

## Happy Valley Interim Source Removal Action (ISRA) Soil Sampling for Radionuclides Results and Statistical Analysis Waste Certification

This data package provides the laboratory results and statistical analysis of pre-excavation samples taken from the Happy Valley Interim Source Removal Action (ISRA) area. This analysis and data interpretation complies with procedures approved by the California Department of Public Health<sup>1</sup>.

Forty four (44) samples taken for waste disposal characterization were analyzed for strontium-90, tritium and gamma emitting radionuclides by gamma spectroscopy, using an off-site laboratory. Minimum detectable activity (MDA) for cesium-137 and strontium-90 averaged ~0.04 pCi/g and ~0.04 pCi/g respectively. Minimum detectable activity for tritium averaged ~1.0 pCi/g. The gamma spectroscopy library also included the following contaminants-of-concern: Na-22, K-40, Mn-54, Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Th-228, Th-232, U-235, U-238 and Am-241. Laboratory data packages are available on request.

Statistical evaluation of sample analytical results to determine whether or not the sampled waste contains Cs-137 or Sr-90 activity elevated above local background was conducted using the Wilcoxon Rank Sum Test using protocols described in NUREG-1505<sup>2</sup> and DTSC guidance<sup>3</sup> (See Appendix 1). Appendix 2 shows the complete analytical results for all radionuclides. Complete laboratory data packages are available on request.

Local background data for cesium-137 and strontium-90 was taken from Table 20 of the 1995 McLaren/Hart report<sup>4</sup>. Background for tritium in soil is not well established, and is not reported in the 1995 McLaren/Hart report, therefore tritium background in soil is conservatively assumed to be zero. Tritium data is therefore compared to the MDA of the analysis and the EPA preliminary remediation goal (PRG)<sup>5</sup> for residential  $10^{-6}$  risk.

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<sup>1</sup> Boeing, "Northern Drainage Waste Sampling for Radionuclides." Revision 9, November 5, 2007. (Attachment 3 to Northern Drainage Work Plan) and "ISRA Waste Sampling for Radionuclides", Attachment A to the ISRA Soil Management Plan.

<sup>2</sup> NUREG-1505, Nuclear Regulatory Commission, "A Non-parametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys." January 1998. [http://www.philrutherford.com/Radiation\\_Cleanup\\_Standards/NUREG-1505.pdf](http://www.philrutherford.com/Radiation_Cleanup_Standards/NUREG-1505.pdf)

<sup>3</sup> DTSC, "Selecting Inorganic Constituents as Chemicals of Concern at Risk Assessments at Hazardous Waste Sites and Permitted Facilities." February 1997.

<sup>4</sup> McLaren/Hart, "Additional Soil and Water Sampling at the Brandeis-Bardin Institute and Santa Monica Mountains Conservancy." Jan 19, 1995. <http://www.etec.energy.gov/Health-and-Safety/Documents/BrandeisBardin/AddSoilandWaterSamp.pdf>

<sup>5</sup> EPA preliminary remediation goals for radionuclides - <http://epa-prgs.ornl.gov/radionuclides/>.

## Conclusions

**Cesium-137** - Based on the results of the statistical analysis of Appendix 1, soil to be excavated from the Happy Valley ISRA area does not exceed the local background for Cs-137. The incremental dose from Cs-137 above background is therefore zero mrem/y. The highest Cs-137 result is 0.113 pCi/g which is less than the highest background result. The highest non-background subtracted Cs-137 result is less than an effective dose of 0.08 mrem/y<sup>6</sup>.

**Strontium-90** - Based on the results of the statistical analysis of Appendix 1, soil to be excavated from the Happy Valley ISRA area does not exceed the local background for Sr-90. The incremental dose from Sr-90 above background is therefore zero mrem/y. The highest Sr-90 result is 0.042 pCi/g which is less than the highest background result. The highest non-background subtracted Sr-90 result is less than an effective dose of 0.013 mrem/y<sup>6</sup>.

**Tritium** - All tritium results are non-detect, the average tritium result is -0.24 pCi/g and the highest non-detect tritium result is 0.39 pCi/g. The highest non-detect, non-background subtracted tritium result is less than an effective dose of 0.0055 mrem/y<sup>6</sup>.

This waste is certified to be “radiologically” acceptable for shipment to, and disposal at, any Class 1, 2 or 3 disposal facility. There are no radiological controls or restrictions imposed on future disposition or use of this soil.

This waste meets the requirements of disposal facility permits<sup>7,8</sup> and complies with the California Health & Safety Code<sup>9</sup>.

The Governor’s Executive Order D-62-02 prohibits the “*disposal of decommissioned materials to Class III landfills or unclassified management units.*” The soil from the Happy Valley ISRA area is

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<sup>6</sup> EPA dose compliance concentrations for radionuclides - <http://epa-dccs.ornl.gov/>. Soil concentrations that meet the 10<sup>-6</sup> residential risk PRG are < 0.1 mrem/y. The Cs-137 residential PRG of 0.0597 pCi/g is equivalent to 0.042 mrem/y. The Sr-90 residential PRG of 0.231 pCi/g is equivalent to 0.071 mrem/y. The tritium residential PRG of 2.28 pCi/g is equivalent to 0.032 mrem/y.

<sup>7</sup> This waste is exempt from regulation and licensing or is expressly authorized for disposal under the Radiation Control Law (Division 104, Part 9, Chapter 5 of the California Health & Safety Code).

<sup>8</sup> This waste is not prohibited from disposal by any government agency with jurisdictional authority over this waste.

<sup>9</sup> Division 104, Part 9, Chapter 5, Article 1, Section 114715, “No person shall bury, throw away, or in any manner dispose of radioactive wastes within the state except in a manner and at locations as will result in no significant radioactive contamination of the environment.” For the purposes of this requirement, “significant” is defined in Section 114710 as amounts of radioactive materials that are likely to expose persons to ionizing radiation greater than the guide levels published by the Federal Radiation Council (FRC). The FRC no longer exists, but the applicable guide level last published by the FRC was 500 mrem per year to a member of the public. Because the regulatory dose limit to members of the public has since been lowered to 100 mrem per year, CDPH/RHB conservatively utilizes the lower dose for purposes of defining “significant” radioactive contamination in this Article of the California Health and Safety Code.  
<http://www.leginfo.ca.gov/cgi-bin/displaycode?section=hsc&group=114001-115000&file=114705-114780>

not decommissioned material, and does not originate from the proximity of any radiological facility. The sampling in this certification has therefore been conducted as a best management practice that also complies with the requirements of D-62-02. Verification sampling and/or approval by the California Department of Public Health (CDPH) Radiologic Health Branch (RHB) are not required for the off-site disposal of decommissioned material or of the subject material<sup>10</sup>.



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Manager, Health, Safety & Radiation Services

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<sup>10</sup> The California Department of Public Health (CDPH) Radiologic Health Branch (RHB) has stated in a November 9, 2007 email to Phil Rutherford (Boeing) ... *"The Governor's Executive Order D-62-02, does not specifically require the Department of Health Services (now the Department of Public Health) to perform verification sampling of decommissioned material or to provide approval for disposal of specific decommissioned material shipped offsite (e.g., to Class I or II landfills). The California DPH has not imposed a requirement that Boeing or the Department of Energy (DOE) seek DPH verification sampling or approval of all decommissioned material destined for Class I or II landfills in compliance with the Governor's Executive Order."*

**Appendix 1**

**Wilcoxon Rank Sum Statistical Test for Cesium-137 and Strontium-90**

**Wilcoxon Rank Sum Test -- (Cesium-137)****General Information:**

The WRS tests whether or not measurements of samples from a survey area (S) tend to be consistently larger than those from a background reference area (R) by more than the DCGL.

The null hypothesis,  $H_0$ , is: Survey sample concentrations exceed those in the background

The alternative hypothesis,  $H_a$ , is: Survey sample concentrations do not exceed those in the background

**Instruction on how to use this template:**

- 1) Enter analysis results in pCi/gram
- 2) Enter number of samples for background and survey data sets, m and n.
- 3) The WRS test is calculated using the method prescribed in NUREG-1505, Nuclear Regulatory Commission, "A Non-parametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys." January 1998.

DCGL (pCi/g)	0.00
Type I Error Rate, Alpha:	0.05
Type II Error Rate, Beta:	0.05
Number of Background Samples, m:	51
Number of Survey Samples, n:	46
Z-value for Alpha	1.645
Critical Value	2727
Sum of Reference Ranks	3217

If the sum of the reference ranks is larger than the critical value, there is enough evidence to reject the null hypothesis and accept the alternative hypothesis. Otherwise the null hypothesis is accepted.

**Test Result:**

**Survey sample concentrations do not exceed those in the background by more than the DCGL**

	Bkgd Ref (R)	Survey (S)
Mean	0.087	0.026
Max	0.213	0.113
Min	0.015	-0.023
$\sigma$	0.062	0.035
$m-1.96\sigma$	-0.035	-0.042
$m+1.96\sigma$	0.210	0.094

No.	Soil ID	Cs-137	Adjusted Cs-137	Area	Ranks	Reference Ranks
1		0.092	0.092	R	72	72
2		0.020	0.020	R	32	32
3		0.020	0.020	R	32	32
4		0.100	0.100	R	76.5	76.5
5		0.020	0.020	R	32	32
6		0.158	0.158	R	89.5	89.5
7		0.175	0.175	R	91	91
8		0.209	0.209	R	96	96
9		0.180	0.180	R	92	92
10		0.030	0.030	R	42	42
11		0.213	0.213	R	97	97
12		0.025	0.025	R	38	38
13		0.020	0.020	R	32	32
14		0.020	0.020	R	32	32
15		0.074	0.074	R	64	64
16		0.147	0.147	R	85	85
17		0.100	0.100	R	76.5	76.5
18		0.067	0.067	R	61.5	61.5
19		0.099	0.099	R	75	75

No.	Soil ID	Cs-137	Adjusted Cs-137	Area	Ranks	Reference Ranks
20		0.101	0.101	R	78	78
21		0.148	0.148	R	86	86
22		0.153	0.153	R	88	88
23		0.025	0.025	R	38	38
24		0.188	0.188	R	93	93
25		0.198	0.198	R	95	95
26		0.030	0.030	R	42	42
27		0.079	0.079	R	67	67
28		0.158	0.158	R	89.5	89.5
29		0.109	0.109	R	80	80
30		0.059	0.059	R	58	58
31		0.067	0.067	R	61.5	61.5
32		0.113	0.113	R	81.5	81.5
33		0.015	0.015	R	25	25
34		0.031	0.031	R	44	44
35		0.042	0.042	R	53	53
36		0.097	0.097	R	73.5	73.5
37		0.015	0.015	R	25	25
38		0.020	0.020	R	32	32
39		0.085	0.085	R	69	69
40		0.080	0.080	R	68	68
41		0.015	0.015	R	25	25
42		0.020	0.020	R	32	32
43		0.035	0.035	R	47.5	47.5
44		0.035	0.035	R	47.5	47.5
45		0.025	0.025	R	38	38
46		0.150	0.150	R	87	87
47		0.140	0.140	R	83.5	83.5
48		0.190	0.190	R	94	94
49		0.097	0.097	R	73.5	73.5
50		0.030	0.030	R	42	42
51		0.140	0.140	R	83.5	83.5
52	ISWC0001S001	-0.010	-0.010	S	6	0
53	ISWC0002S001	0.008	0.008	S	20	0
54	ISWC0003S001	0.000	0.000	S	11.5	0
55	ISWC0004S001	0.018	0.018	S	27	0
56	ISWC0005S001	0.040	0.040	S	50	0
57	ISWC0006S001	0.052	0.052	S	56	0
58	ISWC0009S001	0.087	0.087	S	70	0
59	ISWC0010S001	0.087	0.087	S	71	0
60	ISWC0011S001	0.065	0.065	S	60	0
61	ISWC0012S001	0.034	0.034	S	46	0
62	ISWC0013S001	0.023	0.023	S	36	0
63	ISWC0014S001	0.070	0.070	S	63	0
64	ISWC0015S001	0.113	0.113	S	81.5	0
65	ISWC0016S001	0.029	0.029	S	40	0
66	ISWC0019S001	0.001	0.001	S	14	0
67	ISWC0020S001	0.042	0.042	S	54	0
68	ISWC0023S001	0.041	0.041	S	51	0
69	ISWC0024S001	-0.001	-0.001	S	10	0
70	ISWC0028S001	0.036	0.036	S	49	0
71	ISWC0041S001	0.001	0.001	S	15	0
72	ISWC0042S001	-0.022	-0.022	S	2	0
73	ISWC0043S001	0.000	0.000	S	13	0
74	ISWC0044S001	-0.002	-0.002	S	9	0
75	ISWC0045S001	0.031	0.031	S	45	0
76	ISWC0046S001	0.102	0.102	S	79	0
77	ISWC0047S001	-0.003	-0.003	S	8	0
78	ISWC0048S001	0.018	0.018	S	28	0
79	ISWC0077RadS001	0.047	0.047	S	55	0
80	ISWC0078RadS001	0.007	0.007	S	19	0
81	ISWC0079RadS001	-0.013	-0.013	S	4	0

No.	Soil ID	Cs-137	Adjusted Cs-137	Area	Ranks	Reference Ranks
82	ISWC0080RadS001	0.003	0.003	S	18	0
83	ISWC0081RadS001	-0.010	-0.010	S	5	0
84	ISWC0084RadS001	0.010	0.010	S	21	0
85	ISWC0085RadS001	0.001	0.001	S	16	0
86	ISWC0086RadS001	0.010	0.010	S	22	0
87	ISWC0087RadS001	0.042	0.042	S	52	0
88	ISWC0088RadS001	-0.019	-0.019	S	3	0
89	ISWC0089RadS001	0.002	0.002	S	17	0
90	ISWC0090RadS001	0.058	0.058	S	57	0
91	ISWC0091RadS001	0.061	0.061	S	59	0
92	ISWC0092RadS001	0.074	0.074	S	65	0
93	ISWC0093RadS001	0.012	0.012	S	23	0
94	ISWC0082RadS001	0.076	0.076	S	66	0
95	ISWC0083RadS001	0.000	0.000	S	11.5	0
96	ISWC0094RadS001	-0.005	-0.005	S	7	0
97	ISWC0095RadS001	-0.023	-0.023	S	1	0
				Sum	4753	3216.5

**Wilcoxon Rank Sum Test -- (Strontium-90)****General Information:**

The WRS tests whether or not measurements of samples from a survey area (S) tend to be consistently larger than those from a background reference area (R) by more than the DCGL.

The null hypothesis, Ho, is: Survey sample concentrations exceed those in the background

The alternative hypothesis, Ha, is: Survey sample concentrations do not exceed those in the background

**Instruction on how to use this template:**

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- 2) Enter number of samples for background and survey data sets, m and n.
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DCGL (pCi/g)	0.00
Type I Error Rate, Alpha:	0.05
Type II Error Rate, Beta:	0.05
Number of Background Samples, m:	51
Number of Survey Samples, n:	46
Z-value for Alpha	1.645
Critical Value	2727
Sum of Reference Ranks	3382

If the sum of the reference ranks is larger than the critical value, there is enough evidence to reject the null hypothesis and accept the alternative hypothesis. Otherwise the null hypothesis is accepted.

Test Result:

**Survey sample concentrations do not exceed those in the background by more than the DCGL**

	Bkgd Ref (R)	Survey (S)
Mean	0.051	0.016
Max	0.130	0.042
Min	0.005	-0.018
$\sigma$	0.030	0.016
m-1.96 $\sigma$	-0.008	-0.016
m+1.96 $\sigma$	0.109	0.048

No.	Soil ID	Sr-90	Adjusted Sr-90	Area	Ranks	Reference Ranks
1		0.030	0.030	R	47	47
2		0.010	0.010	R	22.5	22.5
3		0.045	0.045	R	72.5	72.5
4		0.045	0.045	R	72.5	72.5
5		0.050	0.050	R	82	82
6		0.040	0.040	R	62	62
7		0.035	0.035	R	52.5	52.5
8		0.050	0.050	R	82	82
9		0.050	0.050	R	82	82
10		0.130	0.130	R	96.5	96.5
11		0.120	0.120	R	95	95
12		0.040	0.040	R	62	62
13		0.045	0.045	R	72.5	72.5
14		0.130	0.130	R	96.5	96.5
15		0.050	0.050	R	82	82
16		0.088	0.088	R	90	90
17		0.080	0.080	R	87	87
18		0.100	0.100	R	94	94
19		0.069	0.069	R	86	86
20		0.097	0.097	R	92	92
21		0.084	0.084	R	89	89



No.	Soil ID	Sr-90	Adjusted Sr-90	Area	Ranks	Reference Ranks
22		0.098	0.098	R	93	93
23		0.045	0.045	R	72.5	72.5
24		0.045	0.045	R	72.5	72.5
25		0.020	0.020	R	29	29
26		0.045	0.045	R	72.5	72.5
27		0.089	0.089	R	91	91
28		0.050	0.050	R	82	82
29		0.045	0.045	R	72.5	72.5
30		0.050	0.050	R	82	82
31		0.045	0.045	R	72.5	72.5
32		0.040	0.040	R	62	62
33		0.045	0.045	R	72.5	72.5
34		0.045	0.045	R	72.5	72.5
35		0.045	0.045	R	72.5	72.5
36		0.025	0.025	R	38.5	38.5
37		0.082	0.082	R	88	88
38		0.045	0.045	R	72.5	72.5
39		0.040	0.040	R	62	62
40		0.035	0.035	R	52.5	52.5
41		0.025	0.025	R	38.5	38.5
42		0.005	0.005	R	17	17
43		0.020	0.020	R	29	29
44		0.010	0.010	R	22.5	22.5
45		0.020	0.020	R	29	29
46		0.020	0.020	R	29	29
47		0.050	0.050	R	82	82
48		0.030	0.030	R	47	47
49		0.030	0.030	R	47	47
50		0.020	0.020	R	29	29
51		0.040	0.040	R	62	62
52	ISWC0001S001	0.024	0.024	S	34.5	0
53	ISWC0002S001	0.015	0.015	S	26	0
54	ISWC0003S001	0.001	0.001	S	13	0
55	ISWC0004S001	0.025	0.025	S	37	0
56	ISWC0005S001	0.022	0.022	S	32	0
57	ISWC0006S001	0.042	0.042	S	65	0
58	ISWC0009S001	0.027	0.027	S	41	0
59	ISWC0010S001	-0.002	-0.002	S	5	0
60	ISWC0011S001	0.024	0.024	S	34.5	0
61	ISWC0012S001	0.034	0.034	S	51	0
62	ISWC0013S001	0.030	0.030	S	44	0
63	ISWC0014S001	0.036	0.036	S	55	0
64	ISWC0015S001	0.003	0.003	S	15	0
65	ISWC0016S001	0.009	0.009	S	21	0
66	ISWC0019S001	-0.001	-0.001	S	6	0
67	ISWC0020S001	-0.018	-0.018	S	1	0
68	ISWC0023S001	0.037	0.037	S	57	0
69	ISWC0024S001	0.025	0.025	S	36	0
70	ISWC0028S001	0.033	0.033	S	50	0
71	ISWC0041S001	0.036	0.036	S	54	0
72	ISWC0042S001	0.009	0.009	S	20	0
73	ISWC0043S001	0.005	0.005	S	16	0
74	ISWC0044S001	-0.001	-0.001	S	7	0
75	ISWC0045S001	-0.010	-0.010	S	2	0
76	ISWC0046S001	0.038	0.038	S	58	0
77	ISWC0047S001	0.037	0.037	S	56	0
78	ISWC0048S001	-0.001	-0.001	S	8	0
79	ISWC0077RadS001	0.031	0.031	S	49	0
80	ISWC0078RadS001	0.000	0.000	S	12	0
81	ISWC0079RadS001	0.002	0.002	S	14	0
82	ISWC0080RadS001	0.023	0.023	S	33	0
83	ISWC0081RadS001	0.014	0.014	S	25	0
84	ISWC0084RadS001	0.008	0.008	S	19	0

No.	Soil ID	Sr-90	Adjusted Sr-90	Area	Ranks	Reference Ranks
85	ISWC0085RadS001	0.042	0.042	S	66	0
86	ISWC0086RadS001	0.000	0.000	S	10	0
87	ISWC0087RadS001	0.000	0.000	S	9	0
88	ISWC0088RadS001	0.005	0.005	S	18	0
89	ISWC0089RadS001	0.010	0.010	S	24	0
90	ISWC0090RadS001	0.030	0.030	S	45	0
91	ISWC0091RadS001	0.027	0.027	S	42	0
92	ISWC0092RadS001	0.026	0.026	S	40	0
93	ISWC0093RadS001	0.027	0.027	S	43	0
94	ISWC0082RadS001	0.000	0.000	S	11	0
95	ISWC0083RadS001	0.038	0.038	S	59	0
96	ISWC0094RadS001	-0.004	-0.004	S	4	0
97	ISWC0095RadS001	-0.010	-0.010	S	3	0
Sum					4753	3382

### Soil Data from Happy Valley ISRA

No.	Sample ID	Stockpile ID	Sampling Date	Laboratory Batch	Cesium-137 (pCi/g)				Strontium-90 (pCi/g)				Tritium (pCi/g)			
					Activity	+/- 2σ Error	MDA	Non-detect?	Activity	+/- 2σ Error	MDA	Non-detect?	Activity	+/- 2σ Error	MDA	Non-detect?
1	ISWC0001S001	N/A	7/1/2009	233955	-0.0102	0.0289	0.0501	NDA	0.0237	0.0284	0.0479	NDA	-0.271	0.381	0.757	NDA
2	ISWC0002S001	N/A	7/1/2009	233955	0.00772	0.021	0.0372	NDA	0.0154	0.0261	0.0449	NDA	-0.723	0.768	1.37	NDA
3	ISWC0003S001	N/A	7/1/2009	233955	0	0.0561	0.0473	NDA	0.000558	0.0236	0.0473	NDA	0.342	0.468	0.798	NDA
4	ISWC0004S001	N/A	7/1/2009	233955	0.0181	0.0229	0.0416	NDA	0.0247	0.027	0.0446	NDA	-0.56	0.784	1.39	NDA
5	ISWC0005S001	N/A	7/1/2009	233955	0.0396	0.0286	0.0507	NDA	0.0217	0.025	0.0421	NDA	-0.883	0.745	1.34	NDA
6	ISWC0006S001	N/A	7/1/2009	233955	0.0524	0.0418	0.0459		0.0415	0.0231	0.0322		-0.946	0.768	1.39	NDA
7	ISWC0009S001	N/A	7/1/2009	233955	0.0865	0.037	0.0343		0.027	0.028	0.0468	NDA	0.387	0.46	0.774	NDA
8	ISWC0010S001	N/A	7/1/2009	233955	0.0868	0.0252	0.0295		-0.00173	0.0272	0.0477	NDA	0.124	0.445	0.765	NDA
9	ISWC0011S001	N/A	7/1/2009	233955	0.0654	0.0389	0.0423		0.0237	0.0279	0.0469	NDA	0	0.437	0.76	NDA
10	ISWC0012S001	N/A	7/1/2009	233955	0.0342	0.0414	0.0482	NDA	0.0344	0.0254	0.0413	NDA	-0.412	0.423	0.762	NDA
11	ISWC0013S001	N/A	7/1/2009	233955	0.0231	0.0247	0.0452	NDA	0.0298	0.0281	0.0468	NDA	-0.164	0.43	0.757	NDA
12	ISWC0014S001	N/A	7/1/2009	233955	0.0704	0.0289	0.0323		0.0361	0.0196	0.0276		-0.297	0.425	0.758	NDA
13	ISWC0015S001	N/A	7/1/2009	233955	0.113	0.0458	0.0383		0.0034	0.0253	0.0456	NDA	-0.164	0.431	0.76	NDA
14	ISWC0016S001	N/A	7/1/2009	233955	0.0291	0.0277	0.0493	NDA	0.00886	0.0183	0.0327	NDA	-0.0409	0.434	0.757	NDA
15	ISWC0019S001	N/A	7/1/2009	233955	0.000785	0.0212	0.0362	NDA	-0.00142	0.0243	0.0454	NDA	-0.343	0.788	1.39	NDA
16	ISWC0020S001	N/A	7/1/2009	233955	0.0421	0.0202	0.0242		-0.0182	0.0257	0.0469	NDA	-0.994	0.75	1.36	NDA
17	ISWC0023S001	N/A	7/1/2009	233955	0.0408	0.0219	0.027		0.0371	0.0289	0.0475	NDA	-0.776	0.776	1.39	NDA
18	ISWC0024S001	N/A	7/1/2009	233955	-0.00101	0.0189	0.0321	NDA	0.0245	0.0284	0.0478	NDA	0.052	0.444	0.768	NDA
19	ISWC0028S001	N/A	7/1/2009	233955	0.0361	0.025	0.0453	NDA	0.0329	0.0269	0.043	NDA	0.174	0.443	0.758	NDA
20	ISWC0041S001	N/A	7/1/2009	233955	0.000885	0.0165	0.0292	NDA	0.0359	0.0232	0.0373	NDA	0.155	0.408	0.723	NDA
21	ISWC0042S001	N/A	7/1/2009	233955	-0.0218	0.025	0.038	NDA	0.00868	0.0256	0.0444	NDA	-0.728	0.773	1.38	NDA
22	ISWC0043S001	N/A	7/1/2009	233955	0.000188	0.0206	0.0362	NDA	0.00492	0.022	0.0381	NDA	-1.08	0.761	1.38	NDA
23	ISWC0044S001	N/A	7/1/2009	233955	-0.00186	0.0209	0.0356	NDA	-0.00133	0.0222	0.0398	NDA	-0.386	0.786	1.39	NDA
24	ISWC0045S001	N/A	7/1/2009	233955	0.0312	0.0345	0.0401	NDA	-0.01	0.0267	0.0481	NDA	-0.509	0.772	1.37	NDA
25	ISWC0046S001	N/A	7/1/2009	233955	0.102	0.0279	0.0283		0.0375	0.0217	0.032		-0.428	0.782	1.38	NDA
26	ISWC0047S001	N/A	7/1/2009	233955	-0.00259	0.0197	0.0346	NDA	0.0365	0.0283	0.0462	NDA	-1.12	0.777	1.41	NDA
27	ISWC0048S001	N/A	7/1/2009	233955	0.0182	0.0286	0.051	NDA	-0.000557	0.0173	0.0334	NDA	-0.435	0.779	1.38	NDA
28	ISWC0077RadS001	N/A	7/29/2009	234325	0.0466	0.0253	0.0324		0.0307	0.0238	0.0372	NDA	-0.202	0.488	0.946	NDA
29	ISWC0078RadS001	N/A	7/29/2009	234325	0.00741	0.0218	0.0384	NDA	0.0004	0.0232	0.0459	NDA	-0.0891	0.508	0.958	NDA
30	ISWC0079RadS001	N/A	7/29/2009	234325	-0.0128	0.0199	0.0342	NDA	0.00167	0.0184	0.0353	NDA	-0.0547	0.524	0.981	NDA
31	ISWC0080RadS001	N/A	7/29/2009	234325	0.00257	0.0275	0.0485	NDA	0.0227	0.019	0.0295	NDA	0.26	0.346	0.588	NDA
32	ISWC0081RadS001	N/A	7/29/2009	234325	-0.0104	0.0237	0.0405	NDA	0.0142	0.017	0.0287	NDA	-0.198	0.479	0.928	NDA
33	ISWC0084RadS001	N/A	7/29/2009	234325	0.00972	0.0292	0.0503	NDA	0.00833	0.0263	0.0455	NDA	0.124	0.529	0.954	NDA
34	ISWC0085RadS001	N/A	7/29/2009	234325	0.00143	0.0315	0.054	NDA	0.0419	0.0261	0.0419	NDA	-0.0553	0.529	0.99	NDA
35	ISWC0086RadS001	N/A	7/29/2009	234325	0.0101	0.0252	0.043	NDA	0.000108	0.0164	0.0334	NDA	-0.0265	0.511	0.951	NDA
36	ISWC0087RadS001	N/A	7/29/2009	234325	0.0416	0.0345	0.0431	NDA	3.85E-05	0.0223	0.0397	NDA	0	0.516	0.955	NDA
37	ISWC0088RadS001	N/A	7/29/2009	234325	-0.0187	0.0256	0.0429	NDA	0.00507	0.0218	0.0381	NDA	0.155	0.342	0.598	NDA
38	ISWC0089RadS001	N/A	7/29/2009	234325	0.00158	0.0276	0.0449	NDA	0.0103	0.0272	0.0471	NDA	-0.0415	0.528	0.943	NDA
39	ISWC0090RadS001	N/A	7/29/2009	234325	0.0578	0.0398	0.0413		0.0299	0.0272	0.0451	NDA	-0.0613	0.484	0.898	NDA
40	ISWC0091RadS001	N/A	7/29/2009	234325	0.0611	0.0403	0.044		0.0272	0.0283	0.0472	NDA	-0.183	0.513	0.987	NDA
41	ISWC0092RadS001	N/A	7/29/2009	234325	0.0743	0.0305	0.0407		0.0264	0.0247	0.041	NDA	0.0279	0.537	0.951	NDA
42	ISWC0093RadS001	N/A	7/29/2009	234325	0.0124	0.0255	0.0441	NDA	0.0273	0.0216	0.0333	NDA	-0.331	0.483	0.963	NDA
43	ISWC0082RadS001	N/A	7/30/2009	234376	0.076	0.0434	0.0391		0.000193	0.0153	0.0306	NDA	0.217	0.391	0.677	NDA
44	ISWC0083RadS001	N/A	7/30/2009	234376	0	0.0279	0.053	NDA	0.0378	0.0236	0.0348		0.0694	0.379	0.677	NDA
	ISWC0094RadS001	N/A	8/17/2009	235405	-0.00482	0.0288	0.0505	NDA	-0.00381	0.026	0.0476	NDA	-0.0872	0.703	1.25	NDA
	ISWC0095RadS001	N/A	8/17/2009	235405	-0.023	0.0254	0.0409	NDA	-0.00968	0.0123	0.0296	NDA	-0.423	0.678	1.24	NDA

	Cesium-137 (pCi/g)				Strontium-90 (pCi/g)				Tritium (pCi/g)			
	Activity	+/- 2σ Error	MDA	Non-detect?	Activity	+/- 2σ Error	MDA	Non-detect?	Activity	+/- 2σ Error	MDA	Non-detect?
Average	0.026		0.041		0.016		0.041		-0.238		1.014	
Maximum	0.113		0.054		0.042		0.048		0.387		1.410	
Minimum	-0.023		0.024		-0.018		0.028		-1.120		0.588	
Count				46				46				46
Number of Non-Detects				32				42				46

### Soil Data from Happy Valley ISRA

No.	Sample ID	Stockpile ID	Sampling Date	Laboratory Batch	Cesium-137 (pCi/g)				Strontium-90 (pCi/g)				Tritium (pCi/g)			
					Activity	+/- 2σ Error	MDA	Non-detect?	Activity	+/- 2σ Error	MDA	Non-detect?	Activity	+/- 2σ Error	MDA	Non-detect?
				% Non-Detects				70%				91%				100%

**Appendix 2**  
**Analytical Radionuclide Results**























