

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 09	Description:	Plant SEA Open Land Area
Survey Unit:	01	Description:	Eastern Portion of Rail Line
Survey Type:	FSS	Classification:	Class 2

Measurement or Sample ID	Surface or CSM	Type	Start Elevation*	End Elevation*	Northing** (Y Axis)	Easting** (X Axis)	Remarks / Notes
L09-01-01-P-S-S-00	Uniform	S	432.3	431.8	864918	827780	Surface 6-inch grab
L09-01-02-P-R-S-00	Uniform	S	431.8	427.4	864918	827780	Root 53-inch composite
L09-01-03-P-E-S-00	Uniform	S	427.4	426.9	864918	827780	Excavation 6-inch grab
L09-01-04-P-S-S-00	Uniform	S	431.8	431.3	864918	827832	Surface 6-inch grab
L09-01-05-P-R-S-00	Uniform	S	431.3	426.9	864918	827832	Root 53-inch composite
L09-01-06-P-E-S-00	Uniform	S	426.9	426.4	864918	827832	Excavation 6-inch grab
L09-01-07-P-S-S-00	Uniform	S	429.2	428.7	864964	827911	Surface 6-inch grab
L09-01-08-P-R-S-00	Uniform	S	428.7	424.3	864964	827911	Root 53-inch composite
L09-01-09-P-E-S-00	Uniform	S	424.3	423.8	864964	827911	Excavation 6-inch grab
L09-01-10-P-S-S-00	Uniform	S	431.8	431.3	864964	827963	Surface 6-inch grab
L09-01-11-P-R-S-00	Uniform	S	431.3	426.9	864964	827963	Root 53-inch composite
L09-01-12-P-E-S-00	Uniform	S	426.9	426.4	864964	827963	Excavation 6-inch grab
L09-01-13-P-S-S-00	Uniform	S	428.4	427.9	865009	827990	Surface 6-inch grab
L09-01-14-P-R-S-00	Uniform	S	427.9	423.5	865009	827990	Root 53-inch composite
L09-01-15-P-E-S-00	Uniform	S	423.5	423.0	865009	827990	Excavation 6-inch grab
L09-01-16-P-S-S-00	Uniform	S	430.6	430.1	865009	828042	Surface 6-inch grab
L09-01-17-P-R-S-00	Uniform	S	430.1	425.7	865009	828042	Root 53-inch composite
L09-01-18-P-E-S-00	Uniform	S	425.7	425.2	865009	828042	Excavation 6-inch grab
L09-01-19-P-S-S-00	Uniform	S	432.3	431.8	865009	828095	Surface 6-inch grab
L09-01-20-P-R-S-00	Uniform	S	431.8	427.4	865009	828095	Root 53-inch composite
L09-01-21-P-E-S-00	Uniform	S	427.4	426.9	865009	828095	Excavation 6-inch grab
L09-01-22-P-S-S-00	Uniform	S	432.3	431.8	865055	828173	Surface 6-inch grab
L09-01-23-P-R-S-00	Uniform	S	431.8	427.4	865055	828173	Root 53-inch composite
L09-01-24-P-E-S-00	Uniform	S	427.4	426.9	865055	828173	Excavation 6-inch grab
L09-01-14-P-R-Q-00	Uniform	Q	427.9	423.5	865009	827990	Root 53-inch composite
L09-01-19-P-S-Q-00	Uniform	Q	432.3	431.8	865009	828095	Surface 6-inch grab
L09-01-25-P-S-B-00	Uniform	B	432.3	431.8	865027.0	828140.0	Biased 6-in 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

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	54	54	
9574-SS-140910-01-02	Reference	1.18	2.179	45	45	
9574-SS-140910-01-03	Reference	1.06	2.064	40	40	
9574-SS-140910-01-04	Reference	1.10	2.101	41	41	
9574-SS-140910-01-05	Reference	1.29	2.293	53	53	
9574-SS-140910-01-07	Reference	1.34	2.339	55	55	
9574-SS-140910-01-08	Reference	1.15	2.154	44	44	
9574-SS-140910-01-09	Reference	1.18	2.182	46	46	
9574-SS-140910-01-10	Reference	1.23	2.227	51	51	
9574-SS-140910-01-11	Reference	1.38	2.380	56	56	
9574-SS-140910-01-12	Reference	1.05	2.055	39	39	
9574-SS-140910-01-13	Reference	0.94	1.941	29	29	
9574-SS-140910-01-14	Reference	1.12	2.119	42	42	
9574-SS-140910-01-15	Reference	1.15	2.152	43	43	
9574-SS-140910-01-16	Reference	1.03	2.028	36	36	
9574-SS-140910-01-17	Reference	0.44	1.443	25	25	
9574-SS-140910-01-18	Reference	1.19	2.188	48	48	
9574-SS-140910-01-20	Reference	0.76	1.757	26	26	
9574-SS-140910-01-21	Reference	1.02	2.023	35	35	
9574-SS-140910-01-22	Reference	1.02	2.018	34	34	
9574-SS-140910-01-23	Reference	1.00	2.002	31	31	
9574-SS-140910-01-24	Reference	0.87	1.873	28	28	
9574-SS-140910-01-25	Reference	1.04	2.040	38	38	
9574-SS-140910-01-26	Reference	0.96	1.959	30	30	
9574-SS-140910-01-27	Reference	1.20	2.204	49	49	
9574-SS-140910-01-28	Reference	1.01	2.007	33	33	
9574-SS-140910-01-29	Reference	1.22	2.223	50	50	
9574-SS-140910-01-30	Reference	1.03	2.035	37	37	
9574-SS-140910-01-31	Reference	1.00	2.005	32	32	
9574-SS-140910-01-32	Reference	0.86	1.865	27	27	
9574-SS-140910-01-33	Reference	1.24	2.238	52	52	
9574-SS-140910-01-34	Reference	1.19	2.185	47	47	
L09-01-01-P-S-S-00	Survey Unit	0.89	0.889	6	0	No WRS test necessary
L09-01-02-P-R-S-00	Survey Unit	0.94	0.937	10	0	No WRS test necessary
L09-01-03-P-E-S-00	Survey Unit	0.97	0.971	14	0	No WRS test necessary
L09-01-04-P-S-S-00	Survey Unit	0.45	0.454	1	0	No WRS test necessary
L09-01-05-P-R-S-00	Survey Unit	0.90	0.903	8	0	No WRS test necessary
L09-01-06-P-E-S-00	Survey Unit	1.05	1.052	17	0	No WRS test necessary
L09-01-07-P-S-S-00	Survey Unit	0.89	0.894	7	0	No WRS test necessary
L09-01-08-P-R-S-00	Survey Unit	1.19	1.188	22	0	No WRS test necessary
L09-01-09-P-E-S-00	Survey Unit	1.13	1.129	21	0	No WRS test necessary
L09-01-10-P-S-S-00	Survey Unit	0.54	0.538	2	0	No WRS test necessary
L09-01-11-P-R-S-00	Survey Unit	0.91	0.906	9	0	No WRS test necessary
L09-01-12-P-E-S-00	Survey Unit	1.26	1.264	23	0	No WRS test necessary
L09-01-13-P-S-S-00	Survey Unit	0.96	0.963	13	0	No WRS test necessary
L09-01-14-P-R-S-00	Survey Unit	1.04	1.045	16	0	No WRS test necessary
L09-01-15-P-E-S-00	Survey Unit	1.09	1.090	18	0	No WRS test necessary
L09-01-16-P-S-S-00	Survey Unit	0.62	0.622	3	0	No WRS test necessary
L09-01-17-P-R-S-00	Survey Unit	0.99	0.995	15	0	No WRS test necessary
L09-01-18-P-E-S-00	Survey Unit	1.11	1.111	20	0	No WRS test necessary
L09-01-19-P-S-S-00	Survey Unit	0.69	0.692	4	0	No WRS test necessary
L09-01-20-P-R-S-00	Survey Unit	0.94	0.944	12	0	No WRS test necessary
L09-01-21-P-E-S-00	Survey Unit	1.10	1.099	19	0	No WRS test necessary
L09-01-22-P-S-S-00	Survey Unit	0.81	0.807	5	0	No WRS test necessary
L09-01-23-P-R-S-00	Survey Unit	1.39	1.393	24	0	No WRS test necessary
L09-01-24-P-E-S-00	Survey Unit	0.94	0.937	11	0	No WRS test necessary
Rank Sums				1596	1296	W_r Step 8.5.3e
# Reference Area Measurements				m	32	
# Survey Unit Measurements				n	24	
Total Number of Measurements Step 8.5.3c				N	56	
(1-α) percentile of a standard normal distribution (MARSSIM Pg. I-10)				z	1.645	$\alpha = 0.05$
WRS Critical Value (MARSSIM Pg. I-10, Eq. I.1)				CV	1012	

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

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)	0.05
Shift	0.95
Relative Shift (Δ/σ)	10.70
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 09-01				Survey Unit Description:	Eastern Portion of Rail Line						
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						
L09-01-14-P-R-S-00	L09-01-14-P-R-Q-00	Ra-226	1.02	0.0571	0.893	0.0688	0.957	1.9	0.127	0.269	0.403	N
L09-01-14-P-R-S-00	L09-01-14-P-R-Q-00	Tc-99	-0.00214	0.214	-0.0219	0.219	-0.012	25.1	NA	3.552	5.321	NA
L09-01-14-P-R-S-00	L09-01-14-P-R-Q-00	Th-232	0.995	0.117	0.965	0.0765	0.980	2.0	0.030	0.283	0.424	N
L09-01-14-P-R-S-00	L09-01-14-P-R-Q-00	U-234 ¹	0.937	N/A	0.828	N/A	0.883	195.4	0.109	27.649	41.425	N
L09-01-14-P-R-S-00	L09-01-14-P-R-Q-00	U-235	0.0472	0.298	-0.0739	0.385	-0.013	51.6	NA	7.301	10.939	NA
L09-01-14-P-R-S-00	L09-01-14-P-R-Q-00	U-238	0.785	0.781	0.828	0.775	0.807	168.8	0.043	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

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

Survey Unit No.:	LSA 09-01				Survey Unit Description:	Eastern Portion of Rail Line						
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						
L09-01-19-P-S-S-00	L09-01-19-P-S-Q-00	Ra-226	0.662	0.0933	0.754	0.0466	0.708	1.9	0.092	0.269	0.403	N
L09-01-19-P-S-S-00	L09-01-19-P-S-Q-00	Tc-99	0.0902	0.196	0.0544	0.272	0.072	25.1	NA	3.552	5.321	NA
L09-01-19-P-S-S-00	L09-01-19-P-S-Q-00	Th-232	0.657	0.0702	0.633	0.0888	0.645	2.0	0.024	0.283	0.424	N
L09-01-19-P-S-S-00	L09-01-19-P-S-Q-00	U-234 ¹	1.018	N/A	0.387	N/A	0.703	195.4	0.631	27.649	41.425	N
L09-01-19-P-S-S-00	L09-01-19-P-S-Q-00	U-235	0.0513	0.465	0.016	0.412	0.034	51.6	NA	7.301	10.939	NA
L09-01-19-P-S-S-00	L09-01-19-P-S-Q-00	U-238	0.83	0.616	0.824	0.509	0.827	168.8	0.006	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: _____

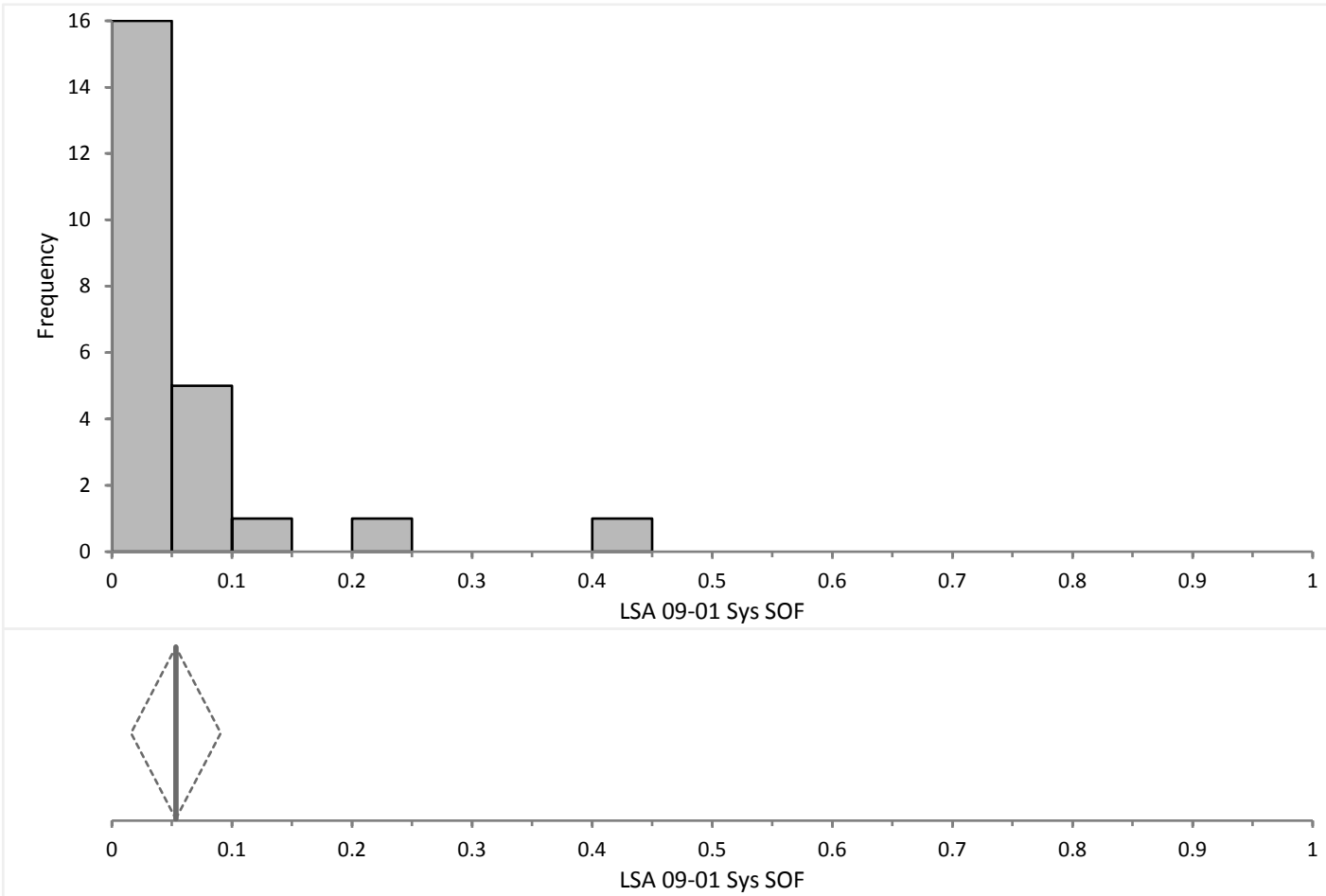
Date: _____

Quality Record

LSA 09-01 Sys SOF

0.0
0.0
0.0
0.0
0.0
0.1
0.0
0.1
0.1
0.0
0.0
0.2
0.0
0.0
0.1
0.0
0.0
0.1
0.0
0.0
0.1
0.0
0.4
0.0

Descriptives



N 24		Mean	95% CI	Mean SE	SD	Variance	Skewness	Kurtosis
LSA 09-01 Sys SOF		0.05	0.02 to 0.09	0.018	0.09	0.01	3.2	11.31
		Minimum	1st quartile	Median	97.73% CI	3rd quartile	Maximum	IQR
LSA 09-01 Sys SOF		0.001	0.01	0.02	0.01 to 0.06	0.07	0.4	0.06