Toxicity assessment of sediments from the Grand Lake O' the Cherokees with the amphipod *Hyalella azteca*

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Executive Summary

Sediment toxicity tests were conducted to support Natural Resource Damage Assessment and Restoration (NRDAR) activities for the Grand Lake O' the Cherokees (Grand Lake) located in Oklahoma. The Tri-state Mining District (TSMD) watershed upstream of Grand Lake in Missouri, Kansas, and Oklahoma has been impacted by historic mining of metals. The objective of the study was to evaluate the chemistry and toxicity of 40 sediment samples collected from Grand Lake in October 2008. Based on previous studies conducted in the TSMD, primary chemicals of interest in sediment included zinc, cadmium, and lead. Effects on survival, length, weight, or total biomass of the amphipod *Hyalella azteca* were evaluated in a 28-d whole-sediment toxicity test with the samples collected from Grand Lake. *Hyalella azteca* was chosen because previous laboratory toxicity testing of sediments in the TSMD watershed showed that this organism provided stronger discrimination between a range of metal-contaminated sediments compared to testing conducted with mussels or midge.

Survival and growth of amphipods in the negative control sediment met test acceptability requirements outlined in the ASTM and USEPA methods. Nine sediments were identified as reference sediments based on low metal chemistry (mean metal probable effect concentrations quotients [PEC-Qs] <0.2). Toxicity of samples from Grand Lake to amphipods was established as reduced survival or growth (length, weight, or total biomass) of amphipods relative to the lowest mean response of amphipods in the nine reference sediments (the reference envelope). Mean survival or growth of amphipods was below the lower limit of the reference envelope in only two of the 40 sediment samples (5%) collected from Grand Lake.

Sediment quality guidelines (SQGs) were used to evaluate relationships between the responses of amphipods to the measures of metals in samples of whole sediment or to the measures of metals in pore water. These SQGs included: (1) metal PEC-Qs; (2) simultaneously extracted metals and acid volatile sulfides, normalized to organic carbon (ΣSEM-AVS or Σ(SEM-AVS)/*f*oc); and (3) toxic units for metals in pore water, based on hardness-adjusted water quality criteria. While concentrations of metals were moderately elevated in some of the samples, no significant correlations were observed between the responses of amphipods relative to these three SQGs for metals. Moreover, sediment toxicity thresholds based on these three types of SQGs were

infrequently exceeded and toxicity was infrequently observed when these thresholds were periodically exceeded. Hence, our results indicate that metal concentrations in the Grand Lake sediment samples were not high enough to reduce survival or growth of amphipods.

Results of this study indicate that metals in the sediment samples collected from Grand Lake in October 2008 were not likely causing or substantially contributing to toxicity to sediment-dwelling organisms. However, additional analyses are needed to determine if the 40 sediment samples evaluated in the current study represent the spatial and temporal variability of metals or AVS in Grand Lake sediments. Sampling Grand Lake sediments in October may represent a relatively high seasonal concentration of AVS compared to other times of the year. Additionally, the current study did not evaluate bioaccumulation of sediment-associated metals by amphipods. Bioaccumulation of contaminants has been demonstrated to result in injury to fish and wildlife resources at other sites at concentrations lower than is required to injure sediments or sediment-dwelling organisms (e.g., there is a fish consumption advisory for Grand Lake based on concentrations of lead in fish tissues [Oklahoma Department of Environmental Quality, 2007]).

Introduction

The Tri-State Mining District (TSMD) is a historic lead and zinc mining area that includes portions of Kansas, Missouri, and Oklahoma covering an area of more than 6,400 square kilometers (MacDonald *et al.* 2009). Historic mining activities in the TSMD from about 1885 to 1970 have resulted in contamination of surface water, groundwater, sediments, and/or flood plain soils by lead, zinc, and other heavy metals in this expansive area including the Spring River watershed and Neosho River watershed which are the two main rivers of the upper Grand River watershed. The Grand River watershed has numerous large dams including Pensacola Dam on the Neosho River which forms the Grand Lake O' the Cherokees (Grand Lake) in northeastern Oklahoma (Dudding 2008). The toxicity and distribution of mining-related contaminants in sediments has been documented upstream of Grand Lake in the Neosho and Spring Rivers and tributaries of the TSMD (MacDonald *et al.* 2009); however, the status of Grand Lake is not well known. Limited sediment sampling in upper Grand Lake was conducted by the Oklahoma Water Resources Board in 1982 and by the USGS in 2002 and 2004 indicating elevated concentrations of metals in sediment (Dudding 2008). A recent analysis of sediments in the Empire Lake located upstream of Grand Lake in Kansas indicates metal-contaminated sediments have washed past the Empire Lake Dam and have deposited in Grand Lake (Juracek 2006). However, no studies have been conducted to evaluate the toxicity or bioavailability of the metal-contaminated sediments that have been deposited in Grand Lake.

The objectives of this study were to: (1) evaluate the spatial extent of metal contamination in surface sediment of Grand Lake (Phase I; Dudding 2008) and (2) determine the toxicity and bioavailability of metals to sediment-dwelling organisms at a subset of these locations (Phase II). Results of the Phase I sediment sampling will be summarized in a separate report (Suzanne Dudding, UWFWS, Tulsa OK, personal communication). This report describes the results of the Phase II sampling designed to determine if metals in sediments collected from Grand Lake are elevated to concentrations that may be toxic to the amphipod *Hyalella azteca* in 28-d whole-sediment toxicity tests (USEPA 2000a, ASTM 2008). *Hyalella azteca* was chosen because previous laboratory toxicity testing of sediments in the TSMD watershed showed that this organism provided stronger discrimination between a range of metal-contaminated sediments

compared to testing conducted with mussels or midge (Ingersoll *et al.* 2008a, MacDonald *et al.* 2009).

Results of this study will be used by the USFWS to evaluate injury to natural resources and their habitats associated with releases of hazardous substances under the US Department of the Interior's Natural Resource Damage Assessment and Restoration (NRDAR) regulations. Relationships between sediment chemistry and the response of amphipods in the sediment toxicity tests were evaluated by using rank correlation analysis and by using exceedances of various toxicity thresholds for whole sediment or for pore water associated with sediment. This study did not evaluate bioaccumulation of metals by amphipods exposed to the sediment samples. Bioaccumulation of some contaminants has been demonstrated to result in injury to fish and wildlife resources at other sites at concentrations lower than is required to injure sediments or sediment-dwelling organisms (e.g., fish consumption advisories for mercury or polychlorinated biphenyls; MacDonald *et al.* 2002).

Materials and Methods

Sediment Collection

Phase I sampling of 93 sediment samples was conducted by USFWS on September 30 to October 1, 2008 with the collection of sediments from 12 transects with about 8 surface sediment samples collected from each transect (Figure 1; Dudding 2008). Most of these transects were located in the lower two-thirds of the lake. The upper 10 cm of sediment was collected using an Ekman Grab sampler deployed from boats. Each Phase I sample was collected as a composite sample within about a 10- to 20-m radius of the designated coordinates at each site. Upon retrieval, the sample was placed in a stainless steel tray on the deck of the boat for homogenization and then transferred into 250 ml (8 oz) wide-mouth glass jars. The bottles were filled to the top to minimize exposure of the sediment to air and after sealing, the caps were secured using electrical tape and held in the dark at 4°C until analysis. Each sediment sample was dried, re-homogenized and then characterized for total metal concentrations using x-ray fluorescence (XRF, EPA Method 6200; Dudding 2008). About 10% of the sediment samples were sieved to less than 64 µm for confirmation of concentration of metals using Inductively

Coupled Plasma/Atomic Emission Spectrometry (ICP-AES, EPA Method 6010B and EPA Method 3052; Dudding 2008).

The XRF results of the Phase I sampling were used to identify 40 sites for Phase II sediment toxicity testing (Table 1). The locations of the Phase II sediment samples were selected to represent a range of metal chemistry (Table 1). Phase II sediments were collected on October 21, 2008 and followed the procedures used to collect the Phase I samples. Sediment samples were held in the dark on ice in 500-ml wide-mouth Amber glass bottles before being driven to the Columbia Environmental Research Center (CERC) in Columbia, MO for physical and chemical analyses and toxicity testing. Sediments were held in the dark at 4ºC at CERC for about 1 week before the sediments were processed to start the toxicity tests. The negative control sediment tested was obtained from West Bearskin Lake located in northeastern Minnesota (Ankley *et al.* 1994, Ingersoll *et al.* 1998).

Toxicity Testing

Amphipods were mass cultured at the CERC facility at 23ºC in well water (hardness 280 mg/L as $CaCO_3$) following procedures outlined in Ingersoll *et al.* (1998, 2002). Amphipods at the start of the toxicity tests were obtained by collecting organisms that passed through a #35 U.S. Standard size sieve (500-µm opening) and retained on a #40 sieve (425-µm opening) placed under water. Amphipods were held in 3 L of water with gentle aeration and with a small amount of Tetramin® and a maple leaf (*Acer* spp.) for 24 h before the start of the toxicity test. Mean length of amphipods at the start of the toxicity test was 1.78 mm (0.071 standard error of the mean [SE]) and mean weight of amphipods at the start of the toxicity test was 0.026 mg (0.0034 SE; about the size of a 7-d-old amphipod; Ingersoll *et al.* 1998).

Toxicity tests were conducted for 28 d following USEPA (2000a) and ASTM (2008) methods (Table 2). Endpoints measured included 28-d survival, length, weight, and total biomass of amphipods (Tables 3 and 4; Appendix A). Sediments were homogenized in a stainless steel bowl using a plastic spoon and added to the exposure beakers. Amphipods were exposed to 100 ml of sediment with 175 ml of overlying water in 300-ml beakers, with four replicates tested with each treatment. The overlying water was well water diluted with deionized water to a hardness of 100

mg/L (as $CaCO_3$). To better stabilize sediment and the associated pore water, beakers containing sediment and overlying water were held under static conditions at 23°C from Day -7 to Day -1 before the start of the exposures on Day 0 (Ingersoll *et al.* 2008a). Sub-samples of sediment were collected on Day -7 for analysis of pore water quality, physical characteristics (grain size, total organic carbon, percent moisture; Appendix B), and for XRF analyses by the USFWS (Dudding 2008).

The photoperiod was 16 h light: 8 h dark at an intensity of about 200 lux at the surface of the exposure beakers. Water temperature was maintained at 23ºC. Each beaker received about two-volume additions/d of overlying water starting on Day -1 (Ingersoll *et al.* 2002). The water delivery system cycled every 8 h with each cycle delivering about 125 ml of water to each beaker. Tests were started on Day 0 by placing 10 amphipods into each beaker using an eyedropper. Each beaker containing amphipods were fed daily a 1.0 ml of Yeast-Cerophyll-trout chow (YCT; 1.8 g/L) in a water suspension (USEPA 2000a, ASTM 2008). The response of a subset of *H. azteca* in a 48-hour water-only NaCl reference toxicant test (LC50; median lethal concentration) was 5.1 g/L (95% confidence interval of 4.6-5.7) and is similar to historic NaCl reference toxicant tests conducted with *H. azteca* at our laboratory in ASTM hard water. For example, Ingersoll *et al.* (2008a) reported 48-h LC50s of 5.7 and 6.1 g/L for *H. azteca* in reference toxicant tests conducted in association with the TSMD sediment toxicity tests.

Overlying water quality characteristics (dissolved oxygen, pH, conductivity, hardness, ammonia and alkalinity) were determined in representative sediment exposure treatments at the beginning and the end of each exposure. Dissolved oxygen and conductivity were measured at least weekly in the overlying water in a replicate from each sediment treatment (Table 5). Temperature in the water baths containing the exposure beakers was recorded daily. Dissolved oxygen was measured with an YSI Model 54A oxygen meter and an YSI 5739 probe (YSI, Yellow Springs, OH). Conductivity was measured with an Orion 140 S-C-T Meter and a 014010 conductivity cell. Alkalinity and pH were measured with an Orion EA940 Ionalyzer, with Orion 917001 ATC probe, and Orion 8165BN combination pH probe (Thermo Electron, Beverly MA). Total hardness was measured by EDTA titration (Kemble *et al.* 1994). Total ammonia nitrogen (N) was determined by use of an Orion ammonia electrode and Orion EA940 meter. Total ammonia

concentrations were normalized to a pH of 8 and concentrations of unionized ammonia were calculated using methods outlined in USEPA (1999). Overlying water pH, alkalinity, total hardness, conductivity, dissolved oxygen and total ammonia measurements were similar among all treatments. Hardness, alkalinity, pH, and conductivity in the overlying water varied by less than 25% during the exposures and dissolved oxygen in overlying water was above the acceptable level of 2.5 mg/L in all treatments throughout the exposures (USEPA 2000a, ASTM 2008). Total ammonia varied by less than 50% during the exposure. Mean characteristics of overlying water quality (ranges in parentheses) were: pH 8.0 (7.9 to 8.1), alkalinity 81 (77 to 89 mg/L as $CaCO_3$), hardness 112 (107 to 121 mg/L as $CaCO_3$), dissolved oxygen 6.4 (5.6 to 7.3 mg/L), conductivity 215 (200 to 242 µmho/cm), total ammonia 0.05 (0.04 to 0.08 mg N/L), and unionized ammonia 0.0023 (0.0007 to 0.0039 mg N/L; Table 5). Duplicate analyses of overlying water samples from CERC-30 and CERC-32 were relatively consistent for all water quality characteristics (Table 5).

About 50 ml of pore water was isolated on Day -7 from the sediment samples by centrifugation at 5200 rpm (7000 g) for 15 min at 4°C (Kemble *et al.* 1994). Immediately after pore water was isolated, dissolved oxygen, pH, alkalinity, temperature, conductivity, total ammonia, and hardness were measured (Table 6). Mean characteristics of pore-water water quality (ranges in parentheses) were: pH 7.3 (6.9 to 7.6), alkalinity 238 (100 to 560 mg/L as $CaCO_3$), hardness 285 (196 to 560 mg/L as $CaCO_3$), dissolved oxygen 3.5 (1.8 to 6.8 mg/L), conductivity 464 (182 to 941 µmho/cm), total ammonia 1.47 (0.035 to 4.70 mg N/L), and unionized ammonia 0.012 (0.0003 to 0.038 mg N/L). Duplicate analyses of pore water isolated from samples CERC-5 and CERC-18 were relatively consistent for all water quality characteristics (Table 6). Pore-water samples for metal analyses were also collected on Day 6 of the sediment toxicity tests using peepers (described below; Appendix B). Subsamples of sediment for analysis of simultaneously extracted metals (SEM) and acid-volatile sulfide (AVS) were also obtained on Day 6 of the sediment toxicity test (described below; Appendix B).

Amphipods were isolated on Day 28 of the sediment exposures by pouring off about 75% of the overlying water, gently swirling the remaining overlying water and upper layer of sediment, and then washing the sediment through a No. 50 sieve (300-µm opening). The material that was

retained on the sieve was washed into a glass pan and the surviving amphipods were counted, collected, and preserved in 8% sugar formalin for subsequent length measurement. This process was repeated with the remainder of the sediment in a beaker if all 10 of the amphipods were not recovered from the upper layer of the sediment. Length of amphipods was measured along the dorsal surface from the base of the first antenna to the tip of the third uropod along the curve of the dorsal surface. Amphipod length measurements were made using an EPIX imaging system (PIXCI® SV4 imaging board and XCAP software; EPIX Inc., Buffalo Grove, IL) connected to a computer and a microscope (Ingersoll *et al.* 2002). Dry weight of individual amphipods (in mg) was estimated from the measurements of the lengths of individual amphipods (in mm) using a regression equation (Table A1 and A2; Ingersoll *et al.* 2008a). Total biomass of amphipods in each replicate beaker was estimated from the individual weights of surviving amphipods in that replicate beaker. If 11 test organisms were recovered from a replicate beaker, the total biomass estimate for that replicate beaker was adjusted to represent the total biomass of 10 organisms (Table A2: CERC-17 replicate 4, CERC-26 replicate 3, CERC-32 replicate 4).

Physical and Chemical Characterization of Sediments

Sediment chemistry measured on the 40 Phase II sediment samples included pore-water metals (analyzed at CERC), simultaneously-extracted metals (SEM), acid-volatile sulfide (AVS), total organic carbon (TOC), and particle size distribution (analyzed by the Trace Element Research Laboratory, Texas A&M University, College Station, TX under the direction of Bob Taylor; Table B1 to B4 in Appendix B). Organic analyses of sediments (e.g., polycyclic aromatic hydrocarbons, organochlorine compounds) were not included in the analyses of the sediment due to the low frequency of detection of these compounds in sediments collected from the TSMD watershed (Ingersoll *et al.* 2008a; MacDonald *et al.* 2009).

Grain size was determined using the pipette method (Folk 1974). It is based on the settling velocity of particles after the sediment has been treated with hydrogen peroxide to remove oxide and organic coatings, deflocculated with sodium hexametaphosphate, and sieved to separate sand-sized particles. Aliquots of the mixed suspension were withdrawn at known times during settling and the solids determined gravimetrically after drying in order to measure the clay and silt plus clay fractions.

Total carbon and organic carbon concentrations were determined on oven-dried (40 to 50°C) sediment samples using a CE440 Carbon Analyzer made by Exeter Analytical. Dried samples were combusted in an oxygen atmosphere and the carbon dioxide produced from each sample was swept out of the furnace's combustion chamber by the helium carrier gas flow. The gases were then passed through a dust trap and two reaction tubes. The contents of these tubes act as catalysts to remove unwanted combustion components and to convert any carbon monoxide present into carbon dioxide. Carbon dioxide was measured with a static detector and quantified based on peak area. Total organic carbon was determined after sample acidification. Carbonate (inorganic) carbon was determined as the difference between total carbon and total organic carbon.

Samples for analysis of acid volatile sulfide (AVS) and simultaneously extracted metals (SEM) were collected on Day 6 of the toxicity test. Concentrations of AVS and SEM were determined using wet sediment samples corresponding to about 25 g dry weight (USEPA 376.3 and 200.8). Samples were placed in reaction vessels with 135 ml of 1N HCl and extracted at room temperature while purging using oxygen-free inert gas for one hour. The liberated H_2S gas was swept by carrier gas through a NaOH trapping solution stabilized with antioxidants where sulfide was retained for analysis by ICP-OES. The extract was filtered and analyzed for metals using a Spectro Analytical CirOS axial ICP-OES.

Dissolved (filterable) concentrations of metals were measured in the pore water using the peeper sampling method with analysis by ICP-MS (Brumbaugh *et al.* 2007). Peepers were prepared from nominal 2.5-ml volume polyethylene snap-cap vials in which a 5-mm hole had been cut in the cap using a hole-punch tool. After acid rinsing and soaking in high-purity water, a 0.4-µm pore-size polyether-sulfone membrane was sealed under the cap while the peeper was submerged and then stored in a container of de-oxygenated, high-purity water at 4°C until placement into the sediment exposure beakers. For each sediment, a peeper was prepared for in-situ pore-water sampling during the sediment toxicity tests (peeper beakers also contained amphipods that were fed on a daily basis as described previously for the sediment toxicity beakers). The peeper was inserted on Day -1 of the test (the day before amphipods were placed in the sediment exposures)

and was removed on Day 6. Upon retrieval, each peeper was rinsed in the 100 mg/L hardness water to remove visible sediment particles, and then rinsed with a stream of high purity water. The liquid contents of the peeper were transferred to a 30-ml pre-cleaned low-density-polyethylene bottle using an acid rinsed mini-pipette, and then diluted to 29 ml with 1% HNO_3. Three peeper blanks were similarly processed.

Results of quality control (QC) samples indicated satisfactory accuracy and precision for pore-water metals analyzed using ICP-MS. QC samples analyzed included continuing blank and calibration verification solutions, a laboratory control sample, a five-fold dilution check for selected samples, spiked samples, an interference check solution, blanks, and method detection limit determinations (Appendix B Tables B5 to B12). Of these various QC measurements, only recoveries of Ni and Zn in the interference check solution were outside the target limits (in this instance, 80 to 120%). However, that check solution contains extraordinary concentrations of elements known to cause isobaric interferences and concentrations of the interfering elements were presumed to be much lower in pore-water samples. Recoveries from a laboratory control solution ranged from 98 to 100% (Table B6); relative percent differences between duplicate analyses ranged from 0.1 to 2.0% (Table B7); and recovery of spikes ranged from 94 to 107% (Table B8). Method detection limits (µg/L) were 0.48 for Cu, 0.11 for Ni, 2.2 for Zn, 0.04 for Cd, and 0.08 for Pb (Table B12). Peeper blanks (Table B3) contained measureable concentrations of some elements, particularly Zn; however, these concentrations were later determined to be largely associated with leaching from the storage container used for the blank peepers during the 7 day deployment of peepers in the sediment samples. That finding, in addition to the fact that many of the sample peepers had lower concentrations than the blank peepers, indicate that peeper blank concentrations did not accurately reflect blank contributions for peepers actually deployed in sediment samples.

Overall, results of QC samples provided by TERL indicated satisfactory accuracy and precision for metals and AVS determinations. QC samples analyzed with AVS and SEM determinations included procedural blanks, a control sample, duplicate preparations, and spiked samples (Appendix B Tables B15 to B18). QC results for the supplemental analytes are presented in these same tables “for informational purposes only” (those QC results were not critically reviewed).

Blank equivalent concentrations (BECs) for AVS were <5 mg/kg dry weight (Table B15). The BECs for primary SEM analytes (in mg/kg dry weight) were as follows: Cd, 0.0035 and 0.0026; Cu, 0.080 and 0.040; Ni, <0.005 and 0.007; Pb, 0.052 and 0.075; Zn, 0.32 and 0.40. Recovery of the primary analytes from laboratory control samples ranged from 89 to 114% (Table B16). Relative percent differences between duplicate SEM preparations (2 duplicate pairs prepared for each analyte) averaged 30% for Cd, Cu, Ni, Pb, and Zn. The greatest RPDs were for Ag (80% for each duplicate pair), followed by AVS (75% for one pair, 8% for the other). Variations between duplicates prepared by TERL were perhaps on average, slightly greater than expected; however, most of the greatest RPDs were obtained for samples with comparatively low concentrations (in some instances near the method detection limits) where high relative measurement variation is expected. Except for one Pb spike recovery (39%), recoveries for spiked samples averaged 92% and ranged from 67 to 142% (Table B18).

Data Analyses

Spearman rank correlation analysis was used to evaluate relationships between responses in the toxicity tests and the physical or chemical characteristics of the sediment samples (Table 7 and 8). Statistical significance for the rank correlations was established at 0.05. Experimental-wise error was not adjusted (Bonferroni method; Snedecor and Cochran 1982) in order to identify potential trends in the various relationships between the toxicity tests and the characteristics of the sediment. All statistical analyses were performed with Statistical Analyses System programs (SAS 2007).

Empirically based probable effect concentrations (PECs, MacDonald et al. 2000) and mechanistically based sediment quality guidelines (SQGs, USEPA 2005) for concentrations of metals in sediment or in pore water were used to assess relationships between the sediment chemistry and the response of the amphipods in the sediment toxicity tests. Thresholds established for each of these SQGs are listed in Table 7. Frequency of exceedance of these sediment toxicity thresholds and frequency of toxicity of samples that exceeded a threshold were evaluated for each threshold. These thresholds included general thresholds developed for sites across North America (Ingersoll *et al.* 2009) and thresholds developed specifically for the TSMD watershed (MacDonald *et al.* 2009; Table 7).

The PECs are effect-based SQGs that were established as concentrations of individual chemicals above which adverse effects in sediments are expected to frequently occur in field-collected sediments (MacDonald *et al.* 2000). Mean quotients based on PECs were calculated to provide an overall measure of chemical contamination and to support an evaluation of the combined effects of multiple contaminants in sediments (MacDonald *et al.* 2000; USEPA 2000b; Ingersoll *et al.* 2001, 2002; Table B2). A PEC quotient (PEC-Q) was calculated for each metal measured in each sediment sample by dividing the dry-weight concentration of the metal by the PEC for that metal. We were interested in equally weighting the contribution of each metal in the evaluation of sediment chemistry and toxicity. For this reason, an average PEC-Q for metals was calculated for each sample (for five metals: Zn, Cd, Pb, Cu, and Ni, for three metals: Zn, Cd, Pb; and for various combinations of two metals: Zn and Cd, Zn and Pb, or Cd and Pb; Table B2). The PEC-Q for metals was based on SEM concentrations of Cd, Cu, Pb, Ni, and Zn (SEM rather than total metal concentrations). Use of SEM concentrations may underestimate total metal concentrations by about a factor of about two (e.g., Brumbaugh *et al.* 2004, Ingersoll *et al.* 2008a; Table B2).

Relationships between toxicity and concentrations of metals in sediment samples were also evaluated using mechanically based SQGs based on the molar difference between the sum of simultaneously extracted metals (SEM for Cd, Cu, Pb, Ni, Zn) and acid volatile sulfide (AVS) normalized to dry weight (ΣSEM-AVS) or normalized to the fraction of organic carbon (Σ(SEM-AVS)/*f*oc, USEPA 2005; Table B2).

Potential toxicity associated with metals in pore water was evaluated with a pore metal toxic units approach (=criteria units; USEPA 2005). Toxic units were calculated by dividing the concentrations of each metal (Zn, Cd, Pb, Ni, and Cu) by its chronic water quality criterion (adjusted for pore water hardness; USEPA 2004; Besser *et al.* 2007, 2009a,b; MacDonald *et al.* 2009; Table B3). Toxic units for the five metals were summed to estimate cumulative risks from metal mixtures, assuming that toxicity of these metals is approximately additive. Increasing values of sum pore-water toxic units represent increasing risk of toxicity of the metal mixture, with little or no toxicity expected for values of sum toxic units less than 1.0 (USEPA 2005).

Individual sediment samples were designated as toxic or not toxic using a reference envelope approach. Specifically, toxicity was established by comparing mean survival, length, weight, or total biomass of amphipods exposed to Grand Lake sediments to the mean responses of amphipods exposed to reference sediments from the site (Table 3 and 4). Reference sediments were identified as those samples with a mean metals PEC-Q for five metals (Zn, Cd, Pb, Ni, and Cu) less than 0.2 (Table B2; Ingersoll *et al.* 2002; MacDonald *et al.* 2004, 2005; n=9, Table 4). Although a mean PEC-Q of <0.1 has been previously used to identify sediment samples with minimal concentrations of contamination (e.g., Ingersoll *et al.* 2001), a threshold of 0.2 has also been used in other investigations to increase the number of samples included in the reference envelope (e.g., Ingersoll *et al.* 2009). Statistical differences between the responses of amphipods exposed to Grand Lake sediments compared to the control sediment were also evaluated using one-way analysis of variance (ANOVA) at $\alpha = 0.05$ for all endpoints except length or weight which was analyzed using a one-way nested ANOVA at $\alpha = 0.05$ (amphipods nested within a beaker). Percent survival data were arcsine transformed and length, weight, and total biomass data were log transformed before analysis. If the results of the ANOVA were significant, mean separation was performed by Fisher's protected least-significant difference test at $\alpha = 0.05$. While significant reduction of survival, length, weight, or total biomass of amphipods relative to the control sediment are reported in Table 3, these multiple statistical comparisons to the single control sediment were not used to establish toxicity due to the low power associated with the multiple comparisons (i.e., 40 paired comparisons to a single control sediment).

Although several other procedures could have been used to designate samples as toxic or not toxic (e.g., analysis of variance compared to the single negative control sediment, paired T-tests with control results, minimum significant difference from the control; Thursby *et al.* 1997), the reference envelope approach was used because this approach provides a means of evaluating incremental toxicity of test sediments when compared to relatively uncontaminated sediments from the same area (i.e., reference sediments; Hunt *et al.* 2001, Ingersoll and MacDonald 2002, Ingersoll *et al.* 2009, MacDonald *et al.* 2009). In this way, only the toxicity that is attributable to differences in the chemical characteristics of test and reference samples was considered.
All nine of the samples selected for use in the reference envelope calculation exhibited survival

and growth consistent with criteria for acceptability of a negative control sediment (ASTM 2008, USEPA 2000a; Table 4). Sediment samples were designated as toxic if survival, length, weight, or total biomass of amphipods were lower than the lowest mean response of amphipods exposed to the reference sediments (Table 3 and 8; Besser *et al.* 2009b). Other investigations have established toxicity as sediment samples below the lower 5th percentile of the response of test organisms exposed to reference sediments (e.g., Ingersoll *et al.* 2009, MacDonald *et al.* 2009). The lower limit of the response range of amphipods was used in the current study due to the limited number of reference sediments (n=9; Table 4).

Results and Discussion

Physical and Chemical Characteristics of Sediment Samples

Concentrations of total organic carbon in the Grand Lake sediment samples averaged 2.0% and ranged from 0.35 to 3.6% (Table 8) and averaged 0.84% and ranged from 0.35 to 1.5% in the reference sediments (Table 4). Sand, silt, and clay content in the Grand Lake sediment samples exhibited broad ranges (sand: 0.1 to 82% [mean 13%]; silt: 4.2 to 97% [mean 36%]; clay: 1.1 to 94% [mean 51%]; Table 8). Similarly, a broad range in grain size was represented in the reference sediments (e.g., sand 0.3 to 80% [mean 45%]; Table 4).

Concentrations of metals in whole sediment (Zn, Cd, Pb, Cu, Ni as SEM) for the Grand Lake sediments are reported in Table B2. Probable effect concentration quotients (PEC-Qs) for these individual metals ranged from 0.09 to 1.47 for Zn (mean 0.64); 0.6 to 1.5 for Cd (mean 0.38); 0.04 to 0.46 for Pb (mean 0.22); 0.005 to 0.13 for Cu (mean 0.05); and 0.02 to 0.32 for Ni (mean 0.14; Table 8). Mean metal PEC-Qs based on Zn, Cd, and Pb ranged from 0.07 to 1.14 (mean 0.41) in the Grand Lake sediments (Table 8) and ranged from 0.07 to 0.20 (mean 0.13) in the reference sediments (Table 4).

Concentrations of metals in pore water isolated from the Grand Lake sediments with peepers are reported in Table B3. Pore-water toxic units (metal concentrations normalized to the chronic water quality criterion) ranged from 0.003 to 0.47 for Zn (mean 0.08); 0.03 to 0.43 for Cd (mean 0.070; 0.01 to 0.37 for Pb (mean 0.07); 0.01 to 0.11 for Cu (mean 0.03); 0.006 to 0.04 for Ni (mean 0.02); and 0.09 to 1.26 for sum pore-water toxic units (mean 0.27; Table 8). Sum pore-

water toxic units ranged from 0.15 to 0.33 (mean 0.21) in the reference sediments (Table 4).

Concentrations of acid volatile sulfide (AVS) in the Grand Lake sediments ranged from 0.3 to 97 µmole/g (mean 13.8 µmole/g; Table B4 and Table 9) and tended to be higher than concentrations of AVS reported for the TSMD watershed by MacDonald *et al.* 2009; Table B4 and Table 9. Values of ΣSEM-AVS ranged from -81 to 10.3 µmole/g (mean -9.2 µmole/g; Table 8) in the Grand Lake sediments and ranged from -1.4 to 1.5 µmole/g (mean -0.22 µmole/g; Table 4) in the reference sediments. Values of Σ(SEM-AVS)/*f*oc ranged from -2510 to 548 µmole/goc (mean -294 µmole/goc; Table 8) in the Grand Lake sediments and ranged from -128 to 425 µmole/goc (mean 59 µmole/goc; Table 4) in the reference sediments.

Sediment Toxicity

The response of amphipods in the negative control sediment met test acceptability requirements, as outlined in USEPA (2000a), ASTM (2008) and in Ingersoll *et al.* (2008b; mean survival 100%, mean length 3.9 mm, mean weight 0.29, mean total biomass 2.84 mg; Table 8). Mean survival of amphipods was below the lower limit of the reference envelope (85% survival) in only one of the Grand Lake sediments (75% survival in CERC-24; Table 3 and 8). Mean length of amphipods was below the lower limit of the reference envelope (3.45 mm length) in only one of the Grand Lake sediments (3.43 mm length in CERC-18; Table 3 and 8). Mean weight or mean total biomass of amphipods was not below the lower limit of the reference envelope in any of the Grand Lake sediments (Table 3 and 8). Overall, mean survival or length of amphipods was below the lower limit of the reference envelope in only two of the 40 sediment samples (5%) from Grand Lake. Therefore, sediments with mean metal PEC-Qs >0.2 (based on Zn, Cd, and Pb) were not substantially more toxic than reference sediments. Analysis of variance identified 15 samples (38% of the Grand Lake sediments) with survival or growth significantly reduced compared to the single control sediment (Table 3). However, 44% of the reference sediments (n=4) with low metal chemistry also exhibited reduced growth in comparison to the control sediment (Table 4). Hence, the incidence in toxicity in Grand Lake sediments relative to sediment toxicity thresholds was evaluated relative to reference conditions.

Comparisons of Sediment Characteristics to the Responses of Amphipods in the Toxicity Tests

Table 7 provides a summary of Spearman rank correlation analyses between various toxicity endpoints and between the toxicity endpoints to either the physical or chemical characteristics of the Grand Lake sediment samples. The percentage of the samples that exceeded sediment toxicity thresholds and the percentage of toxic samples exceeding sediment toxicity thresholds are also listed in Table 7. The "General thresholds" listed in Table 7 were derived from a variety of sources (Ingersoll *et al.* 2009). The "TSMD thresholds" were derived based on the results of *H. azteca* sediment toxicity tests conducted with TSMD sediments. Specifically, the TSMD thresholds represent concentrations of metals in sediment predicted to reduce survival of *H. azteca* by 10% relative to reference conditions in the TSMD (MacDonald *et al.* 2009). The TSMD sediment toxicity thresholds for metals listed in Table 7 are also consistent with thresholds for mean metal PEC-Qs, ΣSEM-AVS, and (ΣSEM-AVS)/*f*oc described by Ingersoll (2007) in an evaluation of injury to sediments in the TSMD.

For the PEC-Q thresholds listed in Table 7, it was conservatively estimated that the SEM concentrations in the present study were 50% of the total metal concentrations (see mean values for ratios of XRF to SEM Zn and Pb listed in Table B4 and Figures B1 and B2 in Appendix B). Hence, the PEC-Qs in the present study were multiplied by a factor of 2.0 to evaluate the frequency of exceeding the PEC-Q thresholds listed in Table 7.

Significant positive correlations were observed between the various growth endpoints (length, weight, and total biomass; Table 7). No significant correlations were observed between survival and the growth endpoints (Table 7; Figures 2 and 3). No significant correlations were observed between the four toxicity endpoints (survival, length, weight, or total biomass of amphipods) compared to the physical characteristics of the Grand Lake sediments (TOC, grain size, or ammonia; Table 7). *Hyalella azteca* is relatively tolerant of a wide range in these physical characteristics in sediment (see for example, the literature summarized in USEPA 2000a and in ASTM 2008); hence no General thresholds or TSMD thresholds were listed for TOC or grain size in Table 7. Concentrations of total ammonia and unionized ammonia were at least a factor of 7 below the General thresholds for ammonia listed in Table 7.

No significant correlations were observed between the toxicity endpoints and individual PEC-Qs for Zn, Cd, Pb, Cu or Ni or between the toxicity endpoints and the various mean metal PEC-Qs (based on the average of the five metals or the average of two to three metals listed in Table 7). Figures 4 and 5 illustrate the lack of a relationship between survival or total biomass of amphipods and mean metal PEC-Qs (based on Zn, Cd, and Pb). While up to 73% Grand Lake sediment samples marginally exceeded the General thresholds for PEC-Qs listed in Table 7, less than 7% of the samples that exceeded these conservative thresholds were toxic to amphipods (based on comparisons to reference conditions). The sediment samples that exceeded the General thresholds typically exceeded the thresholds by less than a factor of 2. Moreover, only 2.5% of the Grand Lake sediment samples exceeded some of the TSMD thresholds for PEC-Qs listed in Table 7 and none of the samples that exceeded the TSMD thresholds were toxic to amphipods. Hence, based on these evaluations with PEC-Qs, is it unlikely that metals caused toxicity to the amphipods in the sediment samples from Grand Lake relative to reference conditions.

No significant correlations were observed between the toxicity endpoints and the metal toxic units for pore-water samples measured in the Grand Lake sediments (Table 7). In addition, the General threshold and TSMD thresholds for pore-water metals were infrequently exceeded and the pore-water samples that exceeded these thresholds were infrequently toxic (Table 7). Figures 6 and 7 illustrate the lack of a relationship between survival or total biomass of amphipods and concentrations of metals in pore water (based on sum metal toxic units). Similarly, no significant correlations were observed between the toxicity endpoints and ΣSEM-AVS or (ΣSEM-AVS)/*f*oc (Table 7). While the general thresholds for ΣSEM-AVS or (ΣSEM-AVS)/*f*oc were exceeded in 18 to 35% of the Grand Lake sediment samples, none of the samples that exceeded these conservative General thresholds or the TSMD thresholds for ΣSEM-AVS or (ΣSEM-AVS)/*f*oc were toxic to amphipods (based on comparisons relative to reference conditions; Table 7). Figures 8 and 9 illustrate the lack of a relationship between survival or total biomass of amphipods and ΣSEM-AVS or (ΣSEM-AVS)/*f*oc. Measures of AVS and fraction of organic carbon indicate that concentrations of metals in the sediment samples would not be expected to be toxic to the amphipods. Hence, based on these evaluations of concentrations of metals in pore water and based on measures of ΣSEM-AVS or (ΣSEM-AVS)/*f*oc, is it unlikely that metals

caused toxicity to amphipods in the sediment samples from Grand Lake relative to reference conditions. Concentrations of AVS have been shown to be highest in late summer and lowest in late winter in both marine and freshwater sediments (Boothman and Helmstetter, 1992, Leonard et al. 1993). Hence sampling Grand Lake sediments in October may represent a relatively high seasonal concentration of AVS compared to other times of the year.

Conclusions

Sediment toxicity tests were conducted to support a NRDAR project associated with the Grand Lake located in Oklahoma. Mean survival or growth of amphipods exposed to sediments collected from Grand Lake in October 2008 was below the lower limit of the reference envelope in only two of the 40 samples (5%). While concentrations of metals were moderately elevated in some of the samples, no significant correlations were observed between the responses of amphipods relative to the SQGs for metals (i.e., metal PEC-Qs, ΣSEM-AVS, Σ(SEM-AVS)/*f*oc) or toxic units for metals in pore water). Moreover, sediment toxicity thresholds based on these three types of SQGs were infrequently exceeded and toxicity was infrequently observed when these thresholds were periodically exceeded. Hence, our results indicate that metal concentrations in the Grand Lake sediment samples were not high enough to reduce survival or growth of amphipods.

Results of this study indicate that metals in the sediment samples collected from Grand Lake in October 2008 were not likely causing or substantially contributing to toxicity to sediment-dwelling organisms based on toxicity tests with the amphipod *H. azteca*, a species demonstrated to be sensitive to metal exposure in sediment from the TSMD watershed. However, additional analyses are needed to determine if the 40 Phase II sediment samples evaluated in the current study represent the spatial and temporal variability of metals or AVS in Grand Lake sediments. Table 10 summarizes the average conditions of sediments across each of the transects sampled in Phase II (Figure 1). There was a tendency for concentrations of metals in sediment and in pore water to be slighted elevated in transects in the upper portion of Grand Lake (Table 1). Comparisons should be made between the surficial sediment samples evaluated in the Phase II portion of the study (n=40) to the distribution and chemistry of the Phase I sediment samples collected in September 2008 (n=93). In addition, the sediment chemistry of the Phase I and

Phase II samples should also be compared to historic sediment chemistry for Grand Lake based on sampling sediment cores or sampling of other surficial sediments. Importantly, these additional datasets for Grand Lake should be evaluated relative to the frequency of exceeding the TSMD sediment toxicity thresholds for metals listed in Table 7. The seasonal influence of AVS should also be evaluated relative to these sediment toxicity thresholds given that sediments in Grand Lake sampled in October may have higher concentrations of AVS compared to other locations in the watershed that were used to establish the TSMD sediment toxicity thresholds listed in Table 7. Additionally, the current study did not evaluate bioaccumulation of sediment-associated metals by amphipods. Bioaccumulation of contaminants has been demonstrated to result in injury to fish and wildlife resources at other sites at concentrations lower than is required to injure sediments or sediment-dwelling organisms (e.g., there is a fish consumption advisory for Grand Lake based on concentrations of lead in fish tissues [Oklahoma Department of Environmental Quality, 2007]).

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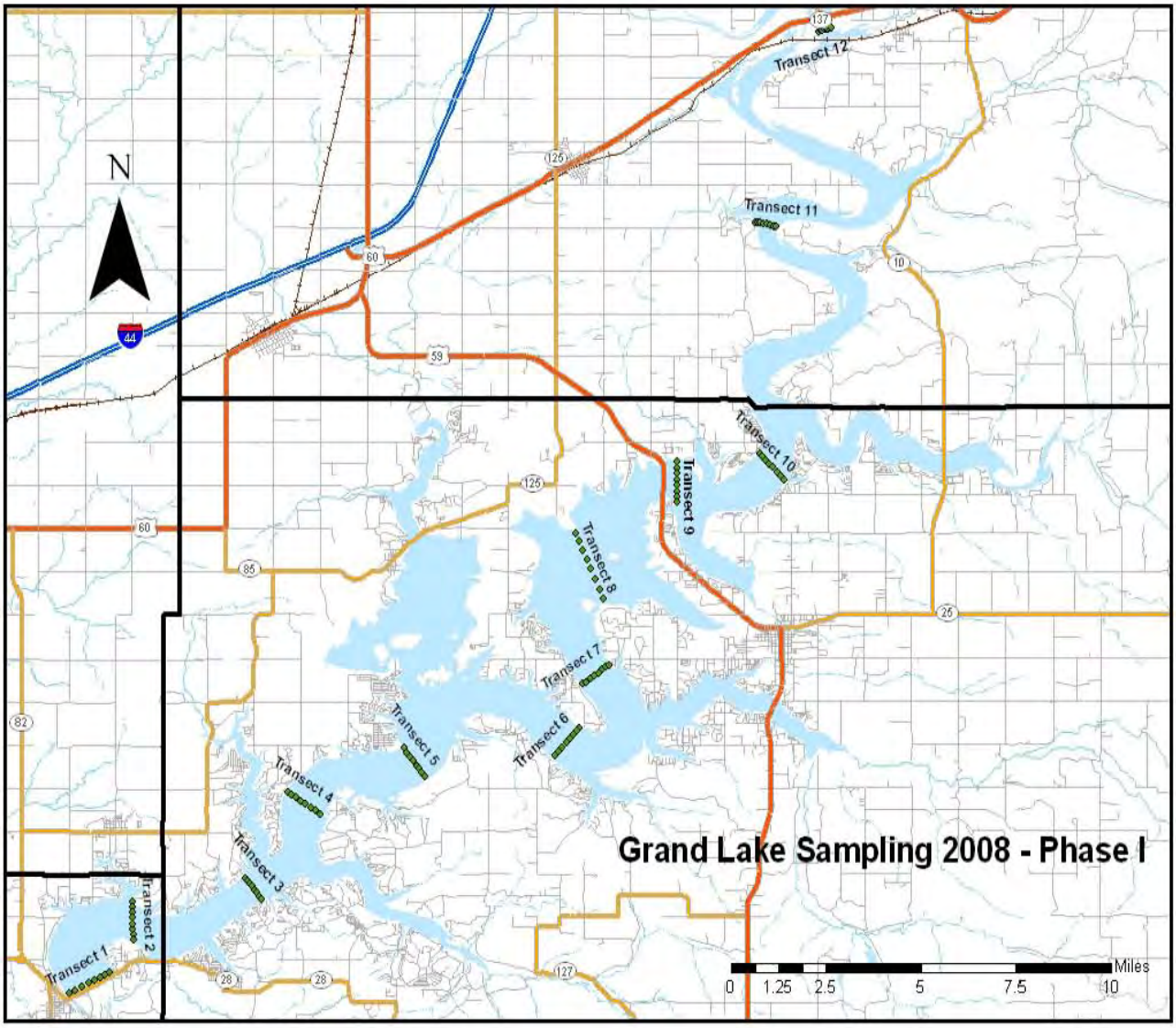
Fig 1. Locations of transects for the Phase I sediment sampling locations (Dudding 2008).



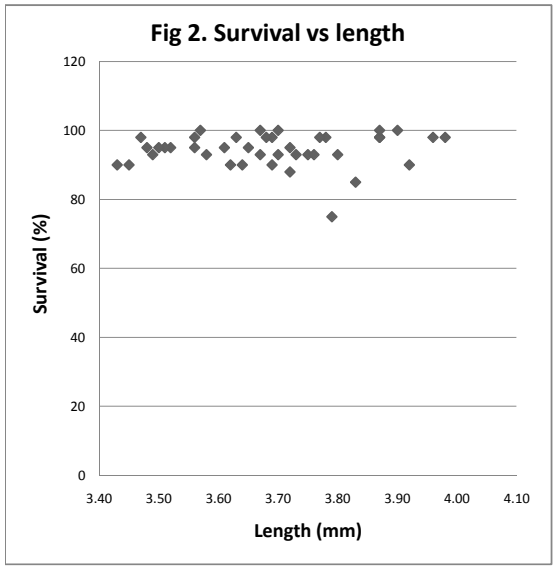


Fig 2. Survival vs length
Survival (%)
Length (mm)
0
20
40
60
80
100
120
3.40
3.50
3.60
3.70
3.80
3.90
4.00
4.10

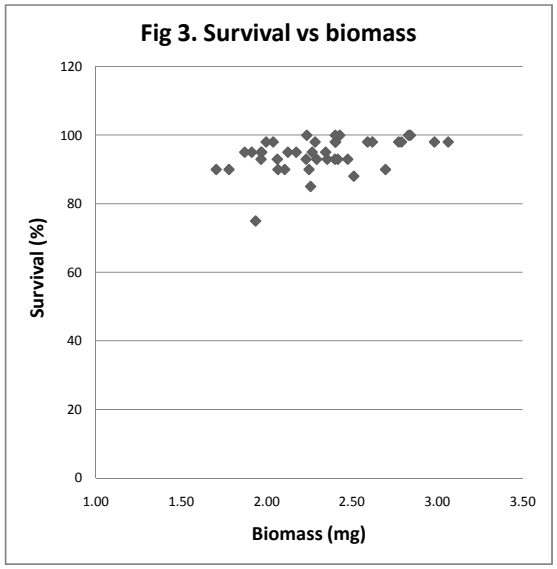


Fig 3. Survival vs biomass
Survival (%)
Biomass (mg)
0
20
40
60
80
100
120
1.00
1.50
2.00
2.50
3.00
3.50

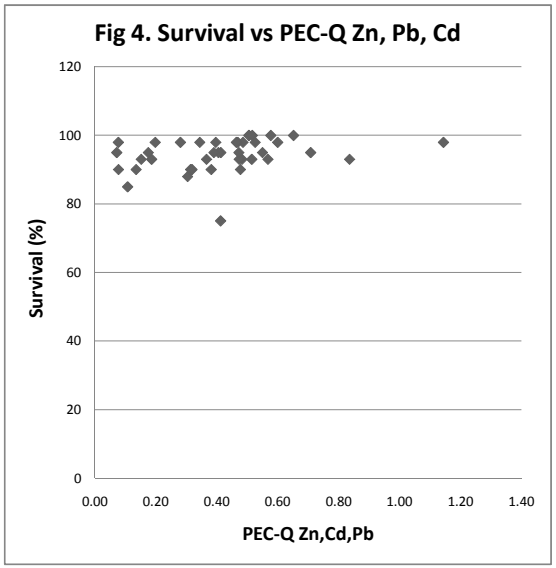


Fig 4. Survival vs PEC-Q Zn, Pb, Cd
Survival (%)
PEC-Q Zn,Cd,Pb
0
20
40
60
80
100
120
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40

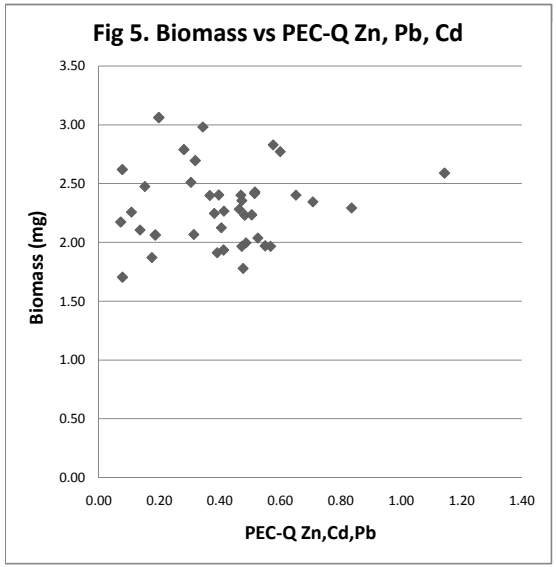


Fig 5. Biomass vs PEC-Q Zn, Pb, Cd
Biomass (mg)
PEC-Q Zn,Cd,Pb
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40

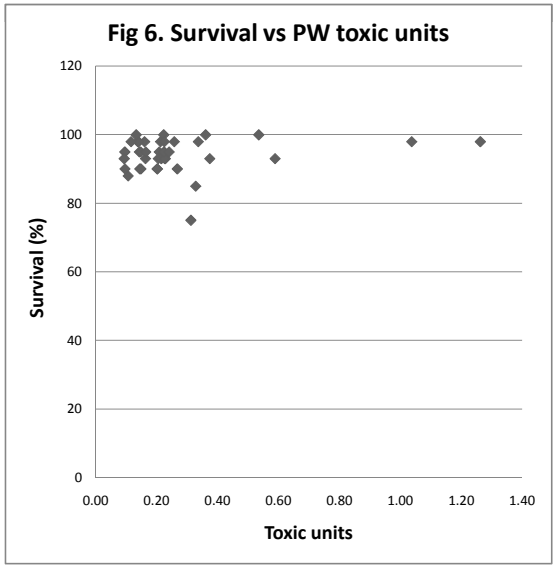


Fig 6. Survival vs PW toxic units
Survival (%)
Toxic units
0
20
40
60
80
100
120
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40

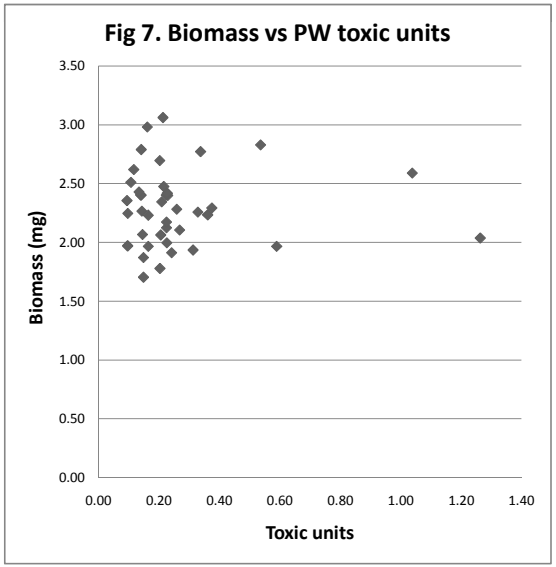


Fig 7. Biomass vs PW toxic units
Biomass (mg)
Toxic units
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40

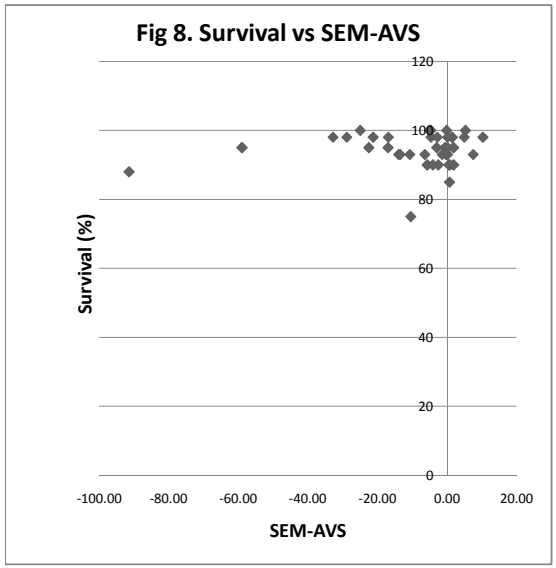


Fig 8. Survival vs SEM-AVS
Survival (%)
120
100
80
60
40
20
0
-100.00
-80.00
-60.00
-40.00
-20.00
0.00
20.00
SEM-AVS

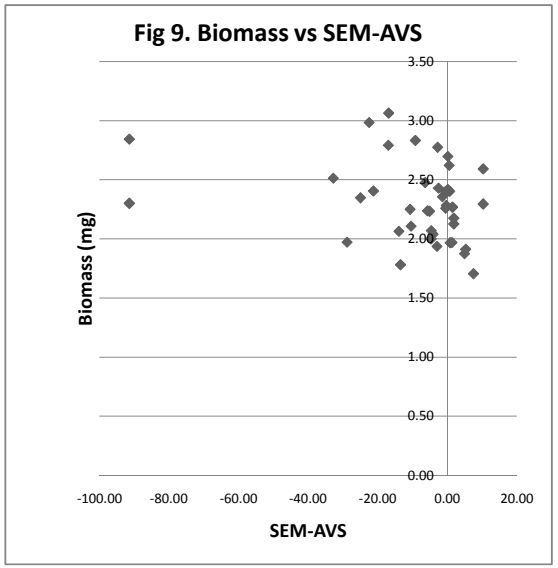


Fig 9. Biomass vs SEM-AVS
Biomass (mg)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-100.00
-80.00
-60.00
-40.00
-20.00
0.00
20.00
SEM-AVS

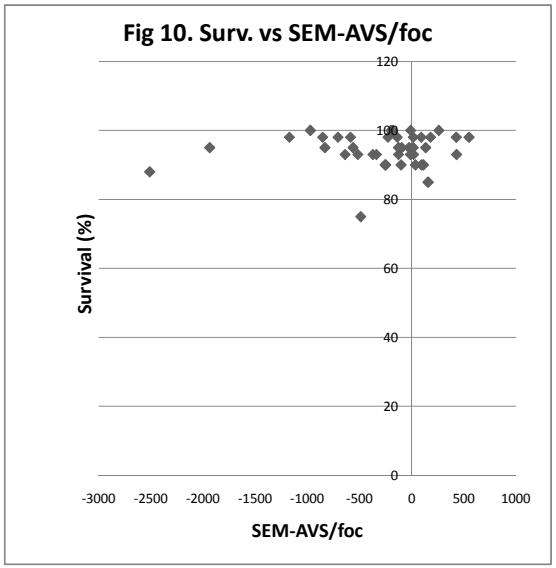


Fig 10. Surv. vs SEM-AVS/foc
Survival (%)
120
100
80
60
40
20
0
-3000
-2500
-2000
-1500
-1000
-500
0
500
1000
SEM-AVS/foc

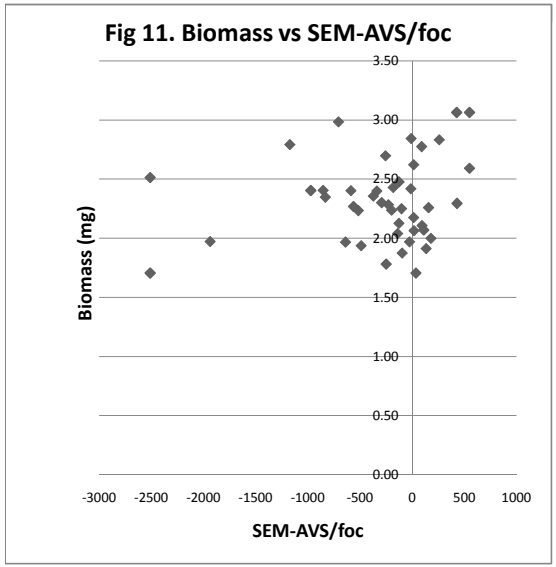


Fig 11. Biomass vs SEM-AVS/foc
Biomass (mg)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-3000
-2500
-2000
-1500
-1000
-500
0
500
1000
SEM-AVS/foc

Table 1. Identification codes for Phase II sediment samples collected in from the Grand Lake. NA = Not applicable. Category Low (n=8), Moderate (n=7), or High (n=25) based on mean Zn and Pb probable effect concentrations quotients (PEC-Qs) calculated from Phase I XRF metal data (Suzanne Dudding, USFWS, Tulsa OK; personal communication).

CERCsample identification	USFWS sample identification	Date sampled	Latitude (degrees W)	Longitude (degrees N)	Phase I XRF analyses March 2009					
					Zn (µg/g)	Zn PEC-Q	Pb (µg/g)	Pb PEC-Q	Mean Zn and Pb PEC-Q	Category
WB	NA, Control	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	GL-SED-T1-03	21-Oct-08	36.47273049	-95.03617826	414	0.90	50	0.39	0.65	Medium
2	GL-SED-T1-04	21-Oct-08	36.47213722	-95.03485903	508	1.11	57	0.45	0.78	High
3	GL-SED-T2-02	21-Oct-08	36.49544595	-95.01459033	501	1.09	56	0.44	0.76	High
4	GL-SED-T3-01	21-Oct-08	36.50909898	-94.97339764	507	1.10	53	0.41	0.76	High
5	GL-SED-T4-02	21-Oct-08	36.53643857	-94.95706407	498	1.08	54	0.42	0.75	High
6	GL-SED-T4-03	21-Oct-08	36.53192097	-94.94674813	412	0.90	48	0.38	0.64	Medium
7	GL-SED-T4-07	21-Oct-08	36.53624587	-94.95396034	142	0.31	26	0.20	0.26	Low
8	GL-SED-T5-02	21-Oct-08	36.55109617	-94.91214545	568	1.24	56	0.44	0.84	High
9	GL-SED-T5-04	21-Oct-08	36.54829385	-94.90976701	536	1.17	59	0.46	0.81	High
10	GL-SED-T5-07	21-Oct-08	36.54424137	-94.90599766	649	1.41	49	0.38	0.90	High
11	GL-SED-T6-01	21-Oct-08	36.55872647	-94.84721982	139	0.30	34	0.27	0.28	Low
12	GL-SED-T6-02	21-Oct-08	36.55756189	-94.84920138	250	0.54	23	0.18	0.36	Low
13	GL-SED-T6-03	21-Oct-08	36.55658053	-94.84867039	342	0.75	37	0.29	0.52	Medium
14	GL-SED-T6-06	21-Oct-08	36.55348283	-94.85270443	538	1.17	56	0.44	0.80	High
15	GL-SED-T6-08	21-Oct-08	36.55027458	-94.85591018	535	1.17	63	0.49	0.83	High
16	GL-SED-T7-01	21-Oct-08	36.57295953	-94.84496660	595	1.30	58	0.45	0.87	High
17	GL-SED-T7-02	21-Oct-08	36.57545666	-94.84398826	562	1.22	58	0.45	0.84	High
18	GL-SED-T7-04	21-Oct-08	36.57746086	-94.84081110	562	1.22	59	0.46	0.84	High
19	GL-SED-T7-05	21-Oct-08	36.57849175	-94.83935416	494	1.08	50	0.39	0.73	Medium
20	GL-SED-T7-06	21-Oct-08	36.57936648	-94.83771348	569	1.24	61	0.48	0.86	High
21	GL-SED-T7-08	21-Oct-08	36.58088109	-94.83510730	665	1.45	50	0.39	0.92	High
22	GL-SED-T8-01	21-Oct-08	36.62511474	-94.84796086	238	0.52	53	0.41	0.47	Low
23	GL-SED-T8-03	21-Oct-08	36.61982476	-94.84462378	140	0.31	33	0.26	0.28	Low
24	GL-SED-T8-06	21-Oct-08	36.60989447	-94.83969631	465	1.01	47	0.37	0.69	Medium
25	GL-SED-T9-03	21-Oct-08	36.64555703	-94.80806175	497	1.08	52	0.41	0.74	Medium
26	GL-SED-T9-07	21-Oct-08	36.63753513	-94.80887563	529	1.15	51	0.40	0.78	High
27	GL-SED-T9-08	21-Oct-08	36.63534301	-94.80901334	516	1.12	56	0.44	0.78	High
28	GL-SED-2007-T6	21-Oct-08	36.74119530	-94.72916909	771	1.68	42	0.33	1.00	High
29	GL-SED-2007-T4	21-Oct-08	36.70065681	-94.74209466	493	1.07	40	0.31	0.69	Medium
30	GL-SED-T10-02	21-Oct-08	36.65100913	-94.77651436	579	1.26	56	0.44	0.85	High
31	GL-SED-T10-03	21-Oct-08	36.64986835	-94.77500092	554	1.21	52	0.41	0.81	High
32	GL-SED-T10-04	21-Oct-08	36.64872279	-94.77363182	576	1.25	54	0.42	0.84	High
33	GL-SED-T11-06	21-Oct-08	36.72913928	-94.77370491	664	1.45	57	0.45	0.95	High
34	GL-SED-T12-01	21-Oct-08	36.79456632	-94.75424054	113	0.25	22	0.17	0.21	Low
35	GL-SED-T12-02	21-Oct-08	36.79469062	-94.75409822	120	0.26	21	0.16	0.21	Low
36	GL-SED-T12-03	21-Oct-08	36.79488651	-94.75363302	129	0.28	24	0.19	0.23	Low
37	GL-SED-T12-04	21-Oct-08	36.79510427	-94.75279835	764	1.66	64	0.50	1.08	High
38	GL-SED-T12-06	21-Oct-08	36.79568388	-94.75166470	1708	3.72	114	0.89	2.31	High
39	GL-SED-T12-07	21-Oct-08	36.79556586	-94.75094914	1344	2.93	100	0.78	1.85	High
40	GL-SED-T12-08	21-Oct-08	36.79596266	-94.75047749	1471	3.20	115	0.90	2.05	High

Table 2. Summary of test conditions for conducting Grand Lake sediment toxicity tests with the amphipod *Hyalella azteca* (based on USEPA 2000 ASTM 2008).

Test conditions	Characteristics
1 **Test species:**	*Hyalella azteca*
2 **Test type:**	Whole-sediment exposures with water renewal
3 **Test Duration:**	28 d
4 **Temperature:**	23°C
5 **Light quality:**	Ambient laboratory light
6 **Light intensity:**	about 200 lux
7 **Photoperiod:**	16L:8D
8 **Test chamber size:**	300-ml beakers
10 **Sediment volume:**	100 ml
11 **Water Renewal:**	2 volume additions/d
12 **Age of test organisms:**	about 7-d old
13 **Organisms/beaker:**	10 individuals
14 **Number of replicates:**	4 replicates/treatment
15 **Feeding:**	YCT (1.0 ml/d of 1800 mg/L stock)
16 **Aeration:**	None
17 **Test water:**	Well water diluted with deionized water to a hardness of about 100 mg/L (as $CaCO_3$), alkalinity 85 mg/L (as $CaCO_3$), and pH about 8.0.
18 **Water quality:**	Overlying water: Dissolved oxygen, pH, conductivity, ammonia hardness, and alkalinity determined at the beginning and end of the exposures. Dissolved oxygen, temperature and conductivity at the start of the exposures and weekly in all of the treatments.
19 **Pore-water characterization:**	Hardness, alkalinity, conductivity, pH, ammonia isolated by centrifugation of sediment samples at the beginning of the exposures. Pore-water metals in diffusion samplers (peepers) on Day 7 of the toxicity tests.
20 **Whole-sediment characterization:**	Simultaneously extracted metals,acid volatile sulfide, total organic carbon, and particle size distribution at the start of the toxicity tests. Total metal concentrations using XRF (under the direction of Suzanne Dudding, USFWS, Tulsa, OK).
21 **Endpoints:**	Day 28 survival, length, dry weight/individual, total biomass/treatment (dry weight/individual and total biomass calculated based on measurement of length; Ingersoll et al. 2008)
22 **Test acceptability criteria:**	Minimum mean control survival of 80% on Day 28 and additional acceptability requirements outlined in ASTM (2008) and USEPA (2000).

Table 3. Mean responses of the amphipod, *Hyalella azteca*, in sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin: WB). SEM = standard error of the mean. Cells with text highlighted in bold indicate samples that were significantly reduced from the control sediment (p<0.05). Cells highlighted in gray indicate samples that were below the reference envelope (Table 5).

CERC ID	Survival (%)	Survival SEM	Survival (% of control)	Length (mm/ individual)	Length SEM	Length (% of control)	Weight (mg/ individual)	Weight SEM	Weight (% of control)	Total biomass (mg/ replicate)	Total biomass SEM	Total biomass (% of control)
WB	100	0.000	100	3.90	0.11	100	0.29	0.03	100	2.84	0.18	100
1	88	0.750	88	3.72	0.16	95	0.28	0.040	97	2.51	0.48	88
2	95	0.289	95	**3.52**	0.09	90	**0.22**	0.020	76	**1.97**	0.13	69
3	98	0.250	98	3.87	0.10	99	0.29	0.020	100	2.79	0.23	98
4	98	0.250	98	3.69	0.04	95	0.25	0.010	86	2.40	0.15	85
5	95	0.289	95	3.65	0.08	94	0.24	0.020	83	2.27	0.16	80
6	98	0.250	98	3.96	0.03	102	0.31	0.010	107	2.98	0.04	105
7	98	0.250	98	3.98	0.12	102	0.31	0.030	107	3.06	0.35	108
8	95	0.289	95	3.72	0.07	95	0.26	0.020	90	2.35	0.15	83
9	98	0.250	98	3.68	0.06	94	0.25	0.010	86	2.40	0.06	85
10	100	0.000	100	3.70	0.09	95	0.25	0.020	86	2.40	0.16	85
11	85	1.190	85	3.83	0.12	98	0.28	0.030	97	2.26	0.16	79
12	93	0.479	93	3.58	0.11	92	**0.23**	0.020	79	**2.06**	0.11	73
13	95	0.289	95	**3.51**	0.02	90	**0.21**	0.000	72	**1.87**	0.09	66
14	93	0.250	93	3.67	0.07	94	0.24	0.010	83	2.23	0.08	79
15	98	0.250	98	**3.47**	0.05	89	**0.20**	0.010	69	**2.00**	0.08	70
16	100	0.000	100	3.57	0.09	92	**0.22**	0.020	76	2.24	0.17	79
17	100	0.000	100	3.67	0.07	94	0.25	0.020	86	2.43	0.14	85
18	90	0.408	90	**3.43**	0.09	88	**0.20**	0.020	69	**1.78**	0.15	63
19	90	0.408	90	3.69	0.13	95	0.25	0.030	86	2.25	0.15	79
20	93	0.479	93	**3.49**	0.02	89	**0.21**	0.000	72	**1.97**	0.08	69
21	93	0.479	93	3.73	0.04	96	0.26	0.010	90	2.36	0.12	83
22	90	0.408	90	3.62	0.11	93	0.24	0.020	83	**2.11**	0.23	74
23	93	0.479	93	3.80	0.09	97	0.27	0.020	93	2.48	0.12	87
24	**75**	1.190	75	3.79	0.15	97	0.27	0.03	93	**1.94**	0.20	68
25	93	0.250	93	3.75	0.05	96	0.26	0.010	90	2.40	0.15	84
26	95	0.289	95	**3.56**	0.18	91	**0.23**	0.040	79	**2.12**	0.32	75
27	95	0.289	95	**3.50**	0.03	90	**0.21**	0.010	72	**1.97**	0.05	69
28	90	0.408	90	3.64	0.05	93	0.24	0.010	83	**2.07**	0.08	73
29	98	0.250	98	3.87	0.03	99	0.29	0.01	100	2.77	0.13	98
30	98	0.250	98	3.63	0.07	93	0.24	0.010	83	2.28	0.10	80
31	98	0.250	98	**3.56**	0.03	91	**0.22**	0.01	76	**2.04**	0.12	72
32	93	0.750	93	3.76	0.11	96	0.26	0.020	90	2.42	0.31	85
33	90	0.577	90	3.92	0.05	101	0.30	0.01	103	2.70	0.17	95
34	98	0.250	98	3.78	0.18	97	0.27	0.040	93	2.62	0.33	92
35	95	0.289	95	3.61	0.11	93	0.23	0.020	79	2.17	0.15	77
36	90	0.408	90	**3.45**	0.08	88	**0.20**	0.020	69	**1.70**	0.20	60
37	95	0.289	95	**3.48**	0.13	89	**0.21**	0.030	72	**1.91**	0.23	67
38	93	0.250	93	3.70	0.04	95	0.25	0.010	86	2.29	0.13	81
39	100	0.000	100	3.87	0.06	99	0.28	0.010	97	2.83	0.13	100
40	98	0.250	98	3.77	0.14	97	0.27	0.030	93	2.59	0.33	91

Table 4. Reference envelope calculations for 28-d whole-sediment toxicity tests with the amphipod, *Hyalella azteca*, exposed to sediment samples from the Grand Lake. Cells with text highlighted in bold indicate samples that were significantly reduced from the control sediment (p<0.05; Table 4). NA = Not applicable.

CERC ID	Survival (%)	Length (mm)	Weight (mg)	Total biomass (mg)	Sand (%)	TOC (%)	Mean PEC-Q (five metals)	Zn, Cd, Pb PEC-Q	Sum pore-water toxic units	ΣSEM-AVS (µmole/g)	Σ(SEM-AVS)/foc (µmole/goc)
WB (Control)	100	3.90	0.290	2.84	53.5	1.00	0.03	0.02	0.10	-0.12	-12
7	98	3.98	0.310	3.06	76.2	0.35	0.13	0.20	0.21	1.48	425
11	85	3.83	0.280	2.26	80.2	0.46	0.07	0.11	0.33	0.72	156
12	93	3.58	**0.230**	**2.06**	50.8	0.64	0.12	0.19	0.21	0.11	17
13	95	**3.51**	**0.210**	**1.87**	78.5	0.52	0.11	0.17	0.15	-0.50	-97
22	90	3.62	0.240	**2.11**	60.1	0.86	0.09	0.13	0.27	0.80	93
23	93	3.80	0.270	2.48	35.7	1.13	0.10	0.15	0.22	-1.44	-128
34	98	3.78	0.270	2.62	14.2	1.23	0.06	0.08	0.12	0.17	14
35	95	3.61	0.230	2.17	10.5	0.90	0.06	0.07	0.22	0.11	13
36	90	**3.45**	**0.200**	**1.70**	0.3	1.47	0.07	0.08	0.15	0.51	35
Mean	93.0	3.68	0.249	2.26	45.2	0.84	0.09	0.13	0.21	0.22	59
5th percentile[1]	87.0	3.47	0.204	1.77	NA	NA	NA	NA	NA	NA	NA
Lower limit[2]	85.0	3.45	0.200	1.70	NA	NA	NA	NA	NA	NA	NA

[1]All data were log transformed prior to calculating the 5th percentile of the distribution.

[2]Used to designate samples as toxic (Table 4).

Table 5. Mean water quality characteristics of overlying water during the exposures to Grand Lake sediments. NA = Not applicable

CERC ID	Dissolved oxygen (mg/L)	Conductivity @25°C (µmoh/cm)	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as $CaCO_3$)	pH	Total ammonia (mg N/L)	Total ammonia @pH 8 (mg N/L)	Unionized ammonia (mg N/L)
Well water	8.32	619	315	254	8.0	0.03	0.03	0.0015
WB	7.04	200	107	77	7.9	0.08	0.07	0.0033
1	5.67	228						
2	6.08	219						
3	6.31	220						
4	6.59	216						
5	6.56	214						
6	6.17	220						
7	7.31	206						
8	5.89	222						
9	6.29	214	108	84	8.1	0.05	0.05	0.0026
10	6.13	219						
11	7.01	205						
12	7.06	219						
13	7.05	218	121	89	8.1	0.04	0.05	0.0007
14	6.23	220						
15	6.05	219	117	85	8.0	0.05	0.05	0.0020
16	6.20	211						
17	6.44	216						
18	6.31	211						
19	6.21	214						
20	6.48	215						
21	6.17	217						
22	6.96	209						
23	6.83	209						
24	6.19	224						
25	6.14	217						
26	5.83	242						
27	5.64	215						
28	6.32	215						
29	6.58	211	110	80	8.0	0.04	0.04	0.0018
30	6.43	214						
30-DUP	5.67	207						
31	6.47	213	111	79	8.0	0.05	0.05	0.0023
32	6.14	214	111	79	7.9	0.04	0.04	0.0016
32-DUP	6.66	212	110	79	8.0	0.05	0.05	0.0022
33	6.92	217						
34	6.31	215						
35	7.10	209	109	80	8.1	0.04	0.05	0.0039
36	6.67	215						
37	6.67	212						
38	6.43	212						
39	6.71	214						
40	6.75	215						
Grand mean	6.43	215	112	81	8.0	0.05	0.05	0.0023
Maximum	7.31	242	121	89	8.1	0.08	0.07	0.0039
Mimimum	5.64	200	107	77	7.9	0.04	0.04	0.0007

Table 6. Water quality characteristics of pore water isolated from Grand Lake sediments at the start of the exposures.

CERC ID Number	Dissolved oxygen (mg/L)	Conductivity @25°C (µmoh/cm)	Hardness (mg/L as $CaCO_3$)	Alkalinity (mg/L as $CaCO_3$)	pH	Total ammonia (mg N/L)	Total ammonia @pH 8 (mg N/L)	Unionized ammonia (mg N/L)
Well	8.5	598	304	248	8.0	0.02	0.02	0.0010
WB	2.6	182	250	100	6.9	0.96	0.38	0.0039
1	2.6	469	246	260	7.1	4.24	1.81	0.0258
2	3.3	342	230	178	7.2	1.70	0.75	0.0119
3	3.0	408	260	200	7.2	2.03	0.93	0.0170
4	3.8	437	264	230	7.1	1.34	0.57	0.0076
5	3.5	421	240	220	7.0	1.32	0.55	0.0067
5-DUP	3.3	423	320	220	7.0	1.39	0.57	0.0069
6	1.8	498	244	266	7.1	3.48	1.50	0.0216
7	5.1	337	216	156	7.3	0.33	0.16	0.0030
8	3.2	447	250	256	7.3	1.94	0.90	0.0170
9	2.5	445	260	260	7.2	1.69	0.76	0.0132
10	3.3	363	280	196	7.2	0.97	0.45	0.0081
11	6.8	321	200	162	7.6	0.51	0.31	0.0096
12	6.1	375	220	190	7.6	0.70	0.41	0.0124
13	4.2	385	260	190	7.6	0.44	0.26	0.0079
14	3.9	492	270	276	7.3	1.97	0.95	0.0193
15	3.6	751	410	430	7.2	4.70	2.15	0.0385
16	3.6	492	270	290	7.2	3.16	1.43	0.0247
17	2.9	521	340	280	7.2	2.32	1.05	0.0181
18	3.2	441	240	240	7.2	1.94	0.88	0.0152
18-DUP	3.6	435	240	230	7.2	2.03	0.91	0.0155
19	3.1	941	536	560	7.0	3.94	1.64	0.0209
20	2.9	387	270	210	7.2	0.64	0.29	0.0050
21	3.7	558	320	312	7.2	2.81	1.30	0.0241
22	3.7	329	210	184	7.5	0.41	0.22	0.0057
23	3.4	361	240	182	7.4	0.85	0.43	0.0098
24	3.0	348	222	204	7.4	0.94	0.47	0.0105
25	2.4	318	196	184	7.3	0.68	0.33	0.0071
26	3.1	454	280	250	7.3	1.28	0.60	0.0117
27	3.6	589	340	332	7.3	2.39	1.13	0.0219
28	2.8	780	470	460	7.3	1.12	0.53	0.0103
29	4.2	470	260	250	7.2	2.28	1.02	0.0170
30	2.8	336	224	170	7.2	0.56	0.25	0.0044
31	3.3	338	230	204	7.3	1.41	0.66	0.0129
32	2.9	440	240	240	7.2	1.60	0.74	0.0137
33	3.5	352	210	180	7.4	0.83	0.44	0.0110
34	4.0	472	340	220	7.5	0.39	0.21	0.0053
35	3.4	403	236	180	7.4	0.09	0.04	0.0011
36	3.6	490	300	256	7.6	0.32	0.21	0.0069
37	4.4	388	250	184	7.5	0.62	0.35	0.0097
38	2.9	470	280	262	7.5	0.74	0.43	0.0126
39	4.2	875	550	200	7.1	0.06	0.03	0.0004
40	5.2	885	560	160	7.3	0.03	0.02	0.0003
Mean	3.53	464	285	238	7.3	1.47	0.67	0.012
Maximum	6.80	941	560	560	7.6	4.70	2.15	0.038
Mimimum	1.80	182	196	100	6.9	0.035	0.016	0.00031

Table 7. Spearman rank correlation coefficients for toxicity data and the sediment physical or chemical data for the Grand Lake sediment samples . Shaded values indicate significant correlations at p <0.05. Percentage of samples exceeding sediment toxicity thresholds described in Ingersoll et al. (2009) or in MacDonald et al. (2009) are also listed. ND = Not determined, NA = Not applicable.

Metric	Fraction	Survival	Length	Weight	Biomass	General Thresholds			TSMD Thresholds[1]		
						Threshold	Percentage exeeding threshold	Percentage toxic exceeding threshold	Threshold	Percentage exceeding threshold	Percentage toxic exceeding threshold
Toxicity endpoints											
Survival	NA	1.0000	0.0138	-0.0189	0.3921	NA	NA	NA	NA	NA	NA
Length	NA	--	1.0000	0.9864	0.9022	NA	NA	NA	NA	NA	NA
Weight	NA	--	--	1.0000	0.8998	NA	NA	NA	NA	NA	NA
Biomass	NA	--	--	--	1.0000	NA	NA	NA	NA	NA	NA
Physical characteristics											
Total ammonia	Sediment	0.0673	-0.0608	-0.0144	0.0543	>32 mg N/L[2]	0%	0%	ND	ND	NA
Unionized ammonia	Sediment	0.0062	-0.1416	-0.1110	-0.0718	>1.5 mg N/L[2]	0%	0%	ND	ND	NA
Sand	Sediment	-0.0850	0.2205	0.1954	0.1288	ND	NA	NA	ND	NA	NA
Silt	Sediment	-0.2358	0.0045	0.0495	-0.0381	ND	NA	NA	ND	NA	NA
Clay	Sediment	0.2417	-0.1659	-0.1816	-0.0660	ND	NA	NA	ND	NA	NA
Total organic carbon	Sediment	0.1674	-0.0647	0.0207	0.0710	ND	NA	NA	ND	NA	NA
PEC-Qs											
Mean five metals	Sediment	0.2771	-0.0415	-0.0422	0.0695	1.0	7.5%	0%	1.11	2.5%	0%
Mean Zn, Cd, Pb	Sediment	0.2850	-0.0118	-0.0201	0.0915	1.0	30%	0%	2.64	2.5%	0%
Mean Zn, Cd	Sediment	0.2766	-0.0011	-0.0111	0.0946	1.0	78%	6.4%	ND	NA	NA
Mean Zn, Pb	Sediment	0.2962	-0.0365	-0.0379	0.0802	1.0	43%	5.9%	ND	NA	NA
Mean Cd, Pb	Sediment	0.2768	-0.0046	-0.0146	0.0919	1.0	53%	4.8%	ND	NA	NA
Zn	Sediment	0.2933	-0.0250	-0.0287	0.0852	459 µg/g[3]	73%	6.9%	2083 µg/g	0%	0%
Cd	Sediment	0.2329	0.0281	0.0122	0.0987	4.98 µg/g[3]	20%	0%	11.1 µg/g	2.5%	0%
Pb	Sediment	0.2851	-0.0627	-0.0585	0.0652	128 µg/g[3]	0%	0%	150 µg/g	0%	0%
Cu	Sediment	0.1440	-0.2277	-0.1888	-0.0862	149 µg/g[3]	0%	0%	ND	NA	NA
Ni	Sediment	0.1362	-0.1755	-0.1397	-0.0760	48.6 µg/g[3]	0%	0%	ND	NA	NA
Metal toxic units											
Sum toxic units	Pore water	0.0844	-0.0186	-0.0341	-0.0204	1.0	5.0%	0%	1.03	5.0%	0%
Zn	Pore water	0.1428	0.1390	0.1029	0.1438	1.0	0%	0%	0.581	0%	0%
Cd	Pore water	0.0659	-0.0206	-0.0299	-0.0245	1.0	0%	0%	0.160	5.0%	0%
Pb	Pore water	0.0605	-0.1824	-0.2110	-0.1741	1.0	0%	0%	0.096	20%	13%
Cu	Pore water	0.1865	-0.0954	-0.1064	-0.0508	1.0	0%	0%	ND	NA	NA
Ni	Pore water	0.0441	-0.0004	-0.0195	-0.0275	1.0	0%	0%	ND	NA	NA
SEM and AVS											
ΣSEM-AVS	Sediment	0.0785	-0.0376	-0.1449	-0.0987	0 µmole/g[4]	35%	0%	7.82 µmole/g	2.5%	0%
Σ(SEM-AVS)/*f* oc	Sediment	0.0817	-0.0888	-0.2040	-0.1568	130 µmole/foc[4]	18%	0%	ND	NA	NA

[1]MacDonald et al. (2009). Thresholds predicted to reduce survival of *Hyalella azteca* by 10% with exposure to Tri-state Mining District sediments.

[2]Ingersoll et al. (2009) *Hyalella azteca* 28-d 20% inhibition concentration (total ammonia calculated for pH 8).

[3]MacDonald et al. (2000) probable effect concentration

[4]USEPA (2005)

Table 8. Summary statistics for the toxicity tests and sediment physical and chemical characteristics for the Grand Lake. Grey highlighted cells for toxicity data indicate treatments below the reference envelope and bold toxicity data indicate treatments signficantly less than the control sediment (see Tables 3 and 4 for additional detail). Exceedances of General Sediment Chemistry Threholds are highlighted in grey and exceedances of TSMD Sediment Chemistry Thresholds are highlighted in bold (see Table 7 for additional detail).

		Toxicity data				Sediment physical characteristcs				Pore water					PEC-Qs											SEM and AVS		Pore-water toxic units					
CERC ID	USFWS sample identification	Survival (%)	Length (mm)	Weight (mg)	Biomass (mg)	TOC (%)	Sand (%)	Silt (%)	Clay (%)	Dissolved oxygen (mg/L)	Conductivity @25°C (µmoh/cm)	Total ammonia (mg N/L)	Total ammonia @pH 8 (mg N/L)	Unionized ammonia (mg N/L)	Five metals	Zn, Cd, Pb	Zn, Cd	Zn, Pb	Cd, Pb	Zn	Cd	Pb	Cu	Ni	ΣSEM -AVS	Σ(SEM-AVS)/foc	Zn	Cd	Pb	Cu	Ni	Sum
Short name	NA	HAS	HAL	HAW	HAB	TOC	SND	SLT	CLY	DO	CON	TAM	AM8	UAM	PEC5	PECZCP	PECZC	PECZB	PECCP	PECZ	PECC	PECP	PECU	PECN	SAVS	SFOC	PWZ	PWC	PWP	PWU	PWN	PSUM
WB (Control)	NA, control	100	3.90	0.29	2.84	1.00	53.5	46.5	<0.1	2.6	182	0.96	0.38	0.0039	0.03	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.01	0.06	-0.12	-12	0.01	0.04	0.003	0.021	0.02	0.10
1	GL-SED-T1-03	88	3.72	0.28	2.51	3.64	0.5	97.4	2.1	2.6	469	4.24	1.81	0.0258	0.25	0.30	0.70	0.37	0.35	0.53	0.18	0.21	0.10	0.21	-91.38	-2510	0.01	0.04	0.02	0.026	0.01	0.11
2	GL-SED-T1-04	95	**3.52**	**0.22**	**1.97**	3.04	0.5	7.9	91.6	3.3	342	1.70	0.75	0.0119	0.41	0.55	1.29	0.65	0.64	0.94	0.35	0.36	0.09	0.29	-58.93	-1936	0.01	0.05	0.01	0.016	0.01	0.10
3	GL-SED-T2-02	98	3.87	0.29	2.79	2.80	0.5	12.6	86.9	3.0	408	2.03	0.93	0.0170	0.20	0.28	0.66	0.33	0.33	0.49	0.18	0.18	0.04	0.14	-32.80	-1173	0.02	0.04	0.03	0.039	0.01	0.14
4	GL-SED-T3-01	98	3.69	0.25	2.40	3.38	1.2	19.3	79.5	3.8	437	1.34	0.57	0.0076	0.29	0.40	0.95	0.46	0.47	0.68	0.27	0.24	0.06	0.19	-28.85	-853	0.02	0.04	0.02	0.025	0.02	0.14
5	GL-SED-T4-02	95	3.65	0.24	2.27	3.01	0.6	6.2	93.2	3.5	421	1.32	0.55	0.0067	0.31	0.41	0.97	0.47	0.48	0.68	0.29	0.27	0.11	0.23	-16.94	-562	0.02	0.04	0.03	0.026	0.02	0.14
6	GL-SED-T4-03	98	3.96	0.31	2.98	3.01	0.4	14.5	85.1	1.8	498	3.48	1.50	0.0216	0.25	0.34	0.81	0.39	0.40	0.56	0.24	0.22	0.07	0.17	-21.24	-706	0.04	0.04	0.03	0.024	0.02	0.16
7	GL-SED-T4-07	98	3.98	0.31	3.06	0.35	76.2	22.1	1.6	5.1	337	0.33	0.16	0.0030	0.13	0.20	0.44	0.23	0.22	0.32	0.12	0.15	0.01	0.04	1.48	425	0.05	0.05	0.03	0.064	0.02	0.21
8	GL-SED-T5-02	95	3.72	0.26	2.35	2.70	3.1	4.2	92.6	3.2	447	1.94	0.90	0.0170	0.51	0.71	1.71	0.79	0.85	1.17	0.53	0.41	0.12	0.32	-22.48	-833	0.06	0.04	0.06	0.027	0.02	0.21
9	GL-SED-T5-04	98	3.68	0.25	2.40	2.86	0.6	6.9	92.5	2.5	445	1.69	0.76	0.0132	0.35	0.47	1.11	0.53	0.55	0.77	0.34	0.30	0.10	0.22	-16.83	-588	0.02	0.04	0.04	0.023	0.01	0.14
10	GL-SED-T5-07	100	3.70	0.25	2.40	2.57	3.6	33.9	62.5	3.3	363	0.97	0.45	0.0081	0.45	0.65	1.65	0.72	0.82	1.13	0.52	0.31	0.05	0.24	-24.99	-972	0.06	0.04	0.08	0.028	0.01	0.22
11	GL-SED-T6-01	85	3.83	0.28	2.26	0.46	80.2	15.9	3.8	6.8	321	0.51	0.31	0.0096	0.07	0.11	0.27	0.10	0.14	0.16	0.12	0.05	0.00	0.02	0.72	156	0.11	0.05	**0.12**	0.033	0.02	0.33
12	GL-SED-T6-02	93	3.58	**0.23**	**2.06**	0.64	50.8	48.1	1.1	6.1	375	0.70	0.41	0.0124	0.12	0.19	0.50	0.17	0.25	0.29	0.22	0.05	0.01	0.02	0.11	17	0.08	0.05	0.03	0.035	0.02	0.21
13	GL-SED-T6-03	95	**3.51**	**0.21**	**1.87**	0.52	78.5	17.8	3.7	4.2	385	0.44	0.26	0.0079	0.11	0.17	0.44	0.19	0.22	0.29	0.15	0.08	0.00	0.02	-0.50	-97	0.04	0.04	0.02	0.021	0.02	0.15
14	GL-SED-T6-06	93	3.67	0.24	2.23	2.69	1.5	10.0	88.4	3.9	492	1.97	0.95	0.0193	0.35	0.48	1.15	0.53	0.58	0.77	0.38	0.30	0.08	0.20	-13.90	-516	0.05	0.04	0.04	0.025	0.01	0.16
15	GL-SED-T6-08	98	**3.47**	**0.20**	**2.00**	2.76	0.4	15.9	83.7	3.6	751	4.70	2.15	0.0385	0.35	0.49	1.15	0.52	0.58	0.74	0.41	0.31	0.11	0.18	4.93	179	0.04	0.08	0.07	0.022	0.02	0.23
16	GL-SED-T7-01	100	3.57	**0.22**	2.24	2.55	0.3	12.7	87.0	3.6	492	3.16	1.43	0.0247	0.35	0.51	1.22	0.54	0.61	0.78	0.43	0.30	0.07	0.18	-5.06	-199	0.05	0.04	**0.23**	0.031	0.01	0.36
17	GL-SED-T7-02	100	3.67	0.25	2.43	2.56	0.2	7.7	92.0	2.9	521	2.32	1.05	0.0181	0.37	0.52	1.25	0.56	0.63	0.81	0.44	0.30	0.09	0.21	-4.68	-183	0.02	0.03	0.05	0.018	0.01	0.13
18	GL-SED-T7-04	90	**3.43**	**0.20**	**1.78**	2.28	0.3	5.8	93.9	3.2	441	1.94	0.88	0.0152	0.34	0.48	1.15	0.52	0.58	0.75	0.40	0.28	0.08	0.19	-5.70	-250	0.04	0.04	0.08	0.020	0.01	0.20
19	GL-SED-T7-05	90	3.69	0.25	2.25	2.50	0.1	9.5	90.4	3.1	941	3.94	1.64	0.0209	0.27	0.38	0.92	0.40	0.46	0.59	0.33	0.22	0.06	0.14	-2.56	-103	0.02	0.03	0.03	0.011	0.01	0.10
20	GL-SED-T7-06	93	**3.49**	**0.21**	**1.97**	2.11	7.9	72.4	19.7	2.9	387	0.64	0.29	0.0050	0.39	0.57	1.42	0.60	0.71	0.93	0.49	0.28	0.06	0.19	-13.47	-640	0.13	0.11	**0.28**	0.039	0.02	0.59
21	GL-SED-T7-08	93	3.73	0.26	2.36	2.87	1.9	26.3	71.9	3.7	558	2.81	1.30	0.0241	0.33	0.47	1.15	0.51	0.58	0.76	0.39	0.26	0.05	0.19	-10.71	-374	0.00	0.04	0.02	0.021	0.01	0.09
22	GL-SED-T8-01	90	3.62	0.24	**2.11**	0.86	60.1	19.9	19.9	3.7	329	0.41	0.22	0.0057	0.09	0.13	0.33	0.15	0.16	0.23	0.10	0.08	0.01	0.04	0.80	93	0.05	0.05	0.08	0.072	0.02	0.27
23	GL-SED-T8-03	93	3.80	0.27	2.48	1.13	35.7	31.9	32.4	3.4	361	0.85	0.43	0.0098	0.10	0.15	0.38	0.16	0.19	0.25	0.13	0.07	0.01	0.05	-1.44	-128	0.06	0.04	0.06	0.024	0.02	0.22
24	GL-SED-T8-06	75	3.79	0.27	**1.94**	2.13	1.3	61.1	37.6	3.0	348	0.94	0.47	0.0105	0.29	0.41	1.01	0.43	0.50	0.64	0.37	0.23	0.05	0.16	-10.44	-490	0.11	0.05	**0.11**	0.034	0.01	0.31
25	GL-SED-T9-03	93	3.75	0.26	2.40	1.88	7.8	40.6	51.6	2.4	318	0.68	0.33	0.0071	0.26	0.37	0.91	0.38	0.46	0.57	0.34	0.18	0.05	0.13	-6.38	-340	0.10	0.05	0.04	0.025	0.02	0.23
26	GL-SED-T9-07	95	**3.56**	**0.23**	**2.12**	2.33	0.8	31.4	67.7	3.1	454	1.28	0.60	0.0117	0.28	0.40	1.01	0.41	0.51	0.62	0.39	0.20	0.04	0.14	-3.00	-129	0.08	0.04	0.06	0.021	0.02	0.22
27	GL-SED-T9-08	95	**3.50**	**0.21**	**1.97**	2.20	0.2	28.7	71.2	3.6	589	2.39	1.13	0.0219	0.33	0.47	1.17	0.48	0.59	0.72	0.46	0.24	0.07	0.18	-0.58	-26	0.06	0.03	0.04	0.018	0.01	0.16
28	GL-SED-2007-T	90	3.64	0.24	**2.07**	1.68	0.2	62.1	37.7	2.8	780	1.12	0.53	0.0103	0.21	0.31	0.80	0.30	0.40	0.46	0.34	0.14	0.03	0.10	1.84	109	0.04	0.03	0.04	0.014	0.03	0.15
29	GL-SED-2007-T	98	3.87	0.29	2.77	1.51	2.1	69.7	28.1	4.2	470	2.28	1.02	0.0170	0.39	0.60	1.52	0.57	0.76	0.86	0.67	0.27	0.04	0.12	1.37	91	0.07	0.10	**0.10**	0.027	0.03	0.34
30	GL-SED-T10-02	98	3.63	0.24	2.28	2.02	0.3	51.6	48.1	2.8	336	0.56	0.25	0.0044	0.32	0.46	1.17	0.46	0.59	0.70	0.47	0.22	0.06	0.15	-4.60	-228	0.08	0.05	0.05	0.068	0.02	0.26
31	GL-SED-T10-03	98	**3.56**	**0.22**	**2.04**	2.03	0.1	45.6	54.2	3.3	338	1.41	0.66	0.0129	0.35	0.53	1.33	0.51	0.66	0.78	0.55	0.25	0.04	0.15	-2.83	-140	0.31	**0.43**	**0.37**	0.110	0.03	**1.26**
32	GL-SED-T10-04	93	3.76	0.26	2.42	2.06	0.7	38.9	60.4	2.9	440	1.60	0.74	0.0137	0.36	0.51	1.30	0.51	0.65	0.78	0.52	0.25	0.07	0.18	-0.28	-14	0.05	0.04	0.08	0.033	0.01	0.23
33	GL-SED-T11-06	90	3.92	0.30	2.70	1.61	4.0	46.6	49.4	3.5	352	0.83	0.44	0.0110	0.22	0.32	0.83	0.32	0.41	0.51	0.32	0.13	0.02	0.11	-4.12	-256	0.07	0.05	0.04	0.024	0.02	0.20
34	GL-SED-T12-01	98	3.78	0.27	2.62	1.23	14.2	61.5	24.3	4.0	472	0.39	0.21	0.0053	0.06	0.08	0.18	0.08	0.09	0.12	0.06	0.05	0.02	0.07	0.17	14	0.02	0.03	0.01	0.015	0.03	0.12
35	GL-SED-T12-02	95	3.61	0.23	2.17	0.90	10.5	69.2	20.3	3.4	403	0.09	0.04	0.0011	0.06	0.07	0.17	0.08	0.08	0.11	0.06	0.04	0.02	0.06	0.11	13	0.05	0.04	0.08	0.040	0.01	0.22
36	GL-SED-T12-03	90	**3.45**	**0.20**	**1.70**	1.47	0.3	63.3	36.4	3.6	490	0.32	0.21	0.0069	0.07	0.08	0.16	0.08	0.08	0.09	0.07	0.07	0.03	0.09	0.51	35	0.03	0.04	0.01	0.028	0.04	0.15
37	GL-SED-T12-04	95	**3.48**	**0.21**	**1.91**	1.40	1.8	66.9	31.3	4.4	388	0.62	0.35	0.0097	0.26	0.39	1.01	0.37	0.51	0.58	0.43	0.16	0.03	0.08	1.85	132	0.07	0.04	0.08	0.022	0.02	0.24
38	GL-SED-T12-06	93	3.70	0.25	2.29	1.75	12.2	71.0	16.9	2.9	470	0.74	0.43	0.0126	0.52	0.84	2.16	0.77	1.08	1.19	0.97	0.34	0.03	0.09	7.50	428	0.09	0.10	**0.12**	0.024	0.04	0.37
39	GL-SED-T12-07	100	3.87	0.28	2.83	2.04	50.1	37.0	12.9	4.2	875	0.06	0.03	0.0004	0.36	0.58	1.50	0.54	0.75	0.85	0.65	0.23	0.02	0.05	5.26	258	0.39	0.06	0.05	0.012	0.02	0.54
40	GL-SED-T12-08	98	3.77	0.27	2.59	1.88	18.2	64.2	17.6	5.2	885	0.03	0.02	0.0003	**0.71**	**1.14**	2.97	0.97	1.48	1.47	**1.50**	0.46	0.04	0.10	10.30	548	0.47	**0.32**	**0.21**	0.022	0.02	**1.04**
Grand mean		94.3	3.68	0.25	2.30	2.03	13.2	35.7	51.0	3.56	473	1.47	0.68	0.0125	0.29	0.41	1.02	0.43	0.51	0.64	0.38	0.22	0.051	0.14	-9.19	-294	0.078	0.065	0.074	0.030	0.018	0.266
Maximum		100	3.98	0.31	3.06	3.64	80.2	97.4	93.9	6.80	941	4.70	2.15	0.0385	0.71	1.14	2.97	0.97	1.48	1.47	1.50	0.46	0.125	0.32	10.30	548	0.47	0.43	0.37	0.11	0.04	1.26
Mimimum		75	3.43	0.20	1.70	0.35	0.10	4.20	1.10	1.80	318	0.035	0.016	0.0003	0.06	0.07	0.16	0.08	0.08	0.09	0.06	0.04	0.005	0.021	-91.38	-2510	0.003	0.025	0.013	0.011	0.006	0.094

Table 9. Summary of concentrations of acid volatile sulfide (μmole/g) in sediments from Grand Lake in the present study compared to sediments in the Tristate Mining District (TSMD) reported in Ingersoll et al. (2008).

Site	Mean	Minimum	25th percentile	50th percentile	75th percentile	Maximum
Grand Lake	13.8	0.300	1.28	7.72	19.8	96.6
TSMD	7.34	0.003	0.371	1.67	7.24	109

Table 10. Summary statistics for the toxicity tests and sediment physical and chemical characteristics for the Grand Lake sorted by transect (see Figure 1 and Table 8 for additional detail). Rows highlighted in yellow indicate mean for a transect.

		Toxicity data				Sediment physical characteristcs				Pore water					PEC-Qs										SEM and AVS		Pore-water toxic units					
CERC ID	USFWS sample identification	Survival (%)	Length (mm)	Weight (mg)	Biomass (mg)	TOC (%)	Sand (%)	Silt (%)	Clay (%)	Dissolved oxygen (mg/L)	Conductivity @25°C (µmoh/cm)	Total ammonia (mg N/L)	Total ammonia @pH 8 (mg N/L)	Unionized ammonia (mg N/L)	Five metals	Zn, Cd, Pb	Zn, Cd	Zn, Pb	Cd, Pb	Zn	Cd	Pb	Cu	Ni	ΣSEM -AVS	Σ(SEM-AVS)/ƒoc	Zn	Cd	Pb	Cu	Ni	Sum
Short name	NA	HAS	HAL	HAW	HAB	TOC	SND	SLT	CLY	DO	CON	TAM	AM8	UAM	PEC5	PECZCP	PECZC	PECZB	PECCP	PECZ	PECC	PECP	PECU	PECN	SAVS	SFOC	PWZ	PWC	PWP	PWU	PWN	PSUM
WB (Control)	NA, control	100	3.90	0.29	2.84	1.00	53.5	46.5	<0.1	2.6	182	0.96	0.38	0.0039	0.03	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.01	0.06	-0.12	-12	0.01	0.04	0.003	0.021	0.02	0.10
1	GL-SED-T1-03	88	3.72	0.28	2.51	3.64	0.5	97.4	2.1	2.6	469	4.24	1.81	0.0258	0.25	0.30	0.70	0.37	0.35	0.53	0.18	0.21	0.10	0.21	-91.38	-2510	0.01	0.04	0.02	0.026	0.01	0.11
2	GL-SED-T1-04	95	**3.52**	**0.22**	**1.97**	3.04	0.5	7.9	91.6	3.3	342	1.70	0.75	0.0119	0.41	0.55	1.29	0.65	0.64	0.94	0.35	0.36	0.09	0.29	-58.93	-1936	0.01	0.05	0.01	0.016	0.01	0.10
Mean T1	T1	91.50	3.62	0.25	2.24	3.34	0.50	52.65	46.85	2.95	405.50	2.97	1.28	0.02	0.33	0.43	0.99	0.51	0.50	0.73	0.26	0.29	0.10	0.25	-75.16	-2222.89	0.01	0.04	0.02	0.02	0.01	0.10
3	GL-SED-T2-02	98	3.87	0.29	2.79	2.80	0.5	12.6	86.9	3.0	408	2.03	0.93	0.0170	0.20	0.28	0.66	0.33	0.33	0.49	0.18	0.18	0.04	0.14	-32.80	-1173	0.02	0.04	0.03	0.039	0.01	0.14
4	GL-SED-T3-01	98	3.69	0.25	2.40	3.38	1.2	19.3	79.5	3.8	437	1.34	0.57	0.0076	0.29	0.40	0.95	0.46	0.47	0.68	0.27	0.24	0.06	0.19	-28.85	-853	0.02	0.04	0.02	0.025	0.02	0.14
5	GL-SED-T4-02	95	3.65	0.24	2.27	3.01	0.6	6.2	93.2	3.5	421	1.32	0.55	0.0067	0.31	0.41	0.97	0.47	0.48	0.68	0.29	0.27	0.11	0.23	-16.94	-562	0.02	0.04	0.03	0.026	0.02	0.14
6	GL-SED-T4-03	98	3.96	0.31	2.98	3.01	0.4	14.5	85.1	1.8	498	3.48	1.50	0.0216	0.25	0.34	0.81	0.39	0.40	0.56	0.24	0.22	0.07	0.17	-21.24	-706	0.04	0.04	0.03	0.024	0.02	0.16
7	GL-SED-T4-07	98	3.98	0.31	3.06	0.35	76.2	22.1	1.6	5.1	337	0.33	0.16	0.0030	0.13	0.20	0.44	0.23	0.22	0.32	0.12	0.15	0.01	0.04	1.48	425	0.05	0.05	0.03	0.064	0.02	0.21
29	GL-SED-2007-T4	98	3.87	0.29	2.77	1.51	2.1	69.7	28.1	4.2	470	2.28	1.02	0.0170	0.39	0.60	1.52	0.57	0.76	0.86	0.67	0.27	0.04	0.12	1.37	91	0.07	0.10	**0.10**	0.027	0.03	0.34
Mean T4	T4	98.0	3.94	0.30	2.94	1.62	26.23	35.43	38.27	3.70	435.00	2.03	0.89	0.01	0.26	0.38	0.92	0.40	0.46	0.58	0.34	0.22	0.04	0.11	-6.13	-63.47	0.06	0.07	0.05	0.04	0.02	0.24
Maximum		98.0	3.98	0.31	3.06	3.01	76.20	69.70	85.10	5.10	498.00	3.48	1.50	0.02	0.39	0.60	1.52	0.57	0.76	0.86	0.67	0.27	0.07	0.17	1.48	425.18	0.07	0.10	0.10	0.06	0.03	0.34
Mimimum		98.0	3.87	0.29	2.77	0.35	0.40	14.50	1.60	1.80	337.00	0.33	0.16	0.00	0.13	0.20	0.44	0.23	0.22	0.32	0.12	0.15	0.01	0.04	-21.24	-706.22	0.04	0.04	0.03	0.02	0.02	0.16
8	GL-SED-T5-02	95	3.72	0.26	2.35	2.70	3.1	4.2	92.6	3.2	447	1.94	0.90	0.0170	0.51	0.71	1.71	0.79	0.85	1.17	0.53	0.41	0.12	0.32	-22.48	-833	0.06	0.04	0.06	0.027	0.02	0.21
9	GL-SED-T5-04	98	3.68	0.25	2.40	2.86	0.6	6.9	92.5	2.5	445	1.69	0.76	0.0132	0.35	0.47	1.11	0.53	0.55	0.77	0.34	0.30	0.10	0.22	-16.83	-588	0.02	0.04	0.04	0.023	0.01	0.14
10	GL-SED-T5-07	100	3.70	0.25	2.40	2.57	3.6	33.9	62.5	3.3	363	0.97	0.45	0.0081	0.45	0.65	1.65	0.72	0.82	1.13	0.52	0.31	0.05	0.24	-24.99	-972	0.06	0.04	0.08	0.028	0.01	0.22
Mean T5	T5	97.7	3.70	0.25	2.38	2.71	2.43	15.00	82.53	3.00	418.33	1.53	0.70	0.01	0.44	0.61	1.49	0.68	0.74	1.02	0.46	0.34	0.09	0.26	-21.43	-797.53	0.05	0.04	0.06	0.03	0.01	0.19
Maximum		100.0	3.72	0.26	2.40	2.86	3.60	33.90	92.60	3.30	447.00	1.94	0.90	0.02	0.51	0.71	1.71	0.79	0.85	1.17	0.53	0.41	0.12	0.32	-16.83	-587.85	0.06	0.04	0.08	0.03	0.02	0.22
Mimimum		95.0	3.68	0.25	2.35	2.57	0.60	4.20	62.50	2.50	363.00	0.97	0.45	0.01	0.35	0.47	1.11	0.53	0.55	0.77	0.34	0.30	0.05	0.22	-24.99	-971.86	0.02	0.04	0.04	0.02	0.01	0.14
11	GL-SED-T6-01	85	3.83	0.28	2.26	0.46	80.2	15.9	3.8	6.8	321	0.51	0.31	0.0096	0.07	0.11	0.27	0.10	0.14	0.16	0.12	0.05	0.00	0.02	0.72	156	0.11	0.05	**0.12**	0.033	0.02	0.33
12	GL-SED-T6-02	93	3.58	**0.23**	**2.06**	0.64	50.8	48.1	1.1	6.1	375	0.70	0.41	0.0124	0.12	0.19	0.50	0.17	0.25	0.29	0.22	0.05	0.01	0.02	0.11	17	0.08	0.05	0.03	0.035	0.02	0.21
13	GL-SED-T6-03	95	**3.51**	**0.21**	**1.87**	0.52	78.5	17.8	3.7	4.2	385	0.44	0.26	0.0079	0.11	0.17	0.44	0.19	0.22	0.29	0.15	0.08	0.00	0.02	-0.50	-97	0.04	0.04	0.02	0.021	0.02	0.15
14	GL-SED-T6-06	93	3.67	0.24	2.23	2.69	1.5	10.0	88.4	3.9	492	1.97	0.95	0.0193	0.35	0.48	1.15	0.53	0.58	0.77	0.38	0.30	0.08	0.20	-13.90	-516	0.05	0.04	0.04	0.025	0.01	0.16
15	GL-SED-T6-08	98	**3.47**	**0.20**	**2.00**	2.76	0.4	15.9	83.7	3.6	751	4.70	2.15	0.0385	0.35	0.49	1.15	0.52	0.58	0.74	0.41	0.31	0.11	0.18	4.93	179	0.04	0.08	0.07	0.022	0.02	0.23
28	GL-SED-2007-T6	90	3.64	0.24	**2.07**	1.68	0.2	62.1	37.7	2.8	780	1.12	0.53	0.0103	0.21	0.31	0.80	0.30	0.40	0.46	0.34	0.14	0.03	0.10	1.84	109	0.04	0.03	0.04	0.014	0.03	0.15
Mean T6	T6	92.33	3.62	0.23	2.08	1.46	35.27	28.30	36.40	4.57	517.33	1.57	0.77	0.02	0.20	0.29	0.72	0.30	0.36	0.45	0.27	0.15	0.04	0.09	-1.13	-25.33	0.06	0.05	0.05	0.03	0.02	0.20
Maximum		98.00	3.83	0.28	2.26	2.76	80.20	62.10	88.40	6.80	780.00	4.70	2.15	0.04	0.35	0.49	1.15	0.53	0.58	0.77	0.41	0.31	0.11	0.20	4.93	178.65	0.11	0.08	0.12	0.03	0.03	0.33
Mimimum		85.00	3.47	0.20	1.87	0.46	0.20	10.00	1.10	2.80	321.00	0.44	0.26	0.01	0.07	0.11	0.27	0.10	0.14	0.16	0.12	0.05	0.00	0.02	-13.90	-516.10	0.04	0.03	0.02	0.01	0.01	0.15
16	GL-SED-T7-01	100	3.57	**0.22**	2.24	2.55	0.3	12.7	87.0	3.6	492	3.16	1.43	0.0247	0.35	0.51	1.22	0.54	0.61	0.78	0.43	0.30	0.07	0.18	-5.06	-199	0.05	0.04	**0.23**	0.031	0.01	0.36
17	GL-SED-T7-02	100	3.67	0.25	2.43	2.56	0.2	7.7	92.0	2.9	521	2.32	1.05	0.0181	0.37	0.52	1.25	0.56	0.63	0.81	0.44	0.30	0.09	0.21	-4.68	-183	0.02	0.03	0.05	0.018	0.01	0.13
18	GL-SED-T7-04	90	**3.43**	**0.20**	**1.78**	2.28	0.3	5.8	93.9	3.2	441	1.94	0.88	0.0152	0.34	0.48	1.15	0.52	0.58	0.75	0.40	0.28	0.08	0.19	-5.70	-250	0.04	0.04	0.08	0.020	0.01	0.20
19	GL-SED-T7-05	90	3.69	0.25	2.25	2.50	0.1	9.5	90.4	3.1	941	3.94	1.64	0.0209	0.27	0.38	0.92	0.40	0.46	0.59	0.33	0.22	0.06	0.14	-2.56	-103	0.02	0.03	0.03	0.011	0.01	0.10
20	GL-SED-T7-06	93	**3.49**	**0.21**	**1.97**	2.11	7.9	72.4	19.7	2.9	387	0.64	0.29	0.0050	0.39	0.57	1.42	0.60	0.71	0.93	0.49	0.28	0.06	0.19	-13.47	-640	0.13	0.11	**0.28**	0.039	0.02	0.59
21	GL-SED-T7-08	93	3.73	0.26	2.36	2.87	1.9	26.3	71.9	3.7	558	2.81	1.30	0.0241	0.33	0.47	1.15	0.51	0.58	0.76	0.39	0.26	0.05	0.19	-10.71	-374	0.00	0.04	0.02	0.021	0.01	0.09
Mean T7	T7	94.33	3.60	0.23	2.17	2.48	1.78	22.40	75.82	3.23	556.67	2.47	1.10	0.02	0.34	0.49	1.19	0.52	0.59	0.77	0.42	0.27	0.07	0.18	-7.03	-291.35	0.04	0.05	0.12	0.02	0.01	0.25
Maximum		100.00	3.73	0.26	2.43	2.87	7.90	72.40	93.90	3.70	941.00	3.94	1.64	0.02	0.39	0.57	1.42	0.60	0.71	0.93	0.49	0.30	0.09	0.21	-2.56	-102.66	0.13	0.11	0.28	0.04	0.02	0.59
Mimimum		90.00	3.43	0.20	1.78	2.11	0.10	5.80	19.70	2.90	387.00	0.64	0.29	0.00	0.27	0.38	0.92	0.40	0.46	0.59	0.33	0.22	0.05	0.14	-13.47	-639.98	0.00	0.03	0.02	0.01	0.01	0.09
22	GL-SED-T8-01	90	3.62	0.24	**2.11**	0.86	60.1	19.9	19.9	3.7	329	0.41	0.22	0.0057	0.09	0.13	0.33	0.15	0.16	0.23	0.10	0.08	0.01	0.04	0.80	93	0.05	0.05	0.08	0.072	0.02	0.27
23	GL-SED-T8-03	93	3.80	0.27	2.48	1.13	35.7	31.9	32.4	3.4	361	0.85	0.43	0.0098	0.10	0.15	0.38	0.16	0.19	0.25	0.13	0.07	0.01	0.05	-1.44	-128	0.06	0.04	0.06	0.024	0.02	0.22
24	GL-SED-T8-06	**75**	3.79	0.27	**1.94**	2.13	1.3	61.1	37.6	3.0	348	0.94	0.47	0.0105	0.29	0.41	1.01	0.43	0.50	0.64	0.37	0.23	0.05	0.16	-10.44	-490	0.11	0.05	**0.11**	0.034	0.01	0.31
Mean T8	T8	86.0	3.74	0.26	2.17	1.37	32.37	37.63	29.97	3.37	346.00	0.73	0.37	0.01	0.16	0.23	0.57	0.25	0.29	0.37	0.20	0.13	0.02	0.08	-3.69	-174.93	0.08	0.05	0.08	0.04	0.02	0.27
Maximum		93.0	3.80	0.27	2.48	2.13	60.10	61.10	37.60	3.70	361.00	0.94	0.47	0.01	0.29	0.41	1.01	0.43	0.50	0.64	0.37	0.23	0.05	0.16	0.80	93.17	0.11	0.05	0.11	0.07	0.02	0.31
Mimimum		75.0	3.62	0.24	1.94	0.86	1.30	19.90	19.90	3.00	329.00	0.41	0.22	0.01	0.09	0.13	0.33	0.15	0.16	0.23	0.10	0.07	0.01	0.04	-10.44	-490.40	0.05	0.04	0.06	0.02	0.01	0.22
25	GL-SED-T9-03	93	3.75	0.26	2.40	1.88	7.8	40.6	51.6	2.4	318	0.68	0.33	0.0071	0.26	0.37	0.91	0.38	0.46	0.57	0.34	0.18	0.05	0.13	-6.38	-340	0.10	0.05	0.04	0.025	0.02	0.23
26	GL-SED-T9-07	95	**3.56**	**0.23**	**2.12**	2.33	0.8	31.4	67.7	3.1	454	1.28	0.60	0.0117	0.28	0.40	1.01	0.41	0.51	0.62	0.39	0.20	0.04	0.14	-3.00	-129	0.08	0.04	0.06	0.021	0.02	0.22
27	GL-SED-T9-08	95	**3.50**	**0.21**	**1.97**	2.20	0.2	28.7	71.2	3.6	589	2.39	1.13	0.0219	0.33	0.47	1.17	0.48	0.59	0.72	0.46	0.24	0.07	0.18	-0.58	-26	0.06	0.03	0.04	0.018	0.01	0.16
Mean T9	T9	94.3	3.60	0.23	2.16	2.13	2.93	33.57	63.50	3.03	453.67	1.45	0.69	0.01	0.29	0.41	1.03	0.42	0.52	0.64	0.40	0.21	0.05	0.15	-3.32	-165.20	0.08	0.04	0.05	0.02	0.02	0.21
Maximum		95.0	3.75	0.26	2.40	2.33	7.80	40.60	71.20	3.60	589.00	2.39	1.13	0.02	0.33	0.47	1.17	0.48	0.59	0.72	0.46	0.24	0.07	0.18	-0.58	-26.40	0.10	0.05	0.06	0.02	0.02	0.23
Mimimum		93.0	3.50	0.21	1.97	1.88	0.20	28.70	51.60	2.40	318.00	0.68	0.33	0.01	0.26	0.37	0.91	0.38	0.46	0.57	0.34	0.18	0.04	0.13	-6.38	-340.35	0.06	0.03	0.04	0.02	0.01	0.16
30	GL-SED-T10-02	98	3.63	0.24	2.28	2.02	0.3	51.6	48.1	2.8	336	0.56	0.25	0.0044	0.32	0.46	1.17	0.46	0.59	0.70	0.47	0.22	0.06	0.15	-4.60	-228	0.08	0.05	0.05	0.068	0.02	0.26
31	GL-SED-T10-03	98	**3.56**	**0.22**	**2.04**	2.03	0.1	45.6	54.2	3.3	338	1.41	0.66	0.0129	0.35	0.53	1.33	0.51	0.66	0.78	0.55	0.25	0.04	0.15	-2.83	-140	0.31	**0.43**	**0.37**	0.110	0.03	**1.26**
32	GL-SED-T10-04	93	3.76	0.26	2.42	2.06	0.7	38.9	60.4	2.9	440	1.60	0.74	0.0137	0.36	0.51	1.30	0.51	0.65	0.78	0.52	0.25	0.07	0.18	-0.28	-14	0.05	0.04	0.08	0.033	0.01	0.23
Mean T10	T10	96.3	3.65	0.24	2.25	2.04	0.37	45.37	54.23	3.00	371.33	1.19	0.55	0.01	0.34	0.50	1.27	0.49	0.63	0.75	0.52	0.24	0.06	0.16	-2.57	-127.06	0.15	0.17	0.17	0.07	0.02	0.58
Maximum		98.0	3.76	0.26	2.42	2.06	0.70	51.60	60.40	3.30	440.00	1.60	0.74	0.01	0.36	0.53	1.33	0.51	0.66	0.78	0.55	0.25	0.07	0.18	-0.28	-13.72	0.31	0.43	0.37	0.11	0.03	1.26
Mimimum		93.0	3.56	0.22	2.04	2.02	0.10	38.90	48.10	2.80	336.00	0.56	0.25	0.00	0.32	0.46	1.17	0.46	0.59	0.70	0.47	0.22	0.04	0.15	-4.60	-227.83	0.05	0.04	0.05	0.03	0.01	0.23
34	GL-SED-T12-01	98	3.78	0.27	2.62	1.23	14.2	61.5	24.3	4.0	472	0.39	0.21	0.0053	0.06	0.08	0.18	0.08	0.09	0.12	0.06	0.05	0.02	0.07	0.17	14	0.02	0.03	0.01	0.015	0.03	0.12
35	GL-SED-T12-02	95	3.61	0.23	2.17	0.90	10.5	69.2	20.3	3.4	403	0.09	0.04	0.0011	0.06	0.07	0.17	0.08	0.08	0.11	0.06	0.04	0.02	0.06	0.11	13	0.05	0.04	0.08	0.040	0.01	0.22
36	GL-SED-T12-03	90	**3.45**	**0.20**	**1.70**	1.47	0.3	63.3	36.4	3.6	490	0.32	0.21	0.0069	0.07	0.08	0.16	0.08	0.08	0.09	0.07	0.07	0.03	0.09	0.51	35	0.03	0.04	0.01	0.028	0.04	0.15
37	GL-SED-T12-04	95	**3.48**	**0.21**	**1.91**	1.40	1.8	66.9	31.3	4.4	388	0.62	0.35	0.0097	0.26	0.39	1.01	0.37	0.51	0.58	0.43	0.16	0.03	0.08	1.85	132	0.07	0.04	0.08	0.022	0.02	0.24
38	GL-SED-T12-06	93	3.70	0.25	2.29	1.75	12.2	71.0	16.9	2.9	470	0.74	0.43	0.0126	0.52	0.84	2.16	0.77	1.08	1.19	0.97	0.34	0.03	0.09	7.50	428	0.09	0.10	**0.12**	0.024	0.04	0.37
39	GL-SED-T12-07	100	3.87	0.28	2.83	2.04	50.1	37.0	12.9	4.2	875	0.06	0.03	0.0004	0.36	0.58	1.50	0.54	0.75	0.85	0.65	0.23	0.02	0.05	5.26	258	0.39	0.06	0.05	0.012	0.02	0.54
40	GL-SED-T12-08	98	3.77	0.27	2.59	1.88	18.2	64.2	17.6	5.2	885	0.03	0.02	0.0003	**0.71**	**1.14**	2.97	0.97	1.48	1.47	**1.50**	0.46	0.04	0.10	10.30	548	0.47	**0.32**	**0.21**	0.022	0.02	**1.04**
Mean T12	T12	95.6	3.67	0.24	2.30	1.52	15.3	61.9	22.8	4.0	569	0.322	0.183	0.0052	0.29	0.45	1.16	0.41	0.58	0.63	0.54	0.19	0.03	0.08	3.67	204	0.16	0.09	0.08	0.02	0.03	0.38
Maximum		100.0	3.87	0.28	2.83	2.04	50.1	71.0	36.4	5.2	885	0.743	0.430	0.0126	0.71	1.14	2.97	0.97	1.48	1.47	1.50	0.46	0.04	0.10	10.30	548	0.47	0.32	0.21	0.04	0.04	1.04
Mimimum		90.0	3.45	0.20	1.70	0.90	0.3	37.0	12.9	2.9	388	0.035	0.016	0.0003	0.06	0.07	0.16	0.08	0.08	0.09	0.06	0.04	0.02	0.05	0.11	13	0.02	0.03	0.01	0.01	0.01	0.12

Short name	NA	HAS	HAL	HAW	HAB	TOC	SND	SLT	CLY	DO	CON	TAM	AM8	UAM	PEC5	PECZCP	PECZC	PECZB	PECCP	PECZ	PECC	PECP	PECU	PECN	SAVS	SFOC	PWZ	PWC	PWP	PWU	PWN	PSUM
Mean T1	T1	91.50	3.62	0.25	2.24	3.34	0.50	52.65	46.85	2.95	405.50	2.97	1.28	0.02	0.33	0.43	0.99	0.51	0.50	0.73	0.26	0.29	0.10	0.25	-75.16	-2222.89	0.01	0.04	0.02	0.02	0.01	0.10
3	T2	98.00	3.87	0.29	2.79	2.80	0.50	12.60	86.90	3.00	408.00	2.03	0.93	0.02	0.20	0.28	0.66	0.33	0.33	0.49	0.18	0.18	0.04	0.14	-32.80	-1172.73	0.02	0.04	0.03	0.04	0.01	0.14
4	T3	98.00	3.69	0.25	2.40	3.38	1.20	19.30	79.50	3.80	437.00	1.34	0.57	0.01	0.29	0.40	0.95	0.46	0.47	0.68	0.27	0.24	0.06	0.19	-28.85	-853.08	0.02	0.04	0.02	0.03	0.02	0.14
Mean T4	T4	98.00	3.94	0.30	2.94	1.62	26.23	35.43	38.27	3.70	435.00	2.03	0.89	0.01	0.26	0.38	0.92	0.40	0.46	0.58	0.34	0.22	0.04	0.11	-6.13	-63.47	0.06	0.07	0.05	0.04	0.02	0.24
Mean T5	T5	97.67	3.70	0.25	2.38	2.71	2.43	15.00	82.53	3.00	418.33	1.53	0.70	0.01	0.44	0.61	1.49	0.68	0.74	1.02	0.46	0.34	0.09	0.26	-21.43	-797.53	0.05	0.04	0.06	0.03	0.01	0.19
Mean T6	T6	92.33	3.62	0.23	2.08	1.46	35.27	28.30	36.40	4.57	517.33	1.57	0.77	0.02	0.20	0.29	0.72	0.30	0.36	0.45	0.27	0.15	0.04	0.09	-1.13	-25.33	0.06	0.05	0.05	0.03	0.02	0.20
Mean T7	T7	94.33	3.60	0.23	2.17	2.48	1.78	22.40	75.82	3.23	556.67	2.47	1.10	0.02	0.34	0.49	1.19	0.52	0.59	0.77	0.42	0.27	0.07	0.18	-7.03	-291.35	0.04	0.05	0.12	0.02	0.01	0.25
Mean T8	T8	86.00	3.74	0.26	2.17	1.37	32.37	37.63	29.97	3.37	346.00	0.73	0.37	0.01	0.16	0.23	0.57	0.25	0.29	0.37	0.20	0.13	0.02	0.08	-3.69	-174.93	0.08	0.05	0.08	0.04	0.02	0.27
Mean T9	T9	94.33	3.60	0.23	2.16	2.13	2.93	33.57	63.50	3.03	453.67	1.45	0.69	0.01	0.29	0.41	1.03	0.42	0.52	0.64	0.40	0.21	0.05	0.15	-3.32	-165.20	0.08	0.04	0.05	0.02	0.02	0.21
Mean T10	T10	96.33	3.65	0.24	2.25	2.04	0.37	45.37	54.23	3.00	371.33	1.19	0.55	0.01	0.34	0.50	1.27	0.49	0.63	0.75	0.52	0.24	0.06	0.16	-2.57	-127.06	0.15	0.17	0.17	0.07	0.02	0.58
Mean T12	T12	95.57	3.67	0.24	2.30	1.52	15.33	61.87	22.81	3.96	569.00	0.32	0.18	0.01	0.29	0.45	1.16	0.41	0.58	0.63	0.54	0.19	0.03	0.08	3.67	203.84	0.16	0.09	0.08	0.02	0.03	0.38

Table A1. Replicate response of *Hyalella azteca* in sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Total biomass for samples with 11 organisms recovered (CERC-17 rep 4, CERC-26 rep 3, CERC-32 rep 4; highlighted bold text) was estimated from a starting number of 10 organisms. Archive = starting size of amphipods.

CERC ID	Replicate	Number recovered	Length (mm/ individual)	Weight (mg/ individual)	Total biomass (mg/ replicate)	Count
Archive	NA	20	1.784	0.0262	NA	1
WB	1	10	3.775	0.2623	2.62	2
WB-DUP	1	10	3.980	0.3099	3.10	3
WB	2	10	3.765	0.2599	2.60	4
WB	3	10	3.840	0.2779	2.78	5
WB	4	9	4.221	0.3742	3.37	6
1	1	8	3.614	0.2512	2.01	7
1-Dup	1	8	3.642	0.2540	2.03	8
1	2	10	4.159	0.3861	3.86	9
1	3	10	3.695	0.2491	2.49	10
1	4	8	3.430	0.2106	1.68	11
2	1	10	3.259	0.1679	1.68	12
2	2	10	3.602	0.2295	2.29	13
2	3	8	3.595	0.2311	1.85	14
2	4	9	3.616	0.2291	2.06	15
3	1	10	3.972	0.3126	3.13	16
3	2	9	3.916	0.2948	2.65	17
3	3	10	4.008	0.3185	3.18	18
3	4	10	3.570	0.2200	2.20	19
4	1	9	3.625	0.2313	2.08	20
4	2	10	3.809	0.2785	2.78	21
4	3	10	3.676	0.2422	2.42	22
4	4	10	3.628	0.2330	2.33	23
5	1	9	3.454	0.1996	1.80	24
5	2	10	3.635	0.2338	2.34	25
5	3	10	3.683	0.2458	2.46	26
5	4	9	3.830	0.2752	2.48	27
6	1	10	3.966	0.3065	3.07	28
6	2	10	3.879	0.2883	2.88	29
6	3	9	4.050	0.3287	2.96	30
6	4	10	3.947	0.3030	3.03	31
7	1	10	3.904	0.2928	2.93	32
7	2	10	3.911	0.2948	2.95	33
7	3	10	4.330	0.4017	4.02	34
7	4	9	3.772	0.2624	2.36	35
8	1	9	3.716	0.2523	2.27	36
8	2	10	3.675	0.2463	2.46	37
8	3	9	3.551	0.2202	1.98	38
8	4	9	3.907	0.2965	2.67	39
8-Dup	4	9	3.888	0.2929	2.64	40
9	1	10	3.679	0.2476	2.48	41
9	2	10	3.558	0.2225	2.23	42
9-Dup	2	10	3.599	0.2313	2.31	43
9	3	9	3.825	0.2774	2.50	44
9	4	10	3.659	0.2410	2.41	45

Table A1. Replicate response of *Hyalella azteca* in sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Total biomass for samples with 11 organisms recovered (CERC-17 rep 4, CERC-26 rep 3, CERC-32 rep 4; highlighted bold text) was estimated from a starting number of 10 organisms. Archive = starting size of amphipods.

CERC ID	Replicate	Number recovered	Length (mm/ individual)	Weight (mg/ individual)	Total biomass (mg/ replicate)	Count
10	1	10	3.626	0.2310	2.31	46
10	2	10	3.469	0.2021	2.02	47
10	3	9	3.841	0.2767	2.49	48
10	4	10	3.846	0.2790	2.79	49
11	1	10	3.620	0.2293	2.29	50
11	2	9	3.768	0.2614	2.35	51
11	3	10	3.755	0.2582	2.58	52
11	4	5	4.168	0.3607	1.80	53
12	1	9	3.481	0.2055	1.85	54
12	2	10	3.396	0.1904	1.90	55
12	3	10	3.543	0.2158	2.16	56
12	4	8	3.907	0.2929	2.34	57
13	1	9	3.455	0.2001	1.80	58
13	2	9	3.472	0.2020	1.82	59
13	3	8	3.551	0.2176	1.74	60
13	4	10	3.537	0.2130	2.13	61
14	1	9	3.688	0.2444	2.20	62
14	2	10	3.473	0.2031	2.03	63
14	3	9	3.761	0.2615	2.35	64
14	4	9	3.767	0.2607	2.35	65
15	1	10	3.367	0.1827	1.83	66
15	2	10	3.414	0.1942	1.94	67
15	3	10	3.533	0.2204	2.20	68
15	4	9	3.580	0.2240	2.02	69
16	1	10	3.494	0.2075	2.07	70
16	2	10	3.763	0.2600	2.60	71
16	3	10	3.353	0.1829	1.83	72
16	4	10	3.682	0.2438	2.44	73
17	1	10	3.799	0.2677	2.68	74
17	2	10	3.786	0.2663	2.66	75
17	3	10	3.514	0.2124	2.12	76
17	4	11	3.572	0.2253	**2.25**	77
18	1	9	3.283	0.1726	1.55	78
18	2	10	3.506	0.2119	2.12	79
18	3	8	3.656	0.2424	1.94	80
18	4	9	3.274	0.1675	1.51	81
19	1	10	3.630	0.2325	2.33	82
19	2	8	4.063	0.3302	2.64	83
19	3	10	3.511	0.2090	2.09	84
19	4	9	3.539	0.2154	1.94	85
20	1	10	3.430	0.1960	1.96	86
20	2	8	3.544	0.2166	1.73	87
20	3	10	3.489	0.2075	2.08	88
20	4	10	3.508	0.2098	2.10	89
21	1	8	3.735	0.2539	2.03	90

Table A1. Replicate response of *Hyalella azteca* in sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Total biomass for samples with 11 organisms recovered (CERC-17 rep 4, CERC-26 rep 3, CERC-32 rep 4; highlighted bold text) was estimated from a starting number of 10 organisms. Archive = starting size of amphipods.

CERC ID	Replicate	Number recovered	Length (mm/ individual)	Weight (mg/ individual)	Total biomass (mg/ replicate)	Count
21	2	10	3.623	0.2350	2.35	91
21	3	10	3.721	0.2553	2.55	92
21	4	9	3.841	0.2764	2.49	93
22	1	9	3.878	0.2876	2.59	94
22	2	9	3.728	0.2525	2.27	95
22	3	10	3.495	0.2074	2.07	96
22	4	8	3.384	0.1866	1.49	97
23	1	10	3.560	0.2216	2.22	98
23	2	8	4.000	0.3143	2.51	99
23	3	9	3.784	0.2637	2.37	100
23	4	10	3.853	0.2800	2.80	101
24	1	9	3.798	0.2689	2.42	102
24	2	9	3.459	0.2099	1.89	103
24	3	8	3.705	0.2492	1.99	104
24	4	4	4.167	0.3600	1.44	105
25	1	9	3.608	0.2304	2.07	106
25	2	10	3.833	0.2787	2.79	107
25	3	9	3.832	0.2766	2.49	108
25	4	9	3.713	0.2499	2.25	109
26	1	9	4.068	0.3343	3.01	110
26	2	10	3.521	0.2109	2.11	111
26	3	11	3.393	0.1892	**1.89**	112
26	4	9	3.258	0.1654	1.49	113
27	1	10	3.496	0.2099	2.10	114
27	2	9	3.575	0.2218	2.00	115
27	3	10	3.427	0.1938	1.94	116
27	4	9	3.471	0.2041	1.84	117
28	1	8	3.744	0.2575	2.06	118
28	2	9	3.628	0.2360	2.12	119
28	3	9	3.693	0.2488	2.24	120
28	4	9	3.491	0.2053	1.85	121
29	1	9	3.788	0.2651	2.39	122
29	2	10	3.850	0.2814	2.81	123
29	3	10	3.894	0.2904	2.90	124
29	4	10	3.933	0.2992	2.99	125
30	1	10	3.722	0.2539	2.54	126
30	2	10	3.508	0.2081	2.08	127
30	3	9	3.757	0.2607	2.35	128
30	4	10	3.523	0.2166	2.17	129
31	1	9	3.562	0.2209	1.99	130
31	2	10	3.484	0.2054	2.05	131
31	3	10	3.616	0.2353	2.35	132
31	4	8	3.564	0.2197	1.76	133
32	1	10	4.048	0.3271	3.27	134
32	2	7	3.784	0.2638	1.85	135

Table A1. Replicate response of *Hyalella azteca* in sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Total biomass for samples with 11 organisms recovered (CERC-17 rep 4, CERC-26 rep 3, CERC-32 rep 4; highlighted bold text) was estimated from a starting number of 10 organisms. Archive = starting size of amphipods.

CERC ID	Replicate	Number recovered	Length (mm/ individual)	Weight (mg/ individual)	Total biomass (mg/ replicate)	Count
32	3	10	3.548	0.2157	2.16	136
32	4	11	3.663	0.2397	**2.40**	137
33	1	8	3.901	0.3004	2.40	138
33	2	10	3.779	0.2632	2.63	139
33	3	8	4.027	0.3214	2.57	140
33	4	10	3.985	0.3183	3.18	141
34	1	10	3.800	0.2683	2.68	142
34	2	10	3.647	0.2370	2.37	143
34	3	9	4.260	0.3894	3.50	144
34	4	10	3.407	0.1922	1.92	145
34-Dup	4	10	3.371	0.1860	1.86	146
35	1	9	3.802	0.2683	2.42	147
35	2	9	3.812	0.2717	2.45	148
35-Dup	2	9	3.826	0.2750	2.47	149
35	3	10	3.432	0.1946	1.95	150
35	4	10	3.386	0.1891	1.89	151
36	1	9	3.657	0.2416	2.17	152
36	2	9	3.291	0.1700	1.53	153
36	3	9	3.497	0.2081	1.87	154
36	4	7	3.333	0.1770	1.24	155
37	1	10	3.316	0.1744	1.74	156
37	2	9	3.318	0.1758	1.58	157
37	3	9	3.421	0.1924	1.73	158
37	4	9	3.873	0.2879	2.59	159
38	1	9	3.637	0.2335	2.10	160
38	2	10	3.769	0.2621	2.62	161
38	3	9	3.624	0.2323	2.09	162
38	4	9	3.778	0.2628	2.37	163
39	1	10	3.710	0.2481	2.48	164
39	2	10	3.870	0.2835	2.84	165
39	3	10	3.895	0.2885	2.88	166
39	4	10	3.986	0.3125	3.12	167
40	1	10	4.148	0.3529	3.53	168
40	2	9	3.713	0.2505	2.25	169
40	3	10	3.736	0.2552	2.55	170
40	4	10	3.469	0.2029	2.03	171

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
Archive	1	1	2.153	0.044	1
Archive	1	2	1.165	0.006	2
Archive	1	3	1.839	0.026	3
Archive	1	4	2.492	0.070	4
Archive	1	5	1.74	0.022	5
Archive	1	6	2.119	0.041	6
Archive	1	7	1.325	0.009	7
Archive	1	8	2.107	0.041	8
Archive	1	9	1.714	0.021	9
Archive	1	10	2.112	0.041	10
Archive	1	11	1.59	0.016	11
Archive	1	12	1.885	0.028	12
Archive	1	13	1.734	0.021	13
Archive	1	14	1.87	0.027	14
Archive	1	15	1.516	0.014	15
Archive	1	16	1.986	0.033	16
Archive	1	17	1.457	0.012	17
Archive	1	18	1.716	0.021	18
Archive	1	19	1.529	0.014	19
Archive	1	20	1.631	0.017	20
Archive	Average		1.784	0.026	
	SEM		0.071	0.0034	
WB	1	1	3.985	0.309	21
WB	1	2	3.942	0.299	22
WB	1	3	3.834	0.274	23
WB	1	4	3.632	0.231	24
WB	1	5	3.676	0.240	25
WB	1	6	3.47	0.200	26
WB	1	7	3.712	0.247	27
WB	1	8	3.689	0.243	28
WB	1	9	3.834	0.274	29
WB	1	10	3.972	0.306	30
WB-DUP	1	1	4.037	0.322	31
WB-DUP	1	2	4.1	0.338	32
WB-DUP	1	3	3.637	0.232	33
WB-DUP	1	4	4.184	0.360	34
WB-DUP	1	5	3.676	0.240	35
WB-DUP	1	6	4.067	0.329	36
WB-DUP	1	7	3.991	0.311	37
WB-DUP	1	8	4.124	0.344	38
WB-DUP	1	9	3.908	0.291	39
WB-DUP	1	10	4.079	0.333	40
WB	2	1	3.62	0.229	41
WB	2	2	3.836	0.274	42
WB	2	3	3.7	0.245	43
WB	2	4	3.754	0.256	44

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
WB	2	5	3.868	0.282	45
WB	2	6	3.513	0.208	46
WB	2	7	3.931	0.296	47
WB	2	8	3.918	0.293	48
WB	2	9	3.865	0.281	49
WB	2	10	3.649	0.235	50
WB	3	1	3.999	0.313	51
WB	3	2	3.621	0.229	52
WB	3	3	4.085	0.334	53
WB	3	4	4.05	0.325	54
WB	3	5	3.667	0.238	55
WB	3	6	3.83	0.273	56
WB	3	7	3.781	0.262	57
WB	3	8	4.078	0.332	58
WB	3	9	3.878	0.284	59
WB	3	10	3.407	0.189	60
WB	4	1	4.52	0.458	61
WB	4	2	3.985	0.309	62
WB	4	3	4.174	0.357	63
WB	4	4	4.193	0.362	64
WB	4	5	4.07	0.330	65
WB	4	6	4.005	0.314	66
WB	4	7	4.032	0.321	67
WB	4	8	4.249	0.378	68
WB	4	9	4.761	0.538	69
1	1	1	3.935	0.297	70
1	1	2	4.622	0.491	71
1	1	3	3.095	0.139	72
1	1	4	3.09	0.139	73
1	1	5	4.381	0.416	74
1	1	6	3.907	0.291	75
1	1	7	2.894	0.113	76
1	1	8	2.986	0.124	77
1	2	1	4.426	0.429	78
1	2	2	5.829	1.008	79
1	2	3	3.898	0.288	80
1	2	4	3.31	0.173	81
1	2	5	4.384	0.416	82
1	2	6	4.665	0.505	83
1	2	7	3.834	0.274	84
1	2	8	3.699	0.245	85
1	2	9	3.883	0.285	86
1	2	10	3.665	0.238	87
1	3	1	3.256	0.164	88
1	3	2	4.251	0.378	89
1	3	3	3.409	0.189	90

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
1	3	4	3.576	0.220	91
1	3	5	3.857	0.279	92
1	3	6	3.44	0.195	93
1	3	7	4.091	0.336	94
1	3	8	3.651	0.235	95
1	3	9	3.863	0.280	96
1	3	10	3.551	0.215	97
1	4	1	3.632	0.231	98
1	4	2	3.731	0.251	99
1	4	3	2.802	0.102	100
1	4	4	3.826	0.272	101
1	4	5	2.751	0.096	102
1	4	6	2.797	0.101	103
1	4	7	3.462	0.199	104
1-Dup	1	1	3.887	0.286	105
1-Dup	1	2	3.141	0.146	106
1-Dup	1	3	2.828	0.105	107
1-Dup	1	4	3.984	0.309	108
1-Dup	1	5	4.574	0.475	109
1-Dup	1	6	3.2	0.155	110
1-Dup	1	7	3.177	0.152	111
1-Dup	1	8	4.344	0.405	112
2	1	1	3.137	0.146	113
2	1	2	3.35	0.179	114
2	1	3	3.124	0.144	115
2	1	4	3.116	0.143	116
2	1	5	3.382	0.185	117
2	1	6	2.95	0.120	118
2	1	7	3.659	0.237	119
2	1	8	3.417	0.191	120
2	1	9	2.813	0.103	121
2	1	10	3.644	0.234	122
2	2	1	3.412	0.190	123
2	2	2	3.937	0.298	124
2	2	3	3.669	0.239	125
2	2	4	3.668	0.238	126
2	2	5	3.121	0.143	127
2	2	6	3.137	0.146	128
2	2	7	3.827	0.272	129
2	2	8	3.771	0.260	130
2	2	9	3.566	0.218	131
2	2	10	3.91	0.291	132
2	3	1	3.519	0.209	133
2	3	2	2.741	0.095	134
2	3	3	3.493	0.204	135
2	3	4	3.639	0.232	136

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
2	3	5	3.74	0.253	137
2	3	6	3.686	0.242	138
2	3	7	4.032	0.321	139
2	3	8	3.912	0.292	140
2	4	1	3.324	0.175	141
2	4	2	3.775	0.261	142
2	4	3	3.604	0.226	143
2	4	4	3.795	0.265	144
2	4	5	3.484	0.203	145
2	4	6	3.57	0.219	146
2	4	7	3.771	0.260	147
2	4	8	3.66	0.237	148
2	4	9	3.561	0.217	149
3	1	1	3.559	0.217	150
3	1	2	3.95	0.301	151
3	1	3	3.754	0.256	152
3	1	4	4.52	0.458	153
3	1	5	3.819	0.271	154
3	1	6	3.564	0.218	155
3	1	7	3.998	0.312	156
3	1	8	4.454	0.438	157
3	1	9	4.23	0.372	158
3	1	10	3.876	0.283	159
3	2	1	3.666	0.238	160
3	2	2	3.869	0.282	161
3	2	3	3.754	0.256	162
3	2	4	3.997	0.312	163
3	2	5	4.149	0.351	164
3	2	6	3.635	0.232	165
3	2	7	3.981	0.308	166
3	2	8	4.202	0.365	167
3	2	9	3.989	0.310	168
3	3	1	3.905	0.290	169
3	3	2	4.026	0.319	170
3	3	3	4.283	0.387	171
3	3	4	3.971	0.306	172
3	3	5	3.98	0.308	173
3	3	6	3.808	0.268	174
3	3	7	3.708	0.247	175
3	3	8	4.109	0.340	176
3	3	9	4.548	0.467	177
3	3	10	3.737	0.253	178
3	4	1	3.562	0.217	179
3	4	2	3.551	0.215	180
3	4	3	3.621	0.229	181
3	4	4	3.346	0.178	182

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
3	4	5	3.741	0.254	183
3	4	6	3.325	0.175	184
3	4	7	3.524	0.210	185
3	4	8	3.738	0.253	186
3	4	9	3.535	0.212	187
3	4	10	3.754	0.256	188
4	1	1	3.371	0.183	189
4	1	2	3.408	0.189	190
4	1	3	3.491	0.204	191
4	1	4	3.638	0.232	192
4	1	5	3.822	0.271	193
4	1	6	3.568	0.219	194
4	1	7	3.827	0.272	195
4	1	8	3.852	0.278	196
4	1	9	3.645	0.234	197
4	2	1	3.729	0.251	198
4	2	2	3.679	0.241	199
4	2	3	3.899	0.289	200
4	2	4	3.963	0.304	201
4	2	5	3.651	0.235	202
4	2	6	4.147	0.350	203
4	2	7	4.053	0.326	204
4	2	8	2.67	0.087	205
4	2	9	4.118	0.343	206
4	2	10	4.184	0.360	207
4	3	1	3.412	0.190	208
4	3	2	3.783	0.263	209
4	3	3	3.451	0.197	210
4	3	4	3.944	0.299	211
4	3	5	3.474	0.201	212
4	3	6	3.611	0.227	213
4	3	7	3.911	0.291	214
4	3	8	3.671	0.239	215
4	3	9	3.575	0.220	216
4	3	10	3.927	0.295	217
4	4	1	3.444	0.196	218
4	4	2	3.585	0.222	219
4	4	3	3.834	0.274	220
4	4	4	3.767	0.259	221
4	4	5	3.403	0.188	222
4	4	6	3.235	0.160	223
4	4	7	3.677	0.240	224
4	4	8	3.667	0.238	225
4	4	9	4.002	0.313	226
4	4	10	3.67	0.239	227
5	1	1	3.434	0.194	228

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
5	1	2	3.262	0.165	229
5	1	3	3.192	0.154	230
5	1	4	3.718	0.249	231
5	1	5	3.587	0.222	232
5	1	6	3.629	0.230	233
5	1	7	3.722	0.250	234
5	1	8	3.207	0.156	235
5	1	9	3.335	0.177	236
5	2	1	3.783	0.263	237
5	2	2	3.648	0.234	238
5	2	3	3.88	0.284	239
5	2	4	3.866	0.281	240
5	2	5	3.74	0.253	241
5	2	6	3.367	0.182	242
5	2	7	3.527	0.211	243
5	2	8	3.772	0.260	244
5	2	9	3.415	0.190	245
5	2	10	3.349	0.179	246
5	3	1	3.922	0.294	247
5	3	2	3.159	0.149	248
5	3	3	3.561	0.217	249
5	3	4	3.963	0.304	250
5	3	5	3.278	0.167	251
5	3	6	3.782	0.262	252
5	3	7	3.544	0.214	253
5	3	8	3.974	0.306	254
5	3	9	3.921	0.294	255
5	3	10	3.727	0.251	256
5	4	1	3.671	0.239	257
5	4	2	4.055	0.326	258
5	4	3	3.949	0.300	259
5	4	4	3.671	0.239	260
5	4	5	3.686	0.242	261
5	4	6	3.74	0.253	262
5	4	7	3.717	0.249	263
5	4	8	3.738	0.253	264
5	4	9	4.24	0.375	265
6	1	1	4.263	0.382	266
6	1	2	4.022	0.318	267
6	1	3	3.76	0.258	268
6	1	4	3.834	0.274	269
6	1	5	4.244	0.376	270
6	1	6	4.004	0.314	271
6	1	7	3.887	0.286	272
6	1	8	4.003	0.314	273
6	1	9	3.927	0.295	274

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
6	1	10	3.719	0.249	275
6	2	1	3.798	0.266	276
6	2	2	3.845	0.276	277
6	2	3	3.474	0.201	278
6	2	4	3.797	0.266	279
6	2	5	4.013	0.316	280
6	2	6	4.211	0.367	281
6	2	7	3.843	0.276	282
6	2	8	4.421	0.427	283
6	2	9	3.649	0.235	284
6	2	10	3.737	0.253	285
6	3	1	3.867	0.281	286
6	3	2	4.102	0.338	287
6	3	3	3.943	0.299	288
6	3	4	4.133	0.346	289
6	3	5	4.151	0.351	290
6	3	6	4.545	0.466	291
6	3	7	4.146	0.350	292
6	3	8	4.169	0.356	293
6	3	9	3.706	0.246	294
6	4	1	3.911	0.291	295
6	4	2	3.464	0.199	296
6	4	3	4.002	0.313	297
6	4	4	3.889	0.286	298
6	4	5	4.209	0.367	299
6	4	6	3.933	0.297	300
6	4	7	3.794	0.265	301
6	4	8	3.99	0.310	302
6	4	9	4.315	0.396	303
6	4	10	3.965	0.304	304
7	1	1	4.187	0.361	305
7	1	2	3.928	0.295	306
7	1	3	3.947	0.300	307
7	1	4	3.826	0.272	308
7	1	5	3.763	0.258	309
7	1	6	4.184	0.360	310
7	1	7	3.604	0.226	311
7	1	8	3.507	0.207	312
7	1	9	3.99	0.310	313
7	1	10	4.102	0.338	314
7	2	1	4.175	0.358	315
7	2	2	3.926	0.295	316
7	2	3	3.611	0.227	317
7	2	4	3.795	0.265	318
7	2	5	3.474	0.201	319
7	2	6	4.195	0.363	320

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
7	2	7	3.806	0.268	321
7	2	8	3.979	0.308	322
7	2	9	4.069	0.330	323
7	2	10	4.084	0.334	324
7	3	1	4.411	0.424	325
7	3	2	4.075	0.331	326
7	3	3	4.23	0.372	327
7	3	4	4.382	0.416	328
7	3	5	4.157	0.353	329
7	3	6	4.448	0.436	330
7	3	7	4.507	0.454	331
7	3	8	4.283	0.387	332
7	3	9	4.364	0.411	333
7	3	10	4.439	0.433	334
7	4	1	3.953	0.301	335
7	4	2	3.964	0.304	336
7	4	3	3.822	0.271	337
7	4	4	3.667	0.238	338
7	4	5	3.852	0.278	339
7	4	6	4.027	0.319	340
7	4	7	3.499	0.206	341
7	4	8	3.684	0.242	342
7	4	9	3.482	0.202	343
8	1	1	3.748	0.255	344
8	1	2	3.892	0.287	345
8	1	3	3.824	0.272	346
8	1	4	3.737	0.253	347
8	1	5	4.004	0.314	348
8	1	6	4.097	0.337	349
8	1	7	3.413	0.190	350
8	1	8	3.408	0.189	351
8	1	9	3.32	0.174	352
8	2	1	3.758	0.257	353
8	2	2	3.933	0.297	354
8	2	3	4.383	0.416	355
8	2	4	4.039	0.322	356
8	2	5	3.528	0.211	357
8	2	6	3.445	0.196	358
8	2	7	3.559	0.217	359
8	2	8	3.425	0.192	360
8	2	9	3.374	0.183	361
8	2	10	3.307	0.172	362
8	3	1	3.422	0.192	363
8	3	2	3.49	0.204	364
8	3	3	3.247	0.162	365
8	3	4	3.769	0.260	366

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
8	3	5	3.89	0.287	367
8	3	6	3.887	0.286	368
8	3	7	3.007	0.127	369
8	3	8	3.846	0.277	370
8	3	9	3.404	0.188	371
8	4	1	4.232	0.373	372
8	4	2	3.789	0.264	373
8	4	3	4.069	0.330	374
8	4	4	4.305	0.393	375
8	4	5	4.04	0.323	376
8	4	6	3.524	0.210	377
8	4	7	3.87	0.282	378
8	4	8	3.285	0.168	379
8	4	9	4.049	0.325	380
8-Dup	4	1	4.274	0.385	381
8-Dup	4	2	3.742	0.254	382
8-Dup	4	3	4.058	0.327	383
8-Dup	4	4	4.294	0.390	384
8-Dup	4	5	4.066	0.329	385
8-Dup	4	6	3.507	0.207	386
8-Dup	4	7	3.837	0.275	387
8-Dup	4	8	3.229	0.160	388
8-Dup	4	9	3.986	0.309	389
9	1	1	4.382	0.416	390
9	1	2	3.162	0.149	391
9	1	3	3.819	0.271	392
9	1	4	3.848	0.277	393
9	1	5	3.89	0.287	394
9	1	6	3.37	0.183	395
9	1	7	3.605	0.226	396
9	1	8	3.203	0.155	397
9	1	9	3.701	0.245	398
9	1	10	3.808	0.268	399
9	2	1	3.697	0.244	400
9	2	2	3.62	0.229	401
9	2	3	3.568	0.219	402
9	2	4	4.407	0.423	403
9	2	5	3.327	0.175	404
9	2	6	3.379	0.184	405
9	2	7	3.438	0.194	406
9	2	8	3.223	0.159	407
9	2	9	3.544	0.214	408
9	2	10	3.378	0.184	409
9-Dup	2	1	3.741	0.254	410
9-Dup	2	2	3.739	0.253	411
9-Dup	2	3	3.532	0.212	412

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
9-Dup	2	4	4.506	0.454	413
9-Dup	2	5	3.354	0.180	414
9-Dup	2	6	3.497	0.205	415
9-Dup	2	7	3.479	0.202	416
9-Dup	2	8	3.307	0.172	417
9-Dup	2	9	3.493	0.204	418
9-Dup	2	10	3.342	0.178	419
9	3	1	3.784	0.263	420
9	3	2	4.338	0.403	421
9	3	3	3.316	0.173	422
9	3	4	3.875	0.283	423
9	3	5	4.035	0.321	424
9	3	6	3.861	0.280	425
9	3	7	3.789	0.264	426
9	3	8	3.395	0.187	427
9	3	9	4.036	0.322	428
9	4	1	3.616	0.228	429
9	4	2	3.656	0.236	430
9	4	3	3.793	0.265	431
9	4	4	3.739	0.253	432
9	4	5	2.946	0.119	433
9	4	6	3.482	0.202	434
9	4	7	3.61	0.227	435
9	4	8	4.06	0.328	436
9	4	9	3.777	0.261	437
9	4	10	3.91	0.291	438
10	1	1	3.436	0.194	439
10	1	2	3.803	0.267	440
10	1	3	3.497	0.205	441
10	1	4	3.459	0.198	442
10	1	5	3.631	0.231	443
10	1	6	3.599	0.225	444
10	1	7	3.678	0.240	445
10	1	8	3.677	0.240	446
10	1	9	3.895	0.288	447
10	1	10	3.586	0.222	448
10	2	1	3.629	0.230	449
10	2	2	3.592	0.223	450
10	2	3	3.299	0.171	451
10	2	4	3.17	0.150	452
10	2	5	3.463	0.199	453
10	2	6	3.397	0.187	454
10	2	7	3.776	0.261	455
10	2	8	3.533	0.212	456
10	2	9	3.195	0.154	457
10	2	10	3.639	0.232	458

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
10	3	1	3.846	0.277	459
10	3	2	3.688	0.242	460
10	3	3	4.038	0.322	461
10	3	4	4.071	0.330	462
10	3	5	3.661	0.237	463
10	3	6	3.809	0.268	464
10	3	7	3.711	0.247	465
10	3	8	3.871	0.282	466
10	3	9	3.878	0.284	467
10	4	1	3.737	0.253	468
10	4	2	3.975	0.307	469
10	4	3	3.724	0.250	470
10	4	4	3.885	0.285	471
10	4	5	4.332	0.401	472
10	4	6	3.586	0.222	473
10	4	7	3.743	0.254	474
10	4	8	3.925	0.295	475
10	4	9	3.898	0.288	476
10	4	10	3.65	0.235	477
11	1	1	3.678	0.240	478
11	1	2	3.657	0.236	479
11	1	3	3.552	0.215	480
11	1	4	3.522	0.210	481
11	1	5	3.46	0.198	482
11	1	6	3.862	0.280	483
11	1	7	3.654	0.236	484
11	1	8	3.532	0.212	485
11	1	9	3.662	0.237	486
11	1	10	3.618	0.228	487
11	2	1	3.527	0.211	488
11	2	2	4.012	0.316	489
11	2	3	3.681	0.241	490
11	2	4	3.83	0.273	491
11	2	5	3.858	0.279	492
11	2	6	3.433	0.194	493
11	2	7	3.937	0.298	494
11	2	8	3.883	0.285	495
11	2	9	3.755	0.257	496
11	3	1	3.836	0.274	497
11	3	2	3.546	0.214	498
11	3	3	3.917	0.293	499
11	3	4	3.729	0.251	500
11	3	5	3.947	0.300	501
11	3	6	3.468	0.200	502
11	3	7	3.694	0.244	503
11	3	8	3.636	0.232	504

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
11	3	9	3.792	0.265	505
11	3	10	3.988	0.310	506
11	4	1	4.484	0.447	507
11	4	2	3.882	0.285	508
11	4	3	4.414	0.425	509
11	4	4	3.82	0.271	510
11	4	5	4.242	0.376	511
12	1	1	3.435	0.194	512
12	1	2	3.1	0.140	513
12	1	3	3.657	0.236	514
12	1	4	3.114	0.142	515
12	1	5	3.647	0.234	516
12	1	6	3.893	0.287	517
12	1	7	3.605	0.226	518
12	1	8	3.541	0.213	519
12	1	9	3.334	0.176	520
12	2	1	3.516	0.209	521
12	2	2	2.879	0.111	522
12	2	3	3.633	0.231	523
12	2	4	3.33	0.176	524
12	2	5	3.334	0.176	525
12	2	6	3.664	0.238	526
12	2	7	3.736	0.253	527
12	2	8	3.465	0.199	528
12	2	9	3.109	0.141	529
12	2	10	3.297	0.170	530
12	3	1	3.42	0.191	531
12	3	2	3.664	0.238	532
12	3	3	3.478	0.202	533
12	3	4	3.418	0.191	534
12	3	5	3.228	0.159	535
12	3	6	3.476	0.201	536
12	3	7	3.891	0.287	537
12	3	8	3.474	0.201	538
12	3	9	3.858	0.279	539
12	3	10	3.519	0.209	540
12	4	1	4.196	0.363	541
12	4	2	3.714	0.248	542
12	4	3	3.807	0.268	543
12	4	4	4.053	0.326	544
12	4	5	4.091	0.336	545
12	4	6	3.552	0.215	546
12	4	7	3.926	0.295	547
12	4	8	3.915	0.292	548
13	1	1	3.428	0.193	549
13	1	2	3.513	0.208	550

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
13	1	3	3.284	0.168	551
13	1	4	3.454	0.197	552
13	1	5	3.073	0.136	553
13	1	6	3.714	0.248	554
13	1	7	3.374	0.183	555
13	1	8	3.409	0.189	556
13	1	9	3.85	0.277	557
13	2	1	3.209	0.156	558
13	2	2	3.489	0.204	559
13	2	3	3.527	0.211	560
13	2	4	3.559	0.217	561
13	2	5	3.497	0.205	562
13	2	6	3.503	0.206	563
13	2	7	3.6	0.225	564
13	2	8	3.707	0.246	565
13	2	9	3.154	0.148	566
13	3	1	3.372	0.183	567
13	3	2	3.248	0.162	568
13	3	3	3.503	0.206	569
13	3	4	3.306	0.172	570
13	3	5	3.567	0.218	571
13	3	6	3.839	0.275	572
13	3	7	3.685	0.242	573
13	3	8	3.824	0.272	574
13	3	9	3.615	0.228	575
13	4	1	3.519	0.209	576
13	4	2	3.392	0.186	577
13	4	3	3.583	0.221	578
13	4	4	3.414	0.190	579
13	4	5	3.606	0.226	580
13	4	6	3.543	0.214	581
13	4	7	3.513	0.208	582
13	4	8	3.644	0.234	583
13	4	9	3.65	0.235	584
13	4	10	3.505	0.207	585
14	1	1	3.677	0.240	586
14	1	2	3.398	0.187	587
14	1	3	3.577	0.220	588
14	1	4	3.807	0.268	589
14	1	5	3.615	0.228	590
14	1	6	3.645	0.234	591
14	1	7	3.753	0.256	592
14	1	8	4.095	0.337	593
14	1	9	3.625	0.230	594
14	2	1	3.141	0.146	595
14	2	2	3.344	0.178	596

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
14	2	3	3.386	0.185	597
14	2	4	3.537	0.213	598
14	2	5	3.337	0.177	599
14	2	6	3.245	0.162	600
14	2	7	3.826	0.272	601
14	2	8	3.641	0.233	602
14	2	9	3.683	0.241	603
14	2	10	3.593	0.223	604
14	3	1	3.863	0.280	605
14	3	2	4.075	0.331	606
14	3	3	3.695	0.244	607
14	3	4	3.76	0.258	608
14	3	5	3.968	0.305	609
14	3	6	3.738	0.253	610
14	3	7	3.173	0.151	611
14	3	8	3.932	0.296	612
14	3	9	3.649	0.235	613
14	4	1	3.82	0.271	614
14	4	2	3.55	0.215	615
14	4	3	3.96	0.303	616
14	4	4	3.999	0.313	617
14	4	5	3.678	0.240	618
14	4	6	3.694	0.244	619
14	4	7	3.629	0.230	620
14	4	8	3.959	0.303	621
14	4	9	3.611	0.227	622
15	1	1	3.298	0.171	623
15	1	2	3.157	0.149	624
15	1	3	3.498	0.205	625
15	1	4	3.384	0.185	626
15	1	5	3.409	0.189	627
15	1	6	3.586	0.222	628
15	1	7	3.439	0.195	629
15	1	8	3.23	0.160	630
15	1	9	3.307	0.172	631
15	1	10	3.358	0.181	632
15	2	1	3.237	0.161	633
15	2	2	3.69	0.243	634
15	2	3	3.091	0.139	635
15	2	4	3.829	0.273	636
15	2	5	3.06	0.135	637
15	2	6	3.214	0.157	638
15	2	7	3.787	0.263	639
15	2	8	3.578	0.220	640
15	2	9	3.223	0.159	641
15	2	10	3.427	0.192	642

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
15	3	1	3.264	0.165	643
15	3	2	3.256	0.164	644
15	3	3	3.096	0.140	645
15	3	4	3.438	0.194	646
15	3	5	3.259	0.164	647
15	3	6	4.495	0.450	648
15	3	7	3.78	0.262	649
15	3	8	3.621	0.229	650
15	3	9	3.665	0.238	651
15	3	10	3.46	0.198	652
15	4	1	3.446	0.196	653
15	4	2	3.922	0.294	654
15	4	3	3.695	0.244	655
15	4	4	3.637	0.232	656
15	4	5	3.085	0.138	657
15	4	6	3.711	0.247	658
15	4	7	3.783	0.263	659
15	4	8	3.335	0.177	660
15	4	9	3.602	0.225	661
16	1	1	3.178	0.152	662
16	1	2	3.763	0.258	663
16	1	3	3.658	0.236	664
16	1	4	3.081	0.137	665
16	1	5	3.549	0.215	666
16	1	6	3.518	0.209	667
16	1	7	3.443	0.195	668
16	1	8	3.334	0.176	669
16	1	9	3.848	0.277	670
16	1	10	3.567	0.218	671
16	2	1	3.86	0.280	672
16	2	2	3.905	0.290	673
16	2	3	4.015	0.316	674
16	2	4	3.817	0.270	675
16	2	5	3.972	0.306	676
16	2	6	3.708	0.247	677
16	2	7	3.691	0.243	678
16	2	8	3.529	0.211	679
16	2	9	3.509	0.207	680
16	2	10	3.623	0.229	681
16	3	1	3.192	0.154	682
16	3	2	3.414	0.190	683
16	3	3	2.94	0.119	684
16	3	4	3.421	0.191	685
16	3	5	3.837	0.275	686
16	3	6	3.583	0.221	687
16	3	7	3.396	0.187	688

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
16	3	8	3.336	0.177	689
16	3	9	3.396	0.187	690
16	3	10	3.017	0.129	691
16	4	1	3.604	0.226	692
16	4	2	3.897	0.288	693
16	4	3	3.454	0.197	694
16	4	4	3.303	0.171	695
16	4	5	3.879	0.284	696
16	4	6	3.562	0.217	697
16	4	7	3.924	0.295	698
16	4	8	3.648	0.234	699
16	4	9	3.964	0.304	700
16	4	10	3.58	0.221	701
17	1	1	3.908	0.291	702
17	1	2	3.967	0.305	703
17	1	3	4.012	0.316	704
17	1	4	3.808	0.268	705
17	1	5	3.493	0.204	706
17	1	6	3.693	0.244	707
17	1	7	3.561	0.217	708
17	1	8	3.845	0.276	709
17	1	9	3.911	0.291	710
17	1	10	3.792	0.265	711
17	2	1	3.56	0.217	712
17	2	2	3.796	0.265	713
17	2	3	4.039	0.322	714
17	2	4	3.905	0.290	715
17	2	5	3.605	0.226	716
17	2	6	3.511	0.208	717
17	2	7	4.011	0.315	718
17	2	8	3.47	0.200	719
17	2	9	4.09	0.335	720
17	2	10	3.877	0.284	721
17	3	1	3.209	0.156	722
17	3	2	3.613	0.227	723
17	3	3	3.503	0.206	724
17	3	4	4.13	0.346	725
17	3	5	3.211	0.157	726
17	3	6	3.702	0.245	727
17	3	7	3.219	0.158	728
17	3	8	3.358	0.181	729
17	3	9	3.527	0.211	730
17	3	10	3.663	0.237	731
17	4	1	4.112	0.341	732
17	4	2	3.124	0.144	733
17	4	3	3.278	0.167	734

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
17	4	4	3.661	0.237	735
17	4	5	3.209	0.156	736
17	4	6	3.225	0.159	737
17	4	7	3.641	0.233	738
17	4	8	3.429	0.193	739
17	4	9	3.805	0.267	740
17	4	10	3.973	0.306	741
17	4	11	3.837	0.275	742
18	1	1	3.538	0.213	743
18	1	2	3.142	0.146	744
18	1	3	3.375	0.183	745
18	1	4	3.119	0.143	746
18	1	5	2.941	0.119	747
18	1	6	3.926	0.295	748
18	1	7	2.987	0.125	749
18	1	8	3.214	0.157	750
18	1	9	3.309	0.172	751
18	2	1	4.02	0.318	752
18	2	2	3.511	0.208	753
18	2	3	3.28	0.168	754
18	2	4	3.008	0.127	755
18	2	5	3.47	0.200	756
18	2	6	3.31	0.173	757
18	2	7	3.679	0.241	758
18	2	8	3.398	0.187	759
18	2	9	4.017	0.317	760
18	2	10	3.363	0.181	761
18	3	1	4.05	0.325	762
18	3	2	3.741	0.254	763
18	3	3	3.958	0.303	764
18	3	4	2.897	0.113	765
18	3	5	3.917	0.293	766
18	3	6	3.464	0.199	767
18	3	7	3.599	0.225	768
18	3	8	3.619	0.229	769
18	4	1	3.212	0.157	770
18	4	2	3.487	0.203	771
18	4	3	3.461	0.199	772
18	4	4	3.321	0.174	773
18	4	5	3.075	0.137	774
18	4	6	3.138	0.146	775
18	4	7	3.266	0.165	776
18	4	8	3.286	0.169	777
18	4	9	3.219	0.158	778
19	1	1	3.583	0.221	779
19	1	2	3.439	0.195	780

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
19	1	3	3.682	0.241	781
19	1	4	3.419	0.191	782
19	1	5	3.716	0.248	783
19	1	6	3.988	0.310	784
19	1	7	3.648	0.234	785
19	1	8	3.472	0.201	786
19	1	9	3.833	0.274	787
19	1	10	3.523	0.210	788
19	2	1	4.241	0.376	789
19	2	2	3.947	0.300	790
19	2	3	4.079	0.333	791
19	2	4	4.234	0.374	792
19	2	5	3.825	0.272	793
19	2	6	3.946	0.300	794
19	2	7	4.287	0.388	795
19	2	8	3.946	0.300	796
19	3	1	3.789	0.264	797
19	3	2	3.486	0.203	798
19	3	3	3.331	0.176	799
19	3	4	3.561	0.217	800
19	3	5	3.342	0.178	801
19	3	6	3.429	0.193	802
19	3	7	3.595	0.224	803
19	3	8	3.726	0.250	804
19	3	9	3.34	0.177	805
19	3	10	3.509	0.207	806
19	4	1	3.466	0.199	807
19	4	2	3.66	0.237	808
19	4	3	3.646	0.234	809
19	4	4	3.475	0.201	810
19	4	5	3.759	0.257	811
19	4	6	3.177	0.152	812
19	4	7	3.703	0.246	813
19	4	8	3.751	0.256	814
19	4	9	3.213	0.157	815
20	1	1	3.253	0.163	816
20	1	2	3.819	0.271	817
20	1	3	3.446	0.196	818
20	1	4	3.467	0.200	819
20	1	5	3.503	0.206	820
20	1	6	3.76	0.258	821
20	1	7	3.283	0.168	822
20	1	8	3.571	0.219	823
20	1	9	3.071	0.136	824
20	1	10	3.124	0.144	825
20	2	1	3.813	0.269	826

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
20	2	2	3.58	0.221	827
20	2	3	3.743	0.254	828
20	2	4	3.352	0.180	829
20	2	5	3.628	0.230	830
20	2	6	3.459	0.198	831
20	2	7	3.687	0.242	832
20	2	8	3.088	0.138	833
20	3	1	3.597	0.224	834
20	3	2	3.303	0.171	835
20	3	3	4.022	0.318	836
20	3	4	3.137	0.146	837
20	3	5	3.282	0.168	838
20	3	6	3.49	0.204	839
20	3	7	3.148	0.147	840
20	3	8	3.598	0.224	841
20	3	9	3.66	0.237	842
20	3	10	3.656	0.236	843
20	4	1	3.481	0.202	844
20	4	2	3.062	0.135	845
20	4	3	3.511	0.208	846
20	4	4	3.7	0.245	847
20	4	5	3.301	0.171	848
20	4	6	3.655	0.236	849
20	4	7	3.886	0.286	850
20	4	8	3.347	0.179	851
20	4	9	3.576	0.220	852
20	4	10	3.561	0.217	853
21	1	1	3.758	0.257	854
21	1	2	3.663	0.237	855
21	1	3	4.137	0.348	856
21	1	4	3.593	0.223	857
21	1	5	3.795	0.265	858
21	1	6	3.691	0.243	859
21	1	7	3.66	0.237	860
21	1	8	3.58	0.221	861
21	2	1	3.145	0.147	862
21	2	2	4.028	0.320	863
21	2	3	3.195	0.154	864
21	2	4	3.975	0.307	865
21	2	5	3.57	0.219	866
21	2	6	3.917	0.293	867
21	2	7	3.409	0.189	868
21	2	8	3.73	0.251	869
21	2	9	3.903	0.290	870
21	2	10	3.36	0.181	871
21	3	1	2.936	0.118	872

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
21	3	2	3.939	0.298	873
21	3	3	3.989	0.310	874
21	3	4	3.939	0.298	875
21	3	5	3.894	0.288	876
21	3	6	3.447	0.196	877
21	3	7	3.869	0.282	878
21	3	8	4.037	0.322	879
21	3	9	3.576	0.220	880
21	3	10	3.585	0.222	881
21	4	1	3.978	0.307	882
21	4	2	3.784	0.263	883
21	4	3	3.964	0.304	884
21	4	4	3.68	0.241	885
21	4	5	4.076	0.332	886
21	4	6	3.735	0.252	887
21	4	7	3.708	0.247	888
21	4	8	3.864	0.281	889
21	4	9	3.778	0.262	890
22	1	1	4.448	0.436	891
22	1	2	3.83	0.273	892
22	1	3	3.942	0.299	893
22	1	4	3.695	0.244	894
22	1	5	3.803	0.267	895
22	1	6	4.044	0.324	896
22	1	7	3.74	0.253	897
22	1	8	3.853	0.278	898
22	1	9	3.55	0.215	899
22	2	1	3.344	0.178	900
22	2	2	3.669	0.239	901
22	2	3	3.633	0.231	902
22	2	4	3.832	0.273	903
22	2	5	3.798	0.266	904
22	2	6	3.637	0.232	905
22	2	7	3.833	0.274	906
22	2	8	3.952	0.301	907
22	2	9	3.855	0.279	908
22	3	1	3.623	0.229	909
22	3	2	3.473	0.201	910
22	3	3	3.727	0.251	911
22	3	4	3.893	0.287	912
22	3	5	3.194	0.154	913
22	3	6	3.456	0.198	914
22	3	7	3.687	0.242	915
22	3	8	3.32	0.174	916
22	3	9	3.257	0.164	917
22	3	10	3.316	0.173	918

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
22	4	1	3.302	0.171	919
22	4	2	3.777	0.261	920
22	4	3	3.407	0.189	921
22	4	4	3.473	0.201	922
22	4	5	3.366	0.182	923
22	4	6	3.218	0.158	924
22	4	7	3.177	0.152	925
22	4	8	3.35	0.179	926
23	1	1	4.012	0.316	927
23	1	2	3.752	0.256	928
23	1	3	3.966	0.305	929
23	1	4	3.24	0.161	930
23	1	5	3.571	0.219	931
23	1	6	3.631	0.231	932
23	1	7	3.433	0.194	933
23	1	8	3.579	0.221	934
23	1	9	3.342	0.178	935
23	1	10	3.071	0.136	936
23	2	1	4.119	0.343	937
23	2	2	4.182	0.359	938
23	2	3	3.945	0.300	939
23	2	4	3.878	0.284	940
23	2	5	3.895	0.288	941
23	2	6	3.812	0.269	942
23	2	7	4.264	0.382	943
23	2	8	3.906	0.290	944
23	3	1	3.885	0.285	945
23	3	2	3.918	0.293	946
23	3	3	3.52	0.209	947
23	3	4	3.696	0.244	948
23	3	5	3.754	0.256	949
23	3	6	3.81	0.269	950
23	3	7	3.71	0.247	951
23	3	8	3.9	0.289	952
23	3	9	3.863	0.280	953
23	4	1	3.733	0.252	954
23	4	2	3.677	0.240	955
23	4	3	3.956	0.302	956
23	4	4	4.203	0.365	957
23	4	5	3.598	0.224	958
23	4	6	3.786	0.263	959
23	4	7	3.759	0.257	960
23	4	8	4.019	0.317	961
23	4	9	3.902	0.289	962
23	4	10	3.898	0.288	963
24	1	1	3.79	0.264	964

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
24	1	2	3.579	0.221	965
24	1	3	4.164	0.355	966
24	1	4	3.658	0.236	967
24	1	5	3.92	0.294	968
24	1	6	3.739	0.253	969
24	1	7	3.561	0.217	970
24	1	8	3.619	0.229	971
24	1	9	4.153	0.352	972
24	2	1	3.767	0.259	973
24	2	2	3.442	0.195	974
24	2	3	2.439	0.065	975
24	2	4	3.285	0.168	976
24	2	5	3.211	0.157	977
24	2	6	3.735	0.252	978
24	2	7	3.735	0.252	979
24	2	8	3.304	0.172	980
24	2	9	4.214	0.368	981
24	3	1	3.619	0.229	982
24	3	2	3.436	0.194	983
24	3	3	3.909	0.291	984
24	3	4	3.859	0.280	985
24	3	5	4.146	0.350	986
24	3	6	3.637	0.232	987
24	3	7	3.556	0.216	988
24	3	8	3.481	0.202	989
24	4	1	3.899	0.289	990
24	4	2	3.929	0.296	991
24	4	3	4.517	0.457	992
24	4	4	4.323	0.399	993
25	1	1	3.117	0.143	994
25	1	2	3.695	0.244	995
25	1	3	3.923	0.294	996
25	1	4	3.962	0.304	997
25	1	5	3.72	0.249	998
25	1	6	3.355	0.180	999
25	1	7	3.703	0.246	1000
25	1	8	3.692	0.243	1001
25	1	9	3.304	0.172	1002
25	2	1	3.703	0.246	1003
25	2	2	3.546	0.214	1004
25	2	3	4.232	0.373	1005
25	2	4	3.736	0.253	1006
25	2	5	4.226	0.371	1007
25	2	6	4.236	0.374	1008
25	2	7	3.553	0.216	1009
25	2	8	3.485	0.203	1010

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
25	2	9	3.923	0.294	1011
25	2	10	3.689	0.243	1012
25	3	1	3.46	0.198	1013
25	3	2	3.844	0.276	1014
25	3	3	3.763	0.258	1015
25	3	4	3.459	0.198	1016
25	3	5	4.074	0.331	1017
25	3	6	3.848	0.277	1018
25	3	7	3.894	0.288	1019
25	3	8	4.07	0.330	1020
25	3	9	4.077	0.332	1021
25	4	1	3.62	0.229	1022
25	4	2	3.939	0.298	1023
25	4	3	3.788	0.264	1024
25	4	4	3.641	0.233	1025
25	4	5	3.383	0.185	1026
25	4	6	3.644	0.234	1027
25	4	7	4.08	0.333	1028
25	4	8	3.561	0.217	1029
25	4	9	3.76	0.258	1030
26	1	1	4.045	0.324	1031
26	1	2	4.391	0.419	1032
26	1	3	3.929	0.296	1033
26	1	4	3.58	0.221	1034
26	1	5	4.001	0.313	1035
26	1	6	3.979	0.308	1036
26	1	7	4.003	0.314	1037
26	1	8	4.129	0.345	1038
26	1	9	4.559	0.470	1039
26	2	1	3.361	0.181	1040
26	2	2	3.738	0.253	1041
26	2	3	3.513	0.208	1042
26	2	4	3.617	0.228	1043
26	2	5	3.391	0.186	1044
26	2	6	3.256	0.164	1045
26	2	7	3.497	0.205	1046
26	2	8	3.776	0.261	1047
26	2	9	3.537	0.213	1048
26	2	10	3.522	0.210	1049
26	3	1	3.075	0.137	1050
26	3	2	3.412	0.190	1051
26	3	3	3.176	0.151	1052
26	3	4	3.337	0.177	1053
26	3	5	3.35	0.179	1054
26	3	6	3.512	0.208	1055
26	3	7	3.364	0.182	1056

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
26	3	8	3.953	0.301	1057
26	3	9	3.532	0.212	1058
26	3	10	3.261	0.165	1059
26	3	11	3.356	0.180	1060
26	4	1	3.168	0.150	1061
26	4	2	3.024	0.130	1062
26	4	3	3.096	0.140	1063
26	4	4	3.202	0.155	1064
26	4	5	3.543	0.214	1065
26	4	6	3.164	0.150	1066
26	4	7	3.472	0.201	1067
26	4	8	3.289	0.169	1068
26	4	9	3.36	0.181	1069
27	1	1	3.256	0.164	1070
27	1	2	3.548	0.215	1071
27	1	3	3.106	0.141	1072
27	1	4	3.418	0.191	1073
27	1	5	3.588	0.222	1074
27	1	6	4.266	0.382	1075
27	1	7	3.402	0.188	1076
27	1	8	3.5	0.206	1077
27	1	9	3.311	0.173	1078
27	1	10	3.562	0.217	1079
27	2	1	3.654	0.236	1080
27	2	2	3.617	0.228	1081
27	2	3	3.316	0.173	1082
27	2	4	3.791	0.264	1083
27	2	5	3.515	0.208	1084
27	2	6	3.512	0.208	1085
27	2	7	3.904	0.290	1086
27	2	8	3.356	0.180	1087
27	2	9	3.514	0.208	1088
27	3	1	3.641	0.233	1089
27	3	2	3.731	0.251	1090
27	3	3	3.425	0.192	1091
27	3	4	3.356	0.180	1092
27	3	5	3.124	0.144	1093
27	3	6	3.442	0.195	1094
27	3	7	3.503	0.206	1095
27	3	8	3.367	0.182	1096
27	3	9	3.293	0.170	1097
27	3	10	3.384	0.185	1098
27	4	1	4.03	0.320	1099
27	4	2	3.186	0.153	1100
27	4	3	3.713	0.248	1101
27	4	4	3.232	0.160	1102

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
27	4	5	3.413	0.190	1103
27	4	6	3.205	0.156	1104
27	4	7	3.406	0.189	1105
27	4	8	3.433	0.194	1106
27	4	9	3.618	0.228	1107
28	1	1	4.292	0.390	1108
28	1	2	3.689	0.243	1109
28	1	3	3.881	0.285	1110
28	1	4	3.575	0.220	1111
28	1	5	3.594	0.224	1112
28	1	6	3.66	0.237	1113
28	1	7	3.521	0.210	1114
28	1	8	3.738	0.253	1115
28	2	1	3.41	0.189	1116
28	2	2	3.425	0.192	1117
28	2	3	3.49	0.204	1118
28	2	4	3.843	0.276	1119
28	2	5	2.948	0.120	1120
28	2	6	3.833	0.274	1121
28	2	7	3.877	0.284	1122
28	2	8	3.988	0.310	1123
28	2	9	3.842	0.276	1124
28	3	1	3.363	0.181	1125
28	3	2	4.074	0.331	1126
28	3	3	3.419	0.191	1127
28	3	4	4.145	0.350	1128
28	3	5	3.537	0.213	1129
28	3	6	3.695	0.244	1130
28	3	7	3.722	0.250	1131
28	3	8	3.281	0.168	1132
28	3	9	3.998	0.312	1133
28	4	1	3.487	0.203	1134
28	4	2	3.642	0.233	1135
28	4	3	3.746	0.255	1136
28	4	4	3.406	0.189	1137
28	4	5	3.403	0.188	1138
28	4	6	3.609	0.227	1139
28	4	7	3.484	0.203	1140
28	4	8	3.458	0.198	1141
28	4	9	3.183	0.152	1142
29	1	1	3.793	0.265	1143
29	1	2	3.82	0.271	1144
29	1	3	3.712	0.247	1145
29	1	4	3.91	0.291	1146
29	1	5	3.454	0.197	1147
29	1	6	3.814	0.269	1148

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
29	1	7	3.841	0.275	1149
29	1	8	3.679	0.241	1150
29	1	9	4.066	0.329	1151
29	2	1	3.779	0.262	1152
29	2	2	3.733	0.252	1153
29	2	3	3.708	0.247	1154
29	2	4	3.646	0.234	1155
29	2	5	3.622	0.229	1156
29	2	6	4.06	0.328	1157
29	2	7	3.514	0.208	1158
29	2	8	4.046	0.324	1159
29	2	9	4.015	0.316	1160
29	2	10	4.376	0.414	1161
29	3	1	4.262	0.381	1162
29	3	2	3.767	0.259	1163
29	3	3	3.891	0.287	1164
29	3	4	3.938	0.298	1165
29	3	5	4.002	0.313	1166
29	3	6	4.258	0.380	1167
29	3	7	3.648	0.234	1168
29	3	8	3.797	0.266	1169
29	3	9	3.677	0.240	1170
29	3	10	3.703	0.246	1171
29	4	1	4.059	0.327	1172
29	4	2	3.913	0.292	1173
29	4	3	3.953	0.301	1174
29	4	4	4.322	0.398	1175
29	4	5	3.904	0.290	1176
29	4	6	3.967	0.305	1177
29	4	7	3.639	0.232	1178
29	4	8	3.565	0.218	1179
29	4	9	4.049	0.325	1180
29	4	10	3.958	0.303	1181
30	1	1	3.612	0.227	1182
30	1	2	3.66	0.237	1183
30	1	3	3.8	0.266	1184
30	1	4	3.63	0.231	1185
30	1	5	3.285	0.168	1186
30	1	6	3.384	0.185	1187
30	1	7	3.78	0.262	1188
30	1	8	4.211	0.367	1189
30	1	9	4.088	0.335	1190
30	1	10	3.774	0.261	1191
30	2	1	3.654	0.236	1192
30	2	2	3.432	0.193	1193
30	2	3	3.537	0.213	1194

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
30	2	4	3.472	0.201	1195
30	2	5	3.375	0.183	1196
30	2	6	3.684	0.242	1197
30	2	7	3.439	0.195	1198
30	2	8	3.3	0.171	1199
30	2	9	3.699	0.245	1200
30	2	10	3.491	0.204	1201
30	3	1	4.013	0.316	1202
30	3	2	3.575	0.220	1203
30	3	3	3.592	0.223	1204
30	3	4	3.695	0.244	1205
30	3	5	4.316	0.397	1206
30	3	6	3.525	0.210	1207
30	3	7	3.822	0.271	1208
30	3	8	3.708	0.247	1209
30	3	9	3.569	0.219	1210
30	4	1	3.366	0.182	1211
30	4	2	3.88	0.284	1212
30	4	3	3.227	0.159	1213
30	4	4	4.063	0.328	1214
30	4	5	3.011	0.128	1215
30	4	6	3.141	0.146	1216
30	4	7	3.88	0.284	1217
30	4	8	3.732	0.252	1218
30	4	9	3.671	0.239	1219
30	4	10	3.254	0.163	1220
31	1	1	3.474	0.201	1221
31	1	2	3.879	0.284	1222
31	1	3	3.104	0.141	1223
31	1	4	3.888	0.286	1224
31	1	5	3.726	0.250	1225
31	1	6	3.419	0.191	1226
31	1	7	3.295	0.170	1227
31	1	8	3.556	0.216	1228
31	1	9	3.715	0.248	1229
31	2	1	3.591	0.223	1230
31	2	2	3.238	0.161	1231
31	2	3	3.807	0.268	1232
31	2	4	3.417	0.191	1233
31	2	5	3.367	0.182	1234
31	2	7	3.21	0.157	1235
31	2	8	3.311	0.173	1236
31	2	9	3.57	0.219	1237
31	2	10	3.843	0.276	1238
31	3	1	3.532	0.212	1239
31	3	2	3.587	0.222	1240

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
31	3	3	3.183	0.152	1241
31	3	4	3.61	0.227	1242
31	3	5	3.295	0.170	1243
31	3	6	4.001	0.313	1244
31	3	7	3.722	0.250	1245
31	3	8	3.393	0.187	1246
31	3	9	4.448	0.436	1247
31	3	10	3.385	0.185	1248
31	4	1	3.573	0.219	1249
31	4	2	3.525	0.210	1250
31	4	3	3.744	0.254	1251
31	4	4	3.699	0.245	1252
31	4	5	3.455	0.197	1253
31	4	6	3.843	0.276	1254
31	4	7	3.223	0.159	1255
31	4	8	3.45	0.197	1256
32	1	1	3.836	0.274	1257
32	1	2	3.917	0.293	1258
32	1	3	3.834	0.274	1259
32	1	4	4.183	0.360	1260
32	1	5	4.039	0.322	1261
32	1	6	4.216	0.369	1262
32	1	7	3.718	0.249	1263
32	1	8	4.169	0.356	1264
32	1	9	4.234	0.374	1265
32	1	10	4.331	0.401	1266
32	2	1	3.665	0.238	1267
32	2	2	3.873	0.283	1268
32	2	3	4.017	0.317	1269
32	2	4	3.68	0.241	1270
32	2	5	3.827	0.272	1271
32	2	6	3.639	0.232	1272
32	2	7	3.787	0.263	1273
32	3	1	3.513	0.208	1274
32	3	2	3.277	0.167	1275
32	3	3	3.583	0.221	1276
32	3	4	3.527	0.211	1277
32	3	5	3.468	0.200	1278
32	3	6	3.446	0.196	1279
32	3	7	3.728	0.251	1280
32	3	8	3.559	0.217	1281
32	3	9	3.572	0.219	1282
32	3	10	3.805	0.267	1283
32	4	1	3.523	0.210	1284
32	4	2	3.591	0.223	1285
32	4	3	3.333	0.176	1286

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
32	4	4	4.098	0.337	1287
32	4	5	3.811	0.269	1288
32	4	6	3.574	0.220	1289
32	4	7	3.493	0.204	1290
32	4	8	3.777	0.261	1291
32	4	9	3.873	0.283	1292
32	4	10	3.638	0.232	1293
32	4	11	3.578	0.220	1294
33	1	1	3.993	0.311	1295
33	1	2	4.217	0.369	1296
33	1	3	4.241	0.376	1297
33	1	4	3.701	0.245	1298
33	1	5	3.815	0.270	1299
33	1	6	2.859	0.108	1300
33	1	7	4.293	0.390	1301
33	1	8	4.086	0.334	1302
33	2	1	4.057	0.327	1303
33	2	2	3.55	0.215	1304
33	2	3	3.725	0.250	1305
33	2	4	3.854	0.278	1306
33	2	5	3.677	0.240	1307
33	2	6	3.768	0.259	1308
33	2	7	3.889	0.286	1309
33	2	8	3.646	0.234	1310
33	2	9	3.975	0.307	1311
33	2	10	3.653	0.235	1312
33	3	1	4.139	0.348	1313
33	3	2	3.955	0.302	1314
33	3	3	3.859	0.280	1315
33	3	4	3.797	0.266	1316
33	3	5	4.247	0.377	1317
33	3	6	4.28	0.386	1318
33	3	7	4.081	0.333	1319
33	3	8	3.858	0.279	1320
33	4	1	3.775	0.261	1321
33	4	2	3.736	0.253	1322
33	4	3	3.918	0.293	1323
33	4	4	3.911	0.291	1324
33	4	5	4.122	0.344	1325
33	4	6	4.351	0.407	1326
33	4	7	3.09	0.139	1327
33	4	8	4.364	0.411	1328
33	4	9	4.503	0.453	1329
33	4	10	4.079	0.333	1330
34	1	1	3.742	0.254	1331
34	1	2	3.992	0.311	1332

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
34	1	3	3.498	0.205	1333
34	1	4	4.1	0.338	1334
34	1	5	3.7	0.245	1335
34	1	6	3.815	0.270	1336
34	1	7	3.996	0.312	1337
34	1	8	3.582	0.221	1338
34	1	9	3.818	0.270	1339
34	1	10	3.759	0.257	1340
34	2	1	3.239	0.161	1341
34	2	2	3.684	0.242	1342
34	2	3	3.83	0.273	1343
34	2	4	3.906	0.290	1344
34	2	5	3.744	0.254	1345
34	2	6	3.584	0.222	1346
34	2	7	3.99	0.310	1347
34	2	8	3.428	0.193	1348
34	2	9	3.678	0.240	1349
34	2	10	3.384	0.185	1350
34	3	1	3.978	0.307	1351
34	3	2	3.82	0.271	1352
34	3	3	4.14	0.348	1353
34	3	4	4.387	0.417	1354
34	3	5	4.423	0.428	1355
34	3	6	4.807	0.555	1356
34	3	7	4.444	0.434	1357
34	3	8	4.65	0.500	1358
34	3	9	3.691	0.243	1359
34	4	1	3.215	0.157	1360
34	4	2	3.602	0.225	1361
34	4	3	3.71	0.247	1362
34	4	4	3.161	0.149	1363
34	4	5	3.558	0.217	1364
34	4	6	3.655	0.236	1365
34	4	7	2.945	0.119	1366
34	4	8	3.179	0.152	1367
34	4	9	3.575	0.220	1368
34	4	10	3.468	0.200	1369
34-Dup	4	1	3.052	0.133	1370
34-Dup	4	2	3.666	0.238	1371
34-Dup	4	3	3.67	0.239	1372
34-Dup	4	4	3.202	0.155	1373
34-Dup	4	5	3.612	0.227	1374
34-Dup	4	6	3.064	0.135	1375
34-Dup	4	7	3.11	0.142	1376
34-Dup	4	8	3.218	0.158	1377
34-Dup	4	9	3.616	0.228	1378

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
34-Dup	4	10	3.495	0.205	1379
35	1	1	3.798	0.266	1380
35	1	2	3.859	0.280	1381
35	1	3	3.844	0.276	1382
35	1	4	3.578	0.220	1383
35	1	5	3.463	0.199	1384
35	1	6	3.876	0.283	1385
35	1	7	3.912	0.292	1386
35	1	8	3.883	0.285	1387
35	1	9	4.005	0.314	1388
35	2	1	3.641	0.233	1389
35	2	2	3.366	0.182	1390
35	2	3	4.011	0.315	1391
35	2	4	3.742	0.254	1392
35	2	5	3.844	0.276	1393
35	2	6	3.808	0.268	1394
35	2	7	4.077	0.332	1395
35	2	8	4.061	0.328	1396
35	2	9	3.757	0.257	1397
35-Dup	2	1	3.662	0.237	1398
35-Dup	2	2	3.357	0.180	1399
35-Dup	2	3	3.966	0.305	1400
35-Dup	2	4	3.808	0.268	1401
35-Dup	2	5	3.846	0.277	1402
35-Dup	2	6	3.836	0.274	1403
35-Dup	2	7	4.099	0.338	1404
35-Dup	2	8	4.114	0.341	1405
35-Dup	2	9	3.746	0.255	1406
35	3	1	3.142	0.146	1407
35	3	2	3.674	0.240	1408
35	3	3	3.563	0.218	1409
35	3	4	3.579	0.221	1410
35	3	5	3.332	0.176	1411
35	3	6	3.291	0.169	1412
35	3	7	3.402	0.188	1413
35	3	8	3.599	0.225	1414
35	3	9	3.409	0.189	1415
35	3	10	3.324	0.175	1416
35	4	1	2.828	0.105	1417
35	4	2	3.326	0.175	1418
35	4	3	3.43	0.193	1419
35	4	4	3.22	0.158	1420
35	4	5	3.47	0.200	1421
35	4	6	3.884	0.285	1422
35	4	7	3.314	0.173	1423
35	4	8	3.711	0.247	1424

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
35	4	9	3.314	0.173	1425
35	4	10	3.358	0.181	1426
36	1	1	3.748	0.255	1427
36	1	2	3.961	0.303	1428
36	1	3	3.844	0.276	1429
36	1	4	3.169	0.150	1430
36	1	5	3.222	0.158	1431
36	1	6	3.757	0.257	1432
36	1	7	3.305	0.172	1433
36	1	8	3.903	0.290	1434
36	1	9	4	0.313	1435
36	2	1	3.245	0.162	1436
36	2	2	3.209	0.156	1437
36	2	3	3.132	0.145	1438
36	2	4	3.469	0.200	1439
36	2	5	3.387	0.185	1440
36	2	6	3.202	0.155	1441
36	2	7	3.24	0.161	1442
36	2	8	3.363	0.181	1443
36	2	9	3.375	0.183	1444
36	3	1	3.337	0.177	1445
36	3	2	3.619	0.229	1446
36	3	3	3.38	0.184	1447
36	3	4	3.565	0.218	1448
36	3	5	3.676	0.240	1449
36	3	6	4.002	0.313	1450
36	3	7	3.306	0.172	1451
36	3	8	3.277	0.167	1452
36	3	9	3.313	0.173	1453
36	4	1	3.46	0.198	1454
36	4	2	3.334	0.176	1455
36	4	3	3.096	0.140	1456
36	4	4	3.291	0.169	1457
36	4	5	3.453	0.197	1458
36	4	6	3.253	0.163	1459
36	4	7	3.441	0.195	1460
37	1	1	3.217	0.158	1461
37	1	2	3.179	0.152	1462
37	1	3	3.477	0.201	1463
37	1	4	3.292	0.170	1464
37	1	5	3.515	0.208	1465
37	1	6	3.416	0.191	1466
37	1	7	3.226	0.159	1467
37	1	8	3.333	0.176	1468
37	1	9	3.091	0.139	1469
37	1	10	3.416	0.191	1470

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
37	2	1	3.587	0.222	1471
37	2	2	3.289	0.169	1472
37	2	3	3.205	0.156	1473
37	2	4	3.121	0.143	1474
37	2	5	3.467	0.200	1475
37	2	6	3.221	0.158	1476
37	2	7	3.611	0.227	1477
37	2	8	3.341	0.178	1478
37	2	9	3.022	0.129	1479
37	3	1	3.469	0.200	1480
37	3	2	3.575	0.220	1481
37	3	3	3.354	0.180	1482
37	3	4	3.611	0.227	1483
37	3	5	3.556	0.216	1484
37	3	6	3.305	0.172	1485
37	3	7	3.339	0.177	1486
37	3	8	3.353	0.180	1487
37	3	9	3.231	0.160	1488
37	4	1	3.868	0.282	1489
37	4	2	4.051	0.325	1490
37	4	3	4.382	0.416	1491
37	4	4	3.592	0.223	1492
37	4	5	4.069	0.330	1493
37	4	6	3.713	0.248	1494
37	4	7	4.14	0.348	1495
37	4	8	3.59	0.223	1496
37	4	9	3.451	0.197	1497
38	1	1	3.369	0.182	1498
38	1	2	3.562	0.217	1499
38	1	3	3.436	0.194	1500
38	1	4	3.778	0.262	1501
38	1	5	3.686	0.242	1502
38	1	6	3.847	0.277	1503
38	1	7	3.63	0.231	1504
38	1	8	3.77	0.260	1505
38	1	9	3.658	0.236	1506
38	2	1	4.116	0.342	1507
38	2	2	4.051	0.325	1508
38	2	3	3.583	0.221	1509
38	2	4	3.775	0.261	1510
38	2	5	3.704	0.246	1511
38	2	6	3.673	0.239	1512
38	2	7	3.678	0.240	1513
38	2	8	3.501	0.206	1514
38	2	9	3.595	0.224	1515
38	2	10	4.012	0.316	1516

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
38	3	1	3.568	0.219	1517
38	3	2	3.545	0.214	1518
38	3	3	3.91	0.291	1519
38	3	4	3.359	0.181	1520
38	3	5	3.629	0.230	1521
38	3	6	3.848	0.277	1522
38	3	7	3.273	0.166	1523
38	3	8	3.918	0.293	1524
38	3	9	3.568	0.219	1525
38	4	1	3.874	0.283	1526
38	4	2	3.968	0.305	1527
38	4	3	3.598	0.224	1528
38	4	4	3.703	0.246	1529
38	4	5	3.773	0.260	1530
38	4	6	3.679	0.241	1531
38	4	7	3.83	0.273	1532
38	4	8	3.591	0.223	1533
38	4	9	3.989	0.310	1534
39	1	1	3.604	0.226	1535
39	1	2	3.769	0.260	1536
39	1	3	3.516	0.209	1537
39	1	4	3.854	0.278	1538
39	1	5	3.52	0.209	1539
39	1	6	3.901	0.289	1540
39	1	7	3.723	0.250	1541
39	1	8	3.86	0.280	1542
39	1	9	3.576	0.220	1543
39	1	10	3.773	0.260	1544
39	2	1	4.019	0.317	1545
39	2	2	3.746	0.255	1546
39	2	3	3.929	0.296	1547
39	2	4	3.638	0.232	1548
39	2	5	4.096	0.337	1549
39	2	6	4.091	0.336	1550
39	2	7	3.619	0.229	1551
39	2	8	3.82	0.271	1552
39	2	9	3.856	0.279	1553
39	2	10	3.881	0.285	1554
39	3	1	4.075	0.331	1555
39	3	2	4.034	0.321	1556
39	3	3	3.892	0.287	1557
39	3	4	3.762	0.258	1558
39	3	5	3.826	0.272	1559
39	3	6	4.007	0.314	1560
39	3	7	3.875	0.283	1561
39	3	8	3.744	0.254	1562

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
39	3	9	3.778	0.262	1563
39	3	10	3.953	0.301	1564
39	4	1	3.803	0.267	1565
39	4	2	4.044	0.324	1566
39	4	3	4.483	0.446	1567
39	4	4	4.015	0.316	1568
39	4	5	3.951	0.301	1569
39	4	6	3.799	0.266	1570
39	4	7	3.96	0.303	1571
39	4	8	3.623	0.229	1572
39	4	9	4.022	0.318	1573
39	4	10	4.16	0.354	1574
40	1	1	4.251	0.378	1575
40	1	2	4.003	0.314	1576
40	1	3	4.232	0.373	1577
40	1	4	4.265	0.382	1578
40	1	5	4.461	0.440	1579
40	1	6	4.171	0.357	1580
40	1	7	4.206	0.366	1581
40	1	8	3.679	0.241	1582
40	1	9	4.169	0.356	1583
40	1	10	4.041	0.323	1584
40	2	1	3.272	0.166	1585
40	2	2	3.729	0.251	1586
40	2	3	3.976	0.307	1587
40	2	4	3.744	0.254	1588
40	2	5	4.089	0.335	1589
40	2	6	3.689	0.243	1590
40	2	7	3.625	0.230	1591
40	2	8	3.611	0.227	1592
40	2	9	3.685	0.242	1593
40	3	1	3.763	0.258	1594
40	3	2	3.756	0.257	1595
40	3	3	3.568	0.219	1596
40	3	4	3.284	0.168	1597
40	3	5	3.947	0.300	1598
40	3	6	4.017	0.317	1599
40	3	7	3.907	0.291	1600
40	3	8	3.696	0.244	1601
40	3	9	3.895	0.288	1602
40	3	10	3.527	0.211	1603
40	4	1	3.486	0.203	1604
40	4	2	3.568	0.219	1605
40	4	3	3.357	0.180	1606
40	4	4	3.238	0.161	1607
40	4	5	3.781	0.262	1608

Table A2. Individual lengths of *Hyaella azteca* in whole-sediment toxicity tests exposed to sediment samples from the Grand Lake and with a control sediment (West Bearskin WB). Individual weights of amphipods was calculated from the measured individual lengths (Ingersoll et al. 2008). Archive = starting size of amphipods.

CERC ID	Replicate	Organism number	Length (mm)	Weight (mg)	Count
40	4	6	2.998	0.126	1609
40	4	7	3.553	0.216	1610
40	4	8	3.326	0.175	1611
40	4	9	3.679	0.241	1612
40	4	10	3.705	0.246	1613

Table B1. Grain size characteristics of sediments from the Grand Lake.

CERC ID	Sand (%)	Silt (%)	Clay (%)
WB	53.5	46.5	<0.1
1	0.5	97.4	2.1
2	0.5	7.9	91.6
3	0.5	12.6	86.9
4	1.2	19.3	79.5
5	0.6	6.2	93.2
6	0.4	14.5	85.1
7	76.2	22.1	1.6
8	3.1	4.2	92.6
9	0.6	6.9	92.5
10	3.6	33.9	62.5
11	80.2	15.9	3.8
12	50.8	48.1	1.1
13	78.5	17.8	3.7
14	1.5	10	88.4
15	0.4	15.9	83.7
16	0.3	12.7	87
17	0.2	7.7	92
18	0.3	5.8	93.9
19	0.1	9.5	90.4
20	7.9	72.4	19.7
21	1.9	26.3	71.9
22	60.1	19.9	19.9
23	35.7	31.9	32.4
24	1.3	61.1	37.6
25	7.8	40.6	51.6
26	0.8	31.4	67.7
27	0.2	28.7	71.2
28	0.2	62.1	37.7
29	2.1	69.7	28.1
30	0.3	51.6	48.1
31	0.1	45.6	54.2
32	0.7	38.9	60.4
33	4	46.6	49.4
34	14.2	61.5	24.3
35	10.5	69.2	20.3
36	0.3	63.3	36.4
37	1.8	66.9	31.3
38	12.2	71	16.9
39	50.1	37	12.9
40	18.2	64.2	17.6

Table B2. Probable effect concentration quotients (PEC-Qs) calculated from the simultaenously extracted metal concentrations in Grand Lake sediment (Table B14). The ΣSEM-AVS and ΣSEM-AVS/ƒoc values are reported in Table B13. Shaded value indicate mean PEC-Qs <0.20, ΣSEM-AVS <0 µmole/g or ΣSEM-AVS/ƒoc < 130 µmole/goc used to establish reference envelope (Table 4). XRF data for Pb and Zn provided by Suzanne Dudding of the USFWS, Tulsa, OK.

CERC ID	Cd		Cu		Ni		Pb		Zn		Mean PEC-Q					SEM and AVS		Pb XRF	Zn XRF	Ratio SEM to XRF	
	mg/kg	PEC-Q	mg/kg	PEC-Q	mg/kg	PEC-Q	mg/kg	PEC-Q	mg/kg	PEC-Q	Five metals	Zn, Cd, Pb	Zn, Cd	Zn, Pb	Cd, Pb	ΣSEM -AVS	Σ(SEM-AVS)/ƒoc	mg/kg	mg/kg	Pb	Zn
WB	0.08	0.02	1.56	0.01	2.8	0.06	2.4	0.02	11.3	0.02	0.03	0.02	0.04	0.02	0.02	-0.12	-12	ND	ND	ND	ND
1	0.88	0.18	15.00	0.10	10.5	0.21	27	0.21	241	0.53	0.25	0.30	0.70	0.37	0.35	-91	-2510	66	644	0.41	0.37
2	1.73	0.35	14.00	0.09	14.0	0.29	46	0.36	433	0.94	0.41	0.55	1.29	0.65	0.64	-59	-1936	55	435	0.84	1.00
3	0.88	0.18	6.48	0.04	6.8	0.14	22.7	0.18	224	0.49	0.20	0.28	0.66	0.33	0.33	-33	-1173	109	1475	0.21	0.15
4	1.35	0.27	8.33	0.06	9.5	0.19	30.9	0.24	311	0.68	0.29	0.40	0.95	0.46	0.47	-29	-853	49	440	0.63	0.71
5	1.44	0.29	15.70	0.11	11.1	0.23	34.3	0.27	313	0.68	0.31	0.41	0.97	0.47	0.48	-17	-562	58	446	0.59	0.70
6	1.21	0.24	10.50	0.07	8.4	0.17	28.7	0.22	259	0.56	0.25	0.34	0.81	0.39	0.40	-21	-706	63	602	0.45	0.43
7	0.62	0.12	1.20	0.01	2.0	0.04	19.3	0.15	146	0.32	0.13	0.20	0.44	0.23	0.22	1.5	425	41	266	0.47	0.55
8	2.67	0.53	18.60	0.12	15.5	0.32	53.1	0.41	539	1.17	0.51	0.71	1.71	0.79	0.85	-22	-833	53	542	1.01	0.99
9	1.70	0.34	14.60	0.10	10.8	0.22	38.1	0.30	353	0.77	0.35	0.47	1.11	0.53	0.55	-17	-588	58	535	0.66	0.66
10	2.59	0.52	7.26	0.05	11.7	0.24	39.3	0.31	518	1.13	0.45	0.65	1.65	0.72	0.82	-25	-972	54	684	0.73	0.76
11	0.58	0.12	0.72	0.00	1.0	0.02	6.5	0.05	71.3	0.16	0.07	0.11	0.27	0.10	0.14	0.72	156	29	341	0.22	0.21
12	1.09	0.22	0.84	0.01	1.2	0.02	6.91	0.05	131	0.29	0.12	0.19	0.50	0.17	0.25	0.11	17	22	282	0.31	0.46
13	0.77	0.15	0.68	0.00	1.1	0.02	10.3	0.08	133	0.29	0.11	0.17	0.44	0.19	0.22	-0.50	-97	27	251	0.38	0.53
14	1.92	0.38	12.00	0.08	9.8	0.20	37.8	0.30	352	0.77	0.35	0.48	1.15	0.53	0.58	-14	-516	53	521	0.71	0.68
15	2.04	0.41	16.30	0.11	9.1	0.18	39.2	0.31	341	0.74	0.35	0.49	1.15	0.52	0.58	4.9	179	62	547	0.63	0.62
16	2.17	0.43	10.70	0.07	9.0	0.18	38	0.30	360	0.78	0.35	0.51	1.22	0.54	0.61	-5.1	-199	54	527	0.70	0.68
17	2.19	0.44	13.00	0.09	10.1	0.21	38.1	0.30	373	0.81	0.37	0.52	1.25	0.56	0.63	-4.7	-183	58	516	0.66	0.72
18	2.00	0.40	12.20	0.08	9.4	0.19	35.4	0.28	346	0.75	0.34	0.48	1.15	0.52	0.58	-5.7	-250	49	456	0.72	0.76
19	1.67	0.33	9.40	0.06	6.8	0.14	28.6	0.22	269	0.59	0.27	0.38	0.92	0.40	0.46	-2.6	-103	58	571	0.49	0.47
20	2.47	0.49	9.34	0.06	9.1	0.19	35.6	0.28	427	0.93	0.39	0.57	1.42	0.60	0.71	-13	-640	54	581	0.66	0.73
21	1.96	0.39	7.88	0.05	9.4	0.19	33.7	0.26	350	0.76	0.33	0.47	1.15	0.51	0.58	-11	-374	55	494	0.62	0.71
22	0.50	0.10	0.93	0.01	2.0	0.04	9.86	0.08	105	0.23	0.09	0.13	0.33	0.15	0.16	0.80	93	36	359	0.27	0.29
23	0.66	0.13	1.56	0.01	2.3	0.05	9.2	0.07	115	0.25	0.10	0.15	0.38	0.16	0.19	-1.4	-128	27	241	0.34	0.48
24	1.84	0.37	7.38	0.05	8.0	0.16	29.2	0.23	294	0.64	0.29	0.41	1.01	0.43	0.50	-10	-490	39	173	0.74	1.70
25	1.71	0.34	6.76	0.05	6.4	0.13	23.5	0.18	263	0.57	0.26	0.37	0.91	0.38	0.46	-6.4	-340	50	552	0.47	0.48
26	1.96	0.39	6.40	0.04	6.9	0.14	25.7	0.20	285	0.62	0.28	0.40	1.01	0.41	0.51	-3.0	-129	57	558	0.45	0.51
27	2.28	0.46	10.30	0.07	8.7	0.18	31.2	0.24	329	0.72	0.33	0.47	1.17	0.48	0.59	-0.58	-26	54	474	0.58	0.69
28	1.71	0.34	4.48	0.03	4.9	0.10	17.5	0.14	212	0.46	0.21	0.31	0.80	0.30	0.40	1.8	109	48	476	0.36	0.45
29	3.34	0.67	5.68	0.04	5.7	0.12	35.1	0.27	393	0.86	0.39	0.60	1.52	0.57	0.76	1.4	91	60	686	0.59	0.57
30	2.37	0.47	8.86	0.06	7.6	0.15	28	0.22	321	0.70	0.32	0.46	1.17	0.46	0.59	-4.6	-228	52	556	0.54	0.58
31	2.76	0.55	6.63	0.04	7.4	0.15	31.9	0.25	356	0.78	0.35	0.53	1.33	0.51	0.66	-2.8	-140	54	553	0.59	0.64
32	2.60	0.52	10.50	0.07	8.7	0.18	31.7	0.25	356	0.78	0.36	0.51	1.30	0.51	0.65	-0.3	-14	52	563	0.61	0.63
33	1.60	0.32	3.41	0.02	5.4	0.11	16.5	0.13	232	0.51	0.22	0.32	0.83	0.32	0.41	-4.1	-256	45	469	0.37	0.50
34	0.32	0.06	2.73	0.02	3.6	0.07	6.48	0.05	52.8	0.12	0.06	0.08	0.18	0.08	0.09	0.17	14	16	134	0.40	0.40
35	0.30	0.06	2.69	0.02	3.0	0.06	5.66	0.04	50.4	0.11	0.06	0.07	0.17	0.08	0.08	0.11	13	21	160	0.27	0.31
36	0.36	0.07	4.52	0.03	4.5	0.09	9	0.07	40.5	0.09	0.07	0.08	0.16	0.08	0.08	0.51	35	28	156	0.32	0.26
37	2.17	0.43	4.04	0.03	4.0	0.08	20.2	0.16	266	0.58	0.26	0.39	1.01	0.37	0.51	1.8	132	56	616	0.36	0.43
38	4.85	0.97	4.74	0.03	4.2	0.09	43.8	0.34	548	1.19	0.52	0.84	2.16	0.77	1.08	7.5	428	112	1635	0.39	0.34
39	3.24	0.65	2.67	0.02	2.6	0.05	29.7	0.23	390	0.85	0.36	0.58	1.50	0.54	0.75	5.3	258	56	733	0.53	0.53
40	7.49	1.50	6.47	0.04	4.8	0.10	59.1	0.46	675	1.47	0.71	1.14	2.97	0.97	1.48	10	548	119	1457	0.50	0.46
PEC		5.0		149		49		128		459									Mean	0.52	0.58

Table B3. Concentrations of metals in pore water sampled from Grand Lake sediments with peepers. Each peeper was buried in a test sediment for 7 days. Bold and italicized values are > MDL but < MQL and have higher uncertainty. All peeper samples were diluted 10-fold or more for analysis. Toxic units (=criteria units) were calculated by dividing measured metal concentrations by hardness-adjusted chronic watere quality criteria (USEPA 2005). NA=not applicable.

CERC ID	Metal concentration (µg/L)					Pore-water hardness mg/L (as $CaCO_3$)	Water Quality Criteria (adjusted to pore-water hardness)					Toxic Unit (=criteria units)					
	Cd	Ni	Zn	Cu	Pb		Cd	Ni	Zn	Cu	Pb	Cd	Ni	Zn	Cu	Pb	Sum
WB	< 0.04	2.16	***3.7***	0.42	< 0.08	250	0.46	113	257	19.6	6.7	0.04	0.02	0.01	0.021	0.003	0.10
1	< 0.04	***0.69***	***3.2***	0.50	***0.12***	246	0.46	111	253	19.3	6.6	0.04	0.01	0.01	0.026	0.02	0.11
2	< 0.04	***0.87***	***2.9***	***0.29***	***0.09***	230	0.44	105	239	18.2	6.2	0.05	0.01	0.01	0.016	0.01	0.10
3	< 0.04	***1.03***	***5.5***	0.79	***0.21***	260	0.48	117	265	20.3	7.0	0.04	0.01	0.02	0.039	0.03	0.14
4	< 0.04	2.91	***6.7***	0.52	***0.16***	264	0.48	118	269	20.5	7.1	0.04	0.02	0.02	0.025	0.02	0.14
5	< 0.04	2.36	***5.3***	0.50	***0.19***	240	0.45	109	248	18.9	6.4	0.04	0.02	0.02	0.026	0.03	0.14
6	< 0.04	2.38	9.4	0.47	***0.22***	244	0.46	111	252	19.2	6.5	0.04	0.02	0.04	0.024	0.03	0.16
7	< 0.04	1.64	12.4	1.11	***0.17***	216	0.42	100	227	17.3	5.8	0.05	0.02	0.05	0.064	0.03	0.21
8	< 0.04	1.77	15.0	0.53	0.43	250	0.46	113	257	19.6	6.7	0.04	0.02	0.06	0.027	0.06	0.21
9	< 0.04	***1.31***	***5.6***	0.47	0.30	260	0.48	117	265	20.3	7.0	0.04	0.01	0.02	0.023	0.04	0.14
10	< 0.04	1.76	16.3	0.61	0.63	280	0.50	124	283	21.6	7.6	0.04	0.01	0.06	0.028	0.08	0.22
11	< 0.04	1.72	22.6	0.53	0.64	200	0.40	94	213	16.2	5.3	0.05	0.02	0.11	0.033	0.12	0.33
12	< 0.04	2.08	17.8	0.61	***0.15***	220	0.43	101	230	17.6	5.9	0.05	0.02	0.08	0.035	0.03	0.21
13	< 0.04	1.93	11.7	0.43	***0.17***	260	0.48	117	265	20.3	7.0	0.04	0.02	0.04	0.021	0.02	0.15
14	< 0.04	***1.31***	13.6	0.53	0.27	270	0.49	121	274	20.9	7.3	0.04	0.01	0.05	0.025	0.04	0.16
15	***0.050***	2.92	17.3	0.66	0.74	410	0.65	172	390	29.9	11.2	0.08	0.02	0.04	0.022	0.07	0.23
16	< 0.04	1.68	12.8	0.65	1.66	270	0.49	121	274	20.9	7.3	0.04	0.01	0.05	0.031	0.23	0.36
17	< 0.04	***1.57***	***6.8***	0.47	0.45	340	0.57	147	333	25.5	9.3	0.03	0.01	0.02	0.018	0.05	0.13
18	< 0.04	***1.31***	10.5	0.38	0.54	240	0.45	109	248	18.9	6.4	0.04	0.01	0.04	0.020	0.08	0.20
19	< 0.04	2.75	9.5	0.42	0.40	536	0.79	215	490	37.6	14.7	0.03	0.01	0.02	0.011	0.03	0.10
20	***0.056***	2.44	36.3	0.82	2.06	270	0.49	121	274	20.9	7.3	0.11	0.02	0.13	0.039	0.28	0.59
21	< 0.04	1.58	< 2.2	0.50	***0.19***	320	0.55	139	317	24.2	8.7	0.04	0.01	0.003	0.021	0.02	0.09
22	< 0.04	***1.56***	11.2	1.22	0.45	210	0.41	98	222	16.9	5.6	0.05	0.02	0.05	0.072	0.08	0.27
23	< 0.04	2.07	15.9	0.46	0.41	240	0.45	109	248	18.9	6.4	0.04	0.02	0.06	0.024	0.06	0.22
24	< 0.04	***1.19***	25.9	0.61	0.64	222	0.43	102	232	17.7	5.9	0.05	0.01	0.11	0.034	0.11	0.31
25	< 0.04	1.80	20.2	0.39	***0.19***	196	0.39	92	209	15.9	5.2	0.05	0.02	0.10	0.025	0.04	0.23
26	< 0.04	2.07	23.2	0.46	0.49	280	0.50	124	283	21.6	7.6	0.04	0.02	0.08	0.021	0.06	0.22
27	< 0.04	2.07	20.1	0.47	0.34	340	0.57	147	333	25.5	9.3	0.03	0.01	0.06	0.018	0.04	0.16
28	< 0.04	5.22	16.3	0.48	0.50	470	0.72	193	438	33.6	12.9	0.03	0.03	0.04	0.014	0.04	0.15
29	***0.050***	3.72	19.6	0.54	0.70	260	0.48	117	265	20.3	7.0	0.10	0.03	0.07	0.027	0.10	0.34
30	< 0.04	1.73	19.0	1.22	0.27	224	0.43	103	234	17.8	6.0	0.05	0.02	0.08	0.068	0.05	0.26
31	0.19	3.64	75.1	2.01	2.28	230	0.44	105	239	18.2	6.2	0.43	0.03	0.31	0.110	0.37	1.26
32	< 0.04	***1.50***	13.6	0.63	0.52	240	0.45	109	248	18.9	6.4	0.04	0.01	0.05	0.033	0.08	0.23
33	< 0.04	1.70	15.2	0.41	***0.24***	210	0.41	98	222	16.9	5.6	0.05	0.02	0.07	0.024	0.04	0.20
34	< 0.04	4.43	7.8	0.37	***0.12***	340	0.57	147	333	25.5	9.3	0.03	0.03	0.02	0.015	0.01	0.12
35	< 0.04	***1.45***	11.1	0.75	0.51	236	0.45	108	245	18.7	6.3	0.04	0.01	0.05	0.040	0.08	0.22
36	< 0.04	4.92	9.6	0.63	***0.11***	300	0.53	132	300	22.9	8.1	0.04	0.04	0.03	0.028	0.01	0.15
37	< 0.04	2.61	18.3	0.43	0.55	250	0.46	113	257	19.6	6.7	0.04	0.02	0.07	0.022	0.08	0.24
38	***0.051***	5.07	24.9	0.51	0.91	280	0.50	124	283	21.6	7.6	0.10	0.04	0.09	0.024	0.12	0.37
39	***0.048***	4.25	196.	0.46	0.80	550	0.80	220	501	38.4	15.1	0.06	0.02	0.39	0.012	0.05	0.54
40	0.26	4.58	237.	0.86	3.21	560	0.81	224	509	39.0	15.4	0.32	0.02	0.47	0.022	0.21	1.04
BLK-1	< 0.04	< 0.48	29.9	***0.22***	***0.11***	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BLK-2	< 0.04	< 0.48	31.7	0.39	***0.10***	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BLK-3	< 0.04	< 0.48	12.2	0.90	***0.15***	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table B4. Comparison of total organic carbon (TOC) and acid volatile sulfide (AVS) data for sediments from Grand Lake (present study) and for the Tri-state mining district (Ingersoll et al. 2008).

CERC ID	SiteDescription	Study	TOC (%)	AVS (µmole/g)
36	T8085-036	Grand Lake	3.6	0.3
11	T8085-011	Grand Lake	3.0	0.4
40	T8085-040	Grand Lake	2.8	0.6
34	T8085-034	Grand Lake	3.4	0.8
35	T8085-035	Grand Lake	3.0	0.8
7	T8085-007	Grand Lake	3.0	0.9
15	T8085-015	Grand Lake	0.3	0.9
22	T8085-022	Grand Lake	2.7	0.9
39	T8085-039	Grand Lake	2.9	1.0
38	T8085-038	Grand Lake	2.6	1.3
28	T8085-028	Grand Lake	0.5	1.7
12	T8085-012	Grand Lake	0.6	2.0
37	T8085-037	Grand Lake	0.5	2.5
13	T8085-013	Grand Lake	2.7	2.6
23	T8085-023	Grand Lake	2.8	3.3
29	T8085-029	Grand Lake	2.5	5.0
27	T8085-027	Grand Lake	2.6	6.1
32	T8085-032	Grand Lake	2.3	6.2
19	T8085-019	Grand Lake	2.5	7.1
26	T8085-026	Grand Lake	2.1	7.7
33	T8085-033	Grand Lake	2.9	7.9
31	T8085-031	Grand Lake	0.9	8.7
30	T8085-030	Grand Lake	1.1	9.9
25	T8085-025	Grand Lake	2.1	10.8
17	T8085-017	Grand Lake	1.9	11.0
16	T8085-016	Grand Lake	2.3	11.1
18	T8085-018	Grand Lake	2.2	11.5
24	T8085-024	Grand Lake	1.7	15.3
21	T8085-021	Grand Lake	1.5	16.5
14	T8085-014	Grand Lake	2.0	19.8
20	T8085-020	Grand Lake	2.0	20.5
5	T8085-005	Grand Lake	2.1	22.3
9	T8085-009	Grand Lake	1.6	22.8
6	T8085-006	Grand Lake	1.2	25.7
8	T8085-008	Grand Lake	0.9	31.6
10	T8085-010	Grand Lake	1.5	33.4
4	T8085-004	Grand Lake	1.4	34.1
3	T8085-003	Grand Lake	1.8	36.6
2	T8085-002	Grand Lake	2.0	66.3
1	T8085-001	Grand Lake	1.9	95.6
	mean		2.034	14.086
	min		0.348	0.300
	max		3.641	95.625
	median		2.082	7.813
	25 percentile		1.498	1.563
	75 percentile		2.695	20.008

CERC ID	SiteDescription	Study	TOC (%)	AVS (µmole/g)
13	NR-07-SED-13	TSMD	1.0	0.003
05	NR-07-SED-05	TSMD	**0.2**	0.02
02	USR-07-SED-02	TSMD	1.5	0.04
11	USR-07-SED-11	TSMD	0.8	0.08
23	SC-07-SED-23	TSMD	0.8	0.08
32	MSR-07-SED-32	TSMD	**0.2**	0.08
68	TAR-07-SED-68	TSMD	0.6	0.12
56	USR-07-SED-56	TSMD	0.8	0.12
54	TC-07-SED-54	TSMD	**0.2**	0.14
70	MSR-07-SED-70	TSMD	0.6	0.15
57	TAR-07-SED-57	TSMD	**0.2**	0.16
71	TAR-07-SED-71	TSMD	**0.2**	0.17
65	TC-07-SED-65	TSMD	2.0	0.18
06	NR-07-SED-06	TSMD	2.6	0.27
01	USR-07-SED-01	TSMD	1.9	0.30
130	SH-004	TSMD	0.5	0.31
12	USR-07-SED-12	TSMD	**0.2**	0.32
21	TAR-07-SED-21	TSMD	0.8	0.37
50	MSR-07-SED-50	TSMD	1.0	0.39
14	SC-07-SED-14	TSMD	0.5	0.48
16	LC-07-SED-16	TSMD	0.5	0.48
22	MSR-07-SED-22	TSMD	**0.2**	0.49
19	MSR-07-SED-19	TSMD	0.8	0.53
104	LC-003	TSMD	0.7	0.58
10	USR-07-SED-10	TSMD	0.4	0.59
15	USR-07-SED-15	TSMD	2.6	0.62
04	TAR-07-SED-04	TSMD	1.2	1.04
42	CC-07-SED-42	TSMD	0.4	1.10
441	TC-012	TSMD	**0.2**	1.12
72	MSR-07-SED-72	TSMD	**0.2**	1.17
491	SR-604	TSMD	1.3	1.29
09	USR-07-SED-09	TSMD	0.5	1.29
66	CC-07-SED-66	TSMD	0.4	1.32
03	NR-07-SED-03	TSMD	0.6	1.46
26	USR-07-SED-26	TSMD	2.7	1.67
27	USR-07-SED-27	TSMD	1.0	1.73
43	TC-07-SED-43	TSMD	1.5	2.18
62	MSR-07-SED-62	TSMD	0.6	2.26
47	CC-07-SED-47	TSMD	2.9	2.27
63	CC-07-SED-63	TSMD	0.6	2.30
58	TC-07-SED-58	TSMD	**0.2**	2.38
45	USR-07-SED-45	TSMD	2.8	2.44
55	MSR-07-SED-55	TSMD	1.7	2.66
28	MSR-07-SED-28	TSMD	0.9	2.87
25	SC-07-SED-25	TSMD	2.6	2.97
07	USR-07-SED-07	TSMD	2.6	3.33
48	CC-07-SED-48	TSMD	2.4	3.55
181	SH-203	TSMD	2.5	3.62
17	SC-07-SED-17	TSMD	0.5	5.33
51	TC-07-SED-51	TSMD	0.9	5.50
64	TC-07-SED-64	TSMD	0.6	5.94
39	LC-07-SED-39	TSMD	1.2	6.51
34	TAR-07-SED-34	TSMD	0.6	7.48
69	TC-07-SED-69	TSMD	**0.2**	7.68
33	TAR-07-SED-33	TSMD	0.5	7.74
67	TC-07-SED-67	TSMD	1.4	8.04
38	MSR-07-SED-38	TSMD	1.2	8.33
18	CC-07-SED-18	TSMD	1.0	8.61
53	CC-07-SED-53	TSMD	1.0	8.68
158	TC-013	TSMD	0.6	8.99
401	TAR-103	TSMD	0.9	9.73
52	MSR-07-SED-52	TSMD	1.1	10.72
37	CC-07-SED-37	TSMD	1.6	10.96
29	MSR-07-SED-29	TSMD	2.0	12.53
41	MSR-07-SED-41	TSMD	3.8	12.90
36	NR-07-SED-36	TSMD	1.8	17.43
61	TAR-07-SED-61	TSMD	**0.2**	18.45
35	SC-07-SED-35	TSMD	0.5	25.63
59	CC-07-SED-59	TSMD	3.9	45.98
60	TAR-07-SED-60	TSMD	0.5	109.56
	mean		0.8	7.326
	min		0.2	0.003
	max		3.9	109.561
	median		0.804	1.666
	25 percentile		0.490	0.371
	75 percentile		1.528	7.238

Table B5. Concentrations of elements in a continuing calibration blank (CCB) and independent calibration verification standard (ICVS) ran every 10 samples throughout the pore water analysis. Results expressed as ng/mL.

BID[a]	Element	CCB[b]	ICVS	% Rec (ICVS)[c]
11/19/08 Run #1	Cu	-0.00118	14.9	99.
	Ni	0.00379	14.3	96.
	Zn	0.00180	201.	101.
	Cd	-0.00014	3.92	98.
	Pb	0.00265	14.7	98.
11/19/08 Run #2	Cu	-0.00025	16.0	107.
	Ni	-0.00638	15.4	103.
	Zn	0.00491	212.	106.
	Cd	0.00008	3.88	97.
	Pb	-0.00039	14.2	95.
11/19/08 Run #3	Cu	0.00099	16.0	106.
	Ni	-0.00207	15.2	101.
	Zn	0.00379	212.	106.
	Cd	-0.00046	3.91	98.
	Pb	0.00099	14.2	94.
11/19/08 Run #4	Cu	-0.00138	15.7	104.
	Ni	0.00458	15.3	102.
	Zn	-0.00145	211.	105.
	Cd	-0.00050	3.83	96.
	Pb	0.00005	14.1	94.
11/19/08 Run #5	Cu	-0.00062	15.7	105.
	Ni	0.00009	15.2	101.
	Zn	-0.00272	211.	105.
	Cd	-0.00064	3.88	97.
	Pb	0.00010	14.1	94.
11/19/08 Run #6	Cu	0.00105	15.7	105.
	Ni	-0.00004	15.0	100.
	Zn	-0.00443	210.	105.
	Cd	-0.00035	3.93	98.
	Pb	0.00063	13.9	93.
11/19/08 Run #7	Cu	-0.00246	15.3	102.
	Ni	-0.00791	14.7	98.
	Zn	-0.07979	209.	104.
	Cd	-0.00093	3.90	98.
	Pb	0.00187	13.9	92.
11/19/08 Run #8	Cu	-0.00223	15.4	102.
	Ni	-0.00368	14.9	100.
	Zn	-0.07698	208.	104.
	Cd	-0.00134	3.88	97.
	Pb	0.00133	13.9	92.

[a]BID = Block Initiation Date: a date assigned to each member of a group of samples that will identify the sample as a member of the group or "block."

[b]acceptance criteria for CCB is +/- 3 X IDL for each element.

[c]acceptance criteria for ICVS = +/- 10% (90% - 110%).

ICVS = 15ppb for Cu,Ni and Pb; 200ppb for Zn, and 4ppb for Cd.

Table B6. Recoveries of elements from reference solutions used as laboratory control samples in the ICP-MS quantitative analysis of Grand Lake porewater samples.

BID	Analysis date	Element	Actual concentration	Measured concentration	% Rec[a]
11/19/08	11/20/08	Cu	22.76 +/- 0.31	22.4	100.
11/19/08	11/20/08	Ni	62.41 +/- 0.69	62.1	100.
11/19/08	11/20/08	Zn	200 +/- 20	201.	100.
11/19/08	11/20/08	Cd	6.568 +/- 0.073	6.35	98.
11/19/08	11/20/08	Pb	19.63 +/- 0.21	19.2	99.

[a]%Rec = 100% if within range, otherwise calculated based on upper or lower limit of range.

Table B7. Relative percent difference for duplicate analysis of Grand Lake pore water by ICP-MS. Difference, Dup 1 - Dup 2; RPD, relative percent difference (Diff/Mean x 100).

Analysis Date	CERC #	Element	Measured Concentration (µg/g dry) Dup 1	Dup 2	Mean	Diff	RPD
11/19/08	44706	Cu	21.0	21.1	21.1	0.14	0.7
		Ni	20.6	20.5	20.6	0.06	0.3
		Zn	157.	158.	157.	1.76	1.1
		Cd	5.78	5.84	5.81	0.07	1.2
		Pb	18.8	18.8	18.8	0.05	0.3
11/19/08	44709	Cu	21.0	21.2	21.1	0.19	0.9
		Ni	20.3	20.6	20.4	0.28	1.4
		Zn	158.	161.	159.	2.04	1.3
		Cd	5.91	5.94	5.92	0.04	0.6
		Pb	19.0	19.2	19.1	0.19	1.0
11/19/08	44712	Cu	20.4	20.5	20.4	0.19	0.9
		Ni	20.4	20.0	20.2	0.40	2.0
		Zn	157.	157.	157.	0.21	0.1
		Cd	5.79	5.83	5.81	0.041	0.7
		Pb	18.9	18.8	18.8	0.06	0.3

Summary statistics:

Element	Mean RPD	Std Dev
Cu	0.8	0.15
Ni	1.2	0.84
Zn	0.8	0.62
Cd	0.8	0.29
Pb	0.5	0.41

Table B8. Percent recovery of elements spiked in Grand Lake pore water and analyzed by ICP-MS.

BID[a]	Ele.	Spk Type	Analysis Units	Spk Amt.[b] µg	Vol. (mL)	Effective[c] Conc.	Unspiked[d] Conc.	Spk/ Bkgd	Spiked[e] Conc.	% Rec.[f]
11/19/08	Cu	44706	ng/mL	100.	5.	20.0	0.034	588.	20.9	104.
	Ni		ng/mL	100.	5.	20.0	0.11	179.	20.2	101.
	Zn		ng/mL	750.	5.	150.	0.28	529.	157.	104.
	Cd		ng/mL	30.	5.	6.0	- 0.001	7026.	5.78	96.
	Pb		ng/mL	100.	5.	20.0	0.010	2078.	18.8	94.
11/19/08	Cu	44709	ng/mL	100.	5.	20.0	0.052	382.	21.3	106.
	Ni		ng/mL	100.	5.	20.0	0.21	97.	20.7	103.
	Zn		ng/mL	750.	5.	150.	0.52	288.	162.	107.
	Cd		ng/mL	30.	5.	6.0	- 0.001	9554.	6.00	100.
	Pb		ng/mL	100.	5.	20.0	0.019	1030.	19.1	96.
11/19/08	Cu	44712	ng/mL	100.	5.	20.0	0.063	316.	20.6	103.
	Ni		ng/mL	100.	5.	20.0	0.16	125.	20.1	100.
	Zn		ng/mL	750.	5.	150.	1.52	98.	158.	105.
	Cd		ng/mL	30.	5.	6.0	0.002	3797.	5.85	98.
	Pb		ng/mL	100.	5.	20.0	0.043	461.	18.8	94.

[a]BID = Block Initiation Date: a date assigned to each member of a group of samples that will identify the sample as a member of the group or "block." as a member of the group or "block."

[b]Spike Amt. µg = the absolute microgram (µg) amount of the spike which was added to a sample.

[c]Effective Conc. = the Spike Amt (ng) divided by the sample volume (mL), units ng/mL.

[d]Unspiked Conc. = the measured concentration of the sample prior to spiking, units ng/mL.

[e]Spiked Conc. = the measured concentration of the spiked sample (spike + unspiked, units ng/mL).

[f]% Rec. = percent recovery: [(Spiked Conc. - Unspiked Conc.)/Effective Conc. * 100]

Table B9. Interference check of the diluter water matrix using dilution percent difference during ICP-MS quantitative analysis.

BID[a]	Run Date	Sample Used	Matrix	Element	Undiluted Sample	Diluted Sample[b]	Dil Conc X 5	Dil % Diff[c]
11/19/08	11/20/08	44706	water	Cu	21.2	4.52	22.6	6.6
			water	Ni	20.6	4.50	22.5	9.2
			water	Zn	158.	34.0	170.	7.5
			water	Cd	5.86	1.20	6.00	2.4
			water	Pb	18.9	3.97	19.9	5.2
11/19/08	11/20/08	44709	water	Cu	21.3	4.31	21.5	1.1
			water	Ni	20.7	4.21	21.0	1.7
			water	Zn	161.	32.5	163.	1.2
			water	Cd	5.98	1.20	5.99	0.2
			water	Pb	19.0	3.83	19.1	0.6
11/19/08	11/20/08	44712	water	Mn	22.4	4.32	21.6	3.5
			water	Cu	21.6	4.22	21.1	2.5
			water	Ni	169.7	32.86	164.3	3.2
			water	Zn	6.	1.2	6.	5.6
			water	Cd	20.24	3.88	19.42	4.1

[a]BID = Block Initiation Date: a date assigned to each member of a group of samples that will identify the sample as a member of the group or "block."

[b]dilution factor = 5 (1+4); digestates spiked with mid-range standard prior to analysis.

[c]dilution % difference acceptance criteria = +/- 10%; concentrations exceeding +/- 10%. indicative of suspect interferent.

Table B10. Recovery of elements from an interference check solutiona determined during quantitative ICP-MS analysis.

BID	Run Date	Element	Conc (ppb) actual	Mean Conc (ppb) measured	Dilution Factor	Mean % Rec.[b]
11/19/08	11/20/08	Cu	100.	23.8	5	119.
		Ni	200.	67.4	5	168.
		Zn	100.	30.5	5	153.
		Cd	50.	8.52	5	85.
		Pb[c]	20.	20.8	5	104.

[a]High Purity ICP-MS Solution AB in 2% nitric acid, Charleston, SC.; CAT # ICP-MS-ICS.

[b]suggested acceptance tolerance 80% - 120%.

[c]Pb not present in interference check solution but added (effective conc 10ppb) following 5X dilution.

Table B11. Blank equivalent concentrations (BEC) of Mn,Cu, Ni, Zn, Cd, and Pb for reagent blank solutions analyzed as part of the sample group or "block."

BID[a]	Ele.	Matrix	Soln. Units	Soln 1 Conc.	Soln 2 Conc.	Soln 3 Conc.	Mean Conc.[b]	Mean BEC ng/mL	BEC SD ng/mL	PSOP	Prep. Init.	ISOP	Oper. Init.
11/19/08	Cu	water	ng/mL	0.038	0.042	0.036	0.038	0.38	0.033	---	---	P.241	VDM/TWM
11/19/08	Ni	water	ng/mL	0.097	0.097	0.096	0.097	0.97	0.006	---	---	P.241	VDM/TWM
11/19/08	Zn	water	ng/mL	0.72	0.83	0.72	0.76	7.57	0.64	---	---	P.241	VDM/TWM
11/19/08	Cd	water	ng/mL	0.002	0.005	0.002	0.003	0.031	0.013	---	---	P.241	VDM/TWM
11/19/08	Pb	water	ng/mL	0.013	0.015	0.014	0.014	0.14	0.009	---	---	P.241	VDM/TWM

[a]BID = Block Initiation Date: a date assigned to each member of a group of samples that will identify the sample as a member of the group or "block."

[b]Mean Conc. = the mean solution concentration of the procedural blanks for a block, n = 3; units ng/mL.

Table B12. Method detection and quantitation limits for Cu, Ni, Zn, Cd, and Pb.

BID[a]	Ele.	Matrix	W/D/L[b]	Blk SD	Standard SD	IDL[c]	MDL[d]	MQL[e]	PSOP	Prep. Init.	ISOP	Inst. Init.	Units
11/19/08	Cu	water	D	0.033	0.017	0.014	0.11	0.36	P.214	MJW	P.241	VDM/TWM	ng/mL
11/19/08	Ni	water	D	0.006	0.16	0.007	0.48	1.58	P.214	MJW	P.241	VDM/TWM	ng/mL
11/19/08	Zn	water	D	0.64	0.34	1.78	2.20	7.26	P.214	MJW	P.241	VDM/TWM	ng/mL
11/19/08	Cd	water	D	0.013	0.003	0.002	0.040	0.13	P.214	MJW	P.241	VDM/TWM	ng/mL
11/19/08	Pb	water	D	0.009	0.025	0.002	0.080	0.26	P.214	MJW	P.241	VDM/TWM	ng/mL

[a]BID = Block Initiation Date: a date assigned to each member of a group of samples that will identify the sample as a member of the group or "block."

[b]W/D/L = state of starting sample: wet (W), dry (D), or liquid (L).

[c]IDL = instrument detection limit, unit ng/mL.

[d]MDL = method limit of detection, computed as $3 \text{ X } (SD_b^2 + SD_s^2)^{1/2}$ where SD_b = standard deviation of digestion blanks (n = 3) and

SD_s = standard deviation of a low level standard diluted 100X (n = 3).

[e]MQL = 3.3 x MDL.

Table B13. Percent water (H2O), total organic carbon (TOC), acid-volatile sulfide (AVS), and simultaneously-extracted metals (SEM) in Grand Lake sediments.

											Molecular weights:	**32.06**	**107.87**	**112.4**	**63.54**	**58.71**	**207.2**	**65.37**		
Lab#	**CERC ID**	**H_2O (%)**	**TOC (%)**	**AVS mg/kg dw**	**Ag-SEM mg/kg dw**	**Cd-SEM mg/kg dw**	**Cu-SEM mg/kg dw**	**Ni-SEM mg/kg dw**	**Pb-SEM mg/kg dw**	**Zn-SEM mg/kg dw**	**AVS µmol/g**	**Ag-SEM µmol/g**	**Cd-SEM µmol/g**	**Cu-SEM µmol/g**	**Ni-SEM µmol/g**	**Pb-SEM µmol/g**	**Zn-SEM µmol/g**	**ΣSEM-AVS µmol/g**	**(ΣSEM-AVS)/foc µmole/foc**
T8085-041	WB	38.8	1.00	12	0.018	0.081	1.56	2.84	2.4	11.3	0.4	0.00017	0.0007	0.0246	0.0484	0.0116	0.17	-0.1	-12
T8085-001	1	82.3	3.64	3060	0.144	0.876	15	10.5	27	241	95.6	0.00133	0.0078	0.2361	0.1788	0.1303	3.69	-91.4	-2510
T8085-002	2	82.9	3.04	2120	0.173	1.73	14	14	46	433	66.3	0.00160	0.0154	0.2203	0.2385	0.2220	6.62	-58.9	-1936
T8085-003	3	70	2.80	1170	0.061	0.877	6.48	6.75	22.7	224	36.6	0.00057	0.0078	0.1020	0.1150	0.1096	3.43	-32.8	-1173
T8085-004	4	79.7	3.38	1090	0.079	1.35	8.33	9.46	30.9	311	34.1	0.00073	0.0120	0.1311	0.1611	0.1491	4.76	-28.9	-853
T8085-005	5	73.2	3.01	715	0.163	1.44	15.7	11.1	34.3	313	22.3	0.00151	0.0128	0.2471	0.1891	0.1655	4.79	-16.9	-562
T8085-006	6	75.7	3.01	821	0.112	1.21	10.5	8.41	28.7	259	25.7	0.00104	0.0108	0.1653	0.1432	0.1385	3.96	-21.2	-706
T8085-007	7	25	0.35	29	0.034	0.617	1.2	2.04	19.3	146	0.9	0.00032	0.0055	0.0189	0.0347	0.0931	2.23	1.5	425
T8085-008	8	81	2.70	1010	0.243	2.67	18.6	15.5	53.1	539	31.6	0.00225	0.0238	0.2927	0.2640	0.2563	8.25	-22.5	-833
T8085-009	9	78.7	2.86	731	0.151	1.7	14.6	10.8	38.1	353	22.8	0.00140	0.0151	0.2298	0.1840	0.1839	5.40	-16.8	-588
T8085-010	10	70.9	2.57	1070	0.112	2.59	7.26	11.7	39.3	518	33.4	0.00104	0.0230	0.1143	0.1993	0.1897	7.92	-25.0	-972
T8085-011	11	28.6	0.46	14	0.01	0.575	0.72	1.04	6.5	71.3	0.4	0.00009	0.0051	0.0113	0.0177	0.0314	1.09	0.7	156
T8085-012	12	33.7	0.64	63	0.012	1.09	0.84	1.15	6.91	131	2.0	0.00011	0.0097	0.0132	0.0196	0.0333	2.00	0.1	17
T8085-013	13	31.7	0.52	84	0.011	0.773	0.683	1.1	10.3	133	2.6	0.00010	0.0069	0.0107	0.0187	0.0497	2.03	-0.5	-97
T8085-014	14	72.8	2.69	635	0.159	1.92	12	9.76	37.8	352	19.8	0.00147	0.0171	0.1889	0.1662	0.1824	5.38	-13.9	-516
T8085-015	15	48.7	2.76	29	0.161	2.04	16.3	9.05	39.2	341	0.9	0.00149	0.0181	0.2565	0.1541	0.1892	5.22	4.9	179
T8085-016	16	71.3	2.55	355	0.159	2.17	10.7	9	38	360	11.1	0.00147	0.0193	0.1684	0.1533	0.1834	5.51	-5.1	-199
T8085-017	17	75.1	2.56	351	0.156	2.19	13	10.1	38.1	373	11.0	0.00145	0.0195	0.2046	0.1720	0.1839	5.71	-4.7	-183
T8085-018	18	66.5	2.28	369	0.158	2	12.2	9.38	35.4	346	11.5	0.00146	0.0178	0.1920	0.1598	0.1708	5.29	-5.7	-250
T8085-019	19	70.7	2.50	227	0.085	1.67	9.4	6.82	28.6	269	7.1	0.00079	0.0149	0.1479	0.1162	0.1380	4.12	-2.6	-103
T8085-020	20	68.9	2.11	656	0.129	2.47	9.34	9.1	35.6	427	20.5	0.00120	0.0220	0.1470	0.1550	0.1718	6.53	-13.5	-640
T8085-021	21	75.5	2.87	529	0.095	1.96	7.88	9.37	33.7	350	16.5	0.00088	0.0174	0.1240	0.1596	0.1626	5.35	-10.7	-374
T8085-022	22	30.8	0.86	29	0.017	0.496	0.933	1.97	9.86	105	0.9	0.00016	0.0044	0.0147	0.0336	0.0476	1.61	0.8	93
T8085-023	23	50.8	1.13	106	0.02	0.663	1.56	2.31	9.2	115	3.3	0.00019	0.0059	0.0246	0.0393	0.0444	1.76	-1.4	-128
T8085-024	24	69.7	2.13	491	0.113	1.84	7.38	8.02	29.2	294	15.3	0.00105	0.0164	0.1161	0.1366	0.1409	4.50	-10.4	-490
T8085-025	25	61.4	1.88	344	0.099	1.71	6.76	6.44	23.5	263	10.8	0.00092	0.0152	0.1064	0.1097	0.1134	4.02	-6.4	-340
T8085-026	26	67.4	2.33	247	0.087	1.96	6.4	6.87	25.7	285	7.7	0.00081	0.0174	0.1007	0.1170	0.1240	4.36	-3.0	-129
T8085-027	27	68.5	2.20	195	0.103	2.28	10.3	8.65	31.2	329	6.1	0.00095	0.0203	0.1621	0.1473	0.1506	5.03	-0.6	-26
T8085-028	28	54.2	1.68	53	0.048	1.71	4.48	4.94	17.5	212	1.7	0.00044	0.0152	0.0705	0.0841	0.0845	3.24	1.8	109
T8085-029	29	46.4	1.51	161	0.09	3.34	5.68	5.7	35.1	393	5.0	0.00083	0.0297	0.0894	0.0971	0.1694	6.01	1.4	91
T8085-030	30	49.4	2.02	318	0.119	2.37	8.86	7.55	28	321	9.9	0.00110	0.0211	0.1394	0.1286	0.1351	4.91	-4.6	-228
T8085-031	31	65	2.03	278	0.098	2.76	6.63	7.43	31.9	356	8.7	0.00091	0.0246	0.1043	0.1266	0.1540	5.45	-2.8	-140
T8085-032	32	64.5	2.06	199	0.146	2.6	10.5	8.71	31.7	356	6.2	0.00135	0.0231	0.1653	0.1484	0.1530	5.45	-0.3	-14
T8085-033	33	57.9	1.61	253	0.059	1.6	3.41	5.38	16.5	232	7.9	0.00055	0.0142	0.0537	0.0916	0.0796	3.55	-4.1	-256
T8085-034	34	45.7	1.23	25	0.026	0.321	2.73	3.64	6.48	52.8	0.8	0.00024	0.0029	0.0430	0.0620	0.0313	0.81	0.2	14
T8085-035	35	37.6	0.90	25	0.031	0.3	2.69	2.97	5.66	50.4	0.8	0.00029	0.0027	0.0423	0.0506	0.0273	0.77	0.1	13
T8085-036	36	61.2	1.47	<9	0.038	0.358	4.52	4.54	9	40.5	<0.3	0.00035	0.0032	0.0711	0.0773	0.0434	0.62	0.5	35
T8085-037	37	49.1	1.40	79	0.051	2.17	4.04	3.97	20.2	266	2.5	0.00047	0.0193	0.0636	0.0676	0.0975	4.07	1.8	132
T8085-038	38	47.6	1.75	41	0.058	4.85	4.74	4.22	43.8	548	1.3	0.00054	0.0431	0.0746	0.0719	0.2114	8.38	7.5	428
T8085-039	39	43	2.04	31	0.027	3.24	2.67	2.55	29.7	390	1.0	0.00025	0.0288	0.0420	0.0434	0.1433	5.97	5.3	258
T8085-040	40	45.2	1.88	18	0.063	7.49	6.47	4.78	59.1	675	0.6	0.00058	0.0666	0.1018	0.0814	0.2852	10.33	10.3	548

Table B14. Supplemental simultaneously-extracted metals and elements (mg/kg dry weight) measured in Grand Lake sediments.

Lab#	SampleID	Al-SEM	As-SEM	B-SEM	Ba-SEM	Be-SEM	Ca-SEM	Co-SEM	Cr-SEM	Fe-SEM	K-SEM	Mg-SEM	Mn-SEM	Mo-SEM	Na-SEM	P-SEM	Sr-SEM	Ti-SEM	V-SEM
T8085-001	1	3690	1.08	2.23	227	0.893	16100	6.33	4.46	11500	803	673	2210	<0.15	78	713	48.4	41	28.4
T8085-002	2	5040	1.43	2.52	323	1.26	12400	9.11	5.7	14800	1100	878	2710	<0.14	94	856	49.8	51.1	35.8
T8085-003	3	2260	0.62	1.19	145	0.599	8920	3.95	2.43	6970	561	469	944	<0.08	54	493	31.7	26.9	17.2
T8085-004	4	2800	0.97	1.66	190	0.819	11700	5.42	3.04	9350	760	636	1110	<0.11	65	741	43	33.9	25.5
T8085-005	5	4980	1.87	1.74	205	1.06	8160	7.65	6.55	13000	932	824	1200	0.23	56	739	35.6	51.7	29.5
T8085-006	6	3350	1.14	1.56	180	0.855	10000	6.05	3.91	10400	747	645	1130	<0.11	62	706	37.9	37.5	22.6
T8085-007	7	677	0.54	0.89	28.9	0.308	973	4.32	6.79	5620	185	85	1370	0.04	10	220	5.8	18.7	13.7
T8085-008	8	5430	1.96	3.33	263	1.43	11600	11.1	7.34	17100	1210	1020	1610	0.15	89	1350	54	57.4	37.2
T8085-009	9	4470	1.58	2.04	210	1.1	9540	8.2	5.47	13300	927	843	1320	0.15	68	972	41.9	47.7	28.1
T8085-010	10	2770	0.96	1.58	156	0.817	7570	7.23	3.91	9550	723	578	766	<0.09	51	770	33.4	39.5	22.7
T8085-011	11	221	0.27	0.1	21.1	0.142	902	1.17	1.9	1760	88.8	78.7	220	<0.03	7	115	5.49	7.49	3.43
T8085-012	12	270	0.18	0.15	19.8	0.127	974	1.25	1.66	1580	90.8	75.2	263	<0.02	10	106	5	5.55	3.9
T8085-013	13	309	0.29	0.23	21.8	0.176	1000	2.24	2.74	3070	115	70.3	887	<0.03	10	140	5.19	6	6.3
T8085-014	14	4280	1.3	1.92	199	1.06	11000	7.71	4.82	12500	926	886	1090	<0.10	56	846	46.8	38.2	24.8
T8085-015	15	3680	1.96	1.57	98.5	1.07	7390	8.21	4.25	10200	810	744	1430	0.1	35	881	32.3	26	20.5
T8085-016	16	3860	1.45	2.12	181	1.01	7460	7.6	4.54	11400	832	774	1010	0.08	44	749	35.4	32.8	21.7
T8085-017	17	4430	1.67	1.89	197	1.09	8550	8.19	5.2	13000	916	937	1090	0.12	56	867	41.7	40.2	23.4
T8085-018	18	4020	1.46	1.68	175	0.997	7860	7.42	4.93	11600	890	843	925	0.13	43	768	37.2	35.2	22.1
T8085-019	19	2950	1.24	1.26	132	0.773	5170	5.91	3.59	8650	602	590	896	0.09	37	606	24.7	27.9	15.8
T8085-020	20	3590	1.07	1.53	166	0.882	6320	6.54	4.94	9590	744	714	723	0.09	43	554	30.7	35	19.7
T8085-021	21	3640	1.26	1.78	179	0.946	10700	6.66	4.2	10400	847	831	912	<0.10	56	746	43.2	28.4	22.8
T8085-022	22	541	0.35	0.3	33.1	0.234	1400	2.27	3.64	3190	161	153	295	<0.03	9	155	8.33	6.01	6.04
T8085-023	23	821	0.38	0.33	52.7	0.287	2630	2.58	1.48	3420	228	266	333	<0.04	18	182	14.2	6.82	5.83
T8085-024	24	3320	1.04	1.78	147	0.836	7440	6.17	4.39	9410	717	763	667	0.08	41	540	36.7	23.7	17.7
T8085-025	25	2670	0.9	1.32	117	0.652	6560	5.08	3.53	7790	591	647	522	<0.05	32	435	32.4	19.9	13.6
T8085-026	26	3100	0.98	1.39	136	0.753	6590	5.75	3.47	8650	624	733	686	<0.06	39	591	33.7	20.2	13.9
T8085-027	27	3870	1.65	1.47	151	0.883	6640	6.97	4.93	10800	742	861	820	0.12	41	701	32	30.6	17.4
T8085-028	28	1740	0.66	0.69	84.6	0.461	3950	4.8	1.93	5090	381	550	550	<0.05	25	329	20.6	10.1	7.74
T8085-029	29	1890	0.68	1.03	82.1	0.525	3760	5.26	2.67	5830	419	475	353	0.05	23	381	18.7	13.5	9.39
T8085-030	30	3250	0.96	1.66	121	0.715	5250	5.8	4.05	8680	632	769	492	0.08	34	449	29.4	20.8	14.3
T8085-031	31	3050	1.16	1.54	141	0.807	6280	6.47	3.45	8950	672	791	630	<0.06	41	600	35.5	22	14.3
T8085-032	32	3880	1.34	1.92	146	0.858	6030	6.88	4.63	10500	748	865	685	0.1	42	623	32.6	26.9	17.2
T8085-033	33	2060	0.66	1.03	110	0.586	5500	4.87	2.13	6280	476	662	514	<0.05	34	365	33.7	12.4	9.66
T8085-034	34	989	0.47	0.49	59.5	0.314	3280	3.54	1.15	3380	257	405	295	<0.03	25	238	21.2	5.92	6.56
T8085-035	35	974	0.45	0.39	47.7	0.248	2800	2.64	1.28	2960	238	365	192	<0.02	21	178	16.6	9.22	5.55
T8085-036	36	1390	1.15	0.52	99.8	0.42	4910	4.75	1.36	3810	371	649	718	<0.06	33	283	36.4	9.76	8.5
T8085-037	37	1190	0.57	0.48	70.9	0.369	4940	3.94	1.42	3920	309	412	434	<0.04	28	266	18.6	11	6.46
T8085-038	38	902	0.62	0.51	43.2	0.318	3880	4.06	1.92	3840	229	216	336	0.05	22	295	6.2	11.2	5.24
T8085-039	39	391	0.36	0.19	14.5	0.205	2230	2.8	0.986	2300	135	134	196	<0.03	13	205	3.59	4.21	2.96
T8085-040	40	832	0.71	0.62	25.9	0.386	3850	5.36	1.66	3970	254	234	344	<0.04	20	383	6.36	7.24	5.81
T8085-041	WB	426	0.26	0.34	8.91	0.0376	702	0.93	1.14	3000	94.4	198	155	0.05	10	251	1.65	10.3	3.19

Table B15. Laboratory blank results during analysis for simultaneously-extracted metals and acid-volatile sulfide. BEC = blank equivalent concentration in ppm.

LT	QC Code	TestID	RelatedWS	Lab#	TestGroupID	AnalysisDate	LIMS#	MDL	QCCalc1Label	QC Calc	Units	Weight	Volume	Calc MDL	Result	BEC
Primary analytes																
<	B	Ag	6606	Blank	Blank	3/13/2009	31841	0.002		<	ppm	10.00	100.00	0.2	0.029126	0.0029126
<	B	Ag	6607	Blank	Blank	3/13/2009	31845	0.002		<	ppm	20.00	100.00	0.2	0.0994401	0.004972
<	B	AVS	6609	Blank	Blank	12/5/2008	31853	5		<	ppm	10.00	40.00	200	-680.0631	-68.00631
<	B	AVS	6610	Blank	Blank	12/5/2008	31857	5		<	ppm	20.00	40.00	200	87.039416	4.3519708
<	B	Cd	6606	Blank	Blank	3/13/2009	31841	0.001		<	ppm	10.00	100.00	0.1	0.0349235	0.0034923
<	B	Cd	6607	Blank	Blank	3/13/2009	31845	0.001		<	ppm	20.00	100.00	0.1	5.16E-02	0.0025812
	B	Cu	6606	Blank	Blank	3/13/2009	31841	0.002		>	ppm	10.00	100.00	0.2	0.7969782	0.0796978
	B	Cu	6607	Blank	Blank	3/13/2009	31845	0.002		>	ppm	20.00	100.00	0.2	0.7959319	0.0397966
<	B	Ni	6606	Blank	Blank	3/13/2009	31841	0.005		<	ppm	10.00	100.00	0.5	-8.20E-03	-0.00082
<	B	Ni	6607	Blank	Blank	3/13/2009	31845	0.005		<	ppm	20.00	100.00	0.5	0.1426204	0.007131
<	B	Pb	6606	Blank	Blank	3/13/2009	31841	0.02		<	ppm	10.00	100.00	2	0.5247521	0.0524752
<	B	Pb	6607	Blank	Blank	3/13/2009	31845	0.02		<	ppm	20.00	100.00	2	1.4921664	0.0746083
	B	Zn	6606	Blank	Blank	3/13/2009	31841	0.002		>	ppm	10.00	100.00	0.2	3.2383861	0.3238386
	B	Zn	6607	Blank	Blank	3/13/2009	31845	0.002		>	ppm	20.00	100.00	0.2	7.9776015	0.3988801
Supplemental Analytes																
	B	Al	6606	Blank	Blank	3/13/2009	31841	0.01		>	ppm	10.00	100.00	1	18.35091	1.835091
	B	Al	6607	Blank	Blank	3/13/2009	31845	0.01		>	ppm	20.00	100.00	1	37.836407	1.8918204
<	B	As	6606	Blank	Blank	3/13/2009	31841	0.02		<	ppm	10.00	100.00	2	0.9182506	0.0918251
<	B	As	6607	Blank	Blank	3/13/2009	31845	0.02		<	ppm	20.00	100.00	2	-0.353003	-0.01765
<	B	B	6606	Blank	Blank	3/13/2009	31841	0.02		<	ppm	10.00	100.00	2	1.0326262	0.1032626
<	B	B	6607	Blank	Blank	3/13/2009	31845	0.02		<	ppm	20.00	100.00	2	0.4053288	0.0202664
	B	Ba	6606	Blank	Blank	3/13/2009	31841	0.001		>	ppm	10.00	100.00	0.1	0.7419214	0.0741921
	B	Ba	6607	Blank	Blank	3/13/2009	31845	0.001		>	ppm	20.00	100.00	0.1	1.9619701	0.0980985
<	B	Be	6606	Blank	Blank	3/13/2009	31841	0.0005		<	ppm	10.00	100.00	0.05	2.85E-02	0.0028539
<	B	Be	6607	Blank	Blank	3/13/2009	31845	0.0005		<	ppm	20.00	100.00	0.05	3.80E-02	0.0019012
	B	Ca	6606	Blank	Blank	3/13/2009	31841	0.02		>	ppm	10.00	100.00	2	45.448468	4.5448468
	B	Ca	6607	Blank	Blank	3/13/2009	31845	0.02		>	ppm	20.00	100.00	2	67.962641	3.398132
<	B	Co	6606	Blank	Blank	3/13/2009	31841	0.005		<	ppm	10.00	100.00	0.5	2.97E-02	0.0029661
<	B	Co	6607	Blank	Blank	3/13/2009	31845	0.005		<	ppm	20.00	100.00	0.5	6.90E-02	0.0034508
<	B	Cr	6606	Blank	Blank	3/13/2009	31841	0.002		<	ppm	10.00	100.00	0.2	0.1564241	0.0156424
<	B	Cr	6607	Blank	Blank	3/13/2009	31845	0.002		<	ppm	20.00	100.00	0.2	0.1653467	0.0082673
	B	Fe	6606	Blank	Blank	3/13/2009	31841	0.005		>	ppm	10.00	100.00	0.5	115.93773	11.593773
	B	Fe	6607	Blank	Blank	3/13/2009	31845	0.005		>	ppm	20.00	100.00	0.5	165.10874	8.2554371
	B	K	6606	Blank	Blank	3/13/2009	31841	0.1		>	ppm	10.00	100.00	10	109.33333	10.933333
	B	K	6607	Blank	Blank	3/13/2009	31845	0.1		>	ppm	20.00	100.00	10	113.22222	5.6611111
	B	Mg	6606	Blank	Blank	3/13/2009	31841	0.01		>	ppm	10.00	100.00	1.01	4.4336838	0.4433684
	B	Mg	6607	Blank	Blank	3/13/2009	31845	0.01		>	ppm	20.00	100.00	1.01	7.2960384	0.3648019
	B	Mn	6606	Blank	Blank	3/13/2009	31841	0.001		>	ppm	10.00	100.00	0.1	7.57	0.757
	B	Mn	6607	Blank	Blank	3/13/2009	31845	0.001		>	ppm	20.00	100.00	0.1	16.52	0.826
<	B	Mo	6606	Blank	Blank	3/13/2009	31841	0.01		<	ppm	10.00	100.00	1	9.83E-02	0.0098296
<	B	Mo	6607	Blank	Blank	3/13/2009	31845	0.01		<	ppm	20.00	100.00	1	0.1275729	0.0063786
<	B	Na	6606	Blank	Blank	3/13/2009	31841	2		<	ppm	10.00	100.00	200	4.8352941	0.4835294
<	B	Na	6607	Blank	Blank	3/13/2009	31845	2		<	ppm	20.00	100.00	200	37.41	1.8705
<	B	P	6606	Blank	Blank	3/13/2009	31841	0.05		<	ppm	10.00	100.00	5	3.3363636	0.3336364
	B	P	6607	Blank	Blank	3/13/2009	31845	0.05		>	ppm	20.00	100.00	5	7.0454545	0.3522727
<	B	S	6606	Blank	Blank	3/13/2009	31841	0.1		<	ppm	10.00	100.00	10	6.07	0.607
<	B	S	6607	Blank	Blank	3/13/2009	31845	0.1		<	ppm	20.00	100.00	10	3.36	0.168
	B	Sr	6606	Blank	Blank	3/13/2009	31841	0.0002		>	ppm	10.00	100.00	0.02	0.2	0.02
	B	Sr	6607	Blank	Blank	3/13/2009	31845	0.0002		>	ppm	20.00	100.00	0.02	0.39	0.0195
	B	Ti	6606	Blank	Blank	3/13/2009	31841	0.001		>	ppm	10.00	100.00	0.1	0.2102023	0.0210202
	B	Ti	6607	Blank	Blank	3/13/2009	31845	0.001		>	ppm	20.00	100.00	0.1	0.4201053	0.0210053
<	B	V	6606	Blank	Blank	3/13/2009	31841	0.005		<	ppm	10.00	100.00	0.5	0.3524937	0.0352494
<	B	V	6607	Blank	Blank	3/13/2009	31845	0.005		<	ppm	20.00	100.00	0.5	0.4208096	0.0210405

Table B16. Recovery of elements from a laboratory control sample during analysis of simultaneously extracted metals and acid-volatile sulfide.

LT	QC Code	TestID	RelatedWS	Lab#	TestGroupID	AnalysisDate	LIMS#	MDL	Units	Weight	Volume	Result	% Recovery
Primary analytes													
	C	Ag	6606	LCS	BS-w2004	3/13/2009	31842	0.002	ppm	1.00	100.00	48.42	97
	C	Ag	6607	LCS	BS-w2004	3/13/2009	31846	0.002	ppm	1.00	100.00	46.39	93
	C	AVS	6609	LCS	BS-AVS	12/5/2008	31854	5	ppm	1.00	40.00	36548.12	114
	C	AVS	6610	LCS	BS-AVS	12/5/2008	31858	5	ppm	1.00	40.00	35491.98	111
	C	Cd	6606	LCS	BS-w2004	3/13/2009	31842	0.001	ppm	1.00	100.00	47.42	95
	C	Cd	6607	LCS	BS-w2004	3/13/2009	31846	0.001	ppm	1.00	100.00	47.14	94
	C	Cu	6606	LCS	BS-w2004	3/13/2009	31842	0.002	ppm	1.00	100.00	201.48	101
	C	Cu	6607	LCS	BS-w2004	3/13/2009	31846	0.002	ppm	1.00	100.00	190.48	95
	C	Ni	6606	LCS	BS-w2004	3/13/2009	31842	0.005	ppm	1.00	100.00	91.83	92
	C	Ni	6607	LCS	BS-w2004	3/13/2009	31846	0.005	ppm	1.00	100.00	89.19	89
	C	Pb	6606	LCS	BS-w2004	3/13/2009	31842	0.02	ppm	1.00	100.00	93.81	94
	C	Pb	6607	LCS	BS-w2004	3/13/2009	31846	0.02	ppm	1.00	100.00	92.02	92
	C	Zn	6606	LCS	BS-w2004	3/13/2009	31842	0.002	ppm	1.00	100.00	926.76	93
	C	Zn	6607	LCS	BS-w2004	3/13/2009	31846	0.002	ppm	1.00	100.00	925.75	93
Supplemental Analytes													
	C	Al	6606	LCS	BS-w2004	3/13/2009	31842	0.01	ppm	1.00	100.00	1178.55	118
	C	Al	6607	LCS	BS-w2004	3/13/2009	31846	0.01	ppm	1.00	100.00	1102.78	110
	C	As	6606	LCS	BS-w2004	3/13/2009	31842	0.02	ppm	1.00	100.00	93.94	94
	C	As	6607	LCS	BS-w2004	3/13/2009	31846	0.02	ppm	1.00	100.00	93.19	93
	C	B	6606	LCS	BS-w2004	3/13/2009	31842	0.02	ppm	1.00	100.00	469.05	94
	C	B	6607	LCS	BS-w2004	3/13/2009	31846	0.02	ppm	1.00	100.00	445.85	89
	C	Ba	6606	LCS	BS-w2004	3/13/2009	31842	0.001	ppm	1.00	100.00	529.95	106
	C	Ba	6607	LCS	BS-w2004	3/13/2009	31846	0.001	ppm	1.00	100.00	509.50	102
	C	Be	6606	LCS	BS-w2004	3/13/2009	31842	0.0005	ppm	1.00	100.00	10.31	103
	C	Be	6607	LCS	BS-w2004	3/13/2009	31846	0.0005	ppm	1.00	100.00	9.81	98
	C	Ca	6606	LCS	BS-w2004	3/13/2009	31842	0.02	ppm	1.00	100.00	19728.66	99
	C	Ca	6607	LCS	BS-w2004	3/13/2009	31846	0.02	ppm	1.00	100.00	19079.33	95
	C	Co	6606	LCS	BS-w2004	3/13/2009	31842	0.005	ppm	1.00	100.00	93.71	94
	C	Co	6607	LCS	BS-w2004	3/13/2009	31846	0.005	ppm	1.00	100.00	90.97	91
	C	Cr	6606	LCS	BS-w2004	3/13/2009	31842	0.002	ppm	1.00	100.00	94.95	95
	C	Cr	6607	LCS	BS-w2004	3/13/2009	31846	0.002	ppm	1.00	100.00	91.44	91
	C	Fe	6606	LCS	BS-w2004	3/13/2009	31842	0.005	ppm	1.00	100.00	1918.12	96
	C	Fe	6607	LCS	BS-w2004	3/13/2009	31846	0.005	ppm	1.00	100.00	1871.06	94
	C	K	6606	LCS	BS-w2004	3/13/2009	31842	0.1	ppm	1.00	100.00	4744.67	95
	C	K	6607	LCS	BS-w2004	3/13/2009	31846	0.1	ppm	1.00	100.00	4522.22	90
	C	Mg	6606	LCS	BS-w2004	3/13/2009	31842	0.01	ppm	1.00	100.00	9697.71	97
	C	Mg	6607	LCS	BS-w2004	3/13/2009	31846	0.01	ppm	1.00	100.00	9488.74	95
	C	Mn	6606	LCS	BS-w2004	3/13/2009	31842	0.001	ppm	1.00	100.00	499.73	100
	C	Mn	6607	LCS	BS-w2004	3/13/2009	31846	0.001	ppm	1.00	100.00	482.24	96
<	C	Mo	6606	LCS	BS-w2004	3/13/2009	31842	0.01	ppm	1.00	100.00	0.13	0
<	C	Mo	6607	LCS	BS-w2004	3/13/2009	31846	0.01	ppm	1.00	100.00	0.09	0
	C	Na	6606	LCS	BS-w2004	3/13/2009	31842	2	ppm	1.00	100.00	73764.71	na
	C	Na	6607	LCS	BS-w2004	3/13/2009	31846	2	ppm	1.00	100.00	68070.59	na
<	C	P	6606	LCS	BS-w2004	3/13/2009	31842	0.05	ppm	1.00	100.00	0.00	0
<	C	P	6607	LCS	BS-w2004	3/13/2009	31846	0.05	ppm	1.00	100.00	1.49	0
	C	S	6606	LCS	BS-w2004	3/13/2009	31842	0.1	ppm	1.00	100.00	1310.65	0
	C	S	6607	LCS	BS-w2004	3/13/2009	31846	0.1	ppm	1.00	100.00	1312.85	0
	C	Sr	6606	LCS	BS-w2004	3/13/2009	31842	0.0002	ppm	1.00	100.00	0.57	0
	C	Sr	6607	LCS	BS-w2004	3/13/2009	31846	0.0002	ppm	1.00	100.00	0.65	0
	C	Ti	6606	LCS	BS-w2004	3/13/2009	31842	0.001	ppm	1.00	100.00	1.00	0
	C	Ti	6607	LCS	BS-w2004	3/13/2009	31846	0.001	ppm	1.00	100.00	1.01	0
	C	V	6606	LCS	BS-w2004	3/13/2009	31842	0.005	ppm	1.00	100.00	95.72	96
	C	V	6607	LCS	BS-w2004	3/13/2009	31846	0.005	ppm	1.00	100.00	91.19	91

Table B17. Laboratory results for duplicate analyses for simultaneously-extracted metals and acid-volatile sulfide (AVS).

LT	QC Code	TestID	RelatedWS	Lab#	TestGroupID	AnalysisDate	LIMS#	MDL	QCCalc1Labe	Units	Weight	Volume	Calc MDL	Result	RPD (%)
Primary analytes															
	D	Ag	6606	T8085-007D	Dup	3/13/2009	31843	0.002	RPD:	ppm	43.99	114.65	0.005	1.46E-02	80
	D	Ag	6607	T8085-022D	Dup	3/13/2009	31847	0.002	RPD:	ppm	42.38	118.82	0.006	3.92E-02	80
	D	AVS	6609	T8085-007D	Dup	12/5/2008	31855	5	RPD:	ppm	43.99	40.00	5	13.20729316	75
	D	AVS	6610	T8085-022D	Dup	12/5/2008	31859	5	RPD:	ppm	42.38	40.00	5	31.23315744	8
	D	Cd	6606	T8085-007D	Dup	3/13/2009	31843	0.001	RPD:	ppm	43.99	114.65	0.003	0.530813849	15
	D	Cd	6607	T8085-022D	Dup	3/13/2009	31847	0.001	RPD:	ppm	42.38	118.82	0.003	0.724715499	37
	D	Cu	6606	T8085-007D	Dup	3/13/2009	31843	0.002	RPD:	ppm	43.99	114.65	0.005	1.054886899	13
	D	Cu	6607	T8085-022D	Dup	3/13/2009	31847	0.002	RPD:	ppm	42.38	118.82	0.006	1.913955202	69
	D	Ni	6606	T8085-007D	Dup	3/13/2009	31843	0.005	RPD:	ppm	43.99	114.65	0.013	1.834992177	11
	D	Ni	6607	T8085-022D	Dup	3/13/2009	31847	0.005	RPD:	ppm	42.38	118.82	0.014	3.327322115	51
	D	Pb	6606	T8085-007D	Dup	3/13/2009	31843	0.02	RPD:	ppm	43.99	114.65	0.05	17.16042092	12
	D	Pb	6607	T8085-022D	Dup	3/13/2009	31847	0.02	RPD:	ppm	42.38	118.82	0.06	15.49188018	44
	D	Zn	6606	T8085-007D	Dup	3/13/2009	31843	0.002	RPD:	ppm	43.99	114.65	0.005	134.9266261	8
	D	Zn	6607	T8085-022D	Dup	3/13/2009	31847	0.002	RPD:	ppm	42.38	118.82	0.006	152.7106076	37
Supplemental Analytes															
	D	P	6606	T8085-007D	Dup	3/13/2009	31843	0.05	RPD:	ppm	43.99	114.65	0.13	191.4416092	14
	D	P	6607	T8085-022D	Dup	3/13/2009	31847	0.05	RPD:	ppm	42.38	118.82	0.14	260.4800248	51
	D	S	6606	T8085-007D	Dup	3/13/2009	31843	0.1	RPD:	ppm	43.99	114.65	0.3	11.76204926	16
	D	S	6607	T8085-022D	Dup	3/13/2009	31847	0.1	RPD:	ppm	42.38	118.82	0.3	8.133246644	52
	D	Sr	6606	T8085-007D	Dup	3/13/2009	31843	0.0002	RPD:	ppm	43.99	114.65	0.0005	4.858067766	18
	D	Sr	6607	T8085-022D	Dup	3/13/2009	31847	0.0002	RPD:	ppm	42.38	118.82	0.0006	12.11436013	37
	D	Ti	6606	T8085-007D	Dup	3/13/2009	31843	0.001	RPD:	ppm	43.99	114.65	0.003	16.36627923	13
	D	Ti	6607	T8085-022D	Dup	3/13/2009	31847	0.001	RPD:	ppm	42.38	118.82	0.003	13.45031337	77
	D	V	6606	T8085-007D	Dup	3/13/2009	31843	0.005	RPD:	ppm	43.99	114.65	0.013	11.73537354	15
	D	V	6607	T8085-022D	Dup	3/13/2009	31847	0.005	RPD:	ppm	42.38	118.82	0.014	12.56075797	70
	D	Al	6606	T8085-007D	Dup	3/13/2009	31843	0.01	RPD:	ppm	43.99	114.65	0.03	570.0569913	17
	D	Al	6607	T8085-022D	Dup	3/13/2009	31847	0.01	RPD:	ppm	42.38	118.82	0.03	1058.230935	65
	D	As	6606	T8085-007D	Dup	3/13/2009	31843	0.02	RPD:	ppm	43.99	114.65	0.05	0.497567525	7
	D	As	6607	T8085-022D	Dup	3/13/2009	31847	0.02	RPD:	ppm	42.38	118.82	0.06	0.668884069	62
	D	B	6606	T8085-007D	Dup	3/13/2009	31843	0.02	RPD:	ppm	43.99	114.65	0.05	0.698583458	24
	D	B	6607	T8085-022D	Dup	3/13/2009	31847	0.02	RPD:	ppm	42.38	118.82	0.06	1.057606969	111
	D	Ba	6606	T8085-007D	Dup	3/13/2009	31843	0.001	RPD:	ppm	43.99	114.65	0.003	24.45261204	17
	D	Ba	6607	T8085-022D	Dup	3/13/2009	31847	0.001	RPD:	ppm	42.38	118.82	0.003	47.43818803	36
	D	Be	6606	T8085-007D	Dup	3/13/2009	31843	0.0005	RPD:	ppm	43.99	114.65	0.0013	0.265235648	15
	D	Be	6607	T8085-022D	Dup	3/13/2009	31847	0.0005	RPD:	ppm	42.38	118.82	0.0014	0.365236773	44
	D	Ca	6606	T8085-007D	Dup	3/13/2009	31843	0.02	RPD:	ppm	43.99	114.65	0.05	832.6573364	16
	D	Ca	6607	T8085-022D	Dup	3/13/2009	31847	0.02	RPD:	ppm	42.38	118.82	0.06	1903.926113	30
	D	Co	6606	T8085-007D	Dup	3/13/2009	31843	0.005	RPD:	ppm	43.99	114.65	0.013	3.846671792	12
	D	Co	6607	T8085-022D	Dup	3/13/2009	31847	0.005	RPD:	ppm	42.38	118.82	0.014	3.779976237	50
	D	Cr	6606	T8085-007D	Dup	3/13/2009	31843	0.002	RPD:	ppm	43.99	114.65	0.005	5.91746611	14
	D	Cr	6607	T8085-022D	Dup	3/13/2009	31847	0.002	RPD:	ppm	42.38	118.82	0.006	8.581652297	81
	D	Fe	6606	T8085-007D	Dup	3/13/2009	31843	0.005	RPD:	ppm	43.99	114.65	0.013	5203.529462	8
	D	Fe	6607	T8085-022D	Dup	3/13/2009	31847	0.005	RPD:	ppm	42.38	118.82	0.014	5921.388527	60
	D	K	6606	T8085-007D	Dup	3/13/2009	31843	0.1	RPD:	ppm	43.99	114.65	0.3	152.9005592	19
	D	K	6607	T8085-022D	Dup	3/13/2009	31847	0.1	RPD:	ppm	42.38	118.82	0.3	270.3917457	51
	D	Mg	6606	T8085-007D	Dup	3/13/2009	31843	0.01	RPD:	ppm	43.99	114.65	0.01	73.90449149	14
	D	Mg	6607	T8085-022D	Dup	3/13/2009	31847	0.01	RPD:	ppm	42.38	118.82	0.01	229.1933315	40
	D	Mn	6606	T8085-007D	Dup	3/13/2009	31843	0.001	RPD:	ppm	43.99	114.65	0.003	1140.864047	18
	D	Mn	6607	T8085-022D	Dup	3/13/2009	31847	0.001	RPD:	ppm	42.38	118.82	0.003	454.4188725	42
	D	Mo	6606	T8085-007D	Dup	3/13/2009	31843	0.01	RPD:	ppm	43.99	114.65	0.03	4.37E-02	10
	D	Mo	6607	T8085-022D	Dup	3/13/2009	31847	0.01	RPD:	ppm	42.38	118.82	0.03	6.86E-02	150
	D	Na	6606	T8085-007D	Dup	3/13/2009	31843	2	RPD:	ppm	43.99	114.65	5	9.437265762	9
	D	Na	6607	T8085-022D	Dup	3/13/2009	31847	2	RPD:	ppm	42.38	118.82	6	11.96857288	30

Table B18. Recovery of elements from a laboratory-spiked samples during analysis of simultaneously extracted metals.

LT	QC Code	TestID	RelatedWS	Lab#	TestGroupID	AnalysisDate	LIMS#	MDL	QCCalc1Label	Units	Weight	Volume	Amt_Added	SpikeVolume	Calc MDL	Result	% Recovery
Primary analytes																	
	S	Ag	6606	T8085-011S	Wat2004	3/13/2009	31844	0.002	%R:	ppm	44.67	117.93	5	11.79	0.006	1.317622615	99
	S	Ag	6607	T8085-029S	Wat2004	3/13/2009	31848	0.002	%R:	ppm	32.07	127.77	5	12.78	0.009	2.925572478	142
	S	AVS	6609	T8085-011S	AVS_spk	12/5/2008	31856	5	%R:	ppm	44.67	40.00	32000	1	4	786.3601502	108
	S	AVS	6610	T8085-029S	AVS_spk	12/5/2008	31860	5	%R:	ppm	32.07	40.00	32000	1	6	1024.38093	86
	S	Cd	6606	T8085-011S	Wat2004	3/13/2009	31844	0.001	%R:	ppm	44.67	117.93	5	11.79	0.003	1.849976678	97
	S	Cd	6607	T8085-029S	Wat2004	3/13/2009	31848	0.001	%R:	ppm	32.07	127.77	5	12.78	0.004	4.937764936	80
	S	Cu	6606	T8085-011S	Wat2004	3/13/2009	31844	0.002	%R:	ppm	44.67	117.93	20	11.79	0.006	6.064729843	101
	S	Cu	6607	T8085-029S	Wat2004	3/13/2009	31848	0.002	%R:	ppm	32.07	127.77	20	12.78	0.009	14.30981501	108
	S	Ni	6606	T8085-011S	Wat2004	3/13/2009	31844	0.005	%R:	ppm	44.67	117.93	10	11.79	0.015	3.408515206	90
	S	Ni	6607	T8085-029S	Wat2004	3/13/2009	31848	0.005	%R:	ppm	32.07	127.77	10	12.78	0.022	8.628444403	73
	S	Pb	6606	T8085-011S	Wat2004	3/13/2009	31844	0.02	%R:	ppm	44.67	117.93	10	11.79	0.06	9.203107935	103
	S	Pb	6607	T8085-029S	Wat2004	3/13/2009	31848	0.02	%R:	ppm	32.07	127.77	10	12.78	0.09	36.68334463	39
	S	Zn	6606	T8085-011S	Wat2004	3/13/2009	31844	0.002	%R:	ppm	44.67	117.93	100	11.79	0.006	97.90318939	101
	S	Zn	6607	T8085-029S	Wat2004	3/13/2009	31848	0.002	%R:	ppm	32.07	127.77	100	12.78	0.009	419.2905386	67
Supplemental Analytes																	
	S	Al	6606	T8085-011S	Wat2004	3/13/2009	31844	0.01	%R:	ppm	44.67	117.93	100	11.79	0.03	283.7124641	236
	S	Al	6607	T8085-029S	Wat2004	3/13/2009	31848	0.01	%R:	ppm	32.07	127.77	100	12.78	0.04	1837.21264	-135
	S	As	6606	T8085-011S	Wat2004	3/13/2009	31844	0.02	%R:	ppm	44.67	117.93	10	11.79	0.06	2.75713691	94
	S	As	6607	T8085-029S	Wat2004	3/13/2009	31848	0.02	%R:	ppm	32.07	127.77	10	12.78	0.09	4.189360858	88
	S	B	6606	T8085-011S	Wat2004	3/13/2009	31844	0.02	%R:	ppm	44.67	117.93	50	11.79	0.06	10.25110292	77
	S	B	6607	T8085-029S	Wat2004	3/13/2009	31848	0.02	%R:	ppm	32.07	127.77	50	12.78	0.09	14.96869414	70
	S	Ba	6606	T8085-011S	Wat2004	3/13/2009	31844	0.001	%R:	ppm	44.67	117.93	50	11.79	0.003	35.54908101	109
	S	Ba	6607	T8085-029S	Wat2004	3/13/2009	31848	0.001	%R:	ppm	32.07	127.77	50	12.78	0.004	99.45301448	87
	S	Be	6606	T8085-011S	Wat2004	3/13/2009	31844	0.0005	%R:	ppm	44.67	117.93	1	11.79	0.0015	0.40372019	99
	S	Be	6607	T8085-029S	Wat2004	3/13/2009	31848	0.0005	%R:	ppm	32.07	127.77	1	12.78	0.0022	0.878232291	89
	S	Ca	6606	T8085-011S	Wat2004	3/13/2009	31844	0.02	%R:	ppm	44.67	117.93	2000	11.79	0.06	1374.360533	90
	S	Ca	6607	T8085-029S	Wat2004	3/13/2009	31848	0.02	%R:	ppm	32.07	127.77	2000	12.78	0.09	4470.540022	90
	S	Co	6606	T8085-011S	Wat2004	3/13/2009	31844	0.005	%R:	ppm	44.67	117.93	10	11.79	0.015	3.574478999	91
	S	Co	6607	T8085-029S	Wat2004	3/13/2009	31848	0.005	%R:	ppm	32.07	127.77	10	12.78	0.022	8.402390364	79
	S	Cr	6606	T8085-011S	Wat2004	3/13/2009	31844	0.002	%R:	ppm	44.67	117.93	10	11.79	0.006	4.657573709	105
	S	Cr	6607	T8085-029S	Wat2004	3/13/2009	31848	0.002	%R:	ppm	32.07	127.77	10	12.78	0.009	5.961565151	83
	S	Fe	6606	T8085-011S	Wat2004	3/13/2009	31844	0.005	%R:	ppm	44.67	117.93	200	11.79	0.015	1960.906476	386
	S	Fe	6607	T8085-029S	Wat2004	3/13/2009	31848	0.005	%R:	ppm	32.07	127.77	200	12.78	0.022	5619.542215	-270
	S	K	6606	T8085-011S	Wat2004	3/13/2009	31844	0.1	%R:	ppm	44.67	117.93	500	11.79	0.3	212.6412091	94
	S	K	6607	T8085-029S	Wat2004	3/13/2009	31848	0.1	%R:	ppm	32.07	127.77	500	12.78	0.4	589.7314544	86
	S	Mg	6606	T8085-011S	Wat2004	3/13/2009	31844	0.01	%R:	ppm	44.67	117.93	1000	11.79	0.01	330.6838362	95
	S	Mg	6607	T8085-029S	Wat2004	3/13/2009	31848	0.01	%R:	ppm	32.07	127.77	1000	12.78	0.01	830.4082059	89
	S	Mn	6606	T8085-011S	Wat2004	3/13/2009	31844	0.001	%R:	ppm	44.67	117.93	50	11.79	0.003	234.8914173	116
	S	Mn	6607	T8085-029S	Wat2004	3/13/2009	31848	0.001	%R:	ppm	32.07	127.77	50	12.78	0.004	361.5117123	41
<	S	Mo	6606	T8085-011S	Wat2004	3/13/2009	31844	0.01		ppm	44.67	117.93			0.03	-3.66E-04	
<	S	Mo	6607	T8085-029S	Wat2004	3/13/2009	31848	0.01		ppm	32.07	127.77			0.04	2.96E-02	
	S	Na	6606	T8085-011S	Wat2004	3/13/2009	31844	2	%R:	ppm	44.67	117.93	1000	11.79	6	1704.166591	643
	S	Na	6607	T8085-029S	Wat2004	3/13/2009	31848	2	%R:	ppm	32.07	127.77	1000	12.78	9	2588.436111	644
	S	P	6606	T8085-011S	Wat2004	3/13/2009	31844	0.05	%R:	ppm	44.67	117.93	50	11.79	0.15	107.4763589	-59
	S	P	6607	T8085-029S	Wat2004	3/13/2009	31848	0.05	%R:	ppm	32.07	127.77	50	12.78	0.22	358.1951203	-114
	S	S	6606	T8085-011S	Wat2004	3/13/2009	31844	0.1		ppm	44.67	117.93			0.3	61.95796929	
	S	S	6607	T8085-029S	Wat2004	3/13/2009	31848	0.1		ppm	32.07	127.77			0.4	80.79710508	
	S	Sr	6606	T8085-011S	Wat2004	3/13/2009	31844	0.0002		ppm	44.67	117.93			0.0006	5.450907353	
	S	Sr	6607	T8085-029S	Wat2004	3/13/2009	31848	0.0002		ppm	32.07	127.77			0.0009	18.10100591	
	S	Ti	6606	T8085-011S	Wat2004	3/13/2009	31844	0.001		ppm	44.67	117.93			0.003	8.548692986	
	S	Ti	6607	T8085-029S	Wat2004	3/13/2009	31848	0.001		ppm	32.07	127.77			0.004	12.04325586	
	S	V	6606	T8085-011S	Wat2004	3/13/2009	31844	0.005	%R:	ppm	44.67	117.93	10	11.79	0.015	6.166714707	104
	S	V	6607	T8085-029S	Wat2004	3/13/2009	31848	0.005	%R:	ppm	32.07	127.77	10	12.78	0.022	12.45359433	77

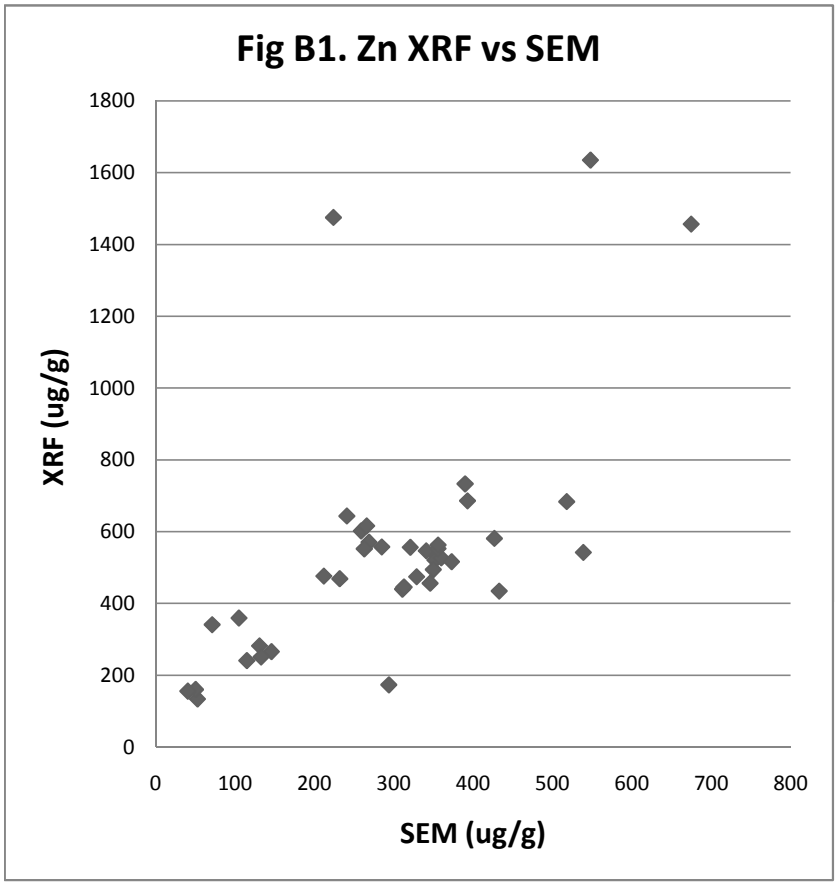


Fig B1. Zn XRF vs SEM
XRF (ug/g)
SEM (ug/g)
0
200
400
600
800
1000
1200
1400
1600
1800
0
100
200
300
400
500
600
700
800

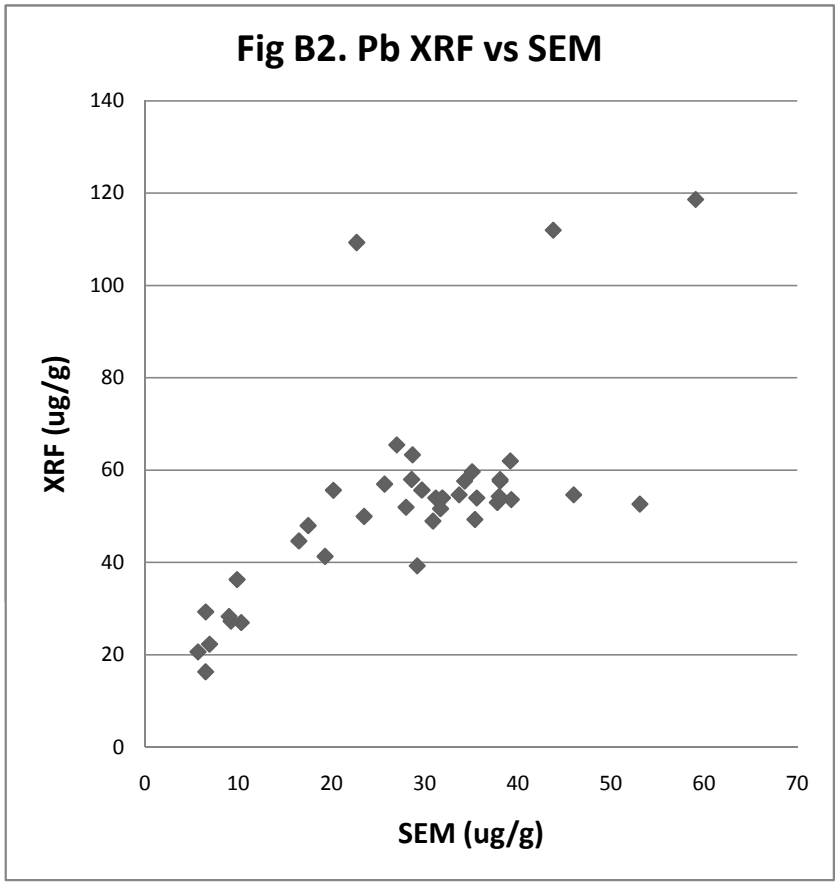


Fig B2. Pb XRF vs SEM
XRF (ug/g)
SEM (ug/g)
0
20
40
60
80
100
120
140
0
10
20
30
40
50
60
70