

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-701, Final Status Survey Plan Development		
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**APPENDIX P-4**

**FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES**

<b>Survey Area:</b>	LSA 12	<b>Description:</b>	Burial Pits Open Land Area
<b>Survey Unit:</b>	09	<b>Description:</b>	South Eastern Survey Unit in "Area 9"
<b>Survey Type:</b>	FSS	<b>Classification:</b>	Class 1

Measurement or Sample ID	Surface or CSM	Type	Start Elevation*	End Elevation*	Northing** (Y Axis)	Easting** (X Axis)	Remarks / Notes
L12-09-01-P-S-S-00	Uniform	S	430.2	429.7	865742	828039	Surface 6-inch grab
L12-09-02-P-R-S-00	Uniform	S	429.7	425.2	865742	828039	Root 59-inch composite
L12-09-04-P-S-S-00	Uniform	S	430.7	430.2	865742	828091	Surface 6-inch grab
L12-09-05-P-R-S-00	Uniform	S	430.2	425.7	865742	828091	Root 59-inch composite
L12-09-07-P-S-S-00	Uniform	S	429.9	429.4	865697	828065	Surface 6-inch grab
L12-09-08-P-R-S-00	Uniform	S	429.4	425.0	865697	828065	Root 59-inch composite
L12-09-10-P-S-S-00	Uniform	S	429.8	429.3	865697	828117	Surface 6-inch grab
L12-09-11-P-R-S-00	Uniform	S	429.3	424.8	865697	828117	Root 59-inch composite
L12-09-13-P-S-S-00	Uniform	S	429.8	429.3	865652	828091	Surface 6-inch grab
L12-09-14-P-R-S-00	Uniform	S	429.3	424.8	865652	828091	Root 59-inch composite
L12-09-16-P-S-S-00	Uniform	S	429.6	429.1	865652	828143	Surface 6-inch grab
L12-09-17-P-R-S-00	Uniform	S	429.1	424.7	865652	828143	Root 59-inch composite
L12-09-19-P-S-S-00	Uniform	S	429.6	429.1	865607	828117	Surface 6-inch grab
L12-09-20-P-R-S-00	Uniform	S	429.1	424.7	865607	828117	Root 59-inch composite
L12-09-22-P-S-S-00	Uniform	S	429.5	429.0	865607	828169	Surface 6-inch grab
L12-09-23-P-R-S-00	Uniform	S	429.0	424.6	865607	828169	Root 59-inch composite
L12-09-07-P-S-Q-00	Uniform	Q	429.9	429.4	865697	828065	Surface 6-inch grab
L12-09-14-P-R-Q-00	Uniform	Q	429.3	424.8	865652	828091	Root 59-inch composite
L12-09-25-P-S-B-00	Uniform	B	429.5	429.0	865654.4	828153.7	Biased 6-inch grab
L12-09-26-P-S-B-00	Uniform	B	429.6	429.1	865618.1	828120.0	Biased 6-inch grab

Green shaded samples are the topmost samples at each sample location, for use in WRS test.

\*Elevations are in feet above mean sea level.  
 \*\* Missouri - East State Plane Coordinates [North American Datum (NAD) 1983]  
 Surface: Floor = F; Wall = W; Ceiling = C; Roof = R  
 CSM: Three-Layer (Surface-Root-Excavation) or Uniform DCGLs used  
 Type: Systematic = S, Biased = B; QC = Q; Investigation = I



**HDP-PR-FSS-721 Final Status Survey Data Evaluation**  
**Step 8.5 Performance of Statistical Tests**

<b>WRS TEST</b>					
<b>SAMPLE ID</b>	<b>AREA (Reference, Survey Unit)</b>	<b>Gross SOF (<math>X_{i,ref}</math>, <math>Y_{i,SU}</math>) Step 8.5.3a</b>	<b>ADJUSTED SOF (<math>Z_i</math>) Step 8.5.3b</b>	<b>RANKS Step 8.5.3d</b>	<b>REFERENCE AREA RANKS</b>
9574-SS-140910-01-01	Reference	1.31	2.310	38	38
9574-SS-140910-01-02	Reference	1.18	2.179	29	29
9574-SS-140910-01-03	Reference	1.06	2.064	24	24
9574-SS-140910-01-04	Reference	1.10	2.101	25	25
9574-SS-140910-01-05	Reference	1.29	2.293	37	37
9574-SS-140910-01-07	Reference	1.34	2.339	39	39
9574-SS-140910-01-08	Reference	1.15	2.154	28	28
9574-SS-140910-01-09	Reference	1.18	2.182	30	30
9574-SS-140910-01-10	Reference	1.23	2.227	35	35
9574-SS-140910-01-11	Reference	1.38	2.380	40	40
9574-SS-140910-01-12	Reference	1.05	2.055	23	23
9574-SS-140910-01-13	Reference	0.94	1.941	13	13
9574-SS-140910-01-14	Reference	1.12	2.119	26	26
9574-SS-140910-01-15	Reference	1.15	2.152	27	27
9574-SS-140910-01-16	Reference	1.03	2.028	20	20
9574-SS-140910-01-17	Reference	0.44	1.443	9	9
9574-SS-140910-01-18	Reference	1.19	2.188	32	32
9574-SS-140910-01-20	Reference	0.76	1.757	10	10
9574-SS-140910-01-21	Reference	1.02	2.023	19	19
9574-SS-140910-01-22	Reference	1.02	2.018	18	18
9574-SS-140910-01-23	Reference	1.00	2.002	15	15
9574-SS-140910-01-24	Reference	0.87	1.873	12	12
9574-SS-140910-01-25	Reference	1.04	2.040	22	22
9574-SS-140910-01-26	Reference	0.96	1.959	14	14
9574-SS-140910-01-27	Reference	1.20	2.204	33	33
9574-SS-140910-01-28	Reference	1.01	2.007	17	17
9574-SS-140910-01-29	Reference	1.22	2.223	34	34
9574-SS-140910-01-30	Reference	1.03	2.035	21	21
9574-SS-140910-01-31	Reference	1.00	2.005	16	16
9574-SS-140910-01-32	Reference	0.86	1.865	11	11
9574-SS-140910-01-33	Reference	1.24	2.238	36	36
9574-SS-140910-01-34	Reference	1.19	2.185	31	31
L12-09-01-P-S-S-00	Survey Unit	1.13	1.127	6	0
L12-09-04-P-S-S-00	Survey Unit	1.01	1.013	3	0
L12-09-05-P-R-S-00	Survey Unit	1.11	1.113	5	0
L12-09-07-P-S-S-00	Survey Unit	1.26	1.255	8	0
L12-09-08-P-R-S-00	Survey Unit	1.17	1.167	7	0
L12-09-10-P-S-S-00	Survey Unit	0.99	0.991	2	0
L12-09-11-P-R-S-00	Survey Unit	1.03	1.027	4	0
L12-09-13-P-S-S-00	Survey Unit	0.59	0.593	1	0
<b>Rank Sums</b>				<b>820</b>	<b>784</b>
<b># Reference Area Measurements</b>				<b>m</b>	<b>32</b>
<b># Survey Unit Measurements</b>				<b>n</b>	<b>8</b>
<b>Total Number of Measurements Step 8.5.3c</b>				<b>N</b>	<b>40</b>
<b>(1-<math>\alpha</math>) percentile of a standard normal distribution (MARSSIM Pg. I-10)</b>				<b>z</b>	<b>1.645</b>
<b>WRS Critical Value (MARSSIM Pg. I-10, Eq. I.1)</b>				<b>CV</b>	<b>705</b>

Step 8.5.1  
Min adjusted bkg SOF  
1.44  
No WRS test necessary  
No WRS test necessary  
No WRS test necessary  
No WRS test necessary  
No WRS test necessary  
No WRS test necessary  
No WRS test necessary  
No WRS test necessary

W, Step 8.5.3e

$\alpha = 0.05$

TEST: **PASS** Step 8.5.3f

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Appendix B.1 Step 8. Calculate the Number of Samples in the Statistical Population

Uniform DCGL Criteria Evaluation	
N/2 Value Verification	
Isotope(s)	SOF (Ra/Tc/Th/Iso U)
St. Dev.	0.07
DCGL <sub>SOF</sub>	1
LBGR (Mean)	0.10
Shift	0.90
Relative Shift ( $\Delta/\sigma$ )	13.08
MARSSIM Table 5.1 ( $P_r$ )	1.000000
N	12
N + 20%	14.4
N/2	8
FSS N/2	8
Verification Check	<b>SUFFICIENT MEASUREMENTS</b>

"N/2" Corresponds to the number of survey unit measurement locations required for the WRS Test

MARSSIM Table 5.1

$\Delta/\sigma$	$P_r$
0.1	0.528182
0.2	0.556223
0.3	0.583985
0.4	0.611335
0.5	0.638143
0.6	0.664290
0.7	0.689665
0.8	0.714167
0.9	0.737710
1.0	0.760217
1.1	0.781627
1.2	0.801892
1.3	0.820978
1.4	0.838864
1.5	0.855541
1.6	0.871014
1.7	0.885299
1.8	0.898420
1.9	0.910413
2.0	0.921319
2.25	0.944167
2.5	0.961428
2.75	0.974067
3.0	0.983039
3.5	0.993329
4.0	0.997658
4.01	1.000000

MARSSIM Table 5.2,  $\alpha = 0.05$ ,  $\beta = 0.10$

$\alpha$ (or $\beta$ )	$Z_{1-\alpha}$ (or $Z_{1-\beta}$ )
0.005	2.576
0.01	2.326
0.015	2.241
0.025	1.960
0.05	1.645
0.10	1.282
0.15	1.036
0.2	0.842
0.25	0.674
0.30	0.524

$\alpha$   
 $\beta$

Hematite Decommissioning Project	Procedure: HDP-PR-FSS-703, Final Status Survey Quality Control										
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**FORM HDP-PR-FSS-703-1  
FIELD DUPLICATE SAMPLE ASSESSMENT**

Survey Unit No.:	LSA 12-09				Survey Unit Description:	Class 1 Laydown Land Area in "Area 13"						
Sample ID	Field Duplicate Sample ID	Radionuclide	Sample (pCi/g)		Field Duplicate Sample (pCi/g)		Average Activity ( $\bar{x}$ ) (pCi/g)	Nuclide DCGL (pCi/g)	Statistic <sup>2</sup>	Warning Limit	Control Limit	Statistic Exceeds Limit? (Y/N)
			Activity ( $x_i$ )	MDC	Activity ( $x_i$ )	MDC						
L12-09-07-P-S-S-00	L12-09-07-P-S-Q-00	Ra-226	0.957	0.0642	0.842	0.0746	0.900	1.9	0.115	0.269	0.403	N
L12-09-07-P-S-S-00	L12-09-07-P-S-Q-00	Tc-99	3	0.241	1.22	0.216	2.110	25.1	1.78	3.552	5.321	N
L12-09-07-P-S-S-00	L12-09-07-P-S-Q-00	Th-232	0.899	0.111	0.786	0.127	0.843	2.0	0.113	0.283	0.424	N
L12-09-07-P-S-S-00	L12-09-07-P-S-Q-00	U-234 <sup>1</sup>	5.046	N/A	8.171	N/A	6.608	195.4	3.125	27.649	41.425	N
L12-09-07-P-S-S-00	L12-09-07-P-S-Q-00	U-235	0.277	0.179	0.451	0.214	0.364	51.6	0.174	7.301	10.939	N
L12-09-07-P-S-S-00	L12-09-07-P-S-Q-00	U-238	1.48	0.757	1.35	0.823	1.415	168.8	0.130	23.885	35.786	N

Comments:

- U-234 is inferred, no MDC available.
- Duplicate assessment is not necessary if the result of either sample is < MDC.

Performed by: \_\_\_\_\_

Reviewed by: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

Quality Record

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**FORM HDP-PR-FSS-703-1  
FIELD DUPLICATE SAMPLE ASSESSMENT**

Survey Unit No.:	LSA 12-09				Survey Unit Description:	Class 1 Laydown Land Area in "Area 13"						
Sample ID	Field Duplicate Sample ID	Radionuclide	Sample (pCi/g)		Field Duplicate Sample (pCi/g)		Average Activity ( $\bar{x}$ ) (pCi/g)	Nuclide DCGL (pCi/g)	Statistic <sup>2</sup>	Warning Limit	Control Limit	Statistic Exceeds Limit? (Y/N)
			Activity ( $x_i$ )	MDC	Activity ( $x_i$ )	MDC						
L12-09-14-P-R-S-00	L12-09-14-P-R-Q-00	Ra-226	0.923	0.0783	1.11	0.0639	1.017	1.9	0.187	0.269	0.403	N
L12-09-14-P-R-S-00	L12-09-14-P-R-Q-00	Tc-99	-0.0848	0.223	-0.0738	0.231	-0.079	25.1	NA	3.552	5.321	NA
L12-09-14-P-R-S-00	L12-09-14-P-R-Q-00	Th-232	1.01	0.0676	1.04	0.113	1.025	2.0	0.030	0.283	0.424	N
L12-09-14-P-R-S-00	L12-09-14-P-R-Q-00	U-234 <sup>1</sup>	1.270	N/A	1.360	N/A	1.315	195.4	0.090	27.649	41.425	N
L12-09-14-P-R-S-00	L12-09-14-P-R-Q-00	U-235	-0.0584	0.579	-0.12	0.509	-0.089	51.6	NA	7.301	10.939	NA
L12-09-14-P-R-S-00	L12-09-14-P-R-Q-00	U-238	1.27	0.937	1.36	0.797	1.315	168.8	0.090	23.885	35.786	N

Comments:

- U-234 is inferred, no MDC available.
- Duplicate assessment is not necessary if the result of either sample is < MDC.

Performed by: \_\_\_\_\_

Reviewed by: \_\_\_\_\_

Date: \_\_\_\_\_

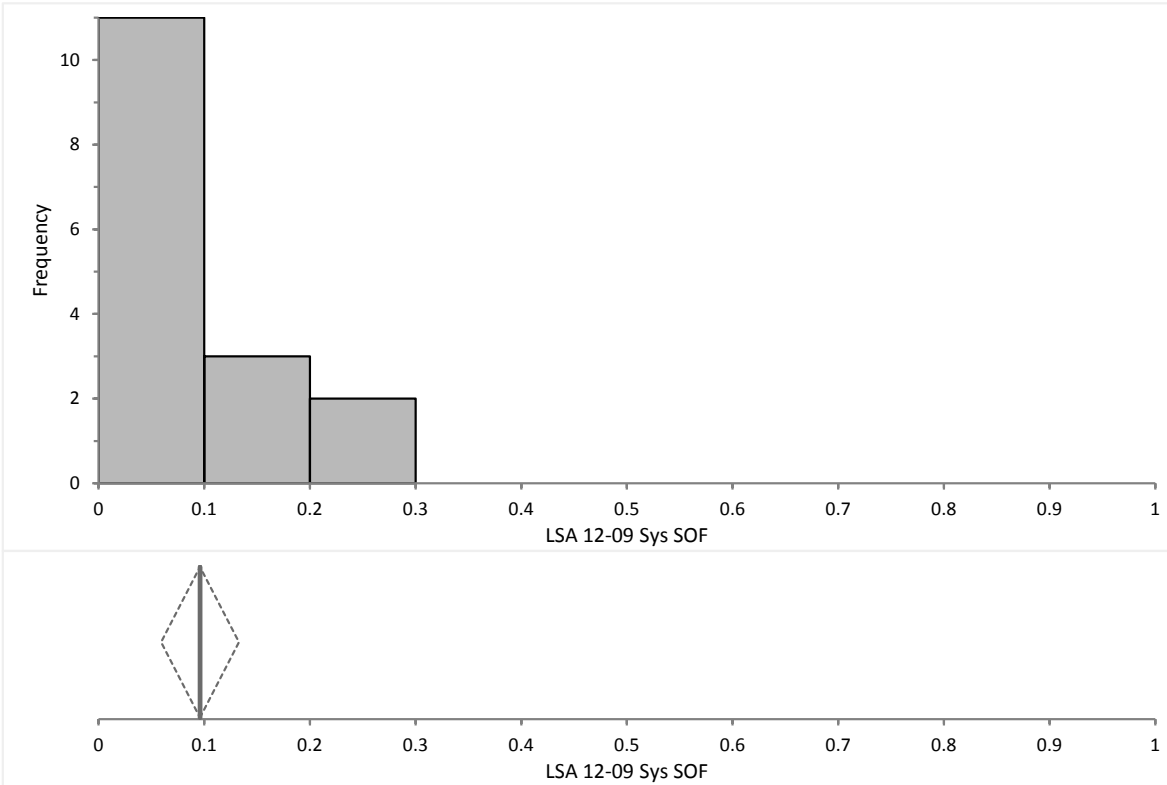
Date: \_\_\_\_\_

Quality Record

LSA 12-09 Sys SOF

0.1  
0.0  
0.1  
0.1  
0.2  
0.2  
0.2  
0.1  
0.1  
0.0  
0.1  
0.0  
0.1  
0.1  
0.1  
0.2

Descriptives



N | 16

	Mean	95% CI	Mean SE	SD	Variance	Skewness	Kurtosis
LSA 12-09 Sys SOF	0.10	0.06 to 0.13	0.017	0.07	0.00	0.9	-0.51
	Minimum	1st quartile	Median	97.87% CI	3rd quartile	Maximum	IQR
LSA 12-09 Sys SOF	0.02	0.05	0.06	0.05 to 0.16	0.15	0.2	0.10