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October 27, 2011

US Army Corps of Engineers, Omaha District
Attn: Kirk Engelbart (CENWO-PM-HA)
1616 Capitol Avenue
Omaha, Nebraska 68102-4901

Subject: Contract W912DR-09-D-0019
Record of Decision
Former Sundance Air Force Station, Wyoming, PM-1 Reactor Site

Dear Mr. Engelbart:

Enclosed please find one copy of the signed Record of Decision for the Former Sundance Air Force Station, PM-1 Reactor Site Off-Site Release, Sundance, Wyoming. A separate CD of the working electronic files of the document is also enclosed. The document is being distributed as noted below. A pdf of the document is included on a CD on the last page of each hard copy.

Sincerely,

AECOM Technical Services, Inc.

Cathy Larson
Project Manager

cc: Mr. Tim Pavek, USAF, Ellsworth Air Force Base (4 copies and one CD with working electronic files)
Dr. Steven Rademacher, Air Force Safety Center (1 copy)
Ms. Pat Smith, USEPA Region 8 (1 Copy)
Mr. Don Fischer, WYDEQ (1 Copy)
Ms. Melissa Markell, AFCEE (pdf)

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Record of Decision

FORMER SUNDANCE AIR FORCE STATION, PM-1 REACTOR SITE
OFF-SITE RELEASE
SUNDANCE, WYOMING

ELLSWORTH AIR FORCE BASE, SOUTH DAKOTA

Prepared By

United States Air Force

September 2011

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Acronyms

AF	Air Force
ALARA	As Low As Reasonably Achievable
amsl	above mean sea level
CEM	conceptual exposure model
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CSM	conceptual site model
C/ROPCs	chemicals/radionuclides of potential concem
^{137}Cs	cesium-137
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
EAFB	Ellsworth Air Force Base
EPC	exposure point concentration
EU	exposure unit
FUDS	Formerly Used Defense Sites
GATR	Ground to Air Transmitter Receiver
HRA	health risk assessment
ISOCs	in-situ object counting system
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
NCP	National Contingency Plan
NFRAP	No Further Response Action Plamed
NPL	National Priority List
NRC	Nuclear Regulatory Commission
PA/SI	Preliminary Assessment/Site Inspection
pCi/g	picoCuries per gram
PM-1	Portable Medium Power Range Nuclear Power Plant, Number 1
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROC	radionuclide of concem
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SF	slope factor
^{90}Sr	strontium-90
UCL	upper confidence level
USAGE	United States Army Corps of Engineers
USAF	United States Air Force

USEPA	United States Envirormental Protection Agency
USPS	United States Forest Service
VOCs	volatile orgarric compounds
WDEQ	Wyoming Department of Environmental Quality

1.0 Declaration

1.1 Site Name and Location

Facility Name: Former Sundance Air Force Station, PM-1 Reactor Site

Site Location: Sundance, Wyoming
(Geographically Separate Unit: Ellsworth Air Force Base (EAFB), Rapid City, South Dakota)

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) ID Number: WY0009177588

Operable Unit/Site: Off-Site Release

1.2 Statement of Basis and Purpose

This decision document presents the Selected Remedy for the Former Sundance Air Force Station, PM-1 Reactor Site Off-Site Release in Sundance, Wyoming, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for this site.

This document is issued by the Department of the Air Force (AF), as the lead agency. The AF is managing contamination at the Off-Site Release in accordance with CERCLA as required by the Defense Environmental Restoration Program (DERP).

As the lead agency, the AF has selected the remedy. The U.S. Enviromental Protection Agency (USEPA) and the Wyoming Department of Environmental Quality (WDEQ) concur with the Selected Remedy.

1.3 Description of Selected Remedy

The AF has determined that no unacceptable risk or threat to public health or the environment exists from the Former Sundance Air Force Station, PM-1 Reactor Site Off-Site Release. No action is necessary to protect public health or welfare or the environment.

1.4 Statutory Determinations

No remedial action is necessary to ensure protection of human health and the enviroment.

Because this remedy will not result in hazardous substances, pollutants, or contaminants remaining from the off-site release above levels that allow for unlimited use and unrestricted exposure, a five-year review will not be required for this remedial action.

1.5 Authorizing Signatures

This signature sheet documents the United States Air Force approval of the remedy selected in this Record of Decision for the Former Sundance Air Force Station, PM-1 Reactor Site, Off-Site Release, Sundance, Wyoming.

27 SEP 11

MARK E. WEATHERINGTON
Colonel, United States Air Force
Commander, 28th Bomb Wing

Date

2.0 Decision Summary

The Decision Summary identifies the Selected Remedy, explains how the remedy fulfills statutory and regulatory requirements, and provides a substantive summary of the Administrative Record file that supports the remedy selection decision.

2.1 Site Name, Location, and Description

The area addressed in this Record of Decision (ROD) is the Former Sundance Air Force Station, PM-1 Reactor Site Off-Site Release (Off-Site Release). The site is listed on the CERCLIS list under identificafion number WY0009177588.

The Off-Site Release is located approximately 7 miles northwest of Sundance, Wyoming, within the Bear Lodge Mountains, as shown on Figure 2-1. The Off-Site Release is located adjacent to the Former Sundance Air Force Station, PM-1 Reactor Site, in Sundance, Wyoming. Both sites are shown on Figure 2-2. This ROD does not address residual radioactive materials within the PM-1 Reactor Site.

The Former Sundance Air Force Station included the Portable Medium Power Range Nuclear Power Plant, Number 1 (PM-1 Reactor). The Off-Site Release is due to a release of radioactive materials from PM-1 Reactor operations. The release was confirmed in 2000 during the Preliminary Assessment/Site Inspection (PA/SI) (USAF 2006). This study indicated the presence of elevated cesium-137 (^{137}Cs) concentrations along the drainage ditch adjacent to the United States Forest Service (USPS) Road 838. A Remedial Investigation (RI) Report (USAF 2007) was completed for the Off-Site Release and showed that elevated ^{137}Cs concentrations were restricted to three study areas within the Off-Site Release area as shown in Figure 2-2. An exposure unit (EU) of 21 acres was established during the human health risk assessment (HRA) which was conducted during the RI. The EU boundaries are those of the Off-Site Release (Figure 2-2).

As the lead agency, the USAF has conducted investigation activities at the Off-Site Release in accordance with CERCLA under the Defense Environmental Restoration Program (DERP) which was established by Section 211 of the Superfund Amendments and Reauthorization Act (SARA) of 1986.

As the support agencies, the USEPA Region 8 and WDEQ were provided opportunity to review and comment on substantive activities conducted during the investigations. No formal agreement was established between the USAF and the support agencies.

Funding for remedial activities is provided by the Defense Environmental Restoration Account; a funding source approved by Congress to clean up contaminated sites on U.S. Department of Defense (DoD) installations.

2.1.1 Adjacent Land Use

The Off-Site Release is located entirely on property owned by the USPS and is used for open grazing of cattle and, to a lesser extent, recreational purposes. The private property adjoining a small portion of the site opposite the Off-Site Release is also used for cattle grazing.

The adjacent PM-1 Reactor Site has been retained by the USAF due to the presence of entombed reactor components. This 3.8-acre area is now a geographically separate unit of EAFB, Rapid City, South Dakota and is shown on Figure 2-3. This ROD does not address residual radioactive materials within the PM-1 Reactor Site. Annual monitoring of the PM-1 Reactor Site will continue for at least 75 years from decommissioning (until at least 2044) in accordance with a Public Notice of Contaminafion filed with Crook County (USAF 1969).

The Warren Peaks area has historically been explored for potential mining opportunities, but there are no active mines identified near the Off-Site Release. Mineral exploration is presently occurring in the Warren Peaks area outside of a ½ mile protective radius of the PM-1 Reactor Site. A restrictive easement preventing blasting activities near the PM-1 Reactor Site is in place on surrounding properties to assure the integrity of the waste entombments at the PM-1 Reactor Site (USAF 1969). These restrictions will be in place until 2044, or that date when the buried radioactive materials are projected to be below the maximum allowable levels for unrestricted access estimated at the time of closure. Therefore, development of fiiture mining operations is restricted.

2.1.2 Near-By Populations

Warren Peak is located in Crook County, which is primarily undeveloped and has a population density of 2.1 persons per square mile (US Census, 2009). During the PA/SI, no residences were located within a 4 mile radius of the Off-Site Release. The site is located on a mountain top and is not conducive to building a permanent residence. Further, there is no access to the area in the winter since the only road to the site (USPS Road 838) is not plowed for snow removal and is administratively closed to wheeled vehicles during the winter months.

The nearest community is Vista West. Vista West is the former USAF housing for the Air Force Station, which been tumed over to private interests and is located slightly over 4 miles from the Off-Site Release. Based on aerial photographs, Vista West is comprised of approximately 30 permanent residences and 10 mobile homes.

The closest city is Sundance, Wyoming, which is located approximately 7 miles south southeast of the Off-Site Release. Sundance had a population of 1,161 in the 2000 US census (US Census 2009).

2.1.3 General Surface and Groundwater Resources

The region is drained by the Belle Fourche River and its principle tributaries: Inyan Kara, Miller, and Houston Creeks. The Belle Fourche River is a relatively large, perennial stream; the creeks in the area are mostly dry except during the spring and early summer (USAF 2006).

Most of the groundwater moving out of Crook County is in the form of underflow through artesian aquifers. Groundwater flows eastward into South Dakota, northward into Montana, and some westward into the Powder River Basin. The groundwater in Crook County occurs under both unconfined (water table) and confined (artesian) conditions (USAF, 2006).

Groundwater flow in the Bear Lodge Mountains occurs in shallow aquifers consisting of weathered bedrock and the overlying unconsolidated sedimentary deposits, where present. Due to minimal primary porosity, most of the bedrock groundwater flow occurs in secondary porosity features such as fractures, gas voids, and layered planes of rock sills.

The PM-1 Reactor Site and the Off-Site Release have an extremely limited groundwater recharge area, as they are located near the peak of a mountain. The site is also located in a semi-arid area, which further limits groundwater recharge. This results in a seasonally high water table in the spring following the melting of the snow pack. The water table drops significantly by mid spring and monitoring wells associated with the PM-1 Reactor Site become dry, or nearly dry, during the remainder of the year.

2.1.4 Ecological Resources

Potential ecologic impacts due to the Off-Site Release are considered negligible since the radiation emitted from reactor-related material is much lower than the natural terrestrial radiation produced by the local bedrock in the area of the Off-Site Release. Further, no ecologically sensitive areas were identifled since the Off-Site Release consists of a ditch adjacent to a roadway and an area that is used for open grazing under permit to the USPS.

2.2 Site History and Enforcement Activities

This section provides background information and summarizes the series of previous site activities and investigations that led to the ROD. It describes the CERCLA response actions undertaken at the Off-Site Release.

The original release to the environment is believed to be from radiologically-contaminated water stored in a 12,000-gallon aboveground storage tank at the PM-1 Reactor Site. Radionuclide contamination was confirmed on the northeastem slope of the PM-1 Reactor Site during decommissioning in 1969. Surveys of the fenced portion of the PM-1 Reactor Site indicated that the contamination followed a path starting at a 12,000-gallon aboveground storage tank and followed the washout of the slope to the eastem fence line and into the drainage ditch. Following remediation of an area of contamination within the fenced area during decommissioning, the USAF concluded that there was no present danger to personnel or the environment either inside or outside the PM-1 fenced area

The Off-Site Release was investigated during the 2000 PA/SI of the former PM-1 Reactor Site (USAF 2006). Additional field work was also performed in the fall of 2001 to better characterize conditions adjacent to the PM-1 Reactor Site.

The contaminants associated with the Off-Site Release were defined, characterized and assessed during the RI in 2004. The Rl included a HRA. The RI concluded that there is no unacceptable risk to current or potential future receptors following USEPA guidance established for CERCLA-regulated sites.

The USAF Safety Center requested that the RI include a recommendation that the removal of soil be assessed following Nuclear Regulatory Commission (NRC) As Low As Reasonably Achievable (ALARA) principles. The analysis was conducted in 2009 and concluded that no action meets ALARA and supports the No Action decision.

A decision document for the PM-1 Reactor Site and the associated Off-Site Release was issued by USEPA on June 23, 2009, with a decision of No Further Response Action Planned (NFRAP). The document was prepared to record USEPA's determination that no further action is warranted at this time under CERCLA and that the Site is not being considered for inclusion on the National Priority List (NPL). "

There have been no other investigations or enforcement actions associated with the Off-Site Release.

2.3 Community Participation

NCP Section 300.430(f)(3) establishes a number of public participation activities that the lead agency must conduct following preparation of the Proposed Plan and review by the support agency. Components of these items and documentation of how each component was satisfied for the Off-Site Release are described in Tables 2-1 and 2-2 below.

Table 2-1
Public Notification of Document Availability

Requirement:	Satisfied by:
Notice of availability of the Proposed Plan and Remedial Investigation/Feasibility Study (RI/FS) must be made in a general circulation major local newspaper.	Notice of a public meeting discussing the no action decision as well as the availability of additional infonnation (including the Proposed Plan and RI) was published in the Sundance Times. A Feasibility Study was not applicable to the Off-Site Release based on results of the HRA.
Notice of availability must include a brief abstract of the proposed plan which describes the alternatives evaluated and identifies the preferred alternative (NCP Section 300.430(f)(3)(i)(A)	Notice of availability included all of these components, as applicable, and is included for reference as Appendix A to this ROD. Discussion of alternatives evaluated was not required since the HRA concluded there was no unacceptable risk to current or potential future receptors.
Notice of availability should consist of the following information: • Site name and location • Date and location of public meeting • Identification of lead and support agencies • Alternatives evaluated in the detailed analysis • Identification of preferred alternative • Request for public comments • Public participation opportunities including: – Location of information repositories and Administrative Record file – Methods by which the public may submit written and oral comments, including a contact person – Dates of public comment period – Contact person	

Table 2-2
Public Comment Period Requirements

Requirement:	Satisfied by:
Lead agency should make document available to public for review on same date as newspaper notification.	Document was made available to the public on April 1, 2010. The notification of availability was made on April 1, 2010 and April 8, 2010.
Lead agency must ensure that all information that forms the basis for selecting the response action is included as part of the Administrative Record file and made available to the public during the public comment period.	EAFB maintains the Administrative Record file for the Off-Site Release. All data collected and all CERCLA primary documents produced for the Off-Site Release are maintained as part of this file at the Sundance Public Library located at 414 East Main Street and the Crook County Museum located at 309 Cleveland Street in Sundance Wyoming and are available to the public.
CERCLA Section 117(a)(2) requires the lead agency to provide the public with a reasonable opportunity to submit written and oral comments on the Proposed Plan. NCP Section 300.430(f)(3)(i) requires the lead agency to allow the public a minimum of 30 days to comment on the RI/FS and the Proposed Plan and other supporting information located in the administrative record and information repository.	The AF provided a public comment period for the RI and the Proposed Plan from April 7, 2010 to May 7, 2010.
The lead agency must extend the public comment period by at least 30 additional days upon timely request.	The AF received no requests to extend the public comment period.
The lead agency must provide the opportunity for a public meeting to be held at or near the site during the public comment period. A transcript of this meeting must be made available to the public and be maintained in the Administrative Record and information repository for the site (pursuant to NCP Section 300.430(f)(3)(i)(E)).	A public meeting was held on April 14, 2010 at the Crook County Courthouse located at 309 Cleveland Street, Sundance, Wyoming. A transcript of this meeting has been added to the Administrative Record file and information repository.

AF responses to comments received during the public comment period are included in the Responsiveness Summary, which is provided as Section 3 of the ROD.

2.4 Scope and Role of Operable Unit or Response Action

As with many large sites, the environmental issues at the Former Sundance Air Force Station are complex. At the same time the AF was assessing the PM-1 Reactor Site, the United States Army Corps of Engineers (USACE) was addressing several other areas of the Former Sundance Air Force Station under the Formerly Used Defense Sites (FUDS) program. Environmental activities were organized into individual areas as described below.

Site Name	Environmental Concern
• Off-Site Release	Contamination of surface soils
• PM-1 Reactor Site:	Entombed reactor components.
• Formerly Used Defense Sites (FUDS):	Sites separately assessed by the USAGE and shown on Figure 2-1 to include: ➢ Former Operations Area, area where the radars and support operations were located atop Warren Peak (CERCLIS ID # WY0010161362) ➢ Ground to Air Transmitter Receiver (GATR) site, an inactive site located near Warren Peak. (CERCLIS ID # WY0010161234) ➢ Cantonment Area, which contained the headquarters and support facilities ➢ Waste Annex, which contained the sewage lagoons for base housing (CERCLIS ID # WY0010161244) ➢ Sundance Water Systems Annex, formerly used to supply water to the Operations Area and PM-1 Reactor. Now called USPS Pump Station which is presently used for stock watering (CERCLIS ID# WY0010161352)

Off-Site Release: This ROD documents the No Action altemative selected for the Off-Site Release. This altemative is supported by the results of the RI that residual radionuclides associated with the Off-Site Release are present at concentrations that do not require a removal action based on the results of a HRA. Further, concentrations at the Off-Site Release will decrease due to the decay of ^{137}Cs, which has a half life of approximately 30 years, and was the only radionuclide present at concentrations high enough to be carried forward in the HRA.

PM-1 Reactor Site: Due to the presence of entombed reactor components, long term monitoring is required at the PM-1 Reactor Site. At the time of decommissioning, the AF filed a Notice of Contamination at the Crook County Courthouse which limited transfer of the PM-1 Reactor Site property and established maintenance and environmental monitoring requirements for the site for at least 75 years, that is, at least until 2044 (USAF 1969). Also, due to the presence of buried radioactive material at the PM-1 Reactor Site, the USAF has issued a Special Nuclear Reactor Permit (USAF-P01E) to the 28th Bomb Wing Commander, EAFB, under the provisions of Section 91b of the Atomic Energy Act of 1954 (USAF 2001). It assigns the responsibility for control, maintenance, and environmental monitoring of the PM-1 Reactor Site to EAFB, South Dakota.

As mentioned earlier, the USEPA issued a decision document for the PM-1 Reactor Site and the associated Off-Site Release on June 23, 2009, with a decision of NFRAP. The decision document stated that the Sundance PM-1 Site "is characteristic of other sites regulated by the Nuclear Regulatory Commission, but exempt from their oversight. The Air Force maintains an internal radiation control and compliance program in lieu of the NRC. The Superfund decision will not affect the Air Force's ongoing management of the nuclear legacy issues at the site." The decision recognizes the AF's long term maintenance and monitoring requirements for the PM-1 Site documented by the Notice of Contamination and the Special Nuclear Reactor Permit.

FUDS: USEPA issued a decision document of NFRAP for each of the five FUDS sites. The purpose of the FUDS program is to address environmental issues at properties no longer owned by the DoD. The AF has no direct responsibilities for FUDS sites and the FUDS sites are not addressed in this ROD.

2.5 Site Characteristics

This section describes the physical characteristics of the Off-Site Release and its surrounding environs. Physical characteristics were primarily defined during the PA/SI (USAF 2006).

2.5.1 Physiography and Climate

The Off-Site Release is located near the top of Warren Peak, which is the tallest of a series of peaks commonly referred to as Warren Peaks. Warren Peaks are located in the south central portion of the Bear Lodge Mountains. The elevation of Warren Peak is 6,637 feet above mean sea level (amsl) and is the highest point in the area. The area evaluated as the Off-Site Release is slightly greater than 21 acres and is confined to the northeastern slope of Warren Peak. The Off-Site Release is located approximately seven miles northwest of Sundance, Wyoming,

Average annual precipitation is 17.41 inches. The average annual air temperature is 43.6 °F with highest and lowest recorded temperatures of 105 °F and -42 °F, respectively (USAF 2006). There is no access to the area in the winter since the only road to the site (USPS Road 838) is not plowed for snow removal and is administratively closed to wheeled vehicles during the winter months.

2.5.2 Geology

Phonolite and trachyte make up most of the Tertiary intrusive rocks that are exposed in the southern Bear Lodge Mountains that include Warren Peaks. The intrusive rocks are extensively fractured and altered by hydrothermal solution activity that occurred during the later part of the Tertiary (USGS, 1983).

The geology of the Off-Site Release is based on observations made during subsurface boring and geophysical surveys during the PA/SI.

The borings indicate that the unconsolidated material overlies weathered bedrock. The unconsolidated material is comprised of either fill associated with the construction and/or decommissioning of the PM-1 Reactor or the construction of the adjacent road way. In general, the fill is composed of coarse-grained materials (sand and gravel). Natural unconsolidated material is generally composed of soil derived from the weathering of bedrock.

Weathered/fractured bedrock is generally encountered at depths of less than 20 feet from the surface, with the exception of the borings placed immediately adjacent to the former reactor, where extensive fill is present.

2.5.3 Hydrogeology

The Off-Site Release area has a limited groundwater recharge area as it is located near the peak of a mountain. Warren Peaks are located in a semi-arid area, which further results in limited water recharge. This creates a seasonal water table that is highest in the spring following the melting of the snow pack. The primary source of groundwater is snowmelt infiltrating through the fill and/or natural overburden. Groundwater then infiltrates into the natural unconsolidated soil that is derived from the weathering of bedrock and into the fracture systems in the underlying bedrock (USAF, 2006).

Based on the regional topography, it is anticipated that groundwater discharges to the sedimentary deposits within the Beaver Creek and Lytle Creek valleys. Potential flow pathways include discharge to unconsolidated soil associated with this valleys, discharge directly to the surface as a spring, and/or discharge to a deeper aquifer. Groundwater elevation measurements on the PM-1 Reactor Site indicate a steep groundwater gradient to the east toward Beaver Creek Valley.

No groundwater resources capable of supporting a residential well have been identified at the Off-Site Release.

2.5.4 Surface Water Hydrology

Surface water mnoff from the Off-Site Release is directed to either Beaver Creek or Lytle Creek, which are generally dry except in the spring. Beaver Creek is a gaining stream with surface flow originating approximately 2,000 feet east of the Off-Site Release. Beaver Creek receives mn-off from the Off-Site Release east of USPS Road 838. The remainder of the Off-Site Release area, including the drainage ditch adjacent to USPS Road 838, flows to Lytle Creek, which is located northwest of the PM-1 Site.

2.5.5 Ecology

Based on the limited magnitude and extent of contamination, a review of sensitive populations and threatened or endangered species was unwarranted.

2.5.6 Previous Site Characterization Activities

- The Off-Site Release was investigated in part during the 2000 PA/SI of the former PM-1 Reactor Site (USAF 2006). Limited soil borings were advanced in the Off-Site Release area and ^{137}Cs was detected in surface soil samples. The highest concentration was located in the drainage ditch just outside the PM-I Site fence. The PA/SI recommended that further environmental investigation be conducted to characterize the off-site release.
- An Expanded PA/SI was performed in August and September 2001. A Radiologic Scoping Survey following the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) was conducted to define surface soil radiological impacts (USEPA 2000). The investigation included *in-situ* gamma spectroscopy measurements with an In-Situ Object

Counting System (ISOCS ®) high-purity germanium detector, collection and analysis of 20 surface soil samples to define the extent of the ^{137}Cs release, and confirmation surface soil samples to verify results from the PA/SI. The Expanded PA/SI Report concluded that ^{137}Cs was present off site above background concentrations and was generally restricted to a surface drainage flow pathway that follows a ditch and other natural drainage features. ^{137}Cs was also elevated at one location east of USPS Road 838 (USAF 2002).

- Sampling for the RI was conducted in 2004. 177 surface soil samples were collected and analyzed for ^{137}Cs to determine the extent of contamination as well as background concentrations. Samples from 50 surface soil locations were also analyzed for strontium-90 (^{90}Sr). The Rl included subsurface sampling at 21 locations with analysis for both ^{137}Cs and ^{90}Sr. Based on the analytical results of the RI, the magnitude and extent of the Off-Site Release were defined. The HRA, performed with the RI, indicated no unacceptable risks to current or potential fiiture human receptors and no action was recommended.

2.5.7 Nature and Extent of Contamination

Information from the PA/SI resulted in the conclusion that ^{137}Cs and ^{90}Sr were the only chemicals/radionuclides of potential concem (C/ROPCs) associated with the Off-Site Release. ^{90}Sr likely was present at the time of release in concentrations similar to ^{137}Cs because both are produced as fission products at similar rates (yield per fission is about 4.5 percent for ^{90}Sr and about 6.3 percent for ^{137}Cs). Therefore, ^{9D}Sr was considered a ROPC in the RI. However, because of its much higher environmental mobility in comparison to that of ^{137}Cs, it was expected that ^{90}Sr soil concentrations measured at the time of the RI would be very low or undetectable. The RI indicated that ^{9D}Sr was not present at concentrations statistically elevated above background. Thus, only ^{137}Cs was assessed in the HRA.

The ^{137}Cs and ^{90}Sr analytical results from the PA/SI and RI are provided in summary tables included in Appendix B along with figures showing the sample locations. Results were compared to the background threshold values of 3.4 picoCuries per gram (pCi/g) for ^{137}Cs and 3.2 pCi/g for ^{9D}Sr.

The ^{137}Cs RI surface soil results are summarized below for the three study areas shown in Figure 2-2. The study areas were established to create a systematic sample grid for collection of surface soils during the RI field investigation. The areas were established based on observations in the PA/Sl that indicated ^{137}Cs was present, but that the magnitude and extent was not defined. An exposure unit (EU) that included the three study areas was established as the typical exposure area for a mral resident. Guidance from the USEPA stated that a mral residence is up to 35 acres. The EU was established as 21 acres and constitutes the boundaries of the Off-Site Release.

Drainage Ditch (Study Area 1): Thirty-one soil samples were collected systematically in the drainage ditch. The samples were collected from the center of the ditch at intervals of approximately 30 feet. The detections ranged from (0.30 ± 0.10) pCi/g to (92 ± 11) pCi/g. Nineteen biased samples were collected adjacent to the systematic sample locations. Samples collected next to sampling points along USPS Road 838 ranged from (0.28 ± 0.11) pCi/g to (17 ± 2.2) pCi/g. The results indicated that ^{137}Cs was restricted to confined drainage flow pathways from the PM-1 Reactor Site.

Huchins Meadow Hillside (Study Area 2): Forty-two systematic samples were collected on the Huchins Meadow Hillside. The sample results ranged from not detected to (22.1 ± 2.8) pCi/g, with six of the 42 samples exceeding background. The highest concentrations were observed along the drainage pathway from the PM-1Reactor Site. The ^{137}Cs dissipated to background concentrations within this study area indicating the extent of the impacted area associated with the Off-Site Release.

East Meadow Hillside (Study Area 3): Thirty systematic samples were collected on the East Meadow Hillside downslope of the PM-1 Site. The sample results for ^{137}Cs ranged from not detected to (10.6 ± 1.4) pCi/g, with seven of the sample results exceeding the background value. All results that exceeded background were in the row closest to USPS Road 838 and were generally across the road from where the highest concentrations of ^{137}Cs were observed in the Drainage Ditch. The results showed that the impacts were limited to the area next to USPS Road 838 and did not extend down the hillside.

Residential Exposure Unit: Twenty biased samples were collected in the residential EU outside of the study areas. The ^{137}Cs concentrations ranged from (0.66 ± 0.16) pCi/g to (3.85 ± 0.54) pCi/g. No ^{137}Cs detections were attributed to PM-1 Reactor operations.

All subsurface soil results were less than the surface background threshold value of 3.4 pCi/g and the results were not carried forward into the HRA. A total of 13 subsurface soil samples were collected from seven soil borings during the RI for site characterization and eight were collected for background characterization. Cesium-137 was detected in five of the seven study area borings at concentrations ranging from (0.31 ± 0.13) pCi/g to (1.22 ± 0.22) pCi/g, which are below the background threshold value.

Based on limited magnitude and extent of contamination, no groundwater or surface water samples were collected as part of the Off-Site Release investigations. Both groundwater and surface water are sampled annually due to permit requirements for the PM-1 Reactor Site.

2.5.8 Conceptual Exposure Model

A conceptual exposure model (CEM), referred to as a conceptual site model (CSM) in the original Sundance documentation, was developed to depict the potential relationship or exposure pathway between contaminant sources and receptors. An exposure pathway describes the means by which a receptor can be exposed to contaminants in environmental media. These pathways were developed as part of the RI and are presented in Figure 2-4, based upon current and reasonably likely future land uses and the potential use of groundwater and surface water at the Off-Site Release (USAF 2007).

2.6 Current and Potential Future Land Use and Resource Uses

A determination has been made that no land use controls are required for the Off-Site Release. This decision is based on the HRA that concluded that there is no unacceptable risk to current or potential future receptors.

The current land use of the Off-Site Release is open grazing of cattle and, to a lesser extent, recreational purposes and is expected to remain the same for the foreseeable future.

2.6.1 Ground and Surface Water Beneficial Uses

Groundwater is seasonally present in the vicinity of the Off-Site Release in weathered and/or fractured bedrock as described in Section 2.5.3. The groundwater is not likely to be affected by site contamination due to limited magnitude and extent of impact and the immobile nature of ^{137}Cs. Groundwater likely discharges to colluvium and alluvium deposits in the valley associated with Beaver Creek or Huchins Spring (Lytle Creek), where it is used for stock watering.

The closest surface water to the Off-Site Release is Beaver Creek and Lytle Creek, which are perennial streams as described in Section 2.5.4. Both creeks are included in the annual monitoring of the PM-1 Reactor Site and no impacts have been observed which were attributed to either the PM-1 Reactor operations, which would include the Off-Site Release.

2.7 Summary of Site Risks

This section provides the primary basis for the No Action decision. This decision is based on the HRA performed at the Off-Site Release which concluded that unacceptable exposures to hazardous substances will not occur.

Due to the limited magnitude and extent of impacts, no ecological risk assessment was conducted for the Off-Site Release.

2.7.1 Summary of Human Health Risk Assessment

The baseline risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the approaches used and the results of the baseline risk assessment for this site. The HRA is divided into the following sections: identification of the radionuclide of concem (ROC) (hazard assessment), exposure assessment, toxicity assessment, and risk characterization. Potential risks for both current and future site occupants are discussed. Key assumptions and uncertainties associated with the HRA are also identified.

2.7.1.1 Identification of Chemicals of Concem

This section describes the process for identifying the single ROC selected for evaluation in the HRA. Although other chemicals and radionuclides were detected at the site, only ^{137}Cs was present at concentrations that required further evaluation. The data used in this risk assessment was deemed to be of sufficient quality and quantity for its intended use. The detection frequency (number of samples in which the chemical was detected divided by the total number of samples analyzed), range of detected concentrations (maximum and minimum concentrations detected), the exposure point concentrations (EPC) (the calculated or assumed concentration of the chemical at the assumed location of exposure) , and the screening concentration (concentration above which the chemical is believed to possibly present a risk to human health or the environment and thus require further evaluation) for chemicals and media of concem are presented in Table 2.3.

Table 2-3
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Area Sampled (Surface Soil)	Radionuclide of Concern	Concentration Detected		Units	Frequency Of Detection	Exposure Point Concentration	Screening Concentration
		Min	Max				
Background	^{137}Cs	0.61	3.9	pCi/g	30/30		
Drainage Ditch (Area 1)	^{137}Cs	0.44	38.4	pCi/g	23/23	18	Not established
Huchins Meadow (Area 2)	^{137}Cs	0.57	66.7	pCi/g	42/43	20.6	Not established
East Meadow (Area 3)	^{137}Cs	0.42	64.9	pCi/g	33/34	6.3	Not established
Remainder of EU	^{137}Cs	0.18	3.8	pCi/g	32/33	2.1	Not established
Entire EU[1]	^{137}Cs	0.18	66.7	pCi/g	130/133	2.87	Not established

Key
^{137}Cs Cesium-137
EU Exposure unit
pCi/g picocuries per gram
[1] An area weighted EPC of 2.87 pCi/g was established for the entire EU using the EPCs calculated for the individual study areas.

A screening risk analysis was performed to select C/RPOCs. This was conducted during the PA/SI by reviewing state and federal screening criteria for the analytes detected and known reactor operations. During this analysis, the analytical data associated with the annual monitoring associated with the Special Nuclear Reactor Permit of groundwater and surface water was also reviewed. Based on the screening risk analysis the PA/SI concluded:

- No volatile organic compounds (VOCs) exceeded state or federal screening values and were omitted for further consideration in all media sampled (soil, sediment, groundwater and surface water).
- The PA/SI results indicated elevated levels of ^{137}Cs and ^{90}Sr in the soil and in the road ditch adjacent to the USPS Road and were therefore identified as ROPC in soil and sediment. Carbon-14, nickel-63, and tritium were also sampled in soil and sediment, but were not sufficiently elevated to be carried forward as ROPC.
- The annual monitoring results for radionuclides in groundwater and surface water did not suggest a release to these media from the off-site release.

Cesium-137 and ^{90}Sr were assessed in soil and subsurface soil in the RI. The RI results indicated that the only statistically elevated radionuclide was ^{137}Cs in surface soil. In conclusion, ^{137}Cs is the only radionuclide of concern and no chemicals of concern were present.

An area weighted approach was used to calculate the EPC for the entire EU. The upper confidence level (UCL) on the mean concentration is the recommended EPC for a site (USEPA 2004). The UCL was calculated separately for Study Areas 1, 2, and 3 and the remainder of the EU. A single value for the entire EU was then calculated as a weighted-average concentration based on the size of each of these study areas to the entire EU. This approach assumes equal access to the entire EU. An area weighted exposure point concentration of 2.87 pCi/g was established for the EU to evaluate the human health risk for all receptors to the Off-Site Release.

2.7.1.2 Exposure Assessment

This section documents the populations and exposure pathways that were quantitatively evaluated in the risk assessment. A CEM was developed to aid in determining reasonable exposure scenarios and pathways of concem; this CEM is shown in Figure 2-4. As described in this section, both current and fiiture populations have been evaluated based on current and reasonably anticipated fiiture land use. The contaminated media to which people may be exposed is also discussed.

Only complete exposure pathways are evaluated in risk assessments. The CEM identified three complete exposure pathways:

- Incidental ingestion of ^{137}Cs in surface soil.
- Inhalation of re-suspended ^{137}Cs in fiigitive dusts.
- Extemal exposure to gamma radiation from ^{137}Cs in surface soil.

The current exposure source is residual off-site soil contamination that likely resulted from a release that occurred during operations or during decommissioning of the PM-1 Reactor. The present release mechanism to the environment is mnoff and infiltration of surface water and/or groundwater in contact with the impacted soil. Environmental media potentially affected by this mechanism include surface soil, subsurface soil and groundwater. No other primary release mechanisms were identified. Two secondary release mechanisms were identified: the release of fiigitive dust from impacted surface soil and recharge of groundwater to surface water and sediment. All food ingestion pathways (consumption of produce, livestock, and game) were identified as secondary pathways.

Three potential receptors were identified: (1) a recreational user who camps within the site, (2) a rancher who repairs water lines or fences within the site, and (3) a resident who builds a home within the site. The recreational user and the rancher were selected to represent the most likely exposure based on current and likely future use of the site. Presently, no residents are located near the impacted area and the property is owned by the USPS. Therefore, development of the impacted area for residential use in the near fiiture is unlikely. However, a fiiture resident was used as a maximally exposed receptor. The resident was evaluated for fiiture use only since there are currently no residents within the EU. The fiiture resident was assessed for both an adult and child living within the EU. In the exposure assessment, the risks of the child and adult residents were summed to estimate the total incremental lifetime cancer risk to this receptor from exposure to contaminants while living within the EU.

The Off-Site Release, or EU, is located near a mountaintop in a semi-arid region which makes many potential exposure pathways insignificant or incomplete. Due to the high elevation, short growing season, poor quality soil, and dry climate, the raising of produce for consumption was considered as a complete but not significant pathway. Ingestion of livestock and game is possible, but the impacted area of the Off-Site Release is not extensive enough to comprise a significant portion of the animal's diet so these pathways were considered not significant. The streams near Warren Peaks are intermittent and cannot support a fish population.

Water for the PM-1 operational site was piped from another source approximately two miles away. No groundwater resources capable of supporting a residential well have been identified at the Off-Site Release. Therefore, the groundwater pathway was considered incomplete.

Ingestion of surface water and sediment were considered potentially complete pathways but not significant. Surface water located as close as ½ mile from the site has been monitored annually in association with the requirements of the Special Nuclear Reactor Permit since the decommissioning of the reactor and has shown no impacts from PM-1 Reactor operations including the Off-Site Release.

Incidental ingestion of subsurface soil was considered a complete pathway, but not significant for residential exposure because sampling showed contaminant concentrations in subsurface soil are negligible.

An individual's radiation exposure dose is dependent upon:

- The concentration of the radionuclide at the point of exposure
- The extent of contact that the individual has with the contaminated medium
- The frequency with which the individual comes into contact with the contaminated medium
- The duration of exposure

For this assessment, default values incorporated into USEPA *Radionuclide Preliminary Remediation Goals (PRGs)* (EPA 2002) were used for the mral resident. Default as well as site-specific parameters were used for the ranching and recreational scenarios. Site-specific parameters were chosen by consensus at a June 2003 Project Managers' meeting that included representatives from the USACE, USAF, USEPA and the WDEQ.

No sensitive subpopulations (highly exposed and/or more susceptible receptors) that may be exposed were identified.

2.7.1.3 Toxicity Assessment

This section describes the toxicity criteria used to calculate the potential risk for the single ROC, ^{137}Cs at the Off-Site Release. The EPA classified all radionuclides as Group A (known human) carcinogens, based on their property of emitting ionizing radiation and on the extensive weight of evidence provided by studies of radiogenic cancers in humans. Toxicity data for ^{137}Cs is presented in Table 2.4. Separate toxicity criteria are listed for ingestion (oral intake, swallowing), inhalation (breathing into the lungs), and extemal (gamma radiation emitted by ^{137}Cs in surface soils) routes of exposure. For carcinogenic ROCs, the toxicity criteria is the slope factor, which is an estimate of the probability of radiogenic cancer mortality (fatal cancers) or morbidity (fatal plus nonfatal cancers) per unit activity of a given radionuclide inhaled or ingested, for intemal exposure, or per unit time-integrated activity concentration in air or soil, for extemal exposure (USEPA 2001a). The weight of evidence/cancer guideline description is a descriptor, provided by the USEPA classifying the degree of confidence that the chemical is a human carcinogen. Slope factors and weight of evidence/cancer guideline descriptions are listed in Table 2.4 along with the source of each slope factor and date of its publication.

The isotope ^{137}Cs is a fission product produced by nuclear reactors and nuclear weapons detonations. It is rapidly absorbed into the blood stream and distributes fairly uniformly throughout the body's soft tissues.

Table 2-4
Cancer Toxicity Data Summary for ^{137}Cs

Exposure Pathway	Slope Factor[1]	Units	Weight of Evidence/Cancer Guideline Description	Source[2]	Date
Soil ingestion (residential)	4.33E-11	Risk/pCi	Group A	HEAST	April 16, 2001
Soil ingestion (camper/rancher)	3.17E-11[3]	Risk/pCi	Group A	PRG	2002
Inhalation of particulates	1.19E-11	Risk/pCi	Group A	HEAST	April 16, 2001
External exposure	2.55E-06	Risk/year per pCi/g	Group A	HEAST	April 16, 2001

Notes:
1 Lifetime excess total cancer risk per unit of intake or exposure.
2 HEAST is *Health Effects Assessment Summary Tables for Radionuclides* (USEPA, 2001b). PRG is the Radionuclide Preliminary Remediation Goal Calculator website (USEPA, 2002).

2.7.1.4 Risk Characterization

This section of the risk assessment combines the results of the exposure assessment with the toxicity criteria identified for the ROCs and pathways. Carcinogenic risks for ^{137}Cs are presented for all populations and media of interest, including both current and future land use settings. Cumulative risks, including all ROCs and pathways, for all relevant pathways and populations are also described. These risk estimates are summarized in Tables 2-5. The results of the human health risk assessment are interpreted within the context of the CERCLA acceptable risk range.

The major uncertainties affecting the risk assessment are also presented in this section.

For carcinogens, risks are generally expressed as the incremental probability of an individual's likelihood of developing cancer over a lifetime as a result of exposure to the carcinogen. The following equations were used to obtain numerical estimates of incremental lifetime cancer risks.

For the ingestion and fugitive dust inhalation pathways:

$Risk = Intake\ (pCi) \times SF\ (pCi)^{-1}$

For the external radiation exposure pathway:

$Risk = Exposure\ (pCi\text{-}yr/g) \times SF\ (risk/year\ per\ pCi/g)$

Where:

Risk = a unitless probability (e.g., 2×10^{-5}) of an individual's likelihood of developing cancer

Intake = Radionuclide intake

Exposure = External radiation exposure

SF = slope factor

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable

maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposure is 10^{-4} to 10^{-6} (1 in 10,000 to 1 in 1,000,000).

A summary of receptor-specific cancer risks from exposure to ^{137}Cs in surface soils is provided in Table 2-5. The risks for each evaluated receptor are discussed below:

Current and **F**uture **R**ancher - The total excess cancer risk to the current and future rancher was 1.5×10^{-7}, which is less than 10^{-6}, the USEPA's cancer risk level of no concern. External radiation exposure accounts for 99.7 percent of this receptor's total risk.

Current and **F**uture **R**ecreational User - The total excess cancer risk to the current and future recreational users was $4.1 \times i0^{-6}$, which is within USEPA's acceptable cancer risk range of 10^{-6} to 10^{-4}. External radiation exposure also accounts for most of the risk to this receptor (99.9 percent).

Future **R**esident - The total excess cancer risk to the future resident (childhood and adult risks combined) was 5.3×10^{-5}, which is within USEPA's acceptable cancer risk range of 10^{-6} to 10^{-4}. External radiation exposure accounts for 99.8 percent of this risk.

The total incremental lifetime cancer risks for all receptors evaluated in this risk assessment are below or within the USEPA Region 8's acceptable risk range of 10^{-6} to 10^{-4}. These results indicate that ^{137}Cs concentrations in surface soils at the EU do not pose an unacceptable risk to current or potential future receptors.

In addition to the quantitative assessment discussed above, a qualitative assessment was also conducted. A quantitative assessment yields a numeric value based on mathematical formulas; whereas, a qualitative assessment is based on scientific judgment and other factors not expressed as mathematical formulas. A qualitative assessment is performed since uncertainties are inherent in the quantitative risk assessment process which is conditional upon the quality of data and models used to identify C/**R**OPCs and estimate exposure concentrations, the assumptions made in estimating the exposure conditions, and the methods used to develop toxicity factors. Uncertainties could result in an overestimation or underestimation of risk.

Uncertainties that were considered to potentially have a high magnitude of effect include:

- All receptors were assumed to have equal access to the entire EU. However, the highest concentrations of the ROPCs were confined to relatively small areas. The weighted-average approach takes this into account. Receptors may, in fact, not access the entire site, but only certain areas, which may result in higher or lower EPCs than the one used in this risk assessment.

- The USEPA stated that the typical exposure area for a mral resident is up to 35 acres, compared to the 21 acres of the EU. The smaller total acreage results in a higher total weighted-average concentration.
- Although the USPS allows a camping frequency of 14 days/year in the general area, no signs of camping, such as fire rings, have been observed in or near the EU. Risks to current or hypothetical future campers are likely overestimated.
- Since the EU is open for grazing, a rancher could visit the site more often to check herds or repair fences, making the risk potentially underestimated for this receptor. However, it is unlikely that a single rancher would perform these activities for 30 years, which indicates the risk could be overestimated.
- The residential scenario is the most conservative of the three scenarios evaluated. There are presently no residents living near the EU. The property is currently owned by the USPS, so residents are not likely to be exposed to any contamination at the EU in the near future.

The risk assessment indicates that for all receptors, over 99 percent of the estimated total excess lifetime cancer risk from the EU is extemal radiation (See Table 2-5). The source of the extemal radiation exposure is the emission of gamma and high-energy beta radiation emitted from the ground surface. This is the same type of radiation that can be measured using hand held field equipment. These surveys are sensitive to both the gamma-emitting reactor-related isotopes, primarily ^{137}Cs, and naturally occurring isotopes in the soil and bedrock and are direct indicators of the radiation received by an individual from extemal radiation.

Site surveys conducted as part of the PA/SI and RI were more influenced by the geologic conditions than the release pathway. This indicates that the primary source of the extemal radiation to a receptor in this area is from natural geologic materials. Also, the geologic conditions contributing to the elevated extemal radiation extend over an area of approximately 10 square miles, and the EU is 21 acres. Based on these observations, it is reasonable to conclude that only a very small percentage of the total dose of radiation received by individuals in the EU would be related to the Off-Site Release.

Table 2-5
Risk Characterization Summary from Exposure to ^{137}Cs in Surface Soils

Exposure Pathway	Exposure Dose (pCi)[1]	Slope Factor (Risk/pCi)[1]	Pathway-Specific Cancer Risk[2]	Pathway-Specific Percent of Total Risk
Current and Future Rancher[4]				
Incidental Ingestion of Soil	12.5	3.17E-11	4.0E-10	< 1
Inhalation of Fugitive Dusts	0.008	1.19E-11	9.5E-14	< 1
External Radiation Exposure	0.057	2.55E-06	1.5E-07	99.7
Total Receptor Cancer Risk			**1.5**E-07	
Current and Future Recreational User[4]				
Incidental Ingestion of Soil	87.3	3.17E-11	2.8E-09	< 1
Inhalation of Fugitive Dusts	0.218	1.19E-11	2.6E-12	< 1
External Radiation Exposure	1.60	2.55E-06	4.1E-06	99.9
Total Receptor Cancer Risk			**4.1**E-06	
Future Resident[3,4]				
Incidental Ingestion of Soil	2620	4.33E-11	1.1E-07	< 1
Inhalation of Fugitive Dusts	0.845	1.19E-11	1.0E-11	< 1
External Radiation Exposure	20.7	2.55E-06	5.3E-05	99.8
Total Receptor Cancer Risk			**5.3**E-05	

Notes:
1 The units of the exposure dose for external radiation exposure are pCi-yr/g, and the units for the external radiation slope factor are risk/yr per pCi/g.
2 The pathway-specific cancer risk is the product of the exposure dose and the slope factor.
3 The exposure doses for the future resident are the sum of the child and adult exposure doses.
4 The total time of exposure was 30 years.

2.7.2 Summary of Ecological Risk Assessment

Due to the limited magnitude and extent of impacts, no ecological risk assessment was conducted for the Off-Site Release.

2.8 Documentation of Significant Changes

No changes were made to the selected remedy.

3.0 Responsiveness Summary

This section provides a summary of the public comments regarding the Proposed Plan for remedial action at the Off-Site Release, EAFB and the Air Force response to comments. At the time of the public review period, the AF had selected No Action as the preferred altemative for the site.

No written comments were received during the public comment period

3.1 Stakeholder Comments and Lead Agency Responses

One Stakeholder comment was received during the comment period. No response or change to the Proposed Plan was required. The comment received was from the USPS as follows:

> Thank you for the opportunity to review and comment on your proposed plan for Former Sundance Air Force Station, PM-1 Off-Site Release. After review by staff from the Bearlodge Ranger District in Sundance, WY and the Supervisor's Officer in Custer, SD, we are in full support of the project and proposed actions.
>
> Claudia C. Hill, P.E.
> Physical Resources Staff Officer
> Black Hills National Forest
> 605-673-9204

3.2 Technical and Legal Issues

No technical or legal issues were identified during the public review period of the Proposed Plan.

4.0 References

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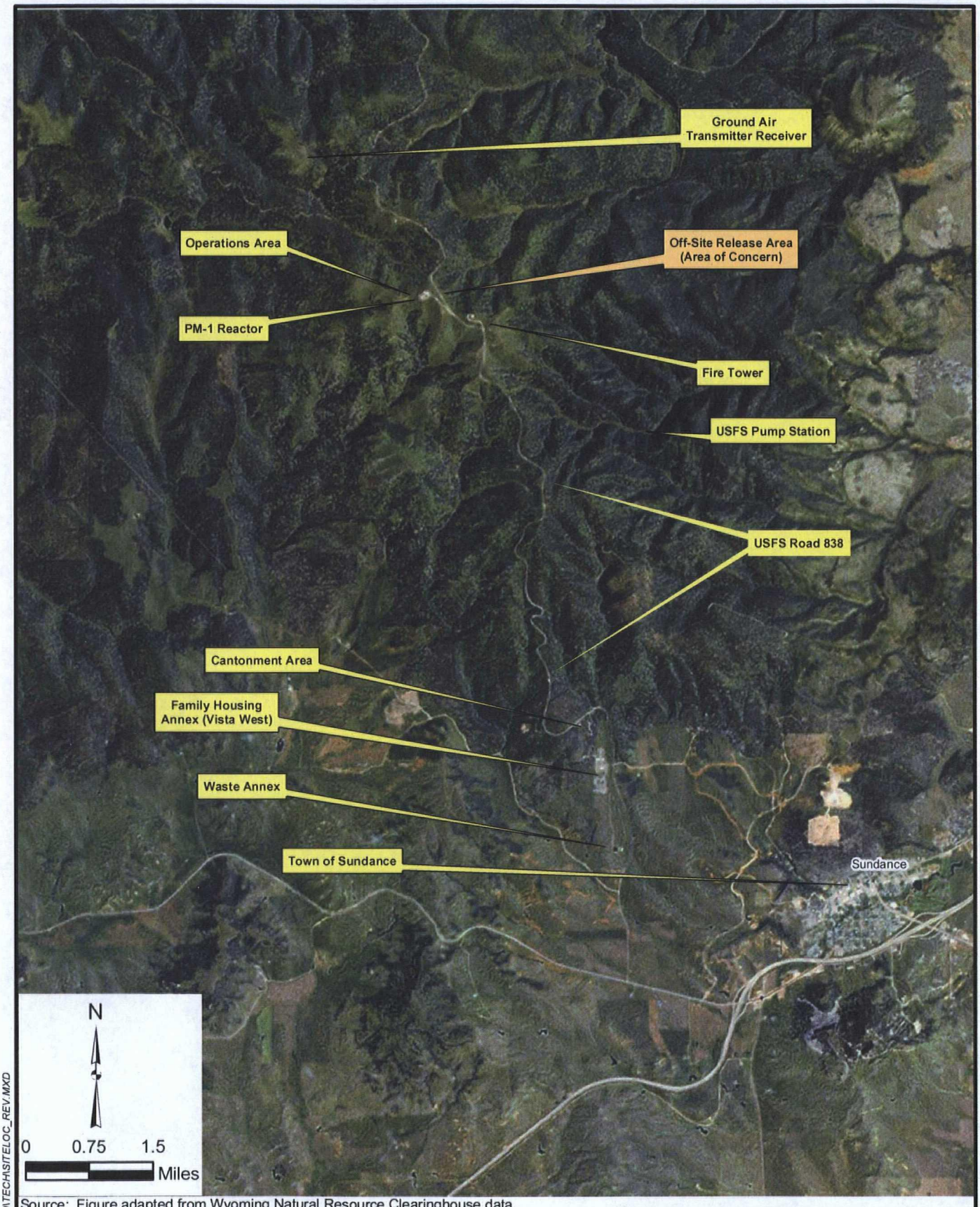
Figures



Source: Figure adapted from Wyoming Natural Resource Clearinghouse data.

File: L:\WORK\TERC\74309\TECH\SITELOC_REV.MXD

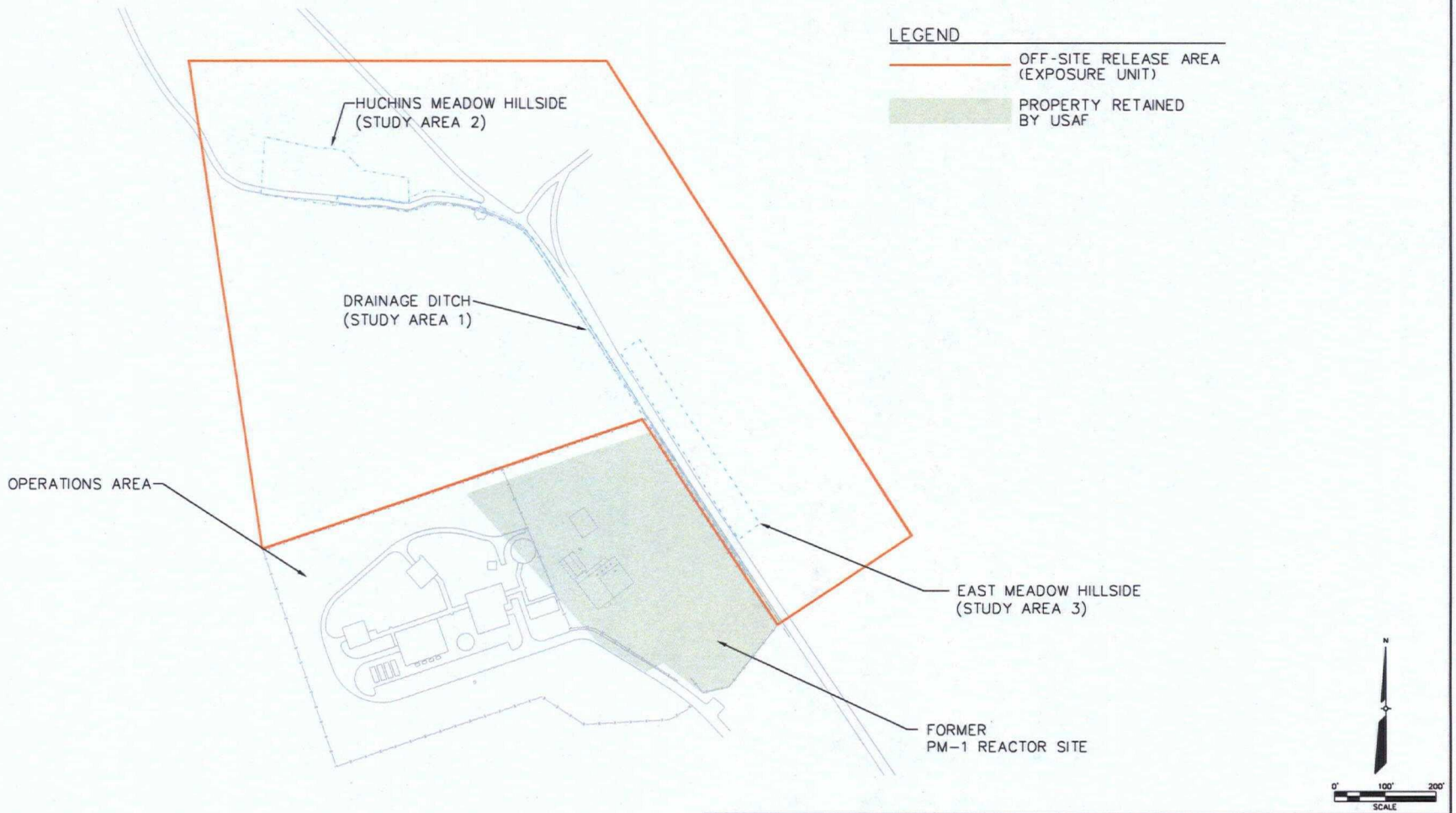
EARTH TECH | AECOM

FIGURE 2-1
SITE LOCATION MAP

FORMER SUNDANCE AIR FORCE STATION
SUNDANCE, WYOMING

OCTOBER 2010

60135669



EARTH TECH | AECOM

FIGURE 2-2
OFF-SITE RELEASE
(EXPOSURE UNIT)
FORMER SUNDANCE AIR FORCE STATION
SUNDANCE, WYOMING

OCTOBER 2010 60135669

File: L:\work\terc\63842_54\codd_01-CRAIG\SEPT10\AREASAMP_LOC.dwg Time: Oct 22, 2010 - 10:08am

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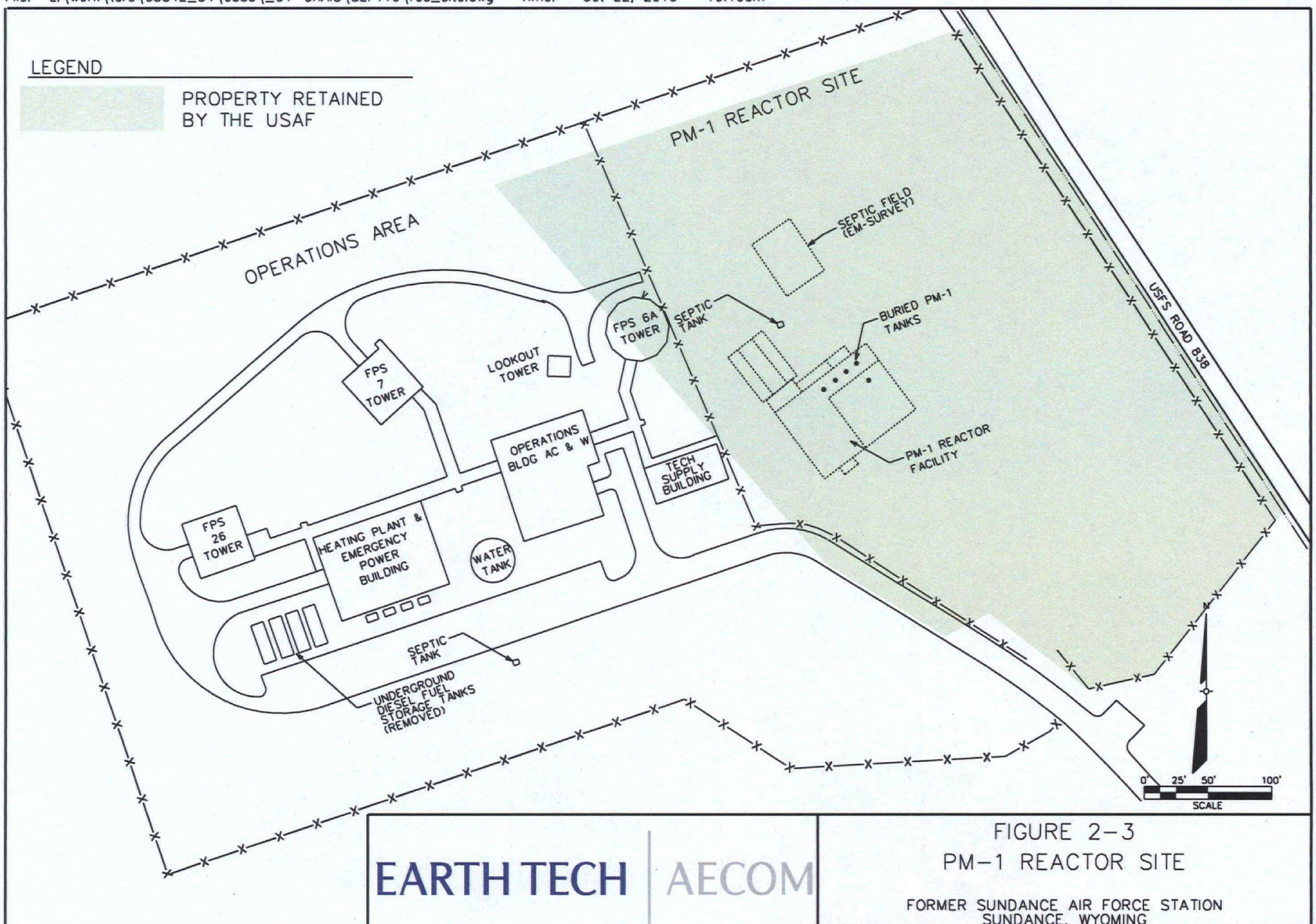


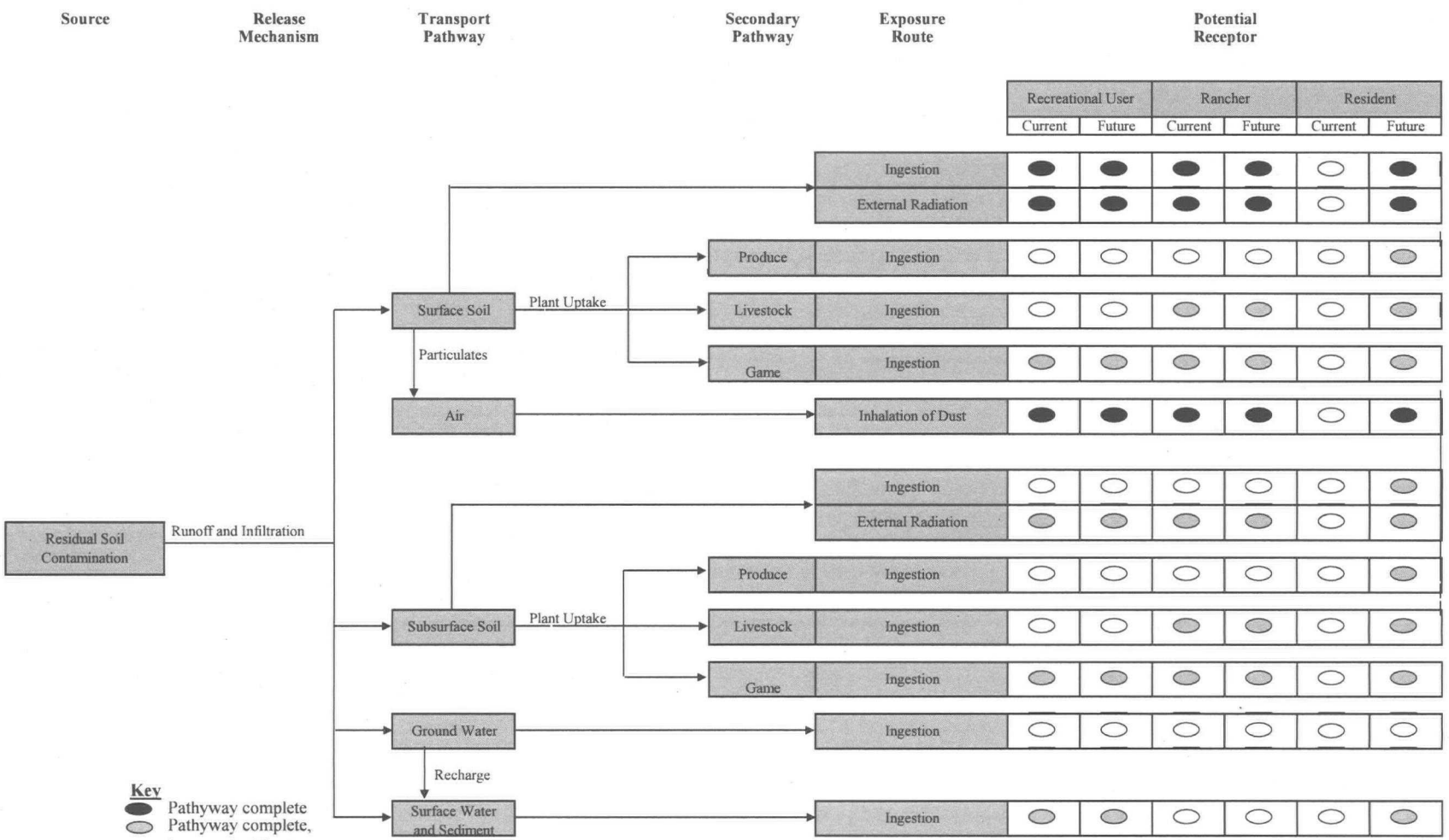
EARTH TECH | AECOM

FIGURE 2-3
PM-1 REACTOR SITE

FORMER SUNDANCE AIR FORCE STATION
SUNDANCE, WYOMING

OCTOBER 2010 60135669

Figure 2-4
Conceptual Exposure Model*
Off-Site Release



* Source: Final Remedial Investigation Report, Former Sundance Air Force Station, Wyoming, 2007

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Appendix A

Advertisement for the Public Meeting

Ellsworth Air Force Base, South Dakota invites its Sundance, Wyoming Neighbors to attend a

Public Meeting

Wednesday/April 14/7:00 PM
Community Room located in the basement of
the Crook County Courthouse
309 Cleveland Street, Sundance, Wyoming

Ellsworth Air Force Base is holding a public meeting to discuss the environmental activities at the former Sundance Air Force Station PM-1 Site located on Warren Peak in the Bearlodge Mountains. Several years ago, the Air Force began an effort to update the annual monitoring plan and investigate a historical release of contaminants from the site. The Air Force has completed investigation of the release and has determined that no further action is needed. The public is invited to comment on this proposed decision. The Air Force will continue to monitor the site through at least 2044.

A 30-day public comment period has been established beginning April 7, 2010. Please submit any comments by May 7, 2010. Additional information is available at the Information Repository at the Sundance Public Library located at 414 East Main Street and the Crook County Museum located at 309 Cleveland Street.

For more information, or to submit comments, please contact Tech. Sgt. Steven Wilson by mail at 28th Bomb Wing Public Affairs, 1958 Scott Drive, Suite 4, Ellsworth AFB, SD 57706-4711, telephone 605-385-5056, fax 605-385-4668, or email steven.wilson2@acc.afmil.

Appendix B

Analytical Results

- Table B-1: RI Analytical Results
- Table B-2: Previous EU Sample Results
- Figure B-1: Figure Location Key (Figures B-2 and B-3)
- Figure B-2: Expanded PA/SI Soil Sample Locations (PM-1 Area)
- Figure B-3: Expanded PA/SI Soil Sample Locations (North Area)
- Figure B-4: RI Surface Soil Sample ^{137}Cs Results

TABLE B-1

RI ANALYTICAL RESULTS
Former Sundance Air Force Station, Wyoming

Sample No.	Date	Cs-137 (pCi/g)				Sr-90 (pCi/g)			
		Value	Uncertainty (2s)	Code	MDC	Value	Uncertainty (2s)	Code	MDC
Reference Area									
SS04RFA1	29-Sep-04	1.09	0.21	J	0.14				
SS04RFA2	29-Sep-04	1.72	0.32	J	0.147	2.19	0.58	J	0.0292
SS04RFA2QC	29-Sep-04	1.45	0.26	J	0.158				
SS04RFA3	29-Sep-04	1.16	0.22	J	0.15				
SS04RFA4	29-Sep-04	1.42	0.27	J	0.177				
SS04RFA5	29-Sep-04	1.02	0.21	J	0.171	1.07	0.28	J	0.0322
SS04RFA6	29-Sep-04	1.48	0.26	J	0.14				
SS04RFB1	29-Sep-04	3.13	0.46	J	0.219				
SS04RFB2	29-Sep-04	1.36	0.24	J	0.142				
SS04RFB3	29-Sep-04	0.691	0.19	J	0.185	1.46	0.38	J	0.0263
SS04RFB4	29-Sep-04	0.886	0.23	J	0.179				
SS04RFB5	29-Sep-04	3.07	0.45	J	0.185				
SS04RFB6	29-Sep-04	3.79	0.56	J	0.185	3.35	0.88	J	0.0266
SS04RFC1	29-Sep-04	1.64	0.26	J	0.134				
SS04RFC2	29-Sep-04	0.898	0.22	J	0.176	1.14	0.3	J	0.0254
SS04RFC2QC	29-Sep-04	1.03	0.24	J	0.178	3.15	0.84	J	0.0271
SS04RFC3	29-Sep-04	1.2	0.25		0.178				
SS04RFC4	29-Sep-04	1.32	0.24		0.159				
SS04RFC5	29-Sep-04	1.46	0.42		0.318	0.776	0.21		0.049
SS04RFC6	29-Sep-04	0.631	0.25		0.278				
SS04RFC6QC	29-Sep-04	0.585	0.22		0.224				
SS04RFD1	29-Sep-04	1.29	0.44		0.266	1.34	0.36		0.0441
SS04RFD2	29-Sep-04	2.43	0.54		0.254				
SS04RFD3	29-Sep-04	1.34	0.36		0.3				
SS04RFD4	29-Sep-04	3.9	0.83		0.446	2.13	0.57		0.0573
SS04RFD5	29-Sep-04	2.24	0.46		0.231				
SS04RFD6	29-Sep-04	1.25	0.39		0.248				
SS04RFE1	29-Sep-04	2	0.41		0.31	1.43	0.38		0.0382
SS04RFE2	29-Sep-04	1.01	0.47		0.374				
SS04RFE3	29-Sep-04	1.62	0.38		0.269				
SS04RFE4	29-Sep-04	2.7	0.58		0.369	1.55	0.41		0.0381
SS04RFE5	29-Sep-04	1.09	0.31		0.351				
SS04RFE6	29-Sep-04	1.4	0.44		0.339				
Ditch Background									
SS04DBK1	2-Oct-04	0.317	0.13	U	0.234				
SS04DBK2	2-Oct-04	-0.0073	0.12	U	0.208				
SS04DBK3	2-Oct-04	0.0757	0.13	U	0.231				
SS04DBK4	2-Oct-04	0.0326	0.11	U	0.196				
SS04DBK4QC	2-Oct-04	0.0081	0.12	U	0.201				
SS04DBK5	2-Oct-04	0.158	0.1	U	0.184				
Drainage Ditch (Study Area 1)									
SS04DDA1	28-Sep-04	-0.0062	0.15	U	0.251	1.86	0.51		0.0345
SS04DDA2	28-Sep-04	-0.0691	0.095	U	0.155				
SS04DDA3	28-Sep-04	0.0901	0.14	U	0.241				
SS04DDA4	28-Sep-04	0.171	0.087	U	0.155	0.515	0.14		0.0285
SS04DDA5	28-Sep-04	5.17	0.76		0.216				
SS04DDA6	28-Sep-04	2.31	0.4		0.205				
SS04DDA7	28-Sep-04	0.299	0.11		0.0984	0.1	0.035		0.0332
SS04DDA8	28-Sep-04	2.94	0.5		0.249				
SS04DDA9	28-Sep-04	47.5	5.8		0.427				
SS04DDA10	28-Sep-04	22	2.7		0.23	0.28	0.078		0.0347
SS04DDA10QC	28-Sep-04	22.6	2.9		0.263	0.275	0.076		0.0278
SS04DDA11	28-Sep-04	92.1	11		0.331				
SS04DDA12	28-Sep-04	12.5	1.7		0.364				
SS04DDA13	28-Sep-04	1.69	0.4		0.313	0.615	0.16		0.0295
SS04DDA14	28-Sep-04	1.66	0.48		0.241				
SS04DDA15	28-Sep-04	0.928	0.28		0.219				
SS04DDA16	28-Sep-04	1.34	0.28		0.188	0.413	0.11		0.0274
SS04DDA17	28-Sep-04	0.517	0.29		0.316				
SS04DDA18	28-Sep-04	3.66	0.62		0.291				
SS04DDA19	28-Sep-04	0.367	0.15		0.149	0.633	0.17		0.0269

TABLE B-1

RI ANALYTICAL RESULTS
Former Sundance Air Force Station, Wyoming

Sample No.	Date	Cs-137 (pCi/g)				Sr-90 (pCi/g)			
		Value	Uncertainty (2s)	Code	MDC	Value	Uncertainty (2s)	Code	MDC
SS04DDA20	28-Sep-04	2.53	0.46		0.263				
SS04DDA20QC	28-Sep-04	2.49	0.45		0.259				
SS04DDA21	28-Sep-04	3.81	0.65		0.323				
SS04DDA22	28-Sep-04	0.594	0.25		0.287	0.777	0.21		0.0262
SS04DDA23	28-Sep-04	0.835	0.29		0.268				
SS04DDA24	28-Sep-04	1.81	0.46		0.324				
SS04DDA25	28-Sep-04	2.54	0.53		0.26	0.778	0.21		0.0271
SS04DDA26	28-Sep-04	15.3	2		0.274				
SS04DDA27	28-Sep-04	0.737	0.3		0.177				
SS04DDA28	28-Sep-04	2.89	0.54		0.36	0.762	0.2		0.0305
SS04DDA29	28-Sep-04	1.31	0.37		0.259				
SS04DDA30	28-Sep-04	3.11	0.59		0.317				
SS04DDA30QC	28-Sep-04	3	0.56		0.321				
SS04DDA31	28-Sep-04	10	1.3		0.158				
Biased Ditch (Study Area 1)									
SS04BD1	4-Oct-04	14.3	1.9		0.344	3.47	0.91	J	0.0189
SS04BD2	4-Oct-04	2.8	0.56		0.356	0.076	0.024	J	0.0192
SS04BD3	4-Oct-04	16.8	2.1		0.278	2	0.53	J	0.0154
SS04BD4	4-Oct-04	1.05	0.3		0.315	4.06	1.1	J	0.0316
SS04BD5	4-Oct-04	17	2.2		0.36				
SS04BD6	4-Oct-04	1.76	0.32		0.181				
SS04BD7	4-Oct-04	0.621	0.19		0.148				
SS04BD8	4-Oct-04	0.283	0.11		0.109				
SS04BD9	4-Oct-04	1.49	0.4		0.331				
SS04BD10	4-Oct-04	0.944	0.36		0.297				
SS04BD11	4-Oct-04	1.78	0.35		0.19	0.719	0.19	J	0.0234
SS04BD12	4-Oct-04	2.25	0.55		0.312				
SS04BD13	4-Oct-04	8.61	1.2		0.244				
SS04BD14	4-Oct-04	0.911	0.23		0.212				
SS04BD15	4-Oct-04	10.9	1.4		0.206	0.767	0.2	J	0.0165
SS04BD15QC	4-Oct-04	10.4	1.4		0.207	0.825	0.22	J	0.0175
SS04BD16	4-Oct-04	6.39	0.93		0.269				
SS04BD17	4-Oct-04	0.44	0.15		0.134				
SS04BD18	4-Oct-04	11.6	1.5		0.131				
SS04BD18QC	4-Oct-04	11	1.5		0.283				
SS04BD19	4-Oct-04	1.36	0.27		0.206				
Huchins Meadow Hillside (Study Area 2)									
SS04HMA1	30-Sep-04	2.02	0.42		0.23	0.278	0.079		0.0385
SS04HMA1 QC	30-Sep-04	1.94	0.48		0.323	0.33	0.09		0.0263
SS04HMA2	2-Oct-04	0.304	0.094	U	0.173				
SS04HMA3	2-Oct-04	1.78	0.35		0.194				
SS04HMA4	2-Oct-04	9.28	1.3		0.276	0.365	0.099		0.0243
SS04HMA5	2-Oct-04	10.7	1.5		0.205				
SS04HMA6	2-Oct-04	1.19	0.28		0.221				
SS04HMB1	2-Oct-04	1.04	0.32		0.243	0.571	0.16		0.0309
SS04HMB2	2-Oct-04	1.03	0.34		0.214				
SS04HMB3	2-Oct-04	2.45	0.5		0.319				
SS04HMB4	2-Oct-04	22.1	2.8		0.369				
SS04HMB5	2-Oct-04	1.03	0.38		0.307	0.36	0.099		0.0328
SS04HMB6	2-Oct-04	0.948	0.34		0.24				
SS04HMB7	4-Oct-04	1.69	0.27		0.14				
SS04HMB8	4-Oct-04	16.8	2		0.154				
SS04HMB9	4-Oct-04	2.51	0.38		0.14	1.44	0.39		0.0277
SS04HMC1	2-Oct-04	2.11	0.54		0.349	0.649	0.17		0.0336
SS04HMC2	2-Oct-04	1.51	0.27		0.109				
SS04HMC3	2-Oct-04	1.12	0.28		0.244				
SS04HMC4	2-Oct-04	7.82	1.2		0.342	0.763	0.2		0.0318
SS04HMC4 QC	2-Oct-04	6.4	0.99		0.204				
SS04HMC5	2-Oct-04	1.37	0.33		0.211				
SS04HMC6	2-Oct-04	1.24	0.32		0.247				
SS04HMC7	4-Oct-04	0.573	0.16		0.132				
SS04HMC8	4-Oct-04	0.696	0.16		0.1				

TABLE B-1

RI ANALYTICAL RESULTS
Former Sundance Air Force Station, Wyoming

Sample No.	Date	Cs-137 (pCi/g)				Sr-90 (pCi/g)			
		Value	Uncertainty (2s)	Code	MDC	Value	Uncertainty (2s)	Code	MDC
SS04HMC9	4-Oct-04	2.65	0.38		0.101	1.47	0.39		0.0286
SS04HMC10	4-Oct-04	1.26	0.24		0.139				
SS04HMC11QC	4-Oct-04	6.85	0.87		0.135				
SS04HMC11	4-Oct-04	7.4	0.94		0.143	1.27	0.33		0.0248
SS04HMD1	2-Oct-04	0.597	0.26		0.239				
SS04HMD2	2-Oct-04	2.04	0.43		0.254	1.02	0.27		0.0413
SS04HMD3	2-Oct-04	1.03	0.36		0.314				
SS04HMD4	2-Oct-04	0.879	0.34		0.264				
SS04HMD5	2-Oct-04	1.41	0.33		0.3	0.724	0.19		0.0308
SS04HMD6	2-Oct-04	1.37	0.33		0.259				
SS04HMD7	4-Oct-04	0.668	0.16		0.102				
SS04HMD8	4-Oct-04	1.81	0.28		0.1				
SS04HMD9	4-Oct-04	1.33	0.23		0.153				
SS04HMD10	4-Oct-04	2.88	0.42		0.149	1.37	0.36		0.0266
SS04HME1	2-Oct-04	1.34	0.34		0.251				
SS04HME2	2-Oct-04	0.792	0.28		0.184				
SS04HME3	2-Oct-04	1.12	0.36		0.239	0.569	0.15		0.0314
SS04HME4	2-Oct-04	0.926	0.25		0.184				
SS04HME5	2-Oct-04	1.12	0.28		0.173	0.502	0.14		0.0301
SS04HME6	2-Oct-04	1.3	0.31		0.221				
SS04HME6 QC	2-Oct-04	1.17	0.47		0.283				
Meadow East Hillside (Study Area 3)									
SS04MEA1	29-Sep-04	1.42	0.49		0.429	0.325	0.089		0.0308
SS04MEA2	29-Sep-04	1.2	0.44		0.388				
SS04MEA3	29-Sep-04	3.27	0.72		0.461				
SS04MEA4	29-Sep-04	6.04	0.93		0.29	0.47	0.13		0.0288
SS04MEA5	29-Sep-04	9.46	1.2		0.214				
SS04MEA5 QC	29-Sep-04	8.38	1.1		0.24				
SS04MEA6	29-Sep-04	5.05	0.84		0.399	0.19	0.054		0.0285
SS04MEA7	29-Sep-04	6.24	0.98		0.335				
SS04MEA8	29-Sep-04	10.1	1.4		0.262				
SS04MEA9	29-Sep-04	7.89	1.2		0.317				
SS04MEA10	29-Sep-04	10.6	1.4		0.227				
SS04MEB1	29-Sep-04	1.13	0.32		0.201				
SS04MEB2	29-Sep-04	0.883	0.29	U	0.577				
SS04MEB3	29-Sep-04	2.75	0.52		0.315	0.833	0.22		0.0327
SS04MEB4	29-Sep-04	3.12	0.54		0.262				
SS04MEB5	29-Sep-04	1.62	0.4		0.272				
SS04MEB6	29-Sep-04	1.29	0.25		0.161	0.335	0.094		0.0457
SS04MEB7	29-Sep-04	1.91	0.34		0.139				
SS04MEB8	29-Sep-04	2.93	0.4		0.108				
SS04MEB9	29-Sep-04	2.7	0.4		0.139				
SS04MEB10	29-Sep-04	2	0.29		0.116	0.374	0.1		0.0363
SS04MEC1	29-Sep-04	1.27	0.21		0.116	0.769	0.2		0.0269
SS04MEC1 QC	29-Sep-04	1.63	0.27		0.173				
SS04MEC2	29-Sep-04	0.754	0.19		0.15				
SS04MEC3	29-Sep-04	0.623	0.16		0.144				
SS04MEC4	29-Sep-04	2.4	0.34		0.122	0.728	0.19		0.0305
SS04MEC5	29-Sep-04	1.43	0.24		0.115				
SS04MEC6	29-Sep-04	0.946	0.17		0.131				
SS04MEC7	29-Sep-04	1.57	0.25		0.103	0.48	0.13		0.0313
SS04MEC8	29-Sep-04	1.53	0.28		0.151				
SS04MEC9	29-Sep-04	2.27	0.35		0.171				
SS04MEC10	29-Sep-04	2.77	0.41		0.145	0.768	0.2		0.0301
SS04MEC10QC	29-Sep-04	2.76	0.4		0.139	0.867	0.23	J	0.024
Exposure Unit (located within EU, but not within specific study Area)									
SS04EU1	2-Oct-04	0.658	0.16		0.145				
SS04EU2	2-Oct-04	1.7	0.29		0.151				
SS04EU3	4-Oct-04	1.3	0.2		0.106				
SS04EU4	2-Oct-04	1.79	0.31		0.166				
SS04EU5	2-Oct-04	1.51	0.24		0.15				
SS04EU6	4-Oct-04	1.83	0.3		0.141				

TABLE B-1

RI **ANALYTICAL** RESULTS
Former Sundance Air Force Station, Wyoming

Sample No.	Date	Cs-137 (pCi/g)				Sr-90 (pCi/g)			
		Value	Uncertainty (2s)	Code	MDC	Value	Uncertainty (2s)	Code	MDC
SS04EU7	4-Oct-04	2.05	0.3		0.112				
SS04EU8	2-Oct-04	1.25	0.22		0.105				
SS04EU9	2-Oct-04	1.56	0.25		0.111				
SS04EU10	1-Oct-04	3.85	0.54		0.195				
SS04EU11	1-Oct-04	1.14	0.23		0.161				
SS04EU12	1-Oct-04	1.11	0.27		0.18				
SS04EU13	1-Oct-04	1.77	0.33		0.155				
SS04EU14	1-Oct-04	0.961	0.21		0.138				
SS04EU14QC	1-Oct-04	1.15	0.24		0.162				
SS04EU15	1-Oct-04	1.18	0.27		0.164				
SS04EU16	1-Oct-04	2.1	0.31		0.118				
SS04EU16QC	1-Oct-04	2.9	0.44		0.193				
SS04EU17	1-Oct-04	1.82	0.3		0.15				
SS04EU18	1-Oct-04	1.13	0.24		0.188				
SS04EU19	1-Oct-04	1.61	0.29		0.201				
SS04EU20	1-Oct-04	1.43	0.3		0.23				
Subsurface Sample - Reference Area									
DP04RFA4(1-4')	1-Oct-04	-0.186	0.1	U	0.162	0.167	0.05	J	0.0327
DP04RFA4(4-8')	1-Oct-04	-0.09	0.14	U	0.239	0.829	0.22	J	0.0243
DP04RFA4(4-8')QC	1-Oct-04	-0.0485	0.14	U	0.24	0.337	0.092	J	0.0271
DP04RFB1(1-4')	1-Oct-04	-0.105	0.11	U	0.176	0.36	0.099	J	0.0267
DP04RFB1(4-8')	1-Oct-04	0.0321	0.11	U	0.192	1.21	0.32	J	0.0243
DP04RFD6(1-4')	1-Oct-04	-0.0509	0.12	U	0.196	0.76	0.2	J	0.032
DP04RFD6(1-4')QC	1-Oct-04	-0.0449	0.12	U	0.203	0.303	0.085	J	0.0336
DP04RFD6(4-8')	1-Oct-04	-0.162	0.12	U	0.189	0.993	0.26	J	0.0313
DP04RFE2(1-4')	1-Oct-04	-0.0698	0.12	U	0.195	0.421	0.11	J	0.029
DP04RFE2(4-8')	1-Oct-04	-0.16	0.19	U	0.303	0.377	0.1	J	0.0278
Subsurface Sample - Exposure Unit									
DP04PM01(1-4')	30-Sep-04	0.759	0.2		0.272	1.34	0.35	J	0.0238
DP04PM01(4-8')	30-Sep-04	-0.141	0.21	U	0.339	0.889	0.24	J	0.029
DP04PM02(1-4')	30-Sep-04	0.367	0.14		0.193	0.315	0.086	J	0.0243
DP04PM02(4-8')	30-Sep-04	-0.0686	0.1	U	0.172	0.488	0.13	J	0.025
DP04PM03(1-4')	1-Oct-04	0.311	0.13		0.143	0.394	0.11	J	0.0349
DP04PM04(1-4')	1-Oct-04	-0.052	0.078	U	0.128	0.154	0.047	J	0.0313
DP04PM04(4-8')	1-Oct-04	-0.165	0.1	U	0.156	0.78	0.21	J	0.0356
DP04PM05(1-3')	30-Sep-04	1.22	0.22		0.159	0.356	0.099	J	0.0346
DP04PM05(4-8')	30-Sep-04	-0.0226	0.076	U	0.131	0.162	0.05	J	0.0319
DP04PM07(1-4')	30-Sep-04	-0.0642	0.083	U	0.137	0.197	0.059	J	0.0348
DP04PM07(4-8')	30-Sep-04	-0.099	0.099	U	0.159	0.323	0.09	J	0.0279
DP04PM08(1-3')	30-Sep-04	0.441	0.16		0.16	2.37	0.63	J	0.0267
DP04PM08(4-8')	30-Sep-04	-0.0508	0.1	U	0.167	1.38	0.36	J	0.0265

Notes:
J = Estimated Value.
MDC = Minimum Detection Concentration.
pCi/g = picoCurie per gram.
U = Not detected.
2s = Uncertainty (2 sigma).
All results inclusive of background.
Source: Table 2-2 of the Final Remedial Investigation Report, October 2007.

TABLE B-2

PREVIOUS EU SAMPLE RESULTS
Former Sundance Radar Station, Wyoming

Sample No.	QC	Sample Date	Soil Type[1]	Units	Cesium-137				Strontium-90			
					Value	Uncertainty (2s)	Code	MDC	Value	Uncertainty (2s)	Code	MDC
Drainage Ditch (Study Area 1)[2]												
DP01PM11 (0-0.5)		08/31/01	GVL	pCi/g	44.60	5.30		0.079	1.61	0.43		0.067
DP01PM13 (0-0.5)		08/31/01	GVL	pCi/g	3.76	0.45		0.047				
DP01PM18 (0-5)		09/01/01	GVL	pCi/g	15.20	1.80		0.045				
DP01PM19 (0-0.5)		09/03/01	GVL	pCi/g	4.68	0.56		0.033				
OAISOCS44 (OA44)		09/01/01	GVL	pCi/g	3.42	0.41		0.039				
PMISOCS44B		09/01/01	ORG	pCi/g	38.90	4.60		0.046				
PMISOCS44B dup	FD	09/01/01	ORG	pCi/g	37.90	4.50		0.037				
PMISOCS44D		09/02/01	ORG	pCi/g	7.59	0.90		0.038				
PMISOCS53		09/03/01	GVL	pCi/g	4.67	0.55		0.037				
PMISOCS55		09/03/01	ORG	pCi/g	23.60	2.80		0.039				
PMISOCS55 dup	FD	09/03/01	ORG	pCi/g	22.90	2.70		0.036				
SB01PM14		09/01/01	GVL	pCi/g	0.33	0.06		0.062				
Huchins Meadow Hillside (Study Area 2)												
PMISOCS74		09/06/01	ORG	pCi/g	66.70	7.90		0.061				
East Meadow Hillside (Study Area 3)												
DP01PM10 (0-0.5)		08/31/01	ORG	pCi/g	1.78	0.22		0.048	0.30	0.10		0.099
DP01PM10 (0-0.5) dup	FD	08/31/01	ORG	pCi/g	1.67	0.20		0.045	1.50	0.40		0.077
DP01PM21 (0-0.5)		09/04/01	ORG	pCi/g	64.90	7.60		0.046				
SB00PM09		10/15/00	ORG	pCi/g	2.30	0.04		0.207	0.65	0.26		0.293
SB00PM10		10/15/00	ORG	pCi/g	0.42	0.23		0.263	0.37	0.21		0.310
Exposure Unit (located within EU but not within a specific study area)												
OAISOCS45 (OA45)		09/01/01	ORG	pCi/g	1.15	0.21		0.107				
PMISOCS07		09/01/01	ORG	pCi/g	0.18	0.04		0.037				
PMISOCS08		09/01/01	ORG	pCi/g	0.36	0.07		0.077				
PMISOCS09		09/01/01	ORG	pCi/g	0.60	0.09		0.054				
PMISOCS26		09/03/01	ORG	pCi/g	1.46	0.18		0.054				
PMISOCS27		09/01/01	ORG	pCi/g	0.72	0.10		0.044				
PMISOCS28		09/01/01	ORG	pCi/g	0.00	0.04	U	0.058				
PMISOCS40		09/01/01	ORG	pCi/g	1.98	0.24		0.066				
PMISOCS44C		09/02/01	ORG	pCi/g	2.31	0.28		0.046				
PMISOCS44E		09/02/01	ORG	pCi/g	1.88	0.23		0.035				
PMISOCS51		09/02/01	ORG	pCi/g	3.77	0.45		0.031				
PMISOCS78		09/06/01	ORG	pCi/g	0.67	0.09		0.026				
PMISOCS80		09/06/01	ORG	pCi/g	0.69	0.09		0.036				

Notes:

[1] - Site soil classification developed for background comparison.

[2] - Samples collected during PA/SI omitted from sample set due to grading of ditch after sample collection.

FD - Field Duplicate.

GVL - (gravel) denotes soils comprised primarily of bedrock-derived gravel with a low percentage of organically-derived soil.

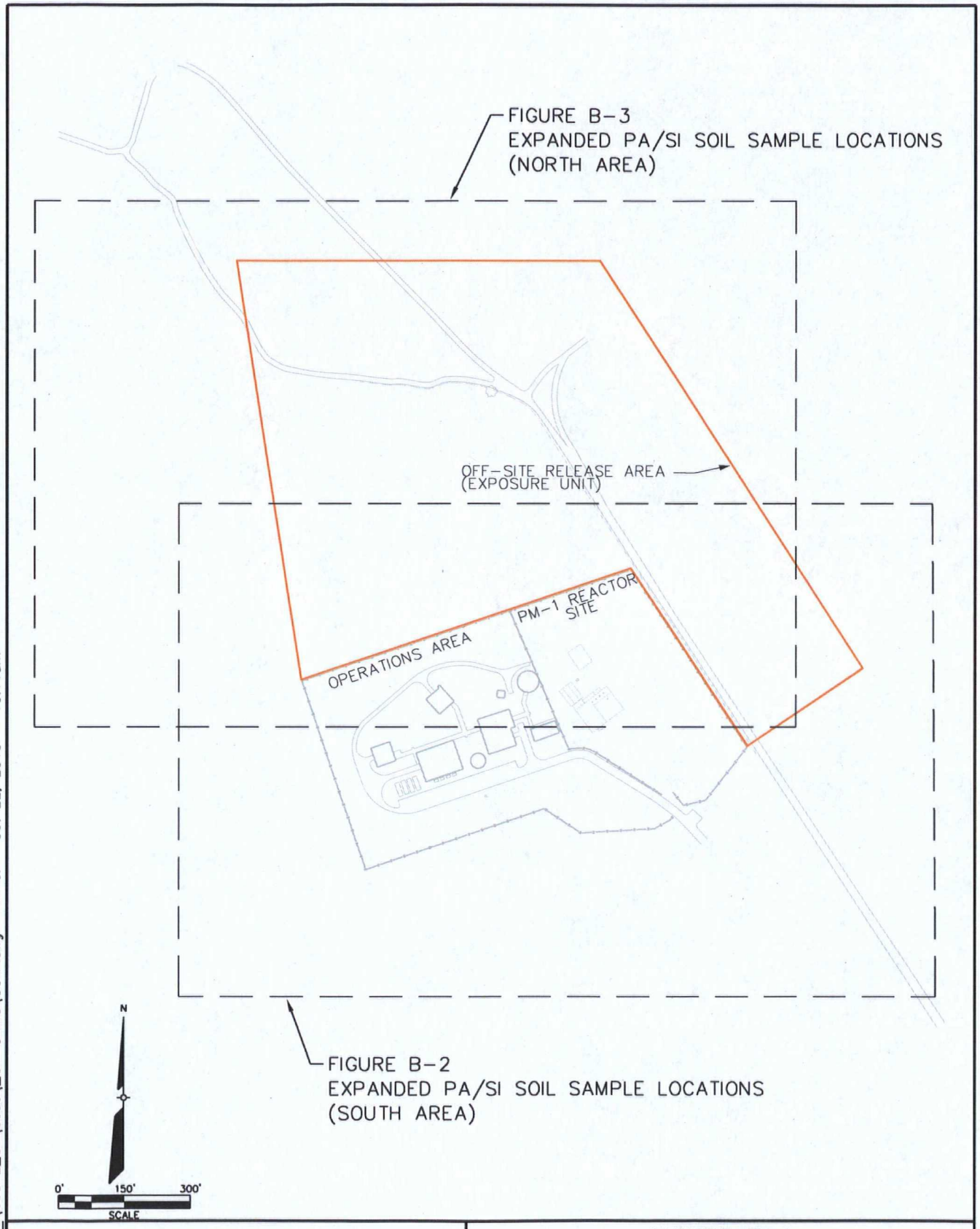
MDC - Minimum detection concentration.

ORG - (organic) denotes soils with a relatively high percentage of organically-derived soil.

U - Not detected.

2s - Uncertainty (2 sigma).

Source: Table 6-2 of the Final Remedial Investigation Report, October 2007.



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EARTH TECH | AECOM

FIGURE B-1

FIGURE LOCATION KEY
(FIG. B-2 AND B-3)

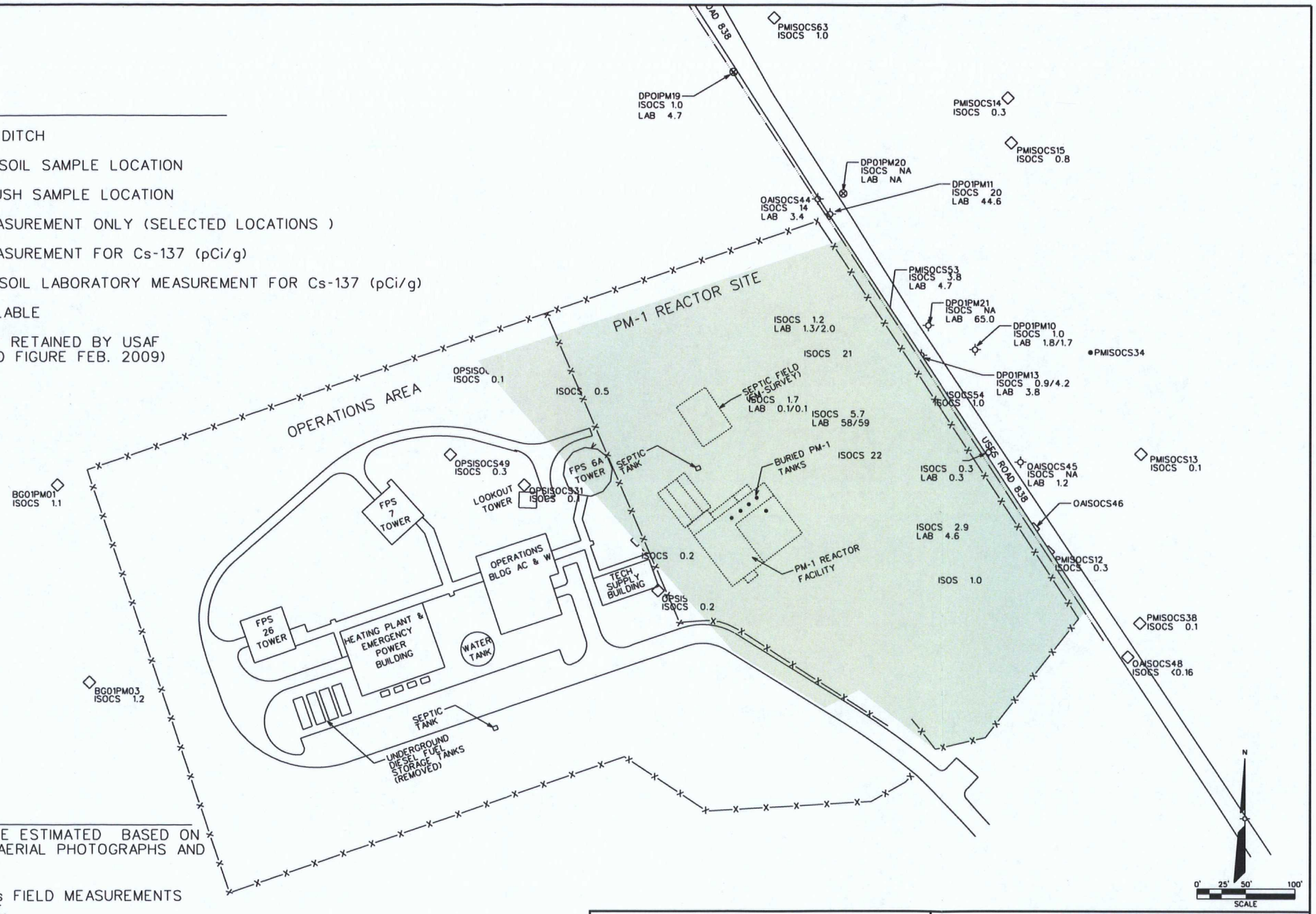
FORMER SUNDANCE AIR FORCE STATION
SUNDANCE, WYOMING

OCTOBER 2010

60135669

LEGEND

- DRAINAGE DITCH
- SURFACE SOIL SAMPLE LOCATION
- DIRECT PUSH SAMPLE LOCATION
- ISOCS MEASUREMENT ONLY (SELECTED LOCATIONS)
- ISOCS 1.3 — ISOCS MEASUREMENT FOR Cs-137 (pCi/g)
- LAB 4.7 — SURFACE SOIL LABORATORY MEASUREMENT FOR Cs-137 (pCi/g)
- NA — NOT AVAILABLE
- PROPERTY RETAINED BY USAF (ADDED TO FIGURE FEB. 2009)



NOTES

1. ROAD LOCATIONS ARE ESTIMATED BASED ON GPS COORDINATES, AERIAL PHOTOGRAPHS AND REGIONAL MAPPING.
2. ONLY SELECT ISOC's FIELD MEASUREMENTS INCLUDED ON FIGURE.
3. SOURCE: FIGURE 1-9 OF THE FINAL REMEDIAL INVESTIGATION REPORT, OCTOBER 2007

EARTH TECH | AECOM

FIGURE B-2
EXPANDED PA/SI SOIL SAMPLE LOCATIONS (PM-1 AREA)
FORMER SUNDANCE AIR FORCE STATION
SUNDANCE WYOMING

OCTOBER 2010 60135669

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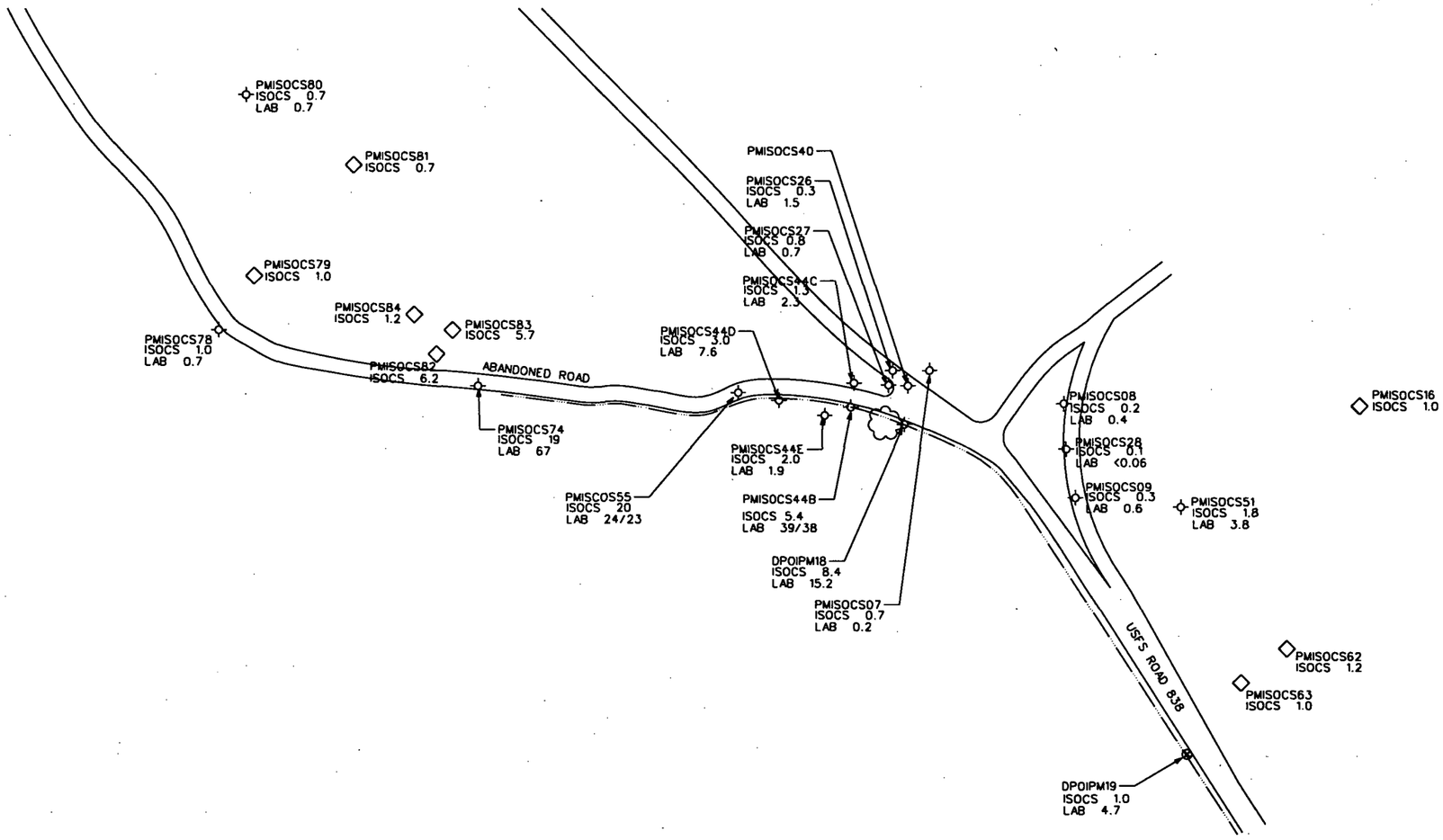

NOTES

1. ROAD LOCATIONS ARE ESTIMATED BASED ON GPS COORDINATES, AERIAL PHOTOGRAPHS AND REGIONAL MAPPING.
2. ONLY SELECT ISOC's FIELD MEASUREMENTS INCLUDED ON FIGURE.
3. SOURCE: FIGURE 1-10 OF THE FINAL REMEDIAL INVESTIGATION REPORT, OCTOBER 2007

LEGEND

—·—·—	DRAINAGE DITCH
⊹	SURFACE SOIL SAMPLE LOCATION
◇	ISOCS MEASUREMENT ONLY (SELECTED LOCATIONS)
ISOCS 1.3	ISOCS MEASUREMENT FOR Cs-137 (pCi/g)
LAB 4.7	SURFACE SOIL LABORATORY MEASUREMENT FOR Cs-137 (pCi/g)

N

0' 25' 50' 100'
SCALE

EARTH TECH | AECOM

FIGURE B-3
EXPANDED PA/SI SOIL SAMPLE LOCATIONS (NORTH END)
FORMER SUNDANCE AIR FORCE STATION
SUNDANCE WYOMING

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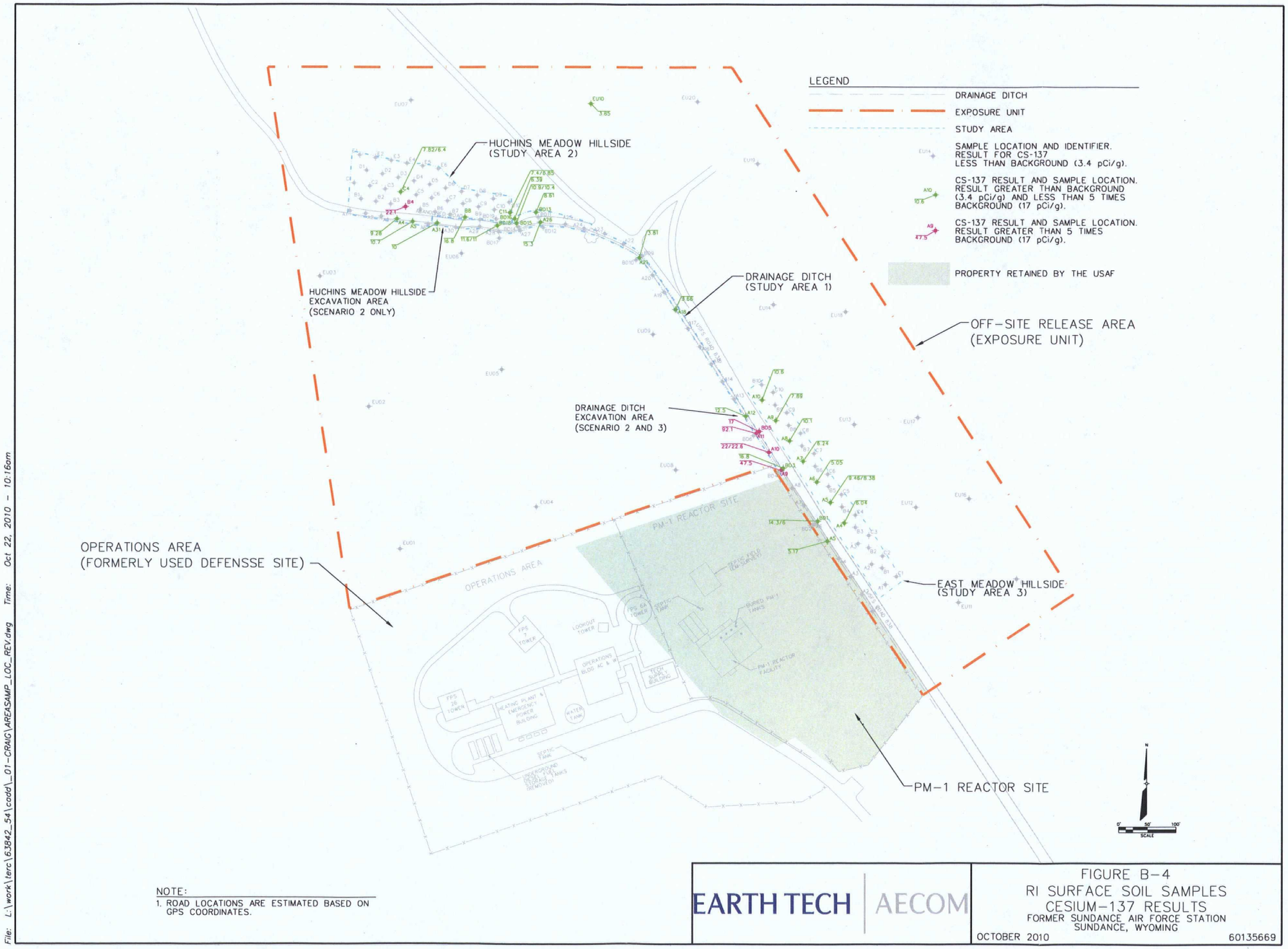

NOTE:
1. ROAD LOCATIONS ARE ESTIMATED BASED ON GPS COORDINATES.

EARTH TECH | AECOM

FIGURE B-4
RI SURFACE SOIL SAMPLES
CESIUM-137 RESULTS
FORMER SUNDANCE AIR FORCE STATION
SUNDANCE, WYOMING

OCTOBER 2010 60135669

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