

| | | | |
|--|---|--------------|---------------------------|
| Hematite Decommissioning Project | Procedure: HDP-PR-FSS-701, Final Status Survey Plan Development | | |
| | | Revision: 10 | Appendix P-4, Page 1 of 1 |

APPENDIX P-4

FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES

| | | | |
|---------------------|--------|------------------------|--------------------------------|
| Survey Area: | LSA 08 | Description: | Plant Soils SEA Open Land Area |
| Survey Unit: | 05 | Description: | Central Open Land Area |
| 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 |
|--------------------------|----------------|------|------------------|----------------|---------------------|--------------------|------------------------|
| L08-05-01-P-S-S-00 | Uniform | S | 436.9 | 436.4 | 865174.7 | 827225.5 | Surface 6-inch grab |
| L08-05-02-P-R-S-00 | Uniform | S | 436.4 | 432.0 | 865174.7 | 827225.5 | Root 4.4-ft composite |
| L08-05-04-P-E-S-00 | Uniform | S | 425.7 | 425.2 | 865174.7 | 827275.3 | Excavation 6-inch grab |
| L08-05-07-P-R-S-00 | Uniform | S | 432.8 | 431.1 | 865131.4 | 827250.4 | Root 1.7-ft composite |
| L08-05-08-P-E-S-00 | Uniform | S | 431.1 | 430.6 | 865131.4 | 827250.4 | Excavation 6-inch grab |
| L08-05-09-P-R-S-00 | Uniform | S | 432.8 | 430.9 | 865131.4 | 827300.3 | Root 1.9-ft composite |
| L08-05-10-P-E-S-00 | Uniform | S | 430.9 | 430.4 | 865131.4 | 827300.3 | Excavation 6-inch grab |
| L08-05-11-P-E-S-00 | Uniform | S | 430.0 | 429.5 | 865088.1 | 827275.3 | Excavation 6-inch grab |
| L08-05-12-P-E-S-00 | Uniform | S | 430.6 | 430.1 | 865088.1 | 827325.2 | Excavation 6-inch grab |
| L08-05-13-P-R-S-00 | Uniform | S | 432.0 | 430.5 | 865088.1 | 827375.1 | Root 1.5-ft composite |
| L08-05-14-P-E-S-00 | Uniform | S | 430.5 | 430.0 | 865088.1 | 827375.1 | Excavation 6-inch grab |
| L08-05-15-P-E-S-00 | Uniform | S | 430.5 | 430.0 | 865044.8 | 827350.1 | Excavation 6-inch grab |
| L08-05-15-P-E-Q-00 | Uniform | Q | 430.5 | 430.0 | 865044.8 | 827350.1 | Lab QA Duplicate |
| L08-05-21-P-E-Q-00 | Uniform | Q | 430.3 | 429.8 | 865094.1 | 827260.6 | Lab QA Duplicate |
| L08-05-16-P-E-B-00 | Uniform | B | 431.9 | 431.4 | 865025.9 | 827347.8 | Sidewall sample |
| L08-05-17-P-E-B-00 | Uniform | B | 436.4 | 435.9 | 865192.7 | 827249.5 | Biased 6-inch grab |
| L08-05-18-P-E-B-00 | Uniform | B | 433.7 | 433.2 | 865177.9 | 827250.6 | Biased 6-inch grab |
| L08-05-19-P-E-B-00 | Uniform | B | 435.1 | 434.6 | 865154.6 | 827247.3 | Biased 6-inch grab |
| L08-05-20-P-E-B-00 | Uniform | B | 430.4 | 429.9 | 865155.4 | 827261.7 | Biased 6-inch grab |
| L08-05-21-P-E-B-00 | Uniform | B | 430.3 | 429.8 | 865094.1 | 827260.6 | 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

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 | 42 | 42 |
| 9574-SS-140910-01-02 | Reference | 1.18 | 2.179 | 33 | 33 |
| 9574-SS-140910-01-03 | Reference | 1.06 | 2.064 | 28 | 28 |
| 9574-SS-140910-01-04 | Reference | 1.10 | 2.101 | 29 | 29 |
| 9574-SS-140910-01-05 | Reference | 1.29 | 2.293 | 41 | 41 |
| 9574-SS-140910-01-07 | Reference | 1.34 | 2.339 | 43 | 43 |
| 9574-SS-140910-01-08 | Reference | 1.15 | 2.154 | 32 | 32 |
| 9574-SS-140910-01-09 | Reference | 1.18 | 2.182 | 34 | 34 |
| 9574-SS-140910-01-10 | Reference | 1.23 | 2.227 | 39 | 39 |
| 9574-SS-140910-01-11 | Reference | 1.38 | 2.380 | 44 | 44 |
| 9574-SS-140910-01-12 | Reference | 1.05 | 2.055 | 27 | 27 |
| 9574-SS-140910-01-13 | Reference | 0.94 | 1.941 | 17 | 17 |
| 9574-SS-140910-01-14 | Reference | 1.12 | 2.119 | 30 | 30 |
| 9574-SS-140910-01-15 | Reference | 1.15 | 2.152 | 31 | 31 |
| 9574-SS-140910-01-16 | Reference | 1.03 | 2.028 | 24 | 24 |
| 9574-SS-140910-01-17 | Reference | 0.44 | 1.443 | 12 | 12 |
| 9574-SS-140910-01-18 | Reference | 1.19 | 2.188 | 36 | 36 |
| 9574-SS-140910-01-20 | Reference | 0.76 | 1.757 | 14 | 14 |
| 9574-SS-140910-01-21 | Reference | 1.02 | 2.023 | 23 | 23 |
| 9574-SS-140910-01-22 | Reference | 1.02 | 2.018 | 22 | 22 |
| 9574-SS-140910-01-23 | Reference | 1.00 | 2.002 | 19 | 19 |
| 9574-SS-140910-01-24 | Reference | 0.87 | 1.873 | 16 | 16 |
| 9574-SS-140910-01-25 | Reference | 1.04 | 2.040 | 26 | 26 |
| 9574-SS-140910-01-26 | Reference | 0.96 | 1.959 | 18 | 18 |
| 9574-SS-140910-01-27 | Reference | 1.20 | 2.204 | 37 | 37 |
| 9574-SS-140910-01-28 | Reference | 1.01 | 2.007 | 21 | 21 |
| 9574-SS-140910-01-29 | Reference | 1.22 | 2.223 | 38 | 38 |
| 9574-SS-140910-01-30 | Reference | 1.03 | 2.035 | 25 | 25 |
| 9574-SS-140910-01-31 | Reference | 1.00 | 2.005 | 20 | 20 |
| 9574-SS-140910-01-32 | Reference | 0.86 | 1.865 | 15 | 15 |
| 9574-SS-140910-01-33 | Reference | 1.24 | 2.238 | 40 | 40 |
| 9574-SS-140910-01-34 | Reference | 1.19 | 2.185 | 35 | 35 |
| L08-05-01-P-S-S-00 | Survey Unit | 1.02 | 1.023 | 2 | 0 |
| L08-05-02-P-R-S-00 | Survey Unit | 1.07 | 1.071 | 3 | 0 |
| L08-05-04-P-E-S-00 | Survey Unit | 1.26 | 1.262 | 8 | 0 |
| L08-05-07-P-R-S-00 | Survey Unit | 1.19 | 1.190 | 6 | 0 |
| L08-05-08-P-E-S-00 | Survey Unit | 1.33 | 1.329 | 10 | 0 |
| L08-05-09-P-R-S-00 | Survey Unit | 1.15 | 1.149 | 4 | 0 |
| L08-05-10-P-E-S-00 | Survey Unit | 1.18 | 1.181 | 5 | 0 |
| L08-05-11-P-E-S-00 | Survey Unit | 1.02 | 1.019 | 1 | 0 |
| L08-05-12-P-E-S-00 | Survey Unit | 1.24 | 1.238 | 7 | 0 |
| L08-05-13-P-R-S-00 | Survey Unit | 1.59 | 1.591 | 13 | 0 |
| L08-05-14-P-E-S-00 | Survey Unit | 1.44 | 1.440 | 11 | 0 |
| L08-05-15-P-E-S-00 | Survey Unit | 1.26 | 1.263 | 9 | 0 |
| Rank Sums | | | | 990 | 911 |
| # Reference Area Measurements | | | | m | 32 |
| # Survey Unit Measurements | | | | n | 12 |
| Total Number of Measurements Step 8.5.3c | | | | N | 44 |
| (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 | 783 |

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
 No WRS test necessary
 Perform WRS test
 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

| Uniform DCGL Criteria Evaluation | |
|------------------------------------|--------------------------------|
| N/2 Value Verification | |
| Isotope(s) | SOF (Ra/Tc/Th/Iso U) |
| St. Dev. | 0.15 |
| DCGL _{SOF} | 1 |
| LBGR (Mean) | 0.18 |
| Shift | 0.82 |
| Relative Shift (Δ/σ) | 5.39 |
| 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

| | | | | | | | | | | | |
|--|--|--|--|--|--|--|--|-------------|-------------|--|--|
| Hematite Decommissioning Project | Procedure: HDP-PR-FSS-703, Final Status Survey Quality Control | | | | | | | | | | |
| | | | | | | | | Revision: 2 | Page 1 of 1 | | |

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

| Survey Unit No.: | | LSA 08-05 | | | | 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 ² | Warning Limit | Control Limit | Statistic Exceeds Limit? (Y/N) | |
| | | | Activity (x _i) | MDC | Activity (x _i) | MDC | | | | | | | |
| L08-05-15-P-E-S-00 | L08-05-15-P-E-Q-00 | Ra-226 | 1.08 | 0.0586 | 1.06 | 0.0748 | 1.070 | 1.9 | 0.02 | 0.269 | 0.403 | N | |
| L08-05-15-P-E-S-00 | L08-05-15-P-E-Q-00 | Tc-99 | 5.35 | 0.201 | 5.9 | 0.204 | 5.625 | 25.1 | 0.55 | 3.552 | 5.321 | N | |
| L08-05-15-P-E-S-00 | L08-05-15-P-E-Q-00 | Th-232 | 0.915 | 0.102 | 1.03 | 0.13 | 0.973 | 2.0 | 0.115 | 0.283 | 0.424 | N | |
| L08-05-15-P-E-S-00 | L08-05-15-P-E-Q-00 | U-234 ¹ | 2.274 | N/A | 3.086 | N/A | 2.680 | 195.4 | 0.812 | 27.649 | 41.425 | N | |
| L08-05-15-P-E-S-00 | L08-05-15-P-E-Q-00 | U-235 | 0.116 | 0.267 | 0.169 | 0.22 | 0.143 | 51.6 | NA | 7.301 | 10.939 | NA | |
| L08-05-15-P-E-S-00 | L08-05-15-P-E-Q-00 | U-238 | 1.65 | 0.914 | 0.972 | 0.82 | 1.311 | 168.8 | 0.678 | 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

| | | | | | | | | | | | |
|--|--|--|--|--|--|--|--|-------------|-------------|--|--|
| Hematite Decommissioning Project | Procedure: HDP-PR-FSS-703, Final Status Survey Quality Control | | | | | | | | | | |
| | | | | | | | | Revision: 2 | Page 1 of 1 | | |

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

| Survey Unit No.: | | LSA 08-05 | | | | | 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 ² | Warning Limit | Control Limit | Statistic Exceeds Limit? (Y/N) | |
| | | | Activity (x _i) | MDC | Activity (x _i) | MDC | | | | | | | |
| L08-05-21-P-E-B-00 | L08-05-21-P-E-Q-00 | Ra-226 | 1.09 | 0.0586 | 0.98 | 0.0668 | 1.035 | 1.9 | 0.11 | 0.269 | 0.403 | N | |
| L08-05-21-P-E-B-00 | L08-05-21-P-E-Q-00 | Tc-99 | 1.68 | 0.206 | 1.29 | 0.213 | 1.485 | 25.1 | 0.39 | 3.552 | 5.321 | N | |
| L08-05-21-P-E-B-00 | L08-05-21-P-E-Q-00 | Th-232 | 1.21 | 0.105 | 1.01 | 0.103 | 1.110 | 2.0 | 0.200 | 0.283 | 0.424 | N | |
| L08-05-21-P-E-B-00 | L08-05-21-P-E-Q-00 | U-234 ¹ | 73.665 | N/A | 75.843 | N/A | 74.754 | 195.4 | 2.177 | 27.649 | 41.425 | N | |
| L08-05-21-P-E-B-00 | L08-05-21-P-E-Q-00 | U-235 | 4.06 | 0.336 | 4.18 | 0.257 | 4.120 | 51.6 | 0.12 | 7.301 | 10.939 | N | |
| L08-05-21-P-E-B-00 | L08-05-21-P-E-Q-00 | U-238 | 18.4 | 1.41 | 18.8 | 1.33 | 18.600 | 168.8 | 0.400 | 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: _____

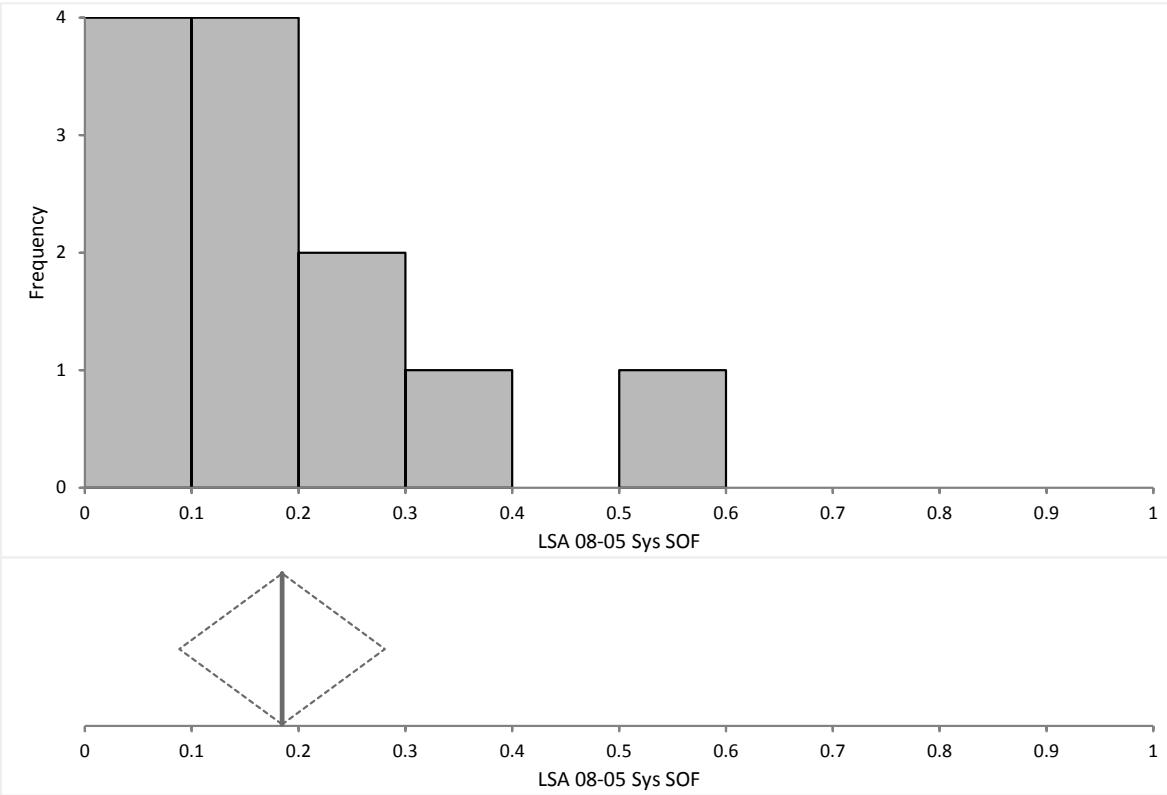
Date: _____

Quality Record

LSA 08-05 Sys SOF

0.0
0.0
0.2
0.1
0.3
0.1
0.1
0.0
0.2
0.5
0.4
0.2

Descriptives



N | 12

| | Mean | 95% CI | Mean SE | SD | Variance | Skewness | Kurtosis |
|-------------------|---------|--------------|---------|--------------|--------------|----------|----------|
| LSA 08-05 Sys SOF | 0.18 | 0.09 to 0.28 | 0.044 | 0.15 | 0.02 | 1.1 | 1.09 |
| | Minimum | 1st quartile | Median | 96.14% CI | 3rd quartile | Maximum | IQR |
| LSA 08-05 Sys SOF | 0.02 | 0.06 | 0.15 | 0.05 to 0.27 | 0.26 | 0.5 | 0.19 |