

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

Survey Area:	LSA 12	Description:	Laydown Area, Plant Soils SEA
Survey Unit:	05	Description:	Class 1 Laydown Land Area in "Area 13"
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
L12-05-01-P-S-S-00	Uniform	S	433.3	432.8	865565	827733	Surface 6-inch grab
L12-05-02-P-R-S-00	Uniform	S	432.8	428.4	865565	827733	Root 59-inch composite
L12-05-04-P-S-S-00	Uniform	S	432.2	431.7	865565	827788	Surface 6-inch grab
L12-05-05-P-R-S-00	Uniform	S	431.7	427.2	865565	827788	Root 59-inch composite
L12-05-07-P-S-S-00	Uniform	S	432.2	431.7	865517	827761	Surface 6-inch grab
L12-05-08-P-R-S-00	Uniform	S	431.7	427.3	865517	827761	Root 59-inch composite
L12-05-10-P-S-S-00	Uniform	S	431.4	430.9	865517	827816	Surface 6-inch grab
L12-05-11-P-R-S-00	Uniform	S	430.9	426.5	865517	827816	Root 59-inch composite
L12-05-13-P-S-S-00	Uniform	S	431.3	430.8	865468	827788	Surface 6-inch grab
L12-05-14-P-R-S-00	Uniform	S	430.8	426.4	865468	827788	Root 59-inch composite
L12-05-16-P-S-S-00	Uniform	S	431.1	430.6	865468	827844	Surface 6-inch grab
L12-05-17-P-R-S-00	Uniform	S	430.6	426.2	865468	827844	Root 59-inch composite
L12-05-19-P-S-S-00	Uniform	S	431.2	430.7	865420	827872	Surface 6-inch grab
L12-05-20-P-R-S-00	Uniform	S	430.7	426.3	865420	827872	Root 59-inch composite
L12-05-22-P-S-S-00	Uniform	S	428.9	428.4	865420	827927	Surface 6-inch grab
L12-05-23-P-R-S-00	Uniform	S	428.4	423.9	865420	827927	Root 59-inch composite
L12-05-08-P-R-Q-00	Uniform	Q	431.7	427.3	865517	827761	Root 59-inch composite
L12-05-14-P-R-Q-00	Uniform	Q	430.8	426.4	865468	827788	Root 59-inch composite
L12-05-25-P-S-B-00	Uniform	B	431.0	430.5	865345.0	827819.0	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

HQP-PR-FSS-721 Final Status Survey Data Evaluation
 Steps 6.3 Preliminary Data Review and 6.4 Calculation of the Sum-of-Fractions (SOF)

Evaluate Final Status Survey Data: LSA-12-05

TotalAmerica Analytical Results Step 6.3.2

Sample ID	Depth	Date	TotalAmerica Analytical Results Step 6.3.2												Total Sulfate	Total Chloride	Total Solids	pH	Temperature	Specific Gravity	Electrical Conductivity	Total Dissolved Solids	Total Suspended Solids	Total Solids
			Calcium	Magnesium	Sulfate	Chloride	Sulfate	Chloride	Sulfate	Chloride	Sulfate	Chloride	Sulfate	Chloride										
LSA-12-05-01-01-01	1.00	1/11/12	1.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10		

Use calculated net results for all SOF Calculations Step 6.4.2

Step 6.4.1: SOF_{Ca}, SOF_{Mg}, SOF_S, SOF_{Cl}

Sample ID	SOF _{Ca}	SOF _{Mg}	SOF _S	SOF _{Cl}
LSA-12-05-01-01-01	0.00	0.00	0.00	0.00

Table with 4 columns: Parameter, Value, Unit, and Comment

Parameter	Value	Unit	Comment
Calcium	1.10	mg/L	
Magnesium	0.10	mg/L	
Sulfate	0.10	mg/L	
Chloride	0.10	mg/L	

Table with 4 columns: Parameter, Value, Unit, and Comment

Parameter	Value	Unit	Comment
Calcium	1.10	mg/L	
Magnesium	0.10	mg/L	
Sulfate	0.10	mg/L	
Chloride	0.10	mg/L	

Step 6.4.2: SOF_{Ca}, SOF_{Mg}, SOF_S, SOF_{Cl}

Sample ID	SOF _{Ca}	SOF _{Mg}	SOF _S	SOF _{Cl}
LSA-12-05-01-01-01	0.00	0.00	0.00	0.00

Step 6.4.3: SOF_{Ca}, SOF_{Mg}, SOF_S, SOF_{Cl}

Contribution for the SOF by multiplying SOF values (including contribution from SOF from SOF_{Ca} and SOF_{Mg}) by 25 times.

SOF_{Ca} = 0.00

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

WRS TEST					
SAMPLE ID	AREA (Reference, Survey Unit)	Gross SOF ($X_{i,ref}$, $Y_{i,SU}$) Step 8.5.3a	ADJUSTED SOF (Z_i) Step 8.5.3b	RANKS Step 8.5.3d	REFERENCE AREA RANKS
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
L12-05-01-P-S-S-00	Survey Unit	1.01	1.012	3	0
L12-05-04-P-S-S-00	Survey Unit	1.12	1.121	5	0
L12-05-07-P-S-S-00	Survey Unit	0.99	0.991	2	0
L12-05-10-P-S-S-00	Survey Unit	1.19	1.188	8	0
L12-05-13-P-S-S-00	Survey Unit	1.17	1.175	7	0
L12-05-16-P-S-S-00	Survey Unit	1.16	1.163	6	0
L12-05-19-P-S-S-00	Survey Unit	1.09	1.092	4	0
L12-05-22-P-S-S-00	Survey Unit	0.96	0.956	1	0
Rank Sums				820	784
# Reference Area Measurements				m	32
# Survey Unit Measurements				n	8
Total Number of Measurements Step 8.5.3c				N	40
(1-α) percentile of a standard normal distribution (MARSSIM Pg. I-10)				z	1.645
WRS Critical Value (MARSSIM Pg. I-10, Eq. I.1)				CV	705

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.	0.09
DCGL _{SOF}	1
LBGR (Mean)	0.11
Shift	0.89
Relative Shift (Δ/σ)	9.91
MARSSIM Table 5.1 (P_r)	1.000000
N	12
N + 20%	14.4
N/2	8
FSS N/2	8
Verification Check	SUFFICIENT MEASUREMENTS

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

MARSSIM Table 5.1

Δ/σ	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, $\alpha = 0.05$, $\beta = 0.10$

α (or β)	$Z_{1-\alpha}$ (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

α
 β

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

Survey Unit No.:	LSA 12-05				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 ²	Warning Limit	Control Limit	Statistic Exceeds Limit? (Y/N)
			Activity (x_i)	MDC	Activity (x_i)	MDC						
L12-05-08-P-R-S-00	L12-05-08-P-R-Q-00	Ra-226	1.08	0.0724	1.04	0.0771	1.060	1.9	0.04	0.269	0.403	N
L12-05-08-P-R-S-00	L12-05-08-P-R-Q-00	Tc-99	0.102	0.221	0.139	0.235	0.121	25.1	NA	3.552	5.321	NA
L12-05-08-P-R-S-00	L12-05-08-P-R-Q-00	Th-232	1.16	0.13	1.05	0.133	1.105	2.0	0.110	0.283	0.424	N
L12-05-08-P-R-S-00	L12-05-08-P-R-Q-00	U-234 ¹	2.317	N/A	2.491	N/A	2.404	195.4	0.173	27.649	41.425	N
L12-05-08-P-R-S-00	L12-05-08-P-R-Q-00	U-235	0.123	0.181	0.136	0.559	0.130	51.6	NA	7.301	10.939	NA
L12-05-08-P-R-S-00	L12-05-08-P-R-Q-00	U-238	1.22	0.777	0.263	1.28	0.742	168.8	NA	23.885	35.786	NA

Comments:
1. U-234 is inferred, no MDC available.
2. 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 12-05				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 ²	Warning Limit	Control Limit	Statistic Exceeds Limit? (Y/N)
			Activity (x_i)	MDC	Activity (x_i)	MDC						
L12-05-14-P-R-S-00	L12-05-14-P-R-Q-00	Ra-226	1.01	0.0695	1.07	0.0519	1.040	1.9	0.06	0.269	0.403	N
L12-05-14-P-R-S-00	L12-05-14-P-R-Q-00	Tc-99	0.0287	0.239	0.0284	0.219	0.029	25.1	NA	3.552	5.321	NA
L12-05-14-P-R-S-00	L12-05-14-P-R-Q-00	Th-232	1.14	0.122	0.775	0.221	0.958	2.0	0.365	0.283	0.424	Y
L12-05-14-P-R-S-00	L12-05-14-P-R-Q-00	U-234 ¹	1.293	N/A	1.719	N/A	1.506	195.4	0.426	27.649	41.425	N
L12-05-14-P-R-S-00	L12-05-14-P-R-Q-00	U-235	0.0673	0.485	0.0877	0.586	0.078	51.6	NA	7.301	10.939	NA
L12-05-14-P-R-S-00	L12-05-14-P-R-Q-00	U-238	0.838	0.738	1.24	0.899	1.039	168.8	0.402	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: _____

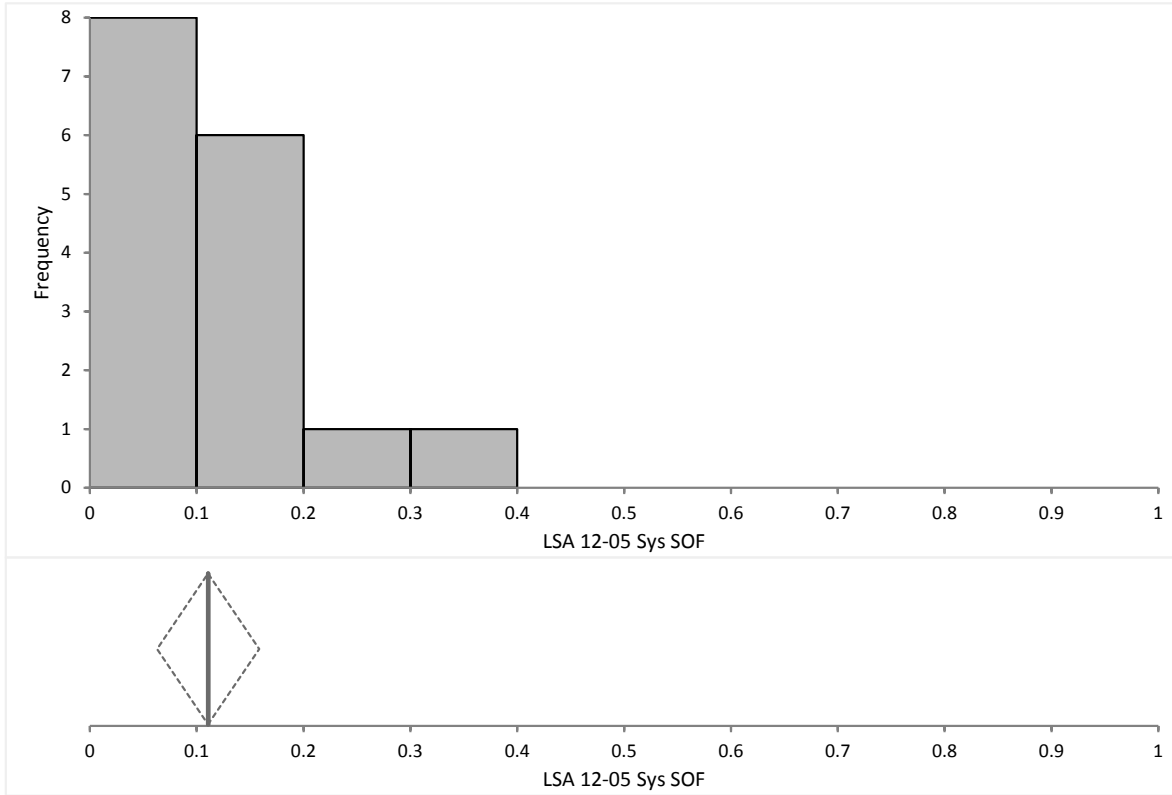
Date: _____

Quality Record

LSA 12-05 Sys SOF

0.1
0.1
0.1
0.0
0.1
0.1
0.3
0.0
0.1
0.1
0.3
0.0
0.1
0.1
0.0
0.1

Descriptives



N | 16

	Mean	95% CI	Mean SE	SD	Variance	Skewness	Kurtosis
LSA 12-05 Sys SOF	0.11	0.06 to 0.16	0.022	0.09	0.01	1.5	2.22
	Minimum	1st quartile	Median	97.87% CI	3rd quartile	Maximum	IQR
LSA 12-05 Sys SOF	0.01	0.05	0.10	0.04 to 0.14	0.13	0.3	0.08