Westinghouse

Hematite Decommissioning Project

NUMBER: **HDP-INST-FSS-LSA05-02**

TITLE: **Final Status Survey Plan and Instructions for Survey Area & Unit: LSA 05-02**

REVISION: **1**

EFFECTIVE DATE: **August 12, 2013**

Approvals:

Author: Michelle E. Bresnahan

Owner: Joseph S. Guido

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

Survey Area: LSA-05 **Description:** Barns and Cistern Open Land Area
Survey Unit: 02 **Description:** Tile Barn Area

1. Verify Survey Unit Isolation & Control

a. Survey Unit properly isolated and/or controlled (indicated by outlining the area with green rope and posting the appropriate signage) as required by HDP-PR-HP-602, *Data Package Development and Isolation and Control Measures to Support Final Status Survey*? Yes☑ No☐
(If "No", discontinue survey design until area turnover requirements have been met.)

2. Evaluate Final Remedial Action Support Survey (RASS) Data

a. Number of RASS Samples: 9
b. Record analytical results and summary statistics for each RASS sample

	U-234 (pCi/g)	U-235 (pCi/g)	U-238 (pCi/g)	Tc-99 (pCi/g)	Th-232 (pCi/g)	Ra-226 (pCi/g)
Minimum	6.08E+00	1.87E-01	< MDA	NR	-1.00E+00	-1.54E-02
Maximum	3.68E+01	1.39E+00	1.25E+01	NR	3.34E-01	7.14E-01
Mean	1.40E+01	5.19E-01	2.13E+00	NR	2.72E-02	3.55E-01
Median	8.41E+00	2.59E-01	< MDA	NR	2.10E-01	3.54E-01
Standard Deviation	1.06E+01	4.43E-01	4.48E+00	NR	4.24E-01	2.23E-01

c. Are all RASS results less, or equal to the appropriate DCGLw? Yes☐ No☑

d. If "No", have remaining locations of elevated concentration been evaluated? N/A☐ Yes☑ No☐
(If "No", discontinue survey design until investigation is complete.)

e. Have elevated areas identified by gamma walkover surveys been investigated? Yes☑ No☐
(If "No", then terminate survey design and perform additional investigation and repeat the planning process)

f. Are the Initial Characterization and RASS data sufficient to support FSS Design? Yes☑ No☐
(If "No", terminate survey design, perform additional characterization or remediation and repeat the planning process.)

3. Define the Survey Unit Classification

Write a short description of the survey unit based on historical use and remedial activities:

LSA 05-02 contains the former footprint of the Tile Barn. The Tile Barn was used to store both clean and contaminated equipment throughout the facility's operating period. The building was demolished and disposed of in Spring 2011. Please see Appendix P-3 for further information over remedial activities for this area.

Classification: 1 Survey Unit Area (m^2): 1402.3

a. Has the Classification changed from the Initial Classification as indicated in DP Ch. 14? Yes☐ No☑
(If "Yes", then include a copy of Appendix P-5, *Survey Unit Classification Change Form.*)

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

b. Is the Survey Unit area less than the maximum size for the Classification? Yes☑ No☐
(If "No", then terminate survey design and evaluate dividing the survey unit into multiple survey units.)

4. Define the Surrogate Evaluation Area (SEA)

a. Select the appropriate SEA as input to calculating scan sensitivity and variability in the RASS SOF.
Plant Soils SEA ☑ Tc-99 SEA ☐ Burial Pit SEA ☐

5. Define Final Survey Unit Conditions

☐ No Excavations, Paved/Partially Paved or Excavated but not Backfilled

☑ Excavated and to be Backfilled

☐ Excavated and Backfilled

Note: If a portion of a Survey Unit is paved, then Surface Soil strata begins at the bottom of the paved surface and extends 15 cm from that point below grade. The lower depth of the Root Strata remains at 1.5 m below grade. The pavement is then treated as a separate structural Survey Unit within the Survey Area.

6. Define the Type of FSS Samples and Measurements

a. Select the appropriate types of samples and measurements for FSS of this Survey Unit that corresponds to the final condition and survey classification of the Survey Unit.

Not Excavated, Paved/Partially Paved or Excavated but not Backfilled:

☐ Surface Soil (<15cm) Samples.

☐ Root Strata Soil Samples composited from 15cm to 1.5m.

Note: If the SOF of the Root Strata sample exceeds 0.5, a composite sample is collect from 1.5 meters to an appropriate depth (deep stratum)

Excavated and to be Backfilled:

☐ Surface Soil Samples taken from any remaining surface soil strata and Root Strata Soil Samples taken at the same locations as Surface Samples, composited over the entire root strata.

☑ Root Strata Soil Samples composited from exposed grade to 1.5m and Deep Strata Soil Samples taken at the same locations as Root Samples of the top 15cm of the deep strata

☑ Deep Strata Soil Samples of the top 15 cm of the exposed Deep Strata.

Excavated and Backfilled

☐ Core through backfill layer to the lowest point where remediation occurred and composite a sample from a coring that extends one meter deeper than the lowest point where remediation occurred.

Scan Measurements:

☑ 100% Scan Coverage of Exposed Soil.

☐ _____% Scan Coverage of Exposed Soil.

☐ Other_____

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

7. Define Derived Concentration Guideline Levels (DCGL)

a. Select the appropriate DCGL for each Radionuclide of Concern (ROC) based on the corresponding SEA and the Uniform Conceptual Site Model (CSM).
- If Tc-99 was measured during the characterization/RASS survey, then the "Measure Tc-99" DCGLs will be used from Appendix A of HDP-PR-FSS-701.
- If Tc-99 was not measured in the characterization/RASS survey, then the modified U-235 DCGL ("Infer Tc-99") will be used from Appendix A HDP-PR-FSS-701.

	Surface Strata (pCi/g)	Root Strata (pCi/g)	Deep Strata [1] (pCi/g)	Uniform (pCi/g)
U-234	508.5	235.6	872.4	195.4
U-235	14.1	3	11.8	2.5
U-238	297.6	183.3	551.1	168.8
Tc-99	151	30.1	74	25.1
Th-232 + C	4.7	2	5.2	2
Ra-226 + C	5	2.1	5.4	1.9

1. The Deep Strata DCGLs correspond to the Excavation Scenario DCGL from Appendix A of HDP-PR-FSS-701.

NOTE: The Uniform DCGL will be used to calculated the number of samples in the statistical survey population.

8. Calculate the Number of Samples in the Statistical Survey Population

NOTE: The Statistical Survey Population is routinely derived based on the Uniform DCGL.
- Alternatively, if the Survey Unit excavation extends into multiple CSMs (e.g. surface, root & deep), then the DCGL(s) from the most limiting strata can be used with the equations below; OR
- If the excavation significantly extends into the deep strata, then the alternate approach presented in section 8.2.5 of HDP-PR-FSS-701 may be used for determining the mean SOF and weighted standard deviation that accounts for the reduced dose from the deeper surface, i.e., by weighting the Root stratum and Excavation $DCGL_W$ values.
- The values used in the following equations (SOF_{mean} and σ_{SOF}) can be found in the tables from Section 2b and Section 7a.

a. Calculate a mean SOF for the characterization/RASS survey data set.

$$SOF_{Mean} = \frac{Conc_{U-234}}{DCGL_{U-234}} + \frac{Conc_{U-235}}{DCGL_{U-235}} + \frac{Conc_{U-238}}{DCGL_{U-238}} + \frac{Conc_{Tc-99}}{DCGL_{Tc-99}} + \frac{Conc_{Th-232}}{DCGL_{Th-232}} + \frac{Conc_{Ra-226}}{DCGL_{Ra-226}}$$

Lower Bound of the Grey Region (LBGR) = $SOF_{Mean} = 0.49$

b. Calculate the mean and standard deviation in the SOF for the characterization/RASS survey data set.

NOTE: For the calculation of SOF_{Mean} and σ_{SOF}, include the concentration for Tc-99 if it was measured. If Tc-99 was not measured, include the modified U-235 DCGL and omit Tc-99 concentration term.

$$\sigma_{SOF} = \sqrt{\left(\left(\frac{\sigma_{U-234}}{DCGL_{U-234}}\right)^2 + \left(\frac{\sigma_{U-235}}{DCGL_{U-235}}\right)^2 + \left(\frac{\sigma_{U-238}}{DCGL_{U-238}}\right)^2 + \left(\frac{\sigma_{Tc-99}}{DCGL_{Tc-99}}\right)^2 + \left(\frac{\sigma_{Th-232}}{DCGL_{Th-232}}\right)^2 + \left(\frac{\sigma_{Ra-226}}{DCGL_{Ra-226}}\right)^2\right)}$$

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

✓ *Used in worksheet survey design*

Survey Unit σ_{SOF} = 0.31 ☑

Background σ_{SOF} = 0.16 ☐

c. Define the Decision Errors.
Type I Error = 0.05 Type II Error = 0.10
NOTE: The Type II Error is set at 0.10 initially but it may be adjusted with RSO concurrence.

d. Calculate the Relative Shift.

$$\text{Relative Shift} = \frac{1 - \text{LBGR}}{\sigma_{SOF}}$$

Relative Shift = 1.66

e. Is the Relative Shift between 1 and 3? Yes ☑ No ☐

- If "Yes", then continue to step 10f.
- If "No", then adjust the LBGR as necessary to achieve a relative shift between 1 and 3. In order to accomplish this, the LBGR may be set as low as the MDC for the analytical technique.

Adjusted LBGR = NA

Adjusted Relative Shift = 1.66

f. Determine the Number of Samples (N for the Sign test or N/2 for the WRS test) required corresponding to the Type I error, Type II Error and the Relative Shift.

- If the Sign Test has been chosen as the statistical test, then use Appendix E of HDP-PR-FSS-701 to determine N.
- If the WRS Test has been chosen as the statistical test, then use Appendix F of HDP-PR-FSS-701 to determine N/2.

No. of Samples (N or N/2) = 12

9. Calculate the Scan MDC for Total Uranium

- When U-235 is reported as negative or zero and U-238 is reported as positive, set the sample enrichment to 0.71% (natural uranium).
- When U-235 is reported as positive and U-238 is reported as negative or zero, set the sample enrichment to 100% (highly enriched).Note: When both U-235 and U-238 data are reported as positive, calculate the U-238/U-235 ratio for each sample and use Appendix G of HDP-PR-FSS-701, to determine the uranium enrichment that corresponds to the mean U-238:U-235 ratio.

a. Calculate and record the average Uranium enrichment for the survey unit using the enrichment calculated for each individual sample.

Average Enrichment (%) 75.88

NOTE: The Activity Fractions (f) for each radionuclide that corresponds to the mean enrichment in the following calculations is obtained from Appendix G of HDP-PR-FSS-701.
If the Uniform DCGL is not used, and the excavation extends into multiple CSMs (e.g. surface,

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

root & deep), then the most conservative DCGLs should be used in the following calculation.

b. Calculate a $DCGL_w$ for Total Uranium

$$DCGL_{wTotU} = \frac{1}{\frac{f_{U-234}}{DCGL_{U-234}} + \frac{f_{U-235}}{DCGL_{U-235}} + \frac{f_{U-238}}{DCGL_{U-238}}}$$

$DCGL_{wTotU}$ for Total Uranium = 54.3 ρCi/g

c. Identify the Radiological Instrument that will be used for scanning.

☑ 2"x 2" NaI Detector ☐ FIDLER NaI Detector ☐ Other_____

d. Calculate the Scan MDC for the selected instrument

NOTE: 2x2 Sodium Iodide (with surveyor efficiency factor of 0.5 and a background count rate of 10,000 cpm).
If the instrument is not a 2"x 2" NaI detector, or if the background count rate exceeds 10,000 cpm, the MDC_{scan} can be determined in accordance with DP Ch. 14, section 14.4.4.2.9 (Reference 5.1) of HDP-PR-FSS-701.

$$ScanMDC = \frac{1}{\frac{f_{U-234}}{7383\,pCi/g} + \frac{f_{U-235}}{4.9\,pCi/g} + \frac{f_{U-238}}{62.8\,pCi/g}}$$

MDC_{scan} for Total Uranium = 126.1 ρCi/g

10. Calculate the Scan MDC for Th-232 and Ra-226

a. Select the appropriate $DCGL_w$ for Th-232 and Ra-226 corresponding to the soil strata that will be exposed at the time of FSS and the SEA where the survey unit is located.

Th-232 $DCGL_w$ = 2 ρCi/g Ra-226 $DCGL_w$ = 1.9 ρCi/g

NOTE: If the Uniform DCGL is not used, and the excavation extends into multiple CSMs (e.g. surface, root & deep), then the most conservative DCGL for the strata should be used. With RSO concurrence, the alternate approach as presented in DP Ch. 14, section 14.4.3.1.10 (Reference 5.1) of HDP-PR-FSS-701 may be used in lieu of using the most conservative.

b. Identify the Radiological Instrument that will be used for scanning.

☑ 2"x 2" NaI Detector ☐ FIDLER NaI Detector ☐ Other_____

c. Calculate the Scan MDC for the selected instrument

Note: Table 6.4 of NUREG-1507 (Reference 5.8) of HDP-PR-FSS-701 has calculated an MDC_{scan} of 1.8 ρCi/g for Th-232 and 2.8 ρCi/g for Ra-226 when using a 2"x 2" NaI detector.

Note: If the selected instrument is not a 2"x 2" NaI detector, then the MDC_{scan} can be determined in accordance with DP Ch. 14, section 14.4.4.2.9 (Reference 5.1) of HDP-PR-FSS-701.

MDC_{scan} for Th-232 = 1.8 ρCi/g MDC_{scan} for Ra-226 = 2.8 ρCi/g

NOTE: If a value is not applicable, mark as N/A.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

11. Adjust the Statistical Sample Population Size (N or N/2) for Scan MDC

a. If the survey unit is either Class 2 or 3, then proceed to step 12.

b. Divide the total area of the survey unit by the Number of Samples (N or N/2) calculated in step 8f to calculate the area bounded by the statistical sample population.
Area Bounded by the Statistical Sample Population (A_{su}) = 116.9 m^2

URANIUM

c. Is the Scan MDC for the selected instrument less than the $DCGL_w$ that was calculated for Total Uranium? (compare values from step 9b and 9d) Yes☐ No☑
(If yes proceed to step 11k)

d. Using the Area Factors in Appendix H of HDP-PR-FSS-701, calculate a Total Uranium AF for each listed area using the Activity Fractions (*f*) for each radionuclide that corresponds to the mean enrichment from Appendix G of HDP-PR-FSS-701.

$$AF_{TotU} = \frac{1}{DCGL_{w,TotU} \times \left(\frac{f_{U\text{-}234}}{AF_{U\text{-}234} \times DCGL_{w,U\text{-}234}} + \frac{f_{U\text{-}235}}{AF_{U\text{-}235} \times DCGL_{w,U\text{-}235}} + \frac{f_{U\text{-}238}}{AF_{U\text{-}238} \times DCGL_{w,U\text{-}238}} \right)}$$

Area (m^2)	153375	10000	3000	1000	300	100	30	10	3	1
AF_{TotalU}	1.00	1.13	1.15	1.15	2.21	3.11	4.25	6.12	12.50	26.52

NOTE: The AFs for the Uniform strata will generally be used. The RSO may approve use of AFs from the Surface, Root or Deep CSMs, or the Excavation Scenario.

e. Find the Area Factor (AF_{TotalU}) calculated in the previous step that corresponds to the area bounded by the Statistical Sample Population (A_{su}).
AF_{TotU} for the Bounded Area (A_{su}) = 3.0

f. Multiply the $DCGL_w$ calculated for Total Uranium by the Area Factor (AF_{TotU}) to derive a $DCGL_{EMC}$ for Total Uranium.
$DCGL_{EMC}$ for Total Uranium = 164.34 pCi/g

g. Is the MDC_{scan} for the selected instrument less than the $DCGL_{EMC}$ that was calculated for Total Uranium? NA☐ Yes☑ No☐
(If "Yes" then proceed to step 11k.)

h. Calculate a new AF (AF_{EMC}) corresponding to the MDC_{scan} for the selected instrument by dividing the MDC_{scan} by the DCGLw.
AF_{EMC} for Utotal = NA

i. Find the Area (A') that corresponds to the Area Factor (AF_{EMC}).
A' for Utotal = NA

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

j. Calculate an Adjusted Number of Samples (N_{EMC}) for the Statistical Sample Population size that corresponds to the bounded A_{EMC}.

$$N_{EMC} = \frac{A_{SU}}{A'}$$

N_{EMC} corresponding to A' for Utotal = NA

THORIUM-232

k. Is the MDC_{Scan} for Th-232 less than the $DCGL_W$? Yes☑ No☐
(If "Yes" then proceed to step 11r)

l. Find the Area Factor (AF) in Appendix H that corresponds to the area bounded by the Statistical Sample Population (A_{su}).

AF_{Th-232} for the Bounded Area (A_{su}) = NA

m. Multiply the $DCGL_W$ for Th-232 by the Area Factor (AF) to derive a $DCGL_{EMC}$ for Th-232
$DCGL_{EMC}$ for Th-232 = NA ρCi/g

n. Is the MDC_{scan} for Th-232 less than the $DCGL_{EMC}$ that was calculated for Th-232?
NA☑ Yes☐ No☐

(If "Yes" then proceed to step 11r)

o. Calculate a new AF (AF_{EMC}) corresponding to the MDC_{scan} for the selected instrument by dividing the MDC_{scan} by the $DCGL_W$.
AF_{EMC} for Th-232 = NA

p. Find the Area (A') that corresponds to the Area Factor (AF_{EMC}).
A' for Th-232 = NA

NOTE: The Area Factors for Th-232 can be found in Appendix H of HDP-PR-FSS-701.

q. Calculate an Adjusted Number of Samples (N_{EMC}) for the Statistical Sample Population size that corresponds to the bounded A_{EMC}.

$$N_{EMC} = \frac{A_{SU}}{A'}$$

N_{EMC} corresponding to A' for Th-232 = NA

RADIUM-226

r. Is the MDC_{Scan} for Ra-226 less than the $DCGL_W$? Yes☐ No☑
(If "Yes" then proceed to step 12)

s. Find the Area Factor (AF) in Appendix H that corresponds to the area bounded by the Statistical Sample Population (A_{su}).
AF_{Ra-226} for the Bounded Area (A_{su}) = 3.93

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

t. Multiply the $DCGL_w$ for Ra-226 by the Area Factor (AF) to derive a $DCGL_{EMC}$ for Ra-226
$DCGL_{EMC}$ for Ra-226 = 7.47

u. Is the MDC_{scan} for Ra-226 less than the $DCGL_{EMC}$ that was calculated for Ra-226?
NA☐ Yes☑ No☐

(If "Yes" then proceed to step 12)

v. Calculate a new AF (AF_{EMC}) corresponding to the MDC_{scan} for the selected instrument by dividing the MDC_{scan} by the $DCGL_w$
AF_{EMC} for Ra-226 = NA

w. Find the Area (A') that corresponds to the Area Factor (AF_{EMC}).
A' for Ra-226 = NA

x. Calculate an Adjusted Number of Samples (N_{EMC}) for the Statistical Sample Population size that corresponds to the bounded A_{EMC}.

$$N_{EMC} = \frac{A_{SU}}{A'}$$

N_{EMC} corresponding to A' for Ra-226 = NA

12. Calculate the Grid Spacing

a. Larger of N from step 8f and the maximum value of N_{EMC} from 11j, 11q or 11x.
(N_{EMC}[max] or N) = 12

b. Is the Survey Unit a Class 3 Survey Unit?
(If "Yes", then continue to step 13)
Yes☐ No☑

c. Calculate Grid Spacing (L).

☑ Triangular Grid $L = \sqrt{\frac{Area}{.866(N \text{ or } N/2)}}$ ☐ Square Grid $L = \sqrt{\frac{Area}{(N \text{ or } N/2)}}$

Grid Spacing (L) for Survey Unit = 11.62 m

13. Generate a Survey Map

a. Assign a unique identification number to each sample in the Statistical Sample Population using the guidance and direction provided in Appendix M of HDP-PR-FSS-701.
b. Generate a graphic representation of the Survey Unit with dimensions and boundaries corresponding to the established reference coordinate system in accordance with step 8.2.10 of HDP-PR-FSS-701.
c. Using the reference coordinate system, ascertain coordinates for each sample location.
d. Designate sample locations, and location coordinates on Appendix P-4, *FSS Sample & Measurement Locations & Coordinates* and attach a copy of that form to this FSSP.
e. Attach a copy of the developed Survey Map with sample locations to this FSSP.

14. QC & Biased Samples

a. Randomly choose 5% of the Statistical Sample Population as QC Samples in accordance with

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

HDP-PR-FSS-703, *Final Status Survey Quality Control* (Reference 5.9) of HDP-PR-FSS-701.

b. Designate QC sample locations, and location coordinates on attached Appendix P-4, *FSS Sample & Measurement Locations & Coordinates.*
c. Designate if any biased samples will be taken at the discretion of the survey designer and the basis for taking them. Necessary biased samples will be explained on Appendix P-3, *FSS Sample Instructions.*
d. Using the reference coordinate system, determine coordinates for each biased sample location.
e. Designate biased sample locations, and location coordinates on attached Appendix P-4, *FSS Sample & Measurement Locations & Coordinates.*

15. Scan Coverage

a. The Survey Unit is: ☑ Class 1 ☐ Class 2 ☐ Class 3

b. Based on the Survey Unit Classification, the scan coverage in this Survey Unit is;
☑ 100% Scan Coverage of exposed soil ☐ _____% Scan Coverage of exposed soil

c. Designate any specific scan locations as determined necessary, on Appendix P-3, *FSS Sample Instructions* and attach a copy of that form to this FSSP.

16. Investigation Levels

a. The Survey Unit is: ☐ Class 3
1) Scan Investigation Levels are set at: NA cpm
Sample Investigation Levels are set at 50% of the $DCGL_W$ when expressed as the SOF.

b. The Survey Unit is: ☐ Class 2
2) Scan Investigation Levels are set at: NA cpm
Sample Investigation Levels are set at the $DCGL_W$ when expressed as the SOF.

c. The Survey Unit is: ☑ Class 1
3) Scan Investigation Levels are set at: 1762 cpm
Sample Investigation Levels are set at the $DCGL_W$ when expressed as the SOF.

17. Survey Instructions and Sample Measurement Locations and Coordinates FSSP Approval

Attach a copy of completed forms as appropriate:
☑ Appendix P-3, *FSS Survey Sample Instructions,*
☑ Appendix P-4, *FSS Sample Measurement Locations & Coordinates*
☐ Appendix P-5, *FSS Unit Classification Change Form*
☑ Appendix P-6, *FSS Field Log*
☑ Survey Unit Figure
☐ Other:

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-1
FINAL STATUS SURVEY SAMPLING PLAN FOR SOIL SURVEY UNITS

18. FSSP Approval

Prepared by :	Michelle Bresnahan (Print Name)	(Signature)	8-12-13 (Date)
Peer Reviewed by :	Rock Nevcau (Print Name)	(Signature)	8-12-13 (Date)
Approved by (RSO):	Joseph Guigo (Print Name)	(Signature)	8-12-13 (Date)

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

Survey Area: 05 **Description:** Barns and Cistern Open Land Area
Survey Unit: 02 **Description:** Tile Barn Area

Comments: REVISION 1: 8/12/2013

The Tile Barn existed on the property prior to purchase by Mallinckrodt in 1956, and is clearly evident in an aerial photograph dated 1954. During the subsequent period of licensed activities, the Tile Barn was used to store both clean and contaminated equipment, and to store emergency equipment during the commercial nuclear phase of operations. The above-grade portion of the Tile Barn was demolished during the Spring of 2011. The concrete foundation and floor of the barn were removed during the first quarter of 2013.

Beginning on May 23, 2013 and continuing through May 30 2013, FSS was performed on survey unit LSA 05-02 under instruction set HDP-INST-FSS-LSA05-02, Rev. 0 (April 18, 2013). The Nuclear Regulator Commission (NRC) in conjunction with Oak Ridge Associated Universities (ORAU) conducted confirmation surveying and sampling on June 3, 2013 through June 6, 2013 on LSA 05-02. During the confirmation survey, two additional areas of elevated measurement were found:

1. Central to the unit (where a fuel pellet fragment was discovered)
2. Unexcavated grassy area directly west of the silo footprint

Health Physics (HP) performed investigation surveys in LSA 05-02 (documented in instruction set HDP-INST-FSS-LSA05-02-01). Based on the investigation results, the project determined that further remediation of LSA 05-02 was required followed by FSS (documented in HDP-PR-FSS-721, Appendix G-4 and Corrective Action Report 13-155-W008). Remediation of LSA 05-02 continued between July and August 2013. During the remediation process RASS (remedial action support surveys) were performed. The results of the RASS are provided in Section 6.0 (RASS Data and Figures). The survey instructions below provide direction to perform the FSS.

The survey unit is classified as MARSSIM Class 1.

END OF COMMENTS

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

Gamma Walkover Survey (GWS):	
Scan Coverage	100% accessible excavation floors and walls
Scan MDC	126.0 pCi/g Total Uranium (1,352 net cpm)
Investigation Action Level (IAL)	1,762 Net CPM* * After the GWS is performed, the data collected will be examined to confirm areas exceeding the calculated IAL and statistical analysis will be performed to determine significance.

Systematic Sampling Locations:

Depth	Number of Sample	Comments
0 – 15 cm	0	None
15 cm – 1.5 m	7	
> 1.5m	12	

Biased Survey/Sampling Locations:

Biased samples may be collected: 1) during Gamma Walkover Surveys (at the discretion of the HP Technician), 2) after statistical analysis of the survey data or, 3) at the direction of Radiological Engineering.

Instrumentation

Ludlum 2221 with 44-10 (2x2 NaI) detector	Used for gamma walkover survey and to obtain static count rates at biased measurement locations.

General Instructions:

1. Summarize daily work activities on Appendix P-6. Each working day provide a description of site conditions (including the condition of isolation controls), samples collected and the status of gamma walkover surveys. In the event that a situation arises where the survey instructions cannot be followed as written, stop work and contact Radiological Engineering (or RSO) for resolution. All changes to the survey instructions shall be approved by Radiological Engineering (or RSO) before continuing work and be documented by the GWS Technician (or Radiological Engineer) in the FSS Field Log.
2. In accordance with HDP-PR-FSS-701, *Final Status Survey Plan Development (Sec. 8.4.2)*, documentation of activities performed, equipment used, potential safety hazards that may be encountered during the performance of characterization activities (along with associated controls) will be documented using the FSS Daily Task Briefing log sheet.
3. A gamma walkover survey (GWS) will be performed using a 2"x2" NaI (Tl) detector held at a distance as close as possible to the surface being surveyed. The meter will be moved in a serpentine pattern at a speed of approximately 1 foot per second or less. The gamma walkover survey will cover the percentage of the accessible surface areas within the area of interest as indicated in the table above. Notify Radiological Engineering of any areas, conditions or constraints where surveying (or subsequent sampling) may not be possible. Document the conditions and any resolutions in the FSS Field Log.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

4. A GPS system and data logger should be interfaced with the meter. The downloaded information will then be used to prepare maps illustrating relative count rates and to perform statistical analysis of the data. If a GPS data logging system is not available, contact Radiological Engineering to determine specific instructions for performing and documenting gamma walkover surveys.
5. Class 1 Open Land Survey Units will be gridded to identify the systematic sampling locations. Each sample location will have associated GPS coordinates specified. In the case of inaccessible sampling locations, the sample location will be relocated within a radial distance of 2 feet of the original sample location.
6. Verify that isolation controls established in accordance with HDP-PR-HP-602 are in place prior to the start of FSS.
7. Perform daily pre and post QC source checks in accordance with HDP-PR-HP-416.
8. A map of the survey unit showing predetermined sample locations is provided. Additional (biased) sampling may be required, based on results of the GWS, at the discretion of the HP Technician based on field conditions, or as determined by Radiological Engineering. Statistical analysis of the survey/sampling data will be used to help identify locations for biased soil sampling. Biased soil samples will be collected in a manner similar to systematic soil sampling locations. Record the location of biased samples on the FSS Field Log.
9. At each systematic soil sampling location a composite soil sample will be collected from each location and depth listed on Appendix P-4. 0, 0 – 15 cm (surface), 7, 15 cm – 1.5 m (root) and 12, > 1.5 m (deep) samples will be collected.
10. Care should be exercised to ensure the entire sample is included from within the depths specified for sampling. When collecting the composite samples, vegetation and native debris/rocks with a diameter greater than 1 inch should be discarded.
11. All samples collected as part of this survey will be analyzed at an off-site laboratory by gamma spectroscopy for uranium and gamma emitting radionuclides (Th-232, Am-241, etc.), and for technetium-99 by liquid scintillation counting or ICPMS.

Specific Instructions:

NOTE: Unless otherwise indicated, the performance of these specific instructions is the responsibility of the HP Technician.

Before Beginning Work

1. **Rad. Engineer/HP Technician:** Verify and document (each shift) that isolation controls established in accordance with HDP-PR-HP-602 are in place prior to the start of FSS using the Daily Task Briefing log sheet.
2. **Rad. Engineer/HP Technician:** Perform a daily task-specific briefing; documenting the attendants, planned work activities, anticipated hazards, and controls on the FSS Daily Task Briefing log sheet. Retain all completed daily briefing log sheets in the Field Log section of this package.

   NOTE: If soil sampling to a depth greater than one foot is required, ensure HDP Safety & Health are aware of the activity, an Excavation Permit (Form HDP-PR-EHS-021-1) has been performed for the work area, and underground utilities have been identified

Gamma Walkover Survey (GWS)

3. Establish a general area background, in accordance with HDP-PR-FSS-711.
4. Perform a gamma walkover of the survey unit holding the probe as close to the surface as possible, in accordance with HDP-PR-FSS-711.
   a. Look and/or listen for locations that exhibit anomalous readings (e.g., count rates in excess of the area background count rate and/or count rates that exceed the IAL for this unit).
   b. Mark the location(s) exhibiting anomalous readings to facilitate possible future investigations (for example, use a flag, stake, or other marking resistant to anticipated environmental conditions).

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

5. At each location where anomalous readings occur, perform a more detailed point survey of the area. Pause and place the survey probe as close as possible to the surface to define and record the total count rate associated with the area of interest on the Field Log.

   NOTE: If field conditions limit the ability to perform contact readings, collect readings as close as practical. Contact HP Supervisor (or Radiological Engineering) regarding the issue for each location. The HP Technician, HP Supervisor and/or Radiological Engineer will log the issue (and resolution) for each location in the FSS Field Log and on applicable HDP survey forms.

6. **GPS (and associated data logger) is the preferred method for performing GWS.**

   When a GPS and data logger is used, down load and provide the survey data to a GIS Specialist.

   a. **GIS Specialist**: Provide colorimetric maps indicating survey coverage and measurements exceeding the IAL and send the survey data to Radiological Engineering.

   b. **Radiological Engineering**: Provide statistical analysis to determine population characteristics of the survey data set and identify any areas requiring additional surveys or sampling. Contact HP Technician to mark additional locations requiring survey or sampling as described above in Step 5 of these Specific Instructions.

   If a GPS and data logger cannot be used to perform GWS in any portion of this survey unit, the HP Technician will contact Radiological Engineering to determine compensatory survey methods. Radiological Engineering will log the compensatory methods in the FSS Survey Log.

Sampling

7. Obtain soil samples at locations and depths identified in Appendix P-4 and at locations specified by Radiological Engineering in accordance with HDP-PR-FSS-711.
8. Collect one duplicate sample for every 20 samples. Collect a minimum of one duplicate sample is required for each survey unit.
9. Submit samples for analysis following sample chain of custody requirements contained in HDP-PR-QA-006.
10. When performing biased sampling, monitor the count rate within the depression created by the biased surface soil sample.
    a. If the count rate within the depression exceeds the count rate on the surface by a factor two, then collect an additional soil sample from a depth of 15 cm – 30 cm.
    b. Monitor the count rate within the depression created at each location requiring a second biased soil sample.
11. Monitor the count rates observed at all accessible surfaces within close proximity (e.g., 2 meter diameter) of each biased sampling location, as practical. Note any accessibility issues and discuss compensatory measures with supervision.
    a. Contact and brief Radiological Engineering (or HP Supervision) on the results obtained from monitoring the locations of biased sampling to receive instructions for further investigation or the need for additional excavation.

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

Required Additional Surveys

NOTE: The following items were identified in LSA 05-02 that require survey. The surveys will be performed in accordance with HDP-PR-HP-311 and will be compared to the limits found in document *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material.*

1) Storm drain (located in the NW corner) adjacent to Highway P;
2) Concrete associated with storm drain pipe (located in the NW corner) adjacent to Highway P;
3) Concrete curb (located due N) adjacent to the storm drain and Highway P;
4) Utility junction box (located due N) adjacent to Highway P;
5) Concrete Footer (located in the center of the unit)

Meters B, I or D (Ludlum 2360 w/ 43-89) will be selected to perform the following surveys. See attached sheets (Minimum Detectable Concentration (MDC) Worksheet) for scan MDC and IAL calculations.

Surface Contamination Survey (SCS):	
Scan Coverage	100% exposed surfaces
Meter B: Alpha Scan MDC	82 dpm/100cm^2
Meter B: Beta Scan MDC	2,057 dpm/100cm^2
Meter B: Alpha Investigation Action Level (IAL)	15 Net CPM
Meter B: Beta Investigation Action Level (IAL)	218 Net CPM
Meter I: Alpha Scan MDC	110 dpm/100cm^2
Meter I: Beta Scan MDC	2,725 dpm/100cm^2
Meter I: Alpha Investigation Action Level (IAL)	19 Net CPM
Meter I: Beta Investigation Action Level (IAL)	252 Net CPM
Meter D: Alpha Scan MDC	169 dpm/100cm^2
Meter D: Beta Scan MDC	2,023 dpm/100cm^2
Meter D: Alpha Investigation Action Level (IAL)	27 Net CPM
Meter D: Beta Investigation Action Level (IAL)	217 Net CPM
Systematic Surface Contamination Measurements:	
Number of Locations	
The number of measurements is dependent on the size of the item. A minimum of one measurement will be performed. * A measurement will be performed on the surface of the item approximately every linear meter.	
Biased Surface Contamination Measurements:	
If a scan result is greater than either the alpha or beta IAL listed above, take a static measurement and a removable activity smear. If the item scanned is concrete (e.g. footer, curb, etc.), collect 3 volumetric samples from 0" to 0.25" depth at locations with the highest static measurements. Volumetric samples will be sent to an offsite laboratory for analysis by gamma spectroscopy and liquid scintillation or ICPMS for Tc-99.	
Instrumentation	
Ludlum 2360 w/ 43-89	Used for direct alpha and beta measurements and surface contamination scan surveys.

JAB 8/14/13 * Note: See Field Log for changes to the number of measurements taken on the Concrete Footer (item 5).

12. Perform daily pre QC source check on the instrument used in accordance with HDP-PR-HP-411. Perform a post QC source

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-3
FSS SAMPLE INSTRUCTIONS

check in the same manner you would perform a pre QC source check. Note in the comment section of Form HDP-PR-HP-411-4 when post QC check is performed.

13. Perform 3 background measurements in alpha mode and 3 background measurements in beta mode in the general location of the area to be surveyed. The average of the 3 measurements for alpha and the 3 measurements for beta will be the field background used.
14. Perform a surface contamination scan survey over 100% of the exposed concrete surfaces in accordance with HDP-PR-HP-311. Hold the detector as close as possible to the surface being surveyed. Move the meter at a speed of approximately 3 inches per second.
15. Perform static surface contamination measurements at systematic locations defined ~~on Appendix P-4~~ in the above table PHS 8/13/13 in accordance with HDP-PR-HP-311. At each measurement location a 1 minute static count will be performed.
16. If results in excess of the IAL are found, follow the instructions listed above under Biased Surface Contamination Measurements.
17. In the locations where a static surface contamination measurement is taken, collect a removable activity smear survey in accordance with HDP-PR-HP-311.
18. Document all surveys performed on items found in the survey unit on Form HDP-PR-HP-311-1.

Prepared by:	Michelle Bresnahan (Print Name)	(Signature)	8/12/13 (Date)
Peer Reviewed by:	Rick Neveau (Print Name)	(Signature)	08-12-13 (Date)
Approved by (RSO):	Joseph Grow (Print Name)	(Signature)	8-12-13 (Date)

HDP-PR-FSS-701, Final Status Survey Plan Development
APPENDIX P-4
FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES

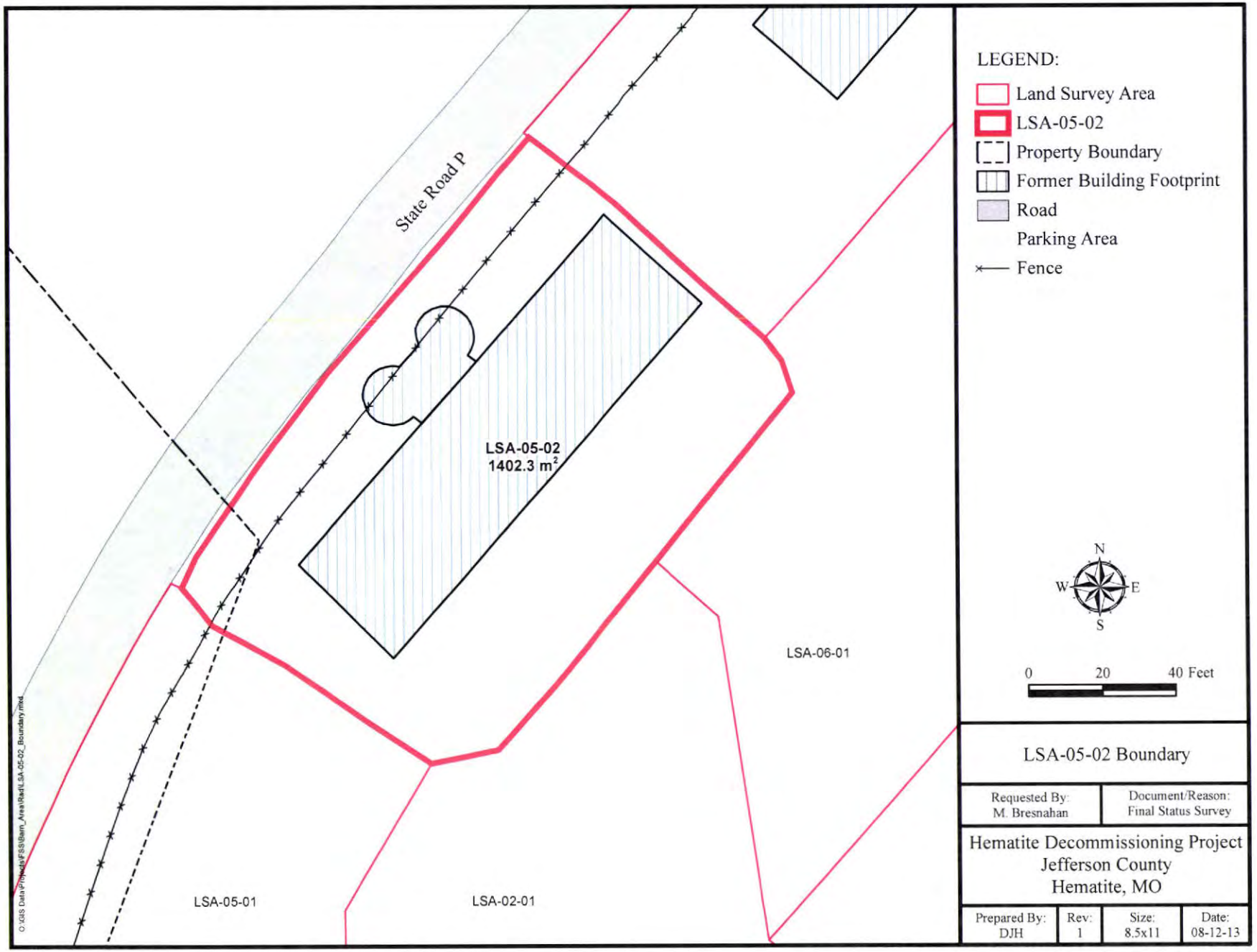
Survey Area: No. 05 **Description:** Barns and Cistern Open Land Area

Survey Unit: No. 02 **Description:** Tile Barn Area

Survey Type: Soil Sampling **Classification:** 1

Measurement or Sample ID	Surface or CSM	Type	Start Depth (feet)	End Depth (feet)	Easting (X axis)	Northing (Y axis)
L050247PRS00	Root	S	0	4.5	826664.3	854784.4
L050248PES00	Deep	S	4.5	5	826664.3	854784.4
L050249PRS00	Root	S	0	4	826637.4	864757.5
L050250PES00	Deep	S	4	4.5	826637.4	864757.5
L050251PRS00	Root	S	0	1	826674.1	864747.7
L050252PES00	Deep	S	1	1.5	826674.1	864747.7
L050253PES00	Deep	S	0	0.5	826710.8	864737.8
L050254PES00	Deep	S	0	0.5	826647.2	864720.8
L050255PES00	Deep	S	0	0.5	826683.9	864711.0
L050256PRS00	Root	S	0	0.5	826620.4	864693.9
L050257PES00	Deep	S	0.5	1	826620.4	864693.9
L050258PES00	Deep	S	0	0.5	826657.1	864684.1
L050259PRQ00	Root	Q	0	3.5	826693.8	864674.3
L050259PRS00	Root	S	0	3.5	826693.8	864674.3
L050260PES00	Deep	S	3.5	4	826693.8	864674.3
L050261PRS00	Root	S	0	2	826593.5	864667.1
L050262PES00	Deep	S	2	2.5	826593.5	864667.1
L050263PES00	Deep	S	0	0.5	826630.2	864657.2
L050264PRS00	Root	S	0	1	826666.9	864647.4
L050265PES00	Deep	S	1	1.5	826666.9	864647.4

* Distance in feet from southwest corner of the surface.
Surface; Floor = F, Wall = W, Ceiling = C, Roof = R
CSM; Surface, Root, Deep or Uniform
Type; Systematic = S, QC = Q, Biased = B, Investigation = I

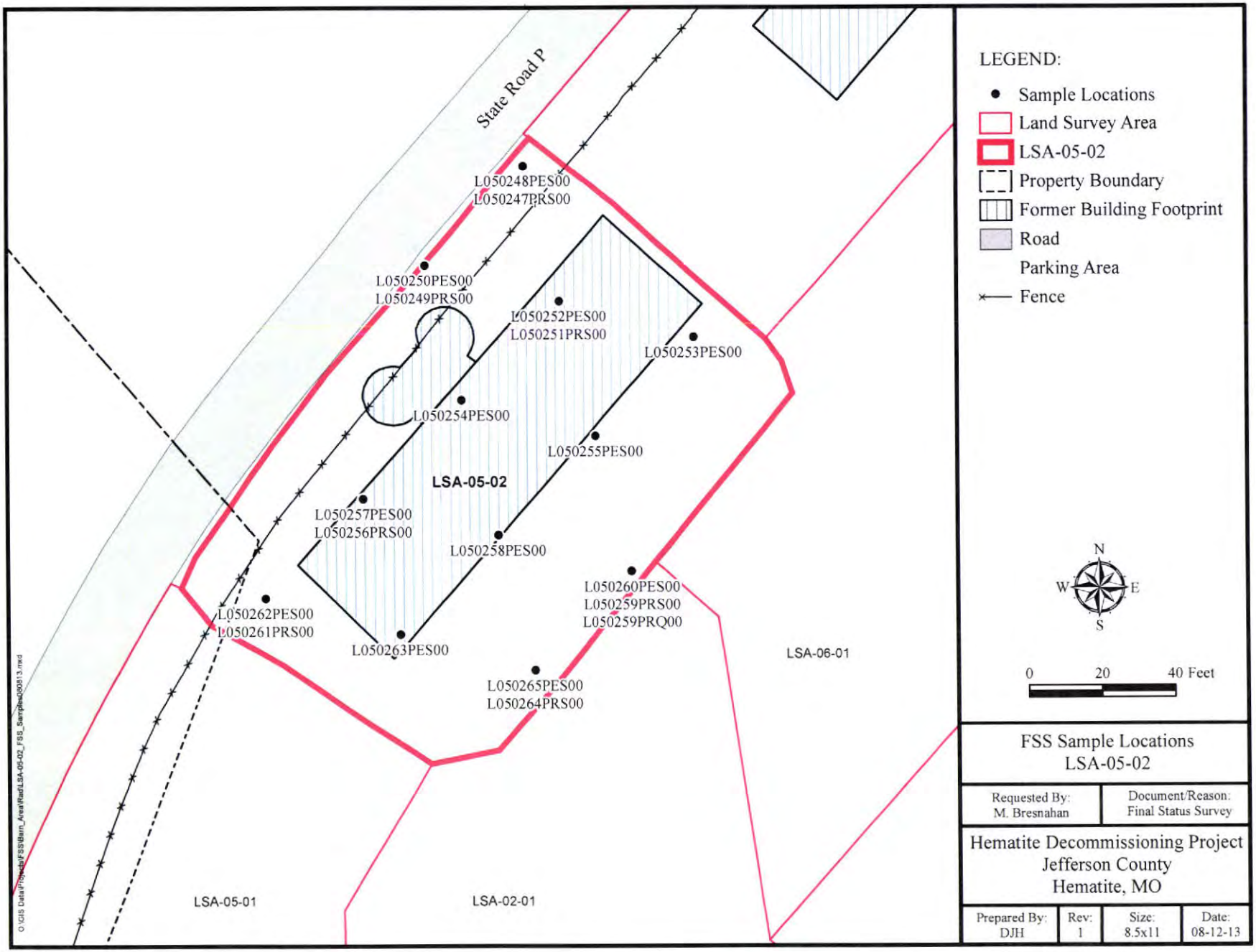


LSA-05-02 Boundary

Requested By:	Document/Reason:
M. Bresnahan	Final Status Survey

Hematite Decommissioning Project
Jefferson County
Hematite, MO

Prepared By:	Rev:	Size:	Date:
DJH	1	8.5x11	08-12-13


State Road P
L050248PES00
L050247PRS00
L050250PES00
L050249PRS00
L050252PES00
L050251PRS00
L050253PES00
L050254PES00
L050255PES00
LSA-05-02
L050257PES00
L050256PRS00
L050258PES00
L050260PES00
L050259PRS00
L050259PRQ00
L050262PES00
L050261PRS00
L050263PES00
L050265PES00
L050264PRS00
LSA-06-01
LSA-05-01
LSA-02-01
LEGEND:
Sample Locations
Land Survey Area
LSA-05-02
Property Boundary
Former Building Footprint
Road
Parking Area
Fence
N
W
E
S
0
20
40 Feet
FSS Sample Locations
LSA-05-02
Requested By:
M. Bresnahan
Document/Reason:
Final Status Survey
Hematite Decommissioning Project
Jefferson County
Hematite, MO
Prepared By:
DJH
Rev:
1
Size:
8.5x11
Date:
08-12-13