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K EAST BASIN SANDFILTER BACKWASH PIT SAMPLES

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7. Abstract

Samples were obtained from different locations from the K East Sandfilter Backwash Pit to characterize the sludge material. These samples were analyzed chemically for elements, radionuclides, and residual compounds. The analytical results were statistically analyzed to determine the mean analyte content and the associated variability for each mean value.

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STATISTICAL EVALUATION OF THE DATA OBTAINED
FROM THE K EAST BASIN SANDFILTER BACKWASH PIT SAMPLES

1.0 SUMMARY

Samples were taken from the K East Basin Sandfilter Backwash Pit to characterize the material contained in the basin. The first sampling campaign occurred in September 1993. The second sampling campaign occurred in November 1993. A summary of the analytical data extrapolated to the volume of the pit is provided in Table 1-1.

Table 1-1. K East Basin Sandfilter Backwash Pit Contents. (sheet 1 of 2)

Analyte	Total amount (mean)	Uncertainty (1 RSD)*
Plutonium	9.75E+01 g *	19.1%
Uranium	3.90E+01 Kg ^	20.4%
Aluminum	3.00E+04 g	25.1%
Barium	4.01E+02 g	24.8%
Beryllium	2.92E+01 g	30.5%
Calcium	2.27E+04 g	24.2%
Cadmium	2.06E+02 g	20.4%
Chromium	4.94E+02 g	35.1%
Copper	1.04E+03 g	23.0%
Iron	8.98E+04 g	34.4%
Magnesium	2.86E+03 g	25.1%
Manganese	1.24E+03 g	18.6%
Lead	3.47E+02 g	17.8%
Zinc	8.88E+02 g	20.2%
Sodium	1.63E+03 g	26.4%
Silicon	3.44E+03 g	19.8%

- : The uncertainty, in terms of 1 RSD (relative standard deviation), associated with the mean value.
- ★: The value reported in WHC-SD-WM-TA-152, Rev. 0.
- ▲: This value is different from the value reported in WHC-SD-WM-TA-152, Rev. 0, because the minimum uranium result (PNL ICP/MS data and PNL laser data combined) from the research samples was used for the structural members instead of the maximum uranium result from the research samples.

Table 1-1. K East Basin Sandfilter Backwash Pit Contents. (sheet 2 of 2)

Analyte	Total amount (mean)	Uncertainty (1 RSD) ^a
Total Beta	1.76E+02 Ci	24.9%
Alpha Total	1.17E+01 Ci	19.9%
²⁴¹ Am (AEA)	6.65E+00 Ci	18.4%
²⁴¹ Am (GEA)	6.67E+00 Ci	19.1%
¹³⁷ Cs	6.14E+01 Ci	22.9%
⁶⁰ Co	1.36E+00 Ci	17.2%
¹⁵⁴ Eu	1.36E+00 Ci	17.8%
¹⁵⁵ Eu	7.46E-01 Ci	22.2%

^a: The uncertainty, in terms of 1 RSD, associated with the mean value.

AEA: Alpha energy analysis.

GEA: Gamma energy analysis.

The analytes silver, boron, molybdenum, samarium, thallium, and plutonium-238 are not included in the above table due to the quantity of "less than" values obtained in the laboratory analyses.

2.0 PURPOSE

The purpose of this report is to provide the results of the statistical analysis of the data generated from the laboratory analyses of the sludge samples obtained from the K East Basin Sandfilter Backwash Pit in September 1993 and November 1993. The sampling requirements were specified in Bushore (1993). These results will be used to perform safety analyses of the neutronic reactivity of the Sandfilter Backwash Pit (Warner and Harris 1994). Uncertainties on the masses of materials present are required so that the safety analyses can be performed at the 95% confidence level.

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3.0 LABORATORY RESULTS

3.1 DATA SUMMARY

Eight samples, obtained from the Backwash Pit (pit) itself, were analyzed for inorganic constituents and radionuclides as specified in the sampling and analysis plan (SAP) (Bushore 1993). The data are presented in Tables A-1 through A-14, Appendix A. Four samples, obtained from the transfer channel (channel), were analyzed for inorganic constituents and radionuclides as specified in the SAP (Bushore 1993). The data are presented in Tables A-15 through A-28, Appendix A. A research sample was obtained from the pit where the sample contents were separated into the "light" material and the "heavy" material. The purpose of the research sample was to see if there were significant quantitative differences in the analyte concentrations between the lighter and heavier layers of sludge. The data are also presented in Tables A-1 through A-14, Appendix A. The sample locations, the sample preparation techniques, and the analytical techniques used are given in Warner and Harris (1994).

The Pu data, as measured by AEA, were reported in the laboratory data packages with units of $\mu\text{Ci/g solid}$. A conversion factor of 12.146 g Pu/Ci was used to convert the AEA Pu data to mg Pu/g solid (see the following equation).

$$\frac{\text{mg Pu}}{g_{\text{solid}}} = \frac{\mu\text{Ci Pu}}{g_{\text{solid}}} * \frac{12.146 \text{ g Pu}}{\text{Ci}} * \frac{\text{Ci}}{1000000 \mu\text{Ci}} * \frac{1000 \text{ mg Pu}}{\text{g Pu}}$$

The derivation of 12.146 g Pu/Ci is provided in Appendix B.

Table 3-1 provides the reference between the sample numbers in Appendices A, C, and D, and the sample numbers associated with the laboratory analyses.

3.2 SAMPLE MEANS

The means for each sample, in units of mg/mL lab settled sludge (mg/mL sludge) or $\mu\text{Ci/mL lab settled sludge}$ ($\mu\text{Ci/mL sludge}$), are listed in Tables C-1 through C-14, Appendix C and illustrated in Figures D-1 through D-28, Appendix D. For each sample the reported laboratory result (mg/g dried solid after the water was removed from the sample or $\mu\text{Ci/g dried solid}$ after the water was removed from the sample) was multiplied by the solids concentration value (g solid/mL lab settled sludge) to get the concentration units as mg/mL sludge. The three results per sample were then averaged to get the results provided in the Appendix C tables. If three values per sample were not/ available (one or more of the laboratory results were either a "less than" value or the analysis was not performed), only those "real" values were

averaged to get the result provided in the Appendix C tables. The symbol, •, has been placed next to those results where less than three observations were used to calculate the average. The solids concentration data are also listed in Table C-1, Appendix C.

Table 3-1. Sample Numbers.

Sample number (Appendices A,C,D)	Section	222S Sample number	PNL Sample number
1	S3059-03 Pit, Quadrant 3	J1229	J1221
2	S3059-04 Pit, Quadrant 4	J1232	J1222
3	S3059-11 Pit, Quadrant 2	J1235	J1223
4	S3062-02 Pit, Quadrant 1	J1425	J1391
5	S3062-03 Pit, Quadrant 2	J1426	J1392
6	S3062-04 Pit, Quadrant 4	J1427	J1394
7	S3062-05 Pit, Quadrant 3	J1428	J1395
8	S3062-06 Pit, Quadrant 1	J1424	J1393
10	S3059-05 Channel	J1285	J1268
11	S3059-06 Channel	J1286	J1269
12	S3059-07 Channel	J1287	J1270
13	S3059-08 Channel	J1289	J1271
15 Research sample	S3062-07 Pit-upper	J1445	J1396
16 Research sample	S3062-08 Pit-lower	J1446	J1397

4.0 CALCULATION OF THE ANALYTE CONTENT BY SECTION

The total amount of an analyte for each section (pit, channel, or structures) was calculated using the formula

$$Z = X * Y$$

where Z is the mean quantity (mg or μCi) of an analyte in the 105KE Basin Backwash Pit section, X is the mean concentration (mg/mL sludge or $\mu\text{Ci/mL}$ sludge) of an analyte, and Y is the mean volume (mL) of sludge in the section.

4.1 VOLUME MEASUREMENTS

Sludge depth measurements were taken in both the pit and the transfer channel (Warner 1994). The mean depth for the pit is 33.0 inches, which corresponds to a volume of 182.79 ft^3 . The mean depth for the transfer channel is 20.25 inches, which corresponds to a volume of 39.13 ft^3 . The volume for the structures was estimated to be 4.74 ft^3 . The details associated with these volume estimates are given in Warner (1994).

The variability associated with the sludge depth measurements were calculated by combining the random and systematic uncertainties. The two sources of uncertainty are given in Table 4-1.

Table 4-1. Volume Uncertainties.

Section	Random	Systematic	Total
Pit	2%	3% (1"/33")	3.6%
Channel	12%	5% (1"/20.25")	13.0%
Structures	12%*	10%#	15.6%

*: The larger estimate of the random variability from the pit and channel.

#: The assigned engineering variability (Warner 1994).

4.2 ANALYTICAL MEASUREMENTS

The "X" term (units of mg/mL sludge or $\mu\text{Ci/mL}$ sludge) in the equation used to determine the total analyte content for each section of the 105KE Basin Backwash Pit represents the analytical laboratory measurement. The 105KE Basin Backwash Pit sampling scheme utilized two different statistical models in determining the mean analyte content for each section of the 105KE Basin Backwash Pit. The first model was for those analytes measured using one

measurement method (by one laboratory). The model is described by the following equation

$$X_{ij} = \mu + S_i + \epsilon_{ij}$$

where X_{ij} is the analyte of interest (e.g., Pu or U) in terms of mg/mL sludge, μ represents the population mean concentration, S_i represents the different samples from the Backwash Pit or the channel, and ϵ_{ij} represents the triplicate analyses performed by the laboratory.

The second model (which did incorporate the different techniques for measuring an analyte) was

$$X_{ijk} = \mu + L_i + S_j + LS_{ij} + \epsilon_{ijk}$$

where X_{ijk} is the analyte of interest (e.g., Pu or U) in terms of mg/mL sludge, μ represents the population mean concentration, L_i represents the measurement method used to measure the analyte (e.g., uranium by PNL ICP/MS, uranium by PNL laser, and uranium by 222S laser), S_j represents the different samples from the Backwash Pit or the channel, LS_{ij} represents the different methodology by sample interaction, and ϵ_{ijk} represents the triplicate analyses performed by the laboratory.

The overall mean for each analyte by section is provided in Table 4-2. The model used to determine the mean value for the pit and the channel is illustrated by the exponent next to the mean value. It was believed that the "upper" portion of the research sample (the lighter material) represented the material which had settled on the structures. For conservatism, the larger analytical result of the two research samples, samples 15 and 16, was used to determine the quantity of Pu on the structurals. For conservatism, the smaller analytical result of the two research samples, samples 15 and 16, was used to determine the quantity of all other analytes on the structurals.

Table 4-2. Mean Concentration Value by Section. (sheet 1 of 2)

Analyte	Units	Mean concentration		
		Pit	Channel	Structures
Pu	mg/mL sludge	1.397E-02 ²	1.991E-02 ²	2.290E-02
U*	mg/mL sludge	5.963E+00 ²	6.604E+00 ²	6.225E+00
U [#]	mg/mL sludge	6.554E+00 ²	6.604E+00 ²	6.225E+00
Al	mg/mL sludge	4.818E+00 ²	4.147E+00 ²	3.590E+00
Ba	mg/mL sludge	6.620E-02 ²	5.142E-02 ²	1.215E-02
Be	mg/mL sludge	4.147E-03 ²	6.696E-03 ²	2.030E-03
Ca	mg/mL sludge	4.230E+00 ²	7.149E-01 ²	2.310E+00
Cd	mg/mL sludge	3.256E-02 ²	3.321E-02 ²	7.235E-03

*: The uranium data, used in the statistical analysis, included PNL ICP/MS results, PNL laser results, and some 222S Laboratory laser results (those not marked as questionable).

#: The uranium data, marked as questionable by 222S Laboratory, were used in the statistical analysis (see Table A-2).

2: The mean analyte content was determined using model two.

Table 4-2. Mean Concentration Value by Section. (sheet 2 of 2)

Analyte	Units	Mean concentration		
		Pit	Channel	Structures
Cr	mg/mL sludge	7.826E-02 ²	7.668E-02 ²	3.310E-02
Cu	mg/mL sludge	1.780E-01 ²	9.992E-02 ²	5.380E-02
Fe	mg/mL sludge	1.048E+01 ²	3.153E+01 ²	4.550E+00
Mg	mg/mL sludge	4.857E-01 ²	3.007E-01 ²	7.150E-02
Mn	mg/mL sludge	1.970E-01 ²	1.924E-01 ²	4.270E-02
Pb	mg/mL sludge	5.427E-02 ²	5.545E-02 ²	3.625E-02
Zn	mg/mL sludge	1.263E-01 ²	2.035E-01 ²	6.515E-02
Na	mg/mL sludge	2.774E-01 ¹	1.720E-01 ¹	4.630E-02
Si	mg/mL sludge	5.324E-01 ¹	6.089E-01 ¹	8.140E-02
U ^{&} (222S ICP)	mg/mL sludge	5.812E+00 ¹	6.393E+00 ¹	6.030E+00
Total Beta	uCi/mL sludge	2.859E+01 ¹	2.365E+01 ¹	1.580E+01
Alpha Total	uCi/mL sludge	1.669E+00 ¹	2.501E+00 ¹	1.900E+00
²⁴¹ Am (AEA)	uCi/mL sludge	9.764E-01 ¹	1.293E+00 ¹	1.240E+00
²⁴¹ Am (GEA)	uCi/mL sludge	9.682E-01 ²	1.341E+00 ²	1.255E+00
¹³⁷ Cs	uCi/mL sludge	1.000E+01 ²	8.091E+00 ²	4.940E+00
⁶⁰ Co	uCi/mL sludge	2.103E-01 ²	2.238E-01 ²	1.475E-01
¹⁵⁴ Eu	uCi/mL sludge	1.993E-01 ²	2.705E-01 ²	2.370E-01
¹⁵⁵ Eu	uCi/mL sludge	1.081E-01 ²	1.531E-01 ²	1.280E-01

&: No standards were analyzed in conjunction with the 222S Laboratory ICP uranium analyses. These data are included for information only.

1: The mean analyte content was determined using model one.

2: The mean analyte content was determined using model two.

The "X" term consists of many individual components. Specific details for each component can be found in Bechtold (1994). The following equations represent this "X" term.

$$\frac{mg}{mL_{sludge}} = \left[\frac{mg}{mL_{digestate}} \right] * \left[\frac{mL_{combined\ digest}}{g_{digested\ dry\ solids}} \right] * (DF_{PCL}) * \left[\frac{g_{dry\ solids}}{mL_{sludge}} \right]$$

$$solids\ concentration = \frac{g_{dry\ solids}}{mL_{sludge}} = \frac{(sludge\ density) * (Wt\% solids)}{100}$$

$$sludge\ density = \frac{net\ weight\ sludge}{sludge\ volume}$$

$$Wt\% solids = \frac{net\ weight\ dry\ solids}{net\ weight\ sludge} * 100$$

$$sludge\ volume = mL\ sludge = \frac{mud\ mark\ \#2\ gross\ weight - sludge\ tare\ weight}{0.998}$$

$$DF_{PCL} = Dilution\ Factor = \frac{500}{500 - 3.3}$$

The DF_{PCL} is a correction for the 3.3 mL withdrawals from the serial digests. See Bechtold (1994) or laboratory notebook WHC-N-341-2, page 26.

$$digest\ rate = \frac{mL_{combined\ digest}}{g_{digested\ dry\ solids}} = \frac{total\ volume\ digestate}{net\ weight\ digested\ dry\ solids}$$

or

$$\frac{mg}{mL_{sludge}} = \frac{mg}{mL_{digestate}} * \frac{total\ volume\ digestate}{net\ weight\ digested\ dry\ solids} * DF_{PCL} * \frac{net\ weight\ sludge}{sludge\ volume} * \left[\frac{net\ weight\ dry\ solids}{net\ weight\ sludge} * 100 \right] * \frac{1}{100}$$

or

$$\frac{\text{mg}}{\text{mL}_{\text{sludge}}} = \frac{\text{mg}}{\text{mL}_{\text{digestate}}} * \frac{\text{total volume digestate}}{\text{net weight digested dry solids}} * DF_{\text{PCL}} \\ * \left(\frac{0.998}{\text{mud mark \#2 gross weight} - \text{sludge tare weight}} \right) * (\text{net weight dry solids})$$

From this equation it can be seen that there are seven components which contribute to the systematic analytical uncertainty. The seven components are

- 1) lab analysis - mg/mL_{digestate}
- 2) volume - total volume digestate
- 3) weight - net weight digested dry solids
- 4) DF_{PCL} - dilution factor by Process Chemistry Laboratory personnel
- 5) sludge volume - mud mark #2 gross weight minus sludge tare weight
- 6) .998 - the estimate of the density of the laboratory deionized water at ambient temperature
- 7) weight - net weight dry solids.

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5.0 UNCERTAINTY CALCULATIONS

The uncertainty for Z is estimated using the following formula. This assumes that X and Y are independent variables.

$$\text{RSD}^2(\text{Z}) \approx \text{RSD}^2(\text{X}) + \text{RSD}^2(\text{Y})$$

The estimates of the measurement uncertainties are a combination of both the random and systematic variability in the measurement techniques. The random analytical variability is estimated from the replicate measurements. The random sampling variability is estimated from the differences between the samples. The systematic analytical variability is estimated from either the spike recoveries or the standard recoveries. The random volume variability is estimated from the differences between the depth measurements. The systematic volume variability was taken as one inch.

5.1 ANALYTICAL AND SAMPLING UNCERTAINTY

The random analytical and sampling variability for "X" is estimated using the models given in Section 4.2 in conjunction with analysis of variance (ANOVA) techniques. Analytical measurements reported as a "less than" value were not used in the statistical analysis.

The analytical results from samples 1 through 8 were used to determine the random sampling and analytical variability for the pit section. The analytical results from samples 10 through 13 were used to determine the random sampling and analytical variability for the transfer channel section.

The larger of the two analytical results from the research samples, samples 15 and 16, was used to determine the quantity of Pu on the structurals. The smaller of the two analytical results from the research samples, samples 15 and 16, was used to determine the quantity of the remaining analytes on the structurals. Since there were only two samples, the larger estimate of the random analytical and sampling variability from the pit or channel was used to represent this variability for the structures.

The systematic sampling variability was estimated from an engineering mockup experiment conducted for the sampling equipment. This systematic sampling variability is 9% (1 RSD).

The systematic analytical variability is estimated from the "steps" involved in the procedure (see Section 4.2). Since the equation for "X" consists of products and quotients, the $\text{RSD}^2(\text{X})$ for the systematic variability is approximated by the sum of the RSD^2 of each component. This assumes that each component is independent of the others. Table 5-1 lists the estimates of the systematic analytical variability associated with each analytical method for the pit and structures sections of the 105KE Basin Backwash Pit. Table 5-2 lists the estimates of the systematic analytical variability associated with each analytical method for the channel.

The systematic analytical uncertainties for the transfer channel measurements are significantly larger than those for the pit measurements. The sludge volume of one sample, S3059-06, was only 19 mL with an uncertainty

of 10 mL. The sludge volume uncertainty, in terms of one RSD, is then 53% (53% = 10/19 *100). This uncertainty, 53%, was applied to all channel samples.

The sources of variability for each section of the KE Backwash Pit are listed in Tables 5-3 (pit), 5-4 (channel), and 5-5 (structures).

Table 5-1. Systematic Analytical Variability - Pit and Structures. (sheet 1 of 2)

Pit and structures sections Constituent, laboratory, method	"X"						
	Part 1	Part 2	Part 3	Part 4	Part 5	Part 6	Part 7
	Lab	Volume	Weight	DF _{PCL}	Sludge volume	0.998	Weight
Pu-PNL-ICP/MS	3%	0.1%	2%	0.2%	9%	0.1%	2%
Pu-222S-AEA	5%	0.1%	2%	0.2%	9%	0.1%	2%
U-PNL-ICP/MS	10.5%	0.1%	2%	0.2%	9%	0.1%	2%
U-PNL-laser	10%	0.1%	2%	0.2%	9%	0.1%	2%
U-222S-laser	10%	0.1%	2%	0.2%	9%	0.1%	2%
Al-222S-ICP	1.9%	0.1%	2%	0.2%	9%	0.1%	2%
Al-PNL-ICP/MS	23% [§]	0.1%	2%	0.2%	9%	0.1%	2%
Ba-222S-ICP	1.8%	0.1%	2%	0.2%	9%	0.1%	2%
Ba-PNL-ICP/MS	2.1%	0.1%	2%	0.2%	9%	0.1%	2%
Be-222S-ICP	1.7%	0.1%	2%	0.2%	9%	0.1%	2%
Be-PNL-ICP/MS	12.7%	0.1%	2%	0.2%	9%	0.1%	2%
Ca-222S-ICP	1.3%	0.1%	2%	0.2%	9%	0.1%	2%
Ca-PNL-ICP/MS	6.5% [§]	0.1%	2%	0.2%	9%	0.1%	2%
Cd-222S-ICP	3.8%	0.1%	2%	0.2%	9%	0.1%	2%
Cd-PNL-ICP/MS	2.4%	0.1%	2%	0.2%	9%	0.1%	2%
Cr-222S-ICP	1.4%	0.1%	2%	0.2%	9%	0.1%	2%
Cr-PNL-ICP/MS	8.7%	0.1%	2%	0.2%	9%	0.1%	2%
Cu-222S-ICP	0.8%	0.1%	2%	0.2%	9%	0.1%	2%
Cu-PNL-ICP/MS	3.8%	0.1%	2%	0.2%	9%	0.1%	2%
Fe-222S-ICP	1.4%	0.1%	2%	0.2%	9%	0.1%	2%
Fe-PNL-ICP/MS	20% [§]	0.1%	2%	0.2%	9%	0.1%	2%
Mg-222S-ICP	3.5%	0.1%	2%	0.2%	9%	0.1%	2%
Mg-PNL-ICP/MS	11.3%	0.1%	2%	0.2%	9%	0.1%	2%
Mn-222S-ICP	2.2%	0.1%	2%	0.2%	9%	0.1%	2%
Mn-PNL-ICP/MS	6.7%	0.1%	2%	0.2%	9%	0.1%	2%
Pb-222S-ICP	2.1%	0.1%	2%	0.2%	9%	0.1%	2%
Pb-PNL-ICP/MS	2.4%	0.1%	2%	0.2%	9%	0.1%	2%
Zn-222S-ICP	1.8%	0.1%	2%	0.2%	9%	0.1%	2%
Zn-PNL-ICP/MS	7.9%	0.1%	2%	0.2%	9%	0.1%	2%
Na-222S-ICP	1.2%	0.1%	2%	0.2%	9%	0.1%	2%
Si-222S-ICP	1.4%	0.1%	2%	0.2%	9%	0.1%	2%
U-222S-ICP [#]	10% [♦]	0.1%	2%	0.2%	9%	0.1%	2%

§: Not all the spike recoveries were used to determine the laboratory systematic error. This included the spike recovery of 276% for Al, 320% for Ca, and -257% for Fe.

#: No standards were analyzed in conjunction with the 222S Laboratory ICP uranium analyses. These results are included for information only.

♦: Assigned value, standards and/or spikes were not analyzed.

Table 5-1. Systematic Analytical Variability - Pit and Structures. (sheet 2 of 2)

Pit and structures							Constituent, laboratory, method
Part 1	Part 2	Part 3	Part 4	Part 5	Part 6	Part 7	
Lab	Volume	Weight	DF _{PCL}	Sludge volume	Weight	Weight	
"X"							
Total Beta-222S	5.0%	0.1%	2%	0.2%	9%	0.1%	2%
Alpha Total-222S	1.7%	0.1%	2%	0.2%	9%	0.1%	2%
²⁴¹ Am-222S-AEA	3.5%	0.1%	2%	0.2%	9%	0.1%	2%
²⁴¹ Am-222S-GEA	5.0%	0.1%	2%	0.2%	9%	0.1%	2%
²⁴¹ Am-PNL-GEA	5.0%	0.1%	2%	0.2%	9%	0.1%	2%
¹³⁷ Cs-222S-GEA	2.3%	0.1%	2%	0.2%	9%	0.1%	2%
¹³⁷ Cs-PNL-GEA	5.0%	0.1%	2%	0.2%	9%	0.1%	2%
⁶⁰ Co-222S-GEA	0.8%	0.1%	2%	0.2%	9%	0.1%	2%
⁶⁰ Co-PNL-GEA	1.0%	0.1%	2%	0.2%	9%	0.1%	2%
¹⁵⁴ Eu-222S-GEA	1.0%	0.1%	2%	0.2%	9%	0.1%	2%
¹⁵⁴ Eu-PNL-GEA	1.0%	0.1%	2%	0.2%	9%	0.1%	2%
¹⁵⁵ Eu-222S-GEA	5.0%	0.1%	2%	0.2%	9%	0.1%	2%
¹⁵⁵ Eu-PNL-GEA	5.0%	0.1%	2%	0.2%	9%	0.1%	2%

Table 5-2. Systematic Analytical Variability - Channel. (sheet 1 of 2)

Channel section							Constituent, laboratory, method
Part 1	Part 2	Part 3	Part 4	Part 5	Part 6	Part 7	
Lab	Volume	Weight	DF _{PCL}	Sludge volume	Weight	Weight	
"X"							
Pu-PNL-ICP/MS	3%	0.1%	2%	0.2%	53%	0.1%	2%
Pu-222S-AEA	5%	0.1%	2%	0.2%	53%	0.1%	2%
U-PNL-ICP/MS	10.5%	0.1%	2%	0.2%	53%	0.1%	2%
U-PNL-laser	10%	0.1%	2%	0.2%	53%	0.1%	2%
U-222S-laser	10%	0.1%	2%	0.2%	53%	0.1%	2%
Al-222S-ICP	1.9%	0.1%	2%	0.2%	53%	0.1%	2%
Al-PNL-ICP/MS	23%	0.1%	2%	0.2%	53%	0.1%	2%
Ba-222S-ICP	1.8%	0.1%	2%	0.2%	53%	0.1%	2%
Ba-PNL-ICP/MS	2.1%	0.1%	2%	0.2%	53%	0.1%	2%
Be-222S-ICP	1.7%	0.1%	2%	0.2%	53%	0.1%	2%
Be-PNL-ICP/MS	12.7%	0.1%	2%	0.2%	53%	0.1%	2%
Ca-222S-ICP	1.3%	0.1%	2%	0.2%	53%	0.1%	2%
Ca-PNL-ICP/MS	6.5%	0.1%	2%	0.2%	53%	0.1%	2%

§: Not all the spike recoveries were used to determine the laboratory systematic error. This included the spike recovery of 276% for Al, 320% for Ca, and -257% for Fe.

Table 5-2. Systematic Analytical Variability - Channel. (sheet 2 of 2)

Channel section Constituent, laboratory, method	"X"						
	Part 1	Part 2	Part 3	Part 4	Part 5	Part 6	Part 7
	Lab	Volume	Weight	DF _{PCL}	Sludge volume	0.998	Weight
Cd-222S-ICP	3.8%	0.1%	2%	0.2%	53%	0.1%	2%
Cd-PNL-ICP/MS	2.4%	0.1%	2%	0.2%	53%	0.1%	2%
Cr-222S-ICP	1.4%	0.1%	2%	0.2%	53%	0.1%	2%
Cr-PNL-ICP/MS	8.7%	0.1%	2%	0.2%	53%	0.1%	2%
Cu-222S-ICP	0.8%	0.1%	2%	0.2%	53%	0.1%	2%
Cu-PNL-ICP/MS	3.8%	0.1%	2%	0.2%	53%	0.1%	2%
Fe-222S-ICP	1.4%	0.1%	2%	0.2%	53%	0.1%	2%
Fe-PNL-ICP/MS	20% [§]	0.1%	2%	0.2%	53%	0.1%	2%
Mg-222S-ICP	3.5%	0.1%	2%	0.2%	53%	0.1%	2%
Mg-PNL-ICP/MS	11.3%	0.1%	2%	0.2%	53%	0.1%	2%
Mn-222S-ICP	2.2%	0.1%	2%	0.2%	53%	0.1%	2%
Mn-PNL-ICP/MS	6.7%	0.1%	2%	0.2%	53%	0.1%	2%
Pb-222S-ICP	2.1%	0.1%	2%	0.2%	53%	0.1%	2%
Pb-PNL-ICP/MS	2.4%	0.1%	2%	0.2%	53%	0.1%	2%
Zn-222S-ICP	1.8%	0.1%	2%	0.2%	53%	0.1%	2%
Zn-PNL-ICP/MS	7.9%	0.1%	2%	0.2%	53%	0.1%	2%
Na-222S-ICP	1.2%	0.1%	2%	0.2%	53%	0.1%	2%
Si-222S-ICP	1.4%	0.1%	2%	0.2%	53%	0.1%	2%
U-222S-ICP [#]	10% [♦]	0.1%	2%	0.2%	53%	0.1%	2%
Total Beta-222S	5.0%	0.1%	2%	0.2%	53%	0.1%	2%
Alpha Total-222S	1.7%	0.1%	2%	0.2%	53%	0.1%	2%
²⁴¹ Am-222S-AEA	3.5%	0.1%	2%	0.2%	53%	0.1%	2%
²⁴¹ Am-222S-GEA	5.0%	0.1%	2%	0.2%	53%	0.1%	2%
²⁴¹ Am-PNL-GEA	5.0%	0.1%	2%	0.2%	53%	0.1%	2%
¹³⁷ Cs-222S-GEA	2.3%	0.1%	2%	0.2%	53%	0.1%	2%
¹³⁷ Cs-PNL-GEA	5.0%	0.1%	2%	0.2%	53%	0.1%	2%
⁶⁰ Co-222S-GEA	0.8%	0.1%	2%	0.2%	53%	0.1%	2%
⁶⁰ Co-PNL-GEA	1.0%	0.1%	2%	0.2%	53%	0.1%	2%
¹⁵⁴ Eu-222S-GEA	1.0%	0.1%	2%	0.2%	53%	0.1%	2%
¹⁵⁴ Eu-PNL-GEA	1.0%	0.1%	2%	0.2%	53%	0.1%	2%
¹⁵⁵ Eu-222S-GEA	5.0%	0.1%	2%	0.2%	53%	0.1%	2%
¹⁵⁵ Eu-PNL-GEA	5.0%	0.1%	2%	0.2%	53%	0.1%	2%

§: Not all the spike recoveries were used to determine the laboratory systematic error. This included the spike recovery of 276% for Al, 320% for Ca, and -257% for Fe.

#: No standards were analyzed in conjunction with the 222S Laboratory ICP uranium analyses. These results are included for information only.

♦: Assigned value, standards and/or spikes were not analyzed.

Table 5-3. Overall Uncertainty Associated with the Mean - Pit. (sheet 1 of 2)

Constituent, laboratory, method	Type of uncertainty (1 RSD)					Total
	X			Y		
	Random	Sys	Sys	Random	Sys	
	Anal samp (mean)	Samp	Anal	Volume (mean)	Volume	
Pu-PNL-ICP/MS	10.2% ¹	9%	9.9%	2%	3%	18%
Pu-222S-AEA	11.0% ¹	9%	10.7%	2%	3%	18%
Pu-Combined	11.2% ²	9%	10.7%	2%	3%	19%
U-PNL-ICP/MS	9% ¹	9%	14.1%	2%	3%	19%
U-PNL-laser	11% ¹	9%	13.7%	2%	3%	20%
U-222S-laser	16% ¹	9%	13.7%	2%	3%	23%
U-Combined	10% ² * 14% ² #	9%	14.1%	2%	3%	20% 24%
Al-Combined	9.6% ²	9%	25%	2%	3%	28%
Ba-Combined	23.6% ²	9%	10%	2%	3%	27%
Be-Combined	26.6% ²	9%	16%	2%	3%	32%
Ca-Combined	19.7% ²	9%	12%	2%	3%	25%
Cd-Combined	15.4% ²	9%	10%	2%	3%	21%
Cr-Combined	37.3% ²	9%	13%	2%	3%	41%
Cu-Combined	21.0% ²	9%	10%	2%	3%	25%
Fe-Combined	24.6% ²	9%	22%	2%	3%	34%
Mg-Combined	19.6% ²	9%	15%	2%	3%	27%
Mn-Combined	11.4% ²	9%	12%	2%	3%	19%
Pb-Combined	10.9% ²	9%	10%	2%	3%	18%
Zn-Combined	9.5% ²	9%	12%	2%	3%	18%
Na-222S-ICP	25.5% ¹	9%	10%	2%	3%	29%
Si-222S-ICP	14.7% ¹	9%	10%	2%	3%	20%
U-222S-ICP ^{&}	10.3% ¹	9%	14%	2%	3%	20%

SYS: Systematic.

Anal: Analytical.

Samp: Sampling.

1: The random analytical and sampling uncertainty was determined from the ANOVA using model 1.

2: The random analytical and sampling uncertainty was determined from the ANOVA results using model 2.

*: The combined analytical and sampling uncertainty used PNL ICP/MS data, PNL laser data, and the 222S laser data that was not marked as questionable.

#: The combined analytical and sampling uncertainty used PNL ICP/MS data, PNL laser data, and all the 222S laser data.

&: No standards were analyzed in conjunction with the 222S ICP uranium analyses. These results are included for information only.

Table 5-3. Overall Uncertainty Associated with the Mean - Pit. (sheet 2 of 2)

Constituent, laboratory, method	Type of uncertainty (1 RSD)					Total
	X			Y		
	Random	Sys	Sys	Random	Sys	
	Anal samp (mean)	Samp	Anal	Volume (mean)	Volume	
Total Beta-222S	23.6% ¹	9%	11%	2%	3%	28%
Alpha Total-222S	12.4% ¹	9%	12%	2%	3%	20%
²⁴¹ Am-222S-AEA	10.9% ¹	9%	11%	2%	3%	18%
²⁴¹ Am-Combined-GEA	10.5% ²	9%	12%	2%	3%	19%
¹³⁷ Cs-Combined-GEA	19.7% ²	9%	11%	2%	3%	25%
⁶⁰ Co-Combined-GEA	9.9% ²	9%	10%	2%	3%	17%
¹⁵⁴ Eu-Combined-GEA	10.9% ²	9%	10%	2%	3%	17%
¹⁵⁵ Eu-Combined-GEA	11.1% ²	9%	12%	2%	3%	19%

Table 5-4. Overall Uncertainty Associated with the Mean - Channel. (sheet 1 of 2)

Constituent, laboratory, method	Type of uncertainty (1 RSD)					Total
	X			Y		
	Random	Sys	Sys	Random	Sys	
	Anal samp (mean)	Samp	Anal	Volume (mean)	Volume	
Pu-PNL-ICP/MS	11% ¹	9%	53.2%	12%	5%	57%
Pu-222S-AEA	13% ¹	9%	53.3%	12%	5%	57%
Pu-Combined (ICP/MS, AEA)	12% ²	9%	53.3%	12%	5%	57%
U-PNL-ICP/MS	4.4% ¹	9%	54.1%	12%	5%	57%
U-PNL-laser	6.5% ¹	9%	54.0%	12%	5%	57%
U-222S-laser	4.2% ¹	9%	54.0%	12%	5%	56%
U-Combined (ICP/MS, laser)	5.0% ²	9%	54.0%	12%	5%	57%
Al-Combined	13.3% ²	9%	58%	12%	5%	61%
Ba-Combined	34.5% ²	9%	53%	12%	5%	65%
Be-Combined	50.1% ²	9%	55%	12%	5%	76%
Ca-Combined	25.7% ²	9%	53%	12%	5%	61%
Cd-Combined	27.5% ²	9%	53%	12%	5%	62%

SYS: Systematic.

Anal: Analytical.

Samp: Sampling.

1: The random analytical and sampling uncertainty was determined from the ANOVA using model 1.

2: The random analytical and sampling uncertainty was determined from the ANOVA results using model 2.

Table 5-4. Overall Uncertainty Associated with the Mean - Channel. (sheet 2 of 2)

Constituent, laboratory, method	Type of uncertainty (1 RSD)					Total
	X			Y		
	Random	Sys	Sys	Random	Sys	
	Anal samp (mean)	Samp	Anal	Volume (mean)	Volume	
Cr-Combined	22.0% ²	9%	54%	12%	5%	60%
Cu-Combined	12.5% ²	9%	53%	12%	5%	57%
Fe-Combined	38.8% ²	9%	57%	12%	5%	71%
Mg-Combined	39.1% ²	9%	54%	12%	5%	69%
Mn-Combined	19.3% ²	9%	54%	12%	5%	59%
Pb-Combined	16.6% ²	9%	53%	12%	5%	58%
Zn-Combined	22.6% ²	9%	54%	12%	5%	60%
Na-222S-ICP	22.6% ¹	9%	53%	12%	5%	60%
Si-222S-ICP	19.7% ¹	9%	53%	12%	5%	59%
U-222S-ICP ^{&}	6.8% ¹	9%	54%	12%	5%	57%
Total Beta-222S	7.0% ¹	9%	53%	12%	5%	56%
Alpha Total-222S	8.5% ¹	9%	54%	12%	5%	56%
²⁴¹ Am-222S-AEA	12.0% ¹	9%	53%	12%	5%	57%
²⁴¹ Am-Combined-GEA	12.4% ²	9%	54%	12%	5%	57%
¹³⁷ Cs-Combined-GEA	24.4% ²	9%	53%	12%	5%	61%
⁶⁰ Co-Combined-GEA	13.3% ²	9%	53%	12%	5%	57%
¹⁵⁴ Eu-Combined-GEA	8.9% ²	9%	53%	12%	5%	56%
¹⁵⁵ Eu-Combined-GEA	9.7% ²	9%	54%	12%	5%	57%

SYS: Systematic.

Anal: Analytical.

Samp: Sampling.

1: The random analytical and sampling uncertainty was determined from the ANOVA using model 1.

2: The random analytical and sampling uncertainty was determined from the ANOVA results using model 2.

&: No standards were analyzed in conjunction with the 222S ICP uranium analyses. These results are included for information only.

Table 5-5. Overall Uncertainty Associated with the Mean - Structures.

Constituent, laboratory, method	Type of uncertainty (1 RSD)					Total
	X			Y		
	Random	Sys	Sys	Random	Sys	
	Anal samp (mean)	Samp	Anal	Volume (mean)	Volume	
Pu-PNL-ICP/MS	12%	9%	10%	12%	10%	24%
Pu-222S-AEA	13%	9%	11%	12%	10%	25%
U-PNL-ICP/MS	9%	9%	14%	12%	10%	25%
U-PNL-laser	11%	9%	14%	12%	10%	25%
U-222S-laser	16%	9%	14%	12%	10%	28%
Al-Combined	13.3%	9%	25%	12%	10%	25%
Ba-Combined	34.5%	9%	10%	12%	10%	40%
Be-Combined	50.1%	9%	16%	12%	10%	56%
Ca-Combined	25.7%	9%	12%	12%	10%	33%
Cd-Combined	27.5%	9%	10%	12%	10%	35%
Cr-Combined	37.3%	9%	13%	12%	10%	43%
Cu-Combined	21.0%	9%	10%	12%	10%	29%
Fe-Combined	38.8%	9%	22%	12%	10%	48%
Mg-Combined	39.1%	9%	15%	12%	10%	46%
Mn-Combined	19.3%	9%	12%	12%	10%	29%
Pb-Combined	16.6%	9%	10%	12%	10%	26%
Zn-Combined	22.6%	9%	12%	12%	10%	31%
Na-222S-ICP	25.5%	9%	10%	12%	10%	33%
Si-222S-ICP	19.7%	9%	10%	12%	10%	28%
U-222S-ICP ^{&}	10.3%	9%	14%	12%	10%	25%
Total Beta-222S	23.6%	9%	11%	12%	10%	32%
Alpha Total-222S	12.4%	9%	12%	12%	10%	25%
²⁴¹ Am-222S-AEA	12.0%	9%	11%	12%	10%	24%
²⁴¹ Am-Combined-GEA	12.4%	9%	12%	12%	10%	25%
¹³⁷ Cs-Combined-GEA	24.4%	9%	11%	12%	10%	32%
⁶⁰ Co-Combined-GEA	13.3%	9%	10%	12%	10%	24%
¹⁵⁴ Eu-Combined-GEA	10.9%	9%	10%	12%	10%	23%
¹⁵⁵ Eu-Combined-GEA	11.1%	9%	12%	12%	10%	24%

SYS: Systematic.
 Anal: Analytical.
 Samp: Sampling.
 &: No standards were analyzed in conjunction with the 222S ICP uranium analyses. These results are included for information only.

5.2 TOTAL QUANTITY OF AN ANALYTE AND THE ASSOCIATED UNCERTAINTY

The total quantity of an analyte (e.g., Pu or U) for the 105KE Basin Backwash Pit is the sum of the analyte values estimated for the three sections of the Backwash Pit. That is,

$$T = P + C + S$$

where T is the total quantity of the analyte of interest, P is the quantity of the analyte of interest from the pit, C is the quantity of the analyte of interest from the channel, and S is the quantity of the analyte of interest from the structures. The variability associated with T is estimated using the equation

$$\text{Var}(T) = \text{Var}(P) + \text{Var}(C) + \text{Var}(S)$$

where Var represents the variance (variance = mean² * RSD²). It is assumed that P, C, and S are independent. Both the mean value and the associated RSD, by section, are given in Tables 5-3, 5-4, and 5-5. The total amount for an analyte along with the associated uncertainty are provided in Table 5.6. The total Pu content is given in Warner and Harris (1994). The total uranium content differs from that given in Warner and Harris (1994) because the smaller uranium result from the research samples was used to calculate the quantity on the structurals instead of the larger uranium result.

Table 5-6. K East Basin Sandfilter Backwash Pit Contents. (sheet 1 of 2)

Analyte	Total amount (mean)	Uncertainty (1 RSD) [■]
Plutonium	9.75E+01 g [*]	19.1%
Uranium	3.90E+01 Kg [▲] 4.21E+01 Kg [#]	20.4% 20.3%
Aluminum	3.00E+04 g	25.1%
Barium	4.01E+02 g	24.8%
Beryllium	2.92E+01 g	30.5%
Calcium	2.27E+04 g	24.2%
Cadmium	2.06E+02 g	20.4%
Chromium	4.94E+02 g	35.1%
Copper	1.04E+03 g	23.0%
Iron	8.98E+04 g	34.4%
Magnesium	2.86E+03 g	25.1%

■: The uncertainty, in terms of 1 RSD, associated with the mean value.

*: The value reported in SD-WHC-WM-TA-152, Rev. 0.

▲: This value is different from the value reported in SD-WHC-WM-TA-152, Rev. 0, because the minimum uranium result from the research samples was used for the structures instead of the maximum uranium result from the research samples.

#: The laser fluorometry uranium data, marked as questionable by 222S Laboratory were used in the statistical analysis.

Table 5-6. K East Basin Sandfilter Backwash Pit Contents. (sheet 2 of 2)

Analyte	Total amount (mean)	Uncertainty (1 RSD) [■]
Manganese	1.24E+03 g	18.6%
Lead	3.47E+02 g	17.8%
Zinc	8.88E+02 g	20.2%
Sodium	1.63E+03 g	26.4%
Silicon	3.44E+03 g	19.8%
Uranium (222S ICP) ^{&}	3.80E+01 Kg	19.1%
Total Beta	1.76E+02 Ci	24.9%
Alpha Total	1.17E+01 Ci	19.9%
²⁴¹ Am (AEA)	6.65E+00 Ci	18.4%
²⁴¹ Am (GEA)	6.67E+00 Ci	19.1%
¹³⁷ Cs	6.14E+01 Ci	22.9%
⁶⁰ Co	1.36E+00 Ci	17.2%
¹⁵⁴ Eu	1.36E+00 Ci	17.8%
¹⁵⁵ Eu	7.46E-01 Ci	22.2%

■: The uncertainty, in terms of 1 RSD, associated with the mean value.

&: No standards were analyzed in conjunction with the 222S Laboratory ICP uranium analyses. These results are included for information only.

The analytes silver, boron, molybdenum, samarium, thallium, and plutonium-238 are not included in the above table due to the quantity of "less than" values obtained in the laboratory analyses.

6.0 STATISTICAL CORRELATIONS

Several correlations between the 105KE Sandfilter Backwash Pit sample results were of interest. Linear regression techniques were used to determine the correlations. The data used in the regression analysis are provided in Tables C-1 through C-15, Appendix C. Linear regression techniques provide equations of the form

$$Y = a + bX$$

where Y is the dependent variable, X is the independent variable, b is the slope, and a is the y-intercept. The regression results are provided in Table 6-1. The data and the regression equation for each correlation of interest are illustrated in Figures E-1 through E-24, Appendix E.

Several measures of association are also provided in Table 6-1. Measures of association are used to determine how "good" the regression equation is. The coefficient of determination, the R^2 value, indicates the amount of variability of Y (dependent variable) associated with the use of X (independent variable). The closer an R^2 value is to 100%, the greater is said to be the degree of association. The square root of R^2 , $\pm r$, is called the correlation coefficient. A plus or minus sign is attached to this measure according to whether the slope of the fitted regression line is positive or negative. The correlation coefficient indicates the strength and magnitude of the linear relationship. The standard error of the Y estimate indicates the width of the confidence or prediction interval (precision). The standard error of the Y estimate is also known as the square root of the mean square error obtained from the linear regression analysis.

Table 6-1. Results of the Regression Analysis.

	Dependent variable	Units	Independent variable	Units	Slope	Sign diff 0	Constant	R ²	r	Std Err of Y Est	N
1	Solids concentration	g/mL	Pu-PNL-ICP/MS	mg/g	-9.910E-01	Yes	4.698E-01	50.2%	-0.708	1.56E-01	14
2	Solids concentration	g/mL	Pu-222S-AEA	mg/g	-9.192E-01	Yes	4.680E-01	49.8%	-0.705	1.56E-01	14
3	Solids concentration	g/mL	U-PNL-laser	mg/g	-3.510E-03	Yes	4.931E-01	56.7%	-0.753	1.45E-01	14
4	Solids concentration	g/mL	U-222S-laser	mg/g	-3.640E-03	Yes	5.122E-01	59.4%	-0.771	1.41E-01	14
5	Solids concentration	g/mL	U-PNL-ICP/MS	mg/g	-3.750E-03	Yes	4.976E-01	57.4%	-0.757	1.44E-01	14
6	Solids concentration	g/mL	Am241-222S-AEA	uCi/g	-1.424E-02	Yes	4.713E-01	52.0%	-0.721	1.53E-01	14
7	Solids concentration	g/mL	Am241-PNL-GEA	uCi/g	-1.285E-02	Yes	4.678E-01	51.1%	-0.715	1.54E-01	14
8	AT-222S	uCi/g	Pu-222S-AEA	uCi/g	1.430E+00	Yes	2.755E-01	99.3%	0.996	1.72E+00	14
9	Am241-PNL-GEA	uCi/g	Pu239-PNL-ICP/MS	mg/g	7.717E+01	Yes	-1.647E-01	98.3%	0.991	1.62E+00	14
10	Cs137-PNL-GEA	uCi/g	Pu239-PNL-ICP/MS	mg/g	2.021E+02	Yes	1.536E+01	82.9%	0.910	1.45E+01	14
11	Co60-PNL-GEA	uCi/g	Pu239-PNL-ICP/MS	mg/g	8.253E+00	Yes	2.232E-01	96.3%	0.981	2.55E-01	14
12	Eu154-PNL-GEA	uCi/g	Pu239-PNL-ICP/MS	mg/g	1.445E+01	Yes	3.319E-02	98.0%	0.990	3.27E-01	14
13	Eu155-PNL-GEA	uCi/g	Pu239-PNL-ICP/MS	mg/g	8.221E+00	Yes	5.950E-03	98.6%	0.993	1.57E-01	14
14	Pu239-PNL-ICP/MS	mg/g	Cs137-PNL-GEA	uCi/g	4.100E-03	Yes	-4.560E-02	82.9%	0.910	6.53E-02	14
15	Am241-222S-GEA	uCi/g	Pu-222S-AEA	uCi/g	8.454E-01	Yes	-8.769E-02	99.6%	0.998	8.07E-01	11
16	Cs137-222S-GEA	uCi/g	Pu-222S-AEA	uCi/g	2.312E+00	Yes	1.916E+01	86.2%	0.929	1.47E+01	11
17	Co60-222S-GEA	uCi/g	Pu-222S-AEA	uCi/g	9.590E-02	Yes	2.528E-01	94.4%	0.971	3.91E-01	10
18	Eu154-222S-GEA	uCi/g	Pu-222S-AEA	uCi/g	1.578E-01	Yes	5.510E-02	97.4%	0.987	4.82E-01	8
19	Eu155-222S-GEA	uCi/g	Pu-222S-AEA	uCi/g	9.042E-02	Yes	1.398E-03	98.9%	0.994	1.92E-01	7
20	Am241-222S-GEA	uCi/g	Am241-222S-AEA	uCi/g	1.055E+00	Yes	-1.050E-01	99.9%	0.999	4.35E-01	11
21	Am241-PNL-GEA	uCi/g	Am241-PNL-AEA	uCi/g	1.081E+00	Yes	-2.864E-01	100.0%	1.000	5.71E-02	5
22	Pu-222S-AEA	uCi/g	Cs137-222S-GEA	uCi/g	3.730E-01	Yes	-5.807E+00	86.2%	0.929	5.90E+00	11
23	Pu-222S-AEA	uCi/g	Eu154-222S-GEA	uCi/g	6.170E+00	Yes	-1.536E-02	97.4%	0.987	3.01E+00	8
24	Pu-222S-AEA	uCi/g	Eu155-222S-GEA	uCi/g	1.093E+01	Yes	1.426E-01	98.9%	0.994	2.12E+00	7

Sign Diff 0: Is the slope significantly different from zero at the 0.05 level of significance?

Std Err of Y Est: Standard error of the Y estimate.

R²: The coefficient of determination.

r: The coefficient of correlation.

N: The number of observations used in the regression analysis.

7.0 REFERENCES

- Bechtold, D. B., 1994, *Report of Laboratory Test Plan for Analysis of KE Basin Backwash Pit Samples*, WHC-SD-NR-TRP-021, Rev. 0, Westinghouse Hanford Company, Richland, Washington.
- Bushore, R. P., 1993, *Sampling and Analysis Plan for 105-KE Basin Filter Backwash Pit*, WHC-SD-NR-PLN-013, Rev. 1, Westinghouse Hanford Company, Richland, Washington.
- Warner, R. D., 1994, *105-KE SFBWP Sludge Volume Calculation*, WHC-SD-WM-TI-606, Rev. 0, Westinghouse Handford Company, Richland, Washington.
- Warner, R. D., and R. A. Harris, 1994, *Safety Evaluation of the Plutonium and Uranium Content of the K East Basin Sandfilter Backwash Pit*, WHC-SD-WM-TA-152, Rev. 0, Westinghouse Handford Company, Richland, Washington.

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APPENDIX A

K East Basin Sandfilter Backwash Pit

ANALYTICAL SAMPLE RESULTS

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Table A-1. Plutonium Data from the Pit Samples.

Sample number	Result	²³⁹ Pu ICP/MS mg/g	²³⁹ Pu ICP/MS Mass %	Total Pu ICP/MS mg/g	Total Pu AEA-222S mg/g	Total Pu* AEA-PNL mg/g
1	1	7.22E-02	85.46	8.45E-02	9.36E-02	
	2	7.15E-02	85.45	8.37E-02	8.83E-02	
	3	7.48E-02	85.43	8.76E-02	9.32E-02	
2	1	3.89E-02	85.60	4.54E-02	4.51E-02	
	2	3.47E-02	85.59	4.05E-02	4.34E-02	
	3	3.87E-02	85.66	4.52E-02	3.95E-02	
3	1	1.89E-02	85.69	2.21E-02	2.72E-02	2.51E-02
	2	1.94E-02	85.71	2.26E-02	2.74E-02	2.59E-02
	3	2.01E-02	85.70	2.35E-02	2.74E-02	2.96E-02
4	1	3.28E-02	85.71	3.83E-02	3.83E-02	
	2	3.40E-02	85.60	3.97E-02	3.72E-02	
	3	3.32E-02	85.58	3.88E-02	3.44E-02	
5	1	2.32E-02	85.72	2.71E-02	2.62E-02	2.76E-02
	2	2.35E-02	85.75	2.74E-02	2.60E-02	3.29E-02
	3	2.48E-02	85.78	2.89E-02	2.73E-02	2.67E-02
6	1	5.95E-02	85.62	6.95E-02	7.21E-02	
	2	6.16E-02	85.67	7.19E-02	7.37E-02	
	3	5.84E-02	85.67	6.82E-02	6.72E-02	
7	1	1.95E-02	85.95	2.27E-02	2.68E-02	
	2	1.90E-02	85.95	2.21E-02	2.56E-02	
	3	2.02E-02	85.96	2.35E-02	2.77E-02	
8	1	8.91E-03	85.60	1.04E-02	1.05E-02	
	2	9.75E-03	85.60	1.14E-02	1.24E-02	
	3	8.98E-03	85.67	1.05E-02	1.13E-02	
15	1	3.36E-01	85.70	3.92E-01	4.02E-01	4.81E-01
	2	3.62E-01	85.69	4.22E-01	3.87E-01	4.55E-01
	3	3.53E-01	85.71	4.12E-01	4.37E-01	4.34E-01
16	1	3.97E-02	85.66	4.63E-02	4.66E-02	6.11E-02
	2	4.18E-02	85.69	4.88E-02	5.02E-02	5.47E-02
	3	4.46E-02	85.66	5.20E-02	4.72E-02	5.13E-02

*: The Total Pu results by AEA-PNL were not used in determining the overall Pu content of the K East Sandfilter Backwash Pit. These results were used for confirmation only.
mg/g: mg/g dried solid after the water was removed from the sample.

Table A-2. Uranium Data from the Pit Samples.

Sample number	Result	U-Laser PNL mg/g	U-Laser 222S mg/g	U-ICP/MS PNL mg/g
1	1	3.81E+01	3.65E+01	3.95E+01
	2	3.69E+01	3.93E+01	3.97E+01
	3	3.81E+01	3.65E+01	3.99E+01
2	1	1.30E+01	1.11E+01	1.43E+01
	2	1.30E+01	1.05E+01	1.32E+01
	3	1.30E+01	1.11E+01	1.48E+01
3	1	1.42E+01	1.23E+01	1.48E+01
	2	1.44E+01	1.34E+01	1.49E+01
	3	1.42E+01	1.38E+01	1.53E+01
4	1	2.34E+01	3.23E+01 *	1.97E+01
	2	2.28E+01	3.23E+01 *	1.98E+01
	3	2.22E+01	3.23E+01 *	1.82E+01
5	1	1.25E+01	1.67E+01 *	1.29E+01
	2	1.31E+01	1.67E+01 *	1.30E+01
	3	1.22E+01	1.83E+01 *	1.32E+01
6	1	3.24E+01	5.14E+01 *	3.02E+01
	2	3.12E+01	5.37E+01 *	2.89E+01
	3	3.22E+01	5.14E+01 *	3.10E+01
7	1	7.69E+00	1.18E+01 *	7.81E+00
	2	7.69E+00	1.41E+01 *	8.25E+00
	3	7.69E+00	1.41E+01 *	8.41E+00
8	1	4.25E+00	5.98E+00 *	4.34E+00
	2	4.25E+00	6.12E+00 *	4.45E+00
	3	4.25E+00	5.98E+00 *	4.44E+00
15	1	1.15E+02	1.37E+02 *	1.06E+02
	2	1.12E+02	1.37E+02 *	1.11E+02
	3	1.16E+02	1.22E+02 *	1.07E+02
16	1	1.68E+01	3.07E+01 *	1.58E+01
	2	1.74E+01	3.07E+02 *	1.63E+01
	3	1.62E+01	3.38E+02 *	1.75E+01

*: Data said to be questionable by the laboratory.

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-3. Al and Ba Data from the Pit Samples.

Sample number	Result	Al-222S ICP mg/g	Al-PNL ICP/MS mg/g	Ba-222S ICP mg/g	Ba-PNL ICP/MS mg/g
1	1	2.64E+01	2.29E+01	9.43E-02	1.57E-01
	2	2.58E+01	2.79E+01	9.10E-02	1.40E-01
	3	2.59E+01	2.55E+01	9.11E-02	1.51E-01
2	1	1.13E+01	1.04E+01	8.19E-02	1.73E-01
	2	1.14E+01	9.37E+00	8.25E-02	1.65E-01
	3	1.10E+01	1.17E+01	7.89E-02	1.71E-01
3	1	1.62E+01	1.55E+01	2.56E-01	3.37E-01
	2	1.67E+01	1.71E+01	2.68E-01	3.40E-01
	3	1.68E+01	1.70E+01	2.71E-01	3.30E-01
4	1	1.37E+01	1.37E+01	1.82E-01	2.21E-01
	2	1.35E+01	1.27E+01	1.80E-01	2.10E-01
	3	1.32E+01	1.27E+01	1.74E-01	1.87E-01
5	1	9.47E+00	9.50E+00	1.29E-01	1.57E-01
	2	9.30E+00	9.05E+00	1.27E-01	1.52E-01
	3	9.31E+00	8.95E+00	1.27E-01	1.61E-01
6	1	1.83E+01	1.68E+01	2.76E-01	3.30E-01
	2	1.79E+01	1.68E+01	2.69E-01	2.97E-01
	3	1.77E+01	1.63E+01	2.63E-01	3.14E-01
7	1	6.69E+00	6.87E+00	8.43E-02	1.12E-01
	2	6.74E+00	5.85E+00	8.61E-02	1.25E-01
	3	6.85E+00	6.45E+00	8.74E-02	1.14E-01
8	1	6.25E+00	6.95E+00	4.12E-02	7.20E-02
	2	6.39E+00	5.95E+00	4.17E-02	7.65E-02
	3	6.42E+00	6.60E+00	4.29E-02	7.00E-02
15	1	6.32E+01	6.15E+01	1.80E-01	2.51E-01
	2	6.46E+01	6.95E+01	1.84E-01	2.48E-01
	3	6.49E+01	6.10E+01	1.87E-01	2.51E-01
16	1	9.45E+00	9.27E+00	9.31E-02	1.24E-01
	2	9.31E+00	9.51E+00	9.16E-02	1.25E-01
	3	9.53E+00	9.77E+00	9.05E-02	1.25E-01

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-4. Be and Ca Data from the Pit Samples.

Sample number	Result	Be-222S ICP mg/g	Be-PNL ICP/MS mg/g	Ca-222S ICP mg/g	Ca-PNL ICP/MS mg/g
1	1	1.68E-02	3.92E-02	7.07E+00	6.41E+00
	2	1.58E-02	3.77E-02	6.77E+00	6.57E+00
	3	1.60E-02	3.60E-02	6.77E+00	7.13E+00
2	1	7.29E-03	3.60E-02	8.50E+00	7.48E+00
	2	7.34E-03	2.19E-02	8.59E+00	8.38E+00
	3	6.87E-03	1.74E-02	8.18E+00	7.84E+00
3	1	7.18E-03	2.10E-02	1.81E+01	1.93E+01
	2	7.74E-03	2.73E-02	1.88E+01	1.89E+01
	3	8.03E-03	1.95E-02	1.91E+01	2.04E+01
4	1	8.76E-03	9.51E-03	1.23E+01	1.97E+01
	2	9.63E-03	8.40E-03	1.22E+01	1.59E+01
	3	7.63E-03	7.70E-03	1.18E+01	1.28E+01
5	1	6.73E-03	5.30E-03	7.67E+00	1.35E+01
	2	7.11E-03	4.10E-03	7.58E+00	8.30E+00
	3	6.98E-03	6.67E-03	7.57E+00	7.20E+00
6	1	1.50E-02	1.47E-02	1.28E+01	1.54E+01
	2	1.30E-02	1.30E-02	1.25E+01	1.24E+01
	3	1.39E-02	1.54E-02	1.21E+01	1.28E+01
7	1	4.96E-03	3.70E-03	4.30E+00	7.20E+00
	2	5.33E-03	5.50E-03	4.31E+00	4.72E+00
	3	4.59E-03	4.10E-03	4.42E+00	3.73E+00
8	1	3.21E-03	3.50E-03	5.34E+00	1.14E+01
	2	3.58E-03	3.50E-03	5.53E+00	6.25E+00
	3	3.70E-03	2.90E-03	5.56E+00	5.30E+00
15	1	2.90E-02	4.17E-02	3.21E+00	7.40E+00
	2	3.05E-02	4.00E-02	3.31E+00	4.58E+00
	3	3.14E-02	4.50E-02	3.40E+00	2.84E+00
16	1	8.12E-03	8.57E-03	7.31E+00	8.71E+00
	2	7.21E-03	1.10E-02	7.10E+00	7.61E+00
	3	7.89E-03	1.03E-02	7.03E+00	6.21E+00

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-5. Cd and Cr Data from the Pit Samples.

Sample number	Result	Cd-222S ICP mg/g	Cd-PNL ICP/MS mg/g	Cr-222S ICP mg/g	Cr-PNL ICP/MS mg/g
1	1	7.63E-02	7.48E-02	2.62E-01	2.87E-01
	2	7.25E-02	8.13E-02	2.49E-01	3.02E-01
	3	7.35E-02	9.00E-02	2.54E-01	2.93E-01
2	1	4.89E-02	5.10E-02	1.62E-01	1.78E-01
	2	4.94E-02	5.90E-02	1.63E-01	1.91E-01
	3	4.55E-02	5.43E-02	1.54E-01	1.92E-01
3	1	9.01E-02	1.15E-01	8.93E-02	1.33E-01
	2	9.58E-02	1.22E-01	9.43E-02	1.24E-01
	3	9.80E-02	1.01E-01	9.43E-02	1.17E-01
4	1	1.29E-01	1.23E-01	1.55E-01	1.75E-01
	2	1.26E-01	1.19E-01	1.55E-01	1.67E-01
	3	1.18E-01	1.07E-01	1.43E-01	1.49E-01
5	1	9.13E-02	8.15E-02	8.85E-02	1.10E-01
	2	8.54E-02	7.60E-02	8.80E-02	1.03E-01
	3	8.86E-02	8.05E-02	8.40E-02	1.13E-01
6	1	1.83E-01	2.00E-01	9.89E-01	9.40E-01
	2	1.82E-01	1.70E-01	9.56E-01	9.35E-01
	3	1.71E-01	1.92E-01	9.27E-01	1.00E+00
7	1	4.13E-02	3.68E-02	4.68E-02	7.35E-02
	2	4.50E-02	3.54E-02	4.11E-02	6.55E-02
	3	4.61E-02	4.23E-02	4.43E-02	7.10E-02
8	1	3.86E-02	2.60E-02	5.66E-02	7.55E-02
	2	3.01E-02	2.88E-02	5.54E-02	7.75E-02
	3	3.32E-02	2.52E-02	5.44E-02	8.00E-02
15	1	1.18E-01	1.39E-01	5.40E-01	6.40E-01
	2	1.18E-01	1.44E-01	5.43E-01	6.25E-01
	3	1.23E-01	1.33E-01	5.50E-01	6.50E-01
16	1	7.12E-02	7.31E-02	7.90E-02	1.07E-01
	2	6.67E-02	7.39E-02	8.08E-02	1.19E-01
	3	6.43E-02	7.67E-02	7.79E-02	1.07E-01

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-6. Cu and Fe Data from the Pit Samples.

Sample number	Result	Cu-222S ICP mg/g	Cu-PNL ICP/MS mg/g	Fe-222S ICP mg/g	Fe-PNL ICP/MS mg/g
1	1	4.28E-01	4.32E-01	7.42E+01	7.50E+01
	2	4.14E-01	4.53E-01	7.07E+01	7.38E+01
	3	4.14E-01	4.44E-01	7.11E+01	6.67E+01
2	1	2.25E-01	2.15E-01	4.44E+01	4.33E+01
	2	2.28E-01	2.25E-01	4.47E+01	4.49E+01
	3	2.19E-01	2.23E-01	4.21E+01	4.03E+01
3	1	6.78E-01	7.37E-01	4.05E+01	4.58E+01
	2	7.01E-01	7.17E-01	4.29E+01	4.30E+01
	3	7.13E-01	7.84E-01	4.35E+01	4.47E+01
4	1	8.03E-01	8.40E-01	3.09E+01	4.11E+00
	2	7.95E-01	7.90E-01	3.07E+01	8.70E+00
	3	7.73E-01	7.60E-01	2.93E+01	9.65E+00
5	1	5.88E-01	6.05E-01	2.39E+01	3.40E+00
	2	5.81E-01	6.00E-01	2.36E+01	6.03E+00
	3	5.78E-01	6.40E-01	2.36E+01	7.45E+00
6	1	8.02E-01	8.35E-01	4.25E+01	9.75E+00
	2	7.87E-01	7.75E-01	4.14E+01	1.27E+01
	3	7.71E-01	8.45E-01	4.00E+01	1.39E+01
7	1	1.59E-01	1.65E-01	1.13E+01	1.31E+00
	2	1.60E-01	1.77E-01	1.13E+01	2.38E+00
	3	1.64E-01	1.59E-01	1.17E+01	2.99E+00
8	1	9.83E-02	9.25E-02	1.90E+01	3.12E+00
	2	9.54E-02	9.70E-02	1.98E+01	4.70E+00
	3	9.40E-02	9.55E-02	1.99E+01	6.30E+00
15	1	1.41E+00	1.56E+00	1.14E+02	3.79E+01
	2	1.44E+00	1.58E+00	1.19E+02	5.30E+01
	3	1.45E+00	1.61E+00	1.20E+03	4.34E+01
16	1	1.44E-01	1.39E-01	2.86E+01	8.14E+00
	2	1.40E-01	1.41E-01	2.76E+01	1.07E+01
	3	1.38E-01	1.34E-01	2.73E+01	1.17E+01

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-7. Mg and Mn Data from the Pit Samples.

Sample number	Result	Mg-222S ICP mg/g	Mg-PNL ICP/MS mg/g	Mn-222S ICP mg/g	Mn-PNL ICP/MS mg/g
1	1	8.71E-01	1.33E+00	7.91E-01	9.54E-01
	2	8.35E-01	1.41E+00	7.53E-01	9.40E-01
	3	8.42E-01	1.37E+00	7.58E-01	8.38E-01
2	1	6.57E-01	1.58E+00	3.17E-01	3.53E-01
	2	6.56E-01	8.74E-01	3.18E-01	3.87E-01
	3	6.22E-01	9.99E-01	3.01E-01	3.45E-01
3	1	1.55E+00	2.24E+00	5.18E-01	6.64E-01
	2	1.65E+00	2.24E+00	5.49E-01	6.19E-01
	3	1.66E+00	2.37E+00	5.56E-01	6.62E-01
4	1	1.88E+00	2.03E+00	7.08E-01	6.70E-01
	2	1.85E+00	1.94E+00	7.02E-01	6.70E-01
	3	1.77E+00	1.87E+00	6.74E-01	5.90E-01
5	1	1.17E+00	1.29E+00	5.55E-01	5.20E-01
	2	1.15E+00	1.27E+00	5.47E-01	5.00E-01
	3	1.15E+00	1.39E+00	5.46E-01	5.50E-01
6	1	1.31E+00	1.38E+00	9.94E-01	9.05E-01
	2	1.27E+00	1.43E+00	9.65E-01	8.95E-01
	3	1.23E+00	1.51E+00	9.35E-01	9.45E-01
7	1	4.60E-01	4.77E-01	2.42E-01	2.24E-01
	2	4.63E-01	5.20E-01	2.41E-01	2.32E-01
	3	4.75E-01	4.84E-01	2.49E-01	2.25E-01
8	1	6.41E-01	7.25E-01	1.96E-01	2.01E-01
	2	6.69E-01	8.15E-01	2.04E-01	2.23E-01
	3	6.70E-01	7.75E-01	2.04E-01	2.05E-01
15	1	1.13E+00	1.37E+00	7.08E-01	8.00E-01
	2	1.18E+00	1.38E+00	7.45E-01	7.90E-01
	3	1.19E+00	1.41E+00	7.49E-01	7.85E-01
16	1	7.46E-01	8.17E-01	4.49E-01	4.47E-01
	2	7.25E-01	8.57E-01	4.33E-01	4.55E-01
	3	7.21E-01	8.41E-01	4.30E-01	4.32E-01

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-8. Pb and Sm Data from the Pit Samples.

Sample number	Result	Pb-222S ICP mg/g	Pb-PNL ICP/MS mg/g	Sm-222S ICP mg/g	Sm-PNL ICP/MS mg/g
1	1	3.28E-01	3.47E-01	4.01E-02	<
	2	3.13E-01	3.47E-01	2.48E-02	<
	3	3.18E-01	3.13E-01	2.56E-02	<
2	1	1.53E-01	1.52E-01	3.56E-02	<
	2	1.56E-01	2.31E-01	1.58E-02	<
	3	1.46E-01	1.42E-01	<	<
3	1	1.56E-01	2.40E-01	4.28E-02	<
	2	1.60E-01	1.65E-01	5.26E-02	<
	3	1.62E-01	1.68E-01	4.96E-02	<
4	1	1.68E-01	1.43E-01	<	1.90E-03
	2	1.64E-01	1.37E-01	<	1.50E-03
	3	1.12E-01	1.29E-01	<	1.62E-03
5	1	1.28E-01	9.15E-02	<	1.20E-03
	2	9.91E-02	8.60E-02	<	1.20E-03
	3	9.74E-02	8.95E-02	7.88E-02	2.00E-03
6	1	2.21E-01	1.65E-01	1.15E-01	3.80E-03
	2	2.04E-01	1.53E-01	8.39E-02	2.30E-03
	3	1.45E-01	1.57E-01	7.73E-02	2.00E-03
7	1	8.27E-02	6.30E-02	<	4.30E-04
	2	8.23E-02	6.80E-02	<	9.00E-04
	3	1.14E-01	6.45E-02	<	7.50E-04
8	1	1.09E-01	4.91E-02	<	1.00E-03
	2	<	5.20E-02	7.09E-02	1.03E-03
	3	<	4.83E-02	<	1.50E-03
15	1	1.09E+00	1.07E+00	2.93E-01	1.30E-02
	2	1.06E+00	1.08E+00	3.63E-01	1.20E-02
	3	1.10E+00	1.09E+00	3.46E-01	1.00E-02
16	1	1.27E-01	7.31E-02	<	1.30E-03
	2	1.18E-01	7.41E-02	<	1.90E-03
	3	9.71E-02	7.47E-02	<	1.30E-03

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-9. Tl and Zn Data from the Pit Samples.

Sample number	Result	Tl-222S ICP mg/g	Tl-PNL ICP/MS mg/g	Zn-222S ICP mg/g	Zn-PNL ICP/MS mg/g
1	1	1.38E-01	<	5.06E-01	6.37E-01
	2	9.86E-02	<	4.90E-01	6.80E-01
	3	1.04E-01	<	4.93E-01	5.92E-01
2	1	4.62E-02	<	2.82E-01	3.15E-01
	2	3.81E-02	<	2.81E-01	3.79E-01
	3	<	<	2.69E-01	3.35E-01
3	1	<	<	2.80E-01	4.27E-01
	2	5.08E-02	<	2.92E-01	3.83E-01
	3	4.10E-02	<	2.95E-01	4.05E-01
4	1	<	4.80E-04	3.70E-01	3.35E-01
	2	<	1.64E-04	3.56E-01	3.52E-01
	3	<	2.51E-04	3.63E-01	3.37E-01
5	1	<	1.40E-04	2.75E-01	2.33E-01
	2	<	2.20E-04	2.69E-01	2.64E-01
	3	<	3.20E-04	2.49E-01	2.48E-01
6	1	<	5.20E-04	5.29E-01	5.15E-01
	2	<	6.20E-04	5.21E-01	5.05E-01
	3	<	2.60E-04	5.04E-01	5.65E-01
7	1	<	3.20E-04	1.43E-01	1.64E-01
	2	<	3.00E-04	1.49E-01	1.35E-01
	3	<	1.60E-04	1.84E-01	1.50E-01
8	1	<	2.00E-04	1.98E-01	1.77E-01
	2	<	1.30E-04	2.08E-01	1.79E-01
	3	<	1.80E-04	2.17E-01	2.00E-01
15	1	4.38E-01	4.30E-04	1.11E+00	1.17E+00
	2	5.23E-01	1.00E-05	1.18E+00	1.14E+00
	3	5.95E-01	4.70E-04	1.18E+00	1.20E+00
16	1	<	1.90E-04	3.14E-01	3.19E-01
	2	<	1.50E-04	3.04E-01	3.33E-01
	3	<	1.40E-04	3.09E-01	3.49E-01

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-10. B, Mo, Na, Si and U (222S-ICP) Data from the Pit Samples.

Sample number	Result	B-222S ICP mg/g	Mo-222S ICP μg/g	Na-222S ICP μg/g	Si-222S ICP μg/g	U-222S* ICP mg/g
1	1	1.69E-02	7.57E+00	5.32E+02	2.41E+03	3.57E+01
	2	1.23E-02	6.43E+00	5.24E+02	2.36E+03	3.44E+01
	3	1.43E-02	6.63E+00	5.23E+02	2.37E+03	3.44E+01
2	1	1.18E-02	4.37E+00	4.55E+02	1.53E+03	1.23E+01
	2	1.16E-02	4.32E+00	4.57E+02	1.51E+03	1.28E+01
	3	8.33E-03	3.99E+00	4.47E+02	1.47E+03	1.29E+01
3	1	8.76E-03	<	1.63E+03	1.44E+03	1.31E+01
	2	8.57E-03	<	1.66E+03	1.50E+03	1.37E+01
	3	1.00E-02	<	1.67E+03	1.52E+03	1.39E+01
4	1	<	<	7.31E+02	1.13E+03	2.17E+01
	2	<	<	7.16E+02	1.11E+03	2.16E+01
	3	<	<	7.06E+02	1.07E+03	2.07E+01
5	1	1.67E-02	<	5.90E+02	1.08E+03	1.30E+01
	2	<	<	5.84E+02	1.07E+03	1.28E+01
	3	<	<	5.87E+02	1.07E+03	1.29E+01
6	1	<	2.23E+01	9.39E+02	9.13E+02	3.22E+01
	2	<	<	9.15E+02	8.94E+02	3.13E+01
	3	<	1.97E+01	8.92E+02	8.73E+02	3.06E+01
7	1	<	<	3.66E+02	9.75E+02	8.00E+00
	2	<	<	3.63E+02	9.82E+02	7.71E+00
	3	<	<	4.06E+02	1.01E+03	8.08E+00
8	1	<	<	2.42E+02	1.05E+03	4.06E+00
	2	<	<	2.43E+02	1.07E+03	4.35E+00
	3	<	<	2.46E+02	1.08E+03	4.37E+00
15	1	<	<	8.09E+02	1.42E+03	1.07E+02
	2	<	<	8.28E+02	1.47E+03	1.10E+02
	3	<	<	8.45E+02	1.47E+03	1.11E+02
16	1	<	<	3.67E+02	1.00E+03	1.59E+01
	2	<	<	3.69E+02	9.78E+02	1.56E+01
	3	<	<	2.88E+03 ^{\$}	9.81E+02	1.54E+01

*: The U results from the ICP-222S were not used in determining the overall U content of the K East Sandfilter Backwash Pit. These results were used for confirmation only.

mg/g: mg/g dried solid after the water was removed from the sample.

μg/g: μg/g dried solid after the water was removed from the sample.

\$: Possible outlier, data not used in any calculations.

Table A-11. Alpha Total (AT) and Total Beta (TB) Data from the Pit Samples.

Sample number	Result	TB 222S $\mu\text{Ci/g}$	TB* PNL $\mu\text{Ci/g}$	AT 222S $\mu\text{Ci/g}$	AT* PNL $\mu\text{Ci/g}$
1	1	6.13E+01		1.21E+01	
	2	6.57E+01		1.27E+01	
	3	6.25E+01		1.29E+01	
2	1	3.79E+01		5.62E+00	
	2	3.97E+01		6.04E+00	
	3	3.95E+01		5.56E+00	
3	1	1.62E+02	1.12E+02	2.91E+00	5.05E+00
	2	1.54E+02	1.14E+02	3.64E+00	4.72E+00
	3	1.53E+02	1.18E+02	3.58E+00	4.79E+00
4	1	9.76E+01		4.22E+00	
	2	1.00E+02		4.33E+00	
	3	9.62E+01		4.65E+00	
5	1	5.83E+01	5.04E+01	3.34E+00	5.63E+00
	2	5.70E+01	4.40E+01	2.75E+00	4.41E+00
	3	5.63E+01	4.80E+01	2.99E+00	5.06E+00
6	1	1.23E+02		8.03E+00	
	2	1.25E+02		8.15E+00	
	3	1.26E+02		8.17E+00	
7	1	3.55E+01		2.49E+00	
	2	3.41E+01		2.27E+00	
	3	3.52E+01		2.22E+00	
8	1	2.16E+01		1.32E+00	
	2	2.14E+01		1.12E+00	
	3	2.01E+01		1.17E+00	
15	1	3.08E+02	2.59E+02	5.27E+01	7.75E+01
	2	3.11E+02	2.67E+02	4.82E+01	8.09E+01
	3	3.21E+02	2.53E+02	5.73E+01	7.68E+01
16	1	4.00E+01	3.68E+01	5.14E+00	8.25E+00
	2	4.12E+01	4.18E+01	5.11E+00	1.03E+01
	3	4.15E+01	3.74E+01	4.51E+00	8.86E+00

*: The TB results by PNL and the AT results by PNL were not used in determining the overall Total β and α Total contents of the K East Sandfilter Backwash Pit. These results were used for confirmation only.

$\mu\text{Ci/g}$: $\mu\text{Ci/g}$ dried solid after the water was removed from the sample.

Table A-12. ^{241}Am Data from the Pit Samples.

Sample number	Result	$^{241}\text{Am-AEA}$ 222S $\mu\text{Ci/g}$	$^{241}\text{Am-GEA}$ 222S $\mu\text{Ci/g}$	$^{241}\text{Am-AEA}^*$ PNL $\mu\text{Ci/g}$	$^{241}\text{Am-GEA}$ PNL $\mu\text{Ci/g}$
1	1	7.13E+00			6.80E+00
	2	6.85E+00			6.80E+00
	3	6.95E+00			6.90E+00
2	1	3.05E+00			3.09E+00
	2	2.95E+00			3.07E+00
	3	2.77E+00			3.05E+00
3	1	1.68E+00	1.91E+00	1.92E+00	1.70E+00
	2	1.75E+00	1.77E+00	1.86E+00	1.78E+00
	3	1.85E+00	2.00E+00	1.84E+00	1.85E+00
4	1	2.80E+00	2.68E+00		2.62E+00
	2	2.51E+00	2.72E+00		2.74E+00
	3	2.22E+00	2.70E+00		2.72E+00
5	1	1.81E+00	1.83E+00	1.94E+00	1.83E+00
	2	1.70E+00	1.84E+00	1.93E+00	1.80E+00
	3	1.78E+00	1.82E+00	2.09E+00	1.81E+00
6	1	4.46E+00	4.65E+00		4.80E+00
	2	4.97E+00	4.50E+00		4.81E+00
	3	4.75E+00	4.55E+00		4.93E+00
7	1	1.38E+00	1.49E+00		1.48E+00
	2	1.41E+00	1.51E+00		1.61E+00
	3	1.44E+00	1.37E+00		1.45E+00
8	1	7.79E-01	8.55E-01		8.03E-01
	2	8.17E-01	7.83E-01		8.02E-01
	3	7.83E-01	7.81E-01		7.73E-01
15	1	3.11E+01	3.05E+01	3.21E+01	3.23E+01
	2	2.85E+01	2.97E+01	2.93E+01	3.31E+01
	3	2.92E+01	3.06E+01	3.12E+01	3.38E+01
16	1	3.08E+00	3.28E+00	3.44E+00	3.26E+00
	2	3.03E+00	3.07E+00	3.15E+00	3.40E+00
	3	3.49E+00	3.20E+00	3.28E+00	3.32E+00

*: The ^{241}Am results by AEA-PNL were not used in determining the overall ^{241}Am content of the K East Sandfilter Backwash Pit. These results were used for confirmation only.

$\mu\text{Ci/g}$: $\mu\text{Ci/g}$ dried solid after the water was removed from the sample.

Table A-13. ^{137}Cs and ^{60}Co Data from the Pit Samples.

Sample number	Result	^{137}Cs -GEA 222S $\mu\text{Ci/g}$	^{137}Cs -GEA PNL $\mu\text{Ci/g}$	^{60}Co -GEA 222S $\mu\text{Ci/g}$	^{60}Co -GEA PNL $\mu\text{Ci/g}$
1	1		2.06E+01		7.80E-01
	2		2.04E+01		8.00E-01
	3		2.14E+01		8.00E-01
2	1		1.57E+01		4.40E-01
	2		1.56E+01		4.30E-01
	3		1.56E+01		4.40E-01
3	1	4.83E+01	4.85E+01	4.58E-01	4.00E-01
	2	4.83E+01	4.69E+01	3.93E-01	4.00E-01
	3	4.99E+01	4.79E+01	4.21E-01	4.00E-01
4	1	3.19E+01	3.18E+01	6.26E-01	6.56E-01
	2	3.24E+01	3.24E+01	6.57E-01	6.65E-01
	3	3.22E+01	3.21E+01	6.75E-01	6.66E-01
5	1	1.48E+01	1.42E+01	4.84E-01	4.87E-01
	2	1.47E+01	1.39E+01	4.79E-01	4.76E-01
	3	1.48E+01	1.39E+01	5.15E-01	4.78E-01
6	1	4.32E+01	4.22E+01	1.00E+00	1.02E+00
	2	4.35E+01	4.22E+01	1.05E+00	1.03E+00
	3	4.37E+01	4.33E+01	1.05E+00	1.05E+00
7	1	1.49E+01	1.46E+01	3.07E-01	3.20E-01
	2	1.51E+01	1.47E+01	3.36E-01	3.21E-01
	3	1.52E+01	1.44E+01	3.25E-01	3.16E-01
8	1	1.26E+01	1.18E+01	3.25E-01	3.12E-01
	2	1.20E+01	1.20E+01	3.25E-01	3.17E-01
	3	1.19E+01	1.17E+01	3.23E-01	3.07E-01
15	1	1.18E+02	1.14E+02	2.61E+00	2.63E+00
	2	1.17E+02	1.15E+02	2.58E+00	2.66E+00
	3	1.19E+02	1.17E+02	2.63E+00	2.69E+00
16	1	1.31E+01	1.25E+01	7.12E-01	7.05E-01
	2	1.30E+01	1.27E+01	7.10E-01	7.15E-01
	3	1.29E+01	1.26E+01	7.06E-01	7.13E-01

 $\mu\text{Ci/g}$: $\mu\text{Ci/g}$ dried solid after the water was removed from the sample.

Table A-14. ^{154}Eu and ^{155}Eu Data from the Pit Samples.

Sample number	Result	^{154}Eu -GEA 222S $\mu\text{Ci/g}$	^{154}Eu -GEA PNL $\mu\text{Ci/g}$	^{155}Eu -GEA 222S $\mu\text{Ci/g}$	^{155}Eu -GEA PNL $\mu\text{Ci/g}$
1	1		1.53E+00		8.20E-01
	2		1.50E+00		8.40E-01
	3		1.54E+00		8.70E-01
2	1		6.50E-01		3.50E-01
	2		6.40E-01		3.50E-01
	3		6.50E-01		3.70E-01
3	1	3.58E-01	3.80E-01		2.10E-01
	2	3.18E-01	4.00E-01		2.10E-01
	3	4.05E-01	3.90E-01		1.90E-01
4	1	4.83E-01	5.61E-01	2.84E-01	3.11E-01
	2	5.37E-01	5.80E-01	3.25E-01	3.09E-01
	3	5.78E-01	5.59E-01	2.23E-01	3.11E-01
5	1	3.85E-01	3.74E-01	2.07E-01	2.04E-01
	2	3.61E-01	3.62E-01	1.78E-01	2.07E-01
	3	3.73E-01	3.69E-01	1.94E-01	1.93E-01
6	1	9.52E-01	9.64E-01	5.20E-01	5.44E-01
	2	9.33E-01	9.52E-01	4.20E-01	5.15E-01
	3	1.04E+00	9.89E-01	5.25E-01	5.39E-01
7	1	2.65E-01	2.92E-01	1.39E-01	1.68E-01
	2	2.91E-01	2.90E-01	2.01E-01	1.62E-01
	3	2.55E-01	2.86E-01	1.75E-01	1.60E-01
8	1		1.69E-01	9.22E-02	8.82E-02
	2		1.76E-01	8.37E-02	8.36E-02
	3		1.65E-01	9.92E-02	8.82E-02
15	1	6.42E+00	6.17E+00	3.53E+00	3.49E+00
	2	6.18E+00	6.29E+00	3.39E+00	3.46E+00
	3	6.35E+00	6.39E+00	3.26E+00	3.49E+00
16	1	6.33E-01	5.99E-01	3.22E-01	3.38E-01
	2	6.40E-01	6.08E-01	3.51E-01	3.13E-01
	3	5.99E-01	6.04E-01	3.21E-01	3.44E-01

 $\mu\text{Ci/g}$: $\mu\text{Ci/g}$ dried solid after the water was removed from the sample.

Table A-15. Plutonium Data from the Channel Samples.

Sample number	Result	²³⁹ Pu ICP/MS mg/g	²³⁹ Pu ICP/MS Mass %	Total Pu ICP/MS mg/g	Total Pu AEA-222S mg/g	Total Pu★ AEA-PNL mg/g
10	1	4.97E-01	86.06	5.78E-01	5.55E-01	
	2	4.28E-01	86.14	4.97E-01	5.60E-01	
	3	4.31E-01	86.09	5.01E-01	5.49E-01	
11	1	5.81E-02	85.62	6.79E-02	6.02E-02	6.81E-02
	2	5.90E-02	85.59	6.89E-02	5.98E-02	6.78E-02
	3	5.17E-02	85.55	6.04E-02	6.28E-02	6.80E-02
12	1	2.87E-02	85.81	3.34E-02	3.53E-02	
	2	2.98E-02	85.73	3.48E-02	3.64E-02	
	3	3.08E-02	85.88	3.59E-02	3.74E-02	
13	1	3.82E-02	85.98	4.44E-02	5.45E-02	
	2	3.98E-02	86.07	4.62E-02	5.42E-02	
	3	3.94E-02	85.96	4.58E-02	5.19E-02	

★: The Total Pu results by AEA-PNL were not used in determining the overall Pu content of the K East Sandfilter Backwash Pit. These results were used for confirmation only.

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-16. Uranium Data from the Channel Samples.

Sample number	Result	U-Laser PNL mg/g	U-Laser 222S mg/g	U-ICP/MS PNL mg/g
10	1	1.65E+02	1.50E+02	1.69E+02
	2	1.55E+02	1.38E+02	1.46E+02
	3	1.64E+02	1.50E+02	1.45E+02
11	1	2.67E+01	2.51E+01	2.77E+01
	2	2.78E+01	2.38E+01	2.86E+01
	3	2.67E+01	2.38E+01	2.60E+01
12	1	1.28E+01	1.29E+01	1.25E+01
	2	1.29E+01	1.29E+01	1.27E+01
	3	1.26E+01	1.25E+01	1.36E+01
13	1	1.48E+01	1.56E+01	1.48E+01
	2	1.46E+01	1.33E+01	1.58E+01
	3	1.48E+01	1.56E+01	1.59E+01

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-17. Al and Ba Data from the Channel Samples.

Sample number	Result	Al-222S ICP mg/g	Al-PNL ICP/MS mg/g	Ba-222S ICP mg/g	Ba-PNL ICP mg/g
10	1	6.76E+01	5.48E+01	4.73E-01	7.07E-01
	2	6.65E+01	6.95E+01	4.59E-01	7.13E-01
	3	6.76E+01	7.27E+01	4.70E-01	8.04E-01
11	1	1.24E+01	1.31E+01	1.36E-01	2.92E-01
	2	1.19E+01	1.23E+01	1.31E-01	2.64E-01
	3	1.17E+01	1.45E+01	1.28E-01	3.12E-01
12	1	1.05E+01	9.87E+00	8.13E-02	1.65E-01
	2	1.06E+01	1.18E+01	8.26E-02	1.70E-01
	3	1.04E+01	1.17E+01	8.03E-02	1.59E-01
13	1	1.15E+01	1.08E+01	1.11E-01	1.94E-01
	2	1.15E+01	1.32E+01	1.10E-01	1.98E-01
	3	1.17E+01	1.41E+01	1.11E-01	2.17E-01

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-18. Be and Ca Data from the Channel Samples.

Sample number	Result	Be-222S ICP mg/g	Be-PNL ICP/MS mg/g	Ca-222S ICP mg/g	Ca-PNL ICP/MS mg/g
10	1	7.85E-02	1.15E-01	8.07E+00	8.04E+00
	2	7.32E-02	1.20E-01	7.80E+00	9.37E+00
	3	7.76E-02	1.48E-01	8.05E+00	9.09E+00
11	1	1.20E-02	5.24E-02	2.13E+00	2.78E+00
	2	1.13E-02	4.19E-02	2.06E+00	8.12E-01
	3	1.09E-02	2.35E-02	2.01E+00	3.45E+00
12	1	5.78E-03	2.42E-02	2.05E+00	2.32E+00
	2	5.63E-03	1.51E-02	2.11E+00	4.53E+00
	3	5.21E-03	1.04E-02	2.05E+00	1.83E+00
13	1	1.08E-02	3.27E-02	1.49E+00	2.52E+00
	2	1.05E-02	3.00E-02	1.47E+00	1.17E+00
	3	1.10E-02	5.40E-02	1.49E+00	2.11E+00

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-19. Cd and Cr Data from the Channel Samples.

Sample number	Result	Cd-222S ICP mg/g	Cd-PNL ICP/MS mg/g	Cr-222S ICP mg/g	Cr-PNL ICP/MS mg/g
10	1	5.19E-01	5.85E-01	9.83E-01	1.12E+00
	2	4.98E-01	5.58E-01	9.47E-01	1.11E+00
	3	5.22E-01	6.30E-01	9.84E-01	1.17E+00
11	1	1.04E-01	1.33E-01	3.69E-01	4.53E-01
	2	9.89E-02	1.29E-01	3.54E-01	4.45E-01
	3	9.37E-02	1.20E-01	3.36E-01	4.40E-01
12	1	4.12E-02	5.10E-02	1.72E-01	2.37E-01
	2	4.13E-02	4.78E-02	1.76E-01	2.19E-01
	3	3.94E-02	4.37E-02	1.68E-01	2.15E-01
13	1	9.63E-02	1.33E-01	9.64E-02	1.47E-01
	2	9.48E-02	1.21E-01	9.86E-02	1.51E-01
	3	9.75E-02	2.87E-01	9.88E-02	2.83E-01

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-20. Cu and Fe Data from the Channel Samples.

Sample number	Result	Cu-222S ICP mg/g	Cu-PNL ICP/MS mg/g	Fe-222S ICP mg/g	Fe-PNL ICP/MS mg/g
10	1	1.53E+00	1.45E+00	1.46E+02	1.60E+02
	2	1.49E+00	1.67E+00	1.41E+02	1.48E+02
	3	1.53E+00	1.63E+00	1.48E+02	1.55E+02
11	1	3.33E-01	3.40E-01	2.38E+02	2.33E+02
	2	3.23E-01	3.38E-01	2.32E+02	2.33E+02
	3	3.15E-01	3.78E-01	2.26E+02	2.17E+02
12	1	2.21E-01	2.30E-01	9.70E+01	9.93E+01
	2	2.25E-01	2.37E-01	9.93E+01	9.38E+01
	3	2.21E-01	2.53E-01	9.59E+01	9.47E+01
13	1	2.95E-01	3.14E-01	3.27E+01	3.97E+01
	2	2.94E-01	3.27E-01	3.23E+01	3.72E+01
	3	2.96E-01	3.55E-01	3.28E+01	3.74E+01

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-21. Mg and Mn Data from the Channel Samples.

Sample number	Result	Mg-222S ICP mg/g	Mg-PNL ICP/MS mg/g	Mn-222S ICP mg/g	Mn-PNL ICP/MS mg/g
10	1	1.77E+00	3.03E+00	2.60E+00	3.31E+00
	2	1.71E+00	3.17E+00	2.51E+00	3.15E+00
	3	1.78E+00	3.01E+00	2.61E+00	3.17E+00
11	1	6.01E-01	1.08E+00	6.31E-01	8.12E-01
	2	5.74E-01	1.00E+00	6.03E-01	8.34E-01
	3	5.59E-01	1.05E+00	5.85E-01	7.69E-01
12	1	7.61E-01	1.15E+00	3.42E-01	4.95E-01
	2	7.75E-01	1.27E+00	3.50E-01	4.40E-01
	3	7.41E-01	1.25E+00	3.38E-01	4.27E-01
13	1	6.44E-01	1.00E+00	5.16E-01	7.44E-01
	2	6.38E-01	1.17E+00	5.13E-01	6.97E-01
	3	6.54E-01	1.84E+00	5.21E-01	8.23E-01

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-22. Pb and Sm Data from the Channel Samples.

Sample number	Result	Pb-222S ICP mg/g	Pb-PNL ICP/MS mg/g	Sm-222S ICP mg/g	Sm-PNL ICP/MS mg/g
10	1	7.83E-01	8.25E-01	<	<
	2	7.45E-01	7.41E-01	<	<
	3	7.84E-01	8.11E-01	<	<
11	1	2.22E-01	1.71E-01	<	<
	2	2.07E-01	1.89E-01	<	<
	3	1.91E-01	1.63E-01	<	<
12	1	1.56E-01	1.78E-01	<	<
	2	1.58E-01	1.62E-01	<	<
	3	1.45E-01	2.08E-01	<	<
13	1	1.28E-01	2.06E-01	<	<
	2	1.07E-01	1.15E-01	<	<
	3	1.20E-01	1.29E-01	<	<

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-23. Tl and Zn Data from the Channel Samples.

Sample number	Result	Tl-222S ICP mg/g	Tl-PNL ICP/MS mg/g	Zn-222S ICP mg/g	Zn-PNL ICP/MS mg/g
10	1	5.92E-01	<	2.23E+00	2.71E+00
	2	5.25E-01	<	2.19E+00	2.70E+00
	3	5.48E-01	<	2.25E+00	2.71E+00
11	1	<	<	1.08E+00	1.47E+00
	2	<	<	1.05E+00	1.28E+00
	3	<	<	1.03E+00	1.24E+00
12	1	<	<	3.95E-01	4.89E-01
	2	<	<	3.98E-01	4.89E-01
	3	<	<	3.84E-01	5.63E-01
13	1	<	<	3.53E-01	4.85E-01
	2	<	<	3.52E-01	5.33E-01
	3	<	<	3.59E-01	5.04E-01

mg/g: mg/g dried solid after the water was removed from the sample.

Table A-24. B, Mo, Na, Si and U (222S-ICP) Data from the Channel Samples.

Sample number	Result	B-222S ICP mg/g	Mo-222S ICP μg/g	Na-222S ICP μg/g	Si-222S ICP μg/g	U-222S ★ ICP mg/g
10	1	3.60E-02	2.32E-02	1.41E+00	5.15E+00	1.55E+02
	2	2.94E-02	1.76E-02	1.39E+00	5.01E+00	1.50E+02
	3	4.04E-02	2.11E-02	1.38E+00	5.14E+00	1.54E+02
11	1	1.28E-02	1.40E-02	6.24E-01	2.93E+00	2.75E+01
	2	5.14E-03	1.24E-02	6.25E-01	2.84E+00	2.64E+01
	3	<	1.33E-02	6.29E-01	2.79E+00	2.55E+01
12	1	7.40E-03	1.05E-02	4.60E-01	1.52E+00	1.20E+01
	2	8.72E-03	1.05E-02	4.57E-01	1.51E+00	1.22E+01
	3	4.51E-03	8.65E-03	4.49E-01	1.46E+00	1.18E+01
13	1	7.14E-03	4.39E-03	5.96E-01	1.84E+00	1.38E+01
	2	5.68E-03	4.39E-03	5.92E-01	1.81E+00	1.38E+01
	3	5.96E-03	<	6.00E-01	1.84E+00	1.39E+01

★: The U results from the ICP-222S were not used in determining the overall U content of the K East Sandfilter Backwash Pit. These results were used for confirmation only.

mg/g: mg/g dried solid after the water was removed from the sample.

μg/g: μg/g dried solid after the water was removed from the sample.

Table A-25. Total Beta (TB) and Alpha Total (AT) Data from the Channel Samples.

Sample number	Result	TB 222S $\mu\text{Ci/g}$	TB★ PNL $\mu\text{Ci/g}$	AT 222S $\mu\text{Ci/g}$	AT★ PNL $\mu\text{Ci/g}$
10	1	5.23E+02		6.33E+01	
	2	5.21E+02		5.83E+01	
	3	5.33E+02		6.52E+01	
11	1	7.52E+01	6.34E+01	7.99E+00	1.03E+01
	2	7.65E+01	6.56E+01	8.59E+00	1.13E+01
	3	7.35E+01	6.19E+01	7.86E+00	1.15E+01
12	1	5.27E+01		4.85E+00	
	2	5.51E+01		4.93E+00	
	3	5.27E+01		4.70E+00	
13	1	5.98E+01		6.41E+00	
	2	5.98E+01		6.19E+00	
	3	5.86E+01		6.41E+00	

★: The TB results by PNL and the AT results by PNL were not used in determining the overall Total β and α Total contents of the K East Sandfilter Backwash Pit. These results were used for confirmation only.

$\mu\text{Ci/g}$: $\mu\text{Ci/g}$ dried solid after the water was removed from the sample.

Table A-26. ^{241}Am Data from the Channel Samples.

Sample number	Result	^{241}Am -AEA 222S $\mu\text{Ci/g}$	^{241}Am -GEA 222S $\mu\text{Ci/g}$	^{241}Am -AEA★ PNL $\mu\text{Ci/g}$	^{241}Am -GEA PNL $\mu\text{Ci/g}$
10	1	3.75E+01	3.79E+01		3.70E+01
	2	3.49E+01	3.71E+01		3.72E+01
	3	3.15E+01	3.66E+01		3.76E+01
11	1	3.71E+00		4.40E+00	4.37E+00
	2	3.87E+00		3.86E+00	4.14E+00
	3	4.20E+00		4.34E+00	4.12E+00
12	1	2.25E+00	2.51E+00		2.67E+00
	2	2.09E+00	2.47E+00		2.50E+00
	3	2.40E+00	2.74E+00		2.41E+00
13	1	3.82E+00	3.05E+00		3.07E+00
	2	3.12E+00	3.19E+00		2.87E+00
	3	3.22E+00	3.14E+00		3.13E+00

★: The ^{241}Am results by AEA-PNL were not used in determining the overall ^{241}Am content of the K East Sandfilter Backwash Pit. These results were used for confirmation only.

$\mu\text{Ci/g}$: $\mu\text{Ci/g}$ dried solid after the water was removed from the sample.

Table A-27. ^{137}Cs and ^{60}Co Data from the Channel Samples.

Sample number	Result	^{137}Cs -GEA 222S $\mu\text{Ci/g}$	^{137}Cs -GEA PNL $\mu\text{Ci/g}$	^{60}Co -GEA 222S $\mu\text{Ci/g}$	^{60}Co -GEA PNL $\mu\text{Ci/g}$
10	1	1.10E+02	1.06E+02	5.35E+00	4.95E+00
	2	1.09E+02	1.06E+02	5.29E+00	5.06E+00
	3	1.08E+02	1.06E+02	5.08E+00	4.95E+00
11	1		1.63E+01		7.65E-01
	2		1.67E+01		7.86E-01
	3		1.66E+01		7.68E-01
12	1	2.59E+01	2.52E+01		3.34E-01
	2	2.53E+01	2.53E+01		3.21E-01
	3	2.61E+01	2.47E+01		3.21E-01
13	1	2.57E+01	2.57E+01	6.67E-01	7.32E-01
	2	2.64E+01	2.58E+01	6.22E-01	7.15E-01
	3	2.64E+01	2.59E+01	8.38E-01	7.33E-01

$\mu\text{Ci/g}$: $\mu\text{Ci/g}$ dried solid after the water was removed from the sample.

Table A-28. ^{154}Eu and ^{155}Eu Data from the Channel Samples.

Sample number	Result	^{154}Eu -GEA 222S $\mu\text{Ci/g}$	^{154}Eu -GEA PNL $\mu\text{Ci/g}$	^{155}Eu -GEA 222S $\mu\text{Ci/g}$	^{155}Eu -GEA PNL $\mu\text{Ci/g}$
10	1	7.13E+00	6.93E+00	3.56E+00	3.93E+00
	2	5.81E+00	7.08E+00	4.47E+00	4.16E+00
	3	6.79E+00	6.98E+00	3.62E+00	3.99E+00
11	1		8.73E-01		5.11E-01
	2		8.65E-01		5.08E-01
	3		8.82E-01		4.93E-01
12	1		5.28E-01		2.88E-01
	2		5.23E-01		2.86E-01
	3		5.25E-01		2.86E-01
13	1		6.98E-01		3.59E-01
	2		6.62E-01		3.97E-01
	3		6.59E-01		3.68E-01

$\mu\text{Ci/g}$: $\mu\text{Ci/g}$ dried solid after the water was removed from the sample.

APPENDIX B

DERIVATION OF 12.146 g Pu/Ci

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CALCULATION OF TOTAL PLUTONIUM WHEN (^{239}Pu + ^{240}Pu) μCi ARE KNOWN

Situation:

- 1) The (^{239}Pu + ^{240}Pu) activity in $\mu\text{Ci/g}$ of sample is known.
- 2) The plutonium isotopic composition (mass %) is also known.

Analytical Chemistry Results (PNL TIMS for 9/93 and 11/93 samples):

^{239}Pu	85.73 mass%
^{240}Pu	12.83 mass%
$^{239+240}\text{Pu}$	98.56 mass%

Additional Necessary Information:

N_A Avogadro's Number	6.022045×10^{23} atoms/gram-mole (6.022045E+23)
μCi Definition	$1 \mu\text{Ci} = 3.7 \times 10^4$ dis/s (3.7E+4)

Isotope	AW(Atomic Weight)	$t_{1/2}$ (half-life) yr
^{239}Pu	239.052157	24,100
^{240}Pu	240.053808	6,560

Calculation:

$$\begin{aligned}
 (^{239}\text{Pu} \text{ grams}) \times (\text{atoms/gram}) \times (\mu\text{Curies/atom}) &= ^{239}\text{Pu} \mu\text{Ci/g Pu} \\
 (^{240}\text{Pu} \text{ grams}) \times (\text{atoms/gram}) \times (\mu\text{Curies/atom}) &= ^{240}\text{Pu} \mu\text{Ci/g Pu} \\
 ^{239}\text{Pu} \mu\text{Ci/g Pu} + ^{240}\text{Pu} \mu\text{Ci/g Pu} &= (^{239}\text{Pu} + ^{240}\text{Pu}) \mu\text{Ci/g Pu}
 \end{aligned}$$

Example for ^{239}Pu + ^{240}Pu :

$$\frac{.8573 \text{ g } ^{239}\text{Pu}}{1 \text{ g Pu}} \times \frac{6.022045\text{E}+23 \text{ atoms/g-mole}}{239.052157 \text{ g } ^{239}\text{Pu/g-mole}} \times \frac{\ln(2) \text{ dis/s/atom}}{24,100 \times 365.25 \times 24 \times 60 \times 60} \times \frac{1 \mu\text{Ci } ^{239}\text{Pu}}{3.7\text{E}+4 \text{ dis/s}}$$

$$= 5.320\text{E}+4 \mu\text{Ci } ^{239}\text{Pu/g Pu}$$

$$\frac{.1283 \text{ g } ^{240}\text{Pu}}{1 \text{ g Pu}} \times \frac{6.022045\text{E}+23 \text{ atoms/g-mole}}{240.053808 \text{ g } ^{240}\text{Pu/g-mole}} \times \frac{\ln(2) \text{ dis/s/atom}}{6,560 \times 365.25 \times 24 \times 60 \times 60} \times \frac{1 \mu\text{Ci } ^{240}\text{Pu}}{3.7\text{E}+4 \text{ dis/s}}$$

$$= 2.913\text{E}+4 \mu\text{Ci } ^{240}\text{Pu/g Pu}$$

$$5.320\text{E}+4 \mu\text{Ci } ^{239}\text{Pu/g Pu} + 2.913\text{E}+4 \mu\text{Ci } ^{240}\text{Pu/g Pu} = 8.233\text{E}+4 \mu\text{Ci } (^{239}\text{Pu} + ^{240}\text{Pu})/\text{g Pu}$$

$$\text{or } 12.146 \text{ g Pu/Ci } (^{239}\text{Pu} + ^{240}\text{Pu})$$

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APPENDIX C

K East Basin Sandfilter Backwash Pit

ANALYTICAL SAMPLE MEANS

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Table C-1. Plutonium Mean for Each Sample.

Sample number	Solid concentration g solid/mL sludge	Total Pu ICP/MS mg Pu/mL sludge	Total Pu AEA-222S mg Pu/mL sludge	Total Pu★ AEA-PNL mg Pu/mL sludge
1	0.123	1.05E-02	1.13E-02	
2	0.483	2.11E-02	2.06E-02	
3	0.452	1.03E-02	1.24E-02	1.30E-02
4	0.308	1.20E-02	1.13E-02	
5	0.479	1.33E-02	1.27E-02	1.39E-02
6	0.288	2.01E-02	2.05E-02	
7	0.594	1.35E-02	1.59E-02	
8	0.818	8.80E-03	9.33E-03	
10	0.049	2.57E-02	2.72E-02	
11	0.251	1.65E-02	1.53E-02	1.71E-02
12	0.484	1.68E-02	1.76E-02	
13	0.406	1.85E-02	2.17E-02	
15	0.056	2.29E-02	2.29E-02	2.56E-02
16	0.386	1.89E-02	1.85E-02	2.15E-02

★: The Total Pu results by AEA-PNL were not used in determining the overall Pu content of the K East Sandfilter Backwash Pit. These results were used for confirmation only.

Table C-2. Uranium Mean for Each Sample.

Sample number	U-Laser PNL mg U/mL sludge	U-Laser 222S mg U/mL sludge	U-ICP/MS PNL mg U/mL sludge
1	4.64E+00	4.60E+00	4.88E+00
2	6.28E+00	5.26E+00	6.81E+00
3	6.45E+00	5.95E+00	6.78E+00
4	7.02E+00	9.95E+00 *	5.92E+00
5	6.04E+00	8.25E+00 *	6.24E+00
6	9.20E+00	1.50E+01 *	8.65E+00
7	4.57E+00	7.92E+00 *	4.85E+00
8	3.48E+00	4.93E+00 *	3.61E+00
10	7.91E+00	7.15E+00	7.51E+00
11	6.79E+00	6.08E+00	6.89E+00
12	6.18E+00	6.18E+00	6.26E+00
13	5.98E+00	6.02E+00	6.29E+00
15	6.40E+00	7.39E+00 *	6.05E+00
16	6.48E+00	1.23E+01 *	6.38E+00

*: Data said to be questionable by the laboratory.

Table C-3. Al and Ba Means for Each Sample.

Sample number	Al - ICP 222S mg/mL sludge	Al - ICP/MS PNL mg/mL sludge	Ba- ICP 222S mg/mL sludge	Ba - ICP/MS PNL mg/mL sludge
1	3.20E+00	3.13E+00	1.13E-02	1.83E-02
2	5.43E+00	5.05E+00	3.92E-02	8.19E-02
3	7.49E+00	7.47E+00	1.20E-01	1.52E-01
4	4.15E+00	4.00E+00	5.50E-02	6.34E-02
5	4.48E+00	4.39E+00	6.12E-02	7.49E-02
6	5.17E+00	4.79E+00	7.76E-02	9.02E-02
7	4.02E+00	3.80E+00	5.10E-02	6.95E-02
8	5.20E+00	5.32E+00	3.43E-02	5.96E-02
10	3.29E+00	3.22E+00	2.29E-02	3.63E-02
11	3.01E+00	3.34E+00	3.30E-02	7.26E-02
12	5.08E+00	5.38E+00	3.94E-02	7.97E-02
13	4.70E+00	5.16E+00	4.49E-02	8.24E-02
15	3.60E+00	3.58E+00	1.03E-02	1.40E-02
16	3.64E+00	3.67E+00	3.54E-02	4.81E-02

Table C-4. Be and Ca Means for Each Sample.

Sample number	Be - ICP 222S mg/mL sludge	Be - ICP/MS PNL mg/mL sludge	Ca - ICP 222S mg/mL sludge	Ca - ICP/MS PNL mg/mL sludge
1	1.99E-03	4.62E-03	8.45E-01	8.25E-01
2	3.46E-03	1.21E-02	4.07E+00	3.82E+00
3	3.46E-03	1.02E-02	8.44E+00	8.83E+00
4	2.67E-03	2.63E-03	3.73E+00	4.96E+00
5	3.32E-03	2.57E-03	3.64E+00	4.63E+00
6	4.01E-03	4.14E-03	3.59E+00	3.90E+00
7	2.95E-03	2.63E-03	2.58E+00	3.10E+00
8	2.86E-03	2.70E-03	4.48E+00	6.26E+00
10	3.75E-03	6.26E-03	3.91E-01	4.33E-01
11	2.86E-03	9.86E-03	5.19E-01	5.89E-01
12	2.68E-03	8.02E-03	1.00E+00	1.40E+00
13	4.37E-03	1.58E-02	6.02E-01	7.84E-01
15	1.70E-03	2.36E-03	1.85E-01	2.77E-01
16	2.99E-03	3.84E-03	2.76E+00	2.90E+00

Table C-5. Cd and Cr Means for Each Sample.

Sample number	Cd - ICP 222S mg/mL sludge	Cd - ICP/MS PNL mg/mL sludge	Cr - ICP 222S mg/mL sludge	Cr - ICP/MS PNL mg/mL sludge
1	9.11E-03	1.01E-02	3.14E-02	3.61E-02
2	2.32E-02	2.65E-02	7.71E-02	9.03E-02
3	4.28E-02	5.09E-02	4.19E-02	5.63E-02
4	3.83E-02	3.58E-02	4.65E-02	5.04E-02
5	4.24E-02	3.80E-02	4.16E-02	5.21E-02
6	5.15E-02	5.40E-02	2.76E-01	2.76E-01
7	2.62E-02	2.27E-02	2.62E-02	4.16E-02
8	2.78E-02	2.18E-02	4.54E-02	6.35E-02
10	2.51E-02	2.90E-02	4.76E-02	5.55E-02
11	2.48E-02	3.20E-02	8.86E-02	1.12E-01
12	1.97E-02	2.30E-02	8.32E-02	1.08E-01
13	3.91E-02	7.31E-02	3.98E-02	7.86E-02
15	6.70E-03	7.77E-03	3.05E-02	3.57E-02
16	4.62E-02	2.87E-02	3.06E-02	4.28E-02

Table C-6. Cu and Fe Means for Each Sample.

Sample number	Cu - ICP 222S mg/mL sludge	Cu - ICP/MS PNL mg/mL sludge	Fe - ICP 222S mg/mL sludge	Fe - ICP/MS PNL mg/mL sludge
1	5.15E-02	5.45E-02	8.86E+00	8.83E+00
2	1.08E-01	1.07E-01	2.11E+01	2.07E+01
3	3.15E-01	3.37E-01	1.91E+01	2.01E+01
4	2.43E-01	2.45E-01	9.33E+00	2.31E+00
5	2.79E-01	2.95E-01	1.14E+01	2.70E+00
6	2.27E-01	2.36E-01	1.19E+01	3.48E+00
7	9.56E-02	9.90E-02	6.79E+00	1.32E+00
8	7.84E-02	7.77E-02	1.60E+01	3.85E+00
10	7.43E-02	7.74E-02	7.11E+00	7.56E+00
11	8.12E-02	8.84E-02	5.82E+01	5.71E+01
12	1.08E-01	1.16E-01	4.71E+01	4.64E+01
13	1.20E-01	1.35E-01	1.32E+01	1.55E+01
15	8.03E-02	8.87E-02	6.59E+00	2.51E+00
16	5.43E-02	5.33E-02	1.07E+01	3.92E+00

Table C-7. Mg and Mn Means for Each Sample.

Sample number	Mg - ICP 222S mg/mL sludge	Mg - ICP/MS PNL mg/mL sludge	Mn - ICP 222S mg/mL sludge	Mn - ICP/MS PNL mg/mL sludge
1	1.04E-01	1.68E-01	9.44E-02	1.12E-01
2	3.12E-01	5.56E-01	1.51E-01	1.75E-01
3	7.32E-01	1.03E+00	2.45E-01	2.93E-01
4	5.65E-01	5.99E-01	2.14E-01	1.98E-01
5	5.54E-01	6.29E-01	2.63E-01	2.51E-01
6	3.66E-01	4.15E-01	2.78E-01	2.64E-01
7	2.77E-01	2.93E-01	1.45E-01	1.35E-01
8	5.40E-01	6.31E-01	1.65E-01	1.72E-01
10	8.59E-02	1.50E-01	1.26E-01	1.57E-01
11	1.45E-01	2.62E-01	1.52E-01	2.02E-01
12	3.67E-01	5.90E-01	1.66E-01	2.20E-01
13	2.62E-01	5.43E-01	2.10E-01	3.06E-01
15	6.53E-02	7.77E-02	4.11E-02	4.43E-02
16	2.82E-01	3.23E-01	1.69E-01	1.72E-01

Table C-8. Pb and Sm Means for Each Sample.

Sample number	Pb - ICP 222S mg/mL sludge	Pb - ICP/MS PNL mg/mL sludge	Sm - ICP 222S mg/mL sludge	Sm - ICP/MS PNL mg/mL sludge
1	3.93E-02	4.12E-02	3.71E-03	<
2	7.33E-02	8.45E-02	1.24E-02•	<
3	7.20E-02	8.63E-02	2.18E-02	<
4	4.56E-02	4.20E-02	<	5.15E-04
5	5.18E-02	4.26E-02	3.77E-02•	7.03E-04
6	5.47E-02	4.56E-02	2.65E-02	7.78E-04
7	3.49E-02	3.87E-02	<	4.12E-04
8	8.92E-02•	4.07E-02	5.80E-02•	9.63E-04
10	3.78E-02	3.88E-02	<	<
11	5.19E-02	4.38E-02	<	<
12	7.41E-02	8.84E-02	<	<
13	4.80E-02	6.09E-02	<	<
15	6.07E-02	6.05E-02	1.87E-02	6.53E-04
16	4.40E-02	2.85E-02	<	5.79E-04

•: The mean is an average of one or two measurements.

Table C-9. Tl and Zn Means for Each Sample.

Sample number	Tl - ICP 222S mg/mL sludge	Tl - ICP/MS PNL mg/mL sludge	Zn - ICP 222S mg/mL sludge	Zn - ICP/MS PNL mg/mL sludge
1	1.40E-02	<	6.10E-02	7.82E-02
2	2.04E-02•	<	1.34E-01	1.66E-01
3	1.88E-02•	<	1.31E-01	1.83E-01
4	<	9.19E-05	1.12E-01	1.05E-01
5	<	1.09E-04	1.27E-01	1.19E-01
6	<	1.34E-04	1.49E-01	1.52E-01
7	<	1.54E-04	9.42E-02	8.89E-02
8	<	1.39E-04	1.70E-01	1.52E-01
10	2.72E-02	<	1.09E-01	1.33E-01
11	<	<	2.64E-01	3.34E-01
12	<	<	1.90E-01	2.49E-01
13	<	<	1.44E-01	2.06E-01
15	2.90E-02	1.70E-05	6.48E-02	6.55E-02
16	<	6.18E-05	1.19E-01	1.29E-01

•: The mean is an average of one or two measurements.

Table C-10. B, Mo, Na, Si and U (222S-ICP) Means for Each Sample.

Sample number	B - ICP 222S mg/mL sludge	Mo - ICP 222S mg/mL sludge	Na - ICP 222S mg/mL sludge	Si - ICP 222S mg/mL sludge	U - ICP ★ 222S mg/mL sludge
1	1.78E-03	8.47E-04	6.48E-02	2.93E-01	4.28E+00
2	5.11E-03	2.04E-03	2.18E-01	7.26E-01	6.10E+00
3	4.11E-03	<	7.47E-01	6.71E-01	6.13E+00
4	<	<	2.22E-01	3.41E-01	6.57E+00
5	2.67E-03•	<	2.81E-01	5.14E-01	6.18E+00
6	<	<	2.63E-01	2.57E-01	9.03E+00
7	<	<	2.25E-01	5.87E-01	4.71E+00
8	<	<	1.99E-01	8.71E-01	3.48E+00
10	1.73E-03	1.01E-03	6.83E-02	2.50E-01	7.51E+00
11	1.93E-03•	3.33E-03	1.57E-01	7.17E-01	6.65E+00
12	3.32E-03	4.77E-03	2.20E-01	7.25E-01	5.80E+00
13	2.54E-03	1.74E-03•	2.42E-01	7.44E-01	5.62E+00
15	<	<	4.63E-02	8.14E-02	6.12E+00
16	<	<	1.21E+00	9.86E-01	6.03E+00

•: The mean is an average of one or two measurements.

★: The U results by ICP-222S were not used in determining the overall U content of the K East Sandfilter Backwash Pit. These results were used for confirmation only.

Table C-11. Total Beta (TB) and Alpha Total (AT) Means for Each Sample.

Sample number	TB 222S $\mu\text{Ci/mL}$ sludge	TB★ PNL $\mu\text{Ci/mL}$ sludge	AT 222S $\mu\text{Ci/mL}$ sludge	AT★ PNL $\mu\text{Ci/mL}$ sludge
1	7.77E+00		1.55E+00	
2	1.89E+01		2.77E+00	
3	7.07E+01	5.18E+01	1.53E+00	2.19E+00
4	3.02E+01		1.36E+00	
5	2.74E+01	1.60E+01	1.45E+00	2.41E+00
6	3.59E+01		2.34E+00	
7	2.08E+01		1.38E+00	
8	1.72E+01		9.84E-01	
10	2.58E+01		3.05E+00	
11	1.88E+01	2.27E+01	2.04E+00	2.77E+00
12	2.59E+01		2.34E+00	
13	2.41E+01		2.57E+00	
15	1.75E+01	1.45E+01	2.95E+00	4.39E+00
16	1.58E+01	1.49E+01	1.90E+00	3.53E+00

★: The TB results by PNL and the AT results by PNL were not used in determining the overall Total β and α Total contents of the K East Sandfilter Backwash Pit. These results were used for confirmation only.

Table C-12. ^{241}Am Mean for Each Sample.

Sample number	^{241}Am -AEA 222S $\mu\text{Ci/mL}$ sludge	^{241}Am -GEA 222S $\mu\text{Ci/mL}$ sludge	^{241}Am -AEA★ PNL $\mu\text{Ci/mL}$ sludge	^{241}Am -GEA PNL $\mu\text{Ci/mL}$ sludge
1	8.58E-01			8.41E-01
2	1.41E+00			1.48E+00
3	7.96E-01	8.56E-01	8.47E-01	8.03E-01
4	7.73E-01	8.32E-01		8.30E-01
5	8.45E-01	8.77E-01	9.52E-01	8.69E-01
6	1.36E+00	1.32E+00		1.40E+00
7	8.38E-01	8.65E-01		8.99E-01
8	6.49E-01	6.60E-01		6.48E-01
10	1.70E+00	1.82E+00		1.83E+00
11	9.86E-01		1.05E+00	1.05E+00
12	1.09E+00	1.25E+00		1.22E+00
13	1.37E+00	1.27E+00		1.23E+00
15	1.66E+00	1.69E+00	1.73E+00	1.85E+00
16	1.24E+00	1.23E+00	1.27E+00	1.28E+00

★: The ^{241}Am results by AEA-PNL were not used in determining the overall ^{241}Am content of the K East Sandfilter Backwash Pit. These results were used for confirmation only.

Table C-13. ^{137}Cs and ^{60}Co Means for Each Sample.

Sample number	^{137}Cs -GEA 222S $\mu\text{Ci/mL}$ sludge	^{137}Cs -GEA PNL $\mu\text{Ci/mL}$ sludge	^{60}Co -GEA 222S $\mu\text{Ci/mL}$ sludge	^{60}Co -GEA PNL $\mu\text{Ci/mL}$ sludge
1		2.56E+00		9.76E-02
2		7.55E+00		2.11E-01
3	2.21E+01	2.16E+01	1.92E-01	1.81E-01
4	9.91E+00	9.89E+00	2.01E-01	2.04E-01
5	7.07E+00	6.71E+00	2.36E-01	2.30E-01
6	1.25E+01	1.23E+01	2.98E-01	2.98E-01
7	8.95E+00	8.65E+00	1.92E-01	1.89E-01
8	9.95E+00	9.68E+00	2.65E-01	3.93E-01
10	5.34E+00	5.19E+00	2.57E-01	2.44E-01
11		4.15E+00		1.94E-01
12	1.25E+01	1.21E+01		1.57E-01
13	1.06E+01	1.05E+01	2.88E-01	2.95E-01
15	6.61E+00	6.46E+00	1.46E-01	1.49E-01
16	5.02E+00	4.86E+00	2.74E-01	2.74E-01

Table C-14. ^{154}Eu and ^{155}Eu Means for Each Sample.

Sample number	^{154}Eu -GEA 222S $\mu\text{Ci/mL}$ sludge	^{154}Eu -GEA PNL $\mu\text{Ci/mL}$ sludge	^{155}Eu -GEA 222S $\mu\text{Ci/mL}$ sludge	^{155}Eu -GEA PNL $\mu\text{Ci/mL}$ sludge
1		1.87E-01		1.04E-01
2		3.12E-01		1.72E-01
3	1.63E-01	1.76E-01		9.19E-02
4	1.64E-01	1.75E-01	8.54E-02	9.56E-02
5	1.79E-01	1.76E-01	9.24E-02	9.64E-02
6	2.81E-01	2.79E-01	1.41E-01	1.53E-01
7	1.61E-01	1.72E-01	1.02E-01	9.70E-02
8		1.39E-01		7.09E-02
10	3.22E-01	3.43E-01	1.90E-01	1.97E-01
11		2.19E-01		1.27E-01
12		2.54E-01		1.39E-01
13		2.73E-01		1.52E-01
15	3.54E-01	3.52E-01	1.90E-01	1.95E-01
16	2.41E-01	2.33E-01	1.28E-01	1.28E-01

APPENDIX D

K East Basin Sandfilter Backwash Pit

COMPARISON OF THE ANALYTICAL SAMPLE MEANS

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Figure D-1. Pu Means by Sample.

Figure D-2. U Means by Sample.

Figure D-3. Al Means by Sample.

Figure D-4. Ba Means by Sample.

Figure D-5. Be Means by Sample.

Figure D-6. Ca Means by Sample.

Figure D-7. Cd Means by Sample.

Figure D-8. Cr Means by Sample.

Figure D-9. Cu Means by Sample.

Figure D-10. Fe Means by Sample.

Figure D-11. Mg Means by Sample.

Figure D-12. Mn Means by Sample.

Figure D-13. Pb Means by Sample.

Figure D-14. Sm Means by Sample.

Figure D-15. Tl Means by Sample.

Figure D-16. Zn Means by Sample.

Figure D-17. B Means by Sample.

Figure D-18. Mo Means by Sample.

Figure D-19. Na (edited) Means by Sample.

Figure D-20. Si Means by Sample.

Figure D-21. U (222S-ICP) Means by Sample.

Figure D-22. Total Beta Means by Sample.

Figure D-23. Alpha Total Means by Sample.

Figure D-24. ^{241}Am Means by Sample.

Figure D-25. ^{137}Cs Means by Sample.

Figure D-26. ^{60}Co Means by Sample.

Figure D-27. ^{154}Eu Means by Sample.

Figure D-28. ^{155}Eu Means by Sample.

APPENDIX E

K East Basin Sandfilter Backwash Pit

CORRELATIONS BETWEEN THE ANALYTICAL SAMPLE RESULTS

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Figure E-1. Pu (ICP/MS) vs. Solids Concentration.

Figure E-2. Pu (AEA) vs. Solids Concentration.

Figure E-3. U (PNL Laser) vs. Solids Concentration.

Figure E-4. U (222S Laser) vs. Solids Concentration.

Figure E-5. U (PNL-ICP/MS) vs. Solids Concentration.

Figure E-6. ^{241}Am (AEA-222S) vs. Solids Concentration.

Figure E-7. ^{241}Am (PNL-GEA) vs. Solids Concentration.

Figure E-8. Pu (222S-AEA) vs. AT (222S).

Figure E-9. ^{239}Pu (PNL-ICP/MS) vs. ^{241}Am (PNL-GEA).

Figure E-10. ^{239}Pu (PNL-ICP/MS) vs. ^{137}Cs (PNL-GEA).

Figure E-11. ^{239}Pu (PNL-ICP/MS) vs. ^{60}Co (PNL-GEA).

Figure E-12. ^{239}Pu (PNL-ICP/MS) vs. ^{154}Eu (PNL-GEA).

Figure E-13. ^{239}Pu (PNL-ICP/MS) vs. ^{155}Eu (PNL-GEA).

Figure E-14. ^{137}Cs (PNL-GEA) vs. ^{239}Pu (PNL-ICP/MS).

Figure E-15. Pu (222S-AEA) vs. ^{241}Am (222S-GEA).

Figure E-16. Pu (222S-AEA) vs. ^{137}Cs (222S-GEA).

Figure E-17. Pu (222S-AEA) vs. ^{60}Co (222S-GEA).

Figure E-18. Pu (222S-AEA) vs. ^{154}Eu (222S-GEA).

Figure E-19. Pu (222S-AEA) vs. ^{155}Eu (222S-GEA).

Figure E-20. ^{241}Am (222S-AEA) vs. ^{241}Am (222S-GEA).

Figure E-21. ^{241}Am (PNL-AEA) vs. ^{241}Am (PNL-GEA).

Figure E-22. ^{137}Cs (222S-GEA) vs. Pu (222S-AEA).