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Date: July 3, 2008

From: Bill Wright and Colin Duffy, MWH

Reference: P4 Production, Monsanto Elemental Phosphorus Plant

Subject: Transmittal of Second CERCLA Five-Year Review Sediment Report – Final – Rev. 0

Dear Mark, Doug, Clyde, and Lenna,

Please find enclosed the *Second CERCLA Five-Year Review Sediment Report – Final - Rev. 0*. As no comments were provided for the draft version of this document submitted on May 15, 2008, we have revised the title and consider this a final draft. This document will be transmitted electronically via our FTP site as well as in hard copy accompanied by CD. This sediment report is submitted as one of two reports that MWH plan to submit. A technical soil report is to accompany and will be submitted at the same time.

Sincerely,

Bill Wright
Project Manager

P4 PRODUCTION
MONSANTO ELEMENTAL PHOSPHORUS PLANT

Second CERCLA Five-Year Review Soil Report - Rev. 1 - Final

Prepared by

MWH

2353 130th Avenue N.E., Suite 200
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July 2008

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APPENDICES

Appendix A Sediment Data Evaluation and Quality Control Summary

LIST OF ACRONYMS

ARARs	applicable or relevant or appropriate requirements
COC	contaminant of concern
COPC	constituent of potential concern
DW	dry weight
USEPA-10	US Environmental Protection Agency Region 10
FS	feasibility study
IDEQ	Idaho Department of Environmental Quality
K-S	Kolmogorov-Smirnov
K-W	Kruskal-Wallis
LSD	Fisher’s least significant difference
NPDES	National Pollutant Discharge Elimination System
RI/FS	remedial investigation/feasibility study
RI	remedial investigation
ROD	record of decision

1.0 INTRODUCTION

Sediment samples were collected as part of the phase II (1992-1995) remedial investigation (RI), and five and ten-year monitoring program (in 2002 and 2007) in the Alexander Reservoir at the inlets of Soda Creek and Bear River using a mini-ponar dredge at nine locations in each inlet. Samples were also collected along the upstream and downstream reaches of Soda Creek during phases I (1991-1992) & II remedial investigations and as part of the five-year monitoring program. These samples were collected in an effort to determine what, if any, impacts the Monsanto elemental phosphorus plant has on Soda Creek and Alexander Reservoir.

Soda Creek is over six miles in length, flows along the western side of the plant in a general north-to-south direction, and discharges into the Alexander Reservoir. Monsanto utilizes an NPDES-permitted outfall for cooling water that discharges into Soda Creek.

Samples collected during the five and ten-year monitoring programs were subject to analysis with a reduced analyte list that included arsenic (As), cadmium (Cd), copper (Cu), nickel (Ni), selenium (Se), silver (Ag), vanadium (V), and polonium-210 (^{210}Po). The reduction in analytes from the phase I & II investigations was approved by the USEPA-10 and is found in the record of decision (ROD; USEPA, 1997). These eight analytes remain because they were the only contaminants that remained at elevated concentrations in the reservoir or the creek after the RI.

2.0 METHODOLOGY

Data collected from the RI and five and ten-year monitoring program events were grouped into control and affected categories for evaluation. Data collected in Alexander Reservoir during the RI spatially matched the monitoring data collected by MWH in 2002 and 2007. The analyte lists were also equivalent, save for ^{210}Po, which was not analyzed during the RI, but was analyzed during five-year review monitoring in the reservoir. The same stations were sampled during the monitoring as during the RI.

In Soda Creek, data were not collected in the exact same locations from the RI as during the monitoring. However, samples were collected at locations sufficiently close so as to provide a reliable comparison. Similarly, the analyte lists were comparable between the RI and the 2002 and 2007 monitoring. Soda Creek samples were classified as control (upstream) or affected (downstream) depending on their location in relation to the Monsanto plant outfall.

Supplemental Phase II RI data collected for Soda Creek from the time Alexander Reservoir was sampled (in 1994) are ignored here. The supplemental sediment quality data for the creek are reported as mg/kg clay in Golder Associates, 1997, and are thus not comparable to previously collected data or to those collected during the 2002 and 2007 samplings, which are reported as mg/kg dw fines (where fines are less than 2 mm in effective diameter—i.e., fine sands, silts, and clays).

Sediment collection in the reservoir and the creek followed the appropriate field sampling plan (MWH, 2002).

For the first five-year review, statistical analysis was conducted nonparametrically with a Kruskal-Wallis (K-W) analysis of variance (ANOVA). When the K-W test was statistically significant, a Fisher's least significant difference (LSD) test was used to determine specific differences between sampling areas (control vs. affected) and times (RI and monitoring).. These tests were performed in Excel using formulae provided in Georgia Institute of Technology (2003). Each K-W test and any subsequent Fisher's LSD tests were performed at a Type I error rate (i.e., false alarm rate) of 0.05.

The Type I error rate, α, for the Fisher's LSD tests is controlled on a per-comparison basis and is accurate only when there are exactly three groups being compared. The LSD test is a refined form of multiple t tests. For multiple t tests there is a multiple comparison problem where the experiment-wise Type I error rate, α_e, (the overall error rate applied once all comparisons have been completed) inflates as the number of comparisons, denoted by r, increases as follows:

$$\alpha_e = 1 - (1 - \alpha)^r .$$

(http://www.psych.utoronto.ca/courses/c1/chap12/chap12.html). Thus, when r > 1, $\alpha_e > \alpha$. For example, when $\alpha = 0.050$ and r = 3, $\alpha_e \approx 0.143$; when $\alpha = 0.050$ and r = 30, $\alpha_e \approx 0.785$. The relevance is that a large number of multiple comparisons can end up

showing significant differences, even when no such differences exist. Given that the LSD is not performed unless the K-W test is significant, the LSD test is regarded as protected LSD. However, with more than three groups to compare, the LSD results, even though protected by the K-W test, are going to be more liberal than the specified α (i.e., $\alpha_e > \alpha$).

During the five-year review there were four groups: (1) RI control, (2) RI affected, (3) monitoring year 5 control, and (4) monitoring year 5 affected. Thus, use of the LSD to identify which groups differ should not be excessively liberal. However, the 10-year review now has six groups: the previously identified four plus (5) monitoring year 10 control, and (6) monitoring year 10 affected. We have opted to continue to use the K-W and LSD for the ten-year review, but we call out the multiple comparison problem and add an additional test to nonparametrically test the 10-year monitoring affected areas to their respective controls without any multiple comparisons—the Kolmogorov-Smirnov two distribution (K-S) test.

We recommend using the K-S test to evaluate the results of future monitoring. Unlike the K-W test, it does not merely test the difference between medians of distributions, it tests the difference between entire distributions. Because control data and affected data are available for each setting, there are no multiple comparisons with the K-S test—it will merely test whether the affected distribution is higher than the corresponding control distribution for a given year. It also has the advantage of generating an easily understood graph for each test. The test statistic for the K-S test is D, the maximum vertical distance between the two empirical cumulative distribution functions.

In the future there will undoubtedly be a desire to compare results from control data and affected data for all sampling events to determine whether significant change is occurring over time. Rather than using the protected Fisher's LSD, we recommend adopting an alternative method of multiple comparison; for example, Tukey's Honestly Signficant Difference (HSD), in which Type I error is controlled on an experiment-wise basis (http://www.psych.utoronto.ca/courses/c1/chap12/chap12.html).

For the 10-year monitoring the K-W and K-S tests were performed with XLStat, statistics software that is added on to Excel. Unfortunately, XLStat does not handle multiple comparisons other than if there are multiple comparisons to a single control, which does not fit our needs. Thus, the LSDs following a significant K-W test are calculated based on the results of a nonparametric ANOVA performed with Excel on the ranked concentrations for a given analyte in a given setting—Soda Creek or Alexander Reservoir. Excel worksheets with such calculations and XLStat outputs are appended. Results from the data interpretation are presented in the sections that follow. Nonparametric methods are used because of heterogeneity of variance between control and affected areas that is not eliminated with a simple transformation. A detailed discussion of the K-W test is provided in the 5-year review report because all calculations were conducted in Excel worksheets. A description of the LSD procedure is outlined here because these calculations are conducted in the appended Excel worksheets.

Nonparametric Protected Fisher's LSD Procedure

- K-W test is performed on data using XLStat.
- If the K-W test is significant, rank all concentrations for a given analyte in a given setting.
- Use Excel's single factor ANOVA function to conduct an analysis of variance on the ranked data; ignore the p value, because the K-W test has already informed us that at least one significant difference between groups exists; the Excel ANOVA output organizes the results to make the LSD calculations more convenient.
- Calculate the critical LSD value for the difference in mean rank between any two groups, i and j, as follows:

$$LSD = t_{\alpha/2,\nu}\sqrt{MS_w\left(\frac{1}{n_i}+\frac{1}{n_j}\right)},$$

where: $t_{\alpha/2,\nu}$ is the two-sided Student's t value for a given Type I error rate and ν degrees of freedom, which are the degrees of freedom associated with the within mean square error of the ANOVA on the ranks, MS_w; and n_i and n_j are the number of samples in each of the two groups being evaluated. When:

$$\left|\bar{y}_i - \bar{y}_j\right| > LSD$$

then the difference in the mean ranks of the two groups, $\bar{y}_i$ and $\bar{y}_j$, is regarded as statistically significant.

Results from the data interpretation are presented in the following sections.

3.0 STATISTICAL RESULTS

3.1 SEDIMENT RESULTS

Sediment analytical results from the K-W and K-S tests for Alexander Reservoir and Soda Creek are presented below.

3.1.1 Alexander Reservoir Sediments

Sediment sample medians collected in Alexander Reservoir are presented below. The data presented are from the RI conducted by Golder Associates, and the five and ten-year monitoring efforts conducted by MWH. In the tables below, sample median concentrations that are indistinguishable from one another are shown with their medians highlighted on the same row. Any differences are denoted by displaying medians on different rows. 'RI' results are from remedial investigation sampling events, and 'M05' and 'M10' results are data collected during the five and ten-year monitoring programs, respectively.

For each analyte a graphical display of the data plotted against distance from the mouth of the Bear River (for control data) or the mouth of Soda Creek (for affected data) is presented. These plots are provided for visual interpretation to see changes over space and time. The graphical results from the K-S tests are also presented for each analyte. For each control/affected pair the empirical cumulative distribution functions are plotted along with the p value derived from the K-S test.

3.1.1.1 Arsenic

The medians of the arsenic data are presented in Table 3.1, *Alexander Reservoir Arsenic Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show that contamination is present, but conditions have been at steady state with some variance since the RI. The graphical plot in Figure 3.1 confirms the statistical analysis, whereas Figure 3.1.1 confirms that M10 control and affected concentrations are statistically different.

Table 3.1: Alexander Reservoir Arsenic Comparisons

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[As]_{sed}$ mg/kg dw		5.9				9.6	Affected area elevated, but does not appear to be increasing
				3.6			
	2.4				2.9		
			1.9				

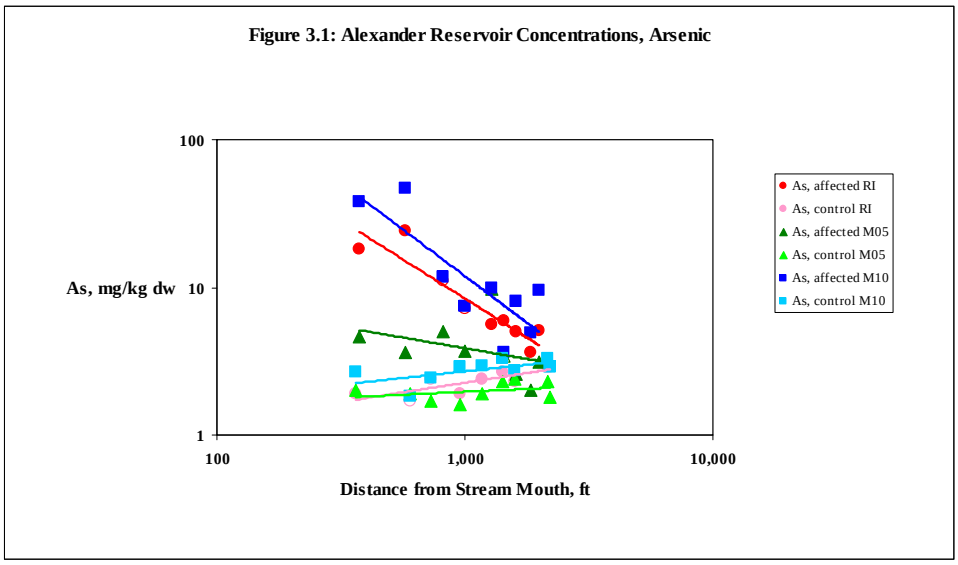
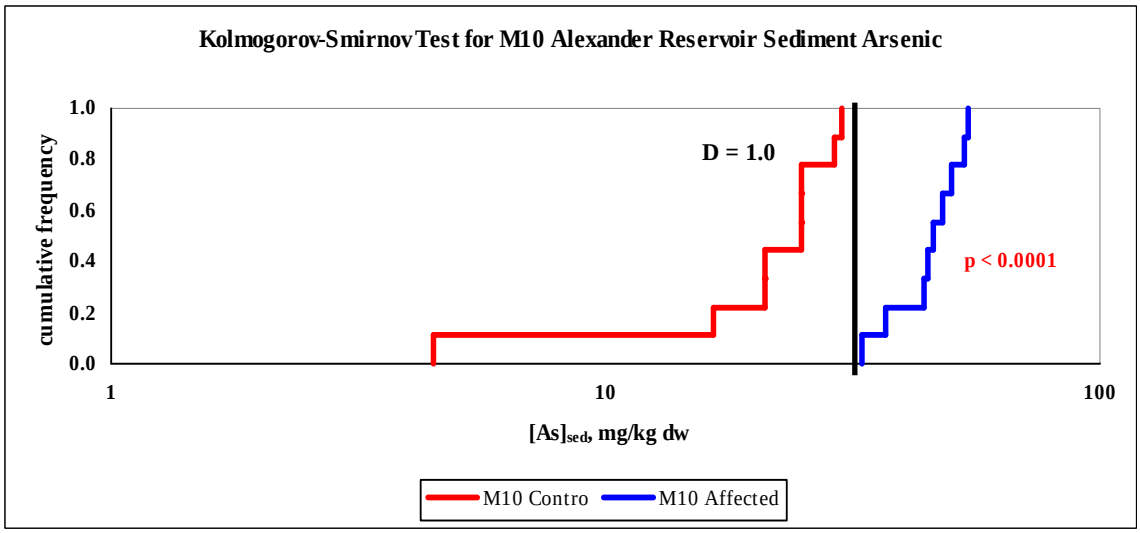


Figure 3.1.1



3.1.1.2 Cadmium

The medians of the cadmium data are presented in Table 3.2, *Alexander Reservoir Cadmium Comparisons*. The results of the Kruskal-Wallis test and Fisher's LSD show that contamination is present, but conditions have been at steady state with some variance since the RI. The graphical plot in Figure 3.2 confirms the statistical analysis, whereas Figure 3.2.1 confirms that M10 control and affected concentrations are statistically different.

Table 3.2: Alexander Reservoir Cadmium Comparisons

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[Cd]_{sed}$ mg/kg dw		8.9				4.8	Affected area elevated, but does not appear to be increasing
				2.8			
					0.60		
	0.30		0.46				

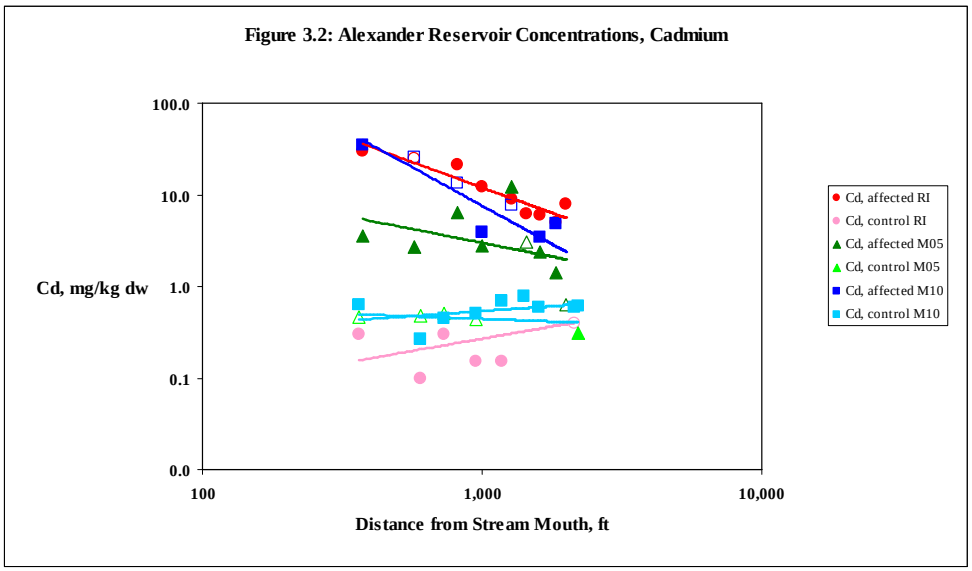
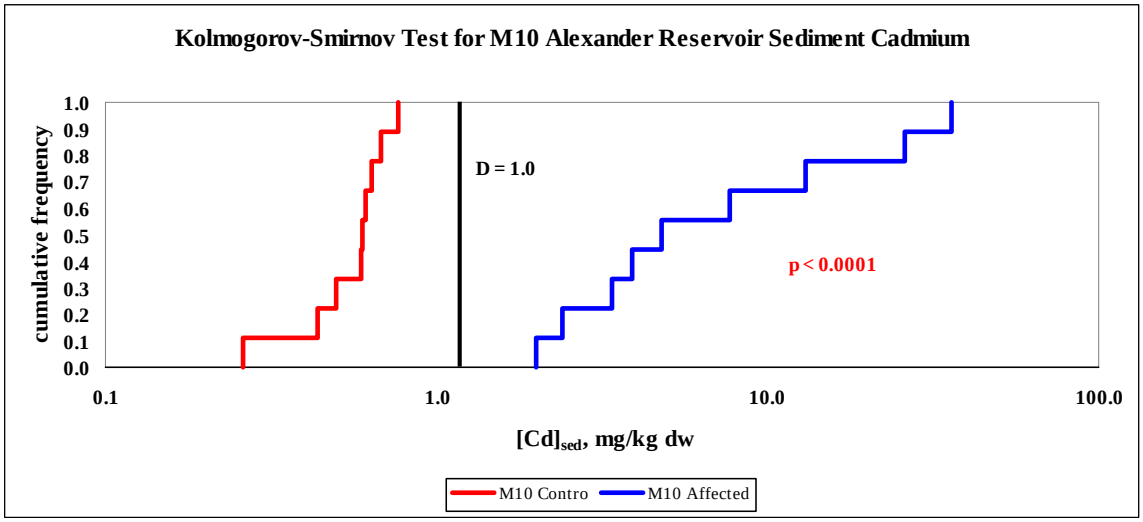


Figure 3.2.1:



3.1.1.3 Copper

The medians of the copper data are presented in Table 3.3, *Alexander Reservoir Copper Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show that copper concentrations are not, and never have been, elevated. The graphical plot in Figure 3.3 confirms the statistical analysis but suggests that there may be an upstream source of copper, whereas Figure 3.3.1 confirms that confirms that M10 control and affected concentrations are not statistically different.

Table 3.3: Alexander Reservoir Copper Comparisons

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[Cu]_{sed}$ mg/kg dw	6.7	6.4	5.1	5.9	7.3	7.5	Affected area not elevated

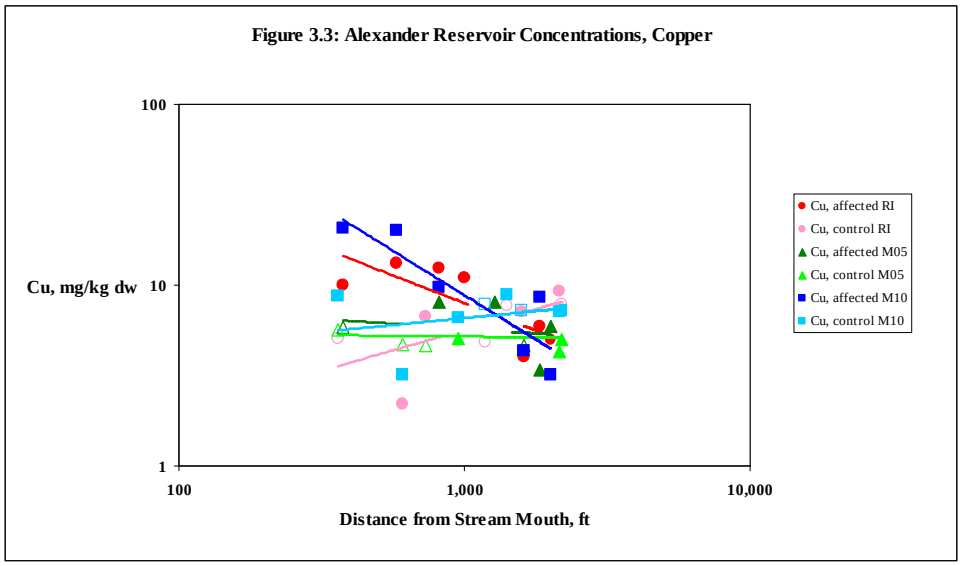
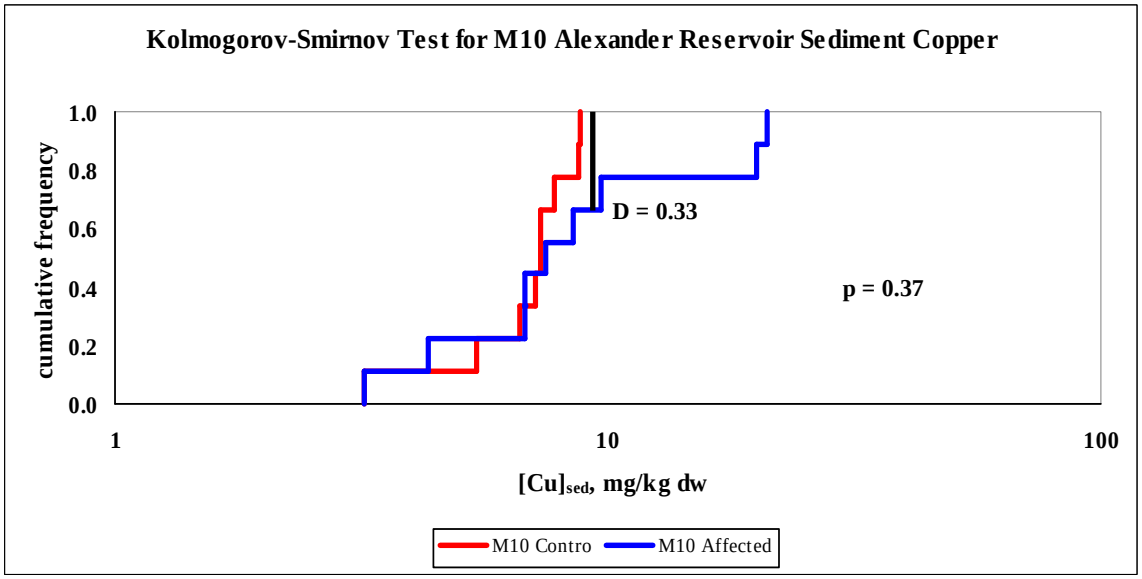


Figure 3.3.1:



3.1.1.4 Nickel

The medians of the nickel data are presented in Table 3.4, *Alexander Reservoir Nickel Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show that concentrations are elevated, but conditions have been at steady state with some variance since the RI. The graphical plot in Figure 3.4 confirms the statistical analysis but suggests that there may be a natural source of nickel upstream, whereas Figure 3.4.1 confirms that M10 control and affected concentrations are statistically different.

Table 3.4: Alexander Reservoir Nickel Comparisons

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[Ni]_{sed}$ mg/kg dw		20				17	Affected area elevated, but does not appear to be increasing
				11			
	8.0		7.2		9.0		

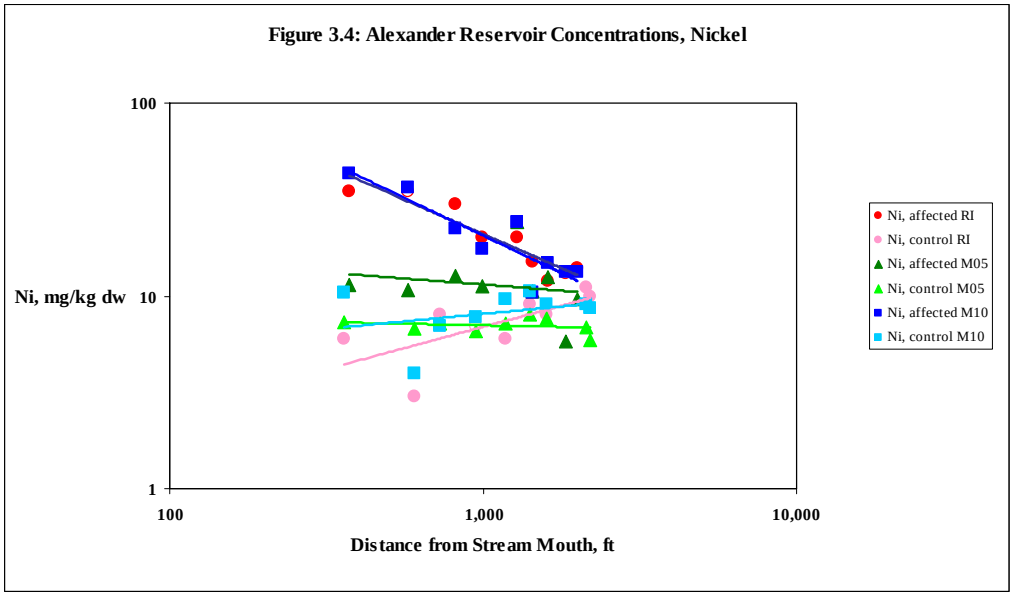
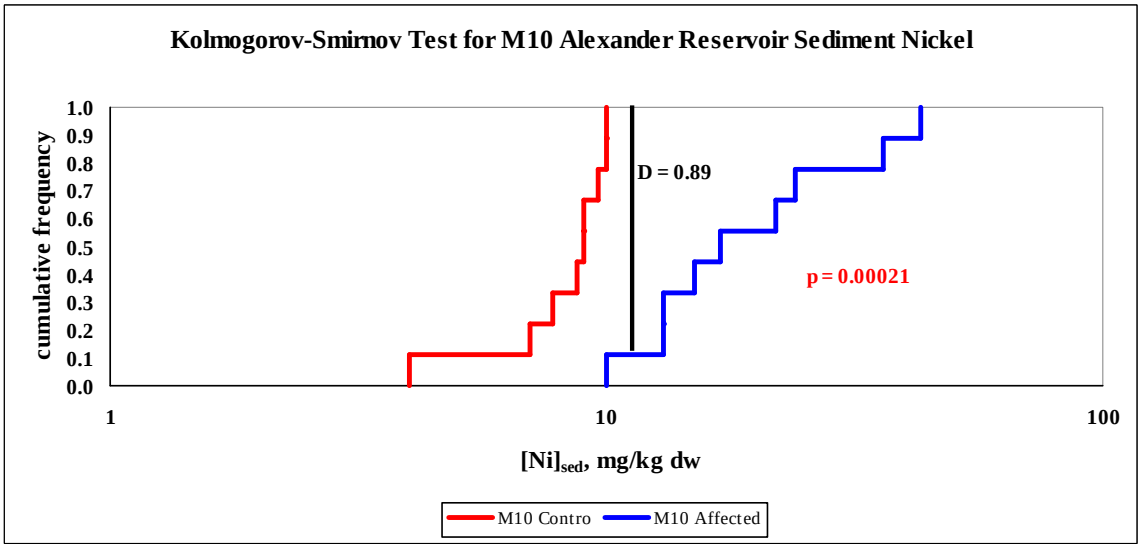


Figure 3.4.1:

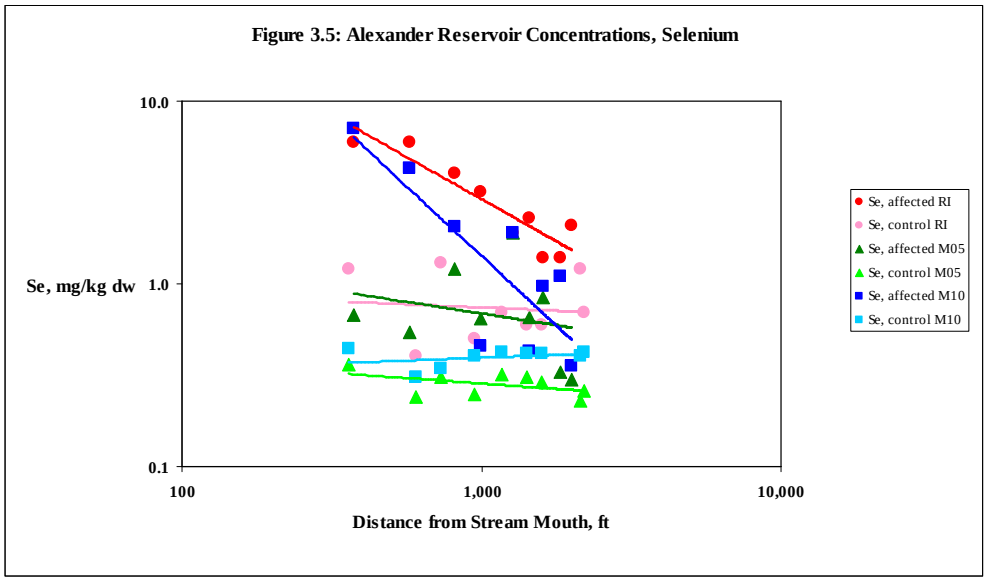


3.1.1.5 Selenium

The medians of the selenium data are presented in Table 3.5, *Alexander Reservoir Selenium Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show that concentrations are elevated, but have been at steady state with some variance since the RI. The graphical plot in Figure 3.5 confirms the statistical analysis, whereas Figure 3.5.1 confirms that M10 control and affected concentrations are statistically different.

Table 3.5: Alexander Reservoir Selenium Comparisons

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[Se]_{sed}$ mg/kg dw		2.3					Affected area elevated, but does not appear to be increasing
	0.70					1.1	
				0.66			
					0.42		
			0.29				



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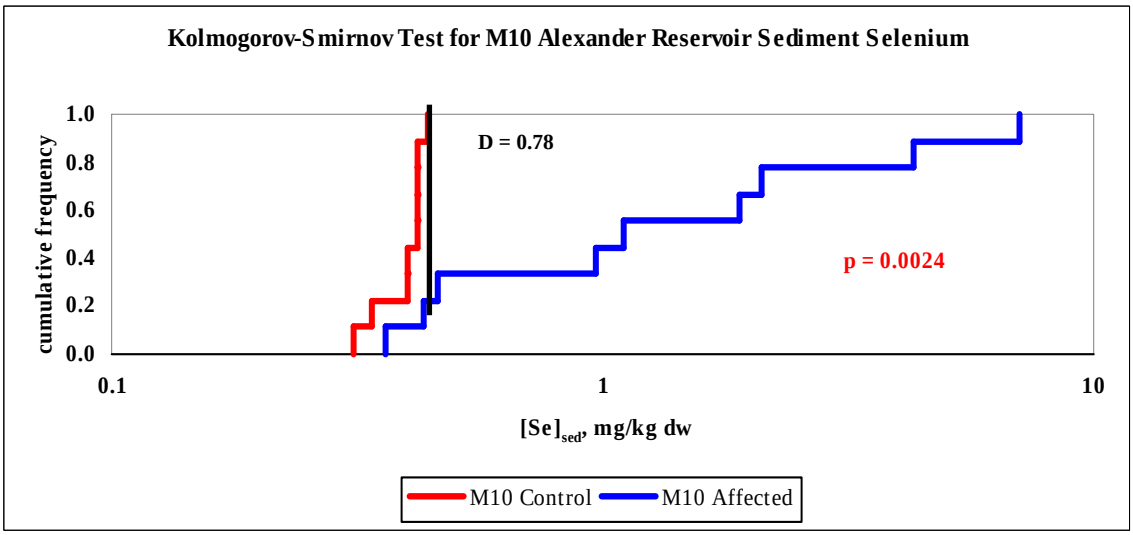
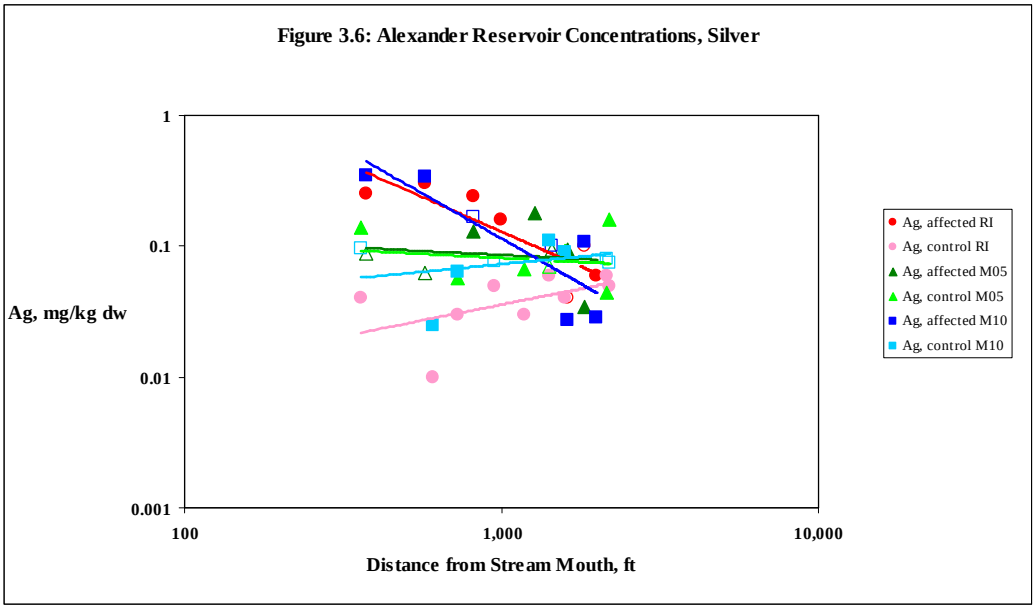


3.1.1.6 Silver

The medians of the silver data are presented in Table 3.6, *Alexander Reservoir Silver Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show that concentrations were elevated during the RI, but have since dropped to background levels and have reached steady state. The graphical plot in Figure 3.6 confirms the statistical analysis but suggests that there may be inputs arriving from Soda Creek, whereas Figure 3.6.1 confirms that M10 control and affected concentrations are not statistically different.

Table 3.6: Alexander Reservoir Silver Comparisons

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[Ag]_{sed}$ mg/kg dw		0.10	0.077	0.087	0.090	0.10	Affected area may have been elevated in the past,
	0.040						but does not appear elevated now



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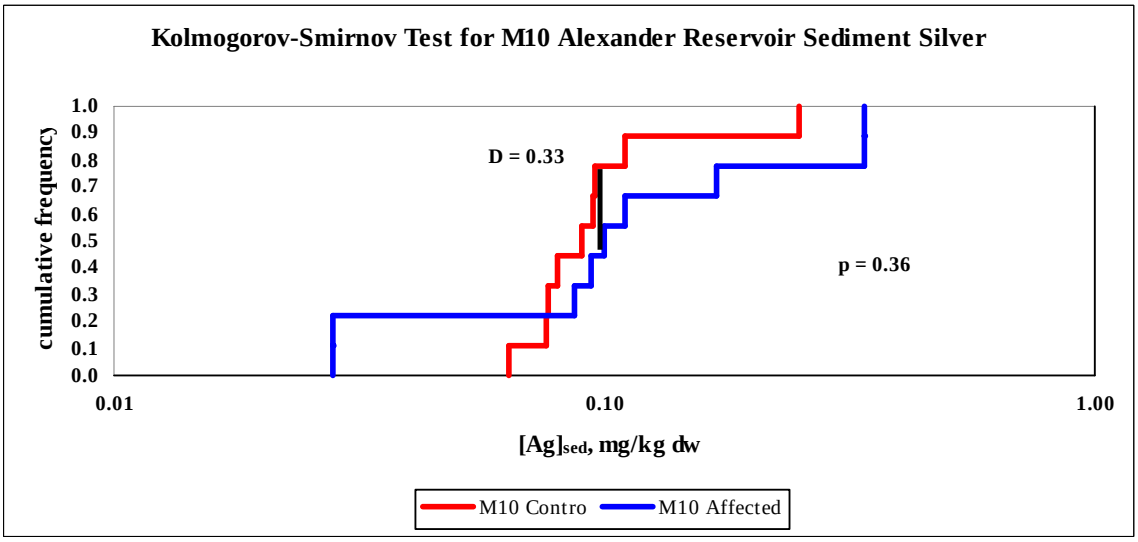


3.1.1.7 Vanadium

The medians of the vanadium data are presented in Table 3.7, *Alexander Reservoir Vanadium Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show that concentrations have been elevated in the past, but no longer appear to be significant because as shown below, in section 3.1.2.7, Soda Creek does not show vanadium contamination. Figure 3.7 suggests that there may be natural vanadium inputs upstream in Soda Creek, whereas Figure 3.6.1 confirms that M10 control and affected concentrations are statistically different.

Table 3.7: Alexander Reservoir Vanadium Comparisons

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[V]_{sed}$ mg/kg dw		25				21	Affected area elevated, but does not appear to be increasing
	18						
				11	15		
			7.8				

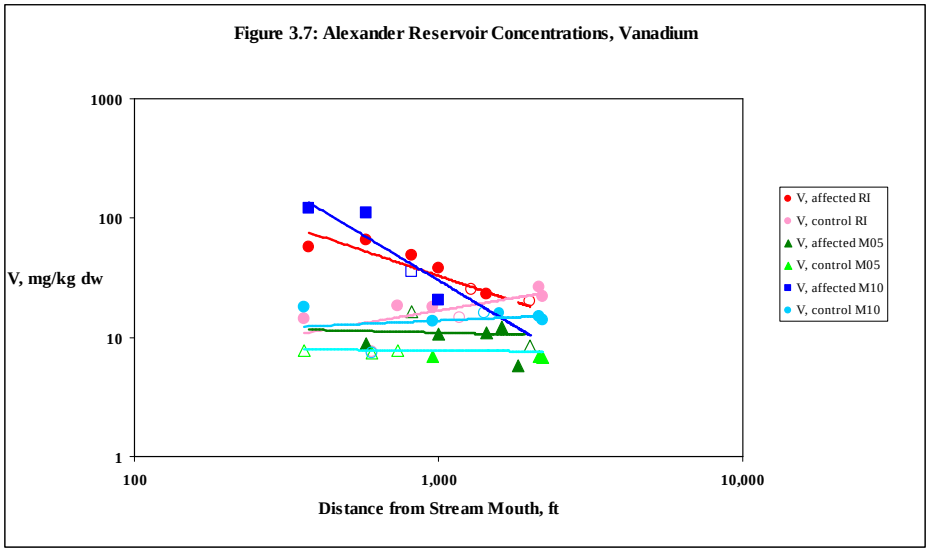
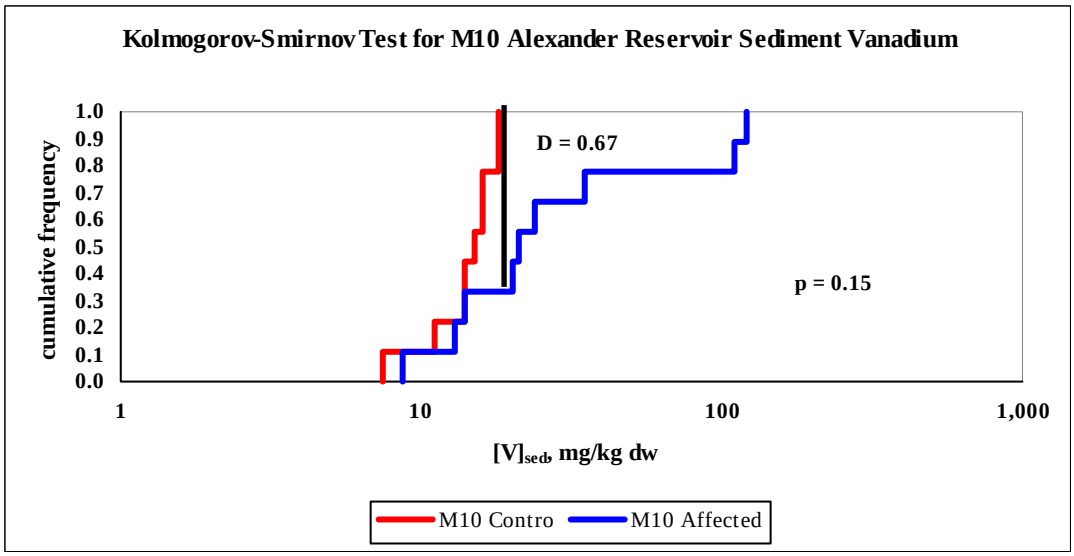


Figure 3.7.1:



3.1.1.8 Polonium-210

The medians of the polonium-210 data are presented in Table 3.8, *Alexander Reservoir Polonium-210 Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show concentrations are not, and never have been, elevated. The graphical plot in Figure 3.8 confirms the statistical analysis, whereas Figure 3.8.1 that M10 control and affected concentrations are not statistically different.

Table 3.8: Alexander Reservoir Polonium-210 Comparisons

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[^{210}Po]_{sed}$ pCi/g dw	Not Sampled	Not Sampled	1.1	1.2	0.93	1.2	Affected area not elevated

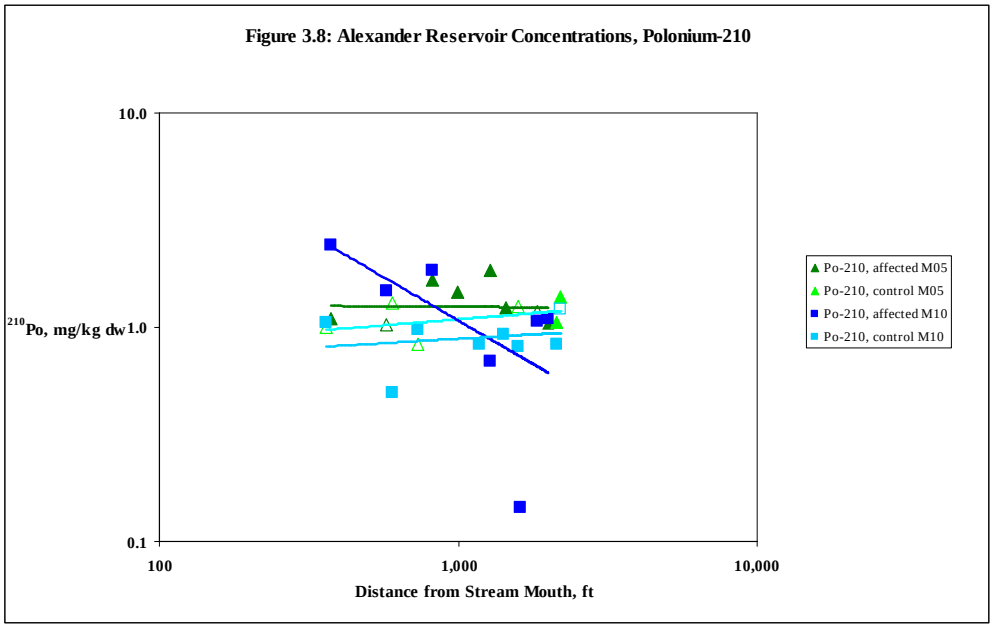
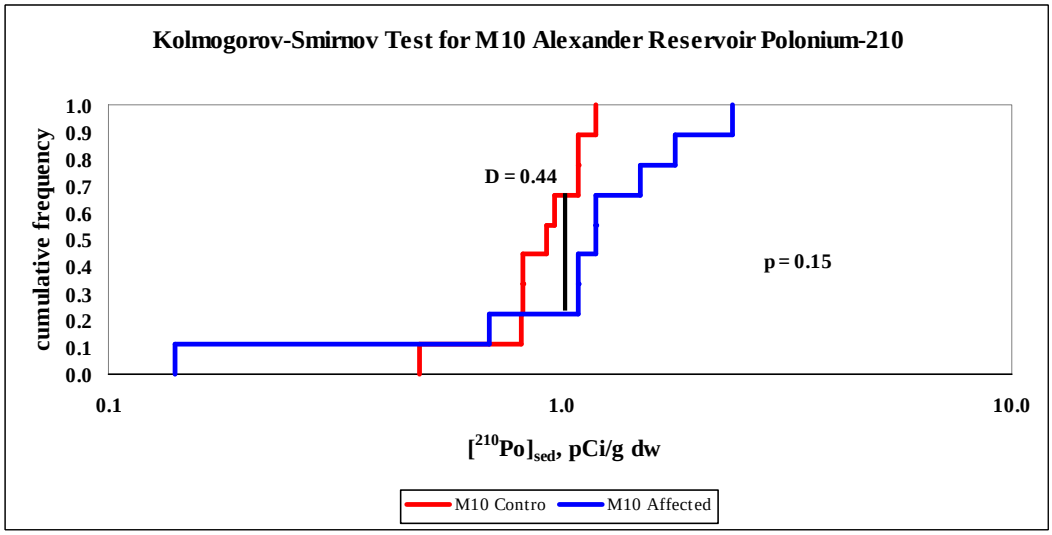


Figure 3.8.1:



3.1.2 Soda Creek Sediments

Sediment sample medians collected in Soda Creek are presented below. The data presented are from the RI conducted by Golder Associates, and the five and ten-year monitoring conducted by MWH. In the tables below, median concentrations that are indistinguishable from one another are shown with their medians highlighted on the same row. Any differences are denoted by displaying medians on different rows. 'RI' results are from remedial investigation sampling events, and 'M05' and 'M10' results are data collected during the five and ten-year monitoring programs, respectively.

For each analyte a graphical display is presented of the data plotted against distance from the Monsanto outfall; upstream (for control data) or downstream (for affected data). These plots are provided for visual interpretation. There is only a single control sample from the RI. The results from the K-S test are also presented for each analyte.

3.1.2.1 Arsenic

The medians of the arsenic data are presented in Table 3.9, *Soda Creek Arsenic Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show that concentrations are not, and have never been, elevated. The graphical plot in Figure 3.9 confirms the statistical analysis, whereas Figure 3.9.1 confirms that M10 control and affected concentrations are not statistically different.

Table 3.9: Soda Creek Arsenic Comparisons

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[As]_{sed}$ mg/kg dw	6.2	33	24	9.2	12	62	Affected area not elevated

Figure 3.9: Soda Creek Concentrations, Arsenic

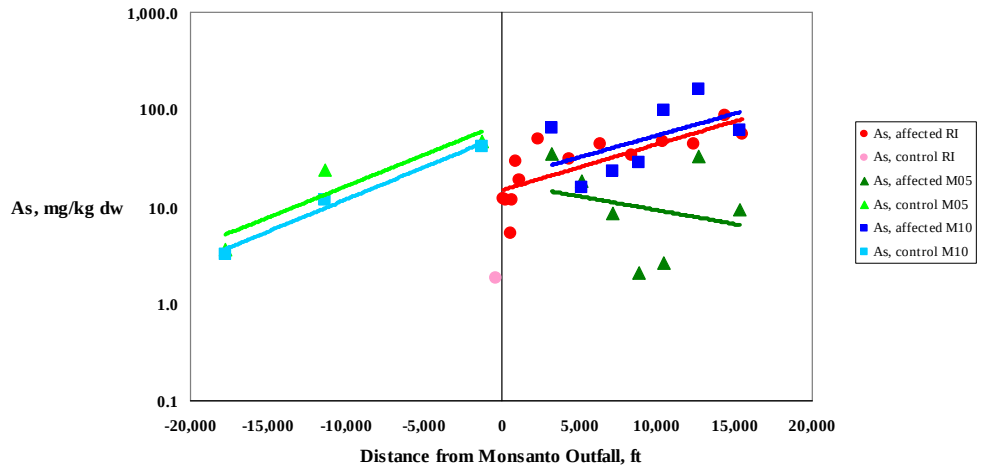
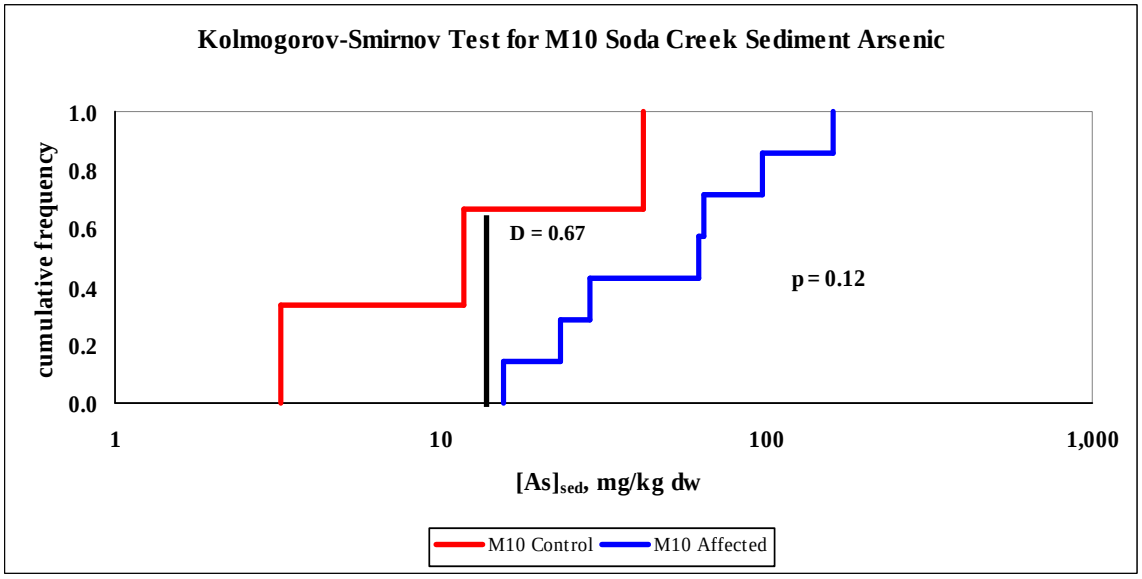


Figure 3.9.1:



3.1.2.2 Cadmium

The medians of the cadmium data are presented in Table 3.10, *Soda Creek Cadmium Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show that concentrations are currently elevated and appear to be at steady state. The graphical plot in Figure 3.10 confirms the statistical analysis, whereas Figure 3.10.1 confirms that M10 control and affected concentrations are statistically different.

Table 3.10: Soda Creek Cadmium Comparisons

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[Cd]_{sed}$ mg/kg dw	11	22				15	Affected area elevated, but does not appear to be increasing
				10			
					0.65		
			0.38				

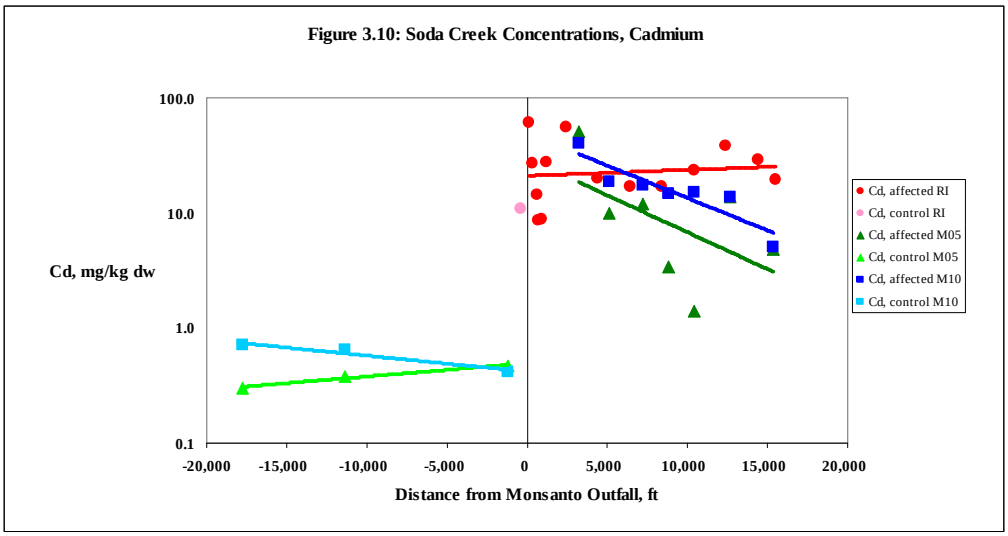
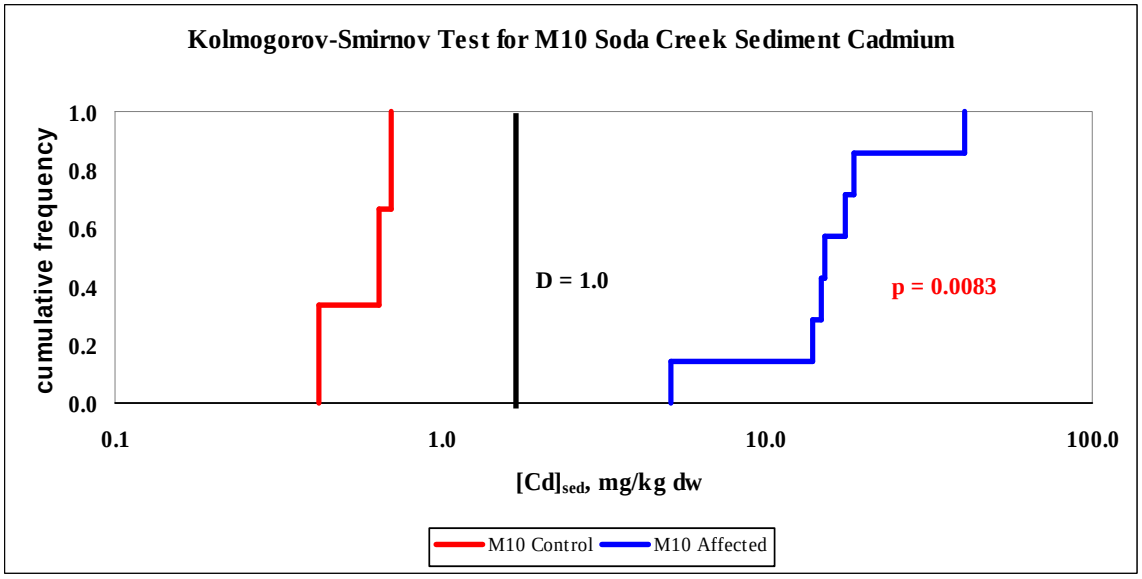


Figure 3.10.1:



3.1.2.3 Copper

The medians of the copper data are presented in Table 3.11, *Soda Creek Copper Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show that concentrations are currently elevated but have varied historically. The graphical plot in Figure 3.11 confirms the statistical analysis, whereas Figure 3.11.1 confirms that M10 control and affected concentrations are statistically different.

Table 3.11: Soda Creek Copper Comparisons

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[Cu]_{sed}$ mg/kg dw		17				9.1	Affected area elevated, but does not appear to be increasing
			6.4				
	2.7			5.1	4.5		

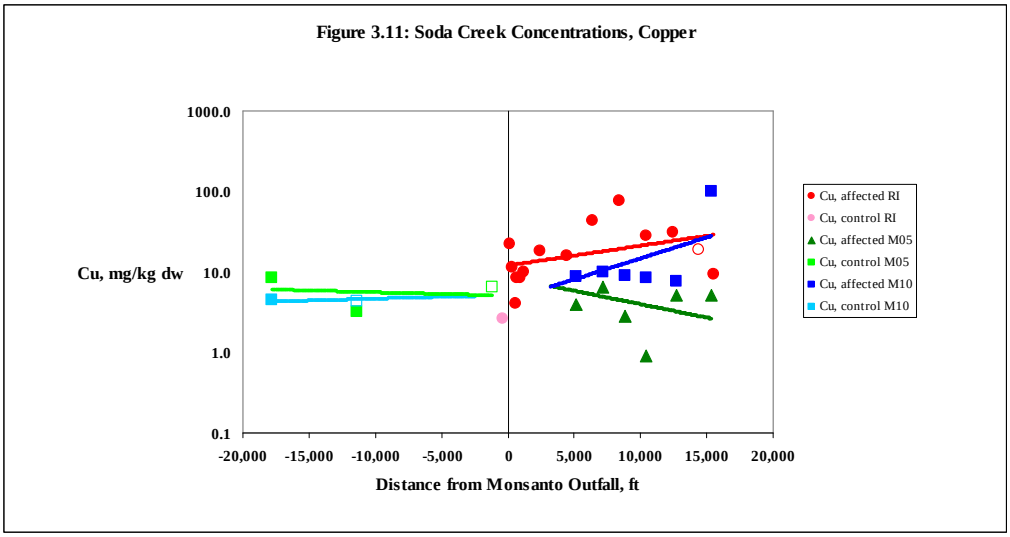
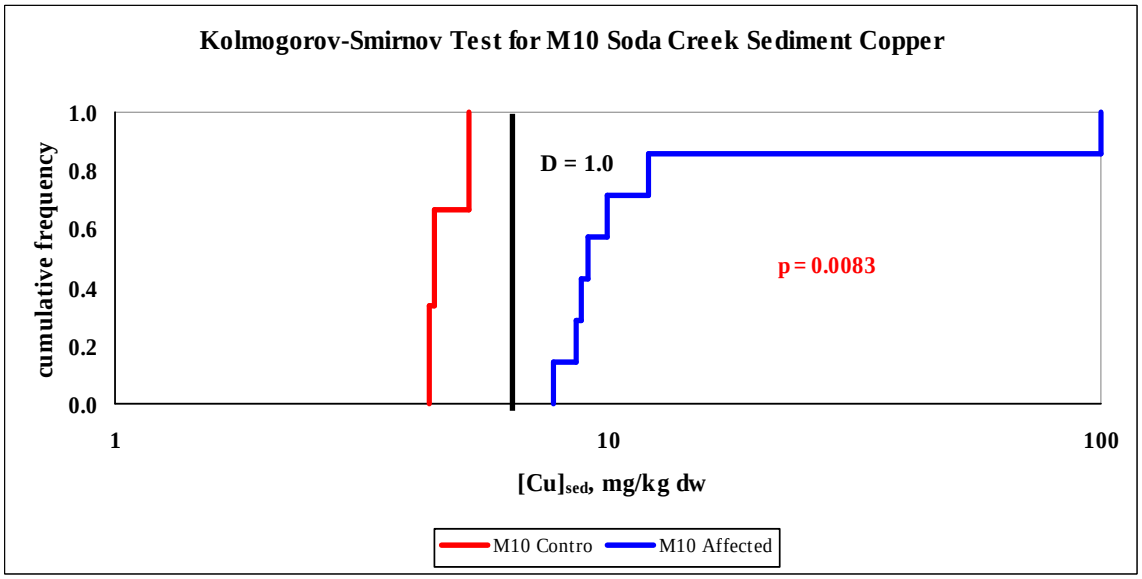


Figure 3.11.1:



3.1.2.4 Nickel

The medians of the nickel data are presented in Table 3.12, *Soda Creek Nickel Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show that nickel concentrations have never been elevated. The graphical plot in Figure 3.12 confirms the statistical analysis, whereas Figure 3.12.1 confirms that M10 control and affected concentrations are not statistically different.

Table 3.12: Soda Creek Nickel Comparisons							
	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[Ni]_{sed}$ mg/kg dw	55	35	30	12	22	30	Affected area not elevated

Figure 3.12: Soda Creek Concentrations, Nickel

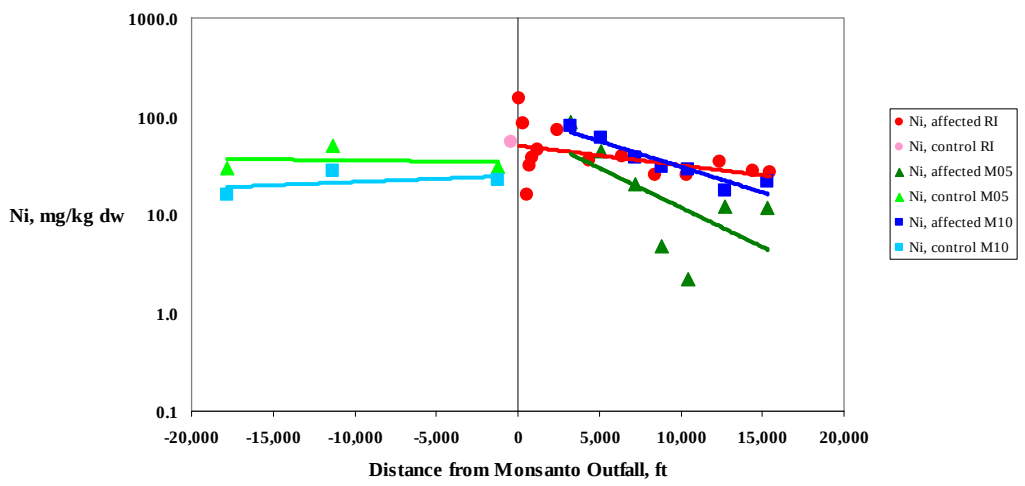
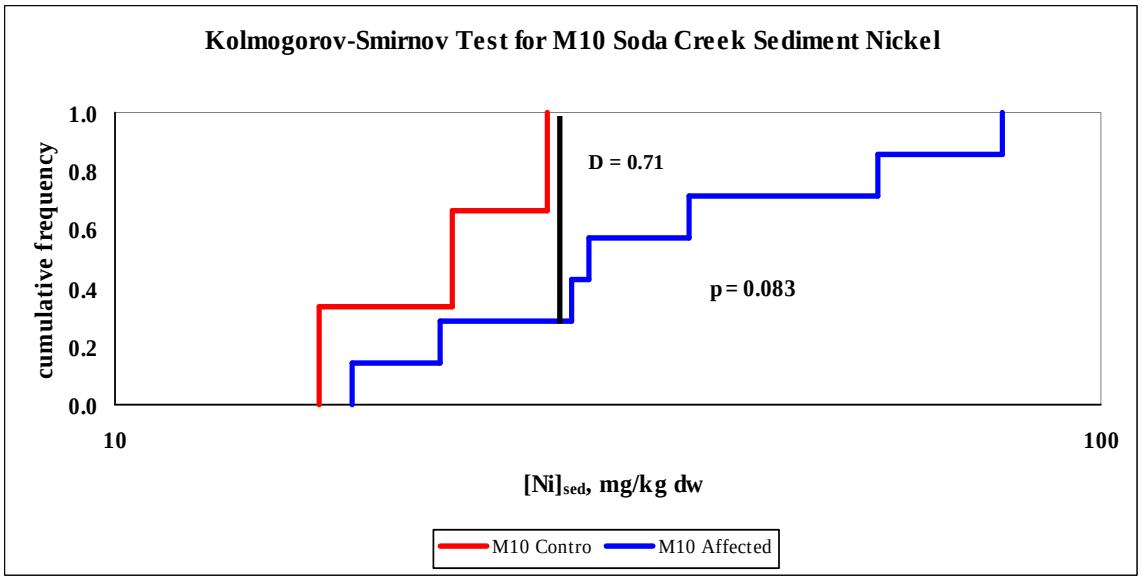


Figure 3.12.1:



3.1.2.5 Selenium

The medians of the selenium data are presented in Table 3.13, *Soda Creek Selenium Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show that concentrations have always been elevated, but appear to be at steady state. The graphical plot in Figure 3.13 confirms the statistical analysis, whereas Figure 3.13.1 confirms that M10 control and affected concentrations are statistically different.

Table 3.13: Soda Creek Selenium Comparisons							
	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[Se]_{sed}$ mg/kg dw		3.5		3.3		4.0	Affected area elevated, but does not appear to be increasing
			0.79				
	0.60				0.60		

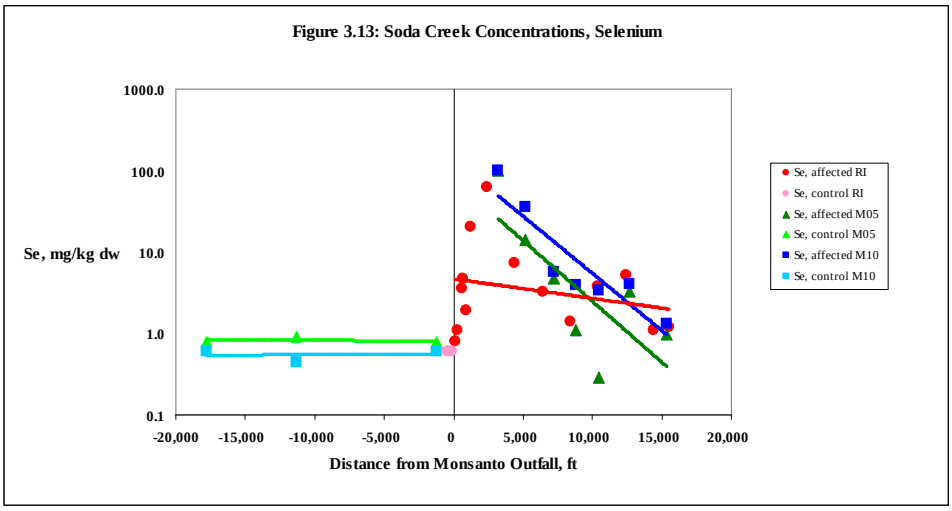
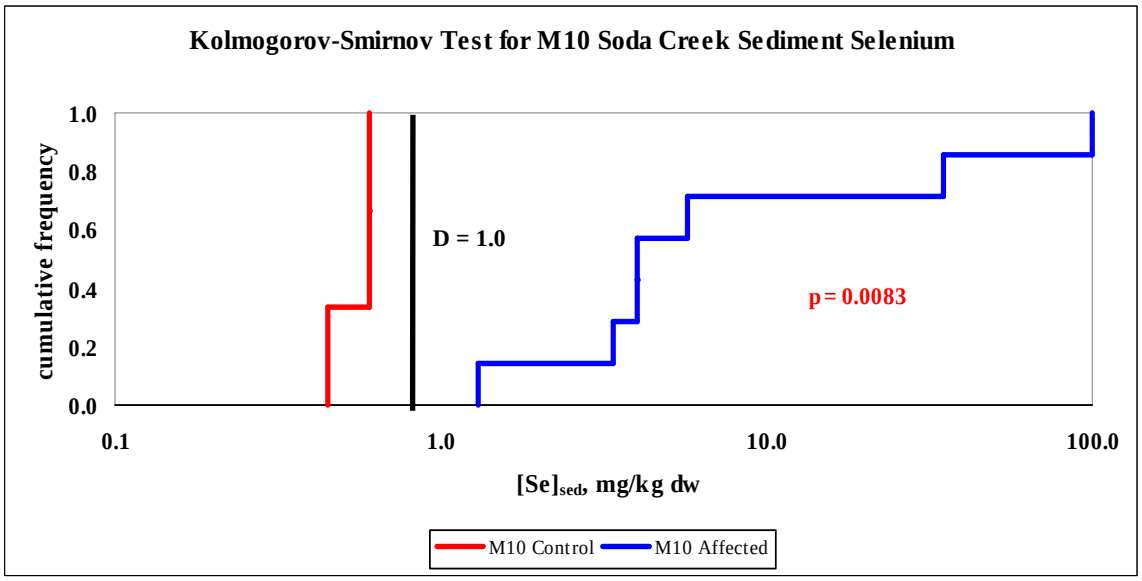


Figure 3.13.1:



3.1.2.6 Silver

The medians of the silver data are presented in Table 3.14, *Soda Creek Silver Comparisons.* The results of the Kruskal-Wallis test and Fisher's LSD show that contamination is currently present, and concentrations have varied historically since the RI. The graphical plot in Figure 3.14 confirms the statistical analysis, whereas Figure 3.14.1 confirms that M10 control and affected concentrations are statistically different.

Table 3.14: Soda Creek Silver Comparisons

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[Ag]_{sed}$ mg/kg dw		1.6				0.22	Affected area elevated, but it may be decreasing
	0.10						
			0.14	0.11	0.049		

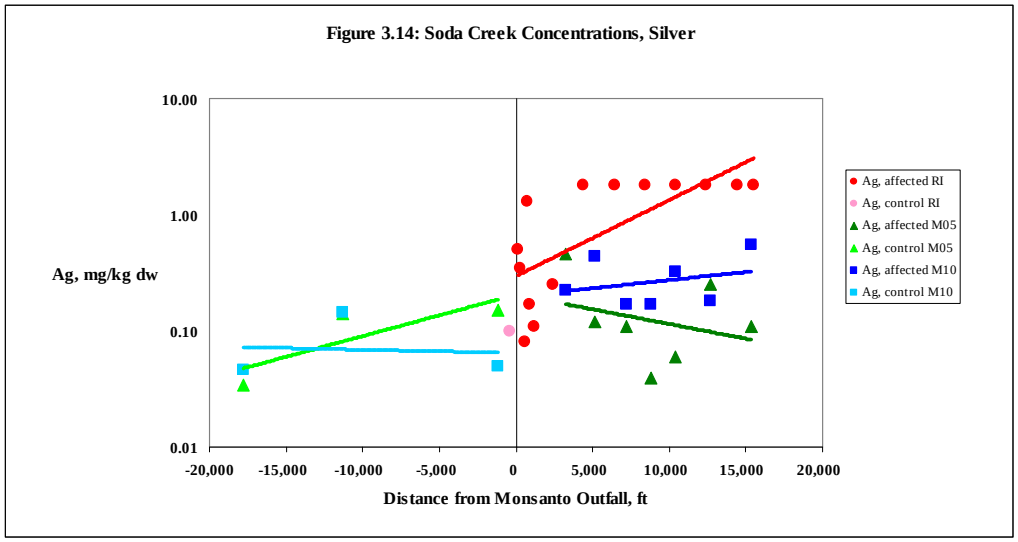
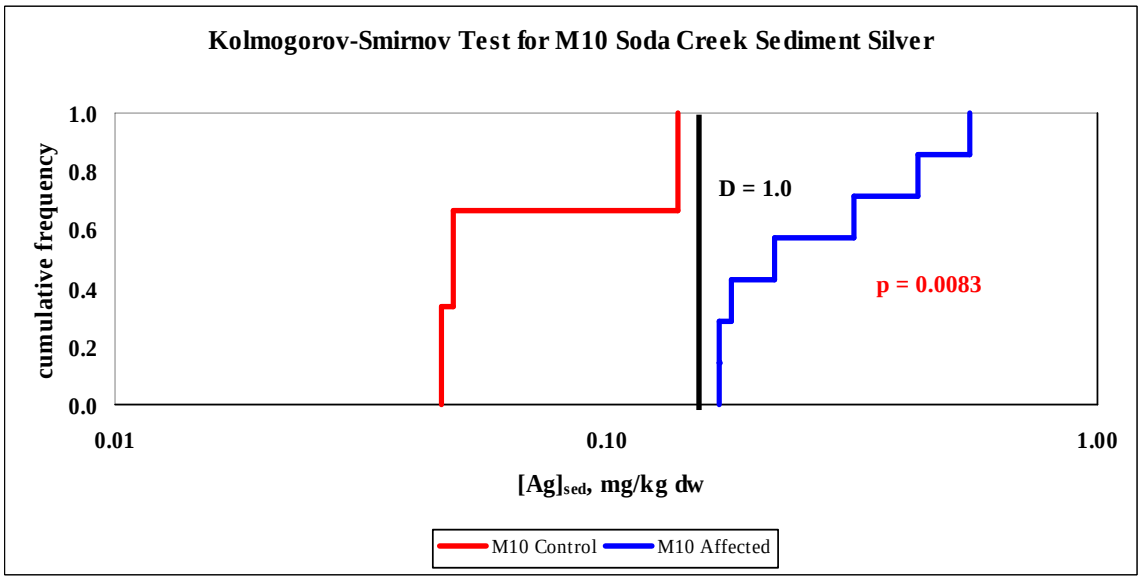


Figure 3.14.1:



3.1.2.7 Vanadium

The medians of the vanadium data are presented in Table 3.15, *Soda Creek Vanadium Comparisons.* Although the results of the Kruskal-Wallis test and Fisher's LSD show that concentrations were historically, and are currently, elevated, figure 3.15.1 suggests that there is currently no difference between the control and affected sites. Thus suggesting that Soda Creek vanadium concentrations at affected sites, are at control concentrations.

Table 3.15: Soda Creek Vanadium Comparisons							
	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[V]_{sed}$ mg/kg dw		100				87	Affected area has been elevated at times,
	23		50	41	41		but does not appear to be increasing

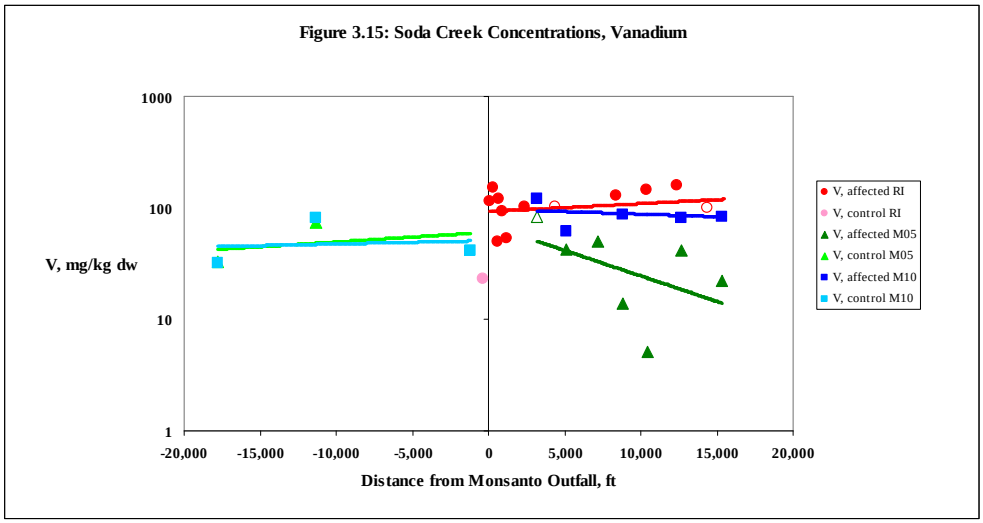
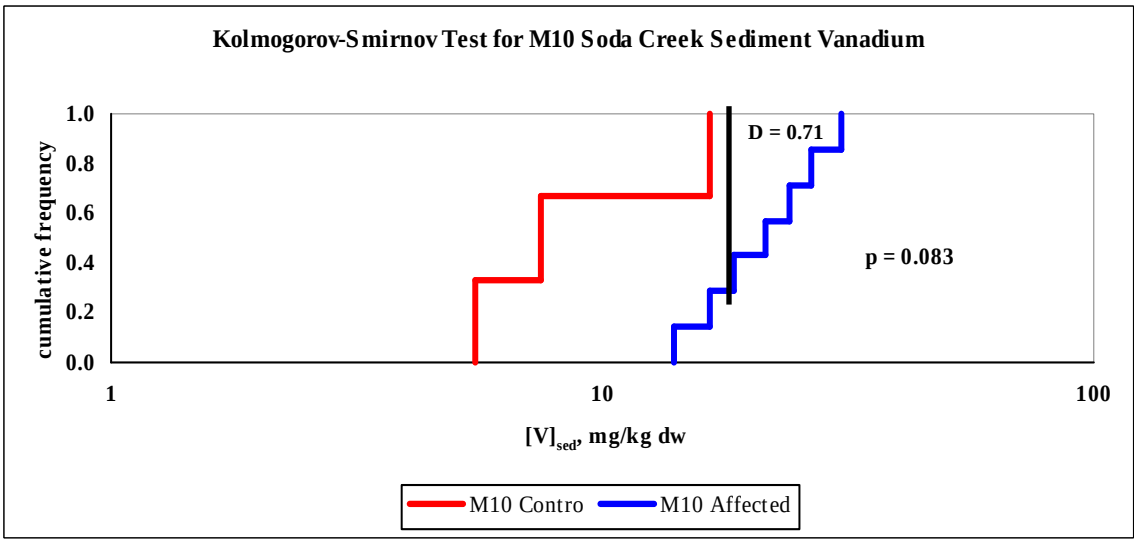


Figure 3.15.1:



3.1.2.8 Polonium-210

The medians of the ^{210}Po data are presented in Table 3.16, *Soda Creek Polonium-210 Comparisons*. The results of the Kruskal-Wallis test and Fisher's LSD show that concentrations have never been elevated. The graphical plot in Figure 3.16 confirms the statistical analysis, whereas Figure 3.16.1 confirms that M10 control and affected concentrations are not statistically different.

Table 3.16: Soda Creek Polonium-210 Comparisons							
	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[^{210}Po]_{sed}$ pCi/g dw	0.67	1.2	0.96	2.0	0.92	1.2	Affected area not elevated

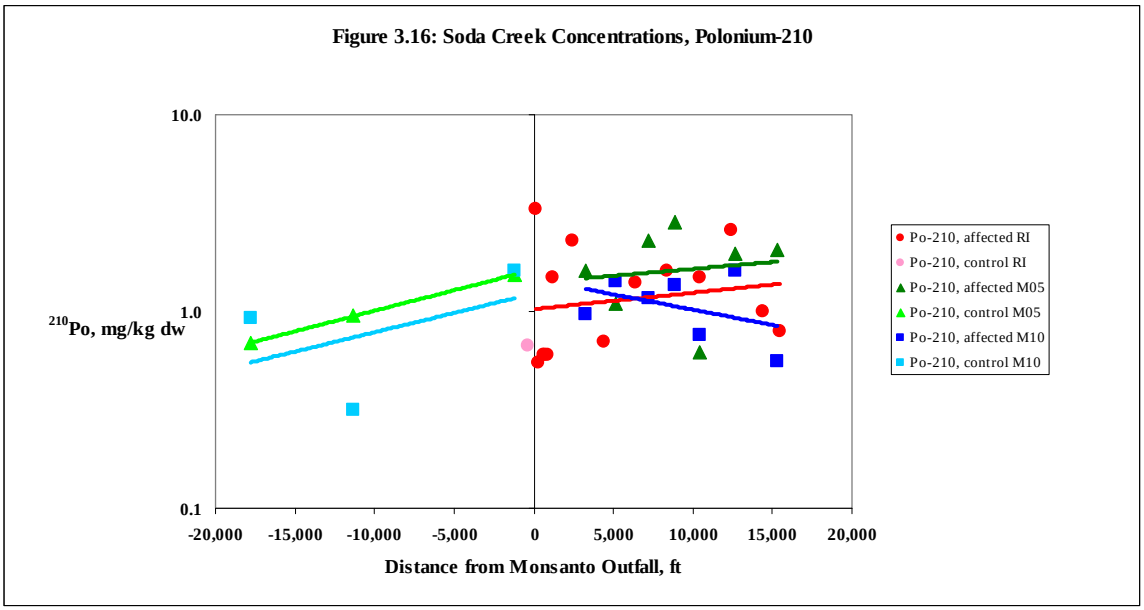
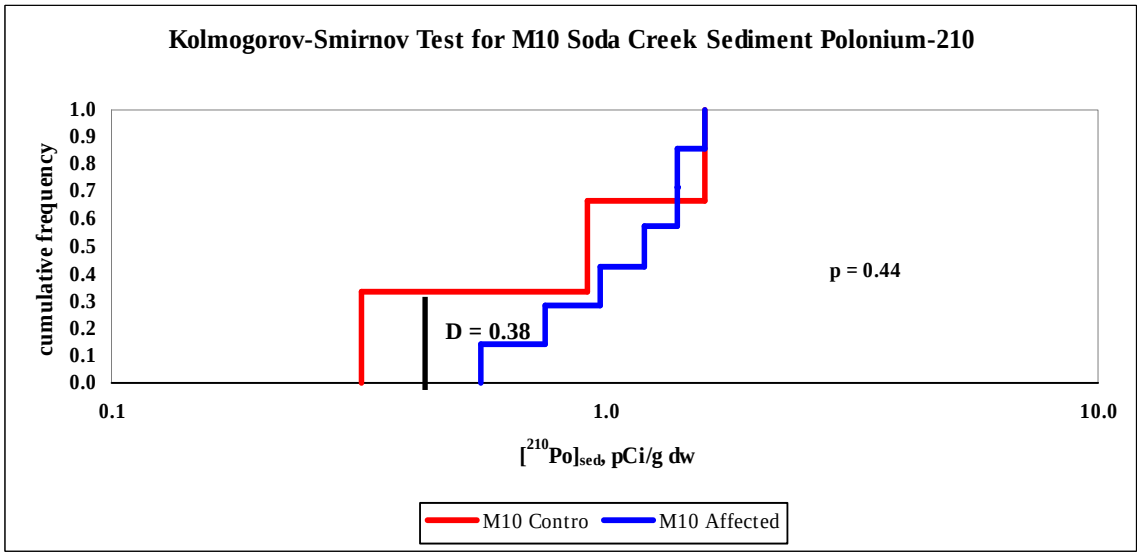


Figure 3.16.1:



3.1.3 Alexander Reservoir Sediment Summary

Table 3.17, *Sediment Quality Summary in Alexander Reservoir* presents a summary of the Kruskal-Wallis and Fisher's LSD test. The right side column presents the interpretation of these data.

Table 3.17: Sediment Quality Summary in Alexander Reservoir

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[As]_{sed}$ mg/kg dw		5.9				9.6	Affected area elevated, but does not appear to be increasing
				3.6			
	2.4				2.9		
			1.9				
$[Cd]_{sed}$ mg/kg dw		8.9				4.8	Affected area elevated, but does not appear to be increasing
				2.8			
					0.60		
	0.30		0.46				
$[Cu]_{sed}$ mg/kg dw	6.7	6.4	5.1	5.9	7.3	7.5	Affected area not elevated
$[Ni]_{sed}$ mg/kg dw		20				17	Affected area elevated, but does not appear to be increasing
				11			
	8.0		7.2		9.0		
$[Se]_{sed}$ mg/kg dw		2.3					Affected area elevated, but does not appear to be increasing
	0.70					1.1	
				0.66			
					0.42		
			0.29				
$[Ag]_{sed}$ mg/kg dw		0.10	0.077	0.087	0.090	0.10	Affected area may have been elevated in the past, but does not appear elevated now
	0.040						
$[V]_{sed}$ mg/kg dw		25				21	Affected area elevated, but does not appear to be increasing
	18						
				11	15		
			7.8				
$[^{210}Po]_{sed}$ pCi/g dw	NS	NS	1.1	1.2	0.93	1.2	Affected area not elevated

3.1.4 Soda Creek Sediment Summary

Table 3.18, *Sediment Quality Summary in Soda Creek* presents a summary of the Kruskal-Wallis and Fisher's LSD test. The right side column presents the interpretation of these data.

Table 3.18: Sediment Quality Summary in Soda Creek

	RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected	
$[As]_{sed}$ mg/kg dw	6.2	33	24	9.2	12	62	Affected area not elevated
$[Cd]_{sed}$ mg/kg dw	11	22				15	Affected area elevated, but does not appear to be increasing
				10			
					0.65		
			0.38				
$[Cu]_{sed}$ mg/kg dw		17				9.1	Affected area elevated, but does not appear to be increasing
			6.4				
	2.7			5.1	4.5		
$[Ni]_{sed}$ mg/kg dw	55	35	30	12	22	30	Affected area not elevated
$[Se]_{sed}$ mg/kg dw		3.5		3.3		4.0	Affected area elevated, but does not appear to be increasing
			0.79				
	0.60				0.60		
$[Ag]_{sed}$ mg/kg dw		1.6				0.22	Affected area elevated, but it may be decreasing
	0.10						
			0.14	0.11	0.049		
$[V]_{sed}$ mg/kg dw		100				87	Affected area has been elevated at times, but does not appear to be increasing
	23		50	41	41		
$[^{210}Po]_{sed}$ pCi/g dw	0.67	1.2	0.96	2.0	0.92	1.2	Affected area not elevated

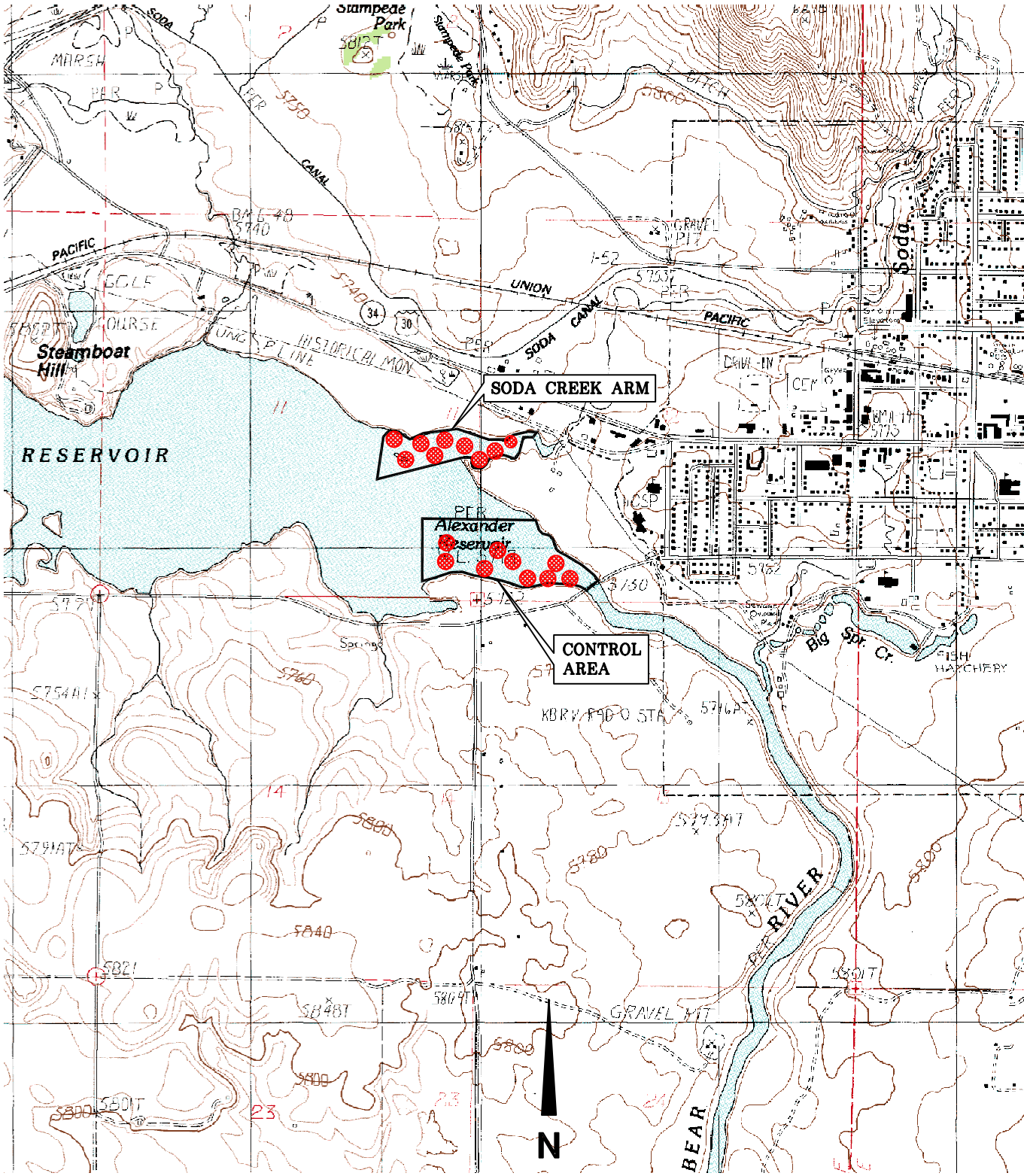
Figure 3-25, *Alexander Reservoir Sample Locations* presents the locations of the sediment samples collected in the Soda Creek and control arms of the reservoir. Figure 3-26, *Five-Year Review Sediment Sampling Locations: Middle and Upper Soda Creek Control Areas* and Figure 3-27, *Five-Year Review Sediment Sampling Locations: Lower Soda Creek Control and Downstream Areas* present the locations for the control and downstream sediment sampling locations.

3.1.5 Overall Summary

When looking at the reservoir and creek sediments as a whole, it appears a case could be made for deleting As, Cu, Ni, Ag, V, and ^{210}Po from the monitoring analyte list for this medium. As we stated in the 5-year monitoring review, none of these analytes is known to be a contaminant in either the groundwater underneath or NPDES discharge from the Monsanto plant. Furthermore, ^{210}Po is a concern from a stack emissions perspective and is regulated by the USEPA under the Clean Air Act's program called the National Emission Standards for Hazardous Air Pollutants (NESHAPs). Polonium, a volatile metal similar to lead, is driven off in the heat of the rotary kiln and monitored at the stacks; it is not a concern in water, and thus is not of concern in sediment.

The eight sediment monitoring analytes—the six listed above plus Cd and Se—were identified by USEPA-10 in the ROD as being elevated in either the reservoir or the creek. While we have not formally compared reservoir and creek samples, a review of Tables 3-17 and 3-18 shows, according to the 10-year review K-W test and subsequent LSD tests, that ^{210}Po was not elevated in the creek during the RI (it was not tested in the reservoir then). And, median concentrations in the Soda Creek arm of Alexander Reservoir (the affected portion of the reservoir) are comparable to control concentrations in the creek for As, Cd, Ni, Ag, and V.

We have avoided performing additional formal statistical comparisons at this time as this would only aggravate the multiple comparison problem. And we don't recommend deleting any analytes from the sediment monitoring list at this time. We do, however, recommend that the idea of deleting As, Cu, Ni, Ag, V, and ^{210}Po be accepted as an alternative hypothesis to be tested during the 15-year review. To do this effectively means redesigning the statistical analyses—e.g., finding a more reliable way of dealing with multiple comparisons, comparing reservoir results to creek result, and factoring in spatial considerations, and doing so in consultation with an experienced statistician.



Explanation

Sediment Sampling Location

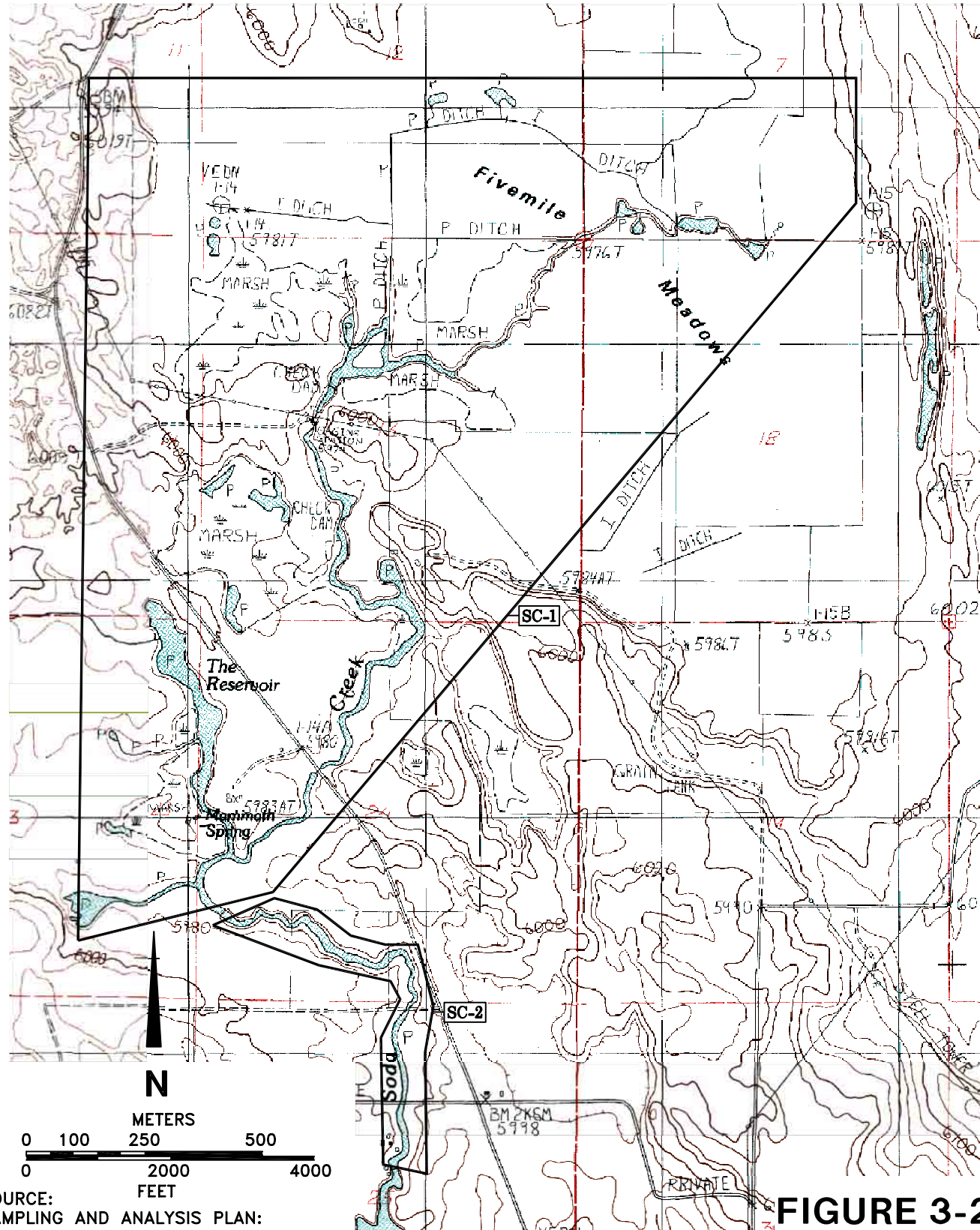
SOURCE:
SAP FOR SODA CREEK AND ALEXANDER RESERVOIR (GOLDER, 1994)

USGS Topographic Maps: Soda Springs Idaho 1:24,000 (1982), Alexander Idaho 1:24,000 (1982)

METERS
0 100 250 500
0 2000 4000
FEET

FIGURE 3-25
ALEXANDER RESERVOIR SAMPLE LOCATIONS
MONSANTO/CERCLA FIVE YEAR REVIEW

MWH



SOURCE:
SAMPLING AND ANALYSIS PLAN: SODA CREEK AND ALEXANDER RESERVOIR (GOLDER, 1994)

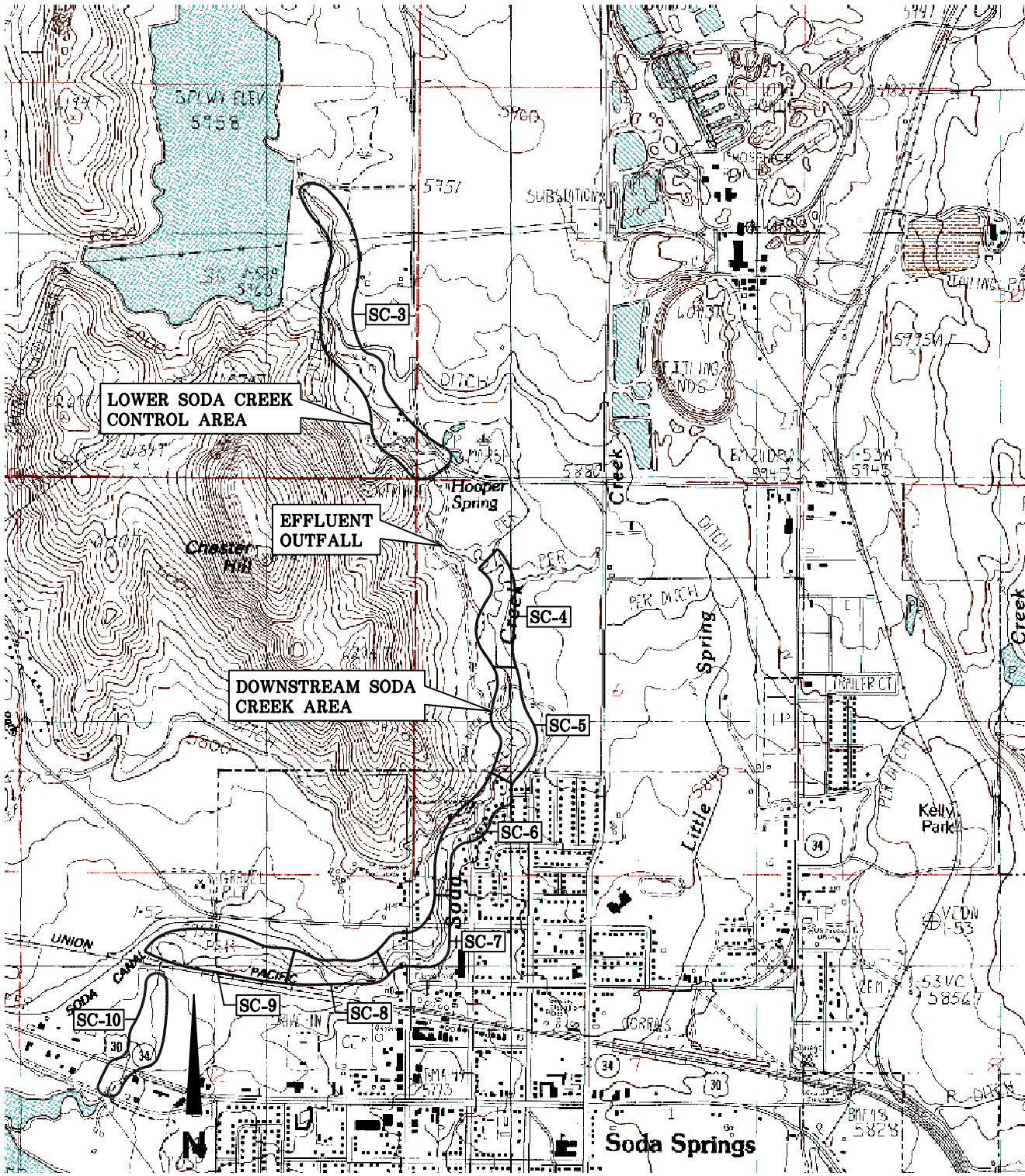
USGS Topographic Maps: Soda Springs Idaho 1:24,000 (1982), Alexander Idaho 1:24,000 (1982)

FIGURE 3-26

FIVE-YEAR REVIEW SEDIMENT SAMPLING LOCATIONS: MIDDLE AND UPPER SODA CREEK CONTROL AREAS

MONSANTO/CERCLA FIVE YEAR REVIEW

MWH



METERS
0 100 250 500
0 2000 4000
FEET

SOURCE:
SAMPLING AND ANALYSIS PLAN: SODA CREEK AND ALEXANDER RESERVOIR (GOLDER, 1994)
USGS Topographic Maps: Soda Springs Idaho 1:24,000 (1982)

FIGURE 3-27

FIVE-YEAR REVIEW SEDIMENT SAMPLING LOCATIONS: LOWER SODA CREEK CONTROL AND DOWNSTREAM AREAS

MONSANTO/CERCLA FIVE YEAR REVIEW

MWH

4.0 STATISTICAL CALCULATIONS

The statistical calculations for the above analyses are presented on the following pages. The calculations were completed using the XLSTAT add-on application in Microsoft Excel.

Alexander Reservoir Sediment Quality
Arsenic, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
1.7	3.6	1.6	2.0	1.8	3.6
1.9	5.0	1.7	2.6	2.4	4.9
1.9	5.1	1.8	3.1	2.7	7.4
2.3	5.6	1.9	3.4	2.7	8.1
2.4	5.9	1.9	3.6	2.9	9.6
2.4	7.2	2.0	3.7	2.9	9.9
2.7	11	2.3	4.6	2.9	12
2.9	18	2.3	5.0	3.3	38
2.9	24	2.4	9.7	3.3	47

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/24/2008 at 5:14:05 PM
Samples: Workbook = Alexander Reservoir Sediment Quality Statistics 2007.xls / Sheet = As! / Range = 'As!'!$A$3:$F$12 / 9 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	41.496
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	< 0.0001
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.
The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Ties have been detected in the data and the appropriate corrections have been applied.

Arsenic, rank

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
2.5	33	1	10.5	4.5	33
7.5	38.5	2.5	19	16.5	37
7.5	40	4.5	28	21	44
13	41	7.5	31	21	45
16.5	42	7.5	33	25	46
16.5	43	10.5	35	25	48
21	49	13	36	25	50
25	51	13	38.5	29	53
25	52	16.5	47	30	54

Anova: Single Factor

SUMMARY

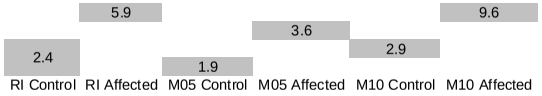
Groups	*Count*	*Sum*	*Average*	*Variance*
RI Control	9	134.5	14.9	64.2
RI Affected	9	389.5	43.3	39.3
M05 Control	9	76.0	8.4	27.3
M05 Affected	9	278.0	30.9	116.3
M10 Control	9	197.0	21.9	59.8
M10 Affected	9	410.0	45.6	48.3

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p*
Between Groups	10,248.00	5	2,049.60	34.62	0.0000000000000081
Within Groups	2,841.50	48	59.20		
Total	13,089.50	53			

Fisher's Least Significant Difference

Comparison			$\lvert\Delta\rvert$	$LSD_{0.050}$	significance
RI Control	v.	RI Affected	28.3	7.3	!
RI Control	v.	M05 Control	6.5	7.3	
RI Control	v.	M05 Affected	15.9	7.3	!
RI Control	v.	M10 Control	6.9	7.3	
RI Control	v.	M10 Affected	30.6	7.3	!
RI Affected	v.	M05 Control	34.8	7.3	!
RI Affected	v.	M05 Affected	12.4	7.3	!
RI Affected	v.	M10 Control	21.4	7.3	!
RI Affected	v.	M10 Affected	2.3	7.3	
M05 Control	v.	M05 Affected	22.4	7.3	!
M05 Control	v.	M10 Control	13.4	7.3	!
M05 Control	v.	M10 Affected	37.1	7.3	!
M05 Affected	v.	M10 Control	9.0	7.3	!
M05 Affected	v.	M10 Affected	14.7	7.3	!
M10 Control	v.	M10 Affected	23.7	7.3	!



Currently: As contamination present.
Historically: As contamination has been present in the past, but does not appear to be increasing.

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/28/2008 at 3:31:49 PM
Sample 1: Workbook = Alexander Reservoir Sediment Quality Statistics 2007.xls / Sheet = As! / Range = 'As!'!$E$25:$E$34 / 9 rows and 1 column
Sample 2: Workbook = Alexander Reservoir Sediment Quality Statistics 2007.xls / Sheet = As! / Range = 'As!'!$F$25:$F$34 / 9 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	9	0	9	4.500	30.000	21.889	7.733
M10 Affected	9	0	9	33.000	54.000	45.556	6.948

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	1.000
p-value	< 0.0001
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:

H_0: The samples are not significantly different.

H_a: The samples do not come from the same population.

As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Ties have been detected in the data and the appropriate corrections have been applied.

Alexander Reservoir Sediment Quality
Cadmium, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
0.10	5.0	0.31	0.62	0.26	2.0
0.15	6.0	0.37	1.4	0.44	2.4
0.15	6.2	0.44	2.4	0.50	3.4
0.30	8.0	0.44	2.7	0.59	3.9
0.30	8.9	0.46	2.8	0.60	4.8
0.40	12	0.46	3.0	0.61	7.7
0.50	21	0.48	3.5	0.64	13
0.50	25	0.50	6.3	0.68	26
0.50	30	0.52	12	0.77	36

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/24/2008 at 5:40:20 PM
Samples: Workbook = Alexander Reservoir Sediment Quality Statistics 2007.xls / Sheet = Cd! / Range = 'Cd!'!$A$3:$F$12 / 9 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	43.884
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	< 0.0001
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.
The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Ties have been detected in the data and the appropriate corrections have been applied.

Cadmium, rank

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
1	40	7	25	4	30
2.5	41	8	29	11	31.5
2.5	42	11	31.5	18	36
5.5	45	11	33	22	38
5.5	46	13.5	34	23	39
9	47.5	13.5	35	24	44
18	50	15	37	26	49
18	51	18	43	27	52
18	53	21	47.5	28	54

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
RI Control	9	80.0	8.9	52.0
RI Affected	9	415.5	46.2	21.3
M05 Control	9	118.0	13.1	20.3
M05 Affected	9	315.0	35.0	47.2
M10 Control	9	183.0	20.3	64.8
M10 Affected	9	373.5	41.5	76.3

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p*
Between Groups	10,849.22	5	2,169.84	46.21	0.000000000000000033
Within Groups	2,253.78	48	46.95		
Total	13,103.00	53			

Fisher's Least Significant Difference

Comparison			|Δ|	$LSD_{0.050}$	significance
RI Control	v.	RI Affected	37.3	6.5	!
RI Control	v.	M05 Control	4.2	6.5	
RI Control	v.	M05 Affected	26.1	6.5	!
RI Control	v.	M10 Control	11.4	6.5	!
RI Control	v.	M10 Affected	32.6	6.5	!
RI Affected	v.	M05 Control	33.1	6.5	!
RI Affected	v.	M05 Affected	11.2	6.5	!
RI Affected	v.	M10 Control	25.8	6.5	!
RI Affected	v.	M10 Affected	4.7	6.5	
M05 Control	v.	M05 Affected	21.9	6.5	!
M05 Control	v.	M10 Control	7.2	6.5	!
M05 Control	v.	M10 Affected	28.4	6.5	!
M05 Affected	v.	M10 Control	14.7	6.5	!
M05 Affected	v.	M10 Affected	6.5	6.5	!
M10 Control	v.	M10 Affected	21.2	6.5	!

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
	8.9				4.8
			2.8		
				0.60	
0.30		0.46			

Currently: Cd contamination present.
Historically: Cd contamination has been present in the past, but does not appear to have increased.

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/28/2008 at 3:40:51 PM
Sample 1: Workbook = Alexander Reservoir Sediment Quality Statistics 2007.xls / Sheet = Cd! / Range = 'Cd!'!$E$3:$E$12 / 9 rows and 1 column
Sample 2: Workbook = Alexander Reservoir Sediment Quality Statistics 2007.xls / Sheet = Cd! / Range = 'Cd!'!$F$3:$F$12 / 9 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	9	0	9	0.260	0.770	0.566	0.149
M10 Affected	9	0	9	2.000	36.000	11.022	12.075

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	1.000
p-value	< 0.0001
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:

H_0: The samples are not significantly different.

H_a: The samples do not come from the same population.

As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.

The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Alexander Reservoir Sediment Quality
Copper, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
2.2	4.0	4.3	3.4	3.2	3.2
4.8	5.0	4.6	4.6	5.4	4.3
5.1	5.9	4.7	4.7	6.6	6.8
5.6	6.3	5.0	5.8	7.1	6.8
6.7	6.4	5.1	5.9	7.3	7.5
7.1	10	5.6	6.1	7.3	8.5
7.7	11	5.8	6.4	7.8	9.7
7.8	12	5.9	8.0	8.7	20
9.3	13	6.0	8.1	8.8	21

6.7	6.4	5.1	5.9	7.3	7.5
RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected

Currently: No evidence of Cu contamination.
Historically: No evidence of Cu contamination.

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/24/2008 at 7:27:24 PM
Samples: Workbook = Alexander Reservoir Sediment Quality Statistics 2007.xls / Sheet = Cu / Range = Cu!$A$3:$F$12 / 9 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	9.612
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	0.087
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is greater than the significance level alpha = 0.050, one should accept the null hypothesis H_0.
The risk to reject the null hypothesis H_0 while it is true is 8.70%.

Ties have been detected in the data and the appropriate corrections have been applied.

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/28/2008 at 3:47:33 PM
Sample 1: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (03-28-08).xls / Sheet = Cu / Range = Cu!$E$3:$E$12 / 9 rows and 1 column
Sample 2: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (03-28-08).xls / Sheet = Cu / Range = Cu!$F$3:$F$12 / 9 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	9	0	9	3.200	8.800	6.911	1.734
M10 Affected	9	0	9	3.200	21.000	9.756	6.406

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	0.333
p-value	0.366
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is greater than the significance level alpha = 0.050, one should accept the null hypothesis H_0.
The risk to reject the null hypothesis H_0 while it is true is 36.57%.

Ties have been detected in the data and the appropriate corrections have been applied.

Alexander Reservoir Sediment Quality

Nickel, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
3.0	12	5.9	5.8	4.0	10
6.0	13	6.6	9.6	7.0	13
6.0	14	6.8	11	7.8	13
7.0	15	6.9	11	8.7	15
8.0	20	7.2	11	9.0	17
8.0	20	7.2	11	9.0	22
9.0	30	7.3	12	10	24
10	35	7.6	13	10	36
11	35	8.0	24	10	43

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/24/2008 at 10:07:11 PM
Samples: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (version 1).xls / Sheet = Ni! / Range = 'Ni!'!$A$3:$F$12 / 9 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	38.231
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	< 0.0001
alpha	0.05

Test interpretation:

H_0: The samples are not significantly different.

H_a: The samples do not come from the same population.

As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.
The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Ties have been detected in the data and the appropriate corrections have been applied.

Nickel, rank

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
1	35.5	4	3	2	27.5
5.5	38.5	7	24.5	10.5	38.5
5.5	41	8	32	16	38.5
10.5	42.5	9	32	20	42.5
18	45.5	12.5	32	22	44
18	45.5	12.5	32	22	47
22	50	14	35.5	24.5	48.5
27.5	51.5	15	38.5	27.5	53
32	51.5	18	48.5	27.5	54

Anova: Single Factor

SUMMARY

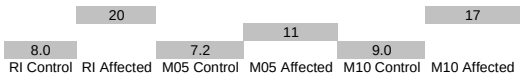
Groups	*Count*	*Sum*	*Average*	*Variance*
RI Control	9	140.0	15.6	113.3
RI Affected	9	401.5	44.6	32.9
M05 Control	9	100.0	11.1	19.5
M05 Affected	9	278.0	30.9	151.6
M10 Control	9	172.0	19.1	70.5
M10 Affected	9	393.5	43.7	68.1

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p*
Between Groups	9,441.67	5	1,888.33	24.85	0.0000000000029
Within Groups	3,647.33	48	75.99		
Total	13,089.00	53			

Fisher's Least Significant Difference

Comparison			|Δ|	$LSD_{0.050}$	significance
RI Control	v.	RI Affected	29.1	8.3	!
RI Control	v.	M05 Control	4.4	8.3	
RI Control	v.	M05 Affected	15.3	8.3	!
RI Control	v.	M10 Control	3.6	8.3	
RI Control	v.	M10 Affected	28.2	8.3	!
RI Affected	v.	M05 Control	33.5	8.3	!
RI Affected	v.	M05 Affected	13.7	8.3	!
RI Affected	v.	M10 Control	25.5	8.3	!
RI Affected	v.	M10 Affected	0.9	8.3	
M05 Control	v.	M05 Affected	19.8	8.3	!
M05 Control	v.	M10 Control	8.0	8.3	
M05 Control	v.	M10 Affected	32.6	8.3	!
M05 Affected	v.	M10 Control	11.8	8.3	!
M05 Affected	v.	M10 Affected	12.8	8.3	!
M10 Control	v.	M10 Affected	24.6	8.3	!



Currently: Ni contamination present.
Historically: Ni contamination has been present in the past, but does not appear to be increasing.

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/28/2008 at 3:54:04 PM
Sample 1: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (03-28-08).xls / Sheet = Ni! / Range = 'Ni!'!$E$3:$E$12 / 9 rows and 1 column
Sample 2: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (03-28-08).xls / Sheet = Ni! / Range = 'Ni!'!$F$3:$F$12 / 9 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	9	0	9	4.000	10.000	8.344	1.905
M10 Affected	9	0	9	10.000	43.000	21.444	11.282

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	0.889
p-value	0.00021
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:

H_0: The samples are not significantly different.

H_a: The samples do not come from the same population.

As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.

The risk to reject the null hypothesis H_0 while it is true is lower than 0.02%.

Ties have been detected in the data and the appropriate corrections have been applied.

Alexander Reservoir Sediment Quality
Selenium, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
0.40	1.4	0.23	0.30	0.31	0.36
0.50	1.4	0.24	0.33	0.34	0.43
0.60	1.9	0.25	0.54	0.40	0.46
0.60	2.1	0.26	0.64	0.40	0.97
0.70	2.3	0.29	0.66	0.42	1.1
0.70	3.2	0.31	0.68	0.42	1.9
1.2	4.0	0.31	0.84	0.42	2.1
1.2	6.0	0.32	1.2	0.42	4.3
1.3	6.0	0.36	1.9	0.44	7.1

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/24/2008 at 10:40:43 PM
Samples: Workbook = Alexander Reservoir Sediment Quality Statistics 2007.xls / Sheet = Se! / Range = 'Se!'!$A$3:$F$12 / 9 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	38.160
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	< 0.0001
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.
The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Ties have been detected in the data and the appropriate corrections have been applied.

Selenium, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
16	41.5	1	6	8	13.5
25	41.5	2	11	12	22
27.5	44	3	26	16	24
27.5	46.5	4	29	16	35
32.5	48	5	30	19.5	36
32.5	49	8	31	19.5	44
38	50	8	34	19.5	46.5
38	52.5	10	38	19.5	51
40	52.5	13.5	44	23	54

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
RI Control	9	277.0	30.8	58.6
RI Affected	9	425.5	47.3	17.9
M05 Control	9	54.5	6.1	16.9
M05 Affected	9	249.0	27.7	147.8
M10 Control	9	153.0	17.0	21.1
M10 Affected	9	326.0	36.2	196.3

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p*
Between Groups	9,433.11	5	1,886.62	24.69	0.0000000000032
Within Groups	3,668.39	48	76.42		
Total	13,101.50	53			

Fisher's Least Significant Difference

Comparison			$\lvert\Delta\rvert$	$LSD_{0.050}$	significance
RI Control	v.	RI Affected	16.5	8.3	!
RI Control	v.	M05 Control	24.7	8.3	!
RI Control	v.	M05 Affected	3.1	8.3	
RI Control	v.	M10 Control	13.8	8.3	!
RI Control	v.	M10 Affected	5.4	8.3	
RI Affected	v.	M05 Control	41.2	8.3	!
RI Affected	v.	M05 Affected	19.6	8.3	!
RI Affected	v.	M10 Control	30.3	8.3	!
RI Affected	v.	M10 Affected	11.1	8.3	!
M05 Control	v.	M05 Affected	21.6	8.3	!
M05 Control	v.	M10 Control	10.9	8.3	!
M05 Control	v.	M10 Affected	30.2	8.3	!
M05 Affected	v.	M10 Control	10.7	8.3	!
M05 Affected	v.	M10 Affected	8.6	8.3	!
M10 Control	v.	M10 Affected	19.2	8.3	!

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
	2.3				
0.70					1.1
			0.66		
				0.42	
		0.29			

Currently: Se contamination present.
Historically: Se contamination has been present in the past, but appears to not have increased.

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/28/2008 at 4:19:00 PM
Sample 1: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (03-28-08).xls / Sheet = Se! / Range = 'Se!'!$E$3:$E$12 / 9 rows and 1 column
Sample 2: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (03-28-08).xls / Sheet = Se! / Range = 'Se!'!$F$3:$F$12 / 9 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	9	0	9	0.310	0.440	0.397	0.043
M10 Affected	9	0	9	0.360	7.100	2.080	2.254

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	0.778
p-value	0.0024
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:

H_0: The samples are not significantly different.

H_a: The samples do not come from the same population.

As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.

The risk to reject the null hypothesis H_0 while it is true is lower than 0.24%.

Ties have been detected in the data and the appropriate corrections have been applied.

Alexander Reservoir Sediment Quality

Silver, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
0.010	0.040	0.044	0.034	0.064	0.028
0.030	0.060	0.057	0.062	0.076	0.028
0.030	0.080	0.066	0.075	0.077	0.087
0.040	0.090	0.070	0.081	0.080	0.094
0.040	0.10	0.077	0.087	0.090	0.10
0.050	0.16	0.077	0.093	0.095	0.11
0.050	0.24	0.092	0.095	0.096	0.17
0.060	0.25	0.14	0.13	0.11	0.34
0.060	0.30	0.16	0.18	0.25	0.34

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/24/2008 at 11:10:46 PM
Samples: Workbook = Alexander Reservoir Sediment Quality Statistics 2007.xls / Sheet = Ag! / Range = 'Ag!'!$A$3:$F$12 / 9 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	17.384
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	0.004
alpha	0.050

Test interpretation:

H_0: The samples are not significantly different.

H_a: The samples do not come from the same population.

As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.

The risk to reject the null hypothesis H_0 while it is true is lower than 0.38%.

Ties have been detected in the data and the appropriate corrections have been applied.

Silver, rank

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
1	8	10	6	18	2.5
4.5	15	13	17	22	2.5
4.5	26.5	19	21	24	29.5
8	31.5	20	28	26.5	35
8	39.5	24	29.5	31.5	39.5
11.5	45.5	24	34	36.5	41.5
11.5	49	33	36.5	38	47
15	50.5	44	43	41.5	53.5
15	52	45.5	48	50.5	53.5

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
RI Control	9	79.0	8.8	23.8
RI Affected	9	317.5	35.3	258.6
M05 Control	9	232.5	25.8	158.9
M05 Affected	9	263.0	29.2	172.0
M10 Control	9	288.5	32.1	109.9
M10 Affected	9	304.5	33.8	377.7

ANOVA

Source of Variation	SS	df	MS	F	p
Between Groups	4,298.61	5	859.72	4.69	0.0015
Within Groups	8,806.89	48	183.48		
Total	13,105.50	53			

Fisher's Least Significant Difference

Comparison			$\|\Delta\|$	$LSD_{0.050}$	significance
RI Control	v.	RI Affected	26.5	12.8	!
RI Control	v.	M05 Control	17.1	12.8	!
RI Control	v.	M05 Affected	20.4	12.8	!
RI Control	v.	M10 Control	23.3	12.8	!
RI Control	v.	M10 Affected	25.1	12.8	!
RI Affected	v.	M05 Control	9.4	12.8	
RI Affected	v.	M05 Affected	6.1	12.8	
RI Affected	v.	M10 Control	3.2	12.8	
RI Affected	v.	M10 Affected	1.4	12.8	
M05 Control	v.	M05 Affected	3.4	12.8	
M05 Control	v.	M10 Control	6.2	12.8	
M05 Control	v.	M10 Affected	8.0	12.8	
M05 Affected	v.	M10 Control	2.8	12.8	
M05 Affected	v.	M10 Affected	4.6	12.8	
M10 Control	v.	M10 Affected	1.8	12.8	

	0.10	0.077	0.087	0.090	0.10
0.040					
RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected

Currently: No evidence of Ag contamination.
Historically: Ag contamination may have been present in the past, but does not appear to exist now.

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/28/2008 at 4:28:48 PM
Sample 1: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (03-28-08).xls / Sheet = Ag! / Range = 'Ag!'!$E$3:$E$12 / 9 rows and 1 column
Sample 2: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (03-28-08).xls / Sheet = Ag! / Range = 'Ag!'!$F$3:$F$12 / 9 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	9	0	9	0.064	0.250	0.104	0.056
M10 Affected	9	0	9	0.028	0.340	0.144	0.119

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	0.333
p-value	0.36
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:

H_0: The samples are not significantly different.

H_a: The samples do not come from the same population.

As the computed p-value is greater than the significance level alpha = 0.050, one should accept the null hypothesis H_0.

The risk to reject the null hypothesis H_0 while it is true is 36.35%.

Ties have been detected in the data and the appropriate corrections have been applied.

Alexander Reservoir Sediment Quality
Vanadium, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
7.5	15	6.8	5.8	7.4	8.7
14	20	6.9	8.5	11	13
15	20	6.9	8.9	14	14
18	23	7.4	9.4	14	20
18	25	7.8	11	15	21
20	38	7.8	11	16	24
22	49	8.5	12	16	35
23	57	8.6	16	18	110
26	66	9.1	22	18	120

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/24/2008 at 11:51:10 PM
Samples: Workbook = Alexander Reservoir Sediment Quality Statistics 2007.xls / Sheet = V / Range = V!$A$3:$F$12 / 9 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	31.343
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	< 0.0001
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis
The risk to reject the null hypothesis H_0 while it is true is lower than 0.01%.

Ties have been detected in the data and the appropriate corrections have been applied.

Vanadium, rank

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
7	27	2	1	5.5	13
23.5	37.5	3.5	10.5	18	21
27	37.5	3.5	14	23.5	23.5
33.5	43.5	5.5	16	23.5	37.5
33.5	46	8.5	18	27	40
37.5	49	8.5	18	30	45
41.5	50	10.5	20	30	48
43.5	51	12	30	33.5	53
47	52	15	41.5	33.5	54

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
RI Control	9	294.0	32.7	150.1
RI Affected	9	393.5	43.7	68.9
M05 Control	9	69.0	7.7	19.2
M05 Affected	9	169.0	18.8	132.5
M10 Control	9	224.5	24.9	79.0
M10 Affected	9	335.0	37.2	219.1

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p*
Between Groups	7,743.11	5	1,548.62	13.89	0.000000021
Within Groups	5,350.39	48	111.47		
Total	13,093.50	53			

Fisher's Least Significant Difference

Comparison			$\lvert\Delta\rvert$	$LSD_{0.050}$	significance
RI Control	v.	RI Affected	11.1	10.0	!
RI Control	v.	M05 Control	25.0	10.0	!
RI Control	v.	M05 Affected	13.9	10.0	!
RI Control	v.	M10 Control	7.7	10.0	
RI Control	v.	M10 Affected	4.6	10.0	
RI Affected	v.	M05 Control	36.1	10.0	!
RI Affected	v.	M05 Affected	24.9	10.0	!
RI Affected	v.	M10 Control	18.8	10.0	!
RI Affected	v.	M10 Affected	6.5	10.0	
M05 Control	v.	M05 Affected	11.1	10.0	!
M05 Control	v.	M10 Control	17.3	10.0	!
M05 Control	v.	M10 Affected	29.6	10.0	!
M05 Affected	v.	M10 Control	6.2	10.0	
M05 Affected	v.	M10 Affected	18.4	10.0	!
M10 Control	v.	M10 Affected	12.3	10.0	!

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
	25				21
18					
			11	15	
		7.8			

Currently: V contamination present.
Historically: V contamination has been present in the past, but appears to not have increased.

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/28/2008 at 4:41:45 PM
Sample 1: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (03-28-08).xls / Sheet = V! / Range = 'V!'!$E$3:$E$12 / 9 rows and 1 column
Sample 2: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (03-28-08).xls / Sheet = V! / Range = 'V!'!$F$3:$F$12 / 9 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	9	0	9	7.400	18.000	14.378	3.396
M10 Affected	9	0	9	8.700	120.000	40.633	42.900

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	0.667
p-value	0.015
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:

H_0: The samples are not significantly different.

H_a: The samples do not come from the same population.

As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.

The risk to reject the null hypothesis H_0 while it is true is lower than 1.45%.

Ties have been detected in the data and the appropriate corrections have been applied.

Alexander Reservoir Sediment Quality
Polonium-210, pCi/g dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
		0.84	0.94	0.49	0.14
		0.99	1.0	0.82	0.70
		0.99	1.0	0.83	1.1
		1.0	1.1	0.83	1.1
		1.1	1.2	0.93	1.2
		1.2	1.2	1.0	1.2
		1.2	1.5	1.1	1.5
		1.3	1.7	1.1	1.8
		1.4	1.8	1.2	2.4
		1.1	1.2	0.93	1.2
RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected

Currently: No evidence of Po-210 contamination.
Historically: No evidence of Po-210 contamination.

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/24/2008 at 10:30:49 PM
Samples: Workbook = Alexander Reservoir Sediment Quality Statistics 2007.xls / Sheet = Po-210 / Range = 'Po-210'!$C$3:$F$12 / 9 rows and 4 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	7.099
K (Critical value)	7.815
DF	3
p-value (Two-tailed)	0.069
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is greater than the significance level alpha = 0.050, one should accept the null hypothesis H_0.
The risk to reject the null hypothesis H_0 while it is true is 6.88%.

Ties have been detected in the data and the appropriate corrections have been applied.

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/28/2008 at 4:10:57 PM
Sample 1: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (03-28-08).xls / Sheet = Po-210 / Range = 'Po-210'!$E$3:$E$12 / 9 rows and 1 column
Sample 2: Workbook = Alexander Reservoir Sediment Quality Statistics 2007 (03-28-08).xls / Sheet = Po-210 / Range = 'Po-210'!$F$3:$F$12 / 9 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	9	0	9	0.490	1.200	0.919	0.211
M10 Affected	9	0	9	0.140	2.400	1.238	0.639

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	0.444
p-value	0.15
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is greater than the significance level alpha = 0.050, one should accept the null hypothesis H_0.
The risk to reject the null hypothesis H_0 while it is true is 14.97%.

Ties have been detected in the data and the appropriate corrections have been applied.

Soda Creek Sediment Quality
Arsenic, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
6.2	12	3.6	2.1	3.2	16
	5.3	24	2.6	12	23
	12	47	8.4	42	29
	12		9.2		62
	19		18		64
	29		33		97
	31		35		160
	34				
	44				
	45				
	46				
	49				
	56				
	88				

6.2	33	24	9.2	12	62
RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected

Currently: No evidence of As contamination.
Historically: No evidence of As contamination.

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/21/2008 at 3:42:38 PM
Samples: Workbook = Soda Creek Sediment Quality Statistics 2007.xls / Sheet = As / Range = As!$A$3:$F$17 / 14 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	10.247
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	0.069
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is greater than the significance level alpha = 0.050, one should accept the null hypothesis H_0.
The risk to reject the null hypothesis H_0 while it is true is 6.85%.

Ties have been detected in the data and the appropriate corrections have been applied.

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/27/2008 at 2:09:47 PM
Sample 1: Workbook = Soda Creek Sediment Quality Statistics 2007.xls / Sheet = As / Range = As!$E$3:$E$6 / 3 rows and 1 column
Sample 2: Workbook = Soda Creek Sediment Quality Statistics 2007.xls / Sheet = As / Range = As!$F$3:$F$10 / 7 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	3	0	3	3.240	41.800	18.913	20.267
M10 Affected	7	0	7	15.600	160.000	64.329	50.892

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	0.667
p-value	0.13
alpha	0.050

The p-value is computed using an exact method.

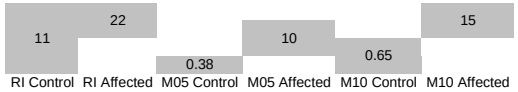
Test interpretation:
H_0: The distribution of the two samples is not significantly different.
H_a: The distribution of the first sample is shifted to the right of the distribution of the second sample.
As the computed p-value is greater than the significance level alpha = 0.05, one should accept the null hypothesis H_0.
The risk to reject the null hypothesis H_0 while it is true is 12.50%.

Soda Creek Sediment Quality
Cadmium, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
11	8.6	0.30	1.4	0.42	5.1
	8.9	0.38	3.4	0.65	14
	14	0.47	4.8	0.70	15
	17		10		15
	17		12		18
	20		14		19
	20		51		40
	24				
	27				
	28				
	29				
	38				
	56				
	61				

Cadmium, rank

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
14	11	1	7	3	10
	12	2	8	5	17
	17	4	9	6	19.5
	21.5		13		19.5
	21.5		15		23
	25.5		17		24
	25.5		33		32
	27				
	28				
	29				
	30				
	31				
	34				
	35				



Currently: Cd contamination is present.
Historically: Cd contamination has been present, but does not appear to be increasing.

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/21/2008 at 3:49:02 PM
Samples: Workbook = Soda Creek Sediment Quality Statistics 2007.xls / Sheet = Cd / Range = Cd!$A$3:$F$17 / 14 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	19.989
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	0.001
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.
The risk to reject the null hypothesis H_0 while it is true is lower than 0.13%.

Ties have been detected in the data and the appropriate corrections have been applied.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
RI Control	1	14.0	14.0	
RI Affected	14	348.0	24.9	55.7
M05 Control	3	7.0	2.3	2.3
M05 Affected	7	102.0	14.6	80.0
M10 Control	3	14.0	4.7	2.3
M10 Affected	7	145.0	20.7	45.8

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p*
Between Groups	2,077.81	5	415.56	8.10	0.000070
Within Groups	1,488.69	29	51.33		
Total	3,566.50	34			

Fisher's Least Significant Difference

Comparison			$\|\Delta\|$	$LSD_{0.050}$	significance
RI Control	v.	RI Affected	10.9	15.2	
RI Control	v.	M05 Control	11.7	16.9	
RI Control	v.	M05 Affected	0.6	15.7	
RI Control	v.	M10 Control	9.3	16.9	
RI Control	v.	M10 Affected	6.7	15.7	
RI Affected	v.	M05 Control	22.5	9.3	!
RI Affected	v.	M05 Affected	10.3	6.8	!
RI Affected	v.	M10 Control	20.2	9.3	!
RI Affected	v.	M10 Affected	4.1	6.8	
M05 Control	v.	M05 Affected	12.2	10.1	!
M05 Control	v.	M10 Control	2.3	12.0	
M05 Control	v.	M10 Affected	18.4	10.1	!
M05 Affected	v.	M10 Control	9.9	10.1	
M05 Affected	v.	M10 Affected	6.1	7.8	
M10 Control	v.	M10 Affected	16.0	10.1	!

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/27/2008 at 4:36:29 PM
Sample 1: Workbook = Soda Creek Sediment Quality Statistics 2007 (03-27-08).xls / Sheet = Cd ! / Range = 'Cd !'!$E$3:$E$6 / 3 rows and 1 column
Sample 2: Workbook = Soda Creek Sediment Quality Statistics 2007 (03-27-08).xls / Sheet = Cd ! / Range = 'Cd !'!$F$3:$F$10 / 7 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	3	0	3	0.420	0.704	0.591	0.150
M10 Affected	7	0	7	5.080	40.300	17.869	10.812

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	1.000
p-value	0.0083
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:

H_0: The distribution of the two samples is not significantly different.

H_a: The distribution of the first sample is shifted to the right of the distribution of the second sample.

As the computed p-value is lower than the significance level alpha = 0.05, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.

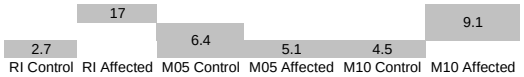
The risk to reject the null hypothesis H_0 while it is true is lower than 0.83%.

Soda Creek Sediment Quality
Copper, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
2.7	4.0	3.2	0.91	4.3	7.7
	8.4	6.4	2.8	4.5	8.6
	8.4	8.6	3.9	5.2	8.8
	9.4		5.1		9.1
	10		5.2		10
	12		6.4		12
	16		16		100
	18				
	19				
	22				
	28				
	31				
	43				
	76				

Copper, rank

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
2	6	4	1	7	14
	15.5	12.5	3	8	17.5
	15.5	17.5	5	10.5	19
	21	26.5	9		20
	22.5		10.5		22.5
	24.5		12.5		24.5
	26.5				35
	28				
	29				
	30				
	31				
	32				
	33				
	34				



Currently: Cu contamination is present.
Historically: Cu contamination has been present at times, but does not appear to be increasing.

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/21/2008 at 5:21:59 PM
Samples: Workbook = Soda Creek Sediment Quality Statistics 2007.xls / Sheet = Cu / Range = Cu!$A$3:$F$17 / 14 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	18.233
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	0.003
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.
The risk to reject the null hypothesis H_0 while it is true is lower than 0.27%.

Ties have been detected in the data and the appropriate corrections have been applied.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
RI Control	1	2.0	2.0	
RI Affected	14	348.5	24.9	65.1
M05 Control	4	60.5	15.1	88.6
M05 Affected	6	41.0	6.8	20.5
M10 Control	3	25.5	8.5	3.3
M10 Affected	7	152.5	21.8	45.4

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p*
Between Groups	2,073.46	5	414.69	8.05	0.000073
Within Groups	1,493.04	29	51.48		
Total	3,566.50	34			

Fisher's Least Significant Difference

Comparison			$\|\Delta\|$	$LSD_{0.050}$	significance
RI Control	v.	RI Affected	22.9	15.2	!
RI Control	v.	M05 Control	13.1	16.4	
RI Control	v.	M05 Affected	4.8	15.9	
RI Control	v.	M10 Control	6.5	16.9	
RI Control	v.	M10 Affected	19.8	15.7	!
RI Affected	v.	M05 Control	9.8	8.3	!
RI Affected	v.	M05 Affected	18.1	7.2	!
RI Affected	v.	M10 Control	16.4	9.3	!
RI Affected	v.	M10 Affected	3.1	6.8	
M05 Control	v.	M05 Affected	8.3	9.5	
M05 Control	v.	M10 Control	6.6	11.2	
M05 Control	v.	M10 Affected	6.7	9.2	
M05 Affected	v.	M10 Control	1.7	10.4	
M05 Affected	v.	M10 Affected	15.0	8.2	!
M10 Control	v.	M10 Affected	13.3	10.1	!

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/27/2008 at 2:50:57 PM
Sample 1: Workbook = Soda Creek Sediment Quality Statistics 2007.xls / Sheet = Cu ! / Range = 'Cu !'!$E$3:$E$6 / 3 rows and 1 column
Sample 2: Workbook = Soda Creek Sediment Quality Statistics 2007.xls / Sheet = Cu ! / Range = 'Cu !'!$F$3:$F$10 / 7 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	3	0	3	4.330	5.210	4.663	0.477
M10 Affected	7	0	7	7.740	100.000	22.337	34.274

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	1.000
p-value	0.0083
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:
H0: The distribution of the two samples is not significantly different.
Ha: The distribution of the first sample is shifted to the right of the distribution of the second sample.
As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 0.83%.

Soda Creek Sediment Quality
Nickel, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
55	16	30	2.2	16	17
	25	30	4.8	22	21
	25	50	12	28	29
	27		12		30
	28		20		38
	31		44		59
	35		88		80
	35				
	38				
	39				
	45				
	72				
	86				
	150				
55	35	30	12	22	30
RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected

Currently: No evidence of Ni contamination.
Historically: No evidence of Ni contamination.

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/21/2008 at 5:48:40 PM
Samples: Workbook = Soda Creek Sediment Quality Statistics 2007.xls / Sheet = Ni / Range = Ni!$A$3:$F$17 / 14 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	7.682
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	0.175
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is greater than the significance level alpha = 0.050, one should accept the null hypothesis H_0.
The risk to reject the null hypothesis H_0 while it is true is 17.47%.

Ties have been detected in the data and the appropriate corrections have been applied.

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/27/2008 at 5:09:03 PM
Sample 1: Workbook = Soda Creek Sediment Quality Statistics 2007 (03-27-08).xls / Sheet = Ni / Range = Ni!$E$3:$E$6 / 3 rows and 1 column
Sample 2: Workbook = Soda Creek Sediment Quality Statistics 2007 (03-27-08).xls / Sheet = Ni / Range = Ni!$F$3:$F$10 / 7 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	3	0	3	16.100	27.500	21.867	5.701
M10 Affected	7	0	7	17.400	79.500	39.300	22.383

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	0.714
p-value	0.083
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:
H_0: The distribution of the two samples is not significantly different.
H_a: The distribution of the first sample is shifted to the right of the distribution of the second sample.
As the computed p-value is greater than the significance level alpha = 0.05, one should accept the null hypothesis H_0.
The risk to reject the null hypothesis H_0 while it is true is 8.33%.

Soda Creek Sediment Quality
Selenium, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
0.60	0.80	0.77	0.29	0.45	1.3
0.60	1.1	0.79	0.96	0.60	3.4
	1.1	0.92	1.1	0.60	4.0
	1.2		3.3		4.0
	1.4		4.7		5.7
	1.9		14		35
	3.3		100		100
	3.6				
	3.8				
	4.8				
	5.2				
	7.3				
	20				
	63				

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/24/2008 at 11:14:40 AM
Samples: Workbook = Soda Creek Sediment Quality Statistics 2007.xls / Sheet = Se ...! / Range = 'Se ...!'!$A$3:$F$17 / 14 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	17.243
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	0.004
alpha	0.050

Test interpretation:

H_0: The samples are not significantly different.

H_a: The samples do not come from the same population.

As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.

The risk to reject the null hypothesis H_0 while it is true is lower than 0.41%.

Ties have been detected in the data and the appropriate corrections have been applied.

Selenium, rank

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
4.5	9	7	1	2	16
4.5	13	8	11	4.5	21
	13	10	13	4.5	24.5
	15		19.5		24.5
	17		26		29
	18		31		33
	19.5		35.5		35.5
	22				
	23				
	27				
	28				
	30				
	32				
	34				

Anova: Single Factor

SUMMARY

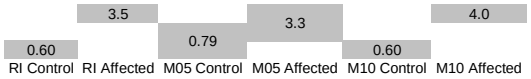
Groups	*Count*	*Sum*	*Average*	*Variance*
RI Control	2	9.0	4.5	0.0
RI Affected	14	300.5	21.5	61.0
M05 Control	3	25.0	8.3	2.3
M05 Affected	7	137.0	19.6	147.9
M10 Control	3	11.0	3.7	2.1
M10 Affected	7	183.5	26.2	46.2

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p*
Between Groups	1,909.79	5	381.96	5.83	0.00071
Within Groups	1,966.71	30	65.56		
Total	3,876.50	35			

Fisher's Least Significant Difference

Comparison			$\lvert\Delta\rvert$	$LSD_{0.050}$	significance
RI Control	v.	RI Affected	17.0	12.5	!
RI Control	v.	M05 Control	3.8	15.1	
RI Control	v.	M05 Affected	15.1	13.3	!
RI Control	v.	M10 Control	0.8	15.1	
RI Control	v.	M10 Affected	21.7	13.3	!
RI Affected	v.	M05 Control	13.1	10.5	!
RI Affected	v.	M05 Affected	1.9	7.7	
RI Affected	v.	M10 Control	17.8	10.5	!
RI Affected	v.	M10 Affected	4.8	7.7	
M05 Control	v.	M05 Affected	11.2	11.4	
M05 Control	v.	M10 Control	4.7	13.5	
M05 Control	v.	M10 Affected	17.9	11.4	!
M05 Affected	v.	M10 Control	15.9	11.4	!
M05 Affected	v.	M10 Affected	6.6	8.8	
M10 Control	v.	M10 Affected	22.5	11.4	!



Currently: Se contamination is present.
Historically: Se contamination has been present, but does not appear to be increasing.

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/27/2008 at 5:29:12 PM
Sample 1: Workbook = Soda Creek Sediment Quality Statistics 2007 (03-27-08).xls / Sheet = Se ! / Range = 'Se !'!$E$3:$E$6 / 3 rows and 1 column
Sample 2: Workbook = Soda Creek Sediment Quality Statistics 2007 (03-27-08).xls / Sheet = Se ! / Range = 'Se !'!$F$3:$F$10 / 7 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	3	0	3	0.450	0.600	0.550	0.087
M10 Affected	7	0	7	1.300	100.000	21.914	36.380

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	1.000
p-value	0.0083
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:

H_0: The distribution of the two samples is not significantly different.

H_a: The distribution of the first sample is shifted to the right of the distribution of the second sample.

As the computed p-value is lower than the significance level alpha = 0.05, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.

The risk to reject the null hypothesis H_0 while it is true is lower than 0.83%.

Ties have been detected in the data and the appropriate corrections have been applied.

Soda Creek Sediment Quality
Silver, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
0.10	0.080	0.034	0.039	0.046	0.17
	0.11	0.14	0.060	0.049	0.17
	0.17	0.15	0.11	0.14	0.18
	0.25		0.11		0.22
	0.35		0.12		0.32
	0.50		0.25		0.43
	1.3		0.46		0.55
	1.8				
	1.8				
	1.8				
	1.8				
	1.8				
	1.8				
	1.8				

Silver, rank

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
7	6	1	2	3	16
	9	12.5	5	4	16
	16	14	9	12.5	18
	20.5		9		19
	23		11		22
	26		20.5		24
	28		25		27
	32				
	32				
	32				
	32				
	32				
	32				
	32				

	1.6				0.22
0.10		0.14	0.11	0.05	
RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected

Currently: Ag contamination is present.
Historically: Ag contamination has been present, but it may be decreasing.

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/24/2008 at 11:30:43 AM
Samples: Workbook = Soda Creek Sediment Quality Statistics 2007.xls / Sheet = Ag ...! / Range = 'Ag ...!'!$A$3:$F$17 / 14 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	17.233
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	0.004
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.
The risk to reject the null hypothesis H_0 while it is true is lower than 0.41%.

Ties have been detected in the data and the appropriate corrections have been applied.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
RI Control	1	7.0	7.0	
RI Affected	14	352.5	25.2	82.7
M05 Control	3	27.5	9.2	50.6
M05 Affected	7	81.5	11.6	68.1
M10 Control	3	19.5	6.5	27.3
M10 Affected	7	142.0	20.3	17.6

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p*
Between Groups	1,792.74	5	358.55	5.96	0.00066
Within Groups	1,744.26	29	60.15		
Total	3,537.00	34			

Fisher's Least Significant Difference

Comparison			$\|\Delta\|$	$LSD_{0.050}$	significance
RI Control	v.	RI Affected	18.2	16.4	!
RI Control	v.	M05 Control	2.2	18.3	
RI Control	v.	M05 Affected	4.6	17.0	
RI Control	v.	M10 Control	0.5	18.3	
RI Control	v.	M10 Affected	13.3	17.0	
RI Affected	v.	M05 Control	16.0	10.1	!
RI Affected	v.	M05 Affected	13.5	7.3	!
RI Affected	v.	M10 Control	18.7	10.1	!
RI Affected	v.	M10 Affected	4.9	7.3	
M05 Control	v.	M05 Affected	2.5	10.9	
M05 Control	v.	M10 Control	2.7	13.0	
M05 Control	v.	M10 Affected	11.1	10.9	!
M05 Affected	v.	M10 Control	5.1	10.9	
M05 Affected	v.	M10 Affected	8.6	8.5	!
M10 Control	v.	M10 Affected	13.8	10.9	!

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/27/2008 at 5:39:20 PM
Sample 1: Workbook = Soda Creek Sediment Quality Statistics 2007 (03-27-08).xls / Sheet = Ag ! / Range = 'Ag !'!$E$3:$E$6 / 3 rows and 1 column
Sample 2: Workbook = Soda Creek Sediment Quality Statistics 2007 (03-27-08).xls / Sheet = Ag ! / Range = 'Ag !'!$F$3:$F$10 / 7 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	3	0	3	0.046	0.140	0.078	0.053
M10 Affected	7	0	7	0.170	0.550	0.291	0.149

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	1.000
p-value	0.0083
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:

H_0: The distribution of the two samples is not significantly different.

H_a: The distribution of the first sample is shifted to the right of the distribution of the second sample.

As the computed p-value is lower than the significance level alpha = 0.05, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.

The risk to reject the null hypothesis H_0 while it is true is lower than 0.83%.

Ties have been detected in the data and the appropriate corrections have been applied.

Soda Creek Sediment Quality
Vanadium, mg/kg dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
23	50	32	5.1	32	62
	53	50	14	41	80
	86	74	22	80	84
	87		41		87
	92		42		99
	100		50		100
	100		84		120
	100				
	110				
	120				
	130				
	140				
	150				
	160				

Vanadium, rank

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
4	11	5.5	1	5.5	14
	13	11	2	7.5	16.5
	20	15	3	16.5	18.5
	21.5		7.5		21.5
	23		9		24
	26.5		11		26.5
	26.5		18.5		30.5
	26.5				
	29				
	30.5				
	32				
	33				
	34				
	35				

	100				87
23		50	41	41	
RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected

Currently: V contamination is present.
Historically: V contamination has been present at times, but does not to be increasing.

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/21/2008 at 6:25:00 PM
Samples: Workbook = Soda Creek Sediment Quality Statistics 2007.xls / Sheet = V / Range = V!$A$3:$F$17 / 14 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	21.932
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	0.001
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is lower than the significance level alpha = 0.050, one should reject the null hypothesis H_0, and accept the alternative hypothesis H_a.
The risk to reject the null hypothesis H_0 while it is true is lower than 0.05%.

Ties have been detected in the data and the appropriate corrections have been applied.

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
RI Control	1	4.0	4.0	
RI Affected	14	361.5	25.8	55.3
M05 Control	3	31.5	10.5	22.8
M05 Affected	7	52.0	7.4	38.0
M10 Control	3	29.5	9.8	34.3
M10 Affected	7	151.5	21.6	33.7

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*p*
Between Groups	2,296.46	5	459.29	10.54	0.0000077
Within Groups	1,263.54	29	43.57		
Total	3,560.00	34			

Fisher's Least Significant Difference

Comparison			$\|\Delta\|$	$LSD_{0.050}$	significance
RI Control	v.	RI Affected	21.8	14.0	!
RI Control	v.	M05 Control	6.5	15.6	
RI Control	v.	M05 Affected	3.4	14.4	
RI Control	v.	M10 Control	5.8	15.6	
RI Control	v.	M10 Affected	17.6	14.4	!
RI Affected	v.	M05 Control	15.3	8.6	!
RI Affected	v.	M05 Affected	18.4	6.2	!
RI Affected	v.	M10 Control	16.0	8.6	!
RI Affected	v.	M10 Affected	4.2	6.2	
M05 Control	v.	M05 Affected	3.1	9.3	
M05 Control	v.	M10 Control	0.7	11.0	
M05 Control	v.	M10 Affected	11.1	9.3	!
M05 Affected	v.	M10 Control	2.4	9.3	
M05 Affected	v.	M10 Affected	14.2	7.2	!
M10 Control	v.	M10 Affected	11.8	9.3	!

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/27/2008 at 6:11:45 PM
Sample 1: Workbook = Soda Creek Sediment Quality Statistics 2007 (03-27-08).xls / Sheet = V ! / Range = 'V !'!$E$25:$E$28 / 3 rows and 1 column
Sample 2: Workbook = Soda Creek Sediment Quality Statistics 2007 (03-27-08).xls / Sheet = V ! / Range = 'V !'!$F$25:$F$32 / 7 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	3	0	3	5.500	16.500	9.833	5.859
M10 Affected	7	0	7	14.000	30.500	21.643	5.807

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	0.714
p-value	0.083
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:

H_0: The distribution of the two samples is not significantly different.

H_a: The distribution of the first sample is shifted to the right of the distribution of the second sample.

As the computed p-value is greater than the significance level alpha = 0.05, one should accept the null hypothesis H_0.

The risk to reject the null hypothesis H_0 while it is true is 8.33%.

Ties have been detected in the data and the appropriate corrections have been applied.

Soda Creek Sediment Quality
Polonium-210, pCi/g dw

RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected
0.67	0.55	0.69	0.62	0.32	0.56
	0.60	0.96	1.1	0.92	0.76
	0.60	1.5	1.6	1.6	0.98
	0.60		2.0		1.2
	0.70		2.1		1.4
	0.80		2.3		1.4
	1.0		2.8		1.6
	1.4				
	1.5				
	1.5				
	1.6				
	2.3				
	2.6				
	3.3				
0.67	1.2	0.96	2.0	0.92	1.2
RI Control	RI Affected	M05 Control	M05 Affected	M10 Control	M10 Affected

Currently: No evidence of Po-210 contamination.
Historically: No evidence of Po-210 contamination.

XLSTAT 2006 - Comparison of k samples (Kruskal-Wallis, Friedman, ...) - on 3/21/2008 at 6:00:28 PM
Samples: Workbook = Soda Creek Sediment Quality Statistics 2007.xls / Sheet = Po-210 / Range = 'Po-210'!$A$3:$F$17 / 14 rows and 6 columns
Hypothesized difference (D): 0
Significance level (%): 5

Kruskal-Wallis test:

K (Observed value)	5.247
K (Critical value)	11.070
DF	5
p-value (Two-tailed)	0.386
alpha	0.050

Test interpretation:
H_0: The samples are not significantly different.
H_a: The samples do not come from the same population.
As the computed p-value is greater than the significance level alpha = 0.050, one should accept the null hypothesis H_0.
The risk to reject the null hypothesis H_0 while it is true is 38.65%.

Ties have been detected in the data and the appropriate corrections have been applied.

XLSTAT 2006 - Comparison of two distributions (Kolmogorov-Smirnov, ...) - on 3/27/2008 at 5:16:33 PM
Sample 1: Workbook = Soda Creek Sediment Quality Statistics 2007 (03-27-08).xls / Sheet = Po-210 / Range = 'Po-210'!$E$3:$E$6 / 3 rows and 1 column
Sample 2: Workbook = Soda Creek Sediment Quality Statistics 2007 (03-27-08).xls / Sheet = Po-210 / Range = 'Po-210'!$F$3:$F$10 / 7 rows and 1 column
Hypothesized difference (D): 0
Significance level (%): 5

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
M10 Control	3	0	3	0.320	1.600	0.947	0.640
M10 Affected	7	0	7	0.560	1.600	1.129	0.378

Two-sample Kolmogorov-Smirnov test / Upper-tailed test:

D	0.381
p-value	0.44
alpha	0.050

The p-value is computed using an exact method.

Test interpretation:
H_0: The distribution of the two samples is not significantly different.
H_a: The distribution of the first sample is shifted to the right of the distribution of the second sample.
As the computed p-value is greater than the significance level alpha = 0.05, one should accept the null hypothesis H_0.
The risk to reject the null hypothesis H_0 while it is true is 44.17%.

Ties have been detected in the data and the appropriate corrections have been applied.

5.0 DATA

Tables 3.19 and 3.20 present the Alexander Reservoir and Soda Creek analytical data, respectively.

Table 3.19: 2007 Sediment Data (mg/kg dw), Alexander Reservoir																		
			Aresenic		Cadmium		Polonium-210		Nickle		Copper		Selenium		Silver		Vanadium	
Station ID	Latitude	Longitude	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Copper	Flag	Result	Flag	Result	Flag	Result	Flag
		AFFECTED																
AR-1	42 39 16.67373	111 37 38.07183	38		36		2.4		43		21		7.1		0.35		120	
AR-2	42 39 16.23926	111 37 33.21025	47		26		1.5		36		20		4.3		0.34		110	
AR-3	42 39 16.51582	111 37 28.83832	12		13		1.8		22		9.7		2.1		0.17		35	
AR-4	42 39 15.99626	111 37 25.34101	7.4		3.9		1.2		17		7.5		< 0.91	U	0.094		21	
AR-5	42 39 16.52691	111 37 16.72130	9.9		7.7		0.70		24		6.8		1.9		0.087		24	
AR-6	42 39 14.94050	111 37 19.67915	8.1		3.4		0.14		15		4.3		1.0		< 0.055	U	13	
AR-7	42 39 13.72165	111 37 23.00560	9.6		2.0		1.1		13		3.2		< 0.71	U	< 0.057	U	8.7	
AR-8	42 39 14.48981	111 37 30.71525	4.9		4.8		1.1		13		8.5		1.1		0.11		20	
AR-9 avg	42 39 13.96611	111 37 36.01897	3.6		2.4		1.2		10		6.8		< 0.86	U	0.10	J	14	
AR-9-R1	43 39 13.96611	112 37 36.01897	3.3		2.3		0.72		10		6.77		<0.86	U	0.11	J	13	
AR-9-R2	44 39 13.96611	113 37 36.01897	4.0		2.6		0.92		11		6.99		<0.84	U	0.10	J	15	
AR-9-R3	45 39 13.96611	114 37 36.01897	3.4		2.4		1.8		10		6.75		<0.88	U	0.092	J	14	
AR-10 avg	42 39 00.38363	111 37 28.48255	3.3		0.77		0.93		11		8.8		< 0.83	U	0.11	J	16	
AR-10-R1	43 39 00.38363	112 37 28.48255	3.5		0.79		0.86		11		9.66		<0.86	U	0.12	J	17	
AR-10-R2	44 39 00.38363	113 37 28.48255	3.4		0.84		0.66		11		9.37		<0.79	U	0.13	J	16	
AR-10-R3	45 39 00.38363	114 37 28.48255	3.0		0.67		1.3		10		7.29		<0.83	U	0.09	J	14	
		CONTROL																
AR-11	42 38 59.43636	111 37 21.58064	2.9		0.61		1.2		8.7		7.3		< 0.85	U	0.076		14	
AR-12	42 38 58.11901	111 37 13.81436	3.3		0.59		0.83		9.0		7.1		< 0.81	U	0.080		15	
AR-13	42 38 58.16957	111 37 10.03349	2.7		0.60		0.82		9.0		7.3		< 0.83	U	0.090		16	
AR-14	42 38 58.12848	111 37 06.22245	2.9		0.68		0.83		10		7.8		< 0.84	U	0.095		18	
AR-15	42 38 59.96908	111 37 08.62329	2.9		0.50		1.1		7.8		6.6		< 0.81	U	0.077		14	
AR-16	42 39 00.41757	111 37 16.36620	2.4		0.44		1.0		7.0		5.4		< 0.69	U	0.064		11	
AR-17	42 39 01.78020	111 37 19.23613	1.8		0.26		0.49		4.0		3.2		< 0.62	U	< 0.050	U	7.4	
AR-18	42 39 02.87615	111 37 28.55387	2.7		0.64		1.1		10		8.7		< 0.88	U	0.10		18	

Notes:
avg - Lab replicates have been averaged.
(U) - The material was analyzed for, but not detected above the level of the associated value. The associated value is the simple reporting limit.
(J) - The result is an estimated quantity.
R1, R2, R3 - These denote lab generated QA replicates.

Table 3.20: 2007 Sediment Data (mg/kg dw), Soda Creek																		
			Arsenic		Cadmium		Polonium-210		Nickel		Copper		Selenium		Silver		Vanadium	
Station ID	Latitude	Longitude	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag
AFFECTED																		
SC-4	42 40 14.32805	111 35 54.22960	64		40		1.0		80		12		100		0.22		120	
SC-5	42 39 59.98769	111 35 55.51840	16		19		1.4		59		8.8		35		0.43		62	
SC-6	42 39 44.15251	111 36 05.48682	23		18		1.2		38		10		5.7		0.17		100	
SC-7	42 39 34.35396	111 36 15.56945	29		15		1.4		30		9.1		4.0		0.17		87	
SC-8-avg	42 39 35.87813	111 36 32.40570	99		15		0.76		29		8.6		3.4		0.32	J	100	
SC-8-R1	43 39 35.87813	112 36 32.40570	110		13		0.92		29		7.5		2.8		0.24	J	99	
SC-8-R2	44 39 35.87813	113 36 32.40570	100		17		0.74		33		9.6		4.1		0.43		110	
SC-8-R3	45 39 35.87813	114 36 32.40570	86		14		0.62		25		8.8		3.3		0.28	J	92	
SC-9	42 39 35.98726	111 36 54.94849	160		14		0.56		17		7.7		4.0		0.18		80	
SC-10	42 39 17.24880	111 37 05.34616	62		5.1		0.76		21		100		1.3		0.55		84	
CONTROL																		
SC-1	42 42 36.29933	111 37 18.05155	3.2		0.70		0.93		16		4.5		< 1.2	U	< 0.93	U	32	
SC-2	42 42 00.24167	111 36 44.15931	12		0.65		0.32		28		4.3		< 0.90	U	0.14		80	
SC-3	42 40 39.89715	111 36 08.97724	42		0.42		1.6		22		5.2		< 1.2	U	< 0.98	U	41	

Notes:
avg - Lab replicates have been averaged.
(U) - The material was analyzed for, but not detected above the level of the associated value. The associated value is the simple reporting limit.
(J) - The result is an estimated quantity
R1, R2, R3 - These denote lab generated QA replicates.

6.0 REFERENCES

Georgia Institute of Technology, March 2003. *Scientific Approaches for Transportation Research* (http://traffic.ce.gatech.edu/nchrp2045/v2chapter6.html). Prepared for National Coorporative Highway Research Program.

Golder Associates, November 1997. *Monsanto. Selected Text from Phase I and Phase II remedial Investigations and Reports. Relating to Characterization of Soda Creek.* Prepared for Monsanto.

Montgomery Watson Harza (MWH), October 2002. *Final Work Plan for CERCLA Five-year Review. Monsanto Elemental Phosphorous Plant, Soda Springs, Idaho.* Prepared for Monsanto.

USEPA, April 1997. *Record of Decision: Monsanto Chemical Company, Superfund Site, Caribou County, Idaho.* USEPA Region X, Office of Environmental Cleanup.

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Data Validation Summary Report: 2nd Five-Year CERCLA Review – Sediment Samples

Table 1 – Summary of Triplicate and QA Split Sample Results for Metals

Table 2 – Summary of Triplicate and QA Split Sample Results for Radiological Parameter

GEL SDG 195901 – Metals

GEL SDG 195901 – Polonium-210

Attachment A – Radiochemical Data Verification and Validation

Attachment B – Data Validation_Worksheet GEL SDG 195901

GEL SDG 195904 – Metals

GEL SDG 195904 – Polonium-210

Attachment A – Radiochemical Data Verification and Validation

Attachment B – Data Validation_Worksheet GEL SDG 195904

GEL SDGs 195909 and 196021 – Metals

GEL SDG 195909 – Polonium-210

Attachment A – Radiochemical Data Verification and Validation

Attachment B – Data Validation_Worksheet GEL SDG 195909

GEL SDG 196021 – Polonium-210

Attachment A – Radiochemical Data Verification and Validation

Attachment B – Data Validation_Worksheet GEL SDG 196021

ACZ SDG L65816

DATA VALIDATION SUMMARY REPORT

2ND FIVE-YEAR CERCLA REVIEW – SEDIMENT SAMPLES

This report is a summary of the data validation and quality control (QC) review conducted for sediment samples collected in October 2007 in support of the 2nd Five-Year CERCLA Review for the Monsanto Soda Springs Plant, located in Soda Springs, Idaho. This effort was completed on the behalf of Monsanto Elemental Phosphorous Plant. General Engineering Laboratories (GEL), located in Charleston, South Carolina, performed analyses on all primary, triplicate, and field blank samples. ACZ Laboratories (ACZ), located in Steamboat Springs, Colorado, was contracted to perform metals analysis on the quality assurance (QA) split samples. Sanford Cohen and Associates (SCA), located in Vienna, Virginia, was contracted to perform radionuclide analysis on QA split samples. All laboratories were selected prior to sampling and are proficient in the analysis of metals and radionuclides as requested by the United States Environmental Protection Agency (USEPA) Region 10 and the Idaho Department of Environmental Quality (IDEQ).

Data generated by GEL and ACZ were validated as specified in the Quality Assurance Project Plan (QAPP) portion of the 2nd Five-Year CERCLA Review Work Plan (MWH, 2007), and as referenced in the *Final Work Plan for CERCLA Five-Year Review* (MWH, 2002). The QAPP specified use of *USEPA National Functional Guidelines for Inorganic Data Review* (USEPA, 2004) to validate metals data. Radionuclide data were validated using applicable guidance specified in *Evaluation of Radiochemical Data Usability* (United States Department of Energy [USDOE], 1997b). Data validation reports were produced for each laboratory Sample Delivery Group (SDG), and are provided in Attachment A.

Sediment samples were collected and submitted to GEL where they were homogenized and dried. In addition, three equipment rinsate and three source water blank samples were collected and submitted to GEL. Three of the primary field samples were selected for triplicate and QA analyses. These three primary field samples were homogenized and split into four parts. One part of each sample was submitted to ACZ for metals analysis and SCA for radionuclide

analysis. The remaining three parts were identified as triplicate samples and analyzed by GEL. All sample submittals were made under chain-of-custody protocols.

GEL analyzed the primary samples for the following:

- Arsenic, cadmium, copper, nickel, selenium, and vanadium by USEPA Method SW6020.
- Polonium-210 (^{210}Po) by Environmental Measurements Laboratory (EML) Health and Safety Laboratory (HASL)-300 Manual, Section 4.5.4 (Po-01-RC: alpha ray spectrometry (USDOE, 1997a) and GEL's Standard Operating Procedure (SOP) GL-RAD-A-016 Rev #9.

ACZ analyzed the QA split samples for arsenic, cadmium, copper, nickel, selenium, and vanadium by SW6020, and SCA analyzed the QA split samples for Polonium-210 by EML HASL 300, Po-01-RC.

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of these data required to meet the goals of site investigation and/or to support decisions made in environmental management activities. Although analytical chemistry DQOs for the October 2007 sampling event were not specified in the Work Plan (MWH, 2007), chemical data generated from field samples are typically evaluated in terms of precision, accuracy, representativeness, completeness, and comparability. The results of laboratory quality control (QC) samples were evaluated against these parameters. QC sample results that fall outside the method- and laboratory-specified control criteria serve to signal unacceptable or biased data that may result in corrective action or qualification of data. The following is a summary review of these data, including data qualification that resulted from the data validation.

Precision and Accuracy

Precision is the degree of agreement among repeated measurements of the same characteristic under the same or similar conditions. Data precision indicates how consistent and reproducible the field sampling or analytical procedures have been. Precision was evaluated based on the results of QC samples collected in the field and created in the laboratory. The percent differences (or drift) calculated from continuing calibration verification (CCV) standards provided information on precision of the analytical system. The calculated relative percent differences

(RPDs) for replicate field samples or matrix spike/matrix spike duplicate (MS/MSD) pairs provided information on precision of sampling and analytical procedures, and the RPDs for laboratory control sample/laboratory control sample duplicate (LCS/LCSD) pairs provided information on precision of the analytical procedures.

Accuracy is defined as the closeness of agreement between an observed value and an accepted reference value. Accuracy was evaluated based on relative standard deviations (RSDs) generated from initial calibrations and recoveries from second-source initial calibration verifications (ICVs) and recoveries from MS/MSD and LCS/LCSD samples. Field sample results associated with recoveries and RSDs outside the acceptance limits were qualified.

- All GEL and ACZ calibrations were acceptable for the metals analysis. Neither GEL nor SCA provided calibration data for radiochemical analyses, so calibration data were not evaluated. Data validation was not performed on the QA split samples analyzed by SCA because only summary data were not provided.

- All ACZ spike recoveries for metals were acceptable. GEL spike recoveries for metals were acceptable, with two exceptions: one or metals were qualified as estimated in samples 101107SEAR-1-0-C(3), 101207SEMSC-1-0-C(3), and 101207SEMSC-4-0-C(3) because MS/MSD recoveries and/or RPDs were outside the control limits. All other spike sample recoveries and RPDs were acceptable. Spike sample exceedances are summarized in the data validation reports for SDGs 195901 and 195904.

- GEL and ACZ analyzed laboratory duplicates associated with all metals analyses. Metals data were qualified in samples 101207SEMSC-1-0-C(3), 101207SEMSC-4-0-C(3), 101207SEMSC-8-1-C(3), 101207SEMSC-8-2-C(3), and 101207SEMSC-8-3-C(3) because RPDs were greater than the control limit. All laboratory duplicate exceedances are summarized in the data validation reports for SDG 195904 and 195909/196021.

- All recoveries for interference check samples analyzed by ACZ for arsenic, cadmium, copper, nickel, selenium, and vanadium were acceptable. Interference check samples were not analyzed by GEL.

- All recoveries for ICP-MS tuning analyses were acceptable.

- All LCS/LCSD recoveries and RPDs were acceptable for metals.

- All percent differences for serial dilutions were acceptable, with two exceptions. One or more metals results were qualified in samples 101207SEMSC-1-0-C(3) and 101107SEAR-9-4-C-(3) because percent differences were outside the control limit. These exceedances are summarized in the data validation reports for SDGs 195904 and L65816.

- All recoveries and RPDs for radionuclide QC sample analysis were within laboratory-established control limits.
- The radionuclide sample identification and quantitation criteria for reporting (that is, the detected activity as compared to the uncertainly and sample-specific minimum detectable activity [MDA] or concentration [MDC]) were acceptable, with the exceptions noted in each data validation report (GEL SDGs 195901, 195904, 196909, and 196021).

Representativeness

Representativeness is evaluated by reviewing blank results and overall data quality. Blanks are analyzed before and during the analytical process. GEL and ACZ analyzed blanks using initial calibration blanks and continuing calibration blanks (ICB/CCB). Both labs had one or more metals detected in their preparation blanks and calibration blanks. Additionally, metals were detected in the field and equipment blanks associated with the analysis of the three QA split samples. Sample results associated with detected blanks that were greater than the method detection limit and less than five times the detected blank were qualified as undetected at five times the highest blank detection for that particular analyte. All other blank results were below detection limit. Metals data that were qualified due to blank detections are summarized in data validation reports for SDGs L65816 and 195909/186921.

Representative for radionuclide analysis was determined from the laboratory blank data. The normalized absolute difference (NAD) was calculated as follows:

$$\text{NAD} = \frac{\left|[\text{Sample}] - [\text{Blank}]\right|}{([\text{Uncertainty}_{\text{Sample}}{}^{2} + \text{Uncertainty}_{\text{Blank}}{}^{2})^{1/2}}$$

If the NAD were greater than 2.58, then the reported results were acceptable. If the NAD was less than 2.58 but greater than 1.96, then the data were qualified as estimated. If the NAD was less than 1.96 and the reported concentration were less than two times the uncertainty, then the radionuclide was considered not detected (flagged as UJ) at the reported concentration. Polonium-210 results that were qualified because of method blank contamination are summarized in each data validation report.

All samples were analyzed within the recommended holding times for metals and radionuclides analyses.

Completeness

All field samples, field blank samples, and QA Split samples were collected and analyzed as specified in the *Work Plan, Field Sampling Plan, Quality Assurance Program Plan, and Health and Safety Memoranda for the 2nd CERCLA Five-Year Review* (MWH, 2007). GEL's and ACZ's laboratory data were complete for metals and radionuclide analyses. SCA laboratory data were complete with the exception of back-up (raw) data in the laboratory report. Both GEL and ACZ provided raw data packets that contained information on the specific analytes for which sediment samples were analyzed.

Comparability

Comparability is defined as the confidence with which one data set can be evaluated against another. On this project, comparability was assured by analyzing all samples according to the specified methods and procedures described in the *Work Plan, Field Sampling Plan, Quality Assurance Program Plan, and Health and Safety Memoranda for the 2nd CERCLA Five-Year Review* and via the analysis of QA Split samples. Table 1 provides the results of the QA split samples for metals, and Table 2 provides the results for Polonium-210.

Of the 51 RPDs calculated for metals for the three sets of triplicate and QA Split samples, all but nine were with the QAPP-defined acceptance criterion of 35 for duplicates. Other than the fact that the QA laboratory's results were generally greater than the primary laboratory's results, there did not seem to be any apparent pattern to the differences. The triplicate and QA Split sample results for the three sets of sediment samples indicate that the metals data were generally comparable.

All RPDs and duplicate error ratios (see Table 2 for calculation) calculated for Polonium-210 for the three sets of triplicate and QA Split samples were within control, with one exception. The RPD for Polonium-210 calculated from the results of triplicate sample 101107SEAR-9-2-C(3) and QA Split sample 101107SEAR-9-2-C(3) was 48, greater than the QAPP-defined acceptance

criterion of 35 for duplicate samples. Many of the Polonium-210 results reported by GEL were validated as not detected at the reported concentration (see individual data validation reports). As validated, the triplicate and QA Split sample results for the three sets of sediment samples indicate that the Polonium-210 data were generally comparable.

Summary of Data Quality

Analytical data generated from sediment samples collected in support of the 2nd Five-Year CERCLA Review for the Monsanto Soda Springs Plant were reviewed and validated according to the *USEPA National Functional Guidelines for Inorganic Data Review* and *USDOE Evaluation of Radiochemical Data Usability*. None of the data was rejected, and all data are usable as qualified.

References

MWH, 2002. *Final Field Sampling Plan for CERCLA Five-Year Review Soil and Sediment Investigation.* Monsanto Elemental Phosphorus Plant, Soda Springs, Idaho. Prepared by MWH for Monsanto.

MWH, 2007. *Work Plan, Field Sampling Plan, Quality Assurance Program Plan, and Health and Safety Memoranda for the 2nd CERCLA Five-Year Review*. Monsanto Elemental Phosphorus Plant, Soda Springs, Idaho. August.

United States Department of Energy (USDOE), 1997a Department of Energy, Environmental Measurements Laboratory, *Health and Safety Laboratory (HASL)-300 Manual*, Section 4.5.4 (Po-01-RC: alpha ray spectrometry), 28th Edition, February.

USDOE, 1997b. Department of Energy, *Evaluation of Radiochemical Data Usability*, es/er/ms-5, April.

USEPA, 2004. National Functional Guidelines for Inorganic Data Review, Office of Superfund Remediation and Technology Innovation, Washington DC. OSWER 9240.1-45; EPA 540-R-04-004. October.

ATTACHMENT A

DATA VALIDATION REPORTS

GEL SDG No. 195901 Metals
GEL SDG No. 195901 Polonium-210
GEL SDG No. 195904 Metals
GEL SDG No. 195904 Polonium-210
GEL SDG No. 195909 and 196021 Metals
GEL SDG No. 195909 Polonium-210
GEL SDG No. 196021 Polonium-210
ACZ SDG No. L65816 Metals

TABLE 1

SUMMARY OF TRIPLICATE AND QA SPLIT SAMPLE RESULTS FOR METALS
2ND CERCLA 5-YEAR REVIEW
MONSANTO
(Page 1 of 3)

Sample Identification	Laboratory Identification	Sample Type	Chemical Parameter	Laboratory Result mg/kg	Laboratory Qualifier	Validation Qualifier	Precision[a] RPD (<35)
101207SEMSC-8-4-C(3)	L65816-03	QA Split	Arsenic	150			
101207SEMSC-8-1-C(3)	196021001	Triplicate	Arsenic	106		J	34
101207SEMSC-8-2-C(3)	196021002	Triplicate	Arsenic	99.6		J	**40**
101207SEMSC-8-3-C(3)	196021003	Triplicate	Arsenic	85.6		J	**55**
101207SEMSC-8-4-C(3)	L65816-03	QA Split	Cadmium	13.1			
101207SEMSC-8-1-C(3)	196021001	Triplicate	Cadmium	13.0		J	0.77
101207SEMSC-8-2-C(3)	196021002	Triplicate	Cadmium	17.1		J	26
101207SEMSC-8-3-C(3)	196021003	Triplicate	Cadmium	13.7		J	4.5
101207SEMSC-8-4-C(3)	L65816-03	QA Split	Copper	9.5			
101207SEMSC-8-1-C(3)	196021001	Triplicate	Copper	7.50		J	24
101207SEMSC-8-2-C(3)	196021002	Triplicate	Copper	9.59		J	0.94
101207SEMSC-8-3-C(3)	196021003	Triplicate	Copper	8.84		J	7.2
101207SEMSC-8-4-C(3)	L65816-03	QA Split	Nickel	35.7			
101207SEMSC-8-1-C(3)	196021001	Triplicate	Nickel	28.7		J	22
101207SEMSC-8-2-C(3)	196021002	Triplicate	Nickel	33.3		J	7.0
101207SEMSC-8-3-C(3)	196021003	Triplicate	Nickel	24.5		J	**37**
101207SEMSC-8-4-C(3)	L65816-03	QA Split	Selenium	4.46			
101207SEMSC-8-1-C(3)	196021001	Triplicate	Selenium	2.79			**46**
101207SEMSC-8-2-C(3)	196021002	Triplicate	Selenium	4.09			8.7
101207SEMSC-8-3-C(3)	196021003	Triplicate	Selenium	3.26			31
101207SEMSC-8-4-C(3)	L65816-03	QA Split	Silver	0.17			
101207SEMSC-8-1-C(3)	196021001	Triplicate	Silver	0.239	J		34
101207SEMSC-8-2-C(3)	196021002	Triplicate	Silver	0.432			**87**
101207SEMSC-8-3-C(3)	196021003	Triplicate	Silver	0.276	J		**48**
101207SEMSC-8-4-C(3)	L65816-03	QA Split	Vanadium	89.6			
101207SEMSC-8-1-C(3)	196021001	Triplicate	Vanadium	98.6		J	10
101207SEMSC-8-2-C(3)	196021002	Triplicate	Vanadium	105		J	16
101207SEMSC-8-3-C(3)	196021003	Triplicate	Vanadium	92.2		J	2.9
101107SEAR-9-4-C(3)	L65816-01	QA Split	Arsenic	5.1		J	
101107SEAR-9-1-C(3)	196021005	Triplicate	Arsenic	3.26			**44**
101107SEAR-9-2-C(3)	196021006	Triplicate	Arsenic	3.99			24

TABLE 1

SUMMARY OF TRIPLICATE AND QA SPLIT SAMPLE RESULTS FOR METALS
2ND CERCLA 5-YEAR REVIEW
MONSANTO
(Page 2 of 3)

Sample Identification	Laboratory Identification	Sample Type	Chemical Parameter	Laboratory Result mg/kg	Laboratory Qualifier	Validation Qualifier	Precision[a] RPD (<35)
101107SEAR-9-3-C(3)	196021007	Triplicate	Arsenic	3.44			**39**
101107SEAR-9-4-C(3)	L65816-01	QA Split	Cadmium	2.6			
101107SEAR-9-1-C(3)	196021005	Triplicate	Cadmium	2.29		U	
101107SEAR-9-2-C(3)	196021006	Triplicate	Cadmium	2.59		U	
101107SEAR-9-3-C(3)	196021007	Triplicate	Cadmium	2.36		U	
101107SEAR-9-4-C(3)	L65816-01	QA Split	Copper	8.2			
101107SEAR-9-1-C(3)	196021005	Triplicate	Copper	6.77			19
101107SEAR-9-2-C(3)	196021006	Triplicate	Copper	6.99			16
101107SEAR-9-3-C(3)	196021007	Triplicate	Copper	6.75			19
101107SEAR-9-4-C(3)	L65816-01	QA Split	Nickel	11.3			
101107SEAR-9-1-C(3)	196021005	Triplicate	Nickel	10.4			8.3
101107SEAR-9-2-C(3)	196021006	Triplicate	Nickel	10.8			4.5
101107SEAR-9-3-C(3)	196021007	Triplicate	Nickel	10.1			11
101107SEAR-9-4-C(3)	L65816-01	QA Split	Selenium	1.24			
101107SEAR-9-1-C(3)	196021005	Triplicate	Selenium	ND	U		
101107SEAR-9-2-C(3)	196021006	Triplicate	Selenium	ND	U		
101107SEAR-9-3-C(3)	196021007	Triplicate	Selenium	ND	U		
101107SEAR-9-4-C(3)	L65816-01	QA Split	Silver	0.09	B		
101107SEAR-9-1-C(3)	196021005	Triplicate	Silver	0.110	J		20
101107SEAR-9-2-C(3)	196021006	Triplicate	Silver	0.103	J		13
101107SEAR-9-3-C(3)	196021007	Triplicate	Silver	0.0916	J		1.8
101107SEAR-9-4-C(3)	L65816-01	QA Split	Vanadium	14.6			
101107SEAR-9-1-C(3)	196021005	Triplicate	Vanadium	13.1			11
101107SEAR-9-2-C(3)	196021006	Triplicate	Vanadium	14.7			0.68
101107SEAR-9-3-C(3)	196021007	Triplicate	Vanadium	13.5			7.8
101107SEAR-10-4-C(3)	L65816-02	QA Split	Arsenic	4.7			
101107SEAR-10-1-C(3)	196021009	Triplicate	Arsenic	3.53			28
101107SEAR-10-2-C(3)	196021010	Triplicate	Arsenic	3.36			33
101107SEAR-10-3-C(3)	196021011	Triplicate	Arsenic	3.01			**44**
101107SEAR-10-4-C(3)	L65816-02	QA Split	Cadmium	0.91			
101107SEAR-10-1-C(3)	196021009	Triplicate	Cadmium	0.791		U	
101107SEAR-10-2-C(3)	196021010	Triplicate	Cadmium	0.839		U	

TABLE 1

SUMMARY OF TRIPLICATE AND QA SPLIT SAMPLE RESULTS FOR METALS
2ND CERCLA 5-YEAR REVIEW
MONSANTO
(Page 3 of 3)

Sample Identification	Laboratory Identification	Sample Type	Chemical Parameter	Laboratory Result mg/kg	Laboratory Qualifier	Validation Qualifier	Precision[a] RPD (<35)
101107SEAR-10-3-C(3)	196021011	Triplicate	Cadmium	0.672		U	
101107SEAR-10-4-C(3)	L65816-02	QA Split	Copper	9.6			
101107SEAR-10-1-C(3)	196021009	Triplicate	Copper	9.66			0.62
101107SEAR-10-2-C(3)	196021010	Triplicate	Copper	9.37			2.4
101107SEAR-10-3-C(3)	196021011	Triplicate	Copper	7.29			27
101107SEAR-10-4-C(3)	L65816-02	QA Split	Nickel	10.5			
101107SEAR-10-1-C(3)	196021009	Triplicate	Nickel	11.2			6.5
101107SEAR-10-2-C(3)	196021010	Triplicate	Nickel	10.6			0.95
101107SEAR-10-3-C(3)	196021011	Triplicate	Nickel	9.59			9.1
101107SEAR-10-4-C(3)	L65816-02	QA Split	Selenium	0.83			
101107SEAR-10-1-C(3)	196021009	Triplicate	Selenium	ND	U		
101107SEAR-10-2-C(3)	196021010	Triplicate	Selenium	ND	U		
101107SEAR-10-3-C(3)	196021011	Triplicate	Selenium	ND	U		
101107SEAR-10-4-C(3)	L65816-02	QA Split	Silver	0.1			
101107SEAR-10-1-C(3)	196021009	Triplicate	Silver	0.120	J		18
101107SEAR-10-2-C(3)	196021010	Triplicate	Silver	0.131	J		27
101107SEAR-10-3-C(3)	196021011	Triplicate	Silver	0.086	J		15
101107SEAR-10-4-C(3)	L65816-02	QA Split	Vanadium	16.7			
101107SEAR-10-1-C(3)	196021009	Triplicate	Vanadium	16.8			0.60
101107SEAR-10-2-C(3)	196021010	Triplicate	Vanadium	16.4			1.8
101107SEAR-10-3-C(3)	196021011	Triplicate	Vanadium	13.5			21

J - result is estimated because of one or more quality control results that are outside the acceptance limits
U - the analyte is not considered present above the RL

[a] The relative percent difference (RPD) was calculated for each triplicate sample result against the associated QA Split sample result when both results were reported as detections (that is, not non-detected). An RPD value that is bolded and boxed is above the acceptance criterion. The RPD acceptance criteria is 35.

$$RPD = \frac{|(\text{Triplicate - QA Split})|}{(\text{Triplicate + QA Split})/2}$$

TABLE 2

SUMMARY OF TRIPLICATE AND QA SPLIT SAMPLE RESULTS FOR RADIOLOGICAL PARAMETER
2ND CERCLA 5-YEAR REVIEW
MONSANTO

Sample Identification	Laboratory Identification	Sample Type	Chemical Parameter	Laboratory Result (pCi/g)				Validation Result [a]		Precision [b]	
				Result	Uncertainty	Qualifier	MDC	Qual	ReasonCode	RPD (<35)	DER (≤ 1.42)
101207SEMSC-8-1-C(3)	196021001	TRIPLICATE	Polonium-210	0.915	0.473		0.564	UJ	Q09,B01,C03	NA	0.23
101207SEMSC-8-2-C(3)	196021002	TRIPLICATE	Polonium-210	0.743	0.479		0.644	UJ	Q09,B01,C03	NA	0.32
101207SEMSC-8-3-C(3)	196021003	TRIPLICATE	Polonium-210	0.616	0.438	U	0.630		C03	NA	0.40
101207SEMSC-8-4-C(3)	MWW07-8021-01	QA Split	Polonium-210	1.33	0.776		0.48	- - not validated -			
101107SEAR-9-1-C(3)	196021005	TRIPLICATE	Polonium-210	0.715	0.481		0.652	UJ	Q09,B01,C03	NA	0.46
101107SEAR-9-2-C(3)	196021006	TRIPLICATE	Polonium-210	0.916	0.448		0.427	J	Q09,C03	**48**	0.35
101107SEAR-9-3-C(3)	196021007	TRIPLICATE	Polonium-210	1.82	0.663		0.499	J	Q09,C03	19	0.16
101107SEAR-9-4-C(3)	MWW07-8021-02	QA Split	Polonium-210	1.5	0.711		0.289	- - not validated -			
101107SEAR-10-1-C(3)	196021009	TRIPLICATE	Polonium-210	0.862	0.475		0.502	UJ	Q09,B01,C03	NA	0.42
101107SEAR-10-2-C(3)	196021010	TRIPLICATE	Polonium-210	0.663	0.425		0.504	UJ	Q09,B01,C03	NA	0.55
101107SEAR-10-3-C(3)	196021011	TRIPLICATE	Polonium-210	1.26	0.489		0.356	J	Q09,C03	26	0.20
101107SEAR-10-4-C(3)	MWW07-8021-03	QA Split	Polonium-210	1.63	0.773		0.314	- - not validated -			

[a] The triplicate sample data were validated, but not the quality assurance (QA) split samples. The QA Split laboratory report did not contain sufficient back-up data to perform validation. Reason codes are defined in the individual validation reports.

[b] The relative percent difference (RPD) and duplicate error ratio (DER) were calculated for each triplicate sample result against the associated QA Split sample result when both results were reported as detections (that is, not non-detected). An RPD or DER value that is bolded and boxed is above the acceptance criterion. The RDP and DER acceptance criteria are 35 and 1.42, respectively.

J - result is estimated because of one or more quality control results that are outside the acceptance limits
MDC - minimum detectable concentration
pCi/g - pico-Curries per gram
UJ - result is considered not detected at the laboratory-reported concentration. The non-detected value is considered estimated.

$$RPD = \frac{|(\text{Triplicate - QA Split})|}{(\text{Triplicate + QA Split})/2}$$

$$DER = \frac{|(\text{Triplicate - QA Split})|}{2 * (\text{Uncert}_{\text{Triplicate}}^{2} + \text{Uncert}_{\text{QA Split}}^{2})^{1/2}}$$

MWH Client: Monsanto Company

MWH Project Name: CERCLA 2nd 5-Year Review

MWH Project Number: 1010076.011601

Laboratory: GEL Laboratories, LLC (Charleston, SC)

Data packages: Sample Delivery Group (SDG) Number 195901

Methods: Total arsenic, cadmium, copper, nickel, selenium, silver, and vanadium by EPA Method 6020

Guidance: USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, October 2004, ICP-AES and ICP-MS

Modification: Data validator evaluated blank contamination as defined in the Inorganic Data Assessment Summary of the P4 Production Southeast Idaho Mine-Specific Selenium Program "Comprehensive Site Investigation, Sampling and Analysis Plan" (MWH, 2004)

Sample Cross Reference:

Field Sample Identification	Date Collected	Laboratory Sample Identification
101107SEAR-1-0-C(3)	10/11/07	195901001
101107SEAR-2-0-C(3)	10/11/07	195901002
101107SEAR-3-0-C(3)	10/11/07	195901003
101107SEAR-4-0-C(3)	10/11/07	195901004
101107SEAR-5-0-C(3)	10/11/07	195901005
101107SEAR-6-0-C(3)	10/11/07	195901006
101107SEAR-7-0-C(3)	10/11/07	195901007
101107SEAR-8-0-C(3)	10/11/07	195901008
101107SEAR-11-0-C(3)	10/11/07	195901011
101107SEAR-12-0-C(3)	10/11/07	195901012
101107SEAR-13-0-C(3))	10/11/07	195901013
101107SEAR-14-0-C(3)	10/11/07	195901014
101107SEAR-15-0-C(3)	10/11/07	195901015
101107SEAR-16-0-C(3)	10/11/07	195901016
101107SEAR-17-0-C(3)	10/11/07	195901017
101107SEAR-18-0-C(3)	10/11/07	195901019

I. Holding Times

__X__ ICP/GFAA metals completed in <6 months from collection
_____ Mercury analyzed in <28 days from collection
_____ Chloride, fluoride, sulfate completed in <28 days from collection
_____ TSS and TDS completed within 7 days from collection
_____ O-phosphorus completed within 48 hours from collection
_____ Nitrate-nitrite as N completed within 48 hours
_____ Alkalinity completed within 14 days from collection
_____ pH completed within 24 hours from collection
_____ Sample analyzed outside recommended hold time, estimated (J/UJ)
_____ Sample analyzed > 2x recommended hold time, unusable (R/UR)

A total of 16 sediment samples were submitted to GEL Laboratories, LLC (Charleston, SC) for metals analysis. The samples were collected October 11, 2007 and we received at the laboratory on October 17, 2007. The cooler temperatures ranged from 13 °C to 19 °C when they arrived at the lab, which is outside of the recommended temperature criteria of 4 ± 2 °C. Metals are not impacted by the elevated temperature, so no data were qualified. All samples were extracted and analyzed within the EPA recommended hold times.

II. Initial Calibration

Initial Calibration
__X__ IC correlation coefficient ≥ 0.995
_____ IC correlation coefficient < 0.995, results > MDL estimated (J); < MDL unusable (R)

Initial Calibration Verification
__X__ ICV %R 90 - 110, results acceptable
_____ ICV %R 75-89, results > MDL estimated (J); < MDL estimated (UJ)
_____ ICV %R < 75, results > MDL estimated (J); < MDL unusable (R)
_____ ICV %R 111-160 results > MDL estimated (J)
_____ ICV %R > 160, results > MDL unusable (R)

ICP-MS Tune Analysis (check all that apply):
__X__ Tune %RSD for all analytes <5%, mass calibration within 0.1 amu
_____ Tune not performed, all results unusable (R/UR)
_____ Tune not performed properly, results estimated (J/UJ)
_____ Mass calibration not within 0.1 amu, results estimated (J/UJ)
_____ %RSD>5%, results estimated (J/UJ)

All initial calibration data were within method-established control limits.

III. Calibration Verification

__X__ CCV %R 90 - 110, results acceptable
_____ CCV %R 75-89, results > MDL estimated (J); < MDL estimated (UJ)
_____ CCV %R < 75, results > MDL estimated (J); < MDL unusable (UR)
_____ CCV %R 111-160 results > MDL estimated (J)
_____ CCV %R > 160, results > MDL unusable (R)

All continuing verification data were within method-established control limits.

IV. Blanks

_____ Target analyte detected in ICB/CCB
_____ Target analyte detected in preparation blank
_____ Target analyte detected in field blank
_____ Target analyte detects ≤ 5x blank result qualified as not detected at sample concentration (U).

No target analytes were detected in any of the blanks.

V. Interference Checks

_____ ICS A/B Recoveries Acceptable
_____ Al, Ca, Fe, Mg sample concentrations >ICS concentrations
_____ ICS %R> 120%, results > MDL estimated (J)
_____ ICS %R 50-79%, results >MDL estimated (J), possible false negative
_____ ICS %R 50-79%, results < MDL estimated (UJ)
_____ ICS %R <50%, results > MDL and <MDL rejected (R/UR)
_____ ICS %R>120, results < MDL acceptable

No interference check sample was reported for this SDG.

VI. Laboratory Control Samples

__X__ LCS %R 80-120 (Ag, Sb no limits)
_____ LCS %R 50-79% or >120%, results estimated (UJ/J)
_____ LCS %R > 150% and all results rejected (R)
_____ LCS %R < 50%, results < MDL rejected (R), detections estimated (J)

All recoveries and relative percent differences for LCS/LCSD pairs were within control limits.

VII. Duplicate Sample Analysis

__X__ Duplicate RPD ≤20% for waters (≤35% for soils) for results >5X PQL
_____ Duplicate range is within ±PQL (±2xPQL for soils) for results ≤ 5X PQL
_____ Qualify positive results estimated (J) if the above criteria were not met.

All laboratory replicate RPDs were within control limits.

VIII. Matrix Spikes/Matrix Spike Duplicates and Analytical/Post Digestion Spikes

_____ Spike %R within 75-125%
__X__ Spike %R 30-74%, >125%, results > MDL estimated (J)
_____ Spike %R 30-74% results < MDL estimated (UJ)
_____ Spike %R <30%, results < MDL rejected (R)
_____ Field blank used for spike analysis
_____ Spike %R >125%, results < MDL acceptable
_____ Sample concentration exceeds spike concentration by a factor of > 4x, acceptable

All recoveries and relative percent differences for MS/MSD pairs were within control limits with one exception. The MSD percent recovery associated with the arsenic analysis of project sample 101107SEAR-1-0-C(3) was greater than the upper control limit. Arsenic in the parent sample was qualified as estimated (J).

IX. Serial Dilutions

__X__ Sample concentration > 50x MDL and %D < 10, result acceptable
_____ Sample concentration > 50x MDL and %D > 10, results > MDL estimated (J)
_____ Sample concentration > 50x MDL and %D > 10, results < MDL estimated (UJ)

All serial dilution percent differences were within control limits.

X. Field Duplicates

_____ Field duplicate RPD ≤20% waters (≤35% for soils)
_____ Field duplicate range is within ±CRDL (±2x CRDL for soils) for results <5xCRDL

Note: There are no qualification requirements for field QC samples exceeding limits.

No field duplicates were collected for this SDG.

XI. Overall Assessment of Data

With the exceptions of the out-of-control result specified herein, all quality control data associated with the field samples were within control limits. With the exception of the qualified data summarized below, none of the out-of-control data resulted in the qualification of field data. All field results are usable as reported by the laboratory.

Summary of Qualified Data:

Field Sample Identification	Laboratory Sample Identification	Parameter	Result / Lab Flag (mg/kg)	Data Validation Result / Flag (mg/kg)	Reason Code[a]
101107SEAR-1-0-C(3)	1905901001	Arsenic	3.30	3.30 J	08

[a] See definitions on last page of this report

Definitions:

QC Sample Type Cross-Reference:

ACZ Acronym	EPA Method Acronym	Definition
AS/ ASD		Analytical Spike / Analytical Spike Duplicate (Post Digestion)
CCB	Calibration Blank	Continuing Calibration Blank
CCV	CAL	Continuing Calibration Verification Standard
DUP	LD1 and LD2	Laboratory Sample Duplicate
ICB	Calibration Blank	Initial Calibration Blank
ICV	IPC Solution	Initial Calibration Verification
ICSAB	SIC Solution	Inter-element Correction Standard
LCSS/ LCSSD		Laboratory Control Sample / Laboratory Control Sample Duplicate (Soil)
LCSW/ LCSWD		Laboratory Control Sample / Laboratory Control Sample Duplicate (Water)
LFB	LFB (LCS)	Laboratory Fortified Blank
LFM/ LFMD	LFM/ LFMD	Laboratory Fortified Matrix / Laboratory Fortified Matrix Duplicate
LRB	LRB	Laboratory Reagent Blank
MS/MSD		Matrix Spike / Matrix Spike Duplicate
PBS/PBW		Prep Blank – Soil / Prep Blank -Water
PQV	CRQL	Practical Quantitation Verification Standard
SDL		Serial Dilution

Qualifiers:

Reason Code	Definition
01	Hold time or sample receipt non-conformance
02	Initial calibration non-conformance
03	Continuing calibration outside control limit
04	Blank contamination
05	Interference check sample recovery outside control limit
06	Laboratory control sample / duplicate recovery or RPD outside control limit
07	Laboratory duplicate is outside control limit
08	Matrix spike / duplicate recovery or RPD outside control limit
09	Serial dilution percent difference outside control limit

MWH Client:	Monsanto Company
MWH Project Name:	CERCLA 2nd 5-Year Review
MWH Project Number:	1010076.011701
Laboratory:	GEL Laboratories, LLC (Charleston, SC)
Data packages:	Sample Delivery Group (SDG) Number 195901
Analytical Batches:	694902
Method:	Polonium (Po) 210 (^{210}Po) by EML HASL 300, Po-01-RC and per the laboratory's SOP GL-RAD-A-016 REV#9 (an alpha spectrometry method)
Guidance Documents:	U.S. Department of Energy, *Evaluation of Radiochemical Data Usability*, es/er/ms-5, April 1997. U.S. Department of Energy, Environmental Measurements Laboratory, *Health and Safety Laboratory (HASL)-300 Manual*, Section 4.5.4 (Po-01-RC: alpha ray spectrometry), 28th Edition, February 1997.
Modification:	Data Flags and Reason Codes as specified in Appendix A of *Evaluation of Radiochemical Data Usability* (see Attachment A below) were used to qualify the data, with modification for the evaluation of laboratory duplicate (duplicate sample error ratio used instead of normalized absolute difference).
Clarifications:	GEL did not provide calibration data. Results were not qualified, but sample results in the project database were populated with the applicable Reason Code (C03).
Attachment A:	Validation Flags and Reason Codes
Attachment B:	Validation Worksheet

Sample Cross Reference:

No.	Field Sample Identification	Date Collected	Laboratory Sample Identification
1	101107SEAR-1-0-C(3)	10/11/2007	195901001
2	101107SEAR-2-0-C(3)	10/11/2007	195901002
3	101107SEAR-3-0-C(3)	10/11/2007	195901003
4	101107SEAR-4-0-C(3)	10/11/2007	195901004
5	101107SEAR-5-0-C(3)	10/11/2007	195901005
6	101107SEAR-6-0-C(3)	10/11/2007	195901006
7	101107SEAR-7-0-C(3)	10/11/2007	195901007
8	101107SEAR-8-0-C(3)	10/11/2007	195901008
9	101107SEAR-11-0-C(3)	10/11/2007	195901011
10	101107SEAR-12-0-C(3)	10/11/2007	195901012
11	101107SEAR-13-0-C(3)	10/11/2007	195901013
12	101107SEAR-14-0-C(3)	10/11/2007	195901014
13	101107SEAR-15-0-C(3)	10/11/2007	195901015
14	101107SEAR-16-0-C(3)	10/11/2007	195901016
15	101107SEAR-17-0-C(3)	10/11/2007	195901017
16	101107SEAR-18-0-C(3)	10/11/2007	195901018

I. Chain-of-Custody Procedure, Sample Preservation, and Holding Time

_X__ Signatures on chain(s) and all samples accounted for
_X__ ^{210}Po: collected in HDPE (polyethylene) containers

A total of 16 sediment samples were collected on October 11, 2007 in HDPE containers. All samples collected during this week were shipped in 11 coolers, and arrived at the laboratory on October 17, 2007. Sample chain-of-custody and laboratory receipt documentation appears intact. The 16 samples were prepared on October 25, 2007, and analyzed on November 1, 2007, 21 days into the 138-day half-life of ^{210}Po.

II. Instrument Calibration

____ Confirm summary report includes: dates of calibration, geometry, count times for all analysis, number of counts for each standard, measured activity for all samples
____ Confirm matrix used in geometry standard
____ Evidence of decay correction of standard prior to calculation of efficiencies, as appropriate
____ Calibration points including efficiency, energy, and peak resolution

Initial calibration data were not assessed because none was provided in the data package.

III. Calibration Verification

____ Tolerance chart or statistical control chart of the appropriate 20 efficiencies and 20 relevant peak energies with 3 F+/- limits
____ Resolution demonstration of relevant peak(s)
____ Listing of X/Y coordinates in constructing the control charts
____ Evidence of decay correction of standard prior to calculation of efficiencies, as appropriate
____ Geometries used in analysis

Calibration verification data were not assessed because none was provided in the data package.

IV. Target Compound Identification and Quantitation

_X___ Confirm all samples less than MDC are qualified not detected (U)
_X___ Less than two times the uncertainty were reported by the laboratory as not detected (U)

All sample results that were either less than two times the uncertainty were reported by the laboratory as not detected (U), or were greater than two times the uncertainty and greater than the minimum detectable concentration (MDC), with the following exceptions:

Field Sample Identification	Laboratory Sample Identification	Parameter	Result Minus 2*Uncert	Result (pCi/g)/Lab Flag	Data Validation Flag	Reason Code
101107SEAR-5-0-C(3)	195901005	^{210}Po	-0.219	0.699	UJ	Q09
101107SEAR-12-0-C(3)	195901012	^{210}Po	-0.173	0.833	UJ	Q09
101107SEAR-17-0-C(3)	195901017	^{210}Po	-0.065	0.493	UJ	Q09

The results were flagged as not detected (UJ) at the reported concentrations because they failed both the above "two times uncertainty" criterion and the blank criterion specified in Section V below.

V. Blanks

_X___ Method blank results < MDC
_X___ Calculate normalized absolute difference (NAD) =

$$\left|(\text{Sample} - \text{Blank})\right| / ([\text{Uncertainty}^2_{\text{Sample}} + \text{Uncertainty}^2_{\text{Blank}}]^{1/2})$$

_X___ If normalized absolute difference is > 2.58, no action necessary
_X___ If normalized absolute difference is between 1.96 and 2.58, qualify sample J
_____ If normalized absolute difference is less than 1.96, consider rejecting data

All normalized absolute differences (per above calculation) were greater than 2.58 for all sample results that were reportable (that is, reported as a detection above the MDC), with the following exceptions:

Field Sample Identification	Laboratory Sample Identification	Parameter	NAD	Result (pCi/g)/Lab Flag	Data Validation Flag	Reason Code
101107SEAR-4-0-C(3)	195901004	^{210}Po	2.41	1.22	J	B01
101107SEAR-5-0-C(3)	195901005	^{210}Po	1.55	0.699	UJ	B01
101107SEAR-7-0-C(3)	195901007	^{210}Po	2.39	1.10	J	B01
101107SEAR-8-0-C(3)	195901008	^{210}Po	2.13	1.07	J	B01
101107SEAR-11-0-C(3)	195901011	^{210}Po	2.28	1.21	J	B01
101107SEAR-12-0-C(3)	195901012	^{210}Po	1.69	0.833	UJ	B01
101107SEAR-13-0-C(3)	195901013	^{210}Po	2.16	0.815	J	B01
101107SEAR-14-0-C(3)	195901014	^{210}Po	2.01	0.829	J	B01
101107SEAR-15-0-C(3)	195901015	^{210}Po	2.49	1.07	J	B01
101107SEAR-16-0-C(3)	195901016	^{210}Po	2.20	0.974	J	B01
101107SEAR-17-0-C(3)	195901017	^{210}Po	1.72	0.493	UJ	B01

Field Sample Identification	Laboratory Sample Identification	Parameter	NAD	Result (pCi/g)/Lab Flag	Data Validation Flag	Reason Code
101107SEAR-18-0-C(3)	195901018	^{210}Po	2.50	1.06	J	B01

VI. Radiochemical Tracers

_X___ Must be analyzed for each sample and laboratory QC sample
_X___ Compare %R with laboratory control limits (25-125%)

All recoveries for Polonium (Po) 209 (^{209}Po) for each field sample and laboratory control samples were within control limits.

VII. Laboratory Duplicates

_X___ Must be analyzed for each batch or for every 20 samples
_X___ RPDs within the laboratory's control limits (RPD not calculated when one or both duplicate results are not detected)
_X___ Calculate the duplicate error ratio (DER)) =

$$|(\text{Sample} - \text{Duplicate})| / (2 * ([\text{Uncertainty}^2_{\text{Sample}} + \text{Uncertainty}^2_{\text{Duplicate}}]^{1/2}))$$

$$\text{DER} \leq 1.42$$

_____ If DER > 1.42, qualify sample J

The laboratory's laboratory duplicate criteria are: If duplicate activities are less than 5 times MDC, then the RPD should be less than 100%; if activities are greater than 5 times the MDC, the RPD should be less than 20%.

The RPD and DER associated with the laboratory duplicate pair was within these criteria.

VIII. Matrix Spikes

_X___ Must be analyzed for each batch or for every 20 samples
_X___ Compare %R with laboratory control limits (75-125%)

Matrix spike recovery was within the control limits.

IX. Laboratory Control Samples

_X___ Must be analyzed for each batch or for every 20 samples
_X___ Compare %R with laboratory control limits (75-125%)

Laboratory control sample recovery was within control limits.

X. Equipment and Water Blank Samples

A total of 3 equipment blanks and 3 water blanks were collected on October 11 and 12, 2007 for ^{210}Po analysis. All water blanks were not detected for both ^{210}Po, and 1 of the 3 equipment blanks was detected for ^{210}Po. Equipment blank sample 101108SEAR-10-EQ-0 contained 0.366 pci/L of ^{210}Po, which equates to 0.0732 pCi based on the 0.2L initial volume. Detections of ^{210}Po in this SDG ranged from 0.137 to 0.518 pCi. Since the amount of ^{210}Po in the equipment blank was less than that of the field samples, the field sample results were not qualified because of the equipment blank contamination.

XI. Overall Assessment of Data

With the following exceptions, all quality control data associated with the field samples were within control limits. All other field results are usable as reported by the laboratory.

Summary of Qualified Data:

Field Sample Identification	Laboratory Sample Identification	Parameter	Result (pCi/g)/Lab Flag	Data Validation Result/Flag	Reason Code
All sample results				No flag	C03
101107SEAR-4-0-C(3)	195901004	^{210}Po	1.22	J	B01
101107SEAR-5-0-C(3)	195901005	^{210}Po	0.699	UJ	B01,Q09
101107SEAR-7-0-C(3)	195901007	^{210}Po	1.10	J	B01
101107SEAR-8-0-C(3)	195901008	^{210}Po	1.07	J	B01
101107SEAR-11-0-C(3)	195901011	^{210}Po	1.21	J	B01
101107SEAR-12-0-C(3)	195901012	^{210}Po	0.833	UJ	B01,Q09
101107SEAR-13-0-C(3)	195901013	^{210}Po	0.815	J	B01
101107SEAR-14-0-C(3)	195901014	^{210}Po	0.829	J	B01
101107SEAR-15-0-C(3)	195901015	^{210}Po	1.07	J	B01
101107SEAR-16-0-C(3)	195901016	^{210}Po	0.974	J	B01
101107SEAR-17-0-C(3)	195901017	^{210}Po	0.493	UJ	B01,Q09
101107SEAR-18-0-C(3)	195901018	^{210}Po	1.06	J	B01

ATTACHMENT A
Radiochemical Data Verification and Validation: Per Appendix A in *Evaluation of Radiochemical Data Usability, es/er/ms-5* USDOE April, 1995

Flag	Definition
U	Nuclide considered not detected above the reported MDC or 2 times the uncertainty
J	Nuclide identified; the associated value is approximated
UJ	Nuclide not detected above the reported MDC or 2 times the uncertainty and a quality deficiency affects the data and impacts the uncertainty of the reported data
R	Result is not usable for its intended purpose

Reason Code	Definition
Method Blank	
B01	Concentration of contaminant in the method blank at a level ≥ the qualification level
B02	Method blank was not the same matrix as the analytical samples
B03	Gross contamination exists
B04	Blanks were not analyzed at the appropriate frequency
B05	Sample not significantly different than radiochemical method blank
B06	Blank data not reports
B07	Other (describe in comments)
Calibration	
C01	Initial calibration sequence was not followed as appropriate
C02	Calibration was not performed at the appropriate frequency
C03	Calibration data not reported
C04	Calibration not performed
C05	Chemical resolution criteria were not satisfied
C06	Standard curve was established with fewer than the required number of standards
C07	Instrumental system determined to be out of control
C08	Other (describe in comments)
Laboratory Duplicate	
D01	Significant difference between sample and duplicate
D02	Laboratory duplicate was not analyzed at the appropriate frequency
D03	Laboratory duplicate data was not reported
D04	Other (describe in comments)
Evidentiary Concerns	
E01	Custody of sample in question
E02	Standard not traceable
E03	Other (describe in comments)
General	
G01	Professional judgment was used to qualify the data
G02	Other (describe in comments)
Holding Times	
H01	Holding times were exceeded
H02	Holding times were grossly exceeded
H03	Samples were not preserved properly
H04	Other (describe in comments)
Laboratory Control Sample	
L01	LCS recovery above upper control limit
L02	LCS recovery below lower control limit
L03	LCS was not analyzed at appropriate frequency
L04	LCS not the same matrix as the analytical samples

Reason Code	Definition
L05	LCS data not reported
L06	Other (describe in comments)
Matrix Spike and MS/MSD	
M01	MS recovery above upper control limit
M02	MS recovery below lower control limit
M03	MS not analyzed at the appropriate frequency
M04	MS data not reported
M05	Other (describe in comments)
Instrument Performance	
P01	High background levels or a shift in the energy calibration were observed
P02	Extraneous peaks were observed
P03	Loss of resolution was observed
P04	Peak-tailing or peak splitting that may result in inaccurate quantitation were observed
P05	Instrument performance not analyzed at the appropriate frequency
P06	Other (describe in comments)
Quantitation	
Q01	Peak misidentified
Q02	Target analyte affected by interfering peak
Q03	Qualitative criteria were not satisfied
Q04	Cross contamination occurred
Q05	No raw data were provided to confirm Quantitation
Q06	MDC > RDL
Q07	Inappropriate aliquot sizes were used
Q08	Sample result < MDC
Q09	Sample result < 2s uncertainty
Q10	Negative result
Q11	Compounds were not adequately resolved
Q12	Sample weight different from calibration geometry
Q13	Sample weight greater than greatest weight on mass attenuation curve
Q14	Other (describe in comments)
Radiochemical Yield	
Y01	Radiochemical tracer yield was above the upper control limit
Y02	Radiochemical tracer yield was below the lower control limit
Y03	Radiochemical tracer yield was zero
Y04	Radiochemical yield data was not present
Y05	Other (describe in comments)

ATTACHMENT B: DATA VALIDATION_WORKSHEET
GEL SDG 195901
CERCLA 2ND 5-YEAR REVIEW_SEDIMENT 2007
MONSANTO
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									Data Validation					
Sample_No	Lab_Id	Assoc_Blnk	Sample_Type	Parameter	Lab_Result	Uncertainty	Lab_Qual	MDC	Result-MDC	Result-2*Unc	Dval_MB	Dval_DER	Qual	ReasonCode
101107SEAR-1-0-C(3)	195901001	1201443973	SAMPLE	Polonium-210	2.42	0.703		0.503	1.917	1.014	3.44	0.49		C03
101107SEAR-2-0-C(3)	195901002	1201443973	SAMPLE	Polonium-210	1.47	0.562		0.450	1.020	0.346	2.62			C03
101107SEAR-3-0-C(3)	195901003	1201443973	SAMPLE	Polonium-210	1.84	0.632		0.518	1.322	0.576	2.91			C03
101107SEAR-4-0-C(3)	195901004	1201443973	SAMPLE	Polonium-210	1.22	0.506		0.413	0.807	0.208	2.41		J	B01,C03
101107SEAR-5-0-C(3)	195901005	1201443973	SAMPLE	Polonium-210	0.699	0.459		0.624	0.075	-0.219	1.55		UJ	Q09,B01,C03
101107SEAR-6-0-C(3)	195901006	1201443973	SAMPLE	Polonium-210	0.144	0.304	U	0.576	-0.432	-0.464	0.57			C03
101107SEAR-7-0-C(3)	195901007	1201443973	SAMPLE	Polonium-210	1.10	0.459		0.403	0.697	0.182	2.39		J	B01,C03
101107SEAR-8-0-C(3)	195901008	1201443973	SAMPLE	Polonium-210	1.07	0.506		0.488	0.582	0.058	2.13		J	B01,C03
101107SEAR-11-0-C(3)	195901011	1201443973	SAMPLE	Polonium-210	1.21	0.534		0.526	0.684	0.142	2.28		J	B01,C03
101107SEAR-12-0-C(3)	195901012	1201443973	SAMPLE	Polonium-210	0.833	0.503		0.625	0.208	-0.173	1.69		UJ	Q09,B01,C03
101107SEAR-13-0-C(3)	195901013	1201443973	SAMPLE	Polonium-210	0.815	0.372		0.311	0.504	0.071	2.16		J	B01,C03
101107SEAR-14-0-C(3)	195901014	1201443973	SAMPLE	Polonium-210	0.829	0.413		0.390	0.439	0.003	2.01		J	B01,C03
101107SEAR-15-0-C(3)	195901015	1201443973	SAMPLE	Polonium-210	1.07	0.425		0.291	0.779	0.220	2.49		J	B01,C03
101107SEAR-16-0-C(3)	195901016	1201443973	SAMPLE	Polonium-210	0.974	0.443		0.421	0.553	0.088	2.20		J	B01,C03
101107SEAR-17-0-C(3)	195901017	1201443973	SAMPLE	Polonium-210	0.493	0.279		0.269	0.224	-0.065	1.72		UJ	Q09,B01,C03
101107SEAR-18-0-C(3)	195901018	1201443973	SAMPLE	Polonium-210	1.06	0.419		0.360	0.700	0.222	2.50		J	B01
MB	1201443973	1201443973	MB	Polonium-210	-0.0499	0.146	U	0.363						
101107SEAR-1-0-C(3)	1201443974	1201443973	DUP	Polonium-210	1.50	0.625		0.666						

Dupl RPD= 47

Sample_No	Coll_date	Rec_date	Ext_date	Anal_date
101107SEAR-1-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-2-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-3-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-4-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-5-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-6-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-7-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-8-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-11-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-12-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-13-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-14-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-15-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-16-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-17-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
101107SEAR-18-0-C(3)	10/11/07	10/17/07	10/25/07	11/01/07
MB	11/01/07	11/01/07	11/01/07	11/01/07
101107SEAR-1-0-C(3)	11/01/07	11/01/07	11/01/07	11/01/07

					Sample			
Equipment Rinsate detection					Conc.,pCi/g	Initial Wt, g	Amt, pCi	Sort
101107SEAR-10-EQ-0 (10/11/2007)					2.42	0.214	0.518	0.137
Polonium-210					1.47	0.288	0.423	0.145
					1.84	0.209	0.385	0.176
Result	0.366	pCi/L			1.22	0.212	0.259	0.178
Initial Vol	0.2	L			0.699	0.208	0.145	0.188
Amount	0.0732	pCi			0.144U	0.232	ND	0.211
					1.10	0.226	0.249	0.222
					1.07	0.197	0.211	0.236
					1.21	0.209	0.253	0.249
					0.833	0.211	0.176	0.253
Sample Range (pCi):					0.815	0.219	0.178	0.259
0.137-0.518					0.829	0.227	0.188	0.278
					1.07	0.221	0.236	0.385
					0.974	0.228	0.222	0.423
					0.493	0.277	0.137	0.518
					1.06	0.262	0.278	ND

MWH Client: Monsanto Company

MWH Project Name: CERCLA 2nd 5-Year Review

MWH Project Number: 1010076.011601

Laboratory: GEL Laboratories, LLC (Charleston, SC)

Data packages: Sample Delivery Group (SDG) Number 195904

Methods: Total arsenic, cadmium, copper, nickel, selenium, silver, and vanadium by EPA Method 6020

Guidance: USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, October 2004, ICP-AES and ICP-MS

Modification: Data validator evaluated blank contamination as defined in the Inorganic Data Assessment Summary of the P4 Production Southeast Idaho Mine-Specific Selenium Program "Comprehensive Site Investigation, Sampling and Analysis Plan" (MWH, 2004)

Sample Cross Reference:

Field Sample Identification	Date Collected	Laboratory Sample Identification
101207SEMSC-1-0-C(3)	10/12/07	195904001
101207SEMSC-2-0-C(3)	10/12/07	195904002
101207SEMSC-3-0-C(3)	10/12/07	195904003
101207SEMSC-4-0-C(3)	10/12/07	195904004
101207SEMSC-5-0-C(3)	10/12/07	195904005
101207SEMSC-6-0-C(3)	10/12/07	195904006
101207SEMSC-7-0-C(3)	10/12/07	195904007
101207SEMSC-9-0-C(3)	10/12/07	195904009
101207SEMSC-10-0-C(3)	10/12/07	195904010

I. Holding Times

__X__ ICP/GFAA metals completed in <6 months from collection
_____ Mercury analyzed in <28 days from collection
_____ Chloride, fluoride, sulfate completed in <28 days from collection
_____ TSS and TDS completed within 7 days from collection
_____ O-phosphorus completed within 48 hours from collection
_____ Nitrate-nitrite as N completed within 48 hours
_____ Alkalinity completed within 14 days from collection
_____ pH completed within 24 hours from collection
_____ Sample analyzed outside recommended hold time, estimated (J/UJ)

_____ Sample analyzed > 2x recommended hold time, unusable (R/UR)

A total of nine sediment samples were submitted to GEL Laboratories, LLC (Charleston, SC) for metals analysis. The samples were collected October 11, 2007 and were received at the laboratory on October 17, 2007. The cooler temperatures ranged from 13 °C to 19 °C when they arrived at the lab, which is outside of the recommended temperature criteria of 4 ± 2 °C. Metals are not impacted by the elevated temperature, so no data were qualified. All samples were extracted and analyzed within the EPA recommended hold times.

II. Initial Calibration

Initial Calibration
__X__ IC correlation coefficient ≥ 0.995
_____ IC correlation coefficient < 0.995, results > MDL estimated (J); < MDL unusable (R)

Initial Calibration Verification
__X__ ICV %R 90 - 110, results acceptable
_____ ICV %R 75-89, results > MDL estimated (J); < MDL estimated (UJ)
_____ ICV %R < 75, results > MDL estimated (J); < MDL unusable (R)
_____ ICV %R 111-160 results > MDL estimated (J)
_____ ICV %R > 160, results > MDL unusable (R)

ICP-MS Tune Analysis (check all that apply):
__X__ Tune %RSD for all analytes <5%, mass calibration within 0.1 amu
_____ Tune not performed, all results unusable (R/UR)
_____ Tune not performed properly, results estimated (J/UJ)
_____ Mass calibration not within 0.1 amu, results estimated (J/UJ)
_____ %RSD>5%, results estimated (J/UJ)

All initial calibration data were within method-established control limits.

III. Calibration Verification

__X__ CCV %R 90 - 110, results acceptable
_____ CCV %R 75-89, results > MDL estimated (J); < MDL estimated (UJ)
_____ CCV %R < 75, results > MDL estimated (J); < MDL unusable (UR)
_____ CCV %R 111-160 results > MDL estimated (J)
_____ CCV %R > 160, results > MDL unusable (R)

All continuing verification data were within method-established control limits.

IV. Blanks

_____ Target analyte detected in ICB/CCB
_____ Target analyte detected in preparation blank
_____ Target analyte detected in field blank
_____ Target analyte detects ≤ 5x blank result qualified as not detected at sample concentration (U).

Copper was detected in one preparation blank associated with one sample (batch 695411). The blank contamination was considered negligible (defined as less than 20 percent of the lowest sample value), so the data were not qualified.

V. Interference Checks

_____ ICS A/B Recoveries Acceptable
_____ Al, Ca, Fe, Mg sample concentrations >ICS concentrations
_____ ICS %R> 120%, results > MDL estimated (J)
_____ ICS %R 50-79%, results >MDL estimated (J), possible false negative
_____ ICS %R 50-79%, results < MDL estimated (UJ)
_____ ICS %R <50%, results > MDL and <MDL rejected (R/UR)
_____ ICS %R>120, results < MDL acceptable

No interference check sample was reported for this SDG.

VI. Laboratory Control Samples

__X__ LCS %R 80-120 (Ag, Sb no limits)
_____ LCS %R 50-79% or >120%, results estimated (UJ/J)
_____ LCS %R > 150% and all results rejected (R)
_____ LCS %R < 50%, results < MDL rejected (R), detections estimated (J)

All recoveries and relative percent differences for LCS/LCSD pairs were within control limits.

VII. Duplicate Sample Analysis

_____ Duplicate RPD ≤20% for waters (≤35% for soils) for results >5X PQL
_____ Duplicate range is within ±PQL (±2xPQL for soils) for results ≤ 5X PQL
__X__ Qualify positive results estimated (J) if the above criteria were not met.

Three laboratory duplicate RPDs associated with the metals analysis of project sample 101207SEMSC-1-0-C(3) were greater than the control limit for arsenic, nickel, and vanadium. Nickel and vanadium were qualified as estimated (J). Arsenic was not detected in the sample at a concentration greater than five times the PQL, so the result was not qualified.

One laboratory duplicate RPD associated with the metals analysis of project sample 101207SEMSC-4-0-C(3) was greater than the control limit for cadmium. Cadmium was qualified as estimated (J).

VIII. Matrix Spikes/Matrix Spike Duplicates and Analytical/Post Digestion Spikes

_____ Spike %R within 75-125%
__X__ Spike %R 30-74%, >125%, results > MDL estimated (J)
_____ Spike %R 30-74% results < MDL estimated (UJ)
_____ Spike %R <30%, results < MDL rejected (R)
_____ Field blank used for spike analysis

_____ Spike %R >125%, results < MDL acceptable
_____ Sample concentration exceeds spike concentration by a factor of > 4x, acceptable

The MS/MSD percent recoveries associated with the metals analysis of project sample 101207SEMSC-1-0-C(3) were greater than the control limit for arsenic, nickel, and vanadium. Additionally, the MS/MSD RPD was greater than the control limit for nickel. Arsenic, nickel, and vanadium were qualified as estimated (J) in the parent sample.

The MS and/or MSD percent recoveries associated with the metals analysis of project sample 101207SEMSC-4-0-C(3) were outside control limits for arsenic, cadmium, and copper. All three metals were qualified as estimated (J) in the parent sample.

IX. Serial Dilutions

_____ Sample concentration > 50x MDL and %D < 10, result acceptable
__X__ Sample concentration > 50x MDL and %D > 10, results > MDL estimated (J)
_____ Sample concentration > 50x MDL and %D > 10, results < MDL estimated (UJ)

One %D associated with the serial dilution of project sample 101207SEMSC-1-0-C(3) was greater than the control limit for arsenic. Arsenic was qualified as estimated (J).

X. Field Duplicates

_____ Field duplicate RPD ≤20% waters (≤35% for soils)
_____ Field duplicate range is within ±CRDL (±2x CRDL for soils) for results <5xCRDL

Note: There are no qualification requirements for field QC samples exceeding limits.

No field duplicates were collected for this SDG.

XI. Overall Assessment of Data

With the exceptions of the out-of-control results specified herein, all quality control data associated with the field samples were within control limits. With the exception of the qualified data summarized below, none of the out-of-control data resulted in the qualification of field data. All field results are usable as reported by the laboratory.

Summary of Qualified Data:

Field Sample Identification	Laboratory Sample Identification	Parameter	Result / Lab Flag (mg/kg)	Data Validation Result / Flag (mg/kg)	Reason Code[a]
101207SEMSC-1-0-C(3)	195904001	Arsenic	3.24	3.24 J	08, 09
101207SEMSC-1-0-C(3)	195904001	Nickel	16.1	16.1 J	07, 08
101207SEMSC-1-0-C(3)	195904001	Vanadium	32.3	32.3 J	07, 08
101207SEMSC-4-0-C(3)	195904004	Arsenic	63.9	63.9 J	08
101207SEMSC-4-0-C(3)	195904004	Cadmium	40.3	40.3 J	07, 08
101207SEMSC-4-0-C(3)	195904004	Copper	12.1	12.1 J	08

[a] See definitions on last page of this report

Definitions:

QC Sample Type Cross-Reference:

ACZ Acronym	EPA Method Acronym	Definition
AS/ ASD		Analytical Spike / Analytical Spike Duplicate (Post Digestion)
CCB	Calibration Blank	Continuing Calibration Blank
CCV	CAL	Continuing Calibration Verification Standard
DUP	LD1 and LD2	Laboratory Sample Duplicate
ICB	Calibration Blank	Initial Calibration Blank
ICV	IPC Solution	Initial Calibration Verification
ICSAB	SIC Solution	Inter-element Correction Standard
LCSS/ LCSSD		Laboratory Control Sample / Laboratory Control Sample Duplicate (Soil)
LCSW/ LCSWD		Laboratory Control Sample / Laboratory Control Sample Duplicate (Water)
LFB	LFB (LCS)	Laboratory Fortified Blank
LFM/ LFMD	LFM/ LFMD	Laboratory Fortified Matrix / Laboratory Fortified Matrix Duplicate
LRB	LRB	Laboratory Reagent Blank
MS/MSD		Matrix Spike / Matrix Spike Duplicate
PBS/PBW		Prep Blank – Soil / Prep Blank -Water
PQV	CRQL	Practical Quantitation Verification Standard
SDL		Serial Dilution

Qualifiers:

Reason Code	Definition
01	Hold time or sample receipt non-conformance
02	Initial calibration non-conformance
03	Continuing calibration outside control limit
04	Blank contamination
05	Interference check sample recovery outside control limit
06	Laboratory control sample / duplicate recovery or RPD outside control limit
07	Laboratory duplicate is outside control limit
08	Matrix spike / duplicate recovery or RPD outside control limit
09	Serial dilution percent difference outside control limit

MWH Client:	Monsanto Company
MWH Project Name:	CERCLA 2nd 5-Year Review
MWH Project Number:	1010076.011701
Laboratory:	GEL Laboratories, LLC (Charleston, SC)
Data packages:	Sample Delivery Group (SDG) Number 195904
Analytical Batches:	694903
Method:	Polonium (Po) 210 (^{210}Po) by EML HASL 300, Po-01-RC and per the laboratory's SOP GL-RAD-A-016 REV#9 (an alpha spectrometry method)
Guidance Documents:	U.S. Department of Energy, *Evaluation of Radiochemical Data Usability*, es/er/ms-5, April 1997. U.S. Department of Energy, Environmental Measurements Laboratory, *Health and Safety Laboratory (HASL)-300 Manual*, Section 4.5.4 (Po-01-RC: alpha ray spectrometry), 28th Edition, February 1997.
Modification:	Data Flags and Reason Codes as specified in Appendix A of *Evaluation of Radiochemical Data Usability* (see Attachment A below) were used to qualify the data, with modification for the evaluation of laboratory duplicate (duplicate sample error ratio used instead of normalized absolute difference).
Clarifications:	GEL did not provide calibration data. Results were not qualified, but sample results in the project database were populated with the applicable Reason Code (C03).
Attachment A:	Validation Flags and Reason Codes
Attachment B:	Validation Worksheet

Sample Cross Reference:

No.	Field Sample Identification	Date Collected	Laboratory Sample Identification
1	101207SEMSC-1-0-C(3)	10/12/2007	195904001
2	101207SEMSC-2-0-C(3)	10/12/2007	195904002
3	101207SEMSC-3-0-C(3)	10/12/2007	195904003
4	101207SEMSC-4-0-C(3)	10/12/2007	195904004
5	101207SEMSC-5-0-C(3)	10/12/2007	195904005
6	101207SEMSC-6-0-C(3)	10/12/2007	195904006
7	101207SEMSC-7-0-C(3)	10/12/2007	195904007
8	101207SEMSC-9-0-C(3)	10/12/2007	195904009
9	101207SEMSC-10-0-C(3)	10/12/2007	195904010

I. Chain-of-Custody Procedure, Sample Preservation, and Holding Time

_X__ Signatures on chain(s) and all samples accounted for
_X__ ^{210}Po: collected in HDPE (polyethylene) containers

A total of 9 sediment samples were collected on October 12, 2007 in HDPE containers. All samples collected during this week were shipped in 11 coolers, and arrived at the laboratory on October 17, 2007. Sample chain-of-custody and laboratory receipt documentation appears intact. The 9 samples were prepared on October 25, 2007, and analyzed on November 1, 2007, 20 days into the 138-day half-life of ^{210}Po.

II. Instrument Calibration

____ Confirm summary report includes: dates of calibration, geometry, count times for all analysis, number of counts for each standard, measured activity for all samples
____ Confirm matrix used in geometry standard
____ Evidence of decay correction of standard prior to calculation of efficiencies, as appropriate
____ Calibration points including efficiency, energy, and peak resolution

Initial calibration data were not assessed because none was provided in the data package.

III. Calibration Verification

____ Tolerance chart or statistical control chart of the appropriate 20 efficiencies and 20 relevant peak energies with 3 F+/- limits
____ Resolution demonstration of relevant peak(s)
____ Listing of X/Y coordinates in constructing the control charts
____ Evidence of decay correction of standard prior to calculation of efficiencies, as appropriate
____ Geometries used in analysis

Calibration verification data were not assessed because none was provided in the data package.

IV. Target Compound Identification and Quantitation

_X___ Confirm all samples less than MDC are qualified not detected (U)
_X___ Less than two times the uncertainty were reported by the laboratory as not detected (U)

All sample results that were either less than two times the uncertainty were reported by the laboratory as not detected (U), or were greater than two times the uncertainty and greater than the minimum detectable concentration (MDC), with the following exception:

Field Sample Identification	Laboratory Sample Identification	Parameter	Result Minus 2*Uncert	Result (pCi/g)/Lab Flag	Data Validation Flag	Reason Code
101207SEMSC-10-0-C(3)	195904010	^{210}Po	-0.116	0.558	UJ	Q09

The result was flagged as not detected (UJ) at the reported concentration because it failed both the above "two times uncertainty" criterion and the blank criterion specified in Section V below.

V. Blanks

_X___ Method blank results < MDC
_X___ Calculate normalized absolute difference (NAD) =

$$|(\text{Sample} - \text{Blank})| / ([TPU^2_{Sample} + TPU^2_{Blank}]^{1/2})$$

_X___ If normalized absolute difference is > 2.58, no action necessary
_X___ If normalized absolute difference is between 1.96 and 2.58, qualify sample J
_____ If normalized absolute difference is less than 1.96, consider rejecting data

All normalized absolute differences (per above calculation) were greater than 2.58 for all sample results that were reportable (that is, reported as a detection above the MDC), with the following exception:

Field Sample Identification	Laboratory Sample Identification	Parameter	NAD	Result (pCi/g)/Lab Flag	Data Validation Flag	Reason Code
101207SEMSC-1-0-C(3)	195904001	^{210}Po	2.29	0.925	J	B01
101207SEMSC-4-0-C(3)	195904004	^{210}Po	2.29	0.976	J	B01
101207SEMSC-10-0-C(3)	195904010	^{210}Po	1.55	0.558	UJ	B01

VI. Chemical Tracers

_X___ Must be analyzed for each sample and laboratory QC sample
_X___ Compare %R with laboratory control limits (25-125%)

All recoveries for Polonium (Po) 209 (^{209}Po) for each field sample and laboratory control samples were within control limits.

VII. Laboratory Duplicates

_X___ Must be analyzed for each batch or for every 20 samples
_X___ RPDs within the laboratory's control limits (RPD not calculated when one or both duplicate results are not detected)
_X___ Calculate the duplicate error ratio (DER)) =

$$|(\text{Sample} - \text{Duplicate})| / (2 * ([\text{Uncertainty}^2_{Sample} + \text{Uncertainty}^2_{Duplicate}]^{1/2}))$$

$$DER \leq 1.42$$

_____ If DER > 1.42, qualify sample J

The laboratory's laboratory duplicate criteria are: If duplicate activities are less than 5 times MDC, then the RPD should be less than 100%; if activities are greater than 5 times the MDC, the RPD should be less than 20%.

The RPD and DER associated with the laboratory duplicate pair was within these criteria.

VIII. Matrix Spikes

_X___ Must be analyzed for each batch or for every 20 samples
_X___ Compare %R with laboratory control limits (75-125%)

Matrix spike recovery was within the control limits.

IX. Laboratory Control Samples

_X___ Must be analyzed for each batch or for every 20 samples
_X___ Compare %R with laboratory control limits (75-125%)

Laboratory control sample recovery was within control limits.

X. Equipment and Water Blank Samples

A total of 3 equipment blanks and 3 water blanks were collected on October 11 and 12, 2007 for ^{210}Po analysis. All water blanks were not detected for both ^{210}Po, and 1 of the 3 equipment blanks was detected for ^{210}Po. Equipment blank sample 101108SEAR-10-EQ-0 contained 0.366 pci/L of ^{210}Po, which equates to 0.0732 pCi based on the 0.2L initial volume. Detections of ^{210}Po in this SDG ranged from 0.112 to 0.340 pCi. Since the amount of ^{210}Po in the equipment blank was less than that of the field samples, the field sample results were not qualified because of the equipment blank contamination.

XI. Overall Assessment of Data

With the following exceptions, all quality control data associated with the field samples were within control limits. All other field results are usable as reported by the laboratory.

Summary of Qualified Data:

Field Sample Identification	Laboratory Sample Identification	Parameter	Result (pCi/g)/Lab Flag	Data Validation Result/Flag	Reason Code
All sample results				No flag	C03
101207SEMSC-1-0-C(3)	195904001	^{210}Po	0.925	J	B01
101207SEMSC-4-0-C(3)	195904004	^{210}Po	0.976	J	B01
101207SEMSC-10-0-C(3)	195904010	^{210}Po	0.558	UJ	B01,Q09

ATTACHMENT A
Radiochemical Data Verification and Validation: Per Appendix A in *Evaluation of Radiochemical Data Usability, es/er/ms-5* USDOE April, 1995

Flag	Definition
U	Nuclide considered not detected above the reported MDC or 2 times the uncertainty
J	Nuclide identified; the associated value is approximated
UJ	Nuclide not detected above the reported MDC or 2 times the uncertainty and a quality deficiency affects the data and impacts the uncertainty of the reported data
R	Result is not usable for its intended purpose

Reason Code	Definition
Method Blank	
B01	Concentration of contaminant in the method blank at a level ≥ the qualification level
B02	Method blank was not the same matrix as the analytical samples
B03	Gross contamination exists
B04	Blanks were not analyzed at the appropriate frequency
B05	Sample not significantly different than radiochemical method blank
B06	Blank data not reports
B07	Other (describe in comments)
Calibration	
C01	Initial calibration sequence was not followed as appropriate
C02	Calibration was not performed at the appropriate frequency
C03	Calibration data not reported
C04	Calibration not performed
C05	Chemical resolution criteria were not satisfied
C06	Standard curve was established with fewer than the required number of standards
C07	Instrumental system determined to be out of control
C08	Other (describe in comments)
Laboratory Duplicate	
D01	Significant difference between sample and duplicate
D02	Laboratory duplicate was not analyzed at the appropriate frequency
D03	Laboratory duplicate data was not reported
D04	Other (describe in comments)
Evidentiary Concerns	
E01	Custody of sample in question
E02	Standard not traceable
E03	Other (describe in comments)
General	
G01	Professional judgment was used to qualify the data
G02	Other (describe in comments)
Holding Times	
H01	Holding times were exceeded
H02	Holding times were grossly exceeded
H03	Samples were not preserved properly
H04	Other (describe in comments)
Laboratory Control Sample	
L01	LCS recovery above upper control limit
L02	LCS recovery below lower control limit

Reason Code	Definition
L03	LCS was not analyzed at appropriate frequency
L04	LCS not the same matrix as the analytical samples
L05	LCS data not reported
L06	Other (describe in comments)
Matrix Spike and MS/MSD	
M01	MS recovery above upper control limit
M02	MS recovery below lower control limit
M03	MS not analyzed at the appropriate frequency
M04	MS data not reported
M05	Other (describe in comments)
Instrument Performance	
P01	High background levels or a shift in the energy calibration were observed
P02	Extraneous peaks were observed
P03	Loss of resolution was observed
P04	Peak-tailing or peak splitting that may result in inaccurate quantitation were observed
P05	Instrument performance not analyzed at the appropriate frequency
P06	Other (describe in comments)
Quantitation	
Q01	Peak misidentified
Q02	Target analyte affected by interfering peak
Q03	Qualitative criteria were not satisfied
Q04	Cross contamination occurred
Q05	No raw data were provided to confirm Quantitation
Q06	MDC > RDL
Q07	Inappropriate aliquot sizes were used
Q08	Sample result < MDC
Q09	Sample result < 2s uncertainty
Q10	Negative result
Q11	Compounds were not adequately resolved
Q12	Sample weight different from calibration geometry
Q13	Sample weight greater than greatest weight on mass attenuation curve
Q14	Other (describe in comments)
Radiochemical Yield	
Y01	Radiochemical tracer yield was above the upper control limit
Y02	Radiochemical tracer yield was below the lower control limit
Y03	Radiochemical tracer yield was zero
Y04	Radiochemical yield data was not present
Y05	Other (describe in comments)

ATTACHMENT B: DATA VALIDATION_WORKSHEET
GEL SDG 195904
CERCLA 2ND 5-YEAR REVIEW_SEDIMENT 2007
MONSANTO
(Page 1 of 1)

										Data Validation					
Sample_No	Lab_Id	Assoc_Blnk	Sample_Type	Parameter	Lab_Result	Uncertainty	Lab_Qual	MDL		Result-MDA	Result-2*Unc	Dval_MB	Dval_DER	Qual	ReasonCode
101207SEMSC-1-0-C(3)	195904001	1201443977	SAMPLE	Polonium-210	0.925	0.387		0.326		0.599	0.151	2.29	0.09	J	B01,C03
101207SEMSC-2-0-C(3)	195904002	1201443977	SAMPLE	Polonium-210	0.317	0.350	U	0.567		-0.250	-0.383	0.82			C03
101207SEMSC-3-0-C(3)	195904003	1201443977	SAMPLE	Polonium-210	1.62	0.506		0.304		1.316	0.608	3.12			C03
101207SEMSC-4-0-C(3)	195904004	1201443977	SAMPLE	Polonium-210	0.976	0.483		0.559		0.417	0.010	1.95		J	B01,C03
101207SEMSC-5-0-C(3)	195904005	1201443977	SAMPLE	Polonium-210	1.42	0.447		0.311		1.109	0.526	3.08			C03
101207SEMSC-6-0-C(3)	195904006	1201443977	SAMPLE	Polonium-210	1.17	0.398		0.297		0.873	0.374	2.83			C03
101207SEMSC-7-0-C(3)	195904007	1201443977	SAMPLE	Polonium-210	1.35	0.484		0.376		0.974	0.382	2.71			C03
101207SEMSC-9-0-C(3)	195904009	1201443977	SAMPLE	Polonium-210	1.62	0.488		0.359		1.261	0.644	3.24			C03
101207SEMSC-10-0-C(3)	195904010	1201443977	SAMPLE	Polonium-210	0.558	0.337		0.419		0.139	-0.116	1.55		UJ	Q09,B01,C03
MB	1201443977	1201443977	MB	Polonium-210	0.0247	0.0696	U	0.157							
101207SEMSC-1-0-C(3)	1201443978	1201443977	DUP	Polonium-210	1.02	0.368		0.251							

Dupl RPD= -10

Sample_No	Coll_date	Rec_date	Ext_date	Anal_date
101207SEMSC-1-0-C(3)	10/12/07	10/17/07	10/25/07	10/31/07
101207SEMSC-2-0-C(3)	10/12/07	10/17/07	10/25/07	10/31/07
101207SEMSC-3-0-C(3)	10/12/07	10/17/07	10/25/07	10/31/07
101207SEMSC-4-0-C(3)	10/12/07	10/17/07	10/25/07	11/02/07
101207SEMSC-5-0-C(3)	10/12/07	10/17/07	10/25/07	10/31/07
101207SEMSC-6-0-C(3)	10/12/07	10/17/07	10/25/07	10/31/07
101207SEMSC-7-0-C(3)	10/12/07	10/17/07	10/25/07	10/31/07
101207SEMSC-9-0-C(3)	10/12/07	10/17/07	10/25/07	10/31/07
101207SEMSC-10-0-C(3)	10/12/07	10/17/07	10/25/07	10/31/07
MB	10/31/07	10/31/07	10/31/07	10/31/07
101207SEMSC-1-0-C(3)	10/12/07	10/17/07	10/31/07	10/31/07
101207SEMSC-1-0-C(3)	10/12/07	10/17/07	10/31/07	10/31/07
LCS	10/31/07	10/31/07	10/31/07	10/31/07

Equipment Rinsate detection
101107SEAR-10-EQ-0 (10/11/2007)
Polonium-210

Result 0.366 pCi/L
Initial Vol 0.2 L
Amount 0.0732 pCi

Sample Range (pCi):
0.112-0.340

Sample Conc.,pCi/g	Initial Wt, g	Amt, pCi	Sort
0.925	0.196	0.181	0.112
0.317U	0.209	ND	0.181
1.62	0.195	0.316	0.219
0.976	0.224	0.219	0.293
1.42	0.237	0.337	0.294
1.17	0.251	0.294	0.316
1.35	0.217	0.293	0.337
1.62	0.21	0.340	0.340
0.558	0.201	0.112	ND

MWH Client: Monsanto Company

MWH Project Name: CERCLA 2nd 5-Year Review

MWH Project Number: 1010076.011601

Laboratory: GEL Laboratories, LLC (Charleston, SC)

Data packages: Sample Delivery Group (SDG) Numbers 195909 and 196021

Methods: Total arsenic, cadmium, copper, nickel, selenium, silver, and vanadium by EPA Method 6020

Guidance: USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, October 2004, ICP-AES and ICP-MS

Modification: Data validator evaluated blank contamination as defined in the Inorganic Data Assessment Summary of the P4 Production Southeast Idaho Mine-Specific Selenium Program "Comprehensive Site Investigation, Sampling and Analysis Plan" (MWH, 2004)

Sample Cross Reference:

Field Sample Identification	Date Collected	Laboratory Sample Identification
101107SEAR-10-B-U	10/11/07	195909001
101107SEAR-10-EQ-U	10/11/07	195909002
101107SEAR-9-B-U	10/11/07	195909003
101107SEAR-9-EQ-U	10/11/07	195909004
101207SEMSC-8-B-U	10/12/07	195909005
101207SEMSC-8-EQ-U	10/12/07	195909006
101207SEMSC-8-1-C(3)	10/12/07	196021001
101207SEMSC-8-2-C(3)	10/12/07	196021002
101207SEMSC-8-3-C(3)	10/12/07	196021003
101107SEAR-9-1-C(3)	10/11/07	196021005
101107SEAR-9-2-C(3)	10/11/07	196021006
101107SEAR-9-3-C(3)	10/11/07	196021007
101107SEAR-10-1-C(3)	10/11/07	196021009
101107SEAR-10-2-C(3)	10/11/07	196021010
101107SEAR-10-3-C(3)	10/11/07	196021011

I. Holding Times

__X__ ICP/GFAA metals completed in <6 months from collection
_____ Mercury analyzed in <28 days from collection
_____ Chloride, fluoride, sulfate completed in <28 days from collection
_____ TSS and TDS completed within 7 days from collection
_____ O-phosphorus completed within 48 hours from collection
_____ Nitrate-nitrite as N completed within 48 hours
_____ Alkalinity completed within 14 days from collection
_____ pH completed within 24 hours from collection
_____ Sample analyzed outside recommended hold time, estimated (J/UJ)
_____ Sample analyzed > 2x recommended hold time, unusable (R/UR)

A total of nine sediment samples were submitted to GEL Laboratories, LLC (Charleston, SC) for metals analysis. The samples were collected October 11-12, 2007 and we received at the laboratory on October 17, 2007. The cooler temperatures ranged from 13 °C to 19 °C when they arrived at the lab, which is outside of the recommended temperature criteria of 4 ± 2 °C. Metals are not impacted by the elevated temperature, so no data were qualified. All samples were extracted and analyzed within the EPA recommended hold times.

II. Initial Calibration

Initial Calibration
__X__ IC correlation coefficient ≥ 0.995
_____ IC correlation coefficient < 0.995, results > MDL estimated (J); < MDL unusable (R)

Initial Calibration Verification
__X__ ICV %R 90 - 110, results acceptable
_____ ICV %R 75-89, results > MDL estimated (J); < MDL estimated (UJ)
_____ ICV %R < 75, results > MDL estimated (J); < MDL unusable (R)
_____ ICV %R 111-160 results > MDL estimated (J)
_____ ICV %R > 160, results > MDL unusable (R)

ICP-MS Tune Analysis (check all that apply):
__X__ Tune %RSD for all analytes <5%, mass calibration within 0.1 amu
_____ Tune not performed, all results unusable (R/UR)
_____ Tune not performed properly, results estimated (J/UJ)
_____ Mass calibration not within 0.1 amu, results estimated (J/UJ)
_____ %RSD>5%, results estimated (J/UJ)

All initial calibration data were within method-established control limits.

III. Calibration Verification

__X__ CCV %R 90 - 110, results acceptable
_____ CCV %R 75-89, results > MDL estimated (J); < MDL estimated (UJ)
_____ CCV %R < 75, results > MDL estimated (J); < MDL unusable (UR)
_____ CCV %R 111-160 results > MDL estimated (J)
_____ CCV %R > 160, results > MDL unusable (R)

All continuing verification data were within method-established control limits.

IV. Blanks

_____ Target analyte detected in ICB/CCB
_____ Target analyte detected in preparation blank
__X__ Target analyte detected in field blank
__X__ Target analyte detects ≤ 5x blank result qualified as not detected at sample concentration (U).

Three sets of equipment rinsate blanks and source water blanks were collected and analyzed in GEL SDG 195909. Each pair of blanks were associated with a triplicate set of samples analyzed in SDG 196021.

The source water blank, 101207SEMSC-8-B-U, associated with the three samples collected at SEMSC-8 contained arsenic. The blank contamination was considered negligible (defined as less than 20 percent of the lowest sample value), so the data were not qualified.

The source water blank, 101107SEAR-10-B-U, associated with the three samples collected at SEAR-10 contained copper. The equipment rinsate sample, 101107SEAR-10-EQ-U contained cadmium, copper, and nickel. Cadmium was detected in the associated samples at concentrations less than five times the equipment rinsate result and was qualified as not detected at the reporting limit (U) in all three samples. Additionally the reporting limit was raised to the sample concentrations. The blank contamination for copper and nickel were considered negligible (defined as less than 20 percent of the lowest sample value), so the data were not qualified.

The equipment rinsate blank, 101107SEAR-9-EQ-U contained cadmium and copper. Cadmium was detected in the associated samples at concentrations less than five times the equipment rinsate result and was qualified as not detected at the reporting limit (U) in all three samples. Additionally the reporting limit was raised to the sample concentrations. The blank contamination for copper was considered negligible (defined as less than 20 percent of the lowest sample value), so the data were not qualified.

V. Interference Checks

_____ ICS A/B Recoveries Acceptable
_____ Al, Ca, Fe, Mg sample concentrations >ICS concentrations
_____ ICS %R> 120%, results > MDL estimated (J)
_____ ICS %R 50-79%, results >MDL estimated (J), possible false negative
_____ ICS %R 50-79%, results < MDL estimated (UJ)
_____ ICS %R <50%, results > MDL and <MDL rejected (R/UR)
_____ ICS %R>120, results < MDL acceptable

No interference check sample was reported for this SDG.

VI. Laboratory Control Samples

__X__ LCS %R 80-120 (Ag, Sb no limits)
_____ LCS %R 50-79% or >120%, results estimated (UJ/J)
_____ LCS %R > 150% and all results rejected (R)
_____ LCS %R < 50%, results < MDL rejected (R), detections estimated (J)

All recoveries and relative percent differences for LCS/LCSD pairs were within control limits.

VII. Duplicate Sample Analysis

_____ Duplicate RPD ≤20% for waters (≤35% for soils) for results >5X PQL
_____ Duplicate range is within ±PQL (±2xPQL for soils) for results ≤ 5X PQL
__X__ Qualify positive results estimated (J) if the above criteria were not met.

Three laboratory duplicate RPDs associated with the metals analysis of project sample 101207SEMSC-8-1-C(3) were greater than the control limit for arsenic, cadmium, copper, nickel, and vanadium. All five metals were qualified as estimated (J) in 101207SEMSC-8-1-C(3), 101207SEMSC-8-2-C(3), and 101207SEMSC-8-3-C(3).

VIII. Matrix Spikes/Matrix Spike Duplicates and Analytical/Post Digestion Spikes

_____ Spike %R within 75-125%
__X__ Spike %R 30-74%, >125%, results > MDL estimated (J)
_____ Spike %R 30-74% results < MDL estimated (UJ)
_____ Spike %R <30%, results < MDL rejected (R)
_____ Field blank used for spike analysis
_____ Spike %R >125%, results < MDL acceptable
_____ Sample concentration exceeds spike concentration by a factor of > 4x, acceptable

The MS/MSD percent recoveries associated with the metals analysis of project sample 101207SEMSC-8-1-C(3) were outside control limits for cadmium and nickel. Additionally, the MS/MSD RPD was greater than the control limit for cadmium. Nickel and cadmium were qualified as estimated (J) in 101207SEMSC-8-1-C(3), 101207SEMSC-8-2-C(3), and 101207SEMSC-8-3-C(3).

IX. Serial Dilutions

__X__ Sample concentration > 50x MDL and %D < 10, result acceptable
_____ Sample concentration > 50x MDL and %D > 10, results > MDL estimated (J)
_____ Sample concentration > 50x MDL and %D > 10, results < MDL estimated (UJ)

All serial dilution %Ds were with the control limits.

X. Field Duplicates

_____ Field duplicate RPD ≤20% waters (≤35% for soils)
_____ Field duplicate range is within ±CRDL (±2x CRDL for soils) for results <5xCRDL

Note: There are no qualification requirements for field QC samples exceeding limits.

The field duplicate RPD is intended to be used to evaluate sampling precision when two replicate sample volumes are collected. Since this sample was collected in triplicate, the field duplicate parameters are not applicable.

Samples 101207SEMSC-8, 101107SEAR-9, 101107SEAR-10 were collected in triplicate; an average of the three results is reported in the final data tables.

XI. Overall Assessment of Data

With the exceptions of the out-of-control results specified herein, all quality control data associated with the field samples were within control limits. With the exception of the qualified data summarized below, none of the out-of-control data resulted in the qualification of field data. All field results are usable as reported by the laboratory.

Summary of Qualified Data:

Field Sample Identification	Laboratory Sample Identification	Parameter	Result / Lab Flag (mg/kg)	Data Validation Result / Flag (mg/kg)	Reason Code[a]
101207SEMSC-8-1-C(3)	196021001	Arsenic	106	106 J	07
101207SEMSC-8-1-C(3)	196021001	Cadmium	13.0	13.0 J	07, 08
101207SEMSC-8-1-C(3)	196021001	Copper	7.50	7.50 J	07
101207SEMSC-8-1-C(3)	196021001	Nickel	98.6	98.6 J	07, 08
101207SEMSC-8-1-C(3)	196021001	Vanadium	13.0	13.0 J	07
101207SEMSC-8-2-C(3)	196021001	Arsenic	99.6	99.6 J	07
101207SEMSC-8-2-C(3)	196021001	Cadmium	17.1	17.1 J	07, 08
101207SEMSC-8-2-C(3)	196021001	Copper	9.59	9.59 J	07
101207SEMSC-8-2-C(3)	196021001	Nickel	33.3	33.3 J	07, 08
101207SEMSC-8-2-C(3)	196021001	Vanadium	105	105 J	07
101207SEMSC-8-3-C(3)	196021001	Arsenic	85.6	85.6 J	07
101207SEMSC-8-3-C(3)	196021001	Cadmium	13.7	13.7 J	07, 08
101207SEMSC-8-3-C(3)	196021001	Copper	8.84	8.84 J	07
101207SEMSC-8-3-C(3)	196021001	Nickel	24.5	24.5 J	07, 08
101207SEMSC-8-3-C(3)	196021001	Vanadium	92.2	92.2 J	07
101107SEAR-9-1-C(3)	196021005	Cadmium	2.29	2.29 U	04
101107SEAR-9-2-C(3)	196021006	Cadmium	2.59	2.59 U	04
101107SEAR-9-3-C(3)	196021007	Cadmium	2.36	2.36 U	04
101107SEAR-10-1-C(3)	196021009	Cadmium	0.791	0.791 U	04
101107SEAR-10-2-C(3)	196021010	Cadmium	0.839	0.839 U	04
101107SEAR-10-3-C(3)	196021011	Cadmium	0.672	0.672 U	04

[a] See definitions on last page of this report

Definitions:

QC Sample Type Cross-Reference:

ACZ Acronym	EPA Method Acronym	Definition
AS/ ASD		Analytical Spike / Analytical Spike Duplicate (Post Digestion)
CCB	Calibration Blank	Continuing Calibration Blank
CCV	CAL	Continuing Calibration Verification Standard
DUP	LD1 and LD2	Laboratory Sample Duplicate
ICB	Calibration Blank	Initial Calibration Blank
ICV	IPC Solution	Initial Calibration Verification
ICSAB	SIC Solution	Inter-element Correction Standard
LCSS/ LCSSD		Laboratory Control Sample / Laboratory Control Sample Duplicate (Soil)
LCSW/ LCSWD		Laboratory Control Sample / Laboratory Control Sample Duplicate (Water)
LFB	LFB (LCS)	Laboratory Fortified Blank
LFM/ LFMD	LFM/ LFMD	Laboratory Fortified Matrix / Laboratory Fortified Matrix Duplicate
LRB	LRB	Laboratory Reagent Blank
MS/MSD		Matrix Spike / Matrix Spike Duplicate
PBS/PBW		Prep Blank – Soil / Prep Blank -Water
PQV	CRQL	Practical Quantitation Verification Standard
SDL		Serial Dilution

Qualifiers:

Reason Code	Definition
01	Hold time or sample receipt non-conformance
02	Initial calibration non-conformance
03	Continuing calibration outside control limit
04	Blank contamination
05	Interference check sample recovery outside control limit
06	Laboratory control sample / duplicate recovery or RPD outside control limit
07	Laboratory duplicate is outside control limit
08	Matrix spike / duplicate recovery or RPD outside control limit
09	Serial dilution percent difference outside control limit

MWH Client:	Monsanto Company
MWH Project Name:	CERCLA 2nd 5-Year Review
MWH Project Number:	1010076.011701
Laboratory:	GEL Laboratories, LLC (Charleston, SC)
Data packages:	Sample Delivery Group (SDG) Number 195909
Analytical Batches:	694904
Method:	Polonium (Po) 210 (^{210}Po) by EML HASL 300, Po-01-RC and per the laboratory's SOP GL-RAD-A-016 REV#9 (an alpha spectrometry method)
Guidance Documents:	U.S. Department of Energy, *Evaluation of Radiochemical Data Usability*, es/er/ms-5, April 1997. U.S. Department of Energy, Environmental Measurements Laboratory, *Health and Safety Laboratory (HASL)-300 Manual*, Section 4.5.4 (Po-01-RC: alpha ray spectrometry), 28th Edition, February 1997.
Modification:	Data Flags and Reason Codes as specified in Appendix A of *Evaluation of Radiochemical Data Usability* (see Attachment A below) were used to qualify the data, with modification for the evaluation of laboratory duplicate (duplicate sample error ratio used instead of normalized absolute difference).
Clarifications:	GEL did not provide calibration data. Results were not qualified, but sample results in the project database were populated with the applicable Reason Code (C03).
Attachment A:	Validation Flags and Reason Codes
Attachment B:	Validation Worksheet

Sample Cross Reference:

No.	Field Sample Identification	Date Collected	Laboratory Sample Identification
1	101107SEAR-10-B-U	10/11/07	195909001
2	101107SEAR-10-EQ-U	10/11/07	195909002
3	101107SEAR-9-B-U	10/11/07	195909003
4	101107SEAR-9-EQ-U	10/11/07	195909004
5	101207SEMSC-8-B-U	10/12/07	195909005
6	101207SEMSC-8-EQ-U	10/12/07	195909006

I. Chain-of-Custody Procedure, Sample Preservation, and Holding Time

_X__ Signatures on chain(s) and all samples accounted for
_X__ ^{210}Po: collected in HDPE (polyethylene) containers

A total of 3 equipment blanks and 3 water blanks were collected on October 11 and 12, 2007 for ^{210}Po analysis. These field blanks were collected along with all the soil and sediment samples collected during this week, shipped in 11 coolers, and arrived at the laboratory on October 17, 2007. Sample chain-of-custody and laboratory receipt documentation appears intact. The 6 blanks were prepared and analyzed on October 29, 2007, 17 and 18 days into the 138-day half-life of ^{210}Po.

II. Instrument Calibration

____ Confirm summary report includes: dates of calibration, geometry, count times for all analysis, number of counts for each standard, measured activity for all samples
____ Confirm matrix used in geometry standard
____ Evidence of decay correction of standard prior to calculation of efficiencies, as appropriate
____ Calibration points including efficiency, energy, and peak resolution

Initial calibration data were not assessed because none was provided in the data package.

III. Calibration Verification

____ Tolerance chart or statistical control chart of the appropriate 20 efficiencies and 20 relevant peak energies with 3 F+/- limits
____ Resolution demonstration of relevant peak(s)
____ Listing of X/Y coordinates in constructing the control charts
____ Evidence of decay correction of standard prior to calculation of efficiencies, as appropriate
____ Geometries used in analysis

Calibration verification data were not assessed because none was provided in the data package.

IV. Target Compound Identification and Quantitation

_X___ Confirm all samples less than MDC are qualified not detected (U)
_X___ Less than two times the uncertainty were reported by the laboratory as not detected (U)

All sample results that were either less than two times the uncertainty were reported by the laboratory as not detected (U), or were greater than two times the uncertainty and greater than the minimum detectable concentration (MDC), with the following exception:

Field Sample Identification	Laboratory Sample Identification	Parameter	Result Minus 2*Uncert	Result (pCi/g)/Lab Flag	Data Validation Flag	Reason Code
101107SEAR-10-EQ-U	195909002	^{210}Po	-0.116	0.558	UJ	Q09

The result was flagged as not detected (UJ) at the reported concentration because it failed both the above "two times uncertainty" criterion and the blank criterion specified in Section V below.

V. Blanks

_X___ Method blank results < MDC
_X___ Calculate normalized absolute difference (NAD) =

$$|(\text{Sample} - \text{Blank})| / ([\text{Uncertainty}^2_{\text{Sample}} + \text{Uncertainty}^2_{\text{Blank}}]^{1/2})$$

_____ If normalized absolute difference is > 2.58, no action necessary
_____ If normalized absolute difference is between 1.96 and 2.58, qualify sample J
_X___ If normalized absolute difference is less than 1.96, consider rejecting data

All normalized absolute differences (per above calculation) were greater than 2.58 for all sample results that were reportable (that is, reported as a detection above the MDC), with the following exception:

Field Sample Identification	Laboratory Sample Identification	Parameter	NAD	Result (pCi/L)/Lab Flag	Data Validation Flag	Reason Code
101107SEAR-10-EQ-U	195909002	^{210}Po	1.38	0.366	UJ	B01

VI. Radiochemical Tracers

_X___ Must be analyzed for each sample and laboratory QC sample
_X___ Compare %R with laboratory control limits (25-125%)

All recoveries for Polonium (Po) 209 (^{209}Po) for each field sample and laboratory control samples were within control limits.

VII. Laboratory Duplicates

_X___ Must be analyzed for each batch or for every 20 samples
_____ RPDs within the laboratory's control limits (RPD not calculated when one or both duplicate results are not detected)
_____ Calculate the duplicate error ratio (DER)) =

$$|(\text{Sample} - \text{Duplicate})| / (2 * ([\text{Uncertainty}^2_{\text{Sample}} + \text{Uncertainty}^2_{\text{Duplicate}}]^{1/2}))$$

$$\text{DER} \leq 1.42$$

_____ If DER > 1.42, qualify sample J

The laboratory's laboratory duplicate criteria are: If duplicate activities are less than 5 times MDC, then the RPD should be less than 100%; if activities are greater than 5 times the MDC, the RPD should be less than 20%.

Laboratory duplicate results were not detected, so neither an RPDs nor a DER was calculated.

VIII. Matrix Spikes

_X___ Must be analyzed for each batch or for every 20 samples
_X___ Compare %R with laboratory control limits (75-125%)

Matrix spike recovery was within the control limits.

IX. Laboratory Control Samples

_X___ Must be analyzed for each batch or for every 20 samples
_X___ Compare %R with laboratory control limits (75-125%)

Laboratory control sample recovery was within control limits.

X. Equipment and Water Blank Samples

A total of 3 equipment blanks and 3 water blanks were collected on October 11 and 12, 2007 for ^{210}Po analysis. All water blanks were not detected for both ^{210}Po, and 1 of the 3 equipment blanks was detected for ^{210}Po. Equipment blank sample 101108SEAR-10-EQ-0 contained 0.366 pci/L of ^{210}Po, which equates to 0.0732 pCi based on the 0.2L initial volume. Detections of ^{210}Po in field samples ranged from 0.112 to 0.518 pCi (see data validation reports for GEL SDGs 195901 and 195904). Since amount of ^{210}Po in the equipment blank was less than that of the field samples and the NAD was less that 1.96 (see Section V") indicating that the detection is relatively uncertain, the field sample results were not qualified because of the equipment blank contamination.

XI. Overall Assessment of Data

With the following exceptions, all quality control data associated with the field samples were within control limits. All other field results are usable as reported by the laboratory.

Summary of Qualified Data:

Field Sample Identification	Laboratory Sample Identification	Parameter	Result (pCi/L)/Lab Flag	Data Validation Result/Flag	Reason Code
All sample results				No flag	C03
101107SEAR-10-EQ-U	195909002	^{210}Po	0.366	UJ	Q09,B01

ATTACHMENT A
Radiochemical Data Verification and Validation: Per Appendix A in *Evaluation of Radiochemical Data Usability, es/er/ms-5* USDOE April, 1995

Flag	Definition
U	Nuclide considered not detected above the reported MDC or 2 times the uncertainty
J	Nuclide identified; the associated value is approximated
UJ	Nuclide not detected above the reported MDC or 2 times the uncertainty and a quality deficiency affects the data and impacts the uncertainty of the reported data
R	Result is not usable for its intended purpose

Reason Code	Definition
Method Blank	
B01	Concentration of contaminant in the method blank at a level ≥ the qualification level
B02	Method blank was not the same matrix as the analytical samples
B03	Gross contamination exists
B04	Blanks were not analyzed at the appropriate frequency
B05	Sample not significantly different than radiochemical method blank
B06	Blank data not reports
B07	Other (describe in comments)
Calibration	
C01	Initial calibration sequence was not followed as appropriate
C02	Calibration was not performed at the appropriate frequency
C03	Calibration data not reported
C04	Calibration not performed
C05	Chemical resolution criteria were not satisfied
C06	Standard curve was established with fewer than the required number of standards
C07	Instrumental system determined to be out of control
C08	Other (describe in comments)
Laboratory Duplicate	
D01	Significant difference between sample and duplicate
D02	Laboratory duplicate was not analyzed at the appropriate frequency
D03	Laboratory duplicate data was not reported
D04	Other (describe in comments)
Evidentiary Concerns	
E01	Custody of sample in question
E02	Standard not traceable
E03	Other (describe in comments)
General	
G01	Professional judgment was used to qualify the data
G02	Other (describe in comments)
Holding Times	
H01	Holding times were exceeded
H02	Holding times were grossly exceeded
H03	Samples were not preserved properly
H04	Other (describe in comments)
Laboratory Control Sample	
L01	LCS recovery above upper control limit
L02	LCS recovery below lower control limit
L03	LCS was not analyzed at appropriate frequency
L04	LCS not the same matrix as the analytical samples

Reason Code	Definition
L05	LCS data not reported
L06	Other (describe in comments)
Matrix Spike and MS/MSD	
M01	MS recovery above upper control limit
M02	MS recovery below lower control limit
M03	MS not analyzed at the appropriate frequency
M04	MS data not reported
M05	Other (describe in comments)
Instrument Performance	
P01	High background levels or a shift in the energy calibration were observed
P02	Extraneous peaks were observed
P03	Loss of resolution was observed
P04	Peak-tailing or peak splitting that may result in inaccurate quantitation were observed
P05	Instrument performance not analyzed at the appropriate frequency
P06	Other (describe in comments)
Quantitation	
Q01	Peak misidentified
Q02	Target analyte affected by interfering peak
Q03	Qualitative criteria were not satisfied
Q04	Cross contamination occurred
Q05	No raw data were provided to confirm Quantitation
Q06	MDC > RDL
Q07	Inappropriate aliquot sizes were used
Q08	Sample result < MDC
Q09	Sample result < 2s uncertainty
Q10	Negative result
Q11	Compounds were not adequately resolved
Q12	Sample weight different from calibration geometry
Q13	Sample weight greater than greatest weight on mass attenuation curve
Q14	Other (describe in comments)
Radiochemical Yield	
Y01	Radiochemical tracer yield was above the upper control limit
Y02	Radiochemical tracer yield was below the lower control limit
Y03	Radiochemical tracer yield was zero
Y04	Radiochemical yield data was not present
Y05	Other (describe in comments)

ATTACHMENT B: DATA VALIDATION_WORKSHEET
GEL SDG 195909
CERCLA 2ND 5-YEAR REVIEW_SEDIMENT 2007
MONSANTO

										Data Validation					
Sample_No	Lab_Id	Assoc_Blnk	Sample_Type	Parameter	Lab_Result	Uncertainty	Lab_Qual	MDL		Result-MDC	Result-2*Unc	Dval_MB	Dval_DER	Qual	ReasonCode
101107SEAR-10-B-U	195909001	1201443981	SAMPLE	Polonium-210	0.158	0.164	U	0.258		-0.100	-0.170	0.79	ND		C03
101107SEAR-10-EQ-U	195909002	1201443981	SAMPLE	Polonium-210	0.366	0.241		0.316		0.050	-0.116	1.38		UJ	Q09,B01,C03
101107SEAR-9-B-U	195909003	1201443981	SAMPLE	Polonium-210	0.0384	0.0852	U	0.170		-0.132	-0.132	0.22			C03
101107SEAR-9-EQ-U	195909004	1201443981	SAMPLE	Polonium-210	0.0997	0.137	U	0.236		-0.136	-0.174	0.54			C03
101207SEMSC-8-B-U	195909005	1201443981	SAMPLE	Polonium-210	0.0992	0.160	U	0.291		-0.192	-0.221	0.48			C03
101207SEMSC-8-EQ-U	195909006	1201443981	SAMPLE	Polonium-210	-0.0158	0.143	U	0.336		-0.352	-0.302	0.16			C03
MB	1201443981	1201443981	MB	Polonium-210	0.0106	0.0903	U	0.210							
101107SEAR-10-B-U	1201443982	1201443981	DUP	Polonium-210	0.188	0.250	U	0.408							
101107SEAR-10-B-U	1201443983	1201443981	MS	Polonium-210	91	3.03		0.427							
LCS	1201443984	1201443981	LCS	Polonium-210	101	3.01		0.337							

MWH Client:	Monsanto Company
MWH Project Name:	CERCLA 2nd 5-Year Review
MWH Project Number:	1010076.011701
Laboratory:	GEL Laboratories, LLC (Charleston, SC)
Data packages:	Sample Delivery Group (SDG) Number 195921
Analytical Batches:	694893
Method:	Polonium (Po) 210 (^{210}Po) by EML HASL 300, Po-01-RC and per the laboratory's SOP GL-RAD-A-016 REV#9 (an alpha spectrometry method)
Guidance Documents:	U.S. Department of Energy, *Evaluation of Radiochemical Data Usability*, es/er/ms-5, April 1997. U.S. Department of Energy, Environmental Measurements Laboratory, *Health and Safety Laboratory (HASL)-300 Manual*, Section 4.5.4 (Po-01-RC: alpha ray spectrometry), 28th Edition, February 1997.
Modification:	Data Flags and Reason Codes as specified in Appendix A of *Evaluation of Radiochemical Data Usability* (see Attachment A below) were used to qualify the data, with modification for the evaluation of laboratory duplicate (duplicate sample error ratio used instead of normalized absolute difference).
Clarifications:	GEL did not provide calibration data. Results were not qualified, but sample results in the project database were populated with the applicable Reason Code (C03).
Attachment A:	Validation Flags and Reason Codes
Attachment B:	Validation Worksheet

Sample Cross Reference:

No.	Field Sample Identification	Date Collected	Laboratory Sample Identification
1	101207SEMSC-8-1-C(3)	10/12/07	196021001
2	101207SEMSC-8-2-C(3)	10/12/07	196021002
3	101207SEMSC-8-3-C(3)	10/12/07	196021003
4	101107SEAR-9-1-C(3)	10/11/07	196021005
5	101107SEAR-9-2-C(3)	10/11/07	196021006
6	101107SEAR-9-3-C(3)	10/11/07	196021007
7	101107SEAR-10-1-C(3)	10/11/07	196021009
8	101107SEAR-10-2-C(3)	10/11/07	196021010
9	101107SEAR-10-3-C(3)	10/11/07	196021011

I. Chain-of-Custody Procedure, Sample Preservation, and Holding Time

_X__ Signatures on chain(s) and all samples accounted for
_X__ ^{210}Po: collected in HDPE (polyethylene) containers

A total of 9 sediment samples (3 sets of triplicate samples) were collected on October 11 and 12, 2007 in HDPE containers. All samples collected during this week were shipped in 11 coolers, and arrived at the laboratory on October 17, 2007. Sample chain-of-custody and laboratory receipt documentation appears intact. The 9 samples were prepared on October 19, 2007, and analyzed on October 30, 2007, 18 and 19 days into the 138-day half-life of ^{210}Po.

II. Instrument Calibration

____ Confirm summary report includes: dates of calibration, geometry, count times for all analysis, number of counts for each standard, measured activity for all samples
____ Confirm matrix used in geometry standard
____ Evidence of decay correction of standard prior to calculation of efficiencies, as appropriate
____ Calibration points including efficiency, energy, and peak resolution

Initial calibration data were not assessed because none was provided in the data package.

III. Calibration Verification

____ Tolerance chart or statistical control chart of the appropriate 20 efficiencies and 20 relevant peak energies with 3 F+/- limits
____ Resolution demonstration of relevant peak(s)
____ Listing of X/Y coordinates in constructing the control charts
____ Evidence of decay correction of standard prior to calculation of efficiencies, as appropriate
____ Geometries used in analysis

Calibration verification data were not assessed because none was provided in the data package.

IV. Target Compound Identification and Quantitation

_X___ Confirm all samples less than MDC are qualified not detected (U)

_X___ Less than two times the uncertainty were reported by the laboratory as not detected (U)

All sample results that were either less than two times the uncertainty were reported by the laboratory as not detected (U), or were greater than two times the uncertainty and greater than the minimum detectable concentration (MDC), with the following exception:

Field Sample Identification	Laboratory Sample Identification	Parameter	Result Minus 2*Uncert	Result (pCi/g)/Lab Flag	Data Validation Flag	Reason Code
101207SEMSC-8-1-C(3)	196021001	^{210}Po	-0.031	0.915	UJ	Q09
101207SEMSC-8-2-C(3)	196021002	^{210}Po	-0.215	0.743	UJ	Q09
101107SEAR-9-1-C(3)	196021005	^{210}Po	-0.247	0.715	UJ	Q09
101107SEAR-10-1-C(3)	196021009	^{210}Po	-0.088	0.862	UJ	Q09
101107SEAR-10-2-C(3)	196021010	^{210}Po	-0.187	0.663	UJ	Q09

Some results were flagged as not detected (UJ) at the reported concentrations because they failed both the above "two times uncertainty" criterion and the blank criterion specified in Section V below.

V. Blanks

_X___ Method blank results < MDC
_X___ Calculate normalized absolute difference (NAD) =

$$|(\text{Sample} - \text{Blank})| / ([TPU^2_{Sample} + TPU^2_{Blank}]^{1/2})$$

_X___ If normalized absolute difference is > 2.58, no action necessary
_X___ If normalized absolute difference is between 1.96 and 2.58, qualify sample J
_X___ If normalized absolute difference is less than 1.96, consider rejecting data

All normalized absolute differences (per above calculation) were greater than 2.58 for all sample results that were reportable (that is, reported as a detection above the MDC), with the following exception:

Field Sample Identification	Laboratory Sample Identification	Parameter	NAD	Result (pCi/g)/Lab Flag	Data Validation Flag	Reason Code
101207SEMSC-8-1-C(3)	196021001	^{210}Po	1.86	0.915	UJ	B01
101207SEMSC-8-2-C(3)	196021002	^{210}Po	1.49	0.743	UJ	B01
101107SEAR-9-1-C(3)	196021005	^{210}Po	1.43	0.715	UJ	B01
101107SEAR-9-2-C(3)	196021006	^{210}Po	1.96	0.916	J	B01
101107SEAR-9-3-C(3)	196021007	^{210}Po	2.69	1.82	J	B01
101107SEAR-10-1-C(3)	196021009	^{210}Po	1.75	0.862	UJ	B01
101107SEAR-10-2-C(3)	196021010	^{210}Po	1.49	0.663	UJ	B01
101107SEAR-10-3-C(3)	196021011	^{210}Po	2.48	1.26	J	B01

VI. Chemical Tracers

_X___ Must be analyzed for each sample and laboratory QC sample
_X___ Compare %R with laboratory control limits (25-125%)

All recoveries for Polonium (Po) 209 (^{209}Po) for each field sample and laboratory control samples were within control limits.

VII. Laboratory Duplicates

_X___ Must be analyzed for each batch or for every 20 samples
_X___ RPDs within the laboratory's control limits (RPD not calculated when one or both duplicate results are not detected)
_X___ Calculate the duplicate error ratio (DER)) =

$$\left|(\text{Sample} - \text{Duplicate})\right| / (2 * ([\text{Uncertainty}^2_{\text{Sample}} + \text{Uncertainty}^2_{\text{Duplicate}}]^{1/2}))$$

$$\text{DER} \leq 1.42$$

_____ If DER > 1.42, qualify sample J

The laboratory's laboratory duplicate criteria are: If duplicate activities are less than 5 times MDC, then the RPD should be less than 100%; if activities are greater than 5 times the MDC, the RPD should be less than 20%.

The RPD and DER associated with the laboratory duplicate pair was within these criteria.

VIII. Matrix Spikes

_X___ Must be analyzed for each batch or for every 20 samples
_X___ Compare %R with laboratory control limits (75-125%)

Matrix spike recovery was within the control limits.

IX. Laboratory Control Samples

_X___ Must be analyzed for each batch or for every 20 samples
_X___ Compare %R with laboratory control limits (75-125%)

Laboratory control sample recovery was within control limits.

X. Equipment and Water Blank Samples

A total of 3 equipment blanks and 3 water blanks were collected on October 11 and 12, 2007 for ^{210}Po analysis. All water blanks were not detected for both ^{210}Po, and 1 of the 3 equipment blanks was detected for ^{210}Po. Equipment blank sample 101108SEAR-10-EQ-0 contained 0.366 pci/L of ^{210}Po, which equates to 0.0732 pCi based on the 0.2L initial volume. Detections of ^{210}Po in this SDG ranged from 0.134 to 0.362 pCi. Since amount of ^{210}Po in the equipment blank was less than that of the field samples, the field sample results were not qualified because of the equipment blank contamination.

XI. Overall Assessment of Data

With the following exceptions, all quality control data associated with the field samples were within control limits. All other field results are usable as reported by the laboratory.

Summary of Qualified Data:

Field Sample Identification	Laboratory Sample Identification	Parameter	Result (pCi/g)/Lab Flag	Data Validation Result/Flag	Reason Code
All sample results				No flag	C03

Field Sample Identification	Laboratory Sample Identification	Parameter	Result (pCi/g)/Lab Flag	Data Validation Result/Flag	Reason Code
101207SEMSC-8-1-C(3)	196021001	^{210}Po	0.915	UJ	Q09,B01
101207SEMSC-8-2-C(3)	196021002	^{210}Po	0.743	UJ	Q09,B01
101107SEAR-9-1-C(3)	196021005	^{210}Po	0.715	UJ	Q09,B01
101107SEAR-9-2-C(3)	196021006	^{210}Po	0.916	J	B01
101107SEAR-9-3-C(3)	196021007	^{210}Po	1.82	J	B01
101107SEAR-10-1-C(3)	196021009	^{210}Po	0.862	UJ	Q09,B01
101107SEAR-10-2-C(3)	196021010	^{210}Po	0.663	UJ	Q09,B01
101107SEAR-10-3-C(3)	196021011	^{210}Po	1.26	J	B01

ATTACHMENT A
Radiochemical Data Verification and Validation: Per Appendix A in *Evaluation of Radiochemical Data Usability, es/er/ms-5* USDOE April, 1995

Flag	Definition
U	Nuclide considered not detected above the reported MDC or 2 times the uncertainty
J	Nuclide identified; the associated value is approximated
UJ	Nuclide not detected above the reported MDC or 2 times the uncertainty and a quality deficiency affects the data and impacts the uncertainty of the reported data
R	Result is not usable for its intended purpose

Reason Code	Definition
Method Blank	
B01	Concentration of contaminant in the method blank at a level ≥ the qualification level
B02	Method blank was not the same matrix as the analytical samples
B03	Gross contamination exists
B04	Blanks were not analyzed at the appropriate frequency
B05	Sample not significantly different than radiochemical method blank
B06	Blank data not reports
B07	Other (describe in comments)
Calibration	
C01	Initial calibration sequence was not followed as appropriate
C02	Calibration was not performed at the appropriate frequency
C03	Calibration data not reported
C04	Calibration not performed
C05	Chemical resolution criteria were not satisfied
C06	Standard curve was established with fewer than the required number of standards
C07	Instrumental system determined to be out of control
C08	Other (describe in comments)
Laboratory Duplicate	
D01	Significant difference between sample and duplicate
D02	Laboratory duplicate was not analyzed at the appropriate frequency
D03	Laboratory duplicate data was not reported
D04	Other (describe in comments)
Evidentiary Concerns	
E01	Custody of sample in question
E02	Standard not traceable
E03	Other (describe in comments)
General	
G01	Professional judgment was used to qualify the data
G02	Other (describe in comments)
Holding Times	
H01	Holding times were exceeded
H02	Holding times were grossly exceeded
H03	Samples were not preserved properly
H04	Other (describe in comments)
Laboratory Control Sample	
L01	LCS recovery above upper control limit
L02	LCS recovery below lower control limit
L03	LCS was not analyzed at appropriate frequency
L04	LCS not the same matrix as the analytical samples

Reason Code	Definition
L05	LCS data not reported
L06	Other (describe in comments)
Matrix Spike and MS/MSD	
M01	MS recovery above upper control limit
M02	MS recovery below lower control limit
M03	MS not analyzed at the appropriate frequency
M04	MS data not reported
M05	Other (describe in comments)
Instrument Performance	
P01	High background levels or a shift in the energy calibration were observed
P02	Extraneous peaks were observed
P03	Loss of resolution was observed
P04	Peak-tailing or peak splitting that may result in inaccurate quantitation were observed
P05	Instrument performance not analyzed at the appropriate frequency
P06	Other (describe in comments)
Quantitation	
Q01	Peak misidentified
Q02	Target analyte affected by interfering peak
Q03	Qualitative criteria were not satisfied
Q04	Cross contamination occurred
Q05	No raw data were provided to confirm Quantitation
Q06	MDC > RDL
Q07	Inappropriate aliquot sizes were used
Q08	Sample result < MDC
Q09	Sample result < 2s uncertainty
Q10	Negative result
Q11	Compounds were not adequately resolved
Q12	Sample weight different from calibration geometry
Q13	Sample weight greater than greatest weight on mass attenuation curve
Q14	Other (describe in comments)
Radiochemical Yield	
Y01	Radiochemical tracer yield was above the upper control limit
Y02	Radiochemical tracer yield was below the lower control limit
Y03	Radiochemical tracer yield was zero
Y04	Radiochemical yield data was not present
Y05	Other (describe in comments)

ATTACHMENT B: DATA VALIDATION_WORKSHEET
GEL SDG 196021
CERCLA 2ND 5-YEAR REVIEW_SEDIMENT 2007
MONSANTO
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											Data Validation					
Sample_No	Lab_Id	Batch_No	Assoc_Blnk	Sample_Type	Parameter	Lab_Result	Uncertainty	Lab_Qual	MDL		Result-MDA	Result-2*Unc	Dval_MB	Dval_DER	Qual	ReasonCode
101207SEMSC-8-1-C(3)	196021001	694893	1201443950	SAMPLE	Polonium-210	0.915	0.473		0.564		0.351	-0.031	1.86	0.02	UJ	Q09,B01,C03
101207SEMSC-8-2-C(3)	196021002	694893	1201443950	SAMPLE	Polonium-210	0.743	0.479		0.644		0.099	-0.215	1.49		UJ	Q09,B01,C03
101207SEMSC-8-3-C(3)	196021003	694893	1201443950	SAMPLE	Polonium-210	0.616	0.438	U	0.630		-0.014	-0.260	1.35			C03
101107SEAR-9-1-C(3)	196021005	694893	1201443950	SAMPLE	Polonium-210	0.715	0.481		0.652		0.063	-0.247	1.43		UJ	Q09,B01,C03
101107SEAR-9-2-C(3)	196021006	694893	1201443950	SAMPLE	Polonium-210	0.916	0.448		0.427		0.489	0.020	1.96		J	Q09,C03
101107SEAR-9-3-C(3)	196021007	694893	1201443950	SAMPLE	Polonium-210	1.82	0.663		0.499		1.321	0.494	2.69		J	Q09,C03
101107SEAR-10-1-C(3)	196021009	694893	1201443950	SAMPLE	Polonium-210	0.862	0.475		0.502		0.360	-0.088	1.75		UJ	Q09,B01,C03
101107SEAR-10-2-C(3)	196021010	694893	1201443950	SAMPLE	Polonium-210	0.663	0.425		0.504		0.159	-0.187	1.49		UJ	Q09,B01,C03
101107SEAR-10-3-C(3)	196021011	694893	1201443950	SAMPLE	Polonium-210	1.26	0.489		0.356		0.904	0.282	2.48		J	Q09,C03
MB	1201443950	694893	1201443950	MB	Polonium-210	-0.00457	0.144	U	0.360							
101207SEMSC-8-1-C(3)	1201443951	694893	1201443950	DUP	Polonium-210	0.936	0.462		0.480							
101207SEMSC-8-1-C(3)	1201443952	694893	1201443950	MS	Polonium-210	102	3.07		0.375							
LCS	1201443953	694893	1201443950	LCS	Polonium-210	90	2.27		0.219							

Dupl RPD= -2.3

Equipment Rinsate detection
101107SEAR-10-EQ-0 (10/11/2007)
Polonium-210

Result	0.366	pCi/L
Initial Vol	0.2	L
Amount	0.0732	pCi

Sample			
Conc.,pCi/g	Initial Wt, g	Amt, pCi	Sort
0.915	0.203	0.186	0.134
0.743	0.201	0.149	0.136
0.616	0.217	0.134	0.143
0.715	0.2	0.143	0.149
0.916	0.199	0.182	0.178
1.82	0.199	0.362	0.182
0.862	0.206	0.178	0.186
0.663	0.205	0.136	0.252
1.26	0.2	0.252	0.362

Sample Range (pCi):
0.134-0.362

MWH Client: Monsanto Company

MWH Project Name: CERCLA 2nd 5-Year Review

MWH Project Number: 1010076.011601

Laboratory: ACZ Laboratories, Inc. (Steamboat Springs, CO)

Data packages: Sample Delivery Group (SDG) Number L65816

Methods: Total arsenic, cadmium, copper, nickel, selenium, silver, and vanadium by EPA Method 6020

Guidance: USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, October 2004, ICP-AES and ICP-MS

Modification: Data validator evaluated blank contamination as defined in the Inorganic Data Assessment Summary of the P4 Production Southeast Idaho Mine-Specific Selenium Program "Comprehensive Site Investigation, Sampling and Analysis Plan" (MWH, 2004)

Sample Cross Reference:

Field Sample Identification	Date Collected	Laboratory Sample Identification
101107SEAR-9-4-C(3)	10/11/07	L65816-01
101107SEAR-10-4-C(3)	10/11/07	L65816-02
101207SEMSC-8-4-C(3)	10/12/07	L65816-03

I. Holding Times

__X__ ICP/GFAA metals completed in <6 months from collection
_____ Mercury analyzed in <28 days from collection
_____ Chloride, fluoride, sulfate completed in <28 days from collection
_____ TSS and TDS completed within 7 days from collection
_____ O-phosphorus completed within 48 hours from collection
_____ Nitrate-nitrite as N completed within 48 hours
_____ Alkalinity completed within 14 days from collection
_____ pH completed within 24 hours from collection
_____ Sample analyzed outside recommended hold time, estimated (J/UJ)
_____ Sample analyzed > 2x recommended hold time, unusable (R/UR)

A total of three sediment samples were submitted to ACZ Laboratories, Inc. (ACZ) for metals analysis. The samples were collected October 11, 2007 and we received at the laboratory on October 23, 2007. The cooler temperature was 13.1 °C when it arrived at the lab, which is outside of the recommended temperature criteria of 4 ± 2 °C. Metals are not impacted.by the elevated temperature, so no data were qualified. All samples were extracted and analyzed within the EPA recommended hold times.

II. Initial Calibration

Initial Calibration
__X__ IC correlation coefficient ≥ 0.995
_____ IC correlation coefficient < 0.995, results > MDL estimated (J); < MDL unusable (R)

Initial Calibration Verification
__X__ ICV %R 90 - 110, results acceptable
_____ ICV %R 75-89, results > MDL estimated (J); < MDL estimated (UJ)
_____ ICV %R < 75, results > MDL estimated (J); < MDL unusable (R)
_____ ICV %R 111-160 results > MDL estimated (J)
_____ ICV %R > 160, results > MDL unusable (R)

ICP-MS Tune Analysis (check all that apply):
__X__ Tune %RSD for all analytes <5%, mass calibration within 0.1 amu
_____ Tune not performed, all results unusable (R/UR)
_____ Tune not performed properly, results estimated (J/UJ)
_____ Mass calibration not within 0.1 amu, results estimated (J/UJ)
_____ %RSD>5%, results estimated (J/UJ)

All initial calibration data were within method-established control limits.

III. Calibration Verification

__X__ CCV %R 90 - 110, results acceptable
_____ CCV %R 75-89, results > MDL estimated (J); < MDL estimated (UJ)
_____ CCV %R < 75, results > MDL estimated (J); < MDL unusable (UR)
_____ CCV %R 111-160 results > MDL estimated (J)
_____ CCV %R > 160, results > MDL unusable (R)

All continuing verification data were within method-established control limits.

IV. Blanks

__X__ Target analyte detected in ICB/CCB
__X__ Target analyte detected in preparation blank
_____ Target analyte detected in field blank
_____ Target analyte detects ≤ 5x blank result qualified as not detected at sample concentration (U).

Arsenic was detected in the preparation blank and two continuing calibration blanks associated with batch WG235762. Additionally, arsenic was detected in the preparation blank associated with batch WG235919. The blank contamination was considered

negligible (defined as less than 20 percent of the lowest sample value), so the data were not qualified.

Vanadium was detected in the preparation blank, the initial calibration verification blank, and two continuing calibration blanks associated with batch WG235814. The blank contamination was considered negligible (defined as less than 20 percent of the lowest sample value), so the data were not qualified.

Selenium was detected in the preparation blank associated with batch WG235762. The blank contamination was considered negligible (defined as less than 20 percent of the lowest sample value), so the data were not qualified

V. Interference Checks

_____ ICS A/B Recoveries Acceptable
_____ Al, Ca, Fe, Mg sample concentrations >ICS concentrations
_____ ICS %R> 120%, results > MDL estimated (J)
_____ ICS %R 50-79%, results >MDL estimated (J), possible false negative
_____ ICS %R 50-79%, results < MDL estimated (UJ)
_____ ICS %R <50%, results > MDL and <MDL rejected (R/UR)
_____ ICS %R>120, results < MDL acceptable

All interference check sample recoveries were within control limits.

VI. Laboratory Control Samples

__X__ LCS %R 80-120 (Ag, Sb no limits)
_____ LCS %R 50-79% or >120%, results estimated (UJ/J)
_____ LCS %R > 150% and all results rejected (R)
_____ LCS %R < 50%, results < MDL rejected (R), detections estimated (J)

All recoveries and relative percent differences for LCS/LCSD pairs were within control limits.

VII. Duplicate Sample Analysis

__X__ Duplicate RPD ≤20% for waters (≤35% for soils) for results >5X PQL
_____ Duplicate range is within ±PQL (±2xPQL for soils) for results ≤ 5X PQL
_____ Qualify positive results estimated (J) if the above criteria were not met.

All laboratory replicate RPDs were within control limits.

VIII. Matrix Spikes/Matrix Spike Duplicates and Analytical/Post Digestion Spikes

__X__ Spike %R within 75-125%
_____ Spike %R 30-74%, >125%, results > MDL estimated (J)
_____ Spike %R 30-74% results < MDL estimated (UJ)
_____ Spike %R <30%, results < MDL rejected (R)
_____ Field blank used for spike analysis

_____ Spike %R >125%, results < MDL acceptable
_____ Sample concentration exceeds spike concentration by a factor of > 4x, acceptable

All recoveries and relative percent differences for LFM/LFMD pairs were within control limits with one exception. The matrix spike recoveries associated with the metals analysis of all three project samples were outside the control limits. The matrix spike was not performed on a project sample, so no data were qualified.

IX. Serial Dilutions

_____ Sample concentration > 50x MDL and %D < 10, result acceptable
__X__ Sample concentration > 50x MDL and %D > 10, results > MDL estimated (J)
_____ Sample concentration > 50x MDL and %D > 10, results < MDL estimated (UJ)

The serial dilution percent difference associated with the analysis of arsenic in project sample 101107SEAR-9-4-C-(3) was greater than the control limit. Arsenic was qualified as estimated (J) in the sample.

X. Field Duplicates

_____ Field duplicate RPD ≤20% waters (≤35% for soils)
_____ Field duplicate range is within ±CRDL (±2x CRDL for soils) for results <5xCRDL

Note: There are no qualification requirements for field QC samples exceeding limits.

No field duplicates were collected for this SDG.

XI. Overall Assessment of Data

With the exceptions of the out-of-control results specified herein, all quality control data associated with the field samples were within control limits. With the exception of the qualified data summarized below, none of the out-of-control data resulted in the qualification of field data. All field results are usable as reported by the laboratory.

Summary of Qualified Data:

Field Sample Identification	Laboratory Sample Identification	Parameter	Result / Lab Flag (mg/kg)	Data Validation Result / Flag (mg/kg)	Reason Code[a]
101107SEAR-9-4-C(3)	L65816-01	Arsenic	5.1	5.1 J	09

[a] See definitions on last page of this report

Definitions:

QC Sample Type Cross-Reference:

ACZ Acronym	EPA Method Acronym	Definition
AS/ ASD		Analytical Spike / Analytical Spike Duplicate (Post Digestion)
CCB	Calibration Blank	Continuing Calibration Blank
CCV	CAL	Continuing Calibration Verification Standard
DUP	LD1 and LD2	Laboratory Sample Duplicate
ICB	Calibration Blank	Initial Calibration Blank
ICV	IPC Solution	Initial Calibration Verification
ICSAB	SIC Solution	Inter-element Correction Standard
LCSS/ LCSSD		Laboratory Control Sample / Laboratory Control Sample Duplicate (Soil)
LCSW/ LCSWD		Laboratory Control Sample / Laboratory Control Sample Duplicate (Water)
LFB	LFB (LCS)	Laboratory Fortified Blank
LFM/ LFMD	LFM/ LFMD	Laboratory Fortified Matrix / Laboratory Fortified Matrix Duplicate
LRB	LRB	Laboratory Reagent Blank
MS/MSD		Matrix Spike / Matrix Spike Duplicate
PBS/PBW		Prep Blank – Soil / Prep Blank -Water
PQV	CRQL	Practical Quantitation Verification Standard
SDL		Serial Dilution

Qualifiers:

Reason Code	Definition
01	Hold time or sample receipt non-conformance
02	Initial calibration non-conformance
03	Continuing calibration outside control limit
04	Blank contamination
05	Interference check sample recovery outside control limit
06	Laboratory control sample / duplicate recovery or RPD outside control limit
07	Laboratory duplicate is outside control limit
08	Matrix spike / duplicate recovery or RPD outside control limit
09	Serial dilution percent difference outside control limit