

Figure 6-103: 2-Chlorotoluene Soil Sample Results (0-2" and 0-6").

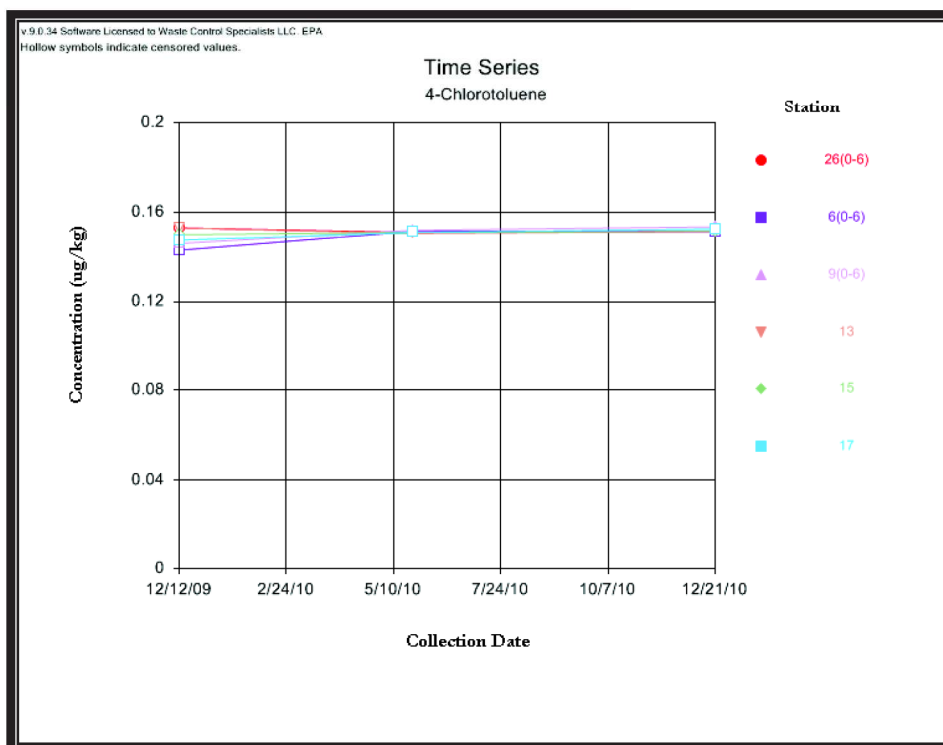


Figure 6-104: 4-Chlorotoluene Soil Sample Results (0-2" and 0-6").

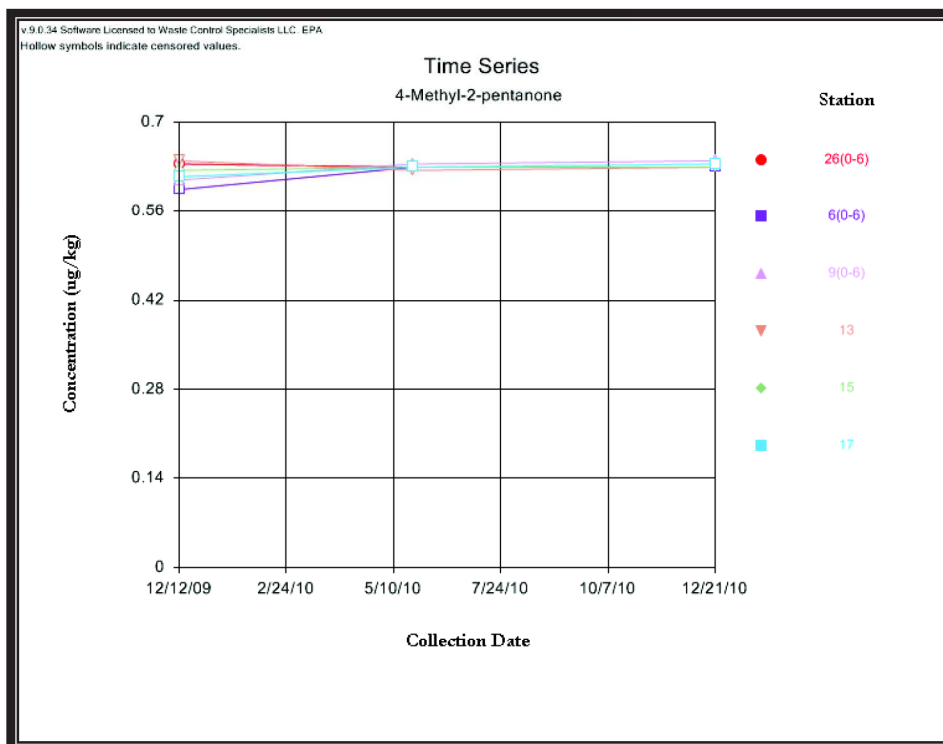


Figure 6-105: 4-Methyl-2-pentanone Soil Sample Results (0-2" and 0-6").

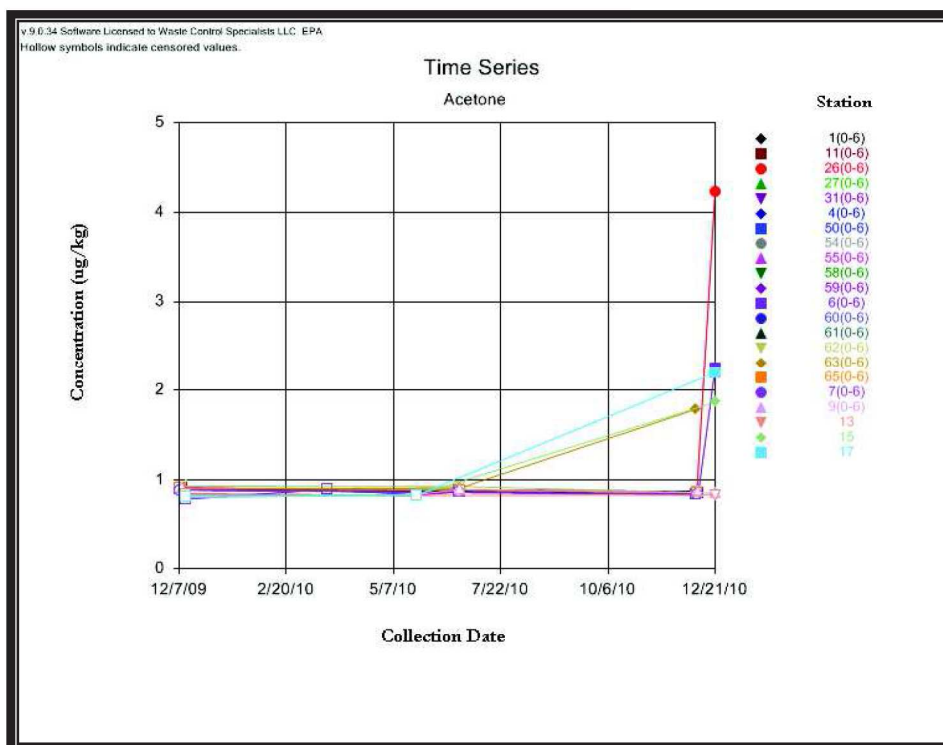


Figure 6-106: Acetone Soil Sample Results (0-2" and 0-6").

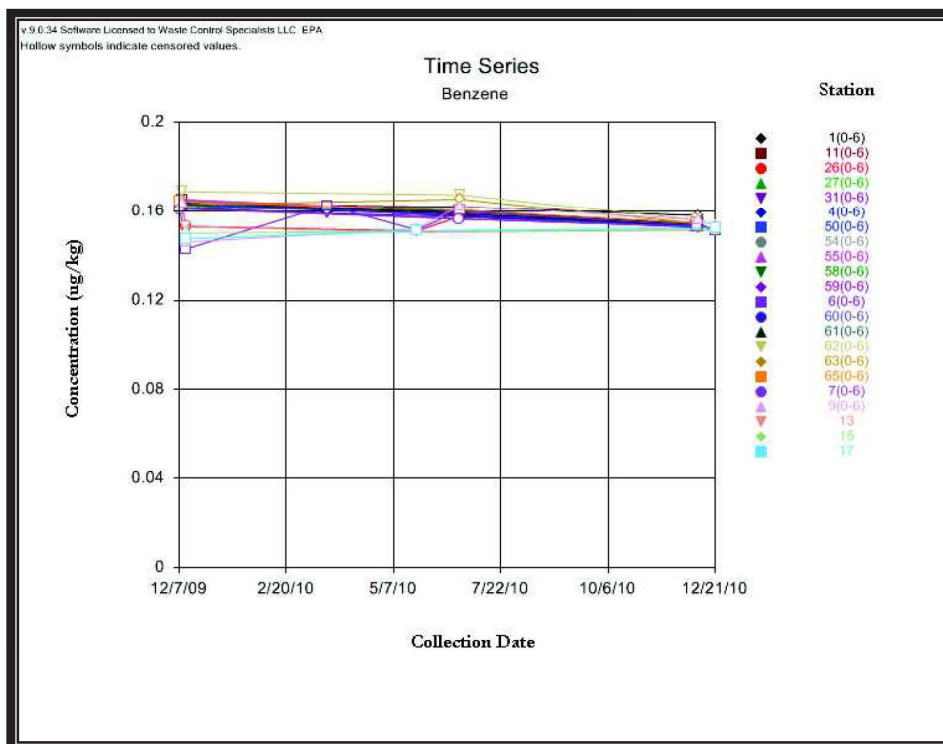


Figure 6-107: Benzene Soil Sample Results (0-2" and 0-6").

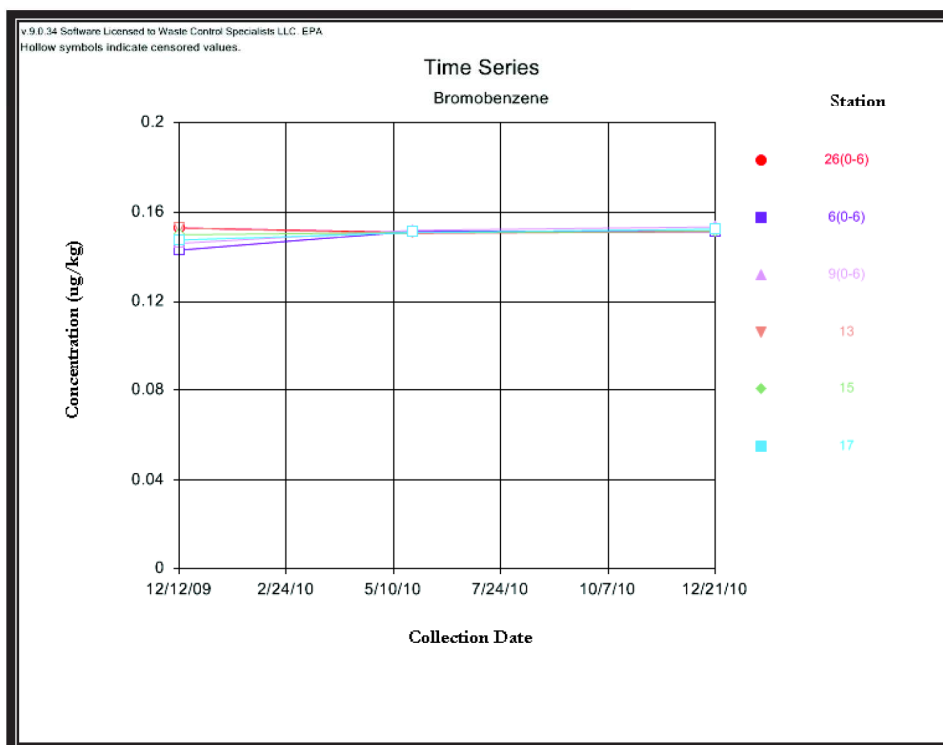


Figure 6-108: Bromobenzene Soil Sample Results (0-2" and 0-6").

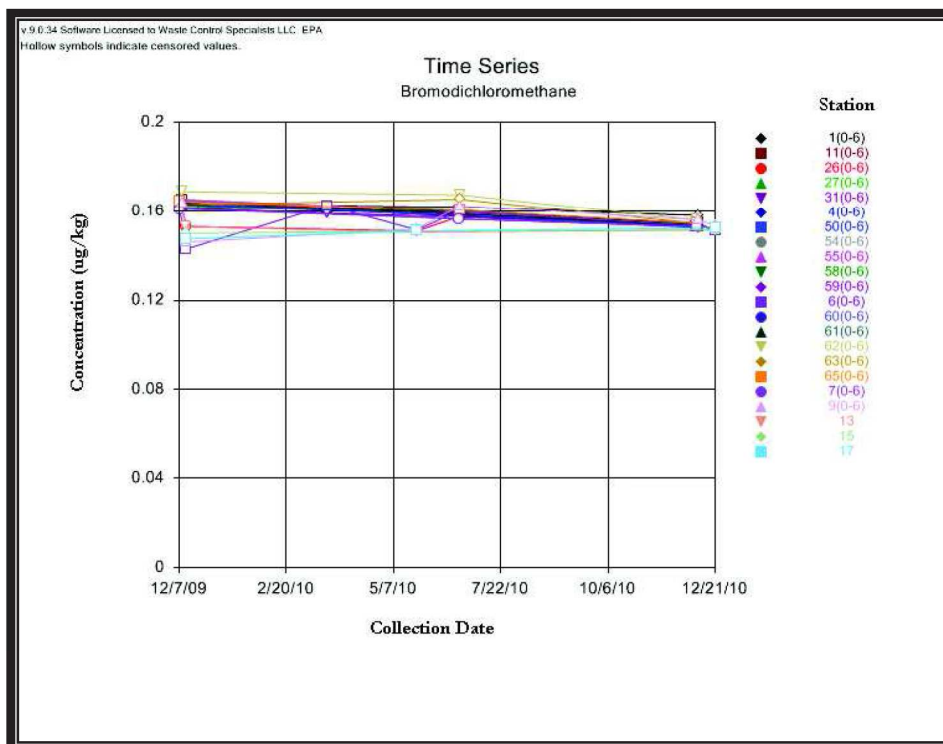


Figure 6-109: Bromodichloromethane Soil Sample Results (0-2" and 0-6").

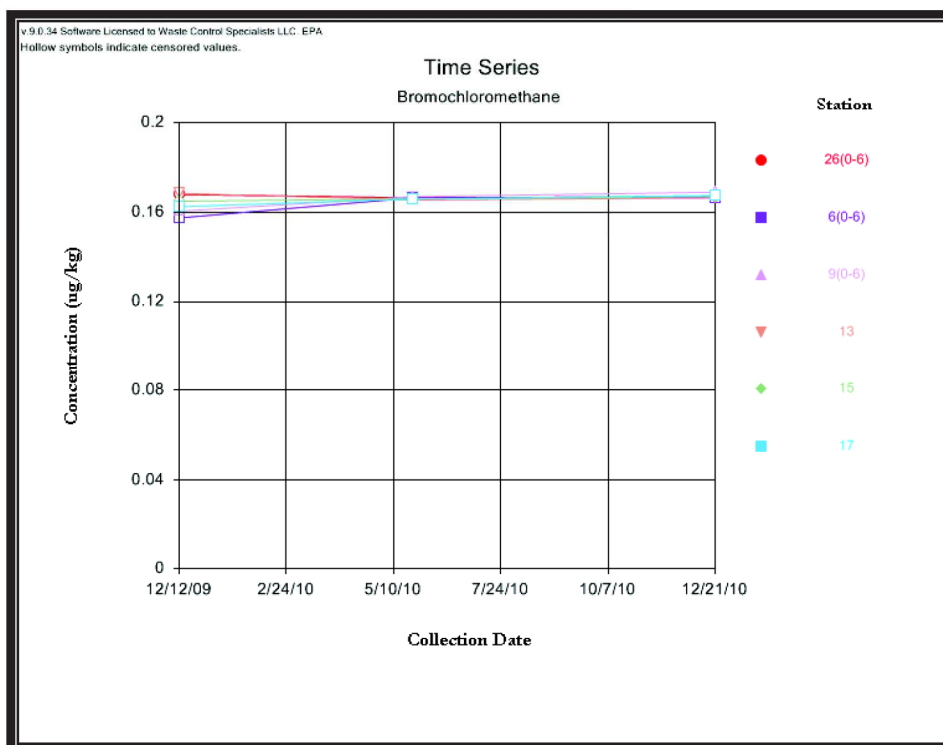


Figure 6-110: Bromochloromethane Soil Sample Results (0-2" and 0-6").

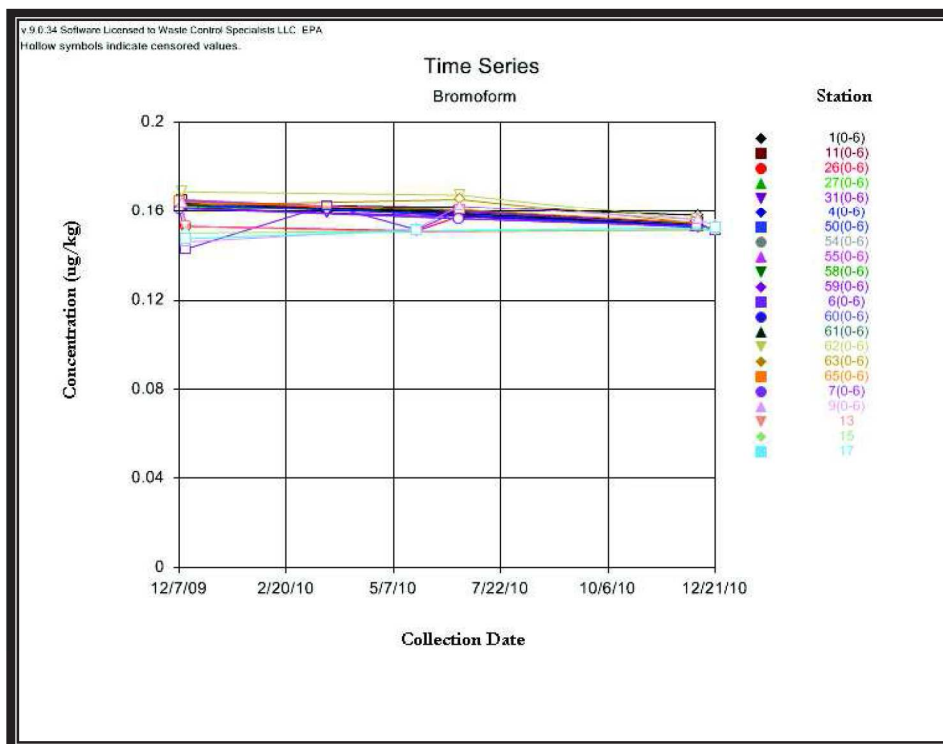


Figure 6-111: Bromoform Soil Sample Results (0-2" and 0-6").

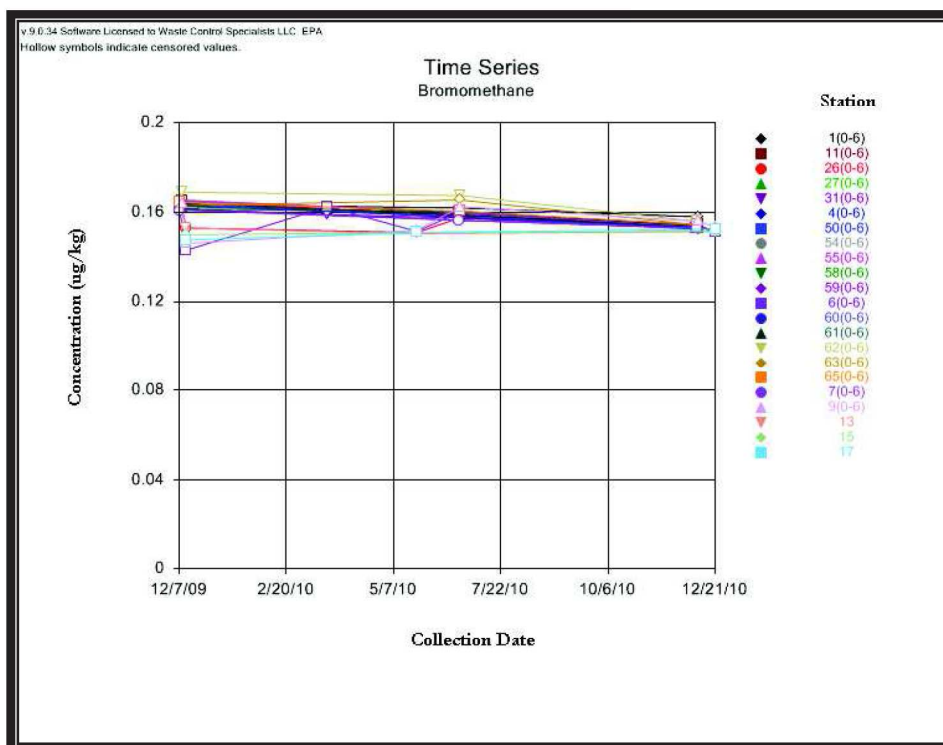


Figure 6-112: Bromomethane Soil Sample Results (0-2" and 0-6").

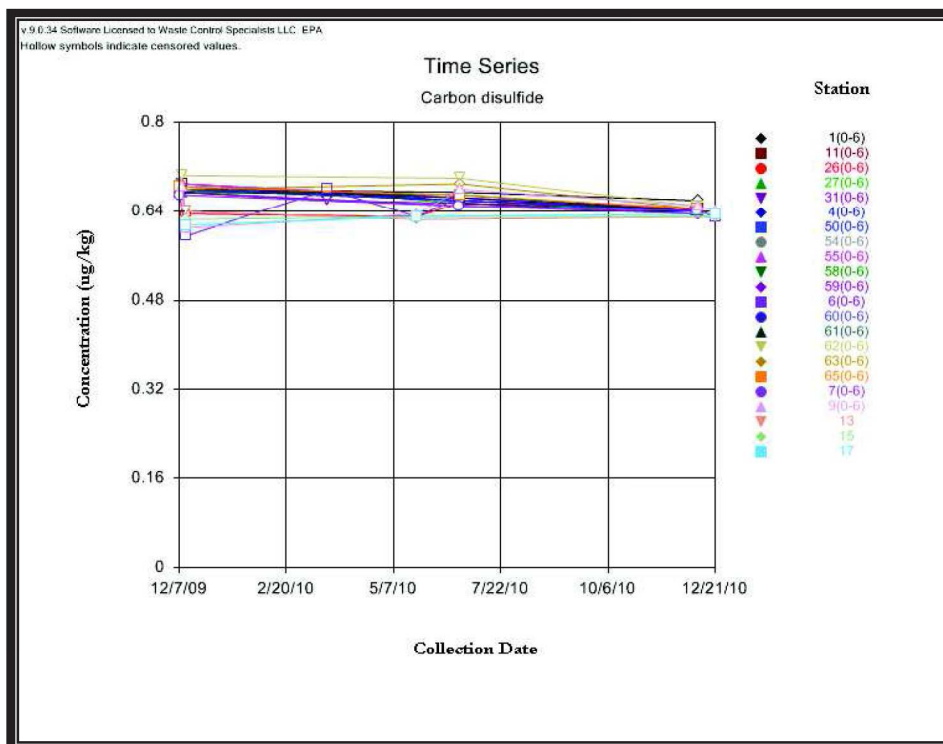


Figure 6-113: Carbon disulfide Soil Sample Results (0-2" and 0-6").

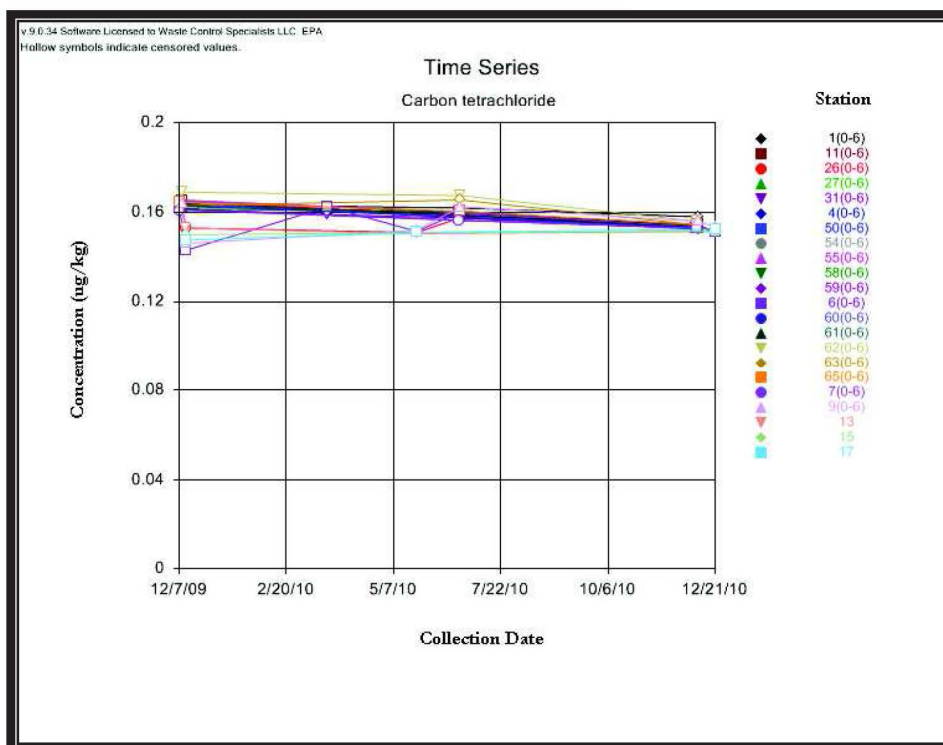


Figure 6-114: Carbon tetrachloride Soil Sample Results (0-2" and 0-6").

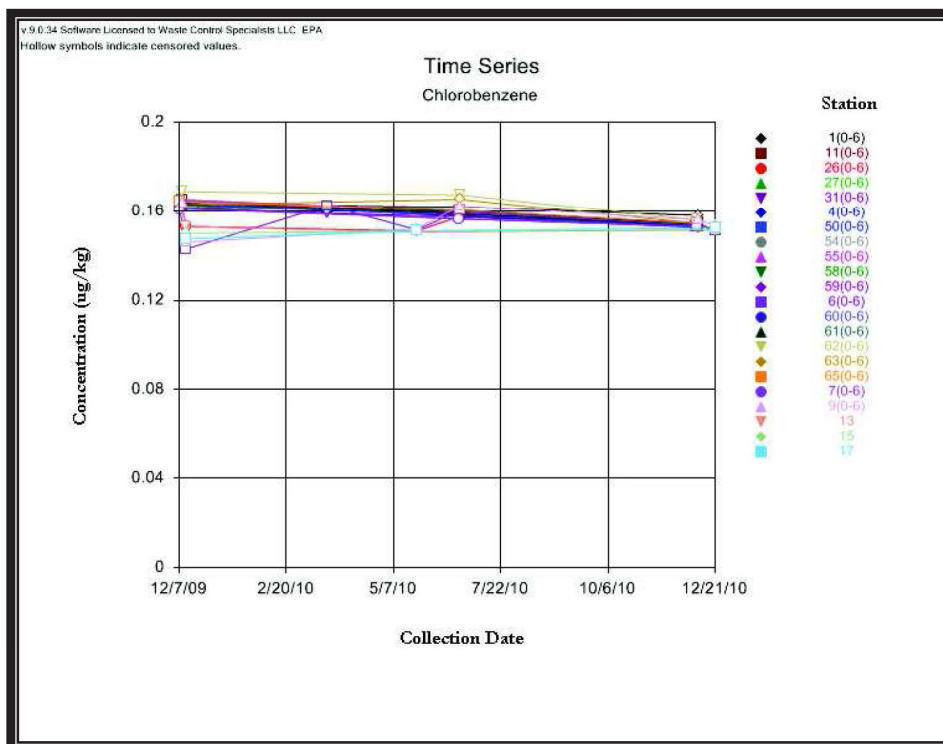


Figure 6-115: Chlorobenzene Soil Sample Results (0-2" and 0-6").

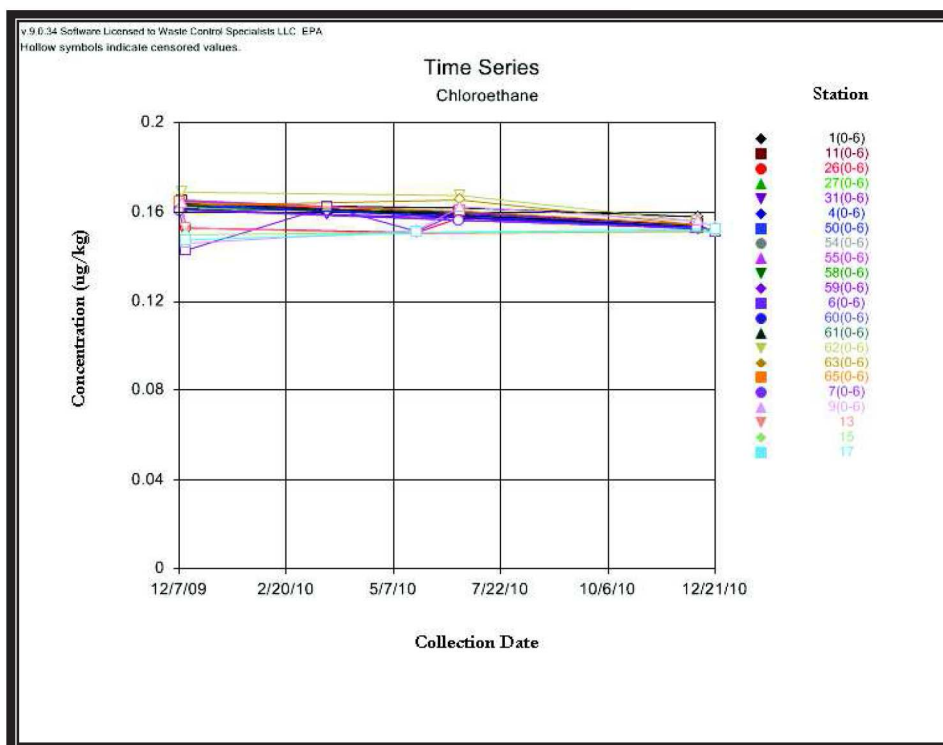


Figure 6-116: Chloroethane Soil Sample Results (0-2" and 0-6").

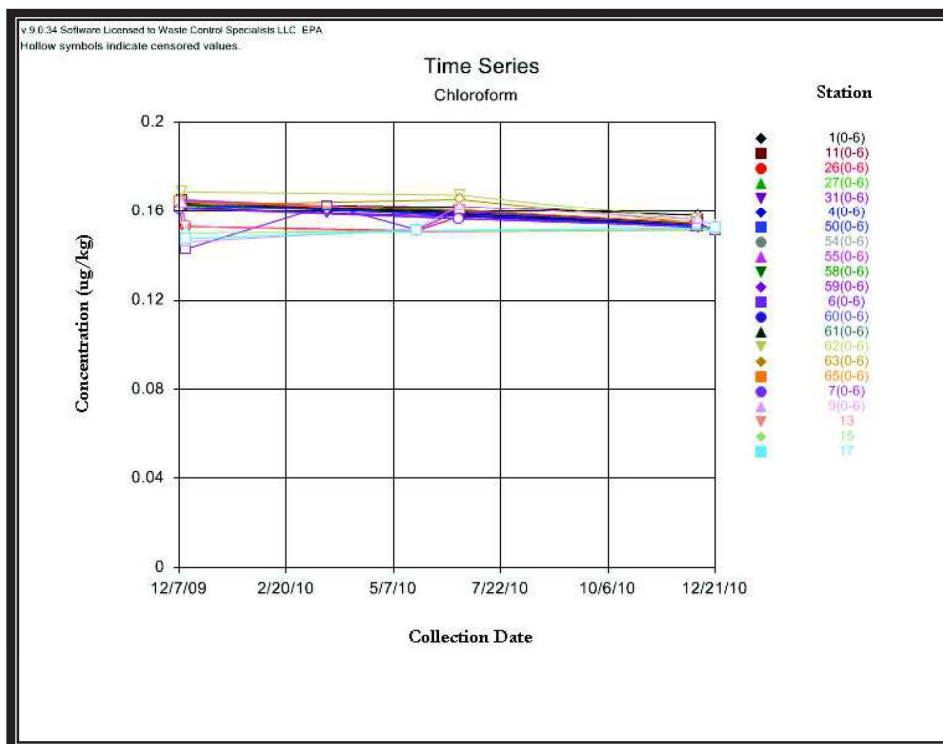


Figure 6-117: Chloroform Soil Sample Results (0-2" and 0-6").

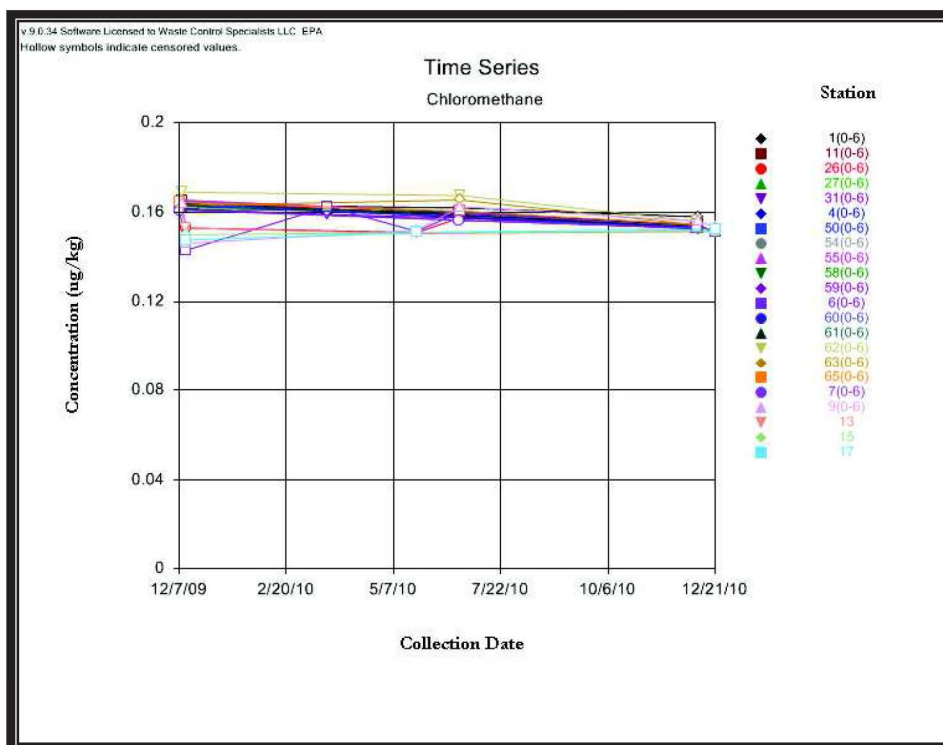


Figure 6-118: Chloromethane Soil Sample Results (0-2" and 0-6").

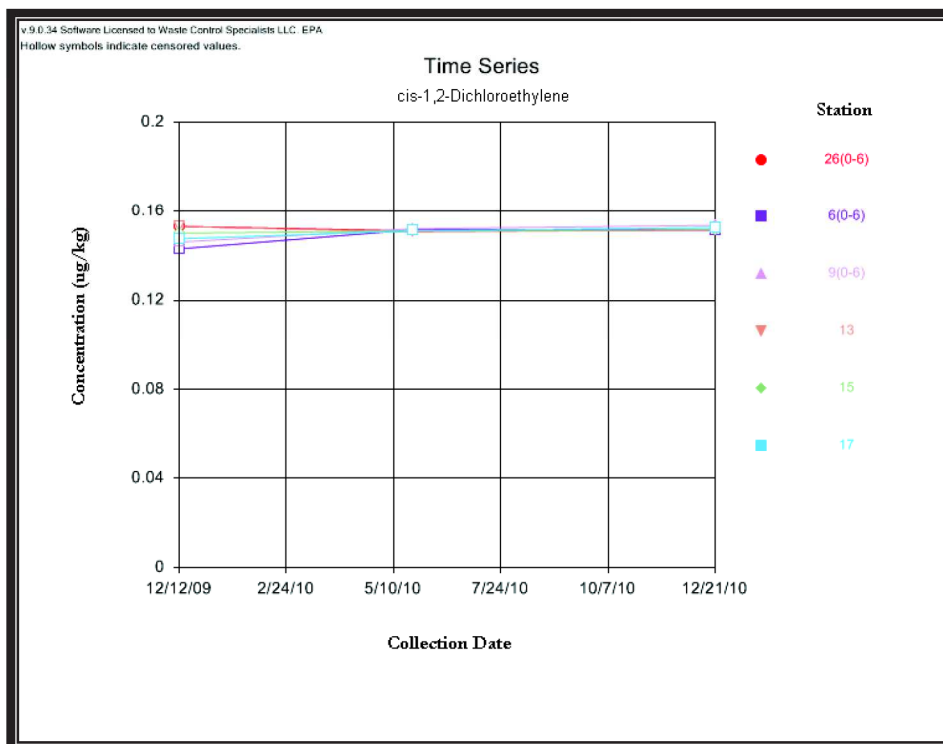


Figure 6-119: cis-1,2-Dichloroethylene Soil Sample Results (0-2" and 0-6").

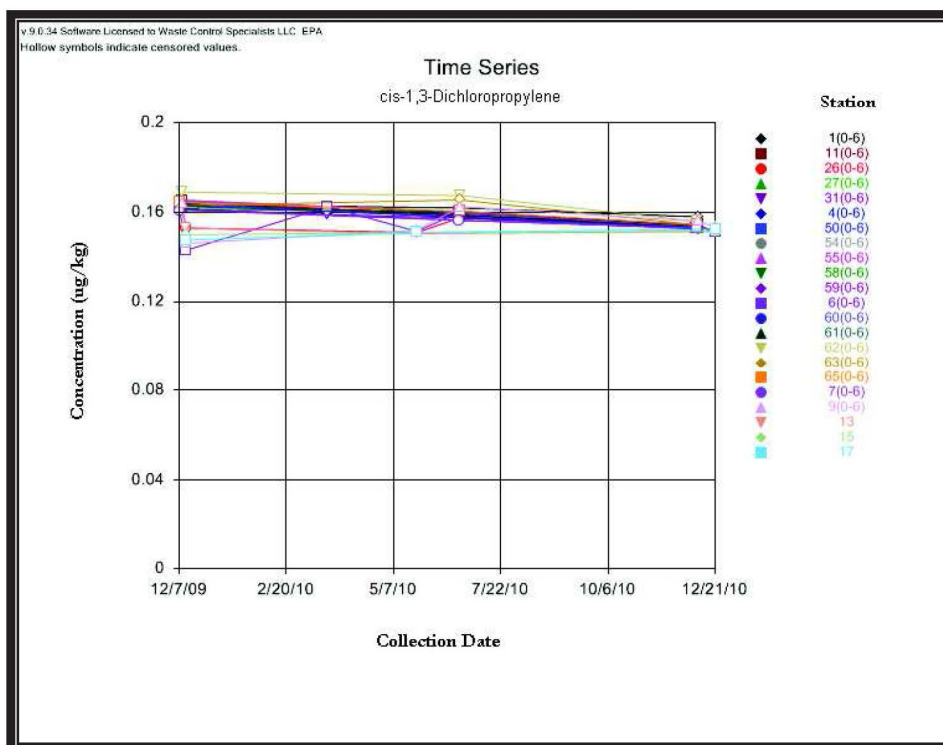


Figure 6-120: cis-1,3-Dichloropropylene Soil Sample Results (0-2" and 0-6").

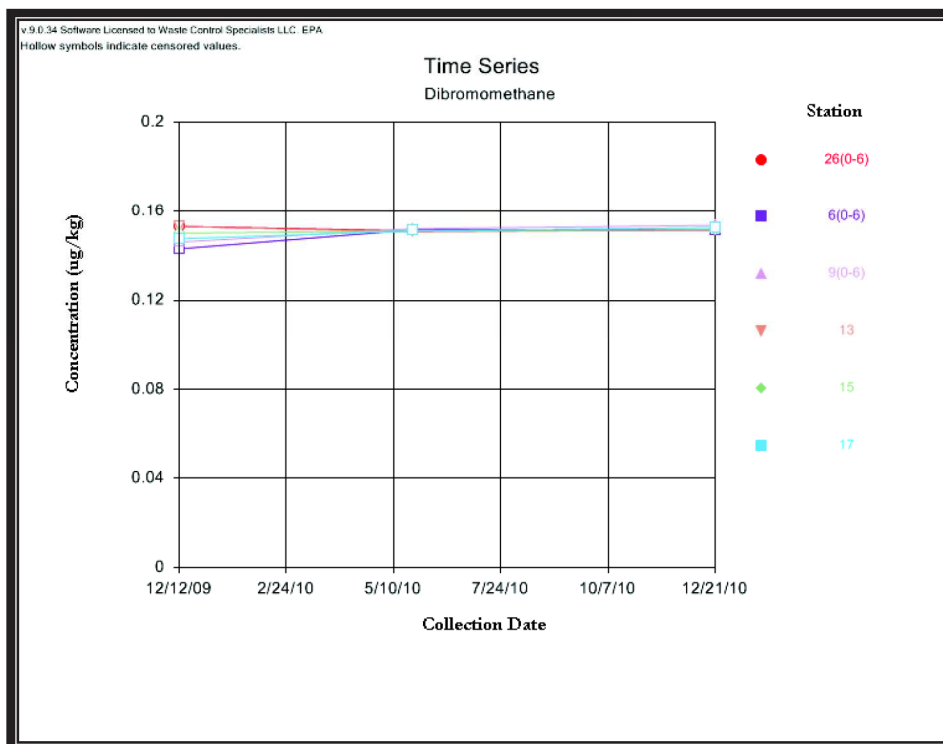


Figure 6-121: Dibromomethane Soil Sample Results (0-2" and 0-6").

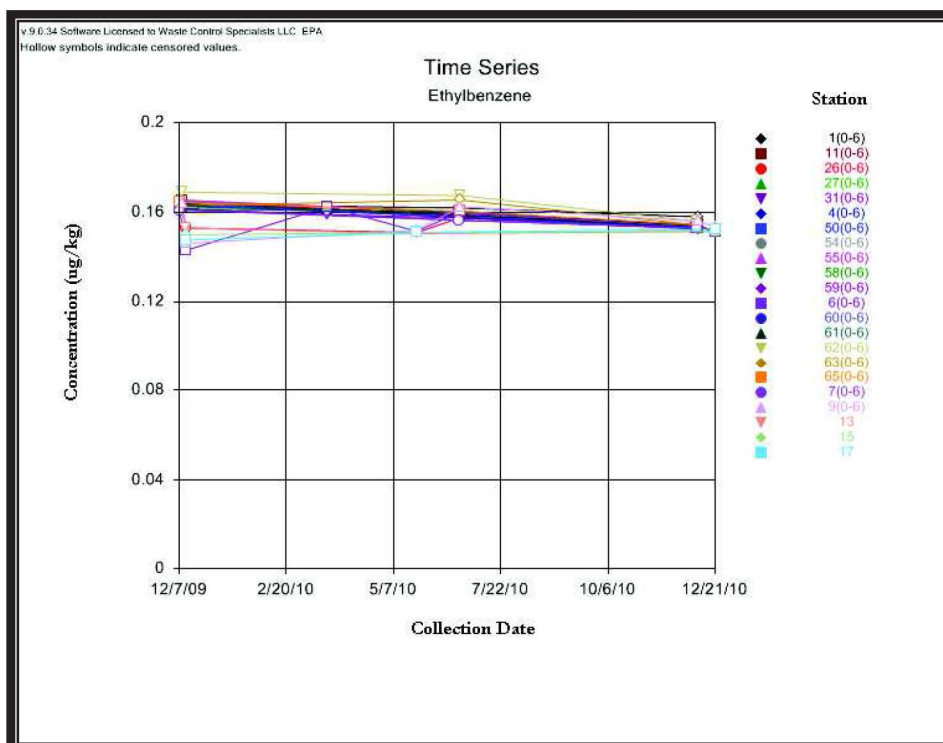


Figure 6-122: Ethylbenzene Soil Sample Results (0-2" and 0-6").

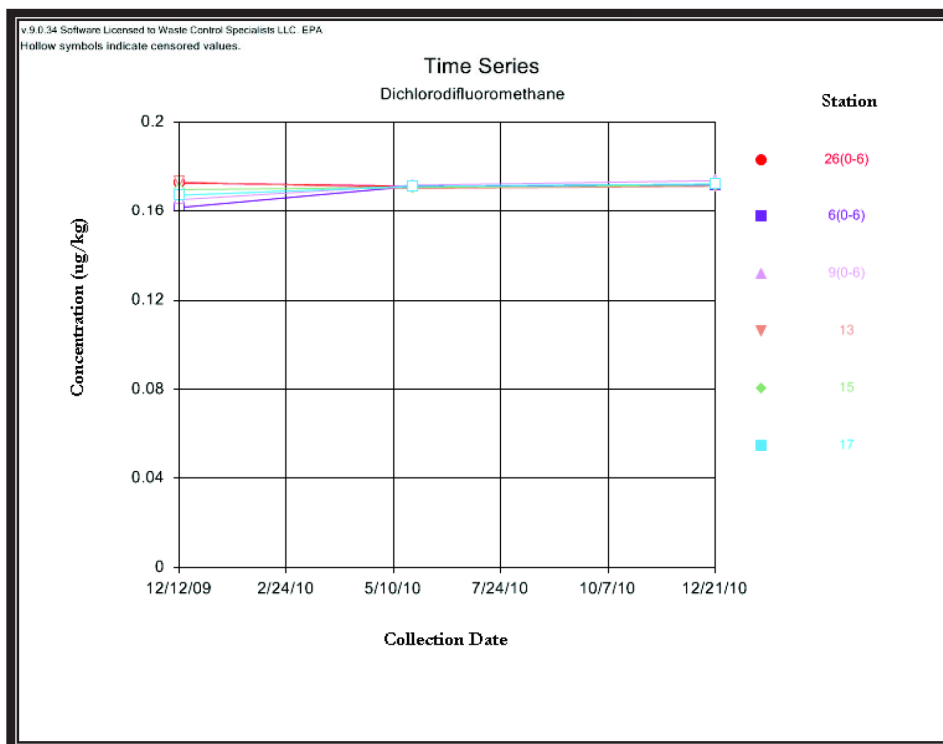


Figure 6-123: Dichlorodifluoromethane Soil Sample Results (0-2" and 0-6").

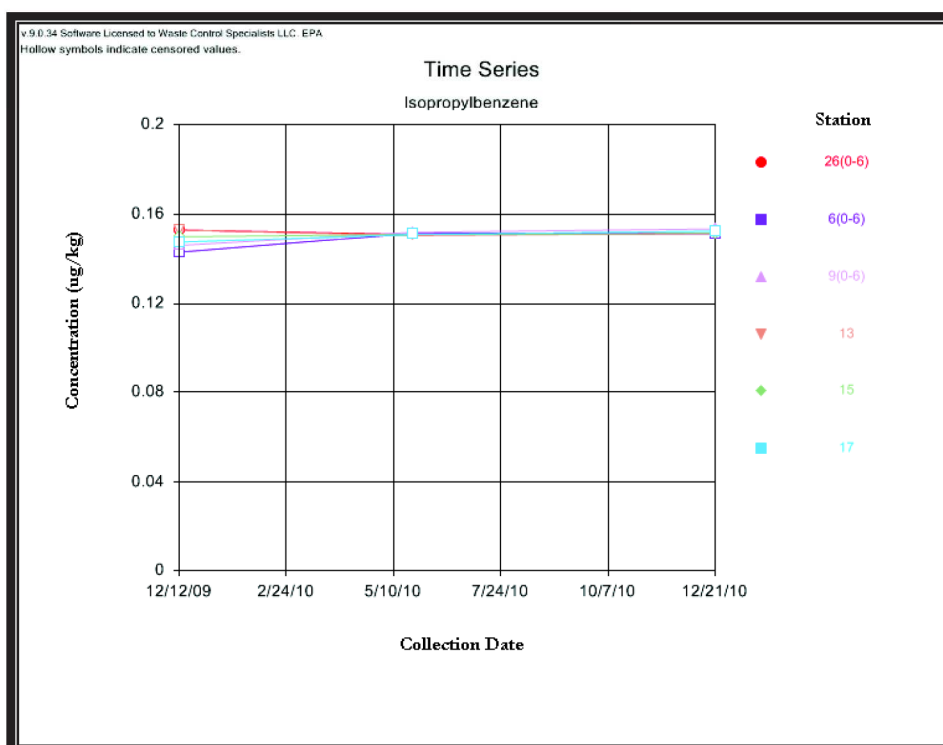


Figure 6-124: Isopropylbenzene Soil Sample Results (0-2" and 0-6").

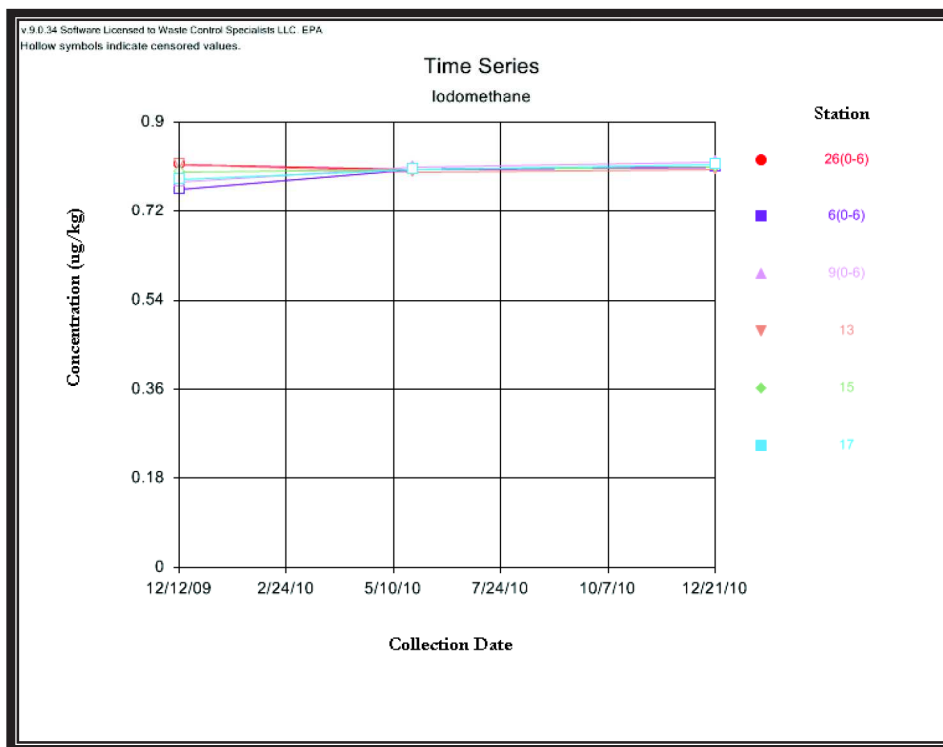


Figure 6-125: Iodomethane Soil Sample Results (0-2" and 0-6").

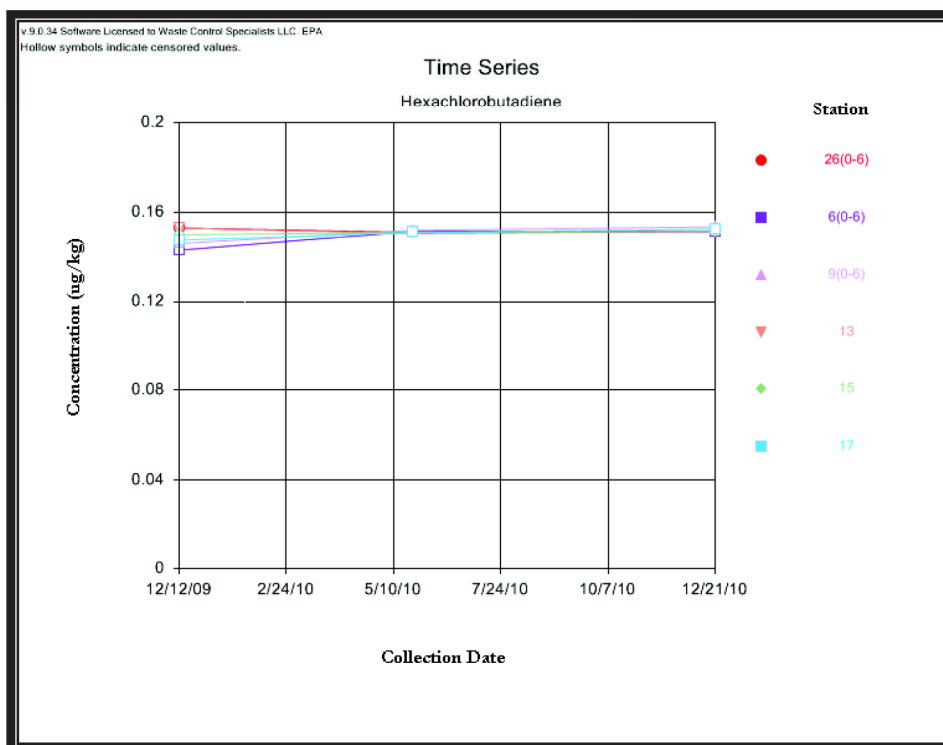


Figure 6-126: Hexachlorobutadiene Soil Sample Results (0-2" and 0-6").

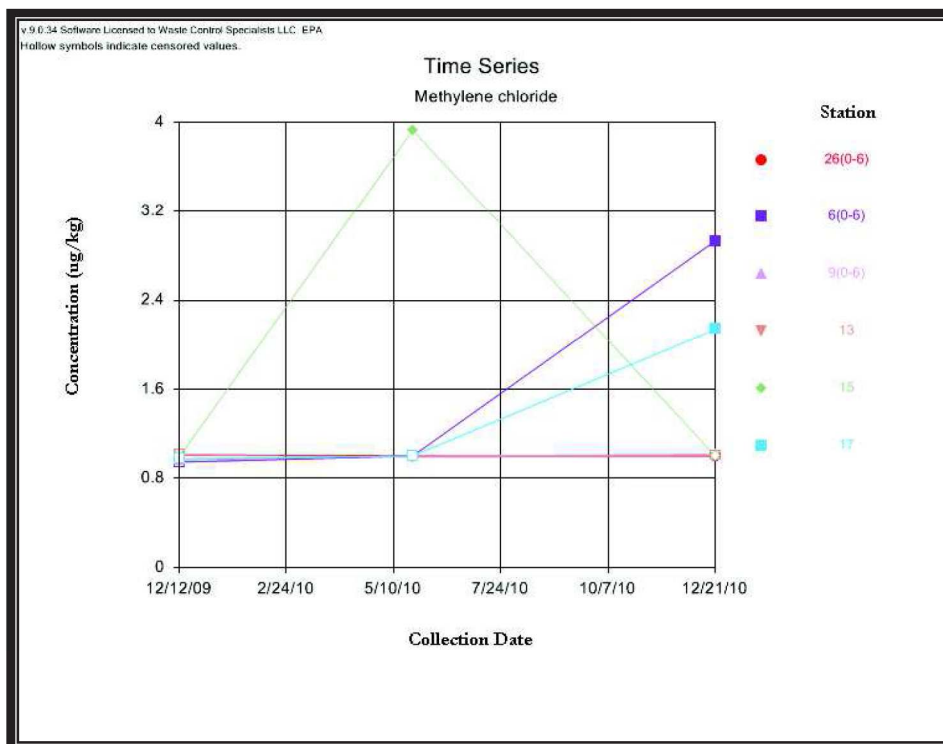


Figure 6-127: Methylene chloride Soil Sample Results (0-2" and 0-6").

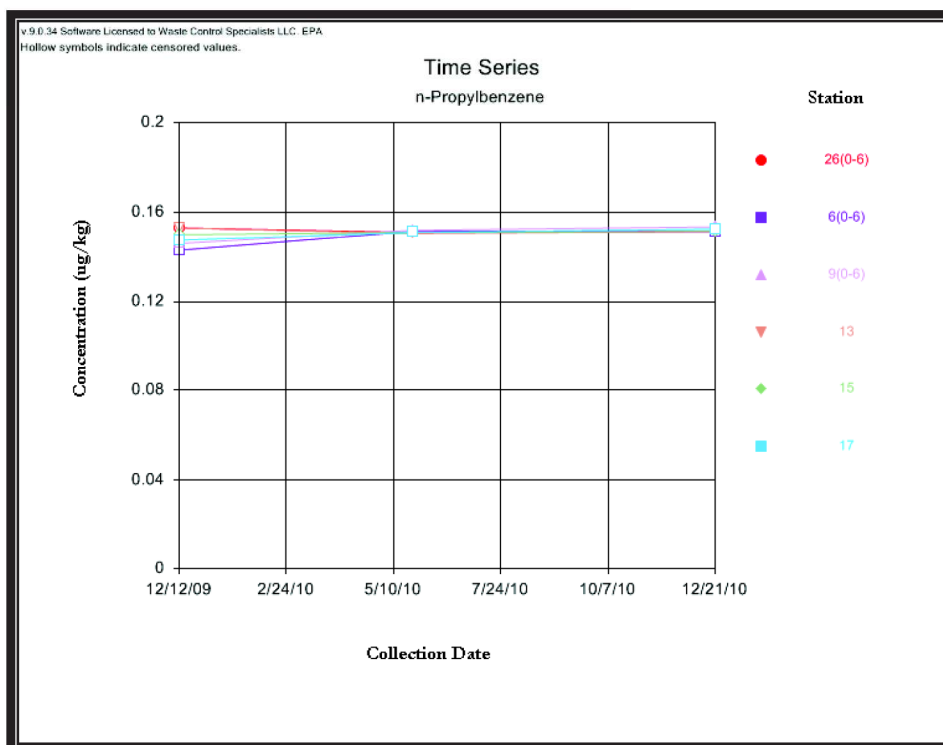


Figure 6-128: n-Propylbenzene Soil Sample Results (0-2" and 0-6").

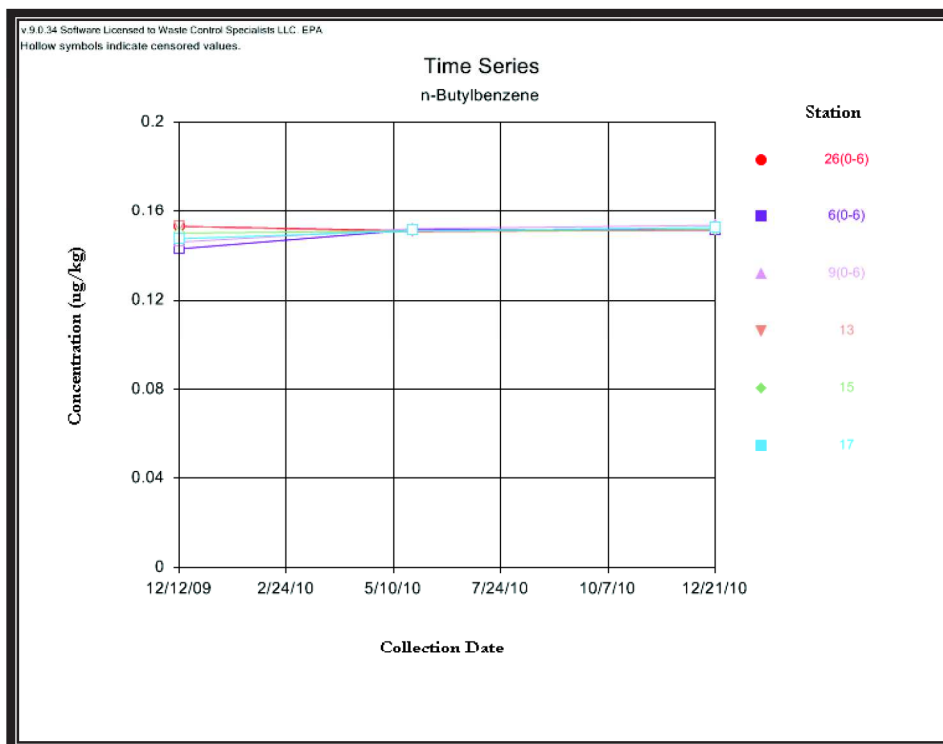


Figure 6-129: n-Butylbenzene Soil Sample Results (0-2" and 0-6").

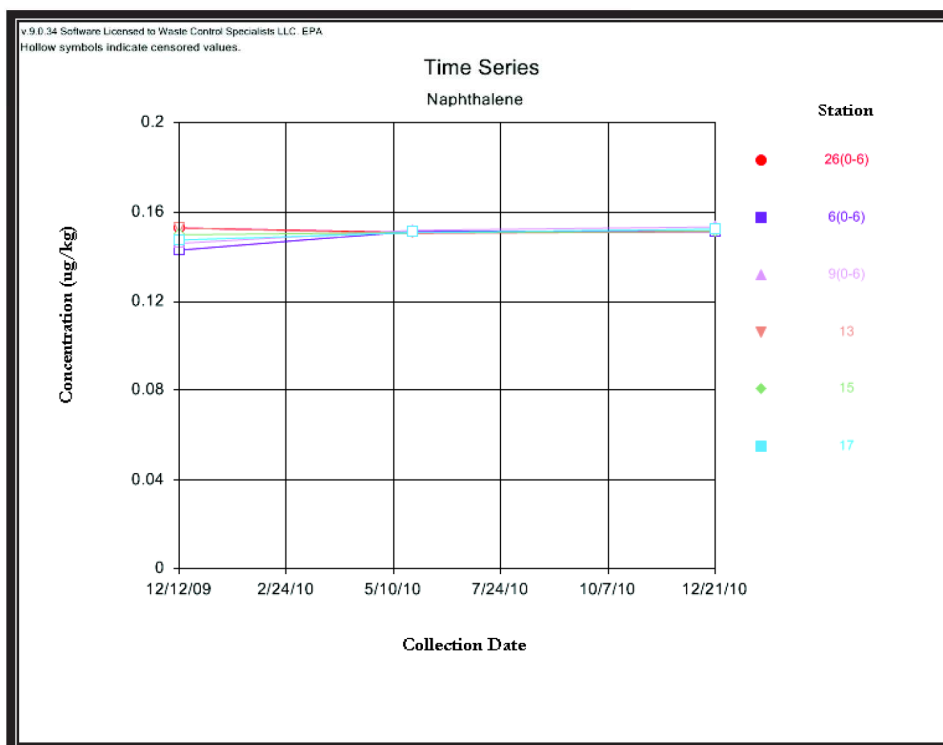


Figure 6-130: Naphthalene Soil Sample Results (0-2" and 0-6").

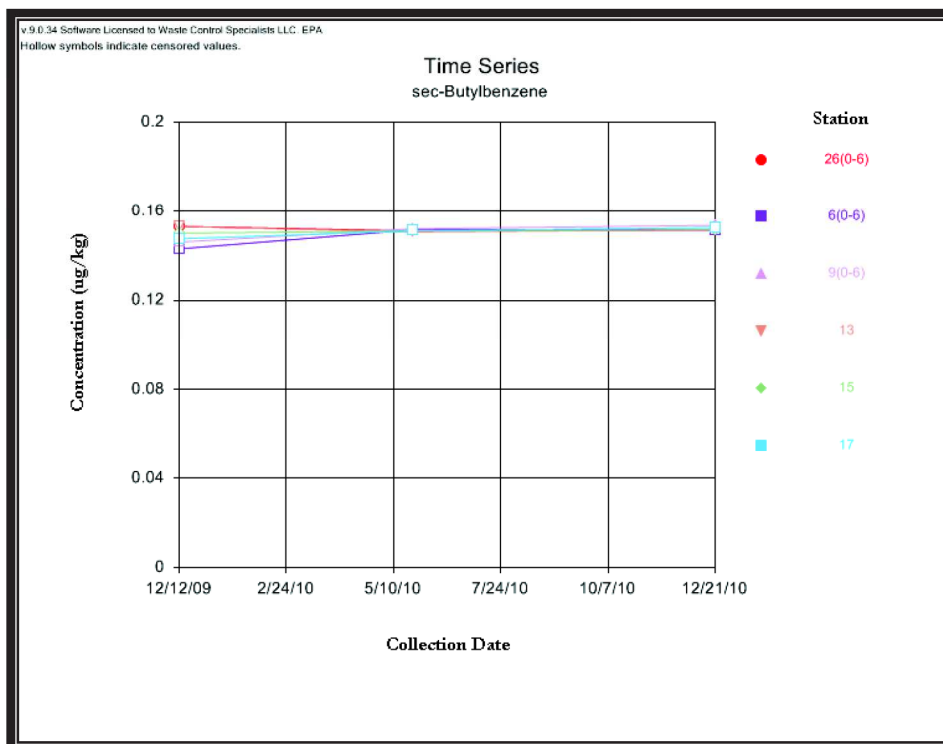


Figure 6-131: sec-Butylbenzene Soil Sample Results (0-2" and 0-6").

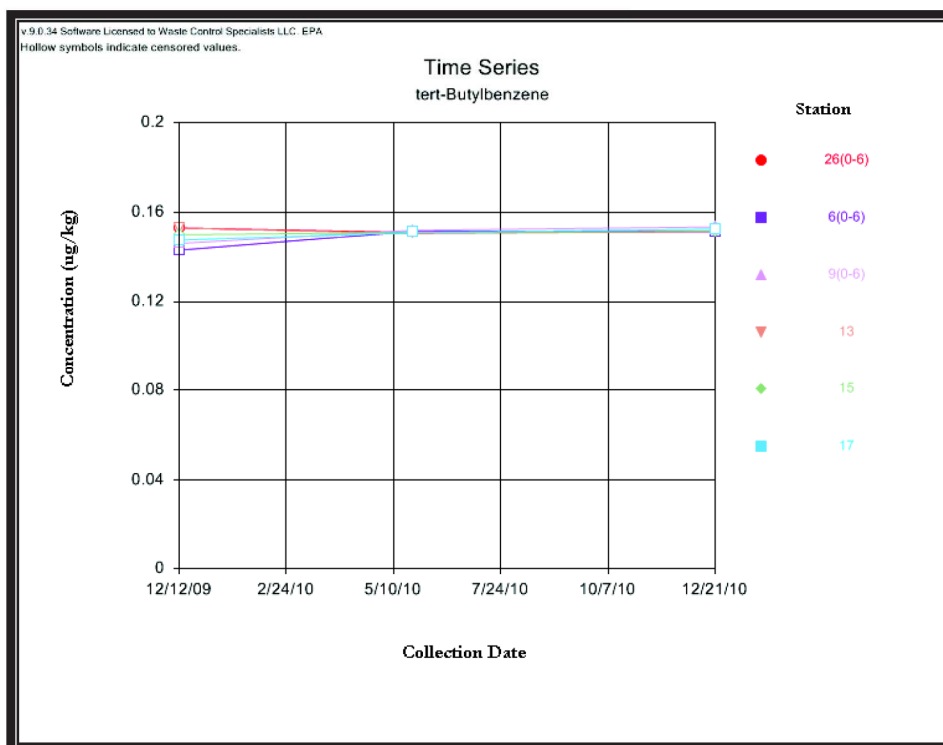


Figure 6-132: tert-Butylbenzene Soil Sample Results (0-2" and 0-6").

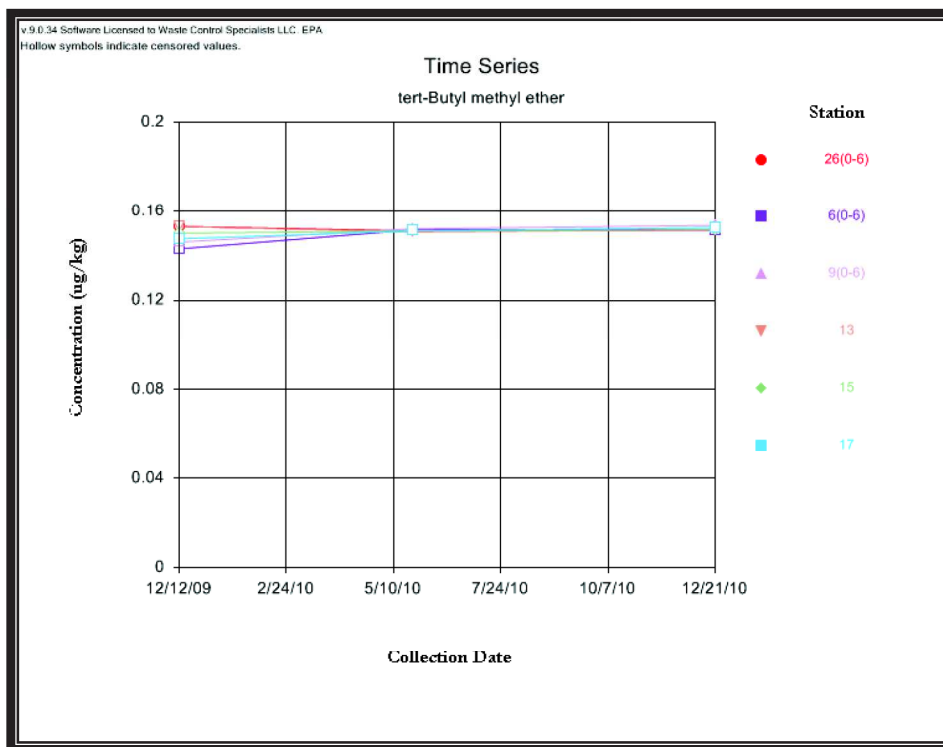


Figure 6-133: tert-Butyl methyl ether Soil Sample Results (0-2" and 0-6").

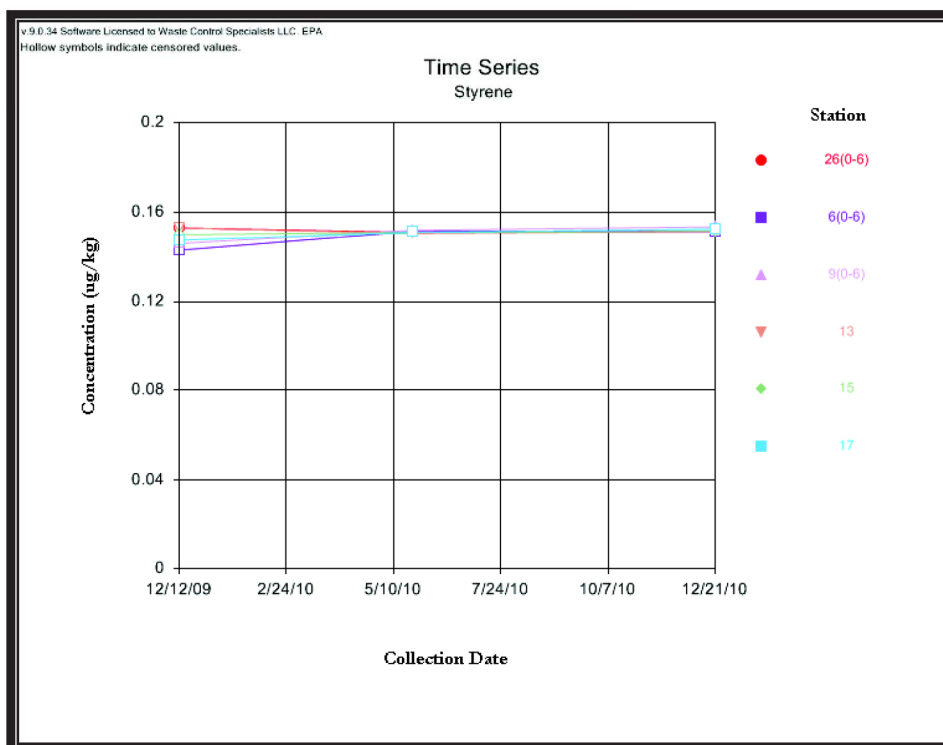


Figure 6-134: Styrene Soil Sample Results (0-2" and 0-6").

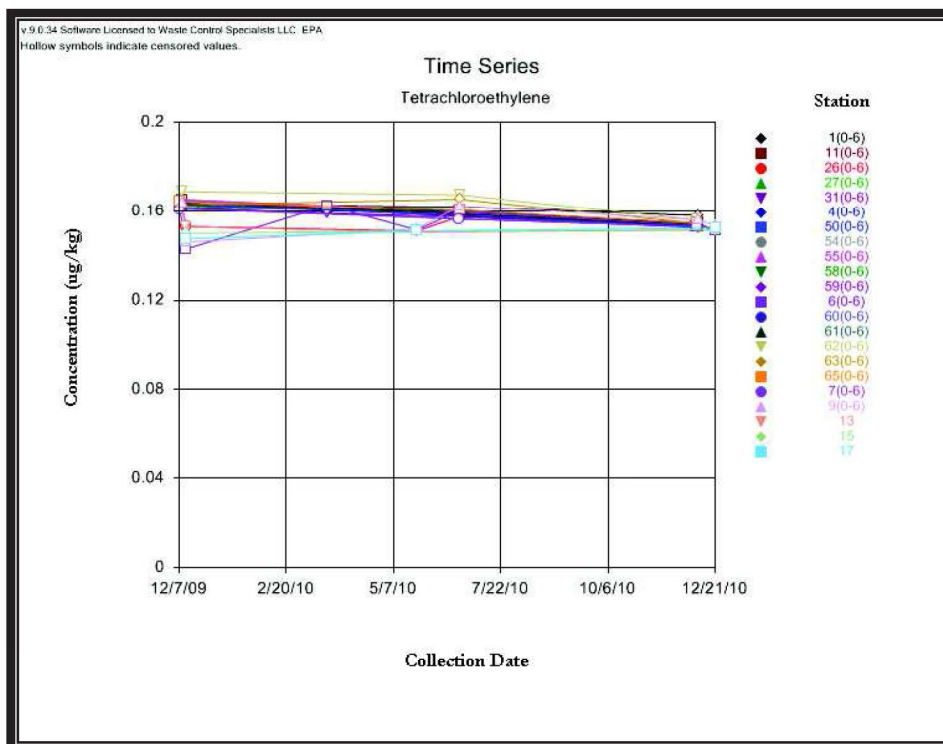


Figure 6-135: Tetrachloroethylene Soil Sample Results (0-2" and 0-6").

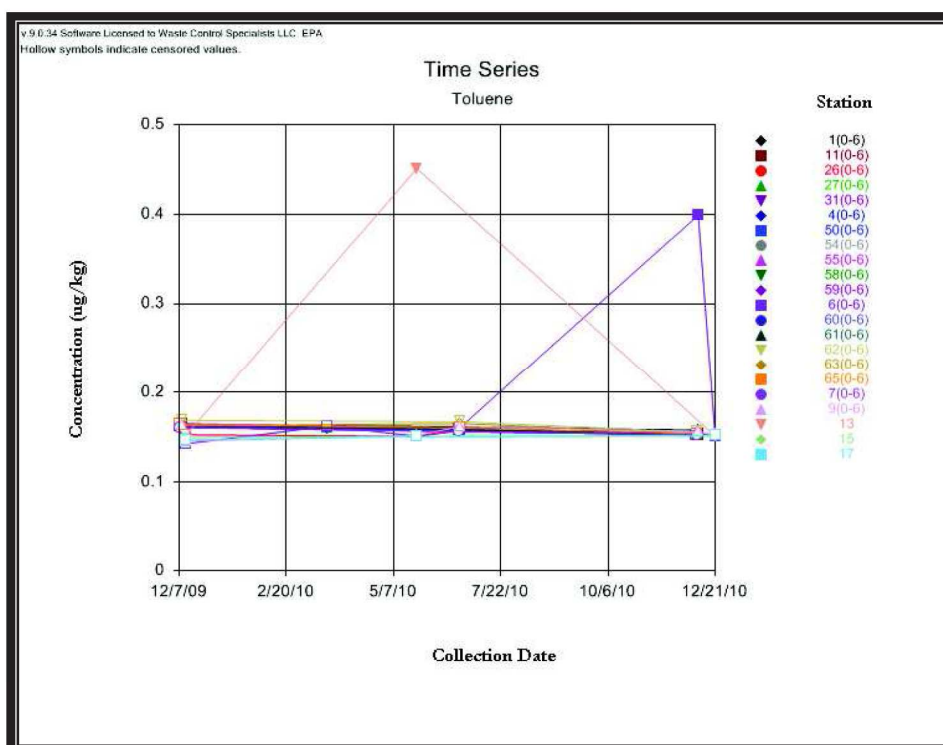


Figure 6-136: Toluene Soil Sample Results (0-2" and 0-6").

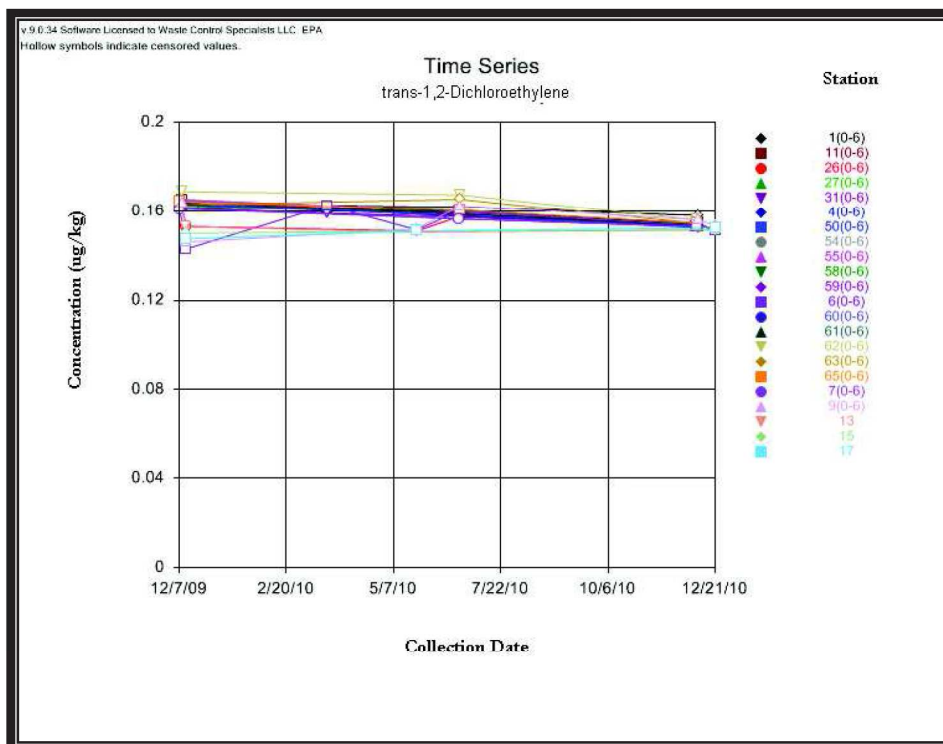


Figure 6-137: trans-1,2-Dichloroethylene Soil Sample Results (0-2" and 0-6").

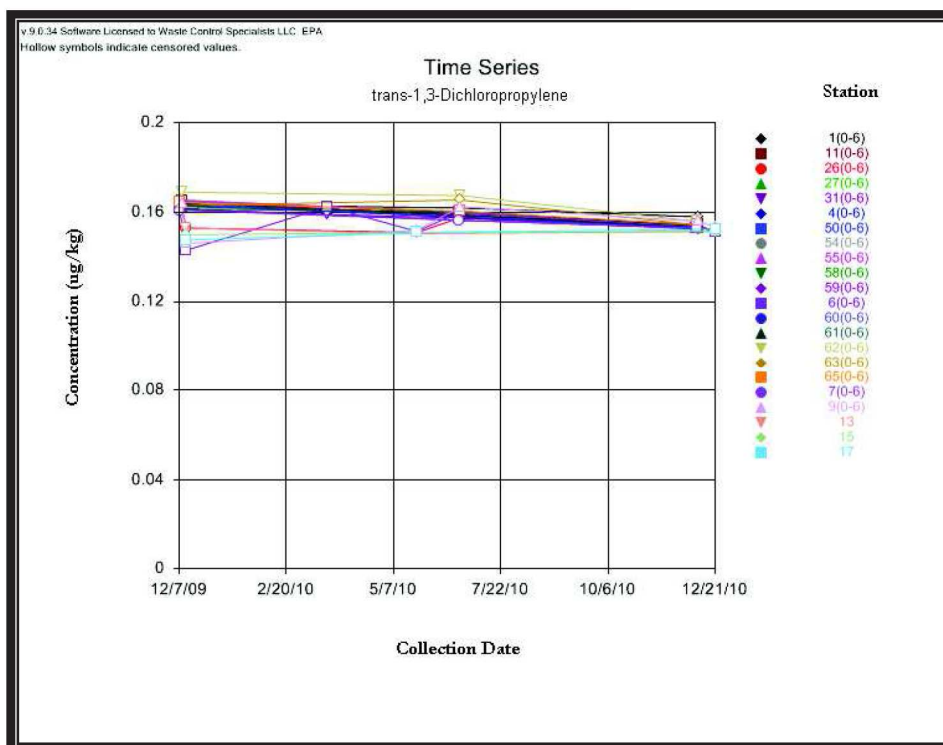


Figure 6-138: trans-1,3-Dichloropropylene Soil Sample Results (0-2" and 0-6").

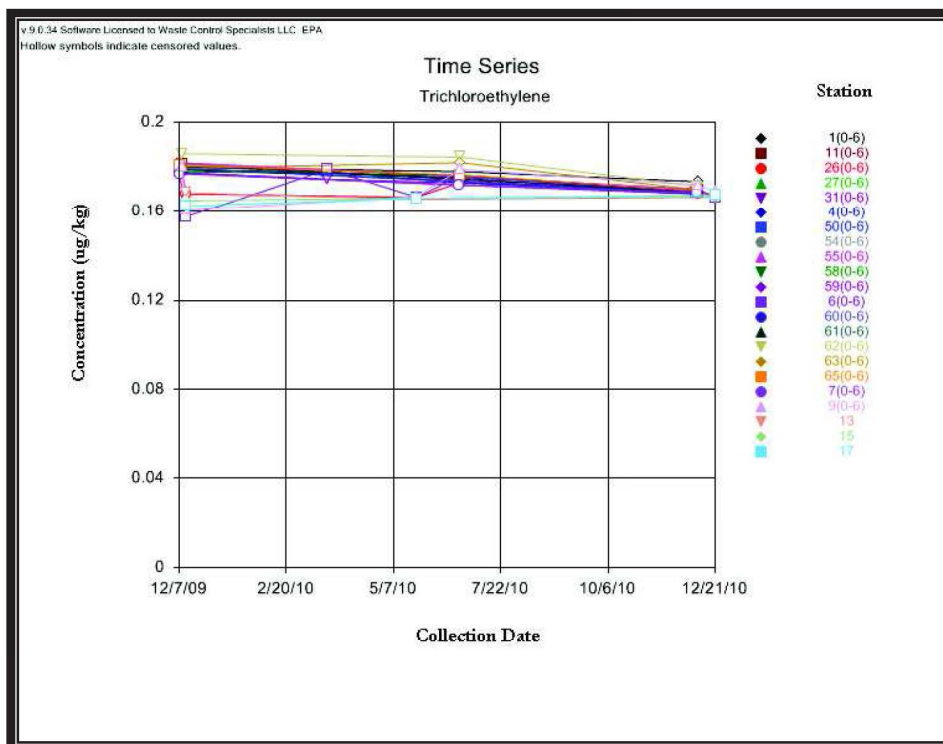


Figure 6-139: Trichloroethylene Soil Sample Results (0-2" and 0-6").



Figure 6-140: Vinyl chloride Soil Sample Results (0-2" and 0-6").

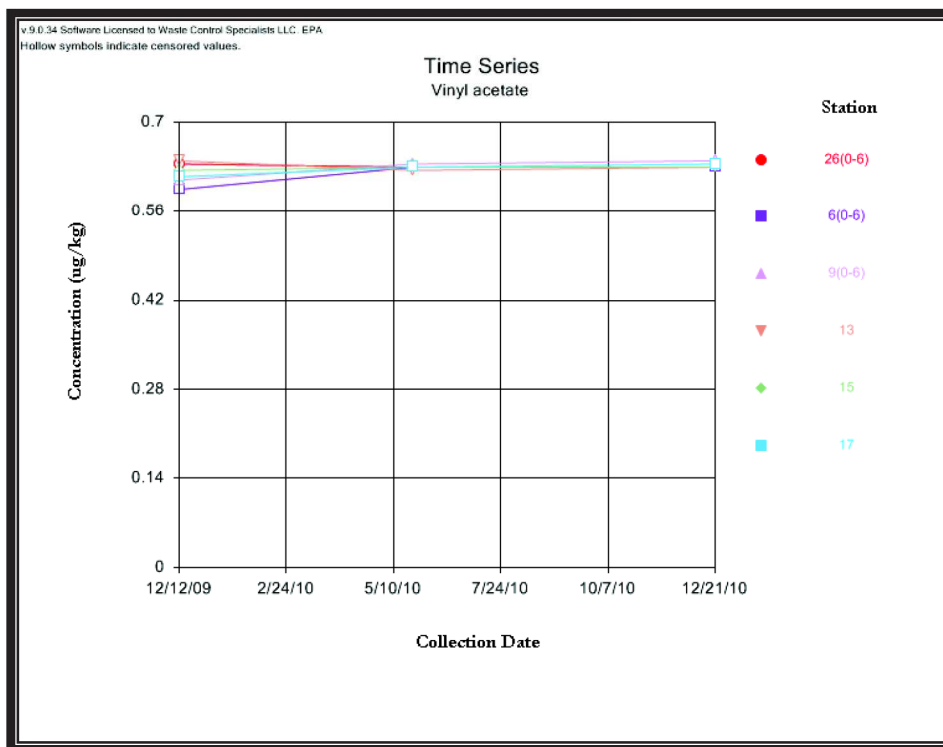


Figure 6-141: Vinyl acetate Soil Sample Results (0-2" and 0-6").

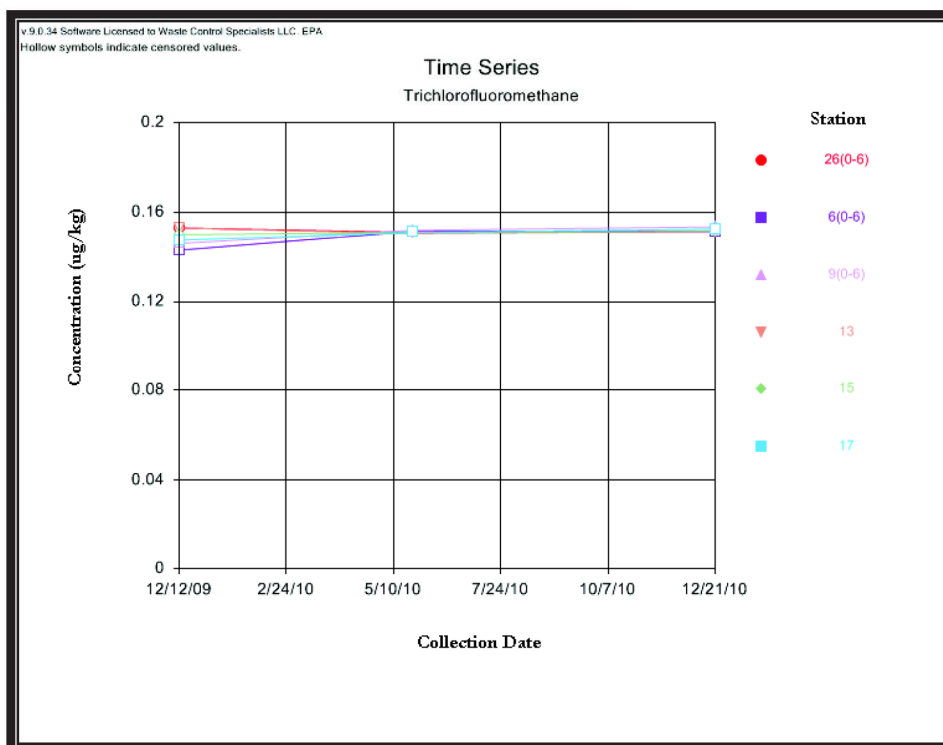


Figure 6-142: Trichlorofluoromethane Soil Sample Results (0-2" and 0-6").

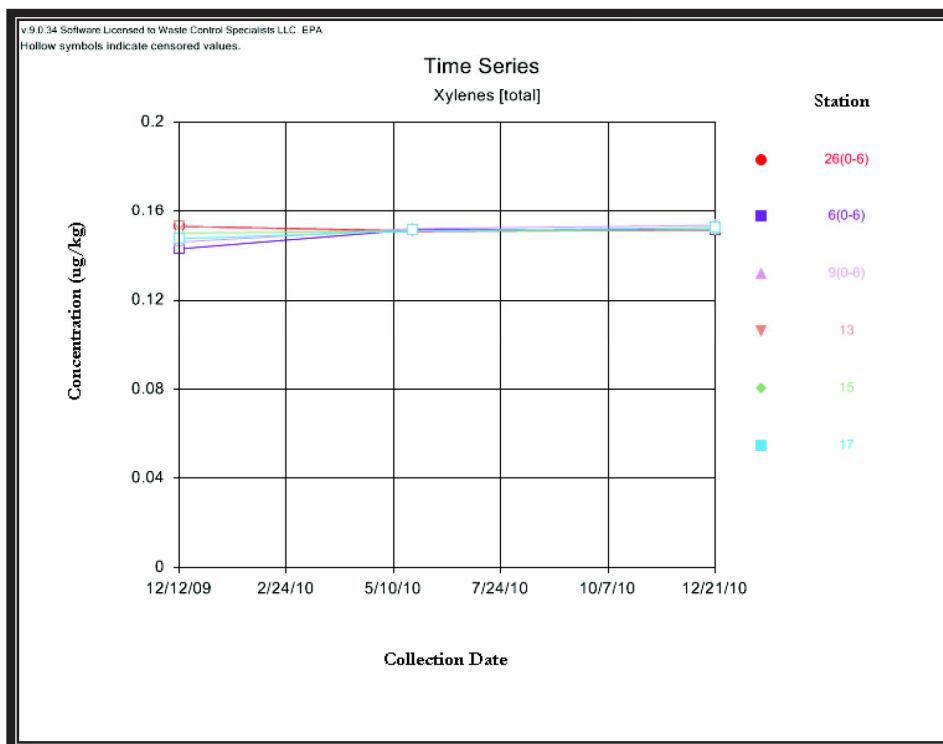


Figure 6-143: Xylenes [total] Soil Sample Results (0-2" and 0-6").

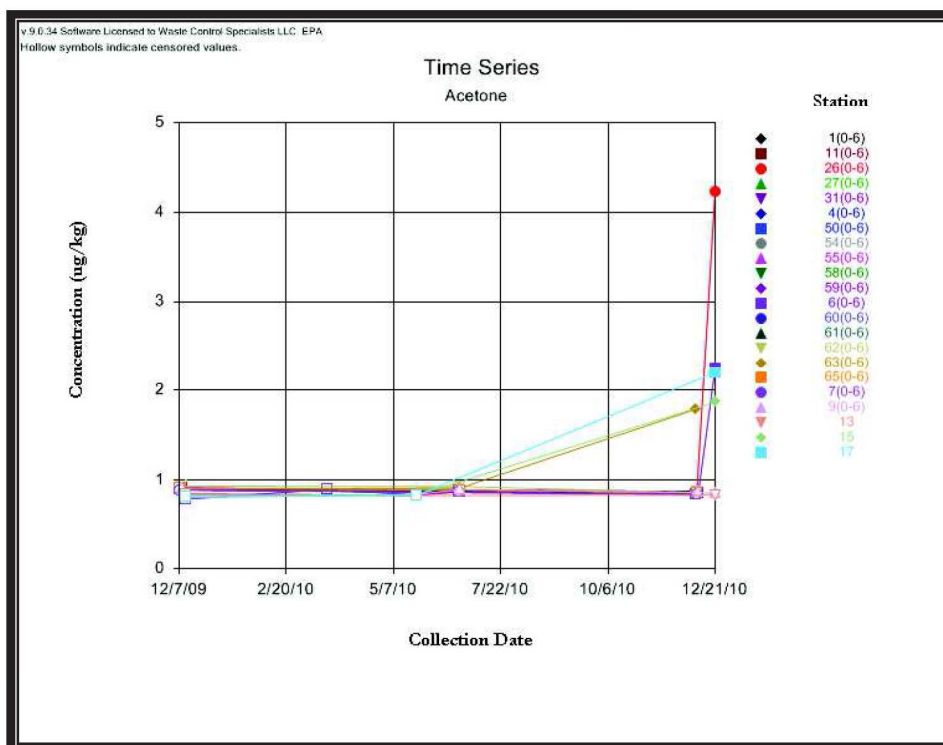


Figure 6-144: Acetone Soil Sample Results (0-2" and 0-6").

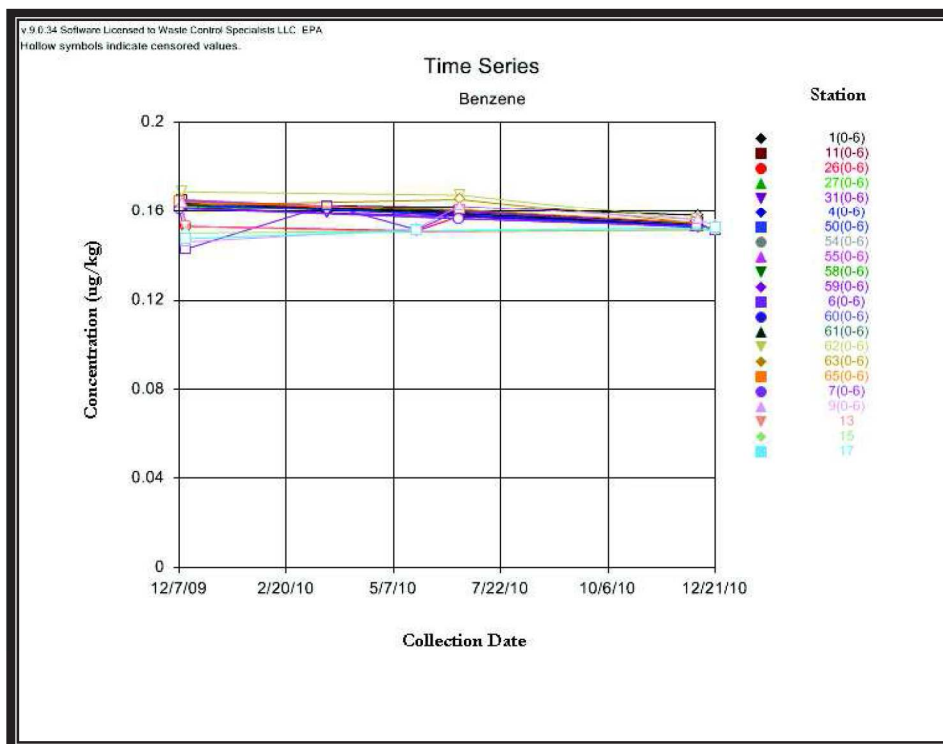


Figure 6-145: Benzene Soil Sample Results (0-2" and 0-6").

Results: Soil Samples From 6-12 Inches bgs

Summary statistics for the radiological analytes in the 6-12 inch bgs stratum are presented in Table 6-7. Please note that WCS only collects radiological samples from this stratum (non-radiological samples are not collected from this depth). Figure 6-142 through Figure 6-169 graphically depict the pre-operational soil results for the 6-12 inch bgs stratum. As previously mentioned, all pre-operational soil sample results are given in Appendix D.

Table 6-7: Summary Statistics for Routine Soil (6-12 inches)(pCi/g).

	Number of Observations	Number of Stations	<Lc	Maximum	Minimum	Mean	Standard Deviation
Alpha	114	19	0	1.51E+01	2.76E+00	7.40E+00	2.40E+00
Am-241	114	19	90	6.92E-03	-1.20E-02	7.58E-04	2.55E-03
Beta	114	19	1	2.67E+01	1.23E-01	1.31E+01	4.22E+00
C-14	114	19	105	4.61E-01	-5.42E-01	-3.12E-02	1.45E-01
Cs-137	114	19	9	2.06E-01	-7.59E-03	5.78E-02	3.85E-02
Cr-51	114	19	114	1.09E+00	-2.46E+00	-1.03E-01	4.51E-01
Co-60	114	19	104	1.31E-02	-1.22E-02	1.89E-04	5.12E-03
Cu-242	114	19	96	3.29E-02	-3.17E-03	1.66E-03	4.03E-03
Cu-243/244	114	19	87	1.32E-02	-7.30E-03	1.48E-03	3.02E-03
I-129	114	19	104	1.36E-01	-1.39E-01	1.42E-02	5.09E-02
Mn-54	114	19	99	2.32E-02	-1.18E-02	1.69E-03	5.93E-03
Np-237	114	19	109	1.86E-02	-2.10E-02	-9.04E-04	6.37E-03
Pb-210	114	19	29	2.26E+00	-3.43E-01	6.91E-01	4.68E-01
Pu-238	114	19	84	2.39E-02	-7.51E-03	2.73E-03	3.81E-03
Pu239/240	114	19	79	1.53E-02	-4.77E-03	3.07E-03	3.51E-03
Pu-241	114	19	107	5.64E-01	-6.05E-01	-3.16E-02	1.98E-01
Pu-242	114	19	106	1.15E-02	-5.11E-03	1.23E-03	2.71E-03
Ra-226	114	19	0	8.52E-01	3.51E-01	6.06E-01	1.16E-01
Ra-228	114	19	0	1.07E+00	2.47E-01	6.01E-01	1.45E-01
Sr-90	114	19	83	2.64E-01	-1.22E-01	3.60E-02	7.44E-02
Tc-99	114	19	104	3.14E-01	-3.03E-01	-1.02E-02	1.24E-01
Th-228	114	19	2	1.48E+00	1.61E-01	5.90E-01	2.27E-01
Th-230	114	19	2	1.47E+00	1.58E-01	7.63E-01	2.80E-01
Th-232	114	19	2	1.25E+00	1.30E-01	5.69E-01	2.34E-01
H-3	114	19	113	5.04E-01	-3.87E-01	2.94E-02	1.96E-01
U-233/234	114	19	0	7.54E-01	2.22E-01	4.47E-01	1.06E-01
U-235/236	114	19	53	6.79E-02	-1.04E-02	2.71E-02	1.66E-02
U-238	114	19	0	7.14E-01	2.43E-01	4.46E-01	1.03E-01

*Values of Critical Level Estimated as one-half of the MDC.

Naturally occurring radionuclides detected in these data include: Tritium, Carbon-14, Lead-210, Radium-226, Radium-228, Thorium-228, Thorium-230, and Thorium-232, Uranium-234, and Uranium-235 and Uranium-238. The concentrations of these radionuclides are consistent with natural background.

Cesium-137 and Plutonium-239/240 were measured in soil at levels well above the 5% false positive rates that was expected. While the presence of these radionuclides were confirmed in soil the very low

concentrations that were detected are consistent with and attributable to atmospheric fallout from above-ground nuclear weapons testing.

Since the critical level is established at the $\alpha = 0.05$ significance level, a 5% false positive rate is expected. The routine soil (6-12") results for Americium-241, Curium-242, Curium-243/244, Manganese-54, Plutonium-238, Plutonium-239/240, Plutonium-241, Plutonium-242, Strontium-90, and Technetium-99 have a higher than expected false positive rate. WCS suspects that these are not true false positives because they are being compared against critical values that were estimated by WCS as one-half of the MDC. When the measurement uncertainty is taken into account the potential errors overlap with zero indicating that the reported results are strongly influenced by the instrumentation or detector noise. Because the false positives are very close to the critical level, WCS suspects that if these data were compared against their true critical levels that the false positive rate would approach 5%. In addition, if the background counts were extremely low, the estimated critical values would be artificially low. WCS is requesting documentation of background counts for these data from the analytical laboratory.

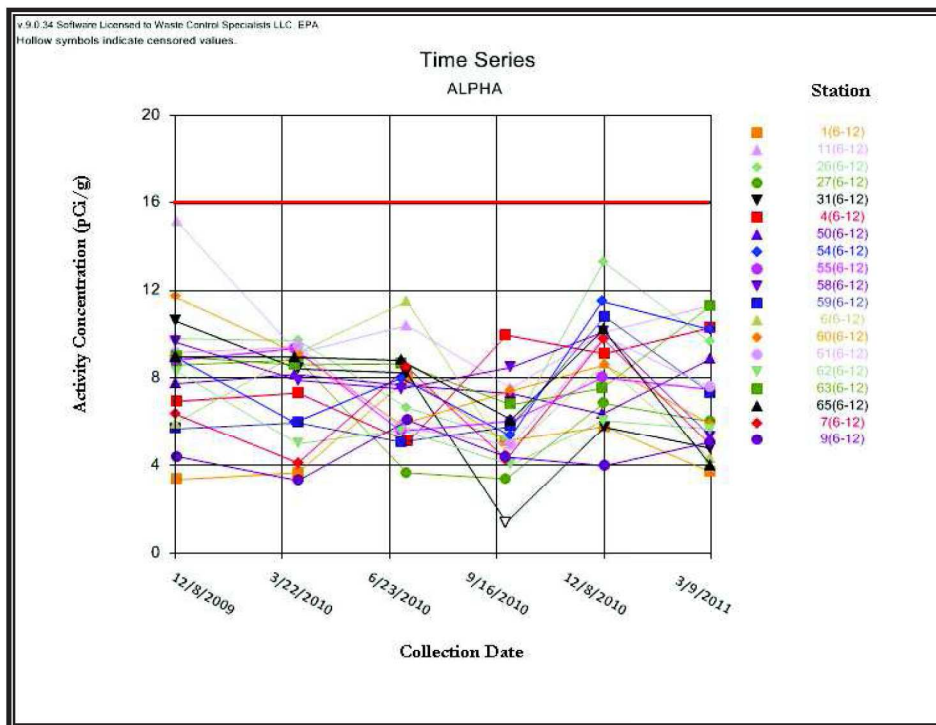


Figure 6-146: Alpha Soil Sample Results (6-12").

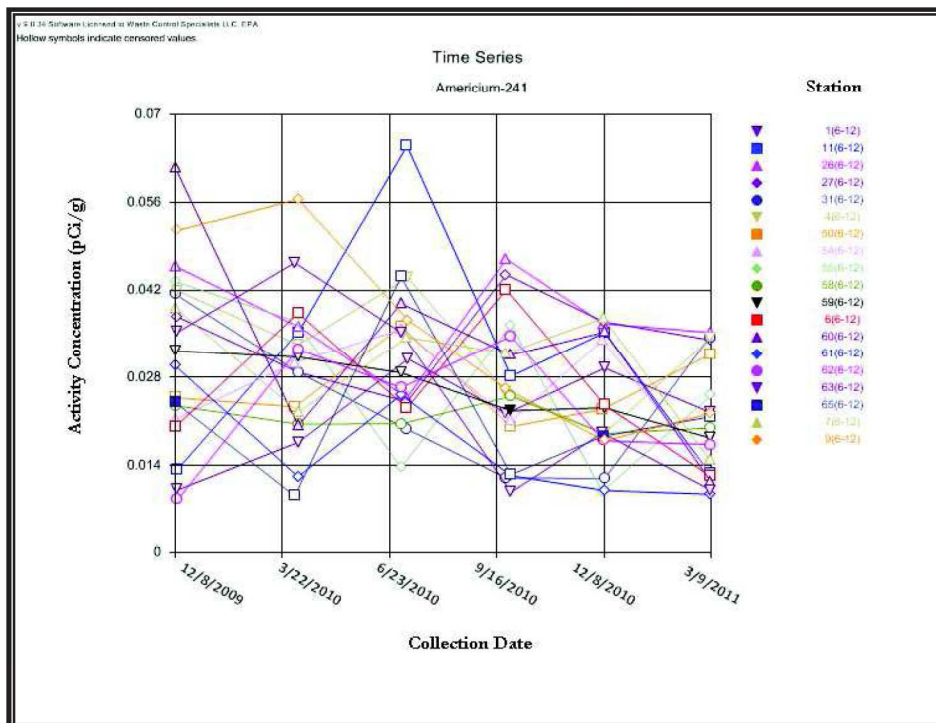


Figure 6-147: Americium-241 Soil Sample Results (6-12").

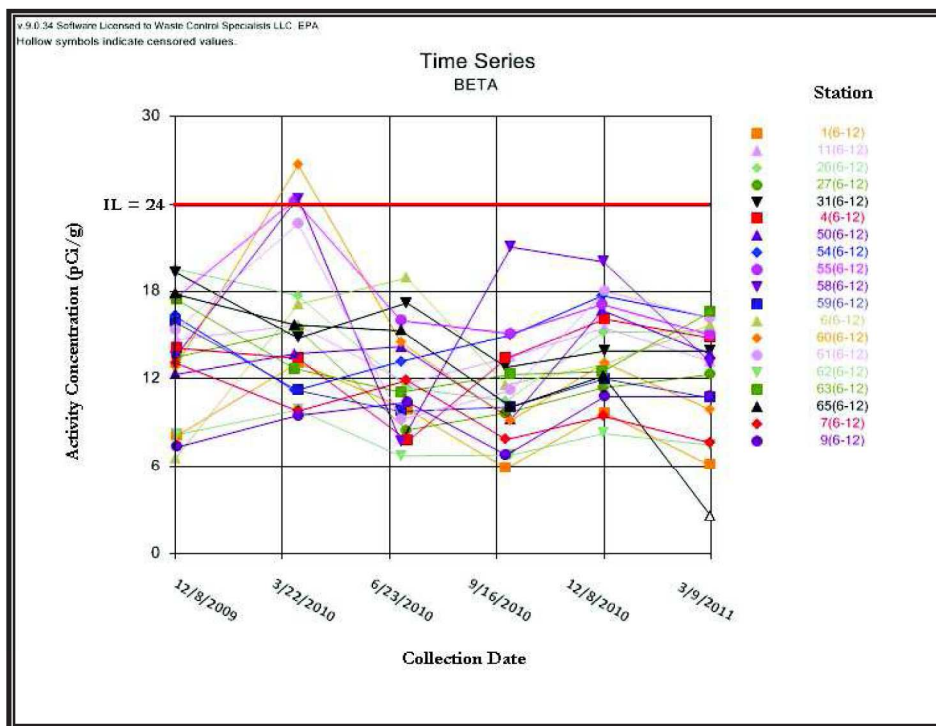


Figure 6-148: Beta Soil Sample Results (6-12").

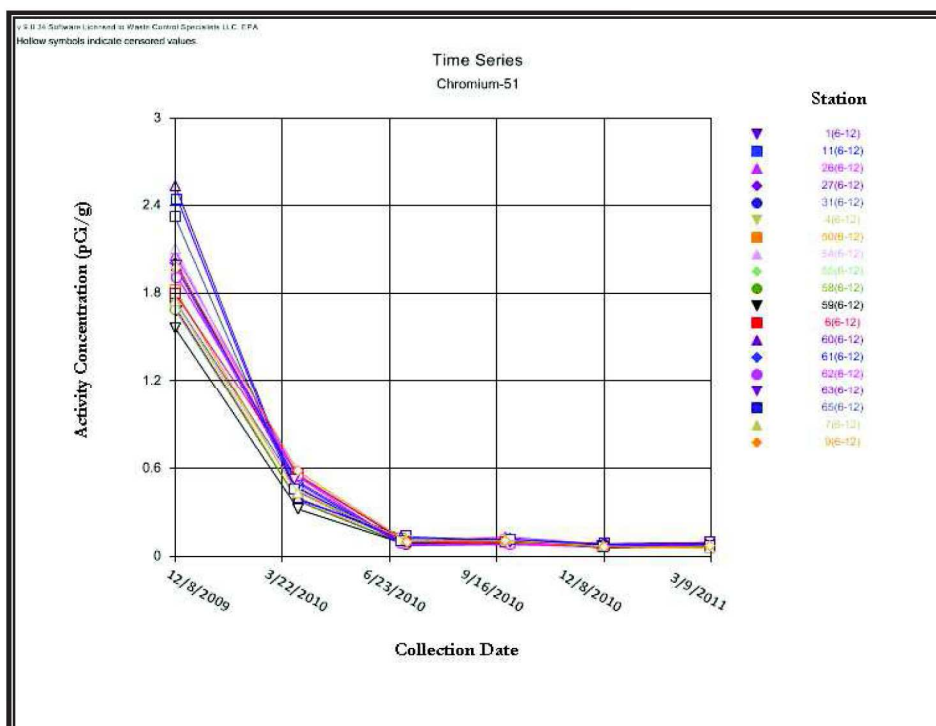


Figure 6-149: Chromium-51 Soil Sample Results (6-12").

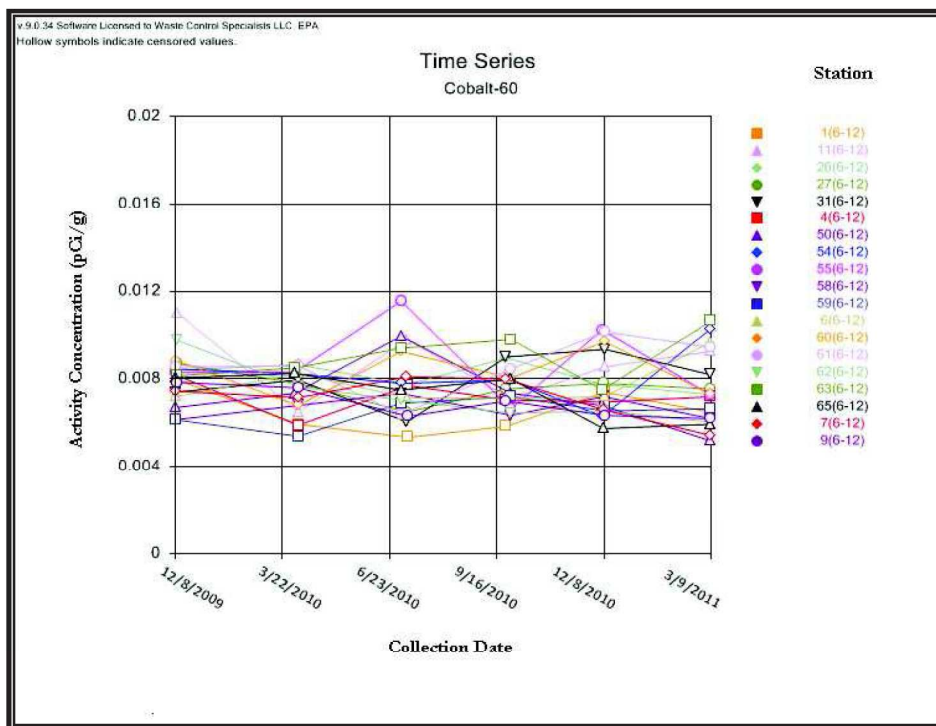


Figure 6-150: Cobalt-60 Soil Sample Results (6-12").

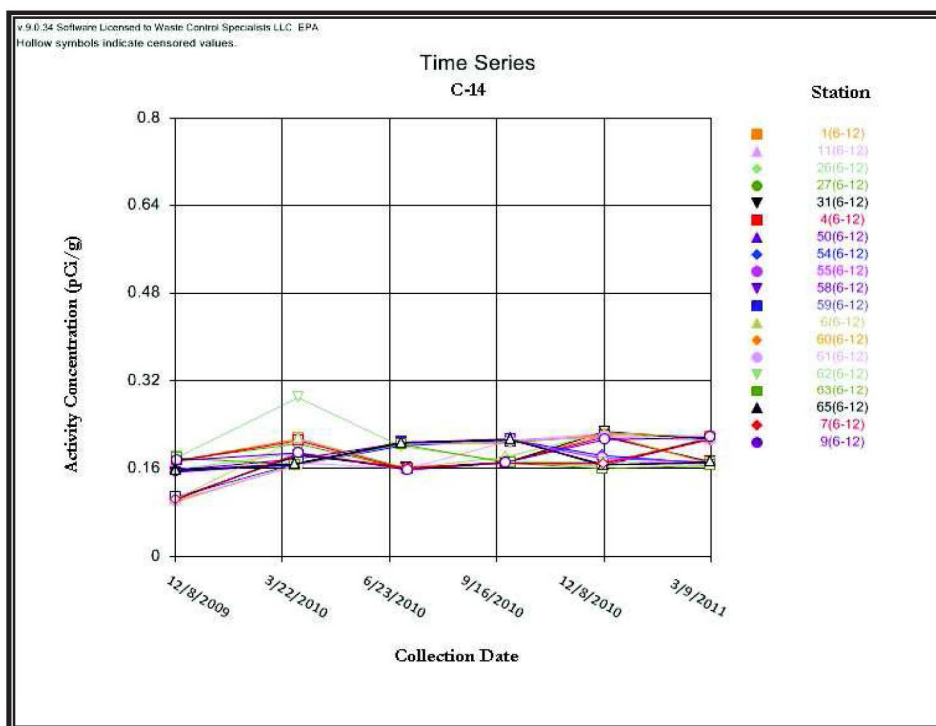


Figure 6-151: Carbon-14 Soil Sample Results (6-12").

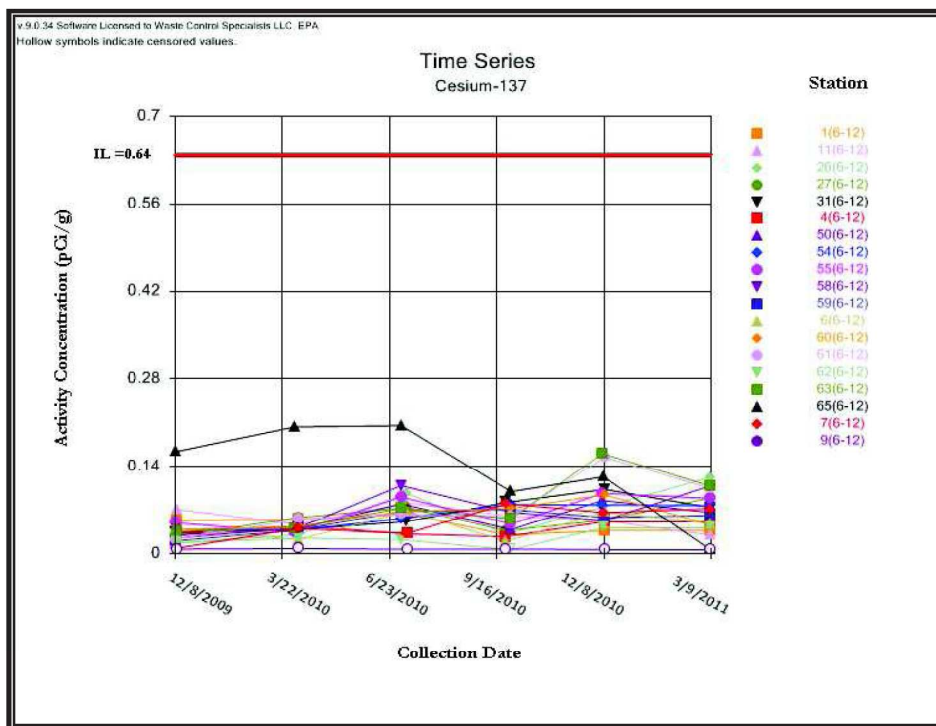


Figure 6-152: Cesium-137 Soil Sample Results (6-12”).

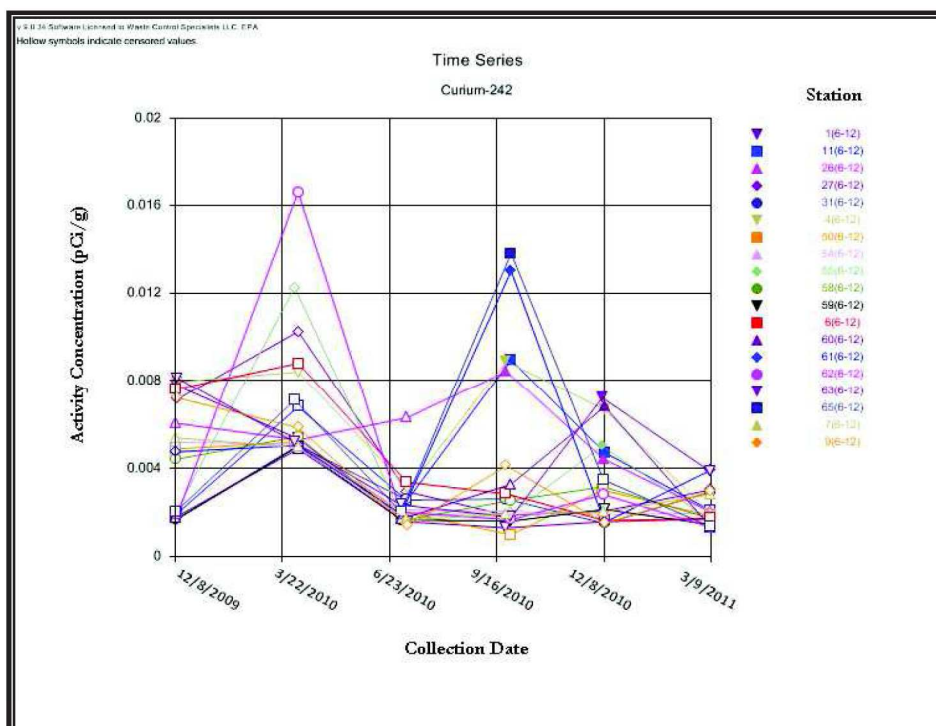


Figure 6-153: Curium-242 Soil Sample Results (6-12”).

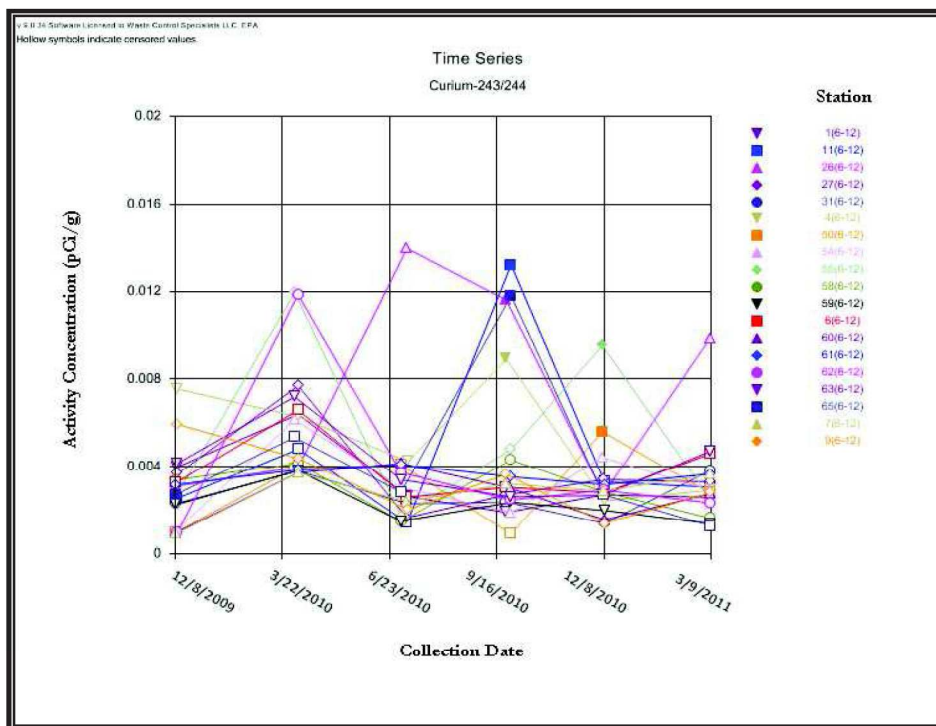


Figure 6-154: Curium-243/244 Soil Sample Results (6-12").

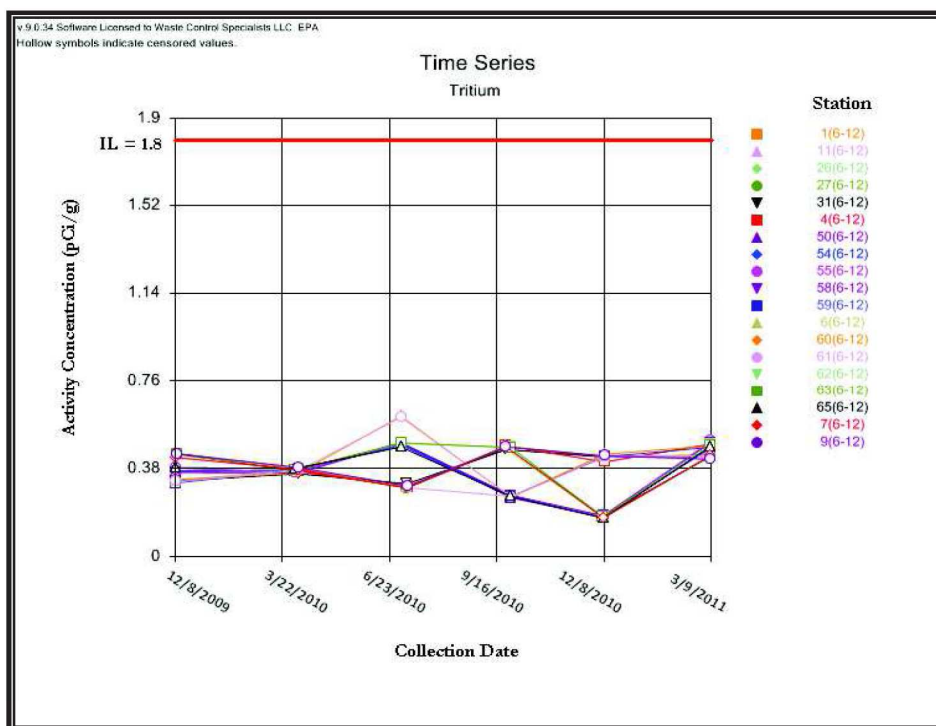


Figure 6-155: Tritium Soil Sample Results (6-12").

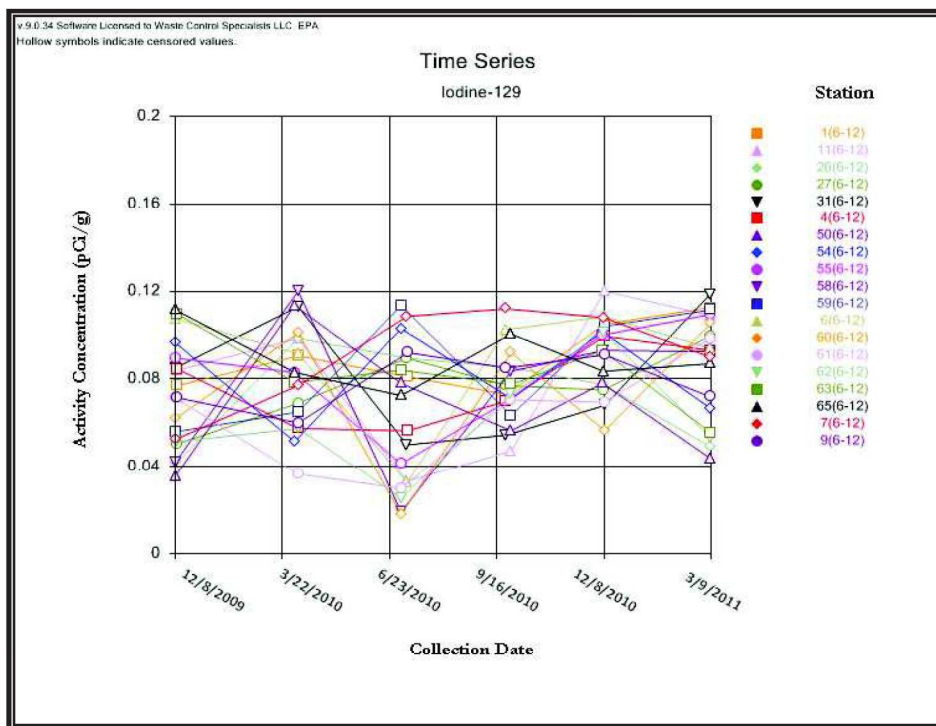


Figure 6-156: Iodine-129 Soil Sample Results (6-12").

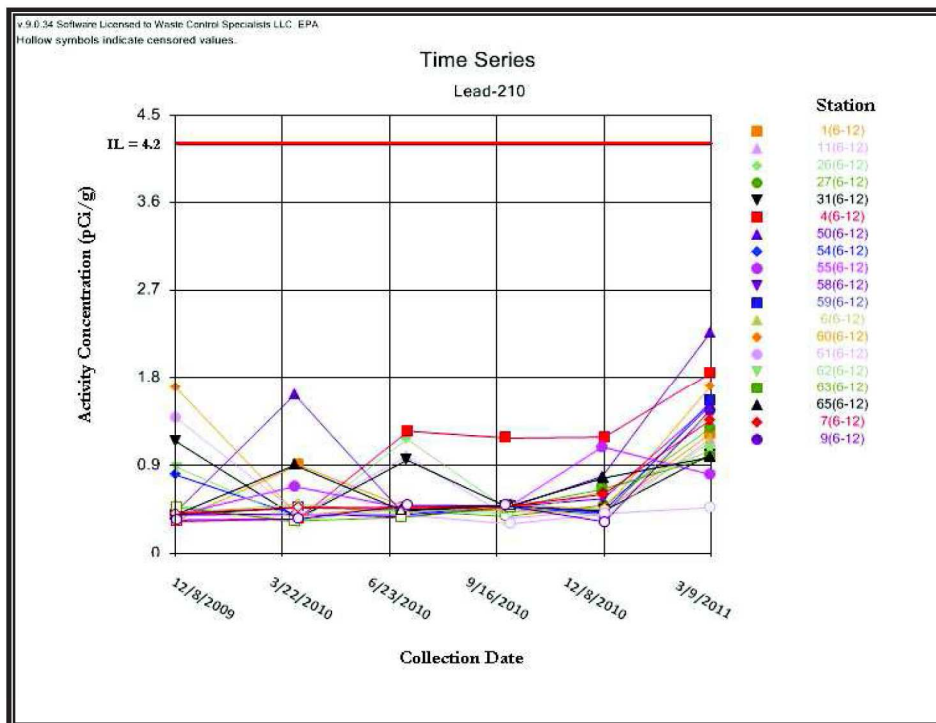


Figure 6-157: Lead-210 Soil Sample Results (6-12").

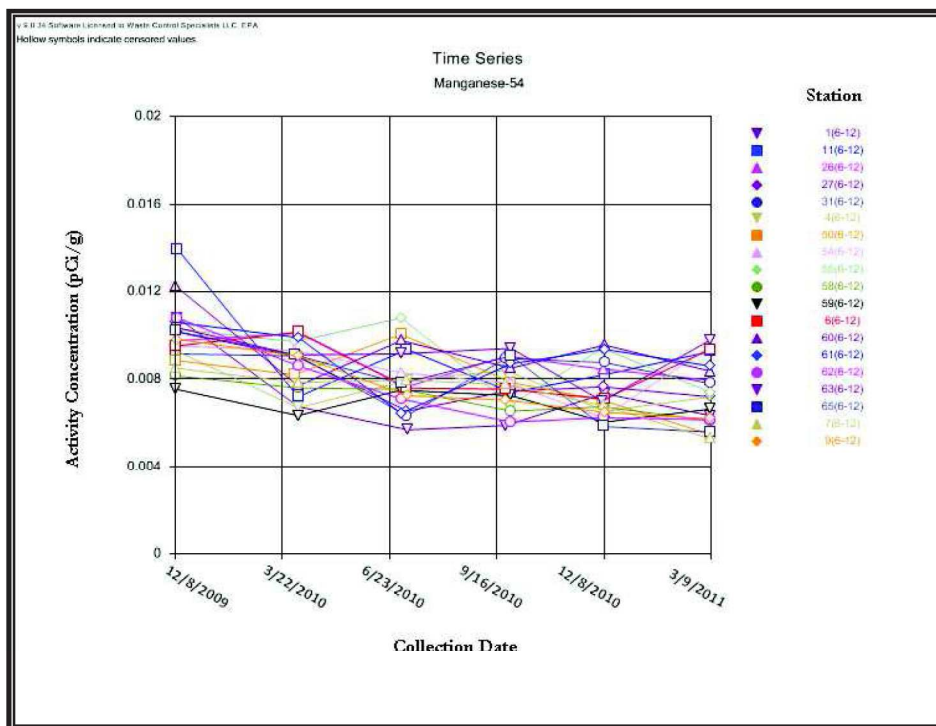


Figure 6-158: Manganese-54 Soil Sample Results (6-12").

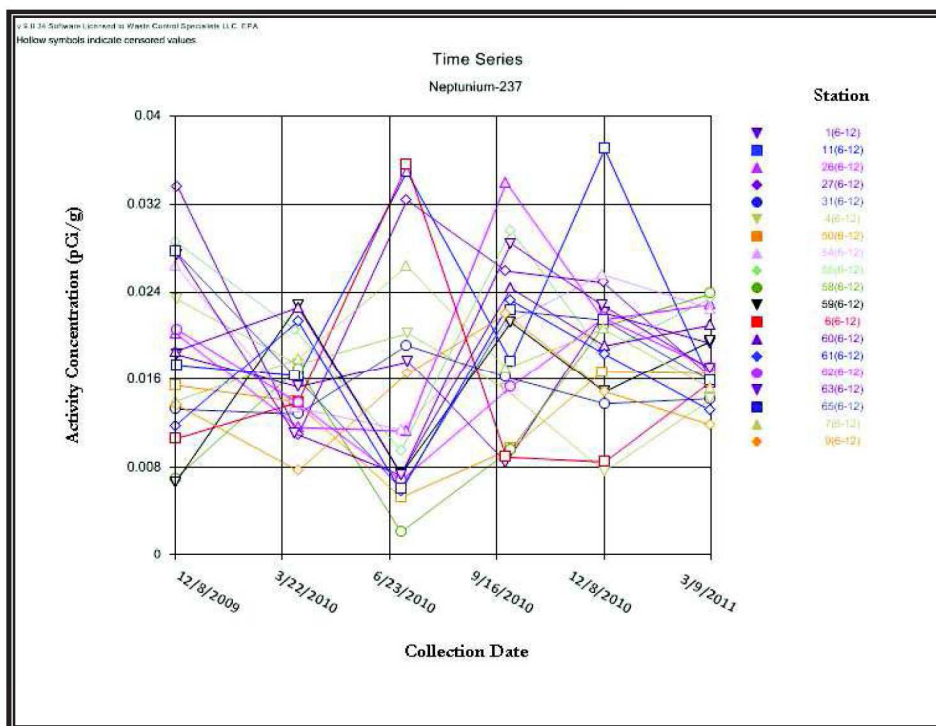


Figure 6-159: Neptunium-237 Soil Sample Results (6-12").

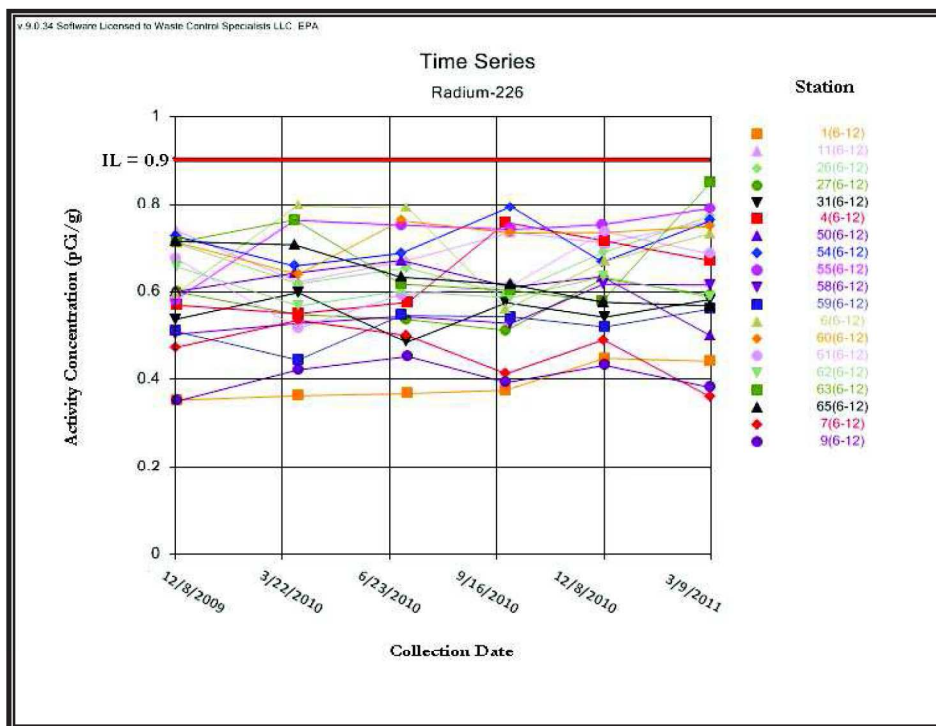


Figure 6-160: Radium-226 Soil Sample Results (6-12").

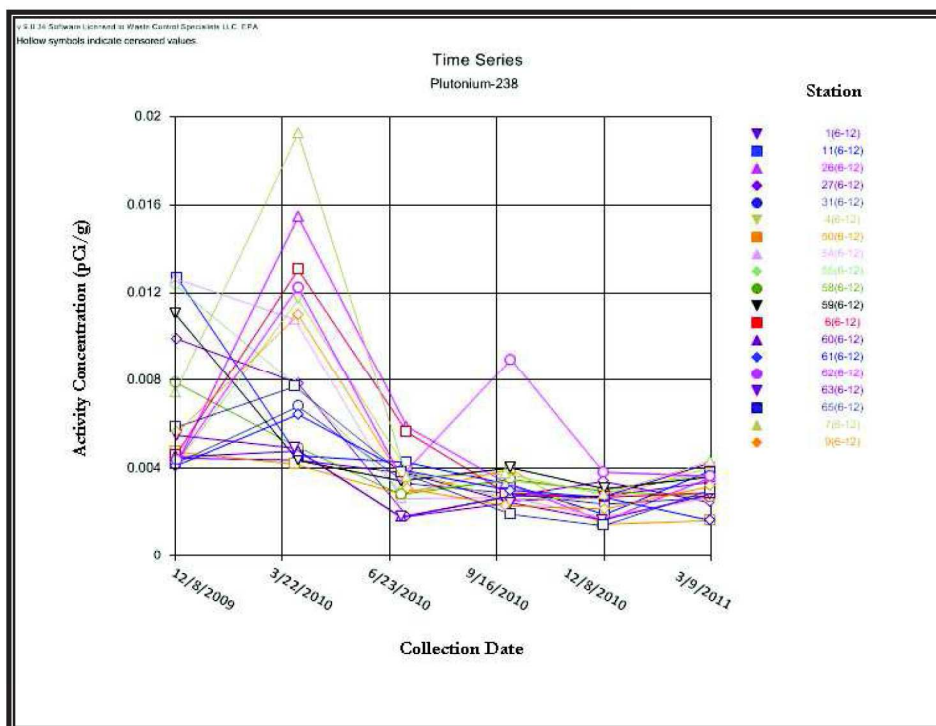


Figure 6-161: Plutonium-238 Soil Sample Results (6-12").

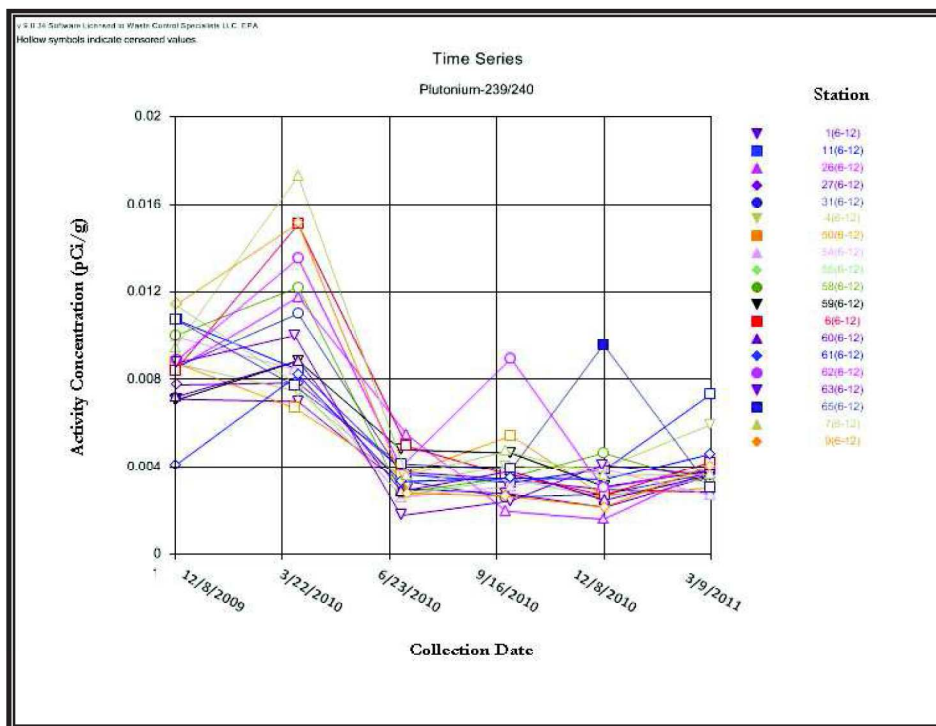


Figure 6-162: Plutonium-239/240 Soil Sample Results (6-12").

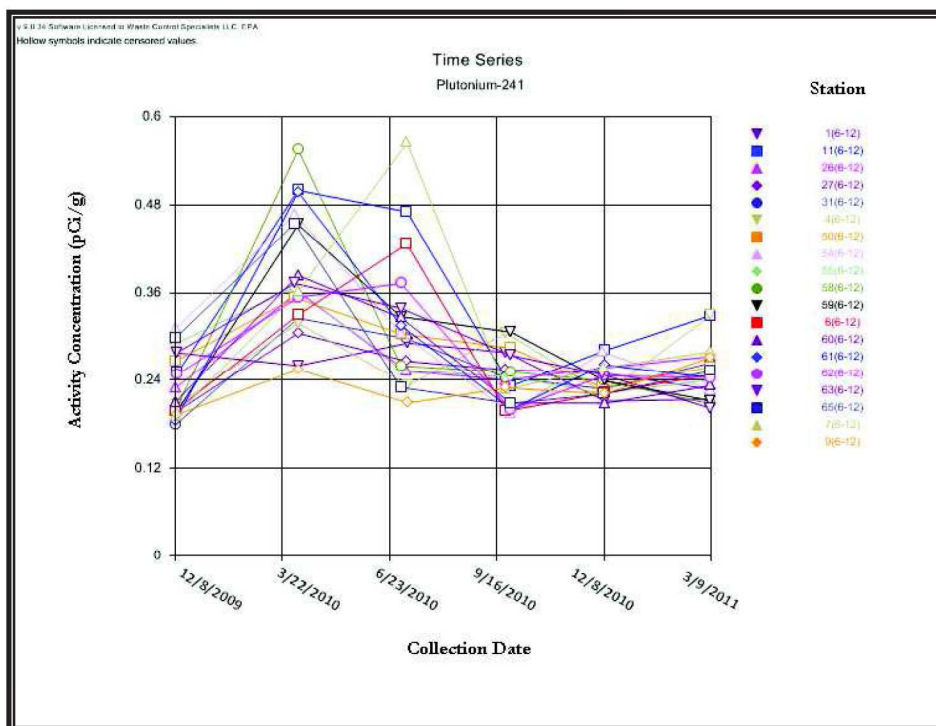


Figure 6-163: Plutonium-241 Soil Sample Results (6-12").

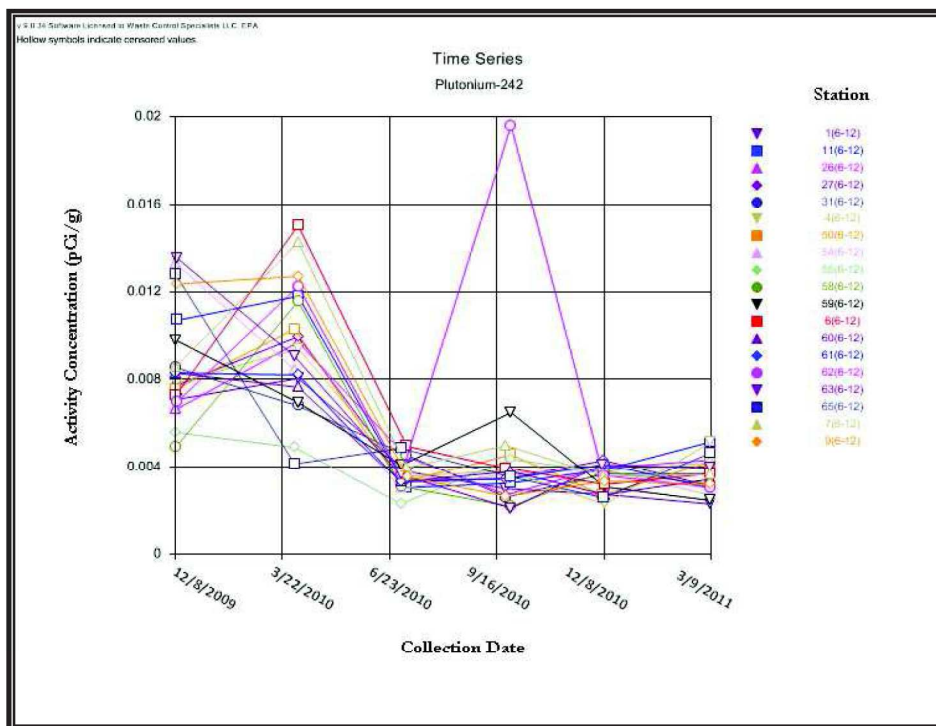


Figure 6-164: Plutonium-242 Soil Sample Results (6-12”).

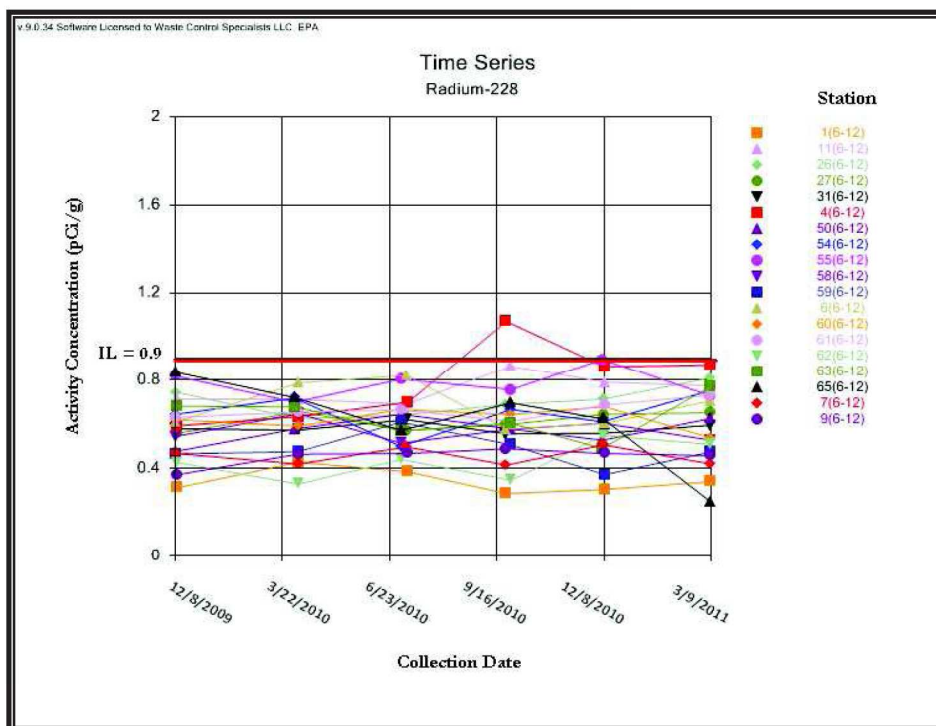


Figure 6-165: Radium-228 Soil Sample Results (6-12”).

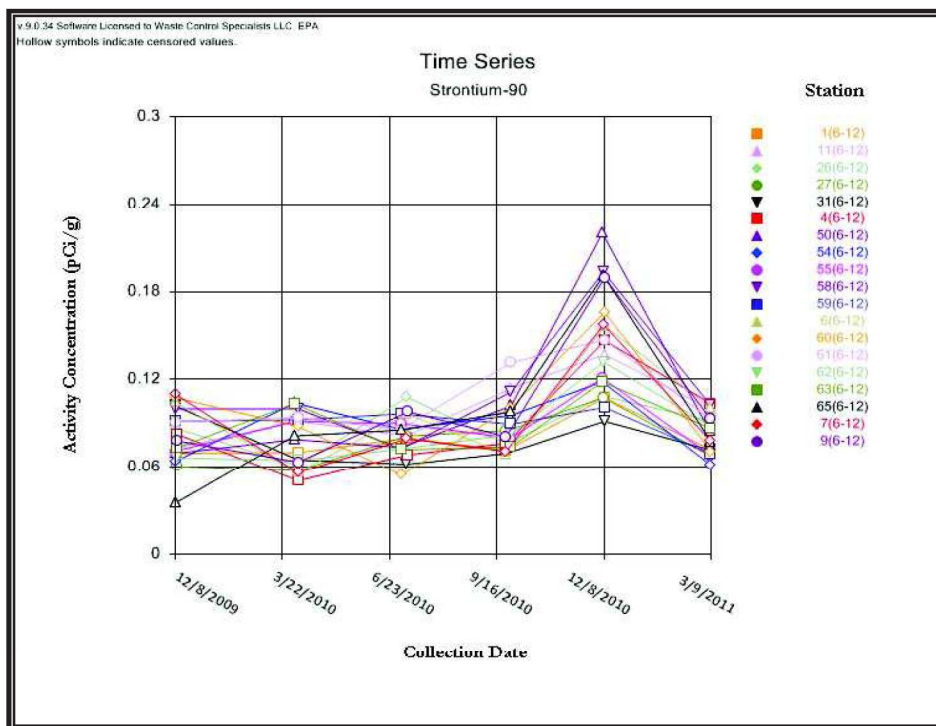


Figure 6-166: Strontium-90 Soil Sample Results (6-12”).

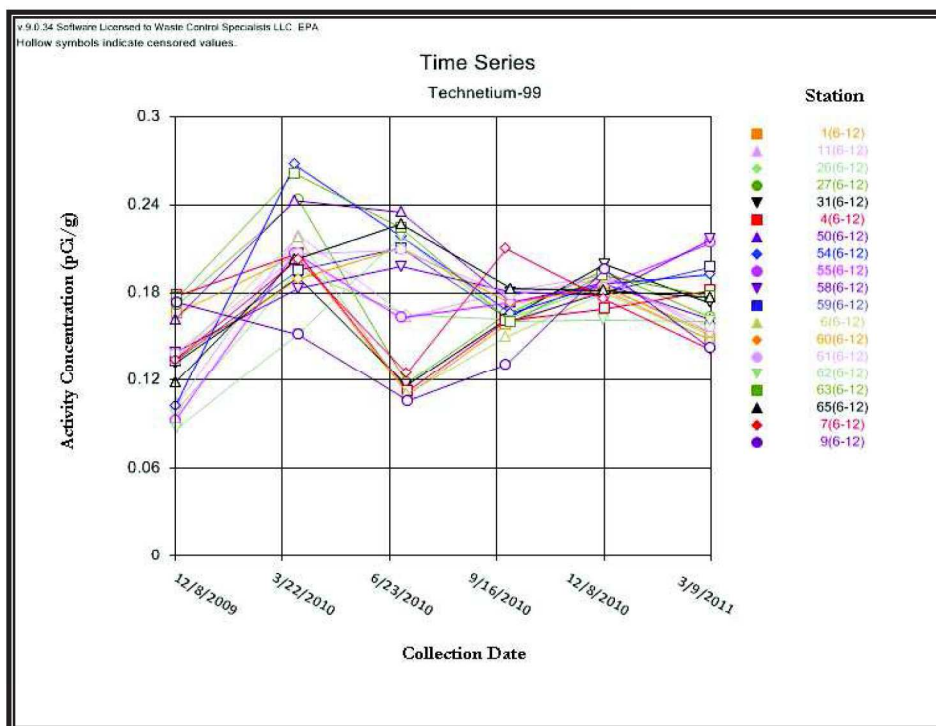


Figure 6-167: Technetium-99 Soil Sample Results (6-12”).

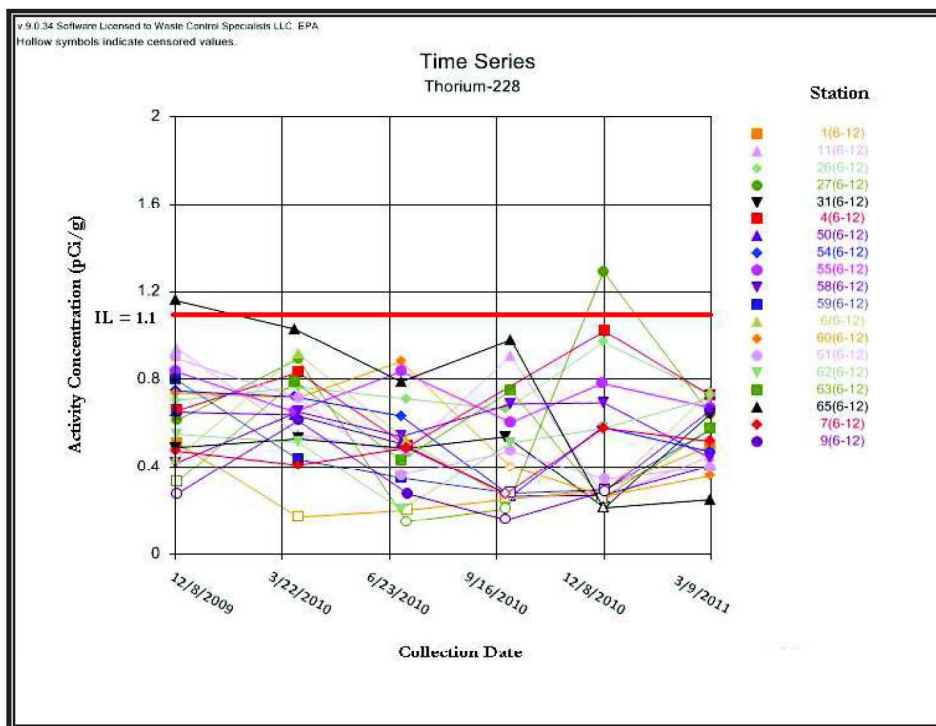


Figure 6-168: Thorium-228 Soil Sample Results (6-12").

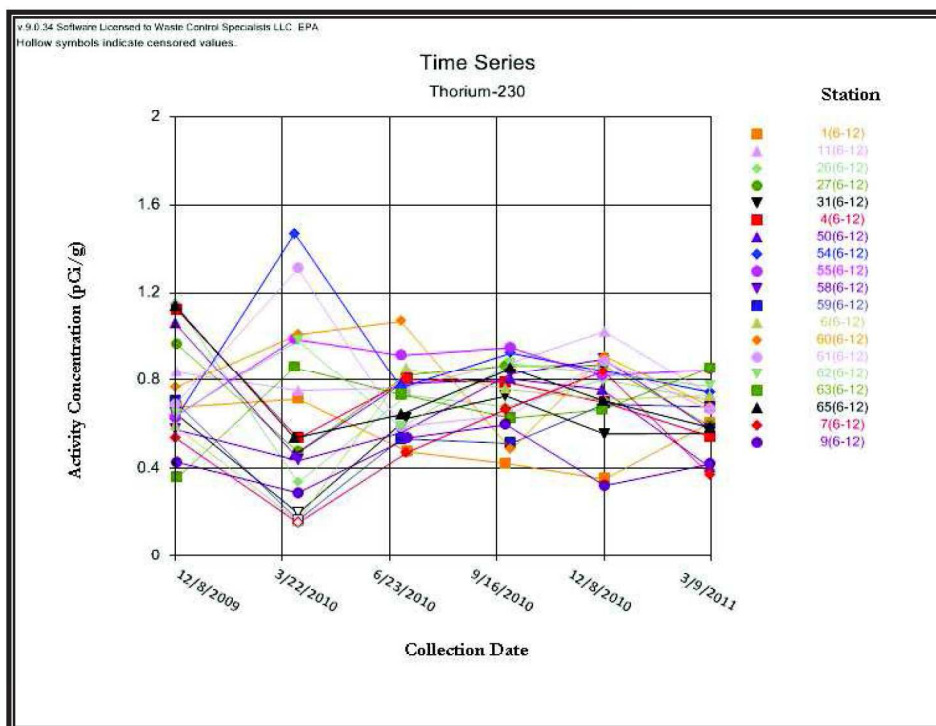


Figure 6-169: Thorium-230 Soil Sample Results (6-12").

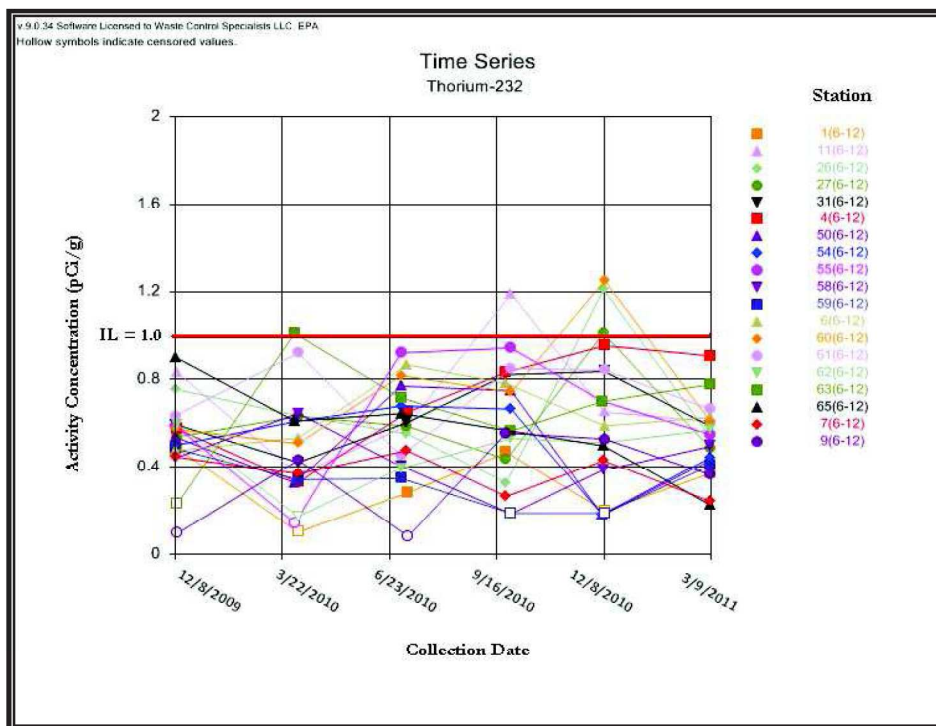


Figure 6-170: Thorium-232 Soil Sample Results (6-12").

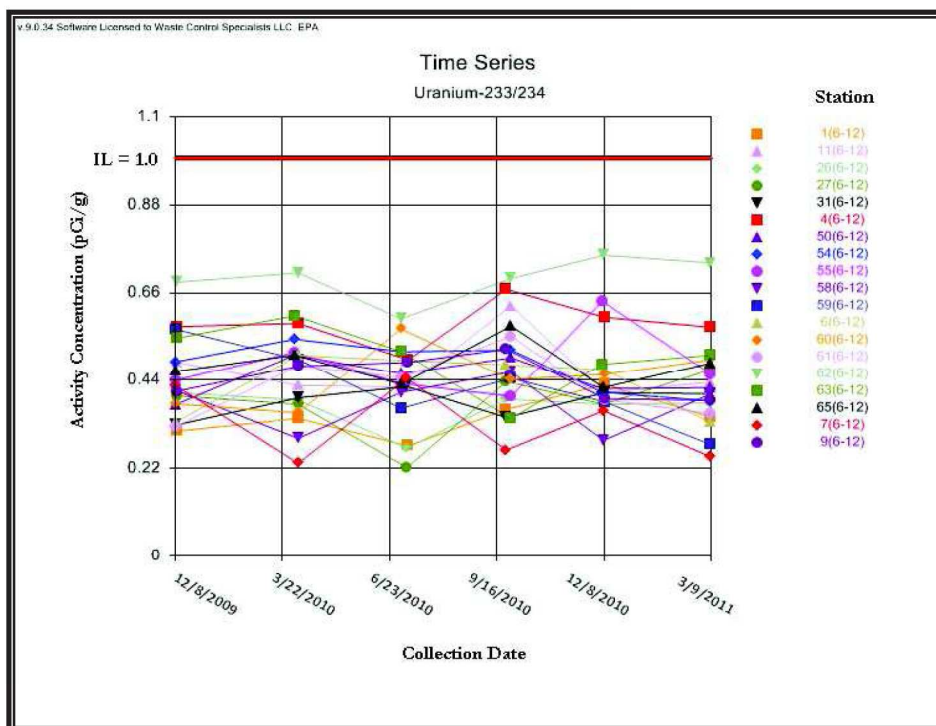


Figure 6-171: Uranium-233/234 Soil Sample Results (6-12").

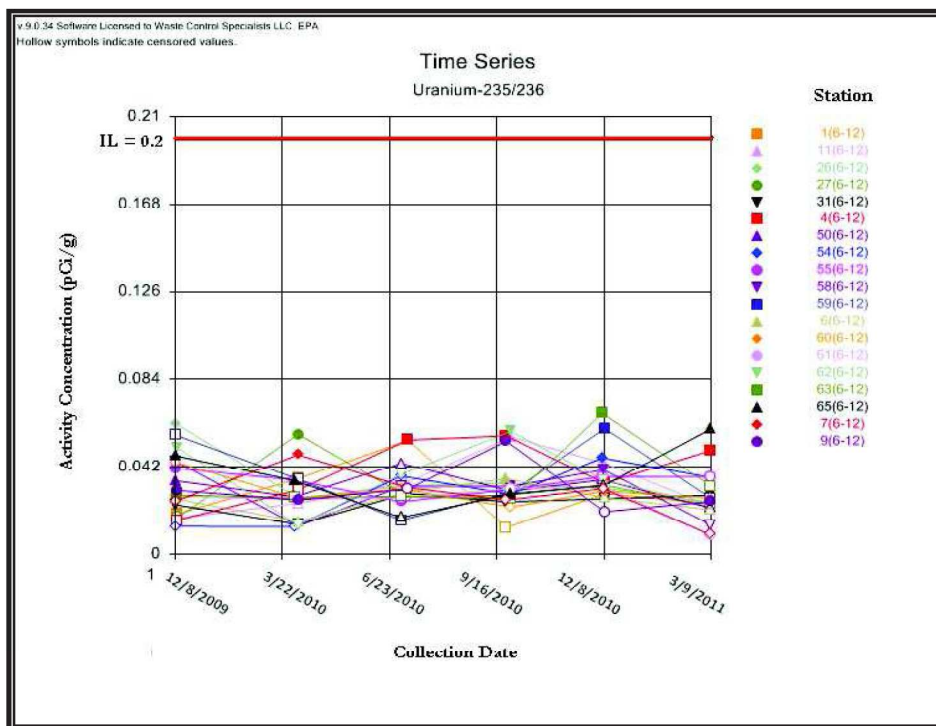


Figure 6-172: Uranium-235/236 Soil Sample Results (6-12”).

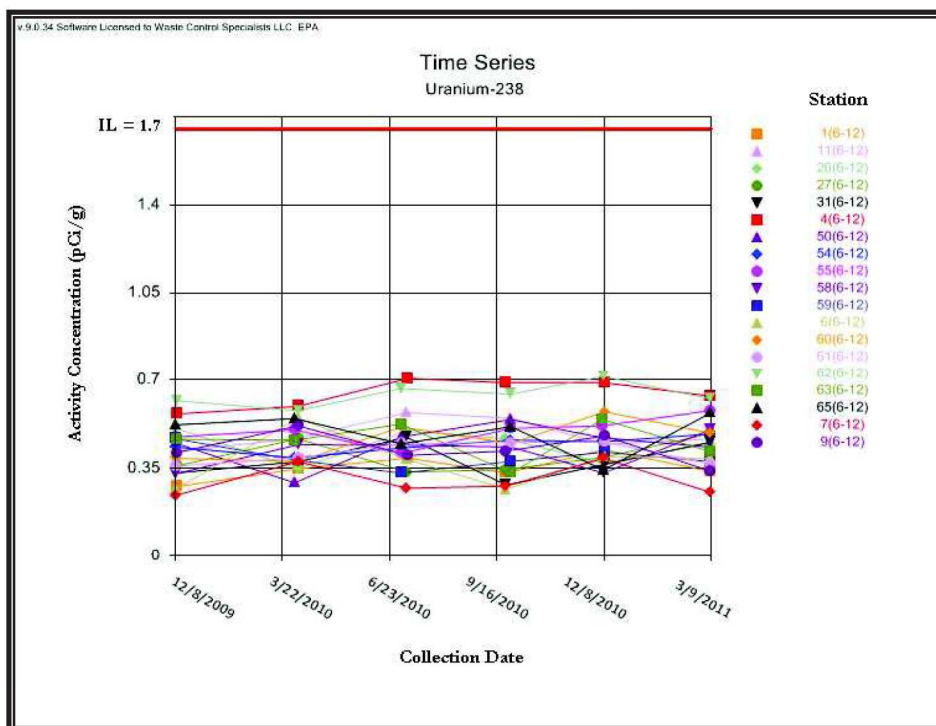


Figure 6-173: Uranium-238 Soil Sample Results (6-12”).

Results: Soil Samples From 0-2 Inches bgs Over a 1 Meter Square Area

Summary statistics for radiological analytes and non-radiological analytes that were detected in the 0-2 inch bgs stratum are presented in Table 6-8 and Table 6-9. In the preceding section Figures 6-61 through 6-73 graphically depict the pre-operational soil results for the 0-2 inch bgs stratum. As previously mentioned, all pre-operational soil sample results are given in Appendix D.

Table 6-8: Radiological Summary Statistics for Routine Soil (0-2 inches).

	Units	Number of Observations	Number of Stations	<Lc*	Maximum	Minimum	Mean	Standard Deviation
Alpha	pCi/g	3	3	0	7.06E+00	6.25E+00	6.57E+00	4.33E-01
Am-241	pCi/g	3	3	3	1.99E-03	-2.27E-03	5.40E-04	2.43E-03
Beta	pCi/g	3	3	0	9.65E+00	5.09E+00	7.72E+00	2.36E+00
C-14	pCi/g	3	3	3	-5.54E-01	-6.76E-01	-6.08E-01	6.21E-02
Cs-137	pCi/g	3	3	1	9.01E-02	1.75E-03	4.17E-02	4.48E-02
Cr-51	pCi/g	3	3	3	5.95E-02	-1.44E-02	1.09E-02	4.21E-02
Co-60	pCi/g	3	3	2	1.04E-02	-1.98E-04	4.48E-03	5.41E-03
I-129	pCi/g	3	3	3	2.07E-02	-5.21E-02	-1.48E-02	3.64E-02
Mn-54	pCi/g	3	3	3	4.36E-03	4.98E-04	2.38E-03	1.93E-03
Pb-210	pCi/g	3	3	0	8.35E-01	2.58E-01	5.69E-01	2.91E-01
Pu-241	pCi/g	3	3	3	1.23E-01	-1.36E-01	-1.11E-02	1.30E-01
Ra-226	pCi/g	3	3	0	4.36E-01	2.20E-01	3.12E-01	1.11E-01
Ra-228	pCi/g	3	3	0	2.77E-01	2.13E-01	2.54E-01	3.56E-02
Sr-90	pCi/g	3	3	3	1.33E-01	-8.75E-02	3.13E-03	1.15E-01
Tc-99	pCi/g	3	3	3	1.36E-01	1.93E-02	6.16E-02	6.47E-02
Th-228	pCi/g	3	3	2	2.58E-01	-1.15E-01	3.98E-02	1.94E-01
Th-230	pCi/g	3	3	0	1.61E+00	7.76E-01	1.21E+00	4.18E-01
Th-232	pCi/g	3	3	0	6.09E-01	3.68E-01	5.07E-01	1.25E-01
H-3	pCi/g	3	3	3	7.62E-02	-3.21E-01	-1.83E-01	2.25E-01

*Values of Critical Level are estimated as one-half MDC.

Naturally occurring radionuclides detected in these data include: Tritium, Carbon-14, Lead-210, Radium-226, Radium-228, Thorium-228, Thorium-230, Thorium-232, Uranium-234, Uranium-235 and Uranium-238. The concentrations of these radionuclides are consistent with natural background. Cesium-137 was measured in soil at levels consistent with fallout from nuclear weapons.

Since the critical level is established at the $\alpha = 0.05$ significance level, a 5% false positive rate is expected. One of the 0-2" soil results for Cobalt-60 has a higher than expected false positive rate. WCS suspects that this does not represent a true false positive because the values are being compared against critical values that were estimated by WCS as one-half of the MDC. Because the false positive value is very close to the critical level, WCS suspects that if the data were compared against the true critical level that the false positive rate would approach 5%. In addition, if the background counts were extremely low, the estimated critical values

would be artificially low. WCS is requesting documentation of background counts for these data from the analytical laboratory.

Table 6-9: Non-radiological Summary Statistics for Routine Soil (0-2 inches).

Analyte	Units	Observations	No. of Stations	< PQL	Max. Value	Min. Value	Mean Value*	Standard Dev.*
Antimony	µg/Kg	9	3	9 (2 "J" flags)	2340 J	<303	530.4	725.2
Arsenic	µg/Kg	9	3	6 (4 "J" flags)	19000	<459	4302.2	5703.7
Barium	µg/Kg	9	3	0	156000	28800	104255.5	51725.2
Beryllium	µg/Kg	9	3	9 (9 "J" flags)	508 J	146 J	277.1	123.6
Cadmium	µg/Kg	9	3	8 (7 "J" flags)	490	<102	240.3	135.6
Chromium	µg/Kg	9	3	0	7350	3330	4644.4	1503.9
Cobalt	µg/Kg	9	3	0	3210	668	1459.1	891.9
Lead	µg/Kg	9	3	8 (8 "J" flags)	7210	2480	3710.0	1526.7
Mercury	µg/Kg	9	3	9 (7 "J" flags)	7.48 J	<3.69	2.92	1.96
Nickel	µg/Kg	9	3	0	6070	1370	3487.8	1789.7
Selenium	µg/Kg	9	3	9 (7 "J" flags)	10400 J	<475	1927.8	3250.2
Zinc	µg/Kg	9	3	0	20300	10500	13700	3510.7
1,4-Dioxane	µg/Kg	9	3	9	<2.0	<2.0	N/A	N/A
2-Acetyl-aminofluorene	µg/Kg	9	3	9 (1 "J" flag)	174 J	<99.9	N/A	N/A
Phenol	µg/Kg	9	3	9	<1.0	<1.0	N/A	N/A
Benzo(a)anthracene	µg/Kg	9	3	9 (1 "J" flag)	11.6 J	<9.99	N/A	N/A
Benzo(b)fluoranthene	µg/Kg	9	3	9	<10.0	<10.0	N/A	N/A
Benzo(ghi)perylene	µg/Kg	9	3	9 (1 "J" flag)	14.1 J	<9.99	N/A	N/A
Chrysene	µg/Kg	9	3	8	34.7	<9.99	N/A	N/A
Fluoranthene	µg/Kg	9	3	9 (2 "J" flags)	34.6 J	<9.99	N/A	N/A
Indeno(1,2,3-cd)pyrene	µg/Kg	9	3	7	117	<9.99	N/A	N/A
Phenanthrene	µg/Kg	9	3	9 (1 "J" flag)	10.6 J	<9.99	N/A	N/A
Pyrene	µg/Kg	9	3	9 (2 "J" flags)	20.3 J	<9.99	N/A	N/A
Other SVOCs	µg/Kg	9	3	9	ND	ND	N/A	N/A
1,1,1-Trichloroethane	µg/Kg	9	3	9	<0.325	<0.325	N/A	N/A
1,1,2,2-Tetrachloroethane	µg/Kg	9	3	9	<0.25	<0.25	N/A	N/A
1,1,2-Trichloroethane	µg/Kg	9	3	9	<0.25	<0.25	N/A	N/A
1,1-Dichloroethane	µg/Kg	9	3	9	<0.3	<0.3	N/A	N/A
1,1-Dichloroethylene	µg/Kg	9	3	9	<0.3	<0.3	N/A	N/A
1,2-Dichloroethane	µg/Kg	9	3	9	<0.25	<0.25	N/A	N/A
1,2-Dichloropropane	µg/Kg	9	3	9	<0.25	<0.25	N/A	N/A
Acetone	µg/Kg	9	3	9 (2 "J" flags)	2.2 J	<1.63	N/A	N/A
Benzene	µg/Kg	9	3	9	<0.3	<0.3	N/A	N/A
Bromodichloromethane	µg/Kg	9	3	9	<0.25	<0.25	N/A	N/A
Bromoform	µg/Kg	9	3	9	<0.25	<0.25	N/A	N/A
Bromomethane	µg/Kg	9	3	9	<0.3	<0.3	N/A	N/A
Carbon disulfide	µg/Kg	9	3	9	<1.25	<1.25	N/A	N/A
Carbon tetrachloride	µg/Kg	9	3	9	<0.3	<0.3	N/A	N/A
Chlorobenzene	µg/Kg	9	3	9	<0.25	<0.25	N/A	N/A
Chloroethane	µg/Kg	9	3	9	<0.3	<0.3	N/A	N/A
Chloroform	µg/Kg	9	3	9	<0.25	<0.25	N/A	N/A
Chloromethane	µg/Kg	9	3	9	<0.3	<0.3	N/A	N/A
cis-1,3-Dichloropropylene	µg/Kg	9	3	9	<0.25	<0.25	N/A	N/A
Dibromochloromethane	µg/Kg	9	3	9	<0.3	<0.3	N/A	N/A
Ethylbenzene	µg/Kg	9	3	9	<0.25	<0.25	N/A	N/A
Methylene chloride	µg/Kg	9	3	9 (1 "J" flag)	0.451 J	<1.97	N/A	N/A
Tetrachloroethylene	µg/Kg	9	3	9	<0.3	<0.3	N/A	N/A
Toluene	µg/Kg	9	3	9 (1 "J" flag)	3.93 J	<0.295	N/A	N/A
trans-1,2-Dichloroethylene	µg/Kg	9	3	9	<0.3	<0.3	N/A	N/A

Analyte	Units	Observations	No. of Stations	< PQL	Max. Value	Min. Value	Mean Value*	Standard Dev.*
trans-1,3-Dichloropropylene	µg/Kg	9	3	9	<0.25	<0.25	N/A	N/A
Trichloroethylene	µg/Kg	9	3	9	<0.25	<0.25	N/A	N/A
Vinyl chloride	µg/Kg	9	3	9	<0.5	<0.5	N/A	N/A
Other VOCs	µg/Kg	9	3	9	ND	ND	N/A	N/A

NOTES: * Non-detect values were replaced with one half of the MDL for summary statistics.

As summarized in Appendix D and in the table above, a number of naturally occurring metals were reported in soil from the 0-2 inch bgs stratum at the site. Collectively, the concentrations of these non-radiological metals are representative of background conditions at WCS.

A number of false positives were reported during the pre-operational period as well. False positives were identified during the data validation process WCS implements to verify and validate analytical data. The organic constituents listed in the table above are considered to be false positives. All of the concentrations reported for each of these analytes except indeno(1,2,3-cd)pyrene were estimated (they were too low to be quantified). The two quantifications of indeno(1,2,3-cd)pyrene are considered false positives because it hasn't been detected consistently at the site.

7.0 Vegetation

In accordance with the LLRW pre-operational monitoring requirements, two distinct vegetation sampling campaigns were performed. These include: Routine Vegetation (Radiological and chemical) and LLRW Grid Sampling (radiological and chemical). These campaigns were conducted pursuant to the Modified Natural Radiation Monitoring Program, Attachment A and Pre-Operational, Construction, and Operational Environmental Monitoring Program, Attachment B of RML R04100, the EV-1.1.0, Radiological Environmental Monitoring Program and the Non-Radiological Environmental Monitoring Program.

Grid Vegetation

As part of the Modified Natural Monitoring Program, WCS performed a one-time vegetation sampling event. Vegetation was collected from a grid established over the future LLRW disposal facility. Figure 7-1 depicts the locations where the vegetation samples were collected. Radiological samples were collected from all 33 grid locations, while, non-radiological samples were only collected from 27 grid locations due to insufficient vegetation for sampling.

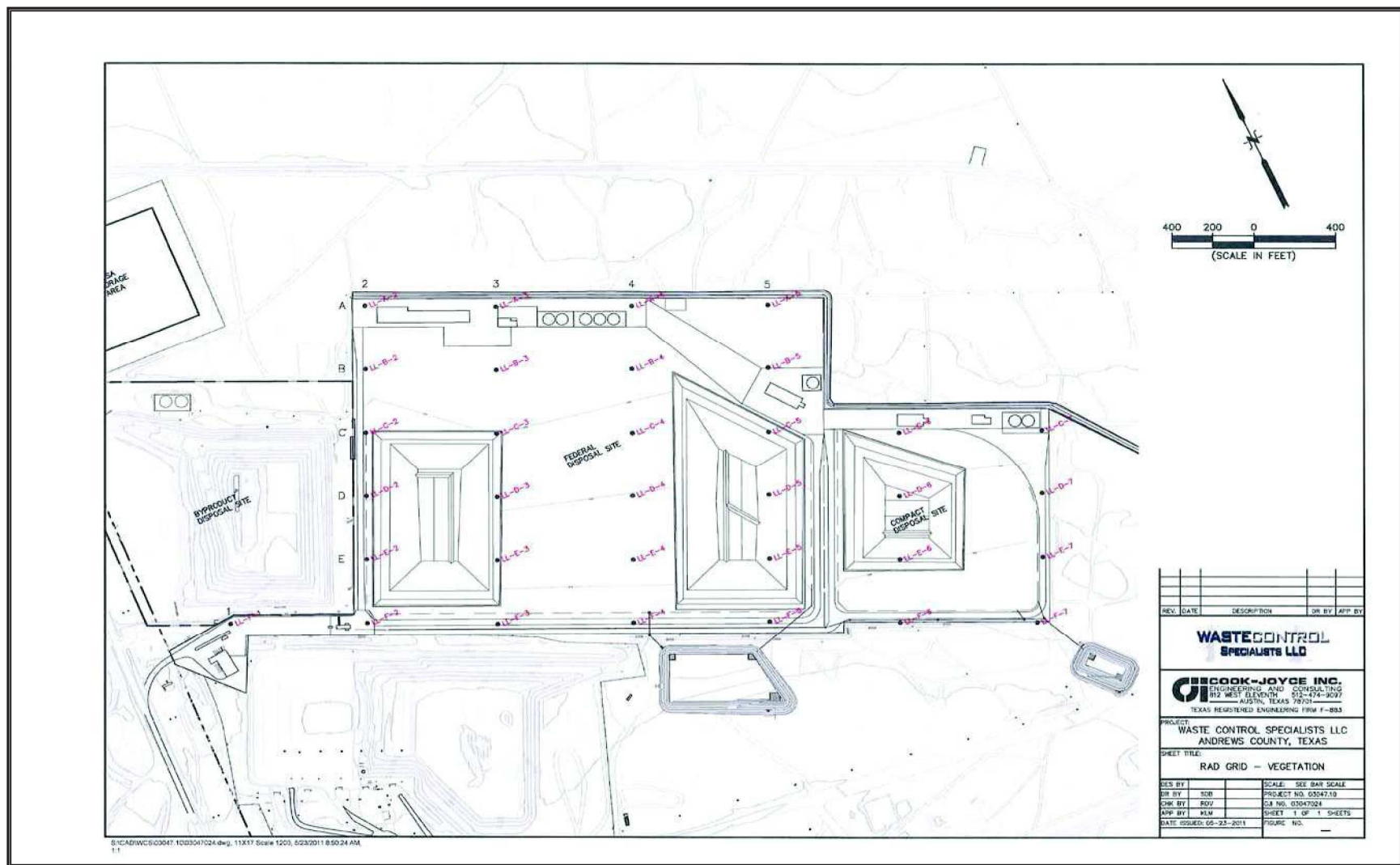


Figure 7-1: Radiological Vegetation Grid Locations.

Grid Vegetation Results

Summary statistics for the pre-operational radiological vegetation results are presented in the Table 7-1 and the non-radiological results are presented in Table 7-2. Figures 7-2 through 7-71 graphically depict the pre-operational vegetation results by constituent. All pre operational vegetation sample results are given in Appendix E.

Table 7-1: Radiological Summary Statistics for Vegetation Grid (pCi/g).

	Observations	Number of Stations	Below Lc*	Maximum	Minimum	Mean	Standard Deviation
Alpha	33	33	25	4.20E+00	-1.12E+00	2.96E-01	9.11E-01
Am-241	33	33	30	2.82E-03	-2.35E-03	-7.66E-05	1.07E-03
Beta	33	33	0	5.39E+01	7.04E+00	2.84E+01	1.49E+01
C-14	33	33	32	1.01E+00	-1.35E+00	-1.36E-01	5.19E-01
Cs-137	33	33	27	5.82E-02	-4.83E-02	5.81E-03	2.08E-02
Cr-51	33	33	33	2.03E-01	-3.75E-01	-3.80E-02	1.45E-01
Co-60	33	33	33	3.32E-02	-4.10E-02	-6.36E-04	1.59E-02
Cu-242	33	33	33	1.10E-03	-4.65E-04	2.36E-05	3.38E-04
Cu-243/244	33	33	32	2.72E-03	-8.93E-04	-3.09E-05	6.37E-04
I-129	33	33	32	1.21E-01	-1.76E-01	-7.03E-03	6.45E-02
Mn-54	33	33	32	4.42E-02	-3.50E-02	-7.48E-05	1.59E-02
Np-237	33	33	33	1.14E-02	-8.91E-03	-1.18E-03	3.74E-03
Pb-210	33	33	0	8.04E-01	2.00E-01	4.20E-01	1.59E-01
Pu-238	33	33	24	8.24E-03	-8.47E-04	1.52E-03	1.81E-03
Pu239/240	33	33	31	5.54E-03	-1.02E-03	6.46E-04	1.36E-03
Pu-241	33	33	32	2.07E-01	-3.93E-01	-7.48E-02	1.32E-01
Pu-242	33	33	30	5.31E-03	-1.74E-03	6.87E-04	1.53E-03
Ra-226	33	33	25	1.46E-01	-8.97E-02	2.50E-02	5.18E-02
Ra-228	33	33	29	2.03E-01	-4.67E-01	5.30E-03	1.18E-01
Sr-90	33	33	16	9.81E-02	-6.02E-02	3.50E-02	3.39E-02
Tc-99	33	33	31	1.21E+00	-9.32E-01	-3.38E-02	3.96E-01
Th-228	33	33	30	1.26E-01	-9.50E-02	1.90E-02	4.80E-02
Th-230	33	33	28	1.07E-01	-7.46E-02	-2.60E-03	3.83E-02
Th-232	33	33	29	1.07E-01	-2.55E-02	1.33E-02	3.01E-02
H-3	33	33	24	3.30E-01	-2.36E-01	5.86E-02	1.17E-01
U-233/234	33	33	29	1.77E-02	-2.22E-02	1.46E-03	1.04E-02
U-235/236	33	33	31	1.92E-02	-5.35E-03	3.60E-03	5.46E-03
U-238	33	33	24	2.13E-02	-3.98E-03	7.15E-03	7.33E-03

*Lc estimated as half of MDC.

Naturally occurring radionuclides detected in these data include: Carbon-14, Lead-210, Radium-226, Radium-228, Thorium-228, Thorium-230, Thorium-232, Tritium, Uranium-234, and Uranium-238. The concentrations of these radionuclides are consistent with natural background.

Cesium-137 and Strontium-90 were measured in vegetation at levels consistent with fallout from nuclear weapons testing.

The radiological vegetation grid results for Plutonium-238 had a higher than expected false positive rate. Based upon the critical level, there should be five percent false positive rate for these constituents. It should

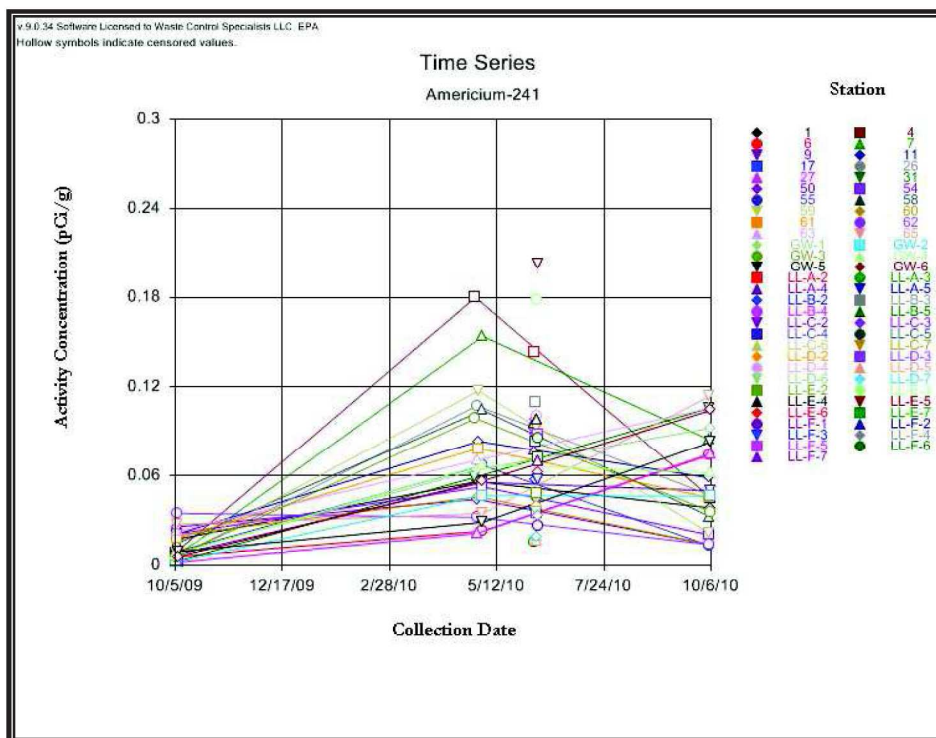
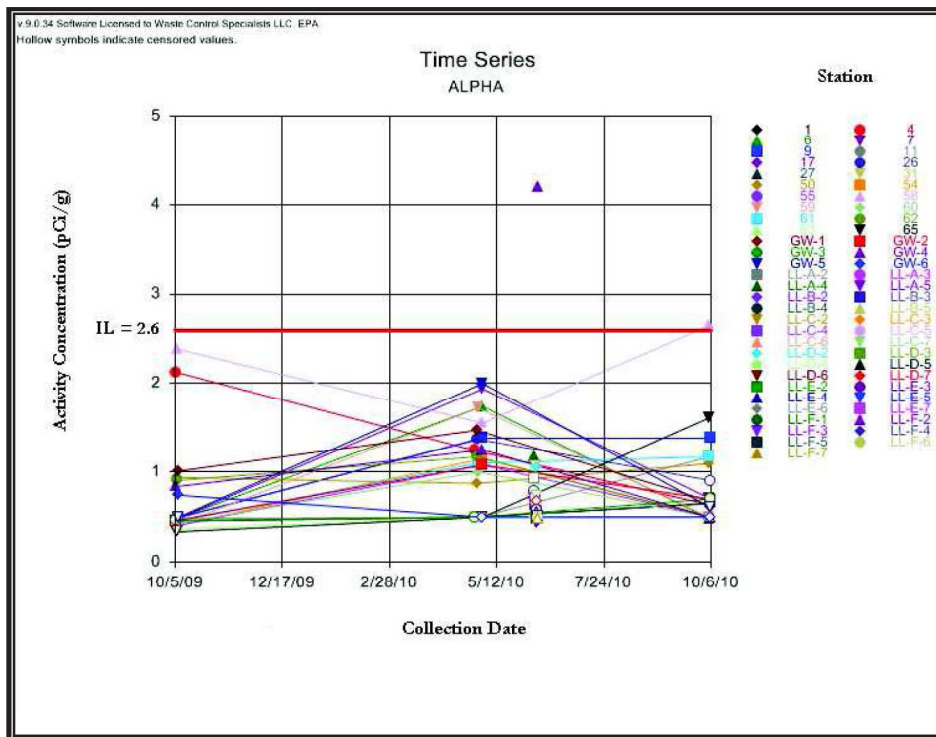
be noted that the critical values were estimated as one-half of the MDC. Nine results for Pu-238 were over the estimated critical level; however, only one value was greater than the MDC. Currently the laboratory background and method of calculating critical levels are under investigation to ensure that more accurate values of the critical level are provided in the future.

Table 7-2: Non-Radiological Analyses of Vegetation Samples from Sampling Grid Over Future Facilities, Low Level Pre-Operational Monitoring Program.

Analyte	Units	Observations	No. of Stations	< PQL	Max. Value	Min. Value	Mean Value*	Standard Dev.*
Arsenic	µg/Kg	27	27	27 (25 "J" flags)	1980 J	<484	1361.7	401.1
Cadmium	µg/Kg	27	27	27 (10 "J" flags)	290 J	<92.1	110.3	87.8
Nickel	µg/Kg	27	27	25 (8 "J" flags)	589	<132	165.6	156.2
Selenium	µg/Kg	27	27	27 (9 "J" flags)	1100	<436	394.7	255.6
1,4-Dioxane	µg/Kg	27	27	27	<4000	<198	N/A	N/A
Phenol	µg/Kg	27	27	27	<4000	<198	N/A	N/A
1,1,1-Trichloroethane	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
1,1,2,2-Tetrachloroethane	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
1,1,2-Trichloroethane	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
1,1-Dichloroethane	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
1,1-Dichloroethylene	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
1,2-Dichloroethane	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
1,2-Dichloropropane	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
4-Isopropyltoluene	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Acetone	µg/Kg	27	27	25 (1 J-flag)	2060	<213	N/A	N/A
Benzene	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Bromodichloromethane	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Bromoform	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Bromomethane	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Carbon disulfide	µg/Kg	27	27	27	<279	<152	N/A	N/A
Carbon tetrachloride	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Chlorobenzene	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Chloroethane	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Chloroform	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Chloromethane	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
cis-1,3-Dichloropropylene	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Dibromochloromethane	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Ethylbenzene	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Tetrachloroethylene	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Toluene	µg/Kg	27	27	27 (2 J-flags)	170 J	<36.6	N/A	N/A
trans-1,2-Dichloroethylene	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
trans-1,3-Dichloropropylene	µg/Kg	27	27	27	<67	<36.6	N/A	N/A
Trichloroethylene	µg/Kg	27	27	27	<73.7	<36.6	N/A	N/A
Vinyl chloride	µg/Kg	27	27	27	<67	<36.6	N/A	N/A

NOTES: * Non-detect values were replaced with one half of the MDL for summary statistics.

cadmium, nickel, and selenium. These concentrations are considered natural background for the area. In addition, there were some false positive results. Three detected concentrations of acetone (including one estimated concentration) and two estimated concentrations of toluene were detected in these samples. They are considered to either be sampling or laboratory artifacts.



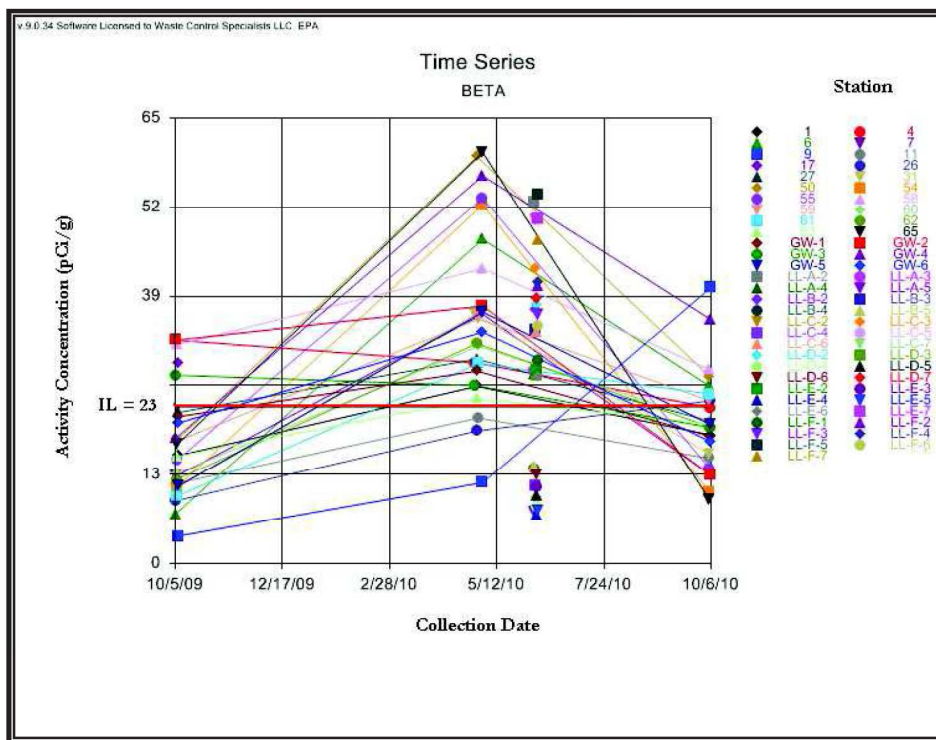


Figure 7-4: Beta Vegetation Sample.

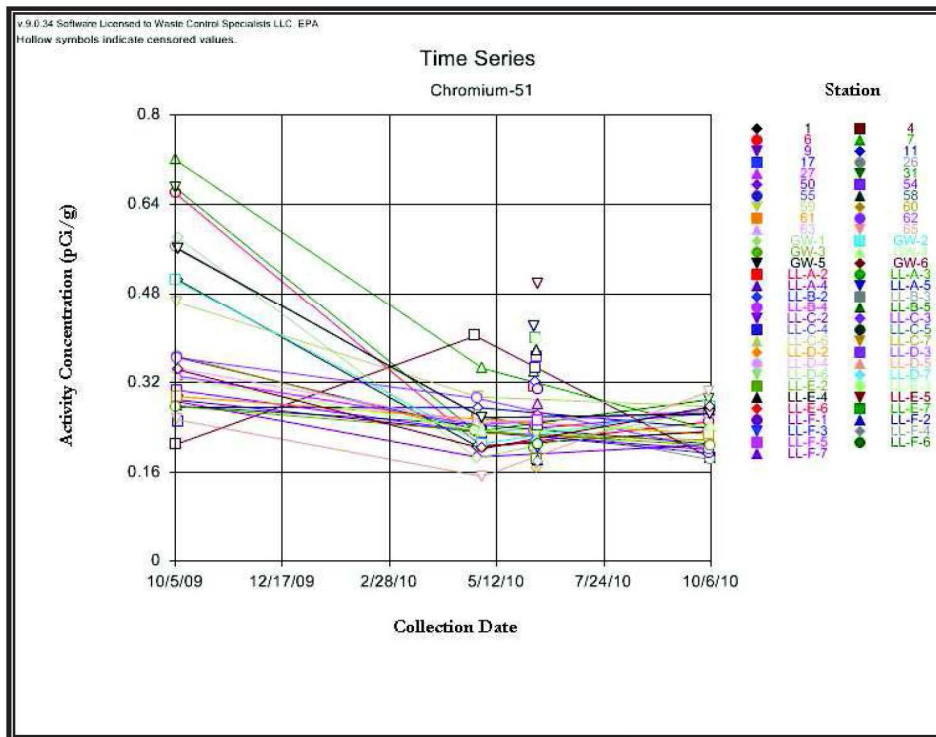


Figure 7-5: Chromium-51 Vegetation Sample.

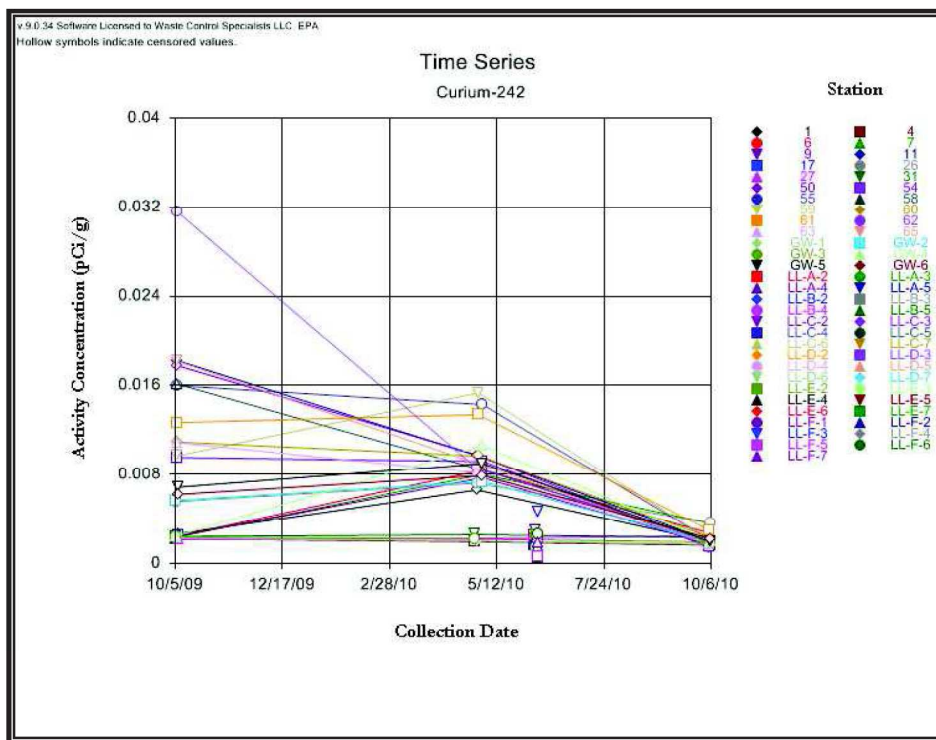


Figure 7-6: Curium-242 Vegetation Samples.

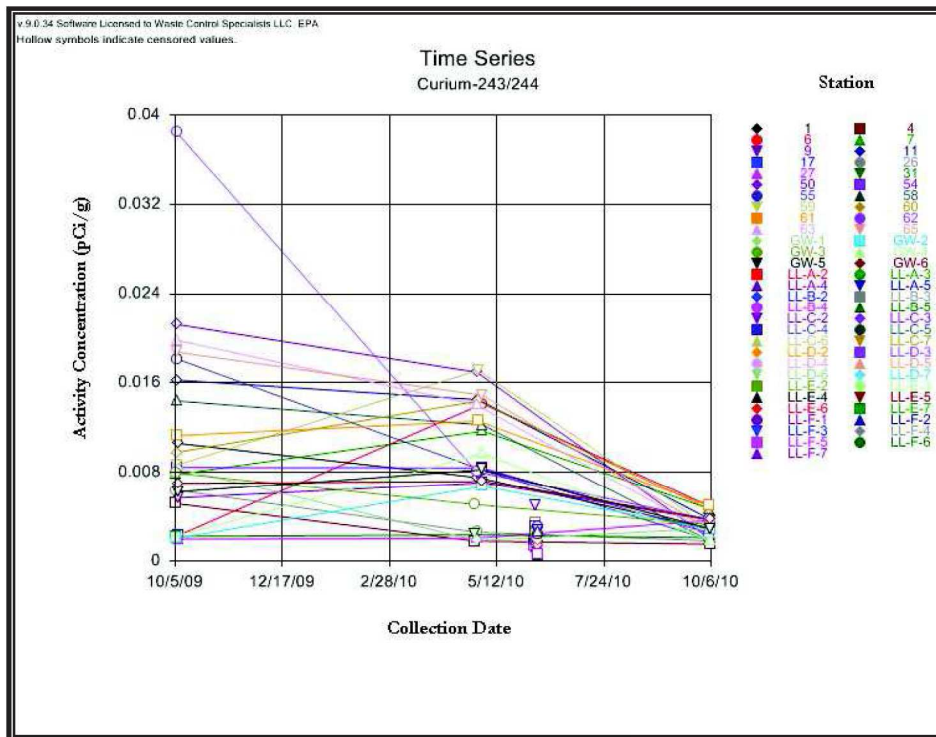


Figure 7-7: Curium-243/244 Vegetation Samples.

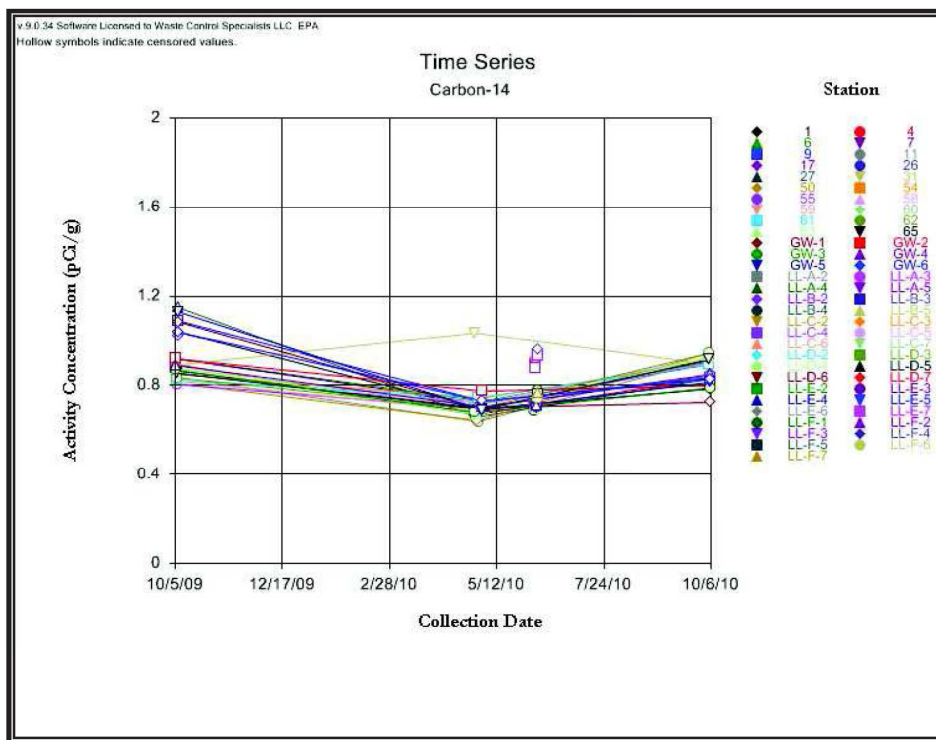
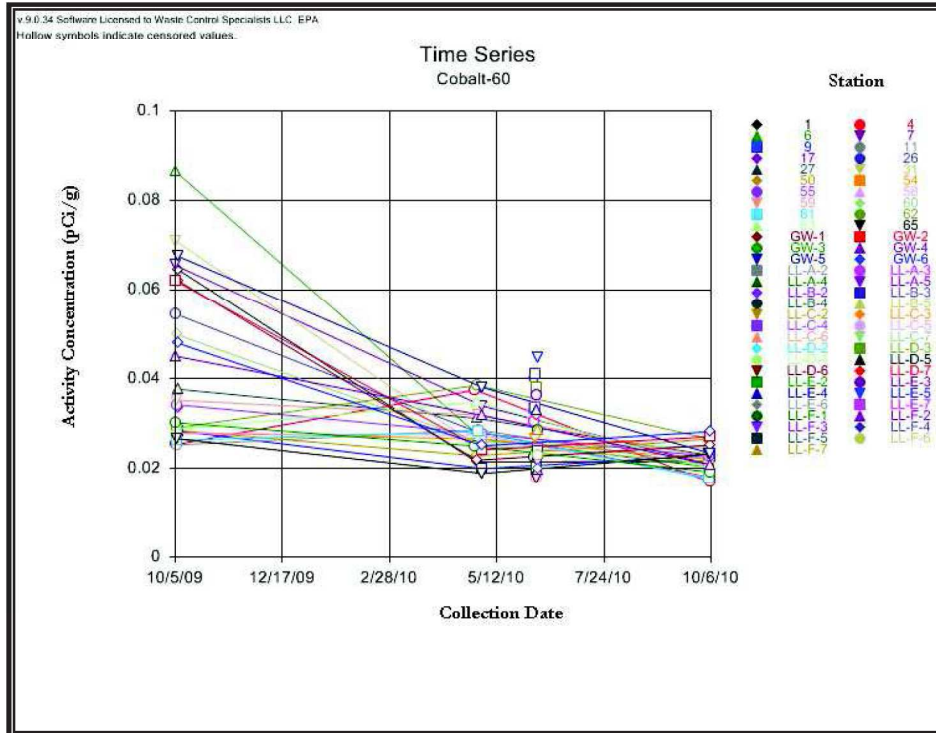


Figure 7-8: Carbon-14 Vegetation Sample.



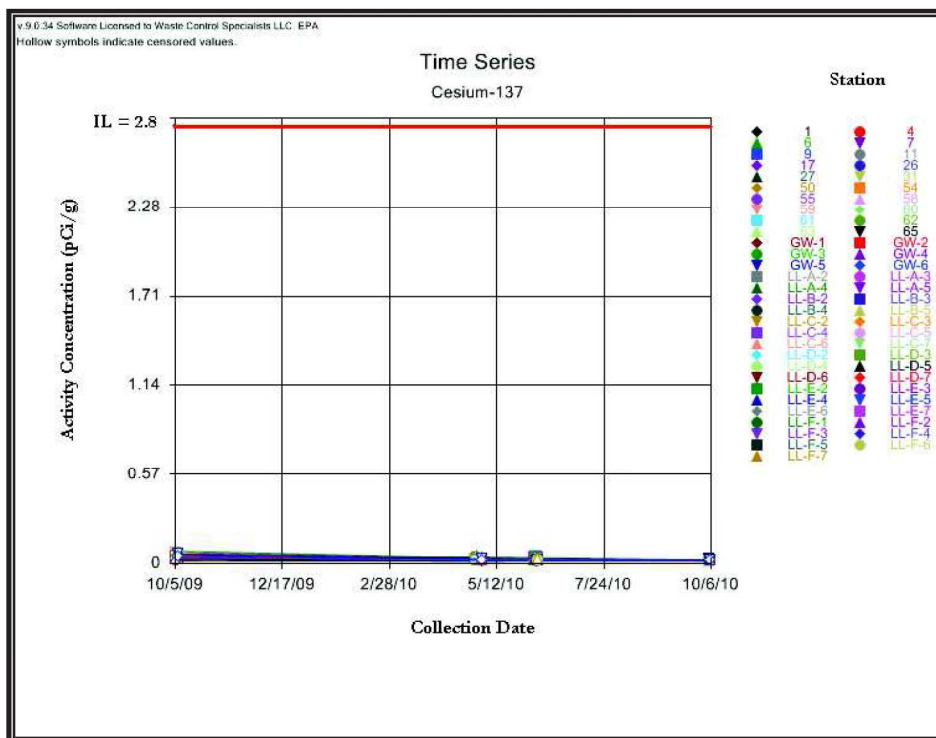


Figure 7-10: Cesium-137 Vegetation Sample.

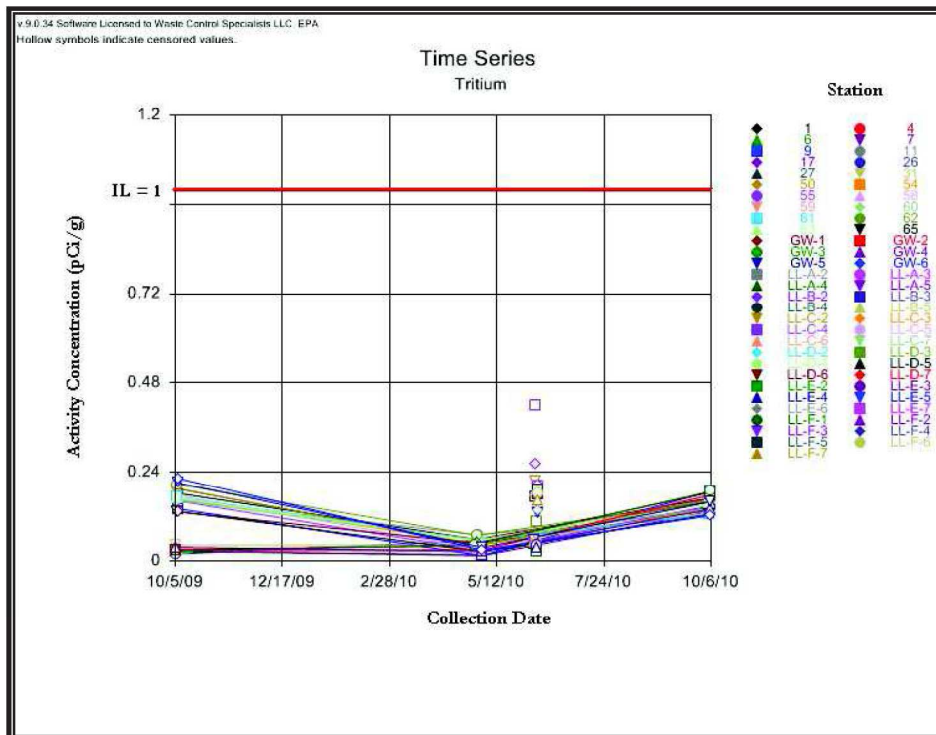


Figure 7-11: Tritium Vegetation Sample.

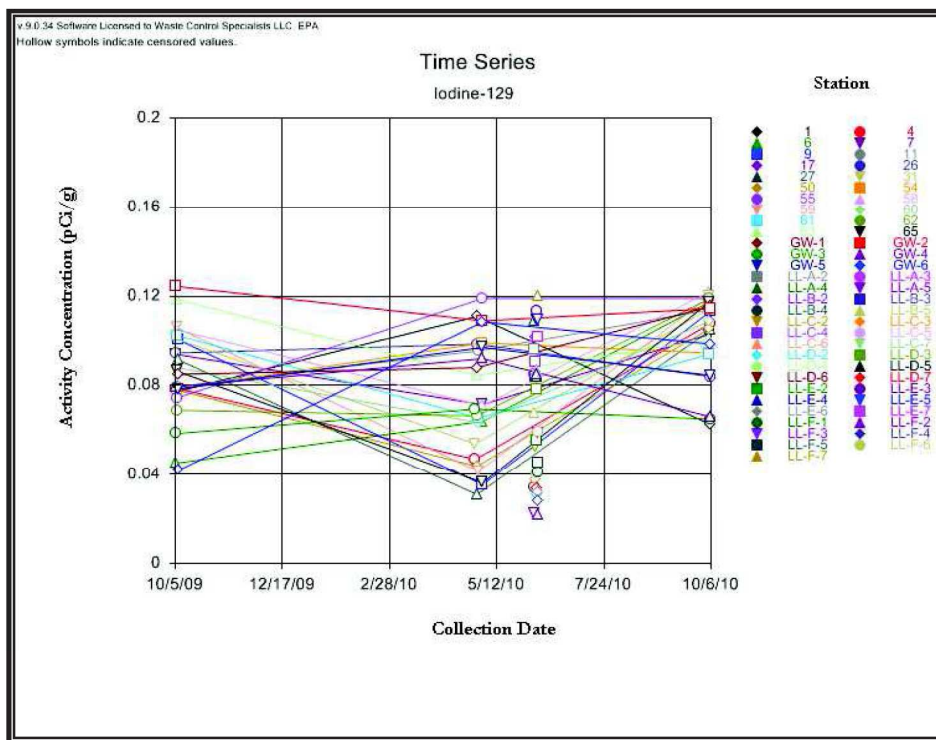


Figure 7-12: Iodine-129 Vegetation Sample.

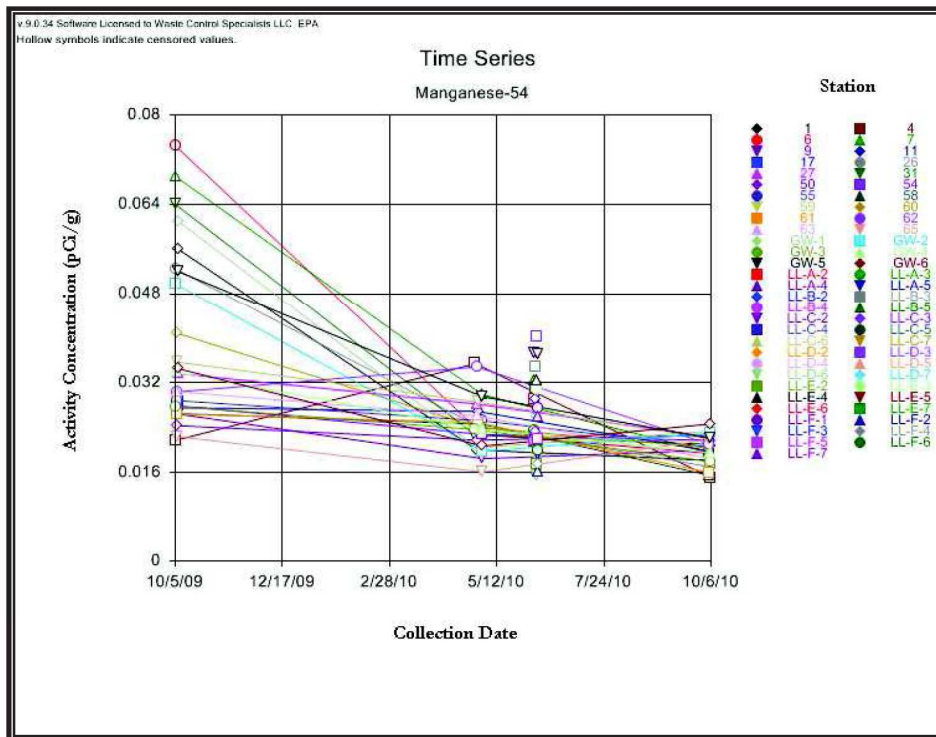


Figure 7-13: Manganese-54 Vegetation Sample.

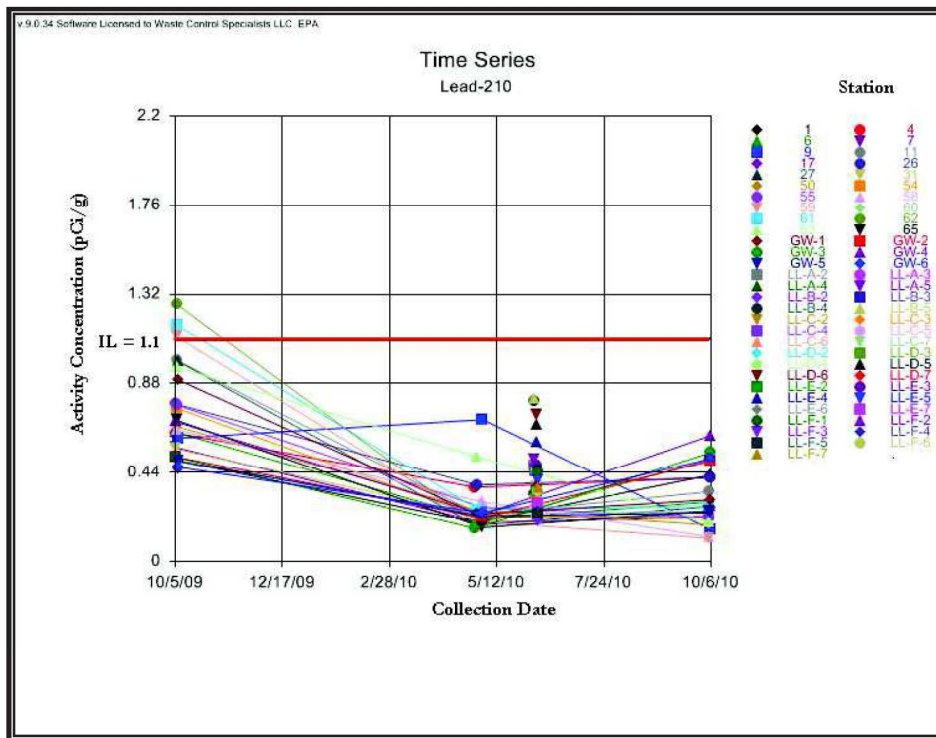


Figure 7-14: Lead-210 Vegetation Sample.

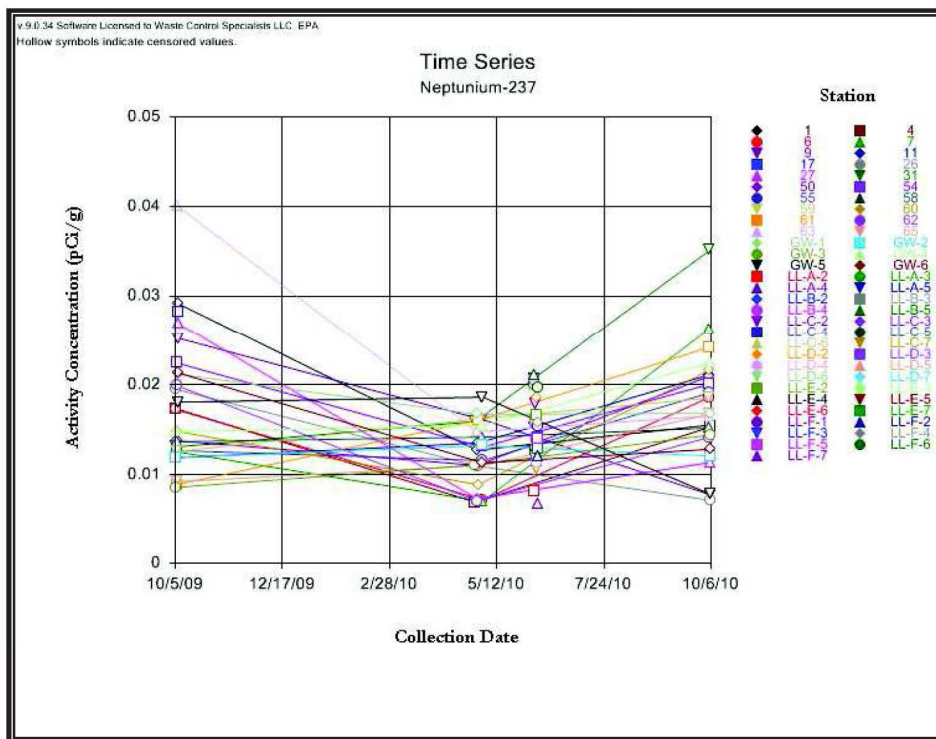


Figure 7-15: Neptunium-237 Vegetation Sample.

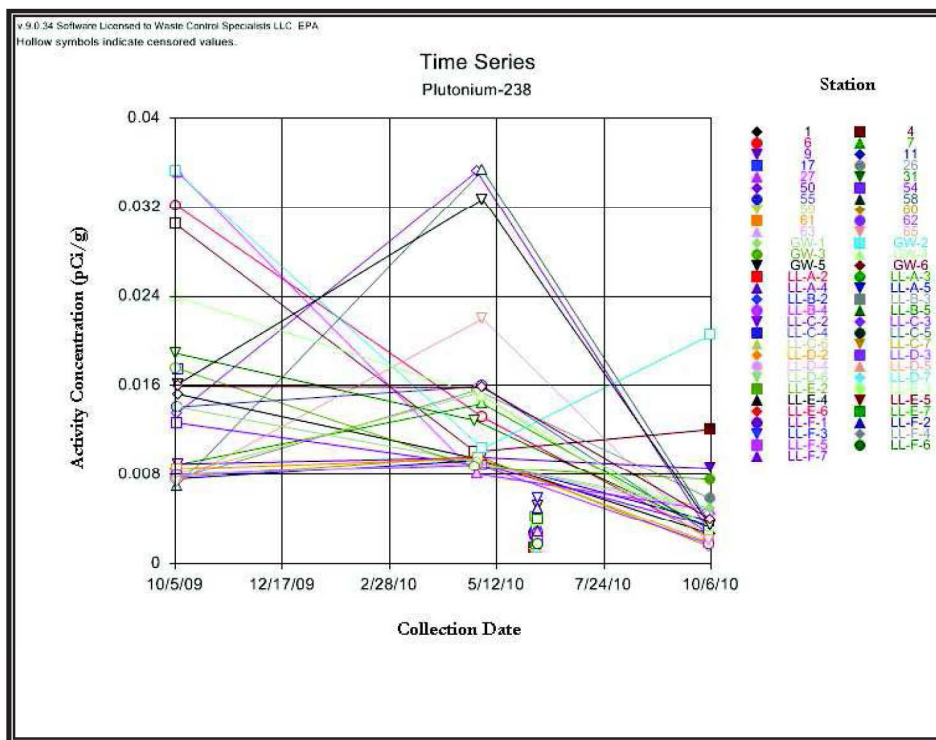


Figure 7-16: Plutonium-238 Vegetation Sample.

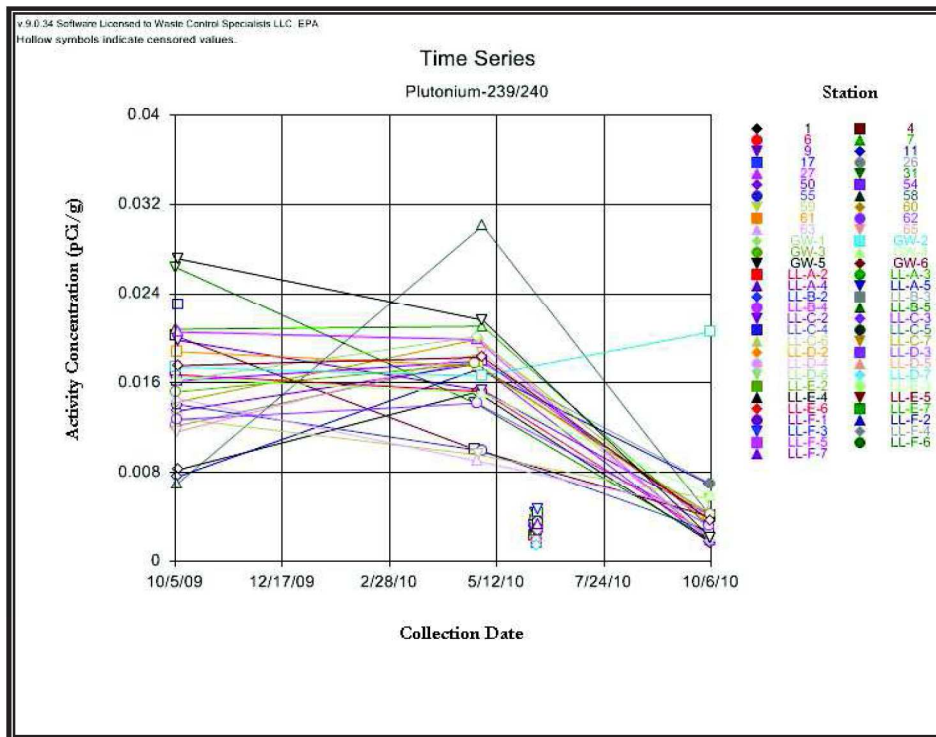
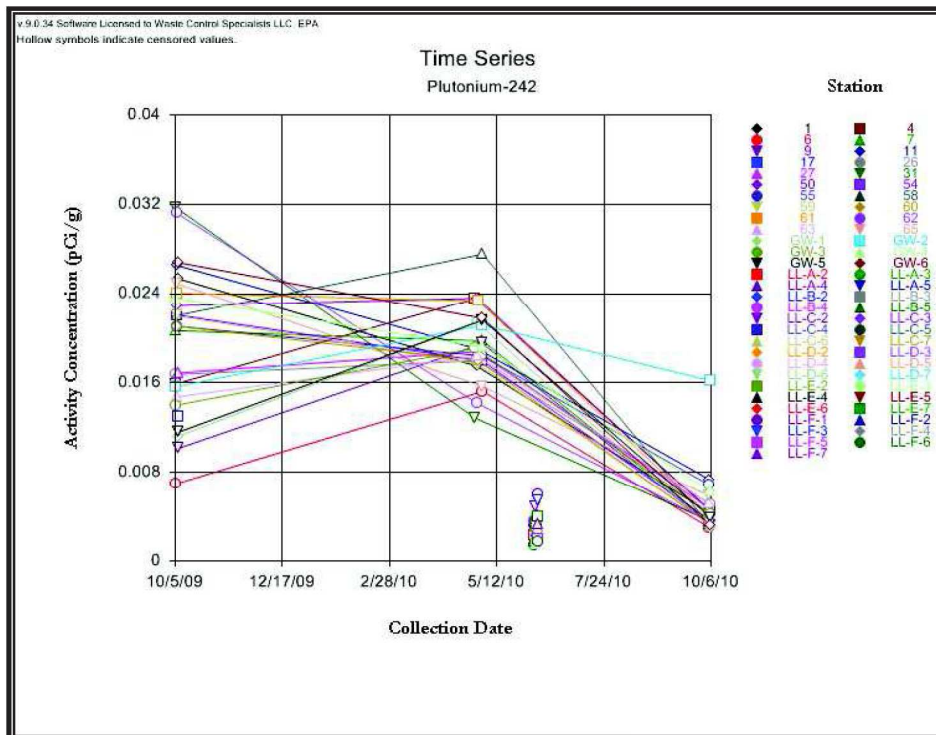
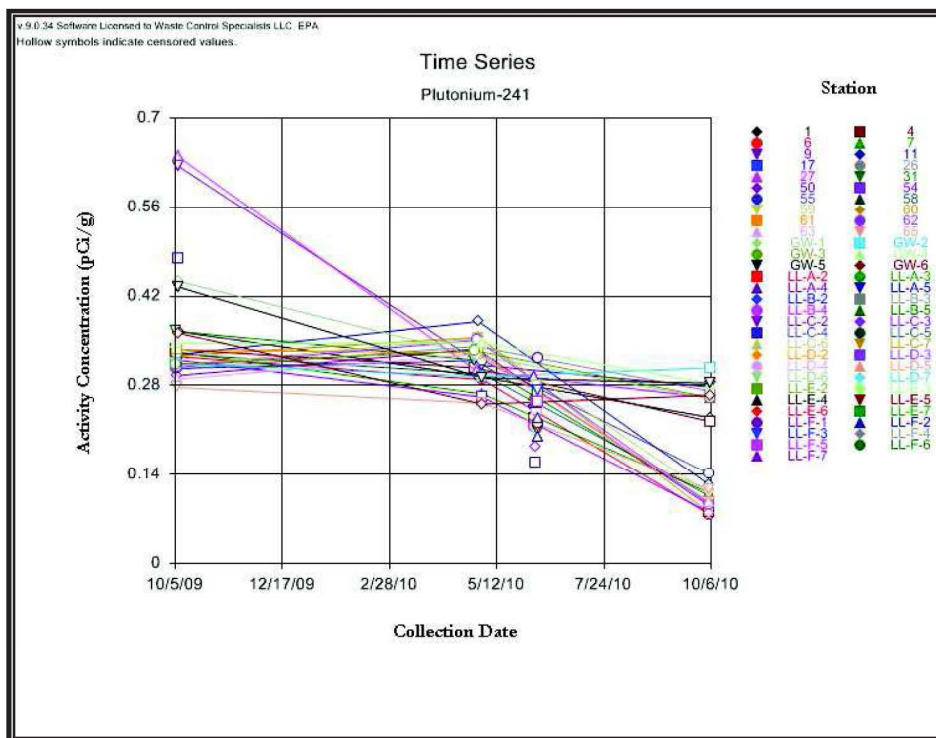


Figure 7-17: Plutonium-239/240 Vegetation Samples.



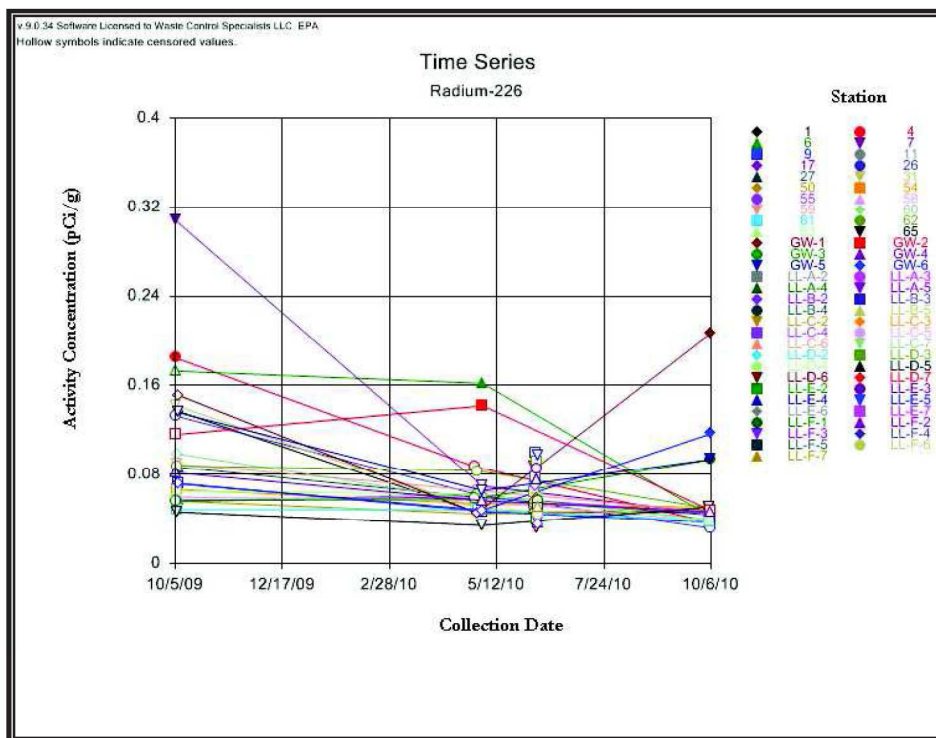


Figure 7-20: Radium-226 Vegetation Sample.

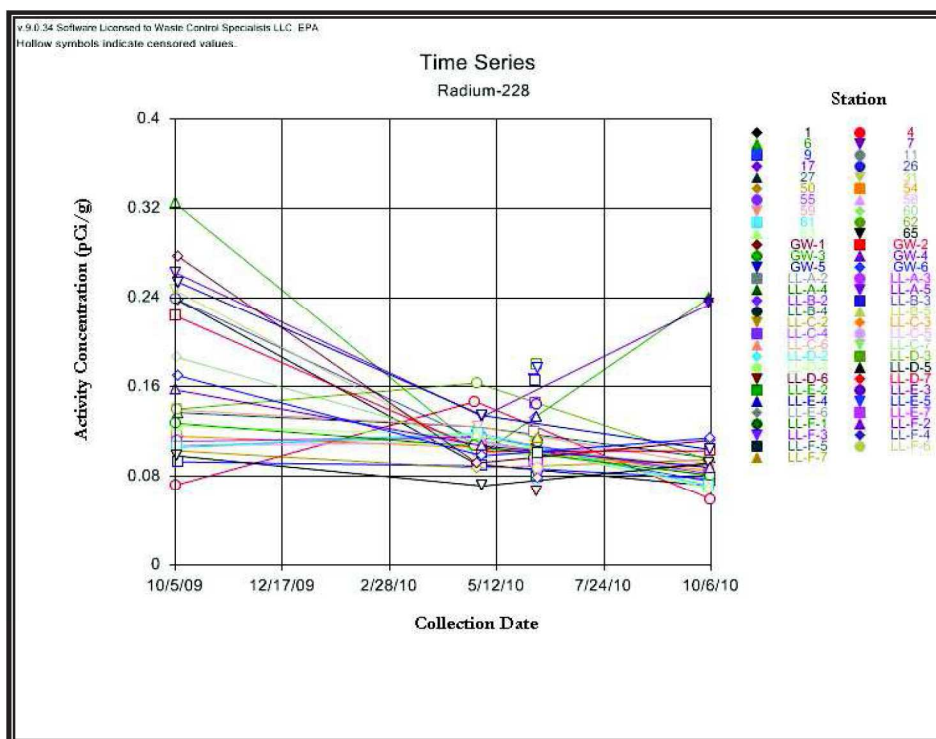


Figure 7-21: Radium-228 Vegetation Sample.

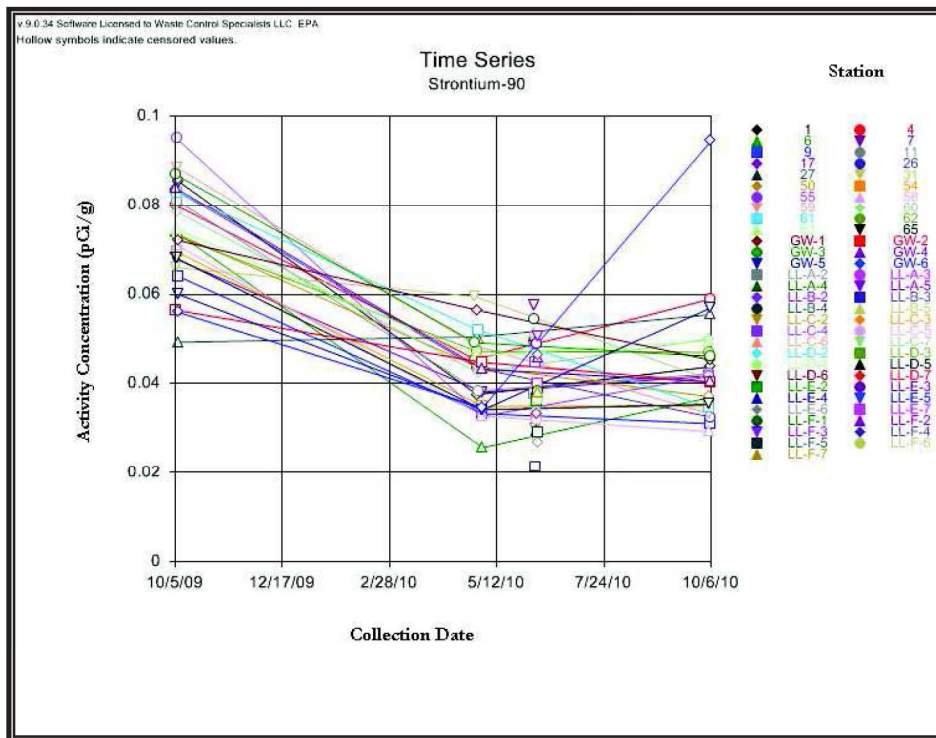


Figure 7-22: Strontium-90 Vegetation Sample.

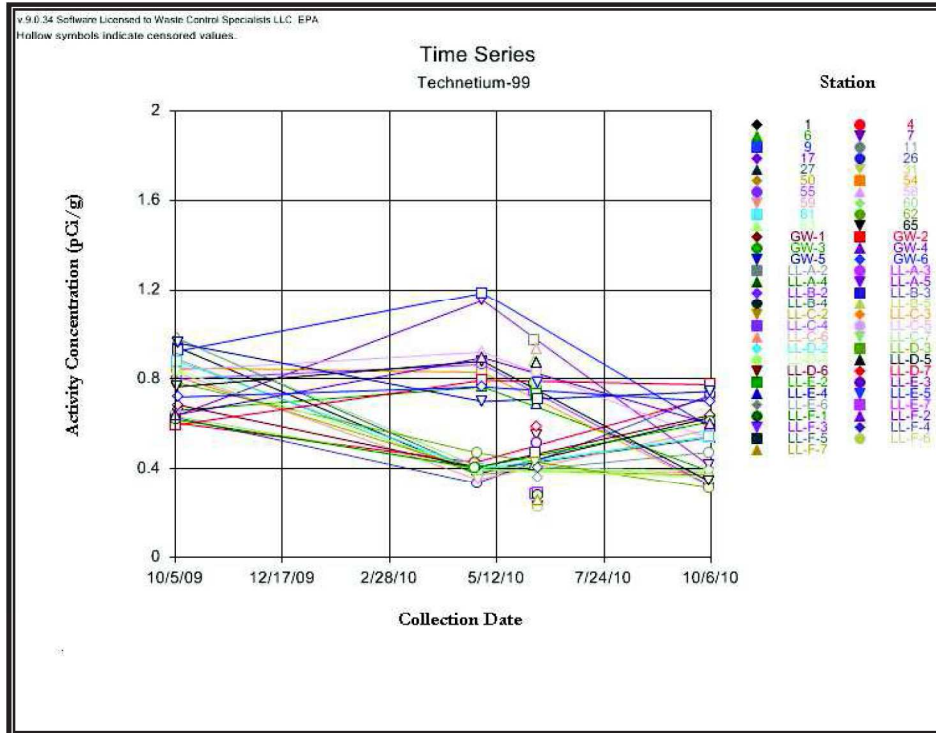


Figure 7-23: Technetium-99 Vegetation Sample.

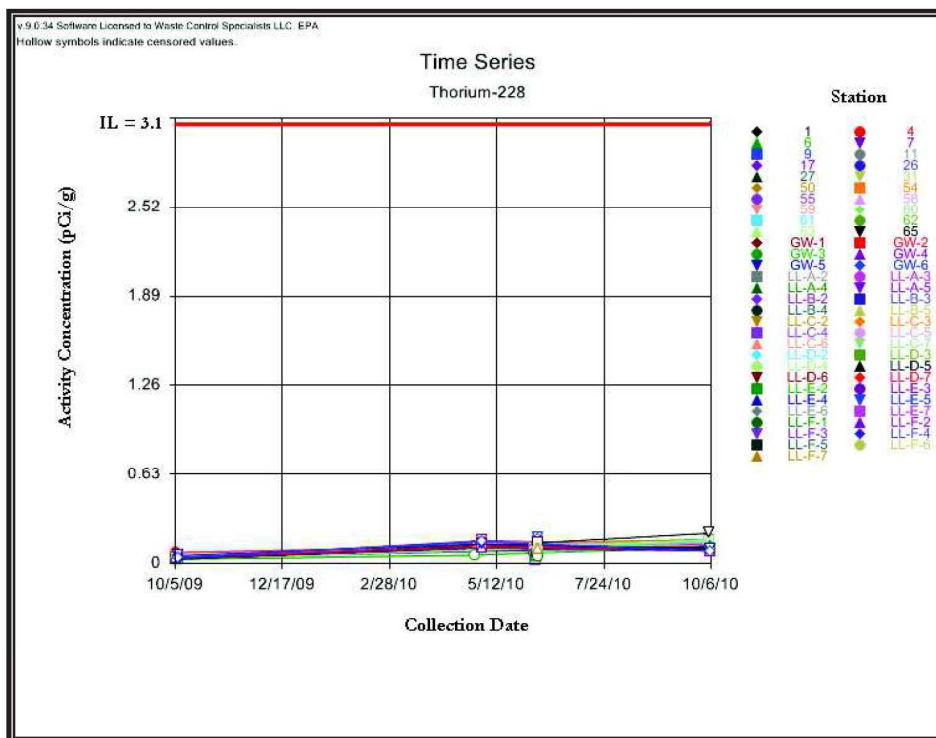


Figure 7-24: Thorium-228 Vegetation Sample.

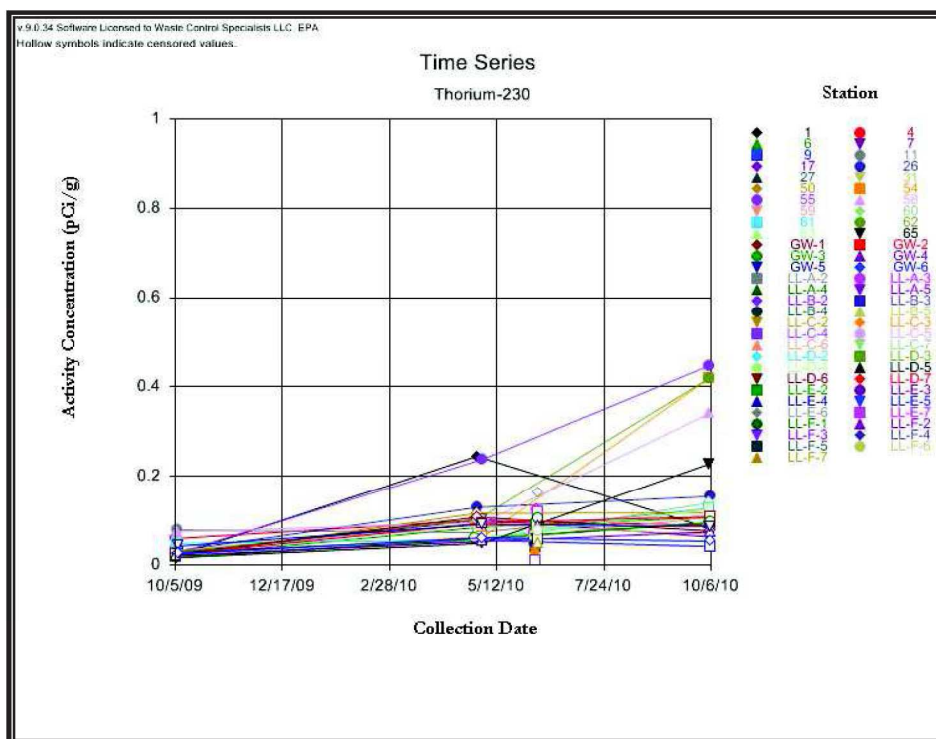


Figure 7-25: Thorium-230 Vegetation Sample.

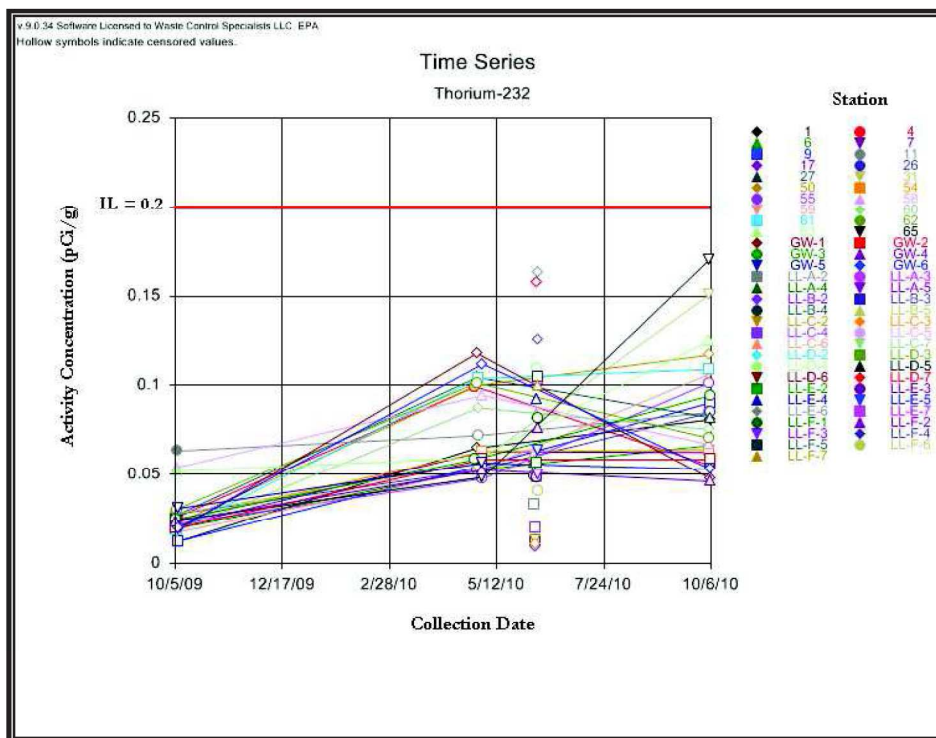


Figure 7-26: Thorium-232 Vegetation Sample.

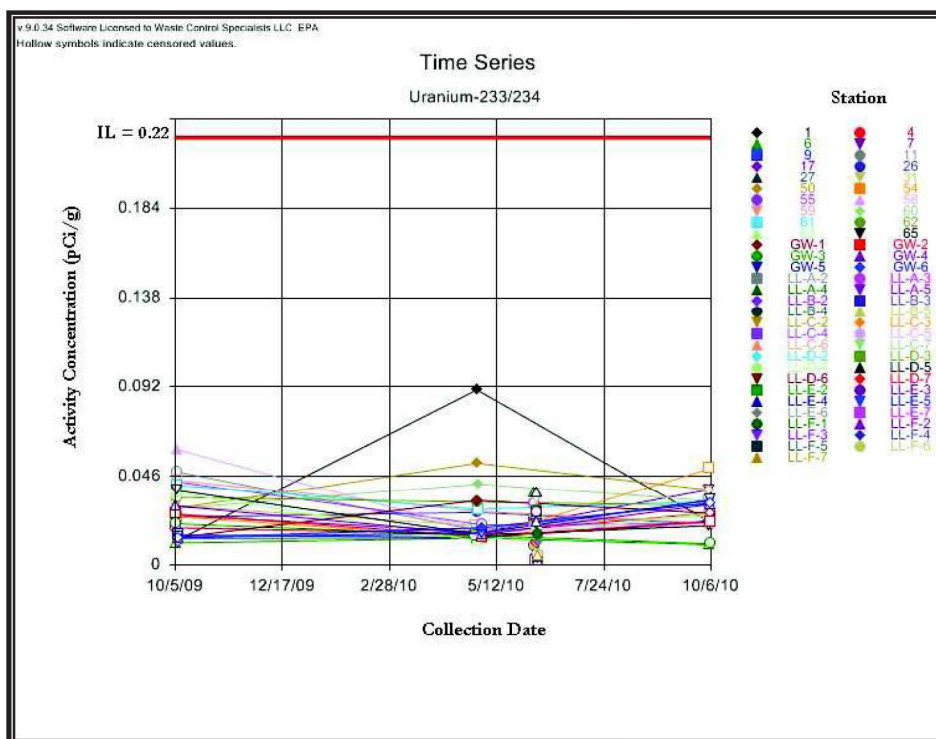


Figure 7-27: Uranium-233/234 Vegetation Sample.

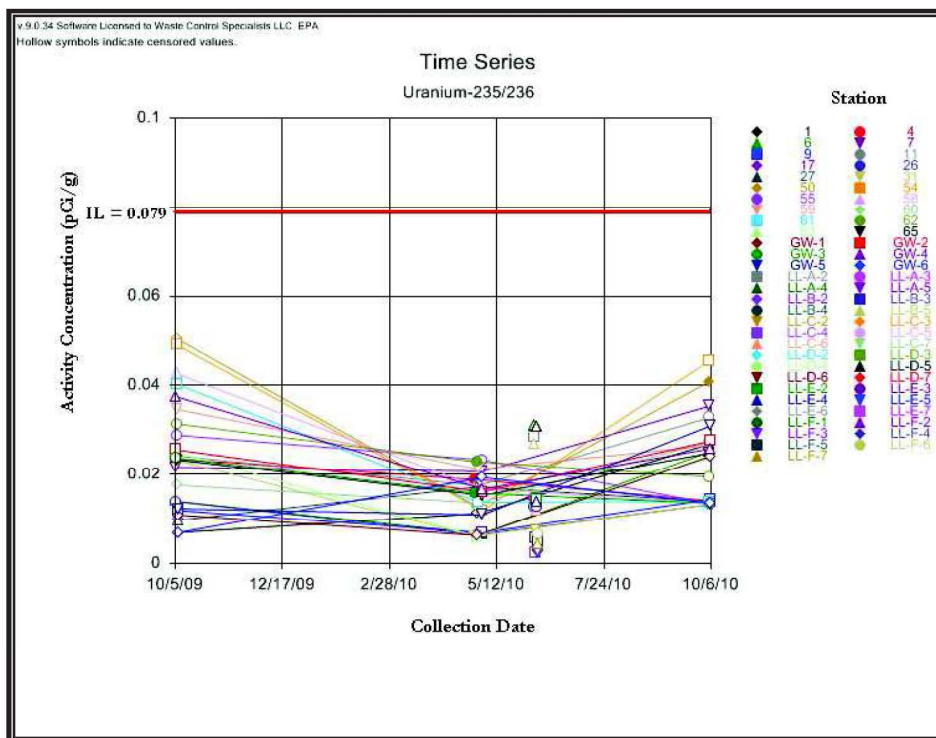


Figure 7-28: Uranium-235/236 Vegetation Sample.

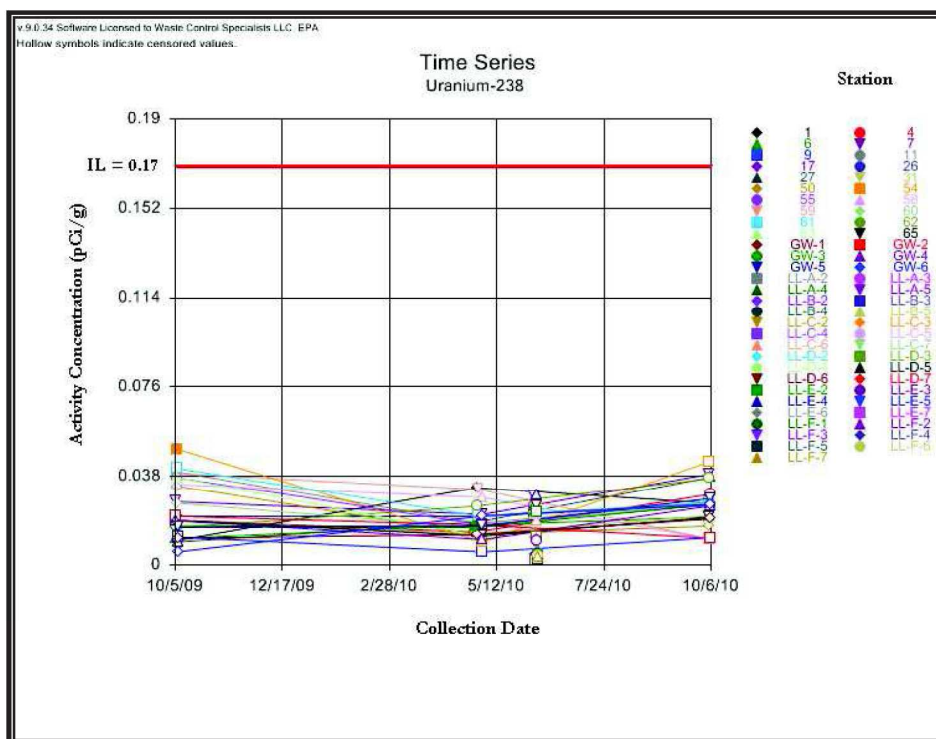


Figure 7-29: Uranium-238 Vegetation Sample.

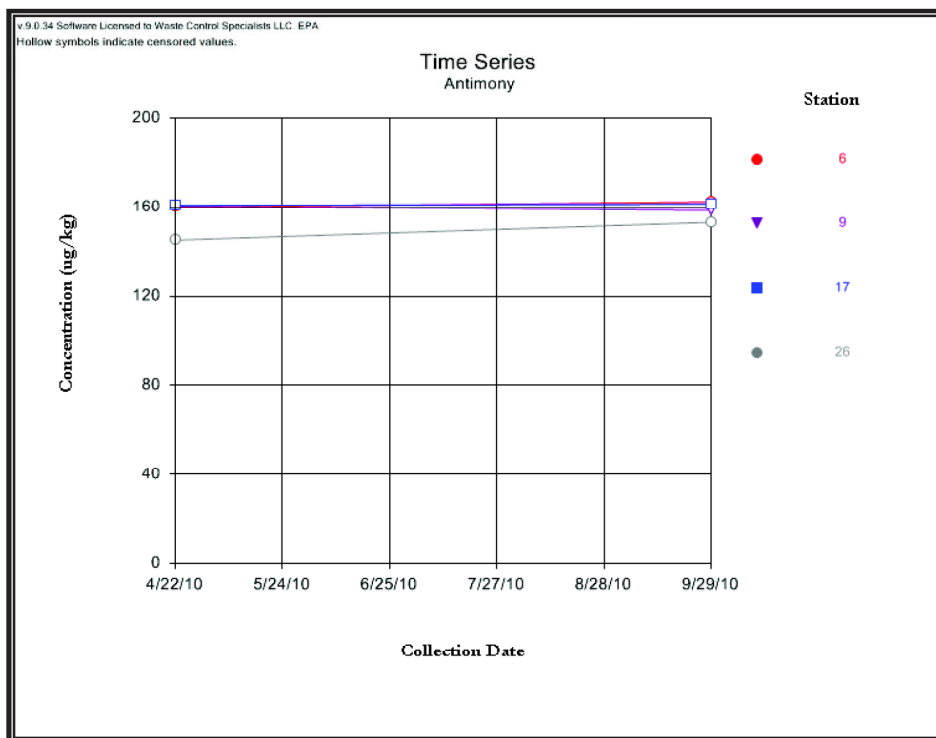


Figure 7-30: Antimony Vegetation Sample Results.

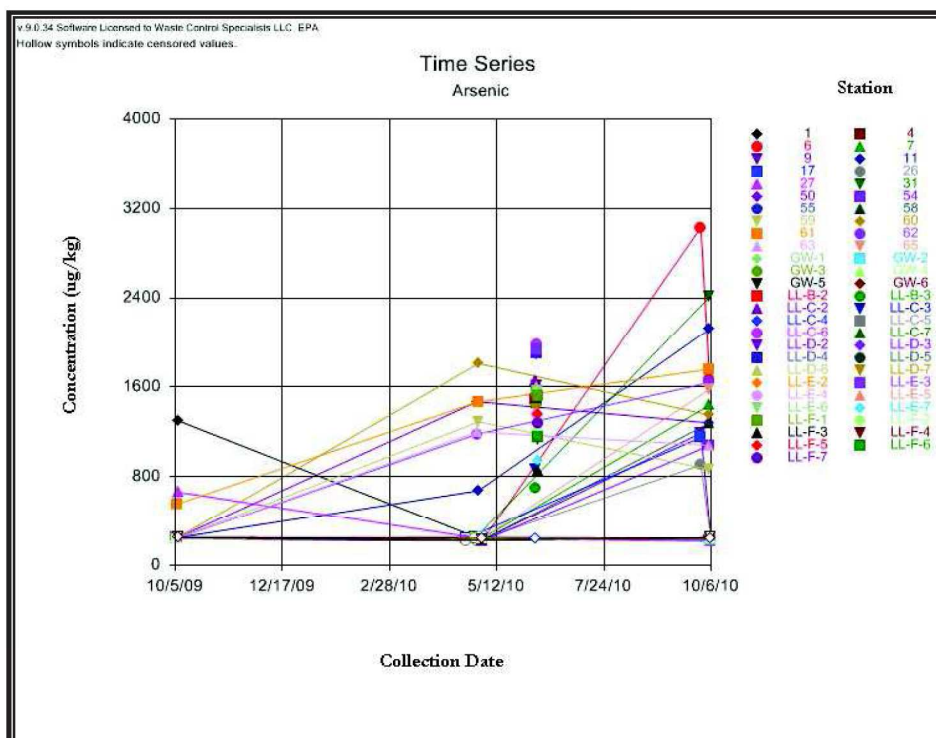


Figure 7-31: Arsenic Vegetation Sample Results.

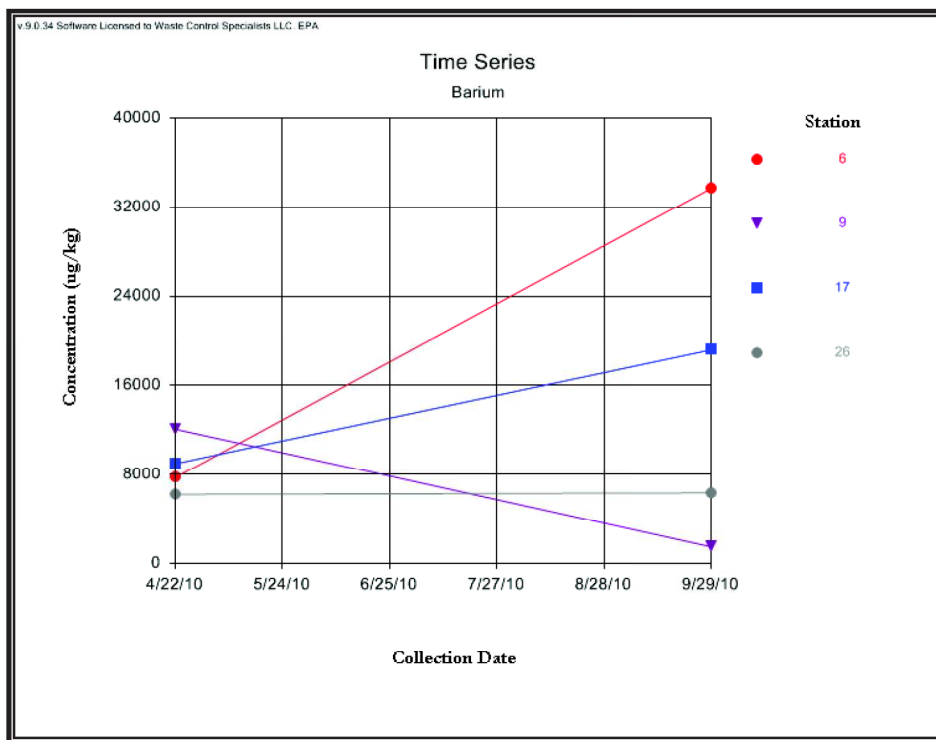


Figure 7-32: Barium Vegetation Sample Results.

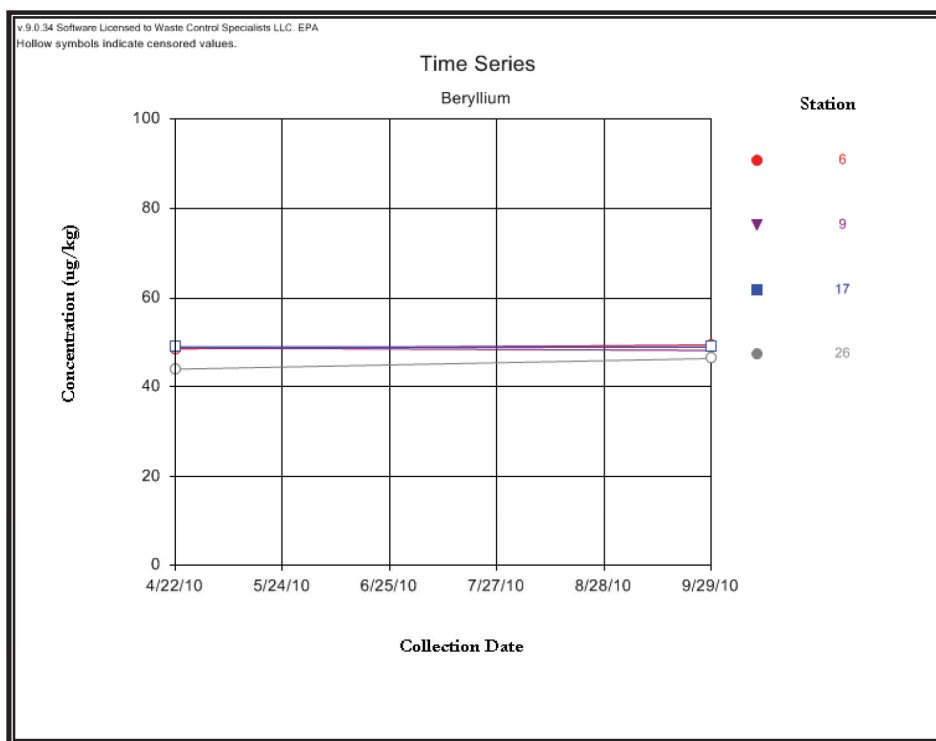


Figure 7-33: Beryllium Vegetation Sample Results.

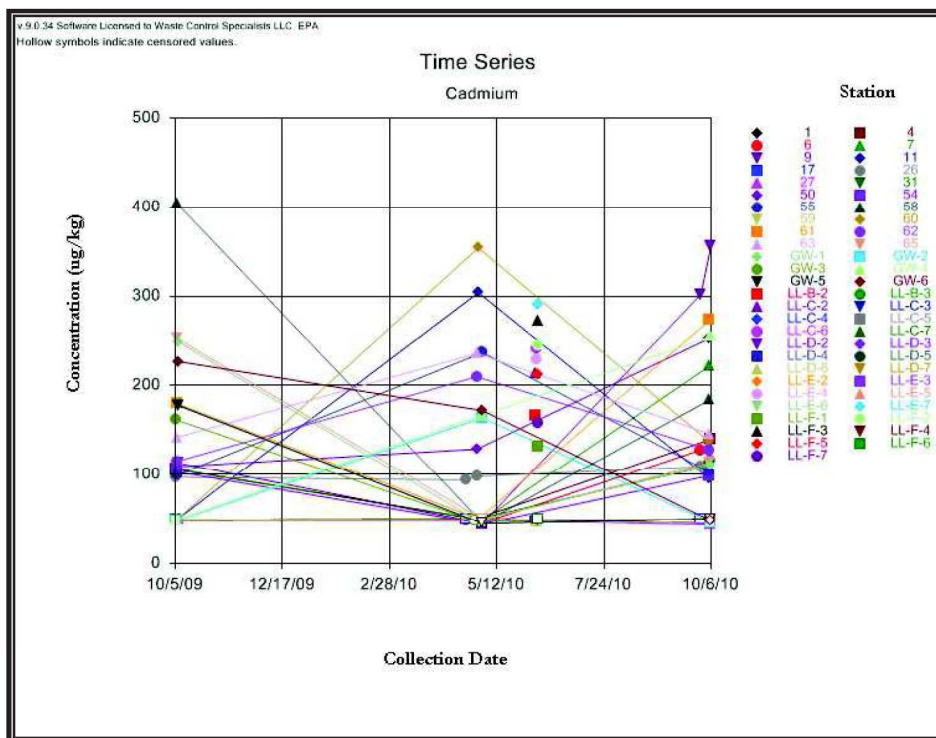


Figure 7-34: Cadmium Vegetation Sample Results.

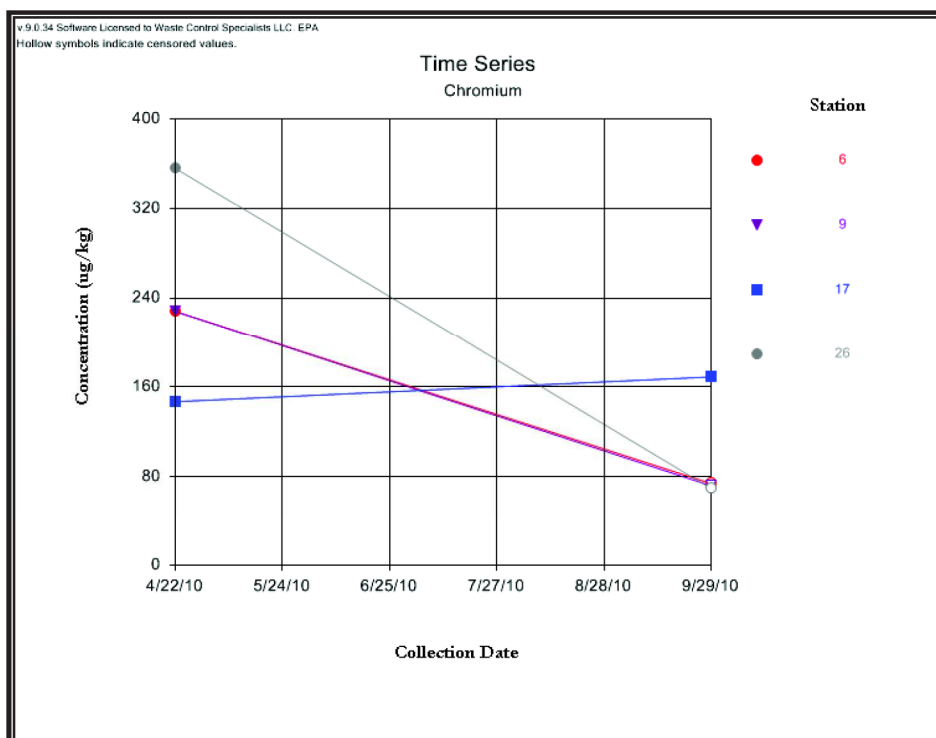


Figure 7-35: Chromium Vegetation Sample Results.

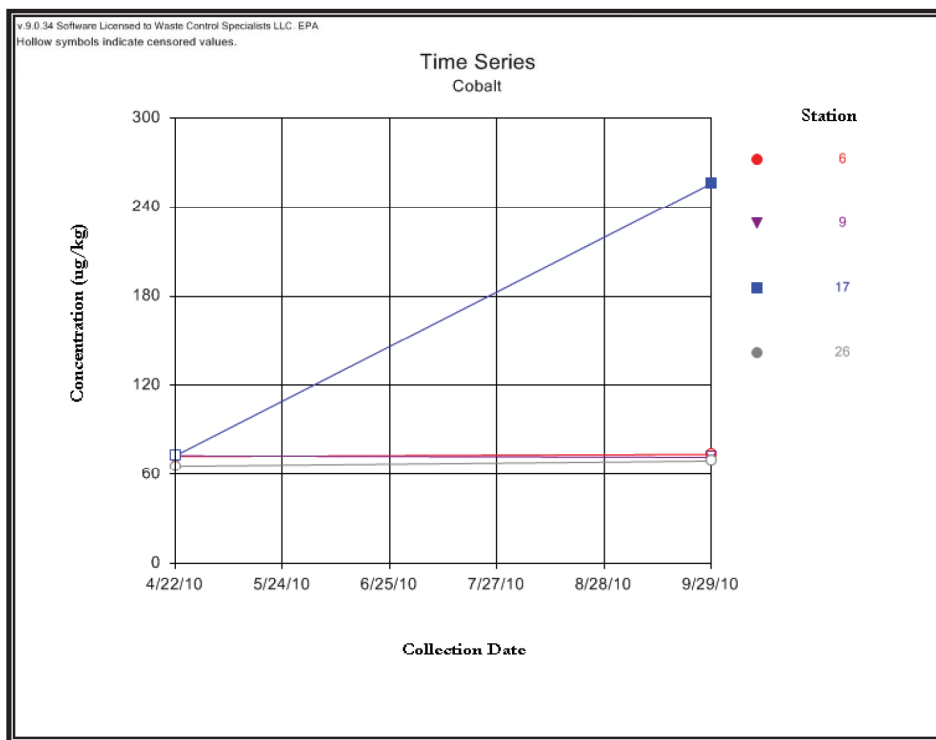


Figure 7-36: Cobalt Vegetation Sample Results.

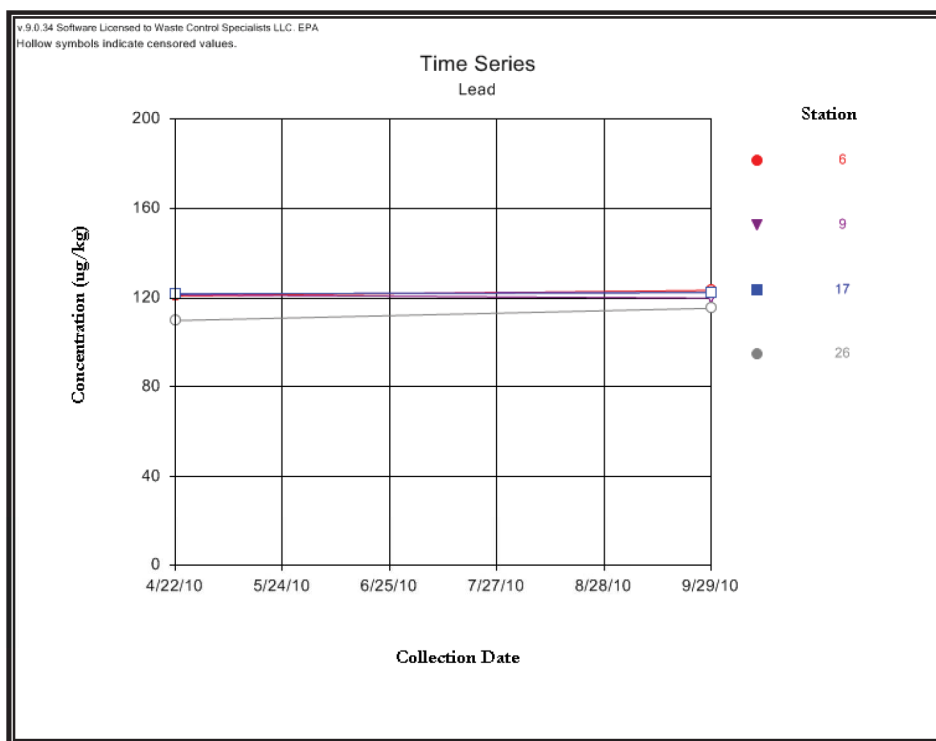


Figure 7-37: Lead Vegetation Sample Results.

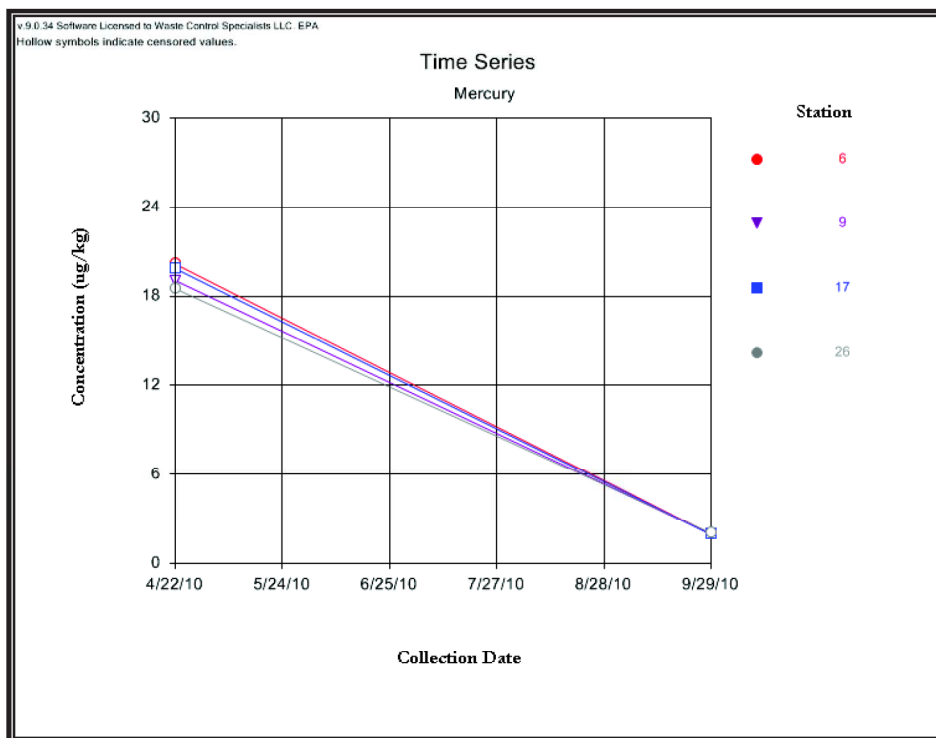


Figure 7-38: Mercury Vegetation Sample Results.

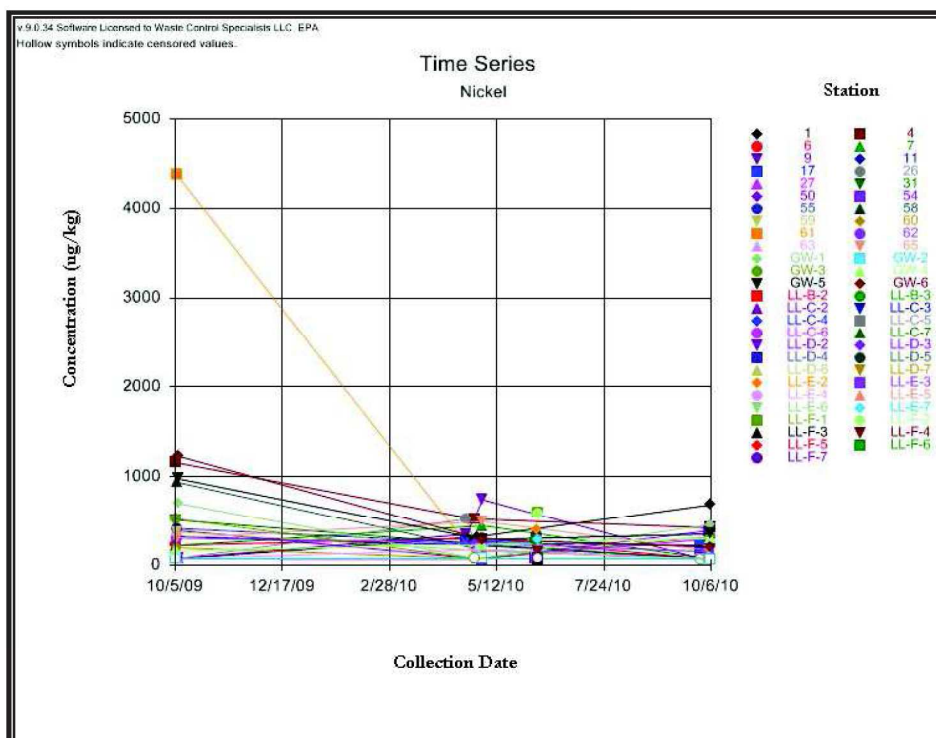


Figure 7-39: Nickel Vegetation Sample Results.

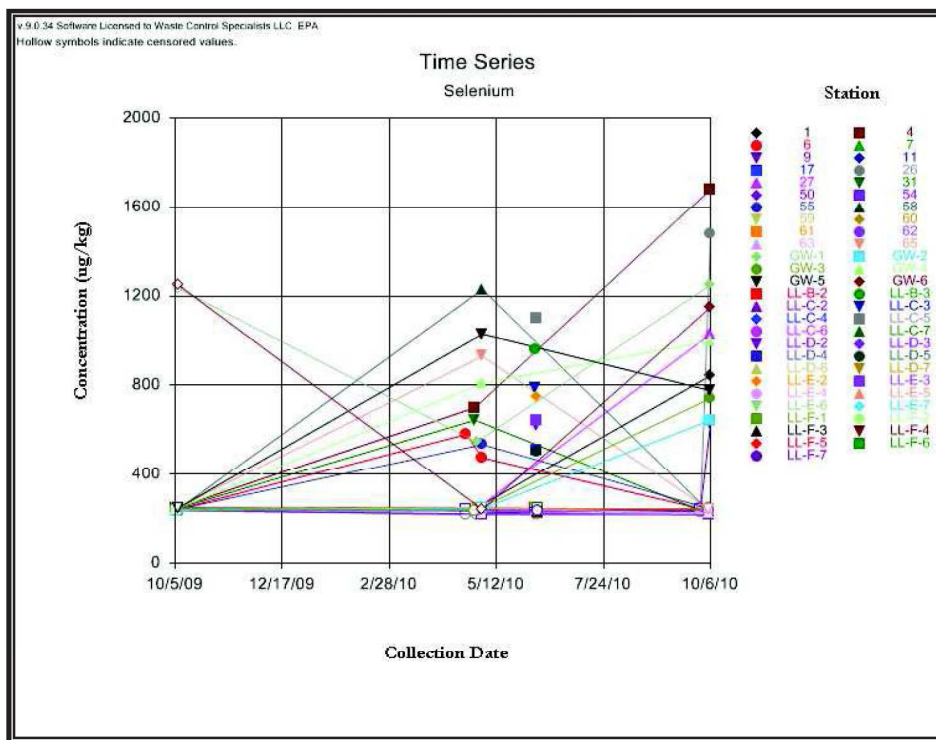


Figure 7-40: Selenium Vegetation Sample Results.

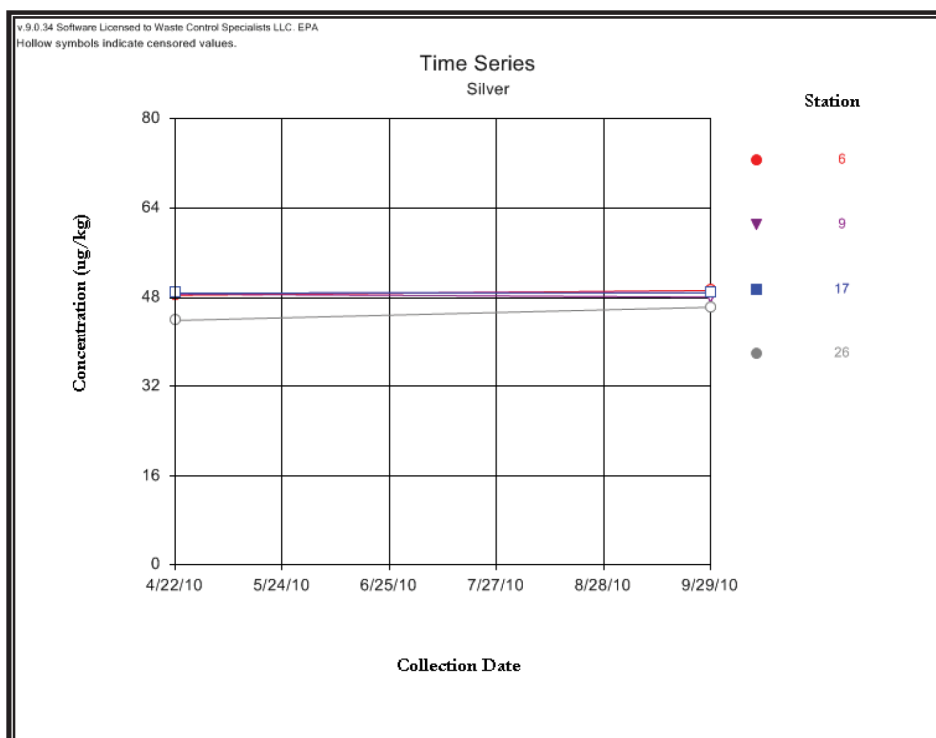


Figure 7-41: Silver Vegetation Sample Results.

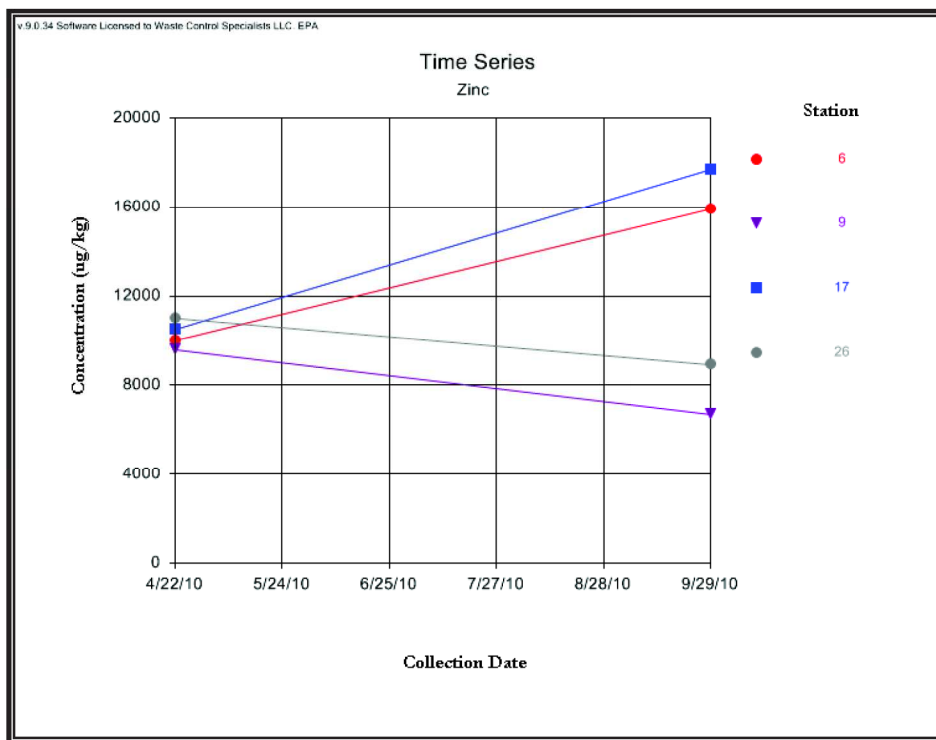


Figure 7-42: Zinc Vegetation Sample Results.

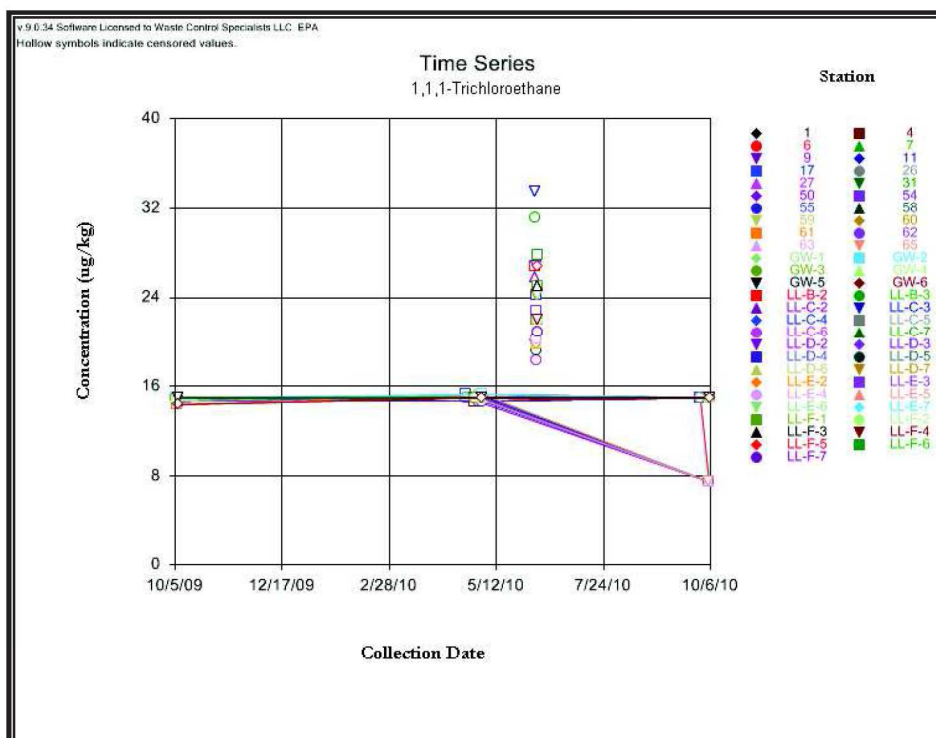


Figure 7-43: 1,1,1-Trichloroethane Vegetation Sample Results.

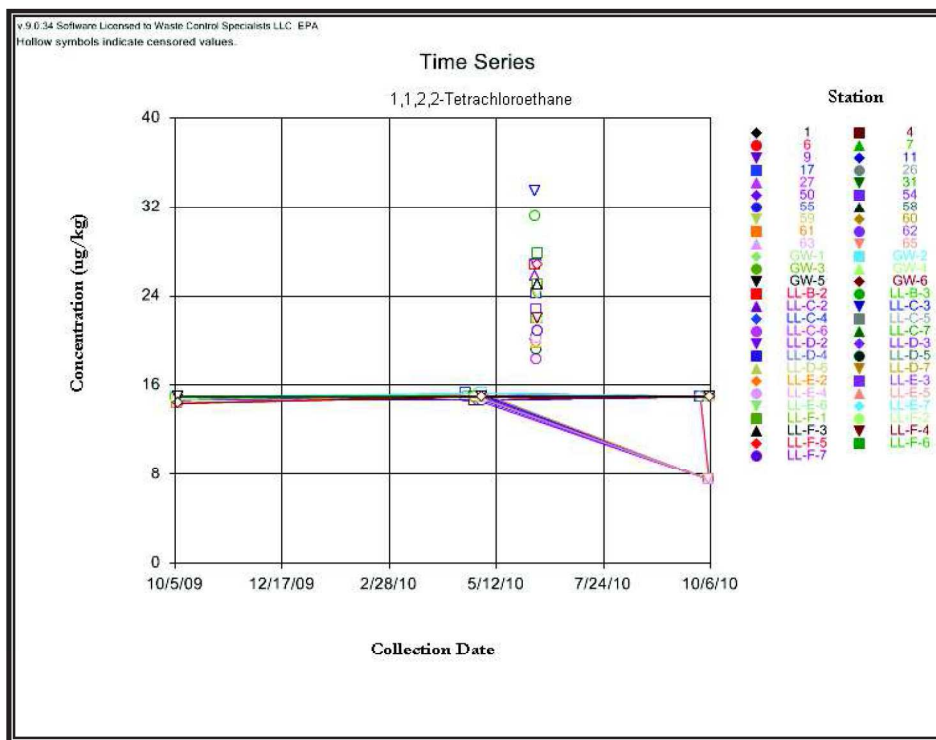


Figure 7-44: 1,1,2,2-Tetrachloroethane Vegetation Sample Results.

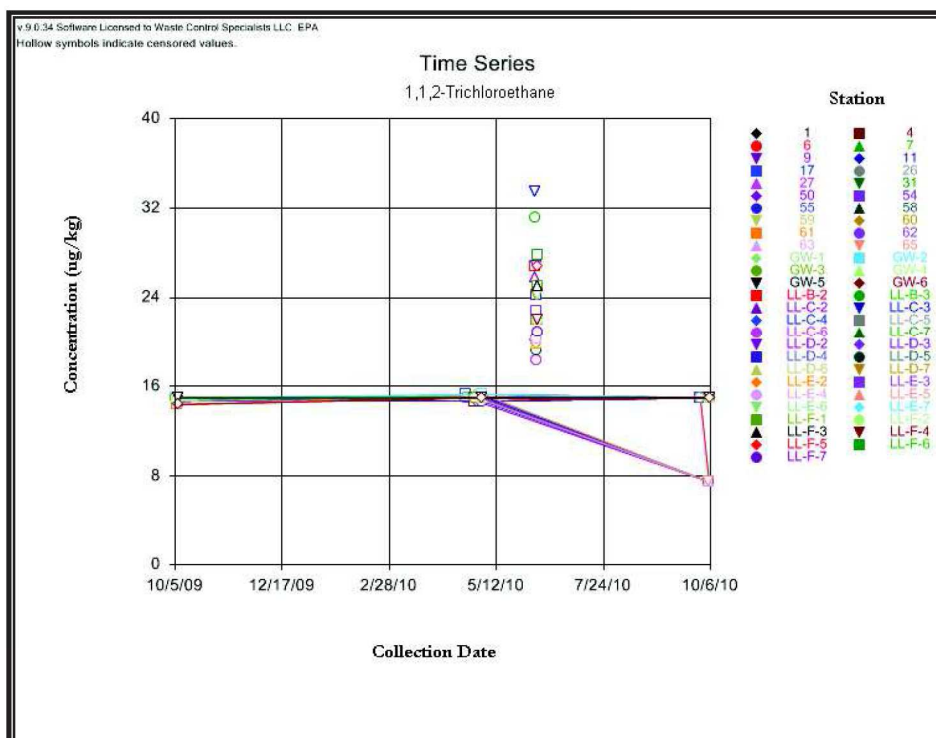


Figure 7-45: 1,1,2-Trichloroethane Vegetation Sample Results.

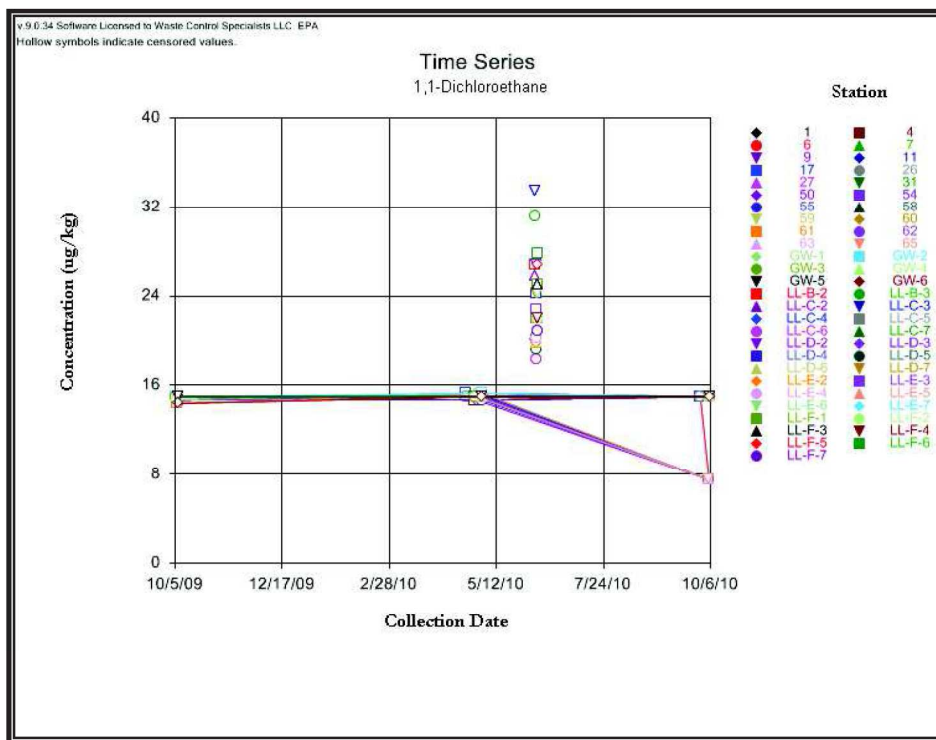


Figure 7-46: 1,1-Dichloroethane Vegetation Sample Results.

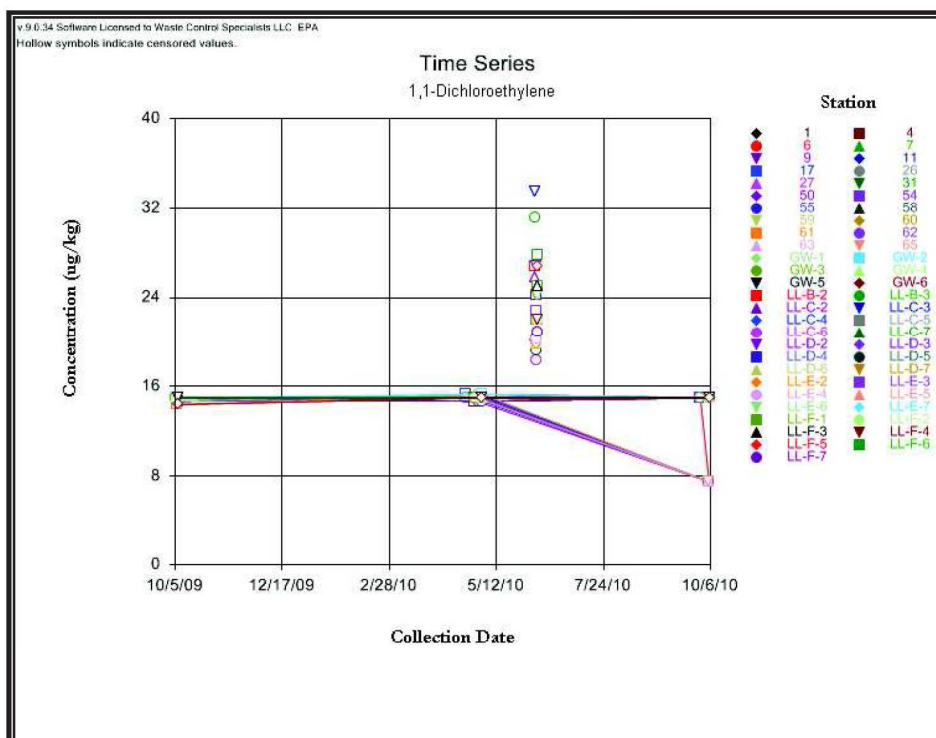


Figure 7-47: 1,1-Dichloroethylene Vegetation Sample Results.

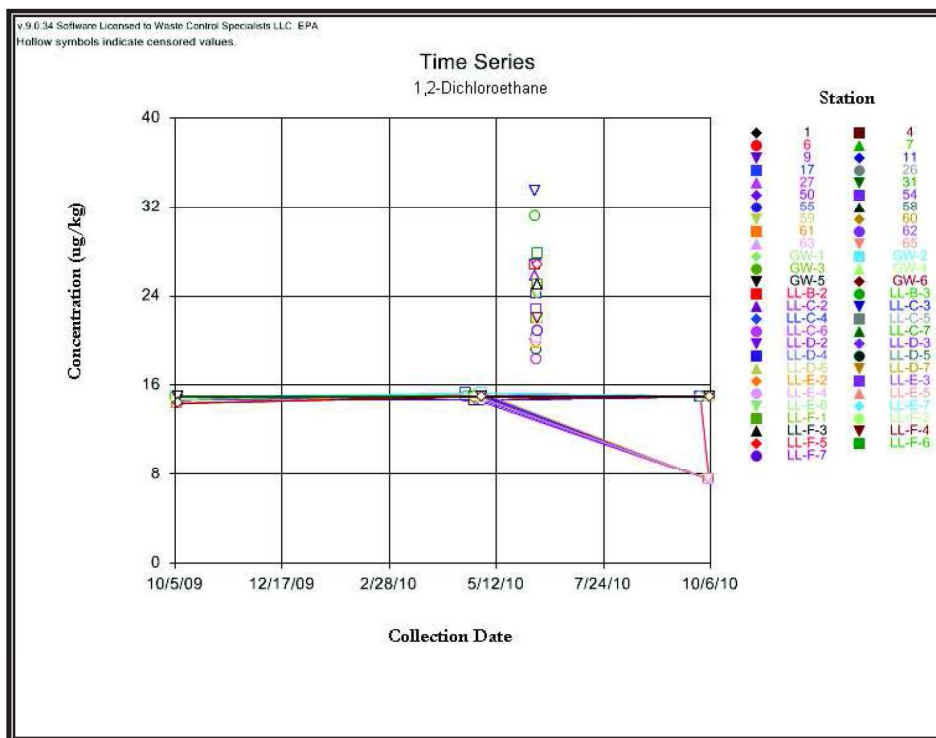


Figure 7-48: 1,2-Dichloroethane Vegetation Sample Results.

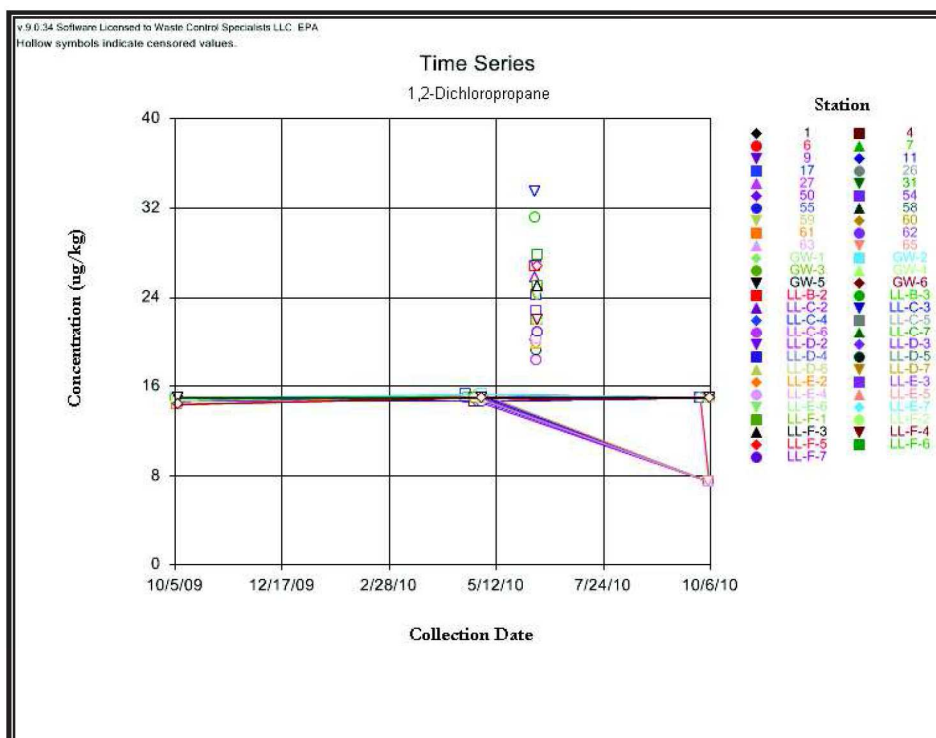


Figure 7-49: 1,2-Dichloropropane Vegetation Sample Results.

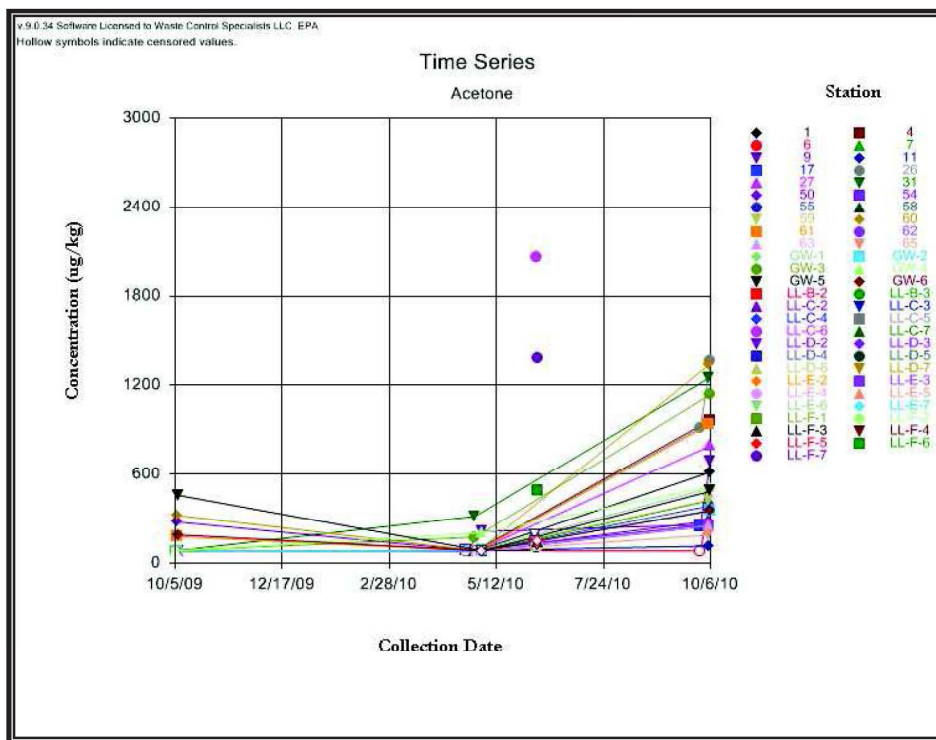


Figure 7-50: Acetone Vegetation Sample Results.

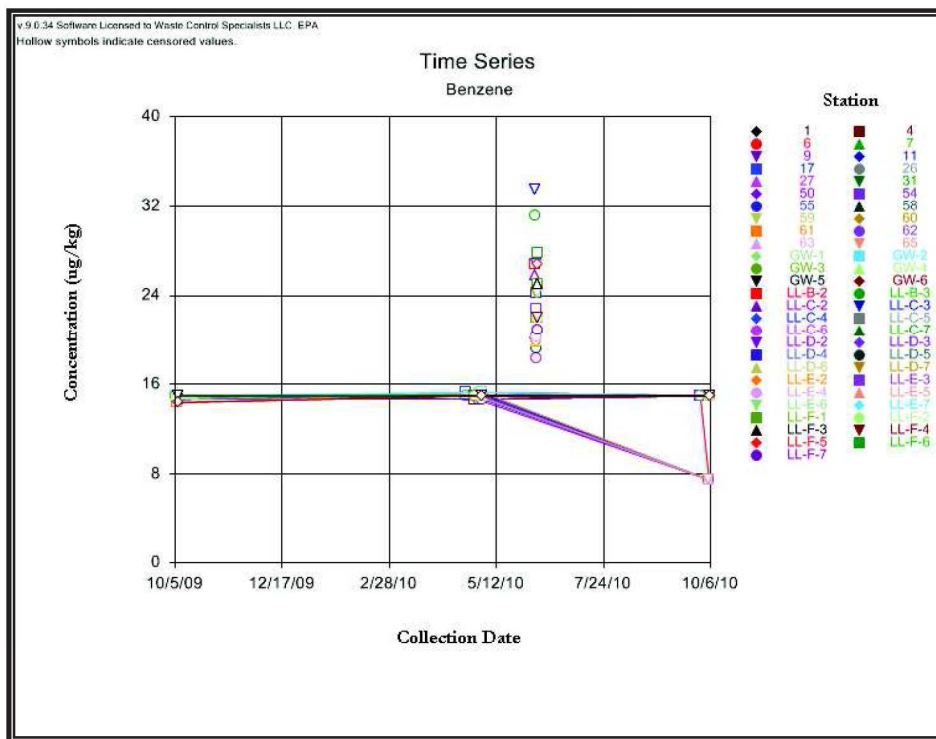


Figure 7-51: Benzene Vegetation Sample Results.

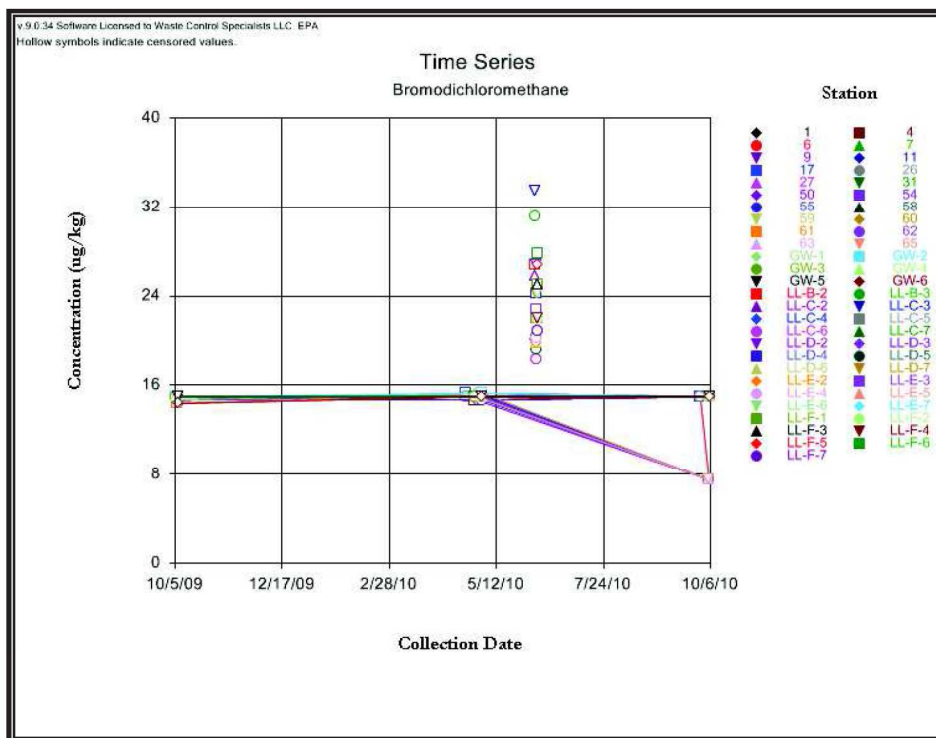


Figure 7-52: Bromodichloromethane Vegetation Sample Results.

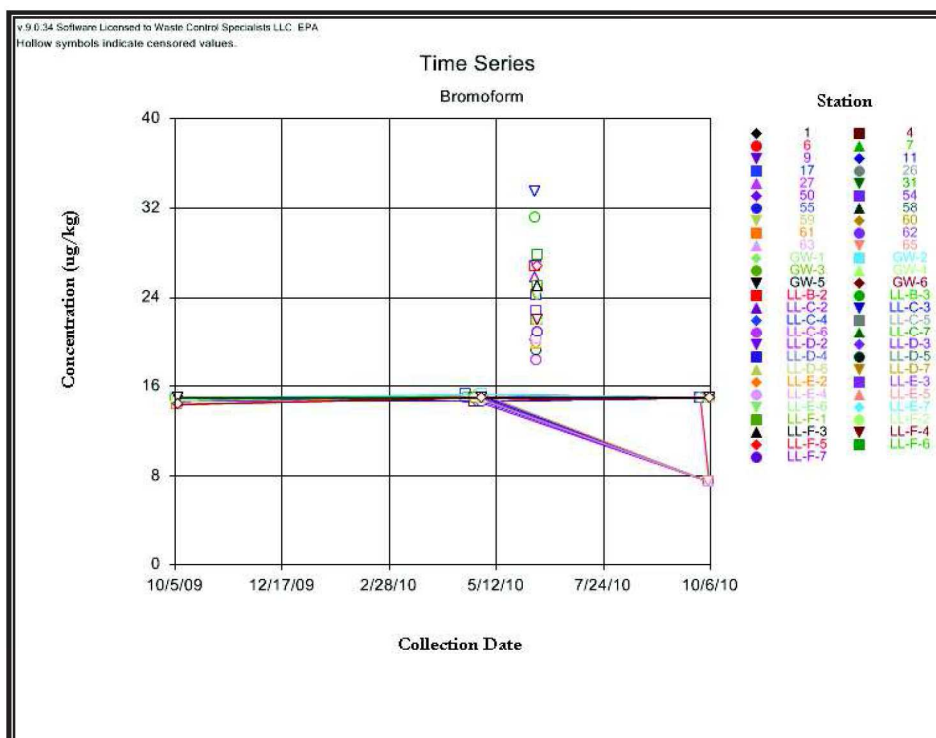


Figure 7-53: Bromoform Vegetation Sample Results.

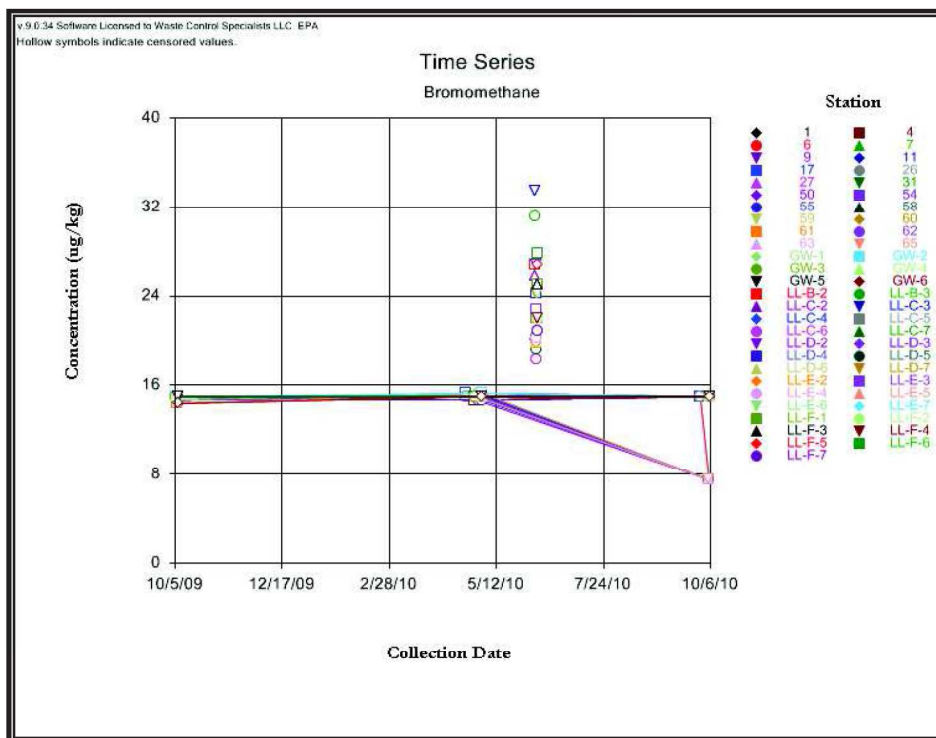


Figure 7-54: Bromomethane Vegetation Sample Results.

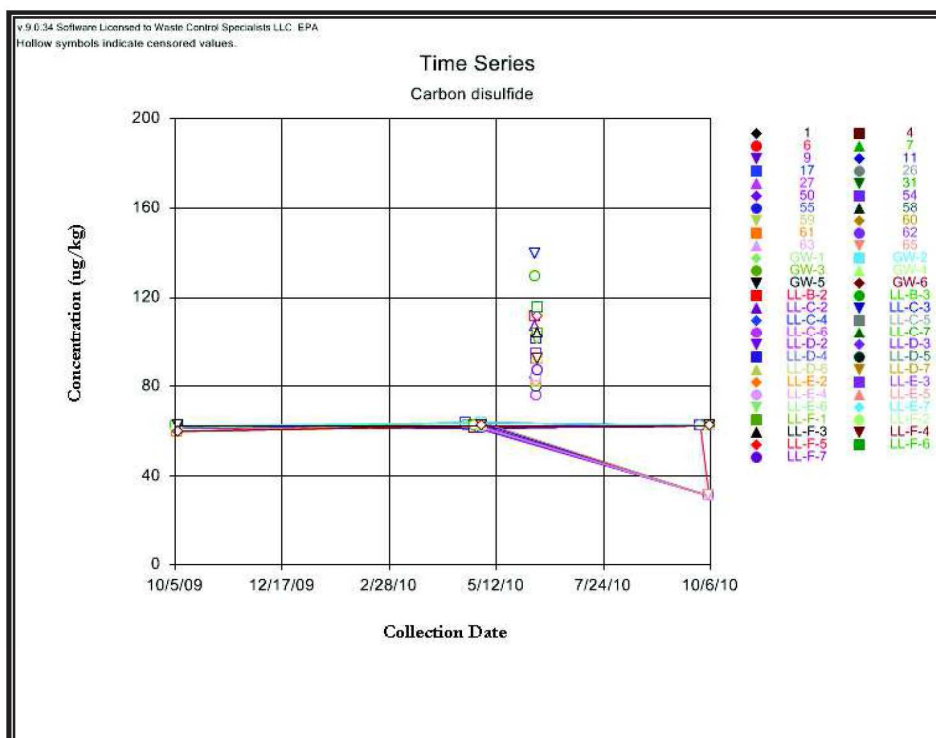


Figure 7-55: Carbon Disulfide Vegetation Sample Results.

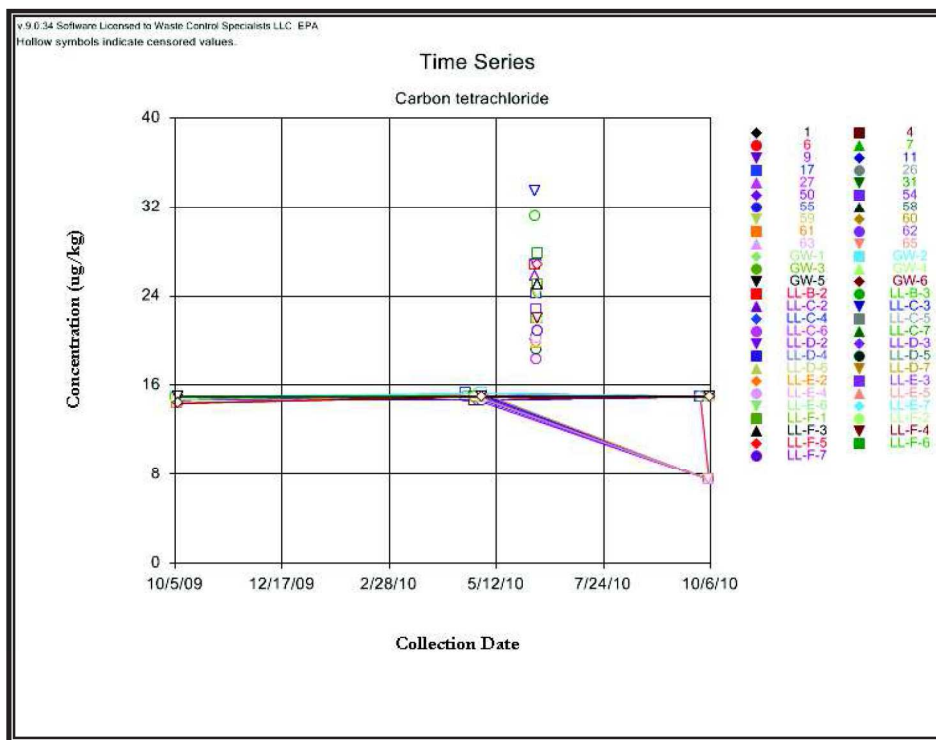


Figure 7-56: Carbon Tetrachloride Vegetation Sample Results.

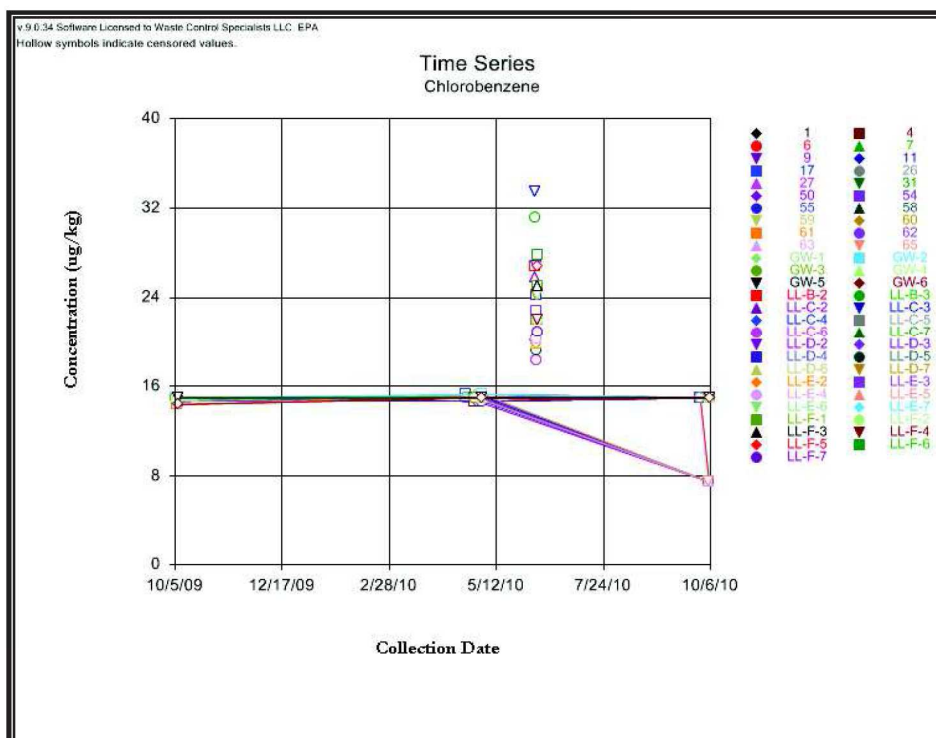


Figure 7-57: Chlorobenzene Vegetation Sample Results.

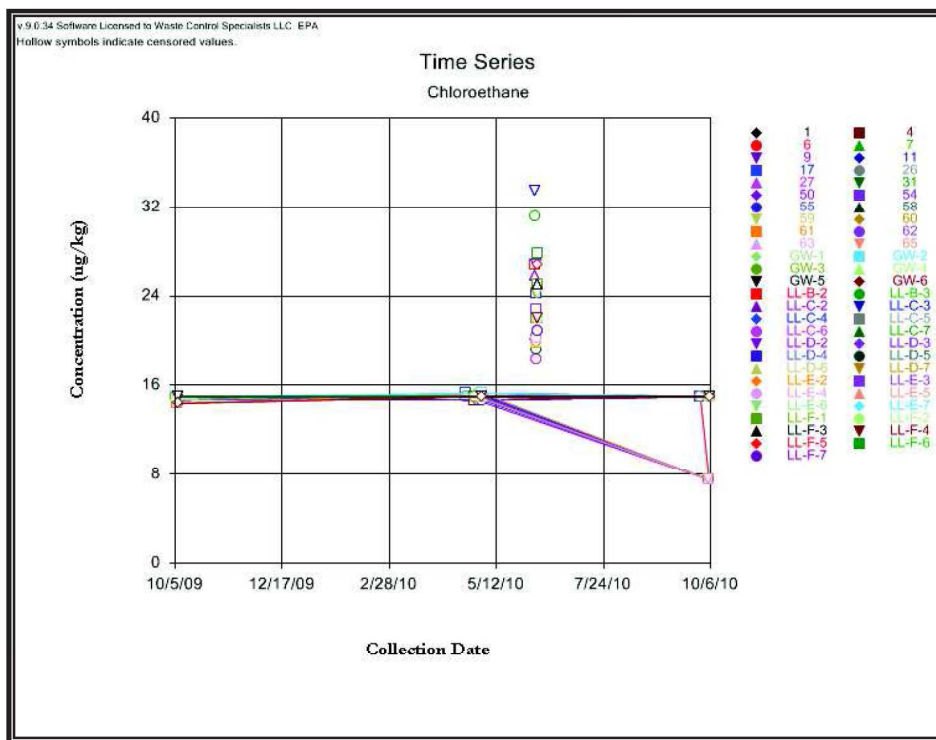


Figure 7-58: Chloroethane Vegetation Sample Results.

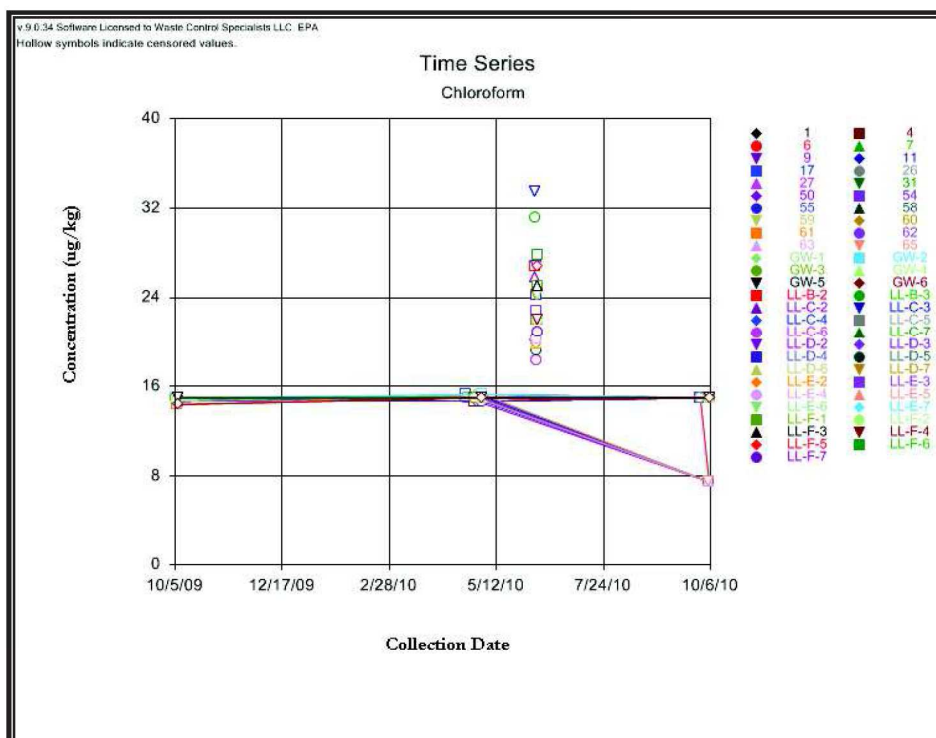


Figure 7-59: Chloroform Vegetation Sample Results.

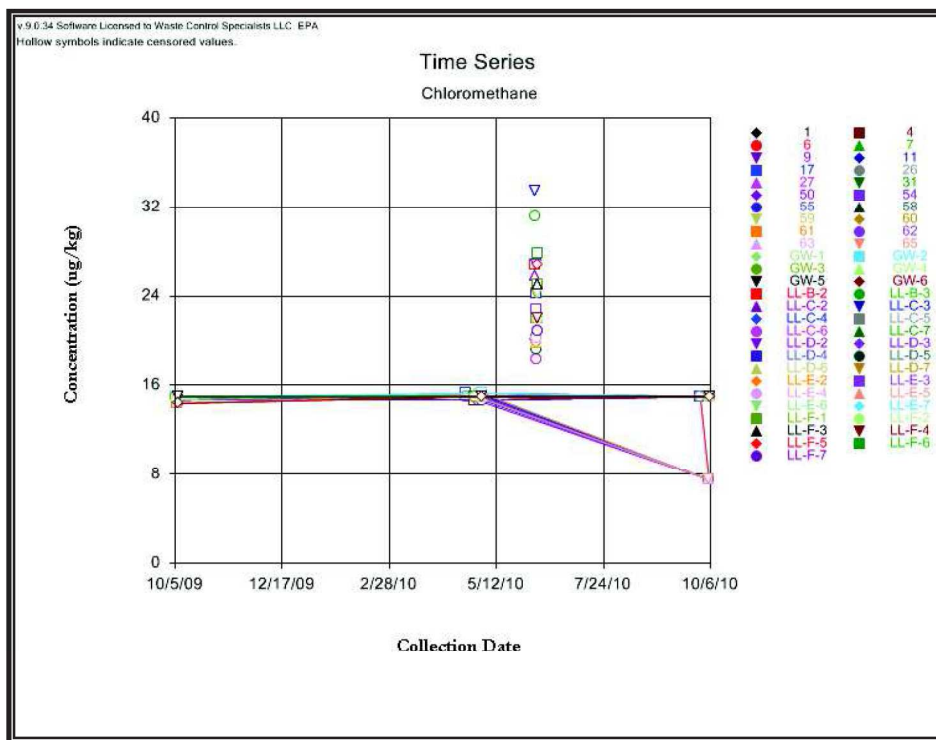
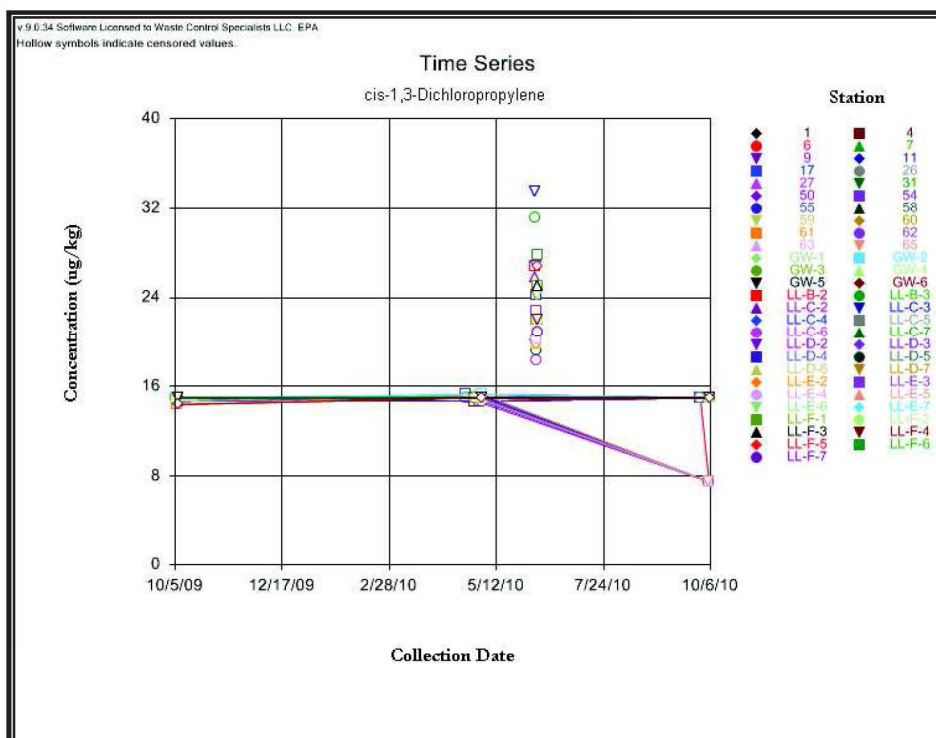


Figure 7-60: Chloromethane Vegetation Sample Results.



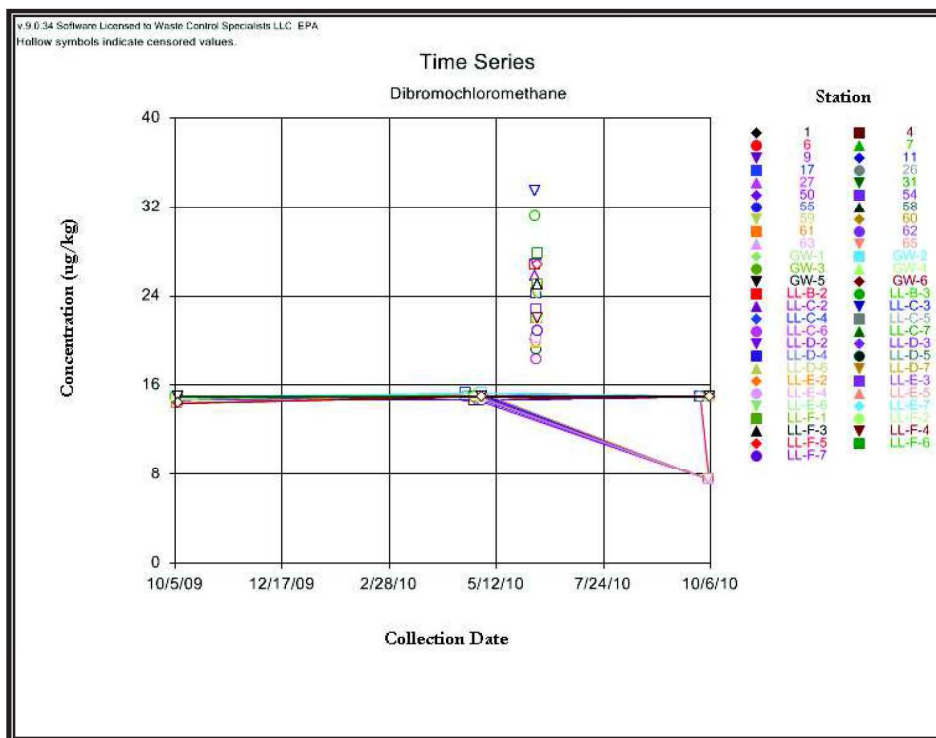


Figure 7-62: Dibromochloromethane Vegetation Sample Results.

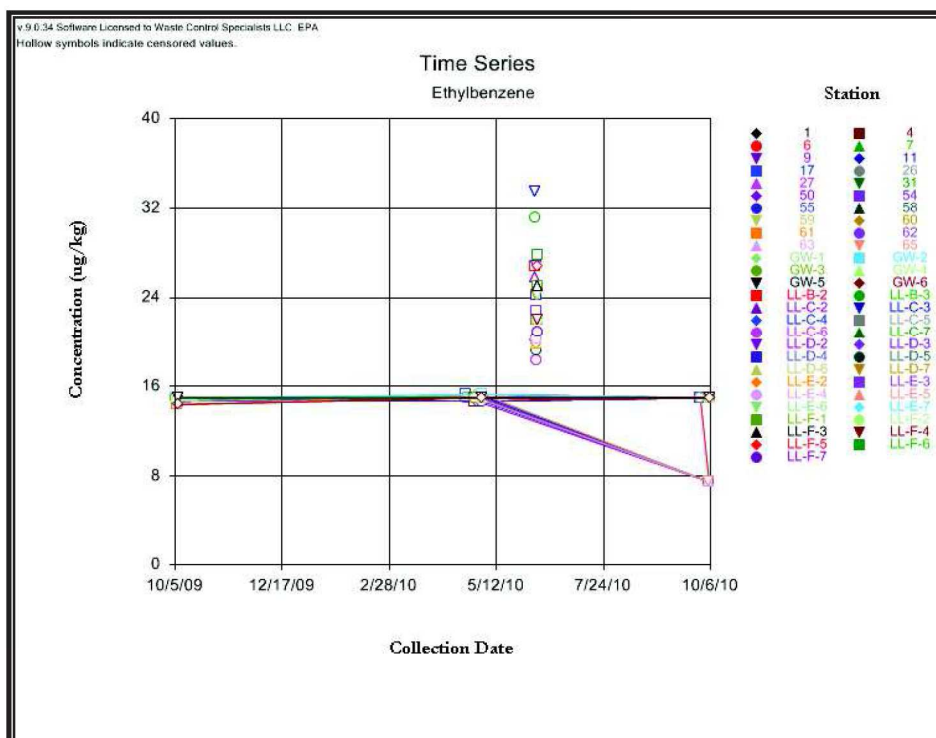


Figure 7-63: Ethylbenzene Vegetation Sample Results.

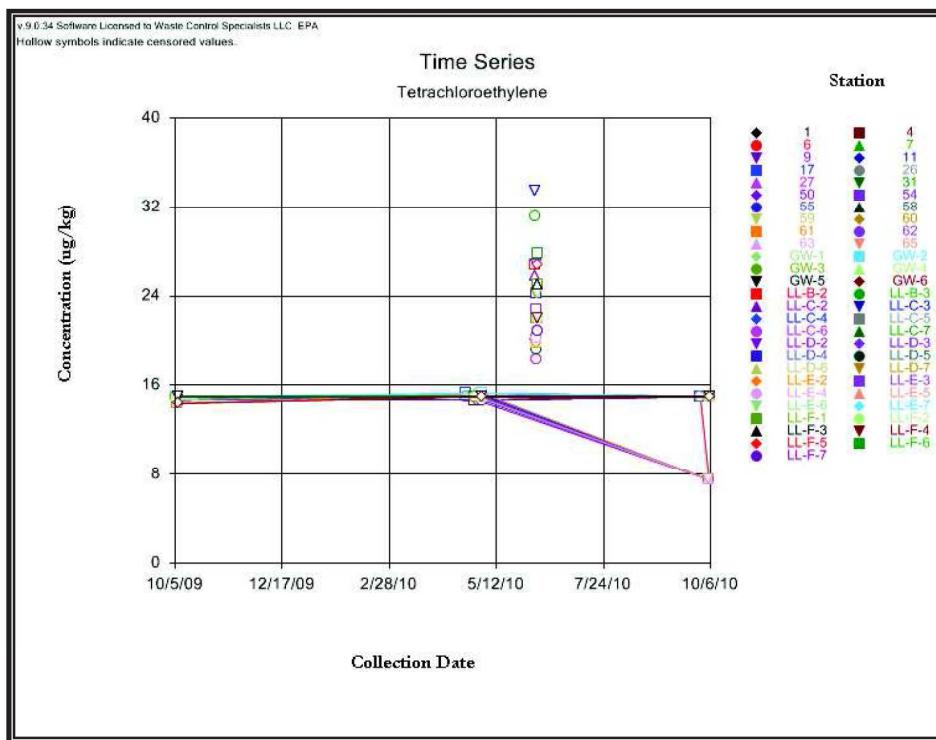


Figure 7-64: Tetrachloroethylene Vegetation Sample Results.

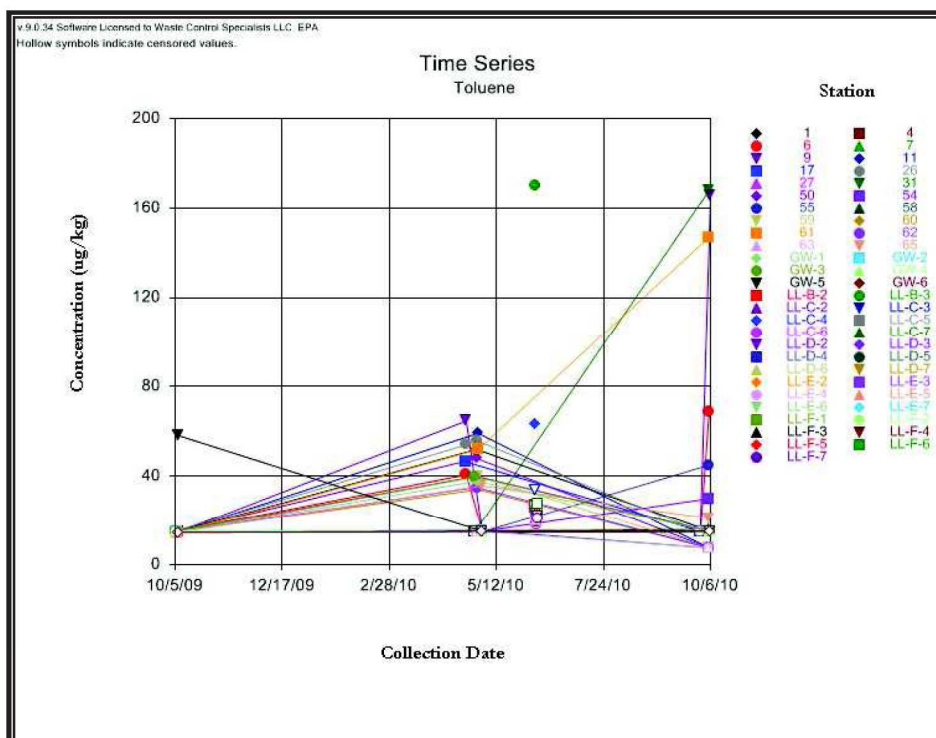


Figure 7-65: Toluene Vegetation Sample Results.

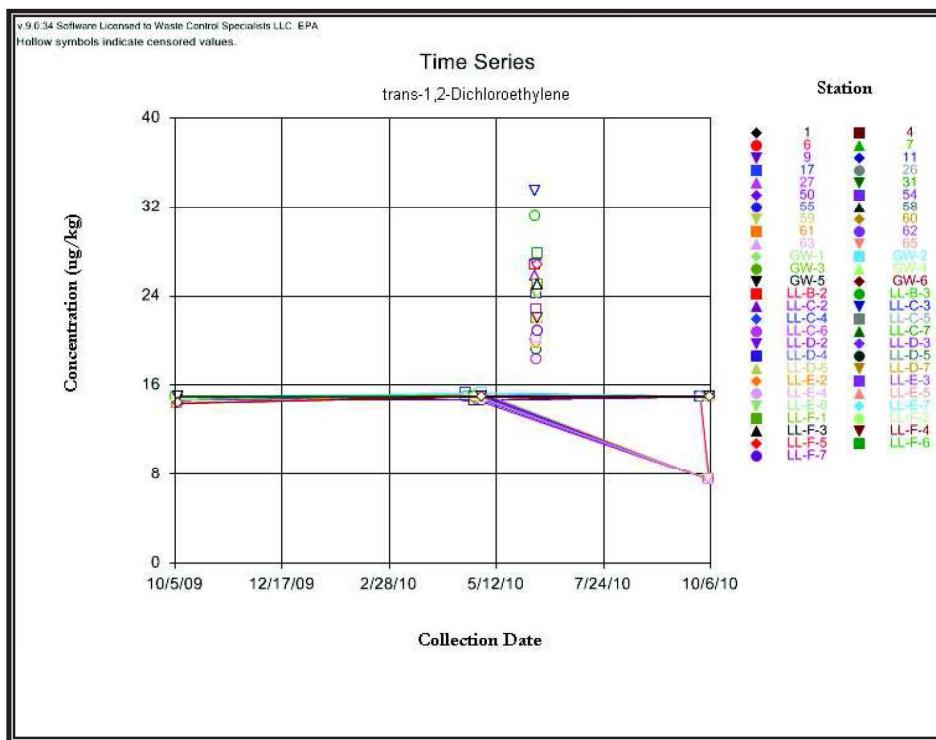


Figure 7-66: trans-1,2-Dichloroethylene Vegetation Sample Results.

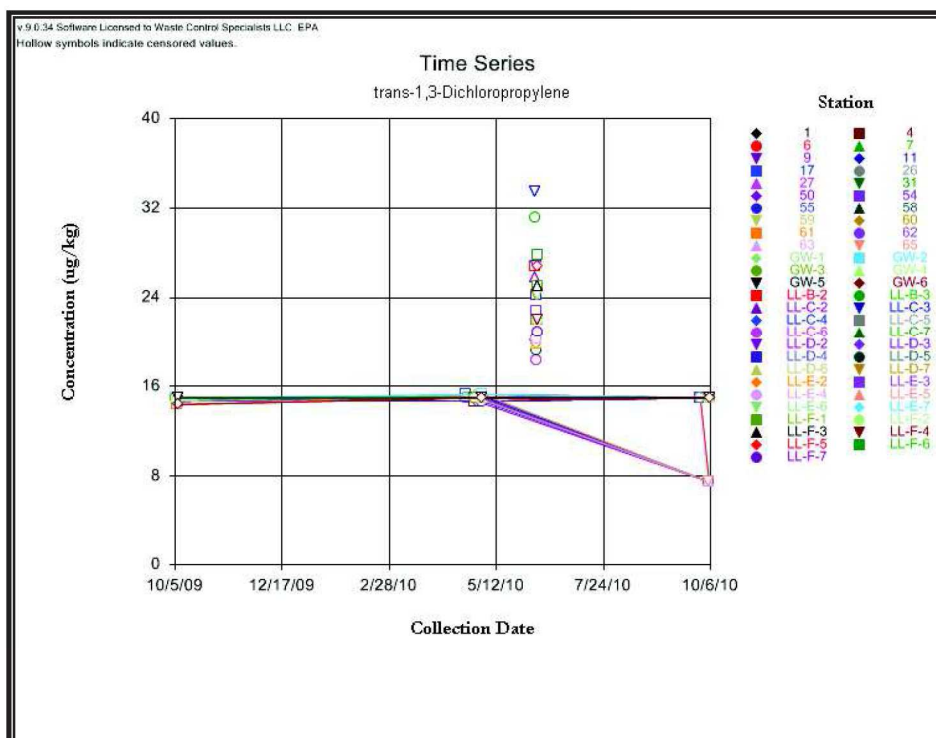
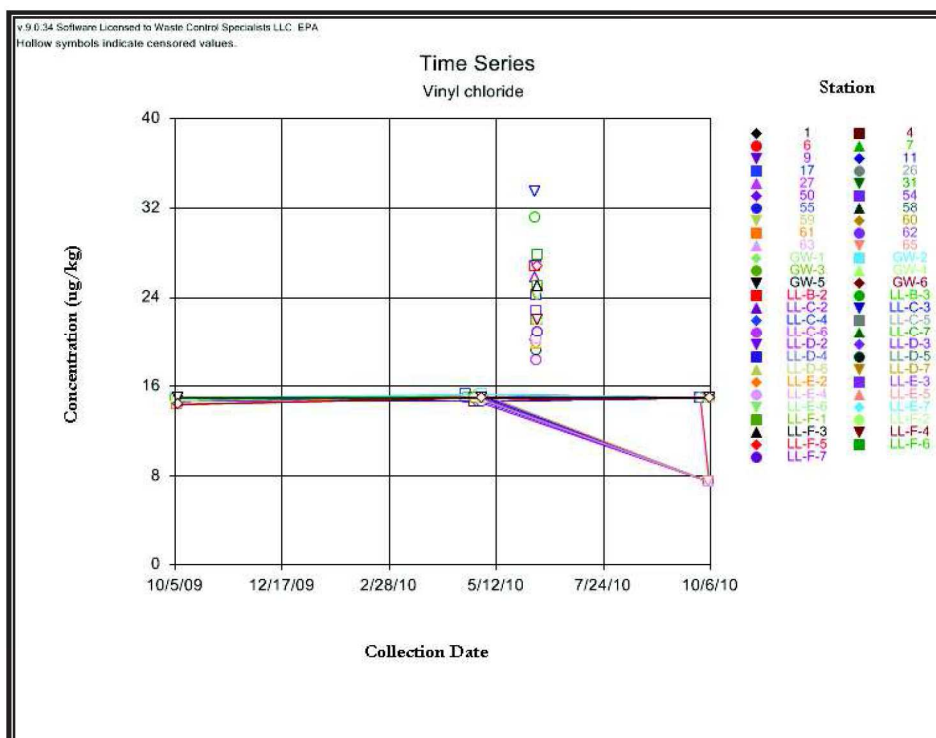
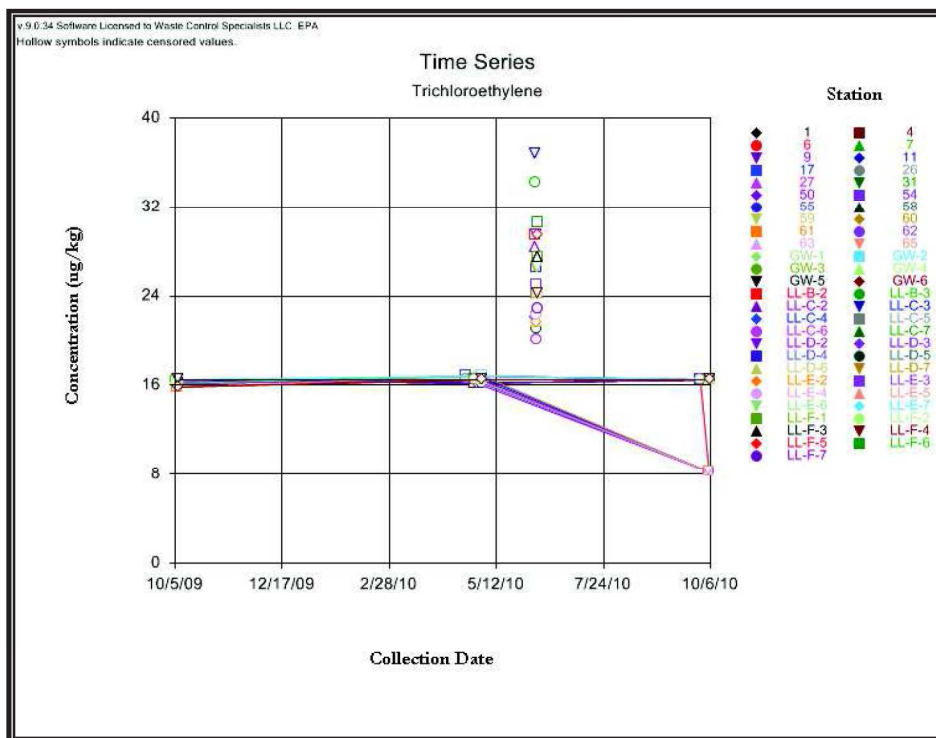


Figure 7-67: trans-1,3-Dichloropropylene Vegetation Sample Results.



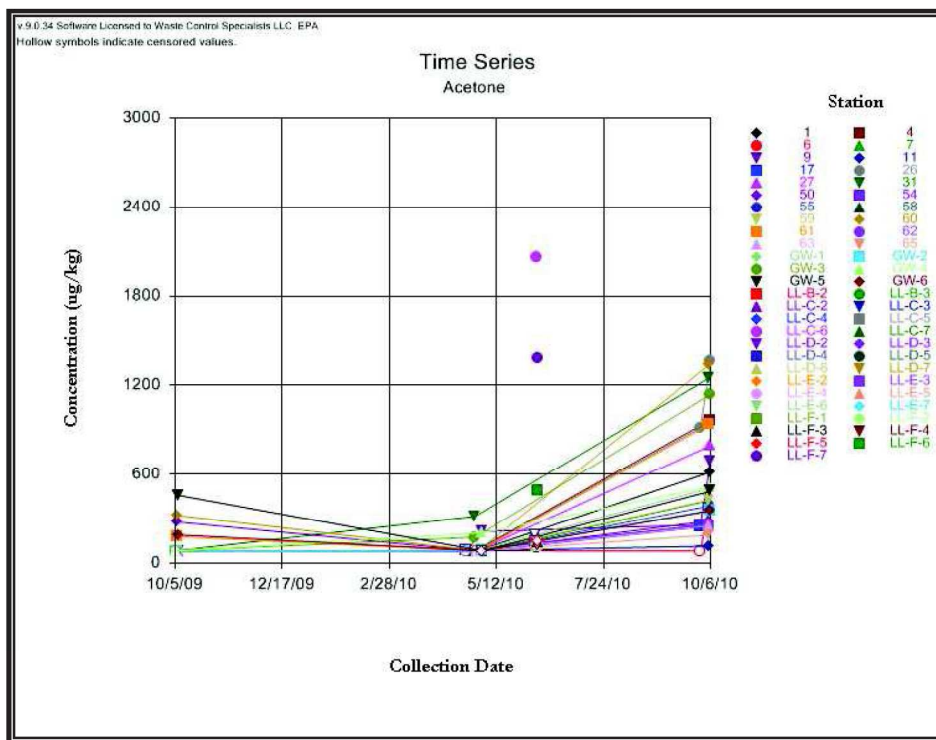


Figure 7-70: Acetone Vegetation Sample Results.

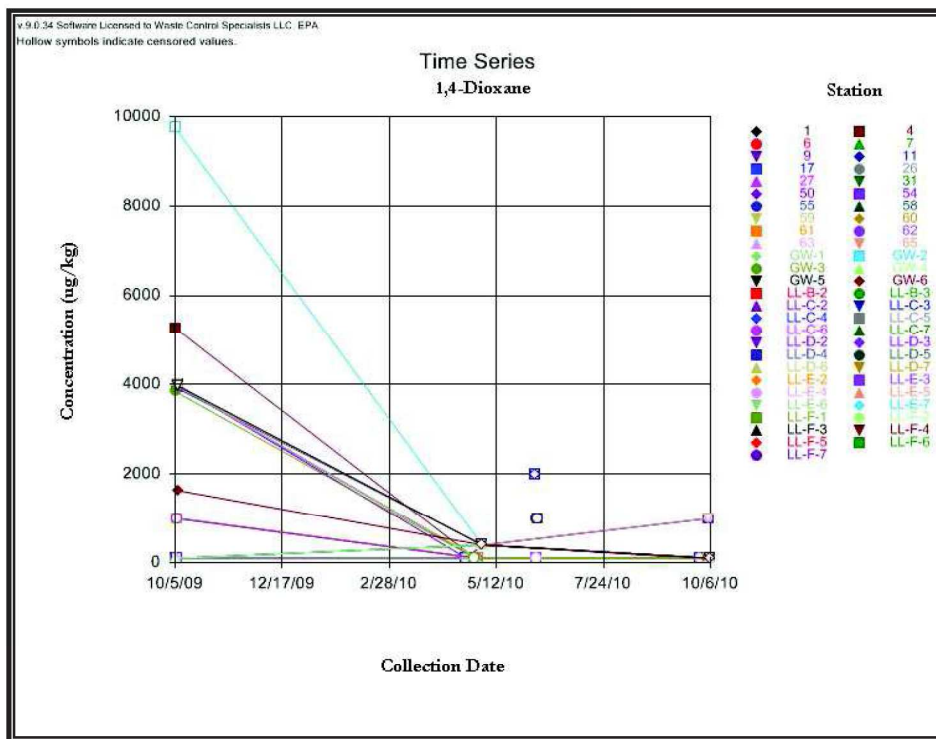


Figure 7-71: 1,4-Dioxane Vegetation Sample Results.

Routine Vegetation

As part of the pre-operational program environmental monitoring program, vegetation is sampled semi-annually at 25 locations for non-radiological analysis and semi-annually at 24 locations. Vegetation samples are also collected annually at Station 17 for radiological analysis. Figure 72 contains a map that displays the vegetation locations.

Vegetation Locations: Station 1, Station 4, Station 6, Station 7, Station 9, Station 11, Station 17, Station 26, Station 27, Station 31, Station 50, Station 54, Station 55, Station 58, Station 59, Station 60, Station 61, Station 62, Station 63, Station 65, Station GW-1, Station GW-2, Station GW-3, Station GW-4, Station GW-5, and Station GW-6.



Routine Vegetation Monitoring Results

Pursuant to LLRW pre-operational monitoring program requirements, vegetation is sampled semi-annually at 25 locations and annually at Station 17.

Radiological summary statistics for the pre operational vegetation radiological results are presented in Table 7-3 and non-radiological results are presented in Table 7-4. Figures 7-2 through 7-71 graphically depict all of the pre-operational vegetation results (including those from routine locations). All pre-operational vegetation samples results are given in Appendix E.

Table 7-3: Radiological Summary Statistics for Routine Radiological Vegetation Results (pCi/g).

	Observations	Number of Stations	Below L _c *	Maximum	Minimum	Mean	Standard Deviation
Alpha	77	26	24	2.65E+00	-1.41E+00	8.08E-01	6.57E-01
Am-241	77	26	65	1.58E-02	-1.96E-02	-6.83E-04	6.56E-03
Beta	77	26	0	6.13E+01	3.98E+00	2.42E+01	1.25E+01
C-14	76	26	71	1.15E+00	-5.63E+00	-1.46E-01	8.88E-01
Cs-137	77	26	63	8.20E-02	-7.86E-02	5.01E-03	2.41E-02
Cr-51	77	26	73	5.06E-01	-3.84E-01	1.46E-02	1.90E-01
Co-60	77	26	69	7.57E-02	-4.59E-02	2.97E-03	2.31E-02
Cu-242	76	26	75	7.31E-03	-3.09E-03	1.35E-04	1.62E-03
Cu-243/244	76	26	75	2.93E-02	-7.89E-03	6.31E-04	4.74E-03
I-129	76	26	72	1.28E-01	-1.68E-01	-5.47E-03	6.01E-02
Mn-54	77	26	74	2.93E-02	-1.50E-01	-8.96E-04	2.30E-02
Np-237	76	26	75	2.88E-02	-1.74E-02	-1.04E-03	6.44E-03
Pb-210	76	26	0	1.27E+00	1.14E-01	4.37E-01	2.70E-01
Pu-238	77	26	60	3.61E-02	-2.32E-02	2.83E-03	6.88E-03
Pu239/240	77	26	69	3.79E-02	-1.08E-02	1.99E-03	6.89E-03
Pu-241	77	26	70	5.48E-01	-9.26E-01	1.86E-03	2.30E-01
Pu-242	76	26	72	2.65E-02	-2.58E-02	1.14E-03	7.53E-03
Ra-226	78	26	53	3.90E-01	-1.57E-01	4.32E-02	8.08E-02
Ra-228	77	26	58	4.54E-01	-3.69E-01	4.01E-02	1.18E-01
Sr-90	76	26	45	1.64E-01	-6.64E-02	3.88E-02	4.63E-02
Tc-99	76	26	76	5.99E-01	-7.91E-01	-5.17E-02	3.13E-01
Th-228	76	26	69	2.09E-01	-6.70E-02	2.01E-02	4.61E-02
Th-230	77	26	37	4.48E-01	-5.11E-02	7.83E-02	1.03E-01
Th-232	77	26	62	1.05E-01	-2.97E-02	1.89E-02	2.78E-02
H-3	77	26	65	1.99E+00	-1.40E-01	5.86E-02	2.34E-01
U-233/234	76	26	51	9.05E-02	-2.40E-02	1.24E-02	1.79E-02
U-235/236	76	26	60	4.09E-02	-1.19E-02	5.15E-03	9.23E-03
U-238	76	26	51	4.97E-02	-1.52E-02	1.09E-02	1.21E-02

*L_c estimated as half of MDC.

Naturally occurring radionuclides detected in these data include: Carbon-14, Lead-210, Radium-226, Radium-228, Thorium-228, Thorium-230, Thorium-232, Tritium, Uranium-234, Uranium-235 and Uranium-238. The concentrations of these radionuclides are consistent with expected natural background.

Cesium-137 and Strontium-90 were measured in vegetation at levels consistent with fallout from nuclear weapons testing in vegetation.

The routine vegetation grid results for Americium-241, Cobalt-60, Plutonium-238, Plutonium-239/240, Plutonium-241, and Plutonium-242 have a higher than expected false positive rates. Based upon the critical level, there should be a five percent false positive rate for these constituents. It should be noted that the critical values were estimated as one-half of the MDC. All routine vegetation results for Americium-241, Cobalt-60, and Plutonium-241 results were below the MDC. Six Plutonium-238 routine vegetation results were greater than the MDC, and two Plutonium-239/240 routine vegetation results were above the MDC. Low background counts can lower estimated values of the critical level and MDC. Currently the laboratory background and method of calculating critical levels are under investigation to ensure that more accurate values of critical levels are provided in the future.

Table 7-4: Routine Vegetation Monitoring Results, Non-Radiological Analytes, Vegetation Samples, Low Level Pre-Operational Monitoring Program.

Analyte	Units	Observations	No. of Stations	< PQL	Max. Value	Min. Value	Mean Value*	Standard Dev.*
Arsenic	µg/Kg	83	26	82 (26 J flags)	3030	<432	612.9	618.8
Barium	µg/Kg	8	4	0	33700	1490	11970	10185
Cadmium	µg/Kg	83	26	83 (48 J flags)	404 J	<86.4	120.5	86.8
Chromium	µg/Kg	8	4	8 (5 J flags)	356 J	<139	167.9	100.5
Cobalt	µg/Kg	8	4	8 (1 J flag)	256 J	<132	94.5	65.3
Nickel	µg/Kg	83	26	70 (41 J flags)	4380	<133	322.8	513.6
Selenium	µg/Kg	83	26	83 (21 J flags)	1680 J	<439	429.0	350.4
Zinc	µg/Kg	8	4	0	17700	6700	11289	3670
1,4-Dioxane	µg/Kg	83	26	80	5260	<195	N/A	N/A
Benzyl alcohol	µg/Kg	8	4	8 (1 J flag)	505 J	<298	N/A	N/A
bis(2-Chloroethyl) ether	µg/Kg	8	4	8 (1 J flag)	303 J	<198	N/A	N/A
Phenol	µg/Kg	83	26	83 (1 J flag)	861 J	<195	N/A	N/A
1,1,1-Trichloroethane	µg/Kg	83	26	83	<30	<15	N/A	N/A
1,1,2,2-Tetrachloroethane	µg/Kg	83	26	83	<30	<15	N/A	N/A
1,1,2-Trichloroethane	µg/Kg	83	26	83	<30	<15	N/A	N/A
1,1-Dichloroethane	µg/Kg	83	26	83	<30	<15	N/A	N/A
1,1-Dichloroethylene	µg/Kg	83	26	83	<30	<15	N/A	N/A
1,2-Dichloroethane	µg/Kg	83	26	83	<30	<15	N/A	N/A
1,2-Dichloropropane	µg/Kg	83	26	83	<30	<15	N/A	N/A
4-Isopropyltoluene	µg/Kg	8	4	4 (1 J flag)	3500	<30	N/A	N/A
Acetone	µg/Kg	83	26	82 (11 J flags, 6 BJ flags, 19 B flags)	915	<83	N/A	N/A
Benzene	µg/Kg	83	26	83	<30	<15	N/A	N/A
Bromodichloromethane	µg/Kg	83	26	83	<30	<15	N/A	N/A
Bromoform	µg/Kg	83	26	83	<30	<15	N/A	N/A
Bromomethane	µg/Kg	83	26	83	<30	<15	N/A	N/A
Carbon disulfide	µg/Kg	83	26	83	<30	<15	N/A	N/A
Carbon tetrachloride	µg/Kg	83	26	83	<30	<15	N/A	N/A
Chlorobenzene	µg/Kg	83	26	83	<30	<15	N/A	N/A
Chloroethane	µg/Kg	83	26	83	<30	<15	N/A	N/A
Chloroform	µg/Kg	83	26	83	<30	<15	N/A	N/A

Analyte	Units	Observations	No. of Stations	< PQL	Max. Value	Min. Value	Mean Value*	Standard Dev.*
Chloromethane	µg/Kg	83	26	83	<30	<15	N/A	N/A
cis-1,3-Dichloropropylene	µg/Kg	83	26	83	<30	<15	N/A	N/A
Dibromochloromethane	µg/Kg	83	26	83	<30	<15	N/A	N/A
Ethylbenzene	µg/Kg	83	26	83	<30	<15	N/A	N/A
Tetrachloroethylene	µg/Kg	83	26	83	<30	<15	N/A	N/A
Toluene	µg/Kg	83	26	79 (21 J flags)	168	<15	N/A	N/A
trans-1,2-	µg/Kg	83	26	83	<30	<15	N/A	N/A
trans-1,3-	µg/Kg	83	26	83	<30	<15	N/A	N/A
Trichloroethylene	µg/Kg	83	26	83	<30	<15	N/A	N/A
Vinyl chloride	µg/Kg	83	26	83	<30	<15	N/A	N/A

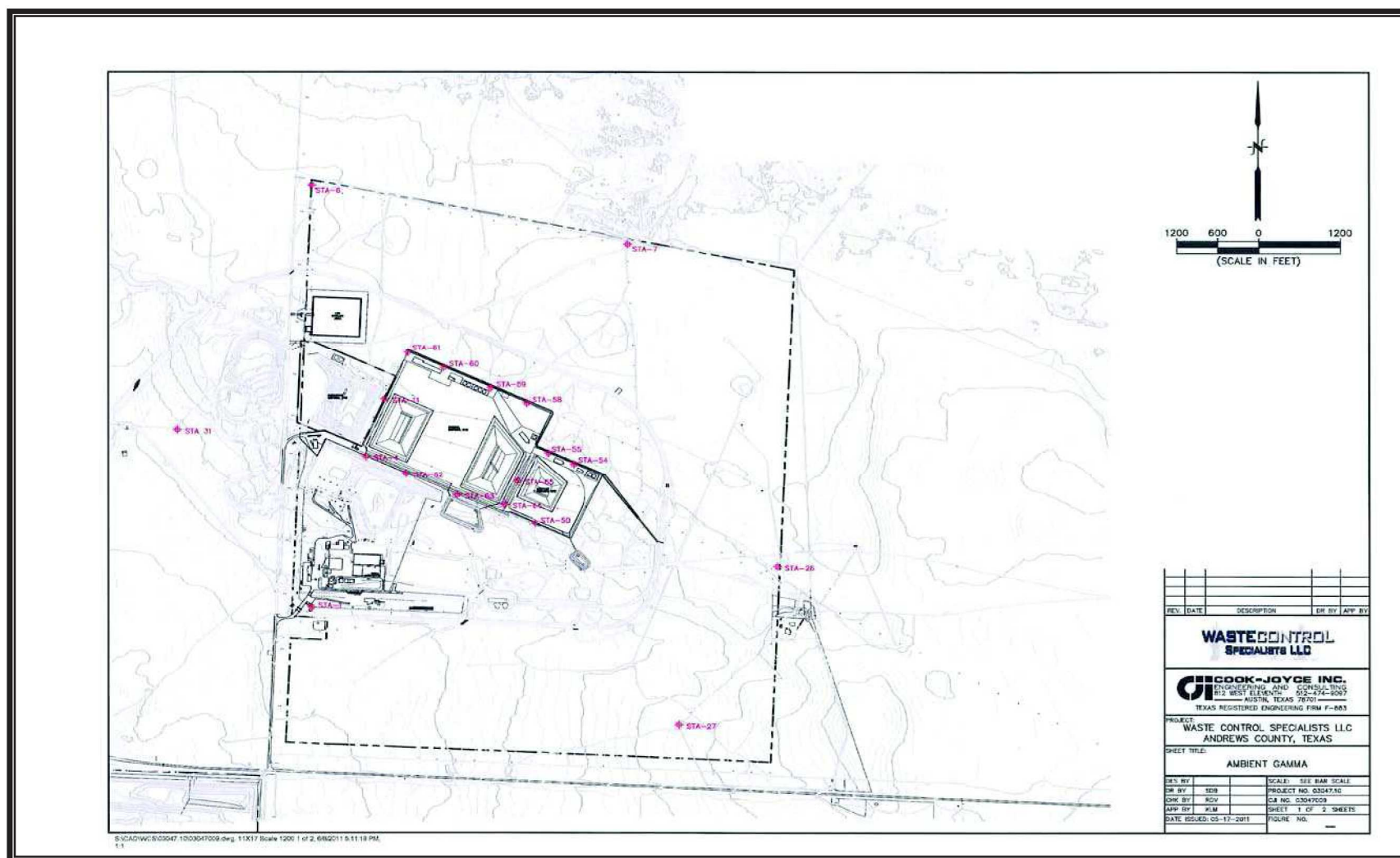
A number of non-radiological metals were also reported in vegetation samples. These detections included 2 quantified concentrations (above the PQL) of nickel and a number of estimated concentrations of arsenic, cadmium, nickel, and selenium. These concentrations are considered natural background for the area.

Based on WCS's data validation procedures, there were also false positives reported in this data set. The chemical false positives include multiple acetone, toluene, and 4-isopropyltoluene detections. The vast majority of these detections are estimated concentrations (J-flags). WCS considers these detections to be either sampling or laboratory artifacts.

8.0 Ambient Radiation

As part of the pre-operational monitoring program, ambient radiation monitoring was conducted at locations in and near the LLRW facility. There are nineteen OSL/TLD environmental monitoring stations associated with the LLRW facility. The locations of the TLD and OSL environmental monitoring stations are displayed in Figure 8-1.

Ambient radiation is monitored using optically stimulated luminescent dosimeters (OSL) and thermoluminescent dosimeters (TLD). These dosimeters are placed one meter above the ground. TLDs and OSLs are exchanged on a quarterly basis and are handled in accordance with approved procedures. Transit and deployment control dosimeters are maintained in a shielded storage box. The dosimeters are shipped to an off-site laboratory (Landauer) for analysis and processing within two days of collection.



Tables 8-1 and 8-2 contain results for OSLs and TLDs respectively. For comparison, the total annual dose from ambient background radiation for Calendar Year 2010 as measured with an OSL at the WCS office in Andrews was 20 mrem.

Table 8-1: OSL Direct Gamma Results (mrem).

Station	4th Quarter 09	1st Quarter 10	2nd Quarter 10	3rd Quarter 10	4th Quarter 10	1st Quarter 11
1	M	M	1	M	1	2
4	2	3	6	1	6	6
6	1	4	4	M	3	6
7	M	M	1	M	1	2
8	M	3	3	M	3	M
9	M	M	2	M	M	2
11	6	2	5	M	4	3
19	4	4	4	M	2	5
26	1	3	4	M	1	2
27	M	M	4	M	3	4
31	M	2	4	M	4	3
50	M	2	2	M	3	1
51	M	3	3	M	2	Damaged
52	M	M	4	M	3	4
54	M	1	2	M	4	4
55	1	3	7	M	6	4
56	1	1	2	M	3	1
58	M	1	5	M	2	3
59	M	3	5	M	2	2
60	2	2	4	M	2	1
61	19	3	4	M	4	3
62	1	1	3	M	M	2
63	M	1	2	M	4	3
64	1	2	4	M	4	M
65	M	3	1	M	2	1

Landauer processes OSLs and only reports results greater than Minimal Detectable Level. Results that are less than minimal detectable level (1 mrem) are reported with an 'M'.

Table 8-2: TLD Direct Gamma Results (mrem).

Station	4th Quarter 09	1st Quarter 10	2nd Quarter 10	3rd Quarter 10	4th Quarter 10	1st Quarter 11
7	1.4	2	2.7	1.8	2.6	2
31	5.1	3.8	3.8	7.7	6.8	2.2
55	5	2.4	6.1	8.6	5.1	5.3
59	11.3	2.5	2	7	6.2	6.2

The fourth quarter 2009 result for station 61 was the highest with a reading of 19 mrem. This results was likely influenced by the storage of the Fernald Canisters on the Low Specific Activity (LSA) pad prior to their placement in the Byproduct Material Landfill. Station 61 is adjacent to the LSA pad. With the exception of Station 61, the results for both TLDs and OSL are consistent with natural background levels.

9.0 Air Radon Monitoring

Radon monitoring was conducted at locations within and adjacent to the LLRW facility during the pre-operational monitoring period. There are nineteen environmental radon monitoring stations associated with the LLRW facilities. Figure 9-1 contains a map of these environmental radon monitoring stations.

Radon is monitored by the use of Track-Etch detectors that are handled in accordance with approved procedures. The Track-Etch detectors are changed out quarterly and shipped within three days of collection to an off-site laboratory for analysis.



Figure 9-1: Radon Monitoring Locations

The radon monitoring results measured at the LLRW Facility for the pre-operational periods are presented in Table . These results are consistent with typical background concentrations at the site. The fourth quarter 2009 radon track-etch results were unable to achieve a sufficient Minimum Detectable Concentration (MDC) due to insufficient deployment lengths of the track-etch cartridges. All of the fourth quarter 2009 results were below the MDC. Sample results are presented in Table 9-1.

Table 9-1: Radon Track-Etch Results (pCi/m³ ± 2σ).

Station	Quarter 4 (2009)	IL%	Quarter 1 (2010)	IL%	Quarter 2 (2010)	IL%	Quarter 3 (2010)	IL%	Quarter 4 (2010)	IL%	Quarter 1 (2011)	IL%
1	700±80*	23.33%	300±50*	10.00%	300±40*	10.00%	500±70	16.67%	700±70	23.33%	300±30*	10.00%
4	700±80*	23.33%	600±60	20.00%	1200±90	40.00%	1100±100	36.67%	900±90	30.00%	1100±100	36.67%
6	700±80*	23.33%	300±40*	10.00%	300±30*	10.00%	600±70	20.00%	900±80	30.00%	500±40	16.67%
9	700±80*	23.33%	300±40*	10.00%	300±30*	10.00%	500±60	16.67%	1100±90	36.67%	300±30*	10.00%
11	700±80*	23.33%	600±50	20.00%	300±30*	10.00%	500±60	16.67%	600±60	20.00%	700±50	23.33%
26	700±80*	23.33%	500±50	16.67%	600±50	20.00%	800±80	26.67%	500±60	16.67%	1200±110	40.00%
27	700±80*	23.33%	600±50	20.00%	400±40	13.33%	800±80	26.67%	900±90	30.00%	1100±100	36.67%
30	700±80*	23.33%	300±40*	10.00%	500±40	16.67%	800±80	26.67%	700±80	23.33%	600±70	20.00%
31	700±80*	23.33%	300±40*	10.00%	300±30*	10.00%	500±60	16.67%	500±60	16.67%	700±60	23.33%
50	700±80*	23.33%	400±40	13.33%	300±30*	10.00%	600±70	20.00%	800±80	26.67%	300±30*	10.00%
54	700±80*	23.33%	300±40*	10.00%	300±30*	10.00%	700±80	23.33%	800±80	26.67%	1400±120	46.67%
55	700±80*	23.33%	300±40*	10.00%	400±30	13.33%	700±80	23.33%	1000±90	33.33%	1200±110	40.00%
58	700±80*	23.33%	400±40	13.33%	300±30*	10.00%	700±70	23.33%	800±80	26.67%	1200±110	40.00%
59	700±80*	23.33%	400±40	13.33%	300±30*	10.00%	600±70	20.00%	600±60	20.00%	500±40	16.67%
60	700±80*	23.33%	400±40	13.33%	400±40	13.33%	600±70	20.00%	700±70	23.33%	800±60	26.67%
61	700±80*	23.33%	600±50	20.00%	300±30*	10.00%	700±80	23.33%	700±70	23.33%	700±50	23.33%
62	700±80*	23.33%	300±40*	10.00%	600±50	20.00%	700±80	23.33%	700±70	23.33%	1000±70	33.33%
63	700±80*	23.33%	300±40*	10.00%	300±30*	10.00%	600±70	20.00%	900±80	30.00%	700±50	23.33%
65	700±80*	23.33%	300±50*	10.00%	300±30*	10.00%	600±70	20.00%	700±70	23.33%	1500±120	50.00%

* Value less than MDC
Radon IL = 3,000 pCi/m³

10.0 Air

As part of the pre-operational monitoring program, air is sampled monthly at 19 locations. Figure 10-1 displays the air sample locations. These locations are sampled for air particulate, air tritium (silica gel), and air vapors (air cartridge).



Figure 10-1: Air Monitoring Locations

Air Particulate

High-volume air particulate samples were collected weekly, composited monthly, and sent to an offsite accredited laboratory for analysis in accordance with the pre-operational monitoring program. Table 10-1 contains summary statistics for the air particulate data. Figure 10-2 through Figure 10-27 graph the data in a time series.

Table 10-1: Radiological Summary Statistics for Air Particulate. (pCi/m3).

	Observations	Number of Stations	Below Lc*	Maximum	Minimum	Mean	Standard Deviation
Alpha	323	19	1	3.20E-03	1.51E-04	1.40E-03	5.79E-04
Am-241	323	19	291	1.31E-04	-1.11E-04	5.63E-10	2.67E-05
Beta	323	19	0	2.75E-02	7.09E-04	8.12E-03	3.17E-03
C-14	323	19	302	1.14E-02	-1.03E-02	-6.91E-04	2.98E-03
Cs-137	323	19	315	2.14E-04	-2.32E-04	4.12E-06	6.54E-05
Cr-51	323	19	309	3.26E-03	-2.66E-03	6.28E-07	9.69E-04
Co-60	323	19	308	1.90E-04	-2.47E-04	3.35E-06	6.81E-05
Cu-242	323	19	311	1.01E-04	-8.30E-05	8.27E-07	1.37E-05
Cu-243/244	323	19	301	1.74E-04	-1.86E-04	-3.95E-06	2.74E-05
I-129	323	19	307	2.38E-03	-3.49E-03	-1.51E-06	7.91E-04
Mn-54	323	19	319	1.69E-04	-1.81E-04	5.17E-06	5.69E-05
Np-237	323	19	309	1.20E-04	-1.98E-04	-9.64E-06	3.19E-05
Pb-210	323	19	0	1.17E-02	5.01E-04	5.39E-03	2.13E-03
Pu-238	323	19	225	1.81E-04	-8.31E-05	1.79E-05	3.73E-05
Pu239/240	323	19	265	1.49E-04	-2.83E-04	4.27E-06	3.76E-05
Pu-241	323	19	313	1.14E-02	-1.36E-02	-5.86E-04	2.65E-03
Pu-242	323	19	276	2.23E-04	-2.98E-04	1.12E-05	4.36E-05
Ra-226	323	19	28	3.42E-03	-1.90E-05	1.14E-04	2.03E-04
Ra-228	324	19	91	4.93E-03	-1.00E-04	1.64E-04	4.02E-04
Sr-90	323	19	243	1.74E-04	-7.96E-05	1.55E-05	3.99E-05
Tc-99	323	19	259	2.44E-02	-2.50E-02	1.06E-03	6.54E-03
Th-228	323	19	62	1.92E-04	-2.78E-05	4.93E-05	2.82E-05
Th-230	323	19	32	2.41E-04	-9.15E-06	5.87E-05	3.19E-05
Th-232	323	19	40	1.24E-04	-6.89E-06	4.50E-05	2.41E-05
U-233/234	323	19	0	5.46E-04	2.90E-05	1.28E-04	6.11E-05
U-235/236	323	19	143	3.88E-05	-6.46E-06	8.94E-06	7.95E-06
U-238	342	19	0	3.91E-04	3.84E-05	1.32E-04	5.75E-05

*Lc estimated as half of MDC.

Naturally occurring radionuclides detected in these samples include: Carbon-14, Lead-210, Radium-226, Radium-228, Thorium-228, Thorium-230, Thorium-232, Uranium-234, and Uranium-235. The concentrations of these radionuclides are consistent with natural background. The U-238 data from the months of January 2011 and February 2011 were elevated due to dust suspension associated with the start of construction at the site which began in early January. These samples were reanalyzed for U-238. The results of the reanalysis were consistent with the original results. Cesium-137 was measured in air particulate samples at levels consistent with fallout from nuclear weapons.

Since the critical level is established at the $\alpha = 0.05$ significance level, a 5% false positive rate is expected. The air particulate results for Americium-241, Plutonium-238, Plutonium-239/240, Plutonium-242, Strontium-90, and Technetium-99 have a higher than expected false positive rate. WCS suspects that these do not represent true false positives because the values are being compared against critical values that were estimated by WCS.

as one-half of the MDC. Because the false positive value is very close to the critical level, WCS suspects that if the data were compared against the true critical level that the false positive rate would approach 5%. As noted in Section 2, the critical levels were estimated values calculated as one-half of the MDC. If the background counts were extremely low, the estimated critical values would be artificially low. WCS is requesting documentation of background counts for these data from the analytical laboratory.

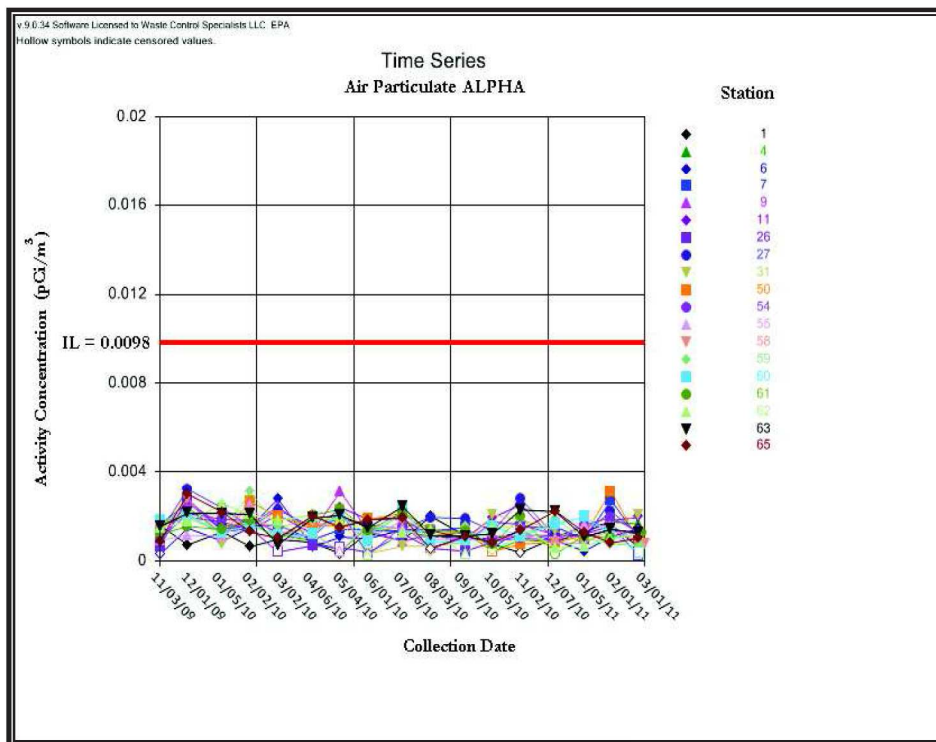


Figure 10-2: Alpha Air Particulate Results.

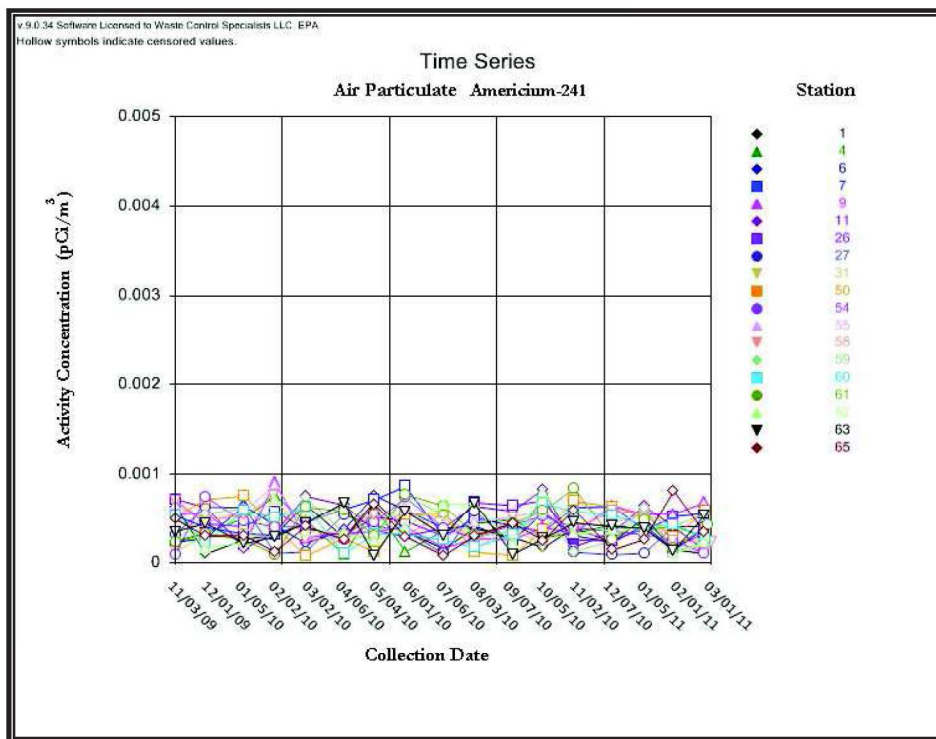


Figure 10-3: Americium-241 Air Particulate Results.

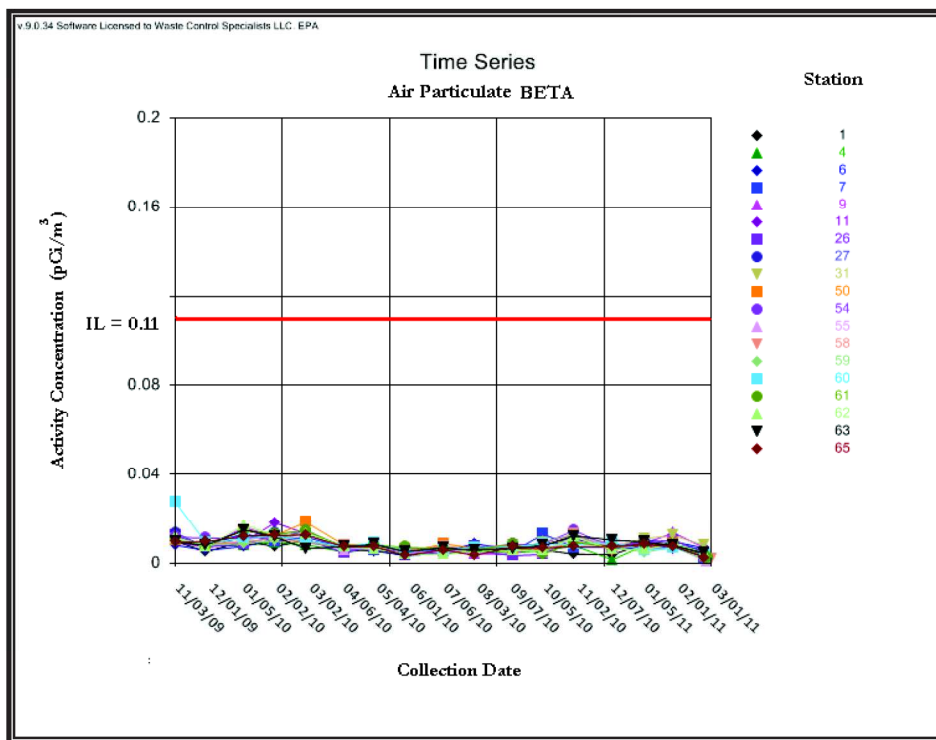


Figure 10-4: Beta Air Particulate Results.

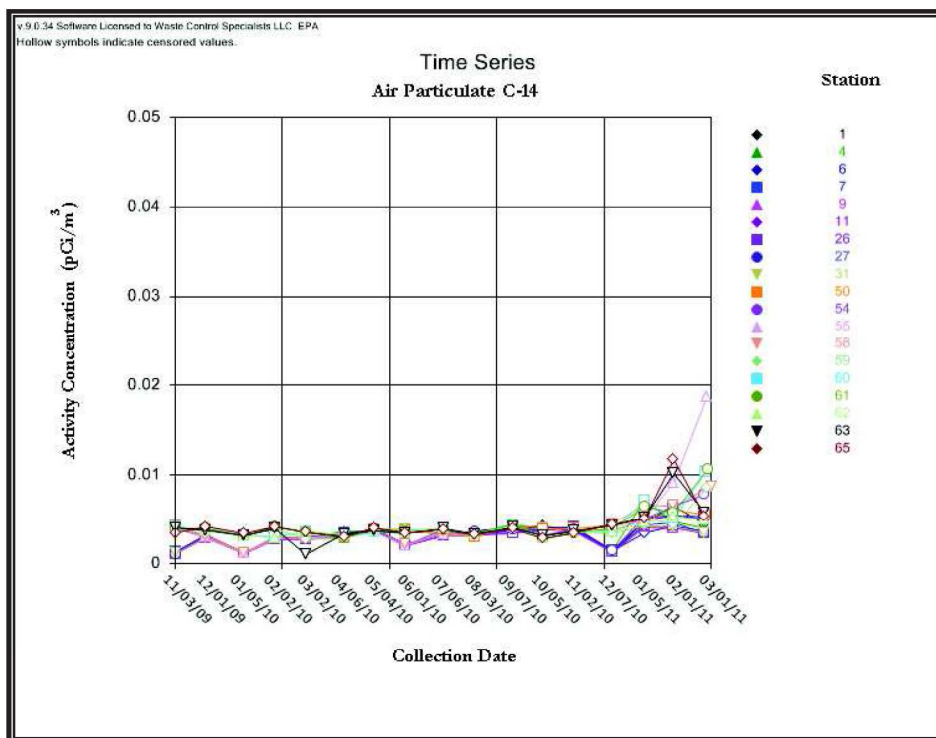


Figure 10-5: Carbon-14 Air Particulate Results.

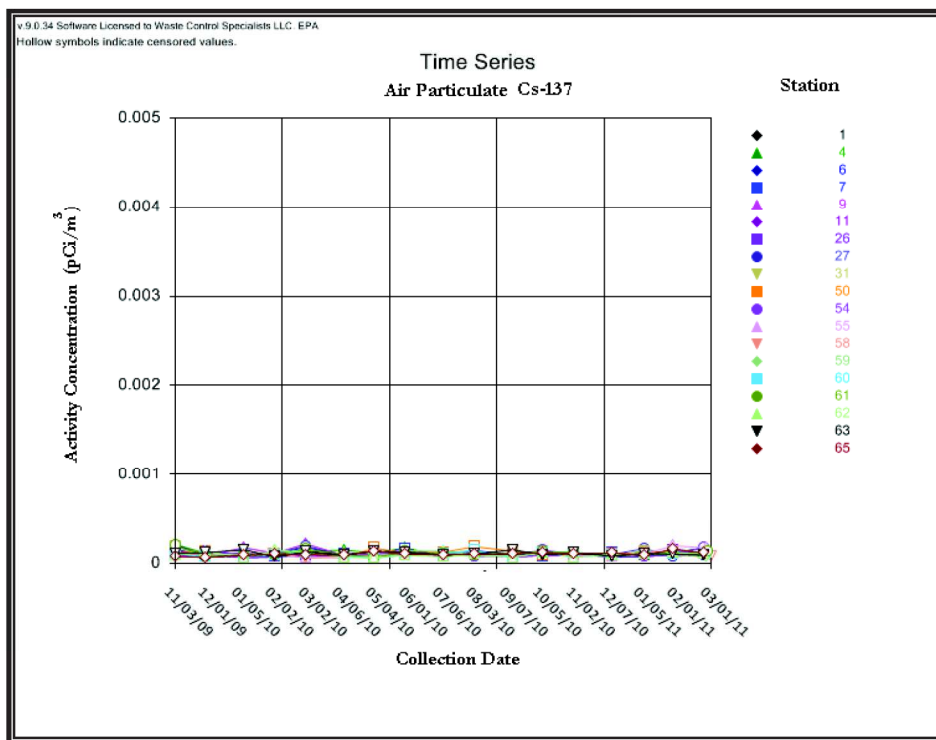


Figure 10-6: Cesium-137 Air Particulate Results.

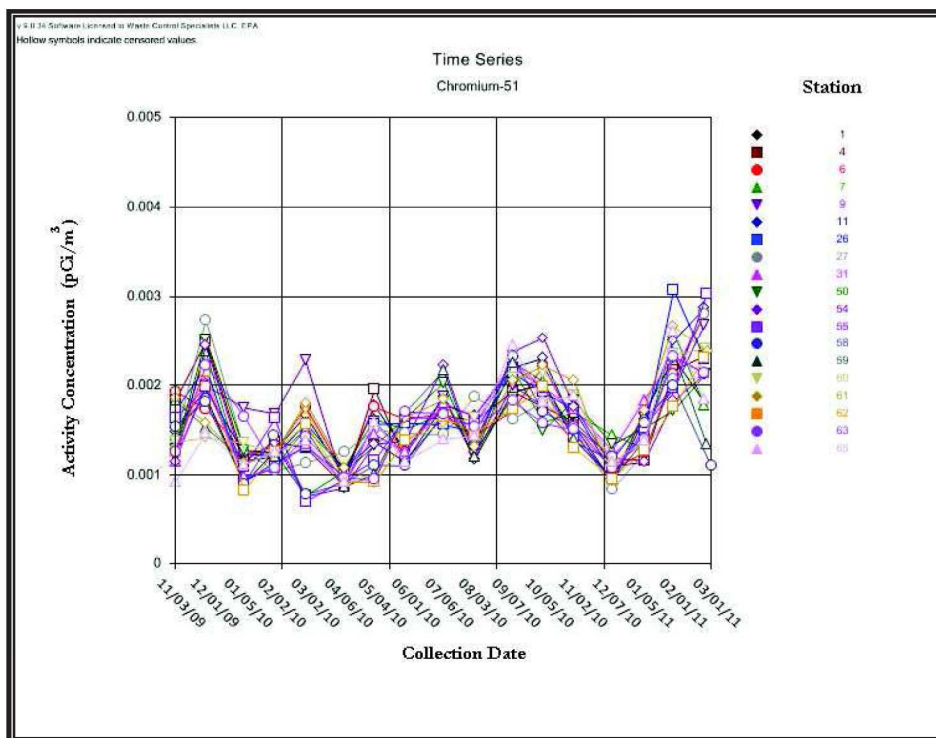


Figure 10-7: Chromium-51 Air Particulate Results.

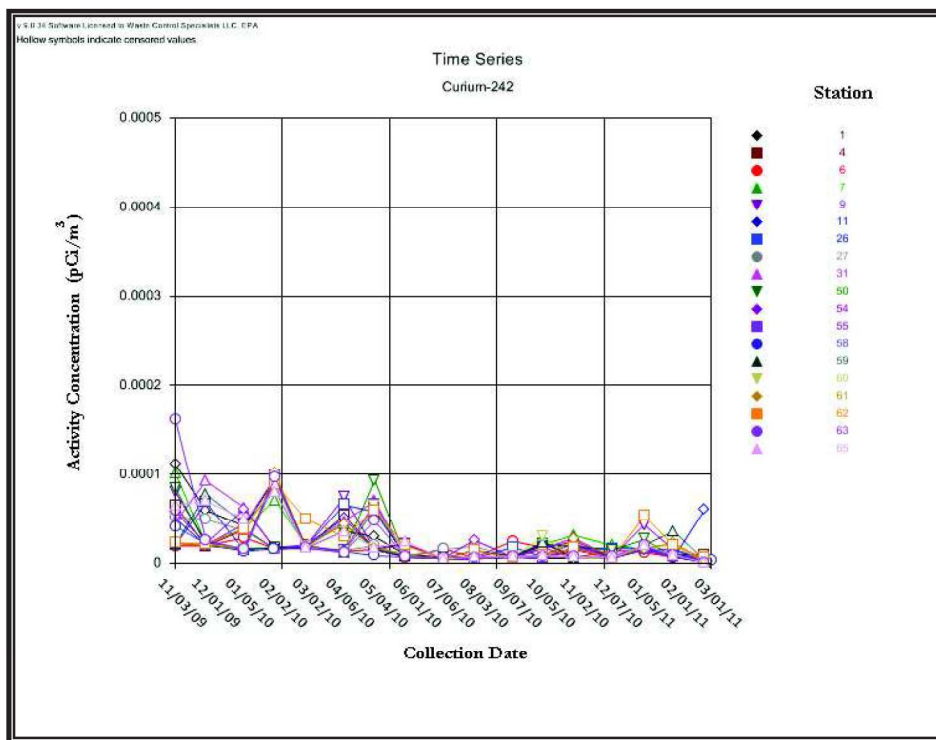


Figure 10-8: Curium-242 Air Particulate Results.

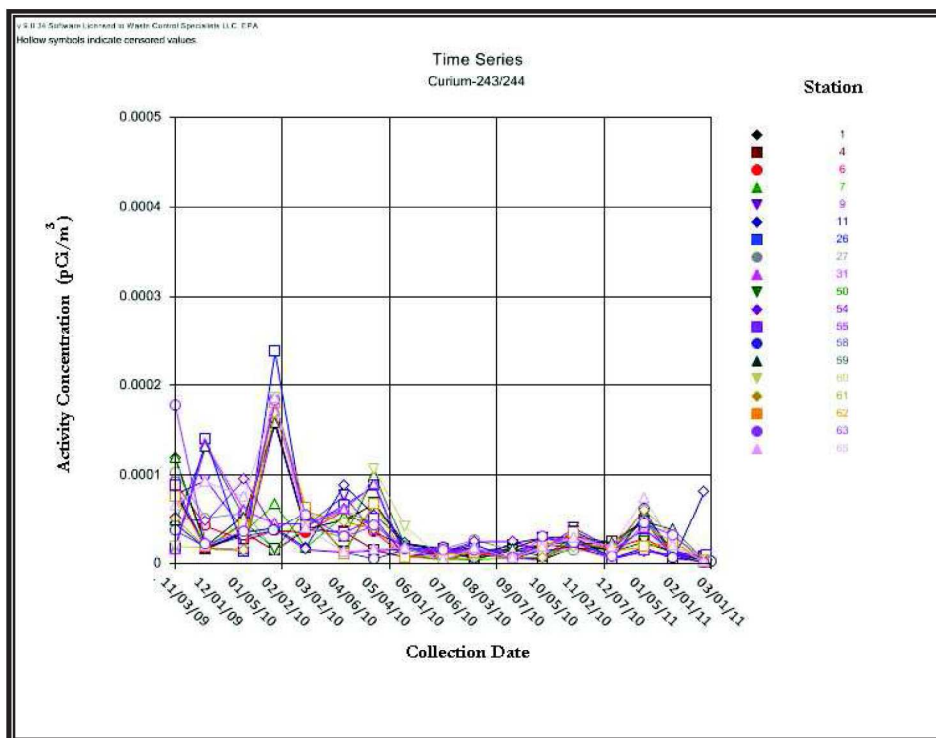


Figure 10-9: Curium-243/244 Air Particulate Results.

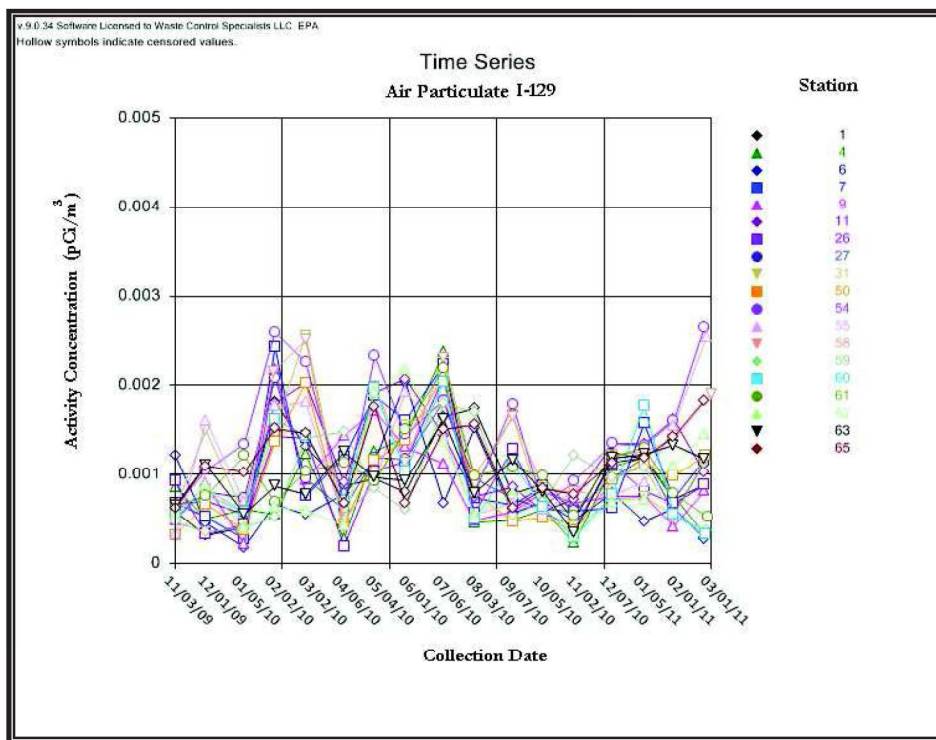


Figure 10-10: Iodine-129 Air Particulate Results.

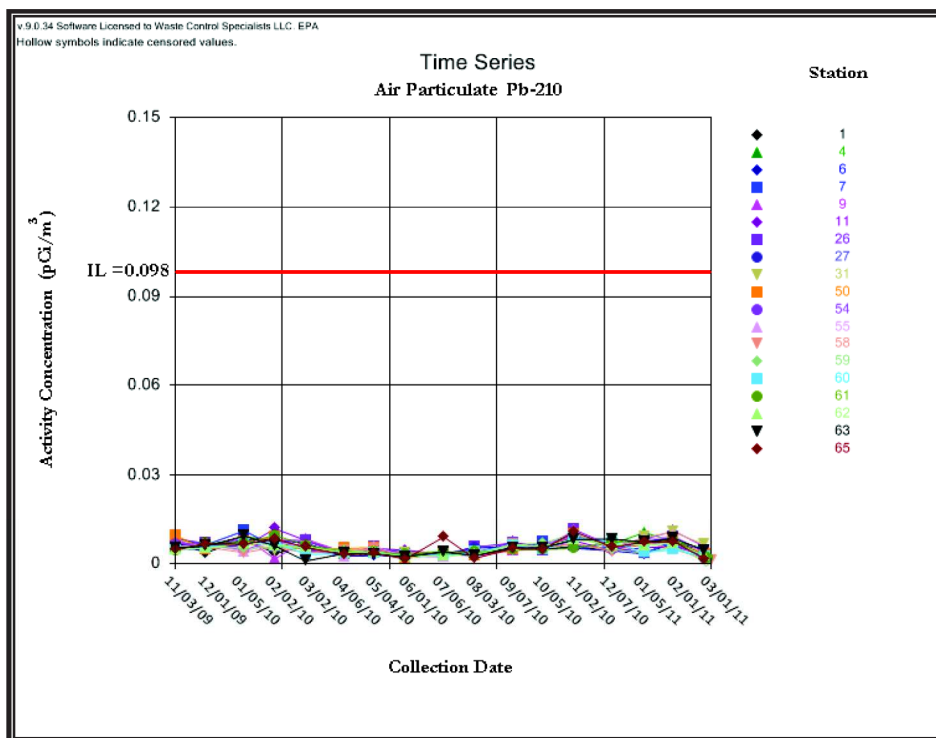


Figure 10-11: Lead-210 Air Particulate Results.

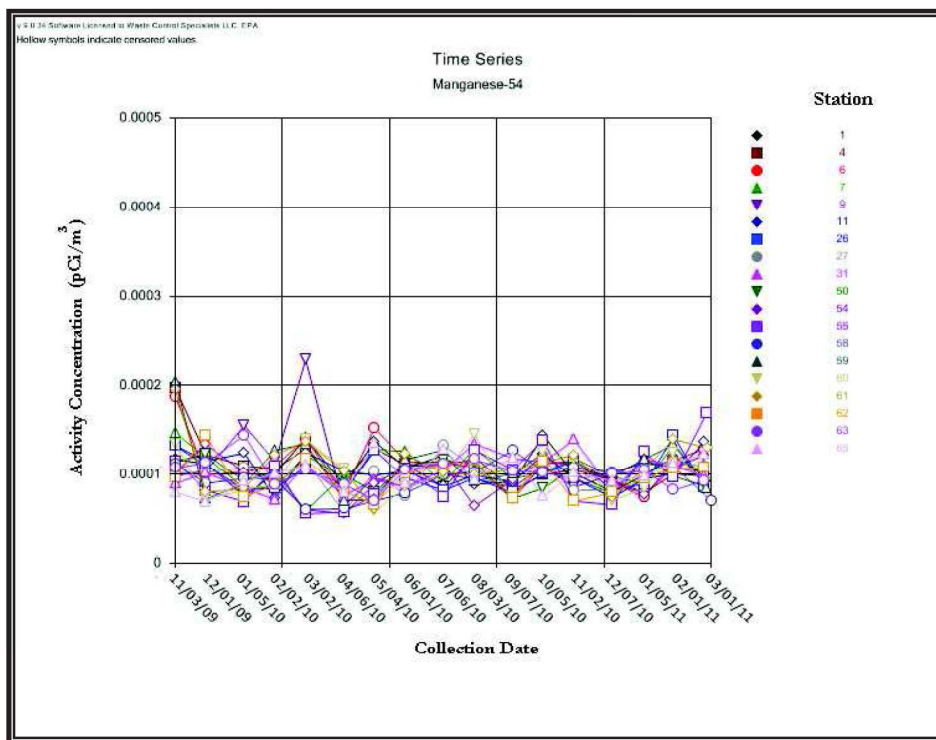


Figure 10-12: Manganese-54 Air Particulate Results.

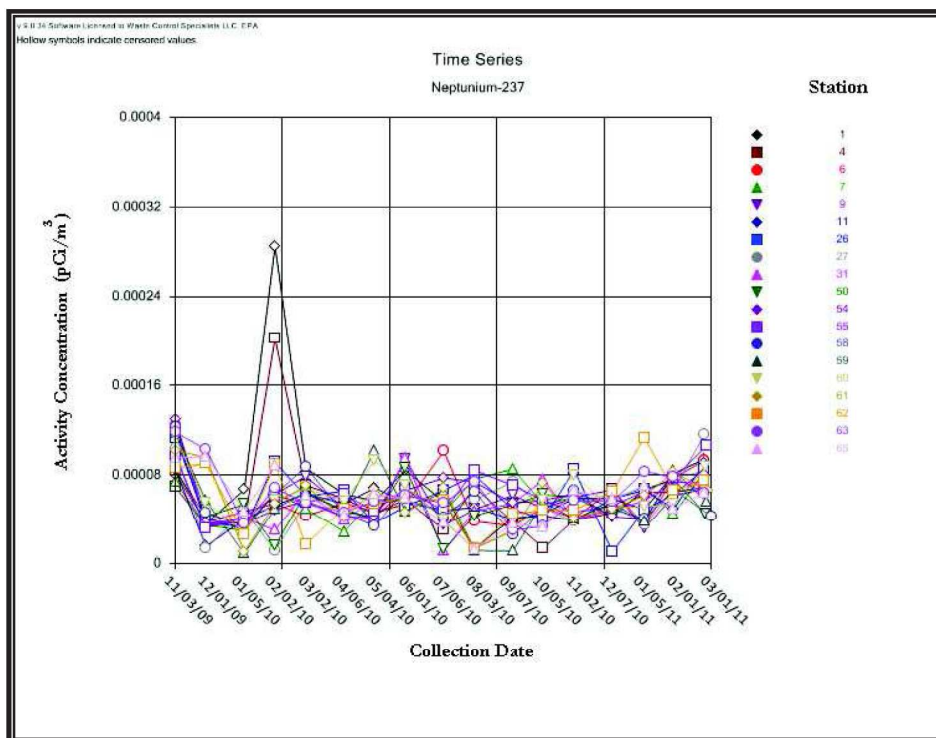


Figure 10-13: Neptunium-237 Air Particulate Results.

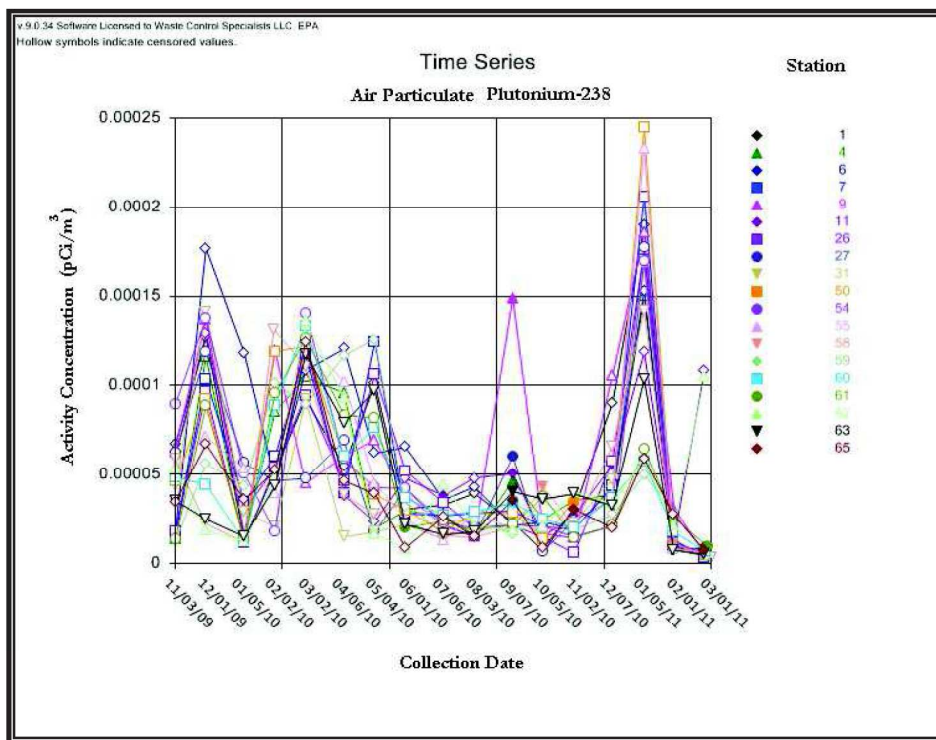


Figure 10-14: Plutonium-238 Air Particulate Results.

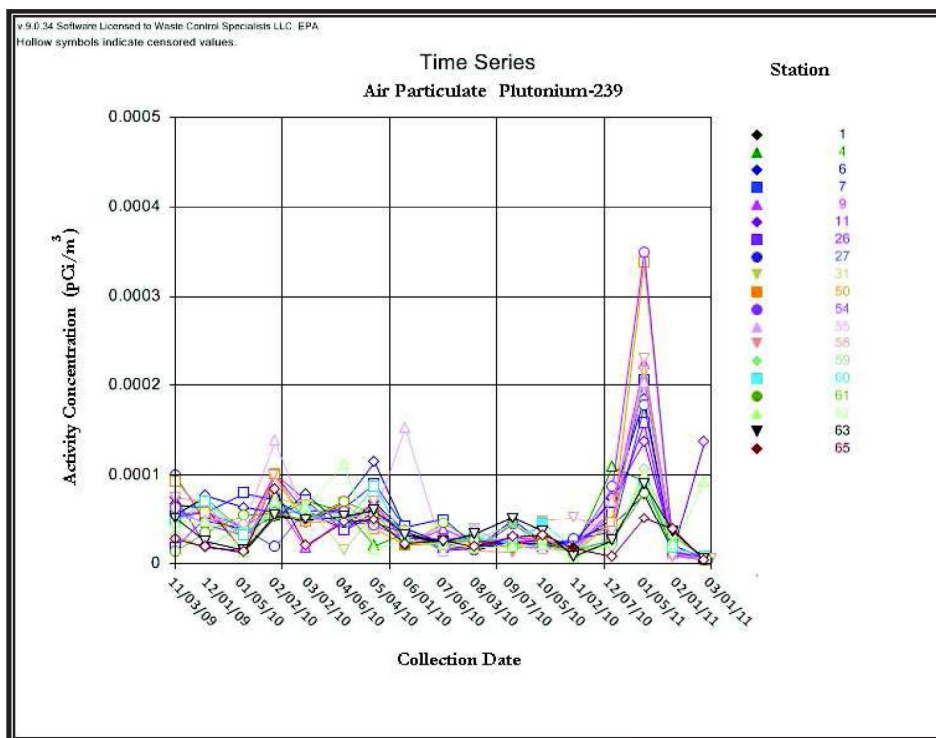


Figure 10-15: Plutonium-239 Air Particulate Results.

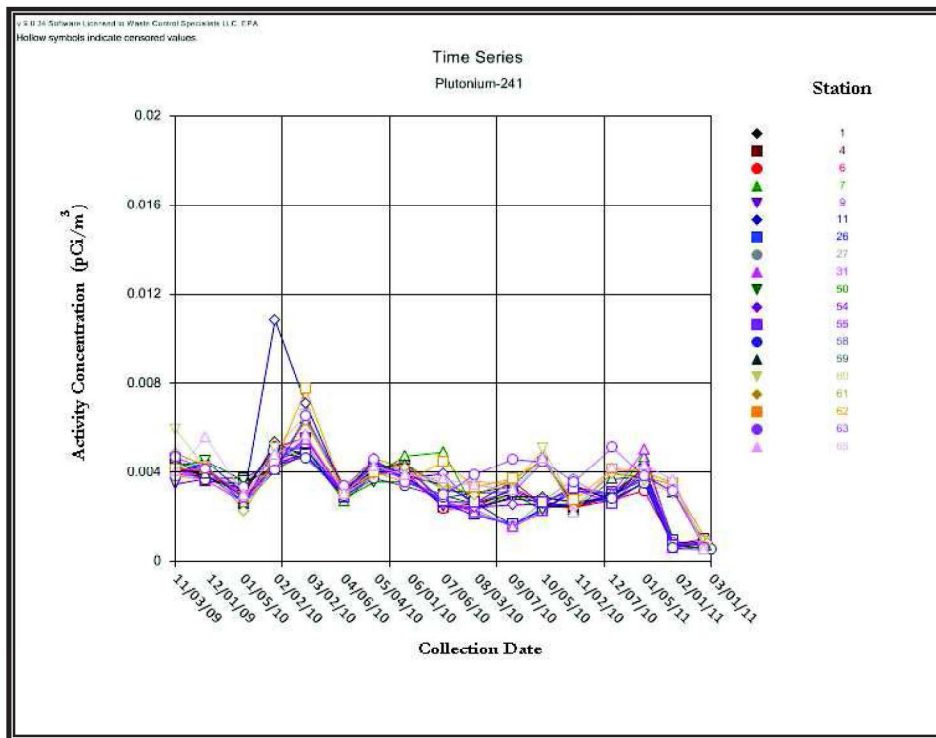


Figure 10-16: Plutonium-241 Air Particulate.

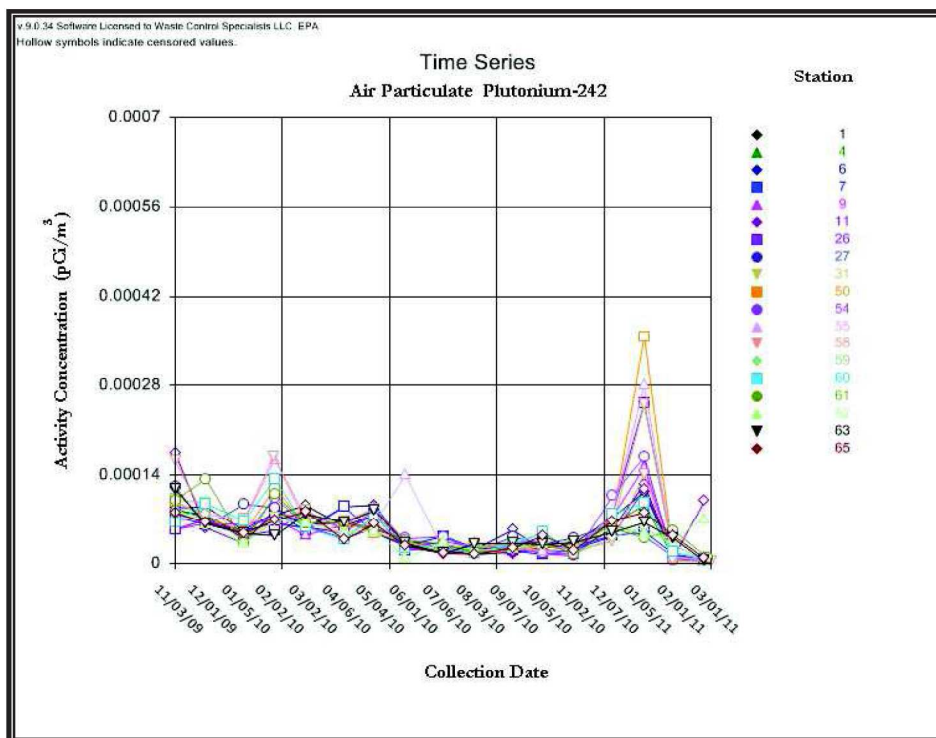


Figure 10-17: Plutonium-241 Air Particulate Results.

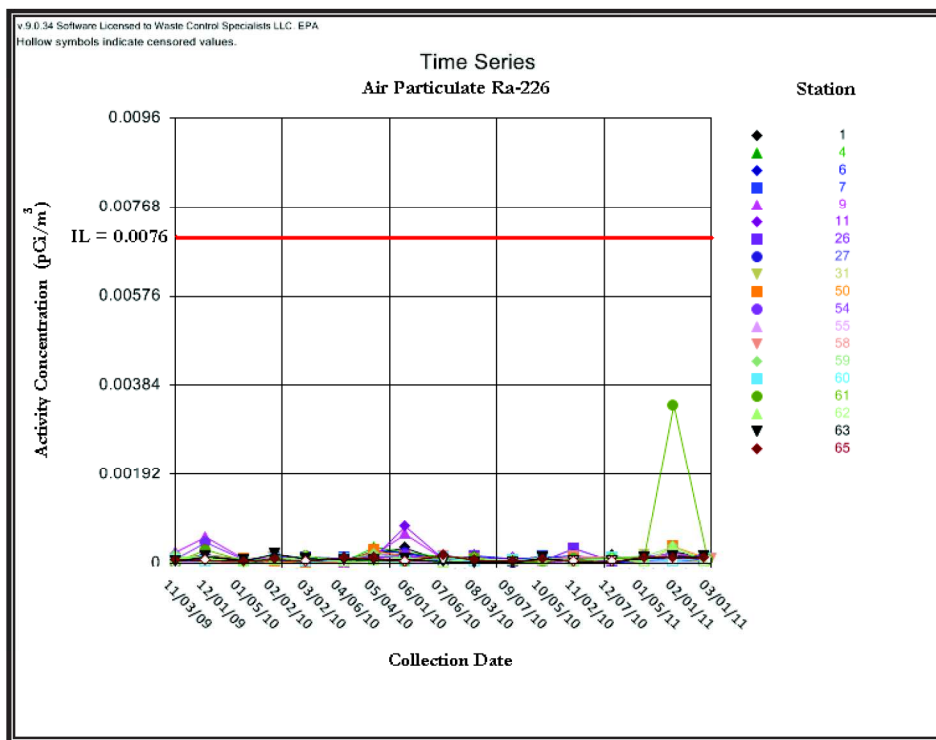


Figure 10-18: Radium-226 Air Particulate Results.

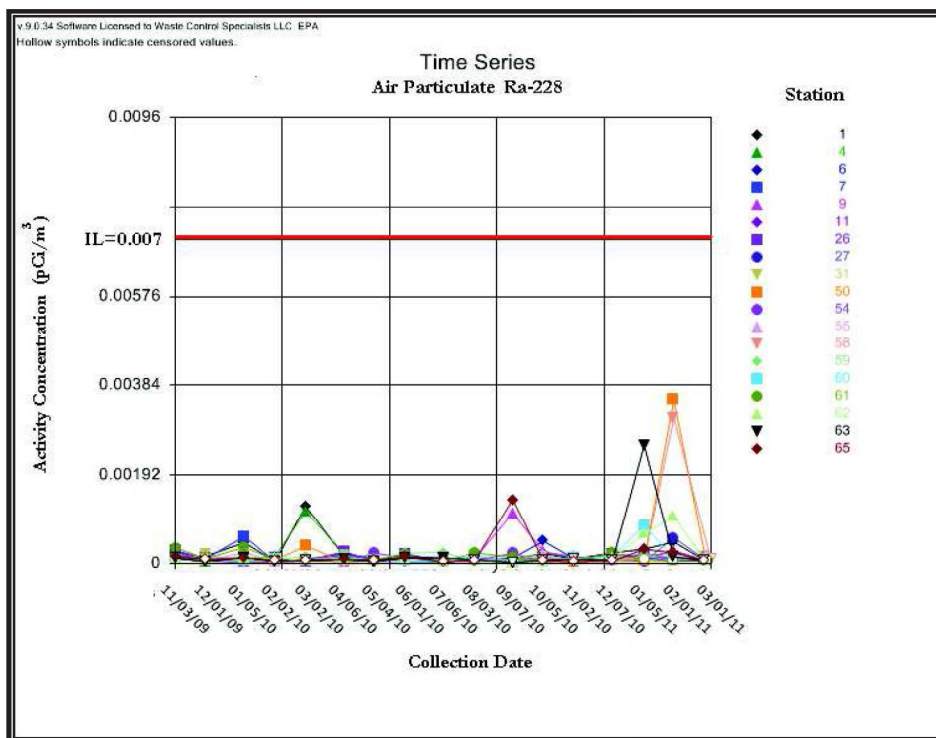


Figure 10-19: Radium-228 Air Particulate Results.

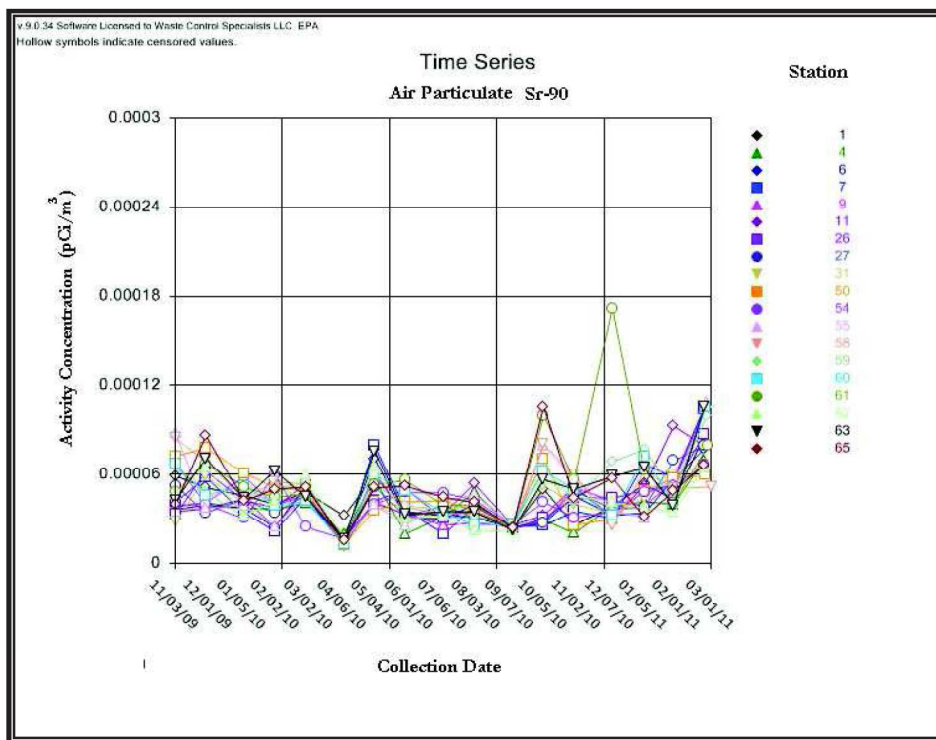


Figure 10-20: Strontium-90 Air Particulate Results.

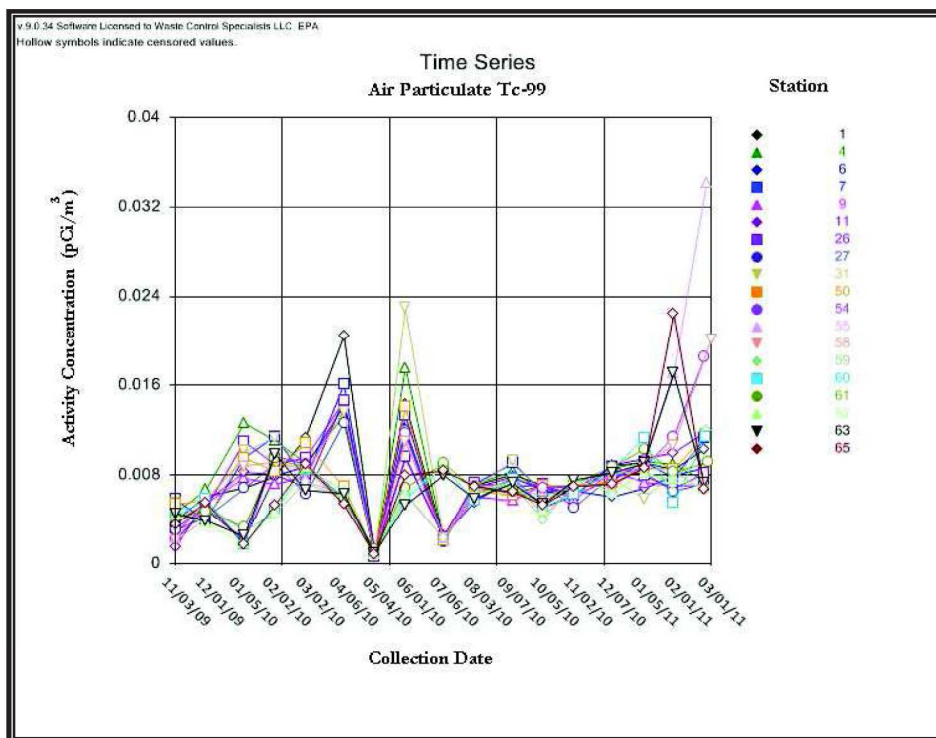


Figure 10-21: Technetium-99 Air Particulate Results.

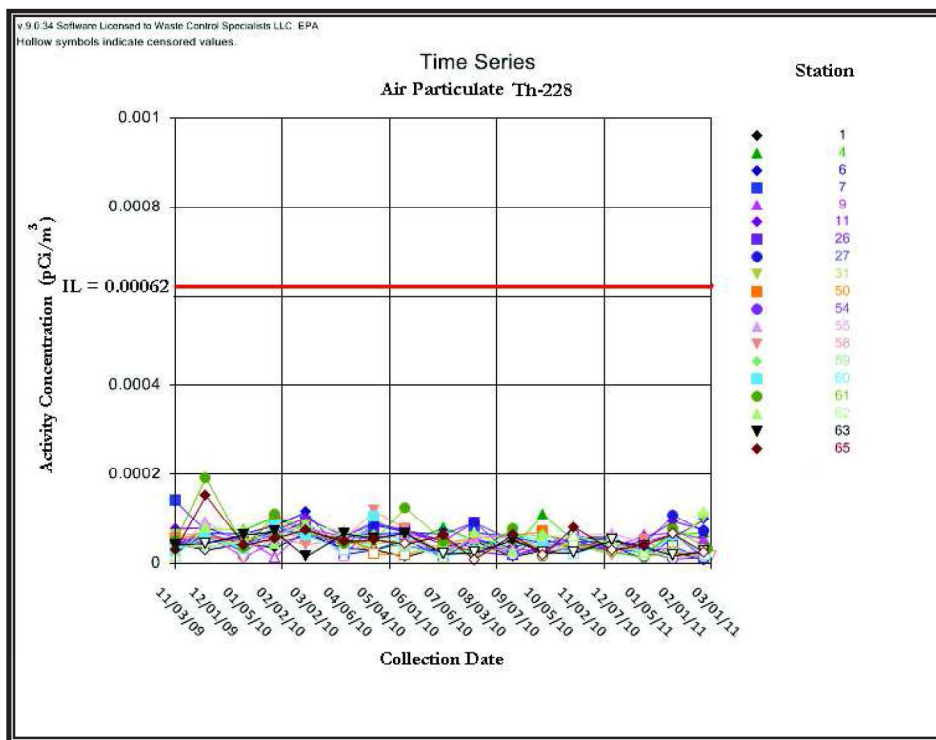


Figure 10-22: Thorium-228 Air Particulate Results.

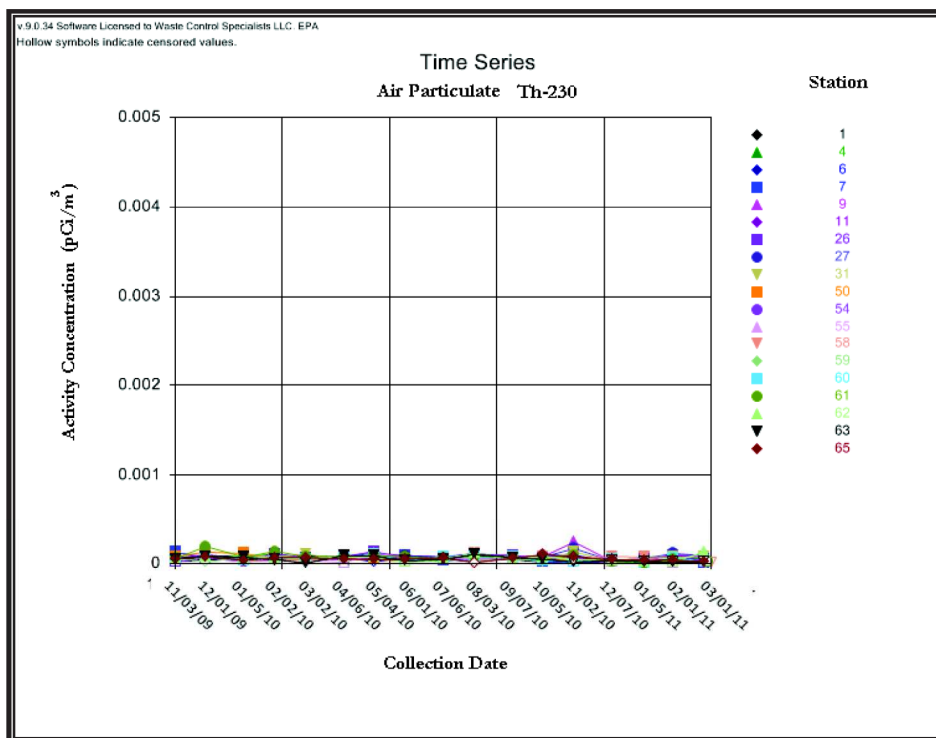


Figure 10-23: Thorium-230 Air Particulate Results.

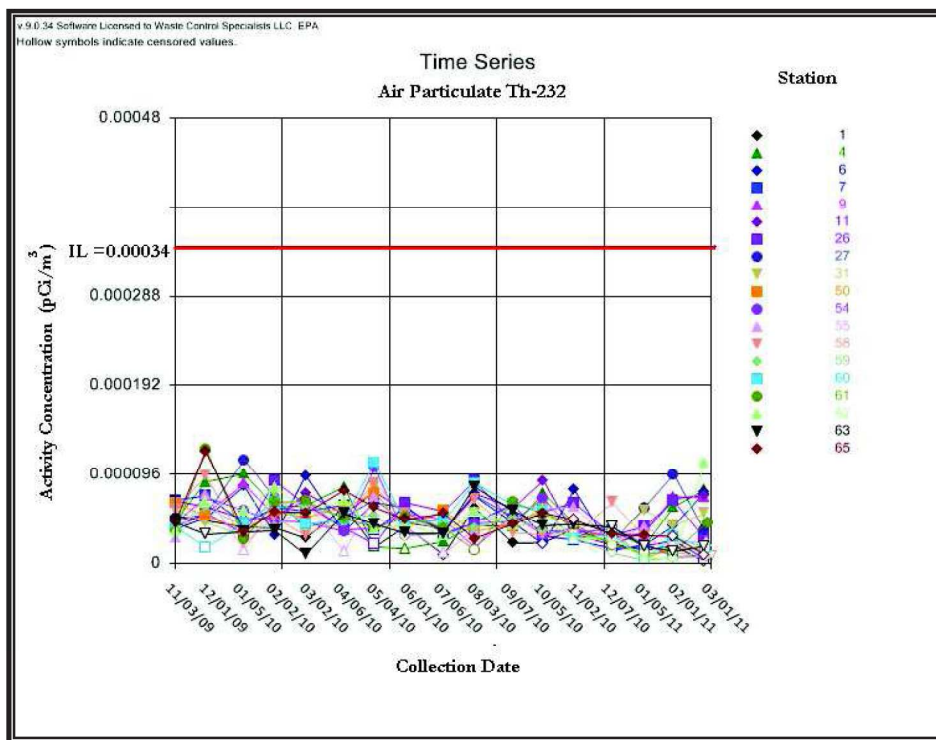


Figure 10-24: Thorium-232 Air Particulate Results.

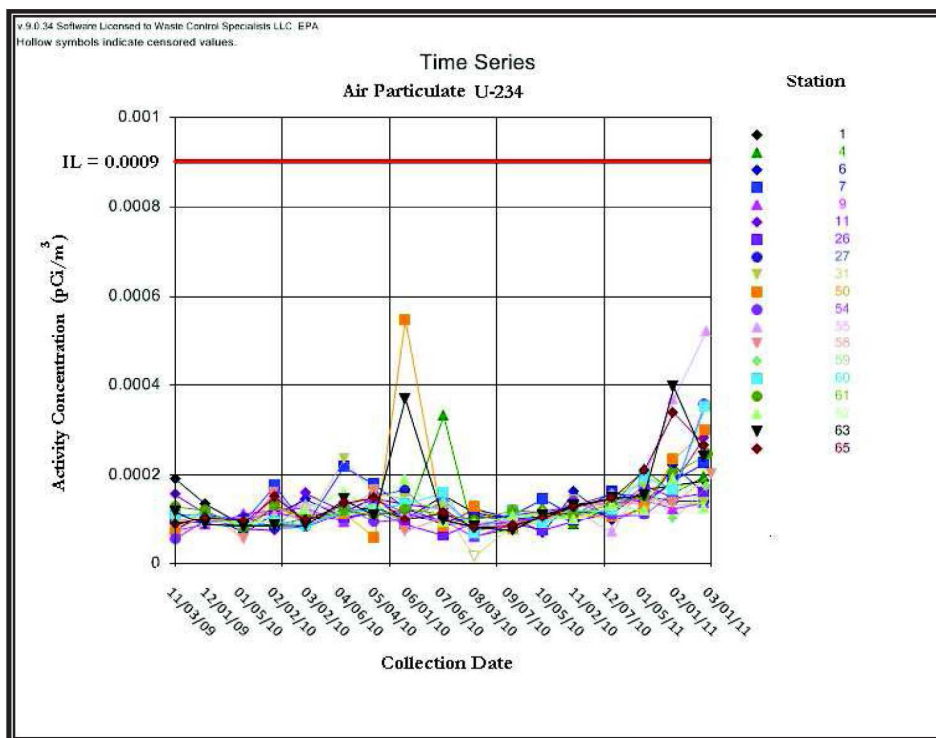


Figure 10-25: Uranium-234 Air Particulate Results.

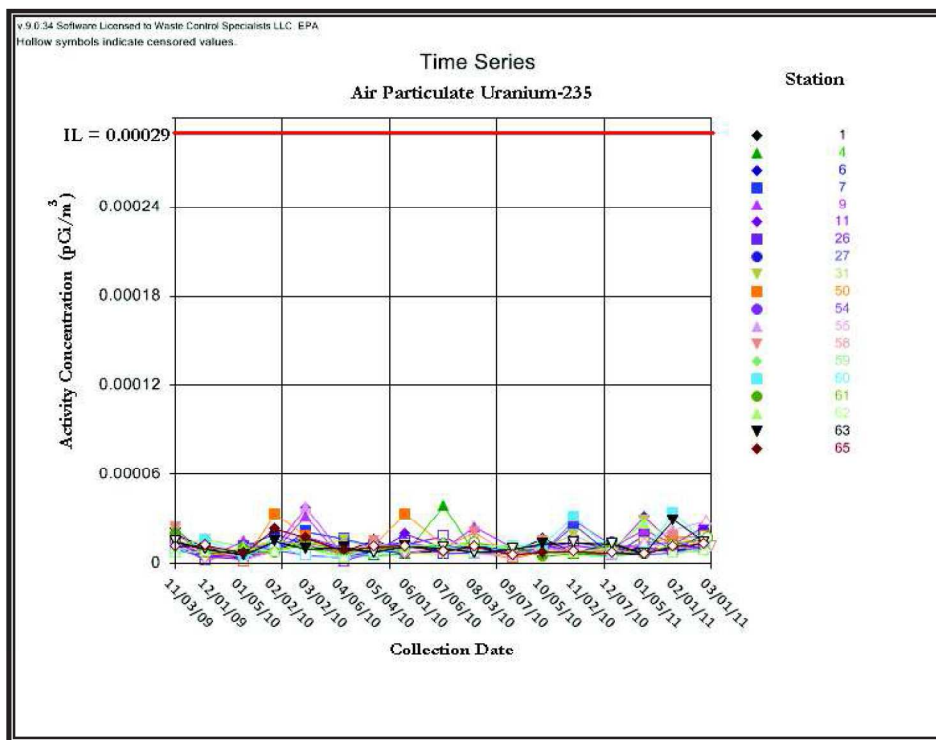


Figure 10-26: Uranium-235 Air Particulate Results.

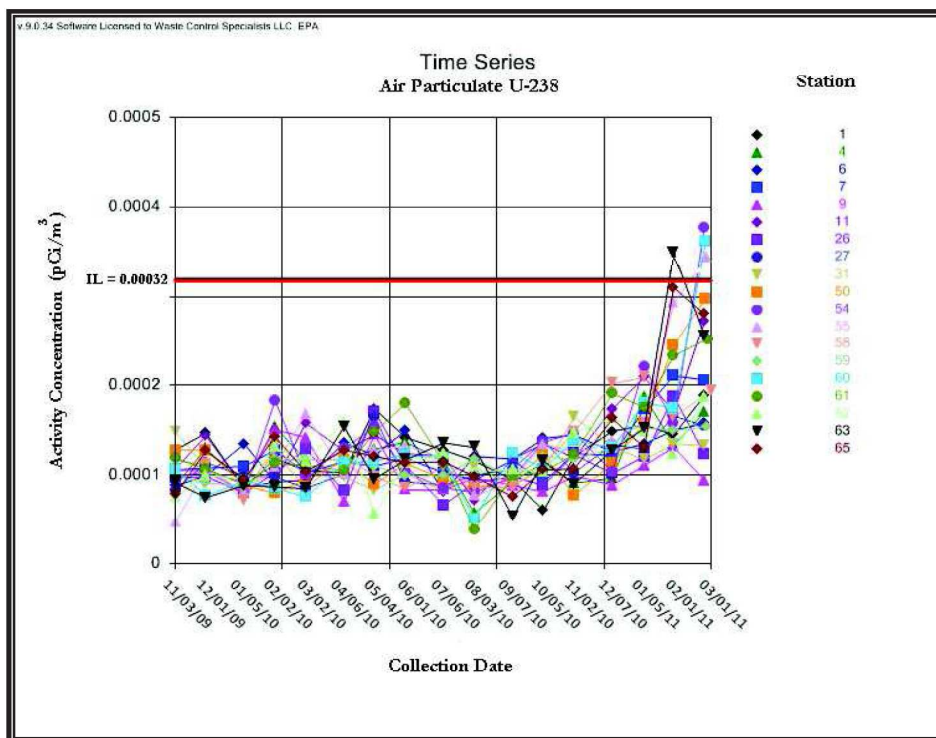


Figure 10-27: Uranium-238 Air Particulate Results.

Air Tritium

Air tritium samples were collected weekly, composited monthly, and sent to an offsite accredited laboratory for analysis in accordance with approved procedures. Table 10-2 contains summary statistics for the air tritium results and Figure 10-28 graphically depicts the data.

Table 10-2: Air Tritium Summary Statistics.

Number of Observations	353
Results Less Than Lc	225
Minimum Value	-21.3+/-21.2
Maximum Value	266+/-5.5
Mean Value	6.21
Standard Deviation	20.5

There were four spikes in the tritium pre-operational data. These tritium spikes are under investigation. The alternating spikes in air tritium data suggests possible contaminations of silica gel. No tritium bearing waste was processed at adjacent WCS facilities when the spikes occurred. Both the laboratory and field sampling will be examined to prevent such events in the future.

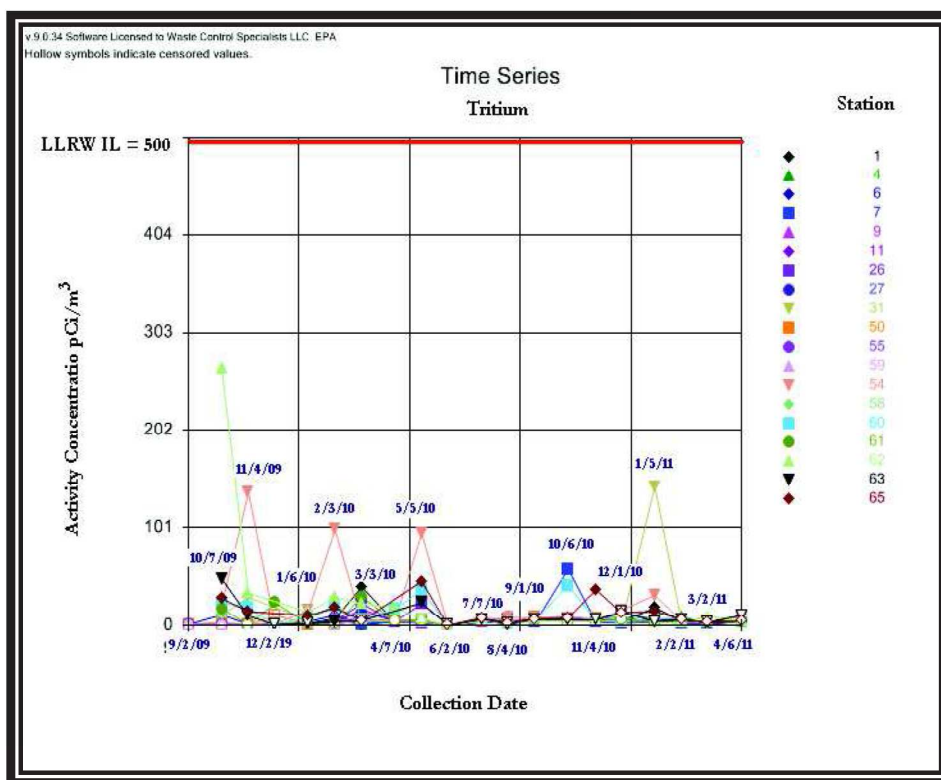


Figure 10-28: Air Tritium Results.

Air Cartridges

Air cartridge samples were collected weekly, composited monthly, and sent to an offsite accredited laboratory for analysis in accordance with approved procedures. Table 10-3 contains the results for air cartridge summary statistics for the pre-operational monitoring period. Figure 10-29, Figure 10-30 and Figure 10-31 graphically depict the air cartridge data with respect to time.

Table 10-3: Air Cartridge Summary Statistics (pCi/m³).

Parameter	No. of Station	Observations	Less than L _c *	Min Value	Max. Value	Mean	Standard Deviation σ
Carbon-14	19	361	361	0.00106	0.122	0.0439	0.0206
Iodine-129	19	361	361	0	0.00268	0.0013	0.000674
Krypton-85	19	361	361	0.00865	1.22	0.534	0.243

* Values of critical level are estimated as one-half of the MDC.

All air cartridge results for Carbon-14, Iodine-129, and Krypton-85 were below their estimated critical levels.

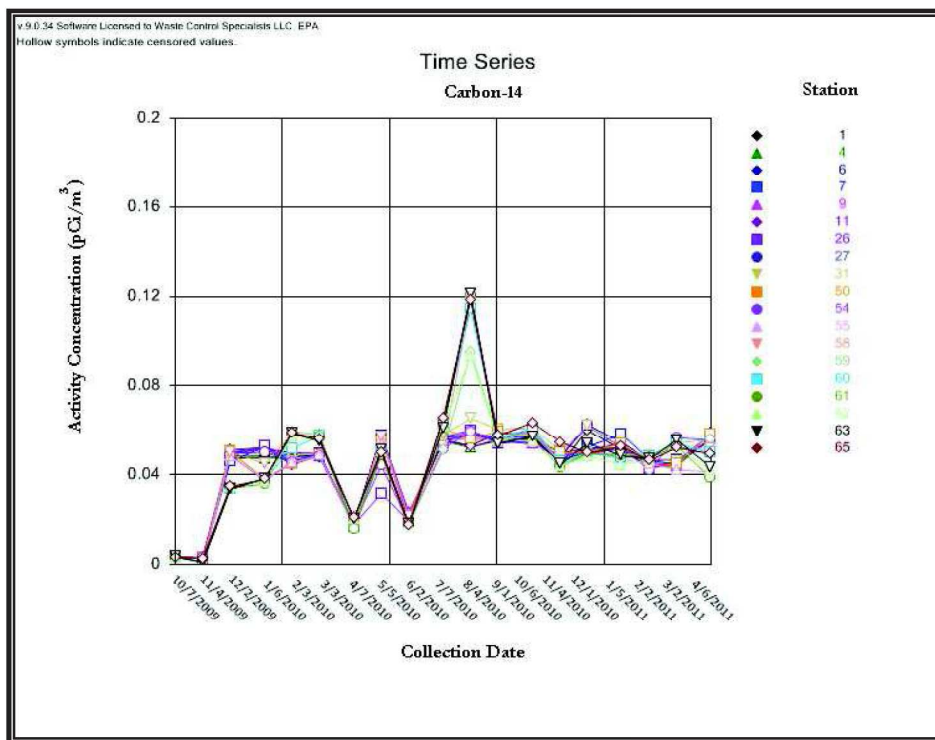


Figure 10-29: Carbon-14 Air Cartridge Results.

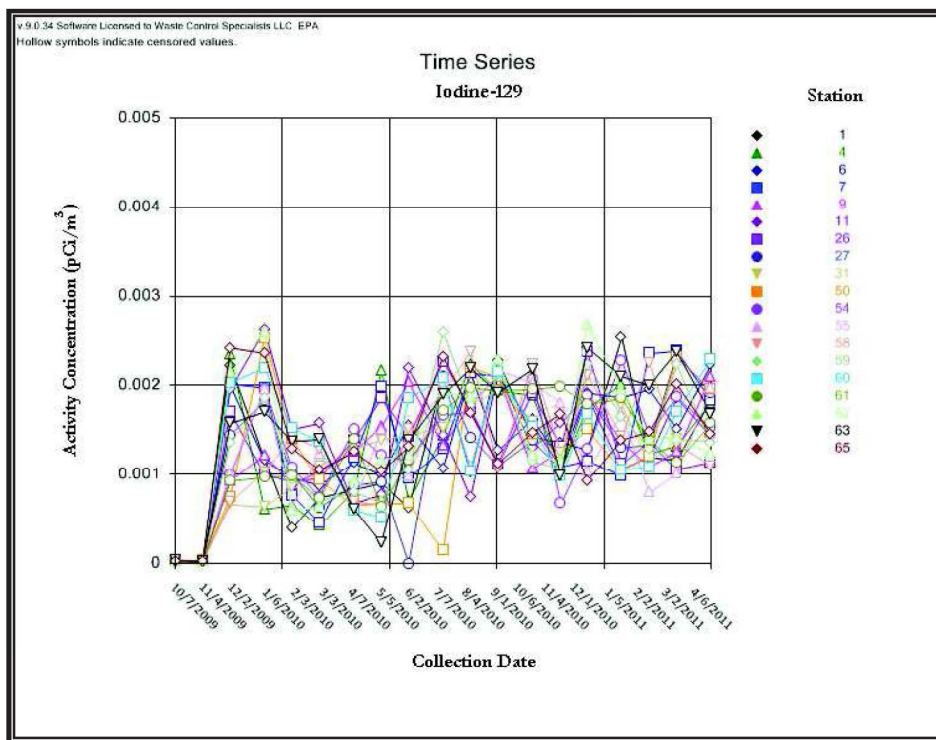


Figure 10-30: Iodine-129 Air Cartridge Results.

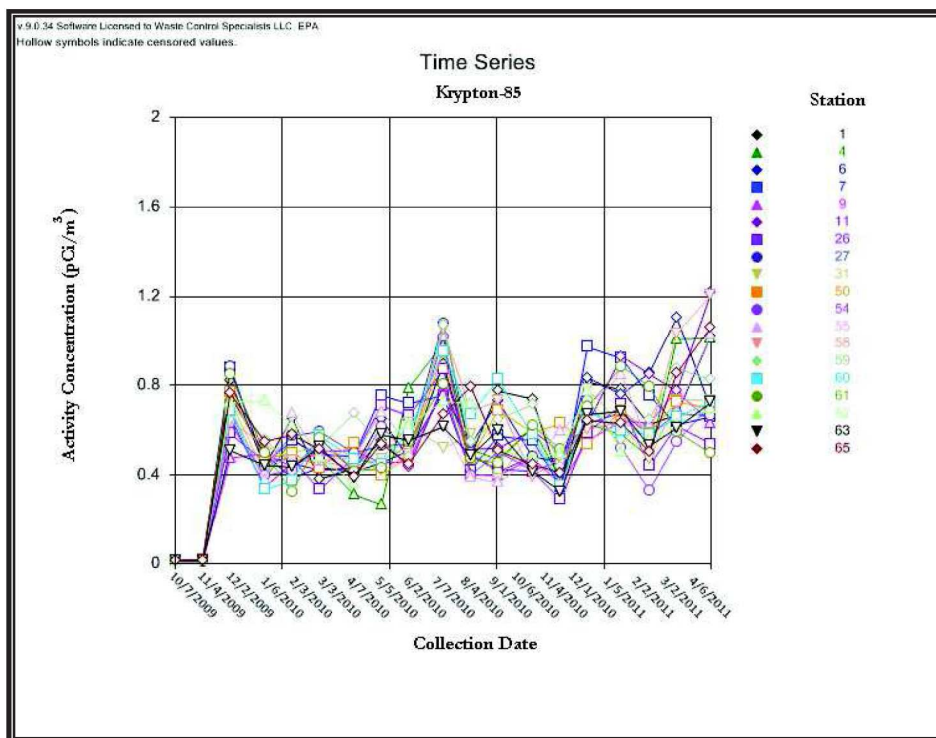


Figure 10-31: Krypton-85 Air Cartridge Results.

11.0 Fauna

A fauna sample (primary herbivore) is collected annually from the general site area as specified in the pre-operational monitoring program. Four Doves and four Rabbits were collected as part of the radiological pre-operational monitoring program. Two Doves were collected for non-radiological analysis. WCS was unable to collect rabbit samples for non-radiological analysis due to construction activities.

Fauna Results

Fauna samples were analyzed for non-radiological and radiological constituents as part of the pre-operational monitoring program. The results for the non-radiological and radiological analytes are summarized in Table 11-1 and Table 11-2 respectively.

Table 11-1: Non-radiological Summary Statistics for Fauna.

Analyte	Units	Observations	No. of Stations	< PQL	Max. Value	Min. Value	Mean Value	Standard Dev.
Barium	µg/Kg	2	1	0	10900	2140	N/A	N/A
Chromium	µg/Kg	2	1	2 (2 J flags)	320 J	155 J	N/A	N/A
Cobalt	µg/Kg	2	1	2 (1 J flag)	383 J	<150	N/A	N/A
Nickel	µg/Kg	2	1	1	538	<150	N/A	N/A
Zinc	µg/Kg	2	1	0	41100	21600	N/A	N/A
All SVOCs	µg/Kg	2	1	2	ND	ND	N/A	N/A
All VOCs	µg/Kg	2	1	2	ND	ND	N/A	N/A

As noted in Table 11-1, there were no detections of any of the organic monitoring parameters. All of the metals that were detected occur naturally and their presence is not unexpected.

Natural radiological parameters observed in fauna samples include Lead-210, Thorium-228, Thorium-230, Thorium-232, Uranium-233/234, and Uranium-238. These parameters are detected in amounts consistent with background.

Radiological false positives for Plutonium-238, and Plutonium-242 were found. These parameters were near the MDC with large uncertainties.

Table 11-2: Fauna Sample Results (pCi/g $\pm 2\sigma$).

	Dove	Dove 2	Rabbit 1	Rabbit 2	Dove	Dove 2	Rabbit 1	Rabbit 2
Collect Date	9/13/2009	9/13/2009	1/27/2010	3/10/2010	9/18/2010	9/18/2010	12/2/2010	12/3/2010
Alpha	2.32 \pm 1.98*	1.75E-1 \pm 1.48*	4.46E-1 \pm 1.43*	2.69 \pm 2.24*	1.77 \pm 1.92*	1.35 \pm 1.46*	1.82 \pm 2.01*	3.69E-1 \pm 1.41*
Am-241	-0.0849 \pm -0.212	0.0811 \pm -0.167	0.0134 \pm -0.0254	0.0231 \pm -0.0406	-0.00858 \pm -0.0175	-0.011 \pm -0.0156	-0.00493 \pm -0.0201	-0.0121 \pm -0.0213
Beta	5.9 \pm 2.42	13 \pm 2.23	2.93 \pm 2.29*	5.59 \pm 2.46	7.35 \pm 3.14	9.78 \pm 2.77	9.47 \pm 3.17	8.84 \pm 3.15
H-3	7.66E-1 \pm 1.87*	1.57 \pm 2.47*	-4.05E-1 \pm 4.91*	-3.97E+0 \pm 4.43*	-6.36E+0 \pm 4*	7.14 \pm 6.38*	-1.04E-1 \pm 2.6*	-2.25E-1 \pm 5.63*
C-14	-4.24E-1 \pm 7.58E-1*	-6.54E-1 \pm 8.77E-1*	-4.03E-1 \pm 9.83E-1*	-3.55E-1 \pm 9.32E-1*	-4.13E-1 \pm 8.70E-1*	-6.74E-1 \pm 5.71E-1*	2.60E-1 \pm 6.35E-1*	2.32E-1 \pm 8.18E-1*
Ch-51	0.105 \pm -0.644	-0.0651 \pm -0.711	-5.71 \pm -6.72	1.41 \pm -2.71	-0.0434 \pm -0.553	0.14 \pm -0.469	-0.219 \pm -0.254	0.0248 \pm -0.288
Co-60	4.27E-2 \pm 5.10E-2*	-7.52E-3 \pm 4.95E-2*	-1.03E-3 \pm 2.96E-2*	2.52E-2 \pm 3.90E-2*	-1.75E-2 \pm 3.84E-2*	3.38E-4 \pm 3.45E-2*	2.94E-3 \pm 2.50E-2*	2.32E-2 \pm 3.64E-2*
Cu-242	0.0148 \pm -0.112*	-0.0163 \pm -0.137	-0.00474 \pm -0.0399	-0.00486 \pm -0.0409	0 \pm -0.0177	0 \pm -0.0149	0 \pm -0.023	0 \pm -0.0225
Cu-243/244	0.143 \pm -0.286	-0.104 \pm -0.143	-0.00743 \pm -0.022	0.0221 \pm -0.0356	0.00857 \pm -0.0242	0 \pm -0.0138	-0.00246 \pm -0.0207	0 \pm -0.0198
Sr-90	-2.58E-2 \pm 2.42E-1*	-1.02E-2 \pm 2.13E-1*	-1.19E-2 \pm 1.17E-1*	2.08E-2 \pm 1.55E-1*	5.83E-2 \pm 1.20E-1*	2.73E-2 \pm 6.83E-2*	5.89E-2 \pm 5.93E-2*	2.63E-1 \pm 3.02E-1*
Tc-99	-9.87E-2 \pm 9.63E-2*	3.69E-3 \pm 9.55E-2*	-1.85E-2 \pm 6.60E-2*	-1.18E-2 \pm 6.31E-2*	2.72E-2 \pm 1.09E-1*	-4.82E-1 \pm 3.43E-1*	5.18E-2 \pm 9.21E-2*	6.77E-3 \pm 8.57E-2*
I-129	4.96E-2 \pm 7.32E-2*	-2.04E-2 \pm 9.03E-2*	1.04E-2 \pm 1.38E-1*	-5.49E-2 \pm 1.51E-1*	-6.44E-2 \pm 1.50E-1*	-4.21E-2 \pm 1.70E-1*	-2.87E-2 \pm 1.21E-1*	6.65E-3 \pm 1.35E-1*
Cs-137	-6.53E-3 \pm 4.55E-2*	2.11E-2 \pm 4.89E-2*	1.46E-2 \pm 2.00E-2*	1.24E-2 \pm 2.90E-2*	-3.52E-2 \pm 6.82E-2*	1.10E-4 \pm 5.75E-2*	2.13E-3 \pm 2.37E-2*	-3.67E-3 \pm 2.99E-2*
Mn-54	-0.0139 \pm -0.0478	0.00687 \pm -0.0474	0.00214 \pm -0.0258	-0.00562 \pm -0.0364	-0.00566 \pm -0.0355	-0.00693 \pm -0.0322	-0.00691 \pm -0.0236	-0.00272 \pm -0.0307
Pu-238	0.0209 \pm -0.0236	-0.00741 \pm -0.0622	0.0224 \pm -0.0495*	-0.00842 \pm -0.0288*	0.00153 \pm -0.0103*	0.00587 \pm -0.013*	0.0141 \pm -0.0276*	0.0107 \pm -0.0285*
Pu-239/240	-0.0209 \pm -0.0305*	-0.00741 \pm -0.0622	0.016 \pm -0.0301	-0.00593 \pm -0.0257	0.00629 \pm -0.0116*	0.0148 \pm -0.0166*	0 \pm -0.0276*	0 \pm -0.0277*
Pu-241	3.22 \pm -6.84*	-5.78 \pm -7.4*	-2.62 \pm -3.6*	1.48 \pm -4.52*	1.35 \pm -2.93*	2.74 \pm -2.79*	-2.24 \pm -3.36*	1.11 \pm -3.6*
Pu-242	0.0399 \pm -0.0296	0.0468 \pm -0.0907*	0.021 \pm -0.0293*	-0.0148 \pm -0.0275*	-0.00641 \pm -0.00985*	0.00727 \pm -0.0177*	-0.0101 \pm -0.0299*	0.00393 \pm -0.0299*
Pb-210	2.64E-1 \pm 1.16E-1	1.76E-1 \pm 1.29E-1*	4.11E-1 \pm 2.09E-1	9.40E-1 \pm 3.53E-1	1.97E-1 \pm 1.51E-1*	2.25E-1 \pm 1.67E-1*	4.19E-2 \pm 1.22E-1*	1.38E-1 \pm 1.34E-1*
Ra-226	-1.36E-1 \pm 1.81E-1*	-9.72E-2 \pm 1.61E-1*	0.00E+0 \pm 8.98E-2*	6.66E-2 \pm 1.02E-1*	0.00E+0 \pm 1.67E-1*	9.26E-2 \pm 1.22E-1*	6.38E-2 \pm 8.51E-2*	0.00E+0 \pm 6.80E-2*
Ra-228	8.25E-3 \pm 3.03E-1*	1.49E-1 \pm 4.00E-1*	9.00E-2 \pm 1.18E-1*	1.87E-1 \pm 1.21E-1*	-1.83E-2 \pm 2.17E-1*	-1.13E-1 \pm 1.83E-1*	5.16E-2 \pm 1.81E-1*	1.73E-1 \pm 1.29E-1*
Th-228	2.46E-2 \pm 2.99E-2*	9.79E-3 \pm 4.32E-2*	1.28E-1 \pm 7.76E-2	3.73E-2 \pm 4.63E-2*	1.56E-2 \pm 3.14E-2*	2.02E-3 \pm 2.25E-2*	-5.53E-4 \pm 3.20E-2*	-4.32E-3 \pm 2.43E-2*
Th-230	1.63E-2 \pm 2.64E-2*	1.05E-3 \pm 2.16E-2*	7.48E-2 \pm 5.15E-2	7.43E-3 \pm 1.74E-2*	5.81E-2 \pm 4.54E-2*	5.17E-2 \pm 4.03E-2*	2.99E-2 \pm 2.82E-2*	4.68E-3 \pm 8.14E-3*
Th-232	2.89E-2 \pm 2.73E-2*	-6.54E-3 \pm 1.82E-2*	-7.33E-3 \pm 1.84E-2*	8.12E-3 \pm 1.74E-2*	2.41E-2 \pm 2.46E-2	2.12E-2 \pm 2.18E-2	1.94E-2 \pm 2.78E-2*	2.11E-2 \pm 1.75E-2
U-234	6.37E-2 \pm 4.47E-2	-6.29E-3 \pm 3.15E-2*	1.06E-2 \pm 2.45E-2*	-1.82E-3 \pm 1.54E-2*	2.30E-2 \pm 2.54E-2	1.21E-2 \pm 2.86E-2*	-1.03E-2 \pm 1.54E-2*	-8.18E-3 \pm 1.50E-2*
U-235	2.90E-2 \pm 3.33E-2*	1.80E-2 \pm 2.49E-2*	7.72E-3 \pm 1.52E-2*	-4.37E-3 \pm 1.90E-2*	1.33E-2 \pm 2.62E-2*	4.49E-3 \pm 2.00E-2*	6.95E-3 \pm 1.85E-2*	1.84E-2 \pm 2.57E-2*
U-238	2.02E-2 \pm 2.76E-2*	-3.28E-3 \pm 1.86E-2*	2.49E-2 \pm 2.90E-2*	1.05E-2 \pm 2.06E-2*	1.43E-2 \pm 2.00E-2*	2.20E-2 \pm 2.51E-2	3.85E-3 \pm 1.54E-2*	5.65E-3 \pm 1.50E-2*

* Result is less than MDC

12.0 Aquatic Eco-Receptors

Samples of aquatic eco-receptors are collected annually if present from six locations specified in Attachments A and B of RML No. R04100. Figure 12-1 contains a map of these locations. During the pre-operational period, sufficient quantity of aquatic eco-receptors were identified at two locations after significant precipitation events in 2010. No aquatic eco-receptors sufficient for sampling and analysis were identified at any of the specified locations in 2011.



Figure 12-1: Aquatic Eco-Receptors.

Radiological Aquatic Eco-Receptor Results

The results and associated uncertainties of the key radionuclides, posted at two standard deviations (2σ), are given in Table 12-1. All results are provided in Appendix H.

Table 12-1: Aquatic Eco-Receptor Sample Results (pCi/g)

	GW-1			GW-2		
Parameter	Result	TPU	MDC	Result	TPU	MDC
Alpha	9.59E+00	2.69E+00	9.64E-01	1.26E+01	3.47E+00	9.38E-01
Americium-241	3.68E-03	4.15E-03	5.25E-03	-4.05E-04	1.86E-03	5.63E-03
Beta	2.08E+01	3.47E+00	2.00E+00	1.77E+01	3.07E+00	1.68E+00
Carbon-14	-4.68E-01	8.03E-01	1.41E+00	-6.07E-01	8.27E-01	1.45E+00
Cesium-137	8.42E-02	4.77E-02	5.57E-02	7.37E-03	8.78E-02	1.48E-01
Chromium-51	1.81E-01	3.29E-01	5.52E-01	5.10E-01	8.66E-01	1.50E+00
Cobalt-60	9.99E-03	3.82E-02	6.47E-02	-1.84E-02	1.03E-01	1.72E-01
Curium-242	0.00E+00	2.30E-03	3.50E-03	0.00E+00	1.79E-03	2.74E-03
Curium-243/244	1.93E-03	3.10E-03	5.25E-03	0.00E+00	1.68E-03	2.57E-03
Iodine-129	4.11E-03	2.63E-02	4.50E-02	1.39E-02	3.63E-02	6.20E-02
Lead-210	3.65E+00	5.65E+00	9.93E+00	7.15E+00	6.65E+00	1.18E+01
Manganese-54	-1.20E-02	3.45E-02	5.67E-02	2.84E-03	9.25E-02	1.58E-01
Neptunium-237	-1.95E-03	1.53E-02	4.22E-02	4.68E-03	1.32E-02	2.97E-02
Plutonium-238	5.41E-03	6.08E-03	9.37E-03	3.47E-03	4.28E-03	6.47E-03
Plutonium-239/240	3.08E-03	3.87E-03	5.36E-03	2.12E-03	2.96E-03	3.18E-03
Plutonium-241	-5.61E-02	2.86E-01	5.00E-01	1.60E-02	2.79E-01	4.83E-01
Plutonium-242	-5.36E-04	2.32E-03	6.18E-03	-2.11E-04	2.36E-03	7.42E-03
Radium-226	6.07E-01	1.80E-01	4.63E-02	1.59E+00	5.58E-01	3.90E-02
Radium-228	5.29E-01	2.49E-01	2.12E-01	1.82E+00	7.76E-01	5.53E-01
Strontium-90	-3.35E-02	8.30E-02	1.67E-01	1.40E-01	1.17E-01	1.84E-01
Technetium-99	-2.93E-01	8.22E-01	1.46E+00	-3.36E-01	1.00E+00	1.78E+00
Thorium-228	4.17E-01	2.37E-01	1.46E-01	1.12E-01	1.30E-01	1.14E-01
Thorium-230	5.78E-01	2.84E-01	1.45E-01	2.51E-01	1.97E-01	1.13E-01
Thorium-232	2.39E-01	1.72E-01	9.02E-02	1.39E-01	1.50E-01	1.80E-01
Tritium	-4.10E-01	4.44E-01	8.63E-01	-3.81E-01	3.88E-01	7.57E-01
Uranium-233/234	2.81E-01	1.42E-01	4.90E-02	7.12E-02	6.91E-02	5.06E-02
Uranium-235/236	2.02E-02	3.97E-02	6.06E-02	2.09E-02	4.10E-02	6.26E-02
Uranium-238	1.76E-01	1.11E-01	7.83E-02	9.72E-02	8.32E-02	8.09E-02

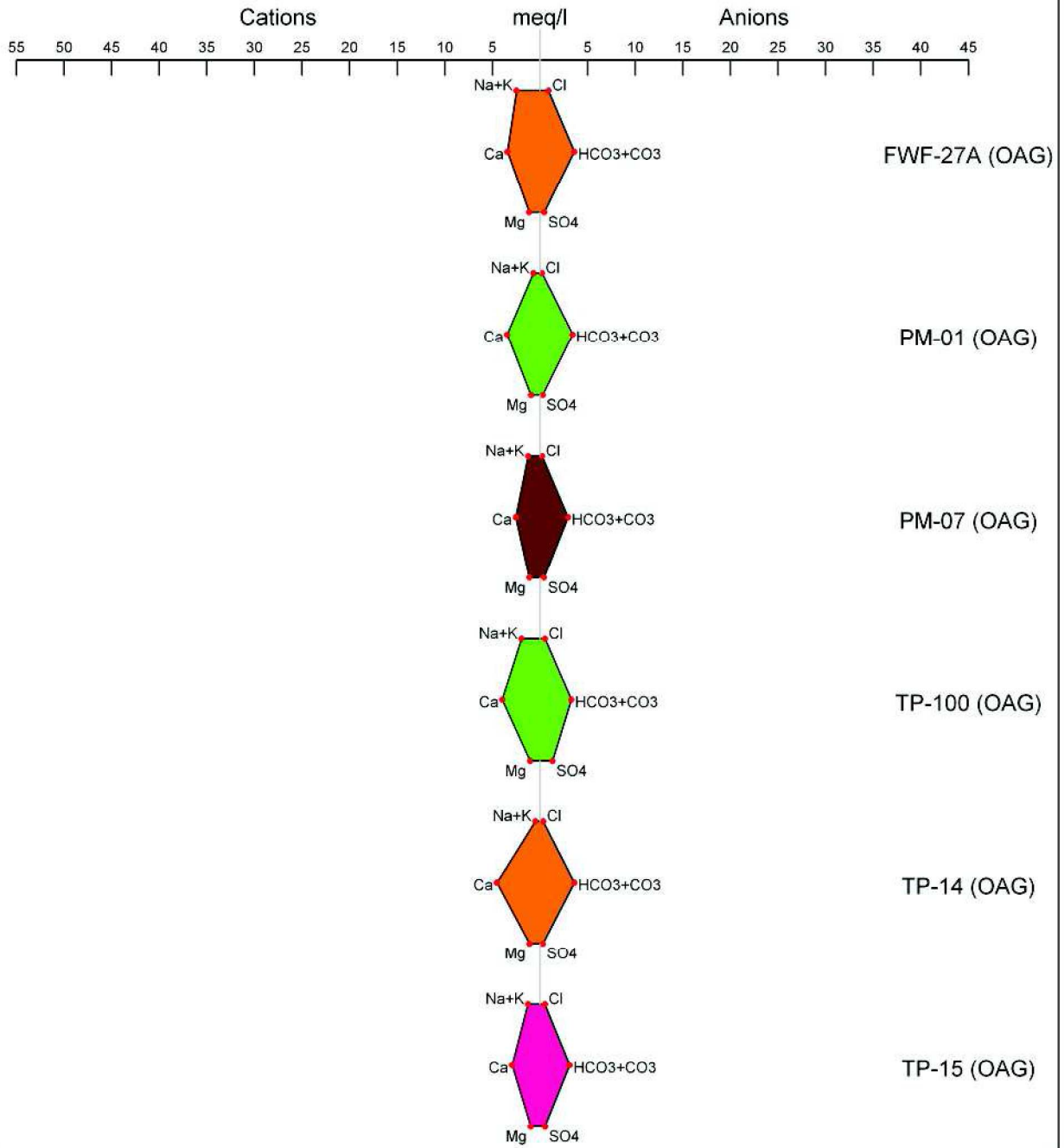
Natural Radiological parameters detected in aquatic receptor samples include Radium-226, Radium-228, Thorium-228, Thorium-230, Thorium-232, Uranium-233/234 and Uranium-238. These results are consistent with what is expected in the environment.

Cesium-137 was also detected in aquatic receptor samples. This is potentially a false positive, but it should be noted that Cesium-137, if present at low levels in the environment, is consistent with fallout from nuclear weapons testing in soils and sediments.

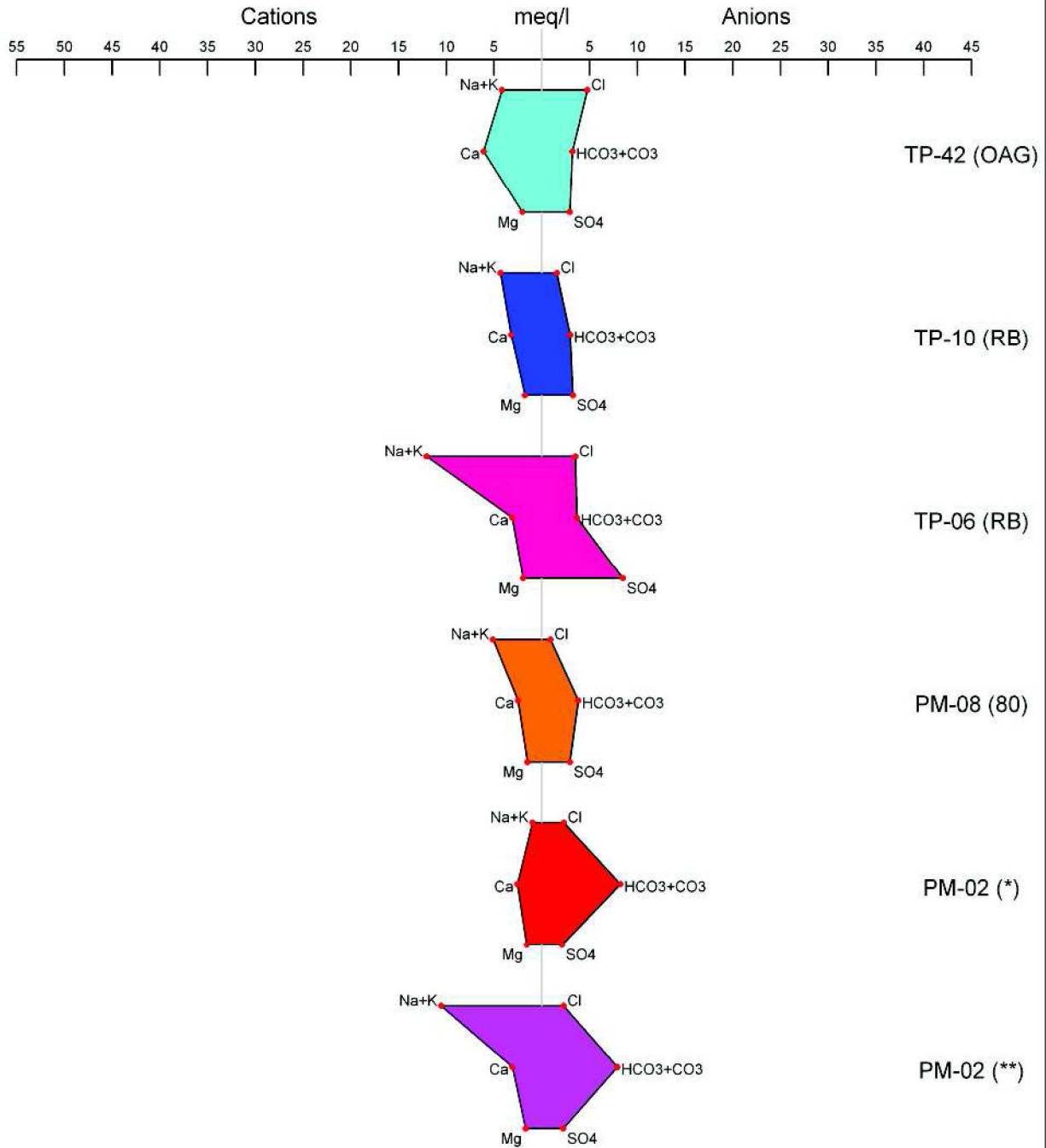
13.0 Conclusion

WCS collected environmental samples to fulfill the requirements in the Modified Natural Radiation Monitoring Program specified in Attachment A of RML R04100; the Pre-Operational Monitoring Program specified in Attachment B in RML R04100; pre-operational environmental monitoring for radionuclides as specified in the WCS Radiological Environmental Monitoring Program document, EV-1.1.0, Rev. 0 dated 4/18/2005 as revised by Addendum No. 1, Revision 2 to the REMF; and the pre-operational environmental monitoring for Non-Radiological Environmental Program Plan. As part of the analysis of this report, WCS has concluded that the Pre-Operational Monitoring Program has been completed. Results collected during this reporting period were indistinguishable from natural background.

WCS Stiff Diagram (Major Ion Comparison)



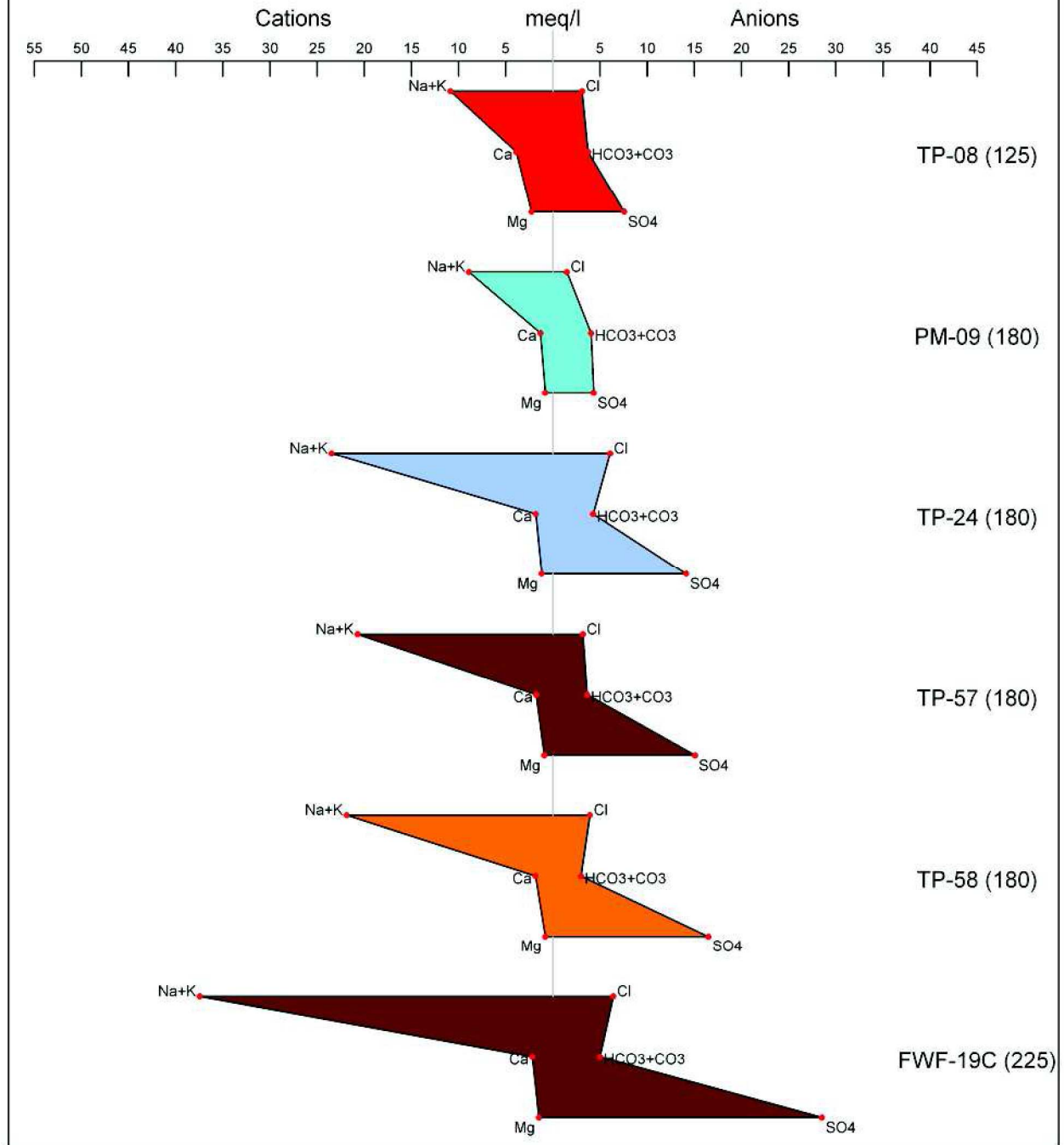
WCS Stiff Diagram (Major Ion Comparison)



(*) OAG/125'-Zone: Sample Collection Date: 4/21/2011

(**) OAG/125'-Zone: Sample Collection Date: 5/17/2011

WCS Stiff Diagram (Major Ion Comparison)



WCS Stiff Diagram (Major Ion Comparison)

