APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN DEVELOPMENT CHECKLIST FOR SOIL SURVEY UNITS

Survey Area: LSA-10 **Description:** Burial Pits Open Land Area

Survey Unit: 03 **Description:** West Central Survey Unit (North Burial Pit Area)

1. Verify Survey Unit Isolation & Control

Survey Unit properly isolated and/or controlled (indicated by outlining the area with green rope and posting the appropriate signage) as required by HDP-PR-HP-602, *Data Package Development and Isolation and Control Measures to Support Final Status Survey*? Yes☒ No☐
(If "No", discontinue survey design until area turnover requirements have been met.)

2. Evaluate Final Remedial Action Support Survey (RASS) Data

a. Number of RASS Samples = 8
b. Record analytical results and summary statistics for the RASS data set.

	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Tc-99 (pCi/g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
Minimum	1.153	0.058	0.708	0.075	0 (<BKG)	0 (<BKG)
Maximum	18.846	1.040	4.220	0.293	0.840	0.260
Mean	5.127	0.281	1.390	0.164	0.295	0.075
Median	3.893	0.215	0.961	0.146	0.230	0.000
Standard Deviation	5.773	0.320	1.162	0.084	0.266	0.108
# of Samples	8	8	8	8	8	8

c. Are all RASS results less, or equal to the appropriate $DCGL_w$ from Appendix A of HDP-PR-FSS-701? Yes☒ No☐

d. If "No", have remaining locations of elevated concentration been evaluated? N/A☒ Yes☐ No☐
(If "No", discontinue survey design until investigation is complete.)

e. Have elevated areas identified by gamma walkover surveys been investigated? Yes☒ No☐
(If "No", then terminate survey design and perform additional investigation and repeat the planning process.)

f. Are the Initial Characterization and RASS data sufficient to support FSS Design? Yes☒ No☐
(If "No", terminate survey design, perform additional characterization or remediation and repeat the planning process.)

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FINAL STATUS SURVEY SAMPLING PLAN DEVELOPMENT CHECKLIST FOR SOIL SURVEY UNITS

3. Define the Survey Unit Classification

Write a short description of the survey unit based on historical use and remedial activities:

The LSA 10-03 survey unit (SU) is classified as MARSSIM Class 1. LSA10-03 is located in the northern half of the Burial Pit Open Land Area. This SU along with LSA10-01, 10-02, 10-04, and 10-12 are collectively referred to as "Area 1" for the purposes of remediation planning and work sequencing. Area 1 contained various types of waste materials, including drums, bags of trash, a tank, filter press plates, fuel pellets, construction debris, spent limestone, and contaminated soils.

The area that comprises the footprint of LSA-10-03 was used to bury radioactive and chemical wastes during the operational period of the Hematite Fuel Fabrication Facility. Documented burial pits, under the governance of the Atomic Energy Commission's regulations, were generated between 1965 and 1970. Also, undocumented waste burials occurred prior to 1965.

Classification: 1 Survey Unit Area (m^2): 1,944.54 (gamma walkover survey total surface area)

Survey Unit Area (m^2): 1,590.0 (planar area on which systematic grid is based)

a. Has the Classification changed from the Initial Classification as indicated in DP Ch. 14 Table 14-16 and Figures 14-14 through 14-17? Yes☐ No☒
(If "Yes", then include a copy of Appendix P-5, *Survey Unit Classification Change Form.*)

b. Is the Survey Unit area less than the maximum size for the Classification? Yes☒ No☐
(If "No", then terminate survey design and evaluate dividing the survey unit into multiple survey units.)

4. Define the Surrogate Evaluation Area (SEA)

Select the appropriate SEA as input to calculating scan sensitivity and variability in the RASS SOF.
Plant Soils SEA ☐ Tc-99 SEA ☐ Burial Pit SEA ☒

5. Define Final Survey Unit Conditions

☐ No Excavations, Paved/Partially Paved or Excavated but not Backfilled

☒ Excavated and to be Backfilled

☐ Excavated and Backfilled

Note: If a portion of a Survey Unit is paved, then Surface Soil Stratum begins at the bottom of the paved surface and extends 15 cm from that point below grade. The lower depth of the Root Stratum remains at 1.5 m below grade. The pavement is then treated as a separate structural Survey Unit within the Survey Area.

6. Define the Type of FSS Samples and Measurements

Select the appropriate types of samples and measurements for FSS of this Survey Unit that corresponds to the final condition and survey classification of the Survey Unit.

Quality Record

APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN DEVELOPMENT CHECKLIST FOR SOIL SURVEY UNITS

Not Excavated, Paved/Partially Paved or Excavated but not Backfilled:

☐ Surface Soil (<15cm) Samples.

☐ Root Stratum Soil Samples composited from 15cm to 1.5m.

Note: If the SOF of the Root Stratum sample exceeds 0.5, a composite sample is collect from 1.5 meters to an appropriate depth (Deep Stratum).

Excavated and to be Backfilled:

☐ Surface Soil Samples taken from any remaining surface soil Stratum and Root Stratum Soil Samples taken at the same locations as Surface Samples, composited over the entire root stratum.

☒ Root Stratum Soil Samples composited from exposed grade to 1.5m and Deep Stratum Soil Samples taken at the same locations as Root Samples of the top 15cm of the Deep Stratum.

☒ Deep Stratum Soil Samples of the top 15 cm of the exposed Deep Stratum.

7. Define Derived Concentration Guideline Levels (DCGL)

Select the appropriate DCGL for each Radionuclide of Concern (ROC) based on the corresponding SEA and the Uniform Conceptual Site Model (CSM).

- If Tc-99 was measured during the characterization/RASS survey, then the "Measure Tc-99" DCGLs will be used from Appendix A of HDP-PR-FSS-701.
- If Tc-99 was not measured in the characterization/RASS survey, then the modified U-235 DCGL ("Infer Tc-99") will be used from Appendix A HDP-PR-FSS-701.

	Surface Stratum DCGL (pCi/g)	Root Stratum DCGL (pCi/g)	Deep Stratum DCGL [1] (pCi/g)	**Uniform DCGL (pCi/g)**
U-234	N/A	N/A	N/A	195.4
U-235	N/A	N/A	N/A	51.6
U-238	N/A	N/A	N/A	168.8
Tc-99	N/A	N/A	N/A	25.1
Th-232 + C	N/A	N/A	N/A	2.0
Ra-226 + C	N/A	N/A	N/A	1.9

1. The Deep Stratum DCGLs correspond to the Excavation Scenario DCGL from Appendix A of HDP-PR-FSS-701.

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FINAL STATUS SURVEY SAMPLING PLAN DEVELOPMENT CHECKLIST FOR SOIL SURVEY UNITS

8. Determine the Number of Samples in the Statistical Survey Population

Note: The statistical survey population is routinely derived based on the Uniform DCGL.

- Alternatively, if the Survey Unit excavation extends into multiple CSMs (e.g. surface, root & deep), then the DCGL(s) from the most limiting strata can be used with the equations below; OR
- If the excavation significantly extends into the Deep Stratum, then the alternate approach presented in Step 8.2.5 of HDP-PR-FSS-701 may be used for determining the mean SOF and weighted standard deviation that accounts for the reduced dose from the deeper surface, i.e., by weighting the Root Stratum and Excavation $DCGL_w$ values.
- The values used in the following equations (SOF_{mean} and σ_{SOF}) can be found in the tables from Section 2b and Section 7a.

a. Determine a mean SOF for the characterization/RASS survey data set using the equation from Step 8.2.5a of HDP-PR-FSS-701.

Lower Bound of the Grey Region (LBGR) = SOF_{Mean} = 0.23

b. Determine the weighted standard deviation in the SOF for the characterization/RASS survey data set using the equation from Step 8.2.5b of HDP-PR-FSS-701.

Note: For the determination of SOF_{Mean} and σ_{SOF}, include the concentration for Tc-99 if it was measured. If Tc-99 was not measured, include the modified U-235 DCGL and omit Tc-99 concentration term.

✓ Larger of the two used in worksheet survey design

Survey Unit σ_{SOF} =	0.15	☒
Background σ_{SOF}=	0.13	☐

c. Define the Decision Errors.

Type I Error = 0.05 Type II Error = 0.10

Note: The Type II Error is set at 0.10 initially but it may be adjusted with RSO concurrence.

d. Determine the Relative Shift using the equation in Step 8.2.5d of HDP-PR-FSS-701.

Relative Shift = 5.18* *spreadsheet value may differ slightly from hand-calculated results due to rounding

Quality Record

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e. Is the Relative Shift between 1 and 3? Yes☐ No☒

- If "Yes", then continue to Step 8f.
- If "No", then adjust the LBGR as necessary to achieve a relative shift between 1 and 3. In order to accomplish this, the LBGR may be set as low as the MDC for the analytical technique.

Adjusted LBGR = 0.56

Adjusted Relative Shift = 3.00

f. Determine the Number of Samples (N/2) required corresponding to the Type I error, Type II Error and the Relative Shift from Appendix F of HDP-PR-FSS-701 or calculate using equation 5-1 from MARSSIM.
No. of Samples (N/2) = 8

9. Determine the Scan MDC for Total Uranium

- When U-235 is reported as negative or zero and U-238 is reported as positive, set the sample enrichment to 0.71% (natural uranium).
- When U-235 is reported as positive and U-238 is reported as negative or zero, set the sample enrichment to 100% (highly enriched).
- When both U-235 and U-238 data are reported as positive, determine the U-238/U-235 ratio for each sample and use Appendix G of HDP-PR-FSS-701, to determine the uranium enrichment that corresponds to the mean U-238:U-235 ratio.

a. Record the average Uranium enrichment for the survey unit using the enrichment determined for each individual sample.

Average Enrichment (%) = 2.8

Note: The Activity Fractions (f) for each radionuclide corresponding to the mean enrichment used in the following calculations is obtained from Appendix G of HDP-PR-FSS-701.
If the Uniform DCGL is not used, and the excavation extends into multiple CSMs (e.g. surface, root & deep), then the most conservative DCGLs should be used in the following calculation.

b. Determine a $DCGL_w$ for Total Uranium using the equation from Step 8.2.6b of HDP-PR-FSS-701.

$DCGL_{wTotU}$ for Total Uranium = 83.1 pCi/g

c. Identify the Radiological Instrument that will be used for scanning.

☒ 2"x 2" NaI Detector ☐ FIDLER NaI Detector ☐ Other_____

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FINAL STATUS SURVEY SAMPLING PLAN DEVELOPMENT CHECKLIST FOR SOIL SURVEY UNITS

d. Determine the Scan MDC for the selected instrument using the equation in Step 8.2.6d of HDP-PR-FSS-701 or the calculations presented in the Open Land Area Gamma Scan MDCs section in Chapter 14 of the DP.

MDC_{scan} for Total Uranium = 84.1 pCi/g

10. Determine the Scan MDC for Th-232 and Ra-226

a. Select the appropriate $DCGL_w$ for Th-232 and Ra-226 corresponding to the soil strata that will be exposed at the time of FSS and the SEA where the survey unit is located.

Th-232 $DCGL_w$ = 2.0 pCi/g Ra-226 $DCGL_w$ = 1.9 pCi/g

Note: If the Uniform DCGL is not used, and the excavation extends into multiple CSMs (e.g. surface, root & deep), then the most conservative DCGL for the strata should be used. With RSO concurrence, the alternate approach as presented in DP Ch. 14, Section 14.4.3.1.10 may be used in lieu of using the most conservative.

b. Determine the Scan MDC for the selected instrument

Note: Table 6.4 of NUREG-1507 has calculated an MDC_{scan} of 1.8 pCi/g for Th-232 and 2.8 pCi/g for Ra-226 when using a 2"x 2" NaI detector.

Note: If the selected instrument is not a 2"x 2" NaI detector, then the MDC_{scan} can be determined in accordance with the Open Land Area Gamma Scan MDCs section in DP Ch. 14.

MDC_{scan} for Th-232 = 1.8 pCi/g MDC_{scan} for Ra-226 = 2.8 pCi/g

Note: If a value is not applicable, mark as N/A.

11. Adjust the Statistical Sample Population Size (N/2) for Scan MDC

a. If the survey unit is either Class 2 or 3, then proceed to Step 12. If the survey unit is Class 1, then proceed to the next step.

b. Divide the total area of the survey unit by the Number of Samples (N/2) determined in Step 8f to determine the area bounded by the statistical sample population.

Area Bounded by the Statistical Sample Population (A_{SU}) = 198.8 m^2

URANIUM

c. Is the Scan MDC for the selected instrument less than the $DCGL_w$ that was determined for Total Uranium? (compare values from Step 9b and 9d) Yes☐ No☒

(If "Yes", then proceed to Step 11k, if "No", then proceed to the next step).

d. Using the Area Factors in Appendix H of HDP-PR-FSS-701 and using the equation from Step 8.2.8d of HDP-PR-FSS-701, determine a Total Uranium AF for each listed area using the Activity Fractions (*f*) for each radionuclide that corresponds to the mean enrichment from Appendix G of HDP-PR-FSS-701.

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FINAL STATUS SURVEY SAMPLING PLAN DEVELOPMENT CHECKLIST FOR SOIL SURVEY UNITS

Area (m^2)	153375	10000	3000	1000	300	100	30	10	3	1
AF_{TotalU}	2.0	2.4	2.6	2.6	6.4	11.1	17.3	26.1	53.7	110.8

Note: The AFs for the Uniform Stratum will generally be used. The RSO may approve use of AFs from the Surface, Root or Deep CSMs, or the Excavation Scenario.

e. Find the Area Factor (AF_{TotalU}) determined in the previous step that corresponds to the area bounded by the statistical sample population (A_{SU}).

AF_{TotU} for the Bounded Area (A_{SU}) = 6.4

f. Multiply the $DCGL_w$ determined for Total Uranium by the Area Factor (AF_{TotU}) to derive a $DCGL_{EMC}$ for Total Uranium.

$DCGL_{EMC}$ for Total Uranium = 530.8 pCi/g

g. Is the MDC_{scan} for the selected instrument less than the $DCGL_{EMC}$ that was determined for Total Uranium? NA☐ Yes☒ No☐

(If "Yes", then proceed to Step 11k, if "No", then proceed to the next step.)

h. Determine a new AF (AF_{EMC}) corresponding to the MDC_{scan} for the selected instrument by dividing the MDC_{scan} by the DCGLw.

AF_{EMC} for U_{total} = NA

i. Find the Area (A') that corresponds to the Area Factor (AF_{EMC}).

A' for U_{total} = NA

j. Determine an Adjusted Number of Samples (N_{EMC}) for the statistical sample population size that corresponds to the bounded A_{EMC} using the equation from Step 8.2.8j of HDP-PR-FSS-701.

N_{EMC} corresponding to A' for U_{total} = NA

RADIUM-226

k. Is the MDC_{Scan} for Ra-226 less than the $DCGL_W$? Yes☐ No☒
(If "Yes" then proceed to Step 12, if "No", then proceed to the next step).

l. Find the Area Factor (AF) in Appendix H of HDP-PR-FSS-701 that corresponds to the area bounded by the statistical sample population (A_{SU}).

AF_{Ra-226} for the Bounded Area (A_{SU}) = 2.5

APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN DEVELOPMENT CHECKLIST FOR SOIL SURVEY UNITS

m. Multiply the $DCGL_w$ for Ra-226 by the Area Factor (AF_{Ra-226}) to derive a $DCGL_{EMC}$ for Ra-226.

$DCGL_{EMC}$ for Ra-226 = 4.75

n. Is the MDC_{scan} for Ra-226 less than the $DCGL_{EMC}$ that was determined for Ra-226?

NA☐ Yes☒ No☐

(If "Yes" then proceed to Step 12, if "No", then proceed to the next step).

o. Determine a new AF (AF_{EMC}) corresponding to the MDC_{scan} for the selected instrument by dividing the MDC_{scan} by the $DCGL_w$.

AF_{EMC} for Ra-226 = NA

p. Find the Area (A') that corresponds to the Area Factor (AF_{EMC}).

A' for Ra-226 = NA

q. Determine an Adjusted Number of Samples (N_{EMC}) for the statistical sample population size that corresponds to the bounded A_{EMC} using the equation from Step 8.2.8q of HDP-PR-FSS-701.

N_{EMC} corresponding to A' for Ra-226 = NA

12. Determine the Grid Spacing

a. Larger of N/2 from Step 8f and the maximum value of N_{EMC} from 11j, or 11q.

(N_{EMC}[max] or N/2) = 8

b. Is the Survey Unit a Class 3 Survey Unit? Yes☐ No☒

(If "Yes", then continue to Step 13, if "No", then proceed to the next step).

c. Determine Grid Spacing (L) using the equation from Step 8.2.9 of HDP-PR-FSS-701.

Grid Spacing (L) for Survey Unit = 15.1 m

13. Generate a Survey Map

a. Assign a unique identification number to each sample in the statistical sample population using the guidance and direction provided in Appendix M of HDP-PR-FSS-701.

b. Generate a graphic representation of the Survey Unit with dimensions and boundaries corresponding to the established reference coordinate system in accordance with Step 8.2.10 of HDP-PR-FSS-701.

c. Using the reference coordinate system, ascertain coordinates for each sample location.

d. Designate sample locations, and location coordinates on Appendix P-4, *FSS Sample & Measurement Locations & Coordinates* and attach a copy of that form to the FSSP.

e. Attach a copy of the developed Survey Map with sample locations to the FSSP.

APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN DEVELOPMENT CHECKLIST FOR SOIL SURVEY UNITS

14. QC & Biased Samples

a. Randomly choose 5% of the statistical sample population as QC samples in accordance with HDP-PR-FSS-703, *Final Status Survey Quality Control.*

b. Designate QC sample locations, and location coordinates on attached Appendix P-4, *FSS Sample & Measurement Locations & Coordinates.*

c. Designate if any biased samples will be taken at the discretion of the HP Staff designing the survey and the basis for taking them. Necessary biased samples will be explained on Appendix P-3, *FSS Sampling Plan.*

d. Using the reference coordinate system, determine coordinates for each biased sample location.

e. Designate biased sample locations, and location coordinates on attached Appendix P-4, *FSS Sample & Measurement Locations & Coordinates.*

15. Scan Coverage

a. The Survey Unit is: ☒ Class 1 ☐ Class 2 ☐ Class 3

b. Based on the Survey Unit Classification, the scan coverage in this Survey Unit is;

☒ 100% Scan Coverage of exposed soil ☐ _____% Scan Coverage of exposed soil

c. Designate any specific scan locations as determined necessary, on Appendix P-3, *FSS Sampling Plan.*

16. Investigation Levels

a. The Survey Unit is: ☐ Class 3

1) Scan Investigation Levels are set at: NA cpm

Sample Investigation Levels are set at 50% of the $DCGL_w$ when expressed as the SOF.

b. The Survey Unit is: ☐ Class 2

2) Scan Investigation Levels are set at: NA cpm

Sample Investigation Levels are set at the $DCGL_w$ when expressed as the SOF.

c. The Survey Unit is: ☒ Class 1

3) Scan Investigation Levels are set at: 4,000 net cpm

Sample Investigation Levels are set at the $DCGL_w$ when expressed as the SOF.

APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN DEVELOPMENT CHECKLIST FOR SOIL SURVEY UNITS

17. Attachments

Attach a copy of completed forms as appropriate:

- ☒ Appendix P-3, *FSS Survey Sampling Plan,*
- ☒ Appendix P-4, *FSS Sample & Measurement Locations & Coordinates*
- ☐ Appendix P-5, *FSS Unit Classification Change Form*
- ☒ Appendix P-6, *FSS Field Log*
- ☒ Survey Unit Figure
- ☐ Other:

18. FSSP Development Checklist Approval

	(Print Name)	(Signature)	(Date)
Prepared by:	Brian A. Miller	Brian A. Miller	1/15/2015
Peer Reviewed by:	Ellen C. Jakub	Ellen C. Jakub	1-15-15
Approved by (RSO):	W. Clark Evers	W. Clark Evers	1/15/15

APPENDIX P-3
FSS PLAN

Survey Area: LSA-10 **Description:** Burial Pits Open Land Area
Survey Unit: 03 **Description:** West Central Survey Unit (North Burial Pit Area)

Overview: The Survey Unit (SU) identified as LSA10-03 has been prepared for Final Status Survey (FSS) by the Hematite Decommissioning Project (HDP). This appendix (FSS Plan, Appendix P-3) provides an overview of the proposed FSS implementation as well as general and specific instructions for the HP Technicians responsible for performing the FSS.

- **Data Quality Objectives**

1. Personnel performing FSS duties meet the qualifications listed in HDP-PR-HP-102 *Health Physics Technician Training* and have received training and instruction commensurate with their duties. The RSO has approved all FSS personnel to perform work associated with their individual roles and responsibilities. Training records are documented in accordance with HDP-PR-GM-020 *Training Material Development and Documentation of Training*.
2. All HDP FSS procedures ("700 series") have been reviewed, revised, and validated in order to ensure performance of actual FSS work activities reflect the requirements detailed in the individual FSS Procedures and the HDP Decommissioning Plan.
3. All FSS instrumentation has undergone a receipt inspection by HDP QA personnel, is within current calibration, and is determined to be functioning within acceptable ranges based on initial set-up and daily source checks in accordance with HDP-PR-HP-411 *Radiological Instrumentation*.

- **Location**

LSA10-03 is designated **Class 1** and is located in the northern half of the Burial Pit Surrogate Evaluation Area (SEA). The two-dimensional areal extent of LSA 10-03 is 1,590 m^2 upon which the systematic sampling grid is based. The interior surface area (three-dimensional) of LSA-10-03 is 1944.54 m^2.

HDP Satellite Site View: "Area 1" in Red Outline; LSA10-03 in Red Crosshatching

- **Background**

Remedial actions began in LSA 10-03 in April 2012 and continued through December 2014. This SU along with LSA10-01, 10-02, 10-04, and 10-12 are collectively known as "Area 1" for the purposes of remediation planning and work sequencing. Area 1 contained various types of waste materials, including drums, bags of trash, a tank, filter press plates, fuel pellets, construction debris, spent limestone, and contaminated soils. LSA 10-03 did not contain any groundwater monitoring wells.

The average depth of excavation in this SU relative to the final backfill grade is 7.6 feet below ground surface (bgs) which corresponds to an approximate in-situ quantity of removed materials of 4,800 cubic yards. Portions of this SU were excavated to a depth beyond 7.6 feet to ensure all areas identified durring site characterization efforts were aqequately remediated.

APPENDIX P-3
FSS PLAN

LSA 10-03 was subject to final Remedial Action Support Surveys (RASS) during the month prior to Isolation and Control posting finalization on December 12, 2014. RASS included 100% gamma walkover survey (GWS), systematic (8-point grid), and biased sampling. Prior to completion of RASS, borings were performed to ensure there was no waste material indicative of a burial pit present. These borings were conducted for the purpose of downgrading from nuclear criticality safety controls and to provide additional radiological information to determine if the area was ready for Final Status Survey. These borings were performed to a minimum depth of 3 feet below the excavation surface on a grid with maximum spacing of 20 feet between boreholes. Radiological surveys were performed on the soil spoils, and within the borehole when conditions permitted (i.e., were not filled with water). The radiological surveys were performed by Health Physics Technicians and consisted of dual independent scans of both the soil spoils and within the borehole. The highest readings obtained within Area 1 which contains LSA10-03 were 9,000 net counts per minute (ncpm) on the spoils material and 12,000 ncpm within the borehole. No material indicative of a burial pit was encountered.

- **Criteria**

All FSS analytical results for samples collected within LSA10-03 will be evaluated against the ***Uniform*** DCGLs.

Radium-226*	Technetium-99	Thorium-232*	Uranium-234	Uranium-235	Uranium-238
1.9 pCi/g	25.1 pCi/g	2.0 pCi/g	195.4 pCi/g	51.6 pCi/g	168.8 pCi/g

*Background values are subtracted from gross results; radium-226 background without ingrowth 0.9 pCi/g; thorium-232 = 1.0 pCi/g

- **Implementation**

As a Class 1 SU, LSA10-03 will undergo a 100% gamma walkover survey (GWS) using a 2" x 2" sodium iodide (NaI) detector. If there are any remaining interior sidewalls, they will be scanned by holding the probe perpendicular as closely as possible to the sidewall moving the probe up and down the sidewall face while advancing. HP Technicians should slow the scan if elevated (> investigation action level) readings are found, focus the survey around the elevated wall area, and flag or mark if GWS measurements warrant a possible biased sample.

Based on a statistical evaluation of the RASS dataset, an eight (8) point systematic grid was developed for SU LSA10-03. No surface stratum remains in the SU; at one (1) of the eight systematic locations, composite root strata samples will be collected prior to the six inch excavation sample.

Biased samples may be collected after a statistical review (e.g. greater than 3σ above mean) of the entire GWS dataset based upon the professional judgment of the FSS Supervisor.

A minimum of one QC duplicate per SU (or 5% of the total number of samples) will be collected.

APPENDIX P-3
FSS PLAN

FSS IMPLEMENTATION SUMMARY TABLE

Gamma Walkover Survey (GWS):		
Scan Coverage	100% accessible excavation floors, benches, pits, and sidewalls	
Scan MDC	84.1 pCi/g total Uranium (based on a 10,000 cpm background)	
Investigation Action Level (IAL)	4,000 net cpm	
Systematic Sampling Locations:		
Depth	Number of Samples	Comments
0 – 15 cm (Surface)	0	These samples will be taken on a systematic grid.
15 cm – 1.5 m (Root)	1	
> 1.5m (Excavation)	8	
Biased Survey/Sampling Locations:		
Biased samples may be collected during GWS at the discretion of the HP Technician, after statistical analysis of the survey data, or at the direction of the FSS Supervisor.		
Instrumentation		
Ludlum 2221 with 44-10 (2" x 2" NaI) detector; with collimation for investigations.	Used for GWS and to obtain static count rates at biased measurement locations.	

APPENDIX P-3
FSS PLAN

General Instructions:

1. Summarize daily work activities on the log sheets provided in Appendix P-6 (FSS Field Log). Provide a description of site conditions (including the condition of isolation controls), samples collected and the status of gamma walkover surveys for every shift that involves work in this survey unit. In the event that a situation arises where the survey instructions cannot be followed as written, stop work and contact the FSS Supervisor for resolution. All changes to the survey instructions shall be approved by the RSO before continuing work and be documented in the FSS Field Log.

2. In accordance with HDP-PR-FSS-701, *Final Status Survey Plan Development (Step 8.4.2),* documentation of activities performed, equipment used, and potential safety hazards that may be encountered during the performance of characterization activities (along with associated controls) will be documented using the Daily Task Briefing form for the FSS field activities.

3. A gamma walkover survey (GWS) will be performed using a 2" x 2" NaI detector. Move the survey probe in a serpentine pattern approximately 6-inches off-set from centerline to the body (e.g., "shoulder-to-shoulder") with the probe as close to the surface as possible; maintaining the detector as close as possible to the surface (not to exceed 3-in. distance from the surface). The meter will be moved at a speed of approximately 0.5 meter (or 1.5 feet) per second or less. The gamma walkover survey will cover the percentage of the accessible surface areas within the area of interest as indicated in the table above. Notify the FSS Supervisor of any areas, conditions or constraints where surveying (or subsequent sampling) may not be possible (e.g. areas covered by standing water, or excessively muddy conditions). Document the conditions and any resolutions in the FSS Field Log.

4. A GPS system and data logger should be interfaced with the meter. The downloaded information will then be used to prepare maps illustrating relative count rates and to perform statistical analysis of the data. If a GPS data logging system is not available, contact the FSS Supervisor to determine specific instructions for performing and documenting gamma walkover surveys.

5. LSA 10-03 is a Class 1 Survey Unit. Each sample location will be selected systematically and have associated GPS coordinates specified. In the case of inaccessible sampling locations, additional sample coordinates may be generated with the FSS Supervisor's and RSO's approval in order to identify an acceptable sampling location.

6. A map of the survey unit showing predetermined sample locations with associated GPS coordinates will be generated. A copy of the sample map and survey locations will be attached to this Survey Plan.

7. Verify that isolation controls established in accordance with HDP-PR-HP-602 are in place prior to the start of FSS. Ensure isolation controls include, as necessary, the use of straw wattles, a berm, or trenching to minimize the potential for contaminated soils and water from surrounding areas to cross the boundary of this unit.

8. Perform daily pre and post QC source checks in accordance with HDP-PR-HP-416.

9. Soil samples will be collected from each location and depth as determined after the completion of excavation and are provided in Appendix P-4, FSS Sample & Measurement Locations & Coordinates. The systematic sample locations will include zero (0) grab samples taken at a depth of 0 – 15 cm bgs (surface), one (1) composite samples collected within the root stratum (up to 1.5 meters bgs), and 8 (eight) grab samples collected at a depth of 1.5 m to 1.65 m bgs (excavation).

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10. Biased soil sampling locations may be determined at the discretion of the HP Technician during the performance of the GWS. Biased soil sampling locations may also be determined at the discretion of the FSS Supervisor based on statistical analysis of the survey/sampling data or process/historical knowledge of the area. Biased soil samples will be collected in a manner similar to systematic soil sampling locations. The HP Technician will log the reason for collection of biased samples in the Field Log sheet and record the location of biased samples on Appendix P-4 associated with this Survey Plan.

    NOTE: If trash, waste, or other non-native materials are observed during sample collection, stop sampling activities and notify HP Supervision (or Radiological Engineering) before collecting samples at any sample location in the unit.

11. All samples collected as part of this survey will be analyzed at an off-site laboratory by gamma spectroscopy for radium, thorium, and uranium, and inductively coupled plasma-mass spectrometry (ICP-MS) for Tc-99.

Specific Instructions:

NOTE: Unless otherwise indicated, the performance of these specific instructions is the responsibility of the HP Technician.

Before Beginning Work

1. **FSS Supervisor/HP Technician:** Verify before each shift that isolation controls established in accordance with HDP-PR-HP-602, are in place prior to the start of FSS using the Daily Task Briefing form.
2. **FSS Supervisor/HP Technician:** Prior to gamma walkover survey in the area to be surveyed, walk the area looking specifically for any debris material (e.g. asphalt, plastic, concrete, etc.) that may indicate further remediation efforts are necessary.
3. **FSS Supervisor:** Perform a daily task-specific briefing; documenting the attendants, planned work activities, anticipated hazards, and controls on the Daily Task Briefing form.

    NOTE: If soil sampling to a depth greater than one foot is required, ensure HDP Safety & Health is aware of the activity, an Excavation Permit (Form HDP-PR-EHS-021-1) has been prepared for the work area, and underground utilities have been identified and marked.

Gamma Walkover Surveys (GWS)

1. Establish a general area background, in accordance with HDP-PR-FSS-711.
2. Perform a gamma walkover of the survey unit holding the probe as close to the surface as possible, in accordance with HDP-PR-FSS-711.
    a. Look and/or listen for locations that exhibit anomalous readings (e.g., count rates in excess of the area background count rate and/or count rates that exceed the investigation action level (IAL) for this unit). The IAL for this SU is 4,000 net counts per minute (ncpm) as determined by the RSO.
    b. Mark the location(s) exhibiting anomalous readings to facilitate possible future investigations (e.g., use a flag, stake, or other marking resistant to anticipated environmental conditions).
3. At each location where anomalous readings occur, perform a more detailed survey of the area using a collimated detector. Pause and place the survey probe as close as possible to the surface to define and record the total count rate associated with the area of interest on the Field Log.

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NOTE: If field conditions limit the ability to perform contact readings, collect readings as close as practical and log the issue (and resolution) for each location in the FSS Field Log and notify the FSS Supervisor.

4. **GPS (and associated data logger) is the preferred method for collecting GWS data.**
   When a GPS and data logger is used, down load and provide the survey data to a GIS Specialist.

   a. **GIS Specialist**: Provide colorimetric maps indicating survey coverage and measurements exceeding the IAL and send the survey data to the FSS Supervisor.

   b. **FSS Supervisor**: Provide statistical analysis to determine population characteristics of the survey dataset and identify any areas requiring additional surveys or sampling. Contact the HP Technician to mark additional locations requiring survey or bias sampling (see below Step 5 of the Soil Sampling section).

   If a GPS and data logger cannot be used to collect GWS data in any portion of this survey unit, the HP Technician will contact the FSS Supervisor who will then notify the RSO to determine compensatory survey methods. The FSS Supervisor will log the compensatory methods in the FSS Survey Log.

   Download the survey data at the end of each shift. To minimize data loss, periodically save the GWS dataset throughout the shift.

Soil Sampling

1. Collect soil samples in accordance with HDP-PR-FSS-711 at locations identified in Appendix P-4. Note that additional biased sampling locations may also be listed as determined by the GWS or as determined by the FSS Supervisor.
2. Collect one QC duplicate sample for every 20 samples. A minimum of one QC duplicate sample is required for each survey unit.
3. Care should be exercised to ensure the entire sample is included from within the depths specified for sampling. When collecting the composite samples, vegetation and native debris/rocks with a diameter greater than 1 inch should be discarded.

   NOTE: If a discrete source of radiation (e.g., a fuel pellet) is discovered during the performance of sampling activities, contact the FSS Supervisor who will then notify the RSO for subsequent material management. Pause any additional characterization work in the immediate area and use a plastic bag to contain the material.
4. Monitor the count rates observed at all accessible surfaces within close proximity (e.g., 1 meter diameter) of each biased sampling location, using a collimated detector. Note any accessibility issues and discuss compensatory measures with supervision.

   a. Inform the FSS Supervisor of the results obtained from monitoring the locations of biased sampling to receive instructions for further investigation or the need for additional excavation.
5. Collect bias samples from the excavation surface to a depth of 6 inches or as directed by FSS Supervisor.
6. Monitor the count rates within the depression created by the collection of biased soil samples.
7. Obtain and record the count rate on contact with features other than soil within the excavation. (e.g., native rock). Record the nature and extent of features other than soil found within the excavation in the FSS Survey Log and contact the FSS Supervisor to determine additional characterization methods, if necessary.

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8. Submit samples for analysis to TestAmerica following sample chain of custody requirements contained in HDP-PR-QA-006.

Prepared by:	Brian A. Miller (Print Name)	(Signature)	1/15/2015 (Date)
Peer Reviewed by:	Ellen C. Jakub (Print Name)	(Signature)	1-15-15 (Date)
Approved by (RSO):	W. Clark Evers (Print Name)	(Signature)	1/15/15 (Date)

APPENDIX P-4
FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES

Survey Area: LSA-10 **Description:** Burial Pits Open Land Area
Survey Unit: 03 **Description:** West Central Survey Unit (North Burial Pit)
Survey Type: FSS **Classification:** Class 1

Measurement or Sample ID	Surface or CSM	Type	Start Elevation	End Elevation	Northing (Y Axis) *	Easting (X Axis) *	Remarks / Notes
L10-03-01-B-E-S-00	Uniform	S	425.7	425.2	865253.0	827323.7	Excavation 6-inch grab
L10-03-02-B-E-S-00	Uniform	S	423.4	422.9	865253.0	827373.2	Excavation 6-inch grab
L10-03-03-B-E-S-00	Uniform	S	426.1	425.6	865210.0	827298.9	Excavation 6-inch grab
L10-03-04-B-E-S-00	Uniform	S	423.7	423.2	865210.0	827348.5	Excavation 6-inch grab
L10-03-05-B-E-S-00	Uniform	S	424.6	424.1	865210.0	827398.0	Excavation 6-inch grab
L10-03-06-B-E-S-00	Uniform	S	427.9	427.4	865167.0	827323.7	Excavation 6-inch grab
L10-03-07-B-E-S-00	Uniform	S	426.8	426.3	865167.0	827373.2	Excavation 6-inch grab
L10-03-08-B-R-S-00	Uniform	S	431.3	429.8	865124.0	827348.5	Root 1.5-foot composite
L10-03-09-B-E-S-00	Uniform	S	429.8	429.3	865124.0	827348.5	Excavation 6-inch grab
L10-03-07-B-E-Q-00	Uniform	Q	426.8	426.3	865167.0	827373.2	Excavation 6-inch grab
L10-03-10-B-E-B-00	Uniform	B	TBD	TBD	TBD	TBD	Bias sample may be taken after evaluation of GWS data (e.g., data ≥ 3σ over the mean of the walkover data).

* Distance in feet from southwest corner of the surface
Surface: Floor = F; Wall = W; Ceiling = C; Roof = R
CSM: Three-Layer (Surface-Root-Deep) or Uniform
Type: Systematic = S, Biased = B; QC =Q; Investigation =

APPENDIX P-6
FSS FIELD LOG

Survey Area: LSA-10 **Description:** Burial Pit Open Land Area

Survey Unit: 03 **Description:** West Central Survey Unit (North Burial Pit Area)

FSS Field Log:

Date/Time:	Observation or Comment:	Technician

LSA-10-03 Systematic Sample Locations

L10-03-01-B-E-S-00 L10-03-02-B-E-S-00

LSA-10-03
1590 Planar m^2

L10-03-03-B-E-S-00 L10-03-04-B-E-S-00 L10-03-05-B-E-S-00

L10-03-06-B-E-S-00 L10-03-07-B-E-S-00
L10-03-07-B-E-Q-00

L10-03-08-B-R-S-00
L10-03-09-B-E-S-00

0 10 20 40 60 80 Feet

N

Sample ID	Start Depth (inches)	End Depth (inches)	Northing	Easting
L10-03-01-B-E-S-00	0	6	865253.0	827323.7
L10-03-02-B-E-S-00	0	6	865253.0	827373.2
L10-03-03-B-E-S-00	0	6	865210.0	827298.9
L10-03-04-B-E-S-00	0	6	865210.0	827348.5
L10-03-05-B-E-S-00	0	6	865210.0	827398.0
L10-03-06-B-E-S-00	0	6	865167.0	827323.7
L10-03-07-B-E-S-00	0	6	865167.0	827373.2
L10-03-08-B-R-S-00	0	17	865124.0	827348.5
L10-03-09-B-E-S-00	17	23	865124.0	827348.5
L10-03-07-B-E-Q-00	0	6	865167.0	827373.2