APPENDIX P-4
FSS SAMPLE & MEASUREMENT LOCATIONS & COORDINATES

Survey Area: LSA 09 **Description:** Open Land Area, Tc-99 SEA
Survey Unit: 02 **Description:** Central Open Land Area Survey Unit in "Area 12"
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
L09-02-01-P-S-S-00	Uniform	S	434.2	433.7	864732	827483	Surface 6-inch grab
L09-02-02-P-R-S-00	Uniform	S	433.7	429.3	864732	827483	Root 4.4-ft composite
L09-02-04-P-S-S-00	Uniform	S	434.2	433.7	864753	827514	Surface 6-inch grab
L09-02-05-P-R-S-00	Uniform	S	433.7	429.3	864753	827514	Root 4.4-ft composite
L09-02-06-P-E-S-00	Uniform	S	429.3	428.8	864753	827514	Excavation 6-inch grab
L09-02-07-P-S-S-00	Uniform	S	434.1	433.6	864771	827540	Surface 6-inch grab
L09-02-08-P-R-S-00	Uniform	S	433.6	429.2	864771	827540	Root 4.4-ft composite
L09-02-10-P-S-S-00	Uniform	S	434.2	433.7	864820	827587	Surface 6-inch grab
L09-02-11-P-R-S-00	Uniform	S	433.7	429.3	864820	827587	Root 4.4-ft composite
L09-02-13-P-S-S-00	Uniform	S	433.2	432.7	864842	827616	Surface 6-inch grab
L09-02-14-P-R-S-00	Uniform	S	432.7	428.3	864842	827616	Root 4.4-ft composite
L09-02-16-P-S-S-00	Uniform	S	431.5	431.1	864846	827649	Surface 6-inch grab
L09-02-17-P-R-S-00	Uniform	S	431.1	426.6	864846	827649	Root 4.4-ft composite
L09-02-19-P-S-S-00	Uniform	S	432.7	432.2	864886	827714	Surface 6-inch grab
L09-02-20-P-R-S-00	Uniform	S	432.2	427.8	864886	827714	Root 4.4-ft composite
L09-02-21-P-E-S-00	Uniform	S	427.8	427.3	864886	827714	Excavation 6-inch grab
L09-02-22-P-S-S-00	Uniform	S	432.2	431.7	864899	827733	Surface 6-inch grab
L09-02-23-P-R-S-00	Uniform	S	431.7	427.3	864899	827733	Root 4.4-ft composite
L09-02-24-P-E-S-00	Uniform	S	427.3	426.8	864899	827733	Excavation 6-inch grab
L09-02-01-P-S-Q-00	Uniform	Q	434.2	433.7	864732	827483	Surface 6-inch grab
L09-02-16-P-S-Q-00	Uniform	Q	431.5	431.1	864846	827649	Surface 6-inch grab
L09-02-25-P-S-B-00	Uniform	B	434.2	433.7	864868	827780	Biased 6-in grab
L09-02-26-P-S-B-00	Uniform	B	430.0	430.0	864802	827575	Sidewall sample

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] (Open Land Area) OR
Distance in feet from lower left corner of the surface (Structures); each surface has it's own (X,Y) = (0,0); OR
For piping the distance from the beginning of the survey unit.
Surface: Floor = F; Wall = W; Ceiling = C; Roof = R
CSM: Three-Layer (Surface-Root-Deep) or Uniform
Type: Systematic = S, Biased = B; QC =Q; Investigation = I

Quality Record

HDP-PR-FSS-721 *Final Status Survey Data Evaluation*
Steps 8.3 Preliminary Data Review and 8.4 Calculation of the Sum-of-Fractions (SOF)

TestAmerica Analytical Results Step 8.3.2

Sample ID	Sample Start Depth (ft)	Type (Systematic, Bias, QC)	Ra-226 Result	Ra-226 Uncertainty	Ra-226 MDC	Ra-226 Qualifier	Ra-226 Net Result*	Ra-226 Corrected Result	Tc-99 Result	Tc-99 Corrected Result	Tc-99 Uncertainty	Tc-99 MDC	Tc-99 Qualifier
L09-02-01-P-S-S-00	0.00	S	0.847	0.12	0.0543	N/A	-0.223	0.000	1.81	1.810	1.95	0.464	N/A
L09-02-02-P-R-S-00	0.50	S	1.2	0.16	0.0725	N/A	0.130	0.130	2.84	2.840	0.28	0.227	N/A
L09-02-04-P-S-S-00	0.00	S	0.704	0.11	0.052	N/A	-0.366	0.000	0.422	0.422	0.09	0.237	N/A
L09-02-05-P-R-S-00	0.50	S	1.17	0.17	0.0717	N/A	0.100	0.100	13.8	13.800	1.27	0.21	N/A
L09-02-06-P-E-S-00	5.00	S	1.09	0.18	0.0938	N/A	0.020	0.020	4.38	4.380	0.43	0.234	N/A
L09-02-07-P-S-S-00	0.00	S	0.852	0.15	0.0783	N/A	-0.218	0.000	23	23.000	2.16	0.242	N/A
L09-02-08-P-R-S-00	0.50	S	1	0.14	0.0599	N/A	-0.070	0.000	6.82	6.820	0.69	0.254	N/A
L09-02-10-P-S-S-00	0.00	S	0.85	0.14	0.0648	N/A	-0.220	0.000	9.38	9.380	0.94	0.226	N/A
L09-02-11-P-R-S-00	0.50	S	1.04	0.14	0.0502	N/A	-0.030	0.000	3.12	3.120	0.34	0.238	N/A
L09-02-13-P-S-S-00	0.00	S	1.03	0.15	0.0608	N/A	-0.040	0.000	9.25	9.250	1	0.267	N/A
L09-02-14-P-R-S-00	0.50	S	1.1	0.17	0.0712	N/A	0.030	0.030	1.58	1.580	0.27	0.237	N/A
L09-02-16-P-S-S-00	0.00	S	1.25	0.16	0.0573	N/A	0.180	0.180	1.92	1.920	0.22	0.231	N/A
L09-02-17-P-R-S-00	0.50	S	0.967	0.14	0.0704	N/A	-0.103	0.000	0.803	0.803	0.24	0.232	N/A
L09-02-19-P-S-S-00	0.00	S	0.135	0.04	0.0303	N/A	-0.935	0.000	0.066	0.066	0.04	0.178	U
L09-02-20-P-R-S-00	0.50	S	0.207	0.04	0.0242	N/A	-0.863	0.000	0.0174	0.017	0.02	0.174	U
L09-02-21-P-E-S-00	5.00	S	0.209	0.05	0.0216	N/A	-0.861	0.000	0.0054	0.005	0.03	0.18	U
L09-02-22-P-S-S-00	0.00	S	0.88	0.13	0.0619	N/A	-0.190	0.000	0.35	0.350	0.06	0.225	N/A
L09-02-23-P-R-S-00	0.50	S	0.721	0.12	0.0673	N/A	-0.349	0.000	0.203	0.203	0.1	0.226	U
L09-02-24-P-E-S-00	5.00	S	0.69	0.12	0.068	N/A	-0.380	0.000	0.116	0.116	0.09	0.219	U
L09-02-01-P-S-Q-00	0.00	Q	0.636	0.11	0.0604	N/A	-0.434	0.000	0.0821	0.082	0.03	0.228	U
L09-02-16-P-S-Q-00	0.00	Q	0.999	0.16	0.071	N/A	-0.071	0.000	2.39	2.390	0.27	0.232	N/A
L09-02-25-P-S-B-00	0.00	B	0.287	0.05	0.0281	N/A	-0.783	0.000	0.116	0.116	0.02	0.186	U
L09-02-26-P-S-B-00	4.20	B	0.943	0.16	0.0822	N/A	-0.127	0.000	0.156	0.156	0.11	0.23	U

Sample ID	Th-232 Result	Th-232 Uncertainty	Th-232 MDC	Th-232 Qualifier	Th-232 Net Result**	Th-232 Corrected Result	Inferred U-234 Result	Inferred U-234 Uncertainty	Inferred U-234 MDC	Inferred U-234 Qualifier	U-235 Result	U-235 Uncertainty	U-235 MDC	U-235 Qualifier	U-238 Result	U-238 Uncertainty	U-238 MDC	U-238 Qualifier
L09-02-01-P-S-S-00	0.969	0.169	0.0967	N/A	-0.031	0.000	1.420	NA	NA	NA	0.07	0.248	0.447	U	1.26	0.623	0.732	NA
L09-02-02-P-R-S-00	1.11	0.165	0.145	N/A	0.110	0.110	5.387	NA	NA	NA	0.293	0.148	0.195	NA	1.94	0.578	0.815	NA
L09-02-04-P-S-S-00	0.861	0.126	0.0903	N/A	-0.139	0.000	0.852	NA	NA	NA	0	0.285	0.472	U	0.852	0.503	0.64	NA
L09-02-05-P-R-S-00	0.984	0.169	0.134	N/A	-0.016	0.000	3.169	NA	NA	NA	0.174	0.12	0.17	NA	0.933	0.307	0.813	NA
L09-02-06-P-E-S-00	1.09	0.183	0.0732	N/A	0.090	0.090	0.869	NA	NA	NA	0.036	0.052	0.634	U	1.7	0.819	1	NA
L09-02-07-P-S-S-00	0.83	0.172	0.0752	N/A	-0.170	0.000	3.369	NA	NA	NA	0.186	0.139	0.177	NA	0.58	0.281	0.747	U
L09-02-08-P-R-S-00	0.893	0.156	0.113	N/A	-0.107	0.000	8.094	NA	NA	NA	0.447	0.159	0.188	NA	1.7	0.533	0.755	NA
L09-02-10-P-S-S-00	0.805	0.165	0.0783	N/A	-0.195	0.000	8.908	NA	NA	NA	0.489	0.203	0.241	NA	1.1	0.342	0.897	NA
L09-02-11-P-R-S-00	0.998	0.157	0.0941	N/A	-0.002	0.000	2.846	NA	NA	NA	0.154	0.099	0.155	U	1.15	0.47	0.702	NA
L09-02-13-P-S-S-00	0.949	0.165	0.132	N/A	-0.051	0.000	5.685	NA	NA	NA	0.314	0.183	0.218	NA	1.12	0.368	0.898	NA
L09-02-14-P-R-S-00	1.17	0.188	0.101	N/A	0.170	0.170	0.901	NA	NA	NA	0	0.072	0.664	U	0.901	0.384	0.984	U
L09-02-16-P-S-S-00	1.09	0.186	0.104	N/A	0.090	0.090	3.600	NA	NA	NA	0.198	0.125	0.192	NA	0.988	0.32	0.839	NA
L09-02-17-P-R-S-00	1.12	0.167	0.0902	N/A	0.120	0.120	1.530	NA	NA	NA	0	0.322	0.534	U	1.53	0.53	0.768	NA
L09-02-19-P-S-S-00	0.05	0.053	0.0597	U	-0.950	0.000	0.281	NA	NA	NA	0	0.058	0.222	U	0.281	0.214	0.281	NA
L09-02-20-P-R-S-00	0.169	0.051	0.0318	N/A	-0.831	0.000	0.358	NA	NA	NA	0.011	0.131	0.22	U	0	0.318	0.537	U
L09-02-21-P-E-S-00	0.077	0.053	0.0995	U	-0.923	0.000	0.261	NA	NA	NA	0	0.077	0.285	U	0.261	0.141	0.354	U
L09-02-22-P-S-S-00	0.918	0.135	0.0915	N/A	-0.082	0.000	1.195	NA	NA	NA	0.057	0.11	0.475	U	1.24	0.481	0.715	NA
L09-02-23-P-R-S-00	1.03	0.153	0.0705	N/A	0.030	0.030	1.130	NA	NA	NA	0	0.1	0.299	U	1.13	0.499	0.748	NA
L09-02-24-P-E-S-00	1.06	0.179	0.115	N/A	0.060	0.060	2.606	NA	NA	NA	0.139	0.118	0.189	U	1.32	0.584	0.882	NA
L09-02-01-P-S-Q-00	0.759	0.137	0.0867	N/A	-0.241	0.000	0.688	NA	NA	NA	0.036	0.208	0.322	U	0.46	0.245	0.684	U
L09-02-16-P-S-Q-00	1.17	0.187	0.0876	N/A	0.170	0.170	4.770	NA	NA	NA	0.263	0.149	0.2	NA	1.14	0.567	0.867	NA
L09-02-25-P-S-B-00	0.199	0.063	0.092	N/A	-0.801	0.000	1.440	NA	NA	NA	0.079	0.072	0.283	U	0.483	0.263	0.402	NA
L09-02-26-P-S-B-00	1.22	0.24	0.125	N/A	0.220	0.220	1.919	NA	NA	NA	0.098	0.186	0.31	U	1.41	0.604	0.904	NA

	Ra-226	Tc-99	Th-232	Inferred U-234	U-235	U-238
Systematic Minimum	0.000	0.005	0.000	0.261	0.000	0.000
Systematic Maximum	0.180	23.000	0.170	8.908	0.489	1.940
Systematic Mean	0.024	4.204	0.035	2.761	0.135	1.052
Systematic Median	0.000	1.810	0.000	1.530	0.070	1.120
Systematic Standard Deviation	0.052	6.014	0.054	2.585	0.155	0.509
Step 8.3.3						
Step 8.4.2	With ingrowth, use Ra226 bkg = 1.07		Th232 bkg = 1.0			

NOTES:
Gross results in units of pCi/g
* Background with ingrowth (1.07 pCi/g) subtracted from gross result
**Background (1.0 pCi/g) subtracted from gross result
U qualifier: A normal, non-detected result (result less than MDC).
All uncertainty values are reported at the 2-sigma confidence level.

Sample ID	Sample Depth (ft)	Type (Systematic, Bias, QC)	Enr. Enrichment (%)	SOF Step 8.4.3	Is Sample in the Root Stratum?	Is ROOT Sample SOF > 0.5?	root count	excavation count	surface count	MDC SOF Step 8.1.1.c
L09-02-01-P-S-S-00	0.00	S	0.9	0.02	SURFACE	good			1	0.06
L09-02-02-P-R-S-00	0.50	S	2.3	0.25	ROOT	good	1			0.14
L09-02-04-P-S-S-00	0.00	S	0.7	0.01	SURFACE	good			1	0.04
L09-02-05-P-R-S-00	0.50	S	2.9	0.53	ROOT	FLAG	1			0.13
L09-02-06-P-E-S-00	5.00	S	0.4	0.08	EXCAVATION	good		1		0.06
L09-02-07-P-S-S-00	0.00	S	4.8	0.16	SURFACE	good			1	0.04
L09-02-08-P-R-S-00	0.50	S	4.0	0.28	ROOT	good	1			0.11
L09-02-10-P-S-S-00	0.00	S	6.5	0.09	SURFACE	good			1	0.05
L09-02-11-P-R-S-00	0.50	S	2.1	0.12	ROOT	good	1			0.10
L09-02-13-P-S-S-00	0.00	S	4.2	0.08	SURFACE	good			1	0.05
L09-02-14-P-R-S-00	0.50	S	0.7	0.16	ROOT	good	1			0.11
L09-02-16-P-S-S-00	0.00	S	3.1	0.08	SURFACE	good			1	0.05
L09-02-17-P-R-S-00	0.50	S	0.7	0.10	ROOT	good	1			0.10
L09-02-19-P-S-S-00	0.00	S	0.7	0.00	SURFACE	good			1	0.02
L09-02-20-P-R-S-00	0.50	S	100.0	0.00	ROOT	good	1			0.07
L09-02-21-P-E-S-00	5.00	S	0.7	0.00	EXCAVATION	good		1		0.03
L09-02-22-P-S-S-00	0.00	S	0.7	0.01	SURFACE	good			1	0.06
L09-02-23-P-R-S-00	0.50	S	0.7	0.03	ROOT	good	1			0.08
L09-02-24-P-E-S-00	5.00	S	1.7	0.02	EXCAVATION	good		1		0.04
L09-02-01-P-S-Q-00	0.00	Q	1.2	0.00	SURFACE	good				0.05
L09-02-16-P-S-Q-00	0.00	Q	3.5	0.07	SURFACE	good				0.05
L09-02-25-P-S-B-00	0.00	B	2.5	0.01	SURFACE	good				0.04
L09-02-26-P-S-B-00	4.20	B	1.1	0.13	ROOT	good				0.14
			6.4	0.001						
			Average Enrichment (%)	0.53		19	8	3	8	
				0.11						
				0.08						
				0.13						

Root Stratum SOF Verification (unexcavated/not backfilled only) Step 8.4.4a.1

count tot
DP Sec. 14.1.5.2
Use number of stations (sample ***locations***) for divisor.

Use corrected net results for all DE calcs 721 Sec. 8.4.2

Step 8.4.1

DCLG$_W$, Measure Tc-99, All SEAs	Surface	Root	Excavation
U-234	508.5	235.6	872.4
U-235	102.3	64.1	208.1
U-238	297.6	183.3	551.1
Tc-99	151	30.1	74
Th-232	4.7	2	5.2
Ra-226	5	2.1	5.4

Step 8.4.5b
weighted SOF$_{MEAN}$ **0.11**

	SS	RS	ES
fractions	0.421052632	0.421052632	0.15789

Step 8.4.5c SOF$_{MEAN}$ Re-use Backfill Material
0

Step 8.4.5e SOF$_{MEAN}$ Groundwater
0.16

Step 8.4.5g (<=1)
SOF$_{MEAN, SU}$ 0.27 **PASS**

Step 8.4.6 Calculate the dose contribution for the SU by multiplying SOF$_{MEAN,SU}$ (including contribution from Re-use backfill and Groundwater) by 25 mrem.
6.7 mrem

Infer U234 Step 8.3.4			
U-238/U235	U-234/U235	U-234	%
17.9	20.2	1.4	0.9
6.6	18.4	5.4	2.3
0.0	0.0	0.9	0.7
5.4	18.2	3.2	2.9
47.4	24.2	0.9	0.4
3.1	18.1	3.4	4.8
3.8	18.1	8.1	4.0
2.2	18.2	8.9	6.5
7.5	18.5	2.8	2.1
3.6	18.1	5.7	4.2
0.0	0.0	0.9	0.7
5.0	18.2	3.6	3.1
0.0	0.0	1.5	0.7
0.0	0.0	0.3	0.7
0.0	32.5	0.4	100.0
0.0	0.0	0.3	0.7
21.8	21.0	1.2	0.7
0.0	0.0	1.1	0.7
9.5	18.7	2.6	1.7
13.0	19.4	0.7	1.2
4.3	18.1	4.8	3.5
6.1	18.3	1.4	2.5
14.4	19.6	1.9	1.1
	Average Enrichment (%)		**6.36**

Infer U-234 MDC using U-235 MDC * ratio of U-234:U-235 @ that sample's enrichment

9.01411
3.58544
0
3.09661
15.3381
3.20562
3.40433
4.39036
2.86406
3.94676
0
3.49077
0
0
7.1506
0
9.95532
0
3.54301
6.24419
3.62701
5.18329
6.07603

New Step for column SOF:	SOF	Sum of Column SOF
L09-02-01-P-S-S-00	0.02	
L09-02-02-P-R-S-00	0.25	0.27
L09-02-04-P-S-S-00	0.01	
L09-02-05-P-R-S-00	0.53	
L09-02-06-P-E-S-00	0.08	0.62
L09-02-07-P-S-S-00	0.16	
L09-02-08-P-R-S-00	0.28	0.44
L09-02-10-P-S-S-00	0.09	
L09-02-11-P-R-S-00	0.12	0.21
L09-02-13-P-S-S-00	0.08	
L09-02-14-P-R-S-00	0.16	0.24
L09-02-16-P-S-S-00	0.08	
L09-02-17-P-R-S-00	0.10	0.10
L09-02-19-P-S-S-00	0.00	
L09-02-20-P-R-S-00	0.00	
L09-02-21-P-E-S-00	0.00	0.01
L09-02-22-P-S-S-00	0.01	
L09-02-23-P-R-S-00	0.03	
L09-02-24-P-E-S-00	0.02	0.06

Ave Conc. Ra-226, SS	Ave Conc. Tc-99, SS	Ave Conc. Th-232, SS	Ave Conc. U-234, SS	Ave Conc. U-235, SS	Ave Conc. U-238, SS
0.000	1.810	0.000	1.420	0.070	1.260
-	-	-	-	-	-
0.000	0.422	0.000	0.852	0.000	0.852
-	-	-	-	-	-
-	-	-	-	-	-
0.000	23.000	0.000	3.369	0.186	0.580
-	-	-	-	-	-
0.000	9.380	0.000	8.908	0.489	1.100
-	-	-	-	-	-
0.000	9.250	0.000	5.685	0.314	1.120
-	-	-	-	-	-
0.180	1.920	0.090	3.600	0.198	0.988
-	-	-	-	-	-
0.000	0.066	0.000	0.281	0.000	0.281
-	-	-	-	-	-
-	-	-	-	-	-
0.000	0.350	0.000	1.195	0.057	1.240
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
0.023	**5.775**	**0.011**	**3.164**	**0.164**	**0.928**

Ave Conc. Ra-226, RS	Ave Conc. Tc-99, RS	Ave Conc. Th-232, RS	Ave Conc. U-234, RS	Ave Conc. U-235, RS	Ave Conc. U-238, RS
-	-	-	-	-	-
0.130	2.840	0.110	5.387	0.293	1.940
-	-	-	-	-	-
0.100	13.800	0.000	3.169	0.174	0.933
-	-	-	-	-	-
-	-	-	-	-	-
0.000	6.820	0.000	8.094	0.447	1.700
-	-	-	-	-	-
0.000	3.120	0.000	2.846	0.154	1.150
-	-	-	-	-	-
0.030	1.580	0.170	0.901	0.000	0.901
-	-	-	-	-	-
0.000	0.803	0.120	1.530	0.000	1.530
-	-	-	-	-	-
0.000	0.017	0.000	0.358	0.011	0.000
-	-	-	-	-	-
-	-	-	-	-	-
0.000	0.203	0.030	1.130	0.000	1.130
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
0.033	**3.648**	**0.054**	**2.927**	**0.135**	**1.161**

Ave Conc. Ra-226, ES	Ave Conc. Tc-99, ES	Ave Conc. Th-232, ES	Ave Conc. U-234, ES	Ave Conc. U-235, ES	Ave Conc. U-238, ES
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
0.02	4.38	0.09	0.8685	0.0359	1.7
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
0	0.0054	0	0.261	0	0.261
-	-	-	-	-	-
-	-	-	-	-	-
0	0.116	0.06	2.6057	0.139	1.32
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
0.007	**1.500**	**0.050**	**1.245**	**0.058**	**1.094**

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	1.13	2.128	43	43		
9574-SS-140910-01-02	Reference	0.72	1.720	21	21		
9574-SS-140910-01-03	Reference	0.97	1.968	30	30		
9574-SS-140910-01-04	Reference	0.97	1.966	29	29		
9574-SS-140910-01-05	Reference	0.95	1.951	27	27		
9574-SS-140910-01-07	Reference	0.83	1.828	23	23		
9574-SS-140910-01-08	Reference	0.99	1.986	33	33		
9574-SS-140910-01-09	Reference	0.90	1.903	25	25		
9574-SS-140910-01-10	Reference	1.14	2.143	44	44		
9574-SS-140910-01-11	Reference	0.96	1.956	28	28		
9574-SS-140910-01-12	Reference	1.16	2.158	45	45		
9574-SS-140910-01-13	Reference	0.98	1.9810	32	32		
9574-SS-140910-01-14	Reference	0.95	1.9500	26	26		
9574-SS-140910-01-15	Reference	0.82	1.823	22	22		
9574-SS-140910-01-16	Reference	1.17	2.169	47	47		
9574-SS-140910-01-17	Reference	1.12	2.123	41	41		
9574-SS-140910-01-18	Reference	1.24	2.241	49	49		
9574-SS-140910-01-20	Reference	1.11	2.115	40	40		
9574-SS-140910-01-21	Reference	1.01	2.009	35	35		
9574-SS-140910-01-22	Reference	1.05	2.053	36	36		
9574-SS-140910-01-23	Reference	1.23	2.234	48	48		
9574-SS-140910-01-24	Reference	1.28	2.277	50	50		
9574-SS-140910-01-25	Reference	1.09	2.091	38	38		
9574-SS-140910-01-26	Reference	1.13	2.127	42	42		
9574-SS-140910-01-27	Reference	1.16	2.160	46	46		
9574-SS-140910-01-28	Reference	1.31	2.314	51	51		
9574-SS-140910-01-29	Reference	1.00	1.999	34	34		
9574-SS-140910-01-30	Reference	0.89	1.891	24	24		
9574-SS-140910-01-31	Reference	1.06	2.064	37	37		
9574-SS-140910-01-32	Reference	1.10	2.097	39	39	Step 8.5.1	
9574-SS-140910-01-33	Reference	0.98	1.975	31	31	Min adjusted bkg SOF: 1.41	**Stratum**
9574-SS-140910-01-34	Reference	0.41	1.411	18	18		
L09-02-01-P-S-S-00	Survey Unit	0.96	0.962	8	0	No WRS test necessary	SURFACE
L09-02-02-P-R-S-00	Survey Unit	1.26	1.259	16	0	No WRS test necessary	ROOT
L09-02-04-P-S-S-00	Survey Unit	0.79	0.788	4	0	No WRS test necessary	SURFACE
L09-02-05-P-R-S-00	Survey Unit	1.53	1.529	19	0	Perform WRS test	ROOT
L09-02-06-P-E-S-00	Survey Unit	1.22	1.223	14	0	No WRS test necessary	EXCAVATION
L09-02-07-P-S-S-00	Survey Unit	1.61	1.605	20	0	Perform WRS test	SURFACE
L09-02-08-P-R-S-00	Survey Unit	1.20	1.200	13	0	No WRS test necessary	ROOT
L09-02-10-P-S-S-00	Survey Unit	1.17	1.170	12	0	No WRS test necessary	SURFACE
L09-02-11-P-R-S-00	Survey Unit	1.12	1.119	10	0	No WRS test necessary	ROOT
L09-02-13-P-S-S-00	Survey Unit	1.31	1.307	17	0	No WRS test necessary	SURFACE
L09-02-14-P-R-S-00	Survey Unit	1.17	1.170	11	0	No WRS test necessary	ROOT
L09-02-16-P-S-S-00	Survey Unit	1.23	1.228	15	0	No WRS test necessary	SURFACE
L09-02-17-P-R-S-00	Survey Unit	1.06	1.062	9	0	No WRS test necessary	ROOT
L09-02-19-P-S-S-00	Survey Unit	0.09	0.094	1	0	No WRS test necessary	SURFACE
L09-02-20-P-R-S-00	Survey Unit	0.19	0.185	3	0	No WRS test necessary	ROOT
L09-02-21-P-E-S-00	Survey Unit	0.14	0.141	2	0	No WRS test necessary	EXCAVATION
L09-02-22-P-S-S-00	Survey Unit	0.90	0.902	7	0	No WRS test necessary	SURFACE
L09-02-23-P-R-S-00	Survey Unit	0.88	0.876	5	0	No WRS test necessary	ROOT
L09-02-24-P-E-S-00	Survey Unit	0.88	0.883	6	0	No WRS test necessary	EXCAVATION
			Rank Sums	1326	1134	W_r Step 8.5.3e	
			# Reference Area Measurements	**m**	32		
			# Survey Unit Measurements	**n**	19		
			Total Number of Measurements Step 8.5.3c	**N**	51		
			α) percentile of a standard normal distribution (MARSSIM Pg. I-10)	**z**	1.645		α = 0.05
			WRS Critical Value (MARSSIM Pg. I-10, Eq. I.1)	**CV**	917		
				TEST:	**PASS**	Step 8.5.3f	

Background Soil Locations - Surface and Sub-Surface Soil - Statistical and Analytical Sample Results
Surface and Sub-Surface - Background Soil - Analytical Results

Sample ID	Ra-226 w/ 21-Day Ingrowth (pCi/g)			Th-232 (pCi/g)			U-234* (pCi/g)			U-235* (pCi/g)			U-238* (pCi/g)			
	Conc.	Error	MDC	Conc.	Error	MDC	Conc.	Error	MDC	Conc.	Error	MDC	Conc.	Error	MDC	SOF
9574-SS-140910-01-01	1.150	0.164	0.068	1.150	0.178	0.133	0.671	0.181	0.050	0.022	0.040	0.071	0.724	0.189	0.050	1.13
9574-SS-140910-01-02	0.719	0.103	0.045	0.749	0.120	0.090	0.353	0.129	0.051	0.011	0.028	0.063	0.379	0.135	0.068	0.72
9574-SS-140910-01-03	1.040	0.166	0.077	0.936	0.183	0.145	0.518	0.164	0.062	0.015	0.030	0.044	0.723	0.195	0.036	0.97
9574-SS-140910-01-04	1.010	0.138	0.051	0.962	0.171	0.090	0.390	0.138	0.034	0.014	0.029	0.043	0.591	0.172	0.060	0.97
9574-SS-140910-01-05	0.995	0.160	0.085	0.948	0.178	0.091	0.345	0.163	0.083	0.000	0.009	0.068	0.421	0.179	0.055	0.95
9574-SS-140910-01-07	0.858	0.133	0.064	0.831	0.150	0.110	0.512	0.160	0.035	0.038	0.051	0.075	0.453	0.150	0.035	0.83
9574-SS-140910-01-08	1.030	0.143	0.064	0.979	0.139	0.087	0.832	0.210	0.075	0.000	0.005	0.043	0.632	0.179	0.053	0.99
9574-SS-140910-01-09	1.080	0.169	0.070	0.768	0.188	0.184	0.484	0.159	0.055	0.043	0.053	0.069	0.493	0.161	0.063	0.90
9574-SS-140910-01-10	1.170	0.174	0.077	1.160	0.191	0.143	0.571	0.169	0.064	0.034	0.050	0.080	0.757	0.196	0.034	1.14
9574-SS-140910-01-11	0.972	0.136	0.084	0.977	0.142	0.079	0.606	0.174	0.059	0.028	0.040	0.042	0.575	0.168	0.034	0.96
9574-SS-140910-01-12	1.220	0.184	0.086	1.140	0.210	0.139	0.747	0.199	0.054	0.056	0.060	0.067	0.997	0.233	0.036	1.16
9574-SS-140910-01-13	1.020	0.140	0.076	0.978	0.157	0.096	0.724	0.198	0.037	0.046	0.053	0.046	0.744	0.201	0.056	0.98
9574-SS-140910-01-14	1.050	0.146	0.061	0.889	0.156	0.080	0.705	0.193	0.061	0.029	0.042	0.044	0.607	0.178	0.067	0.95
9574-SS-140910-01-15	0.805	0.121	0.058	0.871	0.140	0.110	0.434	0.145	0.058	-0.003	0.005	0.064	0.594	0.171	0.034	0.82
9574-SS-140910-01-16	1.320	0.201	0.090	1.070	0.189	0.153	0.513	0.152	0.054	0.049	0.052	0.059	0.835	0.198	0.031	1.17
9574-SS-140910-01-17	1.190	0.165	0.070	1.100	0.179	0.129	0.639	0.183	0.062	0.024	0.043	0.077	0.844	0.213	0.036	1.12
Min	0.72			0.75			0.35			0.00			0.38			0.72
Max	1.32			1.16			0.83			0.06			1.00			
Mean	1.04			0.97			0.57			0.03			0.65			
Stdev	0.16			0.13			0.15			0.02			0.17			

Use Root DCGLs.

Sub-Surface

Sample ID	Ra-226 w/ 21-Day Ingrowth (pCi/g)			Th-232 (pCi/g)			U-234* (pCi/g)			U-235* (pCi/g)			U-238* (pCi/g)			
	Conc.	Error	MDC	Conc.	Error	MDC	Conc.	Error	MDC	Conc.	Error	MDC	Conc.	Error	MDC	SOF
9574-SS-140910-01-18	1.340	0.193	0.085	1.190	0.200	0.117	0.808	0.200	0.062	0.038	0.047	0.062	0.745	0.191	0.049	1.24
9574-SS-140910-01-20	1.260	0.206	0.109	1.010	0.197	0.176	1.120	0.241	0.057	0.068	0.061	0.041	0.710	0.187	0.050	1.11
9574-SS-140910-01-21	1.070	0.156	0.074	0.982	0.153	0.124	1.040	0.232	0.050	0.028	0.039	0.041	0.705	0.187	0.050	1.01
9574-SS-140910-01-22	0.922	0.131	0.057	1.210	0.170	0.106	0.829	0.215	0.065	0.013	0.032	0.071	0.981	0.236	0.037	1.05
9574-SS-140910-01-23	1.130	0.170	0.084	1.370	0.229	0.115	1.140	0.254	0.055	0.073	0.068	0.069	0.994	0.235	0.036	1.23
9574-SS-140910-01-24	1.200	0.165	0.065	1.390	0.221	0.131	1.090	0.247	0.055	0.024	0.043	0.078	0.992	0.234	0.055	1.28
9574-SS-140910-01-25	1.230	0.164	0.065	0.990	0.156	0.126	0.887	0.216	0.053	0.069	0.065	0.065	0.959	0.226	0.070	1.09
9574-SS-140910-01-26	1.080	0.159	0.079	1.210	0.179	0.106	0.730	0.219	0.078	0.019	0.037	0.056	0.764	0.223	0.045	1.13
9574-SS-140910-01-27	1.310	0.185	0.082	1.050	0.163	0.110	1.160	0.255	0.036	0.059	0.059	0.044	0.956	0.228	0.062	1.16
9574-SS-140910-01-28	1.280	0.188	0.089	1.390	0.201	0.131	0.871	0.217	0.055	0.060	0.060	0.045	0.895	0.220	0.036	1.31
9574-SS-140910-01-29	1.080	0.154	0.081	0.955	0.160	0.146	0.842	0.208	0.059	0.011	0.029	0.064	0.708	0.189	0.051	1.00
9574-SS-140910-01-30	0.960	0.161	0.086	0.851	0.166	0.156	0.744	0.196	0.035	0.072	0.065	0.043	0.787	0.203	0.053	0.89
9574-SS-140910-01-31	1.060	0.146	0.050	1.100	0.159	0.089	0.572	0.170	0.070	0.099	0.075	0.043	0.986	0.228	0.052	1.06
9574-SS-140910-01-32	1.060	0.157	0.071	1.170	0.177	0.078	0.598	0.174	0.060	0.058	0.058	0.043	0.758	0.198	0.060	1.10
9574-SS-140910-01-33	1.030	0.147	0.069	0.954	0.153	0.119	0.772	0.196	0.050	0.014	0.028	0.041	0.828	0.203	0.033	0.98
9574-SS-140910-01-34	0.618	0.099	0.040	0.225	0.085	0.099	0.389	0.138	0.052	0.014	0.029	0.043	0.494	0.156	0.035	0.41
Min	0.62			0.23			0.39			0.01			0.49			0.41
Max	1.34			1.39			1.16			0.0992			0.994			
Mean	1.10			1.07			0.85			0.04			0.83			
Stdev	0.18			0.28			0.22			0.03			0.14			

Use Root DCGLs.

	$DCLG_W$, Measure Tc-99, All SEAs		
	Surface	Root	Excavation
U-234	508.5	235.6	872.4
U-235	102.3	64.1	208.1
U-238	297.6	183.3	551.1
Tc-99	151	30.1	74
Th-232	4.7	2	5.2
Ra-226	5	2.1	5.4

No Tc-99 expected in background area.

* alpha spectroscopy results.

Dataset Min = 0.618 0.225 0.345 -0.00262 0.379

Appendix P-1 Step 8. Calculate the Number of Samples in the Statistical Survey Population

DCGL Criteria Evaluation	
N/2 Value Verification	
Isotope(s)	**SOF (Ra/Tc/Th/Iso U)**
St. Dev.	0.13
$DCGL_{SOF}$	1
LBGR (Mean)	0.11
Shift	0.89
Relative Shift (Δ/σ)	6.83
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, α = 0.05, β = 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	α
0.10	1.282	β
0.15	1.036	
0.2	0.842	
0.25	0.674	
0.30	0.524	

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

Survey Unit No.:	LSA 09-02				Survey Unit Description:		Central Open Land Area Survey Unit in "Area 12"					
			Sample (pCi/g)		Field Duplicate Sample (pCi/g)		Average Activity ($\bar{X}$)	Nuclide DCGL		Warning	Control	Statistic Exceeds Limit?
Sample ID	Field Duplicate Sample ID	Radionuclide	Activity (x_i)	MDC	Activity (x_i)	MDC	(pCi/g)	(pCi/g)	Statistic[2]	Limit	Limit	(Y/N)
L09-02-01-P-S-S-00	L09-02-01-P-S-Q-00	Ra-226	0.847	0.0543	0.636	0.060	0.742	5.4	0.211	0.764	1.145	N
L09-02-01-P-S-S-00	L09-02-01-P-S-Q-00	Tc-99	1.81	0.464	0.082	0.228	0.946	74	NA	10.471	15.688	NA
L09-02-01-P-S-S-00	L09-02-01-P-S-Q-00	Th-232	0.969	0.097	0.759	0.087	0.864	5.2	0.210	0.736	1.102	N
L09-02-01-P-S-S-00	L09-02-01-P-S-Q-00	U-234[1]	1.420	N/A	0.688	N/A	1.054	872.4	0.731	123.445	184.949	N
L09-02-01-P-S-S-00	L09-02-01-P-S-Q-00	U-235	0.0704	0.447	0.036	0.322	0.053	208.1	NA	29.446	44.117	NA
L09-02-01-P-S-S-00	L09-02-01-P-S-Q-00	U-238	1.26	0.732	0.460	0.684	0.860	551.1	NA	77.981	116.833	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: Thomas Yardy

Reviewed by: Clark Evers

Date:

Date:

Quality Record

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

Survey Unit No.:	LSA 09-02				Survey Unit Description:		Central Open Land Area Survey Unit in "Area 12"					
			Sample (pCi/g)		Field Duplicate Sample (pCi/g)		Average Activity ($\bar{X}$)	Nuclide DCGL		Warning	Control	Statistic Exceeds Limit?
Sample ID	Field Duplicate Sample ID	Radionuclide	Activity (x_i)	MDC	Activity (x_i)	MDC	(pCi/g)	(pCi/g)	Statistic[2]	Limit	Limit	(Y/N)
L09-02-16-P-S-S-00	L09-02-16-P-S-Q-00	Ra-226	1.250	0.0573	0.999	0.071	1.125	5.4	0.251	0.764	1.145	N
L09-02-16-P-S-S-00	L09-02-16-P-S-Q-00	Tc-99	1.92	0.231	2.390	0.232	2.155	74	0.470	10.471	15.688	N
L09-02-16-P-S-S-00	L09-02-16-P-S-Q-00	Th-232	1.090	0.104	1.170	0.088	1.130	5.2	0.080	0.736	1.102	N
L09-02-16-P-S-S-00	L09-02-16-P-S-Q-00	U-234[1]	3.600	N/A	4.770	N/A	4.185	872.4	1.170	123.445	184.949	N
L09-02-16-P-S-S-00	L09-02-16-P-S-Q-00	U-235	0.198	0.192	0.263	0.200	0.231	208.1	0.065	29.446	44.117	N
L09-02-16-P-S-S-00	L09-02-16-P-S-Q-00	U-238	0.988	0.839	1.140	0.867	1.064	551.1	0.152	77.981	116.833	N

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: Thomas Yardy

Reviewed by: Clark Evers

Date:

Date:

Quality Record

LSA 09-02 Sys SOF

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

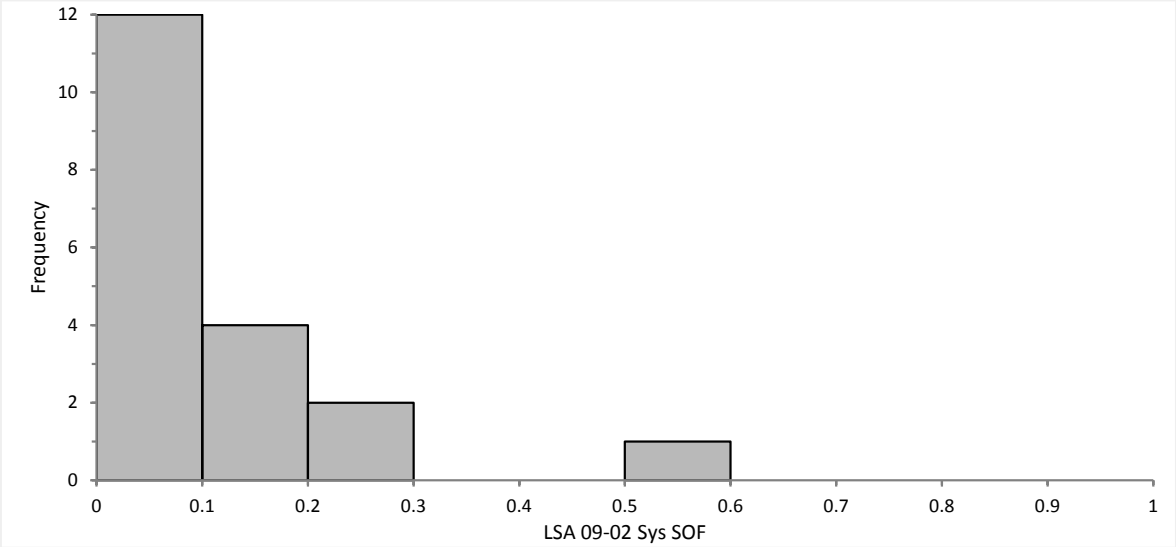
Distribution: LSA 09-02 Sys SOF

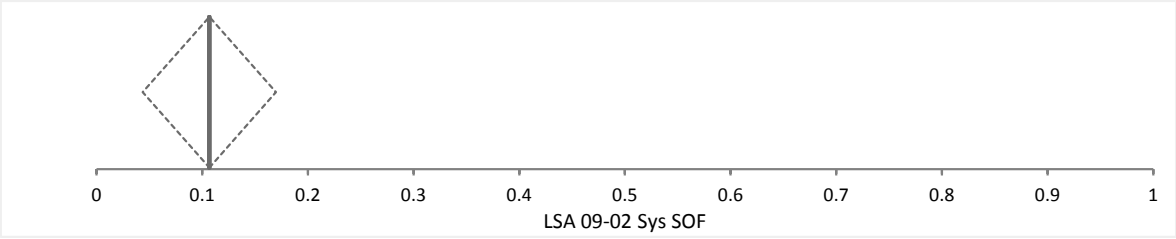
Analyse-it v4.65.2

SOFn Only A1:A20

Last updated 12 April 2017 at 9:52 by W. Clark Evers

Descriptives





	N
	19

	Mean	95% CI	Mean SE	SD	Variance	Skewness	Kurtosis
LSA 09-02 Sys SOF	0.11	0.04 to 0.17	0.030	0.13	0.02	2.1	5.24

	Minimum	1st quartile	Median	98.08% CI	3rd quartile	Maximum	IQR
LSA 09-02 Sys SOF	0.0	0.01	0.08	0.01 to 0.16	0.15	0.5	0.14