11	Proc	edure: HDP-PR-FS	SS-701, Final Status Sur	vey Plan Develop	ment	-
Hematite Decommission Project	ing				Revision: 10	Appendix P- Page 1 of 8
Survey Area:	LSA 08	Description:	APPENDIX P-3 FSS PLAN Southeast Open Land Class 2 "Area 6": (B	Area (Plant Soils	s Area)	
Overview:	The Surv the Hem FSS imp performi	vey Unit (SU) ider atite Decommissio lementation as we ng the FSS.	ntified as LSA 08-15 ha ning Project (HDP). Th ell as general and specif	s been prepared fo is appendix provid ic instructions for	or Final Status S des an overview the technicians	Survey (FSS) b of the propose responsible fo
	Data Quality Objectives					
	1. Perso Phys dutie indiv PR-C	onnel performing ics Technician Tra s. The RSO has idual roles and res GM-020, Training	FSS duties meet the <i>a</i> <i>uning</i> and have received s approved all FSS per sponsibilities. Training <i>Material Development a</i>	ualifications liste training and instr resonnel to perfor records are docum nd Documentation	ed in HDP-PR- ruction commen rm work assoc nented in accord a of Training.	HP-102, <i>Heal</i> surate with the iated with the ance with HD
	 All HDP FSS procedures ("700 series") have been reviewed, revised, and validated in order ensure performance of actual FSS work activities reflect the requirements detailed in individual FSS Procedures and the HDP Decommissioning Plan. 				lated in order detailed in tl	
	3. All I curre set-u <i>Instr</i> (e.g. instru	ESS instrumentation and calibration, and p and daily so <i>umentation</i> . Prior operating tempe umentation.	on has undergone a rec is determined to be fur ource checks in acc to field use, HP techn erature range, no star	eipt inspection by ctioning within ac ordance with H cians will confirm ding water) are	HDP QA pers cceptable ranges IDP-PR-HP-411 n that environm acceptable fo	onnel, is with based on initi , <i>Radiologic</i> ental condition or use of FS
	• Loca	tion				
	LSA 08- the Sout Building within th (SEA); t used onli inferred surrogate calculation analysis status su 235 DCC complian criteria. 08-15 is sampling	15 is designated C heast Open Land 230 concrete pac ne Plant Soil Surr herefore the Plant y for Scan MDC Tc-99 DCGL for U-2 on of Scan MD for Tc-99 will be rvey samples and a GL values will not nee with the fina The two-dimensio s 1,854 m ² upon g grid is based.	Class 2 and is located in Area and includes the d. This SU is located rogate Evaluation Area Soil SEA DCGLs were calculations where the J-235 is 2.5 pCi/g. The 235 was used for the DC only. Laboratory performed on all final as such, the adjusted U- be used to demonstrate and areal extent of LSA which the systematic The LSA is un-excavat	Hematite De HDP Satellite LSA 08 ed and therefore f	Commissio Site View: Area 6 I-15 in Red Crossh the interior surf	N N N N ning Proje in Red Outline atching

n Development	
Revision: 10	Appendix P-3 Page 2 of 8
1	Development Revision: 10

Background

No remedial actions were performed in LSA 08-15.

LSA 08-15was subject to final Remedial Action Support Surveys (RASS) during the month prior to Isolation and Control (I & C) finalization in May, 2016. RASS included gamma walkover survey (GWS).

The current LSA 08-15 land area was not subject to NCS controls. As such, no NCS borings were performed to release the area.

No hybrid wells were within LSA 08-15.

Criteria

All FSS analytical results for samples collected within LSA 08-15 will be evaluated against the Uniform Stratum DCGLs. FSS sampling is implemented using the Three-Layer CSM, however analytical results will be conservatively evaluated using the Uniform Stratum DCGLs. Three-Layer CSM DCGLs may be utilized for FSS data evaluation if necessary.

	Three - Lay	Uniform		
Radionuclide	Surface Stratum	Root Stratum	Excavation Stratum	Stratum (pCi/g)
Radium-226+C ^d	N/A	N/A	N/A	195.4
Technetium-99	NA	N/A	NA	51.6
Thorium-232+C ^d	N/A	N/A	N/A	168.8
Uranium-234	N/A	N/A	N/Λ	25.1
Uranium-235+D ^c	N/A	N/A	N/A	2.0
Uranium-238+D ^c	N/A	N/A	N/A	1.9

^a Table adapted from HDP FSS Procedure HDP-PR-FSS-701 *Final Status Survey Plan Development*, Revision 9, October 2015. ^b The reported DCGL_ws are the activities for the parent radionuclide as specified and were calculated to account for the dose contribution

from insignificant radionuclides.

^c+D indicates the DCGL_w includes short-lived (half-life ≤ 6 mo.) decay products.

^d+C indicates the DCGL_w includes all radionuclides in the associated decay chain.

• Implementation

As a Class 2 SU, LSA 08-15 will undergo a 10 - 100% gamma walkover survey (GWS) using an uncollimated 2" x 2" sodium iodide (NaI) detector. GWS within the SU should be preferentially targeted toward sections of the SU not covered with concrete.

Based on a statistical evaluation of the RASS dataset, a minimum sample size of eight (8) FSS locations was required, and a 8-point systematic sampling grid was designed. A total of eight (8) surface stratum samples, eight (8) root stratum composite samples, and eight (8) excavation stratum grab samples will be collected.

<u>Consideration of residual Tc-99 "hot spots"</u>: Previous characterization data collected prior to remediation indicated no samples exceeding the Uniform Stratum DCGL for Tc-99 in LSA 08-15, with highest results of 8.0 pCi/g originating from depths of 4.5 feet bgs at location NB-133-4.5-SL. Since this concentration is well below the Tc-99 Uniform DCGL, there is little potential for areas of residual Tc-99 activity exceeding the DCGL, and the eight (8)-point systematic sampling pattern is appropriate.

Supplemental Sidewall Sampling: Supplemental sidewall sampling is not applicable since this is a Quality Record

LSA 08-15, 05/19/20	016		
Hematite Decommissioning Project	Procedure: HDP-PR-FSS-701, Final Status Survey Plan Develop	ment Revision: 10	Appendix P-3 Page 3 of 8

Class 2 SU and no remedial excavation was required.

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 RSO or Radiological Engineering.

A minimum of one QC duplicate per SU (or 5% of the total number of samples) will be collected. Since the total number of samples is expected to exceed 20, two QC duplicate samples will be collected within LSA 08-15.

	Procedure: HDP-PR-FS	S-701, Final Statu	s Survey I	Plan Development		
Hemat Decommis Proje	ite sioning ct			Revision: 10	Appendix P Page 4 of 8	
	FSS	IMPLEMENTA	TION S	UMMARY TABLE		
	Gamma Walkover Survey (GWS):				
	Scan Coverage 10-100% exposed grounds					
	Scan MDC	×	42.3 cpm pCi/	2.3 pCi/g total Uranium (based on a 8,0 pm background); 0.77 pCi/g Th-232; 1.4 pCi/g Ra-226*		
	Investigation Action Level (IA	Investigation Action Level (IAL) 1, 624 net cpm**		24 net cpm**		
	Systematic Sampling Locations:					
	Depth	Number of	Samples	Comments		
	$\frac{0-15 \text{ cm (Surface)}}{15}$	8		These samples will be taken on a systematic grid. *** Excavation stratum samples will be collected a archived, but will be analyzed only the event the overlying root stratum sample exceeds a SOF of 0.5		
	> 1.5 m (Excavation)	8**	k			
	Biased Survey/Sampling Lo	cations:				
	Biased samples may be coll statistical analysis of the surve	ected during GW ey data, or at the d	S at the or irection of	discretion of the HP Techn f the RSO or Radiological En	ician, after gineering.	
	Sidewall Sampling Location	IS:				
	Supplemental Sidewall Samp	ling: Not applicabl	e; SU is a	Class 2 (no excavation) area		
	Instrumentation:					
	Ludlum 2221 with 44-10 (2x2	2 NaI) detector	Used for at biase	or GWS and to obtain static ed measurement locations.	count rates	
	 at biased measurement locations. *Values based on information provided in HDP-TBD-FSS-002, "Evaluation and Documentation of the Scanning Minimum Detectable Concentrations (MDC) for Final Status Surveys (FSS). The Scan MDC for total Uranium reflects a conservative assumption of 4% enrichment. The actual RASS enrichment (1.9%) would result in Scan MDC values slightly less than those calculated for FSS planning purposes. **IAL is the net count per minute (ncpm) equivalent to the Uniform Stratum DCGLw (the appropriate criterion for Class 2 and Class 3 LSAs) based on 4% enriched uranium and using the lafer To 00 DCCL for U 225. 					

I	LSA 08-15, 05/19/20	016		
Γ		Procedure: HDP-PR-FSS-701, Final Status Survey Plan Develop	ment	
	Hematite Decommissioning Project		Revision: 10	Appendix P-3 Page 5 of 8

General Instructions:

- Summarize daily work activities on the log sheets provided in Appendix P-6. 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. Document the surveyor name and instrumentation used for each GWS event (i.e., data file) in Appendix P-6 for reporting traceability. In the event that a situation arises where the survey instructions cannot be followed as written, stop work and contact the RSO 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 (Sec. 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 FSS Daily Task Briefing log sheet.
- 3. 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 "wattles", a berm, or trenching to minimize the potential for contaminated soils and water from surrounding areas to cross the boundary of this unit.
- 4. Perform daily pre and post QC source checks in accordance with HDP-PR-HP-416.
- 5. A gamma walkover survey (GWS) will be performed using a 2"x2" NaI (Tl) 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 (nominally 1", but not to exceed 3-in. distance from the surface). The meter will be moved at a speed of approximately 0.3 meter (or 1.0 feet) per second or less. The gamma walkover survey will cover the percentage of the exposed surface areas within the area of interest as indicated in the table above. Notify the RSO of any areas, conditions or constraints where surveying (or subsequent sampling) may not be possible. Document the conditions and any resolutions in the FSS Field Log.
- 6. 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 RSO to determine specific instructions for performing and documenting gamma walkover surveys.
- 7. LSA 08-15 is a Class 2 Survey Unit. Each sample location was systematically distributed on a triangular grid pattern and has associated GPS coordinates specified. In the case of inaccessible sampling locations, additional sample coordinates may be generated with the RSO's approval in order to identify an acceptable sampling location.
- 8. 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 the survey instruction.
- 9. At each systematic soil sampling location, a composite soil sample will be collected from each location and depth as described in Appendix P-4. The systematic sample locations will include eight (8) samples taken at a depth of 0 15 cm (surface), eight (8) samples collected at a depth of 15 cm 1.5 m (root), and eight (8) samples collected at a depth of 1.5 m to 1.65 m (excavation). Excavation stratum samples will be collected and archived, but will be analyzed only in the event the overlying root stratum sample exceeds a SOF of 0.5.
- 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 RSO 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. Radiological Engineer and/or the HP

Quality Record

LSA 08-15, 05/19/2016

Procedure: HDP-PR-FSS-701, Final Status Survey Plan Development

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 of this survey instruction.

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. Supplemental Sidewall Sampling: Not applicable to this SU.
- 12. 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 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. **Rad. Engineer/HP Technician:** Verify, 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 log sheet.
- 2. **Rad. Engineering/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. **Rad. Engineer/HP Technician:** Perform a daily task-specific briefing; documenting the attendants, planned work activities, anticipated hazards, and controls on the FSS Daily Task Briefing log sheet.

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 performed 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. Use this background level in conjunction with the Investigation Action Level (IAL) of 1,677 net counts per minute as a field guide to pause and, if necessary, flag locations for possible biased sampling (see following Steps 2 and 3 below for details).
- 2. Perform a gamma walkover of the survey unit holding the probe as close to the surface as possible (nominally 1", but not to exceed 3"), in accordance with HDP-PR-FSS-711.
 - a. Look and/or listen for elevated count rates and then pause to determine locations that exhibit anomalous readings (e.g., count rates that exceed the IAL for this unit).
 - b. Mark the location(s) exhibiting anomalous readings to facilitate possible future investigations (for example, use a flag, stake, or other marking resistant to anticipated environmental conditions).
- 3. At each location where anomalous readings occur, perform a more detailed point survey of the area. 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.

NOTE: If field conditions limit the ability to perform contact readings, collect readings as close as practical. Contact the RSO (or Radiological Engineering) regarding the issue for each location. The FSS Technician, RSO, and/or Radiological Engineer will log the issue (and resolution) for each location in the FSS Field Log and on applicable HDP survey forms.

4. GPS (and associated data logger) is the preferred method for performing GWS. Quality Record

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Hematite Decommissioning Project		Revision: 10	Appendix P-3 Page 7 of 8

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 Radiological Engineering.
- b. **Radiological Engineering**: Provide statistical analysis to determine population characteristics of the survey data set and identify any areas requiring additional surveys or sampling. Contact FSS Technician to mark additional locations requiring survey or sampling.

If a GPS and data logger cannot be used to perform GWS in any portion of this survey unit, the FSS Technician will contact the RSO to determine compensatory survey methods. The compensatory methods will be logged in the FSS Survey Log.

Download the survey data at the end of each shift. To minimize data loss, periodically save the GWS data set to an external backup drive.

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 RSO.
- Collect a minimum of one duplicate sample for every 20 samples. Two duplicate samples are required for LSA 08-15
- 3. Collect and homogenize the entire volume from the specified depth interval prior to containerizing the sample. When collecting the composite samples, vegetation and native debris/rocks with a diameter greater than 1 inch should be discarded. Remove as much ballast as possible from samples.

NOTE: If a discrete source of radiation (e.g., a fuel pellet) is discovered during the performance of sampling activities, contact the RSO. Pause any additional characterization work in the immediate area and use a plastic bag to contain the material. Label the plastic bag per HDP-PR-HP-201, Section 8.2 "Labeling Radioactive Material" and transfer the material from the survey unit for controlled storage in the Building 230 Sample Cage via physical turnover to the shift Sample Custodian.

- 4. Monitor the count rates observed at all exposed surfaces within close proximity (e.g., 2 meter diameter) of each biased sampling location, as practical. Note any accessibility issues and discuss compensatory measures with supervision.
 - a. Inform Radiological Engineering 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 surface to a depth of 6 inches.
- 6. No supplemental sidewall samples are required in this SU
- 7. Monitor the count rates within the depression created by the collection of biased soil samples.
- 8. 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 RSO to determine additional characterization methods, if necessary.
- 9. Submit samples for analysis to TestAmerica following sample chain of custody requirements contained in HDP-PR-QA-006.

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Hematite Decommissioning Project		,	Revision: 10	Appendix P-3 Page 8 of 8
Prepared by:	Scott G. Zoller (Print Name)	Scot All	- 05-/10 (D	g /// ate)
Peer Reviewed by	y: Matthew E. Cushman (Print Name)	M4A (Signature)	(D	9/16 Pate)
Approved by (RSO):	W. Clark Evers (Print Name)	(Signature)	<u></u> (D	//////////////////////////////////////

Hematite	Procedu	ure: HDP-PR-FSS	-701, Final Sta	tus Survey Plan	Development			
Decommissionit Project	ng				Revision:	Appendix P-1 Page 1 of 9		
			APPENDIX I	P-1				
FINAI	L STATUS S	SURVEY SAMPI	LING PLAN	DEVELOPMEN	T CHECKLIST	FOR		
SOIL SURVEY UNITS								
Survey Area:	LSA 08	Description:	Open Land A	Area, Plant Soils	SEA			
Survey Unit:	15	Description:	Class 2 Sout	heast Open Land	Area in "Area 6"	,		
1. Verify Surv	vev Unit Iso	lation & Control						
Survey D posting Isolation	Unit properly the appropri <i>n</i> and Control	y isolated and/or of ate signage) as re of Measures to Sup	controlled (ind quired by HD port Final Sta	icated by outlini P-PR-HP-602, <i>L</i> tus Survey?	ng the area with Data Package De	green rope and <i>velopment and</i> Yes⊠ No⊡		
(11 100,0	iscontinue sui	rvey design until are	a turnover requ	irements have bee	n met.)			
2 Evaluate Fi	inal Remedi	al Action Suppor	t Survey (RA	SS) Data				
a. Number	of RASS Sa	amples = 8	t Survey (Iax	55) Data				
b. Record	analytical re	sults and summary	statistics for e	each RASS samp	le.			
	U-234	U-235	U-238	Tc-99	Th-232	Ra-226		
	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)		
Minimum	0.369	0.020	0.090	0.160	0.000 (<bkg)< td=""><td>0.000 (<bkg)< td=""></bkg)<></td></bkg)<>	0.000 (<bkg)< td=""></bkg)<>		
Maximum	9.024	0.390	2.600	8.000	0.000	0.200		
Mean	3.469	0.174	1.150	1.673	0.000	0.100		
Median	2.755	0.150	1.300	1.020	0.000	0.100		
Standard Deviation	2.583	0.111	0.821	2.612	0.000	0.093		
# of Samples	8	8	8	8	8	8		
 # of Samples 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8								
C 1 1		· · · 1D		·	0 ' O D D			

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.)

3. Define the Survey Unit Classification

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

The LSA 08-15 survey unit (SU) is classified as MARSSIM Class 2. LSA 08-15 is located in the southeast open land area of the HDP site. The planar area of this SU is $1,854 \text{ m}^2$. This SU along with LSAs 08-08, 08-10 and 08-11 in the central site are collectively referred to as "Area 6" for the purposes of remediation planning and work sequencing.

Hematite	Procedure: HDP-PR-FSS-701,	Final Status Survey Plan Deve	elopment					
Decommissioning Project			Revision: 10	Appendix P-1 Page 2 of 9				
	APPENDIX P-1							
FINAL S	TATUS SURVEY SAMPLING SOIL SU	PLAN DEVELOPMENT C	HECKLIST F	OR				
Classification: 2	Survey Unit Area (n	n ²): 1,854						
 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 surface and at 1.5 m bel Survey Area	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. <u>Not Excavated, Paved/Partially Paved or Excavated but not Backfilled:</u> 								
Surface Soil (<15cm) Samples.	Surface Soil Samples ta surface soil Stratum and l taken at the same locat composited over the entire	iken from any Root Stratum S ions as Surfac e root stratum.	remaining oil Samples e Samples,				
Root Stratum 15cm to 1.5m.	Soil Samples composited from	Root Stratum Soil Sa exposed grade to 1.5m Samples taken at the Samples of the top 15cm of	amples compo and Deep S same location of the Deep Stra	sited from tratum Soil s as Root atum.				
Deep Stratum of the Deep St	Soil Samples of the top 15 cm tratum.	Deep Stratum Soil Sample exposed Deep Stratum.	es of the top 1	5 cm of the				

Hematite Decommission	Procedure: HDI	P-PR-FSS-701, Final St	tatus Survey Plan Devel	lopment	oment		
Project				Revision: 10	Appendix P- Page 3 of 9		
FINA	L STATUS SURVE	APPENDIX Y SAMPLING PLAN SOIL SURVEY	P-1 DEVELOPMENT CH UNITS	HECKLIST F	OR		
Note: If the S to an ap	OF of the Root Stratu opropriate depth (Deep	um sample exceeds 0.5 p Stratum).	, a composite sample is	collected from	n 1.5 meters		
Excavated and	Backfilled						
Core th from a	rough backfill layer to coring that extends on	o the lowest point wher ne meter deeper than the	e remediation occurred e lowest point where rei	and composite	e a sample irred.		
 If To DCC If To ("Inf 	c-99 was measured GLs will be used from c-99 was not measure fer Tc-99") will be use	during the characteriz Appendix A of HDP-P d in the characterizatio ed from Appendix A H	ation/RASS survey, th R-FSS-701. n/RASS survey, then th DP-PR-FSS-701.	nen the "Meas ne modified U	sure Tc-99" -235 DCGL		
	(pCi/g)	(pCi/g)	(pCi/g)	(pC	ci/g)		
U-234	NA	N.A.	N/A	19	5.4		
U-235	NA	NA	N/A	51	.6		
U-238	NA	NA	N/A	16	8.8		
T 00	N/Λ	N/Λ	N/A	25	5.1		
IC-99	NT/A	N/A	N/A	2			
Tc-99 Th-232 + C	18/28			1	.0		
Tc-99 Th-232 + C	1N/2X			-	.0		

- 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 determining the following (SOF_{mean} and σ_{SOF}) can be found in the tables from Section 2b and Section 7.
- 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) = $SOF_{Mean} = 0.15$

LSA 08-15

Hematit	Procedure: 1	HDP-PR-FSS-70)1, Final Status Survey Plan Dev	velopment	
Decommissi Project	oning			Revision: 10	Appendix P-1 Page 4 of 9
FIN	NAL STATUS SUR	AI VEY SAMPLIN SOIL	PPENDIX P-1 NG PLAN DEVELOPMENT (SURVEY UNITS	CHECKLIST F	OR
b. Dete using	rmine the weighted s g the equation from S	standard deviation Step 8.2.5b of HI	on in the SOF for the characteriz	zation/RASS sur	vey data set
Note: For t If T	he determination of c-99 was not measur	SOF_{Mean} and σ_{S} red, include the r	OF, include the concentration for nodified U-235 DCGL and omit	or Tc-99 if it wa t Tc-99 concentra	s measured. ation term.
			\checkmark Larger of the two used	in worksheet sur	vey design
Surve	ey Unit $\sigma_{SOF} =$	0.12	[
Back	aground σ_{SOF} =	0.14		\leq	
c. Defi	ne the Decision Erro	rs.			
Туре	e I Error $= 0.05$		Type II Error = 0.10		
Note	: The Type II Error	is set at 0.10 init	ially but it may be adjusted with	n RSO concurren	ce.
d. Dete	rmine the Relative S	hift using the eq	uation in Step 8.2.5d of HDP-PI	R-FSS-701.	
Rela	tive Shift = 6.05	5* * Spreadsl	neet value may differ from has	nd-calculated res	sults due to
e Isth	e Relative Shift betw	rounding		Ve	No
• If	"Ves" then continue	to Step 8f		10	
• If ac	"No", then adjust the complish this, the LE	e LBGR as neces BGR may be set	ssary to achieve a relative shift l as low as the MDC for the analy	between 1 and 3. rtical technique.	In order to
Adju	sted LBGR = 0.58				
Adju	sted Relative Shift =	= 3.0			
f. Dete and	rmine the Number of the Relative Shift fro	of Samples (N/2 m Appendix F o) required corresponding to the r calculate using equation 5-1 fr	Type I error, Type MARSSIM.	ype II Error
No.	of Samples $(N/2) = 8$	5			
9. DetermineWhen enrice	ine the Scan MDC f en U-235 is reported chment to 0.72% (nat	for Total Urani d as negative o tural uranium).	r zero and U-238 is reported	as positive, set	the sample
• Whe enrice	en U-235 is reported chment to 100% (hig	d as positive an hly enriched).	nd U-238 is reported as negative	ive or zero, set	the sample
• Whe samj	en both U-235 and U ple and use Appen esponds to the mean	-238 data are rej dix G of HDP U-238:U-235 ra	ported as positive, determine the -PR-FSS-701, to determine the tio.	e U-238/U-235 ra e uranium enric	atio for each chment that
a. Reco indiv	ord the average Uran vidual sample.	ium enrichment	for the survey unit using the enr	ichment determin	ned for each
Aver	rage Enrichment (%)	= 6.7			

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Decomm Pro	nissioning oject					Revision: 10	Appendix P-1 Page 5 of 9		
				APPENDI	X P-1				
	FINAL ST	TATUS SI	URVEY SAMP SO	LING PLAI IL SURVEY	N DEVELOPMENT C Y UNITS	CHECKLIST F	OR		
Note:	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 Unroot & d	niform DC eep), then	CGL is not used the most conser	, and the ex- rvative DCG	cavation extends into n Ls should be used in the	nultiple CSMs (e following calc	e.g. surface, ulation.		
b. I	Determine a	DCGLW	for Total Uraniu	im using the	equation from Step 8.2.	6b of HDP-PR-	FSS-701.		
І с. І	DCGL _{WTotU} dentify the	for Total Radiologi	Uranium = cal Instrument tl	42.3 hat will be us	pCi/g sed for scanning.				
[\mathbf{X} 2"x	2" NaI De	tector	FIDLER 1	Nal Detector	Other			
d. I F 1	 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. 								
1	MDC _{scan} for	Total Ura	anium =	36.6	pCi/g				
10. Dete a. S	ermine the Select the a exposed at t	Scan MD ppropriate he time of	C for Th-232 a e DCGL _W for T FSS and the SE	nd Ra-226 Th-232 and F CA where the	Ra-226 corresponding t survey unit is located.	o the soil strata	a that will be		
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. I	Determine t	he Scan M	IDC for the sele	cted instrum	ent				
Note:	ote: HDP-TBD-FSS-002 documents the calculated MDC _{scan} of 0.87 pCi/g for Th-232 and 1.21 pCi/g for Ra-226 when using a 2"x 2" NaI detector with a background of 10,000 cpm. If a different background is indicated, see Appendix C of HDP-TBD-FSS-002 for the appropriate MDC _{scan} .								
Note:	If the selection accordance	cted instru with the (ument is not a Open Land Area	2"x 2" Nal Gamma Sca	detector, then the MI an MDCs section in DP	DC_{scan} can be c Ch. 14.	letermined in		
MDC _{scar}	MDC_{scan} for Th-232 = 0.77 pCi/g MDC_{scan} for Ra-226 = 1.08 pCi/g								
Note: If a value is not applicable, mark as N/A.									

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APPENDIX P-1 FINAL STATUS SURVEY SAMPLING PLAN DEVELOPMENT CHECKLIST FOR SOIL SURVEY UNITS											
 11. Adjust the Statistical Sample Population Size (N/2) for Scan MDC a. 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 											
	Class 2 and 3 survey units - If "Yes", then proceed to Step 12, if "No", then contact the RSO for direction as to changing parameters for scanning such as scanning speed, detector distance, different instrumentation, etc.										
b.	Class 1 survey units, proceed to the next step. 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 Stat	tistical Sar	nple Popul	ation (A _{SI}	J) = NA	m^2			
	URA	NIUM									
c. Was the Scan MDC for the selected instrument less than the DCGL _W that was determined for Total Uranium in Step 11.a? NAX Yes No											
 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 (<i>f</i>) for each radionuclide that corresponds to the mean enrichment from Appendix G of HDP-PR-FSS-701. 											
	(m^2)	153,375	10,000	3,000	1,000	300	100	30	10	3	1
Area											

by the statistical sample population (A_{SU}) .

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

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 = NA pCi/g

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

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

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Presedures LIDP PD ESS 701 Einel Status Survey Plan Development									
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FINAL STATUS SURVEY SAMPLING PLAN DEVELOPMENT CHECKLIST FOR SOIL SURVEY UNITS									
h.	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 U	$J_{total} = NA$							
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 8.2.7j of HDP-PR-FSS-701.								
	N _{EMC} corres	ponding to A' for $U_{total} = NA$							
k.	 TECHNETIUM (Tc-99) k. Determine if the maximum reasonable result for Tc-99 from previous Characterization or RASS remaining within the area is greater than the DCGL_W for the appropriate CSM and SEA? 								
1.	 (If "No", then proceed to Step 12, if "Yes", then proceed to the next step.) Determine the area per sample station needed to account for potential Tc-99 hotspots by dividing the highest Tc-99 result obtained by the Tc-99 DCGL_W for the appropriate CSM and compare that value to the Area Factor Tables in Appendix H. 								
	A' for poten	tial Tc-99 hotspots = NA							
m.	Determine the number of samples needed by dividing the A_{SU} by the A' for potential Tc-99 hotspots determined in Step 111.								
12. De	N corresponding to A' for potential Tc-99 hotspots = NA 12. Determine the Grid Spacing								
a.	Larger of N/2 from Step 8f, the maximum value of N_{EMC} from Step 11j, or N corresponding to A' for potential Tc-99 hotspots from Step 11m. N/2, N_{EMC} [max], or N corresponding to the potential Tc-99 hotspot = 8								
b.	Is the Surve (If "Yes", th	y Unit a Class 3 Survey Unit? Ien continue to Step 13, if "No", then proceed to the next step).	Y	es□ No⊠					
c.	Determine (Grid Spacing (L) using the equation from Step 8.2.9 of HDP-PF	R-FSS-701.						
	Grid Spacing (L) for Survey Unit = 16.3 m								
13. Generate a Survey Mapa. 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.									

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APPENDIX P-1

FINAL STATUS SURVEY SAMPLING PLAN DEVELOPMENT CHECKLIST FOR SOIL SURVEY UNITS

- 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.

14. QC, Biased & Discretionary 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.
- f. Include discretionary sidewall samples as applicable using guidance in Step 8.2.11. Are discretionary sidewall samples required?

 N/A
 Yes
 No

(If "No", then proceed to Step 15, if "Yes", then proceed to the next step.)

g. Determine the number of samples to be collected based on the sidewall surface area compared to the two dimensional systematic surface area.

Number of discretionary sidewall samples = NA (maximum); may be reduced with FSS Supervisor approval if the actual sidewall surface area is significantly less than the CAD-calculated theoretical maximum.

h. Any discretionary sidewall samples will be taken at randomly chosen location(s) of the sidewall(s) (i.e., not based on radiological scans) selected at the discretion of the Health Physics Technician performing soil sampling. Necessary sidewall samples will be explained on Appendix P-3, *FSS Sampling Plan.*

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FINAL S	TATUS SURVEY SAMPLING I	PLAN DEVELOPMENT C	HECKLIST F	OR					
	SOIL SUR	RVEY UNITS							
15 Scan Coverag	e								
a. The Survey	Unit is: Class 1	\boxtimes Class 2	Clas	is 3					
 b. Based on the Survey Unit Classification, the scan coverage in this Survey Unit is; 100% Scan Coverage of exposed soil 									
	ny specific scan locations as det	armined necessary on Appen	div P 3 FSS S	Sampling					
Plan.	my specific scan locations, as det	ennined necessary, on Appen	uix F-5, F55 5	ampling					
16. Investigation	levels								
a. The Survey	Unit is: Class 3								
1) Scan In	vestigation Levels are set at: N	A cpm							
2) Sample	Investigation Levels are set at 50%	% of the DCGL _W when expres	ssed as the SOF	₹.					
b. The Survey	Unit is: 🔀 Class 2								
1) Scan In	vestigation Levels are set at: 1,	.624 net cpm							
2) Sample	2) Sample Investigation Levels are set at the DCGL $_{W}$ when expressed as the SOF								
c. The Survey	c. The Survey Unit is: Class 1								
1) Scan In	vestigation Levels are set at: N	A cpm							
2) Sample	Investigation Levels are set at the	$DCGL_W$ when expressed as t	he SOF.						
 17. Attachments Attach a copy of Appendix I Appendix I Appendix I Appendix I Survey Uni Other: 	of completed forms as appropriate: 2-3, FSS Survey Sampling Plan, 2-4, FSS Sample & Measurement L 2-5, FSS Unit Classification Chang 2-6, FSS Field Log it Figure	Locations & Coordinates ge Form							
18. FSSP Development Checklist Approval									
Prepared by:		SH21	/ /						
	Scott G. Zoller (Print Name)	(Signature)	- 05/19/14						
Peer Reviewed by:		MA A A	C (Date)						
	Matthew E. Cushman	(Signature)	$\sum / \frac{9}{4}$						
Approved by (RSO): <u>W. Clark Evers</u> (Print Name)	W. Chen (Signature)	<u>S/19/1</u> (Date)	6					
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	FSS SAM	PLE &	& MEASUR	REMENT L	OCATIONS &	& COORDINA	ATES		
Survey Area: LSA 08		Description:			Plant Soils SEA Open Land Area				
Survey Unit:	15		 Description:			Central Open Land Area			
Survey Type: FSS		Classification:			(Class 2			
Measurement or Sample	Surface or	T	Start	End	Northing**	Easting**	Bamarka / Notaa		
ID	CSM	Type	Elevation*	Elevation*	(Y Axis)	(X Axis)	Remarks / Notes		
L08-15-01-P-S-S-00	Uniform	S	434.9	434.4	864565.0	827061.5	Surface 6-inch grab		
L08-15-02-P-R-S-00	Uniform	S	434.4	429.9	864565.0	827061.5	Root 4.4-ft composite		
L08-15-03-P-E-S-00	Uniform	S	429.9	429.5	864565.0	827061.5	Excavation 6-inch grab		
L08-15-04-P-S-S-00	Uniform	S	434.6	434.1	864518.7	827034.8	Surface 6-inch grab		
L08-15-05-P-R-S-00	Uniform	S	434.1	429.7	864518.7	827034.8	Root 4.4-ft composite		
L08-15-06-P-E-S-00	Uniform	S	429.7	429.2	864518.7	827034.8	Excavation 6-inch grab		
L08-15-07-P-S-S-00	Uniform	S	434.9	434.4	864518.7	827088.3	Surface 6-inch grab		
L08-15-08-P-R-S-00	Uniform	S	434.4	430.0	864518.7	827088.3	Root 4.4-ft composite		
L08-15-09-P-E-S-00	Uniform	S	430.0	429.5	864518.7	827088.3	Excavation 6-inch grab		
L08-15-10-P-S-S-00	Uniform	S	434.1	433.6	864472.5	827008.0	Surface 6-inch grab		
L08-15-11-P-R-S-00	Uniform	S	433.6	429.2	864472.5	827008.0	Root 4.4-ft composite		
L08-15-12-P-E-S-00	Uniform	S	429.2	428.7	864472.5	827008.0	Excavation 6-inch grab		
L08-15-13-P-S-S-00	Uniform	S	434.5	434.0	864472.5	827061.5	Surface 6-inch grab		
L08-15-14-P-R-S-00	Uniform	S	434.0	429.5	864472.5	827061.5	Root 4.4-ft composite		
L08-15-15-P-E-S-00	Uniform	S	429.5	429.0	864472.5	827061.5	Excavation 6-inch grab		
L08-15-16-P-S-S-00	Uniform	S	434.0	433.6	864426.2	827034.8	Surface 6-inch grab		
L08-15-17-P-R-S-00	Uniform	S	433.6	429.1	864426.2	827034.8	Root 4.4-ft composite		
L08-15-18-P-E-S-00	Uniform	S	429.1	428.6	864426.2	827034.8	Excavation 6-inch grab		
L08-15-19-P-S-S-00	Uniform	S	434.7	434.2	864426.2	827088.3	Surface 6-inch grab		
L08-15-20-P-R-S-00	Uniform	S	434.2	429.8	864426.2	827088.3	Root 4.4-ft composite		
L08-15-21-P-E-S-00	Uniform	S	429.8	429.3	864426.2	827088.3	Excavation 6-inch grab		
L08-15-22-P-S-S-00	Uniform	S	434.1	433.6	864380.0	827061.5	Surface 6-inch grab		
L08-15-23-P-R-S-00	Uniform	S	433.6	429.2	864380.0	827061.5	Root 4.4-ft composite		
L08-15-24-P-E-S-00	Uniform	S	429.2	428.7	864380.0	827061.5	Excavation 6-inch grab		
L08-15-11-P-R-Q-00	Uniform	S	433.6	429.2	864472.5	827008.0	Root 4.4-ft composite		
L08-15-20-P-R-Q-00	Uniform	S	434.2	429.8	864426.2	827088.3	Root 4.4-ft composite		
1.08-15-XX-P-Y-B-00	Cuiforn	В	TBD	TBD	TBD	TBD	Bias sample(s) may be taken after evaluation of GWS data (e.g., data > 30 over the mean of the waikover data).		

APPENDIX P-4

Samples highlighted in red will be collected and archived; radiological analyses performed only if overlying root sample has a SOF >0.5.

*Elevations are in feet above mean sea level.

** Missouri - East State Plane Coordinates [North American Datum (NAD) 1983] (Open Land Area) OR

Distance in feet from lower left corner of the surface (Structures); each surface has it's own (X,Y) = (0,0); OR

For piping the distance from the beginning of the survey unit.

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 = I

Quality Record

