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Distribution			Abstract		
*	Name	Mail Addr.	This document provides procedural instructions for the Final Status Survey of Building 4059 (SNAP Ground Prototype Facility) at the Santa Susana Field Laboratory. This procedure follows the protocols recommended by the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).		
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1.0 INTRODUCTION

The Final Status Survey for Building 4059 will follow the protocols of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (Reference 1). The format of this plan follows closely the format suggested in Appendix A of Reference 1. The objective of this survey is to demonstrate that no residual contamination remains that exceed the Department of Energy (DOE) and the California Department of Health Services (DHS) approved cleanup standards in Reference 2.

The release survey will be completed in two phases. Phase A will be the release of the 4059 site, including the excavated portion, as one Class 1 survey unit and one Class 2 survey unit (Figure 1). After the excavation is sampled and backfilled, the entire work site will be sampled at ground level as one Class 3 survey unit (Figure 2).

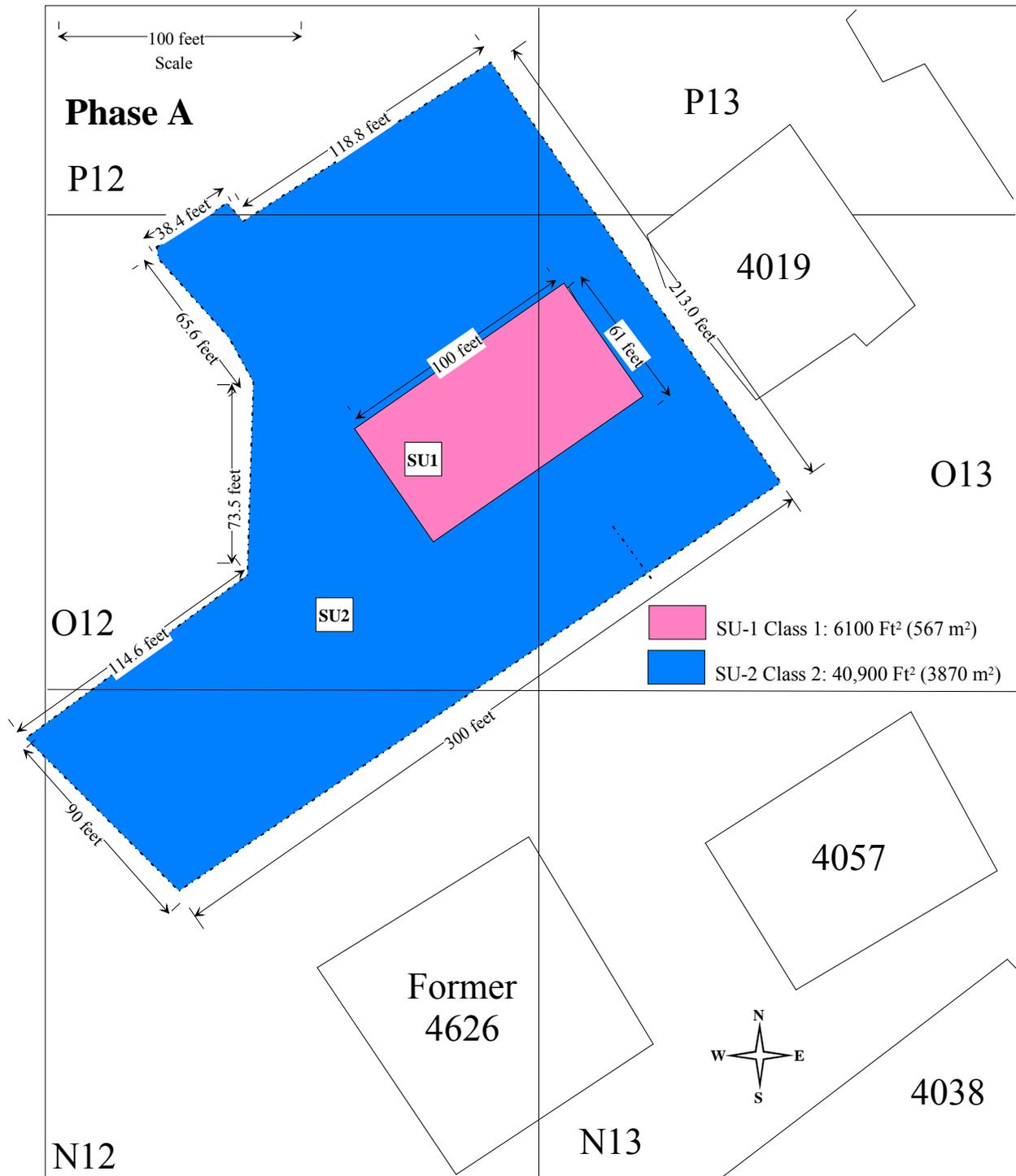


Figure 1: Phase A Class Areas and Site Dimensions

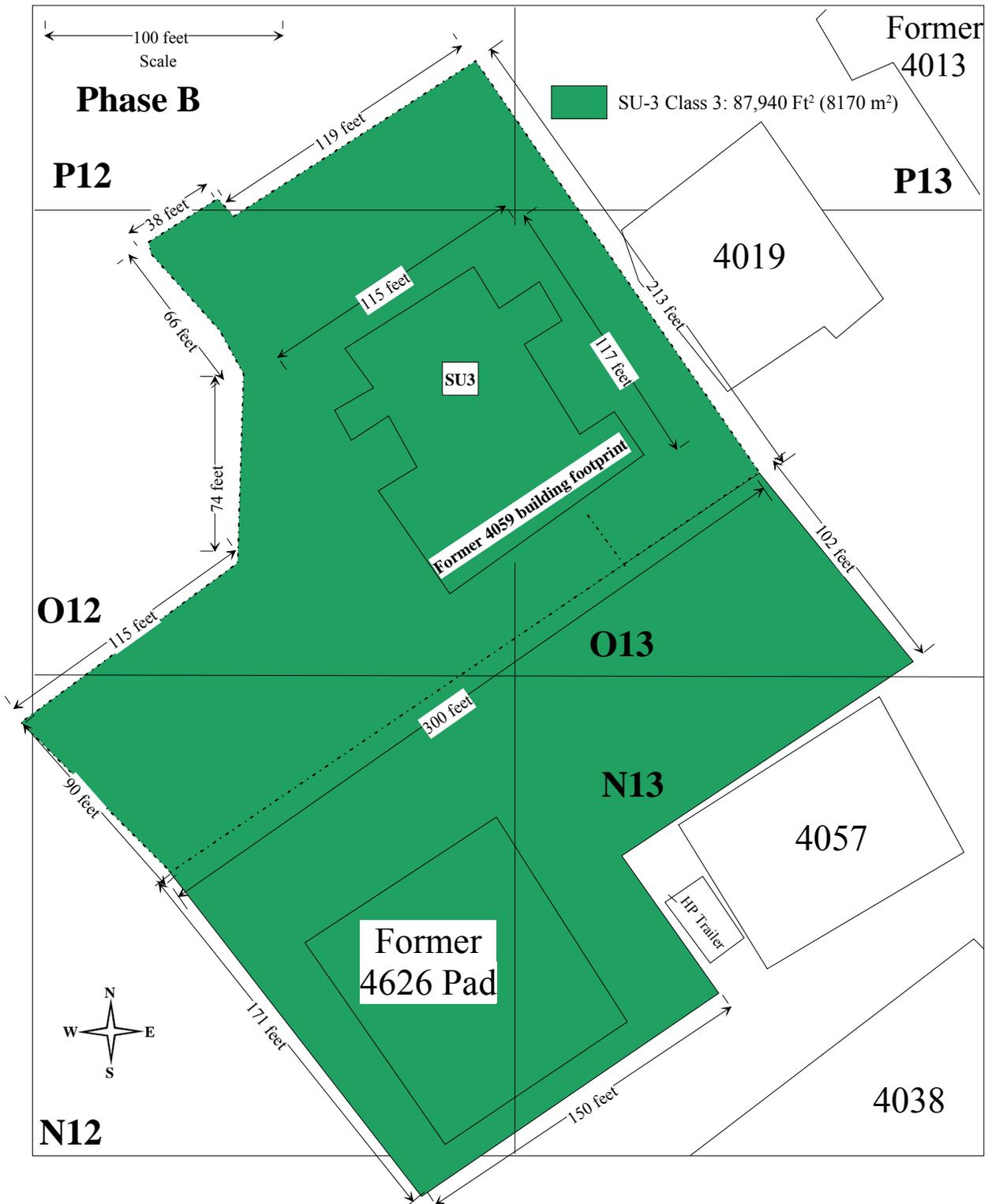


Figure 2: Phase B Class Area and Site Dimensions

2.0 HISTORY

2.1 Background

Building 4059, the SNAP (Space Nuclear Auxiliary Power) Ground Prototype Test Facility (SGPTF) was constructed in 1962 and 1963 to provide the necessary environment for the SNAP-8 Development Reactor (S8DR) test, the second nuclear test of the SNAP-8 reactor. The objective of the SNAP-8 program was to develop a nuclear reactor power source for use in space. The reactor itself was only 619 kilowatts (kWt) and only ran for a short time period yielding a power generated of 182 Mega Watt Days. The SGPTF S8DR tests were run until 1964, when they were shut down for building additions to house a vacuum duct and pumping system. Tests in a vacuum were conducted from January to December of 1969.

In 1970, the reactor core and associated NaK systems were removed and dispositioned off-site. The reactor test cell was sealed, and associated vacuum systems were moth balled. SGPTF remained inactive until 1973 when the SNAP program ended. At that time, all control consoles and reactor instrumentation were dismantled and removed.

In a parallel activity, a non-nuclear sodium experiment known as the Large Leak Test Rig was constructed in the building in Test Cell 2 (South), adjacent to Test Cell 1 (North), which housed S8DR. At that time, a portion of the radioactive materials created by neutron activation were removed and a lead shield wall was constructed between the two cells.

Routine inspections through 1983 indicated no significant findings, though in March of 1982 water was observed in the vacuum duct Pipe Chase Room (PCR). The water was approximately 1 foot above the top of the sand surrounding the vacuum ducting. In June of 1983, LLTR workers noticed water in Test Cell 2. The water was checked for radioactivity and was found to be at background levels. In August of 1983, approximately 5 feet of water was found in Test Cell 2. This time, the water had a radioactive concentration of 6,000 pCi/L of Co-60. The applicable release limit of the time was 30,000 pCi/L. Further investigation found only background level water in other locations, except for the PCR, which was expected since the water was exposed to activated radioactive sand and concrete.

A plan of action was immediately developed to assess the cause of the situation and to process the estimated 30,000 to 40,000 gallons of water in the PCR. Test Cell 2 was decontaminated and the water in the PCR was pumped and transferred to the Radioactive Material Handling Facility (RMHF) for processing.

From late 1983 to 1988, the facility was in a maintenance and surveillance mode. During routine surveillance activities in May of 1987, 3 inches of water contaminated with Co-60, Eu-152 and Na-22 was discovered in Test Cell 1 at levels above release limits of the

time. The conclusion was made that water pathways in and around the Test Cells were changing and could possibly lead to environmental contamination outside of the facility.

The Department of Energy was immediately notified and this led to the initiation of the Building 059 Vault Remediation Program. The Pipe Chase Room Remediation Project was a part of this program also. In the short term, an operating pump was installed in the French drain stand pipe for pumping and sampling. The activated concrete and was monitored closely for years. No contamination was ever found in any of the samples. Groundwater is not in the scope of this project though.

2.2 Decontamination and Decommissioning

Removal of activated and contaminated radioactive material was done in many phases from 1988 to 1998. All materials removed in these projects were disposed of as radioactive waste. From June of 1988 to February of 1989, activated sand and the vacuum ducts were removed from the Pipe Chase Room. The center shield discs and the vacuum vessel in Test Cell 1 were removed from August of 1989 to April of 1990. The puzzle concrete shields and the vacuum vessel frame were removed from October of 1990 to April of 1991.

Jack hammering and removal of the Test Cell 1 cast-in-place, high-density concrete shield took place from May of 1991 to February of 1992. From February of 1992 to September of 1992, the Test Cell 1 metal liner was removed. From September of 1992 to July of 1993, concrete was removed from the Test Cell 1 walls. The Test Cell 2 liner was removed and its walls decontaminated from May of 1994 to July of 1994.

All LLTR sodium tests components were removed from January of 1995 to September of 1998, in two phases. In October of 1998, representative concrete and steel samples were taken in areas outside of the Test Cells to determine the extent of activation in shielded areas. The samples were analyzed using Impacts-BRC 2.1 software (Reference 8), which revealed that the building outside of the activated Test Cells were below release limits and could be disposed of in a conventional waste site.

The entire upper building and basement, excluding the Test Cells, were surveyed with the MARSSIM technique in 1999 (Reference 9). The survey demonstrated that these areas were suitable for release for unrestricted use (Reference 10). These results were confirmed by separate surveys by the Oak Ridge Institute for Science and Education (ORISE) and the State of California Department of Health Service (DHS) in 2000. In October of 2000, the Environmental Protection Agency (EPA) performed a third confirmatory survey. All third party surveys indicated agreement with the Rocketdyne conclusion.

The released, non-radioactive portion of the building has been demolished and shipped to a Class 1 hazardous waste disposal site. The remaining Test Cells and PCR are being demolished and disposed of as radioactive material. The remaining land will be surveyed and sampled as part of the final status survey following the Multi-Agency Radiation

Survey and Site Investigation Manual (MARSSIM, Reference 1) protocols. This document (RS-00023) describes the survey design and procedures required to perform that survey.

3.0 SURVEY DESIGN

3.1 Identification of Radionuclides of Concern

The principle contaminants of concern at 4059 are activation products, including H-3, Fe-55, Co-60, Ni-63, Ba-133, Eu-152, and Eu-154. No other significant isotopes were found during the remediation sampling. However, two small, abandoned, sealed reactor coolant sampling lines discovered during the building structure final survey (Reference 10) contained fission products. Because of this, soil sample analysis will be performed for all potential radionuclides of concern listed above, as well as, Sr-90, Am-241, Pu-241 and isotopic Plutonium, Thorium, and Uranium.

The predominant isotope found in activated sand and bedrock, at this time, is Eu-152, based on Rocketdyne and ORISE samples (Reference 11). It will be used as the primary isotope of concern in the scanning survey design.

3.2 Derived Concentration Guideline Limits (DCGL_w)

The DCGL is a “derived, radionuclide-specific activity concentration within a *survey unit* corresponding to the *release criterion*. The *DCGL* is based on the spatial distribution of the contaminant and hence is derived differently for the *nonparametric* statistical test (DCGL_w) and the *Elevated Measurement Comparison* (DCGL_{EMC}). *DCGLs* are derived from activity/dose relationships through various *exposure pathway* scenarios.” (References 1 and 2)

The objective of this survey is to demonstrate that residual contamination in excess of the derived concentration guideline limits (DCGL) is not present within the survey units. The DCGL_w for Eu-152 by itself in soil is 4.51 pCi/g (Reference 2). Soil radioisotope concentrations shall be compared to the soil clean-up standards (DCGL_w) for all isotopes as listed in Table 1 below (Reference 2). Based on past core sampling result ratios, the sum of fractions of all isotopes compared to cleanup standards shall be utilized to recalculate the DCGL_w for Eu-152. This value will be utilized to determine the number of samples and the scan minimum detectable concentration (MDC).

$$\frac{H3 \text{ pCi/g}}{H3 \text{ DCGL}} + \frac{Fe55 \text{ pCi/g}}{Fe55 \text{ DCGL}} + \frac{Co60 \text{ pCi/g}}{Co60 \text{ DCGL}} + \frac{Ba133 \text{ pCi/g}}{Ba133 \text{ DCGL}} + \frac{Eu152 \text{ pCi/g}}{Eu152 \text{ DCGL}} + \frac{Eu154 \text{ pCi/g}}{Eu154 \text{ DCGL}} < 1$$

Ratios of the Eu-152 to the other isotopes were established from 1995 ORISE 4059 activated concrete sampling results and 1998 Teledyne Brown Engineering laboratory data. If Eu-152 were at the sitewide release limit(4.51 pCi/g) and the other isotopes were at the current ratio, the sum of fractions would be 1.62. 4.51 pCi/g was divided by 1.62 yielding 2.8 pCi/g. The other isotopes were ratioed to this, yielding a sum of fractions of 0.95.

Since DHS has not approved a representative background for SSFL, the multi-isotope sign test from MARSSIM will be utilized for comparison to DCGLs.

3.3 Classification of Areas

The final status survey will be performed in two phases. The purpose of the Phase A survey is to release the excavation required to remove the concrete. After the excavation is released and backfilled, the Phase B survey will be a final status survey of the entire site, including the backfilled area.

3.3.1 Phase A Impacted Areas

During the Area IV survey (Reference 5), all of Area IV was subdivided into 200 ft by 200 ft blocks. The blocks are designated by letter (A-Z) from south to north and numbers (0-60) from west to east. This mapping system was created by Rocketdyne and is not recognized by any standards organization.

The impacted area is considered to be the 4059 fenced-in area within land blocks **N12, O12, O13, P12 and P13** (see Figure 1).

3.3.2 Phase B Impacted Areas

The impacted area is considered to be the 4059 fenced-in area within land blocks **N12, O12, O13, P12 and P13**, as well as the area surrounding former Building 4626 (used as a staging area for block handling and packaging) within land blocks **N12, N13 and O13** (see Figure 2).

3.3.3 Non-Impacted Area

Areas surrounding the survey units were surveyed during the Area IV survey (Reference 5) and are considered to be non-impacted and will require no survey.

3.4 Identification of Survey Units

Table 2 demonstrates the MARSSIM Manual, Roadmap-6 limits the Survey Unit area.

3.4.1 Phase A Survey Units

The Class 1 area is the lowest portion of the excavation which encompassed the Basement, Test Cells and the Pipe Chase Room. Since this area is only 567 m², the entire area is the only Class 1 Survey Unit. It is designated as SU1. The Class 2 area is the rest of the excavation, which is basically the rest of the fenced in area. Since this Area is only 3780 m², the entire area is the only Class 2, Survey Unit. It is designated SU2.

Table 1: Soil Guideline Release Limits

Radionuclide	Soil Guidelines¹ (pCi/g)
Am-241	5.44
Ba-133	16.4
Co-60	1.94
Cs-134	3.33
Cs-137	9.20
Eu-152	4.51
Eu-154	4.11
Fe-55	629,000
H-3	31,900
K-40	27.6
Mn-54	6.11
Na-22	2.31
Ni-59	151,000
Ni-63	55,300
Pu-238	37.2
Pu-239	33.9
Pu-240	33.9
Pu-241	230
Pu-242	35.5
Ra-226	5 and 15 ^a
Sr-90	36
Th-228	5 and 15 ^a
Th-232	5 and 15 ^a
U-234	30 ^b
U-235	30 ^b
U-238	35 ^b

NOTES: (a) DOE Order 5400.5 limits are 5 pCi/g averaged over the first 15 cm of soil depth and 15 pCi/g averaged over 15-cm layers below the top 15 cm.
 (b) Generally, more conservative NRC limits for Uranium isotopes are proposed.

¹From Reference 2, item 1, Rocketdyne Report N001SRR140131, "Approved Sitewide Release Criteria for Remediation of Radiological Facilities at SSFL", February, 1999

TABLE 2: Area Classification

Classification	Potential or Actual Contamination Range	Max Survey Unit Area	Actual Area
Class 1	$X \geq \text{DCGL}$	2,000 m ²	567 m ²
Class 2	$20\% \text{ DCGL} \leq X < \text{DCGL}$	10,000 m ²	3,870 m ²
Class 3	$X < 20\% \text{ DCGL}$	No limit	8,170 m ²

3.4.2 Phase B Survey Unit

After the excavation is backfilled, the entire work site is considered a Class 3 area and is designated as SU3. Its area is only 8170 m², which is less than the maximum area for a Class 2 area. If any contamination were to be found that exceeds the class definition, the survey unit will be upgraded to a higher class number.

3.5 Data Quality Objectives and Number of Samples

In order to establish the design survey, MARSSIM recommends a series of calculations, based on site data. The survey design is based on the Data Quality Objectives (DQO). These calculations yield the number of samples required to confirm that the survey unit meets Derived Concentration Guide Limits (DCGLs).

The acceptable decision error probabilities used were alpha (regulators risk) 0.05 and beta (users risk) 0.05. The lower bound of the gray region (LBGR) was first selected at one half of the effective DCGL_w (2.8 pCi/g) or 1.4 pCi/g. The shift (Δ) is the DCGL_w minus the LBGR. That number is divided by the standard deviation (σ) of the measurements of the survey unit (0.34 pCi/g), which was the standard deviation from detectable samples from the site investigation, and was used to calculate the relative shift. MARSSIM recommends that the relative shift be between 1 and 3. With a LBGR of 1.4 pCi/g the relative shift was over 3. Per MARSSIM recommendations, the LBGR was adjusted up to 1.8 to give a relative shift of 2.91.

To assist with these calculations and the DQO, the computer program called Compass 1.0 (Reference 6) was written by the Oak Ridge Institute for Science and Education (ORISE). The Compass outputs may be reviewed in Appendix A. This program was utilized for this sampling plan during the DQO process. The number of sample points calculated by “Compass” for all 3 survey units (SU) was 14 each.

Some of the calculations involve the scan MDC (minimum detectable concentration) for the survey instruments used to survey Class 1 area prior to sampling. If the scan MDC is greater than the required MDC, the number of sample locations is increased. RESRAD 6.2 was used with Rocketdyne parameters to calculate area factors for Eu-152 required by Compass to calculate the required scan MDC.

The area of contamination in RESRAD 6.2 defaults to 10,000 m². Other than changing the area (*i.e.*, 1, 3, 10, 30, 100, 300, 1,000, or 3,000 m²), the RESRAD default values

were not changed. An area factor is a “factor used to adjust $DCGL_W$ to estimate $DCGL_{EMC}$ and the *minimum detectable concentration* for scanning surveys in *Class 1* survey units— $DCGL_{EMC} = DCGL_W \cdot A_m$. A_m is the magnitude by which the *residual radioactivity* in a small *area of elevated activity* can exceed the $DCGL_W$ while maintaining compliance with the *release criterion*.” (Reference 1)

The area factors were computed by taking the ratio of the dose or risk per unit concentration generated by RESRAD for the default 10,000 m² to that generated for the other areas listed. The area factor for SU-1 was 1.44 so the required scan MDC = 1.44 * 2.8 pCi/g = 4.0 pCi/g. Compass used this formula to calculate the required scan MDC. The area factors calculated are shown in Table 3.

Table 3: Derived Outdoor Area Factors for 1 pCi/g of Eu-152

Area m ²	RESRAD Dose mR/year	Outdoor Area Factor
1	0.35	9.27
3	0.77	4.20
10	1.60	2.03
30	2.20	1.47
100	2.71	1.19
140	2.79	1.16
300	2.94	1.10
430	2.99	1.08
1000	3.08	1.05
3000	3.15	1.03
3800	3.17	1.02
10,000	3.24	1.00

The efficiency for the gamma scan instruments for Eu-152 (377 cpm per $\mu\text{R/hr}$) was calculated using formulas from NUREG-1507 (Reference 7). The multi-energy line method on page 6-21 of Reference 7 was utilized because of Eu-152's many energy lines. This variable was utilized in other NUREG-1507 formulas to calculate the actual scan MDC, 3.1 pCi/g.

Background = B = 3480 cpm (from process knowledge)

Assumed hot spot dimensions = 1.5 ft x 1.5 ft

Assumed hot spot depth = 0.5 ft

Scan Speed = 2.5 ft/sec

Observational interval = 1.5 ft / 2.5 fps = 0.6 sec

Detectability index = 1.38

Surveyor efficiency = 0.5

Background counts in 1 observational interval = $b_i = 3400 \text{ cpm} \cdot 0.6 \text{ sec} \cdot 1 \text{ min}/60 \text{ sec} = 34.8 \text{ counts}$

$MDCR = 1.38 \cdot \sqrt{34.8 \text{ counts}} \cdot 60 \text{ sec}/1 \text{ min} = 488 \text{ cpm}$

$MDCR_{\text{surveyor}} = 488 \text{ cpm} / \sqrt{0.5} = 691 \text{ cpm}$

Instrument Efficiency = 376.9 cpm per $\mu\text{R/hr}$

$MDC (\mu\text{R/hr}) = 691 \text{ cpm} / 377 \text{ cpm per } \mu\text{R/hr} = 1.8 \mu\text{R/hr}$

MicroShield $\mu\text{R/hr}$ for 1 pCi/g Eu-152 in soil = 0.59 $\mu\text{R/hr}$ per pCi/g
 MDC (pCi/g) = 1.8 $\mu\text{R/hr}$ / 0.59 $\mu\text{R/hr}$ per pCi/g = 3.1 pCi/g

Since the actual scan MDC (3.1 pCi/g) is less than the required MDC (4.0 pCi/g), the number of samples remained at 14 for SU-1. These calculations did not apply to SU-2 and SU-3 since it is not required by MARSSIM for Class 2 and Class 3 areas.

The same NUREG 1507 calculations were performed for the TSA large detector (581 cm^2) survey system.

Background = B = 35,087 cpm
 Assumed hot spot dimensions = 1.5 ft x 1.5 ft
 Assumed hot spot depth = 0.5 ft
 Scan Speed = 1.0 ft/sec
 Observational interval = 1.5 ft / 1.0 fps = 1.5 sec
 Detectability index = 1.38
 Surveyor efficiency = 0.5
 Background counts in 1 observational interval = $b_i = 35,087 \text{ cpm} * 1.5 \text{ sec} * 1 \text{ min}/60 \text{ sec}$
 = 877 counts
 MDCR = $1.38 * \sqrt{877 \text{ counts}} * 60 \text{ sec}/1 \text{ min} = 2,452 \text{ cpm}$
 MDCR_{surveyor} = $2,452 \text{ cpm} / \sqrt{0.5} = 3,468 \text{ cpm}$
 Instrument Efficiency = 4,896 cpm per $\mu\text{R/hr}$
 MDC ($\mu\text{R/hr}$) = $3,468 \text{ cpm} / 4,896 \text{ cpm per } \mu\text{R/hr} = 0.7 \mu\text{R/hr}$
 MicroShield $\mu\text{R/hr}$ for 1 pCi/g Eu-152 in soil = 0.59 $\mu\text{R/hr}$ per pCi/g
 MDC (pCi/g) = $0.7 \mu\text{R/hr} / 0.59 \mu\text{R/hr per pCi/g} = 1.2 \text{ pCi/g}$

The actual scan MDC was 1.2 pCi/g which is still less than the required MDC (4.0 pCi/g). If this instrument is utilized, the number of samples remains at 14.

3.6 Gamma Survey Instrument Description and Requirements

3.6.1 Instrument Performance Check

Measurement integrity of the instruments will be monitored throughout all parts of gamma surveys by periodic checks of the instrument's response to normal background radiation, and to a *Field Check Source* (Reference 3).

3.6.2 Environmental Calibration Site

The instrument background, calibration and efficiency checks will be conducted per Reference 3 at a non-radioactive facility, as determined by the Radiation Safety Technicians, with a background similar to or lower than the site. This area will remain the daily source check area throughout the Building 4059 survey. The detector is source checked at the same distance every day.

4.0 PREREQUISITES

4.1 General Instructions

All personnel shall observe the following general instructions:

- 4.1.1 It is important to note that there are strict requirements for entry into the excavation. There are daily inspections required prior to entry. There are also personal protective equipment (PPE) requirements. Contact the PIC well in advance to schedule the inspector and to obtain the latest PPE requirements.
- 4.1.2 Ensure personnel working in the area are aware of the posted Site Emergency Evacuation Plan and know how to implement it, if required.
- 4.1.3 Services are available to provide first aid support when required.
- 4.1.4 Secure all equipment and/or materials removed from the work areas called out in this procedure at the end of each workday.
- 4.1.5 Record the equipment number, serial number, date of use, calibration date and this procedure number on all radiation survey reports and all other survey information documentation specific to this survey.
- 4.1.6 Ensure two personnel are present while working on site for safety purposes.
- 4.1.7 If changes are necessary, redline the working copy of this Survey Procedure and obtain approval from the person in charge, the Radiation Safety Officer (RSO), Health Physics Engineer or designee Health Physics technician. In addition, changes affecting cost and scheduling must be approved and signed by the program manager (PM).
- 4.1.8 A single designated “working copy” of this final survey procedure will be utilized at the work site, identified as *the* working copy on the cover page, and located in an area designated for working copies.
- 4.1.9 At the completion of all tasks covered by this procedure, the working document, including all redline changes incorporated and signed will be filed with Radiation Safety Department in the file labeled *Building 4059 Project* in Building 4057.

4.2 Equipment Checklist

The following equipment and instrumentation will be used during the conduct of the survey. Substitutions may be made by the surveying technician where the equipment performance is essentially equivalent to the instrument listed.

- 4.2.1 Ludlum Model 2221 Scalar/Rate meter.
- 4.2.2 Ludlum Model 44-2 High-Energy Gamma Probe
- 4.2.3 Canberra MCA System with High-Purity Germanium Detector.
- 4.2.4 Cesium 137 check source.
- 4.2.5 Ambient survey detector fixture.
- 4.2.6 Survey detector balance boom.
- 4.2.7 (3) 200ft to 300 ft measuring tapes.
- 4.2.8 Wire stakes with (2) different colored flags [optional].
- 4.2.9 Compass.
- 4.2.10 Hand-held GPS meter
- 4.2.11 TSA Large Detector/GPS survey system

5.0 SOIL AND BEDROCK SAMPLING

5.1 100% Qualitative Scan Survey

Perform a total (100%) qualitative, direct gamma, surface scan in each SU before sampling. Utilize either a NaI detector with a count rate instrument or the TSA GPS cart survey system. If the NaI is utilized, the maximum survey rate shall not exceed 2.5 fps. If the TSA cart system is used, the maximum survey rate shall not exceed 1.0 fps. With the NaI, mark any suspicious elevated hot spots for sampling as you go and document the location. The guideline for hot spots with the NaI detector is 880 cpm above the average background for the area, based on the required scan MDC of 4 pCi/g.

With the TSA cart, dump the data and utilize the Radiation Safety spreadsheet system developed to find any elevated areas of interest.

Record the results on a Radiation Survey Report, form 732-A. Report any hot spots to the Radiation Safety Officer (RSO) or manager.

Elevated areas may either be investigated by sampling or with the ISOCs in situ portable gamma spectrometer.

5.2 Sample Point Spacing

For Survey Units 1 and 2, the grid spacing and scan area between sample points (for a square grid) are calculated as follows:

Where:

$$\text{SCAN AREA} = A, \text{ and } L = \sqrt{\frac{A}{N}} = \text{DISTANCE BETWEEN SAMPLE POINTS}$$

WHERE N = NUMBER OF SAMPLE LOCATIONS (i.e. $\sqrt{\frac{6100}{14}} = 21$ ft for the Class 1 survey unit).

TABLE 4: Sample Point Spacing

CLASS	SURVEY UNIT	TOTAL AREA per Survey Unit	SAMPLE GRID AREA A/14	GRID SPACING $\sqrt{\frac{A}{14}}$
Class 1	SU1 (Phase A)	6100-ft ² (567-m ²)	436-ft ² (41-m ²)	21-ft (6.4-m)
Class 2	SU2 (Phase A)	40,900-ft ² (3870-m ²)	2921-ft ² (271-m ²)	54-ft (16.5-m)
Class 2I	SU3 (Phase B)	87,940-ft ² (8170-m ²)	NA Randomly Generated	NA

For class 3 survey units MARSSIM recommends the use of a random number generator to pick random survey locations rather than use the evenly spaced grid system.

5.3 Starting Point Coordinates for SU-1 and SU-2

In order to designate the starting point of soil sample locations, a pair of random numbers was generated using a combination of a computer random number generator and the random numbers from Table I.6 of the MARSSIM Manual (Reference 1). Rectangular coordinates from each Survey Unit were then calculated by multiplying the random numbers from the table by the survey unit dimensions. Final starting points and spacing will be rounded to the nearest foot.

Survey Unit 1 random multipliers: X = 0.284838, Y = 0.027043

Survey Unit 2 random multipliers: X = 0.008978, Y = 0.140823

TABLE 5: Random Starting Point Coordinates

CLASS	SURVEY UNIT	X * LENGTH	Y * WIDTH OR HEIGHT	STARTING POINT COORDINATES
1	1	100-ft * 0.284838	61-ft * 0.027043	X = 28-ft, Y = 2-ft
2	2	210ft * 0.008978	213-ft * 0.140823	X = 2-ft, Y = 30-ft

Figures 3 and 4 are grid maps showing the sample locations for Survey Units 1 and 2 (Phase A) with their X-Y coordinates. The 0,0 reference point is in the southwest corner of the survey units. 4059 "Site North" is actually geographical northwest. The random locations ended up generating 15 sample points in Survey Unit 1 instead of 14, so 15 samples will be taken in that unit. In Survey Unit 2, where 17 sample points, instead of 14, are identified. Some of these points may be in inaccessible locations due to slope and safety issues. Up to 3 sample locations in unsafe locations may be dropped, bring the sample count down to 14. If any sample locations cannot be reached safely, they should be moved to a random location nearby.

MARSSIM recommends that the sample locations be generated randomly for Class 2I areas. A program called "Random Number Generator Pro" was utilized to generate 45 X, Y coordinates. The first 14 that fell within the survey area were selected for the sampling locations. Figure 5 is a grid map showing the SU-3 sample locations.

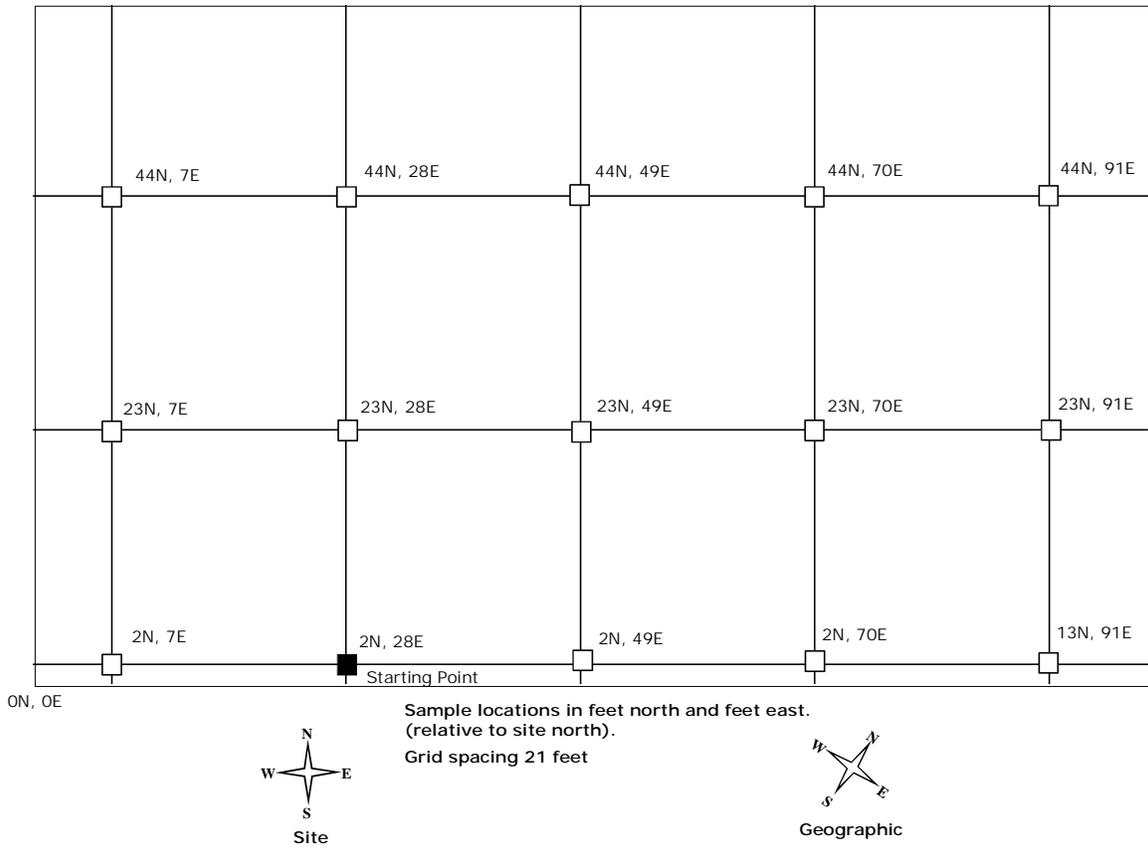


Figure 3: Survey Unit 1 (SU-1) Soil Sample Locations (Phase A)

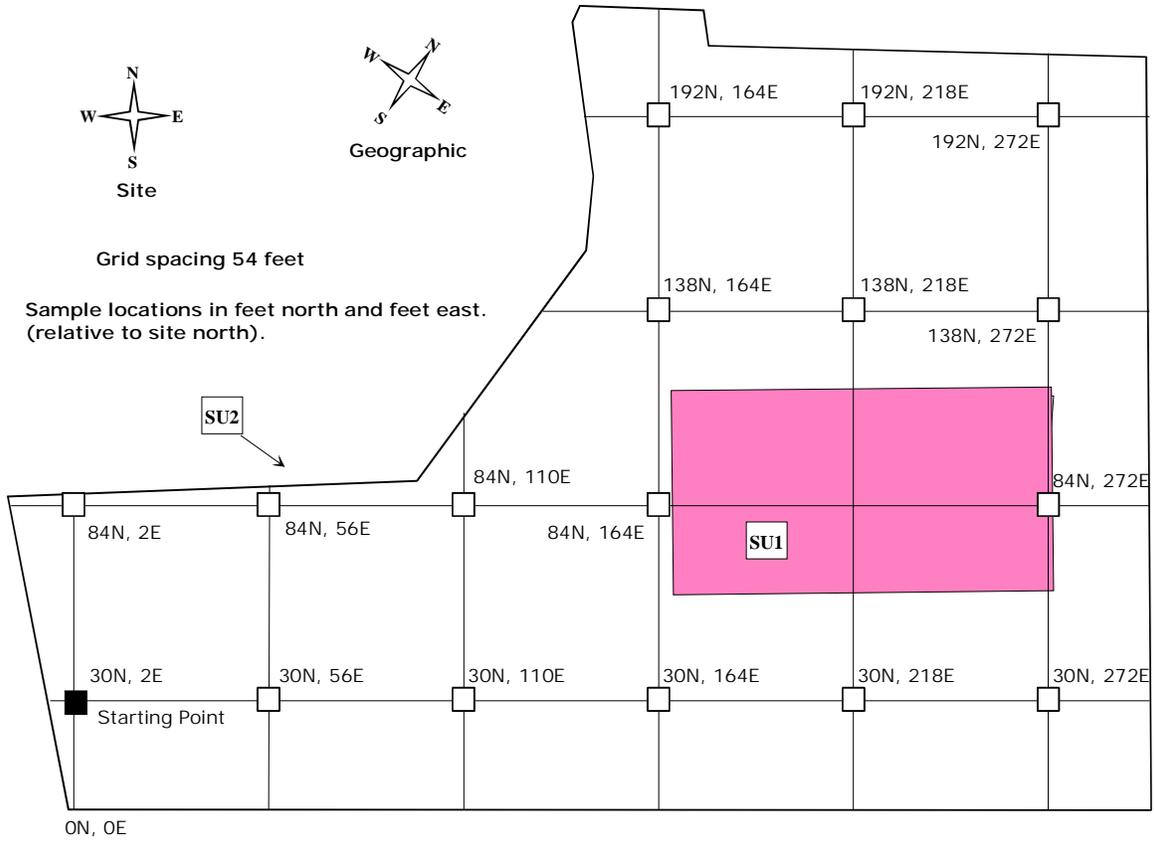


Figure 4: Survey Unit 2 (SU-2) Soil Sample Locations (Phase A)

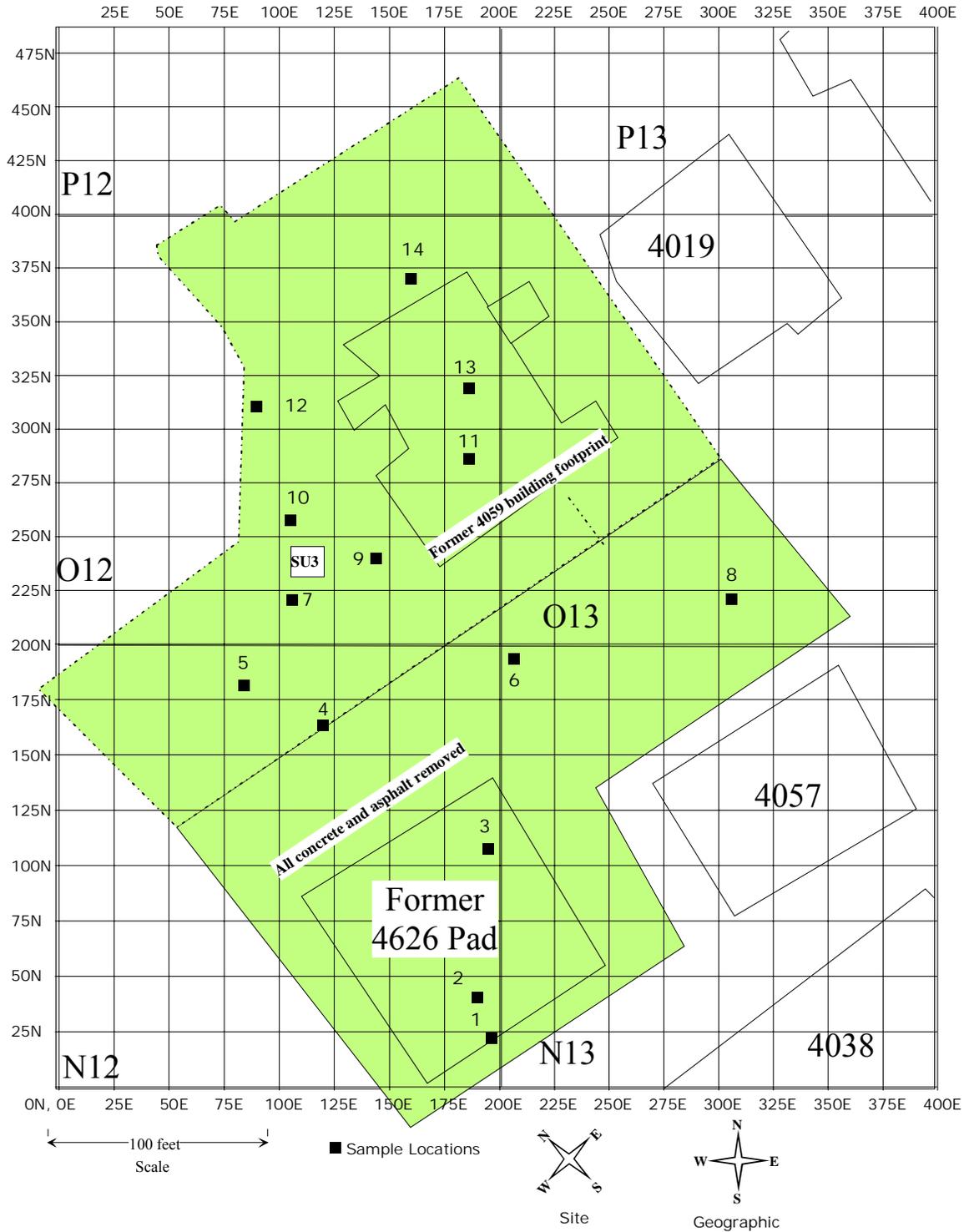


Figure 5: Survey Unit 3 (SU-3) Ground Level Soil Sample Locations (Phase B)

Table 6: Building 4059, SU-3 Sample Locations

Sample #	Grid #	Grid ft North	Grid ft East	Area ft North	Area ft East	GPS Latitude	GPS Longitude
1	N-12	23	198	23	198	34.23158	118.71352
2	N-12	32	187	32	187	34.23160	118.71356
3	N-12	106	199	106	199	34.23181	118.71352
4	N-12	164	124	164	124	34.23196	118.71377
5	N-12	177	80	177	80	34.23200	118.71391
6	N-13	194	4	194	204	34.23205	118.71350
7	O-12	23	104	223	104	34.23213	118.71384
8	O-13	24	107	224	307	34.23213	118.71316
9	O-12	40	149	240	149	34.23217	118.71369
10	O-12	58	104	258	104	34.23222	118.71384
11	O-12	86	182	286	182	34.23230	118.71358
12	O-12	110	84	310	84	34.23236	118.71390
13	O-12	121	179	321	179	34.23240	118.71359
14	O-12	171	159	371	159	34.23253	118.71366

5.4 Representative Reference Background Areas

Since the primary contaminant nuclide of concern, Eu-152, is not present in the background, a reference area is not needed. In addition, DHS has not approved a background data set for SSFL. All isotopes of concern will be reported as gross values and not background subtracted. The statistical test applied during the MARSSIM Data Quality Assessment (DQA) will be the Sign Test.

5.5 Special Equipment, Materials

1. 4133 Field Sample Log Book
2. A working copy of this EWR.
3. 500 ml marinelli beakers
4. Sample container labels
5. Chain of Custody seals
6. Chain of Custody forms
7. Slide hammer and/or jack-hammer auger or suitable equivalent
8. Hole saw for removing asphalt
9. Stainless steel mixing container large enough to mix a 1.5 liter volume of soil without spillage
10. Spoon or spatula for mixing the soil
11. Trowel for clearing back vegetation
12. Tongs or large tweezers for removing rocks and sticks from the samples
13. Buckets for tool cleaning
14. Scrub brush for tool cleaning
15. Drinking water for tool cleaning
16. Suitable non-hazardous detergent for tool washing

17. Deionized water for tool rinseate
18. 5 gallon containers for storing rinseate water for composite sample
19. Bucket for wash water.
20. Hand-held GPS meter

5.6 Sampling Instructions

The samples will be taken with a slide hammer auger, which samples the first 6 inches of soil. If necessary, a slide hammer sample head may be attached to a jackhammer to accommodate hard packed soil. All wash and rinseate buckets should be labeled to avoid confusion. The rinseate individual sample number was picked using Random Number Generator Pro. The following procedure will be used for each sample location:

- 5.6.1 If the sample location is on an asphalted area, use a hole saw to cut out the asphalt and bag it, label it, add it to a chain of custody form and have it analyzed by gamma spectroscopy.
- 5.6.2 Pound the auger into the ground until you reach the top of the sample cup.
- 5.6.3 Remove the auger from the ground and unscrew the sample cup.
- 5.6.4 Dump the soil into the mixing container.
- 5.6.5 Use the tongs to remove large rocks and sticks from the sample.
- 5.6.6 If there is not enough soil to fill a marinelli beaker to the top, repeat steps 6.5 1 through 6.5.6 as near to the original sample as possible. For one of the locations, enough soil to fill two marinelli will have to be collected for a field duplicate sample.
- 5.6.7 Mix the soil thoroughly with a spoon or spatula.
- 5.6.8 Dump or scoop the soil into a marinelli.
- 5.6.9 Close the marinelli and seal it with electrical tape.
- 5.6.10 Place the filled out sample identification label and chain of custody seal on the marinelli.
- 5.6.11 Maintain a sample logbook in the HP Trailer that includes exact location of sampling, description of samples and notes indicating unusual or unexpected characteristics.
- 5.6.12 Go to the tool washing station and thoroughly wash the tools with the brush, tap or drinking water and detergent. They may have to soak for a while to soften up the soil.

- 5.6.13 Then, hold the tools over the rinseate catch bucket (labeled as such) and pour deionized water over them to rinse them off.
- 5.6.14 Dry the tools with paper towels or Kim-Wipes and have the Radiation Safety representative check the tool for removable radioactive contamination before taking the next sample. If the tools are contaminated, decon them per Radiation Safety instructions.
- 5.6.15 If more than one catch bucket is required, then attach a list to each bucket indicating which samples were rinsed into it.
- 5.6.16 Keep the rinseate catch bucket covered when not in use.
- 5.6.17 When the sample from location number 6 is completed, catch the rinseate into a separate clean container and fill a marinelli with this rinseate for analysis.
- 5.6.18 If this is the last sample, collect a sample(s) from the rinseate composite collection bucket(s) for analysis.
- 5.6.19 Adequately characterize and appropriately manage the washing fluids.
- 5.6.20 Transport the samples to the Gamma Spectroscopy Laboratory for analysis.

5.7 Sample Transfer and Control

The samples in the marinelli beakers will be labeled and sealed with electrical tape to prevent leakage. A chain of custody seal will be placed across the container lid to ensure sample integrity until it reaches the labs. A chain of custody form (Figure 13) will be filled out. It will be signed by the sampler and by all sample custodians throughout the sample's life. It will remain with the samples all the way to the off site lab.

Table 7: Required Minimum Detectable Activities (MDA) by Isotope

Isotope	MDA (pCi/g)
Am-241	0.1
Co-60	0.03
Cs-137	0.02
Eu-152	0.05
Eu-154	0.03
Pu-238	0.05
Pu-239/240	0.05
Pu-241	1.0
Ra-226	0.1
Sr-90	0.1
Th-228	0.05
Th-230	0.05
Th-232	0.05
U-234	0.02
U-235	0.02
U-238	0.02

6.0 REFERENCES

1. NUREG 1575, EPA 402-R-97-016, "Multi Agency Radiation Survey and Site Investigation Manual (MARSSIM)", Rev.1, August 2000
2. N001SRR140131, "Approved Site wide Release Criteria for Remediation of Radiological Facilities at the Santa Susana Field Laboratory", February 18, 1999
3. RS-00012, "Methods and Procedures for Radiological Monitoring", Rev A, January 2, 2002
4. Rocketdyne Form 732-A, Rev. 8-97, "Radiation Survey Report"
5. Rocketdyne Report A4CM-ZR-0011, "Area IV Radiological Characterization Survey", August 15, 1996
6. Compass, Oak Ridge Institute for Science and Education (ORISE), Version 1.0.0, © 2000, 2001
7. NUREG 1507, "Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions", June 1998
8. Impacts BRC software, Sandia National Laboratory, Version 2.1, April 1990
9. RS-00001, "Building 4059, Phase 1 Final Status Survey Procedure", Rev New, April 29, 1999
10. RS-00002, "Building 4059 Final Status Survey Report", Rev New, August 20, 1999
11. ORISE, "Radiological Survey of the Building 059 Reactor Vault, Santa Susana Laboratory, Rockwell International, Ventura County, California", June 1995

APPENDIX A

Compass Computer Program Screen Shots

Phase A, Survey Unit 1 Compass Run

COMPASS - Add Site Wizard



Listing of Existing Site Names:

Introduction

This wizard will guide you through the process of site setup. Required information include:

- » site name
- » planner(s)
- » contaminants, series and/or single radionuclides
- » DCGLw for each contaminant

Optionally, the area factor table for each contaminant can be entered. If the area factor table is not entered and is required in the DQO and DQA wizards, those wizards will not be able to be completed.

Site Description

Enter a unique site name:
(see the list to the left for existing site names)

Building 4059 SU-1

Enter the site planner(s):

Ray McGinnis

Enable Training Card Help
v1.0.0

BACK **NEXT**

 **COMPASS - Add Site Wizard** _ □ X

Uranium, Thorium, and Radium Series Selection

The following radionuclide series can be added to the site. Each radionuclide series includes a description to help with series selection. If your site does not have any of the listed series, then continue to the Single Radionuclide section at the bottom.

<input type="checkbox"/> Uranium Ore Consists of U-238 in secular equilibrium with all its progeny. (14 radionuclides)	<input type="checkbox"/> Th-230 Consists of Th-230 (parent) in secular equilibrium with the Ra-226 decay chain; for example, uranium ore tailings.
<input type="checkbox"/> Processed Natural Uranium Consists of U-238 (Th-234 and Pa-234m), U-235 (Th-231), and U-234 at natural isotopic abundances.	<input type="checkbox"/> Natural Thorium Consists of the natural thorium (Th-232) decay chain.
<input type="checkbox"/> Enriched or Depleted Uranium Consists of processed uranium that has been enriched or depleted in U-235; for example, reactor sites or ammunition plant.	<input type="checkbox"/> Radium (Ra-226) Consists of Ra-226 and its progeny in secular equilibrium. Select this series if Th-230 is not in secular equilibrium with Ra-226 and its progeny.

Single Radionuclide

Check the following box to add single radionuclide contaminants to the site; for example, Co-60 or Th-230 when not in equilibrium with Ra-226 and its progeny. If a series is not selected, you will have to click this box to continue.

Add single radionuclide contaminants

  Enable Training Card Help
v1.0.0  

COMPASS - Add Site Wizard

Single Radionuclide Contaminant Selection

From the list below, select single contaminants. Click the ADD button to enter DCGLw(s) for the selected contaminant. If available, the NRC LOOKUP button will become enabled. Click this button if you wish to use the published NRC screening value(s). Click the SAVE button to add the selected contaminant with the entered DCGL(s) to the site. Click the CANCEL button to quit data entry. Repeat this process for each contaminant to be include in the site. A DCGLw can be entered for each survey type—surface soil and building surface.

Select Single Contaminants:

Radionuclide	Surface Soil	Building Surface
<input type="checkbox"/> Cs-137		
<input type="checkbox"/> Cu-67		
<input checked="" type="checkbox"/> Eu-152	2.79	
<input type="checkbox"/> Eu-154		

Enter DCGL(s)

Surface Soil: pCi/g

Building Surface: dpm/100 cm²

SAVE CANCEL NRC LOOKUP

Enable Training Card Help

v1.0.0

BACK NEXT

COMPASS - Add Site Wizard

Enter Area Factors for Site Contaminants (Optional)

Enter the area factors for each site contaminant. If a contaminant has both a surface soil and building surface DCGL, then enter two area factor tables. It is important to enter area factor tables now. If they are needed in the DQO or DQA and are not provided here, the DQO and DQA will be unable to be completed.

Site Contaminant		Area Factors	
Contaminant	Type	Area	Factor
Eu-152	Surface Soil	1	9.27
		3	4.2
		10	2.03
		30	1.47
		137	1.16
		300	1.1

ADD

ERASE

Enter Data:

Area (m²):

Area Factor:

SAVE CANCEL

Enable Training Card Help
v1.0.0

BACK NEXT

COMPASS - DQO Wizard for Surface Soil Assessment

Site Selection

From the list below, select a site. The second list shows which contaminants have been entered for the selected site, the surface soil DCGLw, and if the NRC screening value was used.

Select a Site

Building 4059 SU-1

Site Contaminants

Contaminant	DCGLw (pCi/g)	Screening Value?
Eu-152	2.79	No

  Enable Training Card Help
v1.0.0  

COMPASS - DQO Wizard for Surface Soil Assessment

Survey Unit Details

Enter in a description of the survey unit. This text must be unique for the selected site and will be used when selecting a survey plan to re-print or to begin the data quality assessment (DQA) wizard. The list box below shows all the names previously entered. Then enter the survey unit area and classification.

Survey Unit Description:
Building 4059 SU-1

Survey Unit Area (m²): 567 Class: 1

Additional comments below. These comments will appear on the survey plan report and entry is optional.
Comments: (Optional)
Basement Footprint

Enable Training Card Help
v1.0.0

BACK NEXT

COMPASS - DQO Wizard for Surface Soil Assessment

Select Survey Unit Contaminants

From the list below, put a check mark next to each site contaminant to be included in the DQO process. To un-check a contaminant, click on it again.

Contaminant	DCGLw (pCi/g)
<input checked="" type="checkbox"/> Eu-152	2.79

 SELECT ALL  CLEAR ALL

  Enable Training Card Help  BACK  NEXT

v1.0.0

COMPASS - DQO Wizard for Surface Soil Assessment

Enter Estimated Concentration Levels

Enter the estimated mean (pCi/g) and standard deviation (pCi/g) for each measured contaminant. If data is available for the reference area, be sure to include it as well. This will allow you to later make comparisons between the Sign and WRS tests if reference area data for at least one contaminant is included.

Measured Contaminant Estimated Mean Value(s)

Measured Contaminant	Survey Unit (pCi/g)	Reference Area (pCi/g)
Eu-152		

Enter Estimated Values for Eu-152

Survey Unit Mean (pCi/g): ± (1σ)

Reference Area Mean (pCi/g): ± (1σ)

Enable Training Card Help

v1.0.0

COMPASS - DQO Wizard for Surface Soil Assessment

SIGN TEST Sample Size and Prospective Power Curve Design

This step calculates the Sign Test sample size and prospective power curve. Enter values for the DQO parameters, then click the calculate button at the bottom. When you are satisfied with this design, click the NEXT button.

Enter Values

LBGR:

Alpha:

Beta:

Calculations

DCGL:

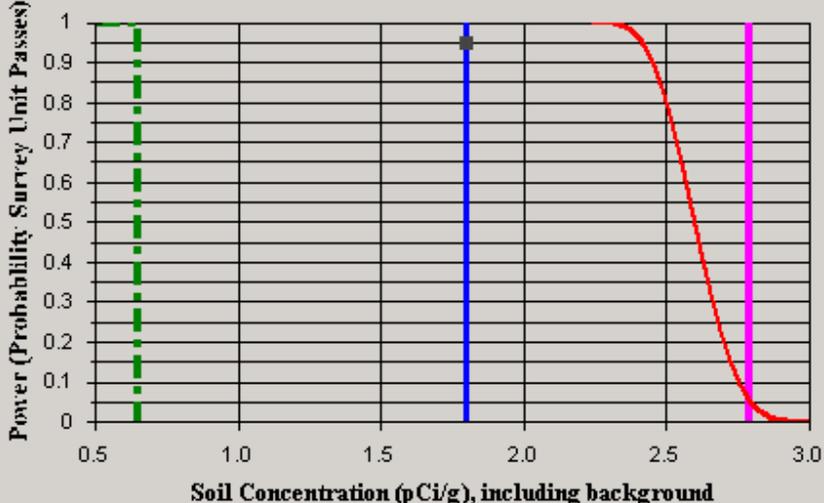
Sigma:

Δ/σ :

SignP:

N:

Calculate Sample Size/Update Prospective Power Curve



The graph plots Power (Probability Survey Unit Passes) on the y-axis (0 to 1) against Soil Concentration (pCi/g, including background) on the x-axis (0.5 to 3.0). A red curve represents the Prospective Power, which starts at 1.0 for concentrations below 2.3 pCi/g and drops to 0.0 by 3.0 pCi/g. A vertical blue line at 1.8 pCi/g represents the LBGR, with a black dot at approximately 0.95 power. A vertical pink line at 2.79 pCi/g represents the DCGL. A vertical green dashed line at approximately 0.6 pCi/g represents the Estimated Power. A legend below the graph identifies: Prospective Power (red line), DCGL (pink line), Estimated Power (green dashed line), LBGR (blue line), and 1-beta (black dot).

Power (Probability Survey Unit Passes)

Soil Concentration (pCi/g), including background

— Prospective Power — DCGL - - - Estimated Power
— LBGR ■ 1-beta

←

📄

Enable Training Card Help

← BACK NEXT →

v1.0.0

COMPASS - DQO Wizard for Surface Soil Assessment

Statistical Survey Design Summary

Below is a comparison of the Sign Test and WRS Test designs. Select which design you feel will provide the best results, then press the NEXT button to continue.

If no reference area data was included, the WRS Test was not completed and the Sign Test is selected automatically. Press the NEXT button to continue.

Sign Test Results	WRS Test Results
DCGL: 2.79	DCGL: <input type="text"/>
LBGR: 1.8	LBGR: <input type="text"/>
Sigma: 0.34	Sigma: <input type="text"/>
Alpha: 0.050	Alpha: <input type="text"/>
Beta: 0.050	Beta: <input type="text"/>
N: 14	N/2: <input type="text"/>
Estimated Power: 1	Estimated Power: <input type="text"/>

WRS

Enable Training Card Help

v1.0.0

BACK NEXT

COMPASS - DQO Wizard for Surface Soil Assessment

Elevated Measurement Comparison (EMC)

Enter in a description for the scanning instrumentation used. Then enter a scan MDC for each measured contaminant. Click the CALCULATE button to view the integrated survey design results. All entered and calculated scan MDC and DCGL units are in pCi/g.

Scanning Instrumentation Description:

Contaminant	Scan MDC
Eu-152	3.1

Enter Scan MDC

Scan MDC:

Statistical Design

N:

Bounded Area (m²):

Area Factor:

DCGLw:

Scan MDC Required:

Hot Spot Design

Actual Scan MDC:

Area Factor:

Bounded Area (m²):

Post-EMC N:

Enable Training Card Help

v1.0.0

Phase A, Survey Unit 2, Compass Runs for MARSSIM

COMPASS - Add Site Wizard



Listing of Existing Site Names:

Building 4059 SU-1

Introduction

This wizard will guide you through the process of site setup. Required information include:

- » site name
- » planner(s)
- » contaminants, series and/or single radionuclides
- » DCGLw for each contaminant

Optionally, the area factor table for each contaminant can be entered. If the area factor table is not entered and is required in the DQO and DQA wizards, those wizards will not be able to be completed.

Site Description

Enter a unique site name:
(see the list to the left for existing site names)

Building 4059 SU-2

Enter the site planner(s):

Ray McGinnis

Enable Training Card Help
v1.0.0

BACK NEXT

COMPASS - Add Site Wizard

Uranium, Thorium, and Radium Series Selection

The following radionuclide series can be added to the site. Each radionuclide series includes a description to help with series selection. If your site does not have any of the listed series, then continue to the Single Radionuclide section at the bottom.

<input type="checkbox"/> Uranium Ore Consists of U-238 in secular equilibrium with all its progeny. (14 radionuclides)	<input type="checkbox"/> Th-230 Consists of Th-230 (parent) in secular equilibrium with the Ra-226 decay chain; for example, uranium ore tailings.
<input type="checkbox"/> Processed Natural Uranium Consists of U-238 (Th-234 and Pa-234m), U-235 (Th-231), and U-234 at natural isotopic abundances.	<input type="checkbox"/> Natural Thorium Consists of the natural thorium (Th-232) decay chain.
<input type="checkbox"/> Enriched or Depleted Uranium Consists of processed uranium that has been enriched or depleted in U-235; for example, reactor sites or ammunition plant.	<input type="checkbox"/> Radium (Ra-226) Consists of Ra-226 and its progeny in secular equilibrium. Select this series if Th-230 is not in secular equilibrium with Ra-226 and its progeny.

Single Radionuclide

Check the following box to add single radionuclide contaminants to the site; for example, Co-60 or Th-230 when not in equilibrium with Ra-226 and its progeny. If a series is not selected, you will have to click this box to continue.

Add single radionuclide contaminants

Enable Training Card Help
v1.0.0

COMPASS - Add Site Wizard

Single Radionuclide Contaminant Selection

From the list below, select single contaminants. Click the ADD button to enter DCGLw(s) for the selected contaminant. If available, the NRC LOOKUP button will become enabled. Click this button if you wish to use the published NRC screening value(s). Click the SAVE button to add the selected contaminant with the entered DCGL(s) to the site. Click the CANCEL button to quit data entry. Repeat this process for each contaminant to be include in the site. A DCGLw can be entered for each survey type—surface soil and building surface.

Select Single Contaminants:

Radionuclide	Surface Soil	Building Surface
<input type="checkbox"/> Cs-137		
<input type="checkbox"/> Cu-67		
<input checked="" type="checkbox"/> Eu-152	2.79	
<input type="checkbox"/> Eu-154		

Enter DCGL(s)

Surface Soil: pCi/g

Building Surface: dpm/100 cm²

SAVE CANCEL NRC LOOKUP

Enable Training Card Help
v1.0.0

BACK NEXT

COMPASS - Add Site Wizard

Enter Area Factors for Site Contaminants (Optional)

Enter the area factors for each site contaminant. If a contaminant has both a surface soil and building surface DCGL, then enter two area factor tables. It is important to enter area factor tables now. If they are needed in the DQO or DQA and are not provided here, the DQO and DQA will be unable to be completed.

Site Contaminant		Area Factors	
Contaminant	Type	Area	Factor
Eu-152	Surface Soil	1	9.27
		3	4.2
		10	2.03
		30	1.47
		100	1.19
		140	1.16

ADD **ERASE**

Enter Data:

Area (m²):

Area Factor:

SAVE **CANCEL**

Enable Training Card Help
v1.0.0

BACK **NEXT**

COMPASS - DQO Wizard for Surface Soil Assessment

Site Selection

From the list below, select a site. The second list shows which contaminants have been entered for the selected site, the surface soil DCGLw, and if the NRC screening value was used.

Select a Site

- Building 4059 SU-1
- Building 4059 SU-2**

Site Contaminants

Contaminant	DCGLw (pCi/g)	Screening Value?
Eu-152	2.79	No

  Enable Training Card Help
v1.0.0  

COMPASS - DQO Wizard for Surface Soil Assessment

Survey Unit Details

Enter in a description of the survey unit. This text must be unique for the selected site and will be used when selecting a survey plan to re-print or to begin the data quality assessment (DQA) wizard. The list box below shows all the names previously entered. Then enter the survey unit area and classification.

Survey Unit Description:
Building 4059 SU-2

Survey Unit Area (m²): 3870 Class: 2

Comments: (Optional)
Phase A

Enable Training Card Help
v1.0.0

BACK NEXT

COMPASS - DQO Wizard for Surface Soil Assessment

Select Survey Unit Contaminants

From the list below, put a check mark next to each site contaminant to be included in the DQO process. To un-check a contaminant, click on it again.

Contaminant	DCGLw (pCi/g)
<input checked="" type="checkbox"/> Eu-152	2.79

SELECT ALL  CLEAR ALL

 Enable Training Card Help  

v1.0.0

COMPASS - DQO Wizard for Surface Soil Assessment

Enter Estimated Concentration Levels

Enter the estimated mean (pCi/g) and standard deviation (pCi/g) for each measured contaminant. If data is available for the reference area, be sure to include it as well. This will allow you to later make comparisons between the Sign and WRS tests if reference area data for at least one contaminant is included.

Measured Contaminant Estimated Mean Value(s)

Measured Contaminant	Survey Unit (pCi/g)	Reference Area (pCi/g)
Eu-152	0.65 ± 0.34	

Enter Estimated Values

Survey Unit Mean (pCi/g): ± (1σ)

Reference Area Mean (pCi/g): ± (1σ)

Enable Training Card Help

v1.0.0

COMPASS - DQO Wizard for Surface Soil Assessment

SIGN TEST Sample Size and Prospective Power Curve Design

This step calculates the Sign Test sample size and prospective power curve. Enter values for the DQO parameters, then click the calculate button at the bottom. When you are satisfied with this design, click the NEXT button.

Enter Values

LBGR:

Alpha:

Beta:

Calculations

DCGL:

Sigma:

Δ/σ :

SignP:

N:

Calculate Sample Size/Update Prospective Power Curve

Power (Probability Survey Unit Passes)

Soil Concentration (pCi/g), including background

— Prospective Power — DCGL - - - Estimated Power

— LBGR ■ 1-beta

Enable Training Card Help

v1.0.0

BACK NEXT

COMPASS - DQO Wizard for Surface Soil Assessment

Statistical Survey Design Summary

Below is a comparison of the Sign Test and WRS Test designs. Select which design you feel will provide the best results, then press the NEXT button to continue.

If no reference area data was included, the WRS Test was not completed and the Sign Test is selected automatically. Press the NEXT button to continue.

Sign Test Results	WRS Test Results
DCGL: 2.79	DCGL: <input type="text"/>
LBGR: 1.8	LBGR: <input type="text"/>
Sigma: 0.34	Sigma: <input type="text"/>
Alpha: 0.050	Alpha: <input type="text"/>
Beta: 0.050	Beta: <input type="text"/>
N: 14	N/2: <input type="text"/>
Estimated Power: 1	Estimated Power: <input type="text"/>



 WRS

Enable Training Card Help
v1.0.0

Phase B, Survey Unit 3, Compass Runs for MARSSIM

COMPASS - Add Site Wizard



Listing of Existing Site Names:

- Building 4059 SU-1
- Building 4059 SU-2

Introduction

This wizard will guide you through the process of site setup. Required information include:

- » site name
- » planner(s)
- » contaminants, series and/or single radionuclides
- » DCGLw for each contaminant

Optionally, the area factor table for each contaminant can be entered. If the area factor table is not entered and is required in the DQO and DQA wizards, those wizards will not be able to be completed.

Site Description

Enter a unique site name:
(see the list to the left for existing site names)

Building 4059 SU-3

Enter the site planner(s):

Ray McGinnis

Enable Training Card Help
v1.0.0

BACK NEXT

 **COMPASS - Add Site Wizard**   

Uranium, Thorium, and Radium Series Selection

The following radionuclide series can be added to the site. Each radionuclide series includes a description to help with series selection. If your site does not have any of the listed series, then continue to the Single Radionuclide section at the bottom.

<input type="checkbox"/> Uranium Ore Consists of U-238 in secular equilibrium with all its progeny. (14 radionuclides)	<input type="checkbox"/> Th-230 Consists of Th-230 (parent) in secular equilibrium with the Ra-226 decay chain; for example, uranium ore tailings.
<input type="checkbox"/> Processed Natural Uranium Consists of U-238 (Th-234 and Pa-234m), U-235 (Th-231), and U-234 at natural isotopic abundances.	<input type="checkbox"/> Natural Thorium Consists of the natural thorium (Th-232) decay chain.
<input type="checkbox"/> Enriched or Depleted Uranium Consists of processed uranium that has been enriched or depleted in U-235; for example, reactor sites or ammunition plant.	<input type="checkbox"/> Radium (Ra-226) Consists of Ra-226 and its progeny in secular equilibrium. Select this series if Th-230 is not in secular equilibrium with Ra-226 and its progeny.

Single Radionuclide

Check the following box to add single radionuclide contaminants to the site; for example, Co-60 or Th-230 when not in equilibrium with Ra-226 and its progeny. If a series is not selected, you will have to click this box to continue.

Add single radionuclide contaminants

  Enable Training Card Help  

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COMPASS - Add Site Wizard

Single Radionuclide Contaminant Selection

From the list below, select single contaminants. Click the ADD button to enter DCGLw(s) for the selected contaminant. If available, the NRC LOOKUP button will become enabled. Click this button if you wish to use the published NRC screening value(s). Click the SAVE button to add the selected contaminant with the entered DCGL(s) to the site. Click the CANCEL button to quit data entry. Repeat this process for each contaminant to be include in the site. A DCGLw can be entered for each survey type—surface soil and building surface.

Select Single Contaminants:

Radionuclide	Surface Soil	Building Surface
<input type="checkbox"/> Cs-137		
<input type="checkbox"/> Cu-67		
<input checked="" type="checkbox"/> Eu-152	2.79	
<input type="checkbox"/> Eu-154		

Enter DCGL(s)

Surface Soil: pCi/g

Building Surface: dpm/100 cm²

Buttons: ADD, ERASE, SAVE, CANCEL, NRC LOOKUP

Footer: Enable Training Card Help, v1.0.0, BACK, NEXT

COMPASS - Add Site Wizard

Enter Area Factors for Site Contaminants (Optional)

Enter the area factors for each site contaminant. If a contaminant has both a surface soil and building surface DCGL, then enter two area factor tables. It is important to enter area factor tables now. If they are needed in the DQO or DQA and are not provided here, the DQO and DQA will be unable to be completed.

Site Contaminant		Area Factors	
Contaminant	Type	Area	Factor
Eu-152	Surface Soil	1	9.27
		3	4.2
		10	2.03
		30	1.47
		100	1.19
		140	1.16

ADD **ERASE**

Enter Data:

Area (m²):

Area Factor:

SAVE **CANCEL**

Enable Training Card Help

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BACK **NEXT**

COMPASS - DQO Wizard for Surface Soil Assessment

Site Selection

From the list below, select a site. The second list shows which contaminants have been entered for the selected site, the surface soil DCGLw, and if the NRC screening value was used.

Select a Site

- Building 4059 SU-1
- Building 4059 SU-2
- Building 4059 SU-3**

Site Contaminants

Contaminant	DCGLw (pCi/g)	Screening Value?
Eu-152	2.79	No

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COMPASS - DQO Wizard for Surface Soil Assessment

Survey Unit Details

Enter in a description of the survey unit. This text must be unique for the selected site and will be used when selecting a survey plan to re-print or to begin the data quality assessment (DQA) wizard. The list box below shows all the names previously entered. Then enter the survey unit area and classification.

Survey Unit Description:
Building 4059 SU-3

Survey Unit Area (m²): 8170 Class: 3

Comments: (Optional)
Phase B

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BACK NEXT

COMPASS - DQO Wizard for Surface Soil Assessment

Select Survey Unit Contaminants

From the list below, put a check mark next to each site contaminant to be included in the DQO process. To un-check a contaminant, click on it again.

Contaminant	DCGLw (pCi/g)
<input checked="" type="checkbox"/> Eu-152	2.79

 SELECT ALL  CLEAR ALL

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COMPASS - DQO Wizard for Surface Soil Assessment



Enter Estimated Concentration Levels

Enter the estimated mean (pCi/g) and standard deviation (pCi/g) for each measured contaminant. If data is available for the reference area, be sure to include it as well. This will allow you to later make comparisons between the Sign and WRS tests if reference area data for at least one contaminant is included.

Measured Contaminant Estimated Mean Value(s)

Measured Contaminant	Survey Unit (pCi/g)	Reference Area (pCi/g)
Eu-152	0.65 ± 0.34	

Enter Estimated Values

Survey Unit Mean (pCi/g): ± (1σ)

Reference Area Mean (pCi/g): ± (1σ)



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COMPASS - DQO Wizard for Surface Soil Assessment

SIGN TEST Sample Size and Prospective Power Curve Design

This step calculates the Sign Test sample size and prospective power curve. Enter values for the DQO parameters, then click the calculate button at the bottom. When you are satisfied with this design, click the NEXT button.

Enter Values

LBGR:

Alpha:

Beta:

Calculations

DCGL:

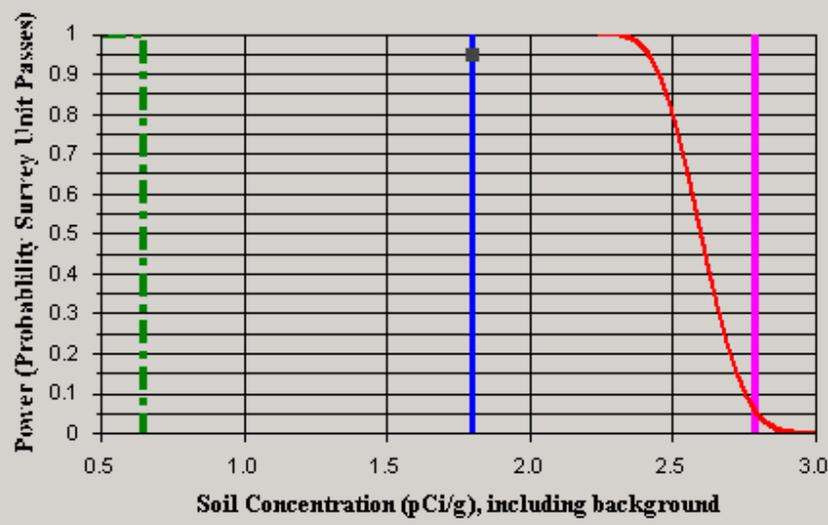
Sigma:

Δ/σ :

SignP:

N:

Calculate Sample Size/Update Prospective Power Curve



The graph plots Power (Probability Survey Unit Passes) on the y-axis (0 to 1) against Soil Concentration (pCi/g), including background on the x-axis (0.5 to 3.0). A red curve represents the Prospective Power, which starts at 1.0 for concentrations below 2.0 pCi/g and drops to 0.0 by 3.0 pCi/g. A vertical blue line at 1.8 pCi/g represents the LBGR, with a black dot at the intersection of the curve and the line, indicating a power of approximately 0.99. A vertical magenta line at 2.79 pCi/g represents the DCGL. A vertical green dashed line at approximately 0.6 pCi/g represents the Estimated Power.

Legend:

- Prospective Power (Red line)
- DCGL (Magenta line)
- Estimated Power (Green dashed line)
- LBGR (Blue line)
- 1-beta (Black dot)

Enable Training Card Help

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COMPASS - DQO Wizard for Surface Soil Assessment

Statistical Survey Design Summary

Below is a comparison of the Sign Test and WRS Test designs. Select which design you feel will provide the best results, then press the NEXT button to continue.

If no reference area data was included, the WRS Test was not completed and the Sign Test is selected automatically. Press the NEXT button to continue.

Sign Test Results	WRS Test Results
DCGL: 2.79	DCGL: <input type="text"/>
LBGR: 1.8	LBGR: <input type="text"/>
Sigma: 0.34	Sigma: <input type="text"/>
Alpha: 0.050	Alpha: <input type="text"/>
Beta: 0.050	Beta: <input type="text"/>
N: 14	N/2: <input type="text"/>
Estimated Power: 1	Estimated Power: <input type="text"/>

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