Janine Katanic

From: Paige Walton [paigewalton@msn.com]
Sent: Thursday, August 28, 2008 9:31 AM
To: Janine Katanic; David Larsen
Cc: Carter, Jeffery DPG; greg.komp@us.army.mil; tanya.oxenberg@conus.army.mil
Subject: SWMU-11 Work Plan (UNCLASSIFIED)
Attachments: SWMU11.pdf

Janine,

Attached please find the Final Work Plan for Dugway Proving Ground's SWMU 11. Please let me know if you need additional information.

Thanks,

Paige

Date: 22 August 2008
To: Ed Staes/Emily Hayes, Parsons
Written By: John Hackett

SUBJECT: Revisions to Final Phase II RCRA Facility Investigation Work Plan, SWMU-11 Radiological Survey, March 2005

The original SWMU-11 Work Plan Addendum contained investigation plans for multiple SWMUs at Dugway Proving Ground. References to other SWMUs originally included in the work plan have been removed from the document. In addition, the document has been reformatted for consistent section, figure, and table numbering.

None of the original technical or historical content of the work plan has been changed. As such, some clarifications of the original work plan based on the characterization work or other known changes are presented below:

Page 2-5/Table 2.1: Project Health Physicist: John Hackett is currently with Cabrera Services, Inc., as a subcontractor to Parsons to support the SWMU-11 project.

Page 3-1: Radionuclides of Concern: The statement "Based on historical evidence, the primary radionuclides of concern (ROCs) addressed in this work plan are tritium (H-3), carbon-14 (C-14), cobalt-60 (Co-60), and radium-226 (Ra-226). Records indicate that these radionuclides were present in significant quantities at SWMU-11" is a generalization for the entire Dugway Proving Ground facility and is not technically correct for SWMU-11. Compounds containing tritum and carbon-14 were stored within the CONEX box at SWMU-11, and may have been disposed within the burial area. There is no specific record that items containing cobalt-60 or radium-226 were disposed there, and they were not detected during the characterization. Based on the characterization work performed, uranium and strontium-90 would also be considered ROCs.

Page 3-6/Figure 1.2: SWMU-11 Survey Area: As described in the SWMU-11 characterization report, the survey area was increased as a result of the detection of a metal/radiological anomaly located to the south of the open trenches. Additional survey grids were established to the south and west of the open trenches.

Page 3-9: Subsurface Soil Samples: Subsurface soil samples as described in the original work plan were not collected. Soils and debris removed from test pits at SWMU-11 were screened using hand-held instrumentation for above-background radioactivity. One debris sample from a test pit at the open trenches (MS001) had levels of uranium apparently present in activity fractions consistent with depleted uranium.

Page 3-10. CONEX Soil Sampling: Samples were not collected from soils directly beneath the CONEX container due to access limitations.

DUGWAY PROVING GROUND
DUGWAY, UTAH

FINAL
PHASE II RCRA FACILITY
WORK PLAN

SWMU-11
RADIOLOGICAL SURVEY

Contract Number: GS-10F-0179J
Delivery Order: W91238-04-F-0090

US Army Corps
of Engineers®

Submitted to:
U.S. Army Corps of Engineers
Sacramento District

March 2005

PARSONS

Prepared by:
PARSONS
Salt Lake City, Utah

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ACRONYMS AND ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
ANSI	Americal National Standards Institute
C-14	Carbon-14
Co-60	Cobalt-60
cm^2	Square Centimeters
CMS	Corrective Measures Study
cpm	Counts per Minute
DCGL	Derived Concentration Guideline Levels
DPG	Dugway Proving Ground
dpm	Decays per Minute
DQO	Data Quality Objective
DSHW	Division of Solid and Hazardous Waste
ERA	Ecological Risk Assessment
GM	Geiger Mueller Pancake Probe
H-3	Tritium
HRA	Human Risk Assessment
IRP	Installation Restoration Program
IRW	Installation Restoration Waste
keV	Kilo electron Volt
MARLAP	Multi Agency Radiation Laboratory Analytical Protocol
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDA	Minimum Detectable Amount
MeV	Mega-electron Volt
mrem/hr	Microrems per Year
mrem/yr	Millirem per Year
NaI	Sodium Iodide
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
PHP	Project Health Physicist
PHSO	Project Health and Safety Officer
QA	Quality Assurance
QC	Quality Control
Ra-226	Radium-226
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
ROC	Radionuclide of Concern
SAP	Sampling and Analysis Plan
SHSO	Site Health and Safety Officer
SSHP	Site Safety and Health Plan
STL	Severn Trent Laboratories
SOP	Standard Operating Procedure

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SOW	Statement of Work
SWMU	Solid Waste Management Unit
TEDE	Total Effective Dose Equivalent
URSA	Universal Radiation Spectrum Analyzer
USACE	US Army Corps of Engineers
USEPA	United States Environmental Protection Agency

SECTION 1.0

INTRODUCTION

This addendum to the Dugway Proving Ground (DPG) Final Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan (Parsons, 1998) addresses the radiological concerns associated with the Radioactive Waste Landfill (Solid Waste Management Unit 11 [SWMU-11]) located on the east side of Granite Mountain. This addendum incorporates by reference the Utah Division of Solid and Hazardous Waste (DSHW) approved documents associated with and including the Phase II RFI Work Plan (Parsons, 1998). The RFI Work Plan was developed for Dugway's Installation Restoration Program (IRP), which was charged with investigating past disposal practices on DPG. The location of SWMU-11 is shown on Figure 1.1. Pertinent site features are shown on Figure 1.2.

The purpose of this Work Plan is to identify the Data Quality Objectives (DQOs), radiological survey procedures, and sampling of environmental media required to identify the nature and extent of potential releases at SWMU-11.

The investigation being completed at this site follows previously approved investigation techniques as identified in the following documents:

- RFI Phase II Work Plan – (Parsons, 1998)
- RFI Phase II Health and Safety Plan - (Parsons, 1999)
- Risk Assumptions Document (Parsons, 2002)
- Characterization and Recommended Use of Facility-Wide Background Soil Metals Data (Parsons, 2001a)

In addition to the information discussed in the documents listed above, these activities will address the license termination requirements associated with the Radioactive Waste Landfill, as mandated under:

- 10 CFR 20.1402, "Criteria for License Termination Under Unrestricted Conditions"
- 10 CFR 20.1403, "Criteria for License Termination Under Restricted Conditions"
- 10 CFR 20.1404, "Alternative Criteria for License Termination"

- The associated Nuclear Regulatory Commission (NRC) communication (NRC, 1997a; NRC, 2001a)

All radiological investigations associated with SWMU-11 will be conducted in a manner consistent with the existing work plan (Parsons, 1998) and applicable NRC guidance for license termination, such as:

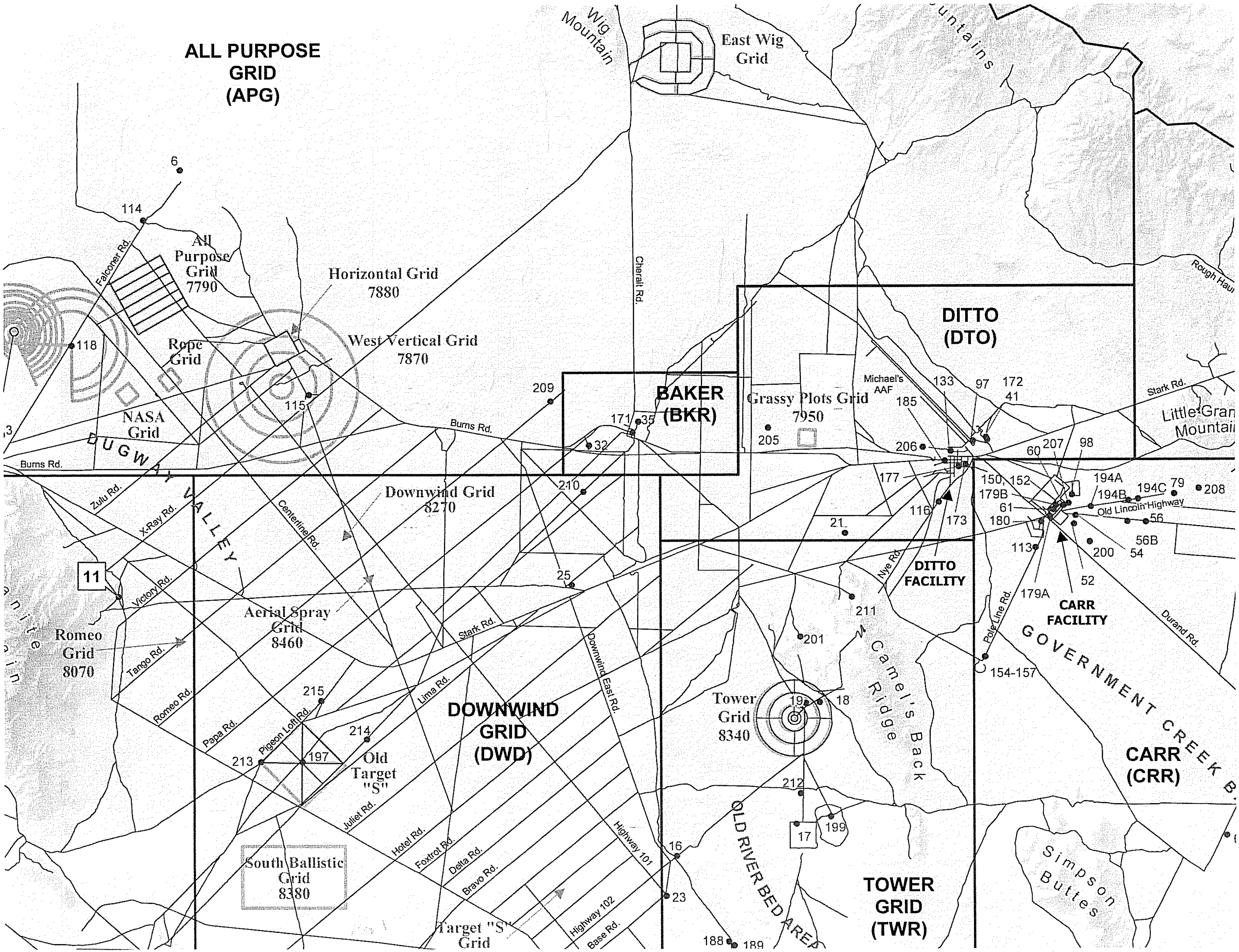
- NUREG-1727, "NMSS Decommissioning Standard Review Plan" (NRC, 2000a)
- NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)" (NRC, 2000b)
- NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination" (NRC,1992)
- NUREG-1505, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys" (NRC, 1997b)
- NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (NRC, 1997c)

The development of the DQOs, reporting, and the associated survey and sampling activities will comply with the applicable United States Environmental Protection Agency (USEPA) guidance, as discussed in the original work plan (Parsons, 1998).

1.1 OBJECTIVES AND SCOPE OF INVESTIGATIONS

The objective of this addendum is to address radiological characterization activities not addressed in the existing work plan (Parsons, 1998). The intent of this addendum is as follows:

- Confirm or refute the presence of residual radioactive contamination.
- Verify that any residual radioactive contamination at these sites does not present a significant hazard to workers, the public, or the environment.
- Ensure that the dose to the public from any residual contamination will not result in a dose greater than 25 millirem per year (mrem/yr) (total effective dose equivalent [TEDE]) and is as low as reasonably achievable (ALARA), consistent with the applicable NRC guidance mentioned above. This evaluation will also address the cost differential, if any, from setting the dose limit at 100 mrem/yr (TEDE).


ALL PURPOSE GRID (APG)
All Purpose Grid 7790
Horizontal Grid 7880
West Vertical Grid 7870
Rope Grid
NASA Grid
DUGWAY VALLEY
Wig Mountain
East Wig Grid
Cherait Rd.
Burns Rd.
Falconer Rd.
Zulu Rd.
X-Ray Rd.
Victory Rd.
Tango Rd.
Romeo Rd.
Papa Rd.
Pigeon Loft Rd.
Juliet Rd.
Hotel Rd.
Foxtrot Rd.
Delta Rd.
Bravo Rd.
Lima Rd.
Stark Rd.
Centerline Rd.
Downwind East Rd.
Highway 101
Highway 102
Base Rd.
Nye Rd.
Pole Line Rd.
Durand Rd.
Old Lincoln Highway
Rough Haul
Romeo Grid 8070
Aerial Spray Grid 8460
Downwind Grid 8270
DOWNWIND GRID (DWD)
Old Target "S"
South Ballistic Grid 8380
Target "S" Grid
BAKER (BKR)
DITTO (DTO)
Grassy Plots Grid 7950
Michael's AAF
DITTO FACILITY
CARR FACILITY
CARR (CRR)
GOVERNMENT CREEK B
Little Gran Mountai
Camel's Back Ridge
Tower Grid 8340
TOWER GRID (TWR)
OLD RIVER BED AREA
Simpson Buttes
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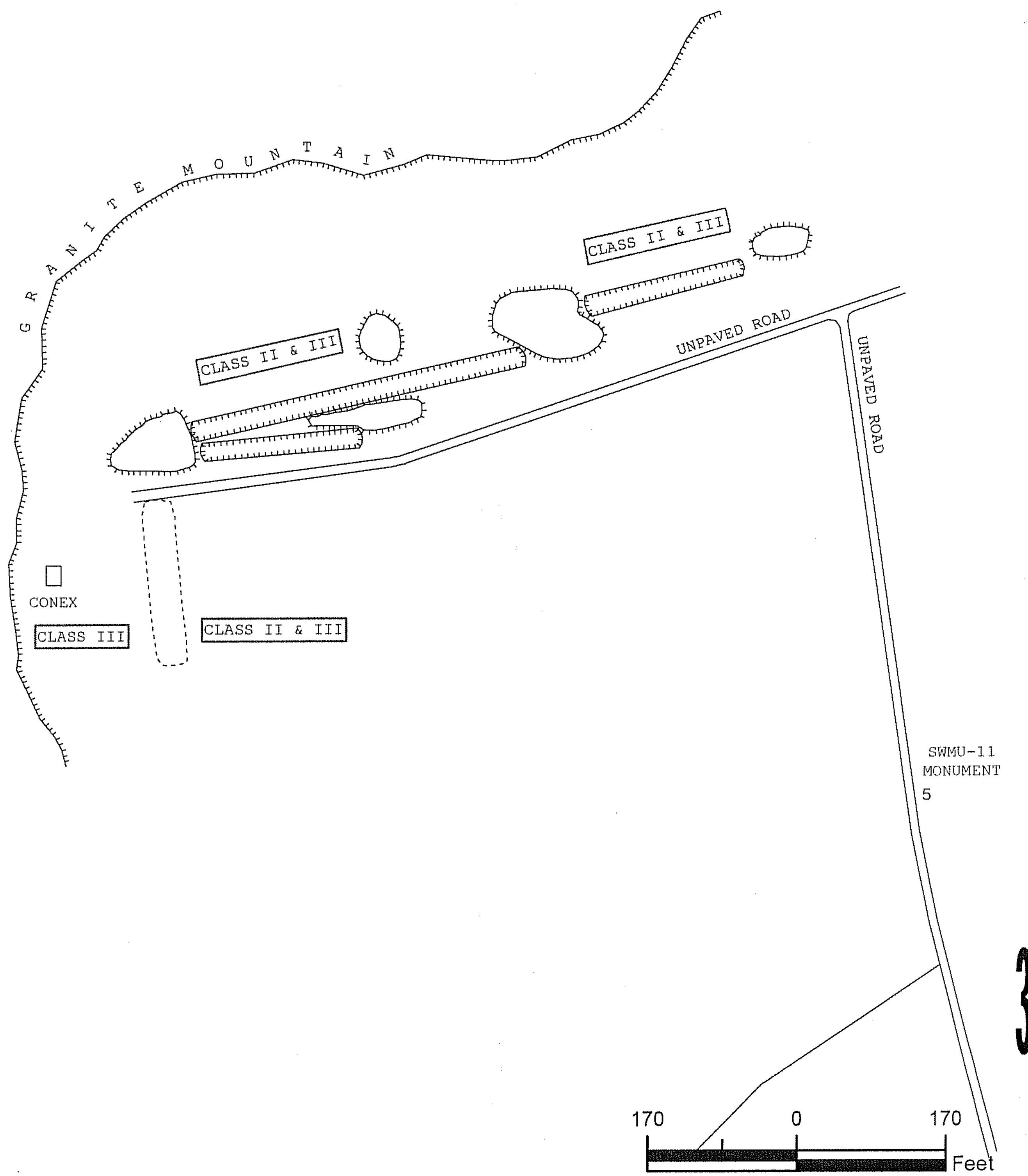

LEGEND

CLASS III — PROPOSED RADIOLOGICAL SURVEY

DEPRESSED AREA / TRENCH

MOUND

FIGURE 1.2

SITE MAP
SWMU-11, BURIAL PITS
GRANITE MOUNTAIN AREA

DUGWAY PROVING GROUND RFI

- Provide a radiological characterization survey plan for SWMU-11 consistent with NRC guidance.
- Ensure that the integrated risks from SWMU-11 meets the requirements specified for total risk in the existing work plan and/or address implementation of the appropriate decontamination/removal actions necessary to meet these objectives.

To achieve these objectives, this addendum identifies the appropriate DQOs and sampling and analysis plan (SAP) in Section 3. Radiological data collection methods identified in Section 3 includes:

- Direct radiation survey using field instrumentation
- Sampling and laboratory analysis for gross alpha/beta activity and gamma spectroscopy (as needed)
- In-situ gamma spectroscopy (as needed)
- Radionuclide specific analysis or low energy beta analysis (as needed)

These radiological survey methods were selected based on the review of the historical information about the site. Methods may be revised based on data collected during the survey and sampling process, as necessary. Any changes in the data collection methodology will be documented as a work plan variance. Changes based on ongoing data collection that involve the collection of additional samples and/or the extension of the sampling area will not require an addendum to this work plan, but must be explained in the Phase II report.

Class II and III radiological survey areas have been identified at SWMU-11 as shown on Figure 1.2, respectively. The class determination identifies the potential of identifying residual radioactive contamination within an area. The two classes of radiological surveys to be performed at SWMU-11 were identified from site operating history, previous investigations, and from previous surveys. These survey classes are defined as:

- Class II areas are those areas where radioactive materials were used, but residual contamination is not expected to be above the Derived Concentration Guideline Level (DCGL).
- Class III areas are those areas potentially impacted, but residual radioactivity is expected to contain levels of residual radioactivity at a small fraction of the DCGL or near background.

The DCGL is defined by MARSSIM as the volumetric or surface concentration that corresponds to the dose limit of a receptor. The DCGL may be determined by site-specific dose pathway modeling or generic screening levels may be used.

1.2 WORK PLAN ORGANIZATION

The site-specific radiological characterization plan presented in this addendum is intended to supplement the chemical SAPs previously specified for SWMU-11 presented in the original Phase II Work Plan (Parsons, 1998). The Safety and Health Hazard analysis can be found in the RFI Phase II Health and Safety Plan (Parsons, 1999). The original SAP for SWMU-11 is presented in Section 4.8.17 of Addendum B to the Phase II RFI Work Plan (Parsons, 2000). Any information pertaining to the radiological investigations at SWMU-11 that was presented the original work plan is superceded by information presented in this addendum.

SECTION 2.0

PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 PROJECT ORGANIZATION

Parsons has been awarded the task of investigating SWMU-11 and is responsible for document preparation and overall implementation. The Parsons Salt Lake City office will conduct this project with support from other Parsons offices and subcontractors.

The organizations who will be directly involved in the performance of this task include the DSHW, the DPG Environmental Management Office, the United States Army Corps of Engineers (USACE) – Sacramento District (CESPK), and Parsons. The organizations, key personnel from each organization, and personnel contacts are listed in Table 2.1.

DSHW is the primary oversight regulatory agency at Dugway and will receive copies of the Draft Final and Final Work Plan. All applicable communication and reports for this project will be delivered from Parsons to the DPG Environmental Management Office for delivery to DSHW. Parsons will not work directly with DSHW to initiate project activities unless specifically directed to do so by the DPG Environmental Management Office.

The DPG Environmental Management Office is responsible for executing the investigation and has the responsibility of reviewing all documents generated. Mr. Scott Reed has been designated the Project Coordinator for the DPG Environmental Management Office. DPG Environmental Management Office also has the authority to stop work if unsafe work conditions exist.

CESPK is the contracting officer's representative and technical oversight lead that acts on behalf of the DPG Environmental Management Office. CESPK is responsible for approving all documents prior to the initiation of fieldwork and releasing reports. CESPK also has the authority to modify the current statement of work (SOW) with Parsons, and can issue a stop work order. Mr. Bruce Handel has been designated the CESPK Project Manager.

TABLE 2.1
KEY PROJECT CONTACTS

DUGWAY PROVING GROUND

Project Coordinator
Mr. Scott Reed
Environmental Management Office

Dugway Proving Ground
Dugway Proving Ground, Utah 84022

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Project IRW Coordinator
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Dugway Proving Ground
Dugway Proving Ground, Utah 84022

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SACRAMENTO CORPS. OF ENGINEERS

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Project Health and Safety Officer
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TABLE 2.1 (Continued)
KEY PROJECT CONTACTS

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Phone: (801) 572-5999
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Project Health Physicist
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Project Chemist
Mr. Jan Barbas
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Project Health and Safety Officer
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Mile High Center
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Phone: (303) 831-8100
Fax: (303) 831-8208

Client Sponsor/Principal-In-Charge
Dr. Ross Miller, PhD, PE
Vice President
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South Jordan, Utah 84095

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Project Geologist
Mr. Jeffrey Fitzmayer, RG
406 West South Jordan Parkway, Ste
South Jordan, Utah 84095

Phone: (801) 572-5999
Fax: (801) 572-9069

Project IRW Coordinator
Mr. Kurt Alloway
406 West South Jordan Parkway, Ste 300
South Jordan, Utah 84095

Phone: (801) 572-5999
Fax: (801) 572-9069

TABLE 2.1 (Continued)
KEY PROJECT CONTACTS

UTAH DIVISION OF SOLID AND HAZARDOUS WASTE

Project Director
Mr. Dave Larsen
Division of Solid and Hazardous Waste
288 North 1460 West
Salt Lake City, Utah 84114-4880

Phone: (801) 538-6001 / (801) 538-6170
Fax: (801) 538-6715

2.2 PROJECT RESPONSIBILITIES

Mr. Edward Staes, PE, will serve as the Parsons Project Manager. The Project Manager is responsible for overall implementation of the project. The Project Manager is the central point of contact for CESPK and Parsons project personnel, and is responsible for coordination and prioritization of project activities.

Dr. Ross Miller, PhD, PE, will serve as the Client Sponsor/Principal-In-Charge. As the manager of Parsons' Restoration and Design sector, Dr. Miller is positioned to assist the client with any concerns that may arise. Dr. Miller provides routine oversight of project management.

Mr. Jeffrey Fitzmayer, RG, will serve as the Project Geologist. The Project Geologist is the point of contact for geology and hydrogeology issues and will coordinate directly with the Field Geologist to ensure that related procedures are implemented in accordance with approved procedures. Mr. Fitzmayer will report to the Project Manager.

Mr. Timothy Mustard, CIH, will serve as the Project Health and Safety Officer (PHSO). The PHSO will review the Site Safety and Health Plan (SSHP); ensure that the required training has been completed, and required records are kept for site personnel; coordinate and provide an initial training session during the kickoff meeting to provide an overview of specific project health and safety issues; and will be responsible for implementing all project health and safety requirements throughout the life of the project. The PHSO will serve as a point of contact and coordinate with the Army-appointed Health and Safety Officer for safety issues. Mr. Mustard will report to the Project Manager.

Mr. Jan Barbas will serve as the Project Chemist. The Project Chemist will assist the project team in selecting the analytical laboratory and operating in accordance with the existing QAPP. The Project Chemist will provide coordination with the analytical laboratory to implement project specific requirements; review analytical data as it becomes available to ensure conformance with quality standards; implement corrective actions in accordance with these specifications when review of data uncovers deficiencies; and serve as a point of contact for the Army-appointed chemist for issues related to environmental chemistry. The Project Chemist will also review all data validation reports prepared by subcontractors for accuracy. Mr. Barbas will report to the Project Manager.

Mr. John Hackett will serve as the Project Health Physicist (PHP). The PHP will be responsible for the daily performance monitoring of the radiological survey instrumentation; the proper use of radiological survey instrumentation; and radiation-related health and safety issues. Mr. Hackett will report directly to the Project Manager.

Mr. Kurt Alloway will serve as the Quality Control/Installation Restoration Waste (QC/IRW) Field Coordinator. The QC/IRW Field Coordinator will be responsible for IRW management, maintenance of the sampling database, and sample coordination. Ms. Thomas will report directly to the Project Manager.

Field Geologist and Site Health and Safety Officer (SHSO). The Field Geologist will be determined prior to the initiation of fieldwork. The Field Geologist will be responsible for oversight of day-to-day operations during the field work. The Field Geologist is responsible for ensuring that all activities are implemented in accordance with approved procedures and will coordinate with subcontractors, DPG, and other personnel potentially impacted by site operations. The SHSO is responsible for implementing the SSHP. Specific duties of the SSHO include conducting daily heath and safety meetings, recording health and safety field notes, operation of any required monitoring equipment, and ensuring that personal protective equipment is used properly. The Field Geologist will report directly to the Project Geologist concerning technical issues and directly to the PHSO concerning health and safety issues.

Subcontractors will provide analytical services, drilling, well development and sampling, and surveying in support of this project.

SECTION 3.0

RADIOLOGICAL CHARACTERIZATION FIELD SURVEY METHODOLOGY

3.1 RADIONUCLIDES OF CONCERN

Several radionuclides were used at SWMU-11. Based on historical evidence, the primary radionuclides of concern (ROCs) addressed in this work plan are tritium (H-3), carbon-14 (C-14), cobalt-60 (Co-60), and radium-226 (Ra-226). Records indicate that these radionuclides were present in significant quantities at SWMU-11. Each of these radionuclides represents a different type of radioactive decay – H-3 and C-14 are beta emitters, Co-60 is a high-energy gamma emitter, and Ra-226 is an alpha and low-energy gamma emitter. By designing the survey to detect these radionuclides, any unknown radionuclides with similar decay characteristics may also be detected.

3.2 SCREENING LEVELS

A dose-based risk goal, consistent with current regulatory guidance of 25 mrem/yr TEDE, is the initial basis for defining acceptable risk. However, to minimize the potential for unnecessary expenditures associated with the development of radionuclide-specific screening levels, the initial basis for the investigation will be to assess if:

- Soil contamination at the site meets the screening values listed in Table 3.1, as published in Table 3 of Federal Register, December 7, 1999 (Volume 64, # 234, pages 68395 to 68396).
- Surface contamination meets the screening values for building surface contamination listed in Table 3.1, as published in Table 1 of Federal Register, November 18, 1998 (Volume 63, # 222, pages 64132 to 64134), or for Ra-226, as published by the American National Standards Institute in *Surface and Volume Radioactivity Standards for Clearance* (ANSI, 1999).

If the soil screening levels are met for surface soils and subsurface soils are at background levels, no further action is required at SWMU-11. However, if these values are not met, or subsurface or other unexpected contamination is discovered, applicable DCGLs may be required, consistent with guidance found in MARSSIM. A Site Characterization Report will only be prepared if the preliminary screening values established are not met, and further investigation or remediation actions are required.

TABLE 3.1

SCREENING LEVELS, FIELD INSTRUMENTATION, AND MINIMUM DETECTABLE AMOUNTS FOR RADIONUCLIDES OF CONCERN AT SWMU-11

DUGWAY PROVING GROUND, UTAH

Radionuclide	Preliminary Screening Levels[a/]		Instrument		Primary Instrument				
	Surface (dpm/100 cm^2)[b/]	Soil (pCi/g)[c/]	Primary	Secondary	Instrument Efficiency[d/]	Background gross (cpm)[e/]	Probe Area (cm^2)[f/]	MDA (dpm/100 cm^2) Static[g/]	MDA (dpm/100 cm^2) Scanning[h/]
H-3	1.20E+08	110	Smear Sampling	N/A	N/A	N/A	N/A	N/A	N/A
C-14	3.10E+07	12	44-9 Pancake GM	N/A	0.05	80	15	23,782	72,000
Co-60	7,100	3.8	Ludlum 44-20 3"x3" NaI	Pancake GM	0.21	10000	45	4,952	16,000
Ra-226	*600*	0.7	FIDLER	Ludlum 44-20 3"x3" NaI	0.18	3000	126	1,136	3,700

[a/] The preliminary surface and soil screening levels obtained from Federal Register, Vol. 64, No. 234, Table 3 (12/1999), and Federal Register, Vol. 63, No. 222, Table 1 (11/98), respectively, and correspond to a dose of 25 mrem/yr. The italicized surface screening level for Ra-226 was obtained from ANSI/HPS N13.12-1999, *Surface and Volume Radioactivity Standards for Clearance* (1999), and corresponds to a dose of 1 mrem/yr.

[b/] dpm/100 cm^2 = Disintegrations per minute per 100 square centimeters.

[c/] pCi/g = Picocuries per gram.

[d/] Instrument efficiencies are based on manufacturer's estimates or previous field experience.

[e/] cpm = Counts per minute; Gross background for C-14 is estimated. Background for Co-60 and Ra-226 estimated assuming that the instrument is configured to the primary gamma energy of that radionuclide.

[f/] cm^2 = Square centimeters.

[g/] Static MDA (minimum detectable amount) is calculated based on Equation 6-7 in MARSSIM (refer to Appendix A of this work plan) and is for a one-minute count.

[h/] Scanning MDA is calculated based on MARSSIM Section 6.7.2 (refer to Appendix A of this work plan) and rounded to two significant figures.

Such a report will document the basis for this decision and will address any plans to implement a remediation and a post-remediation Final Status Survey.

3.3 DATA COLLECTION

This section describes the field instrumentation and sampling that will be used to collect data to support the characterization surveys. Field instrument efficiencies and Minimum Detectable Activities (MDAs) are presented in Table 3.1. Preliminary field instrument flag values (based on screening levels and estimated background values) for static and scanning measurements are listed in Table 3.2. The preliminary flag values will be recalculated after the collection of additional site-specific background data during the characterization surveys.

3.3.1 Alpha and Beta Radiation Surveys

A Ludlum Model 44-9 Geiger Mueller (GM) Pancake Probe or equivalent instrument will be used to scan for gross alpha, beta, and gamma radiation during outdoor surveys. In addition, the GM will be used for health and safety purposes (i.e., personnel and equipment frisking prior to leaving affected areas). The efficiency of the GM for detection of C-14 is approximately 0.05 counts per minute/decays per minute (cpm/dpm). The GM will be used per Standard Operating Procedure (SOP) 38.

3.3.2 Gamma Radiation Surveys

A Bicron G5 FIDLER coupled with a Bicron Analyst portable count-rate meter (FIDLER) or equivalent instrument will be used to conduct low energy gamma surveys (i.e., for the 186 kilo-electron Volt [keV] Ra-226 gamma). A Ludlum 44-20 3"x3" sodium iodide (NaI) detector (3"x3" NaI) or equivalent instrument (i.e., a 2"x2" NaI) will be used to conduct high energy gamma surveys (i.e., for the 1.17 and 1.33 Mega-electron Volt [MeV] Co-60 gammas). The probe areas for these two instruments are 126 and 45 square centimeters (cm^2), respectively. The detection efficiency for the FIDLER in detecting Ra-226 is approximately 0.18 cpm/dpm, while the detection efficiency for the 3"x3" NaI in detecting Co-60 is approximately 0.21 cpm/dpm. Gamma radiation surveys will be conducted per SOPs 39 and 41.

3.3.3 Exposure Rate Surveys

Exposure rate surveys will be conducted using a Ludlum Model 19 or equivalent (exposure rate meter). Exposure rate surveys will be performed for health and safety

TABLE 3.2

PRELIMINARY INSTRUMENT FLAG VALUES FOR STATIC AND SCANNING MEASUREMENTS FOR RADIONUCLIDES OF CONCERN AT SWMU-11

DUGWAY PROVING GROUND, UTAH

Instrument	Radionuclides	Surface Screening Level	Probe Area	Instrument Efficiency[c]	Net Instrument Equivalent	Background	Preliminary Field Instrument Flag Value
		(dpm/100cm^2)[a]	(cm^2)[b]		(cpm)[d]	(cpm)[e]	(cpm)[f]
Static and Scanning Measurements							
44-20 3"x3" NaI	Co-60	7,100	45	0.21	671	10000	11,000
FIDLER	Ra-226	600	126	0.18	136	3000	3,100
44-9 GM Pancake Probe	C-14	3.10E+07	12	0.05	186,000	80	160

a/ dpm/100cm^2 = Distintegrations per minute per 100 square centimeters.

b/ cm^2 = Square centimeters.

c/ Instrument efficiencies are based on manufacturer's recommendations or previous field experience.

d/ cpm = Counts per minute.

e/ Background values for C-14 are estimated. Background for Co-60 and Ra-226 are estimated assuming that the instrument is configured to the primary gamma energy of that radionuclide.

f/ Preliminary instrument flag values for static and scanning measurements include background and are rounded to two significant figures. Because the flag value based on the screening level is significantly greater than background, the preliminary field instrument flag value has been set as two times background for the 44-9 GM Pancake Probe.

purposes. Exposure rate measurements will be taken upon entering an unknown area, and at each sampling/measurement location. Maximum readings of 500 microrem per hour (μrem/hr) will be the limit for an acceptable working area. Exposure rate measurements will be conducted per SOP 45.

3.3.4 Additional Instrumentation

An NaI-based gamma spectroscopy system (using either a FIDLER or 3"x3" NaI detector) may be used to identify and quantify sources of gamma radiation during the characterization surveys. The system utilizes the Universal Radiation Spectrum Analyzer (URSA) software, developed by Radiation Safety Associates, Inc., to analyze and identify energy peaks associated with photon emissions. In-situ gamma spectroscopy may be performed prior to sending a sample to an off-site laboratory if the basis for taking that sample was a scanning or static measurement with one of the gamma instruments that exceeded the instrument flag value (i.e., indicating elevated gamma emissions).

3.3.5 Instrument Function Check Procedure

To ensure that the highest quality data possible are collected during the survey program, all radiation survey data will be collected using laboratory-calibrated radiation survey instruments. At a minimum, all survey instruments are to be on a 1-year calibration cycle.

The gamma spectroscopy system will be calibrated in the field by qualified personnel using National Institute of Standards and Technology (NIST)-traceable calibration sources at the site, consistent with the manufacturer's recommendations.

In addition to the periodic laboratory calibrations, function checks will be completed over the duration of the survey period to demonstrate that the instrument is operating properly. This will be done by collecting a background and source reading every morning, afternoon, and evening that the instrument is being used. The reading will be input into a control chart that will plot the distribution of the data. Tracking the distribution using this method will allow for the identification of an improperly operating instrument. The first 5 days that the instrument is being used, the instrument will be considered to be properly operating if readings are within +/- 20-percent; after 5 days there will be enough data to have an accurate distribution curve to identify uncertainty within a 2-sigma range. This function check procedure will account for the variability associated with temperature, pressure, background, electronics, etc., in assessing the status of the equipment. All checks will be performed using NIST-traceable radioactive sources.

3.3.6 Laboratory Analysis

To supplement the field measurements, soil and material samples will be collected and analyzed for gross alpha and beta radiation by Severn Trent Laboratories (STL) St. Louis. If gross alpha or beta analytical results indicate the presence of radioactivity above background, additional isotope-specific analyses may be performed. In addition, gamma spectroscopy will be performed on these samples, and all detected gamma energies will be identified and reported. Smear samples on available smooth surfaces will be collected and analyzed for gross alpha, beta, and gamma radiation and/or H-3. Further information regarding the analytical sampling program is presented in Sections 3.4 and 3.5.

3.3.7 Quality Assurance/Quality Control Testing

Appropriate quality assurance and quality control (QA/QC) measures will be used throughout the program to ensure the certainty of the data collected for the surveys. Standardized survey techniques and SOPs will be utilized to assure consistency in the sampling methods.

3.4 SWMU-11 CHARACTERIZATION SURVEYS

Information addressing the location, topography, geology, and hydrogeology of SWMU-11 (radioactive waste burial site) is presented in Section 4.8 of the original work plan. The boundaries of the impacted area at SWMU-11 are currently the subsidence areas, the unfilled trenches, and the CONEX box. It is assumed that the impacted area at SWMU-11 currently ends approximately 10 feet from the trenched areas. Based on historical records, it is believed that wastes containing H-3, C-14, Co-60, and/or Ra-226 may have been buried at this site.

Characterization of SWMU-11 will involve field measurements and soil sampling, as listed in Table 3.3 and discussed below. Soil samples will be taken at various depths (typically 1 to 2 foot intervals within excavations running perpendicular to the trenches) from each trench within SWMU-11. If debris is encountered, it will be surveyed for contamination and may be segregated and sampled, as appropriate, if field measurements indicate elevated radioactivity levels.

TABLE 3.3

SAMPLING AND ANALYSIS SUMMARY FOR CHARACTERIZATION SURVEYS AT SWMU-11

DUGWAY PROVING GROUND, UTAH

SWMU	Survey Area	Survey Class	Survey			Soil/Material Sampling	Dose Rate
			Scanning	Static	Smears		
			Scanning Frequency	Number of Measurements	Number of Smears		Frequency
11	Opened Trenches	II	100%	20	None	Minimum of 20; a minimum of one surface soil sample from each trench, and at 1-2 ft depth intervals within each trench and at the trench bottom.	100%
11	Surface Soils Outside of debris area in opened trenches	III	10%	At each survey grid scanned	None	At elevated surface measurement locations.	100%
11	CONEX Box Interior and Exterior Surfaces	III	100%	20	5	None	Inside CONEX box
11	Surface Soils Beneath the CONEX Box	III	100%	3	None	3	100%
SWMU-11 Background		N/A	20 sampling grids	20	None	Minimum of 3 surface and 5 subsurface samples	100%

The probability of radioactive contamination within the subsurface portion of SWMU-11 trenches is low, considering the radioactive decay of materials initially present. However, there is a possibility that long-lived radionuclides (i.e., the ROCs noted above) may have been disposed of within the trenches. As a result, the subsurface soils of the trenches are classified as a single Class II survey unit per MARSSIM guidance. The trench surface soils and soils outside of the immediate trench areas are classified as Class III. In addition, the CONEX container, the soils immediately adjacent to it, and surface soils beneath it are all classified as Class III Areas, since the CONEX contained only packaged radioactive material. Those areas in SWMU-11 not associated with the trenches or the CONEX box are assumed to be unimpacted. The classifications of different areas within SWMU-11 are listed in Table 3.3.

The site characterization data from this investigation will be used to support the human risk assessment (HRA), ecological risk assessment (ERA), and corrective measures study (CMS) decisions for SWMU-11.

3.4.1 Sampling Design for SWMU-11 Trenches

The characterization survey at the SWMU-11 trenches will consist of four different aspects:

- Scanning
- Static measurements
- Surface soil sampling
- Subsurface soil sampling

A sampling grid will be established prior to sample collection per MARSSIM and SOP 37. The appropriate sampling grid size will be determined during the field effort when the survey area has been delineated. The sampling requirements for the characterization surveys of SWMU-11 trenches and adjacent soils are summarized in Table 3.3.

Surface scanning will be conducted following the sampling grid using the 3"x3" NaI, FIDLER, and GM, per the appropriate SOPs (Section 3.3). One hundred-percent of the trench surfaces (both on the ground surface and within the excavations) will be scanned, while 10-percent of the areas surrounding the trenches will be scanned. If elevated activities are measured outside the trench area, additional scanning will be conducted to determine the extent of the contamination.

One-minute static measurements will be collected within each sampling grid that has been scanned. Static measurements will be taken either at the location of the highest scanning measurement within a sampling grid (if a scanning measurement has exceeded the flag value) or at the center of the sampling grid. A minimum of 20 static measurements will be collected. Static measurements will be taken with the 3"x3" NaI, FIDLER, and GM, per the appropriate SOPs (Section 3.3).

Surface soil samples will be collected outside the trench area if scanning or static measurements indicate that elevated activity may be present (i.e., the measurements are greater than the flag values listed in Table 3.2). The samples will be collected in accordance with the appropriate SOPs.

Subsurface soil samples will be collected in 2-foot depth intervals within the trenches. Soil samples also will be collected at the bottom of the trench (i.e., when native soil is reached). Additional subsurface soil samples may also be collected based on scanning or static measurement results within the trenches. The number of required soil samples is based on MARSSIM guidance assuming a relative shift of 1.7 (Appendix A). The guidance indicates that a minimum of 10 survey unit samples is required; however, a minimum of 20 samples will be collected to allow for process failures and to minimize the impact of results below the detection level of the laboratory.

3.4.2 Sampling Design for SWMU-11 CONEX Box

The characterization survey at the SWMU-11 CONEX box will consist of three aspects:

- Scanning
- Static measurements
- Surface soil sampling

The sampling requirements for the characterization surveys of the SWMU-11 CONEX box and adjacent soils are summarized in Table 3.3.

Scanning will be performed on all interior and exterior surfaces of the box. Scanning also will be conducted on the soils underneath the box (if accessible) and within a 10-foot radius of the box. If elevated scanning measurements are identified, additional scanning may be performed to determine the extent of the contamination. Scanning will be conducted with the 3"x3" NaI, FIDLER, and GM, per the appropriate SOPs (Section 3.3).

A minimum of 20 one-minute static measurements will be conducted on interior and exterior locations on the CONEX box and on adjacent soils. Static measurements will be taken at all locations where the scanning measurement exceeds the flag value. Additional static measurements will be biased to locations where contamination would be likely to accumulate (e.g., corners, handles, etc.). At least 10 measurements will be taken on the interior floor of the CONEX box. In addition, static measurements will be taken at the three soil sampling locations beneath the box. Static measurements will be performed with the 3"x3" NaI, FIDLER, and GM, per the appropriate SOPs (Section 3.3).

A minimum of three surface soil samples will be taken from beneath the CONEX box. Samples will be collected from the center of the box imprint and at two additional sampling points randomly selected from the box imprint. Additional soil samples may be collected if ground surface scanning indicates elevated activities.

To determine if removable H-3 contamination is present, smear samples will be collected per SOP 40 from any box surface location with scanning or static measurements that exceed the flag values. These samples may be evaluated on-site with field instrumentation and/or be sent off-site for analysis.

3.4.3 Sampling Design for SWMU-11 Background Locations

Appropriate background locations for SWMU-11 will be determined upon arrival on-site. A sampling grid will be established at the background area, and a minimum of 20 sampling grids will be subject to scanning and static measurements with all of the outdoor survey instruments – 3"x3" NaI, FIDLER, GM, and exposure rate meter. In addition, background measurements will be conducted at a CONEX box (or another container of similar construction) located in an unimpacted area. The scanning and static results from the background surveys will be used to generate new instrument flag values and replace those listed in Table 3.2. A minimum of three surface and five subsurface soil samples will be collected from the background area and analyzed for gross alpha, beta, and gamma radiation. Additional surface background samples may be necessary if surface soils at the trenches and beneath the CONEX box appear to be significantly different. The background soil samples will also be analyzed for the presence of H-3.

3.4.4 Laboratory Analysis

Soil samples will be sent to an off-site laboratory (STL St. Louis) for gross alpha, beta, and gamma spectroscopy analysis. Smear samples collected from the CONEX box will be analyzed for H-3 contamination.

3.4.5 Health and Safety

Exposure rate measurements will be conducted at each static measurement location per SOP 45. If site conditions indicate the presence of airborne radioactive material, filter-based air samplers may be placed around the perimeter of the trenches to monitor personnel exposure. Smear sampling will be performed per SOP 40 on the outside of sample containers to determine if cross-contamination has taken place. Prior to the interior measurements of the CONEX box, all appropriate confined space procedures will be followed. All applicable health and safety SOPs will be followed during the SWMU-11 characterization surveys.

SECTION 4.0

REFERENCES

10 CFR 20.1402, "Criteria for License Termination Under Unrestricted Conditions"

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10 CFR 20.1404, "Alternative Criteria for License Termination."

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APPENDIX A

SUPPORTING CALCULATIONS

A.1 MINIMUM DETECTABLE AMOUNT (MDA)

Direct Measurements

Minimum Detectable Amounts (MDAs) for direct measurements for the alpha, beta, and gamma instrumentation (Table 3.1) were calculated using the following equation from MARSSIM (NRC, 2000b):

$$Static\ MDA = \frac{3 + 4.65\sqrt{B}}{\varepsilon_i * \varepsilon_s * \frac{A}{100\,cm^2}}$$

where:

B = Background counts, in counts per minute (cpm).
ε_i = Instrument detection efficiency.
ε_s= Surface efficiency, equal to 1 for gamma emission and 0.25 for beta emission, per NUREG-1507 (NRC, 1997c).
A = Active probe area, in square centimeters (cm^2).

Scanning Measurements

MDAs for scanning measurements were calculated for each instrument (**Table 311**) using the following equations from MARSSIM:

$$MDCR = d'\sqrt{b_i} \times (60/i)$$

$$Scan\ MDA = \frac{MDCR}{\sqrt{p}\varepsilon_i\varepsilon_s \frac{A}{100\ cm^2}}$$

where:

$MDCR$ = minimum detectable count rate (cpm)
d' = index of sensitivity; as an example for a correct detection rate of 95% and a false positive rate of 60%, d' is equal to 1.38 (per MARSSIM Table 6-5).

b_i = background counts during observation interval i.
i = scanning observation interval, equal to 1 second for scanning measurements.
p = surveyor efficiency, equal to 0.5.
ε_i = instrument-specific efficiency
ε_s = surface efficiency, equal to 1 for gamma emission and 0.25 for beta emission, per NUREG-1507 (NRC, 1997c)

A.2 INSTRUMENT FLAG VALUES

The field flag values listed in Table 3.2 were calculated using the surface screening level, the assumed background levels, the probe area, and the estimated detection efficiency for the instrument. Flag values were determined using the following equation:

$$Flag\ Value(cpm) = \left[Surface\ Screening\ Level\left({dpm}/{100\ cm^2} \right) \times \frac{probe\ area}{100}(cm^2) \times Efficiency \right] + Background(cpm)$$

Scanning flag values were rounded to two significant figures.

A.3 MINIMUM NUMBER OF SAMPLES

Calculating the minimum number of samples or measurements required for statistical tests is based on the procedure outlined in MARSSIM Section 5.5.2.2. It is important to determine the minimum number of samples to ensure that the Wilcoxon Rank Sum (WRS) test or Sign test (for contaminants not present in background) that will be performed on the data is statistically valid. The variables listed in this section can be found in Table A.1.

There are several steps to calculate the minimum number of samples. These steps are: 1) calculate the relative shift (Δ/σ); 2) determine the random measurement probability (P_r or Sign p); 3) determine the decision error percentiles ($Z_{1-\alpha}$ and $Z_{1-\beta}$); and 4) calculate the number of samples for WRS test or Sign test. Alternatively step 2 may be skipped and the number of samples found from Table 5.3 or Table 5.5 of MARSSIM once the relative shift and error percentiles are known. Each step is briefly detailed below and further explanation can be found in MARSSIM Section 5.5.2.2:

1) Calculate the relative shift (Δ/σ)

The relative shift is calculated using the screening level, the Lower Bound of the Gray Region (LBGR), and the standard deviation in the contaminant level. The LBGR may be initially estimated as being half the screening level. The shift (Δ) is then found by subtracting LBGR from the DCGL (DCGL – LBGR).

TABLE A.1

MINIMUM NUMBER OF MEASUREMENTS OR SAMPLES FOR CHARACTERIZATION SURVEYS AT SWMU-11

DUGWAY PROVING GROUND, UTAH

Measurement	Surface Screening Level (dpm/100cm^2) [a/]	Surface Screening Level (cpm) [b/]	LBGR [c/]	Δ [d/]	Estimated Survey σ (cpm) [e/]	Estimated Bkgd σ (cpm) [e/]	Δ/σ [f/]	Pr [g/]	Z(1-α) [h/]	Z(1-β) [h/]	Total N [i/]
Field Measurements											
For Wilcoxon Rank Sum Test											
3x3 NaI - Co-60	7100	671	335	335	N/A [j/]	100	3.4	0.98	1.645	1.645	15
FIDLER - Ra-226	600	136	68	68	N/A	55	1.2	0.80	1.645	1.645	40
GM - C-14	3.10E+07	111000	55500	55500	N/A	8.9	6205.1	1.00	1.645	1.645	14

Measurement	Soil Screening Level (pCi/g) [k/]	LBGR [c/]	Δ [d/]	Estimated Survey σ (pCi/g) [l/]	Estimated Bkgd σ (pCi/g)	Δ/σ [f]	Pr [g/]	Z(1-α) [h/]	Z(1-β) [h/]	Total N [i/]	Minimum Number of Samples N [m/]
Analytical Measurements											
For Wilcoxon Rank Sum Test											
H-3	110	55	55	N/A	17	3.3	0.98	1.645	1.645	15	19
C-14	12	6	6	N/A	1.8	3.3	0.98	1.645	1.645	15	19
Ra-226	0.70	0.35	0.35	N/A	0.11	3.3	0.98	1.645	1.645	15	19

TABLE A.1

MINIMUM NUMBER OF MEASUREMENTS OR SAMPLES FOR CHARACTERIZATION SURVEYS AT SWMU-11

DUGWAY PROVING GROUND, UTAH

Measurement	Surface Screening Level ($dpm/100cm^2$) [a]	Surface Screening Level (cpm) [b]	LBGR [c]	Δ [d]	Estimated Survey σ (cpm) [e]	Estimated Bkgd σ (cpm) [e]	Δ/σ [f]	Pr [g]	Z(1-α) [h]	Z(1-β) [h]	Total N [i]
For Sign Test											
Co-60	3.80	1.90	1.90	1	N/A	3.3	1.00	1.645	1.645	11	13

[a] $dpm/100cm^2$ = decays per minute per 100 square centimeters.

[b] cpm = counts per minute. Screening level in units of cpm.

[c] LBGR = lower bound of gray region. Per MARSSIM, LBGR was set to 1/2 of the surface screening level.

[d] Δ = Sreening Level - LBGR.

[e] The estimated standard deviation (σ) for the background measurements is equal to the square root of the estimated background of each instrument (Tables 3.1 and 3.2).

[f] Δ/σ = relative shift.

[g] Values of Pr are from Table 5.1 (for WRS test) or Table 5.4 (for Sign test) of MARSSIM using Δ/σ. Pr is defined by MARSSIM as the probability that a random measurement from the survey unit exceeds a random measurement from the background reference area by less than the screening level when the survey unit median is equal to the LBGR above background.

[h] Values of Z(1-α) and Z(1-β) (decision error percentiles) are from Table 5.2 of MARSSIM for $\alpha=\beta=0.05$.

[i] N = total required number of measurements or samples. This number includes both survey unit and background areas for the WRS test, and only the survey unit for the Sign test.

[j] N/A = not applicable.

[k] pCi/g = picocuries per gram.

[l] The estimated σ for the analytical measurements is equal to the 30% of the LBGR. For Co-60, the estimated σ is listed as a survey σ because that radionuclide is not present in background.

[m] This number includes the survey unit and the background samples, and a 20% increase as recommended by MARSSIM. However, 20 samples will be collected from each survey unit and background, making the N for each WRS test equal to 40 (and equal to 20 for the Sign test).

The standard deviation (σ) in the contaminant level may be found from initial characterization efforts or can be reasonably estimated as 30% of the LBGR per MARSSIM guidance. The relative shift is found by taking the ratio of the shift to the standard deviation (Δ/σ).

2) Determine the Random Measurement Probability (P_r for WRS test; Sign p for Sign test)

Once the relative shift has been calculated, this parameter is found from Table 5.1 or Table 5.4 of MARSSIM. If the value of the relative shift does not appear in the table, the next lower value is chosen.

3) Determine the Decision Error Percentiles ($Z_{1-\alpha}$ and $Z_{1-\beta}$)

These parameters are standard statistical values and are representative of the selected error decision levels (α and β). As with the LBGR, the decision error levels are typically chosen during the DQO process. The decision error percentiles corresponding to the decision error levels can be found in Table 5.2 of MARSSIM.

4) Calculate the Number of Samples for WRS Test and Sign Test

The total number of samples required for the WRS test (N_{WRS}) and the Sign Test (N_{SIGN}) are found using the following equations:

$$N_{WRS} = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{3\,(P_r - 0.5)^2}$$

$$N_{SIGN} = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4\,(\text{Sign p} - 0.5)^2}$$

The values of N found using these equations are approximations based on P_r (or Sign p) and an estimated σ and as such, there is some uncertainty. Because it is likely there will be some missing or unusable data from any survey, the number of samples should be increased by 20% to account for these unanticipated issues. The value of N is then the minimum number of samples that must be collected from each reference/survey unit pair to satisfy the WRS test or the Sign test. For the WRS test, it is recommended that the number of samples to be collected from the survey unit and the background area be half the value of N.

Alternatively, if the values from steps 1 and 3 are known the number of samples for each area can be found in Table 5.3 and Table 5.5 of MARSSIM (value of N/2). The values in Table 5.3 and Table 5.5 of MARSSIM have been calculated using the same procedure outlined above.

Following the above procedure it was determined that the minimum number of survey measurements needed to satisfy MARSSIM guidance is 40 measurements (i.e., the worst-case, calculated for the FIDLER; Table A.1). Although the minimum numbers of measurements for the other instruments were much lower, all survey instruments will have a minimum of 20 measurements at each survey unit and 20 measurements at the background area. Because survey measurements are recorded and interpreted in the field, measurement errors resulting from instrument performance or survey technique can be observed and corrected as they are happening. As such, the 20% correction factor noted above is not applied to survey measurements.

In addition, the minimum number of analytical samples was determined for the WRS and Sign tests. In the absence of preliminary background or survey data, the estimated σ is equal to 30% of the LBGR, per MARSSIM. The total minimum number of samples required for the WRS test is equal to 20 (i.e., 10 for survey unit and 10 for background), rounded up to the nearest even number. However, to account for the uncertainty in the estimated σ, 20 samples will be collected from each survey unit. For the Sign test for Co-60, which is not present in background, a minimum of 13 samples was calculated. For reasons discussed above, 20 samples will be collected and analyzed for Co-60. A post-sampling evaluation of the number of samples or measurements collected will be performed to demonstrate that the statistical power of the number of samples collected was sufficient.