

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 08	<b>Description:</b>	Plant Soils SEA Open Land Area
<b>Survey Unit:</b>	04	<b>Description:</b>	Central Open Land Area
<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
L08-04-01-P-S-S-00	Uniform	S	437	436.5	865132.0	827217.0	Surface 6-inch grab
L08-04-02-P-R-S-00	Uniform	S	436.5	432.1	865132.0	827217.0	Root zone composite
L08-04-04-P-S-S-00	Uniform	S	437	436.5	865089.0	827142.0	Surface 6-inch grab
L08-04-05-P-R-S-00	Uniform	S	436.5	434.7	865089.0	827142.0	Root zone composite
L08-04-07-P-S-S-00	Uniform	S	435.9	435.4	865089.0	827192.0	Surface 6-inch grab
L08-04-08-P-R-S-00	Uniform	S	435.4	431.0	865089.0	827192.0	Root zone composite
L08-04-10-P-R-S-00	Uniform	S	430.8	430.3	865089.0	827242.0	Root zone composite
L08-04-11-P-E-S-00	Uniform	S	430.3	429.8	865089.0	827242.0	Excavation 6-inch grab
L08-04-12-P-R-S-00	Uniform	S	430.1	429.6	865046.0	827217.0	Root zone composite
L08-04-13-P-E-S-00	Uniform	S	429.6	429.0	865046.0	827217.0	Excavation 6-inch grab
L08-04-14-P-E-S-00	Uniform	S	430.8	430.3	865046.0	827267.0	Excavation 6-inch grab
L08-04-15-P-R-S-00	Uniform	S	433.2	432.7	865003.0	827242.0	Root zone composite
L08-04-16-P-E-S-00	Uniform	S	432.7	432.2	865003.0	827242.0	Excavation 6-inch grab
L08-04-17-P-E-S-00	Uniform	S	430.2	429.7	865003.0	827292.0	Excavation 6-inch grab
L08-04-15-P-R-Q-00	Uniform	Q	433.2	432.7	865003.0	827242.0	Lab QA Duplicate
L08-04-21-P-E-Q-00	Uniform	Q	431.9	431.4	865018.0	827241.0	Lab QA Duplicate
L08-04-18-P-E-B-00	Uniform	B	428.0	428.0	865090.0	827216.0	6-inch Sidewall Sample
L08-04-19-P-E-B-00	Uniform	B	428.3	427.8	865089.0	827257.0	Biased 6-inch grab
L08-04-20-P-E-B-00	Uniform	B	428.0	427.5	865050.0	827225.0	Biased 6-inch grab
L08-04-21-P-E-B-00	Uniform	B	431.9	431.4	865018.0	827241.0	Biased 6-inch grab

Green shaded samples are the 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

Quality Record



**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	44	44
9574-SS-140910-01-02	Reference	1.18	2.179	35	35
9574-SS-140910-01-03	Reference	1.06	2.064	30	30
9574-SS-140910-01-04	Reference	1.10	2.101	31	31
9574-SS-140910-01-05	Reference	1.29	2.293	43	43
9574-SS-140910-01-07	Reference	1.34	2.339	45	45
9574-SS-140910-01-08	Reference	1.15	2.154	34	34
9574-SS-140910-01-09	Reference	1.18	2.182	36	36
9574-SS-140910-01-10	Reference	1.23	2.227	41	41
9574-SS-140910-01-11	Reference	1.38	2.380	46	46
9574-SS-140910-01-12	Reference	1.05	2.055	29	29
9574-SS-140910-01-13	Reference	0.94	1.941	19	19
9574-SS-140910-01-14	Reference	1.12	2.119	32	32
9574-SS-140910-01-15	Reference	1.15	2.152	33	33
9574-SS-140910-01-16	Reference	1.03	2.028	26	26
9574-SS-140910-01-17	Reference	0.44	1.443	15	15
9574-SS-140910-01-18	Reference	1.19	2.188	38	38
9574-SS-140910-01-20	Reference	0.76	1.757	16	16
9574-SS-140910-01-21	Reference	1.02	2.023	25	25
9574-SS-140910-01-22	Reference	1.02	2.018	24	24
9574-SS-140910-01-23	Reference	1.00	2.002	21	21
9574-SS-140910-01-24	Reference	0.87	1.873	18	18
9574-SS-140910-01-25	Reference	1.04	2.040	28	28
9574-SS-140910-01-26	Reference	0.96	1.959	20	20
9574-SS-140910-01-27	Reference	1.20	2.204	39	39
9574-SS-140910-01-28	Reference	1.01	2.007	23	23
9574-SS-140910-01-29	Reference	1.22	2.223	40	40
9574-SS-140910-01-30	Reference	1.03	2.035	27	27
9574-SS-140910-01-31	Reference	1.00	2.005	22	22
9574-SS-140910-01-32	Reference	0.86	1.865	17	17
9574-SS-140910-01-33	Reference	1.24	2.238	42	42
9574-SS-140910-01-34	Reference	1.19	2.185	37	37
L08-04-01-P-S-S-00	Survey Unit	1.19	1.185	7	0
L08-04-02-P-R-S-00	Survey Unit	1.24	1.245	11	0
L08-04-04-P-S-S-00	Survey Unit	1.11	1.112	2	0
L08-04-05-P-R-S-00	Survey Unit	1.16	1.156	6	0
L08-04-07-P-S-S-00	Survey Unit	1.05	1.054	1	0
L08-04-08-P-R-S-00	Survey Unit	1.31	1.310	13	0
L08-04-10-P-R-S-00	Survey Unit	1.20	1.200	9	0
L08-04-11-P-E-S-00	Survey Unit	1.40	1.399	14	0
L08-04-12-P-R-S-00	Survey Unit	1.12	1.120	3	0
L08-04-13-P-E-S-00	Survey Unit	1.14	1.135	4	0
L08-04-14-P-E-S-00	Survey Unit	1.20	1.198	8	0
L08-04-15-P-R-S-00	Survey Unit	1.15	1.149	5	0
L08-04-16-P-E-S-00	Survey Unit	1.28	1.279	12	0
L08-04-17-P-E-S-00	Survey Unit	1.22	1.221	10	0
<b>Rank Sums</b>				<b>1081</b>	<b>976</b>
<b># Reference Area Measurements</b>				<b>m</b>	<b>32</b>
<b># Survey Unit Measurements</b>				<b>n</b>	<b>14</b>
<b>Total Number of Measurements Step 8.5.3c</b>				<b>N</b>	<b>46</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>821</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  
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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

**HDP-PR-FSS-701 Final Status Survey Plan Development**  
**Appendix P-1 Step 8. Calculate the Number of Samples in the Statistical Population**

<b>Uniform DCGL Criteria Evaluation</b>	
<b>N/2 Value Verification</b>	
Isotope(s)	<b>SOF (Ra/Tc/Th/Iso U)</b>
St. Dev.	0.08
DCGL <sub>SOF</sub>	1
LBGR (Mean)	0.14
Shift	0.86
Relative Shift ( $\Delta/\sigma$ )	10.74
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

$\alpha$   
 $\beta$

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

Survey Unit No.:		LSA 08-04				Survey Unit Description:		Central Open Land Area					
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							
L08-04-15-P-R-S-00	L08-04-15-P-R-Q-00	Ra-226	1.1	0.0668	1.18	0.075	1.140	1.9	0.08	0.269	0.403	N	
L08-04-15-P-R-S-00	L08-04-15-P-R-Q-00	Tc-99	0.0308	0.201	0.0265	0.192	0.029	25.1	NA	3.552	5.321	NA	
L08-04-15-P-R-S-00	L08-04-15-P-R-Q-00	Th-232	1.1	0.0547	1.01	0.124	1.055	2.0	0.090	0.283	0.424	N	
L08-04-15-P-R-S-00	L08-04-15-P-R-Q-00	U-234 <sup>1</sup>	1.970	N/A	0.752	N/A	1.361	195.4	1.218	27.649	41.425	N	
L08-04-15-P-R-S-00	L08-04-15-P-R-Q-00	U-235	0.104	0.218	-0.028	0.244	0.038	51.6	NA	7.301	10.939	NA	
L08-04-15-P-R-S-00	L08-04-15-P-R-Q-00	U-238	1.09	0.783	0.752	0.873	0.921	168.8	NA	23.885	35.786	NA	

Comments:

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

Performed by: Thomas Yardy \_\_\_\_\_

Reviewed by: Clark Evers \_\_\_\_\_

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

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

Quality Record

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 08-04				Survey Unit Description:	Central Open Land Area						
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 <sub>i</sub> )	MDC	Activity (x <sub>i</sub> )	MDC						
L08-04-21-P-E-B-00	L08-04-21-P-E-Q-00	Ra-226	1.1	0.0671	1.09	0.0638	1.095	1.9	0.01	0.269	0.403	N
L08-04-21-P-E-B-00	L08-04-21-P-E-Q-00	Tc-99	-0.0151	0.225	0.00158	0.226	-0.007	25.1	NA	3.552	5.321	NA
L08-04-21-P-E-B-00	L08-04-21-P-E-Q-00	Th-232	0.965	0.112	1.07	0.106	1.018	2.0	0.105	0.283	0.424	N
L08-04-21-P-E-B-00	L08-04-21-P-E-Q-00	U-234 <sup>1</sup>	0.944	N/A	1.136	N/A	1.040	195.4	0.192	27.649	41.425	N
L08-04-21-P-E-B-00	L08-04-21-P-E-Q-00	U-235	-0.00654	0.23	0.0542	0.223	0.024	51.6	NA	7.301	10.939	NA
L08-04-21-P-E-B-00	L08-04-21-P-E-Q-00	U-238	0.944	0.801	1.19	0.783	1.067	168.8	0.246	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: Thomas Yardy \_\_\_\_\_

Reviewed by: Clark Evers \_\_\_\_\_

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

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

Quality Record

LSA 08-04 Sys SOF

0.1

0.2

0.1

0.1

0.0

0.2

0.1

0.3

0.1

0.1

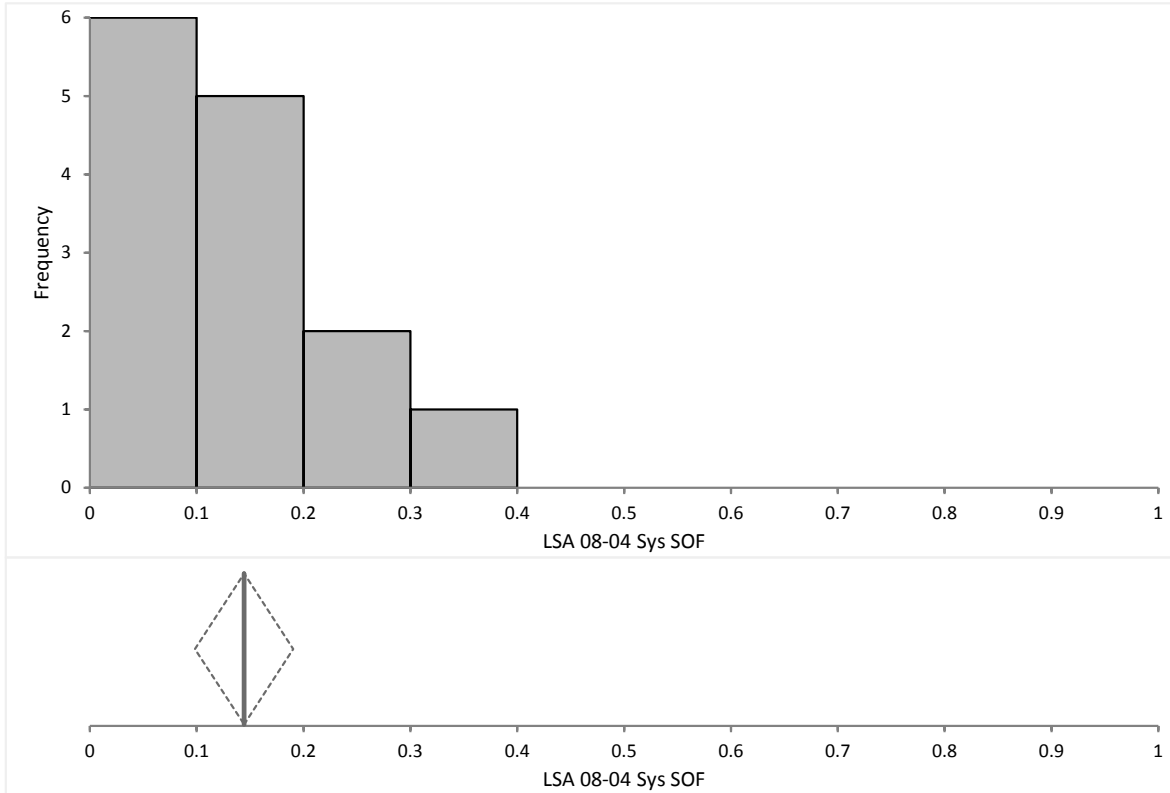
0.1

0.1

0.2

0.2

Descriptives



N | 14

	Mean	95% CI	Mean SE	SD	Variance	Skewness	Kurtosis
LSA 08-04 Sys SOF	0.14	0.10 to 0.19	0.021	0.08	0.01	1.1	1.31
	Minimum	1st quartile	Median	98.71% CI	3rd quartile	Maximum	IQR
LSA 08-04 Sys SOF	0.0	0.09	0.13	0.09 to 0.22	0.18	0.3	0.09