1228921

RPP-RPT-58339 DRAFT A

PHASE 2 RCRA FACILITY INVESTIGATION REPORT FOR WASTE MANAGEMENT C

SECTION 4 OF 5

Figure Q-45. Distribution Map of Butylbenzylphthalate at WMA C

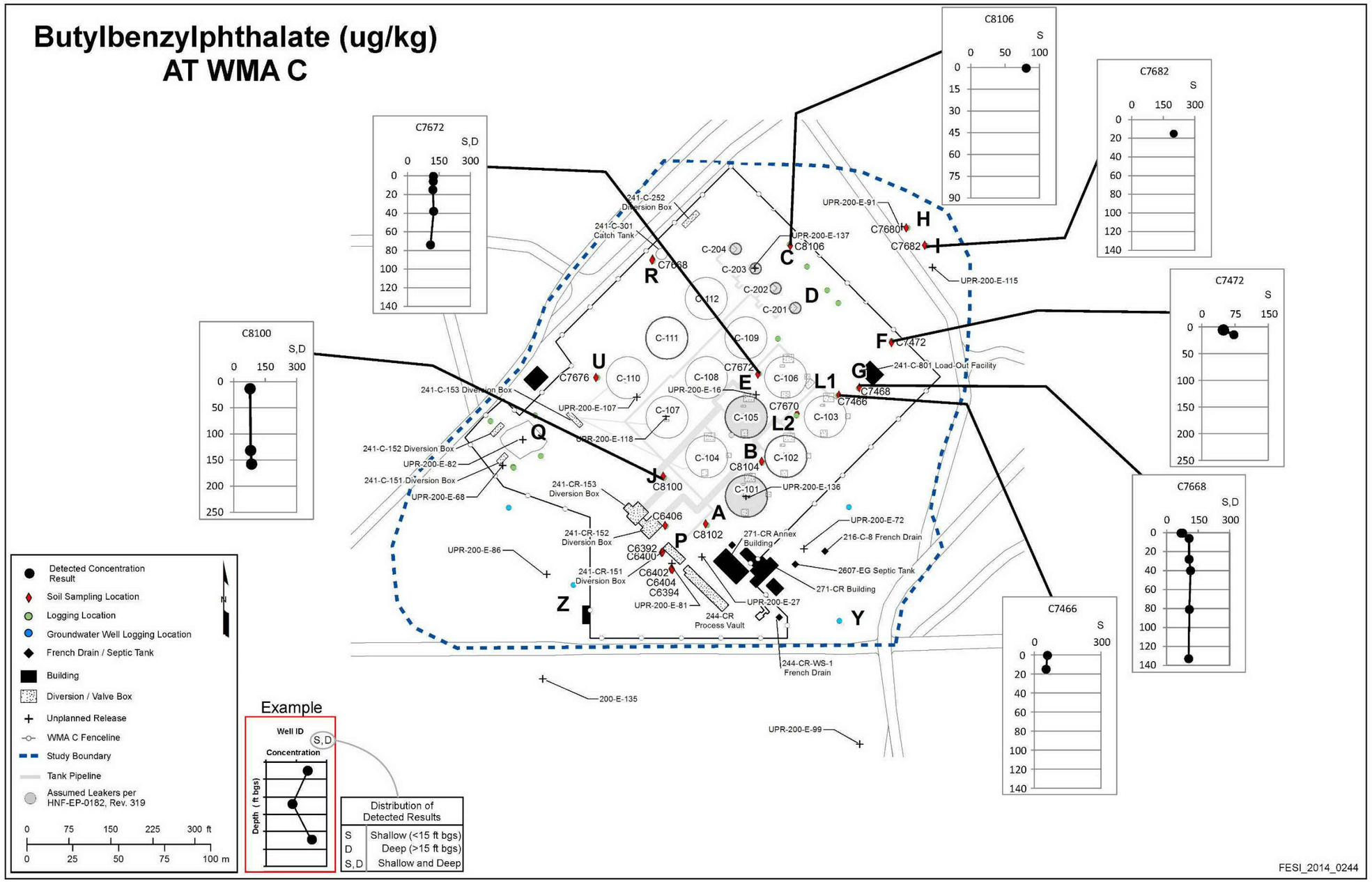

Figure Q-46. Distribution Map of Di-n-butylphthalate at WMA C

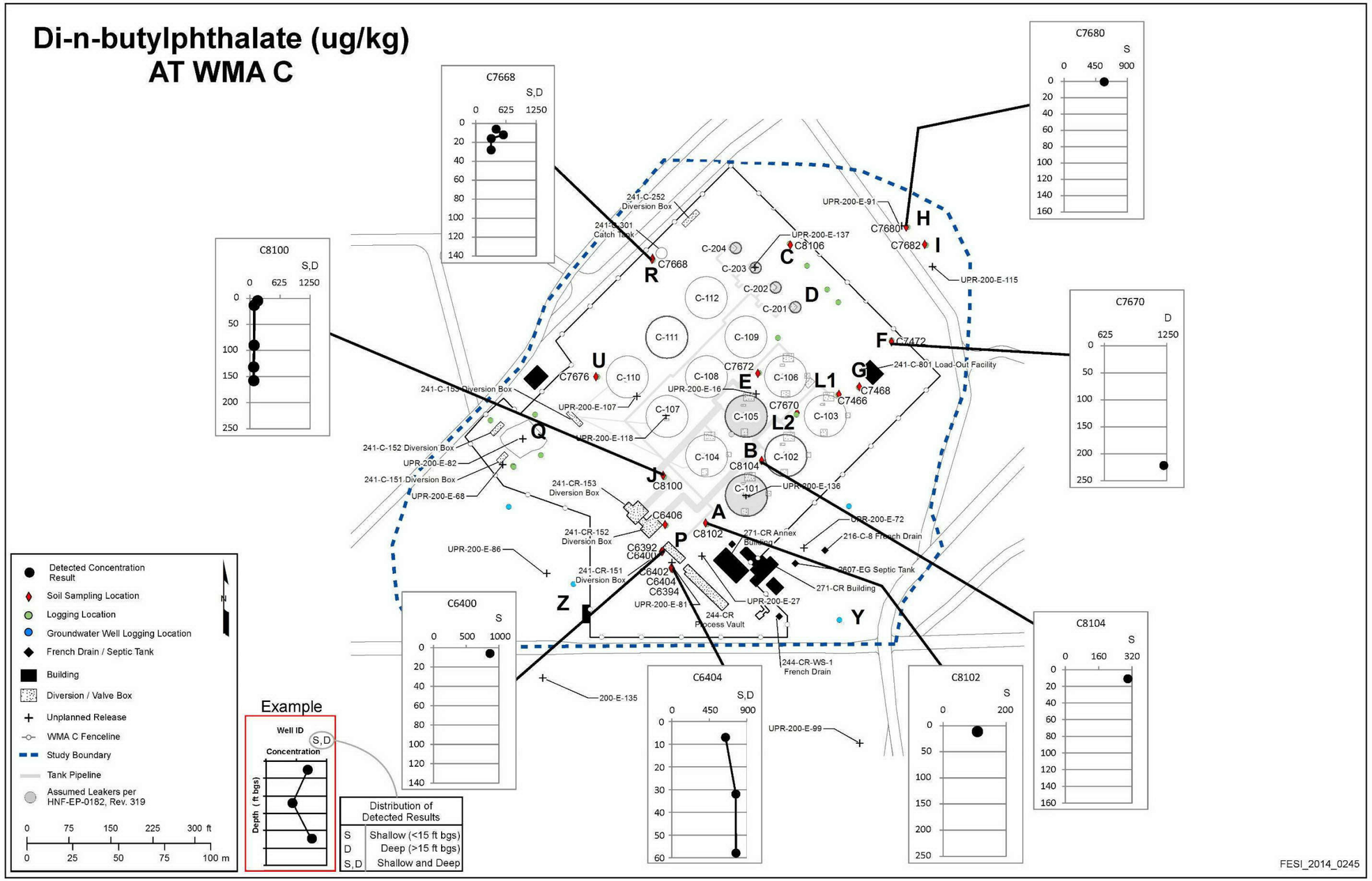

Figure Q-47. Distribution Map of Di-n-octylphthalate at WMA C

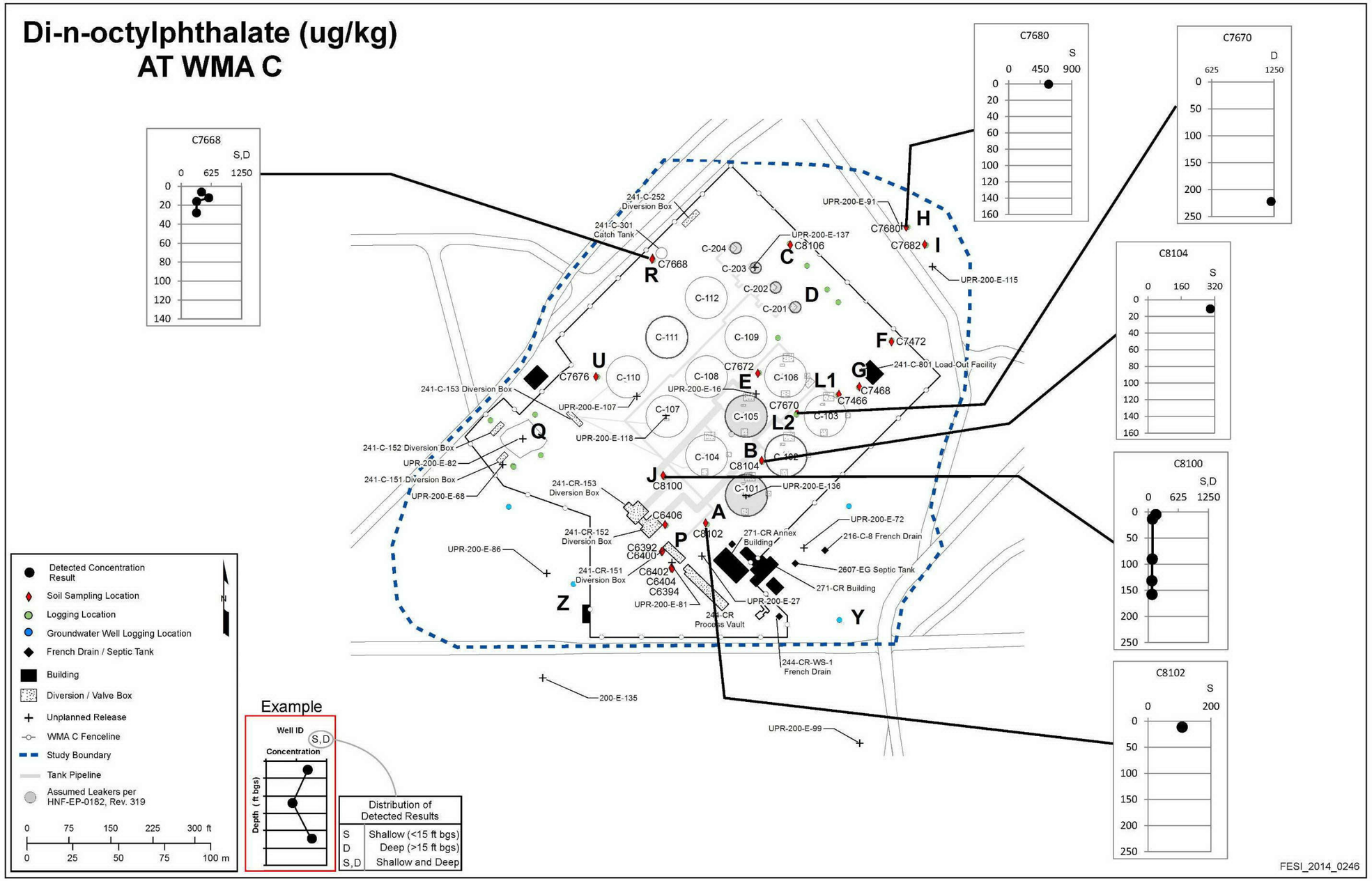

Figure Q-48. Distribution Map of Ethylene glycol at WMA C

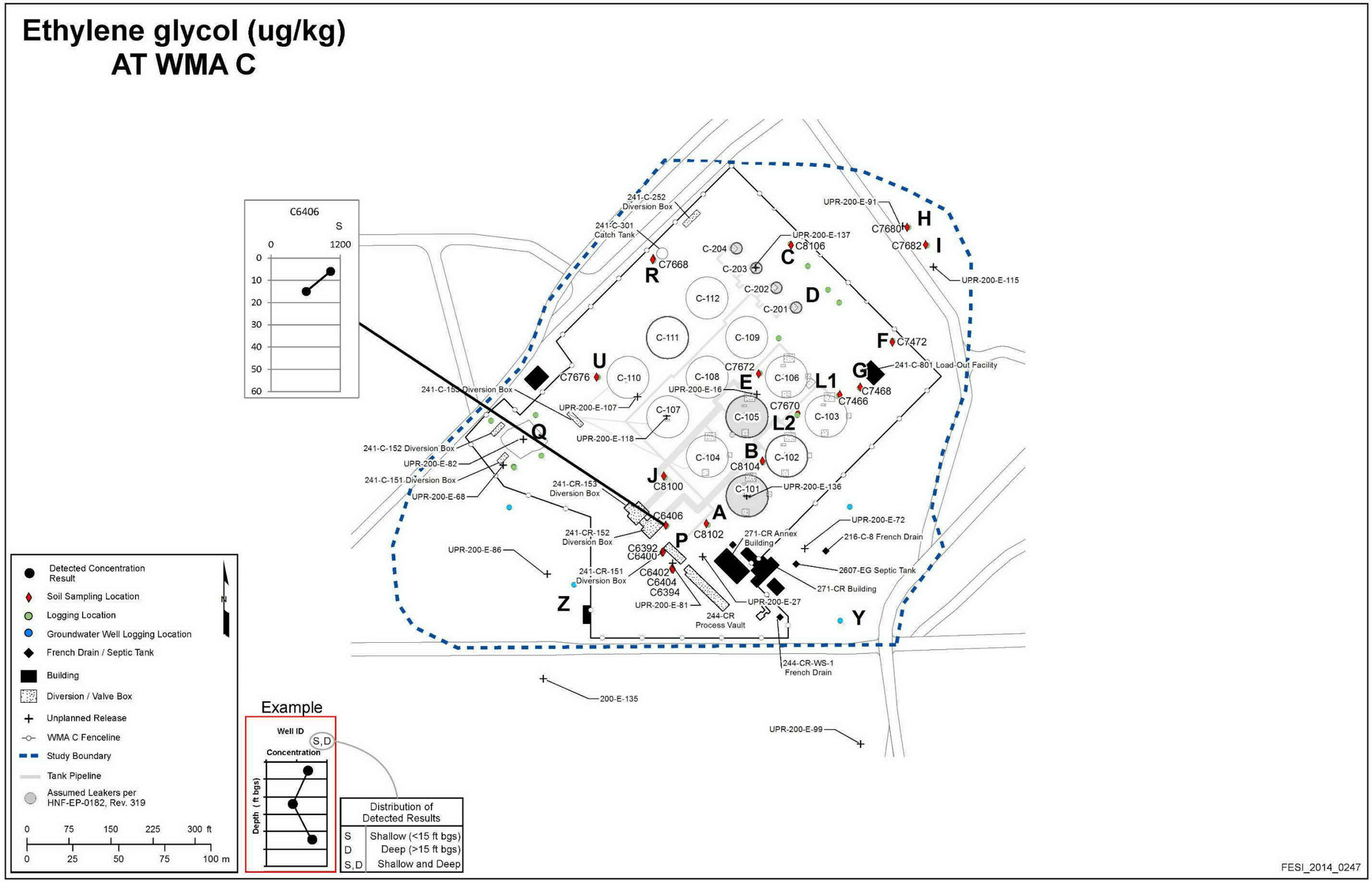

Figure Q-49. Distribution Map of 2-Hydroxyacetate at WMA C

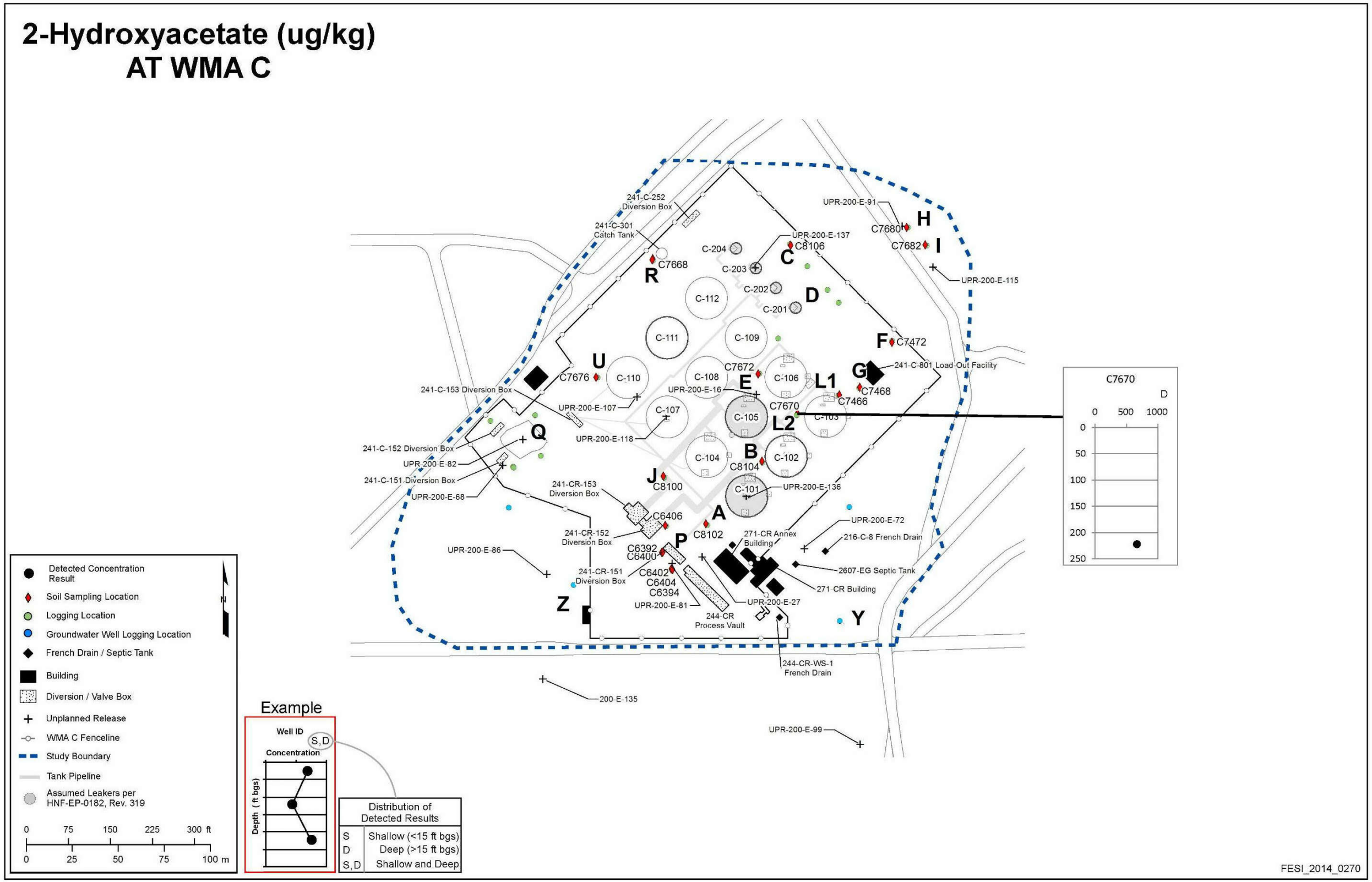

Figure Q-50. Distribution Map of Acetate at WMA C

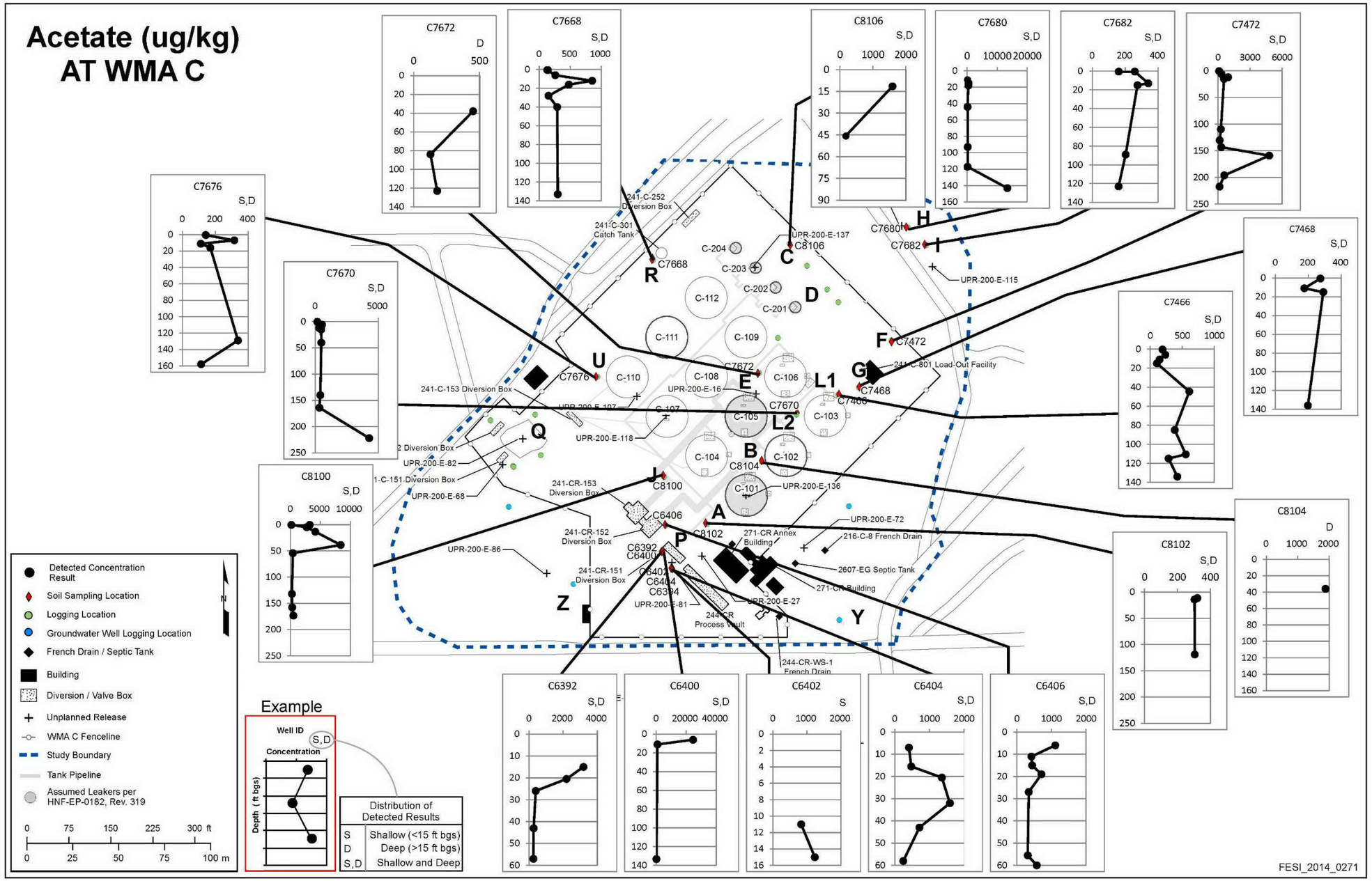

Figure Q-51. Distribution Map of Ammonium ion at WMA C

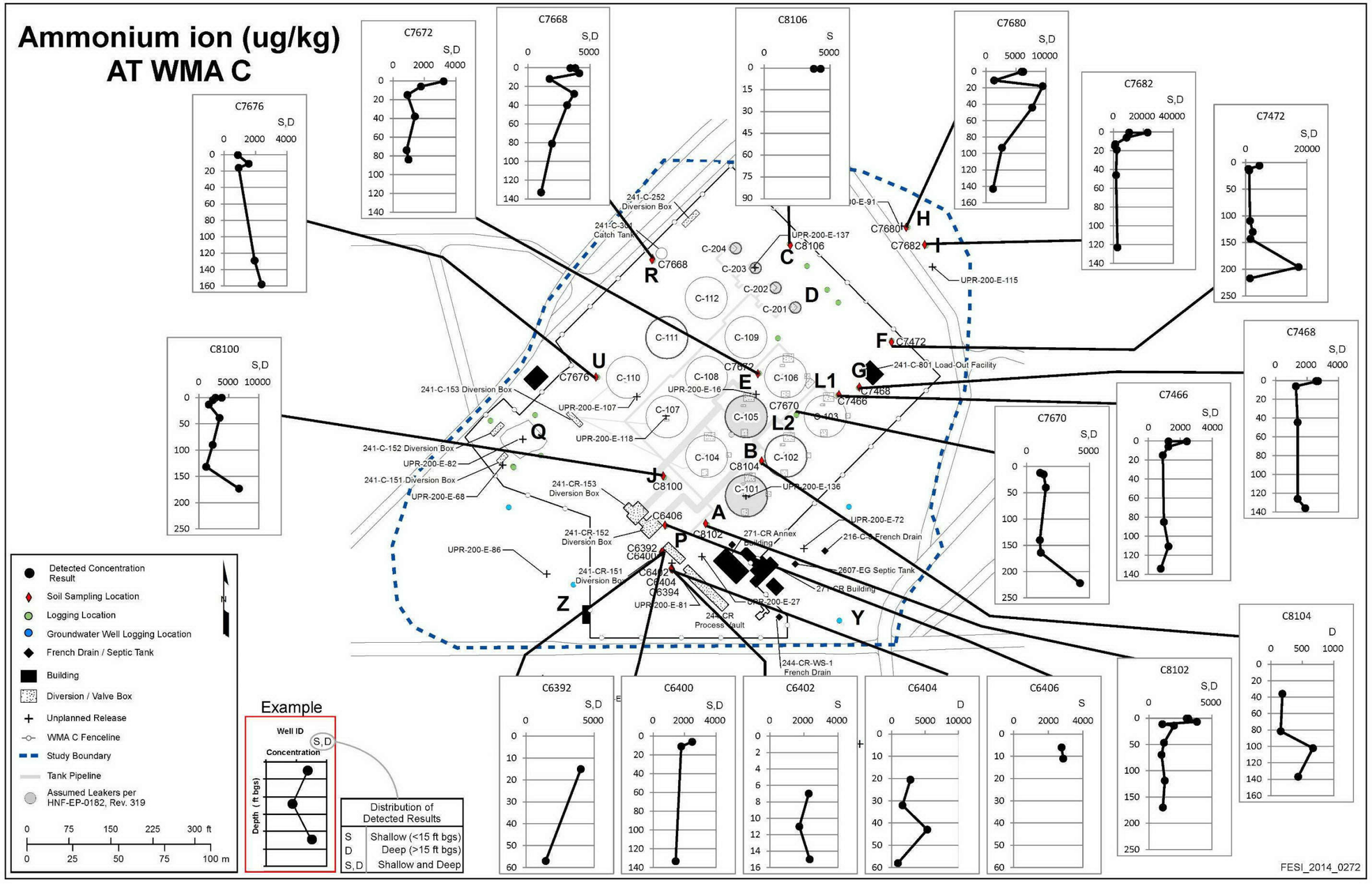

Figure Q-52. Distribution Map of Formate at WMA C

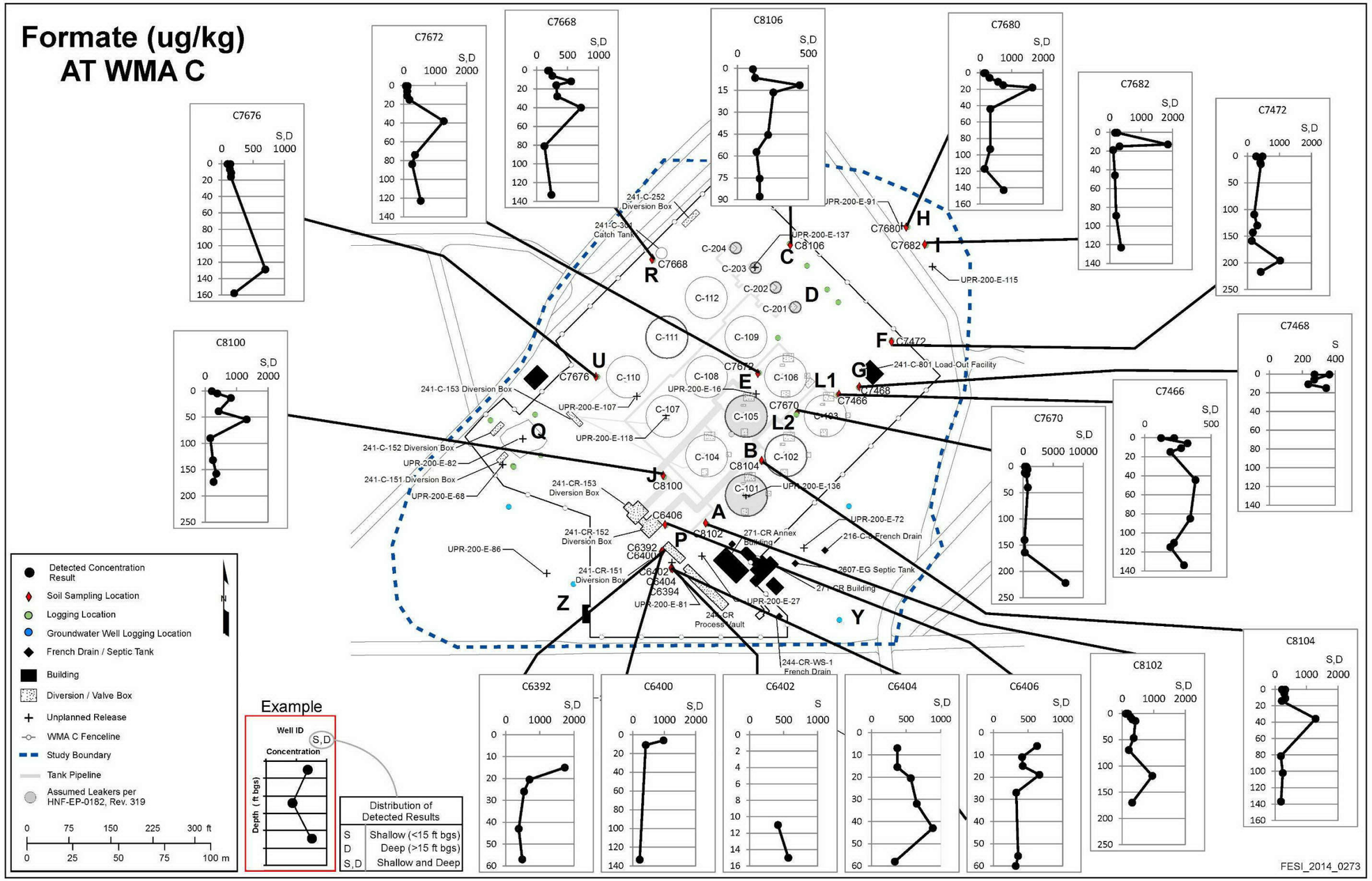

Figure Q-53. Distribution Map of Nitrite at WMA C

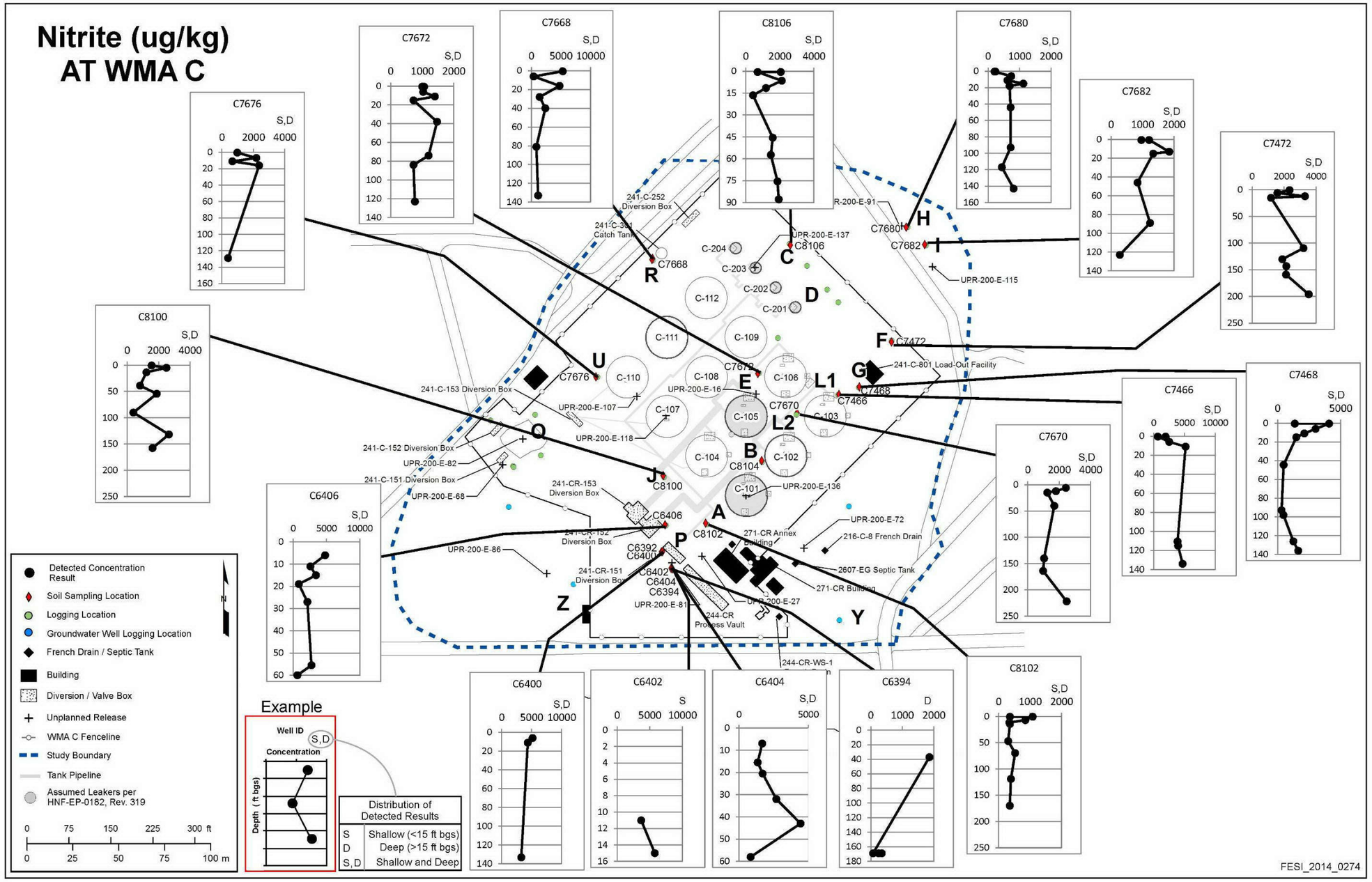

Figure Q-54. Distribution Map of Oxalate at WMA C

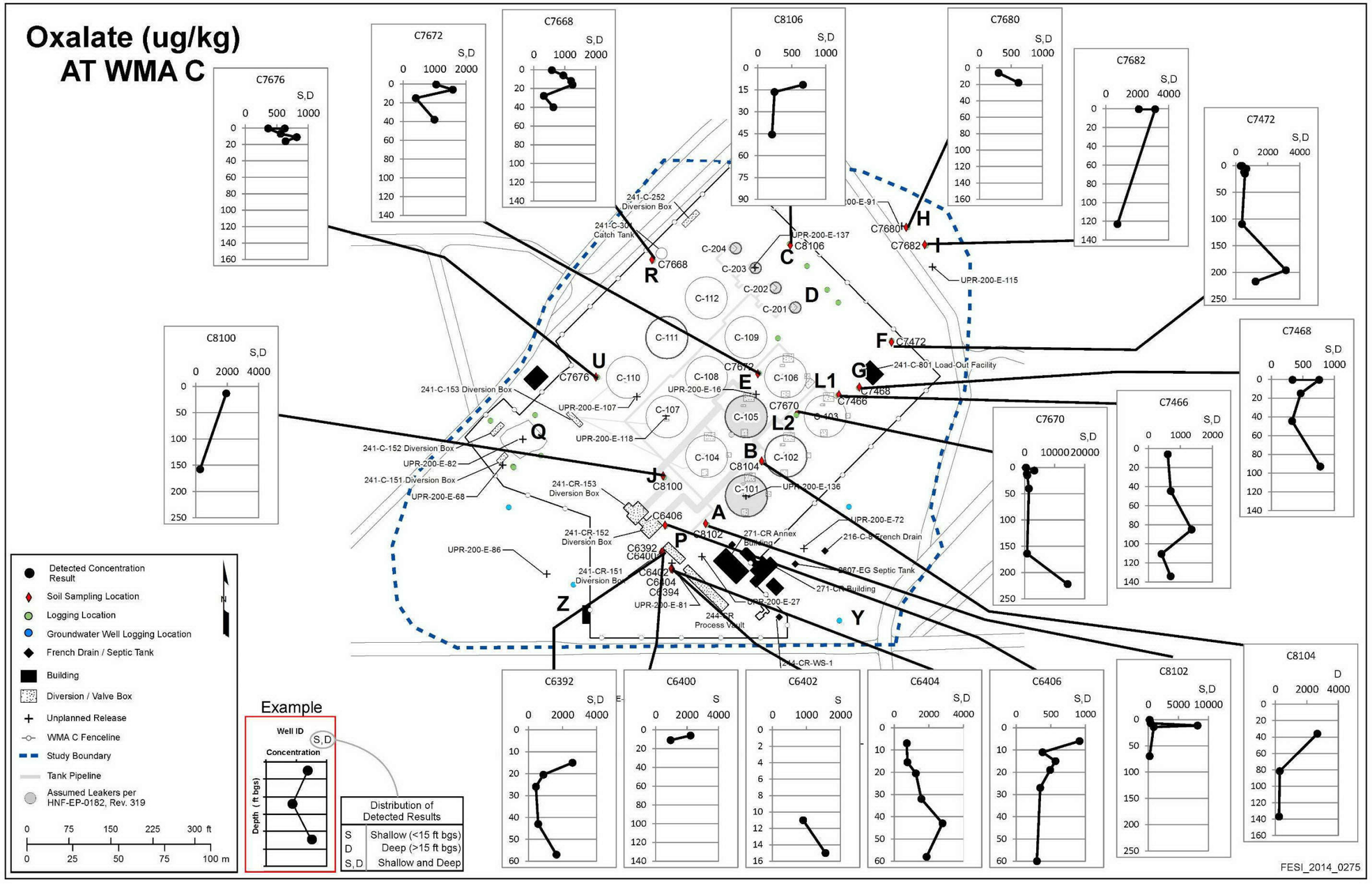

Figure Q-55. Distribution Map of Phosphorus at WMA C

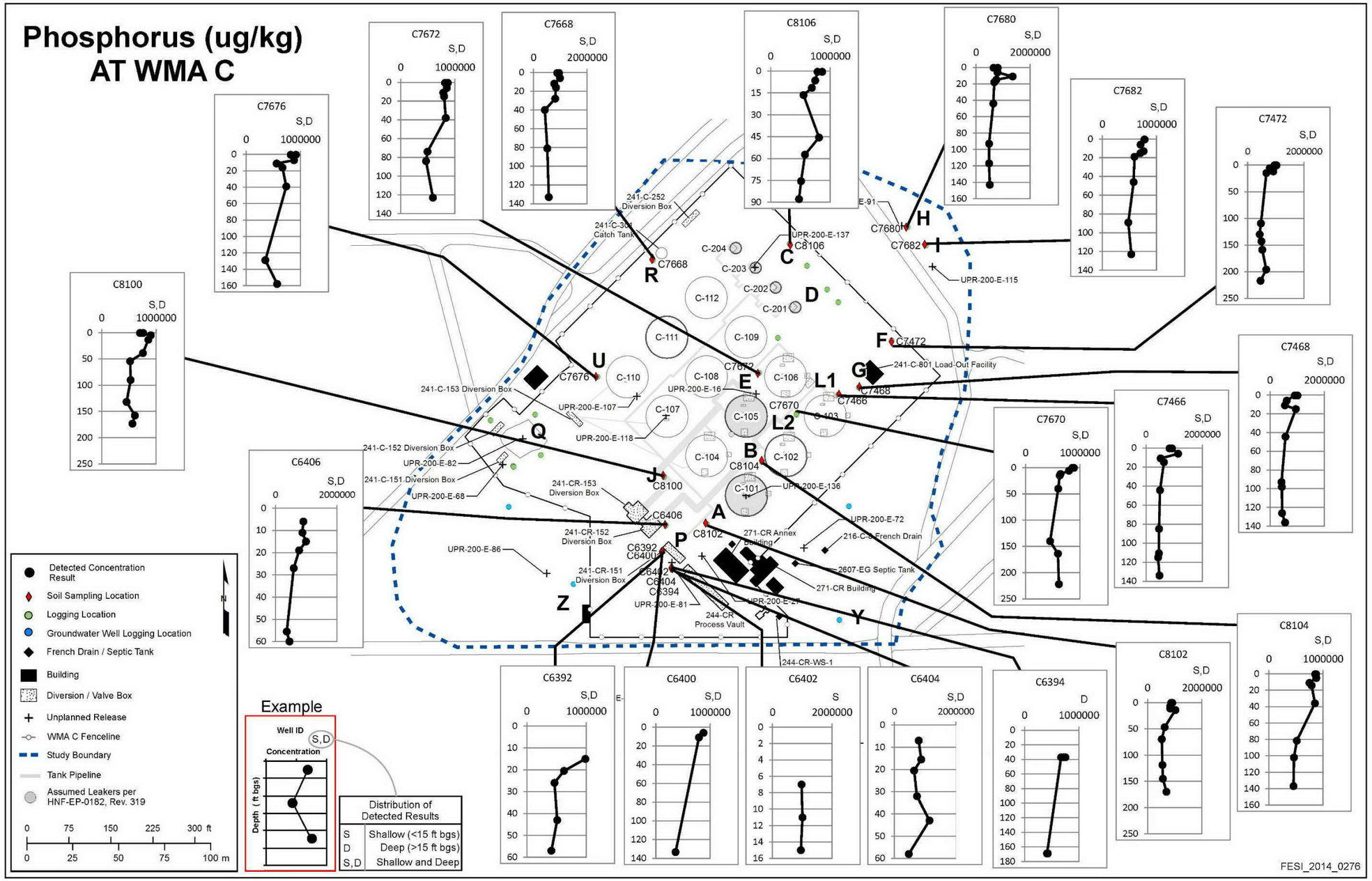

Figure Q-56. Distribution Map of Strontium WMA C

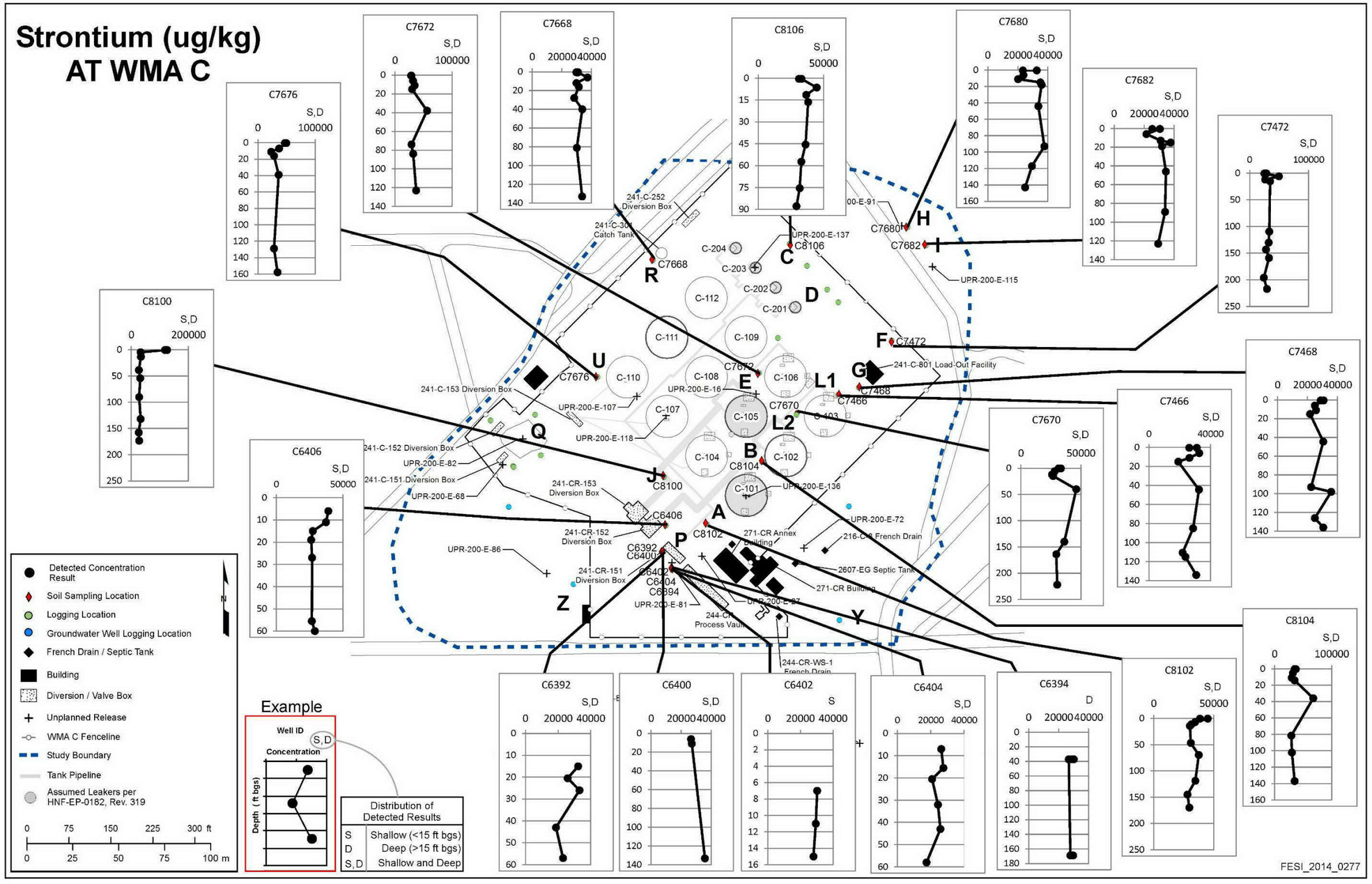

Figure Q-57. Distribution Map of Sulfide at WMA C

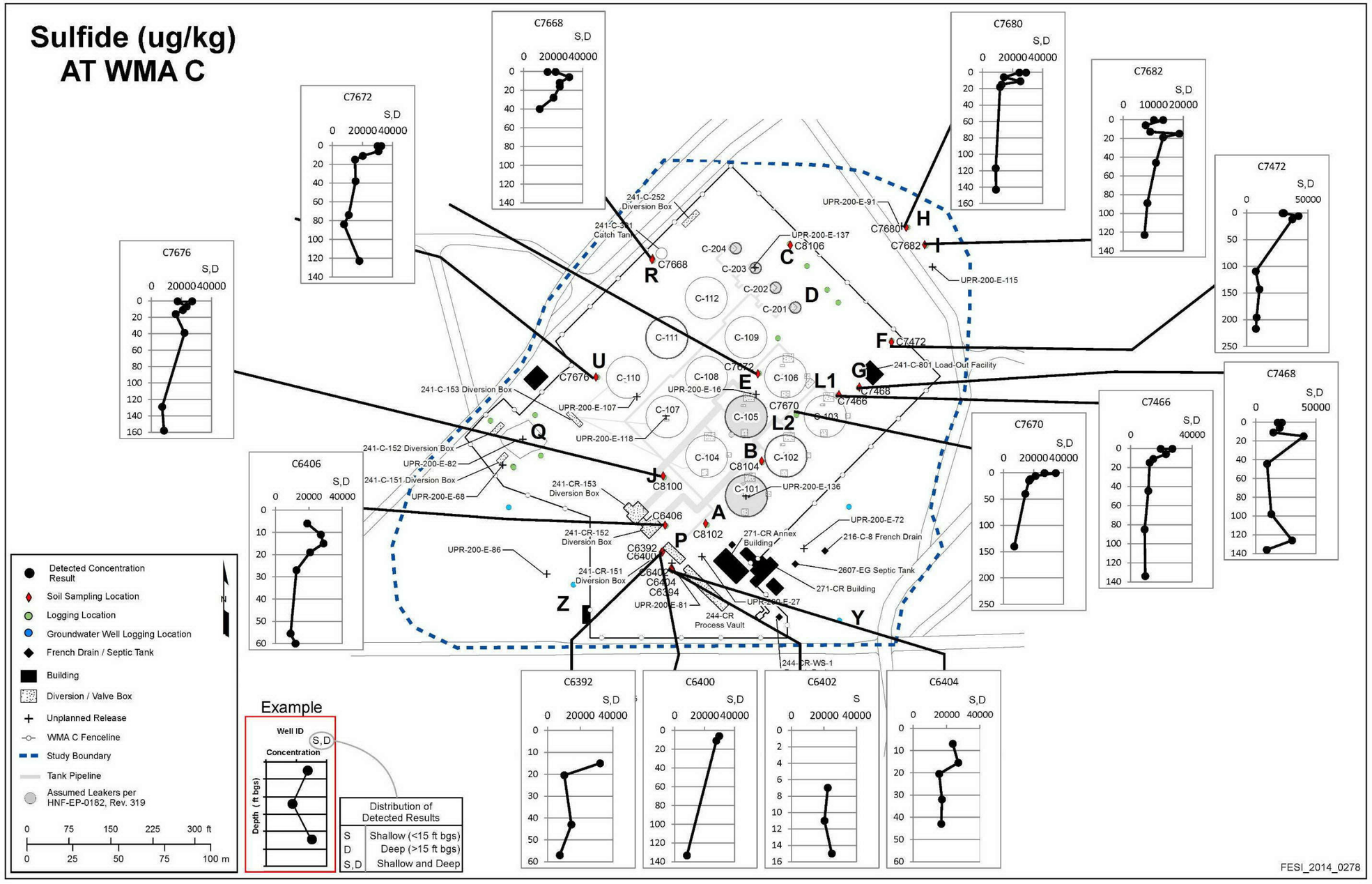

Figure Q-58. Distribution Map of Bismuth at WMA C

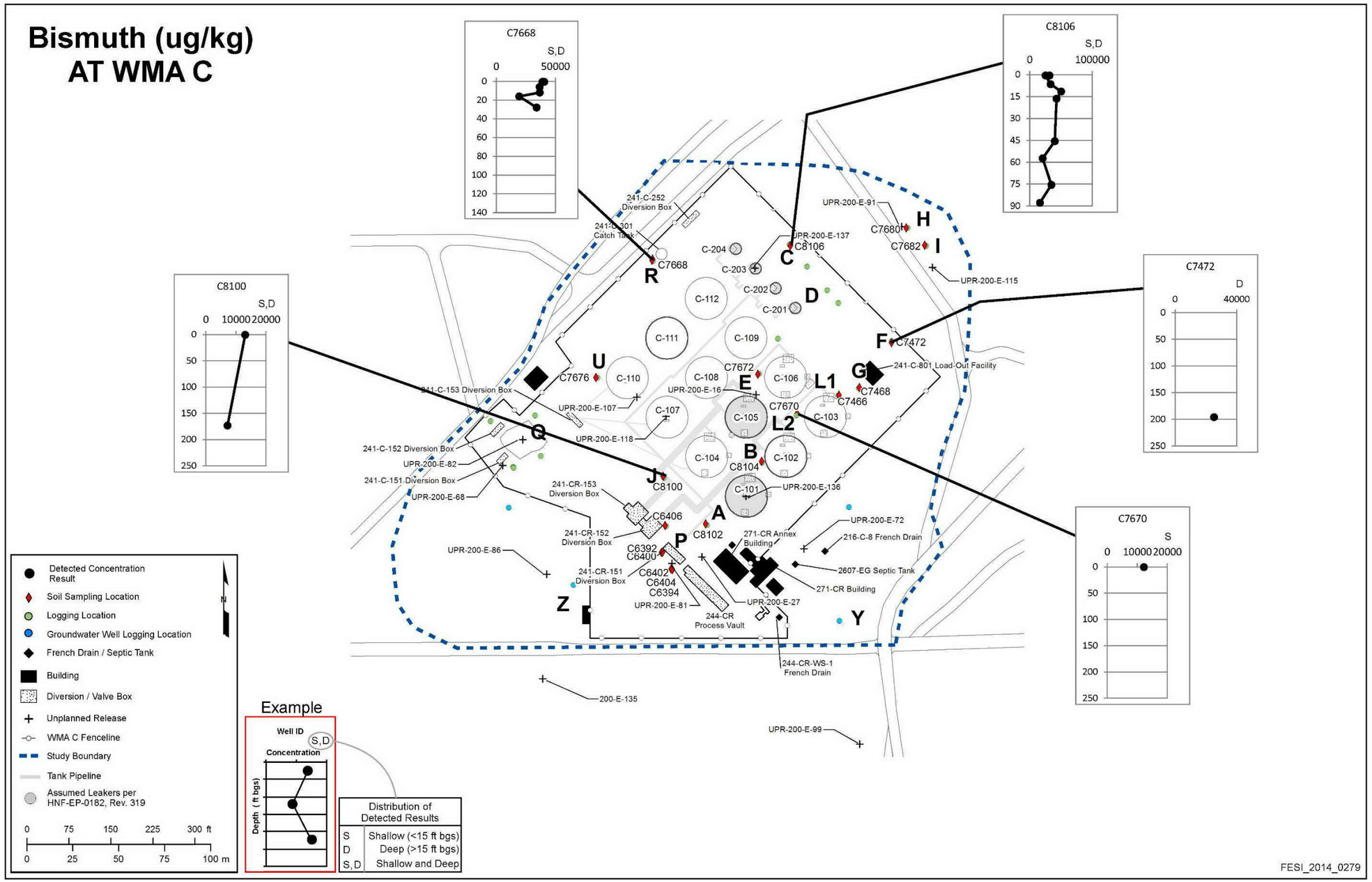

Figure Q-59. Distribution Map of Bromide at WMA C

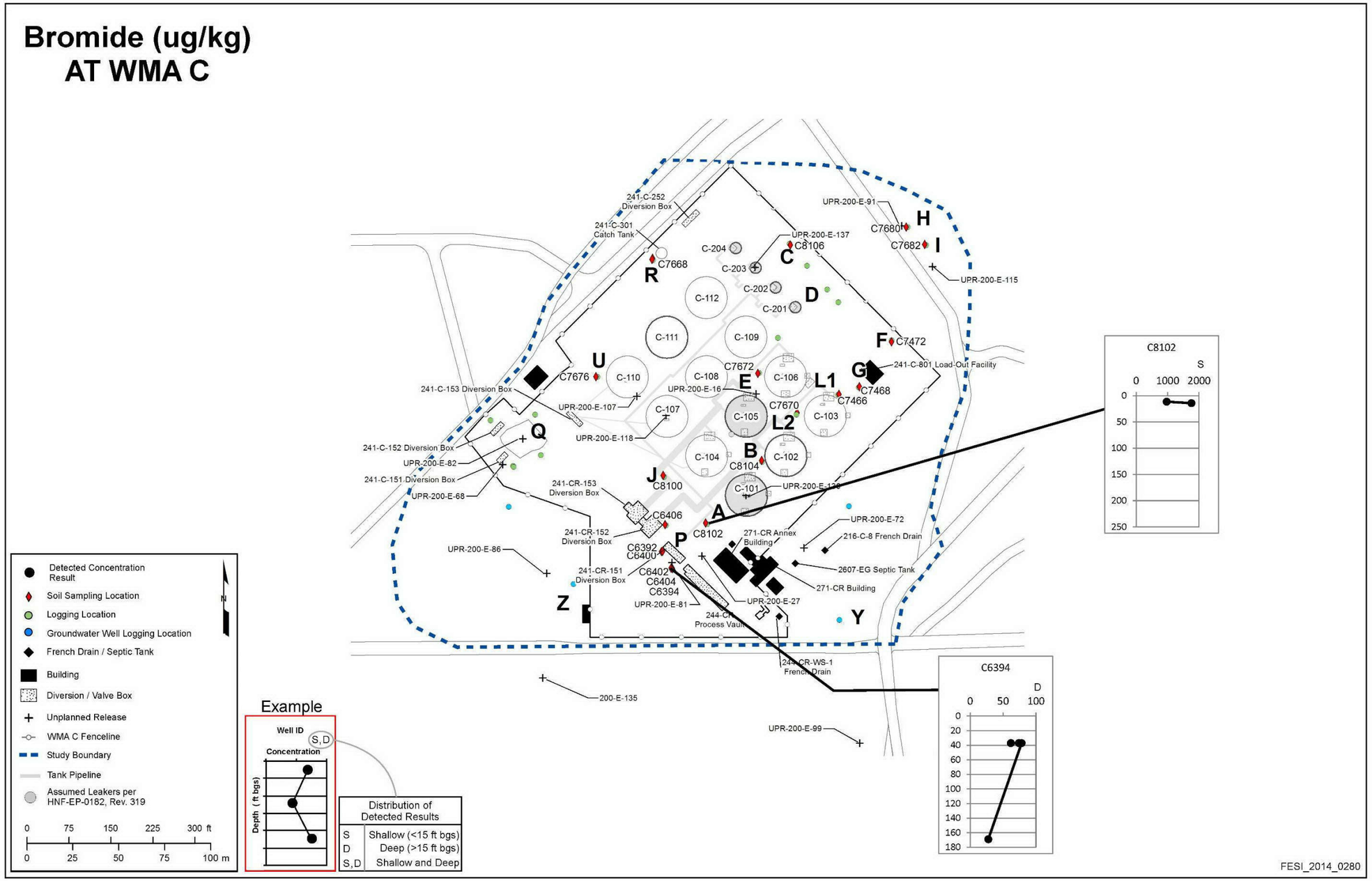

Figure Q-60. Distribution Map of Cerium at WMA C

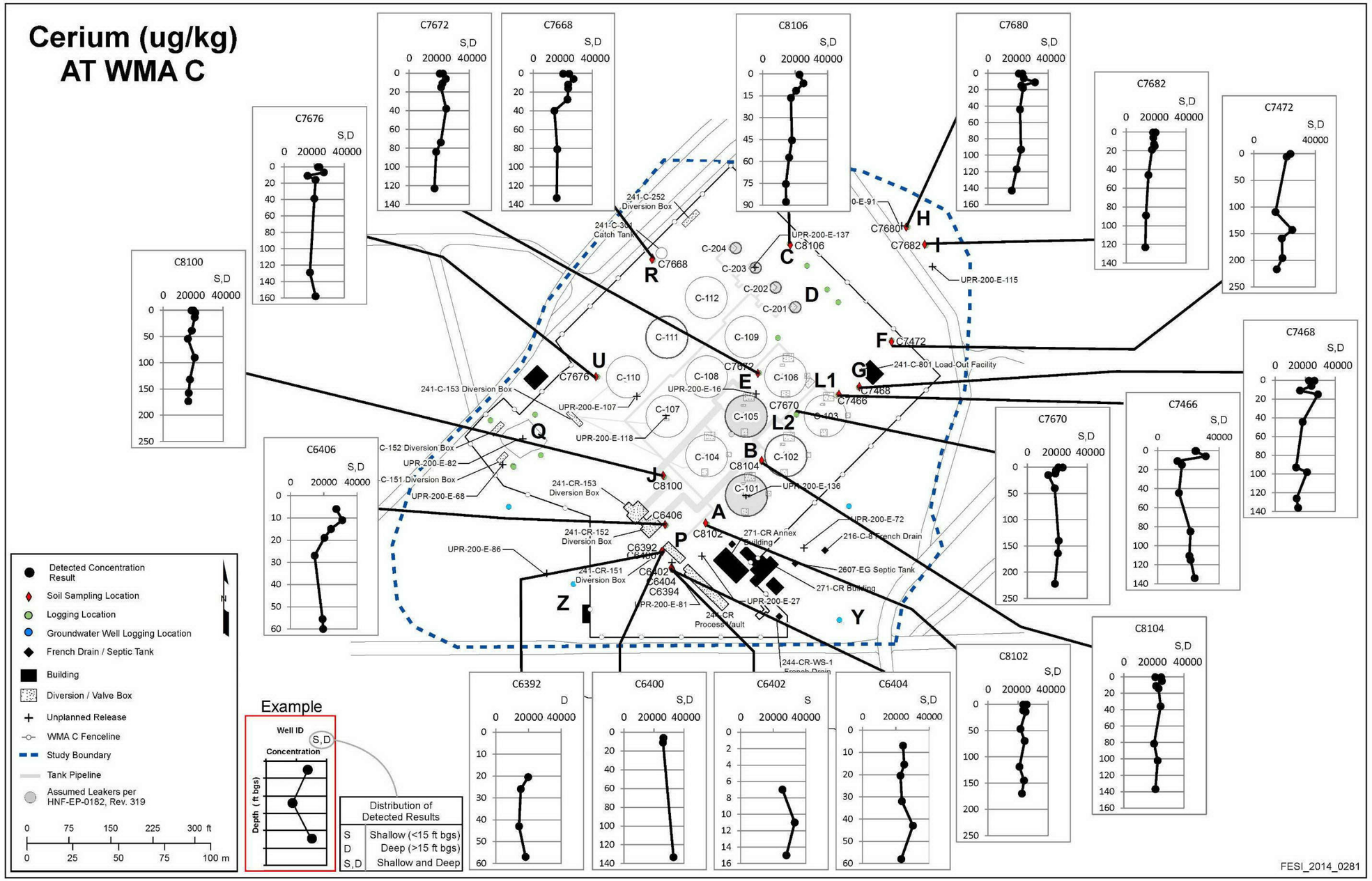

Figure Q-61. Distribution Map of Europium at WMA C

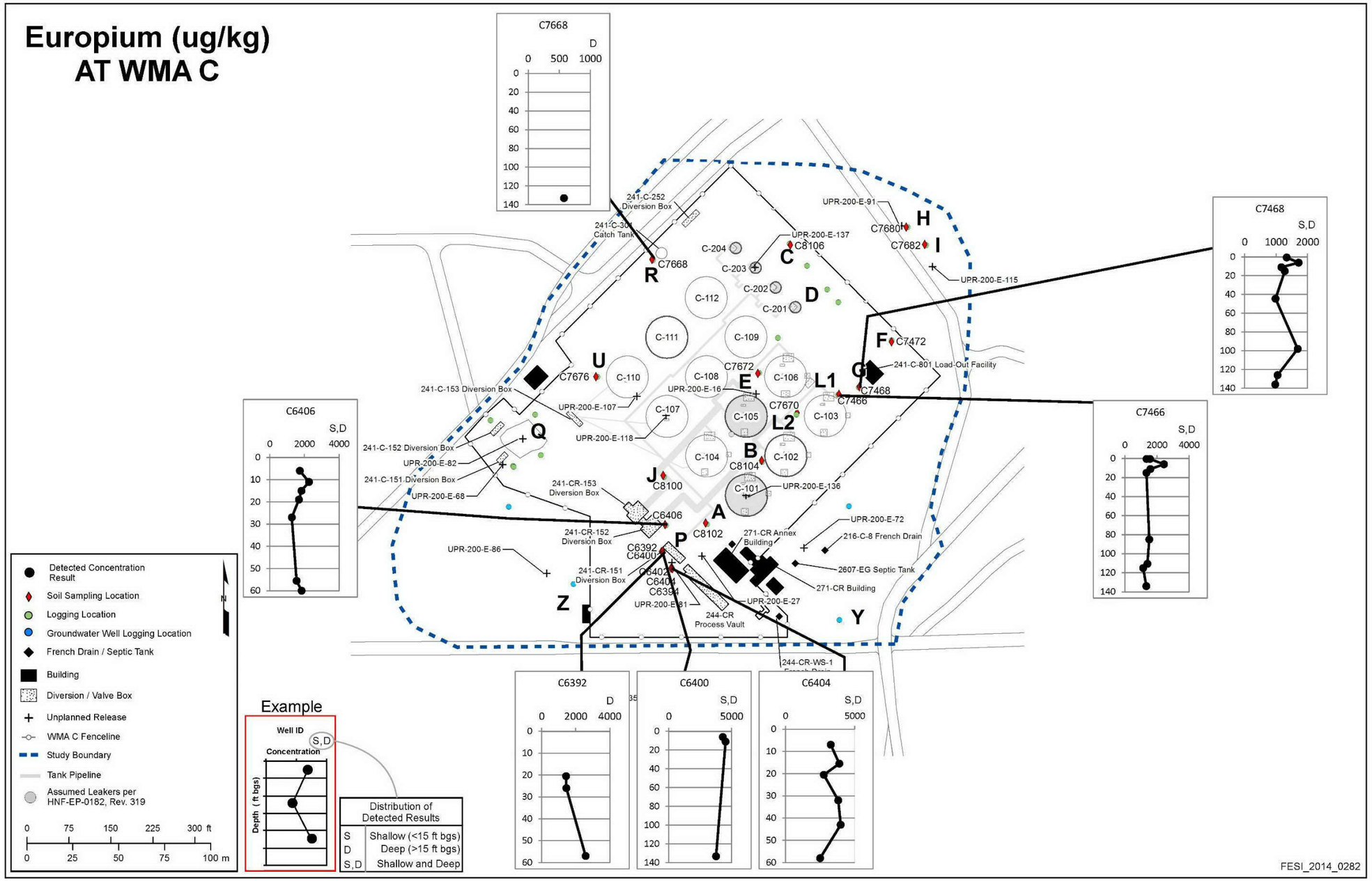

Figure Q-62. Distribution Map of Lanthanum at WMA C

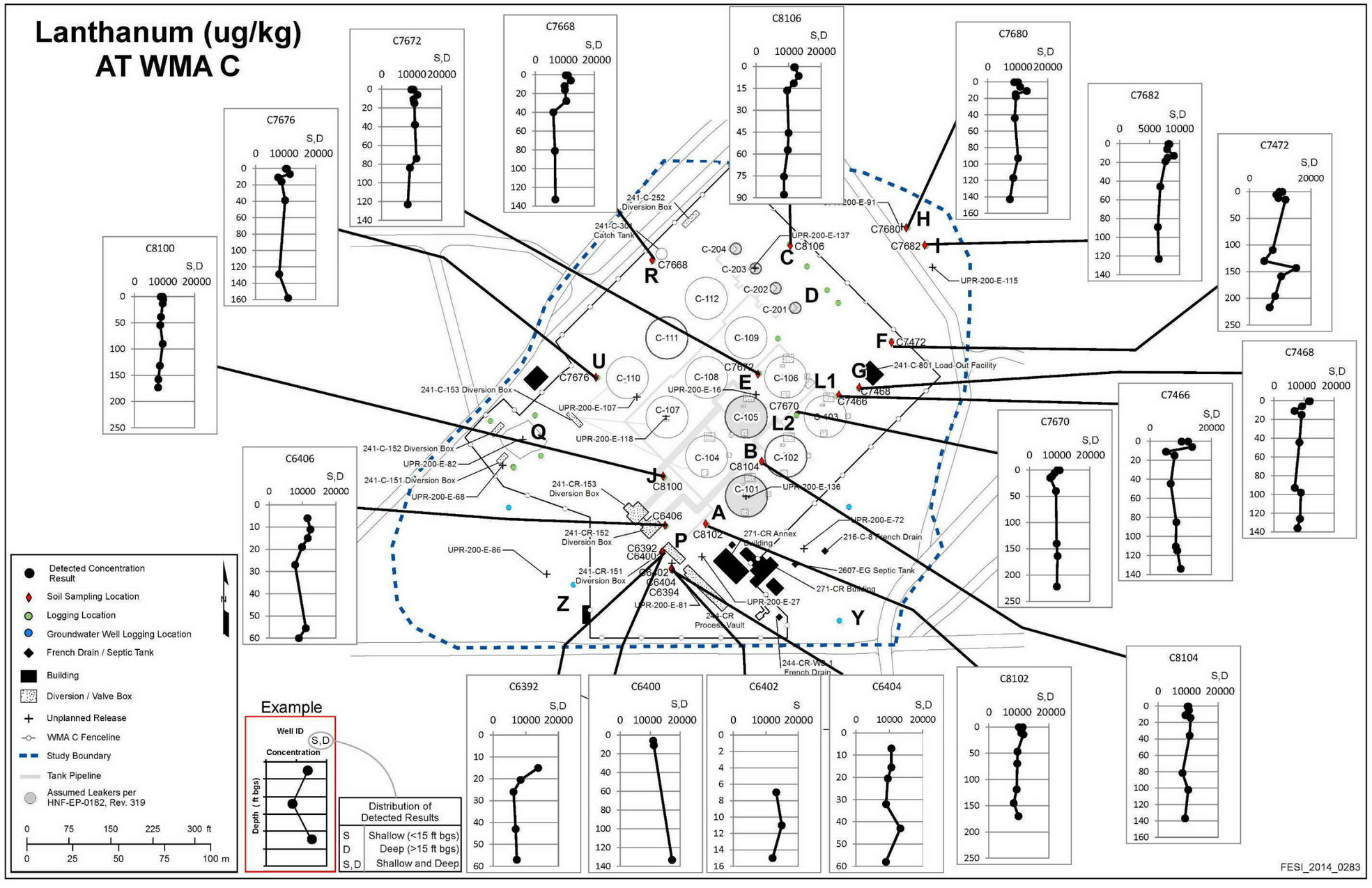

Figure Q-63. Distribution Map of Neodymium at WMA C

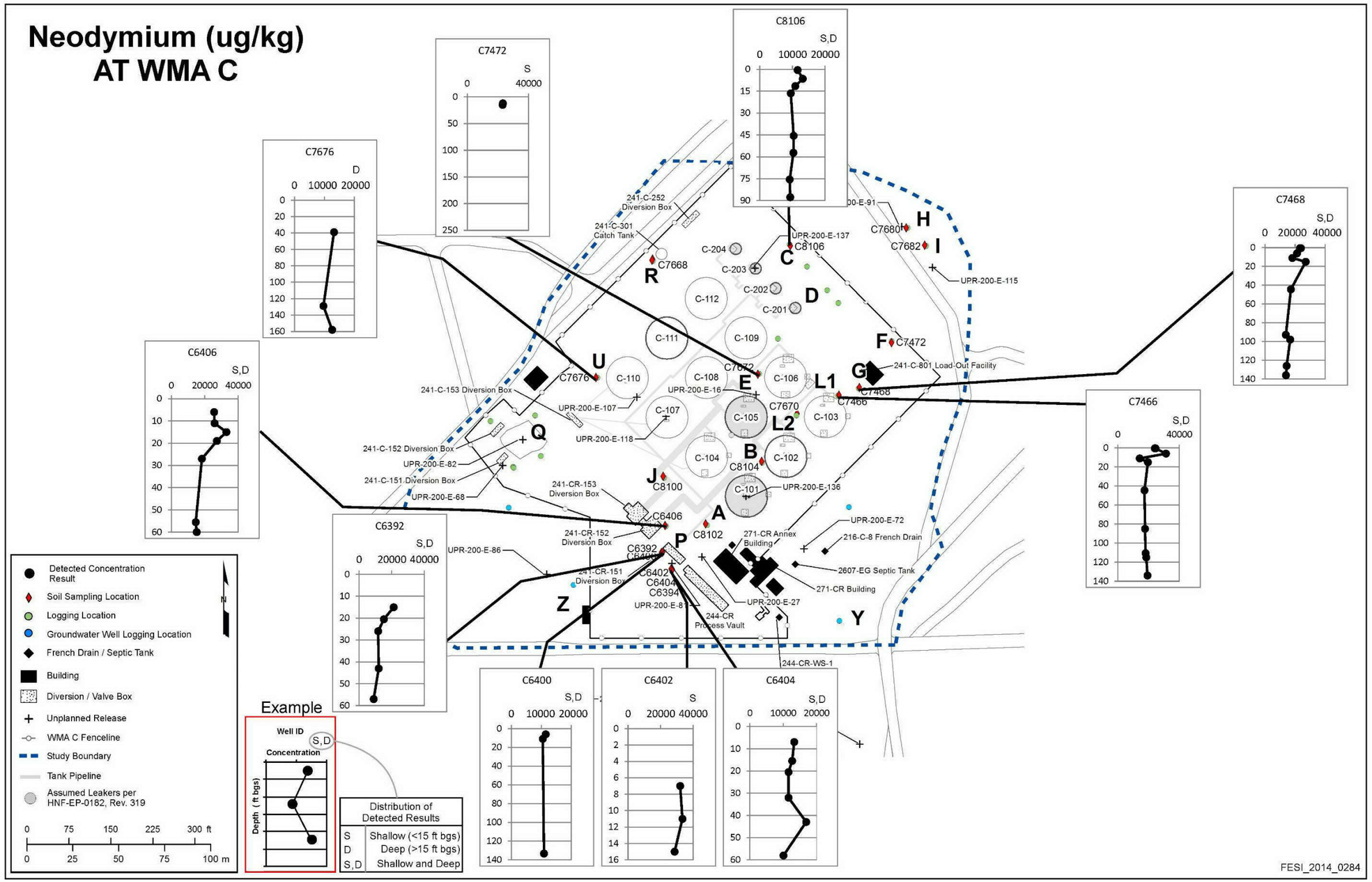

Figure Q-64. Distribution Map of Palladium at WMA C

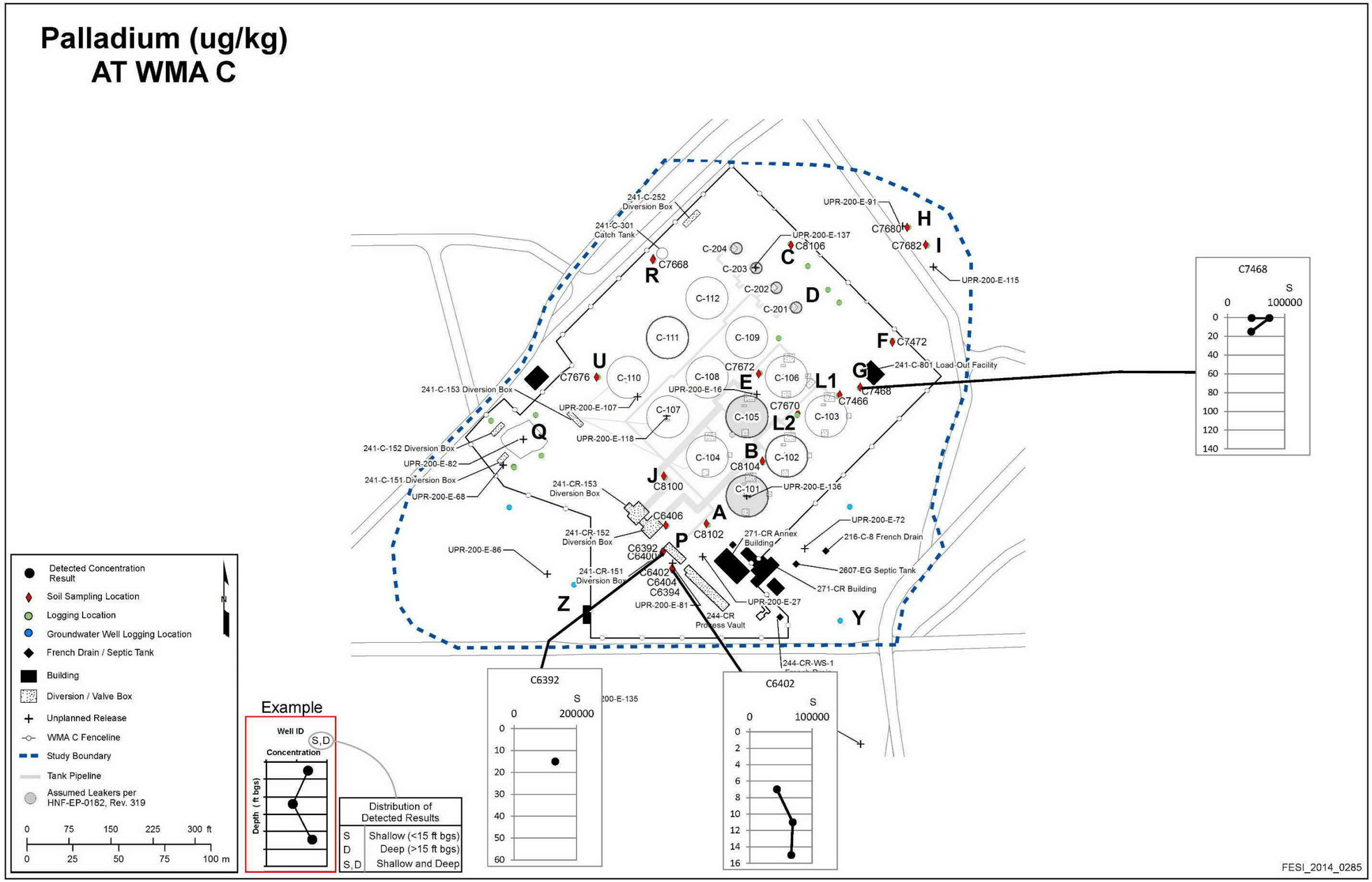

Figure Q-65. Distribution Map of Praseodymium at WMA C

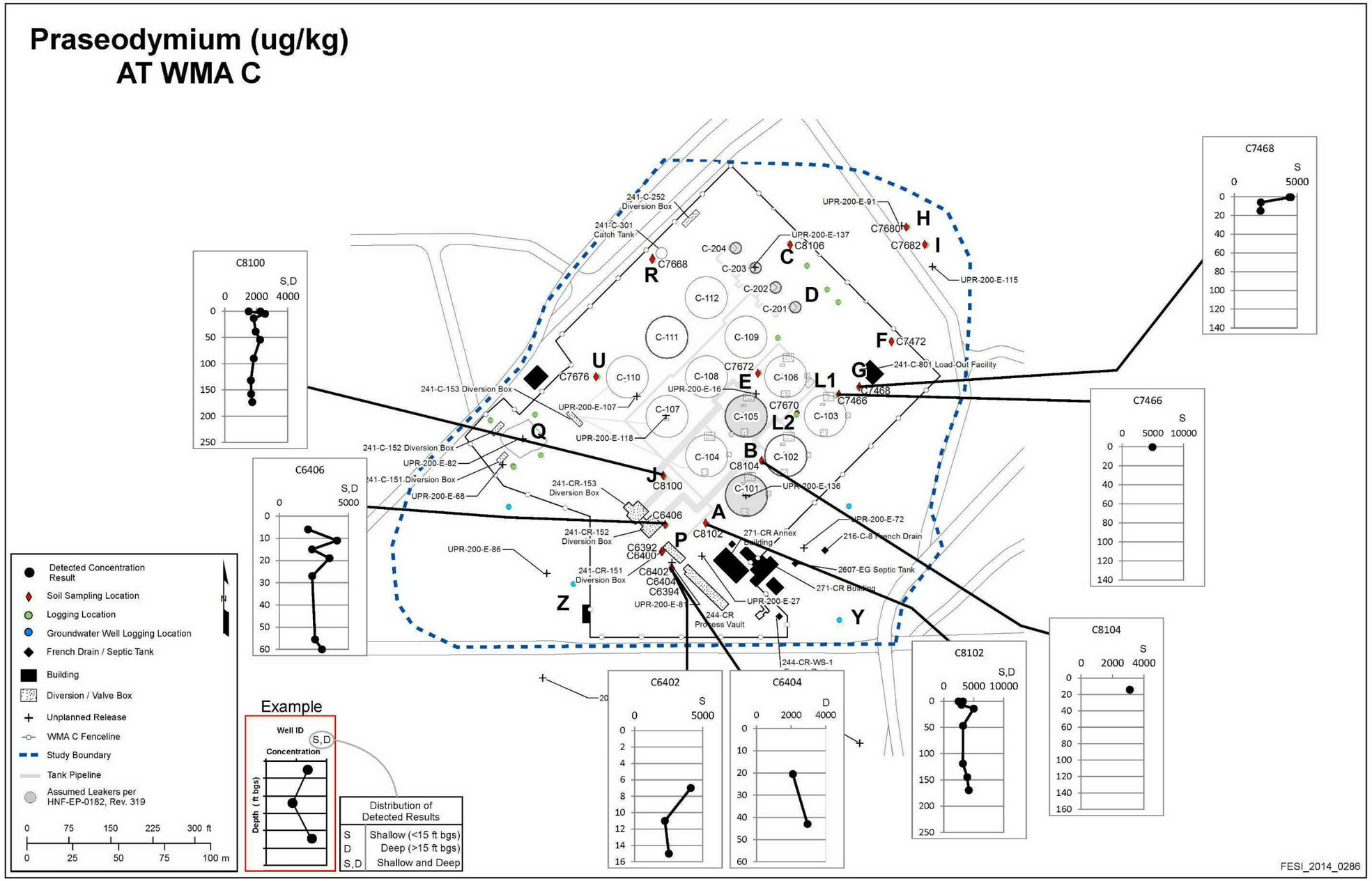

Figure Q-66. Distribution Map of Rubidium at WMA C

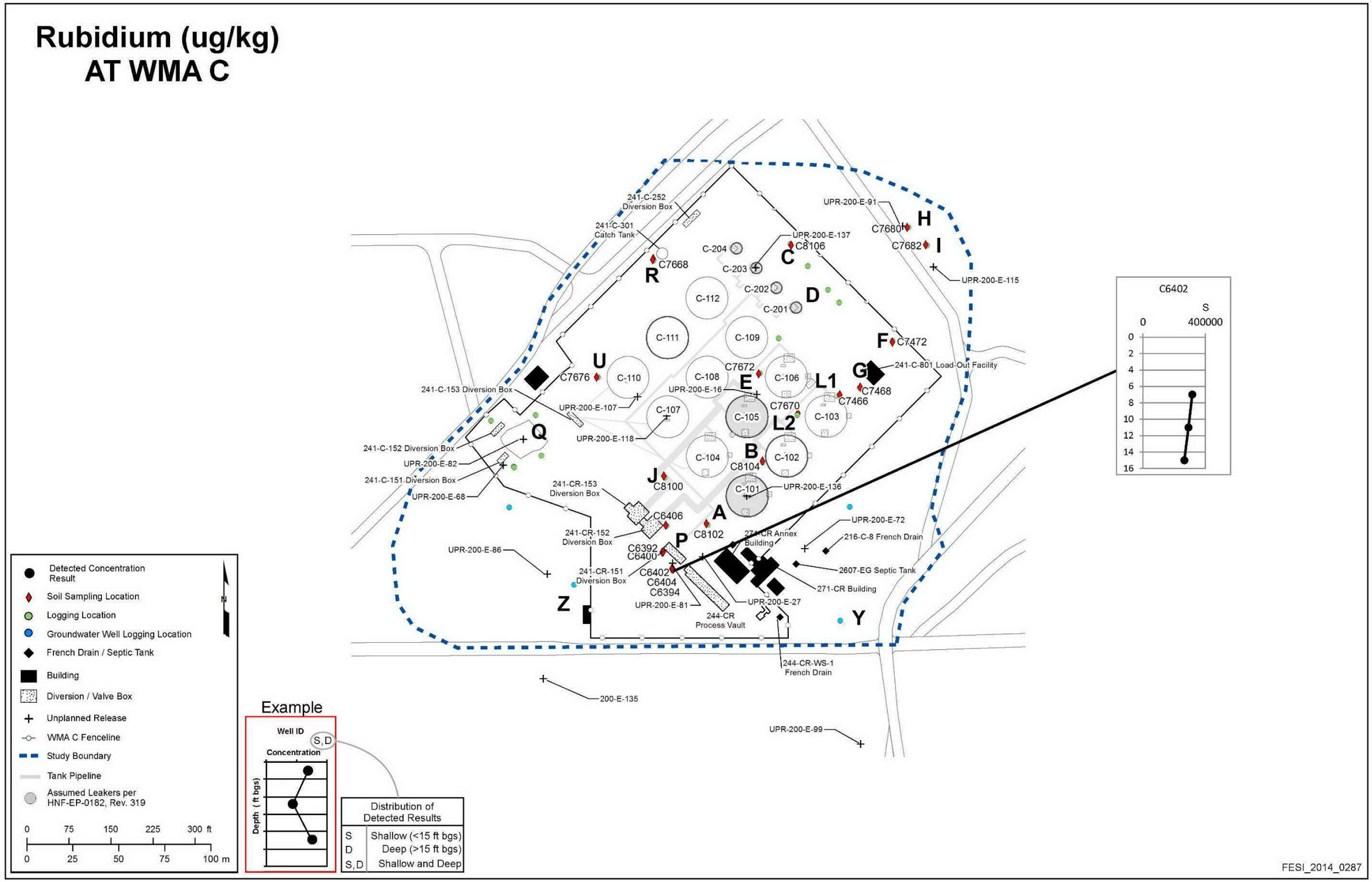

Figure Q-67. Distribution Map of Ruthenium at WMA C

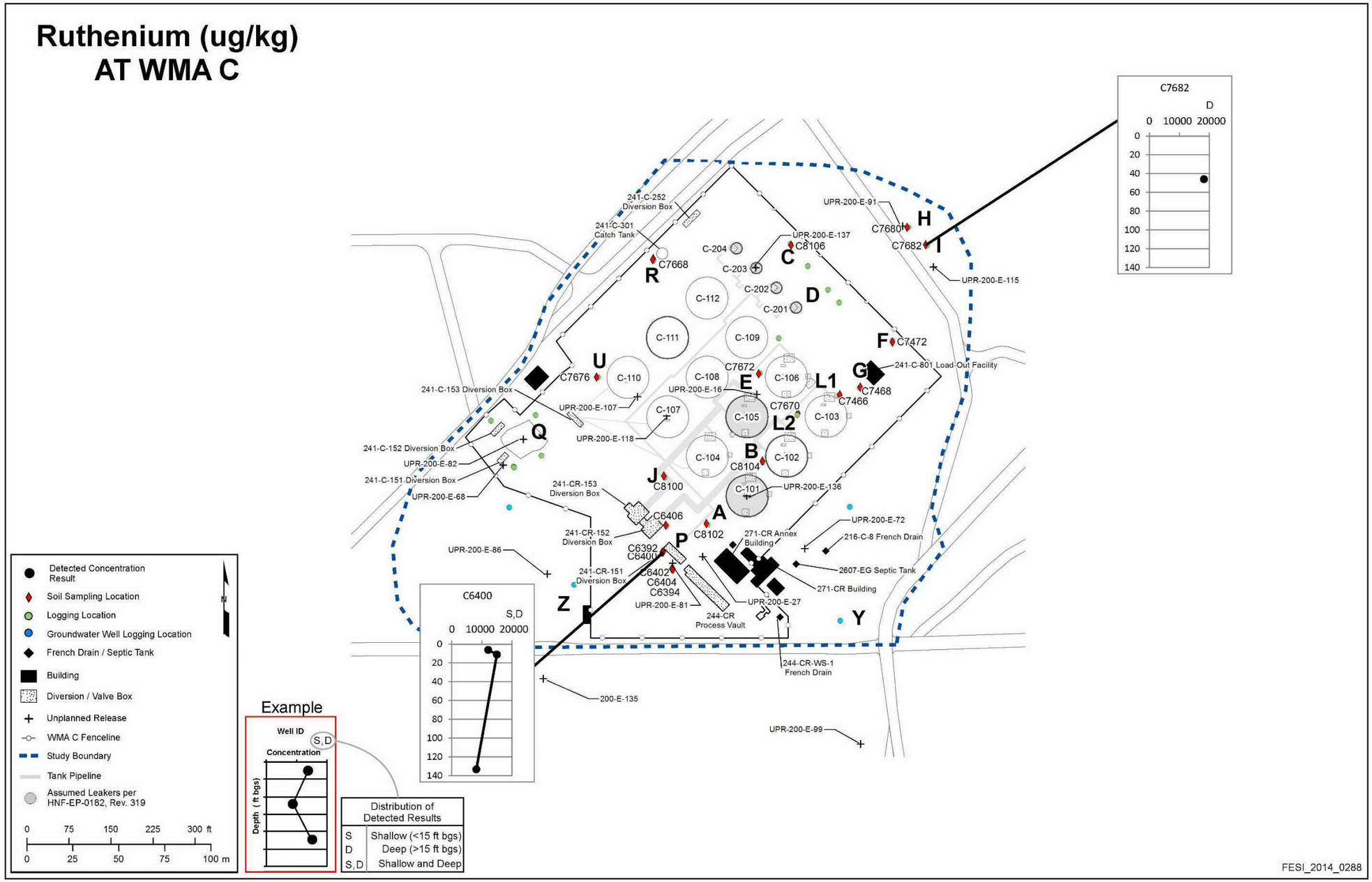

Figure Q-68. Distribution Map of Samarium at WMA C

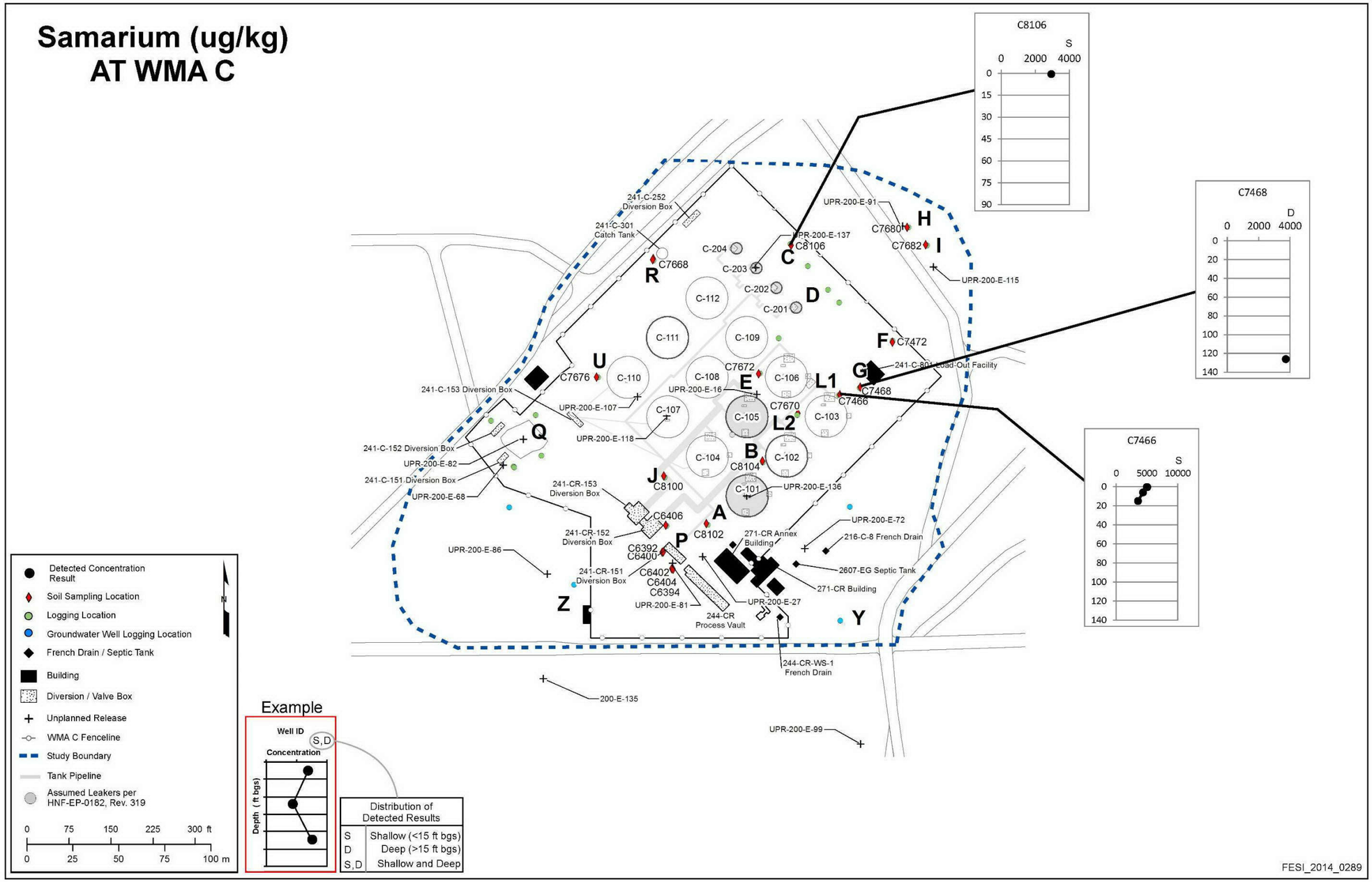

Figure Q-69. Distribution Map of Silicon at WMA C

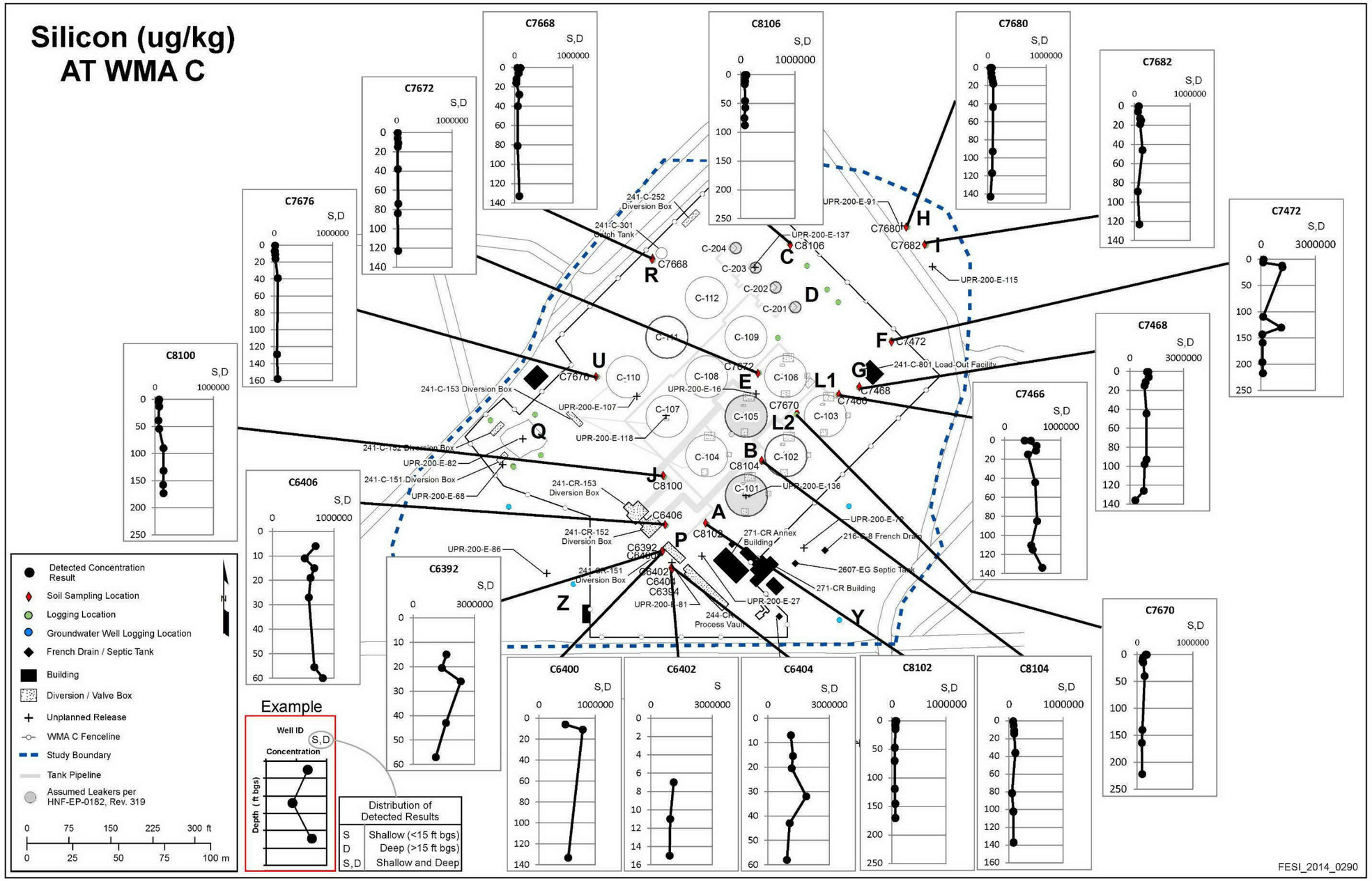

Figure Q-70. Distribution Map of Sulfur at WMA C

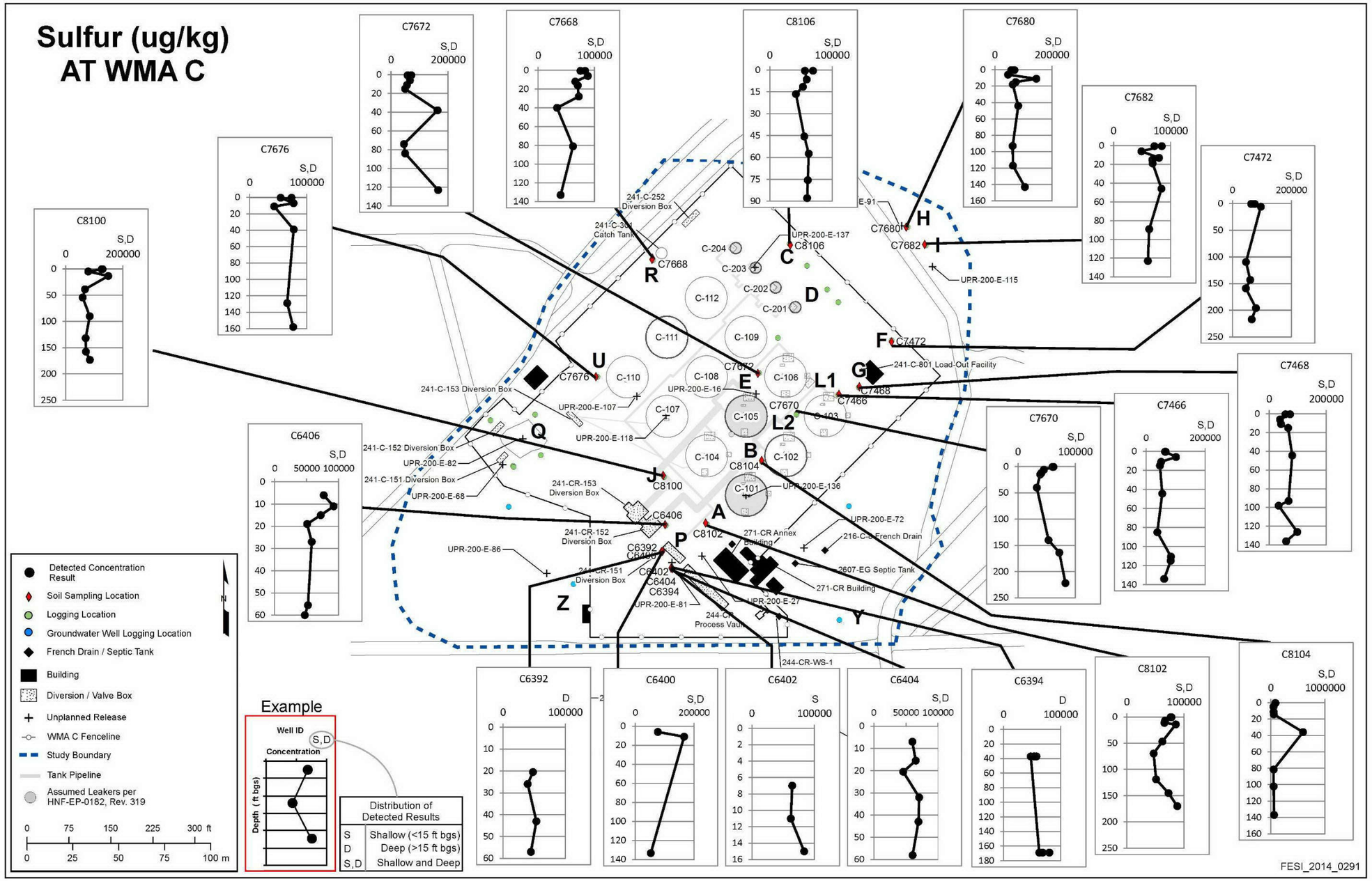

Figure Q-71. Distribution Map of Tantalum at WMA C

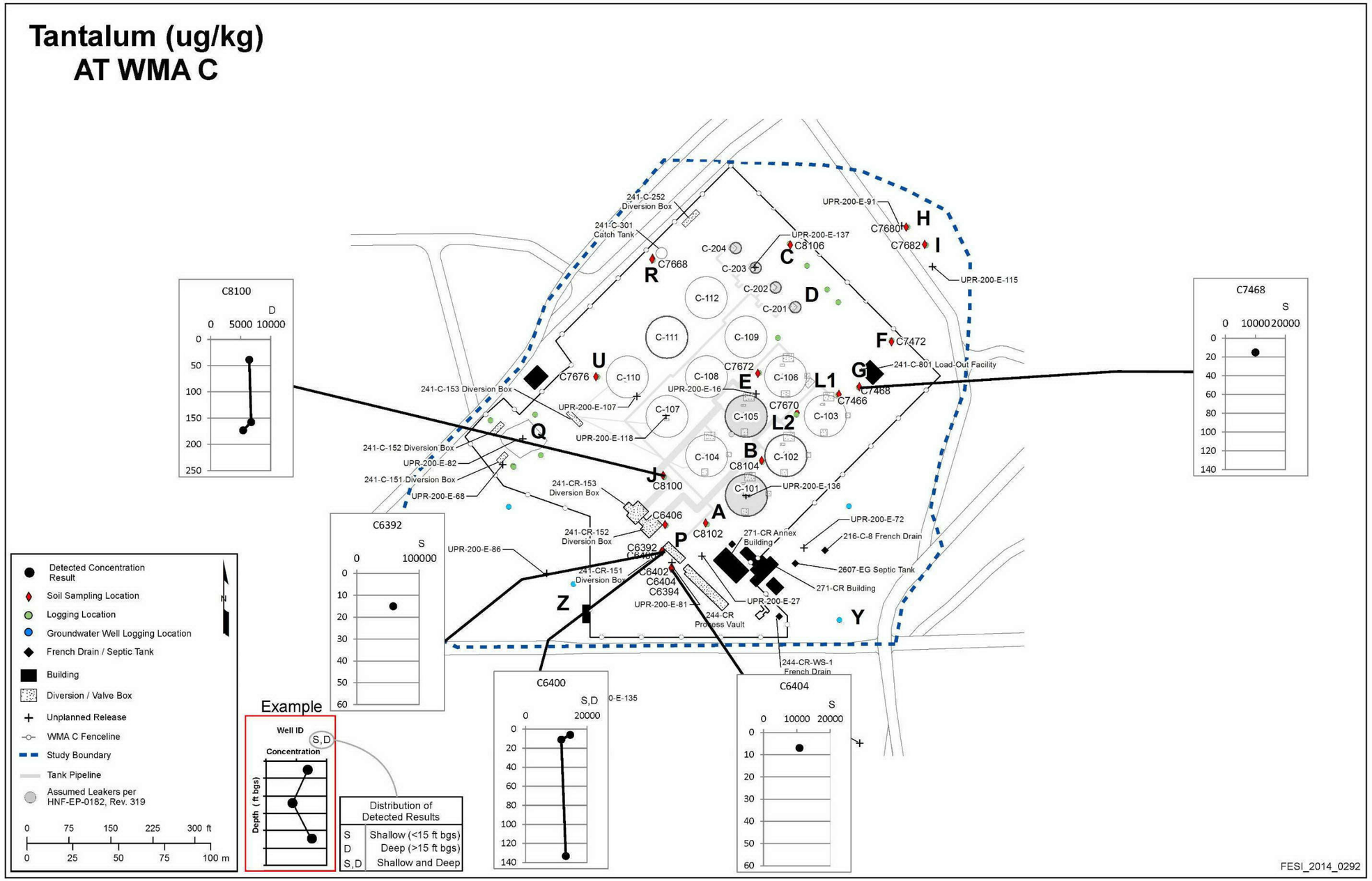

Figure Q-72. Distribution Map of Tellurium at WMA C

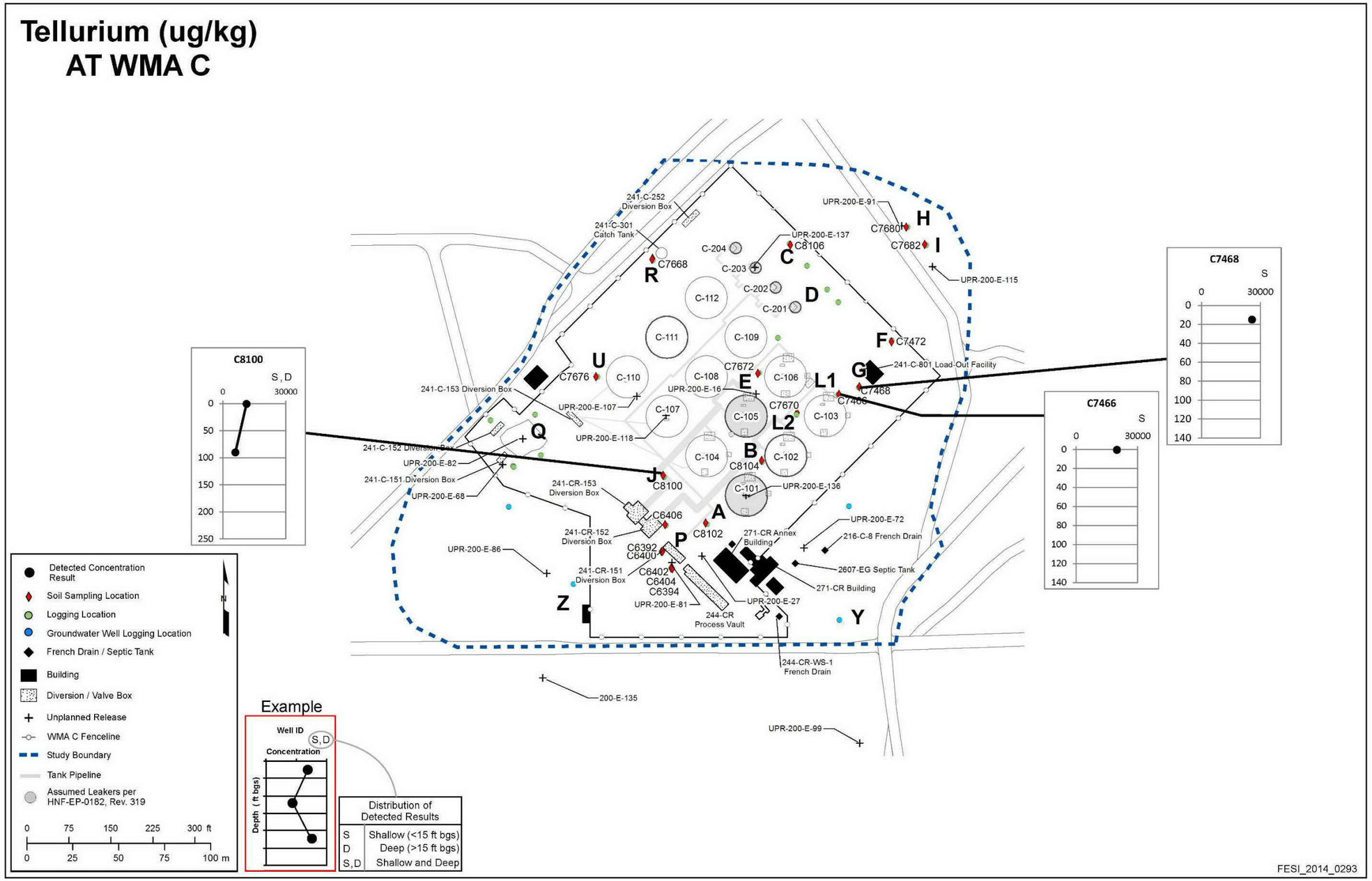

Figure Q-73. Distribution Map of Tin at WMA C

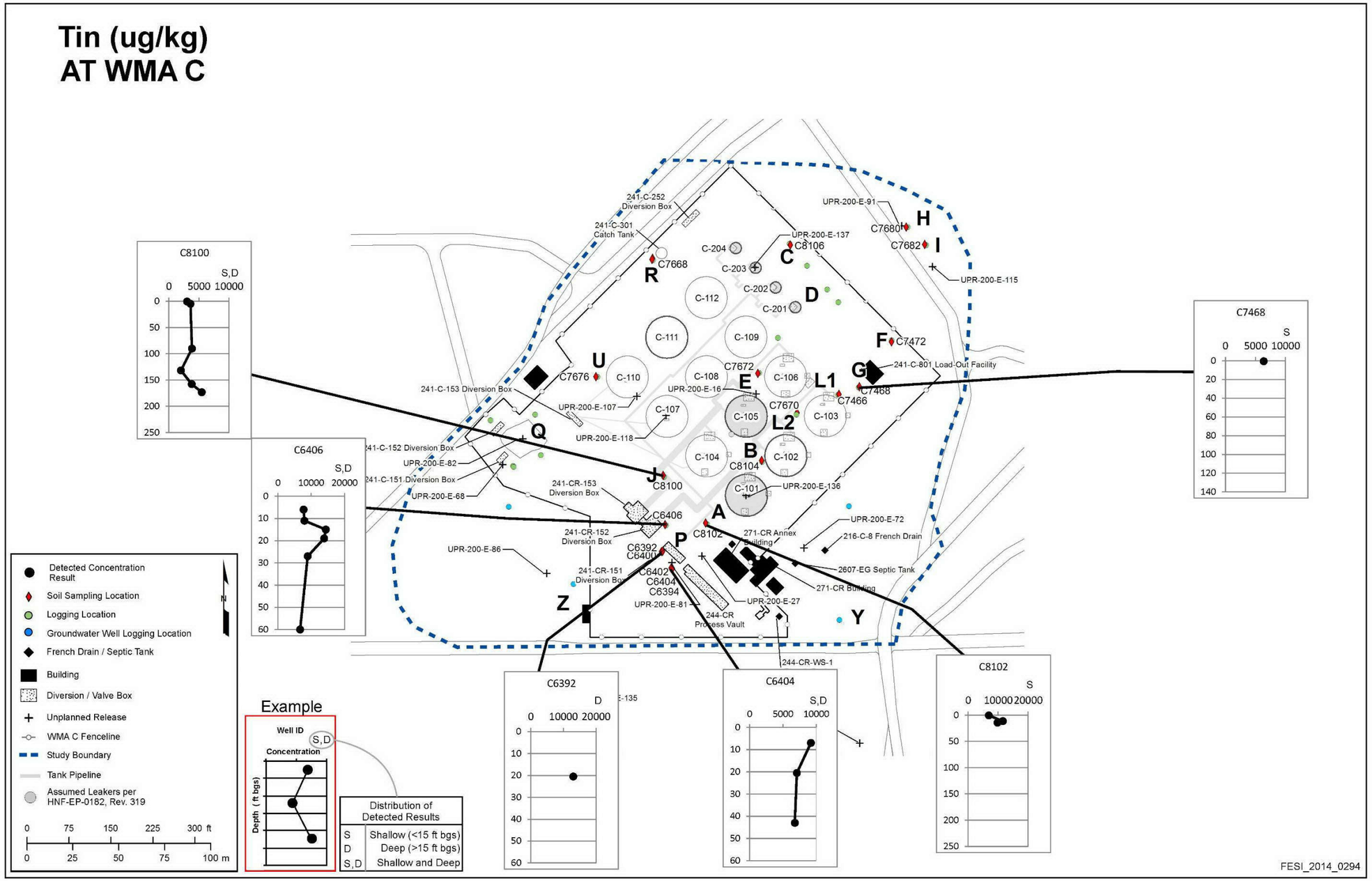

Figure Q-74. Distribution Map of Titanium at WMA C

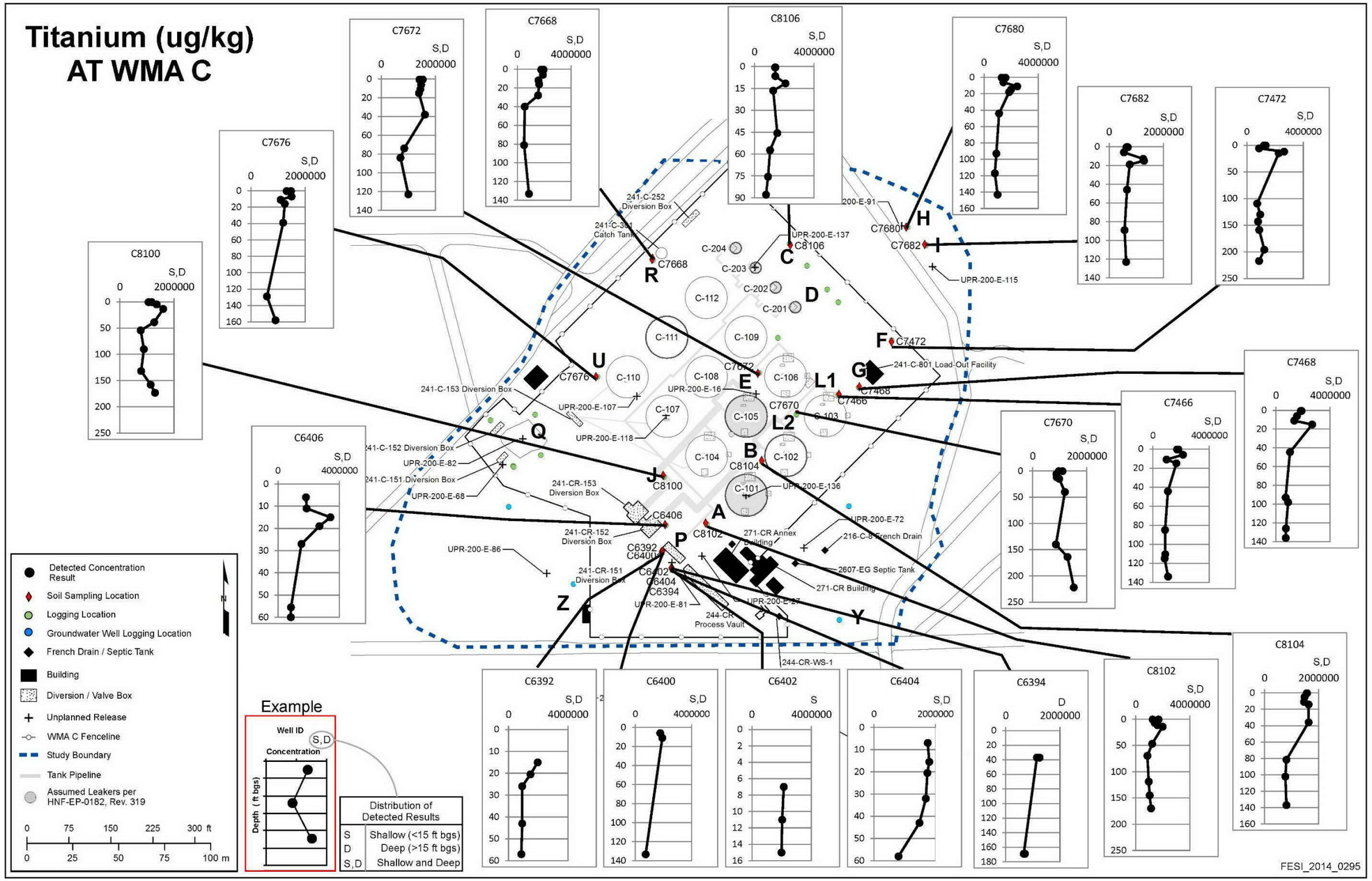

Figure Q-75. Distribution Map of Tungsten at WMA C

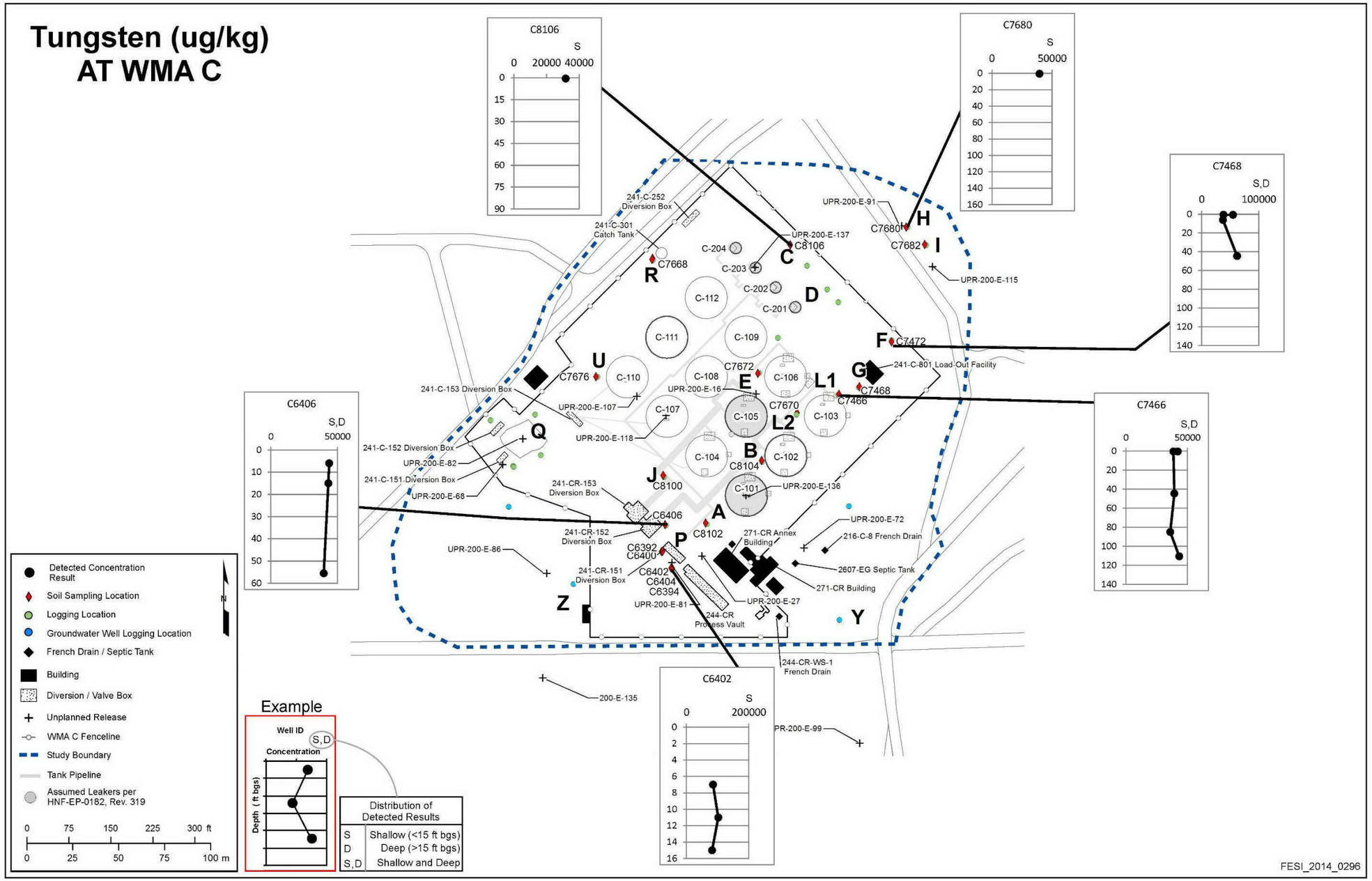

Figure Q-76. Distribution Map of Yttrium at WMA C

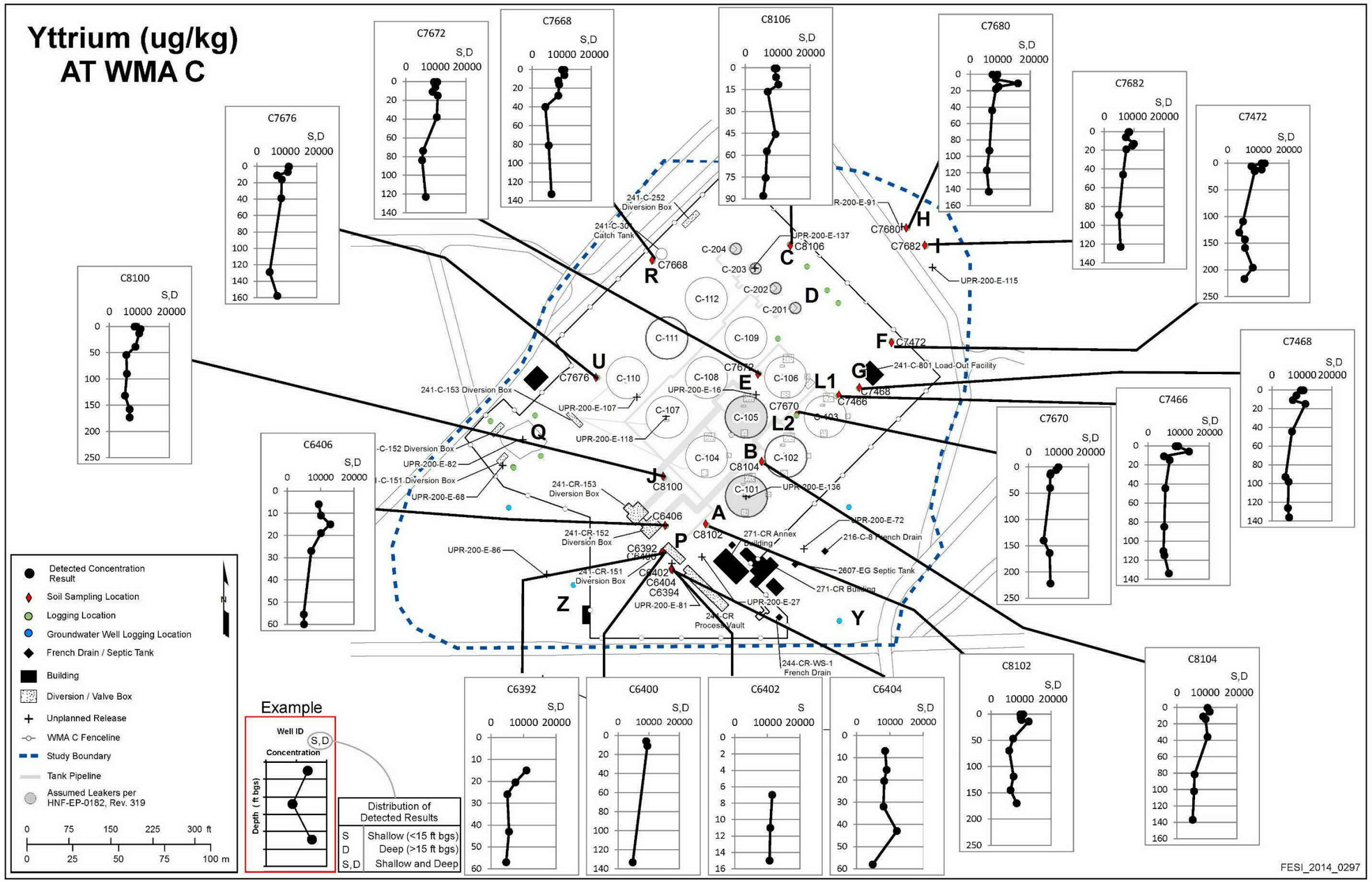

Figure Q-77. Distribution Map of Zirconium at WMA C

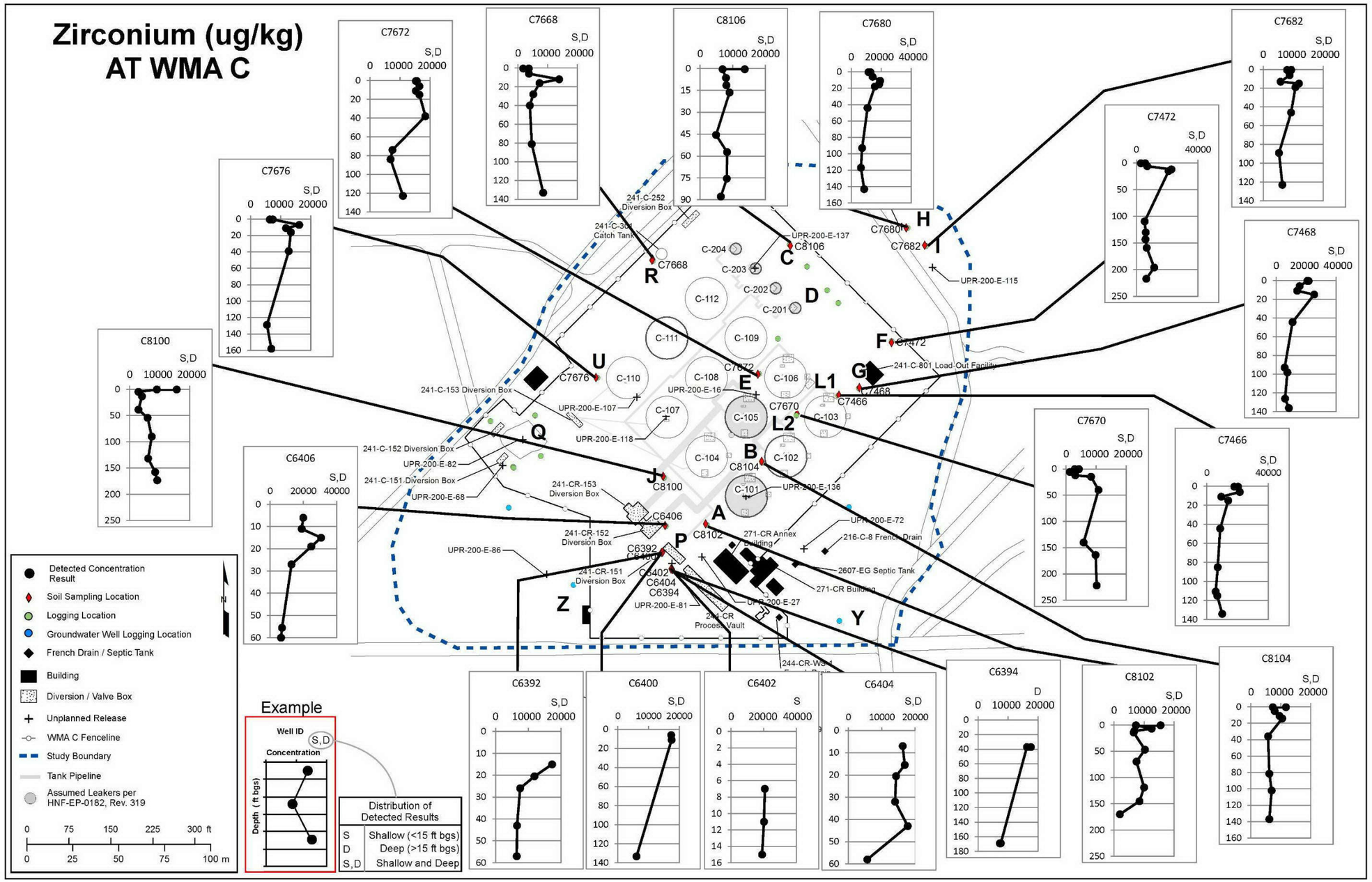

Figure Q-78. Distribution Map of Americium-241 at WMA C

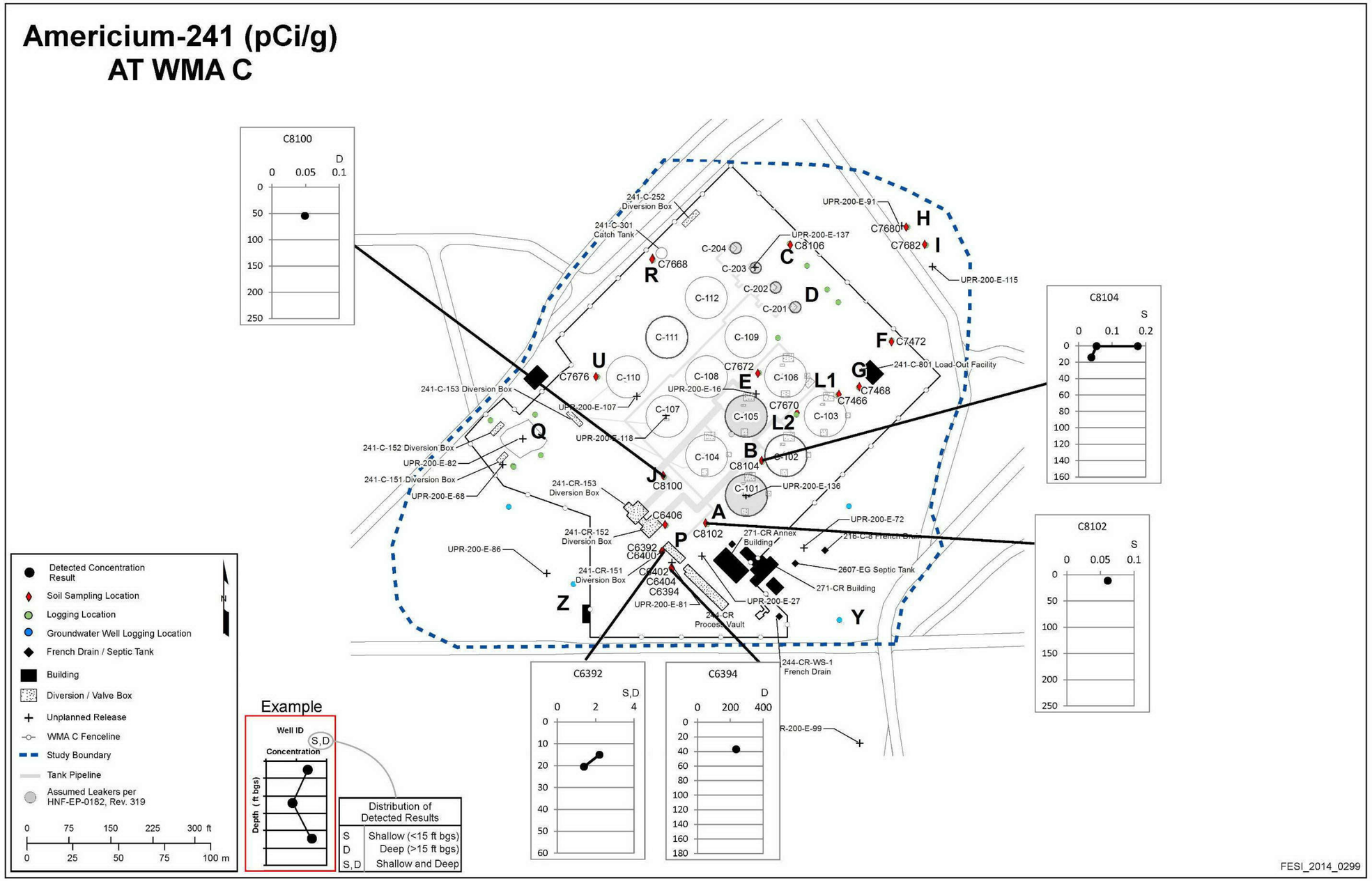

Figure Q-79. Distribution Map of Antimony-125 at WMA C

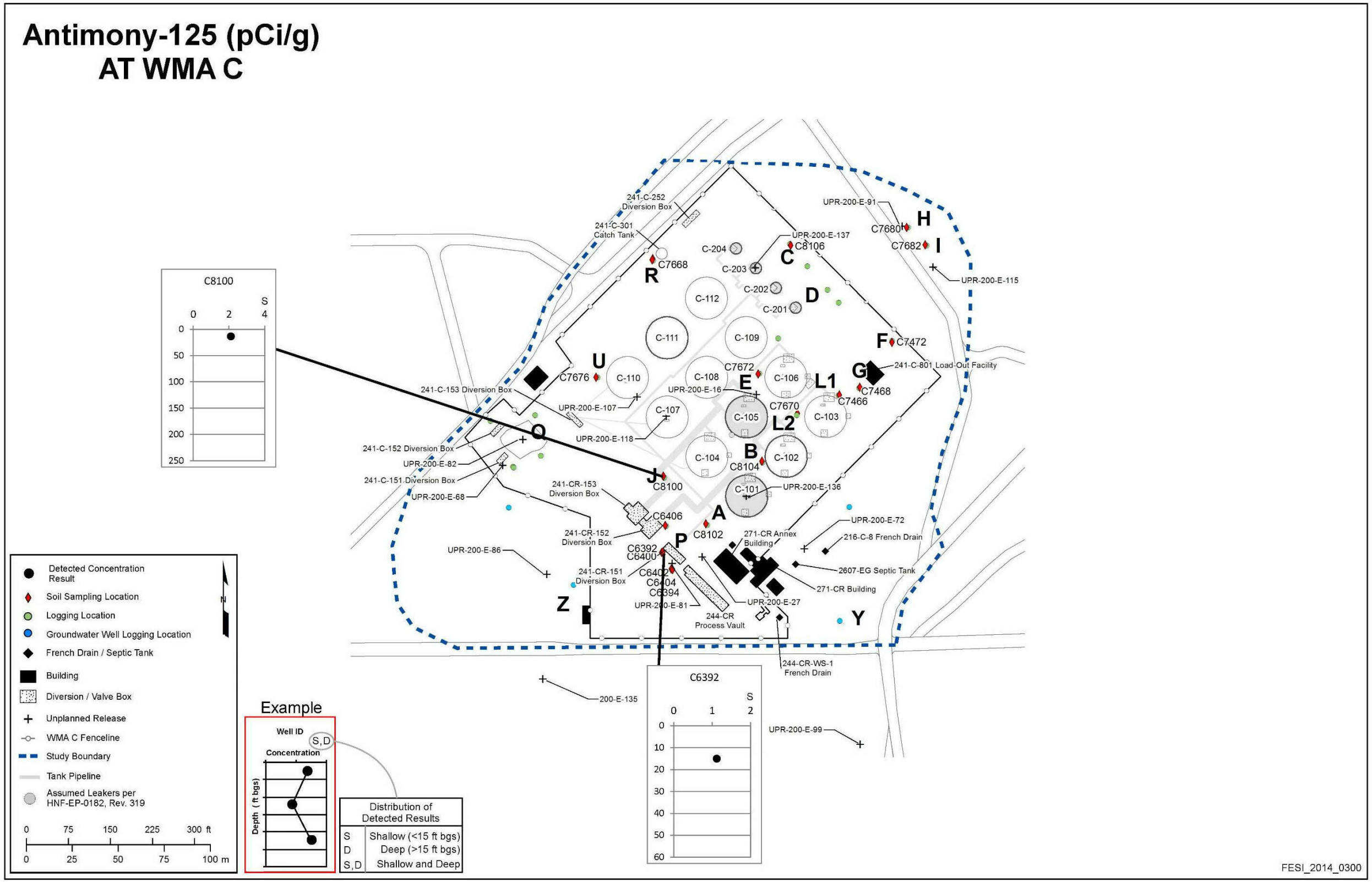

Figure Q-80. Distribution Map of Carbon-14 at WMA C

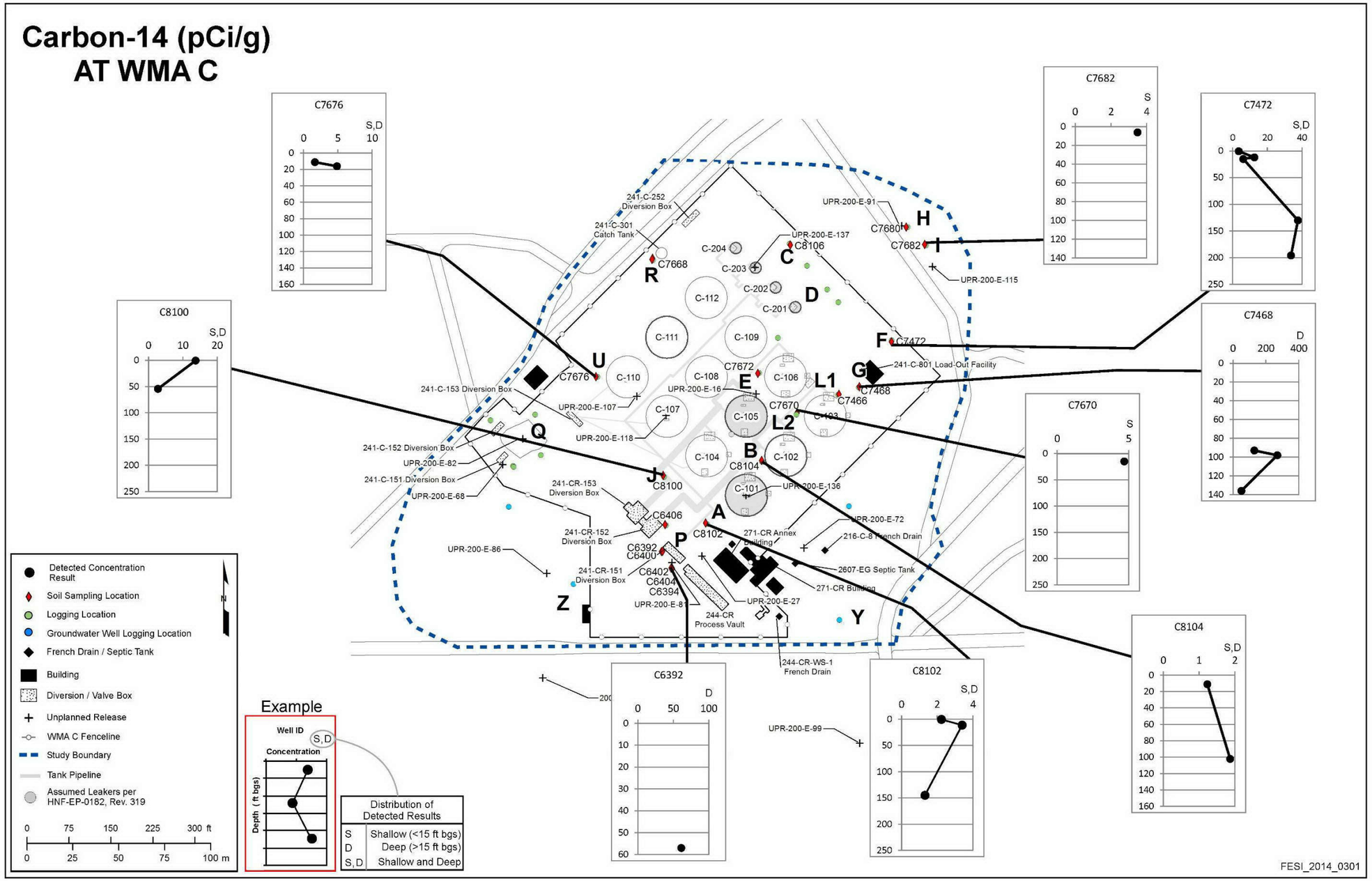

Figure Q-81. Distribution Map of Iodine-129 at WMA C

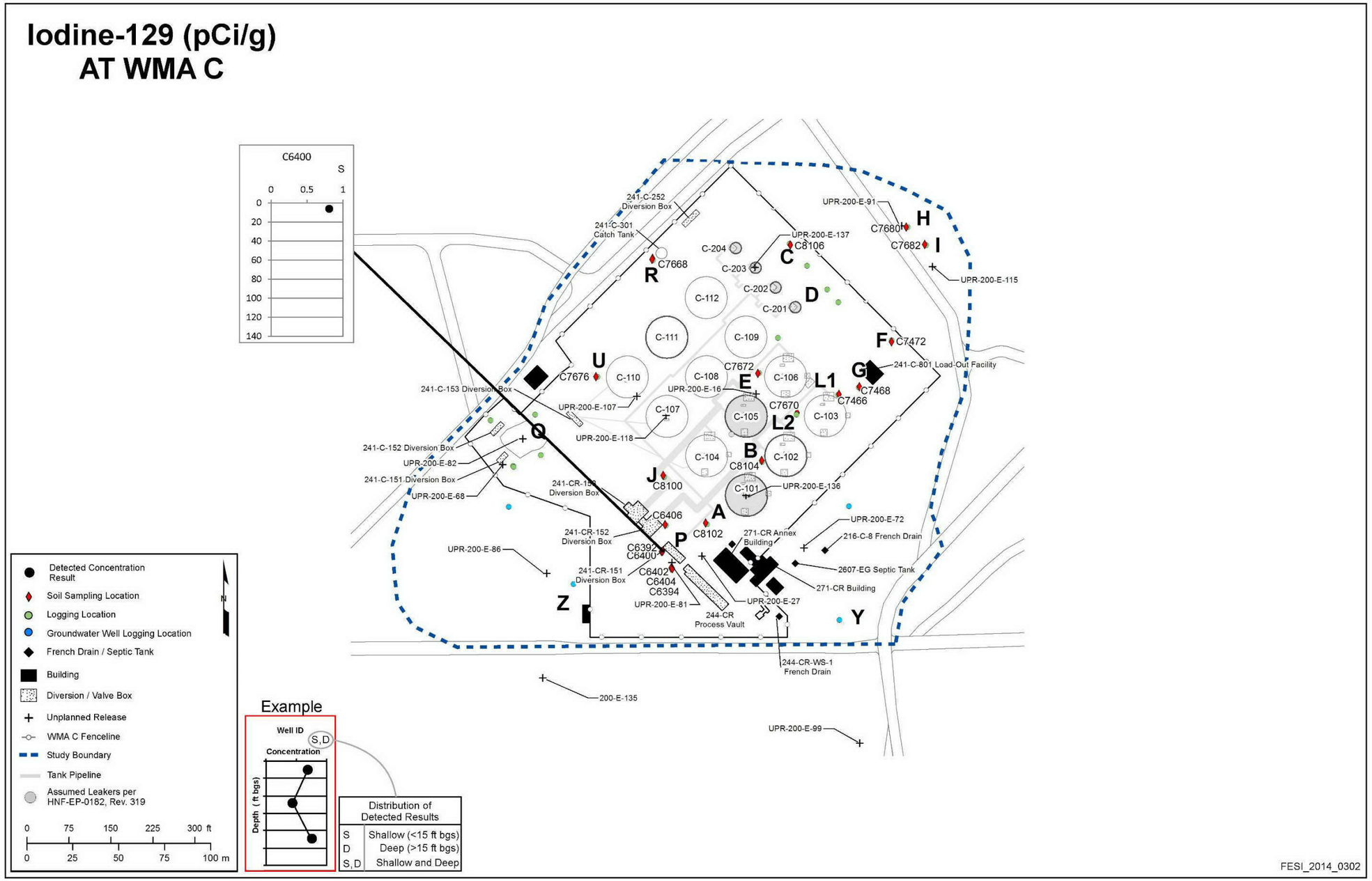

Figure Q-82. Distribution Map of Neptunium-237 at WMA C

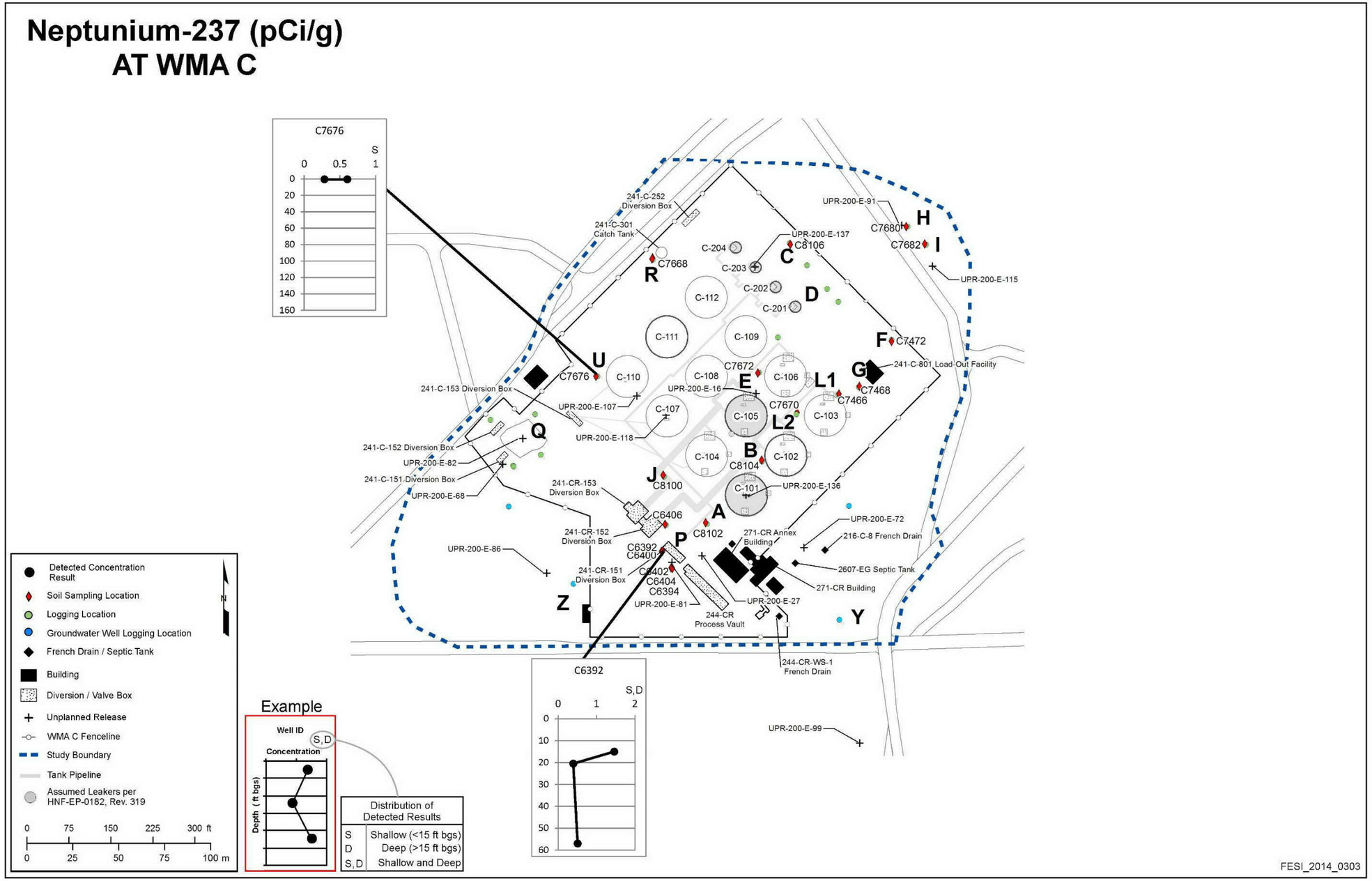

Figure Q-83. Distribution Map of Nickel-63 at WMA C

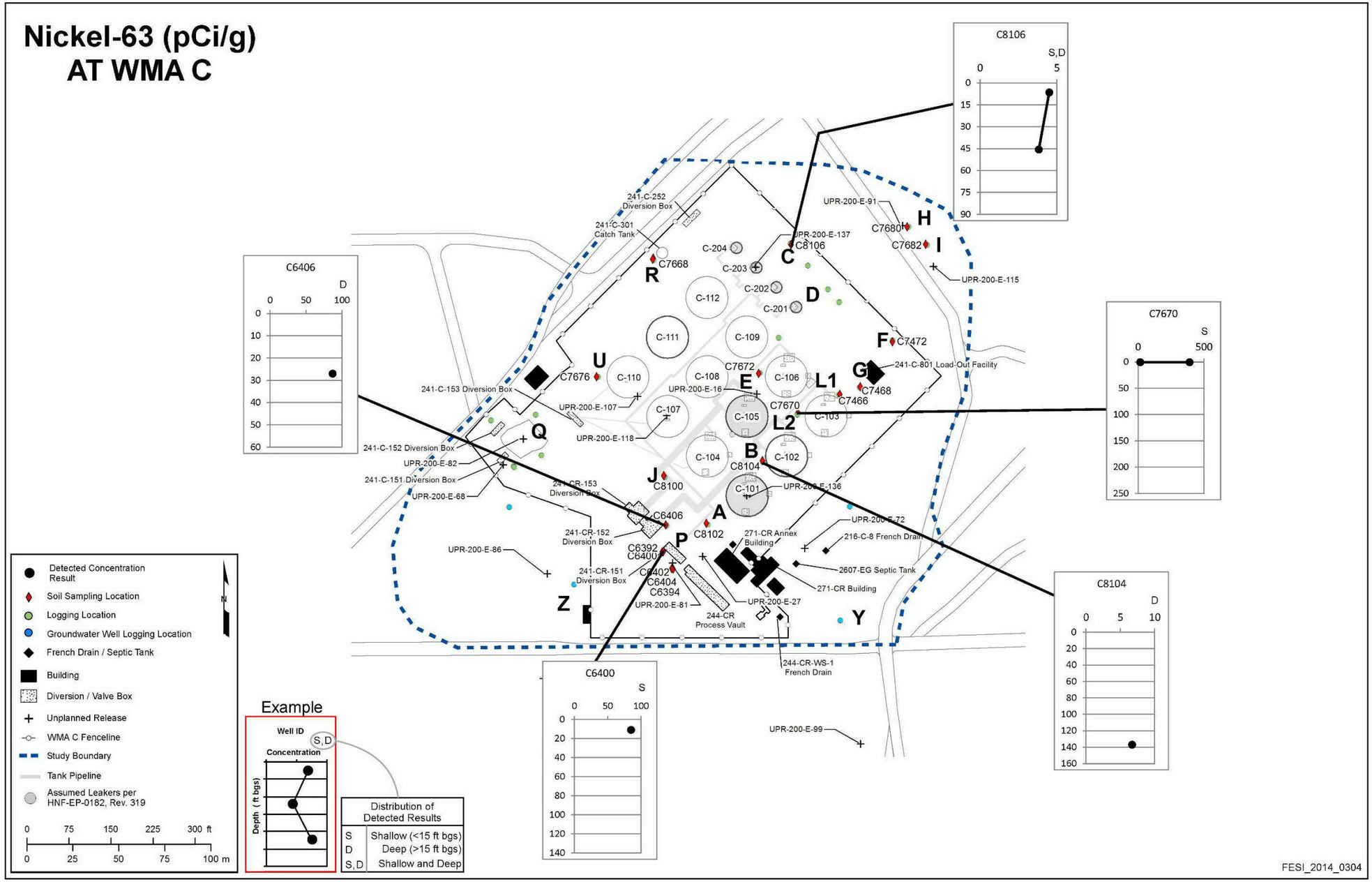

Figure Q-84. Distribution Map of Selenium-79 at WMA C

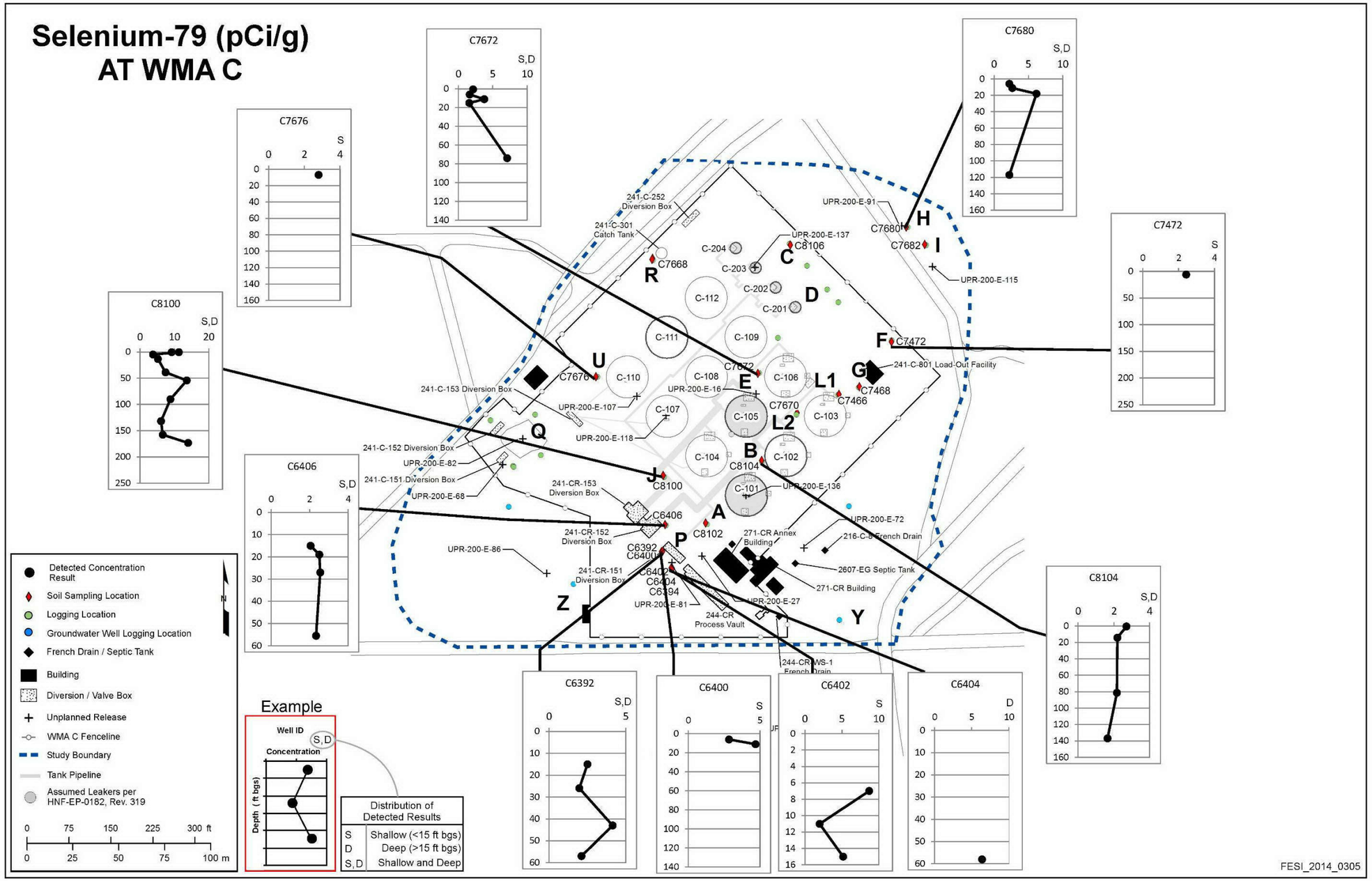

Figure Q-85. Distribution Map of Technetium-99 at WMA C

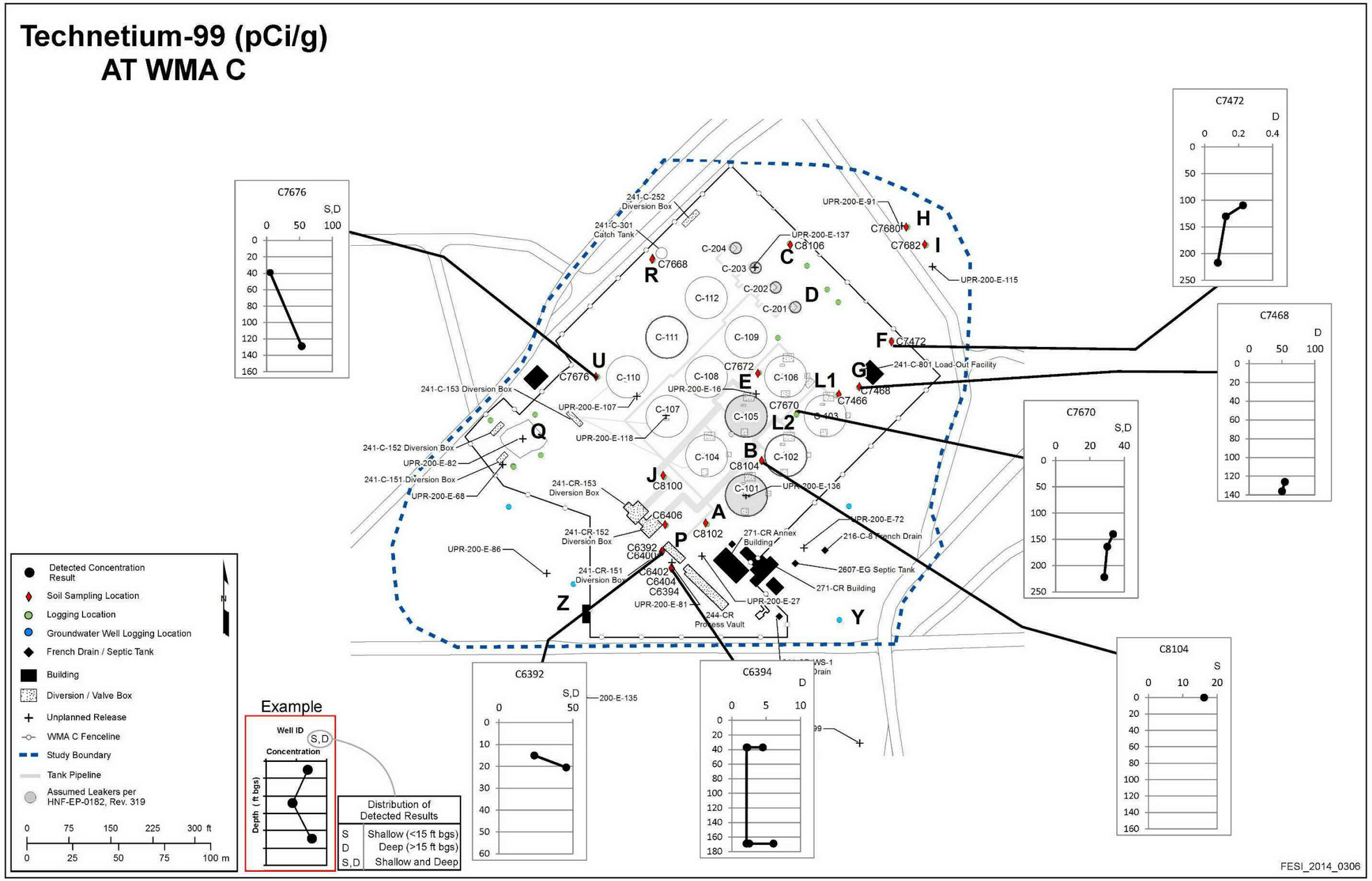

Figure Q-86. Distribution Map of Thorium-230 at WMA C

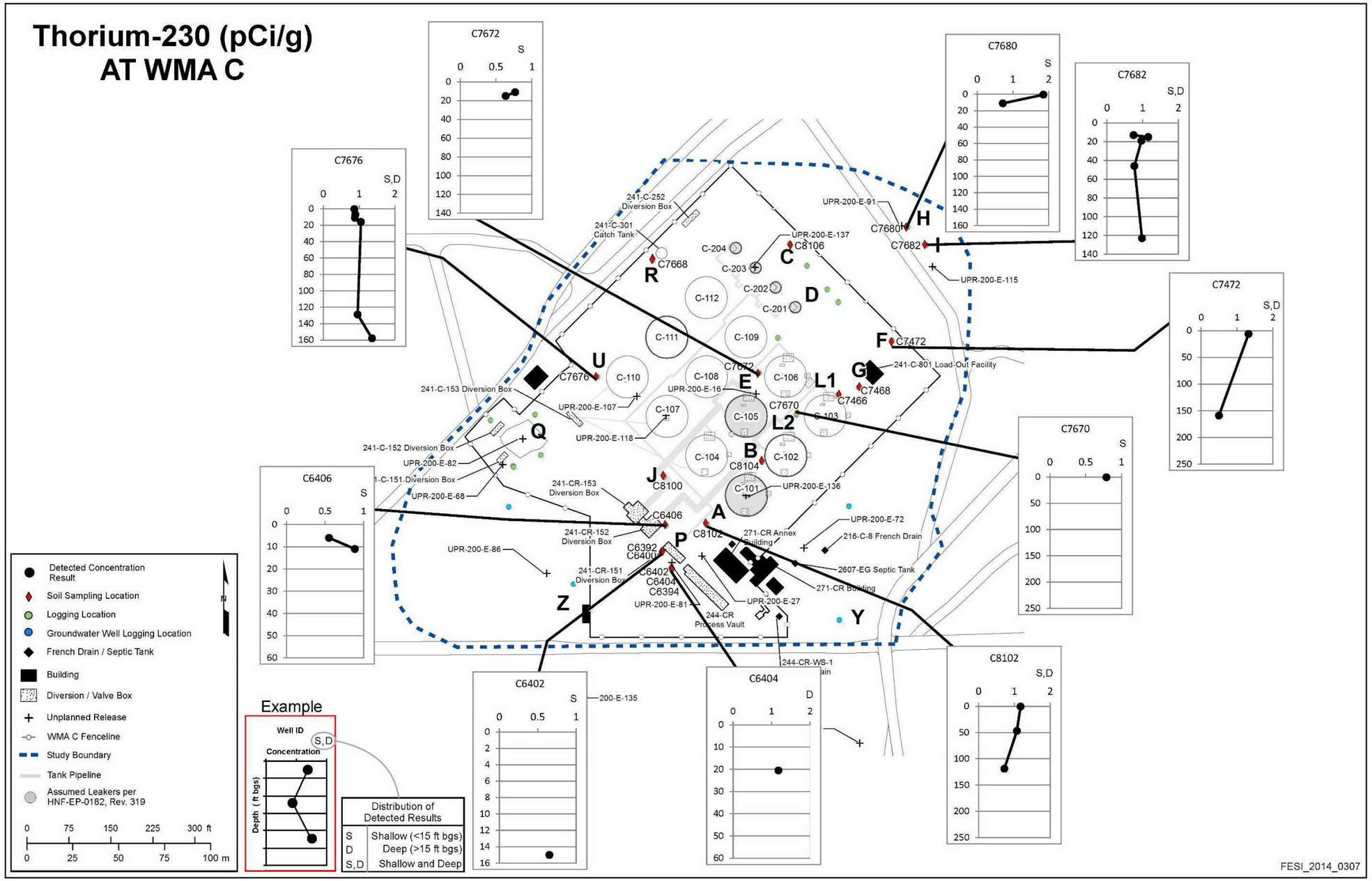

Figure Q-87. Distribution Map of Thorium-234 at WMA C

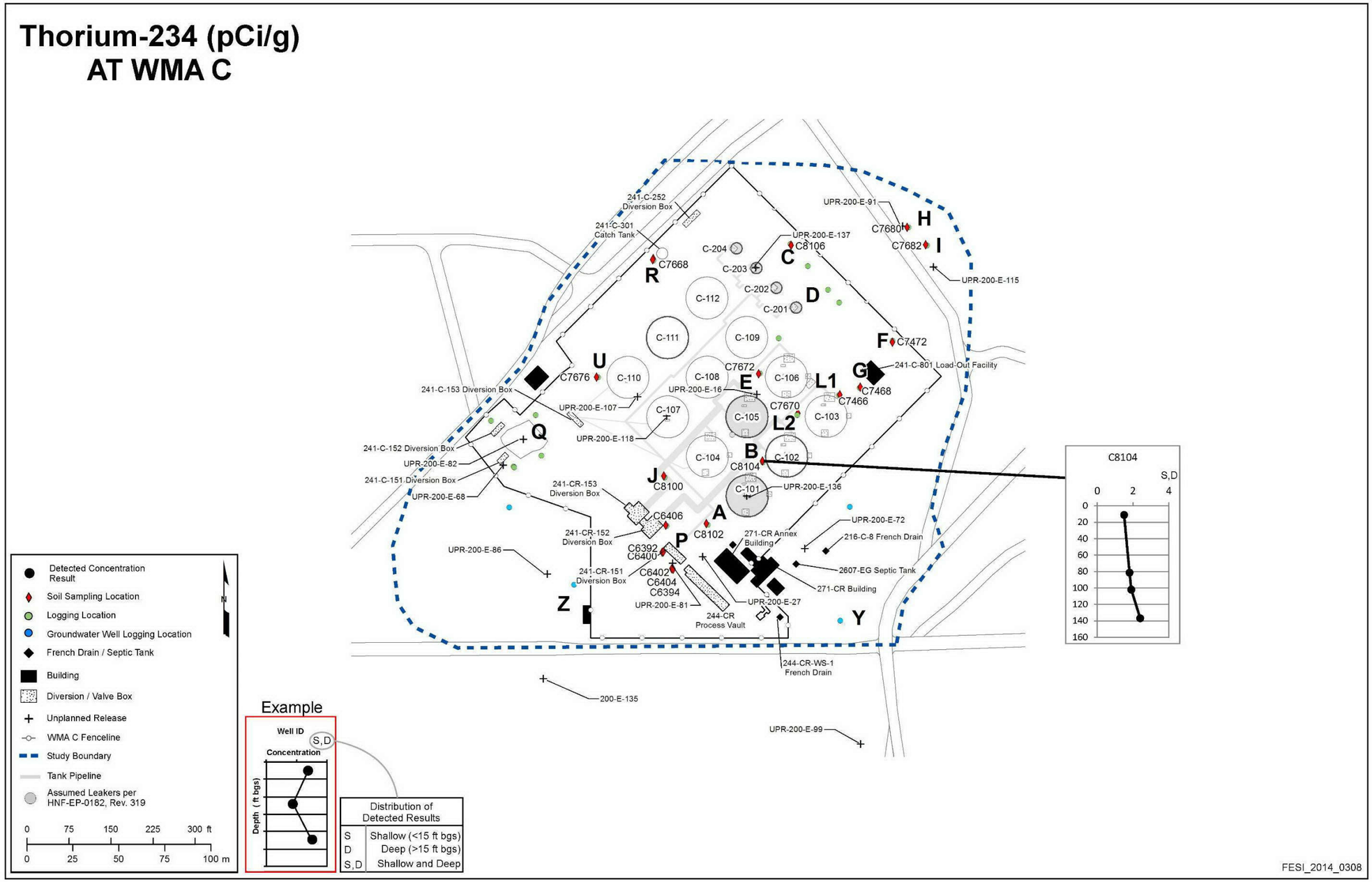

Figure Q-88. Distribution Map of Tin-126 at WMA C

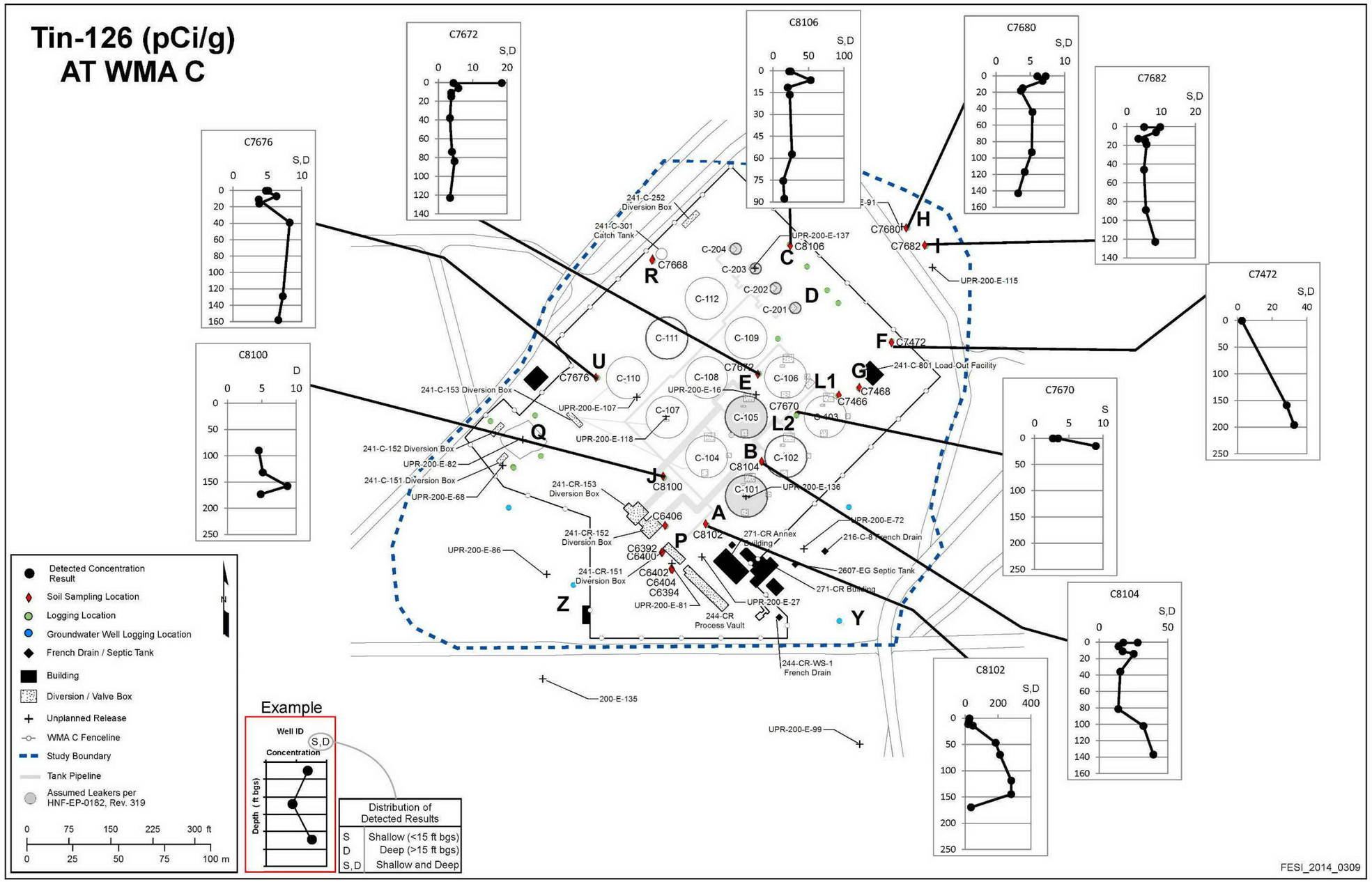

Figure Q-89. Distribution Map of Tritium at WMA C

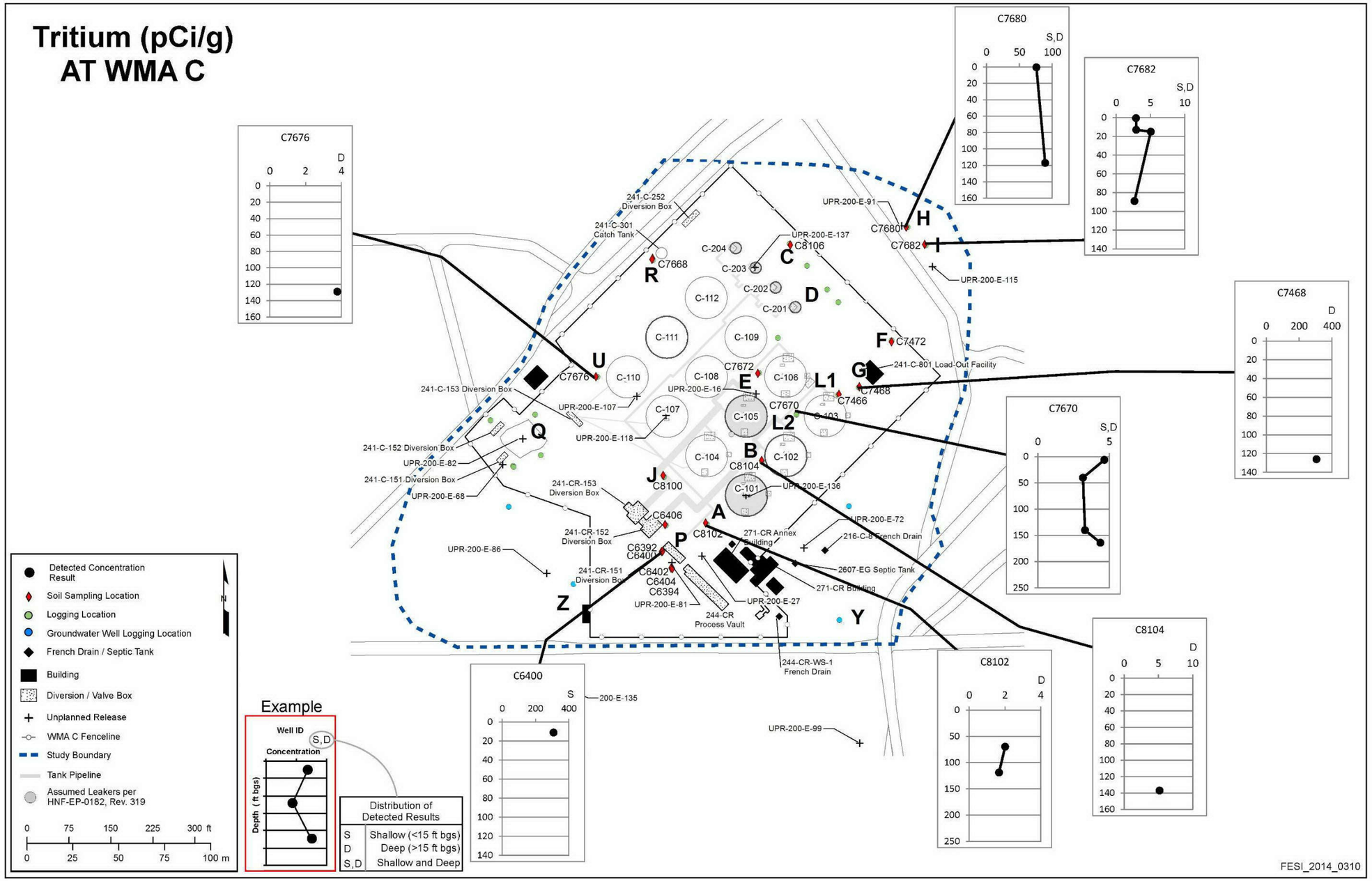

Figure Q-90. Distribution Map of Uranium-233 at WMA C

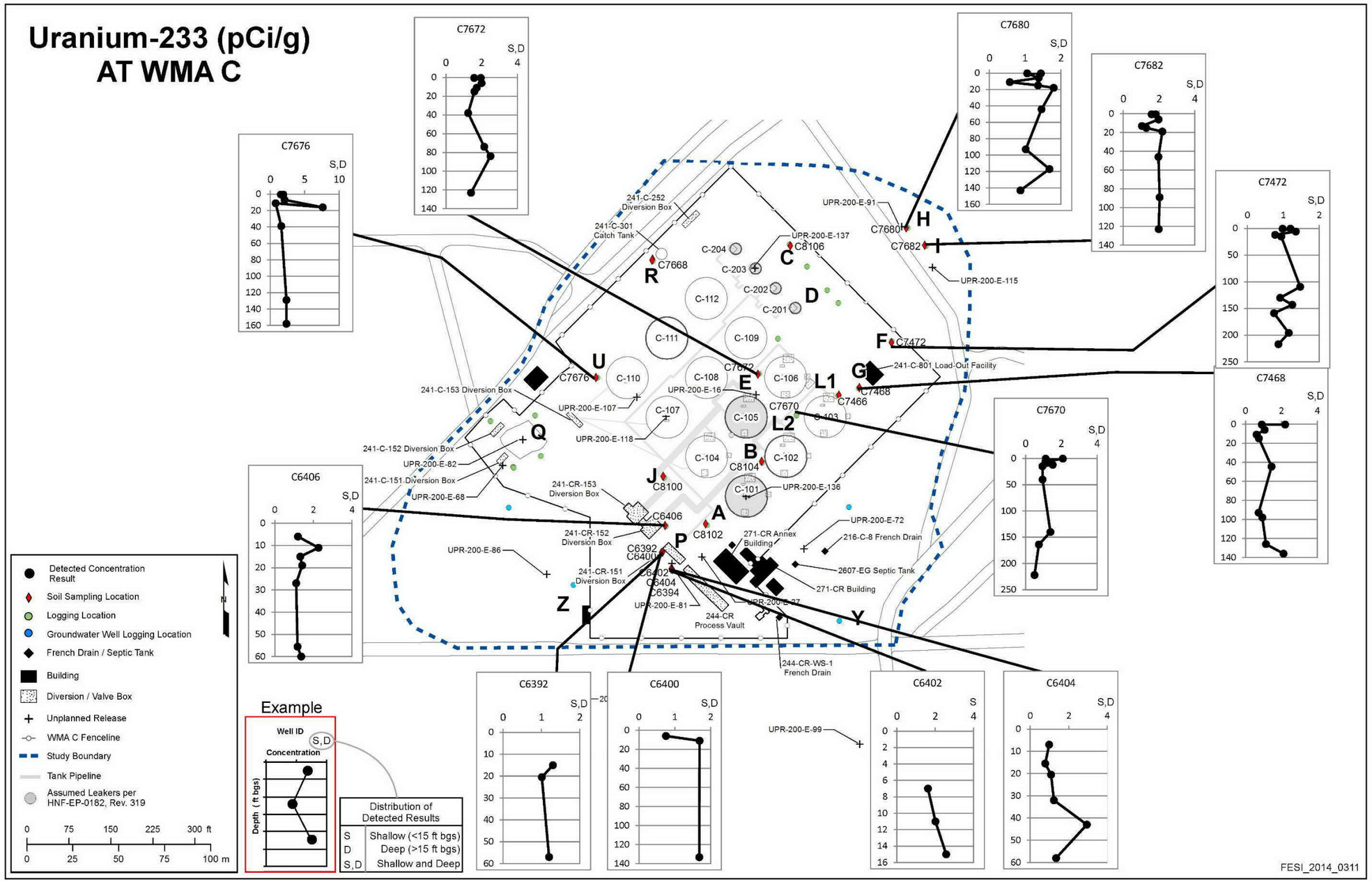

Figure Q-91. Distribution Map of Uranium-236 at WMA C

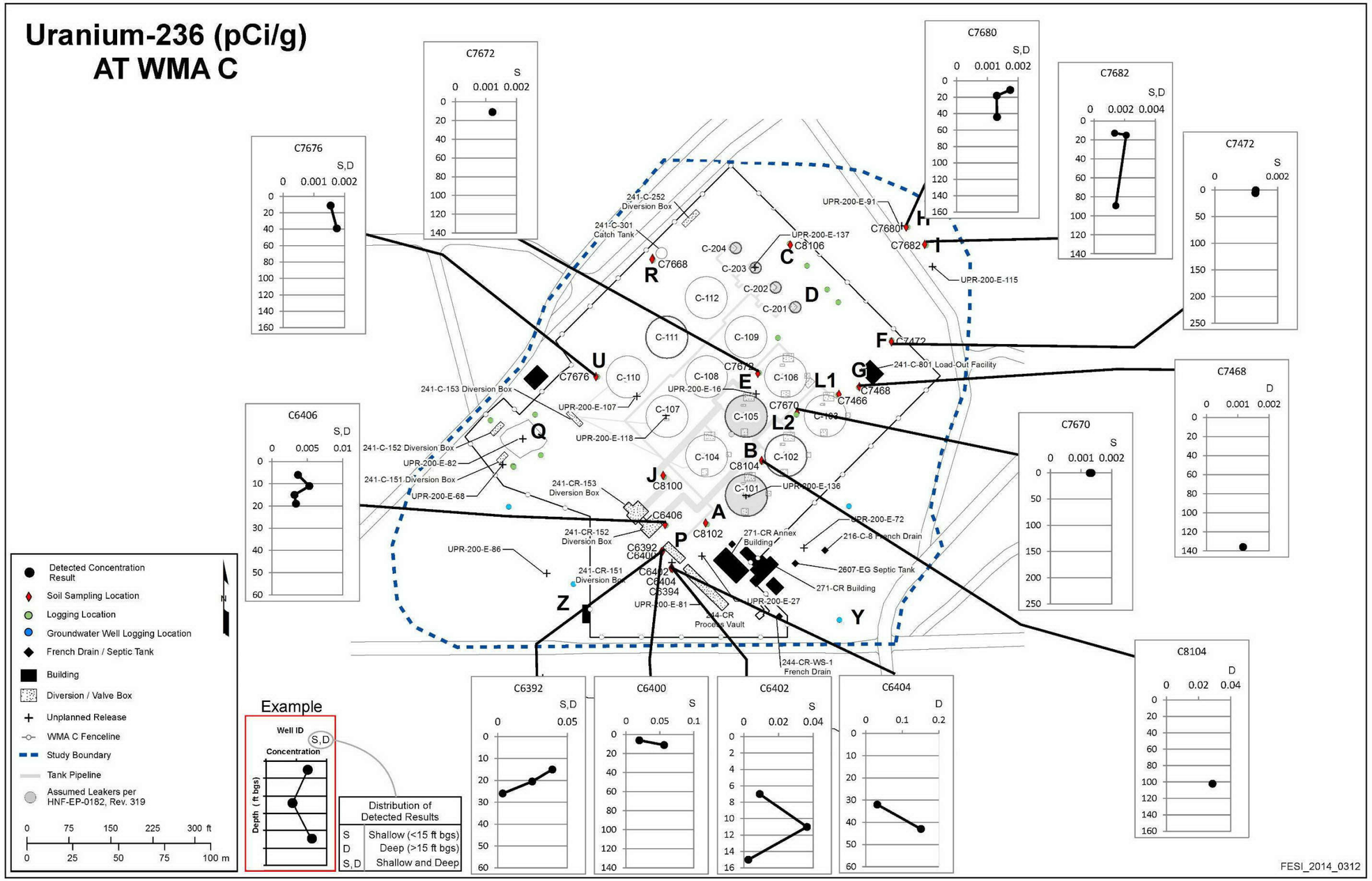

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Figure Q-92. Distribution Map of Actinium-228 at WMA C

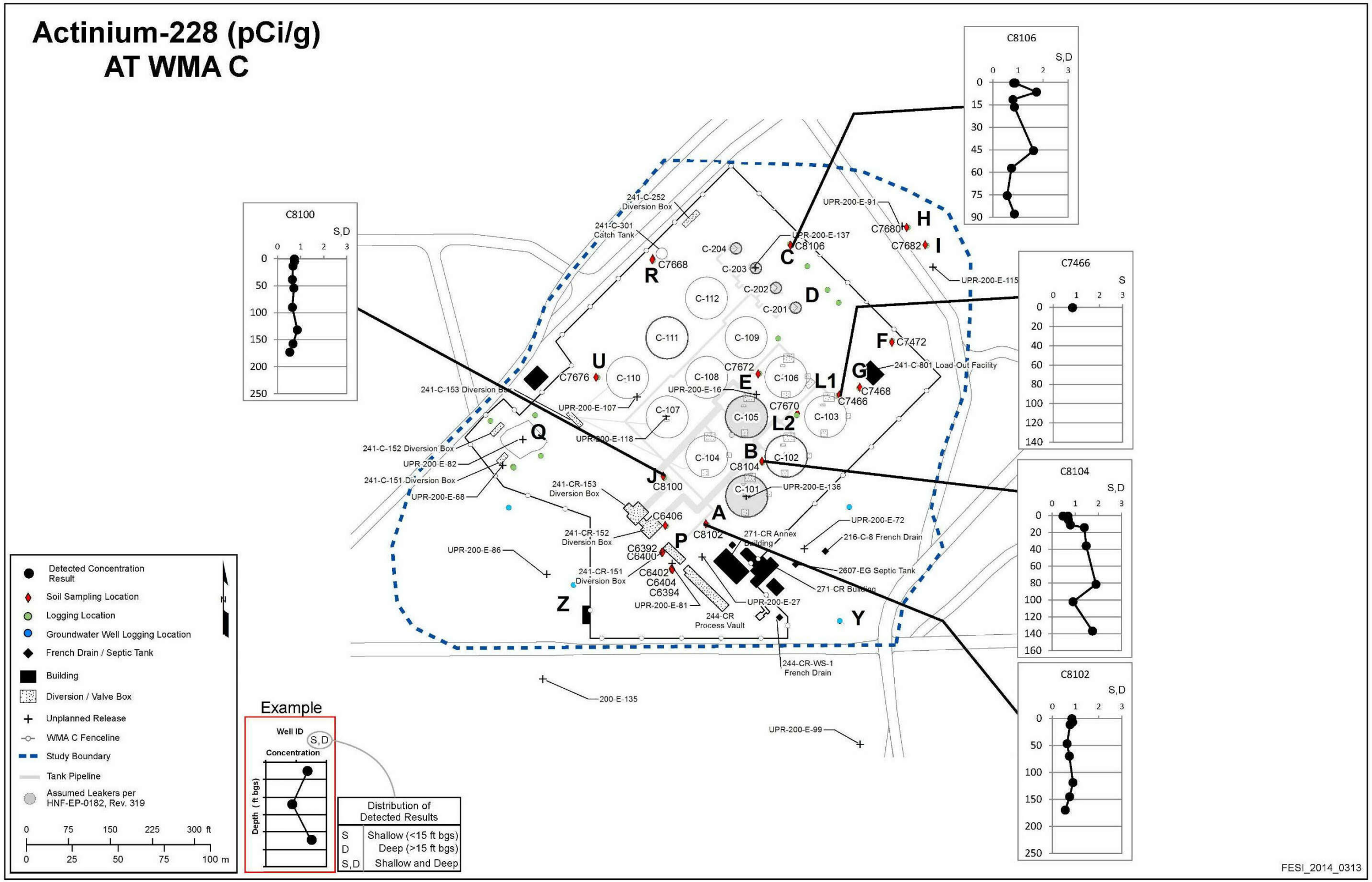


Figure Q-93. Distribution Map of Bismuth-212 at WMA C

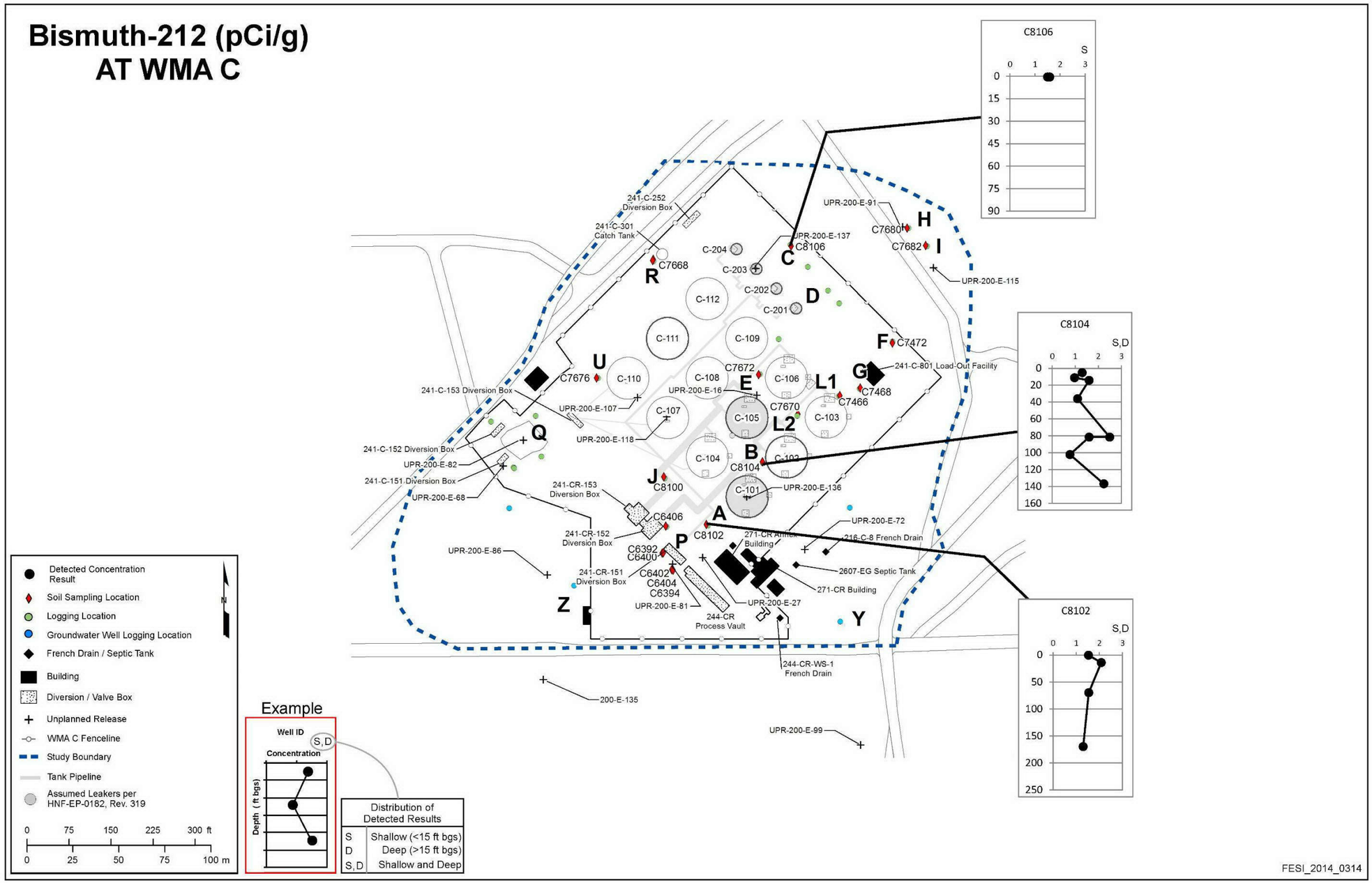


Figure Q-94. Distribution Map of Bismuth-214 at WMA C

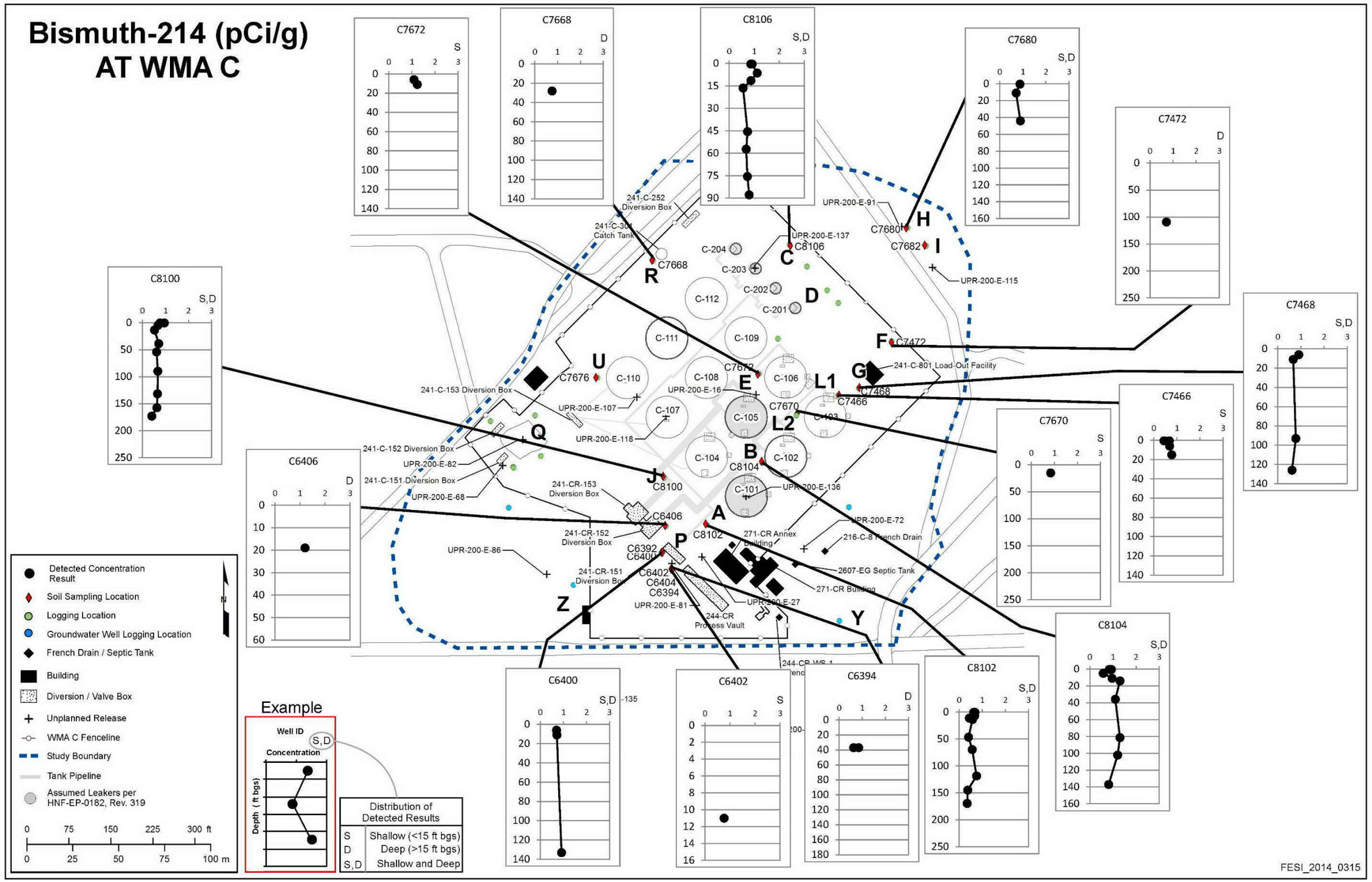


Figure Q-95. Distribution Map of Lead-212 at WMA C

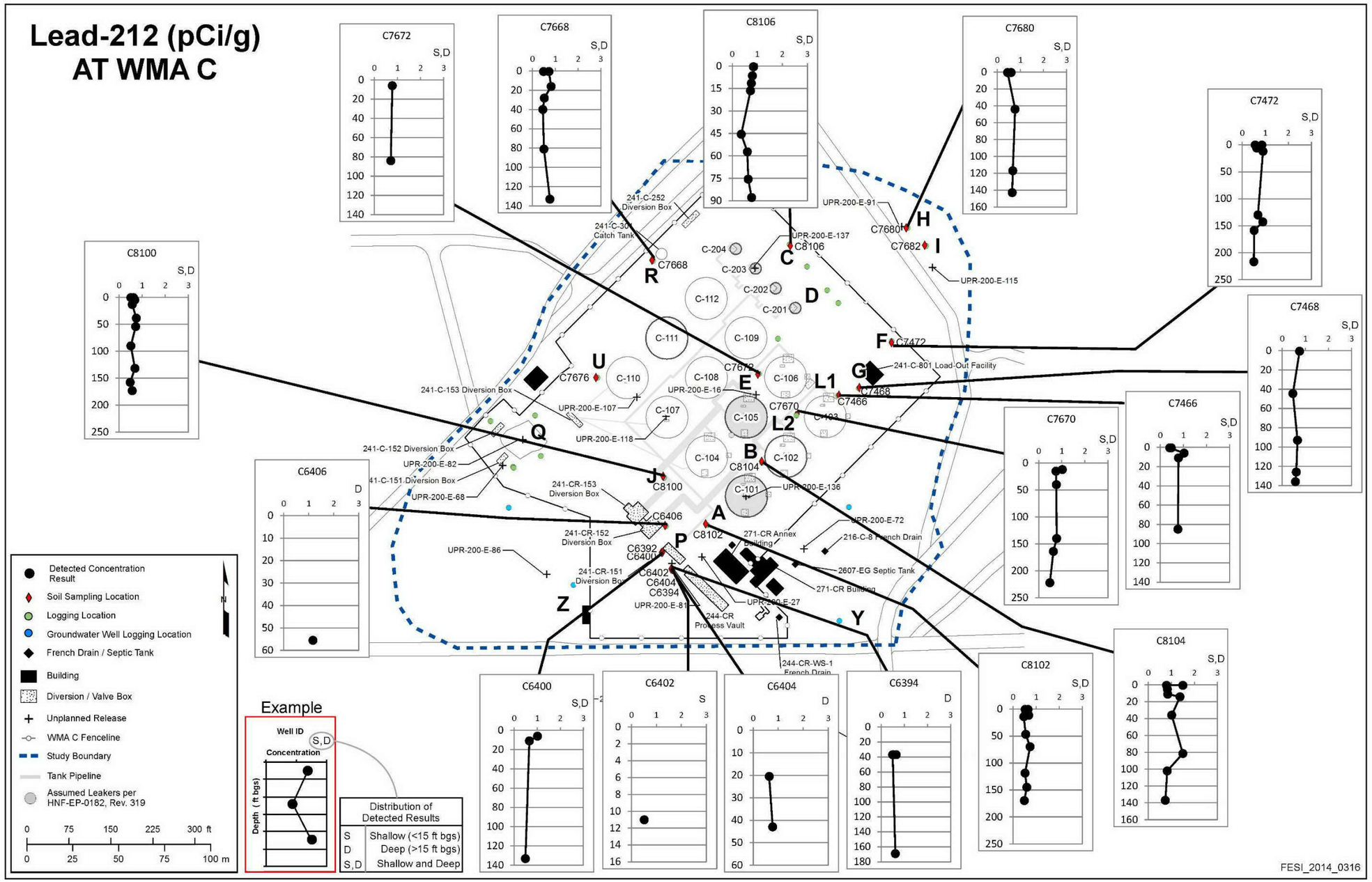


Figure Q-96. Distribution Map of Lead-214 at WMA C

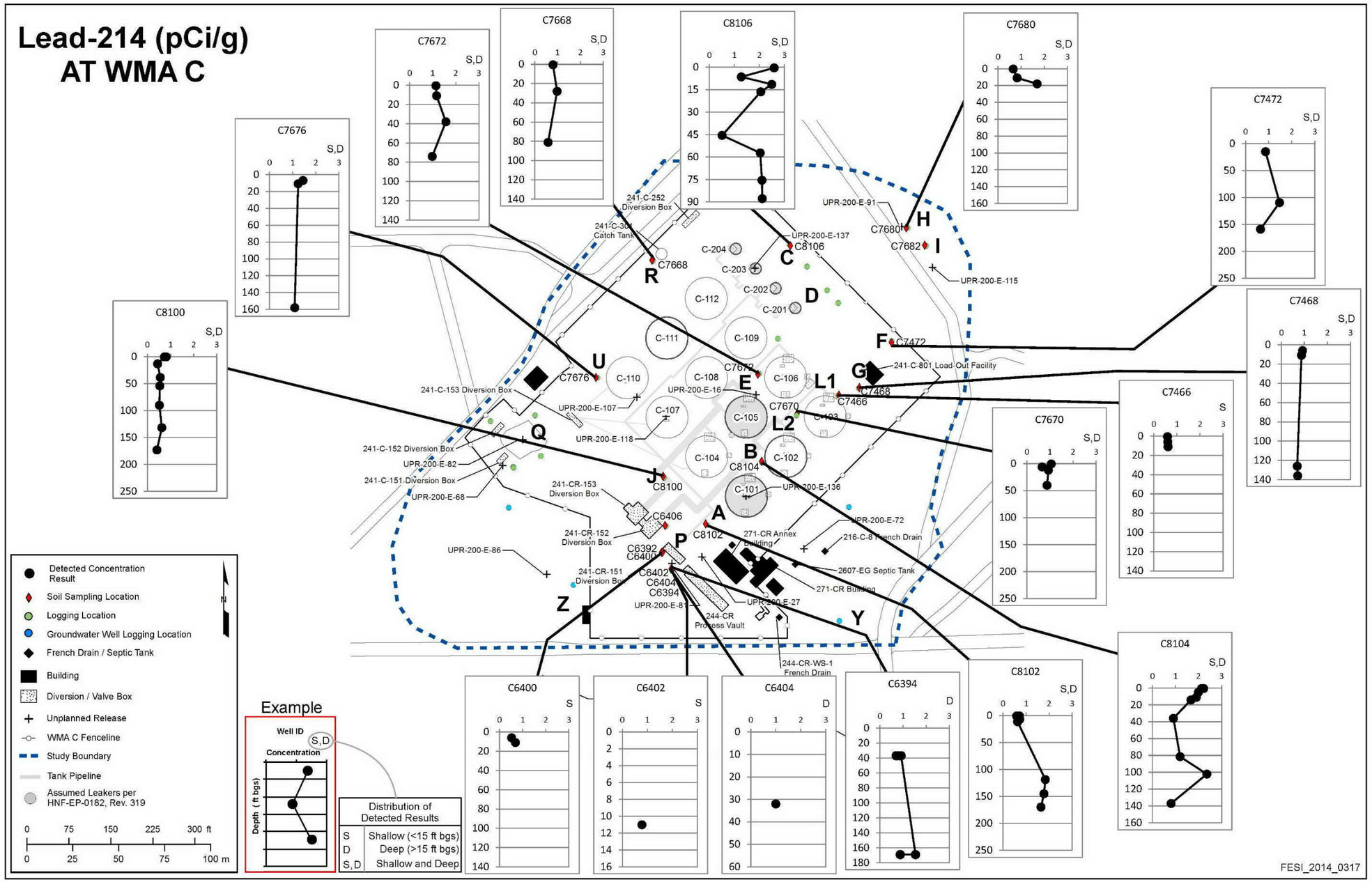


Figure Q-97. Distribution Map of Manganese-54 at WMA C

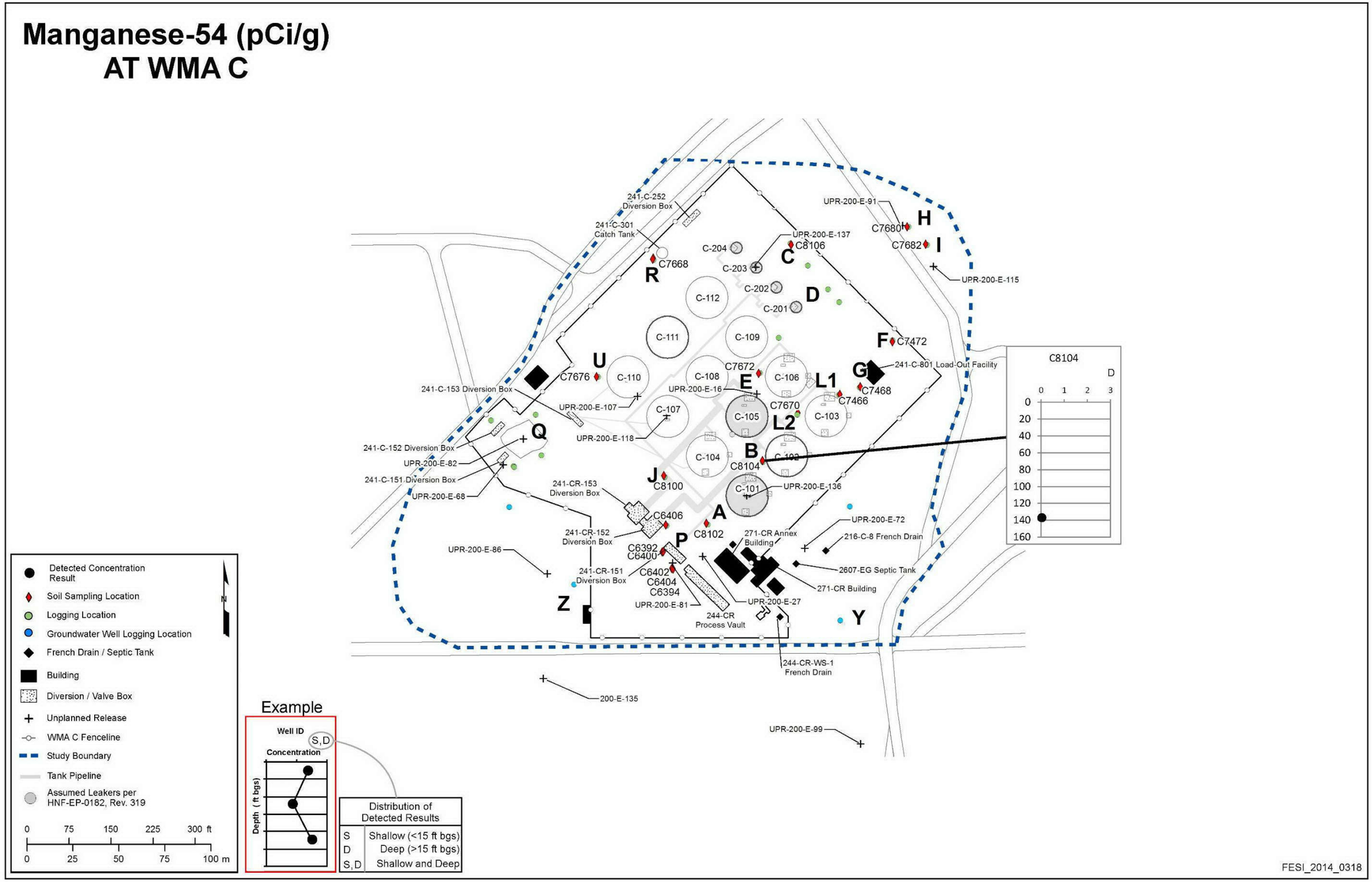


Figure Q-98. Distribution Map of Radium-228 at WMA C

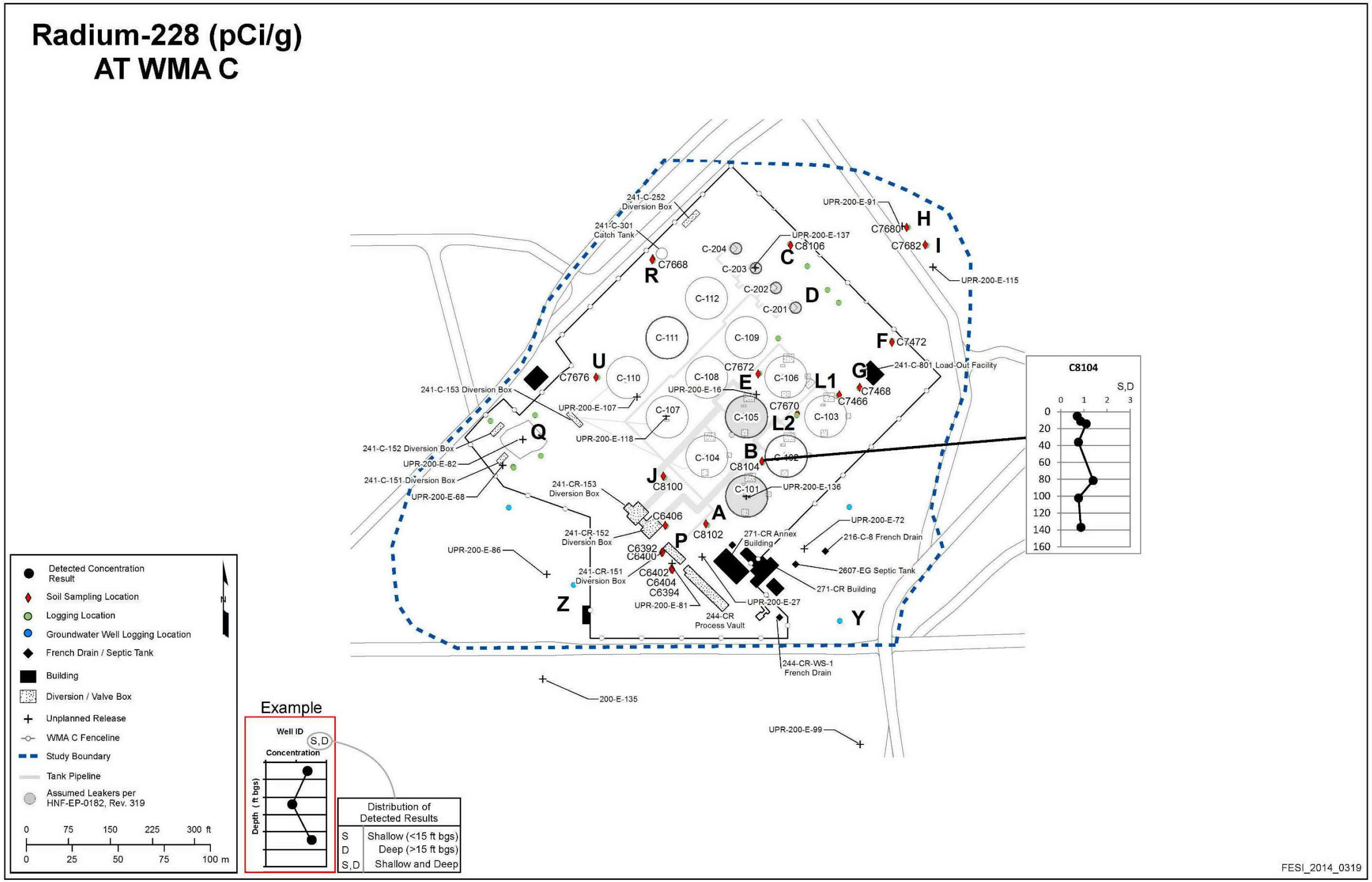


Figure Q-99. Distribution Map of Thallium-208 at WMA C

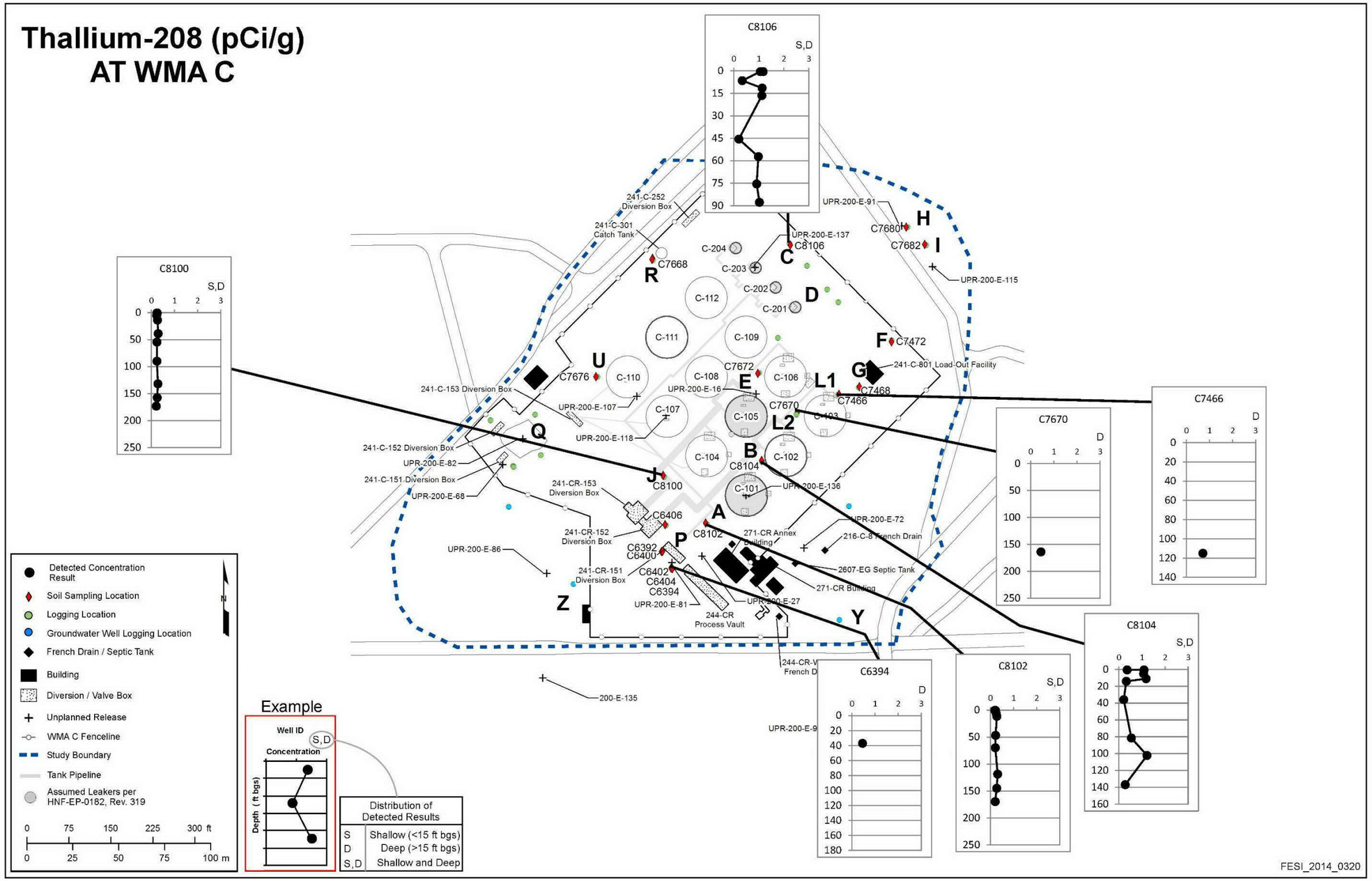
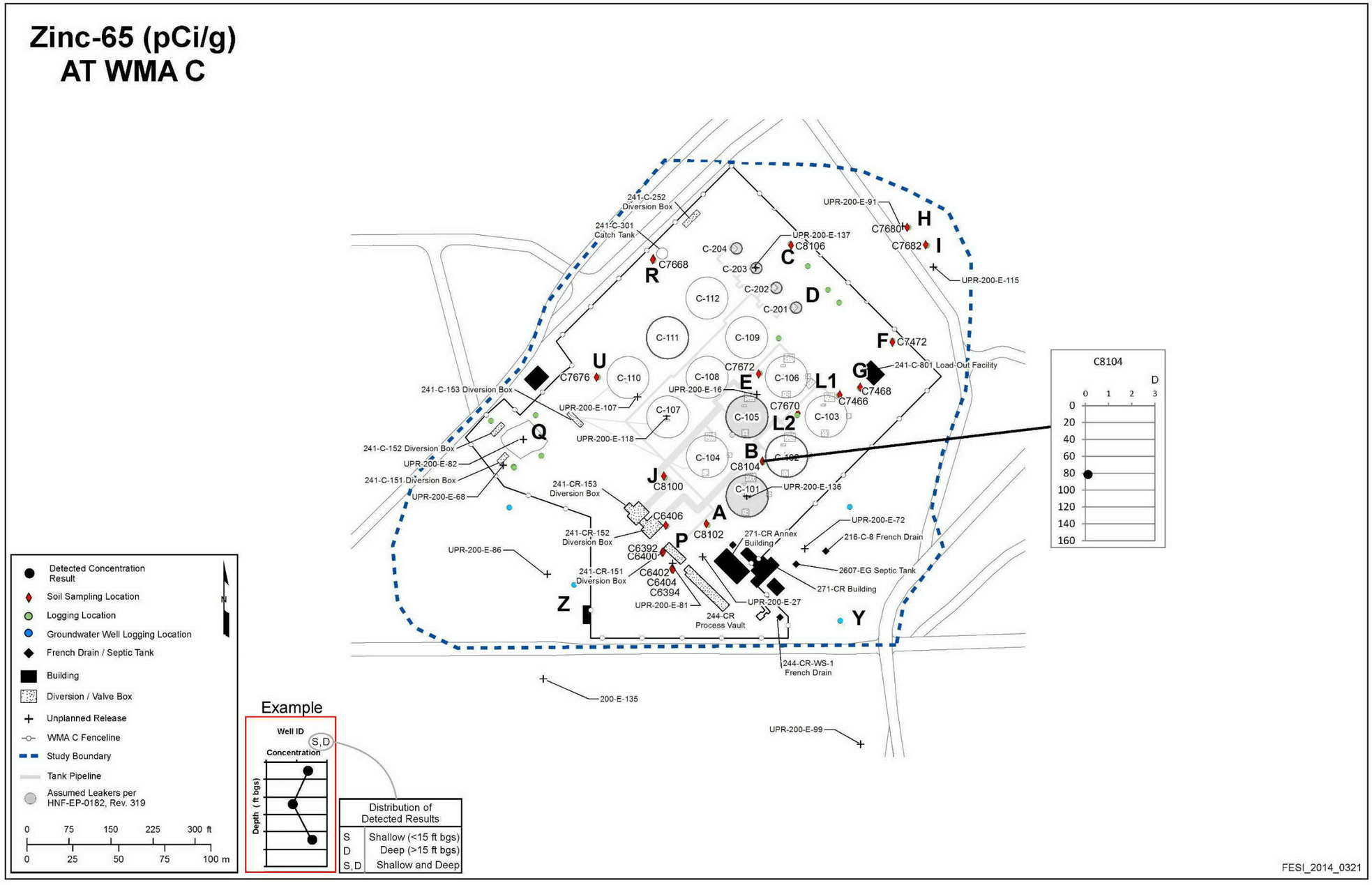


Figure Q-100. Distribution Map of Zinc-65 at WMA C



APPENDIX R

SUMMARY OF EXTENT OF SOIL CONTAMINATION ABOVE BACKGROUND IN SHALLOW AND DEEP SOILS BY INVESTIGATION GROUP AND ANALYTE

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APPENDIX R
SUMMARY OF SOIL RESULTS BY SAMPLE AND DEPTH FOR INVESTIGATION GROUPS AT WMA C

This appendix consists of Table R-1, which identifies those constituents reported above background or reported as detected when no background value is available for comparison (i.e., exceedance). Table R-1 identifies if these exceedances occurred within shallow and/or deep soil (i.e., S or D) for each investigation site/group by constituent and also identifies the following:

- Hanford Site Background Value (if applicable)
- Number of investigation sites/groups (i.e., areas encountered)
- Number of exceedances for each constituent in WMA C
- If the constituent is considered a dangerous waste

Table R-1. Summary of Shallow and Deep Exceedances

CLASS	STD_CON_ID	CONSTITUENT	Waste Designation	Background	A+B	C	E	F+G	H+I	J	L1+L2	P	R	U	Number of Areas Encountered	Only Shallow	Only Deep	Both Shallow and Deep	Total Count of Exceedances at WMA C
PH	pH	pH Measurement		*no background*	S, D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	132
WETCHEM	GLYCOLATE	2-Hydroxyacetate		*no background*							D				1	0	1	0	1
WETCHEM	71-50-1	Acetate		*no background*	S,D	S,D	D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	1	9	99
WETCHEM	14798-03-9	Ammonium ion		*no background*	S,D	S	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	1	0	9	98
WETCHEM	24959-67-9	Bromide		*no background*	S							D			2	1	1	0	6
WETCHEM	16984-48-8	Fluoride		2810			D	S				S,D	S		4	2	1	1	8
WETCHEM	FORMATE	Formate		*no background*	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	135
WETCHEM	14797-55-8	Nitrate		52000	D			D	S		D	D		D	6	1	5	0	10
WETCHEM	14797-65-0	Nitrite		*no background*	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	119
WETCHEM	338-70-5	Oxalate		*no background*	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	81
WETCHEM	14265-44-2	Phosphate		785	S,D	S	S	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	2	0	8	87
WETCHEM	14808-79-8	Sulfate		237000	S,D				S						2	1	0	1	3
WETCHEM	18496-25-8	Sulfide		*no background*			S,D	S,D	S,D		S,D	S,D	S,D	S,D	7	0	0	7	95
METALS	7440-36-0	Antimony	DW	130	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	124
METALS	7440-38-2	Arsenic	DW	6470		S,D			S	D		D		S,D	5	1	2	2	13
METALS	7440-39-3	Barium	DW	132000						S					1	1	0	0	2
METALS	7440-69-9	Bismuth		*no background*		S,D		D		S,D	S		S,D		5	1	1	3	19
METALS	7440-42-8	Boron		3890	S,D					S,D		D		S	4	1	1	2	21
METALS	7440-43-9	Cadmium	DW	563			S,D					D	S,D		3	0	1	2	24
METALS	7440-70-2	Calcium		17200000	D	S		S							3	2	1	0	3
METALS	7440-45-1	Cerium		*no background*	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	143
METALS	7440-47-3	Chromium	DW	18500	D	D	D	D	S,D	D	D	S,D		S,D	9	0	6	3	29
METALS	7440-50-8	Copper		22000							D				1	0	1	0	1
METALS	7440-53-1	Europium		*no background*				S,D			S,D	S,D	D		4	0	1	3	37
METALS	7439-91-0	Lanthanum		*no background*	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	147
METALS	7439-92-1	Lead	DW	10200	D	S			S,D		D	D			5	1	3	1	7
METALS	7439-95-4	Magnesium		7060000		S									1	1	0	0	1
METALS	7439-97-6	Mercury	DW	13	D		S	S,D		S	S,D	S,D	S	S	8	4	1	3	35
METALS	7439-98-7	Molybdenum		470	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	153
METALS	7440-00-8	Neodymium		*no background*		S,D		S,D			S,D	S,D		D	5	0	1	4	58
METALS	7440-02-0	Nickel	DW	19100			D				D	D		D	4	0	4	0	9
METALS	7440-05-3	Palladium		*no background*				S				S			2	2	0	0	7
METALS	7723-14-0	Phosphorus		*no background*	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	153
METALS	7440-10-0	Praseodymium		*no background*	S,D			S		S,D	S	S,D			5	2	0	3	36
METALS	7440-17-7	Rubidium		*no background*								S			1	1	0	0	3
METALS	7440-18-8	Ruthenium		*no background*					D			S,D			2	0	1	1	4
METALS	7440-19-9	Samarium		*no background*		S		D			S				3	2	1	0	6
METALS	7782-49-2	Selenium	DW	780				S,D	S,D	S,D	S	D		S,D	6	1	1	4	45
METALS	7440-21-3	Silicon		*no background*	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	147
METALS	7440-22-4	Silver	DW	167								S,D			1	0	0	1	10
METALS	7440-23-5	Sodium		690000			D					S,D			2	0	1	1	9
METALS	7440-24-6	Strontium		*no background*	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	153
METALS	7704-34-9	Sulfur		*no background*	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	148
METALS	7440-25-7	Tantalum		*no background*				S		S,D		S,D			3	1	0	2	9
METALS	13494-80-9	Tellurium		*no background*				S		S,D	S				3	2	0	1	4
METALS	7440-28-0	Thallium	DW	185		S,D			S,D			D	S,D		4	0	1	3	22
METALS	7440-31-5	Tin		*no background*	S			S		S,D		S,D			4	2	0	2	20
METALS	7440-32-6	Titanium		*no background*	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	153
METALS	7440-33-7	Tungsten		*no background*		S		S,D	S		S,D	S,D			5	2	0	3	17
METALS	7440-61-1	Uranium		3210				S,D			S,D	S,D			3	0	0	3	44
METALS	7440-62-2	Vanadium		85100								S,D			1	0	0	1	2
METALS	7440-65-5	Yttrium		*no background*	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	147
METALS	7440-66-6	Zinc		67800								S,D			1	0	0	1	2
METALS	7440-67-7	Zirconium		*no background*	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	153
RAD	14331-83-0	Actinium-228		*no background*	S,D	S,D				S,D	S				4	1	0	3	36
RAD	14596-10-2	Americium-241		*no background*	S					D		S,D			3	1	1	1	8

Table R-1. Summary of Shallow and Deep Exceedances

CLASS	STD_CON_ID	CONSTITUENT	Waste Designation	Background	A+B	C	E	F+G	H+I	J	L1+L2	P	R	U	Number of Areas Encountered	Only Shallow	Only Deep	Both Shallow and Deep	Total Count of Exceedances at WMA C
RAD	14234-35-6	Antimony-125		*no background*						S		S			2	2	0	0	2
RAD	14913-49-6	Bismuth-212		*no background*	S,D	S									2	1	0	1	13
RAD	14733-03-0	Bismuth-214		*no background*	S,D	S,D		S,D	S,D	S,D	S	S,D	D		8	1	1	6	61
RAD	14762-75-5	Carbon-14		*no background*	S,D			S,D	S	S,D	S	D		S,D	7	2	1	4	22
RAD	10045-97-3	Cesium-137		1.1	S	S	S	S,D		S	S	S,D		S	8	6	0	2	34
RAD	10198-40-0	Cobalt-60		0.0084	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	148
RAD	15585-10-1	Europium-154		0.033	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	146
RAD	14391-16-3	Europium-155		0.054	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	150
RAD	15046-84-1	Iodine-129		*no background*								S			1	1	0	0	1
RAD	15092-94-1	Lead-212		*no background*	S,D	S,D		S,D	S,D	S,D	S,D	S,D	S,D		8	0	0	8	87
RAD	15067-28-4	Lead-214		*no background*	S,D	S,D		S,D	S,D	S,D	S,D	S,D	S,D	S,D	9	0	0	9	71
RAD	13966-31-9	Manganese-54		*no background*	D										1	0	1	0	1
RAD	13994-20-2	Neptunium-237		*no background*								S,D		S	2	1	0	1	5
RAD	13981-37-8	Nickel-63		*no background*	D	S,D					S	S,D			4	1	1	2	7
RAD	13981-16-3	Plutonium-238		0.0038	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	146
RAD	PU-239/240	Plutonium-239/240		0.025	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	10	0	0	10	145
RAD	PU-241_calc	Plutonium-241 *		*no background*	S					S,D		S							5
RAD	13966-00-2	Potassium-40		17	S,D		D	D	S,D	D		D	D	D	8	1	6	1	15
RAD	13982-63-3	Radium-226		0.82	S,D					S,D		D			3	0	1	2	22
RAD	15262-20-1	Radium-228		*no background*	S,D										1	0	0	1	7
RAD	15758-45-9	Selenium-79		*no background*	S,D		S,D	S	S,D	S,D	S,D	S,D	D	S	9	2	1	6	45
RAD	10098-97-2	Strontium-90		0.18	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S,D	S	S	10	2	0	8	121
RAD	14133-76-7	Technetium-99		*no background*	D			D			D	S,D	D	D	6	0	5	1	17
RAD	14913-50-9	Thallium-208		*no background*	S,D	S,D				S,D	D	D			5	0	2	3	40
RAD	14269-63-7	Thorium-230		*no background*	S,D		S	S,D	S,D		S,D	S,D		S,D	7	1	0	6	29
RAD	TH-232	Thorium-232		1.3										D	1	0	1	0	6
RAD	15065-10-8	Thorium-234		*no background*	S,D										1	0	0	1	4
RAD	15832-50-5	Tin-126		*no background*	S,D	S,D	S,D	S,D	S,D	D	S		D	S,D	9	1	2	6	74
RAD	10028-17-8	Tritium		*no background*	D			D	S,D		S	S	S,D	D	7	2	3	2	20
RAD	13968-55-3	Uranium-233		*no background*			S,D	S,D	S,D		S,D	S,D	S,D	S,D	7	0	0	7	107
RAD	13966-29-5	Uranium-234		1.1								S,D			1	0	0	1	4
RAD	15117-96-1	Uranium-235		0.11								D			1	0	1	0	6
RAD	13982-70-2	Uranium-236		*no background*	D		S	S,D	S,D		S	S,D		S,D	7	2	1	4	30
RAD	U-238	Uranium-238		1.1								D			1	0	1	0	1
RAD	13982-39-3	Zinc-65		*no background*	D										2	0	1	0	1
GENORG	TPHDIESEL	Total petroleum hydrocarbons - diesel range		*no background*					S			S,D			2	1	0	1	8
GENORG	TPHGASOLINE	Total petroleum hydrocarbons - gasoline range		*no background*								S			1	1	0	0	1
PEST/PCB	309-00-2	Aldrin		*no background*			S								1	1	0	0	1
PEST/PCB	11097-69-1	Aroclor-1254	DW	*no background*	S										1	1	0	0	3
PEST/PCB	11096-82-5	Aroclor-1260	DW	*no background*				S				S			2	2	0	0	3
PEST/PCB	319-85-7	beta-1,2,3,4,5,6-Hexachlorocyclohexane (beta-BHC)		*no background*				S			S	S,D			3	2	0	1	14
PEST/PCB	58-89-9	Gamma-BHC (Lindane)		*no background*				S							1	1	0	0	1
SVOA	117-81-7	Bis(2-ethylhexyl) phthalate		*no background*				S,D	D	S	S,D	S,D			5	1	1	3	24
SVOA	85-68-7	Butylbenzylphthalate	DW	*no background*		S	S,D	S	S	S,D	S		S,D		7	4	0	3	21
SVOA	84-74-2	Di-n-butylphthalate	DW	*no background*					S			S,D			2	1	0	1	5
SVOA	117-84-0	Di-n-octylphthalate	DW	*no background*	S					S,D	D		S,D		4	1	1	2	12
SVOA	107-21-1	Ethylene glycol		*no background*								S			1	1	0	0	2
SVOA	142-82-5	n-Heptane		*no background*	D					S,D					2	0	1	1	9
VOA	179601-23-1	(m+p)-Xylene		*no background*				S							1	1	0	0	1
VOA	75-35-4	1,1-Dichloroethene	DW	*no background*								D			1	0	1	0	1
VOA	71-36-3	1-Butanol		*no background*							S				1	1	0	0	1
VOA	78-93-3	2-Butanone	DW	*no background*			D	S,D						D	3	0	2	1	7
VOA	591-78-6	2-Hexanone		*no background*				D					S		2	1	1	0	4
VOA	107-87-9	2-Pentanone		*no background*										D	1	0	1	0	1
VOA	106-35-4	3-Heptanone		*no background*					D				D	D	3	0	3	0	3
VOA	108-10-1	4-Methyl-2-pentanone		*no background*				D							1	0	1	0	2

Table R-1. Summary of Shallow and Deep Exceedances

CLASS	STD_CON_ID	CONSTITUENT	Waste Designation	Background	A+B	C	E	F+G	H+I	J	L1+L2	P	R	U	Number of Areas Encountered	Only Shallow	Only Deep	Both Shallow and Deep	Total Count of Exceedances at WMA C
VOA	67-64-1	Acetone		*no background*			S,D				S,D	S,D	S,D	S,D	5	0	0	5	35
VOA	71-43-2	Benzene	DW	*no background*							D			S	2	1	1	0	2
VOA	75-15-0	Carbon disulfide	DW	*no background*								D			1	0	1	0	1
VOA	110-54-3	Hexane		*no background*				S,D			S,D			D	3	0	1	2	21
VOA	75-09-2	Methylene chloride	DW	*no background*				S,D				S,D	S,D		3	0	0	3	17
VOA	95-47-6	o-Xylene		*no background*				S							1	1	0	0	1
VOA	100-42-5	Styrene		*no background*			D	S,D	S,D		D			S,D	5	0	2	3	23
VOA	109-99-9	Tetrahydrofuran		*no background*					D	D					2	0	2	0	2
VOA	108-88-3	Toluene	DW	*no background*			S,D	S,D	S,D	D	D	S,D	S,D	S,D	8	0	2	6	50
VOA	75-69-4	Trichloromonofluoromethane	DW	*no background*									D		1	0	1	0	3
VOA	1330-20-7	Xylenes (total)		*no background*				S							1	1	0	0	1

* Concentrations for plutonium-241were derived by multiplying the detected sampling results of plutoniom-239/240 with the scaling factor of 3.73 for each sample location (SVF-3009,*Pu241_Soil_Estimate.xls*).

APPENDIX S

SUMMARY OF SPECTRAL GAMMA LOGGING DATA FOR SELECTED LOCATIONS IN WMA C

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1.0 INTRODUCTION

This appendix provides a summary of spectral gamma logging (SGL) data collected at select locations in Waste Management Area (WMA) C. The data were collected between January 1997 and June 2013 from a total of 91 individual logging locations that included dry wells (wells completed in the vadose zone and used for monitoring of leaks and/or losses from tanks and ancillary infrastructure), groundwater wells, and direct push boreholes. These data provide radionuclide-specific soil radioactive decay activities, based on depth-discrete measurements, at each location, of the gamma emitting radionuclides cesium-137, cobalt-60, europium-152, europium-154, uranium-235, and uranium-238.

2.0 METHODOLOGY

The spectral gamma logging data were processed for inclusion in this appendix by performing the following steps:

- Extracting SGL Data – During this step, SGL data from 91 logging locations were extracted from the Hanford Environmental Information System (HEIS) Geophysical Logging (GPL) database.
- Organizing SGL data with respect to exposure scenarios - Under the 2007 Washington State *Model Toxics Control Act* (RCW 70.105D, "Hazardous Waste Cleanup — Model Toxics Control Act") cleanup regulations WAC 173-340-740, "Unrestricted Land Use Soil Cleanup Standards"), the point of compliance for soil cleanup levels based on the direct contact pathway is defined as the zone extending from the ground surface to 15 ft below ground surface (bgs). A deep vadose zone (>15 ft bgs) exposure scenario will be evaluated to screen for sites that pose a potential risk from inadvertent exposure through deep zone excavation activities and to allow institutional controls to be established at those sites to control access to deep zone contamination. Therefore, the SGL data for each location were divided into shallow-zone (0 to 15 ft bgs) and deep-zone (>15 ft bgs) data sets.
- Grouping of SGL data – The SGL data from 91 locations were grouped into three groups – (1) SGL data collected in all dry wells used for vadose zone monitoring at specific single-shell tanks; (2) SGL data collected at Phase 2 sampling locations; and (3) SGL data collected in all wells used for groundwater monitoring. As mentioned earlier, SGL data within each group were further divided into shallow-zone (0 to 15 ft bgs) and deep-zone (>15 ft bgs) data sets. Statistical summaries were computed later for each radionuclides within each dataset.
- Correcting of original soil activity measurements due to radioactive decay – Prior to computing summary statistics, the original radioactive decay activity measurements for each radionuclide were adjusted to take into account the additional radioactive decay from the original reported data to January 1, 2014.
- Computing of summary statistics – During the final step, summary statistics for each radionuclide in the shallow-zone and deep-zone data sets were computed.

3.0 SOFTWARE APPLICATIONS

Software used for this evaluation includes HEIS, Microsoft Access[1] database software, and Microsoft Excel[2]. HEIS is a central repository for storing and maintaining access to environmental data collected for the Hanford Site. Microsoft Access is used to query and sort the data downloaded from HEIS. Microsoft Excel is used to perform decay calculations and present the data and other information in spreadsheets.

4.0 RESULTS

SGL data were collected between January 1997 and June 2013 from a total of 91 individual logging locations that included dry wells, groundwater wells, and direct push boreholes. These data provide radionuclide-specific radioactive decay activities, based on depth-discrete measurements in the soil at each location, of the gamma emitting radionuclides cesium-137, cobalt-60, europium-152, europium-154, uranium-235, and uranium-238. Analytical results from these 91 individual logging locations reside in, and were downloaded for this evaluation from the HEIS database. A total of 27,909 records for the six radionuclides mentioned above were obtained from HEIS, and were included in the data set prior to analytical data processing.

SGL data from 91 individual locations were grouped into three groups based on well type and each group was further divided into shallow-zone (0 to 15 ft bgs) and deep-zone (>15 ft bgs) data sets. Those results of these grouping are provided in Tables S-1, S-2 and S-3. A summary of the number of dry well, direct push, and groundwater well locations by isotope is summarized in Table S-4

Table S-1 shows how logging data collected in all dry wells used for vadose zone monitoring at specific single-shell tanks were specifically grouped together and evaluated as single locations, shallow and deep. Locations of the dry well logging sites are provided in Figure S-2. Table S-2 shows how logging data collected at Phase 2 sampling locations were grouped together based on common characterization objectives and evaluated as single locations, shallow and deep. Table S-3 shows how logging data collected in all wells used for groundwater monitoring were grouped together and evaluated as single locations, shallow, and deep. Locations of the direct push and groundwater well logging sites are provided in Figure S-2. An overview of the grouping of spectral logging locations is depicted in Figure S-3.

During the third step, the original radioactive decay activities for each radionuclide in the soil were updated to take into account the additional radioactive decay from the original reported date to January 1, 2014. For detected samples, they were computed by using the original reported value, the decay constant of the radionuclide and the time difference (in days) between the date for detected results and January 1, 2014. For non-detect samples, the minimum detectable activity was used instead of the reported sample result.

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1 Access is a trademark of Microsoft Corporation, Redmond, Washington.

2 Excel is a trademark of Microsoft Corporation, Redmond, Washington.

During the final step, radionuclide-specific summary statistics based on the updated SGL results reported for each radionuclide in shallow zone and deep zone soil at each location were computed. The results are presented in Table S-4.

Figures S-4 through S-6 display the spatial location of shallow and deep detects for cesuim-137, cobalt-60, and europium-154. The values used for these plots are percent frequency of detects. This was chosen to reduce bias due to infrequent versus frequent sampling events as some wells were logged over one hundred times while others were logged only one or two times. This approach creates a more conservative bias by showing wells with a single detect and a single logging event as 100%.

Figure S-4 shows cesium-137 percent detect frequency for shallow and deep measurements. This effectively conveys the pervasiveness of cesium-137 throughout the soil column within the vicinity of the 100-series tanks.

Figure S-5 presents cobalt-60 data in the same manner as Figure S-4. The majority of the cobalt-60 detects can be found in the direct vicinity of Tanks C-105, C-106, C-109, and C-112.

Figure S-6 presents the europium-154 detect frequency data for the WMA C drywells. Results indicate low frequency of detects throughout the farm. Detects occurred between Tanks C-104 and C-105, between Tanks C-108 and C-109, and north of Tank C-112.

5.0 REFERENCES

RCW 70.105D, "Public Health and Safety," "Washington Clean Air Act," *Revised Code of Washington,* Washington State, Olympia, Washington.

RPP-PLAN-39114, 2012, *Phase 2 RCRA Facility Investigation/Corrective Measures Study Work Plan for Waste Management Area C*, Rev. 2, Washington River Protection Solutions, LLC, Richland, Washington.

WAC 173-340-740, "Model Toxics Control Act—Cleanup," "Unrestricted Land Use Soil Clean Standards," *Washington Administrative Code,* Olympia Washington.

Table S-1. WMA C Grouped Dry Well Logging Locations

Grouped Logging Location	Drywells Included	General Location Within WMA C
30-00-01_Shallow 30-00-01_Deep	30-00-01	East of Tank C-106 and general area of tanks and ancillary facilities
30-00-03_Shallow 30-00-03_Deep	30-00-03	East of Tank C-102 and southeast of general area of tanks and ancillary facilities
30-00-06_Shallow 30-00-06_Deep	30-00-06	Southwest of Tank C-101 and south of general area of tanks and ancillary facilities
30-00-09_Shallow 30-00-09_Deep	30-00-09	Southwest of Tank C-110 and west of general area of tanks and ancillary facilities
30-00-10_Shallow 30-00-10_Deep	30-00-10	West of Tank C-111 and northwest of general area of tanks and ancillary facilities
30-00-11_Shallow 30-00-11_Deep	30-00-11	Southwest of general area of tanks and ancillary facilities near diversion box 241-C-152
30-00-12_Shallow 30-00-12_Deep	30-00-12	East of Tank C-112 and north of general area of tanks and ancillary facilities
30-00-13_Shallow 30-00-13_Deep	30-00-13	Northwest of general area of tanks and ancillary facilities near C-301 catch tank
30-00-22_Shallow 30-00-22_Deep	30-00-22	Southwest of general area of tanks and ancillary facilities near diversion box 241-C-151
30-00-24_Shallow 30-00-24_Deep	30-00-24	Southwest of general area of tanks and ancillary facilities near diversion box 241-C-153
30-01_Shallow 30-01_Deep	30-01-01 30-01-06 30-01-09 30-01-12	Area near Tank C-101
30-03_Shallow 30-03_Deep	30-03-01 30-03-03 30-03-05 30-03-07 30-03-09	Area near Tank C-103
30-04_Shallow 30-04_Deep	30-04-01 30-04-02 30-04-03 30-04-04 30-04-05 30-04-08 30-04-12	Area near Tank C-104
30-05_Shallow 30-05_Deep	30-05-02 30-05-03 30-05-04 30-05-05 30-05-06 30-05-07 30-05-08	Area near Tank C-105

Table S-1. WMA C Grouped Dry Well Logging Locations

Grouped Logging Location	Drywells Included	General Location Within WMA C
	30-05-09 30-05-10	
30-06_Shallow 30-06_Deep	30-06-02 30-06-03 30-06-04 30-06-09 30-06-10 30-06-12	Area near Tank C-106
30-07_Shallow 30-07_Deep	30-07-01 30-07-02 30-07-05 30-07-07 30-07-08 30-07-10 30-07-11	Area near Tank C-107
30-08_Shallow 30-08_Deep	30-08-02 30-08-03 30-08-12	Area near Tank C-108
30-09_Shallow 30-09_Deep	30-09-01 30-09-02 30-09-06 30-09-07 30-09-10 30-09-11	Area near Tank C-109
30-10_Shallow 30-10_Deep	30-10-01 30-10-02 30-10-09 30-10-11	Area near Tank C-110
30-11_Shallow 30-11_Deep	30-11-01 30-11-05 30-11-06 30-11-09 30-11-11	Area near Tank C-111
30-12_Shallow 30-12_Deep	30-12-01 30-12-03 30-12-09 30-12-13	Area near Tank C-112

Note: See Figure S-1 for further information.

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Figure S-1. Drywell Logging Locations

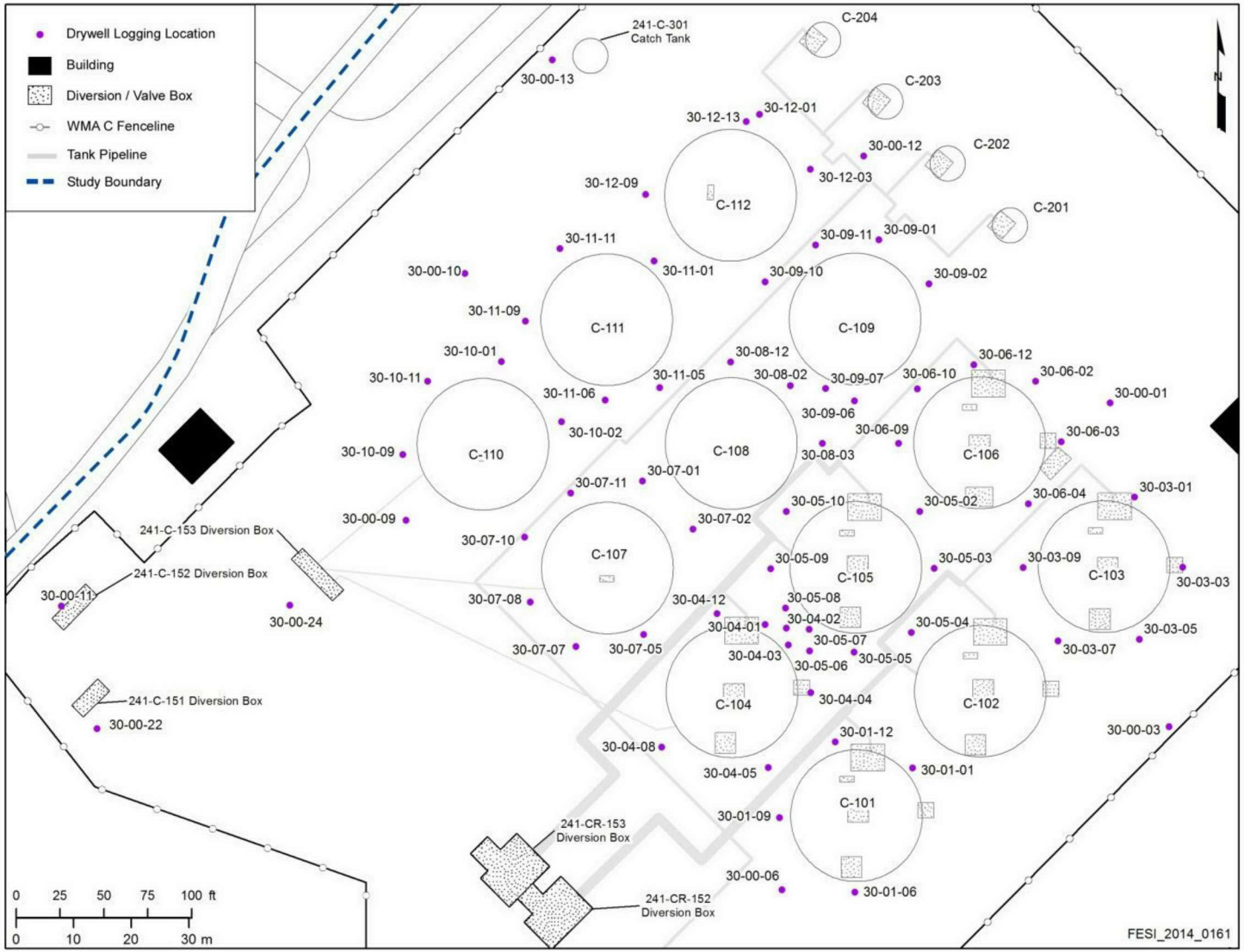

Table S-2. WMA C Grouped Direct Push Logging Locations

Grouped Sampling Location	Direct Push Locations Included	General Location Within WMA C	Phase 2 Characterization Objective[a]
D_Shallow D_Deep	C8765	Area near 241-C-200 series tanks	Determine if any 200-series tanks actually leaked, refine conceptual models 1, 2, and 4, and determine if any 200-series tank leaked during retrieval
E_Shallow	C7671	Area between tanks 241-C-106 and 241-C-109	Assess ^{60}Co and refine conceptual models 1, 2, and 4
F +G_Shallow F +G_Deep	C7467 C7471	Area near tank 241-C-103 and Bldg. C-801, and Bldg. C-801 chemical drain	Assess release of Plutonium Uranium Extraction plant waste, ^{137}Cs and ^{99}Tc, and ^{60}Co and refine conceptual models 1, 2, and 4
L1+L2_Shallow	C7465 C7669	Area between Tanks C-103 and C-106	Updated logging data for ^{60}Co, ^{137}Cs, Uranium, and moisture and assess potential release and refine conceptual models 1, 2, and 4
P_Shallow P_Deep	C6403 C6405	Area near UPR-81	Characterize release and refine conceptual models 1, 2, and 4
Q_Shallow	C7941 C7942	Area near UPR-82	Resolve depth with deep electrodes; define plume at UPR-82; refine conceptual models 1, 2 and 4
R_Shallow R_Deep	C7667	Area near 241-C-301 catch tank	Assess potential catch tank release; refine conceptual models 1, 2 and 4
U_Shallow	C7675	Area near tank 241-C-110	Characterize Tank C-110 release and conceptual models 1, 2, and 4
C-105_Shallow C-105_Deep	C4297	Area near single shell tank C-105	Characterize Tank C-105 release and conceptual models 1, 2, and 4

[a] Conceptual models 1, 2, and 4 refer to alternative conceptualizations of contaminant release and subsequent migration from Waste Management Area C infrastructure. Conceptual model descriptions are provided in Section 3.3 of RPP-PLAN-39114, *Phase 2 RCRA Facility Investigation/Corrective Measures Study Work Plan for Waste Management Area C*.

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Figure S-2. Locations of Direct Push and Groundwater Well Logging Locations

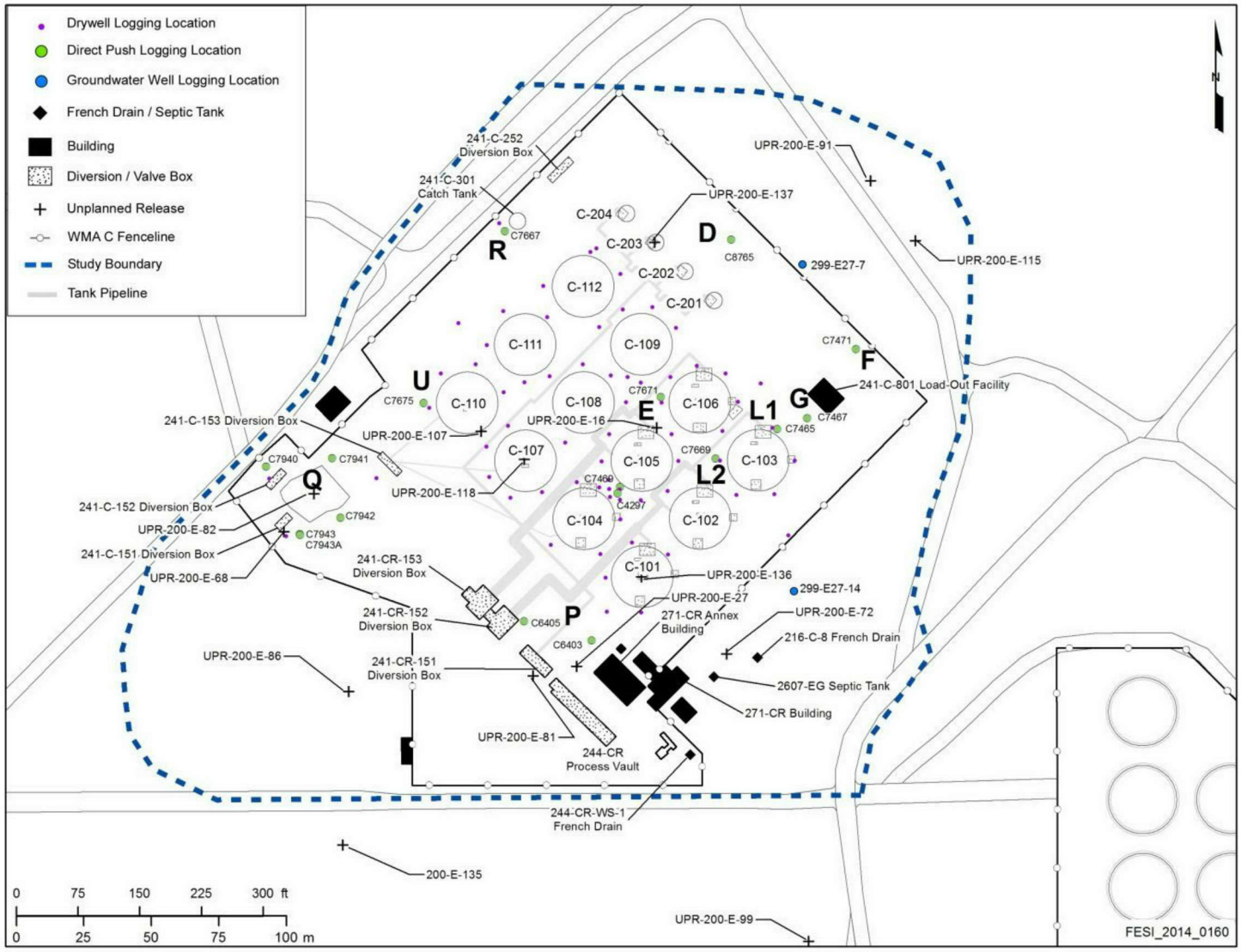

Figure S-3. Overview of Spectral Gamma Logging Data Grouping Process

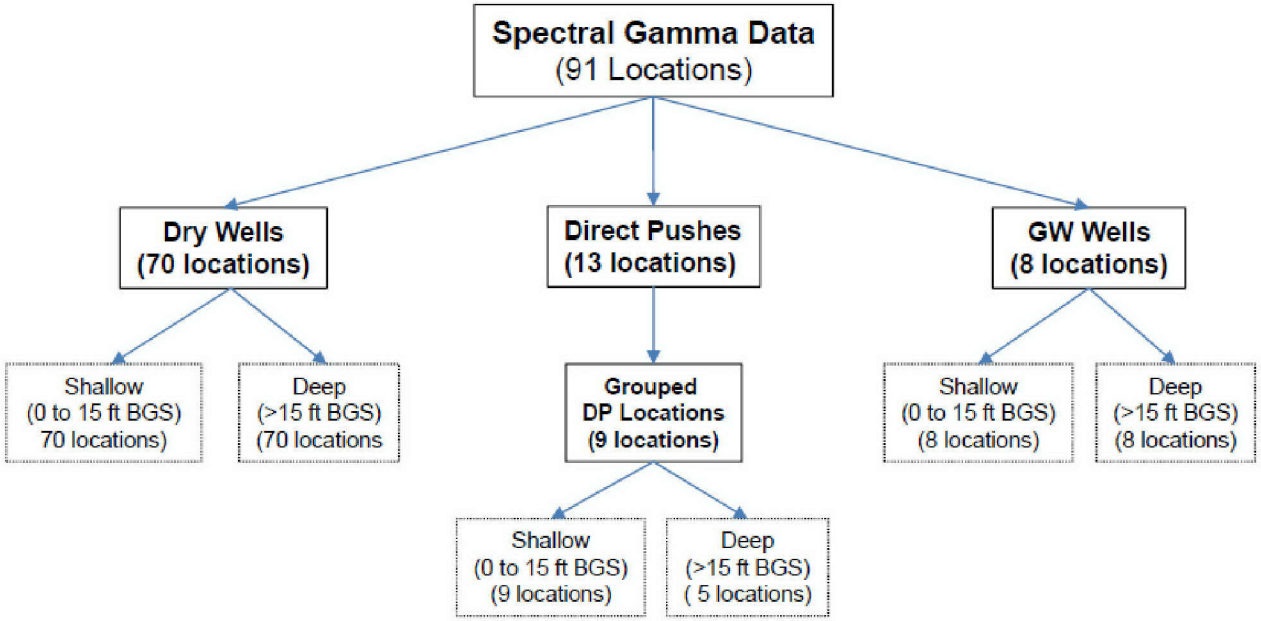

Figure S-4. Shallow and Deep Cesium-137 Detect Locations

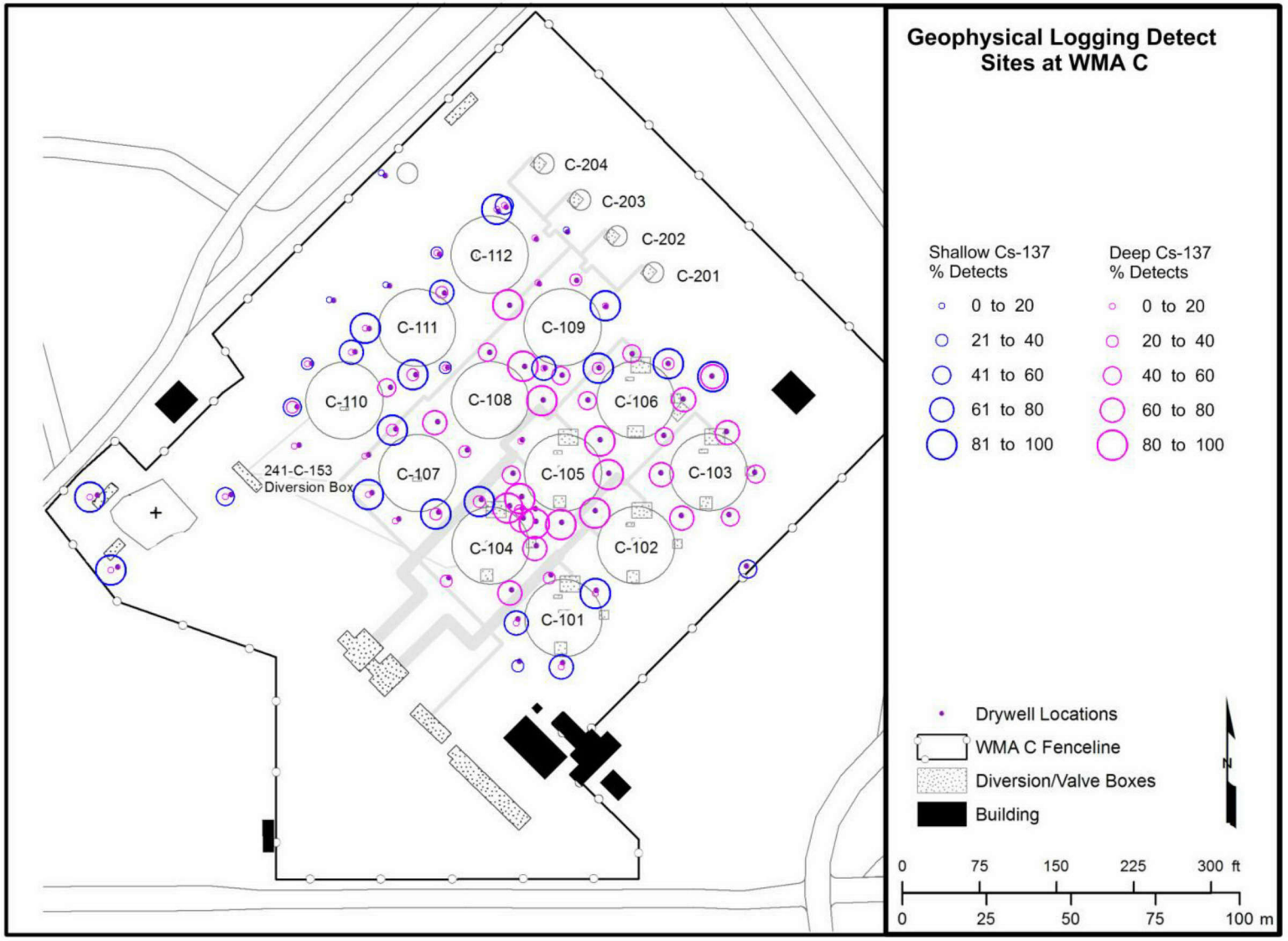

Figure S-5. Shallow and Deep Cobalt-60 Detect Locations

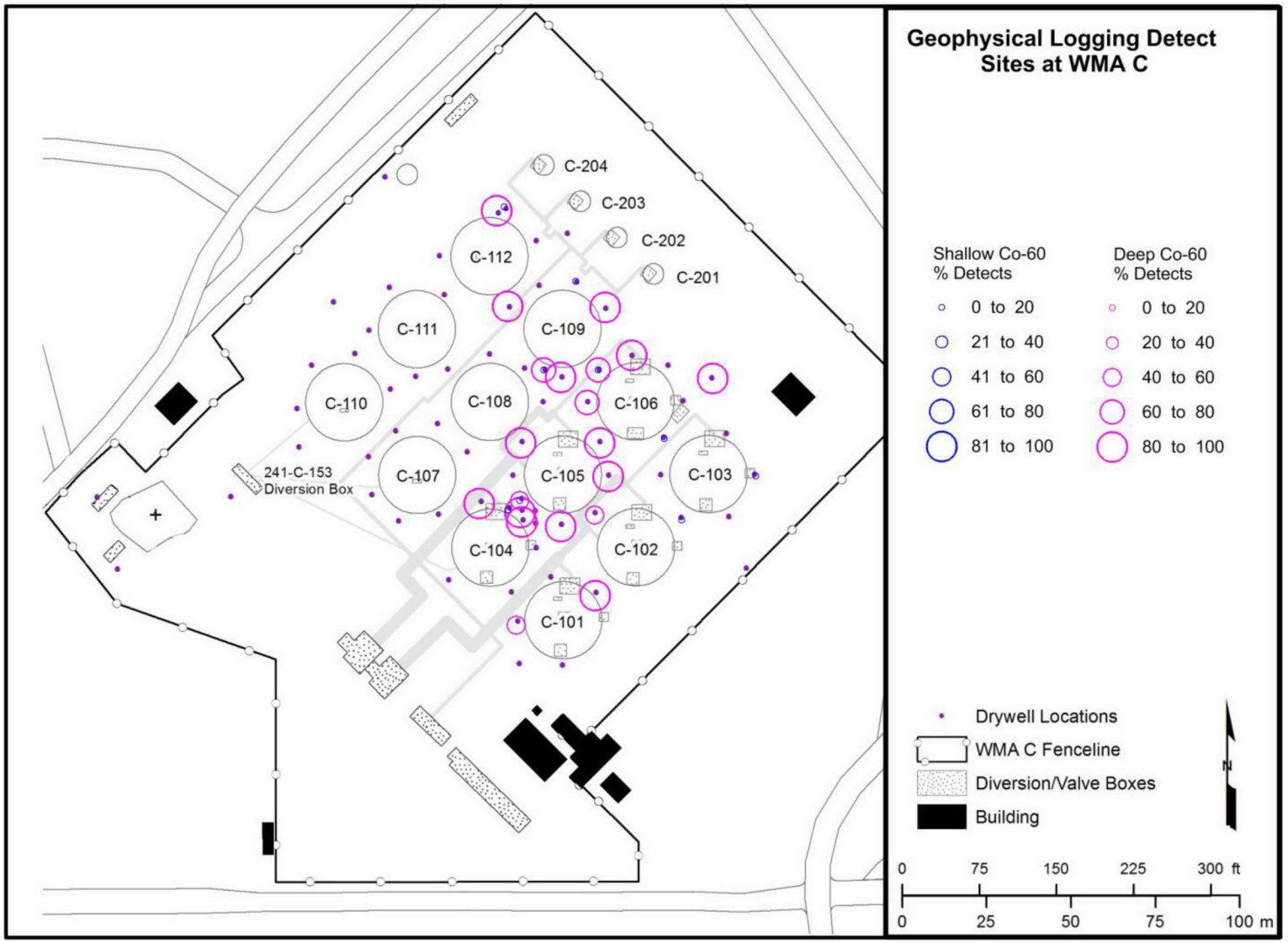

Figure S-6. Shallow and Deep Europium-154 Detect Locations

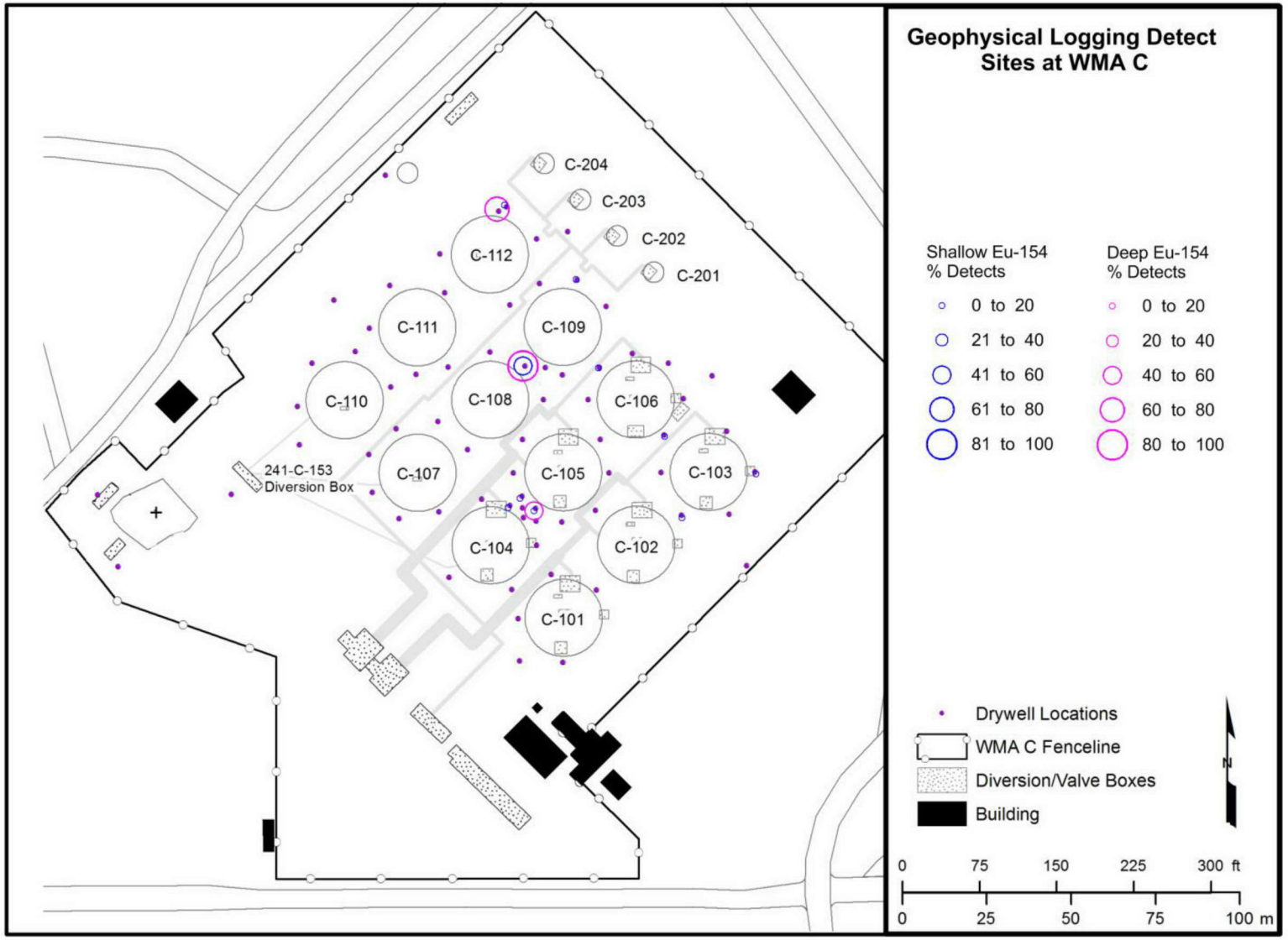

Table S-3. WMA C Grouped Groundwater Well Logging Locations

Grouped Sampling Location	Groundwater Well or Borehole Locations Included	General Location near WMA C
299-E27-7_Deep 299-E27-7_Shallow	299-E27-7	Northeast of WMA C
299-E27-14_Deep 299-E27-14_Shallow	299-E27-14	Southeast of WMA C
299-E27-21_Deep 299-E27-21_Shallow	299-E27-21	South of WMA C
299-E27-22_Deep 299-E27-22_Shallow	299-E27-22	Northeast of WMA C
299-E27-23_Deep 299-E27-23_Shallow	299-E27-23	Southwest of WMA C
299-E27-24_Deep 299-E27-24_Shallow	299-E27-24	Southeast of WMA C
299-E27-25_Deep 299-E27-25_Shallow	299-E27-25	Northeast of WMA C
299-E27-155_Deep 299-E27-155_Shallow	299-E27-155	Southwest of WMA C

Table S-4. Number of Drywell, Direct Push, and Groundwater Well Locations by Isotope

Isotope	No of Dry Well Locations		No. of Direct Push Location		No. of Groundwater Well Location	
	Shallow (0-15 ft bgs)	Deep (> 15 ft bgs)	Shallow (0-15 ft bgs)	Deep (> 15 ft bgs)	Shallow (0-15 ft bgs)	Deep (> 15 ft bgs)
Cs-137	70	70	9	4	8	8
Co-60	12	33	1	1	1	2
Eu-152	10	11	0	0	0	0
Eu-154	13	12	0	0	0	0
U-235	5	0	0	0	0	0
U-238	0	0	0	0	1	1

Table S-5. Summary of Spectral Gamma Logging Data for Selected Locations in WMA C

Location	Radionuclide	CAS #	Units	First Log Date	Last Log Date	Number of Results	Number of Detects	Frequency of Detection (%)	Non-Detect Decay Activities		Detected Decay Activities			
									Min	Max	Min	Max	Mean	Median
299-E27-14_Deep	**Cesium-137**	**10045-97-3**	**pCi/g**	3/28/2007	4/2/2007	285	4	1.4	0.11	0.18	0.11	0.21	0.17	0.18
299-E27-14_Shallow				4/2/2007	4/2/2007	12	5	41.67	0.078	0.13	0.083	1.0	0.48	0.18
299-E27-155_Deep				10/2/2007	10/30/2007	362	2	0.55	0.28	0.81	0.34	0.37	0.36	0.36
299-E27-155_Shallow				10/3/2007	10/3/2007	19	0	0	0.25	0.36	0	0	0	0
299-E27-21_Deep				7/21/2003	7/22/2003	336	7	2.08	0.18	0.55	0.17	0.27	0.22	0.22
299-E27-21_Shallow				7/21/2003	7/21/2003	16	1	6.25	0.19	0.28	0.20	0.20	0.20	0.20
299-E27-22_Deep				9/8/2003	9/8/2003	267	6	2.25	0.17	0.50	0.18	0.26	0.22	0.22
299-E27-22_Shallow				9/8/2003	9/8/2003	26	1	3.85	0.18	0.27	0.19	0.19	0.19	0.19
299-E27-23_Deep				8/7/2003	8/8/2003	337	3	0.89	0.18	0.47	0.19	0.22	0.21	0.22
299-E27-23_Shallow				8/8/2003	8/8/2003	16	4	25	0.20	0.24	0.24	0.49	0.35	0.33
299-E27-24_Deep				5/17/2010	5/17/2010	334	0	0	0.19	0.42	0	0	0	0
299-E27-24_Shallow				5/17/2010	5/17/2010	16	2	12.5	0.24	0.33	0.23	0.74	0.49	0.49
299-E27-25_Deep				4/9/2010	4/9/2010	178	0	0	0.22	0.40	0	0	0	0
299-E27-25_Shallow				4/9/2010	4/9/2010	376	2	0.53	0.17	0.32	0.22	0.22	0.22	0.22
299-E27-7_Deep				1/3/2008	1/16/2008	282	7	2.48	0.088	0.19	0.082	0.14	0.11	0.10
299-E27-7_Shallow				1/3/2008	1/3/2008	16	4	25	0.13	0.14	0.22	1.2	0.68	0.67
30-00-01_Deep				4/14/1997	4/15/1997	110	76	69.09	0.090	0.17	0.10	2.0	0.47	0.28
30-00-01_Shallow				4/15/1997	4/15/1997	31	29	93.55	0.12	0.20	0.13	16.4	1.1	0.27
30-00-03_Deep				4/16/1997	4/17/1997	210	109	51.9	0.086	0.21	0.13	1.2	0.45	0.41
30-00-03_Shallow				4/15/1997	4/17/1997	29	17	58.62	0.10	0.19	0.12	15.3	2.1	0.16
30-00-06_Deep				3/25/1997	3/26/1997	195	66	33.85	0.12	0.23	0.11	1.1	0.29	0.23
30-00-06_Shallow				3/26/1997	3/26/1997	31	9	29.03	0.11	0.20	0.16	13.6	5.6	3.6
30-00-09_Deep				4/1/1997	4/1/1997	85	0	0	0.13	0.19	0	0	0	0
30-00-09_Shallow				4/1/1997	4/1/1997	29	6	20.69	0.13	0.20	0.36	10.7	3.9	3.4
30-00-10_Deep				4/8/1997	4/8/1997	74	0	0	0.13	0.20	0	0	0	0
30-00-10_Shallow				4/8/1997	4/8/1997	31	6	19.35	0.14	0.18	0.12	5.5	1.3	0.46
30-00-11_Deep				4/18/1997	4/18/1997	87	5	5.75	0.14	0.20	0.14	0.56	0.32	0.33
30-00-11_Shallow				4/17/1997	4/18/1997	34	31	91.18	0.16	0.17	0.14	2.0	0.84	0.66
30-00-12_Deep				4/15/1997	4/17/1997	287	13	4.53	0.084	0.18	0.10	0.27	0.17	0.16
30-00-12_Shallow				4/15/1997	4/15/1997	31	4	12.9	0.11	0.16	0.22	9.8	2.8	0.61
30-00-13_Deep				4/9/1997	4/9/1997	80	0	0	0.12	0.16	0	0	0	0
30-00-13_Shallow				4/8/1997	4/9/1997	34	4	11.76	0.13	0.17	0.14	1.8	0.62	0.25
30-00-22_Deep				4/4/1997	4/4/1997	77	5	6.49	0.10	0.19	0.12	0.69	0.38	0.35
30-00-22_Shallow				4/4/1997	4/8/1997	32	29	90.63	0.11	0.15	0.13	585	65.1	0.92
30-00-24_Deep				4/3/1997	4/3/1997	87	9	10.34	0.11	0.20	0.13	0.56	0.29	0.27
30-00-24_Shallow				4/3/1997	4/3/1997	31	17	54.84	0.13	0.17	0.11	3.3	0.42	0.20

Table S-5. Summary of Spectral Gamma Logging Data for Selected Locations in WMA C

Location	Radionuclide	CAS #	Units	First Log Date	Last Log Date	Number of Results	Number of Detects	Frequency of Detection (%)	Non-Detect Decay Activities		Detected Decay Activities			
									Min	Max	Min	Max	Mean	Median
30-01_Deep				3/20/1997	4/1/1997	719	144	20.03	0.092	0.20	0.11	386	15.2	0.30
30-01_Shallow				3/20/1997	3/31/1997	130	107	82.31	0.090	0.18	0.12	65.0	5.1	0.84
30-03_Deep				4/8/1997	10/27/2010	1,276	744	58.31	0.10	0.26	0.12	142	7.4	1.3
30-03_Shallow				4/8/1997	10/26/2010	221	221	100	--	--	0.34	225	29.5	11.9
30-04_Deep				2/7/1997	8/4/2010	1,396	686	49.14	0.10	0.32	0.11	479	7.1	0.47
30-04_Shallow				2/6/1997	8/4/2010	260	259	99.62	0.13	0.13	0.16	984	25.6	6.9
30-05_Deep				1/16/1997	8/2/2010	1,680	1,279	76.13	0.088	0.22	0.11	18,138,100	86,982	0.53
30-05_Shallow				1/15/1997	8/2/2010	317	317	100	--	--	0.13	792	27.5	8.3
30-06_Deep				1/16/1997	3/11/2011	2,309	943	40.84	0.10	0.28	0.095	26.1	1.1	0.29
30-06_Shallow				1/16/1997	3/9/2011	281	272	96.8	0.11	0.25	0.13	1,410	15.3	3.1
30-07_Deep				3/7/1997	3/20/1997	1,245	363	29.16	0.068	0.20	0.11	3.3	0.50	0.31
30-07_Shallow				3/10/1997	12/16/1999	222	213	95.95	0.12	83.3	0.12	546	8.5	0.67
30-08_Deep				3/14/1997	3/20/1997	286	207	72.38	0.11	0.20	0.12	735	17.0	0.44
30-08_Shallow				3/14/1997	3/20/1997	93	93	100	--	--	0.19	686	15.8	0.61
30-09_Deep				3/21/1997	12/30/2010	1,268	426	33.6	0.10	0.36	0.11	7.9	0.78	0.40
30-09_Shallow				3/20/1997	12/20/2010	228	213	93.42	0.10	0.21	0.14	165	7.8	1.2
30-10_Deep				2/27/1997	3/7/1997	766	151	19.71	0.088	0.20	0.10	11.2	0.91	0.44
30-10_Shallow				2/28/1997	3/5/1997	128	80	62.5	0.10	0.18	0.12	13.7	1.8	0.75
30-11_Deep	**Cesium-137**	**10045-97-3**	**pCi/g**	2/28/1997	3/12/1997	871	106	12.17	0.092	0.20	0.12	0.72	0.33	0.30
30-11_Shallow				2/28/1997	3/12/1997	223	116	52.02	0.10	0.19	0.11	20.1	1.2	0.29
30-12_Deep				2/24/1997	7/15/2010	967	124	12.82	0.094	1.0	0.10	1.4	0.26	0.20
30-12_Shallow				2/24/1997	7/13/2010	200	121	60.5	0.10	8.9	0.12	78.7	3.7	0.63
C-105_Deep				3/3/2004	3/19/2004	208	9	4.33	0.16	0.43	0.15	1.9	0.58	0.23
C-105_Shallow				3/3/2004	3/3/2004	16	16	100	--	--	2.6	1,320	163	10.3
D_Deep				5/28/2013	6/3/2013	435	435	100	--	--	-12.1	-4.6	-8.7	-8.7
D_Shallow				6/3/2013	6/3/2013	30	30	100	--	--	-8.4	38.3	-2.7	-5.2
E_Shallow				6/16/2010	6/16/2010	4	4	100	--	--	4.3	112	51.9	45.4
F+G_Deep				7/20/2009	7/20/2009	1	1	100	--	--	1.7	1.7	1.7	1.7
F+G_Shallow				7/20/2009	12/1/2009	8	8	100	--	--	1.0	4.6	2.6	2.2
L1+L2_Shallow				7/14/2009	12/8/2009	23	23	100	--	--	2.6	26.1	7.6	5.9
P_Deep				3/2/2009	3/13/2009	579	579	100	--	--	-0.42	3.1	0.59	0.57
P_Shallow				3/2/2009	3/13/2009	63	63	100	--	--	0	3,376	300	0.87
Q_Shallow				10/14/2010	10/22/2010	4	4	100	--	--	0.093	7.3	4.6	5.6
R_Deep				12/17/2009	12/17/2009	2	2	100	--	--	4.6	27.4	16.0	16.0
R_Shallow				12/17/2009	12/17/2009	9	9	100	--	--	0.92	518	212	147
U_Shallow				6/28/2010	6/28/2010	1	1	100	--	--	3.0	3.0	3.0	3.0
TOTALS				**1/15/1997**	**6/3/2013**	**20,952**	**8,852**	**42.25**	**0.068**	**83.3**	**-12.1**	**18,138,100**	**12,576**	**0.55**
299-E27-14_Deep	**Cobalt-60**	**10198-40-0**	**pCi/g**	3/28/2007	4/2/2007	46	44	95.65	0.020	0.020	0.020	0.14	0.048	0.035

Table S-5. Summary of Spectral Gamma Logging Data for Selected Locations in WMA C

Location	Radionuclide	CAS #	Units	First Log Date	Last Log Date	Number of Results	Number of Detects	Frequency of Detection (%)	Non-Detect Decay Activities		Detected Decay Activities			
									Min	Max	Min	Max	Mean	Median
299-E27-7_Deep				1/3/2008	1/16/2008	282	30	10.64	0.016	0.044	0.014	0.24	0.089	0.066
299-E27-7_Shallow				1/3/2008	1/3/2008	16	0	0	0.026	0.036	0	0	0	0
30-00-01_Deep				4/14/1997	4/14/1997	9	8	88.89	0.011	0.011	0.012	0.023	0.017	0.014
30-00-06_Deep				3/25/1997	3/25/1997	1	1	100	--	--	0.024	0.024	0.024	0.024
30-01_Deep				3/24/1997	3/31/1997	13	10	76.92	0.0076	0.011	0.011	0.018	0.015	0.015
30-03_Deep				4/9/1997	10/27/2010	441	109	24.72	0.032	0.078	0.0089	0.36	0.065	0.049
30-03_Shallow				10/18/2010	10/26/2010	66	0	0	0.029	0.079	0	0	0	0
30-04_Deep				2/18/1997	8/4/2010	222	132	59.46	0.0080	0.076	0.0087	0.66	0.17	0.054
30-04_Shallow				8/4/2010	8/4/2010	30	0	0	0.036	0.068	0	0	0	0
30-05_Deep				1/16/1997	8/2/2010	241	155	64.32	0.0070	0.10	0.0065	0.26	0.048	0.028
30-05_Shallow				1/16/1997	8/2/2010	38	6	15.79	0.0090	0.074	0.011	0.017	0.014	0.013
30-06_Deep				1/29/1997	3/11/2011	791	347	43.87	0.0079	0.091	0.010	0.21	0.072	0.074
30-06_Shallow	**Cobalt-60**	**10198-40-0**	**pCi/g**	11/2/2010	3/9/2011	60	0	0	0.026	0.35	0	0	0	0
30-07_Shallow				3/10/1997	3/12/1997	2	2	100	--	--	0.024	0.030	0.027	0.027
30-08_Deep				3/19/1997	3/19/1997	67	67	100	--	--	0.014	1.1	0.32	0.23
30-08_Shallow				3/20/1997	3/20/1997	1	1	100	--	--	0.010	0.010	0.010	0.010
30-09_Deep				3/21/1997	12/30/2010	322	116	36.02	0.0079	0.079	0.0077	0.70	0.072	0.020
30-09_Shallow				3/20/1997	12/20/2010	31	0	0	0.0086	0.084	0	0	0	0
30-12_Deep				2/25/1997	7/15/2010	236	40	16.95	0.0078	0.078	0.011	0.12	0.026	0.019
30-12_Shallow				7/13/2010	7/13/2010	31	0	0	0.033	0.067	0	0	0	0
C-105_Deep				3/3/2004	3/3/2004	37	35	94.59	0.017	0.022	0.027	0.19	0.11	0.11
C-105_Shallow				3/3/2004	3/3/2004	2	2	100	--	--	0.079	0.27	0.18	0.18
TOTALS				**1/16/1997**	**3/11/2011**	**2,985**	**1,105**	**37.02**	**0.0070**	**0.35**	**0.0065**	**1.1**	**0.092**	**0.050**
30-01_Deep				3/25/1997	3/25/1997	1	1	100	--	--	54.6	54.6	54.6	54.6
30-03_Deep				10/19/2010	10/27/2010	331	0	0	0.14	0.48	0	0	0	0
30-03_Shallow				4/8/1997	10/26/2010	67	1	1.49	0.19	0.46	8.8	8.8	8.8	8.8
30-04_Deep				8/4/2010	8/4/2010	82	0	0	0.16	0.42	0	0	0	0
30-04_Shallow				8/4/2010	8/4/2010	30	0	0	0.22	0.42	0	0	0	0
30-05_Deep				1/21/1997	8/2/2010	82	1	1.22	0.19	9.8	18.2	18.2	18.2	18.2
30-05_Shallow				1/22/1997	8/2/2010	32	1	3.13	0.19	3.8	5.2	5.2	5.2	5.2
30-06_Deep	**Europium-152**	**14683-23-9**	**pCi/g**	11/2/2010	3/11/2011	524	0	0	0.16	0.51	0	0	0	0
30-06_Shallow				11/2/2010	3/9/2011	59	0	0	0.20	1.7	0	0	0	0
30-08_Deep				3/20/1997	3/20/1997	1	1	100	--	--	0.12	0.12	0.12	0.12
30-09_Deep				12/20/2010	12/30/2010	194	0	0	0.10	0.50	0	0	0	0
30-09_Shallow				12/20/2010	12/20/2010	30	0	0	0.22	0.43	0	0	0	0
30-12_Deep				7/13/2010	7/15/2010	194	0	0	0.18	0.45	0	0	0	0
30-12_Shallow				7/13/2010	7/13/2010	31	0	0	0.20	0.42	0	0	0	0
TOTALS				**1/21/1997**	**3/11/2011**	**1,658**	**5**	**0.3**	**0.10**	**9.8**	**0.12**	**54.6**	**17.4**	**8.8**

Table S-5. Summary of Spectral Gamma Logging Data for Selected Locations in WMA C

Location	Radionuclide	CAS #	Units	First Log Date	Last Log Date	Number of Results	Number of Detects	Frequency of Detection (%)	Non-Detect Decay Activities		Detected Decay Activities			
									Min	Max	Min	Max	Mean	Median
30-01_Deep	**Europium-154**	**15585-10-1**	**pCi/g**	3/25/1997	3/25/1997	1	1	100	--	--	27.6	27.6	27.6	27.6
30-03_Deep				10/19/2010	10/27/2010	332	0	0	0.11	0.31	0	0	0	0
30-03_Shallow				4/8/1997	10/26/2010	67	1	1.49	0.12	0.31	3.6	3.6	3.6	3.6
30-04_Deep				8/4/2010	8/4/2010	82	0	0	0.16	0.30	0	0	0	0
30-04_Shallow	**Europium-154**	**15585-10-1**	**pCi/g**	8/4/2010	8/4/2010	30	0	0	0.19	0.27	0	0	0	0
30-05_Deep				1/21/1997	8/2/2010	92	17	18.48	0.15	35.7	0.15	19.7	4.2	2.9
30-05_Shallow				1/22/1997	8/2/2010	36	5	13.89	0.054	1.7	0.20	1.2	0.52	0.38
30-06_Deep				11/2/2010	3/11/2011	524	0	0	0.15	0.35	0	0	0	0
30-06_Shallow				1/29/1997	3/9/2011	61	3	4.92	0.16	0.28	0.054	2.1	0.93	0.62
30-07_Shallow				3/10/1997	3/12/1997	4	4	100	--	--	0.17	0.92	0.46	0.37
30-08_Deep				3/18/1997	3/19/1997	11	9	81.82	0.074	7.1	0.27	7.4	2.6	1.6
30-08_Shallow				3/18/1997	3/18/1997	2	1	50	0.052	0.052	0.13	0.13	0.13	0.13
30-09_Deep				12/20/2010	12/30/2010	194	4	2.06	0.025	0.093	0.052	0.066	0.061	0.062
30-09_Shallow				12/20/2010	12/20/2010	30	0	0	0.018	0.10	0	0	0	0
30-12_Deep				2/27/1997	7/15/2010	198	3	1.52	0.064	0.31	0.15	0.39	0.25	0.23
30-12_Shallow				7/13/2010	7/13/2010	31	0	0	0.16	0.29	0	0	0	0
C-105_Deep				3/3/2004	3/3/2004	1	1	100	--	--	0.82	0.82	0.82	0.82
C-105_Shallow				3/3/2004	3/3/2004	4	4	100	--	--	0.54	175	51.2	14.7
TOTALS				**1/21/1997**	**3/11/2011**	**1,700**	**53**	**3.12**	**0.018**	**35.7**	**0.052**	**175**	**6.4**	**1.1**
299-E27-7_Deep	**Uranium-235**	**15117-96-1**	**pCi/g**	1/3/2008	1/16/2008	282	6	2.13	0.59	1.8	1.6	2.0	1.7	1.6
299-E27-7_Shallow				1/3/2008	1/3/2008	16	0	0	1.2	3.4	0	0	0	0
30-04_Shallow				2/14/1997	2/19/1997	2	2	100	--	--	4.1	5.8	4.9	4.9
30-05_Deep				1/21/1997	1/21/1997	5	2	40	9.1	219	94.9	156	126	126
30-05_Shallow				1/15/1997	1/22/1997	8	3	37.5	2.9	4.7	3.6	6.6	5.2	5.2
30-06_Shallow				1/29/1997	2/3/1997	2	2	100	--	--	6.2	19.9	13.0	13.0
30-08_Shallow				3/20/1997	3/20/1997	1	1	100	--	--	9.5	9.5	9.5	9.5
TOTALS				**1/15/1997**	**1/16/2008**	**316**	**16**	**5.06**	**0.59**	**219**	**1.6**	**156**	**20.2**	**4.7**
299-E27-7_Deep	**Uranium-238**	**U-238**	**pCi/g**	1/3/2008	1/16/2008	282	15	5.32	7.9	15.7	7.9	20.8	12.6	12.9
299-E27-7_Shallow				1/3/2008	1/3/2008	16	0	0	10.1	13.5	0	0	0	0
TOTALS				**1/3/2008**	**1/16/2008**	**298**	**15**	**5.03**	**7.9**	**15.7**	**7.9**	**20.8**	**12.6**	**12.9**

APPENDIX T

GEOPHYSICAL LOGGING RESULTS

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APPENDIX T
GEOPHYSICAL LOGGING RESULTS

This appendix presents the results of geophysical logging performed as part of the WMA C Phase 2 RCRA Field Investigation. Geophysical logging was completed through the direct push soil investigations using slim-hole spectral gamma and neutron moisture logging tools. Logging was also completed at select drywell locations dispersed throughout the 100-series tanks (Site M) as specified by the work plan (RPP-PLAN-39114, Rev 2). Logging specific to the drywells included spectral gamma logging systems, neutron moisture logging systems, radionuclide assessment system, and handheld neutron moisture logging. Radionuclide assessment system and handheld neutron moisture logging were completed as part of retrieval monitoring activities and are included only through the retrieval logging summaries provided as part of the retrieval data reports. To date this encompasses drywells in the vicinity of the Tanks C-104, C-108, C-109, and C-110.

Groundwater wells in the vicinity of WMA C were selected for geophysical logging and are included in the work plan as Site W. Originally five wells were indicated; however, after extensive review of the well casing construction information it was determined that three of the wells were not suitable for accurate logging: 299-E27-12, 299-E27-13, and 299 E27-15.

DRYWELL LOGGING RESULTS FOR 299-E27-56 (A6681)

2010-2011 C-Farm Re-Baseline

30-00-01
299-E27-56 (A6681)
Log Data Report

Borehole Information:

Log Date:	2010-07-22	Filename:	A6681_HG_2010-07-22	Site:	241-C-106
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:	7/21/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	12/27/44	N/A	145	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	unknown	8	0.313	0.0	145
Welded Steel	0.0	unknown	12	0.500	0.0	45

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The depth interval logged in 2010 was from 0 to 66.5 feet. The location of the borehole is indicated in the figure titled "Borehole 30-00-01 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1963 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-106* (DOE 1997).

The zero reference is the top of casing.

Logging Equipment Information:

Logging System:	Gamma 2 BR	Type:	DHMCA[5] SGLS
Effective Calibration Date:	09/03/09	Serial No.:	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

SGLS Log Run Information:

Log Run	1	2	3 Repeat		
HEIS Number	1016208	1016209	1018084		
Date	7/21/10	7/22/10	7/22/10		
Logging Engineer	Spatz/Holloway/ Legler	Spatz/Holloway/ Legler	Spatz/Holloway/ Legler		
Start Depth (ft)	0.0	51.0	59.0		
Finish Depth (ft)	52.0	66.5	65.0		
Count Time (sec)	100	100	100		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.5	0.5	0.5		
Log Speed (ft/min)	N/A	N/A	N/A		
Pre-Verification	_B_10721	_B_10722	_B_10722		
Start File	_D_000000	_D_005100	_D_005900		
Finish File	_D_005197	_D_006656	_D_006502		
Post-Verification	_A_10721	_A_10722	_A_10722		
Depth Return Error (in.)	0.0	N/A	0.0		
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made		

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the table above due to the length of the file names (e.g., _D_000000 for RUN01_BR_1016281_D_000000).

Analysis Notes:

Analyst:	Legler	Date:	9/23/2011	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Casing corrections for a combined casing thickness of 0.813-in. (0.313-in. + 0.5000-in. for 8-in. and 12-in. casings respectively) from 0 to 45 ft and 0.313-in. thick casing from 45 to 66.5 ft were applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20090903_BRr0b, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better

[6] minimum detection level

defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 and Co-60 were decayed to a common date of July 22, 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154 and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected almost continuously from ground surface to 20.5 ft, intermittently from 22.5 to 44.5 ft and continuously from 45.5 to 66.5 ft, with a maximum concentration of approximately 15.7 pCi/g at ground surface. No significant changes have occurred since 1997.

Co-60 was not detected in the primary log but was detected in the repeat log run at 64.5 ft. Co-60 that existed in the depth interval from 58.5 to 67 ft in 1997 has generally decayed below the 2010 MDL. A single detection of Co-60 is observed at 64.5 ft slightly above the MDL of 0.1 pCi/g.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

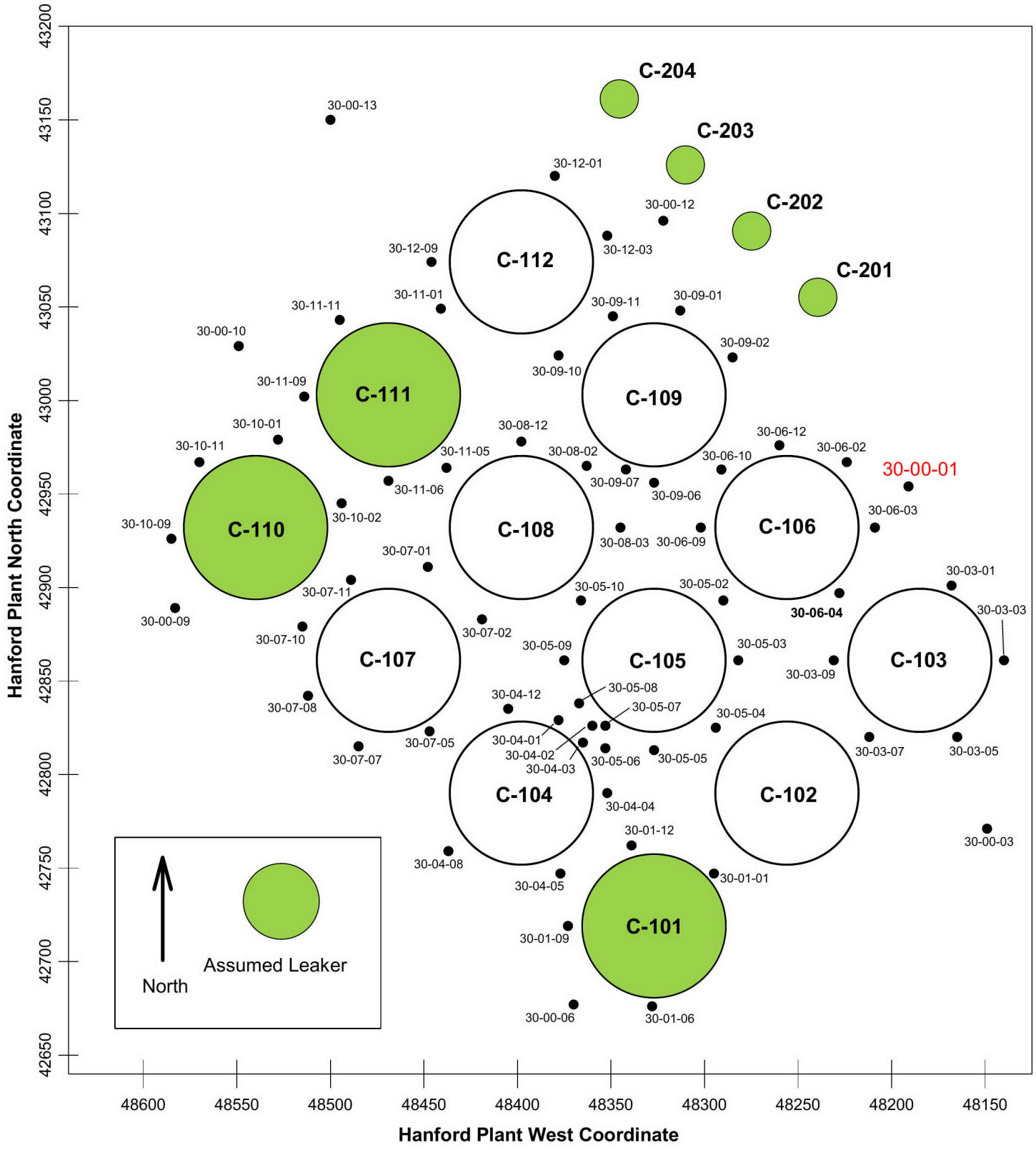
Depth Reference is top of casing

Borehole 30-00-01 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy (DOE) 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-106* GJ-HAN-84 Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-00-01 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-00-01 (299-E27-56) (A6681)

Borehole Information

Site: C Farm, Tank C-106			
Coordinates (HAN Plant):	**North: 42954**	**West: 48191**	**Elevation (ft): 645.17**
Coordinates (WA Plane):	**North: 136575.842**	**East: 575205.486**	**Elevation (m): 197.654**
Drill Date: 12/27/1944	**Type: Cable Tool**	**Depth (ft): 65**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 7/21/10**	**D/W Reference: Stoller**	

Comments: This borehole was drilled to a depth of 145 ft. The 8" casing was perforated from 43 to 143 ft. The total depth now is only 65 ft. There may be a well cap stuck at 65 ft. SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, WA State Plane Coordinates are NAVD88

Casing Information

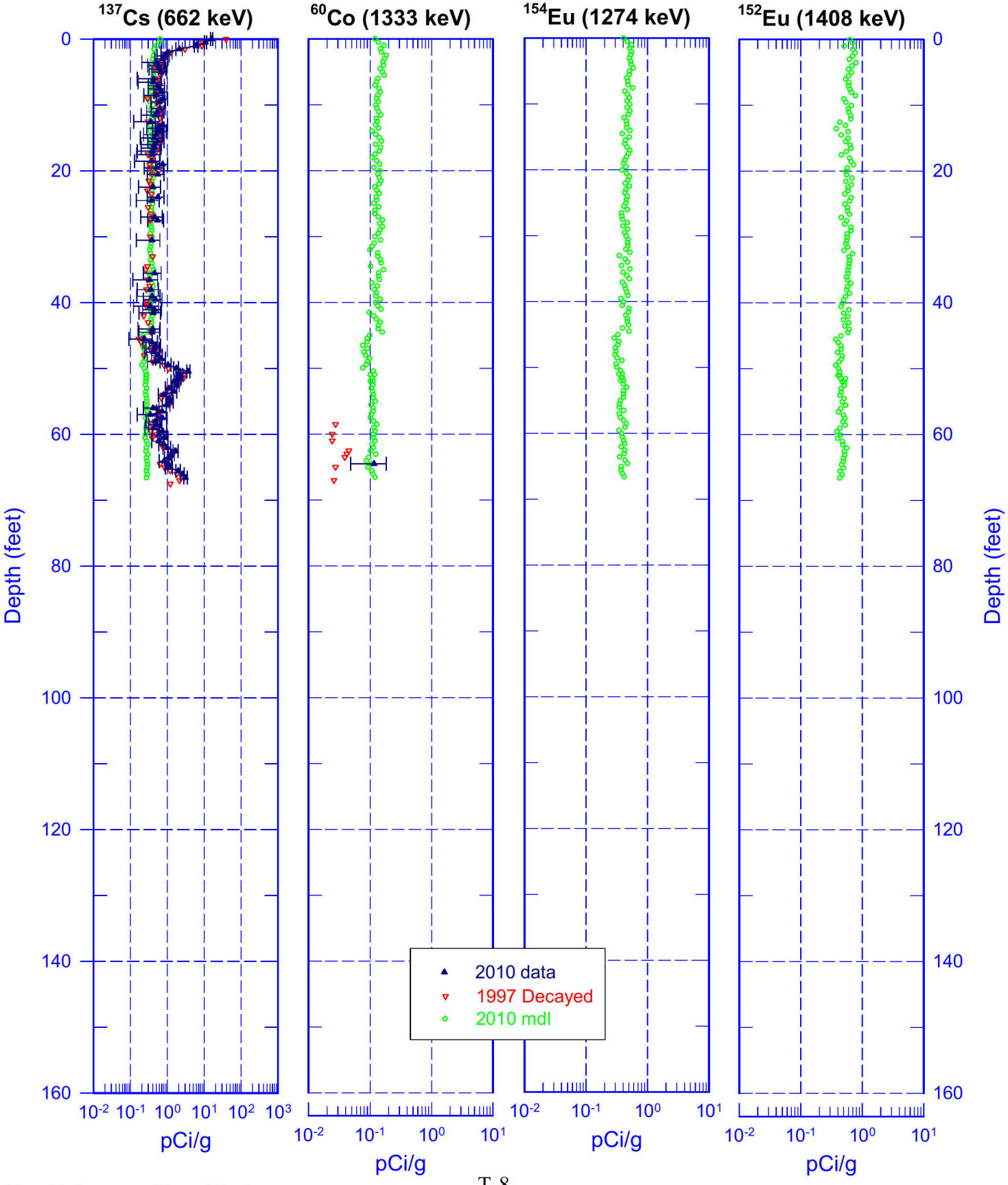
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	145	8	0.313	0	Stoller
Steel	0	45	12	0.5	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
5/27/1963	Nat Gamma	Unk	NA	0-150	PNL	On file at Sigma 5
11/5/1964	Nat Gamma	Unk	NA	4-150	PNL	On file at Sigma 5
4/14/1997	SGLS	G2A	1	0-67.5	MACTEC-ERS	Baseline
4/24/2002	RAS	Large	A	30-67	MACTEC-ERS	No Apparent Change
1/16/2003	RAS	Large-New	B	0-67	Stoller	No Apparent Change
4/28/2003	RAS	Large-New	C	0-61	Stoller	No Apparent Change
7/22/2003	RAS	Large-New	D	0-61	Stoller	No Apparent Change
9/15/2003	RAS	Large-New	E	0-65	Stoller	No Apparent Change
11/3/2003	RAS	Large-New	F	0-65	Stoller	No Apparent Change
12/2/2003	RAS	Large-New	G	0-65	Stoller	No Apparent Change
3/1/2004	RAS	Large-New	H	0-65	Stoller	No Apparent Change
2/14/2005	RAS	Large-New	I	0-65	Stoller	No Apparent Change
7/22/2010	SGLS	BR	2	0-66.5	Stoller	Co-60 increase at 64 .5 ft

30-00-01 (299-E27-56 [A6681])

Comparison of Manmade Radionuclides (2010 & 1997)



Zero Reference = Top of Casing

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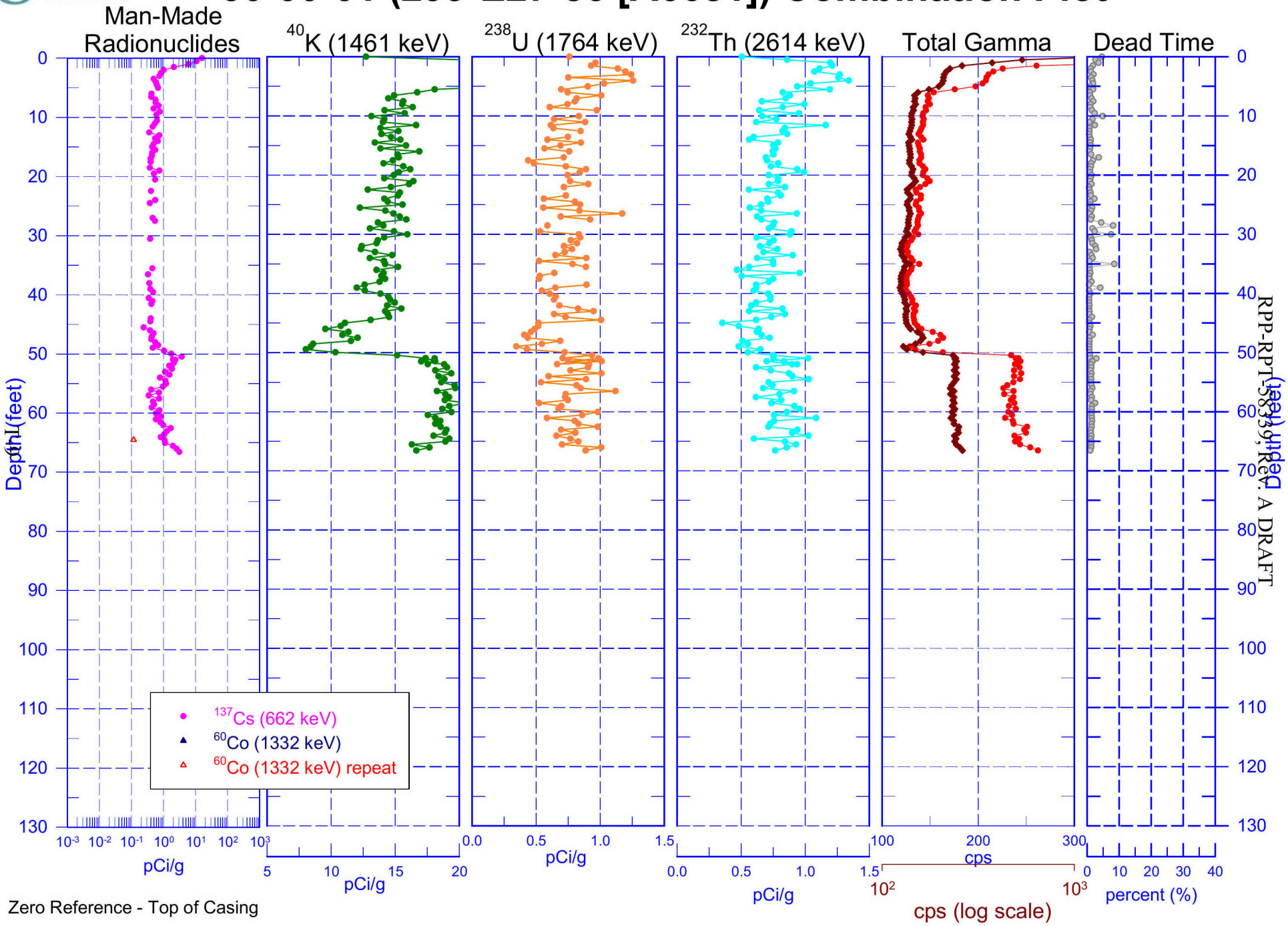
Hanford Office

30-00-01 (299-E27-56 [A6681]) Combination Plot



RPP-RPT-58339, Rev. A DRAFT

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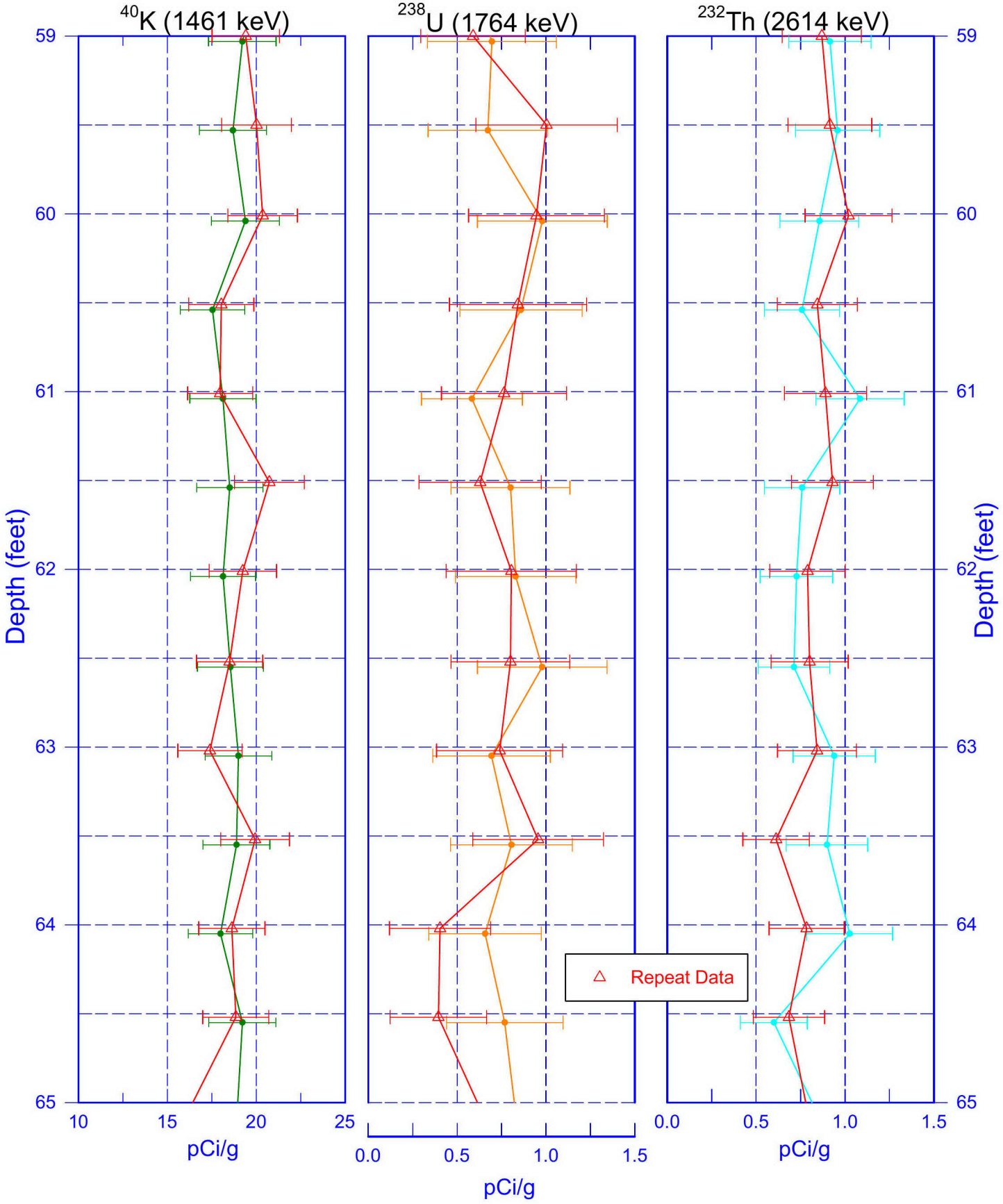
30-00-01 (299-E27-56 [A6681])

Repeat Section of Natural Gamma Logs

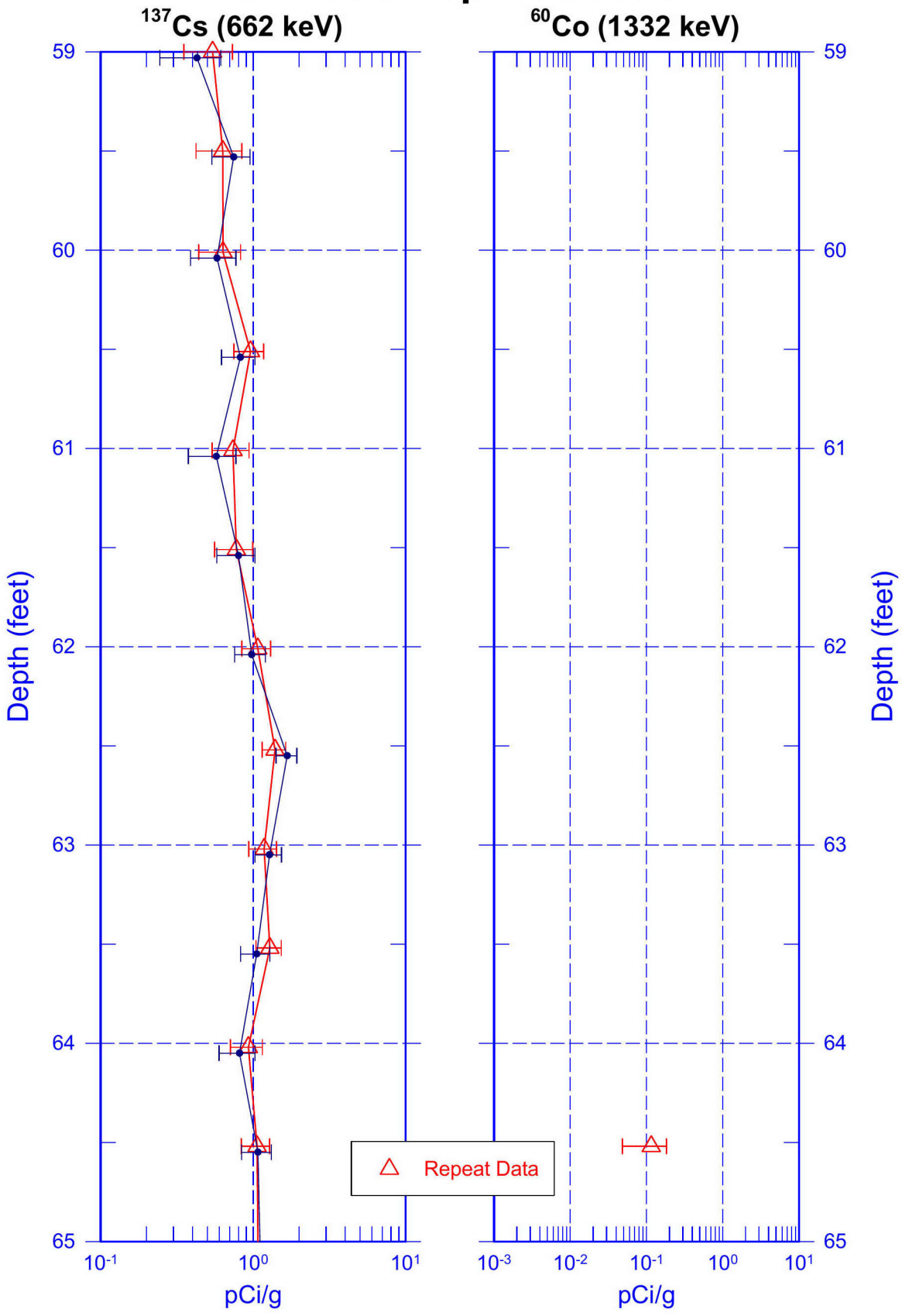


Zero Reference - Top of Casing

Stoller Hanford Office

30-00-01 (299-E27-56 [A6681])

Manmade Repeat Section



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-58 (A6683)

2010-2011 C-Farm Re-Baseline

30-01-09
299-E27-58 (A6683)
Log Data Report

Borehole Information:

Log Date:	2010-09-01	Filename:	A6683_HG_2010-09-01	Site:	241-C-101
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:	8/25/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	04/1970	N/A	100	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	100

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The location of the borehole is indicated in the figure titled "Borehole 30-01-09 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] and HRLS[5] data acquired in 1997 and 2010. A summary of other logging data acquired since 1994 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-101* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

No water was observed in this borehole.

The zero reference is the top of casing, approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2	Type:	DHMCA[6] SGLS BR
Effective Calibration Date:	09/22/10	Serial No.:	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] High Rate Logging System
[6] Down-Hole Multi-Channel Analyzer

Logging System:	Gamma 2 C	**Type:**	DHMCA HRLS
Effective Calibration Date:	4/23/2010	**Serial No.:**	39A314
Calibration Reference:	HGLP-CC-063, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Handheld Moisture Meter # MI-HP-3	**Type:**	Model # 503DR Campbell Pacific Nuclear Moisture Gauge
Effective Calibration Date:	6/21/10	**Serial No.:**	H-38068291
Calibration Reference:	HGLP-CC-039, Rev. 1	**Logging Procedure:**	TO-320-022, D-3

SGLS Log Run Information:

Log Run	**1**	**2**	**3**	**4 Repeat**	
HEIS Number	1016242	1016243	1016244	1016245	
Date	08/26/10	08/30/10	08/31/10	08/31/10	
Logging Engineer	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway	
Start Depth (ft)	0.0	53.5	64.0	34.0	
Finish Depth (ft)	54.50	65.0	97.5	40.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	_B_10826	_B_10830	1016244_B_10831	1016244_B_10831	
Start File	_D_000000	_D_005350	_D_006400	_D_003400	
Finish File	_D_005450	_D_006502	_D_009750	_D_004000	
Post-Verification	_A_10826	_A_10830	1016245_A_10831	1016245_A_10831	
Depth Return Error (in.)	0.0	0.0	N/A	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

HRLS Log Run Information:

Log Run	**5**				
HEIS Number	1016241				
Date	8/25/10				
Logging Engineer	Spatz/Legler				
Start Depth (ft)	26.0				
Finish Depth (ft)	31.0				
Count Time (sec)	300				
Live/Real	R				
Shield (Y/N)	N				

Log Run	5				
MSA Interval (ft)	0.5				
Log Speed (ft/min)	N/A				
Pre-Verification	_B_002800				
Start File	_D_002600				
Finish File	_D_003100				
Post-Verification	_A_002800				
Depth Return Error (in.)	0.0				
Comments	No fine gain adjustments made				

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

HRLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired at a depth of known Cs-137 concentrations in the borehole and in the 1013 field verifier after logging in the tank farm was completed. A centralizer was installed on the sonde.

File names were shortened in the tables above due to the length of file names (for example, _D_000051 for A6683_BR_1016281_D_000051).

Analysis Notes:

Analyst:	Legler	Date:	8/10/2011	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Casing corrections for a 0.28-in. thick casing were applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

HRLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100311_BCr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[7] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade

[7] minimum detection level

radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time corrections in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 and Co-60 were decayed to a common date of September 30, 2010.

SGLS logging is conducted by Stoller, as is logging with the NMLS[8]. NMLS data are acquired digitally at 0.25-ft intervals with a count time of 15 seconds. Where available, the most recent NMLS data are reported in the re-baseline log data reports. Tank Farm's handheld moisture data are acquired by Tank Farms Operations using a handheld moisture gauge that is lowered by hand and held in place for measurements by cable stops at 1-ft increments, at count times of 16 seconds. These data are manually recorded on data sheets, and submitted to Stoller for data entry and analysis. Calibration for both systems to assess system performance and determine volumetric moisture is performed by Stoller using the same procedure. Handheld moisture data are being collected for selected boreholes in C Farm. NMLS data are not available for this borehole. Handheld moisture data were acquired in this borehole on December 3, 2010 using moisture gauge M1-HP-3 and AmBe source H-38068291. These handheld moisture results are included in this report.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected almost continuously from ground surface to 37 ft and intermittently to 97.5 ft, with a maximum concentration of approximately 518 pCi/g at 28.5 ft (HRLS.) Because the HRLS had not been used before, potential changes in the high rate interval cannot be assessed. No changes are observed in the remainder of the borehole since 1997.

Although not detected, MDLs for Co-60, Eu-154, and Eu-152 are plotted on the manmade radionuclides plot. Co-60 detected in 1997 appears to have decayed below the 2010 MDL. Further investigations of the spectra from 1997 data of the Eu-154 and Eu-152 detections indicate that the 1997 detections were not valid peaks.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

Depth Reference is top of casing

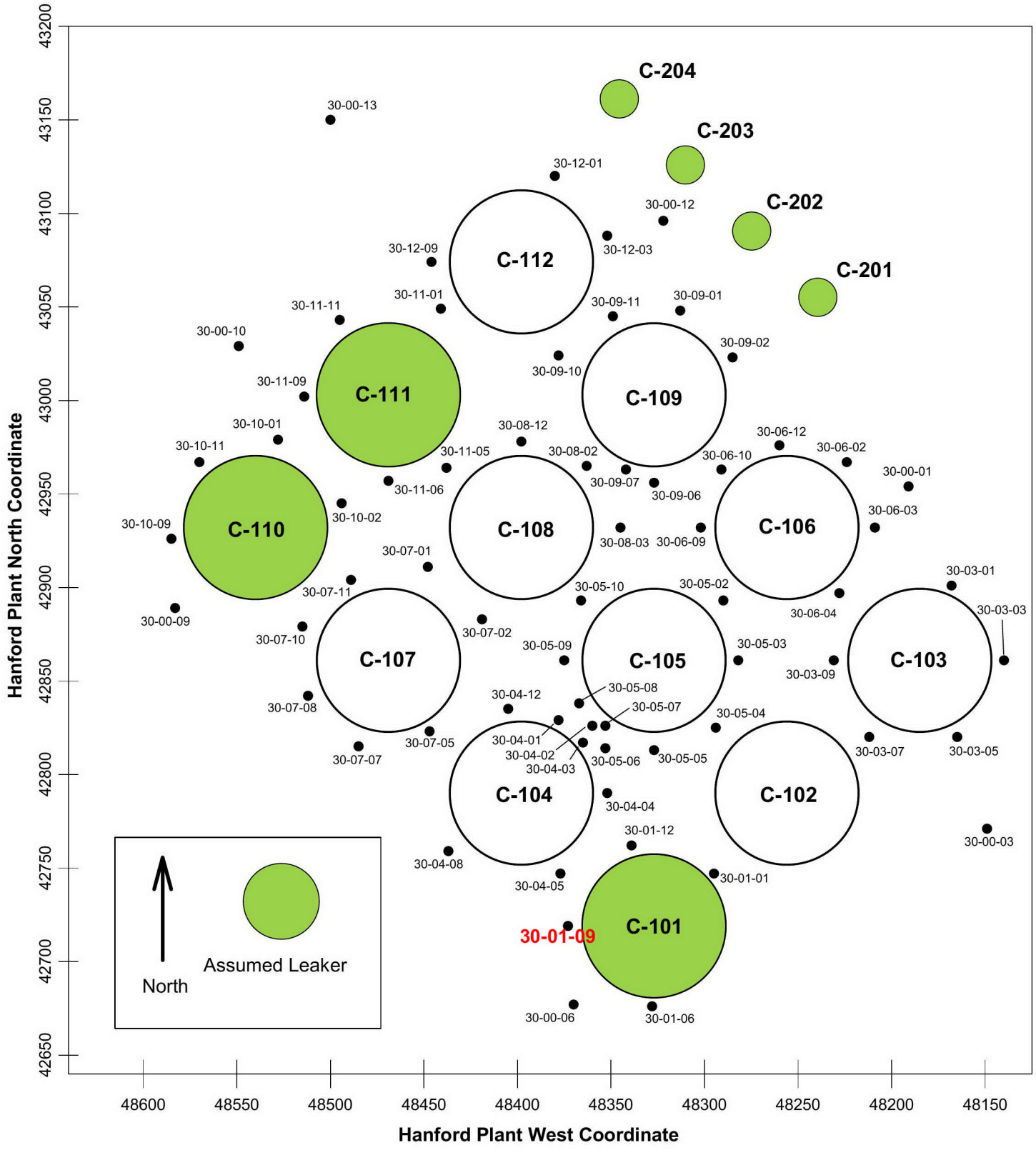
Borehole 30-01-09 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat of Manmade Radionuclides
Repeat Section of Natural Gamma Logs

[8] Neutron Moisture Logging System

References:

U.S. Department of Energy (DOE) 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-101* GJ-HAN-85 Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-01-09 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-01-09 (299-E27-58) (A6683)

Borehole Information

Site: C Farm, Tank C-101			
Coordinates (HAN Plant):	**North: 42719**	**West: 48373**	**Elevation (ft): 647.25**
Coordinates (WA Plane):	**North: 136503.898**	**East: 575148.092**	**Elevation (m): 198.395**
Drill Date: 4/30/1970	**Type: Cable Tool**	**Depth (ft): 97.5**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 4/22/03**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, HRLS: High-Rate Logging System, WA State Plane Coordinates are NAVD88			

Casing Information

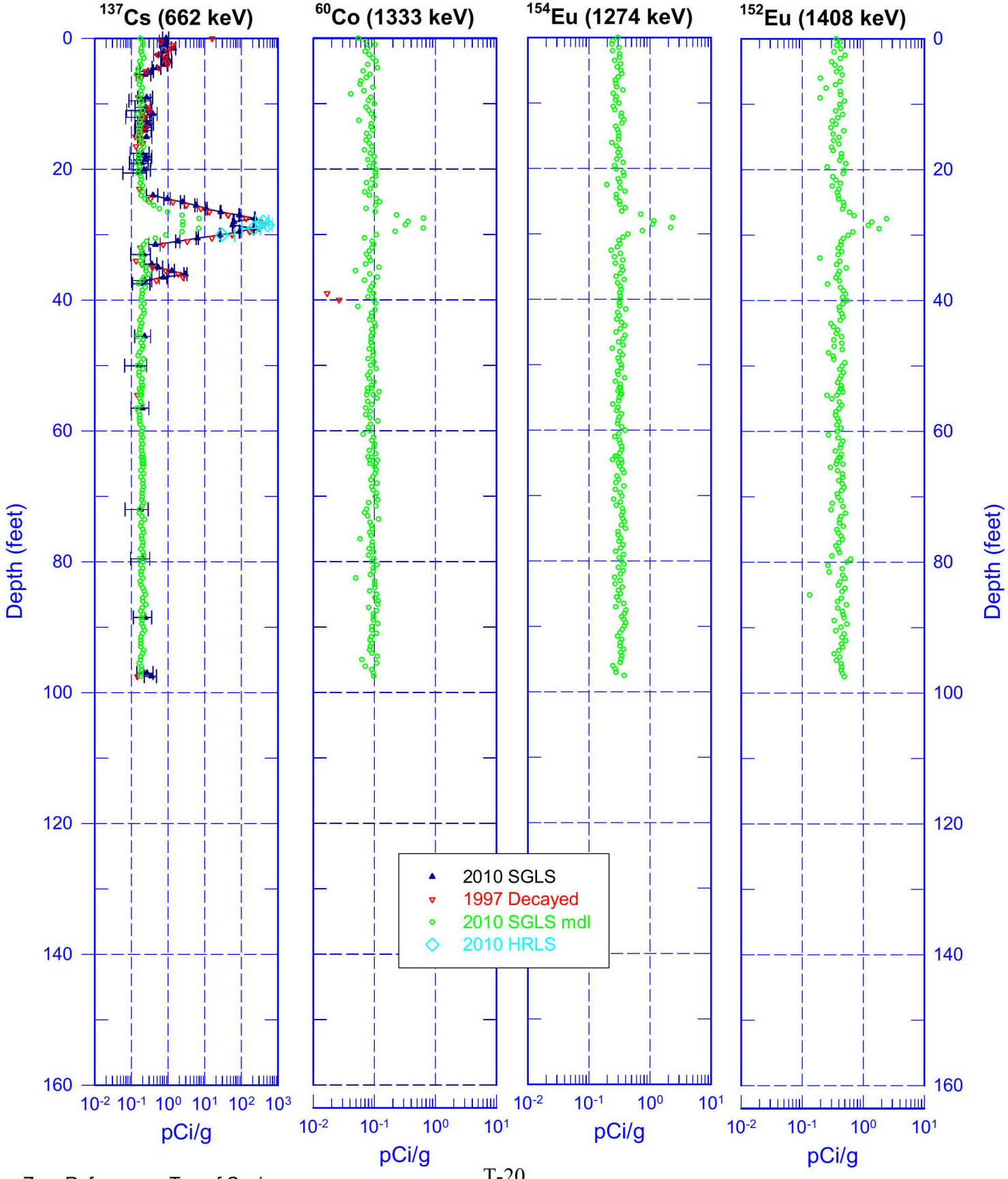
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
3/24/1997	SGLS	G2A	1	0-97.5	MACTEC-ERS	Baseline
4/24/2002	RAS	Large	A	35-70	MACTEC-ERS	No apparent change
4/25/2002	RAS	Medium	A	20-40	MACTEC-ERS	No apparent change
5/7/2003	RAS	Large-New	B	35-70	Stoller	No change, gain too high
5/7/2003	RAS	Medium	B	20-40	Stoller	No apparent change
11/16/2009	RAS	Medium	C	20-40	Stoller	No apparent change
11/23/2009	RAS	Large	C	0-97	Stoller	No apparent change
8/25/2010	HRLS	G2C	1	26-31	Stoller	High-rate baseline
8/31/2010	SGLS	G2BR	2	0-97.5	Stoller	No apparent change

30-01-09 (299-W27-58 [A6683])

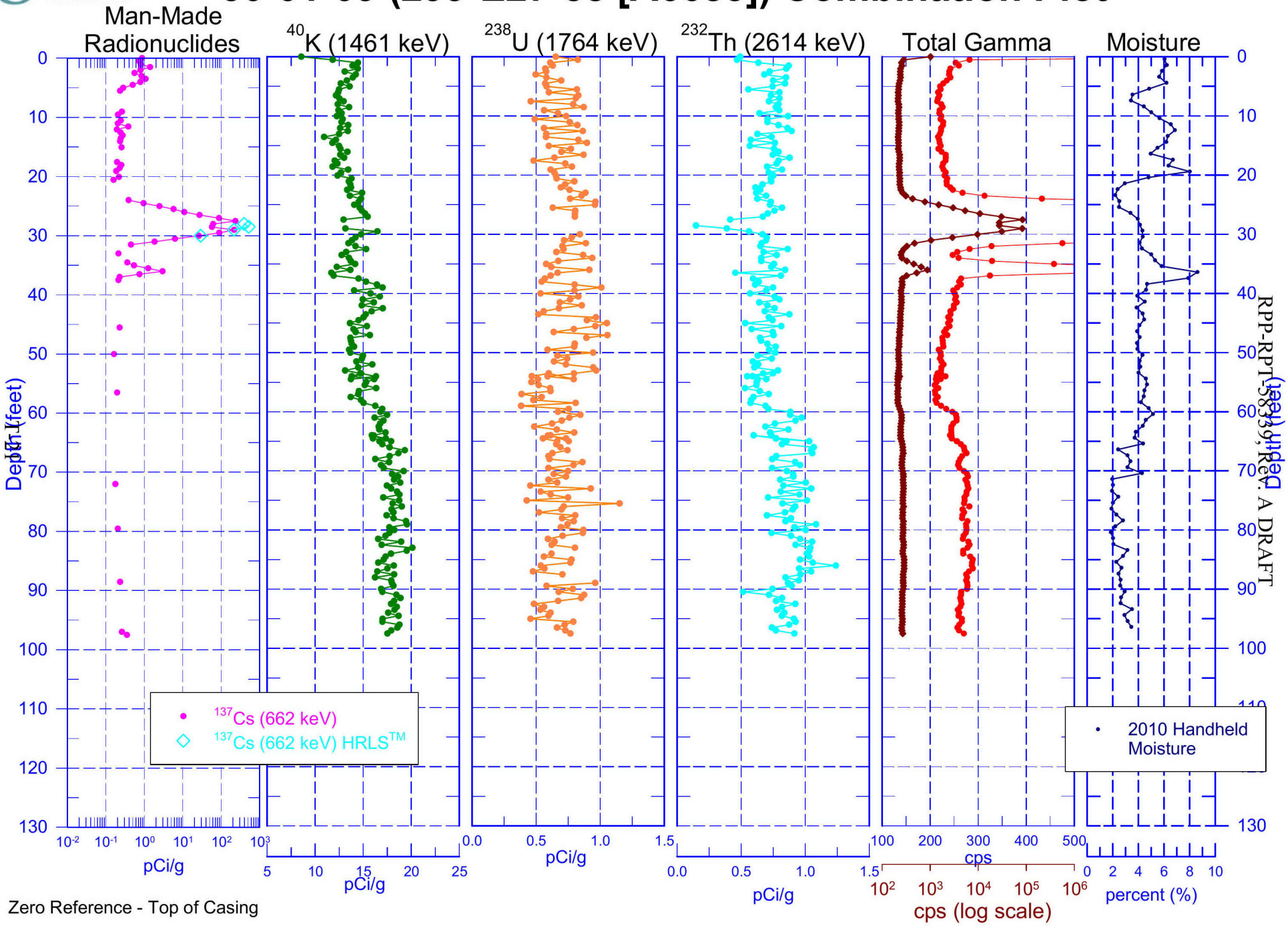
Comparison of Manmade Radionuclides (2010 & 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-01-09 (299-E27-58 [A6683]) Combination Plot

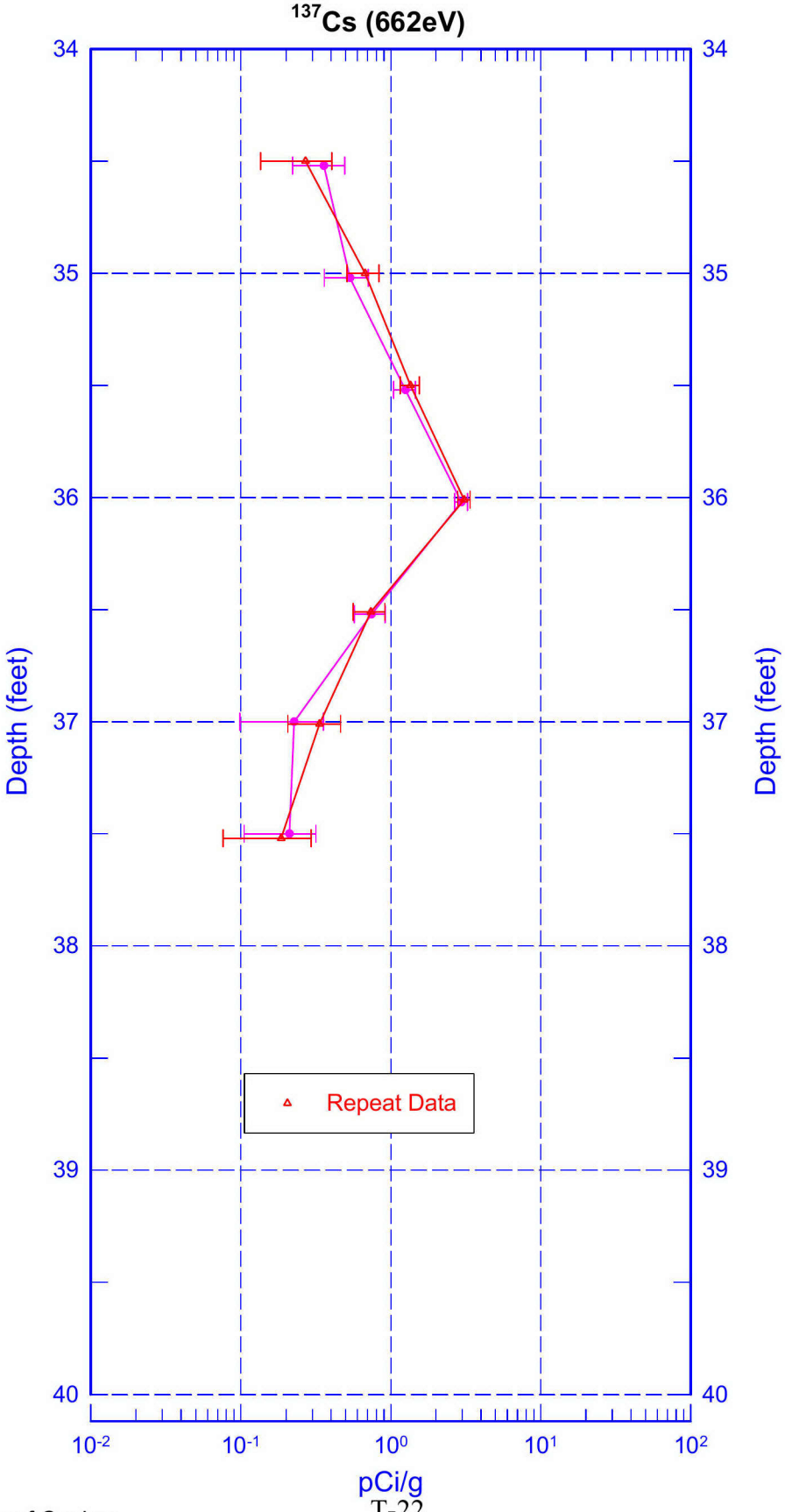


RPP-RPT-58339, Rev. A DRAFT (uncontrolled)

Stoller Hanford Office

30-01-09 (299-W27-58 [A6683])

Repeat of Manmade Radionuclides

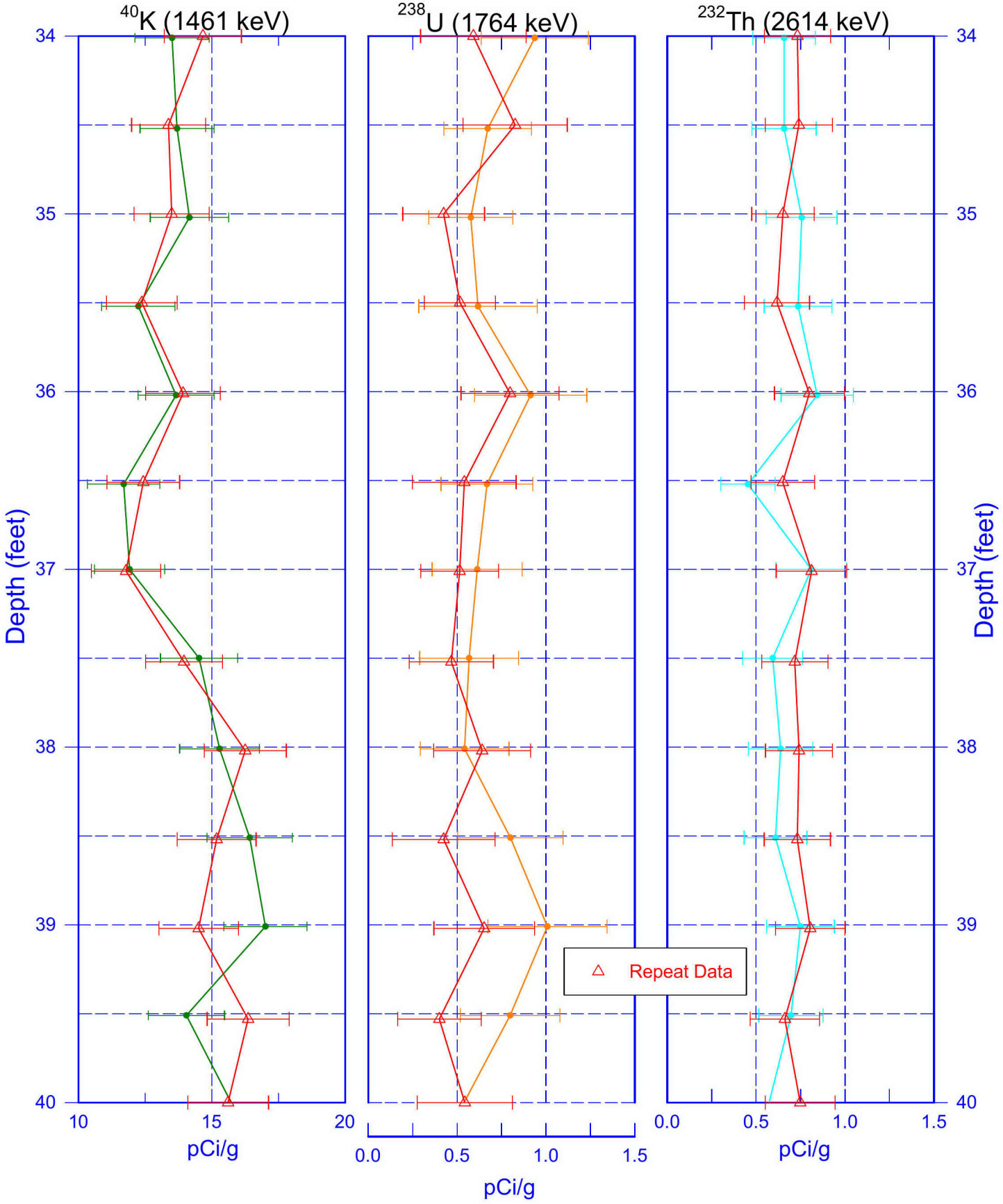


Zero Reference = Top of Casing

Stoller Hanford Office

30-01-09 (299-E27-58 [A6683])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-74 (A6699)

2010-2011 C-Farm Re-Baseline

30-03-01
299-E27-74 (A6699)
Log Data Report

Borehole Information:

Log Date:	2010-10-14	Filename:	A6699_HG_2010-10-14	Site:	241-C-103
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:	10/11/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	6/30/1974	N/A	124.5	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	unknown	6	0.280	0.0	125

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2010 was from 0 to 124.5 ft. The location of the borehole is indicated in the figure titled "Borehole 30-03-01 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1997 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-103* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

No water exists in the borehole casing.

The zero reference is the TOC, approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2 BR	Type:	DHMCA[5] SGLS
Effective Calibration Date:	09/22/10	Serial No.:	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

SGLS Log Run Information:

Log Run	1	2	3	4 Repeat	
HEIS Number	1016277	1016278	1016279	1016280	
Date	10/11/10	10/12/10	10/13/10	10/14/10	
Logging Engineer	Holloway/Spatz/ McClellan	Holloway/Spatz/ McClellan	Holloway/Spatz/ McClellan	Holloway/Spatz/ McClellan	
Start Depth (ft)	0.0	27.0	64.0	94.0	
Finish Depth (ft)	28.0	65.0	124.5	107.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	_B_101011	_B_101012	_B_101013	_B_101014	
Start File	_D_000000	_D_002700	_D_006400	_D_009400	
Finish File	_D_002800	_D_006500	_D_012450	_D_010700	
Post-Verification	_A_101011	_A_101012	_A_101013	_A_101014	
Depth Return Error (in.)	0.0	0.0	1/2 high	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

Logging Operation Notes:

Data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the table above due to the length of file names (for example, _D_000000 for RUN01_BR_1016277_D_000000).

Analysis Notes:

Analyst:	C. Nelson	Date:	9/15/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post survey verification measurements met the acceptance criteria for the established systems.

A casing correction for 0.280-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

[6] minimum detection level

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, 1997 data were reprocessed using a water correction from 124 ft to the total logged depth of the borehole and using the same casing correction as the 2010 data, no water correction was applied in 2010. The efficiency function and dead time corrections in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the 1997 Cs-137 and Co-60 concentrations were decayed to a common date of October 14, 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are still plotted.

Cs-137 was detected from ground surface to 84.5 ft, 96.5 ft, from 99.5 to 101.5 ft, and from 122 to 124.5 ft. A maximum concentration of approximately 287 pCi/g was measured at 1.5 ft. Comparisons with the 1997 data indicate no significant change except from 44 to 46 ft where there is a possible increase.

Co-60 was detected from 95 to 107 ft, 111.5 and 113.5 ft, and from 120.5 to 123.5 ft. A possible increase in Co-60 is indicated over the detected intervals but is not definitive. Additional monitoring of this interval in the future is recommended.

The repeat plots indicate that the system was working properly.

List of Log Plots:

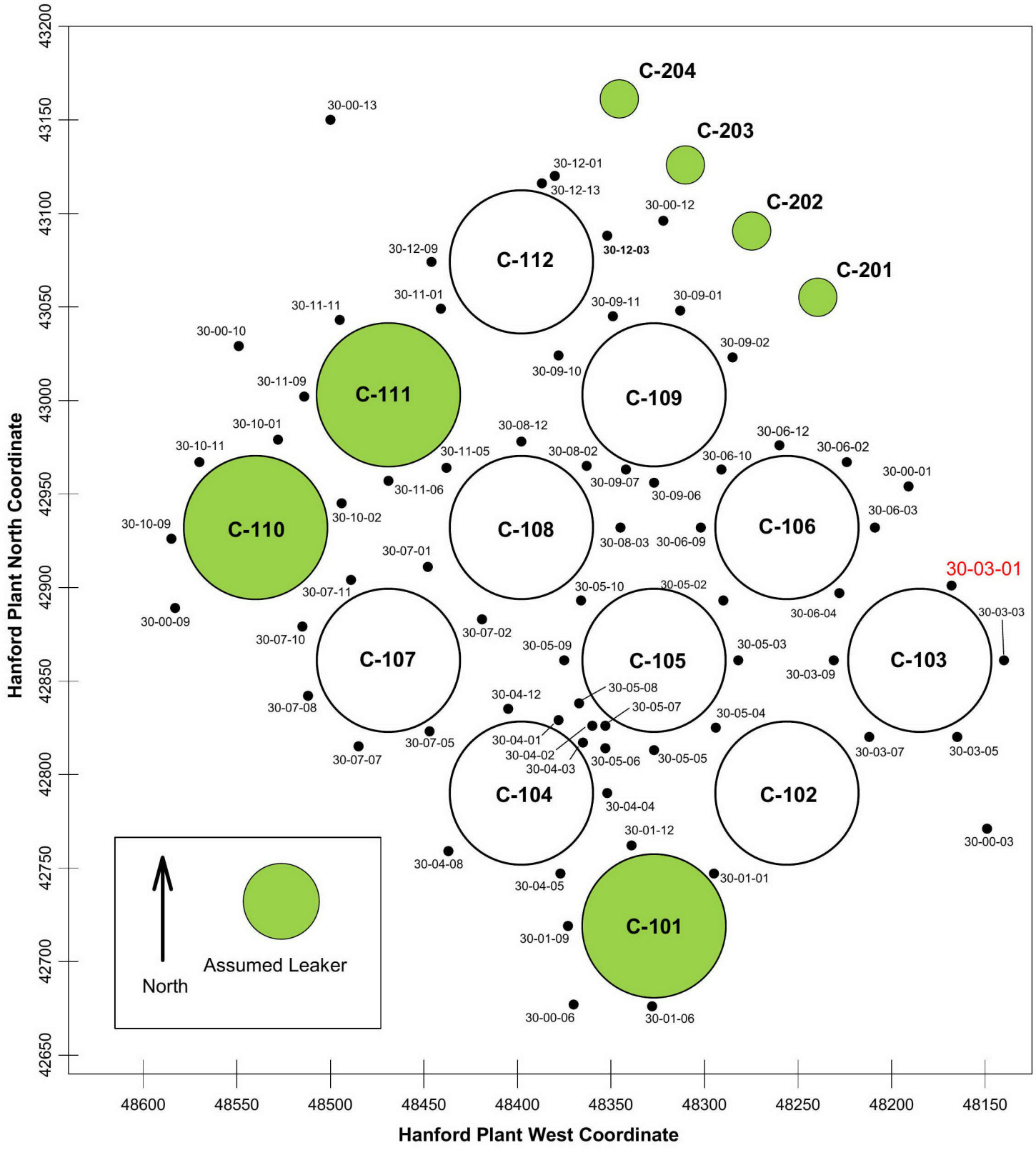
Depth Reference is ground surface

Borehole 30-03-01 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (1997 & 2010)
Combination Plot
Manmade Repeat Section
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-103.* GJ-HAN-82. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-03-01 Location in C Tank Farm



Stoller
Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-03-01 (299-E27-74) (A6699)

Borehole Information

Site: C Farm, Tank C-103			
Coordinates (HAN Plant):	**North: 42901**	**West: 48168**	**Elevation (ft): 645**
Coordinates (WA Plane):	**North: 136559.49**	**East: 575209.785**	**Elevation (m): 197.698**
Drill Date: 6/30/1974	**Type: Cable Tool**	**Depth (ft): 125**	**Depth Datum: TOC**
Depth/Water (ft): None	**D/W Date: 10/11/10**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, WA State Plane Coordinates are NAVD88			

Casing Information

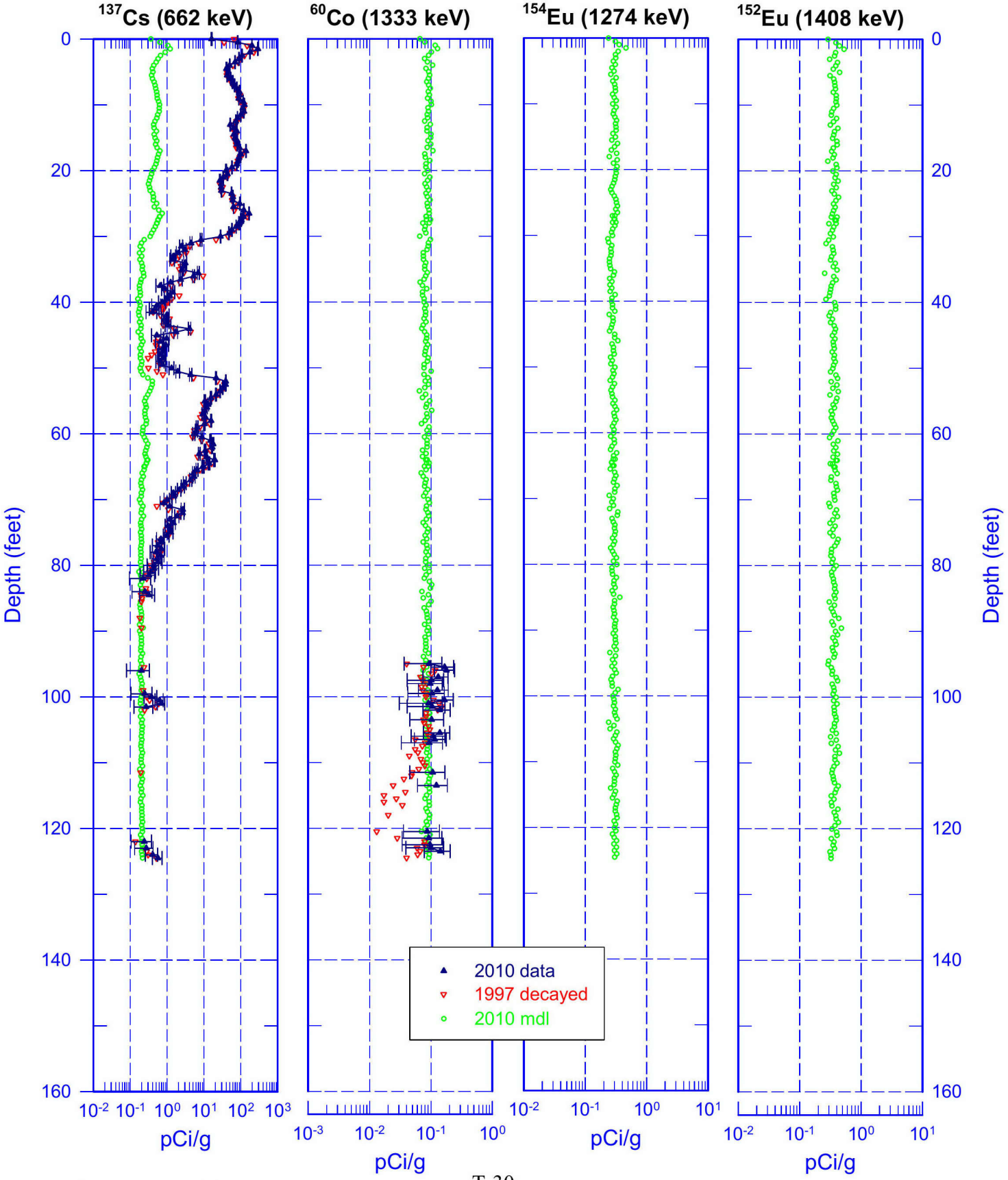
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	125	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
4/21/1997	SGLS	G1A	1	0-124.5	MACTEC-ERS	Baseline
9/29/2005	RAS	Large	A	0-124	Stoller	No Apparent Changes
4/17/2006	RAS	Large	B	0-124	Stoller	No Apparent Changes
2/1/2007	RAS	Large	C	0-124	Stoller	No Apparent Changes
10/14/2010	SGLS	G2BR	2	0-124.5	Stoller	No Apparent Changes

30-03-01 (299-E27-74 [A6699])

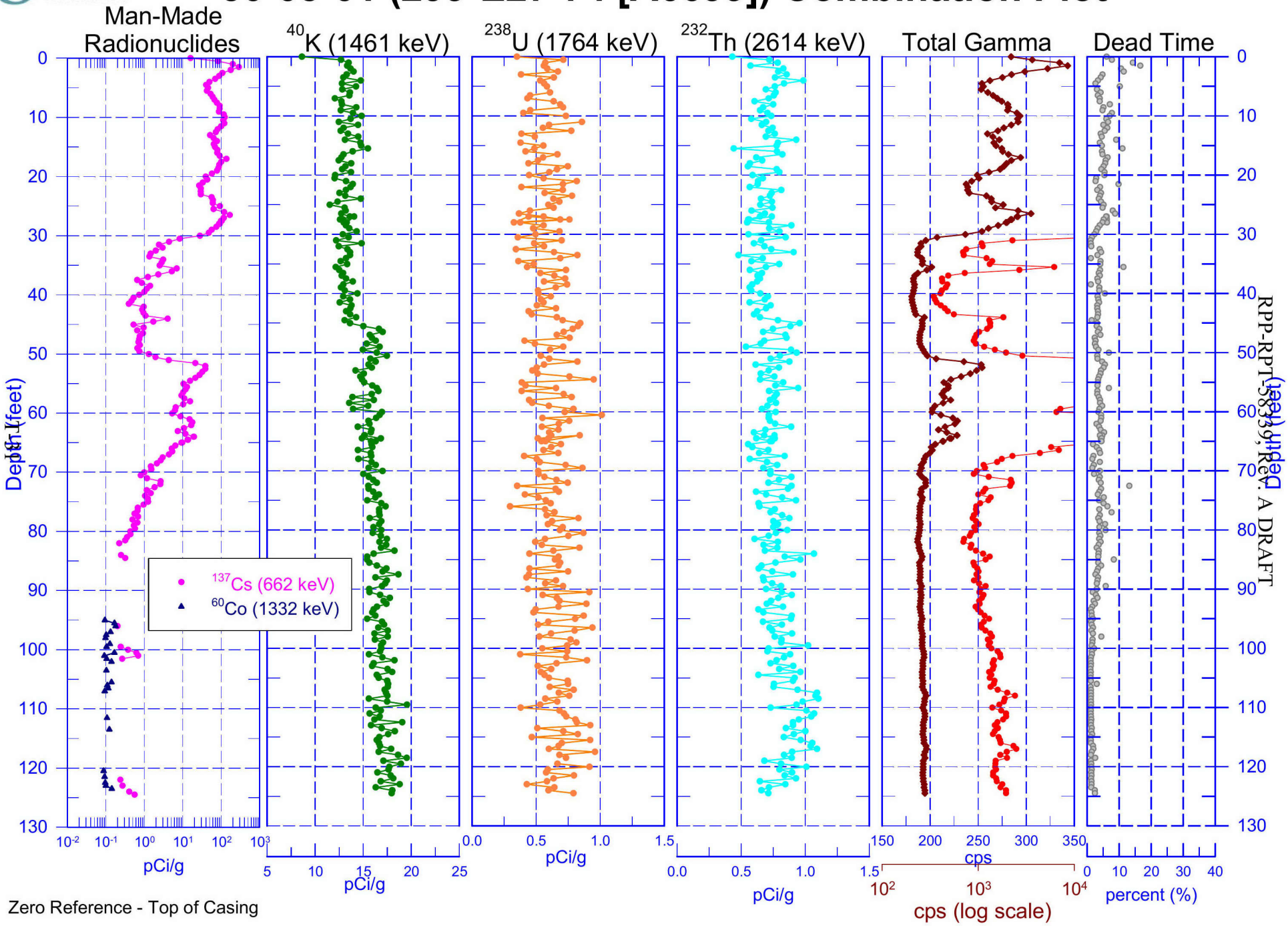
Comparison of Manmade Radionuclides (1997 & 2010)



Zero Reference - Top of Casing

Stoller
Hanford Office

30-03-01 (299-E27-74 [A6699]) Combination Plot

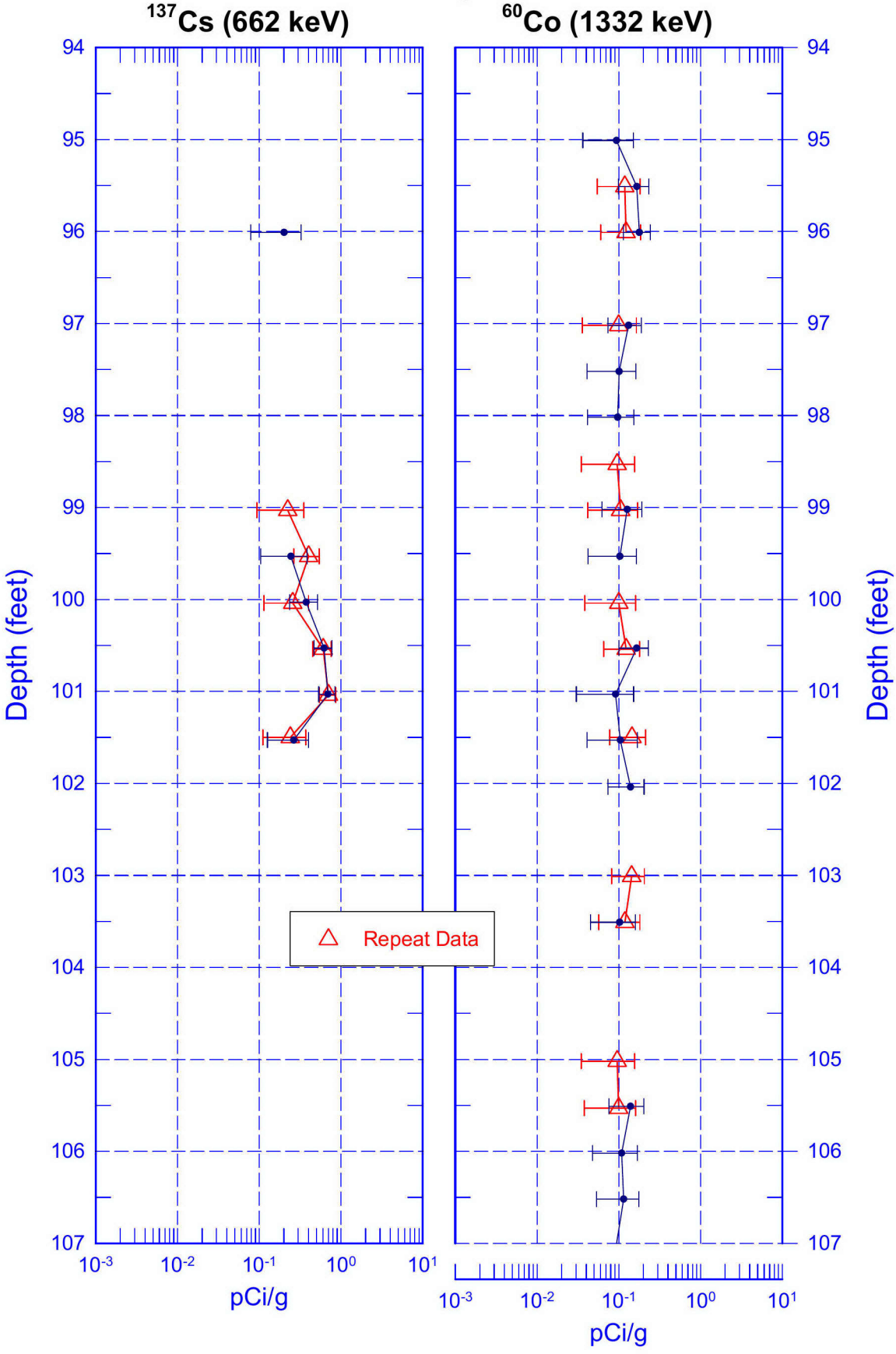


RPP-RPT-58339, Rev. A DRAFT (unpublished)

Stoller Hanford Office

30-03-01 (299-E27-74 [A6699])

Manmade Repeat Section

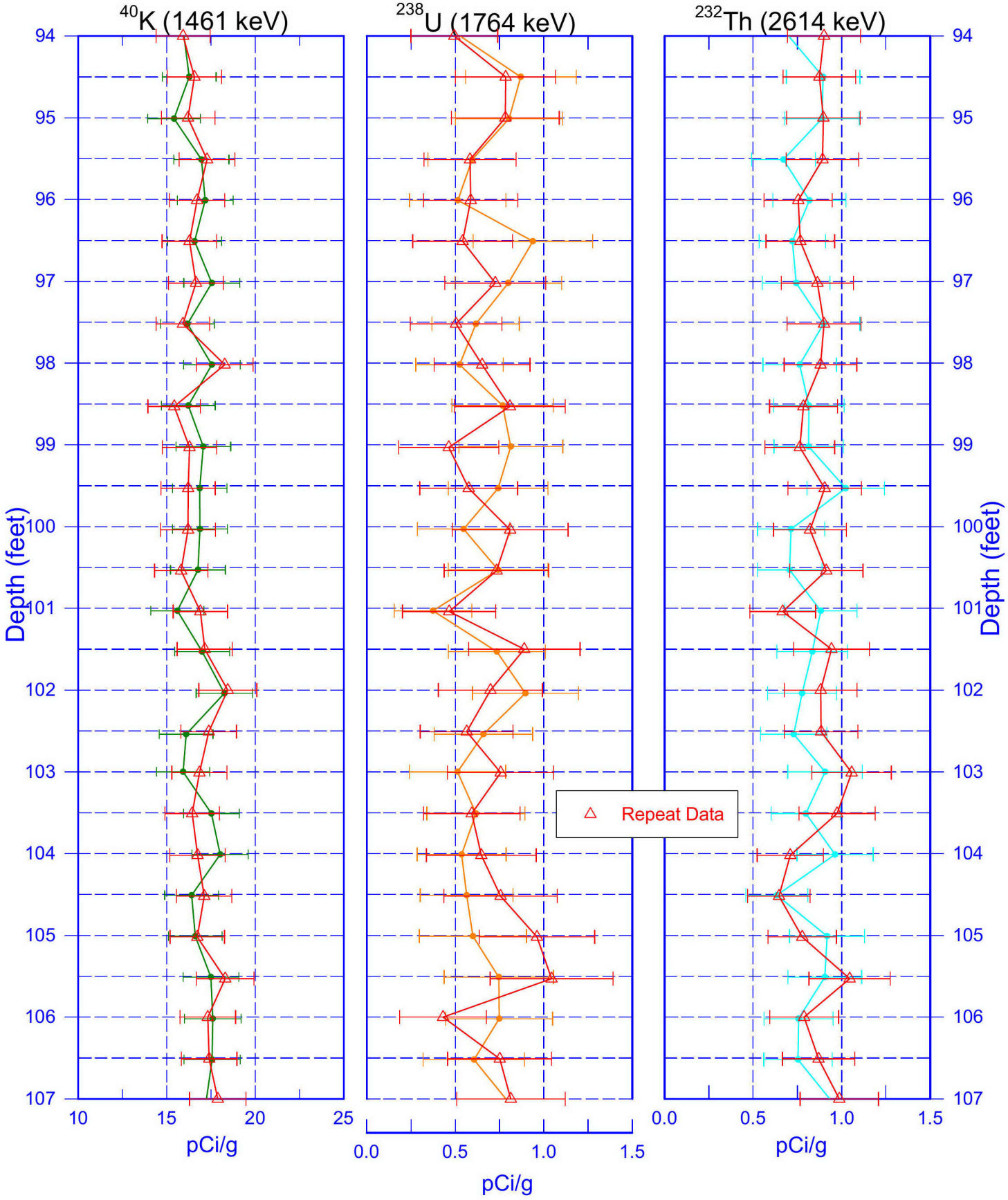


Zero Reference - Top of Casing

Stoller Hanford Office

30-03-01 (299-E27-74 [A6699])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-75 (A6700)

2010-2011 C-Farm Re-Baseline

30-03-03
299-E27-75 (A6700)
Log Data Report

Borehole Information:

Log Date:	2010-10-20	Filename:	A6700_HG_2010-10-20	Site:	241-C-103	
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:		10/11/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)		Type
N/A	N/A	7/31/1974	N/A	100		Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	unknown	6	0.280	0.0	100

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2010 was from 0 to 74 feet just above the level of water inside the borehole casing. Other water levels observed during past logging events are included below. The location of the borehole is indicated in the figure entitled "Borehole 30-03-03 Location in C Tank Farm" plot.

Date	Depth to Borehole Water (ft)
2/18/94	Dry
3/4/94	Dry
4/14/97	18.75
10/4/05	72.35
4/17/06	68.0
1/31/07	68.92
6/20/07	69.4
10/11/10	74.1

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1994 is included in the figure entitled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet".

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-103* (DOE 1998). Casing thicknesses are derived from published values for schedule 40 steel pipe.

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System

The zero reference is the top of casing, approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[5] SGLS BR
Effective Calibration Date:	09/22/10	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Handheld Moisture Meter # MI-HP-3	**Type:**	Model # 503DR Campbell Pacific Nuclear Moisture Gauge
Effective Calibration Date:	6/21/10	**Serial No.:**	H-38068291
Calibration Reference:	HGLP-CC-039, Rev. 1	**Logging Procedure:**	N/A

SGLS Log Run Information:

Log Run	**1**	**2**	**3**	**4 Repeat**	
HEIS Number	1016281	1016282	1016283	1016284	
Date	10/18/10	10/19/10	10/20/10	10/20/10	
Logging Engineer	Spatz/Holloway/ McClellan	Spatz/Holloway/ McClellan	Spatz/Holloway/ McClellan	Spatz/Holloway/ McClellan	
Start Depth (ft)	0.0	4.0	59.0	35.0	
Finish Depth (ft)	5.0	60.0	74.0	45.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	_B_101018	_B_101019	_B_101020	_B_101020	
Start File	_D_000000	_D_000400	_D_005900	_D_003500	
Finish File	_D_000500	_D_006000	_D_007400	_D_004500	
Post-Verification	_A_101018	_A_101019	_A_101020	_A_101020	
Depth Return Error (in.)	0.0	1/2 low	N/A	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above due to the length of file names (For example RUN01_BR_1016281_D_000051).

Analysis Notes:

Analyst:	C. Nelson	**Date:**	6/30/11	**Reference:**	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Casing corrections for a 0.28-in. thick casing were applied during analysis.

[5] Down-Hole Multi-Channel Analyzer

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the1997 data were reprocessed using a water correction from 19 ft to the total logged depth of the borehole and using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 and Co-60 were decayed to a common date of October 20, 2010.

SGLS logging is conducted by S.M. Stoller, as is logging with the NMLS[7]. NMLS data are acquired digitally at 0.25-ft intervals with a count time of 15 seconds. Where available, the most recent NMLS data are reported in the re-baseline log data reports. Tank Farm's handheld moisture data are acquired by Tank Farms Operations using a handheld moisture gauge that is lowered by hand and held in place for measurements by cable stops at 1-ft increments, at count times of 16 seconds. These data are manually recorded on data sheets, and submitted to S.M. Stoller for data entry and analysis. Calibration for both systems to assess system performance and determine volumetric moisture is performed by S.M. Stoller using the same procedure. Handheld moisture data are being collected for selected boreholes in C Farm. NMLS data are not available for this borehole. Handheld moisture data were acquired in this borehole on December 3, 2010 using moisture gauge M1-HP-3 and AmBe source H-38068291. Results are included in this report.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted. There are no data in 2010 to compare to detections in 1997 from 85 ft to 98 ft. Logging depth achieved in 2010 was 74 ft, due to not being able to log into water in accordance with current radiation control protocol.

Cs-137 was detected in this borehole. Cs-137 was detected continuously from ground surface to 39.5 ft and intermittently from 53 to 73 ft, with a maximum concentration of approximately 151 pCi/g at 7 ft. No significant changes have occurred since 1997. Detections of Cs-137 from 45 to 74 ft in 2010 are interpreted to be the result of the enhanced detection system rather than migration of contaminants.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. Moisture data were aquired from the interval of ground surface to 96.4 ft (the moisture gauge appears to have been below water level for approximately 22 ft from 74.4 to 96.4 ft).

[6] minimum detection level
[7] Neutron Moisture Logging System

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

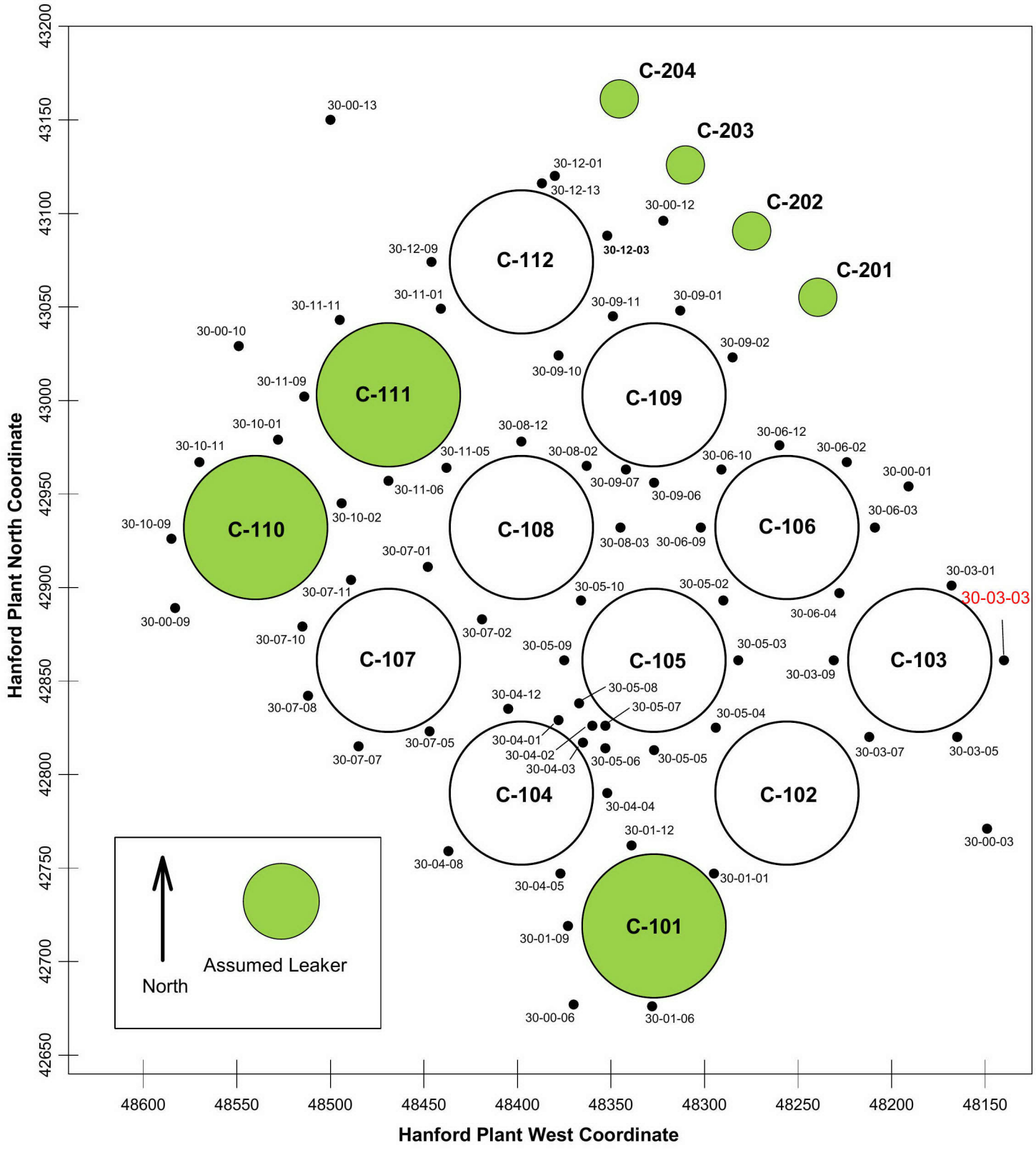
Depth Reference is top of casing

Borehole 30-03-03 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy (DOE) 1998. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-103* GJ-HAN-82 Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-03-03 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-03-03 (299-E27-75) (A6700)

Borehole Information

Site: C Farm, Tank C-103			
Coordinates (HAN Plant):	**North: 42861**	**West: 48140**	**Elevation (ft): 645**
Coordinates (WA Plane):	**North: 136547.362**	**East: 575218.104**	**Elevation (m): 197.602**
Drill Date: 7/31/1974	**Type: Cable Tool**	**Depth (ft): 100**	**Depth Datum: TOC**
Depth/Water (ft): 69.4	**D/W Date: 6/20/07**	**D/W Reference: Stoller**	
Comments: RLS: Radionuclide Logging System, SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System			

Casing Information

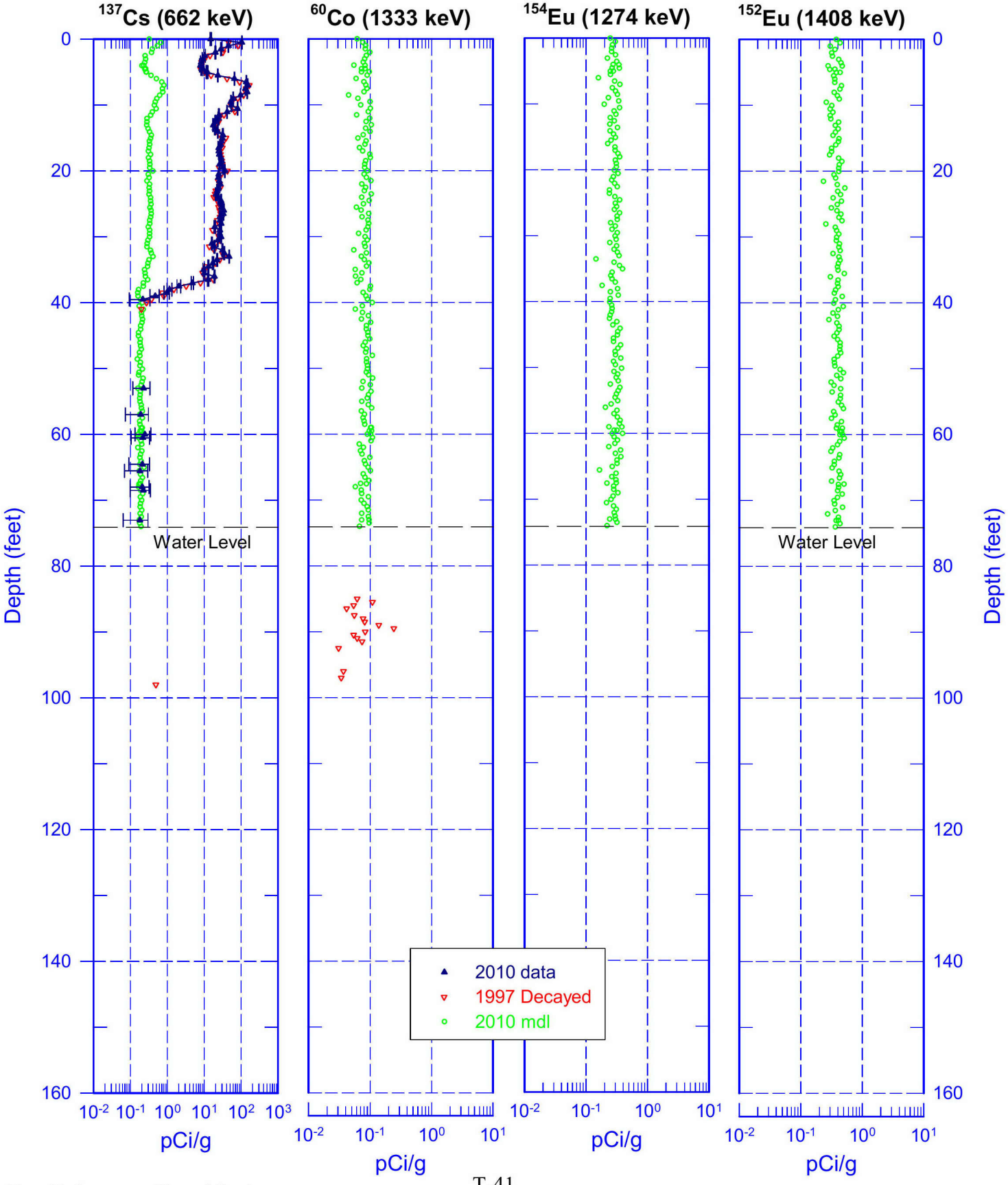
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
2/18/1994	RLS	RLS	NA	0-94.5	WHC	C-103 Invest.
3/4/1994	RLS	NaI	NA	0-92	WHC	C-103 Invest.
4/14/1997	SGLS	G2A	1	0-98	MACTEC-ERS	Baseline
10/16/2005	RAS	Large	A	0-97	Stoller	No Apparent Change
4/17/2006	RAS	Large	B	0-97	Stoller	No Apparent Change
1/31/2007	RAS	Large	C	0-97	Stoller	No Apparent Change
6/20/2007	RAS	Large	D	30-97	Stoller	No Apparent Change
10/20/2010	SGLS	G2BR	2	0-74	Stoller	No Apparent Change

30-03-03 (299-E27-75 [A6700])

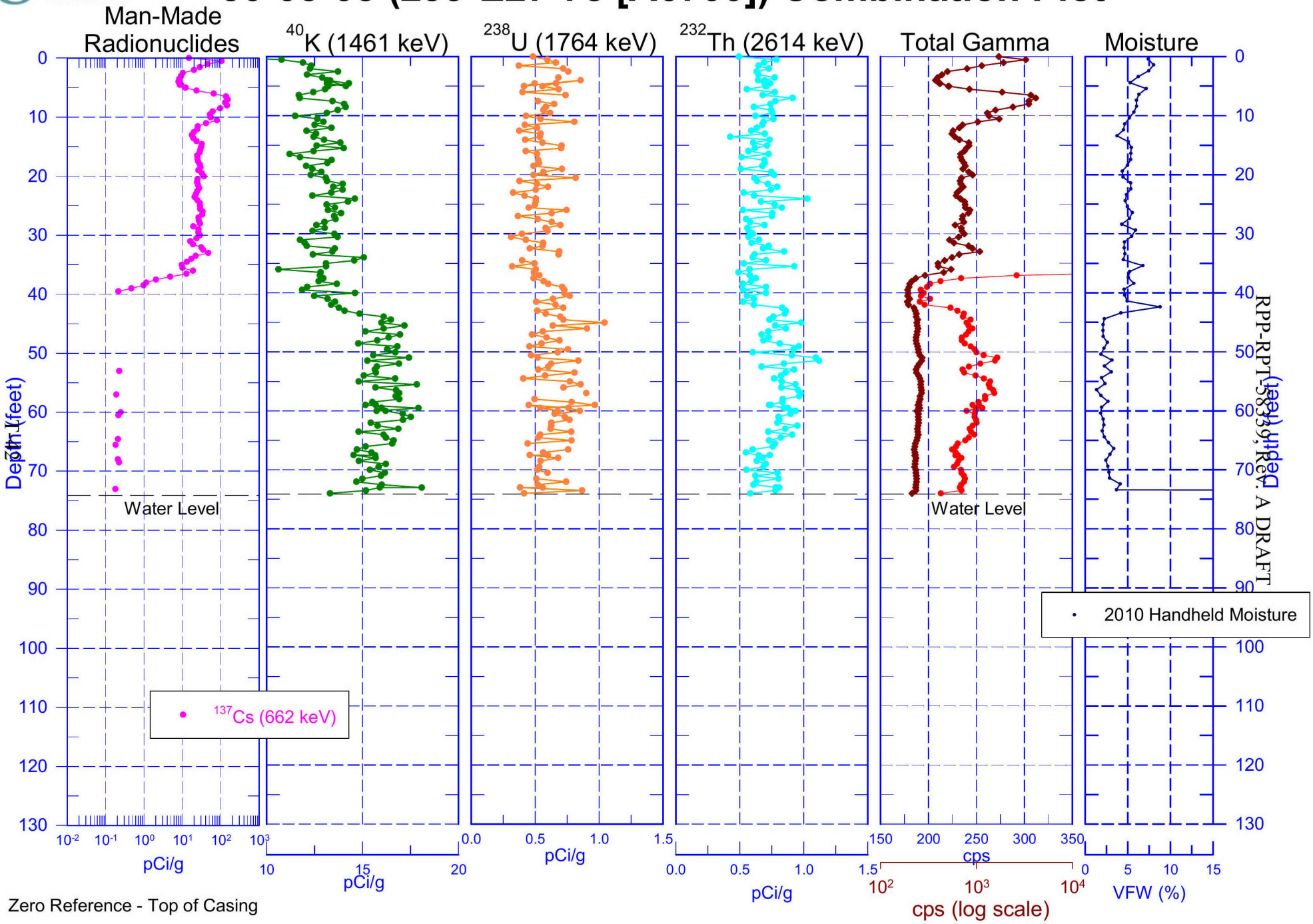
Comparison of Manmade Radionuclides (2010 &1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-03-03 (299-E27-75 [A6700]) Combination Plot

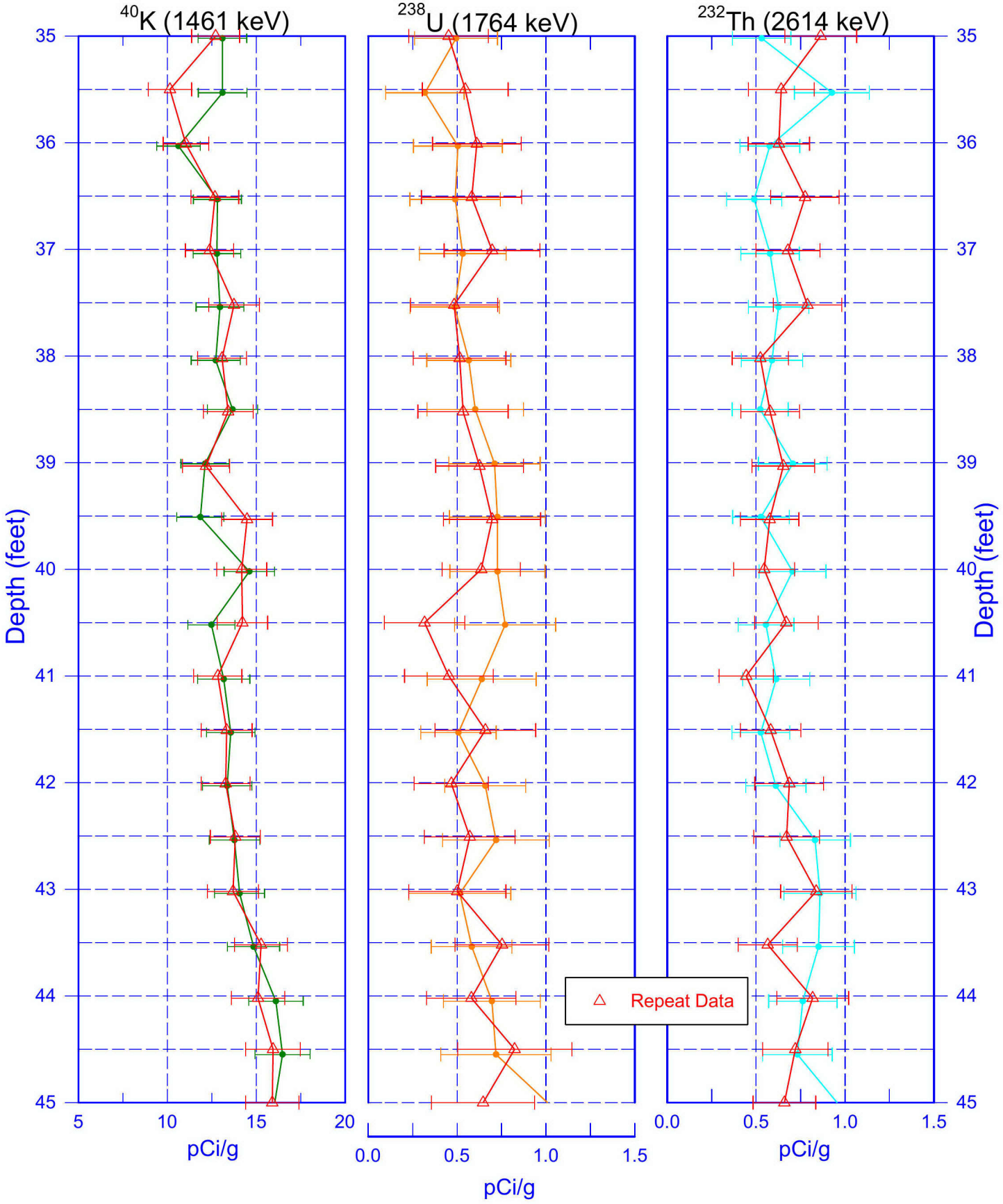


RPP-RPT-58339, Rev. A DRAFT (uncontrolled)

Stoller Hanford Office

30-03-03 (299-E27-75 [A6700])

Repeat Section of Natural Gamma Logs

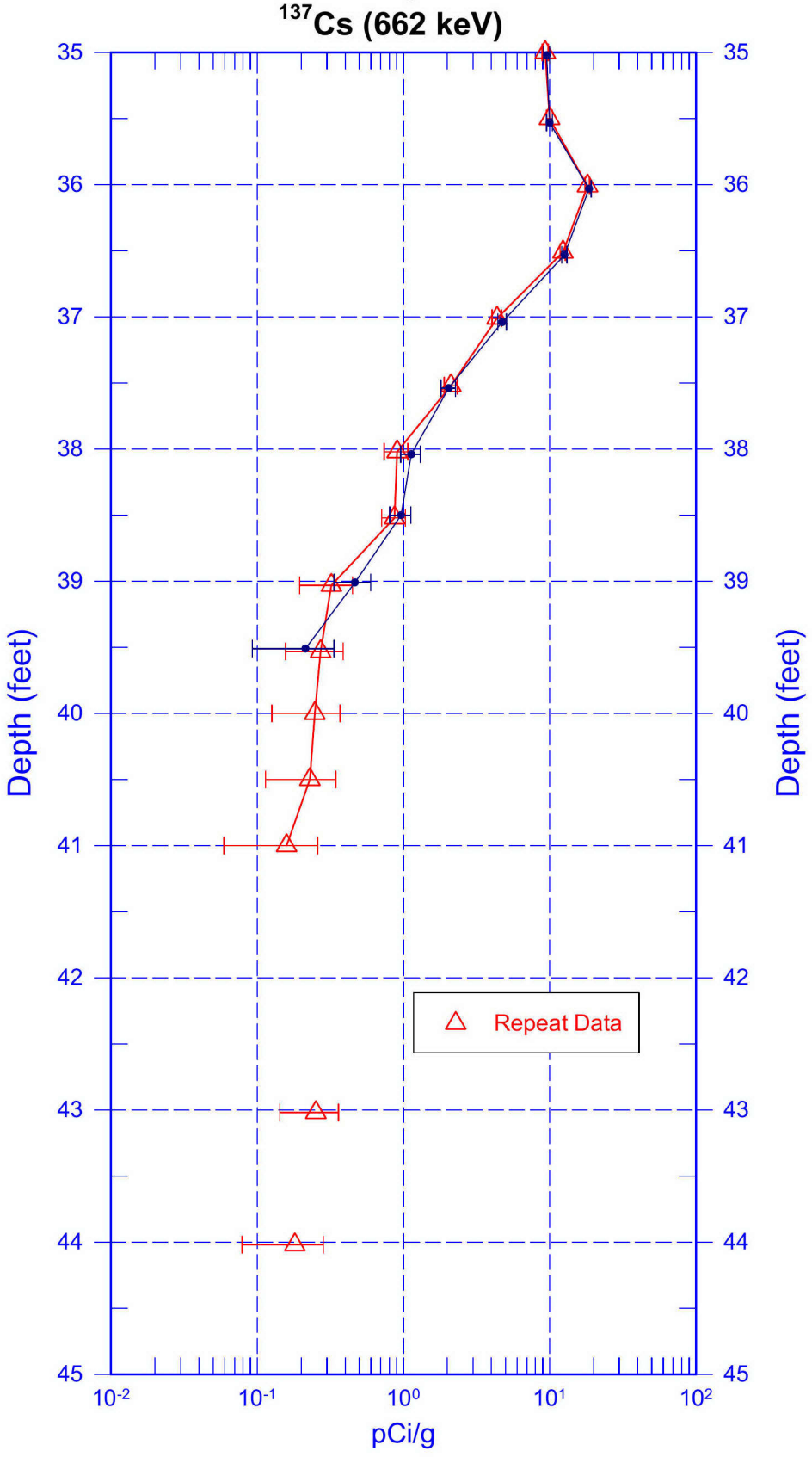


Zero Reference - Top of Casing

Stoller Hanford Office

30-03-03 (299-E27-75 [A6700])

Manmade Repeat Section



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-76 (A6701)

2010-2011 C-Farm Re-Baseline

30-03-05
299-E27-76 (A6701)
Log Data Report

Borehole Information:

Log Date:	2010-11-01	Filename:	A6701_HG_2010-11-01	Site:	241-C-103	
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:		10/27/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)		Type
N/A	N/A	7/31/1974	N/A	100		Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	unknown	6	0.280	0.0	100

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2010 was from 0 to 99.5 ft. The location of the borehole is indicated in the figure titled "Borehole 30-03-05 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997, 2009, and 2010. A summary of other logging data acquired since 1997 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-103* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

No water exists in the borehole casing.

The zero reference is the TOC, approximately at ground surface.

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[5] SGLS
Effective Calibration Date:	09/22/10	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	**1**	**2**	**3**	**4 Repeat**	
HEIS Number	1016293	1016294	1016295	1016296	
Date	10/27/10	10/28/10	11/1/10	11/1/10	
Logging Engineer	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway	
Start Depth (ft)	0.0	14.0	77.0	38.0	
Finish Depth (ft)	15.0	78.0	99.5	48.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	_B_101027	_B_101028	_B_101101	_B_101101	
Start File	_D_000000	_D_001400	_D_007700	_D_003800	
Finish File	_D_001501	_D_007800	_D_009953	_D_004801	
Post-Verification	_A_101027	_A_101028	_A_101101	_A_101101	
Depth Return Error (in.)	0.0	0.0	N/A	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

Logging Operation Notes:

Data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the table above due to the length of file names (for example, _D_000000 for RUN01_BR_1016293_D_000000).

Analysis Notes:

Analyst:	C. Nelson	**Date:**	9/29/11	**Reference:**	HGLP-MAN-003, Rev. 0

[5] Down-Hole Multi-Channel Analyzer

Pre- and post-survey verification measurements met the acceptance criteria for the established system.

A casing correction for 0.280-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, 1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time corrections in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the 1997 and 2009 Cs-137 concentrations were decayed to a common date of November 1, 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are still plotted.

Cs-137 was detected from ground surface to 28.5 ft, intermittently from 29.5 to 32.5, continuously from 35 to 44.5 ft, 54 to 75.5 ft, intermittently from 80.5 to 88.5 and continuously from 95.5 to 99.5 ft. A maximum concentration of approximately 35 pCi/g was measured at 0.5 ft. Comparisons of the 1997 and 2009 data with 2010 data indicate no significant change.

Total gamma data acquired using the RAS[7] on February 2, 2007 had idicated slight, anomalous increases in the gamma count rate between 45 and 50 ft and from 60 to 100 ft. The increases were repeated during a second RAS event on February 22, 2007. A third RAS monitoring event on June 20, 2007 exhibited a reversion to the pre-retrieval baseline character of the total gamma profile over both depth intervals. The 2009 and 2010 Cs-137 data generally match what was detected in 1997. The 2009 and 2010 concentrations appear slightly higher from 42 to 44 ft and 95.5 to 96.5 ft but are within measurement uncertainties. Therefore, there is no evidence of changes in the Cs-137 concentrations in these intervals, or elsewhere. No new gamma-emitting contaminants are observed in 2009 and 2010. It is concluded, therefore, that the anomalous increases in February 2007 were not the result of changes in the contamination profile of the borehole, but were more likely the result of a systematic effect in the monitoring system (electronic) or radon in the borehole.

The repeat plots indicate that the system was working properly.

[6] minimum detection level
[7] Radionuclide Assessment System

List of Log Plots:

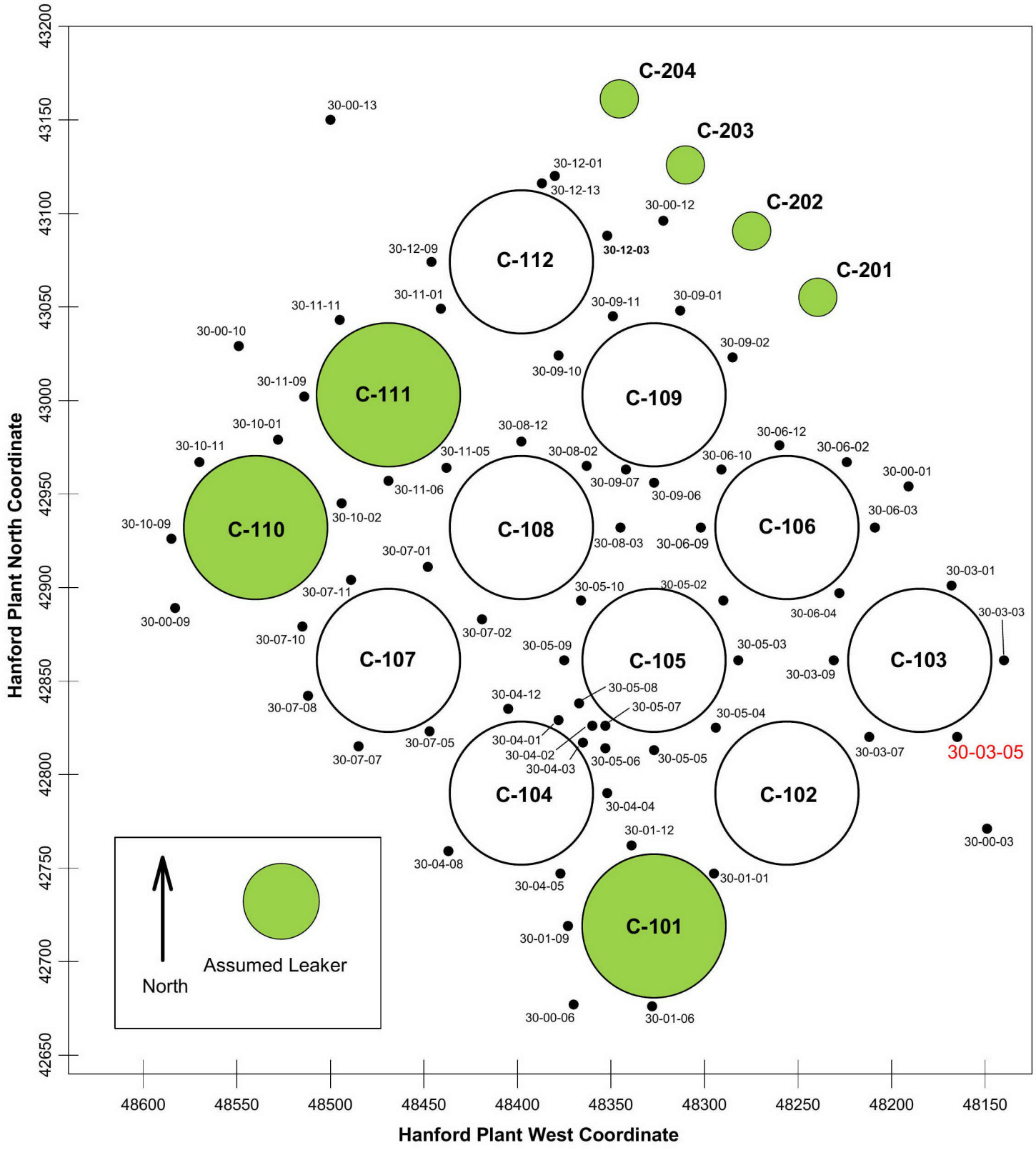
Depth Reference is ground surface

Borehole 30-03-05 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (1997, 2009 & 2010)
Combination Plot
Manmade Repeat Section
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy (DOE) 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-103* GJ-HAN-82 Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-03-05 Location in C Tank Farm



Stoller

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-03-05 (299-E27-76) (A6701)

Borehole Information

Site: C Farm, Tank C-103			
Coordinates (HAN Plant):	**North: 42820**	**West: 48165**	**Elevation (ft): Unk**
Coordinates (WA Plane):	**North: 136534.821**	**East: 575210.558**	**Elevation (m): 197.825**
Drill Date: 7/31/1974	**Type: Cable Tool**	**Depth (ft): 100**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 10/27/10**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, WA State Plane Coordinates are NAVD88			

Casing Information

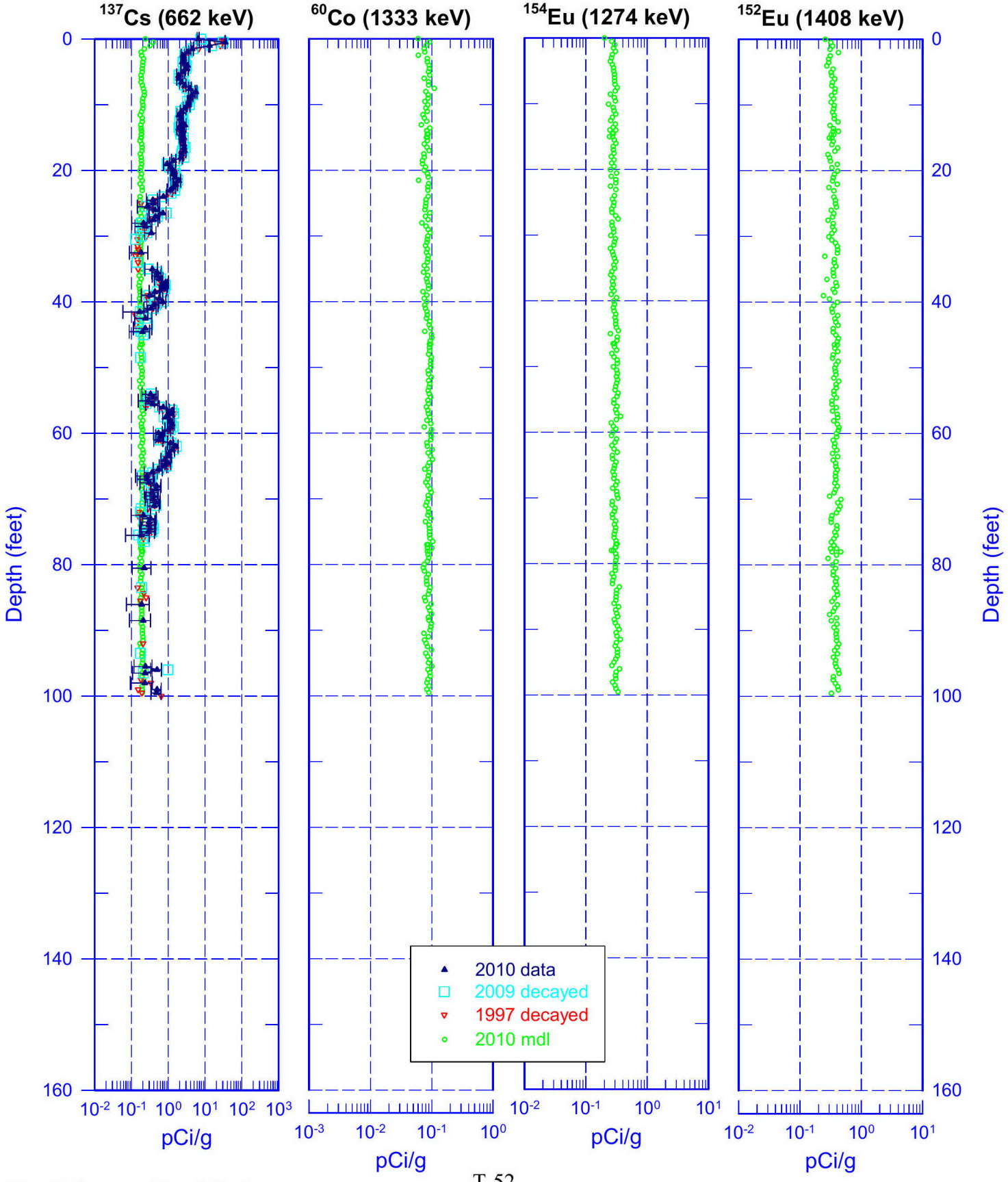
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
4/14/1997	SGLS	G1A	1	0-100	MACTEC-ERS	Baseline
9/11/2002	RAS	Large	A	30-80	Stoller	No Change
10/16/2005	RAS	Large	B	0-96	Stoller	No Change
2/2/2007	RAS	Large	C	0-100	Stoller	Suspicious increase (62-97 ft)
2/22/2007	RAS	Large	D	0-98	Stoller	Increases are repeatable
6/20/2007	RAS	Large	E	30-98	Stoller	No Change, baseline levels
3/17/2009	SGLS	G4N	2	0-97.5	Stoller	No Change, baseline levels
11/1/2010	SGLS	G2BR	3	0-100	Stoller	No Change, baseline levels

30-03-05 (299-E27-76 [A6701])

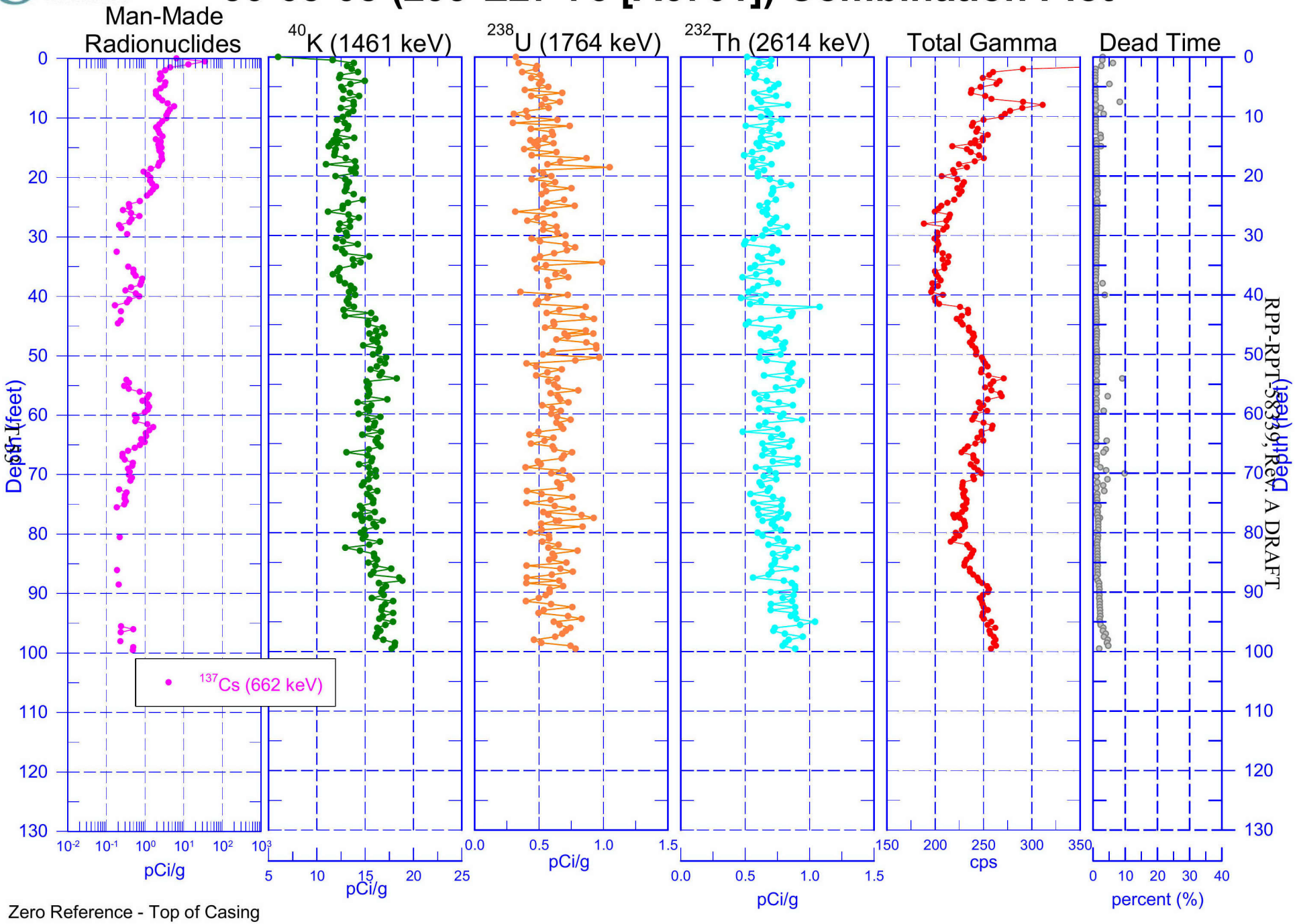
Comparison of Manmade Radionuclides (1997, 2009 & 2010)



Zero Reference - Top of Casing

Stoller
Hanford Office

30-03-05 (299-E27-76 [A6701]) Combination Plot

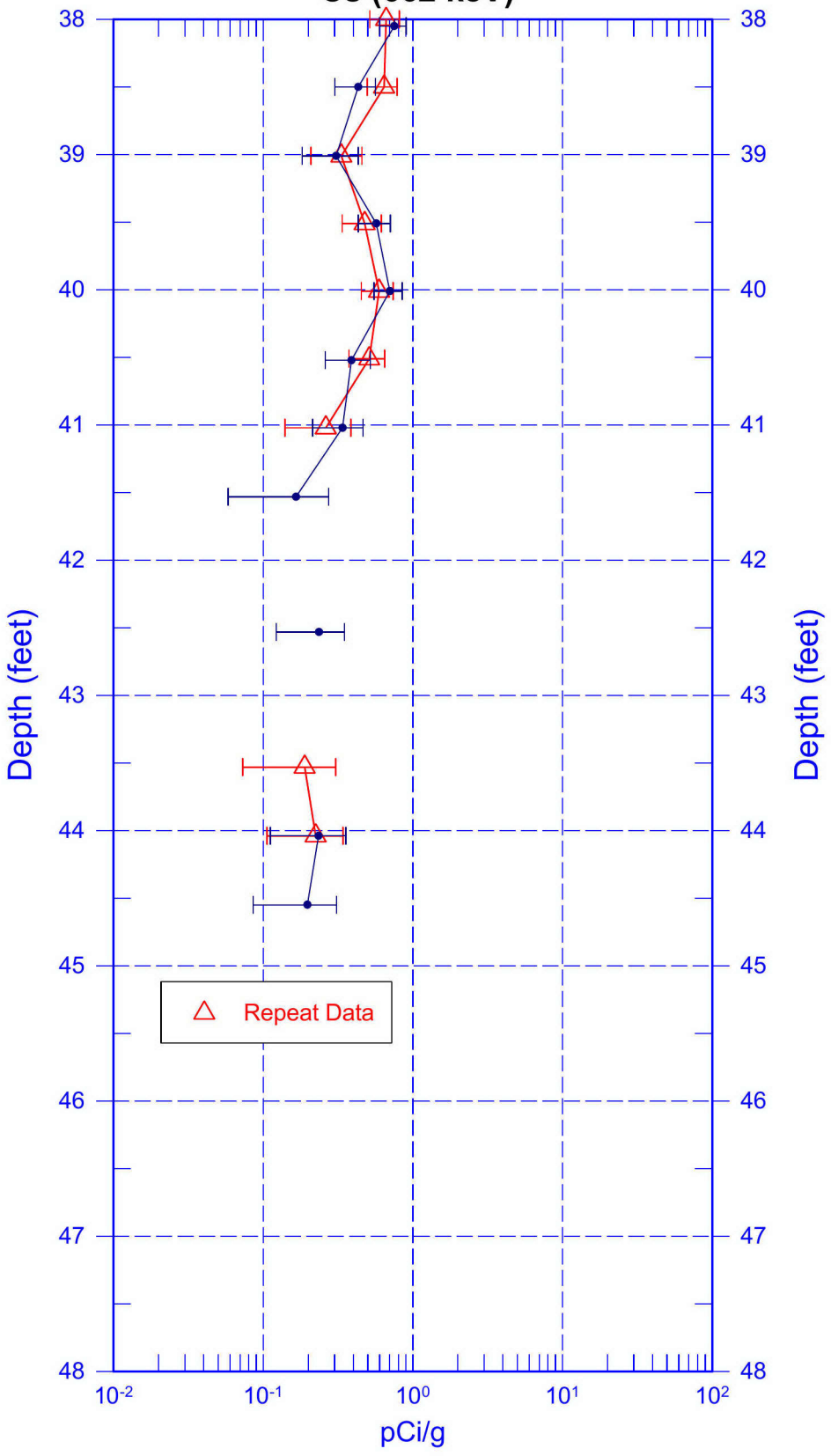


RPP-RPT-58339, Rev. A DRAFT (uncontrolled)

30-03-05 (299-E27-76 [A6701])

Manmade Repeat Section

^{137}Cs (662 keV)

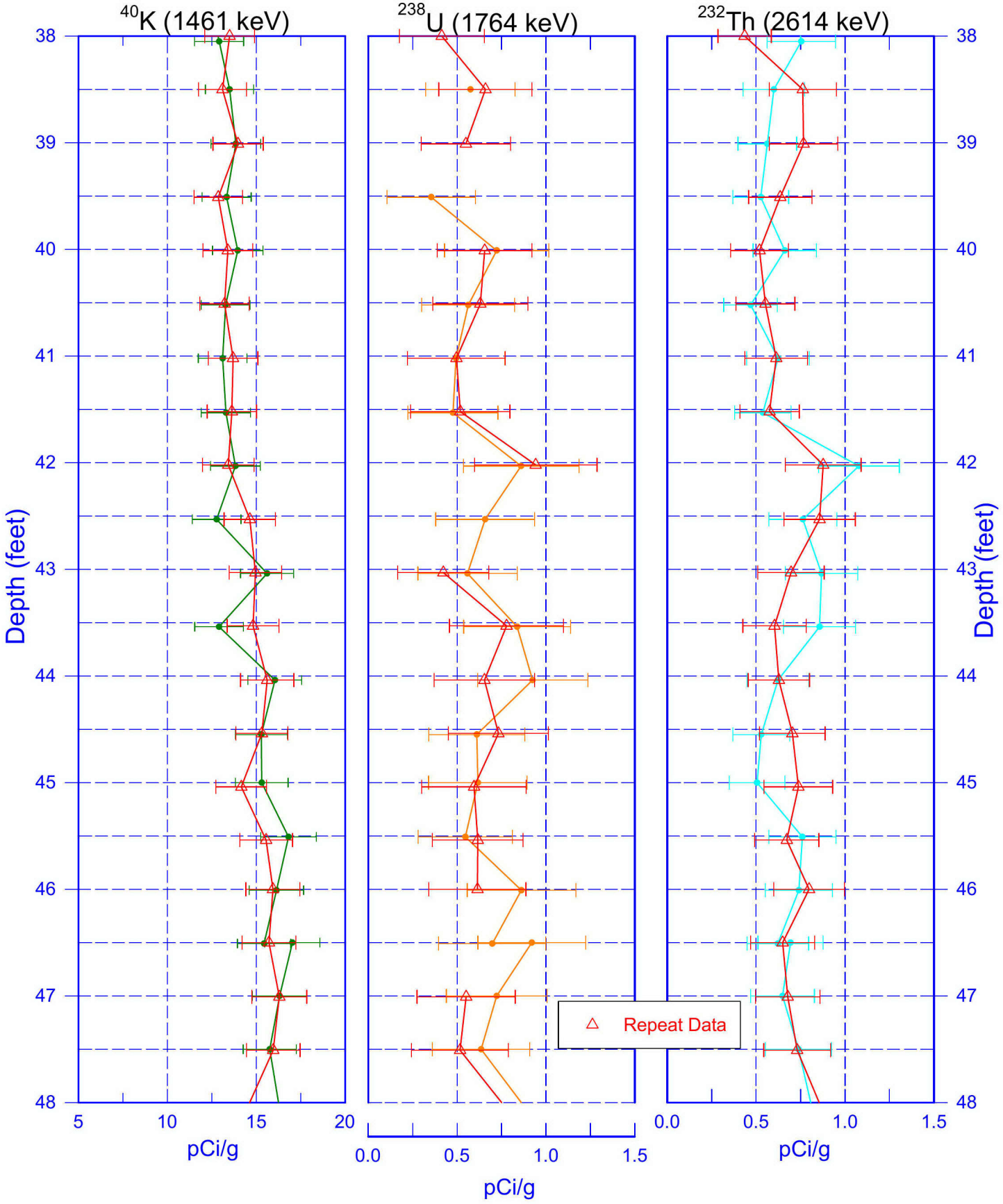


Zero Reference - Top of Casing

Stoller Hanford Office

30-03-05 (299-E27-76 [A6701])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-77 (A6702)

2010-2011 C-Farm Re-Baseline

30-03-07
299-E27-77 (A6702)
Log Data Report

Borehole Information:

Log Date:	2010-10-27	Filename:	A6702_HG_2010-10-27	Site:	C-Farm, 241-C-103
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:	08/03/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	7/31/74	N/A	96.5	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	96.5

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The depth interval logged in 2010 was from 0 to 96.5 feet. The location of the borehole is indicated in the figure titled "Borehole 30-03-07 Location in C Tank Farm" plot.

Water was not observed in this borehole.

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This borehole has SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1994 is included in the figure entitled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-103* (DOE 1997). Casing thicknesses are derived from published values for schedule 40-steel pipe.

The zero reference is the top of casing, approximately at ground surface.

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System

Logging Equipment Information:

Logging System:	Gamma 2	**Type:**	DHMCA[5]SGLS BR
Effective Calibration Date:	1/2011	**Serial No.:**	48-TP50478A
Logging Procedure:	HGLP-MAN-002, Rev. 1	**Calibration Reference:**	HGLP-CC-065, Rev. 0

SGLS Log Run Information:

Log Run	**1**	**2**	**3**	**4 Repeat**	
HEIS Number	1016289	1016290	1016291	1016292	
Date	10/22/10	10/26/10	10/27/10	10/27/10	
Logging Engineer	Spatz/ Holloway	Spatz/ Holloway	Spatz/ Holloway	Spatz/ Holloway	
Start Depth (ft)	0.0	9.0	76.0	38.0	
Finish Depth (ft)	10.0	77.0	96.0	48.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	1016287_B_101022	_B_101026	_B_101027	_B_101027	
Start File	_D_000000	_D_000900	_D_007600	_D_003800	
Finish File	_D_001001	_D_007700	_D_009604	_D_004803	
Post-Verification	_A101022	_A_101026	1016292_A_101027	1016292_A_101027	
Depth Return Error (in.)	0.0	0.0	N/A	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the table above due to length of file name (e.g., A6733_BR_1015868_D_000000).

Analysis Notes:

Analyst:	LEGLER	**Date:**	7/21/2011	**Reference:**	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for a 0.28-in. thick casing was applied during analysis.

[5] Down-Hole Multi-Channel Analyzer

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, 1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 was applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 data were decayed to a common date of November 11, 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are still plotted.

Cs-137 was detected almost continuously from ground surface to total logged depth of the borehole. A maximum concentration of approximately 61 pCi/g was measured at 9.5 ft. No significant changes have occurred since 1997.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

Depth Reference is top of casing

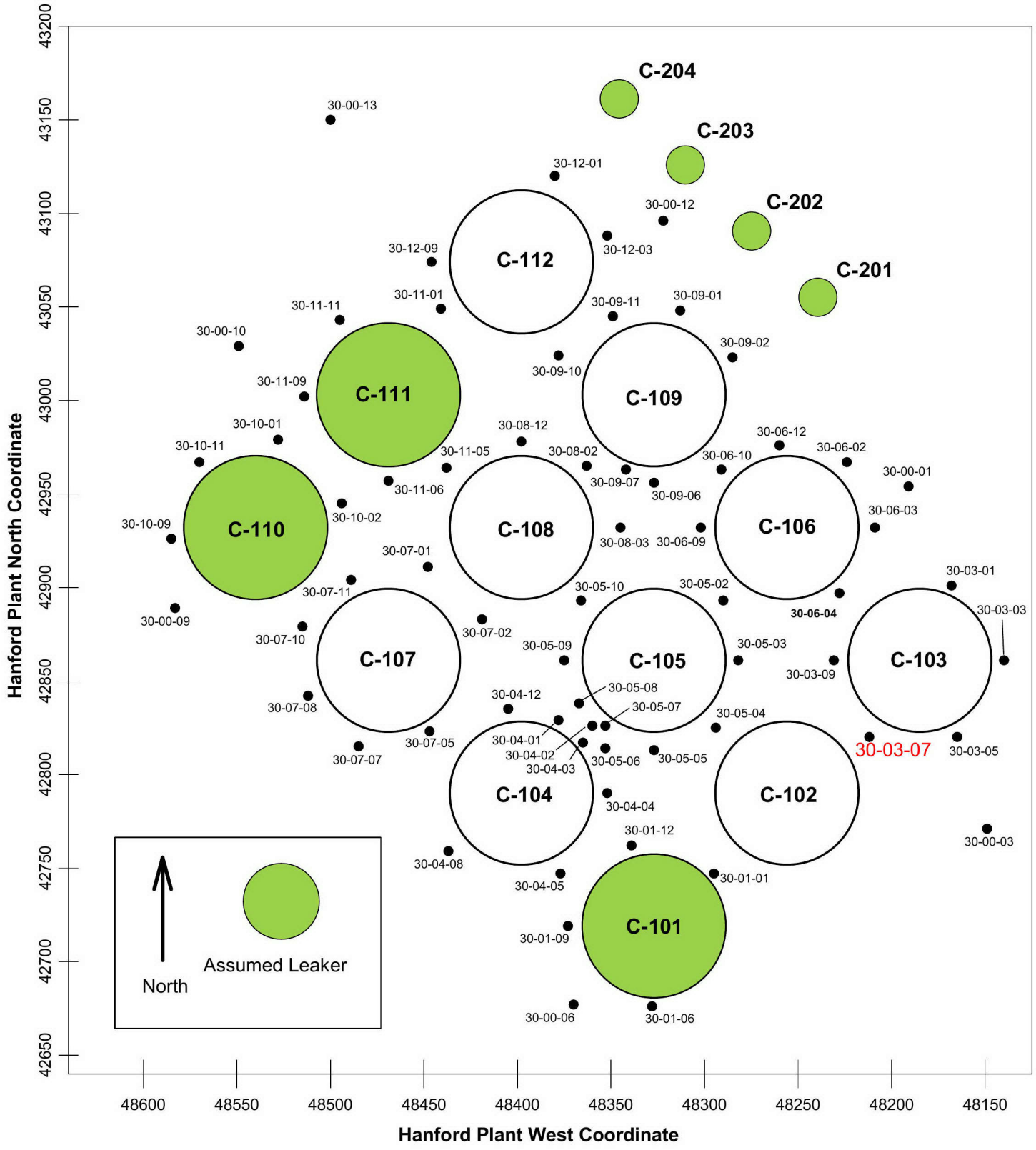
Borehole 30-03-07 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 and 1997)
Combination Plot
Repeat Section of Manmade Radionuclides
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-103.* GJ-HAN-82. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

[6] minimum detection level

Borehole 30-03-07 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-03-07 (299-E27-77) (A6702)

Borehole Information

Site: C Farm, Tank C-103			
Coordinates (HAN Plant):	**North: 42820**	**West: 48212**	**Elevation (ft): Unk**
Coordinates (WA Plane):	**North: 136536.269**	**East: 575195.209**	**Elevation (m): 197.903**
Drill Date: 9/30/1974	**Type: Cable Tool**	**Depth (ft): 96.5**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 4/11/97**	**D/W Reference: Stoller**	
Comments: RLS: Radionuclide Logging System, SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System			

Casing Information

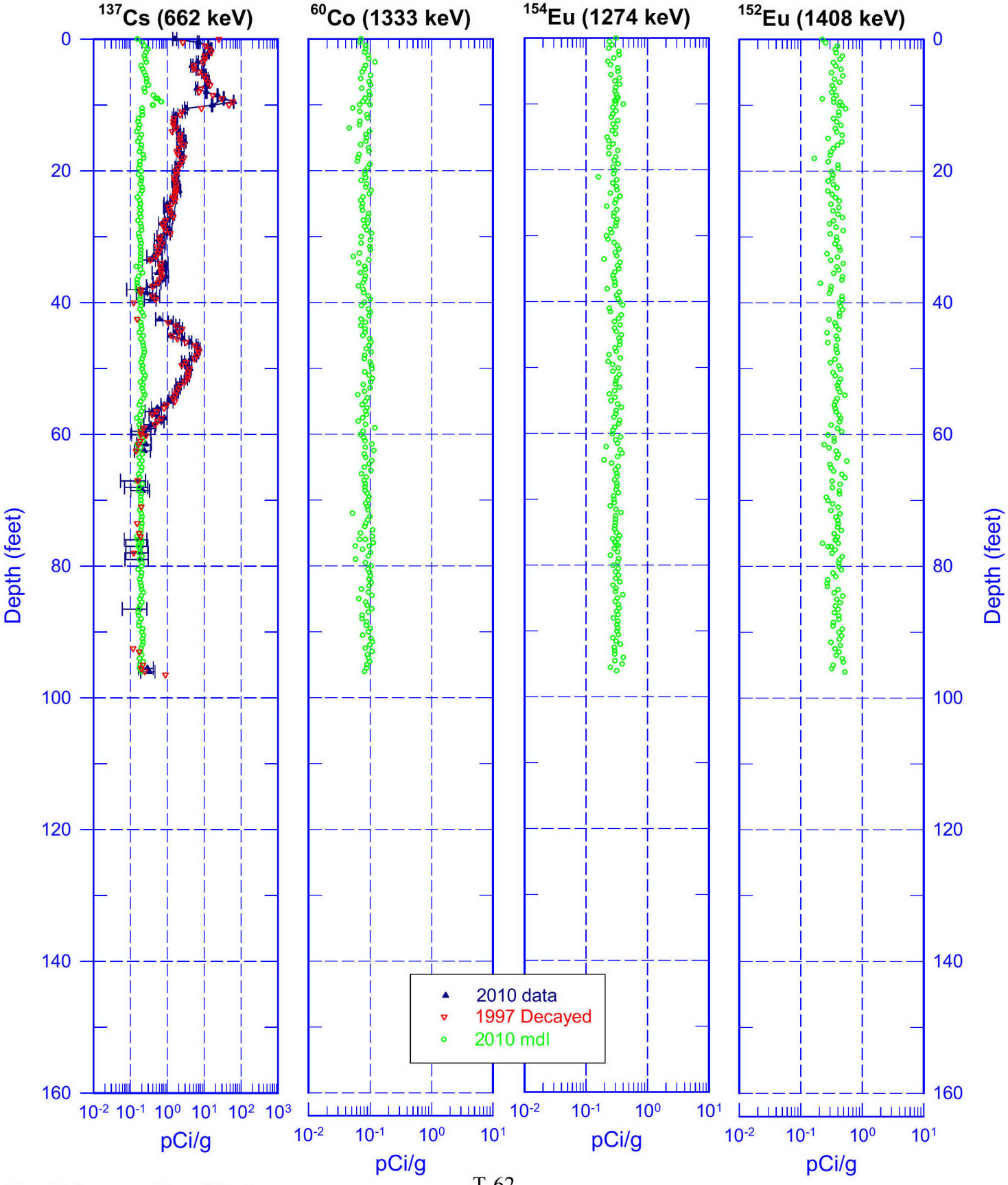
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
1994	RLS	RLS	NA	0-96	WHC	C-103 Invest.
4/11/1997	SGLS	G1A	1	0-96.5	MACTEC-ERS	Baseline
9/11/2002	RAS	Large	A	30-70	Stoller	No Apparent Change
10/13/2005	RAS	Large	B	0-96	Stoller	No Apparent Change
4/13/2006	RAS	Large	C	0-96	Stoller	No Apparent Change
2/16/2007	RAS	Large	D	0-96	Stoller	No Apparent Change
10/27/2010	SGLS	G2BR	2	0-96	Stoller	No Apparent Change

30-03-07 (299-E27-77 [A6702])

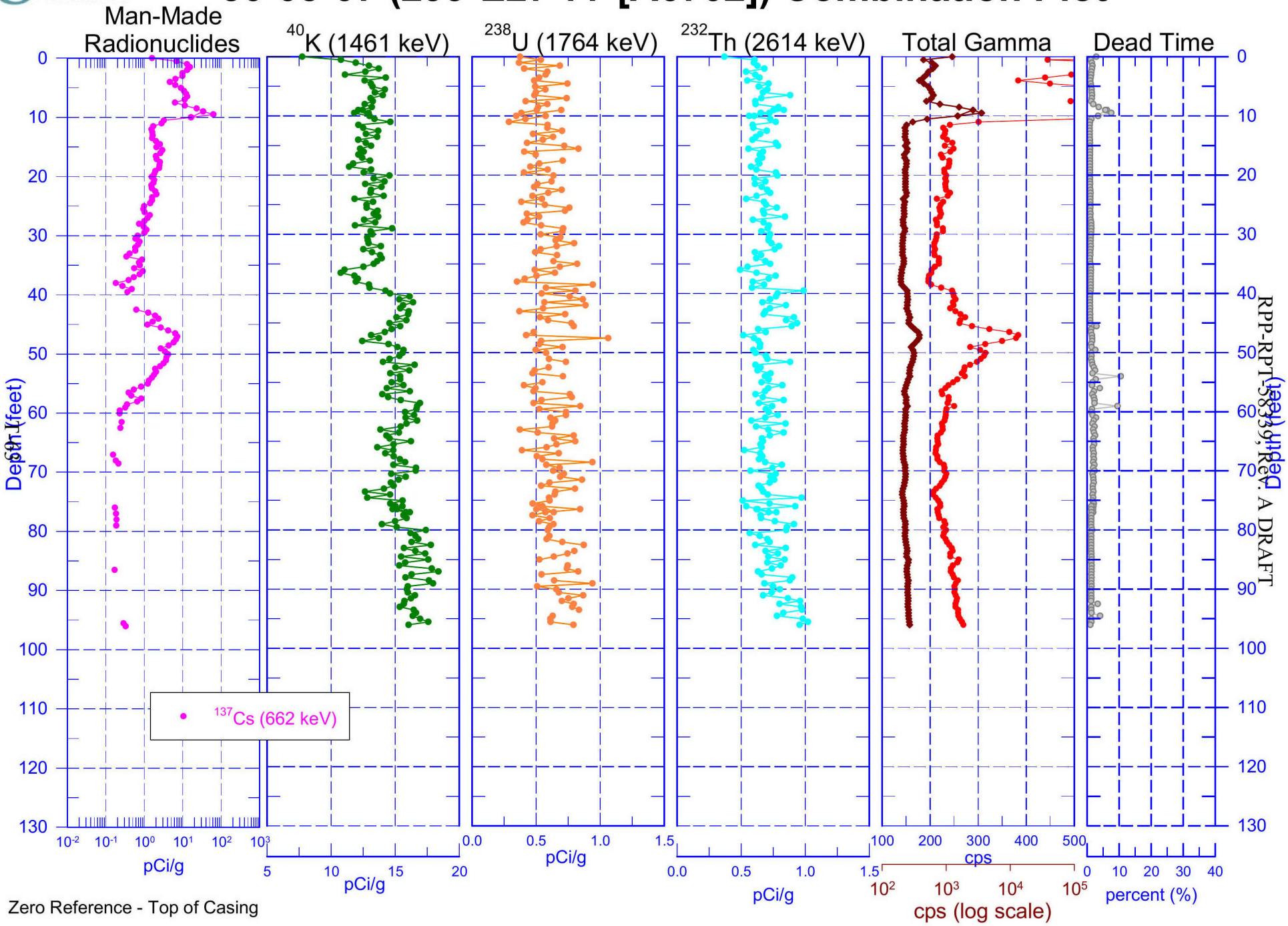
Comparison of Manmade Radionuclides (2010, and 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-03-07 (299-E27-77 [A6702]) Combination Plot

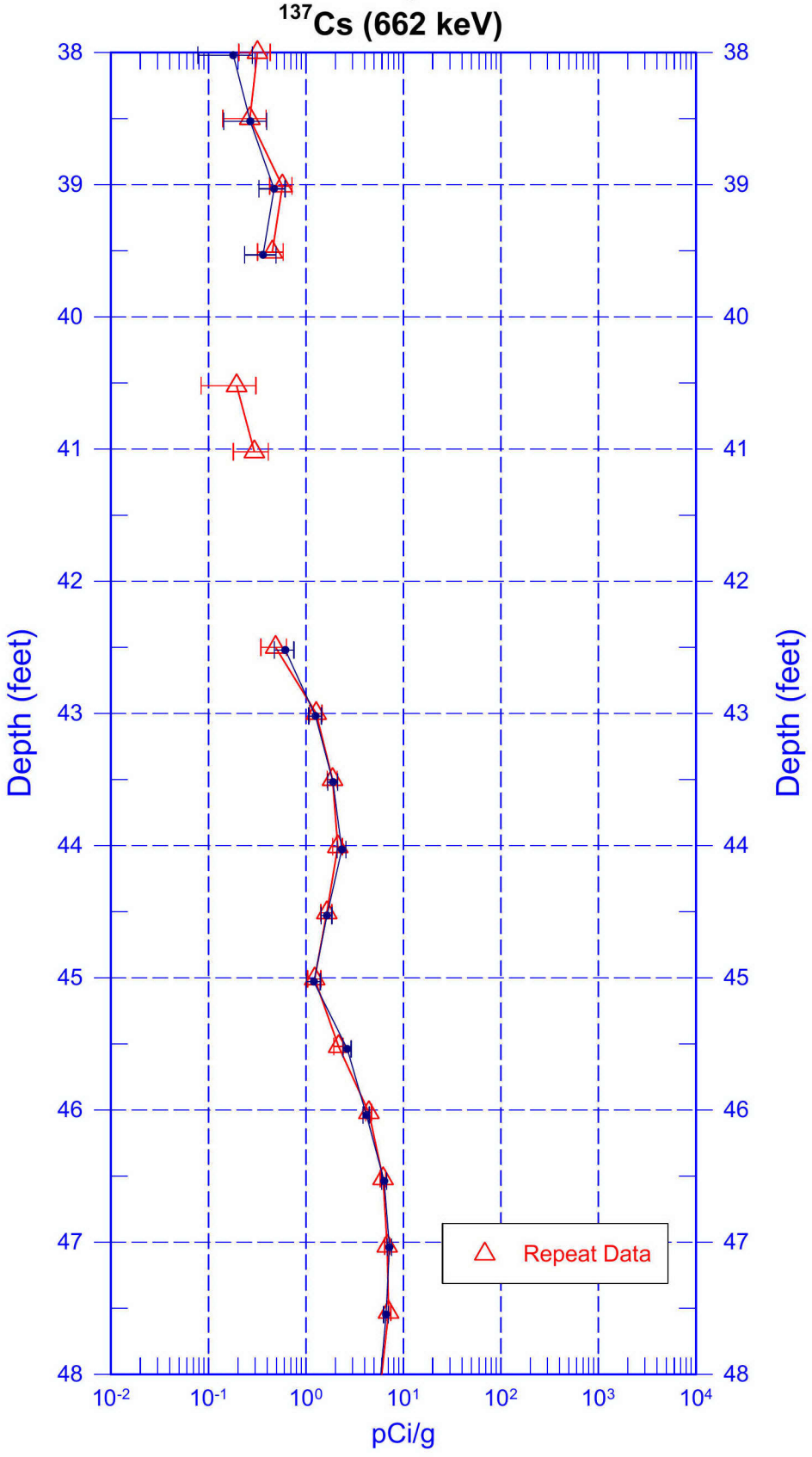


RPP-RPT-58339, Rev. A DRAFT

Stoller Hanford Office

30-03-07 (299-E27-77 [A6702])

Manmade Repeat Section

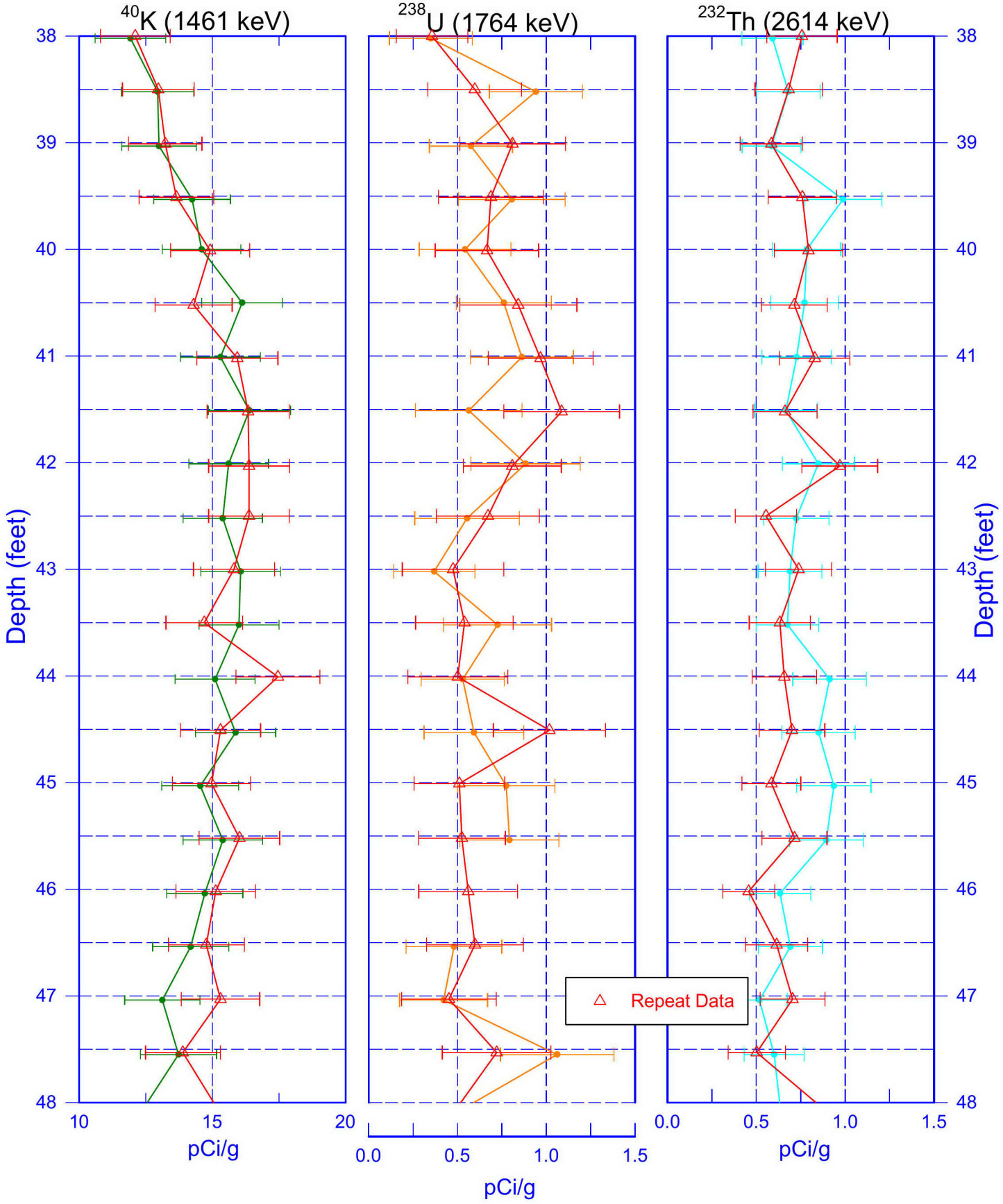


Zero Reference - Top of Casing

Stoller Hanford Office

30-03-07 (299-E27-77 [A6702])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-78 (A6703)

2010-2011 C-Farm Re-Baseline

30-03-09
299-E27-78 (A6703)
Log Data Report

Borehole Information:

Log Date:	2010-10-22	**Filename:**	A6703_HG_2010-10-22	**Site:**	241-C-103
Coordinates (WA St Plane)		**GWL[1] (ft) :**	None	**GWL Date:**	10/20/10
North (m)	**East (m)**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
N/A	N/A	6/30/1974	N/A	100	Cable Tool

Casing Information:

		Diameter (in.)				
Casing Type	**Stickup (ft)**	**Outer**	**Inside**	**Thickness (in.)**	**Top (ft)**	**Bottom (ft)**
Welded Steel	0.0	unknown	6	0.280	0.0	100

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2010 was from 0 to 99 ft. The location of the borehole is indicated in the figure titled "Borehole 30-03-09 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1997 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-103* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

No water exists in the borehole casing.

The zero reference is the TOC, approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[5] SGLS
Effective Calibration Date:	09/22/10	**Serial No.:**	48-TP50478A

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

Calibration Reference:	HGLP-CC-065, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	1	2	3	4 Repeat	
HEIS Number	1016285	1016286	1016287	1016288	
Date	10/20/10	10/21/10	10/22/10	10/22/10	
Logging Engineer	Saptz/Holloway	Saptz/Holloway	Saptz/Holloway	Saptz/Holloway	
Start Depth (ft)	0.0	16.0	80.0	77.0	
Finish Depth (ft)	17.0	81.0	99.0	87.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	_B_101020	_B_101021	_B_101022	_B_101022	
Start File	_D_000000	_D_001600	_D_008000	_D_007700	
Finish File	_D_001700	_D_008101	_D_009903	_D_008700	
Post-Verification	_A_101020	_A_101021	_A_101022	_A_101022	
Depth Return Error (in.)	0.0	0.0	N/A	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

Logging Operation Notes:

Data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the table above due to the length of file names (for example, _D_001700 for RUN01_BR_1016285_D_001700).

Analysis Notes:

Analyst:	C. Nelson	Date:	9/27/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established system.

A casing correction for 0.280-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the

[6] minimum detection level

detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, 1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time corrections in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the 1997 Cs-137 and Co-60 concentrations were decayed to a common date of October 22, 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are still plotted.

Cs-137 was detected from ground surface to 66 ft, and intermittently to the bottom of the borehole. A maximum concentration of approximately 47 pCi/g was measured at 7 ft. Comparisons with the 1997 data indicate no significant change.

Co-60 was detected from 78 to 90.5 ft with a maximum concentration of approximately 0.4 pCi/g measured at 78.5 ft. Comparisons with the 1997 data indicate no significant change.

Eu-152 and Eu-154 detected in 1997 (121 and 123 keV respectively) at ground surface were removed from the data set in the Addendum to the C Tank Farm Report (DOE 2000) and are not plotted on the manmade comparison plot in this report. After review of the spectra, there appears to be no supporting energy peaks for the Eu-152 and Eu-154 detected 1997, nor were they detected in 2010.

The repeat plots indicate that the system was working properly.

List of Log Plots:

Depth Reference is ground surface

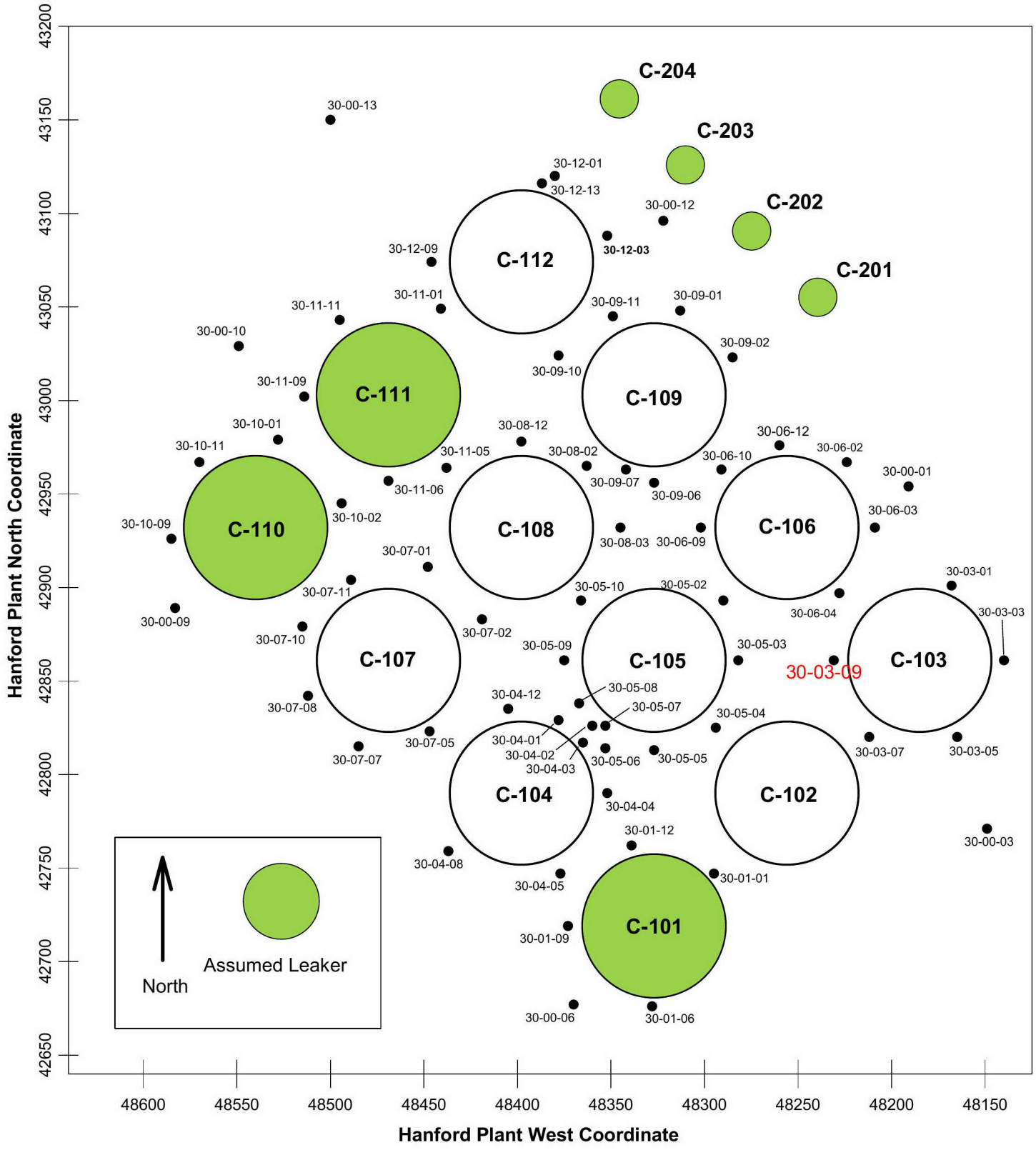
Borehole 30-03-09 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (1997 & 2010)
Combination Plot
Manmade Repeat Section
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-103.* GJ-HAN-82. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

U.S. Department of Energy (DOE). 2000. *Hanford Tank Farms Vadose Zone, Addendum to the C Tank Farm Report.* GJO-HAN-18. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-03-09 Location in C Tank Farm



Stoller

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-03-09 (299-E27-78) (A6703)

Borehole Information

Site: C Farm, Tank C-103			
Coordinates (HAN Plant):	**North: 42861**	**West: 48231**	**Elevation (ft): 645.00**
Coordinates (WA Plane):	**North: 136547.279**	**East: 575190.404**	**Elevation (m): 197.903**
Drill Date: 6/30/1974	**Type: Cable Tool**	**Depth (ft): 99.1**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 10/20/10**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, WA State Plane Coordinates are NAVD88			

Casing Information

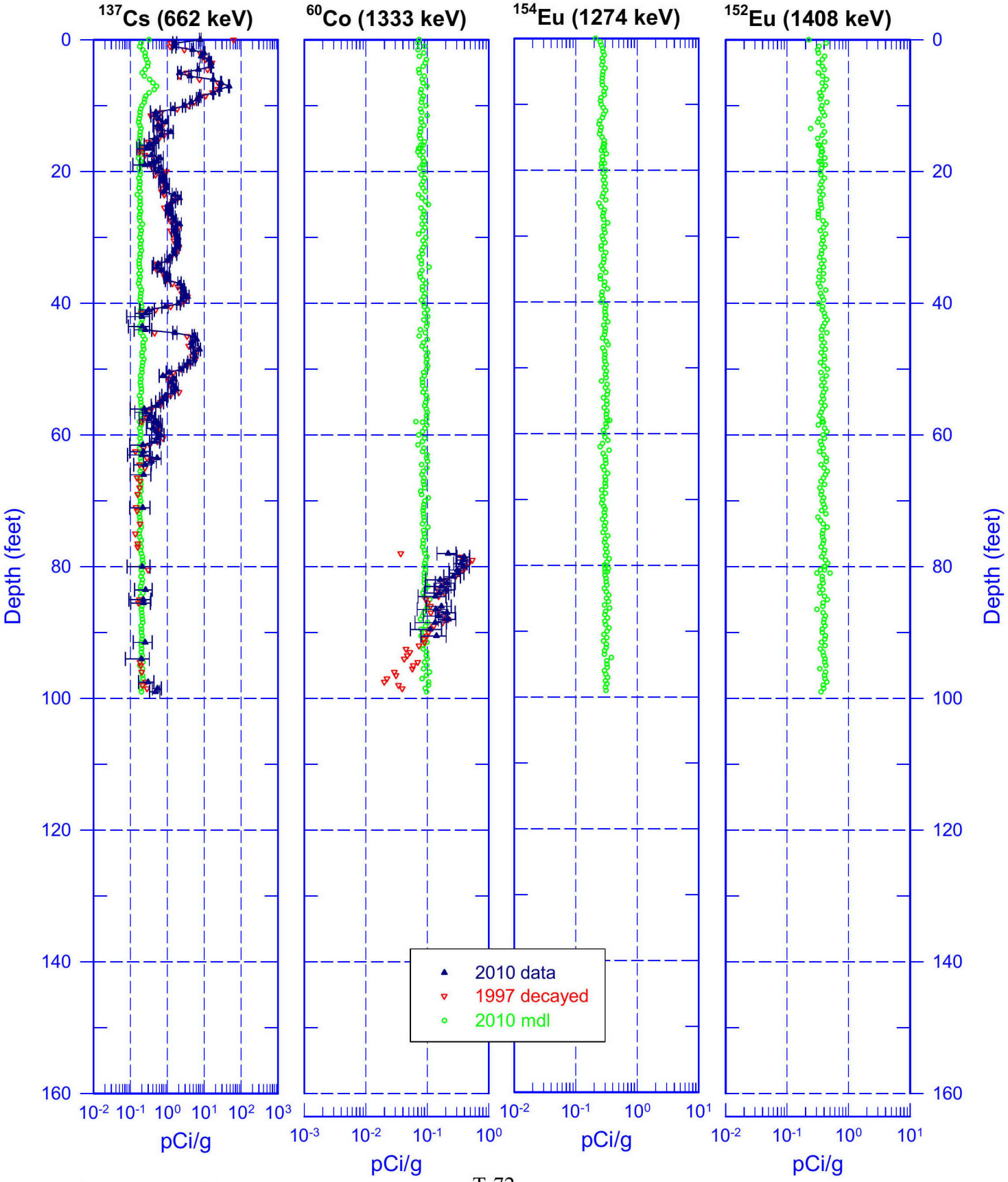
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
4/8/1997	SGLS	G1B	1	0-98.5	MACTEC-ERS	Baseline
4/19/2002	RAS	Large	A	30-98	MACTEC-ERS	No Apparent Change
5/6/2003	RAS	Large-New	B	30-98	Stoller	No Apparent Change
10/11/2005	RAS	Large2	C	0-98	Stoller	No Apparent Change
4/13/2006	RAS	Large2	D	0-95	Stoller	No Apparent Change
2/14/2007	RAS	Large2	E	0-98	Stoller	No Apparent Change
6/21/2007	RAS	Large2	F	30-98	Stoller	No Apparent Change
10/22/2010	SGLS	G2BR	2	0-99	Stoller	No Apparent Change

30-03-09 (299-E27-78 [A6703])

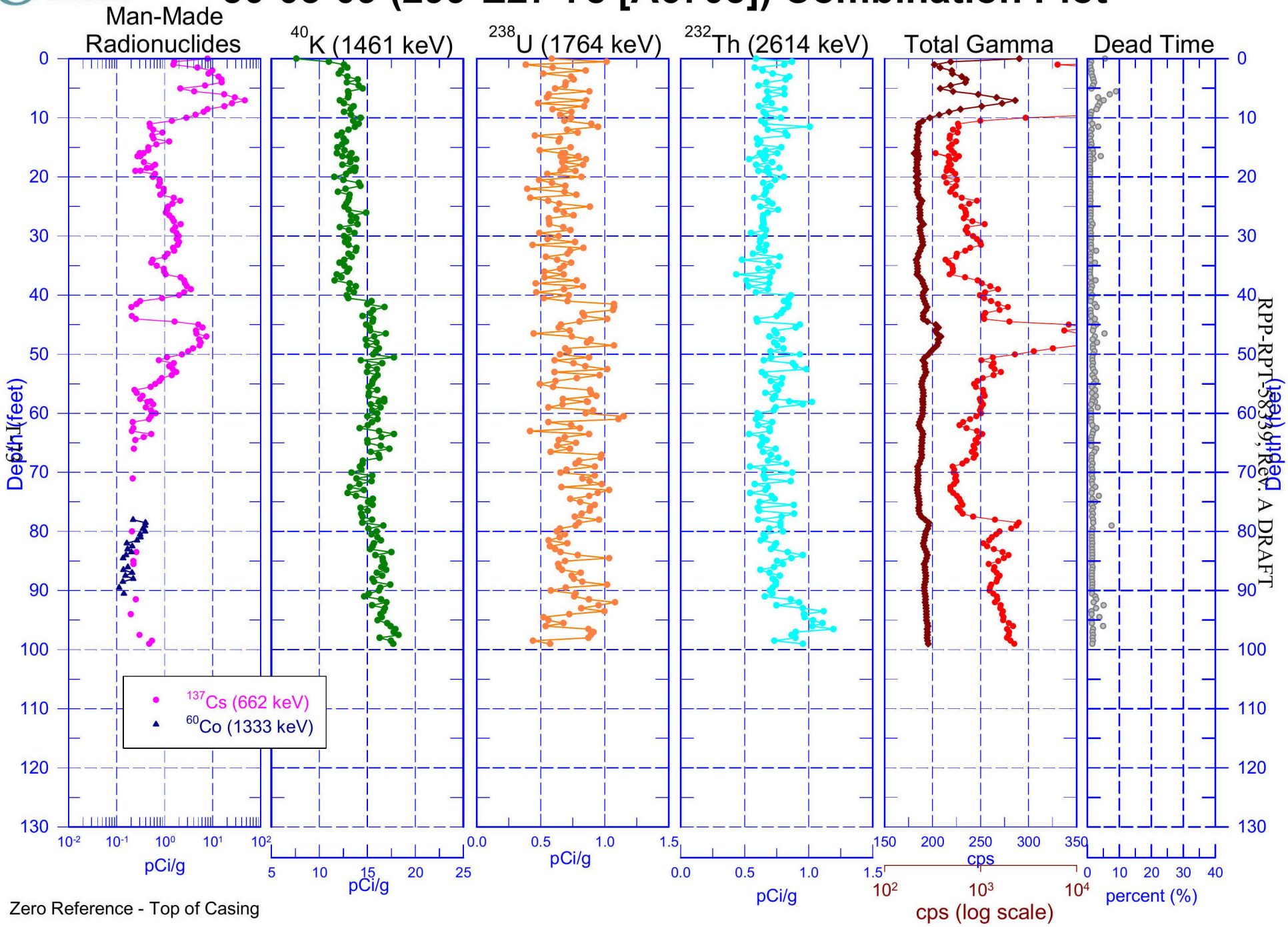
Comparison of Manmade Radionuclides (1997 & 2010)



Zero Reference - Top of Casing

Stoller
Hanford Office

30-03-09 (299-E27-78 [A6703]) Combination Plot

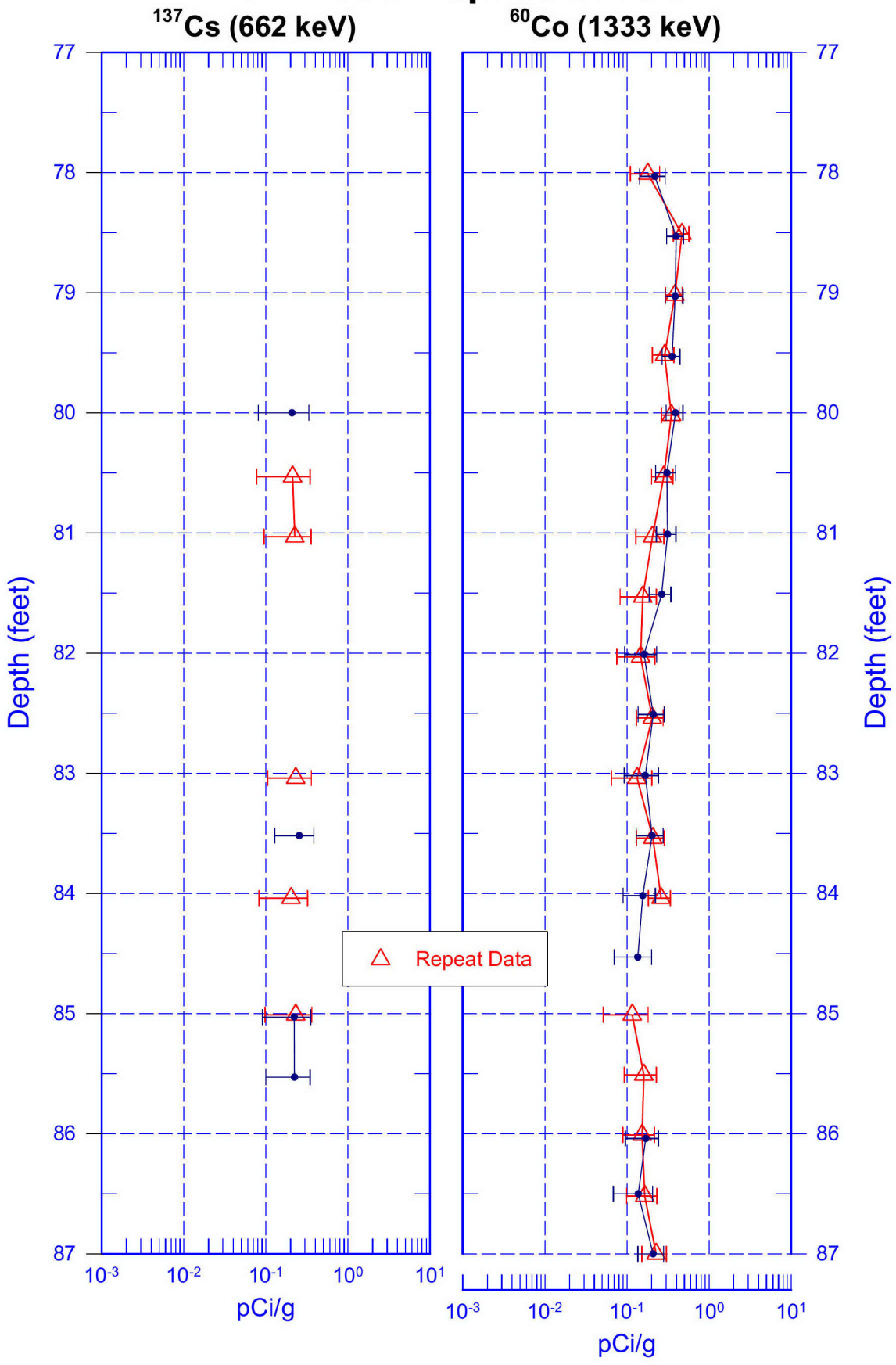


RPP-RPT-58339, Rev. A DRAFT (text hidden)

Stoller Hanford Office

30-03-09 (299-E27-78 [A6703])

Manmade Repeat Section

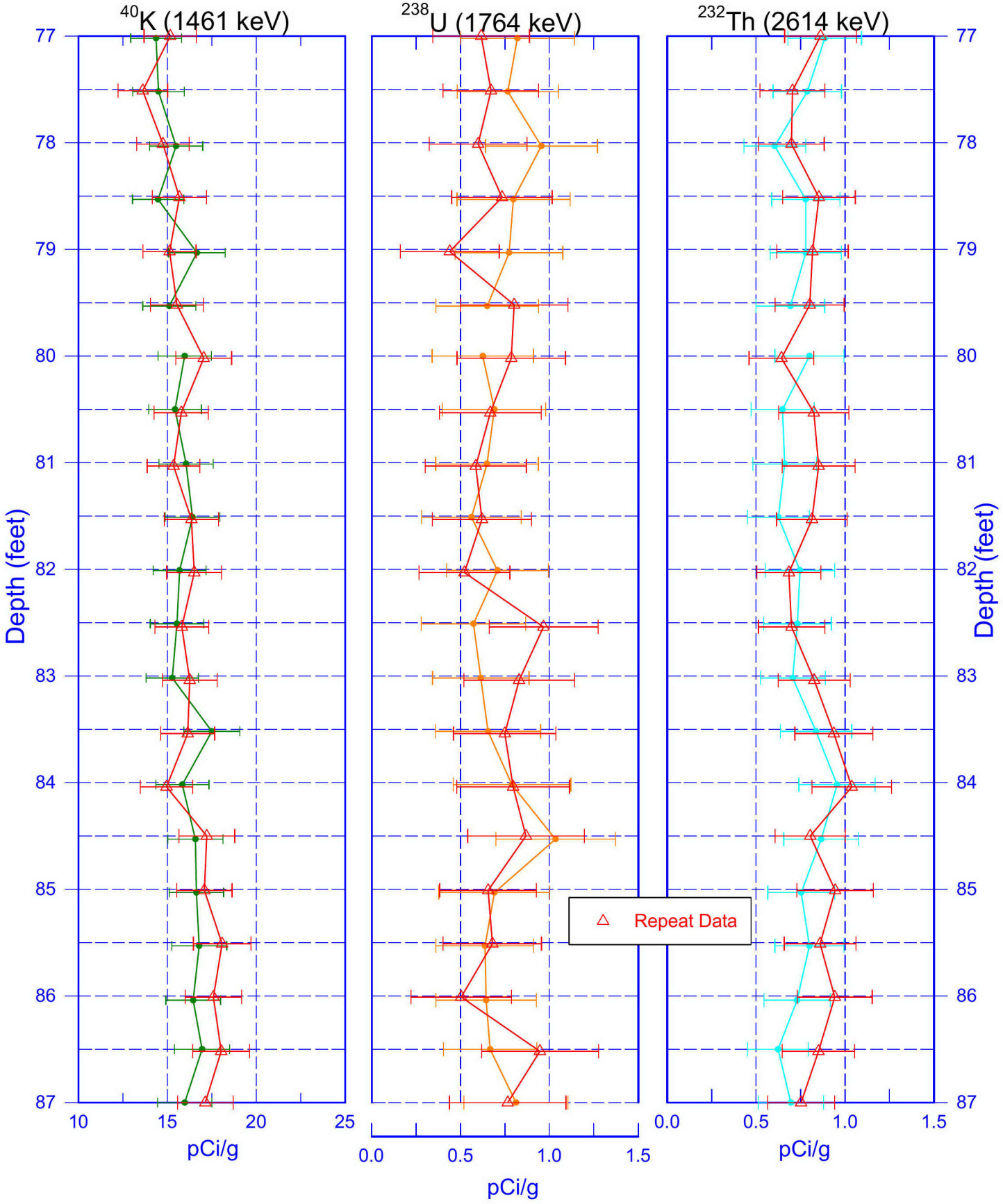


Zero Reference - Top of Casing

Stoller Hanford Office

30-03-09 (299-E27-78 [A6703])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-115 (A6735)

2010-2011 C-Farm Re-Baseline

30-04-01
299-E27-115 (A6735)
Log Data Report

Borehole Information:

Log Date:	2010-08-04	Filename:	A6735_HG_2010-08-04	Site:	241-C-104	
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:		08/03/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)		Type
N/A	N/A	07/1974	N/A	50.0		Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	50.0

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2010 was from 0 to 49.0 ft. The location of the borehole is indicated in the figure titled "Borehole 30-04-01 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1997 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-104* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

No water exists in the borehole casing.

The zero reference is the TOC, approximately at ground surface.

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System

Logging Equipment Information:

Logging System:	Gamma 2	**Type:**	DHMCA[5] SGLS BR
Effective Calibration Date:	09/03/09	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-062, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	**1**	**2 Repeat**			
HEIS Number	1016223	1016224			
Date	8/4/10	8/4/10			
Logging Engineer	Spatz/Legler	Spatz/Legler			
Start Depth (ft)	0.0	35.0			
Finish Depth (ft)	49.0	41.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.5	0.5			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	1016223_B	1016223_B			
Start File	_D_000000	_D_003500			
Finish File	_D_004900	_D_004100			
Post-Verification	1016224_A	1016224_A			
Depth Return Error (in.)	N/A	1/2 high			
Comments	No fine gain adjustments made	No fine gain adjustments made			

Logging Operation Notes:

Data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above due to the length of file names (for example, _D_000000 for RUN01_BR_1016223_D_000000).

Analysis Notes:

Analyst:	C. Nelson	**Date:**	8/15/11	**Reference:**	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for 0.280-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20090903_BRr0b, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

[5] Down-Hole Multi-Channel Analyzer

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, 1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time corrections in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 concentrations were decayed to a common date of August 4, 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are still plotted.

Cs-137 was detected almost continuously from ground surface to the total logged depth of the borehole. A maximum concentration of approximately 49 pCi/g was measured at 1.0 ft. Comparisons with the 1997 data indicate no significant change.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

Depth Reference is ground surface

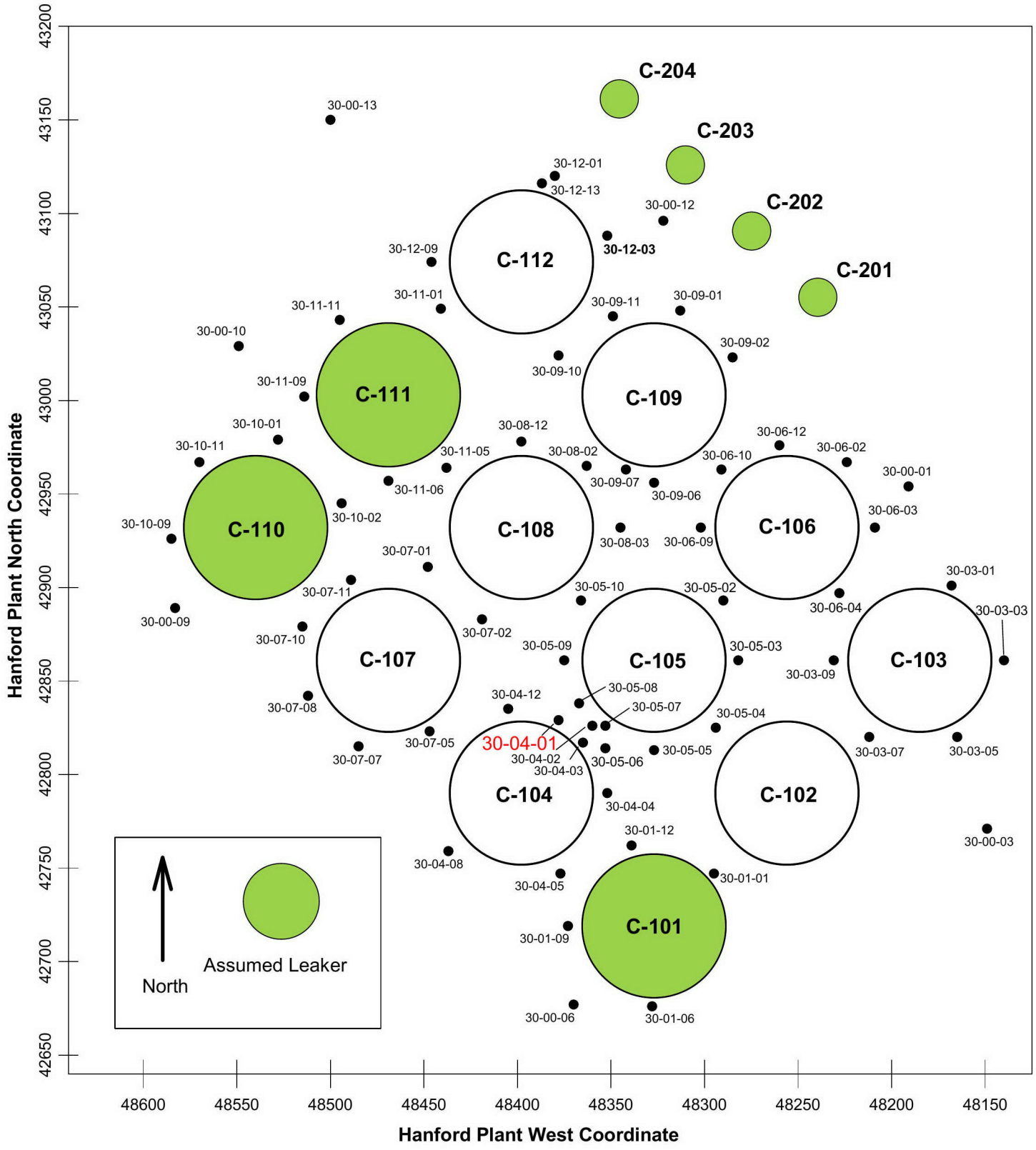
Borehole 30-04-01 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Manmade Repeat Section
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-104.* GJ-HAN-87. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

[6] minimum detection level

Borehole 30-04-01 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-04-01 (299-E27-115) (A6735)

Borehole Information

Site: C Farm, Tank C-104			
Coordinates (HAN Plant):	**North: 42829**	**West: 48378**	**Elevation (ft): 646.00**
Coordinates (WA Plane):	**North: 136537.415**	**East: 575145.644**	**Elevation (m): 198.28**
Drill Date: 7/31/1974	**Type: Cable Tool**	**Depth (ft): 49**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 12/10/03**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, WA State Plane Coordinates are NAVD88			

Casing Information

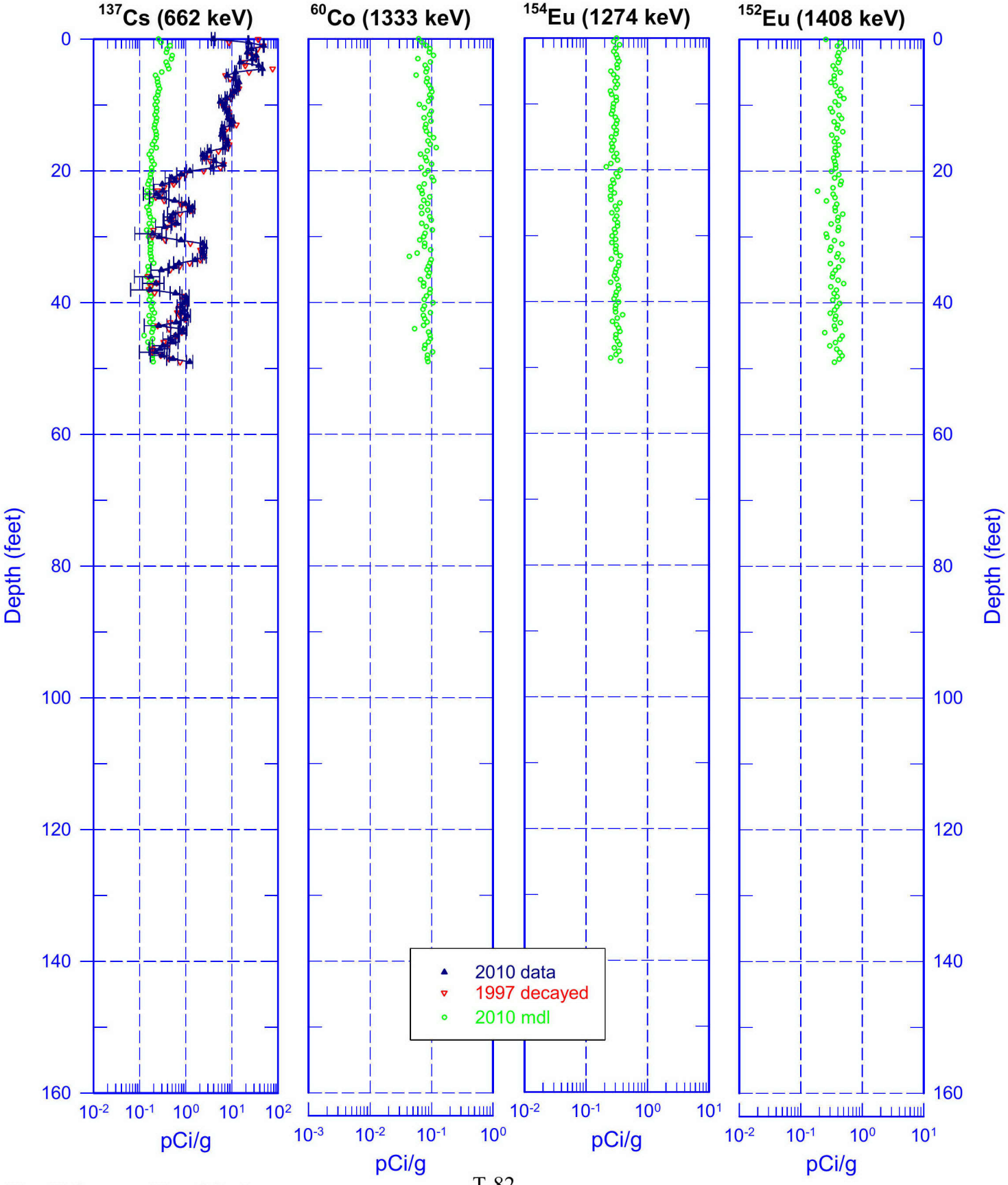
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	50	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
2/24/1997	SGLS	G2A	1	0-49	MACTEC-ERS	Baseline
12/17/2003	RAS	Large-New	A	0-48	Stoller	No Apparent Change
8/26/2009	RAS	Large	B	0-48	Stoller	Change at surface
8/3/2010	SGLS	G2BR	2	0-49	Stoller	No Apparent Change

30-04-01 (299-E27-115 [A6735])

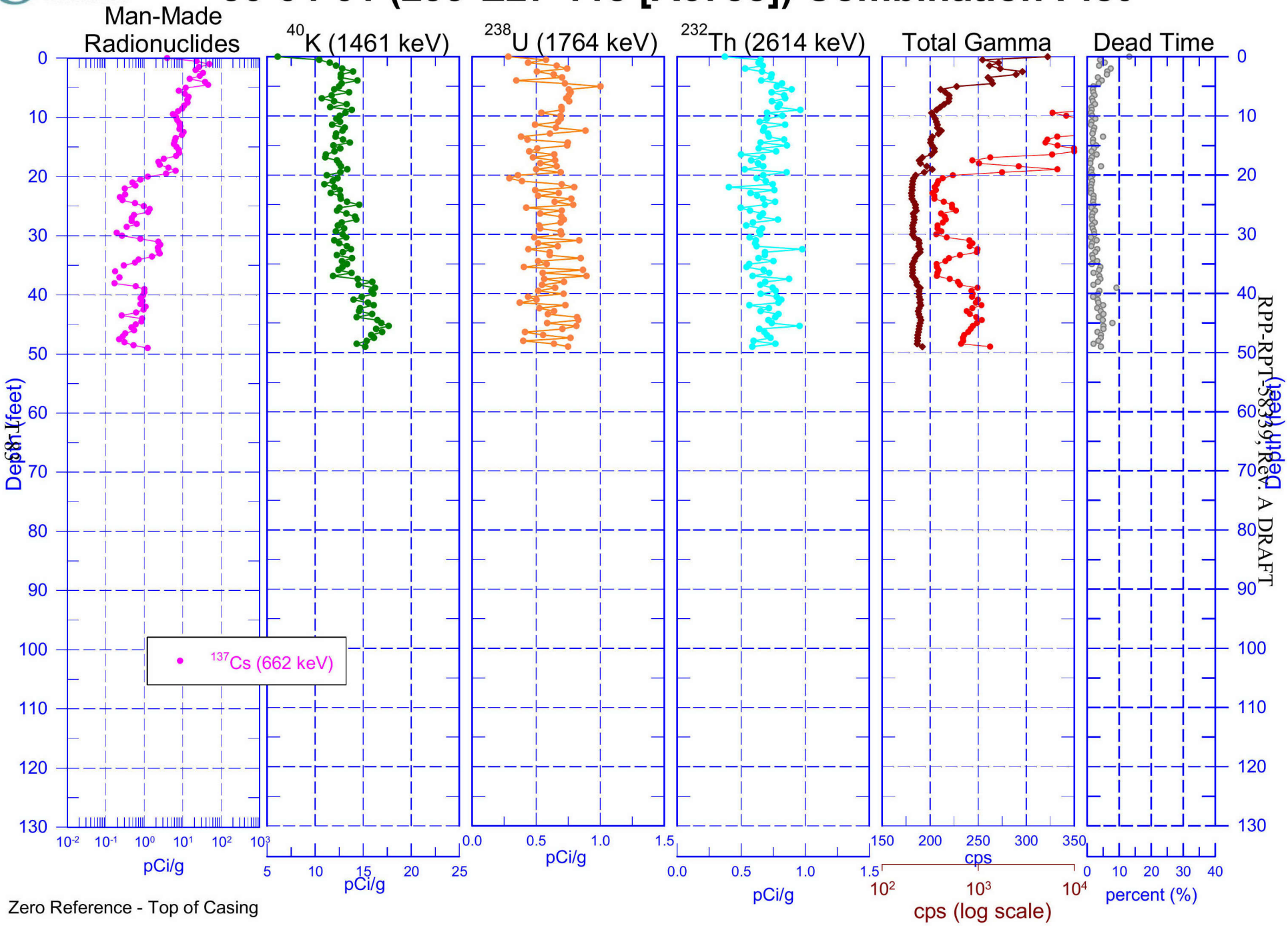
Comparison of Manmade Radionuclides (2010 &1997)



Zero Reference - Top of Casing

Stoller
Hanford Office

30-04-01 (299-E27-115 [A6735]) Combination Plot



RPP-RPT-58339, Rev. A DRAFT

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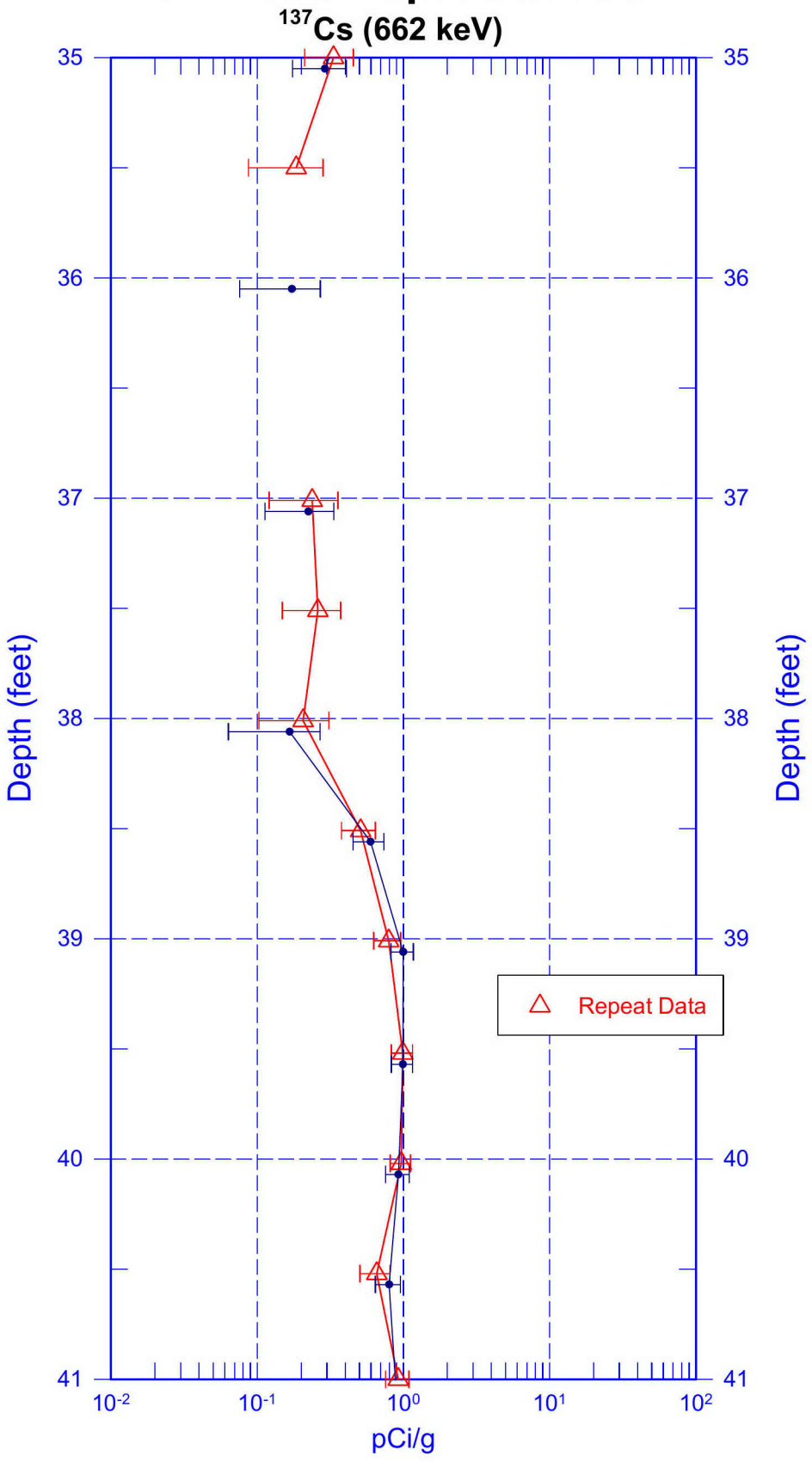
30-04-01 (299-E27-115 [A6735])

Manmade Repeat Section

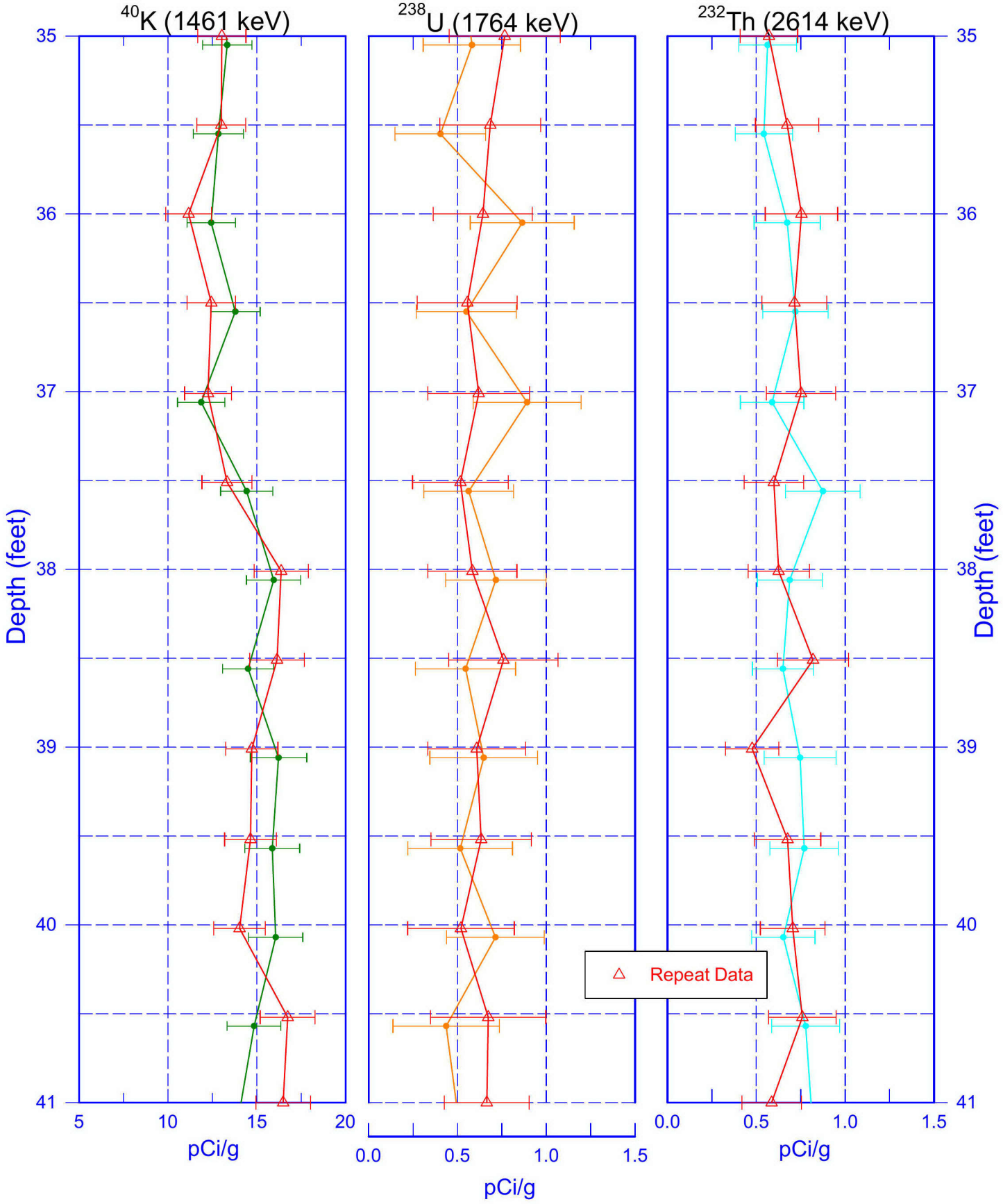


Zero Reference - Top of Casing

Stoller Hanford Office

30-04-01 (299-E27-115 [A6735])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-70 (A6695)

2010-2011 C-Farm Re-Baseline

30-05-02
299-E27-70 (A6695)
Log Data Report

Borehole Information:

Log Date:	2010-09-08	Filename:	A6695_HG_2010-09-08	Site:	241-C-105
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:	08/03/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	11/30/1972	N/A	130	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	130

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The depth interval logged in 2010 was from 0 to 127.5 feet. The location of the borehole is indicated in the figure titled "Borehole 30-05-02 Location in C Tank Farm."

Water was not observed in this borehole.

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997, 2004, and 2010. A summary of other logging data acquired since 1997 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-105* (DOE 1997). Casing thicknesses are derived from published values for schedule 40-steel pipe.

The zero reference is the top of casing, approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2 BR	Type:	DHMCA[5] SGLS BR
Effective Calibration Date:	09/03/09	Serial No.:	48-TP50478A

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

Calibration Reference:	HGLP-CC-062, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 2 A	**Type:**	35% HPGe SGLS
Effective Calibration Date:	12/22/03	**Serial No.:**	34TP20893A
Calibration Reference:	GJO-2004-593-TAC	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 2F	**Type:**	NMLS[6]
Effective Calibration Date:	10/04	**Serial No.:**	H380932510
Calibration Reference:	DOE-EM/GJ754-2004	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev. 0

SGLS Log Run Information:

Log Run	**1**	**2**	**3**	**4**	**5 Repeat**
HEIS Number	1016247	1016248	1016249	1016250	1016251
Date	09/01/10	09/02/10	09/07/10	09/08/10	09/08/10
Logging Engineer	Spatz/ Holloway	Spatz/Holloway	Spatz/ Holloway	Spatz/ Holloway	Spatz/ Holloway
Start Depth (ft)	0.0	9.0	66.0	121.0	20.0
Finish Depth (ft)	10.0	67.0	122.0	127.5	33.0
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	B_1091	B_1092	B_1097	1016250_B_1098	1016250_B_1098
Start File	_D_000000	_D_000900	_D_006600	_D_012100	_D_002000
Finish File	_D_001000	_D_006700	_D_012200	_D_012750	_D_003300
Post-Verification	A_1091	A1092	A_1097	1016251_A_1098	1016251_A_1098
Depth Return Error (in.)	0.0	0.0	1 high	N/A	0.0
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made

Log Run	**6 Repeat**	**7**			
HEIS Number	10178769	1017870			
Date	2/26/04	2/26/04			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	40.0	40.0			
Finish Depth (ft)	46.0	90.0			
Count Time (sec)	100	100			
Live/Real	R	R			

[6] Neutron Moisture Logging System

Log Run	6 Repeat	7			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.5	0.5			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	BA307CAB	BA307CAB			
Start File	BA307000	BA307013			
Finish File	BA307012	BA307113			
Post-Verification	BA308CAA	BA308CAA			
Depth Return Error (in.)	1" low	1/4 high			
Comments	No fine gain adjustments made	Adjusted gain after files: BA307033, BA307045, BA307059			

NMLS Log Run Information:

Log Run	8	9 Repeat			
HEIS Number	1017867	1017868			
Date	11/04/04	11/04/04			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	90.0			
Finish Depth (ft)	100.0	127.25			
Count Time (sec)	N/A	N/A			
Live/Real	N/A	N/A			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	1.0	1.0			
Pre-Verification	BF188CAB	BF188CAB			
Start File	BF188000	BF188401			
Finish File	BF188400	BF188550			
Post-Verification	BF188CAA	BF188CAA			
Depth Return Error (in.)	0.0	1/4 high			
Comments	None	Repeat section 90.0 to 100.0 ft			

Logging Operation Notes:

Data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

NMLS data were collected using Gamma 1, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the AmBe standard field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above for 2010 SGLS log run information due to the length of file names (e.g., RUN01_BR_1016247_D_000000).

Analysis Notes:

Analyst:	C. Nelson	Date:	7/13/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Casing corrections for a 0.28-in. thick casing were applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20090903_BRr0, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[7] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, 1997 and 2004 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 and 2004 were applied during reprocessing. For purposes of comparison with the 2010 data, the 1997 and 2004 Cs-137 and Co-60 were decayed to a common date of September 8, 2010. Data were acquired in 2004 from the depth interval of 40 to 90 ft.

During the time from April 2003 to November 2004 NMLS data were acquired 8 times. The most recent NMLS data are reported in this log data report.

Results and Interpretations:

The "Comparison of Manmade Radionuclides" plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected almost continuously from ground surface to 88.5 ft, intermittently from 92.5 to 117.0 ft, and almost continuously from 119.5 to 127.5 ft. A maximum concentration of approximately 762 pCi/g was measured at 1.5 ft. Comparisons with the 2004 and 1997 data indicate no significant change.

Co-60 was detected at 75, 76.5, and 116.5 ft with a maximum concentration of approximately of 0.1 pCi/g at 75 ft. Co-60 detected in 1997 and 2004 from 75 to 83 ft has apparently decayed below the 2010 MDL.

Eu-154 detected at ground surface in 1997 has apparently decayed below the 2010 MDL.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of

[7] minimum detection level

relatively high silt or clay content. Moisture data were acquired from the interval of ground surface to 127.25 ft. The most recent 2004 NMLS data are reported in this log data report.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

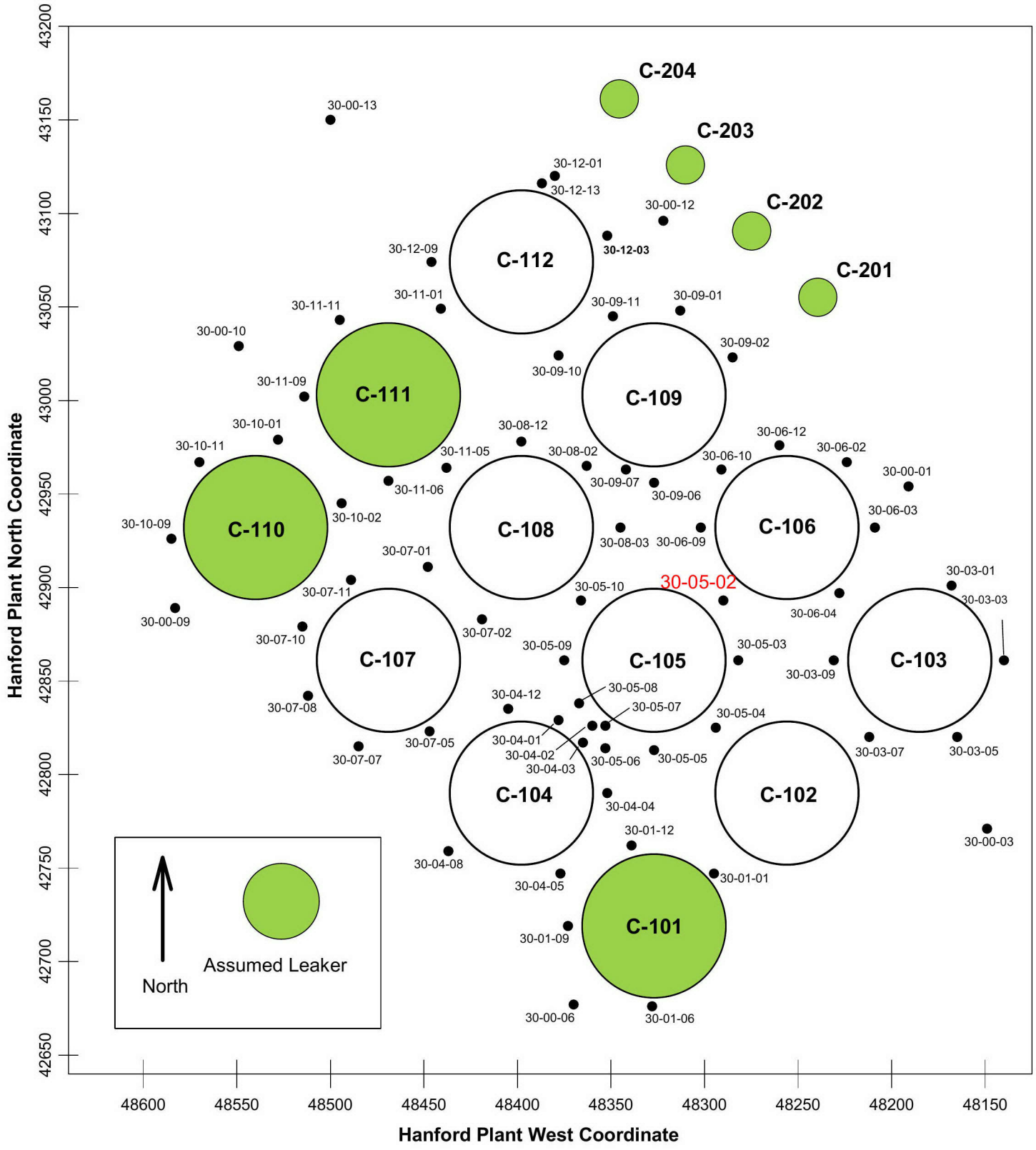
Depth Reference is top of casing

Borehole 30-05-02 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010, 2004, & 1997)
Combination Plot
Manmade Repeat Section
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-105.* GJ-HAN-83. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-05-02 Location in C Tank Farm



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Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-05-02 (299-E27-70) (A6695)

Borehole Information

Site: C Farm, Tank C-105			
Coordinates (HAN Plant):	**North: 42893**	**West: 48290**	**Elevation (ft): 645.70**
Coordinates (WA Plane):	**North: 136557.039**	**East: 575172.445**	**Elevation (m): 197.972**
Drill Date: 11/30/1972	**Type: Cable Tool**	**Depth (ft): 127.5**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 12/2/03**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, NMLS: Neutron Moisture Logging System			

Casing Information

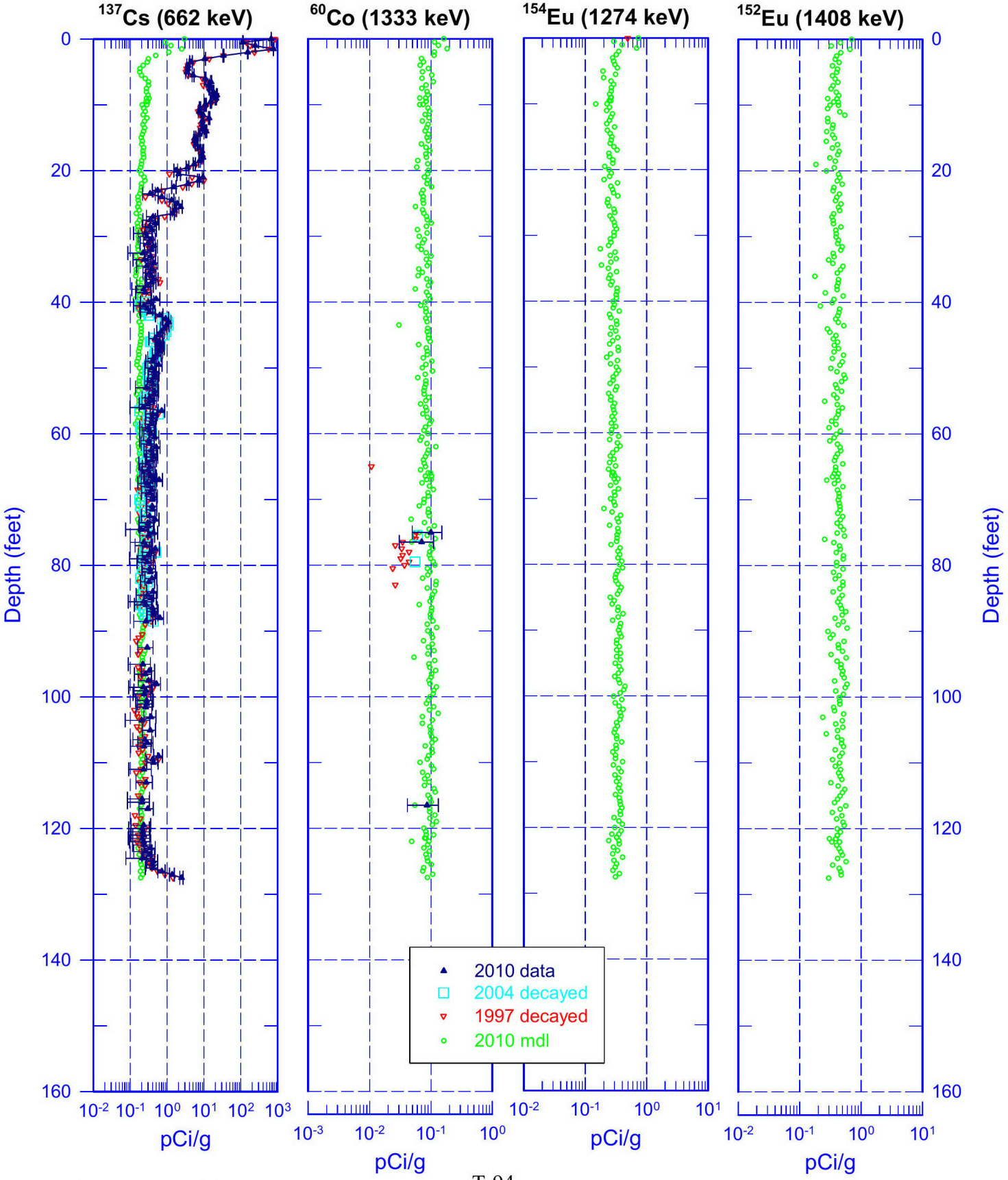
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	130	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
02/05/97	SGLS	G2A	1	0-127.5	MACTEC-ERS	Baseline
04/22/02	RAS	Large	A	30-90	MACTEC-ERS	No Apparent Change
01/29/03	RAS	Large-New	B	5-127	Stoller	No Apparent Change
04/29/03	RAS	Large-New	C	5-127	Stoller	No Apparent Change
07/23/03	RAS	Large-New	D	5-127	Stoller	No Apparent Change
04/28/03	NMLS	Moisture	1	0-127.25	Stoller	Moisture Baseline
07/21/03	NMLS	Moisture	2	0-127.25	Stoller	No Apparent Change
09/08/03	NMLS	Moisture	3	0-127.25	Stoller	No Apparent Change
09/17/03	RAS	Large-New	E	0-127	Stoller	No Apparent Change
10/22/03	NMLS	Moisture	4	0-127.25	Stoller	No Apparent Change
10/23/03	RAS	Large-New	F	5-127	Stoller	No Apparent Change
12/02/03	NMLS	Moisture	5	0-127.25	Stoller	No Apparent Change
12/08/03	NMLS	Moisture	6	40-60	Stoller	No Apparent Change
12/15/03	RAS	Large-New	G	5-127	Stoller	No Apparent Change
02/11/04	NMLS	Moisture	7	0-127.25	Stoller	No Apparent Change
02/19/04	RAS	Large-New	H	5-127	Stoller	No Apparent Change
02/26/04	SGLS	G2A	2	40-90	Stoller	No Apparent Change
11/04/04	NMLS	Moisture	8	0-127.25	Stoller	No Apparent Change
05/08/05	RAS	Large-New	I	5-127	Stoller	No Apparent Change
09/08/10	SGLS	G2BR	3	0-127.5	Stoller	No Apparent Change

30-05-02 (299-E27-70 [A6695])

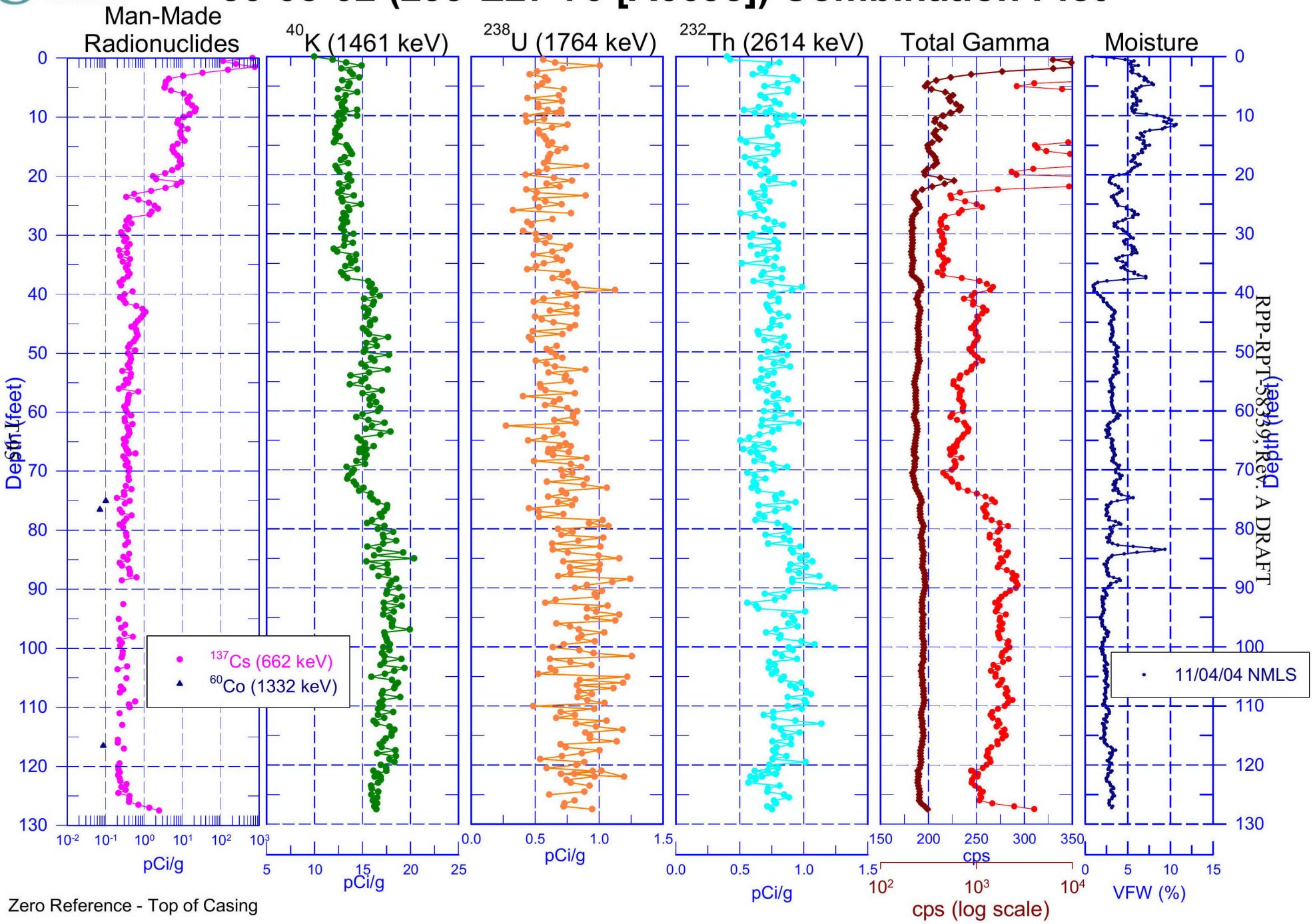
Comparison of Manmade Radionuclides (2010, 2004 &1997)



Zero Reference - Top of Casing

Stoller
Hanford Office

30-05-02 (299-E27-70 [A6695]) Combination Plot



RPP-RPT-58339, Rev. A DRAFT

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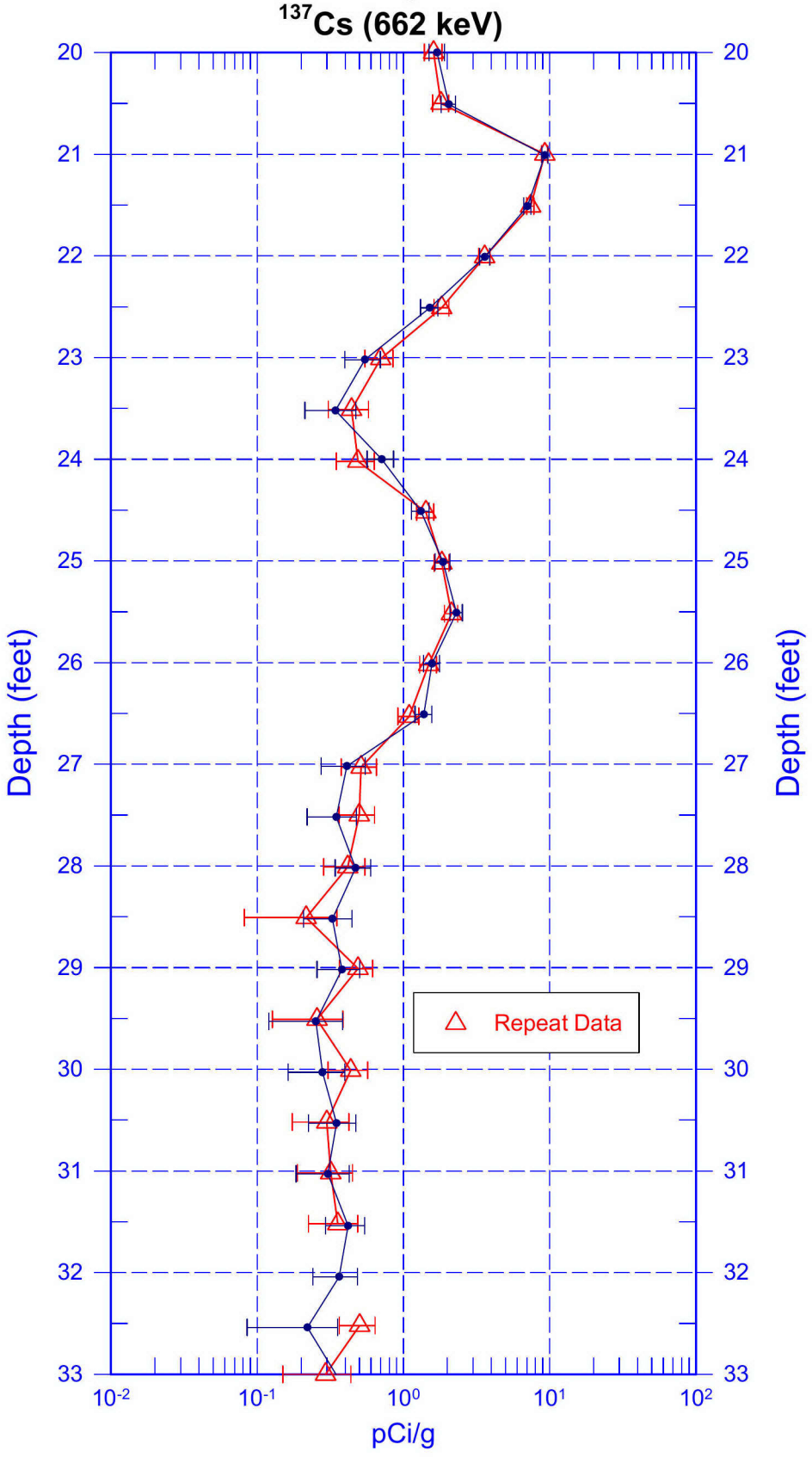
30-05-02 (299-E27-70 [A6695])

Manmade Repeat Section

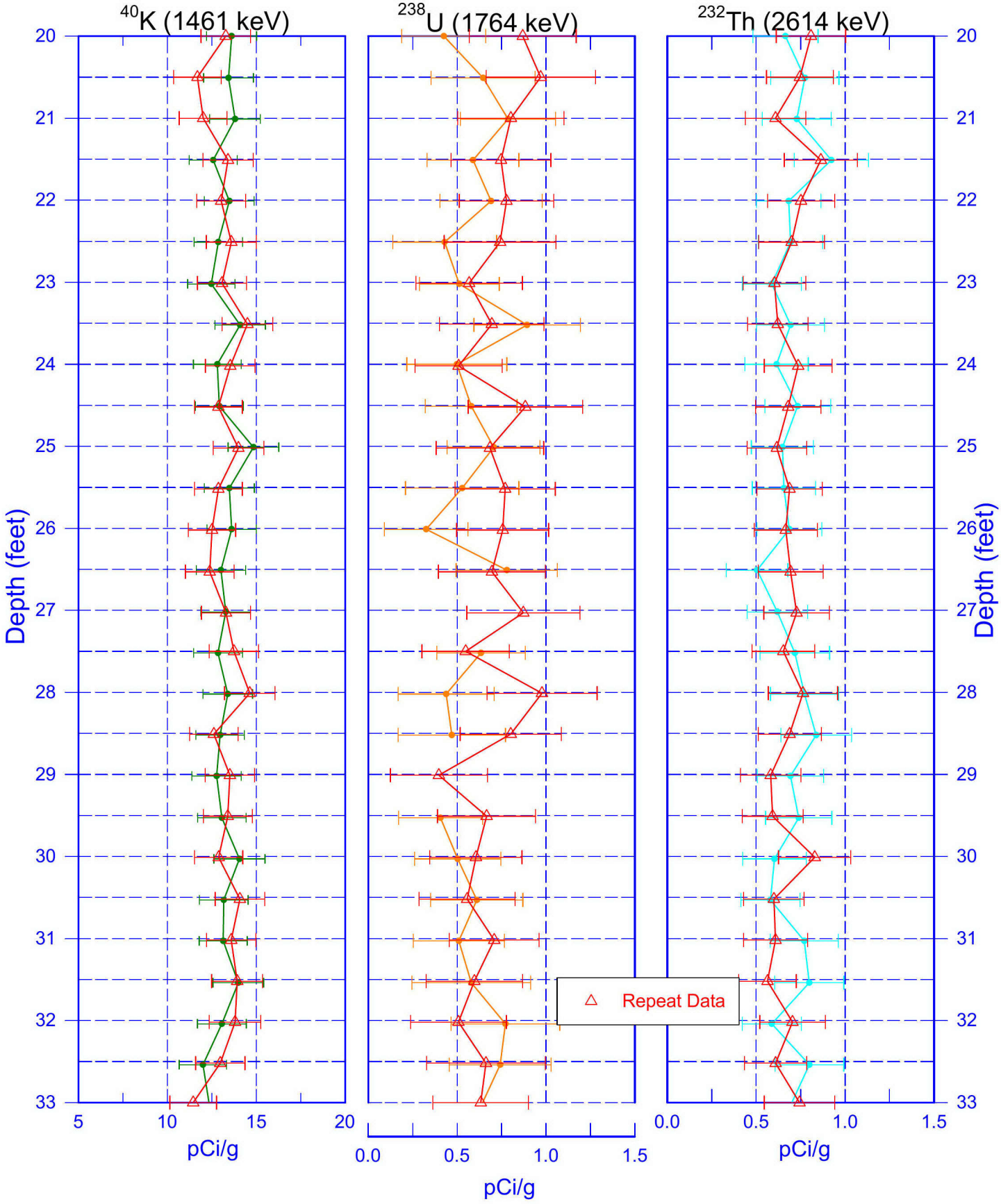


Zero Reference - Top of Casing

Stoller Hanford Office

30-05-02 (299-E27-70 [A6695])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-119 (A6739)

2010-2011 C-Farm Re-Baseline

30-05-06
299-E27-119 (A6739)
Log Data Report

Borehole Information:

Log Date:	2010-07-30	Filename:	A6739_HG_2010-07-30	Site:	241-C-105
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:	07/28/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	07/1974	N/A	61	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	61

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2010 was from 0 to 57.0 ft. The location of the borehole is indicated in the figure titled "Borehole 30-05-06 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1993 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-105* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

No water exists in the borehole casing.

The zero reference is the TOC, approximately at ground surface.

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System

Logging Equipment Information:

Logging System:	Gamma 2	**Type:**	DHMCA[5] SGLS BR
Effective Calibration Date:	09/03/09	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-062, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

SGLS Log Run Information:

Log Run	**1**	**2**	**3 Repeat**		
HEIS Number	1016214	1016215	1016216		
Date	7/28/10	7/30/10	7/30/10		
Logging Engineer	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway		
Start Depth (ft)	0.0	42.0	35.0		
Finish Depth (ft)	43.0	57.0	41.0		
Count Time (sec)	100	100	100		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.5	0.5	0.5		
Log Speed (ft/min)	N/A	N/A	N/A		
Pre-Verification	1016214_B	1016215_B	1016215_B		
Start File	_D_000000	_D_004200	_D_003500		
Finish File	_D_004303	_D_005702	_D_004103		
Post-Verification	1016214_A	1016216_A	1016216_A		
Depth Return Error (in.)	1/2 low	N/A	0.0		
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made		

Logging Operation Notes:

Data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above due to the length of file names (for example, _D_000000 for RUN01_BR_1016214_D_000000).

Analysis Notes:

Analyst:	C. Nelson	**Date:**	8/10/11	**Reference:**	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for 0.280-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20090903_BRr0b, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

[5] Down-Hole Multi-Channel Analyzer

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, 1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time corrections in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 concentrations were decayed to a common date of July 30, 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are still plotted.

Cs-137 was detected almost continuously from ground surface to the total logged depth of the borehole. A maximum concentration of approximately 18 pCi/g was measured at 1.0 ft. Comparisons with the 1997 data indicate no significant change. Comparison of 1997 and 2010 data with RLS[7] data acquired in 1993 indicate similar profiles.

RLS data acquired in 1993, suggested Co-60 was detected discontinuously from 16 to 51 ft at less than 0.3 pCi/g. The Co-60 was mostly observed from 45 to 50 ft. There was no evidence of Co-60 in the 1997 or 2010 log data.

A detection of U-235 in 1997 at ground surface is determined to be erroneous based on inspection of the spectrum, and has been removed from the data set.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

Depth Reference is ground surface

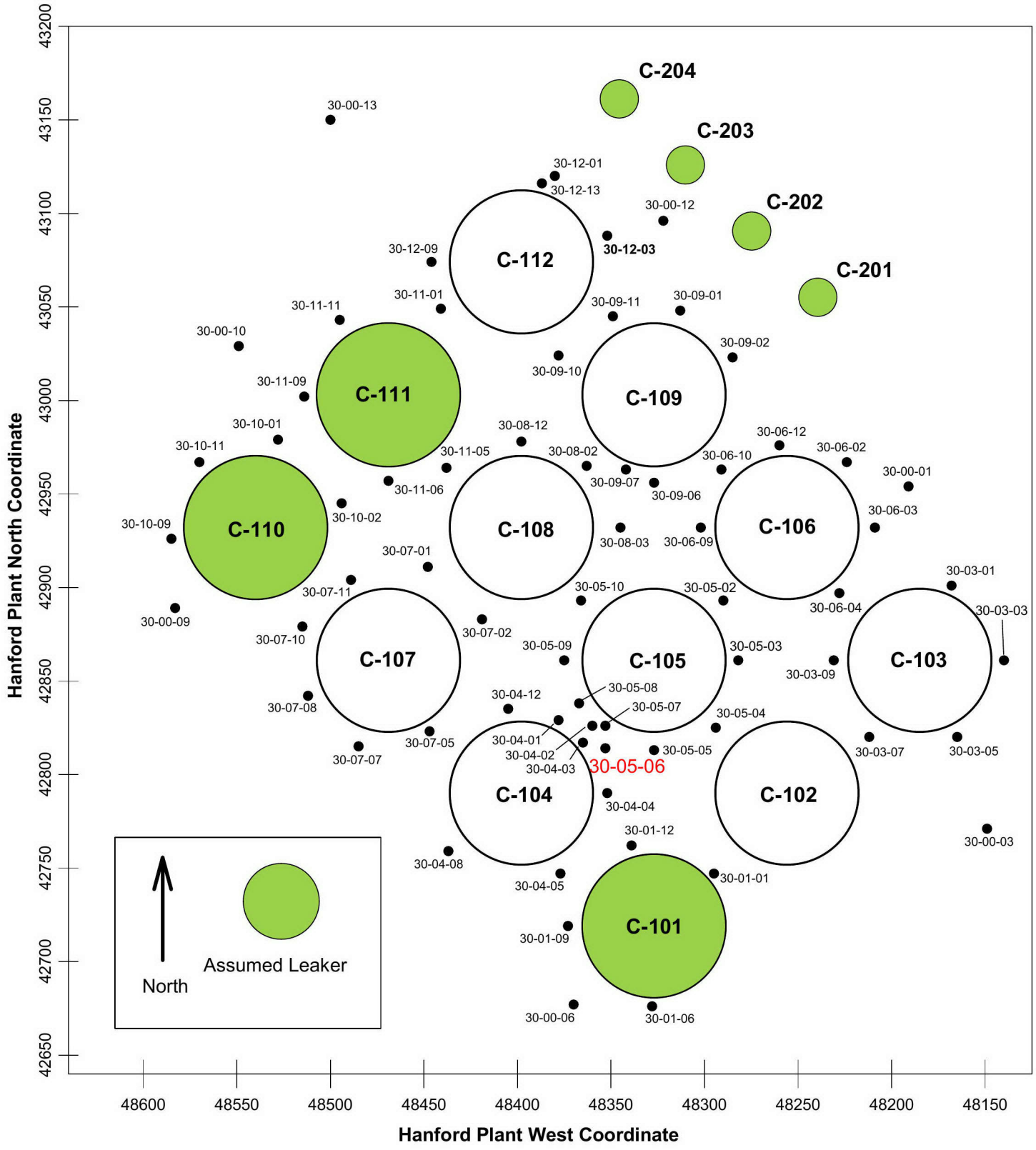
Borehole 30-05-06 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Manmade Repeat Section
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy (DOE) 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-105* GJ-HAN-83 Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

[6] minimum detection level
[7] Radionuclide Logging System

Borehole 30-05-06 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-05-06 (299-E27-119) (A6739)

Borehole Information

Site: C Farm, Tank C-105			
Coordinates (HAN Plant):	**North: 42814**	**West: 48353**	**Elevation (ft): 646.00**
Coordinates (WA Plane):	**North: 136532.824**	**East: 575153.361**	**Elevation (m): 198.272**
Drill Date: 7/31/1974	**Type: Cable Tool**	**Depth (ft): 57.5**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 1/28/04**	**D/W Reference: Stoller**	
Comments: RLS: Radionuclide Logging System, SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, WA State Plane Coordinates are NAVD88			

Casing Information

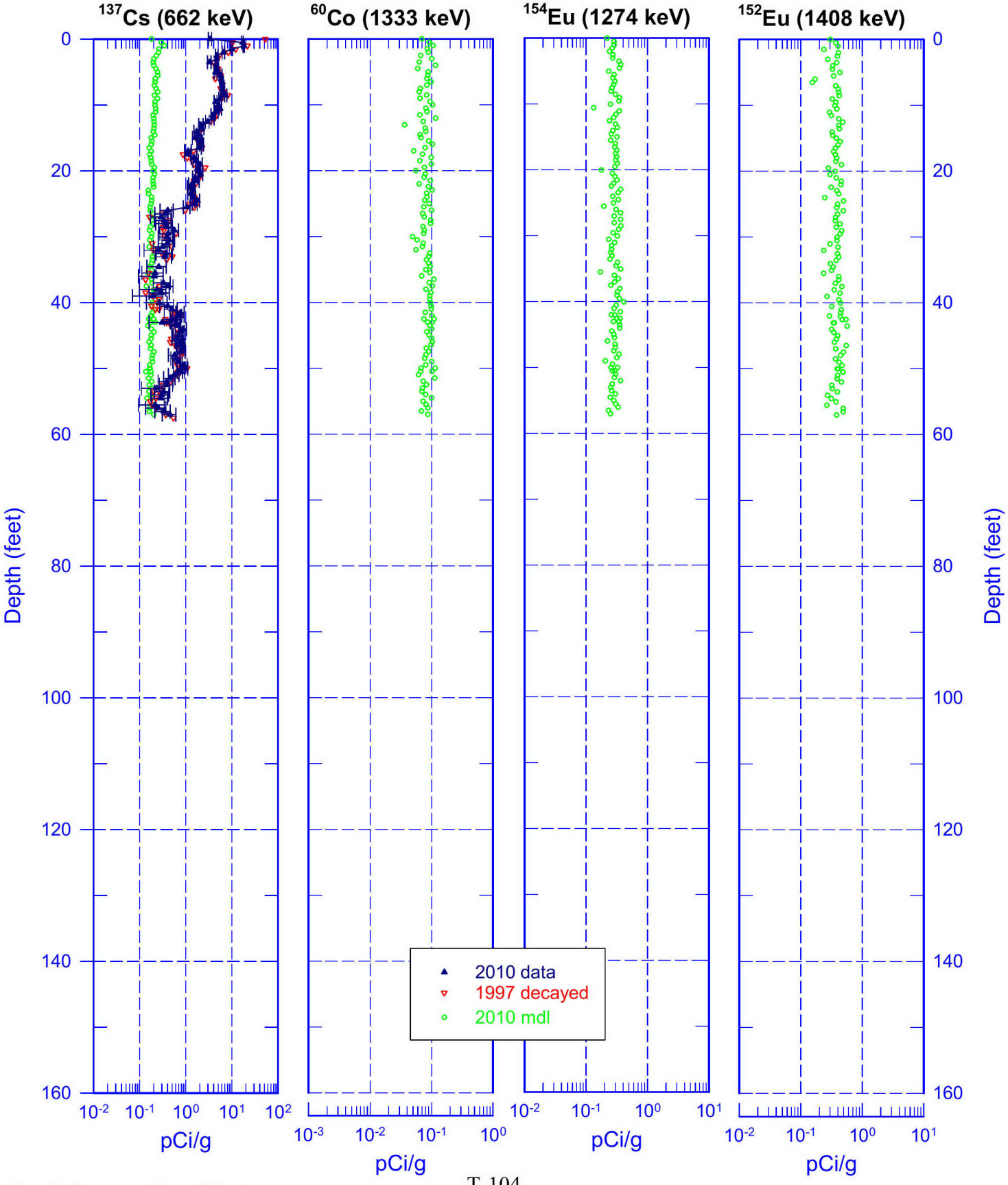
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	60	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
1993	RLS	Unk	NA	0-53	WHC	C-106 Investigation
1/22/1997	SGLS	G2A	1	0-57.5	MACTEC-ERS	Baseline
1/28/2004	RAS	Large-New	A	0-57	Stoller	No Apparent Change
9/3/2009	RAS	Large	B	0-56.5	Stoller	No Apparent Change
7/30/2010	SGLS	G2BR	2	0-57	Stoller	No Apparent Change

30-05-06 (299-E27-119 [A6739])

Comparison of Manmade Radionuclides (2010 &1997)



Zero Reference - Top of Casing

Stoller
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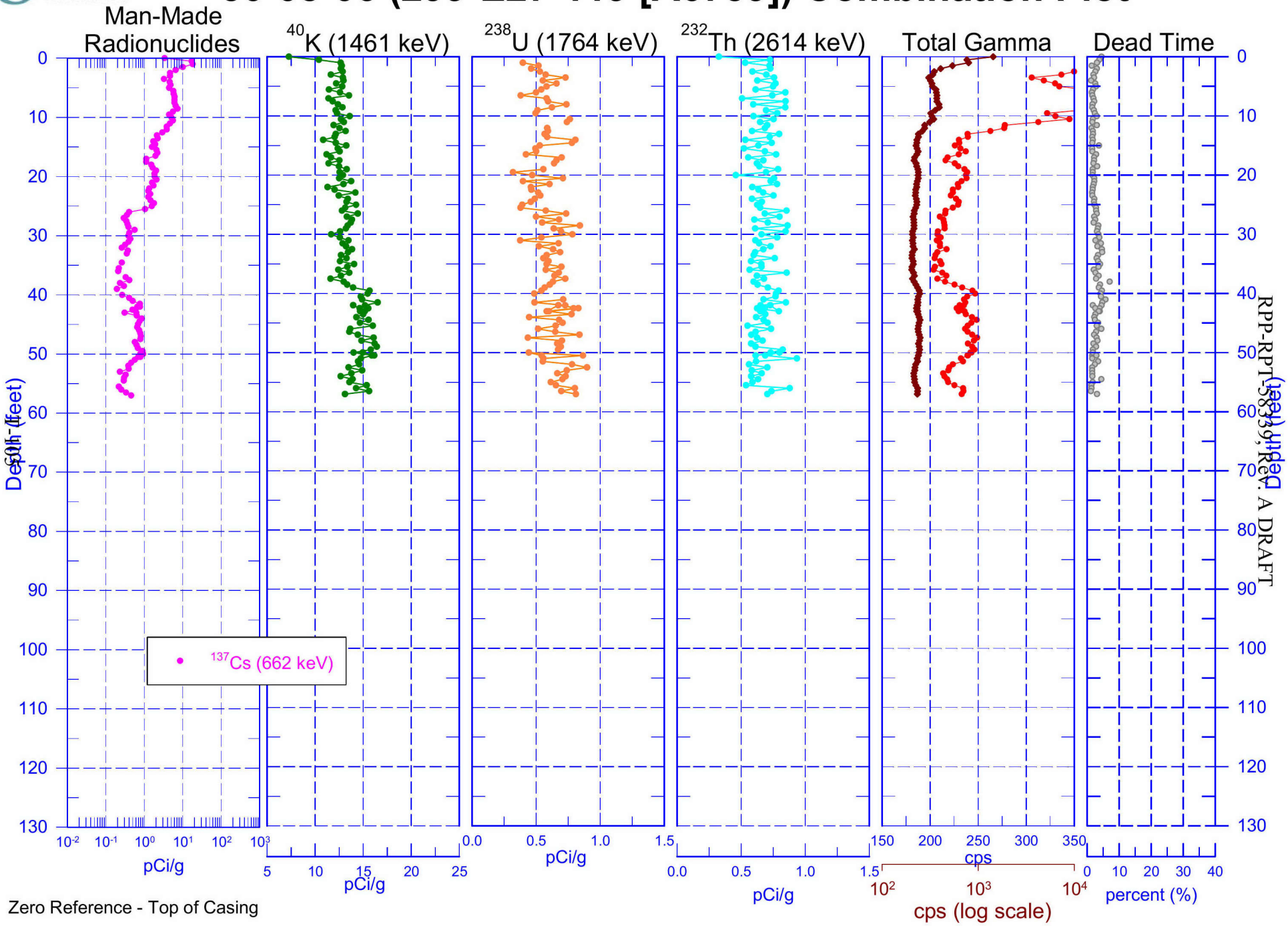
30-05-06 (299-E27-119 [A6739]) Combination Plot

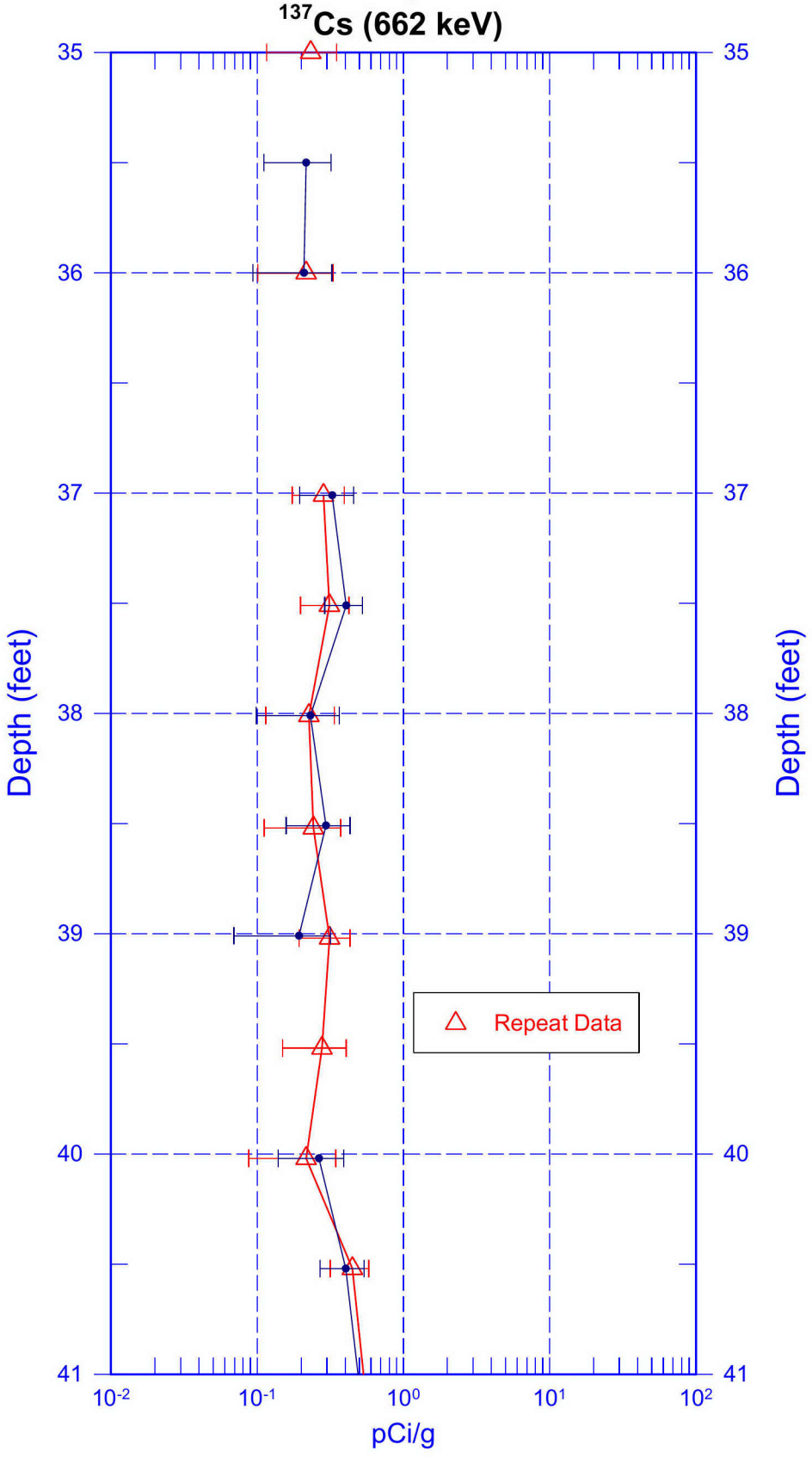


RPP-RPT-58339, Rev. A DRAFT

Stoller Hanford Office

30-05-06 (299-E27-119 [A6739])

Manmade Repeat Section

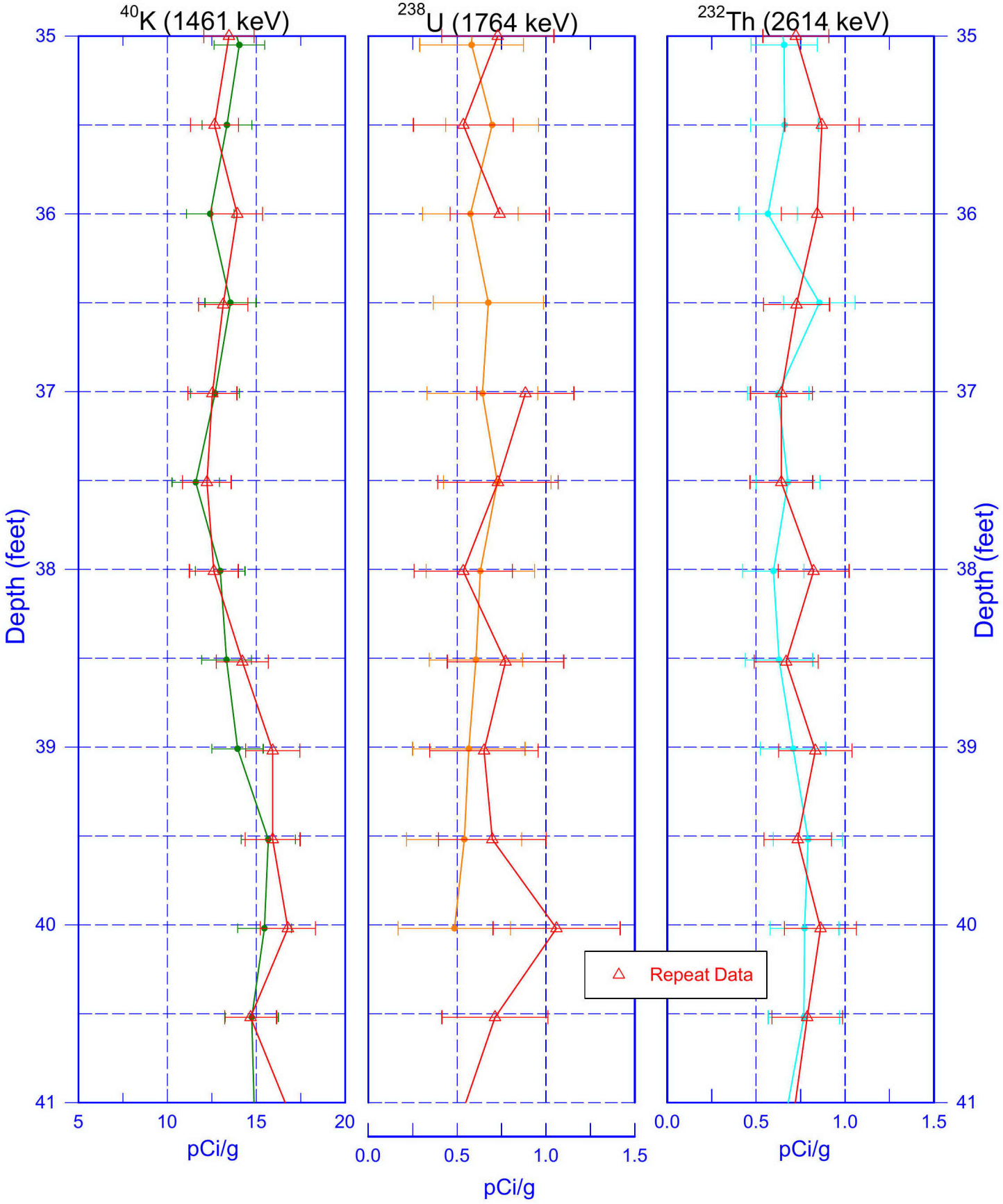


Zero Reference - Top of Casing

Stoller Hanford Office

30-05-06 (299-E27-119 [A6739])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-118 (A6738)

2010-2011 C-Farm Re-Baseline

30-05-07
299-E27-118 (A6738)
Log Data Report

Borehole Information:

Log Date:	2010-08-23	Filename:	A6738_HG_2010-08-23	Site:	241-C-105	
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:		08/03/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)		Type
N/A	N/A	7/1974	N/A	70		Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	70.0

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The depth interval logged in 2010 was from 0 to 66.5 feet. The location of the borehole is indicated in the figure titled "Borehole 30-05-07 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010, and HRLS[5] data acquired in 1999, 2004, and 2010. A summary of other logging data acquired since 1997 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-105* (DOE 1997). Casing thicknesses are derived from published values for schedule 40-steel pipe.

No water exists in this borehole.

The zero reference is the top of casing.

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] High Rate Logging System

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[6] SGLS
Effective Calibration Date:	09/22/10	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 2 C	**Type:**	DHMCA HRLS
Effective Calibration Date:	3/11/2010	**Serial No.:**	39A314
Calibration Reference:	HGLP-CC-063	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Handheld Moisture	**Type:**	Meter # MI-HP-3 Model # 503DR Campbell Pacific Nuclear Moisture Gauge
Effective Calibration Date:	6/21/10	**Serial No.:**	H-38068291
Calibration Reference:	HGLP-CC-039, Rev. 1	**Logging Procedure:**	TO-320-022, D-3

SGLS Log Run Information:

Log Run	**1**	**2**	**3**	**4 Repeat**	
HEIS Number	1016219	1016220	1016221	1016222	
Date	8/3/10	8/3/10	8/3/10	8/3/10	
Logging Engineer	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway	
Start Depth (ft)	0.0	31.5	64.0	9.0	
Finish Depth (ft)	33.5	64.5	66.5	15	
Count Time (sec)	100	20	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	1016219_B_1083	1016219_B_1083	1016219_B_1083	1016219_B_1083	
Start File	_D_000000	_D_003150	_D_006400	_D_000900	
Finish File	_D_003356	_D_006451	_D_006651	_D_001502	
Post-Verification	1016222_A_1083	1016222_A_1083	1016222_A_1083	1016222_A_1083	
Depth Return Error (in.)	N/A	N/A	N/A	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

HRLS Log Run Information:

Log Run	**5**	**6**	**7**	**8**	**9**
HEIS Number	1016236	1016237	1016238	1016239	1016240
Date	8/19/10	8/19/10	8/19/10	8/23/10	8/23/10
Logging Engineer	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway

[6] Down-Hole Multi-Channel Analyzer

Log Run	5	6	7	8	9
Start Depth (ft)	30.5	34.5	41.5	54.0	34.5
Finish Depth (ft)	35.5	42.5	55.0	62.0	42.5
Count Time (sec)	300	20	300	300	300
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	Internal
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	1016236_B_003450	1016236_B_003450	1016236_B_003450	1016236_B_003450	1016239_B_003450
Start File	_D_003050	_D_003450	_D_004150	_D_005400	_D_00345
Finish File	_D_003550	_D_004250	_D_00550	_D_006200	_D_004250
Post-Verification	1016238_A_003450	1016238_A_003450	1016238_A_003450	1016238_A_003450	1016240_A_003450
Depth Return Error (in.)	N/A	N/A	0.0	0.0	0.0
Comments	No fine gain adjustments made	Dead time >50%	Dead time <50%	No fine gain adjustments made	No fine gain adjustments made

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

HRLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the borehole at a depth with known Cs-137 concentrations. A centralizer was installed on the sonde.

File names were shortened on the table above due to the length of file names (for example, _D_000000 for RUN01_BR_1016281_D_000000).

Analysis Notes:

Analyst:	Legler	Date:	10/3/2011	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for a 0.28-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

HRLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100311_BCr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[7] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the

[7] minimum detection level

detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, all prior Cs-137 data were decayed to a common date of August 23, 2010.

SGLS logging is conducted by S.M. Stoller, as is logging with the NMLS[8]. NMLS data are acquired digitally at 0.25-ft intervals with a count time of 15 seconds. Where available, the most recent NMLS data are reported in the re-baseline log data reports. Tank Farm's handheld moisture data are acquired by Tank Farms Operations using a handheld moisture gauge that is lowered by hand and held in place for measurements by cable stops at 1-ft increments, at count times of 16 seconds. These data are manually recorded on data sheets, and submitted to S.M. Stoller for data entry and analysis. Calibration for both systems to assess system performance and determine volumetric moisture is performed by S.M. Stoller using the same procedure. Handheld moisture data are being collected for selected boreholes in C Farm. NMLS data are not available for this borehole. Handheld moisture data were acquired in this borehole on March 6, 2011 using moisture gauge M1-HP-3 and AmBe source H-38068291. Results are included in this report.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154 and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected almost continuously from ground surface to 66.5 ft, with a maximum concentration of approximately 19,800,000 pCi/g at 37.5 ft measured using the HRLS with an internal tungsten shield. No significant changes have occurred since 1997.

Co-60 detected in 1997 at 28.5 ft and 65 to 66.5 ft has apparently decayed below the 2010 MDL. However, it is likely it exists in the high activity zone below 35 ft.

Detections using the routine processing software in 1997 for Eu-154, Eu-152, and U-235 have been determined to be invalid. These erroneous detections have been removed from the data set.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. The detector is influenced by extremely high gamma activity between 34 and 42 ft and does not reflect the true moisture content.

The repeat plots indicate that the respective systems were working properly.

[8] Neutron Moisture Logging System

List of Log Plots:

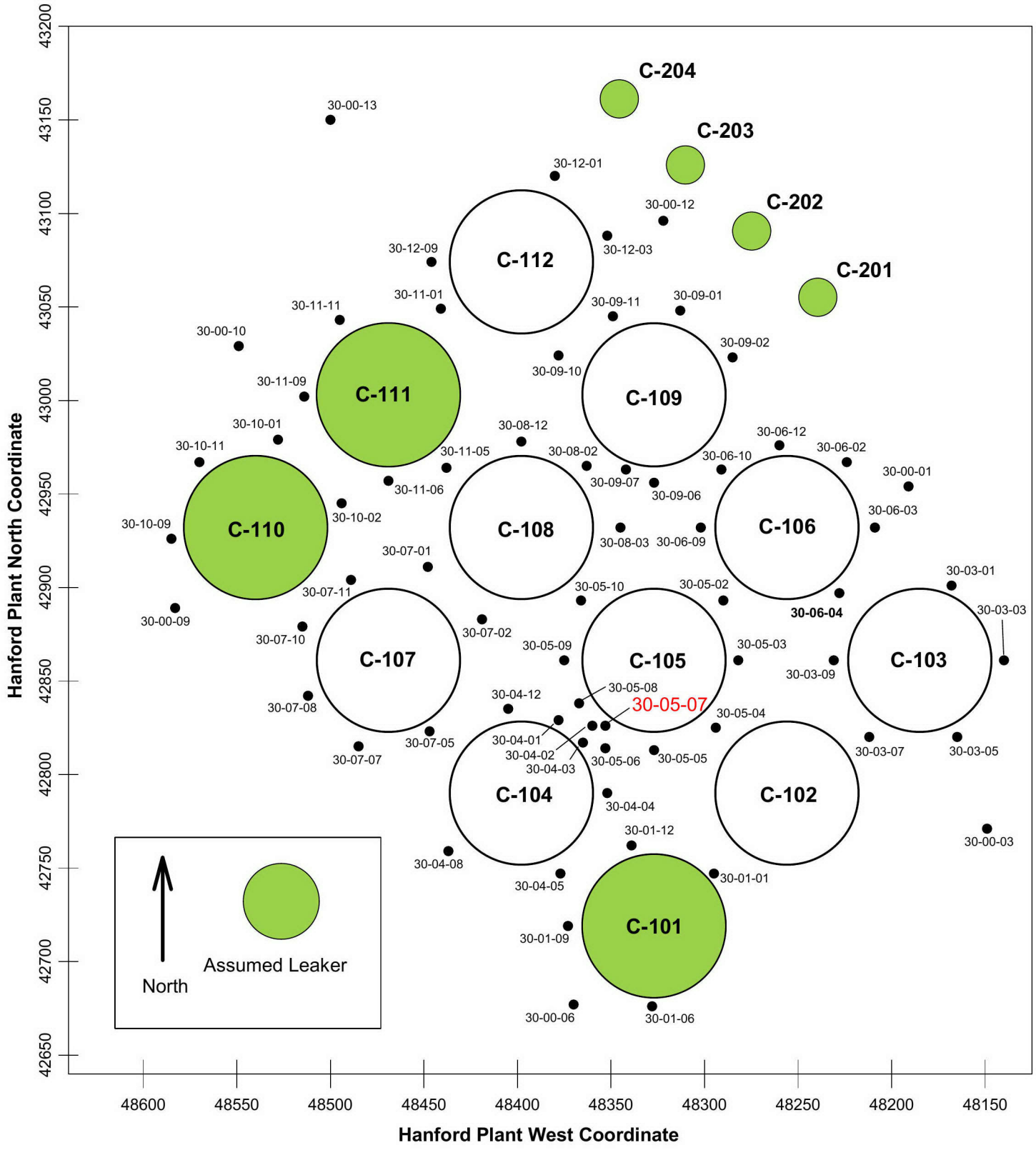
Depth Reference is top of casing

Borehole 30-05-07 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010, 2004, 1999 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-105.* GJ-HAN-105. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-05-07 Location in C Tank Farm



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Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-05-07 (299-E27-118) (A6738)

Borehole Information

Site: C Farm, Tank C-101			
Coordinates (HAN Plant):	**North: 42826**	**West: 48353**	**Elevation (ft): 646.00**
Coordinates (WA Plane):	**North: 136536.582**	**East: 575153.242**	**Elevation (m): 198.191**
Drill Date: 7/31/1974	**Type: Cable Tool**	**Depth (ft): 67**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 4/22/03**	**D/W Reference: Stoller**	
Comments: A well cap was stuck in the borehole at approximately 48 ft. This well cap was removed prior to HRLS logging on 3/8/04. GLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, HRLS: High Rate Logging System WA State Plane Coordinates are NAVD88			

Casing Information

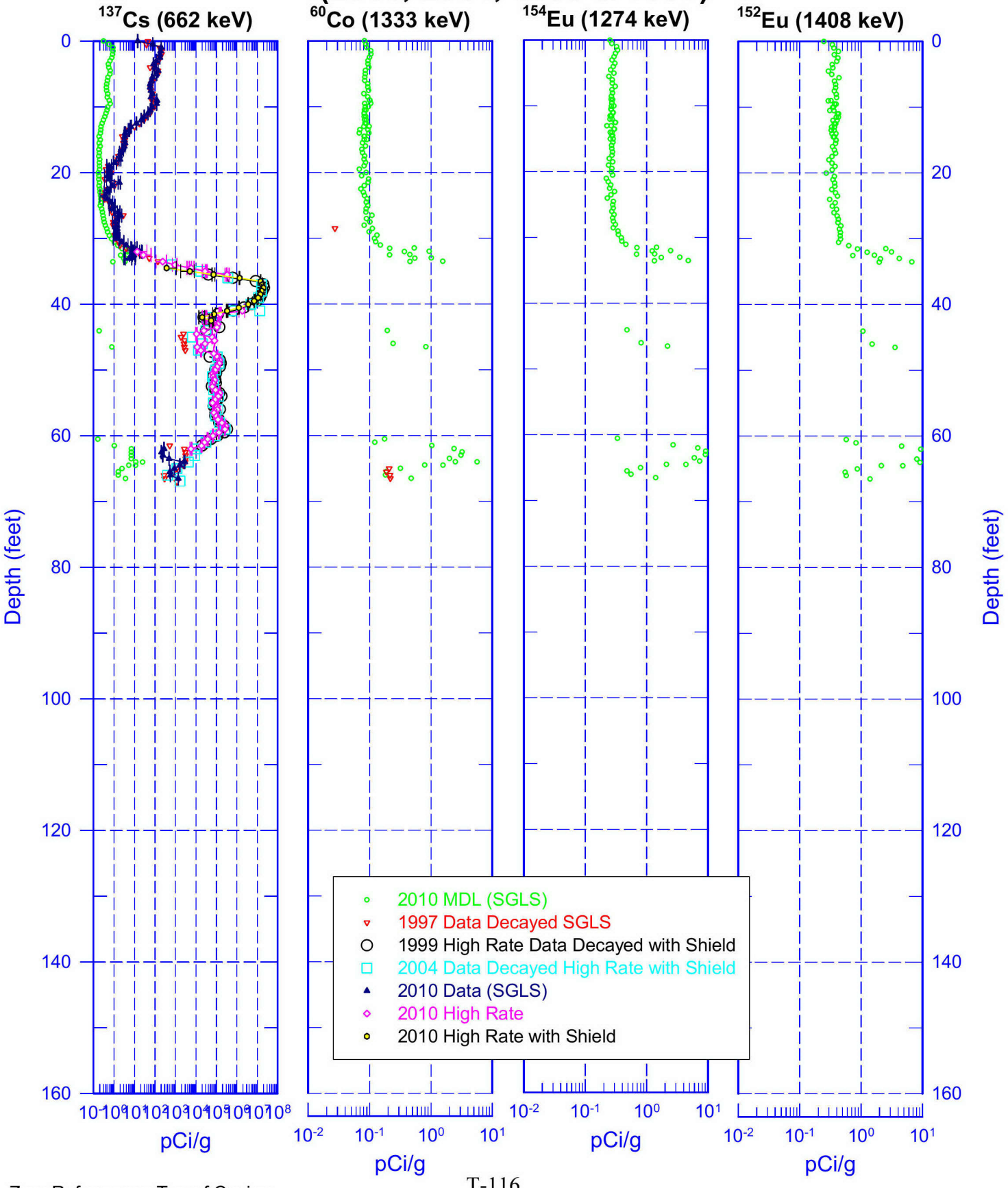
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	70	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
1/21/1997	SGLS	G2A	1	0-67	MACTEC-ERS	Baseline
12/16/1999	HRLS	Highrate	1	30-67	MACTEC-ERS	Baseline-Highrate
4/25/2002	RAS	Small	A	30-35	MACTEC-ERS	No Change
4/25/2002	RAS	Small	A	42-48	MACTEC-ERS	No Change
5/7/2003	RAS	Small	B	30-35	Stoller	No Change
5/7/2003	RAS	Small	B	42-48	Stoller	No Change
3/8/2004	HRLS	Highrate	2	30-67	Stoller	No change
8/3/2010	SGLS	2BR	2	0-66.5	Stoller	No change
8/23/2010	HRLS	2BC	3	30.5-62	Stoller	No change

30-05-07 (299-E27-118 [A6738])

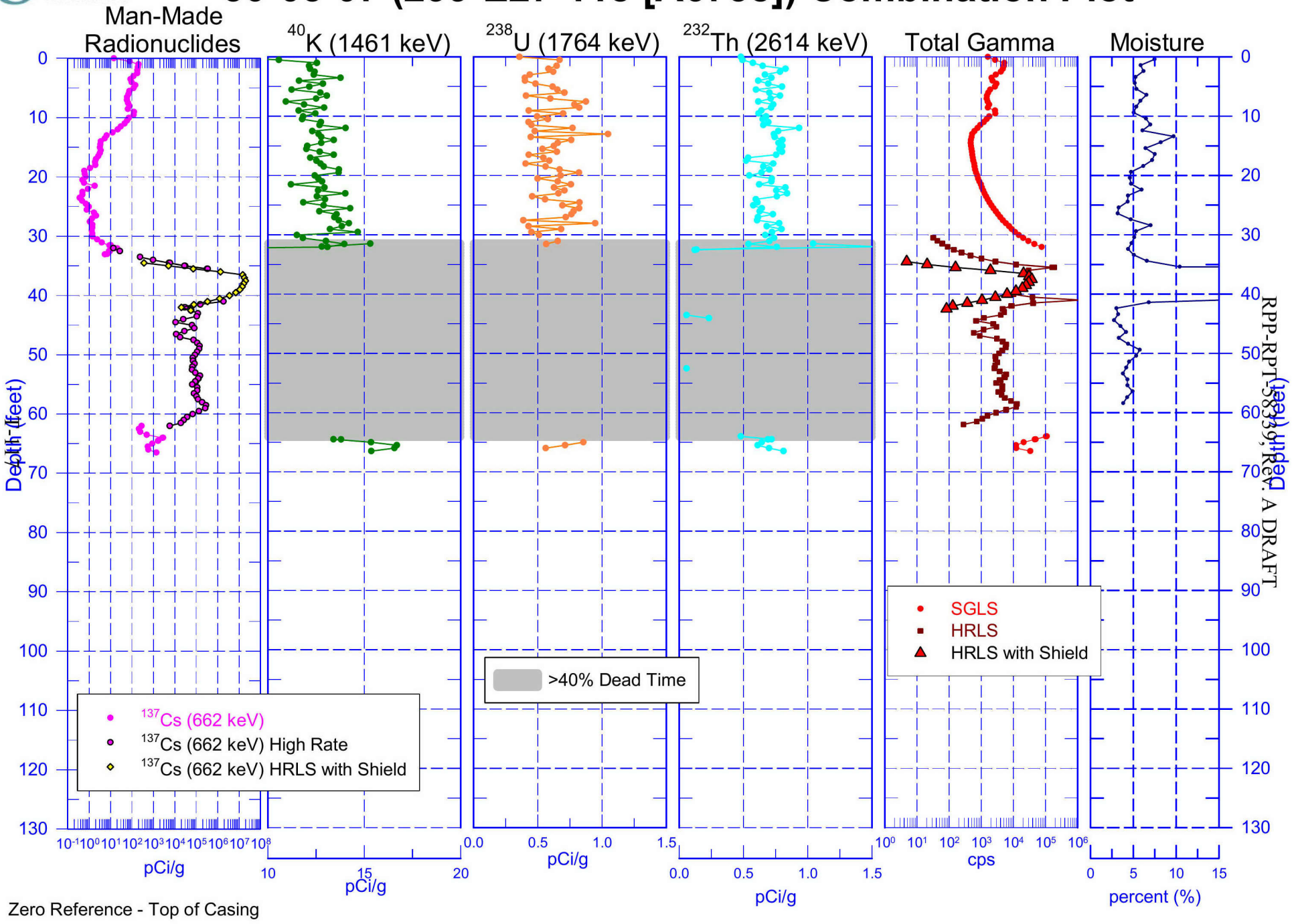
Comparison of Manmade Radionuclides (2010, 2004, 1999 & 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-05-07 (299-E27-118 [A6738]) Combination Plot



RPP-RPT-58339, Rev. A DRAFT

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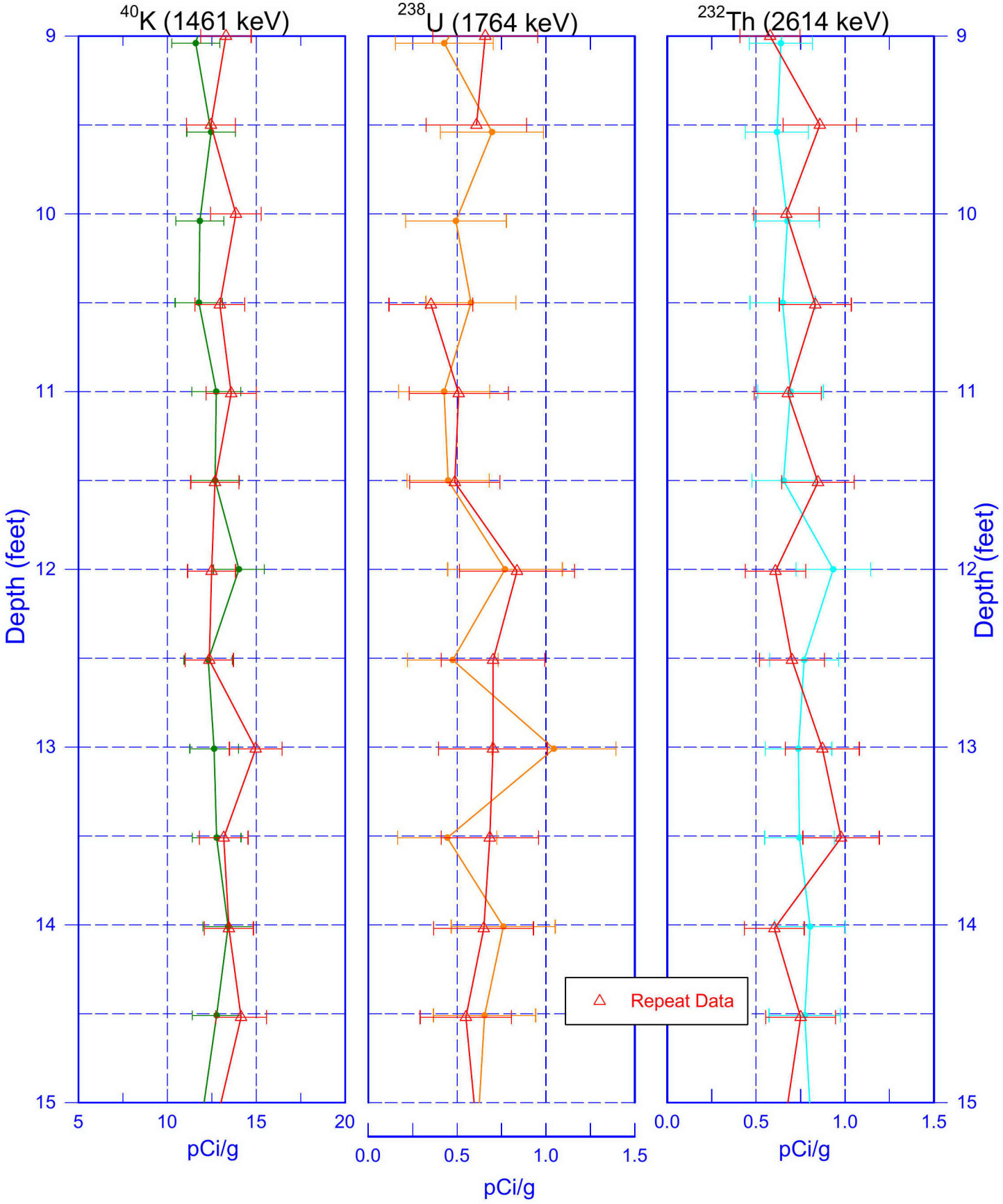
30-05-07 (299-E27-118 [A6738])

Repeat Section of Natural Gamma Logs

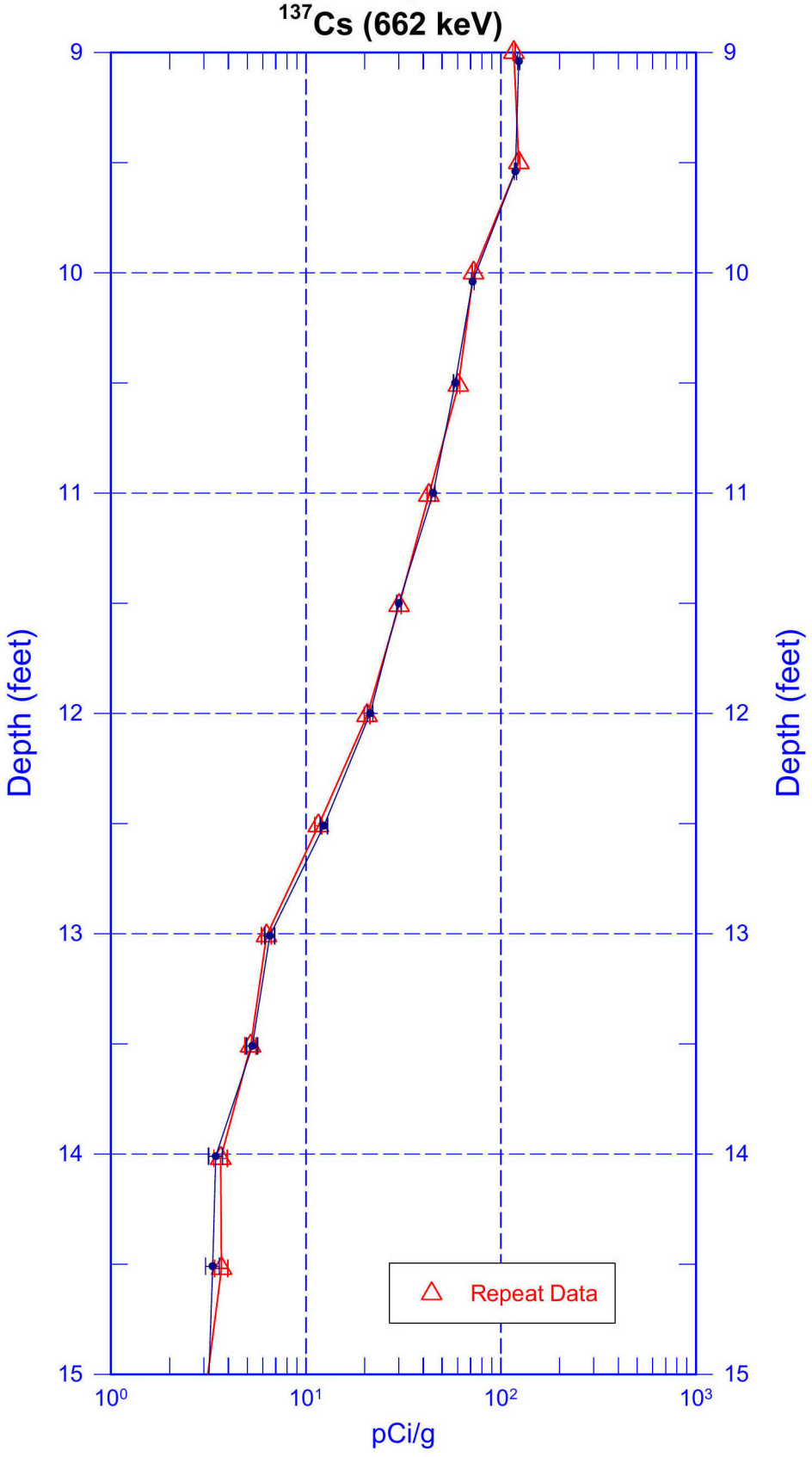


Zero Reference - Top of Casing

Stoller Hanford Office

30-05-07 (299-E27-118 [A6738])

Manmade Repeat Section



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-117 (A6737)

Stoller Hanford Office established 1959

HGLP-LDR-611, Rev. 0

2010-2011 C-Farm Re-Baseline

30-05-08
299-E27-117 (A6737)
Log Data Report

Borehole Information:

Log Date:	2010-08-02	Filename:	A6737_HG_2010-08-02	Site:	241-C-105
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:	10/11/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	7/1974	N/A	50	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	50

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The location of the borehole is indicated in the figure titled "Borehole 30-05-08 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS™ [4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1993 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-105* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

No water was observed in this borehole.

The zero reference is the top of casing, approximately at ground surface.

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System

Logging Equipment Information:

Logging System:	Gamma 2	**Type:**	DHMCA[5] SGLS BR
Effective Calibration Date:	9/10/2009	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-062, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Handheld Moisture Meter # MI-HP-3	**Type:**	Model # 503DR Campbell Pacific Nuclear Moisture Gauge
Effective Calibration Date:	6/21/10	**Serial No.:**	H-38068291
Calibration Reference:	HGLP-CC-039, Rev. 1	**Logging Procedure:**	TO-320-022, D-3

SGLS Log Run Information:

Log Run	**1**	**2**			
HEIS Number	1016217	1016218			
Date	8/02/10	8/02/10			
Logging Engineer	Spatz/Holloway	Spatz/Holloway			
Start Depth (ft)	0.0	35.0			
Finish Depth (ft)	48.0	40.0			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.5	0.5			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	1016217_B	1016217_B			
Start File	_D_000000	_D_003500			
Finish File	_D_004801	_D_004002			
Post-Verification	1016218_A	1016218_A			
Depth Return Error (in.)	N/A	0.0			
Comments	No fine gain adjustments made	No fine gain adjustments made			

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the table above due to the length of file names (for example, _D_000051 for A6737_BR_1016281_D_000051).

[5] Down-Hole Multi-Channel Analyzer

Analysis Notes:

Analyst:	Legler	Date:	8/15/2011	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Casing corrections for a 0.28-in. thick casing were applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20090903_BRr0b, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the 1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137, Co-60, and Eu-154 were decayed to a common date of August 2, 2010.

SGLS logging is conducted by Stoller, as is logging with the NMLS[7]. NMLS data are acquired digitally at 0.25-ft intervals with a count time of 15 seconds. Where available, the most recent NMLS data are reported in the re-baseline log data reports. Tank Farm's handheld moisture data are acquired by Tank Farms Operations using a handheld moisture gauge that is lowered by hand and held in place for measurements by cable stops at 1-ft increments, at count times of 16 seconds. These data are manually recorded on data sheets, and submitted to Stoller for data entry and analysis. Calibration for both systems to assess system performance and determine volumetric moisture is performed by Stoller using the same procedure. Handheld moisture data are being collected for selected boreholes in C Farm. NMLS data are not available for this borehole. Handheld moisture data were acquired in this borehole on March 6, 2011 using moisture gauge M1-HP-3 and AmBe source H-38068291. Results of the handheld moisture are included in this report.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137, Co-60, and Eu-154 were detected in this borehole.

Cs-137 was detected continuously from ground surface to 48 ft, with a maximum concentration of approximately 104 pCi/g at 1 ft. No significant changes have occurred since 1997.

[6] minimum detection level
[7] Neutron Moisture Logging System

Co-60 was detected almost continuously from 35 to 39.5 ft, with a maximum concentration of approximately 0.3 pCi/g at 38 ft. No significant changes occurred since 1997. However, Co-60 concentrations that were detected in 1997 at some depth locations have decayed below the MDL of the 2011 SGLS.

Eu-154 was detected continuously from 14 to 18 ft, with a maximum concentration of approximately 7.8 pCi/g at 16.5 ft. No significant changes occurred since 1997.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

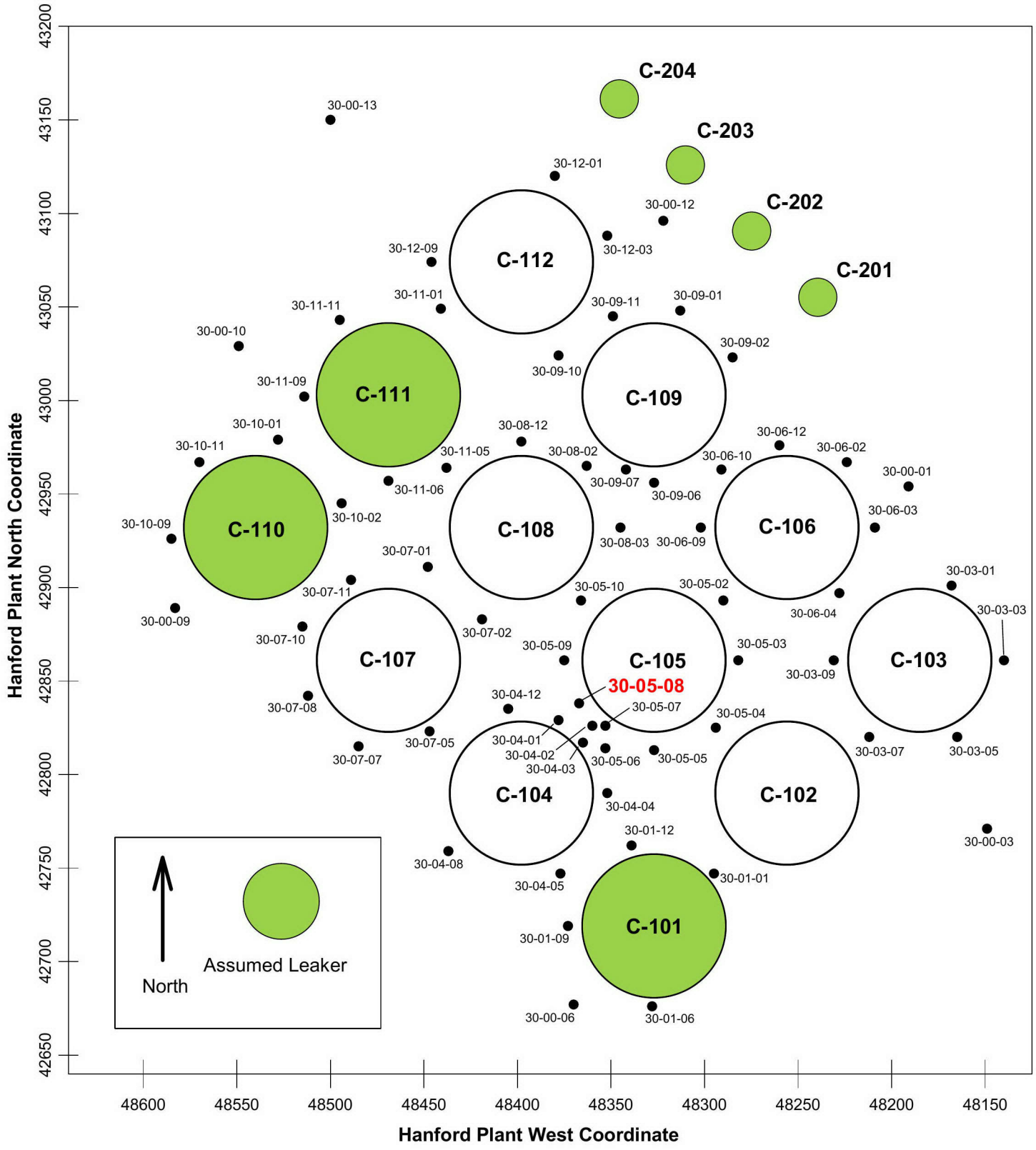
Depth Reference is top of casing

Borehole 30-05-08 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-105.* GJ-HAN-83. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-05-08 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-05-08 (299-E27-117) (A6737)

Borehole Information

Site: C Farm, Tank C-105			
Coordinates (HAN Plant):	**North: 42838**	**West: 48367**	**Elevation (ft): 646.00**
Coordinates (WA Plane):	**North: 136540.214**	**East: 575149.137**	**Elevation (m): 198.176**
Drill Date: 7/31/1974	**Type: Cable Tool**	**Depth (ft): 49**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 4/22/03**	**D/W Reference: Stoller**	
Comments: RLS: Radionuclide Logging System, SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, WA State Plane Coordinates are NAVD88			

Casing Information

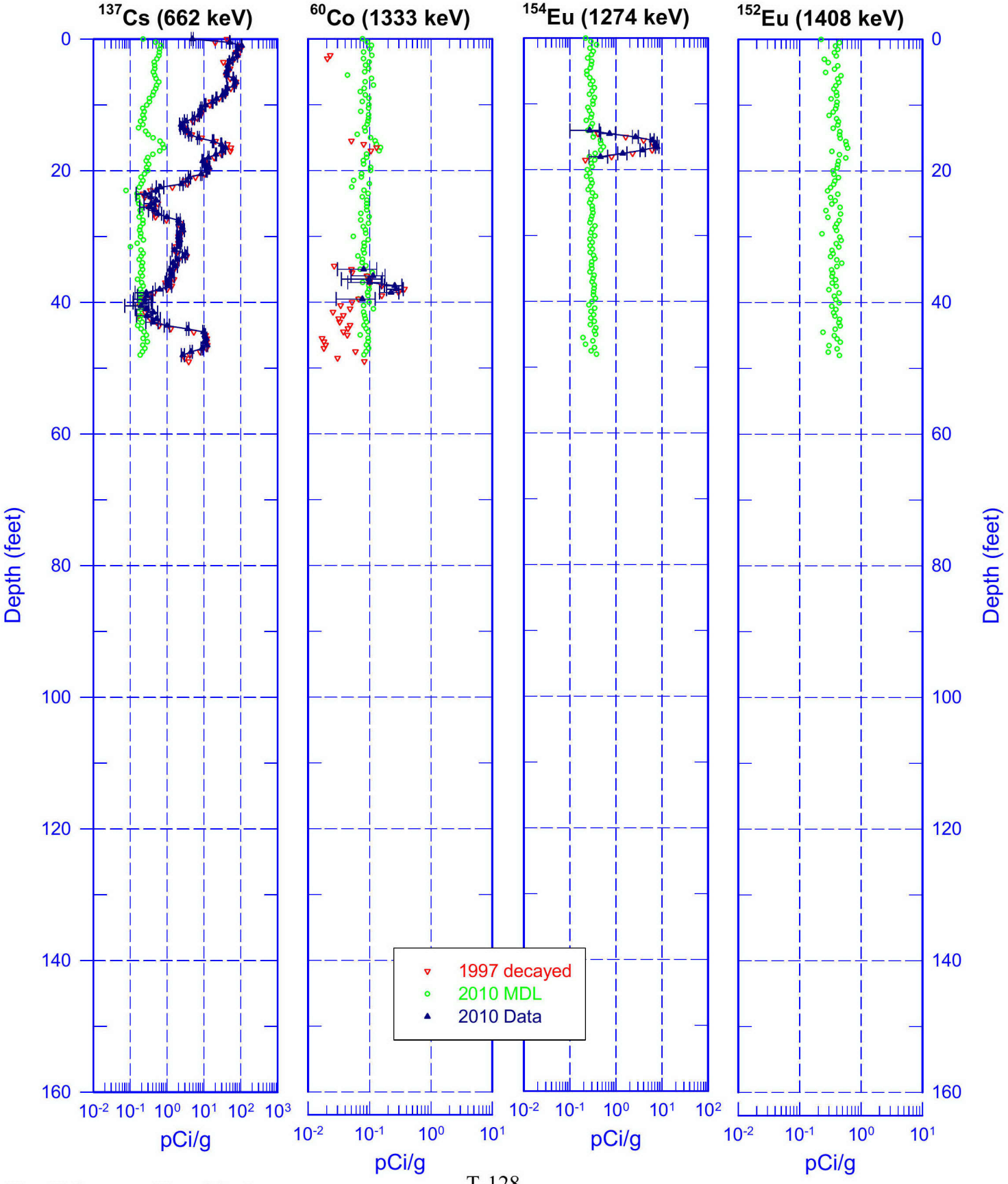
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	50	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
1993	RLS	Unk	NA	0-44	WHC	C-106 Investigation
1/24/1997	SGLS	G2A	1	0-49	MACTEC-ERS	Baseline
4/22/2002	RAS	Large	A	30-49	MACTEC-ERS	No Apparent Change
5/1/2003	RAS	Large-New	B	25-48	Stoller	No Apparent Change
8/2/2010	SGLS	G2BR	2	0-48	Stoller	No Apparent Change

30-05-08 (299-E27-117 [A6737])

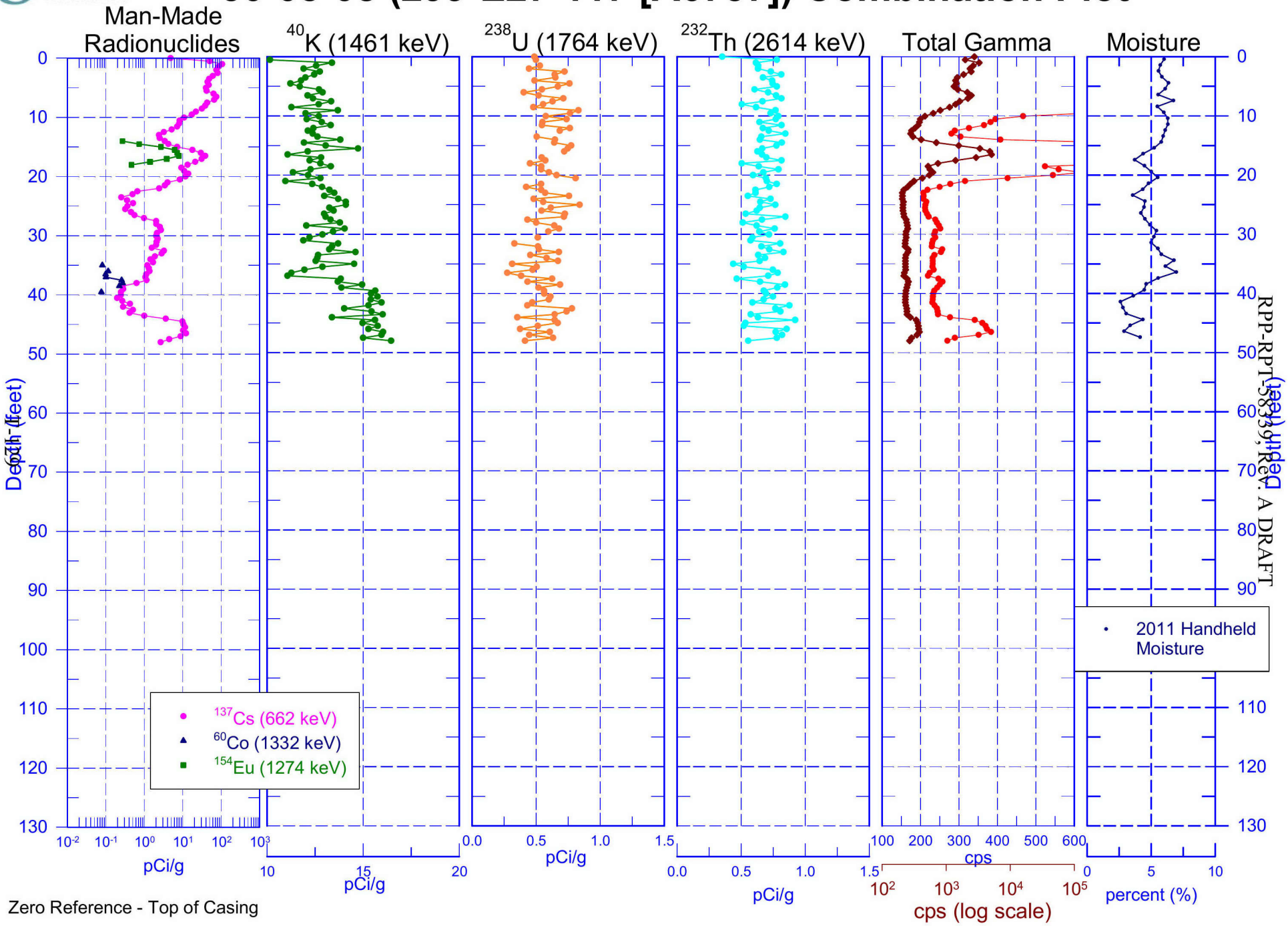
Comparison of Manmade Radionuclides (2010 & 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-05-08 (299-E27-117 [A6737]) Combination Plot



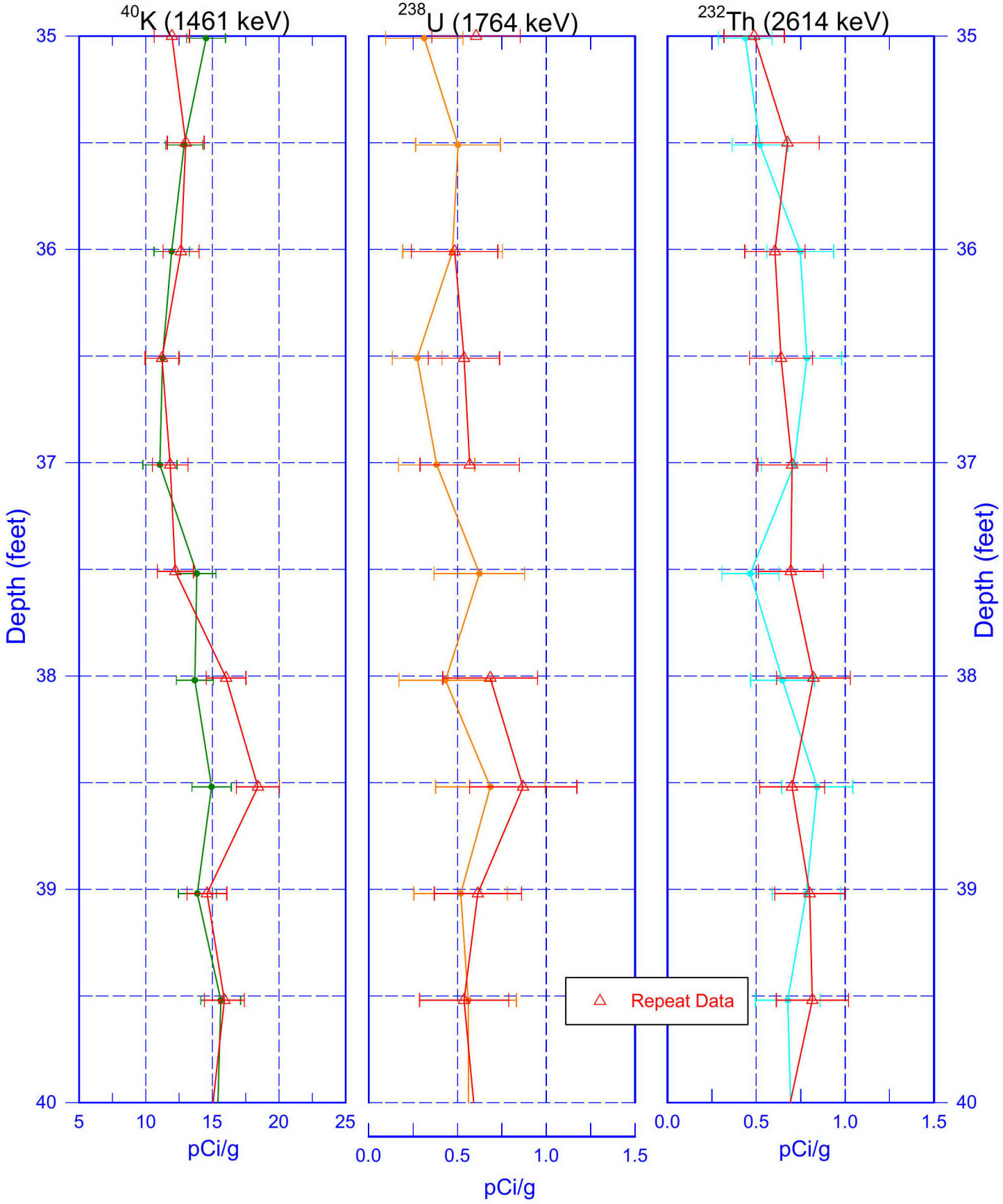
Zero Reference - Top of Casing

RPP-RPT-58339, Rev. A DRAFT (Uncontrolled)

Stoller Hanford Office

30-05-08 (299-E27-117 [A6737])

Repeat Section of Natural Gamma Logs

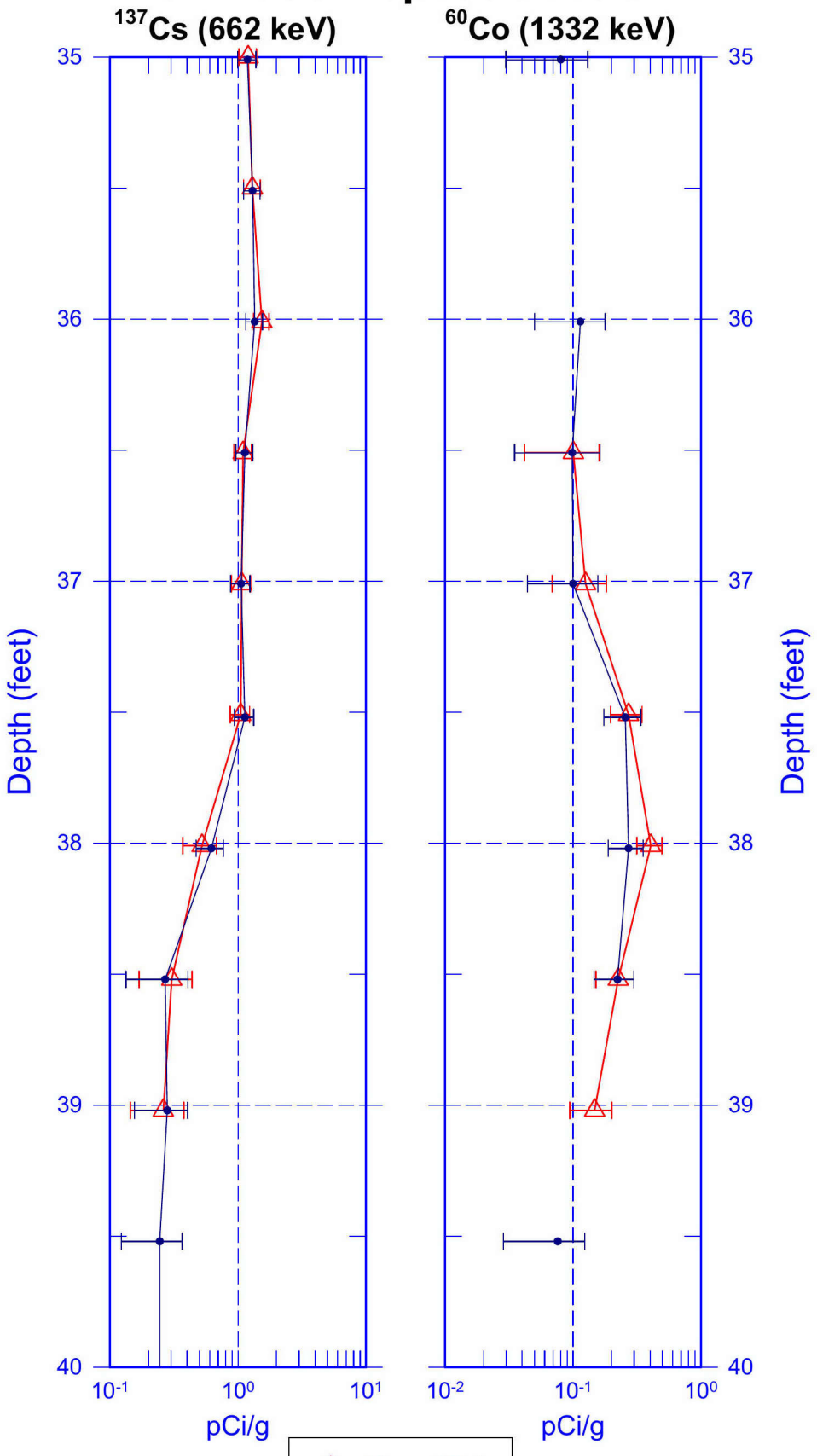


Zero Reference - Top of Casing

Stoller Hanford Office

30-05-08 (299-E27-117 [A6737])

Manmade Repeat Section



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-72 (A6697)

2010-2011 C-Farm Re-Baseline

30-06-02
299-E27-72 (A6697)
Log Data Report

Borehole Information:

Log Date:	2010-09-29	Filename:	A6697_HG_2010-09-29	Site:	241-C-106
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:	09/27/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	11/30/1972	N/A	125	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	122.5

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2010 was from 0 to 122 feet. The location of the borehole is indicated in the figure titled "Borehole 30-06-02 Location in C Tank Farm."

Water was not observed in this borehole.

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997, 2004 and 2010. A summary of other logging data acquired since 1993 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-106* (DOE 1997). Casing thicknesses are derived from published values for schedule 40-steel pipe.

The zero reference is the top of casing, approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2 BR	Type:	DHMCA[5] SGLS BR
Effective Calibration Date:	09/22/10	Serial No.:	48-TP50478A

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

Calibration Reference:	HGLP-CC-065, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 2 A	**Type:**	35% HPGe SGLS
Effective Calibration Date:	12/22/03	**Serial No.:**	34TP20893A
Calibration Reference:	GJO-2004-593-TAC	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 2F	**Type:**	NMLS[6]
Effective Calibration Date:	10/04	**Serial No.:**	H380932510
Calibration Reference:	DOE-EM/GJ754-2004	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev. 0

SGLS Log Run Information:

Log Run	**1**	**2**	**3**	**4 Repeat**	
HEIS Number	1016270	1016271	1016272	1016273	
Date	9/27/10	9/28/10	9/29/10	9/29/10	
Logging Engineer	Spatz/Holloway/ Legler	Spatz/Holloway/ Legler	Spatz/Holloway/ Legler	Spatz/Holloway/ Legler	
Start Depth (ft)	0.0	20.0	82.0	35.0	
Finish Depth (ft)	21.0	83.0	122.0	47.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	B_10927	B_10928	B_10929	1016272_B10929	
Start File	_D_000000	_D_002000	_D_008200	_D_003500	
Finish File	_D_002104	_D_008300	_D_012200	_D_004700	
Post-Verification	A_10927	A_10928	1016273_A_10929	A_10929	
Depth Return Error (in.)	0.0	0.0	N/A	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

Log Run	**6**	**7 Repeat**			
HEIS Number	1017884	1017885			
Date	3/1/04	3/1/04			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	40.0	55.0			
Finish Depth (ft)	80.0	59.0			
Count Time (sec)	100	100			
Live/Real	R	R			

[6] Neutron Moisture Logging System

Log Run	6	7 Repeat			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.5	0.5			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	BA310CAB	BA310CAB			
Start File	BA310000	BA310081			
Finish File	BA310080	BA310089			
Post-Verification	BA311CAA	BA311CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	Adjusted gain after file BA310069	No fine gain adjustments made			

NMLS Log Run Information:

Log Run	8	9 Repeat			
HEIS Number	1017886	1017887			
Date	10/29/04	10/29/04			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	85.0			
Finish Depth (ft)	95.0	122.0			
Count Time (sec)	N/A	N/A			
Live/Real	N/A	N/A			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	1.0	1.0			
Pre-Verification	BF184CAB	BF184CAB			
Start File	BF184000	BF184381			
Finish File	BF184380	BF184529			
Post-Verification	BF184CAA	BF184CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	None	Repeat section 85.0 to 95.0 ft			

Logging Operation Notes:

Data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

NMLS data were collected using Gamma 1, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the AmBe standard field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above for 2010 SGLS log run information due to the length of file names (e.g. RUN01_BR_1016270_D_000000).

Analysis Notes:

Analyst:	C. Nelson	Date:	7/21/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Casing corrections for a 0.28-in. thick casing were applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1b, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[7] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, 1997 and 2004 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 and 2004 were applied during reprocessing. For purposes of comparison with the 2010 data, the 1997 and 2004 Cs-137 were decayed to a common date of September 29, 2010. Data were acquired in 2004 from the depth interval of 40 to 80 ft.

During the time from April 2003 to October 2004 NMLS data were acquired seven times. The most recent NMLS data are reported in this log data report.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154 and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected from ground surface to 14 ft, intermittently from 21 to 60.5 ft, and intermittently from 114 ft to the total logged depth of the borehole. A maximum concentration of approximately 8 pCi/g was measured at 0.5 ft. Comparisons with the 2004 and 1997 data indicate no significant change.

[7] minimum detection level

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. Moisture data were acquired from the interval of ground surface to 122 ft. The most recent 2004 NMLS data are reported in this log data report.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

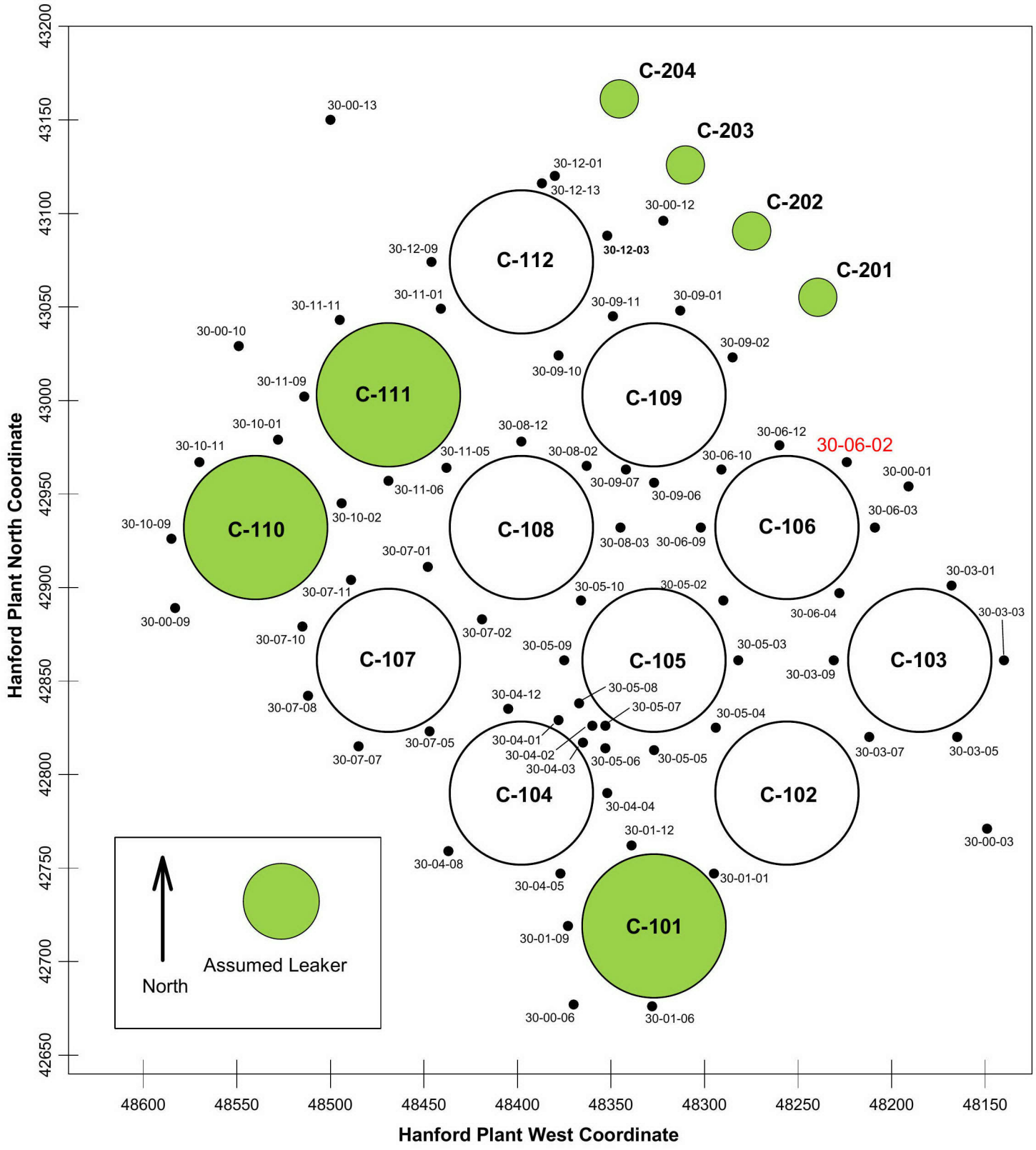
Depth Reference is top of casing

Borehole 30-06-02 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010, 2004 & 1997)
Combination Plot
Manmade Repeat Section
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-106.* GJ-HAN-84. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-06-02 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-06-02 (299-E27-72) (A6697)

Borehole Information

Site: C Farm, Tank C-106			
Coordinates (HAN Plant):	**North: 42967**	**West: 48244**	**Elevation (ft): 645.33**
Coordinates (WA Plane):	**North: 136579.598**	**East: 575192.544**	**Elevation (m): 197.644**
Drill Date: 11/30/1972	**Type: Cable Tool**	**Depth (ft): 122.5**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 2/22/05**	**D/W Reference: Stoller**	
Comments: RLS: Radionuclide Logging System, SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, NMLS: Neutron Moisture Logging System			

Casing Information

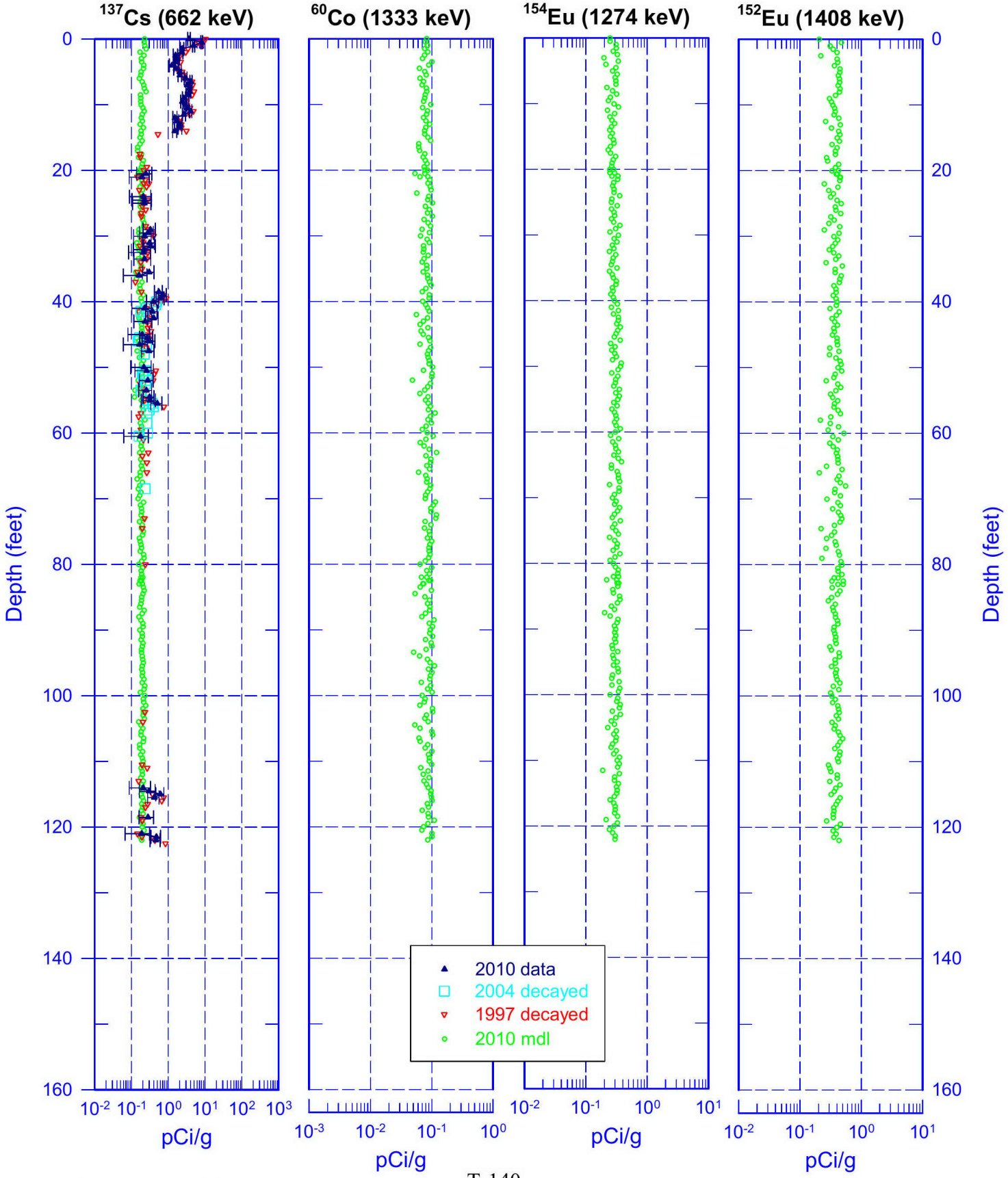
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	125	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
1993	RLS	Unk	NA	0-117	WHC	C-106 Investigation
01/22/97	SGLS	G1A	1	0-122.5	MACTEC-ERS	Baseline
01/27/03	RAS	Large-New	A	0-122	Stoller	No Apparent Change
04/28/03	RAS	Large-New	B	0-122	Stoller	No Apparent Change
07/21/03	RAS	Large-New	C	0-122	Stoller	No Apparent Change
04/30/03	NMLS	Moisture	1	0-122	Stoller	Moisture Baseline
07/22/03	NMLS	Moisture	2	0-122	Stoller	No Apparent Change
09/10/03	NMLS	Moisture	3	0-122	Stoller	No Apparent Change
09/16/03	RAS	Large-New	D	0-122	Stoller	No Apparent Change
10/20/03	NMLS	Moisture	4	0-122	Stoller	No Apparent Change
10/21/03	RAS	Large-New	E	0-122	Stoller	No Apparent Change
12/04/03	NMLS	Moisture	5	0-122	Stoller	No Apparent Change
01/26/04	RAS	Large-New	F	0-122	Stoller	No Apparent Change
02/18/04	NMLS	Moisture	6	0-122	Stoller	No Apparent Change
02/23/04	RAS	Large-New	G	0-122	Stoller	No Apparent Change
03/01/04	SGLS	G2A	2	40-80	Stoller	No Apparent Change
10/29/04	NMLS	G2F	7	0-122	Stoller	No Apparent Change
02/22/05	RAS	Large-2	H	0-121	Stoller	No Apparent Change
09/29/10	SGLS	G2BR	3	0-122	Stoller	No Apparent Change

30-06-02 (299-E27-72 [A6697])

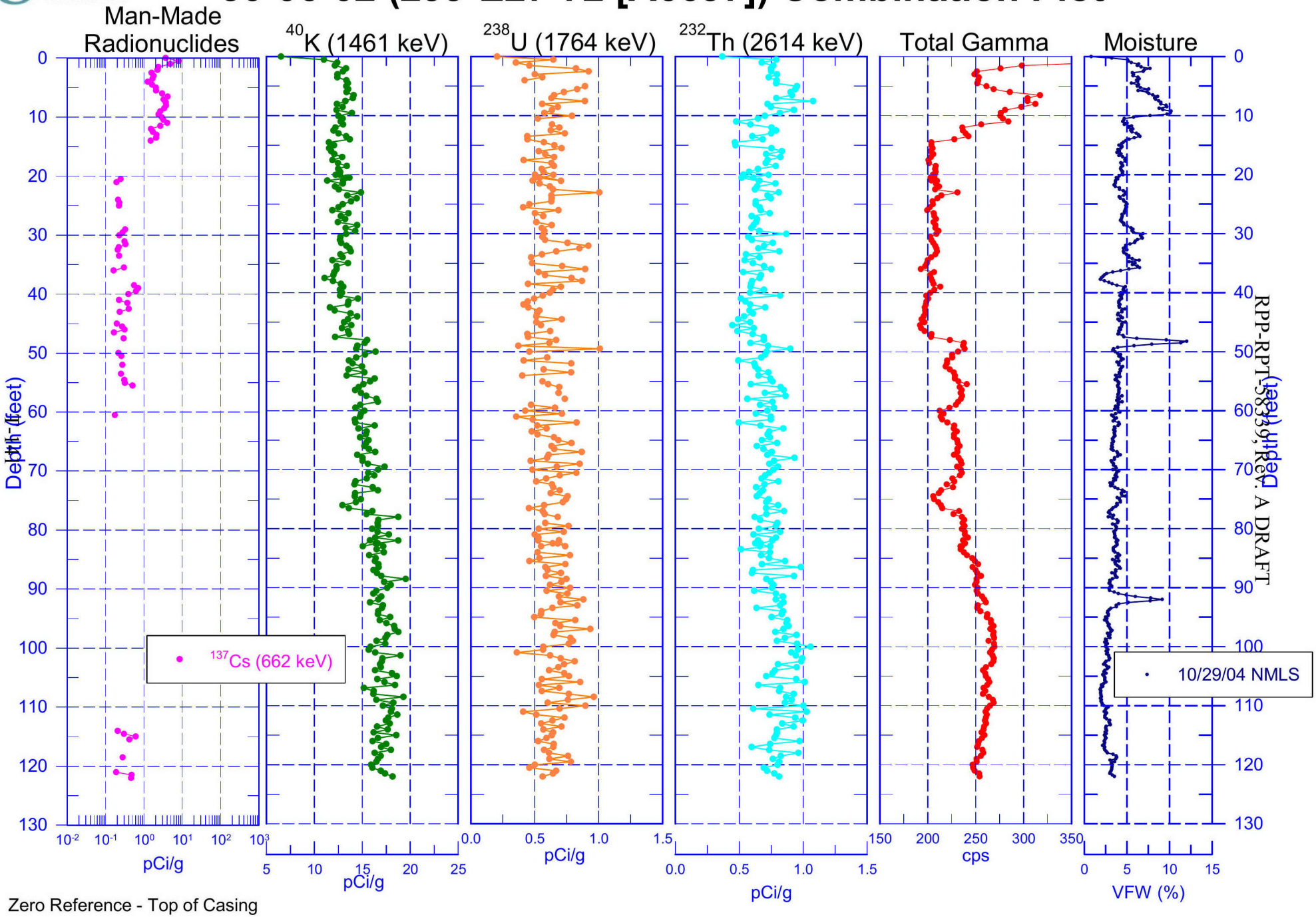
Comparison of Manmade Radionuclides (2010, 2004 &1997)



Zero Reference - Top of Casing

Stoller
Hanford Office

30-06-02 (299-E27-72 [A6697]) Combination Plot

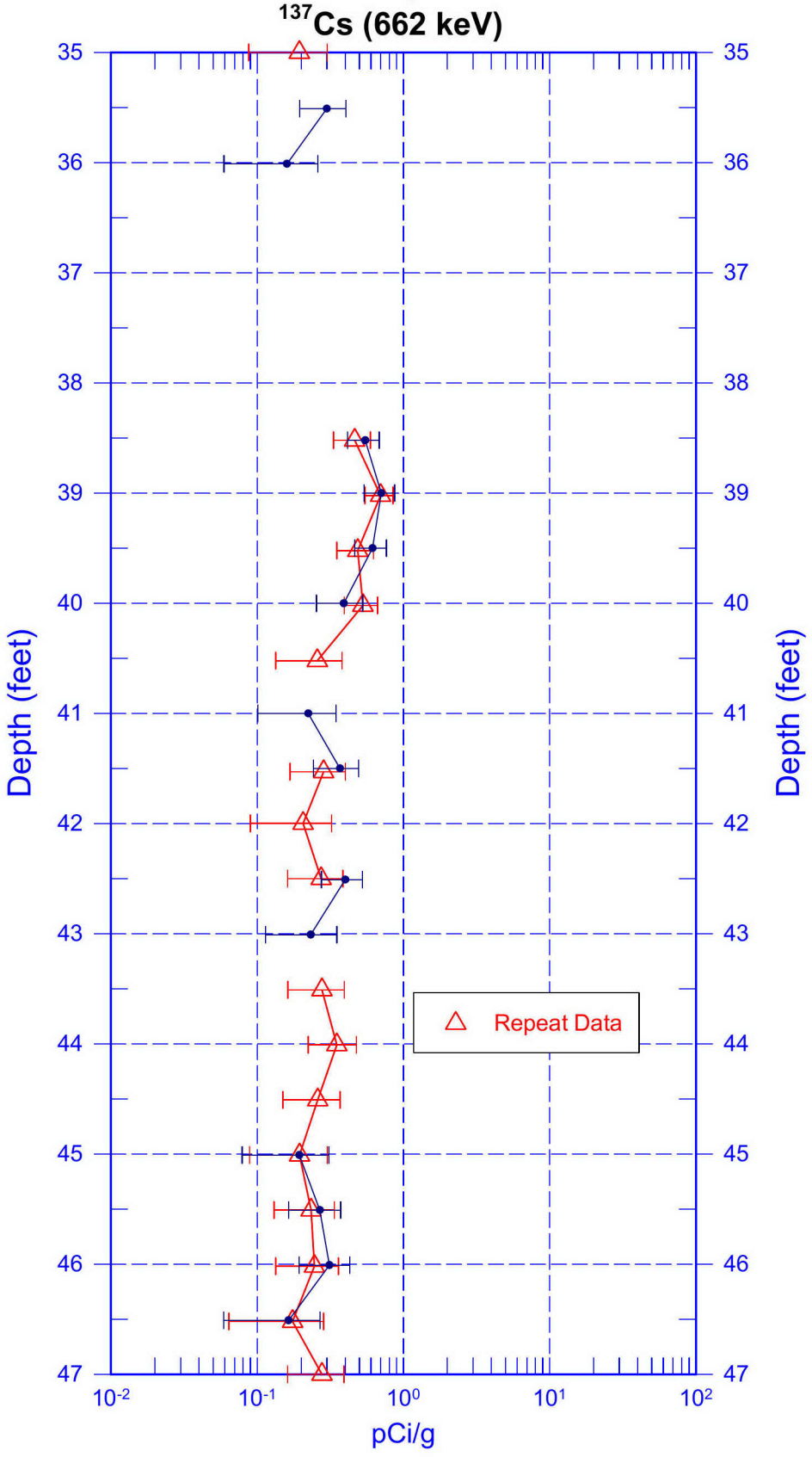


RPP-RPT-58339, Rev. A DRAFT (Uncontrolled)

Stoller Hanford Office

30-06-02 (299-E27-72 [A6697])

Manmade Repeat Section

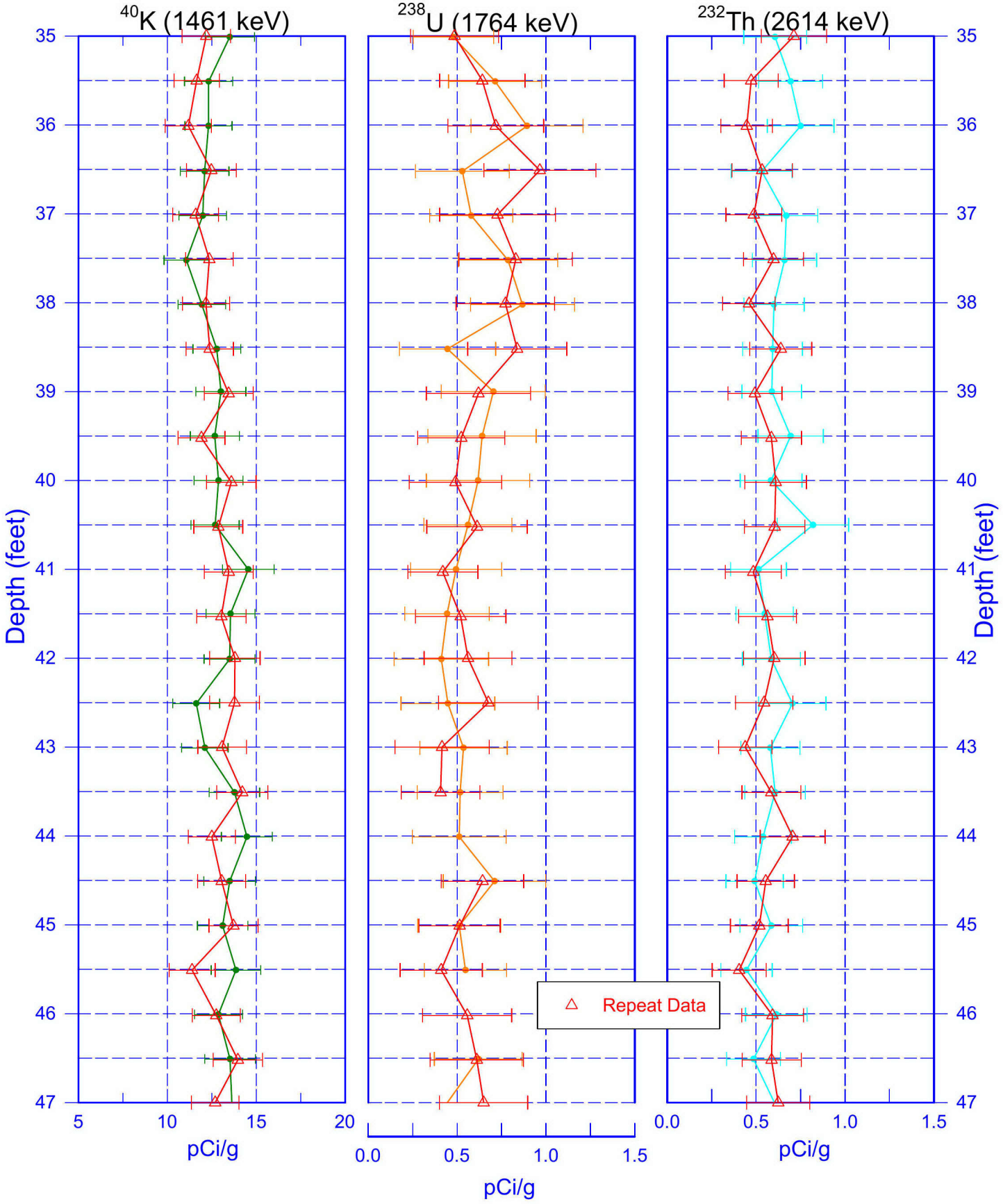


Zero Reference - Top of Casing

Stoller Hanford Office

30-06-02 (299-E27-72 [A6697])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-84 (A6709)

2010-2011 C-Farm Re-Baseline

30-06-03
299-E27-84 (A6709)
Log Data Report

Borehole Information:

Log Date:	2010-10-11	Filename:	A6733_HG_2010-10-11	Site:	241-C-106
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:	10/11/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	6/30/1974	N/A	100	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	unknown	6	0.280	0.0	100

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The depth interval logged in 2010 was from 0 to 98 feet just above the level of water inside the borehole casing. Other water levels observed during past logging events are included below. The location of the borehole is indicated in the figure titled "Borehole 30-06-03 Location in C Tank Farm."

Date	Depth to Borehole Water (ft)
3/03/1993	None
1/16/1997	None
12/06/2002	79.2
3/31/2003	82.5
7/15/2003	None
8/6/2003	None
9/25/2003	None
11/14/2003	None
2/09/2004	None
6/24/2004	None
9/27/2010	98.1

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1993 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-106* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

The zero reference is the top of casing.

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[5] SGLS
Effective Calibration Date:	09/22/10	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 2 F	**Type:**	NMLS[6]
Effective Calibration Date:	10/2004	**Serial No.:**	H380932510
Calibration Reference:	DOE-EM/GJ754-2004	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev. 0

SGLS Log Run Information:

Log Run	**1**	**2**	**3 Repeat**		
HEIS Number	1016274	1016275	1016276		
Date	9/30/10	10/08/10	10/11/10		
Logging Engineer	Spatz/Holloway/ McClellan	Spatz/Holloway/ McClellan	Spatz/Holloway/ McClellan		
Start Depth (ft)	0.0	56.0	25.0		
Finish Depth (ft)	57.0	98.0	35.0		
Count Time (sec)	100	100	100		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.5	0.5	0.5		
Log Speed (ft/min)	N/A	N/A	N/A		
Pre-Verification	_B_10930	_B_10108	_B_101011		
Start File	_D_000000	_D_005600	_D_002500		
Finish File	_D_005700	_D_009800	_D_003500		
Post-Verification	_A_10930	_A_10108	_A_101011		
Depth Return Error (in.)	Low 1	0.0	0.0		
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made		

[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer
[6] Neutron Moisture Logging System

NMLS Log Run Information:

Log Run	4	5 Repeat			
HEIS Number	1018070	1018071			
Date	10/26/04	10/28/04			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	25.0			
Finish Depth (ft)	30.0	98.25			
Count Time (sec)	N/A	N/A			
Live/Real	N/A	N/A			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	1.0	1.0			
Pre-Verification	BF182CAB	BF182CAB			
Start File	BF182000	BF183000			
Finish File	BF182120	BF183293			
Post-Verification	BF182CAA	BF183CAA			
Depth Return Error (in.)	0.0	1/2 high			
Comments	None	Repeat section 25.0 to 30.0 ft			

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the table above (for SGLS) due to the length of the file names (e.g., _D_000000 for A6709_BR_1016281_D_000000).

Analysis Notes:

Analyst:	Legler	Date:	9/14/2011	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for a 0.28-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[7] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better

[7] minimum detection level

defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the 1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 was decayed to a common date of October 11, 2010.

SGLS logging is conducted by S.M. Stoller, as is logging with the NMLS. NMLS data are usually acquired digitally at 0.25-ft intervals with a count time of 15 seconds. Where available, the most recent NMLS data are reported in the re-baseline log data reports.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected continuously from ground surface to 46.5 ft, and from 48 to 67.5 ft, at 69 ft, 71.5 ft, 74 ft, and at 98 ft, with a maximum concentration of approximately 61 pCi/g at 0.5 ft. No significant changes have occurred since 1997.

Eu-154 was detected at ground surface with a concentration of approximately 0.9 pCi/g. Although not detected in the 1997 baseline, the ground surface measurement may be influenced by a distant surface source unrelated to the borehole.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

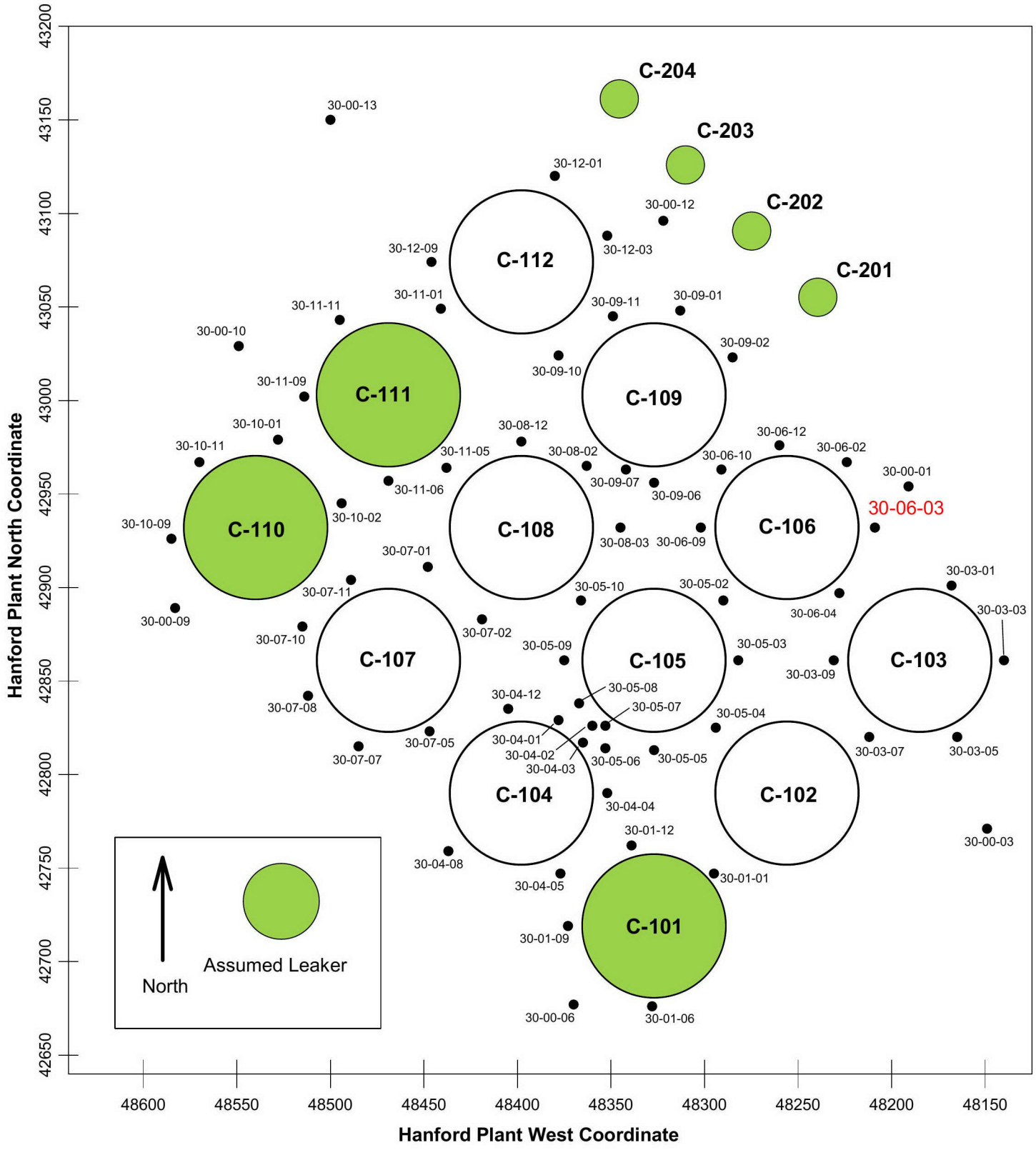
Depth Reference is top of casing

Borehole 30-06-03 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy (DOE) 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-106.* GJ-HAN-84. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-06-03 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-06-03 (299-E27-84) (A6709)

Borehole Information

Site: C Farm, Tank C-106			
Coordinates (HAN Plant):	**North: 42932**	**West: 48209**	**Elevation (ft): 644.80**
Coordinates (WA Plane):	**North: 136569.106**	**East: 575197.02**	**Elevation (m): 197.649**
Drill Date: 6/30/1974	**Type: Cable Tool**	**Depth (ft): 98.5**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 2/17/04**	**D/W Reference: Stoller**	
Comments: The water level changes frequently in this borehole. The borehole was dry on 10/28/04. Surface water enters borehole. SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System. WA State Plane Coordinates are NAVD88			

Casing Information

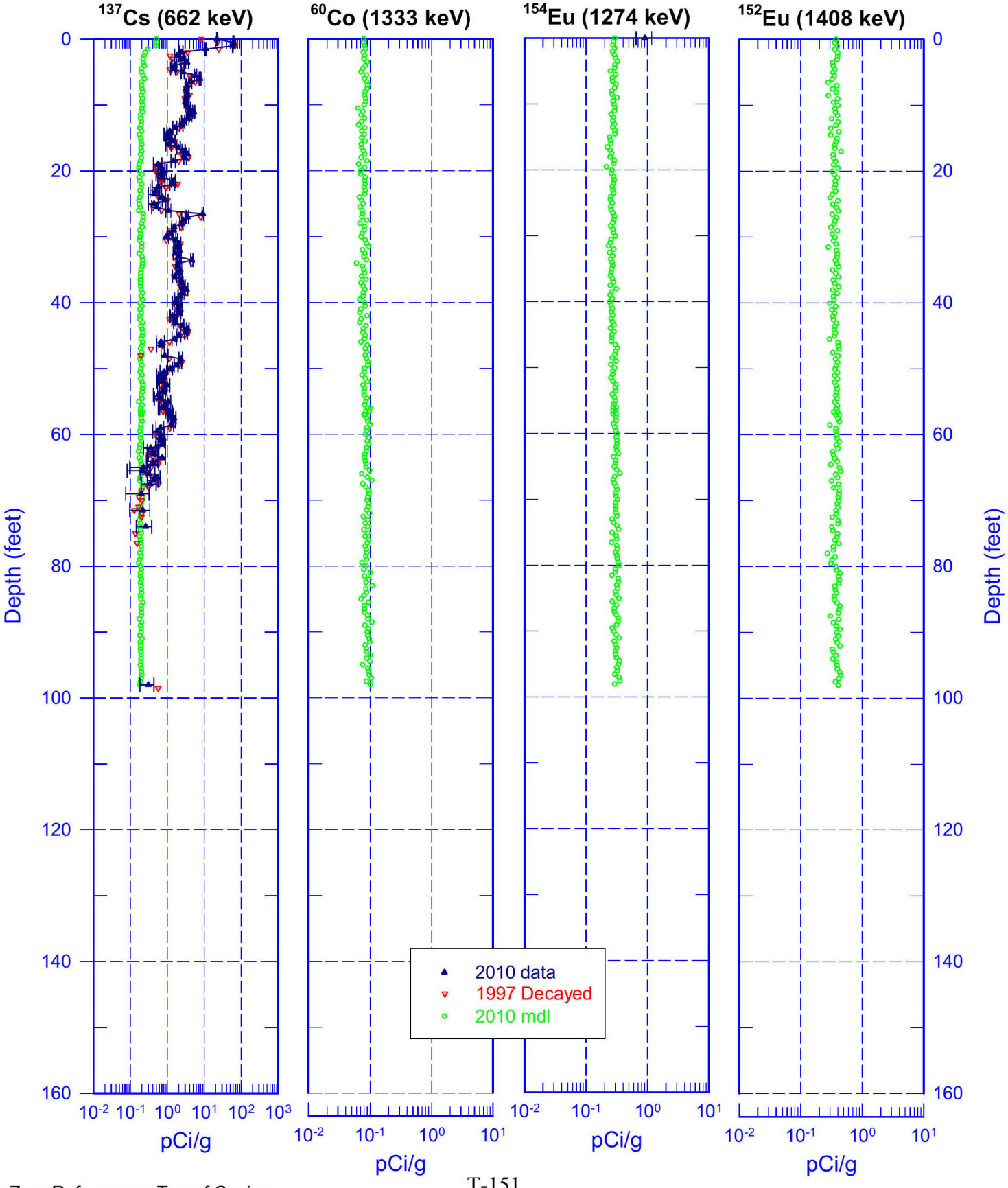
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
1993	RLS	Unk	NA	0-93	WHC	C-106 Investigation
01/16/97	SGLS	G1A	1	0-98.5	MACTEC-ERS	Baseline
01/23/03	RAS	Large-New	A	0-98	Stoller	No Apparent Change
04/28/03	RAS	Large-New	B	0-82	Stoller	No Apparent Change
04/30/03	NMLS	Moisture	1	0-82.25	Stoller	Moisture Baseline
07/21/03	RAS	Large-New	C	0-83	Stoller	No Apparent Change
07/22/03	NMLS	Moisture	2	0-98.25	Stoller	No Apparent Change
09/09/03	NMLS	Moisture	3	0-98.25	Stoller	No Apparent Change
09/16/03	RAS	Large-New	D	0-98	Stoller	No Apparent Change
10/21/03	NMLS	Moisture	4	0-98.25	Stoller	No Apparent Change
10/22/03	RAS	Large-New	E	0-98	Stoller	No Apparent Change
12/02/03	RAS	Large-New	F	0-98	Stoller	No Apparent Change
12/04/03	NMLS	Moisture	5	0-98.25	Stoller	No Apparent Change
02/17/04	NMLS	Moisture	6	0-98.25	Stoller	No Apparent Change
02/23/04	RAS	Large-New	G	0-98	Stoller	No Apparent Change
10/28/04	NMLS	Moisture	7	0-98.25	Stoller	No Apparent Change
2/28/05	RAS	Large-New	H	0-98	Stoller	No Apparent Change
10/11/10	SGLS	G2BR	2	0-98	Stoller	Eu-154 detected at surface

30-06-03 (299-E27-84 [A6709])

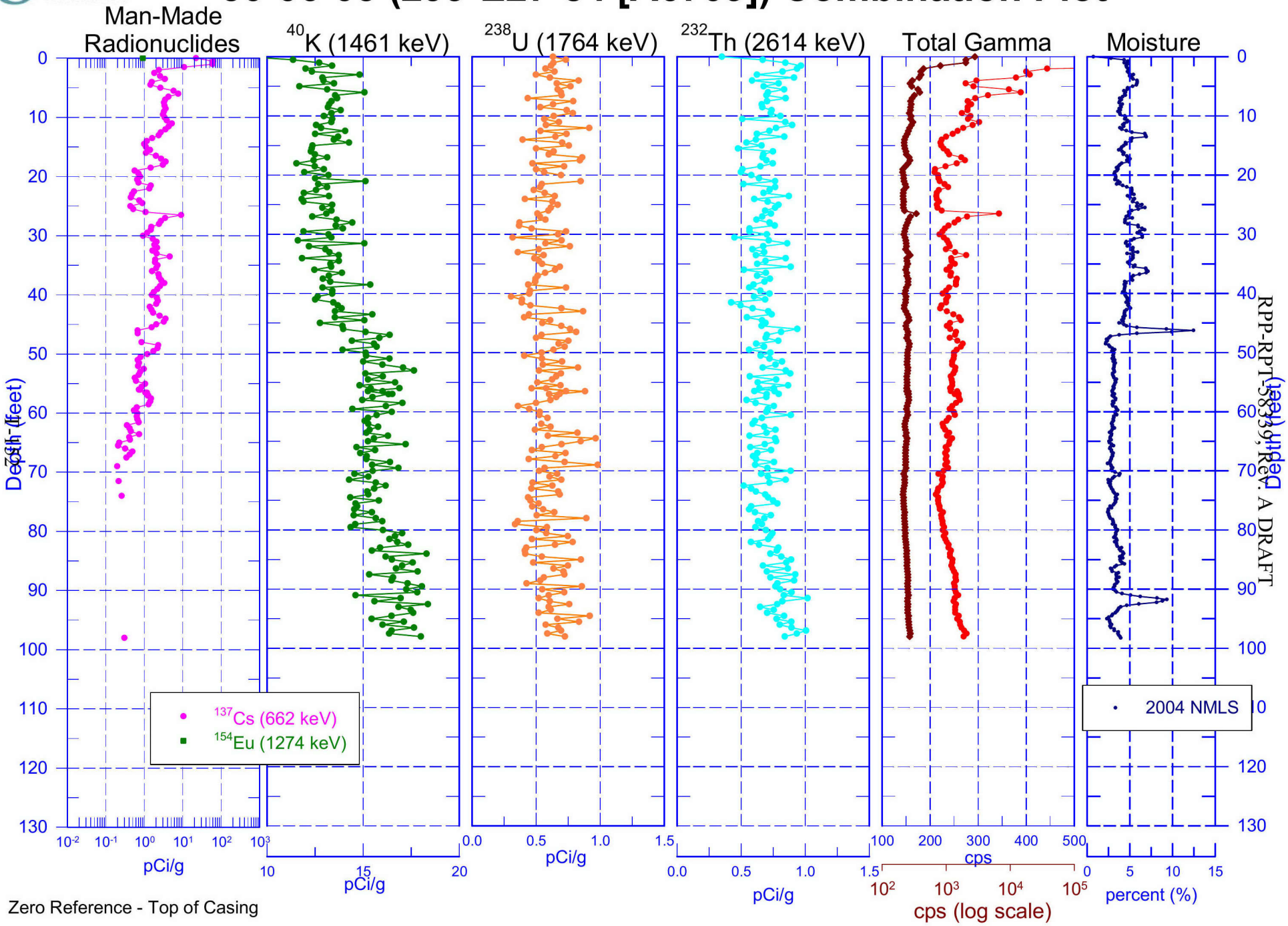
Comparison of Manmade Radionuclides (2010 & 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-06-03 (299-E27-84 [A6709]) Combination Plot

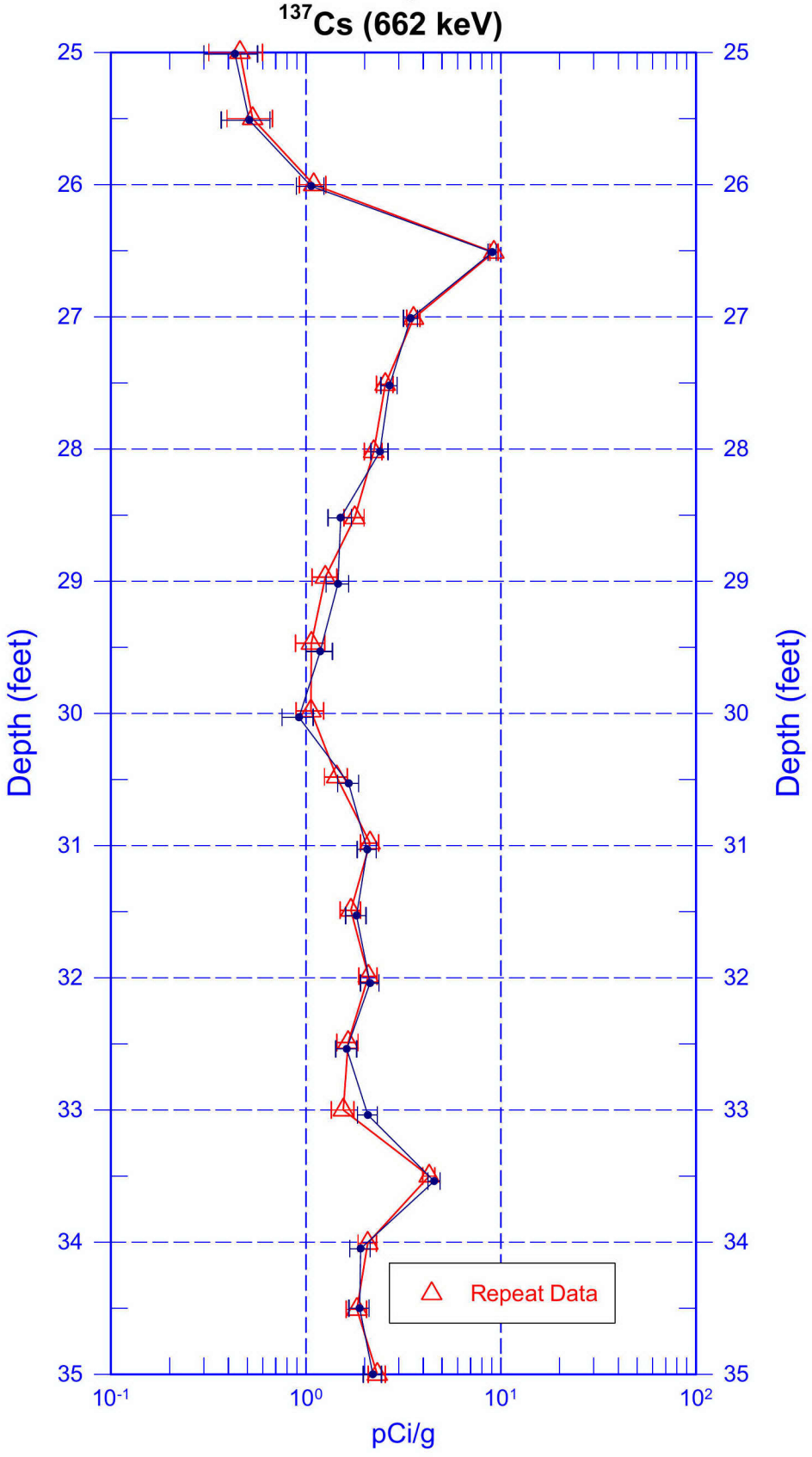


RPP-RPT-58339, Rev. A DRAFT (text hidden)

Stoller Hanford Office

30-06-03 (299-E27-84 [A6709])

Manmade Repeat Section

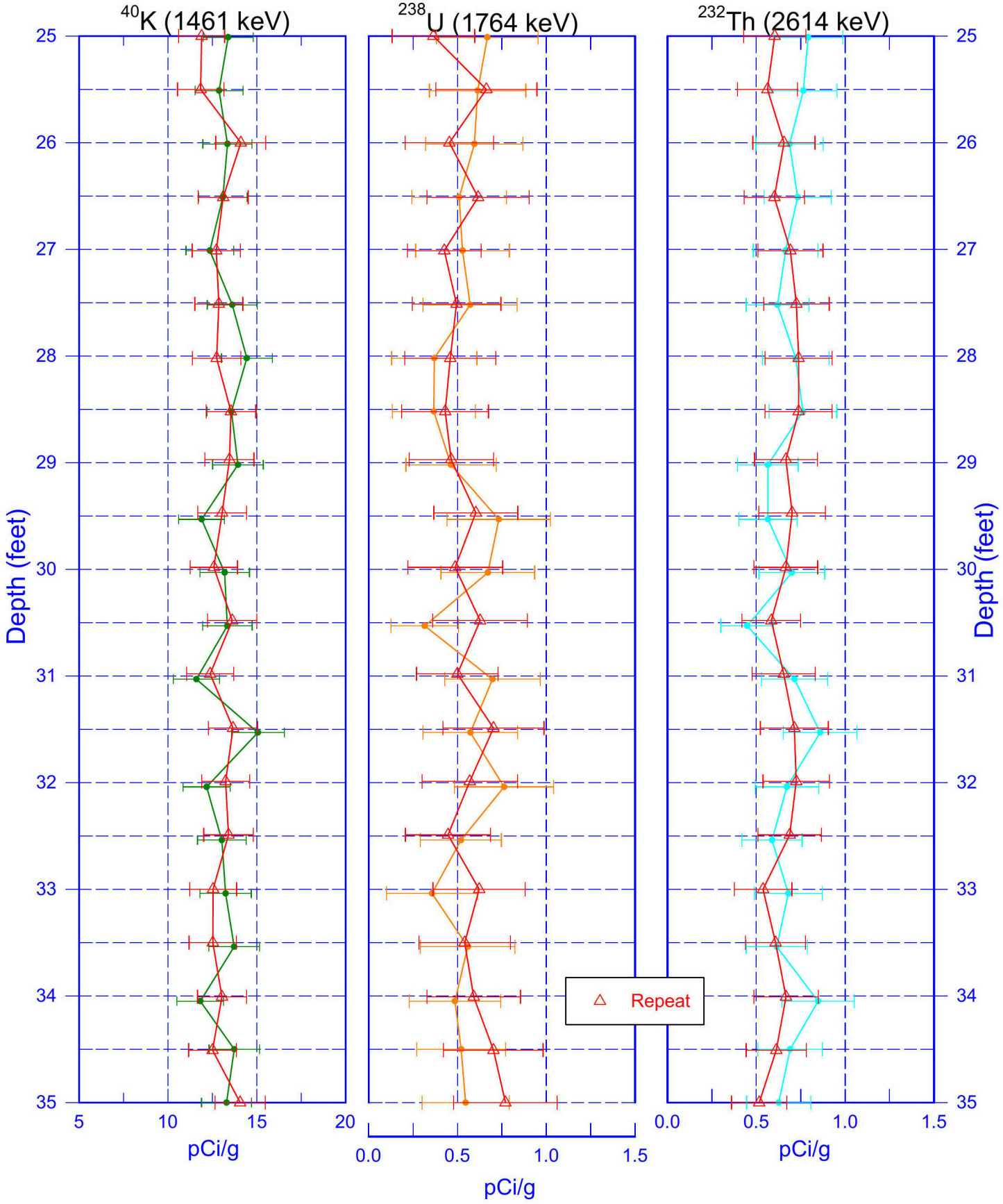


Zero Reference - Top of Casing

Stoller Hanford Office

30-06-03 (299-E27-84 [A6709])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-73 (A6698)

2010-2011 C-Farm Re-Baseline

30-06-04
299-E27-73 (A6698)
Log Data Report

Borehole Information:

Log Date:	11/04/10	Filename:	A6698_HG_2010-11-04	Site:	241-C-Farm, 241-C-106
Coordinates (WA St Plane)		GWL[1] (ft):	None	GWL Date:	11/02/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	11/30/1972	N/A	130	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	129.5

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma emitting radionuclides in support of the C Tank Farm RCRA[3] field investigations. The depth interval logged in 2010 was from 0 to 129.5 feet. The location of the borehole is indicated in the figure titled "Borehole 30-06-04 Location in C Tank Farm."

Water was not observed in this borehole.

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This borehole has SGLS[4] data acquired in 1997, 2004, and 2010. A summary of other logging data acquired since 1993 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-106* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

The zero reference is the top of casing, approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2	Type:	DHMCA[5] SGLS BR
Calibration Reference:	HGLP-CC-065, Rev. 0	Serial No.:	48-TP50478A
Effective Calibration Date:	09/22/10	Logging Procedure:	HGLP-MAN-002, Rev. 1

[1] groundwater level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

Logging System:	Gamma 2	**Type:**	35% HPGe SGLS
Calibration Reference:	GJO-2004-593-TAC, Rev. 0	**Serial No.:**	34TP20893A
Effective Calibration Date:	12/22/2003	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 2	**Type:**	NMLS[6]
Calibration Reference:	DOE-EM/GJ754-2004	**Serial No.:**	H380932510
Effective Calibration Date:	10/2004	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev. 0

SGLS Log Run Information:

Log Run	1	2	3	4 Repeat	5
HEIS Number	1016297	1016298	1016299	1017354	1017739
Date	11/02/10	11/03/10	11/04/10	11/04/10	3/1/2004
Logging Engineer	Spatz/ Holloway	Spatz/ Holloway	Spatz/ Holloway	Spatz/ Holloway	Pearson
Start Depth (ft)	0.0	51.0	104.0	82.0	40.0
Finish Depth (ft)	52.0	105.0	129.5	95.0	100.0
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	_B_10112	_B_10113	_B_10114	1016299 _B_10114	BA310CAB
Start File	_D_000000	_D_005100	_D_010400	_D_008200	BA311000
Finish File	_D_005200	_D_010500	_D_012950	_D_009501	BA311120
Post-Verification	_A_10112	_A_10113	1017354 _A_10114	_A_10114	BA311CAA
Depth Return Error (in.)	0.0	0.0	N/A	0.0	N/A
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	Gain adjustments after BA311024, BA311050, BA311078

Log Run	6 Repeat				
HEIS Number	1017740				
Date	3/1/2004				
Logging Engineer	Pearson				
Start Depth (ft)	85.0				
Finish Depth (ft)	91.0				
Count Time (sec)	100				
Live/Real	R				

[6]Neutron Moisture Logging System

Log Run	6 Repeat				
Shield (Y/N)	N				
MSA Interval (ft)	0.5				
Log Speed (ft/min)	N/A				
Pre-Verification	BA310CAB				
Start File	BA311121				
Finish File	BA311133				
Post-Verification	BA311CAA				
Depth Return Error (in.)	0.0				
Comments	Repeat section				

NMLS Log Run Information:

Log Run	5	6 Repeat			
HEIS Number	1017743	1017744			
Date	11/9/04	11/12/04			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	90.0			
Finish Depth (ft)	100.0	129.25			
Count Time (sec)	N/A	N/A			
Live/Real	N/A	N/A			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	1.0	1.0			
Pre-Verification	BF189CAB	BF190CAB			
Start File	BF189000	BF190000			
Finish File	BF189400	BF190157			
Post-Verification	BF189CAA	BF190CAA			
Depth Return Error (in.)	1/4 high	0.0			
Comments	None	Repeat section 90.0 to 100.0			

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTH-082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the SGLS table above due to length of file name (for example, _D_000000 for A6733_BR_1015868_D_000000.)

Analysis Notes:

Analyst:	LEGLER	Date:	6/13/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for a 0.280-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[7] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, 1997 and 2004 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 and 2004 were applied during reprocessing. For purposes of comparison with the 2010 data, the Co-60 and Cs-137 were decayed to a common date of November 11, 2010.

Where available, the most recent NMLS data are reported in this re-baseline log data report.

Results and Interpretations:

The "Comparison of Manmade Radionuclides" plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants is not found, MDLs for the radionuclide are still plotted.

Cs-137, Co-60, and Eu-154 were detected in this borehole. Co-60 is not generally considered significant as a contaminant, but Co-60 is important for use as a "tracer" to track subsurface contamination movement.

Cs-137 was detected continuously from ground surface to 56.5 ft and intermittently throughout the remainder of the borehole. A maximum concentration of approximately 1500 pCi/g was measured at the ground surface. Comparisons with the 2004 and 1997 data indicate no significant change.

Co-60 was detected at the bottom of the borehole in 2010 with an approximate concentration of 0.1 pCi/g and at 92 ft (repeat run). Co-60 detected in 1997 and 2004 between 83 and 93 ft has apparently decayed below the 2010 MDL.

Eu-154 was detected at the ground surface with an approximate concentration of 3 pCi/g. Eu-154 was not reported in the 1997 baseline data, although upon closer review of the spectrum at this depth, Eu-154 may have been present although not identified by the processing software.

Although not detected, MDLs for Eu-152 are plotted on the "Comparison of Manmade Radionuclides (2010, 2004, and 1997)" plot.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

[7] minimum detection level

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

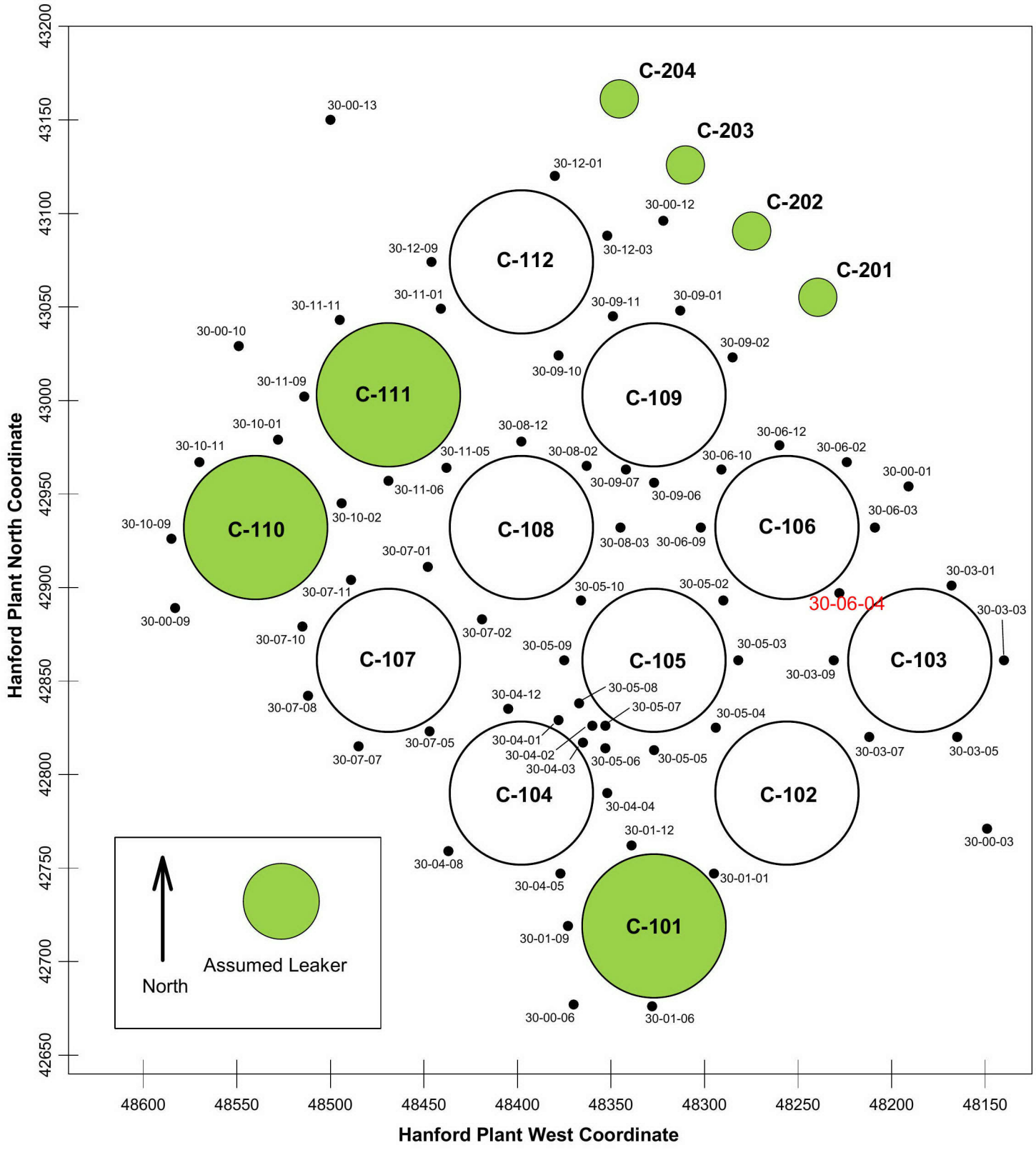
Depth Reference is top of casing

Borehole 30-06-04 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010, 2004, and 1997)
Combination Plot
Repeat Section of Manmade Radionuclides
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy (DOE) 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-106* GJ-HAN-84 Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-06-04 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-06-04 (299-E27-73) (A6698)

Borehole Information

Site: C Farm, Tank C-106			
Coordinates (HAN Plant):	**North: 42897**	**West: 48288**	**Elevation (ft): 644.71**
Coordinates (WA Plane):	**North: 136558.321**	**East: 575191.287**	**Elevation (m): 197.894**
Drill Date: 11/30/1972	**Type: Cable Tool**	**Depth (ft): 129.5**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 12/10/03**	**D/W Reference: Stoller**	
Comments: RLS: Radionuclide Logging System, SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, NMLS: Neutron Moisture Logging System			

Casing Information

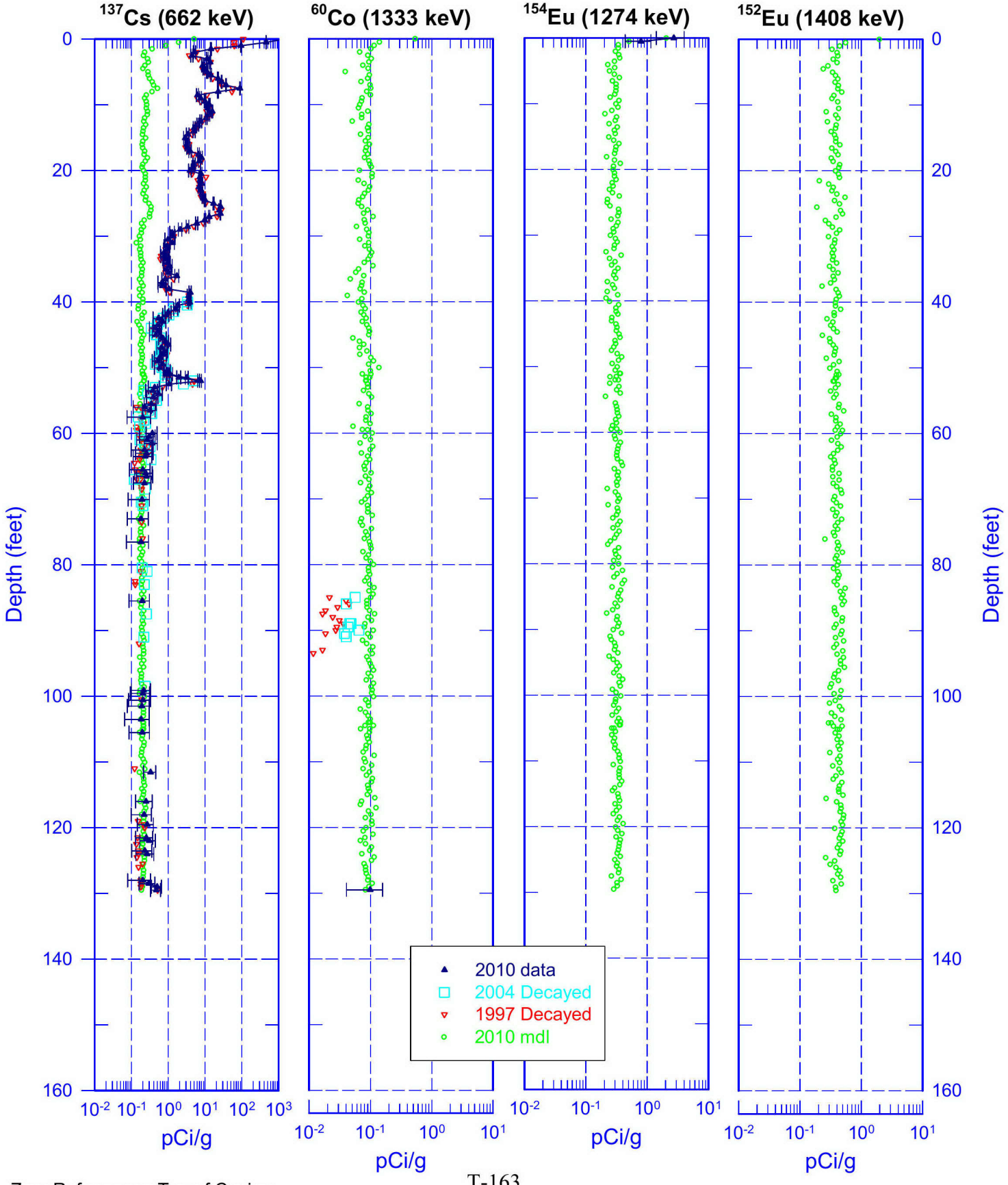
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	130	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
1993	RLS	Unk	NA	0-123	WHC	C-106 Investigation
2/5/1997	SGLS	G1A	1	0-129.5	MACTEC-ERS	Baseline
9/11/2002	RAS	Large	A	20-100	Stoller	No Apparent Change
1/27/2003	RAS	Large-New	B	0-129	Stoller	No Apparent Change
4/29/2003	RAS	Large-New	C	0-129	Stoller	No Apparent Change
4/30/2003	NMLS	Moisture	1	0-129.25	Stoller	Moisture Baseline
7/23/2003	RAS	Large-New	D	0-129	Stoller	No Apparent Change
7/23/2003	NMLS	Moisture	2	0-129.25	Stoller	No Apparent Change
9/11/2003	NMLS	Moisture	3	0-129.25	Stoller	No Apparent Change
9/17/2003	RAS	Large-New	E	0-129	Stoller	No Change, gain drift
10/23/2003	NMLS	Moisture	4	0-129.25	Stoller	No Apparent Change
10/31/2003	RAS	Large-New	F	0-129	Stoller	No Change, gain drift
12/10/2003	NMLS	Moisture	5	0-129.25	Stoller	No Apparent Change
12/22/2003	RAS	Large-New	G	0-129	Stoller	No Apparent Change
2/25/2004	RAS	Large-New	H	0-129	Stoller	No Apparent Change
3/1/2004	SGLS	G2A	2	40-100	Stoller	No Apparent Change
3/1/2004	NMLS	Moisture	6	0-129.25	Stoller	Seasonal Increase (0-13 ft)
11/12/2004	NMLS	Moisture	7	0-129.25	Stoller	No Apparent Change
5/8/2005	RAS	Large-New	I	0-129	Stoller	No Apparent Change
10/4/2005	RAS	Large-New	J	0-129	Stoller	No Apparent Change
2/14/2007	RAS	Large-New	K	0-129	Stoller	No Apparent Change
11/4/2010	SGLS	G2BR	3	0-129.5	Stoller	No Apparent Change

30-06-04 (299-E27-73 [A6698])

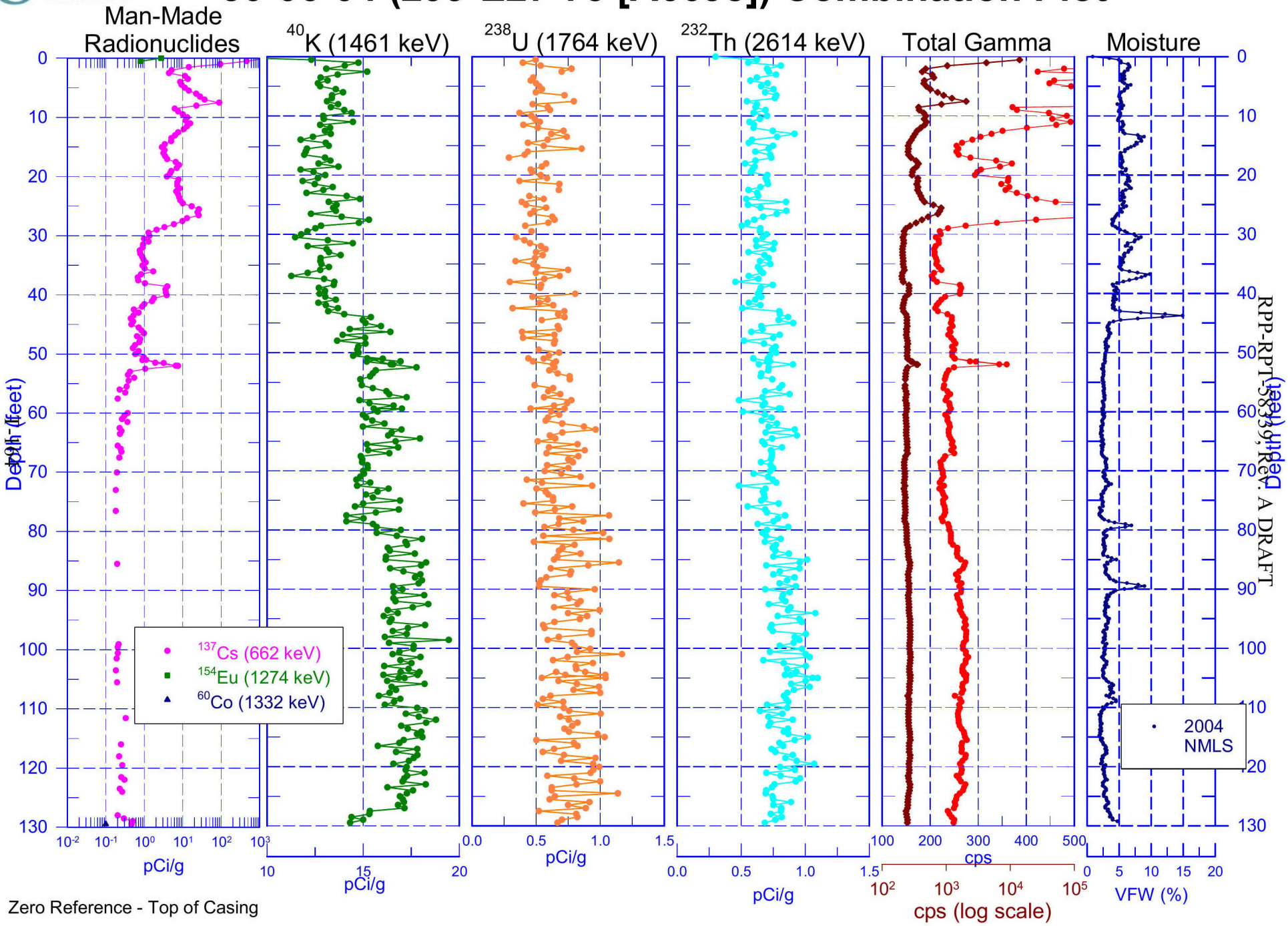
Comparison of Manmade Radionuclides (2010, 2004 & 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

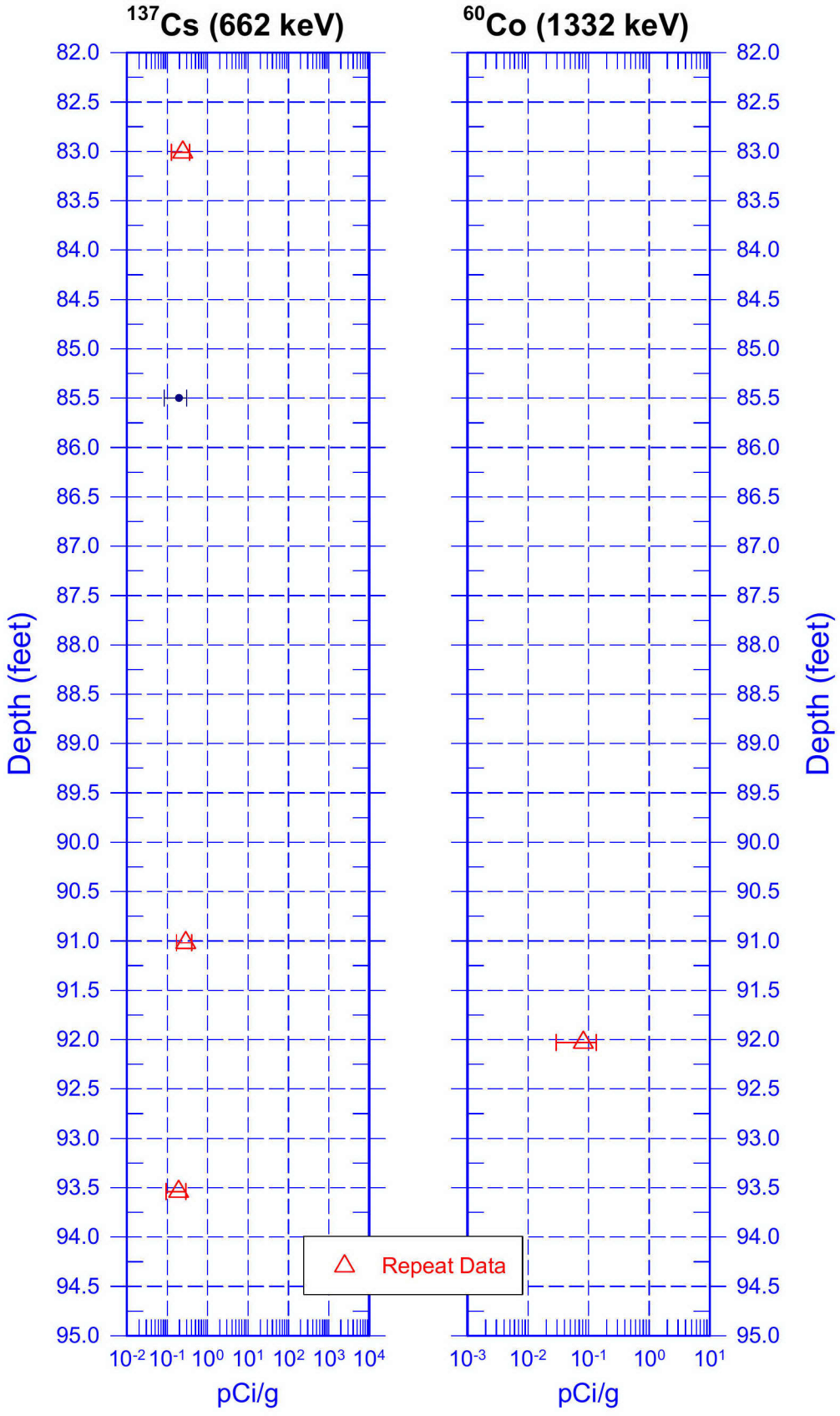
30-06-04 (299-E27-73 [A6698]) Combination Plot



RPP-RPT-58339, Rev. A DRAFT

Stoller Hanford Office

30-06-04 (299-E27-73 [A6698])
Manmade Repeat Section

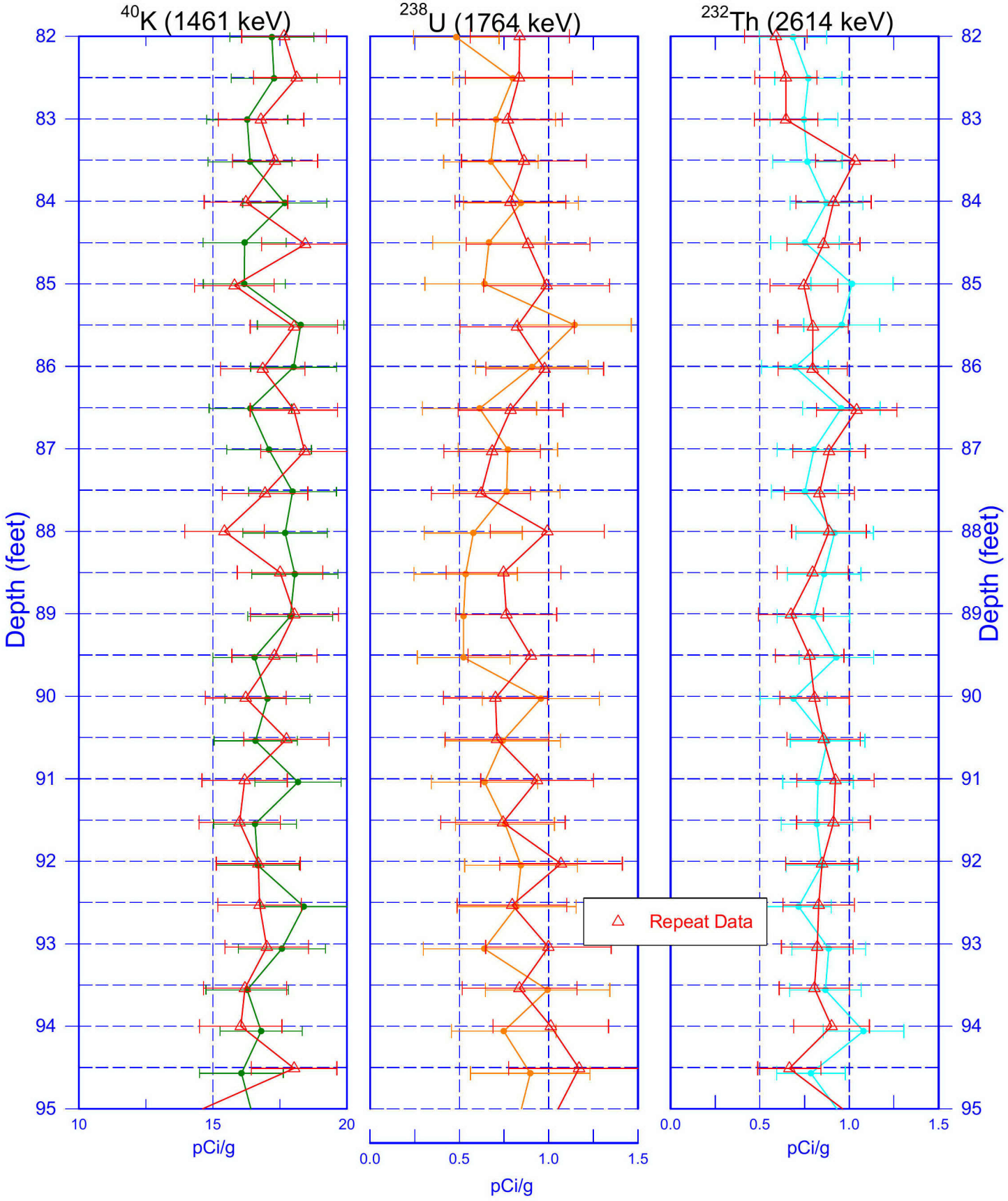


Zero Reference - Top of Casing

Stoller Hanford Office

30-06-04 (299-E27-73 [A6698])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-85 (A6710)

Stoller Hanford Office established 1959

HGLP-LDR-617, Rev. 0

2010-2011 C-Farm Re-Baseline

30-06-09
299-E27-85 (A6710)
Log Data Report

Borehole Information:

Log Date:	2010-09-27	**Filename:**	A6710_HG_2010-09-27	**Site:**	241-C-106
Coordinates (WA St Plane)		**GWL[1] (ft) :**	None	**GWL Date:**	09/08/10
North (m)	**East (m)**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
N/A	N/A	07/31/1974	N/A	100.0	Cable Tool

Casing Information:

		Diameter (in.)				
Casing Type	**Stickup (ft)**	**Outer**	**Inside**	**Thickness (in.)**	**Top (ft)**	**Bottom (ft)**
Welded Steel	0.0	unknown	6	0.280	0.0	100.0

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2010 was from 0 to 98.5 ft. The location of the borehole is indicated in the figure titled "Borehole 30-06-09 Location in C Tank Farm."

Water was not observed in this borehole.

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997, 2004,k and 2010. A summary of other logging data acquired since 1993 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-106* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

The zero reference is the top of casing, approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[5] SGLS
Effective Calibration Date:	09/22/10	**Serial No.:**	48-TP50478A

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

Calibration Reference:	HGLP-CC-065, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 2 A	**Type:**	35% HPGe SGLS
Effective Calibration Date:	12/22/03	**Serial No.:**	34TP20893A
Calibration Reference:	GJO-2004-593-TAC	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev.0

Logging System:	Gamma 2 F	**Type:**	NMLS[6]
Effective Calibration Date:	10/04	**Serial No.:**	H380932510
Calibration Reference:	DOE-EM/GJ754-2004	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev.0

SGLS Log Run Information:

Log Run	1	2	3 Repeat	4	5 Repeat
HEIS Number	1016267	1016268	1016269	1017918	1017919
Date	9/23/10	9/23/10	9/27/10	2/26/04	2/26/04
Logging Engineer	Spatz/Holloway/ Legler	Spatz/Holloway/ Legler	Spatz/Holloway/ Legler	Pearson	Pearson
Start Depth (ft)	0.0	55.0	35.0	40.0	40.0
Finish Depth (ft)	56.0	98.5	45.0	80.0	44.0
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	_B_10923	_B_10924	_B_10927	BA307CAB	BA307CAB
Start File	_D_000000	_D_005500	_D_003500	BA308000	BA308081
Finish File	_D_005600	_D_009850	_D_004500	BA308080	BA308089
Post-Verification	_A_10923	_A_10924	_A_10927	BA308CAA	BA308CAA
Depth Return Error (in.)	0.0	2 high	0.0	N/A	0.0
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made

[6] Neutron Moisture Logging System

NMLS Log Run Information:

Log Run	6	7 Repeat			
HEIS Number	1017920	1017921			
Date	11/3/04	11/3/04			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	20.0			
Finish Depth (ft)	30.0	98.25			
Count Time (sec)	N/A	N/A			
Live/Real	N/A	N/A			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	1.0	1.0			
Pre-Verification	BF187CAB	BF187CAB			
Start File	BF187000	BF187121			
Finish File	BF187120	BF187434			
Post-Verification	BF187CAA	BF187CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	None	Repeat section 20.0 to 30.0 ft			

Logging Operation Notes:

Data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

NMLS data were collected using Gamma 1, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the AmBe standard field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above for 2010 SGLS log run information due to the length of file names (e.g., _D_000000 for RUN01_BR_1016267_D_000000).

Analysis Notes:

Analyst:	C. Nelson	Date:	8/23/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Casing corrections for a 0.28-in. thick casing were applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1b, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[7] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the

[7] minimum detection level

detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, 1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the 1997 and 2004 Cs-137 and Co-60 were decayed to a common date of September 27, 2010.

NMLS data were acquired seven times from April 2003 to November 2004. The most recent NMLS data are reported in this log data report.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected almost continuously from ground surface to 60.5 ft, intermittently from 64 to 89.5 ft, and continuously from 96.5 to 98.5 ft. A maximum concentration of approximately 64.7 pCi/g was measured at ground surface. Comparisons of all SGLS data indicate no significant change.

Co-60 detected at 27.0, 27.5, and 74.5 ft at less than 0.2 pCi/g in 1997 has apparently decayed below the 2010 MDL.

A detection of U-235 in 1997 at ground surface was determined to be erroneous, based on inspection of the spectrum, and has been removed from the data set.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. Moisture data were acquired from the interval of ground surface to 98.25 ft. The most recent 2004 NMLS data are reported in this log data report.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

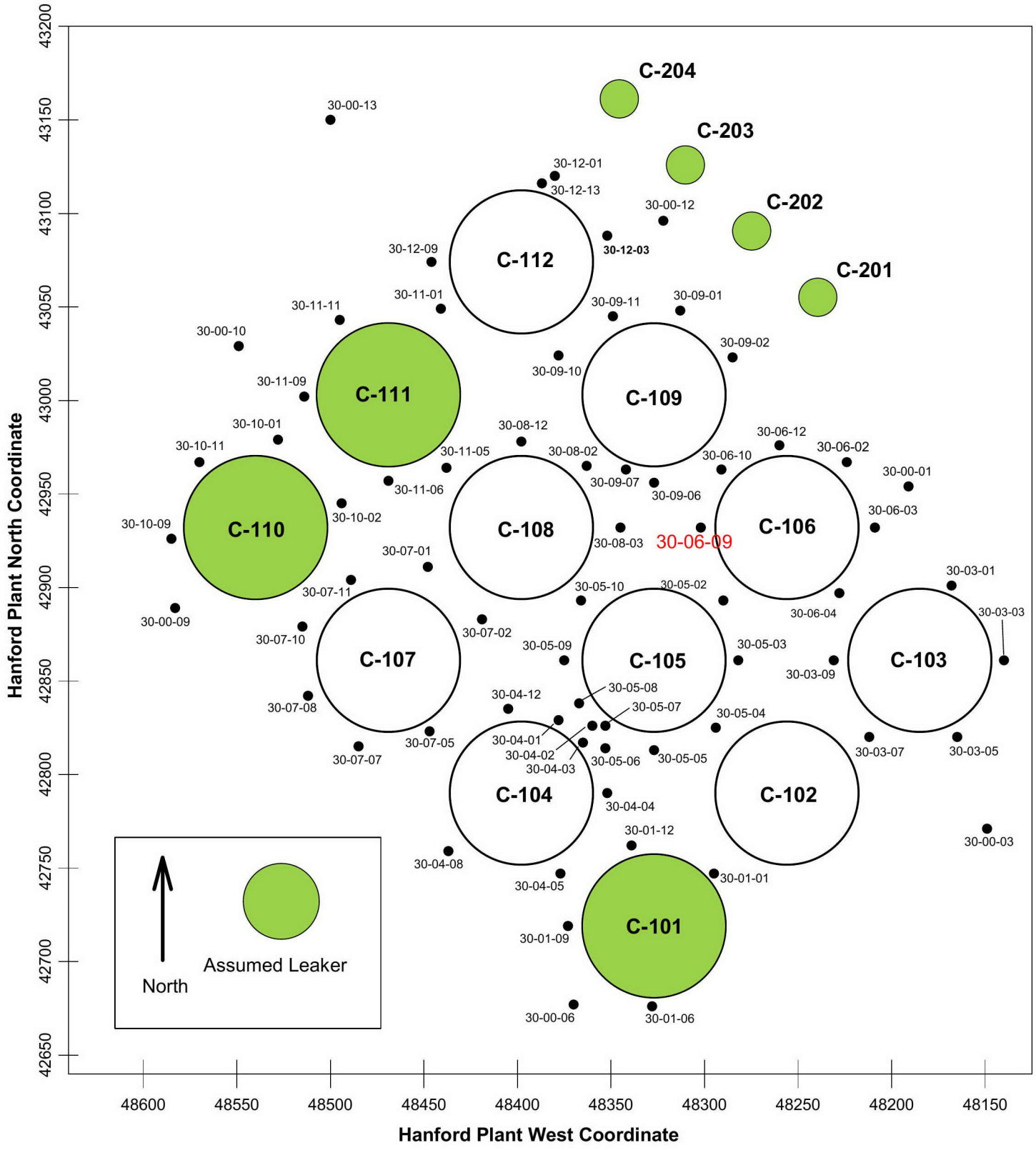
Depth Reference is top of casing

Borehole 30-06-09 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010, 2004 & 1997)
Combination Plot
Manmade Repeat Section
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy. 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-106.* GJ-HAN-84. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-06-09 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-06-09 (299-E27-85) (A6710)

Borehole Information

Site: C Farm, Tank C-108			
Coordinates (HAN Plant):	**North: 42932**	**West: 48302**	**Elevation (ft): 645.40**
Coordinates (WA Plane):	**North: 136568.821**	**East: 575168.813**	**Elevation (m): 197.979**
Drill Date: 7/31/1974	**Type: Cable Tool**	**Depth (ft): 98.5**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 2/19/04**	**D/W Reference: Stoller**	
Comments: RLS: Radionuclide Logging System, SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, NMLS: Neutron Moisture Logging System, WA State Plane Coordinates are NAVD88			

Casing Information

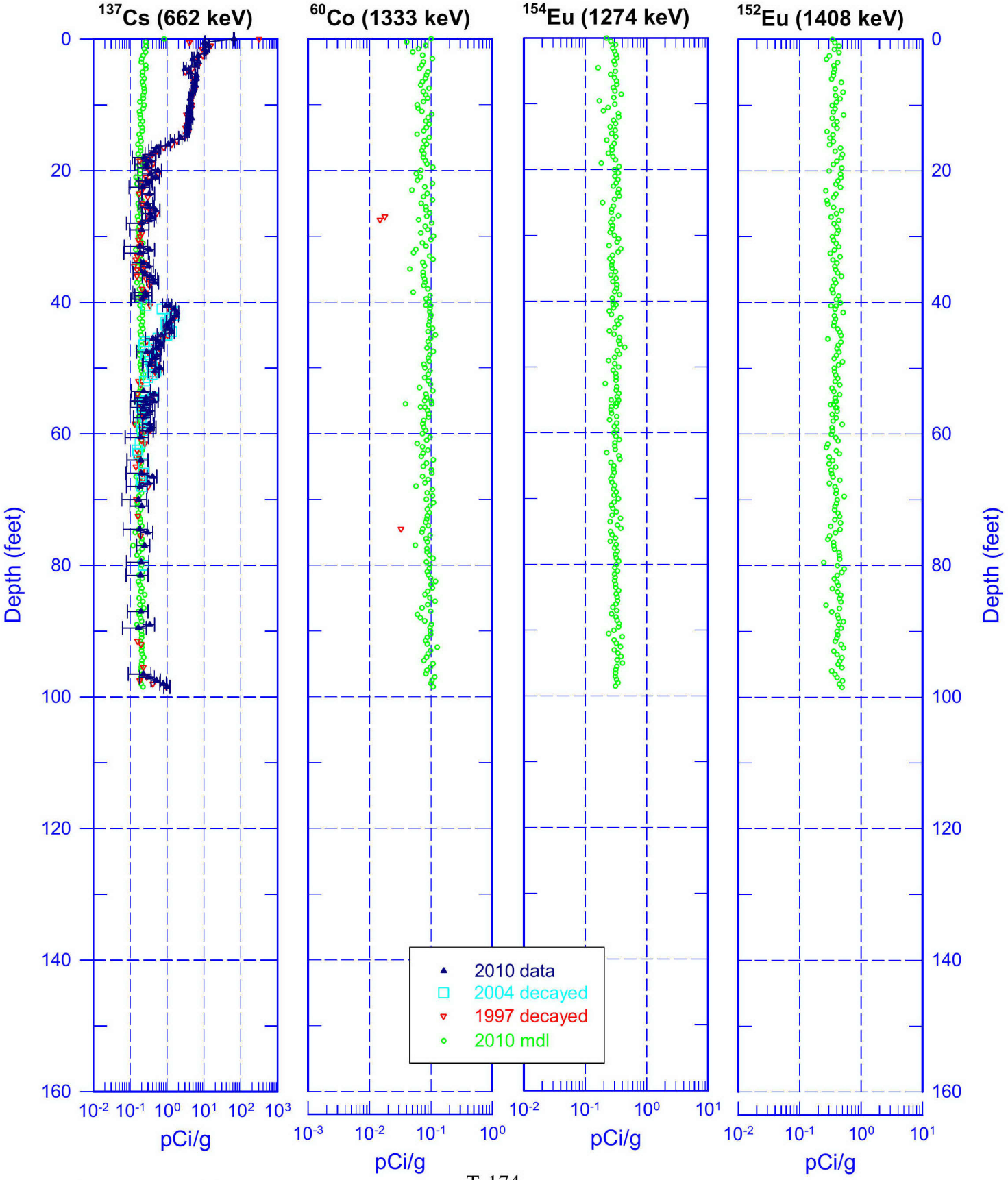
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
04/22/93	RLS	Unk	NA	0-95	WHC	C-106 Investigation
2/3/97	SGLS	G1A	1	0-98.5	MACTEC-ERS	Baseline
4/22/02	RAS	Large	A	25-80	MACTEC-ERS	No Apparent Change
1/22/03	RAS	Large-New	B	5-98	Stoller	No Change (gain drift)
4/22/03	RAS	Large-New	C	5-98	Stoller	No Apparent Change
7/22/03	RAS	Large-New	D	5-98	Stoller	No Apparent Change
4/28/03	NMLS	Moisture	1	0-98.25	Stoller	Moisture Baseline
7/21/03	NMLS	Moisture	2	0-98.25	Stoller	No Apparent Change
9/8/03	NMLS	Moisture	3	0-98.25	Stoller	No Apparent Change
9/10/03	RAS	Large-New	E	5-98	Stoller	No Apparent Change
10/22/03	NMLS	Moisture	4	0-98.25	Stoller	No Apparent Change
10/23/03	RAS	Large-New	F	0-98	Stoller	No Apparent Change
12/2/03	NMLS	Moisture	5	0-98.25	Stoller	No Apparent Change
12/12/03	RAS	Large-New	G	0-98	Stoller	No Change (gain drift)
2/12/04	NMLS	Moisture	6	0-98.25	Stoller	No Apparent Change
2/19/04	RAS	Large-New	H	5-98	Stoller	No Apparent Change
2/26/04	SGLS	G2A	2	40-80	Stoller	No Apparent Change
11/3/04	NMLS	Moisture	7	0-98.25	Stoller	No Apparent Change
3/8/05	RAS	Large2	I	5-98	Stoller	No Apparent Change
8/27/10	SGLS	G2BR	3	0-98.5	Stoller	No Apparent Change

30-06-09 (299-E27-85 [A6710])

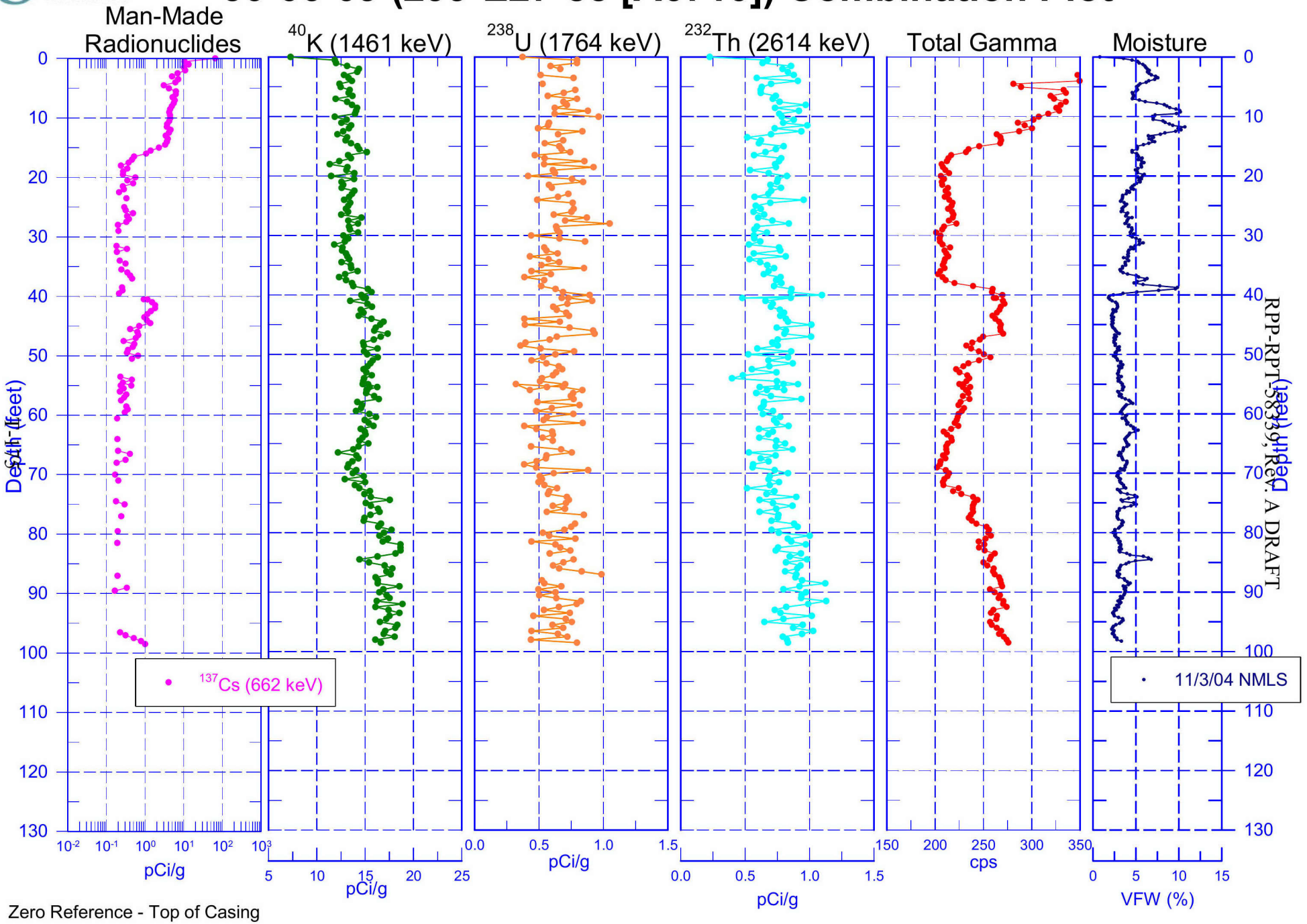
Comparison of Manmade Radionuclides (2010, 2004 &1997)



Zero Reference - Top of Casing

Stoller
Hanford Office

30-06-09 (299-E27-85 [A6710]) Combination Plot



RPP-RPT-58339, Rev. A DRAFT (uncontrolled)

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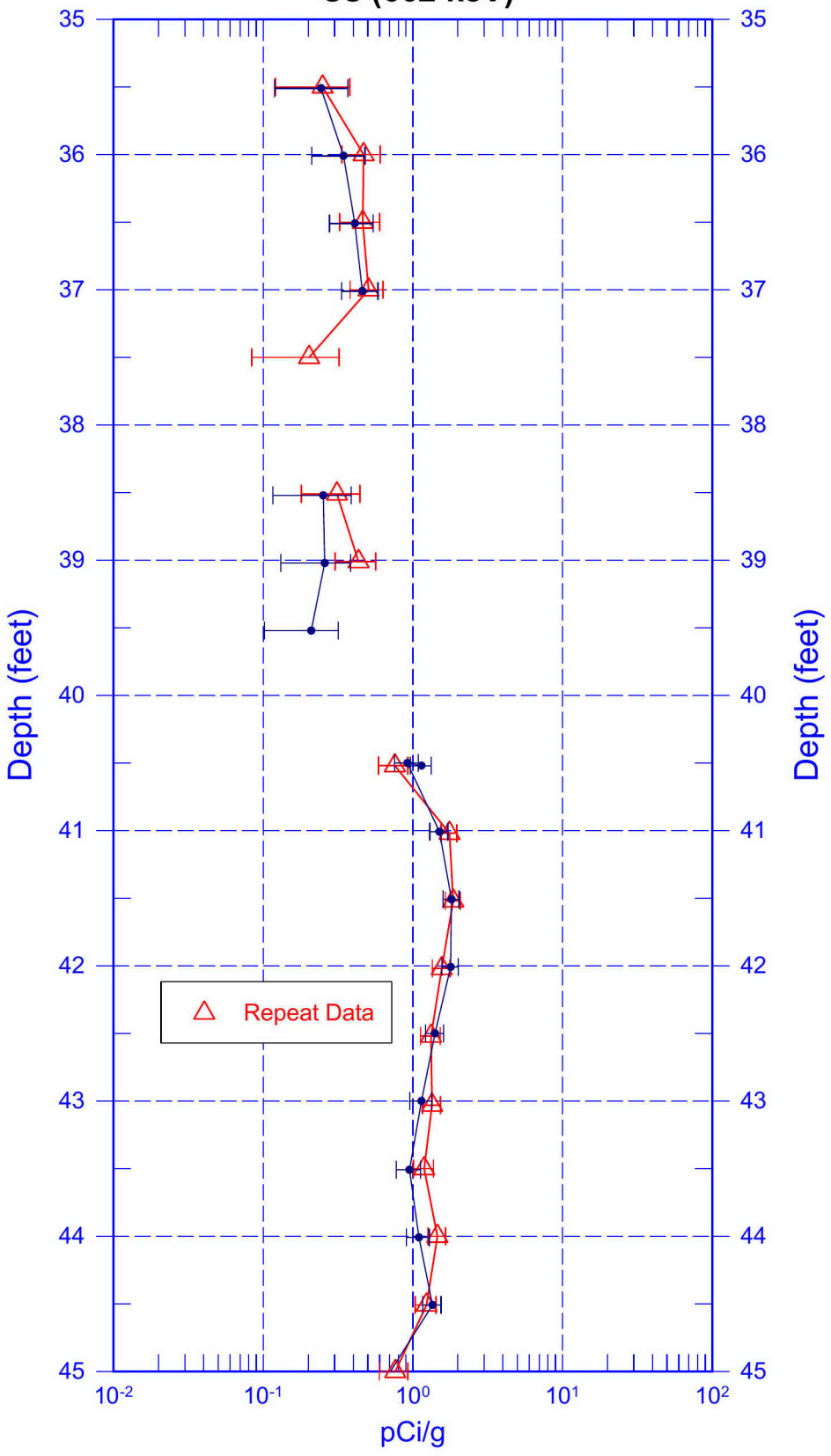
30-06-09 (299-E27-85 [A6710])

Manmade Repeat Section

^{137}Cs (662 keV)

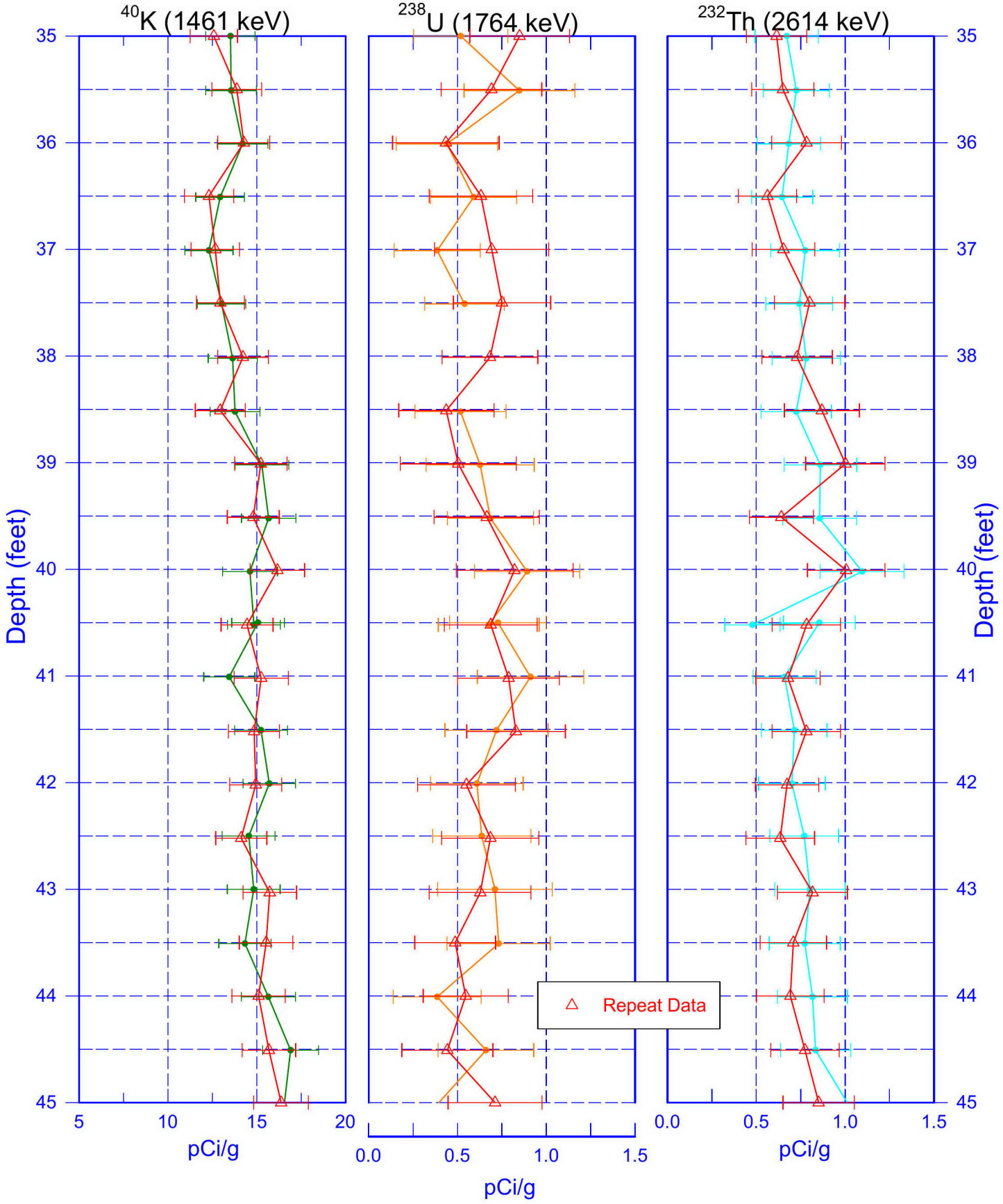


Zero Reference - Top of Casing

Stoller Hanford Office

30-06-09 (299-E27-85 [A6710])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-71 (A6696)

2010-2011 C-Farm Re-Baseline

30-06-10
299-E27-71 (A6696)
Log Data Report

Borehole Information:

Log Date:	2011-03-11	Filename:	A6696_HG_2011-03-11	Site:	241-C-106	
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:		03/07/11
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)		Type
N/A	N/A	11/30/1972	N/A	129		Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	129.0

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2011 was from 0 to 128.5 ft. The location of the borehole is indicated in the figure titled "Borehole 30-06-10 Location in C Tank Farm."

Water was not observed in this borehole.

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997, 1999, 2003, 2004, and 2011. A summary of other logging data acquired since 1993 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-106* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

The zero reference is the top of casing, approximately at ground surface.

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System

Logging Equipment Information:

Logging System:	Gamma 2	**Type:**	DHMCA[5] SGLS BR
Effective Calibration Date:	09/22/10	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 2 A	**Type:**	35% HPGe SGLS
Effective Calibration Date:	12/22/03	**Serial No.:**	34TP20893A
Calibration Reference:	GJO-2004-593-TAC	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev.0

Logging System:	Gamma 2 F	**Type:**	NMLS[6]
Effective Calibration Date:	10/04	**Serial No.:**	H380932510
Calibration Reference:	DOE-EM/GJ754-2004	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev.0

SGLS Log Run Information:

Log Run	1	2	3	4 Repeat	5
HEIS Number	1017390	1017391	1017392	1017393	1017900
Date	3/9/11	3/10/11	3/11/11	3/11/11	9/4/03
Logging Engineer	Holloway/ McClellan	Holloway/ McClellan	Holloway/ McClellan	Holloway/ McClellan	Pearson
Start Depth (ft)	0.0	57.0	114.0	115.0	0.0
Finish Depth (ft)	58.0	115.0	128.5	128.0	60.0
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	B_1139	B_11310	B_11311	B_11311	BA212CAB
Start File	_D_000000	_D_005700	_D_011400	_D_011500	BA212000
Finish File	_D_005800	_D_011500	_D_012850	_D_012800	BA212120
Post-Verification	A_1139	A_11310	A_11311	A_11311	BA212CAA
Depth Return Error (in.)	1.0 high	0.0	0.0	0.0	N/A
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made

[5] Down-Hole Multi-Channel Analyzer
[6] Neutron Moisture Logging System

Log Run	6 Repeat	7	8 Repeat		
HEIS Number	1017901	1017902	1017903		
Date	9/4/03	2/27/04	2/27/04		
Logging Engineer	Pearson	Pearson	Pearson		
Start Depth (ft)	40.0	40.0	115.0		
Finish Depth (ft)	46.0	129.0	124.0		
Count Time (sec)	100	100	100		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	0.5	0.5	0.5		
Log Speed (ft/min)	N/A	N/A	N/A		
Pre-Verification	BA212CAB	BA309CAB	BA309CAB		
Start File	BA212121	BA309000	BA309179		
Finish File	BA212133	BA309178	BA309197		
Post-Verification	BA212CAA	BA309CAA	BA309CAA		
Depth Return Error (in.)	0.0	N/A	1.0 high		
Comments	No fine gain adjustments made	Adjustments after files: BA309102 & BA309160	No fine gain adjustments made		

NMLS Log Run Information:

Log Run	9	10 Repeat			
HEIS Number	1017916	1017917			
Date	11/2/04	11/2/04			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	70.0			
Finish Depth (ft)	80.0	128.25			
Count Time (sec)	N/A	N/A			
Live/Real	N/A	N/A			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	1.0	1.0			
Pre-Verification	BF186CAB	BF186CAB			
Start File	BF186000	BF186321			
Finish File	BF186320	BF186554			
Post-Verification	BF186CAA	BF186CAA			
Depth Return Error (in.)	N/A	0.5 low			
Comments	None	Repeat section 70.0 to 80.0 ft			

Logging Operation Notes:

Data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

NMLS data were collected using Gamma 1, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the AmBe standard field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above for 2011 SGLS log run information due to the length of file names (e.g., A6696_BR_1017390_D_000000 for _D_000000).

Analysis Notes:

Analyst:	C. Nelson	Date:	8/3/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Casing corrections for a 0.28-in. thick casing were applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1b, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[7] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, 1997 and 1999 data were reprocessed using the same casing correction as the 2011 data. The efficiency function and dead time correction in place in 1997 and 1999 were applied during reprocessing. For purposes of comparison with the 2011 data, the 1997, 1999, 2003 and 2004 Cs-137 and Co-60 were decayed to a common date of March 11, 2011.

During the time from April 2003 to November 2004, NMLS data were acquired seven times. The most recent NMLS data are reported in this log data report.

[7] minimum detection level

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected almost continuously from ground surface to 17 ft, intermittently from 20 to 38.5 ft, almost continuously from 43 to 56 ft, intermittently from 59 to 66.5 ft, at 78 ft, 98 ft, and 124.5 ft and continuously from 127-128.5 ft. A maximum concentration of approximately 5.1 pCi/g was measured at 2.5 ft. Comparisons of all SGLS data indicate no significant change.

A description of changes in the Co-60 contamination profile from 1997 to 2011 is included in the table below. Depths are approximate. Further detail can be observed in the attached figures.

Date	Depth (ft)	Comment
1997	86-117	Baseline
1999	86-124	Co-60 contamination increase from 112 to 124 ft.
2004	86-129	Co-60 below the MDL from 90 to 96 ft; Co-60 increase from 121 to 129 ft
2011	86-129	Co-60 increase from 86 to 90 ft and at 93 ft; Co-60 generally below MDL from 90 to 98 ft; Stable from 98 to 129 ft

A clear lateral and downward migration of Co-60 has been observed in this borehole since 1997 that extends to at least the bottom of the borehole at 129 ft. In 2011, a further influx of contamination is indicated from 86 to 90 ft and at 93 ft, suggesting ongoing migration near the top of the plume from a source in the vicinity of the borehole. Contamination below 98 ft appears to have stabilized although it is not known if contamination has migrated below the bottom of the borehole where migration could be occurring.

Eu-154 detected at ground surface in 1997 has apparently decayed below the 2011 MDL.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. Moisture data were acquired from the interval of ground surface to 128.5 ft. The most recent 2004 NMLS data are reported in this log data report.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

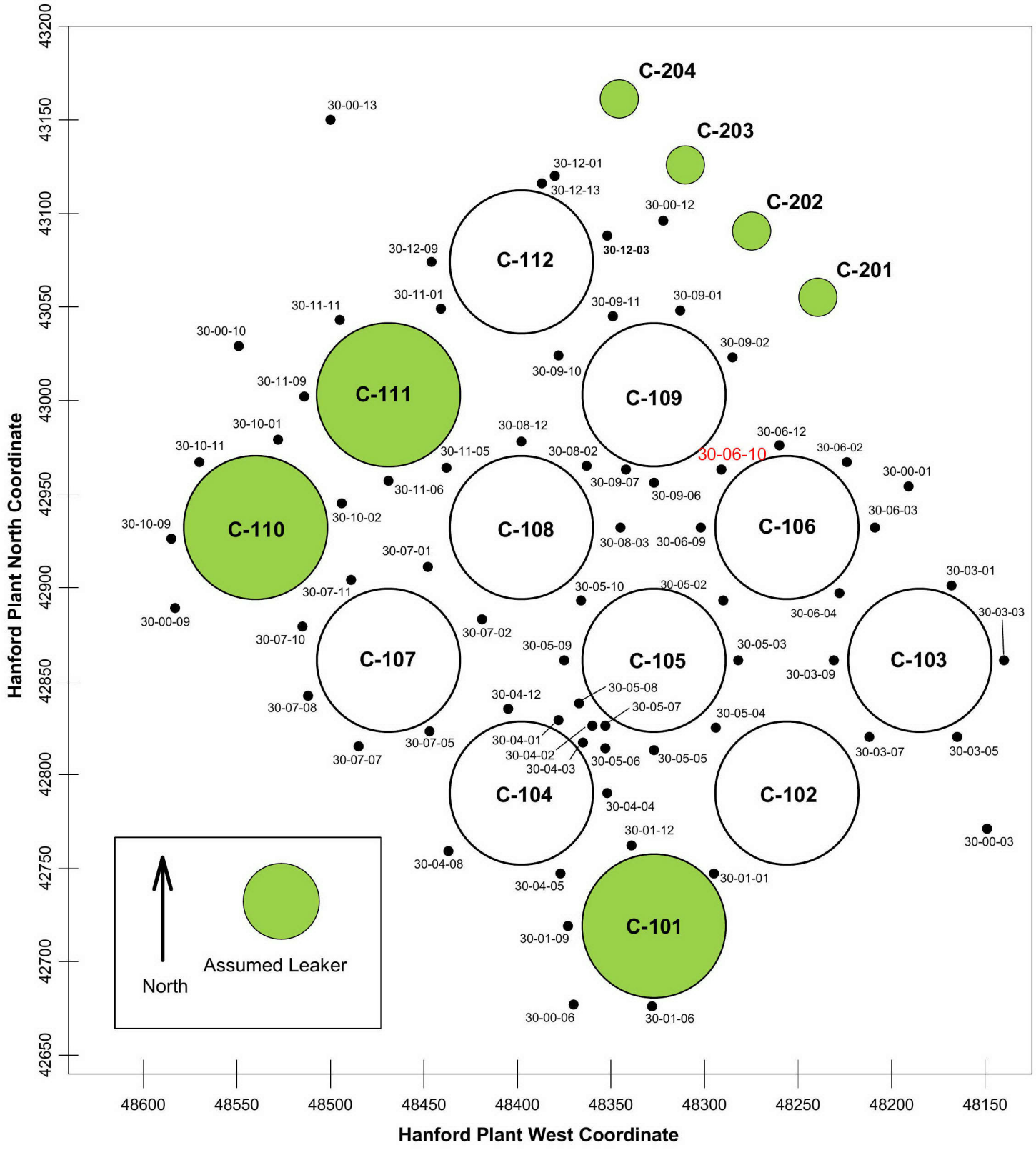
Depth Reference is top of casing

Borehole 30-06-10 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2011, 2004, 2003, 1999, & 1997)
Comparison of Co-60 (2011, 2004, 1999, & 1997)
Combination Plot
Manmade Repeat Section
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-106.* GJ-HAN-84. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-06-10 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-06-10 (299-E27-71) (A6696)

Borehole Information

Site: C Farm, Tank C-106			
Coordinates (HAN Plant):	**North: 42963**	**West: 48291**	**Elevation (ft): 645.31**
Coordinates (WA Plane):	**North: 136578.287**	**East: 575172.083**	**Elevation (m): 197.808**
Drill Date: 11/30/1972	**Type: Cable Tool**	**Depth (ft): 129**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 2/17/04**	**D/W Reference: Stoller**	
Comments: RLS: Radionuclide Logging System, SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, NMLS: Neutron Moisture Logging System, WA State Plane Coordinates are NAVD88			

Casing Information

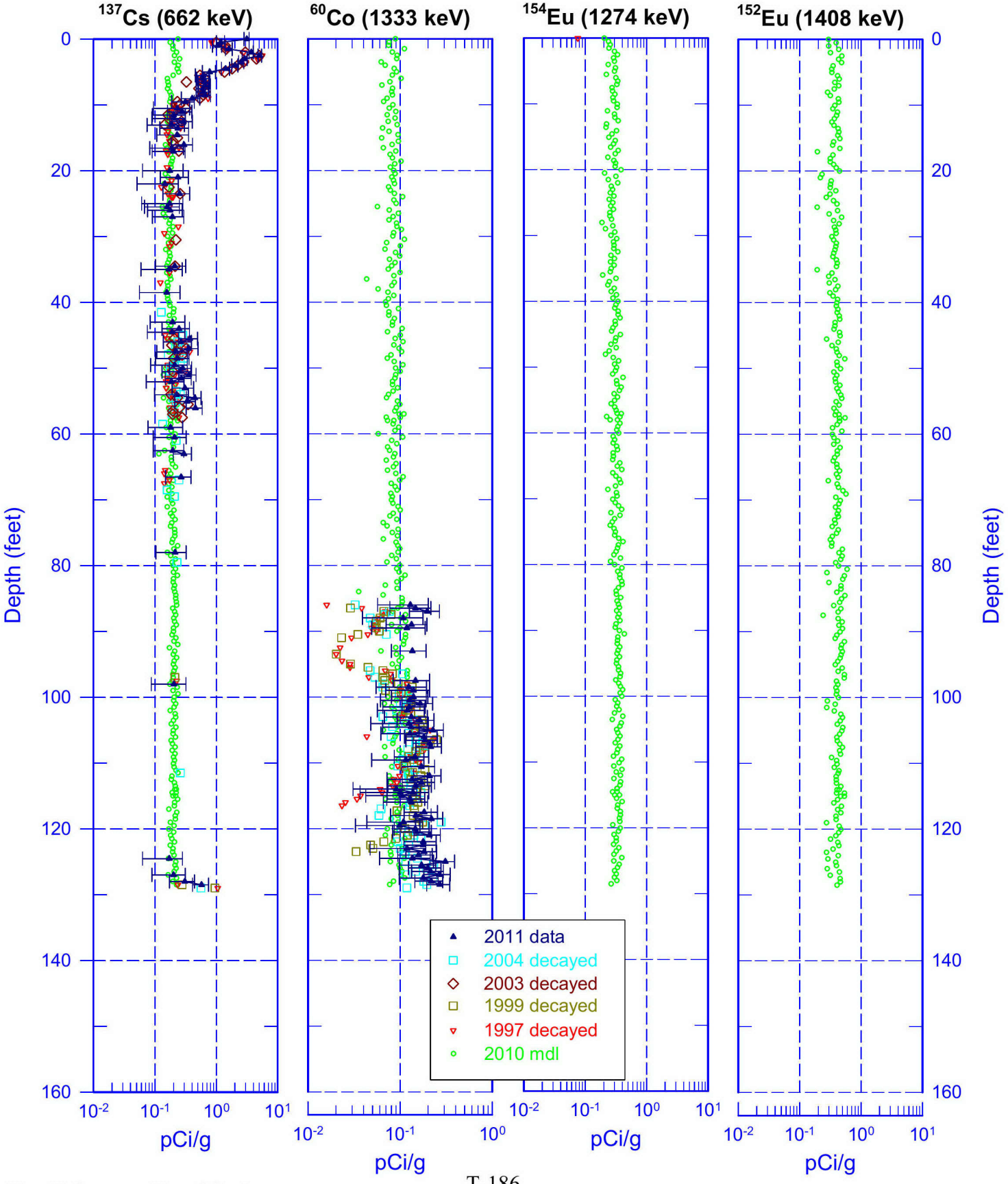
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	130	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
1993	RLS	Unk	NA	0-123	WHC	C-106 Investigation
01/29/97	SGLS	G1A	1	0-129	MACTEC-ERS	Baseline
03/03/99	SGLS	G2B	2	75-129	MACTEC-ERS	Continued Movement
04/23/02	RAS	Large	A	30-129	MACTEC-ERS	Poss. Increase 124-126
01/23/03	RAS	Large-New	B	0-129	Stoller	No change from above
04/22/03	RAS	Large-New	C	0-128	Stoller	Poss. Cs increase 4-5 ft
07/22/03	RAS	Large-New	D	0-128	Stoller	No change from above
04/29/03	NMLS	Moisture	1	0-128.25	Stoller	Moisture Baseline
07/22/03	NMLS	Moisture	2	0-128.25	Stoller	No Apparent Change
09/04/03	NMLS	Moisture	3	0-128.25	Stoller	No Apparent Change
09/04/03	SGLS	G2A	3	0-60	Stoller	No Apparent Change
09/08/03	RAS	Large-New	E	0-128	Stoller	No Apparent Change
10/21/03	NMLS	Moisture	4	0-128.25	Stoller	No Apparent Change
11/03/03	RAS	Large-New	F	0-128	Stoller	No Apparent Change
12/03/03	NMLS	Moisture	5	0-128.25	Stoller	No Apparent Change
12/22/03	RAS	Large-New	G	0-128	Stoller	No Apparent Change
02/17/04	NMLS	Moisture	6	0-128.25	Stoller	No Apparent Change
02/26/04	RAS	Large-New	H	0-128	Stoller	No Apparent Change
02/27/04	SGLS	G2A	4	40-129	Stoller	Cont. move. 124-129
11/02/04	NMLS	Moisture	7	0-128.25	Stoller	No Apparent Change
05/08/05	RAS	Large-New	I	0-128	Stoller	No Apparent Change
3/11/2011	SGLS	G2BR	5	0-128.5	Stoller	Co increase 86-90 & 93 ft

30-06-10 (299-E27-71 [A6696])

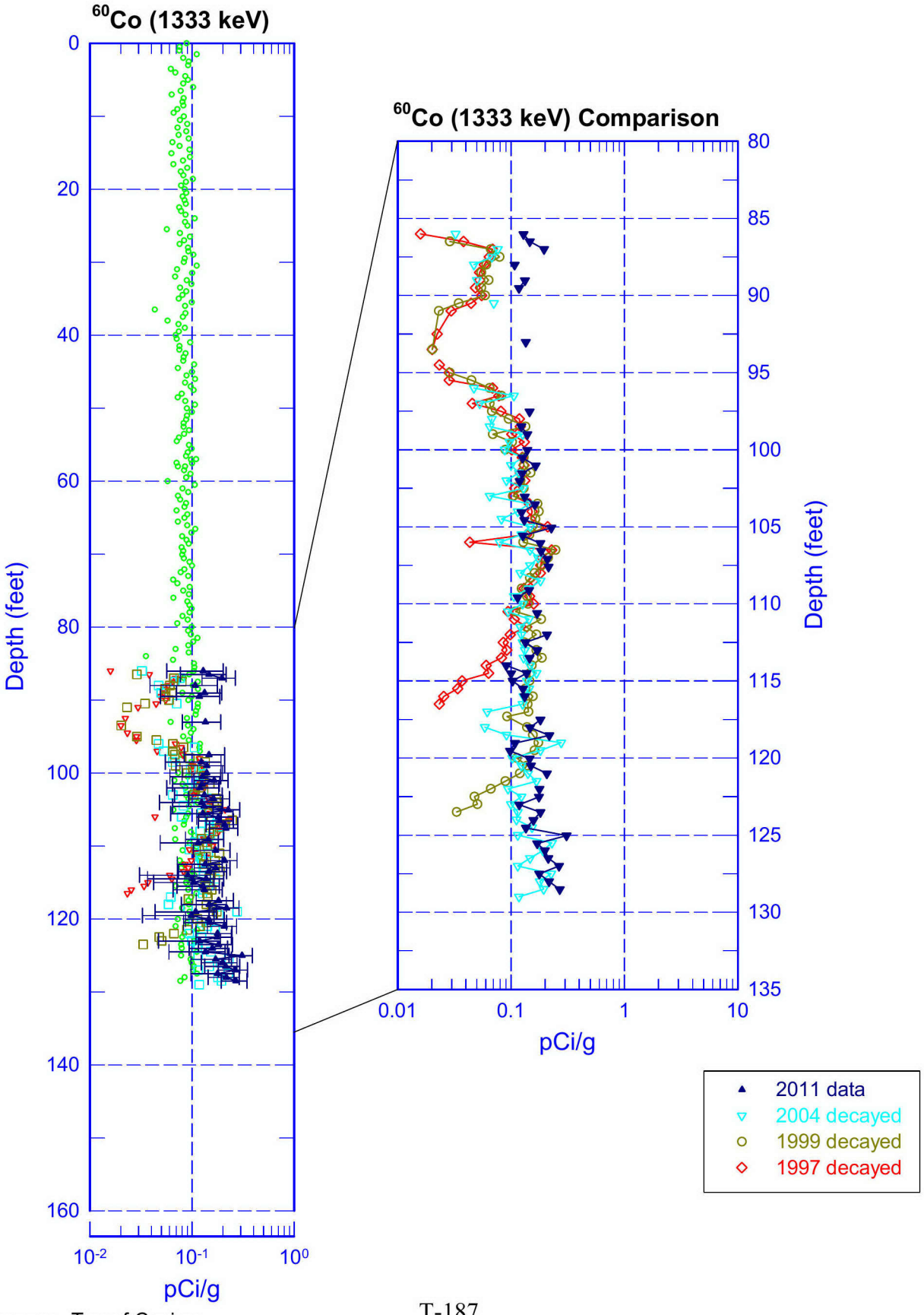
Comparison of Manmade Radionuclides (2011, 2004, 2003, 1999 &1997)



Zero Reference - Top of Casing

30-06-10 (299-E27-71 [A6696])

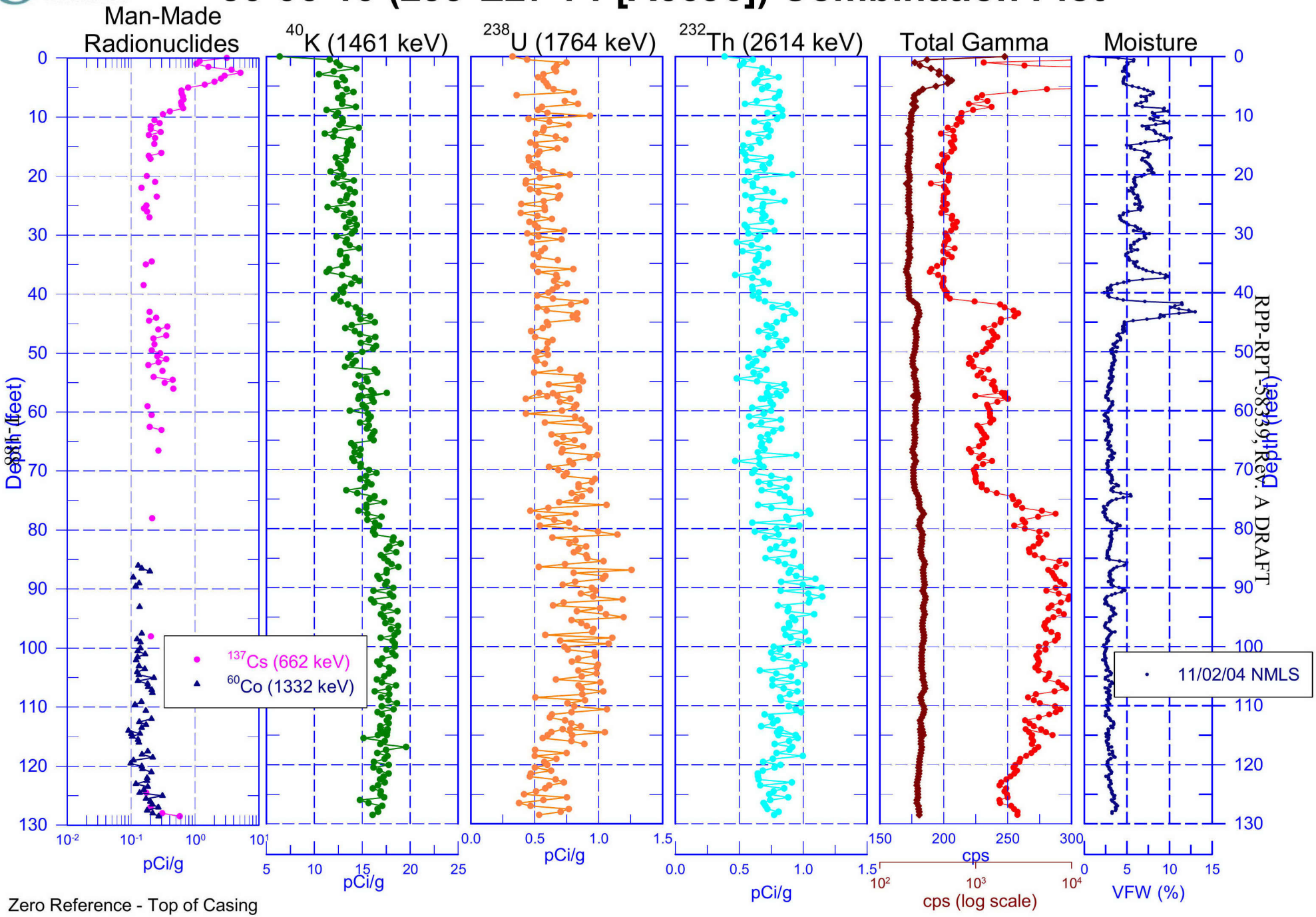
Comparison of Co-60 (2011, 2004, 1999 &1997)



Zero Reference - Top of Casing

Stoller
Hanford Office

30-06-10 (299-E27-71 [A6696]) Combination Plot

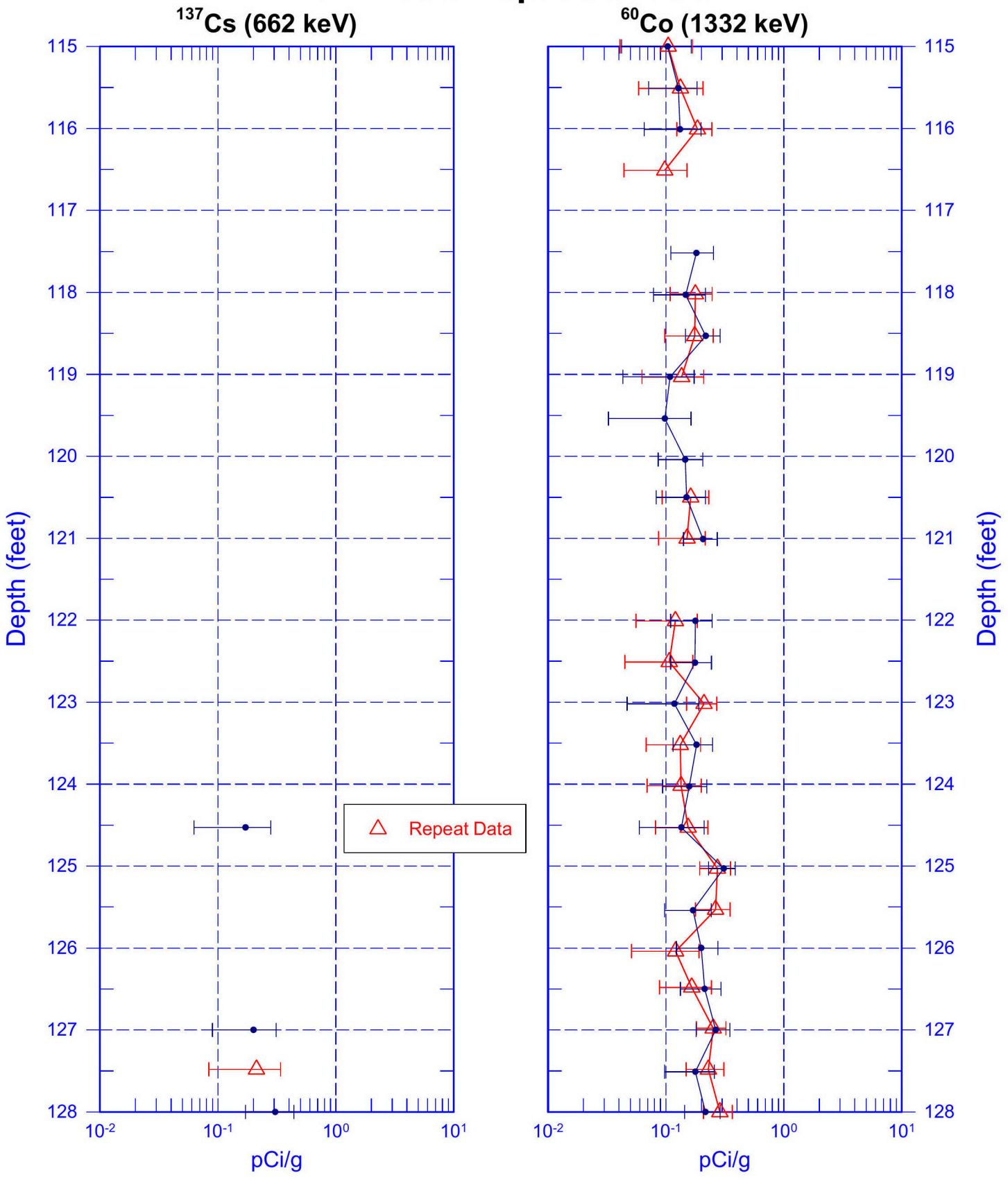


RPP-RPT-58339, Rev. A DRAFT (uncontrolled)

Stoller Hanford Office

30-06-10 (299-E27-71 [A6696])

Manmade Repeat Section

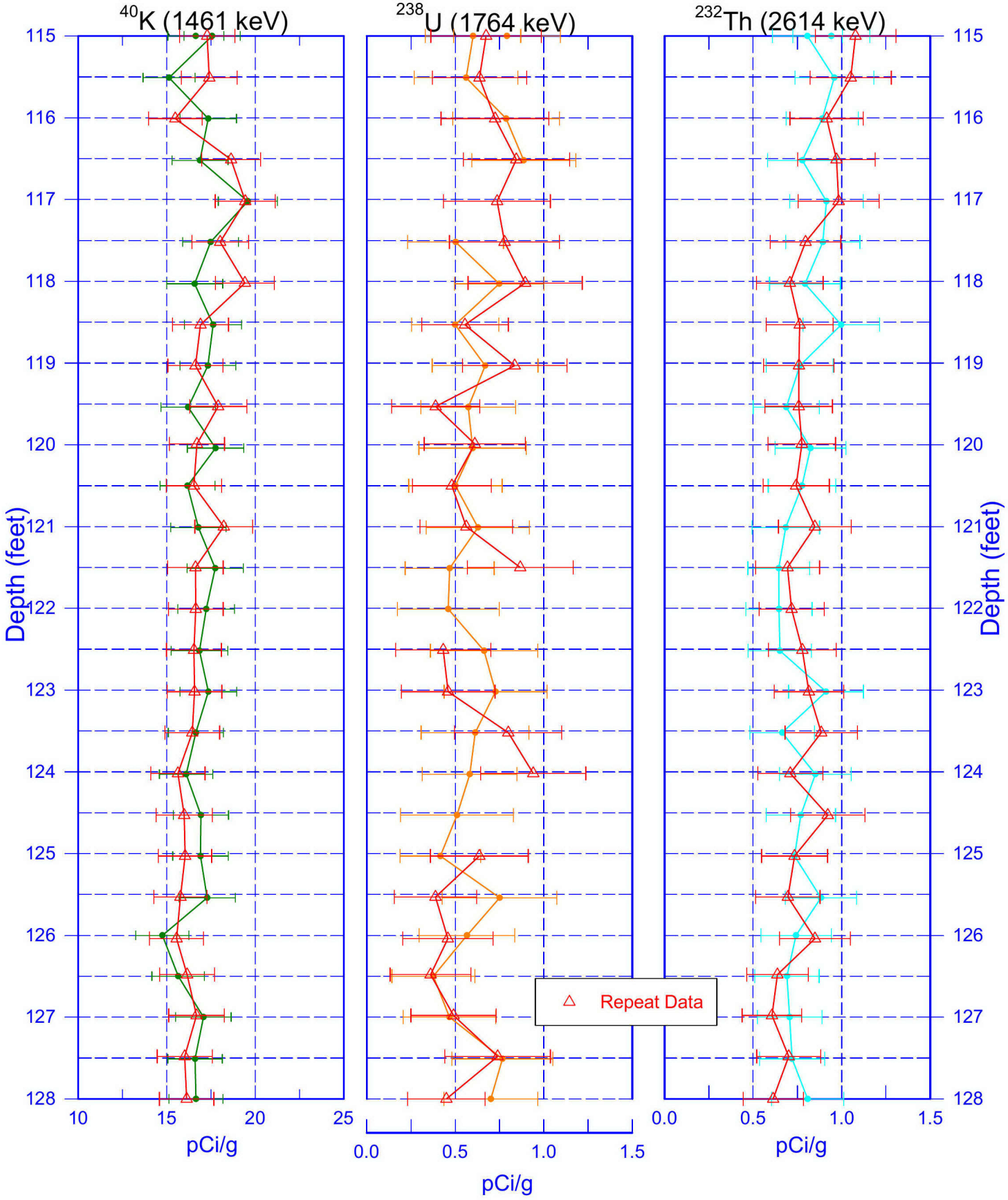


Zero Reference - Top of Casing

Stoller Hanford Office

30-06-10 (299-E27-71 [A6696])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-86 (A6711)

2010-2011 C-Farm Re-Baseline

30-06-12
299-E27-86 (A6711)
Log Data Report

Borehole Information:

Log Date:	2011-03-07	Filename:	A6711_HG_2011-03-07	Site:	241-C-106
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:	11/09/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	8/31/1974	N/A	100	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	99.5

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2011 was from 0 to 99.0 ft. The location of the borehole is indicated in the figure titled "Borehole 30-06-12 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2011. A summary of other logging data acquired since 1993 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-106* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

No water exists in the borehole casing.

The zero reference is the TOC, approximately at ground surface.

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[5] SGLS
Effective Calibration Date:	09/22/10	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 2 F	**Type:**	NMLS[6]
Effective Calibration Date:	10/04	**Serial No.:**	H380932510
Calibration Reference:	DOE-EM/GJ754-2004	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev. 0

SGLS Log Run Information:

Log Run	**1**	**2**	**3**	**4 Repeat**	
HEIS Number	1017386	1017387	1017388	1017389	
Date	3/2/11	3/3/11	3/7/11	3/7/11	
Logging Engineer	Holloway/ McClellan	Holloway/ McClellan	Holloway/ McClellan	Holloway/ McClellan	
Start Depth (ft)	0.0	34.0	73.0	87.0	
Finish Depth (ft)	35.01	74.0	99.0	97.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	_B_1132	_B_1133	_B_1137	1017388_B_1137	
Start File	_D_000000	_D_003400	_D_007300	_D_008700	
Finish File	_D_003501	_D_007400	_D_009900	_D_009700	
Post-Verification	_A_1132	_A_1133	1017389_A_1137	_A_1137	
Depth Return Error (in.)	0.0	0.0	0.0	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

NMLS Log Run Information:

Log Run	**5**	**6 Repeat**			
HEIS Number	1017934	1017935			
Date	11/1/04	11/1/04			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	20.0			
Finish Depth (ft)	30.0	98.5			
Count Time (sec)	N/A	N/A			

[5] Down-Hole Multi-Channel Analyzer
[6] Neutron Moisture Logging System

Log Run	5	6 Repeat			
Live/Real	N/A	N/A			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	1.0	1.0			
Pre-Verification	BF185CAB	BF185CAB			
Start File	BF185000	BF185121			
Finish File	BF185120	BF185435			
Post-Verification	BF185CAA	BF185CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	None	Repeat section 20.0 to 30.0 ft			

Logging Operation Notes:

Data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

NMLS data were collected using Gamma 1, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the AmBe standard field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above for 2011 SGLS log run information due to the length of file names (e.g., A6711_BR_1017386_D_000000 for _D_000000).

Analysis Notes:

Analyst:	C. Nelson	Date:	8/26/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for 0.280-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1b, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[7] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

[7] minimum detection level

To assure comparability, 1997 data were reprocessed using the same casing correction as the 2011 data. The efficiency function and dead time corrections in place in 1997 were applied during reprocessing. For purposes of comparison with the 2011 data, the 1997 Cs-137 and Co-60 concentrations were decayed to a common date of March 7, 2011.

During the time from April 2003 to November 2004, NMLS data were acquired seven times. The most recent NMLS data are reported in this log data report.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are still plotted.

Cs-137 was detected almost continuously from ground surface to 31 ft, intermittently from 34 to 40.5 ft, almost continuously from 43 to 61.5 ft and intermittently from 63 to 74 ft and at 98.5 and 99 ft. A maximum concentration of approximately 19.7 pCi/g was measured at 0.5 ft. Comparisons with the 1997 data indicate no significant change.

Co-60 was detected at 20, 89.5, 91, and 96 ft. Comparison with the 1997 data shows an increase of Co-60 concentrations at depths between 89 and 96.5 ft. Co- 60 detected in 1997 from 19.5 to 22 ft has decayed below the 2011 MDL, except at 20 ft.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

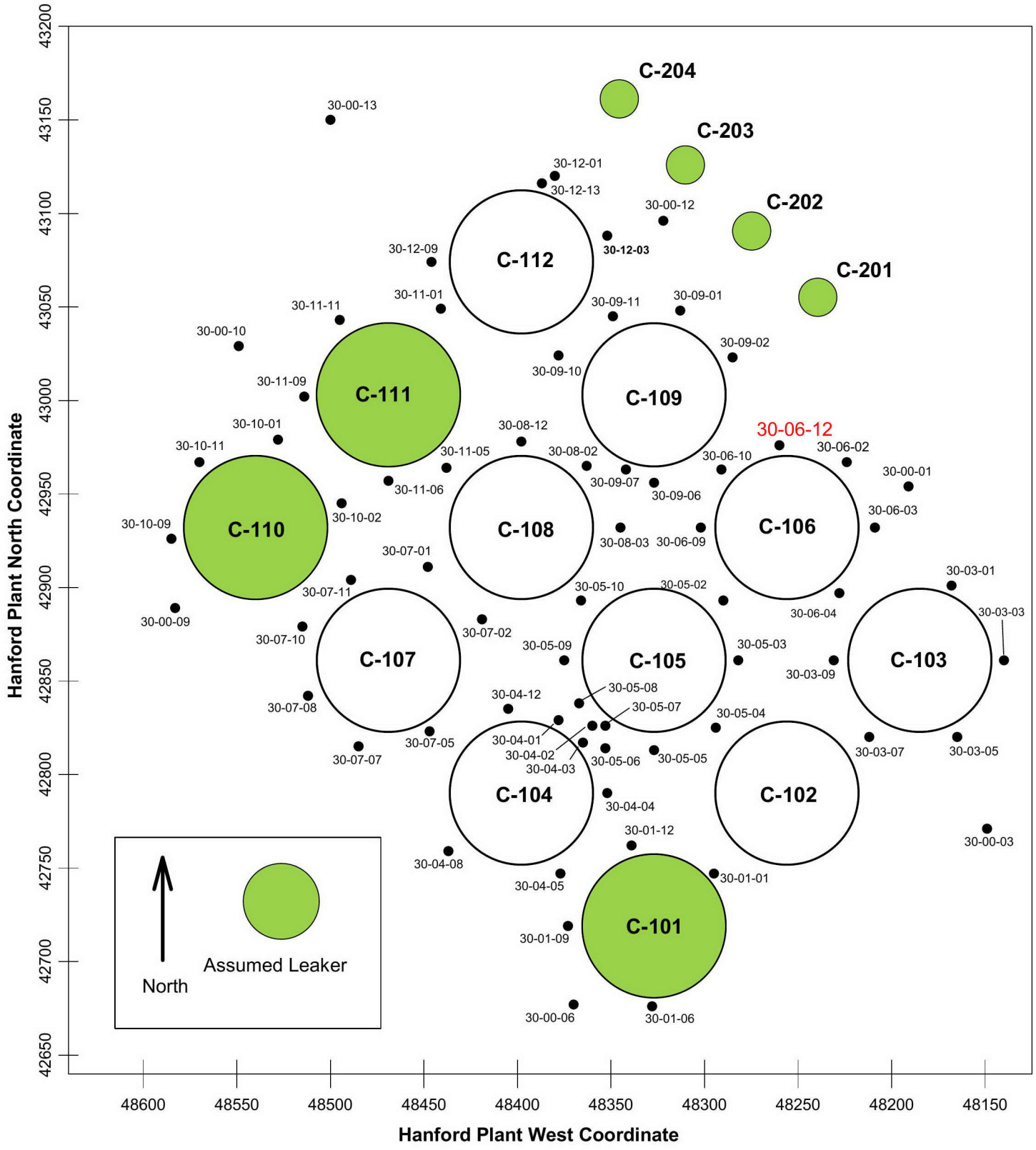
Depth Reference is ground surface

Borehole 30-06-12 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2011 & 1997)
Combination Plot
Manmade Repeat Section
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy. 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-106l.* GJ-HAN-84. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-06-12 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-06-12 (299-E27-86) (A6711)

Borehole Information

Site: C Farm, Tank C-106			
Coordinates (HAN Plant):	**North: 42976**	**West: 48260**	**Elevation (ft): 644.74**
Coordinates (WA Plane):	**North: Unk**	**East: Unk**	**Elevation (m): Unk**
Drill Date: 8/31/1974	**Type: Cable Tool**	**Depth (ft): 98.5**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 05/31/07**	**D/W Reference: Stoller**	
Comments: RLS: Radionuclide Logging System, SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, NMLS: Neutron Moisture Logging System, WA State Plane Coordinates are NAVD88			

Casing Information

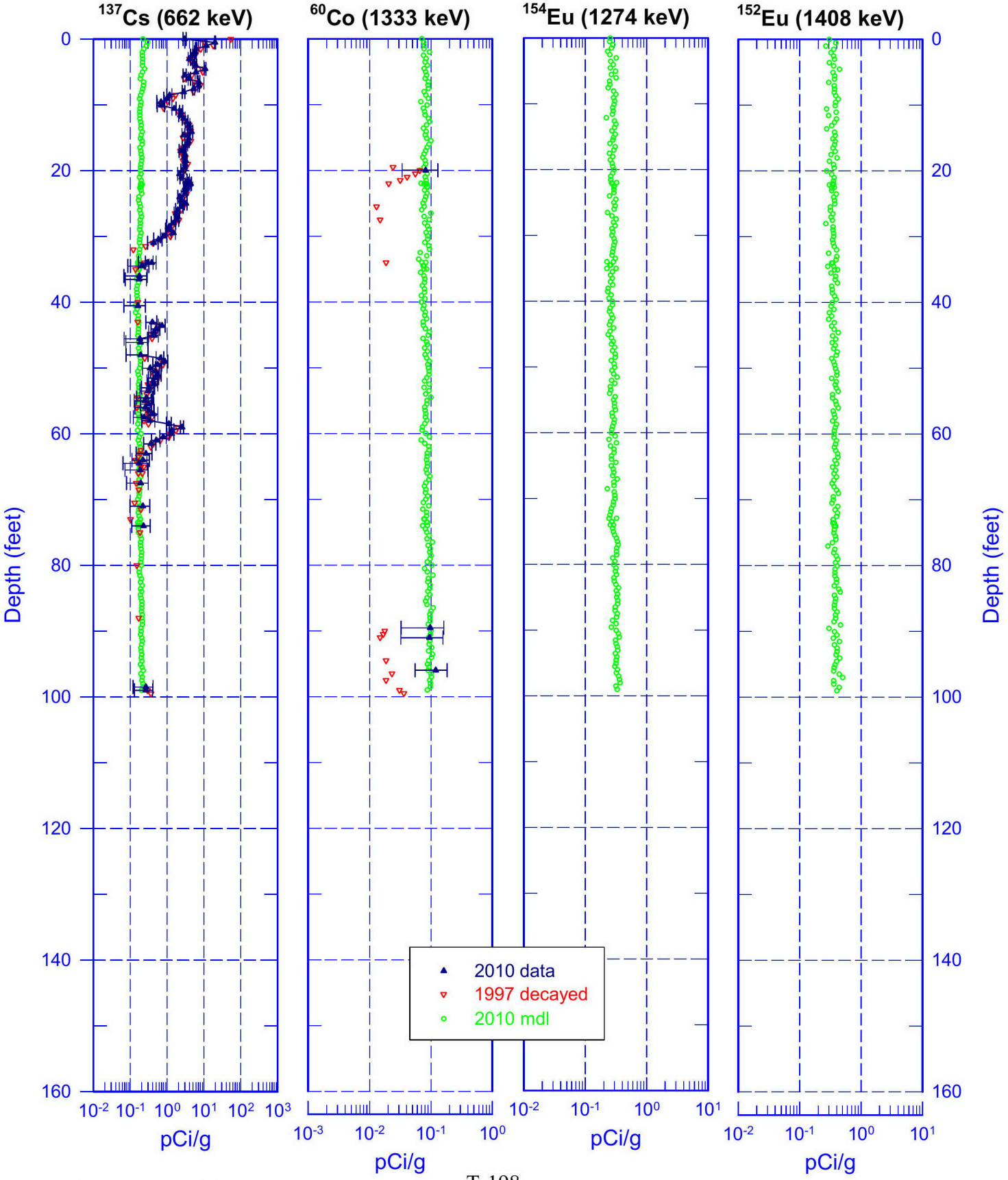
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
1993	RLS	Unk	NA	0-95	WHC	C-106 Investigation
01/27/97	SGLS	G1A	1	0-99.5	MACTEC-ERS	Baseline
04/24/02	RAS	Large	A	10-99.5	MACTEC-ERS	No Apparent Change
01/24/03	RAS	Large-New	B	0-99	Stoller	No Apparent Change
04/29/03	RAS	Large-New	C	0-99	Stoller	No Apparent Change
07/22/03	RAS	Large-New	D	0-98	Stoller	No Apparent Change
04/29/03	NMLS	Moisture	1	0-98.5	Stoller	Moisture Baseline
07/22/03	NMLS	Moisture	2	0-98.5	Stoller	No Apparent Change
09/09/03	NMLS	Moisture	3	0-98.5	Stoller	No Apparent Change
09/11/03	RAS	Large-New	E	0-98	Stoller	No Apparent Change
10/21/03	NMLS	Moisture	4	0-98.5	Stoller	No Apparent Change
10/22/03	RAS	Large-New	F	0-98	Stoller	No Apparent Change
12/04/03	NMLS	Moisture	5	0-98.5	Stoller	No Apparent Change
12/08/03	RAS	Large-New	G	0-98	Stoller	No Apparent Change
02/18/04	NMLS	Moisture	6	0-98.5	Stoller	No Apparent Change
03/01/04	RAS	Large-New	H	0-98	Stoller	No Apparent Change
11/01/04	NMLS	Moisture	7	0-98.5	Stoller	No Apparent Change
05/08/05	RAS	Large-New	I	0-98	Stoller	No Apparent Change
05/31/07	RAS	Large-New	J	0-99	Stoller	No Apparent Change
03/07/11	SGLS	G2BR	2	0-99	Stoller	Poss. Co Increase 89.5, 91 & 96 ft

30-06-12 (299-E27-86 [A6711])

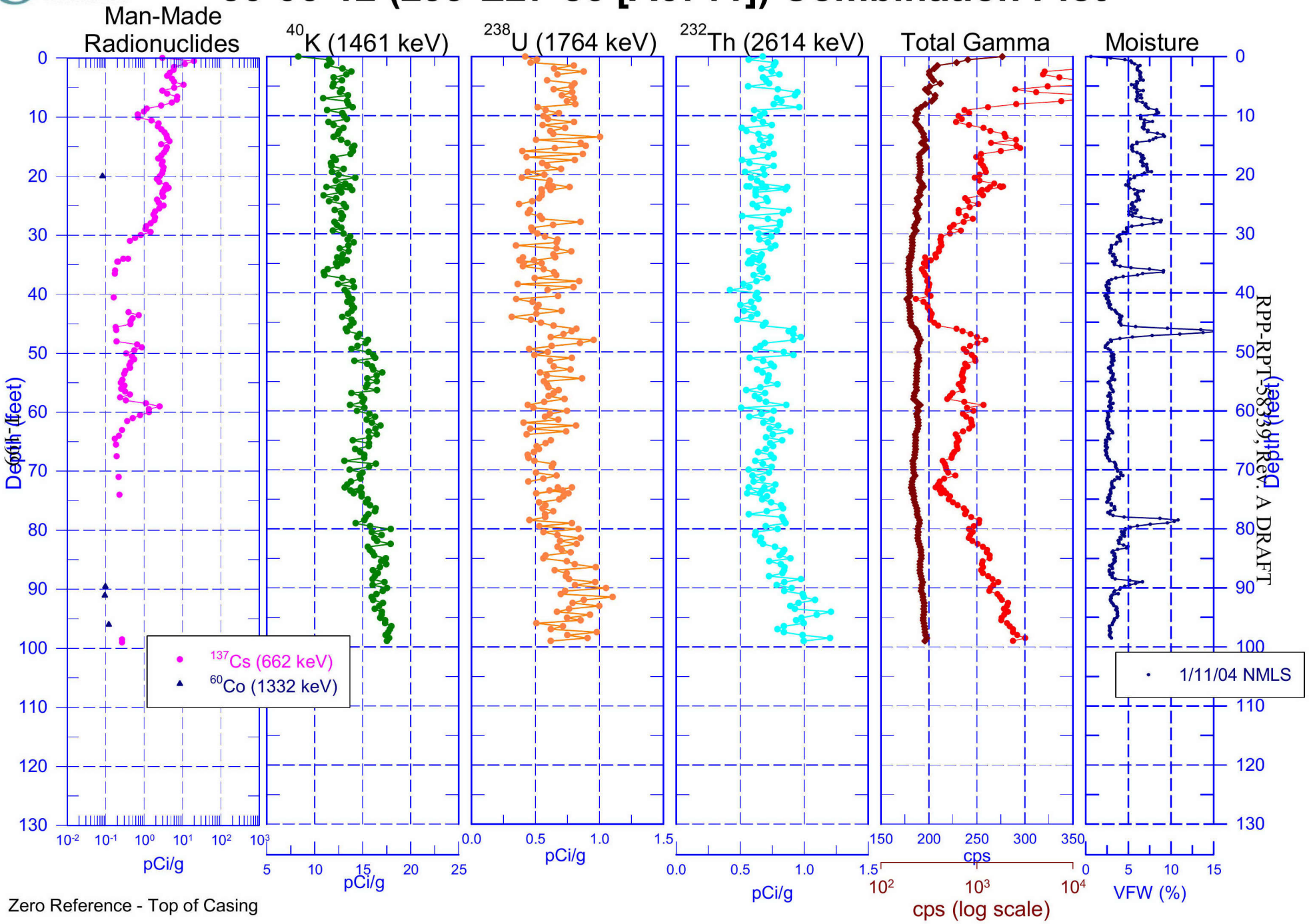
Comparison of Manmade Radionuclides (2011 &1997)



Zero Reference - Top of Casing

Stoller
Hanford Office

30-06-12 (299-E27-86 [A6711]) Combination Plot



RPP-RPT-58339, Rev. A DRAFT

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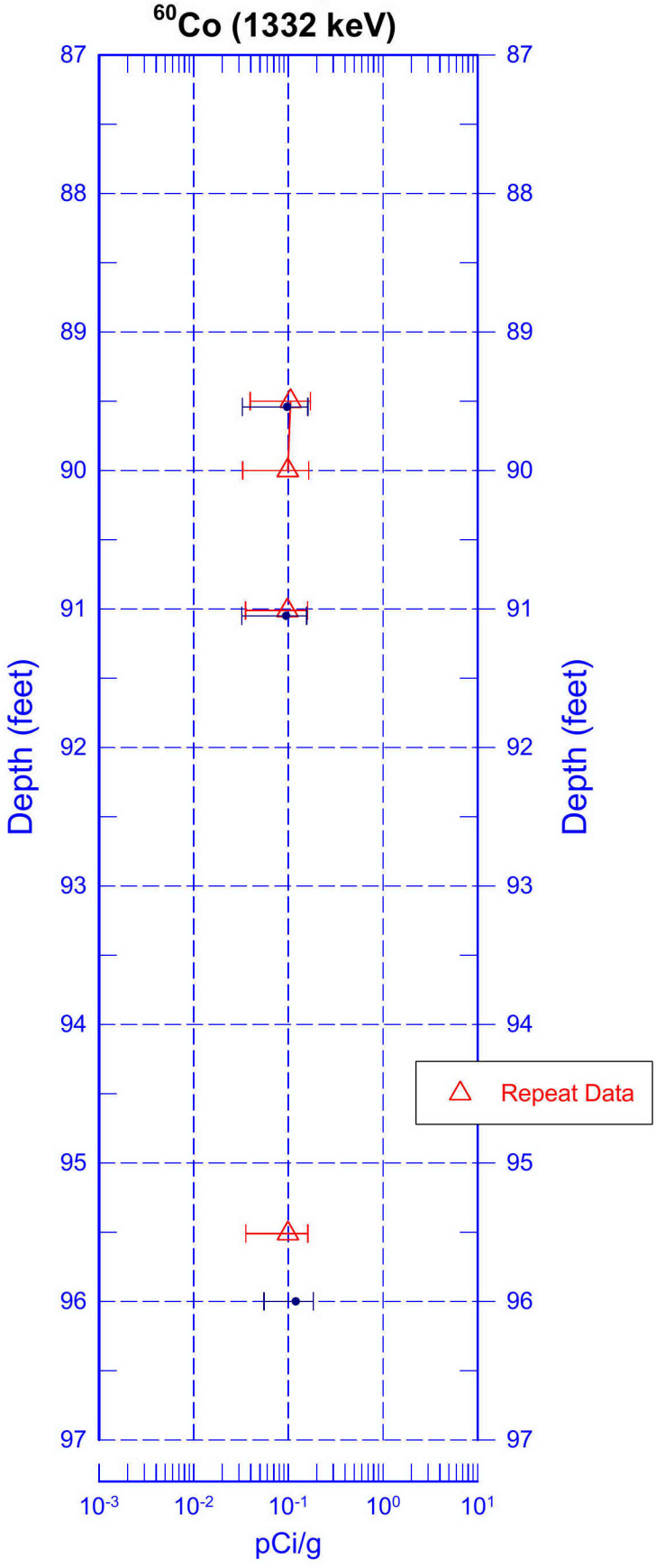
30-06-12 (299-E27-86 [A6711])

Manmade Repeat Section

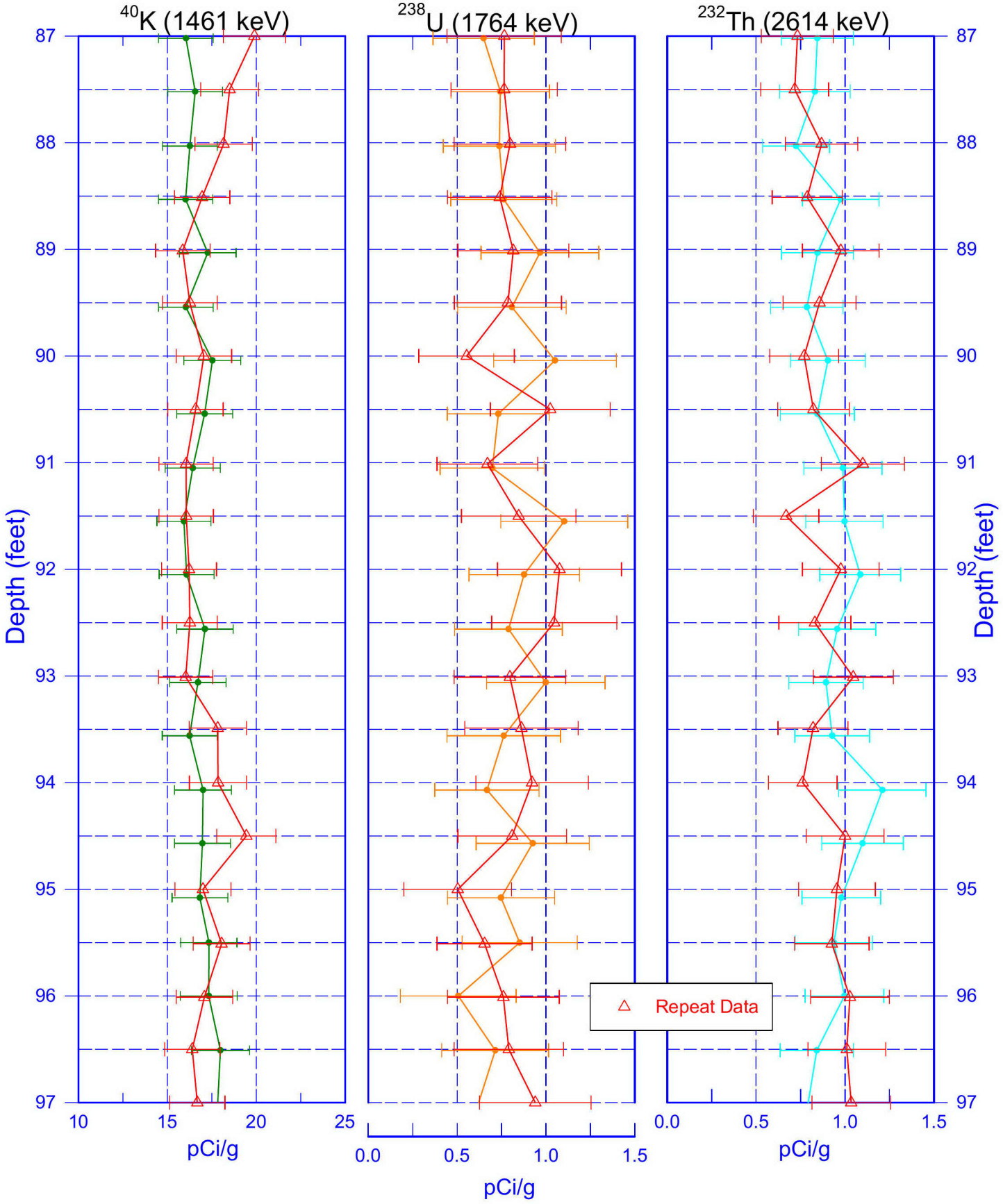


Zero Reference - Top of Casing

Stoller Hanford Office

30-06-12 (299-E27-86 [A6711])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-94 (A6719)

Stoller Hanford Office established 1959

HGLP-LDR-669, Rev. 1

2010-2011 C-Farm Re-Baseline

30-08-02
299-E27-94 (A6719)
Log Data Report

Borehole Information:

Log Date:	2010-11-16	Filename:	A6719_HG_2010-11-16	Site:	241-C-108	
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:		09/09/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)		Type
N/A	N/A	4/1974	N/A	100		Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	100

Revision Summary:

The original Log Data Report included two plots referred to as "Comparison of Manmade Radionuclides (SGLS & HRLS)" and "Comparison of Manmade Radionuclides (SGLS)." The 2004 Co-60 log data included in these plots had not been decayed to 2010 as represented in the report. This revision corrects the omission and provides text changes as appropriate to address the corrections. The "Comparison of Manmade Radionuclides (SGLS & HRLS)" plot is updated, the plot "Comparison of Manmade Radionuclides (SGLS)" is replaced by "Comparison of Co-60 Concentrations from 1997 to 2010," and the plot "Comparison of Cs-137 Concentrations from 1997 to 2010" is added.

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The location of the borehole is indicated in the figure titled "Borehole 30-08-02 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline data acquired in 1997. This report includes SGLS[4] data acquired in 1997, 2004, and 2010 as well as HRLS[5] data from 2010. NMLS[6] data acquired in 2004 are also included. A summary of other logging data acquired since 1994 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-108* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] High Rate Logging System
[6] Neutron Moisture Logging System

The zero reference is the top of casing, which is approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[7] SGLS
Effective Calibration Date:	09/22/10	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 2C	**Type:**	DHMCA HRLS
Effective Calibration Date:	4/23/2010	**Serial No.:**	39A314
Calibration Reference:	HGLP-CC-063, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 2 F	**Type:**	NMLS
Effective Calibration Date:	9/03	**Serial No.:**	H380932510
Calibration Reference:	GJO-2003-520-TAC	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev. 0

SGLS Log Run Information:

Log Run	**1**	**2**	**3**	**4**	**5**
HEIS Number	1016253	1017359	1017360	1017361	1017362
Date	9/10/10	11/09/10	11/10/10	11/11/10	11/15/10
Logging Engineer	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway
Start Depth (ft)	0.0	3.0	12.0	44.0	64.0
Finish Depth (ft)	4.0	13.0	45.0	65.0	99.0
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	_B_10910	_B_10119	_B_101110	_B_101111	_B_101115
Start File	_D_000000	_D_000300	_D_001200	_D_004400	_D_006400
Finish File	_D_000400	_D_001300	_D_004500	_D_006500	_D_009901
Post-Verification	_B_10910	_A_10119	_A_101110	_A_101111	_A_101115
Depth Return Error (in.)	0.0	0.0	0.0	1/2 high	1 high
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made

[7] Down-Hole Multi-Channel Analyzer

Log Run	6 Repeat				
HEIS Number	1017363				
Date	11/16/10				
Logging Engineer	Spatz/ Holloway				
Start Depth (ft)	45.0				
Finish Depth (ft)	55.0				
Count Time (sec)	100				
Live/Real	R				
Shield (Y/N)	N				
MSA Interval (ft)	0.5				
Log Speed (ft/min)	N/A				
Pre-Verification	_B_101116				
Start File	_D_004500				
Finish File	_D_005500				
Post-Verification	_A_101116				
Depth Return Error (in.)	0.0				
Comments	No fine gain adjustments made				

HRLS Log Run Information:

Log Run	7	8			
HEIS Number	1016252	1016254			
Date	9/10/10	9/13/10			
Logging Engineer	Spatz/ Holloway	Spatz/ Holloway			
Start Depth (ft)	19.0	N/A			
Finish Depth (ft)	24.0	N/A			
Count Time (sec)	300	1000			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.5	0.5			
Log Speed (ft/min)	N/A	N/A			
Pre-Verification	_B_002150	N/A			
Start File	_D_001900	N/A			
Finish File	_D_002400	N/A			
Post-Verification	_A_002150	N/A			
Depth Return Error (in.)	0.0	N/A			
Comments	No fine gain adjustments made	Field verifier completed at Cal Models			

NMLS Log Run Information:

Log Run	9	10 Repeat			
HEIS Number	1017755	1017756			
Date	2/20/2004	2/20/2004			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	50.0			
Finish Depth (ft)	60.0	99.0			
Count Time (sec)	N/A	N/A			
Live/Real	N/A	N/A			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	1.0	1.0			
Pre-Verification	BF159CAB	BF159CAB			
Start File	BF159000	BF159241			
Finish File	BF159240	BF159437			
Post-Verification	BF159CAA	BF159CAA			
Depth Return Error (in.)	N/A	0.0			
Comments	No fine gain adjustments made	No fine gain adjustments made			

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

HRLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in a borehole at a depth with a known Cs-137 concentration. A centralizer was installed on the sonde.

NMLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the standard field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above for the 2010 SGLS and HRLS due to the length of file names (for example, _D_000051 for A6719_BR_1016281_D_000051).

Analysis Notes:

Analyst:	Legler/Henwood	Date:	11/30/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Casing corrections for a 0.28-in. thick casing were applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

HRLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 300507_BCr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[8] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the1997 and 2004 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time corrections in place in 1997 and 2004 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137, Co-60, and Eu-154 data were decayed to a common date of September 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants is not found, MDLs for the radionuclide are still plotted.

Cs-137, Co-60, and Eu-154 were detected in this borehole. Co-60 and Eu-154 are not generally considered significant as a contaminant, but are important for use as a "tracer" to track subsurface contamination movement.

Cs-137 was detected continuously from ground surface to 23 ft, intermittently from 24 to 36 ft, almost continuously from 46 to 57 ft, and at 98 and 99 ft, with a maximum concentration of approximately 1380 pCi/g at 21 ft as measured by the HRLS. The HRLS data cannot be directly compared with prior SGLS data at this depth interval because the measurement range of the SGLS was exceeded. However, comparisons of 1997, 2004, and 2010 SGLS data at other depth locations indicate an increase of Cs-137 concentrations from 46 to 57 ft.

Co-60 was detected almost continuously from 47 to 80 ft with a maximum concentration measured at approximately 6.8 pCi/g at 61 ft. Comparisons of 1997 and 2004 data (after decay to a common date) indicate a significant increase of Co-60 concentrations from 47 to 78 ft. Between 2004 and 2010, a decrease in concentration beyond what can be attributed to decay alone occurred from 47 to 58 ft. A significant increase is observed between 58 and 78 ft.

Eu-154 was detected intermittently from 19.5 to 22 ft with a maximum concentration of approximately 2.6 pCi/g at 21 ft. Comparisons of 1997 and 2010 data (this depth interval was not logged in 2004) cannot be made because the measurement range of the SGLS was exceeded at these depths.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. Apparent thin, fine-grained-intervals at 75 and 79 ft may be controlling the depth of the Co-60 contamination by causing lateral migration on top of the fine grained intervals. Otherwise, there is no evidence of relatively high moisture associated with the contamination or where contaminant migration occurred between 1997 and 2004.

The repeat plots indicate that the respective systems were working properly.

[8] minimum detection level

Gamma logging in this borehole has indicated contaminant migration since 1976 between approximately 47 and 79 ft. It can be characterized as at least four episodes of contamination over 35 years that have exhibited downward migration and decay consistent with Co-60. Although previous contaminant migration has been attributed to Co-60, 2010 data strongly suggest Cs-137 concentrations have also increased since 1997 between 46 and 57 ft. Other boreholes in the area have indicated changes in Co-60 concentrations since 1997. These boreholes include 30-09-07, 30-09-06, 30-06-10, 30-06-12, and 30-09-02. It is recommended a detailed evaluation of subsurface contamination in this area be conducted to determine interrelationships, if any. This evaluation should include all available historical tank farms gross gamma, RAS, and SGLS data, as well as moisture data. One hypothesis is that contamination originates near tank C-108 and C-109, migrates downward to 75 to 80 ft, and then moves eastward past 30-09-07 and 30 09-06 to 30-06-10, where it migrates deeper into the vadose zone.

List of Log Plots:

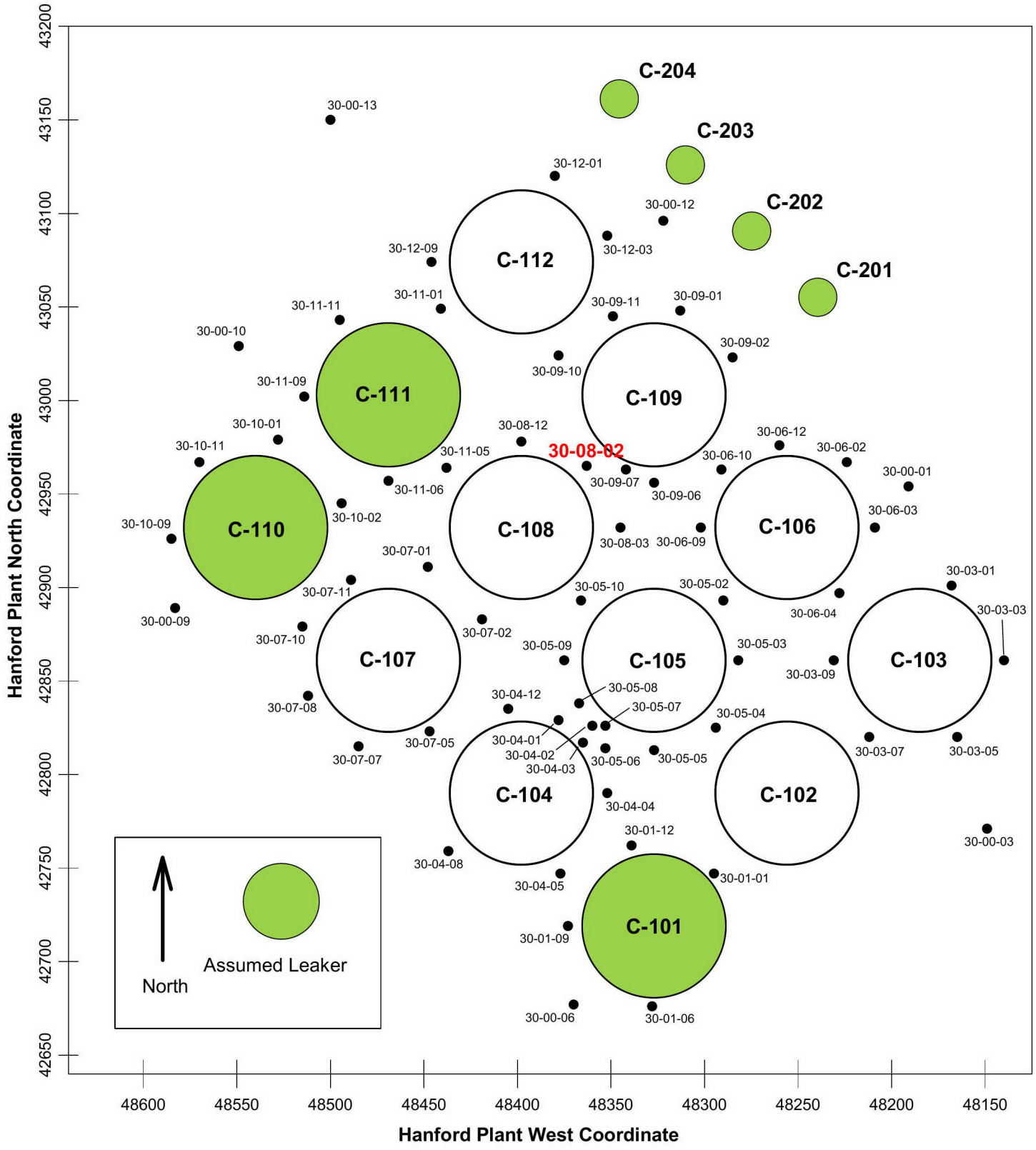
Depth Reference is top of casing

Borehole 30-08-02 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (SGLS & HRLS)
Comparison of Co-60 Concentrations from 1997 to 2010
Comparison of Cs-137 Concentrations from 1997 to 2010
Combination Plot (2010 Data)
Repeat Section of Natural Gamma Logs
Repeat of Manmade Radionuclides

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-108.* GJ-HAN-90. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-08-02 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-08-02 (299-E27-94) (A6719)

Borehole Information

Site: C Farm, Tank C-108			
Coordinates (HAN Plant):	**North: 42965**	**West: 48363**	**Elevation (ft): 647.00**
Coordinates (WA Plane):	**North: 136578.828**	**East: 575150.01**	**Elevation (m): 197.951**
Drill Date: 9/30/1974	**Type: Cable Tool**	**Depth (ft): 99**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 12/9/03**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, NMLS: Neutron Moisture Logging System, HRLS: High-Rate Logging System			

Casing Information

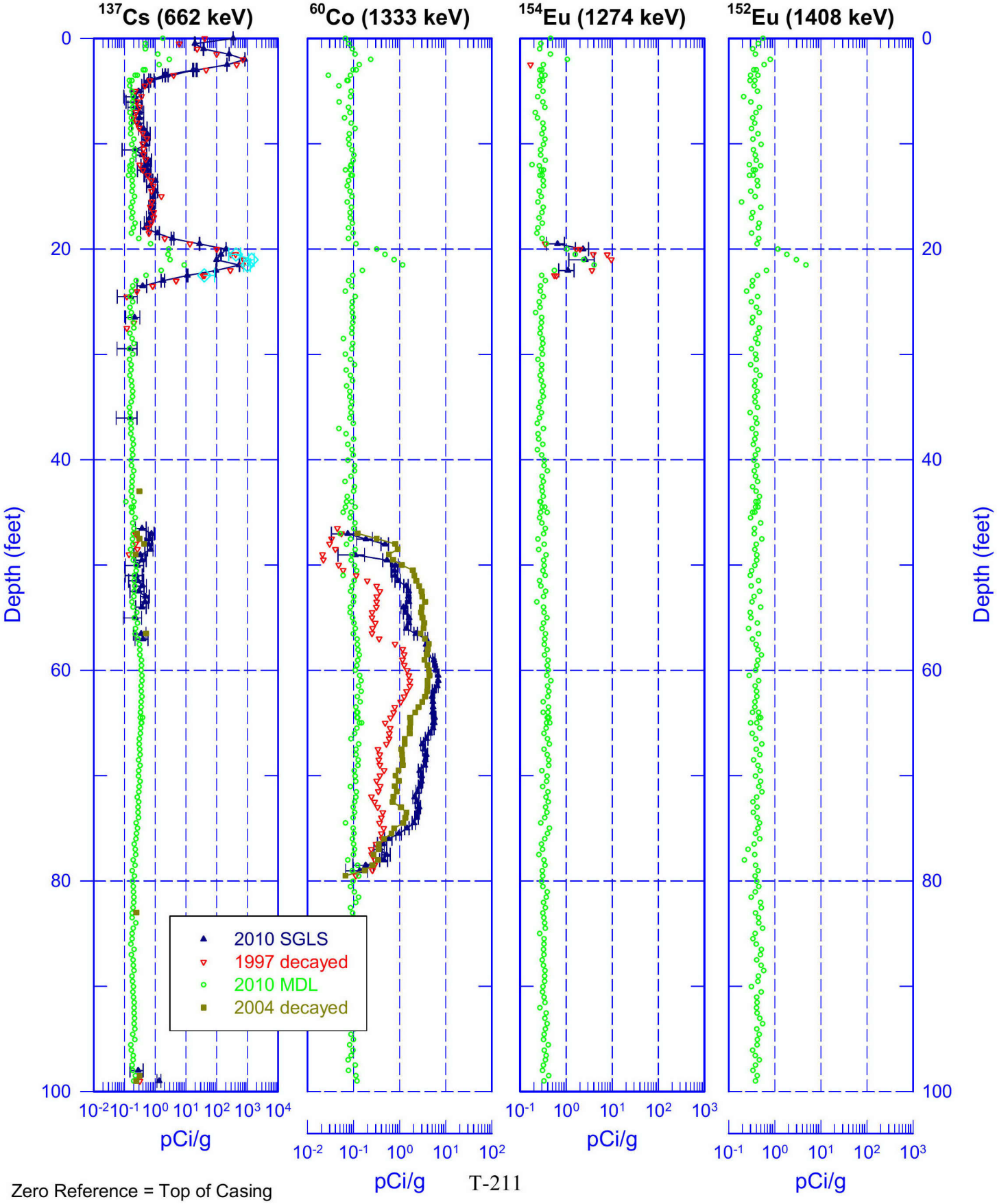
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
03/18/97	SGLS	G1B	1	0-99	MACTEC-ERS	Baseline
09/11/02	RAS	Large	A	30-99	Stoller	Co-60 increase 49-75 ft
09/12/02	RAS	Large	B	30-99	Stoller	No change from above.
01/21/03	RAS	Large-New	C	30-99	Stoller	Downward Movement
05/05/03	RAS	Large-New	D	30-99	Stoller	Downward Movement
07/30/03	RAS	Large-New	E	30-98	Stoller	Downward Movement
11/04/03	RAS	Large-New	F	30-98	Stoller	Downward Movement
12/08/03	NMLS	Moisture	1	0-99	Stoller	Moisture baseline
12/17/03	RAS	Large-New	G	30-99	Stoller	No change from above.
02/17/04	RAS	Large-New	H	30-99	Stoller	Downward Movement
02/20/04	NMLS	Moisture	2	0-99	Stoller	No change
2/23/2004	SGLS	G2A	2	40-99	Stoller	Confirm Co-60 incr. above
12/10/2006	RAS	Large-New	I	30-99	Stoller	Co-60 increase 46-75 ft
5/23/2007	RAS	Large-New	J	0-99	Stoller	Downward Movement
12/9/2007	RAS	Large-New	K	15-99	Stoller	Downward Movement
11/19/2009	RAS	Large	L	0-99	Stoller	Co-60 decreases ~49-69 ft
11/19/2009	RAS	Medium	L	0-30	Stoller	First run; depth error
9/10/2010	HRLS	G2C	1	19-24	Stoller	Baseline
11/16/2010	SGLS	G2BR	3	0-99	Stoller	Downward Movement

30-08-02 (299-E27-94 [A6719])

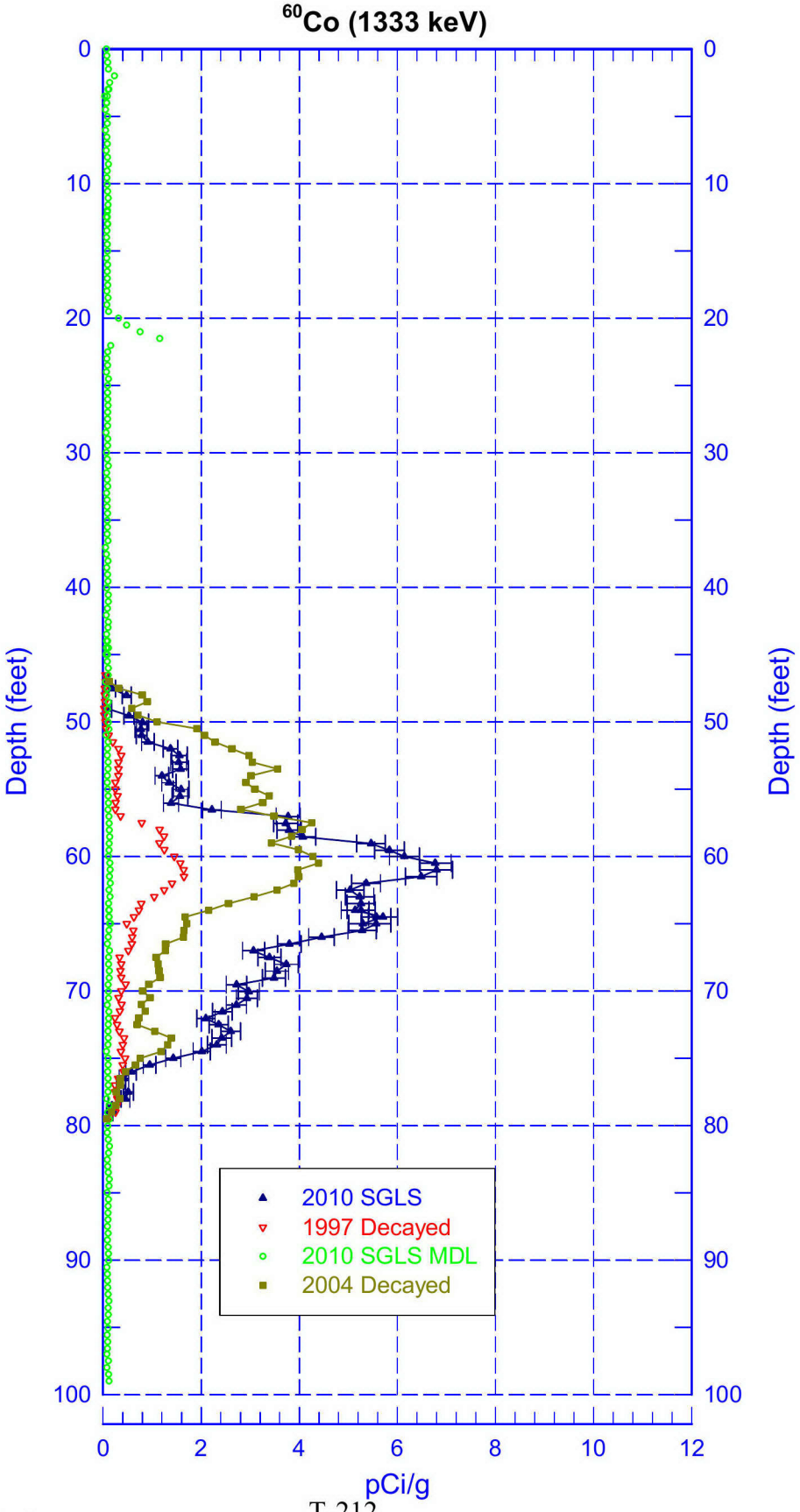
Comparison of Manmade Radionuclides (SGLS & HRLS)



Zero Reference = Top of Casing

30-08-02 (299-E27-94 [A6719])

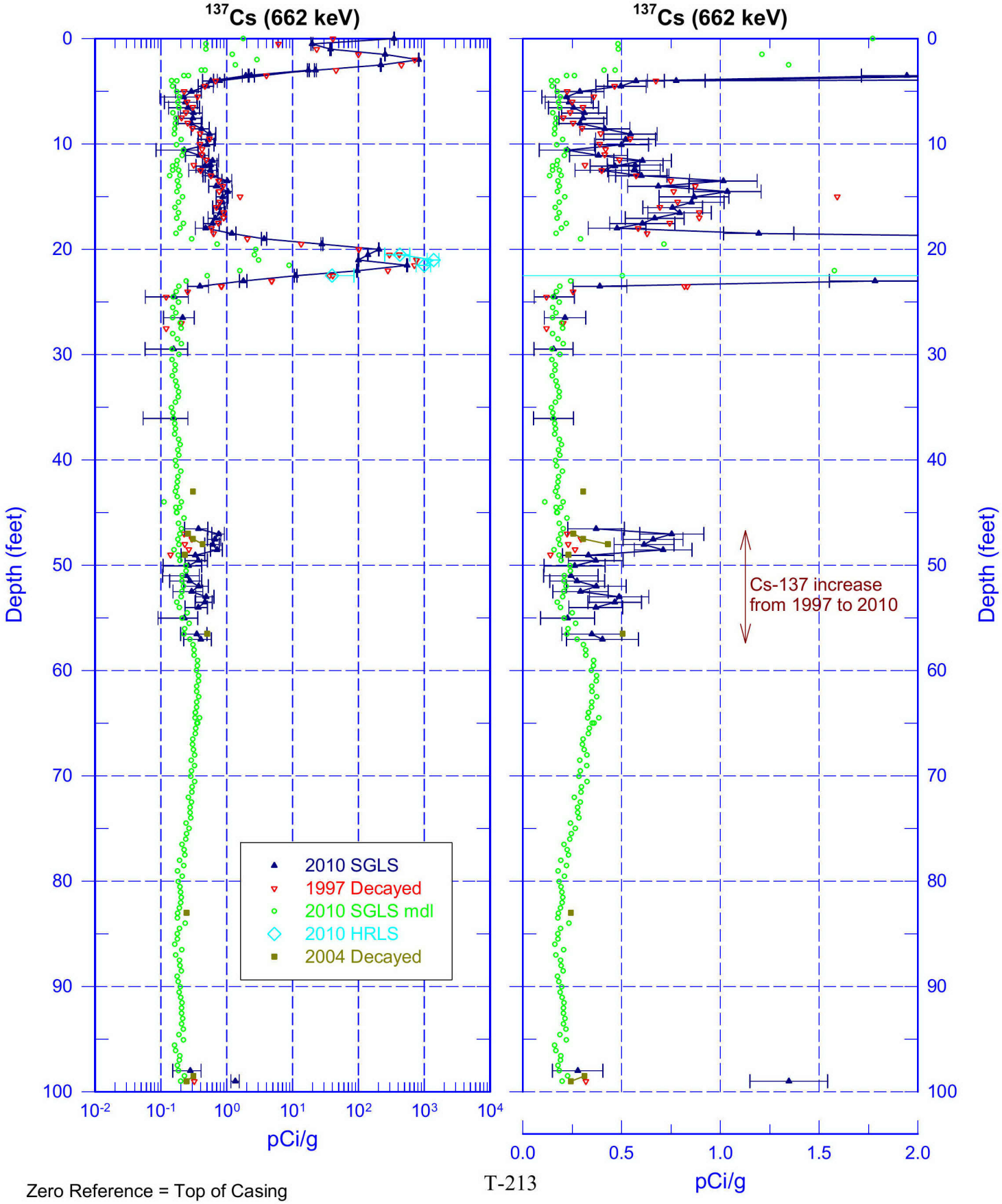
Comparison of Co-60 Concentrations from 1997 to 2010



Zero Reference = Top of Casing

30-08-02 (299-E27-94 [A6719])

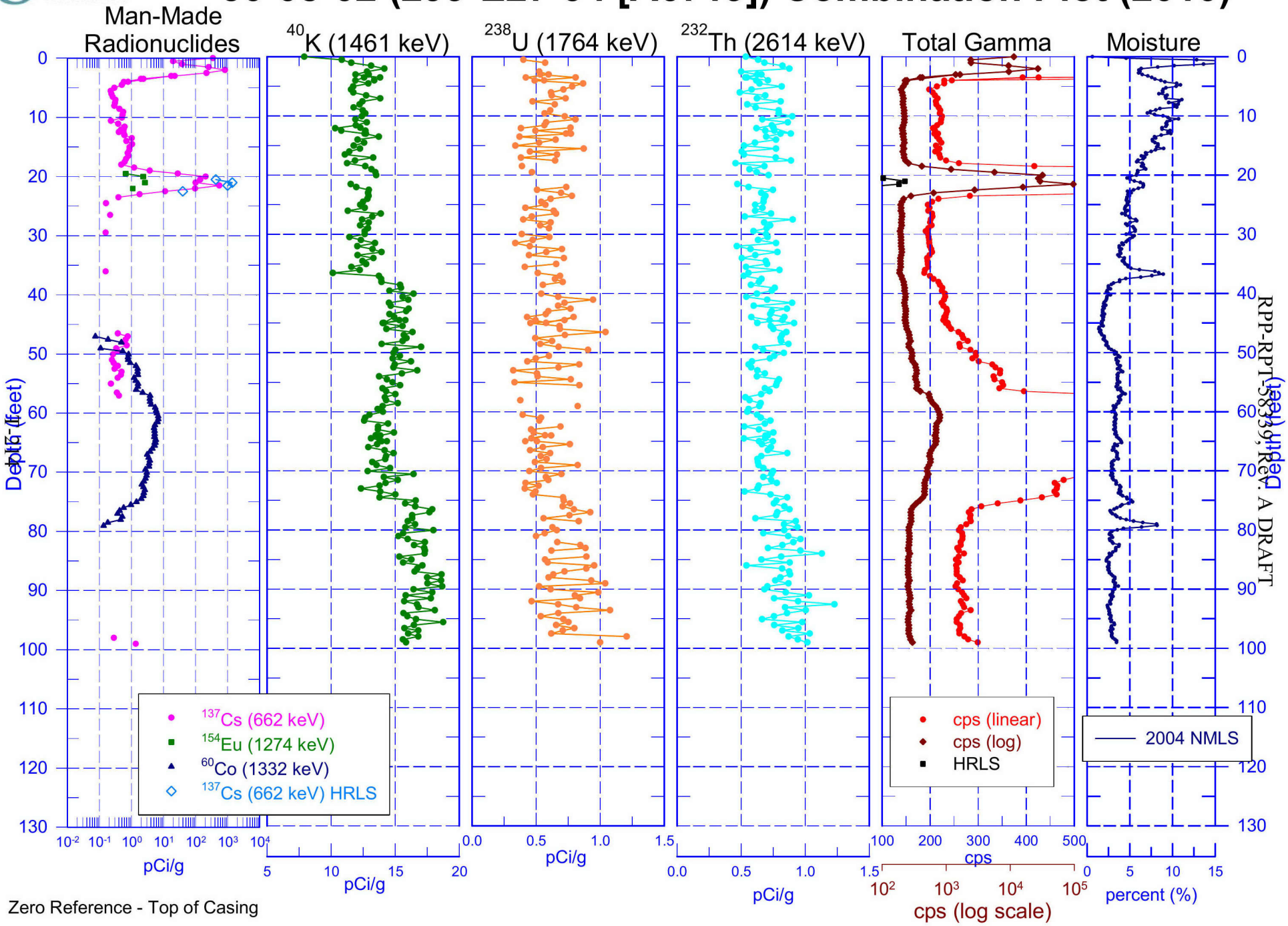
Comparison of Cs-137 Concentrations from 1997 to 2010



Zero Reference = Top of Casing

Stoller
Hanford Office

30-08-02 (299-E27-94 [A6719]) Combination Plot (2010)

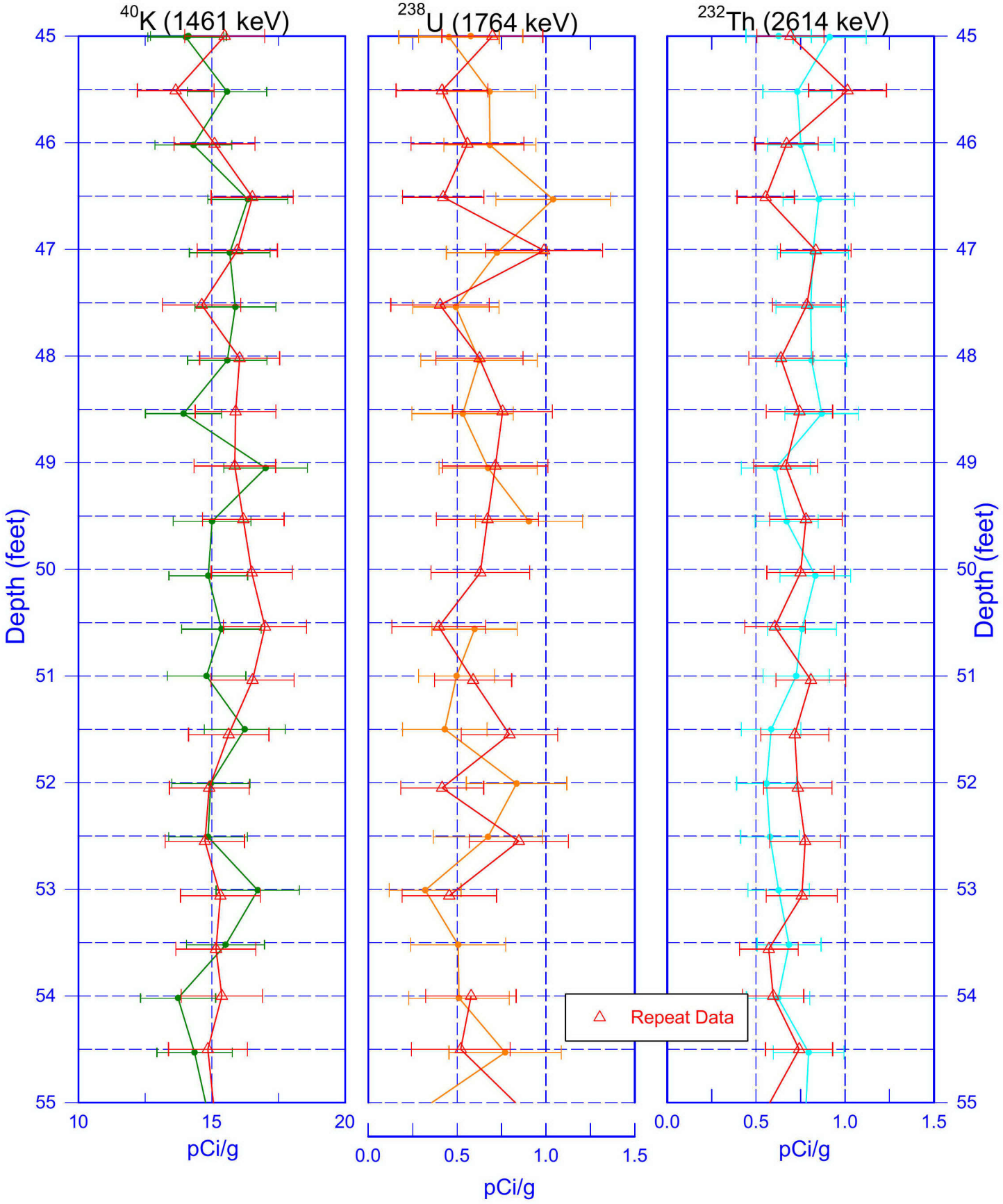


RPP-RPT-58339, Rev. A DRAFT (uncontrolled)

Stoller
Hanford Office

30-08-02 (299-E27-94 [A6719])

Repeat Section of Natural Gamma Logs

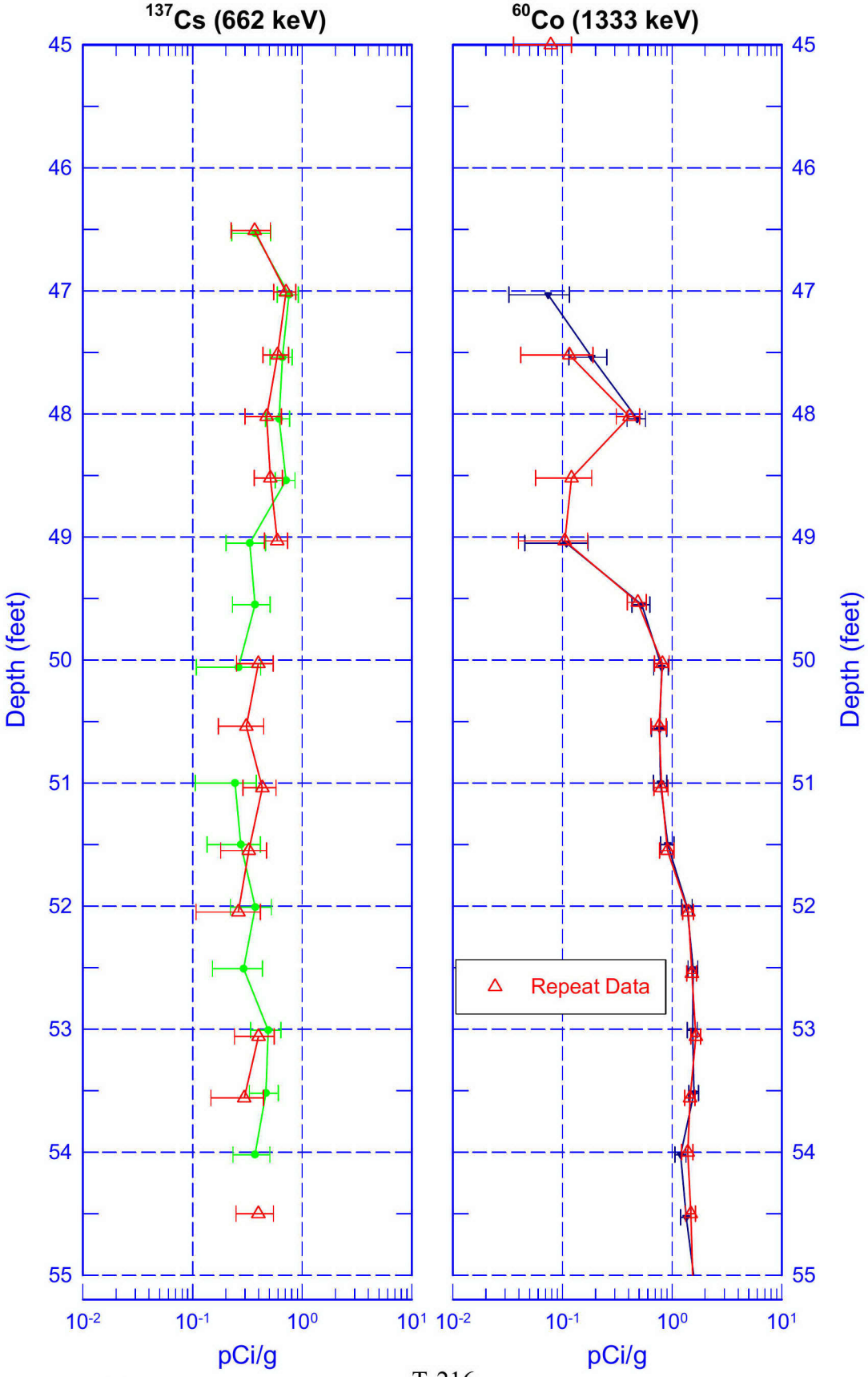


Zero Reference - Top of Casing

Stoller Hanford Office

30-08-02 (299-E27-94 [A6719])

Repeat of Manmade Radionuclides



Zero Reference = Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-96 (A6721)

Stoller Hanford Office established 1959

HGLP-LDR-646, Rev. 0

2010-2011 C-Farm Re-Baseline

30-09-01
299-E27-96 (A6721)
Log Data Report

Borehole Information:

Log Date:	2010-12-30	Filename:	A6721_HG_2010-12-30	Site:	241-C-109	
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:		12/07/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)		Type
N/A	N/A	7/31/1974	N/A	100		Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	98.7

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2010 was from 0 to 98.0 ft. The location of the borehole is indicated in the figure entitled "Borehole 30-09-01 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1997 is included in the figure entitled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-109* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

The zero reference is the TOC, approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2 BR	Type:	DHMCA SGLS BR
Effective Calibration Date:	09/22/10	Serial No.:	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System

SGLS Log Run Information:

Log Run	1	2	3	4 Repeat	
HEIS Number	1017378	1017379	1017380	1017381	
Date	12/20/10	12/21/10	12/30/10	12/30/10	
Logging Engineer	McClellan/ Holloway	McClellan/ Holloway	McClellan/ Holloway	McClellan/ Holloway	
Start Depth (ft)	0.0	17.0	56.0	88.0	
Finish Depth (ft)	18.0	57.0	98.0	98.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	1017376_B_101 220	B_101221	B_101230	1017380_B_101 230	
Start File	_D_000000	_D_001700	_D_005600	_D_008800	
Finish File	_D_001800	_D_005700	_D_009800	_D_009800	
Post-Verification	A_101220	A_101221	1017381_A_101 230	A_101231	
Depth Return Error (in.)	0.0	2 low	N/A	1 low	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

Logging Operation Notes:

Data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above due to the length of file names (e.g., a6721_BR_1017378_D_000000).

Analysis Notes:

Analyst:	C. Nelson	Date:	7/5/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for 0.280-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[5] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed

[5] minimum detection level

from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, 1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 was applied during reprocessing. For purposes of comparison with the 2010 data, the Co-60 and Cs-137 were decayed to a common date of December 30, 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are still plotted.

Cs-137 was detected continuously from ground surface to 37.5 ft, 50.5 ft, and 52 ft; and from 95 ft to the total logged depth of the borehole. A maximum concentration of approximately 30.3 pCi/g was measured at the ground surface. Comparisons with the 1997 data indicate no significant change.

Co-60 was detected at 92 and 95.5 ft in 2010 with a maximum concentration of approximately 0.09 pCi/g was measured at 95 ft. Co-60 detected in 1997 between 89 and 97.5 ft have apparently decayed below the 2010 MDL.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

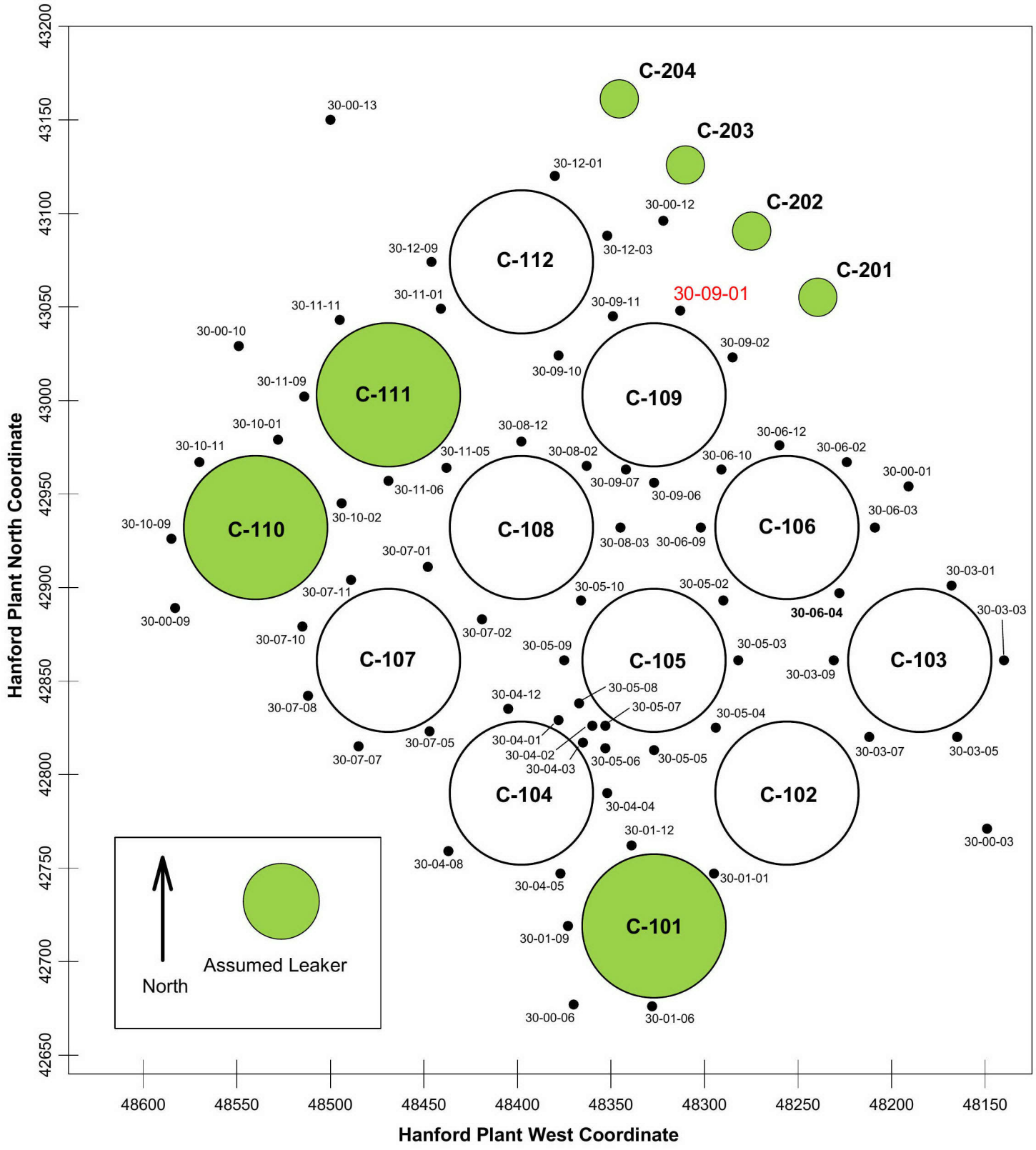
Depth Reference is ground surface

Borehole 30-09-01 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy (DOE) 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-109* GJ-HAN-91 Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-09-01 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-09-01 (299-E27-96) (A6721)

Borehole Information

Site: C Farm, Tank C-109			
Coordinates (HAN Plant):	**North: 43048**	**West: 48313**	**Elevation (ft): 644.85**
Coordinates (WA Plane):	**North: 136604.204**	**East: 575165.408**	**Elevation (m): 197.663**
Drill Date: 7/31/1974	**Type: Cable Tool**	**Depth (ft): 99**	**Depth Datum: TOC**
D/W (ft): Dry	**D/W Date: 7/21/03**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System			

Casing Information

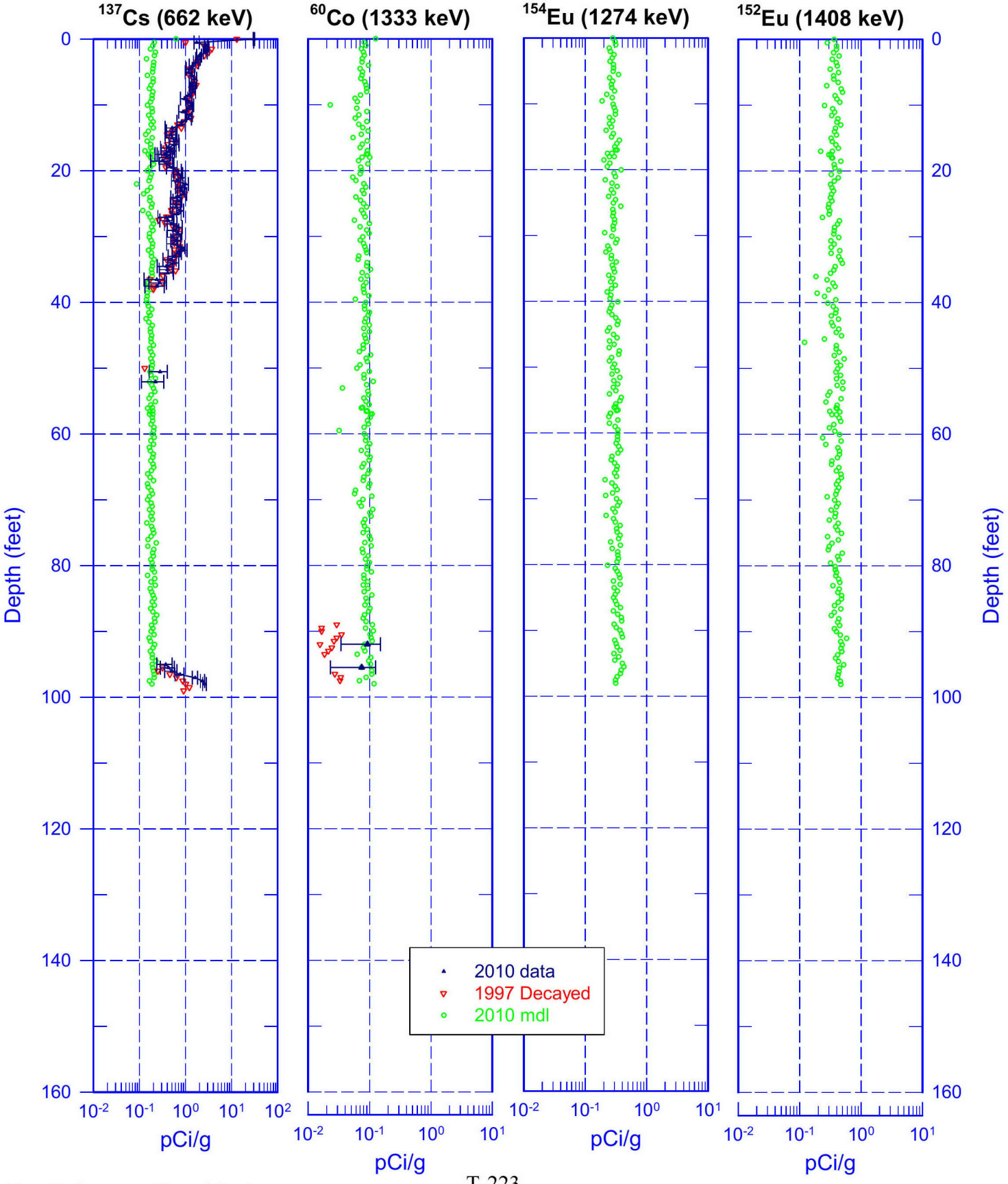
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
3/27/1997	SGLS	G1B	1	0-99	MACTEC-ERS	Baseline
9/11/2002	RAS	Large	A	30-98.5	Stoller	No Apparent Change
7/25/2003	RAS	Large-New	B	30-98	Stoller	No Apparent Change
5/25/2007	RAS	Large-New	C	0-98	Stoller	No Apparent Change
12/9/2007	RAS	Large-New	D	20-98	Stoller	No Apparent Change
4/24/2008	RAS	Large-New	E	20-99	Stoller	No Apparent Change
6/26/2008	RAS	Large	F	0-99	Stoller	No Apparent Change
12/30/2010	SGLS	G2BR	2	0-98	Stoller	No Apparent Change

30-09-01 (299-E27-96 [A6721])

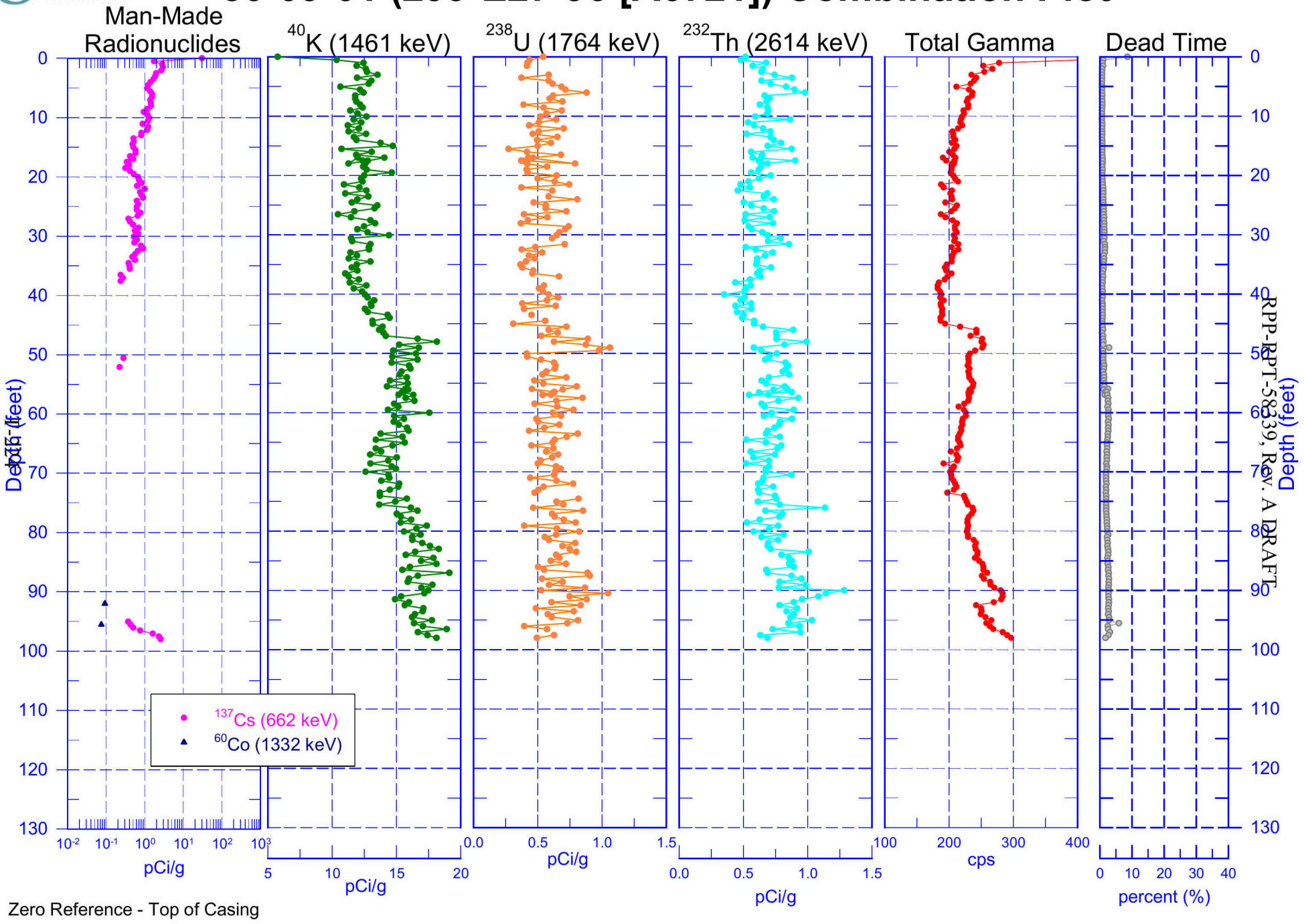
Comparison of Manmade Radionuclides (2010 & 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-09-01 (299-E27-96 [A6721]) Combination Plot



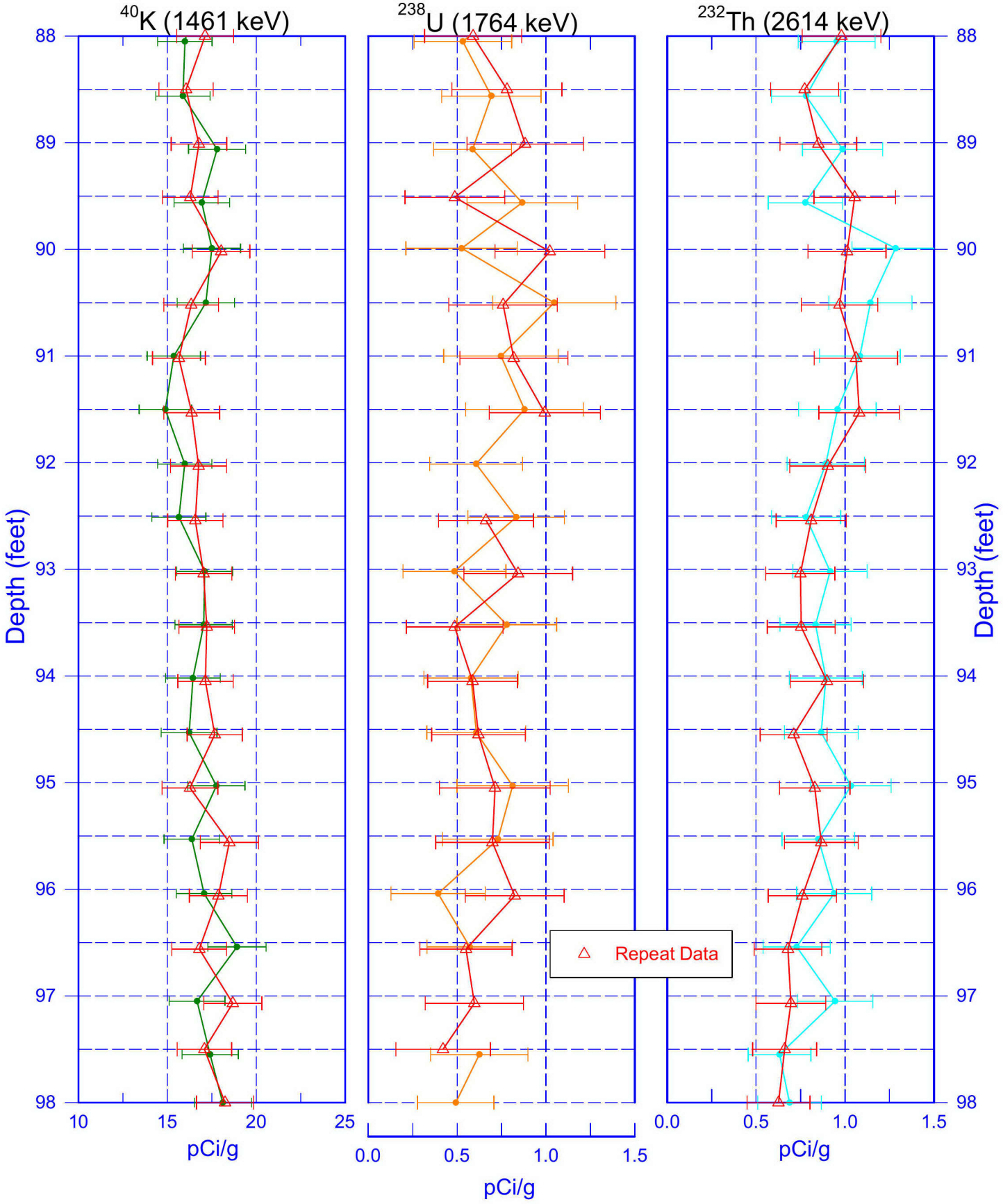
Zero Reference - Top of Casing

RPP-RPT-58339, Rev. A DRAFT

Stoller Hanford Office

30-09-01 (299-E27-96 [A6721])

Repeat Section of Natural Gamma Logs

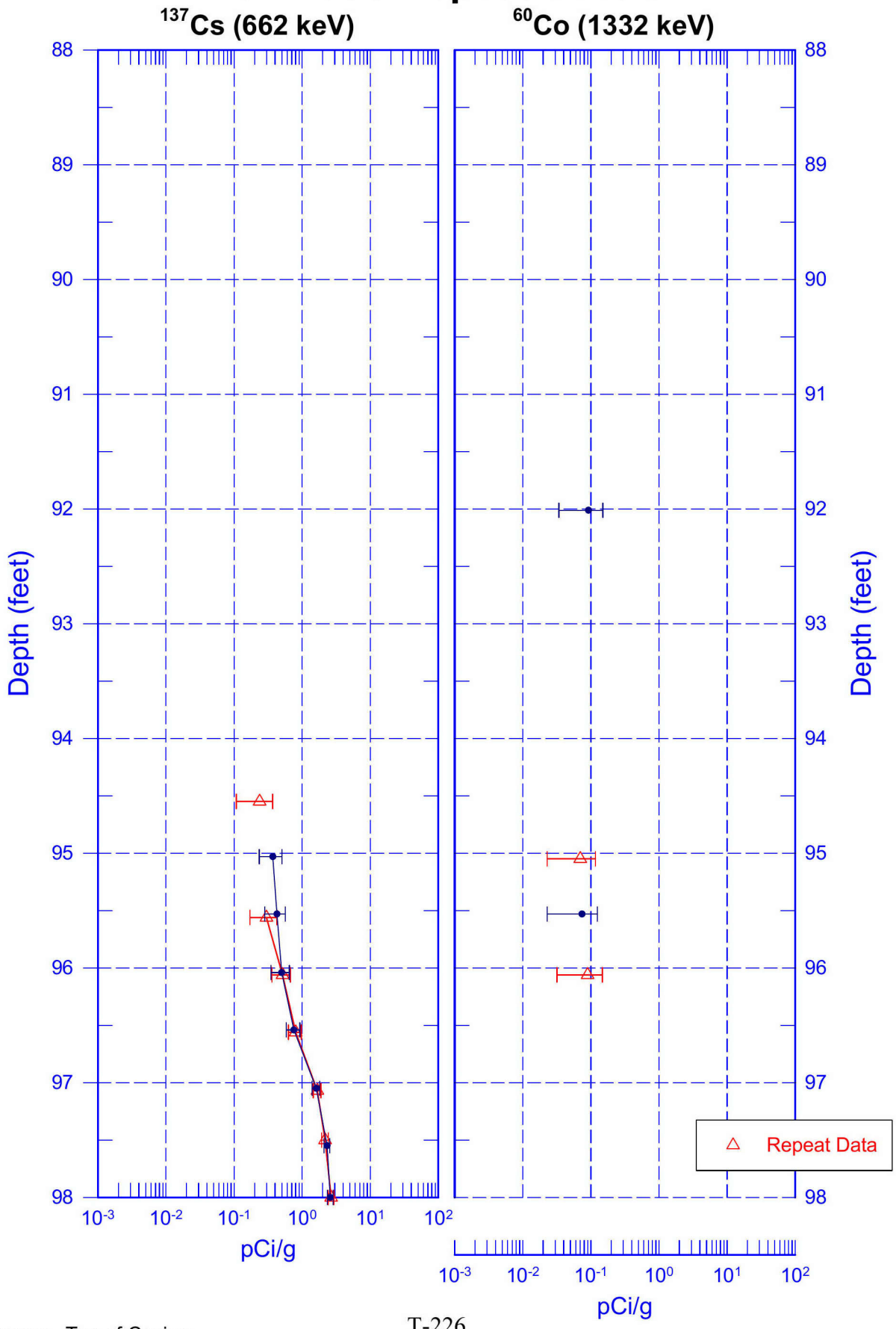


Zero Reference - Top of Casing

Stoller Hanford Office

30-09-01 (299-E27-96 [A6721])

Manmade Repeat Section



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-97 (A6722)

Stoller Hanford Office established 1959

HGLP-LDR-616, Rev. 0

2010-2011 C-Farm Re-Baseline

30-09-02
299-E27-97 (A6722)
Log Data Report

Borehole Information:

Log Date:	2010-12-20	**Filename:**	A6733_HG_2010-12-20	**Site:**	241-C-109
Coordinates (WA St Plane)		**GWL[1] (ft) :**	None	**GWL Date:**	12/07/10
North (m)	**East (m)**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
N/A	N/A	6/30/1974	N/A	100	Cable Tool

Casing Information:

		Diameter (in.)				
Casing Type	**Stickup (ft)**	**Outer**	**Inside**	**Thickness (in.)**	**Top (ft)**	**Bottom (ft)**
Welded Steel	0.0	unknown	6	0.280	0.0	100

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The location of the borehole is indicated in the figure titled "Borehole 30-09-02 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1997 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-109* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

The zero reference is the top of casing.

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[5] SGLS
Effective Calibration Date:	09/22/10	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

SGLS Log Run Information:

Log Run	1	2	3	4	5 Repeat
HEIS Number	1017373	1017374	1017375	1017376	1017377
Date	12/07/10	12/08/10	12/17/10	12/20/10	12/20/10
Logging Engineer	Spatz/McClellan/ Holloway	Spatz/McClellan/ Holloway	Spatz/McClellan/ Holloway	Spatz/McClellan/ Holloway	Spatz/McClellan/ Holloway
Start Depth (ft)	0.0	29.0	56.0	85.0	46.0
Finish Depth (ft)	30.0	57.0	86.5	100.0	56.0
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	1017372_B_101 27	_B_10128	_B_101217	_B_101220	1017376_B_101 220
Start File	_D_000000	_D_002900	_D_005600	_D_008500	_D_004600
Finish File	_D_003000	_D_005700	_D_008650	_D_010000	_D_005600
Post-Verification	_A_10127	_A_10128	_A_101217	1017378_A_101 220	1017378_A_101 220
Depth Return Error (in.)	0.0	1 Low	1 High	N/A	0.0
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made.

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above due to the length of file names (for example, _D_000000 for A6722_BR_1016281_D_000000).

Analysis Notes:

Analyst:	Legler	Date:	9/6/2011	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for a 0.28-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

[6] minimum detection level

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 and Co-60 were decayed to a common date of December 20, 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected almost continuously from ground surface to 13.5 ft, 48 to 49 ft, and 53.5 to 55 ft, with a maximum concentration of approximately 2 pCi/g at 11 ft. No significant changes have occurred since 1997.

Co-60 was detected continuously from 51 to 58 ft, at 75.5 ft, and 76.5 ft, with a maximum concentration of approximately 1.5 pCi/g at 53.5 ft. The Co-60 concentrations appear to increase from 54 to 57 ft and possibly at 76 ft as compared to the 1997 data. This profile may suggest a lateral and downward influx of contamination since 1997 from a relatively distant source. Co-60 contamination that existed between 90 and 97 ft in 1997 has decayed below 2010 MDLs.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

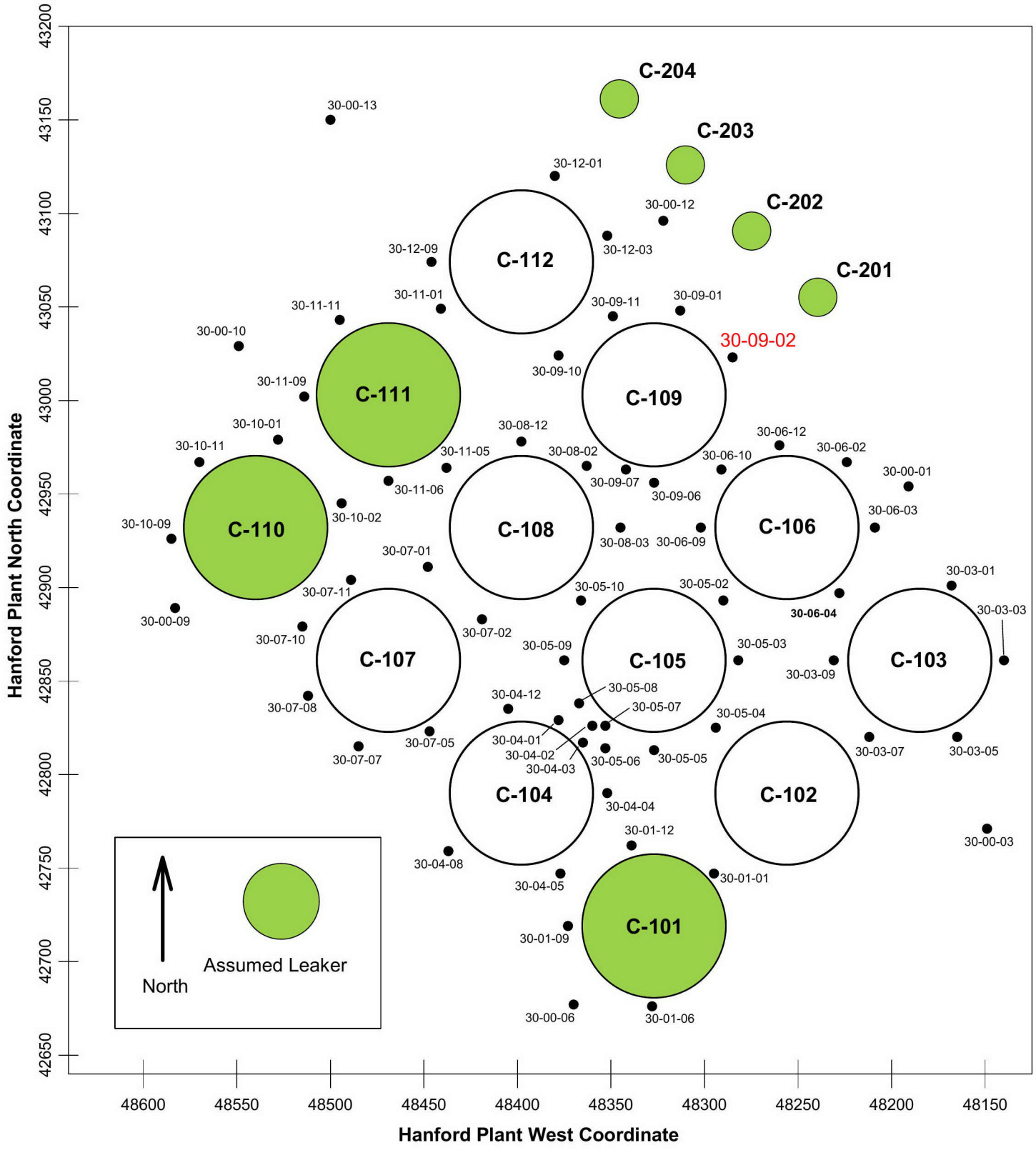
Depth Reference is top of casing

Borehole 30-09-02 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy (DOE). 1998. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-109.* GJ-HAN-91. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-09-02 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-09-02 (299-E27-97) (A6722)

Borehole Information

Site: C Farm, Tank C-109			
Coordinates (HAN Plant):	**North: 43023**	**West: 48285**	**Elevation (ft): 645.17**
Coordinates (WA Plane):	**North: 136596.517**	**East: 575174.074**	**Elevation (m): 197.763**
Drill Date: 6/30/1974	**Type: Cable Tool**	**Depth (ft): 100**	**Depth Datum: TOC**
D/W (ft): Dry	**D/W Date: 7/21/03**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, WA State Plane Coordinates are NAVD88			

Casing Information

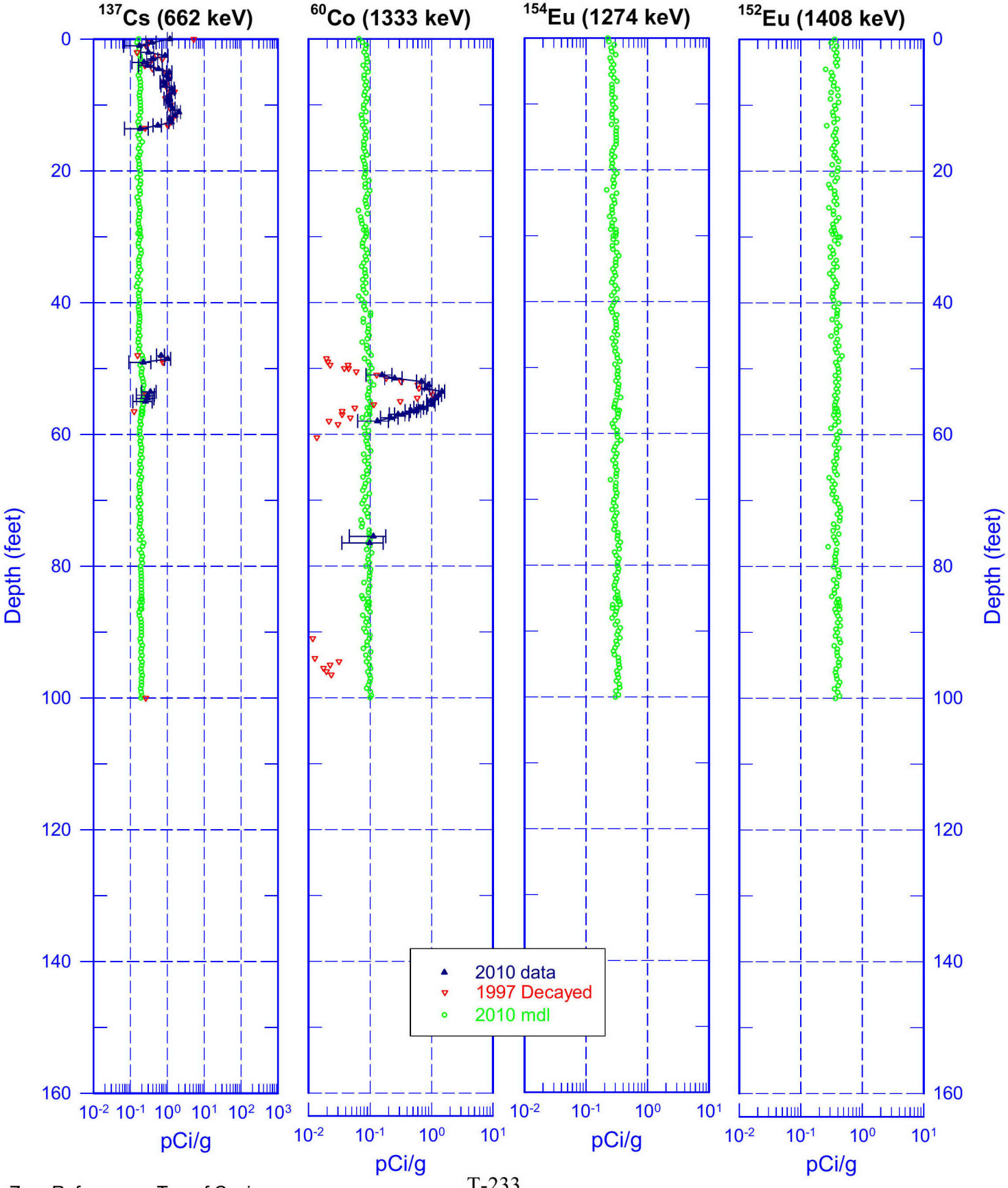
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
3/29/1997	SGLS	G1B	1	0-100	MACTEC-ERS	Baseline
9/11/2002	RAS	Large	A	30-99.5	Stoller	No Apparent Change
7/25/2003	RAS	Large-New	B	30-99	Stoller	No Apparent Change
5/30/2007	RAS	Large-New	C	0-99	Stoller	No Apparent Change
12/20/2010	SGLS	G2BR	2	0-100	Stoller	Co-60 increase 54 to 57 ft

30-09-02 (299-E27-97 [A6722])

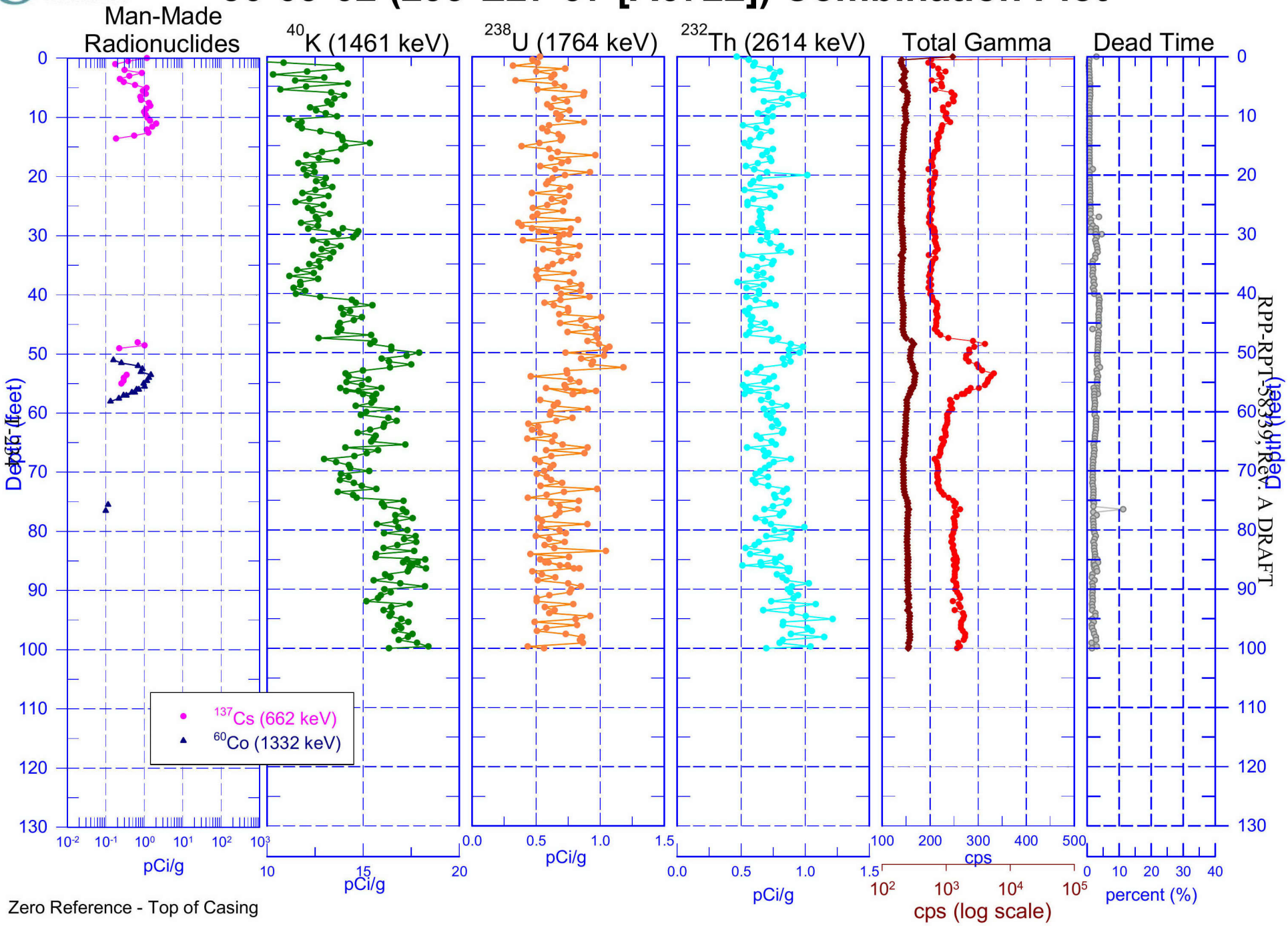
Comparison of Manmade Radionuclides (2010 & 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-09-02 (299-E27-97 [A6722]) Combination Plot



RPP-RPT-58339, Rev. A DRAFT

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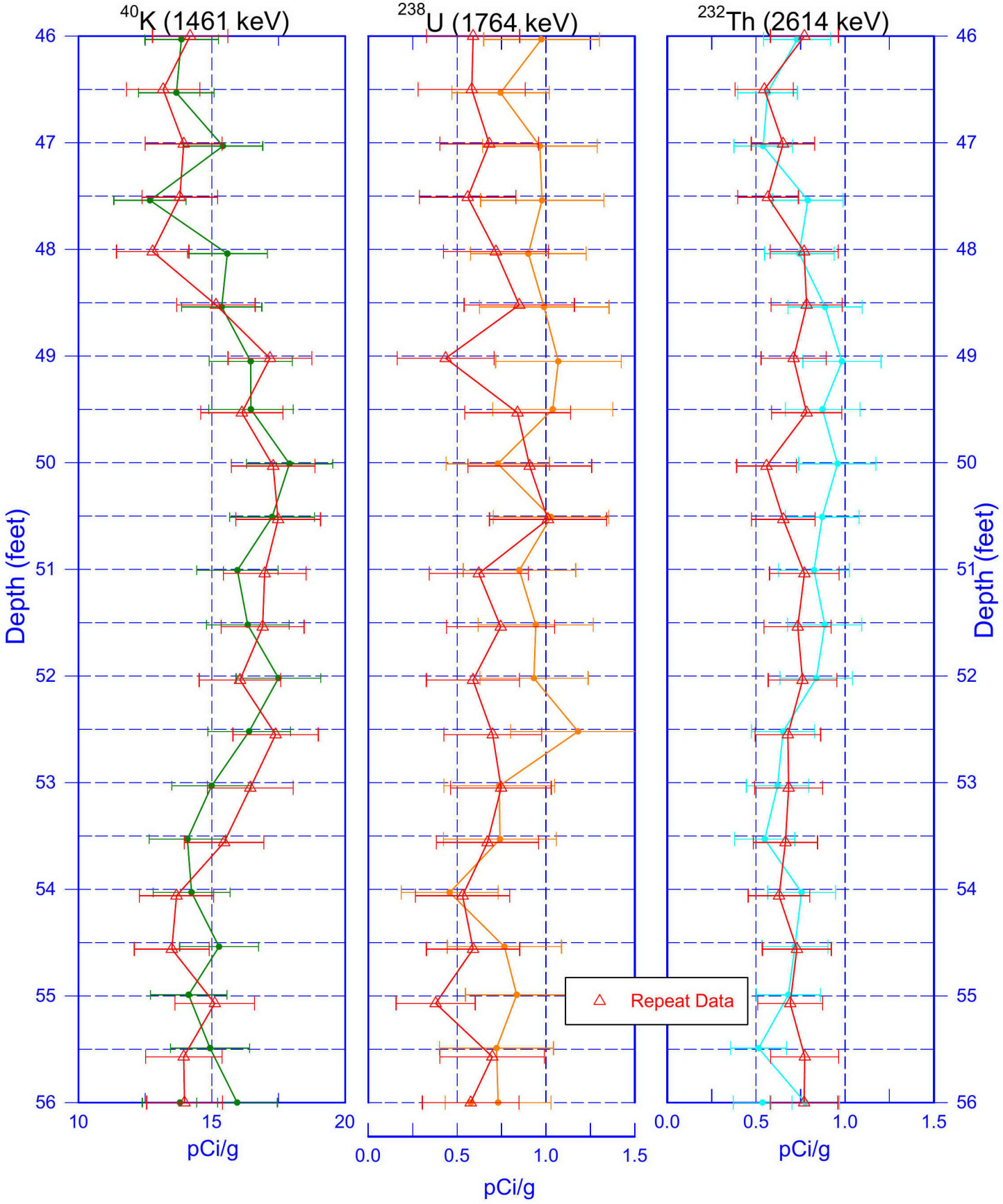
30-09-02 (299-E27-97 [A6722])

Repeat Section of Natural Gamma Logs

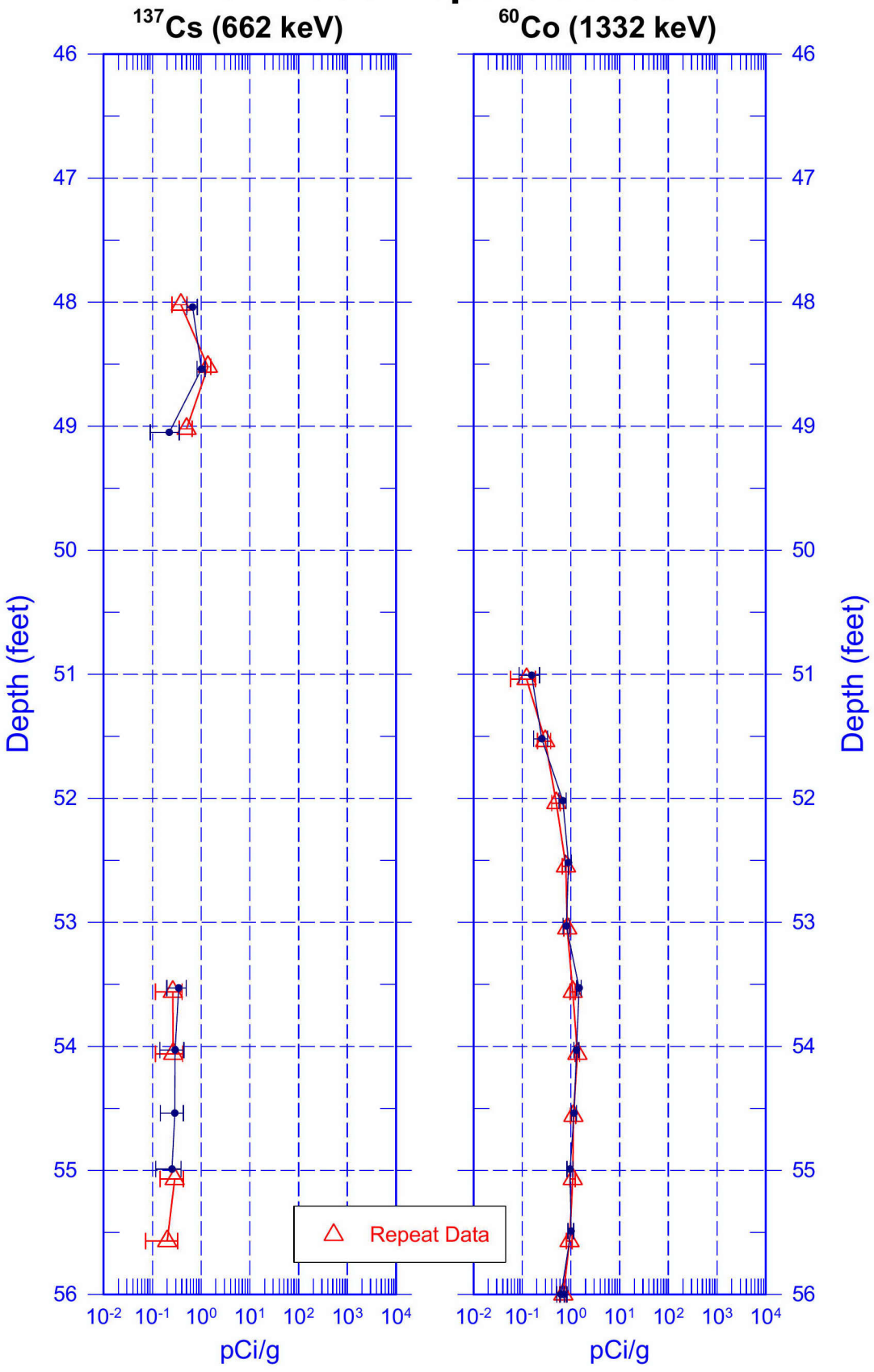


Zero Reference - Top of Casing

Stoller Hanford Office

30-09-02 (299-E27-97 [A6722])

Manmade Repeat Section



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-98 (A6723)

Stoller Hanford Office established 1959

HGLP-LDR-619, Rev. 0

2010-2011 C-Farm Re-Baseline

30-09-06
299-E27-98 (A6723)
Log Data Report

Borehole Information:

Log Date:	2011-03-01	**Filename:**	A6723_HG_2011-03-01	**Site:**	241-C-109
Coordinates (WA St Plane)		**GWL[1] (ft) :**	None	**GWL Date:**	01/03/11
North (m)	**East (m)**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
N/A	N/A	9/30/1974	N/A	100	Cable Tool

Casing Information:

		Diameter (in.)				
Casing Type	**Stickup (ft)**	**Outer**	**Inside**	**Thickness (in.)**	**Top (ft)**	**Bottom (ft)**
Welded Steel	0.0	unknown	6	0.280	0.0	98.4

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The location of the borehole is indicated in the figure titled "Borehole 30-09-06 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2011. A summary of other logging data acquired since 1997 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-109* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

No water was observed in this borehole.

The zero reference is the top of casing.

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[5] SGLS
Effective Calibration Date:	09/22/10	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

Logging System:	Gamma 2 F	**Type:**	NMLS
Effective Calibration Date:	9/2003	**Serial No.:**	H380932510
Calibration Reference:	GJO-2003-520-TAC	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev. 0

SGLS Log Run Information:

Log Run	**1**	**2**	**3**	**4 Repeat**	
HEIS Number	1017382	1017383	1017384	1017385	
Date	1/03/11	1/04/11	3/01/11	3/01/11	
Logging Engineer	Spatz/Holloway/ McClellan	Spatz/Holloway/ McClellan	Spatz/Holloway/ McClellan	Spatz/Holloway/ McClellan	
Start Depth (ft)	0.0	34.0	79.0	74.0	
Finish Depth (ft)	35.0	80.0	98.0	83.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	_B_1113	_B_1114	_B_1131	1017384_B1131	
Start File	_D_000000	_D_003400	_D_007900	_D_007400	
Finish File	_D_003500	_D_008004	_D_009801	_D_008300	
Post-Verification	_A_1113	*None	1017385_A_113 1	_A_1131	
Depth Return Error (in.)	0.0	0.0	N/A	Low 1/2	
Comments	No fine gain adjustments made	No fine gain adjustments made. *Due to Emergency shutdown	No fine gain adjustments made	No fine gain adjustments made	

NMLS Log Run Information:

Log Run	**5**	**6**			
HEIS Number	1017761	1017762			
Date	2/12/04	2/12/04			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	50.0			
Finish Depth (ft)	60.0	98.0			
Count Time (sec)	N/A	N/A			
Live/Real	N/A	N/A			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	1.0	1.0			
Pre-Verification	BF153CAB	BF153CAB			
Start File	BF153000	BF153241			
Finish File	BF153240	BF153433			

Log Run	5	6			
Post-Verification	BF153CAA	BF153CAA			
Depth Return Error (in.)	N/A	1/4 low			
Comments	None	Repeat Section 50.0 to 60.0 ft			

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the table above due to the length of the file names (for example, _D_000000 for A6723_BR_1016281_D_000000).

Analysis Notes:

Analyst:	Legler	Date:	8/24/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for a 0.28-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the1997 data were reprocessed using the same casing correction as the 2011 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2011 data, the Cs-137 and Co-60 were decayed to a common date of March 1, 2011.

SGLS logging is conducted by S.M. Stoller, as is logging with the NMLS[7]. NMLS data are acquired digitally at 0.25-ft intervals with a count time of 15 seconds. Where available, the most recent NMLS data are reported in the re-baseline log data reports.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected almost continuously from ground surface to 98 ft, with a maximum concentration of approximately 598 pCi/g at ground surface. No significant changes have occurred since 1997.

[6] minimum detection level
[7] Neutron Moisture Logging System

Co-60 was detected continuously from 77 to 85 ft, with a maximum concentration of approximately 1.5 pCi/g at 81.5 ft. An increase in Co-60 concentrations was observed since the 1997 baseline.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

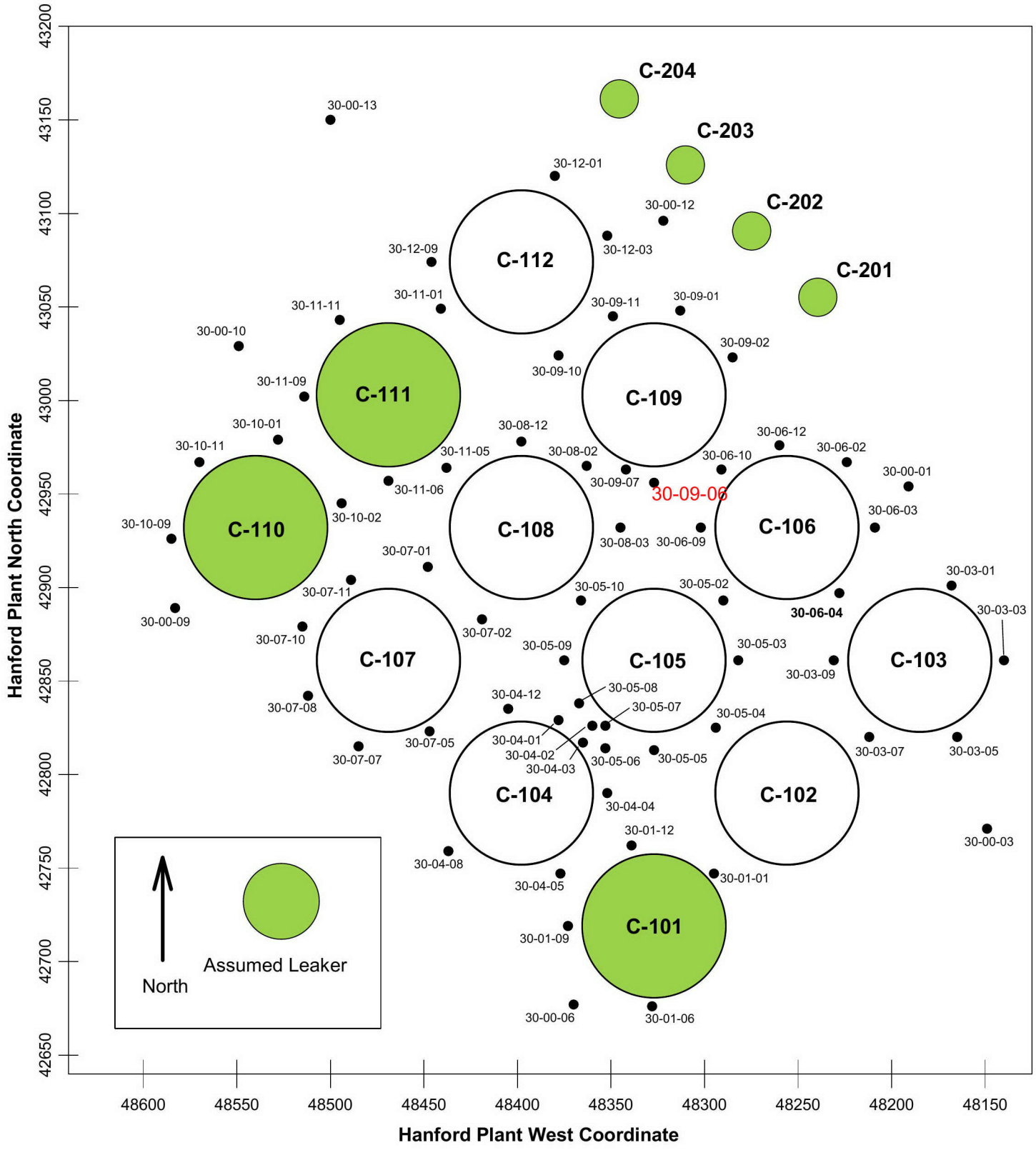
Depth Reference is top of casing

Borehole 30-09-06 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2011 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-109.* GJ-HAN-91. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-09-06 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-09-06 (299-E27-98) (A6723)

Borehole Information

Site: C Farm, Tank C-109			
Coordinates (HAN Plant):	**North: 42956**	**West: 48327**	**Elevation (ft): 645.00**
Coordinates (WA Plane):	**North: 136576.18**	**East: 575161.124**	**Elevation (m): 197.958**
Drill Date: 9/30/1974	**Type: Cable Tool**	**Depth (ft): 98**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 5/31/07**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging system, RAS: Radionuclide Assessment System, NMLS: Neutron Moisture Logging System, WA State Plane Coordinates are NAVD88			

Casing Information

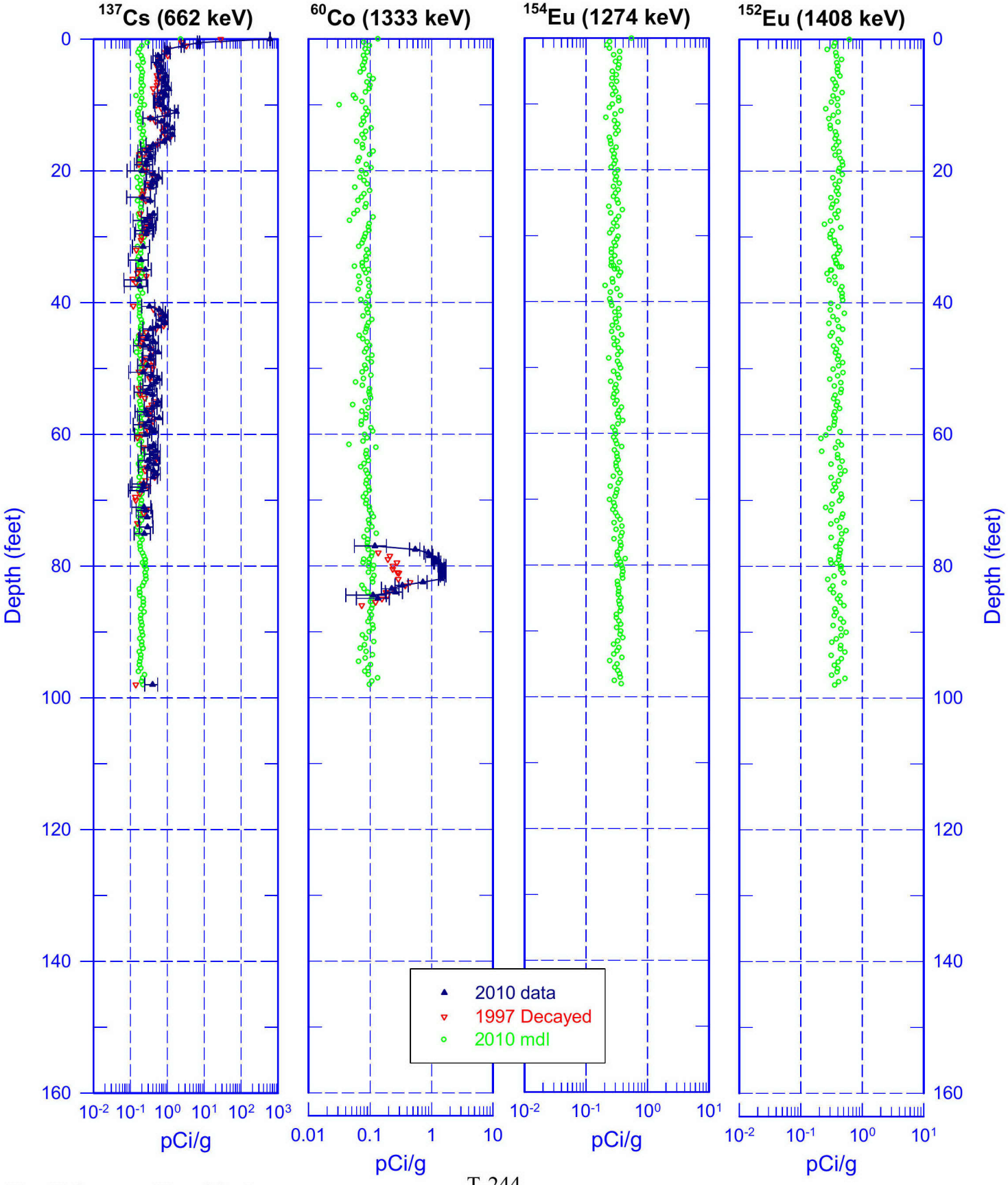
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
04/01/97	SGLS	G1B	NA	0-98	MACTEC-ERS	Baseline
04/23/02	RAS	Large	A	30-98	MACTEC-ERS	No Apparent Change
01/29/03	RAS	Large-New	B	30-98	Stoller	No Apparent Change
05/05/03	RAS	Large-New	C	30-98	Stoller	No Apparent Change
07/30/03	RAS	Large-New	D	30-98	Stoller	No Apparent Change
10/31/03	RAS	Large-New	E	30-98	Stoller	No Apparent Change
12/08/03	NMLS	Moisture	1	0-98	Stoller	Moisture Baseline
12/12/03	RAS	Large-New	F	30-98	Stoller	No Apparent Change
02/12/04	NMLS	Moisture	2	0-98	Stoller	
2/20/2004	RAS	Large-New	G	30-98	Stoller	No Apparent Change
5/31/2007	RAS	Large New	H	0-98	Stoller	Co-60 increase 78-83 ft.
3/1/2011	SGLS	G2BR		0-98	Stoller	Co-60 increase 77-84 ft.

30-09-06 (299-E27-98 [A6723])

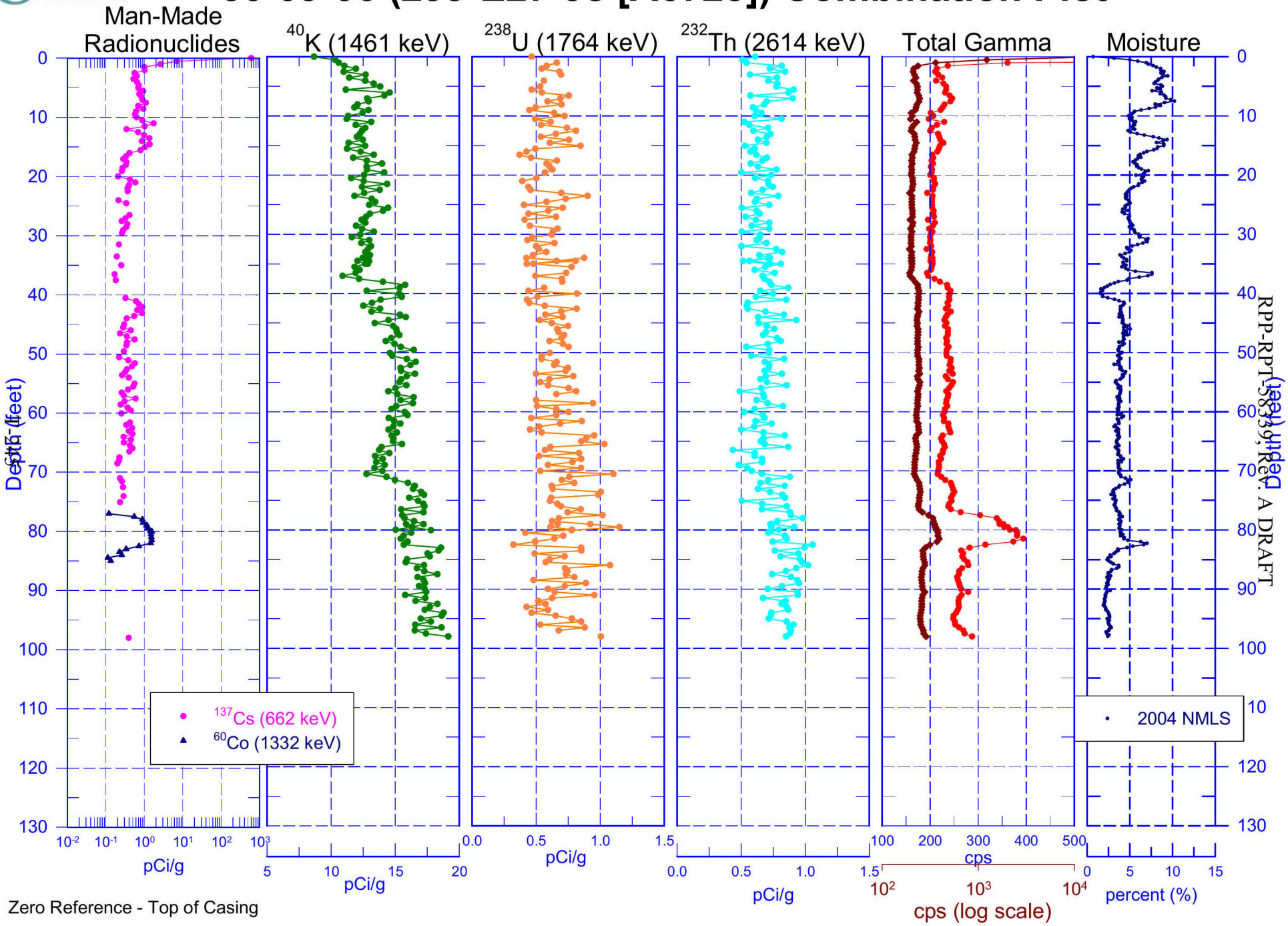
Comparison of Manmade Radionuclides (2011 & 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-09-06 (299-E27-98 [A6723]) Combination Plot



RPP-RPT-58339, Rev. A DRAFT

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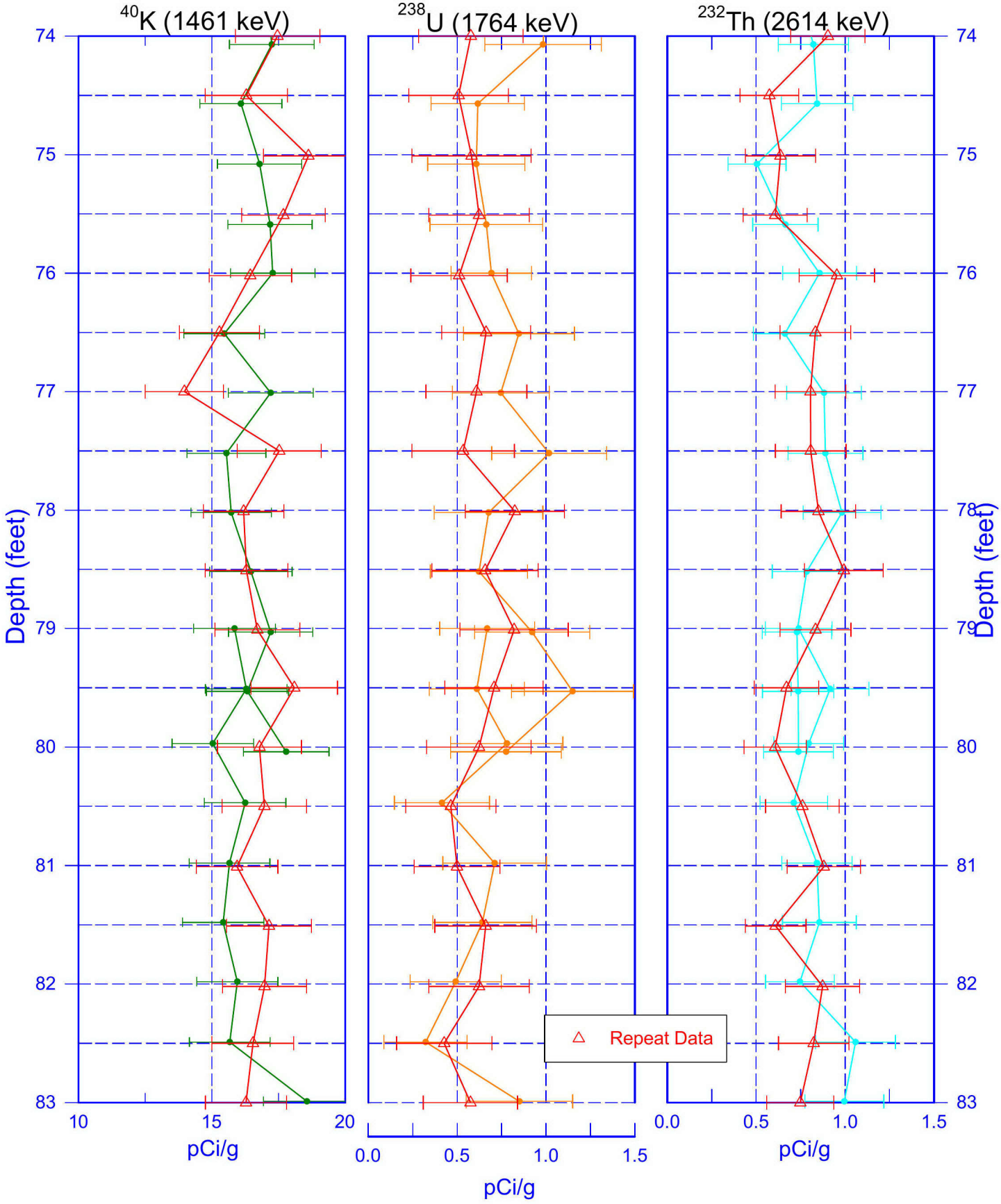
30-09-06 (299-E27-98 [A6723])

Repeat Section of Natural Gamma Logs

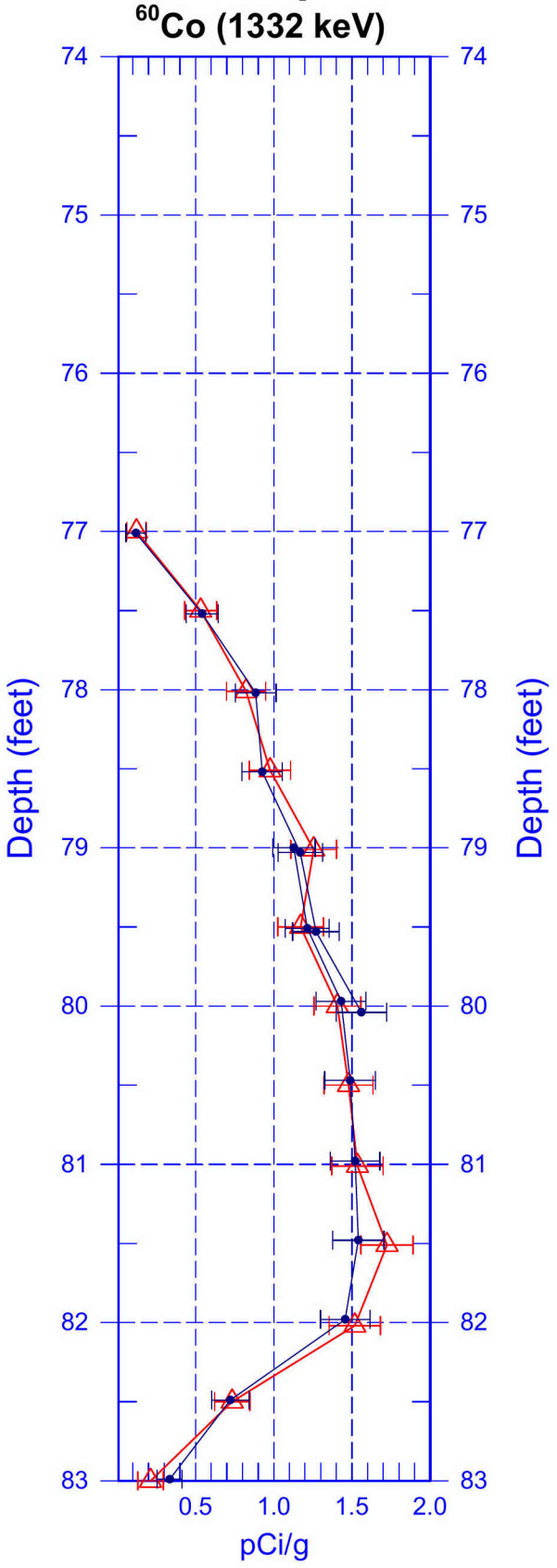


Zero Reference - Top of Casing

Stoller Hanford Office

30-09-06 (299-E27-98 [A6723])

Manmade Repeat Section



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-135 (A6754)

2010-2011 C-Farm Re-Baseline

30-09-07
299-E27-135 (A6754)
Log Data Report

Borehole Information:

Log Date:	2010-11-09	Filename:	A6754_HG_2010-11-09	Site:	241-C-109
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:	11/04/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	3/31/1982	N/A	125	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	unknown	6	0.280	0.0	125

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The depth interval logged in 2010 was from 0 to 121 feet, just above the level of water inside the borehole casing. Other water levels observed during past logging events are included below. The location of the borehole is indicated in the figure titled "Borehole 30-09-07 Location in C Tank Farm."

Date	Depth to Borehole Water (ft)
3/20/1997	122.1
9/1/2002	122.1
12/6/2002	122
3/31/2003	121.4
7/15/2003	121.8
9/25/2003	121
12/11/2003	121.85
2/9/2004	121.85
4/27/2007	122
11/9/2010	121.8

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1997 is included in the figure entitled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-109* (DOE 1997). Casing thicknesses are derived from published values for schedule 40-steel pipe.

The zero reference is the top of casing.

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[5] SGLS
Effective Calibration Date:	09/22/10	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 2 F	**Type:**	NMLS[6]
Effective Calibration Date:	9/2003	**Serial No.:**	H380932510
Calibration Reference:	GJO-2003-520-TAC	**Logging Procedure:**	MAC-HGLP 1.6.5, Rev. 0

SGLS Log Run Information:

Log Run	**1**	**2**	**3**	**4 Repeat**	
HEIS Number	1017355	1017356	1017357	1017358	
Date	11/05/10	11/08/10	11/09/10	11/09/10	
Logging Engineer	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway	Spatz/Holloway	
Start Depth (ft)	0.0	51.0	108.0	75.0	
Finish Depth (ft)	52.0	109.0	121.0	87.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	_B_10115	_B_10118	_B_10119	1017357_B_10119	
Start File	_D_000000	_D_005100	_D_010800	_D_007500	
Finish File	_D_005200	_D_010900	_D_012100	_D_008701	
Post-Verification	_A_10115	_A_10118	1017358_A_10119	_A_10119	
Depth Return Error (in.)	1 high	1/2 low	N/A	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

NMLS Log Run Information:

Log Run	**5**	**6**			
HEIS Number	1017765	1018067			
Date	2/12/04	2/12/04			

[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer
[6] Neutron Moisture Logging System

Log Run	5	6			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	50.0			
Finish Depth (ft)	60.0	121.25			
Count Time (sec)	N/A	N/A			
Live/Real	N/A	N/A			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Log Speed (ft/min)	1.0	1.0			
Pre-Verification	BF154CAB	BF154CAB			
Start File	BF154000	BF154241			
Finish File	BF154240	BF154526			
Post-Verification	BF154CAA	BF154CAA			
Depth Return Error (in.)	N/A	1/4 high			
Comments	None	None			

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the table above (for the SGLS) due to the length of the file names (e.g., _D_000000 for A6754_BR_1016281_D_000000).

Analysis Notes:

Analyst:	Legler	Date:	9/9/2011	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for a 0.28-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[7] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the 1997 data were reprocessed using a water correction from 122 ft to the total logged depth of the borehole and using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 and Co-60 were decayed to a common date of November 9, 2010.

[7] minimum detection level

SGLS logging is conducted by S.M. Stoller, as is logging with the NMLS. NMLS data are acquired digitally at 0.25-ft intervals with a count time of 15 seconds. Where available, the most recent NMLS data are reported in the re-baseline log data reports.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154 and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected almost continuously from ground surface to 39 ft and intermittently from 51 to 53 ft, with a maximum concentration of approximately 7 pCi/g at ground surface. No significant changes have occurred since 1997. Detections of Cs-137 from 51 to 53 ft in 2010 are interpreted to be the result of the enhanced detection system rather than migration of contaminants.

Co-60 was detected almost continuously from 75 to 83 ft, with a maximum concentration of approximately 1.8 pCi/g at 79.5 ft. An increase in Co-60 concentrations since the 1997 baseline was observed from 75 to 83 ft. A possible increase was noted in May 2007 during monitoring using the RAS[8]. Other boreholes in the area have indicated changes in Co-60 concentrations since 1997. These boreholes include 30-08-02, 30-09-06, 30-06-10, 30-06-12, and 30-09-02. A detailed evaluation of the subsurface contamination is recommended for this area to determine if any interrelationships exist.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. The presence of grout is suggested from 25 to 40.75 ft, as indicated by the large increase in volumetric moisture and drop in K-40 concentration.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

Depth Reference is top of casing

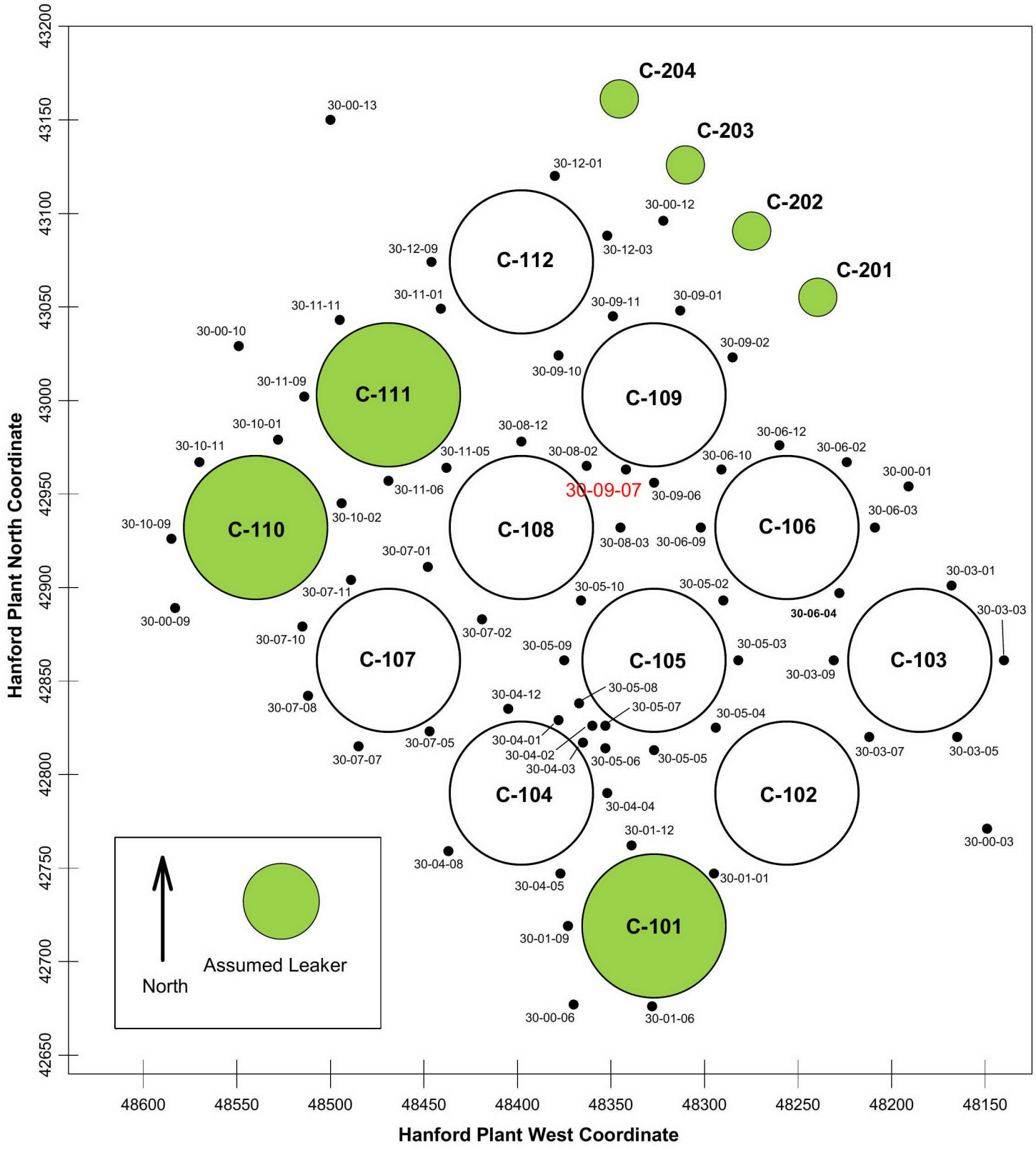
Borehole 30-09-07 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy (DOE) 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-109* GJ-HAN-91 Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

[8] Radionuclide Assessment System

Borehole 30-09-07 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-09-07 (299-E27-135) (A6754)

Borehole Information

Site: C Farm, Tank C-109			
Coordinates (HAN Plant):	**North: 42963**	**West: 48342**	**Elevation (ft): 649.00**
Coordinates (WA Plane):	**North: 136578.341**	**East: 575156.152**	**Elevation (m): 198.458**
Drill Date: 3/31/1982	**Type: Cable Tool**	**Depth (ft): 124.5**	**Depth Datum: TOC**
D/W (ft): 122'	**D/W Date: 5/30/07**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, NMLS: Neutron Moisture Logging System, WA State Plane Coordinates are NAVD88			

Casing Information

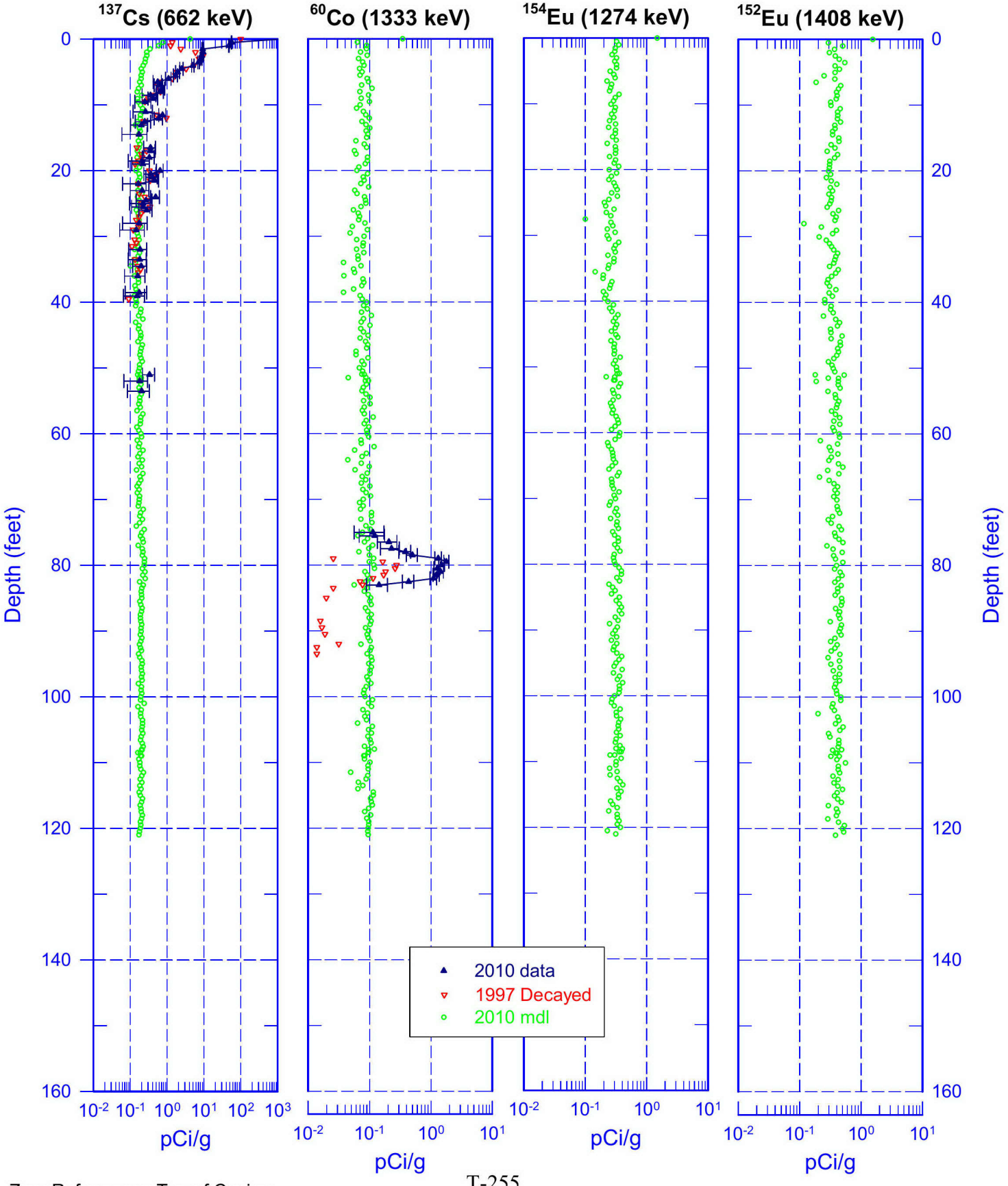
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	125	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
03/20/97	SGLS	G1B	1	0-124.5	MACTEC-ERS	Baseline
09/11/02	RAS	Large	A	30-100	MACTEC-ERS	No Apparent Change
01/16/03	RAS	Large-New	B	30-124	Stoller	No Apparent Change
05/02/03	RAS	Large-New	C	30-121	Stoller	No Apparent Change
07/30/03	RAS	Large-New	D	30-121	Stoller	No Apparent Change
10/29/03	RAS	Large-New	E	30-121	Stoller	No Apparent Change
12/08/03	NMLS	Moisture	1	0-121.5	Stoller	Moisture baseline
12/15/03	RAS	Large-New	F	30-121	Stoller	No Apparent Change
02/12/04	NMLS	Moisture	2	0-121.5	Stoller	No Apparent Change
2/17/2004	RAS	Large-New	G	30-121	Stoller	No Apparent Change
5/30/2007	RAS	Large-New	H	0-124	Stoller	Potential increase 79-82 ft
11/9/2010	SGLS	G2BR	2	0-121	Stoller	Co-60 Increase 75-83 ft

30-09-07 (299-E27-135 [A6754])

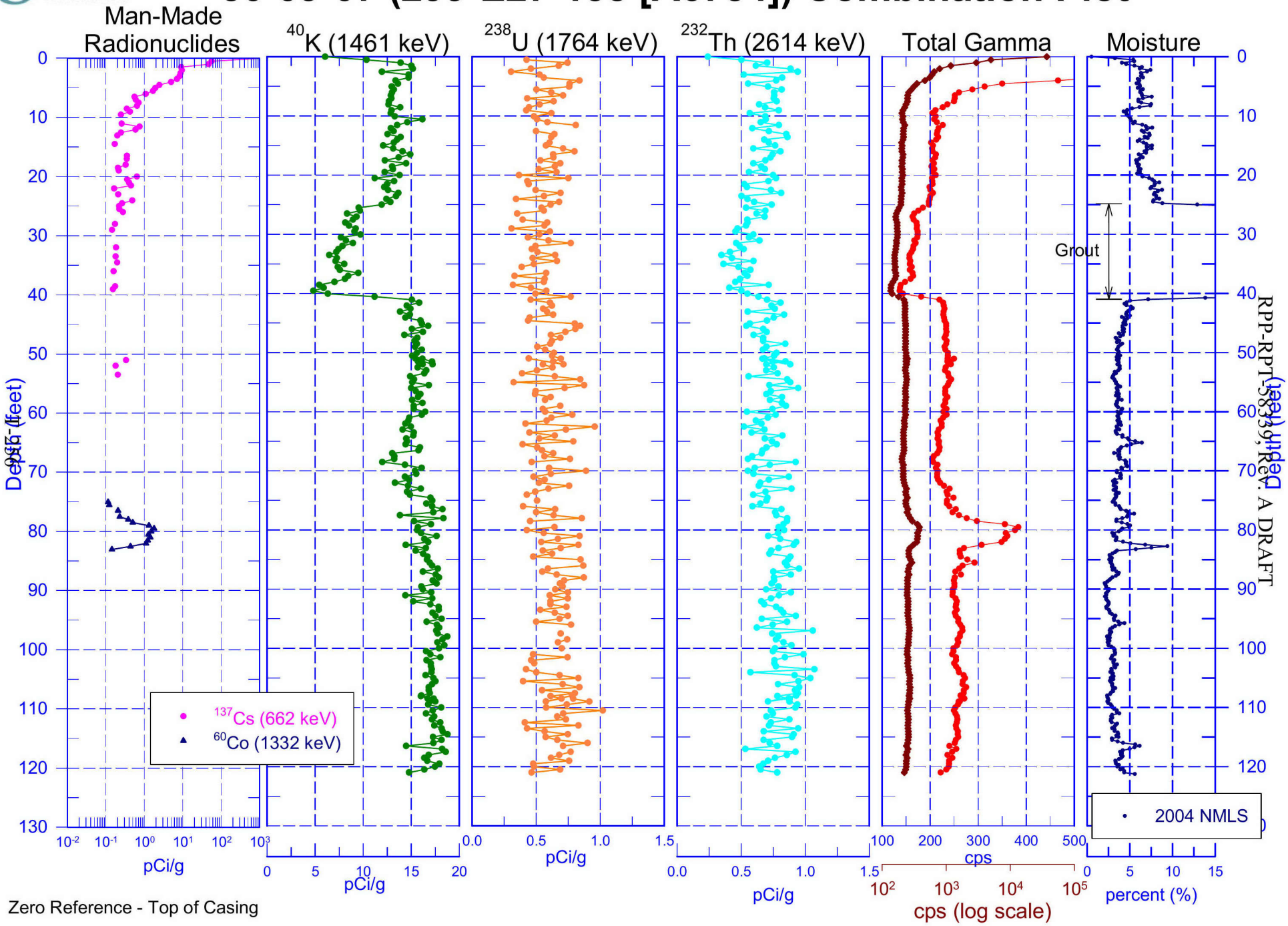
Comparison of Manmade Radionuclides (2010, 2004 & 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-09-07 (299-E27-135 [A6754]) Combination Plot

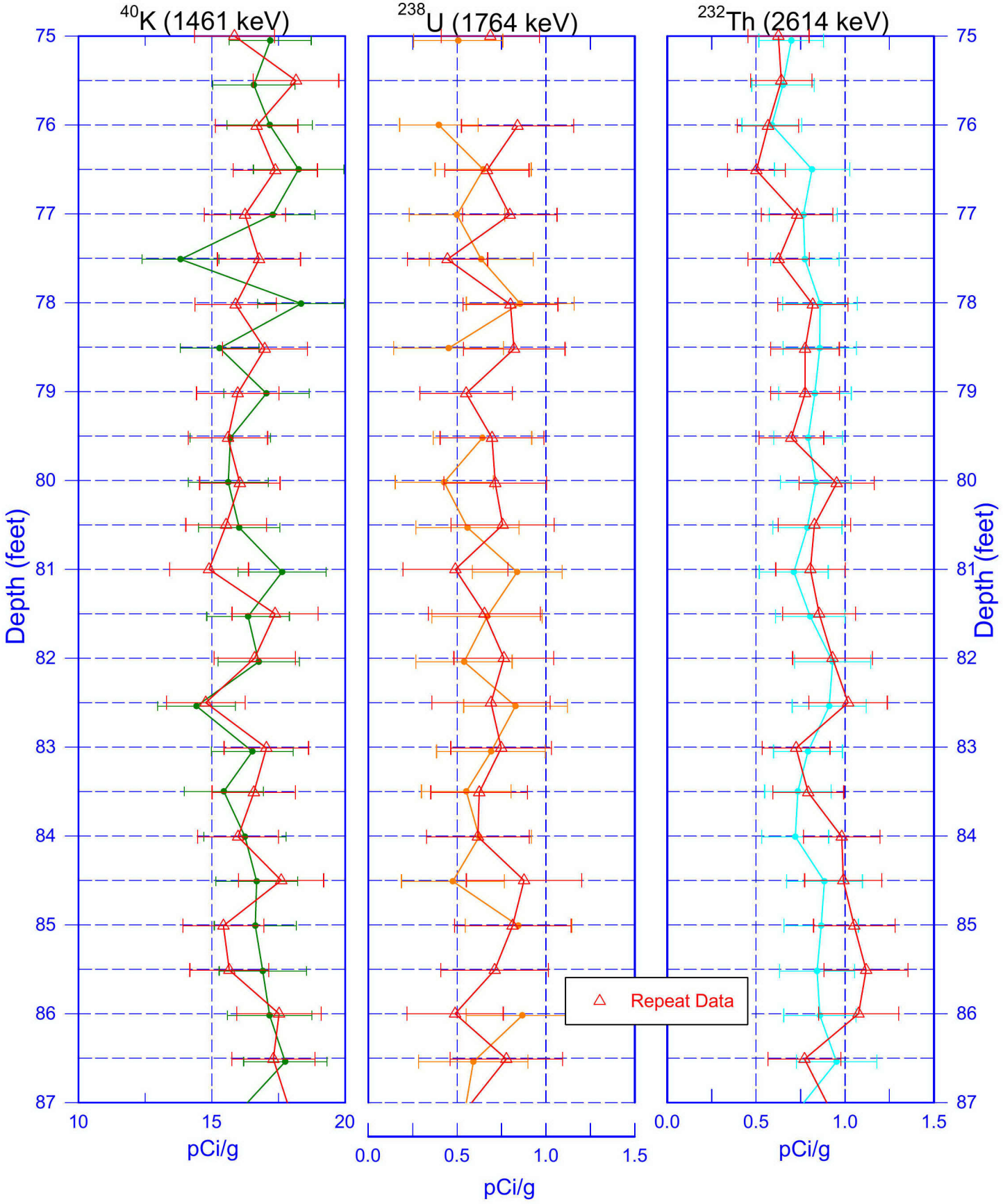


RPP-RPT-58339, Rev. A DRAFT (Left Blank)

Stoller Hanford Office

30-09-07 (299-E27-135 [A6754])

Repeat Section of Natural Gamma Logs

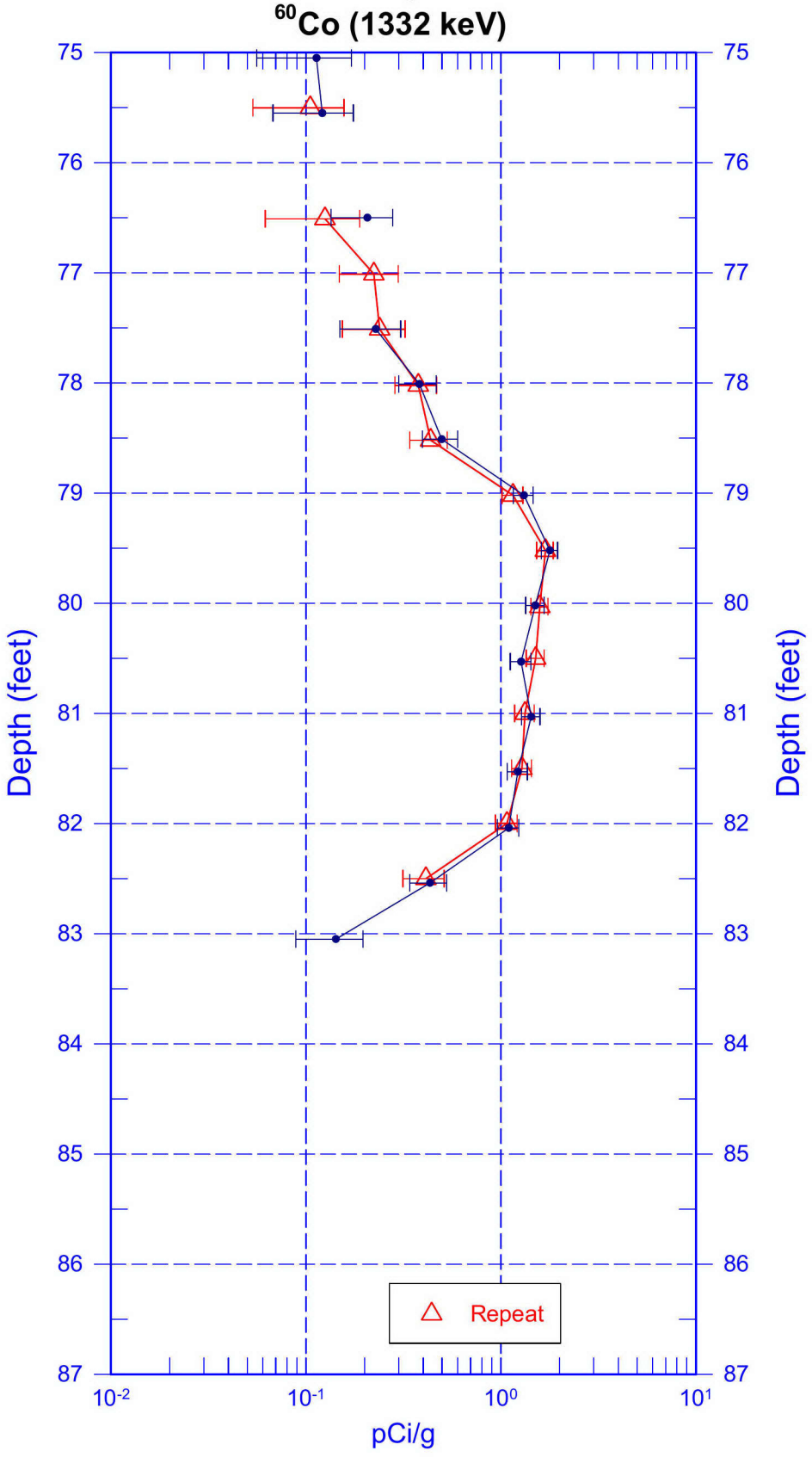


Zero Reference - Top of Casing

Stoller Hanford Office

30-09-07 (299-E27-135 [A6754])

Manmade Repeat Section



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-99 (A6724)

2010-2011 C-Farm Re-Baseline

30-09-10
299-E27-99 (A6724)
Log Data Report

Borehole Information:

Log Date:	2010-11-29	Filename:	A6724_HG_2010-11-29	Site:	241-C-109	
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:		11/9/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)		Type
N/A	N/A	7/31/1974	N/A	100		Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	98

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The location of the borehole is indicated in the figure titled "Borehole 30-09-10 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1997 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-109* (DOE 1997). Casing thicknesses are derived from published values for schedule 40-steel pipe.

The zero reference is the top of casing, which is approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2 BR	Type:	DHMCA[5] SGLS
Effective Calibration Date:	09/22/10	Serial No.:	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

SGLS Log Run Information:

Log Run	1	2	3	4 Repeat	
HEIS Number	1017364	1017365	1017366	1017367	
Date	11/17/10	11/18/10	11/22/10	11/29/10	
Logging Engineer	Spatz/Holloway/ McClellan	Spatz/Holloway/ McClellan	Spatz/Holloway/ McClellan	Spatz/Holloway/ McClellan	
Start Depth (ft)	0.0	44.0	59.0	0.0	
Finish Depth (ft)	45.0	60.0	98.0	10.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	_B_101117	_B_101118	_B_101122	_B_101123	
Start File	_D_000000	_D_004400	_D_005900	_D_000000	
Finish File	_D_004500	_D_006001	_D_009804	_D_001001	
Post-Verification	_A_101117	_A_101118	_A_101122	_A_101113	
Depth Return Error (in.)	1/2 Low	0.0	0.0	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the table above due to the length of file names (e.g., _D_000000 for A6724_BR_1016281_D_000000).

Analysis Notes:

Analyst:	Legler	Date:	8/29/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A Casing correction for a 0.28-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed

[6] minimum detection level

from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 and Co-60 were decayed to a common date of November 29, 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154 and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected almost continuously from ground surface to 67 ft, and 73 to 98 ft, with a maximum concentration of approximately 158 pCi/g at 2.5 ft. No significant changes have occurred since 1997.

Co-60 was detected at 58.5 ft with a concentration of approximately 0.1 pC/g. This detection is a slight increase from the 1997 data, since decay of the 1997 data suggests that the concentration would be below the current MDL.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

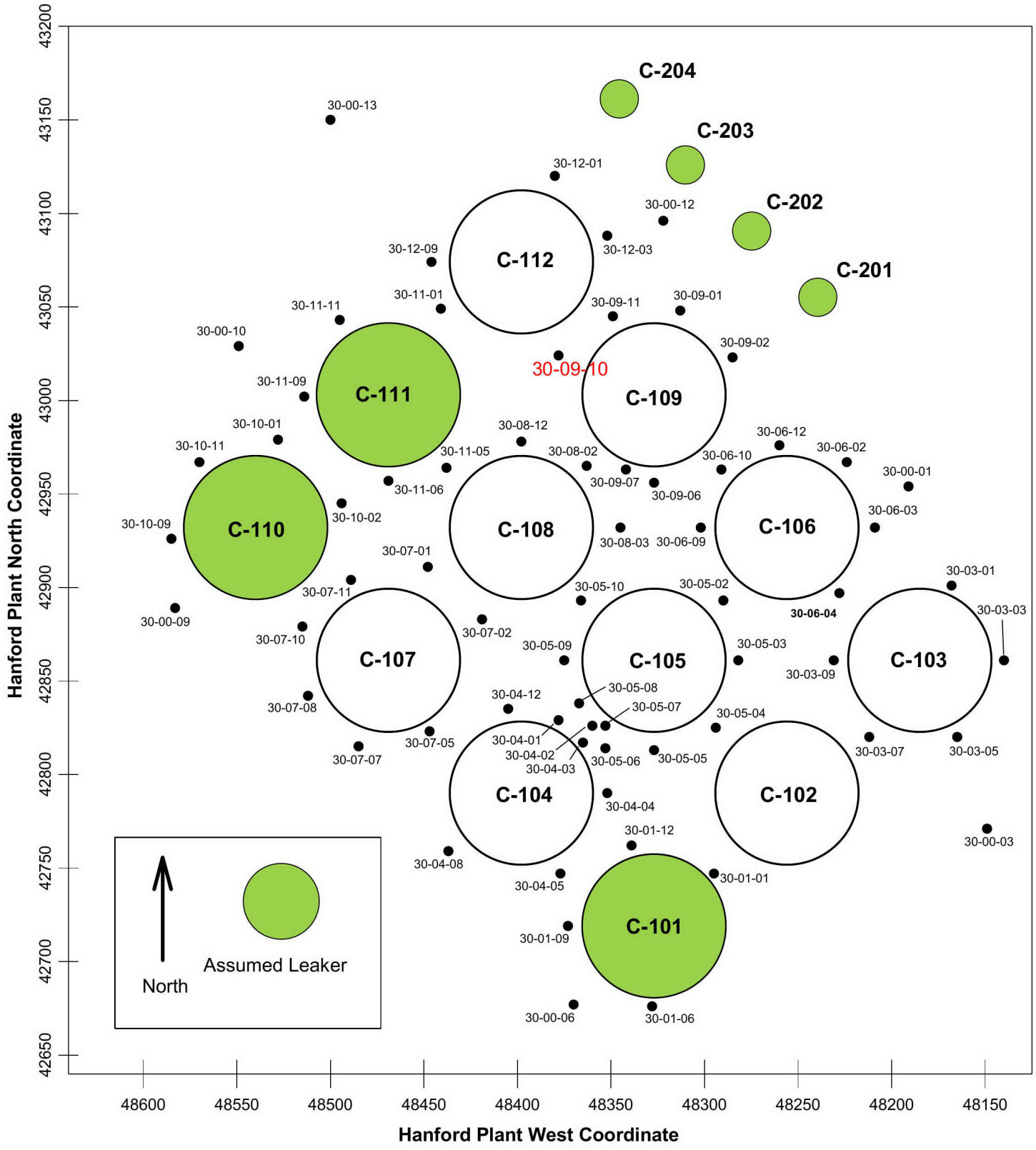
Depth Reference is top of casing

Borehole 30-09-10 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy (DOE) 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-109* GJ-HAN-91 Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-09-10 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-09-10 (299-E27-99) (A6724)

Borehole Information

Site: C Farm, Tank C-109			
Coordinates (HAN Plant):	**North: 43024**	**West: 48378**	**Elevation (ft): 645.43**
Coordinates (WA Plane):	**North: 136596.862**	**East: 575145.591**	**Elevation (m): 197.845**
Drill Date: 7/31/1974	**Type: Cable Tool**	**Depth (ft): 98**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 5/29/07**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System			

Casing Information

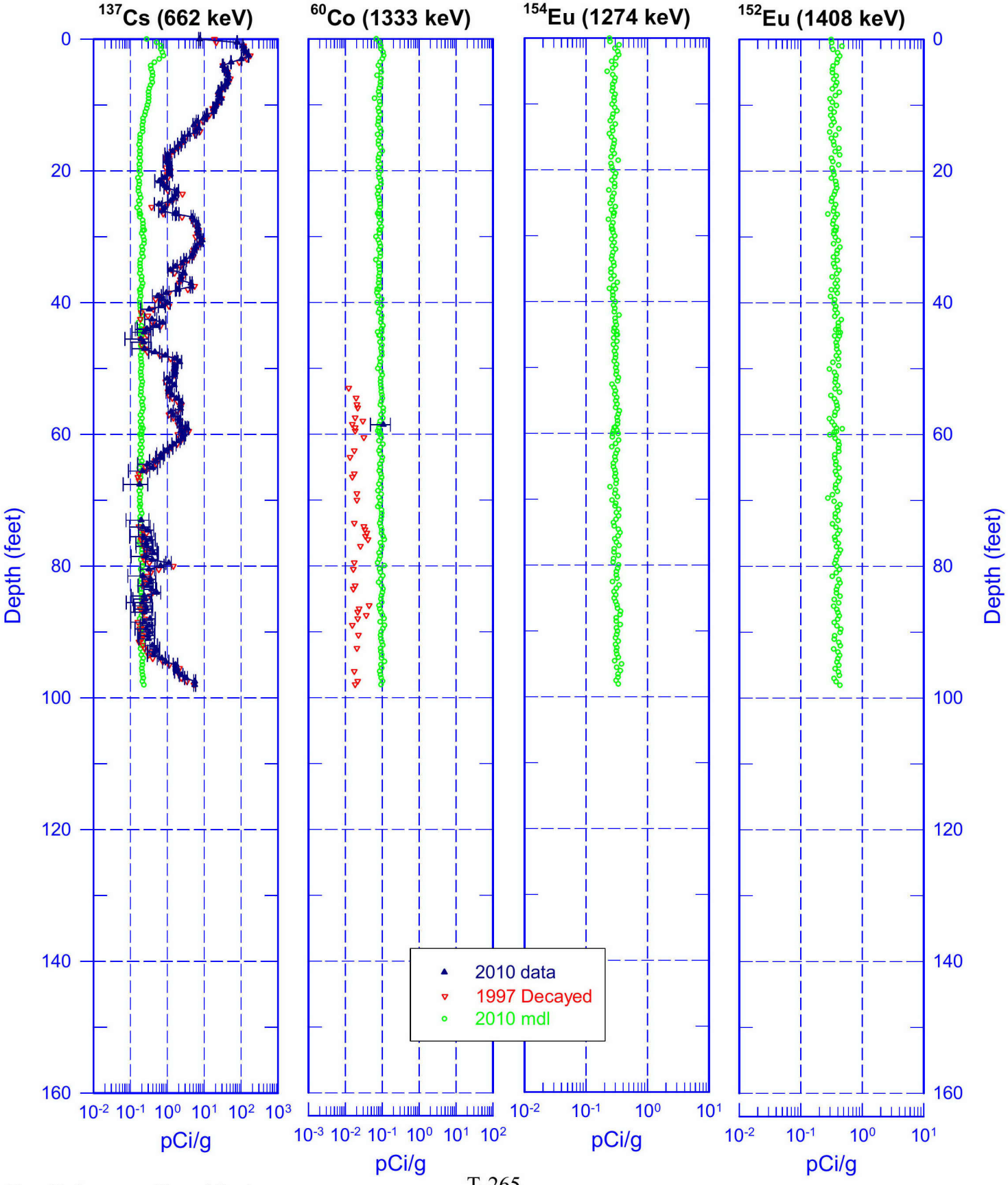
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
3/24/1997	SGLS	G1B	1	0-98	MACTEC-ERS	Baseline
9/11/2002	RAS	Large	A	25-98	Stoller	No Apparent Changes
7/29/2003	RAS	Large-New	B	25-98	Stoller	No Apparent Changes
5/29/2007	RAS	Large -New	C	0-98	Stoller	No Apparent Changes
12/6/2007	RAS	Large-New	D	20-98	Stoller	No Apparent Changes
11/29/2010	SGLS	G2BR	2	0-98	Stoller	No Apparent Changes

30-09-10 (299-E27-99 [A6724])

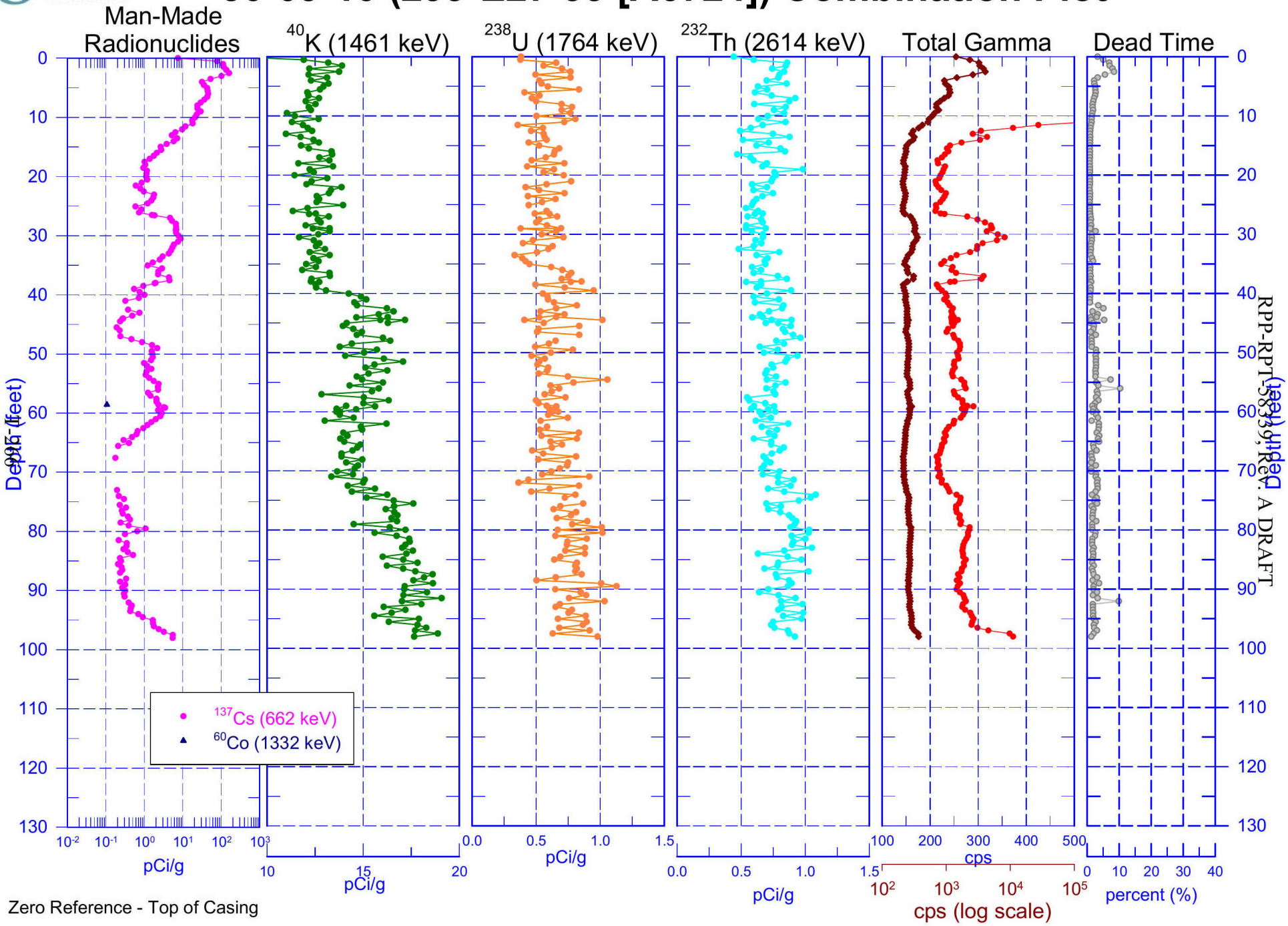
Comparison of Manmade Radionuclides (2010 & 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-09-10 (299-E27-99 [A6724]) Combination Plot

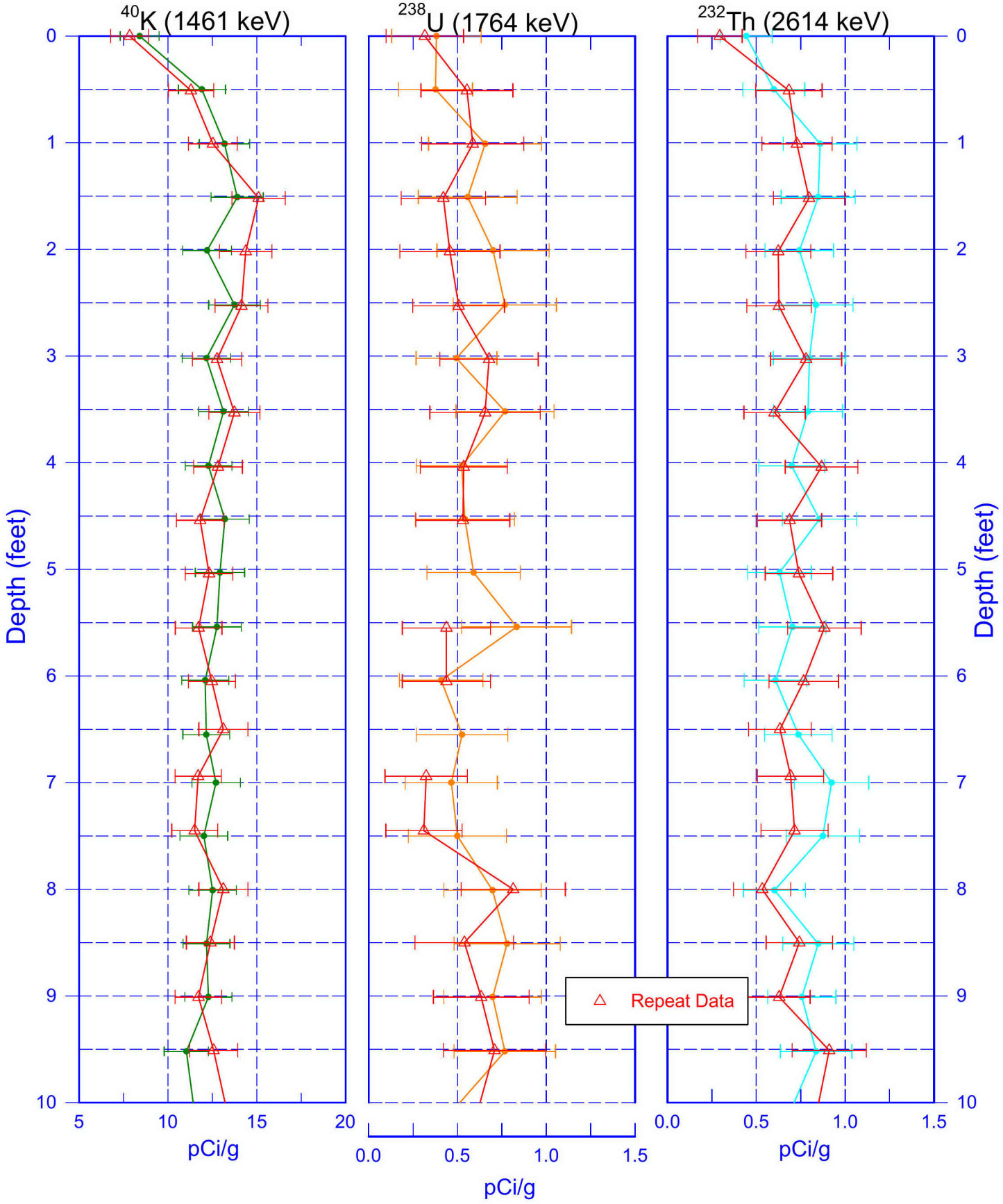


RPP-RPT-58339, Rev. A DRAFT

Stoller
Hanford Office

30-09-10 (299-E27-99 [A6724])

Repeat Section of Natural Gamma Logs



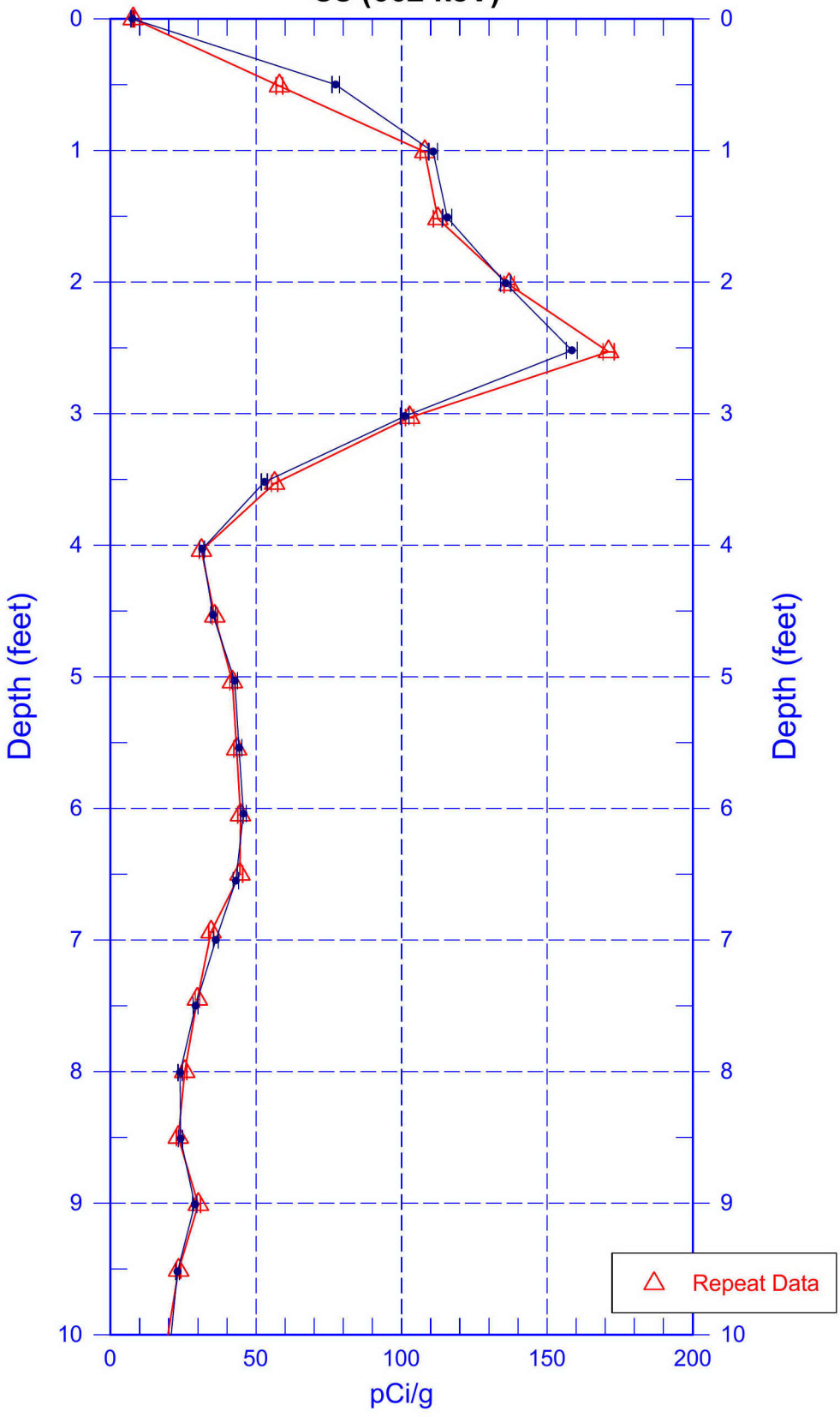
Zero Reference - Top of Casing

Stoller Hanford Office

30-09-10 (299-E27-99 [A6724])

Manmade Repeat Section

^{137}Cs (662 keV)



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-100 (A6725)

Stoller Hanford Office established 1959

HGLP-LDR-618, Rev. 0

2010-2011 C-Farm Re-Baseline

30-09-11
299-E27-100 (A6725)
Log Data Report

Borehole Information:

Log Date:	2010-12-07	Filename:	A6725_HG_2010-12-07	Site:	241-C-109	
Coordinates (WA St Plane)		GWL[1] (ft) :	None	GWL Date:		11/30/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)		Type
N/A	N/A	7/31/1974	N/A	100		Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	unknown	6	0.280	0.0	100

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The location of the borehole is indicated in the figure titled "Borehole 30-09-11 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1997 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

No water was observed in this borehole.

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-109* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

The zero reference is the top of casing.

Logging Equipment Information:

Logging System:	Gamma 2 BR	Type:	DHMCA[5] SGLS
Effective Calibration Date:	09/22/10	Serial No.:	48-TP50478A
Calibration Reference:	HGLP-CC-065, Rev. 0	Logging Procedure:	HGLP-MAN-002, Rev. 1

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

SGLS Log Run Information:

Log Run	1	2	3	4	5 Repeat
HEIS Number	1017368	1017369	1017370	1017371	1017372
Date	11/30/10	12/01/10	12/03/10	12/06/10	12/07/10
Logging Engineer	Spatz/McClellan /Holloway	Spatz/McClellan/ Holloway	Spatz/McClellan/ Holloway	Spatz/McClellan /Holloway	Spatz/McClellan /Holloway
Start Depth (ft)	0.0	2.5	38.0	61.0	0.0
Finish Depth (ft)	3.5	39.0	62.0	98.5	10.0
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	_B_101130	_B_10121	_B_10123	_B_10126	_B_10127
Start File	_D_000000	_D_000250	_D_003800	_D_006100	_D_000000
Finish File	_D_000352	_D_003900	_D_006206	_D_009850	_D_001000
Post-Verification	_A_101130	_A_10121	_A_10123	_A_10126	_A_10127
Depth Return Error (in.)	0.0	0.0	0.0	0.0	0.0
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above due to the length of the file names (e.g., _D_000000 for A6725_BR_1016281_D_000000).

Analysis Notes:

Analyst:	Legler	Date:	8/31/2011	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for a 0.28-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr1, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed

[6] minimum detection level

from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 and Co-60 were decayed to a common date of December 7, 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected from ground surface to19 ft, at 23 ft, at 24.5 ft, from 44.5 to 46.5 ft, at 79.5 ft and from 93 to 98.5 ft, with a maximum concentration of approximately 3 pCi/g at 1 ft. No significant changes have occurred since 1997.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

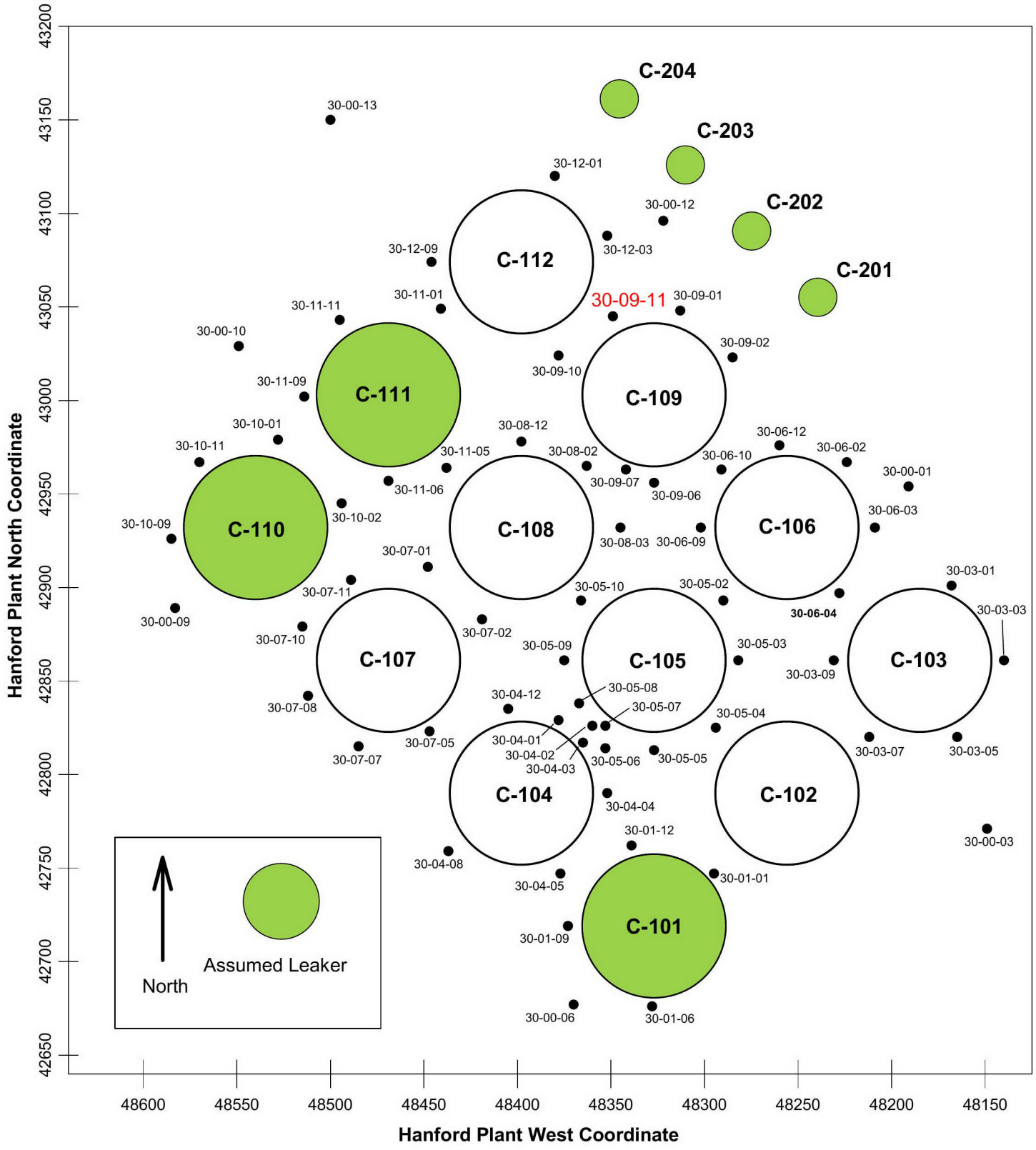
Depth Reference is top of casing

Borehole 30-09-11 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy. 1998. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-103.* GJ-HAN-82. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-09-11 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-09-11 (299-E27-100) (A6725)

Borehole Information

Site: C Farm, Tank C-109			
Coordinates (HAN Plant):	**North: 43045**	**West: 48349**	**Elevation (ft): 644.99**
Coordinates (WA Plane):	**North: 136603.296**	**East: 575154.404**	**Elevation (m): 197.708**
Drill Date: 7/31/1974	**Type: Cable Tool**	**Depth (ft): 98.5**	**Depth Datum: TOC**
Depth/Water (ft): Dry	**D/W Date: 5/30/07**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System, WA State Plane Coordinates are NAVD88			

Casing Information

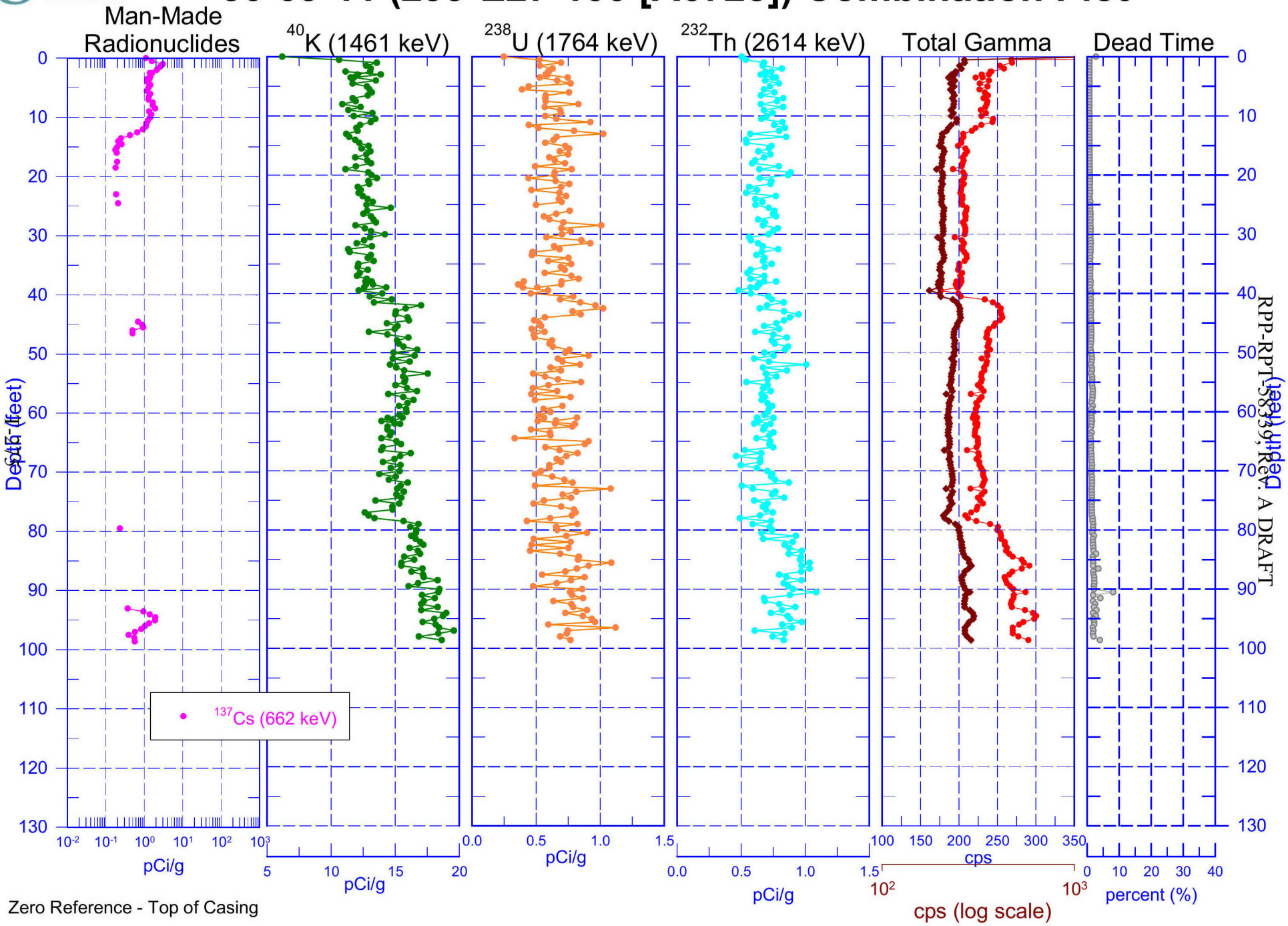
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
3/25/1997	SGLS	G1B	1	0-98.5	MACTEC-ERS	Baseline
9/11/2002	RAS	Large	A	30-98.5	Stoller	No Apparent Change
7/30/2003	RAS	Large-New	B	30-98	Stoller	No Apparent Change
5/30/2007	RAS	Large-New	C	0-98	Stoller	No Apparent Change
12/7/2010	SGLS	G2BR	2	0-98.5	Stoller	No Apparent Change

Stoller
Hanford Office

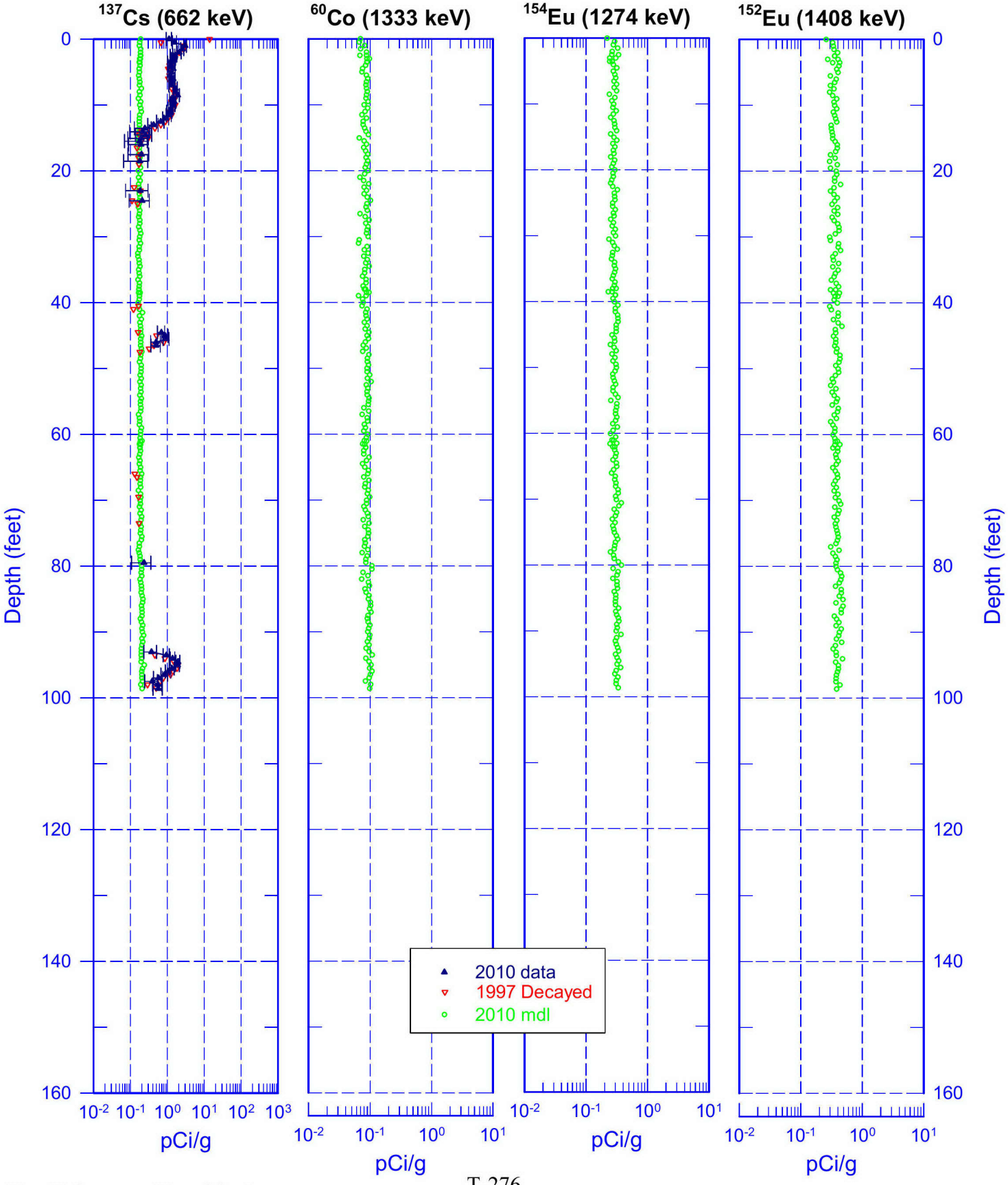
30-09-11 (299-E27-100 [A6725]) Combination Plot



RPP-RPT-58339, Rev. A DRAFT

30-09-11 (299-E27-100 [A6725])

Comparison of Manmade Radionuclides (2010 & 1997)

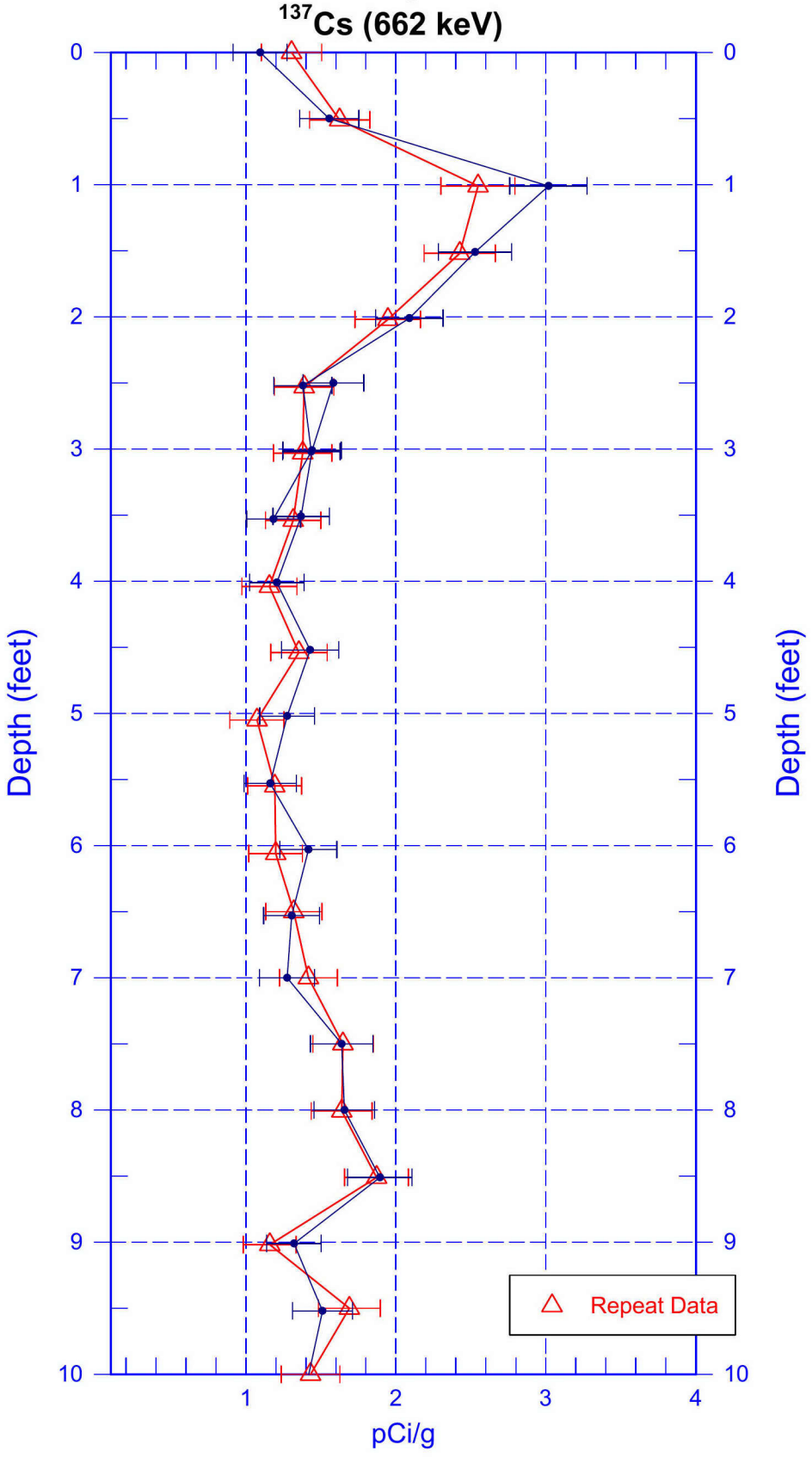


Zero Reference = Top of Casing

Stoller Hanford Office

30-09-11 (299-E27-100 [A6725])

Manmade Repeat Section

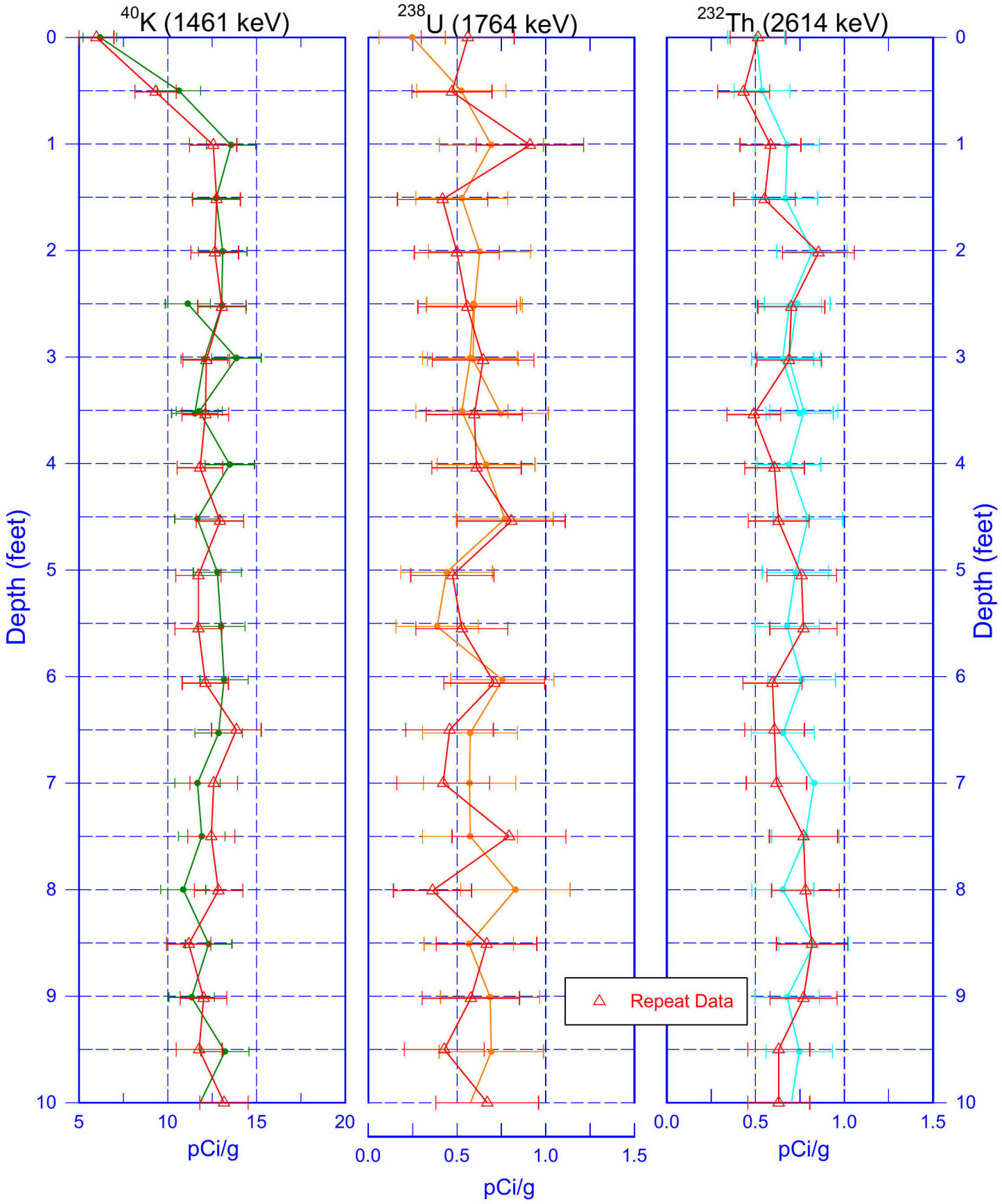


Zero Reference - Top of Casing

Stoller Hanford Office

30-09-11 (299-E27-100 [A6725])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-107 (A6732)

Stoller Hanford Office established 1959

HGLP-LDR-645, Rev. 0

2010-2011 C-Farm Re-Baseline

30-12-01
299-E27-107 (A6732)
Log Data Report

Borehole Information:

Log Date:	2010-07-15	**Filename:**	A6732_HG_2010-07-15	**Site:**	241-C-112
Coordinates (WA St Plane)		**GWL[1] (ft) :**	None	**GWL Date:**	07/08/10
North (m)	**East (m)**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
N/A	N/A	04/30/1975	N/A	99.5	Cable Tool

Casing Information:

		Diameter (in.)				
Casing Type	**Stickup (ft)**	**Outer**	**Inside**	**Thickness (in.)**	**Top (ft)**	**Bottom (ft)**
Welded Steel	0.0	unknown	6	0.280	0.0	99.5

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2010 was from 0 to 98.5 ft. The location of the borehole is indicated in the figure entitled "Borehole 30-12-01 Location in C Tank Farm" plot.

Water was not observed in this borehole.

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1997 is included in the figure entitled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet".

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-112* (DOE 1997). Casing thicknesses are derived from published values for schedule 40-steel pipe.

The zero reference is the TOC, approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[5] SGLS BR
Effective Calibration Date:	09/10/09	**Serial No.:**	48-TP50478A

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

Calibration Reference:	HGLP-CC-062, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Handheld Moisture Meter # MI-HP-3	**Type:**	Model # 503DR Campbell Pacific Nuclear Moisture Gauge
Effective Calibration Date:	6/21/10	**Serial No.:**	H-38068291
Calibration Reference:	HGLP-CC-039, Rev. 1	**Logging Procedure:**	N/A

SGLS Log Run Information:

Log Run	1	2	3	4 Repeat	
HEIS Number	1016201	1016202	1016203	1016204	
Date	07/13/10	07/14/10	07/15/10	07/15/10	
Logging Engineer	Spatz/Legler/ Holloway	Spatz/Legler/ Holloway	Spatz/Legler/ Holloway	Spatz/Legler/ Holloway	
Start Depth (ft)	0.0	28.0	74.0	40.0	
Finish Depth (ft)	29.0	75.0	98.5	50.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	1016200_B	1016202_B	1016203_B	1016203_B	
Start File	_D_000000	_D_002800	_D_007400	_D_004000	
Finish File	_D_002901	_D_007500	_D_009851	_D_004996	
Post-Verification	1016201_A	1016202_A	1016204_A	1016204_A	
Depth Return Error (in.)	0.0	0.0	N/A	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above due to the length of file names (For example, RUN01_BR_1016201_D_000050).

Analysis Notes:

Analyst:	C. Nelson	**Date:**	7/1/11	**Reference:**	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Casing corrections for a 0.28-in. thick casing were applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20090903_BRr0, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the same casing correction used for the 2010 data was applied to the original 1997 processed files. The efficiency function and dead time correction in place in 1997 was applied during reprocessing. For purposes of comparison with the 2010 data, the Co-60 and Cs-137 were decayed to a common date of July 15, 2010.

SGLS logging is conducted by S.M. Stoller, as is logging with the NMLS[7]. NMLS data are acquired digitally at 0.25-ft intervals with a count time of 15 seconds. Where available, the most recent NMLS data are reported in the re-baseline log data reports. Tank Farm's handheld moisture data are acquired by Tank Farms Operations using a handheld moisture gauge that is lowered by hand and held in place for measurements by cable stops at 1-ft increments, at count times of 16 seconds. These data are manually recorded on data sheets, and submitted to S.M. Stoller for data entry and analysis. Calibration for both systems to assess system performance and determine volumetric moisture is performed by S.M. Stoller using the same procedure. Handheld moisture data are being collected for selected boreholes in C Farm. NMLS data are not available for this borehole. Handheld moisture data were acquired in this borehole on December 21, 2010 using moisture gauge M1-HP-3 and AmBe source H-38068291. Results are included in this report.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are still plotted.

Cs-137 was detected almost continuously from ground surface to 18 ft and intermittently from 29 to 61 ft. A maximum concentration of approximately 1.8 pCi/g was measured at the ground surface. Comparisons with the 1997 data indicate no significant change. Detections of Cs-137 from 55 to 61 ft in 2010 are interpreted to be the result of the enhanced detection system rather than migration of contaminants.

Co-60 was detected at 43 ft in 2010 with a concentration of approximately 0.09 pCi/g. Co-60 was detected in 1997 between 43 and 47.5 ft, and has apparently decayed below the 2010 MDL.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. Moisture data were aquired from the interval of ground surface to 97.4 ft.

The repeat plots indicate that the respective systems were working properly.

[6] minimum detection level
[7] Neutron Moisture Logging System

List of Log Plots:

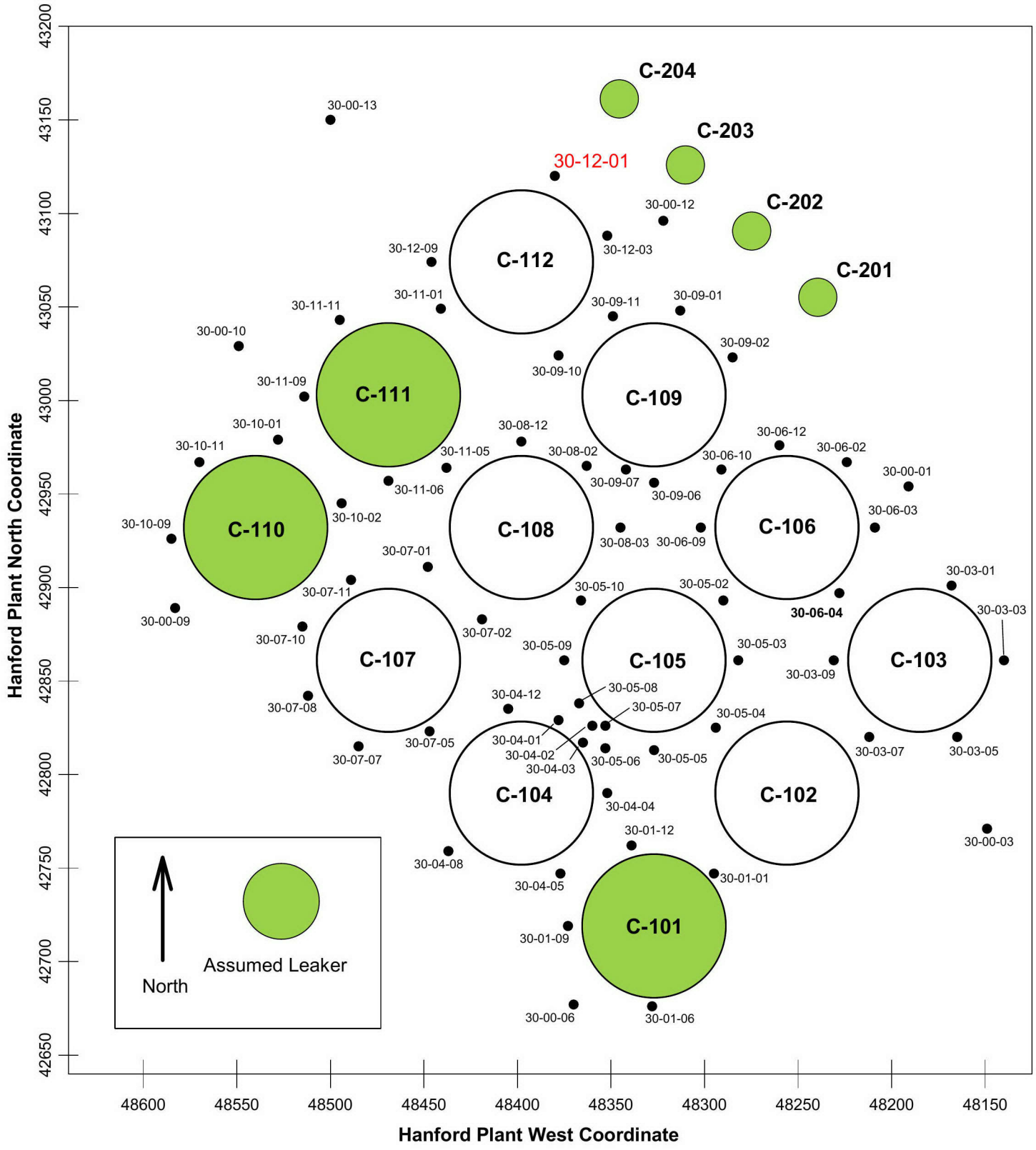
Depth Reference is top of casing

Borehole 30-12-01 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-112.* GJ-HAN-94. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-12-01 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-12-01 (299-E27-107) (A6732)

Borehole Information

Site: C Farm, Tank C-112			
Coordinates (HAN Plant):	**North: 43120**	**West: 48380**	**Elevation (ft): 645.00**
Coordinates (WA Plane):	**North: 136625.96**	**East: 575144.625**	**Elevation (m): 197.65**
Drill Date: 4/30/1975	**Type: Cable Tool**	**Depth (ft): 99.5**	**Depth Datum: TOC**
D/W (ft): Dry	**D/W Date: 7/21/03**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System			

Casing Information

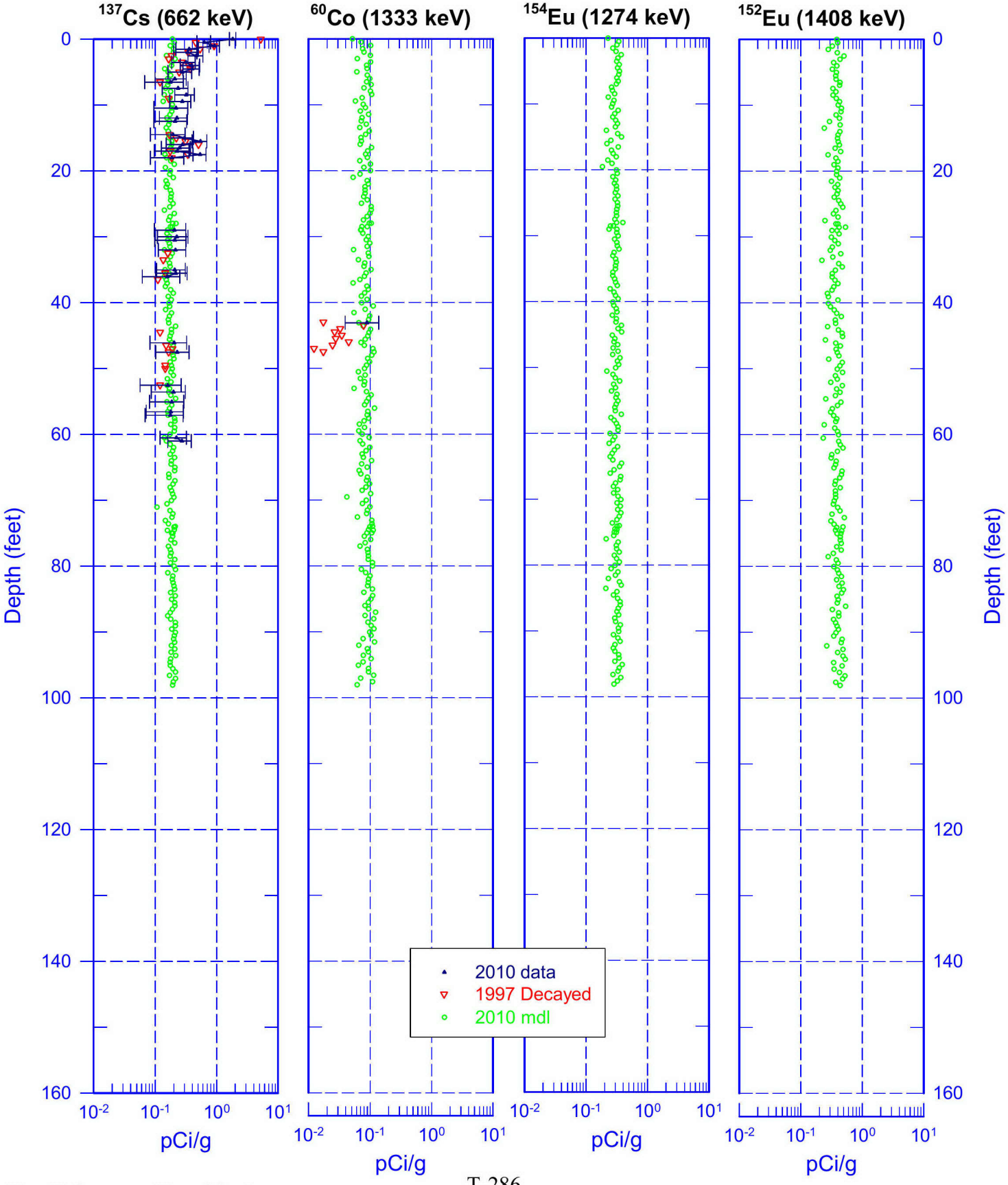
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	97	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
2/24/1997	SGLS	G1B	1	0-99.5	MACTEC-ERS	Baseline
9/10/2002	RAS	Large	A	30-70	Stoller	No Apparent Change
7/25/2003	RAS	Large-New	B	30-70	Stoller	No Apparent Change
7/15/2010	SGLS	G2BR	2	0-98.5	Stoller	No Apparent Change

30-12-01 (299-E27-107 [A6732])

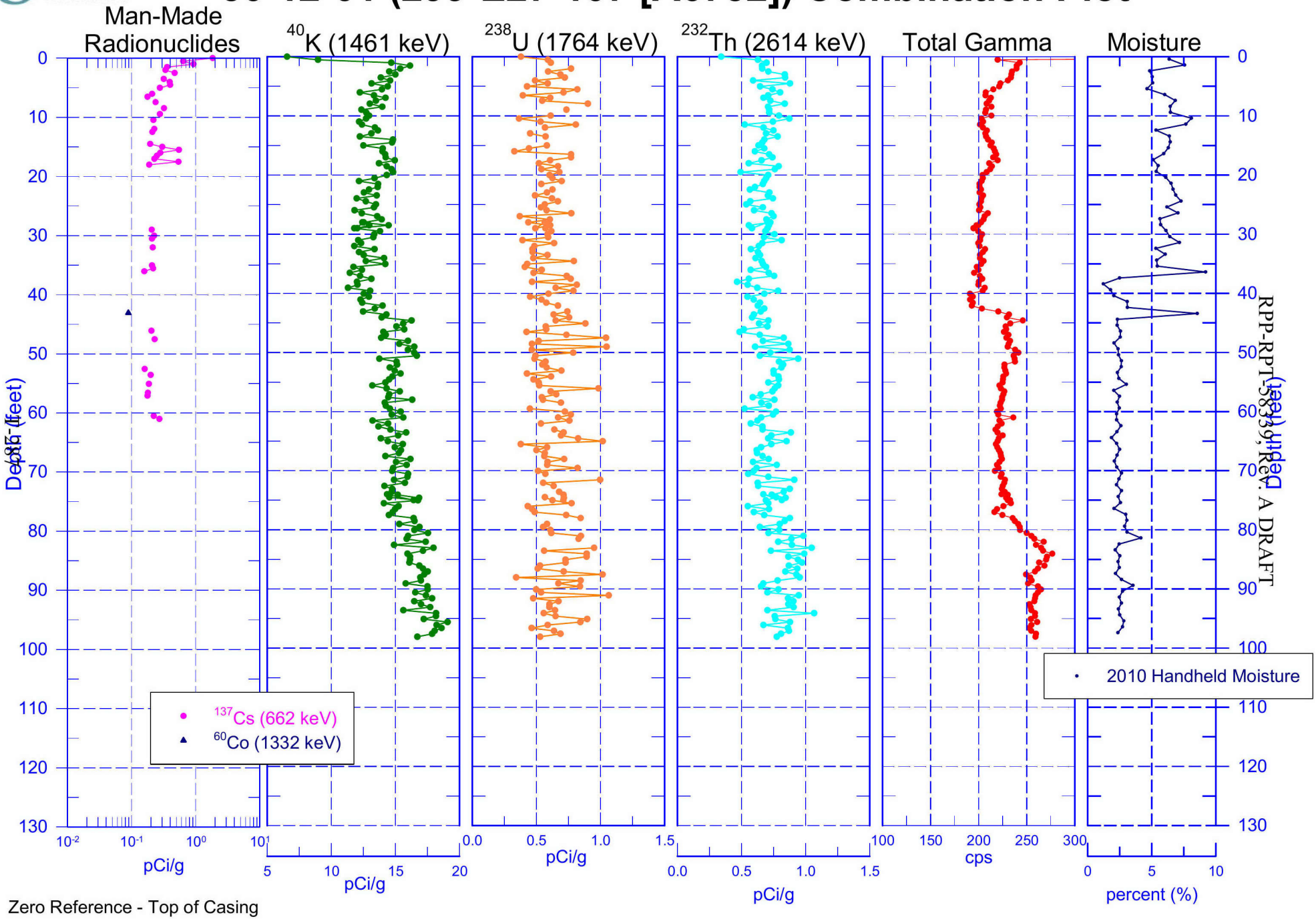
Comparison of Manmade Radionuclides (2010 & 1997)



Zero Reference = Top of Casing

Stoller Hanford Office

30-12-01 (299-E27-107 [A6732]) Combination Plot



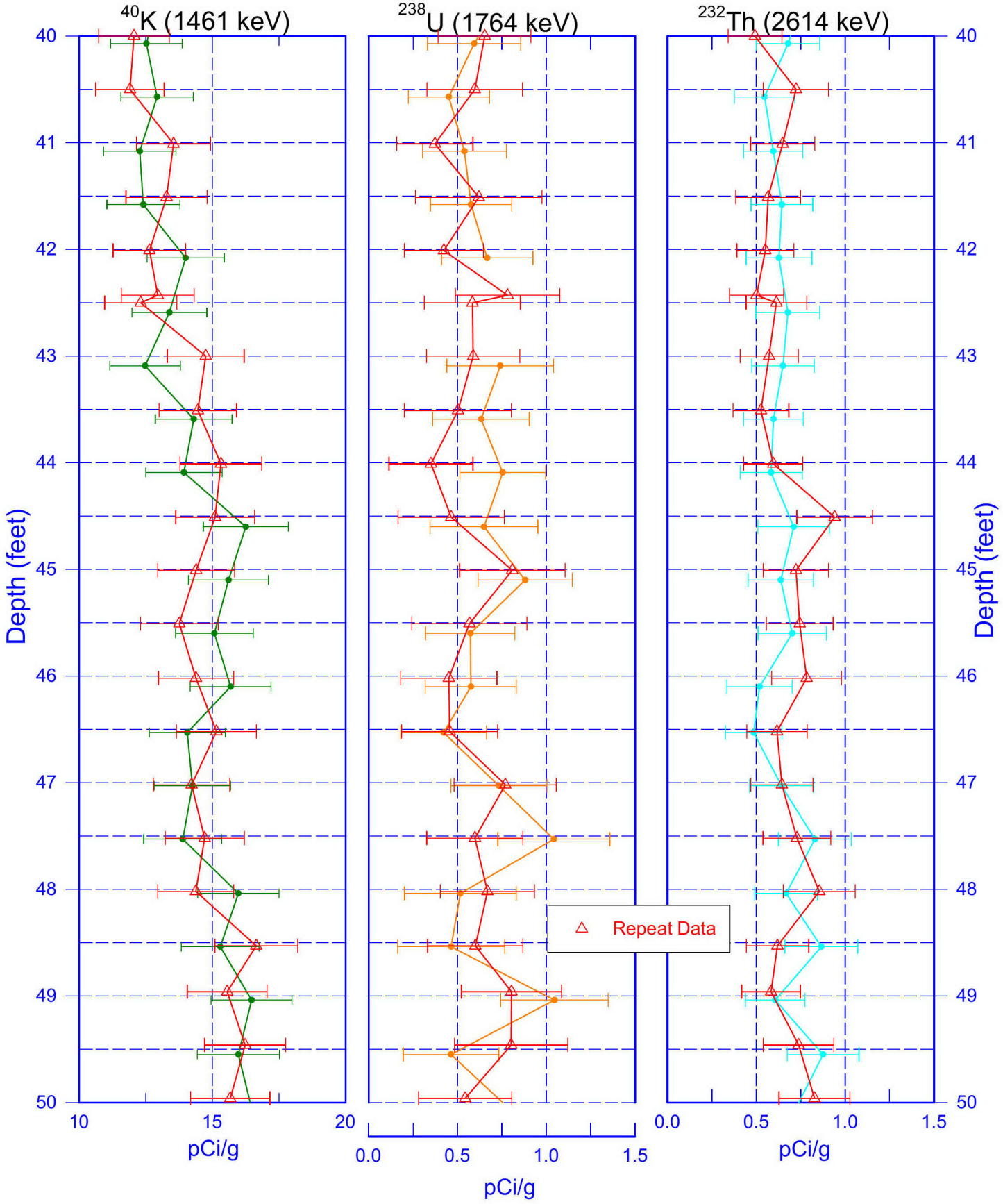
Zero Reference - Top of Casing

RPP-RPT-58339, Rev. A DRAFT

Stoller Hanford Office

30-12-01 (299-E27-107 [A6732])

Repeat Section of Natural Gamma Logs

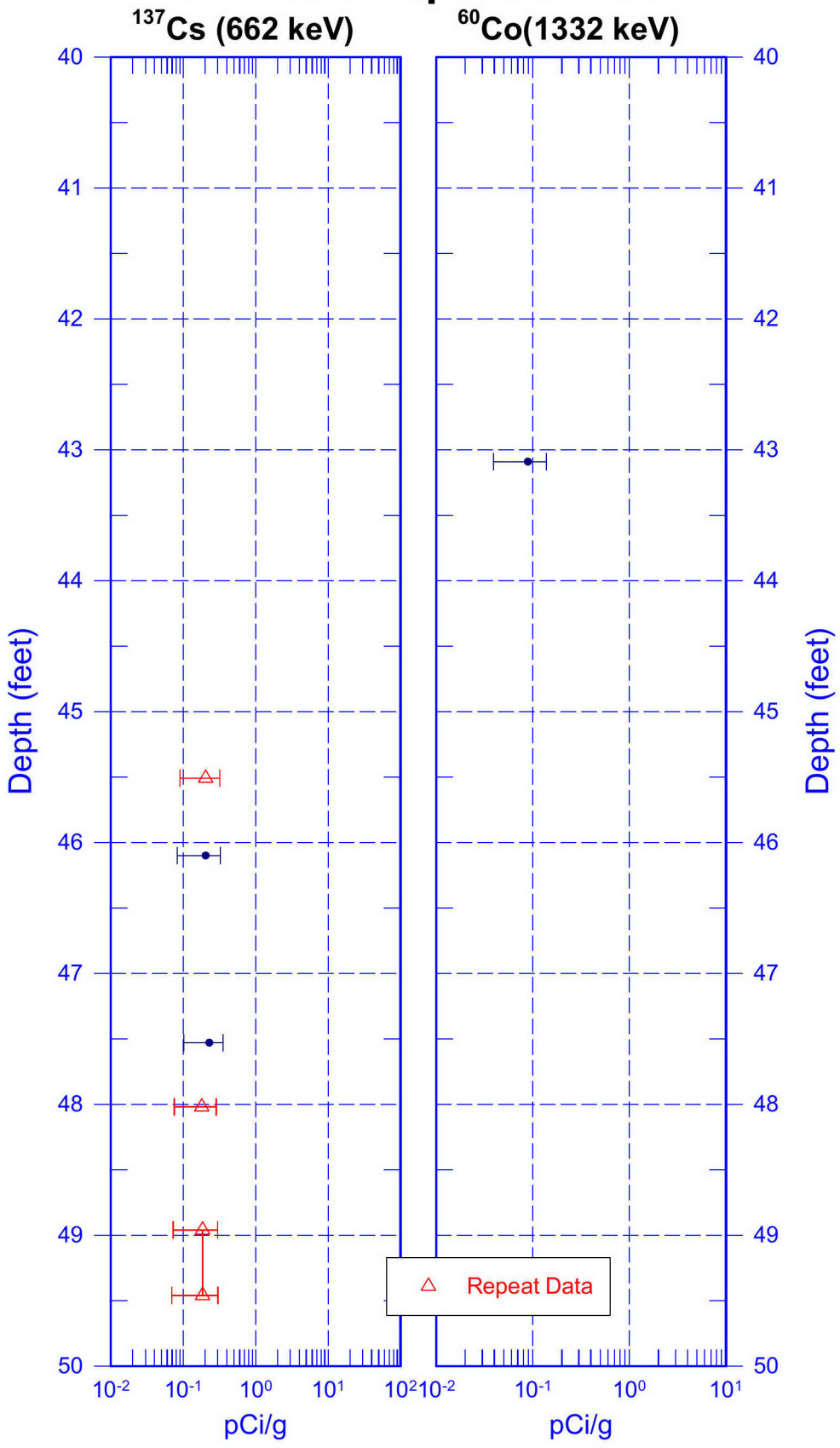


Zero Reference - Top of Casing

Stoller Hanford Office

30-12-01 (299-E27-107 [A6732])

Manmade Repeat Section



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-108 (A6733)

2010-2011 C-Farm Re-Baseline

30-12-03
299-E27-108 (A6733)
Log Data Report

Borehole Information:

Log Date:	2010-07-13	Filename:	A6733_HG_2010-07-13	Site:	241-C-Farm, 241-C-112
Coordinates (WA St Plane)		GWL[1] (ft):	None	GWL Date:	7/8/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	4/30/75	N/A	98.0	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0	97.0

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The location of the borehole is indicated in the figure titled "Borehole 30-12-03 Location in C Tank Farm."

The depth interval logged in 2010 was from 0 to 55.5 feet just above the level of water inside the borehole casing. Water was observed at 56.2 ft in this borehole. Other water levels observed during past logging events are included below. Fluctuating water levels suggest water is introduced inside the borehole from precipitation events and drains into the vadose zone. The rate of drainage during March and April 1997 appears to be about 0.2 ft/day and may be continuing to the present.

Date	Depth to Borehole Water (ft)
12/03/2010	68.4
7/08/2010	56.2
4/09/1997	39.5
3/14/1997	34.9
3/13/1997	34.75
2/24/1997	7.2 (water pumped prior to 3/13/97 data)

[1] groundwater level
[2] top of casing
[3] Resource Conservation and Recovery Act

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with initial baseline data acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010. A summary of other logging data acquired since 1997 is included in the figure titled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."
Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-112* (DOE 1998). Casing thicknesses are derived from published values for schedule 40 steel pipe.

The zero reference is the top of casing, which is approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA [5] SGLS
Effective Calibration Date:	9/20/10	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-065	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Handheld Moisture Meter # MI-HP-3	**Type:**	Model # 503DR Campbell Pacific Nuclear Moisture Gauge
Effective Calibration Date:	6/21/10	**Serial No.:**	H-38068291
Calibration Reference:	HGLP-CC-039, Rev. 1	**Logging Procedure:**	TO-320-022, D-3

SGLS Log Run Information:

Log Run	**1**	**2 Repeat**	**3 Repeat**	**4**	
HEIS Number	1015868	1015869	1016200	1017724	
Date	7/8/10	7/12/10	7/13/10	7/13/10	
Logging Engineer	Spatz/ Legler	Spatz/ Legler	Spatz/ Legler	Spatz/ Legler	
Start Depth (ft)	0.0	11.0	37.0	43.5	
Finish Depth (ft)	12.0	43.0	43.0	55.5	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	_B_1078	_B_10712	_B_10713	1016200_B_10713	
Start File	_D_000000	_D_001100	_D_003700	_D_004350	
Finish File	_D_001201	_D_004304	_D_004300	_D_005556	
Post-Verification	_A_1078	_A_10712	_A_10713	1016201_A_10713	
Depth Return Error (in.)	0.0	0.0	N/A	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh 082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the table above due to the length of the file name (for example, _D_000000 for A6733_BR_1015868_D_000000).

Analysis Notes:

Analyst:	LEGLER	Date:	6/13/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

Casing corrections for a 0.28-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20100922_BRr0, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system was deployed in Tank Farms in the summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the 1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 was decayed to a common date of November 11, 2010.

SGLS logging is conducted by Stoller, as is logging with the NMLS[7]. NMLS data are acquired digitally at 0.25-ft intervals with a count time of 15 seconds. Where available, the most recent NMLS data are reported in the re-baseline log data reports. Tank Farm's handheld moisture data are acquired by Tank Farms Operations using a handheld moisture gauge that is lowered by hand and held in place for measurements by cable stops at 1-ft increments, at count times of 16 seconds. These data are manually recorded on data sheets, and submitted to Stoller for data entry and analysis. Calibration for both systems to assess system performance and determine volumetric moisture is performed by Stoller using the same procedure. Handheld moisture data are being collected for selected boreholes in C Farm. NMLS data are not available for this borehole. Handheld moisture data were acquired in this borehole on December 3, 2010 using moisture gauge M1-HP-3 and AmBe source H-38068291. Results are included in this report.

The lack of water in the interval from 35 to 56 ft in 2010 in comparison to 1997 may have resulted in additional Cs-137 detections due to less attenuation from the water.

[6] minimum detection level
[7] Neutron Moisture Logging System

Results and Interpretations:

Cs-137 was detected in this borehole. Cs-137 was detected intermittently from ground surface to 55 ft, with a maximum concentration of approximately 9 pCi/g at ground surface. Although not detected, MDLs for Co-60, Eu-152, and Eu-154 are plotted on the Comparison of Manmade Radionuclides plot.

Comparisons of Cs-137 concentration suggest no significant change since 1997.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. Moisture data were acquired using the Tank Farm's Handheld Moisture Gauge, from the interval of ground surface to 96 ft. The moisture data were acquired below water level for approximately 28 ft from 68.4 to 96.4 ft as the sonde was raised from the bottom of the borehole. No useful data were acquired in the water and are not reported. Residual moisture that may be retained on the sonde as it is moved up the borehole may cause an over-estimation of volumetric moisture.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

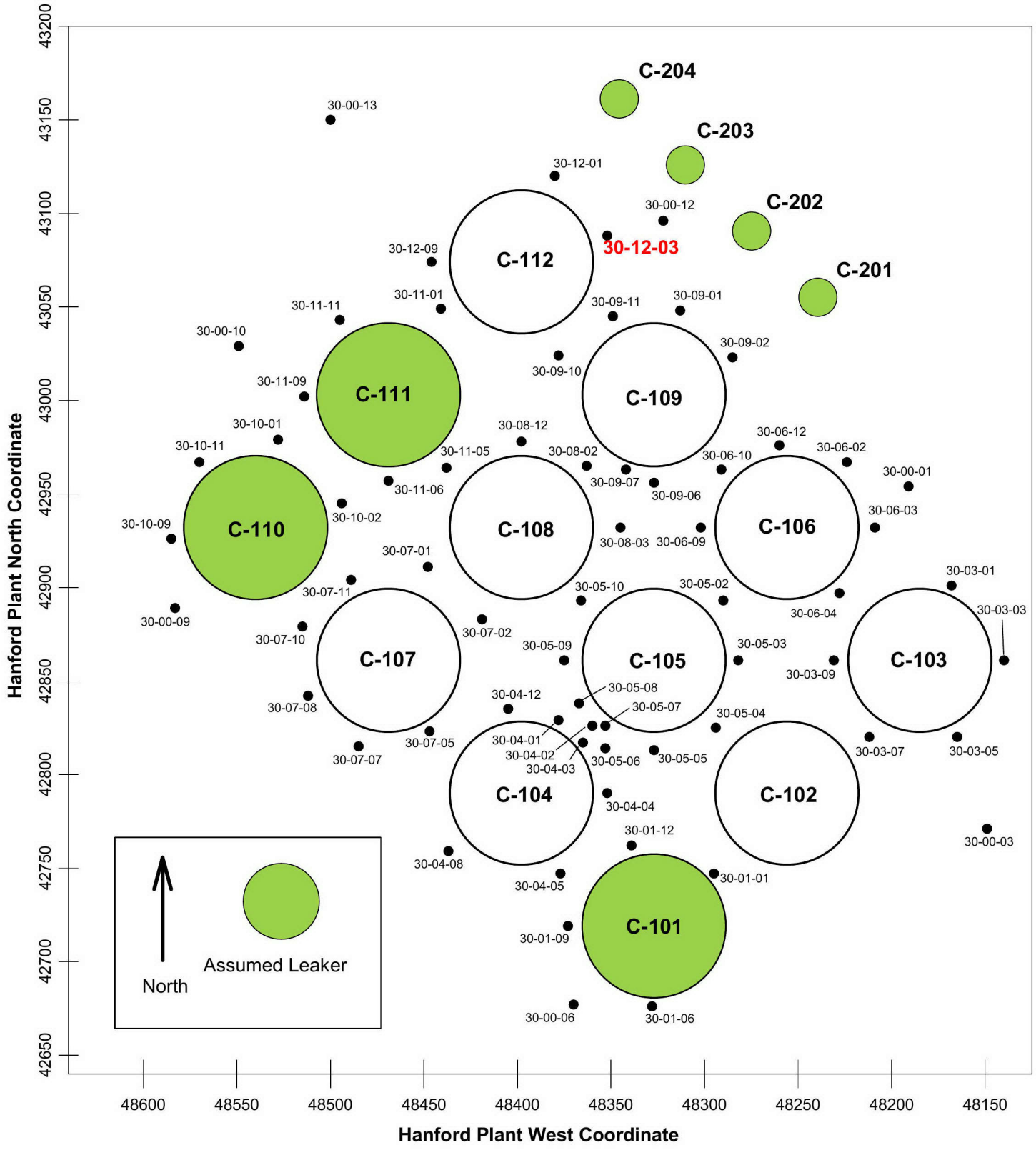
Depth Reference is top of casing

Borehole 30-12-03 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

U.S. Department of Energy (DOE) 1998. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-112* GJ-HAN-94 Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-12-03 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-12-03 (299-E27-108) (A6733)

Borehole Information

Site: C Farm, Tank C-112			
Coordinates (HAN Plant):	**North: 43088**	**West: 48352**	**Elevation (ft): 645.00**
Coordinates (WA Plane):	**North: 136616.431**	**East: 575153.502**	**Elevation (m): 197.589**
Drill Date: 4/30/1975	**Type: Cable Tool**	**Depth (ft): 98.0**	**Depth Datum: TOC**
Depth/Water (ft): 39.5	**D/W Date: 4/9/1997**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, RAS: Radionuclide Assessment System			

Casing Information

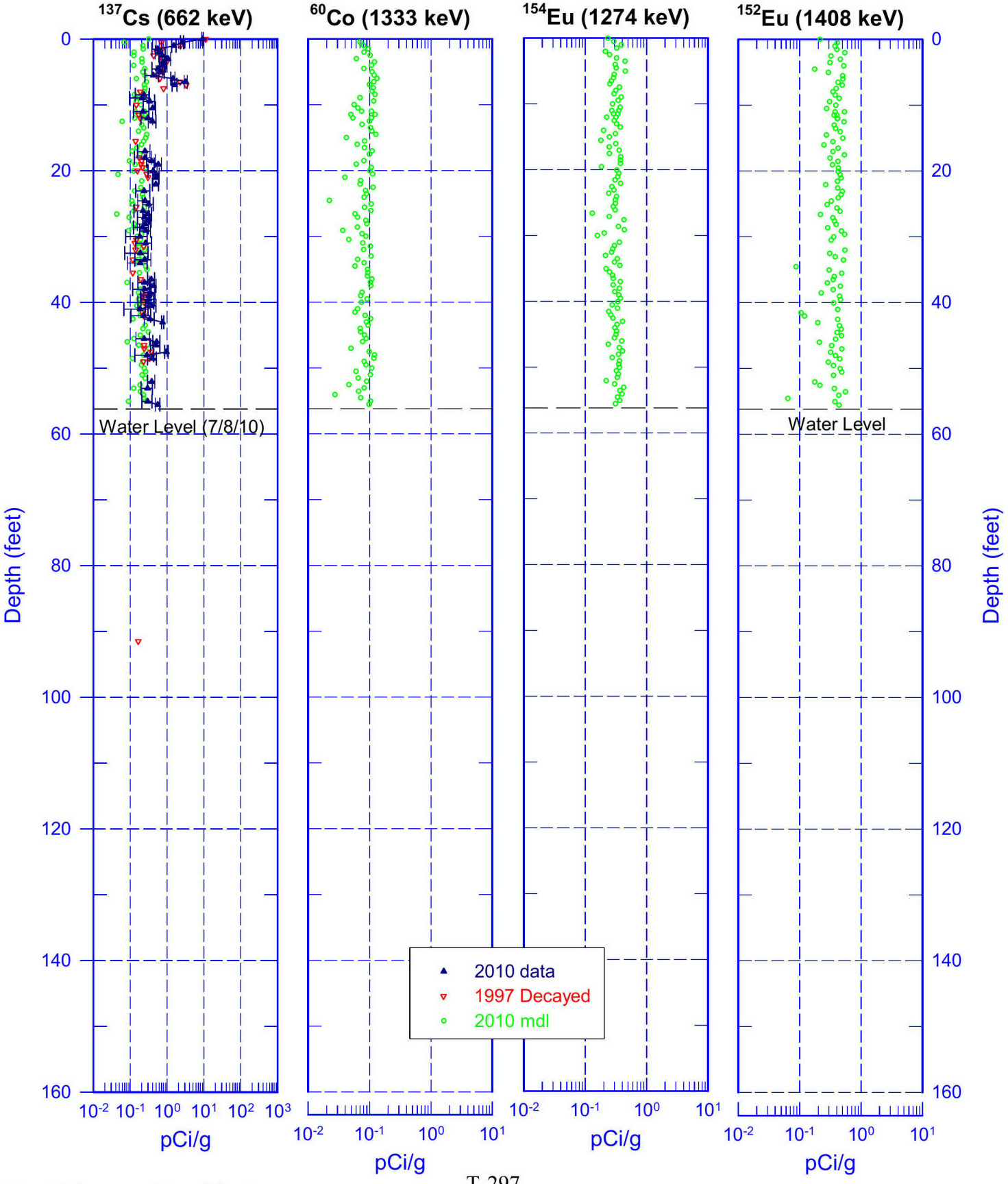
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	100	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
3/13/1997	SGLS	G1B	1	0-34.5	MACTEC-ERS	Baseline
4/9/1997	SGLS	G2A	2	0-98	MACTEC-ERS	Baseline
9/10/2003	RAS	Large-New	A	30-70	Stoller	No Apparent Change
7/13/2010	SGLS	G2BR	3	0-55.5	Stoller	No Apparent Change

30-12-03 (299-E27-108 [A6733])

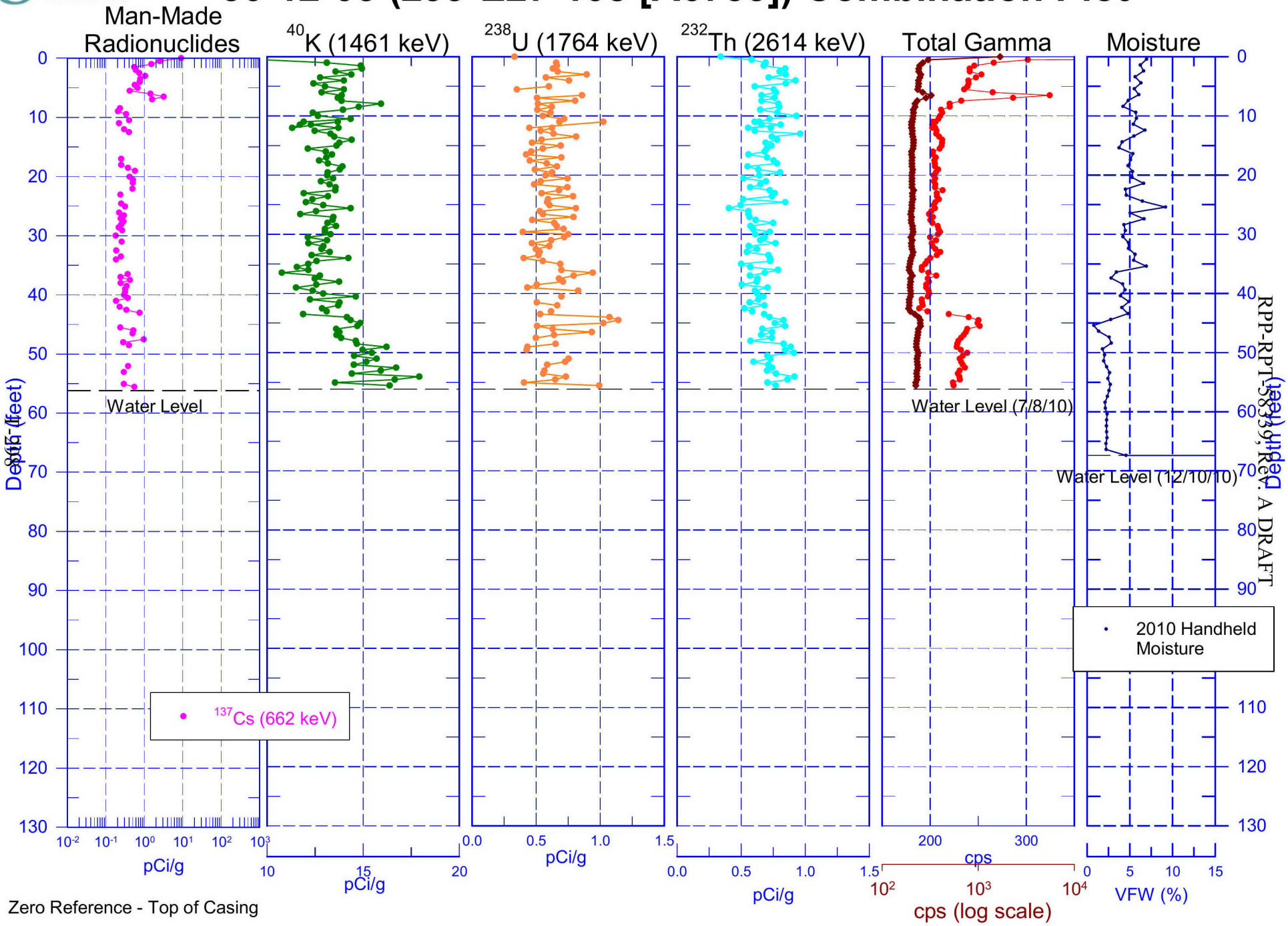
Comparison of Manmade Radionuclides (2010 &1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

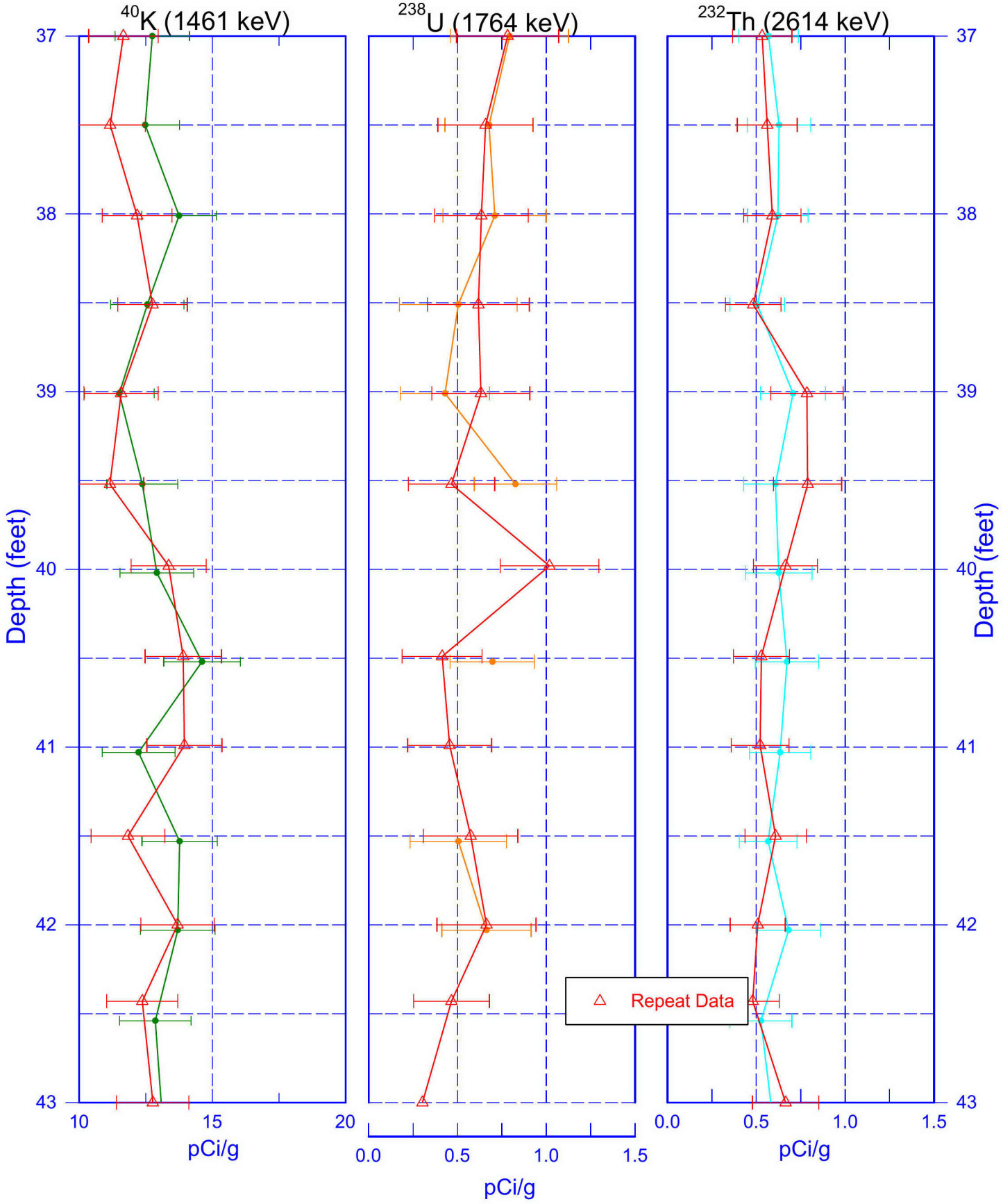
30-12-03 (299-E27-108 [A6733]) Combination Plot



Stoller Hanford Office

30-12-03 (299-E27-108 [A6733])

Repeat Section of Natural Gamma Logs

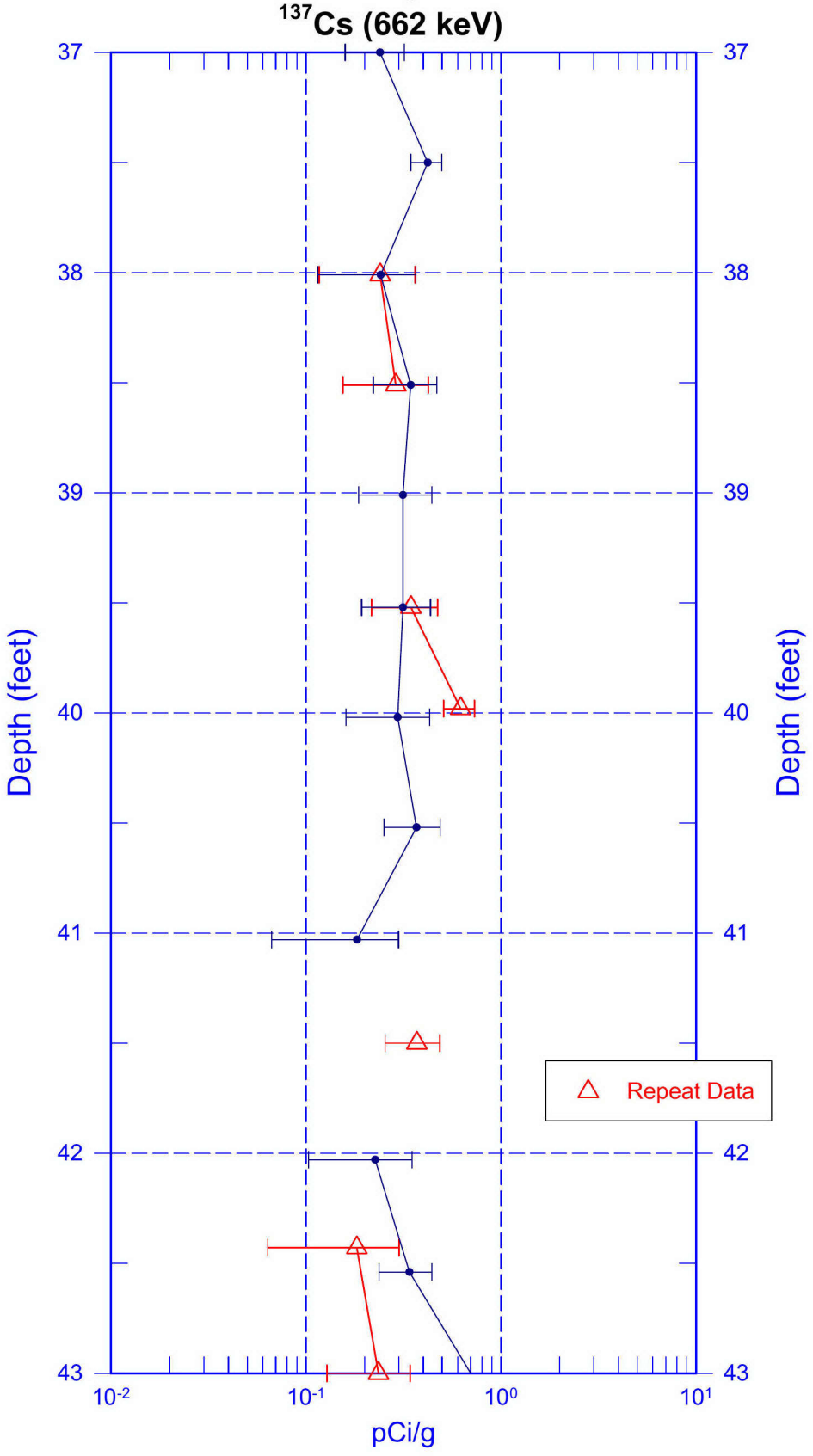


Zero Reference - Top of Casing

Stoller Hanford Office

30-12-03 (299-E27-108 [A6733])

Manmade Repeat Section



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-109 (A6734)

2010-2011 C-Farm Re-Baseline

30-12-09
299-E27-109 (A6734)
Log Data Report

Borehole Information:

Log Date:	2010-07-27	**Filename:**	A6734_HG_2010-07-27	**Site:**	241-C-112
Coordinates (WA St Plane)		**GWL[1] (ft) :**	None	**GWL Date:**	07/21/10
North (m)	**East (m)**	**Drill Date**	**TOC[2] Elevation**	**Total Depth (ft)**	**Type**
N/A	N/A	4/30/1975	N/A	100	Cable Tool

Casing Information:

		Diameter (in.)				
Casing Type	**Stickup (ft)**	**Outer**	**Inside**	**Thickness (in.)**	**Top (ft)**	**Bottom (ft)**
Welded Steel	0.0	unknown	6	0.280	0.0	100

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigations. The depth interval logged in 2010 was from 0 to 99.5 feet. The location of the borehole is indicated in the figure titled "Borehole 30-12-09 Location in C Tank Farm."

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010.

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-112* (DOE 1998). Casing thicknesses are derived from published values for schedule 40 steel pipe.

The zero reference is the top of casing.

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[5] SGLS
Effective Calibration Date:	09/03/09	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-062, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] Down-Hole Multi-Channel Analyzer

SGLS Log Run Information:

Log Run	1	2	3	4 Repeat	
HEIS Number	1016210	1016211	1016212	1016213	
Date	7/22/10	7/26/10	7/27/10	7/27/10	
Logging Engineer	Spatz/Legler	Spatz/Legler	Spatz/Legler	Spatz/Legler	
Start Depth (ft)	0.0	32.0	83.0	35.0	
Finish Depth (ft)	33.0	84.0	99.5	45.0	
Count Time (sec)	100	100	100	100	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.5	0.5	0.5	0.5	
Log Speed (ft/min)	N/A	N/A	N/A	N/A	
Pre-Verification	_B_10722	_B_10726	_B_10727	_B_10727	
Start File	1016210_D_000000	_D_003200	_D_008300	_D_003500	
Finish File	_D_003302	_D_008402	_D_009956	_D_004497	
Post-Verification	_A_10722	_A_10726	_A_10727	_A_10727	
Depth Return Error (in.)	0.0	0.0	N/A	0.0	
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	

Logging Operation Notes:

SGLS data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened in the table above due to the length of the file names (e.g., _D_000000 for RUN01_BR_1016281_D_000000).

Analysis Notes:

Analyst:	Legler	Date:	9/27/2011	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established system.

A casing correction for a 0.28-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20090903_BRr0b, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[6] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade

[6] minimum detection level

radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the1997 data were reprocessed using the same casing correction as the 2010 data. The efficiency function and dead time correction in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Cs-137 was decayed to a common date of July 27, 2010.

Results and Interpretations:

The Comparison of Manmade Radionuclides plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are plotted.

Cs-137 was detected from ground surface to 0.5 ft, and continuously from 7.5 to 10.5 ft with a maximum concentration of approximately 0.7 pCi/g at ground surface. No significant changes have occurred since 1997.

The repeat plots indicate that the respective systems were working properly.

List of Log Plots:

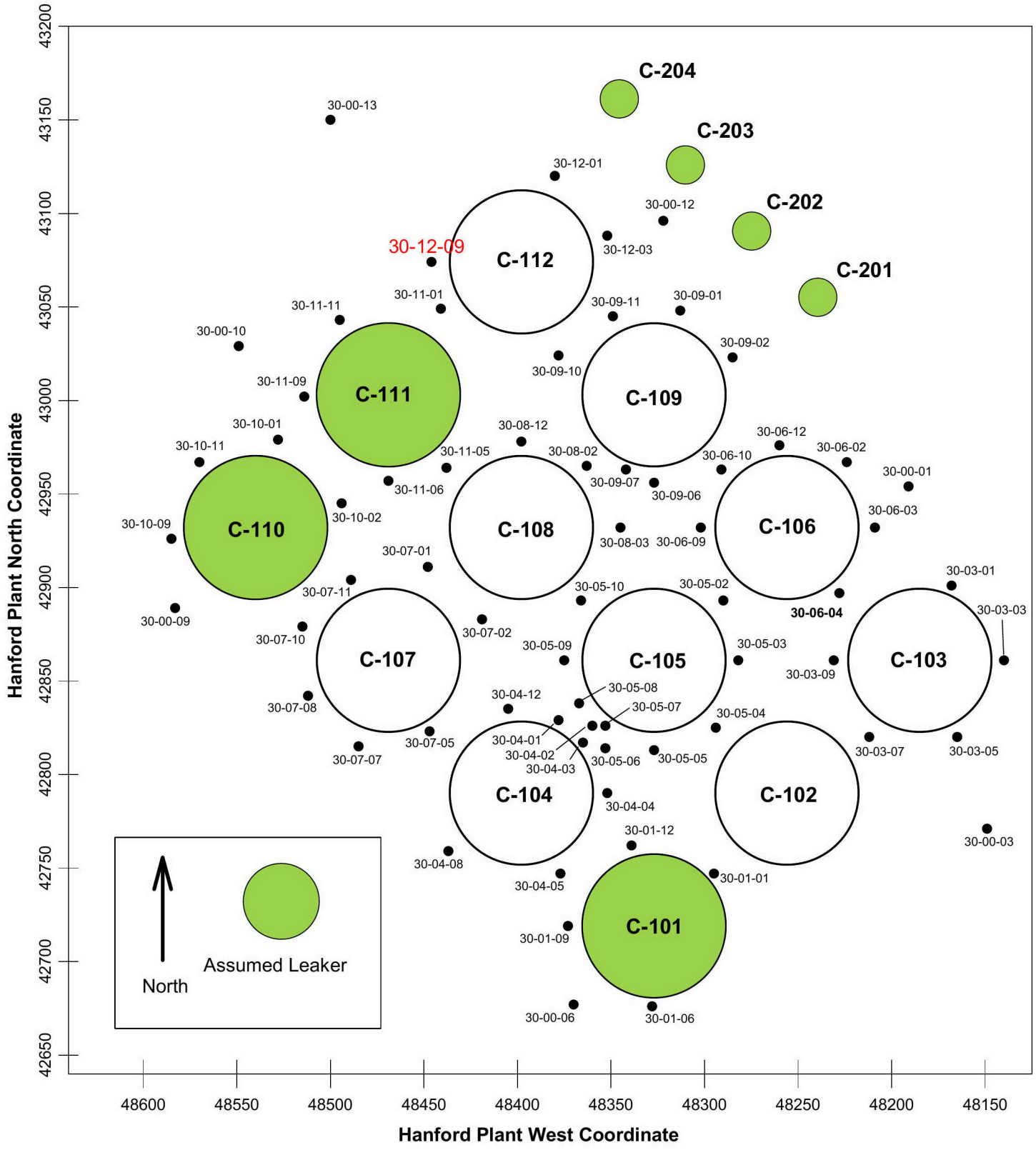
Depth Reference is top of casing

Borehole 30-012-09 Location in C Tank Farm
Comparison of Manmade Radionuclides (2010 & 1997)
Combination Plot
Repeat Section of Natural Gamma Logs
Manmade Repeat Section

References:

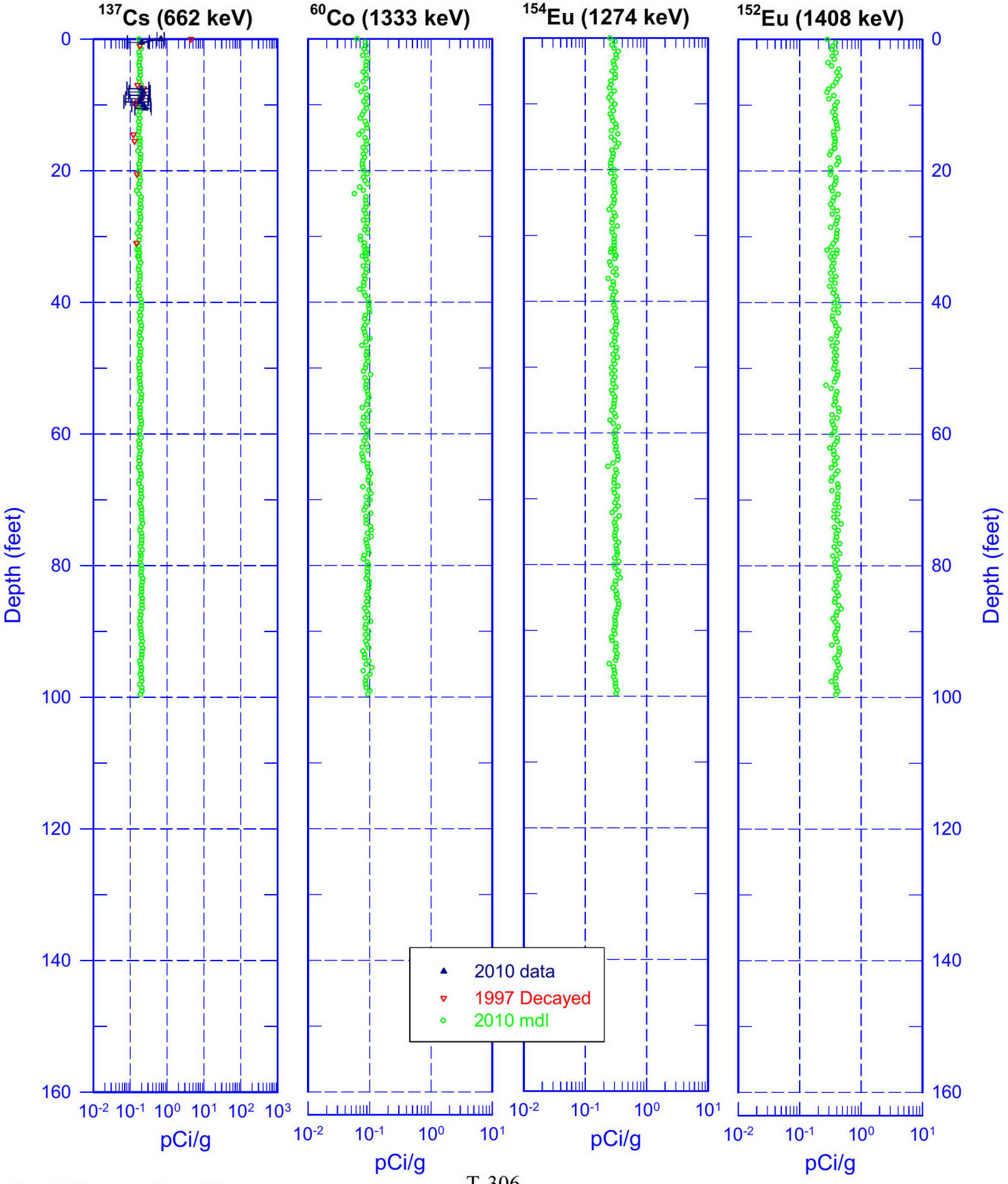
U.S. Department of Energy (DOE). 1998. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-112.* GJ-HAN-94. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-12-09 Location in C Tank Farm



30-12-09 (299-E27-109 [A6734])

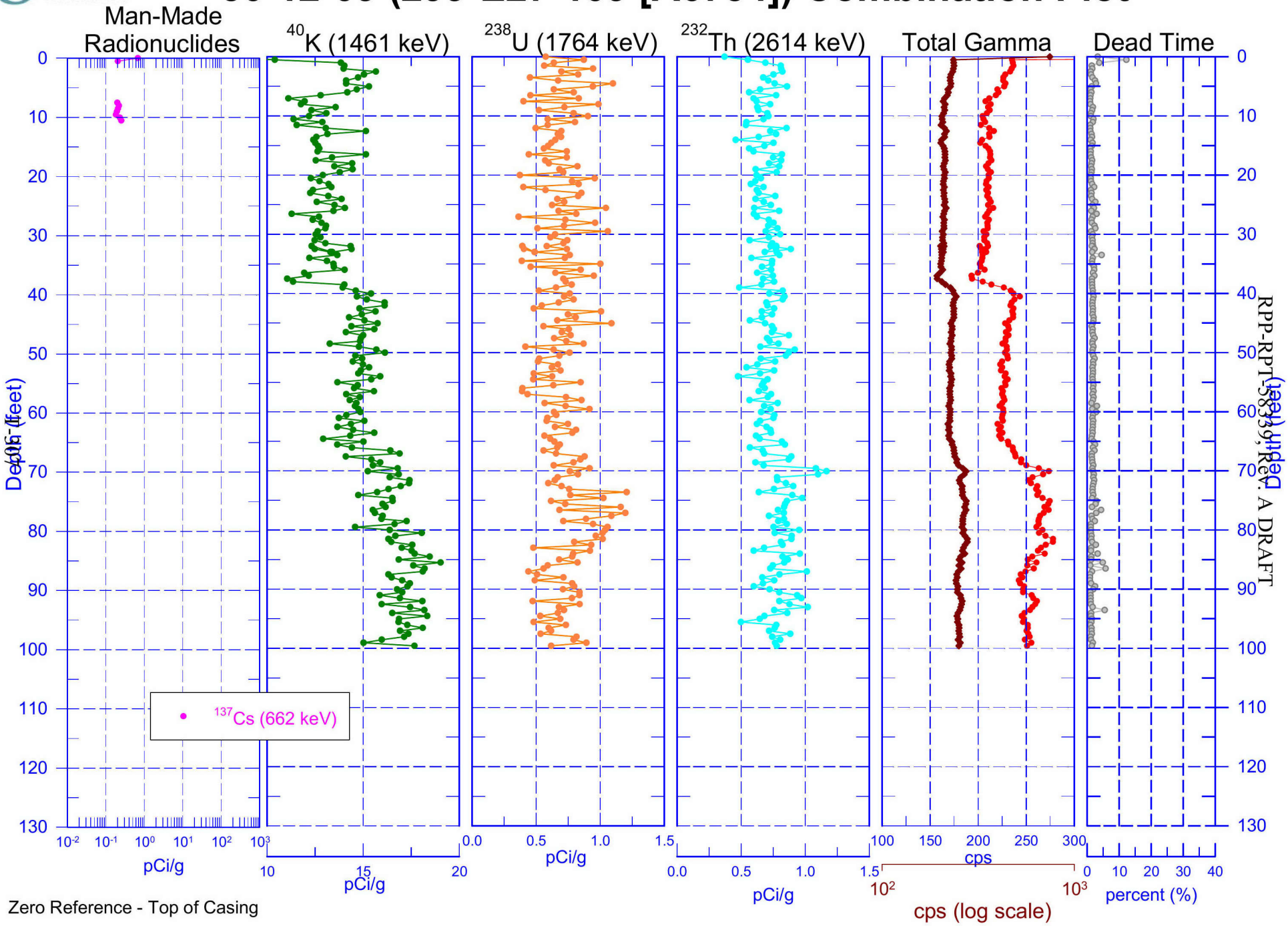
Comparison of Manmade Radionuclides (2010 & 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-12-09 (299-E27-109 [A6734]) Combination Plot

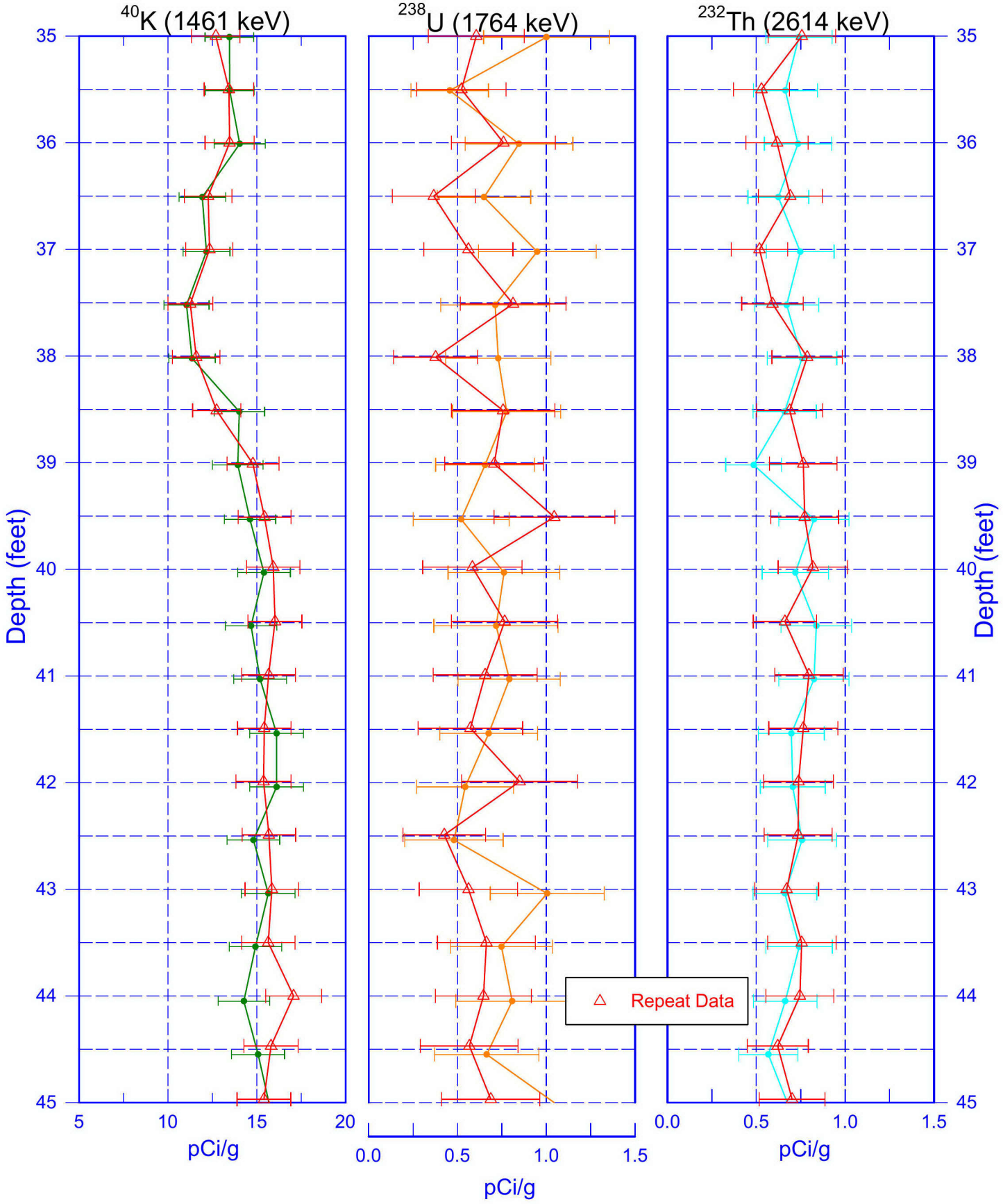


RPP-RPT-58339, Rev. A DRAFT (uncontrolled)

Stoller Hanford Office

30-12-09 (299-E27-109 [A6734])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS FOR 299-E27-125 (A6745)

2010-2011 C-Farm Re-Baseline

30-12-13
299-E27-125 (A6745)
Log Data Report

Borehole Information:

Log Date:	2010-07-20	Filename:	A6745_HG_2010-07-20	Site:	241-C-112
Coordinates (WA St Plane)		GWL[1] (ft):	None	GWL Date:	7/8/10
North (m)	East (m)	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
N/A	N/A	4/1978	N/A	120	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
		Outer	Inside			
Welded Steel	0.0	Unknown	6	0.280	0.0	120

Borehole Notes:

The purpose of this logging event is to update the 1997 to 1998 baseline data to reflect the subsurface distribution of gamma-emitting radionuclides in support of C Tank Farm RCRA[3] field investigation. The depth interval logged in 2010 was from 0 to 114.5 ft just above the water level inside the borehole casing. Other water levels observed during past logging events are included below. The location of the borehole is indicated in the figure labeled "Borehole 30-12-13 Location in C Tank Farm."

Date	Depth to Borehole Water (ft)
2/25/97	117.8
12/5/99	117.2
9/1/02	Dry
7/15/03	115.8
7/8/10	114.5
12/28/10	Approx. 114.5

A re-baseline of selected boreholes in C Farm was conducted in 2010 and 2011 for comparison with the initial baseline acquired in 1997. This report includes SGLS[4] data acquired in 1997 and 2010; and HRLS[5] acquired in 1999. A summary of other logging data acquired since 1994 is included in the figure labeled "Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet."

[1] ground water level
[2] top of casing
[3] Resource Conservation and Recovery Act
[4] Spectral Gamma Logging System
[5] High Rate Logging System

Borehole information and casing data are as reported in the original log data report contained in the *Tank Summary Data Report for Tank C-112* (DOE 1997). Casing thicknesses are derived from published values for schedule 40 steel pipe.

The zero reference is the TOC, approximately at ground surface.

Logging Equipment Information:

Logging System:	Gamma 2 BR	**Type:**	DHMCA[6] SGLS BR
Effective Calibration Date:	09/03/09	**Serial No.:**	48-TP50478A
Calibration Reference:	HGLP-CC-062, Rev. 0	**Logging Procedure:**	HGLP-MAN-002, Rev. 1

Logging System:	Gamma 1 C	**Type:**	HRLS
Effective Calibration Date:	08/1999	**Serial No.:**	39-A314
Calibration Reference:	GJO-HAN-29	**Logging Procedure:**	MAC-VZCP 1.7.10-1

Logging System:	Handheld Moisture Meter # MI-HP-3	**Type:**	Model # 503DR Campbell Pacific Nuclear Moisture Gauge
Effective Calibration Date:	6/21/10	**Serial No.:**	H-38068291
Calibration Reference:	HGLP-CC-039, Rev. 1	**Logging Procedure:**	USQ #TF-10-1873-D, R-0

SGLS Log Run Information:

Log Run	1	2	3	4	5 Repeat
HEIS Number	1016204	1016205	1016206	1016207	1017866
Date	7/15/10	7/16/10	7/19/10	7/20/10	7/20/10
Logging Engineer	Spatz/Holloway/ Legler	Spatz/Holloway/ Legler	Spatz/Holloway/ Legler	Spatz/Holloway/ Legler	Spatz/Holloway
Start Depth (ft)	0.0	11.0	49.0	94.0	35.0
Finish Depth (ft)	12.0	50.1	95.0	114.5	46.0
Count Time (sec)	100	100	100	100	100
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	0.5	0.5	0.5	0.5	0.5
Log Speed (ft/min)	N/A	N/A	N/A	N/A	N/A
Pre-Verification	1016203_B	1016205_B	1016206_B	1016273_B	1016207_B
Start File	D_000000	D_001100	D_004900	D_009400	D_003500
Finish File	D_001199	D_005011	D_009501	D_011451	D_004604
Post-Verification	1016204_A	1016205_A	1016206_A	1016207_A	1016207_A
Depth Return Error (in.)	0.0	0.0	3 low	N/A	1/2 low
Comments	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made	No fine gain adjustments made

[6] Down-Hole Multi-Channel Analyzer

HRLS Log Run Information:

Log Run	6				
HEIS Number	N/A				
Date	12/15/99				
Logging Engineer	Pearson				
Start Depth (ft)	12.0				
Finish Depth (ft)	8.0				
Count Time (sec)	300				
Live/Real	L				
Shield (Y/N)	N				
MSA Interval (ft)	0.5				
Log Speed (ft/min)	N/A				
Pre-Verification	6CDB1CAB				
Start File	6CDB1000				
Finish File	6CDB1008				
Post-Verification	6CDB1CAA				
Depth Return Error (in.)	N/A				
Comments	N/A				

Logging Operation Notes:

Data were collected using Gamma 2, HO 68B-3572. Pre- and post-survey verification measurements were acquired in the KUTh-082 field verifier. A centralizer was installed on the sonde.

File names were shortened on the table above for the 2010 SGLS log runs due to the length of file names (e.g., RUN01_BR_1016204_D_000193).

Analysis Notes:

Analyst:	C. Nelson	Date:	7/6/11	Reference:	HGLP-MAN-003, Rev. 0

Pre- and post-survey verification measurements met the acceptance criteria for the established systems.

A casing correction for 0.280-in. thick casing was applied during analysis.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated in an EXCEL template identified as 20090903_BRr0, using an efficiency function and corrections for casing and dead time as determined by annual calibrations.

During routine processing of gamma spectra, regions of interest are forced at specific energy levels associated with natural and manmade radionuclides that can be anticipated to be present. This processing approach sometimes results in an isolated "detection" near the MDL[7] resulting in a false positive. Where these detections occur, the individual spectrum is scrutinized and a determination is made regarding the validity of the detection. If the detection is deemed not representative of a full energy peak, or if confirming peaks are not detected, it is removed from the data set. The integrity of the raw data files and the processed files are maintained should questions arise in the future regarding these determinations.

[7] minimum detectable level

Since the original baseline data were acquired in the 1990s, an improved detection system has been deployed in Tank Farms as of summer 2010. Detector efficiency is increased and spectral energy peaks used for assay are better defined with improved resolution. These improvements can result in occasional additional detections of manmade radionuclides at concentrations near the MDL that were not evident in the baseline data. These additional detections are therefore not necessarily evidence of contaminant migration.

To assure comparability, the same casing correction used for the 2010 data was applied to the original 1997 process files. The efficiency function and dead time corrections in place in 1997 were applied during reprocessing. For purposes of comparison with the 2010 data, the Co-60 and Cs-137 were decayed to a common date of July 20, 2010. In the high dead time zone there are no values reported for the HRLS data in 1999.

SGLS logging is conducted by S.M. Stoller, as is logging with the NMLS[8]. NMLS data are acquired digitally at 0.25-ft intervals with a count time of 15 seconds. Where available, the most recent NMLS data are reported in the re-baseline log data reports. Tank Farm's handheld moisture data are acquired by Tank Farms Operations using a handheld moisture gauge that is lowered by hand and held in place for measurements by cable stops at 1-ft increments, at count times of 16 seconds. These data are manually recorded on data sheets, and submitted to S.M. Stoller for data entry and analysis. Calibration for both systems to assess system performance and determine volumetric moisture is performed by S.M. Stoller using the same procedure. Handheld moisture data are being collected for selected boreholes in C Farm. NMLS data are not available for this borehole. Handheld moisture data were acquired in this borehole on December 28, 2010 using moisture gauge M1-HP-3 and AmBe source H-38068291. Results are included in this report.

Data files are missing for the top two feet of the borehole due to unknown problems in the field during acquisition or data transfer.

Results and Interpretations:

The "Comparison of Manmade Radionuclides" plot includes the contaminants Cs-137, Co-60, Eu-154, and Eu-152, which are often detected in C Farm. When one or more of these contaminants are not found, MDLs for the radionuclide are still plotted. There are no data in 2010 to compare to detections in 1997 below 114.5 ft. Logging depth achieved in 2010 was restricted to 114.5 ft in accordance with current radiation control protocol, which precludes logging into water in Tank Farms.

A zone of greater than 40% dead time was encountered in 1997 from 9.0 to 10.0 ft. HRLS spectra acquired in 1999 indicate no specific radionuclide. 2010 spectra indicated Cs-137 concentrations that are too low for the measured dead time. It is likely there is a remote source of Cs-137, such as from a pipeline, resulting in low Cs-137 concentrations and elevated low-energy Compton backscatter that contributed to the high dead time. The driller's log (9-24-78) discusses hitting a "water line" at approximately 11 ft in depth.

Cs-137 was detected almost continuously from ground surface to 34 ft and from 44 to 46 ft. A maximum concentration of approximately 6.1 pCi/g was measured at 10 ft. Comparisons with the 1997 data indicate no significant change.

Co-60 was detected continuously from 34.5 to 37 ft and at 45 ft in 2010. A maximum concentration of approximately 0.2 pCi/g was measured at 36.5 ft. Comparisons with the 1997 data indicate no significant change.

Eu-154 was detected at 36 to 36.5 ft with an approximate concentration of 0.6 pCi/g. Comparisons with the 1997 data indicate no significant change.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content may increase in sediments of relatively high silt or clay content. Moisture logging was conducted using the Handheld Moisture Gauge, from the interval of ground surface to 118.5 ft. The Moisture data were acquired below water level for approximately 4 ft from 114.5 to 118.5 ft as the sonde was raised from the bottom of the borehole. No useful data were acquired in the

[8] Neutron Moisture Logging System

water and are not reported. Residual moisture that may be retained on the sonde as it is moved up the borehole may cause an over estimation of volumetric moisture. Elevated moisture from 0 to 16 ft may reflect grout as reported to exist in the well construction report from 1978.

List of Log Plots:

Depth Reference is top of casing

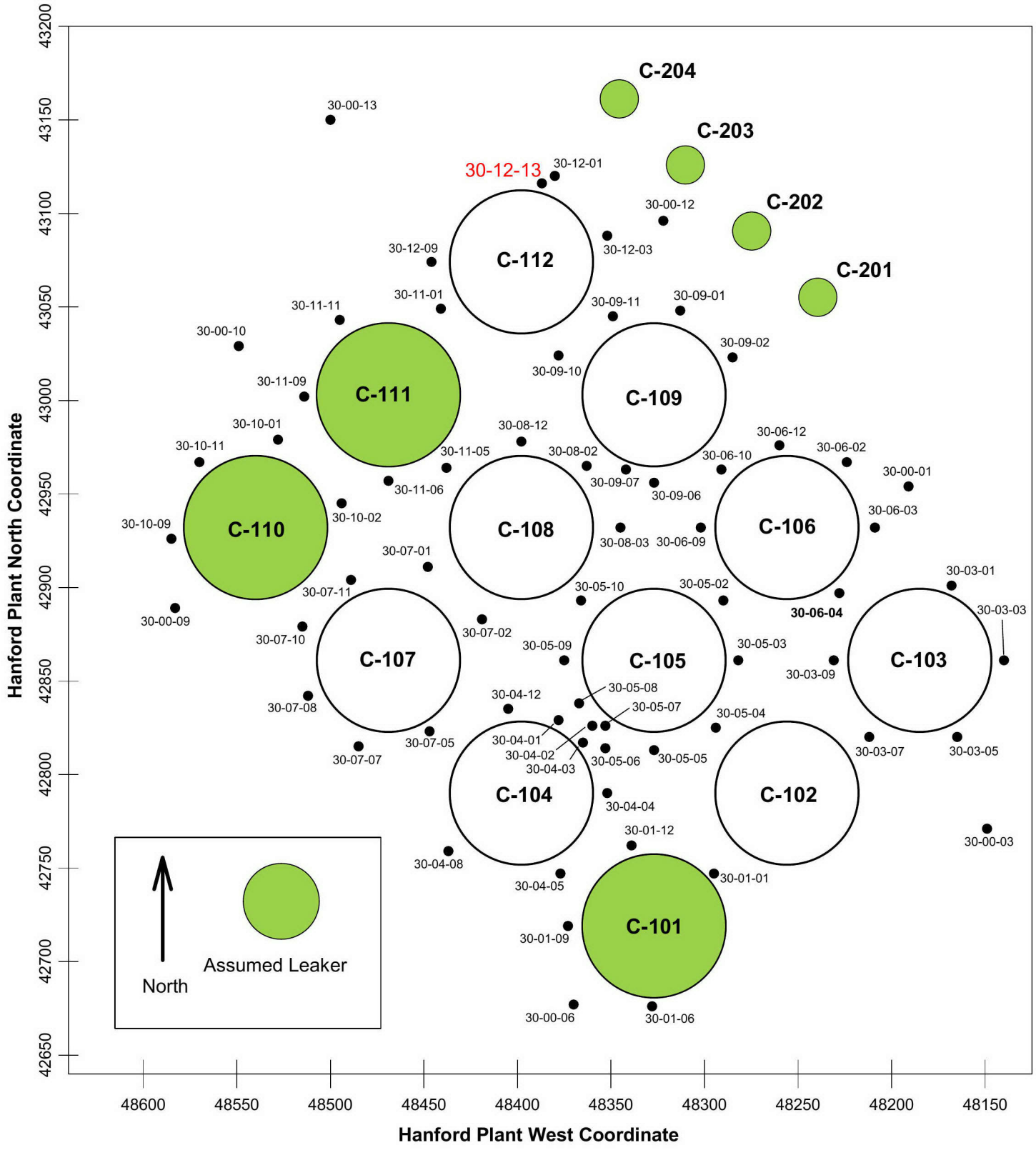
Borehole 30-12-13 Location in C Tank Farm
Hanford Single Shell Tank Farms Borehole Geophysics Summary Sheet
Combination Plot
Comparison of Manmade Radionuclides (2010 and 1997)
Repeat Section of Manmade Radionuclides
Repeat Section of Natural Gamma Logs

References:

U.S. Department of Energy (DOE). 1997. *Hanford Tank Farms Vadose Zone, Tank Summary Data Report for Tank C-112.* GJ-HAN-94. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

U.S. Department of Energy (DOE). 2000. *Hanford Tank Farms Vadose Zone, Addendum to the C Tank Farm Report.* GJO-HAN-18. Prepared by MACTEC-ERS for the Grand Junction Office. Grand Junction, Colorado.

Borehole 30-12-13 Location in C Tank Farm



Stoller Hanford Office

Hanford Single Shell Tank Farms
Borehole Geophysics Summary Sheet

Borehole Number (Alias): 30-12-13 (299-E27-125) (A6745)

Borehole Information

Site: C Farm, Tank C-112			
Coordinates (HAN Plant):	**North: 43116**	**West: 48387**	**Elevation (ft): 644.70**
Coordinates (WA Plane):	**North: 136624.712**	**East: 575142.341**	**Elevation (m): 197.704**
Drill Date: 04/1978	**Type: Cable Tool**	**Depth (ft): 120.5**	**Depth Datum: TOC**
Depth/Water (ft): 117.80	**D/W Date: 2/25/97**	**D/W Reference: Stoller**	
Comments: SGLS: Spectral Gamma Logging System, HRLS: High Rate Logging System, RAS: Radionuclide Assessment System			

Casing Information

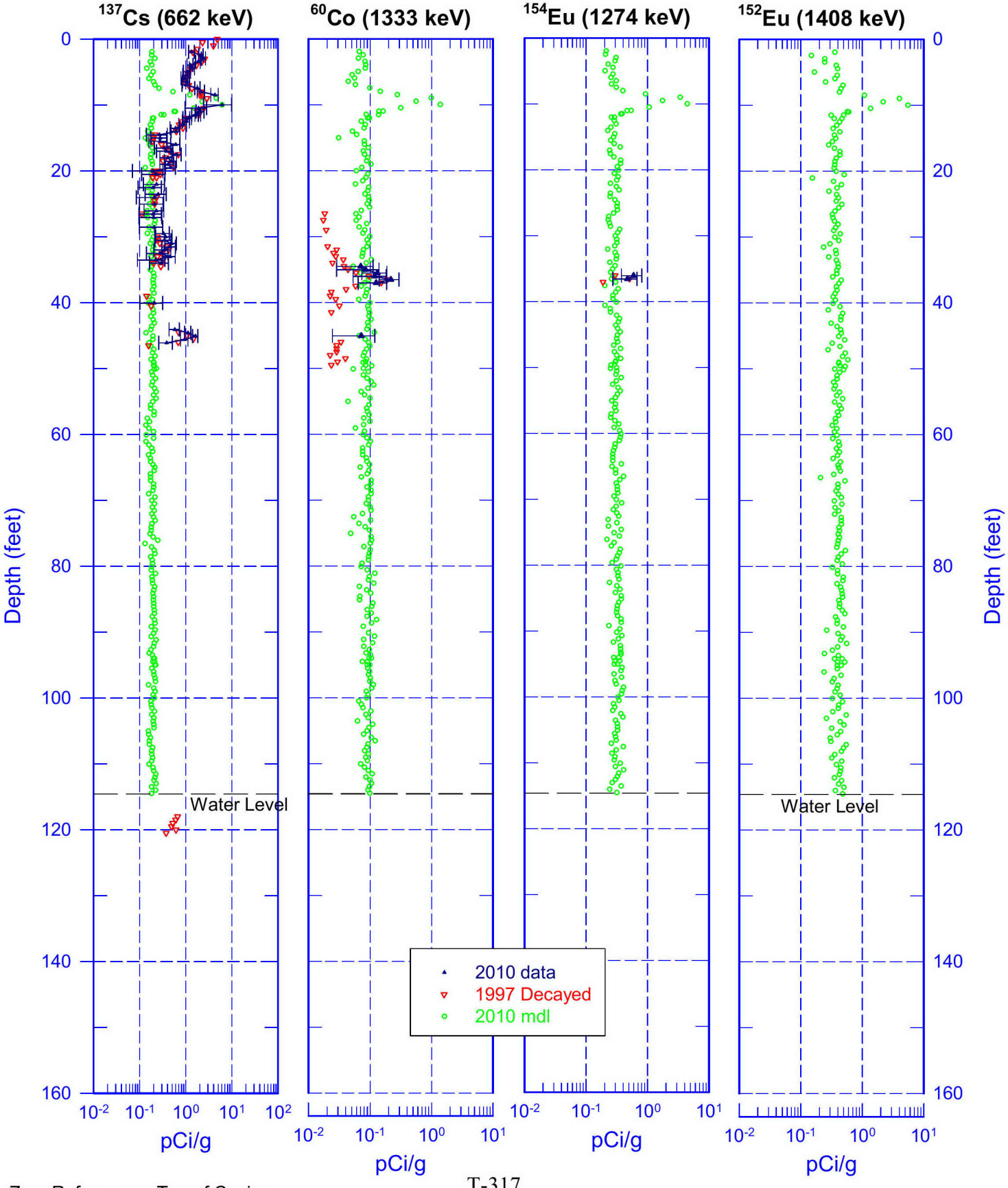
Type	Top(ft)	Bottom (ft)	ID (in)	Thick. (in)	Stickup (ft)	Reference
Steel	0	120	6	0.28	0	Stoller

Log Run Information

Log Date	System	Detector	Event	Log int. (ft)	Contractor	Comments
2/25/1997	SGLS	G1B	1	0-120.5	MACTEC-ERS	Baseline
12/15/1999	HRLS	Highrate	NA	12-Aug	MACTEC-ERS	Baseline-Highrate
9/10/2002	RAS	Large	A	25-70	Stoller	No Apparent Change
7/31/2003	RAS	Large-New	B	25-70	Stoller	No Apparent Change
7/20/2010	SGLS	G2BR	2	0-114.5	Stoller	No Apparent Change

30-12-13 (299-E27-125 [A6745])

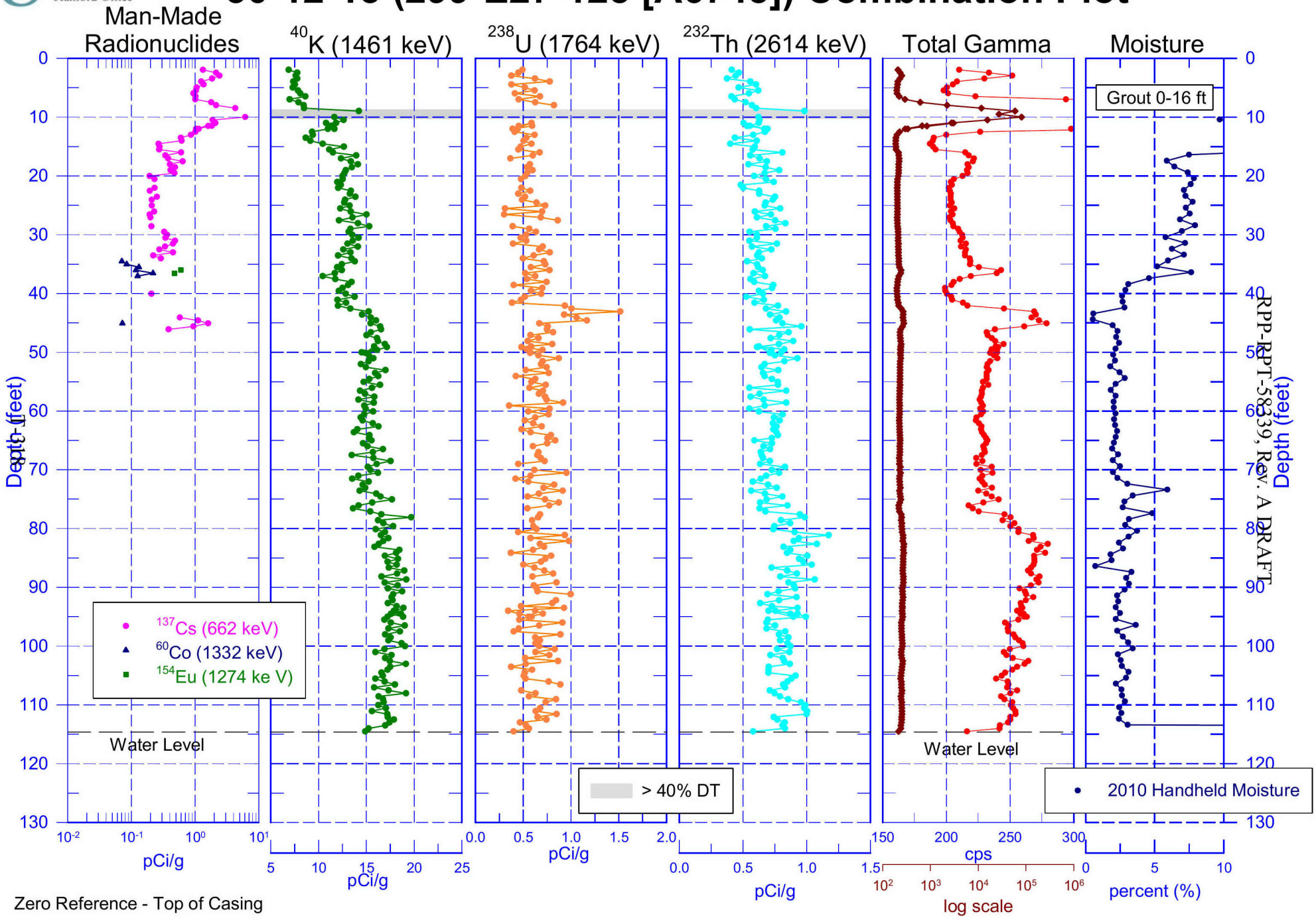
Comparison of Manmade Radionuclides (2010 & 1997)



Zero Reference = Top of Casing

Stoller
Hanford Office

30-12-13 (299-E27-125 [A6745]) Combination Plot

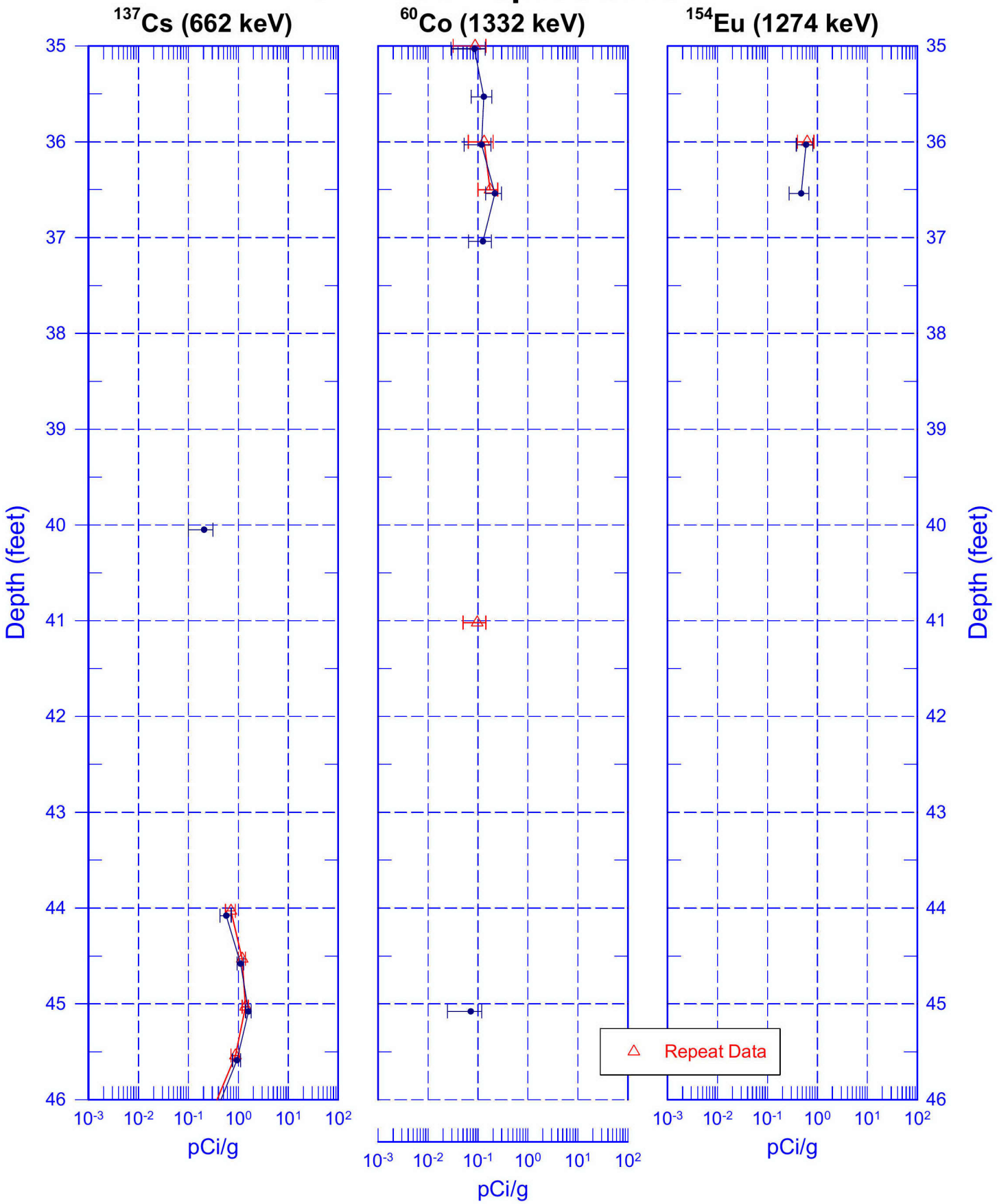


RPP-RPT-58339, Rev. A DRAFT

Stoller Hanford Office

30-12-13 (299-E27-125 [A6745])

Manmade Repeat Section

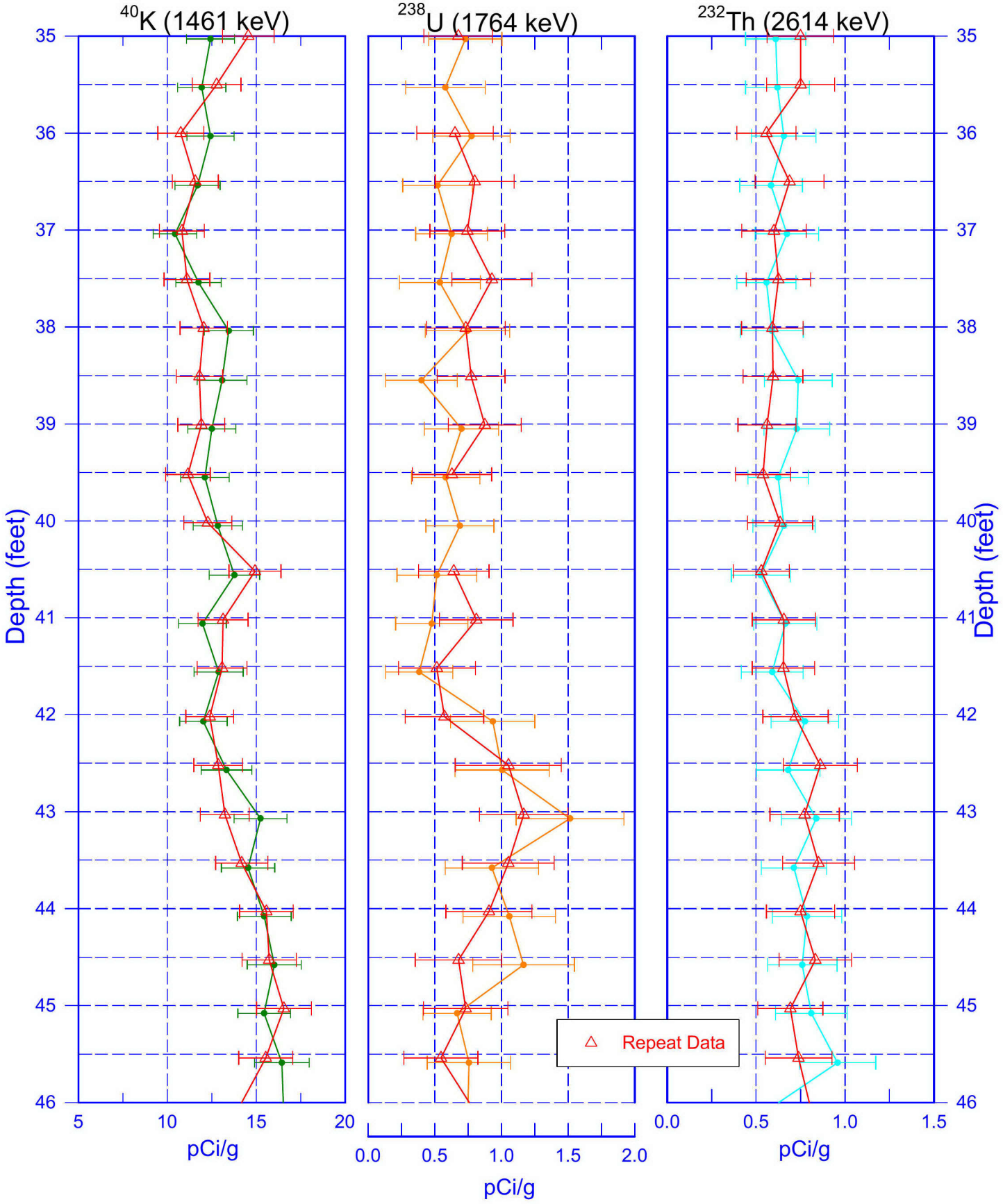


Zero Reference - Top of Casing

Stoller Hanford Office

30-12-13 (299-E27-125 [A6745])

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

DRYWELL LOGGING RESULTS

FROM

RPP-RPT-56085, Rev. 0, COMPLETION REPORT FOR
HANFORD TANK FARMS VADOSE ZONE MONITORING PROJECT

HANFORD GEOPHYSICAL LOGGING PROJECT

HANFORD TANK FARMS VADOSE ZONE MONITORING PROJECT

HGLP-MBL-012, Rev. 0

241-C-104 TANK WASTE RETRIEVAL PROJECT
FINAL REPORT OF DRYWELL MONITORING DATA

October 2013

Prepared for
Washington River Protection Solutions, LLC
Richland, Washington

Prepared by
S.M. Stoller Corporation
Richland Office
Richland, Washington

Stoller
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1.0 INTRODUCTION

241-C-104 is an underground radioactive waste storage tank located in the 241-C Tank Farm in the 200 East Area of the Hanford Site. This tank is a 75 ft - diameter underground domed concrete structure, with a carbon steel liner on the sides and bottom. The base of the tank is approximately 38 ft below ground surface, with about 6 ft of backfill covering the dome. Nominal capacity of the tank is 530,000 gallons. Waste retrieval for this tank began on January 8, 2010 and concluded on August 17, 2012 with the removal of all but a relatively small amount (~160 ft^3) of tank waste.

The Leak Detection and Monitoring (LDM) plan for C-104 is described in the Tank Waste Retrieval Work Plan (TWRWP) (RPP-22393). Early revisions of the TWRWP called for:

- Pre-retrieval baseline moisture and gamma logs in 8 drywells around the tank: 30-04-01, 30-04-02, 30-04-03, 30-05-06, 30-04-04, 30-04-05, 30-04-08, and 30-04-12 (Figure 1-1)
- Weekly moisture (or gamma) measurements over selected depth intervals in the eight drywells during active retrieval operations, or every six week moisture (or gamma) measurements during inactive retrieval operations
- A final round of total depth gamma and moisture measurements in the eight drywells after completion of retrieval activities.

More recent versions of the TWRWP adopt high-resolution resistivity (HRR) as the primary ex-tank leak detection method, using drywell logging as a back-up monitoring option when the HRR system is not running. Note that HRR results are not discussed in this report. In addition, post-retrieval neutron moisture measurements are no longer required under the current revision of the TWRWP, given that gamma logging is always required in the event of anomalous moisture readings. Ergo, only total depth gamma measurements are required after completion of retrieval according to the TWRWP.

All retrieval related routine gamma monitoring in drywells with the radionuclide assessment system (RAS) and handheld neutron-moisture (HHNM) measurements are performed by Tank Farms personnel with technical support and data interpretation provided by the S.M. Stoller Corporation (Stoller). When needed, logging with the neutron moisture logging system (NMLS) and high-resolution spectral gamma logging system (SGLS) is performed by Stoller personnel. All of these logging systems are calibrated on an annual basis, or as needed, by Stoller.

During August to November 2009, prior to the start of retrieval operations, these drywells were monitored for gamma activity using the RAS to establish a pre-retrieval baseline gamma profile against which to compare gamma data acquired during or after retrieval. An increase in gamma activity could be an indication of tank leakage related to retrieval activities. HHNM data acquired with a Campbell Pacific Nuclear 503DR Hydroprobe were also collected in March 2009 to establish a pre-retrieval baseline moisture profile. A significant increase in moisture content below the level of tank waste might be an indicator of leakage associated with tank retrieval operations.

Selected depth intervals (typically about 28 to 53 ft below ground surface) in the eight drywells in the vicinity of C-104 were monitored with the handheld moisture gauge at intervals of approximately six weeks from November 2011 to April 2012, and from October 2012 to April 2013. Since April 2013, additional moisture measurements have been made in a few drywells. During other periods, it is presumed that HRR served as primary ex-tank LDM. Moisture increases are determined to be significant when they exceed a statistical threshold here referred to as a 3-sigma criterion. The 3-sigma criterion is calculated as the mean of the data at a given depth, plus an increment equivalent to three times the standard deviation of all measurements at that depth to date. These criteria are refined as data accumulate. A chart presented as Figure 4-1 in the Process Control Plan is used to help determine the action to take in the event of an increase in moisture content above the 3-sigma criterion. This chart is

reproduced as Figure 1-2 in this document. In general, if the increase is at a depth that is below tank waste level, then the moisture measurement is to be repeated as soon as practicable. Following that, if the repeat measurement confirms the moisture increase, then a follow-up gamma log is to be acquired as soon as practicable. Examples of moisture values exceeding the 3-sigma criteria can be observed in the data plots in several of the drywells (Figure 1-3a through 1-10b). When a value exceeds the 3-sigma criterion, there are several reasons why that may occur. First is an actual significant increase in soil moisture content. Second, since data are recorded by hand in the field, there are opportunities for transcription errors. Third, the detector is manually lowered down the hole and held in place at prescribed depths by "cable stops", which can result in depth errors. Depth errors tend to show up as a systematic shift in the moisture profile when compared with earlier data. Should an obvious transcription error or depth error result in moisture values exceeding 3-sigma criteria, the measurements are not repeated. Transcription errors are usually obvious. For example, a typical count rate might be 1400 counts per second (cps) at a specific depth in a drywell. If a new measurement is recorded as 3400 cps at that depth, but measurements at adjacent depths are consistent with typical values, then a transcription error is suspected. Where an increase is not obviously the result of a transcription or depth error, and it meets the criteria in the chart in Figure 1-2, then the measurement will be repeated.

A re-baseline of selected boreholes in C farm was conducted with the SGLS during 2010 and 2011 for comparison with initial baseline data acquired in 1997. Two drywells around C-104 were included in this re-baseline, and data from those drywells are included in this report.

Figure 1-1 shows the position of various drywells around Tank C-104. Drywell logging and monitoring results are summarized in Figure 1-3 through 1-10. Total gamma logs acquired after completion of retrieval operations show no evidence of increases in gamma activity that might indicate a tank leak during retrieval.

FIGURE 1-1 TANK C-104 DRYWELL LOCATIONS

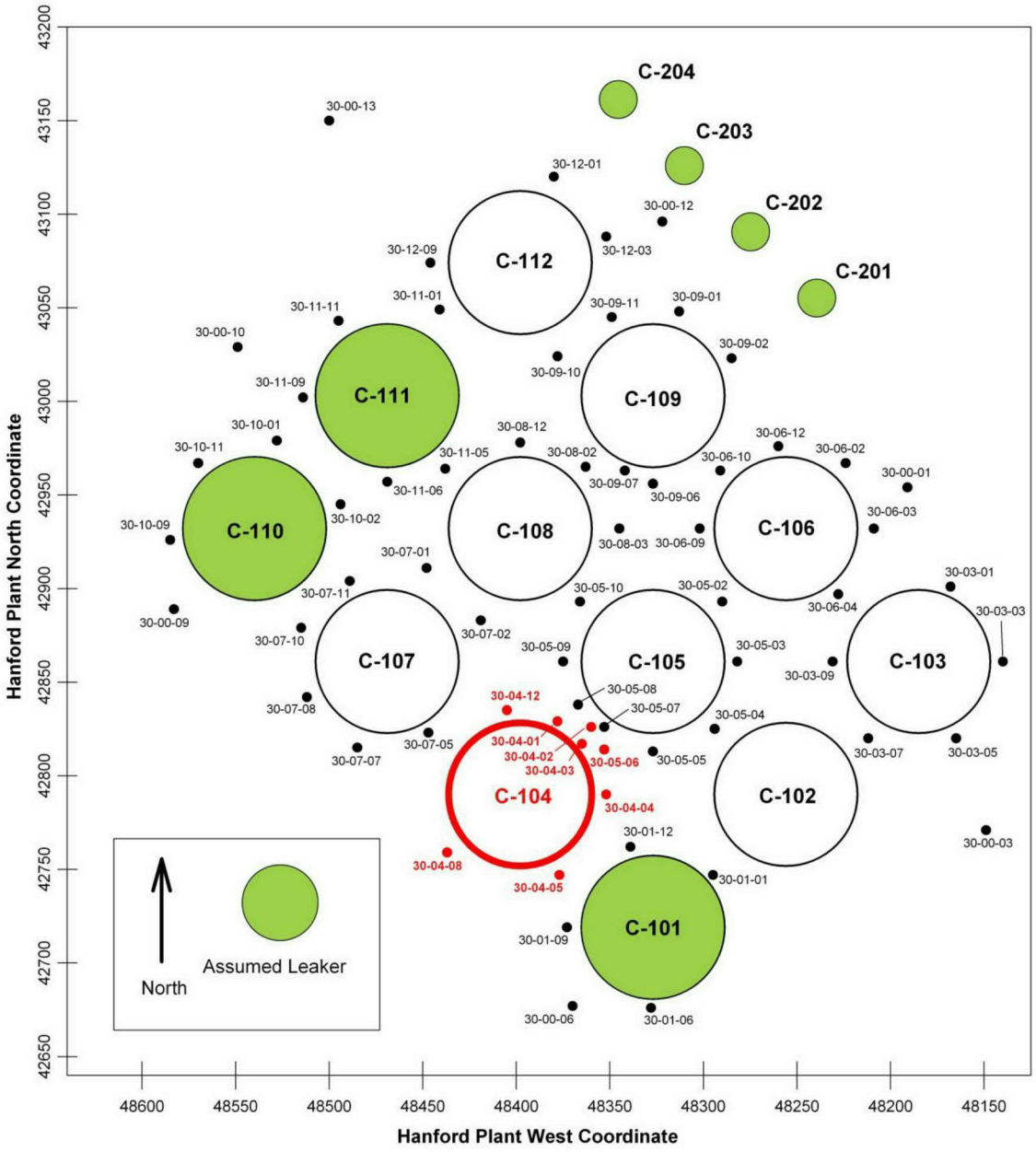


FIGURE 1-2 RPP-PLAN-44944, REV. 2, FIGURE 4-1

RPP-PLAN-44944 Rev. 2

Figure 4-1. Evaluation of Detected Increases in Drywell Measurements

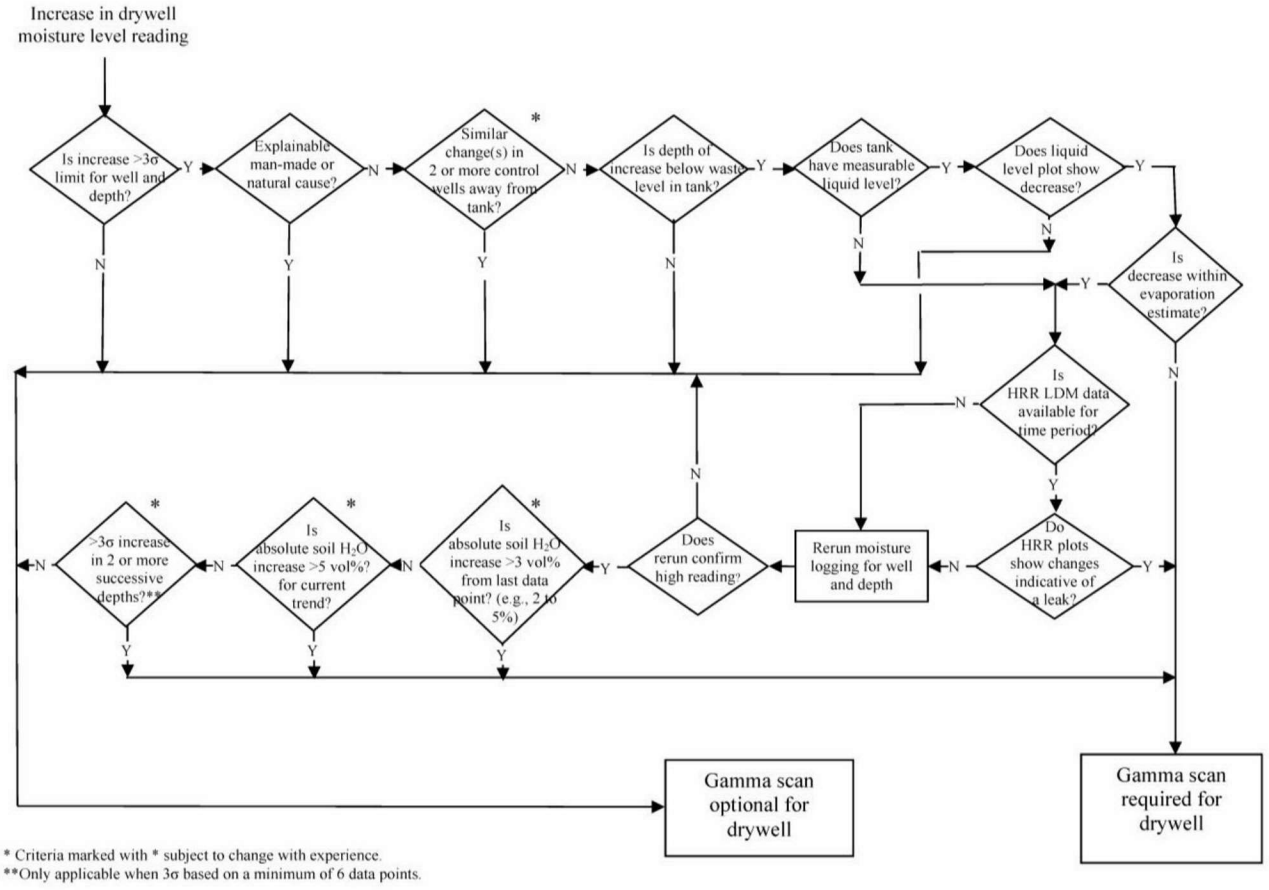


FIGURE 1-3A TANK C-104 BOREHOLE 30-04-01

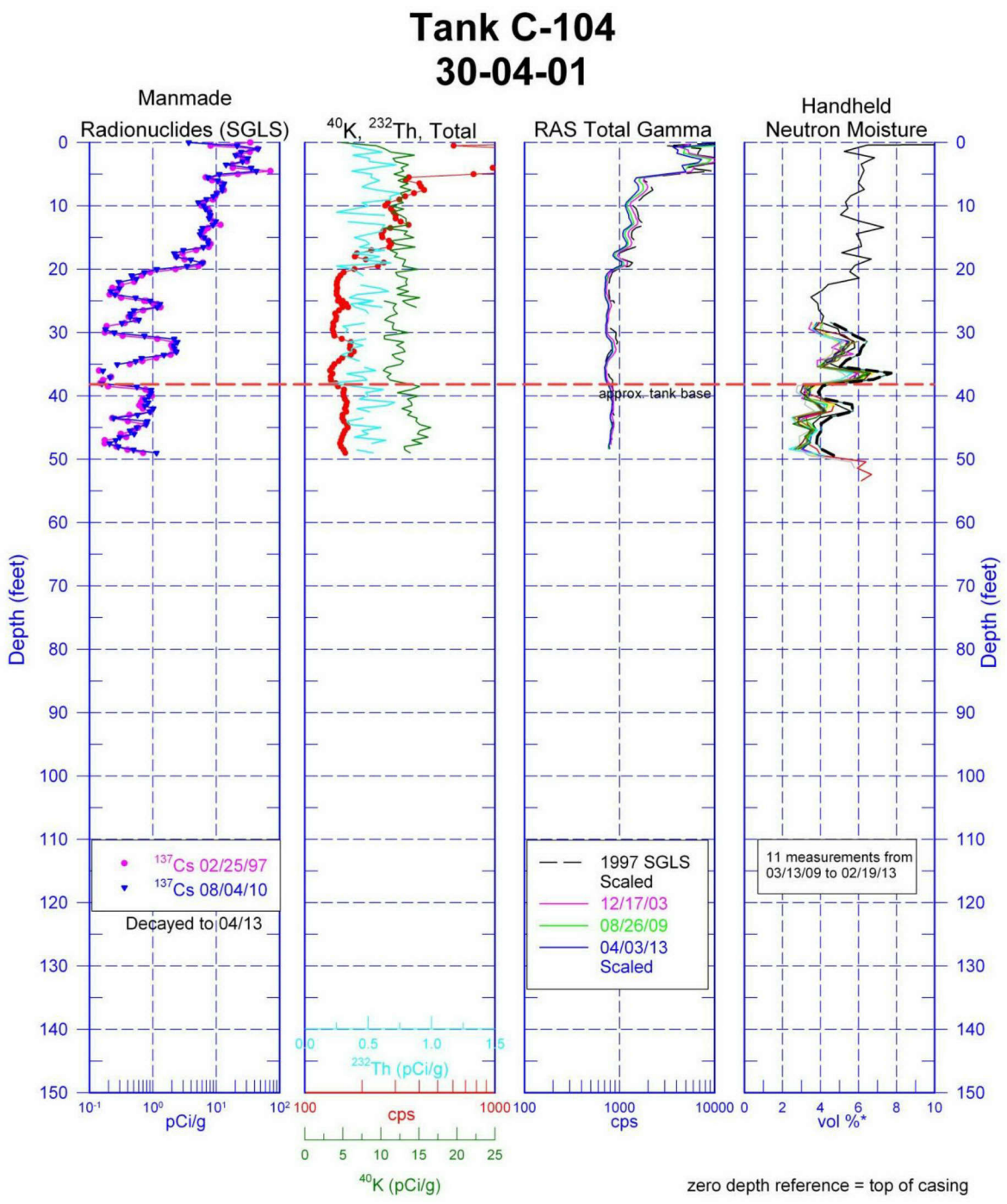


FIGURE 1-3B **30-04-01: RETRIEVAL DATA**

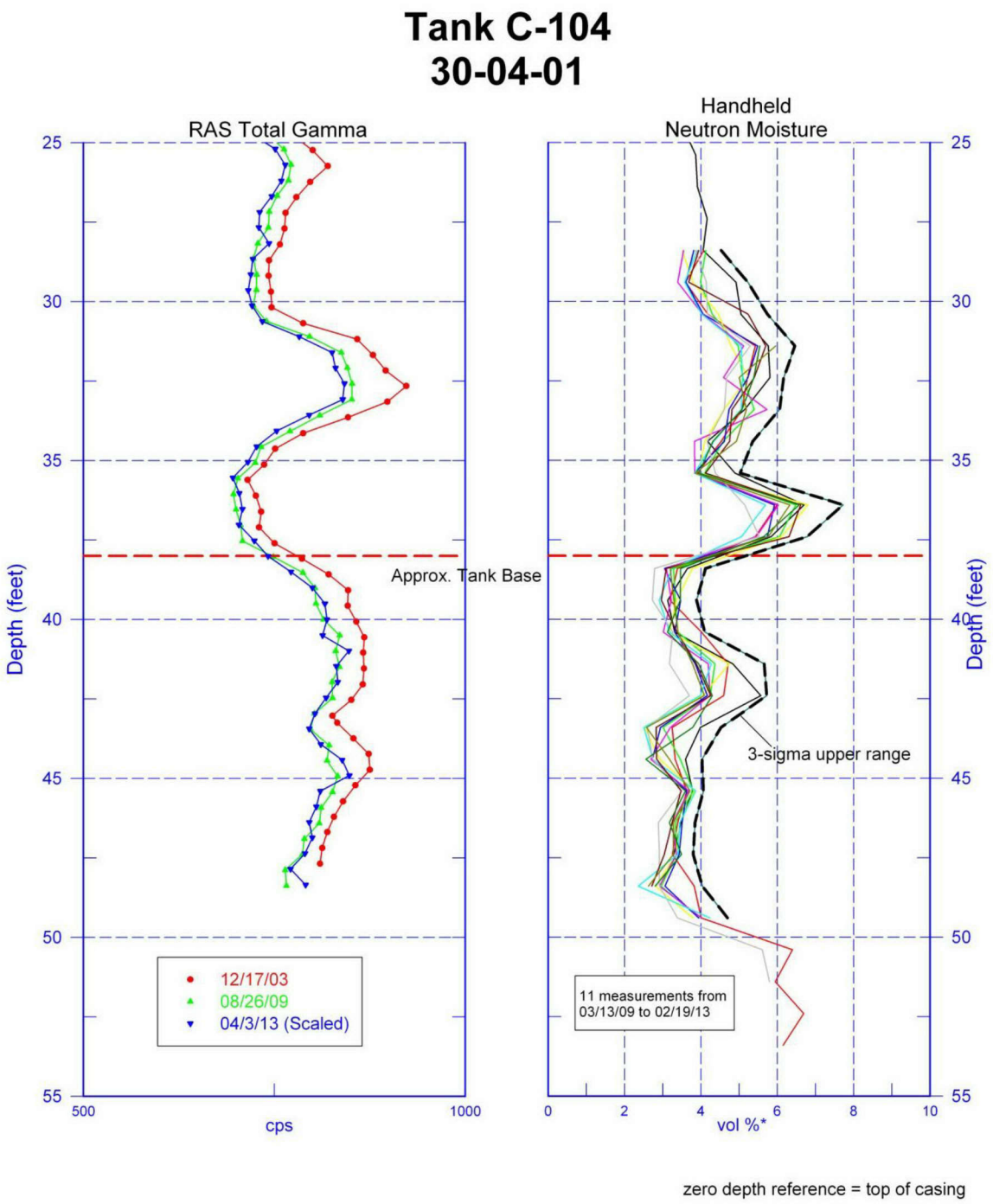


FIGURE 1-4A TANK C-104 BOREHOLE 30-04-02

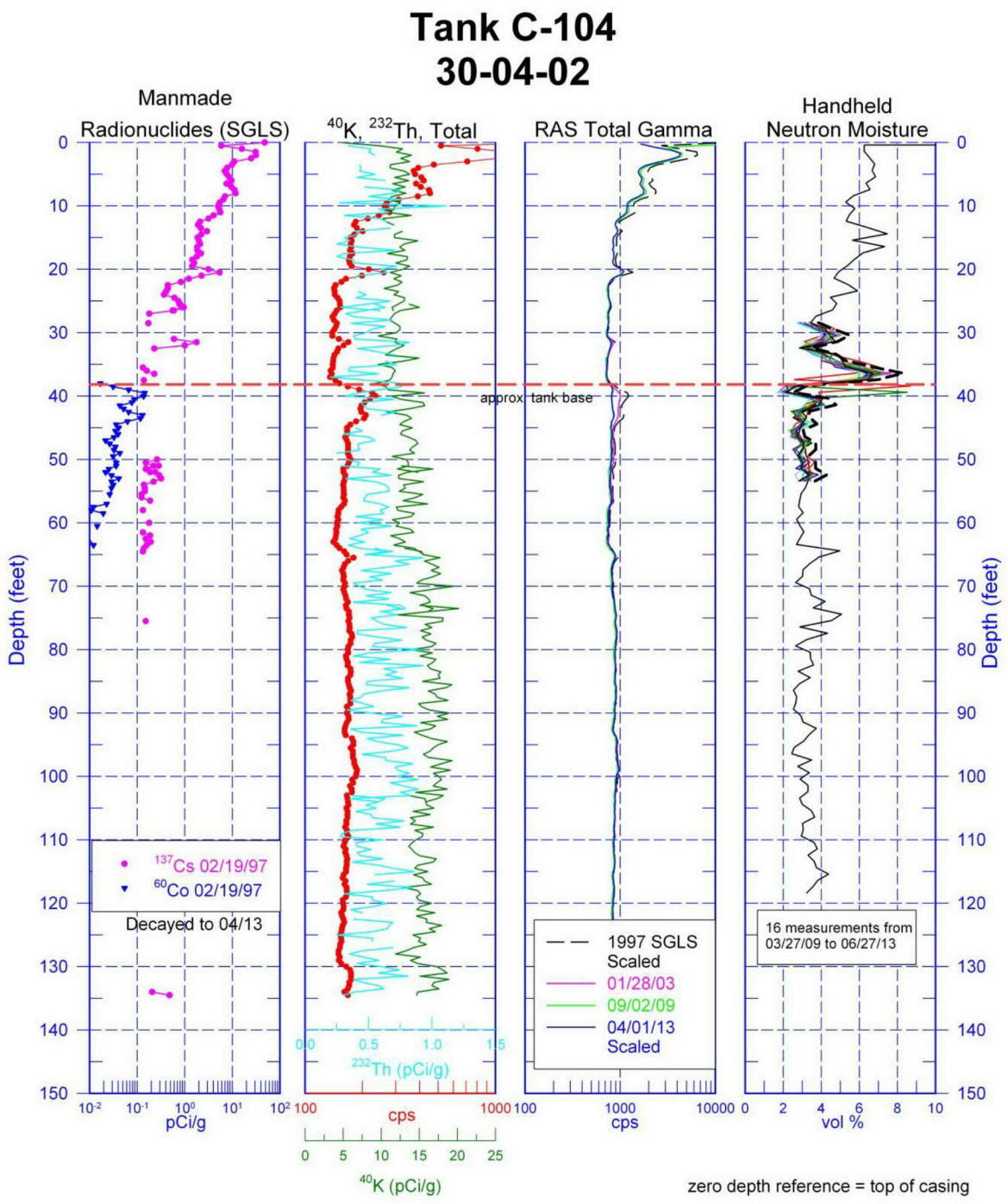


FIGURE 1-4B 30-04-02: RETRIEVAL DATA

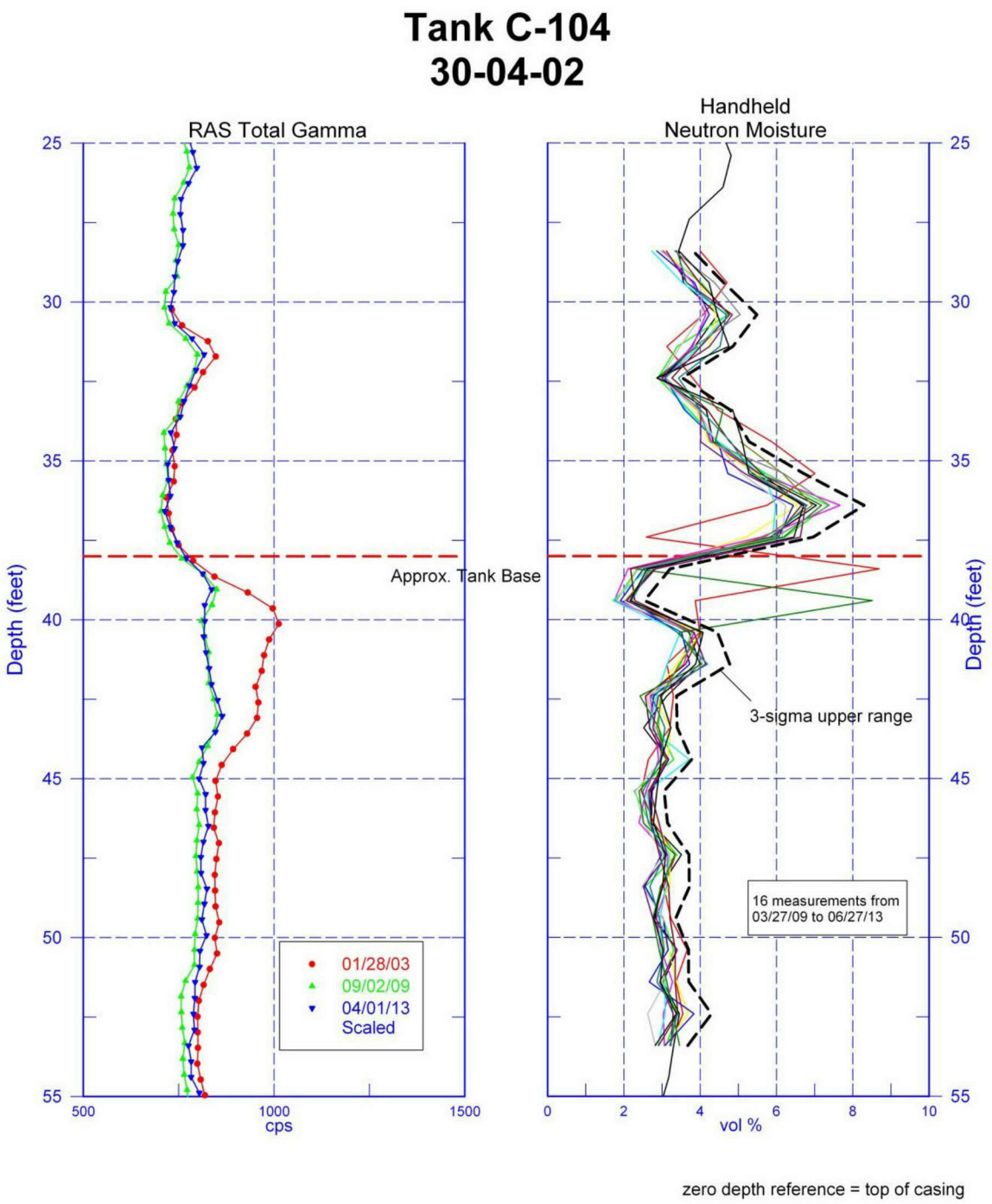


FIGURE 1-5A TANK C-104 BOREHOLE 30-04-03

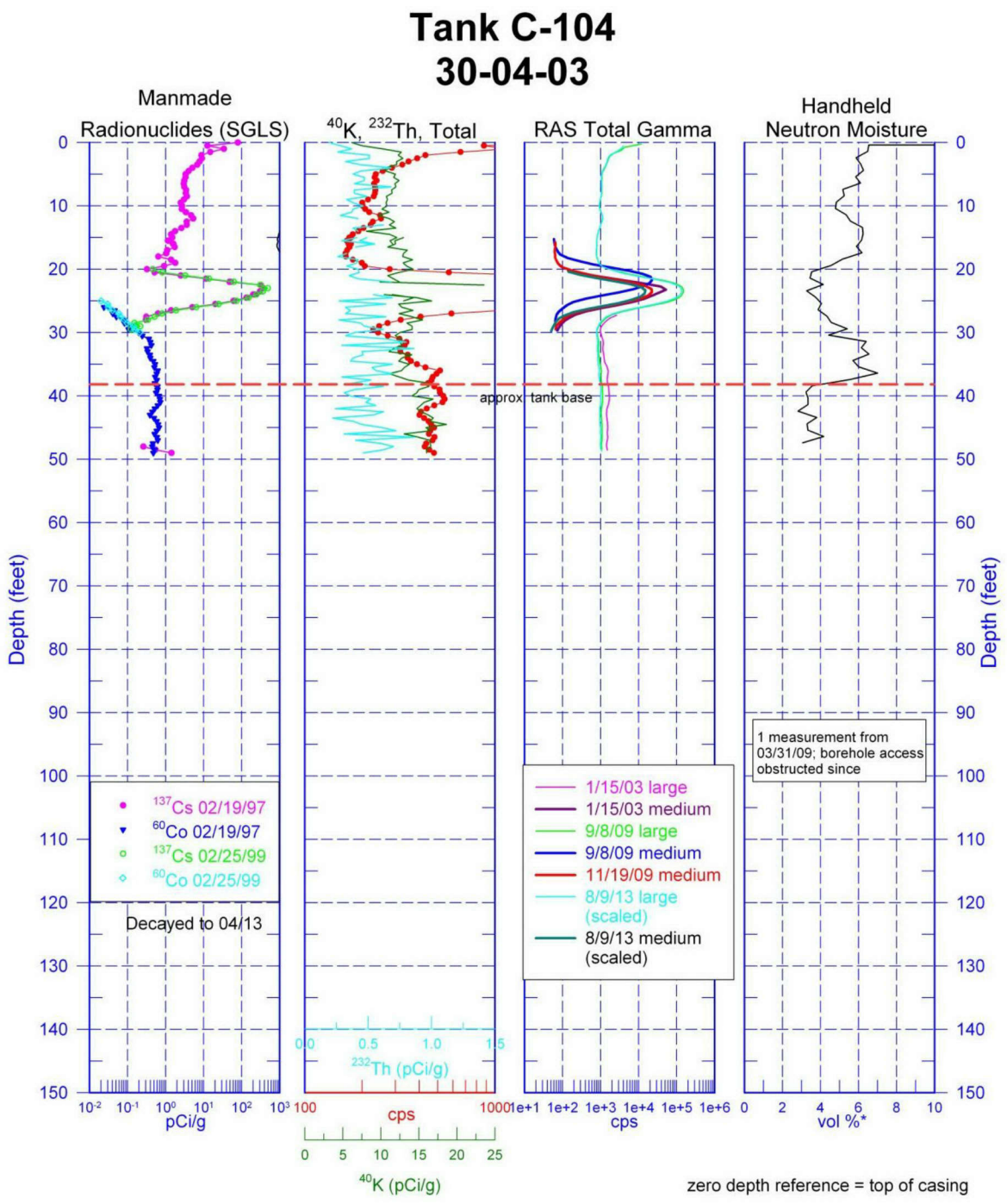


FIGURE 1-5B 30-04-03: RETRIEVAL DATA

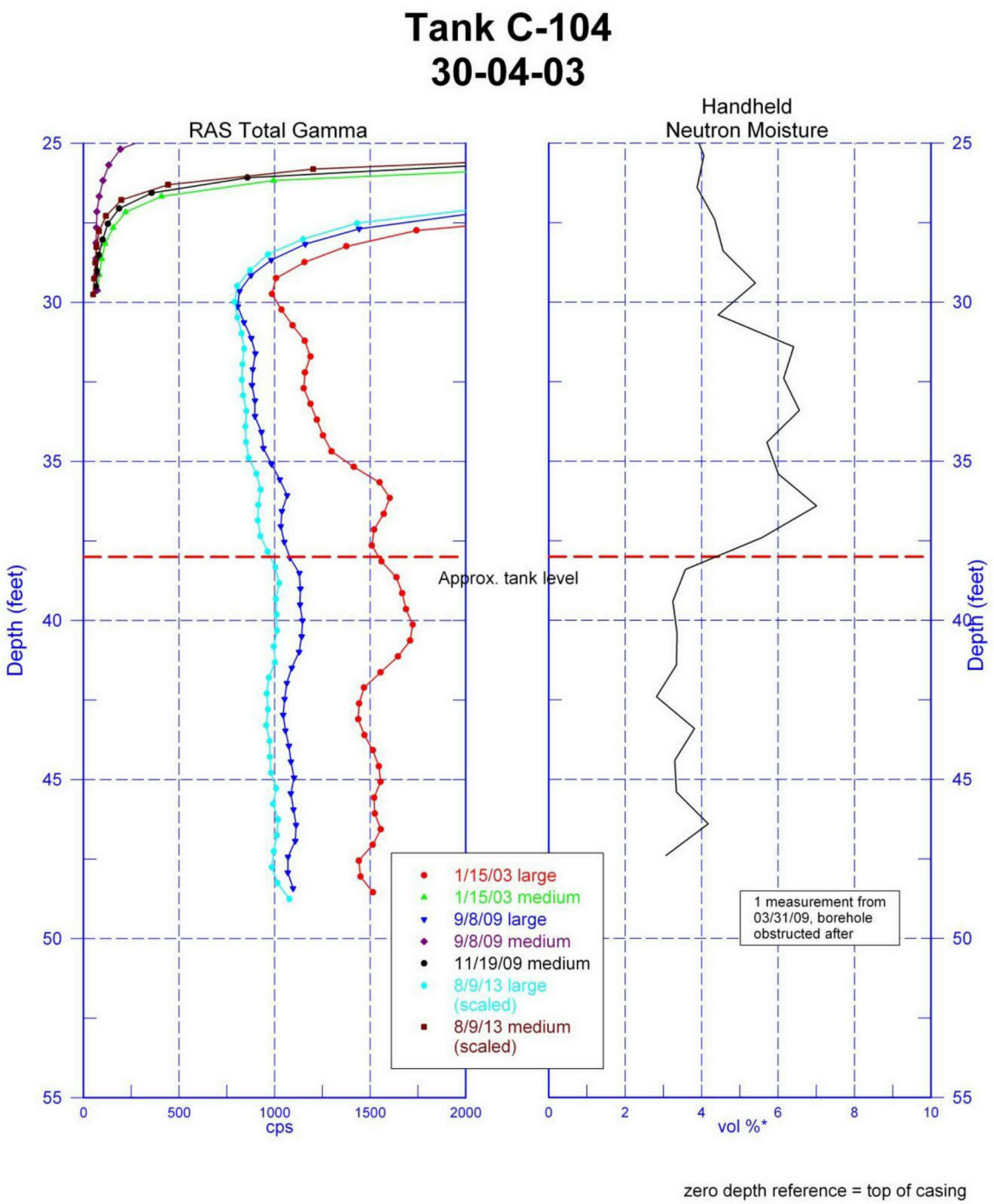


FIGURE 1-6A TANK C-104 BOREHOLE 30-05-06

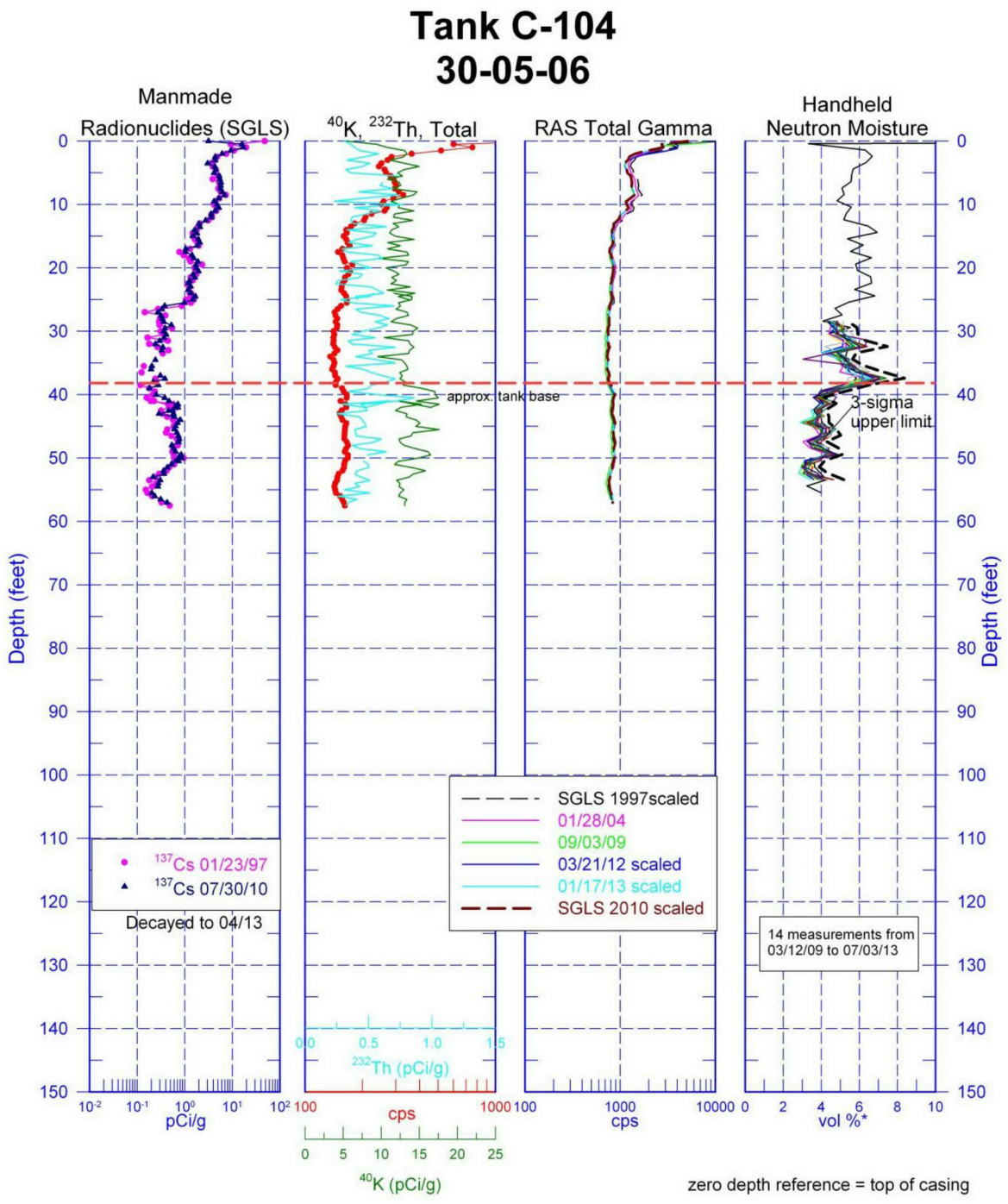


FIGURE 1-6B **30-05-06: RETRIEVAL DATA**

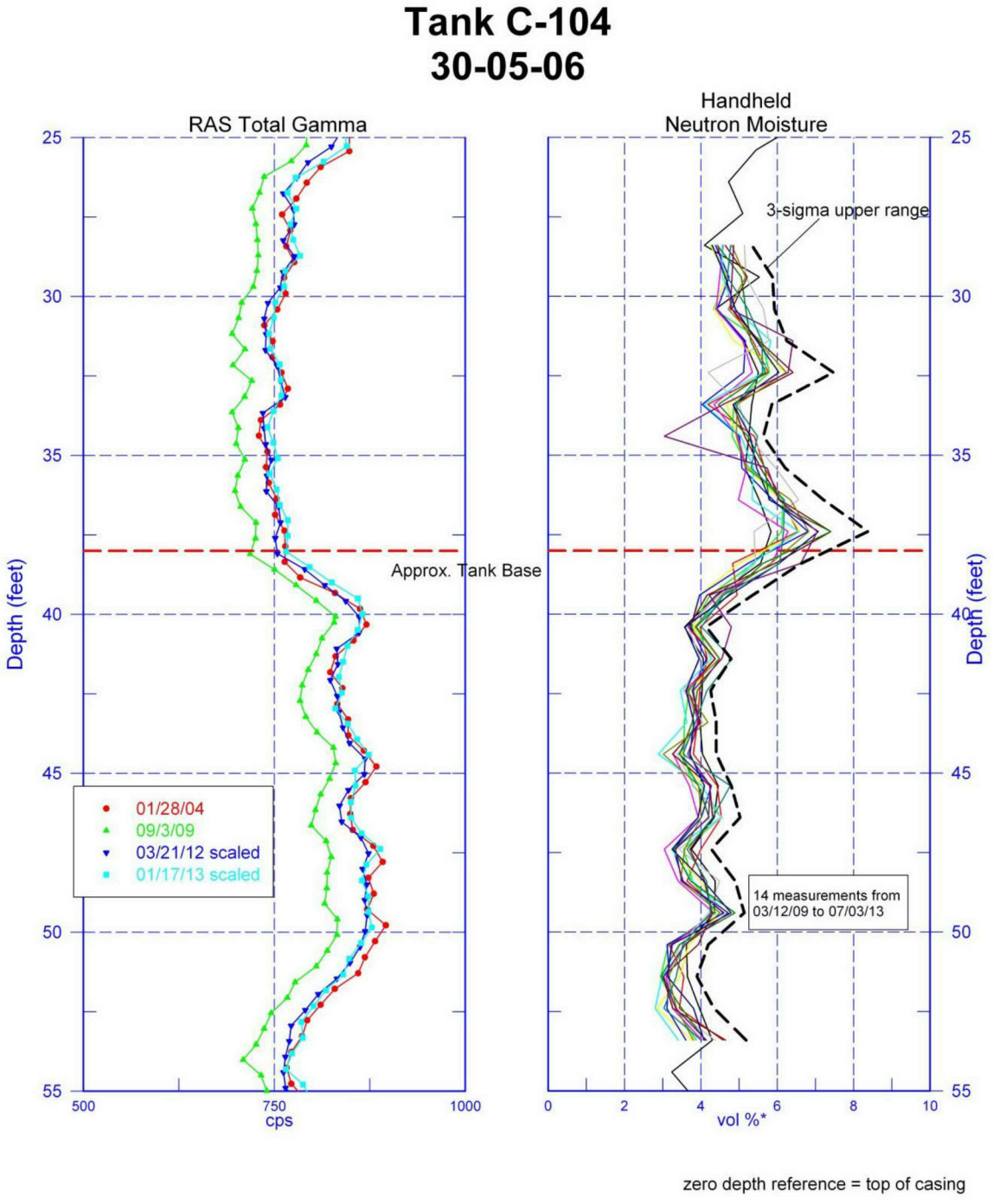


FIGURE 1-7A TANK C-104 BOREHOLE 30-04-04

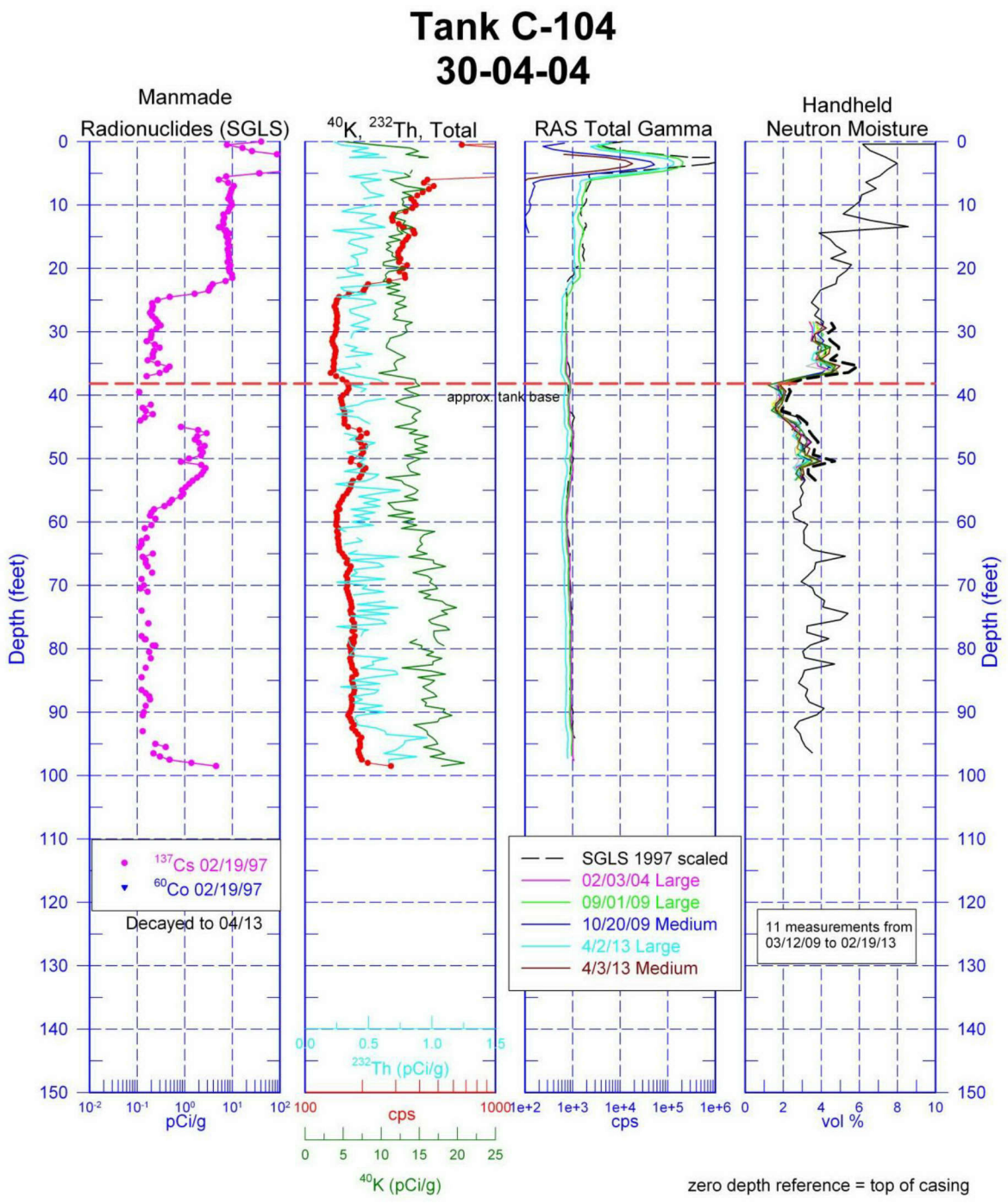


FIGURE 1-7B **30-04-04: RETRIEVAL DATA**

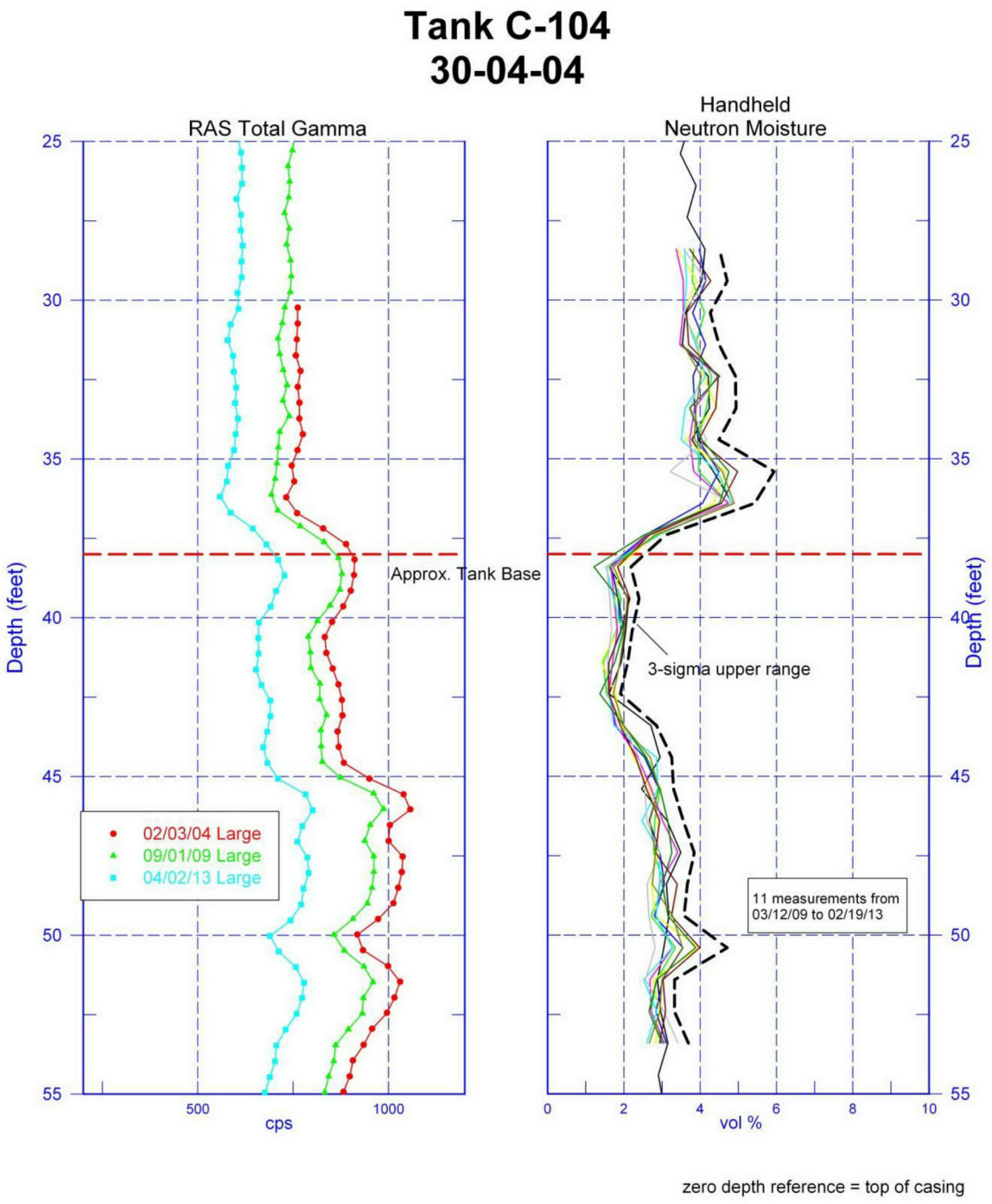


FIGURE 1-8A TANK C-104 BOREHOLE 30-04-05

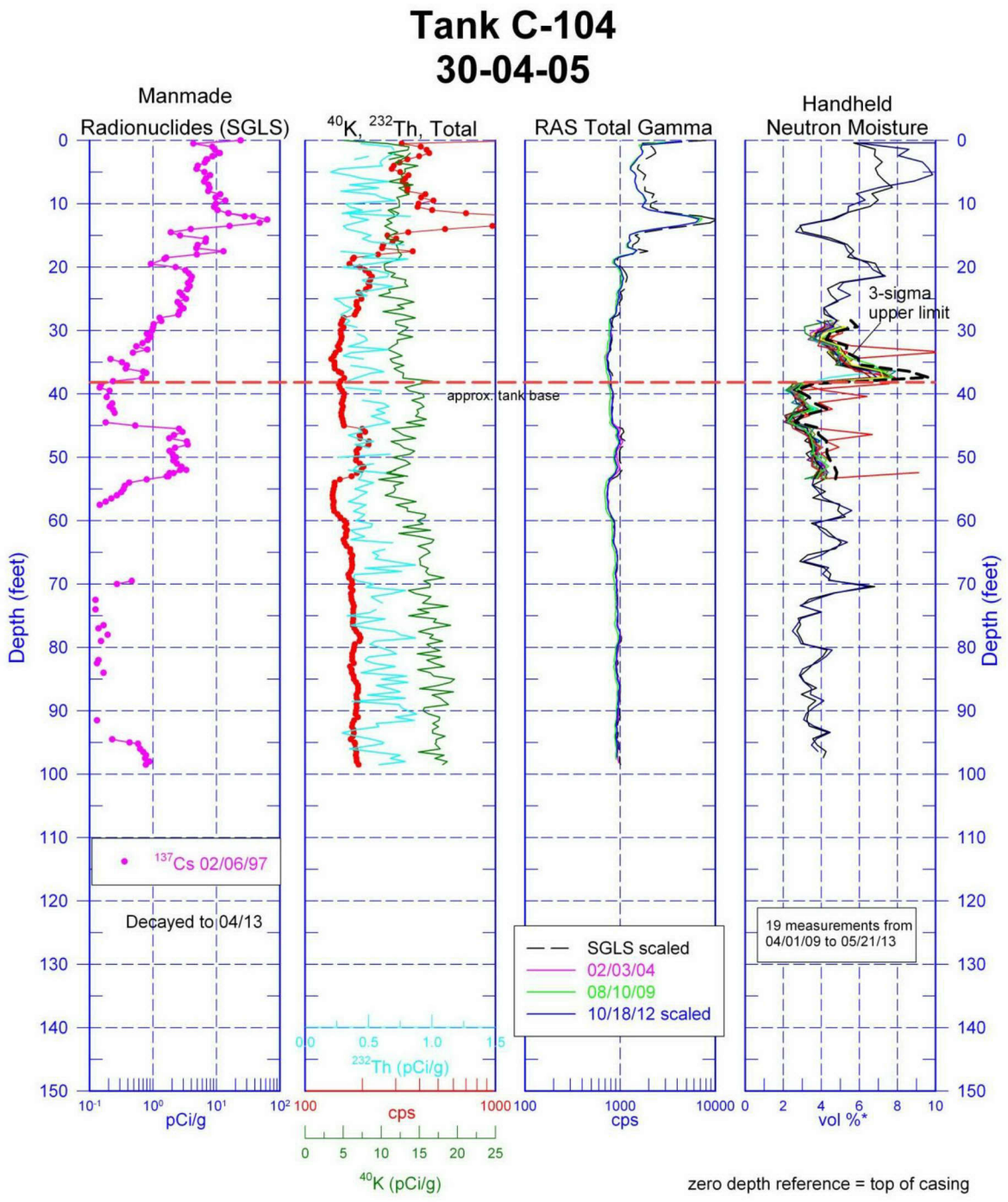


FIGURE 1-8B 30-04-05: RETRIEVAL DATA

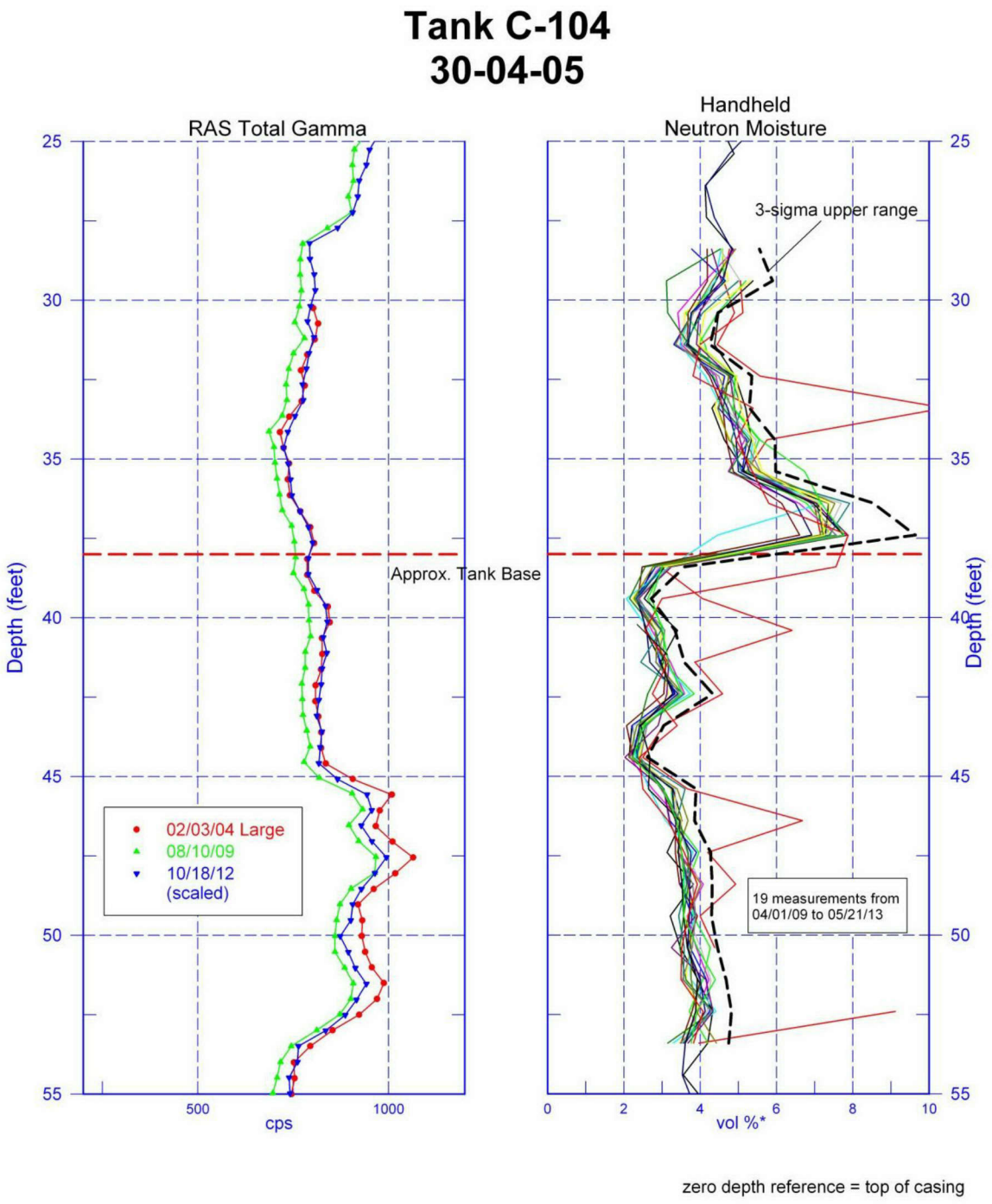


FIGURE 1-9A TANK C-104 BOREHOLE 30-04-08

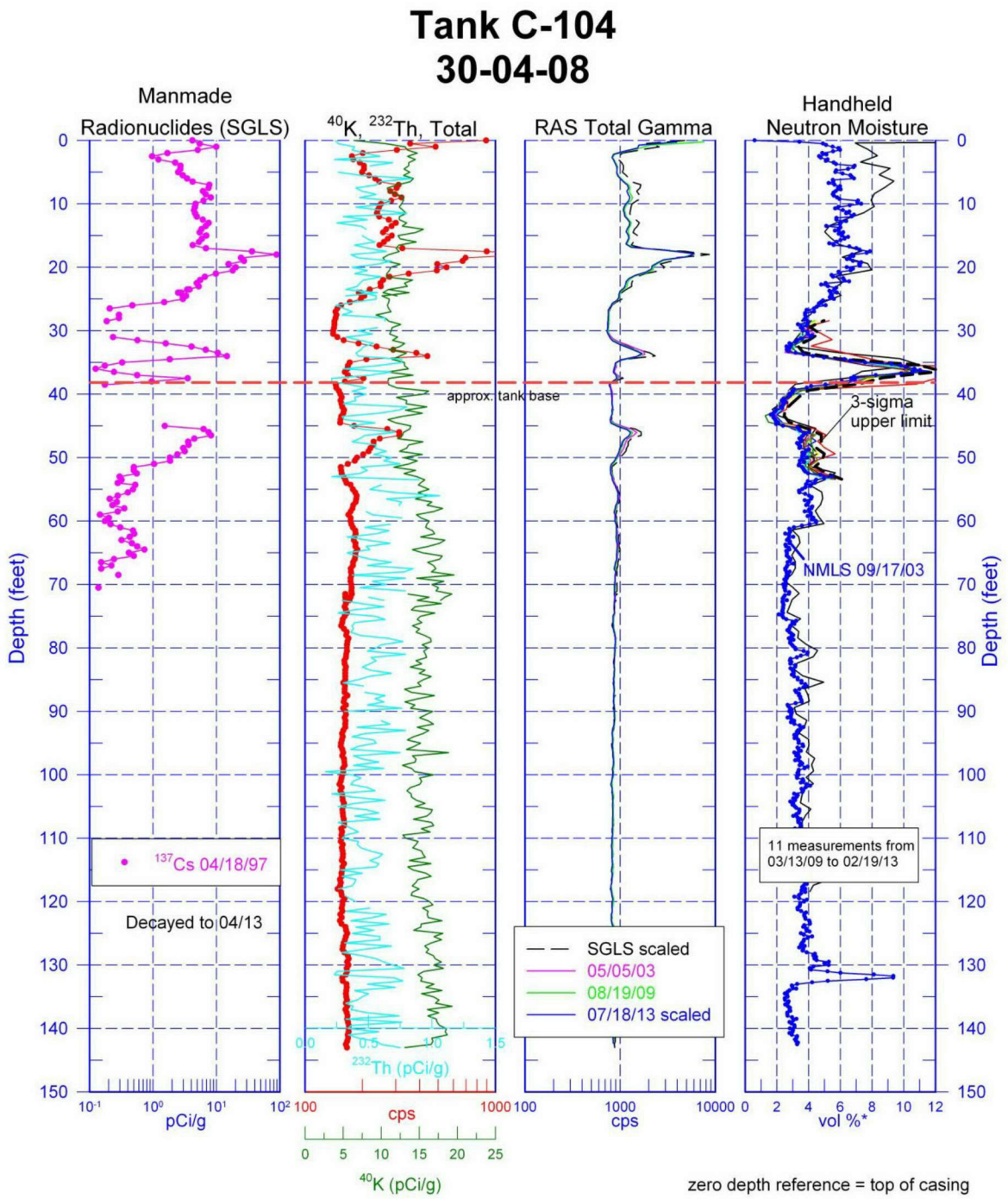


FIGURE 1-9B 30-04-08: RETRIEVAL DATA

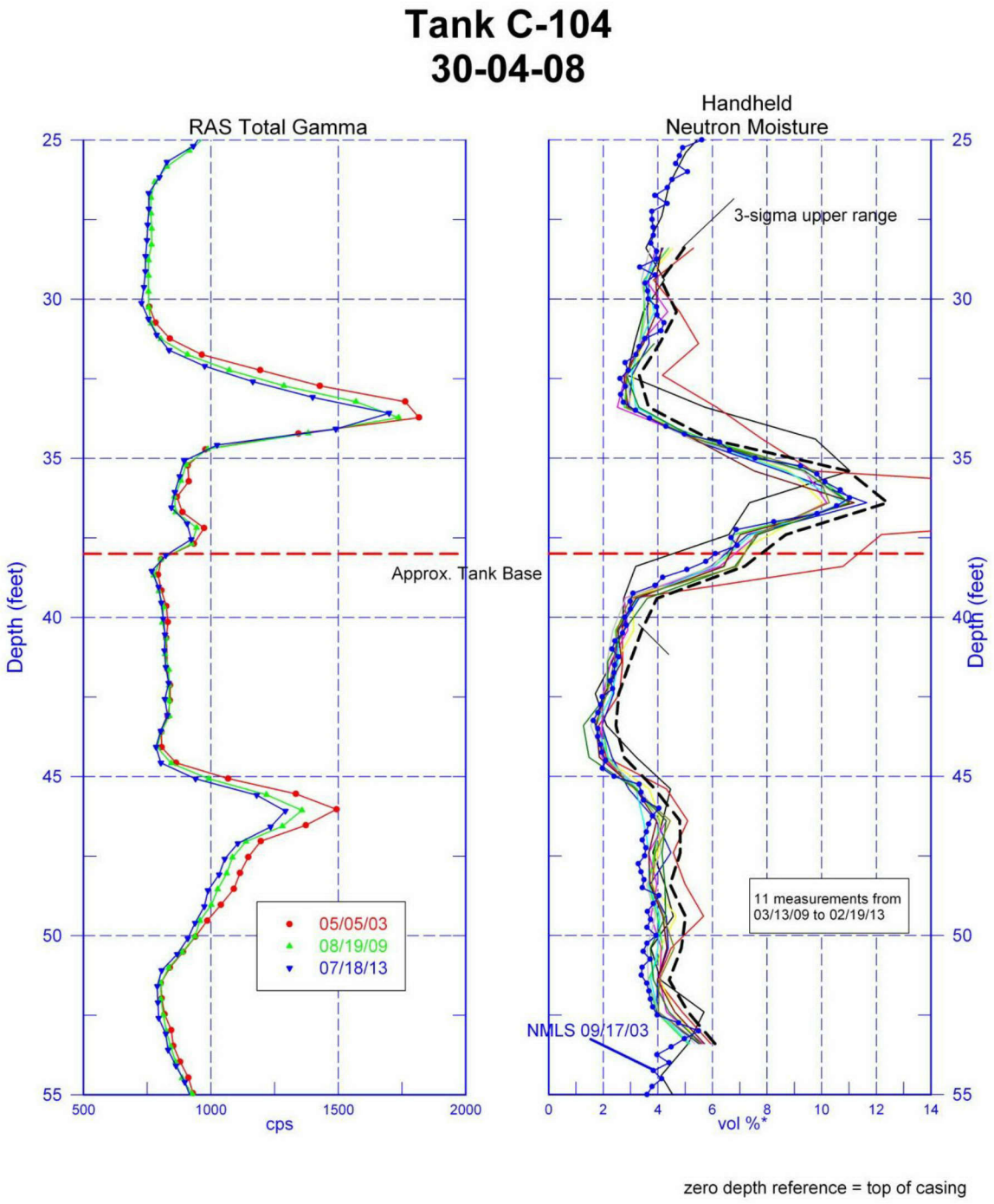


FIGURE 1-10A TANK C-104 BOREHOLE 30-04-12

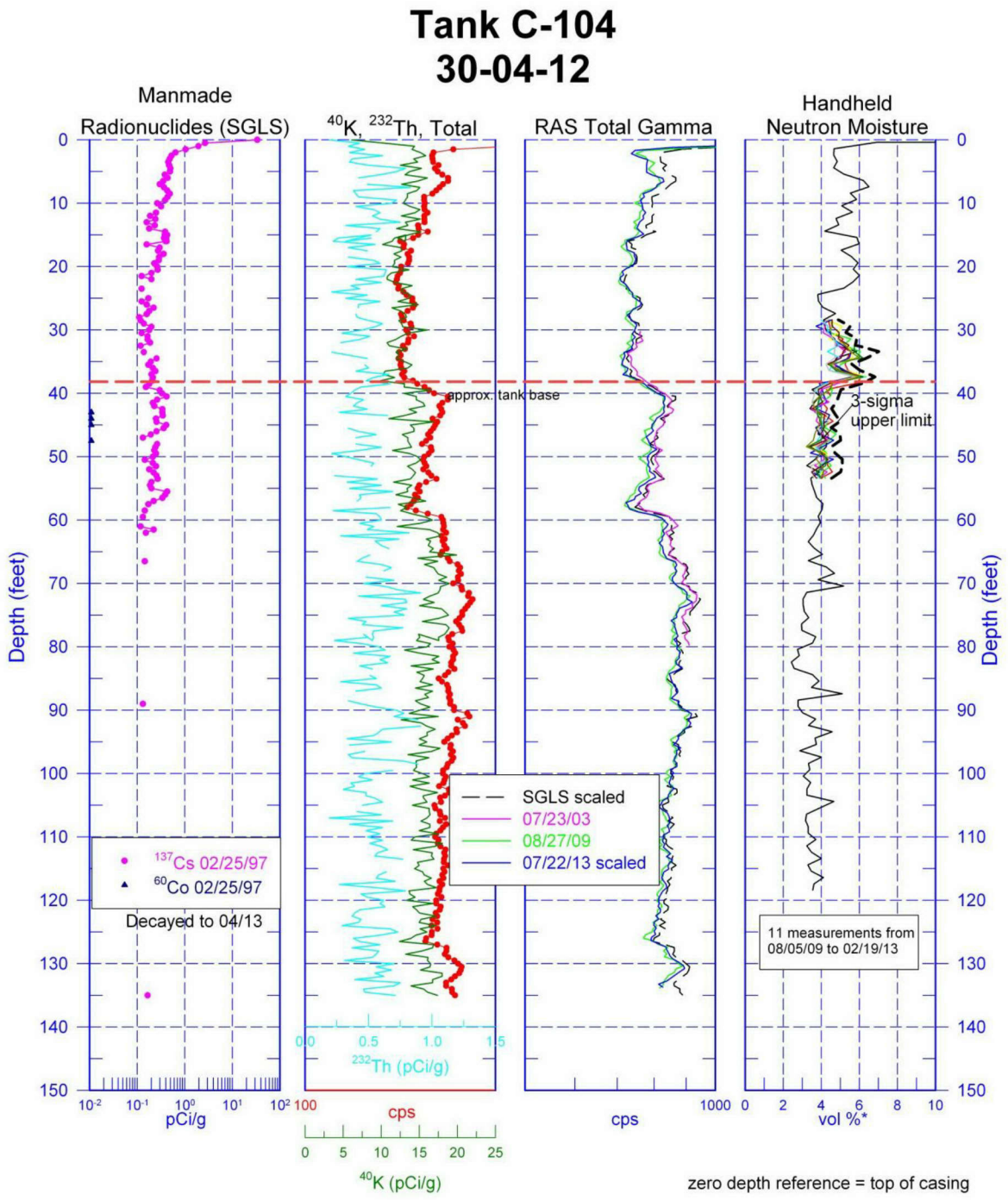
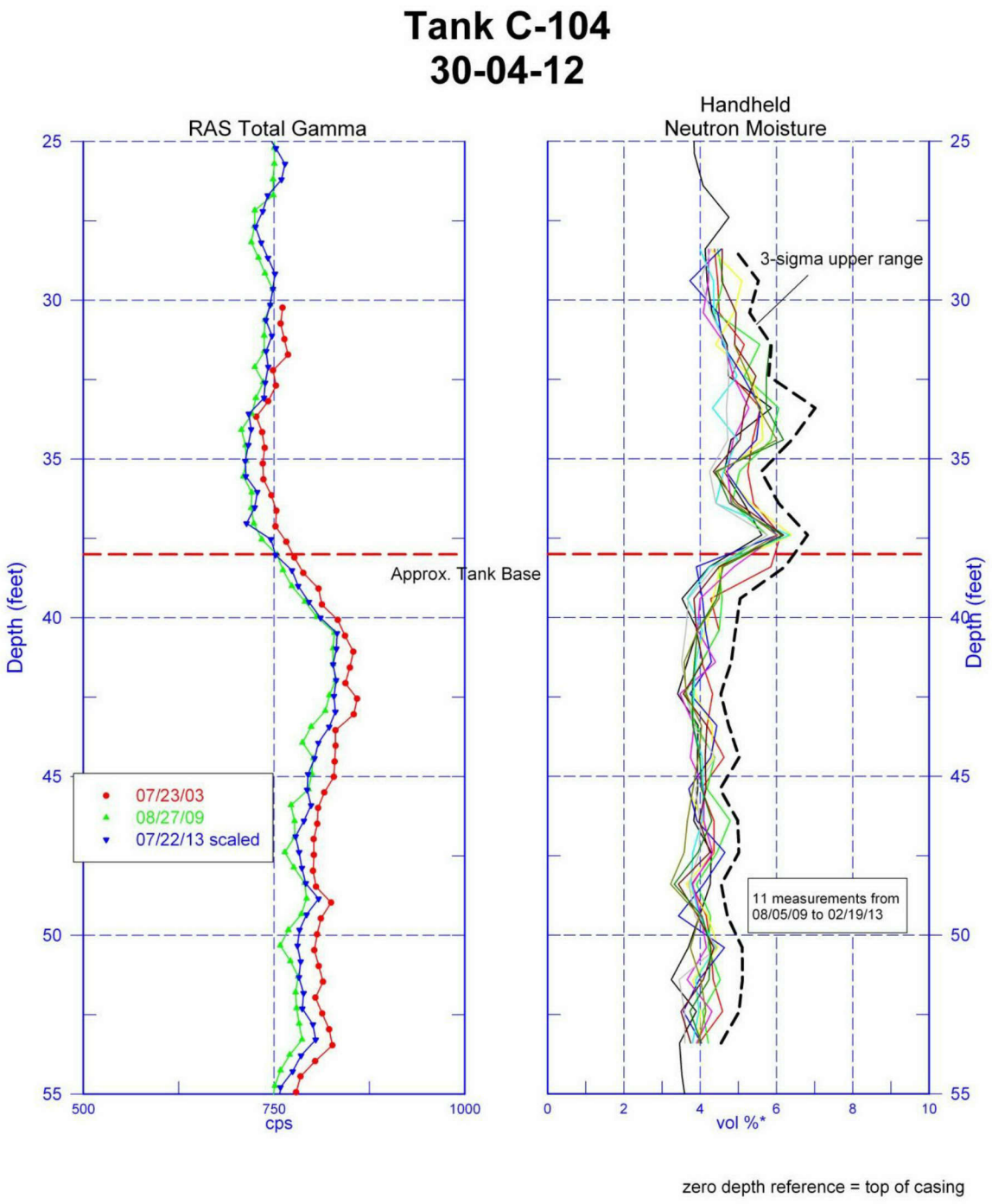


FIGURE 1-10B 30-04-12: RETRIEVAL DATA



2.0 PREVIOUS GEOPHYSICAL LOG DATA

Gross gamma logs were routinely collected in C Tank Farm drywells until 1994. These data are available in electronic format from 1975 to 1994 and have been evaluated by Randall and Price (2001).

A baseline of subsurface contamination conditions in the vicinity of Tank C-104 was established in 1997 and reported in the *Vadose Zone Characterization Project at the Hanford Tank Farms, Tank Summary Data Report for Tank C-104* (DOE 1997). A discussion of subsurface contamination conditions and visualizations of subsurface contaminant plumes were published in the *Hanford Tank Farms Vadose Zone, C Tank Farm Report* (DOE 1998) and updated in 2000 (DOE 2000).

Some RAS and SGLS logging was conducted during the Hanford Tank Farms Vadose Zone Monitoring Project from 2002 through 2004. The program was effectively terminated around the end of 2004, as resources were increasingly diverted to single-shell tank retrieval operations. Results from the monitoring project were presented in quarterly and annual reports drafted by Stoller, issued by DOE-GJO, and presented to DOE-ORP. At the time, Stoller was a prime contractor to DOE-GJO. The last annual report for the program was issued in January 2005, summarizing routine monitoring efforts for fiscal year 2004 (DOE 2005a).

3.0 RECENT GEOPHYSICAL LOG DATA

Baseline RAS measurements were acquired during in drywells 30-04-01, 30-04-02, 30-04-03, 30-05-06, 30-04-04, 30-04-05, 30-04-08, and 30-04-12 between August and October 2009. Table 3-1 summarizes gamma logs collected during and after retrieval operations. The –L and –M designations after the acronym RAS indicate either the Large or Medium detector was used.

HHNM baseline measurements were collected in March 2009. Table 3-2 below summarizes the number of logging/monitoring events occurring in support of retrieval operations with each system for each drywell (Figure 1-1).

Figure 1-3a through 1-10a present a graphical summary of these data, as well as any RAS or SGLS data acquired prior to retrieval of C-104. These data include observed manmade radionuclide (Cs-137 and Co-60) concentrations, K-40, U-238, Th-232 concentrations, and gross gamma collected with the SGLS and RAS, as well as HHNM measurements. Most SGLS gross-gamma data as well as post-2009 RAS data have been scaled to facilitate direct comparisons. The scaling is linear and the scaling factors are empirically derived by averaging count rate ratios over an interval of 10 ft or more in “clean” or “nearly clean” regions of the drywells, as determined from the most recent SGLS logs. RAS and SGLS gross-gamma data are not corrected for decay. Pre- and post-retrieval RAS data were acquired over the entire depth of the drywells. Moisture measurements were typically acquired from about 28 ft to about 53 ft.

Figure 1-3b through Figure 1-9b exhibit only pre-retrieval through post-retrieval RAS and SGLS gross-gamma data from the drywells alongside plots of the HHNM data.

TABLE 3-1 TANK C-104 SUMMARY OF AVAILABLE DRYWELL GAMMA LOGS

August 2009 to Present

	DRYWELL							
DATE	**30-04-01**	**30-04-02**	**30-04-03**	**30-05-06**	**30-04-04**	**30-04-05**	**30-04-08**	**30-04-12**
Aug 2009	RAS-L					RAS-L	RAS-L	RAS-L
Sep 2009		RAS-L	RAS-L/M	RAS-L	RAS-L			
Oct 2009					RAS-M			
Nov 2009			RAS-M					
Jul 2010				SGLS				
Aug 2010	SGLS							
Mar 2012				RAS-L				
Oct 2012						RAS-L		
Jan 2013				RAS-L				
Apr 2013	RAS-L	RAS-L			RAS-L/M			
Jul 2013							RAS-L	RAS-L
Aug 2013	RAS-L/M		RAS-L/M					

TABLE 3-2 LOGGING/MONITORING MEASUREMENTS FOR C-104 RETRIEVAL OPERATIONS

DRYWELL	SGLS	RAS	HHNM	GAMMA CHANGE DURING RETRIEVAL
30-04-01	1	3	11	None
30-04-02	0	2	16	None
30-04-03	0	3	11	None
30-05-06	1	3	14	None
30-04-04	0	3	11	None
30-04-05	0	2	19	None
30-04-08	0	2	11	None
30-04-12	0	2	11	None

4.0 OBSERVATIONS AND FINDINGS

Historical gross-gamma data (1975 to 1994) were not examined during this investigation. Instead, the 1997 SGLS manmade and gross-gamma data were used as a baseline against which to compare RAS gross-gamma data.

Available log data for drywells associated with C-104 (30-04-01, 30-04-02, 30-04-03, 30-05-06, 30-04-04, 30-04-05, 30-04-08, and 30-04-12) show no evidence of any significant changes in either moisture content or gamma activity during and after retrieval operations.

5.0 CONCLUSIONS AND DISCUSSION

None of the drywells around C-104 show evidence of significant changes in either gamma activity or subsurface moisture content. Available data from these drywells provide no evidence of any leak or contaminant movement that might be attributed to tank retrieval operations.

Experience with the handheld moisture data suggests that it is not the most effective drywell monitoring method. This is due in equal measure to the physical basis of the measurement and the way in which it is performed. The handheld moisture gage measures the extent to which "fast" neutrons are scattered and moderated to "thermal" levels in the immediate vicinity of the drywell. It responds primarily to the presence of water. While water would be a major component of any tank leak, increases in soil moisture can also occur from heavy precipitation or a raw (uncontaminated) water leak. Current procedures require that the moisture gage be manually lowered into the drywell, and measurements are made at specific points where "stops" are installed on the cable. For each measurement, the total counts for the specified interval are displayed on the readout unit. The operator copies this number onto a data sheet alongside the depth. This sheet is then faxed or emailed to Stoller and the data are manually typed into an Excel spreadsheet for analysis. Opportunities for error abound in such a system. Moreover, any anomaly requires gamma activity measurements to confirm that the observed moisture increase may actually indicate the possibility of a tank leak.

6.0 REFERENCES

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Washington River Protection Solutions (WRPS). 2011. *241-C-102, 241-C-104, 241-C-107, 241-C-108 and 241-C-112, Tank Waste Retrieval Work Plan, Rev. 6a.* RPP-22393. Prepared by WRPS LLC for Office of River Protection. Richland, Washington.

GROUNDWATER WELL LOGGING RESULTS FOR 299-E27-14 (A4812)

299-E27-14 (A4812)
Log Data Report

Borehole Information:

Borehole:	299-E27-14 (A4812)		Site:	50 ft southeast of C tank farm	
Coordinates (WA St Plane)		GWL[1] (ft):	261.9	GWL Date:	03/28/07
North (m)	East (m)	Drill Date	TOC Elevation	Total Depth (ft)	Type
136498.244	575217.341	10/89	661.92 ft	270	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Stainless steel	3.0	6 5/8	6 3/8	1/8	3.0	2.0
Stainless steel	0.5	4 1/4	4	1/8	0.5	248.8
SS Screen	N/A	4 1/4	4	1/8	248.8	269.8

Borehole Notes:

This borehole has been logged by Westinghouse Hanford Company in October 1989, with a NaI total gamma detection system. Log data were acquired inside a 10-in. casing from ground surface to 137 ft and inside an 8-in. casing from 137 to 266 ft (bgs). No well completion materials had been introduced into the borehole annulus prior to logging. Depth reference for this logging was ground surface.

After the initial logging, a 4-in. stainless steel casing was placed to 245.8 ft (248.8 ft from the top of the 6-in. casing). **Note: For the purposes of this log data report, henceforth, all reported depths are from the top of the 6-in. casing. Depths reported from other log data or well completion summaries are adjusted 3.0 ft.** A 4-in. stainless steel screen was placed from 248.8 to 269.8 ft. The temporary 8- and 10-in. casings were removed from the borehole as well completion materials were introduced into the annular space around the 4-in. casings. A sand pack was placed around the screened interval from 245.7 to 269.8 ft. Volclay tablets were placed from 242.4 to 245.7 ft. Bentonite crumbles were placed from 22.8 to 242.4 ft. A surface seal consisting of cement grout was placed from 5.8 to 22.8 ft. A 4x4x0.5 ft concrete surface pad was placed, extending 5 ft into the annulus. A 6-in. protective surface casing was placed over the 4-in. casing and extends 3.0 ft above ground surface.

An HPGe spectral gamma logging system referred to as the Radionuclide Logging System (RLS) was used by Westinghouse to log this borehole in March 1994. Apparently, a log report was not created to report the results. A printout was available of the activities for natural and manmade radionuclides measured in the borehole by Westinghouse according to their calibrations. The Nez Perce Environmental Restoration & Waste Management group transcribed these data and prepared a log data report in September 2006, describing results and their interpretation of the data. In response to a recommendation by the Nez Perce, the borehole was re-logged with the Spectral Gamma Logging System (SGLS). This report presents these current data and provides comparisons with the prior log data acquired in 1989 and 1994. The log and report prepared by the Nez Perce can be found as an attachment to a letter to Keith Klein, DOE-RL, from Gabriel Bohnee, Nez Perce EWRM director, dated October 17, 2006. (DA03775436 / IDMS ID: 14042992)

The logging engineer measured the 6-in. casing diameter using a steel tape. The 4-in. casing was estimated from visual inspection. Casing depths were derived from the Well Construction and Completion Summary "As =Built." Three feet are added to the casing depths and depths of well completion materials to account for the 3.0 ft of casing stickup. SGLS log data are referenced to the top of the 6-in. casing.

Logging Equipment Information:

Logging System:	Gamma 1G	**Type:**	SGLS (35%) HPGe SN: 34-TP10951A
Effective Calibration Date:	11/22/06	**Calibration Reference:**	HGLP-CC-003
		Logging Procedure:	HGLP-MAN-002, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4 Repeat	5
Date	03/28/07	03/29/07	03/30/07	04/02/07	04/02/07
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	270.0	185.0	102.0	150.0	34.0
Finish Depth (ft)	184.0	101.0	33.0	127.0	4.0
Count Time (sec)	200	200	200	300	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
ft/min	N/A	N/A	N/A	N/A	N/A
Pre-Verification	AG126CAB	AG127CAB	AG128CAB	AG129CAB	AG129CAB
Start File	AG126000	AG127000	AG128000	AG129000	AG129024
Finish File	AG126086	AG127084	AG128069	AG129023	AG129054
Post-Verification	AG126CAA	AG127CAA	AG128CAA	AG129CAA	AG129CAA
Depth Return Error (in.)	2.5 low	0	0	N/A	1.5 low
Comments	Gain adjustment after files -033, -055, -80	No fine gain adjustment	No fine gain adjustment	Fine gain adjustment after file -023	No fine gain adjustment

Logging Operation Notes:

Logging was conducted with no centralizer on the sonde due to the small diameter casing. Repeat data (log run 4) were acquired at a 300 second counting time from 127 to 150 ft to provide additional detail of the highest activity zone. Because the repeat data acquired at 300 seconds are statistically more reliable than data acquired at 200 seconds, the repeat data are plotted as main log data.

Analysis Notes:

Analyst:	Henwood	**Date:**	04/26/07	**Reference:**	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging systems were performed before and after each day's data acquisition. The acceptance criteria were met.

A casing correction for 1/8-in.-thick casing was applied throughout the borehole for the SGLS.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with an EXCEL worksheet template identified as G1GNov06.xls using an efficiency function and corrections for casing and dead time as determined from annual calibrations. A water correction was applied to the data below 261.9 ft.

Results and Interpretations:

Cs-137 and Co-60 are the manmade radionuclides detected in this borehole during the current logging. Cs-137 is detected from 4 to 7 ft. Four ft is the first data point acquired and is approximately 1 ft below ground surface after subtracting the casing stickup of 3 ft. The maximum concentration is 1.2 pCi/g at 6 ft.

Co-60 is detected from 244 to 261 ft, from 130 to 150 ft, and sporadically (7 of 54 depth intervals) from 162 to 216 ft. The maximum concentrations for these intervals are 0.3 pCi/g at 250 ft, 0.1 pCi/g at 142 ft, and 0.1 pCi/g at 162 ft, respectively. The assays are underestimated by an unknown amount due to the presence of completion materials (mostly bentonite). The gamma rays detected by the logging systems are influenced by the material just outside the casing to a greater degree than from 6-12-in. into the formation. Given that 3-3.5 in. of the annular space could be comprised of completion materials, some attenuation of the Co-60 gamma rays will occur.

The naturally occurring radionuclides (K-40, U-238, and Th-232 {KUT}) and total gamma data are dominated by the completion materials residing outside the 4-in. casing. The sand pack in the interval from 245.7 to 269.8 ft that lies just below the Volclay placed from 242.4 to 245.7 ft is clearly distinguished. Bentonite crumbles placed from 22.8 to 242.4 ft reflect very little variation in KUT. The concentrations in this interval are high for the U and T and low for K relative to usual assays of Hanford sediments. The surface grout seal extending to approximately 23 ft is also clearly distinguished. One notable exception is the interval from approximately 130 to 150 ft where gamma rays from the Co-60 contamination are reflected in the total gamma log.

Comparisons are made of the 2007 (SGLS) data and prior data acquired in 1989 (NaI detector) and 1994 (RLS). Comparisons are not always straight forward. For example, as discussed in "Borehole Notes," completion materials were not in the borehole for the first logging event in 1989 with the NaI system. Logging was probably conducted in steel casing approximately 0.5-in. thick for which corrections are not made; the RLS and SGLS data are corrected for 1/8-in. thick casing and completion materials reside behind the casing.

The RLS and SGLS detection systems have different efficiencies, 18% and 35%, respectively. As can be observed by the SGLS/RLS comparison plot of total gamma, the count rate of the SGLS is about double that of the RLS. In addition, counting times of 200 and 300 seconds were used for the SGLS, while the RLS utilized an 80 second counting time. These differences result in a minimum detection limit for Co-60 of approximately 0.05 pCi/g for the SGLS and approximately 0.1 pCi/g for the RLS.

Further complicating the comparisons, is the 5.27 year half life of Co-60. Over 3 half lives have passed since 1989 and over 2 since 1994.

An evaluation of the Nez Perce log data report concludes that the data presented are reasonable and the spectra at depth locations were Co-60 is detected contain full energy peaks at 1173 and/or 1333 keV that unambiguously represent Co-60. A comparison plot of the SGLS data and RLS data decayed to 2007 indicates Co-60 contamination between approximately 130 and 150 ft at generally consistent concentrations. There are a few more detections with the SGLS between 162 and 216 ft than with the RLS. Between 244 and 261 ft, the SGLS detections far exceed that of the RLS.

The Nez Perce report asserts, "A gross gamma log collected when the hole was drilled in 1989 indicates the sediments surrounding this borehole did not contain detectable amounts of manmade radionuclides at that time." A comparison of the 1989 total gamma data with the 1994 RLS and 2007 SGLS total gamma data appears to support this conclusion. The maximum Co-60 concentration determined by the SGLS between 130 and 150 ft is approximately 0.11 pCi/g. If this contamination existed in 1989, the concentration would have been approximately 1.1 pCi/g. It is estimated 1 pCi/g of Co-60 would be reflected in the NaI system by an increase above background in the total gamma count rate on the order of 50 counts per second (cps). The total gamma log shows a possible increase above background on the order of 10-15 cps from 137 to 141 ft (140 to 144 after correcting for stickup); the sharp increase at 137 ft is the result of a casing change from a 10-in. to 8-in. casing. An increase of this magnitude (10-15 cps) could reflect a finer grained sediment rather than the existence of a contaminant. The 1994 RLS total gamma log over the same depth interval, acquired one Co-60 half life later than 1989, shows an increase of

approximately 50 cps over background and the increase is prominent relative to the 1989 log. Therefore, it is concluded the Co-60 contamination most likely reached the vicinity of this borehole between 1989 and 1994.

Groundwater levels have been reported at approximately 253, 256, and 262 ft in 1989, 1994, and 2007 respectively. The NaI system did not appear to detect any contamination at these depths and the RLS only reports contamination at 251 and 252 ft. The SGLS data indicates contamination from 250 to 261 ft. It is postulated that the groundwater is contaminated with Co-60 that adheres to the casing and/or sand pack. As the water level recedes, Co-60 can be detected with the SGLS and RLS because the water is no longer available to attenuate the gamma rays. It is expected as the water level further recedes, Co-60 will be detectable on the casing and/or sand pack at greater depths.

The origin of the sporadic Co-60 contamination between 162 and 216 ft and at approximately 244 ft is unknown. It is possible contamination has migrated to the borehole at low concentrations from a distant source. Another possibility is that contamination from the groundwater has been spread to a few locations inside the casing during well services activities such as removing pumps or groundwater sampling.

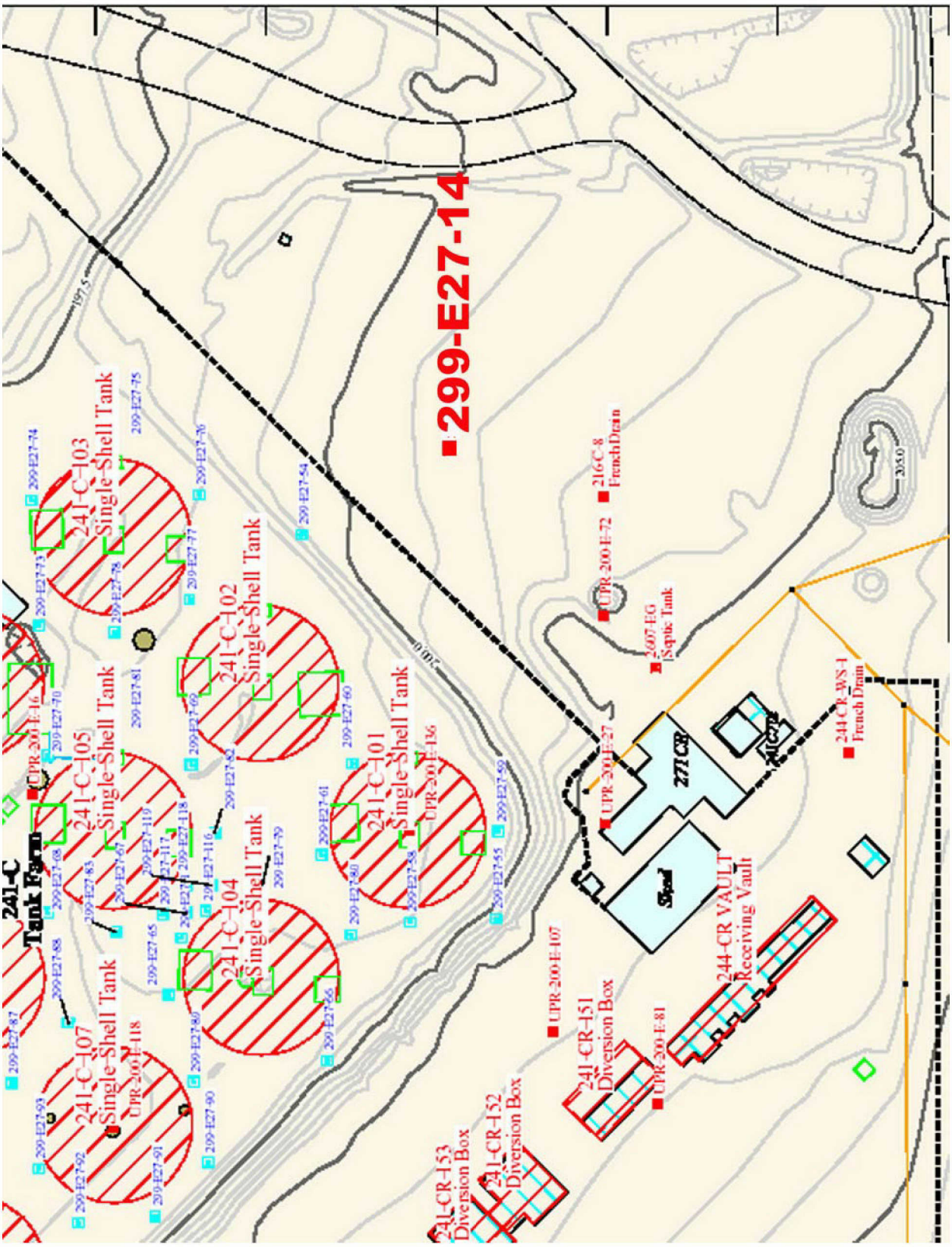
Other borehole data in C Farm, notably in boreholes 30-06-10 and 30-08-02 show evidence of active migration of Co-60 from the 1970's to the present. Available data suggest migration downward and to the east, following stratigraphic dip. It is recommended boreholes immediately outside the C Farm fence line be logged, especially 299-E27-07 on the eastward periphery. All the data, including moisture data acquired as a result of tank retrieval operations, should be integrated and contaminant plumes re-defined as new data are acquired.

Finally, groundwater and vadose zone data should be evaluated to assess any correlation between Tc-99 and Co-60 concentrations. Both contaminants have similar transport properties. Co-60, although largely decayed away, is easily detectable through steel casing and may provide important clues to determine the extent of Tc-99 in the vadose zone.

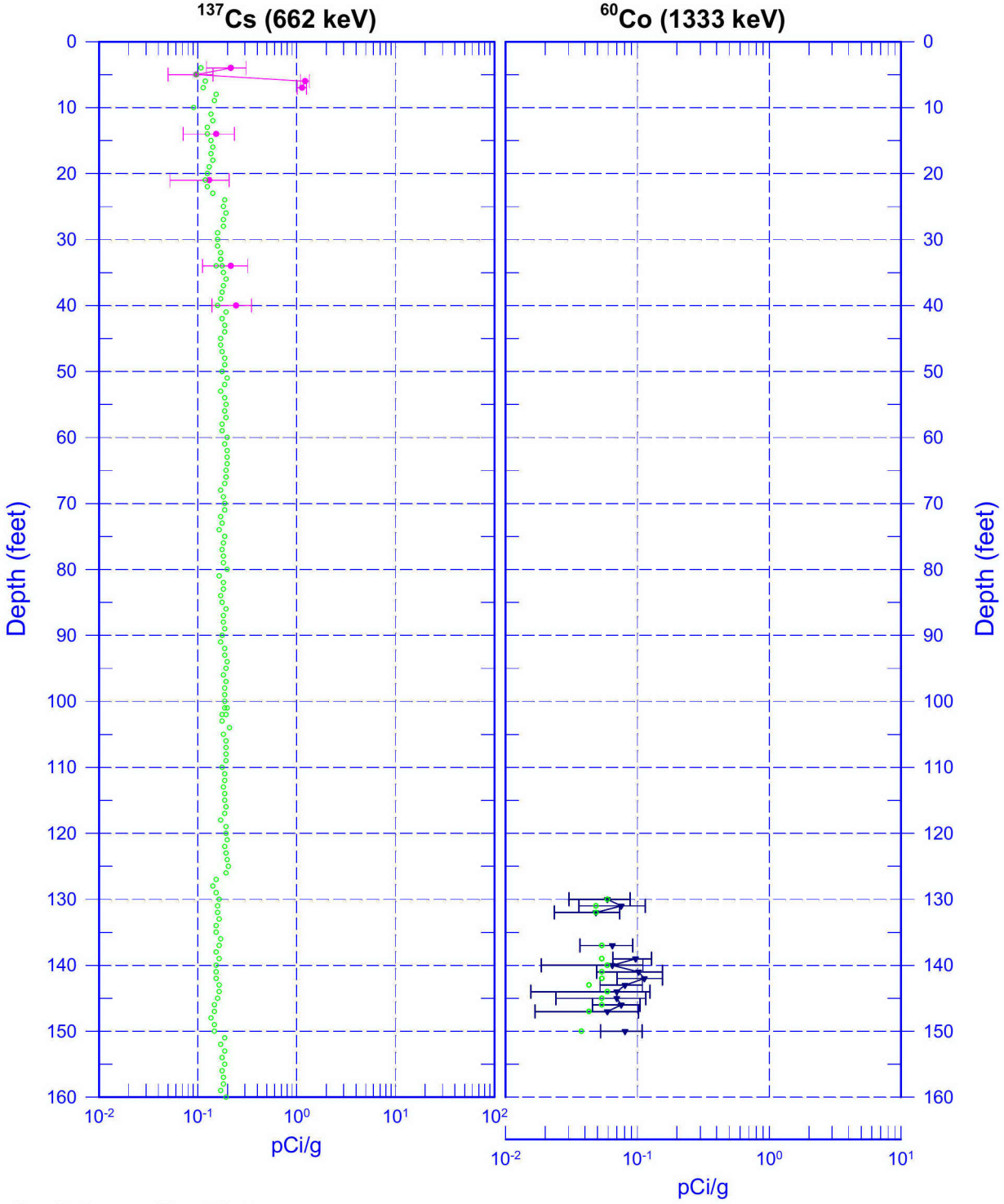
List of Log Plots:

Depth Reference is top of casing
Depth Scale - 20 ft/inch

Map Showing Location of 299-E27-14
Manmade Radionuclides
Natural Gamma Logs
Combination Plot
Combination Plot (0-280 ft)
Total Gamma (SGLS/RLS)
Comparison of RLS (1994) and SGLS (2007)
Manmade Radionuclide Repeat Section
Repeat Section of Natural Gamma Logs
Westinghouse Hanford Company Log Report

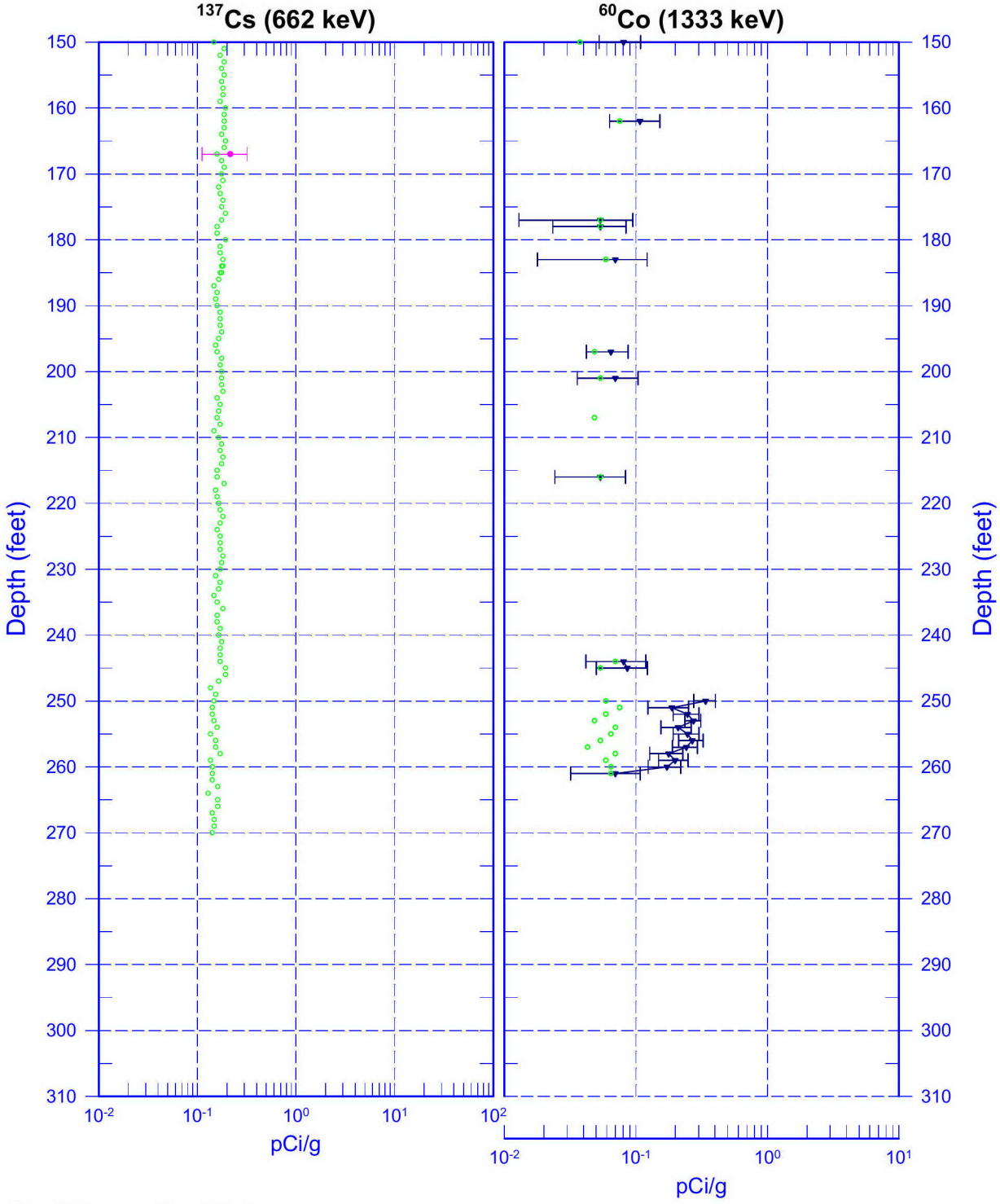

299-E27-14
241-C
Tank Farm
241-C-103
Single-Shell Tank
241-C-102
Single-Shell Tank
241-C-105
Single-Shell Tank
241-C-101
Single-Shell Tank
241-C-104
Single-Shell Tank
241-C-107
Single-Shell Tank
241-CR-151
Diversion Box
241-CR-152
Diversion Box
241-CR-153
Diversion Box
244-CR VAULT
Receiving Vault
271 CR
Shed
216-C-8
French Drain
244-CR-WS-1
French Drain
2607-EG
Septic Tank
UPR-200-E-72
UPR-200-E-27
UPR-200-E-107
UPR-200-E-81
UPR-200-E-136
UPR-200-E-118
UPR-200-E-116
299-E27-74
299-E27-73
299-E27-75
299-E27-76
299-E27-77
299-E27-78
299-E27-54
299-E27-69
299-E27-81
299-E27-70
299-E27-68
299-E27-67
299-E27-83
299-E27-119
299-E27-117
299-E27-118
299-E27-116
299-E27-82
299-E27-60
299-E27-61
299-E27-59
299-E27-58
299-E27-55
299-E27-65
299-E27-66
299-E27-87
299-E27-93
299-E27-92
299-E27-91
299-E27-90
1971.5
2050
0 m

299-E27-14 (A4812)
Man-Made Radionuclides



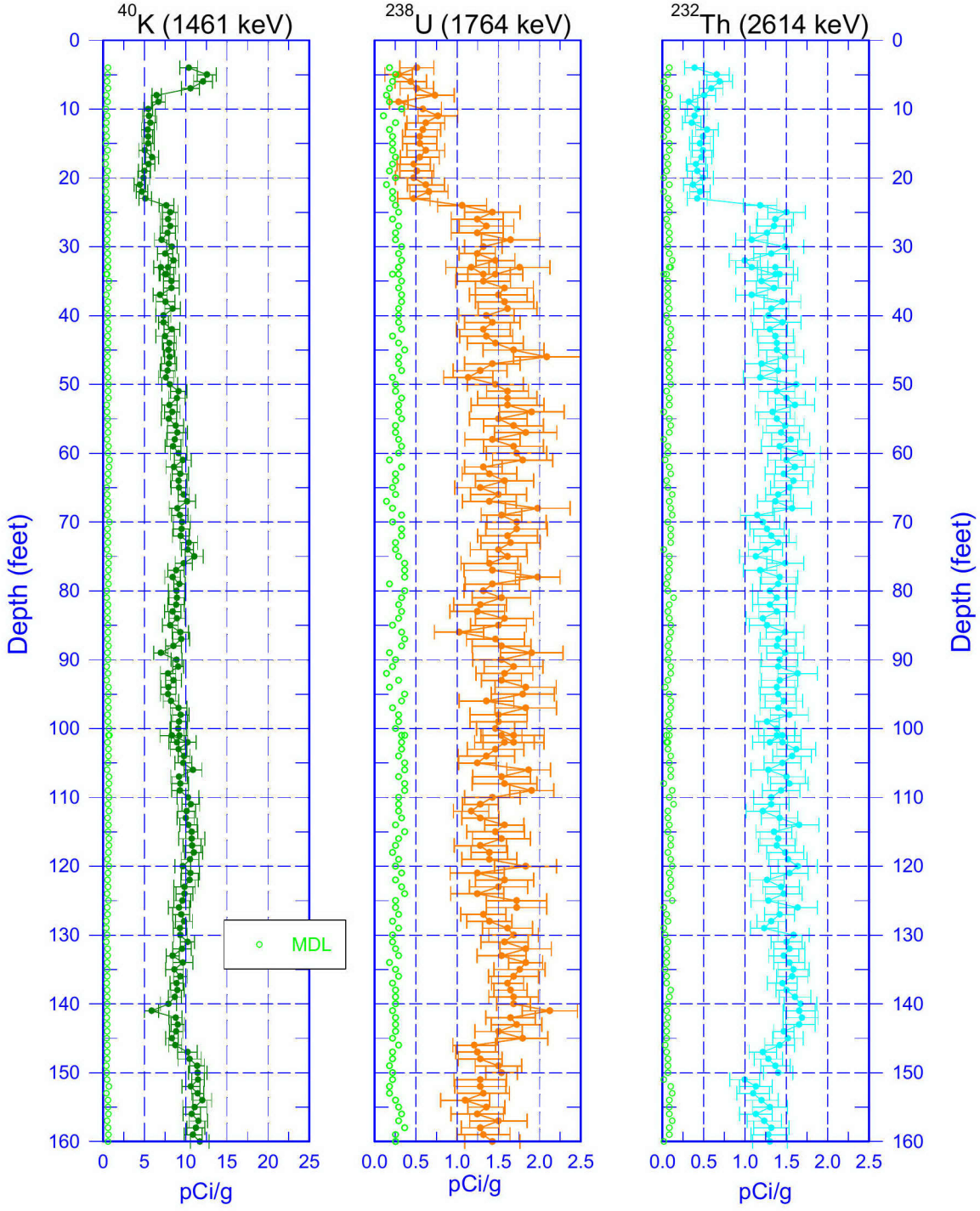
Zero Reference - Top of Casing

299-E27-14 (A4812)
Man-Made Radionuclides



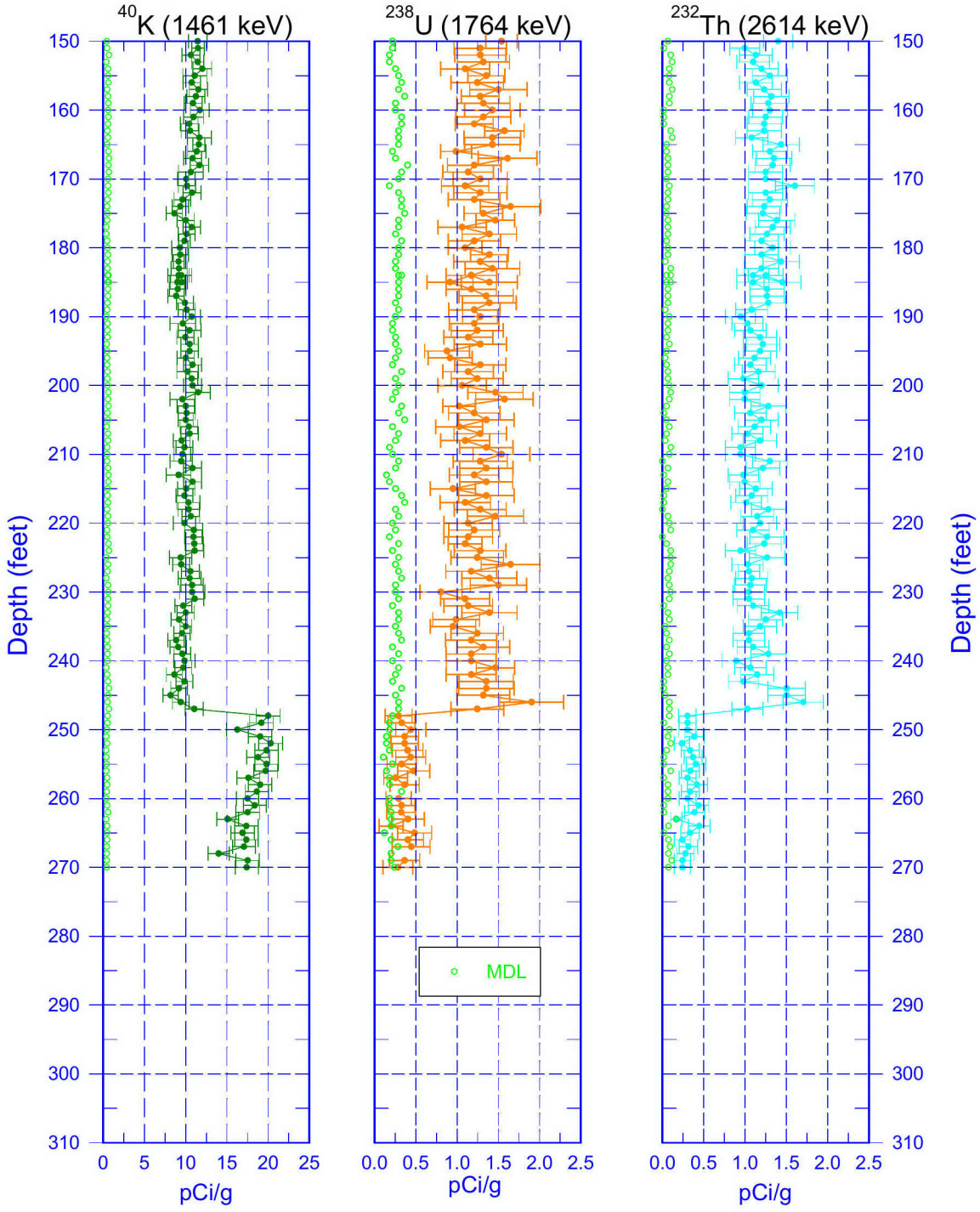
Zero Reference - Top of Casing

299-E27-14 (A4812)
Natural Gamma Logs



Zero Reference = Top of Casing

299-E27-14 (A4812)
Natural Gamma Logs



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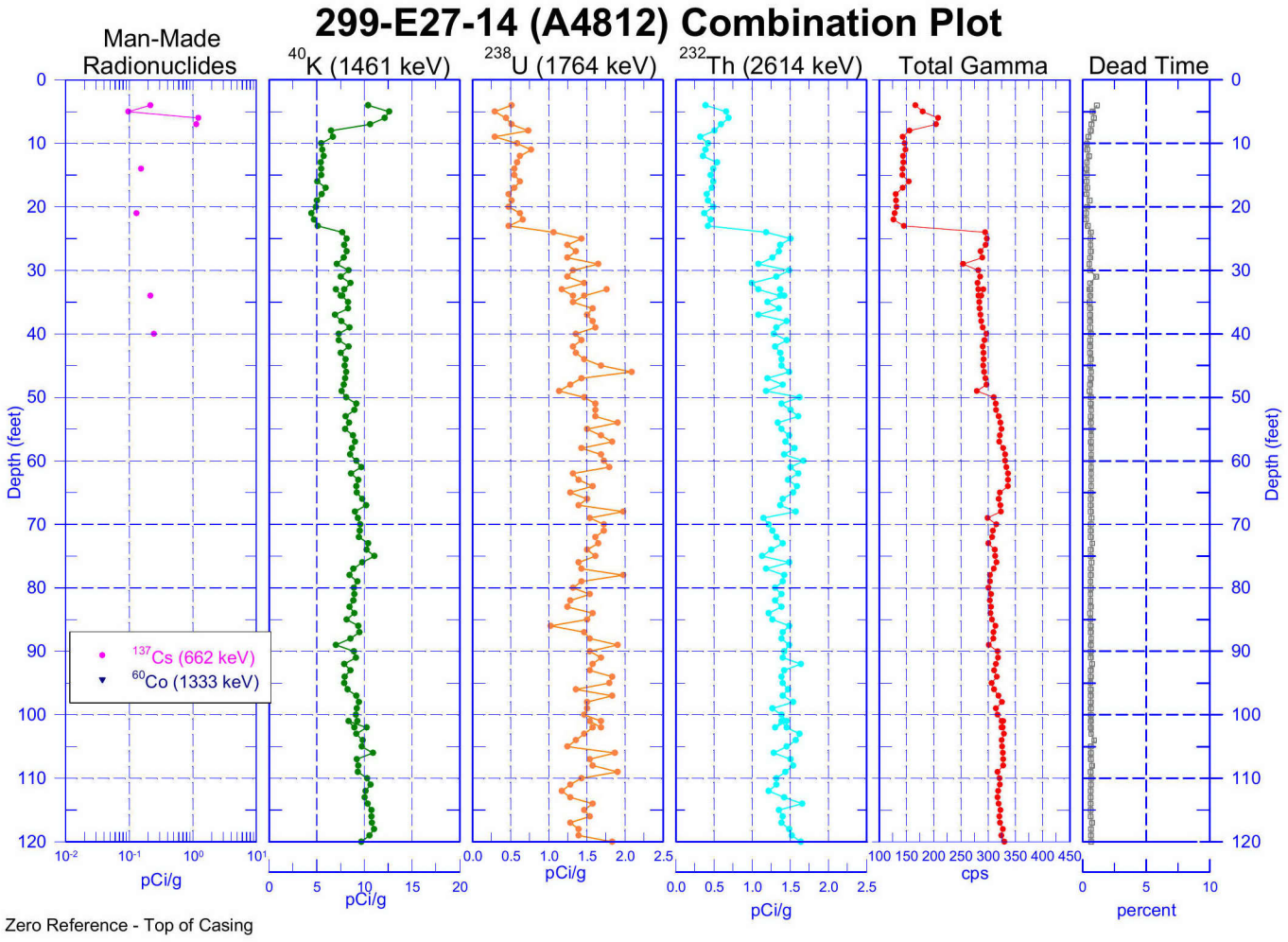
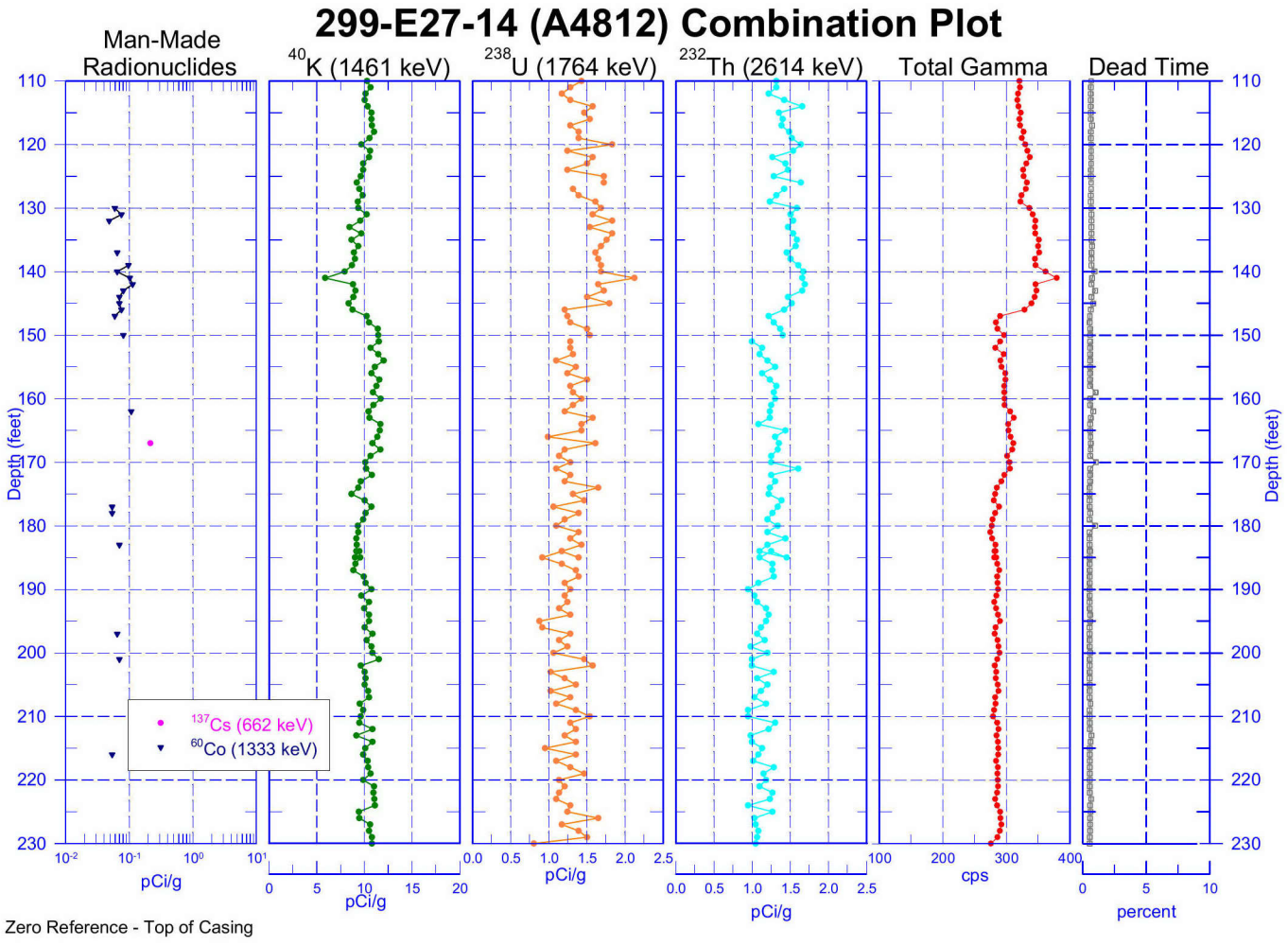
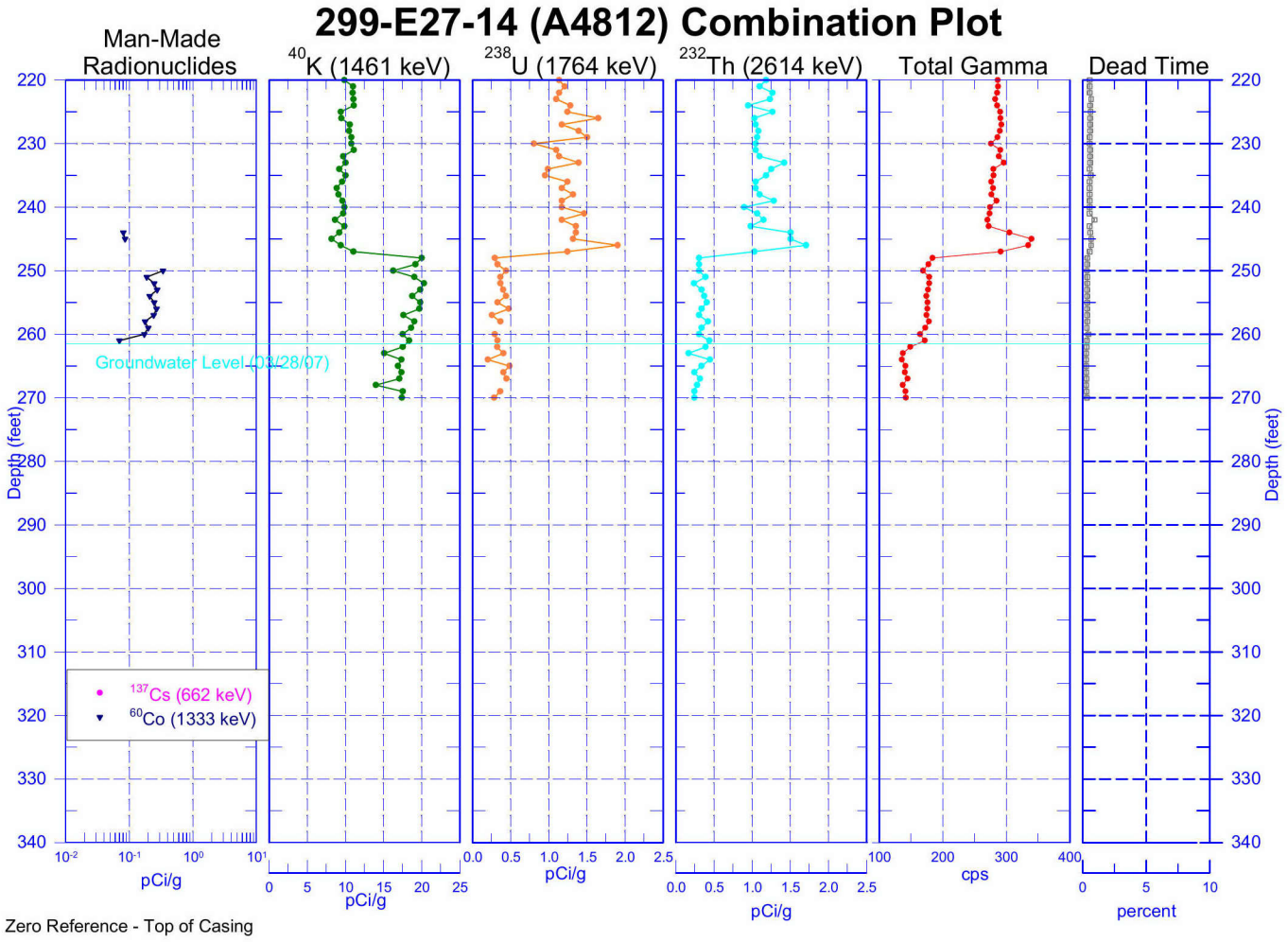
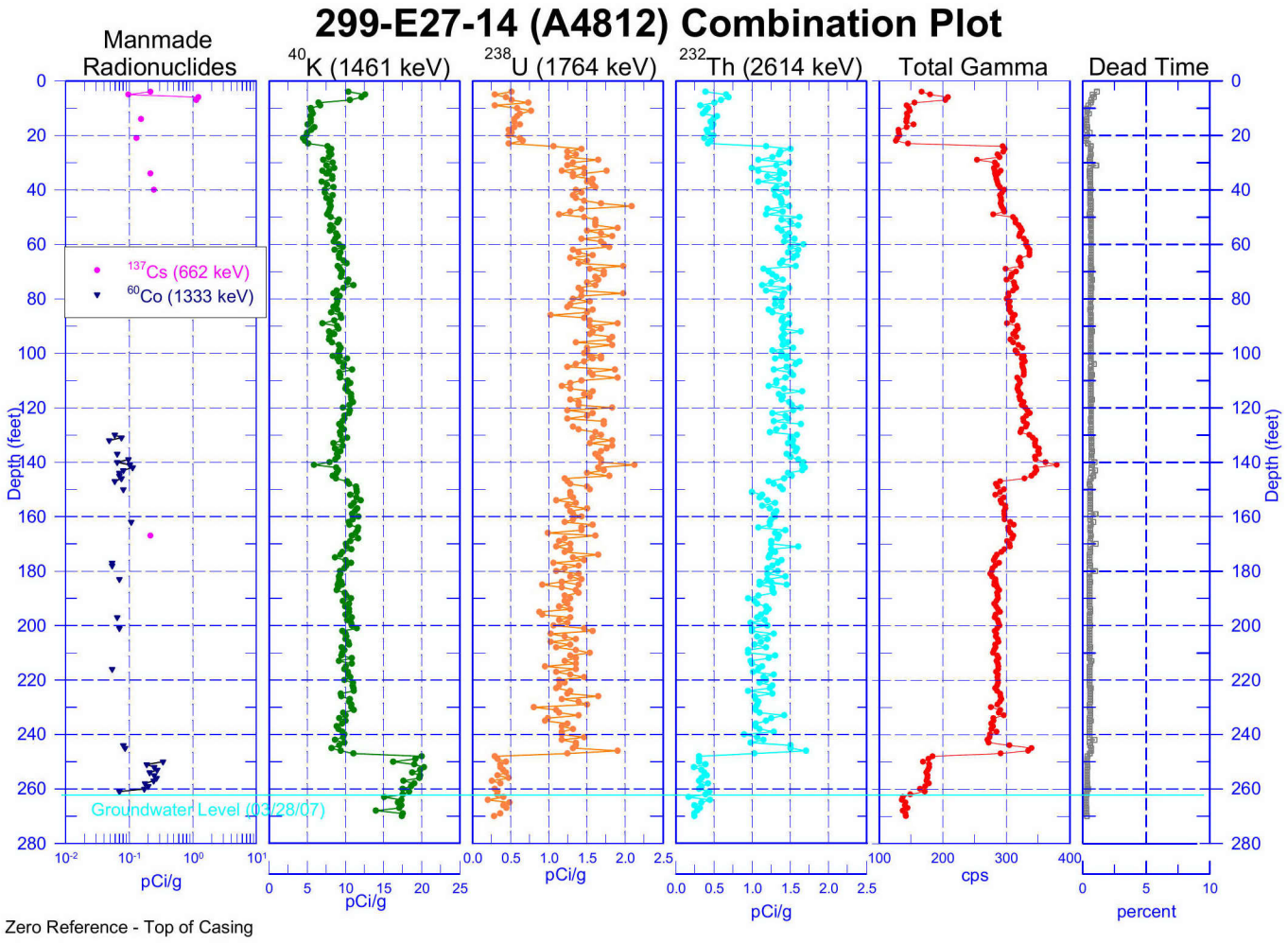
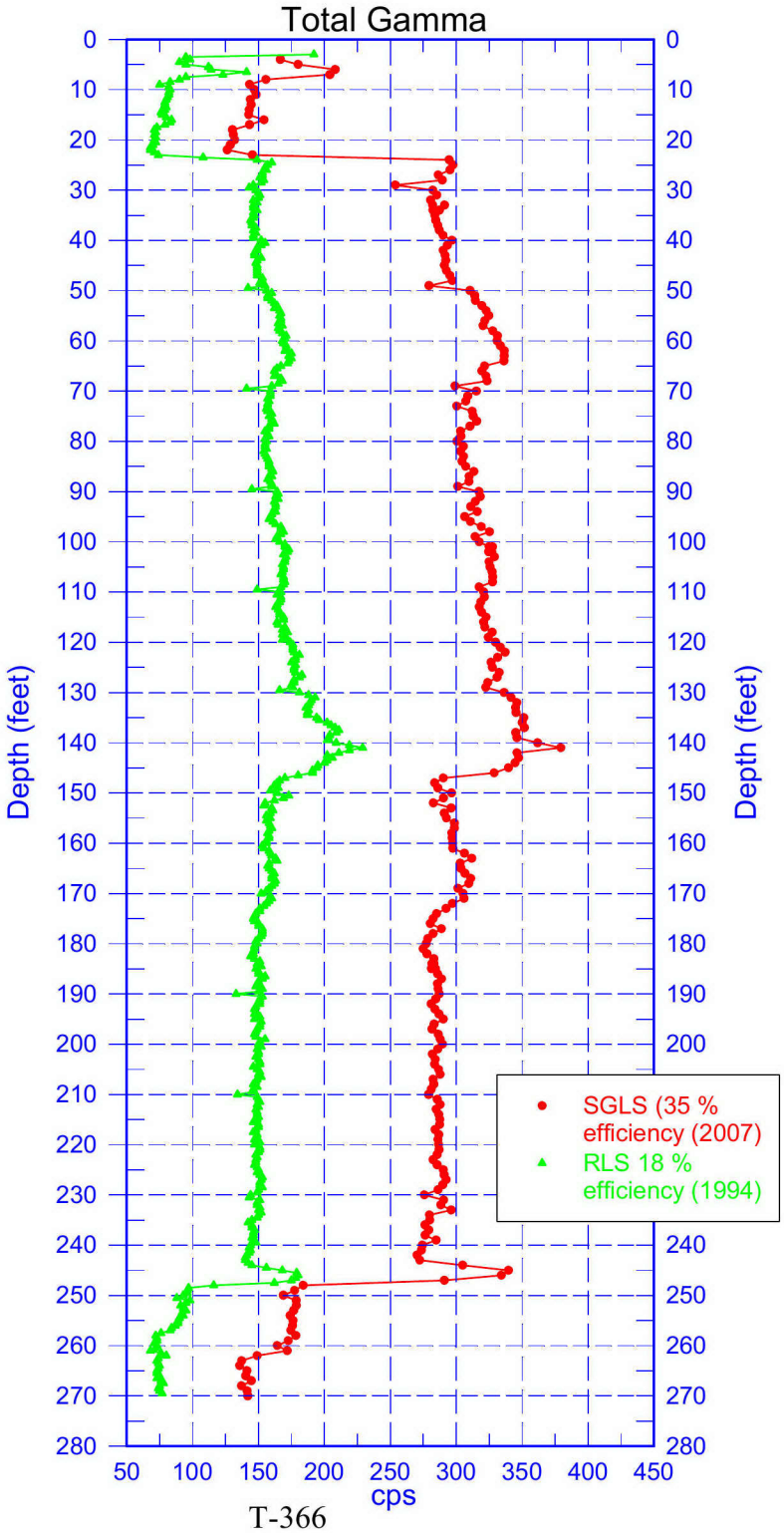

299-E27-14 (A4812) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Dead Time
Depth (feet)
137Cs (662 keV)
60Co (1333 keV)
pCi/g
cps
percent
Zero Reference - Top of Casing


299-E27-14 (A4812) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Dead Time
Depth (feet)
137Cs (662 keV)
60Co (1333 keV)
pCi/g
cps
percent
Zero Reference - Top of Casing

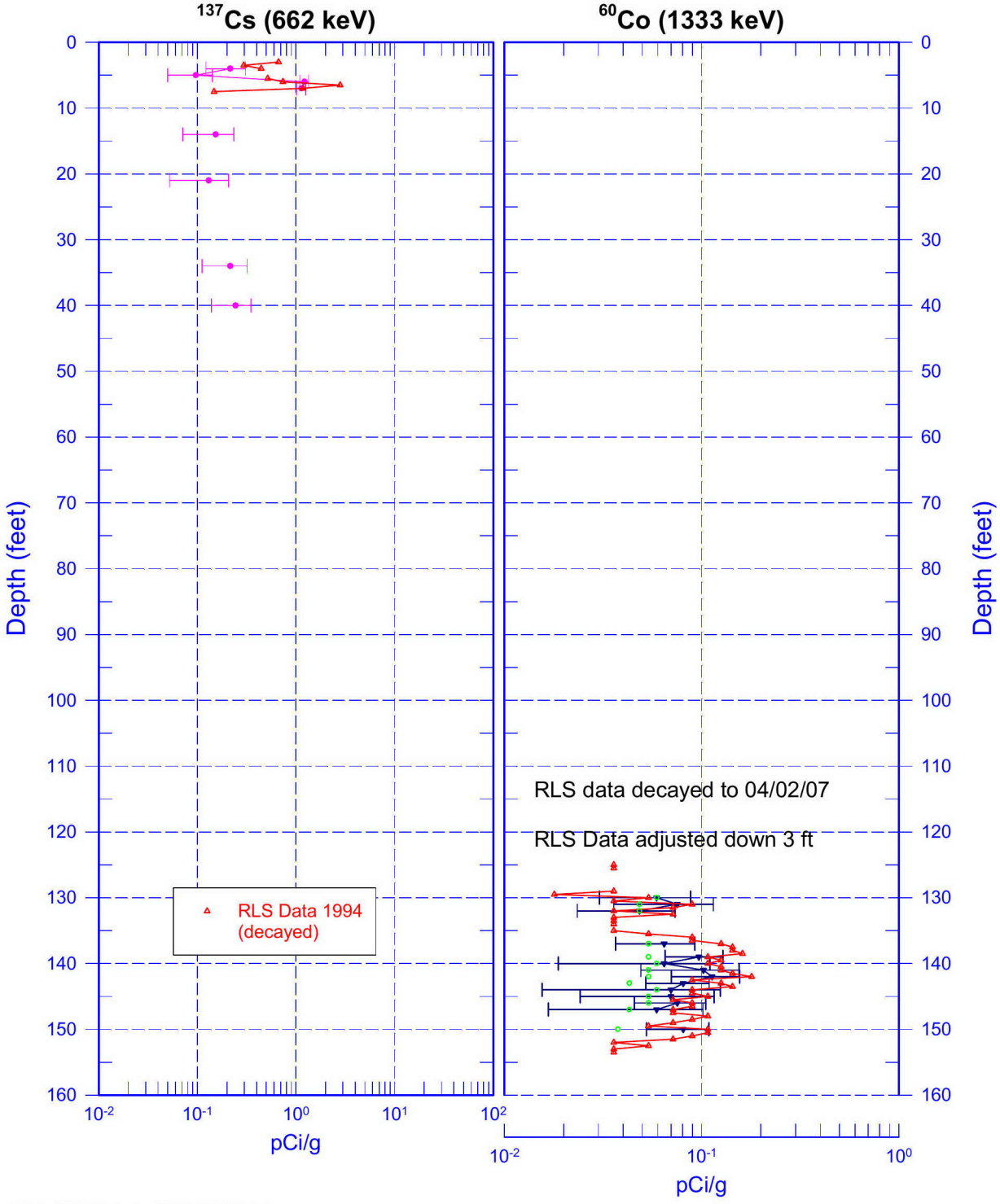

299-E27-14 (A4812) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Dead Time
Groundwater Level (08/28/07)
137Cs (662 keV)
60Co (1333 keV)
Depth (feet)
pCi/g
cps
percent
Zero Reference - Top of Casing


299-E27-14 (A4812) Combination Plot
Manmade Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Dead Time
137Cs (662 keV)
60Co (1333 keV)
Groundwater Level (03/28/07)
Depth (feet)
pCi/g
cps
percent
Zero Reference - Top of Casing

299-E27-14 (A4812)
Total Gamma (SGLS/RLS)



299-E27-14 (A4812)
Comparison of RLS (1994) and SGLS (2007)



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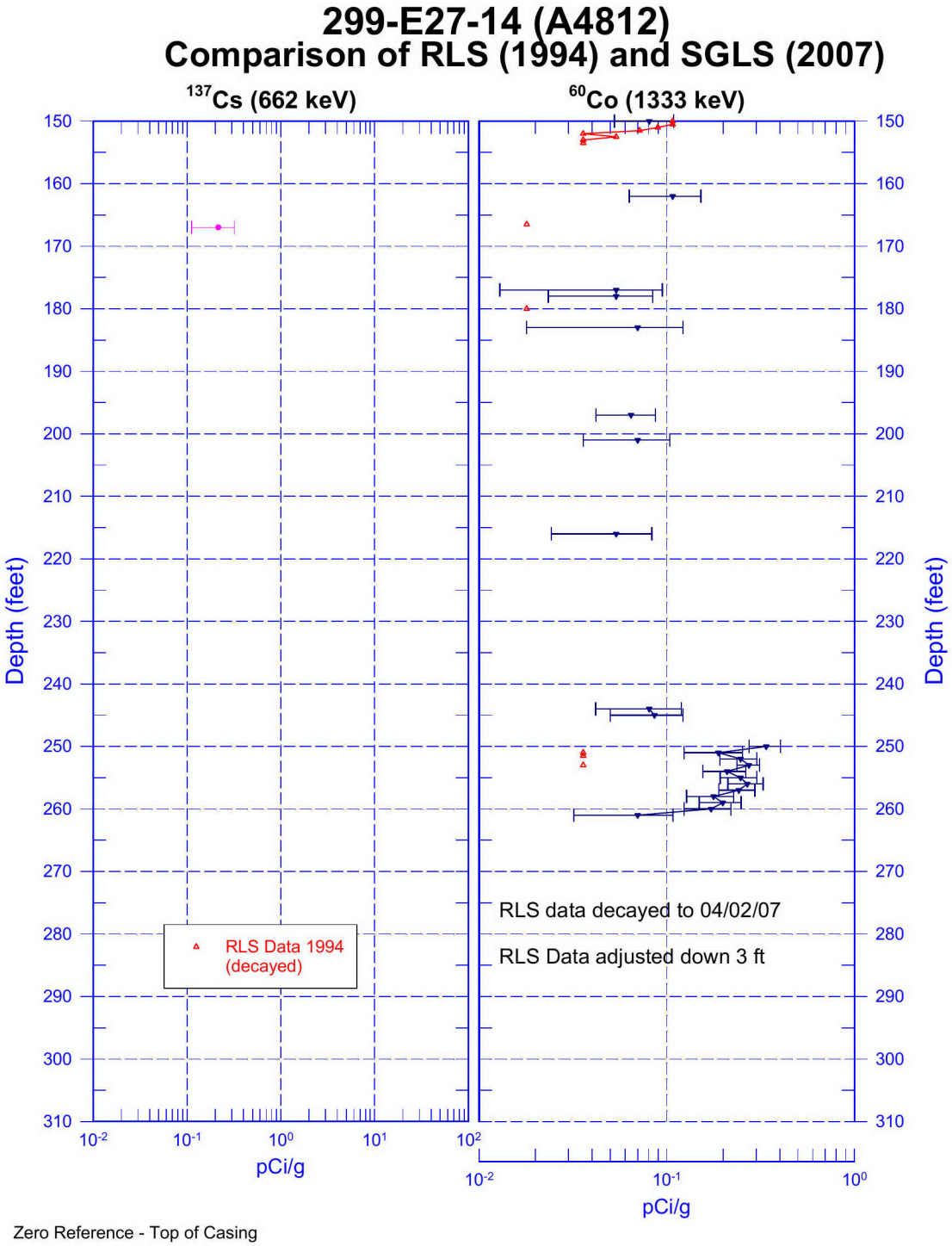
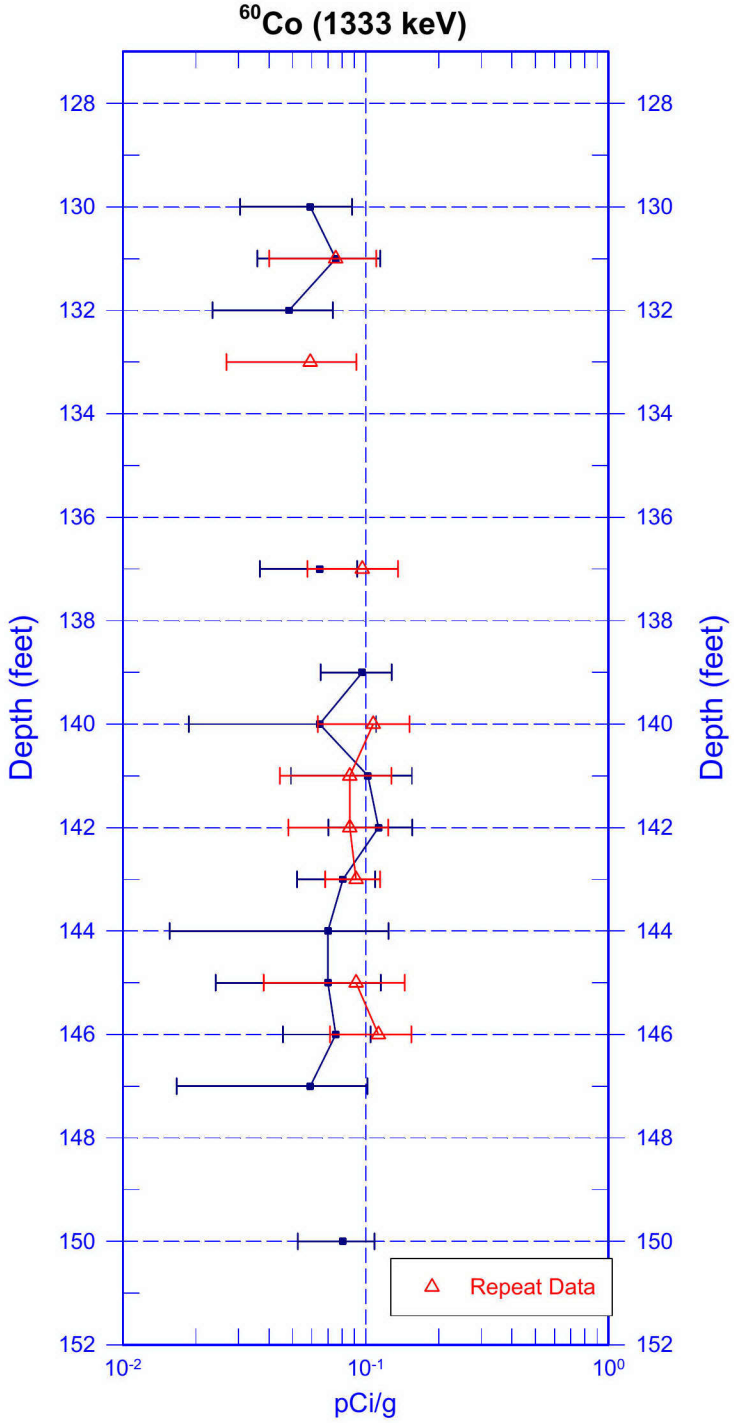


Zero Reference - Top of Casing

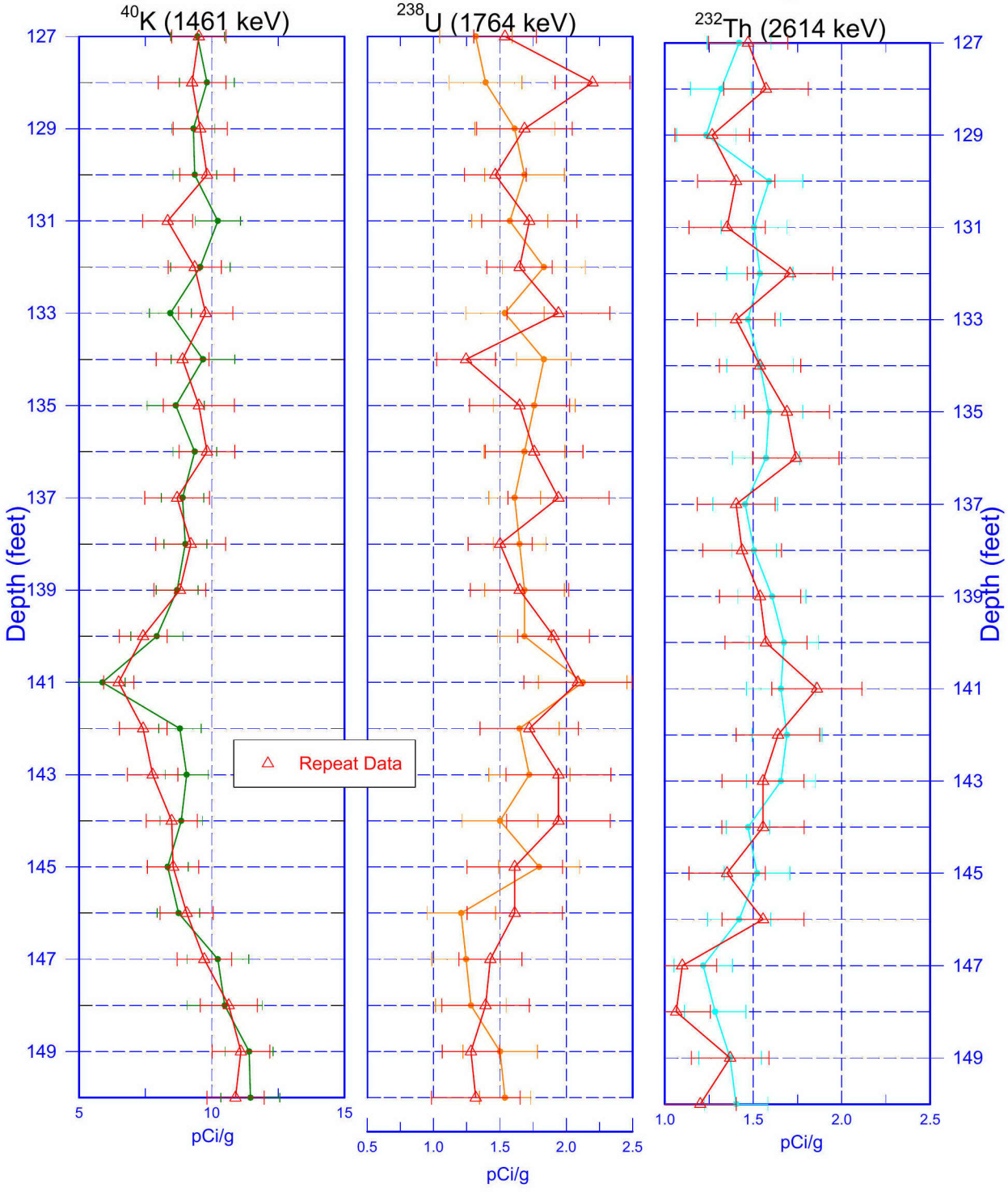
299-E27-14 (A4812)
Manmade Radionuclide Repeat Section



Zero Reference - Top of Casing

299-E27-14 (A4812)

Repeat Section of Natural Gamma Logs



Zero Reference - Top of Casing

WESTINGHOUSE HANFORD COMPANY

WELL NUMBER 299-E27-14 AREA 200-EAST

DATE 10-11-89

LOG RUN #2 LOG TYPE GAMMA RAY

SURVEY COORDINATES 42,700 N 48,144 E

ELEVATION DATUM Top of 8" CASING ELEVATION 658.43

LOG MEASURED FROM GROUND SURFACE

LOCATION DESCRIPTION S.E. SIDE 241-C TANK FARM

GROUND SURFACE ELEVATION 655.34

SURFACE TEMPERATURE 14.7°C WEATHER Cloudy

BOREHOLE INFORMATION

DRILLER LOUIS WATKINS KEH

DRILL RIG TYPE CABLE TOOL	BIT TYPE/DIAMETER REGULAR PATTERN 8"
BOREHOLE DIAMETER(S)/DEPTH 10" – 137' & 8" – 266'	
DEPTH DRILLER 266'	DEPTH LOGGER 265.6'
LIQUID LEVEL 250.02' G.S.	LIQUID APPEARANCE CLEAR
TEMPERATURE	

CASING RECORD

TYPE 10" CARBON STEEL	INTERVAL 137' – SURFACE
TYPE 8" CARBON STEEL	INTERVAL 8", 266' – SURFACE 2.1' Stickup
TYPE	INTERVAL
TYPE	INTERVAL

WELL SCREEN INTERVAL: NA

COMMENTS: DEPTH RETURN ERROR 2"

EQUIPMENT DATA

LOGGING COMPANY PNL

OPERATOR(S) V.L. McGhan

EQUIPMENT BRAND MLS — EQUIPMENT TYPE ANALOG

TOOL TYPE GAMMA RAY — BASE CALIBRATION DATE 12/88

SERIAL NO. CG27A97 — CALIBRATION REFERENCE WHC-EP-0246

CALIBRATION / PROBE FACTOR 8.53×10^{-2} eU ppm/c/s

DEAD TIME 7.4 μ SEC — WARM UP TIME 20 MIN.

LOGGING INFORMATION

LOG INTERVAL FROM 265.6' TO 100'

RERUN(S) 265.6' - 230'

PRE SURVEY CALIBRATION: POSITION 1 250 eU ppm/c/s POSITION 2 61 eU ppm/c/s BACKGROUND 265 c/s

LOGGING SPEED 5'/MIN.

START TIME 0915 — COMPLETION TIME 1000

CHART SPEED(S), FT/IN. 10'/IN.

CHART RECORDER HORIZONTAL SCALE, CPS/IN. 500 c/s, 50 c/s/IN.

RERUN SCALES, CPS/IN. 500 c/s, 50 c/s/IN.

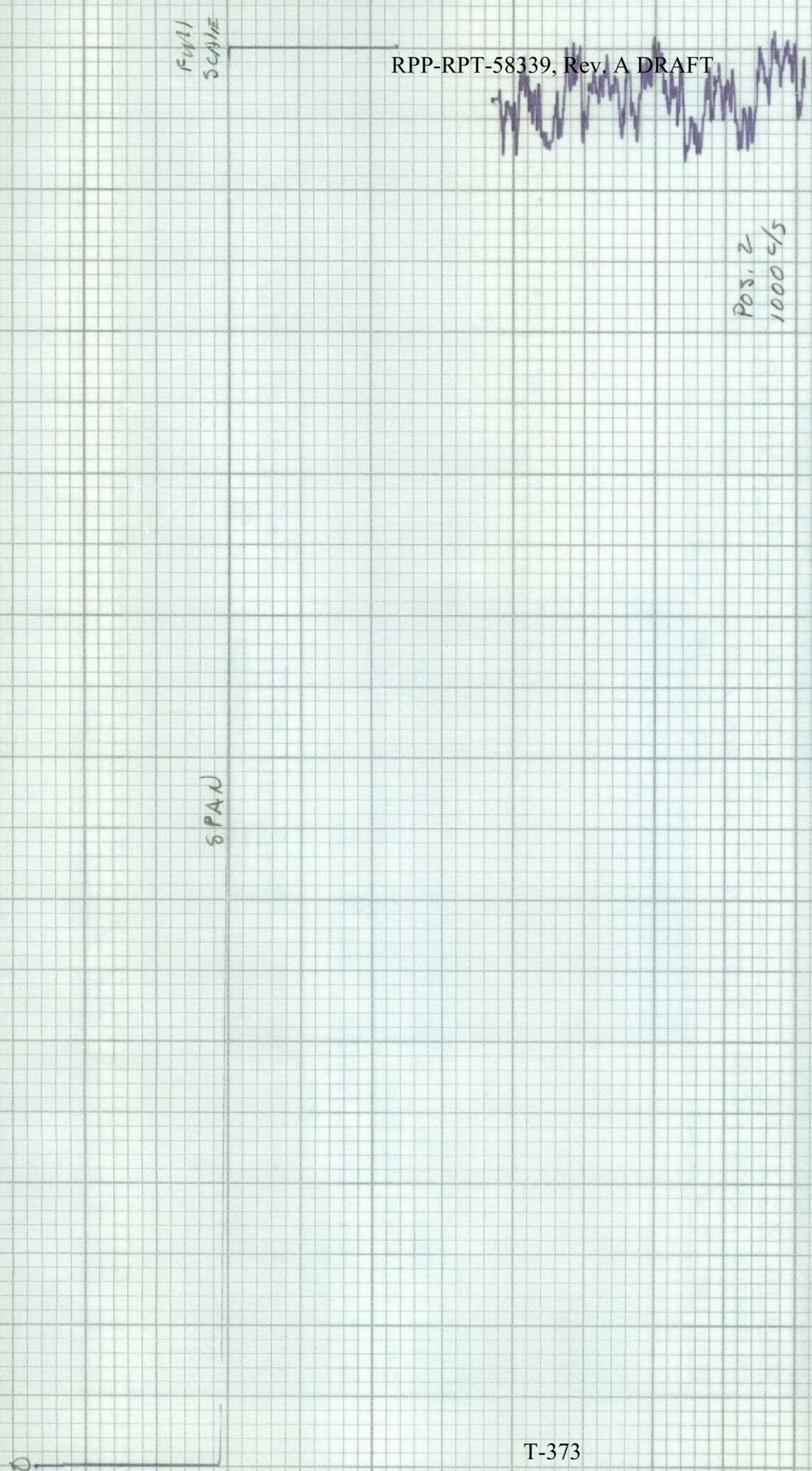
TIME CONSTANT(S) 1 SEC.

POST SURVEY CALIBRATION: POSITION 1 280 eU ppm/c/s POSITION 2 61 eU ppm/c/s BACKGROUND 260 c/s

PERCENT CHANGE: POSITION 1 10.7% POSITION 2 0 %

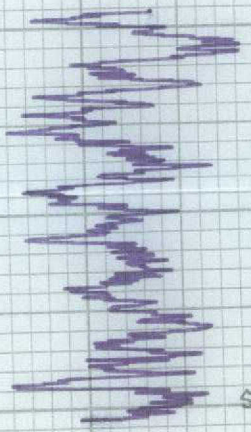
COMMENTS:

WITNESSED AND VERIFIED BY: J. K. Fowler 10-11-89


FULL SCALE
POS. 2
1000 C/S
POS. 1
6 PAD
0

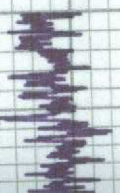
PULSE IN 5000 c/s
RM 10,000 c/s

PULSE IN 5000 c/s
RM 5000 c/s



POST-LOG CALIBRATION

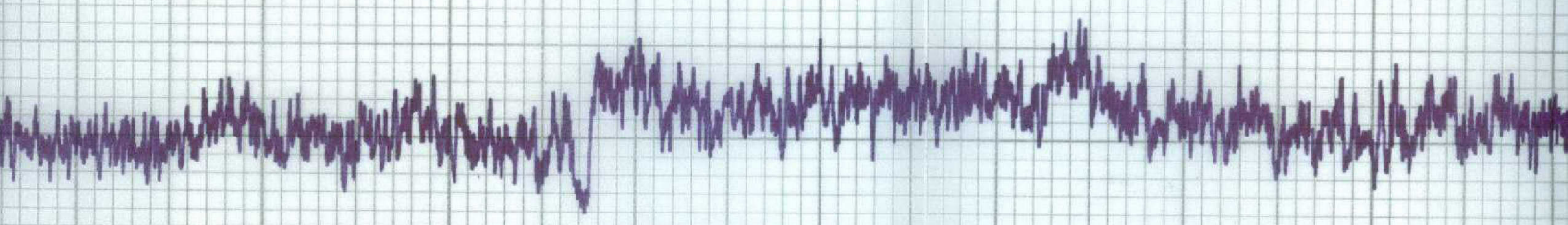
299-E27-14 265.6'-100'

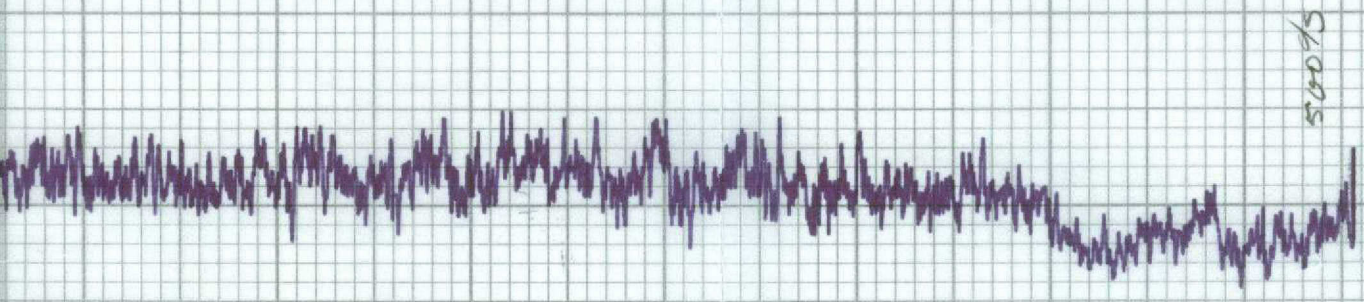


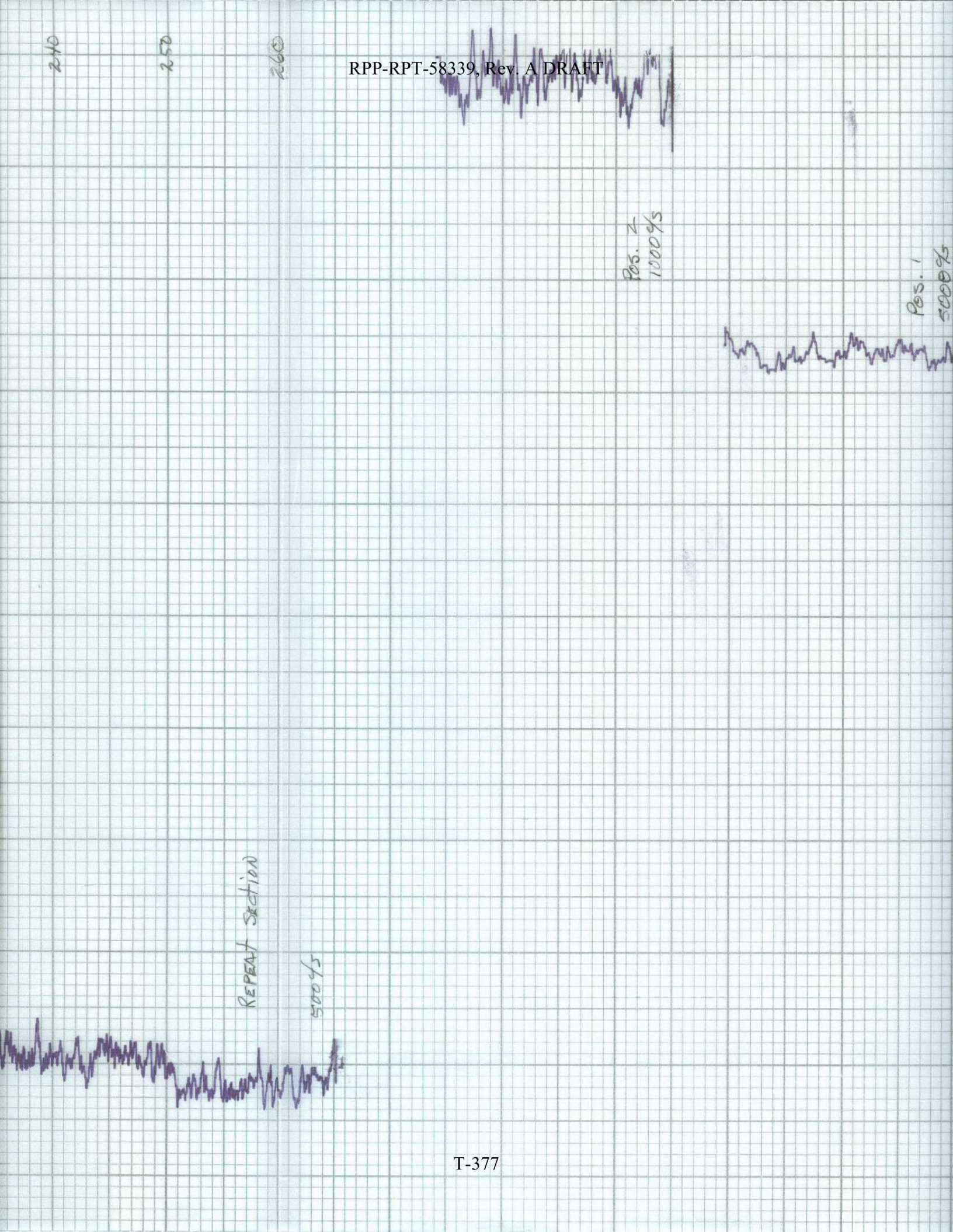
100

T-374

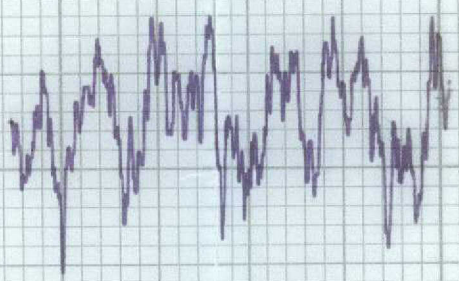
RPP-RPT-58339, Rev. A DRAFT



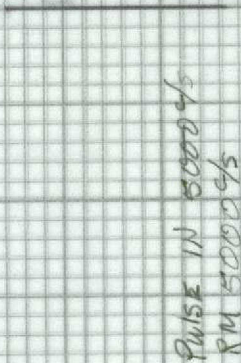



240
250
260
Pos. 2
1000#s
Pos. 1
500#s
REPEAT Section
500#s

Pos. 1
5000 c/s


BACKGROUND
500 c/s

Pulse in 5000 c/s
RM 10,000 c/s


Pulse in 5000 c/s
RM 5000 c/s

GROUNDWATER WELL LOGGING RESULTS FOR 299-E27-07 (A4816)

299-E27-07 (A4816)
Log Data Report

Borehole Information:

Borehole:		299-E27-07 (A4816)		Site:	East of 241-C Tank Farm
Coordinates (WA St Plane)		GWL[1] (ft):	237.75	GWL Date:	01/03/08
North (m)	East (m)	Drill Date	TOC Elevation	Total Depth (ft)	Type
136619.403	575220.59	01/08	638.24 ft	281	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	0	8		0.322	0	150
Welded Steel	0.4	6 5/8	6	9/32	0.4	281

Borehole Notes:

The logging engineer measured the 6-in.-casing diameter with a caliper and steel tape. The 8-in. casing is known to exist from the driller's log but is not visible at the ground surface. The 8-in. casing exists to 150 ft and was perforated from 20 to 140 ft. Grout was introduced into the borehole from the ground surface to 20 ft where a 10-in. temporary casing was removed from the borehole. Grout also exists in the annular space between the 6- and 8-in. casings. Between 234 ft and the bottom of the borehole, a 6-in. 20 slot screen is in place.

Logging Equipment Information:

Logging System:	Gamma 1L		Type: Serial No.:	SGLS HPGe (60%) 45TP22010A
Effective Calibration Date:	07/09/07	Calibration Reference:	HGLP-CC-019	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

Logging System:	Gamma 4H (with AmBe source)		Type: Serial No.:	NMLS H310700352
Effective Calibration Date:	11/06/07	Calibration Reference:	HGLP-CC-021	
		Logging Procedure:	HGLP-MAN-002, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5
Date	01/03/08	01/04/08	01/07/08	01/08/08	01/14/08
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	56.0	120.0	175.0	174.0	214.0
Finish Depth (ft)	0.0	55.0	119.0	215.0	262.0
Count Time (sec)	200	200	200	200	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0	1.0
Pre-Verification	AL010CAB	AL011CAB	AL012CAB	AL013CAB	AL016CAB
Start File	AL010000	AL011000	AL012000	AL013000	AL016000
Finish File	AL010056	AL011065	AL012056	AL013041	AL016048
Post-Verification	AL010CAA	AL011CAA	AL012CAA	AL013CAA	AL016CAA
Depth Return Error (in.)	- 1.0	0	0	0	0
Comments	No fine gain adjustment	No fine gain adjustment	No fine gain adjustment	No fine gain adjustment	No fine gain adjustment

Log Run	6 Repeat				
Date	01/03/08				
Logging Engineer	Spatz				
Start Depth (ft)	171.0				
Finish Depth (ft)	45.0				
Count Time (sec)	200				
Live/Real	R				
Shield (Y/N)	N				
MSA Interval (ft)	1.0				
Pre-Verification	AL017CAB				
Start File	AL017000				
Finish File	AL017027				
Post-Verification	AL017CAA				
Depth Return Error (in.)	0				
Comments	No fine gain adjustment				

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	7	8 Repeat			
Date	01/23/08	01/23/08			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	140.0	150.0			
Finish Depth (ft)	237.5	160.0			
Count Time (sec)	15	15			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	0.25	0.25			
Pre-Verification	DHA32CAB	DHA32CAB			
Start File	DHA32000	DHA32391			
Finish File	DHA32390	DHA32431			
Post-Verification	DHA32CAA	DHA32CAA			
Depth Return Error (in.)	N/A	- 2.0			
Comments	None	None			

Logging Operation Notes:

Logging was conducted with a centralizer on the sondes. All measurements are referenced to top of casing.

Analysis Notes:

Analyst:	Henwood	Date:	02/19/08	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre- and post-run verifications for the logging systems were performed before and after each day's data acquisition. The acceptance criteria were met.

A combined casing correction of 0.60325 (0.2813 + 0.322 for the 6- and 8-in. casings, respectively) thick casing was applied to the SGLS data to 150 ft. Below 150 ft, a correction for 0.28125-in. thick casing was applied for the single 6-in. casing. Data acquired below the 237.75 ft water level were also corrected for water inside the casing.

The moisture data are reported in percent volumetric moisture according to calibration for a 6-in. borehole. The data acquired from 140 to 150 ft can be used qualitatively, only, as this interval contains double casing and grout for which there is no calibration.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL worksheet template identified as G1Ljuly07.xls using efficiency functions and corrections for casing, dead time, and water as determined from annual calibrations.

Results and Interpretations:

Cs-137 was detected near the ground surface (0 to 3 ft) at concentrations less than 1 pCi/g.

Co-60 was detected from 133 to 136 ft, from 150 to 158 ft, and at several isolated depth intervals. Concentrations are all below 1 pCi/g. The Co-60 is probably related to plumes originating in C Farm. Co-60 may be important as a tracer for other contaminants such as Tc-99.

Evidence of processed uranium (U-238 and U-235) exists between 93 and 108 ft. U-238 concentrations are determined by the Pa-234m energy peak at 1001 keV. U-235 is directly measured by the 185.72 keV energy peak. The maximum concentrations for U-238 and U-235 are approximately 21and 2 pCi/g. U-235 is not detected at every depth location where U-238 is identified because it is very near its MDL. It is possible the concentrations are significantly underestimated because this depth interval is double cased and grouted.

The detection of processed uranium at 100 ft is significant, as it has not been previously detected in any of the approximately 70 boreholes in C Farm. The nearest tank to this borehole (C-201) is approximately 110 ft away. All four of the 200 series tanks in C Farm were designated assumed leakers, but there are no drywells in that area. It is recommended one or more boreholes be drilled in the vicinity of these 200 series tanks to investigate the source of uranium. Note that Co-60 and Pa-234m do not contribute detectable amounts to the total gamma activity; high resolution spectral gamma logging is required to detect and assay these contaminants.

Moisture data indicate some variability. Between 140 and 150 ft, the log profile likely reflects the non-standard borehole condition of double casing and grout and should be used qualitatively.

Repeat sections acquired for each logging system indicate good repeatability.

List of Log Plots:

Depth Reference is top of casing

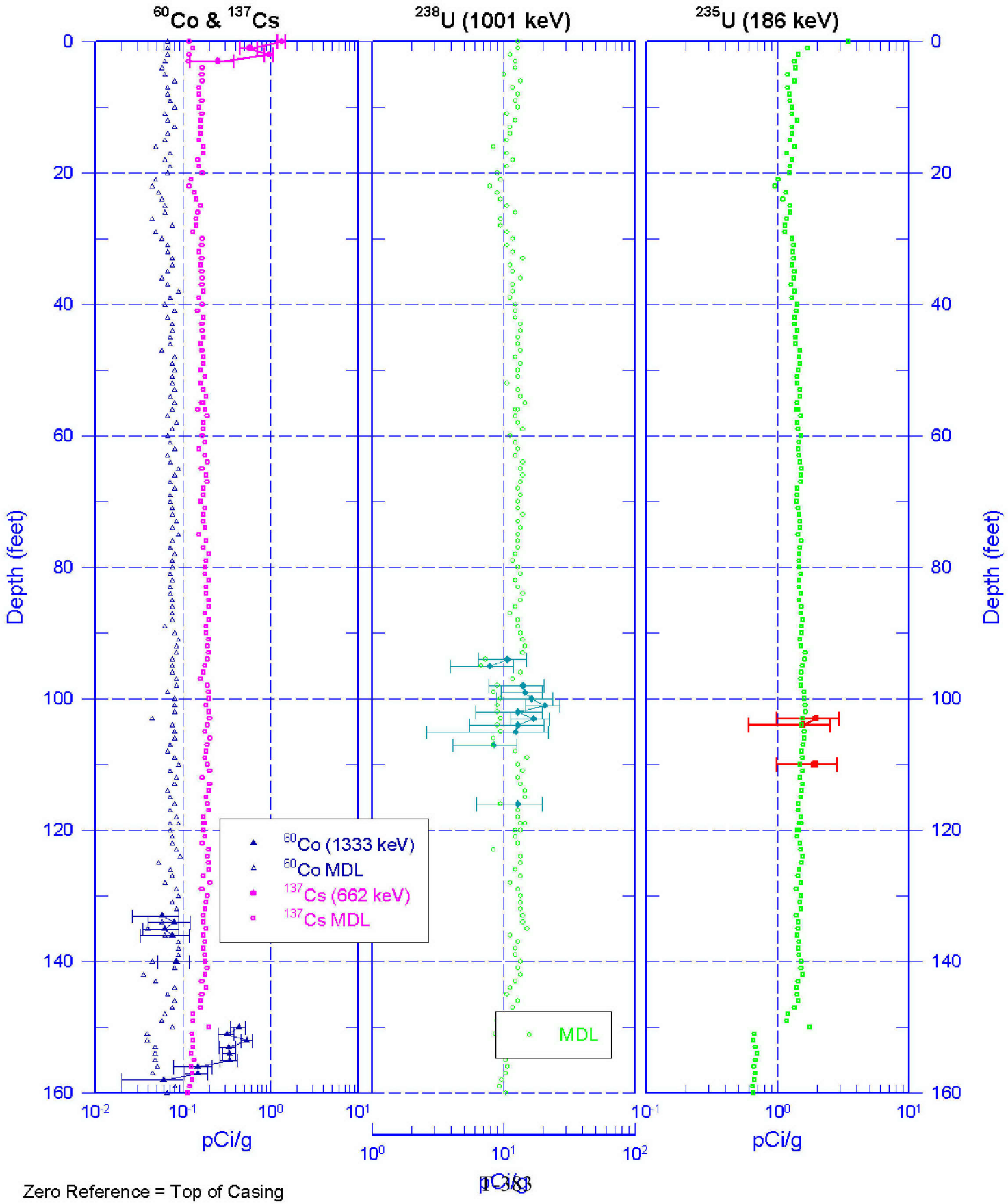
Manmade Radionuclides (2 pages)
Natural Gamma Logs (2 pages)
Combination Plot (3 pages)
Combination Plot (0 to 280 ft)
Total Gamma & Moisture
Repeat Section for Manmade Radionuclides
Repeat Section of Natural Gamma Logs
Repeat Section for Total Gamma & Moisture

[1] GWL – groundwater level

Stoller
Hanford Office

299-E27-07 (A4816)

Man-Made Radionuclides

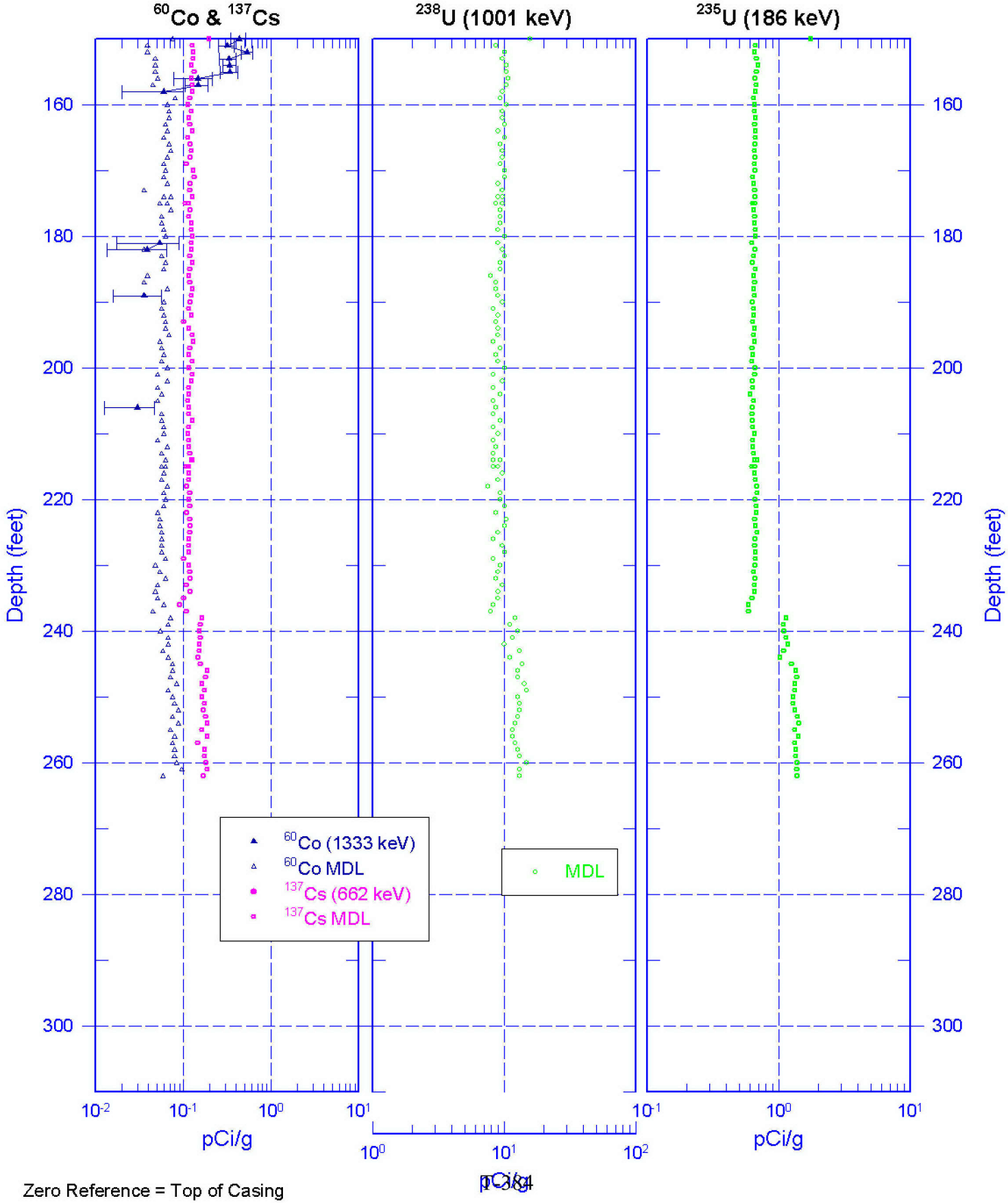


Zero Reference = Top of Casing

Stoller
Hanford Office

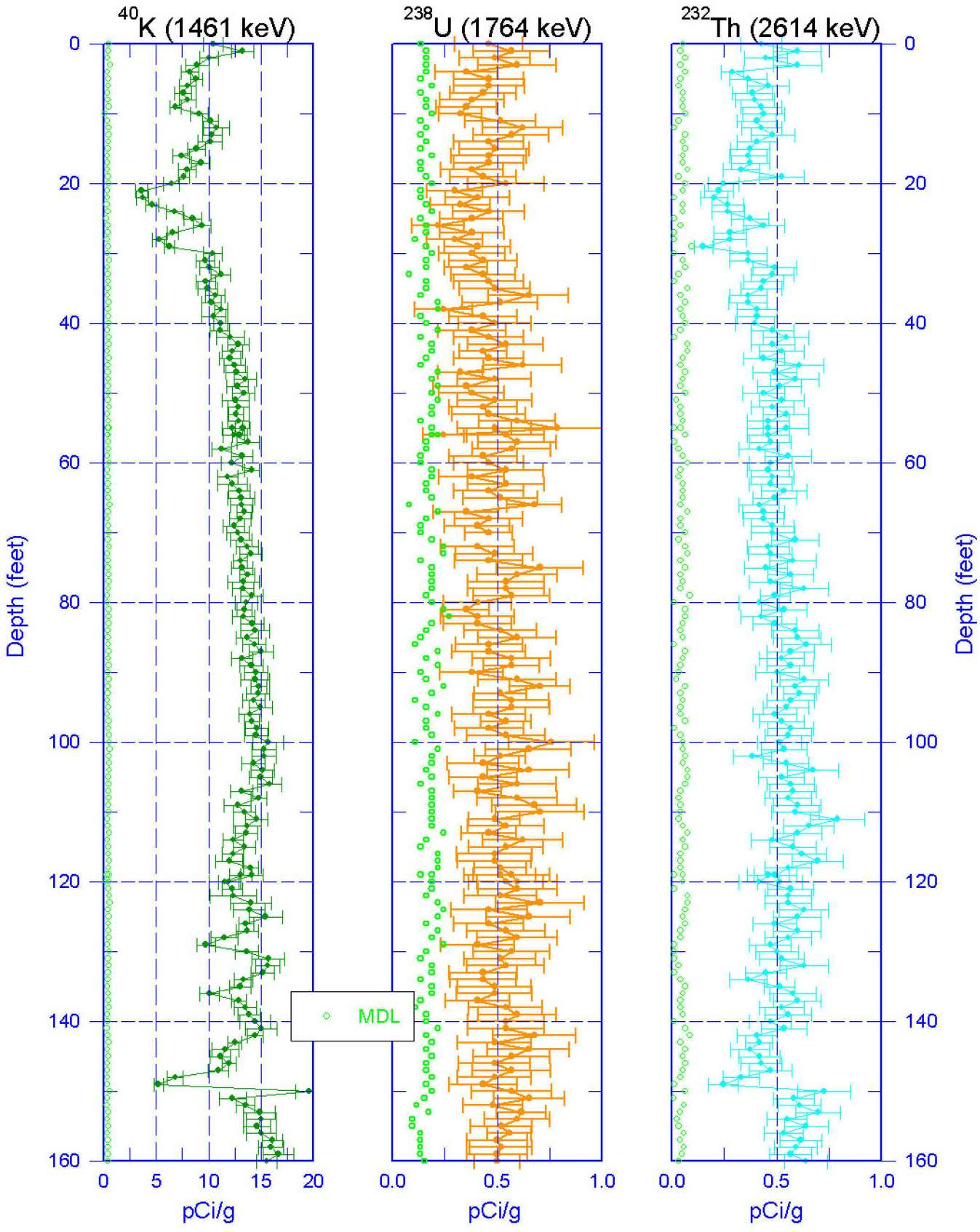
299-E27-07 (A4816)

Man-Made Radionuclides



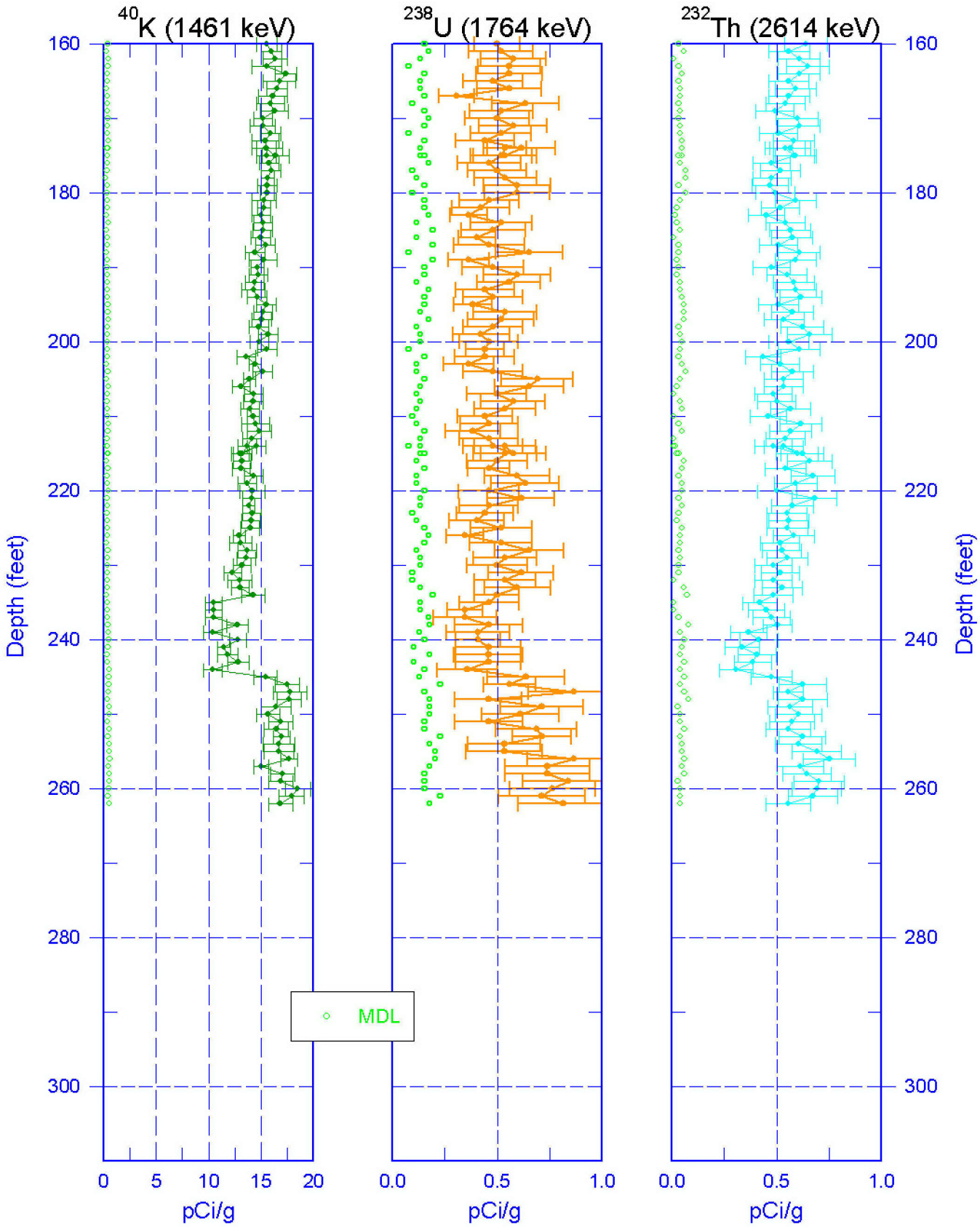
Zero Reference = Top of Casing

299-E27-07 (A4816)
Natural Gamma Logs



Zero Reference = Top of Casing

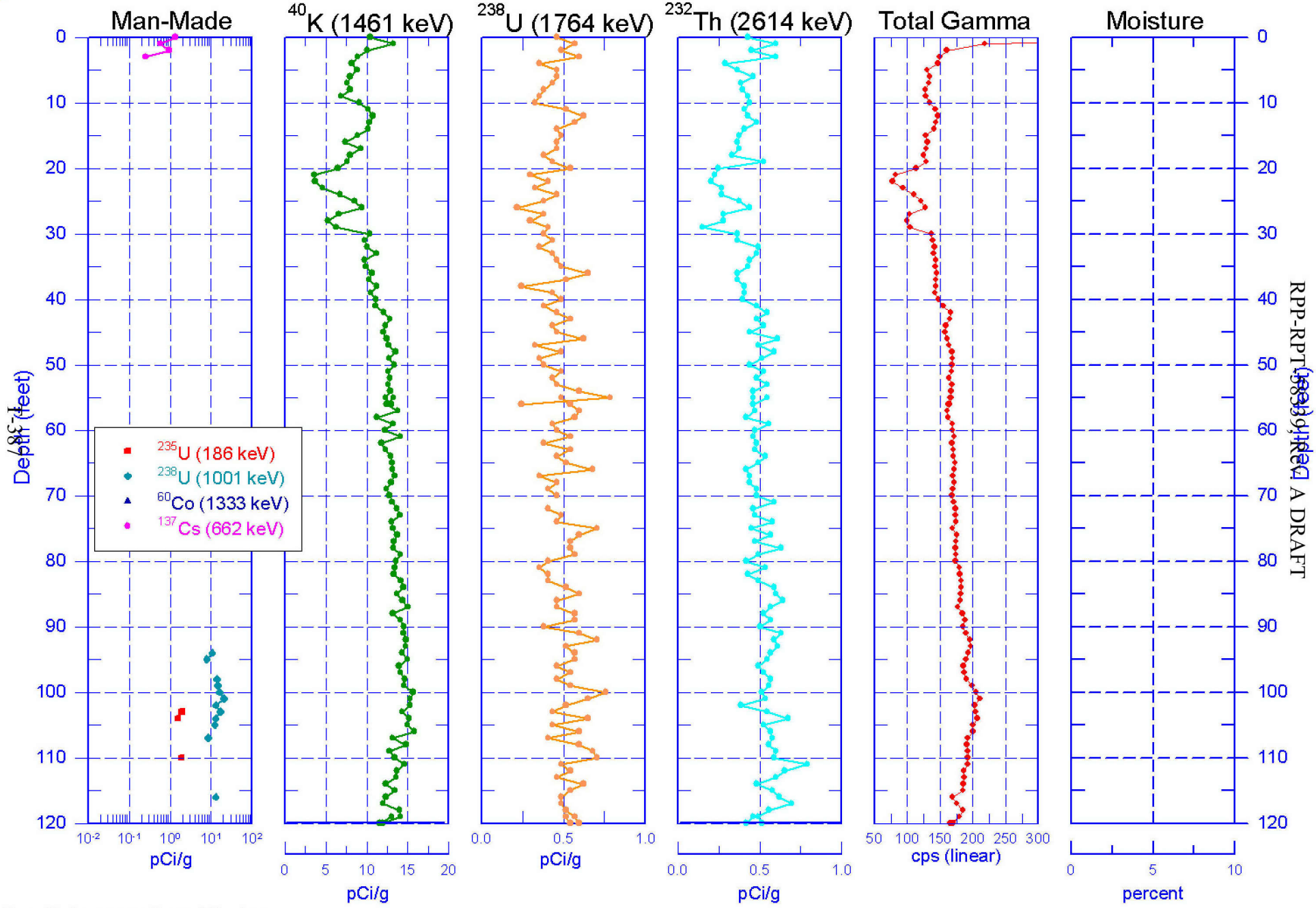
299-E27-07 (A4816)
Natural Gamma Logs



Zero Reference = Top of Casing

Stoller
Hanford Office

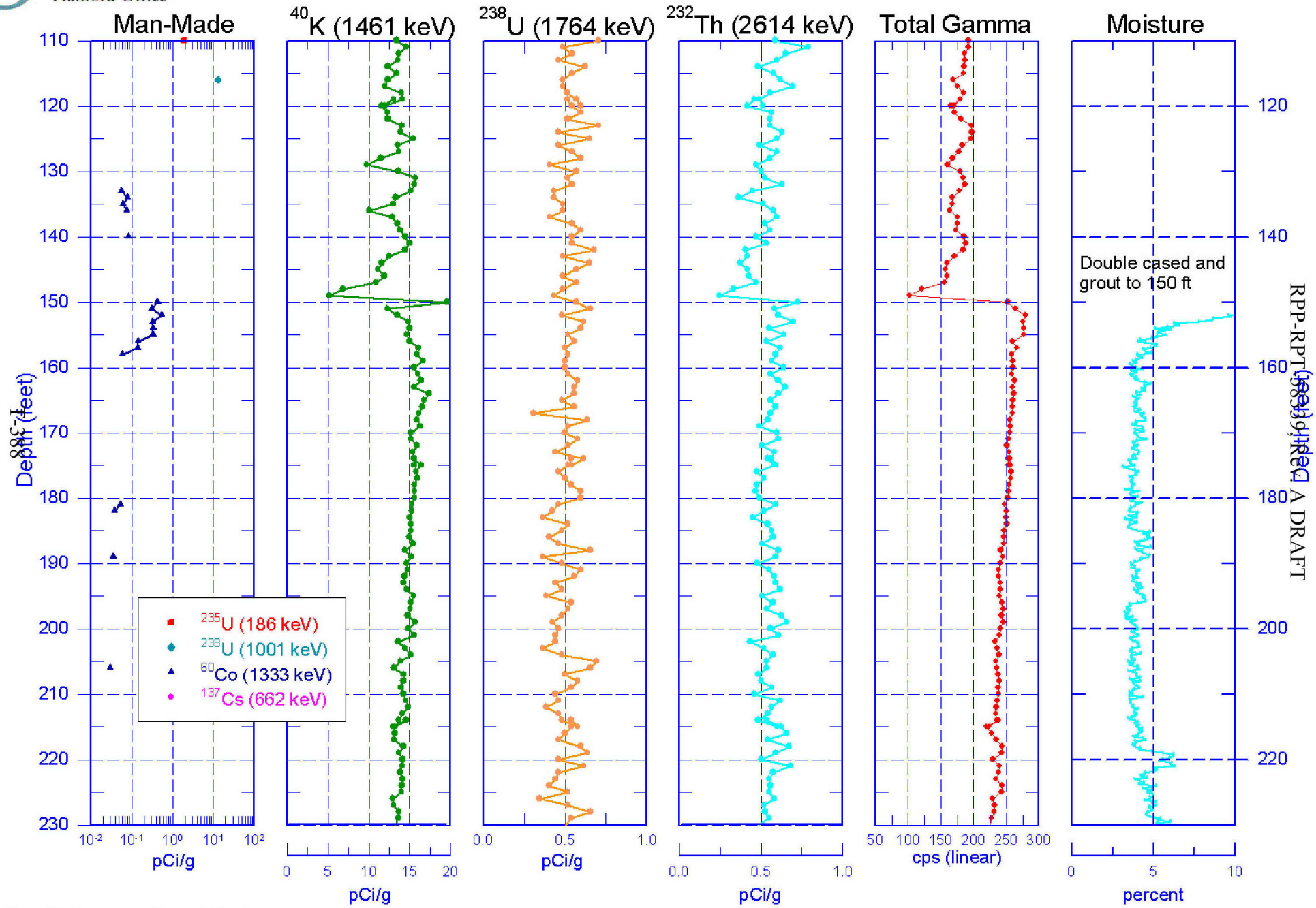
299-E27-07 (A4816) Combination Plot



Zero Reference = Top of Casing

Stoller
Hanford Office

299-E27-07 (A4816) Combination Plot

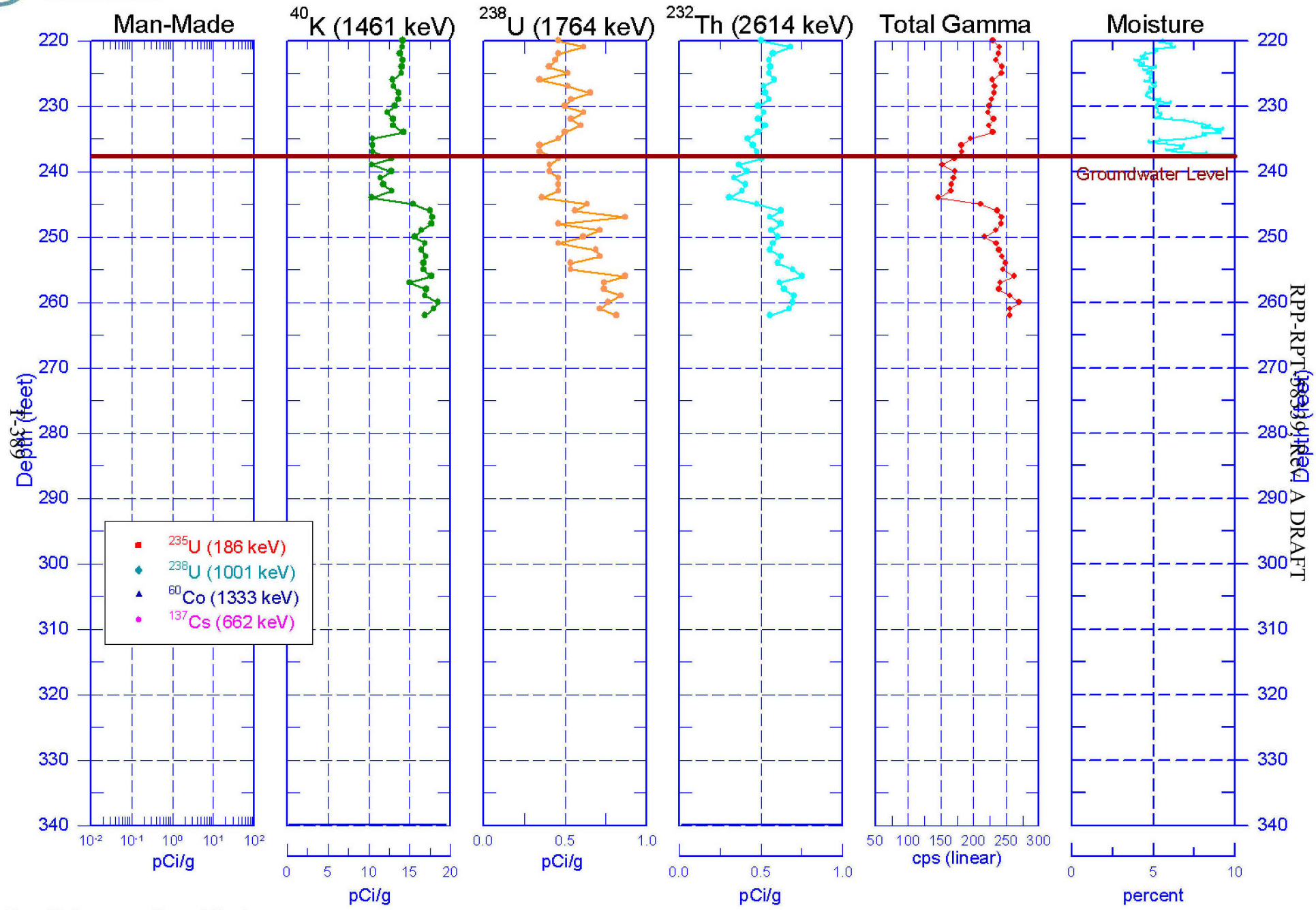


Zero Reference = Top of Casing

RPP-RPT-58339, Rev. A DRAFT

Stoller
Hanford Office

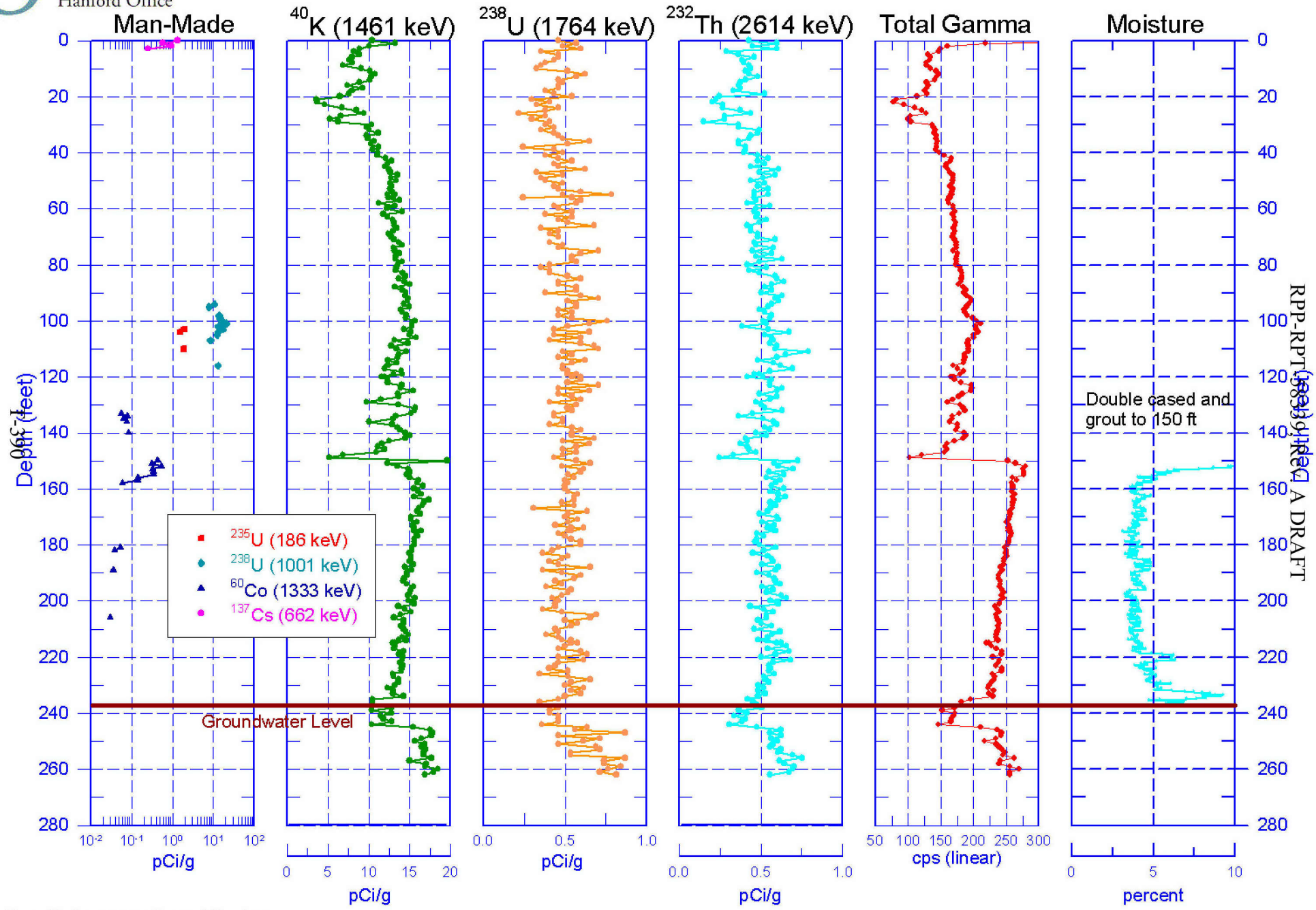
299-E27-07 (A4816) Combination Plot



Zero Reference = Top of Casing

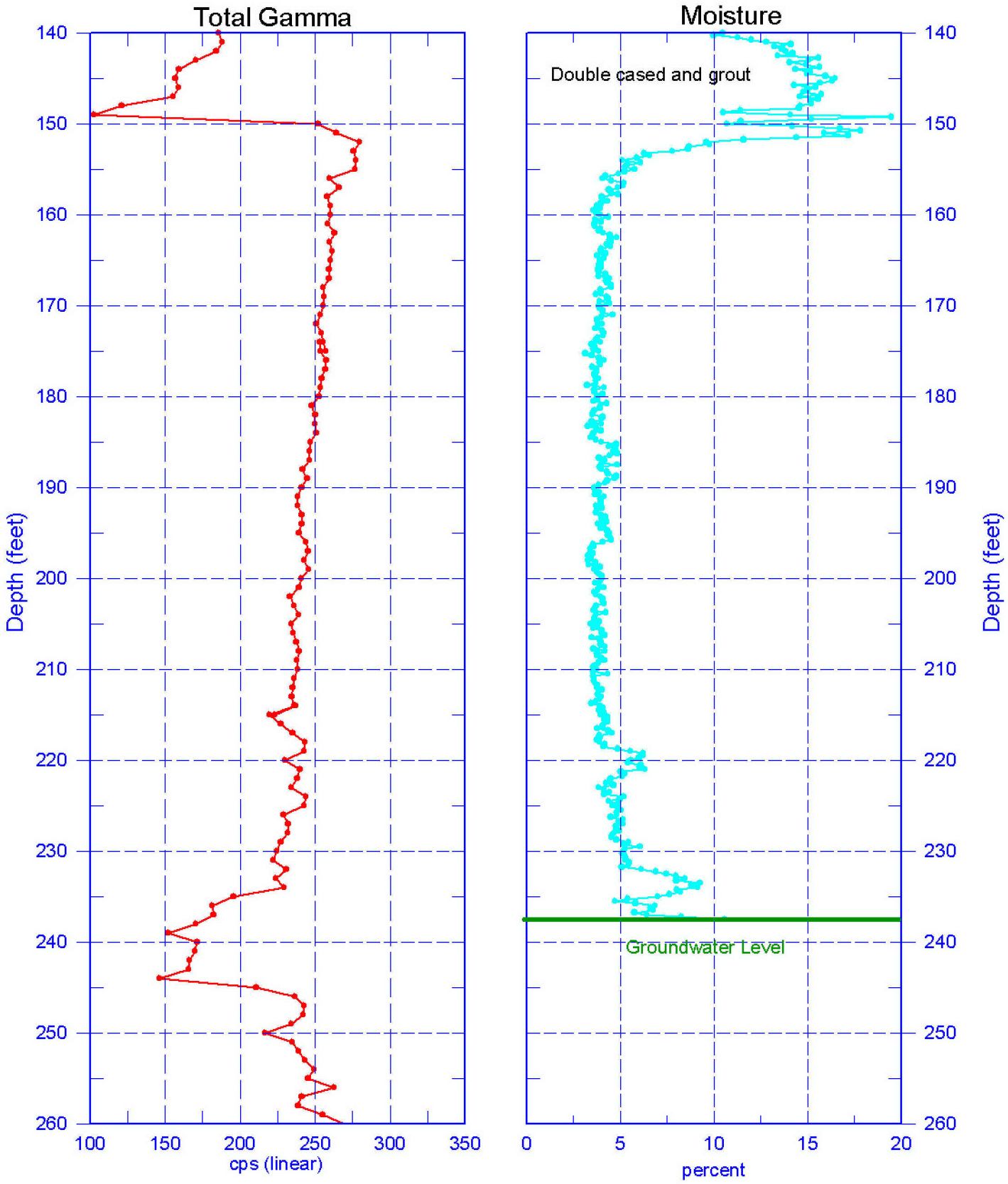
Stoller
Hanford Office

299-E27-07 (A4816) Combination Plot



Zero Reference = Top of Casing

299-E27-07 (A4816)
Total Gamma & Moisture

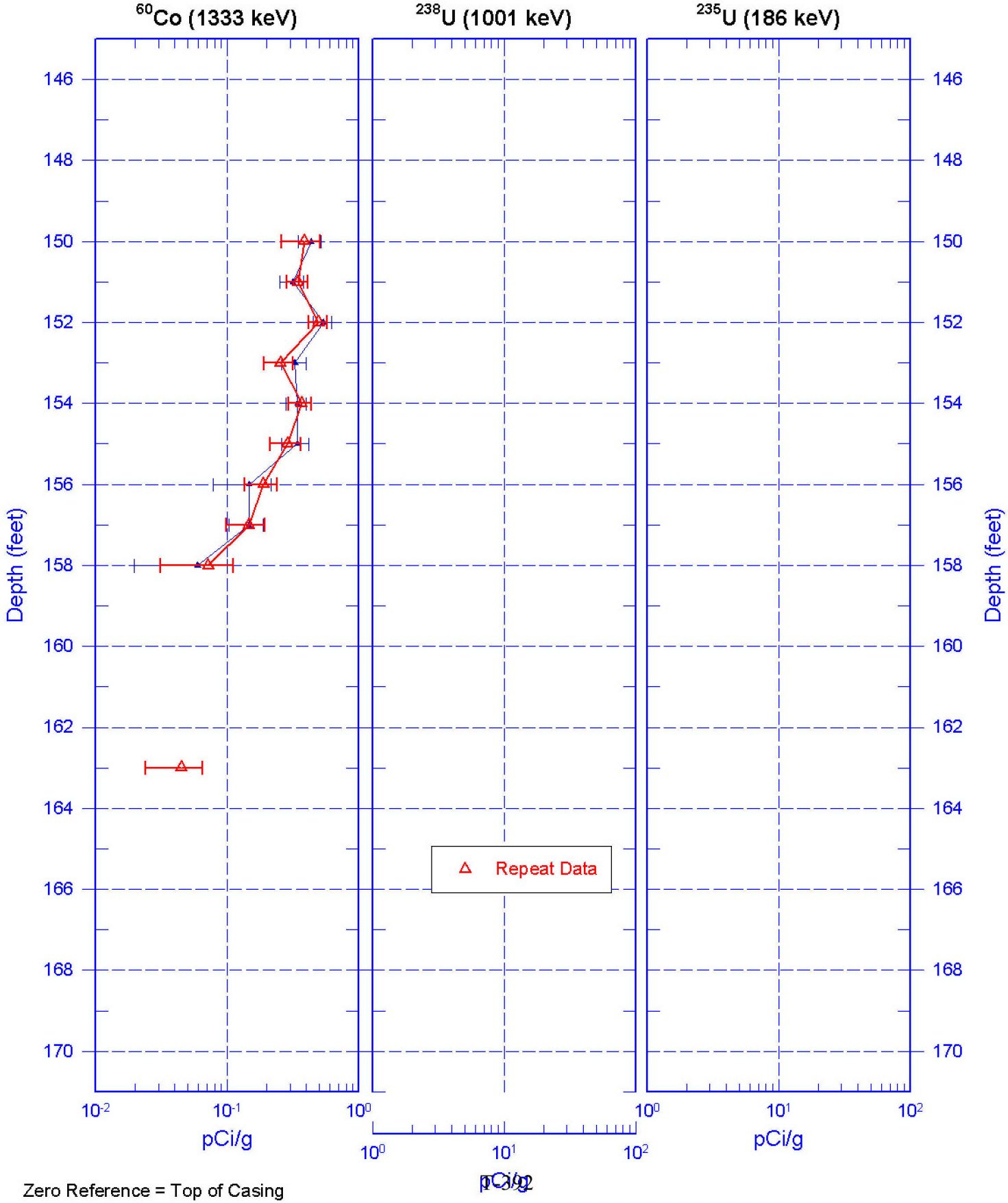


Reference - Top of Casing

Stoller
Hanford Office

299-E27-07 (A4816)

Repeat Section for Man-Made Radionuclides

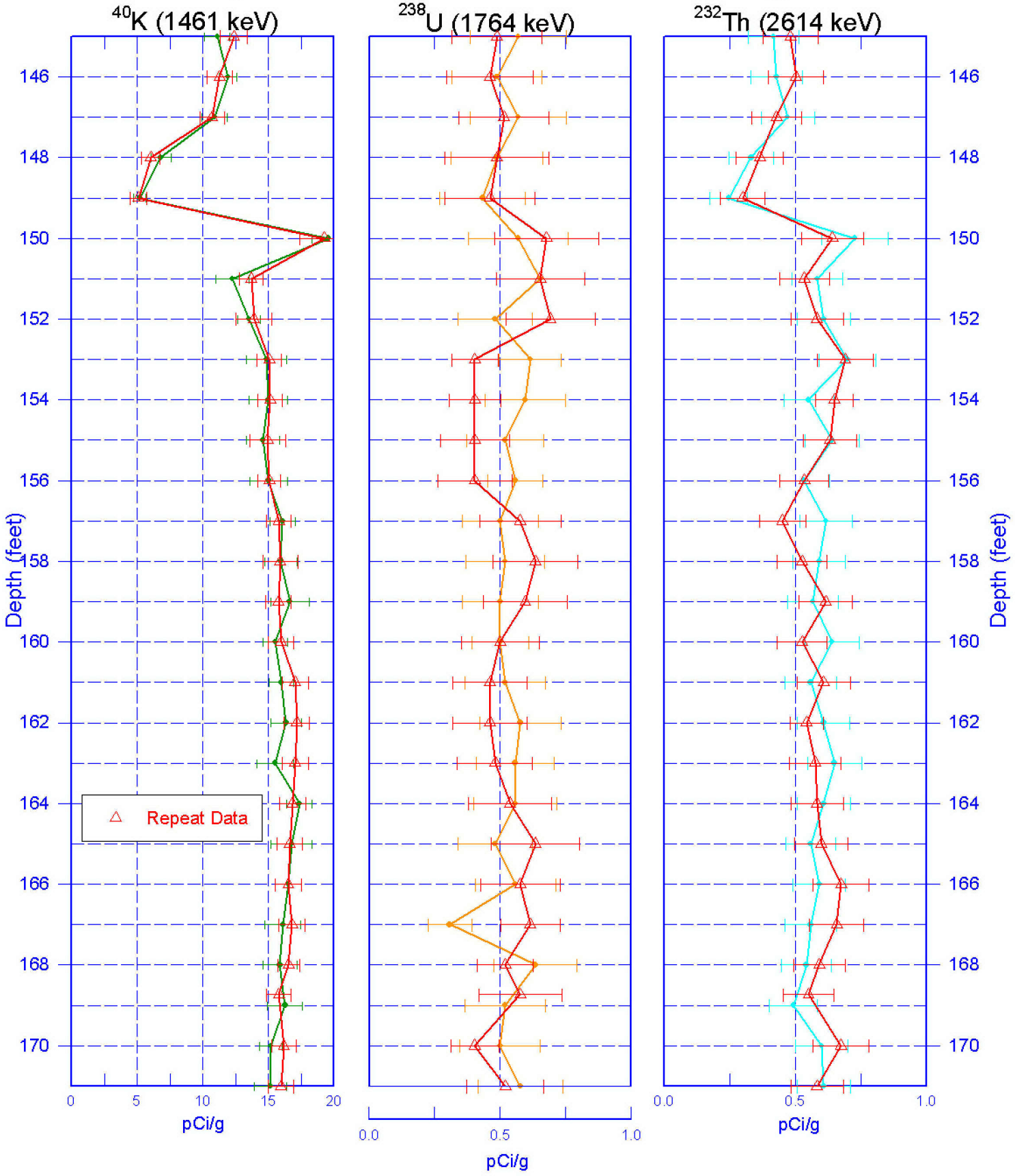


Zero Reference = Top of Casing

Stoller Hanford Office

299-E27-07 (A4816)

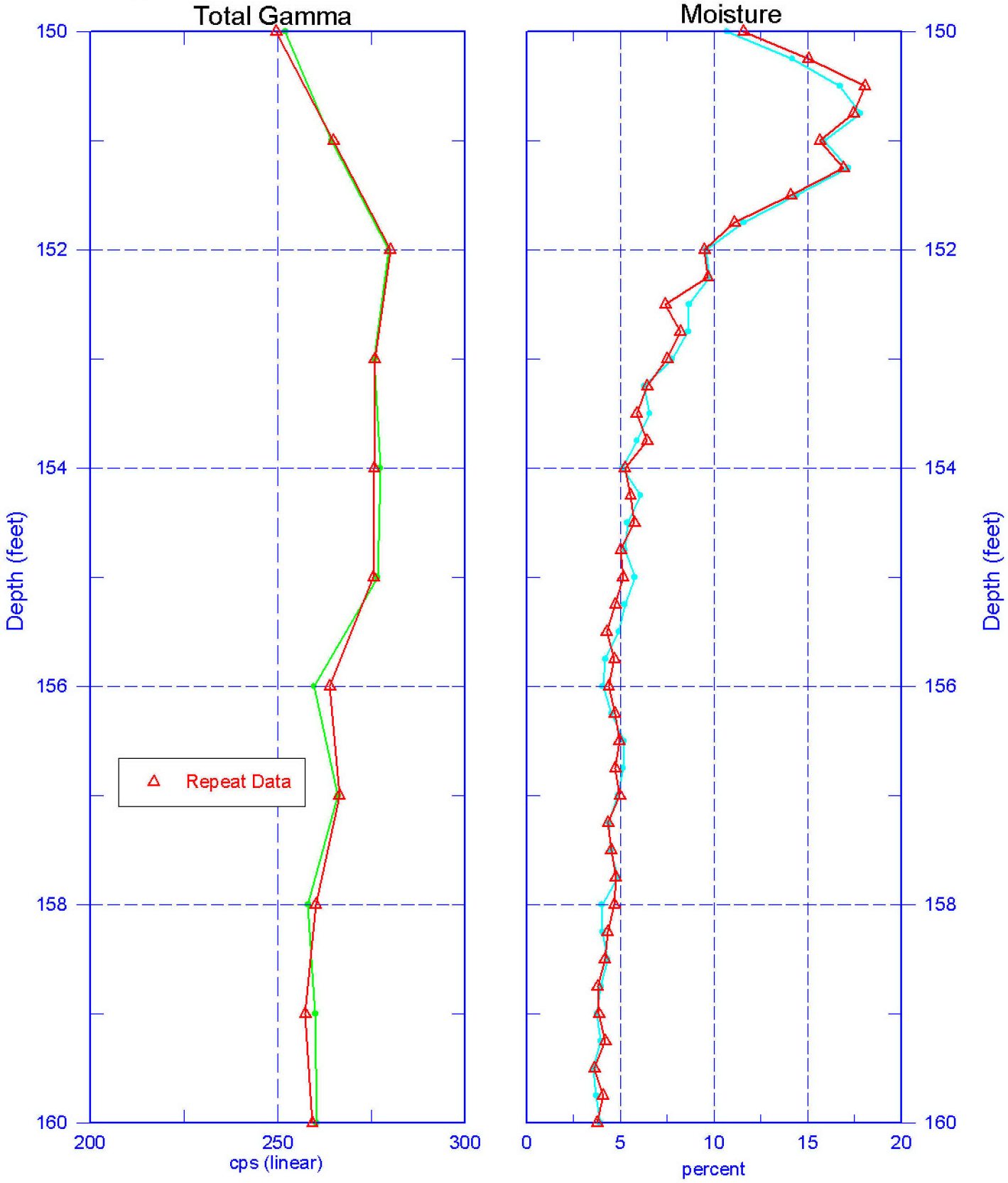
Repeat Section of Natural Gamma Logs



Zero Reference = Top of Casing

299-E27-07 (A4816)

Repeat Section for Total Gamma & Moisture



Reference - Top of Casing

GROUNDWATER WELL LOGGING RESULTS FOR C4124

Stoller
Grand Junction Office established 1959

C-4124
Log Data Report

Borehole Information:

Borehole: C-4124			Site: North of C Tank Farm		
Coordinates (WA St Plane)		GWL[1] (ft) : 230		GWL Date: 09/08/03	
North (Estimated)	East (Estimated)	Drill Date	Ground Level Elevation	Total Depth (ft)	Type
136650 m	575200 m	09/03	Not available	268.0	Becker

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	3.55	9.0	8.0	0.50	+3.55	268.0
Steel Tubing	3.1	6.24	6.0	0.120	+3.1	268.0

Borehole Notes:

The casing dimensions are derived from published values for Becker drill casing. Casing thicknesses at the joints are 0.875- and 0.240-in. for the 8- and 6-in. casings, respectively. The total depth of the borehole was provided by the driller. The well site geologist provided the depth to water. Borehole coordinates were provided by Fluor Hanford's person in charge and are estimates. Ground level elevation was not available. Logging data acquisition is referenced to the ground surface.

Logging Equipment Information:

Logging System:	Gamma 1E		Type:	SGLS (70%) SN: 34TP11019B
Calibration Date:	07/03	Calibration Reference:	GJO-2003-468-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat			
Date	09/08/03	09/08/03			
Logging Engineer	Kos	Kos			
Start Depth (ft)	266.45	31.45			
Finish Depth (ft)	0.45	4.45			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A[2]	N/A			
Pre-Verification	AE031CAB	AE031CAB			
Start File	AE031000	AE031267			
Finish File	AE031266	AE031294			

Log Run	1	2 Repeat			
Post-Verification	AE031CAA	AE031CAA			
Depth Return Error (in.)	-1.25	0			
Comments	No fine-gain adjustment.	No fine-gain adjustment.			

Logging Operation Notes:

Spectral gamma logging was performed in this borehole on September 8, 2003. Logging was conducted with a centralizer on the sonde. Logging was inadvertently initialized at the top of casing. Because the casing was not permanent, during analysis all measurements were corrected by the amount of stickup (3.55 ft) so that the ground surface is the reference point. A repeat section was collected in this borehole to evaluate system performance.

Analysis Notes:

Analyst:	Henwood	Date:	09/10/03	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging system were performed before and after data acquisition. Acceptance criteria were met.

A combined casing correction for 0.620-in.-thick casing was applied throughout the borehole for both casings. The combined thickness at casing joints is 1.115 in. This thickness results in a significant reduction in gamma activity detection as the detector passes by a casing joint. However, it is not practical to correct individual data points for the effect of casing joints. The influence of the thick joints is apparent on the total gamma and ^{40}K logs where reduced count rates and concentrations are exhibited at approximately 10-ft depth intervals.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with an EXCEL worksheet template identified as G1EJul03.xls using efficiency functions and corrections for casing, water, and dead time as determined from annual calibrations. Dead time corrections are applied where dead times exceed 10.5 percent; no dead times in excess of 10.5 percent were encountered. Correction for water was applied to the data below 230 ft.

Log Plot Notes:

Separate log plots are provided for the man-made radionuclide (^{137}Cs) detected in the borehole, naturally occurring radionuclides (^{40}K, ^{238}U, ^{232}Th [KUT]), a combination of man-made, KUT, and dead time, and total gamma plotted with dead time. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, casing corrections, or water corrections. A repeat log section is also included.

Results and Interpretations:

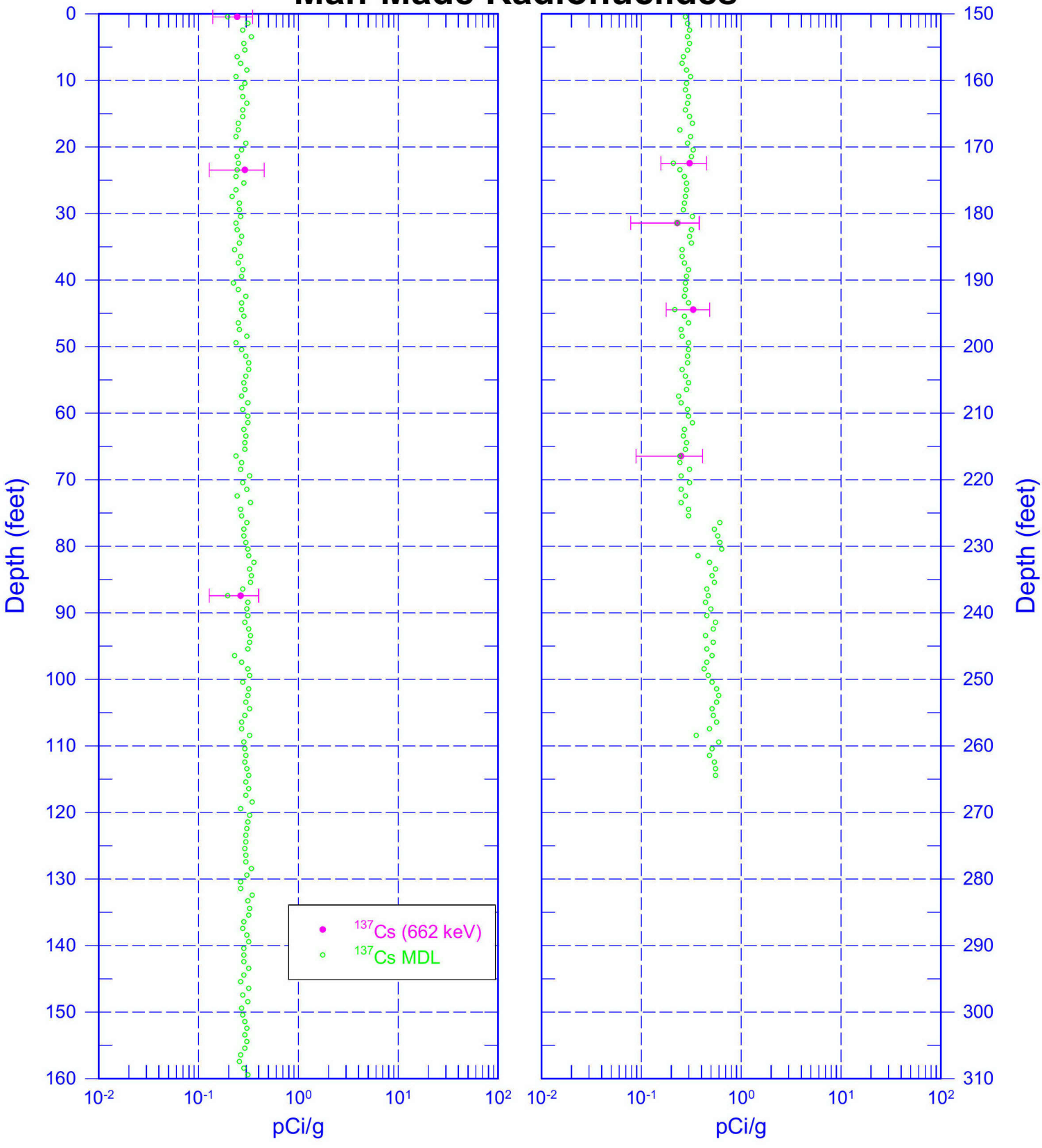
^{137}Cs was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected at a few sporadic locations throughout the borehole near its MDL of approximately 0.2 pCi/g.

The repeat section indicated good agreement of the naturally occurring KUT.

[1] GWL – groundwater level
[2] N/A – not applicable

C-4124

Man-Made Radionuclides

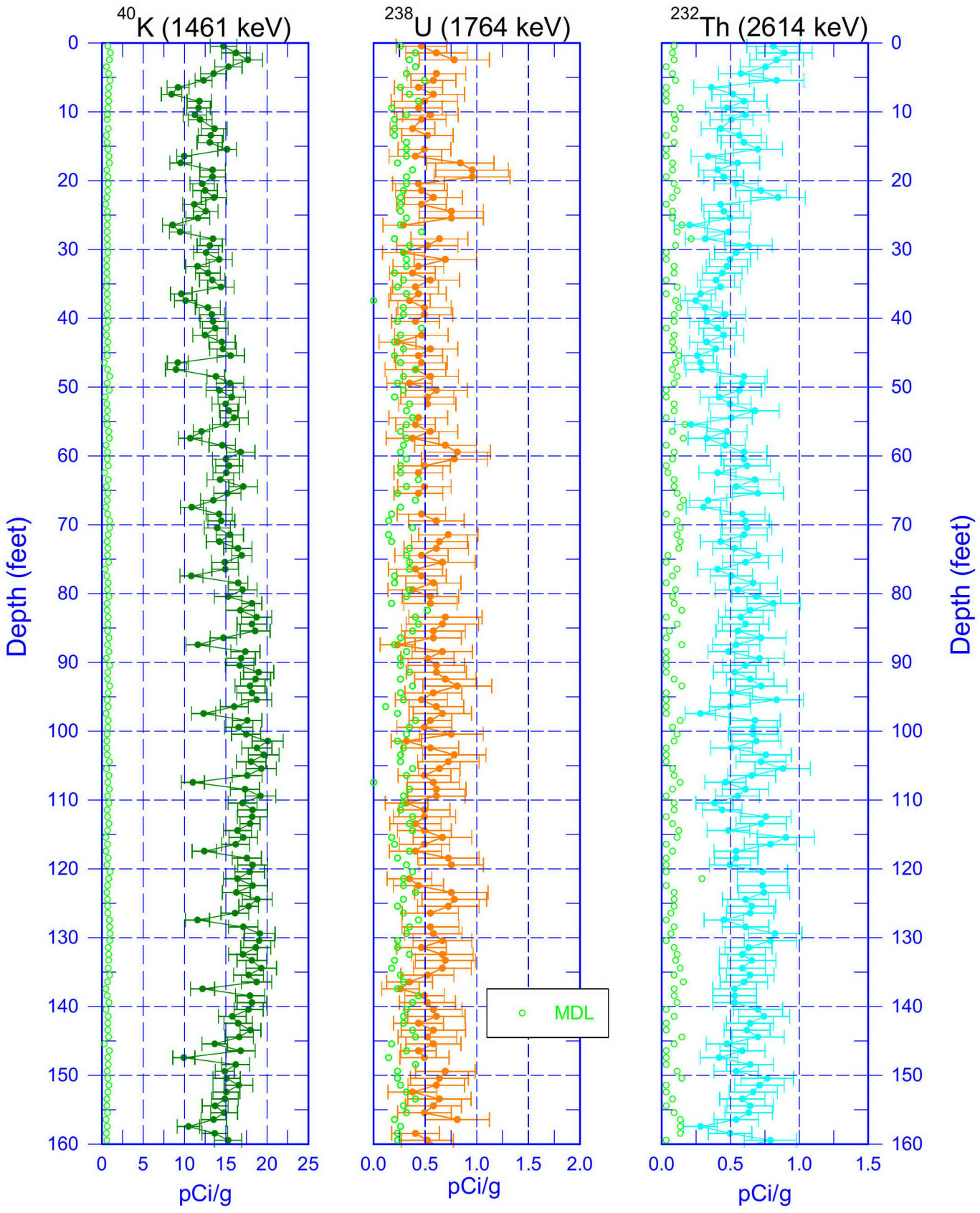


Zero Reference = Ground Surface

Depth scale: 1" = 20 ft

Last Log Date - 09/08/03

C-4124
Natural Gamma Logs



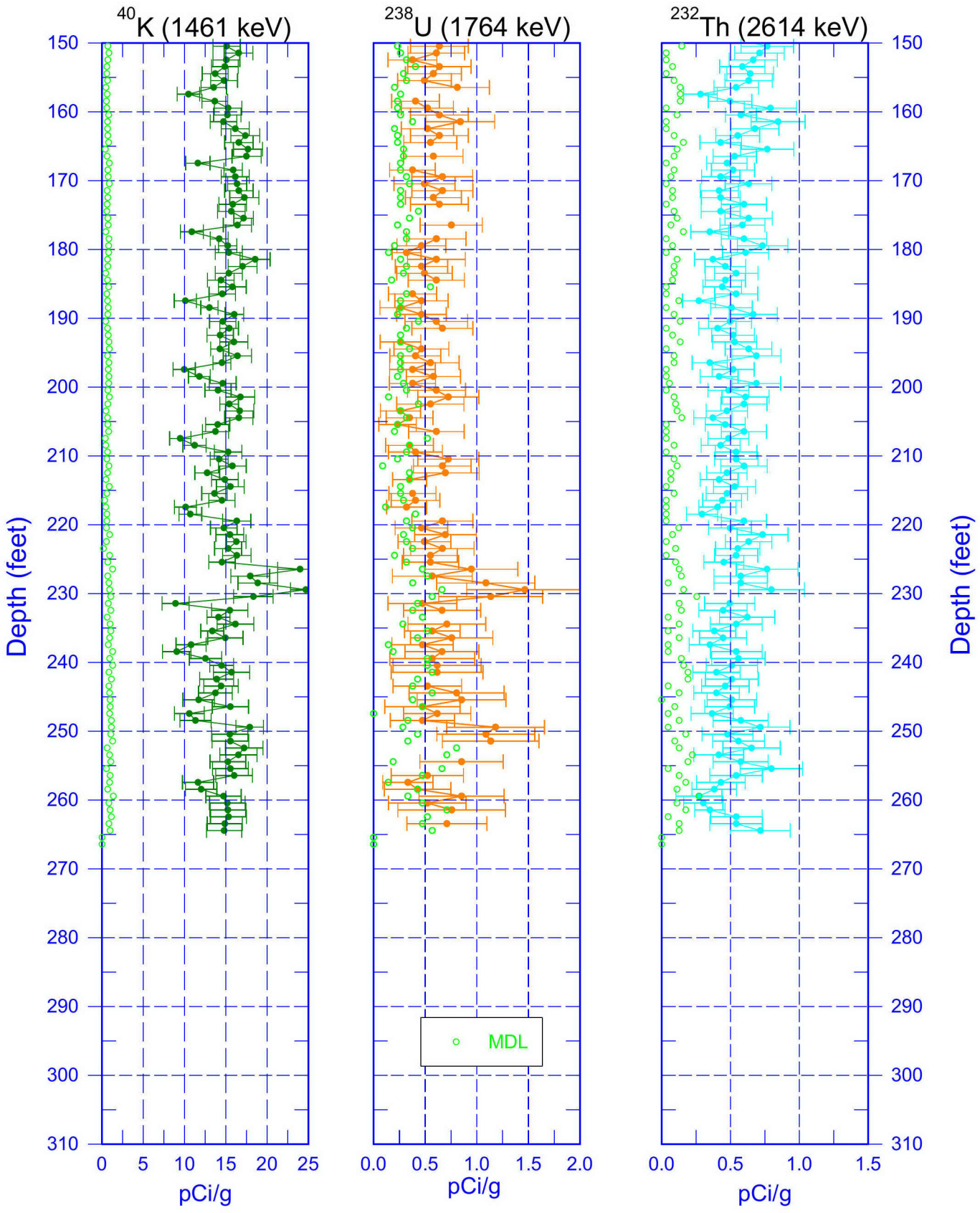
Zero Reference = Ground Surface

Depth scale: 1" = 20 ft

Last Log Date - 09/08/03

C-4124

Natural Gamma Logs

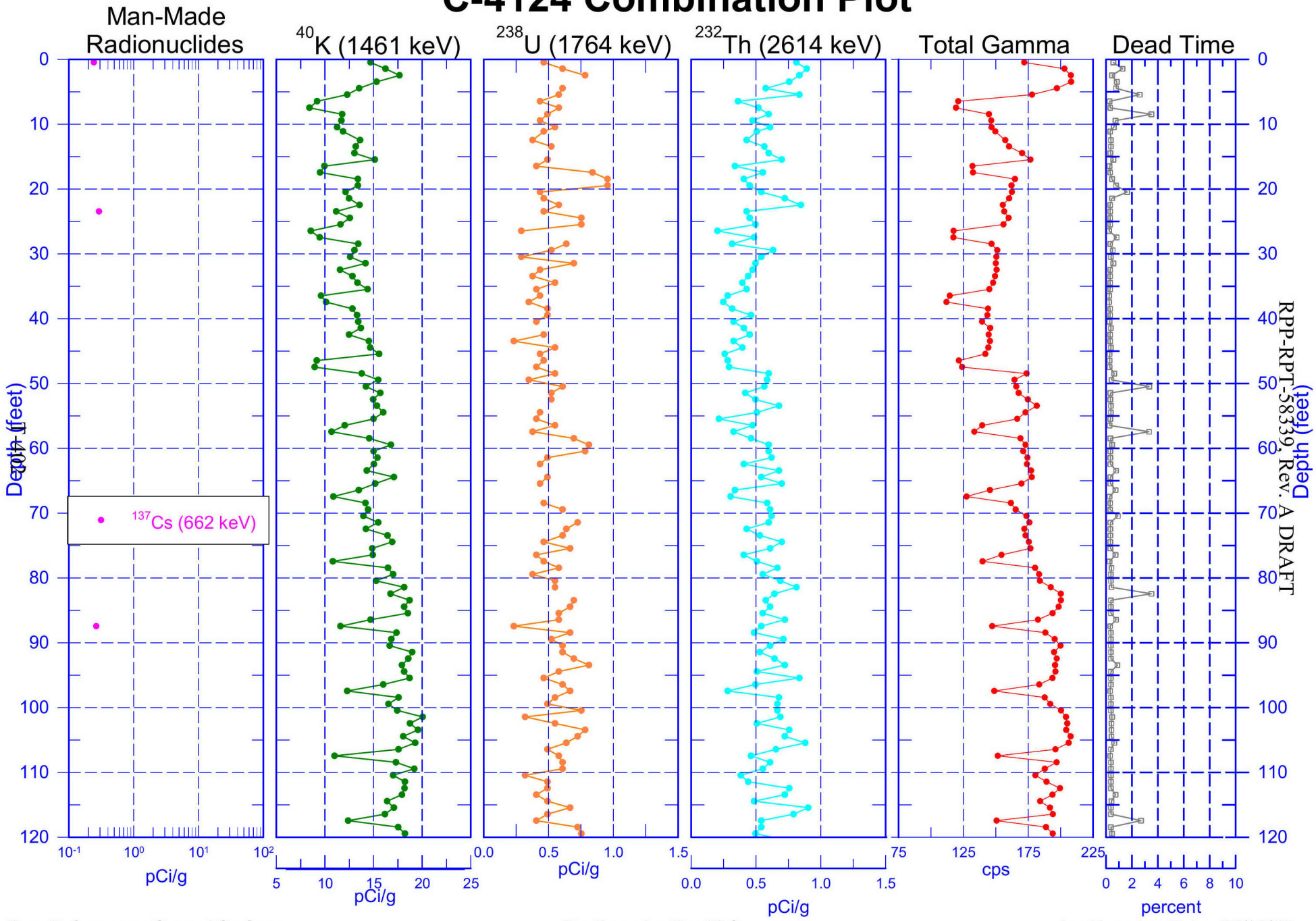


Zero Reference = Ground Surface

Depth scale: 1" = 20 ft

Last Log Date - 09/08/03

C-4124 Combination Plot

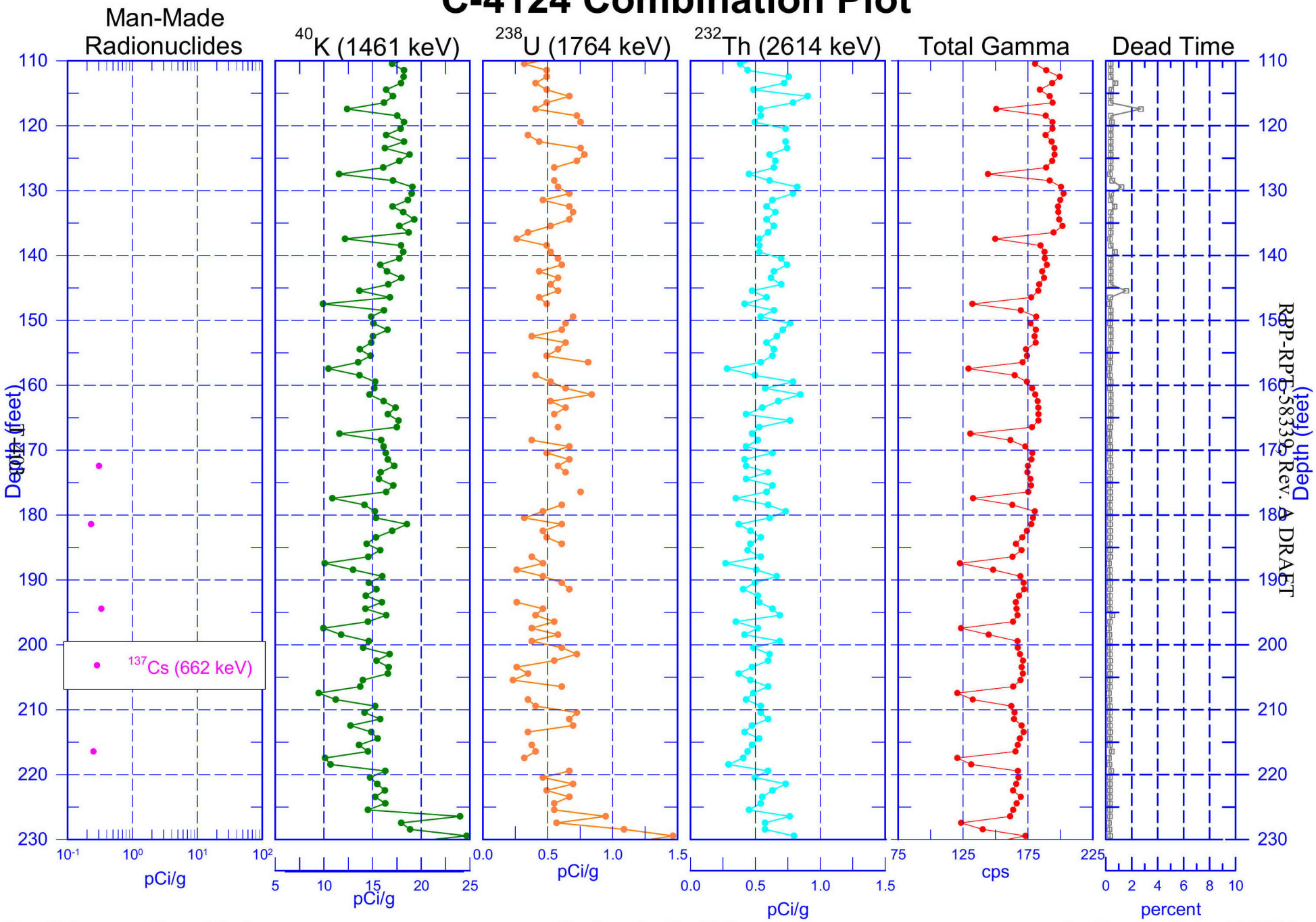


Zero Reference = Ground Surface

Depth scale: 1" = 20 ft

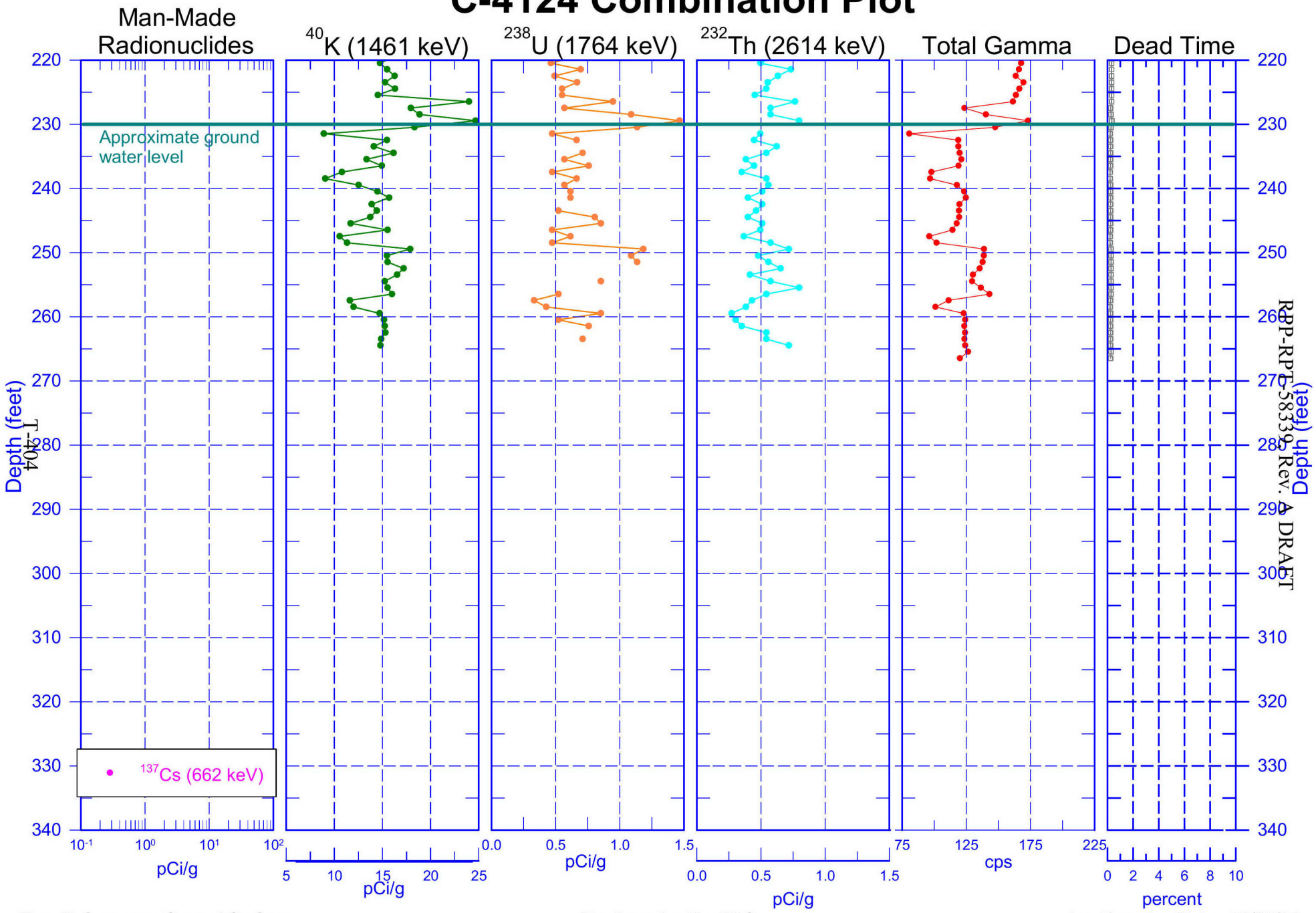
Last Logging Date - 09/08/03

C-4124 Combination Plot



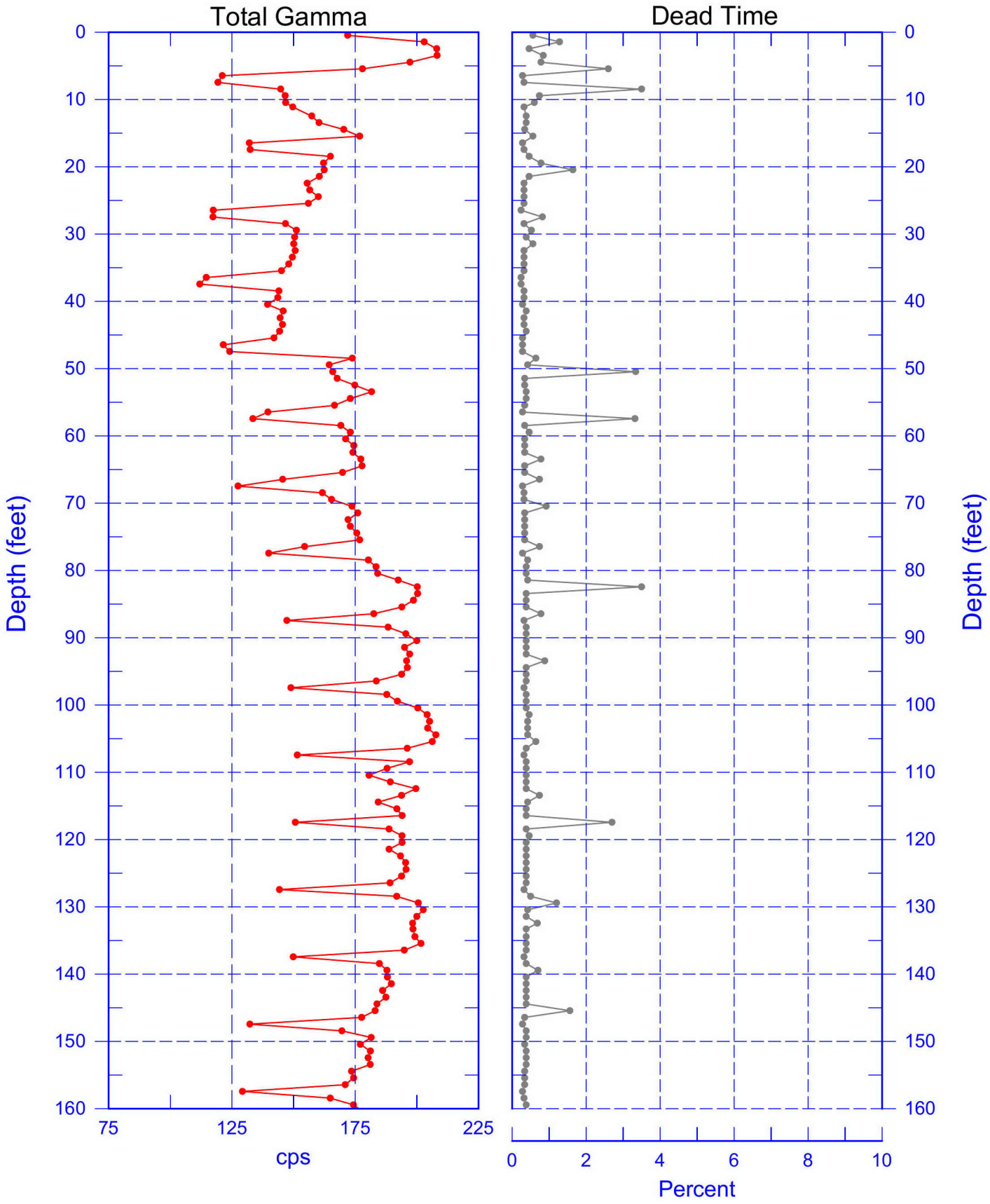
RPP-RPT-58339, Rev. A DRAFT

C-4124 Combination Plot



C-4124

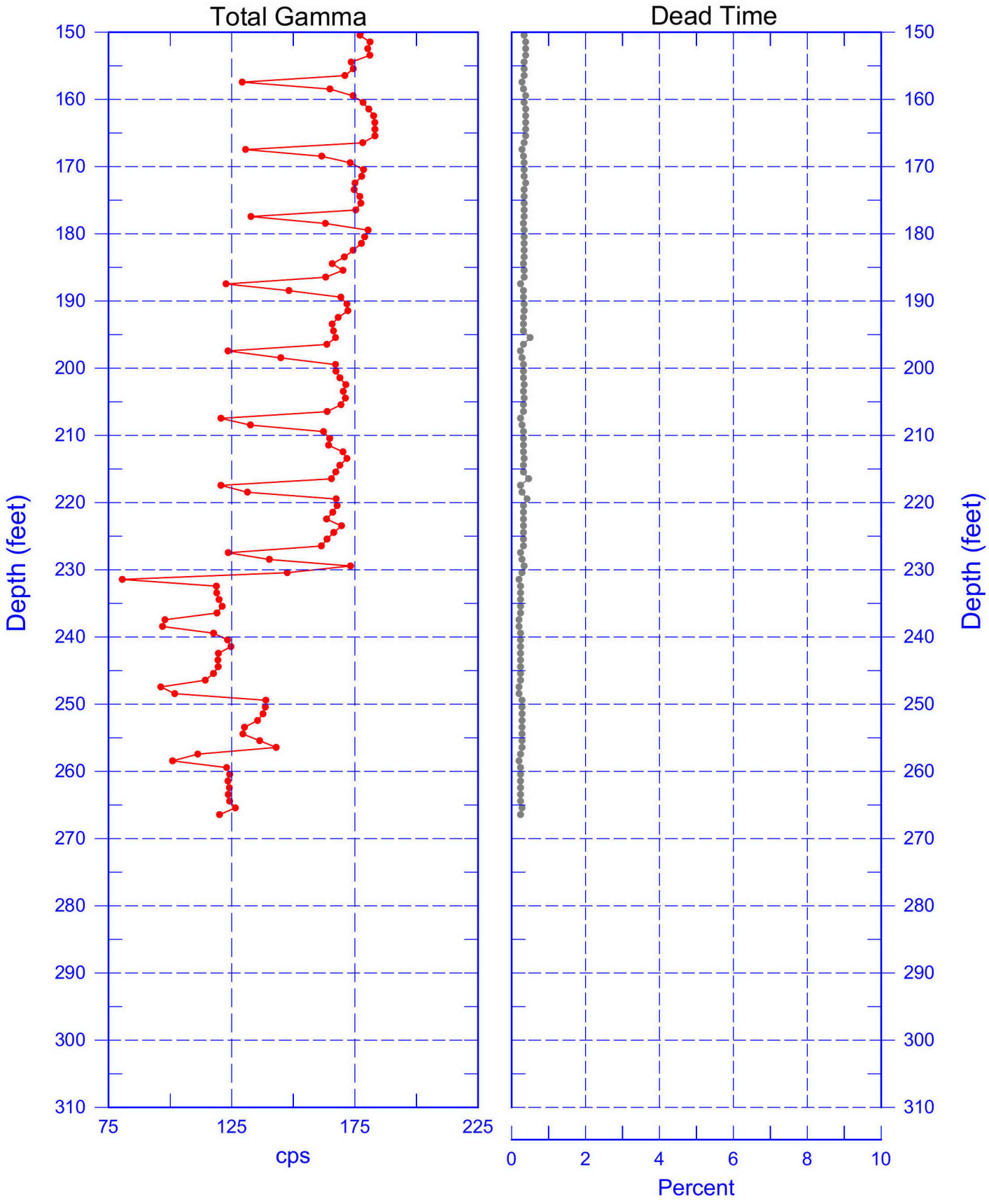
Total Gamma & Dead Time



Reference - Ground Surface | Depth scale: 1" = 20 ft | Last Log Date - 09/08/03

C-4124

Total Gamma & Dead Time



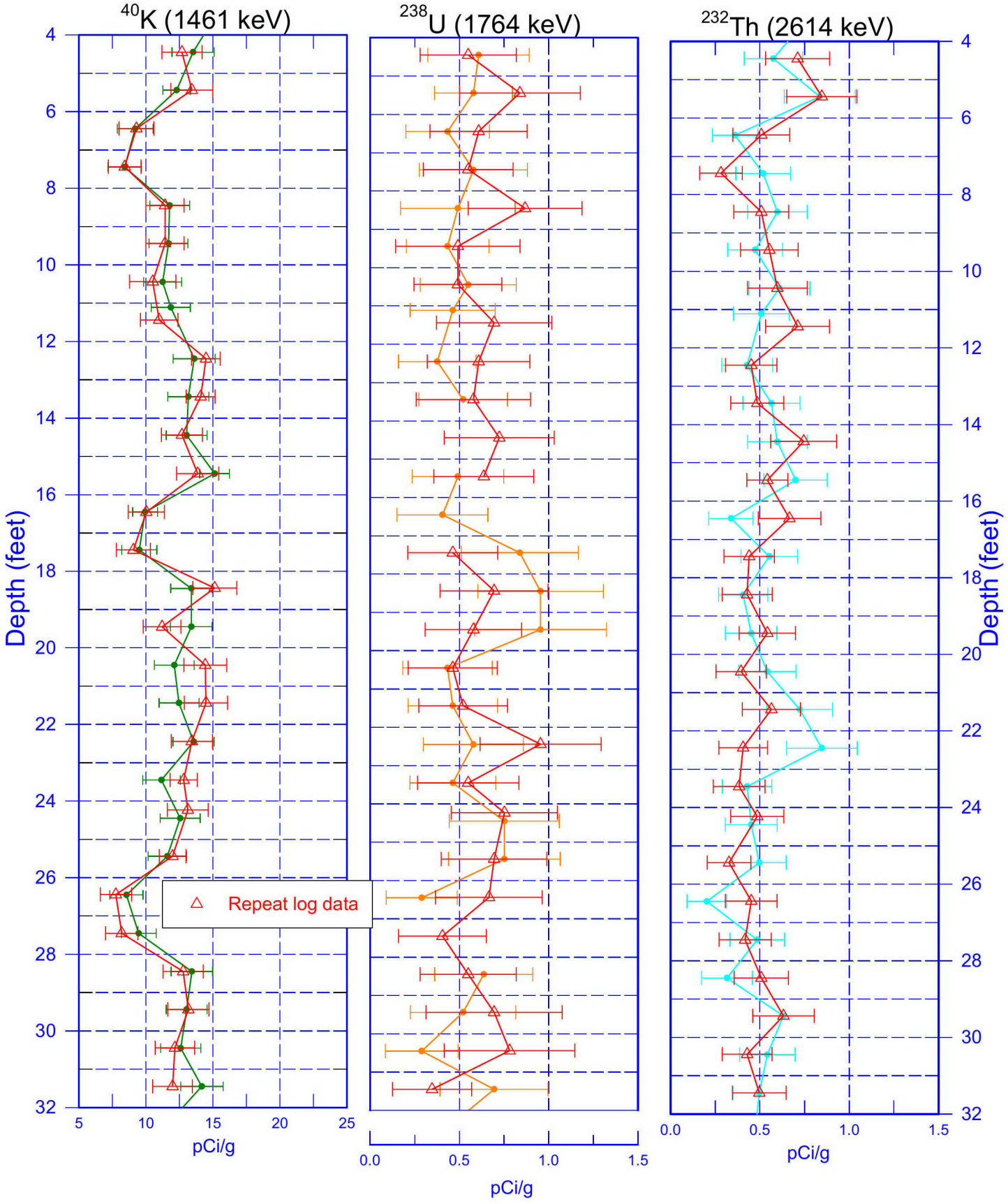
Reference - Ground Surface

Depth scale: 1" = 20 ft

Last Log Date - 09/08/03

C-4124

Repeat Section of Natural Gamma Logs



Zero Reference = Ground Surface

Last Log Date - 09/08/03

GROUNDWATER WELL LOGGING RESULTS FOR C4125

Stoller
Grand Junction Office established 1959

C-4125
Log Data Report

Borehole Information:

Borehole: C-4125			Site: West of C Tank Farm		
Coordinates (WA St Plane)		GWL[1] (ft) : 268		GWL Date: 08/15/03	
North (Estimated)	East (Estimated)	Drill Date	Ground Level Elevation	Total Depth (ft)	Type
136500	575025	08/03	Not available	309.0	Becker

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded steel	1.7	11.0	10.0	0.50	+1.7	30
Becker	3.1	6.24	6.0	0.12	+3.1	309.0
Becker	2.7	9.0	8.0	0.5	+2.7	309.0

Borehole Notes:

The casing dimensions are derived from published values for Becker drill casing. Casing thicknesses at the joints are 0.875- and 0.240-in. for the 8- and 6-in. casings, respectively. The Fluor Hanford drilling supervisor provided the total drilling depth, depth to water, and borehole coordinates. Ground level elevation was not available. Logging data acquisition is referenced to the ground surface.

Logging Equipment Information:

Logging System:	Gamma 1E		Type:	SGLS (70%) SN: 34TP40587A
Calibration Date:	07/03	Calibration Reference:	GJO-2003-468-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat	3		
Date	08/15/03	08/16/03	08/16/03		
Logging Engineer	Spatz	Spatz	Spatz		
Start Depth (ft)	301.0	121.0	89.0		
Finish Depth (ft)	90.0	90.0	25.0		
Count Time (sec)	100	100	100		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	1.0	1.0	1.0		
ft/min	N/A[2]	N/A	N/A		
Pre-Verification	AE018CAB	AE019CAB	AE019CAB		
Start File	AE018000	AE019000	AE019032		
Finish File	AE018211	AE019031	AE019096		

Log Run	1	2 Repeat	3		
Post-Verification	AE018CAA	AE019CAA	AE019CAA		
Depth Return Error (in.)	-1	N/A	N/A		
Comments	Fine-gain adjustment made after files -102, -144, -177, -182.	No fine-gain adjustment.	No fine-gain adjustment.		

Logging Operation Notes:

Spectral gamma logging was performed in this borehole on August 15 and 16, 2003. Logging was conducted with a centralizer on the sonde. Measurements are referenced to ground surface. A repeat section was collected in this borehole to evaluate system performance. No logging was performed between the ground surface and 25 ft because a 10-in. casing was present in addition to the 6- and 8-in. casings. Logging depth achieved was 301 ft, 8.0 ft less than the reported drilling depth.

Analysis Notes:

Analyst:	Henwood	Date:	08/28/03	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging system were performed before and after data acquisition. Acceptance criteria were met.

A combined casing correction for 0.620-in.-thick casing (0.5 +.12 in.) was applied below 25 ft for the 8- and 6-in. casings. The combined thickness at casing joints is 1.115 in. This thickness results in a significant reduction in gamma activity detection as the detector passes by a casing joint. However, it is not practical to correct individual data points for the effect of casing joints. The influence of the thick joints is apparent in the total gamma and ^{40}K logs where reduced count rates and concentrations are exhibited at approximately 10-ft depth intervals. For the depth interval between 25 and 30 ft a correction for 1.12-in. casing was applied where 10, 6, and 8-in. casings were present.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with an EXCEL worksheet template identified as G1EJul03.xls using efficiency functions and corrections for casing, water, and dead time as determined from annual calibrations. Dead time corrections are applied where dead times exceed 10.5 percent; no dead times in excess of 10.5 percent were encountered. Correction for water was applied to the data below 268 ft.

Log Plot Notes:

Separate log plots are provided for the man-made radionuclide (^{137}Cs) detected in the borehole, naturally occurring radionuclides (^{40}K, ^{238}U, ^{232}Th [KUT]), a combination of man-made, KUT, and dead time, and total gamma plotted with dead time. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, casing corrections, or water corrections. A repeat log section is also included.

Results and Interpretations:

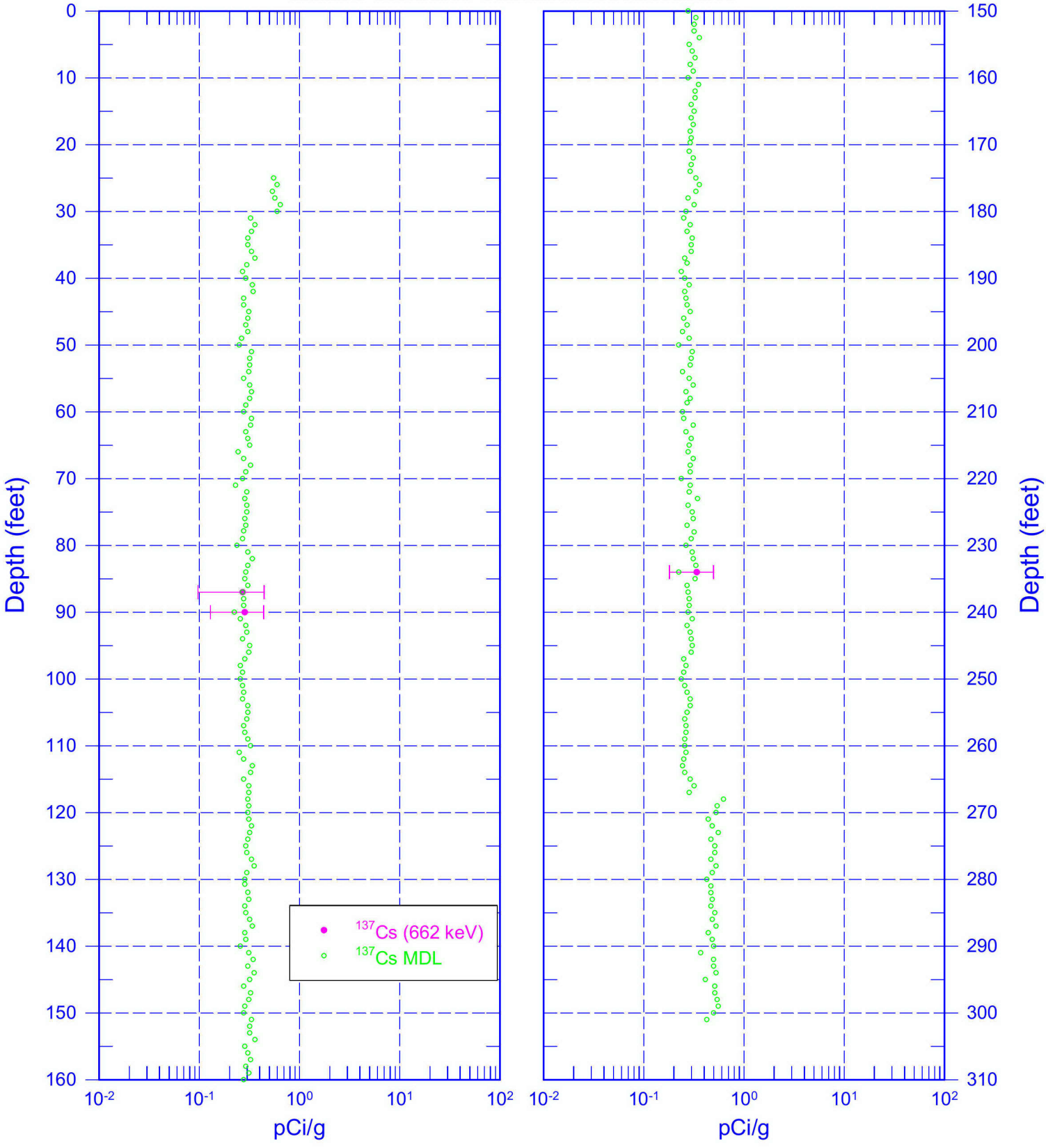
^{137}Cs was the only man-made radionuclide detected in this borehole. ^{137}Cs was detected at a few sporadic locations in the borehole near its MDL of approximately 0.2 pCi/g.

The repeat sections indicated good agreement of the naturally occurring KUT.

[1] GWL – groundwater level
[2] N/A – not applicable

C-4125

Man-Made Radionuclides

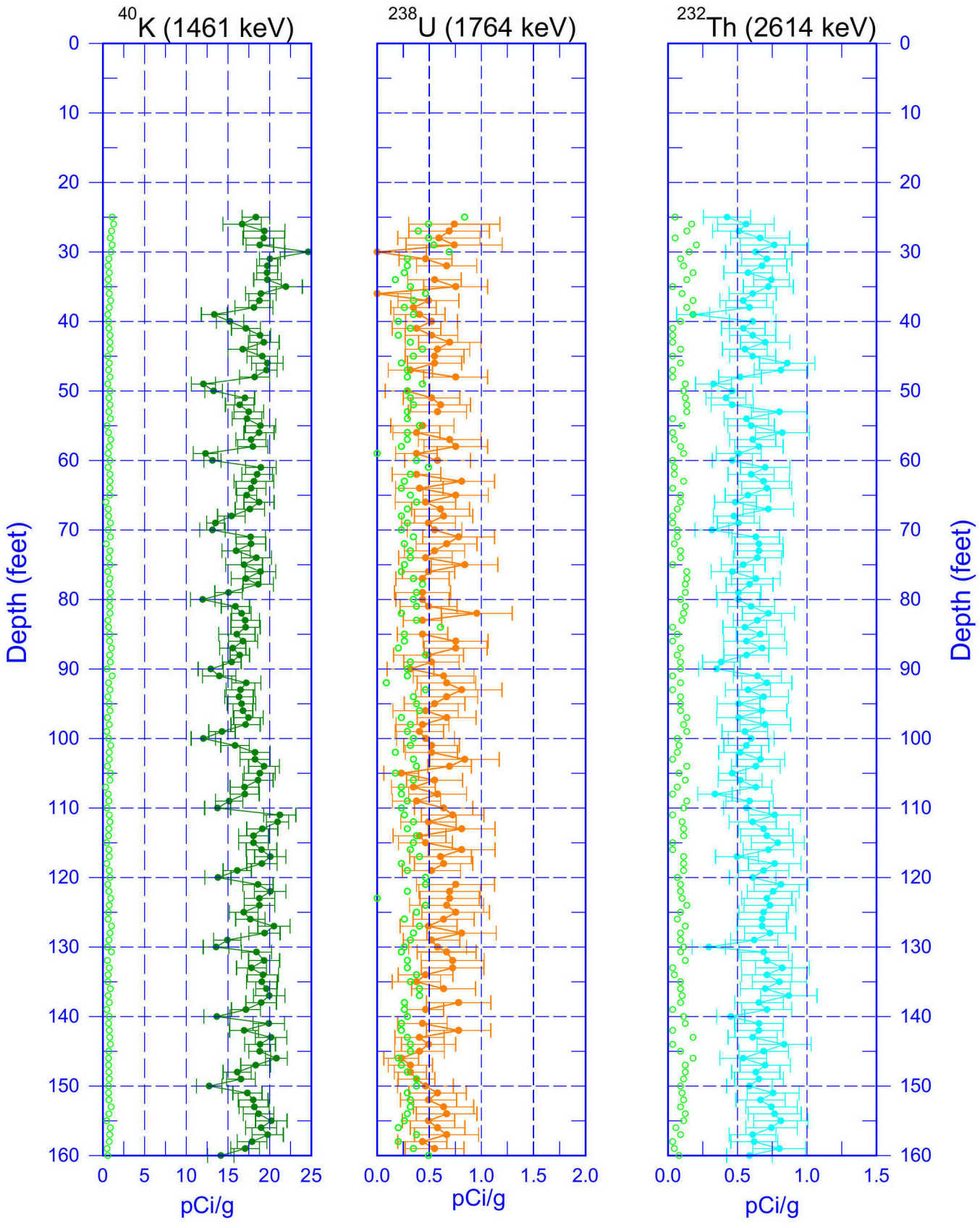


Zero Reference = Ground Surface

Last Log Date - 08/16/03

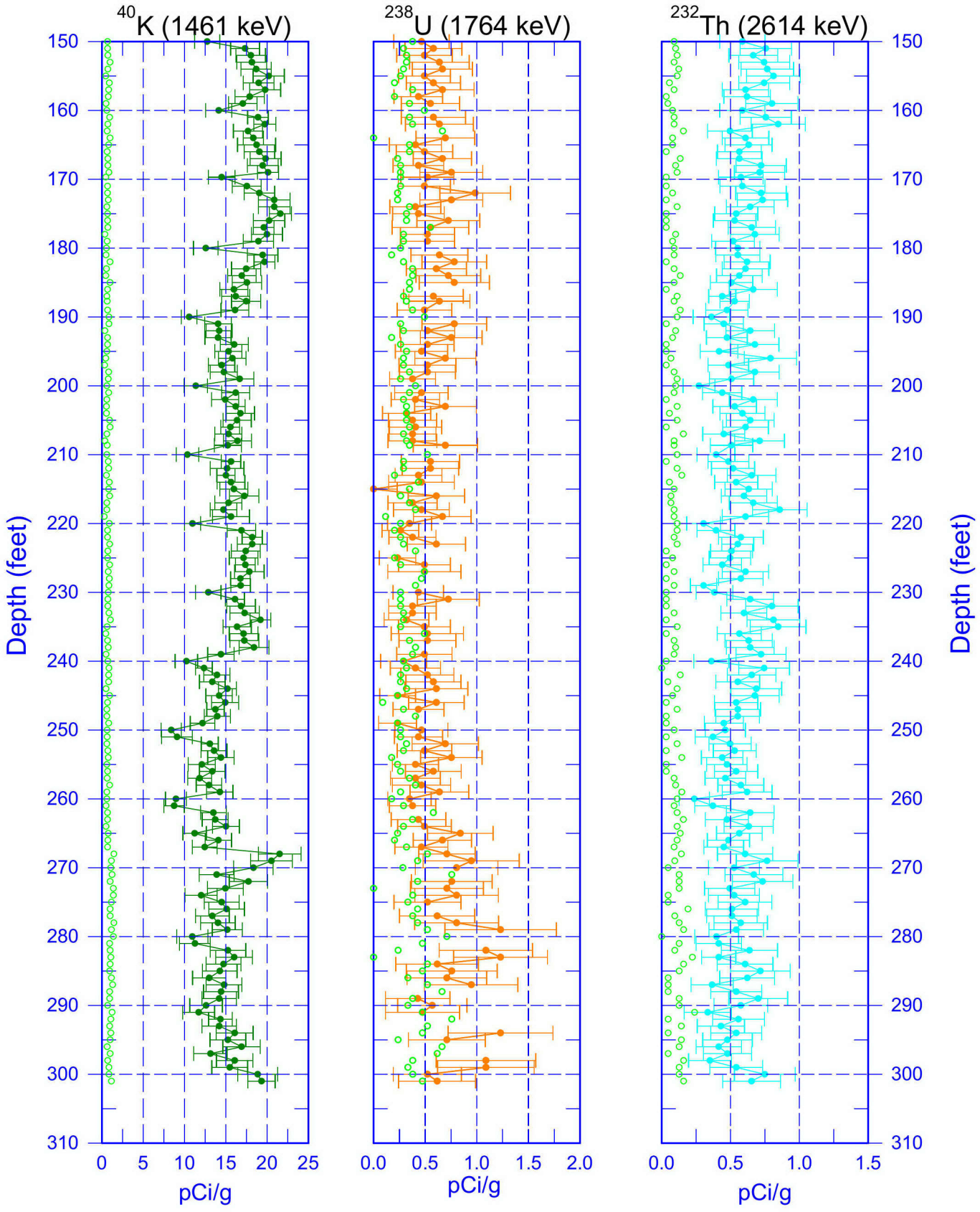
C-4125

Natural Gamma Logs

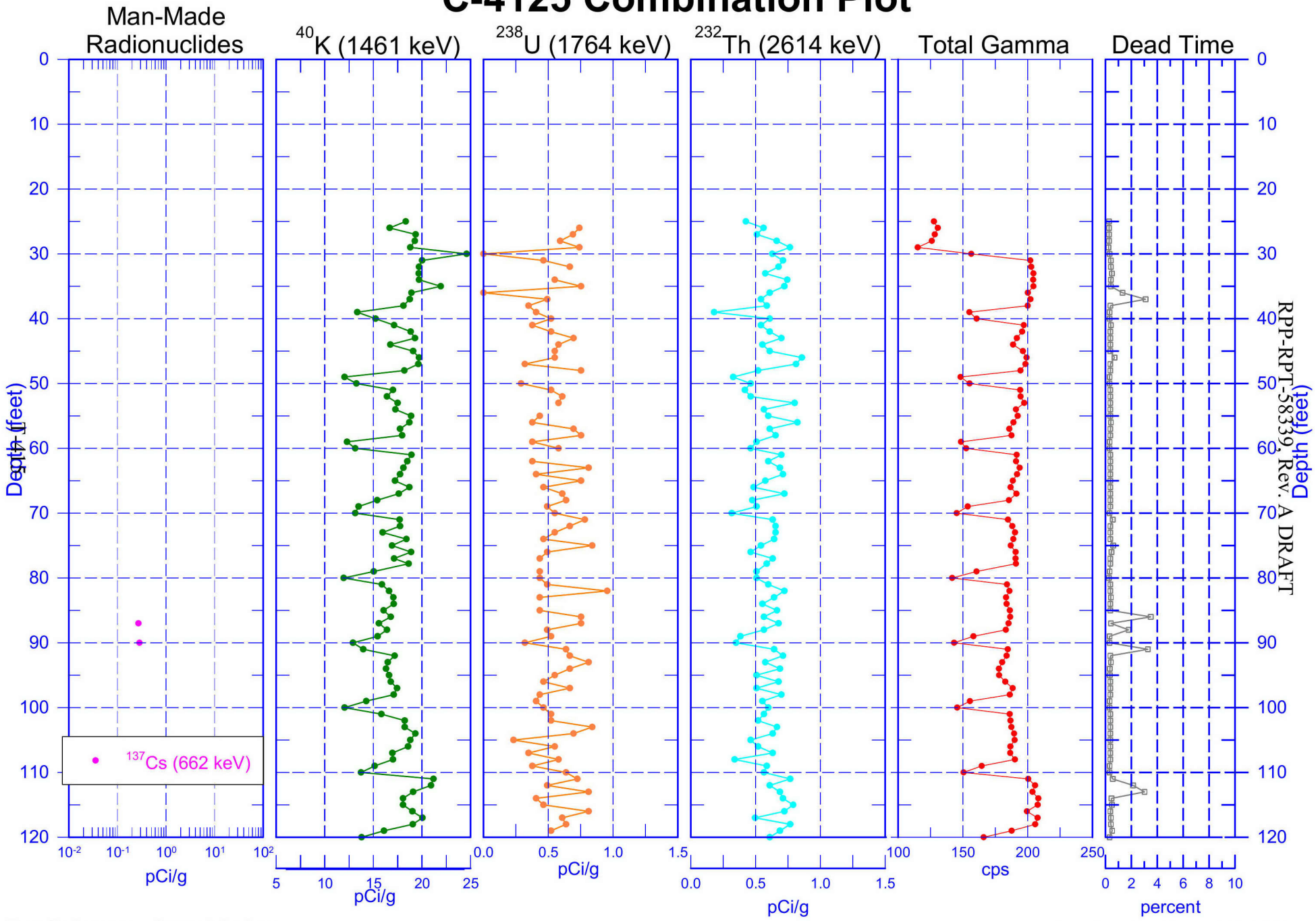


C-4125

Natural Gamma Logs



C-4125 Combination Plot

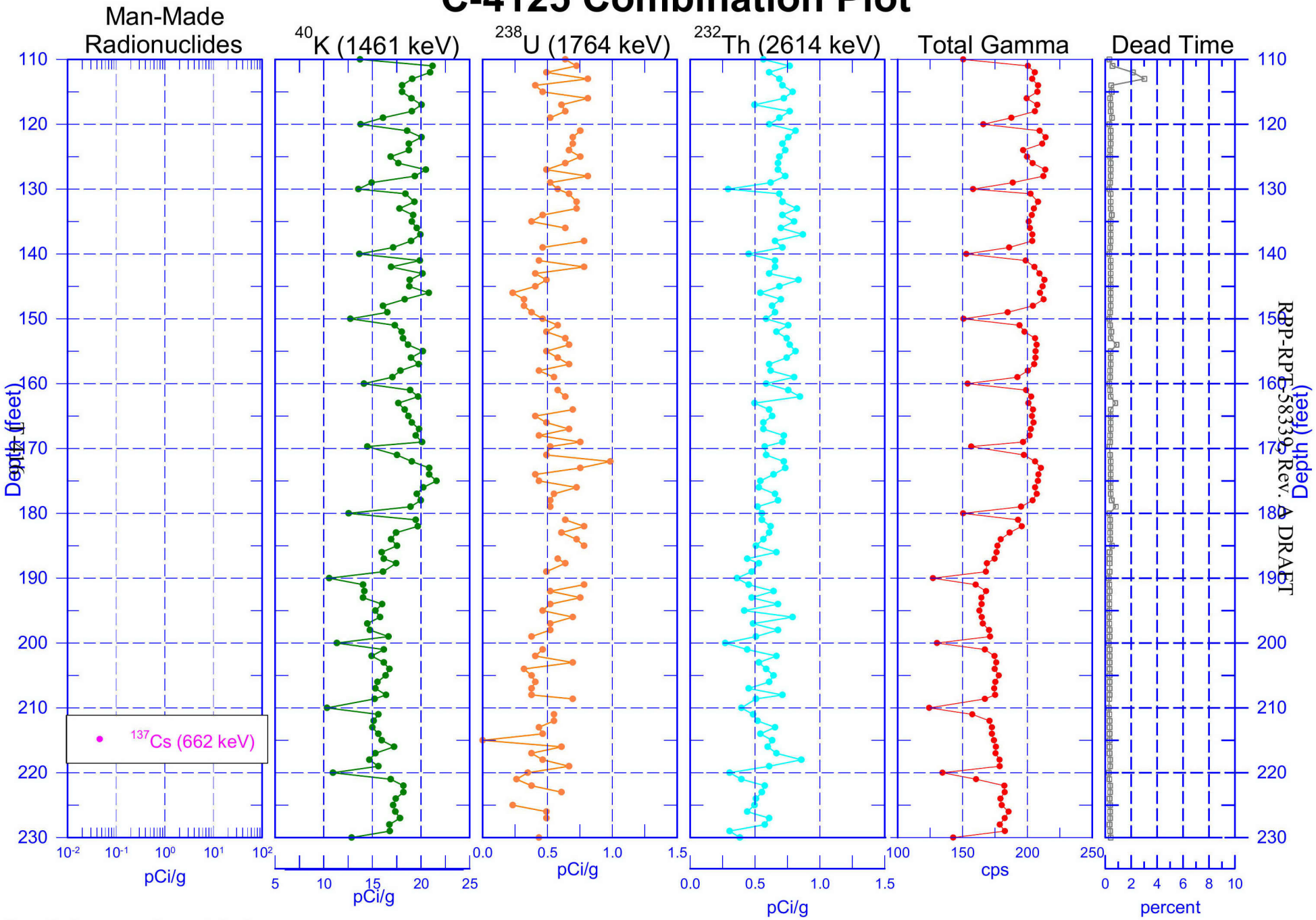


Zero Reference = Ground Surface

Last Logging Date - 08/16/03

RPP-RPT-58339, Rev. A DRAFT

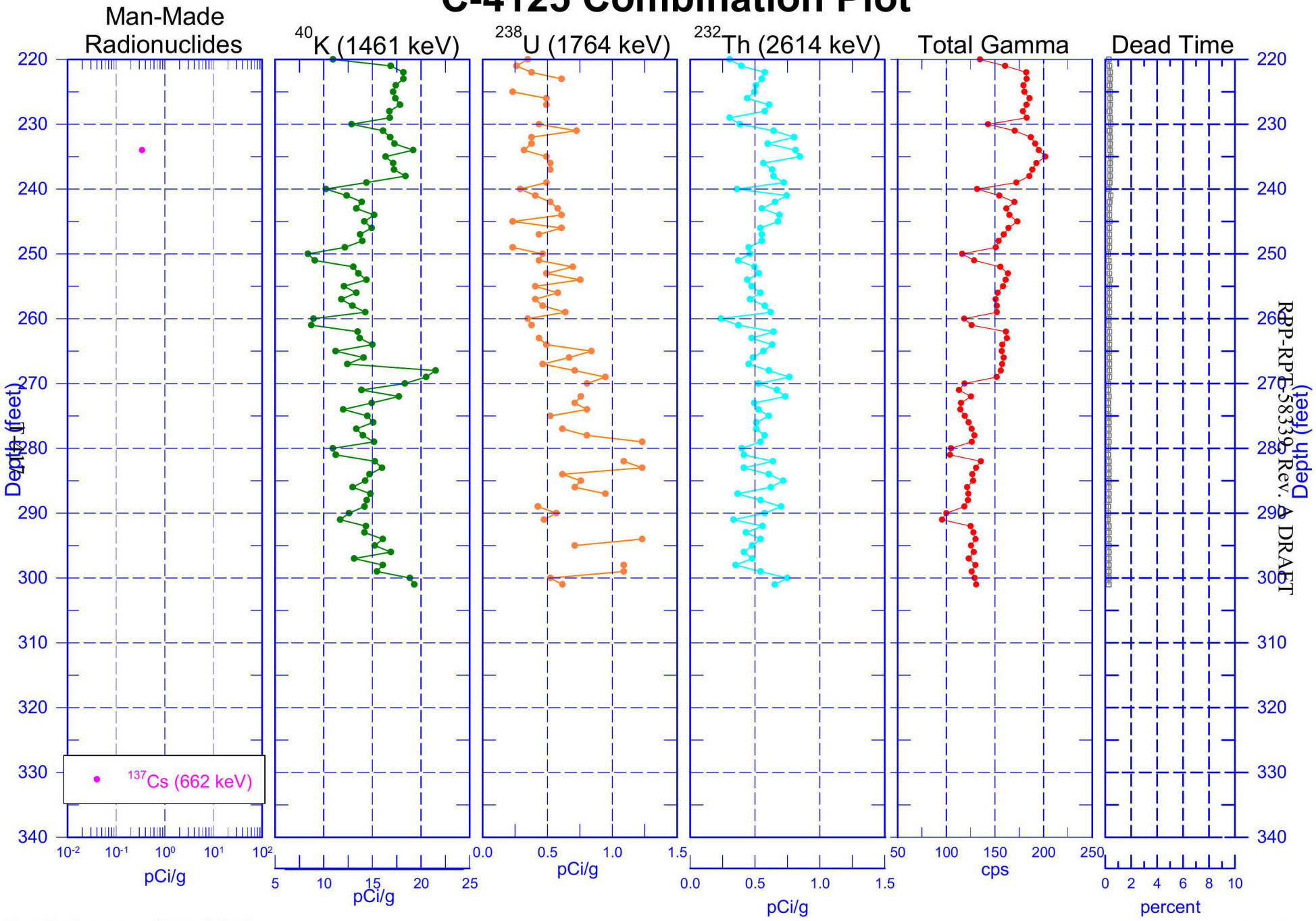
C-4125 Combination Plot



Zero Reference = Ground Surface

Last Logging Date - 08/16/03

C-4125 Combination Plot



Zero Reference = Ground Surface

Last Logging Date - 08/16/03