam.)	900-11 IM/IRA	In Public Review
			Close-Out Report	To be prepared
		Other media (all contam.)	OU1 CAD/ROD	Approved (K-H, 1997a)
IHSS 103	Entire area	Surface Soil (all contam.)	900-11 IM/IRA	In Public Review
			Close-Out Report	To be prepared
		Other media (all contam.)	OU1 CAD/ROD	Approved (K-H, 1997a)
IHSS 104	Entire area	Surface Soil (all contam.)	900-11 IM/IRA	In Public Review
			Close-Out Report	To be prepared
		Other media (all contam.)	OU1 CAD/ROD	Approved (K-H, 1997a)
IHSS 105.1, 105.2	Entire area	Surface Soil (all contam.)	900-11 IM/IRA	In Public Review
			Close-Out Report	To be prepared
		Other media (all contam.)	OU1 CAD/ROD	Approved (K-H, 1997a)
IHSS 106	Entire area	Surface Soil (all contam.)	900-11 IM/IRA	In Public Review
			Close-Out Report	To be prepared
		Other media (all contam.)	OU1 CAD/ROD	Approved (K-H, 1997a)

Table 1-2 (continued)

IHSS/PAC #	Area of IHSS	Media/ contaminant	Relevant Document (Shaded block indicates this IM/IRA)	Status
OU1 (continued)				
IHSS 107	Entire area	Surface Soil (all contam.)	900-11 IM/IRA	In Public Review
			Close-Out Report	To be prepared
		Other media (all contam.)	OU1 CAD/ROD	Approved (K-H, 1997a)
IHSS 119.1, 119.2	Entire area	Surface Soil (all contam.)	900-11 IM/IRA	In Public Review
			Close-Out Report	To be prepared
		Other media (all contam.)	OU1 CAD/ROD	Approved (K-H, 1997a)
IHSS 103	Entire area	Surface Soil (all contam.)	900-11 IM/IRA	In Public Review
			Close-Out Report	To be prepared
		Other media (all contam.)	OU1 CAD/ROD	Approved (K-H, 1997a)
IHSS 145	Entire area	Surface Soil (all contam.)	900-11 IM/IRA	In Public Review
			Close-Out Report	To be prepared
		Other media (all contam.)	OU1 CAD/ROD	Approved (K-H, 1997a)
Other IHSSs				
IHSS-000-501	Entire area	All media (all contam.)	EPA Correspondence documenting NFAA (EPA, 1992)	Approved (EPA, 1992)
IHSS-109	Entire area	All media (all contam.)	EPA, CDPHE Correspondence documenting NFAA (EPA and CDPHE, 2002a)	Approved (EPA and CDPHE, 2002a)
IHSS-900-1316	Entire area	All media (all contam.)	EPA, CDPHE Correspondence documenting NFAA (EPA and CDPHE, 2002a)	Approved (EPA and CDPHE, 2002a)
PAC-SE-1600	Entire area	All media (all contam.)	EPA Correspondence documenting NFAA (EPA, 1992)	Approved (EPA, 1992)
PAC-SE-1601 (1601.1 & 1601.2)	Entire area	All media (all contam.)	EPA Correspondence documenting NFAA (EPA, 1992)	Approved (EPA, 1992)

2.0 SITE DESCRIPTION

2.1 BACKGROUND

Table 2-1 provides a summary description of each of the IHSSs, PACS, and other areas that comprise IHSS Group 900-11, OU1, and the Windblown Area. For each area, the following information is presented:

- A summary of the historic incident or practices that caused the area to be designated as an IHSS or PAC;
- A description of the area's status in terms of its designation as a No Further Accelerated Action (NFAA) location. The NFAA designation for a specific IHSS may apply to non-radionuclides only; therefore, radionuclide contaminants in the surface soil, within an approved NFAA IHSS, may still require remediation;
- A description of prior remediation response actions performed in the area;
- A listing of contaminants, or potential contaminants, that remain in the area, after any prior response actions were completed; and
- An indication of the need for an accelerated action for the area, and if so, why the accelerated action is required. The need for an accelerated action is based on a comparison of environmental data with the corresponding Action Level, as presented in Section 2.3.

Table 2-1. Summary of IHSSs and PACs in IM/IRA Area of Concern

Major Group/ Area	IHSS / PAC #	Title	Summary Description	Prior Response Actions	Remaining Contaminants of Concern (COCs) or Potential COCs (PCOCs)	Accelerated Action Required? (see Sect. 2.3)
IHSS Group 900-11	IHSS-900-112	903 Pad	History and Description: In July 1958, a drum storage area was formed in the southeast corner of the IA at the location where the 903 Pad (IHSS 112) would later be constructed. Drums stored in this area contained hydraulic fluids and lathe coolant contaminated with radionuclides, including Pu and U. Also stored in the drums were vacuum pump oils, trichloroethene (TCE), tetrachloroethane (PCE), silicone oils, and acetone still bottoms (DOE, 1995a). A total of 5,237 steel drums were stored in the area, of which approximately 420 leaked to some degree (ChemRisk, 1992 and DOE, 1995a). In 1964, it was detected that drums were leaking in the field and contaminating the soil beneath. Contamination was detected in the air samplers at the fence east of the Pad following high winds, thereby indicating contamination was spreading from the drum storage area to the area later designated as the Lip Area (IHSS 155) (ChemRisk, 1992). NFAA Status: Closeout Report for 903 Pad will include information for Historical Release Report update that will be NFAA.	903 Pad response action highlights - (January 1966) - Small building added to filter and transfer contaminated oil from leaking drums to new drums - (January 1967) Last drums added to storage. Removal to Building 774 begun. - (June 1968) Last drum shipped to Building 774 for processing. High winds spread some contamination (potential Lip Area impact) - (November 1968 – Sept 1969) Grading and construction of asphalt cover - (November 2002 through December 2003) Removal of asphalt pad, base material, and soil per ER-RSOP (DOE, 2002). Work performed within weather structures. Total amount of contaminated material removed: approximately 32,000 tons.	COCs: None (VOCs below Soil Action Levels)	No - Accelerated action is not necessary for VOCs in soil (based on Soil Action Levels). - Any groundwater issues will be addressed by Groundwater IM/IRA. - Accelerated action for radionuclides in soil was completed in December 2003.
	IHSS-900-140	Hazardous Disposal Area	History and Description: IHSS 140 was used for the reaction and disposal of reactive metals and other chemicals. Reaction of metallic lithium occurred in the 1950s and 1960s. The reaction process included the disposition of metallic lithium in a trench and subsequent contact with water to initiate the reaction. After the reaction, the residue (nontoxic lithium carbonate) was covered with fill and buried at the southeastern corner of the site. It is estimated that approximately 400 to 500 pounds of lithium were reacted at the site. Unknown quantities of other reactive metals (sodium, calcium, and magnesium) and some solvents were also reacted and/or disposed of at this location, as well as nine bottles of nickel carbonyl and one can of iron carbonyl. Surface soil in IHSS 140 also has elevated Pu and Am activities. This contamination is primarily attributed to wind dispersion from the 903 Pad, with potential contributions from historical fires, stack effluent, and stormwater-related surface soil erosion. NFAA Status: IHSS 140 was identified as a proposed No Further Accelerated Action (NFAA IHSS in the 1998 Annual Update of the HRR (K-H, 2001) and in 2003 (K-H, 2003b). The NFAA proposal was not accepted because characterization data is considered not sufficient to approve NFAA status. During the accelerated action to remove surface Pu and Am, an effort will be made to locate and excavate soil from the pits used for metal reactions. If the pit(s) are not located or the initial soil removal action for metals is determined to not be complete, then a Sampling and Analysis Plan will be developed for this IHSS (Contact Record, 2003).	No prior response actions documented.	COCs: Pu and Am (above Radionuclide Soil Action Levels) Metals (including lithium, sodium, calcium, and magnesium, nickel) VOCs Misc. solvents	Yes - Accelerated action is required for radionuclides in surface soil. - Accelerated action is also required for pits historically used for metal reactions
	IHSS-900-155	903 Lip Area	History and Description: Wind and water erosion caused plutonium-contaminated soil to be transported primarily to the south and east of the 903 Pad, resulting in the formation of the 903 Lip Area (IHSS 155). Some of the contamination spread to the Lip Area occurred during drum removal and cleanup activities at the 903 Pad from 1968 through 1970. NFAA Status NFAA designation is not applicable for this IHSS.	(1968) Regrading of area south and east of the Pad (Inner Lip Area) (DOE, 1995a Barker, 1982; and RMRS, 1997a)	COCs: Pu, Am and U (above Radionuclide Soil Action Levels)	Yes Accelerated action required for radionuclides in soil. Remediation of Inner Lip started Dec. 2003

2.2 GENERAL SITE CONDITIONS AND FEATURES

2.2.1 Geology and Hydrogeology

Geologic units in the study area can be grouped into two general categories: unconsolidated surficial deposits and underlying consolidated bedrock (RMRS, 1999). Brief descriptions of these major geologic units are provided below.

2.2.1.1 Unconsolidated Surficial Deposits

Nearly all the Site is covered with unconsolidated surficial deposits. These include: (1) Rocky Flats Alluvium (debris flow); (2) Valley-Fill Alluvium in and along essentially all the drainages; (3) Colluvium along the margins of the creek floodplains; and (4) artificial fill throughout the IA and other locations in the Buffer Zone. The unconsolidated surficial deposits range in thickness from 0 to over 100 feet (EG&G, 1995b). These deposits, combined with the weathered portion of subcropping bedrock formations, are the most important geologic units in terms of groundwater flow at the Site (K-H, 2002a; RMRS, 1999).

2.2.1.2 Consolidated Bedrock Deposits

Bedrock from the Arapahoe and Laramie Formations are significant features at RFETS in terms of transmitting groundwater flow (EG&G, 1995b). The sandstone lenses of the Arapahoe Formation, in particular, transmit significant groundwater flows. This formation ranges in thickness at RFETS from 0 to 50 feet, occurring as claystone and silty claystone with lenticular sandstone in the basal portion of the formation (K-H, 2002a; EG&G, 1995c).

Below the Arapahoe Formation, the Laramie Formation is approximately 600 to 800 feet thick. It is composed of an upper, thick claystone interval and a lower sandstone/claystone/coal interval. The claystones have low hydraulic conductivities which inhibit downward groundwater flow. Shallow groundwater is therefore directed laterally along the interface between the overlying higher conductivity material and the underlying lower conductivity material. Typically the higher conductivity material is composed of surficial materials, Arapahoe sandstone, or weathered bedrock, and the lower conductivity underlying materials are typically

weathered or unweathered Arapahoe, or more commonly, Laramie claystones. Beneath the unweathered Laramie Formation is the regional Laramie-Fox Hills aquifer. A United States Geological Survey (USGS) study and a separate, peer-reviewed Site investigation both indicated that this aquifer was not impacted by RFETS activities because of the low permeability of the overlying Laramie Formation (Hurr, 1976; RMRS, 1996b). The Laramie-Fox Hills aquifer is approximately 650 to 1,000 feet below the Site. Below the Laramie-Fox Hills aquifer is the 7,500 feet thick Pierre Formation that acts as the aquifer's lower confining layer. The thick marine shale Pierre Formation subcrops only in the extreme western part of the Site (RMRS, 1999). Suggested references for additional information on study area geologic features are:

- DOE, 1995a. Final Phase II RFI/RI Report, 903 Pad, Mound, East Trenches Area, Operable Unit No. 2, RF/ER-95-0079.UN.

- EG&G, 1995b. Geologic Characterization Report for the Rocky Flats Environmental Technology Site, Volume I of the Sitewide Geoscience Characterization Study

- EG&G, 1995c. Hydrogeologic Characterization Report for the Rocky Flats Environmental Technology Site, Volume II of the Sitewide Geoscience Characterization Study

2.2.2 Hydrology

2.2.2.1 Current Hydrology in Area of Concern

The area addressed by this IM/IRA is located within the Woman Creek drainage basin. Two retention ponds and one diversion channel exist on-Site in this watershed (Figure 2-1). These structures and their function are described in Table 2-2.

Table 2-2. Woman Creek Basin – Ponds and Diversion Structures

Structure	Function
South Interceptor Ditch	Intercepts runoff from area that includes the 900-11 Area, Windblown Area, and OU1, and diverts the flow into Pond C-2 for retention prior to release.

Table 2-2 (continued)

Structure	Function
Pond C-2	69 acre-feet (22.6 million gallon) capacity pond that receives flows from the South Interceptor Ditch. Batches of water are sampled, and approval is received prior to water being released to flow off-Site. Pond C-2 discharges typically occur once per year. Average annual discharge volume is approximately 27 acre-feet (for Water Years 1997 – 2002)(K-H, 2003f). In dry years (e.g., 2002), Pond C-2 is not discharged.
Pond C-1	Pond C-1 is located on the Woman Creek channel directly south of the Lip Area, downgradient from the South Interceptor Ditch. The South Interceptor Ditch intercepts runoff from the 903 Lip Area before it reaches Woman Creek and Pond C-1. Therefore, runoff from the Lip Area is not routed through Pond C-1; Pond C-1 is a flow-through structure for Woman Creek and is not actively managed.
Woman Creek Bypass Channel	Diversion channel that directs Woman Creek over the South Interceptor Ditch and around Pond C-2 on its north side.

Note: Structures of relevance to the Woman Creek watershed that are located outside the RFETS boundary are discussed in Section 2.2.2.2.

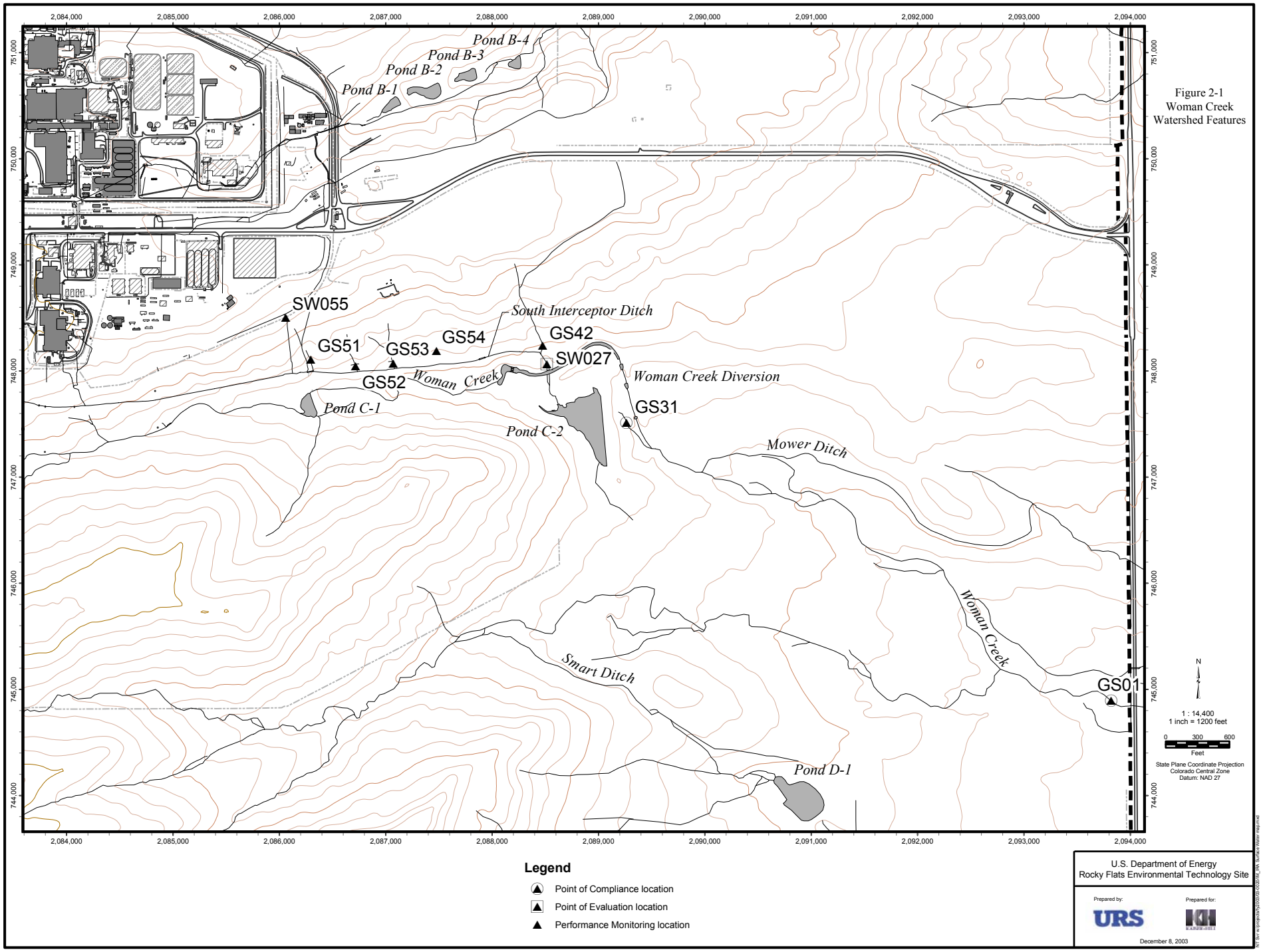


Figure 2-1
Woman Creek
Watershed Features

Legend

- Point of Compliance location
- Point of Evaluation location
- Performance Monitoring location

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: URS

Prepared for:

December 8, 2003

N:\Sw w:\projects\fy2003\03-0020\IM_IRA_Surface Water map.mxd

2.2.2.1.1 Post-Industrial Area Hydrology in Area of Concern

Based on Site-Wide Water Balance model predictions, after the buildings and pavement have been removed, there will be increased infiltration and reduced runoff from the IA (K-H, 2002a). Portions of the 900-11 Area and OU1 will receive reduced runoff resulting from pavement and buildings being eliminated and the areas revegetated. Flows in the SID will be diminished, because of reduced IA runoff in the western portion of the SID watershed (K-H, 2002a). Consequently, Pond C-2, which is currently discharged once every one to two years, will fill less rapidly in the future than it does presently, given the same precipitation conditions. However, Woman Creek flows should be largely unaffected in the future since the Pond C-2 discharges are historically less than 10 percent of the flow measured in Woman Creek at GS01 (Water Year 1996 through Water Year 2001)(Kaiser-Hill, 2002a).

2.2.2.2 Off-Site Hydrology in Woman Creek Drainage

In the 1990s, the Option B water management project was implemented, at the request of the downstream local communities, to isolate municipal water supplies from RFETS surface water discharges. One of the major components of the Option B project involved the construction of the Woman Creek Reservoir, located off-Site just east of Indiana Street. The Woman Creek Reservoir was constructed in 1996 to capture surface water from RFETS before it flows into Standley Lake, which stores water for municipal drinking supplies and irrigation (CH2M-Hill, 1996). Water stored in the Woman Creek Reservoir is normally pumped north to Walnut Creek, at a point east of Great Western Reservoir. Walnut Creek flows into Big Dry Creek, which flows into the South Platte near Fort Lupton. Occasionally, water from the Woman Creek Reservoir is also pumped to Mower Reservoir, which is located immediately north of the Woman Creek Reservoir and is used for irrigation. As a result of the Woman Creek Reservoir, surface water runoff from the IHSS Group 900-11 area, Windblown Area, and OU1 is not utilized for the drinking water supply of neighboring downstream communities.

2.2.3 Climate

The RFETS climate is temperate and semiarid, characteristic of Colorado's Front Range. The average annual precipitation based on 30 years of record is approximately 368 millimeters (mm)

(14.5 inches [in]) (DOE, 1995b). Roughly half of the precipitation occurs as rain and half as snow, with precipitation falling primarily as snow from late October through early April and as rain during the remaining months (Kaiser-Hill, 2002b).

Winds at RFETS are predominantly from the northwest. This wind pattern reflects the influence of local terrain combined with prevailing winds from west to east although daytime winds have a typical midday upslope component from east to west. Winds at RFETS average approximately 4 meters per second (m/s) (9 miles per hour [mph]), with a range from less than 0.5 m/s (calm) to sustained winds over 18 m/s (40 mph), and with gusts over 45 m/s (100 mph) (Kaiser-Hill, 2002b).

2.2.4 Ecology

2.2.4.1 Vegetation

The Lip Area (IHSS 155) is characterized mostly by reclaimed mixed grassland as well as mesic mixed grassland. The reclaimed mixed grassland areas are those that have been revegetated in the past, and are predominantly covered by non-native grasses (K-H, 1997b). The dominant species found in the reclaimed grassland of the lip area is smooth brome (*Bromus inermis*), an aggressive exotic species of grass. Mesic mixed grassland can be found on the hillsides of the southern portion of the lip area. Common species on the mesic mixed grasslands include blue gramma grass (*Bouteloua gracilis*), side-oats gramma grass (*Bouteloua curtipendula*), western wheatgrass (*Agropyron smithii*), green needle grass (*Stipa viridula*), Kentucky bluegrass (*Poa pratensis*), Canada bluegrass (*Poa compressa*), and other forbs and graminoids. The dominance of these species varies from location to location.

The majority of the Windblown Area is characterized by the mesic mixed grassland. Other grassland communities, such as reclaimed grassland, xeric needle and thread, and the xeric tall grass prairie community, are also interspersed throughout the area. Common species on the xeric tall grass prairie include big blue stem (*Andropogon gerardii*), little blue stem (*Andropogon scoparius*), mountain muhly (*Muhlenbergia montana*), needle and thread grass (*Stipa comata*), blue gramma grass (*Bouteloua gracilis*), side oats gramma (*Bouteloua curtipendula*), sedge (*Carex heliophila*), and Canada bluegrass (*Poa compressa*). The xeric needle and thread

grasslands are similar in species composition to the xeric tallgrass prairie, but the most common species is needle and thread grass.

OU1 is characterized by reclaimed mixed grassland, lesser amounts of mesic mixed grassland and wetlands, and a localized area of trees (riparian woodland) immediately south of Building 881. The area of reclaimed mixed grassland is the most extensive and encompasses the area southeast of Building 881 to the east through IHSSs 119.1 and 119.2. The dominant non-native species found in the reclaimed mixed grassland of OU 1 is smooth brome (*Bromus inermis*). The mesic mixed grassland found in OU 1 is located on the hillside immediately southwest, south, and southeast of Building 881. Common species here include blue gramma grass (*Bouteloua gracilis*), side-oats gramma grass (*Bouteloua curtipendula*), western wheatgrass (*Agropyron smithii*), green needle grass (*Stipa viridula*), Kentucky bluegrass (*Poa pratensis*), Canada bluegrass (*Poa compressa*), and other forbs and graminoids. The dominance of these mesic species varies from location to location. The wetlands in OU 1 are found in three areas, the largest of which is south-southeast of Building 881. Two smaller areas are found in the center of IHSS 119.1 and between IHSSs 119.1 and 119.2. Wetland species include common cattail (*Typha latifolia*), bullrush (*Scirpus sp.*), and various species of sedge (*Carex sp*.) and rush (*Juncus sp.).* See the detailed discussion of wetlands in the following paragraph. The riparian woodland area immediately south of Building 881 consists predominantly of plains cottonwood (*Populus deltoides*).

Because of the higher availability of water, areas along Woman Creek and Ponds C-1 and C-2 in the area of concern are characterized by the following habitat types: riparian woodland, willow riparian shrubland, leadplant riparian shrubland, tall marsh, short marsh, wet meadow/marsh ecotone, open water, and short upland shrubland. Plains cottonwood (*Populus deltoides*), narrow leaf cottonwood (*Populus angustifolia*), and the narrow leaf and plains cottonwood hybrid (*Populus x acuminata*) provide the top canopy of the riparian woodland, with an occasional peach-leaf willow tree (*Salix amygdaloides*). The riparian shrublands include coyote willow (*Salix exigua*), lead plant (*Amorpha fruticosa*), snowberry (*Symphoricarpos occidentalis*), and rose (*Rosa arkansana*). Wetland species (located along the streams and around the two ponds) include common cattail (*Typha latifolia*), bullrush (*Scirpus sp.*), and various species of sedge (*Carex sp*.) and rush (*Juncus sp.).* Wetlands are found along the length of Woman Creek, in the

South Interceptor Ditch (SID), and below the pediment top, south and east of the 903 Pad. Wetlands are protected by law and require consultation with the EPA in the case of this project before they can be disturbed, because the EPA has jurisdiction over CERCLA projects in the Site's Buffer Zone. Therefore, EPA is the lead regulatory agency for the area addressed in this IM/IRA. A map of wetlands at the Site is contained in Appendix A.

2.2.4.2 Wildlife

The common wildlife species of the reclaimed and mesic grasslands (the two vegetation communities found in the Lip Area) are mainly limited to small mammals [such as meadow voles (*Microtus pennsylvanicus*), deer mice (*Peromyscus maniculatus*) and pocket gophers (*Thomomys talpoides*)], song birds [such as meadow larks (*Sturnella neglecta*) and vesper sparrows (*Pooecetes gramineus*)], insects, and herpetiles (K-H 1998b, 1999, 2000, 2001c, 2002c). The grasslands are used by these species for shelter, nesting, perches, and food sources. These small animals provide forage for predators such as raptors and coyotes (*Canus lapus*). Raptors that utilize these types of grasslands include the red tailed hawks (*Buteo jamaicensis*), Swainson's hawks (*Buteo swainsoni*), northern harriers (*Circus cyaneus*), great horned owls (*Bubo virginianus*), and American kestrels (*Falco sparverius*). The area is also occasionally used by mule deer (*Odocoileus hemionus*) for feeding.

Not only is the Windblown Area used by most of the previously mentioned grassland species, but the area also includes riparian vegetation, which provides habitat for various other wildlife species. A variety of song and migratory birds use the riparian woodland for shelter, nesting, perches, and food source. Some of these include American goldfinch (*Carduelis tristis*), lesser goldfinch (*Carduelis psaltria*), Bullock's orioles (*Icterus bullockii*), Brewer's blackbirds (*Euphagus cyanocephalus*), yellow warblers (*Dendroica petechia*), western kingbirds (*Tyrannus verticalis*), common nighthaws (*Chordeiles* minor), and Cooper's hawks (*Accipiter cooperii*). Raptors such as red-tailed hawks and great horned owls occasionally use the riparian woodlands in the "Americium Zone" for perches or nesting areas.

The two ponds located in the area of concern, Ponds C-1 and C-2, are two of four ponds located in the south Buffer Zone, and are heavily utilized by waterfowl as breeding habitat or feeding areas. Waterfowl typically found at these areas include: Canada geese (*Branta canadensis*),

mallard ducks (*Anas platyrhynchos*), great blue herons (*Ardea herodias*), Black-crowned night herons (*Botaurus lentiginorus*), double crested cormorants (*Phalacrocorax auritus*), American coots (*Fulica americana*), Pied-billed grebes (*Podilymbus podiceps*), various species of dabbling ducks (*Anas* sp.), and other ducks and shore birds.

The riparian woodland and shrubland along most of the length of Woman Creek is habitat for the Preble's meadow jumping mouse (Preble's mouse, *Zapus hudsonius preblei*). A portion of OU 1, extending southeast of Building 881 to the SID, and encompassing IHSS 102, contains Preble's mouse habitat. The Preble's mouse is a federally listed species under the Endangered Species Act. Historical trapping and telemetry studies have documented the presence of the mouse upstream of the C-2 pond (EG&G 1992b,1993; K-H, 1998c, 2000, 2001). Although Preble's mice have never been captured below the C-2 pond, suitable habitat exists throughout most of the drainage. A map of Preble's mouse habitat at the Site is contained in Appendix A. Disturbance, either direct or indirect, to the Preble's mouse or its habitat requires consultation with the United States Fish and Wildlife Service (USFWS). In addition to the natural vegetation present along the stream, an area downstream of the C-2 pond has been enhanced with plantings of over three hundred native shrubs to enlarge the suitable habitat for the Preble's mouse. The enhancement area is being used as mitigation for another project located in the north Buffer Zone.

2.2.5 Future Site Land Use

The Rocky Flats National Wildlife Refuge Act of 2001 was signed into law on December 28, 2001, thereby establishing Rocky Flats as a National Wildlife Refuge once remediation and closure of the Site is completed (National Defense Authorization Act, 2001). The legislation requires that a Memorandum of Understanding be developed between the DOE and the U.S. Department of the Interior to document the future refuge responsibilities of the DOE and USFWS. It is assumed that Wildlife Refuge Workers (WRWs) will be present onsite for most of the year and engaged in refuge maintenance and ecological work activities. Because of the conceptual land use, residential development is not considered a likely future land use scenario.

2.2.6 Surrounding Land Use and Population

The Site is bounded roughly by State Highway 128 to the north, Indiana Street to the east, State Highway 72 to the south, and State Highway 93 to the west. Over 2.9 million people live within 80 km of the Site. Adjacent land use is a mixture of agriculture, open space, industry, and residential housing. Surrounding communities include Golden to the south, Arvada to the southeast, Broomfield and Westminster to the east, and Boulder and Superior to the north.

2.3 RFCA ACTION LEVEL COMPARISON - DATA SUMMARY

2.3.1 Soil

Data displayed in the soil characterization figures were queried using the Remedial Action Decision Management System (RADMS) to extract data from the Soil Water Database (SWD). At locations where the sample result exceeds the respective Soil Action Level, the locations are denoted by red or yellow dots. The soil samples were collected during multiple investigations, involved the use of several analytical methods, and were collected during the period from March 1991 to November 2003. All data presented are based on a query of the RFETS Soil Water Database conducted on December 4, 2003.

2.3.1.1 Uranium in Soil

2.3.1.1.1 Uranium – 0 to 0.5 Foot Depth

For uranium isotopes U-233/234, U-235, and U-238, maps are presented for concentrations in soil in the 0 to 0.5 foot depth interval (Figure 2-2 to Figure 2-4). The 0 to 0.5 foot depth is the interval where, if a uranium isotope exceeds an action level, the soil is removed as specified in RFCA Attachment 5 (DOE, 2003c). Table 2-3 summarizes the uranium isotopic soil samples from the 0 to 0.5 foot depth interval that exceed their Soil Action Levels and provides their corresponding accelerated action determinations.

Table 2-3. Uranium Isotopes in Soil (0 to 0.5 Feet) - Accelerated Action Determination

Uranium Isotope	Accelerated Action Required?	Sample Results
U-233/234	No. No exceedance of Soil Action Level for WRW.	See Figure 2-2
U-235	No. No exceedance of Soil Action Level for WRW.	See Figure 2-3
U-238	No. No exceedance of Soil Action Level for WRW.	See Figure 2-4

Below 0.5 feet, uranium contamination is addressed using a risk screen approach (DOE, 2003c). Uranium data in this deeper depth interval are presented in Section 2.3.1.1.2.

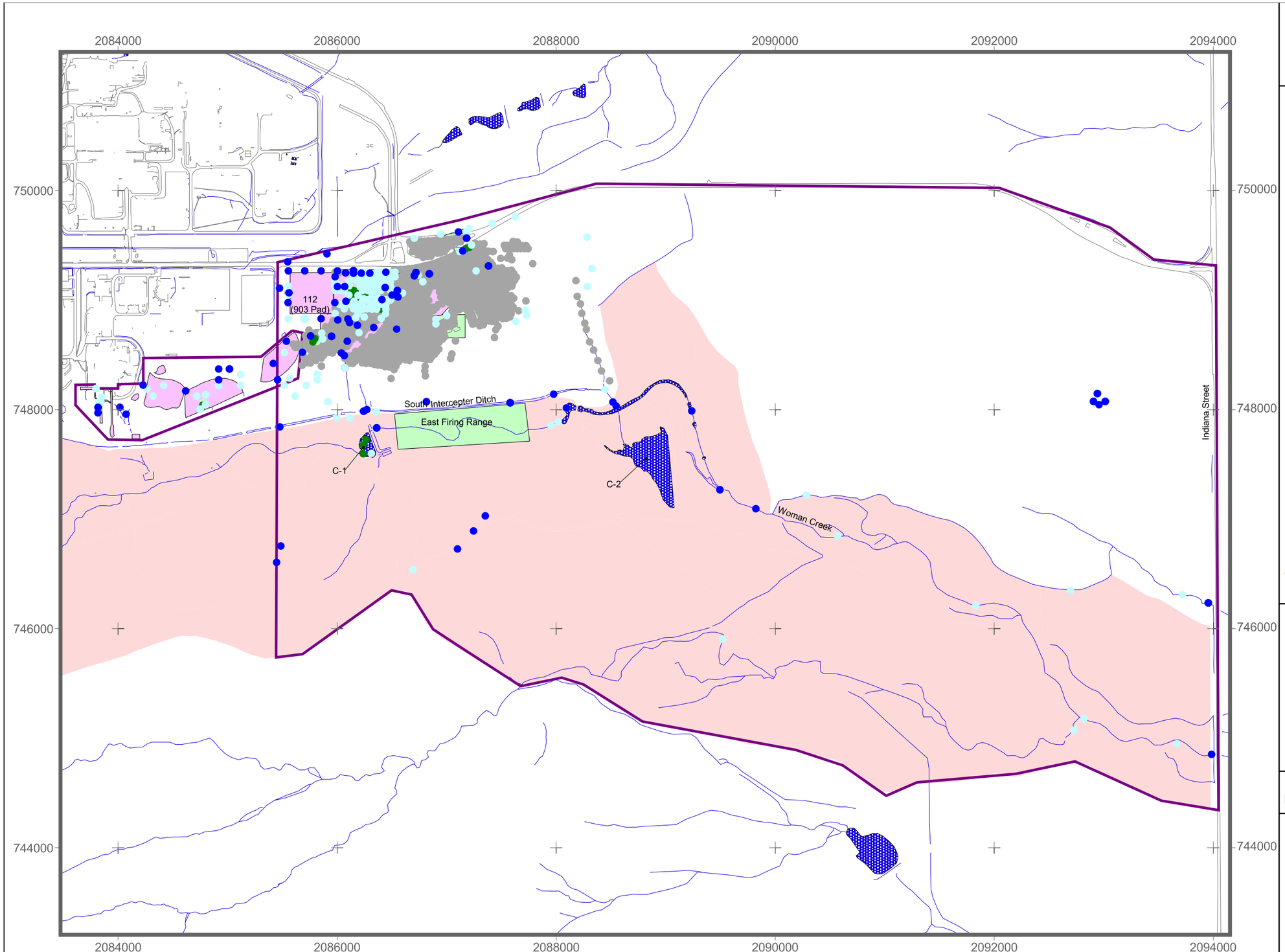
2.3.1.1.2 Uranium – Below 0.5 Foot Depth

For uranium isotopes U-233/234, U-235, and U-238, maps are presented for samples collected below 0.5 feet (Figure 2-5 to Figure 2-7). There is one U-235 result, for a soil sample collected below 0.5 feet, that has activity above the Soil Action Level for a Wildlife Refuge Worker (WRW) (see Figure 2-6). This sample location (location code 13395) is addressed by the Sub-Surface Soil Risk Screen from RFCA Attachment 5 (DOE, 2003c). Table 2-4 summarizes uranium isotopic soil samples below the 0.5 foot depth interval that exceed their Soil Action Levels and provides their corresponding accelerated action determinations.

Table 2-4. Uranium - Locations Requiring Sub-Surface Soil Risk Screen.

Uranium Isotope	Sample Location	Accelerated Action Required?	Screening Details
U-235	13395 (5 ft. depth, south of 903 Pad)	No. Accelerated action not necessary for this location, based on screening evaluation.	See Figure 2-6 and Appendix B, "Location 1"

Figure 2-2.
U-233/234 in Soil
0 to 0.5 Foot Depth



KEY

RSAL = 300 pCi/g

Sampling Results (pCi/g)

- >1000
- >RSAL
- 10 - RSAL
- 5 - 9.99
- 1 - 4.99
- 0 - 0.99
- Non-detect
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N
W E
S

500 0 500 Feet

Scale = 1: 10750

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

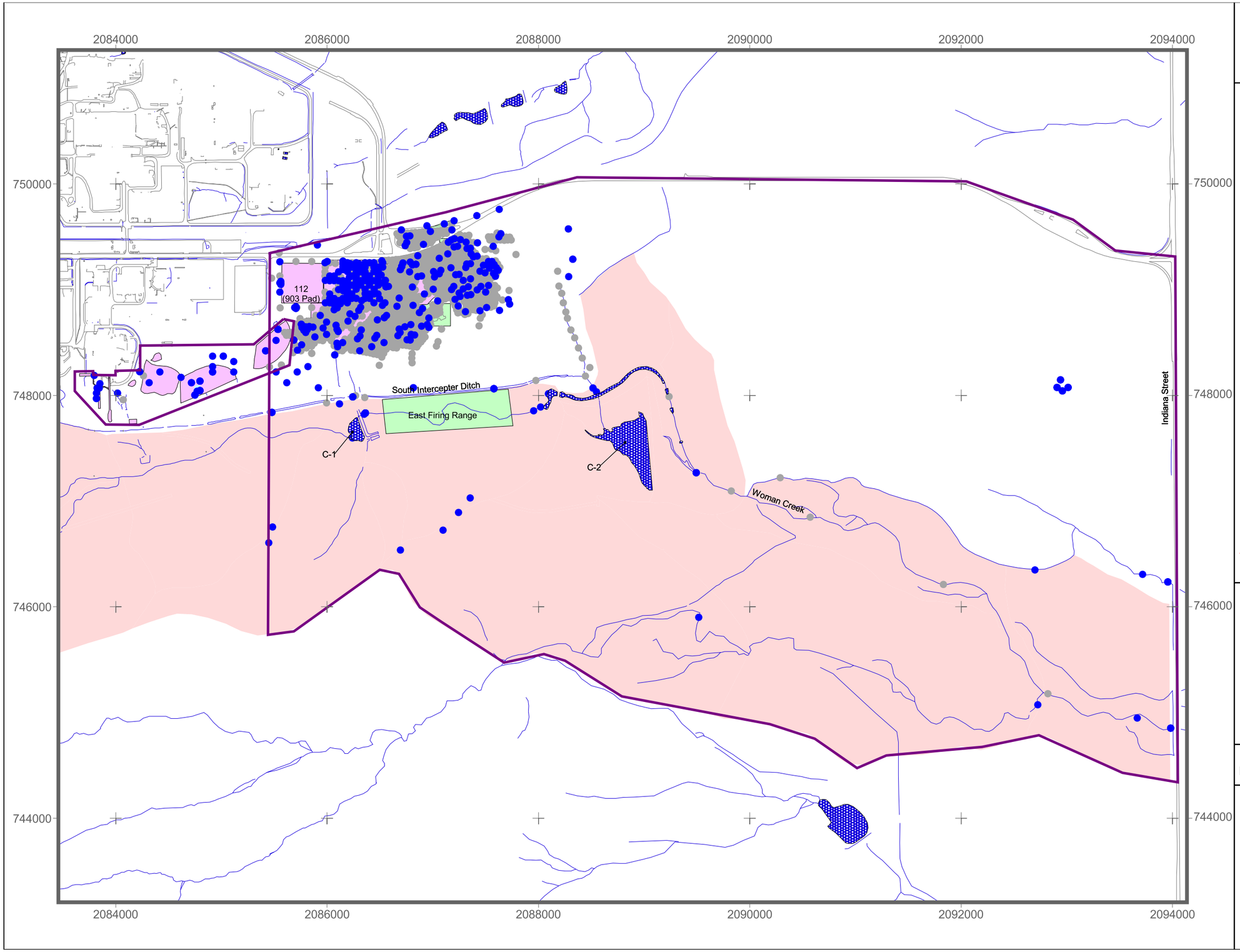
Prepared by: RADMS

Date: 10.29.03

Prepared for: KAISER•HILL COMPANY

File: W:\Projects\Fy2004\900-11_IMIRA\
120403\900-11_120403.apr

Figure 2-3.
U-235 in Soil
0 to 0.5 Foot Depth



KEY

RSAL = 8 pCi/g

Sampling Results (pCi/g)

- >1000
- >RSAL
- 5 - RSAL
- 1 - 4.99
- 0 - 0.99
- Non-detect
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N W E S

500 0 500 Feet

Scale = 1: 10750

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Prepared for: KAISER•HILL COMPANY

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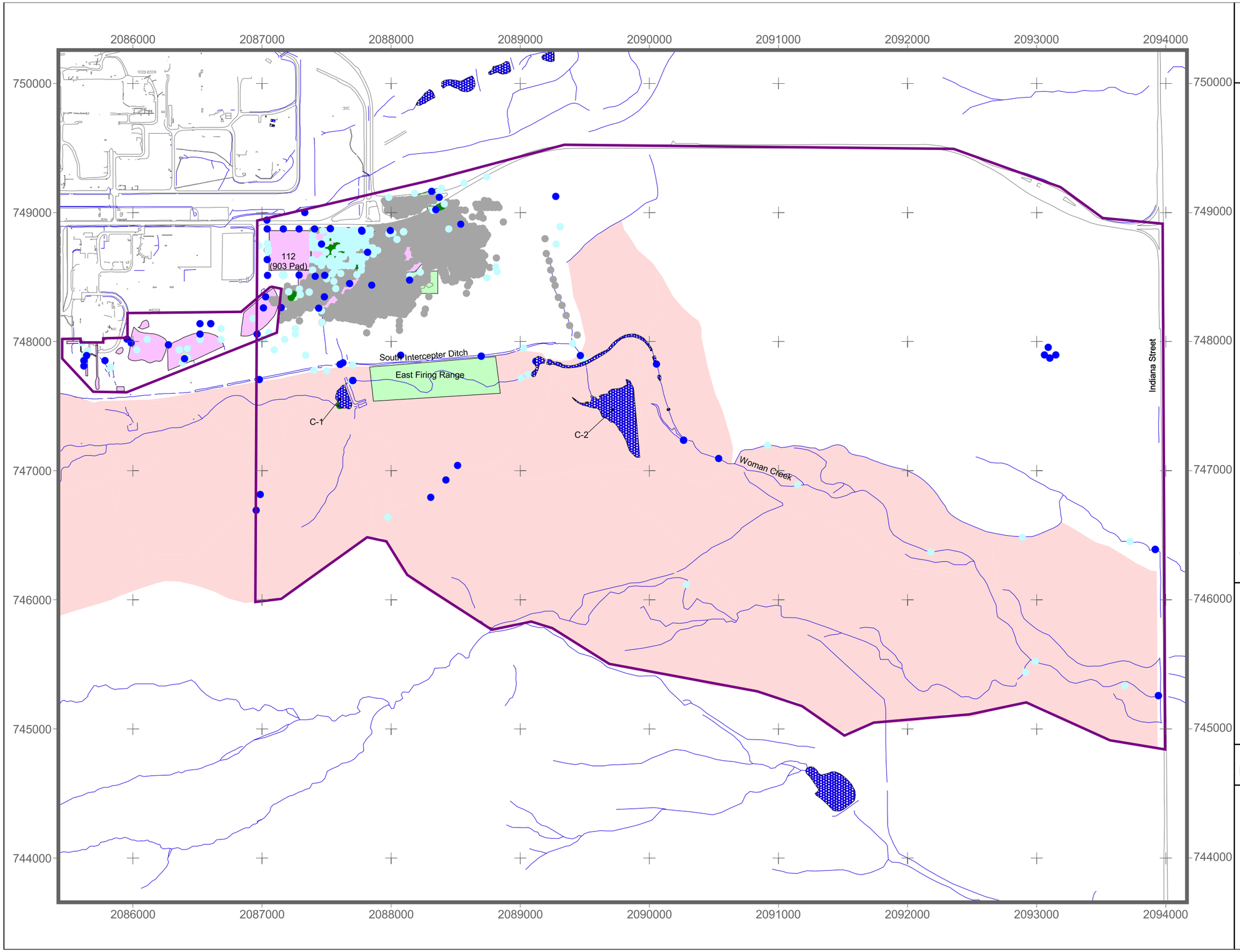
Figure 2-4.
U-238 in Soil
0 to 0.5 Foot Depth



KEY

RSAL = 351 pCi/g

Sampling Results (pCi/g)

- >1000
- >RSAL
- 10 - RSAL
- 5 - 9.99
- 1 - 4.99
- 0 - 0.99
- Non-detect
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N
W E
S

500 0 500 Feet

Scale = 1: 10750

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental Technology Site

Prepared by: RADMS

Date: 10.29.03

Prepared for: KAISER-HILL COMPANY

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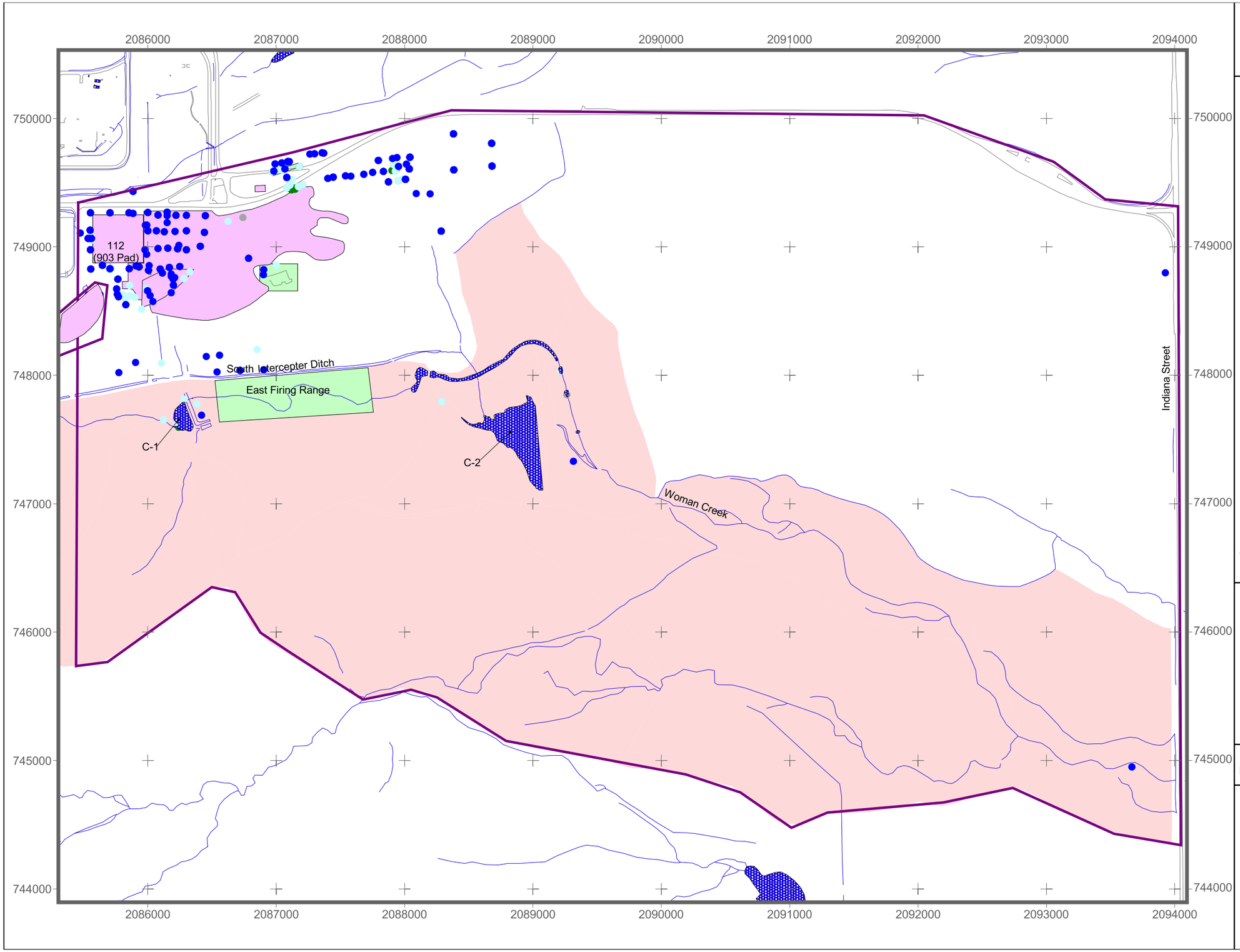
120403\900-11_120403.apr

Figure 2-5.
U-233/234 in Soil
Below 0.5 Foot Depth



KEY

RSAL = 300 pCi/g

Sampling Results (pCi/g)

- >1000
- >RSAL
- 10 - RSAL
- 5 - 9.99
- 1 - 4.99
- 0 - 0.99
- Non-detect
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N
W E
S

500 0 500 Feet

Scale = 1: 8850

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by:

Date: 10.29.03

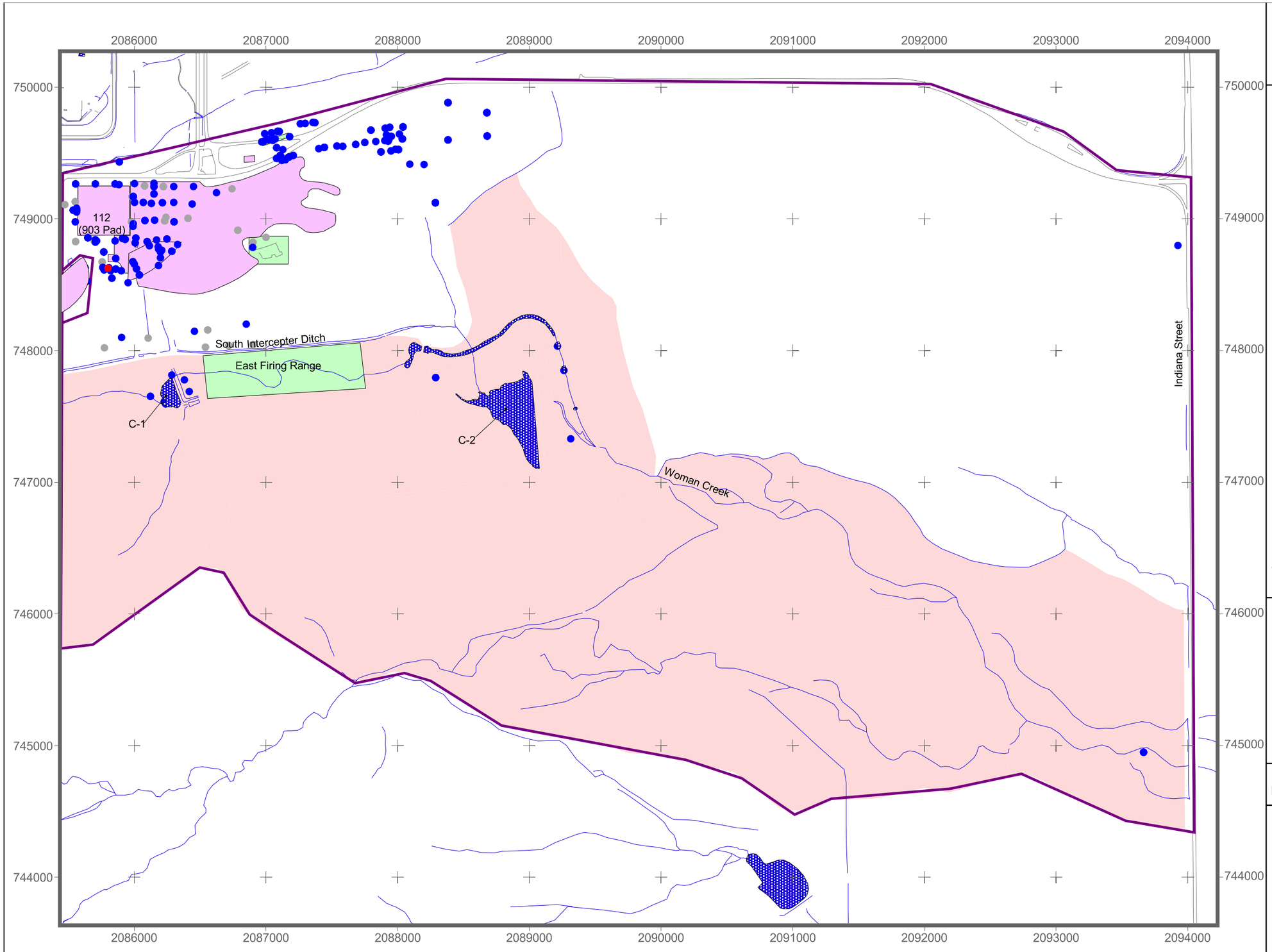
RADMS

Prepared for:

KAISER•HILL COMPANY

File: W:\Projects\Fy2004\900-11_IMIRA\120403\900-11_120403.apr

Figure 2-6.
U-235 in Soil
Below 0.5 Foot Depth



KEY

RSAL = 8 pCi/g

Sampling Results (pCi/g)

- >1000
- >RSAL
- 5 - RSAL
- 1 - 4.99
- 0 - 0.99
- Non-detect
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N
W E
S

500 0 500 Feet

Scale = 1: 8850

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Prepared by:

Date: 10.29.03

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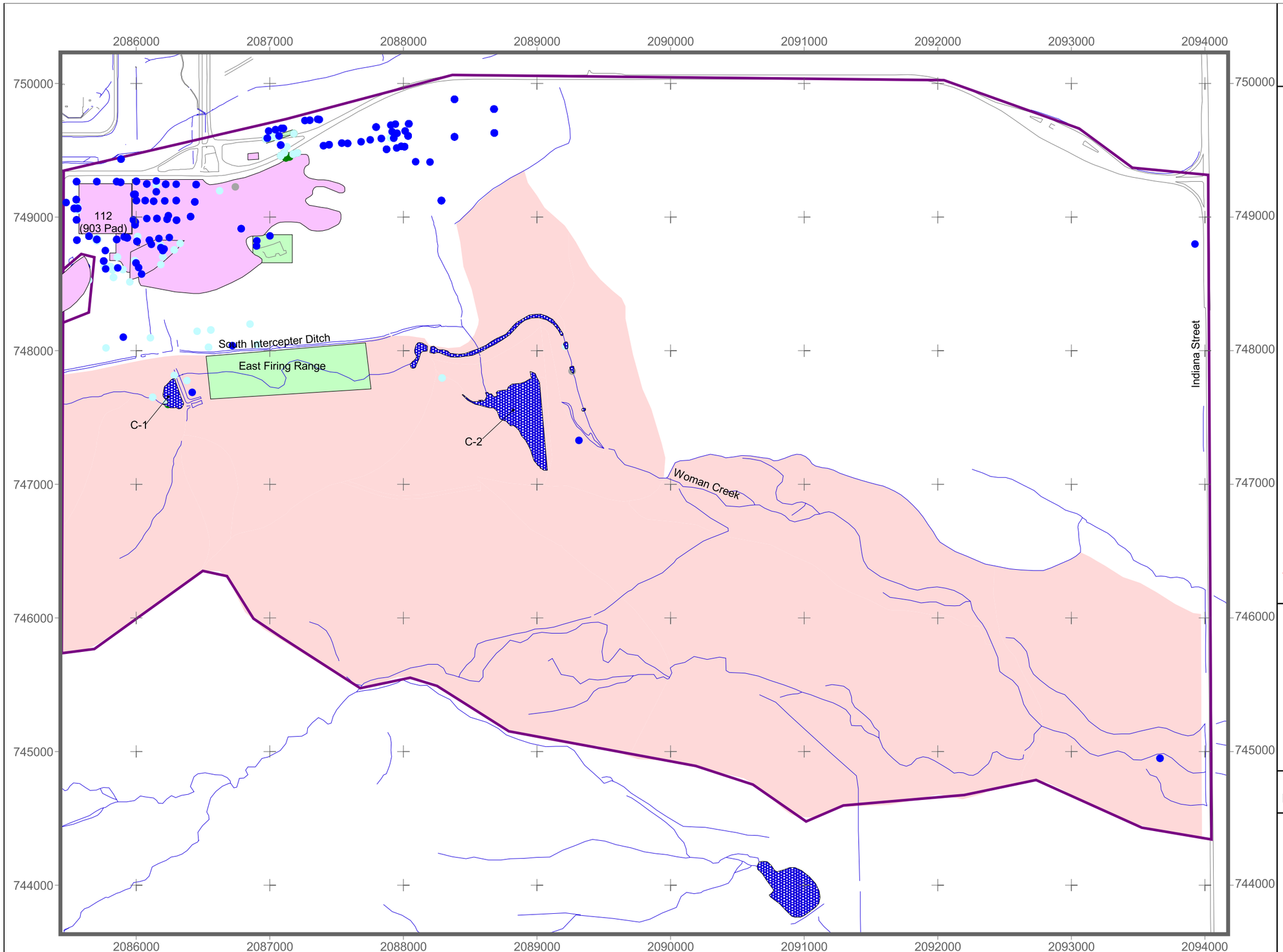
Figure 2-7.
U-238 in Soil
Below 0.5 Foot Depth



KEY

RSAL = 351 pCi/g

Sampling Results (pCi/g)

- >1000
- >RSAL
- 10 - RSAL
- 5 - 9.99
- 1 - 4.99
- 0 - 0.99
- Non-detect
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N
W E
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500 0 500 Feet

Scale = 1: 8850

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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2.3.1.2 Plutonium and Americium in Soil

2.3.1.2.1 Plutonium and Americium – 0 to 0.5 Foot Depth and 0.5 to 3 Foot Depth

Zero to 3 feet is the depth interval defined in RFCA Attachment 5 where soil is removed if Pu or Am exceed their respective Soil Action Levels (DOE, 2003c). Soil data for Pu-239/240 and Am-241 in the 0 to 3 foot depth are further sub-divided, for this report, into two different depth intervals, to provide a better understanding of the vertical distribution of Pu-239/240 and Am-241 in the soil. Pu-239/240 and Am-241 soil concentration maps are presented for the 0 to 0.5 foot depth interval (Figure 2-8 and Figure 2-9) and for the 0.5 foot to 3 foot depth interval (Figure 2-10 and Figure 2-11). Table 2-5 summarizes the Pu and Am soil samples from the 0 to 0.5 foot depth interval that exceed their Soil Action Levels and provides their corresponding accelerated action determinations.

Table 2-5. Pu and Am in Soil (0 to 3 Feet) - Accelerated Action Determination

Isotope	Accelerated Action Required?	Sample Results
Pu-239/240	Yes. Multiple locations exceed Soil Action Level for WRW	See Figure 2-8 and Figure 2-10
Am-241	Yes. Multiple locations exceed Soil Action Level for WRW	See Figure 2-9 and Figure 2-11

Below 3 feet, Pu and Am contamination is addressed using a risk screen approach (DOE, 2003c). Pu and Am data for this deeper depth interval are addressed in Section 2.3.1.2.2.

2.3.1.2.2 Plutonium and Americium – Below 3 Foot Depth

For soil samples collected below the 3 foot depth, maps of Pu-239/240 and Am-241 are presented in Figure 2-12 and Figure 2-13, respectively. For soil with Pu and Am above the Soil Action Level for a WRW, and below 3 feet in depth, the Subsurface Soil Risk Screen in RFCA Attachment 5 provides a process to evaluate whether an accelerated action is necessary (DOE, 2003c). There are three general areas within the area of concern that have Pu and/or Am in sub-surface soil above the Soil Action Level. The Sub-Surface Soil Risk Screen for each of these

locations is presented in Appendix B. The sample locations and accelerated action determination, based on the screening, are summarized in Table 2-6.

Table 2-6. Pu and Am – Locations Requiring Sub-Surface Soil Risk Screen

Analyte	Sample Locations	Accelerated Action Required?	Screening Details
Pu-239/240	50299 (6 ft. depth, N.W. of north portion of PAC-SE-1602, south sample)	No. Accelerated action not necessary for this location, based on screening criteria..	See Figure 2-12 and Appendix B, "Location 2"
Pu-239/240	CU-39-000 (4.5 ft. depth, N.W. of north portion of PAC-SE-1602, north sample)	No. Accelerated action not necessary for this location, based on screening criteria.	See Figure 2-12 and Appendix B, "Location 3"
Pu-239/240 & Am-241	11895, 12095, 12795 (5,5, & 8 ft. depths, in Windblown Area)	No. Accelerated action not necessary for this location, based on screening criteria.	See Figure 2-12, Figure 2-13 and Appendix B, "Location 4"

2.3.1.3 Sum-of-Ratios (SOR) in Soil

2.3.1.3.1 SOR – 0 to 0.5 Feet

A SOR was calculated for the locations where soil data exist for the three uranium isotopes, plus Pu and Am. The formula for calculating the SOR, as documented in the RFCA Modifications Technical Basis Document, involves calculating the ratio between concentration and Radionuclide Soil Action Level (RSAL), as shown below (DOE, 2002a):

SOR = (Concentration [Pu-239/240]/RSAL [Pu-239/240]) + (Concentration [Am-241]/RSAL [Am-241]) + (Concentration [U-238]/RSAL [U-238]) + (Concentration [U-235]/RSAL [U-235]) + (Concentration [U-234]/RSAL [U-234])

It is noted that the RSAL for Pu-239/240 used in the SOR calculation is 116 pCi/g (116 pCi/g is the Pu-239 value calculated for 1 x 10^{-5} risk as noted in RFCA Attachment 5). Figure 2-14 displays the sum-of-ratio value calculated at locations where data are available for all five radionuclide isotopes at a common depth interval (0 and 0.5 feet). Locations requiring an accelerated action, based on the SOR, are summarized in Table 2-7.

Table 2-7. Sum of Ratios (0 to 0.5 Feet) - Accelerated Action Determination

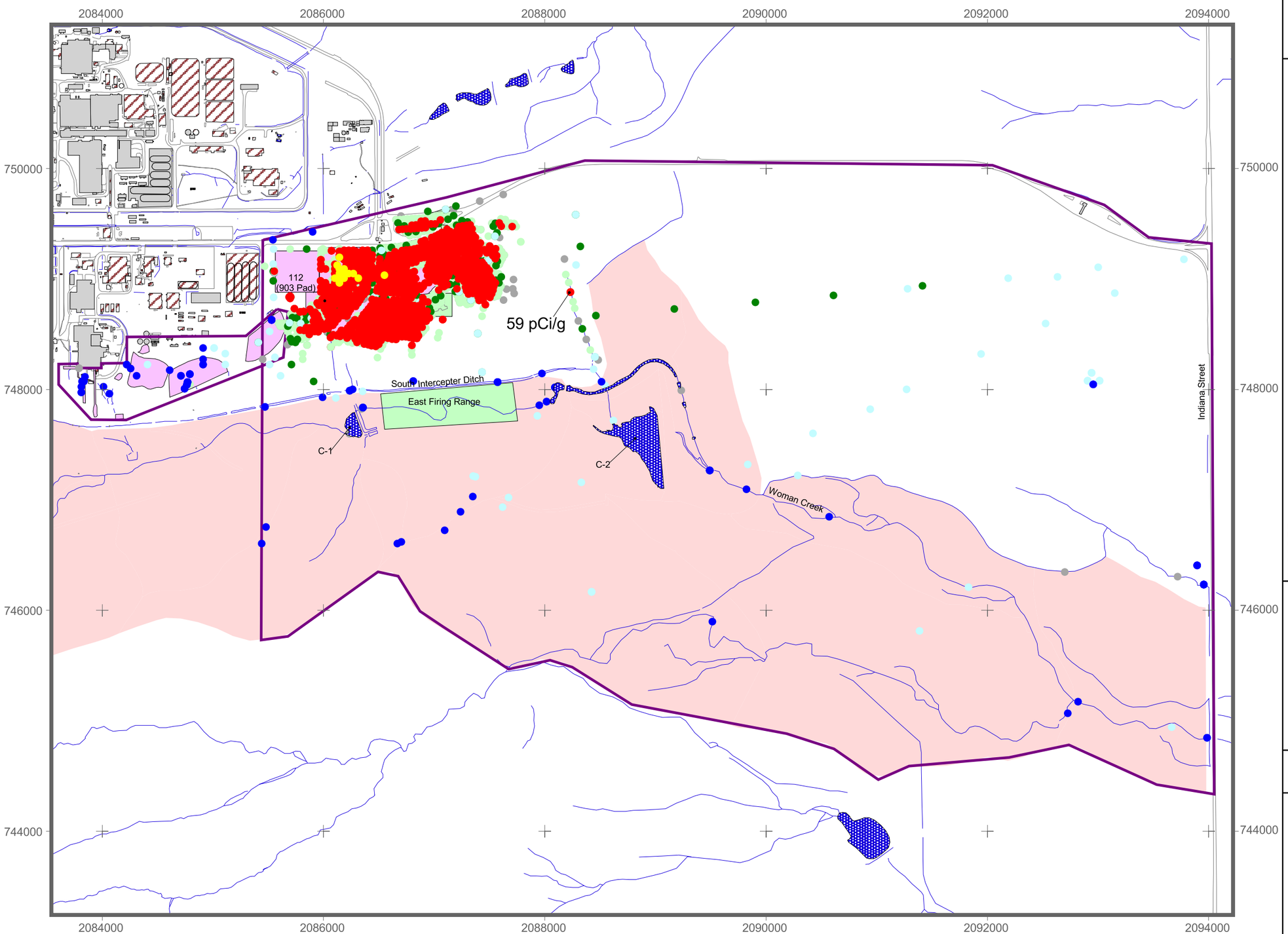
Sample Locations	Accelerated Action Required?	Sample Results
Multiple sample locations in Lip Area and 1 location in OU1	Yes. Multiple locations that exceed SOR Soil Action Level for WRW	See Figure 2-14

2.3.1.3.2 SOR – 0.5 to 3 Feet

SOR values were also calculated for the depth interval from 0.5 to 3 feet, for locations where soil data exist for the three uranium isotopes, plus Pu and Am. Results of the SOR analysis for this depth interval indicate that all of the SOR values in the Outer Lip Area and outlying areas (the area addressed by this IM/IRA), are below the SOR WRW Action Level of 1. Therefore, no figure is provided for SOR values greater than 1 in the depth interval from 0.5 to 3 feet.

In the Inner Lip Area, locations in the 0.5 to 3 foot depth interval that have SOR values greater than 1 are associated with either Pu or Am activity that is greater than their respective individual WRW Action Levels. Therefore, as these locations are remediated for exceeding WRW Action Levels for specific individual radionuclides, as part of the Inner Lip Area remediation (an action separate from this IM/IRA), the SOR will also be addressed.

Figure 2-8.
Pu-239/240 in Soil
0 to 0.5 Foot Depth



KEY

RSAL = 50 pCi/g

Sampling Results (pCi/g)

- >1000
- >RSAL
- 10 - RSAL
- 5 - 9.99
- 1 - 4.99
- 0 - 0.99
- Non-detect
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern
- Demolished Building
- Standing Building

N
W E
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500 0 500 Feet

Scale = 1: 10750

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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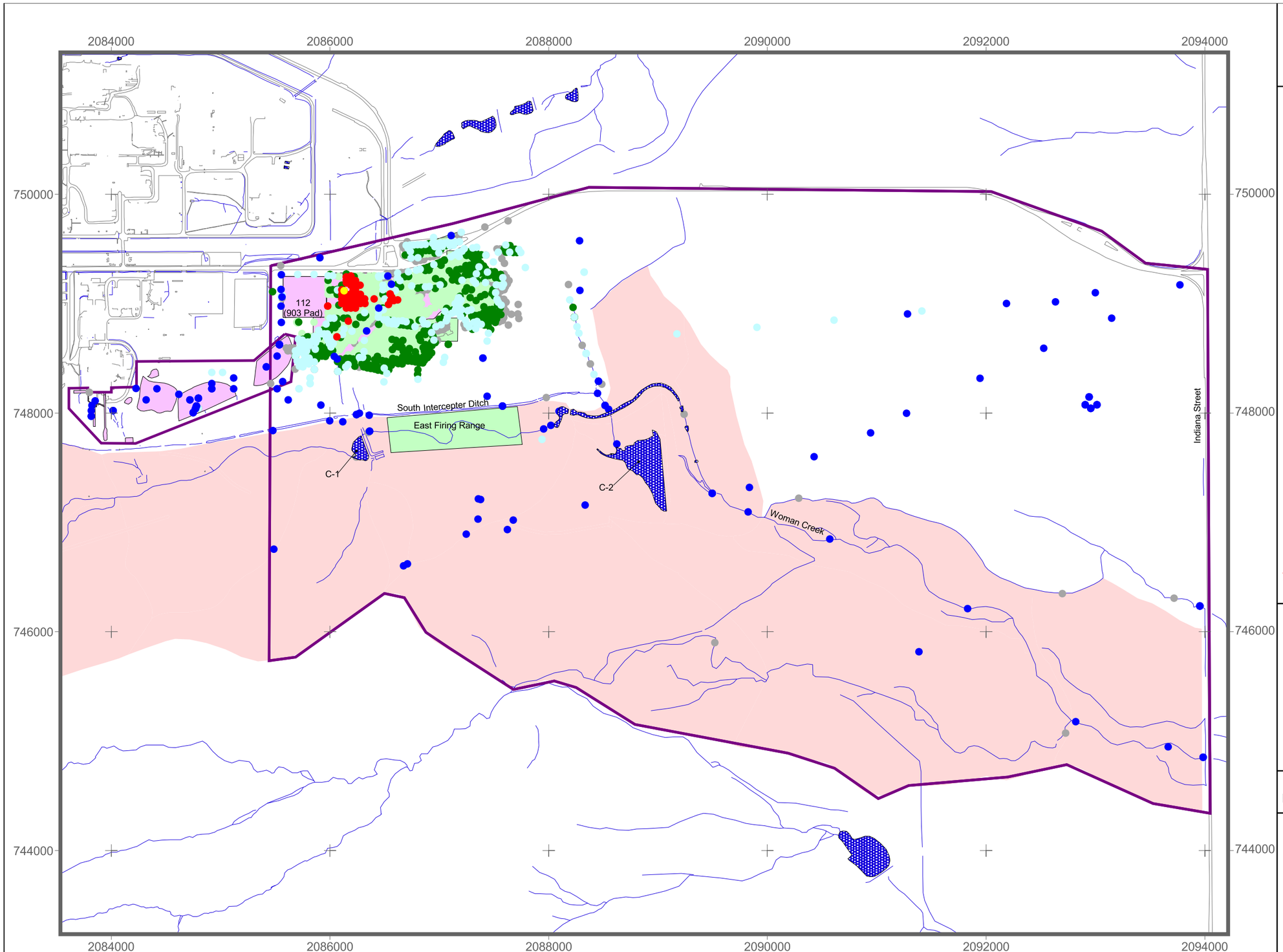
Figure 2-9.
Am-241 in Soil
0 to 0.5 Foot Depth



KEY

RSAL = 76 pCi/g

Sampling Results (pCi/g)

- >1000
- >RSAL
- 10 - RSAL
- 5 - 9.99
- 1 - 4.99
- 0 - 0.99
- Non-detect
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N W E S

500 0 500 Feet

Scale = 1: 10750

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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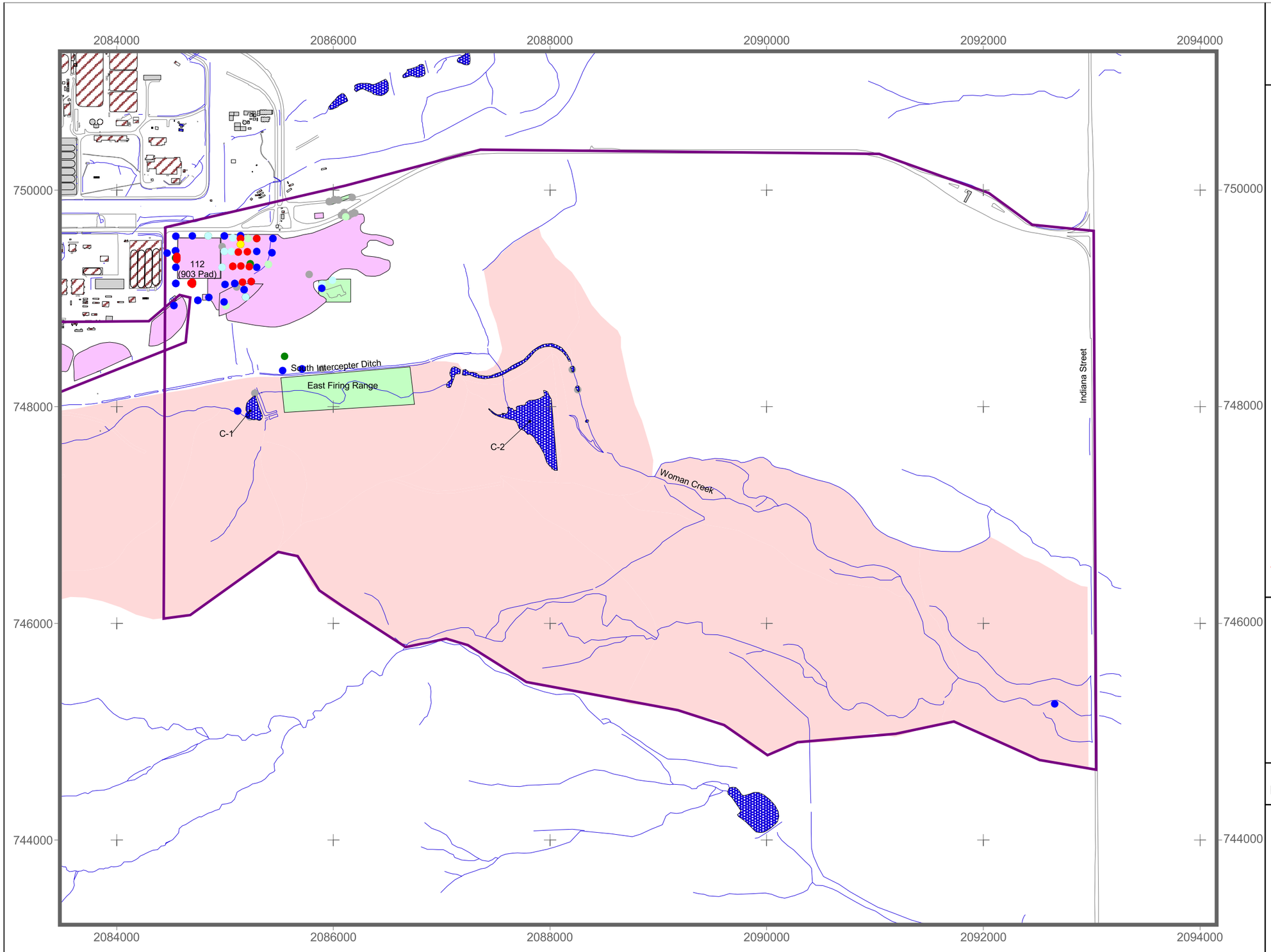
Figure 2-10. Pu-239/240 in Soil from > 0.5 Foot to 3 Foot Depth



KEY

RSAL = 50 pCi/g

Sampling Results (pCi/g)

- >1000
- >RSAL
- 10 - RSAL
- 5 - 9.99
- 1 - 4.99
- 0 - 0.99
- Non-detect
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N W E S

500 0 500 Feet

Scale = 1: 10750

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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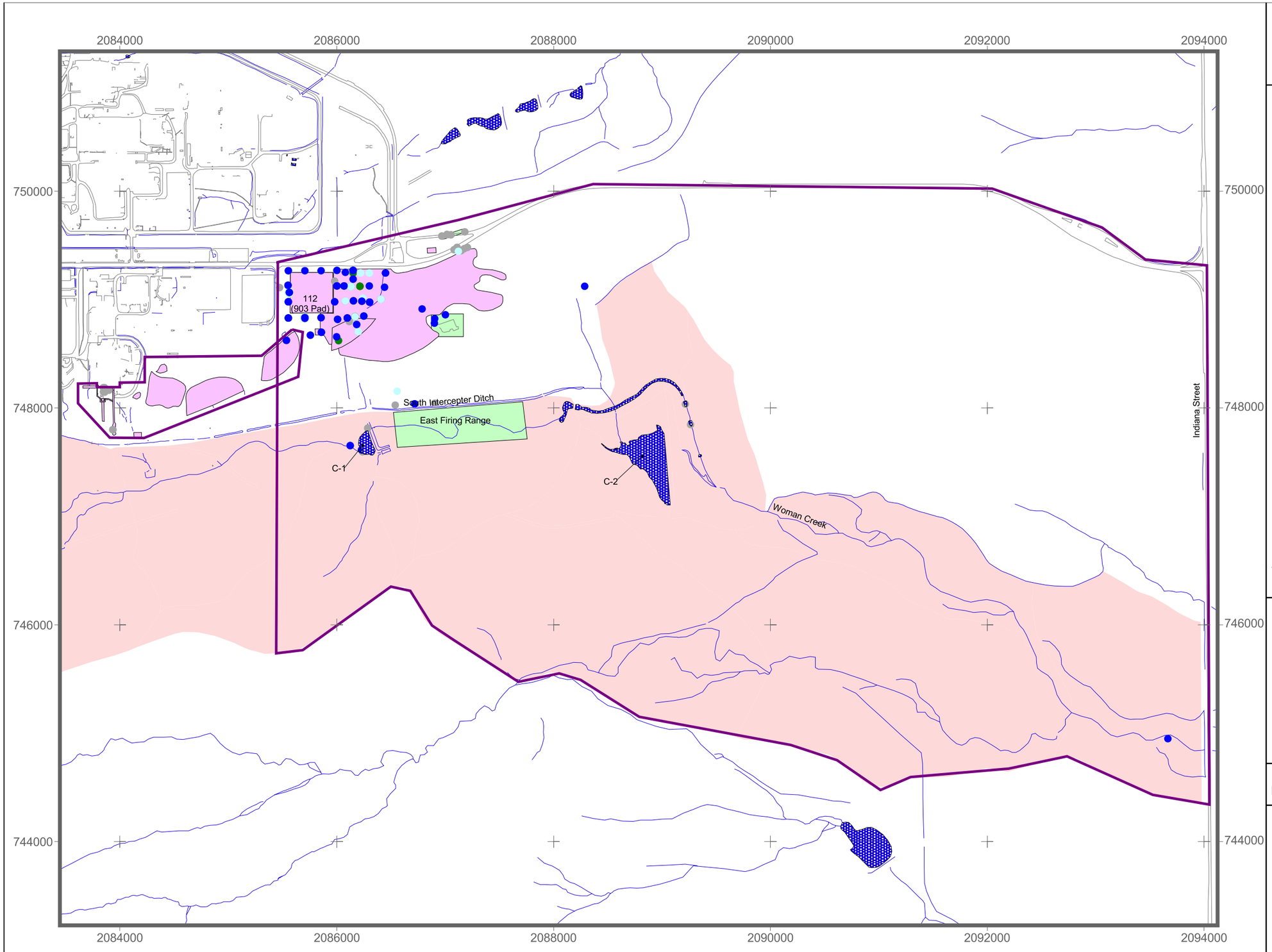
Figure 2-11. Am-241 in Soil from > 0.5 Foot to 3 Foot Depth



KEY

RSAL = 76 pCi/g

Sampling Results (pCi/g)

- >1000
- >RSAL
- 10 - RSAL
- 5 - 9.99
- 1 - 4.99
- 0 - 0.99
- Non-detect
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

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500 0 500 Feet

Scale = 1: 10750

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: RADMS

Date: 10.29.03

Prepared for: KAISER•HILL COMPANY

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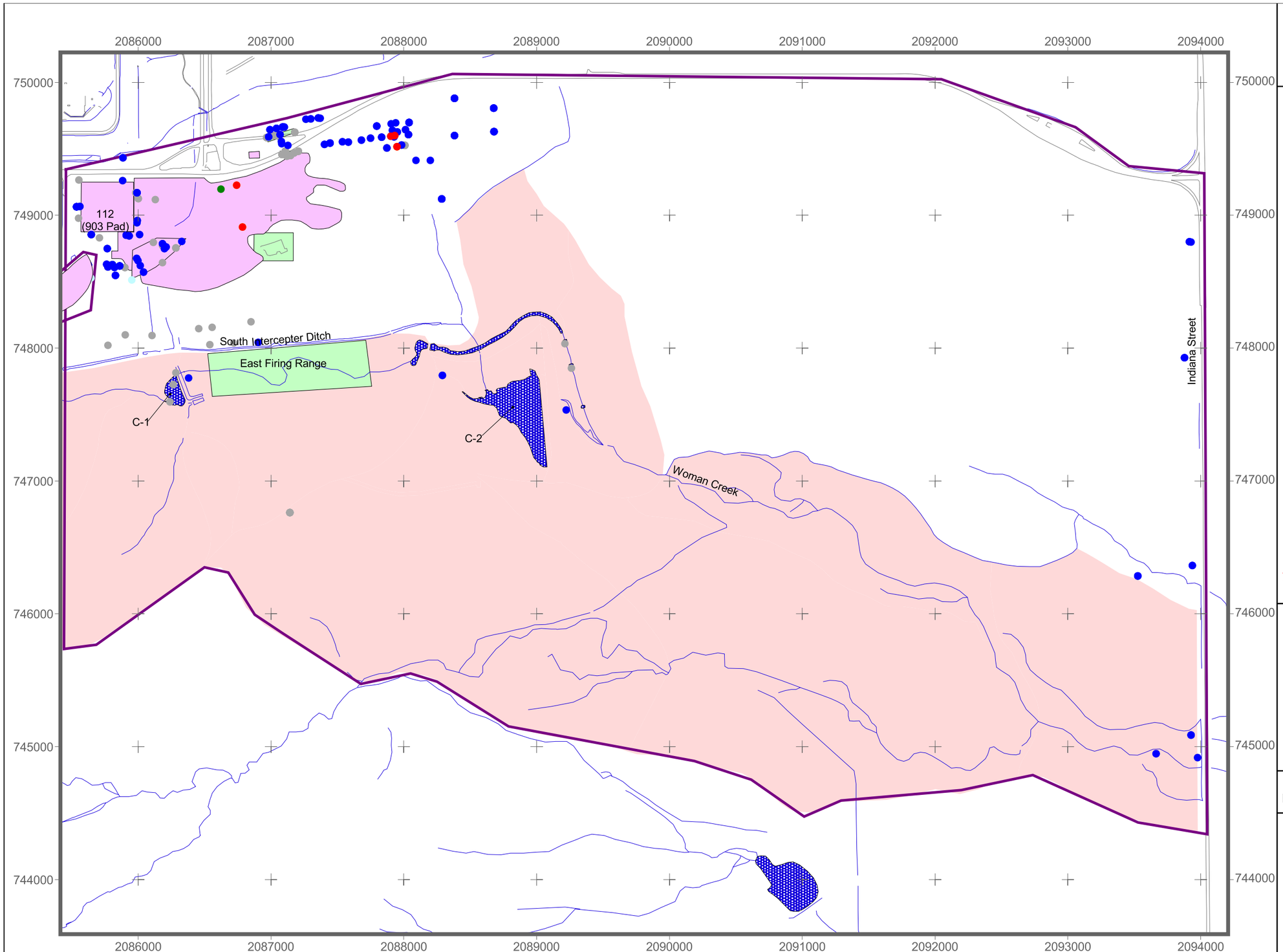
Figure 2-12.
Pu-239/240 in Soil
Below 3 Foot Depth



KEY

RSAL = 50 pCi/g

Sampling Results (pCi/g)

- >1000
- >RSAL
- 10 - RSAL
- 5 - 9.99
- 1 - 4.99
- 0 - 0.99
- Non-detect
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N W E S

500 0 500 Feet

Scale = 1: 8850

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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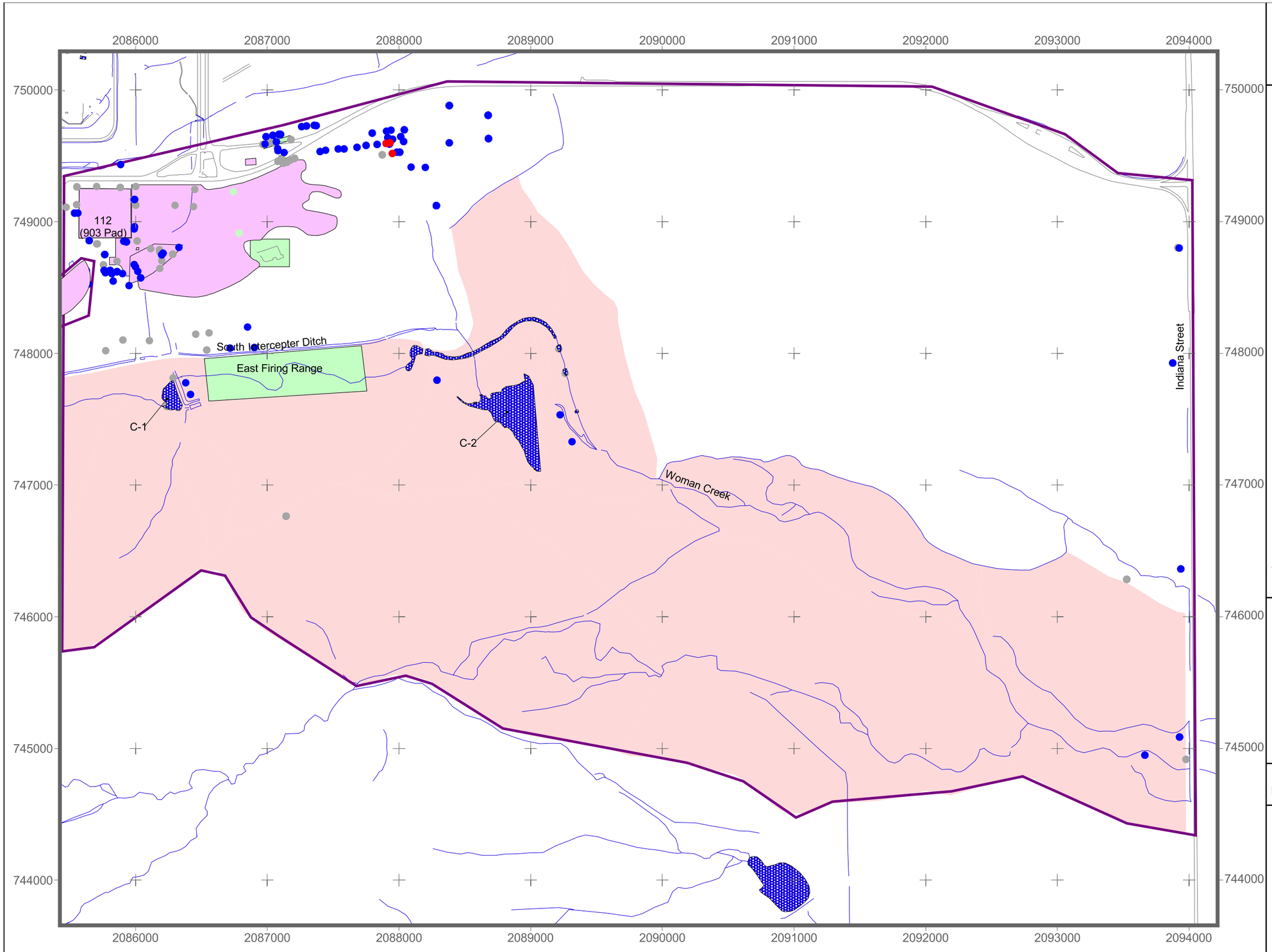
120403\900-11_120403.apr

Figure 2-13.
Am-241 in Soil
Below 3 Foot Depth



KEY

RSAL = 76 pCi/g

Sampling Results (pCi/g)

- >1000
- >RSAL
- 10 - RSAL
- 5 - 9.99
- 1 - 4.99
- 0 - 0.99
- Non-detect
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

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500 0 500 Feet

Scale = 1: 8850

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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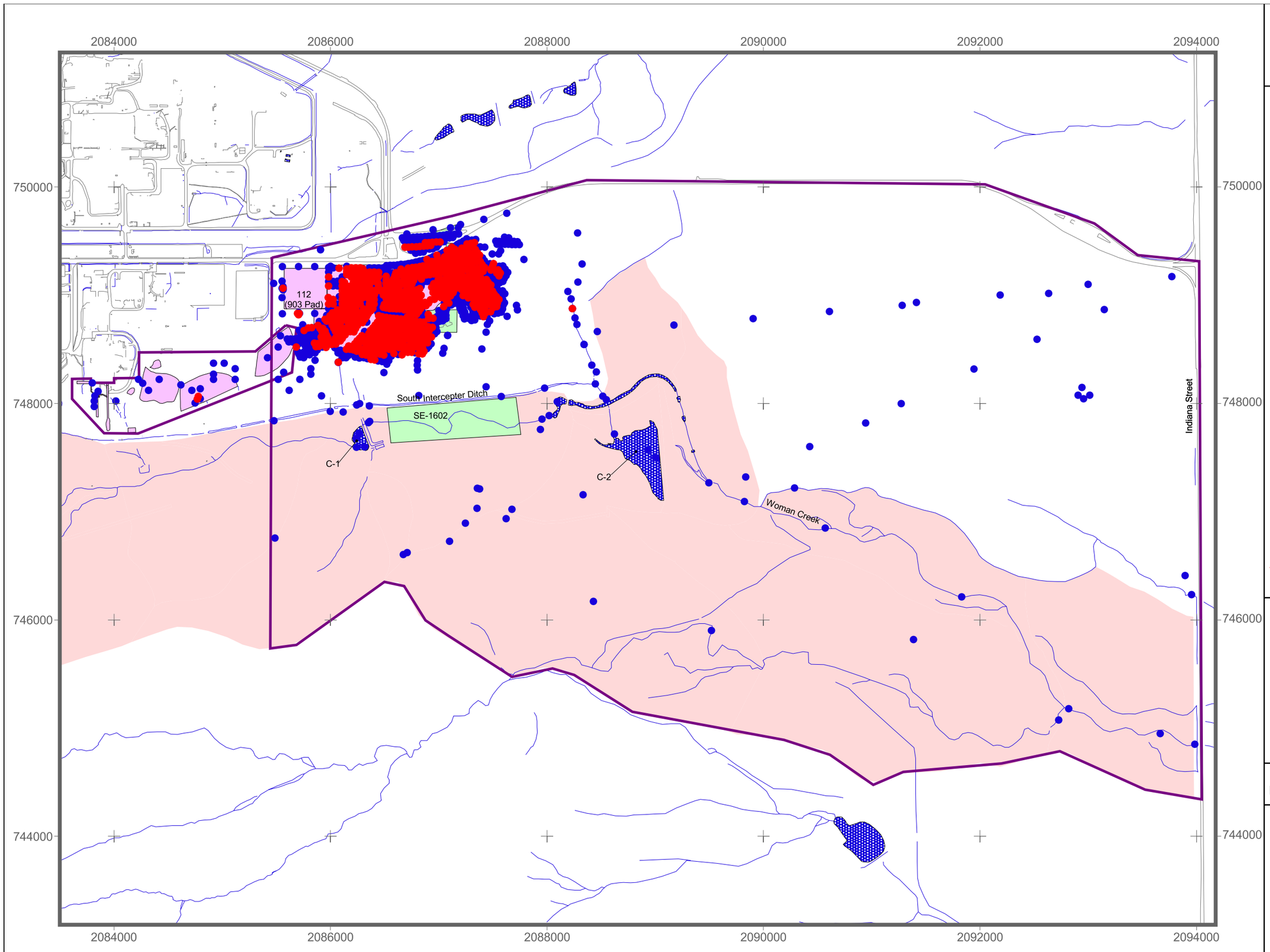
120403\900-11_120403.apr

Figure 2-14.
Sum of Ratios in Soil
0 to 0.5 Foot Depth



KEY

- =>1
- <1
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed

N
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500 0 500 Feet

Scale = 1: 10750

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental Technology Site

Prepared by:

Date: 10.29.03

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120403\900-11_120403.apr

2.3.1.4 Inorganic Analytes in Soil

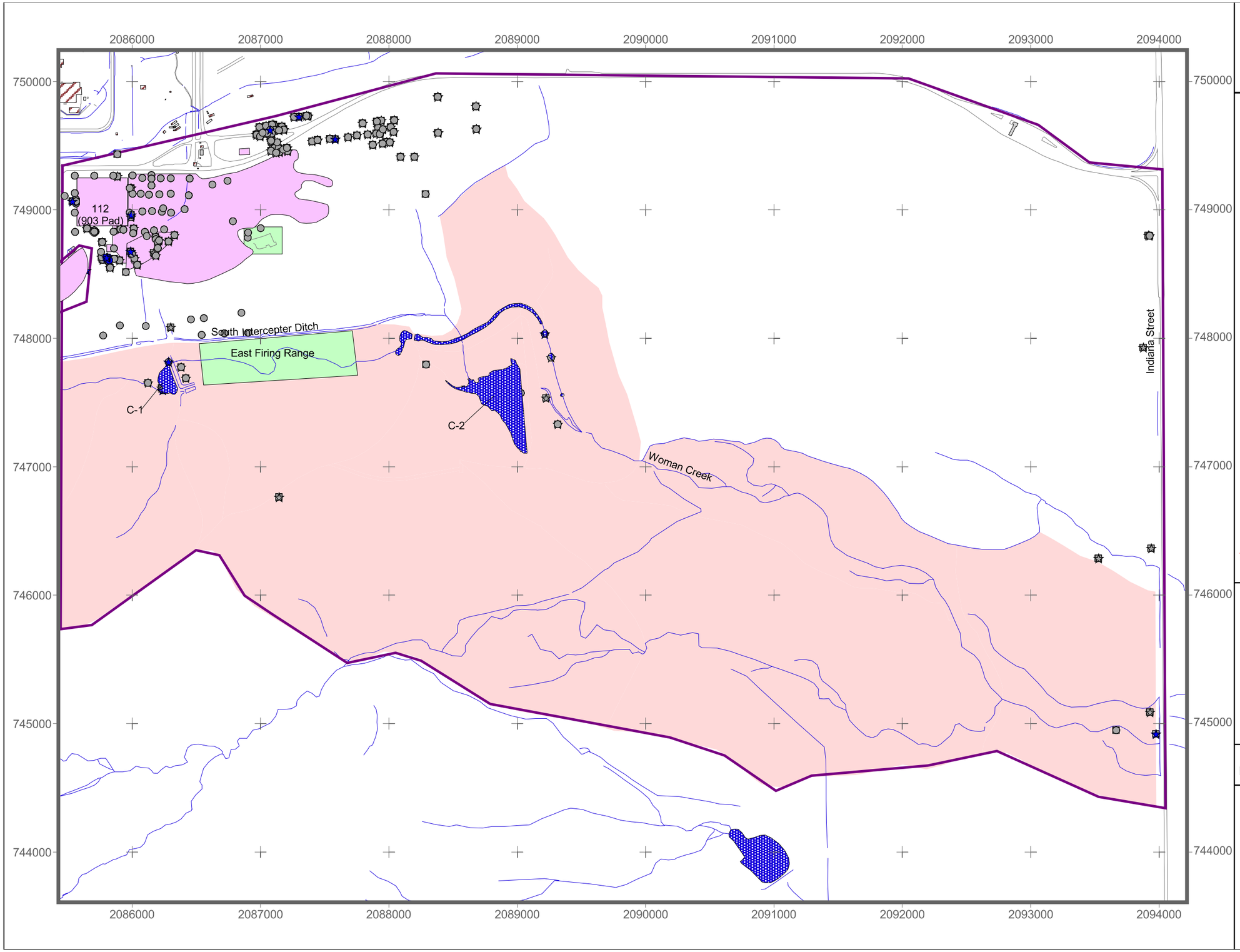
2.3.1.4.1 Inorganic Analytes – 0 to 0.5 Feet in Depth

The inorganic analytes, in soil from 0 to 0.5 feet in depth that exceed their respective Action Level for either a WRW or an Ecological Receptor, are summarized in Table 2-8. For analytes that are above their respective Ecological Receptor Action Level, an accelerated action is not specified in this IM/IRA. Instead, these locations will be included in the accelerated action ecological screening evaluation process, and an additional accelerated action will be taken, if required. Ecological risk will be further evaluated in the Comprehensive Risk Assessment, including the Data Adequacy Review.

Table 2-8. Inorganic Analytes in Soil From 0 to 0.5 Feet – Relative to Action Levels

Action Level Type	Analyte(s)	Sample Location(s)	Above Action Level?	Accelerated Action Required?
Wildlife Refuge Worker	All inorganics sampled	See Figure 2-15	No.	No. No inorganic analytes exceed Soil Action Levels for WRW.
Ecological Receptor	Lead	See Figure 2-15	Yes.	No accelerated action required as part of this IM/IRA – will be evaluated in the Accelerated Action Ecological Screening Evaluation and the Comprehensive Risk Assessment.
	Beryllium	See Figure 2-15	Yes.	No accelerated action required as part of this IM/IRA – will be evaluated in the Accelerated Action Ecological Screening Evaluation and the Comprehensive Risk Assessment.
	Uranium (total)	See Figure 2-15	Yes.	No accelerated action required as part of this IM/IRA – will be evaluated in the Accelerated Action Ecological Screening Evaluation and the Comprehensive Risk Assessment.

Figure 2-15.
Inorganic Analytes in Soil
0 to 0.5 Foot Depth
Above Ecological Receptor Action Level



KEY

- Beryllium Exceedance
- Total Uranium Exceedance
- Lead Exceedance
- Beryllium Below Ecological Action Level
- Total Uranium Below Ecological Action Level
- Lead Below Ecological Action Level
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N
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500 0 500 Feet

Scale = 1: 8850

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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2.3.1.4.2 Inorganic Analytes – Below 0.5 Feet

The inorganic analytes in soil below 0.5 feet, and their relationship to the respective Action Levels for a WRW or Ecological Receptor, are summarized in Table 2-9. Similar to the discussion for soil at depths from 0 to 0.5 feet, analytes below 0.5 feet that are detected above their respective Ecological Receptor Action Levels do not have accelerated actions specified in this IM/IRA. Instead, these locations will be included in the accelerated action ecological screening evaluation process, and an additional accelerated action will be taken, if required. Ecological risk will be further evaluated in the Comprehensive Risk Assessment, including the Data Adequacy Review.

Table 2-9. Inorganic Analytes in Soil Below 0.5 Feet – Relative to Action Levels

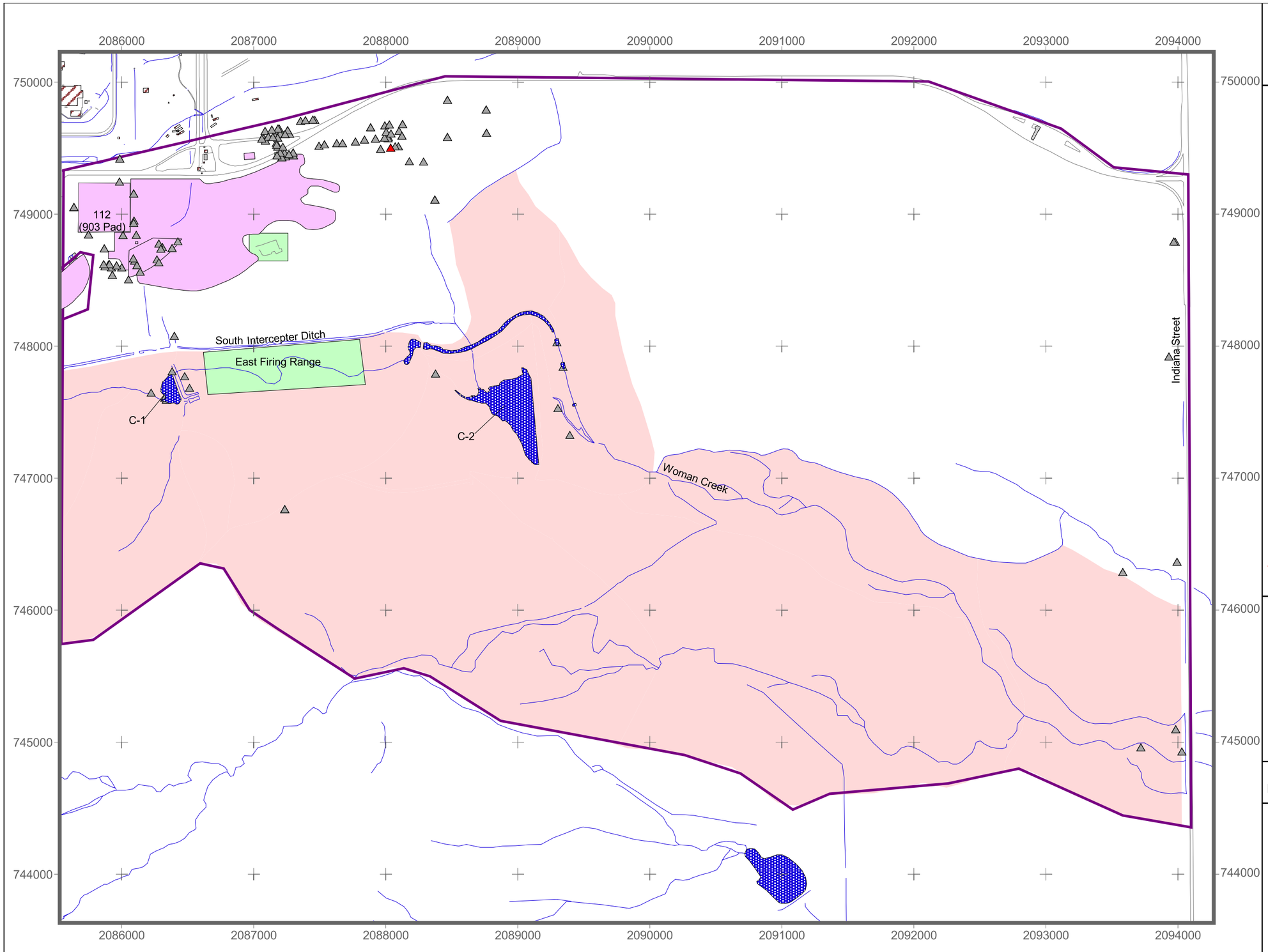
Action Level Type	Analyte(s)	Sample Location(s)	Above Action Level?	Accelerated Action Required?
Wildlife Refuge Worker	All inorganics sampled except chromium	Multiple locations	No.	No. Below Soil Action Levels for WRW.
	Chromium(VI)	12795 (3-8 ft. depth, Windblown Area) (Figure 2-16)	Yes.	No. Accelerated action not necessary for this location, based on Sub-Surface Soil Risk Screen (see Appendix B, "Location 5").
Ecological Receptor	Lead	See Figure 2-17	Yes.	No accelerated action required as part of this IM/IRA – will be evaluated in the Accelerated Action Ecological Screening Evaluation and the Comprehensive Risk Assessment.
	Beryllium	See Figure 2-17	Yes.	No accelerated action required as part of this IM/IRA – will be evaluated in the Accelerated Action Ecological Screening Evaluation and the Comprehensive Risk Assessment.
	Uranium (total)	See Figure 2-17	Yes.	No accelerated action required as part of this IM/IRA – will be evaluated in the Accelerated Action Ecological Screening Evaluation and the Comprehensive Risk Assessment.

2.3.1.5 Organic Analytes in Soil

2.3.1.5.1 Organic Analytes – From 0 to 0.5 Feet

No organic analytes were detected in soil, from 0 to 0.5 feet, above the Soil Action Level for either a WRW or Ecological Receptor.

Figure 2-16.
Chromium in Soil
> 0.5 Foot Depth
Above Wildlife Refuge Worker Action Level



KEY

- WRW Action Level Exceedance
- Below WRW Action Level
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N
W E
S

500 0 500 Feet

Scale = 1: 8850

State Plane Coordinate Projection
Colorado Central Zone
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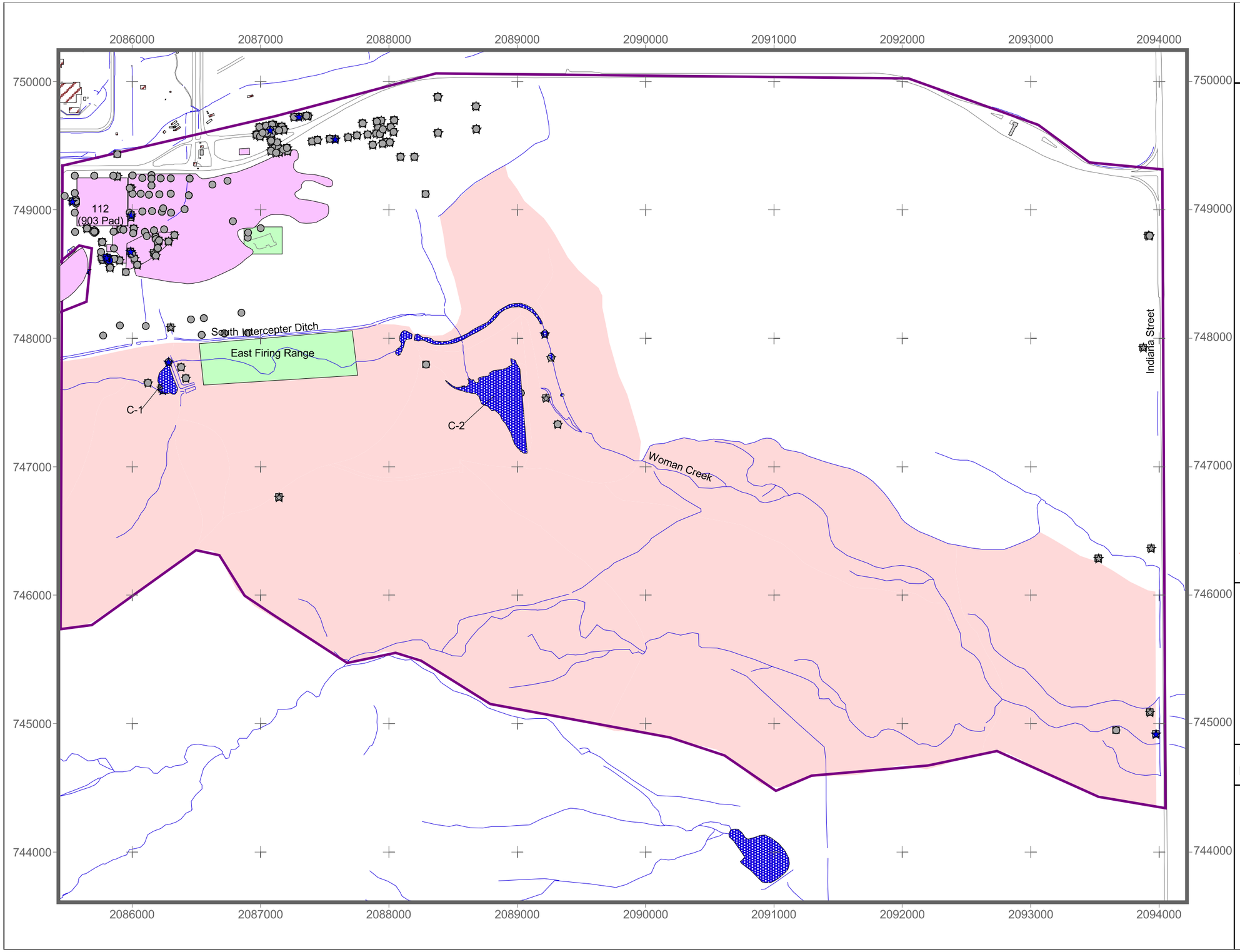
Figure 2-17.
Inorganic Analytes in Soil
> 0.5 Foot Depth
Above Ecological Receptor
Action Level



KEY

- Beryllium Exceedance
- Total Uranium Exceedance
- Lead Exceedance
- Beryllium Below Ecological Action Level
- Total Uranium Below Ecological Action Level
- Lead Below Ecological Action Level
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N
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500 0 500 Feet

Scale = 1: 8850

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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2.3.1.5.2 Organic Analytes- Soil Below 0.5 Feet

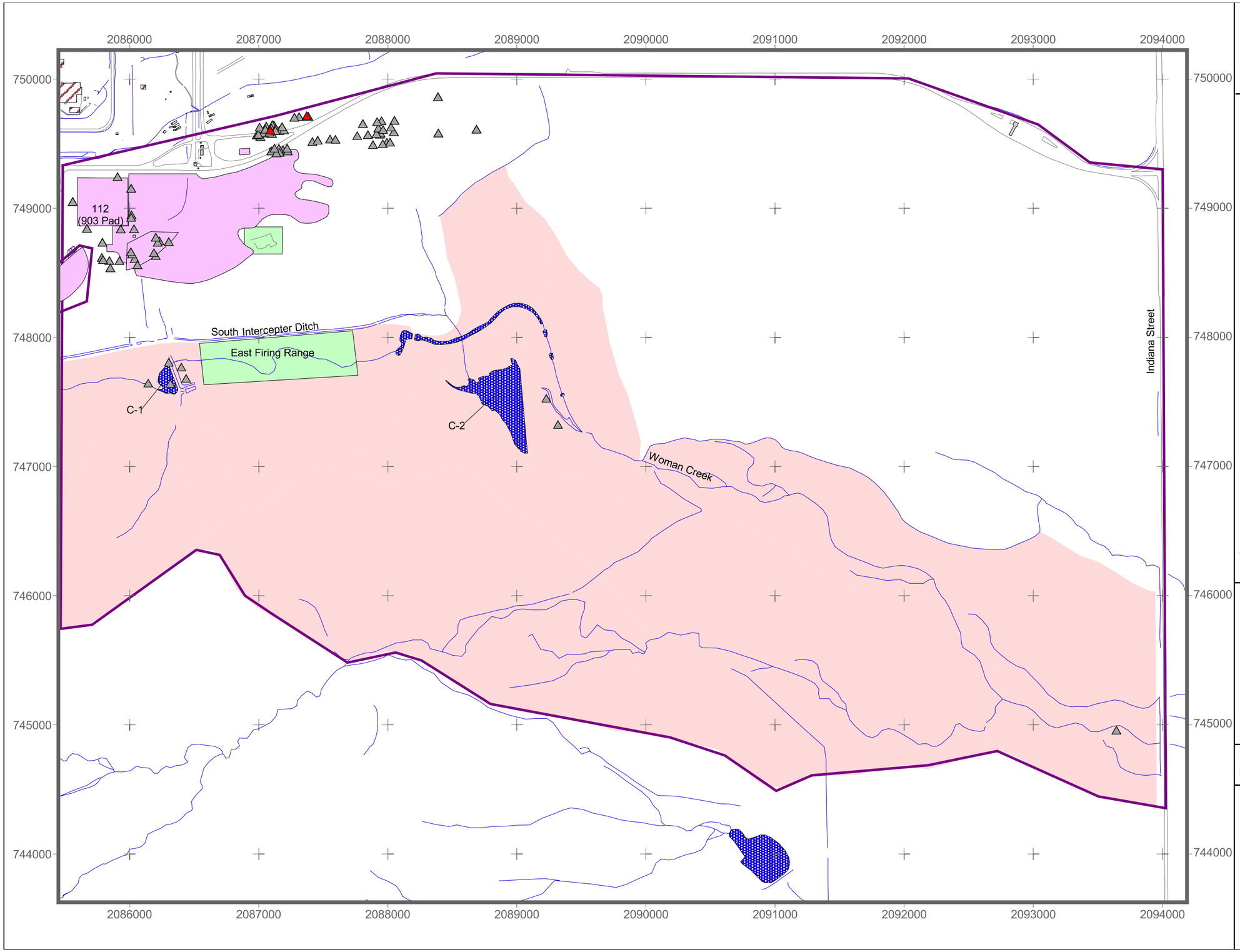
The organic analytes in soil below 0.5 feet, and their relationship to the respective Action Levels for a WRW or Ecological Receptor, are summarized in Table 2-10.

Table 2-10. Organic Analytes in Soil Below 0.5 Feet – Relative to Action Levels

Action Level Type	Analyte(s)	Sample Location(s)	Above Action Level?	Accelerated Action Required?
Wildlife Refuge Worker	All organics sampled except benzo(a)pyrene	Multiple locations	No.	No. Below Soil Action Levels for Wildlife Refuge Worker.
	Benzo(a)pyrene	10395, CV41-004 (2.5 – 7 ft., Windblown Area) (Figure 2-18)	Yes.	No. Accelerated action not necessary for this location, based on Sub-Surface Soil Risk Screen (see Appendix B, "Location 6").
Ecological Receptor	All organics sampled	Multiple locations	No.	No. Below Soil Action Levels for Ecological Receptor.

As shown in Table 2-10, there are not organic data from the SWD data query that are located near or underneath the 903 Pad that exceed RFCA Soil Action Levels. However, it is well documented that volatile organic compounds (VOCs) have been detected in the groundwater underneath the 903 Pad and in the immediate vicinity of the 903 Pad (K-H, 2003e). As noted earlier, the Groundwater IM/IRA, not this document, will address groundwater contaminants, but the groundwater data do imply that VOCs could potentially be detected in the sub-surface soil at levels that could exceed RFCA Soil Action Levels. Therefore, as an additional review of sub-surface soil data, the S*ite Characterization Report for the 903 Drum Storage Area, 903 Lip Area, and Americium Zone* (RMRS, 2000) was reviewed for VOC data in sub-surface soil. These data are displayed in this report as Figure 2-19. Comparing these data with the RFCA Action Levels did not reveal any exceedances of the RFCA Soil Action Levels for a WRW. Therefore, a Sub-Surface Soil Risk Screen is not required for VOCs located underneath the 903 Pad.

Figure 2-18.
Benzo(a)pyrene in Soil
> 0.5 Foot Depth
Above Wildlife Refuge Worker Action Level



KEY

- WRW Action Level Exceedance
- Below WRW Action Level
- Paved roads
- Streams
- Lakes
- IHSS
- PAC
- Woman Creek Watershed
- Area of Concern

N
W E
S

500 0 500 Feet

Scale = 1: 8850

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Prepared by:

Date: 12.11.03

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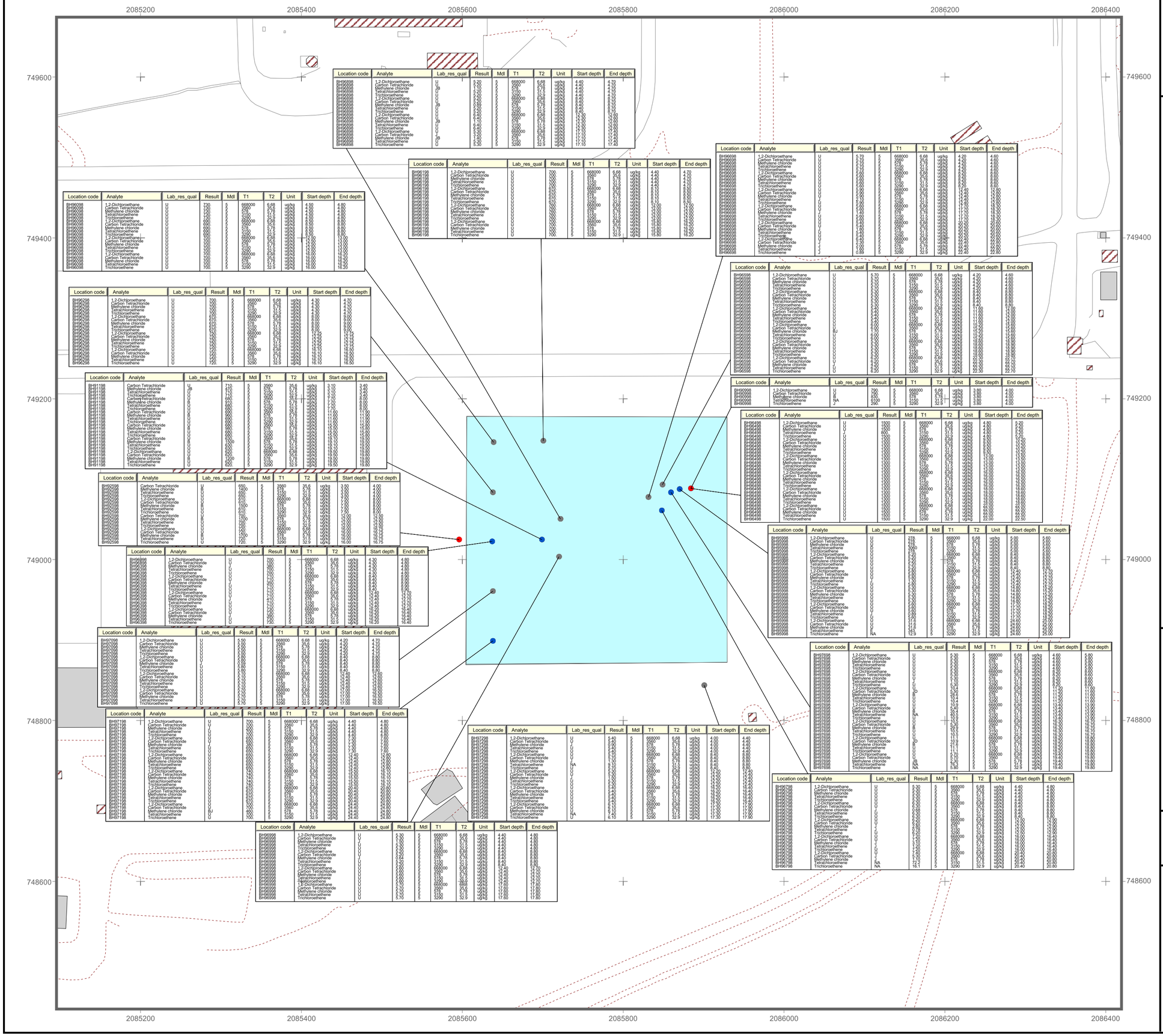

Figure 2-19.
VOC Distribution in Soil

KEY

- Tier 1 Action Level Exceedance
- Tier 2 Action Level Exceedance
- Nondetect
- Paved road
- Dirt road
- IHSS 112
- Demolished building
- Standing building

Source data from Figure 4-18 from Characterization Report for the 903 Drum Storage Area, 903 Lip Area, and Americium Zone (Final Report, September 28, 1999)

N
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60 0 60 120 Feet

Scale 1:1275

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: RADMS

Date: 05.11.04

Prepared for: KAISER-HILL COMPANY

File: W:\Projects\Fy2004\900-11_IMIRA\VOC_Characterization.apr

2.3.2 Surface Water

Measured Pu, Am, and U data are presented in Section 2.3.2.1 for RFCA Point-of-Compliance (POC) monitoring stations GS31 (Below Pond C-2) and GS01 (Woman Creek at Indiana Street)(see Figure 2-1). In addition, data are presented for the Point-of-Evaluation (Section 2.3.2.2) and Performance Monitoring (Section 2.3.2.3) stations located upstream from GS31.

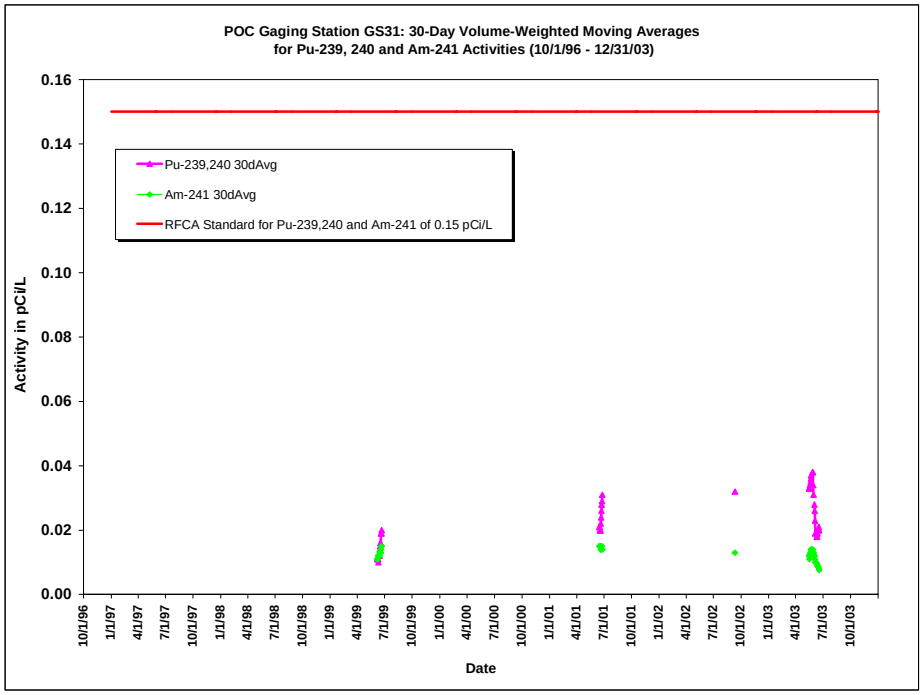
2.3.2.1 Point-of-Compliance Surface Water Monitoring Locations

Surface water monitoring data are presented for the Woman Creek watershed RFCA Point-of-Compliance locations GS31 (below Pond C-2) and GS01 (Woman Creek at Indiana Street). Data are presented for Pu, Am, and, when available, for uranium. It is noted that sampling for uranium was not conducted at the Site boundary (station GS01) until February 2003, with 30-day moving average values not available until March 2003. Data for each analyte are presented as 30-day, volume-weighted moving averages. Only days with flow are used in the calculation.

2.3.2.1.1 GS31

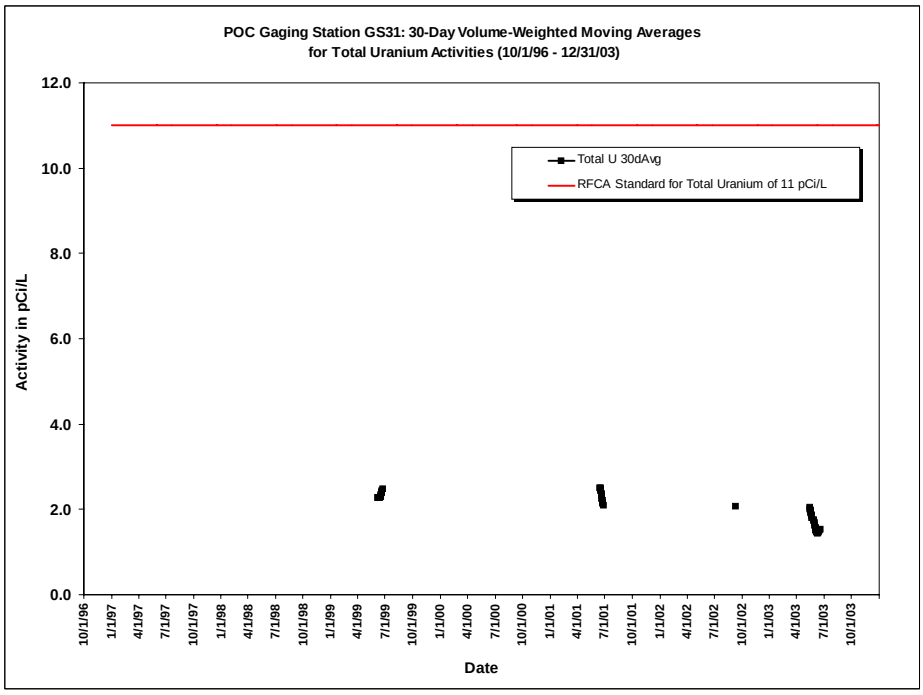
At Point-of-Compliance monitoring station GS31, the 30-day moving average for Pu, Am, and U is intermittent because of the infrequency of the discharges from Pond C-2. Pond C-2 discharges are typically performed once every one to two years, taking approximately 10 days each time. Since RFCA sampling was initiated on October 1, 1996, water discharged at station GS31 has been in continuous compliance with the 0.15 picoCurie per liter (pCi/L) Pu and Am standard, and the uranium 11 pCi/L standard, as shown in Figure 2-20 and Figure 2-21, respectively.

Figure 2-20. GS31 - Pu and Am – 30-Day Moving Average (10/1/96 – 12/31/03)



Note: Period from 10/96 to 6/99 has no values displayed because not enough samples collected from Pond C-2 discharges to calculate the 30-day moving average (average is based on days with flow). Pond C-2 discharges every 1 – 2 years.

Figure 2-21. GS31 - Uranium – 30-Day Moving Average (10/1/96 – 12/31/03)



2.3.2.1.2 GS01 (Walnut Creek at Indiana Street)

Water discharged at Point-of-Compliance monitoring station GS01 has been in continuous compliance with the 0.15 pCi/L Pu and Am standard since RFCA sampling was initiated on October 1, 1996. These data are presented in Figure 2-22. Water quality at GS01 has also been compliant with the total uranium 11 pCi/L standard, though a 30-day moving average for total uranium has only been available since March 2003 (see Figure 2-23). It is noted that flows are ephemeral in Woman Creek at GS01, hence data often do not exist for the summer and fall.

Figure 2-22. GS01 - Pu and Am – 30-Day Moving Average (10/1/96 – 12/31/03)

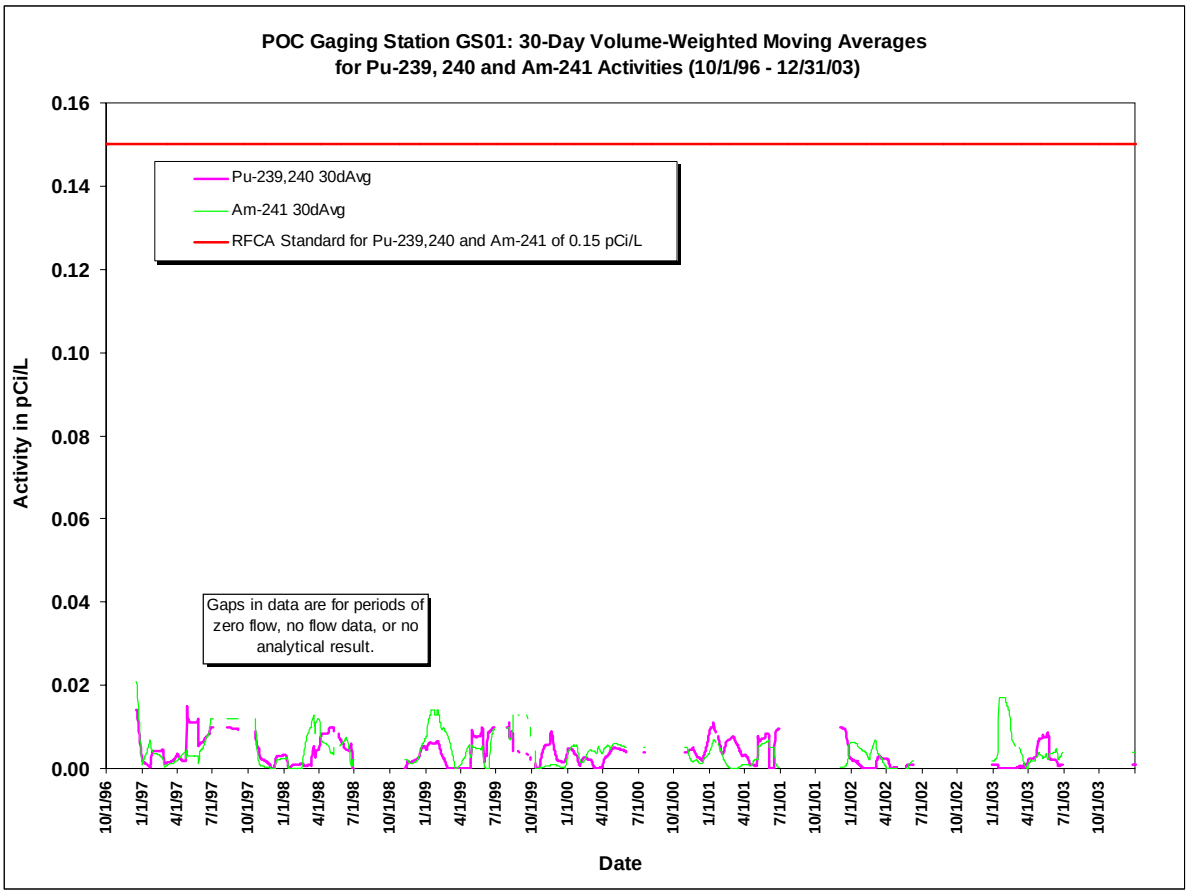
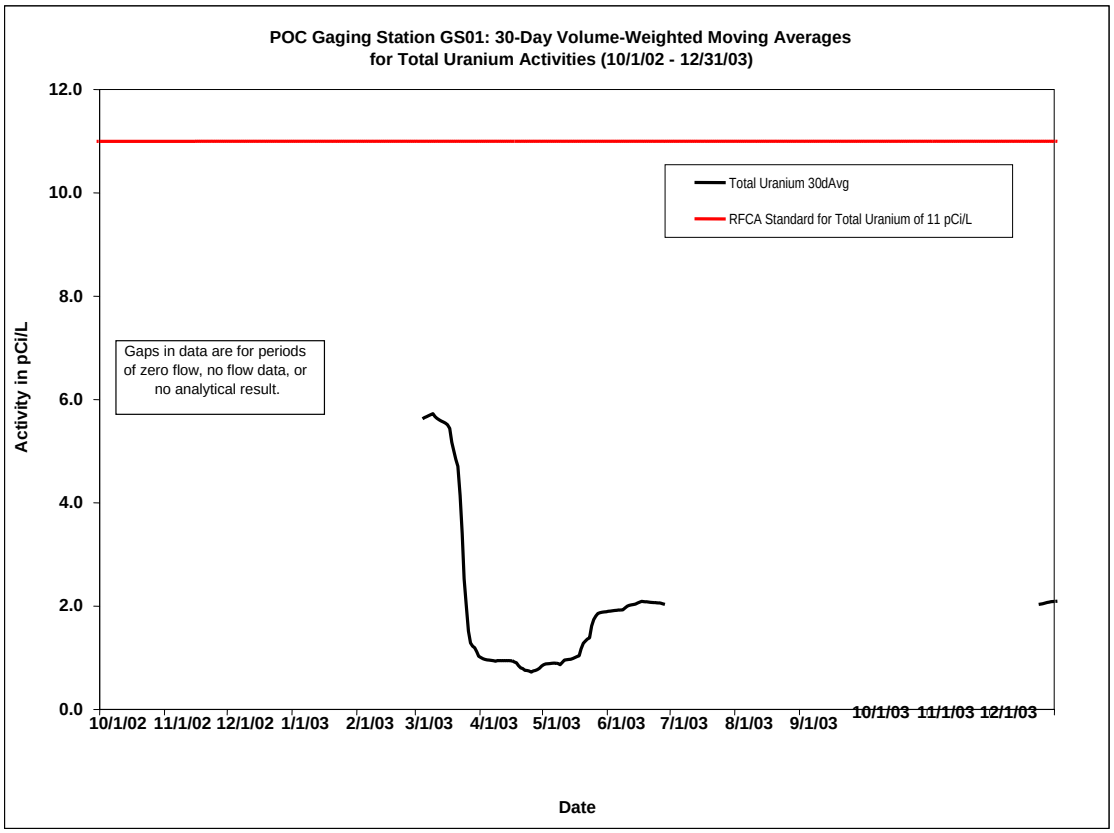


Figure 2-23. GS01 - Uranium – 30-Day Moving Average (10/1/02 – 12/31/03)



2.3.2.2 Point-of-Evaluation Surface Water Monitoring Location

Station SW027 is a Point-of-Evaluation (POE) monitoring station located on the downstream (east) end of the South Interceptor Ditch, immediately upstream from Pond C-2. Pu, Am, and U data for station SW027 are presented in Figure 2-24 and Figure 2-25. As shown in Figure 2-24, since the October 1996 startup of RFCA monitoring, there have been two times when reportable values were observed (above 0.15 pCi/L 30-day moving averages for Pu) at RFCA POE station SW027. The first reportable event occurred during the summer of 1998 and the second in the summer of 2000. In response to the 1998 reportable value event, Site personnel completed an extensive evaluation of historical data and assessed Site activities and monitoring programs as presented in the *Source Evaluation Report for Point of Evaluation SW027, October 1998* (RMRS, 1998). In the 1998 report, Site personnel

concluded that the most probable cause of the reportable 30-day moving averages for plutonium at SW027 was diffuse radionuclide contamination from past Site operations released to the environment through events and conditions over past years, particularly from the 903 Pad.

For the second reportable occurrence, first reported on September 12, 2000, the subsequent "source evaluation" analysis, required by RFCA, again reported no specific localized source. The legacy soil contamination associated with the area surrounding the 903 Pad was indicated to be the cause of the reportable value (DOE, 2001c). The report did note that ongoing use of Pond C-2 (via the South Interceptor Ditch) should be continued to promote passive settling of solids with its resulting benefit to water quality.

It is noted that the accelerated action proposed in this IM/IRA (see Section 5.0) will remove soil from the area identified as the cause of the reportable values at SW027. Therefore, the accelerated action in this IM/IRA should provide long-term beneficial impact to water quality measured at Station SW027.

Figure 2-24. SW027 - Pu and Am – 30-Day Moving Average (10/1/96 – 12/31/03)

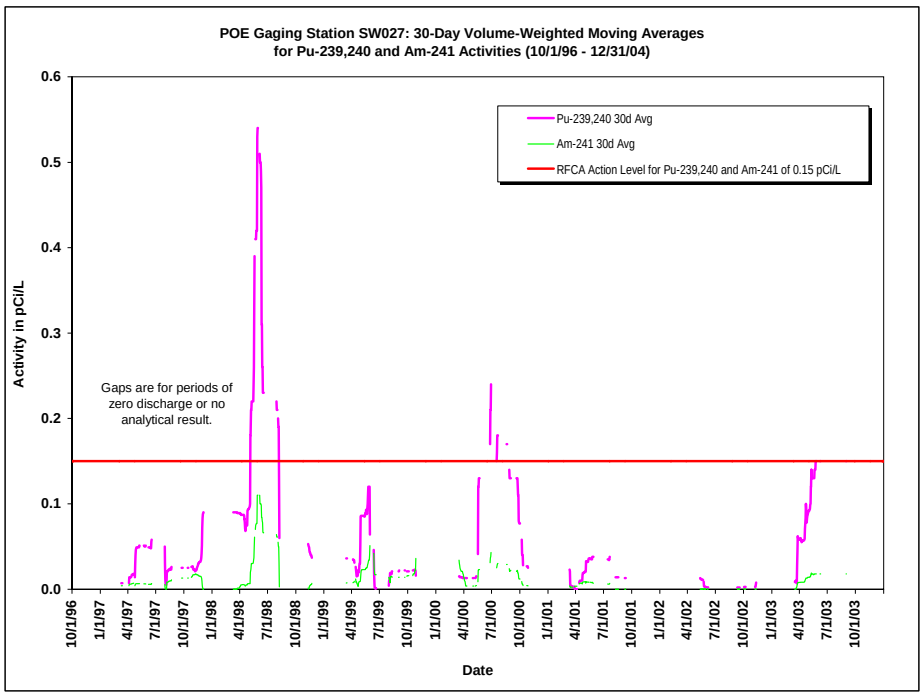
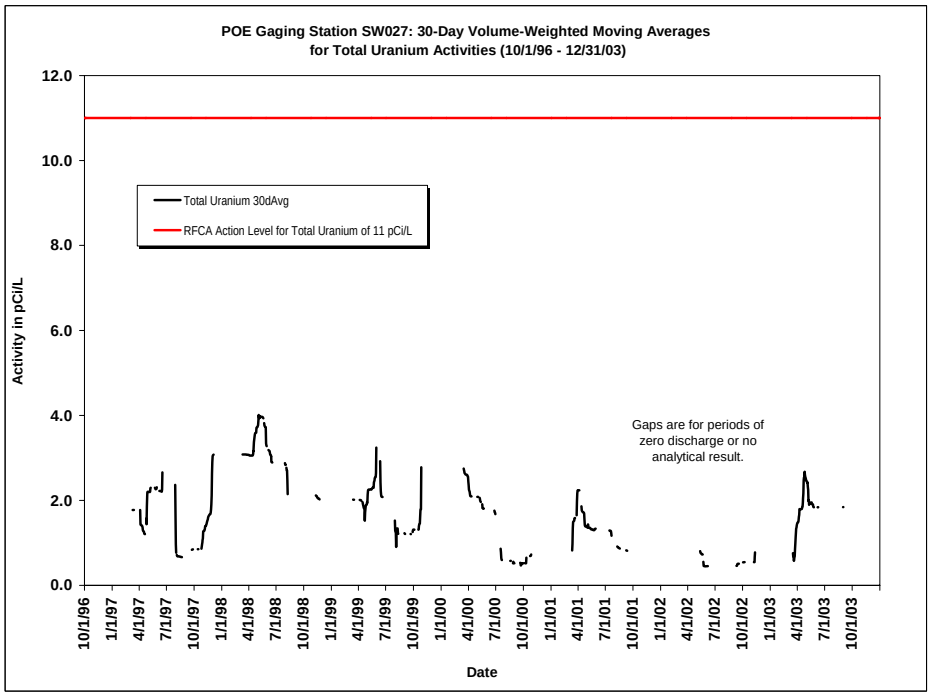


Figure 2-25. SW027 – Uranium – 30-Day Moving Average (10/1/96 – 12/31/03)



2.3.2.3 Performance Monitoring Surface Water Monitoring Locations

Table 2-11 presents Pu and Am surface water data collected at Performance Monitoring locations in the 900-11 Area. Temporal plots of the data are displayed in Appendix C. Locations of the Performance Monitoring stations are shown on Figure 2-1. Operation start dates for the locations vary based on when the stations were installed. The number of samples collected from each location vary as a function of the runoff at the different stations, which are all situated in ditches that are nearly always dry.

Table 2-11. 900-11 Area Surface Water Performance Monitoring Locations – Pu and Am Sample Results (through 11/6/03)

Station	Start Date of Operation	Pu				Am			
		Maximum (pCi/L)	Mean (pCi/L)	Std. Dev. (pCi/L)	# of samples	Maximum (pCi/L)	Mean (pCi/L)	Std. Dev. (pCi/L)	# of samples
SW055	5/22/01	34.000	4.193	9.005	13	3.430	0.477	0.877	13
GS51	8/14/01	8.360	3.595	2.638	9	2.110	0.748	0.640	9
GS52	7/26/01	0.953	0.547	0.264	6	0.129	0.080	0.038	6
GS53	7/26/01	1.655	1.013	0.452	4	0.235	0.144	0.061	4
GS54	8/23/01	0.139	0.077	0.088	2	0.002	0.002	0.000	2
GS42	6/23/98	1.36	0.906	0.315	6	0.170	0.124	0.028	6

Note: All stations remain in operation as of 11/6/03.

2.3.3 Groundwater

Groundwater contaminant issues for the 900-11 Area will be addressed by the Groundwater IM/IRA, which is being developed to provide a comprehensive, Site-wide evaluation of groundwater contaminants and accelerated actions, if necessary.

2.3.4 Air

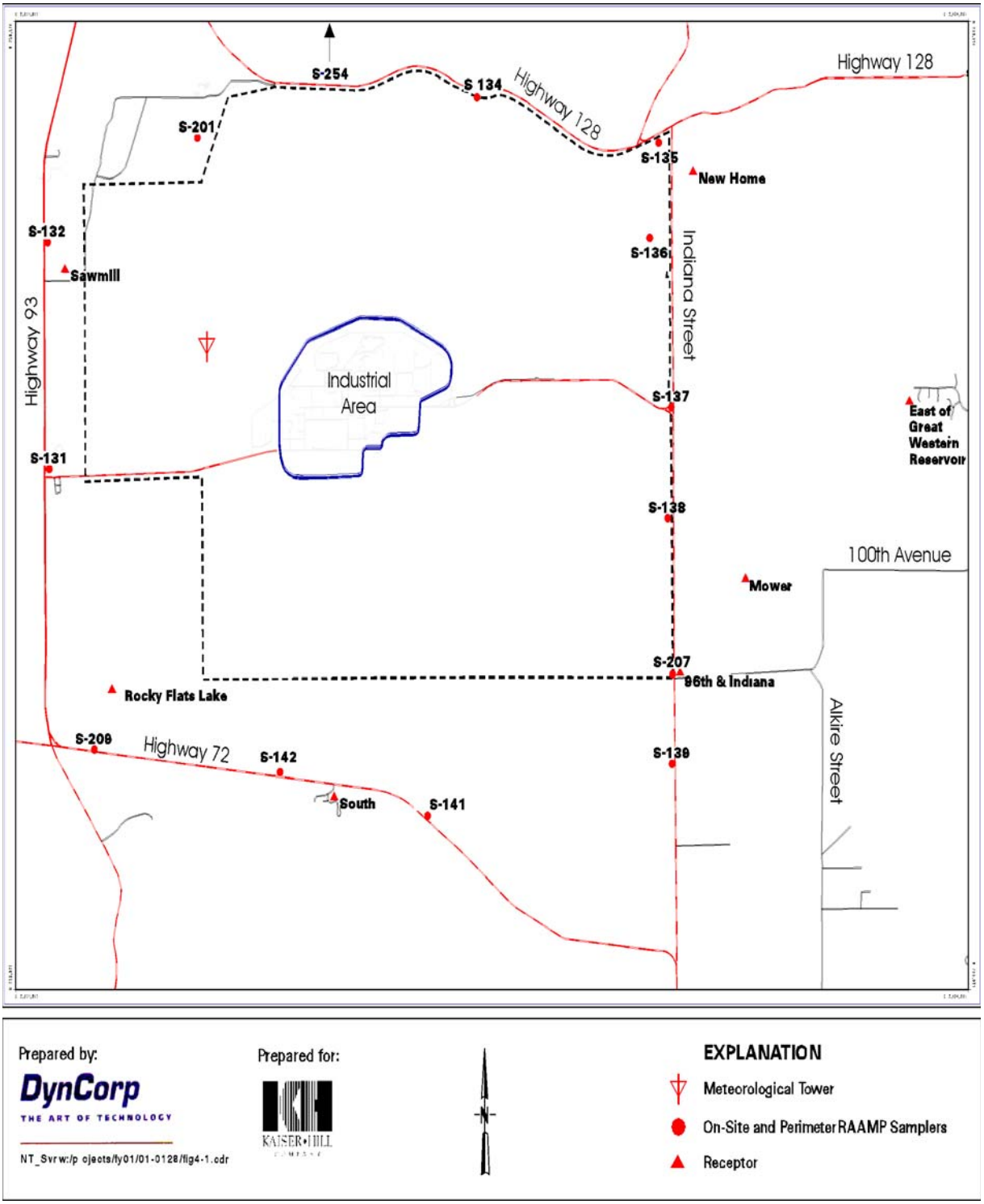
2.3.4.1 Site Boundary - Air Monitoring Results

RFETS is subject to the *National Emission Standards for Emission of Radionuclides Other than Radon from Department of Energy Facilities* (Title 40 of the Code of Federal Regulations [CFR], Part 61, Subpart H). The standard requires that emissions of radionculides to the ambient air from the Site not exceed those amounts that would cause any member of the public to receive in any 12-month period an effective dose equivalent of 10 millirem (mrem) (0.1 milliSieverts [mSv]). Monitoring results from RFETS are provided each year in a report to the EPA and

CDPHE. Radionuclide Air Emissions Annual Reports for calendar years 1989 through 2002 indicate RFETS has been in continual compliance with the 10 mrem standard during that period (DOE, 1990; 1991; 1992; 1993; 1994; 1995b; 1996; 1997; 1998; 1999b; 2000; 2001b; 2002b; 2003d).

The Site currently demonstrates compliance with the standard through alternative environmental monitoring approved by EPA and CDPHE. The Site operates a network of high-volume, size-fractionating ambient air samplers located on and around the Site, and in nearby communities. To monitor for compliance with 40 CFR Part 61, Subpart H, the Site uses 14 of these samplers located along the Site perimeter (Figure 2-26) (DOE, 2002b).

Figure 2-26. Air Monitoring Compliance Sampling Network



The maximum annual concentrations of Pu-239/240, Am-241, U-233/234, U-235, and U-238 measured in the compliance sampling network are compared to the compliance levels listed in Appendix E of 40 CFR 61 (shown in bottom row of Table 2-12). For 2002, the maximum measured concentration of each isotope, as shown in Table 2-12, was less than 1% of the corresponding compliance level. In addition, the fractional sum of all isotopes at the *critical receptor* location (the sampler showing the highest concentrations in 2002) was determined to be 0.0156 (the fractional sum must be 1 or less)(DOE, 2002b). The facility is in compliance when the annual concentration of each isotope is less than its corresponding compliance level and the fractional sum of all isotopes is less than 1.

For additional information on compliance monitoring for airborne radionuclides, the suggested reference is *Radionuclide Air Emissions Annual Report, Calendar Year 2002. Rocky Flats Environmental Technology Site*. (DOE, 2002b).

Table 2-12. 2002 Annual Average Isotopic Concentrations at Compliance Sampling Network Locations

	Pu-239/240 (Ci/m^3)	Am-241 (Ci/m^3)	U-233/234 (Ci/m^3)	U-235 (Ci/m^3)	U-238 (Ci/m^3)	Fractional Sum
Compliance Level (Ci/m^3)[a]	**2.0E-15**	**1.9E-15**	**7.1/7.7E-15**	**7.1E-15**	**8.3E-15**	**1**
Sampler						
S-131	8.75E-19	4.03E-19	3.85E-17	1.80E-18	3.69E-17	0.0108
S-132	8.56E-19	5.68E-19	5.51E-17	3.22E-18	5.55E-17	0.0156
S-134	3.17E-19	3.39E-19	2.82E-17	1.42E-18	2.88E-17	0.0080
S-135	7.98E-19	3.07E-19	3.03E-17	1.91E-18	3.12E-17	0.0089
S-136	1.41E-18	2.73E-19	2.55E-17	1.39E-18	2.62E-17	0.0078
S-137	2.54E-18	3.15E-19	2.84E-17	1.59E-18	2.84E-17	0.0091
S-138	3.08E-18	4.45E-19	2.79E-17	1.52E-18	2.89E-17	0.0094
S-139	7.43E-19	1.11E-19	3.97E-17	2.15E-18	4.01E-17	0.0112
S-141	4.92E-19	1.71E-19	3.35E-17	2.08E-18	3.17E-17	0.0092
S-142	5.05E-19	6.79E-20	3.06E-17	2.06E-18	3.18E-17	0.0087
S-201	4.59E-19	1.93E-19	4.01E-17	1.66E-18	3.82E-17	0.0108
S-207	3.69E-18	6.01E-19	3.76E-17	1.96E-18	3.61E-17	0.0121
S-209	6.66E-19	1.61E-19	3.34E-17	1.71E-18	3.40E-17	0.0095
S-254	8.29E-19	3.60E-19	4.51E-17	2.27E-18	4.62E-17	0.0128

(Source: DOE, 2002b) [a] *Compliance levels are listed for each isotope in Table 2 of Appendix E to 40 CFR 61.*

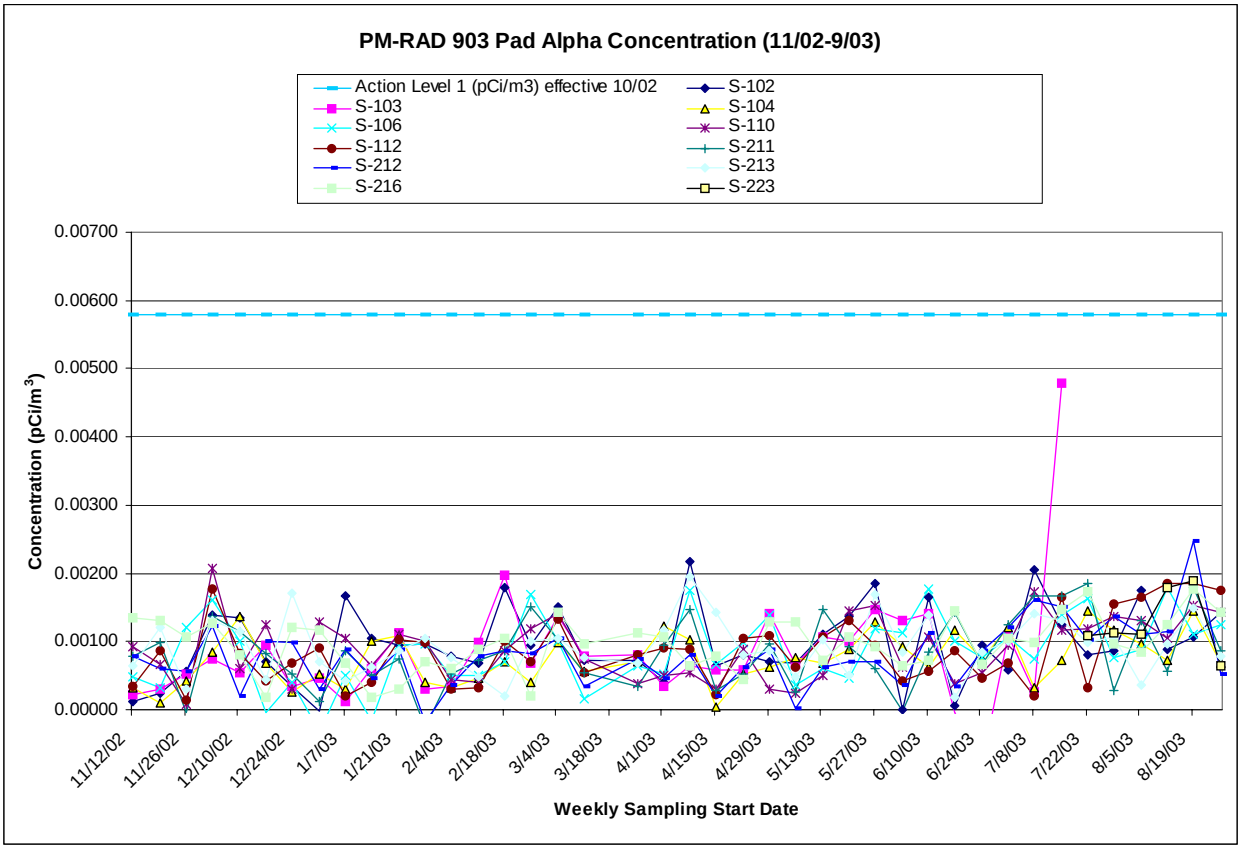
Notes:

Am = Americium
Ci/m^3 = Curies per cubic meter; 1 Ci = 3.7×10^{10} Becquere1 (Bq)
E# = $\times 10^{\#}$
Pu = Plutonium
U = Uranium

2.3.4.2 903 Pad Project Specific Rad Network – Air Monitoring Results

In addition to the compliance air monitoring performed at the Site boundary, air monitoring is also performed around the perimeter of the 903 Pad and Lip Area. Results from these samplers, for the period from November 2002 through August 2003 (during the 903 Pad remediation), are presented in Figure 2-27, with results presented relative to Action Level 1, which is approximately 10 percent of the 10 mrem standard. The results presented in Figure 2-27 correspond with air monitoring station locations displayed in Figure 2-28.

Figure 2-27. 903 Pad PM Rad Network – Air Monitoring Results



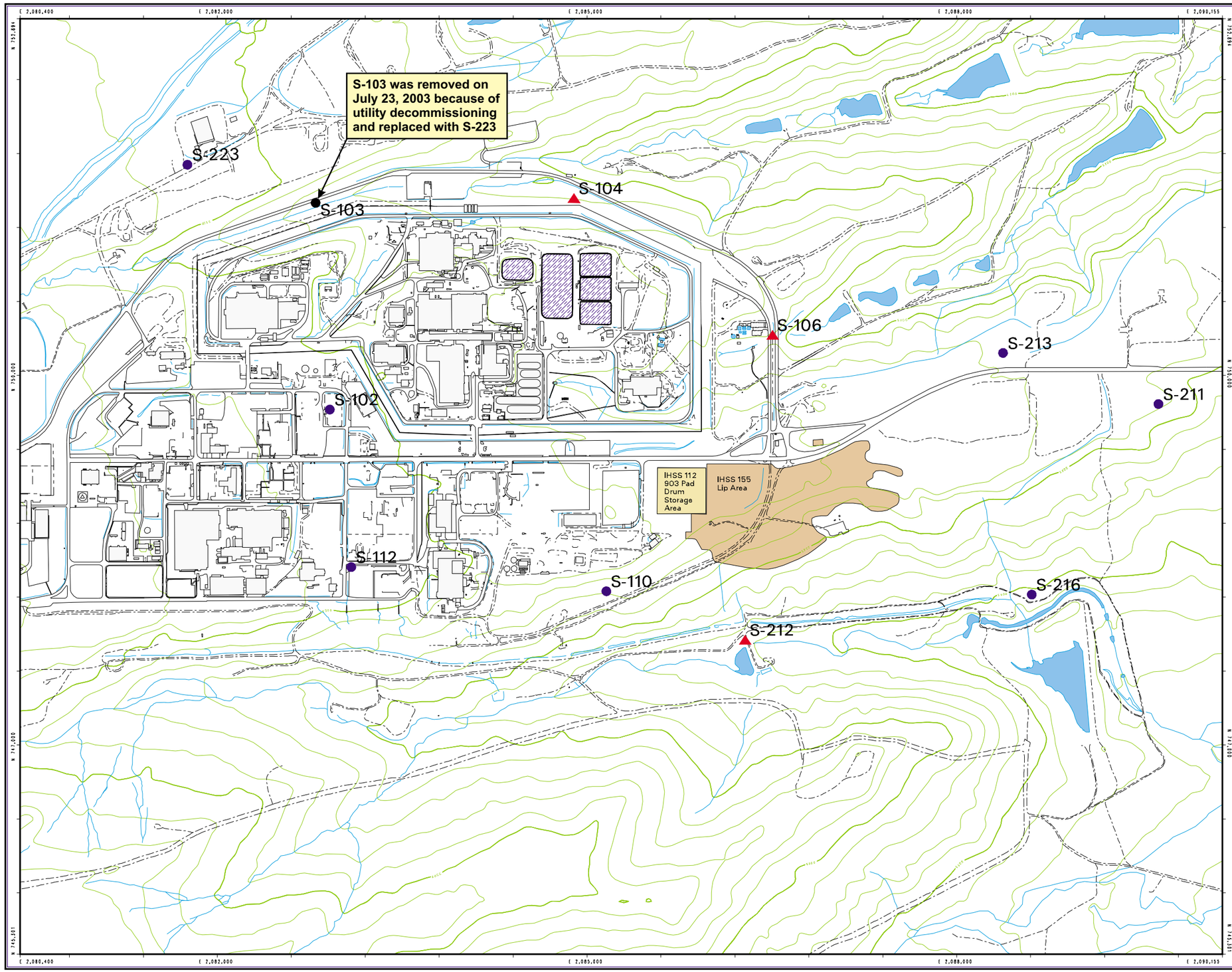


Figure 2-28

Performance Monitoring for Radionuclides Network

Air Sampling

EXPLANATION

- 903 Pad Remediation Project (IHSS 112 & 155)
- Shared Sampler
- IHSS 112
- IHSS 155

Standard Map Features

- Buildings and other structures
- Solar Evaporation Ponds (SEPs)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Topographic Contour (20-Foot)
- Paved roads
- Dirt roads

DATA SOURCE BASE FEATURES:

Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSI, Las Vegas. Digitized from the orthophotographs. 1/95

Topographic contours were derived from digital elevation model (DEM) data by Morrison Knudson (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

N

Scale = 1 : 9800
1 inch represents approximately 817 feet

250 0 500 1000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

GIS Dept. 303-966-7707

DRAFT

January 15, 2004

NT_Svr w:/projects/fy2004/04-0029/perf_monitoring_rad_net_fig2-28.aml

2.3.5 Summary – RFCA Action Level Comparison

A summary of soil data contaminant concentrations, from samples collected at depths from 0 to 0.5 feet, are compared to the respective RFCA Action Level or standard in Table 2-13. Data are presented for radionuclides, as well as for: 1) other contaminants with sample results above their respective Action Level, or 2) other contaminants of interest.

Table 2-13. Summary - Measured Soil Contaminant Data Compared to RFCA Action Levels (sample depth 0 to 0.5 feet)

Environ-mental Media	Contaminant	RFCA Action Level for WRW	Regulatory Reference	Max. Result in Study Area	Sample Location	Above A.L. in Study Area?
Soil (0 - 0.5 ft)						
	Pu-239/240	50 pCi/g	RFCA, Att. 5	14950 pCi/g	BH94098	Yes
	Am-241	76 pCi/g		3140 pCi/g	BH94098	Yes
	U-234	300 pCi/g		89.3 pCi/g	SS100293	No
	U-235	8 pCi/g		3.5 pCi/g	SS100193	No
	U-238	351 pCi/g		75.7 pCi/g	BH94098	No
	Sum-of-Ratios	1.0		170.5	BH94098	Yes
	Benzo(a)pyrene	3,490 μg/kg		3900 μg/kg	SED125	Yes
	Lead	See note 1		See note 1	SE-1602	-
	Antimony	See note 1		See note 1	SE-1602	-
	Arsenic	See note 1		See note 1	SE-1602	-

Notes:

1) Elevated soil concentrations of Potential Contaminants of Concern (PCOCs) lead, antimony, arsenic, and depleted uranium are suspected to exist in the PAC SE-1602 area (firing range). Characterization of this area is currently being planned, but has not yet been performed. Therefore, these analytes are listed as PCOCs because soil concentration data in this area does not currently exist.

2) For additional discussion regarding comparisons of measured data with RFCA Action Levels, see Sect 5.1.5.

Table 2-14 provides a summary of soil data, collected from a depth between 0.5 and 3 feet, with contaminant concentrations compared to the respective RFCA Action Level or standard. Data are presented for radionuclides, as well as for: 1) other contaminants with sample results above their respective Action Level, or 2) other contaminants of interest. It is noted that only Pu-239/240 and Am-241, with WRW Action Levels down to 3 feet, have Action Levels below 0.5 feet. However, data are presented for other contaminants below 0.5 feet because the Sub-Surface Soil Risk Screen applies where soil contamination exists at levels higher than the relevant WRW Action Level.

Table 2-14. Summary - Measured Soil Contaminant Data Compared to RFCA Action Levels (sample depth 0.5 to 3 feet)

Environ-mental Media	Contaminant	RFCA Action Level for WRW	Regulatory Reference	Max. Result in Study Area	Sample Location	Above A.L. in Study Area?
Soil (0.5 - 3 ft)						
	Pu-239/240	50 pCi/g	RFCA, Att. 5	1820 pCi/g	BH95198	Yes
	Am-241	76 pCi/g		406 pCi/g	BH95198	Yes
	U-234	300 pCi/g		170.4 pCi/g	13395	No
	U-235	8 pCi/g		8.6 pCi/g	13395	Yes
	U-238	351 pCi/g		288.4 pCi/g	13395	No
	Lead	See note 1		See note 1	SE-1602	-
	Antimony	See note 1		See note 1	SE-1602	-
	Arsenic	See note 1		See note 1	SE-1602	-

1) Elevated soil concentrations of Potential Contaminants of Concern (PCOCs) lead, antimony, arsenic, and depleted uranium are suspected to exist in the PAC SE-1602 area (firing range). Characterization of this area is currently being planned, but has not yet been performed. Therefore, these analytes are listed as PCOCs because soil concentration data in this area does not currently exist.

Table 2-15 provides a summary of surface water data for radionuclides, compared to the respective RFCA Action Levels. Table 2-16 provides a summary of air quality data for radionuclides compared to the 40 CFR Part 61, Subpart H standard. Groundwater data are not presented because groundwater is not addressed in this IM/IRA.

Table 2-15. Summary – Surface Water Quality Data Compared to RFCA Action Levels

Environ-mental Media	Contaminant	RFCA Action Level for WRW	Regulatory Reference	Max. Result in Study Area (30-day average)	Sample Location	Sample Date / Period	Above A.L. in Study Area?
Surface Water		Units = pCi/L		Units = pCi/L			
	POC Station:	**GS31**					
	Pu-239/240	0.15 pCi/L (30-day avg.)	RFCA, Att. 5	0.038	GS31	10/1/96 – 12/31/03	No
	Am-241	0.15 pCi/L (30-day avg.)		0.015	GS31	10/1/96 – 12/31/03	No
	Total U	11 pCi/L (30-day avg.)		2.497	GS31	10/1/96 – 12/31/03	No
	POC Station:	**GS01**					
	Pu-239/240	0.15 pCi/L (30-day avg.)	RFCA, Att. 5	0.015	GS01	10/1/96 – 12/31/03	No
	Am-241	0.15 pCi/L (30-day avg.)		0.021	GS01	10/1/96 – 12/31/03	No
	Total U[1]	11 pCi/L (30-day avg.)		5.724	GS01	10/1/02 – 12/31/03	No

1) Uranium was added to the GS01 Analyte of Interest list on 10/1/02. Uranium results for GS01 are reported for the time period during which it has been an Analyte of Interest.

Table 2-16. Summary – Air Quality Data Compared to 40 CFR 61, Subpart H Standard

Environ-mental Media	Contaminant	Standard	Regulatory Reference	Max. Result in Study Area (30-day average)	Sample Location	Sample Date / Period	Above A.L. in Study Area?
Air		Units = pCi/m^3		Units = pCi/m^3			
	Pu-239/240	2.0E-15	40 CFR 61, Subpart H	3.69E-18	S-209	2002	No
	Am-241	1.9E-15		6.01E-19	S-209	2002	No
	U-234	7.1 / 7.7E-15		5.51E-17	S-132	2002	No
	U-235	7.1 E-15		3.22E-18	S-132	2002	No
	U-238	8.3E-15		5.55E-17	S-132	2002	No
	Fractional Sum	1 (unitless)		0.0156 (unitless)	S-132	2002	No

3.0 REMEDIAL ACTION OBJECTIVES

Based on environmental contaminant data presented for the Area of Concern (Section 2.3), and a comparison of that data with the relevant Action Levels, as well as results of Sub-Surface Soil Risk Screens, RAOs were identified for this IM/IRA. RAOs for different environmental media and subject matters are discussed in Sections 3.1 through 3.4.

3.1 SOIL

The RAOs for soil addressed by this IM/IRA are summarized in Table 3-1. Soil Action Levels, and their applicable depth intervals, are delineated in RFCA, Attachment 5. Soil characterization data indicate that accelerated action will be required for soil in the IM/IRA area of concern to comply with soil action levels.

Table 3-1. Summary of Soil Remedial Action Objectives for the 900-11 Area.

Contaminant of Concern	Depth	Remedial Action Objective
Pu-239/240	0 – 3 feet	50 pCi/g or less
Am-241	0 – 3 feet	76 pCi/g or less
Sum-of-Ratios	0 – 3 feet	1.0 or less
Lead[1]	0 – 0.5 feet	1000 mg/kg or less
Arsenic[1]	0 – 0.5 feet	22.2 mg/kg or less
Antimony[1]	0 – 0.5 feet	40.9 mg/kg or less

Note: [1]Potential Contaminant of Concern for PAC-SE-1602 (Firing Range)

3.2 SURFACE WATER

Accelerated actions are not required in the IHSS Group 900-11 area to bring surface water quality into compliance. Surface water quality measured at the Points-of-Compliance downstream from the IHSS Group 900-11 Area (GS31 [below Pond C-2] and GS01 [at Woman Creek and Indiana Street]) has been in continual compliance with applicable water quality standards since RFCA-based surface water monitoring began on October 1, 1996 (see Section 2.3.2.1).

Protection of surface water quality in the long-term is an RAO. In the near-term, if an accelerated action involves disturbance of surface soil, that action can potentially accelerate soil erosion processes by surface water and thereby impact surface water quality. Minimizing impacts to surface water quality is to be considered in the evaluation of alternative accelerated actions. It is noted, however, that any accelerated actions taken should serve to improve surface water quality over the long term and therefore achieve the RAO.

3.3 AIR

Accelerated actions are not necessary in the IHSS Group 900-11 area to bring air quality into compliance. Air quality monitored at the Site boundary has been in continual compliance with the 10 mrem standard for airborne radionuclides (per 40 CFR 61, Subpart H) since the regulation was promulgated on December 15, 1989 (DOE, 1990 and Federal Register, 1989). Protection of air quality in the long-term is an RAO. In the near-term, if an accelerated action involves disturbance of surface soil, that action can potentially accelerate wind erosion processes and thereby impact air quality. Minimizing impacts to air quality is to be considered in the evaluation of alternative accelerated actions. It is noted, however, that any accelerated actions taken should serve to improve air quality over the long term and therefore achieve the RAO.

3.4 GROUNDWATER

Groundwater contaminant issues for the IHSS Group 900-11 area will be addressed by the Groundwater IM/IRA.

4.0 ALTERNATIVE SELECTION PROCESS

4.1 INTRODUCTION TO THE ACCELERATED ACTION ALTERNATIVES

The accelerated action alternatives presented in this section were developed to address the RAOs identified in Section 3. As previously noted, based solely on comparisons with relevant Action Levels and standards, soil is the only environmental media in the area of concern that requires an accelerated remedial action. Surface water *does not* require an accelerated action, based on a comparison of measured surface water quality with applicable RFCA standards. However, to address community concerns, accelerated actions to address improvement of surface water quality beyond the RFCA standards are considered in the alternatives analysis presented in this Section.

4.1.1 Radionuclides in Soil

The required remedy for radionuclides in surface soil that are present above their respective RSAL is specified clearly in RFCA (DOE, 2002a). These soils, including soil with combined radionuclide activity above the RSAL for SOR, must be removed until the activity is measured below the RSAL. In terms of the accelerated action alternatives presented in Section 4.2, all of the alternatives involve removing soil with contamination above RSALs, except for the No Action alternative (Alternative 1).

The radionuclides specifically addressed by the accelerated action alternatives are Pu and Am, because of their presence in the IHSS Group 900-11 soils at concentrations above their respective RSALs (Section 2.3.1.2). In contrast, uranium isotopes are not present at levels above their RSALs in the 0 to 0.5 foot range (the applicable depth for uranium RSALs as specified in RFCA, Attachment 5). Below 0.5 feet, one location does exist with U-235 above the RSAL. However, that location does not warrant remediation based on the Sub-Surface Soil Risk Screening Analysis (see Section 2.3.1.1.2). In addition, uranium concentrations in surface water in the Woman Creek drainage have continually been in compliance at the Point of Evaluation and Points of Compliance (see Section 2.3.2). Therefore, for radionuclides, data do not indicate that uranium, by itself, warrants accelerated action.

4.1.2 Non-Radionuclides in Soil

For non-radioactive contaminants above their respective Action Levels, there are two specific areas (one IHSS and one PAC) within the area addressed by this IM/IRA, with pre-determined requirements for accelerated actions, as specified by the regulatory agencies. These two areas are identified in Sections 4.1.2.1 and 4.1.2.2.

4.1.2.1 IHSS 140

IHSS 140 (Hazardous Disposal Area) will be subject to a soil removal action for metals, at the same time the accelerated action for radionuclides in surface soil is being performed. This specific action for IHSS 140 is included with the description of the overall accelerated action provided in Section 4.2.

4.1.2.2 PAC-SE-1602

For PAC-SE-1602 (East Firing Range), a plan has been agreed upon with the regulatory agencies for an accelerated action for the northern portion of the East Firing Range (K-H, 2003g). The plan for this area is included with the description of the overall accelerated action provided in Section 4.2. However, additional characterization work for other areas of the Firing Range (other than the North Firing Range) still needs to be performed, as described in the Sampling and Analysis Plan for PAC SE-1602 (K-H, 2003g). An accelerated action for the other areas in PAC-SE-1602 is potentially required, but is not presently defined (pending completion of additional characterization work) and is therefore not included with the alternatives below.

4.1.3 Surface Water Quality

An accelerated action is not required to meet surface water standards at Point-of-Compliance station GS01 (Woman Creek at Indiana Street) given the current surface management configuration. Water quality measured at station GS01 has been continually compliant with the RFCA standard for Pu and Am since the inception of RFCA monitoring (October 1996). For perspective, compared to the 0.15 pCi/L RFCA standard, the historic median concentration of Pu at GS01 (from Water Year 1997 through 2002) is approximately 0.002 pCi/L. The historic

maximum concentration of Pu at GS01 during that period is 0.024 pCi/L (or roughly an order of magnitude below the standard) (K-H, 2003f).

Although an accelerated action is not specifically required to meet surface water standards at Point-of-Compliance station GS01, actions could be taken to provide additional assurance to stakeholders regarding reducing the amount of actinide mass loading to Woman Creek. For example, specific areas exist within the GS01 basin which currently run off directly to Woman Creek but that could be routed, via diversion channels, into Pond C-2. Routing runoff from these areas into Pond C-2, for retention and settling of suspended solids, would potentially provide additional protection for the water quality in Woman Creek. This option to divert runoff in the Woman Creek watershed (Alternative 3) was included in the alternatives analysis process to address stakeholder concerns (see Section 4.4.2.2).

Two other options for accelerated action were also considered for this area to address stakeholder concerns about low levels of residual actinides in the soil, and the potential impact on water quality. These other options include: 1) construct an engineered rock layer for added erosion protection over a wide expanse of the Woman Creek watershed, and 2) excavate and remove surface soil from a large expanse of the Woman Creek watershed. These two other options were not retained as alternatives and are discussed in Section 4.3 and Appendix D.

4.2 DESCRIPTION OF ALTERNATIVES

Three alternatives were identified as potential accelerated action options for the areas addressed by this IM/IRA, including the No Action alternative. A listing and brief description of the alternatives is provided in Table 4-1. Conceptual diagrams of these alternatives are presented in Figure 4-1, and their analysis is discussed in Section 4.4.

Table 4-1. Summary of Accelerated Action Alternatives

Alternative	Description	Major Components of the Alternative
1	No Further Accelerated Action	**Area: Entire Area of Concern** Action No accelerated actions performed (beyond those already completed or in progress for the 903 Pad and Inner Lip Area) Basis for action The "No Action" alternative provides a baseline reference to assess the implications if no accelerated action is performed.
2	Soil Removal (Several Areas) and Surface Water Monitoring	**Area: 903 Pad Outer Lip Area** Action Remove and dispose of soil from the 903 Outer Lip Area (IHSS 155) and nearby isolated areas where actinide soil activity exceeds the respective Radionuclide Soil Action Levels (RSALs)(for Pu, Am, and Sum-of-Ratios [SOR]). Confirmation sampling will be performed in areas where soil is removed. If confirmation sample does not meet RSAL, additional soil will be removed. Approximate area impacted: 23.5 acres (see Appendix G for map of soil removal area). Basis for action Soil removal is performed to comply with RSALs. RSALs were developed based on calculations for a WRW exposure to soil, and represent a 1×10^{-5} excess cancer risk, though Pu RSAL is more stringent. (see RFCA, Attachment 5 for detail [DOE, 2003c]).
		Area: OU1 (soil from 0 to 0.5 feet in IHSS 119.1) Action Remove surface soil from isolated location in OU1 (IHSS 119.1) where the sum-of-ratios value is greater than 1. Basis for Action Sum-of-ratios for radionclides exceeds 1.0 (RSAL for SOR).
		Area: IHSS 140 (Hazardous Disposal Area) Action Remove soil in IHSS 140 (Hazardous Disposal Area) from pits used for reactive metal processing. This will occur during action to remove radionuclides in surface soil. If pits not detected, then additional characterization will be performed. Basis for Action Regulator guidance (Regulatory Contact Record, 2003)

(Table continued on next page)

Table 4-1 (continued)

Alternative	Description	Major Components of the Alternative
2 (continued)	Soil Removal (Several Areas) and Surface Water Monitoring	**Area: PAC-SE-1602 (East Firing Range)** Action Remove asphalt, berms, and other fixtures from the north portion of the East Firing Range (PAC-SE-1602). Additional accelerated action may be required following characterization to be performed in remainder of PAC in accordance with Sampling and Analysis Plan (K-H, 2003g). Basis for Action Regulator guidance (K-H, 2003g)
		Area: 903 Pad Outer Lip Area and Windblown Area Action Perform surface water monitoring for Pu and Am at 7 locations (in addition to Point-of-Compliance monitoring) in drainages with residual actinide contamination that will remain after soil is remediated to meet Soil Action Levels. Locations identified for continued additional long-term monitoring are: SW055, SW027, GS54, GS53, GS52, GS51, and GS42 (see Figure 2-1). Monitoring at these locations will be performed through the first CERCLA periodic review, and the need for continuing such monitoring will be evaluated at that time. Basis for action Additional long-term surface water monitoring will provide a quantified understanding of the actinide loads contributed to surface water from different sub-basins.

(Table continued on next page)

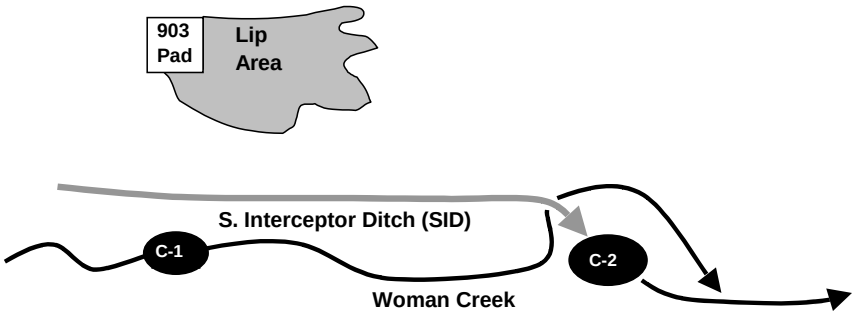
Table 4-1 (continued)

Alternative	Description	Major Components of the Alternative
3	Soil Removal (Several Areas) and Surface Water Monitoring and Extension of the South Interceptor Ditch	**Area: Entire Area of Concern** Actions Perform Alternative 2 actions: - Remove/dispose of soil (in several areas) - Perform surface water monitoring in addition to POC stations Extend South Interceptor Ditch (see text in box below) Basis for action - See Alternative 2 description of basis (regarding Soil Action Levels). - Stakeholder concern exists about areas in the Woman Creek watershed with actinides in soil below RSALs, but which may contribute to actinide loads in surface water.
		Area: Windblown Area Action Construct channel to divert surface water runoff into Pond C-2 from an area (approximately 17 acres) that currently flows to Woman Creek (POC station GS01). The new gravity flow channel would flow from east to west and connect to the east end of the existing South Interceptor Ditch (SID). Basis for action Stakeholder concern exists about areas in the Woman Creek watershed that are below RSALs, but maycontribute to actinide loads in surface water. The 17-acre area addressed by this alternative is an area in the GS01 drainage basin (with residual Pu and Am in the soil) that, based on topography, could have its runoff diverted into Pond C-2 (using gravity flow). This area (approximately 1,000 feet east of the edge of the Lip Area [IHSS 155]) is separate from the area proposed for soil removal. However, some residual Pu and Am activity, below 50 pCi/g, exists in the soil. Runoff from this hillside currently flows directly to Woman Creek (without being captured by Pond C-2). It is estimated this area contributes approximately 10% to 25% of the Pu load (depending on storm size and intensity) delivered to station GS01 (at Woman Creek and Indiana Street). For large storms (>100 year event), this area is identified as the largest single source of Pu concentration measured at POC station GS01. Estimates of Pu loads contributed by different areas are based on models of erosion processes in the Woman Creek watershed (Appendix I). It is noted that the water quality measured at station GS01 has been in continuous compliance with the 0.15 pCi/L RFCA standard for Pu and Am, since RFCA monitoring was implemented in October 1996.

Figure 4-1. Conceptual Diagram - IHSS Group 900-11 IM/IRA Alternatives

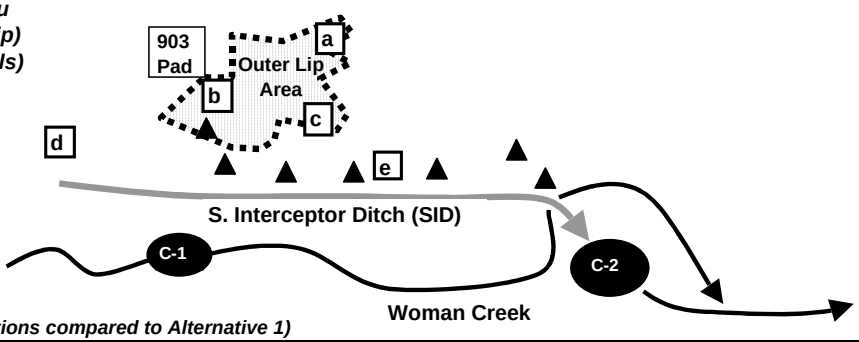
Diagrams not to scale

Alternative 1
- No Action



Alternative 2
- Soil Removal (Several Areas)
- Surface Water Monitoring

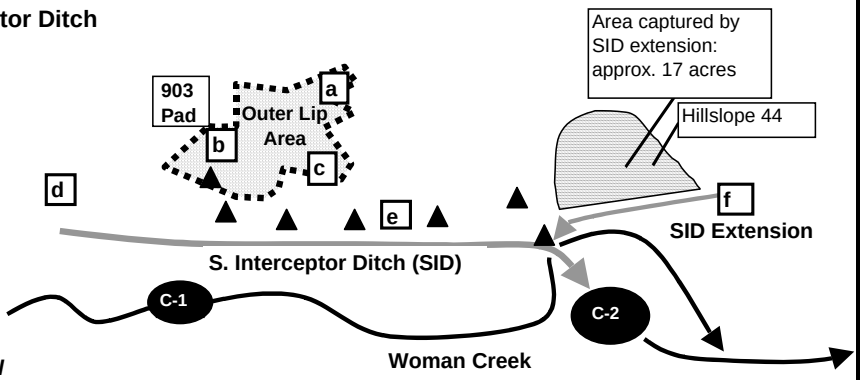
a) Soil removal for >50 pCi/g Pu (approx. 23 acres, in Outer Lip)
b) IHSS 140 soil removal (metals)
c) PAC-SE-1602 asphalt, berm, equip. removal
d) OU1 soil removal (SOR)
e) Performance monitoring (surface water)



(bold type indicates additional actions compared to Alternative 1)

Alternative 3
- Soil Removal (Several Areas)
- Surface Water Monitoring
- Extension of South Interceptor Ditch

a) Soil removal for >50 pCi/g Pu (approx. 23 acres, in Outer Lip)
b) IHSS 140 soil removal (metals)
c) PAC-SE-1602 asphalt, berm, equip. removal
d) OU1 soil removal (SOR)
e) Performance monitoring (surface water)
f) Construct diversion channel that connects to SID to capture runoff from area with residual Pu and Am in soil
to capture runoff from area with residual Pu and Am in soil



(bold type indicates additional actions compared to Alternative 2)

4.3 OTHER ALTERNATIVES CONSIDERED

In addition to the alternatives described in Section 4.2, two other accelerated action alternatives were considered during the course of developing this IM/IRA to address stakeholder concern about Woman Creek Pu loading. The additional alternatives considered were focused primarily on addressing hypothetical scenarios related to the Windblown Area and its potential impact on surface water quality. These other alternatives are:

a) Construct an engineered rock layer for erosion protection over a large expanse (approximately 190 acres) of the Woman Creek watershed downstream from Pond C-2; and

b) Remove and dispose of surface soil as low-level waste from a large expanse (approximately 190 acres) of the Woman Creek watershed downstream from Pond C-2.

Although these options potentially offer some increased long-term confidence that surface water standards will continue to be met at the Point of Compliance (because of reduced Pu and Am loads in Woman Creek), they also have major adverse impacts. These impacts were considered adverse enough to make these alternatives not warrant additional consideration, particularly when acknowledging the existing compliant water quality at GS01. Specifically, the maximum Pu concentration observed at GS01 (0.024 pCi/L) is nearly an order of magnitude below the 0.15 pCi/L RFCA standard for Pu (K-H, 2003f).

Destruction of widespread habitat is a long-term negative consequence directly associated with expansive erosion control and soil removal options. Air and water quality degradation, resulting from widespread soil disturbance, are very real potential negative impacts, in the short-term, of both options. Finally, both options have extremely high costs, as presented in Appendix D.

As stated previously, when adhering to the IM/IRA process to develop alternatives to address RAOs, an accelerated action is not necessary to bring surface water quality into compliance (since the water quality is already compliant). However, to address stakeholder concerns, alternatives were developed. Since implementing these two alternatives would introduce negative impacts, both in the short-term and long-term, and both are extremely expensive, they

were not carried forward in the alternatives analysis presented in Section 4.4. However, additional information on these other alternatives considered is provided in Appendix D.

4.4 ANALYSIS OF ALTERNATIVES

4.4.1 Evaluation Criteria

Appendix B of the Final RFCA IGD identifies the criteria that should be used to evaluate the different alternatives in an IM/IRA (DOE, 1999a). These criteria are summarized in Table 4-2.

Table 4-2. Summary of Criteria Used to Evaluate Alternatives

Major Criteria	Sub-Criteria	Subject(s) Addressed
Effectiveness	Protectiveness	Public health
		Worker health
		Environment
		Attainment of ARARs (see Section 5.1.5)
	Achieve RAOs	Level of treatment/containment
		No residual effect concerns
		Maintain control in short-term until long-term solution implemented
Implementability	Technical Feasibility	Construction and operation
		Demonstrated performance
		Adaptable to environmental conditions
		Need for permits
	Availability	Equipment
		Personnel and services
		Outside laboratory testing
		Offsite treatment and disposal
		Post-removal site control
	Administrative Feasibility	Permits required
		Easements or rights-of-way required
		Impact on adjoining property
		Ability to impose institutional controls
Cost	Capital cost	Costs to engineer, procure, construct required equipment and facilities
	Operation and maint. cost	Treatment, monitoring, site maintenance
	Present worth cost	For alternatives with more than 1 year of operation and maintenance.

4.4.2 Analysis of Individual Alternatives

Using the criteria described in Table 4-1, the three alternatives were analyzed. The Alternative 1 (the No Action Alternative), analysis is summarized in Table 4-3. The Alternative 2 analysis is

provided in Section 4.4.2.1 and Table 4-4. The Alternative 3 analysis is provided in Section 4.4.2.2 and Table 4-5.

Table 4-3. Analysis of Alternative 1 - No Action

		Evaluation Criteria						
		Effectiveness		Implementability			Costs	
Alternative	**Alternative Description**	**Protectiveness**	**Achieve Remedial Action Objectives**	**Technical Feasibility**	**Availability**	**Administrative Feasibility**	**Capital Costs**	**Operation and Maintenance Costs**
Alternative No Action	No action performed	Public health Protective. Based on: a) air quality at boundary has been in continuous compliance with 10 mrem standard; air quality at 903 Pad is also below 10 mrem standard, and b) surface water quality at boundary (station GS01) has been in continuous compliance with 0.15 pCi/L standard for Pu and Am. Worker health Not Protective. Based on Radionuclide Soil Action Levels (RSALs), "no action" will not meet RFCA-based Action Levels for Wildlife Refuge Worker. Environment Not protective. Existing Pu and Am concentrations in soil above ecological PRGs. Attainment of ARARs All identified ARARs attained. (see Sect. 5.1.5 & Appendix H).	Does achieve: - Air Quality - Surface Water Quality Does not achieve: Soil (RSAL) Alternative *does not* achieve soil remedial action objective: All soils must be remediated to meet RSALs (including maximum concentration of 50 pCi/g for Pu).	Technically feasible – no action performed	Easily implemented – no action performed	Administratively feasible – no action performed	Not applicable – no action performed	Not applicable – no action performed Note: Other operations and maintenance costs (including environmental monitoring), that are already planned for the area addressed by this IM/IRA, are not included in the cost estimate. Therefore, this No Action alternative refers to no *additional* actions, hence no additional operations and maintenance costs.

4.4.2.1 Alternative 2 - Analysis

Alternative 2 involves removing and disposing of soil from several areas, and performing ongoing surface water monitoring, as outlined in Table 4-1. This section (4.4.2.1) provides a general discussion of major issues related to the evaluation of this alternative. The Alternative 2 evaluation, using all evaluation criteria, is summarized in Table 4-4.

4.4.2.1.1 Soil Removal Action

The required remedy for radionuclides in surface soil that are present above their respective RSAL is specified clearly in RFCA (DOE, 2002a). These soils must be removed until the activity is measured below the RSAL. An alternative solution, such as construction of a cover to minimize erosion, is not acceptable for soils with radionuclides detected above the RSAL. Therefore, the action for addressing surficial radionuclides, the predominant contaminants in the area of concern, is clearly dictated by the requirements of RFCA.

The long-term benefits from the accelerated soil removal action are apparent. However, it is acknowledged that potential negative short-term impacts exist with the soil removal action. Specifically, soil disturbance during the removal action can cause increased transport of contaminants via airborne and surface water pathways. Therefore, when considering Alternative 2, it is recognized that the soil removal action must involve the use of aggressive dust suppression during the excavation process. Second, stringent erosion control measures must be implemented on the disturbed soil areas to reduce the amount of soil mobilized by erosive forces. These control measures must be considered part of the accelerated action.

Surface water runoff from the area impacted by the Lip Area soil removal is captured by the South Interceptor Ditch and routed into Pond C-2 for retention and settling of solids. Airborne transport, however, is not captured in the same manner. Therefore, a modeling analysis was performed for the potential transport of radionuclides via the air pathway, caused by the Alternative 2 soil removal action. The results of this analysis are summarized in Section 4.4.2.1.2.

4.4.2.1.2 Air Modeling Analysis

Potential dust emissions and the associated Pu and Am transport from soil disturbances associated with excavation of the 903 Lip Area have been estimated using fugitive dust emission factors from the US Environmental Protection Agency (EPA) Compilation of Air Pollutant Emission Factors (AP-42), Volume I, Sections 11 and 13. Emissions were associated with excavation of soil by trackhoe, handling of excavated soil by front-loader, contouring of remediated soil with scrapers and bulldozers, and dust emissions from project traffic on paved roads. Additionally, the dust emissions caused by wind erosion of soil storage piles and exposed soils were estimated. Appropriate radionuclide activities were assigned to each potential dust source, and EPA's CAP88-PC atmospheric dispersion model was used to estimate radionuclide dose to public receptors at the Site boundary. A description of the modeling process and a summary of modeling results is presented in Appendix E.

The modeling predicts emissions will result in a radiological dose of less than 0.1 mrem Effective Dose Equivalent (EDE) to the maximally-exposed hypothetical public receptor, located at the site boundary over the lifetime of the project. This compares with the 40 CFR, Part 61, Subpart H standard of 10 millirem (mrem) EDE for a 12-month period for any member of the public. The modeled dose of less than 0.1 mrem is based on the potential uncontrolled project emissions; the emission estimates that went into the model were developed without taking credit for dust controls. Because dust controls will be implemented throughout the project, actual particulate and radionuclide emissions should be at least 50% lower than modeled.

These model results indicate the short-term air quality impacts associated with the soil removal action in the Outer Lip Area are predicted to be within the acceptable range, in terms of air quality.

4.4.2.1.3 Cost Information

The cost estimate for Alternative 2 is approximately $15,400,000. Detail on the development of this cost figure is presented in Appendix F.

Table 4-4. Analysis of Alternative 2 - Soil Removal

		Evaluation Criteria						
		Effectiveness		Implementability			Costs	
Alternative	**Alternative Description**	**Protectiveness**	**Achieve Remedial Action Objectives**	**Technical Feasibility**	**Availability**	**Administrative Feasibility**	**Capital Costs**	**Operation and Maintenance Costs**
Alternative 2 Soil Removal (Several Areas) and Surface water monitoring	Shallow soil removal Remove all soil with Pu, Am, or Sum-of-Ratio activity greater than Radionuclide Soil Action Levels (RSALs). Soil removal will involve only the soil with actinide activity higher than the respective RSALs (primarily soil with Pu greater than 50 pCi/g, and mainly within the top 6 inches of soil, though a minimum depth of excavation is not specified). Excavation will be primarily focused in the IHSS 155 area (Lip Area), although "hot spots" exist in other locations within the area of concern, including a SOR location in OU1 (IHSS119.1) IHSS-Specific actions IHSS 140 soil removal and PAC-SE-1602 removal of asphalt, berm, and fixtures. Surface Water Monitoring Perform ongoing surface water monitoring at locations in the area of concern, south and east of the 903 Lip Area. Can utilize Performance Monitoring locations: - SW055, GS54, GS53, GS52, GS51, GS42, SW027	Public health Protective. Based on: a) air quality at boundary has been in continuous compliance with 10 mrem standard, and b) surface water quality at boundary (station GS01) has been in continuous compliance with 0.15 pCi/L standard for Pu and Am. c) Soil – 50 pCi/g Pu falls within the acceptable risk range for a rural resident. Therefore, that level is protective of a Wildlife Refuge visitor who spends times in the Lip Area. Worker health Protective. Based on removal of soil to below RSAL level, will meet RFCA-based Action Level for Wildlife Refuge Worker (1×10^{-5} risk). Environment Impact to approximately 1 acre of wetlands - seep area on hillslope southeast of 903 Pad. Impact from removing vegetation and shallow soil from approximately 23.5 acres (in Outer Lip Area). Attainment of ARARs All identified ARARs attained. (see Sect. 5.1.5 & Appendix H).	Does meet objectives for: - Soil (RSAL) - Air quality (currently in compliance) - Surface water quality (currently in compliance) - Habitat/ecology considerations (minor impact – approx. 1 acre of wetlands in soil removal area) Does not meet objectives for: Not applicable. All objectives identified are met. Potential impacts to RAOs Potential short-term impacts to air and surface water quality caused by soil disturbance over 23.5 acres (in Outer Lip Area).	Construction and operation Feasible. Removal of soil is a routine remediation/construction operation. Demonstrated performance Removal of soil to meet RSAL will meet conditions for soil remediation. Adaptable to Environmental Conditions All components of this alternative are suited for the environmental conditions in the project area. Need for permits None identified.	Equipment Conventional excavating equipment will be used for soil removal and is readily available. Surface water monitoring will use automated equipment already in use at RFETS Personnel and services Site and sub-contractor personnel are available to perform soil excavation. Site personnel trained for surface water monitoring Off-Site treatment and disposal Soil disposal at Low-Level Waste disposal facility is routine and that transportation of the waste is available.	Permits required None identified. Easements or rights-of-way required None required Impact on adjoining property Excavation activity impacts anticipated to have minimal impacts (noise, dust emissions) to adjoining property. Ability to impose institutional controls In accordance with the Rocky Flats Wildlife Refuge Act of 2001 (Pub.L. 107-107, Sec. 3171-3182, [December 28, 2001]), DOE will retain administrative jurisdiction over the area associated with the proposed action, and its associated institutional controls.	Estimated capital cost: $15,400,000	Estimated operation and maintenance cost (weed control, vegetation mgmt, surface water monitoring equipment, sample collection, analytical costs, data analysis and reporting) $52,000 / year

4.4.2.2 Alternative 3 – Analysis

Alternative 3 involves all the components of Alternative 2 (soil removal and surface water monitoring), plus an additional action to construct a diversion channel in the Woman Creek watershed. The new channel would flow from east to west and connect to the South Interceptor Ditch at a point approximately 400 feet upstream from where the South Interceptor Ditch enters Pond C-2. The purpose of the new channel would be to increase the size of the watershed diverted into Pond C-2. Diverting runoff from this area into Pond C-2 would potentially reduce the mass loading of Pu and Am delivered to Woman Creek downstream of Pond C-2.

This section (4.4.2.2) provides a general discussion of the major issues identified in the evaluation of the diversion channel. A summary of the Alternative 3 evaluation is provided in Table 4-5. The other components of this Alternative that are also part of Alternative 2 (e.g., soil removal) are not addressed here since they were previously discussed in Section 4.4.2.1.

4.4.2.2.1 Consideration of Action for Water Quality Protection in Woman Creek

As noted previously, the maximum Pu concentration observed at GS01 (0.024 pCi/L) is nearly one order of magnitude below the 0.15 pCi/L RFCA standard (KH, 2003). The historic median concentration of Pu at GS01, approximately 0.002 pCi/L (from Water Year 1997 through 2002), is nearly two orders of magnitude below the RFCA standard (KH, 2003). Therefore, the diversion channel discussed in this alternative is not proposed in response to a specific Remedial Action Objective for surface water quality. It is considered as an additional measure to protect surface water quality in Woman Creek to address community interests.

4.4.2.2.2 Selection of Watershed Area Captured by the SID Extension

The area addressed by this alternative, also referred to as Hillslope 44, is located in the Windblown Area approximately 1,000 feet east of the edge of the Lip Area [IHSS 155]). This 17-acre area is completely separate from the Lip Area proposed to have soil removed. Therefore, residual Pu and Am activity (below 50 pCi/g) will exist in the soil in this area after the Lip Area soil removal is completed (see description for Alternative 2). Runoff from this hillside currently flows directly to Woman Creek, without being captured by Pond C-2. However, this specific portion of the GS01 watershed, based on its elevation and the topography,

could have its runoff diverted into Pond C-2, using a gravity flow diversion channel. The new diversion channel would flow for approximately 700 feet, from east to west, and connect to the eastern end of the existing South Interceptor Ditch (SID), which flows into Pond C-2. Pond C-2 is proven to effectively settle solids to which Pu and Am are attached, thereby removing these actinides from the water.

For storms where runoff is generated from this area, it is estimated this hillside currently contributes approximately 10% to 25% of the Pu concentration (depending on storm size and intensity) measured at station GS01 (see modeling discussion in Appendix I). However, because this area is completely vegetated and free of pavement, it requires a significant storm to generate runoff. With dry antecedent soil moisture conditions, such an area may require a storm with 0.8 inches or more of precipitation to generate measurable runoff (K-H, 2000). Estimates of Pu loads contributed by different areas are based on models of erosion processes in the Woman Creek watershed (see Appendix I). It is also recognized that this area has not generated large relative quantities of Pu in the surface water, as evidenced by the low maximum (0.024 pCi/L) and median (0.002) concentrations measured at GS01 (K-H, 2003f). Therefore, although the Hillslope 44 area may offer the best option in terms of re-routing runoff to improve water quality, any benefits from constructing the diversion channel would be difficult to measure.

4.4.2.2.3 Other Issues Related to Extending the South Interceptor Ditch

A long-term benefit to Woman Creek, in terms of reduced actinide loads, may exist from constructing the diversion channel as described. However, it is recognized that potential negative short-term impacts also exist with this alternative. These adverse impacts and other considerations are listed below:

- Soil disturbance during the channel construction could cause increased transport of contaminants, to workers and the public, via the airborne and surface water pathways. Construction of the channel would require the use of aggressive dust suppression during the excavation process and the implementation of stringent erosion control measures for disturbed soil areas.

- Excavated soil would be placed and compacted on the downstream embankment of the new channel. This embankment would create a new potential source for actinides to be transported in the air and surface water. The embankment would require stringent erosion control measures until vegetation could be established.

- An active natural gas pipeline, 12 inches in diameter with 600 pounds per square inch of pressure and owned by Xcel Energy, runs north-south through the area where the diversion channel would be constructed. Surveys conducted by Xcel Energy indicate the pipeline varies from five feet to over ten feet below grade, in the area of interest. The diversion channel design and construction would have to take the natural gas line into consideration to protect and pass by the natural gas pipeline, in the interest of worker safety and continuity of natural gas service.

When considering the diversion channel alternative, the potential long-term benefits to Woman Creek water quality must be weighed against the potential adverse impacts to air and surface water quality, as well as worker and public safety issues.

4.4.2.2.4 Other Area Evaluated for Diversion into Pond C-2

In addition to the Hillslope 44 area described, there are other areas within the Windblown Area (with residual Pu and Am in the surface soil below 50 pCi/g), that could be diverted into Pond C-2. Other than Hillslope 44, the primary area to consider for diverting the runoff into Pond C-2 is referenced as Hillslope 27 (approximately 34 acres). Hillslope 27 is located along the south side of Woman Creek, between Ponds C-1 and C-2. Reasons for considering Hillslope 27 as an area to divert runoff into Pond C-2 are:

- Based on model estimates for relatively small storms (2-year event frequency), Hillslope 27 delivers the largest fraction of the Pu observed at GS01 (approximately 40% of the total) of any single hillslope.

- Hillslope 27 is relatively close to Pond C-2, on the upstream side, and can be diverted into Pond C-2 based on the topography.

While constructing a diversion channel to route runoff from Hillslope 27 into Pond C-2 could provide some potential water quality benefit, it is recognized that potential negative short-term impacts also exist with this option. Potential negative aspects of the Hillslope 27 channel, as well as comparisons with the Hillslope 44 diversion channel, are listed below:

- Though Hillslope 27 is predicted to contribute the largest Pu loads for relatively smaller storms (because of its close proximity and long frontage alongside Woman Creek), small storms have historically not caused a compliance problem at GS01. Therefore, a need for diverting this specific area has not been demonstrated.

- The Hillslope 27 diversion would require a channel approximately 2000 feet-long (compared to a 700 foot-long Hillslope 44 channel). Soil disturbance created by the channel construction would cause a concern for impact to surface water quality in Woman Creek.

- Per unit length of diversion channel, the amount of area captured by the Hillslope 44 channel is approximately 50 percent more than the area captured by the Hillslope 27 channel. In addition, the Hillslope 27 area has generally less Pu activity in the soil than the Hillslope 44 area. Therefore, the Hillslope 44 channel captures a larger watershed area per linear foot of diversion channel constructed, and captures runoff from an area with higher Pu and Am activity in the soil than the Hillslope 27 watershed.

Based on the cumulative potential benefits of the Hillslope 27 diversion channel, versus potential negative aspects, it was determined that Hillslope 44 is a more suitable area to consider for diverting into Pond C-2.

4.4.2.2.5 Cost Information

The estimated incremental cost for the diversion channel component of Alternative 3 (to divert runoff from Hillslope 44 into Pond C-2) is approximately $260,000. This includes costs for RFETS planning and work controls, as well as the cost of the channel design and construction. The total estimated Alternative 3 cost is approximately $15,660,000 (this includes soil removal actions from Alternative 2 that are included with Alternative 3). Detail on the estimate is presented in Appendix F.

Table 4-5. Analysis of Alternative 3 – Diversion Channel Connected to South Interceptor Ditch

		Evaluation Criteria						
		Effectiveness		Implementability			Costs	
Alternative	**Alternative Description**	**Protectiveness**	**Achieve Remedial Action Objectives**	**Technical Feasibility**	**Availability**	**Administrative Feasibility**	**Capital Costs**	**Operation and Maintenance Costs**
Alternative 3 Soil Removal (Several Areas) and Additional surface water monitoring and Extension of South Interceptor Ditch	Remove all soil with Pu, Am, or Sum-of-Ratio greater than Radioactive Soil Action Levels (RSALs). Soil removal will involve primarily the top 6 inches of soil, focused in the IHSS 155 area (Lip Area). and Perform ongoing surface water monitoring at locations in the area of concern, south and east of the 903 Lip Area. Can utilize Performance Monitoring locations: - SW055 - GS54 - GS53 - GS52 - GS51 - GS42 - SW027 and Construct diversion channel that connects to the east end of the South Interceptor Ditch. The diversion would flow from east to west. The channel would capture runoff from approximately 17 acres and route it into the SID and into Pond C-2.	Public health Protective. Based on: a) air quality at boundary has been in continuous compliance with 10 mrem standard, and b) surface water quality at boundary (station GS01) has been in continuous compliance with 0.15 pCi/L standard for Pu and Am. Worker health Protective. Based on removal of soil to below RSAL level, will meet RFCA-based standard for Wildlife Refuge Worker. Environment Impact to approximately 1 acre of wetlands - seep area on hillslope southeast of 903 Pad. Impact from removing vegetation and shallow soil from approximately 23.5 acres (in Outer Lip Area). Impact on approximately 1 acre of mesic mixed grassland from channel construction. Small area (~0.2 acre) of wetlands in SID may be impacted where channel armoring is required where new diversion connects with SID Attainment of ARARs All identified ARARs attained.	Does meet objectives for: - Soil (RSAL) - Air quality (currently in compliance) - Surface water quality (currently in compliance) - Habitat/ecology considerations (minor impact – approx. 1 acre of wetlands in soil removal area, and minor potential impact to wetlands where proposed diversion channel connects to SID) Does not meet objectives for: Not applicable. All objectives identified are met. Potential impacts to RAOs: Potential short-term impacts to air and surface water quality caused by soil disturbance over 23.5 acres (in Outer Lip Area). Potential short-term impacts to air and surface water quality caused by soil disturbance over 1 acre (diversion channel).	Construction and operation Feasible. Removal of soil is a routine remediation/construction operation. Construction of small diversion channel is a routine construction project. Demonstrated performance Removal of soil to meet RSAL will meet conditions for soil remediation. Adaptable to Environmental Conditions All components of this alternative are suited for the environmental conditions in the project area. Need for permits None identified.	Equipment Conventional excavating equipment will be used for soil removal and is readily available. Surface water monitoring will use automated equipment already in use at RFETS Conventional construction equipment will be used for building the diversion channel and is readily available. Personnel and services Site and sub-contractor personnel are available to perform soil excavation. Site personnel trained for surface water monitoring Site and sub-contractor personnel are available for diversion channel construction. Off-Site treatment and disposal Assumption that Low-Level Waste disposal facility will accept soil removed from Lip Area. No soil treatment /disposal related to diversion ditch.	Permits required None identified. Easements or rights-of-way required None required Impact on adjoining property Construction activity impacts anticipated to have minimal impacts to adjoining property (noise, dust emissions) Ability to impose institutional controls Routine RFETS institutional controls will be implemented to control work and work area.	Estimated capital cost: $15,660,000	Estimated operation and maintenance cost: (weed control, vegetation mgmt, surface water monitoring equipment, sample collection, analytical costs, data analysis and reporting) $53,000 / year

4.4.3 Comparative Analysis of Alternatives

Alternatives were compared against one another using the evaluation criteria presented in Section 4.4.1, and using information from the individual alternative analyses presented in Table 4-3 through Table 4-5. The comparison of alternatives is summarized in Table 4-6.

Table 4-6. Comparison Matrix of Alternatives

Alternative	**Evaluation Criteria (Ranking scale: high-3, medium-2, low-1, fails RAOs-0)**			**Ranking Total (sum)**
	Effectiveness	**Implementability**	**Cost**	
1 No Action	Ranking: 0 Basis for ranking: Does not meet RAO to achieve RSAL requirements.	Ranking: 0 Basis for ranking: Technically feasible, but does not demonstrate performance to achieve RSAL requirements.	Ranking: 3 Basis for ranking: Low cost relative to other alternatives.	3
2 - Soil Removal - Surface water monitoring	Ranking: 3 Basis for ranking: Achieves all Remedial Action Objectives.	Ranking: 2 Basis for ranking: Technically feasible. Personnel and equipment available, and feasible administratively.	Ranking: 2 Basis for ranking: Cost ranks in middle relative to other alternatives.	7
3 - Soil Removal - Surface water monitoring – Extension of S. Interceptor Ditch	Ranking: 3 Basis for ranking: Achieves all Remedial Action Objectives. Potential benefit to water quality in long-term is somewhat offset by near-term soil disturbance, with potential air and water quality impacts.	Ranking: 2 Basis for ranking: Technically feasible. Personnel and equipment available, and feasible administratively.	Ranking: 1 Basis for ranking: Cost slightly higher than Alternative 2.	6

As shown in the alternatives analysis ranking summarized in Table 4-6, Alternative 1 (the No Action Alternative) received the lowest ranking, since it does not meet the RAO to satisfy RSAL requirements. Alternatives 2 and 3 received comparable scores, but Alternative 2 received a slightly higher ranking based on the cost criterion. Although Alternative 3 offers some potential additional water quality benefits, the benefits did not warrant it receiving a higher relative effectiveness score, because water quality in the Woman Creek drainage has been demonstrated to be well within compliance criteria. In addition, Alternative 3 has additional short-term soil disturbance that compromises the potential positive aspects of the alternative. Therefore,

Alternative 2 was selected as the most appropriate remedial action. This alternative is discussed further in Section 5.0.

5.0 ACCELERATED ACTION - PROJECT APPROACH

This section discusses the accelerated action selected in Section 4.4.3 in terms of the RAOs and the scope and methods proposed to implement the proposed action.

5.1 PROPOSED ACCELERATED ACTION

5.1.1 Description of Proposed Accelerated Action

5.1.1.1 Scope of the proposed accelerated action

The proposed accelerated action involves 1) removing and disposing of soil in locations where the RSAL is exceeded, and 2) performing ongoing surface water monitoring at seven locations.

The accelerated action will involve the following activities:

- Excavation of shallow soil in areas with radionuclides that exceed RSALs using conventional excavation equipment; e.g excavators, loaders, etc. Due to the erosion deposition, it is anticipated that contamination has typically only impacted the upper 1 to 3 inches of soil, however some areas of contamination may be deeper. Excavation will be sequenced in a down slope direction to reduce the potential to re-contaminate excavated areas.

- Dust suppression using water mist will be conducted during excavation activities.

- Confirmation soil samples will be immediately collected in the excavated area and analyzed with gamma spectroscopy. If the analysis indicates that the soil is less than the RSAL, no additional soil will be excavated from that area.

- If the confirmation sample analysis indicates that the soil is greater than the RSAL, additional soil will be excavated from that area and another confirmation sample will be collected and analyzed. This sequence will be repeated until the confirmation sample indicates that the remaining soil is less than RSAL.

- Excavated soil will be placed into containers for shipping on a daily basis.

- After confirmation samples indicate the accelerated action has been completed in a specific area, the area will be graded, as necessary, and the placement of degradable erosion mat will be implemented.

- Some additional soil grading may occur to effectively manage storm water if a storm event is anticipated.

- Excavated areas with erosion mat will be seeded on a periodic basis.

At the 903 Pad, two movable, tent-like structures were used to provide weather protection over the area being remediated. For the proposed action addressed by this IM/IRA, weather protection structures will not be utilized. At the 903 Pad, the weather protection structures were moved by heavy equipment over the asphalt and compacted material of the pad area. However, pulling the tents over the uneven, sloped terrain of the Outer Lip Area is not feasible, as the tents would be destroyed. Therefore, weather protection structures will not be used during the action proposed in this IM/IRA. Work will be performed as weather permits. Stringent erosion control measures will be implemented, as discussed in Section 5.1.1.5.

The boundary delineating the area to be remediated will be defined using a geostatistical analysis of the characterization data. This geostatistical approach is described in Appendix G. The geostatistical method was adopted to provide a statistically-based, 90 percent degree of confidence that all soil with Pu concentrations above 50 pCi/g is removed. This type of approach was used because, regardless of the sampling methodology, there is always a degree of uncertainty whether the boundary has been delineated correctly to excavate all the soil that warrants remediation. This uncertainty is an artifact of not being able to sample every particle of soil in the area of concern; the samples are merely representative of the surrounding soil. Therefore, the geostatistical approach for delineating the excavation boundary provides a quantified degree of confidence. The depth of the excavation will also be determined based on field sampling.

Some locations exist with radionuclides above the RSALs that are outside of the area enclosed by the geostatistically-derived boundary. These isolated areas will be remediated as necessary as described in Section 5.1.1.3.3.

Surface water monitoring will be continued after the soil removal action is complete, at seven existing monitoring locations: SW055, SW027, GS54, GS53, GS52, GS51, and GS42 (see Figure 2-1). Surface water sampling for Pu and Am will be conducted using the same flow-weighted sampling protocol as is currently implemented at those locations. Monitoring at these stations will be performed through the first CERCLA periodic review, at which time the need for continuing monitoring will be evaluated.

A general description of the soil removal and disposal action is provided in Section 5.1.1.2 through 5.1.1.6

5.1.1.2 Site Controls Prior to Remediation Being Performed

The following activities will be completed prior to the initiation of remediation activities (K-H, 2003c):

- Straw wattles and/or straw bales will be used to provide runoff control in ditches around the site as necessary.
- Well heads have been identified in work area. Construction fencing will be used to demarcate these areas. All current utilities will be removed from the construction area.
- Access control points will be established at the 903 pad to control access to and from the site as well as control points into the Soil Contamination Areas.
- Waste storage areas will be set up on the 903 and 904 pads.
- Surface water monitoring at Performance Monitoring stations SW055, GS54, GS53, GS52, GS51, and GS42, and at RFCA Point of Evaluation station SW027 (see Figure 2-1).
- Air monitoring at project perimeter.

5.1.1.3 Excavation and Packaging of Contaminated Soils

5.1.1.3.1 General Actions for Areas Requiring Excavation

All activities will be performed in accordance with the Radiological Work Permit. The general work process that will be performed is listed below. Many of these steps can be performed simultaneously, depending on the situation. Changes to the work process may be implemented based on a "continuous improvement process" or as required due to unforeseen events or site conditions. Such changes will be consistent with the RAOs and approved by management. General soil excavation work steps are described below:

- Soil may be scarified and sprayed with water to minimize dust during the operations as necessary, depending on soil moisture content at the time of excavation.

- Soil will be excavated in approximately two- to six-inch lifts, or as needed, based on sampling results. Soil excavation will likely be performed using a hydraulic excavator or other mechanical means as required. Other soil removal methods, such as vacuum technology, may also be utilized if suitable for the application.

- Small structures, concrete pads, power poles, trees, wells, and other debris will be removed if necessary and packaged in appropriate containers.

- Excavated waste will be transported to the intermodal (soil waste container) loading area using a loader or other appropriate method. Excavated soil will not be stockpiled for long periods of time.

- After the soil is excavated, confirmation sampling will be performed in accordance with the Buffer Zone Sampling and Analysis Plan (DOE, 2002c) and in consultation with the regulatory agencies. Based on the results of the confirmation sample, additional excavation may be conducted.

- Erosion controls will be established daily, or as necessary, at a minimum, in the excavation areas to minimize contaminated water run-off into or from excavated areas, as well as to minimize fugitive dust. Additional detail regarding such controls is provided in Section 5.1.1.5.

5.1.1.3.2 Confirmation Sampling

After excavation of soil with greater than 50 pCi/g of plutonium-239/240, confirmation sampling will be conducted to demonstrate that the remediation objectives have been met. The confirmation sampling will include individual grab samples on a 52-foot interval. The 52-foot interval for confirmation sampling is based on geostatistical methodologies described in Section 4.5.2 of the Buffer Zone Sampling and Analysis Plan (DOE, 2002c). A soil sample will be collected at each location from the upper three inches of soil and analyzed by gamma spectroscopy. Ten percent of the samples will be sent off-site for alpha spectroscopy analysis. In addition, K-H will provide a split alpha sample of approximately 50 grams of soil for the EPA.

5.1.1.3.3 Remediation of Isolated Areas With Radionuclides Above RSALs

Several sample locations outside of the main 903 Lip Area remediation area, defined by the geostatistical analysis (see Section 5.1.1.1 and Appendix G), have sample results that clearly exhibit sample results above the RSAL for radiological constituents (See Section 2.3). At these locations, the accelerated action will consist of surface soil removal in a 10-meter diameter circle centered on the location of the sample point. Upon removal of the surface soil, confirmation sampling will be conducted to determine if the soil within the area of the action is below the RSAL.

5.1.1.3.4 Specific Actions in IHSS 140 (Hazardous Disposal Area) Specific

At the same time the accelerated action for radionuclides is being performed for the 903 Lip Area and vicinity, IHSS 140 (Hazardous Disposal Area) will be subject to a soil removal action for metals. The objective of this specific action is to locate and remove soil that was contaminated by the pits, in the IHSS 140 area, where reactive metal processing was conducted in the 1950s and 1960s (see Table 2-1). Detail on the depth, spatial extent, and sampling associated with the IHSS 140 action is provided in minutes from a meeting held with Site personnel and the regulatory agencies on December 18, 2003 (Regulatory Contact Record, 2003). If the pits are not detected, then additional characterization will be performed in accordance with a Sampling and Analysis Plan that would be developed at that time (Regulatory Contact Record, 2003).

5.1.1.3.5 Specific Actions in PAC-SE-1602

For PAC-SE-1602 (East Firing Range), an accelerated action will be conducted as part of this IM/IRA (K-H, 2003g). The accelerated action involves removing the asphalt, berms, and other fixtures located in the northern portion of the East Firing Range. Upon removal of the material, confirmation sampling will be conducted to determine if the soil within the area of the action is below the AL. For other areas in PAC-SE-1602 (other than the northern portion), an accelerated action is potentially required, but is not presently defined and is therefore not addressed in this IM/IRA.

5.1.1.3.6 Specific Action in OU1

One location in OU1, within IHSS 119.1, requires removal of surface soil to address a SOR result that is above the RSAL limit of 1 (see Section 2.3.1.3.1). Surface soil in this isolated location will be removed using a methodology for isolated locations consistent with that described in Section 5.1.1.3.3.

5.1.1.3.7 Specific Action at Sample Location 50299, Northwest of PAC-SE-1602

Sample location 50299, located northwest of the north firing range portion of PAC-SE-1602, requires removal of sub-surface soil based on results of a sub-surface soil risk screen evaluation (see Section 2.3.1.2.2 and Appendix B, Screening Location 2). The sample result driving the remediation, for Pu-239/240, was collected at a 6-foot depth.

5.1.1.4 Contouring and Revegetation

Final contouring will be performed such that positive drainage is established. Once final contouring is completed, revegetation will be performed as needed and using the native grass seed mix specified by the RFETS IA Revegetation Plan (K-H, 2003d).

5.1.1.5 Erosion Control

Newly-disturbed soil surfaces will be stabilized using biodegradable erosion blankets, hydromulch, tackifier, straw-mulch, straw mats, straw wattles, straw bales, and/or other storm water best management practices to minimize soil erosion, sediment transport, and surface water

quality degradation. Control measures will be implemented daily, or as frequently as practicable, to minimize soil erosion caused by both surface water and wind processes. In addition, for protection from wind erosion, excavation work will be suspended during high winds as specified by the project's RWP (Radiological Work Permit).

5.1.1.6 Waste Handling and Staging

Waste will be characterized and managed in accordance with the Environmental Restoration Program Waste Management Plan (ERDC-2002-0002), the Applicable or Relevant and Appropriate Requirements (ARARs) contained in the RFCA Standard Operating Protocol (RSOP) for Routine Soil Remediation, or other applicable decision documents, the Environmental Remediation Operations Plan (ERDC-2002-0001), RFETS procedures and policies, and applicable State and Federal regulations.

5.1.2 Worker Health and Safety

All work under this proposed action will be controlled using the Site Integrated Safety Management System (ISMS) and the Integrated Work Control Program (IWCP). A project-specific Health and Safety Plan (HASP) will be developed to address the safety and health hazards of project execution and specify the requirements and procedures for employee protection. The Occupational Safety and Health Administration (OSHA) construction standard for Hazardous Waste Operations and Emergency Response, 29 Code of Federal Regulations (CFR) 1926.65 will be used as the basis for the HASP. In addition, DOE Order 5480.9A, Construction Project Safety and Health Management applies to this project. This Order requires preparation of a Job Hazard Analyses (JHA) for each task, which includes identifying each task, the hazards associated with each task; and the controls necessary to eliminate or mitigate the hazards.

5.1.3 Post-Accelerated Action Monitoring and Maintenance

5.1.3.1 Monitoring

Site monitoring will include a program to ensure that conditions at the Lip Area do not change in an adverse manner after the accelerated action. Surface water and air monitoring will be

instituted to identify impacts after the action has been implemented. An annual inspection of the area will be conducted to identify areas of erosion that may need repair. More detail regarding site monitoring is presented in Section 5.1.6. Monitoring locations will be reviewed and revised if necessary during the design phase of the accelerated action.

5.1.3.2 Institutional Controls

Institutional controls include administrative controls such as use restrictions, and are intended to prevent or limit adverse exposure to residual contamination, and/or limit access to a site to ensure the ongoing security and effectiveness of facilities such as engineered controls or monitoring devices. Physical controls that restrict access to the site are included as a subset of institutional controls. General and specific post-accelerated action institutional controls for RFETS as a whole are currently being evaluated by DOE and the regulatory agencies, and in consultation with the USFWS, and the community.

The institutional controls to be implemented following this proposed accelerated action are as follows:

1. Current Site-wide security and access controls will be maintained until completion of the RFETS Closure Project, currently scheduled for December 2006. Appropriate security and access controls for the area of concern and other specific areas will be implemented after the Closure Project is completed;

2. The construction and use of buildings that will be occupied on a permanent or temporary basis (such as for residences, offices, shops, breakrooms, etc.) is prohibited. The construction and use of storage sheds or other, non-occupied structures, is permitted, consistent with the restrictions contained in 5) and 6) below;

3. The construction and use of groundwater wells is prohibited, except for wells used for monitoring, remediation or other remedy-related purposes;

4. Excavation below a depth of three feet is prohibited, except for remedy-related purposes;

5. Disturbance of surface soils is permitted only when adequate controls are in place for control of erosion by water and wind;

6. Prohibition of disruption of surface water and air sampling stations until such stations are no longer needed; and

7. Roads and trails will not be allowed in the area subject to the soil excavation for the accelerated action. Signs may be erected that indicate vehicles are prohibited from specific areas and that direct vehicle traffic appropriately. A determination will be made during project construction as to whether signs or fences will be used as the preferred means of restricting access.

Institutional and physical controls for the accelerated action will also be documented in the closeout report. Inspection of these institutional controls will be performed quarterly to determine their continuing effectiveness. Results of these inspections will be reported annually. Long-term institutional controls will also be recommended to be addressed as part of long-term Site stewardship.

5.1.3.3 CERCLA Periodic Reviews

CERCLA periodic reviews are addressed in stewardship section (Section 5.1.6).

5.1.4 Environmental Impacts (NEPA Analysis)

Paragraph 95 of RFCA mandates incorporation of National Environmental Policy Act (NEPA) values into RFETS decision documents. This section of the IM/IRA satisfies the RFCA requirement for a "NEPA-equivalency" assessment of environmental consequences by addressing the environmental consequences of the accelerated action.

The remediation impact analysis relies heavily on conclusions reached in the Cumulative Impacts Document (CID; DOE 1997) and the 2000 CID Update Report (DOE 2001), both of which focus on cumulative impacts resulting from onsite closure activities. The action proposed in this IM/IRA is bounded by the actions analyzed in the CID. In general, the proposed action has positive long-term impacts; however, it also has the potential for adverse short-term impacts

in a variety of resource areas, including air quality, water quality, traffic congestion, and ecological resources. In some instances, the impacts could be intense for a short period of time. However, the impacts will be minimized through mitigation actions (e.g., dust will be controlled with water sprays and erosion will be reduced through various erosion control measures).

The proposed action will have both positive and adverse effects. Positive impacts, such as decreasing the level of radiological surface contamination and limiting movement of potential contaminants, are identified. Adverse impacts identified can often be mitigated through avoidance, minimization, remediation, reduction, or compensation. Certain mitigation measures are required by law. For example, wetland losses will have to be replaced or repaired. This section presents identified mitigation measures by each resource area.

In addition to surface water and air quality, other issues discussed under this NEPA-equivalent section include potential impacts to soils, human health and safety, ecological resources, cultural and historic resources, visual resources, noise levels, transportation, and this project's contribution to site-wide cumulative impacts.

Noise levels will be temporarily elevated during construction activities, but are not expected to exceed levels commonly encountered during highway construction projects. Sensitive human receptors are not found near the construction area, and the noise should not be noticed off-Site. Noise is not expected to significantly impact wildlife.

In accordance with Executive Order 12898, the potential impact of the proposed action on minority and low-income populations is considered. The proposed action will occur onsite away from inhabited areas, and will not lead to off-site indirect effects on nearby populations. Disproportionately high and adverse human health or environmental effects will not be imposed on these populations. The proposed action will provide short-term employment for a limited number of people, and socioeconomic effects of the action will be minimal.

5.1.4.1 Impacts to Soil

The remediation of a substantial amount of contaminated soil will result in a long-term beneficial impact. However, in the short-term, remediation activities will require excavation of

approximately 23 acres in the Outer Lip Area. Potentially adverse impacts include increased soil erosion caused by the soil disturbance.

Subsurface geology is not likely to be affected by remediation activities. Activities will result in limited disturbance of the subsurface, which will, in particular, occur during remediation of the 903 pad inner lip area. These areas have generally been previously disturbed and do not contain mineral resources.

Surface soil has generally not been disturbed in the area of the proposed action. The proposed action will disturb the surface soil to remove the contamination to below the RFCA action levels. Remediation will involve the removal of contaminated soil with no or limited backfilling. The contaminated soil being removed will be put in roll-off containers and shipped off-Site for disposal.

Soil disturbance may result in increased soil erosion due to the large area of soil being removed, particularly in sloped areas where the accelerated action is occurring. Consequently, the proposed accelerated action could potentially impact surface water quality, particularly in the short term as vegetation is re-established in disturbed areas. Erosion will be controlled using methods discussed in Section 5.1.1.5.

5.1.4.2 Impacts to Air Quality

Remediation activities, including soil excavation, equipment operation, soil treatment, and transportation, will generate air pollutants. Regulated air pollutants include criteria air pollutants (i.e., ozone, CO, NOx, sulfur dioxide, lead, and particulate matter), HAPs, and radiological air emissions. Engineering and administrative controls (e.g., dust suppression with water hoses) will be implemented prior to and during excavation activities to control the spread of radiological and hazardous contamination in accordance with job-specific HASPs, As Low as Reasonably Achievable (ALARA) Job Reviews, and RWPs.

The primary pollutant generated as a result of the proposed action will be fugitive dust, which includes total suspended particulates (TSP) and particulate matter 10 micron (PM_{10}), and particulate matter 2.5 microns ($PM_{2.5}$) in size. Dust emissions from construction activities will be controlled with practical, economically reasonable, and technologically feasible work practices,

as required by the Colorado Air Quality Control Commission (CAQCC) Regulation No. 1. Specifically, onsite dust will be controlled through dust minimization techniques, such as the use of water sprays, including pre-excavation watering, to minimize suspension of particulates. Earthmoving activities will be suspended during periods of high wind in accordance with the project's RWP. Particulate emissions will be short-term and controllable, and emissions are not expected to be above enforceable National Ambient Air Quality Standards at the RFETS perimeter. Therefore, potential impacts to workers and the public from proposed action will not be significant.

Remediation activities will also include operation of vehicles, heavy machinery, and other equipment that generate other criteria pollutants. Estimated concentrations of other criteria and HAPs provided in the CID (DOE 1997d) were well below the most restrictive occupational exposure limit, with the exceptions of sulfur dioxide, nitrogen dioxide, and CO, which approached 50 percent of the most restrictive occupational exposure limit. The CID (DOE 1997d) identified the primary sources of these pollutants as diesel-powered emergency generators used to supply backup power at RFETS. According to the CID Update (DOE 2001f), maximum daily emissions will remain about the same as forecast in the CID (DOE 1997d). Equipment emissions from remediation activities are expected to be substantially less than the CID (DOE 1997d) and CID Update (DOE 2001f) estimates; therefore, impacts to workers and the public are not a concern in this IM/IRA.

Radiological concerns associated with dust emissions are triggered at an AL of 0.1 mrem/yr EDE to the most impacted member of the public. A 0.1 mrem/yr EDE warrants regulatory agency notification and monitoring pursuant to 40 CFR 61, Subpart H. Measures to control emissions from the work area will be identified to ensure compliance with applicable air quality regulations and to minimize potential dust emissions. These and other measures will be designed to protect the health of workers, the public, and the environment. Appendix E provides detailed information on expected and worst-case radiological dose to public receptors from this activity.

5.1.4.3 Impacts to Surface Water

Remediation actions may, in the short-term, cause potential impacts to surface water quality such as increased turbidity and contaminant transport resulting from erosion of disturbed soil.

However, the removal of contaminant sources reduces the potential for long-term contaminant migration to surface water. Consequently, long-term impacts to surface water are projected to be beneficial.

Erosion from the work areas will be controlled through prompt application of erosion control processes and materials. Prompt placement of erosion control matting and regular re-vegetation of excavated areas, and sloped areas in particular, will reduce the potential for adverse impacts to surface water quality.

5.1.4.4 Impacts to Human Health and Safety

Potential short-term human health impacts to the public and collocated workers from remediation activities include fugitive dust, exposure to radioactive materials, and traffic associated with onsite and offsite transportation of soil. Workers involved in remediation operations will also be subject to risks of operating heavy machinery.

As a measure of impacts to the public from remediation activities, the CID (DOE 1997d) reports the following estimated annual radiological doses from RFETS closure air emissions: maximally exposed collocated worker, 5.4 mrem; maximally exposed member of the public 0.23 mrem; and population dose, 23 person-rem. The population dose will be expected to produce 0.012 latent cancer fatalities in the region of interest with a population of 2.7 million. Because these estimates include all RFETS closure activities, impacts from activities addressed in this proposed action will be a small fraction of those reported above.

Worker radiological dose estimates for all closure activities are presented in the CID (DOE 1997d), grouped by activity and building cluster. A total worker dose of 383 rem is reported for decommissioning and remediation activities for the 371, 707, 771, 776/777, 779, 881, 886, and 991 building clusters. An additional worker dose of approximately 12 rem is predicted for miscellaneous production zones, TRU cluster, and IA and Buffer Zone decommissioning and remediation activities. The total reported dose to workers for these closure activities is approximately 395 rem. Because doses from decommissioning will dominate these exposures, the proposed action is expected to be a small fraction of the 395 rem reported in the CID (DOE 1997d).

In practice, remediation activities, which address soil with potential radiological contamination, will be subject to RFETS's radiation protection program, which includes administrative controls limiting the dose to any involved worker to a maximum of 500 mrem/yr. Doses resulting from activities addressed in this IM/IRA are expected to comply with this limit. In addition, worker radiation protection for these activities will be governed by the ALARA principle, which mandates that worker exposures be further minimized on a cost-effective basis, consistent with the activities being conducted.

Risks to involved workers will be dominated by standard industrial hazards associated with heavy equipment operations associated with excavation, earthmoving, and transportation equipment. A project-specific Health and Safety Plan (HASP) Addendum and Job Hazard Analysis (JHA) will be prepared before implementing the proposed action.

Environmental impacts of transportation of Low-Level Waste (LLW) from the proposed action to disposal facilities is addressed in Attachment 3 of the RSOP for Facility Disposition (DOE, 2004). The analysis includes transportation for disposal of all LLW and Low-Level Mixed Waste (LLMW) generated during RFETS closure and concluded that:

> "… the cumulative impacts from the off-site shipment of LLW and LLMW, in conjunction with other ongoing and reasonably foreseeable future actions at RFETS, are expected to be minor." (DOE, 2004)

The Facility Disposition RSOP (DOE, 2004) transportation analysis does not directly address transportation of remediation-derived soil to offsite disposal or treatment facilities. However, because remediation waste is a component of LLW and LLMW that is shipped offsite, transportation impacts are bounded by the Facility Disposition RSOP analysis (DOE, 2004).

5.1.4.5 Impact to Ecological Resources

Heavy equipment activities for the proposed action will temporarily affect vegetation communities and wildlife habitat in and around the area. Temporary effects due to surface disturbance associated with soil removal and noise associated with heavy equipment are expected. Approximately 23 acres will be affected by construction activities. Revegetation of areas will be conducted with native prairie species.

The period of increased equipment noise, vehicular traffic, and other human activity will last less than one year. During this time, sensitive wildlife species may avoid the area. The area affected is highly variable and dependent on species and individuals. Some animals may habituate to the activity and return to the area. Although wildlife use of the area may be reduced because of this avoidance response, this area does not represent critical habitat or breeding areas for Site wildlife.

Long-term impacts on ecological resources could include physical alteration of terrestrial habitats. Physical alteration of the habitats could include degradation and/or temporary loss of existing habitat. The primary areas involved are mid-grass prairie in the excavation area of the 903 lip area. Temporary impacts to isolated small wetland areas will occur as a result of the project. Pre- and post-disturbance monitoring of these wetlands will be conducted per discussions between DOE and the EPA.

The Preble's Meadow Jumping Mouse (PMJM) will not be impacted by the proposed action in the 903 Pad Lip Area and vicinity because the project area is outside current Preble's protection areas at RFETS. Migratory birds are protected under the Migratory Bird Treaty Act. To meet the substantive requirements of the statute the following actions will be implemented for the project. Because no active nests are expected to be present in the project area from September 15 through April 15, no nest surveys will be conducted during this timeframe. However, from April 16 through September 14, the following protocol will be used. Nest surveys will be conducted every two weeks of vegetated areas that remain and are scheduled to be disturbed in the project lip. Any active nests located will be recorded by bird species. The nests will be removed and/or relocated. Then the project will be allowed to disturb the area.

5.1.4.6 Impact to Cultural & Historic Resources

The Rocky Flats Plant site was placed on the National Register of Historic Places as a Historic District (5JF1227) on May 19, 1997. Historic District designation mandates compliance with the Historic Preservation Act of 1966, and the Programmatic Agreement among DOE, the Colorado State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding Historic Properties at RFETS. While the proposed action will be conducted within the Historic District boundaries, no impact will occur to protected structures.

5.1.4.7 Impacts to Visual Resources

Remediation activities will result in temporary and minor visual impacts during RFETS closure. However, the long-term visual changes to topography and vegetation cover resulting from remediation activities will not be noticeable. Remediation activities include the revegetation of soil to a native grassland appearance. Revegetation areas will be permanently revegetated using the appropriate native plant species mixture.

5.1.4.8 Noise Impacts

Remediation activities include a temporary increase in local noise levels from the operation of heavy equipment, and the loading and hauling of contaminated soil for offsite disposal. The CID (DOE 1997d) found that noise levels from industrial activities within the RFETS boundary were not distinguishable from background traffic noise levels. Noise levels from the proposed action are not expected to be perceptible at offsite locations.

The primary source of noise to nearby residential areas is traffic movement along local streets and state routes. Remediation activities will result in higher public noise levels due to the increased number of trips for waste transport. However, the effects will be short-term, occurring intermittently during daylight hours, and lasting for several months. The CID Update (DOE 2001f) identified increased offsite traffic relative to the CID (DOE 1997d) due to the shorter closure time, but found that the additional traffic noise will not cause a doubling of noise levels. It indicated that most public reviews of traffic noise by federal and state agencies consider a doubling of sound (10 decibels or greater) to be a moderate to substantial increase. Because traffic, including truck traffic, is already prevalent along the proposed trucking routes, it was concluded in the CID Update (DOE 2001f) that the potential impact is considered low. Given that the CID (DOE 1997d) and CID Update (DOE 2001f) analyses considered offsite waste management transport (LL, LLM, and sanitary waste) and work force commuters, in addition to remediation waste transport, offsite noise impacts from remediation activities alone will be considerably less.

5.1.4.9 Impacts to Transportation

The proposed remediation activities will produce soil waste that requires onsite transportation for interim storage, and offsite transportation for disposal of contaminated soil at offsite facilities. Potential transportation impacts include increased air emissions, increased traffic congestion, and transportation accidents. Tailpipe emissions and airborne particulate matter generated by the anticipated truck traffic is projected to be well below regulatory standards and will not reach a level of concern. Because of stringent Department of Transportation packaging and shipping standards, cargo-related accidents will pose minimal concern to human H&S. The CID Update (DOE 2001f) analyzed traffic in terms of highway and road congestion resulting from RFETS-related traffic. The effects were not projected to be substantial.

In addition to being analyzed in the CID (DOE 1997d) and CID Update (DOE 2001f), transportation of RFETS wastes has been analyzed from a NEPA perspective in the following NEPA documents: Final Waste Management Programmatic Environmental Impact Statement for Managing, Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (DOE 1997f); Environmental Assessment Finding of No Significant Impact for Temporary Storage of Transuranic and Transuranic Mixed Waste (DOE 1999e); Attachment 3 of the RSOP for Facility Disposition (DOE, 2004). These documents analyzed impacts of offsite shipment of RFETS waste to potential treatment and disposal locations including NTS, Envirocare, and Hanford. The RSOP for Facility Disposition, in particular, addressed remediation waste (DOE, 2004). These studies have found that impacts of waste shipments are small, and the shipments themselves contribute to an overall reduction of risk at RFETS.

5.1.4.10 Cumulative Effects

The activities proposed in this IM/IRA support the overall mission to clean up RFETS and make it safe for future uses. The cumulative effects of this broader, sitewide effort are presented in the CID (DOE 1997d) and CID Update (DOE 2001f), which describe the short- and long-term effects from the overall cleanup mission.

The primary focus of the CID (DOE 1997d) was on cumulative impacts resulting from onsite activities implemented through RFETS closure. Cumulative impacts result from the proposed

RFETS activities and the effects of other actions taken during the same time in the same geographic area, including offsite activities, regardless of what agency or person undertakes such other action. The CID Update (DOE 2001f) analysis included updated onsite and offsite transportation requirements, as well as several new offsite activities, although the future non-DOE projects are relatively uncertain. Increased traffic congestion will be the most noticeable impact according to the CID Update (DOE 2001f) (see Section 5.1.4.9). Air pollutants and noise will also have adverse impacts (Sections 5.1.4.2 and 5.1.4.8); however, the impacts are expected to be short-term in nature, with staggered project start and completion dates. Most people will perceive a positive, long-term visual and "quality of life" benefit, as RFETS infrastructure and remediation equipment is removed, returning RFETS to a more natural appearance.

The cumulative impacts of the proposed action are expected to be similar to those analyzed in the CID (DOE 1997) and 2000 CID Update Report (DOE 2001). Over the short term, additional project personnel will have an additive effect on the existing workload for Site operations, and there will be increased air emissions, visual impacts, noise, and traffic impacts resulting from construction activities. These short-term impacts will be minimal. Long-term impacts facilitate future use of the Site and fulfill the mandated cleanup objectives.

5.1.4.11 Irreversible and Irretrievable Commitments of Resources

The proposed action will result in a variety of permanent commitments of resources; however, it is not expected to result in a substantial loss of valuable resources. Most of the resources used for the work are permanently committed to implementation of the accelerated action. Irreversible and irretrievable resources are defined as resources that are either consumed, committed, or lost. For this area, irreversible and irretrievable resources include the following:

1. Consumptive use of geological resources (e.g., quarried rock and gravel for road construction) will be required for construction activities. Supplies of these materials will be provided by an onsite or offsite commercial borrow source. However, adequate supplies are available without affecting local demand for these products.
2. Fuel consumed by construction equipment and vehicles used for the proposed action will not be recovered.

3. Isolated wetland areas associated with hillside seeps will be impacted by the proposed action. Long-term direct impacts to the floodplain resulting in changes of flood elevations will not occur.

4. A long-term commitment of personnel and funds will be required to perform post-closure inspection, maintenance, and monitoring activities.

5. Incidental resources that are consumed, committed, or lost on a temporary and/or partial basis during construction include construction personnel and equipment, the construction water source, and some construction materials.

Monitoring and maintenance activities will be performed, as necessary, to ensure long-term protection of human health and the environment.

5.1.5 Compliance with ARARs

As required by Part 4 of RFCA, the proposed action will be performed to the extent practicable in compliance with applicable or relevant and appropriate requirements (ARARs) under CERCLA. ARARs have been identified for the proposed action consistent with the National Contingency Plan (NCP), the preambles to the proposed and final NCP, and CERCLA Compliance with Other Laws Manuals Part I and Part II (EPA 1988, 1989).

The ARARs are provided in Appendix H. This section provides additional detail for the ARARs related to the excavation and disposal of soil with radioactive contaminants, air, surface water and wildlife.

RFCA paragraphs 16 and 17 established the requirements under which the CERCLA permit waiver applies. For any action, which would require a permit but for the CERCLA waiver, RFCA Paragraph 17 requires that the following information be included in the submittal:

- Identification of each permit that would be required.

- Identification of the standards, requirements, criteria, or limitations, which have to be met in order to obtain each permit.

- Explanation of how the response action proposed will meet the standards, requirements, criteria, or limitations identified in subparagraph b (immediately above).

This information is included for those aspects of the proposed action that are eligible for the permit waiver.

5.1.5.1 Decommissioning Plan Contents

If proposing to use the criteria in RH 4.61.3 and RH 4.61.4 for restricted access, the plan must include analysis demonstrating that reductions in residual radioactivity necessary to comply with the provisions of RH 4.61.2 for unrestricted access would result in net public or environmental harm, or were not being made because residual levels of contamination associated with restricted conditions are ALARA, taking into account consideration of any detriments expected to potentially result from decontamination and waste disposal.

Appendix D provides an analysis of measures necessary to create unrestricted access to the area of concern, and demonstrates that the impacts from such measures result in net environmental harm. Therefore, measures to create unrestricted access are not warranted based on this criterion.

5.1.5.2 Air

The proposed action has the potential to generate fugitive particulate emissions, and some potential for hazardous air pollutant emissions. Subpart H of 40 CFR Part 61 contains the requirements for monitoring and reporting activities within DOE facilities that have the potential to emit radionuclides other than radon. The normal perimeter NESHAPs compliance air monitoring will be conducted during the soil excavation and removal.

Colorado Regulation No. 1 (5 Colorado Code of Regulations [CCR] 1001-3) governs opacity and particulate emissions. Section II of Regulation No. 1 addresses opacity and prohibits stack emissions from fuel-fired equipment exceeding 20 percent opacity. Section III addresses the control of particulate emissions. Fugitive particulate emissions will be generated from construction and transportation activities. During construction activities, dust minimization techniques, such as water sprays, will be used to minimize suspension of particulates. In addition, heavy equipment activities will not be conducted during periods of high wind. The substantive requirements of Regulation No. 1 will be incorporated into the Work Control document, referring to dust suppression as needed.

Colorado Regulation No. 3 (5 CCR 1001-5) provides CDPHE with the authority to inventory emissions and Part A describes Air Pollutant Emission Notice (APEN) requirements. Air quality management subject matter experts will evaluate the project emissions and, if applicable, an APEN will be prepared to facilitate CDPHE's inventory process.

Erosion control measures, such as hydrolmulch, tackifier, and straw will minimize the potential post-action wind erosion of soil and subsequent particulate emissions. Significant air emissions are not anticipated after the soil removal action is complete.

5.1.5.3 Surface Water

5.1.5.3.1 RFCA Points-of-Compliance

Surface water Point-of-Compliance (POC) monitoring locations in the IHSS Group 900-11 area are below Pond C-2 (GS31) and at Woman Creek and Indiana Street (GS01).

5.1.5.3.2 Stormwater Control Measures

The area of disturbed soil with the proposed action is approximately 23 acres. Surface water control measures will be used to minimize surface water contact with potentially contaminated soil and minimize erosional effects during the construction activities. Newly-disturbed soil surfaces will be stabilized using erosion blankets, tackifier, straw-mulch, straw wattles, straw bales and other storm water best management practices (BMPs) to minimize soil erosion, sediment transport, and surface water quality degradation until the required vegetation is established. The use of BMPs minimizes soil loss and fosters re-establishment of a vegetative cover.

5.1.5.3.3 Remediation Wastewater

Remediation-related wastewater will be collected, characterized, and transferred to an approved treatment unit for processing (i.e., the Site sewage treatment plant or another approved onsite or offsite treatment facility), or it will be directly discharged in accordance with requirements of the Site's Incidental Waters Program (K-H 2003c).

5.1.5.4 Wildlife

Heavy equipment activities may impact migratory birds protected by the Migratory Bird Treaty Act, and the Fish and Wildlife Conservation Act. Due to the variations in potential impacts depending upon the season and nesting schedules for migratory birds, the substantive requirements of these federal statutes will be evaluated by the Site Ecology group prior to conducting activities associated with the proposed action. The substantive requirements identified during the evaluation will be implemented throughout the accelerated action.

5.1.6 Long-Term Stewardship Considerations

The objective of this section is to identify additional post-action care (that is, long-term stewardship) requirements of the proposed accelerated action for the 900-11 area. These requirements are necessary for the long-term effectiveness of this remedy and include the following components: information management, periodic review, and maintenance of a responsible controlling authority. Other requirements necessary for the short- and long-term effectiveness of the remedy are identified in Section 5, including institutional controls, inspection and maintenance, environmental monitoring, and controlling authority. These requirements are specific to the accelerated actions described in this IM/IRA and are summarized in Table 5-1. Additionally, these requirements will ultimately be captured (along with post-closure care requirements from other accelerated actions at Rocky Flats) in post-closure regulatory documents, which may include the final Corrective Action Decision/Record of Decision (CAD/ROD) for Rocky Flats, any post-closure Rocky Flats Cleanup Agreement- (RFCA) type agreement, and any post-closure Resource Conservation and Recovery Act (RCRA) permit or other enforceable mechanism. DOE and CDPHE have not reached agreement as to whether a post-closure permit (or, alternatively, an enforceable document as defined in 6CCR 1007-3, Section 100.10(d) will be required for Rocky Flats, and if so, what requirements that permit (or enforceable document) will contain. The Parties will endeavor to resolve this matter. Failing an agreed-upon resolution, each Party reserves its rights as provided in RFCA Part 18.

5.1.6.1 Information Management

A successful stewardship program is dependent on retaining the necessary records about the history and residual contamination of the site. Retained information should include the history of the site, the COCs, the selected remedies, the use of controls and their associated monitoring and maintenance records, and any other information judged necessary for succeeding generations to understand the nature and extent of the residual contamination. At a minimum, the following records will be retained, stored, and retrievable for this accelerated action:

1. This IM/IRA and any future modifications;
2. The final design for the action and field change requests;
3. The post-action drawings of the area;
4. The monitoring and maintenance manual (as needed) and subsequent revisions;
5. Inspection records and logbooks;
6. Maintenance records and logbooks;
7. CERCLA periodic review reports;
8. Correspondence between the agencies associated with modifications to the post-action care regime;
9. The Memorandum of Understanding (MOU) between DOE and the U.S. Department of Interior (DOI) identifying the controlling authority;
10. The CAD/ROD; and
11. The RFETS Historical Release Report (HRR) and other relevant historical documentation.
12. The Closeout Report

This information will be maintained in the Administrative Record (AR) File (See Section 7.0). Currently, a hard copy of the AR File is maintained onsite. DOE is currently looking at options for retaining hard copies of permanent records following Site closure.

Table 5-1. Summary of Post-Accelerated Action Monitoring, Maintenance, and Institutional Control Requirements

Subject	Action	Frequency of Action	Criteria	Possible Follow-on Action
Soil Removal	Visual Inspection	Quarterly	Erosion	Repair, as necessary.

Subject	Action	Frequency of Action	Criteria	Possible Follow-on Action
Area				
			Unwanted vegetation	Remove or employ weed control measures, as necessary.
			Lack of vegetation	Re-seed areas as necessary.
			Burrowing animals	Remove and repair damage, as necessary.

(Table 5-1 continued on next page)

Table 5-1 (continued)

Subject	Action	Frequency of Action	Criteria	Possible Follow-on Action
Surface Water	POCs: GS01 & GS31 Performance: SW055, SW027, GS54, GS53, GS52, GS51, and GS42	Continuous (using automated, flow-paced sampling units)	POCs: Analyze for Pu, Am, and U. Compare 30-day moving average at POCs to RFCA Action Level (0.15 pCi/L for Pu and Am; 11 pCi/L for U). Performance locations: Analyze Pu and Am time trend plots to assess remedy effectiveness over a range of conditions.	If a surface water Action Level is exceeded at POC locations, RFCA parties will consult regarding response action.
Air	Air monitoring (existing RAAMP monitoring network).	Annual Average	Analyze for Pu-239/240, Am-241, U-233/234, U-235, and U-238 and compare annual average to compliance levels in Appendix E of 40 CFR 61.	If an air quality compliance level is exceeded at a boundary monitoring location, RFCA parties will consult regarding response action.
Institu-tional and Physical Controls	Visual Inspection	Quarterly	Security and Access Controls; and overall site conditions	Check signs, fences (if required), markers, and overall condition of the area to determine continuing effectiveness of institutional and physical controls.

5.1.6.2 Periodic Assessments

Periodic assessments are performed to determine whether the selected remedies and stewardship controls continue to operate as designed, and ascertain whether new technologies might exist to eliminate remaining residual contamination in a safe and cost-effective manner. The CERCLA five-year review process is required for all Superfund sites that leave residual contamination behind after closure, and will establish the minimum requirements for post-closure periodic assessments. EPA Comprehensive Five-Year Review Guidance (2001) describes the format of the review and suggests mechanisms that can be implemented through the five-year review process to ensure the protectiveness of the remedy.

DOE is responsible for conducting the five-year reviews. EPA then issues a finding of concurrence or nonconcurrence. The public has indicated an interest in performing reviews more frequently than the five-year interval specified in CERCLA. DOE intends to work with its stakeholders to arrive at a review regimen that meets community needs.

The periodic assessment will include actions such as evaluating monitoring and maintenance records, verifying regulatory compliance, and determining whether land use assumptions are still valid. One specific topic for the periodic assessment for the area is likely to be continuance of surface water quality performance monitoring. Determining when specific types and locations of monitoring are no longer required will be part of this assessment.

5.1.6.3 Controlling Authority

Long-term protection of human health and the environment necessitates that a controlling authority be established with responsibility for post-closure management. CERCLA mandates that DOE, as a responsible party, will retain responsibility for the contamination at RFETS resulting from its activities there, as well as responsibility for long-term maintenance of any remedies. The Rocky Flats National Wildlife Act of 2001 requires that, following certification by U.S. EPA, that the cleanup and closure of Rocky Flats has been completed, certain lands of the current Site will be transferred from the Secretary of the Interior. These lands would be under administrative jurisdiction of the USFWS. The Act also requires the Secretary of Energy to retain administrative jurisdiction of certain real property and facilities, including engineered

structures, required to carry out response actions required for the cleanup and closure of the Site. The MOU currently being negotiated between DOE and DOI will outline this process, although it is unlikely the final boundaries of the land to be transferred will be determined until the final cleanup and closure plans are approved.

5.1.6.4 Reporting Requirements

This IM/IRA includes reporting requirements for data results, inspection results, repairs, and routine maintenance (see Section 5.1.6.1). These requirements may be combined into one report and may be combined with future site-wide maintenance and monitoring reports.

5.1.7 Implementation Schedule

The planned period for implementing the proposed accelerated action is Fiscal Year 2004 (which ends on September 30, 2004).

6.0 CLOSEOUT REPORT

Upon completion of accelerated action activities in the area of concern, a Closeout Report will be prepared in accordance with RFCA to address the accelerated action work performed. The closeout Report will document the work completed within the scope of this IM/IRA. The expected outline for the closeout report is as follows:

- Introduction;
- Remediation action description;
- Dates and duration of specific activities (approximate);
- Deviations from the decision document;
- Final disposition of wastes (actual or anticipated, if required);
- Demarcation of wastes left in place (i.e., survey bench marks and measurements); and
- Demarcation of areas requiring access controls.

Upon completion, the Closeout Report will be submitted for review and approval by EPA, the lead regulatory agency, and CDPHE, and placed in the Administrative Record file.

7.0 ADMINISTRATIVE RECORD REQUIREMENTS

The AR file will contain the 900-11 Area IM/IRA, including scoping meeting minutes, and the final Closeout Report for the project. In addition, project specific information, such as project correspondence, work control documents, and other information generated as a direct result of this project, will be filed in the Project Record. The Project Record files will be transferred to Site Records Management upon completion of the final Closeout Report.

8.0 RESPONSIVENESS SUMMARY

Responses to comments received during the formal comment period, including comments from the regulatory agencies, will be documented and included as an Appendix once comments are received.

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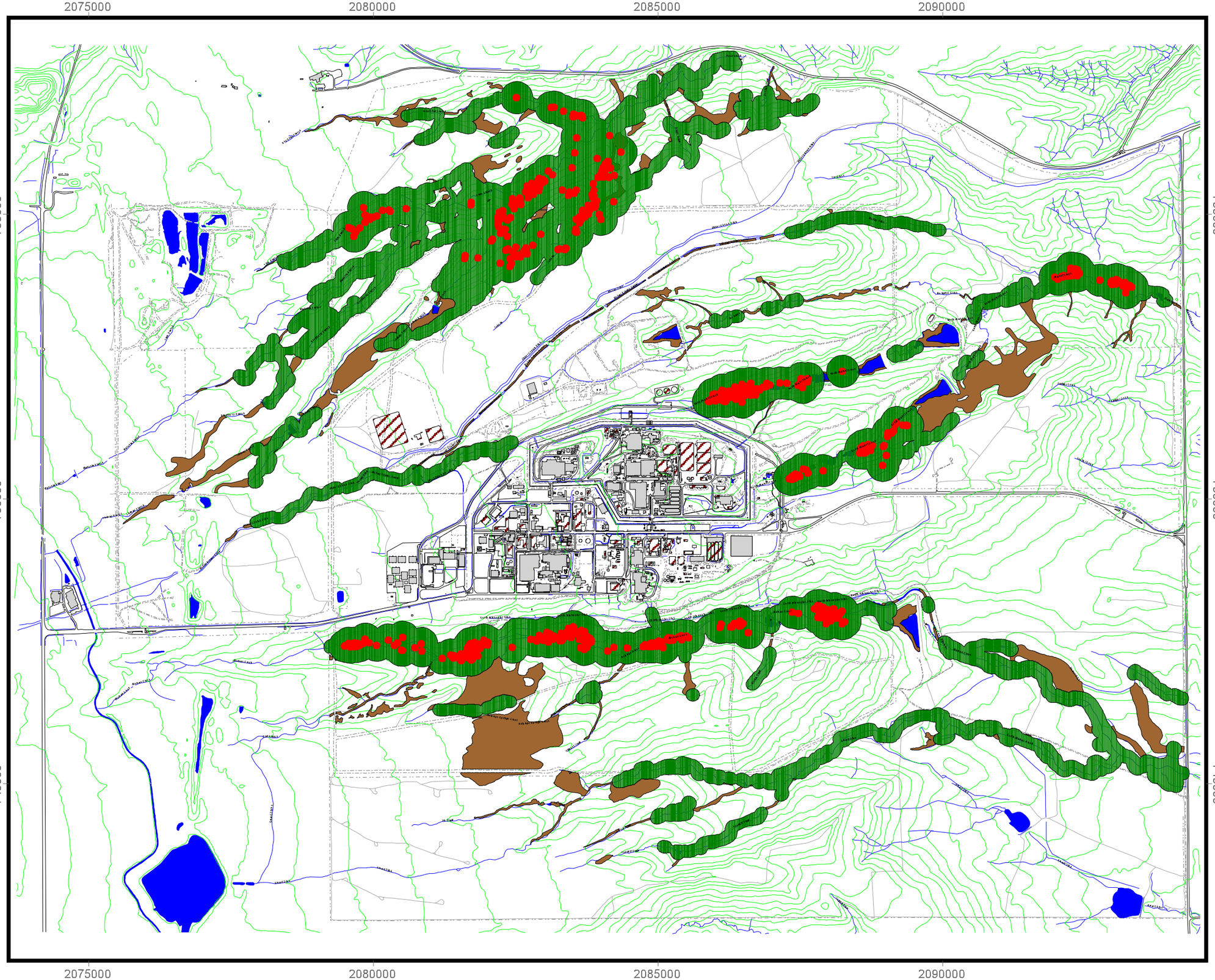
Appendix A – IHSS Group 900-11 Area IM/IRA

Figures:

- RFETS Preble's Meadow Jumping Mouse habitat
- RFETS Wetlands map

Preble's Meadow Jumping Mouse Current Protection Areas at RFETS December 2003

Figure 1



Legend

- Current Preble's Protection Areas
- Contiguous Wetlands
- Preble's mouse telemetry points

Standard Features

- Buildings
- Demolished Buildings
- Lakes & ponds
- Streams & ditches
- Fences
- Paved roads
- Dirt roads
- Contours (20 ft. intervals)

DATA SOURCE BASE FEATURES:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs, 1/95.

N

1000 0 1000 Feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: Professional Environmental Group, L.L.C.

For: Kaiser-Hill Company, LLC

RFETS GIS Dept.
303-966-7707

MAP ID: 04-0006

December 16, 2003

O:\Projects\FY2004\04-0006\PMJ\Melbur.apr\December 2003 PMJM Protection Area Map

Rocky Flats Environmental Technology Site
Wetlands Map

LEGEND

Cowardin Wetlands Classification Codes

- LUBH (Lacustrine Limnetic, Unconsolidated Bottom, Permanently Flooded)
- PABH (Palustrine Aquatic Bed, Permanently Flooded)
- PEMA (Palustrine Emergent, Temporarily Flooded)
- PEMB (Palustrine Emergent, Saturated)
- PEMC (Palustrine Emergent, Seasonally Flooded)
- PEMF (Palustrine Emergent, Semipermanently Flooded)
- PFOA (Palustrine Forested, Temporarily Flooded)
- PFOC (Palustrine Forested, Seasonally Flooded)
- PSSA (Palustrine Scrub-Shrub, Temporarily Flooded)
- PSSC (Palustrine Scrub-Shrub, Seasonally Flooded)
- PUBF (Palustrine Unconsolidated Bottom, Semipermanently Flooded)
- PUBH (Palustrine Unconsolidated Bottom, Permanently Flooded)
- PUSC (Palustrine Unconsolidated Shore Seasonally Flooded)
- R4SBC (Riverine Intermittent, Streambed, Seasonally Flooded)
- R4SBG (Riverine Intermittent, Streambed, Intermittently Exposed)
- R4SBH (Riverine Intermittent, Streambed, Permanently Flooded)
- R4SBJ (Riverine Intermittent, Streambed, Intermittently Flooded)

NOTE:
Very small wetland features consist of points or lines. The point features represent wetlands which are less than 10' in diameter and are shown with small outlined (closed) circles. The line features represent wetlands which are less than 10' in width and are shown with lines which are not bounded by an outline.

Larger wetland features which are greater than 10' in diameter or width are shown with outlined (closed) polygons. Wetland and sub-wetland numbers are designated as 1A, 1B, 2A, etc.

Special wetland types created or modified by impoundment, excavation, ditching or riprap are shown in spreadsheets contained within the "Rocky Flats Plant Wetlands Mapping and Resource Study", December, 1994; U.S. Army Corp of Engineers.

Non-Wetland Features

- Buildings and other structures
- Solar evaporation ponds
- Streams, ditches, or other drainage features
- Tributary boundaries (eg., WCB = watershed drainage)
- Fences and other barriers
- Rocky Flats boundary
- Paved roads
- Dirt roads

DATA SOURCE:
Wetlands data surveyed, compiled, and assembled by the U.S. Army Corps of Engineers; 1994.
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the othophotographs. 1:95

Scale = 1 : 7200
1 Inch represents 600 feet

500 0 1000 2000 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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MAP ID: 98-0208
July 09, 1998

Appendix B – IHSS Group 900-11 Area IM/IRA

Sub-Surface Soil Risk Screens

(For Sub-Surface Soil Locations with Sample Results Above Soil Action Level for Wildlife Refuge Worker)

Sub-Surface Soil Risk Screen

Screening Location #: 1
Location Code and Description: 13395
S. of 903 Pad, outside of Lip Area (IHSS 155) boundary
Contaminant of Concern: U-235
Action Required: None

The Sub-Surface Soil Risk Screen follows the steps identified in Figure 3 in Attachment 5 of the RFCA Modification (DOE et al. 2003):

Screen 1 - Are COC concentrations below RFCA Table 3 Wildlife Refuge Worker (WRW) Soil Action Levels?

No, results for 1 U-235 sub-surface sample (below 3 feet in depth) are above WRW Action Levels below 3 feet in depth, as shown in the table below.

Contaminant of Concern	Wildlife Refuge Worker Action Level (pCi/g)	Sample Result (pCi/g)	Sample Result Above WRW Action Level?	Sample Location Code	Sample End Depth (feet)
U-235	8.0	8.6	Yes	13395	5

Screen 2 - Is there a potential for subsurface soil to become surface soil (landslide and erosion areas identified on RFCA Attachment 5 - Figure 1)?
Yes, the potential exists. As shown in Figure 1, RFCA Attachment 5, the sampling location is on the boundary of the area considered prone to landslides and high erosion.

Screen 3 - Does subsurface soil radiological contamination exceed criteria in Section 5.3 and Attachment 14?
Screen 3 applicable to Pu and Am only.

Screen 4 – Is there an environmental pathway and sufficient quantity of COCs that would cause an exceedance of the surface water standard?

There are two separate pathways by which the contamination in question could theoretically reach surface water: 1) migration via surface erosion, and 2) migration via groundwater that ultimately seeps to the surface and reaches surface water. These two potential pathways are addressed separately:

Surface Erosion: Erosion of the sub-surface U-235 contamination, sufficient to expose it to the surface, is highly improbable, because it is located greater than 3 feet below the ground surface.

The sub-surface soil sample in question is located in the Woman Creek watershed. RFCA Points of Compliance (POC) in the watershed are: 1) GS31 (at the outfall of Pond C-2), and 2) GS01 (at Woman Creek and Indiana Street. The RFCA standard for total uranium in the Woman Creek drainage is 11 pCi/L, based on a 30-day moving average (there is not a standard specifically for U-235). At the Woman Creek POC stations, the Site has maintained continuous compliance with the total uranium standard in surface water since RFCA monitoring was first implemented (see main report, Section 2.3.2).

Point-of-Evaluation monitoring station SW027 is located at the east end of the South Interceptor Ditch (SID), downstream from the sub-surface soil sample location. Station SW027 has also maintained continuous compliance with the 11 pCi/L, 30-day moving average for total uranium (see main report, Section 2.3.2).

Groundwater Migration:
Well 07391 is the closest downgradient well to Ryan's Pit and provides performance monitoring of the accelerated action. Elevated activities of U-235 have been observed in well 07391. U-235 activities exhibit a downward trend up to September 1995 when the accelerated action occurred at Ryan's Pit. However, U-235 activities after the accelerated action have increased above Tier II and the background mean plus two stand deviations. U-235 data collected in 2002 was above the background activity (1.79 pCi/L) (K-H, 2003e).

Screen 5 – Are the COC concentrations above Table 3 Action Levels for ecological receptors?
(Note: Screen 5 is not pertinent, based on the determination to use an Accelerated Action Ecological Screen Process. However, for reference, the results of the screen are displayed here).

No. The U-235 concentration is below the Action Level for ecological receptors as displayed in the table below.

Contaminant of Concern	Ecological Receptor Action Level (pCi/g)	Sample Result (pCi/g)	Sample Result Above Ecological Receptor Level?	Sample Location Code	Sample End Depth (feet)
U-235	1900	8.6	No	13395	5

Summary
Based on the results of the sub-surface soil screening process, excavation and removal of soil at this location does not appear to be warranted. While it is recognized that Screen 2 (erosion potential) yields a positive answer, the sample location is on the boundary of the generally-defined erosion prone area. The sample result is less than 1 pCi/g above the 8.0 pCi/g WRW Action Level for U-235 that applies to the top 6 inches of soil. Excavating down 5 feet to remove this isolated soil area does not appear to be warranted.

Sub-Surface Soil Risk Screen

Screening Location #: 2
Location Code and Description: 50299
903 Lip Area (IHSS 155) – In Outer Lip Area, N.E of Firing Range (south sample)
Contaminant of Concern: Pu-239/240
Action Required: None

The Sub-Surface Soil Risk Screen follows the steps identified in Figure 3 in Attachment 5 of the RFCA Modification (DOE et al. 2003):

Screen 1 - Are COC concentrations below RFCA Table 3 Wildlife Refuge Worker (WRW) Soil Action Levels?

No, results for 1 Pu sub-surface sample (below 3 feet in depth) are above WRW Action Levels as shown in the table below.

Contaminant of Concern	Wildlife Refuge Worker Action Level (pCi/g)	Sample Result (pCi/g)	Sample Result Above WRW Action Level?	Sample Location Code	Sample End Depth (feet)
Pu-239-240	50	161	Yes	50299	6

Screen 2 - Is there a potential for subsurface soil to become surface soil (landslide and erosion areas identified on RFCA Attachment 5 - Figure 1)?
Yes, the potential exists. As shown in Figure 1, RFCA Attachment 5, the sampling location is on the boundary of the area considered prone to landslides and high erosion.

Screen 3 - Does subsurface soil radiological contamination exceed criteria in Section 5.3 and Attachment 14?
No.

As shown in the table below, the Pu result collected below 3 feet (and greater than the WRW Action Level in Screen 1) is below the screen of 3 nanoCuries per gram (nCi/g) (equal to 3,000 pCi/g) (from RFCA Section 5.3).

Contaminant of Concern	Sample Location Code	Sample End Depth (feet)	Sample Result (pCi/g)	Above 3 nCi/g (= 3000 pCi/g)?
Pu-239-240	50299	6	161	No

The RFCA Attachment 14 Screen (related to the Original Process Waste Line (OPWL) system) does not apply to this area.

Screen 4 – Is there an environmental pathway and sufficient quantity of COCs that would cause an exceedance of the surface water standard?

There are two separate pathways by which the contamination in question could theoretically reach surface water: 1) migration via surface erosion, and 2) migration via groundwater that

ultimately seeps to the surface and reaches surface water. These two potential pathways are addressed separately:

Surface Erosion: Erosion of the sub-surface Pu, sufficient to expose it to the surface, is highly improbable, because the contamination is located from 3 to 6 feet below the ground surface.

The sub-surface soil sample in question is located in the Woman Creek watershed. RFCA Points of Compliance (POC) in the watershed are: 1) GS31 (at the outfall of Pond C-2), and 2) GS01 (at Woman Creek and Indiana Street. At these POC locations, the Site has maintained continuous compliance with the 0.15 pCi/L, 30-day moving average standard for Pu and Am since RFCA monitoring was first implemented on October 1, 1996 (see main report, Section 2.3.2).

Point-of-Evaluation monitoring station SW027 is located at the east end of the South Interceptor Ditch (SID), downstream from the sub-surface soil samples. Station SW027 has had historic sample results above the 30-day moving average, 0.15 pCi/L standard for Pu (see main report, Section 2.3.2). However, there is widespread diffuse Pu and Am in the surface soil of the SID watershed. The measured results at SW027 that have exceeded 0.15 pCi/L for Pu are, with high probability, associated with erosion of the surface contamination, and not associated with the sub-surface contamination in question.

Groundwater Migration:
For the Lip Area (IHSS 155), six wells were identified that are pertinent to the discussion (wells 00491, 11791, 50299, 60194, 60294, and 60394). Of these, three wells (11791, 50299, and 00491) have Pu data. The Tier II groundwater action level for Pu is 0.151 pCi/L. The Tier I action level is 15.1 pCi/L (100 times the Tier II level). Results are discussed below.

At well 11791, located in the immediate area of the soil contamination, almost all of the Pu results from 1992 through 1994 are above the Tier II action levels, and some of the Pu results approached the Tier I action level. However, beginning in May 1995 and through June 2000, all Pu results from this well are below the Tier II action levels.

Well 50299 is an "aseptic" well (i.e., constructed to minimize the potential for surficial contamination to be introduced down the well) that is adjacent to and upgradient from 11791. Well 50299 has not exhibited Pu activity greater than the Tier II action level. Well 50299 was installed because of concerns that the drilling and completion techniques used for well 11791 caused contamination of the well. The two sample events from well 50299 (September 1999 and June 2000) support the hypothesis that surficial contamination may have been responsible for the Pu activity observed in well 11791.

The third well with Pu data, 00491, has 20 samples collected from December 1991 to September 2003. This well does not have sample results with Pu activity greater than the Tier II action level.

Screen 5 – Are the COC concentrations above Table 3 Action Levels for ecological receptors?
(Note: Screen 5 is not pertinent, based on the determination to use an Accelerated Action Ecological Screen Process. However, for reference, the results of the screen are displayed here).

No. The Pu concentration is below the Action Level for ecological receptors as displayed below.

Contaminant of Concern	Ecological Receptor Action Level (pCi/g)	Sample Result (pCi/g)	Sample Result Above Ecological Receptor Level?	Sample Location Code	Sample End Depth (feet)
Pu-239/240	3800	161	No	50299	6

Summary

Based on the results of the sub-surface soil screening process, excavation and removal of soil from this location is not considered warranted. As indicated in Screen 3, the 161 pCi/g sample result is well below the screening level of 3 nanoCuries per gram (nCi/g) (equal to 3,000 pCi/g) for samples collected below 3 feet.

In addition to the Screen 3 result, the sub-surface sample is located within the area that is subject to removal of surface soil. As applicable to any location in the that soil excavation area, if confirmation sampling (conducted after surface soil is removed) indicates the underlying soil does not meet WRW RSALs, then additional excavation will be performed as required at that location.

Sub-Surface Soil Risk Screen

Screening Location #: 3
Location Code and Description: CU-39-00
903 Lip Area (IHSS 155) – In Outer Lip Area,
N.E of firing range (north sample)
Contaminant of Concern: Pu-239/240
Action Required: None

The Sub-Surface Soil Risk Screen follows the steps identified in Figure 3 in Attachment 5 of the RFCA Modification (DOE et al. 2003):

Screen 1 - Are COC concentrations below RFCA Table 3 Wildlife Refuge Worker (WRW) Soil Action Levels?

No, results for 1 Pu sub-surface sample (below 3 feet in depth) are above WRW Action Levels below 3 feet in depth, as shown in the table below.

Contaminant of Concern	Wildlife Refuge Worker Action Level (pCi/g)	Sample Result (pCi/g)	Sample Result Above WRW Action Level?	Sample Location Code	Sample End Depth (feet)
Pu-239-240	50	124	Yes	CU-39-000	4.5

Screen 2 - Is there a potential for subsurface soil to become surface soil (landslide and erosion areas identified on RFCA Attachment 5 - Figure 1)?
No. The location is on a flat pediment, not in the area shown in Figure 1, RFCA Attachment 5, to have elevated landslide and erosion potential.

Screen 3 - Does subsurface soil radiological contamination exceed criteria in Section 5.3 and Attachment 14?
No.

As shown in the table below, the Pu result collected below 3 feet (and greater than the WRW Action Level in Screen 1) is below the screen of 3 nanoCuries per gram (nCi/g) (equal to 3,000 pCi/g) (from RFCA Section 5.3).

Contaminant of Concern	Sample Location Code	Sample End Depth (feet)	Sample Result (pCi/g)	Above 3 nCi/g (= 3000 pCi/g)?
Pu-239-240	CU-39-000	4.5	124	No

The RFCA Attachment 14 Screen (related to the Original Process Waste Line (OPWL) system) does not apply to this area.

Screen 4 – Is there an environmental pathway and sufficient quantity of COCs that would cause an exceedance of the surface water standard?

There are two separate pathways by which the contamination in question could theoretically reach surface water: 1) migration via surface erosion, and 2) migration via groundwater that

ultimately seeps to the surface and reaches surface water. These two potential pathways are addressed separately:

Surface Erosion: Erosion of the sub-surface Pu, sufficient to expose it to the surface, is highly improbable, because the contamination is located from 3 to 4.5 feet below the ground surface.

The sub-surface soil sample in question is located in the Woman Creek watershed. RFCA Points of Compliance (POC) in the watershed are: 1) GS31 (at the outfall of Pond C-2), and 2) GS01 (at Woman Creek and Indiana Street. At these POC locations, the Site has maintained continuous compliance with the 0.15 pCi/L, 30-day moving average standard for Pu since RFCA monitoring was first implemented on October 1, 1996 (see main report, Section 2.3.2).

Point-of-Evaluation monitoring station SW027 is located at the east end of the South Interceptor Ditch (SID), downstream from the sub-surface soil samples. Station SW027 has had historic sample results above the 30-day moving average, 0.15 pCi/L standard for Pu (see main report, Section 2.3.2). However, there is widespread diffuse Pu and Am in the surface soil of the SID watershed. The measured results at SW027 that have exceeded 0.15 pCi/L for Pu are, with high probability, associated with erosion of the surface contamination, and not associated with the sub-surface contamination in question.

Groundwater Migration:
For the Lip Area (IHSS 155), six wells were identified that are pertinent to the discussion (wells 00491, 11791, 50299, 60194, 60294, and 60394). Of these, three wells (11791, 50299, and 00491) have Pu data. The Tier II groundwater action level for Pu is 0.151 pCi/L. The Tier I action level is 15.1 pCi/L (100 times the Tier II level). Results are discussed below.

At well 11791, located in the immediate area of the soil contamination, almost all of the Pu results from 1992 through 1994 are above the Tier II action levels, and some of the Pu results approached the Tier I action level. However, beginning in May 1995 and through June 2000, all Pu results from this well are below the Tier II action levels.

Well 50299 is an "aseptic" well (i.e., constructed to minimize the potential for surficial contamination to be introduced down the well) that is adjacent to and upgradient from 11791. Well 50299 has not exhibited Pu activity greater than the Tier II action level. Well 50299 was installed because of concerns that the drilling and completion techniques used for well 11791 caused contamination of the well. The two sample events from well 50299 (September 1999 and June 2000) support the hypothesis that surficial contamination may have been responsible for the Pu activity observed in well 11791.

The third well with Pu data, 00491, has 20 samples collected from December 1991 to September 2003. This well does not have sample results with Pu activity greater than the Tier II action level.

Screen 5 – Are the COC concentrations above Table 3 Action Levels for ecological receptors?
(Note: Screen 5 is not pertinent, based on the determination to use an Accelerated Action Ecological Screen Process. However, for reference, the results of the screen are displayed here).

No. The Pu concentration is below the Action Level for ecological receptors as displayed below.

Contaminant of Concern	Ecological Receptor Action Level (pCi/g)	Sample Result (pCi/g)	Sample Result Above Ecological Receptor Level?	Sample Location Code	Sample End Depth (feet)
Pu-239-240	3800	124	No	CU-39-000	4.5

Summary

Screens 2 through 5 are negative. Action at this location does not appear to be warranted.

Sub-Surface Soil Risk Screen

Location #: 4
Location Codes and Description: 11895, 12095, 12795
Windblown Area, East of Lip Area
Contaminant of Concern: Pu-239/240 and Am-241
Action Required: None

The Sub-Surface Soil Risk Screen follows the steps identified in Figure 3 in Attachment 5 of the RFCA Modification (DOE et al. 2003):

Screen 1 - Are COC concentrations below RFCA Table 3 Wildlife Refuge Worker (WRW) Soil Action Levels?

No, results for 3 Pu samples and 3 Am sub-samples (below 3 feet in depth) are above WRW Action Levels, as shown in the table below:

Contaminant of Concern	Wildlife Refuge Worker Action Level (pCi/g)	Sample Result (pCi/g)	Sample Result Above WRW Action Level?	Sample Location Code	Sample End Depth (feet)
Pu-239-240	50	1486	Yes	11895	5
		2450	Yes	12095	5
		642	Yes	12795	8
Am-241	76	209	Yes	11895	5
		410	Yes	12095	5
		105	Yes	12795	8

Screen 2 - Is there a potential for subsurface soil to become surface soil (landslide and erosion areas identified on RFCA Attachment 5 - Figure 1)?
No. The location is on a flat pediment, not in the area shown in Figure 1, RFCA Attachment 5, to have elevated landslide and erosion potential.

Screen 3 - Does subsurface soil radiological contamination exceed criteria in Section 5.3 and Attachment 14?
No.
As shown in the table below, the Pu and Am samples collected below 3 feet (and greater than the WRW Action Level in Screen 1) are all below the screen of 3 nanoCuries per gram (nCi/g) (equal to 3,000 pCi/g) (from RFCA Section 5.3).

Contaminant of Concern	Sample Location Code	Sample End Depth (feet)	Sample Result (pCi/g)	Above 3 nCi/g (= 3000 pCi/g)?
Pu-239-240	11895	5	1486	No
	12095	5	2450	No
	12795	8	642	No
Am-241	11895	5	209	No
	12095	5	410	No
	12795	8	105	No

The RFCA Attachment 14 Screen (related to the Original Process Waste Line (OPWL) system) does not apply to this area.

Screen 4 – Is there an environmental pathway and sufficient quantity of COCs that would cause an exceedance of the surface water standard?

There are two separate pathways by which the contamination in question could theoretically reach surface water: 1) migration via surface erosion, and 2) migration via groundwater that ultimately seeps to the surface and reaches surface water. These two potential pathways are addressed separately:

Surface Erosion: Erosion of the sub-surface Pu and Am, sufficient to expose it to the surface, is highly improbable, because the contamination is located from 3 to 8 feet below the ground surface.

The sub-surface soil samples in question are located in the Woman Creek watershed. RFCA Points of Compliance (POC) in the watershed are: 1) GS31 (at the outfall of Pond C-2), and 2) GS01 (at Woman Creek and Indiana Street. At these POC locations, the Site has maintained continuous compliance with the 0.15 pCi/L, 30-day moving average standards for Pu and Am since RFCA monitoring was first implemented on October 1, 1996 (see main report, Section 2.3.2).

Point-of-Evaluation monitoring station SW027 is located at the east end of the South Interceptor Ditch (SID), downstream from the sub-surface soil sample. Station SW027 has had historic sample results above the 30-day moving average, 0.15 pCi/L standard for Pu. However, there is widespread diffuse Pu in the surface soil of the SID watershed. The measured results at SW027 that have exceeded 0.15 pCi/L for Pu are, with high probability, associated with erosion of the surface contamination, and not associated with the sub-surface contamination in question.

Groundwater Migration:
For the windblown area, seven wells were identified (04591, 04691, 08091, 10194, 2687, 3287, and 3387) that are pertinent to the discussion. Of these, four wells (04591, 08091, 10194, and 3287) have Pu and Am data. The Tier II groundwater action levels for Pu and Am are 0.151 and 0.145 pCi/L, respectively. The Tier I action levels are 15.1 and 14.5 pCi/L, respectively (100 times the Tier II levels).

The windblown area has four wells with Pu and Am data available for groundwater. Two of the wells, 08091 and 10194, have no results with Pu and Am activities greater than the Tier II action levels. Well 08091 had 1 sample each of Pu and Am, collected in June 1998. Well 10194 had 22 samples collected from July 1994 to August 2003.

Wells 04591 and 3287 have one Pu sample result each that is greater than the Tier II action level. All other results are below Tier II. Well 04591 has a Pu result of 0.58 pCi/L from May 1993 (out of 30 samples collected from December 1991 to July 2003). Well 3287 has a Pu result of 0.1711 pCi/L from May 1992 (out of 16 samples collected from March 1988 to November 1992).

These results suggest that there has been little, if any, impact to groundwater caused by Pu and Am sub-surface soil contamination.

Screen 5 – Are the COC concentrations above Table 3 Action Levels for ecological receptors?

(Note: Screen 5 is not pertinent, based on the determination to use an Accelerated Action Ecological Screen Process. However, for reference, the results of the screen are displayed here).

No. All concentrations are below Action Levels for ecological receptors as displayed in the table below.

Contaminant of Concern	Ecological Receptor Action Level (pCi/g)	Sample Result (pCi/g)	Sample Result Above Ecological Receptor Level?	Sample Location Code	Sample End Depth (feet)
Pu-239-240	3800	1486	No	11895	5
		2450	No	12095	5
		642	No	12795	8
Am-241	1900	209	No	11895	5
		410	No	12095	5
		105	No	12795	8

Summary

Screens 2 through 5 are negative. Action at this location does not appear to be warranted.

Sub-Surface Soil Risk Screen

Screening Location #: 5
Location Code and Description: 12795
Windblown Area, East of Lip Area
Contaminant of Concern: Chromium(VI)
Action Required: None

Screen 1 - Are COC concentrations below RFCA Table 3 Wildlife Refuge Worker (WRW) Soil Action Levels?

No. Results for chromium (VI) are above WRW Action Levels in 1 sample location, which is subject to the sub-surface soil risk screen shown in RFCA Attachment 5, Figure 3 (DOE et al., 2003). Chromium(VI) is subject to the sub-surface soil risk screen if such contamination is identified below 6 inches in depth (DOE et al., 2003).

Contaminant of Concern	Wildlife Refuge Worker Action Level (mg/kg)	Sample Result (mg/kg)	Sample Result Above WRW Action Level?	Sample Location Code	Sample End Depth (feet)
Chromium(VI)	268 mg/kg	4600	Yes	12795	3-8

Screen 2 - Is there a potential for subsurface soil to become surface soil (landslide and erosion areas identified on RFCA Attachment 5 - Figure 1)?
No. Sample location is on the flat pediment, not in the area designated by Screen 2 to have elevated landslide and erosion potential.

Screen 3 - Does subsurface soil radiological contamination exceed criteria in Section 5.3 and Attachment 14?
Screen 3 applicable to Pu and Am only.

Screen 4 – Is there an environmental pathway and sufficient quantity of COCs that would cause an exceedance of the surface water standard?

There are two separate pathways by which the contamination in question could theoretically reach surface water: 1) migration via surface erosion, and 2) migration via groundwater that ultimately seeps to the surface and reaches surface water. Surface water and groundwater concentrations are addressed below:

Surface Water Concentrations:
Surface water data for total chromium are presented in the Final Automated Surface Water Monitoring Report for Water 2002 (K-H, 2003f). The volume-weighted average total chromium concentration in surface water at Station SW027 (at the east end of the South Interceptor Ditch), for the period from Water Years 1997 through 2002, is 1.76 μg/L. The total chromium 30-day average concentration has never exceeded approximately 5 μg/L. This compares to the RFCA Action Level for total chromium of 50 μg/L.

Groundwater Migration:
For the isolated sub-surface soil location in the windblown area of chromium contamination greater than the Soil Action Levels for the Wildlife Refuge Worker, seven wells were identified

(04591, 04691, 08091, 10194, 2687, 3287, and 3387) that are pertinent to the analysis. Of these, four wells (04591, 08091, 10194, and 3287) have groundwater data for chromium. The Tier II groundwater action level for chromium is 100 µg/L. Of the four wells with chromium data, only well 3287 has results above the Tier II action level. Chromium results of 108 µg/L and 161 µg/L were recorded for September 1991 and February 1992, respectively. This well is constructed of stainless steel casing and screen. Other wells at RFETS constructed of stainless steel or equipped with stainless steel pumps have exhibited high chromium (as well as nickel) results.

The results of the groundwater results discussed above suggest that the isolated occurrence of chromium in subsurface soil in the windblown area has little, if any, affect on groundwater east of the 903 Pad.

Screen 5 – Are the COC concentrations above Table 3 Action Levels for ecological receptors?

(Note: Screen 5 is not pertinent, based on the determination to use an Accelerated Action Ecological Screen Process. However, for reference, the results of the screen are displayed here).

There is not an ecological receptor Action Level for Chromium(VI) (DOE et al., 2003).

Contaminant of Concern	Ecological Receptor Action Level (mg/kg)	Sample Result (mg/kg)	Sample Result Above Ecological Receptor Level?	Sample Location Code	Sample End Depth (feet)
Chromium(VI)	NA	4600	NA	12795	8

Summary

Screens 2 through 5 are negative. Action at this location does not appear to be warranted.

Sub-Surface Soil Risk Screen

Screening Location #: 6
Location Code and Description: 10395, CV41-004
Windblown Area, East of Lip Area
Contaminant of Concern: Benzo(a)pyrene
Action Required: None

The Sub-Surface Soil Risk Screen follows the steps identified in Figure 3 in Attachment 5 of the RFCA Modification (DOE et al. 2003):

Screen 1 - Are COC concentrations below RFCA Table 3 Wildlife Refuge Worker (WRW) Soil Action Levels?

No. Results for benzo(a)pyrene are above WRW Action Levels in 2 sample locations and are subject to the sub-surface soil risk screen shown in RFCA Attachment 5, Figure 3 (DOE et al., 2003). Benzo(a)pyrene is subject to the sub-surface soil risk screen if such contamination is identified below 6 inches in depth (DOE et al., 2003).

Contaminant of Concern	Wildlife Refuge Worker Action Level	Sample Result (μg/kg)	Sample Result Above WRW Action Level?	Sample Location Code	Sample Depth (feet)
Benzo(a)pyrene	3,490 μ/kg	11,000	Yes	10395	4 - 7
		9,300	Yes	CV41-004	2.5 – 4.5

Screen 2 - Is there a potential for subsurface soil to become surface soil (landslide and erosion areas identified on RFCA Attachment 5 - Figure 1)?
No. Location is on flat pediment, not in the area designated by Screen 2 to have elevated landslide and erosion potential.

Screen 3 - Does subsurface soil radiological contamination exceed criteria in Section 5.3 and Attachment 14?
Screen 3 applicable to Pu and Am only.

Screen 4 – Is there an environmental pathway and sufficient quantity of COCs that would cause an exceedance of the surface water standard?

There are two separate pathways by which the contamination in question could theoretically reach surface water: 1) migration via surface erosion, and 2) migration via groundwater that ultimately seeps to the surface and reaches surface water. Surface water and groundwater concentrations are addressed below:

Surface Water Concentrations:
Surface water data for benzo(a)pyrene (a semi-volatile analyte) are unavailable. Volatile organic compound samples are collected from Pond C-2 for pre-discharge analysis. However, the analysis does not include semi-volatile compounds.

Groundwater Migration:
Groundwater results were queried for wells in the vicinity of the two isolated locations within the northeast windblown area (due east of the southeast corner of the IA) where soil sample results (below three feet in depth) indicated that benzo(a)pyrene has been observed in concentrations greater than the Soil Action Level for the Wildlife Refuge Worker. For this area, four wells were identified (07891, 12191, 12991, and 13091) that are pertinent to the analysis. All of these wells (00491, 11791, and 50299) have at least one sample event where benzo(a)pyrene was analyzed for, but the results for all of the wells were non-detects. The Tier II groundwater action level for benzo(a)pyrene is 0.2 µg/L.

The results of the groundwater results discussed above suggest that the isolated occurrence of benzo(a)pyrene in subsurface soil in the windblown area has little, if any, affect on groundwater east of the 903 Pad.

Screen 5 – Are the COC concentrations above Table 3 Action Levels for ecological receptors?
(Note: Screen 5 is not pertinent, based on the determination to use an Accelerated Action Ecological Screen Process. However, for reference, the results of the screen are displayed here).

No, benzo(a)pyrene concentrations in the sub-surface soil are not above the ecological receptor Action Level (see table).

Contaminant of Concern	Ecological Receptor Action Level (µg/kg)	Sample Result (µg/kg)	Sample Result Above Ecological Receptor Level?	Sample Location Code	Sample Depth (feet)
Benzo(a)pyrene	25,700	11,000	No	10395	4 - 7
		9,300	No	CV41-004	2.5 – 4.5

Summary
Screens 2 through 5 are negative. Action at this location does not appear to be warranted.

Appendix C – IHSS Group 900-11 Area IM/IRA

900-11 Area Surface Water Performance Monitoring Locations -
Pu and Am Data Plots

Figure 1. Station SW055 – Pu and Am Sample Results (5/22/01 – 10/21/03)

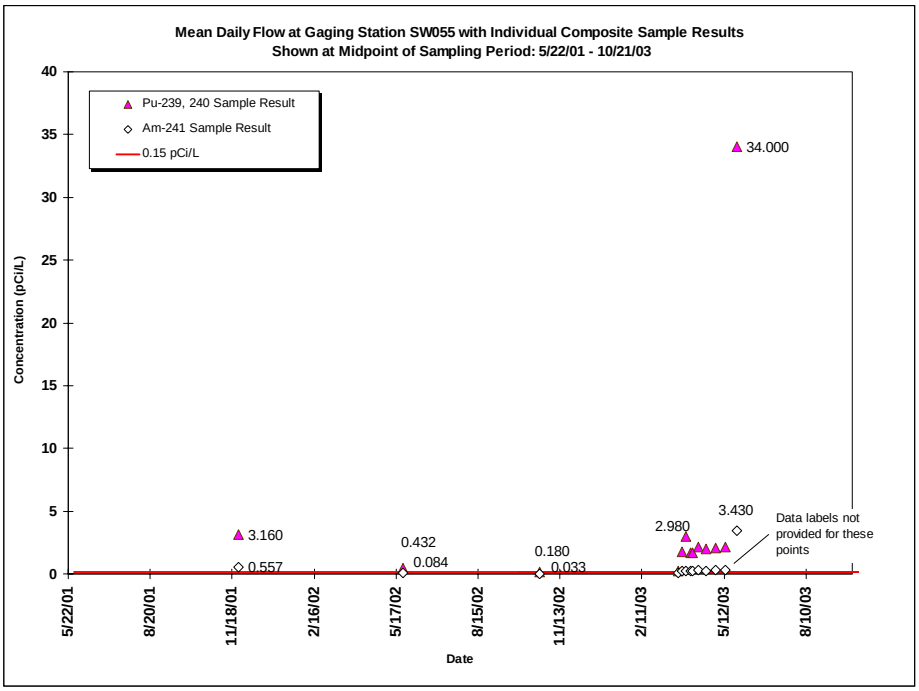


Figure 2. GS51 – Pu and Am Sample Results (8/14/01 – 10/21/03)

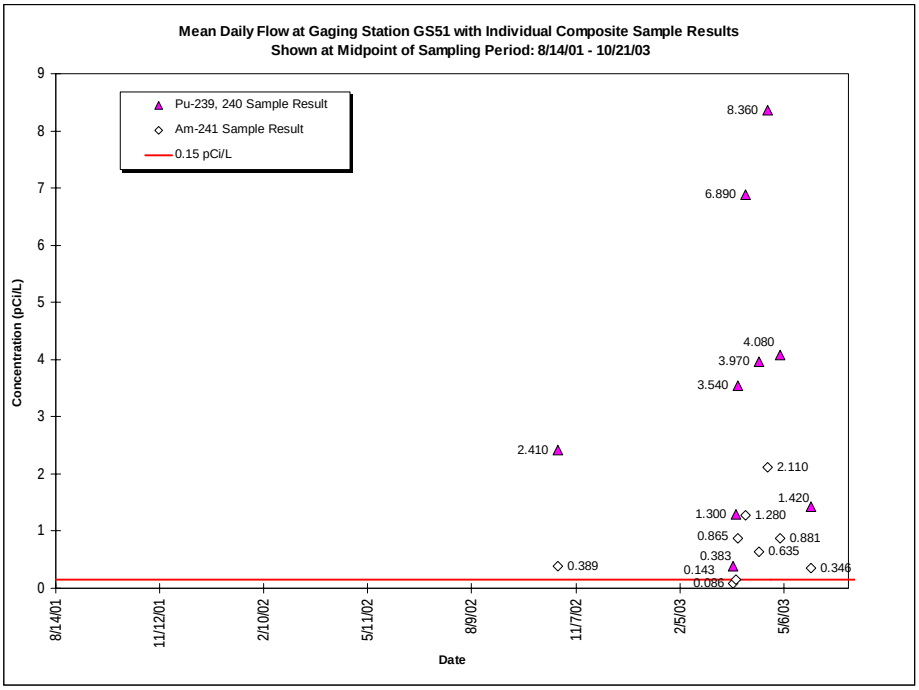


Figure 3. GS52 – Pu and Am Sample Results (7/26/01 – 10/21/03)

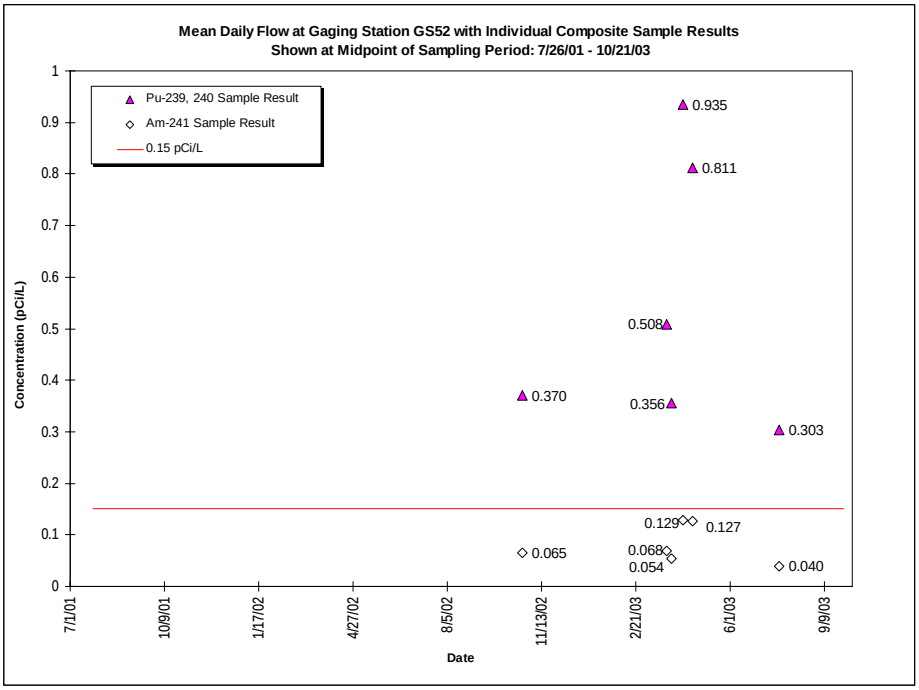


Figure 4. GS53 – Pu and Am Sample Results (7/26/01 – 10/21/03)

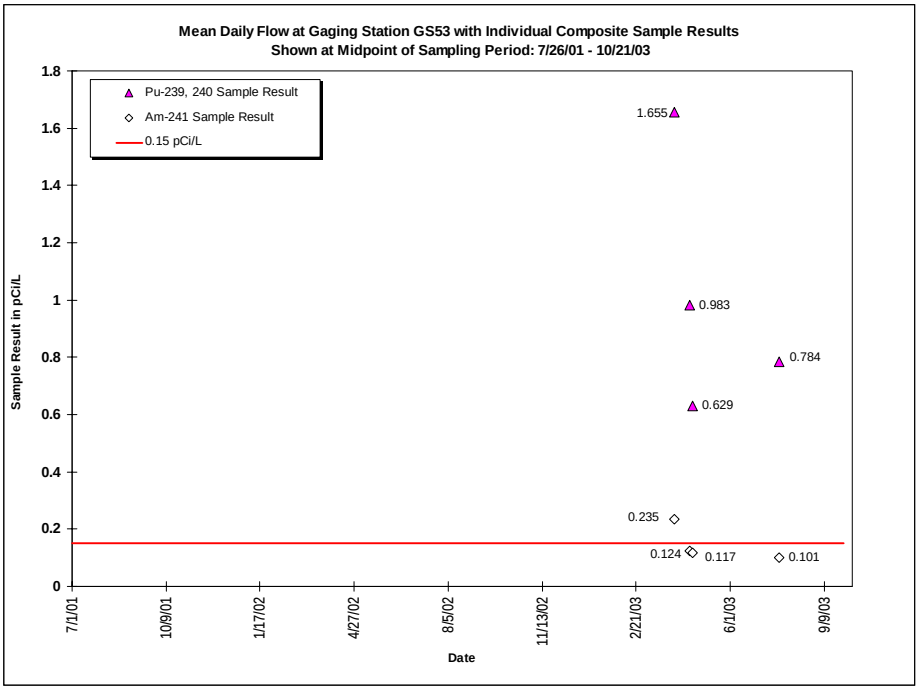


Figure 5. GS54 – Pu and Am Sample Results (8/23/01 – 10/21/03)

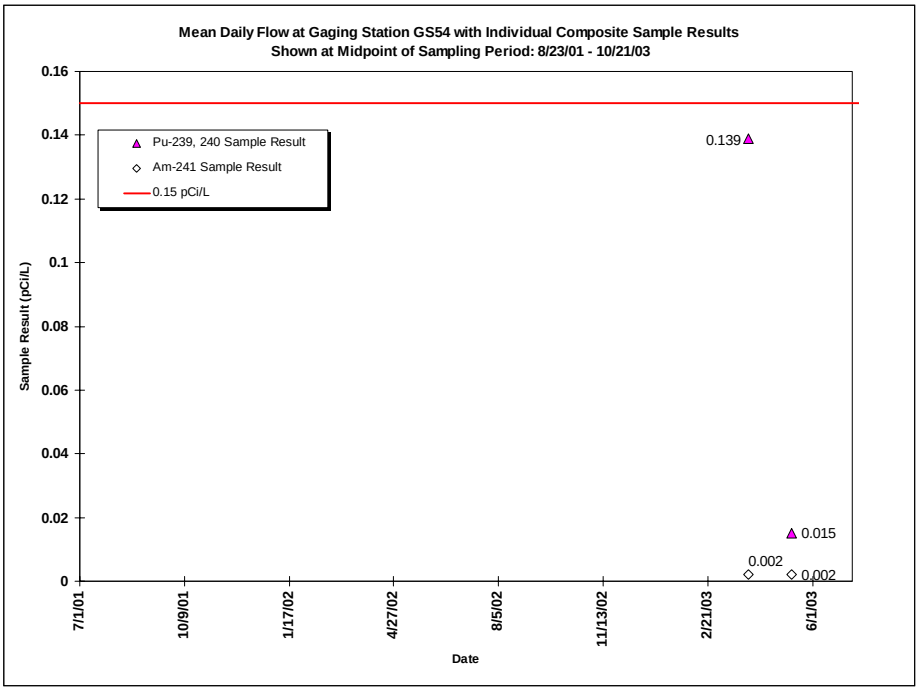
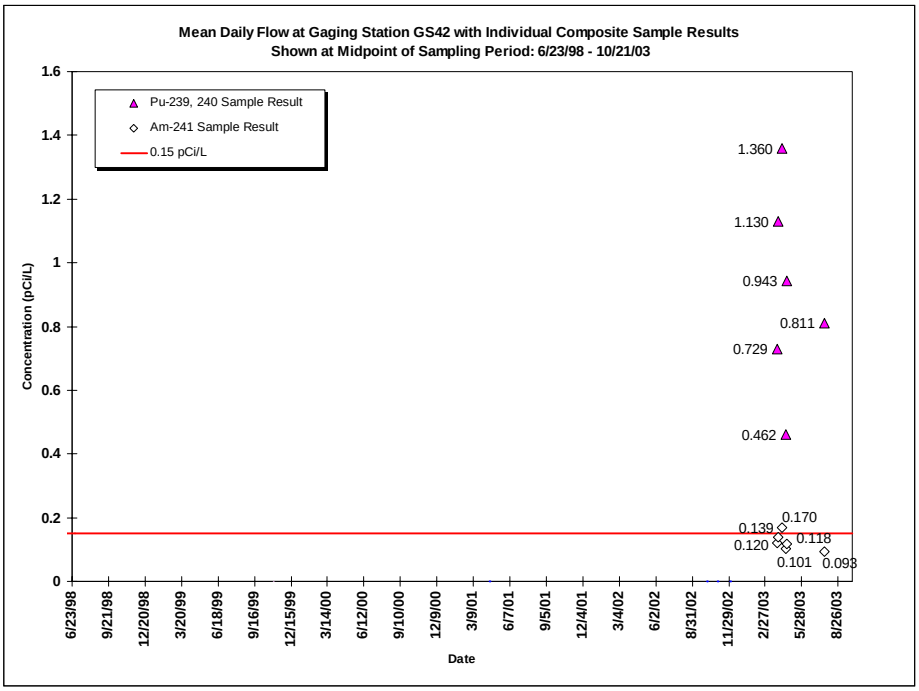


Figure 6. GS42 – Pu and Am Sample Results (6/23/98- 10/21/03)



Appendix D – IHSS Group 900-11 Area IM/IRA

Other Alternatives Considered

Introduction to Other Remedial Action Alternatives Considered

Other accelerated action alternatives, in addition to the alternatives described in Section 4.2, were considered during the course of developing this IM/IRA. Two of these additional alternatives received the most attention prior to being dismissed as viable options that warranted further evaluation. These conceptual alternatives, and information about projected water quality benefits, impacts, and opinions of probable cost for each of them, are described below.

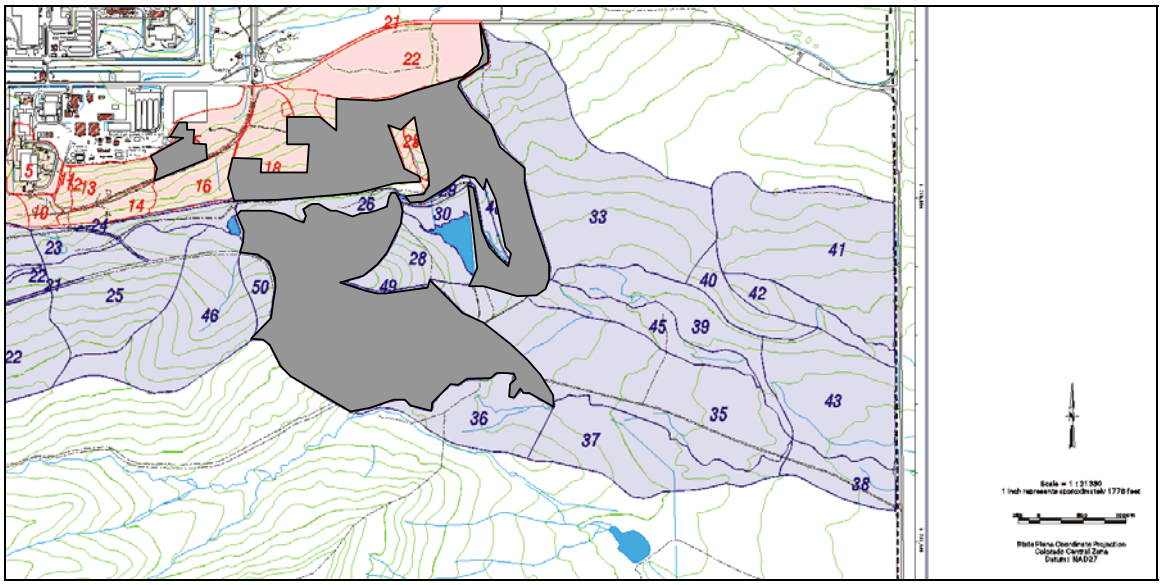
When reviewing these conceptual alternatives, it is important to bear in mind that the Pu concentration measured at station GS01 has not only been in continuous compliance with the 0.15 pCi/L RFCA Action Level since RFCA monitoring was first implemented in October 1996, but on average has been approximately two orders of magnitude lower. From Water Year 1997 through 2002, the median Pu concentration of validated samples measured at GS01 has been approximately 0.002 pCi/L, with a maximum result of 0.024 pCi/L (K-H, 2003f).

Conceptual Alternative 1 – Construct rock erosion-protection layer east of Lip Area

Action Considered

Construct an engineered rock erosion cover over approximately 190 acres, south and east of the Lip Area, in areas of the watershed with residual Pu and Am contamination in the soil below the RSALs (see Figure 1). Figure 1 shows the hillslope areas that would be targeted for action. It is noted that the 190 acres are separate from the soil removal area (approximately 24 acres) subject to action because of radionuclides that exceed RSALs. The purpose of the cover would be to provide additional protection to surface water from potential impacts caused by erosion of soil that contains residual Pu and Am.

Figure 1. Conceptual Alternative 1 – erosion-protection cover (dark area)



Basis for Consideration
The 190 acre area addressed by this alternative is the area that is predicted to contribute the largest portion of Pu load to the SID and Woman Creek, based on results from erosion modeling in the watershed. The areas targeted by this conceptual action are estimated from the model to contribute, depending on storm size and intensity, approximately 85% to 90% of the Pu load delivered to Pond C-2, and approximately 70% to 80% of the Pu load delivered to station GS01 at Indiana Street.

Impacts
There are large impacts to wetlands and Preble's Mouse habitat associated with this conceptual alternative. As part of the 190 acres of Buffer Zone that would be severely disturbed, over 20 acres of Preble's Mouse habitat would be disturbed or destroyed and approximately 3 acres of wetlands would be impacted.

Estimated Cost
The estimated capital cost only for this conceptual alternative is approximately $10,000,000.

Remarks
This alternative could theoretically provide improvement in water quality in terms of the Pu concentration in surface water in the watershed. However, as mentioned previously, the low median Pu activity, relative to the 0.15 pCi/L RFCA standard, makes the action unwarranted, particularly when impacts to habitat and wetlands are significant.

Conceptual Alternative 2 – Remove soil from east of Lip Area

Action Considered
This action is identical to Conceptual Alternative 1 in terms of the area targeted for action. However, instead of constructing an erosion protection layer, this alternative involves removal and disposal of soil from the same 190 acres south and east of the Lip Area identified in Conceptual Alternative 1. The purpose of the soil removal is to provide additional protection to surface water quality from potential impacts from residual Pu and Am in soil.

Basis for Consideration
The 190 acre area addressed by this alternative is the area that is predicted to contribute the largest portion of Pu load to the SID and Woman Creek, based on results from erosion modeling in the watershed. The areas targeted by this conceptual action are estimated by the model to contribute, depending on storm size and intensity, approximately 85% to 90% of the Pu load delivered to Pond C-2, and approximately 70% to 80% of the Pu load delivered to station GS01 at Indiana Street.

Impacts
This action would have large impacts on wetlands and Preble's Mouse habitat. As part of the 190 acres of Buffer Zone that would be severely disturbed, over 20 acres of Preble's

Mouse habitat would be disturbed or destroyed and approximately 3 acres of wetlands would be impacted.

Estimated Cost
The estimated capital cost only for this conceptual alternative is approximately $60,000,000.

Remarks
Similar to Conceptual Alternative 1, this alternative could theoretically provide improvement in surface water quality. But as with the other alternatives, the low Pu activity measured at Station GS01 makes the action unwarranted, particularly when the impacts to habitat and wetlands are significant, and costs are very high.

Relevance to Decommissioning Plan Contents

As noted in the ARARs section of the main report (Section 5.1.5), the accelerated action plan provided by this IM/IRA is required to include an analysis related to a decommissioning plan. The analysis must demonstrate that reductions in residual radioactivity, necessary to comply with the provisions of RH 4.61.2 for unrestricted access, would result in net public or environmental harm. Conceptual Alternatives 1 and 2, presented above, both demonstrate that to mitigate the residual radionuclides present, at levels below RSALs in widespread areas to the east and south of the 903 Lip Area, there are significant detrimental impacts to habitat and wetlands vegetation. Therefore, measures to create unrestricted access are not warranted based on this criterion.

Appendix E – IHSS Group 900-11 Area IM/IRA

Estimating Airborne Dust and Transuranic Radionuclide Emissions from the 903 Lip Remediation

Appendix E. Estimating Airborne Dust and Transuranic Radionuclide Emissions from the 903 Lip Area Remediation

Dust emissions and the associated plutonium (Pu) and americium (Am) transport from the soil disturbances of 903 Lip Area remediation were estimated using fugitive dust emission factors from the US Environmental Protection Agency (EPA) Compilation of Air Pollutant Emission Factors (AP-42), Volume I, Sections 11 and 13. Emissions were associated with excavation of soil by trackhoe, handling of excavated soil by front-loader, contouring of remediated soil with scrapers and bulldozers, and dust emissions from project traffic on paved roads. Additionally, the dust emissions caused by wind erosion of soil storage piles and exposed soils were estimated. Appropriate radionuclide activities were assigned to each potential dust source, and EPA's CAP88-PC atmospheric dispersion model was used to estimate radionuclide dose to public receptors at the Site boundary.

As detailed in Table E-1 below, the dust emissions estimated for the Lip Area remediation project are 23.3 tons of total suspended particulate (TSP) and 9.98 tons of particulate matter 10 micrometers (μm) or smaller (PM_{10}). Dust in the PM_{10} size classification is considered to be inhalable and therefore to have potential respiratory consequences in humans. However, the larger TSP emissions estimate was used when calculating radionuclide emissions to provide conservatism in the potential dose estimate and to better predict the potential radionuclide concentrations that may be measured by Site air samplers.

Table E-2 below presents the radionuclide emission estimates associated with the project. Because concentrations of Pu-239 in lip area soil have been well-characterized through the collection of a very large number of samples, the mean observed Pu-239 concentration was used to estimate Pu-239 and Am-241 emissions. Concentrations of Am-241 in soil were calculated as (Pu-239 concentration/5.7), based on the activity ratio of Pu-239 to Am-241 observed in 903 Pad and Lip Area soils. Radiological emissions from areas that had been remediated were estimated by assuming residual contamination of 50 pCi/g Pu-239 and 8.8 pCi/g Am-241[1]. The resulting radiological dose, **0.070 millirem** (mrem), is representative of the potential uncontrolled project emissions. The emissions estimates presented here were performed without taking credit for dust controls. Because a dust control plan will be implemented throughout the project, actual particulate and radionuclide emissions will likely be at least 50% lower than estimated here.

[1] 8.8 pCi/g of Am-241 is based on a residual of 50 pCi/g Pu-239 and a Pu-239/Am-241 ratio of 5.7.

Table E-1. Dust Emissions from Lip Area

Emission Source	Emission Location	PM_{10} (g/yr)	TSP (g/yr)	PM_{10} (tn/yr)	TSP (tn/yr)
Trackhoe	Inner Lip	$1.47x10^{4}$	$3.73x10^{4}$	$1.6x10^{-2}$	$4.1x10^{-2}$
	Outer Lip	$2.65x10^{4}$	$6.72x10^{4}$	$2.9x10^{-2}$	$7.4x10^{-2}$
Front Loader	Inner Lip	$2.41x10^{3}$	$5.09x10^{3}$	$2.6x10^{-3}$	$5.6x10^{-3}$
	Outer Lip	$4.34x10^{3}$	$9.17x10^{3}$	$4.78x10^{-3}$	$1.0x10^{-2}$
Scraper	Inner Lip	$5.53x10^{5}$	$5.53x10^{5}$	0.61	$6.1x10^{-1}$
	Outer Lip	$9.96x10^{5}$	$9.96x10^{5}$	1.10	1.10
Bulldozer	Inner Lip	$2.19x10^{4}$	$1.12x10^{5}$	$2.4x10^{-2}$	0.12
	Outer Lip	$3.94x10^{4}$	$2.02x10^{5}$	$4.3x10^{-2}$	0.22
Paved Road	Inner Lip	$4.90x10^{5}$	$2.55x10^{6}$	0.54	2.81
	Outer Lip	$9.07x10^{5}$	$4.59x10^{6}$	1.00	5.06
Storage Piles	Inner Lip	$5.67x10^{4}$	$1.13x10^{5}$	0.06	0.12
	Outer Lip	$7.99x10^{3}$	$1.60x10^{4}$	0.01	0.02
Wind Erosion	Inner Lip	$9.91x10^{5}$	$1.98x10^{6}$	1.09	2.19
	Outer Lip	$6.51x10^{4}$	$1.30x10^{5}$	0.07	0.14
	Final Contour	$4.89x10^{6}$	$9.78x10^{6}$	5.38	10.78
Total Emissions	Inner Lip			4.26	9.75
	Outer Lip			5.71	13.6
	All			**9.98**	**23.3**

Notes:

PM_{10} = particulate matter ≤10 μm aerodynamic equivalent diameter (AED)
TSP = total suspended particulate matter, generally ≤30 μm AED
g/yr = grams per year
tn/yr = tons per year

Assumptions:

- 1996 Site meteorological data is reasonably representative of potential wind speed distributions.
- No erosion occurs during any 15-minute period with measurable precipitation or while soil is drying.
- The surface roughness is reasonably well characterized by the "overburden" friction velocity provided in AP-42.
- Inner lip area = 12.5 acres/6 mo X 4046.825 m2/acre X 1 mo/22 work days = ~1946 m2/week.
- Outer lip area = 22.5 acres/6 mo X 4046.825 m2/acre X 1 mo/22 work days = ~3502 m2/week.
- For purposes of estimating wind erosion, each area is disturbed 3 times: first by excavation, then (same week) by grading/contouring, then (1 week later) by final contouring.
- A typical day's work consists of the excavation of 7 cells with a soil volume of 32 yd^3 per cell.
- Each cell's spoils are piled alongside the cell.
- At any given moment, it is assumed that 50% of potential pile volume is available for wind erosion.
- The cell spoils will be removed to a roll-off by front-loader during the day; therefore, each pile is created and removed each day (no piles left overnight).

To ensure that these emissions estimates are sufficiently bounding, the 95 percent upper confidence limit (95% UCL) concentration of Pu-239 observed in soil samples was used to model potential radionuclide dose as a bounding scenario. The 95% UCL data is shown in Table E-3. Though potential public dose from the Lip Area remediation is expected to be less than 0.070 mrem, as described above, it would not exceed 0.099 mrem even if all Lip Area soils are actually contaminated at the 95th percentile upper bound and no dust controls are implemented. Therefore, monitoring requirements are not triggered under 40 Code of Federal Regulations (CFR) 61, Subpart H. However, air monitoring will be conducted in accordance with the Site *Integrated Monitoring Plan* and the Site *Radiological Control Manual*, and as detailed in the project plan.

For the purpose of determining notification requirements under 40 CFR 61, Subpart H, emission control measures are to be applied pursuant to Appendix E (of 40 CFR 61, Subpart H). Taking into account dust control with a 50% efficiency, no notification requirement is triggered for this activity since potential public dose remains less than 0.1 mrem.

Table E-2. Pu-239 and Am-241 Emissions from Lip Area (Mean Pu-239)

Emission Source	Emission Location	TSP (g/yr)	Pu-239 (pCi/g)	Am-241 (pCi/g)	Pu-239 (Ci/yr)	Am-241 (Ci/yr)
Trackhoe	Inner Lip	$3.73x10^{4}$	922	162	$3.44x10^{-5}$	$6.04x10^{-6}$
	Outer Lip	$6.72x10^{4}$	151	27	$1.01x10^{-5}$	$1.81x10^{-6}$
Front Loader	Inner Lip	$5.09x10^{3}$	922	162	$4.69x10^{-6}$	$8.25x10^{-7}$
	Outer Lip	$9.17x10^{3}$	151	27	$1.38x10^{-6}$	$2.48x10^{-7}$
Scraper	Inner Lip	$5.53x10^{5}$	50	8.8	$2.77x10^{-5}$	$4.87x10^{-6}$
	Outer Lip	$9.96x10^{5}$	50	8.8	$4.98x10^{-5}$	$8.76x10^{-6}$
Bulldozer	Inner Lip	$1.12x10^{5}$	50	8.8	$5.60x10^{-6}$	$9.86x10^{-7}$
	Outer Lip	$2.02x10^{5}$	50	8.8	$1.01x10^{-5}$	$1.78x10^{-6}$
Paved Road	Inner Lip	$2.55x10^{6}$	0	0	0	0
	Outer Lip	$4.59x10^{6}$	0	0	0	0
Storage Piles	Inner Lip	$1.13x10^{5}$	922	162	$1.05x10^{-4}$	$1.84x10^{-5}$
	Outer Lip	$1.60x10^{4}$	151	27	$2.41x10^{-6}$	$4.32x10^{-7}$
Wind Erosion	Inner Lip	$1.98x10^{6}$	922	162	$9.64x10^{-4}$	$1.69x10^{-4}$
	Outer Lip	$1.30x10^{5}$	151	27	$1.31x10^{-5}$	$2.33x10^{-6}$
	Final Contour	$9.78x10^{6}$	50	8.8	$4.89x10^{-4}$	$8.61x10^{-5}$
Total Emissions	Inner Lip				$1.14x10^{-3}$	$2.00x10^{-4}$
	Outer Lip				$8.69x10^{-5}$	$1.54x10^{-5}$
	All				**$1.72x10^{-3}$**	**$3.02x10^{-4}$**

Notes:

TSP = total suspended particulate matter, generally ≤30 μm AED
g/yr = grams per year
pCi/g = picocuries per gram
Ci/yr = Curies per year

Assumptions:

- Am-241 activity = (Pu-239 activity)/5.7
- Remediated cells contain residual contamination of 50 pCi/g Pu-239 and 8.8 pCi/g Am-241.

Table E-3. Pu-239 and Am-241 Emissions from Lip Area (95% UCL Pu-239)

Emission Source	Emission Location	TSP (g/yr)	Pu-239 (pCi/g)	Am-241 (pCi/g)	Pu-239 (Ci/yr)	Am-241 (Ci/yr)
Trackhoe	Inner Lip	$3.73x10^{4}$	1550	272	$5.78x10^{-5}$	$1.01x10^{-5}$
	Outer Lip	$6.72x10^{4}$	168	30	$1.13x10^{-5}$	$2.02x10^{-6}$
Front Loader	Inner Lip	$5.09x10^{3}$	1550	272	$7.89x10^{-6}$	$1.38x10^{-6}$
	Outer Lip	$9.17x10^{3}$	168	30	$1.54x10^{-6}$	$2.75x10^{-7}$
Scraper	Inner Lip	$5.53x10^{5}$	50	8.8	$2.77x10^{-5}$	$4.87x10^{-6}$
	Outer Lip	$9.96x10^{5}$	50	8.8	$4.98x10^{-5}$	$8.76x10^{-6}$
Bulldozer	Inner Lip	$1.12x10^{5}$	50	8.8	$5.60x10^{-6}$	$9.86x10^{-7}$
	Outer Lip	$2.02x10^{5}$	50	8.8	$1.01x10^{-5}$	$1.78x10^{-6}$
Paved Road	Inner Lip	$2.55x10^{6}$	0	0	0	0
	Outer Lip	$4.59x10^{6}$	0	0	0	0
Storage Piles	Inner Lip	$1.13x10^{5}$	1550	272	$1.76x10^{-4}$	$3.08x10^{-5}$
	Outer Lip	$1.60x10^{4}$	168	30	$2.69x10^{-6}$	$4.79x10^{-7}$
Wind Erosion	Inner Lip	$1.98x10^{6}$	1550	272	$1.59x10^{-3}$	$2.78x10^{-4}$
	Outer Lip	$1.30x10^{5}$	168	30	$1.42x10^{-5}$	$2.52x10^{-6}$
	Final Contour	$9.78x10^{6}$	50	8.8	$4.89x10^{-4}$	$8.61x10^{-5}$
Total Emissions	Inner Lip				$1.86x10^{-3}$	$3.26x10^{-4}$
	Outer Lip				$8.96x10^{-5}$	$1.58x10^{-5}$
	All				**$2.44x10^{-3}$**	**$4.28x10^{-4}$**

Notes:

TSP = total suspended particulate matter, generally ≤30 μm AED
g/yr = grams per year
pCi/g = picocuries per gram
Ci/yr = Curies per year

Assumptions:

- Am-241 activity = (Pu-239 activity)/5.7
- Remediated cells contain residual contamination of 50 pCi/g Pu-239 and 8.8 pCi/g Am-241.

Appendix F – IHSS Group 900-11 Area IM/IRA

Conceptual Design Development and Cost Estimate Information for Alternatives

Alternative 2 - Cost Estimate Summary

Alternative 2 Actions:
1) Soil removal and disposal, Outer Lip Area - in areas with actinide activity above Radioactive Soil Action Levels
2) Additional long-term surface water monitoring
3) IHSS 140 Soil Removal
4) PAC-SE-1602 soil removal, berm removal, equipment removal
5) OU1 surface soil removal
6) Pu soil removal (based on sub-surface soil risk screen)

Alternative 2 Actions - Summary

Soil Removal Action

Outer Lip Area Soil Removal Action Parameters

Parameter	Quantity	Units	Basis
Remediation area - Outer Lip Area	23.5	acres	Pu soil - kriged data set
Remediation depth - Lip Area	6	inches	I. Litaor study - 1994 paper

Outer Lip Area Soil Removal Action - Estimated Soil Volume

Area (ac)	Area (sq. ft)	Depth (ft)	Volume (ft3)	w/ bulking factor (30%)
23.5	1,023,660	0.5	511,830	665,379

Surface Water Monitoring

Proposed long-term surface water monitoring locations
(in addition to RFCA Point-of-Compliance monitoring locations)

Monitoring location	Location description
SW027	E. end of SID
SW055	S. of 903 Pad
GS42	Tributary to E. end of SID
GS51	Hillslope swale S.E. of 903 Pad
GS52	Hillslope swale S.E. of 903 Pad
GS53	Hillslope swale S.E. of 903 Pad
GS54	Hillslope swale S.E. of 903 Pad

Cost Estimate Summary

Capital Costs

Action	Capital Cost
Soil removal & disposal - Outer Lip Area	$ 13,194,226
Soil removal & disposal - PAC-SE-1602	$ 611,697
Soil removal & disposal - IHSS 140	$ 1,539,299
Soil removal & disposal - OU1 location	$ 53,755
Surface water monitoring	$ -
Total Capital Costs	$ 15,398,976

Annual Operation and Maintenance Costs

Action	O&M cost/year
Outer Lip Area -Veg. monit./maint/weed control	$ 4,830
PAC-SE-1602 - Weed control, etc.	$ 858
IHSS 140 - Weed control, etc.	$ 871
OU1 location - Weed control, etc.	$ 123
Surface water monitoring	$ 45,300
Total O&M cost/year	$ 51,982

Soil Excavation and Disposal Cost Estimate:			Outer Lip Area				
Outer Lip Area	**Soil Removal and Disposal**						
	Anticipated Duration (weeks)	26					
Activity	**Item**	**# of Units**	**Units**	**Unit Rate ($)**	**Cost**	**Assumptions**	
Soil Removal							
	Direct						FTEs on job
	Project Mgmt	1040	hours	$80.00	$83,200	50% time during project	1
	Proj. Mgmt Support	1040	hours	$65.00	$67,600	10% time during project	1
	K-H Safety	1040	hours	$80.00	$83,200	Full time during project	1
	Field Project Manager	1040	hours	$80.00	$83,200	Full time during project	1
	Engineering Support	104	hours	$80.00	$8,320	10% time during project	0.1
	Waste Mgmt Support	1040	hours	$80.00	$83,200	Full time during project	1
	RCT Support	6240	hours	$37.00	$230,880	Full time during project	6
	Misc. Support (planning, procure., reports, QC)	12480	hours	$80.00	$998,400	Full time during project	12
	Direct ODC's	26	week	$100.00	$2,600	$100/week	n/a
	Subtotal				**$1,640,600**		
	Sampling and Analytical						FTEs on job
	Manager	520	hours	$80.00	$41,600	50% time during project	0.5
	Field Techs.	2080	hours	$60.00	$124,800	Full time during project	2
	Lab Expenses	104	days	$2,500.00	$260,000	$2,500/day	n/a
					$426,400		
	Construction Contractor						
	Labor						FTEs on job
	Superintendent	1040	hours	$55.00	$57,200	Full time during project	1
	H&S Officer	1040	hours	$33.00	$34,320	Full time during project	1
	Labor Foreman	1040	hours	$50.00	$52,000	Full time during project	1
	Waste Mgmt - Super	1040	hours	$100.00		50% time during project	1
	Waste Mgmt - Field	4160	hours	$50.00		Full time during project	4
	Equipment Foreman	1040	hours	$51.00	$53,040	Full time during project	1
	Laborers	10400	hours	$36.00	$374,400	Full time during project	10
	Equipment Operators	10400	hours	$40.00	$416,000	Full time during project	10
	Subtotal				**$986,960**		
	Equipment/Supplies						# on job
	Forklift	19.0	month	$3,000.00	$57,073	For entire project duration	3
	Track Hoe	6.3	month	$10,000.00	$63,415	For entire project duration	1
	Loader	6.3	month	$3,000.00	$19,024	For entire project duration	1
	Water Truck	6.3	month	$2,700.00	$17,122	For entire project duration	1
	Pick-up Truck	12.7	month	$600.00	$7,610	2 for entire project duration	2
	Generator	6.3	month	$900.00	$5,707	For entire project duration	1
	Light Tree	6.3	month	$1,100.00	$6,976	For entire project duration	1
	Mower/Disk	6.3	month	$9,000.00	$57,073	For entire project duration	1
	H&S Supplies	6.3	month	$11,500.00	$72,927	For entire project duration ($500/day x 23 days/mo.)	1
	Conex Boxes	12.7	month	$400.00	$5,073	2 for entire project duration	2
	Intermodals (for soil disposal)	6.3	months	$310,000.00	$1,965,854	$20/day lease ea. for 500 intermodels (31 day/mo.)	1
	Misc. Supplies	6.3	month	$1,000.00	$6,341	$1000/mo	1
	Subtotal				**$2,284,195**		
	Erosion Control						
		23.50	acres	$3,000.00	$70,500	$3000/ac	
	Subtotal				**$70,500**		
				Total Soil Removal Cost	**$4,911,755**		
Disposal Cost	**Outer Lip Area**						
	Area	1023660	sq. ft.	-	-	Area from GIS coverage	
	Excavation depth - average over entire area)	0.5000	ft.	-	-		
	Total disposal volume (includes 30% bulking factor)	665,379	cubic feet	-	-		
	Total disposal volume equivalent (cubic meters)	18,842	cubic meters	-	-		
	Volume - Low-Level Waste (m^3)	0	cubic meters	-	-	Assume all waste is Low Level Waste (LLW)	
	Volume - Low-Level Waste (ft^3)	665,379	cubic feet	$5.20	$3,459,971	$5.20/cubic ft. - Low Level Waste (LLW)	
	Volume - Low-Level Mixed Waste (m^3)	18,842	cubic meters	-	-		
	Volume - Low-Level Mixed Waste (ft^3)	-	cubic feet	$20.00	$0	$20/cubic ft. - Low Level Mixed Waste	
	Transport to Disposal Site	1929	roundtrips	$2,500.00	$4,822,500	345 cu. ft./truck and $2500/truck RT to EnviroCare	
				Total Soil Disposal Cost	**$8,282,471**		
				Total Capital Cost (Soil Removal + Disposal)	**$13,194,226**		
Operations and Maintenance Costs - Annual Costs							
	Item	**# of Units**	**Units**	**Unit Rate ($)**	**Cost**	**Assumptions**	
	Weed control	23.50	acres	$150.00	3525	$150 per acre/year for weed control	
	Veg. maintenance/ reseeding	23.50	acres	$30.00	705	$30 per acre/year for reseeding	
	Vegetation monitoring - fieldwork labor	0.5	days	$600.00	300	2 ecologists x 1 day x 8 hours/day @$75/hour	
	Vegetation monitoring - office labor	0.5	days	$600.00	300	1 ecologist x 1 week x 40 hrs/wk 8 $75/hour	
				Total Operations and Maintenance Costs (per year)	**$ 4,830**		

Soil Excavation and Disposal Cost Estimate:			**PAC-SE-1602**				
PAC-SE-1602	**Soil Removal and Disposal**						
	Anticipated Duration (weeks)	2					
Activity	**Item**	**# of Units**	**Units**	**Unit Rate ($)**	**Cost**	**Assumptions**	
Soil Removal							
	Direct						FTEs on job
	Project Mgmt	80	hours	$80.00	$6,400	50% time during project	1
	Proj. Mgmt Support	80	hours	$65.00	$5,200	10% time during project	1
	K-H Safety	80	hours	$80.00	$6,400	Full time during project	1
	Field Project Manager	80	hours	$80.00	$6,400	Full time during project	1
	Engineering Support	8	hours	$80.00	$640	10% time during project	0.1
	Waste Mgmt Support	80	hours	$80.00	$6,400	Full time during project	1
	RCT Support	480	hours	$37.00	$17,760	Full time during project	6
	Misc. Support (planning, procure., reports, QC)	960	hours	$80.00	$76,800	Full time during project	12
	Direct ODC's	2	week	$100.00	$200	$100/week	n/a
	Subtotal				**$126,200**		
	Sampling and Analytical						FTEs on job
	Manager	40	hours	$80.00	$3,200	50% time during project	0.5
	Field Techs.	160	hours	$60.00	$9,600	Full time during project	2
	Lab Expenses	8	days	$2,500.00	$20,000	$2,500/day	n/a
					$32,800		
	Construction Contractor						
	Labor						FTEs on job
	Superintendent	80	hours	$55.00	$4,400	Full time during project	1
	H&S Officer	80	hours	$33.00	$2,640	Full time during project	1
	Labor Foreman	80	hours	$50.00	$4,000	Full time during project	1
	Waste Mgmt - Super	80	hours	$100.00		50% time during project	1
	Waste Mgmt - Field	320	hours	$50.00		Full time during project	4
	Equipment Foreman	80	hours	$51.00	$4,080	Full time during project	1
	Laborers	800	hours	$36.00	$28,800	Full time during project	10
	Equipment Operators	800	hours	$40.00	$32,000	Full time during project	10
	Subtotal				**$75,920**		
	Equipment/Supplies						# on job
	Forklift	1.5	month	$3,000.00	$4,390	For entire project duration	3
	Track Hoe	0.5	month	$10,000.00	$4,878	For entire project duration	1
	Loader	0.5	month	$3,000.00	$1,463	For entire project duration	1
	Water Truck	0.5	month	$2,700.00	$1,317	For entire project duration	1
	Pick-up Truck	1.0	month	$600.00	$585	2 for entire project duration	2
	Generator	0.5	month	$900.00	$439	For entire project duration	1
	Light Tree	0.5	month	$1,100.00	$537	For entire project duration	1
	Mower/Disk	0.5	month	$9,000.00	$4,390	For entire project duration	1
	H&S Supplies	0.5	month	$11,500.00	$5,610	For entire project duration ($500/day x 23 days/month	1
	Conex Boxes	1.0	month	$400.00	$390	2 for entire project duration	2
	Intermodals (for soil disposal)	0.5	months	$310,000.00	$151,220	$20/day lease ea. for 500 intermodels (31 day/mo.)	1
	Misc. Supplies	0.5	month	$1,000.00	$488	$1000/mo	1
	Subtotal				**$175,707**		
	Erosion Control						
		1.43	acres	$3,000.00	$4,299	$3000/ac	
	Subtotal				**$4,299**		
				Total Soil Removal Cost	**$377,827**		
Disposal Cost	**PAC-SE-1602**						
	Area	62416	sq. ft.	-	-	Area from GIS coverage	
	Excavation depth - average over entire area)	0.1462	ft.	-	-		
	Total disposal volume (includes 30% bulking factor)	11,866	cubic feet	-	-		
	Total disposal volume equivalent (cubic meters)	336	cubic meters	-	-	ER reference to waste volume	
	Volume - Low-Level Waste (m^3)	174	cubic meters	-	-		
	Volume - Low-Level Waste (ft^3)	6,145	cubic feet	$5.20	$31,952	$5.20/cubic ft. - Low Level Waste	
	Volume - Low-Level Mixed Waste (m^3)	162	cubic meters	-	-		
	Volume - Low-Level Mixed Waste (ft^3)	5,721	cubic feet	$20.00	$114,417	$20/cubic ft. - Low Level Mixed Waste	
	Transport to Disposal Site	35	roundtrips	$2,500.00	$87,500	345 cu. ft./truck and $2500/truck RT to EnviroCare	
				Total Soil Disposal Cost	**$233,869**		
				Total Capital Cost (Soil Removal + Disposal)	**$611,697**		
Operations and Maintenance Costs - Annual Costs							
	Item	**# of Units**	**Units**	**Unit Rate ($)**	**Cost**	**Assumptions**	
	Weed control	1.43	acres	$150.00	215	$150 per acre/year for weed control	
	Veg. maintenance/ reseeding	1.43	acres	$30.00	43	$30 per acre/year for reseeding	
	Vegetation monitoring - fieldwork labor	0.5	days	$600.00	300	2 ecologists x 1 day x 8 hours/day @$75/hour	
	Vegetation monitoring - office labor	0.5	days	$600.00	300	1 ecologist x 1 week x 40 hrs/wk 8 $75/hour	
				Total Operations and Maintenance Costs (per year)	**$ 858**		

Soil Excavation and Disposal Cost Estimate:			**IHSS 140**				
IHSS 140	**Soil Removal and Disposal**						
	Anticipated Duration (weeks)	2					
Activity	**Item**	**# of Units**	**Units**	**Unit Rate ($)**	**Cost**	**Assumptions**	
Soil Removal							
	Direct						FTEs on job
	Project Mgmt	80	hours	$80.00	$6,400	50% time during project	1
	Proj. Mgmt Support	80	hours	$65.00	$5,200	10% time during project	1
	K-H Safety	80	hours	$80.00	$6,400	Full time during project	1
	Field Project Manager	80	hours	$80.00	$6,400	Full time during project	1
	Engineering Support	8	hours	$80.00	$640	10% time during project	0.1
	Waste Mgmt Support	80	hours	$80.00	$6,400	Full time during project	1
	RCT Support	480	hours	$37.00	$17,760	Full time during project	6
	Misc. Support (planning, procure., reports, QC)	960	hours	$80.00	$76,800	Full time during project	12
	Direct ODC's	2	week	$100.00	$200	$100/week	n/a
	Subtotal				**$126,200**		
	Sampling and Analytical						FTEs on job
	Manager	40	hours	$80.00	$3,200	50% time during project	0.5
	Field Techs.	160	hours	$60.00	$9,600	Full time during project	2
	Lab Expenses	8	days	$2,500.00	$20,000	$2,500/day	n/a
					$32,800		
	Construction Contractor						
	Labor						FTEs on job
	Superintendent	80	hours	$55.00	$4,400	Full time during project	1
	H&S Officer	80	hours	$33.00	$2,640	Full time during project	1
	Labor Foreman	80	hours	$50.00	$4,000	Full time during project	1
	Waste Mgmt - Super	80	hours	$100.00		50% time during project	1
	Waste Mgmt - Field	320	hours	$50.00		Full time during project	4
	Equipment Foreman	80	hours	$51.00	$4,080	Full time during project	1
	Laborers	800	hours	$36.00	$28,800	Full time during project	10
	Equipment Operators	800	hours	$40.00	$32,000	Full time during project	10
	Subtotal				**$75,920**		
	Equipment/Supplies						# on job
	Forklift	1.5	month	$3,000.00	$4,390	For entire project duration	3
	Track Hoe	0.5	month	$10,000.00	$4,878	For entire project duration	1
	Loader	0.5	month	$3,000.00	$1,463	For entire project duration	1
	Water Truck	0.5	month	$2,700.00	$1,317	For entire project duration	1
	Pick-up Truck	1.0	month	$600.00	$585	2 for entire project duration	2
	Generator	0.5	month	$900.00	$439	For entire project duration	1
	Light Tree	0.5	month	$1,100.00	$537	For entire project duration	1
	Mower/Disk	0.5	month	$9,000.00	$4,390	For entire project duration	1
	H&S Supplies	0.5	month	$11,500.00	$5,610	For entire project duration ($500/day x 23 days/mo.)	1
	Conex Boxes	1.0	month	$400.00	$390	2 for entire project duration	2
	Intermodals (for soil disposal)	0.5	months	$310,000.00	$151,220	$20/day lease ea. for 500 intermodels (31 day/mo.)	1
	Misc. Supplies	0.5	month	$1,000.00	$488	$1000/mo	1
	Subtotal				**$175,707**		
	Erosion Control						
		1.50	acres	$3,000.00	$4,511	$3000/ac	
	Subtotal				**$4,511**		
				Total Soil Removal Cost	**$377,827**		
Disposal Cost	**IHSS 140**						
	Area	65498	sq. ft.	-	-	Area from GIS coverage	
	Excavation depth - average over entire area)	0.5	ft.	-	-		
	Total disposal volume (includes 30% bulking factor)	42,574	cubic feet	-	-		
	Total disposal volume equivalent (cubic meters)	1,206	cubic meters	-	-	For comparison to project baseline	
	Volume - Low-Level Waste (m^3)	0	cubic meters	-	-		
	Volume - Low-Level Waste (ft^3)	-	cubic feet	$5.20	$0	$5.20/cubic ft. - Low Level Waste	
	Volume - Low-Level Mixed Waste (m^3)	1,206	cubic meters	-	-	Assume all waste is LLMW	
	Volume - Low-Level Mixed Waste (ft^3)	42,574	cubic feet	$20.00	$851,471	$20/cubic ft. - Low Level Mixed Waste	
	Transport to Disposal Site	124	roundtrips	$2,500.00	$310,000	345 cu. ft./truck and $2500/truck RT to EnviroCare	
				Total Soil Disposal Cost	**$1,161,471**		
			Total Capital Cost (Soil Removal + Disposal)		**$1,539,299**		
Operations and Maintenance Costs - Annual Costs							
	Item	**# of Units**	**Units**	**Unit Rate ($)**	**Cost**	**Assumptions**	
	Weed control	1.50	acres	$150.00	226	$150 per acre/year for weed control	
	Veg. maintenance/ reseeding	1.50	acres	$30.00	45	$30 per acre/year for reseeding	
	Vegetation monitoring - fieldwork labor	0.5	days	$600.00	300	2 ecologists x 1 day x 8 hours/day @$75/hour	
	Vegetation monitoring - office labor	0.5	days	$600.00	300	1 ecologist x 1 week x 40 hrs/wk 8 $75/hour	
				Total Operations and Maintenance Costs (per year)	**$ 871**		

Soil Excavation and Disposal Cost Estimate:			OU1 Surface Soil				
OU1 Surface Soil	Soil Removal and Disposal						
	Anticipated Duration (weeks)	0.2					
Activity	Item	# of Units	Units	Unit Rate ($)	Cost	Assumptions	
Soil Removal							
	Direct						FTEs on job
	Project Mgmt	8	hours	$80.00	$640	50% time during project	1
	Proj. Mgmt Support	8	hours	$65.00	$520	10% time during project	1
	K-H Safety	8	hours	$80.00	$640	Full time during project	1
	Field Project Manager	8	hours	$80.00	$640	Full time during project	1
	Engineering Support	0.8	hours	$80.00	$64	10% time during project	0.1
	Waste Mgmt Support	8	hours	$80.00	$640	Full time during project	1
	RCT Support	48	hours	$37.00	$1,776	Full time during project	6
	Misc. Support (planning, procure., reports, QC)	96	hours	$80.00	$7,680	Full time during project	12
	Direct ODC's	0.2	week	$100.00	$20	$100/week	n/a
	Subtotal				**$12,620**		
	Sampling and Analytical						FTEs on job
	Manager	4	hours	$80.00	$320	50% time during project	0.5
	Field Techs.	16	hours	$60.00	$960	Full time during project	2
	Lab Expenses	0.8	days	$2,500.00	$2,000	$2,500/day	n/a
					$3,280		
	Construction Contractor						
	Labor						FTEs on job
	Superintendent	8	hours	$55.00	$440	Full time during project	1
	H&S Officer	8	hours	$33.00	$264	Full time during project	1
	Labor Foreman	8	hours	$50.00	$400	Full time during project	1
	Waste Mgmt - Super	8	hours	$100.00		50% time during project	1
	Waste Mgmt - Field	32	hours	$50.00		Full time during project	4
	Equipment Foreman	8	hours	$51.00	$408	Full time during project	1
	Laborers	80	hours	$36.00	$2,880	Full time during project	10
	Equipment Operators	80	hours	$40.00	$3,200	Full time during project	10
	Subtotal				**$7,592**		
	Equipment/Supplies						# on job
	Forklift	0.1	month	$3,000.00	$439	For entire project duration	3
	Track Hoe	0.0	month	$10,000.00	$488	For entire project duration	1
	Loader	0.0	month	$3,000.00	$146	For entire project duration	1
	Water Truck	0.0	month	$2,700.00	$132	For entire project duration	1
	Pick-up Truck	0.1	month	$600.00	$59	2 for entire project duration	2
	Generator	0.0	month	$900.00	$44	For entire project duration	1
	Light Tree	0.0	month	$1,100.00	$54	For entire project duration	1
	Mower/Disk	0.0	month	$9,000.00	$439	For entire project duration	1
	H&S Supplies	0.0	month	$11,500.00	$561	For entire project duration ($500/day x 23 days/month	1
	Conex Boxes	0.1	month	$400.00	$39	2 for entire project duration	2
	Intermodals (for soil disposal)	0.0	months	$310,000.00	$15,122	$20/day lease ea. for 500 intermodels (31 day/mo.)	1
	Misc. Supplies	0.0	month	$1,000.00	$49	$1000/mo	1
	Subtotal				**$17,571**		
	Erosion Control						
		0.02	acres	$3,000.00	$58	$3000/ac	
	Subtotal				**$58**		
				Total Soil Removal Cost	**$37,783**		
Disposal Cost	**OU1 Surface Soil**						
	Area	844	sq. ft.	-	-	Area from GIS coverage	
	Excavation depth - average over entire area)	0.5	ft.	-	-		
	Total disposal volume (includes 30% bulking factor)	549	cubic feet	-	-		
	Total disposal volume equivalent (cubic meters)	16	cubic meters	-	-	For comparison to project baseline	
	Volume - Low-Level Waste (m^3)	0	cubic meters	-	-		
	Volume - Low-Level Waste (ft^3)	-	cubic feet	$5.20	$0	$5.20/cubic ft. - Low Level Waste	
	Volume - Low-Level Mixed Waste (m^3)	16	cubic meters	-	-		
	Volume - Low-Level Mixed Waste (ft^3)	549	cubic feet	$20.00	$10,972	$20/cubic ft. - Low Level Mixed Waste	
	Transport to Disposal Site	2	roundtrips	$2,500.00	$5,000	345 cu. ft./truck and $2500/truck RT to EnviroCare	
				Total Soil Disposal Cost	**$15,972**		
			Total Capital Cost (Soil Removal + Disposal)		**$53,755**		
Operations and Maintenance Costs - Annual Costs							
	Item	**# of Units**	**Units**	**Unit Rate ($)**	**Cost**	**Assumptions**	
	Weed control	0.02	acres	$150.00	3	$150 per acre/year for weed control	
	Veg. maintenance/ reseeding	0.02	acres	$30.00	1	$30 per acre/year for reseeding	
	Vegetation monitoring - fieldwork labor	0.1	days	$600.00	60	2 ecologists x 1 day x 8 hours/day @$75/hour	
	Vegetation monitoring - office labor	0.1	days	$600.00	60	1 ecologist x 1 week x 40 hrs/wk 8 $75/hour	
				Total Operations and Maintenance Costs (per year)	**$ 123**		

903 Pad Lip Area - Additional Long-Term Surface Water Monitoring Cost Estimate

Capital Costs

Location	Capital Cost	Assumptions
SW055	$ -	Use existing, installed equipment (Perf. Monitoring station)
GS51	$ -	Use existing, installed equipment (Perf. Monitoring station)
GS52	$ -	Use existing, installed equipment (Perf. Monitoring station)
GS53	$ -	Use existing, installed equipment (Perf. Monitoring station)
GS54	$ -	Use existing, installed equipment (Perf. Monitoring station)
GS42	$ -	Use existing, installed equipment (Perf. Monitoring station)
SW027	$ -	Use existing, installed equipment (POE station)
Total Capital Costs	$ -	

Operation and Maintenance Costs

O&M costs - all stations

Item	Cost/year	Assumptions / Remarks
Equipment parts/replacement	$ 4,500	15 years equipment life, 10 year flume life
Station mainten/sample collection	$ 14,400	2 days/mo x 8 hours/day x 12 mo/yr * $75/hour (see note 1 below)
Sample preparation	$ 2,000	Based on $100/sample * 20 samples/year (see note 2 below)
Analytical costs	$ 10,000	Based on $500/sample * 20 samples/year (Pu,U, Am) (see note 3 below)
Data analysis/workup/reporting	$ 14,400	2 days/mo x 8 hours/day x 12 mo/yr * $75/hour
Annual O&M Costs - All Stations	$ 45,300	

Notes:

1) Sample collection costs do not account for basic "infrastructure" costs such as vehicles, office space, etc. - assumed already in place

2) Sample prep. estimate based on current (2003) costs, using current system.
20 samples/year based on: SW055 (3), GS51 (3), GS52 (2), GS53 (2), GS54 (1), GS42 (2), SW027 (7)

3) Analytical costs based on current lab costs (2003) and sample volume

Alternative 3 - Cost Estimate Summary

Alternative 3 Actions:

1) Perform actions from Alternative 2:
   a) Soil removal and disposal in Outer Lip Area, areas with actinide activity above Radioactive Soil Action Levels
   b) Additional long-term surface water monitoring
   c) Soil removal from other locations (IHSS 140, PAC-SE-1602, OU1, Sub-surface risk screen location)
2) Construct channel to divert Woman Creek hillslope 44 into S. Interceptor Ditch
   (Assume all disturbed soil from channel remains on-site as part of ditch embankment)

Alternative 3 Actions - Diversion Channel Summary

Construct channel to divert Woman Creek hillslope 44 into S. Interceptor Ditch

Diversion Channel Parameters

Parameter	Quantity	Units	Basis
Diversion channel length	700	feet	Hillslope 44 width
Channel bottom width	3	feet	Design flow: 34.1 cfs
Channel width (total)(w/ 3:1 side slopes)	15	feet	Approx. 0.5 ft freeboard
Channel longitudinal slope	0.006	ft/ft	UDFCD guidelines
Channel lining	grass	-	suitability, cost

Cost Estimate Summary

Capital Costs

Action	Capital Cost
Soil removal & disposal - Outer Lip Area	$ 13,194,226
Soil removal & disposal - PAC-SE-1602	$ 611,697
Soil removal & disposal - IHSS 140	$ 1,539,299
Soil removal & disposal - OU1 location	$ 53,755
Surface water monitoring	$ -
Diversion channel into SID	$ 263,284
Total capital costs	**$ 15,662,260**

Annual Operation and Maintenance Costs

Action	O&M cost/year
Outer Lip Area -Veg. monit./maint/weed control	$ 4,830
PAC-SE-1602 - Weed control, etc.	$ 858
IHSS 140 - Weed control, etc.	$ 871
OU1 location - Weed control, etc.	$ 123
Surface water monitoring	$ 45,300
Diversion channel into SID	$ 759
Total O&M cost/year	**$ 52,741**

900-11 Area - Diversion Channel into S. Interceptor Ditch

Peak runoff estimate - for channel design

Conceptual Design Development

Peak Runoff Estimate for Woman Creek Hillslope 44

Use Rational Formula — Reference: Urban Drainage and Flood Control District

Q= CIA — Urban Storm Drainage Criteria Manual (USDCM), June 2001, Section RO

where: — (Applicable to Hillslope 44 watershed, which is approx. 17 acres, see Table RO-1)

Q = peak discharge (cfs)

C = runoff coefficient

I = average internsity of rainfall (in/hr)

A = watershed area (acres)

Storm Event

Use 100-year, 1-hour storm for design purposes

2.7 inches — Reference: USDCM, Fig. RA-6

Soils

Per SCS Soil Classification Map, 1975 — Reference: RFETS Master Drainage Plan, 1992

Soils are:

(31) Denver-Kutch-Midway Loams (9 - 25 percent slopes)

(60) Haverson Loams,(0-3 percent slopes)

(102) Nunn Loam (0-3 percent slopes)

- Use hydrologic soil group C/D for Rational Method

Flow to Proposed Diversion Channel

Determine time of concentration (t_c) — Reference: USDCM, Eq. RO-2

$t_c = t_i + t_t$

where:

t_c = time of concentration (minutes)

t_i = initial or overland flow time (minutes)

t_c =travel time in ditch, storm sewer (minutes)

Overland flow time (ti)

ti = [0.395(1.1-C5)(L^0.5)]/S^(1/3) — Reference: USDCM, Eq. RO-3

C5 = 0.15 — Reference: USDCM, Table RO-5 (0% impervious)

Slope = 120/1000 = 12% (f: 0.1 ft/ft

ti = 24.1 minutes

Overland travel time (tt)

V=Cv*Sw^(0.5)

V=velocity

Cv=conveyance coeff.

Sw = watercourse slope (ft/t)

Cv = 15 (grassed waterway) — Reference: USDCM, Table RO-2

Sw = 0.6%

V= 1.2 ft/sec

travel time = L/V = 602.5 sec

10.0 minutes

time of concentration (tc)

$t_c = t_i + t_t$ 34.1 minutes

Rainfall Intensity

I = (28.5(P1))/((10+tc)^0.786)

P1 = 2.7 for 100-year, 1-hour storm — Reference: Fig. RA-6

I= 3.9 inches/hour

Watershed area

Hillsope 44 = 17.4 acres — Reference: GIS coverage

Determine runoff coefficient, C

Ccd = KCD + (0.858i^3-0.786i^2+0.774i+0.04) — Reference: USDCM, Eq. RO-7, for C/D soils

i = 0% — 0% impervious

Kcd = -0.39i+0.46 = 0.46 — For type C and D soils, Table RO-4

Ccd = KCD + (0.858i^4-0.786i^2+0.774i+0.04)

Ccd = 0.5

Peak Runoff

Q= CIA 34.1 cfs

900-11 Area - Diversion Channel into S. Interceptor Ditch								
Conceptual channel design - unlined grass channel								
	Design parameters							
	peak runoff		34.1	cfs	Reference: see peak ruonoff calc sheet			
	slope		0.6%		Reference: UDFCM, pg. MD-24, (max. for grass-lined channel)			
	Mannings's roughness		0.033		Reference: UDFCM, table MD-1 (for straight channel, with grass)			
	Manning's equation							
	Q=(1.49/n)*A*(R^(2/3))*(S^(1/2))							
	where:							
	Q	flow rate (cfs)						
	n	Manning's roughness factor (unitless)						
	A	flow area (ft^2)						
	R	hydraulic radius (ft) = flow area/wetted perimeter						
	S	slope						
	Use trapezoidal cross-section of:							
		3 -foot bottom width						
		3:1 (H:V) side slopes						
		2 feet deep						
	1.5 foot flow depth discharge:			36.7	cfs	(3.3 ft/sec)	(meets design discharge)	
	2 foot flow depth			69.1	cfs	(3.8 ft/sec)	(0.5 feet above design flow)	
	Volume of material in channel cross-section							
	Cross-sectional area		18	ft^2				
	channel length		700	ft^2				
	channel volume		12600	ft^3				
	channel volume		467	yds^3				
	Area requiring erosion control blankets							
	Width	55	ft					
	length	700	ft					
	Area	38500	sq. ft					
	Area	4278	sq. yd					

900-11 Area - Diversion Channel into S. Interceptor Ditch

(To route Hillslope 44 Runoff into the S. Interceptor Ditch, to Pond C-2)

Diversion Channel - Line item estimates

Item	# of units	units	Unit cost	Total	Assumptions / Basis
Project Management	240	hours	$ 80.00	$ 19,200	1.5 mos. @ full time
Project Support	480	hours	$ 80.00	$ 38,400	1.5 mos. @ full time for 2 (rad engr, H&S)
Engineering Design (subcontracted)	1	ea.	$ 10,000.00	$ 10,000	subcontracted
Procurement and Field Prep	40	hours	$ 80.00	$ 3,200	1 week @ full time
Field Document Prep	120	hours	$ 80.00	$ 9,600	3 weeks @ full time
(FIP, HASP, JHA, RWP, Soil Dist. Permit)	-	-	-	-	
Readiness Assessment	60	hours	$ 80.00	$ 4,800	3 weeks @ half time
Surveying (subcontracted)	1	ea.	$ 3,000.00	$ 3,000	subcontracted
Soil Sampling	-	-	-	$ 25,000	Soil sampling if required for soil disturb.
Equipment Mobilization	4	ea.	$ 1,000.00	$ 4,000	$1K/piece of equipment
Construction (See Detail Below)	-	-	-	$ 123,604	
Rad Survey/Release of Equipment	8	hours	$ 60.00	$ 480	1 RCT for 1 day
Demobilization	4	ea.	$ 1,000.00	$ 4,000	$1K/piece of equipment
Soil - Shipping and Off-Site Disposal	-	-	-	-	No cost - assume all disturbed soil remains at site
Record Documents ("As-Builts")	1	ea.	$ 2,000.00	$ 2,000	subcontracted
Closeout Report	200	hours	$ 80.00	$ 16,000	Full time for 2.5 weeks for 2
Total Cost				**$ 263,284**	

Estimated Construction Cost - Ditch

Item	# of units	units	Unit cost	Total	Assumptions / Basis
H&S Officer	120	hours	$ 33.00	$ 3,960	3 weeks full-time
Labor Foreman	120	hours	$ 50.00	$ 6,000	subcontracted
Equipment Operator	120	hours	$ 40.00	$ 4,800	3 weeks full-time
Laborers (2)	240	hours	$ 36.00	$ 8,640	2 @ 3 weeks fulltime
RCT	120	hours	$ 37.00	$ 4,440	1 RCT full time
Trackhoe	4	week	$ 3,000.00	$ 12,000	Wagner Rental website (includes mob./demob.)
Small track dozer (D-4)	4	week	$ 925.00	$ 3,700	Wagner Rental website (includes mob./demob.)
Compactor	4	week	$ 3,200.00	$ 12,800	Wagner Rental website (includes mob./demob.)
Water Truck	4	week	$ 2,400.00	$ 9,600	Wagner Rental website (includes mob./demob.)
Rip-rap (channel protection, outlet into SID)	120	cy	$ 33.00	$ 3,960	Means guide cost
Bedding (for rip-rap)	60	cy	$ 26.45	$ 1,587	Means guide cost
Erosion vegetation mats	4278	sq yd.	$ 2.50	$ 10,694	Nilex - Vendor quote
Seed	0.88	acres	$ 250.00	$ 221	$250/acre seeding w/ native mix
Contingency (50%)	1	ea.		41,201	
Construction Subtotal				**$ 123,604**	

Operations and Maintenance Costs - Annual Costs

Item	# of units	units	Unit cost	Total	Assumptions / Basis
Weed control	0.88	acres	$150.00	133	$150 per acre/year for weed control
Veg. maintenance/ reseeding	0.88	acres	$30.00	27	$30 per acre/year for reseeding
Vegetation monitoring - fieldwork labor	0.5	days	$600.00	300	2 ecologists x 1 day x 8 hours/day @$75/hour
Vegetation monitoring - office labor	0.5	days	$600.00	300	1 ecologist x 1 week x 40 hrs/wk 8 $75/hour
Total Operations and Maintenance Costs (per year)			**$ 759**		

Appendix G – IHSS Group 900-11 Area IM/IRA

Geostatistical Analysis of the 903 Lip Area

Geostatistical Analysis of the 903 Pad Lip Area at Rocky Flats

I. Introduction

Surface soils in the 903 Pad Lip Area (Lip Area) of the Rocky Flats Environmental Technology Site (RFETS) have been sampled extensively. Sample results indicate that two types of areas exist: (1) those where the activity of $^{239/240}$Pu exceeds the threshold action level of 50 pCi/g ("dirty"); and, (2) those where the $^{239/240}$Pu activity does not exceed 50 pCi/g ("clean"). The activity in unsampled soils between clean and dirty locations must be assessed in order to determine the extents of excavation.

Two basic options exist for assessing the remedial requirements for unsampled areas. The first is to estimate the actual amount of activity in the soils using nearby sample data points. The second is to calculate the probability that the soils exceed the 50 pCi/g threshold, i.e. the probability that they are dirty.

The RFETS has selected and implemented the latter approach. RFETS has applied a geostatistical probability approach for remediation decision-making in order to ensure that a high level of confidence accompanies the clean up and removal of soils. Using geostatistical methods enables RFETS to base remedial decisions on a simultaneous assessment of the amount of activity in the soils as well as the amount of confidence in the decision.

II. Geostatistical Background

Geostatistical methods have been applied widely in environmental characterization to analyze the spatial distribution of contaminants in soils, groundwater, and air (Myers 1997, EPA 1987). Geostatistical approaches customize the analysis to account for the unique features of the contaminant distribution at a particular site so that a more representative model can be produced.

A geostatistical study is composed of two primary processes. First, *variogram* analysis assesses the unique spatial characteristics of the contamination in a quantifiable manner. Next, the spatial information derived by the variogram analysis is applied by a process called *kriging*. The kriging process used in geostatistical studies produces "best" or optimal estimation (minimum error), which ensures a high quality model for decision-making.

In addition, geostatistical techniques provide a measure of the confidence in the estimations and subsequent decision-making process, an attribute unique to geostatistics. The specific geostatistical approach used at a site is linked to the objectives required in the decision-making process.

III. Remedial Objectives in the Lip Area

For the RFETS Lip Area, the remedial objectives focus on the desire to achieve a 90 percent certainty that areas that do not undergo remediation have less than a 10 percent chance of having $^{239/240}$Pu activity greater than 50 pCi/g . Stated another way, the objective is not to remove areas with surface soils that have less than a 10 percent chance of exhibiting $^{239/240}$Pu activity greater than 50 pCi/g.

By removing areas where the chance of exceeding the 50 pCi/g threshold is greater than 10 percent (probability of 0.10), the result is a 90 percent confidence in the remedial effort. The geostatistical approach creates a model of the contamination that allows decision-making to proceed according to the confidence objectives, which themselves are related to the threshold level for maximum desired $^{239/240}$Pu activity.

IV. Data Input

A. Initial Data Input and Review

Surface soil data in the Lip Area were extracted from the Remedial Action Decision Management System (RADMS) database. For locations where more than one analytical value was available at a location, the sample with the highest activity was retained in order to provide a conservative estimate. Approximately 1700 sample data have been used so far in the analysis.

Figure 1 displays the locations of the initial sample data points used in the initial phase of the geostatistical analysis. Sample locations shown in red indicate $^{239/240}$Pu activity in excess of 50 pCi/g. Sample locations shown in blue represent $^{239/240}$Pu activity less than 50 pCi/g. The mustard-colored background indicates the approximate extent of the Individual Hazardous Substance Site (IHSS) 155 (the 903 Pad Lip Area). The map indicates the locations where activity that exceeds 50 pCi/g has been bounded by samples that contain activity below this threshold cutoff as well as locations where exceedances are unbounded.

The purpose of the geostatistical analysis is to determine how far out into the clean zones the remediation needs to go in order to be 90 percent confident that soils do not exceed 50 pCi/g. Without samples with concentrations below 50-pCi/g, the kriging process will extend the excavation line (90 percent confidence) a relatively large distance from the samples above 50 pCi/g. This phenomenon will be seen in the Results section of this Appendix. Since no samples have been taken in these areas to demonstrate that they are below 50 pCi/g, the excavation line must follow the 90 percent confidence line of blocks until boundary samples become available.

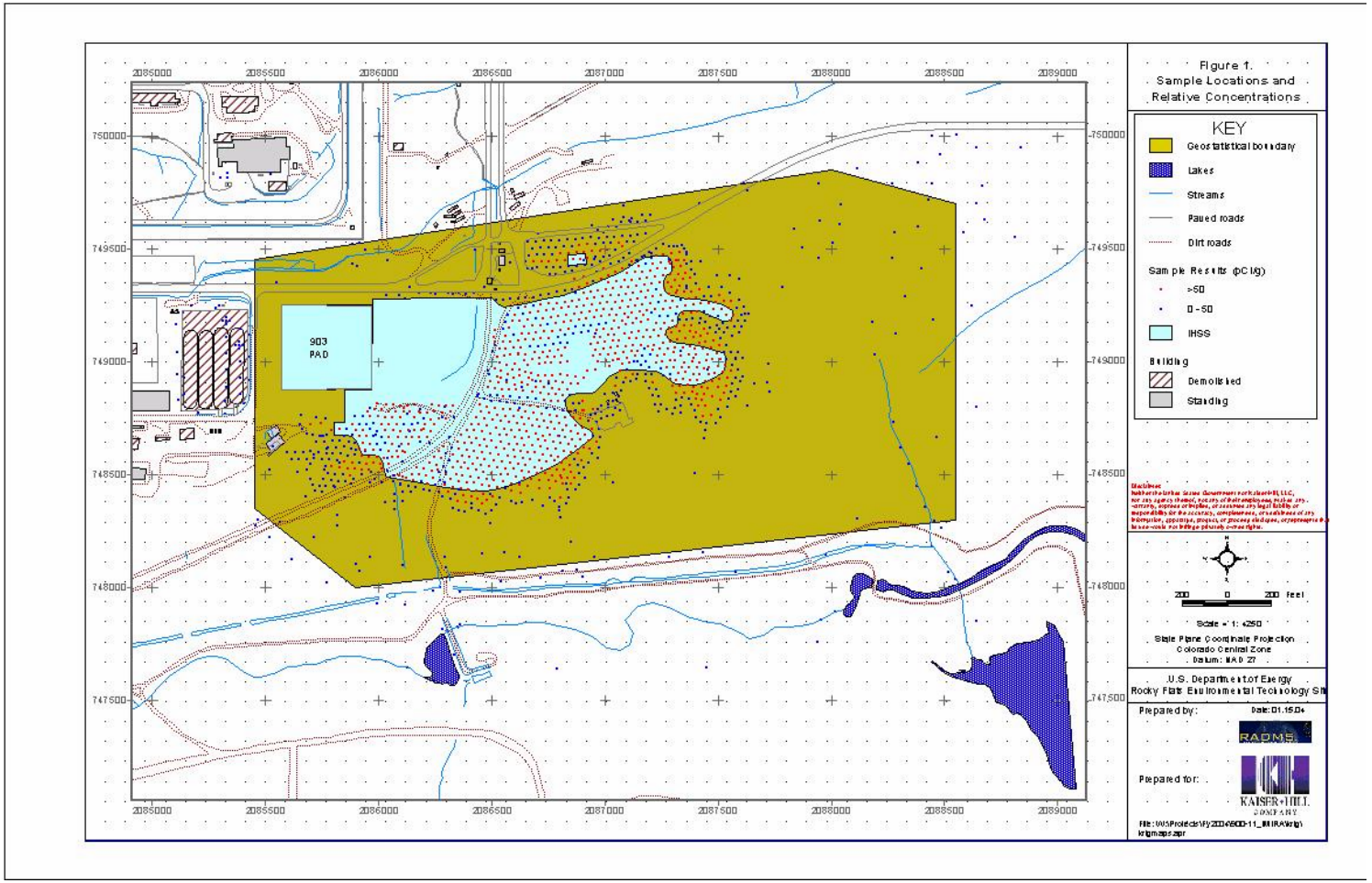


Figure 1 – Soil Sample Locations and Relative Concentrations

B. Dynamic Field Characterization and Data Updates

Because sample data continue to be collected, the opportunity arises for the geostatistical kriged model to be updated with the latest sample information. This dynamic approach ensures that the maximum amount of sample information will be applied to the decision-making process, which subsequently increases confidence in remedial decisions. Dynamic work plans are encouraged by EPA's Technology Innovation Office (TIO) as part of the Triad Approach (Crumbling 2001, Crumbling et al. 2001, EPA 2001).

As excavation progresses in the field, additional soil samples will become available. These new samples will be added to the database and the kriged model will be updated. During this process, certain block probabilities may change category, either from above 0.10 to below 0.10 or from below 0.10 to above 0.10. Remedial excavation will be performed using the most up-to-date sample information and kriged model. Therefore, the final excavation imprint may be slightly different than the one shown in this report.

V. Geostatistical Analysis

A. Variogram Analysis

The sample data in the Lip Area were analyzed for spatial correlation using variogram analysis, which quantifies the degree to which nearby samples are more similar than samples located further from each other. During the variogram analysis, sample values greater than 50 pCi/g were set equal to one (1.0), while samples with values less than 50 pCi/g were set equal to zero (0.0). This type of data transformation is referred to as an *indicator* transformation. The variogram analysis was then performed on the zero and one values.

Figure 2 displays the indicator variogram graphs produced during the variogram analysis. The graphs for five directions are shown: (1) North-South; (2) Northeast-Southwest; (3) East-West; (4) Northwest-Southeast; and, (5) All directions (omni-directional). The fitted model to represent the variogram during kriging is shown in red.

The variogram graphs show very consistent and similar structures across the directions analyzed. A short-range structure is present at a distance of about 80 ft. A longer-range structure is also present, exhibiting a range of about 500 ft. In addition, a nugget effect (randomness parameter) equal to approximately 20 percent of the sill is present.

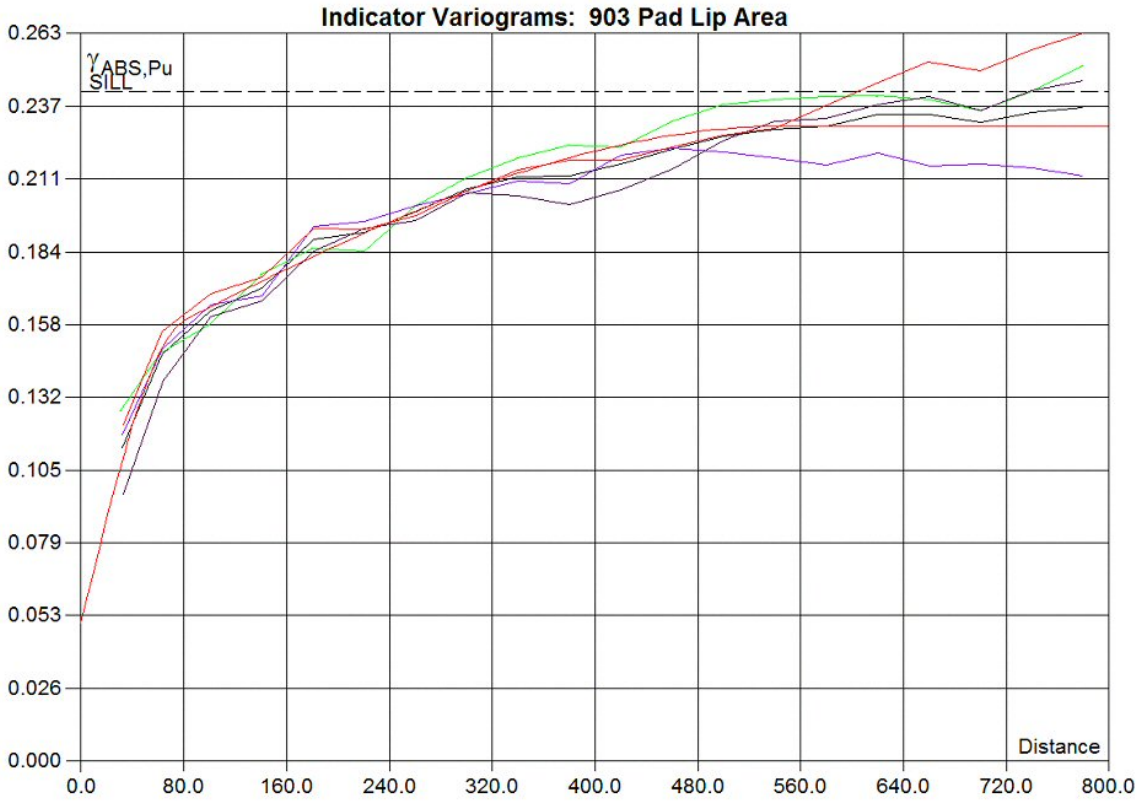


Figure 2 – Variogram Graphs of Indicator Data in the 903 Pad Lip Area

B. Kriging

In the 903 Pad Lip Area, indicator kriging was used to model the sample data. Indicator kriging is a powerful approach to environmental characterization in that it is able to combine the need to limit concentrations on contaminants left in soils with an high confidence that the limits have been achieved. This synthesis of $^{239/240}$Pu activity limits and uncertainty quantification address primary remedial and health concerns "at-a-glance" in the form of a risk-quantified map.

The dense sampling in the Lip Area permitted the use of a relatively small grid for estimation by the kriging process. A regular grid of 20x20 ft. areas was used for the kriging. Using sample data within or close to each cell area, the probability that the surface soil activity exceeds 50 pCi/g was calculated. Over 7000 cells were kriged in the Lip Area. Certain portions of the Lip Area were suppressed during the kriging process. The 903 Pad itself was not estimated because the remediation and confirmation sampling has already been performed. Just to the east of the 903 Pad lies an *Inner Lip Area*, which was omitted from the estimation. This area is being performed as a separate remediation under different criteria.

During the indicator kriging process, a value of one (1.0) is assigned to samples where the activity exceeds 50 pCi/g and a value of zero (0.0) is assigned to samples below 50

pCi/g. The geostatistical model that results contains the probability that any given area location has a $^{239/240}$Pu activity that exceeds 50 pCi/g.

Locations where the probability is 0.10 (10% chance) are 90% likely to have activity below the 50 pCi/g limit. This provides a 90% confidence that the location meets tolerable risk limits. Locations where the probability is between zero (0.0) and 0.10 (0-10% chance of exceeding the cutoff) will not be excavated. Areas where the probability of exceeding the cutoff is greater than 0.10 must be removed.

VI. Results

Figure 3 is a map of initial indicator kriging results for the initial sample data presented in Figure 1. Cell areas are color-coded in ten hues to indicate relative probability levels with the darkest hues indicating the most probable zones of contamination. Probability levels on the map range between zero and one, i.e. between zero and 100 percent. Black areas on the border of the map indicate zones that are either (1) outside the Lip Area or, (2) the 903 Pad (black square) which is being remediated under a separate effort.

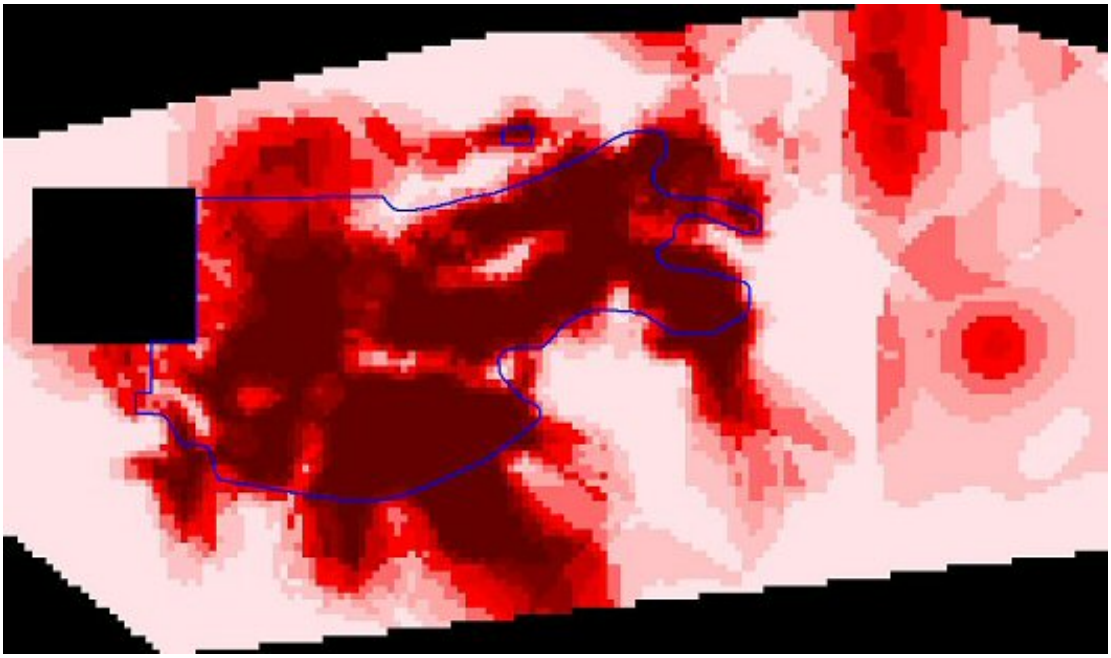


Figure 3 – Probability Map of the 903 Pad Lip Area

Figure 3 shows that a number of areas exist where samples values above 50 pCi/g were not bounded by samples with activity below 50 pCi/g. Such areas exhibit relatively large extensions or concentric zones where probabilities of being above 50 pCi/g exceed 10 percent. These unbounded areas offer opportunities to improve remedial excavation efficiency through the dynamic field data collection activities.

Based on the results shown in Figure 3, additional field samples were collected in the unbounded areas. Approximately 50 new samples were obtained. Using these new data, a revised kriged model of the Lip Area was produced (Figure 4). Figure 4 reveals that the

number of cell areas that exceed a probability of 0.10 has been reduced significantly and that a smaller footprint of excavation now applies.

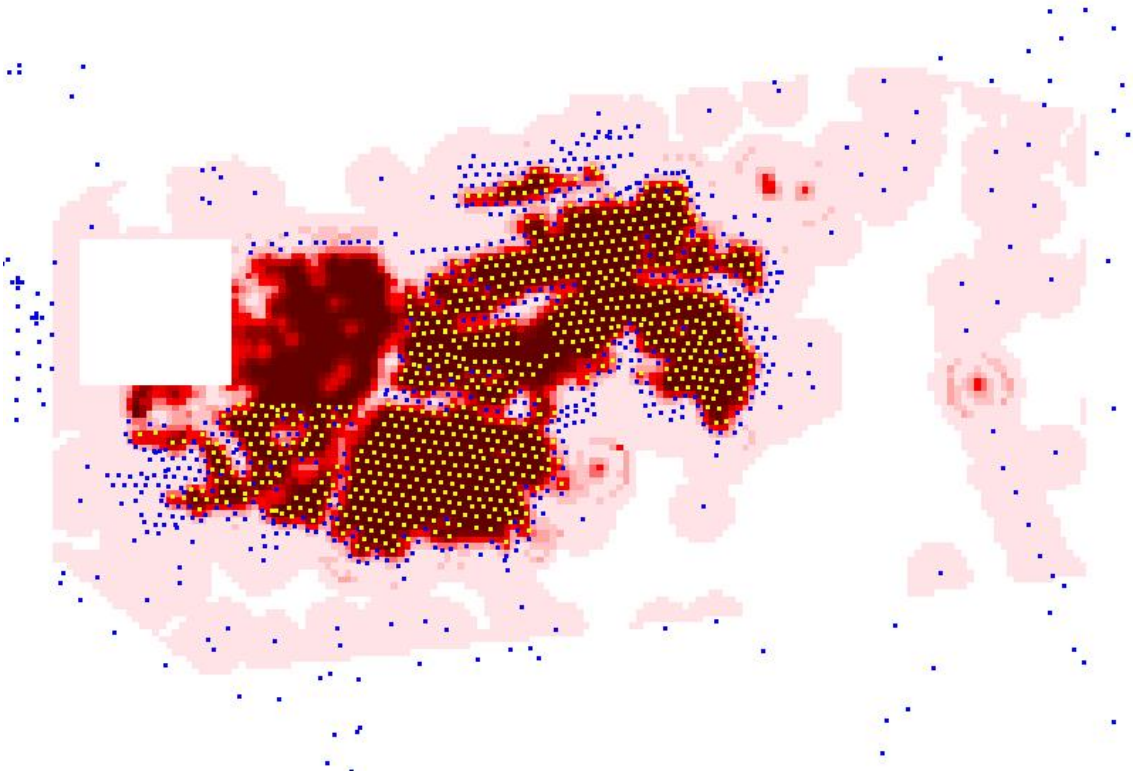


Figure 4 – Probability Map of the 903 Pad Lip Area

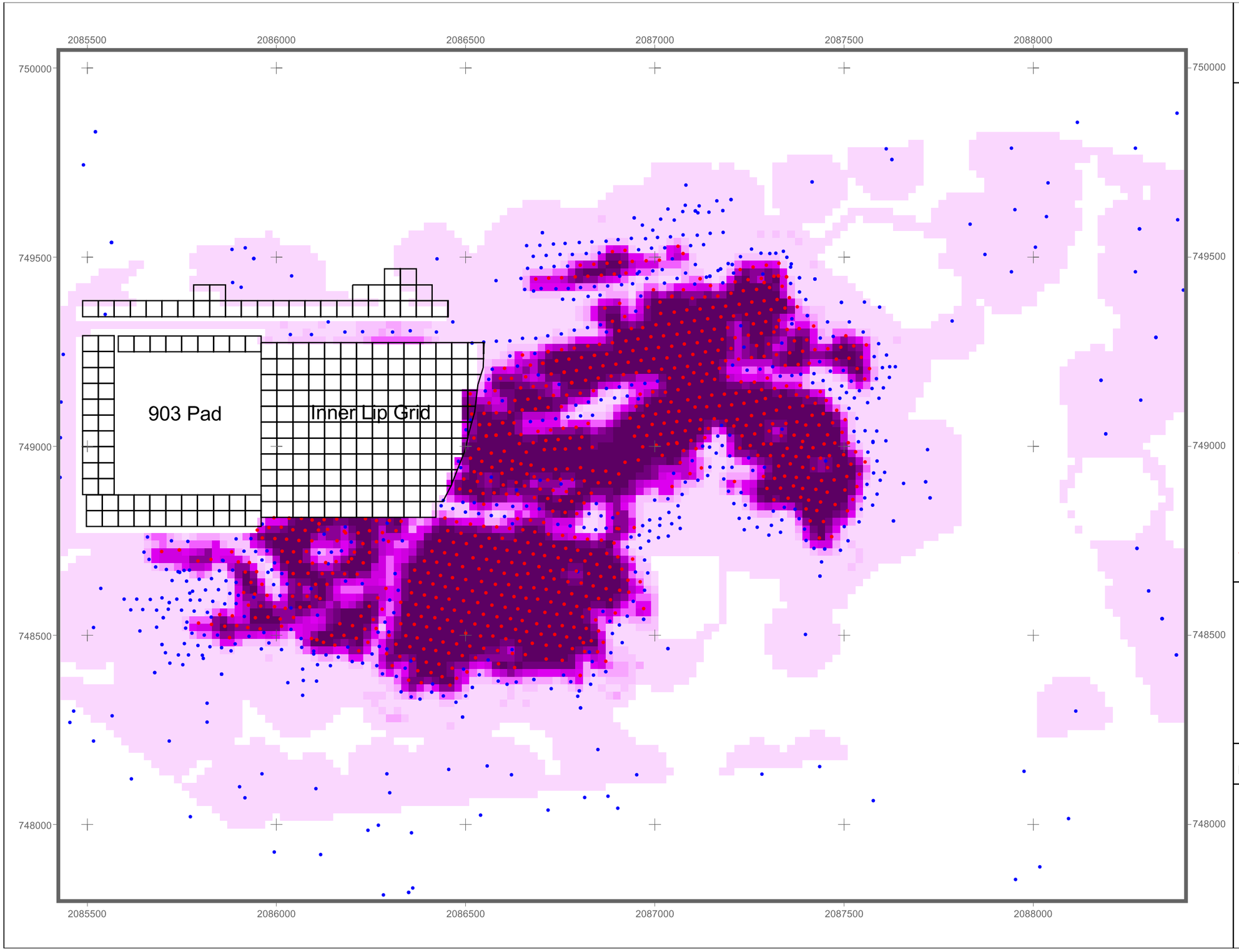
Figure 4 also shows another feature. White areas correspond to either (1) areas outside the Lip Area; or, (2) areas that were not estimated during the creation of the model. The latter situation results from the kriging process. During kriging, the program searches for samples that are within a specified distance of the cell. If no samples are found, then the cell area is not estimated. Hence, these cell areas appear as blanks.

Sample data points are also posted on the figure. Sample locations where the $^{239/240}$Pu activity exceeds 50 pCi/g are shown in yellow; locations where $^{239/240}$Pu activity is less than 50 pCi/g are shown in blue. Areas shaded with the lightest hue represent areas where the confidence that $^{239/240}$Pu activity does not exceed 50 pCi/g is 90 percent or greater. These areas do not require remediation. Areas containing other hues do not achieve a 90 percent confidence level. These areas require remediation based on this approach.

It should be noted that certain areas contain a sample with activity below the threshold, yet display a value indicating that remediation is required. This is because certain areas may not achieve the desired level of confidence, whereas other portions of the area do meet the confidence requirements due to their proximity to samples above 50 pCi/g.

Figure 5 is a map showing the current estimated areas planned for excavation. Areas that have probabilities greater than 0.10 are shaded in red, with areas exhibiting probabilities of 0.10 and below are shaded in pink. It is anticipated that most of the areas shown in red will be removed during the excavation.

Figure 5
Krig Output



KEY

Inner Lip Grid

Sampling Results (pCi/g)
- >RSAL (50 pCi/g)
- 0 - RSAL (50 pCi/g)

Kriging Results
(probability of contamination)
- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1

N
W E
S

200 0 200 Feet

Scale = 1: 3000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: RADMS

Date: 4.13.04

Prepared for: KAISER•HILL COMPANY

File: W:\Projects\Fy2004\900-11_IMIRA\krig\krigmaps.apr

VII. Uncertainty Analysis

A. Sample Data

The sample data values have been obtained through field sampling of surface soils. Samples were analyzed using a variety of analytical techniques including alpha spectroscopy, gamma spectroscopy, and high-purity germanium (HPGe). Each sample analysis has been subjected to rigorous tests to determine if the data quality meets RFETS standards. Only samples that meet the entire suite of QA/QC checks have been retained in for use in the geostatistical analysis.

Certain samples accepted into the geostatistical database have duplicate values associated with them. In these cases, the highest value was retained in order to be conservative. However, in most cases it did not matter which value was retained, as both sample values were either below or above the 50 pCi/g threshold. Thus, when the indicator transform was applied, the result for a sample was identical to what the result for a duplicate would have been. For example, if a sample and its duplicate analysis indicated activity levels of 23.6 and 29.4 pCi/g, then either sample would suffice as both would be transformed to a value of zero during the geostatistical analysis.

Occasionally, sample values and their duplicates counterparts exhibited values both above and below the 50 pCi/g threshold. In these limited cases, the highest value was retained in order to be conservative. By preferentially omitting duplicate values below 50pCi/g, the geostatistical estimator has a greater chance of assigning a confidence value of less than 90 percent to a cell area. This method of retaining duplicate values decreases the chances that a cell area with activity exceeding 50 pCi/g will not be removed.

Sample data values represent estimates of the true activity in the soil material. Due to imperfections in any analytical process, there remains some uncertainty regarding the actual concentration of a particular mass of soil. It is possible sometimes to determine the uncertainty that surrounds the reported activity for an individual sample or group of samples.

For the geostatistical study, analytical uncertainty was not addressed. Because most of the duplicate sample analyses identical indicator classification, it is presumed that most of the sample data are classified correctly with regard to having activity above or below 50pCi/g. As discussed above, the retention rule for duplicates already imparts a level of conservativism to the geostatistical model.

B. Cell Area Estimation

A degree of uncertainty exists regarding the true activity of a cell area that has been estimated using nearby sample values. Tools are available to track and assess the quality

of the geostatistical estimation and the degree of uncertainty. These tools are described below.

1. Misclassification Ellipse

The excavation boundary for the 903 Pad Lip Area has been defined by the techniques of indicator kriging, which identifies blocks that do not meet a 90 percent level of confidence. This means that numerous blocks with less than a 50 percent chance will be excavated, even though it is more likely than not that these blocks contain $^{239/240}$Pu activity below the 50 pCi/g threshold. The impact of the decision-making rule can be examined visually.

Figure 6 is a Misclassification Ellipse (Myers 1997). The diagram tracks estimated values (such as those derived by kriging) on the x-axis. The diagram also tracks the true, but unknown, values on the y-axis. If an estimator, kriging or otherwise, were perfect, estimated values would equal true values and the plot would post as a 45 degree line (Figure 6). Unfortunately, estimation is not perfect and a scatter of points, roughly elliptical, results.

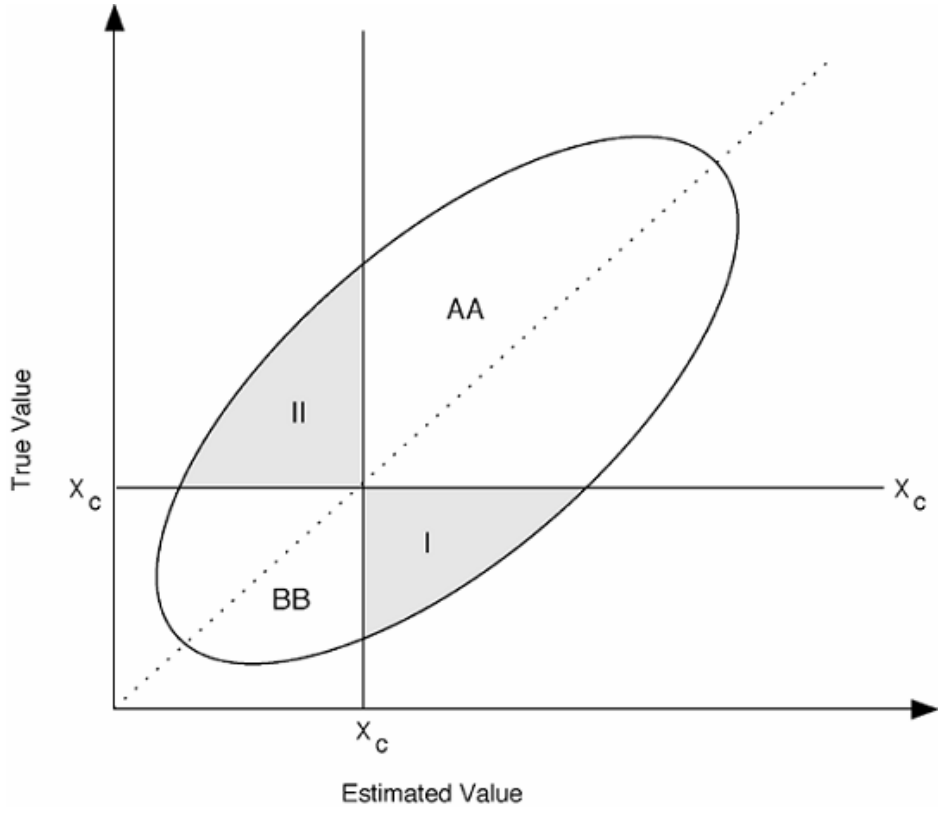


Figure 6: Misclassification Ellipse

In environmental remediation, an action threshold is typically established. Such a threshold has been plotted as a vertical line on the x-axis and a horizontal line on the y-

axis. These lines divide the ellipse into four quadrants, two of which are of concern and two of which are not.

In the lower-left corner, the estimated activity is below the threshold, 50 pCi/g for the 903 Pad Lip Area. The y-axis indicates that the actual value is in fact below the threshold. Thus, the area has been estimated appropriately (below-below or BB) and no excavation will be performed. Similarly, in the upper-right corner, the estimate is above the threshold and the actual value is as well (above-above or AA). In this case the correct decision to remediate the area will be made.

The first problem area resides in the lower-right corner of the ellipse. Here, the estimate indicates activity above 50 pCi/g, whereas the actual activity level is below. This block will be removed unnecessarily during the excavation. This is known as a Type I error or a false positive. Similarly, the area in the upper-left corner of the ellipse indicates the estimated activity to be below the threshold when, in actuality, it is above. In error, this area will not be excavated. This is a Type II error or a false negative.

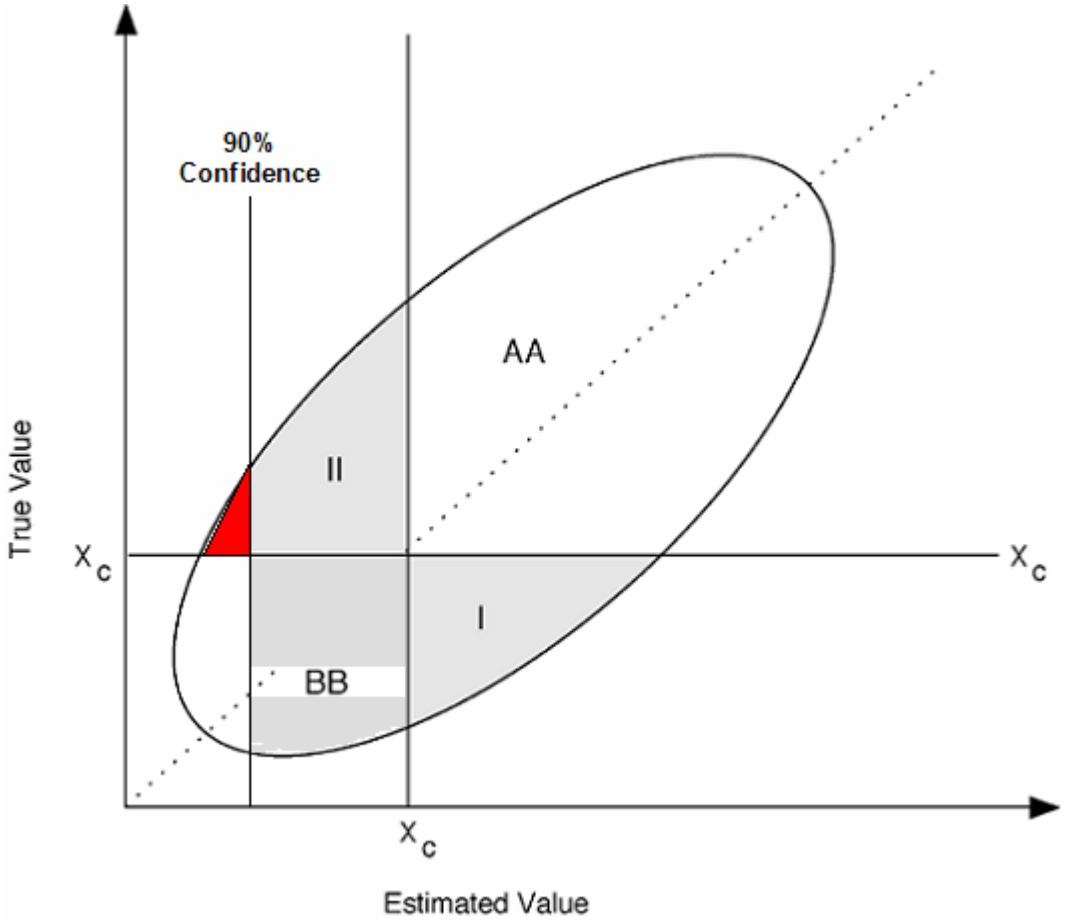


Figure 7: Effect of 90 Percent Confidence on Misclassification Ellipse

The threshold value on the diagram (x_c) corresponds to a 50% probability that a block is above or below the threshold. As such, the Type I and Type II errors are equal in

number. However, the excavation in the 903 Pad Lip Area will be performed to a 90 percent level of confidence. Figure 7 shows the Misclassification Ellipse after an adjustment has been made for the increased level of confidence.
In Figure 7, the threshold x_c for estimated values has been moved to a 10 percent chance of Type II error instead of a 50 percent chance. The area shown in red in Figure 7 is the remaining Type II error (10 percent). Note that by doing this, a 90 percent confidence has been achieved, but that the Type I errors have more than doubled, with a corresponding increase in area remediated unnecessarily.

Note also that the highest activity anticipated to be left unremediated has also been reduced significantly. At 50 percent confidence, the ellipse shows that cell areas with activities up to about 100 pCi/g might be left unremediated. By excavating to a 90 percent level of confidence, the maximum expected Type II error cell area would contain activity of only about 69 pCi/g.

Even though 69 pCi/g is above the threshold, risk goals can still be achieved as long as the average of the IHSS is below 50 pCi/g. It is acceptable under CERCLA to have occasional areas above the threshold as long as the average is below the established risk level (Blacker and Goodman 1994a and 1994b).

2. Efficiencies of Sampling at the Threshold

Figure 8 is a Misclassification Ellipse that shows the effect of sampling along the action line (bounding samples). Based on initial samples and initial indicator kriging, samples locations with activities above 50 pCi/g that did not have samples below 50 pCi/g nearby (outside the plume area) were targeted for additional sampling in an attempt to bound the plume. These new samples were thus taken in the transition zone between above/below 50 pCi/g activity samples.

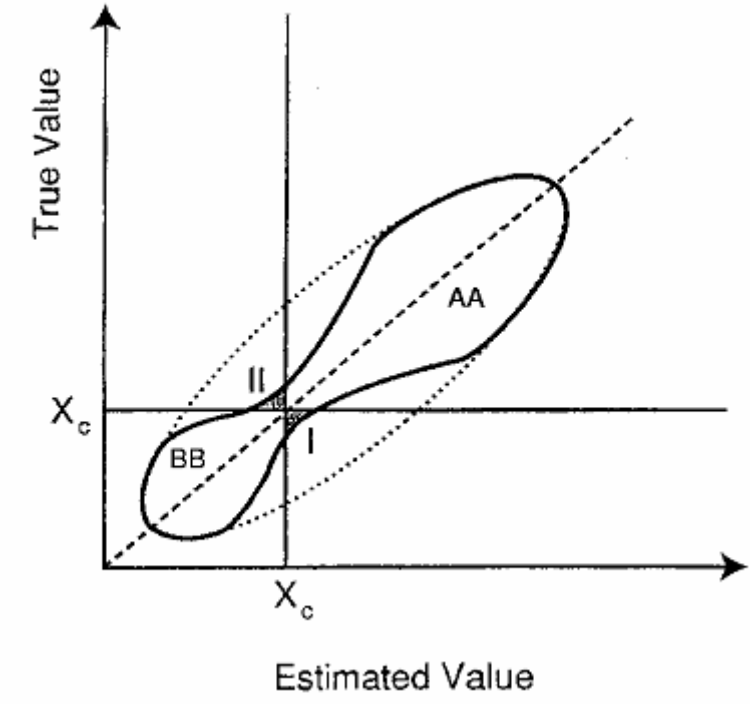


Figure 8: Effect of Action Line Sampling on Misclassification Ellipse

Because these new samples were taken approximately half-way between zones above and below the threshold, they can be viewed as samples taken at the 50 percent probability line, or x_c. This concentration of new information expressly at x_c reduces the width of the ellipse preferentially at x_c. The result is that the zones of Type I and Type II error shrink in size.

Figures 6 through 8 demonstrate that the uncertainty regarding the efficiency of the remediation has been reduced greatly. The error zones have been minimized, combined with a conservative decision rule that minimizes Type II error (potential contamination left behind). These approaches act in tandem to ensure that the remaining activity in the 903 Pad Lip Area has been minimized.

3. Effects of Error Minimization on Excavation Volumes

To demonstrate this minimization, Figure 9 displays the relative efficiencies achieved by the geostatistical approach. The x-axis displays the effect of increasing the amount of excavation from zero to 100 percent of the Lip Area. The y-axis shows either the percentage of the total $^{239/240}$Pu mass associated with or the confidence related to a particular level of excavation.

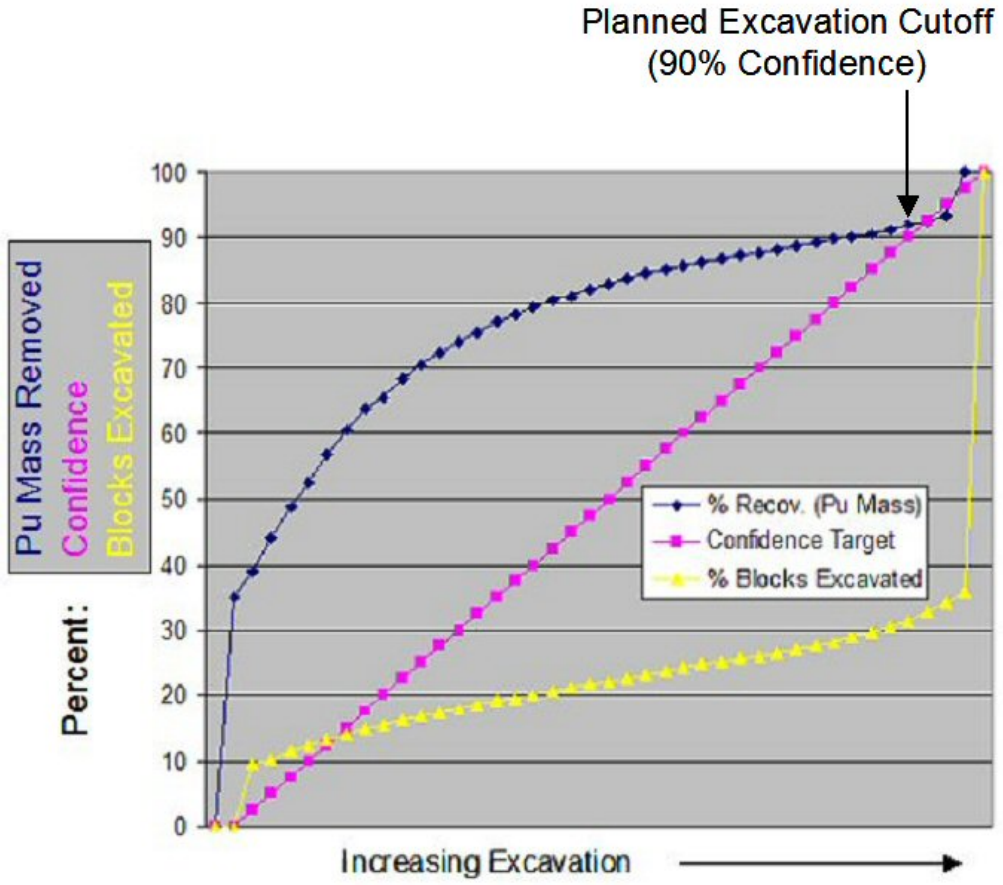


Figure 9: Remedial Efficiency Curve

Three lines appear on the graph. The blue line shows the percent recovery of the total $^{239/240}$Pu mass in the Lip Area. The graph shows that if no excavation were performed, then no $^{239/240}$Pu would be recovered, as shown in the lower-left corner of the graph. Conversely, if the entire Lip Area were excavated, then all of the $^{239/240}$Pu would be removed, as shown in the upper-right portion of the graph. Note that the pink and yellow symbols overlay, and thus block, the final blue point.

The pink line displays the systematic increase of potential probability in 2.5 percent increments, along with the associated confidence. Values start in the lower-left corner of the graph at zero (no confidence) and rise to a maximum (100 percent confidence) in the upper-right. Note that any particular level of confidence could have been selected for implementation during remedial activities.

Finally, the yellow line plots the percentage of the total number of 20x20 ft block areas that must be excavated in the Lip Area to achieve corresponding removal efficiencies as measured by the mass of $^{239/240}$Pu recovered. In other words, this line graphs the percentage of blocks needed to remove a certain percentage of the total mass of $^{239/240}$Pu in the soils in the Lip Area. A key feature of the yellow line is that is shows how large percentages of the $^{239/240}$Pu mass can be removed with only a small amount of disturbance at the site.

The blue line (Pu mass recovery) indicates that with a minimal excavation, a significant proportion of the total mass of $^{239/240}$Pu is removed. For example, by removing only the "hottest" 10 percent of the block areas, more than 50 percent of the total $^{239/240}$Pu mass is remediated. By remediating to the 50 percent confidence/probability line ("best guess"), far more than one-half (about 83 percent) of the $^{239/240}$Pu will be eliminated. By excavating to the 90 percent probability line, approximately 91.9 percent of the $^{239/240}$Pu mass will be eliminated from the Lip Area soils.

The Pu mass recovery line demonstrates that there is great efficiency in excavating the hottest cells. After those cell areas are removed, the efficiency decreases steadily and much more area must be removed to achieve corresponding reductions in mass. For example, removing areas estimated between zero and five percent confidence, a five percent interval, results in 44 percent (almost half) of the mass being removed. However, removing areas between 90 and 95 percent confidence, another five percent confidence interval, only removes about 1.4 percent of the $^{239/240}$Pu mass.

The Pu mass recovery line indicates a point of diminishing returns has been achieved by an excavation strategy focused on a 90 percent confidence for decision-making. The evidence on the graph supports the choice of using the 90 percent confidence level vs. higher confidence levels that would require much more soil to be removed to eliminate each remaining percent of the $^{239/240}$Pu mass.

The mass recovery line increases at a relatively constant rate until approximately 35 percent of the block areas have been removed and a confidence of greater than 99 percent has been achieved. At that point, the graph jumps dramatically to 100 percent. In other words, to remove the last (approximately one percent) of the $^{239/240}$Pu mass, planned excavation would need to almost triple.

VIII. Alternative Threshold Analysis

The Wildlife Refuge Worker (WRW) Action Level for $^{239/240}$Pu in soil at RFETS is 116 pCi/g. This value is based on a 1×10^{-5} increased cancer risk, which represents an average exposure over a 300-acre exposure area. However, the RFCA parties agreed to use the lower, more conservative value of 50 pCi/g as the Action Level to guide soil remediation.

It is useful and informative to compare the results obtained using a threshold of 50 pCi/g vs. the results and excavation plan that would result from using the previous threshold of 116 pCi/g. The excavation plan using 50 pCi/g has identified 3853 block areas that need to be removed. This contrasts with only 2226 blocks that would be removed using a threshold of 116 pCi/g.

The current plan will remove approximately 73 percent more blocks than would be removed under the previous threshold. This adds another level of conservativism and protectionism to the excavation plan. As seen in Figure 7, reducing the threshold (x_c) increases the amount of over-excavation.

IX. Conclusions

The following conclusions can be drawn from the geostatistical analysis:

(1) The sample data in the 903 Pad Lip Area are appropriate for geostatistical analysis. The data are of sufficient density and display good spatial correlation.

(2) Indicator kriging can establish a firm decision rule for soils excavation based on an action level (50 pCi/g) and an agreed level of confidence.

(3) The geostatistical approach is efficient and protective of human health and the environment, as demonstrated by the Misclassification Ellipse. The combination of sampling in the transition zone and using an high level of confidence (90 percent) for excavation provide a conservative approach.

(4) The removal activities will eliminate the vast majority of the $^{239/240}$Pu mass. Should an area with activity exceeding 50 pCi/g be left unremediated, it is highly likely that the block will have an average activity close to 50 pCi/g. This means that the incremental risk associated with the decision error is minimal.

(5) With the vast majority of the $^{239/240}$Pu mass removed from the 903 Pad Lip Area, the overall risk for the EA will be below the established limits with a high degree of confidence, to the point of virtual certainty.

(6) A dynamic work plan incorporating ongoing field sampling with continual updates to the geostatistical model will provide the most precise estimate of the excavation line, which will achieve the efficiencies and degrees confidence listed above.

(7) The change in the Pu Soil Action Level, originally determined to be 116 pCi/g averaged over 300 acres, then lowered to 50 pCi/g averaged over 0.0092 acres (the size of each 20' x 20' grid cell), has increased the planned excavation area by approximately 73 percent. The additional excavation provides more confidence that acceptable risk levels are achieved.

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Appendix H – IHSS Group 900-11 Area IM/IRA

List of Applicable or Relevant and Appropriate Requirements (ARARs)

ARARS Relevant to the IHSS Group 900-11 proposed accelerated action.

RADIATION CONTROL			
Emergency Plan – required if material quantity exceeds Schedule E of Part 3 (e.g., 2 curies of alpha emitters) and evaluation shows maximum dose to offsite person from release exceeds 1 rem (5 rem to thyroid).	RH 3.9.11	A/L	DOE maintains its Emergency Plan in accordance with DOE Order 151.1, "Comprehensive Emergency Management System"
Decommissioning Plan Contents – must include a description of methods used to ensure protection of workers and the environment against radiation hazards during decommissioning.	RH 3.16.4.3.3	A	Planned implementation of Site approved procedures to meet 10 CFR 835, "Occupational Radiation Protection" and the Site's IWCP process will be described for proposed actions.
Decommissioning Plan Contents – must include a description of the planned final radiation survey.	RH 3.16.4.3.4	A/L	Planned implementation of any final sampling and analysis plan for environmental media will be described.
Decommissioning Plan Contents – must include a description of the intended final condition of the site, buildings and/or outdoor areas upon decommissioning.	RH 3.16.4.3.6	A/L	
Decommissioning Plan Contents – if proposing to use the criteria in RH 4.61.3 or RH 4.61.4 (restricted access), the plan must include analysis demonstrating that reductions in residual radioactivity necessary to comply with the provisions of RH 4.61.2 (unrestricted access) would result in net public or environmental harm or were not being made because residual levels of contamination associated with restricted conditions are ALARA, taking into account consideration of any detriments expected to potentially result from decontamination and waste disposal.	RH 3.16.4.3.7.1	A/L	The analysis will be part of any accelerated action or final action regulatory decision document for environmental media cleanup projects proposing restricted access. (see Appendix D)

RADIATION CONTROL			
Decommissioning Plan Contents – if proposing to use the criteria in RH 4.61.3 or RH 4.61.4 (restricted access), the plan must include a description of the institutional controls necessary to satisfy RH 4.61.3.2 (described below), including a description of how the controls will be enforced.	RH 3.16.4.3.7.2	A/L	The description will be required for any final action regulatory decision document for environmental media cleanup projects proposing restricted access. (See Section 5.1.3.2)
Decommissioning Plan Contents – if proposing to use the criteria in RH 4.61.3 or RH 4.61.4 (restricted access), the plan must include an analysis demonstrating that if institutional controls were no longer in effect, the dose criteria of RH 4.61.3.3 (described below) will be met.	RH 3.16.4.3.7.3	A/L	
Decommissioning Plan will be approved by CDPHE if information therein meets RH 3.16, and RH 4.61, decommissioning is completed as soon as practicable, and health and safety of the public is adequately protected.	RH 3.16.4.6	A/L	This section also specifies requirements for a long term care warranty under RH 3.9.5.10 that may be required if using the criteria in RH 4.61.3 or RH 4.61.4 (restricted access). The RFCA Parties agree that further analysis is required to determine whether long term care warranty requirements are relevant and appropriate to Rocky Flats. Planned implementation of Site approved procedures to meet DOE Order 5400.5, "Radiation Protection of the Public and the Environment" and the Site's IWCP process, which includes Lead Regulatory Agency involvement, will be described for proposed actions.

RADIATION CONTROL			
Site radiation survey to establish residual contamination levels and/or confirm absence of contamination. As appropriate, survey building/outdoor areas that contain residual radioactivity.	RH 3.16.6.2	A/L	Requirements for radiation surveys are met through the Sampling and Analysis Plans and the Integrated Monitoring Plan for Environmental Restoration.
Submittal of final survey report, units and other information – specifies, as appropriate, that gamma levels be reported at 1 meter from surface in *micro*rem/hr, removeable and fixed contamination in DPM/100 cm^2, and radioactive concentrations in pCi/L or per gram; identify instruments used and certify proper calibration/testing.	RH 3.16.6.3	A/L	Same as RH 3.16.6.2 above
Criteria for license termination based on CDPHE determination that (1) radioactive materials have been properly disposed; (2) licensee has demonstrated that regulatory requirements for termination have been met; (3) the licensee has established a long-term care warranty; if required; and (4) institutional controls have been implemented to limit public doses, if required.	RH 3.16.7	A/L	Although license termination is not relevant to Rocky Flats, CDPHE believes the substantive criteria in this regulation are relevant and appropriate to determining the end point for decommissioning at Rocky Flats. Subsection (1) is met through compliance with the "offsite rule", 40 CFR 300.440; and subsections (2) and (4) are addressed in RH 4.61.2 through .4 (discussed below). Subsection (3), which is grounded in RH 3.9.5.10, is discussed above under RH 3.16.4.6.
Additional cleanup can be required if, based on new or previously unknown information, CDPHE finds that criteria in RH 4.61 not met and residual radioactivity remaining at site could result in significant threat to public health and safety.	RH 3.16.8	L	This standard is generally consistent with the "imminent and substantial endangerment" standard under CERCLA. Present risk of future harm (e.g., a risk of cancer due to long-term exposure) can be an "imminent" threat.

RADIATION CONTROL			
Radiation Protection Program – To extent practicable, procedures and controls used shall be based on sound radiation protection principles to achieve public doses that are ALARA.	RH 4.5.2	A	Planned implementation of Site approved procedures to meet 10 CFR 835, "Occupational Radiation Protection", DOE Order 5400.5, "Radiation Protection of the Public and the Environment" and the Site's IWCP process, which includes Lead Regulatory Agency involvement, will be described for proposed actions.
Radiation Protection Program – Imposes constraint on air emissions of radioactive material to the environment. "Individual member of the public likely to receive the highest dose" will not be expected to receive a TEDE greater than 10 mrem/yr from air emissions. Requires exceedance reporting and corrective action to ensure against recurrence.	RH 4.5.4	A	**Listed only for completeness of this table. NESHAPS already identified as ARAR.** Radionuclide NESHAPS required monitoring established at site perimeter is used to determine potential for exposure to individual member of the public.
Dose limits for individual members of the public – TEDE from licensed operations less than 100 mrem/yr above background, exclusive of medical exposure and exposure from disposal by sanitary sewer. Dose rate in unrestricted areas less than 2 mrem/hr.	RH 4.14.1	A/L	Site approved procedures to meet DOE Order 5400.5, "Radiation Protection of the Public and the Environment" are based on the same dose rate limits.
Dose Limits for Individual Members of Public – Surveys of radiation levels in unrestricted areas and radioactive materials in effluents released to unrestricted areas shall be made to demonstrate compliance with the dose limits for individual members of the public in RH 4.14.	RH 4.15.1	A/L	Surveys are conducted pursuant to site approved procedures to meet DOE Order 5400.5, "Radiation Protection of the Public and the Environment". Radionuclide NESHAPS required monitoring established at site perimeter is used to determine potential for exposure to individual member of the public. Surface water is monitored in accordance with the Integrated Monitoring Plan and RFCA Attachment 5.

RADIATION CONTROL			
Dose Limits for Individual Members of Public – Provides the means to demonstrate compliance with RH 4.14: by measurement or calculation that dose does not exceed the annual limit or by demonstrating that annual average radioactive material concentration released in gaseous and liquid effluents at boundary of the unrestricted area does not exceed Appendix B, Table II, "Effluent Concentrations".	RH 4.15.2.1 and .2	L	Site approved procedures to meet DOE Order 5400.5, "Radiation Protection of the Public and the Environment" are based on the same dose rate limits. Radionuclide NESHAPS required monitoring established at site perimeter is used to determine potential for exposure to individual member of the public. Surface water is monitored in accordance with the Integrated Monitoring Plan and RFCA Attachment 5.
Surveys shall be made as necessary to evaluate radiation levels, concentrations of radioactive material and potential radiological hazards that could be present.	RH 4.17.1	A/L	Planned implementation of Site approved procedures to meet 10 CFR 835, "Occupational Radiation Protection", DOE Order 5400.5, "Radiation Protection of the Public and the Environment" and the Site's IWCP process, which includes Lead Regulatory Agency involvement, will be described for proposed actions. Requirements for radiation surveys are met through the Reconnaissance Level Characterization Survey Plans and Predemolition Survey Plans for facility decommissioning and through Sampling and Analysis Plans and the Integrated Monitoring Plan for Environmental Restoration.
Instruments and equipment used for qualitative radiation measurements must be calibrated at intervals NTE 12 months, unless otherwise noted by regulation.	RH 4.17.2	A	

RADIATION CONTROL			
Waste Disposal – Shall dispose only by transfer to authorized recipient, by release in effluents within the limits of subpart RH 4.14 (discussed above), or as authorized pursuant to (pertinent to RFETS) RH 4.34, "Method for Obtaining Approval of Proposed Disposal Procedures", or RH 4.35, "Disposal by Release into Sanitary Sewerage".	RH 4.33	A/L	Transfer to authorized recipient is met through compliance with the "offsite rule", 40 CFR 300.440. Proposals for onsite disposal of radioactive waste (if any) will be part of any accelerated action, or any final action regulatory decision document for environmental media cleanup projects proposing specific disposal methods. **RH Part 11, "Special Land Ownership Requirements" which addresses requirements if government ownership of RFETS is transferred to private ownership, and RH Part 14, "Licensing Requirements for Land Disposal of Low Level Radioactive Waste" will be reviewed for relevant and appropriate requirements for cleanup projects proposing specific disposal methods.**
Disposal by Release to Sanitary Sewer – Material must be "readily soluble" in water, monthly average concentrations below Appendix B, Table III, "Concentrations for Release to sanitary Sewerage". Total less than 1 curie/year.	RH 4.35	A	Site approved procedures to meet DOE Order 5400.5, "Radiation Protection of the Public and the Environment" are based on the same concentration limits. Required radionuclide monitoring for the discharge of the RFETS Sewage treatment Plant is established in the Rocky Flats NPDES Permit. Surface water is also monitored in accordance with the Integrated Monitoring Plan and RFCA Attachment 5.
Permissible levels of plutonium in uncontrolled areas – Soil concentration greater than 2 DPM per gram or per cm^2 presents sufficient hazard to the public health that requires use of special construction techniques.	RH 4.60	A/L	All of RFETS is a controlled area as defined in 10 CFR 20.1003 ("controlled area", outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason) and RH 1.4 ("uncontrolled area" means area, access to which is neither limited nor controlled by the licensee). These terms are also consistent with 10 CFR 835.2. DOE does not anticipate any construction in uncontrolled areas to decommission RFETS.

RADIATION CONTROL			
Radiological Criteria for License Termination (i.e., for Decommissioning) – Must calculate maximum TEDE to "average member of the critical group" within the first 1000 years <u>after</u> decommissioning. NOTE: Decommissioning criteria in section RH 4.61 do not apply to waste disposal cells.	RH 4.61.1.2	A/L	Although license termination is not relevant to Rocky Flats, CDPHE believes the substantive criteria in this regulation are relevant and appropriate standards for decommissioning Rocky Flats. **See the RSAL Regulatory Analysis for the RFCA Parties understandings regarding implementation of the "Decommissioning Rule".**
Radiological Criteria (for Decommissioning) – Determination of dose and residual activity levels which are ALARA, must take into account consideration of any detriments expected to potentially result from decontamination and waste disposal.	RH 4.61.1.3	A/L	The analysis will be part of any accelerated action for environmental media cleanup projects and any final action regulatory decision document.
Criteria for Unrestricted Use – Residual radioactivity above background has been reduced to levels that are ALARA and results in TEDE to average member of the critical group that does not exceed 25 mrem/yr., including groundwater sources of drinking water.	RH 4.61.2	A/L	The analysis will be part of any accelerated action for environmental media cleanup projects and any final action regulatory decision document.
Criteria for Restricted Use – Must demonstrate that further residual radioactivity reductions to meet Unrestricted Use: 1) would result in net public or environmental harm OR 2) are not being made because residual levels are ALARA.	RH 4.61.3.1	A/L	
Criteria for Restricted Use – 1) Provisions made for durable, legally enforceable institutional controls that provide reasonable assurance that TEDE to average member of the critical group will not exceed 25 mrem/yr. AND 2) If Institutional Controls were no longer in effect, TEDE above background is ALARA and would not exceed either: 100 mrem/yr. OR 500 mrem/yr., if demonstrated that further reductions are not technically achievable, would be prohibitively expensive or would result in net public or environmental harm.	RH 4.61.3.2 and .3	A/L	

RADIATION CONTROL			
Alternate (Decommissioning) Criteria – 1) Analysis provides assurance that public health and safety would continue to be protected and unlikely TEDE would be more than 100 mrem/yr. 2) Employment of restrictions on site use that minimize exposures at the site. 3) Doses are reduced to ALARA.	RH 4.61.4.1.1 through .3	A/L	
CLEAN AIR ACT (CAA) [42 USC 7401 et. seq.]			
COLORADO AIR QUALITY CONTROL COMMISSION (CAQCC) REGULATIONS • Emission Control Regulations for Particulates, Smokes, Carbon Monoxide, and Sulfur Oxides - Smoke and Opacity - Fugitive Particulate Emissions - Construction Activities - Storage and Handling of Material - Haul Roads - Haul Trucks • Air Pollutant Emission Notices (APEN), Construction Permits and Fees, Operating Permits, and Including the Prevention of Significant Deterioration - APEN Requirements			Air pollutant emissions from stationary sources shall not exceed 20% opacity (emissions from fuel-fired pumps, generators, and compressors, process vents/stacks, etc.). Every activity shall employ control measures and operating procedures that are technologically feasible and economically reasonable which reduce, prevent, and control fugitive particulate emissions (control plans, use of control equipment, watering, etc.). An APEN shall be filed with the CDPHE prior to construction, modification or alteration of, or allowing emissions of air pollutants from any activity. Certain activities are exempted from APEN requirements per specific exemptions listed in the regulation.

CLEAN AIR ACT (CAA) [42 USC 7401 et. seq.]			
- Construction Permits, Including Regulations for the Prevention of Significant Deterioration (PSD) - Construction Permits			Construction permits are not required for CERCLA activities, however, substantive requirements that would normally be associated with construction permits will apply. Also, fuel-fired equipment (generators, compressors, etc.) associated with these activities may require permitting.
- Prevention of Significant Deterioration Requirements • Control of Hazardous Air Pollutants - Part A, Subpart A, General Provisions (CAQCC regulation incorporates CFR by reference)			Even though CERCLA activities are exempt from construction permit requirements, PSD requirements may apply if emissions of certain pollutants exceed certain threshold limits. The requirements include strict emission control requirements, source impact modeling, and pre-construction and post-construction monitoring. This subpart details the general provisions that apply to sources subject to National Emission Standards for Hazardous Air Pollutants (NESHAPs). The provisions will apply to any D&D project that is subject to a NESHAP.

CLEAN AIR ACT (CAA) [42 USC 7401 et. seq.]			
NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS • National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities - Standard	40 CFR 61, Subpart H 61.92	C, L	This section establishes a radionuclide emission standard equal to those emissions that yield an effective dose equivalent (EDE) of 10 mrem/year to any member of the public. The Site complies by using stack effluent discharge data and empirically estimated fugitive emissions in the dose model CAP88-PC for calculating the EDE to the most impacted member of the public to ensure that it does nor exceed 10 mrem/year. Also, the perimeter samplers in the Radioactive Ambient Air Monitoring Program sampler network are utilized to verify compliance with the standard.
- Emission Monitoring and Test Procedures	61.93	C, A	This section establishes emission monitoring and testing protocols required to measure radionuclide emissions and calculate EDEs. This section also requires that radionuclide emissions measurements (stack monitoring) be made at all release points which have a potential to discharge radionuclides into the air which could cause an EDE to the most impacted member of the public in excess of 1% of the standard (0.1 millirem/year).
– Compliance and Reporting	61.96	C, L	This section requires the Site to perform radionuclide air emission assessments of all new and modified sources. For sources that exceed the 0.1 mrem/year EDE threshold (controlled), the appropriate applications for approval must be submitted to the EPA and the CDPHE. Additional substantive requirements may apply if the activity requires approval.

FEDERAL WATER POLLUTION CONTROL ACT (aka Clean Water Act (CWA)) [33 USC 1251 et. seq.]			
COLORADO BASIC STANDARDS AND METHODOLOGIES FOR SURFACE WATER	5 CCR 1002-31	C	Refer to RFCA Attachment 5 for surface water action levels and standards.
DOE COMPLIANCE WITH FLOODPLAIN/WETLANDS ENVIRONMENTAL REVIEW REQUIREMENTS • Floodplain/Wetlands Determination • Floodplain/Wetlands Assessment • Applicant Responsibilities	10 CFR 1022 .11 .12 .13	A/L	

NATURAL RESOURCE AND WILDLIFE PROTECTION LAWS			
ENDANGERED SPECIES ACT (ESA [16 USC 1531 et seq.]			
EARLY CONSULTATION	50 CFR 402.11	A/L	Identify and minimize early in the planning stage of an action, any potential conflicts between the action and federally listed species.
BIOLOGICAL ASSESSMENT • Purpose • Preparation Requirements • Request for Information • Director's Response - No Listed Species or Critical Habitat Present - Listed Species or Critical Habitat Present • Verification of Current Accuracy of Species List • Contents • Identical/Similar to Previous Action • Permit Requirements • Completion Time • Submission of Biological Assessment • Use of Biological Assessment	50 CFR 402.12	A/L	This is the process DOE needs to follow to evaluate the potential effects of the action on listed and proposed species and designated and proposed critical habitat and determine whether any such species or habitat are likely to be adversely affected by the action and is used in determining whether formal consultation or a conference is necessary.
INTERAGENCY COOPERATION • Informal Consultation • Formal Consultation	50 CFR 402 .13 .14	A/L	This is an optional process that includes all discussions, correspondence, etc. between the USFWS and the DOE. It is designed to assist in determining whether formal consultation or a conference is required. If during this step it is determined by the DOE with the written concurrence of the USFWS that the action is not likely to adversely affect listed species or critical habitat, the consultation process is terminated and no further action is necessary. DOE shall review its actions at the earliest possible time to determine whether any action may affect listed species or critical habitat.

MIGRATORY BIRD TREATY [16 USC 701-715]			
TAKING, POSSESSION, TRANSPORTATION, SALE, PURCHASE, BARTER, EXPORTATION, AND IMPORTATION OF WILDLIFE AND PLANTS	50 CFR 10	A/L	Principally focuses on the taking and possession of birds protected under this regulation. Enforcement is predicated on location of the project and time of the year. Current list of protected birds is kept with the Ecology group. Prevent or minimize contact with listed birds and nests. Consult with the responsible RFETS ecologist.
NATURAL RESOURCE AND WILDLIFE PROTECTION LAWS			
COLORADO NONGAME, ENDANGERED, OR THREATENED SPECIES CONSERVATION ACT [CRS 33-1-115, 33-2-101 to 33-2-107]			
• Compliance with the Colorado Nongame Wildlife including Endangered Species	CRS 33-2-104 CRS 33-2-105	A/L	It is unlawful for any person to take, possess, transport, export, process, sell or offer for sale, or ship and for any common contract carrier to knowingly transport or receive for shipment any species or subspecies of wildlife appearing on the list of wildlife indigenous to the State of Colorado determined to be endangered within the state. (The list is continually updated by the Ecology group)

NATURAL RESOURCE AND WILDLIFE PROTECTION LAWS			
NATIONAL HISTORIC PRESERVATION ACT (NHPA [16 USC 470 et. seq.]			
IDENTIFYING HISTORIC PROPERTIES • Assessing Information Needs • Locating Historic Properties • Evaluating Historical Significance • When No Historic Properties Are Found • Historic Property Found	36 CFR 800.4	L	Obligations are met through the Programmatic Agreement among the DOE, Colorado State Historic Preservation Officer and the Advisory Council on Historic Preservation regarding Historic Properties at RFETS, July 17, 1997.
ASSESSING EFFECTS OF THE ACTIVITY ON THE PROPERTY	36 CFR 800.5	L	
DOCUMENTATION REQUIREMENTS	36 CFR 800.8	L	
CRITERIA OF EFFECT AND ADVERSE EFFECT	36 CFR 800.9	L	
PROTECTING NATIONAL HISTORIC LANDMARKS	36 CFR 800.10	L	
HISTORIC PROPERTIES DISCOVERED DURING IMPLEMENTATION	36 CFR 800.11	L	
EMERGENCY UNDERTAKINGS	36 CFR 800.12	L	
PRESERVATION OF AMERICAN ANTIQUITIES	43 CFR 3	L	

NATIONAL RESOURCE AND WILDLIFE PROTECTION LAWS			
ARCHEOLOGICAL RESOURCES PROTECTION [16 USC 470, CHAPTER 1B]			
PROTECTION OF ARCHEOLOGICAL RESOURCES: UNIFORM REGULATIONS • Purpose • Authority • Definitions • Prohibited Acts • Permit Requirements and Exceptions • Application for Permits and Information Collection • Notification to Indian Tribes of Possible Harm to, or Destruction of, Sites on Public Lands Having Religious or Cultural Importance • Relationship to Section 106 of the National Historic Preservation Act • Custody of Archeological Resources • Determination of Archeological or Commercial Value and Cost of Restoration and Repair • Assessment of Civil Penalties • Civil Penalty Amounts • Other Penalties and Rewards • Confidentiality of Archeological Resource Information • Report36 CFR 296	36 CFR 296 .1 .2 .3 .4 .5 .6 .7 .12 .13 .14 .15 .16 .17 .18 .19	L	
NATURAL RESOURCE AND WILDLIFE PROTECTION LAWS			
ARCHEOLOGICAL AND HISTORICAL PRESERVATION ACT (AHPA) [16 USC 469a-1]			
Notification and Request for Preservation of Data Survey of Sites; Preservation of Data; Compensation	16 USC 469a-1(a) 16 USC 469a-1(b)	L	Differs from NHPA in that it encompasses a broader scope of resources than those listed on the National Register and requires only preservation of the data (including analysis and publication).

Appendix I – IHSS Group 900-11 Area IM/IRA

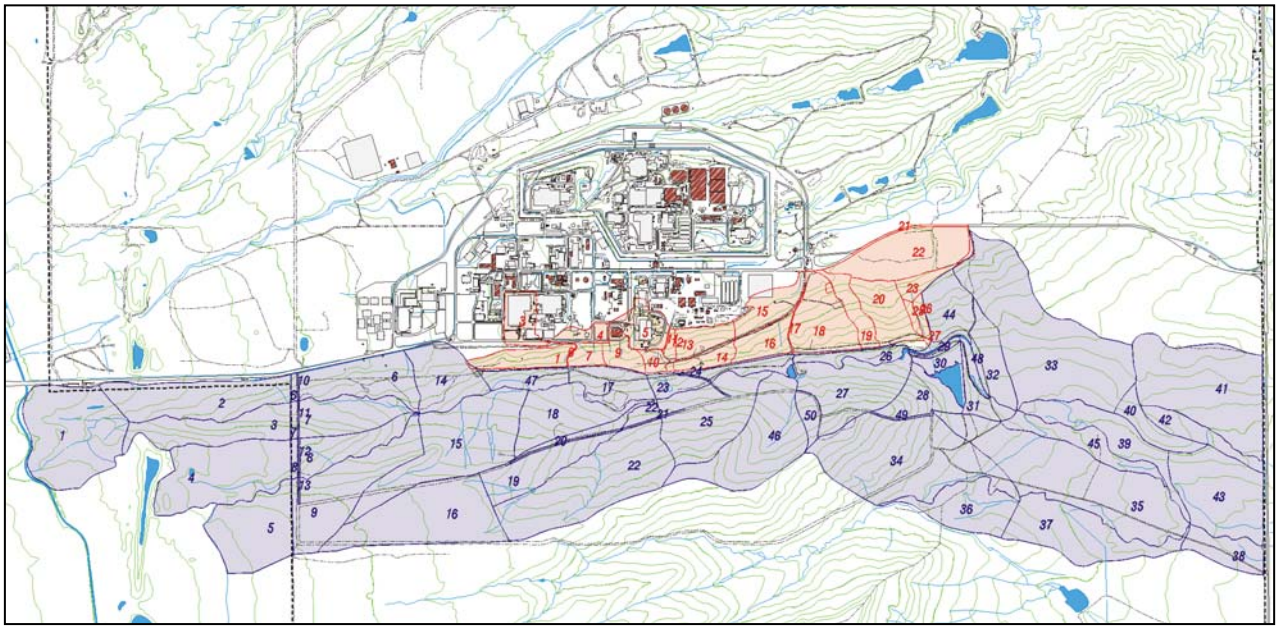
Surface Water Modeling – Summary of Results

1.0 INTRODUCTION

To assess the potential impact on surface water quality caused by hypothetical storm events, including extreme conditions, computer model simulations were developed to predict plutonium-239/240 (Pu) and americium-241 (Am) transport by surface water erosion and sediment transport processes. The transport of soil by erosion and overland flow is modeled using the Watershed Erosion Prediction Project (WEPP) model (Flanagan and Livingston, 1995). The transport of sediments by surface water within Site drainage channels is estimated with the Sedimentation in Stream Networks (HEC-6T) model (Thomas, 1999). WEPP model output for hillslope erosion is routed into the HEC-6T model for channel sediment transport. The WEPP and HEC-6T models are used, along with surface soil actinide data, as input to a spreadsheet to calculate surface-water Pu and Am concentrations. The models are run for a range of storm events, ranging from commonly occurring storms to large floods. Detail on the models and their calibration methodology is provided in the *Report on Soil Erosion and Surface Water Sediment Transport Modeling for the Actinide Migration Evaluation at the Rocky Flats Environmental Technology Site* (K-H, 2000).

Model simulations were based on a scenario in which areas are remediated that have a Pu soil concentration above the 50 pCi/g Soil Action Level. This scenario was used to be consistent with the proposed remediation of Lip Area soils as required by RFCA (see description of Alternative 2 in the main report, Section 4). Therefore, the model simulations represent an analysis of the hypothetical impact on water quality caused by the residual Pu that will remain in the surface soil after areas with greater than 50 pCi/g have been remediated. In addition, the model is based on buildings and pavement within the model boundaries being removed, and the area regraded in accordance with Industrial Area grading plans, in order to reflect the post-closure hydrology of the Site. Model results were used to assess the characteristics of Pu and Am loading to surface water throughout the South Interceptor Ditch and Woman Creek watersheds. Hillslope areas delineated in the model are displayed in Figure 1.

Figure 1. Woman Creek Watershed Study Area and Model Hillslopes



2.0 STORM EVENTS MODELED

Model simulations were performed for a range of 28 storm events of varying magnitude. The events modeled ranged from 19.9 mm [0.78 in] up to 159.8 mm [6.29 in], with return frequencies of approximately 1-year and more than 1,000-years, respectively. Events modeled include synthetic storm events derived from the CLIGEN database for the Fort Collins precipitation record. In addition, single storms were modeled (2-year, 10-year, and 100-year events) that were derived from the Colorado Urban Hydrograph Procedure (CUHP) and presented in the Rocky Flats Drainage and Flood Control Master Plan (EG&G 1992).

These events modeled are summarized in Table 1.

Table 1. Model Storm Events

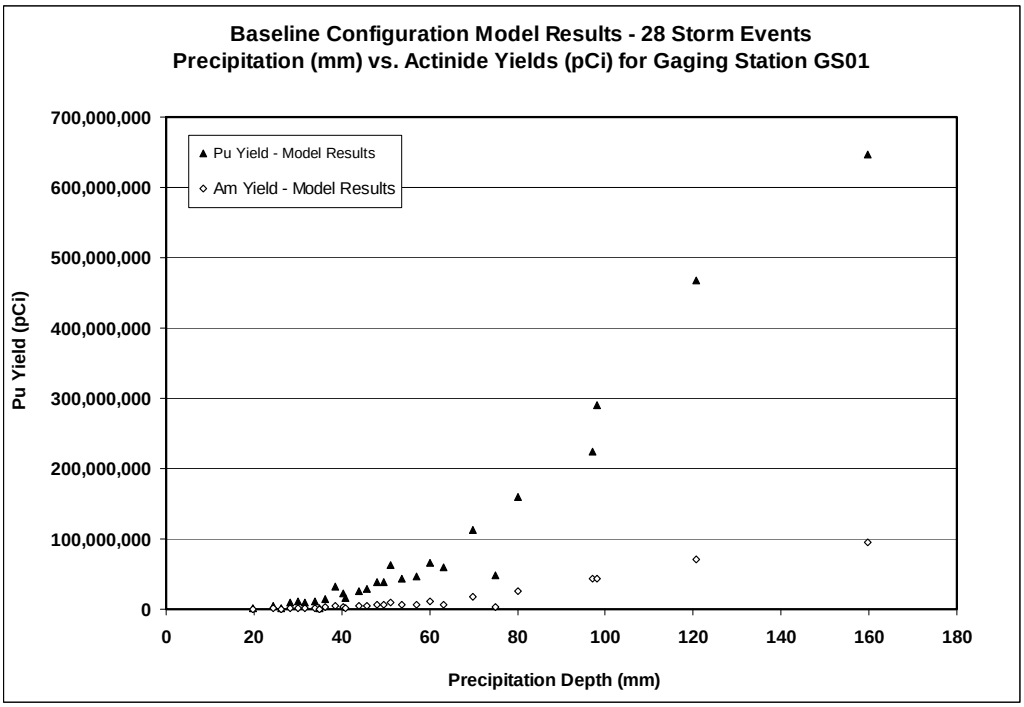
Stom Depth (mm)	Storm Depth (in)	Duration (Hours)	Return Frequency (years)	Reference/ Remarks
19.9	0.78	1.36	-	CLIGEN database (Ft. Collins)
24.5	0.96	7.61	-	CLIGEN database (Ft. Collins)
26.3	1.04	1.88	-	CLIGEN database (Ft. Collins)
28.3	1.11	3.02	-	CLIGEN database (Ft. Collins)
30.1	1.19	4.6	-	CLIGEN database (Ft. Collins)
31.5	1.24	2	2	2-yr, 2-hr storm (from Drainage and Flood Control Master Plan)
34.0	1.34	2.86	-	CLIGEN database (Ft. Collins)
35.0	1.38	11.5	1	Similar distribution, but smaller magnitude than May 17, 1995 event
36.2	1.43	3.18	-	CLIGEN database (Ft. Collins)
38.5	1.52	1.46	-	CLIGEN database (Ft. Collins)
40.4	1.59	2.4	-	CLIGEN database (Ft. Collins)
40.8	1.61	6	2	2-yr, 6-hr storm (from Drainage and Flood Control Master Plan)
43.8	1.72	2.71	-	CLIGEN database (Ft. Collins)
45.7	1.80	4.98	-	CLIGEN database (Ft. Collins)
48.1	1.89	2.37	-	CLIGEN database (Ft. Collins)
49.5	1.95	5.14	-	CLIGEN database (Ft. Collins)
51.1	2.01	1.9	-	CLIGEN database (Ft. Collins)
53.6	2.11	7.08	-	CLIGEN database (Ft. Collins)
57.1	2.25	2.29	-	CLIGEN database (Ft. Collins)
60.2	2.37	2.38	-	CLIGEN database (Ft. Collins)
62.3	2.45	6	10	10-yr, 6-hr storm (from Drainage and Flood Control Master Plan)
69.8	2.75	3.95	-	CLIGEN database (Ft. Collins)
74.9	2.95	11.5	11	Rainfall distribution from May 17, 1995 event
80.1	3.15	7.48	-	CLIGEN database (Ft. Collins)
97.1	3.82	6	100	100-yr, 6-hr storm (from Drainage and Flood Control Master Plan)
98.0	3.86	5.3	-	CLIGEN database (Ft. Collins)
120.7	4.75	5.5	500*	CLIGEN database (Ft. Collins)
159.8	6.29	8.72	1,000+*	CLIGEN database (Ft. Collins)

"-" symbol denotes return frequency not estimated for a specifif storm event.
*Estimated from precipitation versus storm frequency curves, Zero-Offsite Discharge Study (ASI, 1990)

3.0 SUMMARY OF MODEL RESULTS AND INTERPRETATION

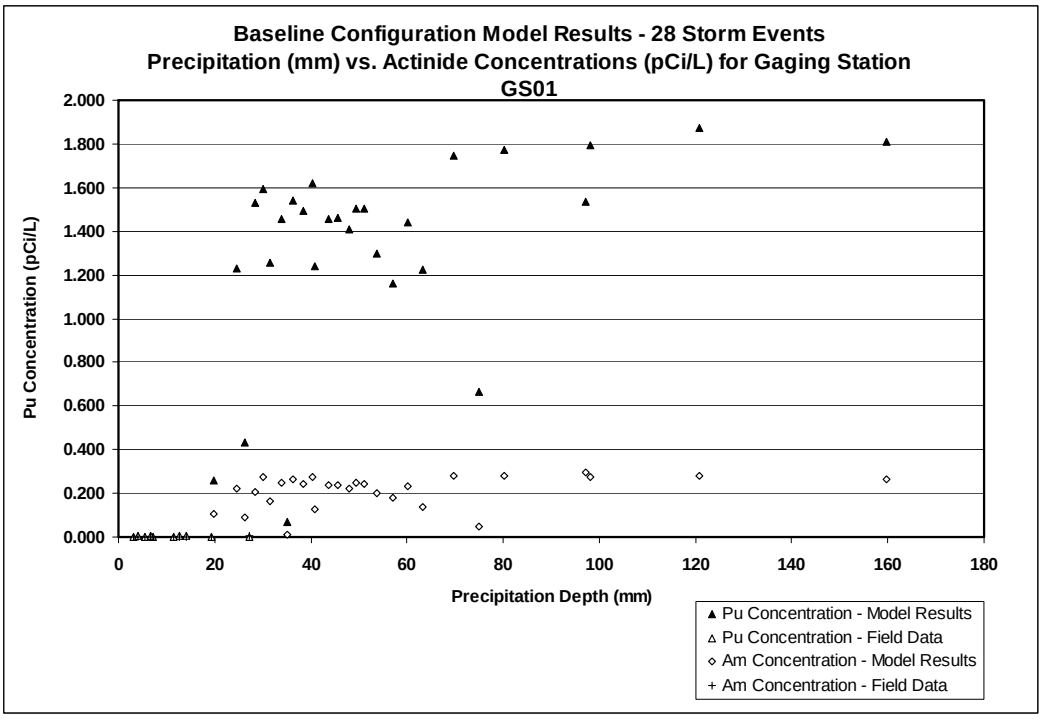
Model-predicted loads of Pu and Am at station GS01, on Woman Creek at the Site boundary on Indiana Street, are displayed in Figure 2 for the range of storms modeled. Model-predicted concentrations of Pu and Am at GS01, for the same range of storms, are presented in Figure 3, along with field measured results for comparison.

Figure 2. Model-Predicted Pu and Am Loads at Station GS01 – Baseline Closure Configuration



As displayed in Figure 2, the model predicts that larger storms cause more erosion and correspondingly larger loads of Pu and Am, as expected. However, the comparatively larger loads associated with the 120.7 mm (4.75 in) storm in the GS01 basin are largely a function of the larger water volume, and do not necessarily correspond to equally large increases in actinide concentrations compared to the smaller storms. For example, the model-predicted Pu and Am concentrations for the 120.7 mm (4.75 in) and 31.5 mm (1.24 in) events are similar (see Figure 3).

Figure 3. Pu and Am Concentrations at Station GS01 – Model-Predicted and Measured Field Data



When interpreting the model predictions in Figure 3, it is important to set in perspective the understanding that the median Pu concentration measured at GS01, from Water Year 1997 through 2002, is approximately 0.002 pCi/L (K-H, 2003). The maximum result observed at GS01 for the same period is 0.024 pCi/L (K-H, 2003). The RFCA standard for Pu or Am is 0.15 pCi/L (DOE, 2003).

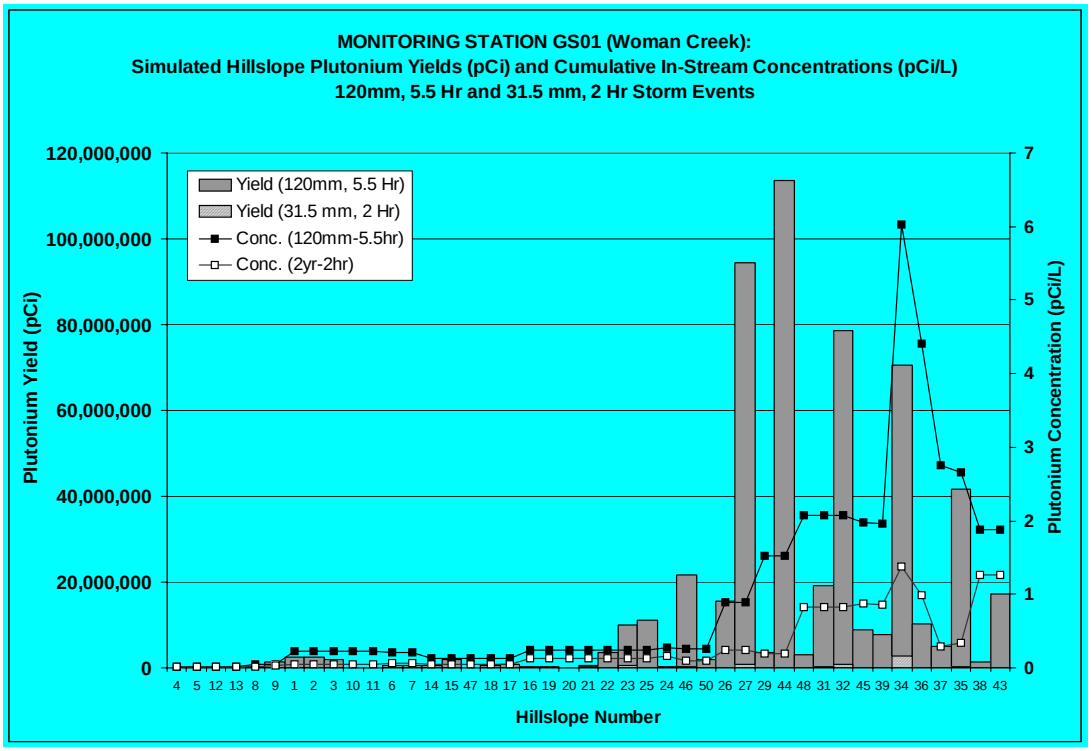
The data for the vast majority of field measurements for isolated storms (lower left corner of Figure 3) have been collected for smaller events (i.e., less that 30 mm) that generate relatively small actinide loads in surface water. The model is difficult to calibrate to accurately simulate erosion and runoff processes from large extreme storm events when the only observational data available are from smaller more frequent storms. The large-storm calibration inputs have been derived from rain simulator results for a 100-year storm event (K-H, 2000). For smaller storms observational data are readily available for calibration purposes. As a general note, however, it

is more reliable to simply infer small-storm behavior from measured data (where practicable), versus using model simulations.

Because of the inherent uncertainties in the model simulations, measured data from the field are assigned a higher degree of confidence than data from model simulations. The model is best used to infer the general behavior of the system due to precipitation conditions, or land configurations, that have not been observed at RFETS during its history. Conversely, because of the model uncertainty, the model is *not* well suited for predicting the actual actinide concentrations in surface water that will result from a given storm event or land configuration. For the purposes of this discussion, model results are best used to characterize trends and associated conditions that lead to them, such as determining which watershed areas contribute the largest relative loads of actinides to surface water.

Keeping this use in mind, two storms (the 31.5 mm [1.24 in], 2-hour event and 120.7 mm [4.75 in], 5.5-hour event) were selected for further analysis to assess Pu loading, over a range of conditions, from hillslopes in the Woman Creek watershed. Figure 4 provides a loading analysis of the two storms, by hillslope, for the Woman Creek watershed. The vertical bars represent model-predicted loads contributed by specific hillslopes for specific storms. The gray bars are for the larger storm (120 mm [4.75 in]), and the white bars with diagonal markings (much shorter and barely visible) represent loads for the smaller storm (31.5 mm [1.24 in]). As indicated by the figure, the predicted loads are much larger from each hillslope for the larger storm.

Figure 4. Woman Creek Station GS01 – Model-Predicted Pu Loads and Concentration in Drainage, by Hillslope, for 120 mm and 31.5 mm Storm Events

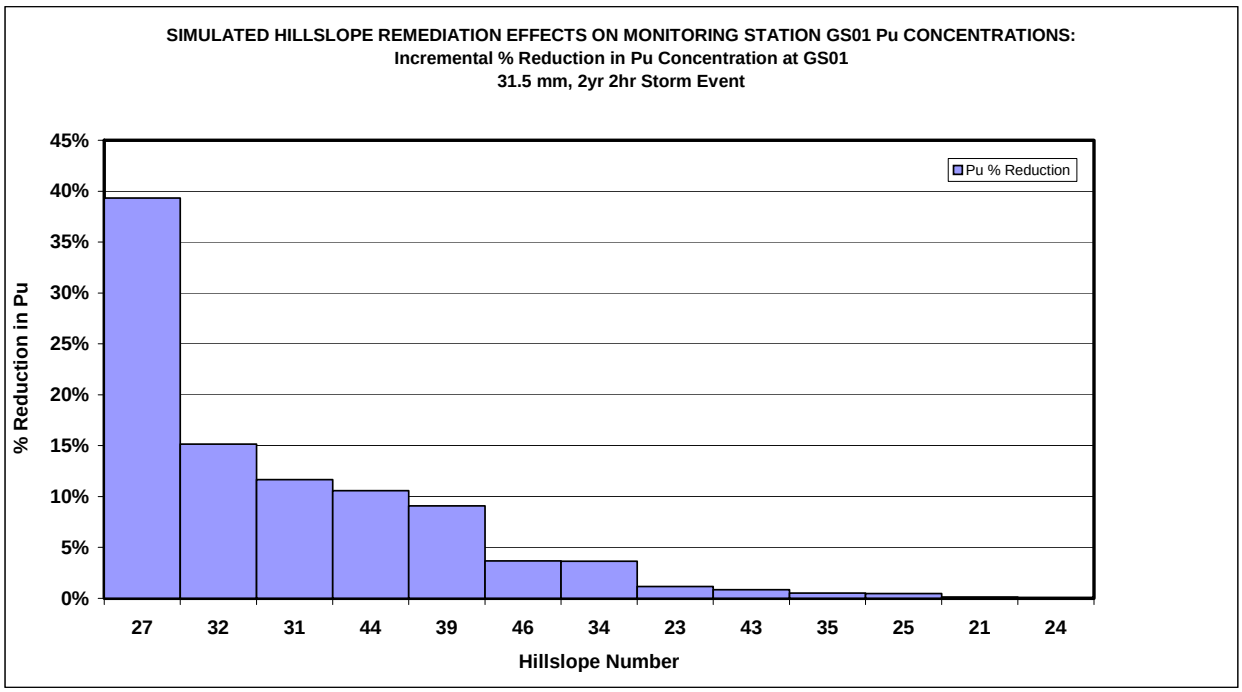


As an illustration of how these results can be important to our understanding of the watershed system, Figure 4 shows that Woman Creek hillslopes 44, 27, 32, 34, and 35 contribute the largest loads during the larger storm (120.7 mm [4.75 in]),. For the smaller event (31.5 mm [1.24 in]), hillslopes 44 and 35 yield disproportionately less runoff, and less erosion, and therefore deliver smaller relative Pu loads to surface water compared to the larger storm. This illustrates the varying degree of load contributed from different hillslopes, depending on the magnitude of the storm event and the characteristics of the hillslope (slope, soils, vegetative cover, etc.).

To assess the impact of remediating individual hillslopes (or diverting runoff from an individual hillslope into a holding basin), model results are displayed in Figure 5 in terms of the percent contribution to concentration, from each hillslope, predicted for GS01. The model results

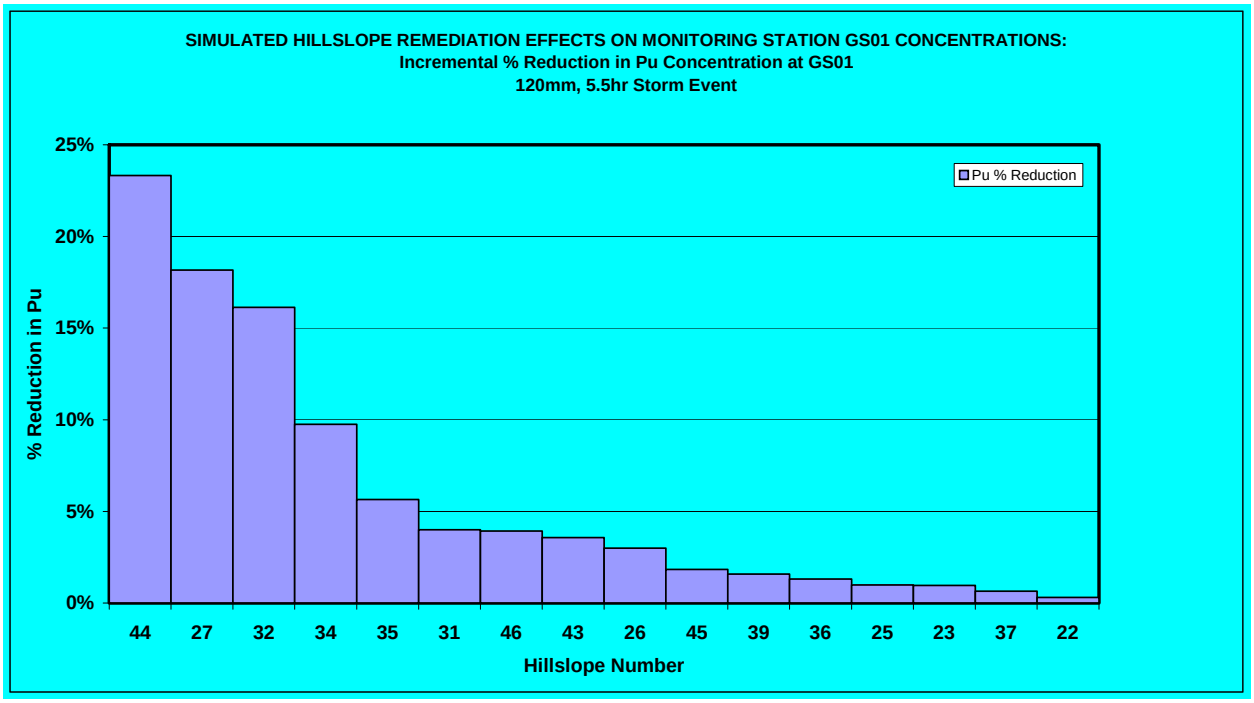
displayed in Figure 5 are for the 31.5 mm (1.24 in) event. For point of reference, it must be noted that the model-predicted concentration for this relatively small storm is more than an order of magnitude higher than concentrations historically observed for storms of the same magnitude and duration. Figure 5 shows that the model simulation predicts Hillslope 27 (located west of Pond C-2 and south of Woman Creek) to be the greatest contributor to the Pu concentration observed at GS01 for the small storm.

Figure 5. Woman Creek at Station GS01 – Model Analysis of Hillslope Contribution to Pu Concentration – 31.5 mm Storm Event (2-Year, 2-Hour Storm)



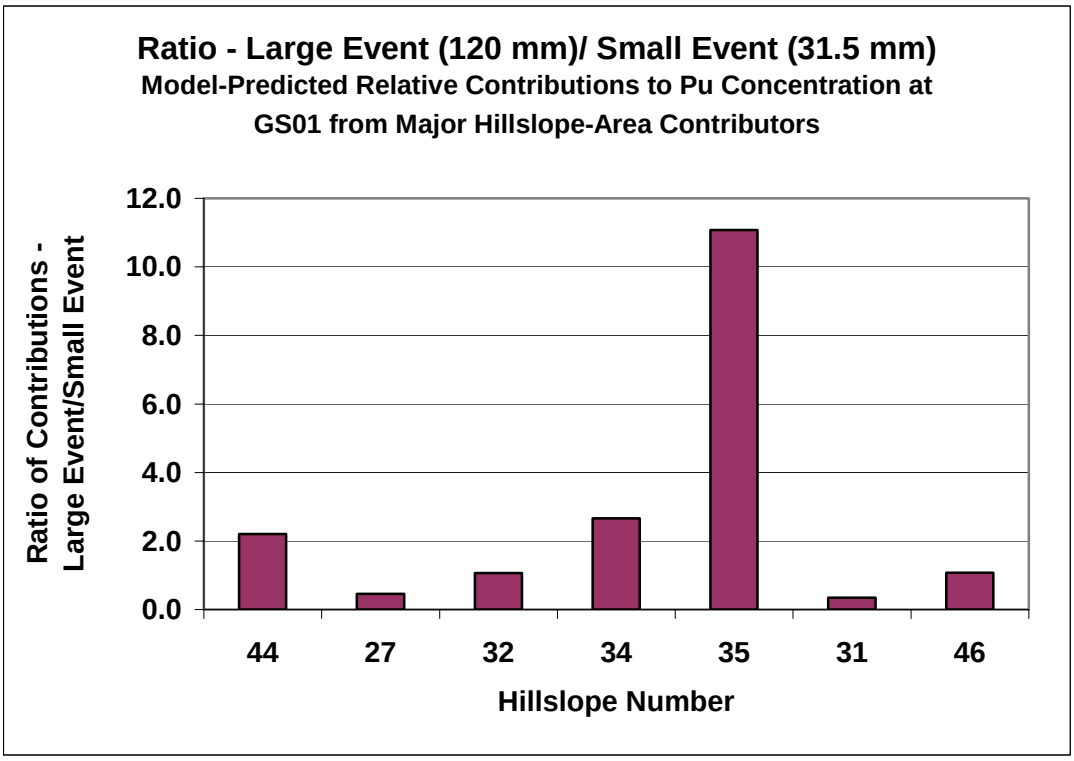
For a relatively larger storm event (120.7 mm [4.74 in], ~ 500-year return frequency), representing a magnitude not measured at RFETS, Figure 6 presents a similar plot to that resulting from the smaller storm. The large-storm model simulation indicates that the largest contribution to Pu concentration at GS01 will come from Hillslope 44 (located north of Pond C-2).

Figure 6. Woman Creek at Station GS01 – Model Analysis of Hillslope Contribution to Pu Concentration – 120.7 mm Storm Event (~500 year storm)



It is possible to compare the results illustrated in Figure 5 and Figure 6 in a somewhat different manner. This comparison, illustrated in Figure 7, shows the ratio of relative contributions to concentration at GS01 from the larger and smaller storm events. This comparison shows that only hillslope 35 provides a notably increased relative contribution under large storm event conditions. However, this hillslope is not a major contributor to concentration at GS01 in either case, as shown in Figure 5 and Figure 6. The same is true of hillslope 34, though it does contribute somewhat more to the large storm events than hillslope 35.

Figure 7. Ratio of Large Event (120 mm): Small Event (31.5 mm), Percent Contribution to Pu Concentration Predicted at GS01



In summary, when analyzing the model-predicted relative contributions of all the hillslopes for large and small events (Figure 5 and Figure 6), and recognizing the importance of increasing influence for larger storms, hillslope 44 stands out. It is predicted to be the biggest contributor for the large storm, and is predicted to increase its percent contribution more than twofold from the small storm to the large event (Figure 7).

References

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