Appendix A -
Summary of Exposure Conditions
Surface Water, Sediment, Tissue

Technical Support Document:
Proposed Site-Specific Selenium Criterion, Sage and Crow Creeks, Idaho

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LIST OF ACRONYMS

ANOVA	Analysis of Variance
BAF	Bioaccumulation Factor
BCF	Bioconcentration Factors
CI	Confidence Interval
DOC	Dissolved Organic Carbon
HUC	Hydrologic Unit Code
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Fish and Game
MCT	Multiple Comparison Test
NCSS	Number Cruncher Statistical Systems
SFSCS	South Fork Sage Creek Springs
SSSC	Site-Specific Selenium Criterion
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
WDEQ	Wyoming Department of Environmental Quality
YCT	Yellowstone Cutthroat Trout

1.0 INTRODUCTION

The J.R. Simplot Company's (Simplot) Smoky Canyon phosphate mine is located in Southeastern Idaho (Figure 1). Recent investigations revealed that elevated levels of selenium are found in some surface waters and fish tissues from Hoopes Spring, Sage Creek, and Crow Creek (Figure 2). Hoopes Spring is located in Sage Valley near the mine. A chronic site-specific selenium criterion (SSSC) is being developed for Hoopes Spring and its downstream receiving waters, Sage Creek and Crow Creek, in conjunction with measures to control releases of selenium from the mine. The SSSC is being developed cooperatively with the SSSC Workgroup, which is composed of agency personnel from Idaho Department of Environmental Quality (IDEQ), Idaho Fish and Game (IDFG), U.S. Forest Service (USFS), Wyoming Department of Environmental Quality (WDEQ), U.S. Environmental Protection Agency (USEPA) headquarters, and USEPA Region 10. This Workgroup provided review and comments to define the methods and approach for the monitoring studies. The field monitoring studies represent one component of the overall approach for developing a SSSC (NewFields 2008), and are complemented by laboratory studies and supported by an ongoing literature review.

The SSSC field monitoring studies component includes monitoring in-stream ambient conditions in biotic and abiotic media. As part of the exposure characterization, surface water, sediments, benthic and periphyton tissues, and well as fish tissues were collected during five sampling events: Fall 2006, Spring 2007, Fall 2007, Spring 2008, and Fall 2008, at up to eleven locations as outlined in the Final Work Plan – *Field Monitoring Studies for Developing a Site-Specific Selenium Criterion* (NewFields 2007).

As described in the Field Monitoring Work Plan (NewFields 2007), the intent of the seasonal monitoring events was to characterize the ambient conditions of the study area. During each event, locations were sampled for a range of chemical, biological, and physical characteristics. This appendix describes the exposure conditions (i.e., chemical quality of various media documented during field monitoring). Activities conducted to monitor and evaluate existing ambient conditions included collection of water, sediment, periphyton, benthic macroinvertebrates, and fish tissue for chemical analyses of selenium concentrations. Results from these activities document selenium exposure conditions in the study area.

2.0 STUDY AREA AND MONITORING LOCATION DESCRIPTIONS

In the fall of 2006, the first SSSC field monitoring effort was implemented to characterize the chemical, biological, and physical conditions of the monitoring locations as part of a multi-seasonal monitoring effort. Following is a description of the locations visited during the five SSSC sampling events from Fall 2006 through Fall 2008.

2.1 Study Area

The waterbodies investigated are found within the Salt Subbasin, Hydrologic Unit Code (HUC) 17040105, of the Upper Snake River Basin. Three waterbody subunits of the Salt Subbasin, as defined by the Idaho Administrative Code's Water Quality Standards (IDAPA 58.01.02), are found within the area being investigated. These subunits are defined as follows:

US-8 Crow Creek – source to Idaho/Wyoming border;

US-9 Sage Creek – source to mouth; and

US-10 Deer Creek – source to mouth.

2.2 Monitoring Locations

The study area includes four background locations, one reference location, and six downstream locations (Figure 3). All of the locations represent a lotic (flowing) system. The four background locations characterize non-mining conditions within the Crow Creek drainage, while the reference location SFTC-1 (not shown) characterizes non-mining conditions in a separate drainage.

Upstream and reference locations include the following:

SFTC-1 – South Fork Tincup Creek upstream of its confluence with Tincup Creek;

CC-75 – Crow Creek upstream of Wells Canyon;

CC-150 – Crow Creek upstream of Deer Creek;

CC-350 – Crow Creek downstream of Deer Creek; and

DC-600 – Deer Creek upstream of its confluence with Crow Creek.

The remaining six locations were selected to evaluate decreasing trends in aqueous selenium concentrations with distance from the source. Downstream receiving water locations include:

HS – Hoopes Spring (near discharge);

HS-3 – Hoopes Spring channel near its confluence with Sage Creek;

LSV-2C – Sage Creek downstream of Hoopes Spring and upstream of South Fork Sage Creek;

LSV-4 – Sage Creek upstream of the confluence with Crow Creek;

CC-1A – Crow Creek downstream of Sage Creek confluence; and

CC-3A – Crow Creek downstream of CC-1A on the Simplot Meade Peak Ranch.

3.0 FIELD MONITORING – EXPOSURE CHARACTERISTICS

A single chemical sample for each media (except fish tissue which included multiple samples per location) was collected during each monitoring event in Fall 2006, Spring and Fall 2007, and Spring and Fall 2008. Three fall sampling periods and two spring sampling periods are available for analysis for most of the media at most locations. All of these data are reported in the draft interim reports that followed each field monitoring event and collectively compiled for all monitoring events in the Final Field Monitoring Data Report (NewFields 2009). Analytical data for surface water, sediment, periphyton and benthic macroinvertebrate tissue samples are provided in Attachment 1.

Data were analyzed using a series of approaches. Typically, data were graphed to visually assess potential trends based on locations, which were arranged by known selenium exposure, or using simple x-y graphs. A least-squares regression approach was used to further evaluate whether a relationship may exist between an individual dependent variable (e.g., population or community biological metric) and independent variable (e.g., biotic or abiotic selenium concentration). If a relevant relationship existed (i.e., decrease in characteristic with increase in selenium concentration), then it was further evaluated to assess whether the relationship was significant, using Number Cruncher Statistical Systems (NCSS 2007) software. Simple linear regressions were used, recognizing that not all environmental data are linearly related and may require transformations to meet assumptions of a linear regression (i.e., data are normally distributed, variances are constant, and the relationship is linear). Correlation coefficients (R^2) [1], for statistically significant relationships were examined to assess how much of the variability in the dependent variable was explained by the independent variable. Low R^2 values can reflect the lack of a linear relationship, high variance, non–normal distribution, and/or that other environmental factors are more important in explaining the variability of the dependant variable.

Because multiple factors may influence an observed relationship, when a relationship was found to be significant and biologically relevant, it was investigated further. Statistical analyses of selenium concentrations in media were conducted using a one-way Analysis of Variance (ANOVA) in NCSS (2007). Either one-way parametric ANOVA using means or non-parametric ANOVA (Kruskal-Wallis) using ranked medians were used based on meeting test requirements for a normal distribution and equal variances. If parametric assumptions were met, one-way ANOVA output was utilized together with the Tukey-Kramer multiple comparison test (MCT) to define differences between groups. Mean values and box plots from the output were used to determine the direction of difference (i.e., greater or less than). If one or both requirements for

[1] R squared (R^2) is the square of the correlation coefficient and it is known as the coefficient of determination. It is the proportion of the variation in one variable that is accounted by the variation in another variable. R squared is a measure of how well a regression model fits the data. A value of R squared near zero indicates no linear relationship, while a value near one indicates a perfect linear fit (Hintze 2007).

the parametric ANOVA were not met, then the Kruskal-Wallis non-parametric ANOVA was used together with a Kruskal-Wallis MCT. The MCTs were used to determine which locations were significantly different from one another. Relationships were determined to be significant if derived probabilities were less than alpha (α) = 0.05[2].

3.1 Water Quality

Seasonal differences in surface water total selenium concentrations are shown in Figure 4. Hoopes Spring is the primary source area for elevated selenium discharge to Sage Creek and downstream Crow Creek. Despite source areas at South Fork Sage Creek Springs (SFSCS), total selenium concentrations at LSV-4 (downstream of Hoopes Spring and SFSCS) nearest Crow Creek are lower than those observed at Hoopes Spring. Statistics for these observations are presented in the following analyses.

Total selenium concentrations at the locations measured across the five seasonal periods were significantly different (ANOVA, $p<<0.05$)[3]. Summary statistics for surface water are presented in Table 1, along with the results of the Tukey-Kramer MCT. Across all seasons, mean total selenium in surface water at Hoopes Spring (HS and HS-3) and Sage Creek (LSV-2C and LSV-4) was significantly higher than mean total selenium at upstream locations (CC-75, CC-150, CC-350, and DC-600) and the reference location (SFTC-1). Total selenium at the Sage Creek and Hoopes Spring locations was also significantly higher than total selenium at both downstream Crow Creek locations (CC-1A and CC-3A).

Among the background and reference locations, aqueous selenium concentrations at the Deer Creek location (DC-600) were significantly higher than the reference location, but not significantly different from the background Crow Creek locations. Total selenium at Hoopes Spring and Sage Creek locations were not significantly different from one another. Downstream Crow Creek locations were not significantly different from CC-150 or DC-600, but were significantly higher than other upstream locations and the reference location. Overall, total selenium concentrations at downstream Crow Creek locations fall within the range of background concentrations measured. Elevated selenium exposure in surface waters occur in Hoopes Spring and Sage Creek based on comparisons to the reference and background location data.

Longer-term data were available from a few locations to examine longer temporal trends at key points in the watershed downstream of the Hoopes Spring and SFSCS discharges. Data

[2] Alpha (α) is the probability of a Type I error and is also known as the level of significance. Alpha is the probability that a null hypothesis will be rejected when in fact it is true (false positive) (USEPA 2009).

[3] The probability value (p) of a statistical hypothesis test is the probability of getting a value of the test statistic as extreme as or more extreme than that observed by chance alone, if the null hypothesis is true (Easton and McColl 1997).

collected prior to Fall 2006 were also evaluated to examine the exposure environment for aqueous selenium. Figure 5 shows aqueous selenium concentration trends at four locations where long-term selenium data are available.

At HS, the Hoopes Spring location immediately upstream of the LSV-2C location, surface water selenium concentrations were increasing in 2007 and 2008. The concentration measured in October 2007 at LSV-2C during the brown trout study (0.0384 mg/L) was the highest measured during that time frame for either Hoopes Spring or LSV-2C. The Fall 2008 monitoring event found a higher aqueous total selenium concentration than previously measured (0.05 mg/L). Subsequent measurement data, however, have shown a decrease in aqueous selenium concentration at Hoopes Spring (Figure 5).

In South Fork Sage Creek, downstream of the South Fork Sage Creek Spring complex, long-term water quality monitoring for selenium reveals that until approximately 2006, concentrations of selenium in the South Fork have been below the Idaho State Standard of 0.005 mg/L. From about late 2006 to mid-2008, selenium concentrations in surface water downstream of the springs were greater than the standard, but typically no higher than 0.007 mg/L. Selenium concentrations again increased later in 2008, with concentrations usually greater than 0.0085 mg/L. While Hoopes Spring is clearly the larger source of selenium, it appears that the spring complex on South Fork Sage Creek is contributing aqueous selenium to the system as well.

Longer-term water quality monitoring in Sage Creek near Crow Creek Road (LSV-4) provides information on selenium concentrations in Sage Creek before discharge to Crow Creek. Figure 5 shows longer-term selenium concentration data from this monitoring location and an increase in selenium during 2008 consistent with increases observed at Hoopes Spring. Concentrations of selenium at LSV-4 during Fall 2008 and into winter show only a slight decrease in concentration below 0.015 mg/L.

Selenium concentrations measured in Crow Creek samples collected downstream of Sage Creek at CC-1A and CC-3A in October 2007 were lower than Idaho's Surface Water Quality Standard (0.005 mg/L). This is consistent with measurement data before and after this time period for these monitoring locations. Selenium in Crow Creek downstream of Sage Creek is typically lower than the State Surface Water Quality Standard as illustrated by data in Figure 5. However, Fall 2008 (September) and subsequent monitoring data (November 2008) indicate that surface water selenium concentrations at CC-1A and CC-3A are greater than the State Surface Water Quality Standard.

Figure 6 compares average selenium (±95% CI) for several locations from two different time periods where sufficient data were available to derive summary statistics. Overall, notable differences are found between pre- and post-Fall 2006 at HS, LSS, and LSV-4. Based on this information, it appears that the exposure environment has changed between the two time

periods, with higher selenium concentrations observed post-Fall 2006. From an exposure perspective, the field monitoring and laboratory studies conducted post-Fall 2006 have captured the higher exposure concentrations and may provide a worst-case exposure scenario.

Using regression analyses, several water quality parameters were evaluated for their potential relationship to total selenium concentrations, including sulfate, dissolved organic carbon (DOC), hardness, and alkalinity. DOC exhibited a moderate non-linear relationship to total selenium concentrations (R^2 = 0.21); however, DOC was highest where selenium was lowest (Figure 7). Hardness and alkalinity showed no apparent relationship to total selenium concentrations. Sulfate was highly correlated to total selenium concentrations, with the highest sulfate concentrations found where the highest selenium concentrations were measured (R^2 = 0.80). Sulfate ranged from 7.2 mg/L in Deer Creek to 49.8 mg/L in Hoopes Spring. Figure 7 shows the relationship of sulfate concentrations to selenium concentrations measured across all locations and time periods. As shown, increasing selenium concentrations are correspondingly mirrored by increasing sulfate concentrations. Hoopes Spring originates as a groundwater discharge, which tends to have higher sulfate concentrations than surrounding surface waters.

This relationship may have important implications on observed toxicity and bioaccumulation where selenium concentrations are highest. Sulfate may ameliorate selenium uptake, thereby reducing the potential effects of selenium exposure. Selenium bioaccumulation and toxicity has been shown to be related to sulfate concentration (US Environmental Protection Agency [USEPA] 2004). Proportional increases in sulfate are inversely related to decreased selenium bioaccumulation and toxicity. Competition between sulfate and selenate uptake has been observed in many species: algae (Riedel and Sanders 1996), aquatic plants (Bailey et al. 1995), crustaceans (Ogle and Knight 1996), fungi (Gharieb et al. 1995), HeLa cells (Yan and Frenkel 1994), and wheat (Richter and Bergmann 1993). Reduced selenate bioconcentration with increasing sulfate concentration has been demonstrated in *Daphnia magna* (Hansen et al. 1993). A significant relationship was shown to exist between acute selenate toxicity to aquatic organisms and ambient sulfate concentrations (Brix et al. 2001a). Simmons and Wallschlager (2005) contend that sulfate ions that are present will be able to inhibit uptake into algae, zooplankton, and forage fish, effectively decreasing the amount of dietary selenium available to predatory fish through food-web interactions. Schlenk et al. (2003) found that rainbow trout reared in high salinity waters were afforded significant protection, despite being fed high selenomethionine diets. The authors contend that one potential explanation for the protective effects of saline conditions may involve the ability of sulfate, calcium, or magnesium to prevent the interaction of selenomethionine with critical subcellular proteins by maintaining the cellular redox potential.

3.2 Sediment Quality

Sediment in stream channels downstream of Hoopes Spring shows a relatively consistent steady decline in selenium concentrations away from the source (Figure 8). During most sampling events, the highest mean sediment concentrations were found at HS-3 and LSV-2C, respectively. Observations of sediment selenium concentrations from all five monitoring events show that sediment selenium concentrations begin to vary more widely as aqueous selenium concentrations increase, at least at Hoopes Spring.

The selenium concentrations in sediment at the reference location, background, downstream Crow Creek locations were significantly different (i.e., lower) from the mean sediment selenium concentrations found at LSV-2C and HS-3 (ANOVA, $p << 0.05$) (Table 2). Deer Creek sediments at DC-600 were significantly different from sediments at the reference location, CC-75, and HS-3. Downstream of the source area, selenium concentrations in sediment from Crow Creek locations CC-1A and CC-3A were not significantly different from background locations (ANOVA, $p << 0.05$). Similar to aqueous selenium, the primary elevated locations are Hoopes Spring and Sage Creek. However, unlike the aqueous selenium concentrations, the highest concentration of selenium in sediment is found at HS-3. Lack of adequate data (e.g., low number of samples) for location LSV-4 did not allow for meaningful comparisons. Collectively, across all seasons, upstream locations had significantly lower concentrations of selenium in sediment than downstream locations (ANOVA, $p << 0.05$).

3.3 Relationship of Selenium in Surface Water and Sediment

Total aqueous selenium was related to total selenium in sediment from co-located locations ($R^2 = 0.67$) (Figure 9). Selenium concentrations in sediment and surface waters at HS are variable and elimination of these data reduced variability in the relationship. The increased strength of the relationship when the HS data were excluded may be due to some attenuation of selenium from the water column to sediment as water moves away from the source area. While sediment accumulation of selenium has been shown to exist in lentic systems, such as Hyco and Belews Lakes in North Carolina where selenium has been a long-standing issue, accumulation in lotic sediment is less pronounced. In lotic environments, selenium in the water column is most often found in the form of selenate and migration to sediment is limited (Adams et al. 2000). This may be a function of several factors, including the fact that transport and accumulation of organic matter occurs during annual scour and deposition of sediment during high-flow events.

While the differences between the two relationships are interesting (i.e., including versus excluding HS data), the more critical question relates to the role of sediment selenium concentrations in bioaccumulation. Evaluation of selenium concentrations in surface waters and sediment relative to concentrations in in-stream biological media will be assessed in the sections that follow.

3.4 Biological Tissue

Selenium concentrations were measured during each monitoring event in fish tissue, benthic macroinvertebrates, and periphyton. Because selenium can bioaccumulate in organisms when present at levels that exceed nutritional requirements, understanding its concentration in potential food or prey items is an important exposure characteristic.

3.4.1 Fish Tissue

The primary targets for fish tissue analyses were trout species (brown and Yellowstone cutthroat trout [YCT]) and sculpin. When opportunities arose to gather additional information about other species, additional species were collected for tissue analysis. However, the bulk of the data available from each location during each monitoring event are for trout and sculpin. More than 700 fish tissue samples were collected from 2006 to 2008 as part of the regular monitoring and special studies for this project. Summary statistics for selenium concentrations in sculpin and trout (YCT and brown trout combined) are presented in Table 3. Individual fish tissue data are presented in Attachment 2.

3.4.1.1 Trout Tissue

For trout species, captured fish ≤ 100 mm in length were targeted for tissue analysis in order to collect trout that were likely resident at a location. This size of trout is believed to be year 1 or younger that would have been spawned at a particular location. When ≤ 100 mm trout were unavailable, the range was extended up to about 150 mm. Table 3 shows the summary statistics for trout tissue selenium concentrations from each location by sampling period.

Tissue data were grouped across the time periods sampled by location (e.g., reference, upstream Crow Creek, Deer Creek, Sage Creek, Hoopes Spring, and downstream Crow Creek) and compared. Trout tissue concentrations of selenium were significantly different among grouped locations (ANOVA, $p<<0.05$). The Kruskal-Wallis MCT was used to assess which groups were significantly different from one another (Table 4).

The reference location has significantly lower trout tissue selenium than trout tissue from other grouped locations. Selenium in trout tissue from the upstream Crow Creek and Deer Creek locations are not significantly different from one another, but are lower than grouped locations from Hoopes Spring, Sage Creek, and Crow Creek downstream (ANOVA $p<< 0.05$) (Table 4). This analysis was conducted to evaluate whether trout tissue from the background locations were different from downstream locations and tributaries that are all connected within the drainage. Considering individual locations, trout tissue selenium concentrations are significantly different among locations (Kruskal-Wallis non-parametric ANOVA, $p<<0.05$) (Table 5). The

Kruskal-Wallis MCT indicates that reference location (SFTC-1) trout tissue have significantly lower concentrations than all locations except background locations (CC-75, CC-150, and CC-350). Likewise, selenium in trout tissue at CC-75, CC-150, and CC-350 is significantly lower than selenium in trout tissue from HS-3 and LSV-2C. Location LSV-4 was not significantly different from all locations except SFTC-1 and CC-75. Locations closest to the source area at HS are not significantly different from one another (i.e., HS-3 and LSV-2C). Trout tissue selenium from CC-1A was significantly lower than tissue from HS-3 and LSV-2C (Table 5).

For trout tissue, natural background selenium appears to range from 5.6 to 8.8 mg/kg dw. Trout tissue selenium concentrations collectively averaged higher than the current Draft National Criterion (7.91 mg/kg dw) at the DC-600 location (average concentration = 8.79 mg/kg dw) and approach this value at the CC-150 location (average concentration = 7.87 mg/kg dw), both of which are background locations. Based on grouping trout tissue data, background and reference trout tissue concentrations are different. Based on analyses of individual location data, background and reference locations are not different (except Deer Creek). This is not unexpected, because Deer Creek has naturally elevated selenium due to exposure of the Meade Peak member of the Phosphoria Formation at locations in the upper watershed. Some have suggested that natural background conditions in the Crow Creek drainage within the phosphate patch are higher than locations outside the phosphate patch and/or influenced by trout movement. Because trout can be migratory as well as resident, this conclusion was tested by evaluating trout tissue from individual locations as well as evaluating tissue concentrations of the non-migratory sculpin which are known to have small home ranges. The results of the trout tissue analysis indicate that background and reference locations are not different (other than Deer Creek). This observation will be checked using the sculpin tissue data.

Brown trout make up the largest percentage of the two trout species collected at most locations. Brown trout tissue data were grouped across time periods by location where they were found and compared. Brown trout tissue selenium concentrations at background locations (CC-75, CC-150, and CC-350) were significantly lower than locations near the source (HS-3 and LSV-2C) (Table 6). Only CC-75 has significantly lower trout selenium concentrations than all Sage Creek and downstream Crow Creek locations. Locations CC-150, CC-350, LSV-4, CC-1A, and CC-3A were not significantly different from one another (Table 6). A similar analysis for YCT was hampered by low numbers of YCT collected at several of the locations.

To gauge whether selenium concentrations in trout tissue are different among the seasonal periods, downstream locations on Sage Creek (LSV-2C and LSV-4) and Crow Creek (CC-1A and CC-3A) were utilized. Trout tissue selenium from Spring 2008 was significantly higher than selenium in trout tissue measured during Spring and Fall 2007. Fall 2006 and Fall 2008 tissue concentrations were not significantly different from any of the other seasonal periods.

3.4.1.2 Sculpin Tissue

Summary statistics for selenium in sculpin tissue are presented in Table 3. Grouping the locations across the time periods sampled by positions in the watershed (e.g., reference, upstream Crow Creek, Deer Creek, Sage Creek, Hoopes Spring, and downstream Crow Creek), it is observed that reference location sculpin tissue selenium concentrations are not significantly different from sculpin tissue concentrations at the upstream Crow Creek locations and Deer Creek locations. Hoopes Spring and Sage Creek were not significantly different from one another but both were significantly higher than downstream Crow Creek locations (Table 7).

Mean sculpin tissue selenium from the reference location (SFTC-1) was 5.8 mg/kg dw, while at the background locations, concentrations ranged from 5.7 to 8.1 mg/kg dw, suggesting that background and reference sculpin tissue concentrations are similar. Statistical analyses confirm this observation, as SFTC-1 sculpin tissue concentrations are not significantly different from those found at CC-75, CC-150, DC-600, or CC-350 (Table 8). Observations for sculpin confirm the observations made about trout tissue (i.e., that reference and background tissue concentrations are not substantially different, except for the Deer Creek location). Also, use of a non-migratory fish to verify whether concentrations in a migratory fish are representative of the Site indicates that they indeed are representative of tissue data derived from this Site. Migration between downstream locations and background locations does not likely affect these results.

Sculpin tissue selenium concentrations from Hoopes Spring and Sage Creek are significantly higher than concentrations from background and reference locations (ANOVA, $p<<0.05$). Downstream Crow Creek locations (CC-1A and CC-3A) had significantly higher concentrations than SFTC-1 and CC-75 locations, while only CC-1A was not significantly different than concentrations at CC-150, CC-350 and DC-600 (Table 8). Sculpin tissue concentrations at CC-1A were significantly lower than concentrations at HS-3, but were not significantly different from concentrations found at Sage Creek locations. Sculpin tissue selenium concentrations at CC-3A were not different from Hoopes and Sage locations, but this lack of differences may be due to the relatively low numbers of sculpin found at CC-3A.

3.4.1.3 Comparison of Trout and Sculpin Tissue Concentrations of Selenium

Based on data from each single monitoring period, mean sculpin tissue selenium concentrations were generally somewhat higher than trout tissue concentrations. To evaluate this observation, trout tissue concentrations for a location were compared to sculpin tissue concentrations from the same location across the seasons (Table 9). Each analysis, except for one, indicated that trout tissue selenium concentrations were not significantly different from sculpin tissue concentrations (ANOVA, $p<<0.05$, $\alpha=0.05$). At the reference location, sculpin tissue concentrations were significantly higher than the trout tissue concentrations. Overall, Crow

Creek drainage trout and sculpin appear to bioaccumulate selenium to a similar level. Similarity of tissue levels between trout and sculpin suggests that although these species have different feeding strategies, the level of selenium accumulation is not so different that their prey base could be causing different levels of accumulation. While sculpin are a primary part of the adult brown trout diet, the fact that most trout specimens collected for tissue analysis were juveniles suggests that these younger trout were likely feeding primarily on benthic invertebrates as opposed to small fish. The similarities of sculpin tissue concentrations and trout tissue concentrations may allow for sculpin to serve as an indicator species for future monitoring as a possible surrogate for trout.

3.4.1.4 Cyprinid and Catostomid Tissue

Table 3 summarizes concentrations of selenium in tissue of cyprinids (redside shiners, longnose and speckled dace) and catostomids (mountain and Utah suckers) that, where present, were collected for fish tissue analysis. Because these species were not collected at all locations, they are grouped to provide a large enough number of samples to derive statistics. Summary statistics for these fish families grouped together at locations where collected are presented in Table 10.

For minnows and suckers, adequate data for statistical comparisons was only available for fish from three locations, CC-350, CC-1A, and CC-3A. Tissue data for this group of species were comprised primarily of dace species (longnose and speckled), with very few redside shiners and Utah suckers included due to smaller numbers of fish from which tissue data were analyzed. Comparison of the log-transformed selenium tissue concentrations from the three locations across the seasons monitored indicates that tissue selenium for this group of species are not significantly different between the three locations (ANOVA, $p=0.495$). Mean selenium tissue concentrations ranged from 11.3 mg/kg dw at CC-350 to 14 mg/kg dw at CC-1A.

3.4.1.5 Adult Trout Tissue

A number of tissue samples for adult trout were generated as part of the adult reproduction studies using Site-collected brown trout and YCT. For brown trout, fish were collected in late fall/early winter, while YCT were collected in late spring. Adults for each species were collected and include fish that were typically >300 mm for brown trout and >250 mm for YCT.

Adult brown trout data include a mix of males and females. Some females, not used in the adult reproduction tests, were suspected of carrying eggs but could not be expressed. A few of these trout were sacrificed to verify the presence of eggs. In most cases, the fish were females, and eggs were present but had not been released from the ovaries. All of these fish data are presented herein to illustrate selenium concentrations measured in adult brown trout. Due to

limited amount of data from some locations, tissue data were grouped to assess significant differences in locations upstream of Sage Creek (CC-150 and CC-350), Sage Creek (LSV-2C), and downstream of Sage Creek (CC-1A and CC-3A). The mean tissue selenium concentration from adult brown trout in Sage Creek was significantly greater than tissue selenium in trout from both the upstream and downstream Crow Creek locations (ANOVA, $p << 0.05$) (Table 11).

Except for brown trout tissue from the LSV-2C location, adult tissue concentrations fell within the range of tissue concentrations observed for a location measured using year 1 or younger fish. The mean adult tissue concentration at LSV-2C (14.03 mg/kg dw) was typically lower than the mean values for younger brown trout collected from 2006 to 2008 (mean ranged from 12.8 to 22.7 mg/kg dw). Adult brown trout tissue data (collected in 2007) compared to juvenile brown trout tissue data (collected in 2006 and 2007) were not significantly different (Kruskal-Wallis - One-way ANOVA, $p = 0.37$). The findings were similar when only 2007 data were compared between the two groups ($p=0.15$) (Figure 10).

Adult YCT collected for the reproduction study were collected from three primary areas including upstream Crow Creek locations (CC-350 and CC-150), Deer Creek (DC near its mouth), and Sage Creek (LSV-2C). Adult YCT collected for the reproduction study had similar concentrations to year 1 fish when compared to the Sage Creek (LSV-2C) location and Deer Creek (DC) location. Adult YCT from the CC-350 location had a higher mean concentration (18.53 mg/kg dw) than year 1 fish collected from the same location (7.73 mg/kg dw). Comparison between adult tissue collected in 2008 and juvenile tissue for YCT collected during 2008 indicate that adult tissue concentrations were significantly different than juvenile tissue concentrations (One-way ANOVA, $p = 0.018$). Examination of the data distribution for the two data sets indicate overlapping ranges, with a large proportion of the juvenile data collected in Deer Creek and upstream Crow Creek (Figure 11).

Numbers of YCT from CC-150 and SFTC-1 were too low to derive any meaningful statistics, but sufficient counts were available to compare fish tissue selenium from location CC-350 and CC-150 (grouped), location LSV-2C, and DC. Mean selenium in YCT was significantly different among the three locations (ANOVA, $p=0.00302$). Selenium in YCT from the DC location was significantly lower than selenium in YCT from CC-350 and LSV-2C, but CC-350 and LSV-2C tissue selenium concentrations were not significantly different from each other (Table 12).

3.4.2 Benthic Tissue

Composite benthic invertebrate tissue were collected at each location during each monitoring period except at LSV-4 where access to the location was limited to Fall 2006 and Spring 2007. Concentrations of selenium in benthic tissue were compared by location across seasons to evaluate whether bioaccumulation was significantly different at the different locations (LSV-4

was excluded from the analysis due to the low number of samples). Summary statistics for benthic invertebrate tissue selenium are provided in Table 13.

Invertebrate tissue concentrations of selenium were significantly different across the monitoring locations (Kruskal-Wallis ANOVA, p=0.00649) when compared to one another. The differences are described below.

Locations upstream or outside of the influence of Hoopes Spring and Sage Creek (SFTC-1, CC-75, CC-150, CC-350, and DC-600) were not significantly different from one another. All of these locations, except DC-600, had significantly lower tissue selenium concentrations than benthic tissue from LSV-2C. Benthic tissue selenium concentrations from SFTC-1 and CC-75 were significantly lower than concentrations from the Hoopes Spring locations and LSV-2C. Only SFTC-1 was significantly lower than CC-1A. Benthic tissue selenium concentrations at downstream locations (LSV-2C, CC-1A, and CC-3A) were not significantly different from one another, nor were they different from the locations nearest the source (HS and HS-3). Variability in selenium concentration from each fall period influences the findings of this analysis (Table 13).

Unlike surface water, sediment, and periphyton, the highest mean benthic tissue concentrations were found at LSV-2C, although all benthic exposure media show decreased selenium concentrations with distance from the source area. Also, for other media evaluated, mean selenium at the downstream Crow Creek locations tended to be low enough to detect significant differences between locations closer to the source area.

3.4.3 Periphyton Tissue

Table 14 shows the summary statistics for selenium measured in periphyton at each of the locations. Selenium in periphyton was significantly different (ANOVA, $p<<0.05$) across sampling locations. Location LSV-4 was excluded from this analysis due to an inadequate number of samples from that location.

Tukey-Kramer MCT results (Table 14) show that selenium concentrations in periphyton from locations SFTC-1, CC-75, CC-150, CC-350, and DC-600 were not significantly different from one another, but these locations (except DC-600) had significantly lower periphyton selenium concentrations as compared to Hoopes Spring locations. Concentrations in periphyton tissue from Sage Creek (LSV-2C) were significantly higher than concentrations at SFTC-1 and concentrations at the two most upstream Crow Creek locations (CC-75 and CC-150), but no differences were observed when periphyton selenium concentrations from LSV-2C were compared to concentrations from CC-350 or DC-600. Concentrations from locations CC-1A and CC-3A were not significantly different from the upstream Crow Creek locations or Deer Creek, but were different from SFTC-1.

Selenium concentrations in periphyton indicate that while Sage Creek (LSV-2C) is not different than Hoopes Spring locations (HS and HS-3), concentrations of selenium decrease as they reach Crow Creek, as both lower Crow Creek locations (CC-1A and CC-3A) are not different than background locations.

3.5 Relationship of Selenium in Lower Trophic Levels to Aqueous and Sediment Selenium Concentrations

Selenium accumulates in the food chain, and has been shown to accumulate to higher levels in algae and periphyton at the base of the food chain when compared to primary and secondary consumers. Evaluating the relationship of selenium in periphyton to selenium in the primary abiotic media (i.e., surface waters and sediment) is a logical first step to evaluating whether these relationships exist and whether the base of the food chain is accumulating selenium. Of the two abiotic media, total selenium in surface water was more strongly correlated to periphyton (R^2 = 0.59) concentrations than was selenium in sediment (R^2 = 0.27) (Figures 12 and 13).

A similar set of comparisons was also made between benthic invertebrate tissue and aqueous total selenium and selenium in sediment. Again, the relationship of benthic tissue concentrations of selenium to each of these abiotic media was strongest for total selenium in surface waters (R^2 = 0.47) as opposed to sediment (R^2 = 0.25) (Figures 14 and 15).

The next logical comparison is that of the primary producer (periphyton) to the primary consumer (benthic invertebrates). Selenium concentrations measured in periphyton accounts for 47 percent of the variability (R^2 = 0.47) in benthic tissue selenium concentrations (Figure 16). The relatively strong relationships of selenium in water to periphyton, and periphyton to benthic tissue, indicates that selenium is accumulating along expected pathways and that periphyton is important in trophic transfer of selenium at the base of the food chain.

3.6 Relationship of Selenium in Fish Tissue to Surface Water, Sediment, and Prey Items

For the most part, sculpin represent the next level in the food chain in terms of trophic transfer. Relationships were evaluated between sculpin selenium tissue concentrations and benthic invertebrate and periphyton tissue concentrations. Both relationships were fairly similar relative to sculpin tissue concentrations, with periphyton tissue concentrations of selenium providing a slightly stronger relationship to sculpin tissue selenium (R^2 = 0.58) than benthic invertebrate selenium (R^2 = 0.52) (Figures 17 and 18). This is surprising, as sculpins are invertebrate consumers; however, they live in close association to stream substrates where inadvertent periphyton consumption is likely occurring.

Considering the fish tissue data presented above, it is important to understand certain relationships that aid in further characterizing exposure. The first relationship examined is for aqueous selenium concentrations relative to all fish tissue concentrations (Figure 19). Surprisingly, there is a very strong relationship between measured concentrations of aqueous selenium and fish tissue selenium concentrations from co-located areas regardless of species. Selenium in surface waters explains approximately 69 percent (R^2 = 0.69) of the selenium variation in all fish tissue collected during this study. Because trout and sculpin comprised the bulk of the fish tissue samples, these two taxa were also evaluated independently to assess if differential relationships to surface water selenium exist. The agreement between the two taxa tissue concentrations relative to aqueous total selenium concentrations was very close. For trout tissue, 74 percent of the variability in concentrations could be explained by the surface water selenium concentration, whereas for sculpin, 69 percent of the variation could be explained (Figures 20 and 21).

The final graphic in this series illustrates the relationship of log-transformed mean tissue selenium concentrations for each species versus the log-transformed surface water concentration of selenium (log transformation done to achieve a normal distribution). As expected, the relationships are very similar. The R^2 for trout and sculpin are 0.79 and 0.82, respectively (Figure 22). The close agreement between sculpin and trout tissue concentrations relative to surface water concentrations is likely due to Site fidelity of sculpin and sampling of young trout from each location that likely derived their exposure history from the location where they were collected.

Because trout and sculpin tissue concentrations are highly similar in their relationship to surface water selenium concentrations, a logical next step was to evaluate their potential relationship to one another. Selenium in trout tissue shows a good relationship to selenium in sculpin tissue (R^2 = 0.8) (Figure 23), suggesting that similar bioaccumulation occurs within the two taxa. One could interpret this relationship to mean that trout tissue concentrations are related to sculpin tissue concentrations as a result of trout preying on sculpins. While this does occur, largely for adult brown trout, the majority of trout collected for tissue analysis were juveniles, and it is assumed that the bulk of their diet at this life stage was invertebrates. Thus, the strength and similarities of both species' relationship to total selenium in surface water, and their relationship to one another, more likely suggest similar bioaccumulation.

3.7 Site-Specific Bioconcentration and Bioaccumulation Factors

Bioconcentration factors (BCF) are defined as the ratio of a chemical concentration in the organism to that in surrounding water. USEPA defines the term bioaccumulation as the uptake and retention of a chemical by an aquatic organism from all surrounding media (e.g., water, food, sediment). A bioaccumulation factor (BAF) is defined as the uptake of a chemical by an organism through all exposure routes (or at least media representative of exposure routes) often

narrowed down to diet. Herein, BAFs are derived as ratios of selenium in an organism to the selenium in its diet. All BCFs and BAFs were developed for paired samples (i.e., from the same location and time period) of selenium in the media evaluated. For surface water, dissolved selenium concentrations were used consistent with USEPA methods. These Site-specific BCFs and BAFs are direct measures of bioaccumulation and storage by organisms, illustrating the variability that occurs in the natural environment at various levels of the food chain (Table 15); however, these BAFs and BCFs are not direct measures of effects.

Consistent with reports in the literature, the periphyton BCFs were high where selenium concentrations were low in surface waters, but tended to decrease as selenium concentrations increased. The inverse relationship of BCFs to selenium in surface water is expected, and has been documented in the literature for selenium as well as other metals. Geometric mean values were derived for BCFs based on positions in the watershed, such as upstream of Sage Creek, Sage Creek, reference, and downstream of Sage Creek. The lowest geometric mean BCFs were for Hoopes Spring and Sage Creek, while BCFs for the reference location, downstream of Sage Creek, and upstream of Sage Creek were all fairly similar, suggesting similar uptake and accumulation.

BAFs for benthic invertebrate accumulation of selenium from periphyton are much lower in magnitude than the BCFs for periphyton from water. This effect has been documented in the literature, where the primary producers (algae) accumulate selenium to higher levels than primary and secondary consumers. BAFs follow a similar patter to BCFs in that higher BAFs are found at locations where selenium is lower (e.g., Crow Creek upstream and downstream of Sage Creek, and the reference location). BAFs for sculpin accumulation of selenium from benthic invertebrates follow a similar pattern to those for benthos and periphyton.

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TABLES

Table 1
Summary Statistics for Surface Water Total Selenium Concentrations and Results of Multiple Comparison Test

Location	Count	Minimum	Maximum	Mean	Median	Standard Deviation	UCL	UCL Method	Distribution	Tukey-Kramer Multiple Comparison Test -Different From Groups
SFTC-1	4	0.0003	0.0010	0.0006	0.0005	0.0003		n too small		DC-600, CC-3A, CC-1A, LSV-4, LSV-2C, HS-3, HS
CC-75	5	0.0003	0.0015	0.0008	0.0005	0.0005	0.0013	95% student's-t UCL	normal	CC-3A, CC-1A, LSV-4, LSV-2C, HS-3, HS
CC-150	5	0.0006	0.0023	0.0012	0.0008	0.0008	0.0020	95% student's-t UCL	normal	CC-3A, CC-1A, LSV-4, LSV-2C, HS-3, HS
CC-350	5	0.0002	0.0012	0.0008	0.0008	0.0004	0.0012	95% student's-t UCL	normal	LSV-4, LSV-2C, HS-3, HS
DC-600	5	0.0014	0.0031	0.0019	0.0018	0.0007	0.0026	95% student's-t UCL	normal	SFTC-1, LSV-4, LSV-2C, HS-3, HS
HS	5	0.0174	0.0502	0.0303	0.0296	0.0122	0.0420	95% student's-t UCL	normal	SFTC-1, CC-75, CC-350, CC-150, DC-600, CC-3A, CC-1A
HS-3	5	0.0108	0.0402	0.0218	0.0198	0.0112	0.0324	95% student's-t UCL	normal	SFTC-1, CC-75, CC-350, CC-150, DC-600, CC-3A, CC-1A
LSV-2C	5	0.0095	0.0242	0.0152	0.0144	0.0054	0.0204	95% student's-t UCL	normal	SFTC-1, CC-75, CC-350, CC-150, DC-600, CC-3A, CC-1A
LSV-4	5	0.0070	0.0140	0.0106	0.0105	0.0025	0.0130	95% student's-t UCL	normal	SFTC-1, CC-75, CC-350, CC-150, DC-600, CC-3A, CC-1A
CC-1A	5	0.0014	0.0065	0.0031	0.0029	0.0020	0.0051	95% student's-t UCL	normal	SFTC-1, CC-75, CC-350, LSV-4, LSV-2C, HS-3, HS
CC-3A	5	0.0011	0.0058	0.0030	0.0030	0.0019	0.0048	95% student's-t UCL	normal	SFTC-1, CC-75, CC-350, LSV-4, LSV-2C, HS-3, HS

One-Way ANOVA on log-transformed data found that total selenium concentrations at locations were significantly different ($p << 0.05$, alpha = 0.05). Multiple Comparison Test used to evaluate differences.

Table 2
Summary Statistics for Sediment Selenium Concentrations and Results of Multiple Comparison Test

Location	Count	Minimum	Maximum	Mean	Median	Standard Deviation	UCL	UCL Method	Distribution	Tukey-Kramer Multiple Comparison Test -Different From Groups
SFTC-1	4	0.21	0.48	0.3275	0.31	0.12		n too small		CC-3A, CC-1A, DC-600, HS, LSV-4, LSV-2C, HS-3
CC-75	5	0.34	0.61	0.514	0.54	0.11	0.62	95% student's-t UCL	normal	DC-600, HS, LSV-4, LSV-2C, HS-3
CC-150	5	0.43	0.88	0.658	0.63	0.19	0.84	95% student's-t UCL	normal	HS, LSV-4, LSV-2C, HS-3
CC-350	5	0.52	1.3	0.776	0.7	0.32	1.08	95% student's-t UCL	normal	HS, LSV-4, LSV-2C, HS-3
DC-600	5	0.95	2.8	1.746	1.4	0.89	2.60	95% student's-t UCL	normal	SFTC-1, CC-75, HS-3
HS	5	1.1	5.9	3.1	2.3	1.99	5.00	95% student's-t UCL	normal	SFTC-1, CC-75, CC-150, CC-350, CC-3A
HS-3	5	2.1	8.1	6.18	7	2.38	8.45	95% student's-t UCL	normal	SFTC-1, CC-75, CC-150, CC-350, CC-3A, CC-1A, DC-600
LSV-2C	5	1.1	5.7	4.26	4.6	1.84	6.01	95% student's-t UCL	normal	SFTC-1, CC-75, CC-150, CC-350, CC-3A, CC-1A
LSV-4	2	3.3	3.9	3.6	3.6	0.42		n too small		SFTC-1, CC-75, CC-150, CC-350, CC-3A
CC-1A	5	0.67	1.8	1.294	1.2	0.46	1.74	95% student's-t UCL	normal	SFTC-1, LSV-2C, HS-3
CC-3A	5	0.66	1.3	0.984	0.93	0.31	1.28	95% student's-t UCL	normal	SFTC-1, HS, LSV-4, LSV-2C, HS-3

One-Way ANOVA on log-transformed data found that total selenium concentrations at locations were significantly different ($p << 0.05$, alpha = 0.05). Multiple Comparison Test used to evaluate differences.

Table 3
Summary of Fish Tissue Selenium Data Collected During the Fall 2006 - Fall 2008 Monitoring Events

Stream	Location	Date	Sculpin (mg/kg dw)				Trout (mg/kg dw)				Dace (mg/kg dw)				Suckers (mg/kg dw)				Shiners (mg/kg dw)			
			Count	Mean	Min	Max	Count	Mean	Min	Max	Count	Mean	Min	Max	Count	Mean	Min	Max	Count	Mean	Min	Max
Reference																						
Sourth Fork Tincup Creek	SFTC-1	5/7/07	6	5.68	3.10	12.20	4	3.68	2.60	5.70	0	-	-	-	0	-	-	-	0	-	-	-
		8/29/07	10	3.75	2.80	4.80	11	2.25	1.80	3.10	0	-	-	-	0	-	-	-	0	-	-	-
		6/26/08	6	9.31	6.38	12.80	4	6.70	4.43	9.16	0	-	-	-	0	-	-	-	0	-	-	-
		9/9/08	6	5.87	3.20	8.61	10	2.64	2.00	3.48	0	-	-	-	0	-	-	-	0	-	-	-
Upstream of Sage Creek																						
Crow Creek	CC-75	9/2/06	4	5.58	4.38	6.95	4	4.05	3.54	4.55	0	-	-	-	0	-	-	-	0	-	-	-
		5/8/07	6	5.03	4.10	5.70	2	5.35	4.80	5.90	0	-	-	-	0	-	-	-	0	-	-	-
		8/23/07	6	3.77	2.20	5.30	11	3.18	2.60	4.10	0	-	-	-	0	-	-	-	0	-	-	-
		5/13/08	6	7.19	5.16	9.05	5	10.32	5.26	13.20	0	-	-	-	0	-	-	-	0	-	-	-
		9/3/08	6	7.08	4.91	11.90	10	6.60	4.27	9.38	0	-	-	-	0	-	-	-	0	-	-	-
	CC-150	9/3/06	4	6.01	5.32	6.69	4	5.83	4.75	7.71	0	-	-	-	0	-	-	-	0	-	-	-
		5/9/07	5	5.04	4.40	5.80	3	8.67	8.00	10.00	0	-	-	-	0	-	-	-	0	-	-	-
		8/24/07	5	5.14	3.40	7.70	2	5.20	4.30	6.10	0	-	-	-	0	-	-	-	0	-	-	-
		5/13/08	6	10.73	8.25	14.70	5	10.14	8.61	12.20	0	-	-	-	0	-	-	-	0	-	-	-
		9/3/08	6	7.35	5.11	10.50	10	7.83	2.52	13.50	0	-	-	-	0	-	-	-	0	-	-	-
	CC-350	8/31/06	4	6.47	5.21	7.56	3	6.28	4.60	7.40	0	-	-	-	0	-	-	-	0	-	-	-
		5/8/07	6	7.12	6.30	8.20	3	8.53	7.40	9.70	4	9.58	7.80	11.60	0	-	-	-	0	-	-	-
		8/23/07	6	5.28	4.10	6.70	4	5.78	4.60	6.80	0	-	-	-	0	-	-	-	0	-	-	-
		5/13/08	6	10.03	9.23	11.30	2	11.50	10.90	12.10	4	13.03	10.60	16.10	0	-	-	-	0	-	-	-
		9/4/08	6	9.53	7.26	11.00	10	7.95	4.97	10.60	0	-	-	-	0	-	-	-	0	-	-	-
Deer Creek	DC-600	9/7/06	4	8.50	6.48	10.75	4	8.54	8.05	9.43	0	-	-	-	0	-	-	-	0	-	-	-
		5/13/07	6	7.87	6.50	10.80	4	6.20	4.30	7.50	0	-	-	-	0	-	-	-	0	-	-	-
		8/27/07	3	7.63	6.90	8.60	10	5.85	4.10	8.70	0	-	-	-	0	-	-	-	0	-	-	-
		5/18/08	6	7.96	5.10	9.40	6	12.83	9.29	14.40	0	-	-	-	0	-	-	-	0	-	-	-
		9/8/08	6	8.62	5.32	11.60	10	10.54	6.35	18.70	0	-	-	-	0	-	-	-	0	-	-	-
Hoopes Spring and Sage Creek																						
Hoopes Spring	HS	9/8/06	4	23.23	11.69	38.57	3	16.52	14.07	20.00	0	-	-	-	0	-	-	-	0	-	-	-
		5/14/07	6	23.25	19.20	29.80	1	25.00	25.00	25.00	0	-	-	-	0	-	-	-	0	-	-	-
		8/24/07	2	10.95	10.20	11.70	4	24.90	21.00	28.80	0	-	-	-	0	-	-	-	0	-	-	-
		5/17/08	6	35.93	30.90	41.80	3	32.63	28.20	38.90	0	-	-	-	0	-	-	-	0	-	-	-
		9/4/08	6	41.30	37.10	45.30	1	22.80	22.80	22.80	0	-	-	-	0	-	-	-	0	-	-	-
	HS-3	9/6/06	4	21.85	17.74	24.87	4	20.60	17.52	25.61	0	-	-	-	0	-	-	-	0	-	-	-
		5/12/07	6	18.57	13.00	26.20	4	18.83	14.70	22.00	0	-	-	-	0	-	-	-	0	-	-	-
		8/28/07	6	26.63	18.70	35.20	11	17.89	12.20	24.40	0	-	-	-	0	-	-	-	0	-	-	-
		5/16/08	6	23.93	21.80	26.90	6	23.68	17.80	31.30	0	-	-	-	0	-	-	-	0	-	-	-
		9/5/08	6	23.68	20.90	25.50	10	28.97	24.30	38.50	0	-	-	-	0	-	-	-	0	-	-	-
Sage Creek	LSV-2C	9/6/06	4	17.47	14.14	22.84	6	19.45	16.00	22.82	0	-	-	-	0	-	-	-	0	-	-	-
		5/12/07	6	11.38	9.40	13.50	4	12.78	8.50	22.20	0	-	-	-	0	-	-	-	0	-	-	-
		8/28/07	6	18.85	15.50	21.00	9	22.67	10.80	33.30	0	-	-	-	0	-	-	-	0	-	-	-
		5/16/08	6	25.95	14.80	36.00	7	19.53	11.40	29.60	0	-	-	-	0	-	-	-	0	-	-	-
		9/5/08	6	20.32	18.60	23.30	11	20.96	17.40	25.00	0	-	-	-	0	-	-	-	0	-	-	-
	LSV-4	9/5/06	4	20.01	14.57	24.44	4	16.20	15.07	18.91	0	-	-	-	0	-	-	-	0	-	-	-
		5/9/07	6	18.28	11.40	31.70	4	15.18	11.70	17.80	0	-	-	-	0	-	-	-	0	-	-	-

Table 3
Summary of Fish Tissue Selenium Data Collected During the Fall 2006 - Fall 2008 Monitoring Events

Stream	Location	Date	Sculpin (mg/kg dw)				Trout (mg/kg dw)				Dace (mg/kg dw)				Suckers (mg/kg dw)				Shiners (mg/kg dw)			
			Count	Mean	Min	Max	Count	Mean	Min	Max	Count	Mean	Min	Max	Count	Mean	Min	Max	Count	Mean	Min	Max
Downstream of Sage Creek																						
Crow Creek	CC-1A	9/1/06	4	9.94	8.92	11.73	4	10.51	8.15	12.74	0	-	-	-	0	-	-	-	0	-	-	-
		5/10/07	5	8.34	7.40	10.80	3	9.33	7.40	10.70	3	10.93	7.30	14.70	0	-	-	-	0	-	-	-
		8/25/07	6	7.78	5.50	12.50	11	9.95	6.30	14.80	0	-	-	-	0	-	-	-	0	-	-	-
		5/14/08	3	17.47	16.20	19.80	6	16.85	13.40	18.30	4	18.03	12.70	25.10	0	-	-	-	1	12.50	12.50	12.50
		9/6/08	3	12.63	10.50	14.10	10	14.03	8.04	23.00	3	12.19	9.66	13.70	0	-	-	-	0	-	-	-
	CC-3A	9/4/06	3	14.45	11.34	16.55	4	10.44	8.31	14.34	0	-	-	-	0	-	-	-	0	-	-	-
		5/11/07	4	11.65	8.80	15.00	4	9.20	7.50	12.70	6	11.60	7.40	19.00	0	-	-	-	0	-	-	-
		8/26/07	3	11.47	8.00	14.20	13	11.25	7.80	15.60	4	7.28	5.60	9.70	0	-	-	-	0	-	-	-
		5/15/08	0	-	-	-	4	15.38	15.00	15.80	5	14.72	9.42	17.00	0	-	-	-	4	11.21	8.72	13.90
		9/7/08	1	20.2	20.2	20.2	8	19.68	16.30	23.20	2	14.25	12.40	16.10	1	10.20	10.20	10.20	3	9.79	8.07	11.20

Note: Trout column includes Brown Trout, Yellowstone Cutthroat Trout, and other trout species.
Dace column includes both Speckled Dace and Longnose Dace species.
- None Collected

Table 4
Comparison of Trout Tissue Selenium Concentrations from Mine-Influenced and Un-influenced Locales in the Crow Creek Watershed and a Reference Location
Fall 2006 - Fall 2008 Monitoring Events

Kruskal-Wallis Multiple Comparison Z-Value Test								
Count	**Median**	**Location**	**SFTC-1**	**CC-75, CC-150, CC-350**	**DC-600**	**HS-3**	**LSV-2C, LSV-4**	**CC-1A, CC-3A**
29	0.41	**SFTC-1**	0					
77	0.82	**CC-75, CC-150, CC-350**	3.2922	0				
34	0.92	**DC-600**	4.1772	1.6444	0			
35	1.36	**HS-3**	10.6228	9.5663	6.6927	0		
45	1.29	**LSV-2C, LSV-4**	10.2611	9.1994	6.1065	0.9939	0	
69	1.10	**CC-1A, CC-3A**	7.6747	5.9188	3.0667	4.6695	3.8881	0

Kruskal-Wallis One-Way ANOVA on Ranks, $p<0.05$.
normal, unequal variances, log-transformed data.
Bonferroni Test: Medians significantly different if z-value > 2.9352.
Shaded cells indicate significant difference.

Table 5
Comparison of Trout Tissue Selenium Concentrations from Each Location
Fall 2006 - Fall 2008 Monitoring Events

Kruskal-Wallis Multiple Comparison Z-Value Test												
Count	**Median**	**Location**	**SFTC-1**	**CC-75**	**CC-150**	**CC-350**	**DC-600**	**HS-3**	**LSV-2C**	**LSV-4**	**CC-1A**	**CC-3A**
29	0.41	**SFTC-1**	0									
32	0.66	**CC-75**	1.8109	0								
23	0.90	**CC-150**	3.2529	1.6241	0							
22	0.88	**CC-350**	3.1324	1.5213	0.0759	0						
34	0.92	**DC-600**	4.1772	2.402	0.5468	0.6223	0					
35	1.33	**HS-3**	10.6228	9.0078	6.5538	6.549	6.6927	0				
37	1.31	**LSV-2C**	10.1193	8.473	6.0311	6.0325	6.1196	0.669	0			
8	1.19	**LSV-4**	5.3514	4.2319	2.9938	3.0312	2.7515	1.3534	0.9557	0		
34	1.07	**CC-1A**	6.5462	4.8333	2.7648	2.8108	2.469	4.2058	3.599	1.2276	0	
35	1.13	**CC-3A**	6.9331	5.2197	3.1022	3.1437	2.845	3.8759	3.2603	1.0109	0.3581	0

Kruskal-Wallis One-Way ANOVA on Ranks, $p<0.05$.
normal, unequal variances, log-transformed data.
Bonferroni Test: Medians significantly different if z-value > 3.3172.
Shaded cells indicate significant difference.

Table 6
Comparison of Brown Trout Tissue Selenium Concentrations from Each Location
Fall 2006 - Fall 2008 Monitoring Events

Kruskal-Wallis Multiple Comparison Z-Value Test										
Count	**Median**	**Location**	**CC-75**	**CC-150**	**CC-350**	**HS-3**	**LSV-2C**	**LSV-4**	**CC-1A**	**CC-3A**
28	0.64	**CC-75**	0							
16	0.90	**CC-150**	0.9372	0						
10	0.85	**CC-350**	0.7548	0.0388	0					
29	1.33	**HS-3**	8.5982	6.372	5.4538	0				
36	1.31	**LSV-2C**	8.4807	6.1346	5.2002	0.5656	0			
5	1.19	**LSV-4**	3.4117	2.6597	2.5165	1.2838	1.0068	0		
31	1.07	**CC-1A**	4.2347	2.6324	2.2712	4.5445	4.2155	1.1462	0	
34	1.13	**CC-3A**	4.8004	3.072	2.6324	4.1659	3.8132	0.9006	0.4872	0

Kruskal-Wallis One-Way ANOVA on Ranks, $p<0.05$.
normal, unequal variances, log-transformed data.
Bonferroni Test: Medians significantly different if z-value > 3.1237.
Shaded cells indicate significant difference.

Table 7
Comparison of Sculpin Tissue Selenium Concentrations from Mine-Influenced and Un-influenced Locales in the Crow Creek Watershed and a Reference Location

Kruskal-Wallis Multiple Comparison Z-Value Test								
Count	**Median**	**Location**	**SFTC-1**	**CC-75, CC-150, CC-350**	**DC-600**	**HS-3**	**LSV-2C, LSV-4**	**CC-1A, CC-3A**
28	0.67	**SFTC-1**	0					
82	0.81	**CC-75, CC-150, CC-350**	1.3538	0				
25	0.91	**DC-600**	2.5007	1.7148	0			
28	1.37	**HS-3**	8.6061	9.1545	5.8583	0		
38	1.27	**LSV-2C, LSV-4**	8.0184	8.6665	5.083	1.2167	0	
32	1.03	**CC-1A, CC-3A**	4.6882	4.3988	1.9671	4.2001	3.2671	0

Kruskal-Wallis One-Way ANOVA on Ranks, $p<0.05$.
normal, unequal variances, log-transformed data.
Bonferroni Test: Medians significantly different if z-value > 2.9352.
Shaded cells indicate significant difference.

Table 8
Comparison of Sculpin Tissue Selenium Concentrations from Each Location

Kruskal-Wallis Multiple Comparison Z-Value Test												
Count	**Median**	**Location**	**SFTC-1**	**CC-75**	**CC-150**	**DC-600**	**CC-350**	**HS-3**	**LSV-2C**	**LSV-4**	**CC-1A**	**CC-3A**
28	0.67	**SFTC-1**	0									
28	0.73	**CC-75**	0.0397	0								
26	0.79	**CC-150**	1.1908	1.2297	0							
25	0.91	**DC-600**	2.5007	2.5392	1.2988	0						
28	0.87	**CC-350**	2.16	2.1996	0.9288	0.4028	0					
28	1.37	**HS-3**	8.6061	8.6458	7.2545	5.8583	6.4462	0				
28	1.27	**LSV-2C**	7.4612	7.5009	6.131	4.7462	5.3012	1.1449	0			
10	1.25	**LSV-4**	5.4436	5.4723	4.5177	3.5206	3.8766	0.8	0.0306	0		
21	0.98	**CC-1A**	3.6617	3.6984	2.4975	1.2464	1.662	4.306	3.246	2.4682	0	
11	1.14	**CC-3A**	4.247	4.2768	3.3001	2.2751	2.6248	2.2167	1.3568	1.1308	1.2204	0

Kruskal-Wallis One-Way ANOVA on Ranks, $p<0.05$.
normal, unequal variances, log-transformed data.
Bonferroni Test: Medians significantly different if z-value > 3.2608.
Shaded cells indicate significant difference.

Table 9
Fish Tissue Comparisons
Sculpin Versus Trout

Location	Stat Tested	Normality	Variances	p	Test	Sig Diff	Notes
SFTC-1	median	no	unequal	0.000004	KW ANOVA	y	sculpin tissue conc sign diff from trout
CC-75	median	no	equal	0.269	KW ANOVA	n	
CC-150	mean	yes	equal	0.321	ANOVA	n	
CC-350	mean	yes	equal	0.001178	ANOVA	n	minnow species diff from sculpin and trout
DC-600	median	no	unequal	0.853	KW ANOVA	n	
HS	median	yes	unequal	0.127	KW ANOVA	n	
HS-3	mean	yes	equal	0.7	ANOVA	n	
LSV-2C	mean	yes	equal	0.4546	ANOVA	n	
CC-1A	median	no	equal	0.059	KW ANOVA	n	4 species
CC-3A	median	yes	unequal	0.605	KW ANOVA	n	4 species

Table 10
Summary Statistics for Cyprinids and Catostomids Combined at Each Location Where Fish Tissue Samples Were Collected

Location	Count	Minimum	Maximum	Mean	Median	Standard Deviation	UCL	UCL Method	Distribution	ANOVA p-value
CC-350	8	7.80	16.10	11.30	10.95	2.703	13.11	95% student's-t UCL	normal	0.495
CC-1A	11	7.30	25.10	14.00	13.20	4.718	16.57	95% student's-t UCL	normal	
CC-3A	25	5.60	19.00	11.41	10.80	3.538	12.62	95% student's-t UCL	normal	

Log-transformed data, ANOVA.

Table 11
Brown Trout Tissue Selenium Summary Statistics

Location	Count	Minimum	Maximum	Mean	Median	Standard Deviation	UCL	UCL Method	Distribution	Notes	Kruskal-Wallis Group	Kruskal-Wallis Group Significantly Different Than
CC-150	10	4.70	8.40	6.25	5.95	1.08	6.87	95% student's-t UCL	normal		upstream	Sage
CC-350	3	5.50	9.20	7.73	8.50	1.97				Data set is too small to compute reliable and meaningful statistics and estimates!	upstream	
LSV-2C	20	6.20	23.80	14.03	13.40	5.56	16.18	95% student's-t UCL	normal		Sage	upstream, downstream
CC-1A	2	6.40	8.70	7.55	7.55	1.63				Data set is too small to compute reliable and meaningful statistics and estimates!	downstream	Sage
CC-3A	4	5.30	8.00	6.50	6.35	1.12				Data set is too small to compute reliable and meaningful statistics and estimates!	downstream	

Data grouped for statistical analyses, summary statistics developed by location.

Table 12
Yellowstone Cutthroat Trout Tissue Selenium Summary Statistics

Location	Count	Minimum	Maximum	Mean	Median	Standard Deviation	UCL	UCL Method	Distribution	Notes	Tukey-Kramer Group	Tukey-Kramer Group Significantly Different Than
SFTC-1	2	2.56	3.51	3.04	3.04	0.67				Data set is too small to compute reliable and meaningful statistics and estimates!	not included	
CC-150	1	16.30	16.30	16.30	16.30					Data set is too small to compute reliable and meaningful statistics and estimates!	upstream	Deer
CC-350	6	11.70	25.70	18.53	18.20	4.67	22.38	95% student's-t UCL	normal	A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!	upstream	Deer
DC-Lower	4	8.17	16.60	10.62	8.85	4.01				Data set is too small to compute reliable and meaningful statistics and estimates!	Deer	upstream, Sage
LSV-2C	9	11.10	25.00	19.87	19.70	3.95	22.32	95% student's-t UCL	normal		Sage	Deer

Table 13
Benthic Invertebrate Tissue Selenium Summary Statistics

Location	Count	Minimum	Maximum	Mean	Median	Standard Deviation	UCL	UCL Method	Distribution	Notes	Kruskal-Wallis Multiple Comparison Z-Value Test, Median Significantly Different Than
SFTC-1	4	0.14	4.83	2.45	2.42	2.02				n too small	HS, HS-3, LSV-2C, and CC-1A
CC-75	4	0.00	3.49	2.25	2.76	1.57				n too small	HS, HS-3, LSV-2C
CC-150	5	1.90	21.60	7.99	4.94	7.83	15.5	95% student's-t UCL	normal		LSV-2C
CC-350	4	2.11	12.30	7.30	7.40	4.91				n too small	LSV-2C
DC-600	4	6.35	10.71	8.18	7.83	1.95				n too small	
HS	4	1.00	33.90	18.08	18.70	13.67				n too small	SFTC-1, CC-75
HS-3	5	11.40	28.40	18.48	15.41	7.63	25.8	95% student's-t UCL	normal		SFTC-1, CC-75
LSV-2C	5	8.26	31.74	23.30	23.90	9.26	32.1	95% student's-t UCL	normal	Recommended UCL exceeds the maximum observation	SFTC-1, CC-75, CC-150, CC-350
LSV-4	2	9.08	10.00	9.54	9.54	0.65				n too small	
CC-1A	5	3.53	15.50	11.15	12.24	4.51	15.5	95% student's-t UCL	normal		SFTC-1
CC-3A	4	5.41	17.80	9.97	8.34	5.88				n too small	

Kruskal-Wallis Multiple Comparison Z-Value Test.

non-normal, unequal variances, log-transformed data.

Regular Test: Medians significantly different if z-value > 1.9600.

Table 14
Periphyton Summary Statistics for Tissue Selenium Concentrations

Location	Count	Minimum	Maximum	Mean	Median	Standard Deviation	UCL	UCL Method	Distribution	Notes	Tukey-Kramer Multiple-Comparison Test, Different from Groups
SFTC-1	4	0.15	1.15	0.69	0.73	0.42				n too small	CC-3A, CC-1A, LSV-2C, HS, HS-3
CC-75	5	0.55	2.70	1.21	1.01	0.86	2.03	95% student's-t UCL	normal		LSV-2C, HS, HS-3
CC-150	5	0.65	2.40	1.28	1.20	0.69	1.94	95% student's-t UCL	normal		LSV-2C, HS, HS-3
CC-350	5	0.59	3.40	1.91	1.50	1.36	3.21	95% student's-t UCL	normal		HS, HS-3
DC-600	4	1.20	8.70	4.75	4.55	3.88				n too small	
HS	5	2.20	35.20	13.66	12.00	13.18	26.23	95% student's-t UCL	normal		SFTC-1, CC-150, CC-75, CC-350
HS-3	5	6.20	28.50	15.48	12.00	10.30	25.30	95% student's-t UCL	normal		SFTC-1, CC-150, CC-75, CC-350
LSV-2C	5	2.60	18.50	9.03	8.09	6.33	15.07	95% student's-t UCL	normal		SFTC-1, CC-150, CC-75
LSV-4	2	7.42	11.70	9.56	9.56	3.03				n too small	not included in analysis
CC-1A	5	3.20	7.10	4.64	3.64	1.74	6.30	95% student's-t UCL	normal		SFTC-1
CC-3A	5	1.67	14.90	5.07	3.10	5.56	15.58	95% student's-t UCL	normal	Recommended UCL exceeds the maximum observation	SFTC-1

Log-transformed data.
equal variances, normal distribution.

Table 15
Site-Specific Bioconcentration and Bioaccumulation Factors from Surface Water

Stream	Location	Monitoring Event	Water Concentrations		Periphyton	Benthos	Sculpin Mean	Trout Mean	BCFs and BAFs*		
			Total Selenium (mg/L)	Dissolved Selenium (mg/L)	Selenium (mg/kg dw)	Selenium (mg/kg dw)	Selenium (mg/kg dw)	Selenium (mg/kg dw)	Periphyton BCF	Ratio Benthos/ Periphyton	Ratio Sculpin/ Benthos
Reference											
SF Tincup Creek	SFTC-1	Spring 2007	0.00033	0.00043	0.82	3.21	5.68	3.68	1906.98	3.91	1.77
		Fall 2007	0.00040	0.00020	0.63	3.21	3.75	2.25	3150.00	5.10	1.17
		Spring 2008	0.00058	0.00044	1.15	4.83	***9.31***	6.70	2613.64	4.20	1.93
		Fall 2008	0.00095	0.00067	0.15	0.14	5.87	2.64	223.88	0.93	41.93
									1369.24	2.97	3.60
Upstream of Sage Creek											
Crow Creek	CC-75	Fall 2006	0.00053	0.00057	1.01	3.11	5.58	4.05	1771.93	3.08	1.79
		Spring 2007	0.00047	0.00046	0.68	**	5.03	5.35	1478.26		
		Fall 2007	0.00033	0.00033	1.1	**	3.77	3.18	3333.33		
		Spring 2008	0.0012	0.0012	2.7	4.45	7.19	***10.32***	2250.00	1.65	1.62
		Fall 2008	0.0015	0.0008	0.55	3.49	7.08	6.60	687.50	6.35	2.03
	CC-150	Fall 2006	0.00062	0.00067	1.2	4.94	6.01	5.83	1791.04	4.12	1.22
		Spring 2007	0.00083	0.00092	1.37	4.46	5.04	***8.67***	1489.13	3.26	1.13
		Fall 2007	0.00059	0.00068	0.77	4.46	5.14	5.20	1132.35	5.79	1.15
		Spring 2008	0.0018	0.0014	2.4	7.03	***10.73***	***10.14***	1714.29	2.93	1.53
		Fall 2008	0.0023	0.0016	0.65	21.60	7.35	7.83	406.25	33.23	0.34
	CC-350	Fall 2006	0.00083	0.00082	1.5	2.11	6.47	6.28	1829.27	1.41	3.07
		Spring 2007	0.00084	0.0011	3.3	4.20	7.12	***8.53***	3000.00	1.27	1.69
		Fall 2007	0.0002	0.00026	0.77	**	5.28	5.78	2961.54		
		Spring 2008	0.001	0.00089	3.4	10.60	***10.03***	***11.50***	3820.22	3.12	0.95
		Fall 2008	0.0012	0.0013	0.59	12.30	***9.53***	***7.95***	453.85	20.85	0.77
Deer Creek	DC-600	Fall 2006	0.0014	0.0013	1.2	10.71	***8.50***	***8.54***	923.08	8.93	0.79
		Spring 2007	0.0019	0.0015	7.44	6.35	7.87	6.20	4960.00	0.85	1.24
		Fall 2007	0.0018	0.002	**	**	7.63	5.85			
		Spring 2008	0.0015	0.0014	8.7	8.65	***7.96***	***12.83***	6214.29	0.99	0.92
		Fall 2008	0.0031	0.0034	1.65	7.01	***8.62***	***10.54***	485.29	4.25	1.23
									1632.35	3.63	1.21
Hoopes Spring and Sage Creek											
Hoopes Spring	HS	Fall 2006	**0.0174**	0.0174	2.2	1.00	***23.23***	***16.52***	126.44	0.45	23.23
		Spring 2007	**0.0301**	0.0205	12.00	15.70	***23.25***	***25.00***	585.37	1.31	1.48
		Fall 2007	**0.0242**	0.0214	3.90	**	***10.95***	***24.90***	182.24		
		Spring 2008	**0.0296**	0.0273	15.0	21.7	***35.93***	***32.63***	549.45	1.45	1.66
		Fall 2008	**0.0502**	0.0536	35.2	33.9	***41.30***	***22.80***	656.72	0.96	1.22
	HS-3	Fall 2006	**0.0108**	0.0092	6.5	12.47	***21.85***	***20.60***	706.52	1.92	1.75
		Spring 2007	**0.0198**	0.018	12.00	11.40	***18.57***	***18.83***	666.67	0.95	1.63
		Fall 2007	**0.0158**	0.0161	6.20	11.40	***26.63***	***17.89***	385.09	1.84	2.34
		Spring 2008	**0.0223**	0.026	28.5	28.4	***23.93***	***23.68***	1096.15	1.00	0.84
		Fall 2008	**0.0402**	0.0375	24.2	24.7	***23.68***	***28.97***	645.33	1.02	0.96
Sage Creek	LSV-2C	Fall 2006	**0.0095**	0.0093	2.6	22.62	***17.47***	***19.45***	279.57	8.70	0.77
		Spring 2007	**0.0135**	0.0135	8.09	8.26	***11.38***	***12.78***	599.26	1.02	1.38
		Fall 2007	**0.0144**	0.0143	18.50	31.74	***18.85***	***22.67***	1293.71	1.72	0.59
		Spring 2008	**0.0145**	0.0141	11.6	30.00	***25.95***	***19.53***	822.70	2.59	0.87
		Fall 2008	**0.0242**	0.0234	4.38	23.90	***20.32***	***20.96***	187.18	5.46	0.85
	LSV-4	Fall 2006	**0.007**	0.0068	7.42	10.00	***20.01***	***16.20***	1091.18	1.35	2.00
		Spring 2007	**0.0103**	0.0101	11.70	9.08	***18.28***	***15.18***	1158.42	0.78	2.01
									537.81	1.50	1.51
Downstream of Sage Creek											
Crow Creek	CC-1A	Fall 2006	0.0029	0.0027	3.64	3.53	***9.94***	***10.51***	1348.15	0.97	2.81
		Spring 2007	0.0016	0.0012	3.39	12.9	***8.34***	***9.33***	2825.00	3.81	0.65
		Fall 2007	0.0014	0.0022	3.20	12.90	7.78	***9.95***	1454.55	4.03	0.60
		Spring 2008	0.0032	0.0029	7.10	15.50	***17.47***	***16.85***	2448.28	2.18	1.13
		Fall 2008	**0.0065**	0.0067	5.86	11.60	***12.63***	***14.03***	874.63	1.98	1.09
	CC-3A	Fall 2006	0.003	0.0029	3.10	5.48	***14.45***	***10.44***	1068.97	1.77	2.64
		Spring 2007	0.0013	0.0014	1.89	5.41	***11.65***	***9.20***	1350.00	2.86	2.15
		Fall 2007	0.0011	0.0018	3.80	**	***11.47***	***11.25***	2111.11		
		Spring 2008	0.0036	0.0026	14.9	17.80	NC	***15.38***	5730.77	1.19	
		Fall 2008	**0.0058**	0.0058	1.67	11.20	***20.20***	***19.68***	287.93	6.71	1.80
									1505.04	2.40	1.39

Shaded cells are geometric means across the seasonal periods and/or the location groupings.
** Insufficient biomass for reanalysis. Initial analyses were compromised.
NC - No sculpin were collected during this timeframe.
Bold values exceed the State of Idaho Water quality standard for total selenium (0.005 mg/L).
Bold and italic values exceed the USEPA draft fish tissue criterion for selenium in whole body fish (7.9 mg/kg dw).

FIGURES

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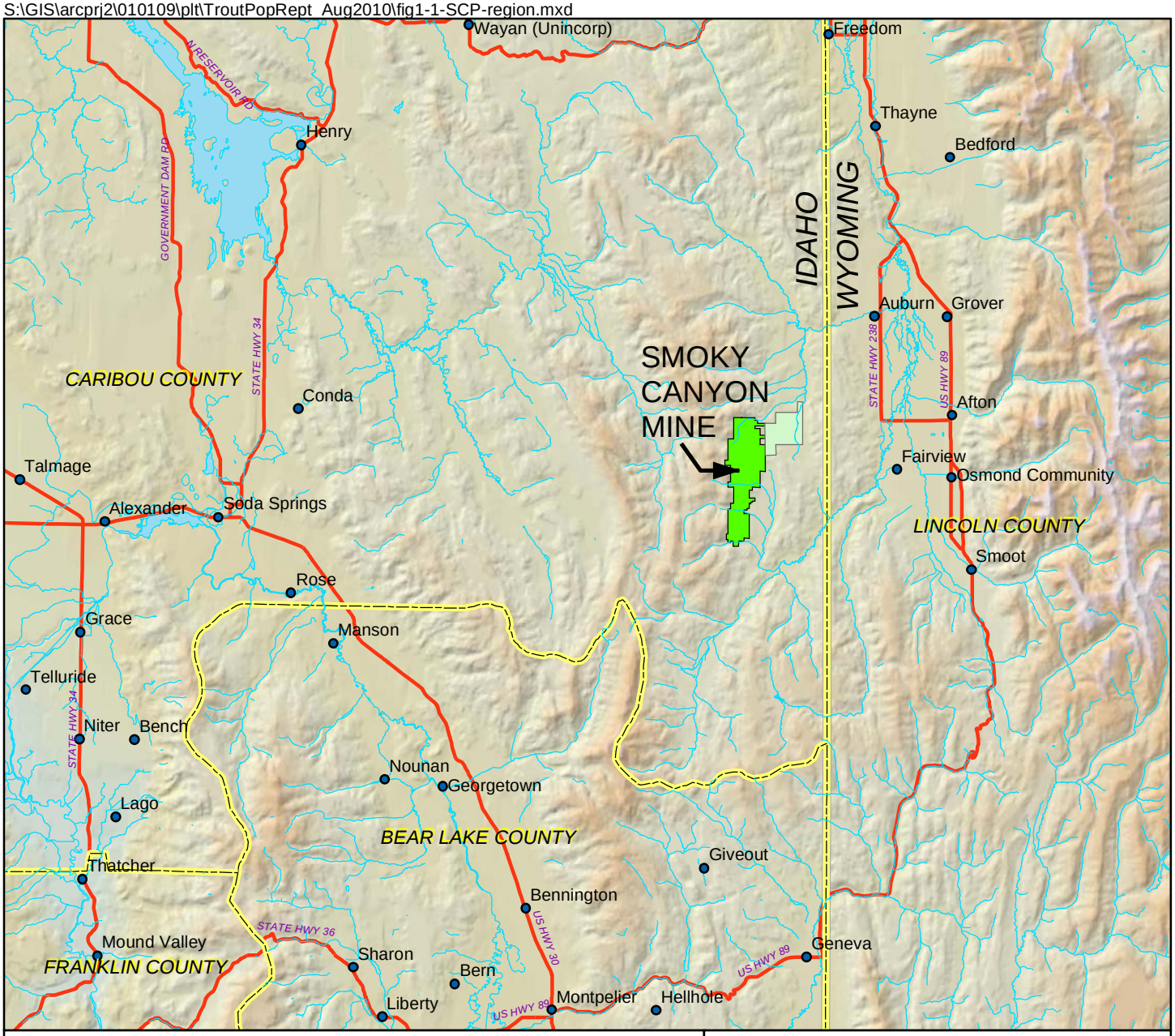

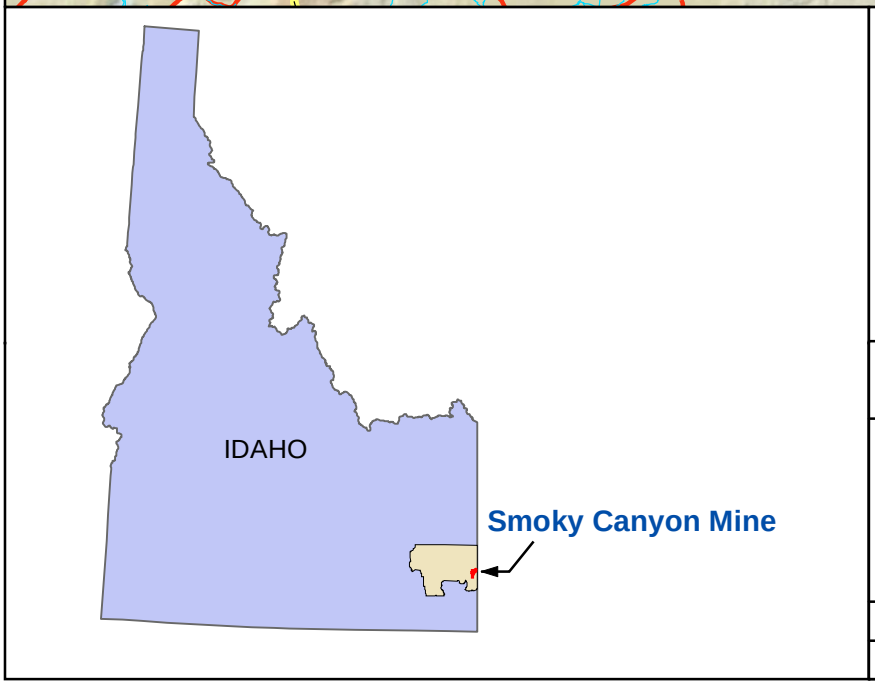

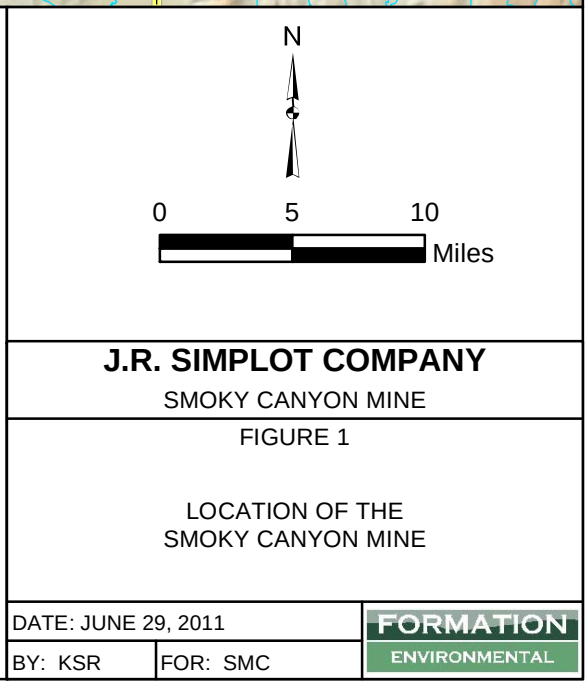

J.R. SIMPLOT COMPANY

SMOKY CANYON MINE

FIGURE 1

LOCATION OF THE
SMOKY CANYON MINE

DATE: JUNE 29, 2011		FORMATION ENVIRONMENTAL
BY: KSR	FOR: SMC	

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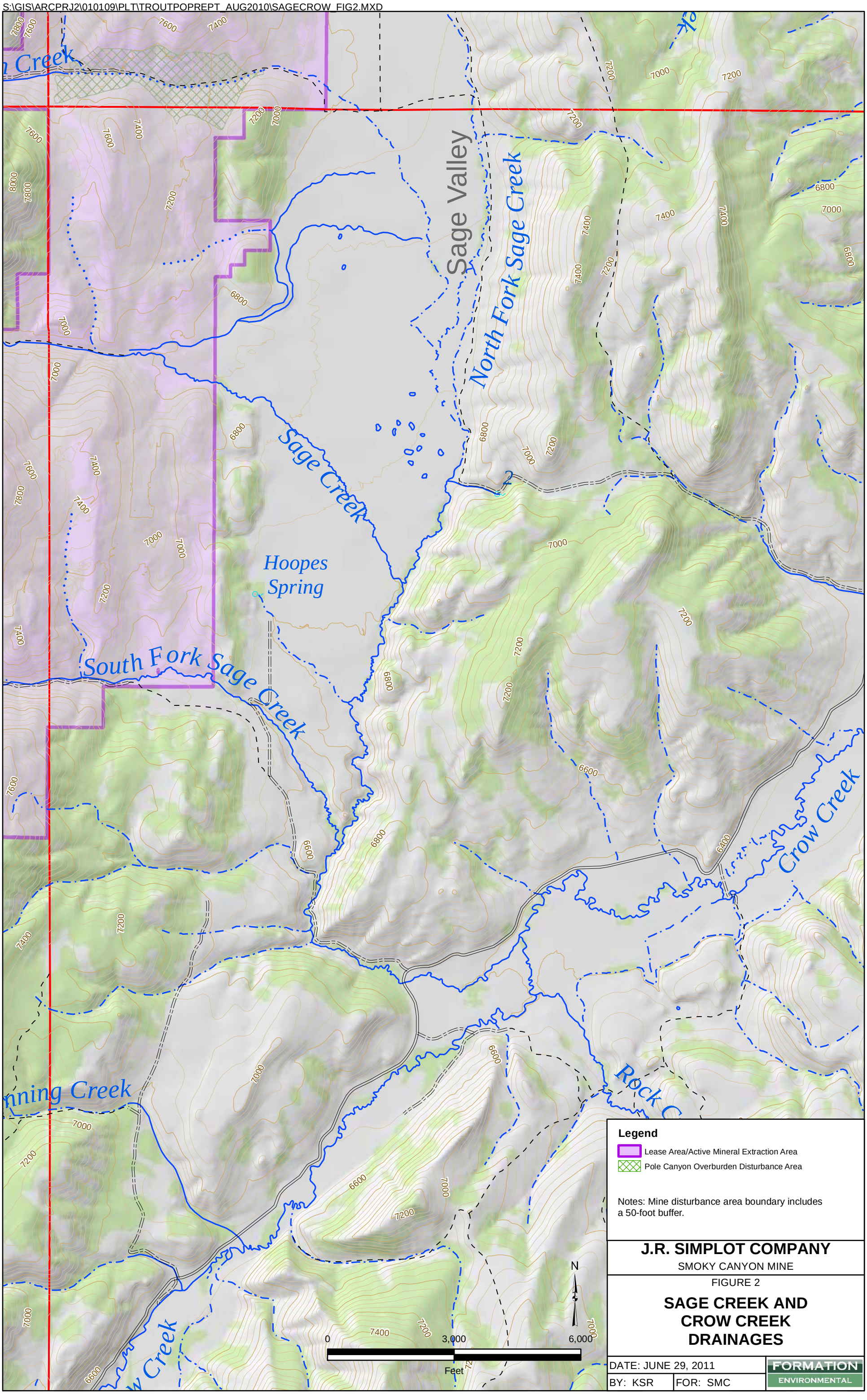

J.R. SIMPLOT COMPANY

SMOKY CANYON MINE

FIGURE 2

SAGE CREEK AND CROW CREEK DRAINAGES

DATE: JUNE 29, 2011

BY: KSR | FOR: SMC

FORMATION ENVIRONMENTAL

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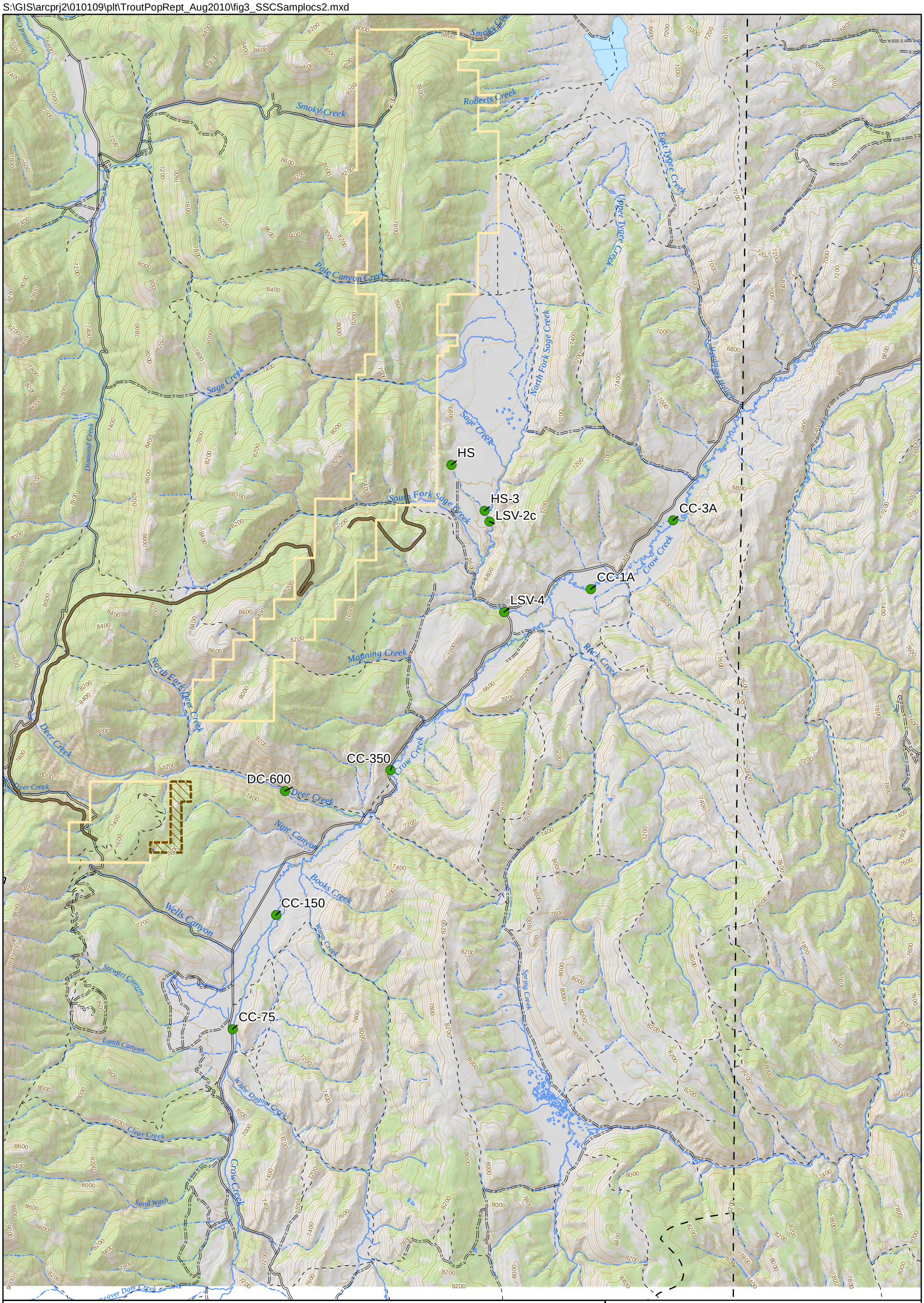


SSSC Monitoring Locations

Pending Lease Modification Area

Lease Area/Active Mineral Extraction Area

N

Miles

0 1 2

J.R. SIMPLOT COMPANY

SMOKY CANYON MINE

FIGURE 3

SITE-SPECIFIC SELENIUM CRITERION STUDY MONITORING LOCATIONS

DATE: JUNE 29, 2011

BY: KSR | FOR: SMC

FORMATION ENVIRONMENTAL

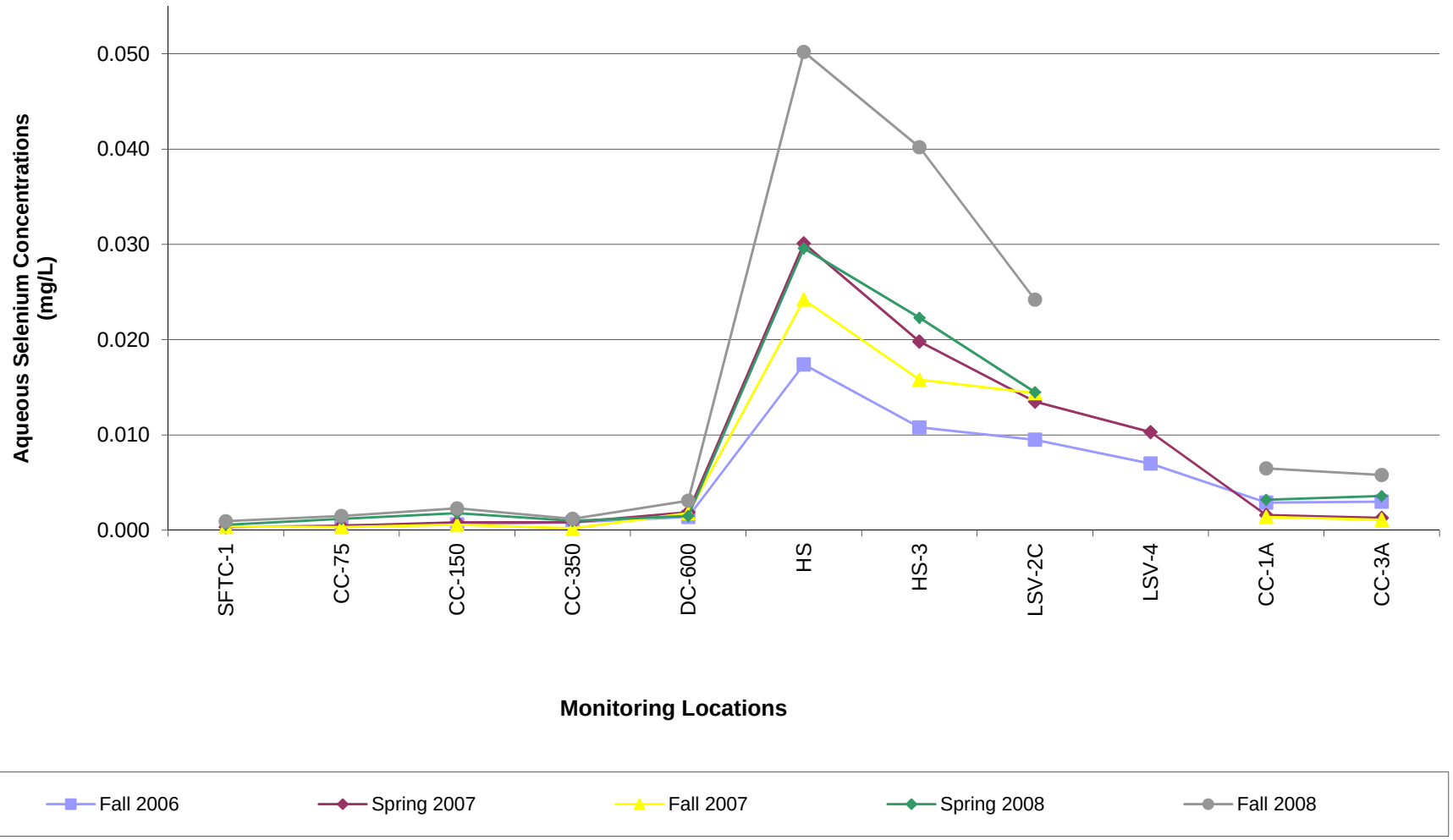
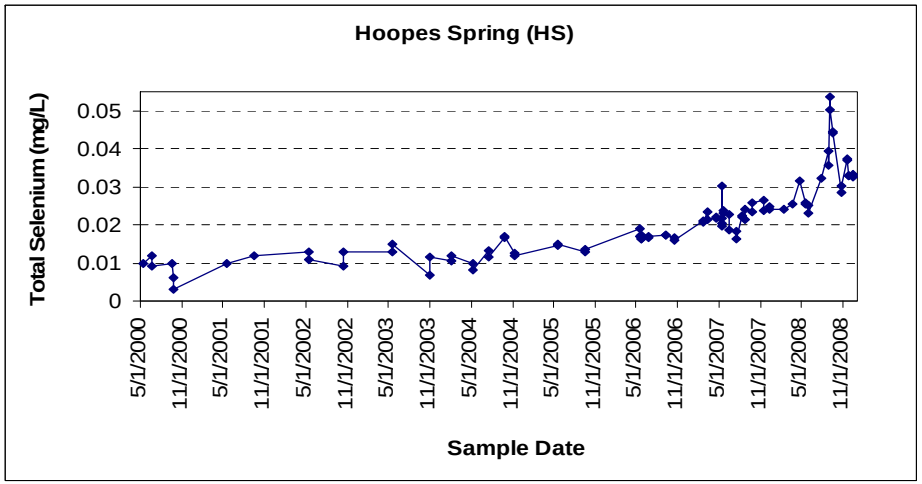


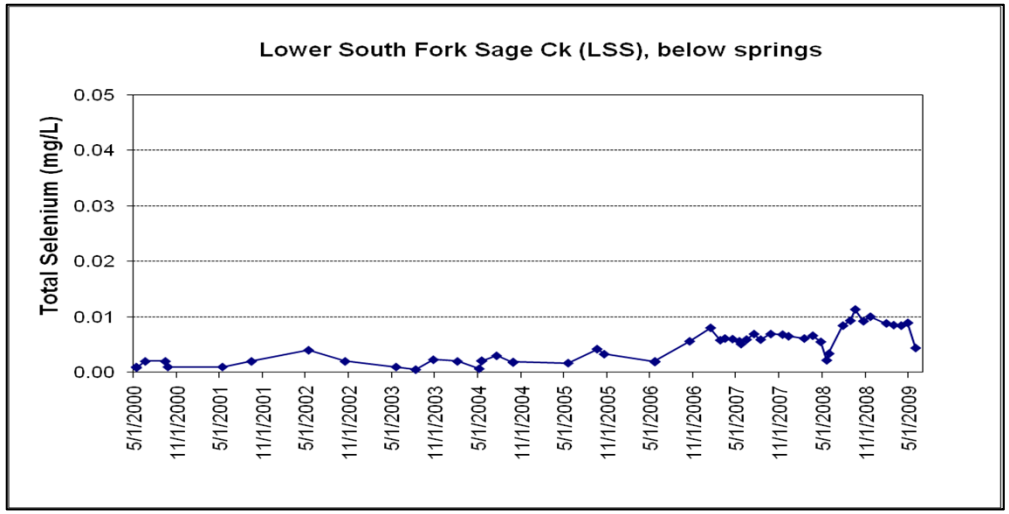
Figure 4
Aqueous Selenium Concentrations from 11 Locations
Fall 2006 – Fall 2008

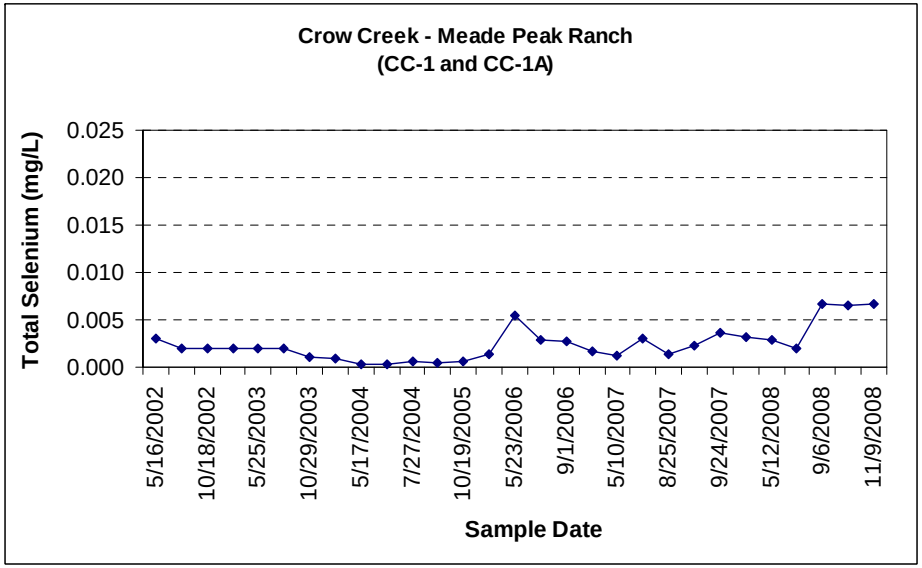
J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL







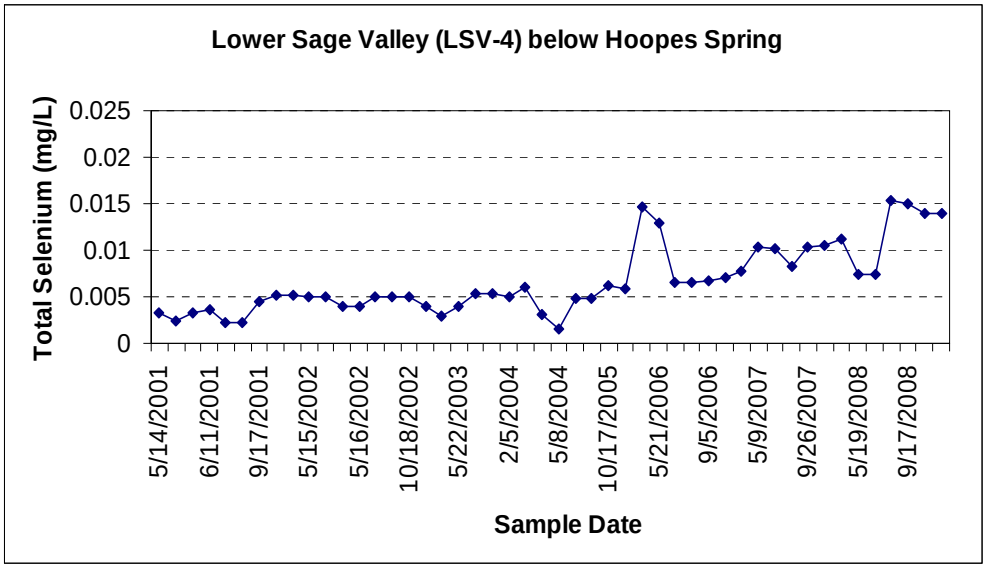
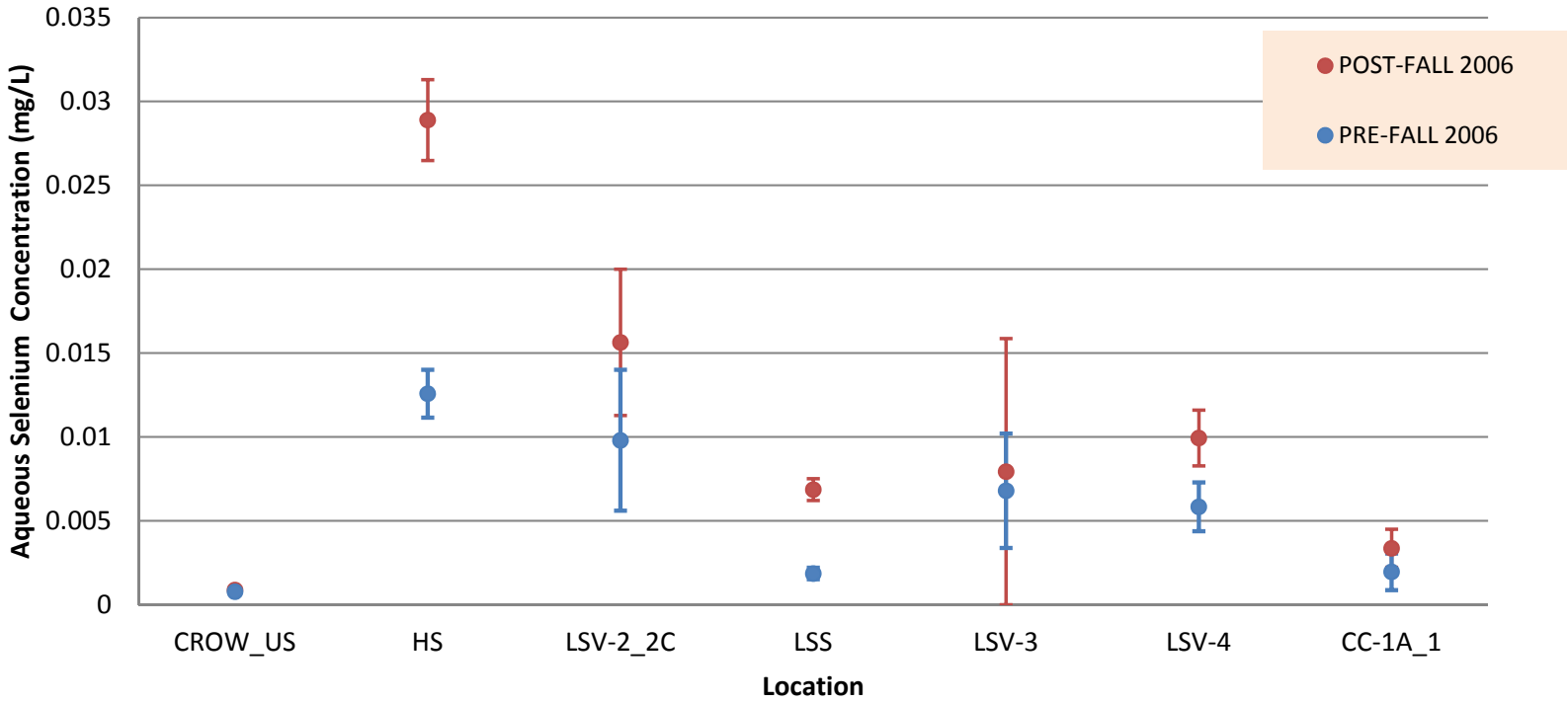


Figure 5
Long-Term Aqueous Selenium Concentration Trends

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL



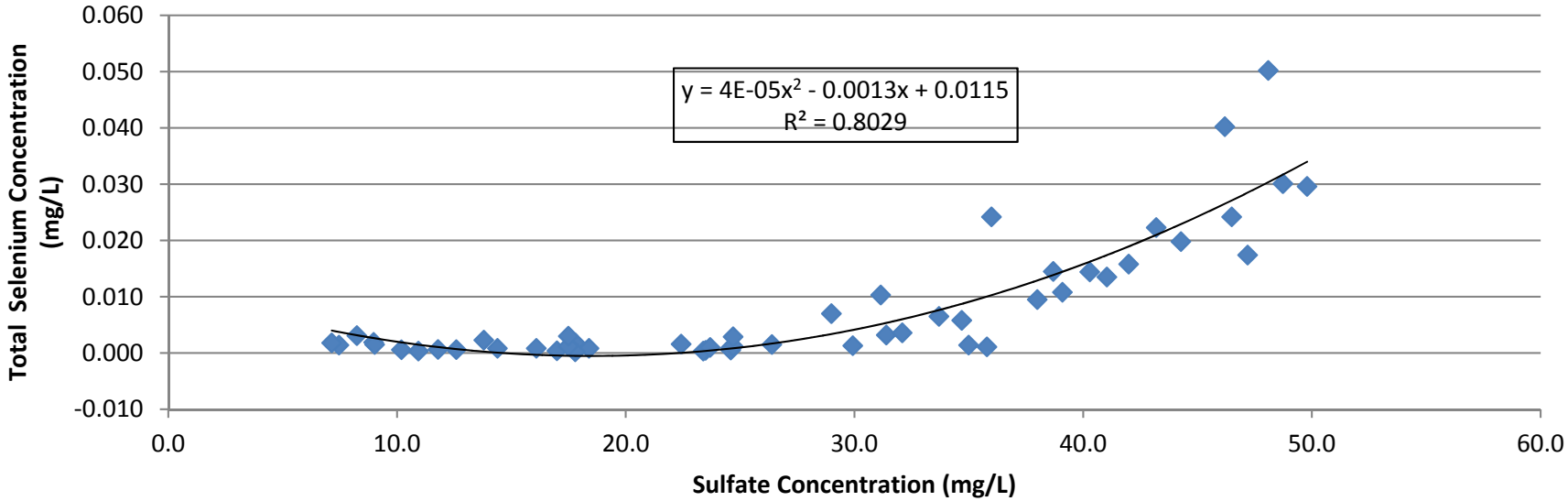
Error bars denote 95 CI.
CROW_US includes Crow Creek locations upstream of Sage Creek (CC-7, SW-CC-100, SW-CC-300, SW-CC-50, AWI012-29, CC-300, CC-350, CC-75, and CC-150); all locations are upstream of SSSC location CC-350.

Figure 6
Average Aqueous Selenium Concentrations Prior to SSSC Study (2000 to 2006) and during the SSSC Study

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL



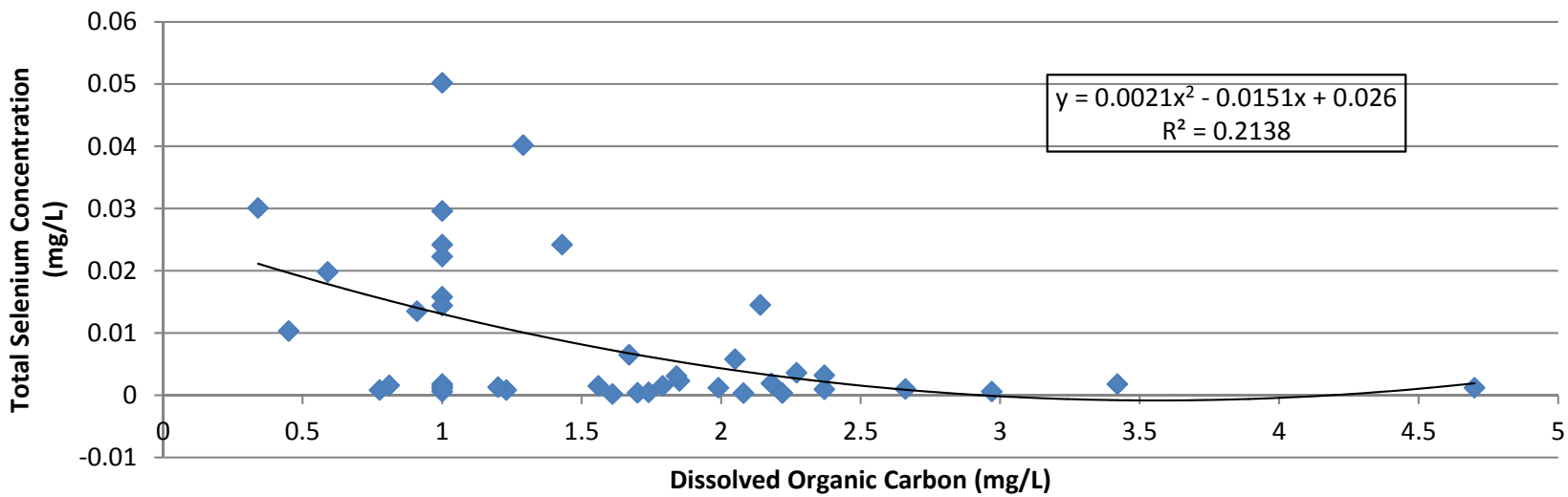


Figure 7
Aqueous Selenium Concentrations Relationship to Sulfate Concentrations and Dissolved Organic Carbon Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

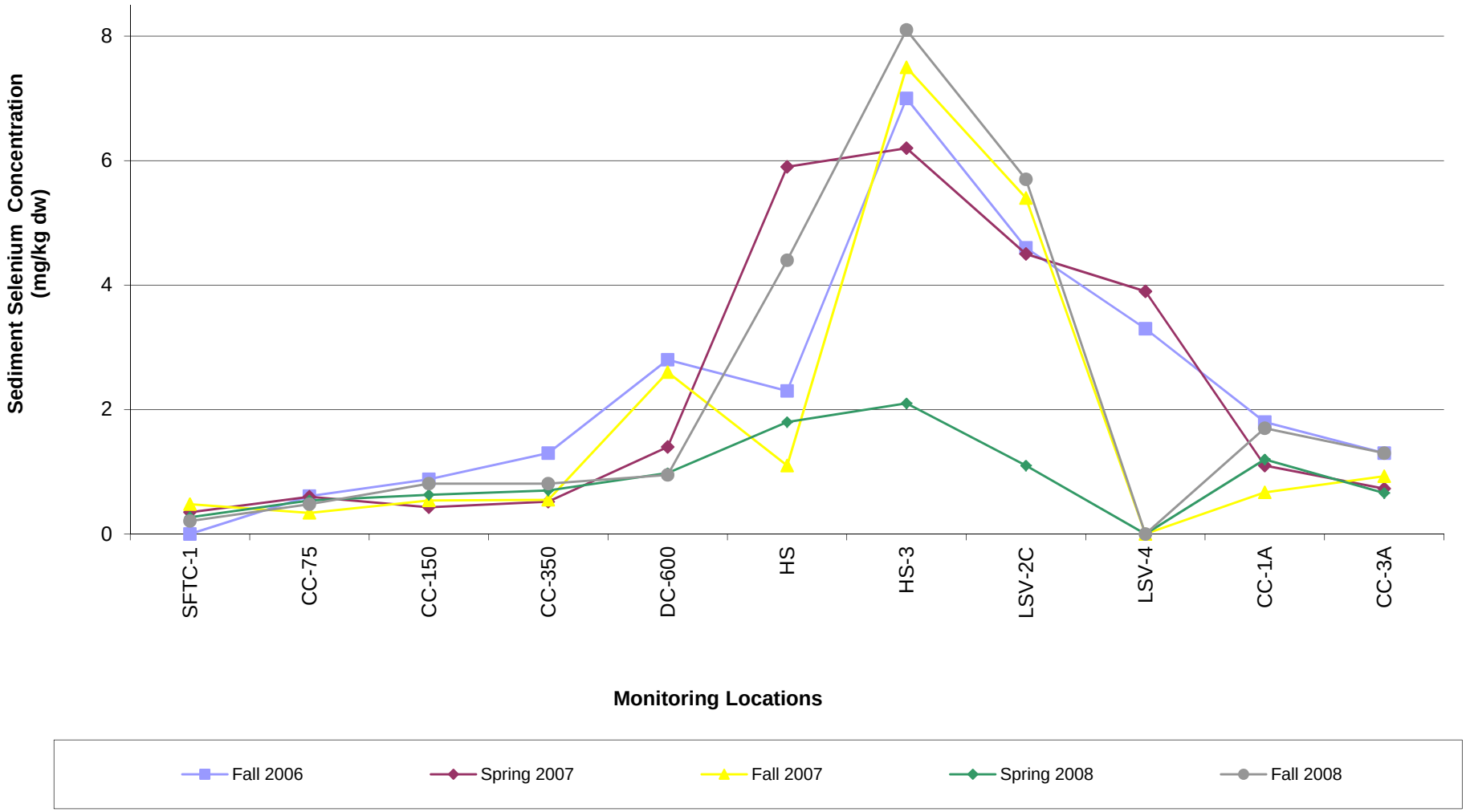


Figure 8
Total Selenium Concentrations in Sediment

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

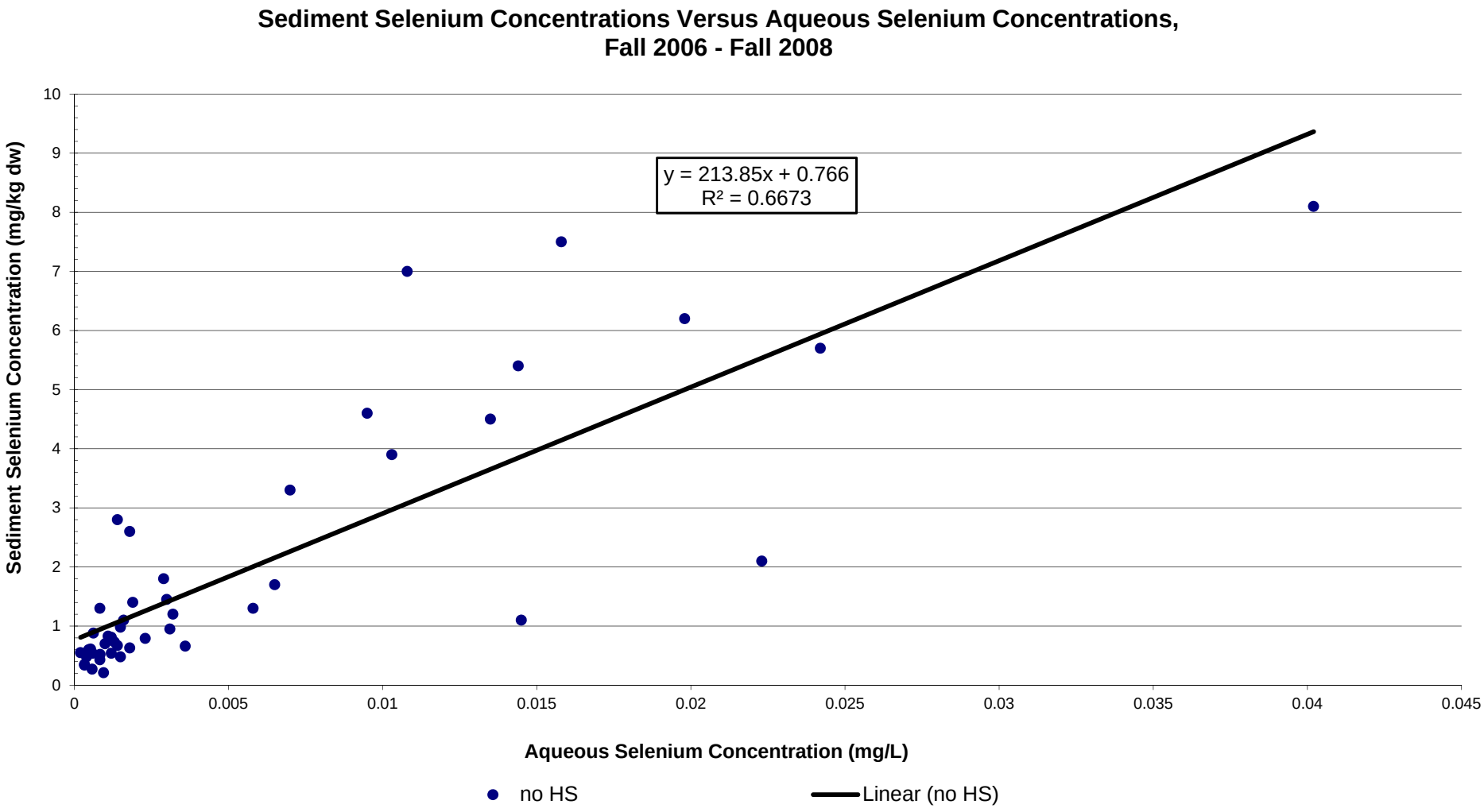


Figure 9
Relationship of Sediment Selenium Concentrations to Aqueous Selenium Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

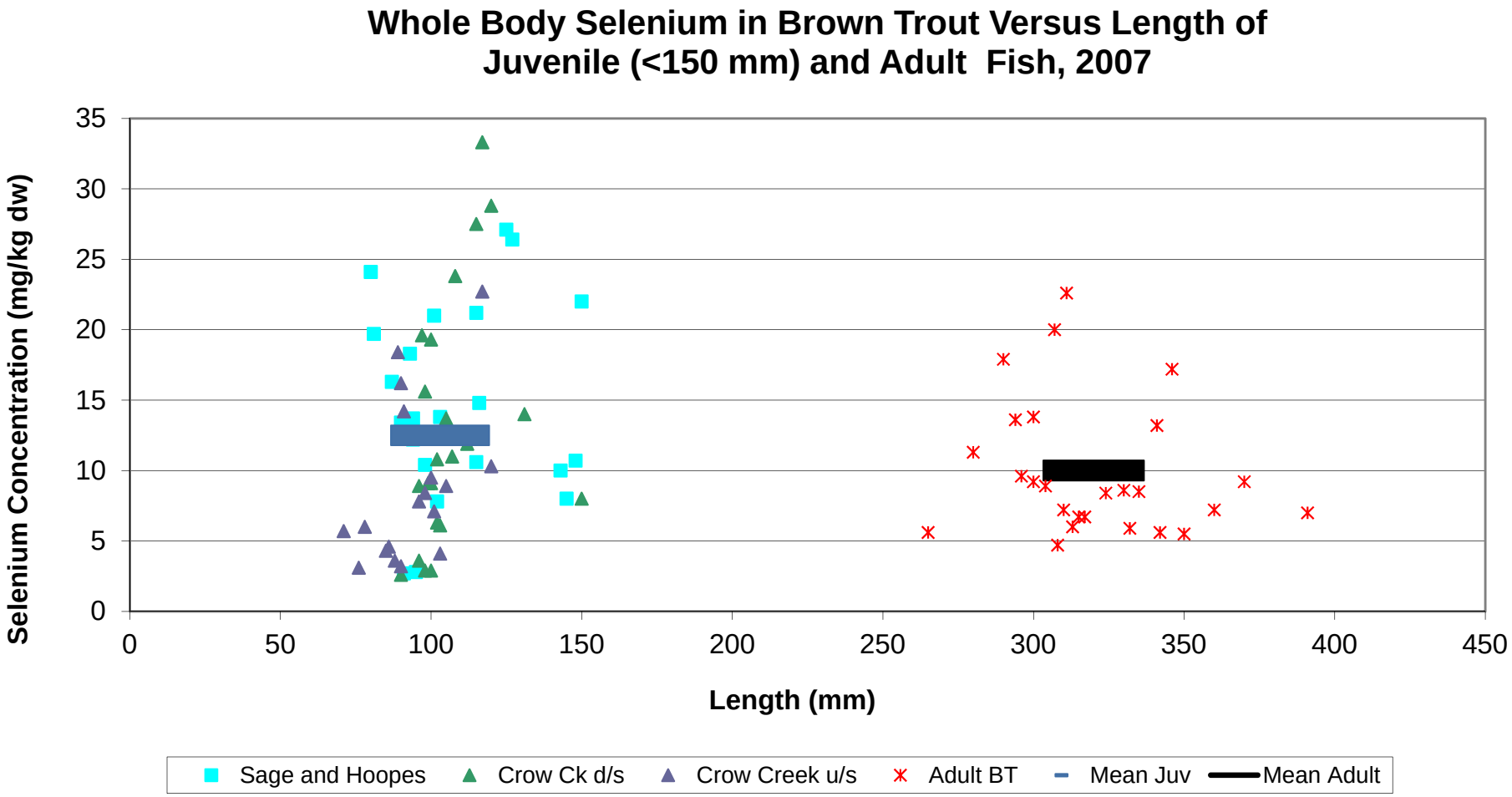


Figure 10
Whole Body Selenium in Brown Trout Versus Length of Juvenile (<150 mm) and Adult Fish, 2007

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

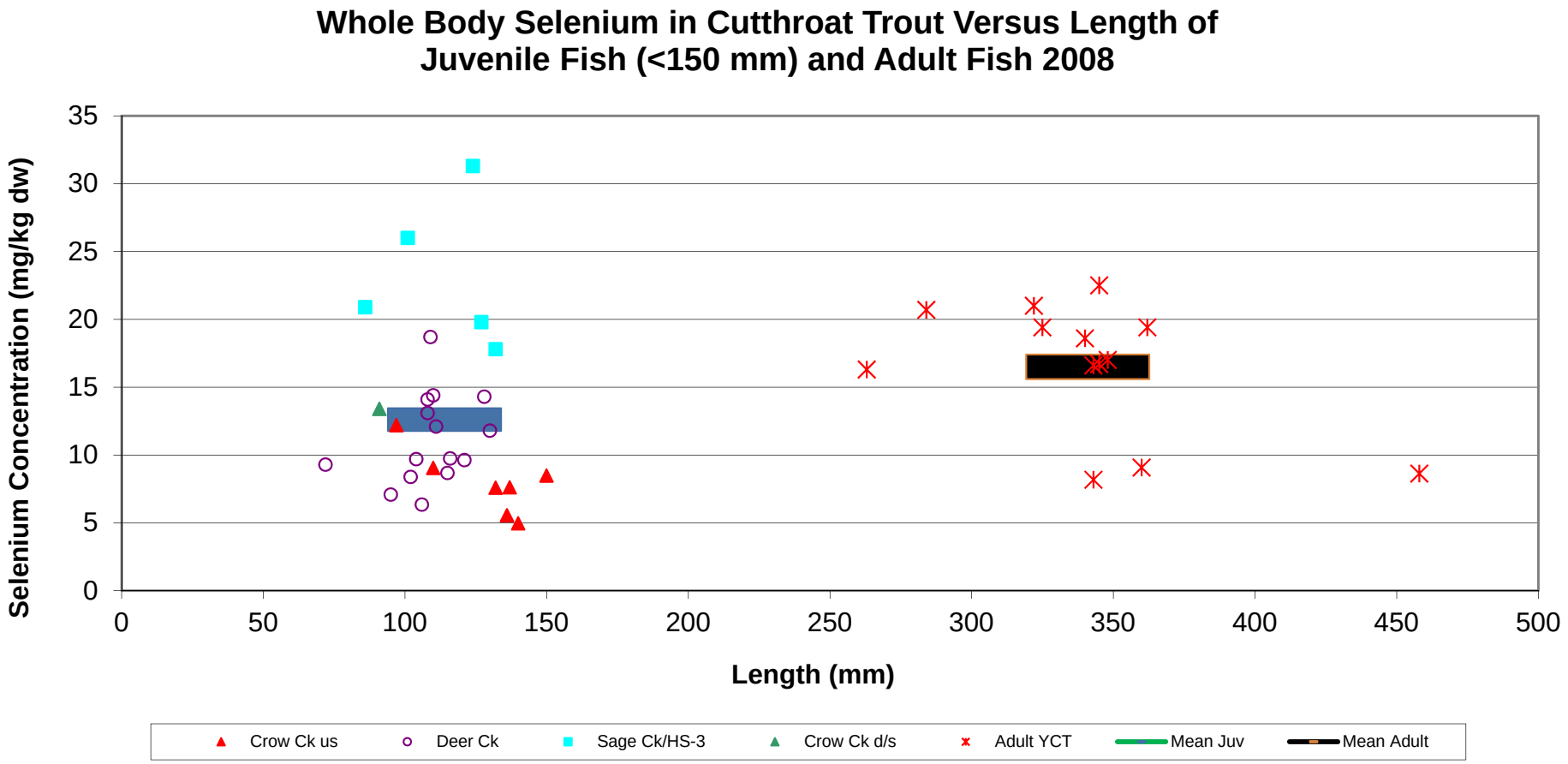


Figure 11
Whole Body Selenium in Cutthroat Trout Versus Length of Juvenile (<150 mm) and Adult Fish, 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

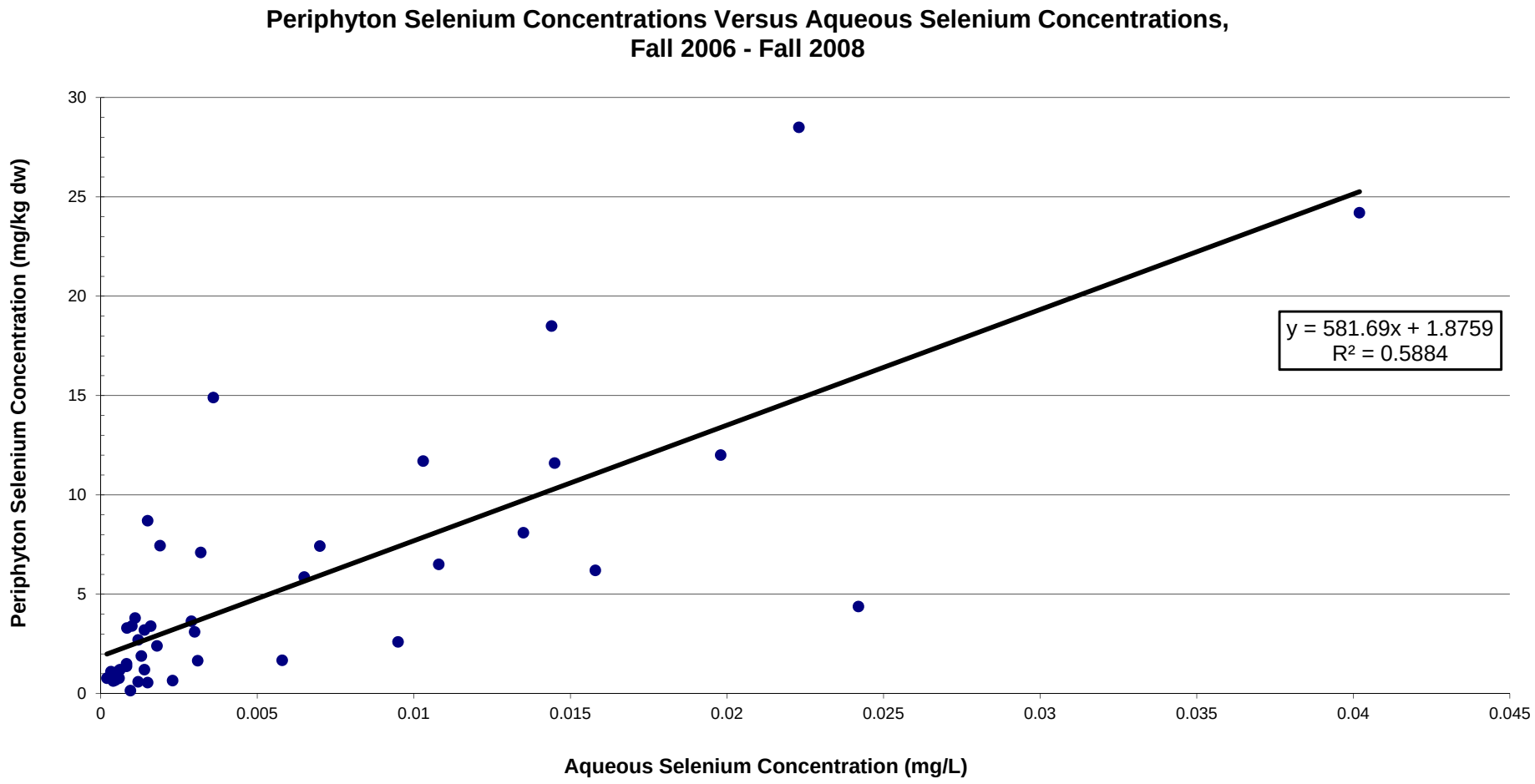


Figure 12
Periphyton Tissue Selenium Concentrations Versus Aqueous Selenium Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

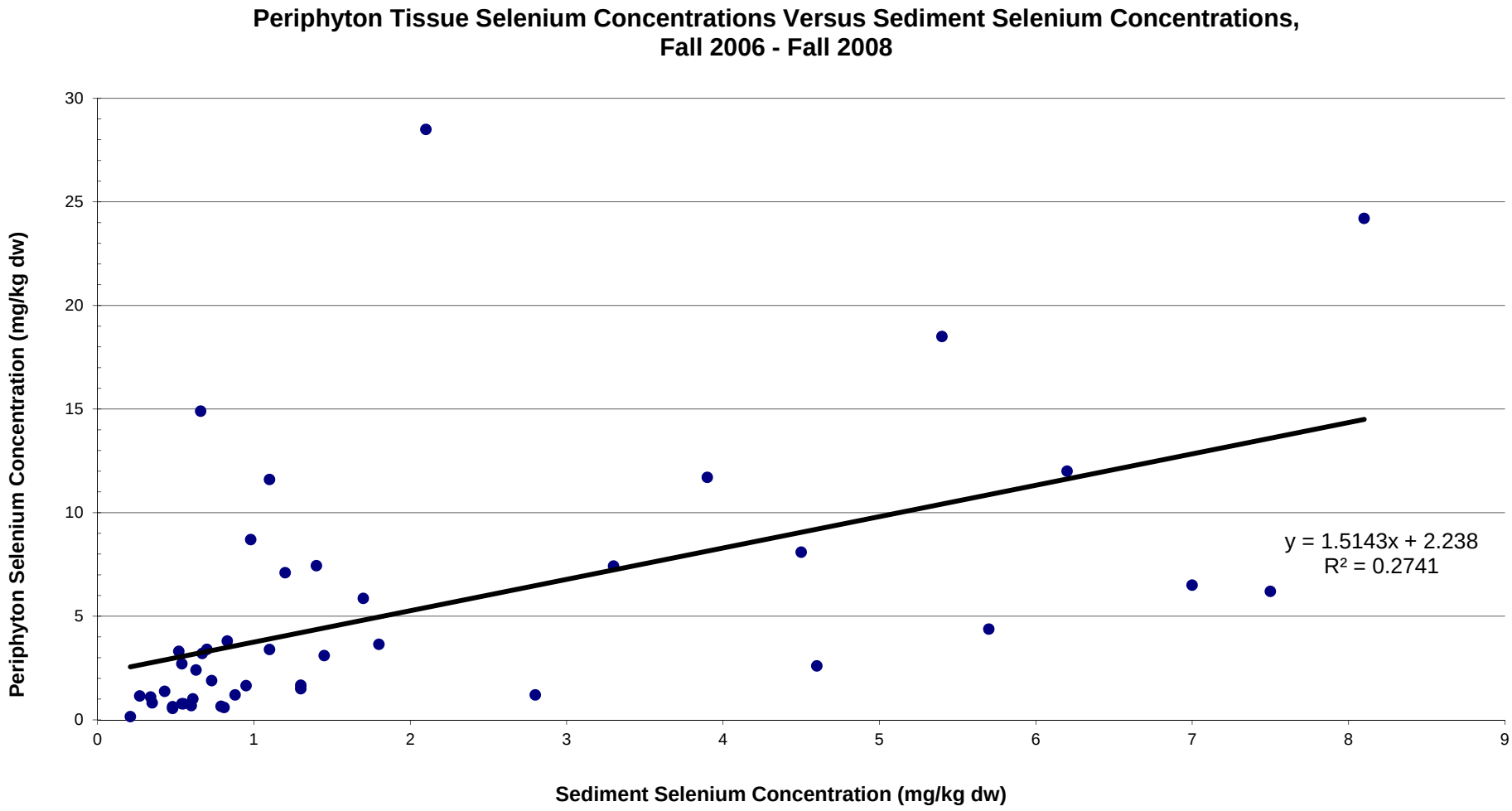


Figure 13
Periphyton Tissue Selenium Concentrations Versus Sediment Selenium Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

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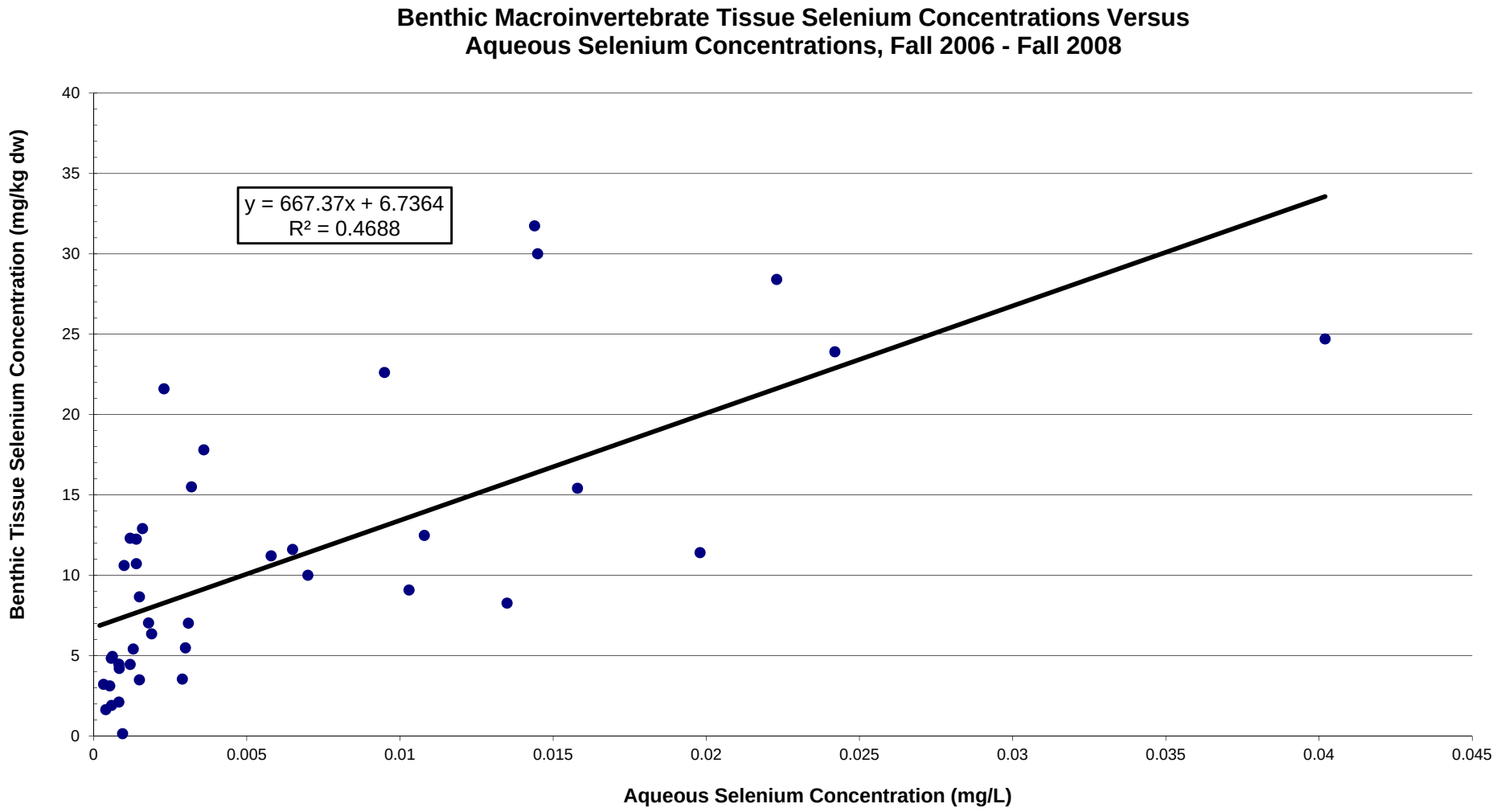

Figure 14
Benthic Macroinvertebrate Tissue Selenium Concentrations Versus Aqueous Selenium Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

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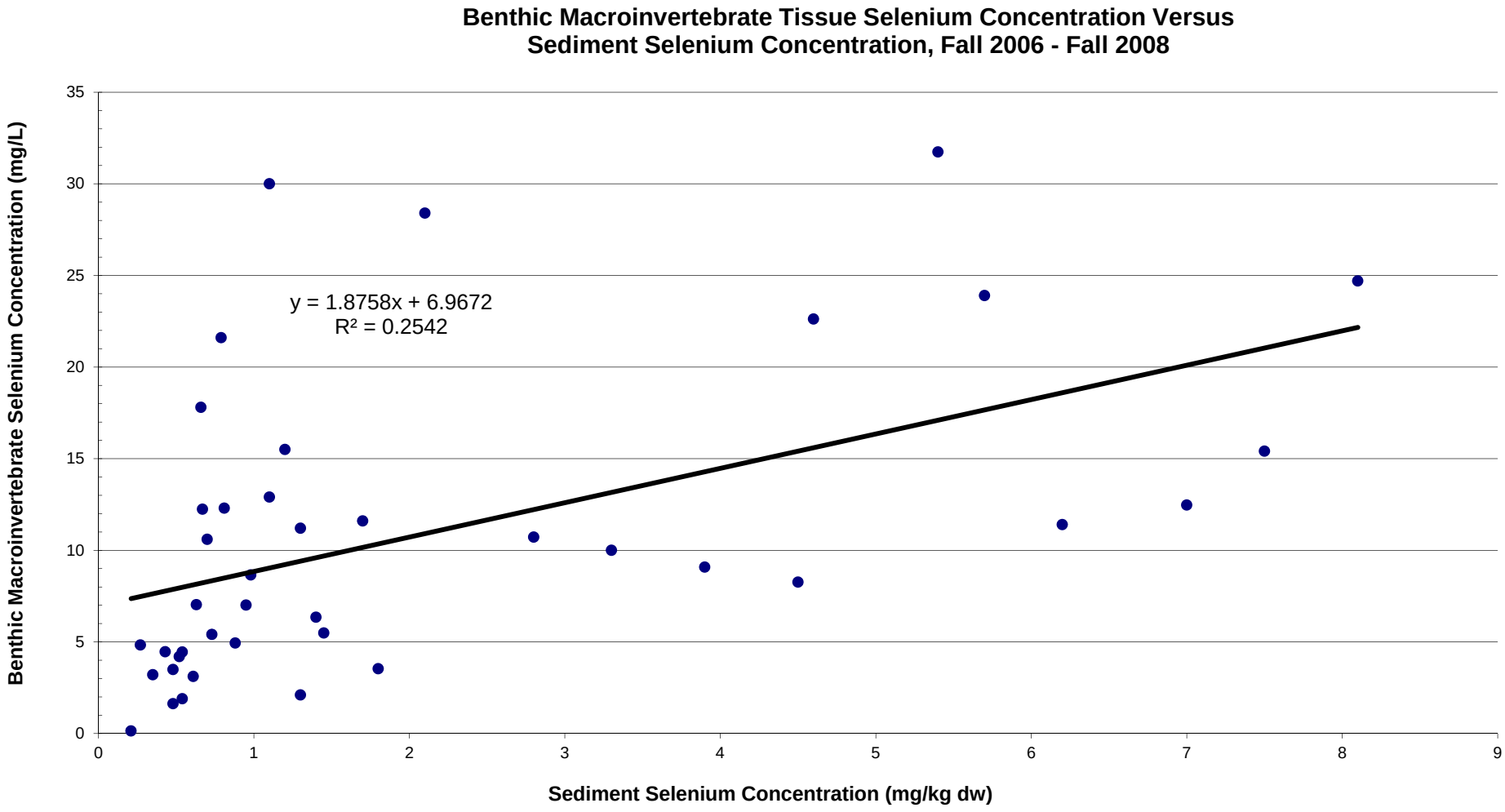

Figure 15
Benthic Macroinvertebrate Tissue Selenium Concentrations Versus Sediment Selenium Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

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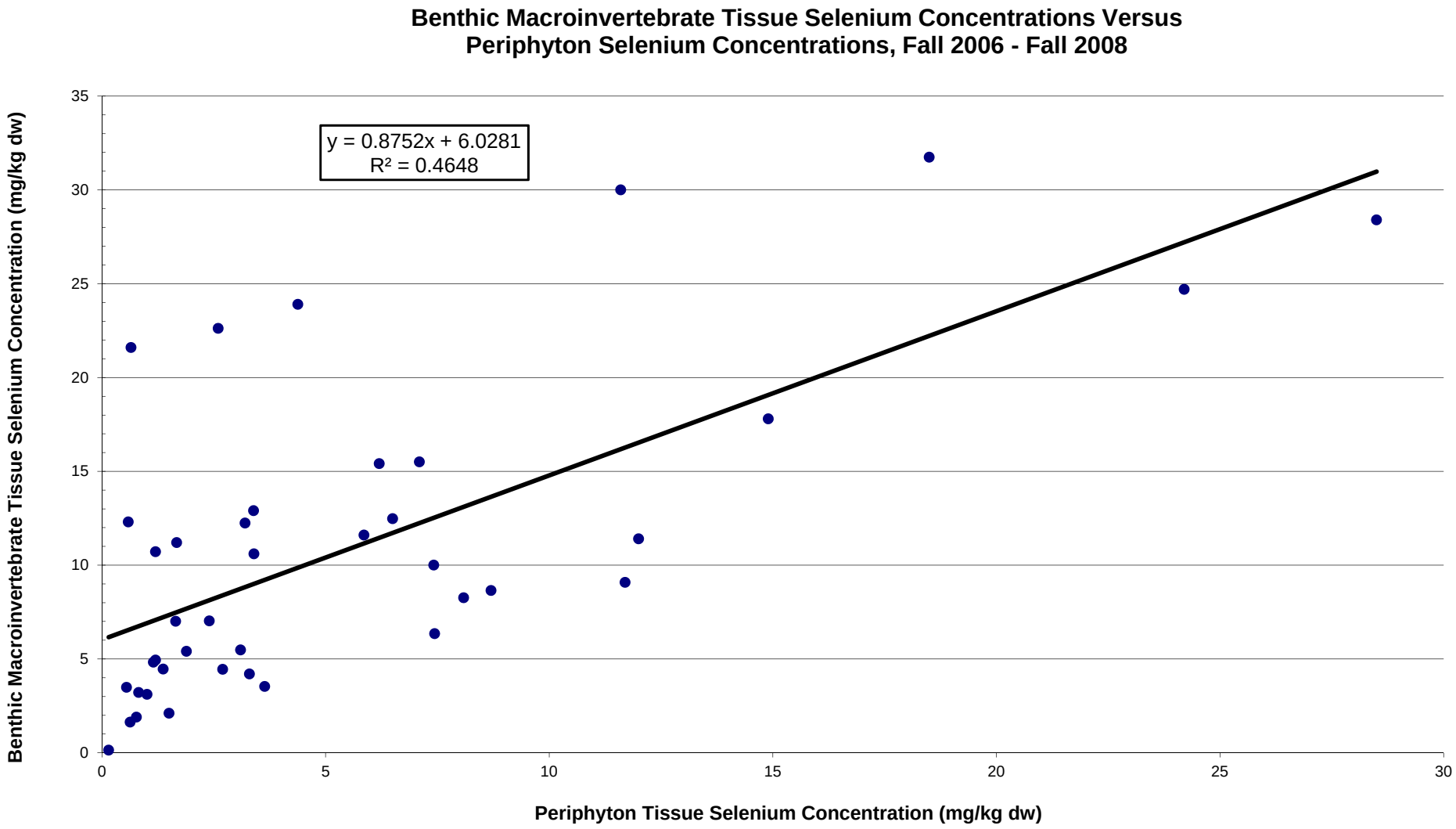

Figure 16
Benthic Macroinvertebrate Tissue Selenium Concentrations Versus Periphyton Tissue Selenium Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

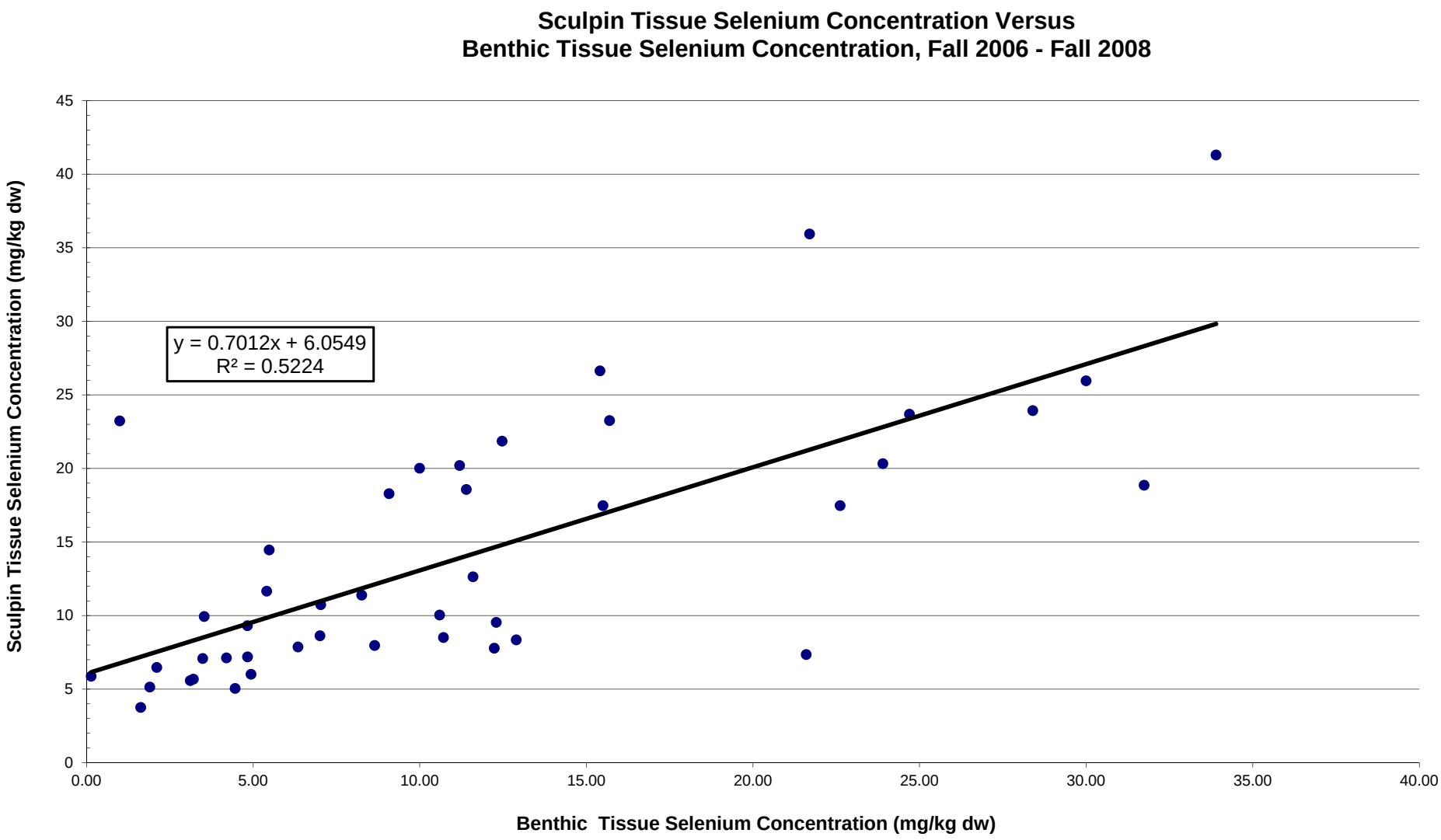

Figure 17
Sculpin Tissue Selenium Concentrations Versus
Benthic Macroinvertebrate Tissue Selenium Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

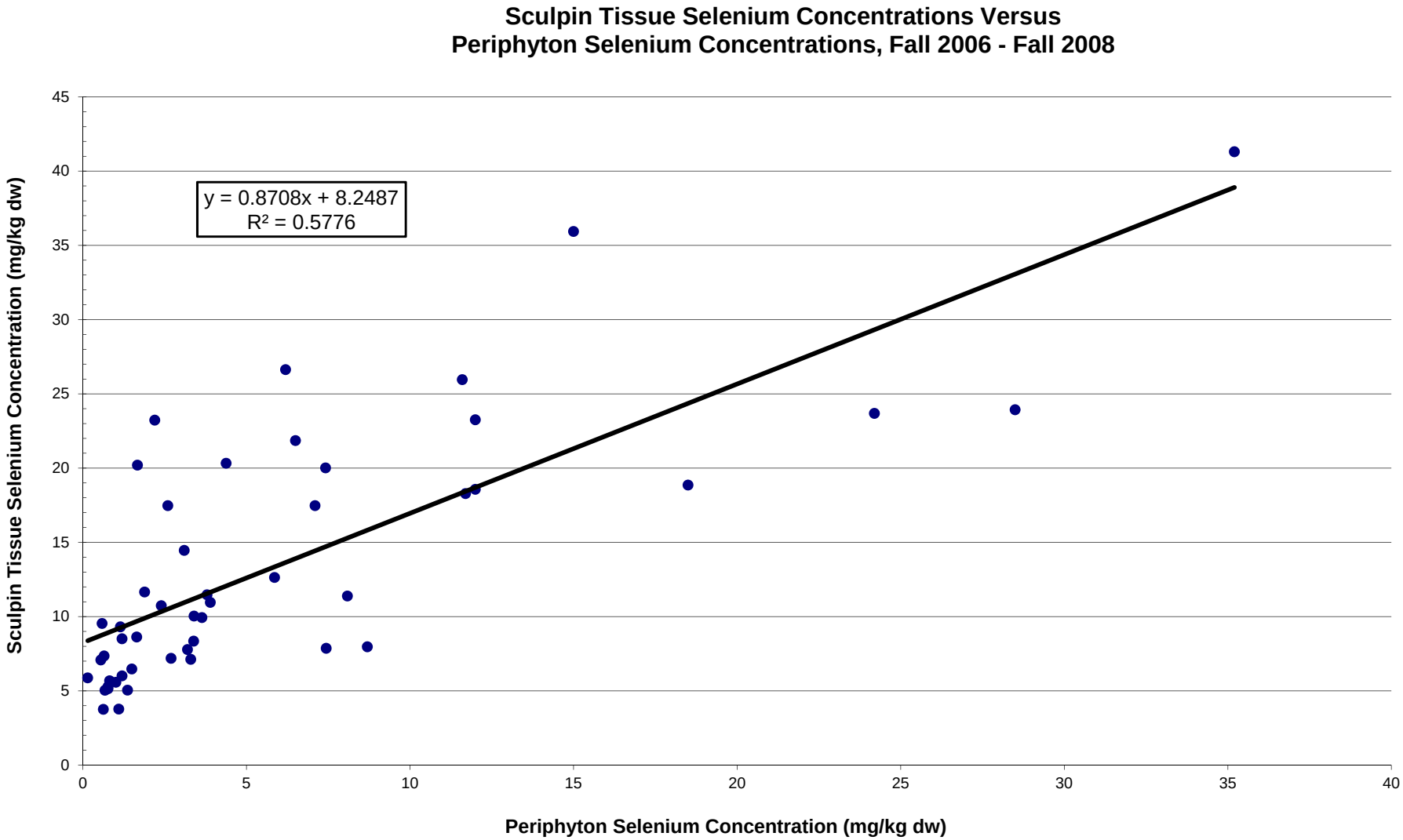

Figure 18
Sculpin Tissue Selenium Concentrations Versus Periphyton Tissue Selenium Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

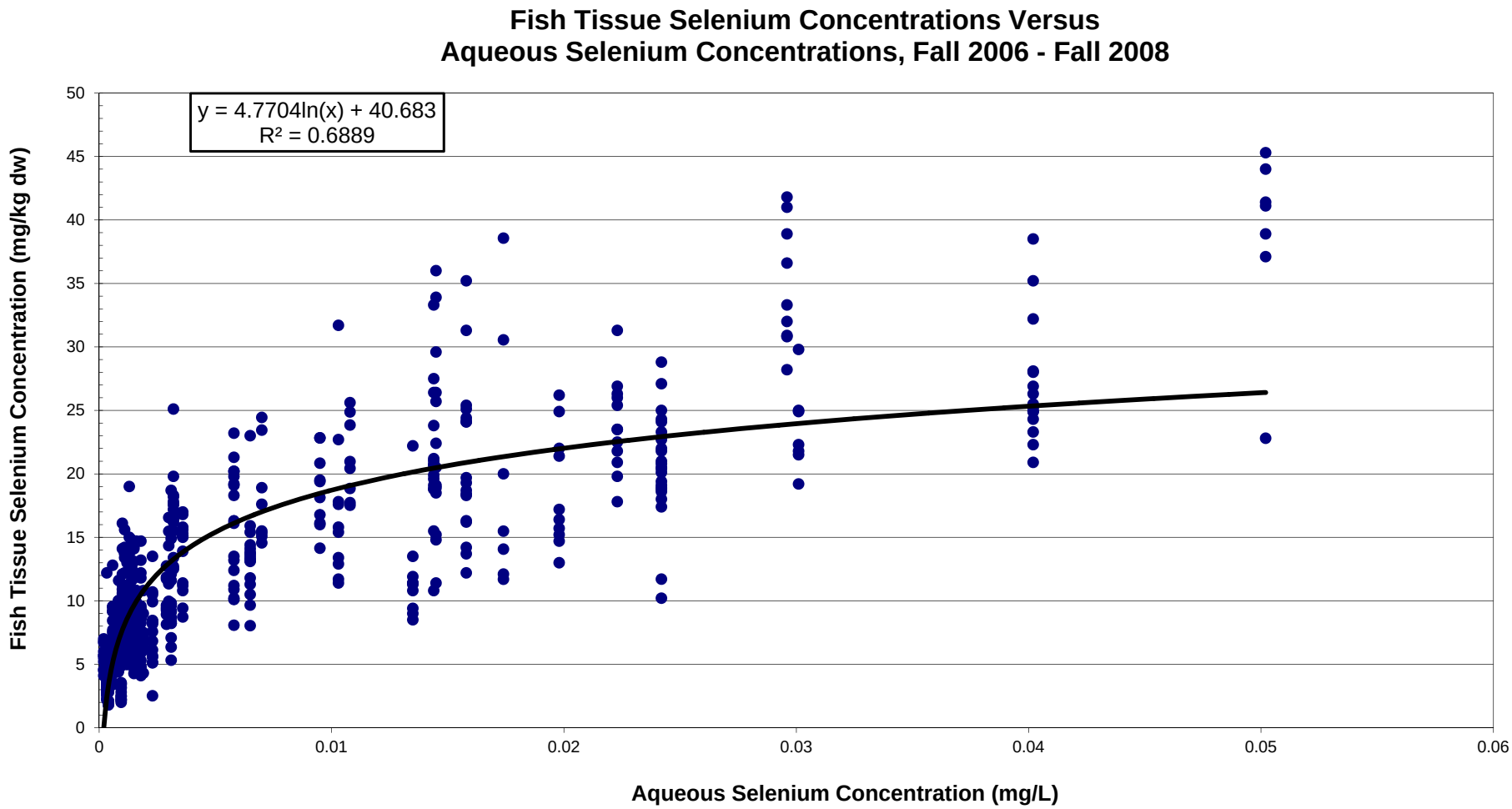

Figure 19
Fish Tissue Selenium Concentrations Versus Aqueous Selenium Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

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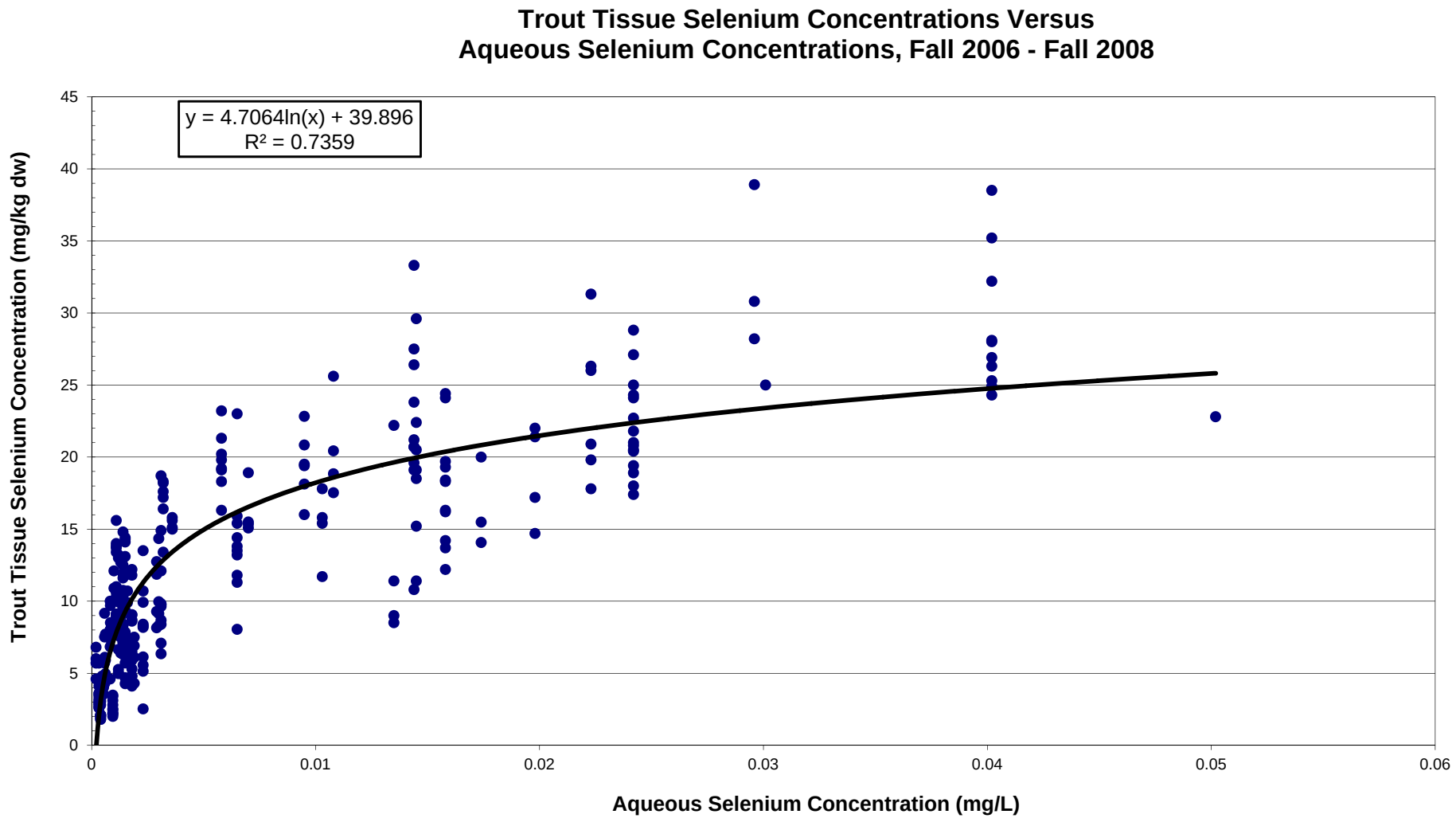

Figure 20
Trout Tissue Selenium Concentrations Versus Aqueous Selenium Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

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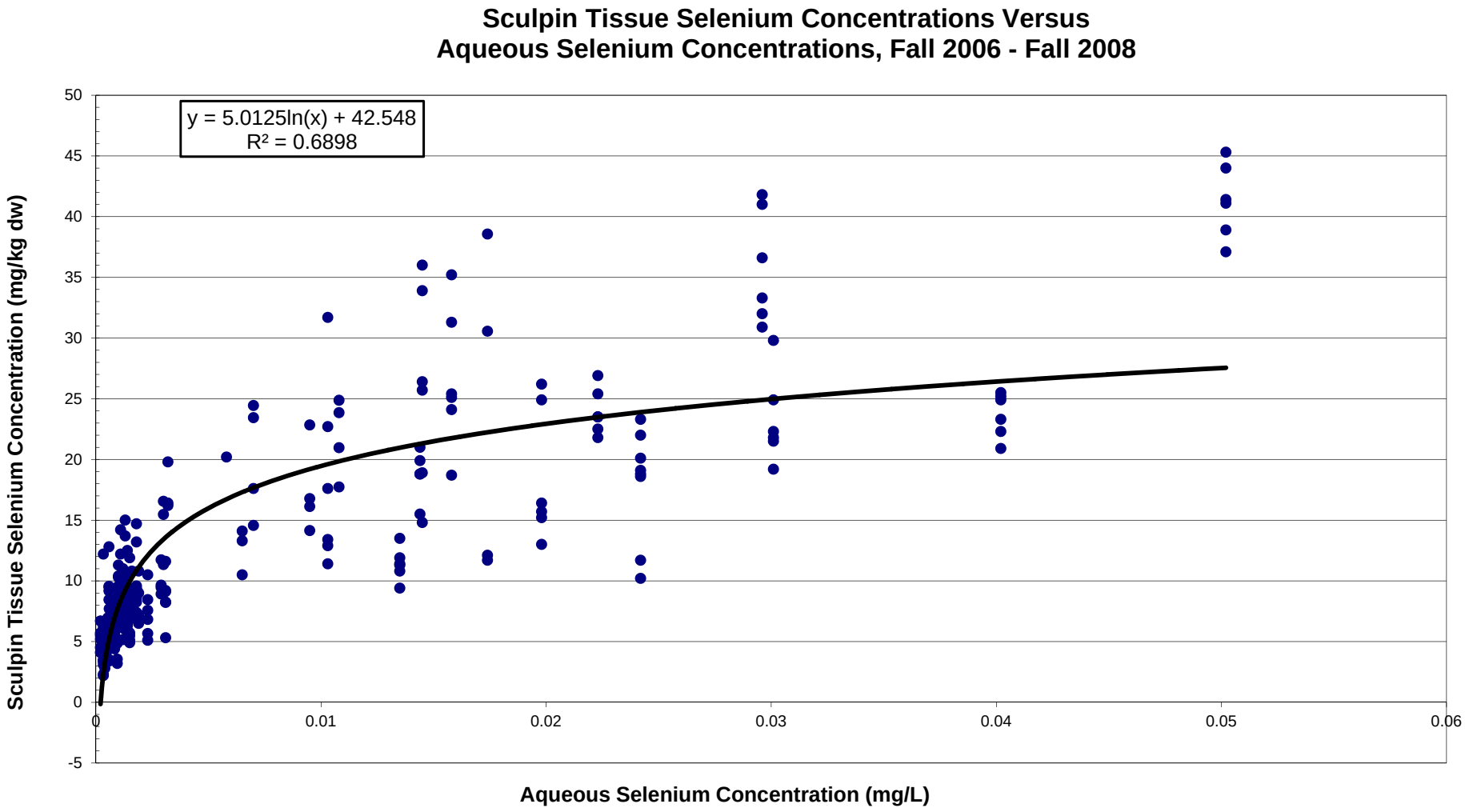

Figure 21
Sculpin Tissue Selenium Concentrations Versus Aqueous Selenium Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

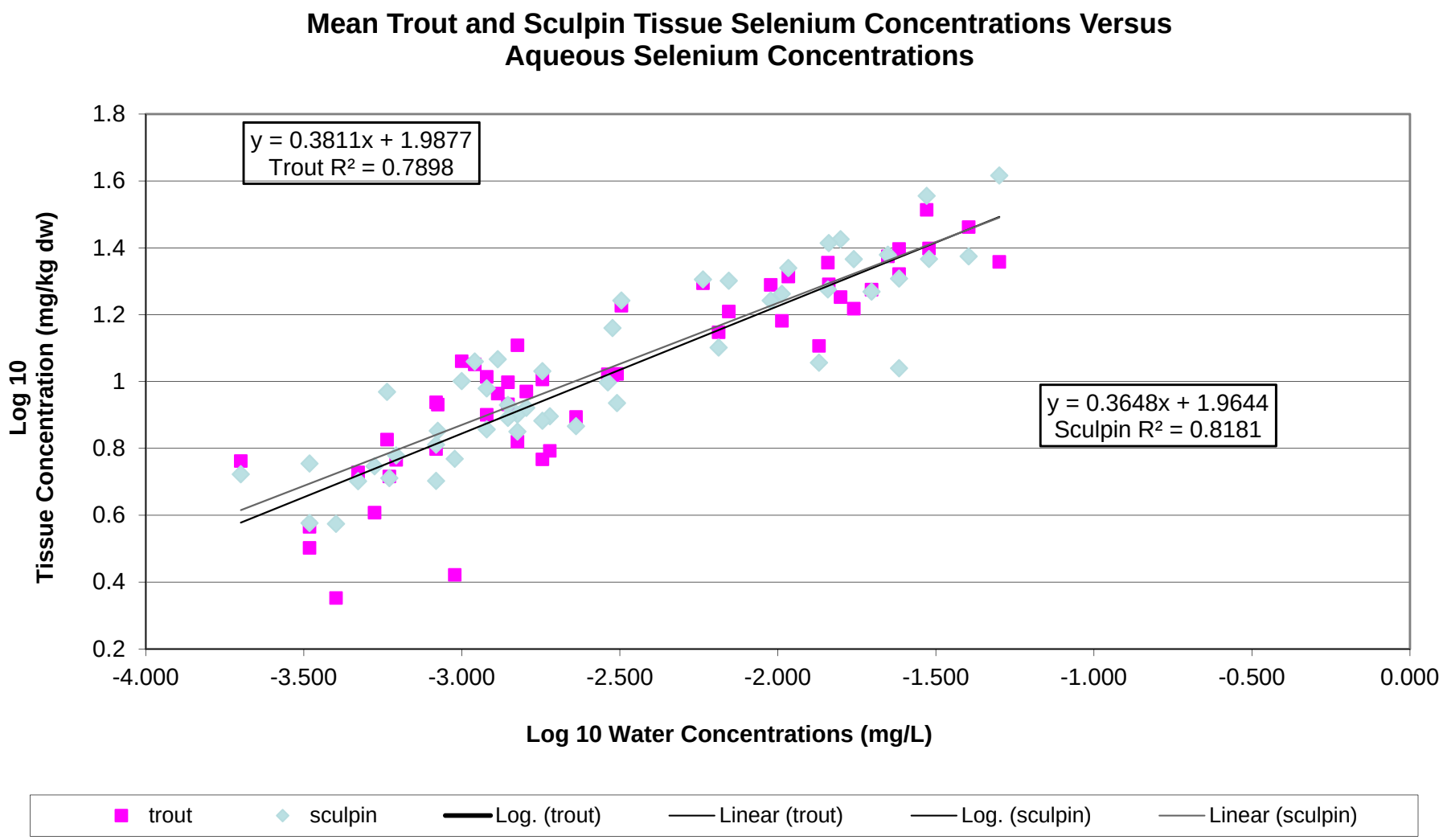

Figure 22
Mean Trout and Sculpin Tissue Selenium Concentrations Versus Aqueous Selenium Concentrations

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

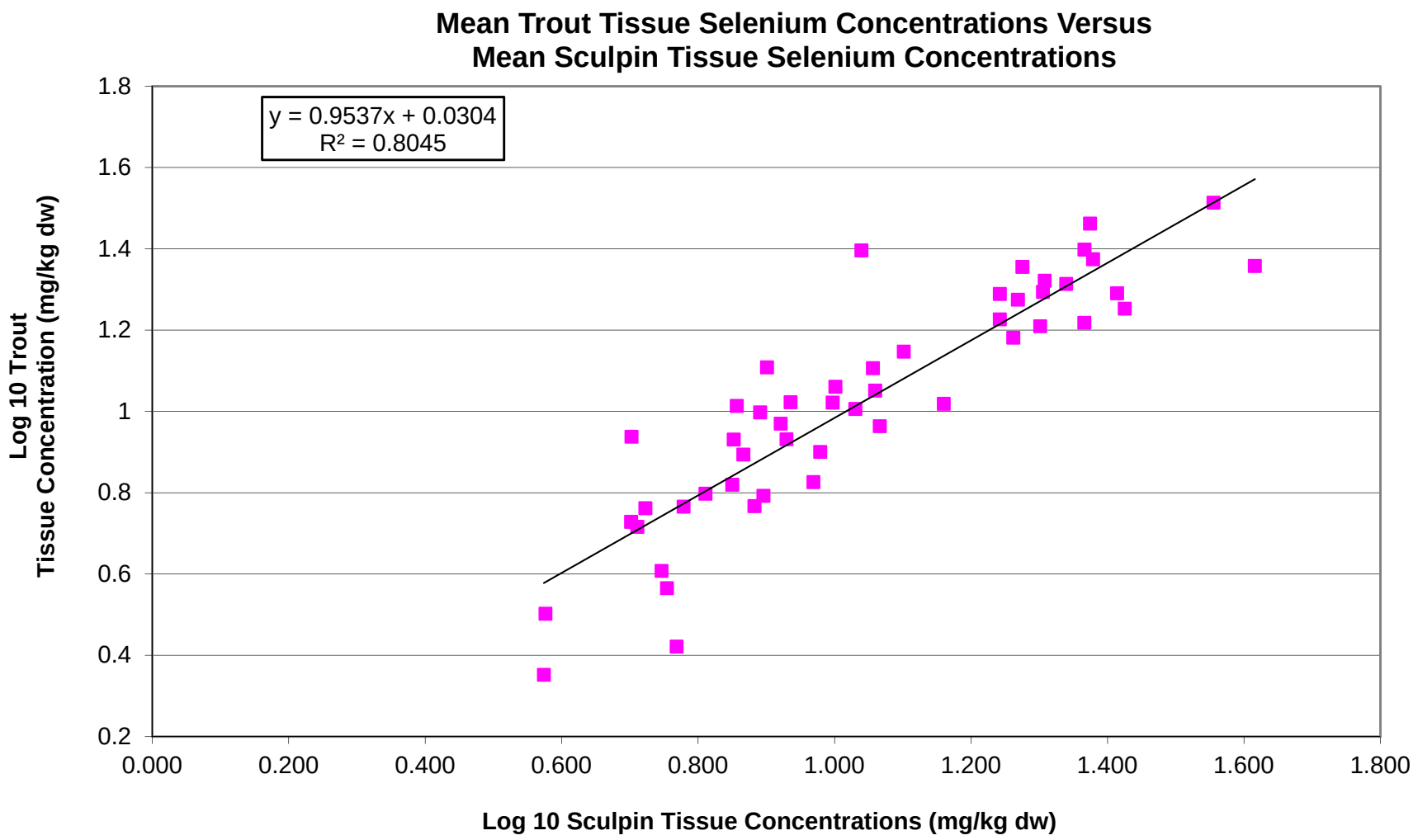

Figure 23
Mean Trout Tissue Selenium Concentrations Versus
Mean Sculpin Tissue Selenium Concentrations

J.R. Simplot Company Site-Specific Selenium Criterion		
PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC
FORMATION ENVIRONMENTAL		

ATTACHMENT 1
Summary of Water, Sediment, and Tissue Selenium Concentrations from the Fall 2006 - Fall 2008 Monitoring Events

Attachment 1
Summary of Water, Sediment, and Tissue Selenium Concentrations from the Fall 2006 - Fall 2008 Monitoring Events

Stream	Location	Monitoring Event	Water Concentrations		Sediment		Periphyton		Benthic Invertebrates	
			Total Selenium (mg/L)	Dissolved Selenium (mg/L)	Selenium (mg/kg dw)	% Solids	Selenium (mg/kg dw)	% Solids	Selenium (mg/kg dw)	% Solids
Reference										
SF Tincup Creek	SFTC-1	Spring 2007	0.00033J	0.00043J	0.35J	62.7	0.82J	0.57	3.21J	24.3
		Fall 2007	0.0004J	0.0002J-	0.48J-	50.1	0.63J	6.16	1.63	**
		Spring 2008	0.00058	0.00044	0.27	69.8	1.15	0.449	4.83J+	17.0
		Fall 2008	0.00095U	0.00067	0.21	60.9	0.15	1.53	0.14	18.8
Upstream of Sage Creek										
Crow Creek	CC-75	Fall 2006	0.00053	0.00057	0.61	68.4	1.01	4.90	3.11J-	22.80
		Spring 2007	0.00047J	0.00046J	0.6J	59.8	0.68J	1.15	**	**
		Fall 2007	0.00033J	0.00033J-	0.34J-	62.9	1.1J	1.07	**	**
		Fall 2007-dup	0.00079J	0.0004J	NM	NM	NM	NM	NM	NM
		Spring 2008	0.0012	0.0012	0.54	57.9	2.7	0.55	4.45	19.3
		Spring 2008-dup[1]	0.0012	0.0011	NM	NM	2.7	0.34	5.22	18.8
		Fall 2008	0.0015U	0.0008	0.48J+	64.3	0.55	0.896	3.49	16.0
		Fall 2008-dup	0.0017U	0.0009	NM	NM	NM	NM	NM	NM
	CC-150	Fall 2006	0.00062	0.00067	0.88	58	1.2	7.40	4.94J-	16.8
		Spring 2007	0.00083J	0.00092J	0.43J	63	1.37J	0.49	4.46J	30.5
		Fall 2007	0.00059J	0.00068J-	0.54J-	62.5	0.77J	4.78	1.90	**
		Spring 2008	0.0018	0.0014	0.63	56.4	2.4	1.98	7.03	20.1
		Spring 2008-dup	NM	NM	0.63	58.5	NM	NM	NM	NM
		Fall 2008	0.0023	0.0016	0.81J+	57.3	0.65	0.426	21.60	20.4
		Fall 2008-dup	NM	NM	0.77J+	58.1	NM	NM	NM	NM
	CC-350	Fall 2006	0.00083	0.00082	1.30	62.8	1.5	0.90	2.11J-	20.4
		Spring 2007	0.00084J	0.0011J	0.52J	69.6	3.3J	0.62	4.2J	29.5
		Fall 2007	0.0002U	0.00026J-	0.55J-	73.9	0.77J	2.44	**	**
		Spring 2008	0.001	0.00089	0.7	63.4	3.4	0.30	10.60	16.6
		Fall 2008	0.0012U	0.0013	0.81	62.8	0.59	0.536	12.30	22.3
Deer Creek	DC-600	Fall 2006	0.0014	0.0013	2.8	60.3	1.2	1.40	10.71J-	9.8
		Spring 2007	0.0019J	0.0015J	1.4J	55.3	7.44J	0.20	6.35J	23.1
		Fall 2007	0.0018J	0.002J-	2.6J-	27	**	**	**	**
		Spring 2008	0.0015	0.0014	0.98J-	51.3	8.7	0.20	8.65	14.6
		Fall 2008	0.0031	0.0034	0.95	72	1.65	0.165	7.01	19.2
Hoopes Spring and Sage Creek										
Hoopes Spring	HS	Fall 2006	**0.0174**	0.0174	2.3	70.4	2.2	1.6	1.00J-	34
		Fall 2006-dup	**0.0174**	0.0168	NM	NM	NM	NM	NM	NM
		Spring 2007	**0.0301J**	0.0205J	5.9J	45.5	12J	0.15	15.7J	24.9
		Fall 2007	**0.0242**	0.0214J-	1.1J-	71.9	3.9J	0.23	**	**
		Spring 2008	**0.0296**	0.0273	1.8J-	60.3	15	0.19	21.7	14.6
		Fall 2008	**0.0502**	0.0536	4.4	76.5	35.2	0.323	33.9	19.7
	HS-3	Fall 2006	**0.0108**	0.0092	7.0	71.3	6.5	5.80	12.47J-	18.2
		Fall 2006-dup	NM	NM	NM	NM	NM	NA	6.58J-	28.1
		Spring 2007	**0.0198J**	0.018J	6.2J	51.7	12J	0.16	11.4J	18.5
		Fall 2007	**0.0158**	0.0161J-	7.5J-	68.2	6.2J	0.94	15.41	**
		Spring 2008	**0.0223**	0.026	2.1J-	66.9	28.5	0.09	28.4	15.3
		Fall 2008	**0.0402**	0.0375	8.1	73.7	24.2	0.714	24.7	25.5
Sage Creek	LSV-2C	Fall 2006	**0.0095**	0.0093	4.6	57	2.6	3.60	22.62J-	10.7
		Spring 2007	**0.0135J**	0.0135J	4.5J	48.3	8.09J	1.33	8.26J	22.1
		Fall 2007	**0.0144**	0.0143J-	5.4J-	56.9	18.5J	1.77	31.74	**
		Spring 2008	**0.0145**	0.0141	1.1J-	62.9	11.6	0.13	30.00	8.65
		Fall 2008	**0.0242**	0.0234	5.7	68.9	4.38	0.461	23.90	23.0
	LSV-4	Fall 2006	**0.007**	0.0068	3.3	55.2	7.42	4.10	10J-	20.4
		Spring 2007	**0.0103J**	0.0101J	3.9J	51.7	11.7J	0.09	9.08J	24.9
Downstream of Sage Creek										
Crow Creek	CC-1A	Fall 2006	0.0029	0.0027	1.8	57.3	3.64	4.50	3.53J-	23.2
		Spring 2007	0.0016J	0.0012J	1.1J	48.2	3.39J	1.69	12.9J	22.8
		Spring 2007-dup	0.0025J	0.002J	NM	NM	NM	NM	NM	NM
		Fall 2007	0.0014J	0.0022J-	0.67J-	67.3	3.2J	1.86	12.24	**
		Spring 2008	0.0032	0.0029	1.2	59.9	7.1	0.59	15.50	10.8
		Fall 2008	**0.0065**	0.0067	1.7	57.4	5.86	0.638	11.60	21.3
	CC-3A	Fall 2006	0.003	0.0029	1.3	65.8	3.10	4.20	5.48J-	19.7
		Fall 2006-dup	0.0029	0.0027	1.6	62	NM	NM	NM	NM
		Spring 2007	0.0013J	0.0014J	0.73J	70.6	1.89J	1.13	5.41J	18.50
		Spring 2007-dup	NM	NM	0.74J	65.7	NM	NM	NM	NM
		Fall 2007	0.0011J	0.0018J-	0.93J-	56	3.8J	0.81	**	**
		Fall 2007-dup	NM	NM	0.73J-	62	NM	NM	NM	NM
		Spring 2008	0.0036	0.0026	0.66J-	70.2	14.9	0.93	17.80	14.1
		Fall 2008	**0.0058**	0.0058	1.3	62.3	1.67	0.688	11.20	25.0

Bold values exceed the State of Idaho Water quality standard for total selenium (0.005 mg/L).

J = Estimated

J- = Estimated, low bias

J+ = Estimated, high bias

NM = Not Measured

** = Insufficient sample for reanalysis

[1]Periphyton and benthic macroinvertebrate samples in this row are additional primary samples, not duplicates.

ATTACHMENT 2
Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Attachment 2

Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Stream	Location	Date	Selenium, total (mg/kg dw)	Percent Solids	Tissue Type
Reference					
SF Tincup Creek	SFTC-1	5/7/07	3.1	28	psc
SF Tincup Creek	SFTC-1	5/7/07	3.4	24.9	psc
SF Tincup Creek	SFTC-1	5/7/07	3.4	23.5	ctt
SF Tincup Creek	SFTC-1	5/7/07	2.6	23.5	ctt
SF Tincup Creek	SFTC-1	5/7/07	3.0	24.7	ctt
SF Tincup Creek	SFTC-1	5/7/07	3.4	28	psc
SF Tincup Creek	SFTC-1	5/7/07	12.2	29.7	psc
SF Tincup Creek	SFTC-1	5/7/07	5.7	21.4	ctt
SF Tincup Creek	SFTC-1	5/7/07	5.8	31.7	psc
SF Tincup Creek	SFTC-1	5/7/07	6.2	29.7	psc
SF Tincup Creek	SFTC-1	8/29/07	3.1	25.3	ctt
SF Tincup Creek	SFTC-1	8/29/07	3.0	25.5	ctt
SF Tincup Creek	SFTC-1	8/29/07	2.8	24.5	ctt
SF Tincup Creek	SFTC-1	8/29/07	2.1	25.3	ctt
SF Tincup Creek	SFTC-1	8/29/07	2.1	22.5	ctt
SF Tincup Creek	SFTC-1	8/29/07	2.1	25.7	ctt
SF Tincup Creek	SFTC-1	8/29/07	1.9	24.2	ctt
SF Tincup Creek	SFTC-1	8/29/07	2.0	25.9	ctt
SF Tincup Creek	SFTC-1	8/29/07	4.8	23.7	psc
SF Tincup Creek	SFTC-1	8/29/07	4.5	21.9	psc
SF Tincup Creek	SFTC-1	8/29/07	4.2	21	psc
SF Tincup Creek	SFTC-1	8/29/07	4.0	20.7	psc
SF Tincup Creek	SFTC-1	8/29/07	3.5	21.1	psc
SF Tincup Creek	SFTC-1	8/29/07	3.8	22.3	psc
SF Tincup Creek	SFTC-1	8/29/07	3.3	26.3	psc
SF Tincup Creek	SFTC-1	8/29/07	3.4	23.8	psc
SF Tincup Creek	SFTC-1	8/29/07	3.2	22.1	psc
SF Tincup Creek	SFTC-1	8/29/07	2.8	24.1	psc
SF Tincup Creek	SFTC-1	8/29/07	1.8	26.3	ctt
SF Tincup Creek	SFTC-1	8/29/07	1.8	27.6	ctt
SF Tincup Creek	SFTC-1	8/29/07	2.0	22.8	ctt
SF Tincup Creek	SFTC-1	6/26/08	9.5 J+	23	psc
SF Tincup Creek	SFTC-1	6/26/08	9.55 J+	24.2	psc
SF Tincup Creek	SFTC-1	6/26/08	8.44 J+	22.7	psc
SF Tincup Creek	SFTC-1	6/26/08	9.17 J+	25.1	psc
SF Tincup Creek	SFTC-1	6/26/08	12.8 J+	25.9	psc
SF Tincup Creek	SFTC-1	6/26/08	7.51 J+	22.6	ctt
SF Tincup Creek	SFTC-1	6/26/08	5.7 J+	22.9	ctt
SF Tincup Creek	SFTC-1	6/26/08	9.16 J+	22.3	ctt
SF Tincup Creek	SFTC-1	6/26/08	6.38 J+	23	psc
SF Tincup Creek	SFTC-1	6/26/08	4.43 J+	22.9	ctt
SF Tincup Creek	SFTC-1	9/9/08	2	22.3	ctt
SF Tincup Creek	SFTC-1	9/9/08	2.8	24.2	ctt
SF Tincup Creek	SFTC-1	9/9/08	3.48	23	ctt
SF Tincup Creek	SFTC-1	9/9/08	2.46	23.3	ctt
SF Tincup Creek	SFTC-1	9/9/08	2.19	22.2	ctt
SF Tincup Creek	SFTC-1	9/9/08	2.51	24.1	ctt
SF Tincup Creek	SFTC-1	9/9/08	3.11	21.7	ctt
SF Tincup Creek	SFTC-1	9/9/08	2.26	22.3	ctt
SF Tincup Creek	SFTC-1	9/9/08	2.16	22.6	ctt
SF Tincup Creek	SFTC-1	9/9/08	3.4	23.7	ctt
SF Tincup Creek	SFTC-1	9/9/08	3.2	20	psc
SF Tincup Creek	SFTC-1	9/9/08	6.45	20.3	psc
SF Tincup Creek	SFTC-1	9/9/08	3.55	20.1	psc
SF Tincup Creek	SFTC-1	9/9/08	4.86	21.7	psc
SF Tincup Creek	SFTC-1	9/9/08	8.57	23.6	psc
SF Tincup Creek	SFTC-1	9/9/08	8.61	23.4	psc

Attachment 2

Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Stream	Location	Date	Selenium, total (mg/kg dw)	Percent Solids	Tissue Type
Upstream of Sage Creek					
Crow Creek	CC-75	9/2/06	4.12	25.5	brn
Crow Creek	CC-75	9/2/06	3.54	24.3	brn
Crow Creek	CC-75	9/2/06	4.55	22	brn
Crow Creek	CC-75	9/2/06	4.01	24.7	ctt
Crow Creek	CC-75	9/2/06	4.38	26	sc
Crow Creek	CC-75	9/2/06	4.72	23.5	sc
Crow Creek	CC-75	9/2/06	6.95	21	sc
Crow Creek	CC-75	9/2/06	6.25	21.6	sc
Crow Creek	CC-75	5/8/07	4.80	23.6	brn
Crow Creek	CC-75	5/8/07	4.60	25.5	psc
Crow Creek	CC-75	5/8/07	5.30	26.2	psc
Crow Creek	CC-75	5/8/07	4.10	30.3	psc
Crow Creek	CC-75	5/8/07	5.40	23.9	psc
Crow Creek	CC-75	5/8/07	5.70	25.2	psc
Crow Creek	CC-75	5/8/07	5.10	26.6	psc
Crow Creek	CC-75	5/8/07	5.90	22.9	ctt
Crow Creek	CC-75	8/23/07	5.30	24.4	psc
Crow Creek	CC-75	8/23/07	3.50	27.6	brn
Crow Creek	CC-75	8/23/07	4.60	23.5	psc
Crow Creek	CC-75	8/23/07	4.70	25.9	psc
Crow Creek	CC-75	8/23/07	3.50	25	psc
Crow Creek	CC-75	8/23/07	2.70	24.8	brn
Crow Creek	CC-75	8/23/07	2.80	22.5	brn
Crow Creek	CC-75	8/23/07	3.10	26.7	brn
Crow Creek	CC-75	8/23/07	2.60	23.4	brn
Crow Creek	CC-75	8/23/07	3.20	24.6	brn
Crow Creek	CC-75	8/23/07	2.90	24.4	brn
Crow Creek	CC-75	8/23/07	3.60	25.3	brn
Crow Creek	CC-75	8/23/07	3.60	23.7	brn
Crow Creek	CC-75	8/23/07	4.10	24.8	brn
Crow Creek	CC-75	8/23/07	2.90	23.3	brn
Crow Creek	CC-75	8/23/07	2.30	27.8	psc
Crow Creek	CC-75	8/23/07	2.20	28.1	psc
Crow Creek	CC-75	5/13/08	7.67 J-	17.2	psc
Crow Creek	CC-75	5/13/08	5.16 J-	23	psc
Crow Creek	CC-75	5/13/08	8.07 J-	22.9	psc
Crow Creek	CC-75	5/13/08	9.05 J-	22.2	psc
Crow Creek	CC-75	5/13/08	6.11 J-	25.5	psc
Crow Creek	CC-75	5/13/08	7.09 J-	23.6	psc
Crow Creek	CC-75	5/13/08	13 J-	21.3	brn
Crow Creek	CC-75	5/13/08	9.94 J-	22	brn
Crow Creek	CC-75	5/13/08	13.2 J-	21.9	brn
Crow Creek	CC-75	5/13/08	10.2 J-	27.7	brn
Crow Creek	CC-75	5/13/08	5.26 J-	21.3	brn
Crow Creek	CC-75	9/3/08	9.38	22.5	brn
Crow Creek	CC-75	9/3/08	6.24	23.4	brn
Crow Creek	CC-75	9/3/08	4.27	23.4	brn
Crow Creek	CC-75	9/3/08	6.95	24.5	brn
Crow Creek	CC-75	9/3/08	6.62	25.3	brn
Crow Creek	CC-75	9/3/08	7.85	23.1	brn
Crow Creek	CC-75	9/3/08	5.48	23.1	psc
Crow Creek	CC-75	9/3/08	11.9	23.2	psc
Crow Creek	CC-75	9/3/08	7.59	24.8	psc
Crow Creek	CC-75	9/3/08	4.91	23.7	psc
Crow Creek	CC-75	9/3/08	5.72	25.6	psc
Crow Creek	CC-75	9/3/08	6.89	24.9	psc
Crow Creek	CC-75	9/3/08	6.7	25.1	brn

Attachment 2

Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Stream	Location	Date	Selenium, total (mg/kg dw)	Percent Solids	Tissue Type
Crow Creek	CC-75	9/3/08	7.59	23.5	ctt
Crow Creek	CC-75	9/3/08	5.71	24.9	ctt
Crow Creek	CC-75	9/3/08	4.69	24.6	brn
Crow Creek	CC-150	9/3/06	5.91	23.7	brn
Crow Creek	CC-150	9/3/06	4.96	23.6	brn
Crow Creek	CC-150	9/3/06	4.75	25.7	brn
Crow Creek	CC-150	9/3/06	7.71	21.4	brn
Crow Creek	CC-150	9/3/06	6.59	22	sc
Crow Creek	CC-150	9/3/06	6.69	24.8	sc
Crow Creek	CC-150	9/3/06	5.43	24.3	sc
Crow Creek	CC-150	9/3/06	5.32	22	sc
Crow Creek	CC-150	5/9/07	10.00	25.4	brn
Crow Creek	CC-150	5/9/07	8.00	24.6	brn
Crow Creek	CC-150	5/9/07	5.80	30.4	psc
Crow Creek	CC-150	5/9/07	4.40	28.6	psc
Crow Creek	CC-150	5/9/07	4.50	28	psc
Crow Creek	CC-150	5/9/07	4.90	29	psc
Crow Creek	CC-150	5/9/07	5.60	26.8	psc
Crow Creek	CC-150	5/9/07	8.00	24.8	brn
Crow Creek	CC-150	8/24/07	5.90	24.7	psc
Crow Creek	CC-150	8/24/07	3.50J-	31.1	psc
Crow Creek	CC-150	8/24/07	5.20	26.7	psc
Crow Creek	CC-150	8/24/07	7.70	25	psc
Crow Creek	CC-150	8/24/07	3.40J-	28.4	psc
Crow Creek	CC-150	8/24/07	6.10	23	brn
Crow Creek	CC-150	8/24/07	4.30J-	24.1	brn
Crow Creek	CC-150	10/30/07	5.40	24.8	brn
Crow Creek	CC-150	11/15/07	5.90	23.1	brn
Crow Creek	CC-150	11/15/07	4.70	23.2	brn
Crow Creek	CC-150	11/15/07	7.20	23.8	brn
Crow Creek	CC-150	11/15/07	6.70	21.7	brn
Crow Creek	CC-150	11/15/07	5.60	22.8	brn
Crow Creek	CC-150	11/15/07	6.00	22.7	brn
Crow Creek	CC-150	11/15/07	8.40	22.6	brn
Crow Creek	CC-150	11/15/07	7.00	23.6	brn
Crow Creek	CC-150	11/15/07	5.60	22.8	brn
Crow Creek	CC-150	5/13/08	9.29	25.2	psc
Crow Creek	CC-150	5/13/08	8.25	25.3	psc
Crow Creek	CC-150	5/13/08	13.2	23.6	psc
Crow Creek	CC-150	5/13/08	9.37	24.1	psc
Crow Creek	CC-150	5/13/08	14.7	26	psc
Crow Creek	CC-150	5/13/08	9.58	25.4	psc
Crow Creek	CC-150	5/13/08	8.61	22	brn
Crow Creek	CC-150	5/13/08	9.05	21.4	ctt
Crow Creek	CC-150	5/13/08	9.06	21.6	brn
Crow Creek	CC-150	5/13/08	11.8	21.7	brn
Crow Creek	CC-150	5/13/08	12.2	21.5	ctt
Crow Creek	CC-150	9/3/08	5.14 J+	24.9	brn
Crow Creek	CC-150	9/3/08	9.92 J+	23.4	brn
Crow Creek	CC-150	9/3/08	6.13 J+	24	brn
Crow Creek	CC-150	9/3/08	8.27 J+	24.2	ctt
Crow Creek	CC-150	9/3/08	13.5 J+	23.9	ctt
Crow Creek	CC-150	9/3/08	8.4 J+	23.1	brn
Crow Creek	CC-150	9/3/08	2.52 J+	23.1	ctt
Crow Creek	CC-150	9/3/08	8.45 J+	24.6	psc
Crow Creek	CC-150	9/3/08	10.5 J+	25.3	psc
Crow Creek	CC-150	9/3/08	6.82 J+	24	psc

Attachment 2

Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Stream	Location	Date	Selenium, total (mg/kg dw)	Percent Solids	Tissue Type
Crow Creek	CC-150	9/3/08	7.57 J+	24.7	psc
Crow Creek	CC-150	9/3/08	5.11 J+	25.8	psc
Crow Creek	CC-150	9/3/08	5.66 J+	23.9	psc
Crow Creek	CC-150	9/3/08	5.56 J+	23	ctt
Crow Creek	CC-150	9/3/08	10.7 J+	22.3	ctt
Crow Creek	CC-150	9/3/08	8.18 J+	24.5	brn
Crow Creek	CC-350	8/31/06	7.56	24.2	sc
Crow Creek	CC-350	8/31/06	7.29	23.6	sc
Crow Creek	CC-350	8/31/06	5.21	25.7	sc
Crow Creek	CC-350	8/31/06	5.81	22.2	sc
Crow Creek	CC-350	8/31/06	6.83	20.2	ctt
Crow Creek	CC-350	8/31/06	7.40	22.3	brn
Crow Creek	CC-350	8/31/06	4.60	26.1	ctt
Crow Creek	CC-350	5/8/07	9.70	25.9	ctt
Crow Creek	CC-350	5/8/07	8.50	26.6	ctt
Crow Creek	CC-350	5/8/07	6.80	25	psc
Crow Creek	CC-350	5/8/07	7.80	26.7	psc
Crow Creek	CC-350	5/8/07	6.70	26.4	psc
Crow Creek	CC-350	5/8/07	8.20	31.4	psc
Crow Creek	CC-350	5/8/07	6.90	31.5	psc
Crow Creek	CC-350	5/8/07	6.30	32	psc
Crow Creek	CC-350	5/8/07	8.90	31.7	lnd
Crow Creek	CC-350	5/8/07	11.60	28.7	lnd
Crow Creek	CC-350	5/8/07	7.80	29.2	lnd
Crow Creek	CC-350	5/8/07	10.00	29.7	lnd
Crow Creek	CC-350	5/8/07	7.40	24.6	ctt
Crow Creek	CC-350	8/23/07	6.00	24.3	brn
Crow Creek	CC-350	8/23/07	5.70	26	psc
Crow Creek	CC-350	8/23/07	5.50	25.5	psc
Crow Creek	CC-350	8/23/07	6.70	23.6	psc
Crow Creek	CC-350	8/23/07	4.10J-	27.7	psc
Crow Creek	CC-350	8/23/07	5.20J-	24.5	psc
Crow Creek	CC-350	8/23/07	4.50J-	26.6	psc
Crow Creek	CC-350	8/23/07	5.70J-	25.1	brn
Crow Creek	CC-350	8/23/07	6.80	25.9	ctt
Crow Creek	CC-350	8/23/07	7.00	24.3	wht
Crow Creek	CC-350	8/23/07	4.60J-	26.4	brn
Crow Creek	CC-350	11/15/07	9.20	22.5	brn
Crow Creek	CC-350	11/15/07	5.50	23.1	brn
Crow Creek	CC-350	11/15/07	8.50	23.1	brn
Crow Creek	CC-350	5/13/08	12.1 J-	22.9	ctt
Crow Creek	CC-350	5/13/08	16.1 J-	27.7	lnd
Crow Creek	CC-350	5/13/08	10.6 J-	26	lnd
Crow Creek	CC-350	5/13/08	14.1 J-	25.4	lnd
Crow Creek	CC-350	5/13/08	11.3 J-	24.5	spd
Crow Creek	CC-350	5/13/08	10.3 J-	25.5	psc
Crow Creek	CC-350	5/13/08	9.23 J-	26.9	psc
Crow Creek	CC-350	5/13/08	10.4 J-	24.4	psc
Crow Creek	CC-350	5/13/08	9.57 J-	23.1	psc
Crow Creek	CC-350	5/13/08	9.37 J-	26.3	psc
Crow Creek	CC-350	5/13/08	11.3 J-	25.6	psc
Crow Creek	CC-350	5/13/08	10.9 J-	24.1	ctt
Crow Creek	CC-350	9/4/08	4.97	26.1	ctt
Crow Creek	CC-350	9/4/08	7.62	25.8	ctt
Crow Creek	CC-350	9/4/08	5.03	24.3	brn
Crow Creek	CC-350	9/4/08	10.4	24.3	brn
Crow Creek	CC-350	9/4/08	10.6	24.4	brn

Attachment 2

Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Stream	Location	Date	Selenium, total (mg/kg dw)	Percent Solids	Tissue Type
Crow Creek	CC-350	9/4/08	8.16	24.4	brn
Crow Creek	CC-350	9/4/08	8.85	25.6	ctt
Crow Creek	CC-350	9/4/08	8.49	24.7	ctt
Crow Creek	CC-350	9/4/08	9	23.9	psc
Crow Creek	CC-350	9/4/08	9.63	26.2	psc
Crow Creek	CC-350	9/4/08	11	24.5	psc
Crow Creek	CC-350	9/4/08	10	24.1	psc
Crow Creek	CC-350	9/4/08	10.3	23.5	psc
Crow Creek	CC-350	9/4/08	7.26	25.1	psc
Crow Creek	CC-350	9/4/08	8.71	22.5	brn
Crow Creek	CC-350	9/4/08	6.64	22.8	brn
Deer Creek	DC-600	9/7/06	8.35	23.6	ctt
Deer Creek	DC-600	9/7/06	8.05	24.6	ctt
Deer Creek	DC-600	9/7/06	8.33	24.6	ctt
Deer Creek	DC-600	9/7/06	9.43	22.9	ctt
Deer Creek	DC-600	9/7/06	9.62	26	sc
Deer Creek	DC-600	9/7/06	6.48	25.6	sc
Deer Creek	DC-600	9/7/06	7.17	24	sc
Deer Creek	DC-600	9/7/06	10.75	24.1	sc
Deer Creek	DC-600	5/13/07	4.30	23.1	ctt
Deer Creek	DC-600	5/13/07	9.00	27	psc
Deer Creek	DC-600	5/13/07	7.10	26.4	psc
Deer Creek	DC-600	5/13/07	10.80	17.5	psc
Deer Creek	DC-600	5/13/07	6.60	27.7	psc
Deer Creek	DC-600	5/13/07	6.10	21.6	ctt
Deer Creek	DC-600	5/13/07	7.50	24.9	ctt
Deer Creek	DC-600	5/13/07	6.90	24.1	ctt
Deer Creek	DC-600	5/13/07	7.20	24.8	psc
Deer Creek	DC-600	5/13/07	6.50	25.6	psc
Deer Creek	DC-600	8/27/07	4.80	25.4	ctt
Deer Creek	DC-600	8/27/07	6.90	23.9	ctt
Deer Creek	DC-600	8/27/07	4.10	24.9	ctt
Deer Creek	DC-600	8/27/07	4.80	25.8	ctt
Deer Creek	DC-600	8/27/07	5.90	25.4	ctt
Deer Creek	DC-600	8/27/07	5.30	24.8	ctt
Deer Creek	DC-600	8/27/07	8.70	22.8	ctt
Deer Creek	DC-600	8/27/07	7.40	28.6	psc
Deer Creek	DC-600	8/27/07	6.50	24.5	ctt
Deer Creek	DC-600	8/27/07	7.20	22.6	ctt
Deer Creek	DC-600	8/27/07	4.30	27.4	ctt
Deer Creek	DC-600	8/27/07	6.90	26	psc
Deer Creek	DC-600	8/27/07	8.60	26	psc
Deer Creek	DC-600	5/18/08	11.8	22.6	ctt
Deer Creek	DC-600	5/18/08	13.1	23.3	ctt
Deer Creek	DC-600	5/18/08	14.4	23.8	ctt
Deer Creek	DC-600	5/18/08	14.3	22.7	ctt
Deer Creek	DC-600	5/18/08	7.69	23.8	psc
Deer Creek	DC-600	5/18/08	8.72	23.4	psc
Deer Creek	DC-600	5/18/08	7.94	26.5	psc
Deer Creek	DC-600	5/18/08	8.93	26.5	psc
Deer Creek	DC-600	5/18/08	9.4	25	psc
Deer Creek	DC-600	5/18/08	5.1	26.7	psc
Deer Creek	DC-600	5/18/08	9.29	21.8	ctt
Deer Creek	DC-600	5/18/08	14.1	23.2	ctt
Deer Creek	DC-600	9/8/08	12.1 J+	22.7	ctt
Deer Creek	DC-600	9/8/08	9.82 J+	21.8	ctt
Deer Creek	DC-600	9/8/08	9.75 J+	22.4	ctt

Attachment 2

Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Stream	Location	Date	Selenium, total (mg/kg dw)	Percent Solids	Tissue Type
Deer Creek	DC-600	9/8/08	7.08 J+	22.9	ctt
Deer Creek	DC-600	9/8/08	8.68	21.6	ctt
Deer Creek	DC-600	9/8/08	18.7	20.6	ctt
Deer Creek	DC-600	9/8/08	6.35	22	ctt
Deer Creek	DC-600	9/8/08	14.9	22.6	ctt
Deer Creek	DC-600	9/8/08	8.39	22	ctt
Deer Creek	DC-600	9/8/08	9.63	22.5	ctt
Deer Creek	DC-600	9/8/08	9.12	22.7	psc
Deer Creek	DC-600	9/8/08	9.2	23.8	psc
Deer Creek	DC-600	9/8/08	8.22	23.4	psc
Deer Creek	DC-600	9/8/08	8.25	24.6	psc
Deer Creek	DC-600	9/8/08	5.32	23.9	psc
Deer Creek	DC-600	9/8/08	11.6	22.7	psc
Hoopes Spring and Sage Creek					
Hoopes Spring	HS	9/8/06	14.07	26.8	brn
Hoopes Spring	HS	9/8/06	20.00	23.2	brn
Hoopes Spring	HS	9/8/06	15.48	25.9	brn
Hoopes Spring	HS	9/8/06	30.56	23.4	sc
Hoopes Spring	HS	9/8/06	38.57	23.7	sc
Hoopes Spring	HS	9/8/06	11.69	24.8	sc
Hoopes Spring	HS	9/8/06	12.11	24.2	sc
Hoopes Spring	HS	5/14/07	22.30	24.1	psc
Hoopes Spring	HS	5/14/07	21.50	25.6	psc
Hoopes Spring	HS	5/14/07	19.20	26.7	psc
Hoopes Spring	HS	5/14/07	29.80	24.8	psc
Hoopes Spring	HS	5/14/07	24.90	24.6	psc
Hoopes Spring	HS	5/14/07	21.80	27	psc
Hoopes Spring	HS	5/14/07	25.00	27.5	brn
Hoopes Spring	HS	8/24/07	27.10	23.4	brn
Hoopes Spring	HS	8/24/07	22.70	23.5	brn
Hoopes Spring	HS	8/24/07	21.00	25.1	brn
Hoopes Spring	HS	8/24/07	10.20	28.6	psc
Hoopes Spring	HS	8/24/07	11.70	25.8	psc
Hoopes Spring	HS	8/24/07	28.80	23.9	brn
Hoopes Spring	HS	5/17/08	28.2	22.2	brn
Hoopes Spring	HS	5/17/08	32	22.8	psc
Hoopes Spring	HS	5/17/08	33.3	23	psc
Hoopes Spring	HS	5/17/08	36.6	23.1	psc
Hoopes Spring	HS	5/17/08	30.9	24	psc
Hoopes Spring	HS	5/17/08	41	24.7	psc
Hoopes Spring	HS	5/17/08	41.8	23.2	psc
Hoopes Spring	HS	5/17/08	38.9	22.9	brn
Hoopes Spring	HS	5/17/08	30.8	21.5	brn
Hoopes Spring	HS	9/4/08	38.9	25.6	psc
Hoopes Spring	HS	9/4/08	44	26.1	psc
Hoopes Spring	HS	9/4/08	45.3	26	psc
Hoopes Spring	HS	9/4/08	37.1	26.1	psc
Hoopes Spring	HS	9/4/08	41.1	26.2	psc
Hoopes Spring	HS	9/4/08	41.4	27.1	psc
Hoopes Spring	HS	9/4/08	22.8	23.7	brn
Hoopes Spring	HS-3	9/6/06	25.61	24.6	brn
Hoopes Spring	HS-3	9/6/06	18.84	24.2	brn
Hoopes Spring	HS-3	9/6/06	20.43	23.4	brn
Hoopes Spring	HS-3	9/6/06	17.52	25	brn
Hoopes Spring	HS-3	9/6/06	23.85	26	sc
Hoopes Spring	HS-3	9/6/06	20.96	26	sc
Hoopes Spring	HS-3	9/6/06	24.87	22.8	sc

Attachment 2

Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Stream	Location	Date	Selenium, total (mg/kg dw)	Percent Solids	Tissue Type
Hoopes Spring	HS-3	9/6/06	17.74	26.5	sc
Hoopes Spring	HS-3	5/12/07	15.70	25.5	psc
Hoopes Spring	HS-3	5/12/07	26.20	23.7	psc
Hoopes Spring	HS-3	5/12/07	15.20	28.2	psc
Hoopes Spring	HS-3	5/12/07	24.90	25.6	psc
Hoopes Spring	HS-3	5/12/07	16.40	27.3	psc
Hoopes Spring	HS-3	5/12/07	13.00	27.3	psc
Hoopes Spring	HS-3	5/12/07	22.00	26.7	brn
Hoopes Spring	HS-3	5/12/07	21.40	25	brn
Hoopes Spring	HS-3	5/12/07	17.20	28.4	brn
Hoopes Spring	HS-3	5/12/07	14.70	28	brn
Hoopes Spring	HS-3	8/28/07	24.40	26.5	brn
Hoopes Spring	HS-3	8/28/07	19.30	25.3	brn
Hoopes Spring	HS-3	8/28/07	12.20	23.8	brn
Hoopes Spring	HS-3	8/28/07	16.20	26.3	brn
Hoopes Spring	HS-3	8/28/07	24.10	21.9	brn
Hoopes Spring	HS-3	8/28/07	13.70	25.1	brn
Hoopes Spring	HS-3	8/28/07	18.30	25.5	brn
Hoopes Spring	HS-3	8/28/07	18.40	25.4	brn
Hoopes Spring	HS-3	8/28/07	19.70	24.1	brn
Hoopes Spring	HS-3	8/28/07	14.20	27.8	brn
Hoopes Spring	HS-3	8/28/07	35.20	25.3	psc
Hoopes Spring	HS-3	8/28/07	25.10	24.5	psc
Hoopes Spring	HS-3	8/28/07	25.40	28	psc
Hoopes Spring	HS-3	8/28/07	18.70	25.3	psc
Hoopes Spring	HS-3	8/28/07	31.30	26.7	psc
Hoopes Spring	HS-3	8/28/07	24.10	25.6	psc
Hoopes Spring	HS-3	8/28/07	16.30	25	brn
Hoopes Spring	HS-3	5/16/08	19.8	25.9	ctt
Hoopes Spring	HS-3	5/16/08	31.3	24	ctt
Hoopes Spring	HS-3	5/16/08	26.3	23.8	brn
Hoopes Spring	HS-3	5/16/08	17.8	24.9	ctt
Hoopes Spring	HS-3	5/16/08	25.4	25	psc
Hoopes Spring	HS-3	5/16/08	23.5	24.1	psc
Hoopes Spring	HS-3	5/16/08	26	22.3	ctt
Hoopes Spring	HS-3	5/16/08	20.9	20.9	ctt
Hoopes Spring	HS-3	5/16/08	22.5	23	psc
Hoopes Spring	HS-3	5/16/08	23.5	23.3	psc
Hoopes Spring	HS-3	5/16/08	21.8	23.9	psc
Hoopes Spring	HS-3	5/16/08	26.9	22.8	psc
Hoopes Spring	HS-3	9/5/08	26.3 J+	23.7	ctt
Hoopes Spring	HS-3	9/5/08	25.3 J+	23.8	brn
Hoopes Spring	HS-3	9/5/08	24.9 J+	24.9	brn
Hoopes Spring	HS-3	9/5/08	35.2 J+	24.6	brn
Hoopes Spring	HS-3	9/5/08	26.9 J+	24.4	brn
Hoopes Spring	HS-3	9/5/08	28 J+	23.2	brn
Hoopes Spring	HS-3	9/5/08	38.5	23.2	brn
Hoopes Spring	HS-3	9/5/08	32.2	24.3	brn
Hoopes Spring	HS-3	9/5/08	24.3	24.8	brn
Hoopes Spring	HS-3	9/5/08	28.1	23.5	brn
Hoopes Spring	HS-3	9/5/08	22.3	24.3	psc
Hoopes Spring	HS-3	9/5/08	20.9	24.1	psc
Hoopes Spring	HS-3	9/5/08	24.9	25	psc
Hoopes Spring	HS-3	9/5/08	25.5	25	psc
Hoopes Spring	HS-3	9/5/08	23.3	25.5	psc
Hoopes Spring	HS-3	9/5/08	25.2	25.2	psc

Attachment 2

Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Stream	Location	Date	Selenium, total (mg/kg dw)	Percent Solids	Tissue Type
Sage Creek	LSV-2C	9/6/06	20.84	22.7	brn
Sage Creek	LSV-2C	9/6/06	22.82	22.7	brn
Sage Creek	LSV-2C	9/6/06	16.00	25	brn
Sage Creek	LSV-2C	9/6/06	19.39	26.4	brn
Sage Creek	LSV-2C	9/6/06	19.50	24.1	brn
Sage Creek	LSV-2C	9/6/06	18.13	25.1	brn
Sage Creek	LSV-2C	9/6/06	16.78	24.5	sc
Sage Creek	LSV-2C	9/6/06	22.84	22.9	sc
Sage Creek	LSV-2C	9/6/06	16.12	25	sc
Sage Creek	LSV-2C	9/6/06	14.14	26.3	sc
Sage Creek	LSV-2C	5/12/07	11.90	25.7	psc
Sage Creek	LSV-2C	5/12/07	10.80	33.3	psc
Sage Creek	LSV-2C	5/12/07	13.50	27.8	psc
Sage Creek	LSV-2C	5/12/07	11.40	25.8	psc
Sage Creek	LSV-2C	5/12/07	9.40	29.9	psc
Sage Creek	LSV-2C	5/12/07	9.00	23.7	brn
Sage Creek	LSV-2C	5/12/07	11.40	26.6	brn
Sage Creek	LSV-2C	5/12/07	22.20	27.6	brn
Sage Creek	LSV-2C	5/12/07	11.30	32.6	psc
Sage Creek	LSV-2C	5/12/07	8.50	27.2	brn
Sage Creek	LSV-2C	8/28/07	10.80	26.2	brn
Sage Creek	LSV-2C	8/28/07	27.50	25.8	brn
Sage Creek	LSV-2C	8/28/07	19.60	24.1	brn
Sage Creek	LSV-2C	8/28/07	26.40	24.7	brn
Sage Creek	LSV-2C	8/28/07	21.20	26.1	brn
Sage Creek	LSV-2C	8/28/07	20.70	26.9	brn
Sage Creek	LSV-2C	8/28/07	19.10	25.2	psc
Sage Creek	LSV-2C	8/28/07	19.90	26.9	psc
Sage Creek	LSV-2C	8/28/07	18.80	26.1	psc
Sage Creek	LSV-2C	8/28/07	15.50	24.2	psc
Sage Creek	LSV-2C	8/28/07	21.00	26.1	psc
Sage Creek	LSV-2C	8/28/07	18.80	26.7	psc
Sage Creek	LSV-2C	8/28/07	33.30	23.7	brn
Sage Creek	LSV-2C	8/28/07	23.80	24.3	brn
Sage Creek	LSV-2C	8/28/07	20.70	29.3	brn
Sage Creek	LSV-2C	11/14/07	23.80	23.2	brn
Sage Creek	LSV-2C	11/14/07	22.60	22	brn
Sage Creek	LSV-2C	11/14/07	9.20	23.6	brn
Sage Creek	LSV-2C	11/14/07	18.90	20.3	brn
Sage Creek	LSV-2C	11/14/07	11.30	21.1	brn
Sage Creek	LSV-2C	11/14/07	20.00	23	brn
Sage Creek	LSV-2C	11/14/07	13.80	22.1	brn
Sage Creek	LSV-2C	11/14/07	13.20	21.6	brn
Sage Creek	LSV-2C	11/14/07	8.60	23.2	brn
Sage Creek	LSV-2C	11/14/07	7.20	24.2	brn
Sage Creek	LSV-2C	11/14/07	17.20	22.8	brn
Sage Creek	LSV-2C	11/14/07	6.20	22.3	brn
Sage Creek	LSV-2C	11/14/07	6.70	23.1	brn
Sage Creek	LSV-2C	11/14/07	8.90	21.5	brn
Sage Creek	LSV-2C	11/14/07	17.30	21.8	brn
Sage Creek	LSV-2C	11/14/07	13.60	21.8	brn
Sage Creek	LSV-2C	11/14/07	9.60	22.5	brn
Sage Creek	LSV-2C	11/14/07	21.40	21.9	brn
Sage Creek	LSV-2C	11/14/07	17.90	21.8	brn
Sage Creek	LSV-2C	11/14/07	13.20	21.6	brn
Sage Creek	LSV-2C	5/16/08	25.7	21.2	psc
Sage Creek	LSV-2C	5/16/08	18.9	23.5	psc
Sage Creek	LSV-2C	5/16/08	26.4	26.1	psc

Attachment 2

Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Stream	Location	Date	Selenium, total (mg/kg dw)	Percent Solids	Tissue Type
Sage Creek	LSV-2C	5/16/08	18.5	21.4	brn
Sage Creek	LSV-2C	5/16/08	19.1	21.7	brn
Sage Creek	LSV-2C	5/16/08	11.4	21.6	brn
Sage Creek	LSV-2C	5/16/08	14.8	25	psc
Sage Creek	LSV-2C	5/16/08	36	24.4	psc
Sage Creek	LSV-2C	5/16/08	33.9	22.9	psc
Sage Creek	LSV-2C	5/16/08	20.5	21.4	brn
Sage Creek	LSV-2C	5/16/08	22.4	22	brn
Sage Creek	LSV-2C	5/16/08	29.6	22.8	brn
Sage Creek	LSV-2C	5/16/08	15.2	23.8	ctt
Sage Creek	LSV-2C	9/5/08	21.8	24.4	brn
Sage Creek	LSV-2C	9/5/08	22	24.6	psc
Sage Creek	LSV-2C	9/5/08	18.8	24.5	psc
Sage Creek	LSV-2C	9/5/08	19.1	24.8	psc
Sage Creek	LSV-2C	9/5/08	18.6	23.1	psc
Sage Creek	LSV-2C	9/5/08	20.1	28.5	psc
Sage Creek	LSV-2C	9/5/08	23.3	25.4	psc
Sage Creek	LSV-2C	9/5/08	25	24.3	brn
Sage Creek	LSV-2C	9/5/08	24.1	24.3	brn
Sage Creek	LSV-2C	9/5/08	20.8	24.3	brn
Sage Creek	LSV-2C	9/5/08	20.4	24.3	brn
Sage Creek	LSV-2C	9/5/08	18	24.2	brn
Sage Creek	LSV-2C	9/5/08	20.5	24.1	brn
Sage Creek	LSV-2C	9/5/08	24.3	24.4	brn
Sage Creek	LSV-2C	9/5/08	18.9	25.4	brn
Sage Creek	LSV-2C	9/5/08	19.4	24.1	brn
Sage Creek	LSV-2C	9/5/08	17.4	24.3	brn
Sage Creek	LSV-4	9/5/06	23.44	25	sc
Sage Creek	LSV-4	9/5/06	14.57	27.6	sc
Sage Creek	LSV-4	9/5/06	24.44	23.4	sc
Sage Creek	LSV-4	9/5/06	17.60	26.3	sc
Sage Creek	LSV-4	9/5/06	15.49	25.5	brn
Sage Creek	LSV-4	9/5/06	18.91	27.5	brn
Sage Creek	LSV-4	9/5/06	15.07	26.8	brn
Sage Creek	LSV-4	9/5/06	15.34	23.6	brn
Sage Creek	LSV-4	5/9/07	15.80	25.6	brn
Sage Creek	LSV-4	5/9/07	15.40	26.6	ctt
Sage Creek	LSV-4	5/9/07	17.80	24.2	ctt
Sage Creek	LSV-4	5/9/07	11.70	27.8	ctt
Sage Creek	LSV-4	5/9/07	31.70	24.7	psc
Sage Creek	LSV-4	5/9/07	17.60	24.6	psc
Sage Creek	LSV-4	5/9/07	22.70	24.3	psc
Sage Creek	LSV-4	5/9/07	13.40	25.5	psc
Sage Creek	LSV-4	5/9/07	12.90	29.2	psc
Sage Creek	LSV-4	5/9/07	11.40	29.4	psc
Downstream of Sage Creek					
Crow Creek	CC-1A	9/1/06	12.74	22.6	ctt
Crow Creek	CC-1A	9/1/06	11.73	25.5	sc
Crow Creek	CC-1A	9/1/06	8.92	25.9	sc
Crow Creek	CC-1A	9/1/06	9.45	23.7	sc
Crow Creek	CC-1A	9/1/06	11.86	22.6	brn
Crow Creek	CC-1A	9/1/06	8.15	25.9	brn
Crow Creek	CC-1A	9/1/06	9.64	28.1	sc
Crow Creek	CC-1A	9/1/06	9.28	26.3	brn
Crow Creek	CC-1A	5/10/07	9.90	25.1	ctt
Crow Creek	CC-1A	5/10/07	7.40	26.3	psc
Crow Creek	CC-1A	5/10/07	10.80	35.9	psc
Crow Creek	CC-1A	5/10/07	10.70	24.3	brn

Attachment 2

Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Stream	Location	Date	Selenium, total (mg/kg dw)	Percent Solids	Tissue Type
Crow Creek	CC-1A	5/10/07	7.40	26.7	brn
Crow Creek	CC-1A	5/10/07	7.50	24.7	psc
Crow Creek	CC-1A	5/10/07	7.70	23.7	psc
Crow Creek	CC-1A	5/10/07	8.30	24.8	psc
Crow Creek	CC-1A	5/10/07	10.80	28.6	spd
Crow Creek	CC-1A	5/10/07	7.30	28.9	lnd
Crow Creek	CC-1A	5/10/07	14.70	29.2	spd
Crow Creek	CC-1A	5/10/07	6.10	25.3	nr
Crow Creek	CC-1A	8/25/07	10.20	26.5	psc
Crow Creek	CC-1A	8/25/07	9.50J-	25.8	brn
Crow Creek	CC-1A	8/25/07	12.50	24.9	psc
Crow Creek	CC-1A	8/25/07	6.30	27.9	psc
Crow Creek	CC-1A	8/25/07	5.80	24.8	psc
Crow Creek	CC-1A	8/25/07	5.50	27.1	psc
Crow Creek	CC-1A	8/25/07	6.40	26	psc
Crow Creek	CC-1A	8/25/07	7.10	25.2	brn
Crow Creek	CC-1A	8/25/07	12.50	27.1	brn
Crow Creek	CC-1A	8/25/07	6.30	27.1	brn
Crow Creek	CC-1A	8/25/07	8.40	26	brn
Crow Creek	CC-1A	8/25/07	11.90	24.3	brn
Crow Creek	CC-1A	8/25/07	7.80	27.6	brn
Crow Creek	CC-1A	8/25/07	10.40	24.6	brn
Crow Creek	CC-1A	8/25/07	9.10	27.5	brn
Crow Creek	CC-1A	8/25/07	12.80	25.7	wht
Crow Creek	CC-1A	8/25/07	14.80	25.5	brn
Crow Creek	CC-1A	8/25/07	11.60	27.9	brn
Crow Creek	CC-1A	10/22/07	6.40	25.8	brn
Crow Creek	CC-1A	10/30/07	8.70	24.8	brn
Crow Creek	CC-1A	5/14/08	17.2	23	brn
Crow Creek	CC-1A	5/14/08	18.3	22.4	brn
Crow Creek	CC-1A	5/14/08	17.6	23.6	lnd
Crow Creek	CC-1A	5/14/08	12.5	26.6	rss
Crow Creek	CC-1A	5/14/08	25.1	27.4	spd
Crow Creek	CC-1A	5/14/08	16.4	23.5	brn
Crow Creek	CC-1A	5/14/08	15.5	24.8	wht
Crow Creek	CC-1A	5/14/08	18.2	21.6	brn
Crow Creek	CC-1A	5/14/08	16.7	25.5	lnd
Crow Creek	CC-1A	5/14/08	17.8 J-	23.7	wht
Crow Creek	CC-1A	5/14/08	12.7 J-	22.9	lnd
Crow Creek	CC-1A	5/14/08	16.4 J-	23.2	psc
Crow Creek	CC-1A	5/14/08	16.2 J-	24.4	psc
Crow Creek	CC-1A	5/14/08	19.8 J-	25.2	psc
Crow Creek	CC-1A	5/14/08	17.6 J-	21.2	brn
Crow Creek	CC-1A	5/14/08	13.4 J-	21.1	ctt
Crow Creek	CC-1A	9/6/08	15.9	26.5	brn
Crow Creek	CC-1A	9/6/08	13.8	24.6	brn
Crow Creek	CC-1A	9/6/08	13.5	25	brn
Crow Creek	CC-1A	9/6/08	11.3 J+	27.4	brn
Crow Creek	CC-1A	9/6/08	13.2 J+	26.1	brn
Crow Creek	CC-1A	9/6/08	8.04 J+	26.1	brn
Crow Creek	CC-1A	9/6/08	11.8 J+	25.7	brn
Crow Creek	CC-1A	9/6/08	23 J+	25	brn
Crow Creek	CC-1A	9/6/08	14.4 J+	25.8	brn
Crow Creek	CC-1A	9/6/08	15.4 J+	23.4	brn
Crow Creek	CC-1A	9/6/08	13.7 J+	30.2	lnd
Crow Creek	CC-1A	9/6/08	13.2 J+	29.7	spd
Crow Creek	CC-1A	9/6/08	9.66 J+	31.3	spd
Crow Creek	CC-1A	9/6/08	10.5 J+	25.5	psc

Attachment 2

Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Stream	Location	Date	Selenium, total (mg/kg dw)	Percent Solids	Tissue Type
Crow Creek	CC-1A	9/6/08	13.3 J+	25.3	psc
Crow Creek	CC-1A	9/6/08	14.1 J+	27.3	psc
Crow Creek	CC-1A	9/6/08	13.1 J+	28.2	wht
Crow Creek	CC-3A	9/4/06	9.14	27.8	brn
Crow Creek	CC-3A	9/4/06	14.34	26.7	brn
Crow Creek	CC-3A	9/4/06	8.31	29.6	ctt
Crow Creek	CC-3A	9/4/06	15.47	27.6	sc
Crow Creek	CC-3A	9/4/06	16.55	23.5	sc
Crow Creek	CC-3A	9/4/06	9.96	25.2	brn
Crow Creek	CC-3A	9/4/06	11.34	26.9	sc
Crow Creek	CC-3A	5/11/07	8.00	25.6	brn
Crow Creek	CC-3A	5/11/07	9.10	29.5	psc
Crow Creek	CC-3A	5/11/07	10.20	30.6	lnd
Crow Creek	CC-3A	5/11/07	11.20	25	lnd
Crow Creek	CC-3A	5/11/07	19.00	25.2	lnd
Crow Creek	CC-3A	5/11/07	7.40	29.8	spd
Crow Creek	CC-3A	5/11/07	11.30	32	spd
Crow Creek	CC-3A	5/11/07	10.50	26.2	lnd
Crow Creek	CC-3A	5/11/07	15.00	24.8	psc
Crow Creek	CC-3A	5/11/07	12.70	23.2	brn
Crow Creek	CC-3A	5/11/07	8.60	24.7	brn
Crow Creek	CC-3A	5/11/07	13.70	31.6	psc
Crow Creek	CC-3A	5/11/07	7.50	25.2	brn
Crow Creek	CC-3A	5/11/07	8.80	32.9	psc
Crow Creek	CC-3A	8/26/07	13.70	25.9	brn
Crow Creek	CC-3A	8/26/07	8.00J-	26.4	psc
Crow Creek	CC-3A	8/26/07	14.20	27.7	psc
Crow Creek	CC-3A	8/26/07	10.60	25.5	brn
Crow Creek	CC-3A	8/26/07	7.80J-	26.9	brn
Crow Creek	CC-3A	8/26/07	10.30	25	brn
Crow Creek	CC-3A	8/26/07	11.00	25.3	brn
Crow Creek	CC-3A	8/26/07	9.10	28.1	brn
Crow Creek	CC-3A	8/26/07	13.80	23.7	brn
Crow Creek	CC-3A	8/26/07	12.20	29	psc
Crow Creek	CC-3A	8/26/07	14.00	25.5	brn
Crow Creek	CC-3A	8/26/07	10.10	29.1	wht
Crow Creek	CC-3A	8/26/07	8.90	26.3	brn
Crow Creek	CC-3A	8/26/07	13.40	26.6	brn
Crow Creek	CC-3A	8/26/07	15.60	26.5	brn
Crow Creek	CC-3A	8/26/07	9.10	25.4	brn
Crow Creek	CC-3A	8/26/07	8.90	26.3	brn
Crow Creek	CC-3A	8/26/07	5.60	33.3	lnd
Crow Creek	CC-3A	8/26/07	5.70	32.3	lnd
Crow Creek	CC-3A	8/26/07	9.70	31.6	lnd
Crow Creek	CC-3A	8/26/07	8.10	31	lnd
Crow Creek	CC-3A	10/24/07	8.00	25.2	brn
Crow Creek	CC-3A	10/24/07	6.30	26.5	brn
Crow Creek	CC-3A	10/24/07	6.40	26.8	brn
Crow Creek	CC-3A	10/24/07	5.30	26.7	brn
Crow Creek	CC-3A	5/15/08	15	22.9	brn
Crow Creek	CC-3A	5/15/08	15.1	23.5	brn
Crow Creek	CC-3A	5/15/08	15.8	23.3	brn
Crow Creek	CC-3A	5/15/08	15.6	23.2	brn
Crow Creek	CC-3A	5/15/08	8.72	26	rss
Crow Creek	CC-3A	5/15/08	15.1	28.3	lnd
Crow Creek	CC-3A	5/15/08	15.3	24.2	spd
Crow Creek	CC-3A	5/15/08	13.9	25.2	rss

Attachment 2

Selenium Concentrations in Whole Body Fish Tissue Collected During the 2006 - 2008 Monitoring Events

Stream	Location	Date	Selenium, total (mg/kg dw)	Percent Solids	Tissue Type
Crow Creek	CC-3A	5/15/08	16.8	23.8	spd
Crow Creek	CC-3A	5/15/08	9.42	27.1	spd
Crow Creek	CC-3A	5/15/08	11.4	25.1	rss
Crow Creek	CC-3A	5/15/08	10.8	26.2	rss
Crow Creek	CC-3A	5/15/08	17	24.7	lnd
Crow Creek	CC-3A	5/15/08	11.2	29	wht
Crow Creek	CC-3A	9/7/08	19.1	24.5	brn
Crow Creek	CC-3A	9/7/08	19.2	22.9	brn
Crow Creek	CC-3A	9/7/08	13.2	27.9	wht
Crow Creek	CC-3A	9/7/08	18.3	22.8	brn
Crow Creek	CC-3A	9/7/08	13.5	28.4	wht
Crow Creek	CC-3A	9/7/08	10.9	28.4	wht
Crow Creek	CC-3A	9/7/08	10.1	29.6	rss
Crow Creek	CC-3A	9/7/08	20.2	23.6	brn
Crow Creek	CC-3A	9/7/08	11.2	26.4	rss
Crow Creek	CC-3A	9/7/08	8.07	29.4	rss
Crow Creek	CC-3A	9/7/08	12.4	28.1	lnd
Crow Creek	CC-3A	9/7/08	16.1	26	spd
Crow Creek	CC-3A	9/7/08	10.2	24.7	uts
Crow Creek	CC-3A	9/7/08	16.3	25.1	brn
Crow Creek	CC-3A	9/7/08	21.3	24.5	brn
Crow Creek	CC-3A	9/7/08	23.2	23.9	brn
Crow Creek	CC-3A	9/7/08	19.8	23.4	brn
Crow Creek	CC-3A	9/7/08	20.2	23.1	psc

Tissue Types				
	brn	Brown Trout	sc	Sculpin
	ctt	Cutthroat Trout	spd	Speckled Dace
	lnd	Longnose Dace	uts	Utah Sucker
	psc	Pauite Sculpin	wht	Mountain Whitefish
	rss	Redside Shiner	nr	Not Recorded