U.S. Army Center for Health Promotion and Preventive Medicine

USCHPPM

INDUSTRIAL RADIATION STUDY NO. 27-MH-0987-R2-97
PELHAM RANGE BURIAL MOUND SITE
FORT MCCLELLAN, ALABAMA
29 AUGUST-15 SEPTEMBER 1995
AND
14-28 JANUARY 1996

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Readiness Thru Health

U.S. Army Center for Health Promotion and Preventive Medicine

The lineage of the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) can be traced back over 50 years. This organization began as the U.S. Army Industrial Hygiene Laboratory, established during the industrial buildup for World War II, under the direct supervision of the Army Surgeon General. Its original location was at the Johns Hopkins School of Hygiene and Public Health. Its mission was to conduct occupational health surveys and investigations within the Department of Defense's (DOD's) industrial production base. It was staffed with three personnel and had a limited annual operating budget of three thousand dollars.

Most recently, it became internationally known as the U.S. Army Environmental Hygiene Agency (AEHA). Its mission expanded to support worldwide preventive medicine programs of the Army, DOD, and other Federal agencies as directed by the Army Medical Command or the Office of The Surgeon General, through consultations, support services, investigations, on-site visits, and training.

On 1 August 1994, AEHA was redesignated the U.S. Army Center for Health Promotion and Preventive Medicine with a provisional status and a commanding general officer. On 1 October 1995, the nonprovisional status was approved with a mission of providing preventive medicine and health promotion leadership, direction, and services for America's Army.

The organization's quest has always been one of excellence and the provision of quality service. Today, its goal is to be an established world-class center of excellence for achieving and maintaining a fit, healthy, and ready force. To achieve that end, the CHPPM holds firmly to its values which are steeped in rich military heritage:

- ★ *Integrity is the foundation*
- ★ *Excellence is the standard*
- ★ *Customer satisfaction is the focus*
- ★ *Its people are the most valued resource*
- ★ *Continuous quality improvement is the pathway*

This organization stands on the threshold of even greater challenges and responsibilities. It has been reorganized and reengineered to support the Army of the future. The CHPPM now has three direct support activities located in Fort Meade, Maryland; Fort McPherson, Georgia; and Fitzsimons Army Medical Center, Aurora, Colorado; to provide responsive regional health promotion and preventive medicine support across the U.S. There are also two CHPPM overseas commands in Landstuhl, Germany and Camp Zama, Japan who contribute to the success of CHPPM's increasing global mission. As CHPPM moves into the 21st Century, new programs relating to fitness, health promotion, wellness, and disease surveillance are being added. As always, CHPPM stands firm in its commitment to Army readiness. It is an organization proud of its fine history, yet equally excited about its challenging future.

Indust Radn Study No. 27-MH-0987-R2-97, Fort McClellan, AL,
29 Aug-15 Sep 95 and 14-28 Jan 96

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DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

EXECUTIVE SUMMARY
INDUSTRIAL RADIATION STUDY NO. 27-MH-0987-R2-97
PELHAM RANGE BURIAL MOUND SITE
FORT MCCLELLAN, ALABAMA
29 AUGUST-15 SEPTEMBER 1995
AND
14-28 JANUARY 1996

I. PURPOSE.

A. This study was performed to assess radiological health hazards associated with potential contamination at the Burial Mound Site, Fort McClellan, Alabama. This area was used as a low-level radioactive material burial ground.

B. This study was also performed to determine if residual radioactivity at the site is in compliance with the Nuclear Regulatory Commission (NRC) guidance for release to unrestricted use.

II. CONCLUSIONS. A review of the survey results indicates there are potential radiological health hazards in the Burial Mound Survey Unit.

A. The soil sampling survey results indicate residual contamination above both the cobalt-60 activity in soil release criteria and the cesium-137 activity in soil release criteria.

B. The sub-surface survey measurements were in some areas 1000 times the associated background measurement. These highly elevated readings are indicative of buried radioactive sources or substantial contamination pockets in the sub-surface environs.

III. RECOMMENDATIONS.

A. Remediate the radioactive contamination identified in the Burial Mound Survey Unit. Excavate, remove and properly dispose of the surface and sub-surface contamination identified. After remediation perform a final status survey of the Burial Mound Survey Unit to support release of this area for unrestricted use.

B. Perform radiological surveys in the "Old Rideout Field" area of Pelham Range to support release of this area for unrestricted use.

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PELHAM RANGE BURIAL MOUND SITE
FORT MCCLELLAN, ALABAMA
29 AUGUST-15 SEPTEMBER 1995
AND
14-28 JANUARY 1996

I. REFERENCES. See Appendix A for a list of references.

II. AUTHORITY. Memorandum, USAEC, SFIM-AEC-TSS, 27 December 1993, subject: Request for Technical Services.

III. PURPOSE.

A. This study was performed to assess radiological health hazards associated with potential contamination at the Burial Mound Site, Fort McClellan, Alabama. This area was used as a low-level radioactive material burial ground.

B. This study was also performed to determine if residual radioactivity at the site is in compliance with the Nuclear Regulatory Commission (NRC) guidance for release to unrestricted use.

IV. GENERAL.

A. Entrance interviews and periodic briefings, to include discussions of the findings and recommendations, were held with Mr. John W. May, Department of the Army Civilian (DAC), Fort McClellan Radiation Protection Officer (RPO) and Staff Sergeant (SSG) Kenneth S. Baugh, Fort McClellan Alternate Radiation Protection Officer.

B. The study was performed under the direction of Ms. Frances Szrom, DAC, Health Physicist, Industrial Health Physics Program, U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). Survey team members are listed in Appendix D. Appendix E contains a list of instrumentation used for this study.

C. The survey team would like to acknowledge Mr. John W. May and SSG Kenneth S. Baugh for their exceptional assistance rendered during the study. Their commitment to project completion was demonstrated in their approach to coordinating and providing the survey team with the required support in the areas of presurvey site preparation, range access coordination, and fuel support. Mr. Mays' and SSG Baughs' personal involvement extended well beyond normal duty hours. Without the level of support provided by these professionals, the study could not have been accomplished.

V. SITE BACKGROUND. A synopsis of the historical information pertaining to the Rideout Field area of Fort McClellan, AL, is contained in the Survey Plans, which are contained in Appendix C. A brief overview is provided below:

A. The radioactive material burial mound site is located at Rideout Field, Pelham Range, Area 24C, Fort McClellan, Alabama. The area known as Rideout Field served as a radiological training area from the mid 1950's through May of 1973. The training concept was to raise and lower sealed radioactive sources to simulate the large area radioactive contamination (fallout) from the surface detonation of a small yield (less than 0.5 kiloton) nuclear weapon. Students were then trained to perform both ground and aerial surveys to map the radiological fallout pattern. The training facility was utilized to train Radiation Control Teams in support of nuclear weapons testing performed by the Atomic Energy Commission (AEC).

B. There were actually two different radiological training areas during this time frame which were referred to as Rideout Field. The first field, which will be referred to as "Old Rideout Field", contained approximately 600 source storage wells and was located north of Cane Creek, between the West Perimeter Road and Centerline Road. The second field, which will be referred to as "New Rideout Field", extended south of Cane Creek along Centerline Road. A diagram of the two fields, which was contained in documentation (Reference 14) pertaining to the installation of New Rideout Field, is reproduced in Figure H-1.

C. The Old Rideout Field used locally fabricated cobalt-60 (Co-60) sources and higher activity commercially procured cesium-137 (Cs-137) sources. While the Co-60 sources were used to simulate a uniform fallout pattern, the Cs-137 sources were used to simulate hot spots within the fallout pattern. The sources were

raised and lowered manually from their shielded storage positions (approximately 6 feet below the ground surface) for each exercise.

D. There were a number of shortcomings with the Old Rideout Field which ultimately lead to the construction of the New Rideout Field:

1. The practice of manually raising and lowering the sources for each exercise resulted in a significant collective total effective dose equivalent (Reference 15).

2. There were an excessive number of leaking locally fabricated Co-60 sources. These leaking sources were routinely buried in cut down 55-gallon drums (Reference 17).

3. The facility was not large enough to perform meaningful aerial surveys (Reference 15).

4. The Chemical School lacked support facilities such as a fixed Hot Cell facility [references to a temporary field Hot Cell have been found, (Reference 5)] for source fabrication, leak testing and storage.

E. The first AEC license (BML 1-2861-1) was issued to the Chemical School in 1957 (Reference 16). Although substantiating documents (shipping papers) have not been located, reference is made to the proper disposal of all locally fabricated Co-60 sources (Reference 18). Despite the reference to the proper disposal of all locally fabricated Co-60 sources, one such source was found, recovered, and properly disposed of in 1985 (Reference 19) from the area referred to as the Burial Mound.

F. For this study, the Burial Mound site was located by the Fort McClellan RPO, based on the report in Reference 20. Grid coordinates and additional site location information for the Burial Mound site is contained in the Survey Plans in Appendix C. The Burial Mound footprint and sampling grids Global Positioning System (GPS) data are displayed in Figure H-2.

G.. Based on previous visits to this site and the documented Co-60 source found in 1985, this site was classified as an "affected open land area" as defined in NUREG/CR-5849. This study was conducted in two phases. Phase I, the scoping survey was conducted 29 August-15 September 1995. During Phase I, a

reconnaissance background survey was performed to establish the Fort McClellan/Rideout Field population background; a background area survey unit was established near the Burial Mound Site; appropriate surface soil samples, instrument measurements and air samples taken; and a 100% scanning survey of the Burial Mound Survey Unit was rendered. Phase II, the characterization survey was conducted 14-28 January 1996. During Phase II, core soil samples were collected from the Background Area and the Burial Mound Survey Unit; and after removal of the soil core, gamma scalar counts were recorded at various depths down the hole, with a small diameter sodium iodide detector.

H. Although the AEC licenses (BML 1-2861-1, BML 1-2861-2, and SNM 344) held by the U.S. Army Chemical Center and School (USACMLCS) were terminated in 1973, a formal close-out survey was not performed as required by the current Title 10, Code of Federal Regulations, Parts 30, and 70. Since no record of a formal close-out survey could be located, the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), requested the U.S. Army Environmental Hygiene Agency (USAEHA) investigate these areas (References 1 and 3). The USATHAMA has been redesignated as the U.S. Army Environmental Center (USAEC) and the USAEHA has been redesignated as the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). This report details the scoping survey and characterization survey (29 Aug-15 Sep 95 and 14-28 Jan 96) investigations at the Burial Mound Site. The Background Area and Burial Mound Survey Unit location of the site are noted on a portion of the Fort McClellan topographic map in Figure H-3.

VI. RADIATION SURVEYS AND RESULTS. The Phase I (Scoping Survey) and Phase II (Characterization Survey) Survey Plans are attached in Appendix C. The Survey Plans contain the basis for this study and explain the various surveys that constitute this study. The results of the various surveys are discussed as follows:

A. Surface Instrumentation Surveys - Scoping Survey.

1. Reconnaissance Background Gamma Surveys - Measurements and Results. The Reconnaissance Background survey was performed to determine the Fort McClellan/Pelham Range "population" background. Ten locations outside the New Rideout Field fence line were selected and surveyed. The 10 locations (Bkg-1 through Bkg-10) are indicated in Figure H-3, which is a portion of the Pelham range topographic map.

a. Monitoring to determine gamma exposure rates were performed with an Eberline model ESP-2 survey meter mated with an Eberline Model SPA-3 Scintillation Probe Assembly. The probe contains a 2 inch by 2 inch sodium iodide [NaI(Tl)] crystal, 2-inch 10 stage photomultiplier tube socket with a dynode resistor string, and magnetic shield. The sensitivity is approximately 1,200,000 counts per minute (cpm) per 1 milliroentgen per hour (mR/hr) with a Cs-137 source and about 500,000 cpm/mR/hr with Co-60.

(1) Reconnaissance background gamma radiation exposure rate measurements ranged from 3.99 - 7.53 microRoentgen per hour (µR/hr); the average gamma exposure rate was 5.286 µR/hr. Measurements were taken 1 meter (m) from the ground surface with the exposure rate averaged electronically (scaler average rate mode) for a period of 18 minutes. See Table F-1 for all Reconnaissance Background ESP-2/SPA-3 exposure rate measurements.

(2) Quality control (QC) limits were established for the ESP-2 survey meter [Serial Number (SN): 355] and SPA-3 probe assembly (SN: 355-4). Operational checks were performed by exposing the detector to a Cs-137 calibration standard prior to each day's operation and periodically during the day.

b. Monitoring to determine gamma exposure rates were also performed with a Reuter-Stokes Ionization Chamber.

(1) The Model RSS-112 Ionization Chamber (SN: F-8591) consists of two main components, an electronics enclosure and a High Pressure Ionization Chamber (HPIC). Key features of the ion chamber include: an 8 liter spherical ionization chamber; an internally mounted electrometer; a nearly flat energy response from 0.07 to 10 million electron volts; ±5% accuracy at back-ground; an omni directional response; a linear output from 0-100 mR/hr; and beta insensitive. Sensitivity is 19.99 mV/µR/hr with a Co-60 source.

(2) Reconnaissance background gamma exposure rate measurements ranged from 5.8 - 11.6 µR/hr; the average gamma exposure rate was 8.24 µR/hr. Measurements were taken 1 m from the ground surface with the exposure rate averaged electronically (220, 5 second measurements). See Table F-1, for all Reconnaissance Background RSS-112 exposure rate measurements.

c. A Canberra Industries, Inc. Portable Plus Multichannel Analyzer with a 3 inch by 3 inch NaI(Tl) detector was used to perform in-situ screening for gamma emitting radionuclides in the Reconnaissance Background areas. The instrument was energy calibrated using Co-60 and Cs-137 calibration standards. The 30 minute acquisitions indicated naturally occurring isotopes from the uranium and thorium decay chains as well as potassium-40 (K-40). No man-made radionuclides were identified in the Reconnaissance Background Locations.

2. Troop Assembly Area Background Gamma Surveys - Measurements and Results. A Background Area Survey Unit was established approximately 100 m North-North-East (NNE) of the Burial Mound in the Troop Assembly Area. The area appeared to be similar geologically and was up gradient from the Burial Mound. Gamma exposure rate measurements and surface soil samples were obtained from this Troop Assembly Background Area. The Troop Assembly Background Area location is indicated on the Pelham Range topographic map at Figure H-3.

a. The Troop Assembly Area Background gamma exposure rate measurements with the ESP-2 survey meter/SPA-3 probe combination ranged from 5.65 µR/hr to 5.90 µR/hr; the average gamma exposure rate was 5.764 µR/hr. Measurements were taken 1 m from the ground surface with the exposure rate averaged electronically (scaler average rate mode) for a period of 18 minutes. Table F-2 contains all ESP-2/SPA-3 Troop Assembly Background Area exposure rate measurements.

b. The Troop Assembly Area Background RS-112 HPIC gamma radiation exposure rate measurements ranged from 7.2 µR/hr to 10.2 µR/hr; the average gamma exposure rate was 8.65 µR/hr. Measurements were taken 1 m from the ground surface with the exposure rate averaged electronically (220, 5 second measurements). Table F-2 contains all RS-112 HPIC Troop Assembly Background Area exposure rate measurements.

c. Scanning surveys were performed using a combination Eberline Model ASP-1/PG-2 instrument-probe assembly. The PG-2 is a ruggedized thin-crystal NaI(Tl) detector 2 inches in diameter by 2 millimeters thick. The thin-crystal gives this probe characteristics which enhance operator ability to locate buried radioactive materials. First, its thin-crystal gives the probe directional discrimination without the use of heavy lead

collimators. Second, its high efficiency for low energy gamma photons and x-rays enable it to detect the bremsstrahlung x-rays from moderate to high energy beta emitters as well as compton scattered gamma photons and x-rays. The probe was attached to the end of a rod and passed back and forth within 6 inches of the surface while the operator moved forward at a rate not to exceed 0.5 meters per second.

(1) Two 10 m by 10 m grids were established in the Troop Assembly Background Area. Sampling locations were marked in accordance with the Survey Plans located in Appendix C.

(2) Each grid in the Troop Assembly Background Area was divided into 10 1 m wide survey lanes. The survey team performed a 100% scanning survey of the Background Area with the ASP-1/PG-2 instrument package. The background count rate varied from 1,200 cpm to 1,900 cpm and averaged 1,400 cpm. Table F-4 includes the Background Area scanning survey results.

(3) Operational checks were performed by exposing the ASP-1/PG-2 survey meter/detector to a Cs-137 calibration standard prior to each day's operation and periodically during the day.

3. Burial Mound Survey Unit Gamma Surveys - Measurements and Results. The area identified as the Burial Mound was gridded into eight 10 m by 10 m grids. One measurement was recorded from each grid center with both the ESP-2/SPA-3 and RSS-112 HPIC instruments. A diagram of the grid layout and sampling scheme are included in Figure 1 of Appendix C.

a. The ESP-2/SPA-3 gamma exposure rate measurements at the Burial Mound Survey Unit varied from 0.964 µR/hr below the Background Area average to 0.766 µR/hr above the Background Area average. Table F-3 contains all ESP-2/SPA-3 Burial Mound Survey Unit exposure rate measurements.

b. The RS-112 HPIC gamma exposure rate measurements varied from 0.85 µR/hr below the Troop Assembly Background Area average to 1.25 µR/hr above the Troop Assembly Background Area. Table F-3 contains all RS-112 HPIC gamma exposure rate measurements.

c. The survey team performed a 100% scanning survey of the Burial Mound Survey Unit with the ASP-1/PG-2 instrument package. Each 10 m by 10 m grid in the Burial Mound Survey Unit was divided

into 10 1 m wide survey lanes. The Troop Assembly Background Area average count rate was 1,400 cpm. Any areas of the Burial Mound Survey Unit that exceeded twice the average background rate background (2,800 cpm) were marked as "hot spots". Twenty-three hot spots were identified and varied from 3,000 to 18,000 cpm (2 to 13 times background). Figures H-4 and H-5 display the hot spot locations relative to the sampling grid. Table F-4, includes the Burial Mound Survey Unit scanning survey results.

d. Gamma Spectroscopy Results. Field screening of the Burial Mound Survey Unit with a Canberra Portable Plus Gamma Spectroscopy System indicated the hot spots included Co-60 and Cs-137. Air samples collected during soil sampling operations were field screened for Co-60 and Cs-137. Photopeaks indicative of Co-60 or Cs-137 were not observed in the air filter gamma-ray spectra. The air filter samples were subsequently screened by the Radiologic, Classic, & Clinical Chemistry Division Laboratory for Co-60 and Cs-137 activity with identical results. Photopeaks indicative of Co-60 or Cs-137 were not observed in the air filter gamma-ray spectra.

B. Surface Soil Sample Results - Scoping Survey. Surface soil samples, from the top 15 centimeters (cm) of soil, were collected in the Reconnaissance Background Locations, the Troop Assembly Background Area, the Burial Mound Survey Unit, and from several of the hot spots identified during the scanning survey. All surface soil samples collected were analyzed for gross alpha activity, gross beta-gamma activity and for gamma emitting isotopes. The representative gross alpha activity minimum detectable activity (MDA) for the analytical technique employed was 5 picocuries per gram of dry soil (pCi/g). The representative gross beta-gamma MDA was 4 pCi/g. The representative gamma spectrometry MDAs for the radionuclides of interest were: K-40 at 4 pCi/g; Co-60 at 0.2 pCi/g; Cs-137 at 0.2 pCi/g; bismuth-214 (Bi-214) at 0.6 pCi/g; thorium-234 (Th-234) at 2 pCi/g; and actinium-228 (Ac-228) at 1.4 pCi/g. Table F-5 includes all surface soil sample results.

1. Reconnaissance Background Surface Soil Sample Results. Surface soil samples were collected from the 10 Reconnaissance Background Locations. The following narrative basic statistics are summarized in Table 1. Complete descriptive statistics, for the Reconnaissance Area surface soil sample data set, are contained in Table G-1.

a. The gross alpha activities ranged from 7 pCi/g to 24 pCi/g; the average Reconnaissance Background gross alpha activity was 14.6 pCi/g.

b. The gross beta-gamma activities ranged from 8 pCi/g to 29 pCi/g; the average Reconnaissance Background gross beta-gamma activity was 12.5 pCi/g.

c. The gamma spectral analyses indicated the presence of K-40, Cs-137, Bi-214, and Ac-228. The K-40 activities ranged from 0.04 pCi/g to 24 pCi/g and averaged 7.10 pCi/g. The Cs-137 activities ranged from 0.07 pCi/g to 1.6 pCi/g and averaged 0.55 pCi/g. The Bi-214 activities ranged 0.7 pCi/g to 1.6 pCi/g and averaged 0.94 pCi/g. The Ac-228 activities ranged from 0.7 pCi/g to 2.3 pCi/g and averaged 1.21 pCi/g. Statistics for Co-60 (range -0.05 pCi/g to 0.08 pCi/g and average 0.012 pCi/g) and Th-234 (range -1 pCi/g to 2 pCi/g and average 1.05 pCi/g) are listed in Table 1 (Basic Statistics) and in Table G-1 (Complete Descriptive Statistics). All Co-60 activity and Th-234 activity results are less than or equal to the respective MDA.

Table 1. Reconnaissance Background Area Surface Soil Samples Basic Statistics

Analyte	Low (pCi/g)	High (pCi/g)	Average (pCi/g)	MDA (pCi/g)
Gross Alpha	7	24	14.6	5
Gross Beta-Gamma	8	29	12.5	4
K-40	0.04	24	7.10	4
Co-60	-0.05	0.08	0.012	0.2
Cs-137	0.07	1.6	0.55	0.2
Bi-214	0.7	1.6	0.94	0.6
Th-234	-1	2	1.05	2
Ac-228	0.7	2.3	1.21	1.4

2. Troop Assembly Background Area Surface Soil Sample Results. Ten Troop Assembly Area Background surface soil samples

were collected. All Troop Assembly Area Background surface soil samples were analyzed for gross alpha, gross beta-gamma activities and for gamma emitting isotopes. The following narrative basic statistics are summarized in Table 2. Complete descriptive statistics, for the Troop Assembly Area Background surface soil samples, are contained in Table G-2.

a. The gross alpha activities ranged from 16 pCi/g to 22 pCi/g; the average Troop Assembly Area Background gross alpha activity was 19.3 pCi/g.

b. The gross beta-gamma activities ranged from 9 pCi/g to 16 pCi/g; the average Troop Assembly Area Background gross beta-gamma activity was 13.3 pCi/g.

c. The gamma spectral analyses indicated the presence of K-40, Cs-137, Bi-214, Th-234 and Ac-228. The K-40 activities ranged from 4 pCi/g to 8 pCi/g and averaged 6.0 pCi/g. The Cs-137 activities ranged from -0.03 pCi/g to 0.3 pCi/g and averaged 0.12 pCi/g. The Bi-214 activities ranged from 1.1 pCi/g to 1.6 pCi/g and averaged 1.28 pCi/g. The Th-234 activities ranged from 1 pCi/g to 4 pCi/g and averaged 2.3 pCi/g. The Ac-228 activities ranged from 1 pCi/g to 2.2 pCi/g and averaged 1.49 pCi/g. Statistics for Co-60 activities (range -0.04 pCi/g to 0.1 pCi/g and average 0.03 pCi/g) are listed in Table 2 (Basic Statistics) and in Table G-1 (Complete Descriptive Statistics). All Co-60 activity results are less than the Co-60 MDA.

Table 2. Troop Assembly Area Background Surface Soil Samples Basic Statistics

Analyte	**Low (pCi/g)**	**High (pCi/g)**	**Average (pCi/g)**	**MDA (pCi/g)**
Gross Alpha	16	22	19.3	5
Gross Beta-Gamma	9	16	13.3	4
K-40	4	8	6.0	4
Co-60	-0.04	0.1	0.03	0.2
Cs-137	-0.03	0.3	0.12	0.2
Bi-214	1.1	1.6	1.28	0.6

Analyte	Low (pCi/g)	High (pCi/g)	Average (pCi/g)	MDA (pCi/g)
Th-234	1	4	2.3	2
Ac-228	1.0	2.2	1.49	1.4

3. Burial Mound Survey Unit Surface Soil Sample Results. Eight surface soil samples were collected from the Burial Mound Survey Unit. One sample was collected from the center of each grid in the Burial Mound Survey Unit. The Burial Mound Survey Unit surface soil samples were analyzed for gross alpha, gross beta-gamma activities and for gamma emitting isotopes. The following narrative basic statistics are summarized in Table 3. Complete descriptive statistics, for the Burial Mound Survey Unit surface soil samples, are contained in Table G-3.

a. The gross alpha activities ranged from 10 pCi/g to 25 pCi/g; the average Burial Mound Survey Unit gross alpha activity was 17.5 pCi/g.

b. The gross beta-gamma activities ranged from 8 pCi/g to 24 pCi/g; the average Burial Mound gross beta-gamma activity was 13.8 pCi/g.

c. The gamma spectral analyses indicated the presence of K-40, Co-60, Cs-137, Bi-214, Th-234 and Ac-228. The K-40 activities ranged from 3 pCi/g to 14 pCi/g and averaged 6.88 pCi/g. The Co-60 activities ranged from -0.03 pCi/g to 0.4 pCi/g and averaged 0.09 pCi/g. The Cs-137 activities ranged from 0.05 pCi/g to 1.6 pCi/g and averaged 0.61 pCi/g. The Bi-214 activities ranged from 1.0 pCi/g to 1.6 pCi/g and averaged 1.24 pCi/g. The Th-234 activities ranged from 0.02 pCi/g to 5 pCi/g and averaged 2.1 pCi/g. The Ac-228 activities ranged from 0.8 pCi/g to 2.0 pCi/g and averaged 1.2 pCi/g.

Table 3. Burial Mound Survey Unit Surface Soil Analysis Summary

Analyte	Low (pCi/g)	High (pCi/g)	Average (pCi/g)	MDA (pCi/g)
Gross Alpha	10	25	17.5	5

Analyte	Low (pCi/g)	High (pCi/g)	Average (pCi/g)	MDA (pCi/g)
Gross Beta-Gamma	8	24	13.8	4
K-40	3	14	6.88	4
Co-60	-0.03	0.4	0.09	0.2
Cs-137	0.05	1.6	0.61	0.2
Bi-214	1.0	1.6	1.24	0.6
Th-234	0.02	5	2.1	2
Ac-228	0.8	2.0	1.20	1.4

4. Burial Mound Hot Spot Surface Soil Sample Results. Surface soil samples, at 7 of the 23 identified hot spots, were collected. The hot spot surface soil samples were analyzed for gross alpha activity, gross beta-gamma activity and for gamma emitting isotopes. The following narrative basic statistics are summarized in Table 4. Complete descriptive statistics, for the seven hot spot surface soil samples, are contained in Table G-4.

a. The gross alpha activities ranged from 16 pCi/g to 22 pCi/g; the average hot spot gross alpha activity was 19.7 pCi/g.

b. The gross beta-gamma activities ranged from 15 pCi/g to 130 pCi/g; the average hot spot gross beta-gamma activity was 42.7 pCi/g.

c. The gamma spectral analyses indicated the presence of K-40, Co-60, Cs-137, Bi-214, Th-234 and Ac-228. The K-40 activities ranged from 4 pCi/g to 10 pCi/g and averaged 6.4 pCi/g. The Co-60 activities ranged from 1.6 pCi/g to 187 pCi/g and averaged 38.0 pCi/g. The Cs-137 activities ranged from 0.2 pCi/g to 179 pCi/g and averaged 32.6 pCi/g. The Bi-214 activities ranged from 0.6 pCi/g to 1.6 pCi/g and averaged 1.0 pCi/g. The Th-234 activities ranged from -5 pCi/g to 5 pCi/g and averaged -0.7 pCi/g. The Ac-228 activities ranged from 0.9 pCi/g to 2 pCi/g and averaged 1.2 pCi/g.

Table 4. Burial Mound Hot Spot Surface Soil Analysis Summary

Analyte	Low (pCi/g)	High (pCi/g)	Average (pCi/g)	MDA (pCi/g)
Gross Alpha	16	22	19.7	5
Gross Beta-Gamma	15	130	42.7	4
K-40	4	10	6.4	4
Co-60	1.6	187	38.0	0.2
Cs-137	0.2	179	32.6	0.2
Bi-214	0.6	1.6	1.0	0.6
Th-234	-5	5	-0.7	2
Ac-228	0.9	2.0	1.2	1.4

d. Hot spot surface soil sample HS-20 had a very localized area of intense activity (approximately 100 times background) when screened with a thin window GM detector in the field. ESP-2/SPA-3 exposure rate readings up to 60 µR/hr were obtained through the sample container (double zip-lock bags).

(1) This sample was submitted to the laboratory with a request to isolate the source of the intense activity and analyze it as a separate sample. The laboratory isolated a speck of soil about the size of the eye of a sewing needle. The Co-60 activity of the soil speck was 253,000 pCi. The mass of the soil speck was 0.0043 gram. Therefore, the specific activity of the soil speck is 58.8 microcuries per gram. Pictures of the soil speck are included in Figures H-6 and H-7.

(2) The remaining surface soil sample HS-20 was analyzed in duplicate. The results of the duplicate analyses indicated the soil sample was not homogeneous. Therefore, the laboratory was requested to analyze all remaining soil from sample HS-20 as additional duplicate samples. The laboratory analyzed two additional sample aliquots. All HS-20 duplicate sample results are listed in Table 9.

Table 9. HS-20 Surface Soil Sample Duplicate Analyses

Analyte	HS-20	HS-20 1st Dup	HS-20 2nd Dup	HS-20 3rd Dup
K-40	7 +/- 4	5 +/- 2	4 +/- 1	5 +/- 2
Co-60	187 +/- 2	19 +/- 1	12 +/- 0.5	17 +/- 1
Cs-137	0.9 +/- 0.5	1.1 +/- 0.3	0.7 +/- 0.2	0.6 +/- 0.4
Bi-214	0.8 +/- 0.6	1.6 +/- 0.5	1.0 +/- 0.3	1 +/- 1
Th-234	-2 +/- 11	3 +/- 2	1 +/- 4	2 +/- 2
Ac-228	2 +/- 2	0.4 +/- 1.0	0.8 +/- 0.5	1 +/- 1

C. Sub-Surface Instrumentation Surveys - Characterization Survey. Sub-surface characterization surveys were performed since the surface soil sample surveys indicated activity concentrations greater than both the Co-60 and Cs-137 release criteria.

1. Troop Assembly Background Area "Down-Hole" Logging Measurements and Results.

a. After removal of the soil core samples (see paragraph VI.D) gamma scalar counts were performed at various depths down the hole. This "down-hole" logging survey was performed with a Ludlum Model 44-62-2 waterproof 0.5 inch diameter 1 inch thick NaI(Tl) detector mated to a Ludlum Model 2350 Data Logger. Where possible, 45 second scaler measurements were recorded from the surface and each one foot interval to the bottom of the hole. Several of the holes collapsed before the planned readings were taken. Basic statistics for the Troop Assembly Background Area "down-hole" logging survey are summarized in Table 5. All Troop Assembly Background Area "down-hole" logging survey results are contained in Table F-6.

Table 5. Troop Assembly Background Area "Down-Hole" Logging Survey Basic Statistics

Relative Depth from Surface (feet)	Minimum NaI Counts in 45 seconds	Maximum NaI Counts in 45 seconds	Average NaI Counts in 45 seconds
0 (surface)	103	158	135
-1	246	349	289
-2	252	412	315
-3	283	470	346
-4	290	474	354
-5	304	480	373
-6	271	499	379
-7	261	449	405
-8	317	508	421
-9	329	534	455
-10	300	594	467
-11	319	579	467
-12	345	641	479

b. Operational checks were performed by exposing the Ludlum 2350/44-62-2 survey meter/NaI detector to a Cs-137 calibration standard prior to each day's operation and periodically during the day.

2. Burial Mound "Down-Hole" Logging Survey Measurements and Results.

a. After removal of the soil core samples (see paragraph VI.D) gamma scalar counts were performed at various depths down the hole. This "down-hole" logging survey was performed with a Ludlum Model 44-62-2 waterproof 0.5 inch diameter 1 inch thick NaI(Tl) detector mated to a Ludlum Model 2350 Data Logger. Where possible,

45 second scaler measurements were recorded from the surface and each 1 foot interval to the bottom of the hole. Several of the holes collapsed before the planned readings were taken. Basic statistics for the Burial Mound Survey Unit "down-hole" logging survey are summarized in Table 6 below. All Burial Mound "down-hole" logging survey results are contained in Table F-7. Soil mounds, from 1 foot to 4 feet above the surrounding surface, were present in portions of the Burial Mound Survey Unit. Measurements from these mound areas are indicated with positive relative depth numbers.

b. The Burial Mound (BM) "down-hole" logging survey indicates elevated measurements when compared to the Troop Assembly background Area "down-hole" logging survey. Several Burial Mound "down-hole" measurements were greater than 1000 times the associated Troop Assembly Area Background Measurement. These elevated results are indicative of buried radioactive sources or substantial contamination pockets (close to but not within the core sample) in the subsurface environs, since there was no significant correlation between the sub-surface soil activity measurements (paragraph VI.D.2) and the "down-hole" logging measurements.

c. The highest measurements of the BM's "down-hole" logging survey were recorded in the following locations; BM C1-5 peaking at a depth of 3 feet below the area's surrounding surface (141,362 counts in 45 seconds); BM C2-1 with two peaks, one at 5 feet below and the other at 8 feet below the area's surrounding surface (301,991 and 249,340 counts in 45 seconds); BM C2-7 peaking at a depth of 5 feet below the area's surrounding surface (939,591 counts in 45 seconds); and BM D2-6 peaking at a depth of 6 feet below the area's surrounding surface (16,285 counts in 45 seconds).

d. Operational checks were performed by exposing the Ludlum 2350/44-62-2 survey meter/NaI detector to a Cs-137 calibration standard prior to each day's operation and periodically during the day.

Table 6. Burial Mound Survey Unit "Down-Hole" Logging Survey Basic Statistics

Relative Depth from Surface (feet)	Minimum NaI Counts in 45 seconds	Maximum NaI Counts in 45 seconds	Average NaI Counts in 45 seconds
+4 (mound)	130	258	170.4
+3 (mound)	90	343	240.7
+2 (mound)	74	506	222.9
+1 (mound)	94	479	235.4
0 (surface)	80	432	156.1
-1	102	814	243.9
-2	150	5697	353
-3	159	141362	2808.4
-4	157	170097	6194.7
-5	159	939591	21036.4
-6	181	427340	9964.8
-7	201	169164	3643.9
-8	242	249340	4793.3
-9	266	33725	1020.7
-10	290	5622	543.7
-11	297	915	476.3
-12	218	727	479.2

D. Sub-Surface Soil Sample Results - Characterization Survey.

1. Sample Collection and Identification.

a. Troop Assembly Background Area. Two 10 m by 10 m grids were established in the Troop Assembly Background Area. Sets of core soil samples were collected from each sample point (6 sample points per grid) as described in the sampling plan (Appendix C). Twelve sets of core soil samples were collected from the Troop Assembly Background Area. One-hundred, forty-four samples were prepared and analyzed from the 12 sets of core soil samples.

b. Burial Mound Survey Unit. Nineteen 10 m by 10 m grids were established in the Burial Mound Survey Unit Area. Forty-nine sets of core soil samples were collected from the Burial Mound

Survey Unit. Five-hundred, seventy-one samples were prepared and analyzed from the Burial Mound Survey Unit.

c. The sampling equipment (Geoprobe Macro-Core Soil Sampling System) used collects a 2 inch diameter soil core up to 4 feet in length. Therefore, core soil samples were planned to be collected in 4-foot sections to a depth of 12 feet below the area's surrounding surface. Soil mounds, from 1 foot to 4 feet above the surrounding surface, were present in portions of the Burial Mound Survey Unit. If a mound was present at a sampling point, then a core soil sample was collected from the top of the mound to the surrounding surface.

d. Each soil core sample collected was labeled with a unique identifier. This identifier indicates the survey unit location [BM or Troop Assembly Background Area (BKG)], the grid sampling point (A0-3, B0-3, C0-3, ..., E2-8, E3-6), and the depth (+4/0, +3/0, +2/0, +1/0, -0/4, -4/8, or -8/12) at which the soil core sample was collected. For example, sample identifier BKG A1-1-0/4, was collected in the Troop Assembly Background Area, at grid location A1-1, from the surface to a depth of 4 feet below the surface. Sample identifier BM C1-5+3/0 was collected in the Burial Mound Survey Unit Area, at grid location C1-5, from a mound that was 3 feet above the surrounding surface to the surrounding surface.

e. In the laboratory each 4 foot core soil sample was split into 4 equal samples prior to analysis. Each partial soil core sample was labeled with a unique identifier following the labeling scheme described above. For example, field sample BKG A1-1-0/4 was split into 4 laboratory samples with the following unique identifiers: BKG A1-1-0/1; BKG A1-1-1/2; BKG A1-1-2/3; and BKG A1-1-3/4. In some instances, the soil core sample had compressed into a length much shorter than the actual sample core depth. For example, field sample core BM B1-3+3/0 was approximately 2 feet in length, although the soil core sample was collected from a mound 3 feet in height. Since the gamma spectral analyses performed by the laboratory required a volume contained in a 1 foot length of the sample tube, this sample core was split into two laboratory samples with the following identifiers: BM B1-3+3/1.5 and BM B1-3+1.5/0.

f. Each laboratory sample prepared was analyzed for gross alpha activity, gross beta-gamma activity and gamma emitting radionuclides. The gamma spectrometry soil sample preparation

steps were modified due to the number of samples collected. Rather than drying and sieving each sample, as specified in the routine procedure, the 1 foot sections were placed directly into Marinelli containers and counted on a high purity germanium (HPGe) detector. A Marinelli soil geometry efficiency calibration curve was prepared and used to quantitate the radionuclides present in the samples. Duplicate samples for gamma spectrometry could not be prepared since the entire sample was analyzed. Therefore, replicate gamma spectral counts of the prepared sample were performed for Quality Assurance (QA) purposes. The gross alpha activity and gross beta-gamma activity analyses were performed after the gamma spectral analyses. Approximately 0.1 gram of soil was removed from the Marinelli and placed on a 2 inch planchet. The soil was spread over the area of the planchet and dried thoroughly. The prepared planchet was then counted in a low background proportional counter for gross alpha activity and gross beta-gamma activity. Efficiency corrections were made based on the areal density of the soil that was spread over the planchet area. Approximately 10% of the samples were prepared and analyzed in duplicate for gross alpha activity and gross beta-gamma activity.

2. Troop Assembly Background Area Core Soil Sample Results. Twelve sets of background core soil samples were collected and 144 samples prepared for analysis. All Troop Assembly Background Area core soil samples were analyzed for gross alpha activity, gross beta-gamma activity and for gamma emitting isotopes. The following narrative basic statistics are summarized in Table 7. Complete descriptive statistics, for the Burial Mound Survey Unit core soil samples, are contained in Table G-5. All background core soil sample results are included in Table F-8.

a. The gross alpha activities ranged from 0.4 pCi/g to 23 pCi/g; the average Troop Assembly Area Background gross alpha activity was 10.4 pCi/g. The alpha activity representative MDA was 7 pCi/g.

b. The gross beta-gamma activities ranged from 4 pCi/g to 34 pCi/g; the average Troop Assembly Area Background gross beta-gamma activity was 18.1 pCi/g. The beta-gamma activity representative MDA ranged from 5 pCi/g to 7 pCi/g.

c. The gamma spectral analyses indicated the presence of K-40, lead-214 (Pb-214), Bi-214 and Ac-228. The K-40 activities ranged from 3 pCi/g to 21 pCi/g and averaged 11.5 pCi/g. The

Pb-214 activities ranged from 0.5 pCi/g to 2.1 pCi/g and averaged 1.3 pCi/g. The Bi-214 activities ranged from 0.6 pCi/g to 1.9 pCi/g and averaged 1.18 pCi/g. The Ac-228 activities ranged from 0.6 pCi/g to 1.9 pCi/g and averaged 1.16 pCi/g. The gamma spectrometry representative MDAs for the radionuclides of interest were: K-40 at 1 pCi/g; Co-60 from 0.1 pCi/g to 0.2 pCi/g; Cs-137 from 0.1 pCi/g to 0.2 pCi/g; Pb-214 from 0.2 pCi/g to 0.4 pCi/g; Bi-214 at 0.5 pCi/g; and Ac-228 from 0.3 pCi/g to 0.6 pCi/g. Statistics for Co-60 and Cs-137 are listed in Table 7 (Basic Statistics) and Table G-5 (Complete Descriptive Statistics). All Co-60 activity and Cs-137 activity results are less than or equal to the respective MDA.

Table 7. Troop Assembly Area Background Core Soil Samples Basic Statistics

Analyte	Low (pCi/g)	High (pCi/g)	Average (pCi/g)	MDA (pCi/g)
Gross Alpha	0.4	23	10.4	7
Gross Beta-Gamma	4	34	18.1	5-7
K-40	3	21	11.5	1
Co-60	-0.08	0.1	0.0002	0.1-0.2
Cs-137	-0.09	0.1	-0.013	0.1-0.2
Pb-214	0.5	2.1	1.3	0.2-0.4
Bi-214	0.6	1.9	1.18	0.5
Ac-228	0.6	1.9	1.16	0.3-0.6

3. Burial Mound Survey Unit Core Soil Sample Results. Sixty-one core soil samples were collected and 571 samples prepared for analysis. All core samples were analyzed for gross alpha, gross beta-gamma activities and for gamma emitting isotopes. The following narrative basic statistics are summarized in Table 8. All Burial Mound Survey Unit core soil sample results are included in Table F-8.

a. The gross alpha activities ranged from -1 pCi/g to 23 pCi/g; the average gross alpha activity was 7.74 pCi/g.

b. The gross beta-gamma activities ranged from 2 pCi/g to 93 pCi/g; the average gross beta-gamma activity was 17.1 pCi/g.

c. The gamma spectral analyses indicated the presence of K-40, Co-60, Cs-137, Pb-214, Bi-214 and Ac-228. The K-40 activities ranged from 1 pCi/g to 39 pCi/g and averaged 11.7 pCi/g. The Co-60 activities ranged from -0.1 pCi/g to 330 pCi/g and averaged 2.56 pCi/g. The Cs-137 activities ranged from -0.1 pCi/g to 12 pCi/g and averaged 0.10 pCi/g. The Pb-214 activities ranged from 0.1 to 2.2 pCi/g and averaged 1.2 pCi/g. The Bi-214 activities ranged from -0.5 pCi/g to 2.2 pCi/g and averaged 1.1 pCi/g. The Ac-228 activities ranged from -1 pCi/g to 3 pCi/g and averaged 1.14 pCi/g. The gamma spectrometry representative MDAs for the radionuclides of interest were: K-40 at 1 pCi/g; Co-60 at 0.2 pCi/g; Cs-137 at 0.2 pCi/g; Pb-214 at 0.4 pCi/g; Bi-214 at 0.5 pCi/g; and Ac-228 at 0.6 pCi/g.

Table 8. Burial Mound Survey Unit Core Soil Samples Basic Statistics

Analyte	Low (pCi/g)	High (pCi/g)	Average (pCi/g)	MDA (pCi/g)
Gross Alpha	-1	23	7.74	7
Gross Beta-Gamma	2	93	17.1	5-7
K-40	1	39	11.7	1
Co-60	-0.1	330	2.56	0.1-0.2
Cs-137	-0.1	12	0.10	0.1-0.2
Pb-214	0.1	2.2	1.2	0.2-0.4
Bi-214	-0.5	2.2	1.1	0.5
Ac-228	-1	3	1.1	0.3-0.6

E. Data Interpretation - Burial Mound Survey Unit. The ultimate goal of the decommissioning process is to assure that future uses of any licensed facility will not result in individuals being exposed to unacceptable levels of radiation and/or radioactive materials. This is normally accomplished by ensuring any residual radioactive material is below the release guidelines

established by regulatory agencies such as the NRC. These guideline values refer to radiation and radioactivity above normal background levels.

1. Gamma Exposure Rate. The release criteria for direct radiation levels is 5 µR/hr above the established background exposure rate. No exposure rates greater than 1.25 µR/hr above background (paragraph VI.A.3.a) were noted. Therefore, the Burial Mound survey unit meets the release criteria for direct radiation levels.

2. Cobalt-60. The Co-60 activity in soil unrestricted use release criteria is 8 pCi/g above background. This radionuclide is not naturally occurring and is typically not found in background samples. Results of the laboratory analyses indicate no detectable Co-60 activity in the Troop Assembly Background Area. However, Co-60 activity above the release criteria was identified in the Burial Mound Survey Unit. The highest surface soil sample Co-60 activity result (Table 4) was 187 pCi/g or 23 times the release criteria. The highest core soil sample Co-60 activity result (Table 8) was 330 pCi/g or 41 times the release criteria. In addition, there may be more items similar to the speck of Co-60 material (paragraph VI.B.4.d) in the burial mound. Although this particular speck has been remediated, a similar item would be more than 7 million times the Co-60 activity in soil unrestricted use release criteria. Therefore, the Burial Mound Survey Unit does not meet the release criteria for Co-60 activity in soil.

3. Cesium-137. The Cs-137 activity in soil unrestricted use release criteria is 15 pCi/g above background. This radionuclide is not naturally occurring, but unlike Co-60 activity, it is found worldwide in surface soil samples. The source of the surface soil Cs-137 activity is fallout from atmospheric nuclear weapons testing and nuclear reactor accidents. The Cs-137 activity is usually found in the top several cm of soil with concentrations ranging from less than 0.1 pCi/g to several pCi/g depending on the location and soil type. Results of the laboratory analyses indicated Cs-137 activity in the background areas up to 1.6 pCi/g (Table 1). The highest surface soil sample Cs-137 activity result (Table 4) was 179 pCi/g or 11 times the release criteria. Therefore, the Burial Mound Survey Unit does not meet the release criteria for Cs-137 activity in soil.

a. If neither the Co-60 soil activity results nor the Cs-137 soil activity results exceeded the respective release criteria, then the "sum of the fractions rule" would have been applied to determine if the Burial Mound Survey Unit met the release criteria, since more than one radionuclide was detected.

b. The Co-60 activity in soil release criteria of 8 pCi/g is based on the assumption that only Co-60 is present. Likewise, the Cs-137 activity in soil release criteria of 15 pCi/g is based on the assumption that only Cs-137 is present. Therefore, when multiple radionuclides are present in a survey unit, the fractions of each radionuclide activity compared to its release criteria are summed and the summed value is compared to one. If the summed value is less than or equal to one then the survey unit meets the release criteria. If the summed value is greater than one, the survey unit does not meet the "sum of the fractions rule" release criteria.

VII. CONCLUSIONS. A review of the survey results indicates there are potential radiological health hazards in the Burial Mound Survey Unit.

A. The soil sampling survey results indicate that there is residual contamination above both the Co-60 activity in soil release criteria and the Cs-137 activity in soil release criteria.

B. The "down-hole" logging survey measurements were in some areas 1000 times the associated background measurement. These highly elevated readings are indicative of buried radioactive sources or substantial contamination pockets in the sub-surface environs.

VIII. RECOMMENDATIONS.

A. Remediate the radioactive contamination identified in the Burial Mound Survey Unit. Excavate, remove and properly dispose of the surface and sub-surface contamination identified. After remediation perform a final status survey of the Burial Mound Survey Unit to support release of this area for unrestricted use.

Indust Radn Study No. 27-MH-0987-R2-97, Fort McClellan, AL, 29 Aug-15 Sep 95 and 14-28 Jan 96

B. Perform radiological surveys in the "Old Rideout Field" area of Pelham Range to support release of this area for unrestricted use.

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APPENDIX A

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APPENDIX B

Abbreviations

Ac-228	actinium-228
AEC	Atomic Energy Commission
ASP	Analog Smart Portable
Bi-214	bismuth-214
BML	Byproduct Material License
Co-60	cobalt-60
cpm	counts per minute
Cs-137	cesium-137
DAC	Department of the Army Civilian
ESP	Eberline Smart Portable
GPS	Global Positioning System
H_0	null hypothesis
IAW	in accordance with
K-40	potassium-40
MDA	minimum detectable activity
mR/hr	milliRoentgen per hour
µR/hr	microRoentgen per hour
NaI(Tl)	sodium iodide, thallium activated
NRC	Nuclear Regulatory Commission
NUREG/CR	Nuclear Regulatory Guide/Contractor Report

Pb-214	lead-214
pCi/g	picocuries per gram
QA	quality assurance
QC	quality control
RAP	Radiological Analysis Program
RPO	Radiation Protection Officer
SN	serial number
SNM	Special Nuclear Material
SOP	Standard Operating Procedure
Sr-90	strontium-90
SSE	South Southeast
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USACMLCS	U.S. Army Chemical Center and School
USAEC	U.S. Army Environmental Center
USAEHA	U.S. Army Environmental Hygiene Agency
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
UTM	Universal Transverse Mercator

APPENDIX C

SURVEY/SAMPLING PLANS

Survey Title	Page
Phase I - Scoping Survey	C-2
Phase II - Characterization Survey	C-11

Survey Plan for Rideout Field
Pelham Range, Fort McClellan, Alabama
30 August 1995 - 16 September 1995

1. **Purpose:** This survey is designed to perform a scoping survey of Rideout Field Cobalt-60 training area as defined in NUREG/CR-5849. The survey monitoring procedures and methodologies are designed to detect and locate potential radioactive materials contamination or sources left behind after all radiological training was terminated.

2. **History:** The area known as Rideout Field served as a radiological training area from 1965 to 1972. The area was also used as an active radioactive material burial site as late as 1959. The radioactive materials associated with the burial site (Co-60, Cs-137, and possibly Sr-90) and the training area (Co-60) were disposed of in NRC licensed disposal facilities when the US Army Chemical Center and School training mission was transferred from Fort McClellan, Alabama to the US Army Ordnance Center and School at Aberdeen Proving Ground, Maryland in 1973. A close-out survey was conducted by the USAEHA in 1973, however, a detailed characterization survey was not performed at that time.

3. **Method:** Three surveys will be performed, which include a background survey, the burial mound area survey, and the training area survey.

Background Survey: A background survey will be performed to determine the Ft. McClellan/Pelham Range "population" background. Six to ten locations outside of the Rideout Field area of concern will be selected and surveyed as follows:

At each background survey location data will be collected using a Reuter-Stokes high pressure ionization chamber and an ESP-2 / SPA-3 survey meter / probe combination calibrated in micro-R per hour. The Reuter-Stokes and SPA-3 measurements will be taken simultaneously. Each detector will be approximately 1 meter from the ground. The detectors will be placed approximately 5 meters apart.

The Reuter-Stokes data will be collected for approximately 18 minutes (220 5-sec intervals). The mean and standard deviation of the 220 intervals will be recorded along with the high and the low reading. From this data the Ft. McClellan population mean and standard deviation will be calculated. This data will also be tested, as described in NUREG/CR-5849, equation 8-22, to demonstrate that average background represents the population background average within 20% at the 95% confidence level. Additional background survey points will be collected, if warranted.

The ESP-2/SPA-3 data will be collected for approximately 18 minutes using the average rate mode. From this data the Ft.

McClellan population mean and standard deviation will be calculated. This data will also be tested, as described in NUREG/CR-5849, equation 8-22, to demonstrate that average background represents the population background average within 20% at the 95% confidence level. Additional background survey points will be collected, if warranted.

A surface soil sample will also be collected at each background sample location. These samples will be analyzed for gross alpha, gross beta, and gamma emitting isotopes by USACHPPM-RAP. Light weight work gloves will be used to minimize the potential for cuts and abrasions during soil sample collection.

At the selected background locations air samples will also be collected in addition to the Reuter-Stokes and SPA-3 measurements. Air samples will be collected through out the surveys (especially when collecting soil samples from the burial area) since re-suspension of Cobalt-60 and Cesium-137 is a radiological health and safety concern to all members of the survey team.

The air sample will be collected using a HI-Q Model CF-993B portable air sampler. The air sample will be collected for approximately 30 minutes. The air sample collection time may be readjusted as necessary, but a minimum of 1500 cubic feet of air will be collected. The air flow rate at the start and end of the air sample will be recorded. The average of these two values will be used in subsequent calculations. The air sample will be analyzed by gamma spectroscopy for Co-60 and Cs-137 with a portable Canberra MCA connected to a 3" by 3" NaI detector. The MCA count time will be established in the field, since it is dependent on the background count rate of the detector in the particular counting environment and geometry. After the gamma spectrum is acquired the air sample will be also analyzed by Koval's method (USACHPPM Radioisotope Program method RAP-0041.000) to determine the activity in the air sample due to long lived isotopes on the air filter. An HP-210L survey instrument or equivalent will be used to count (scalar mode) the air filter. The counting efficiency will be determined with a Tc-99 calibration standard. From this data (MCA counts and Koval method activity calculations) the Ft. McClellan population mean and standard deviation will be calculated. This data will also be tested, as described in NUREG/CR-5849, equation 8-22, to demonstrate that average background represents the population background average within 20% at the 95% confidence level. Additional background survey points will be collected, if warranted. Any unexpected results, such as Co-60 in the background sample, will be brought to the immediate attention of the local RPO and the entire following survey plan readdressed.

Additional background surveys will be performed near the burial mound site in the Troop Assembly area. This area has been selected since it is upgradient from the burial site, close geographically, and similar geologically. The purpose of these additional background surveys is to ensure all members of the survey team are appropriately trained and proficient with the survey procedures and all instrument operating procedures. This portion of the background survey will also be used to establish the gamma scan survey background statistics. The surveys to be performed in this area include an ESP-2/SPA-3 radiation safety survey; air sampling survey; sample grid location surveys with the Reuter-Stokes, portable Canberra MCA / 3" by 3" NaI detector, and ESP-2 / SPA-3; gamma scan survey with ASP-1/PG-2; and soil sampling survey. At the conclusion of these additional background surveys two 100 square meter (10m x 10m) grids will be marked and surveyed in the same manner as the grids in the burial mound area. Shoe covers and light weight fabric coveralls will be worn, at a minimum, throughout the remaining surveys.

The first measurements collected in the Troop Assembly area will cover an area of approximately 600 square meters (two 10m x 10m grids extended by 5m in each direction) with the ESP-2/SPA-3. As long as these measurements are within the 95% confidence interval of the Ft. McClellan population mean, the survey will continue, ingress/egress paths established and personnel monitoring (frisking) procedures established. If these measurements are outside the upper bound of the 95% confidence interval of the Ft. McClellan population mean, then the additional background survey area will be re-located, to another location, perhaps near Rideout Hall, and the ESP-2/SPA-3 measurements and statistical test repeated.

After the additional background area meets the ESP-2/SPA-3 criteria listed above, the HI-Q portable air sampler will be positioned on the downwind side of the additional background survey area and set to collect a sample for the same sample collection time as the background air sample (approximately 30 minutes). The air flow rate at the start and end of the air sample will be recorded. After the air sample is collected, the air sample will be analyzed by gamma spectroscopy for Co-60 and Cs-137 with the portable Canberra MCA / 3" x 3" NaI detector. The MCA count time will be as previously established. As long as Co-60 is not present in the air sample gamma spectrum or Cs-137 does not exceed the established Ft. McClellan population background at the upper bound of the 95% confidence interval, then the survey will continue with the previously established radiation safety procedures. If any Co-60 is present in the gamma spectrum or Cs-137 is present above the previously established Ft. McClellan population background at the upper bound of the 95% confidence interval, the local RPO will be immediately notified and the following additional radiation safety issues addressed and procedures implemented.

The survey team will vacate the area through the established egress path, leaving coveralls and shoe covers. Nasal swipes will be taken and FedExed back to the USACHPPM-RAP laboratory for priority analysis. The air filter will then be analyzed by Koval's method to determine the activity in air due to the long lived isotopes on the air filter. This result will be used to determine if 10% of the ALI via inhalation for the particular isotope could have been exceeded or will be exceeded during the remaining field survey time. (Co-60, class Y, ALI via inhalation = 30 microCuries, DAC = 1e-8 microcuries per milliliter of air, effective half-life = 10 days; Cs-137, class Y, ALI via inhalation = 1e+5 microCuries, DAC = 5e-5 microCuries per milliliter of air, effective half-life = 70 days.) If 10% of the ALI could have been exceeded the air filter sample will then be Fedexed to the USACHPPM-RAP laboratory for a priority quantitative gamma spectral analysis. Also a 24 hour urine bioassay will be collected from each survey team member starting approximately 24 hours after the exposure. Weekly 24 hour urine bioassay samples will be collected thereafter or as determined in consultation with Medical Health Physics and the USACHPPM-RAP laboratory. (Prior to departing USACHPPM for Ft. McClellan all survey members will provide a pre-survey 24 hour urine bioassay sample to the USACHPPM-RAP laboratory. This sample will be analyzed only if the onsite air sampling results warrant such action.) Based on the USACHPPM-RAP quantitative gamma spectral air filter results, nasal swipe results and remaining field survey time a decision will be made to determine if respiratory protection is required for survey team members. If 10% of the ALI for the isotope(s) of concern can be exceeded in the remaining survey time then respiratory protection will be used by the survey team members. If survey members are required to wear respirators then the survey schedule will be re-adjusted as necessary taking into account the heat, humidity and reduced air intake of the individuals. Protective clothing will consist of lightweight coveralls, light duty work gloves over latex or rubber gloves, cloth or paper hoods and shoe coverings.

The next measurements (after air sample is started) to be performed in the additional background survey area (approximately 600 square meters) are with the Reuter/Stokes HPIC. The Reuter-Stokes will be placed in the middle of the 600 square meter area and an 18 minute count performed (220 5 sec intervals). If the average of this data falls in the Ft. McClellan Reuter-Stokes population at the 95% confidence interval the survey will continue. If these measurements are outside the upper bound of the 95% confidence interval of the Ft. McClellan population mean, the additional background survey area will be re-located, to another location and the additional background survey measurements, starting with the ESP-2/SPA-3 survey repeated.

After the additional background area meets the Reuter-Stokes measurement criteria listed above and the air sample results present no problem, two 100 square meter grids (10m x 10m) will be marked in the middle of the 600 square meter area. Five sampling and measurement locations forming a "Z" pattern will be established in each grid (one in the grid center and the other four at the mid-points between the grid center and the grid corners).

Gamma survey measurements will be taken and recorded at 1-meter above the ground for each of the measurement locations. These measurements will be taken with an Eberline ESP-2 and SPA-3 probe combination. These measurements will be repeated with the Reuter Stokes high pressure ionization chamber (HPIC).

In-situ gamma spectroscopy measurements at 1 meter will be recorded for each measurement location. These measurements will be performed using a 3in x 3in Sodium Iodide detector and Canberra Portable Multi Channel Analyzer.

The grid will then be subdivided into 10 1-meter wide survey lanes. Each survey lane will be scanned using an Eberline ASP-1 and PG-2 detector with the speaker on. The PG-2 probe will be attached to a stick and passed back and forth within the lane as close as possible to the lane surface while moving forward at a speed not to exceed 0.5 meters per second. The analog meter readings will be noted, however changes in the instrument response are monitored via the audible output, rather than needle fluctuations. The instrument background will be noted for each survey lane and an average background established for the grid. A Chi square analysis will be performed on the data from each grid. This test will verify that the data is normally distributed, as would be expected in a background area, and will be used to refine the teams' gamma scanning survey technique. The gamma scan survey will be performed by each survey team member. If the data does not pass the Chi square test the team members' survey technique will be refined and the data recollected, until the team member

demonstrates proficiency.

Surface soil samples will be collected from each of the 5 measurement locations in the grid's "Z" pattern. Whenever, soil samples are being collected, an air sample will also be collected at an appropriate distance downwind from the soil sampling area. The air sample results will be interpreted and appropriate actions taken as previously described. At a minimum light duty work gloves will be worn during all soil sampling actions to protect from cut and abrasions.

Burial Mound Area Survey: This survey will be performed to determine the extent of the burial mound area and to identify hot spots and hot zones for further characterization by sub-surface sampling. The sub-surface sampling is anticipated to be performed with a GeoProbe soil sampler from 1-14 November 1995. During a previous site visit, a hot spot significantly above background was detected. Qualitative gamma spectral analysis of the hot spot indicated the presence of Co-60 and Cs-137.

A gamma exposure survey will be performed with the ESP-2/SPA-3. All readings 5 microRoentgen per hour above background will be marked as a preliminary hot spot or hot zone. A hot zone will have the elevated reading spread over an area, whereas, a hot spot the elevated reading will only be located at a single point. Ingress and egress paths will be established through the work area to an equipment/supply staging area. The path will minimize the time the survey team is in the vicinity of the hot areas (ALARA). All survey team members will be monitored (frisked) out of the work area and prior to entering the staging area.

The HI-Q air sampler will be setup downwind from all identified hot spots/zones. After the air sample is collected, the sample will be analyzed, results interpreted and appropriate actions taken as previously described.

The extent of the area to be gridded will be determined using the portable Canberra MCA and 3" x 3" NaI detector at 1 meter. Gamma ray spectra will be collected on the MCA starting at the middle of the burial mound. Gamma ray spectra will be collected at 10 meter intervals on lines that bisect the mound length wise and width wise. The extent of the area to grid will be determined when Co-60 is no longer in the spectra and Cs-137 is at the established background level for 2 consecutive measurements and all hot spots/zones previously identified are included.

The area will be gridded in 10 meter by 10 meter grid squares. Each grid will be subdivided into 10 1 meter wide survey lanes. Each survey lane will be gamma scanned using the ASP-1/PG-2 meter/probe combination with the speaker on. The preliminary hot spots/zones identified with the ESP-2/SPA-3 will be refined, since the ASP-1/PG-2 reading is

unidirectional and the ESP-2/SPA-3 reading is omnidirectional. All readings outside the upper bound of the 95% confidence interval of the background gamma scan will be further investigated with the MCA and Reuter-Stokes.

A Reuter-Stokes measurement (18 minutes - 220 5 second intervals) and MCA gamma spectrum will be collected at the center of each 10m x 10m grid. This will ensure 100% coverage of the radiological suspect area. These results will be compared to the background population averages developed for these measurements to determine whether the area is part of or distinct from the background population.

Surface soil samples will be collected from up to five locations in each grid. If no hot spots/zones have been identified in the grid, then the five samples will be collected (PPE: work gloves minimum) in the "Z" pattern. If there are hot spots/zones , then the samples will be collected (PPE: work gloves over latex or rubber gloves) from the hot spots/zones. When surface soil samples are being collected from hot spots/zones insure a downwind air sample is being collected. After the air sample is collected, the sample will be analyzed, results interpreted and appropriate actions taken as previously described.

Training Area Survey: A radiological training area existed at Rideout Field from 1965 to 1972. All sources (Co-60) used during this time were accounted for by serial number. However, an earlier radiological training field existed at Rideout Field. A Co-60 source was discovered buried at Rideout Field in 1985 and this source is believed to have come from the earlier radiological training area. Therefore, it is possible that other sources remain from this earlier training field.

To determine areas for further investigation the Reuter-Stokes HPIC will be employed. Measurements will be taken at 10 meter intervals along the area suspected to have contained the earlier Co-60 radiological training field. Each measurement will be 18 minutes (220 5 second intervals). The average measurement will be compared to the background population average. Anomalies (any measurement at or above the upper bound of the 68% confidence interval of the population background) will be marked and investigated as time allows. If necessary these areas will be re-visited during the 1-14 November 1995 sub-surface soil sampling survey.

4. Proposed Timeline:

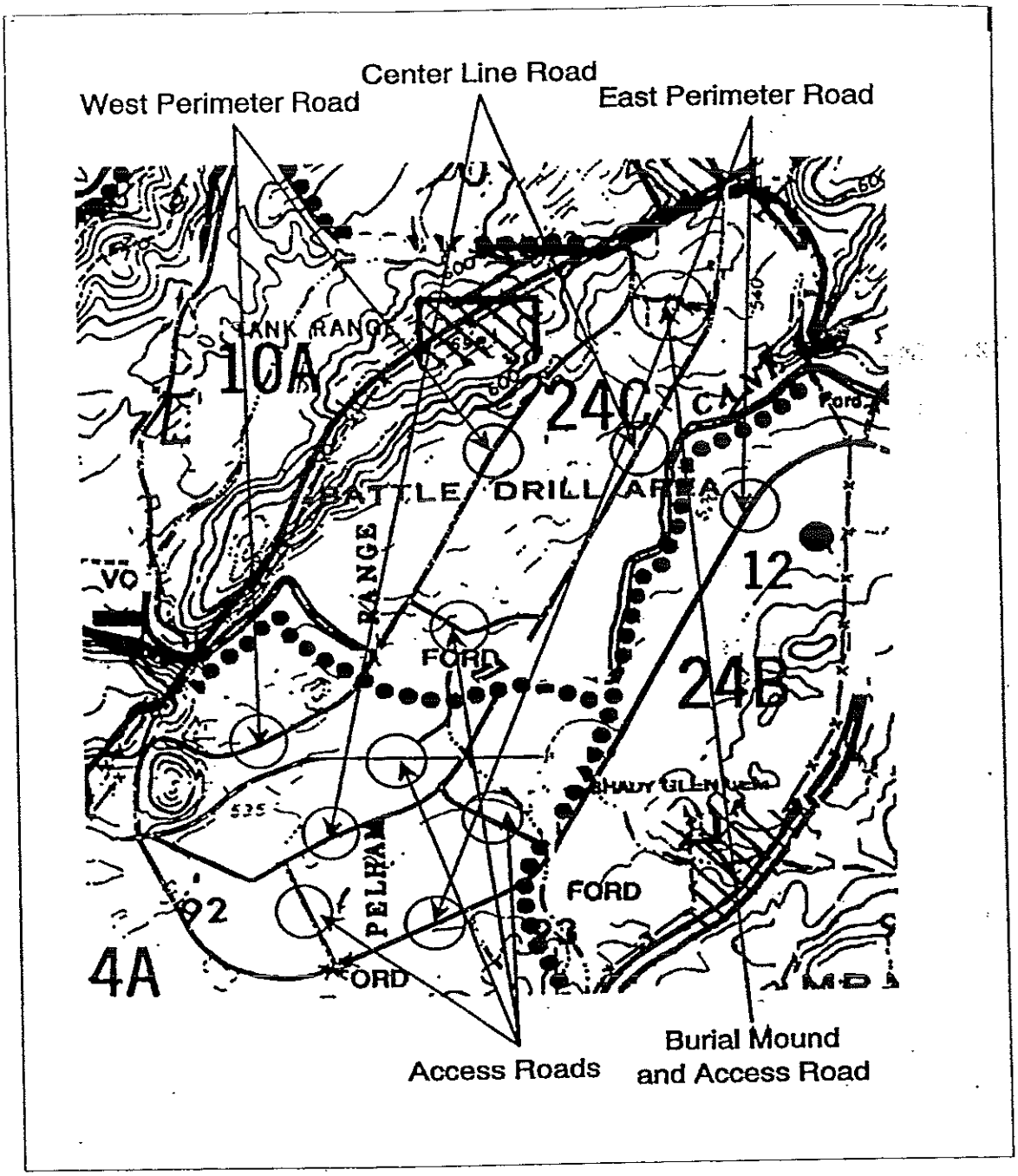
Area to be surveyed (See attached map)	Proposed Dates

Burial Mound and Access Road, North Field (3 days)	30 August - 1 September (and 1 - 14 Nov for Sampling)
Centerline Road, South Field (4 days 8 hrs)	5 - 11 Sep
North Access Road between Centerline Road and East Perimeter Road, South Field (1 day)	11 - 12 Sep
Middle Access Road between Centerline Road and East Perimeter Road, South Field (1 day)	12 - 13 Sep
South Access Road between Centerline Road and East Perimeter Road, South Field (1 day)	13 - 14 Sep
East Perimeter Road, South Field (2 days)	14 - 16 Sep

5. **Proposed Access Coordination:** It is desired that these surveys have minimum impact on the use of the area for military training. Surveys and sampling will be accomplished during daylight hours. It is desired to have a minimum 50-meter buffer around each measurement site which can be delineated by temporary barricades or markings of your choice. Roads will be surveyed at the rate of approximately 300-meters per day. A 400-meter section of road could be barricaded each day, or the entire section of road could be barricaded for the duration of each survey period.

Request the survey team members, equipment, and vehicles be granted umpire or evaluator status (or be accompanied by someone with such status) with authority to cross lines of communication and check-points as required during the survey.

6. **Pre-survey Support Request:** It is requested that the RPO have all trees and brush removed from and within 20-meters of the burial mound as close as possible to but prior to the 30 August start date.


West Perimeter Road
Center Line Road
East Perimeter Road
TANK RANGE
10A
24C
CAMP
Ford
BATTLE DRILL AREA
RANGE
12
FORD
24B
SHADY GLEN
535
PELHAM
FORD
92
4A
ORD
Access Roads
Burial Mound
and Access Road

ENVIRONMENTAL SURVEY PLAN
RIDEOUT FIELD SITE
FORT MCCLELLAN, ALABAMA
8 JANUARY - 19 JANUARY 1996

1. **Purpose**. The purpose of this Survey Plan is to evaluate potential radiological contamination in a Burial Mound at Pelham Range, Fort McClellan, Alabama for unrestricted release or required remediation.

2. **References**.

a. NUREG/CR-5849, Manual for Conducting Radiological Surveys in support of License Termination, June 1992.

b. Industrial Radiation Consultation No. 27-43-EU66-93, U.S. Army Chemical School and Military Police Center and Fort McClellan, Alabama, 27 July 1993.

3. **Historical Data Review Summary**.

a. The historical review completed by USACHPPM, (previously USAEHA) is the Industrial Radiation Consultation No. 27-43-EU66-93, and serves as an initial indication of the scope of work. It will also serve as the guidance for which aspects of the site survey plan must be implemented in each specific area.

b. The burial mound at Pelham Range has been identified as a location where radioactive material was buried. The burial mound is located within the area historically known as Rideout Field. Rideout Field had been used as a radiological training facility by the U.S. Army Chemical School from the mid 1950's through May of 1973. Although this area was released by the Atomic Energy Commission in 1973, the historical review of Fort McClellan identified the need for further investigation (reference Industrial Radiation Consultation No. 27-43-EU66-93 U.S. Army Chemical School and Military Police Center and Fort McClellan, Fort McClellan, Alabama, 27 July 1993). Specifically, there was no formal termination survey performed or documented to substantiate the unrestricted release criteria required by NUREG/CR-5849. The information gathered from historical documents, and written recollections of personnel assigned to Fort McClellan during the time period in question indicate the radiological waste placed

within the burial mound is most likely low-level laboratory waste (Cs-137, some Co-60, and possibly Sr-90). The data review indicates laboratory radiological waste, low-level laboratory waste in Super Tropical Bleach (STB) steel drums, and contaminated dirt removed from other radioactive material burial ground(s) were put into the burial mound (Hand written letter, LTC William G. Powell to MAJ Anderson, subject: Personal Recollections and Information on Iron Mountain and Rattlesnake Gulch, 6 March 1971). This same reference indicates radioactive wastes were buried at depths of 6 to 8 feet.

(1) Groundwater and soil contamination are the primary concerns. Since there are no known records of the quantities, chemical, or physical forms of the radioactive wastes which were placed in the burial mound, the data gathered during the survey is expected to provide a three-dimensional profile of the radioactive contaminants, their relative distributions (solubilities), and source terms. These attributes are required for site-specific modeling of guidelines for allowable residual concentrations of radionuclides and exposure pathway analysis. The potential exposure pathways are external radiation exposure, inhalation of radionuclides, and ingestion of food and water contaminated with radionuclides.

(2) The radioisotopes identified in the data review are cesium-137 (Cs-137), cobalt-60 (Co-60), and strontium-90 (Sr-90). All samples will be analyzed for gross alpha and gross beta-gamma activities. Gamma spectral analysis will be performed to identify specific gamma emitting radionuclides. Elevated beta counting results may require radiochemical determination of strontium-90. Appropriate analyses will be performed to identify any activity detected above background. Background samples will be collected to identify natural occurring radioactivity.

4. **Description of Location**.

a. The burial mound is located at the northwest corner of Pelham Range, northern end of the Battle Drill Area of Range 24C. The mound is oblong in shape and is approximately 25 meters long by 15 meters wide at coordinates 593300 meters East, 3732500 meters North in Universal Transverse Mercator (UTM) Grid Zone 16. The burial mound is surrounded by one ribbon of white Engineer Tape attached to metal fence stakes and marked with DANGER-KEEP OUT signs. The area surrounding the burial mound is utilized as a

maneuver training area for students at the U.S. Army Chemical and Military Police Schools, Active Duty Units, Reserve Units and Alabama National Guard Units.

b. "Affected" and "unaffected" areas classify survey units by contamination potential. NUREG/CR-5849 defines an affected open land survey as follows: "Affected" open land areas have potential radioactive contamination (based on plant operating history) or known radioactive contamination (based on past or preliminary radiological surveillance). This would normally include areas where radioactive materials were used and stored, where records indicate spills or other unusual occurrences that could have resulted in spread of contamination, and where radioactive materials were buried. Areas immediately surrounding or adjacent to locations where radioactive materials were used, stored, spilled, or buried are included in this classification because of the potential for inadvertent spread of contamination.

c. This site has been categorized as an affected open land area as defined in NUREG/CR-5849, based on known radioactive waste burials and elevated survey measurements found during the scoping survey.

5. **Survey Plan**. This plan consists of procedures for performing environmental background surveys, and for performing radiological surveys on site specific areas. Procedures used during all surveys will comply with the procedures outlined in NUREG/CR-5849. This plan is developed to comply with the guidance outlined for an "affected" open land area as defined in NUREG/CR-5849 and above.

5.1. **Background Survey**. A background survey will be performed to determine the Ft. McClellan/Pelham Range "population" background. Six to ten locations outside of the Rideout Field area of concern will be selected and surveyed as follows:

At each background survey location data will be collected using a Reuter-Stokes high pressure ionization chamber (HPIC) and an ESP-2/SPA-3 survey meter/probe combination calibrated in micro-R per hour. The Reuter-Stokes and SPA-3 measurements will be taken simultaneously. Each detector will be approximately 1 meter from the ground. The detectors will be placed approximately 5 meters apart.

The Reuter-Stokes data will be collected for approximately 18

minutes (220 5-sec intervals). The mean and standard deviation of the 220 intervals will be recorded along with the high and the low reading. From this data the Ft. McClellan population mean and standard deviation will be calculated. This data will also be tested, as described in NUREG/CR-5849, equation 8-22, to demonstrate that average background represents the population background average within 20% at the 95% confidence level. Additional background survey points will be collected, if warranted.

The ESP-2/SPA-3 data will be collected for approximately 18 minutes using the average rate mode. From this data the Ft. McClellan population mean and standard deviation will be calculated. This data will also be tested, as described in NUREG/CR-5849, equation 8-22, to demonstrate that average background represents the population background average within 20% at the 95% confidence level. Additional background survey points will be collected, if warranted.

A surface soil sample will also be collected at each background sample location. These samples will be analyzed for gross alpha, gross beta-gamma, and gamma emitting isotopes by USACHPPM-RAP. Light weight work gloves will be used to minimize the potential for cuts and abrasions during soil sample collection.

Additional background surveys will be performed near the burial mound site in the Troop Assembly area. This area has been selected since it is upgradient from the burial site, close geographically, and similar geologically. The purpose of these additional background surveys is to ensure all members of the survey team are appropriately trained and proficient with the survey procedures and all instrument operating procedures. The surveys to be performed in this area include an ESP-2/SPA-3 radiation safety survey; sample grid location surveys with the Reuter-Stokes, portable Canberra MCA/3" by 3" NaI detector, and ESP-2/SPA-3 instrument surveys; gamma scan survey with ASP-1/PG-2; and soil sampling survey. At the conclusion of these additional background surveys two 100 square meter (10m x 10m) grids will be marked and surveyed in the same manner as the grids in the burial mound area. Shoe covers and light weight fabric coveralls will be worn, at a minimum, throughout the remaining surveys.

The first measurements collected in the Troop Assembly area will cover an area of approximately 600 square meters (two 10m x 10m

grids extended by 5m in each direction) with the ESP-2/SPA-3. As long as these measurements are within the 95% confidence interval of the Ft. McClellan population mean, the survey will continue. Ingress/egress paths will be marked and personnel monitoring (frisking) procedures established. If these measurements are outside the upper bound of the 95% confidence interval of the Ft. McClellan population mean, then the additional background survey area will be re-located, to another location, perhaps near Rideout Hall, and the ESP-2/SPA-3 measurements and statistical test repeated.

The next measurements to be performed in the additional background survey area (approximately 600 square meters) are with the Reuter/Stokes HPIC. The Reuter-Stokes will be placed in the middle of the 600 square meter area and an 18 minute count performed (220 5 sec intervals). If the average of this data falls in the Ft. McClellan Reuter-Stokes population at the 95% confidence interval the survey will continue. If these measurements are outside the upper bound of the 95% confidence interval of the Ft. McClellan population mean, the additional background survey area will be re-located, to another location and the additional background survey measurements, starting with the ESP-2/SPA-3 survey repeated.

After the additional background area meets the Reuter-Stokes measurement criteria listed above, two 100 square meter grids (10m x 10m) will be marked in the middle of the 600 square meter area. Five sampling and measurement locations forming a "Z" pattern will be established in each grid (one in the grid center and the other four at the mid-points between the grid center and the grid corners).

Gamma survey measurements will be taken and recorded at 1-meter above the ground for each of the measurement locations. These measurements will be taken with an Eberline ESP-2 and SPA-3 probe combination. These measurements will be repeated with the Reuter Stokes high pressure ionization chamber (HPIC).

In-situ gamma spectroscopy measurements at 1 meter will be recorded for each measurement location. These measurements will be performed using a 3in x 3in Sodium Iodide detector and Canberra Portable Multi Channel Analyzer.

The grid will then be subdivided into 10 1-meter wide survey lanes. Each survey lane will be scanned using an Eberline ASP-1 and PG-2

detector with the speaker on. The PG-2 probe will be attached to a stick and passed back and forth within the lane as close as possible to the lane surface while moving forward at a speed not to exceed 0.5 meters per second. The analog meter readings will be noted, however changes in the instrument response are monitored via the audible output, rather than needle fluctuations. The instrument background will be noted for each survey lane and an average background established for the grid. This exercise will be used to refine the teams' gamma scanning survey technique. The gamma scan survey will be performed by each survey team member.

Surface soil samples will be collected from each of the 5 measurement locations in the grid's "Z" pattern. At a minimum light duty work gloves will be worn during all soil sampling actions to protect from cuts and abrasions.

a. Procedures.

(1) Instrumentation Surveys.

(a) Background instrumentation surveys and soil samples will be collected from outside the affected areas; preferably from an area where the topsoil has not been disturbed.

(b) All instrumentation will have operational checks performed with an appropriate radioactive check source prior to shipping to the field site; before starting the survey and periodically during the survey.

© All gamma surveys will be performed with the gamma detector at approximately 1-m from the soil surface.

(2) Soil Sample Surveys.

(a) All soil samples will be randomly selected. For the purpose of this survey, the soil surface is defined as the top 15 cm of soil. Soil samples will be analyzed for gross alpha, gross beta-gamma, and gamma emitting isotope activities. All sample locations will be posted/marked with an identifiable marker, such as a flag or stake.

(b) The subsurface background samples in the Troop Assembly Area will be collected in a systematic "Z" pattern. The area will be up gradient from and geologically similar to the area

of the burial mound. Surface soil samples will be procured from this area and submitted for laboratory analysis. The area will be made up of 2-10 meter by 10 meter grids with sampling locations in the center of each grid and at the mid-point between the grid center and grid corners (this pattern is typically referred to as the standard "Z" pattern). A core sampler will be used to collect 10 background samples. The soil samples will be collected to a depth of 12 feet below the soil surface. This sampling depth is an integral multiple of the 4 foot sampling tube depth that collects samples at least 3 feet below the known burial depth (8 feet).

(3) Water Sample Surveys. Water samples will be collected from available surface water sources including any run-off areas from the burial mound (no well or tap water sources are available at this site). All background water samples will be collected up gradient from the survey site. Water sample analyses will be performed in accordance with the RAP Analytical Protocols.

5.2. **Burial Mound Survey**. The Burial Mound has been classified as an Affected Open Land Area as defined in NUREG/CR-5849. The classification of this area as "affected" was confirmed during the scoping survey by in-situ gamma spectroscopy with a 3x3 inch sodium iodide detector (NaI(Tl)) and the identification of 23 "hot spots" which were greater than 2 times background by audible surface scanning with a 2 inch diameter, 2 millimeter thick NaI(Tl) detector. The in-situ analysis confirmed the presence of both cesium-137 and cobalt-60 in the burial mound. Preliminary analysis of the scoping survey data indicate the "hot spots" exhibit both point-source and distributed source characteristics.

a. Instrumentation Survey. Field survey meters will be within current calibration. All survey meters will have operational checks performed on them with an appropriate radioactive check source prior to starting the field surveys, and periodically during the survey work.

(1) The site has been 100% scanned with a gamma survey meter matched with a thin crystal sodium iodide detector. The detector was held within 6 inches of the soil surface.

(2) Areas with count rates greater than twice the measured background have been flagged.

(3) After the core samples have been removed (see Soil

Samples below), the boreholes will be logged with a sodium iodide detector each foot (approximately 0.30 m) from the surface to the bottom of the borehole. The detector reading will be zeroed at each position and allowed to acquire counts for a minimum of 1 minute. The instrument reading will then be recorded with the location information.

b. Soil Samples.

(1) Surface soil samples will be collected from grid centers and areas near selected "hot spots" from the survey site and submitted for laboratory analysis. All soil samples collected will be analyzed for gross alpha, gross beta-gamma, and gamma emitting isotope activities.

(2) Core samples will be collected in a systematic triangular pattern as recommended by the Environmental Protection Agency in report number 230/02-99-042 titled Methods for Evaluating the Attainment of Cleanup Standards Volume 1: Soils and Solid Media. A graphical representation of the pattern and the numbering system is attached as Figure 1. Since burial trenches were normally 6-8 feet deep during this time frame, each core location will be sampled to a maximum depth of 12 feet below the mounds surrounding surface (e.g. if the mound surface is 6 feet above the surrounding surface, the maximum core depth would be 18 feet (6 feet for the mound and 12 feet for the trench).

c. Water Samples.

(1) Fort McClellan currently has no Ground Water Monitoring Wells or tap water sources in the vicinity of the burial mound. There is apparently a drinking water well located approximately 350 meters NNE of the burial mound at Rideout Hall. Current data suggests it may be upgradient from the burial mound, but the data is not definitive.

(2) Surface water run-off samples may be collected in the vicinity of the burial mound if available. All samples collected will be analyzed for gross alpha activity, gross beta-gamma activity, and gamma emitting isotopes.

6. **Laboratory Analysis**. All laboratory analyses will be performed by USACHPPM, Radioisotope Analysis Program (RAP), which maintains multiple certifications including the EPA and A2LA.

a. Samples will be analyzed in accordance with USACHPPM, RAP protocols and procedures. Soil samples and water samples analysis will be performed at USACHPPM.

b. All laboratory samples will be controlled in accordance with USACHPPM chain of custody protocol.

7. **Quality Assurance and Quality Control (QA and QC)**.

a. Field survey instruments will be checked daily with a radioactive check source before use. Field QA will consist of blank samples since split and duplicate samples are not feasible with the sampling method to be used.

b. The QA for laboratory instruments will be performed by RAP, USACHPPM. Laboratory QA/QC such as sample spikes and background controls will be implemented by RAP as appropriate.

8. **Sample Contamination Management**.

a. Disposable gloves and splash protective apparel (i.e., saranex aprons, face shields) will be worn when appropriate. Since the soil sampling method effectively isolates each sample, gloves will be changed when integrity is compromised or monitoring results indicate contamination.

b. Sample collection equipment will be wiped clean with maslin cloths (mineral oil treated yellow dust cloths) between each sample. All disposable equipment will be used one time only. Equipment cleaning material will be collected, monitored and controlled.

c. All sample containers will be placed in a secondary container and shipped to USACHPPM via express common carrier or returned with USACHPPM survey equipment and vehicles.

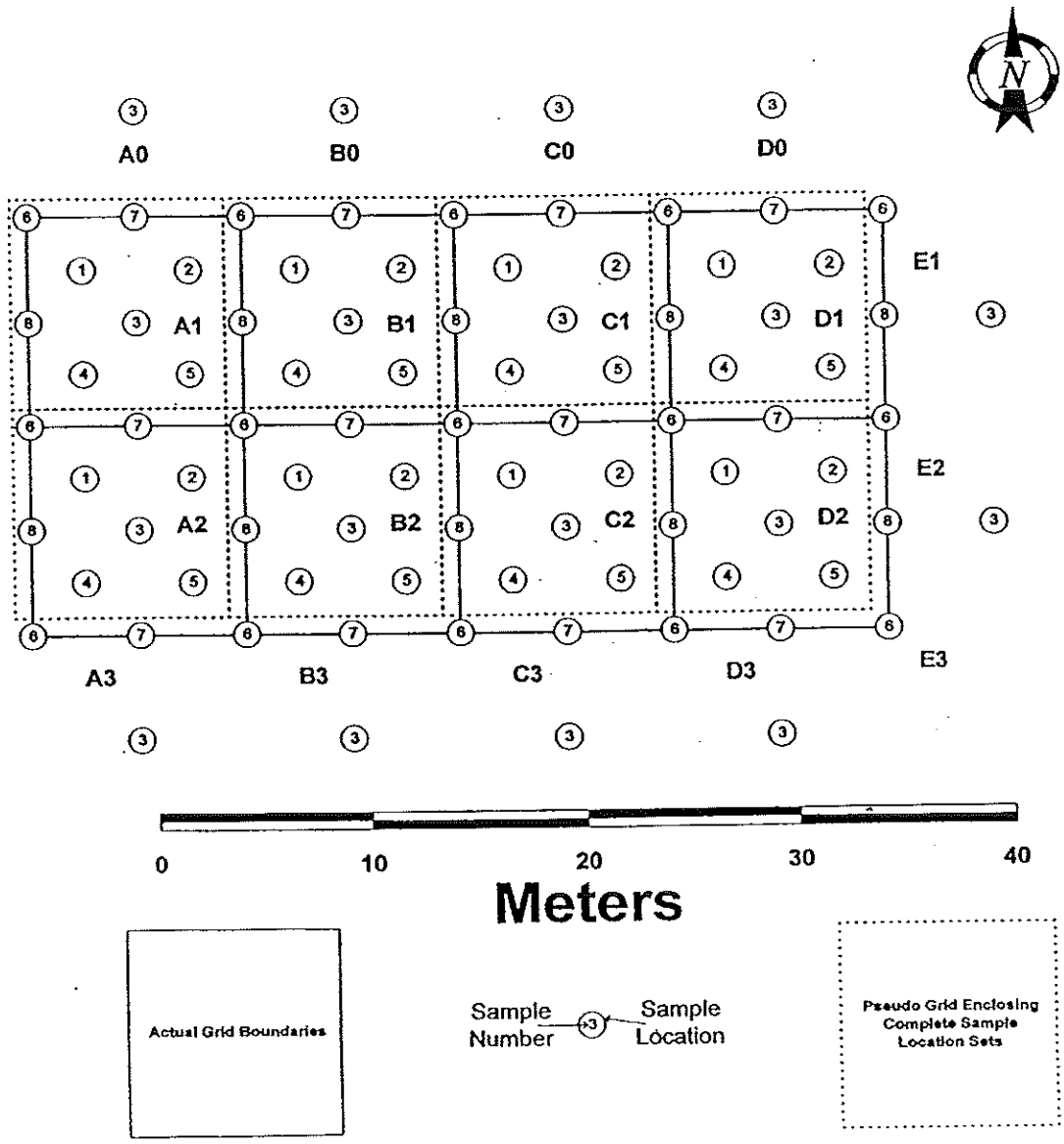
9. **General Safety Plan**. General site safety is covered in the attached Site Safety Plan for Rideout Field, Fort McClellan, AL 8 January - 19 January 1996.

10. **Survey Data**. Survey and Laboratory data will be used to provide recommendations for release of the site for unrestricted use or site remediation work plans. If radiological contamination is observed above acceptable levels, USACHPPM will provide

necessary recommendations to assist in the remediation effort.

Figure 1.

Pelham Range
Burial Mound, Rideout Field
Fort McClellan, Alabama



APPENDIX D

SITE SAFETY PLANS

Safety Plan Page

Phase I - Scoping Survey D-2

Phase II - Characterization Survey D-7

SITE SAFETY PLAN
RIDEOUT FIELD SITE
FORT MCCLELLAN, ALABAMA
PROJECT NUMBER 27-83-0987
AUGUST 1995 - SEPTEMBER 1995

1. INTRODUCTION. Safety is the responsibility of everyone involved in every aspect of this survey. It will be the number one concern and under no circumstance will any compromises be made on established safety standards.

2. ORGANIZATION AND RESPONSIBILITIES.

a. Harris Edge
Program Manager
Industrial Health Physics Program
U.S. Army Center for Health Promotion and Preventive Medicine (Provisional)[USACHPPM (Prov)]

b. Frances Szrom
Project and Site Safety Manager
USACHPPM (Prov)

c. Michael Bush
Co-Project and Site Safety Manager
USACHPPM (Prov)

d. Barthel F. Truffa, III
Health Physics Consultant
Nuclear Support Services

3. SCOPE OF WORK.

a. Purpose. The purpose of these radiological termination surveys is to produce the data to demonstrate that all radiological parameters are in compliance with current applicable Federal, State and local radiological guidelines for release of the areas for unrestricted use.

b. Project Description. Rideout Field, Fort McClellan, AL had been used as a radioactive waste burial site (1959) and radiological training area (1965-1972 and earlier). Records indicate the waste was removed (1970's) and disposed at licensed Nuclear Regulatory Commission (NRC) disposal facilities. However, adequate termination surveys were not performed. Therefore, radiological surveys will be performed following the guidelines currently available in NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination". This survey has been classified as a scoping survey as defined in NUREG/CR-5849. Radiological sampling will comprise survey instrumentation readings and if warranted, surface soil samples (from surface to 15 centimeter depth). Gamma survey instrumentation will be used to scan for elevated

readings. All areas with readings that exceed the limits established in the attached work plan will be identified and marked for further characterization. All characterization surveys will be performed in accordance with the requirements listed in NUREG/CR-5849. The Rideout Field site contains two areas of concern: the radiological burial area and the radiological training area. The radiological burial area is believed to be the dirt mound adjacent to the north most access road between Center Line and West Perimeter Roads of Rideout Field. The radiological training area (1965-1972) was located along the southern end of Center Line Road. An older (prior to 1965) radiological training area is also believed to have existed in this same area. The work to be performed is detailed in the Survey Plan for Rideout Field, Pelham Range, Fort McClellan, AL, 30 August 1995 - 16 September 1995, which is attached.

c. Personnel. The personnel that will be involved on site are listed in paragraphs 2b through 2d above. Either the project manager or co-project manager will be present during on site operations. While on site the survey team may be accompanied by Fort McClellan personnel, as designated by the installation radiation protection officer.

d. Medical Surveillance. All USACHPPM personnel involved in this survey are included in the medical monitoring program through Kirk Army Health Clinic at Aberdeen Proving Ground - Edgewood, Maryland.

4. SITE SPECIFIC HAZARD ANALYSIS.

a. Biological Hazards. Snakes, ticks, and other pests, as well as poisonous plants, are typically found in wooded and field areas in Fort McClellan, AL during the summer months. Therefore, snakes, ticks and poisonous plants will be a significant hazard to the survey personnel. The Fort McClellan Radiation Protection Officer or safety qualified designee will provide training to all survey personnel of the indigenous pests, poisonous plants and hazard minimization techniques prior to start of the field work. Those techniques will be incorporated into the daily work procedures.

b. Chemical Hazards. None apparent.

c. Climatic Hazards/Temperature. Given the timing of this survey, hot weather may present a problem. Fluids, frequent work breaks and light weight coveralls will be used to mitigate warm weather effects. However, if conditions warrant, such as heat alerts or heat advisories in the Fort McClellan area, work will cease until conditions improve. The Fort McClellan Radiation Protection Officer or safety qualified designee will review heat alert/advisory procedures with all survey personnel prior to start of the field work. These procedures will be incorporated into the daily work procedures.

d. Electrical/Utility. None apparent.

e. Flammable/Explosive. None apparent.

f. Ordnance. None apparent.

g. Infectious. None apparent.

h. Oxygen/Confined Space. None apparent.

i. Physical Hazards. Physical hazards are not normally associated with the radiation survey equipment.

j. Noise. Noise is not associated with the radiation survey equipment.

k. Radioactive. The survey plan is attached and has been developed to incorporate radiation protection procedures during the survey. The attached survey plan, along with this safety plan, are staffed with the local Radiation Protection Officer for concurrence. The radiation protection plan ensures that personnel exposures are kept as low as reasonably achievable. Personnel dosimetry and other appropriate radiation protection devices, will be used to monitor all personnel that enter radiation fields of 2 millirads per hour or greater. Since re-suspension of radioactive material (Co-60 and Cs-137) is possible the survey plan includes air filter sampling procedures, result interpretation and appropriate safety actions to be taken based on these air sample monitoring results.

l. Personal Protective Equipment. Steel toed safety boots/shoes will be worn at all times. Safety glasses will be worn as necessary. Light duty work gloves may be used to protect from cuts and abrasions as long as the field radiation survey equipment indicate readings less than 3 times the background count rate. Latex or rubber gloves will be used while sampling, if field radiation survey equipment exceed 3 times the background count rate. Shoe covers and light weight coveralls will be used at a minimum during the survey of the areas of concern. The need for cloth/paper hoods, double gloving (work gloves over latex or rubber gloves) and respiratory protection is addressed in the attached work plan. Respiratory protection may be required since re-suspension of radioactive materials is possible. The results of the air sample monitoring will be used to determine the need for respirators and bioassay samples, as detailed in the attached work plan.

m. Decontamination Procedures. A radiological clean area will be established near the survey site. Potentially contaminated clothing, gloves, shoe covers and equipment will be collected before entering the clean area. Personnel will be monitored (frisked) with a low level survey meter when leaving the work area and prior to entering the radiological clean area. Personnel found to have radiological contamination on them

greater than 2 times background will be required to decontaminate prior to leaving the contaminated area. Personnel and equipment decontamination will be accomplished with soap and water rinses, as necessary.

n. Emergency Procedures. The survey team will have cellular communications available to request emergency medical support and contact necessary Fort McClellan personnel. Illnesses and injuries will be directed to the local medical support centers. Emergency medical services are available through the Ambulance Service which has an MOU with Ft. McClellan, AL. The ambulance service phone number is (205) 848-2345. The ambulance service will transport medical emergencies to Noble Army Community Hospital (205) 848-2152 or Jacksonville Hospital (205) 435-4970.

5. NOTIFICATION. Pre-entry safety and work briefings will be held prior to daily work commencement. The briefings will consist of the familiarization of project personnel with the survey locations and methodologies, site safety procedures, and emergency response procedures. The following individuals acknowledge that they have been notified of the contents of this site safety and health plan, understand its requirements, and agree to comply with the identified procedures:

Name	Signature	Date
Frances Szrom	Frances Szrom	25 Aug 95
Michael Bush	Michael J. Bush	25 Aug 95
Barthel F. Truffa, III	Barthel F Truffa III	25 aug 95

PREPARED BY:

Frances Szrom 25 Aug 95
FRANCES SZROM DATE
Project Manager/Site Safety Manager
Industrial Health Physics Program
USACHPPM

REVIEWED BY:

Harris Edge 25 Aug 95
HARRIS EDGE DATE
Program Manager
Industrial Health Physics Program
USACHPPM

CONCURRENCE BY:

Creighton P. Jacobson 25 Aug. 95
CREIGHTON P. JACOBSON DATE
Safety and Occupational Health Manager
USACHPPM

For
JOHN W. MAY DATE 30 Aug 95
Health Physicist
Radiation Protection Officer
Fort McClellan, Alabama

Please Note: The following copy of the 8-19 January 1996 Site Safety Plan was reproduced from a computer file, since the original printed copy with signatures was lost.

SITE SAFETY PLAN
RIDEOUT FIELD SITE
FORT MCCLELLAN, ALABAMA
PROJECT NUMBER 27-MH-0987
8 JANUARY - 19 JANUARY 1996

1. INTRODUCTION. Safety is the responsibility of everyone involved in every aspect of this survey. It will be the number one concern and under no circumstance will any compromises be made on established safety standards.

2. ORGANIZATION AND RESPONSIBILITIES.

a. Harris Edge
Program Manager
Industrial Health Physics Program
U.S. Army Center for Health Promotion and Preventive Medicine
USACHPPM

b. Frances Szrom
Project and Site Safety Manager
USACHPPM

c. Michael Bush
Co-Project and Site Safety Manager
USACHPPM

d. Barthel F. Truffa, III
Health Physics Consultant
Nuclear Support Services

e. I. Richard Kestner
Engineering Technician
USACHPPM

f. Michael Stewart
Medical Laboratory Technician
USACHPPM

g. Amy L. Bigger
Medical Laboratory Technician
USACHPPM

3. SCOPE OF WORK.

a. Purpose. The purpose of these radiological surveys is to produce the data to demonstrate that all radiological parameters are in compliance with current applicable Federal, State and local radiological guidelines for release of the areas for unrestricted use.

b. Project Description. Rideout Field, Fort McClellan, AL had been used as a radioactive waste burial site (1959) and radiological training area (1965-1972 and earlier). Records indicate the waste was removed (1970's) and disposed at licensed Nuclear Regulatory Commission (NRC) disposal facilities. However, adequate termination surveys were not performed. Therefore, radiological surveys will be performed following the guidelines currently available in NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination". This survey has been classified as a final survey as defined in NUREG/CR-5849. Radiological sampling will comprise survey instrumentation readings and subsurface soil samples (from surface to 12 feet below the mounds surrounding surface). Gamma survey instrumentation will be used to scan the bore holes for elevated readings. Equipment, such as the GeoProbe, which is a hydraulic push sampler, will be used to collect the samples. The burial mound is oblong in shape and is approximately 25 meters long by 15 meters wide and is located at coordinates 593300 meters East, 3732500 meters North in Universal Transverse Mercator (UTM) Grid Zone 16. The work to be performed is detailed in the Survey Protocol No. 27-MH-0987A-P-96 for Fort McClellan, AL to which this appendix is attached.

c. Personnel. The personnel that will be involved on site are listed in paragraphs 2b through 2g above. Either the project manager or co-project manager will be present during on site operations. While on site the survey team may be accompanied by Fort McClellan safety qualified personnel, as designated by the installation safety manager.

d. Medical Surveillance. All USACHPPM personnel involved in

d. Medical Surveillance. All USACHPPM personnel involved in this survey are included in the medical monitoring program through Kirk Army Health Clinic at Aberdeen Proving Ground - Edgewood, Maryland.

4. SITE SPECIFIC HAZARD ANALYSIS.

a. Biological Hazards. Snakes, ticks, and other pests, as well as poisonous plants, are typically found in wooded and field areas in Fort McClellan, AL during the spring to fall seasons. This survey will be performed during the winter months, therefore snakes, ticks and poisonous plants will not be a significant hazard to the survey personnel.

b. Chemical Hazards. None apparent.

c. Climatic Hazards/Temperature. Given the timing of this survey, cold weather changing to warm weather may present a problem. Warm layered clothing and frequent work breaks may be used to mitigate cold weather effects. The doffing of layered clothing will be used to mitigate the effects of warming temperatures. However, if conditions warrant, such as extremely low temperatures, heavy rain or wind, work will cease until conditions improve. The Fort McClellan Radiation Protection Officer or safety qualified designee will review cold advisory procedures with all survey personnel prior to start of the field work. These procedures will be incorporated into the daily work procedures.

d. Electrical/Utility. None apparent.

e. Flammable/Explosive. None apparent.

f. Ordnance. None apparent.

g. Infectious. None apparent.

h. Oxygen/Confined Space. None apparent.

I. Physical Hazards. Numerous physical hazards are associated with hydraulic push sampling equipment. Care will be taken at all times and instructions for safe and proper operation from the equipment operator will be followed by all survey personnel at all times.

j. Noise. Noise is a concern for the equipment operator and nearby personnel. Therefore, the operator and nearby personnel will wear ear plugs/muffs.

k. Radioactive. The survey protocol to which this appendix is attached has been developed to incorporate radiation protection procedures during the survey. The survey protocol, along with this safety plan, are staffed with the local Radiation Protection Officer for concurrence. The radiation protection plan ensures that personnel exposures are kept as low as reasonably achievable. Personnel dosimetry and other appropriate radiation protection devices, will be used to monitor all personnel that enter radiation fields of 2 millirad per hour or greater.

Air samples may be collected when appropriate to assist in determining potential radionuclide airborne concentrations. Air samples will be collected, counted, and results interpreted as below.

Air samples collected during the scoping survey were submitted for laboratory screening. The results showed no detectable Co-60, Cs-137, or Natural Thorium daughter gamma emissions. Although this was the desired result, air sampling will continue due to the aggressive nature of the subsurface soil sampling method to be utilized.

The HI-Q or other appropriate portable air sampler will be positioned on the downwind side and at breathing zone height for the collection of air samples during the acquisition of soil samples. Samples will be collected for at least 20 minutes, the air flow rate at the start and end of the air sample collection period will be recorded. After the air sample is collected, the air filter will be analyzed by gamma spectroscopy for Co-60 and Cs-137 with a portable Canberra MCA with a 3" x 3" NaI detector. As long as Co-60 and Cs-137 are not present in the air sample gamma spectrum, the survey will continue with the previously established radiation safety procedures. If any Co-60 or Cs-137 is present, the following additional radiation safety issues will be addressed and appropriate procedures implemented:

The survey team will vacate the area through the established egress path, leaving coveralls, shoe covers, and gloves. The Installation RPO will be notified immediately.

Nasal swipes will be taken from each member of the survey team and sent back to the USACHPPM-RAP laboratory for priority analysis.

The air filter will then be analyzed by Koval's method to determine the activity in air due to the long lived isotopes on the air filter. This result will be used to determine if 10% of the Annual Limit of Intake (ALI) via inhalation for the particular isotope(s) could have been exceeded or will be exceeded during the remaining field survey time (Co-60, class Y, ALI via inhalation = 30 microcuries, Derived Air Concentration (DAC) = 1e-8 microcuries per milliliter of air, effective half-life = 10 days; Cs-137, class Y, ALI via inhalation = 1e+5 microcuries, DAC = 5e-5 microcuries per milliliter of air, effective half-life = 70 days.)

If 10% of the ALI could have been exceeded the air filter sample will then be returned to the USACHPPM-RAP laboratory for a priority quantitative gamma spectral analysis.

A 24 hour urine bioassay will be collected from each survey team member starting approximately 24 hours after the exposure. Weekly 24 hour urine bioassay samples will be collected thereafter or as determined in consultation with Medical Health Physics and the USACHPPM-RAP laboratory. (Prior to departing USACHPPM for Ft. McClellan all survey members will provide a pre-survey 24 hour urine bioassay sample to the USACHPPM-RAP laboratory. This sample will be analyzed only if the onsite air sampling results warrant such action.)

Based on the USACHPPM-RAP quantitative gamma spectral air filter results, nasal swipe results and remaining field survey time a decision will be made to determine if respiratory protection is required for survey team members. If 10% of the ALI for the isotope(s) of concern can be exceeded in the remaining survey time then respiratory protection will be used by the survey team members. If survey members are required to wear respirators then the survey schedule will be re-adjusted as necessary taking into account the heat, humidity and reduced air intake of the individuals. Protective clothing will consist of coveralls, work gloves over latex or rubber gloves, cloth or paper hoods and shoe coverings.

l. Personal Protective Equipment. Steel toed safety boots/shoes will be worn at all times. Safety glasses will be worn as necessary. Ear plugs/muffs will be worn as necessary. Hard hats will be worn by the equipment operator and nearby personnel. Light duty work gloves may be used to protect from cuts and abrasions as long as the field radiation survey equipment indicate readings less than 3 times the background count rate. Latex or rubber gloves will be used while sampling, if field radiation survey equipment exceed 3 times the background count rate. Shoe covers and light weight coveralls will be used at a minimum during the survey of the areas of concern. The need for cloth/paper hoods, Tyvek, double gloving (work gloves over latex or rubber gloves) and respiratory protection is addressed in the survey protocol and this appendix. Respiratory protection may be required since re-suspension of radioactive materials is possible. The results of the air sample monitoring will be used to determine the need for respirators and bioassay samples, as detailed in this appendix. If required, respirators and fit testing will be coordinated through the Ft. McClellan RPO's office.

m. Decontamination Procedures. A radiological clean area will be established near the survey site. Potentially contaminated clothing, gloves, shoe covers and equipment will be collected before entering the clean area. Personnel will be monitored (frisked) with a low level survey meter when leaving the work area and prior to entering the radiological clean area. Personnel found to have radiological contamination on them greater than 2 times background will be required to decontaminate prior to leaving the contaminated area. Personnel and equipment decontamination will be accomplished with soap and water rinses, as necessary.

n. Emergency Procedures. The survey team will have cellular communications available to request emergency medical support and contact necessary Fort McClellan personnel. Illnesses and injuries will be directed to the local medical support centers. Emergency medical services are available through the Ambulance Service which has an MOU with Ft. McClellan, AL. The ambulance service phone number is (205) 848-2345. The ambulance service will transport medical emergencies to Noble Army Community Hospital (205) 848-2152 or Jacksonville Hospital (205) 435-4970.

5. NOTIFICATION. Pre-entry safety and work briefings will be held prior to daily work commencement. The briefings will consist of the familiarization of project personnel with the survey locations

and methodologies, site safety procedures, and emergency response procedures. The following individuals acknowledge that they have been notified of the contents of this site safety and health plan, understand its requirements, and agree to comply with the identified procedures:

Name	Signature	Date
Frances Szrom		
Michael Bush		
Barthel F. Truffa, III		
I. Richard Kestner		
Michael Stewart		
Amy L. Bigger		

Indust Radn Study No. 27-MH-0987-R2-97, Fort McClellan, AL,
29 Aug-15 Sep 95 and 14-28 Jan 96

PREPARED BY:

FRANCES SZROM DATE
Project Manager/Site Safety Manager
Industrial Health Physics Program
USACHPPM

REVIEWED BY:

HARRIS EDGE DATE
Program Manager
Industrial Health Physics Program
USACHPPM

CONCURRENCE BY:

CREIGHTON P. JACOBSON DATE
Safety and Occupational Health Manager
USACHPPM

JOHN W. MAY DATE
Health Physicist
Radiation Protection Officer
Fort McClellan, Alabama

APPENDIX E

Instrumentation and Laboratory Analyses

I. Field Survey Instrumentation:

A. Eberline Smart Portable (ESP), Model ESP-2, SN 355: calibrated 19 January 1995. The ESP-2 was mated with the following radiation detectors:

1. Eberline Model SPA-3 Scintillation Probe Assembly for measuring gamma exposure rate.

2. Eberline Model HP-270 energy compensated metal GM detector for measuring gamma exposure rate and detecting beta radiation.

B. Eberline Smart Portable (ESP), Model ESP-2, SN 1447 calibrated 7 December 1994. The ESP-2 was mated with the following radiation detectors:

1. Eberline Model HP-210T tungsten shielded thin window GM detector for measuring beta-gamma count rates.

2. Eberline Model AC-3 Zinc Sulfide Scintillation detector for detecting alpha count rates.

3. Eberline Model SPA-3 Scintillation Probe Assembly for measuring gamma exposure rate.

C. Eberline Analog Smart Portable (ASP), Model ASP-1, SN 2871 calibrated 11 October 1994. The ASP-1 was mated with the following radiation detector: Eberline Model PG-2 plutonium gamma thin crystal sodium iodide detector for detection of low energy gamma and x-rays.

D. Ludlum Model 2350 Data Logger, SN 98629, calibrated 1 February 1995. The 2350 was mated to the following detector: Ludlum Model 44-2 1-inch by 1-inch Sodium Iodide detector, SN PR 109560, for the measurement of gamma exposure rates.

II. Laboratory Instrumentation:

A. Tennelec Model LB 5100, Alpha/Beta Gas-flow Proportional Counting System, SN: 52259-1.

B. Tennelec Model LB 5100, Alpha/Beta Gas-flow Proportional Counting System, SN: 57259-2.

C. Ortec Gamma Spectral Analyzer, Model GEM-LB-47220-S, with High Purity Germanium Detector, SN: 25-P-95S.

D. Ortec Gamma Spectral Analyzer, Model GMX-15185-S, with High Purity Germanium Detector, SN: 22-N-71XA.

III. Laboratory Analyses.

A. Phase I - Scoping Survey Surface Soil Sample Analyses. The RCCCD Radiological Laboratory's routine procedures were followed for the gross alpha activity, gross beta-gamma activity and gamma spectral analyses. The routine soil sample preparation were followed. Each soil sample was dried in a forced air furnace. After allowing to dry overnight, all rocks, plant roots, and other materials were screened from the soil.

1. Gross Alpha and Gross Beta. An 0.1 gram aliquot of dried soil was fixed into a pre-weighed planchet. The sample planchet was then counted in a gas flow proportional counter for gross alpha and gross beta activity. Efficiency and absorption factors were calculated based on areal density efficiency curves. In addition, duplicate analyses were performed on several soil samples.

2. Gamma Spectral Analyses. An 100. gram aliquot of dried soil was placed in a calibrated soil geometry container. Each soil sample was counted for 100 minutes on a high purity germanium detector (HPGe) or germanium drifted lithium (GeLi) detector. Results for Co-60, Cs-137, K-40, Ac-228, Bi-214, and Pb-214 were reported.

B. Phase II - Characterization Survey Core Soil Sample Analyses. Due to the number of samples collected in the characterization survey, the RCCCD Radiological Laboratory's routine procedures were modified. The modifications are described in paragraphs VI.D.1.e and VI.D1.1.f of this report.

APPENDIX F

MEASUREMENTS AND RESULTS

Table F-1. Reconnaissance Background Exposure Rate Measurements F-2

Table F-2. Troop Assembly Background Survey Unit Exposure Rate Measurements F-2

Table F-3. Burial Mound Survey Unit Exposure Rate Measurements F-3

Table F-4. Troop Assembly Background Survey Unit and Burial Mound Survey Unit Scanning Survey Results F-3

Table F-5. Surface Soil Sample Laboratory Results F-8

Table F-6. Troop Assembly Background Area "Down-Hole" Logging Survey Results F-10

Table F-7. Burial Mound Survey Unit "Down-Hole" Logging Survey Results F-11

Table F-8. Core Soil Sample Laboratory Results F-14

Table F-1. Reconnaissance Background Exposure Rate Measurements

Location Description	Grid Coordinates	Reuter Stokes (µR/hr)				ESP-2/SPA-3 (µR/hr)
		Average	Max	Min	Std Dev	
Recon Bkg-1	94573510	7.7	9.3	6.6	0.4	4.78
Recon Bkg-2	94303430	9.7	11.6	8.3	0.4	7.53
Recon Bkg-3	93703340	6.9	8.3	5.8	0.4	3.99
Recon Bkg-4	93633282	7.8	9.1	6.5	0.4	4.51
Recon Bkg-5	94003230	7.6	10	6.7	0.4	4.84
Recon Bkg-6	93863211	8.1	10.5	7	0.4	4.97
Recon Bkg-7	93833117	8.4	9.8	7.3	0.4	5.31
Recon Bkg-8	93543070	9.3	11.2	8.1	0.5	6.34
Recon Bkg-9	93063020	8.6	10	7.6	0.4	5.63
Recon Bkg-10	92422940	8.3	9.4	7.5	0.4	4.96

TABLE F-2. Troop Assembly Background Survey Unit Exposure Rate Measurements

Location Description	Grid Coordinates	Reuter Stokes (µR/hr)				ESP-2/SPA-3 (µR/hr)
		Average	Max	Min	Std Dev	
BKG A1-1	--	--	--	--	--	5.74
BKG A1-2	--	--	--	--	--	5.77
BKG A1-3	--	8.6	9.7	7.2	0.4	5.71
BKG A1-4	--	--	--	--	--	5.65
BKG A1-5	--	--	--	--	--	5.9
BKG B1-1	--	--	--	--	--	5.8
BKG B1-2	--	--	--	--	--	5.7
BKG B1-3	--	8.7	10.2	7.6	0.4	5.76
BKG B1-4	--	--	--	--	--	5.72
BKG B1-5	--	--	--	--	--	5.89

Table F-3. Burial Mound Survey Unit Exposure Rate Measurements

Location Description	Grid Coordinates	Reuter Stokes (µR/hr)				ESP-2/SPA-3 (µR/hr)
		Average	Max	Min	Std Dev	
BM A1-3	--	8.2	10.2	7.2	0.4	5.2
BM B1-3	--	8.1	10	7.1	0.4	5.07
BM C1-3	--	9.6	11.2	8.5	0.4	6.16
BM D1-3	--	8.9	10.7	7.7	0.4	5.99
BM A2-3	--	7.8	9.1	6.5	0.4	4.8
BM B2-3	--	8.3	9.7	6.8	0.4	5.37
BM C2-3	--	9.9	11.7	8.3	0.5	6.53
BM D2-3	--	8.4	9.7	7.5	0.4	5.53

Table F-4. Troop Assembly Background Survey Unit and Burial Mound Survey Unit Scanning Survey Results

Location Description	Lane Number	Surveyor	ASP-1/PG-2 (cpm)			Hot Spot cpm(ID#)
			Average	Max	Min	
BKG A1	1	BFT	1500	1700	1300	--
BKG A1	2	BFT	1400	1600	1200	--
BKG A1	3	BFT	1500	1600	1200	--
BKG A1	4	BFT	1600	1800	1400	--
BKG A1	5	BFT	1400	1600	1300	--
BKG A1	6	BFT	1500	1800	1300	--
BKG A1	7	BFT	1500	1900	1300	--
BKG A1	8	BFT	1600	1800	1400	--
BKG A1	9	BFT	1400	1600	1300	--
BKG A1	10	BFT	1400	1700	1300	--
BKG B1	1	BFT	1600	1800	1400	--
BKG B1	2	BFT	1400	1600	1200	--
BKG B1	3	BFT	1400	1700	1200	--
BKG B1	4	BFT	1500	1800	1300	--

Table F-4. Troop Assembly Background Survey Unit and Burial Mound Survey Unit Scanning Survey Results

Location Description	Lane Number	Surveyor	ASP-1/PG-2 (cpm)			Hot Spot cpm(ID#)
			Average	Max	Min	
BKG B1	5	BFT	1500	1800	1200	--
BKG B1	6	BFT	1400	1600	1200	--
BKG B1	7	BFT	1400	1600	1200	--
BKG B1	8	BFT	1500	1700	1300	--
BKG B1	9	BFT	1400	1600	1300	--
BKG B1	10	BFT	1400	1600	1200	--
BM A1	1	BFT	1200	1400	1100	--
BM A1	2	BFT	1300	1500	1100	--
BM A1	3	BFT	1300	1400	1100	--
BM A1	4	BFT	1300	1400	1100	--
BM A1	5	BFT	1300	1500	1100	--
BM A1	6	BFT	1200	1400	1000	--
BM A1	7	BFT	1400	1600	1200	--
BM A1	8	BFT	1200	1400	1100	--
BM A1	9	BFT	1300	1400	1100	--
BM A1	10	BFT	1300	1500	1000	--
BM A2	1	Survey lanes blocked by tank.				
BM A2	2					
BM A2	3					
BM A2	4					
BM A2	5	BFT	1200	1400	1000	--
BM A2	6	BFT	1200	1400	1000	--
BM A2	7	BFT	1300	1500	1100	--
BM A2	8	BFT	1200	1400	1100	--
BM A2	9	BFT	1200	1400	1000	--
BM A2	10	BFT	1200	1400	1000	--
BM B1	1	MJB	1200	1400	1100	--
BM B1	2	MJB	1200	1400	1100	--
BM B1	3	MJB	1300	1400	1100	--
BM B1	4	MJB	1300	1500	1200	--
BM B1	5	MJB	1300	1400	1100	--

Table F-4. Troop Assembly Background Survey Unit and Burial Mound Survey Unit Scanning Survey Results

Location Description	Lane Number	Surveyor	ASP-1/PG-2 (cpm)			Hot Spot cpm(ID#)
			Average	Max	Min	
BM B1	6	MJB	1300	1400	1100	--
BM B1	7	MJB	1200	1400	1100	--
BM B1	8	MJB	1400	1600	1300	--
BM B1	9	MJB	1400	1700	1200	--
BM B1	10	MJB	1400	1400	1200	--
BM B2	1	MJB	1300	1400	1100	--
BM B2	2	MJB	1200	1400	1100	--
BM B2	3	MJB	1200	1400	1100	--
BM B2	4	MJB	1300	1400	1100	--
BM B2	5	MJB	1400	1500	1200	--
BM B2	6	MJB	1400	1600	1300	--
BM B2	7	MJB	1400	1700	1200	--
BM B2	8	MJB	1400	1700	1200	--
BM B2	9	MJB	1600	1800	1300	--
BM B2	10	MJB	1500	1800	1400	--
BM C1	1	BFT	1300	1600	1200	--
BM C1	2	BFT	1500	1700	1300	--
BM C1	3	BFT	1600	1800	1400	--
BM C1	4	BFT	1600	1800	1500	--
BM C1	5	BFT	1600	1800	1400	--
BM C1	6	BFT	1600	2000	1200	--
BM C1	7	BFT	1900	3400	1300	3400(HS3)
BM C1	8	BFT	2400	5600	1200	5600(HS5), 5000(HS6), 4300(HS7)
BM C1	9	BFT	2000	5600	1400	3000(HS8), 5600(HS9), 4700(HS10)

Table F-4. Troop Assembly Background Survey Unit and Burial Mound Survey Unit Scanning Survey Results

Location Description	Lane Number	Surveyor	ASP-1/PG-2 (cpm)			Hot Spot cpm(ID#)
			Average	Max	Min	
BM C1	10	BFT	2600	5400	1200	4200(HS11), 5400(HS12), 3200(HS13), 4000(HS14), 3200(HS15), 3200(HS16)
BM C2	1	BFT	1400	1600	1200	--
BM C2	2	BFT	1600	1900	1400	--
BM C2	3	BFT	2000	2700	1600	--
BM C2	4	BFT	2200	4000	1400	3100(HS1), 4000(HS2)
BM C2	5	BFT	1500	1900	1200	--
BM C2	6	BFT	1400	1800	1200	--
BM C2	7	BFT	1500	1800	1200	--
BM C2	8	BFT	1700	4200	1200	4200(HS4)
BM C2	9	BFT	1500	2200	1200	--
BM C2	10	BFT	1400	1800	1200	--
BM D1	1	MJB	2000	5400	1200	5400(HS17)
BM D1	2	MJB	1700	3600	1300	3600(HS18)
BM D1	3	MJB	1600	4600	1300	4600(HS19)
BM D1	4	MJB	1600	18000	1200	18000(HS20), 12000(HS21), 7400(HS22), 6200(HS23)
BM D1	5	MJB	2000	3800*	1200	*due to HS21
BM D1	6	MJB	1400	1700	1200	--
BM D1	7	MJB	1400	1600	1200	--
BM D1	8	MJB	1300	1400	1200	--
BM D1	9	MJB	1300	1500	1200	--
BM D1	10	MJB	1300	1400	1100	--
BM D2	1	MJB	1600	2000	1200	--
BM D2	2	MJB	1500	1700	1200	--

Table F-4. Troop Assembly Background Survey Unit and Burial Mound Survey Unit Scanning Survey Results

Location Description	Lane Number	Surveyor	ASP-1/PG-2 (cpm)			Hot Spot cpm(ID#)
			Average	Max	Min	
BM D2	3	MJB	1400	1600	1300	--
BM D2	4	MJB	1400	1500	1200	--
BM D2	5	MJB	1400	1600	1200	--
BM D2	6	MJB	1500	1200	1800	--
BM D2	7	MJB	1400	1600	1200	--
BM D2	8	MJB	1400	1600	1200	--
BM D2	9	MJB	1400	1500	1200	--
BM D2	10	MJB	1400	1500	1300	--
BM D0(PhaseII)	1	MJB	1100	1200	1100	--
BM D0	2	MJB	1100	1300	1000	--
BM D0	3	MJB	1100	1200	1100	--
BM D0	4	MJB	1100	1100	1000	--
BM D0	5	MJB	1100	1200	1000	--
BM D0	6	MJB	1100	1400	1000	--
BM D0	7	MJB	1000	1200	1000	--
BM D0	8	MJB	1300	1400	1000	--
BM D0	9	MJB	1200	1400	1000	--
BM D0	10	MJB	1200	1200	1000	--

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Table F-5. Surface Soil Sample Laboratory Results

Sample Identification	Lab Number	Picocuries per Gram +/- 2 Standard Deviations							
		Gross Alpha	Gross Beta	K-40	Co-60	Cs-137	Bi-214	Th-234	Ac-228
Recon Bkg-1	W6764	7+/-4	9+/-3	2+/-1	0.02+/-0.05	0.7+/-0.1	0.9+/-0.2	2+/-3	0.7+/-0.3
Recon Bkg-2	W6765	24+/-7	29+/-4	24+/-3	-0.05+/-0.1	0.1+/-0.1	1.6+/-0.3	2+/-2	2.3+/-0.8
Recon Bkg-3	W6766	7+/-4	8+/-3	5+/-1	0.02+/-0.04	0.6+/-0.1	0.9+/-0.2	2+/-3	0.8+/-0.3
Recon Bkg-3 Dup	W6766	9+/-5	11+/-3						
Recon Bkg-4	W6767	11+/-5	8+/-3	0.04+/-1	0.03+/-0.1	0.4+/-0.2	0.7+/-0.3	1+/-2	0.9+/-0.5
Recon Bkg-5	W6768	15+/-6	9+/-3	3+/-1	0.02+/-0.05	0.5+/-0.1	0.8+/-0.2	0.4+/-3	1.0+/-0.2
Recon Bkg-6	W6769	17+/-6	8+/-3	4+/-2	0.08+/-0.1	0.4+/-0.1	0.9+/-0.3	2+/-2	1.4+/-0.4
Recon Bkg-7	W6770	15+/-6	12+/-3	6+/-1	-0.02+/-0.05	0.5+/-0.1	0.8+/-0.2	-1+/-3	1.0+/-0.3
Recon Bkg-8	W6771	22+/-6	16+/-3	14+/-3	0.03+/-0.1	0.6+/-0.2	0.9+/-0.3	1+/-2	1.2+/-0.5
Recon Bkg-9	W6772	15+/-6	14+/-3	7+/-1	0.002+/-0.05	1.6+/-0.2	0.8+/-0.2	-1+/-3	1.3+/-0.3
Recon Bkg-10	W6773	13+/-5	12+/-3	6+/-2	-0.01+/-0.1	0.1+/-0.1	1.1+/-0.3	2+/-2	1.5+/-0.5
Bkg A1-1	W6779	19+/-6	14+/-3	8+/-2	0.02+/-0.1	0.3+/-0.1	1.5+/-0.4	2+/-2	1.5+/-0.6
Bkg A1-1 Dup	W6779	19+/-6	16+/-3						
Bkg A1-2	W6780	21+/-6	11+/-3	6+/-1	0.03+/-0.04	0.1+/-0.1	1.3+/-0.2	2+/-4	1.2+/-0.4
Bkg A1-3	W6781	18+/-6	15+/-3	5+/-2	0.1+/-0.1	0.1+/-0.1	1.1+/-0.4	3+/-1	1.5+/-0.7
Bkg A1-4	W6782	16+/-6	15+/-3	8+/-1	0.04+/-0.06	0.1+/-0.1	1.1+/-0.2	1+/-4	1.7+/-0.4
Bkg A1-5	W6783	22+/-7	16+/-3	7+/-2	0.03+/-0.1	-0.03+/-0.09	1.3+/-0.3	2+/-2	1.2+/-0.6
Bkg B1-1	W6774	21+/-6	14+/-3	6+/-2	0.1+/-0.1	0.2+/-0.2	1.3+/-0.3	2+/-2	1.2+/-0.5
Bkg B1-2	W6775	19+/-6	11+/-3	5+/-2	-0.04+/-0.08	0.1+/-0.1	1.6+/-0.3	4+/-2	2.2+/-0.5
Bkg B1-3	W6776	16+/-6	16+/-3	5+/-1	-0.001+/-0.06	0.04+/-0.06	1.1+/-0.2	1+/-4	1.5+/-0.3
Bkg B1-4	W6777	22+/-6	12+/-3	6+/-2	0.06+/-0.1	0.2+/-0.2	1.4+/-0.4	3+/-2	1.9+/-0.8
Bkg B1-5	W6778	19+/-6	9+/-3	4+/-2	0.01+/-0.09	0.1+/-0.1	1.1+/-0.4	3+/-2	1.0+/-0.7
MND A1-3	W6784	20+/-6	9+/-3	5+/-1	0.03+/-0.05	0.1+/-0.1	1.1+/-0.2	0.02+/-3.7	1.0+/-0.4
MND B1-3	W6785	13+/-5	12+/-3	3+/-2	-0.01+/-0.1	0.7+/-0.1	1.1+/-0.3	1+/-2	0.8+/-0.4
MND C1-3	W6786	19+/-6	17+/-3	12+/-2	0.3+/-0.1	0.9+/-0.1	1.4+/-0.3	5+/-4	1.3+/-0.4
MND D1-3	W6787	19+/-6	12+/-3	5+/-2	-0.03+/-0.1	0.4+/-0.1	1.2+/-0.3	2+/-2	0.9+/-0.6
MND A2-3	W6788	10+/-5	8+/-3	4+/-1	-0.01+/-0.05	0.1+/-0.7	1.0+/-0.2	3+/-3	0.9+/-0.4
MND B2-3	W6789	25+/-7	17+/-3	8+/-2	-0.01+/-0.1	0.7+/-0.2	1.4+/-0.4	2+/-2	1.5+/-0.6
MND C2-3	W6790	23+/-6	24+/-4	14+/-3	0.4+/-0.2	1.6+/-0.2	1.6+/-0.5	3+/-2	2.0+/-0.5
MND D2-3	W6791	11+/-5	11+/-3	4+/-2	0.02+/-0.1	0.4+/-0.2	1.1+/-0.3	0.4+/-2.3	1.2+/-0.5
HS 2	W6792	21+/-6	15+/-3	4+/-1	6.6+/-0.4	1.1+/-0.2	1.2+/-0.3	5+/-4	1.1+/-0.7
HS 2-DUP	W6792			5+/-2	7+/-1	0.9+/-0.3	1.5+/-0.5	3+/-2	1.2+/-0.7