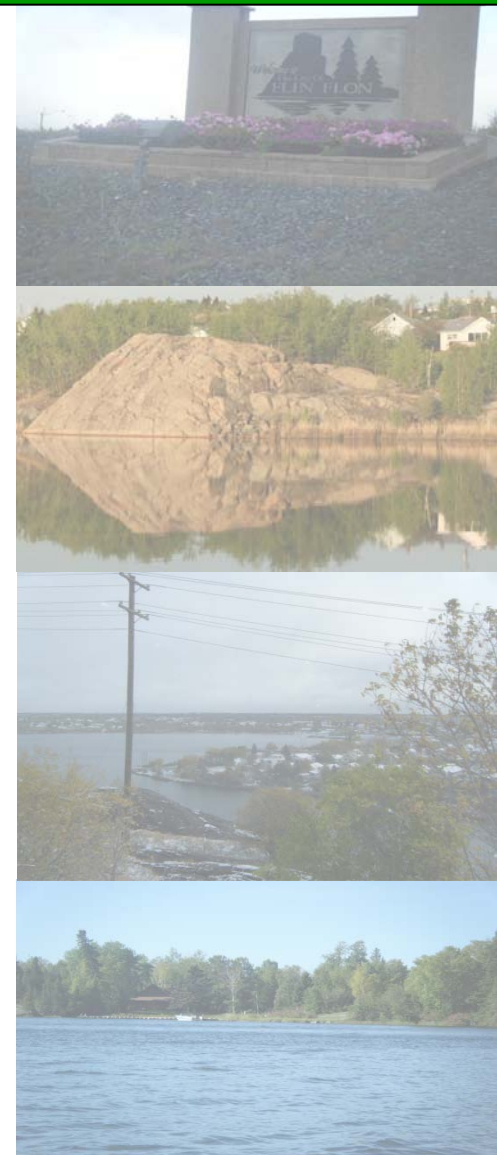


APPENDIX G
BIOACCESSIBILITY



**BIOACCESSIBILITY OF MERCURY, ARSENIC, CADMIUM,
COPPER, LEAD, SELENIUM, AND ZINC IN SOILS FROM THE
FLIN FLON AREA**

2008 Final Report

**Prepared for
Intrinsik Environmental Sciences Inc.**

by

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and
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I. INTRODUCTION

Intrinsic Environmental Sciences Inc. contracted the Environmental Sciences Group (ESG) of the Royal Military College of Canada (RMC), and the Analytical Services Unit (ASU) of Queen's University, to determine the bioaccessibility of mercury (Hg), arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), selenium (Se), and zinc (Zn) in soils from the Flin Flon, Manitoba, area. Intrinsic provided the soils.

The bioaccessibility of a contaminant is the portion of a contaminant in a sample that is soluble in the gastro-intestinal environment, and can be measured in an *in vitro* laboratory setting. It can be used as a surrogate for bioavailability, which is the portion of a contaminant that is actually absorbed by an organism. The measurement of bioavailability usually requires animal studies, which are more logistically and ethically challenging. The use of bioaccessibility in risk assessment is considered to be valid and applicable at specific sites, provided that some basic data requirements are fulfilled to permit regulatory groups (e.g., Health Canada) to ascertain the validity and defensibility of such measurements (Health Canada 2007). The following parameters have been suggested as relevant for investigation at specific sites:

1. Soil particle size – Other researchers have suggested that the <250 μm fraction, typically used in risk assessment, may not be representative of the soil size fraction of greatest relevance to human health risk assessment. Therefore studying a range of soil particle sizes, to ascertain if the particle size affects the bioaccessibility, has been proposed (Health Canada, 2007).
2. Ratio of simulated bioaccessibility fluid volume to soil mass – Other researchers have observed that, for some elements and soils, the ratio of the fluid to the soil mass during the bioaccessibility extraction can affect the bioaccessibility (Health Canada, 2007). To determine if this variable affects the bioaccessibility results, measurements with varying liquid volume to soil mass ratios are recommended (Health Canada, 2007).

The present study was designed in two parts: the first was to investigate the two parameters listed above for three soils and determine the most appropriate method for measuring bioaccessibility, and the second was to measure the bioaccessibility in the remaining soils using this method.

II. METHODS

The ESG laboratory (Analytical Sciences Division) at the Royal Military College of Canada conducted the *in vitro* bioaccessibility extractions to measure the bioaccessible Hg, As, Cd, Cu, Pb, Se, and Zn content of the soil samples. The Analytical Services Unit (ASU) at Queens University in Kingston, Ontario carried out the analysis of the resulting extracts, as well as the analysis of total metals and metalloids in the <45 μm fraction of three soils in Part 1 of the study. The Analytical Sciences Group (ASG) at the Royal Military College, Kingston, Ontario digested several of the bioaccessibility extracts prior to analysis at ASU and analyzed Hg in the <45 μm fraction of two of the three soils used in Part 1. Intrinsic provided the total concentration of the elements of interest in the <250 μm fraction of the soils.

A. *In Vitro* Bioaccessibility Extractions

1. Method Overview

The bioaccessible Hg, As, Cd, Cu, Pb, Se, and Zn content of soils was determined using an *in vitro* bioaccessibility extraction methodology coupled to elemental detection as mentioned previously. The bioaccessibility method is designed to simulate a human receptor and it is a modification of two previously published methods, that of Ruby (1993; 1996) and Rodriguez (1999) incorporating the 100:1 liquid to solid ratio, low molecular weight organic acids, pepsin, bile and pancreatin concentrations used by Ruby and the NaCl and pH conditions of Rodriguez.

For Part 1 of the study, three methods were tested on three soils (FF208B, CS102B, FF276F), in triplicate. The first method (Method 1) used an extraction fluid volume:soil mass of 100:1 and the <45 μm fraction of the soils; the second method (Method 2) used an extraction fluid volume:soil mass of 100:1 and the <250 μm fraction of the soils; and the third method (Method 3) used an extraction fluid volume:soil mass of 2000:1 and the <250 μm fraction of the soils.

Because of the nature of Hg to adhere to plastic surfaces, Teflon® equipment was used for the extractions, and then the extracts were each split into separate aliquots for As, Cd, Cu, Pb, Se, and Zn analysis, and for Hg analysis. In past studies we have determined that the use of pyrolysis – cold vapour generation – atomic absorption spectrometry (pyrolysis-CVAAS) to measure Hg in bioaccessibility extracts was suitable and convenient, but limited with respect to detection limit (0.2 mg/kg bioaccessible

concentration). Therefore to ensure as many detectable Hg results as possible, the bioaccessibility extracts of 16 samples (reports ASD0809b, c) that had total Hg concentrations less than 7 mg/kg were analyzed by cold vapour generation – atomic fluorescence spectrometry (CV-AFS). This method modification necessitated a larger volume of bioaccessibility extract and this is reflected in the method details.

2. Extraction Procedure

All reagents used in the extraction procedures were of environmental quality or purer. All samples were stored at a low temperature before and after analysis to ensure matrix stability. Samples were clearly and uniquely labelled to ensure traceability.

Two aliquots of dried, sieved (<250 μm for most soils; <45 μm for FF208B, CS102B, FF276F in Part 1, using Method 1) and homogenized soil (0.2 g for samples in reports ASD0809a, d, e, f and samples FF208B, CS102B, FF276F by Methods 1 and 2; 0.6 g for reports ASD0809b, c; 0.02 g for samples FF208B, CS102B, FF276F by Method 3) were accurately weighed into uniquely labelled Teflon® extraction vessels with 20 ml (ASD0809a, d, e, f, and samples FF208B, CS102B, FF276F by Methods 1 and 2), in glass jars with 60 ml (ASD0809b, c), or in Teflon® extraction vessels with 40 ml (samples FF208B, CS102B, FF276F by Method 3) of gastric bioaccessibility solution. Samples were labelled P1 for the simulation of the gastric phase and P2 for simulation of the whole GI process (gastric + intestinal). The gastric bioaccessibility solution, which consisted of 1.25g/L pepsin (P-7000), 0.5 g/L sodium citrate, 0.5 g/L malic acid, 1 ml/L glacial acetic acid, 0.15 M NaCl adjusted to pH 1.8 with 32 % HCl, was added to both the P1 and P2 samples to obtain a liquid to solid ratio of 100:1, except for samples FF208B, CS102B, FF276F by Method 3, where 2000:1 was used. On addition of the gastric solution the pH of both P1 and P2 extraction phases was checked to ensure that it was within 1.8 ± 0.05 . If the pH was outside of this tolerance the pH was manually adjusted with 2 or 32 % HCl as required, and the starting pH was recorded. To carry out the stomach phase of the *in vitro* bioaccessibility test, both the P1 and P2 extraction vessels were incubated for 1 hour at 37°C in an incubated shaker at 275 rpm. Thirty minutes into the stomach phase, the pH of the extraction vessels was monitored. If the pH was outside the tolerance of 1.8 ± 0.05 , the pH was adjusted as necessary with 2% or 32% HCl and the extraction vessels were returned to the shaking incubator for the remaining 30 minutes. After the 1 hour incubation period, the pH and weight of the P1 samples were recorded. The P1 samples were then prepared for analysis and the P2 samples were further extracted under intestinal conditions. To alter the conditions in the P2 extraction vessels to simulate conditions in the small intestine of the receptor of interest, the pH was

increased to 7 by the addition of saturated sodium carbonate (Na_2CO_3). Once a neutral pH was achieved pre-weighed masses of bile and pancreatin, according to Table 1, were added to each vessel.

Table 1. Experimental conditions of the bioaccessibility extractions.

| Experiment or soils | Solution volume (ml) | Soil mass (g) | Soil fraction (μm) | Reagents in P1 | Reagents in P2 |
|--------------------------|----------------------|---------------|---------------------------------|--|---|
| Part 1: Method 1 | 20 | 0.2 | <45 | 1.25g/L pepsin 0.5 g/L sodium citrate 0.5 g/L malic acid 1 ml/L glacial acetic acid 0.15 M NaCl pH 1.8 adjusted with 32 % HCl | 35 mg bile extract 10 mg pancreatin |
| Part 1: Method 2 | 20 | 0.2 | <250 | | 35 mg bile extract 10 mg pancreatin |
| Part 1: Method 3 | 40 | 0.02 | <250 | | 70 mg bile extract 20 mg pancreatin |
| Part 2: Total Hg>7 mg/kg | 20 | 0.2 | <250 | | 35 mg bile extract 10 mg pancreatin |
| Part 2: Total Hg<7 mg/kg | 60 | 0.6 | <250 | | 105 mg bile extract 30 mg pancreatin |

Each P2 sample was then further incubated for a total of 4 hours at 37°C. After 2 hours of the intestine phase incubation period, the pH was checked and adjusted to 7.0 with saturated Na_2CO_3 and returned to the incubator for the remaining 2 hours. On completion of the intestinal incubation the final pH and weight of each sample were recorded. The P2 samples were prepared for analysis.

To prepare both the stomach (P1) and intestine (P2) phase samples for analysis, each extract was filtered through a 0.45 μm disposable syringe filter with glass microfibre membrane. Extracts in Part 1 of the study, and extracts of soils with total Hg less than 7 mg/kg were then split into two aliquots: one for analysis of As, Cd, Cu, Pb, Se and Zn (10 ml), and the other for analysis of Hg (4 ml in Part 1, 50 ml otherwise). In Part 1, sample aliquots destined for Hg analysis were preserved with BrCl. Because precipitation of solids was observed in some of these sample aliquots upon preservation, this step was not included in the rest of the study. All filtered extracts were stored refrigerated prior to analysis.

Along with each batch of 8 unknown samples one duplicate sample, one sample of NIST 2710 reference material and two extraction blanks were included. A known amount of Hg was also added to one of the extraction blanks prior to analysis.

B. As, Cd, Cu, Pb, Se, and Zn by (ICP-AES)

ASU determined the inorganic elements As, Cd, Cu, Pb, Se and Zn in the filtered extracts and in the <45 µm fraction of three soil samples (FF208B, CS102B, FF276F) used in Part 1 of the present study. ASU is a CAEAL accredited laboratory and the measurement of inorganic elements (including the elements of interest) in soil and water samples by ICP-AES is listed in its scope of accreditation. For soil analysis, the <45 µm fractions of the samples (provided by ESG) were ground to a fine powder with a mortar and pestle. Approximately 0.5 g of powdered sample were heated with 2 mL of nitric acid and 6 mL of hydrochloric acid overnight so that the volume was reduced to 1-2 mL. This solution was then made up to 25 mL with distilled deionized water). Samples were analyzed together with one blank, one duplicate and one sample of reference material (SS-2). No further pH adjustment or modifications were made to bioaccessibility extracts prior to analysis. Sample volume was not sufficient to analyze any extracts in duplicate. The elements As, Cd, Cu, Pb, Se, and Zn were analyzed in digests and extracts using a Varian VISTA AX CCD Simultaneous ICP-AES. Calibration control standards (prepared from a separate source from that used for calibration) were used to check the calibration periodically, and instrument blanks were also included with all analyses.

C. Hg in <45 µm Fraction of Soils (Part 1)

Analyses were conducted by the ASU and the Analytical Sciences Group (ASG), Royal Military College, Kingston, Ontario. The following methods are included in the scope of accreditation for the two labs. At ASG, the <45 µm fraction of two soils (FF208B, FF276F), provided by ESG, were digested using approximately 0.25 to 0.50g soil and 4mL of Trace Metal Grade Nitric Acid, with 1mL each 5% w/v aqueous potassium permanganate and potassium persulfate, in a CEM Microwave Accelerated Reaction System (MARS) microwave digestion system utilizing MARS Xpress 60mL Teflon vessels (ramp to 200°C in 15minute, held at 200°C for 35minutes). After the digestion 0.5mL hydroxylamine sulphate solution (12% w/v) was added on cooling and the samples were made up to 25mL with distilled deionized water. A set of standards, a duplicate, a blank, and a soil reference were digested with each soil run. The soil digests were analyzed using a Perkin-Elmer FIMS-100 Mercury System equipped with a 253.7 nm source mercury lamp, quartz cell, Perkin-Elmer AS-90 autosampler, and the Perkin Elmer AA WinLab Analyst software. The carrier solution was 3% HCl and the reducing agent was 1.1% tin chloride (SnCl₂) in 3% HCl. Ultra high-purity argon was used as the

carrier gas, with the flow rate set between 40 and 70 mL/min. Three 500 µL replicates for each sample were analyzed. A signal was generated in the quartz cell by measuring the amount of light (wavelength 253.7 nm) absorbed. The mercury concentrations in the samples were determined by comparing sample absorbance responses to a calibration curve generated from standards of known concentration.

At ASU, the <45 µm fraction of sample CS102B, provided by ESG, was detected by CV-AAS, using the Milestone (DMA-80) direct Hg analyser. This instrument allows for direct measurement and has been designed to meet the criteria outlined in US EPA Method 7473. Very small quantities of liquid or solid sample were required with little or no preparation and measurements were made on the total mass of Hg in a test portion. The instrumentation afforded a wide concentration range of measurements to be made within the test samples (0.05 ng to 600 ng) under investigation.

An appropriate mass of soil was weighed into quartz or nickel boats. Within the instrumentation each sample underwent a process of drying followed by thermal decomposition within a continuous flow of oxygen. The combustion products are carried off in the oxygen flow and are further decomposed in a hot catalyst bed. Any Hg vapours are trapped on a gold amalgamator tube and subsequently desorbed for spectrophotometric quantification at 254 nm. Long and short path length cells enable the measurement of low range (0.05 – 35 ng) and high range (35 – 600 ng) Hg concentrations respectively.

The instrument was calibrated from working standards prepared from a 1000 mg/L Hg ICP-AES/ICP MS (PlasmaCAL) stock standard. An aqueous QC (or calibration check sample) was included in all analysis runs and was prepared from an independent Hg source to that used to prepare the calibration standards. The aqueous QC was prepared at a mid-range Hg concentration within each detection cell (i.e. low range or high range). A blank was also included.

D. Hg in Bioaccessibility Extracts (Total Hg in soils >7 mg/kg) pyrolysis-CV-AAS

ASU measured total Hg in the bioaccessibility extracts produced at ESG; the following method for Hg in water was accredited until recently but as described above, analysis of Hg in soil using the same methodology is currently accredited.

As described for Hg in soil, the Hg content of the bioaccessibility extracts was detected by CV-AAS. In order to measure the Hg content of each test sample the maximum boat capacity of 500 µL was volumetrically weighed into quartz or nickel boats.

A blank and an aqueous QC (or calibration check sample) was included in all analysis runs; the latter was prepared from an independent Hg source to that used to prepare the calibration standards.

E. Hg in Bioaccessibility Extracts (Total Hg in soils <7 mg/kg) by CV-AFS

ASG digested P2 bioaccessibility extracts and then ASU measured Hg in all extracts. ASG used the digestion method that is included in the Hg in water analysis method included in its scope of accreditation. The ASU method for Hg in water by CV-AFS was recently accredited.

The extract aliquot was mixed with 4ml of trace metal grade nitric acid in a 60mL Teflon® microwave vessel. Aqueous potassium permanganate (1mL, 5% w/v), and subsequently potassium persulfate (1mL, 5%) are added to the solution prior to microwave digestion. Teflon® vessels were then capped and sealed. Digestion conditions were: ramp to 200°C in 10 minutes and held at 200°C for 30 minutes, and samples were under pressure while microwave digesting. A quantity of 0.5mL hydroxylamine sulphate solution (12% w/v) is added on cooling. The final digest was made up to a volume of 25 mL with distilled deionized water.

For the analysis of Hg in the extracts, a fully automated CV-AFS method combining a Tekran model 2620 autosampler with a 2610 pump unit and 2600 control unit was used. The technique is based on dual stage gold amalgamation with atomic fluorescence. This instrumentation allows for unattended analysis of total mercury in waters at ultra-trace levels (<0.5ppt, limited by reagent purity, trace contamination in preparation areas and sample handling techniques) and can be adapted to analyze other matrices¹. The method has been designed to meet the criteria outlined in US EPA Method 1631 (with modifications). Small quantities of liquid are required (typically 1-50 ml) with minimal preparation.

All sample preparation and analyses were carried out in a two stage clean room. Samples were digested with bromine monochloride (BrCl) and excess halide was neutralized with hydroxylamine hydrochloride. Mercury was converted from Hg²⁺

¹ Tekran Instruments Corporation. Automated Ultra-Trace Mercury Analysis of Aqueous Samples, Series 2600, Powerpoint presentation, Rev: 1.30 Oct 07, 2006.

(soluble and stable) to Hg^0 (volatile) by reduction with stannous chloride. A gas liquid separator is used to purge the Hg^0 from solution prior to being concentrated on two gold concentrator columns. Computer controlled event tables were used to accurately manage the timing and operation of the peristaltic pump, cartridge heating systems, mass flow controller and valve switching to direct the trapped mercury vapor to the CVAFS detector where it was measured. Quality control measures included blanks, calibration standards, and calibration check standards.

III. RESULTS AND DISCUSSION

A. Part 1: Determination of the most appropriate bioaccessibility method

Details of the results were given in the cover letter for this part of the study and only a summary is given here. Three samples (FF208B, CS102B, FF276F) were studied in this part of the study:

Hg bioaccessibility was higher in all samples in Phase 2 extracts (mimicking gastric + intestinal conditions) compared with the Phase 1 extracts (mimicking gastric conditions). All other element concentrations were either similar (As, some Cu) or lower in Phase 2 extracts. Se bioaccessibility was mostly undetectable. Hg is likely more soluble in the Phase 2 extraction because of increased concentrations of organic components (bile extract and pancreatin) in this phase, since Hg binds strongly to organic material. Therefore to obtain the most conservative bioaccessibility results, both phases must be included for this suite of elements.

The bioaccessibility results were generally higher using Method 3. However, the higher dilution used in Method 3 (2000:1) resulted in a large number of undetectable sample results (56% of all measurements), in spite of the attempt to use three samples that had relatively high concentrations of metals and metalloids in them. Therefore, to obtain as many detectable results as possible, we did not recommend using Method 3 for the remaining samples, since the detection is compromised with this method and the remainder of the samples have lower concentrations of contaminants than the samples analyzed in Part 1.

Statistical analysis revealed that although the smaller particle size (<45 μm) may have higher contaminant concentrations, the chemical or mineralogical form of these contaminants is less bioaccessible when bioaccessibility is expressed as a percent of the

total concentration. Thus, since the statistics do not support the use of the <45 μm fraction, we recommended proceeding with the <250 μm fraction, and Method 2 was used for the remainder of the samples.

B. Part 2: Bioaccessibility of Hg, As, Cd, Cu, Pb, Se and Zn

Bioaccessible concentrations (mg/kg) and percent bioaccessibilities were determined for all samples and are summarized in Tables 2 and 3.

Hg bioaccessibilities in Phase 2 (gastric + intestinal) were approximately double those in Phase 1 (gastric only), but did not range higher than 11% overall. Bioaccessibilities for As were generally also slightly higher in Phase 2 and ranged as high as 93%. On the other hand, Cd, Cu, Pb and Zn bioaccessibilities were generally higher in Phase 1. Maximum values for these elements overall were: Cd, 100%, Cu, 69%, Pb, 100%, and Zn, 99%. Bioaccessible Se was detectable in only one sample (FF276F) in Phase 2 (bioaccessible Se was not detectable in Phase 1). A paired t-test comparing percent bioaccessibility values between phases showed significant differences for all elements. This was observed even for As and Cu, which had similar bioaccessibility ranges and averages: average percent bioaccessibility of As in Phase 1 was 28 ± 14 , compared with 33 ± 16 in Phase 2, and average percent bioaccessibility of Cu in Phase 1 was 41 ± 11 , compared with 33 ± 9 in Phase 2. The likely reason that statistical differences were seen, even when element ranges were similar, was that for most elements the percent bioaccessibilities were remarkably consistent across the range of soil samples. Specifically, relative standard deviations (of overall means) ranged from 21% to 50% for most elements and phases. The results that were outside of this range, corresponding to the highest spread in bioaccessibilities, were observed for Hg (RSDs of 140% in Phase 1 and 65% in Phase 2) and Pb in Phase 2 (91%).

IV. CONCLUSIONS

The project commissioned by Intrinsik Environmental to determine the bioaccessibility in Hg, As, Cd, Cu, Pb, Se and Zn in soils from the Flin Flon area was carried out in two parts.

The first part, using three soils, allowed the selection of the most appropriate bioaccessibility extraction method for this site, which included the use of the <250 μm fraction of soils, and a bioaccessibility extraction fluid volume to soil mass ratio of 100:1.

Bioaccessibility of metals and metalloids in the remaining samples was determined with this method, and generally Hg and As bioaccessibilities were higher in Phase 2 (gastric + intestinal) extracts, whereas bioaccessibilities of Cd, Cu, Pb, and Zn were higher in Phase 1 (gastric) extracts. Bioaccessibility of Se was mostly not detectable.

V. LIMITATIONS AND USE OF REPORT

The present report and all previous reports and accompanying cover letters were prepared for the exclusive use of Intrinsik Environmental. The report and other materials, which specifically include all tables and appendices, is based on data obtained from the analysis of samples sent by Intrinsik.

The content of the present report is based on information collected during our analysis, our present understanding of the methods, and our professional judgement in light of such information available in this report. This report provides a professional opinion and does not provide a legal opinion regarding compliance with applicable laws.

The services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the science and engineering professions currently practising under similar conditions.

The findings and conclusions of this report are valid only as of the date of this report.

We trust that this report provides you with the information you require at this time. If you have any questions, please do not hesitate to contact us.

Dr. Allison Rutter, Director, ASU

Dr. Ken Reimer, Director, ESG

Dr. Iris Koch, Senior Analytical Manger,
ESG

VI. REFERENCES

Health Canada, 2007. Federal contaminated site risk assessment in Canada, Part V: guidance on complex site specific human health risk assessment of chemicals (SSRMChem), Version 1.0 Draft final, Prepared by Contaminated Sites Division, Safe Environments Programme.

APPENDIX A: SUMMARY OF RESULTS FROM PART 1

The summary of results from Part 1 is given Table A-1.

APPENDIX B: QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

ESG follows an internal quality assurance/quality control program that was implemented to allow data quality to be monitored on an ongoing basis. However, total metal and metalloid contents for the <250 um fraction were not included in this program since they were provided by the client, and neither ASD nor ASU reviewed the quality control results for the provided data, nor was it verified by either group.

All samples are given sequential, numerical codes before submission to the analytical firms; these codes mask any information concerning sample type or possible concentration of the sample.

Accuracy is measured and controlled by instrument calibration, the use of control spikes and samples, and the preparation and analysis of blanks.

Control spikes and samples are reference materials with known concentrations. In the present study, the soil standard reference material NIST 2710 was used during the bioaccessibility extraction, in which control ranges have been established for most of the elements of interest (As, Cd, Cu, Pb and Zn). NIST 2710 results for each element that are within the acceptable range indicate that the bioaccessibility extractions for that batch are in control. The instrument calibration is evaluated based on comparison of the results with the target concentration and recoveries within the range of 70 to 130 % are considered to be acceptable.

Analytical blanks are processed through extraction/digestion and analysis procedures. These blanks give a measure of the quantity of any contaminant (analyte) that may be added to the overall result during the analysis. Contamination is assumed to be absent when blank results are less than the detection limits for the method.

Precision is measured and controlled by the analysis of duplicates. Extraction duplicates are replicate preparations and analyses of the same sample. Comparison of the average relative standard deviations (RSD) – also known as coefficients of variation, which are calculated as the standard deviation divided by the mean – are used to evaluate laboratory precision. Acceptable limits are generally considered to be less than 40 percent RSD with 20 percent or less considered good agreement.

QC results were generally in control for all samples batches, and results are summarized in Tables B-1, B-2, and B-3. Exceptions and reasons for accepting the data are given below.

In most batches the standard reference soil NIST 2710 results for all elements were within the control limits; the exceptions were Phase 2 results for Cd, Pb and Zn in report ASD0809d and Pb and Zn in ASD0809f, which were slightly low, the Phase 2 Pb result in report ASD0807a, which was slightly high, and Phase 1 results for As, and Zn in report ASD0807a, and As, Cu, Pb and Zn in report ASD0809f, which were slightly high. Because of the preliminary nature of the control limits it is possible that they could be expanded for future use. The sample analyses are considered to be in control since most of the NIST 2710 non-conformances were no more than 40% from the control means.

Hg spike results are included in the absence of available control limits for Hg in the 2710 control sample. One spike was lost to vial breakage (Hg P2 in ASD0809b). One Phase 1 spike result (ASD0809a) and three Phase 2 Hg spike results (ASD0809c, e, f) were lower than the acceptable range (70-130%). The reason for the lower recoveries (P1: 65%; P2: 35%, 62% and 53%) is unknown and is being investigated; it may be related to adsorption/precipitation reactions, resulting from the hypothesized association of Hg with the increased organic components (bile extract, pancreatin) in this phase. In all cases the higher percent bioaccessibility was obtained in Phase 2 for Hg, where the spike recovery was acceptable.

A few blank results were detectable (Pb in ASD0809b, Cu and Pb in ASD0809d, Cd, Cu and Pb in ASD0809e, and Cu in ASD0809f) but in most cases the values were at the limit of detection or barely above it. Since values of Pb, Cu and Cd in samples are well above detection we do not consider sample analyses to be contaminated.

Within-lab repeatability (%RSDs for duplicates) was generally good but in some cases %RSDs were greater than limits usually considered acceptable (40%) (Cu and Pb in ASD0809b, Pb in ASD0809c). In all cases this occurred in Phase 2 extracts and is attributable both to sample heterogeneity and the inconsistent nature of precipitation reactions thought to be occurring in Phase 2 for these elements (Cu and Pb). In the preliminary study, all extracts were preserved at the ESG laboratory with BrCl for Hg analysis. This step caused precipitates to form in the Phase 2 (intestinal) extracts, which, for some samples, caused the repeatability to be higher than the 30% relative standard deviation (RSD) considered to be acceptable.

In some cases greater than 100% bioaccessibility was obtained for samples; these values should be considered to be 100% bioaccessible. Sample heterogeneity (differences in element concentrations in subsamples used in bioaccessibility extracts and total element analysis) is the likely cause of such results, and in most cases the results are within the uncertainty associated with laboratory analysis (30%).

Table A-1. Summary of results for Part 1. Three PBET methods were used: Method 1: <45 um fraction, liquid:solid = 100:1; Method 2: <250 um fraction, liquid:solid = 100:1; Method 3: <250 um fraction, liquid:solid = 2000:1. No substitutions for undetectable values were made when calculating averages and standard deviations.

Bioaccessible Concentrations (mg/kg)

| Phase | | Bioaccessible Hg mg/kg | | | Bioaccessible As mg/kg | | | Bioaccessible Cd mg/kg | | | Bioaccessible Cu mg/kg | | | Bioaccessible Pb mg/kg | | | Bioaccessible Se mg/kg | | | Bioaccessible Zn mg/kg | | |
|---------|---------|------------------------|------------|-------------|------------------------|------------|-------------|------------------------|------------|-------------|------------------------|------------|-------------|------------------------|------------|-------------|------------------------|------------|-------------|------------------------|------------|-------------|
| | | <45 100:1 | <250 100:1 | <250 2000:1 | <45 100:1 | <250 100:1 | <250 2000:1 | <45 100:1 | <250 100:1 | <250 2000:1 | <45 100:1 | <250 100:1 | <250 2000:1 | <45 100:1 | <250 100:1 | <250 2000:1 | <45 100:1 | <250 100:1 | <250 2000:1 | <45 100:1 | <250 100:1 | <250 2000:1 |
| Phase 1 | average | 0.54 | 0.47 | <4.0 | 126 | 72 | 110 | 40 | 33 | 47 | 1753 | 1665 | 2358 | 641 | 443 | 626 | <10 | <10 | <200 | 9881 | 7899 | 10683 |
| | SD | 0.03 | 0.02 | no calc | 5 | 12 | 6 | 1 | 5 | 4 | 146 | 47 | 70 | 29 | 73 | 21 | no calc | no calc | no calc | 754 | 223 | 804 |
| FF208B | average | <0.2 | <0.2 | <4.0 | 13 | 9.4 | <100 | 10 | 9.4 | <40 | 245 | 176 | 238 | 139 | 94 | 126 | <10 | <10 | <200 | 1362 | 1148 | 2277 |
| | SD | no calc | no calc | no calc | 1 | 0.3 | no calc | 1 | 0.3 | no calc | 20 | 3 | 19 | 11 | 3 | 16 | no calc | no calc | no calc | 82 | 52 | 96 |
| CS102B | average | 0.96 | 1.03 | <4.0 | 109 | 63 | <100 | 56 | 45 | 47 | 2326 | 2047 | 2776 | 495 | 365 | 555 | <10 | <10 | <200 | 9812 | 8863 | 11425 |
| | SD | 0.03 | 0.05 | no calc | 5 | 2 | no calc | 2 | 4 | 9 | 108 | 139 | 269 | 12 | 17 | 54 | no calc | no calc | no calc | 748 | 798 | 1165 |
| Phase 2 | average | 4.2 | 3.6 | 11 | 99 | 54 | 118 | 22 | 16.2 | <40 | 1464 | 1222 | 1893 | 132 | 79 | 222 | <10 | 8.9 | <200 | 4427 | 3541 | 3181 |
| | SD | 1.9 | 0.4 | 9 | 2 | 2 | no calc | 0.4 | 0.5 | no calc | 19 | 136 | 68 | 20 | 8 | 20 | no calc | 0.4 | no calc | 304 | 76 | 289 |
| FF208B | average | 0.53 | 0.36 | <4.0 | 13 | 8.5 | <100 | 5.6 | 5.17 | <40 | 226 | 167 | 318 | 15 | 12 | 62 | <10 | <10 | <200 | 601 | 423 | <2000 |
| | SD | 0.23 | 0.11 | no calc | 1 | 0.58 | no calc | 0.6 | 0.58 | no calc | 25 | 6 | 61 | 2 | 1 | 7 | no calc | no calc | no calc | 99 | 27 | no calc |
| CS102B | average | 17 | 11 | 29 | 100 | 65 | 106 | 21 | 21 | 41 | 1752 | 1368 | 3216 | 53 | 46 | 249 | 10.4 | 12 | <200 | 3478 | 3102 | 5464 |
| | SD | 2 | 3 | 5 | 9 | 13 | no calc | 1 | 4 | no calc | 45 | 128 | 268 | 3 | 7 | 15 | 0.8 | 1 | no calc | 210 | 243 | 669 |
| FF276F | average | 4.2 | 3.6 | 11 | 99 | 54 | 118 | 22 | 16.2 | <40 | 1464 | 1222 | 1893 | 132 | 79 | 222 | <10 | 8.9 | <200 | 4427 | 3541 | 3181 |
| | SD | 1.9 | 0.4 | 9 | 2 | 2 | no calc | 0.4 | 0.5 | no calc | 19 | 136 | 68 | 20 | 8 | 20 | no calc | 0.4 | no calc | 304 | 76 | 289 |

SD = standard deviation; RSD = relative standard deviation = standard deviation/average x 100%
no calc = no calculation (2 or 3 replicates are undetectable.)

% Bioaccessibility

| Phase | | % Bioaccessible Hg | | | % Bioaccessible As | | | % Bioaccessible Cd | | | % Bioaccessible Cu | | | % Bioaccessible Pb | | | % Bioaccessible Se | | | % Bioaccessible Zn | | |
|---------|---------|--------------------|------------|-------------|--------------------|------------|-------------|--------------------|------------|-------------|--------------------|------------|-------------|--------------------|------------|-------------|--------------------|------------|-------------|--------------------|------------|-------------|
| | | <45 100:1 | <250 100:1 | <250 2000:1 | <45 100:1 | <250 100:1 | <250 2000:1 | <45 100:1 | <250 100:1 | <250 2000:1 | <45 100:1 | <250 100:1 | <250 2000:1 | <45 100:1 | <250 100:1 | <250 2000:1 | <45 100:1 | <250 100:1 | <250 2000:1 | <45 100:1 | <250 100:1 | <250 2000:1 |
| Phase 1 | average | 0.14 | 0.20 | <1.7 | 39 | 56 | 85 | 78 | 86 | BND | 36 | 58 | 83 | 85 | 85 | BND | <8.1 | <19 | BND | 69 | 82 | BND |
| | SD | 0.01 | 0.01 | no calc | 1 | 9 | 5 | 3 | 14 | no calc | 3 | 2 | 2 | 4 | 14 | no calc | no calc | no calc | no calc | 5 | 2 | no calc |
| FF208B | average | <1.7 | <2.6 | <50 | 12.1 | 17.9 | BND | 85 | 65 | BND | 31 | 24.7 | 34 | 70 | 55 | 74 | SND | BND | BND | 61 | 54 | BND |
| | SD | no calc | no calc | no calc | 0.6 | 0.5 | no calc | 4 | 2 | no calc | 3 | 0.4 | 3 | 6 | 2 | 9 | no calc | no calc | no calc | 4 | 2 | no calc |
| CS102B | average | 0.060 | 0.11 | <0.4 | 35 | 39 | <63 | 79 | 78 | 81 | 35 | 37 | 51 | 59 | 49 | 74 | <1.6 | <3.5 | BND | 65 | 60 | 77 |
| | SD | 0.002 | 0.01 | no calc | 2 | 1 | no calc | 2 | 7 | 17 | 2 | 3 | 5 | 1 | 2 | 7 | no calc | no calc | no calc | 5 | 5 | 8 |
| Phase 2 | average | 1.1 | 1.6 | 4.6 | 30.4 | 42 | 92 | 42.9 | 43 | BND | 29.8 | 43 | 66 | 17 | 15 | 43 | <8.1 | 17 | BND | 31 | 36.8 | 33 |
| | SD | 0.5 | 0.2 | 4.0 | 0.5 | 2 | no calc | 0.7 | 1 | no calc | 0.4 | 5 | 2 | 3 | 1 | 4 | no calc | 1 | no calc | 2 | 0.8 | 3 |
| FF208B | average | 4.6 | 4.7 | <51 | 11.8 | 16 | BND | 46 | 36 | BND | 28 | 23.6 | 45 | 7.5 | 7.3 | 36 | SND | BND | BND | 27 | 20 | <93 |
| | SD | 2.0 | 1.4 | no calc | 0.5 | 1 | no calc | 5 | 4 | no calc | 3 | 0.9 | 9 | 0.8 | 0.7 | 4 | no calc | no calc | no calc | 4 | 1 | no calc |
| CS102B | average | 1.0 | 1.2 | 2.9 | 32 | 41 | 67 | 30 | 36 | 71 | 26 | 25 | 59 | 6.3 | 6 | 33 | 1.6 | 4.1 | BND | 23 | 21 | 37 |
| | SD | 0.1 | 0.3 | 0.5 | 3 | 8 | no calc | 2 | 7 | no calc | 0.7 | 2 | 5 | 0.4 | 1 | 2 | 0.1 | 0.4 | no calc | 1 | 2 | 5 |
| FF276F | average | 1.1 | 1.6 | 4.6 | 30.4 | 42 | 92 | 42.9 | 43 | BND | 29.8 | 43 | 66 | 17 | 15 | 43 | <8.1 | 17 | BND | 31 | 36.8 | 33 |
| | SD | 0.5 | 0.2 | 4.0 | 0.5 | 2 | no calc | 0.7 | 1 | no calc | 0.4 | 5 | 2 | 3 | 1 | 4 | no calc | 1 | no calc | 2 | 0.8 | 3 |

SD = standard deviation; RSD = relative standard deviation = standard deviation/average x 100%
BND = % bioaccessibility cannot be calculated because the total concentration is less than the bioaccessible concentration.
SND = % bioaccessibility cannot be calculated because the total concentration is less than the detection limit.
no calc = no calculation (2 or 3 replicates are undetectable.)



ANALYTICAL SCIENCES DIVISION

ANALYSIS REPORT COVER LETTER

Environmental
Sciences Group

Royal Military
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P.O. Box 17000
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Kingston,
Ontario

K7K 7B4

Report Number: ASD0809a
Report Date: August 21, 2008
Sample(s) reported: 8
Issue Status: complete
Analysis commenced on: July 21, 2008

Sample and Analysis Details

All samples were received in good condition.

To obtain the bioaccessible metal and metalloids contents for the human receptor, a two phase (stomach and intestine) physiologically based extraction test (PBET) method was employed. The soils were sieved to <250 um fraction and a ratio of 100:1 extraction fluid:soil mass was used. To simulate stomach conditions a portion of each (0.2 g) was extracted at body temperature (37°C) in Teflon® extraction vessels with 20 ml of simulated gastric solution at pH 1.8 for 1 hour. To simulate gastric+intestinal conditions a portion of each sample was subjected to the stomach extraction described above, and then the conditions were altered to simulate those approximating the small intestine. Intestinal extraction conditions were applied for 4 hours. The filtered (0.45 um) resulting extracts were analyzed by ICP-OES (As, Cd, Cu, Pb, Se, Zn) and by pyrolysis-cold vapour generation-AAS (Hg).

Table 1. Summary of methods and instrumentation used.

| Analytes | Test Method | Sample Matrix |
|------------------------|------------------|-------------------------|
| As, Cd, Cu, Pb, Se, Zn | ICP-OES | Bioaccessibility (PBET) |
| Hg | Pyrolysis-CV-AAS | Bioaccessibility (PBET) |

To calculate % bioaccessibility, the following equation was used for each element:

$$\% \text{Bioaccessibility} = \text{Bioaccessible Concentration (mg/kg)} / \text{Total Concentration (mg/kg)} \times 100\%$$

The Analytical Service Division does not accept responsibility for the validity of procedures used to obtain or preserve the samples provided to the Laboratory and does not accept any liability for the consequences of any acts taken or omissions made on the basis of the analysis or advice or interpretation provided. The results given relate only to the items tested.

Total metal and metalloid contents for the <250 um fraction were provided by the client. Neither ASD nor ASU reviewed the quality control results for the provided data, nor was it verified by either group.

Two spike results were slightly lower than the acceptable range (70-130%) (Hg Phase 1 and Pb Phase 2). The reason for the slightly lower Hg recovery (65%) is unknown and is being investigated. In all cases the higher % bioaccessibility was obtained in Phase 2 for Hg, where the spike recovery was acceptable. A slightly lower Pb spike recovery is not uncommon, since the Phase 2 conditions (pH 7) are not favourable to keeping dissolved Pb in solution.

Because of limitations with the current software used for reporting data, the number of significant figures quoted in the attached tables may not be representative of the actual uncertainty. Data should be considered accurate to no more than two significant figures.

This report is issued under complete status. All analyses requested for the first phase of the study have been completed and results are issued with full compliance of data verification.

Report authorised by:Iris Koch.....

Date: ...Aug 21, 2008

ESG Bioaccessibility Report ASD0809a

Site: Flin Flon
Analyst: Jessica Harris, Kim House (ESG)
Extraction Date: July 21 2008
Analysis Date: August 14 -15 2008
Report Date: August 21 2008
Method: PBET method <250 µm soil particle size 100:1

Results

| Sample Name | Bioaccessible Hg (mg/kg) | Total Hg (mg/kg) | % Bioaccessible Hg (%) | Bioaccessible As (mg/kg) | Total As (mg/kg) | % Bioaccessible As (%) | Bioaccessible Cd (mg/kg) | Total Cd (mg/kg) | % Bioaccessible Cd (%) | Bioaccessible Cu (mg/kg) | Total Cu (mg/kg) | % Bioaccessible Cu (%) |
|----------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|
| PHASE 1 | | | | | | | | | | | | |
| FF202F P1 | 0.634 | 168 | 0.38 | 15.1 | 51 | 30 | 22.7 | 26 | 86 | 1221 | 3290 | 37 |
| FF206F P1 | <0.2 | 184 | <0.11 | 16.3 | 42 | 39 | 15.4 | 16 | 99 | 914 | 1880 | 49 |
| FF209B P1* | <0.2 | 132 | <0.15 | 33.5 | 97 | 34 | 17.8 | 20 | 90 | 1084 | 1790 | 61 |
| FF229F P1 | <0.2 | 320 | <0.06 | 21.2 | 67 | 32 | 26.0 | 31 | 84 | 788 | 2530 | 31 |
| FF231F P1 | 0.366 | 535 | 0.068 | 76.2 | 124 | 61 | 67.5 | 51 | 132 | 2222 | 3970 | 56 |
| FF235B P1 | <0.2 | 370 | <0.05 | 85.9 | 169 | 51 | 38.3 | 50 | 77 | 1625 | 3850 | 42 |
| FF271F P1 | 0.191 | 330 | 0.058 | 22.2 | 99 | 22 | 46.3 | 50 | 93 | 2523 | 5530 | 46 |
| FF277F P1 | <0.2 | 183 | <0.11 | 127 | 222 | 57 | 30.6 | 37 | 84 | 1458 | 2940 | 50 |
| PHASE 2 | | | | | | | | | | | | |
| FF202F P2 | 3.60 | 168 | 2.1 | 14.2 | 51 | 28 | 11.2 | 26 | 42 | 868 | 3290 | 26 |
| FF206F P2 | 4.98 | 184 | 2.7 | 14.7 | 41.7 | 35 | 8.80 | 16 | 56 | 615 | 1880 | 33 |
| FF209B P2* | 6.11 | 132 | 4.6 | 31.9 | 97.3 | 33 | 10.2 | 20 | 52 | 777 | 1790 | 43 |
| FF229F P2 | 4.69 | 320 | 1.5 | 19.7 | 67 | 29 | 10.0 | 31 | 32 | 444 | 2530 | 18 |
| FF231F P2 | 8.93 | 535 | 1.7 | 62.9 | 124 | 51 | 23.6 | 51 | 46 | 1693 | 3970 | 43 |
| FF235B P2 | 2.85 | 370 | 0.77 | 50.3 | 169 | 30 | 16.4 | 50 | 33 | 1338 | 3850 | 35 |
| FF271F P2 | 7.58 | 330 | 2.3 | 22.9 | 98.9 | 23 | 22.4 | 50 | 45 | 1656 | 5530 | 30 |
| FF277F P2 | 5.44 | 183 | 3.0 | 110 | 222 | 50 | 12.0 | 37 | 33 | 1022 | 2940 | 35 |

| Sample Name | Bioaccessible Pb (mg/kg) | Total Pb (mg/kg) | % Bioaccessible Pb (%) | Bioaccessible Se (mg/kg) | Total Se (mg/kg) | % Bioaccessible Se (%) | Bioaccessible Zn (mg/kg) | Total Zn (mg/kg) | % Bioaccessible Zn (%) |
|----------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|
| PHASE 1 | | | | | | | | | |
| FF202F P1 | 238 | 335 | 71 | <10 | 42 | <24 | 2395 | 4010 | 60 |
| FF206F P1 | 153 | 199 | 77 | <10 | 41 | <24 | 2260 | 3270 | 69 |
| FF209B P1* | 223 | 281 | 80 | <10 | 54 | <19 | 3189 | 4350 | 73 |
| FF229F P1 | 142 | 353 | 40 | <10 | 76 | <13 | 2699 | 4550 | 59 |
| FF231F P1 | 481 | 599 | 80 | <10 | 124 | <8.1 | 13522 | 14900 | 91 |
| FF235B P1 | 635 | 746 | 85 | <10 | 98 | <10 | 10114 | 14800 | 68 |
| FF271F P1 | 468 | 726 | 64 | <10 | 95 | <11 | 5270 | 9220 | 57 |
| FF277F P1 | 494 | 640 | 77 | <10 | 66 | <15 | 8610 | 14200 | 61 |
| PHASE 2 | | | | | | | | | |
| FF202F P2 | 33 | 335 | 10 | <10 | 42 | <24 | 952 | 4010 | 24 |
| FF206F P2 | 22 | 199 | 11 | <10 | 41 | <24 | 1079 | 3270 | 33 |
| FF209B P2* | 36 | 281 | 13 | <10 | 54 | <19 | 1429 | 4350 | 33 |
| FF229F P2 | 18 | 353 | 5.0 | <10 | 76 | <13 | 794 | 4550 | 17 |
| FF231F P2 | 130 | 599 | 22 | <10 | 124 | <8.1 | 4855 | 14900 | 33 |
| FF235B P2 | 95 | 746 | 13 | <10 | 98 | <10 | 2711 | 14800 | 18 |
| FF271F P2 | 53 | 726 | 7.2 | <10 | 95 | <11 | 2104 | 9220 | 23 |
| FF277F P2 | 107 | 640 | 17 | <10 | 66 | <15 | 3371 | 14200 | 24 |

* Average of the duplicate is reported

QA/QC

| QC Samples | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg |
|------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | [Hg] | [As] | [Cd] | [Cu] | [Pb] | [Se] | [Zn] |
| Blank P1 | <0.20 | <5.0 | <2.0 | <1.0 | <0.5 | <10 | <100 |
| Blank P2 | <0.20 | <5.0 | <2.0 | <1.0 | <0.5 | <10 | <100 |
| | | | | | | | |
| Duplicates | RSD % Hg | RSD % As | RSD % Cd | RSD % Cu | RSD % Pb | RSD % Se | RSD % Zn |
| FF209B P1 | no calc | 8.4 | 8.9 | 7.0 | 3.5 | no calc | 0.6 |
| FF209B P2 | 0.5 | 8.3 | 7.3 | 1.6 | 41 | no calc | 2.4 |

no calc = at least value in the duplicate pair is below detection

Control

| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
|--|---------------|---------|---------|---------|---------|---------------|---------|
| 2710 P1 results (%) | no result | 48 | 73 | 58 | 71 | not certified | 27 |
| Accepted range (%) | not available | 19-55 | 53-85 | 53-75 | 58-81 | NA | 23-30 |
| Acceptable | NA | yes | yes | yes | yes | NA | yes |
| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
| 2710 P2 results (%) | no result | 43 | 45 | 51 | 14 | not certified | 12 |
| Accepted range (%) | not available | 22-47 | 40-53 | 45-60 | 9.6-17 | NA | 10.0-17 |
| Acceptable | NA | yes | yes | yes | yes | NA | yes |
| ESG control limits for NIST 2710 100:1 | | | | | | | |

NA = not applicable

Matrix Spikes

| | | | |
|-----------------------------------|-----|-------------------------------|-----|
| Hg P1 expected conc. 0.044 | ppm | Hg P2 expected conc. 0.050 | ppm |
| Actual Hg concentration 0.0287 | ppm | Actual Hg conc. 0.0415 | ppm |
| Recovery 65 | % | Recovery 83 | % |

QA/QC from ASU

| | Hg | As | Cd | Cu | Pb | Se | Zn |
|-----------------------|---------------------------|----------|----------|----------|----------|----------|----------|
| Blank (m/L) | <2.0 ; <2.0 ; <2.0 ; <2.0 | <0.05 | <0.02 | <0.01 | <0.005 | <0.1 | <1.0 |
| Control (mg/L) | 2.0 ; 2.0 | 4.3 | 4.2 | 8.2 | 42.3 | 3.2 | 15.6 |
| Control Target (mg/L) | 2.0 | 4.0 | 4.0 | 8.0 | 40.0 | 3.0 | 15.0 |
| % Recovery | 100; 100 | 108 | 106 | 102 | 106 | 105 | 104 |
| Control (mg/L) | 20.0 ; 20.4 | NA | NA | NA | NA | NA | NA |
| Control Target (mg/L) | 20 | NA | NA | NA | NA | NA | NA |
| % Recovery | 100; 102 | NA | NA | NA | NA | NA | NA |
| Duplicates | % RSD Hg | % RSD As | % RSD Cd | % RSD Cu | % RSD Pb | % RSD Se | % RSD Zn |
| FF231F P1 | 3.7 | NA | NA | NA | NA | NA | NA |
| FF229F P2 | 5.9 | NA | NA | NA | NA | NA | NA |
| FF235B P2 | 3.1 | NA | NA | NA | NA | NA | NA |
| FF277F P2 | 0.1 | NA | NA | NA | NA | NA | NA |

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ANALYSIS REPORT COVER LETTER

Report Number: ASD0809b, c, d, e, f
Report Date: Sept 3, 2008
Sample(s) reported: 47
Issue Status: complete
Analysis commenced on: July 23, 2008

Sample and Analysis Details

All samples were received in good condition.

To obtain the bioaccessible metal and metalloid contents for the human receptor, a two phase (stomach and intestine) physiologically based extraction test (PBET) method was employed. The soils were sieved to <250 um fraction and a ratio of 100:1 extraction fluid:soil mass was used. To simulate stomach conditions a portion of each (0.2 g for samples in reports ASD0809d, e, f; 0.6 g for reports ASD0809b, c) was extracted at body temperature (37°C) in Teflon® extraction vessels with 20 ml (ASD0809d, e, f) or in glass jars with 60 ml (ASD0809b, c) of simulated gastric solution at pH 1.8 for 1 hour. To simulate gastric+intestinal conditions a portion of each sample was subjected to the stomach extraction described above, and then the conditions were altered to simulate those approximating the small intestine. Intestinal extraction conditions were applied for 4 hours. The filtered (0.45 um) resulting extracts were analyzed by ICP-OES (As, Cd, Cu, Pb, Se, Zn) and by pyrolysis-cold vapour generation-AAS (Hg) (reports d, e, f). For samples in reports ASD0809b and ASD0809c, Phase 2 (gastric+intestinal) extracts were digested and then analyzed for Hg by cold vapour generation AFS.

Table 1. Summary of methods and instrumentation used.

| Analytes | Test Method | Sample Matrix |
|------------------------|------------------|--|
| As, Cd, Cu, Pb, Se, Zn | ICP-OES | Bioaccessibility (PBET) |
| Hg (total Hg>7 ppm) | Pyrolysis-CV-AAS | Bioaccessibility (PBET) |
| Hg (total Hg<7 ppm) | CV-AFS | Bioaccessibility (PBET), phase 2 extracts digested |

The Analytical Service Division does not accept responsibility for the validity of procedures used to obtain or preserve the samples provided to the Laboratory and does not accept any liability for the consequences of any acts taken or omissions made on the basis of the analysis or advice or interpretation provided. The results given relate only to the items tested.

To calculate % bioaccessibility, the following equation was used for each element:

$$\% \text{Bioaccessibility} = \text{Bioaccessible Concentration (mg/kg)} / \text{Total Concentration (mg/kg)} \times 100\%$$

Total metal and metalloid contents for the <250 um fraction were provided by the client. Neither ASD nor ASU reviewed the quality control results for the provided data, nor was it verified by either group.

Several blank results were detectable (Pb in ASD0809b, Cu and Pb in ASD0809d, Cd, Cu and Pb in ASD0809e, and Cu in ASD0809f) but in most cases the values were at the limit of detection or barely above it. Since values of Pb, Cu and Cd in samples are well above detection we do not consider sample analyses to be contaminated.

Within-lab repeatability (%RSDs for duplicates) was generally good but in some cases %RSDs were greater than limits usually considered acceptable (40%) (Cu and Pb in ASD0809b, Pb in ASD0809c). In all cases this occurred in Phase 2 extracts and is attributable both to sample heterogeneity and the inconsistent nature of precipitation reactions thought to be occurring in Phase 2 for these elements (Cu and Pb).

A standard reference soil was included in each batch, for which control limits have been established in our lab previously. In most batches results for all elements were within the control limits; the exceptions were Phase 2 results for Cd, Pb and Zn in report ASD0809d and Pb and Zn in ASD0809f, which were slightly low, and Phase 1 results for As, Cu, Pb and Zn in report ASD0809f, which were slightly high. Because of the preliminary nature of the control limits it is possible that they could be expanded for future use. The sample analyses are considered to be in control since most of the non-conformances were no more than 40% from the control means.

Hg spike results are included in the absence of available control limits for Hg in the 2710 control sample. One spike was lost to vial breakage (Hg P2 in ASD0809b). Three Phase 2 Hg spike results were lower than the acceptable range (70-130%) (ASD0809c, e, f). The reason for the lower recoveries (35%, 62% and 53%) is unknown and is being investigated; it may be related to adsorption/precipitation reactions, resulting from the hypothesized association of Hg with the increased organic components (bile extract, pancreatin) in this phase.

In some cases greater than 100% bioaccessibility was obtained for samples; these values should be considered to be 100% bioaccessible. Sample heterogeneity (differences in element concentrations in subsamples used in

bioaccessibility extracts and total element analysis) is the likely cause of such results, and in most cases the results are within the uncertainty associated with laboratory analysis (30%).

Because of limitations with the current software used for reporting data, the number of significant figures quoted in the attached tables may not be representative of the actual uncertainty. Data should be considered accurate to no more than two significant figures.

This report is issued under complete status. All analyses requested for the first phase of the study have been completed and results are issued with full compliance of data verification.

Report authorised by:Iris Koch.....

Date: ...Sept 3, 2008

ESG Bioaccessibility Report ASD0809b

Site: Flin Flon
Analyst: Jessica Harris, Kim House (ESG)
Extraction Date: July 23 2008
Analysis Date: August 12, 22 2008
Report Date: August 26 2008
Method: PBET method, liquid to solid ratio 100:1 and <250 µm soil particle size

Results

| Sample Name | Bioaccessible Hg (mg/kg) | Total Hg (mg/kg) | % Bioaccessible Hg (%) | Bioaccessible As (mg/kg) | Total As (mg/kg) | % Bioaccessible As (%) | Bioaccessible Cd (mg/kg) | Total Cd (mg/kg) | % Bioaccessible Cd (%) | Bioaccessible Cu (mg/kg) | Total Cu (mg/kg) | % Bioaccessible Cu (%) |
|-------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|
| PHASE 1 | | | | | | | | | | | | |
| FF402F P1 | 0.024 | 0.31 | 7.6 | <5.0 | 8.9 | <56 | 2.0 | 2.9 | 70 | 51 | 118 | 43 |
| FF408G P1* | 0.0081 | 0.46 | 1.8 | <5.0 | 7.6 | <66 | 2.0 | 2.3 | 87 | 21 | 95 | 22 |
| FF402G P1 | 0.013 | 0.55 | 2.4 | 6.5 | 16 | 42 | 5.0 | 5.3 | 96 | 59 | 195 | 30 |
| CS112G P1 | 0.036 | 0.60 | 6.1 | 5.1 | 19 | 27 | 5.1 | 3.8 | 132 | 47 | 141 | 33 |
| FF324B P1 | 0.011 | 1.2 | 0.94 | <5.0 | 13 | <38 | 7.2 | 7.9 | 91 | 141 | 389 | 36 |
| FF401B P1 | 0.0094 | 1.2 | 0.77 | <5.0 | 12 | <42 | 3.1 | 3.9 | 78 | 69 | 165 | 42 |
| FF402B P1 | 0.014 | 2.4 | 0.60 | 5.1 | 25 | 20 | 12 | 13 | 96 | 169 | 468 | 36 |
| CS114F P1 | 0.030 | 2.6 | 1.2 | 5.6 | 34 | 16 | 23 | 28 | 84 | 198 | 1090 | 18 |
| PHASE 2 | | | | | | | | | | | | |
| FF402F P2 | 0.018 | 0.31 | 5.7 | <5.0 | 8.9 | <56 | <2.0 | 2.9 | <69 | 48 | 118 | 41 |
| FF408G P2* | 0.013 | 0.46 | 2.9 | 7.1 | 7.6 | 93 | <2.0 | 2.3 | <87 | 66 | 95 | 69 |
| FF402G P2 | 0.020 | 0.55 | 3.7 | 7.4 | 16 | 48 | 2.1 | 5.3 | 40 | 71 | 195 | 37 |
| CS112G P2 | 0.065 | 0.60 | 11 | 6.5 | 19 | 35 | <2.0 | 3.8 | <53 | 55 | 141 | 39 |
| FF324B P2 | 0.068 | 1.2 | 5.6 | <5.0 | 13 | <38 | 2.0 | 7.9 | 25 | 124 | 389 | 32 |
| FF401B P2 | 0.061 | 1.2 | 5.0 | <5.0 | 12 | <42 | 2.1 | 3.9 | 54 | 70 | 165 | 43 |
| FF402B P2 | 0.10 | 2.4 | 4.1 | 7.9 | 25 | 31 | 6.4 | 13 | 50 | 155 | 468 | 33 |
| CS114F P2 | 0.076 | 2.6 | 2.9 | 6.1 | 34 | 18 | 6.1 | 28 | 22 | 194 | 1090 | 18 |

| Sample Name | Bioaccessible Pb (mg/kg) | Total Pb (mg/kg) | % Bioaccessible Pb (%) | Bioaccessible Se (mg/kg) | Total Se (mg/kg) | % Bioaccessible Se (%) | Bioaccessible Zn (mg/kg) | Total Zn (mg/kg) | % Bioaccessible Zn (%) |
|-------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|
| PHASE 1 | | | | | | | | | |
| FF402F P1 | 48 | 56 | 85 | <10 | 0.3 | BND | 245 | 515 | 48 |
| FF408G P1* | 21 | 31 | 68 | <10 | 0.7 | BND | 233 | 438 | 53 |
| FF402G P1 | 61 | 107 | 57 | <10 | 1.1 | BND | 698 | 1020 | 68 |
| CS112G P1 | 1048 | 1490 | 70 | <10 | 5.8 | BND | 346 | 350 | 99 |
| FF324B P1 | 51 | 56 | 92 | <10 | 1.4 | BND | 371 | 567 | 65 |
| FF401B P1 | 63 | 74 | 85 | <10 | 0.8 | BND | 309 | 655 | 47 |
| FF402B P1 | 122 | 226 | 54 | <10 | 2.3 | BND | 2073 | 2960 | 70 |
| CS114F P1 | 77 | 200 | 38 | <10 | 5.6 | BND | 1019 | 1270 | 80 |
| PHASE 2 | | | | | | | | | |
| FF402F P2 | 7.3 | 56 | 13 | <10 | 0.3 | BND | 99 | 515 | 19 |
| FF408G P2* | 23 | 31 | 72 | <10 | 0.7 | BND | <100 | 438 | <23 |
| FF402G P2 | 6.4 | 107 | 6.0 | <10 | 1.1 | BND | 254 | 1020 | 25 |
| CS112G P2 | 131 | 1490 | 8.8 | <10 | 5.8 | BND | <100 | 350 | <29 |
| FF324B P2 | 5.9 | 56 | 11 | <10 | 1.4 | BND | <100 | 567 | <18 |
| FF401B P2 | 9.5 | 74 | 13 | <10 | 0.8 | BND | 112 | 655 | 17 |
| FF402B P2 | 20 | 226 | 8.9 | <10 | 2.3 | BND | 844 | 2960 | 29 |
| CS114F P2 | 7.1 | 200 | 3.6 | <10 | 5.6 | BND | 173 | 1270 | 14 |

*average of duplicate pair reported

BND = total initial concentration is less than the detection limit of bioaccessible fraction, therefore % bioaccessibility cannot be calculated

QA/QC

| QC Samples | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg |
|------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | [Hg] | [As] | [Cd] | [Cu] | [Pb] | [Se] | [Zn] |
| Blank P1 | <0.005 | <5.0 | <2.0 | <1.0 | <0.5 | <10 | <100 |
| Blank P2 | <0.008 | <5.0 | <2.0 | <1.0 | 0.5 | <10 | <100 |
| Duplicates | RSD % Hg | RSD % As | RSD % Cd | RSD % Cu | RSD % Pb | RSD % Se | RSD % Zn |
| FF408G P1 | 31 | no calc | 0 | 7 | 7 | no calc | 3 |
| FF408G P2 | 17 | no calc | no calc | 74 | 135 | no calc | no calc |

bioaccessible concentrations used for the RSD calculations

no calc = one or both duplicates are less than detection

Control

| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
|------------------------|---------------|---------|---------|---------|---------|---------------|---------|
| 2710 P1 results | no result | 42% | 70% | 61% | 66% | not certified | 26% |
| Accepted range (%) | not available | 19-55 | 53-85 | 53-75 | 58-81 | NA | 23-30 |
| Acceptable | NA | yes | yes | yes | yes | NA | yes |
| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
| 2710 P2 results | no result | 36% | 43% | 57% | 10% | not certified | 10% |
| Accepted range (%) | not available | 22-47 | 40-53 | 45-60 | 9.6-17 | NA | 10.0-17 |
| Acceptable | NA | yes | yes | yes | yes | NA | yes |

ESG control limits for NIST 2710 100:1

Matrix Spikes

| | |
|--------------------------------------|--------------------------------------|
| Hg P1 expected conc. 0.054 ppm | Hg P2 expected conc. vial lost |
| Actual Hg concentration 0.041 ppm | Actual Hg concentration vial lost |
| Recovery 76 % | Recovery vial lost |

QA/QC from ASU

| | Hg (ug/L) | As | Cd | Cu | Pb | Se | Zn |
|-----------------------|--|----------|----------|----------|----------|----------|----------|
| Blank (mg/L) | <0.01; <0.01; <0.01; <0.01 | <0.05 | <0.02 | <0.01 | <0.005 | <0.1 | <1.0 |
| Control (mg/L) | 0.006; 0.006; 0.005; 0.005; 0.005; 0.006 | 4.2 | 4.0 | 7.7 | 40.1 | 3.0 | 15.4 |
| Control Target (mg/L) | 0.005 | 4.0 | 4.0 | 8.0 | 40.0 | 3.0 | 15.0 |
| % Recovery | 100 -110 | 105 | 100 | 96 | 100 | 100 | 103 |
| Control (mg/L) | 0.061; 0.064; 0.082; 0.077; 0.072; 0.072 | 4.0 | 3.8 | 7.4 | 38 | 2.9 | 14 |
| Control Target (mg/L) | 0.075 | 4.0 | 4.0 | 8.0 | 40 | 3.0 | 15 |
| % Recovery | 81 - 109 | 100 | 95 | 93 | 95 | 97 | 94 |
| Duplicates | % RSD Hg | % RSD As | % RSD Cd | % RSD Cu | % RSD Pb | % RSD Se | % RSD Zn |
| FF312B P1 | 0.0 | NA | NA | NA | NA | NA | NA |
| FF408B DUP P2 | 3.2 | NA | NA | NA | NA | NA | NA |

ESG Bioaccessibility Report ASD0809c

Site: Flin Flon
Analyst: Jessica Harris, Kim House (ESG)
Extraction Date: July 25 3008
Analysis Date: August 12, 22 2008
Report Date: September 03 2008
Method: PBET method, liquid to solid ratio 100:1 and <250 µm soil particle size

Results

| Sample Name | Bioaccessible Hg (mg/kg) | Total Hg (mg/kg) | % Bioaccessible Hg (%) | Bioaccessible As (mg/kg) | Total As (mg/kg) | % Bioaccessible As (%) | Bioaccessible Cd (mg/kg) | Total Cd (mg/kg) | % Bioaccessible Cd (%) | Bioaccessible Cu (mg/kg) | Total Cu (mg/kg) | % Bioaccessible Cu (%) |
|-------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|
| PHASE 1 | | | | | | | | | | | | |
| FF410 P1 | 0.037 | 3.4 | 1.1 | 4.4 | 36 | 12 | 8.9 | 14 | 62 | 258 | 630 | 41 |
| FF408B P1* | 0.028 | 4.0 | 0.70 | <5.0 | 14 | <36 | 7.4 | 9.3 | 80 | 112 | 284 | 39 |
| CS111F P1 | 0.038 | 4.8 | 0.78 | 6.4 | 36 | 18 | 6.9 | 13 | 54 | 209 | 720 | 29 |
| FF408F P1 | 0.019 | 4.8 | 0.40 | <5.0 | 17 | <29 | 7.8 | 15 | 50 | 94 | 540 | 17 |
| FF221F P1 | 0.040 | 5.0 | 0.80 | 4.9 | 10 | 48 | 4.9 | 4.0 | 124 | 182 | 335 | 54 |
| FF404F P1 | 0.036 | 5.5 | 0.66 | <5.0 | 17 | <29 | 14 | 21 | 68 | 108 | 660 | 16 |
| FF310F P1 | 0.031 | 6.1 | 0.50 | 4.3 | 17 | 25 | 11 | 11 | 103 | 211 | 620 | 34 |
| FF312B P1 | 0.020 | 6.6 | 0.30 | <5.0 | 14 | <36 | 20 | 19 | 104 | 404 | 989 | 41 |
| PHASE 2 | | | | | | | | | | | | |
| FF410 P2 | 0.18 | 3.4 | 5.4 | 7.1 | 36 | 20 | 6.1 | 14 | 43 | 206 | 630 | 33 |
| FF408B P2* | 0.052 | 4.0 | 1.3 | <5.0 | 14 | <36 | 5.1 | 9.3 | 55 | 118 | 284 | 41 |
| CS111F P2 | 0.25 | 4.8 | 5.3 | 11 | 36 | 31 | 5.1 | 13 | 40 | 184 | 720 | 25 |
| FF408F P2 | 0.038 | 4.8 | 0.79 | <5.0 | 17 | <29 | 5.0 | 15 | 33 | 110 | 540 | 20 |
| FF221F P2 | 0.21 | 5.0 | 4.2 | 7.2 | 10 | 70 | 2.9 | 4.0 | 73 | 171 | 335 | 51 |
| FF404F P2 | 0.046 | 5.5 | 0.83 | 5.1 | 17 | 30 | 4.0 | 21 | 20 | 119 | 660 | 18 |
| FF310F P2 | 0.059 | 6.1 | 1.0 | 5.4 | 17 | 32 | 5.9 | 11 | 53 | 185 | 620 | 30 |
| FF312B P2 | 0.078 | 6.6 | 1.2 | <5.0 | 14 | <36 | 8.0 | 19 | 42 | 288 | 989 | 29 |

| Sample Name | Bioaccessible Pb (mg/kg) | Total Pb (mg/kg) | % Bioaccessible Pb (%) | Bioaccessible Se (mg/kg) | Total Se (mg/kg) | % Bioaccessible Se (%) | Bioaccessible Zn (mg/kg) | Total Zn (mg/kg) | % Bioaccessible Zn (%) |
|-------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|
| PHASE 1 | | | | | | | | | |
| FF410 P1 | 100 | 183 | 55 | <10 | 3.0 | BND | 1355 | 3350 | 40 |
| FF408B P1* | 73 | 90 | 81 | <10 | 1.9 | BND | 906 | 1310 | 69 |
| CS111F P1 | 64 | 154 | 42 | <10 | 4.2 | BND | 243 | 476 | 51 |
| FF408F P1 | 67 | 163 | 41 | <10 | 3.1 | BND | 1324 | 3000 | 44 |
| FF221F P1 | 31 | 42 | 75 | <10 | 1.8 | BND | 331 | 484 | 68 |
| FF404F P1 | 53 | 136 | 39 | <10 | 3.0 | BND | 725 | 1190 | 61 |
| FF310F P1 | 196 | 111 | 177 | <10 | 3.6 | BND | 2228 | 3350 | 67 |
| FF312B P1 | 118 | 164 | 72 | <10 | 3.6 | BND | 1367 | 1640 | 83 |
| PHASE 2 | | | | | | | | | |
| FF410 P2 | 11 | 183 | 6.1 | <10 | 3.0 | BND | 544 | 3350 | 16 |
| FF408B P2* | 24 | 90 | 27 | <10 | 1.9 | BND | 410 | 1310 | 31 |
| CS111F P2 | 15 | 154 | 10 | <10 | 4.2 | BND | 96 | 476 | 20 |
| FF408F P2 | 16 | 163 | 9.8 | <10 | 3.1 | BND | 622 | 3000 | 21 |
| FF221F P2 | 4.8 | 42 | 11 | <10 | 1.8 | BND | 127 | 484 | 26 |
| FF404F P2 | 5.1 | 136 | 3.7 | <10 | 3.0 | BND | 116 | 1190 | 10 |
| FF310F P2 | 22 | 111 | 19 | <10 | 3.6 | BND | 576 | 3350 | 17 |
| FF312B P2 | 16 | 164 | 9.8 | <10 | 3.6 | BND | 405 | 1640 | 25 |

* average of duplicate pair

BND = total initial concentration is less than the detection limit of bioaccessible fraction, therefore % bioaccessibility cannot be calculated

QA/QC Experimental

| QC Samples | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg |
|------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Blank | [Hg] | [As] | [Cd] | [Cu] | [Pb] | [Se] | [Zn] |
| Blank P1 | <0.005 | <5.0 | <2.0 | <1.0 | <0.5 | <10 | <100 |
| Blank P2 | <0.008 | <5.0 | <2.0 | <1.0 | <0.5 | <10 | <100 |
| | | | | | | | |
| Duplicates | RSD % Hg | RSD % As | RSD % Cd | RSD % Cu | RSD % Pb | RSD % Se | RSD % Zn |
| FF408B P1 | 2.0 | no calc | 8.7 | 4.8 | 4.8 | no calc | 8.9 |
| FF408B P2 | 17 | no calc | 2.6 | 0.2 | 53 | no calc | 1.0 |

no calc = RSD % could not be calculated since at least one value was below the detection limit

Control

| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
|------------------------|---------------|---------|---------|---------|---------|---------------|---------|
| 2710 P1 results | no result | 37 | 63 | 55 | 60 | not certified | 23 |
| Accepted range (%) | not available | 19-55 | 53-85 | 53-75 | 58-81 | NA | 23-30 |
| Acceptable | NA | yes | yes | yes | yes | NA | yes |
| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
| 2710 P2 results | no result | 40 | 46 | 49 | 12 | not certified | 12 |
| Accepted range (%) | not available | 22-47 | 40-53 | 45-60 | 9.6-17 | NA | 10.0-17 |
| Acceptable | NA | yes | yes | yes | yes | NA | yes |

ESG control limits for NIST 2710 100:1

Matrix Spikes

| | |
|---------------------------------------|--------------------------------------|
| Hg P1 expected conc. 0.054 ppm | Hg P2 expected conc. 0.054 ppm |
| Actual Hg concentration 0.0543 ppm | Actual Hg concentration 0.019 ppm |
| Recovery 101 % | Recovery 35 % |

QA/QC from ASU

| | Hg (ug/L) | As | Cd | Cu | Pb | Se | Zn |
|-----------------------|--|----------|----------|----------|----------|----------|----------|
| Blank (mg/L) | <0.01; <0.01; <0.01; <0.01; <0.01; <0.01 | <0.05 | <0.02 | <0.01 | <0.005 | <0.1 | <1.0 |
| Control (mg/L) | 0.006; 0.006; 0.005; 0.005; 0.005; 0.006 | 4.2 | 4.0 | 7.7 | 40 | 3.0 | 15 |
| Control Target (mg/L) | 0.005 | 4.0 | 4.0 | 8.0 | 40 | 3.0 | 15 |
| % Recovery | 100 - 110 | 105 | 100 | 96 | 100 | 100 | 103 |
| Control (mg/L) | 0.061; 0.064; 0.082; 0.077; 0.072; 0.072 | 4.0 | 3.8 | 7.4 | 38 | 2.9 | 14 |
| Control Target (mg/L) | 0.075 | 4.0 | 4.0 | 8.0 | 40 | 3.0 | 15 |
| % Recovery | 81 - 109 | 100 | 95 | 93 | 95 | 97 | 94 |
| Duplicates | % RSD Hg | % RSD As | % RSD Cd | % RSD Cu | % RSD Pb | % RSD Se | % RSD Zn |
| FF312B P1 | 0.0 | NA | NA | NA | NA | NA | NA |
| FF408B DUP P2 | 3.2 | NA | NA | NA | NA | NA | NA |

ESG Bioaccessibility Report ASD0809d

Site: Flin Flon
Analyst: Jessica Harris, Kim House (ESG)
Extraction Date: July 28 2008
Analysis Date: August 18, Sept 02, 2008
Report Date: September 03 2008
Method: PBET method <250 µm soil particle size 100:1

Results

| Sample Name | Bioaccessible Hg (mg -kg) | Total Hg (mg -kg) | % Bioaccessible Hg (%) | Bioaccessible As (mg -kg) | Total As (mg -kg) | % Bioaccessible As (%) | Bioaccessible Cd (mg -kg) | Total Cd (mg -kg) | % Bioaccessible Cd (%) | Bioaccessible Cu (mg -kg) | Total Cu (mg -kg) | % Bioaccessible Cu (%) |
|-------------|---------------------------|-------------------|------------------------|---------------------------|-------------------|------------------------|---------------------------|-------------------|------------------------|---------------------------|-------------------|------------------------|
| PHASE 1 | | | | | | | | | | | | |
| CS104F P1 | <0.2 | 38.8 | <0.5 | 27 | 314 | 8.6 | 16 | 20.5 | 76 | 546 | 1270 | 43 |
| FF201F P1 | <0.2 | 45 | <0.4 | <5.0 | 18.9 | <26 | 5.8 | 7.22 | 81 | 232 | 640 | 36 |
| FF206B P1 | <0.2 | 100 | <0.2 | 23 | 49.2 | 46 | 20 | 21 | 97 | 863 | 1610 | 54 |
| FF210B P1 | <0.2 | 101 | <0.2 | 19 | 88.5 | 21 | 20 | 26.8 | 76 | 905 | 2120 | 43 |
| FF225B P1 * | <0.2 | 90.0 | <0.2 | 28 | 77.9 | 36 | 21 | 24 | 89 | 752 | 1830 | 41 |
| FF239F P1 | <0.2 | 127 | <0.2 | 27 | 104 | 26 | 49 | 57.9 | 85 | 1614 | 3770 | 43 |
| FF258F P1 | <0.2 | 42 | <0.5 | 27 | 139 | 19 | 26 | 35.1 | 73 | 936 | 2310 | 41 |
| FF278F P1 | <0.2 | 71 | <0.3 | 16 | 138 | 12 | 16 | 25.4 | 64 | 865 | 2920 | 30 |
| PHASE 2 | | | | | | | | | | | | |
| CS104F P2 | 1.8 | 38.8 | 4.7 | 48 | 314 | 15 | 3.9 | 20.5 | 19 | 482 | 1270 | 38 |
| FF201F P2 | 0.71 | 45 | 1.6 | <5.0 | 18.9 | <26 | 2.9 | 7.22 | 41 | 186 | 640 | 29 |
| FF206B P2 | 4.2 | 100 | 4.2 | 24 | 49.2 | 48 | 11 | 21 | 52 | 645 | 1610 | 40 |
| FF210B P2 | 2.9 | 101 | 2.8 | 35 | 88.5 | 40 | 16 | 26.8 | 59 | 700 | 2120 | 33 |
| FF225B P2 * | 2.0 | 90 | 2.2 | 26 | 77.9 | 34 | 14 | 24 | 57 | 704 | 1830 | 38 |
| FF239F P2 | 3.1 | 127 | 2.4 | 28 | 104 | 27 | 23 | 57.9 | 40 | 1135 | 3770 | 30 |
| FF258F P2 | 1.3 | 42 | 3.0 | 29 | 139 | 21 | 15 | 35.1 | 41 | 693 | 2310 | 30 |
| FF278F P2 | 3.0 | 71 | 4.2 | 23 | 138 | 17 | 11 | 25.4 | 42 | 767 | 2920 | 26 |

| Sample Name | Bioaccessible Pb (mg -kg) | Total Pb (mg -kg) | % Bioaccessible Pb (%) | Bioaccessible Se (mg -kg) | Total Se (mg -kg) | % Bioaccessible Se (%) | Bioaccessible Zn (mg -kg) | Total Zn (mg -kg) | % Bioaccessible Zn (%) |
|-------------|---------------------------|-------------------|------------------------|---------------------------|-------------------|------------------------|---------------------------|-------------------|------------------------|
| PHASE 1 | | | | | | | | | |
| CS104F P1 | 101 | 394 | 26 | <10 | 20.4 | <49 | 743 | 1690 | 44 |
| FF201F P1 | 47 | 81.5 | 57 | <10 | 10.2 | <98 | 995 | 1280 | 78 |
| FF206B P1 | 135 | 209 | 65 | <10 | 32.4 | <31 | 3258 | 4410 | 74 |
| FF210B P1 | 266 | 420 | 63 | <10 | 26.5 | <38 | 2491 | 4260 | 58 |
| FF225B P1 * | 211 | 274 | 77 | <10 | 28.4 | <35 | 3053 | 4520 | 68 |
| FF239F P1 | 407 | 638 | 64 | <10 | 43.3 | <23 | 6035 | 8780 | 69 |
| FF258F P1 | 269 | 476 | 56 | <10 | 30.5 | <33 | 3977 | 7210 | 55 |
| FF278F P1 | 219 | 461 | 47 | <10 | 25.2 | <40 | 2328 | 5670 | 41 |
| PHASE 2 | | | | | | | | | |
| CS104F P2 | 31 | 394 | 7.9 | <10 | 20.4 | <49 | 160 | 1690 | 9.5 |
| FF201F P2 | 4.9 | 81.5 | 6.0 | <10 | 10.2 | <98 | 315 | 1280 | 25 |
| FF206B P2 | 18 | 209 | 8.5 | <10 | 32.4 | <31 | 1478 | 4410 | 34 |
| FF210B P2 | 31 | 420 | 7.5 | <10 | 26.5 | <38 | 1693 | 4260 | 40 |
| FF225B P2 * | 36 | 274 | 13 | <10 | 28.4 | <35 | 1215 | 4520 | 27 |
| FF239F P2 | 41 | 638 | 6.4 | <10 | 43.3 | <23 | 2228 | 8780 | 25 |
| FF258F P2 | 22 | 476 | 4.6 | <10 | 30.5 | <33 | 1739 | 7210 | 24 |
| FF278F P2 | 28 | 461 | 6.1 | <10 | 25.2 | <40 | 1194 | 5670 | 21 |

* Average of the duplicate is reported

QA/QC

| QC Samples | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg |
|------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Blank | [Hg] | [As] | [Cd] | [Cu] | [Pb] | [Se] | [Zn] |
| Blank P1 | <0.20 | <5.0 | <2.0 | <1.0 | 1.0 | <10 | <100 |
| Blank P2 | <0.20 | <5.0 | <2.0 | 2.0 | 5.0 | <10 | <100 |
| | | | | | | | |
| Duplicates | RSD % Hg | RSD % As | RSD % Cd | RSD % Cu | RSD % Pb | RSD % Se | RSD % Zn |
| FF209B P1 | no calc | 0.8 | 0.8 | 2.7 | 0.2 | no calc | 0.3 |
| FF209B P2 | 11 | 8.6 | 15 | 27 | 36 | no calc | 13 |

no calc = %RSD not calculated because at least one value in the duplicate pair is below detection

Control

| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
|---------------------|---------------|---------|---------|---------|---------|---------------|---------|
| 2710 P1 results (%) | no result | 46 | 75 | 65 | 71 | not certified | 28 |
| Accepted Range (%) | not available | 19-55 | 53-85 | 53-75 | 58-81 | NA | 23-30 |
| Acceptable | NA | Yes | Yes | Yes | Yes | NA | Yes |
| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
| 2710 P2 results (%) | 12 | 36 | 36 | 54 | 9.2 | not certified | 7.5 |
| Average | not available | 22-47 | 40-53 | 45-60 | 9.6-17 | NA | 10-16 |
| Acceptable | NA | Yes | No | Yes | No | NA | No |

ESG control limits for NIST 2710 100:1

NA = not applicable

Matrix Spikes

| | |
|---------------------------------------|---------------------------------------|
| Hg P1 expected conc. 0.047 ppm | Hg P2 expected conc. 0.042 ppm |
| Actual Hg concentration 0.0378 ppm | Actual Hg concentration 0.0327 ppm |
| Recovery 80 % | Recovery 78 % |

QA/QC from ASU

| | Hg (ug/L) | As | Cd | Cu | Pb | Se | Zn |
|-----------------------|-------------|----------|----------|----------|----------|----------|----------|
| Blank (mg/L) | <2.0 , <2.0 | <0.05 | <0.02 | <0.01 | <0.005 | <0.1 | <1.0 |
| Control (mg/L) | 2.0 ; 2.0 | 4.3 | 3.9 | 7.8 | 40.0 | 3.2 | 14.8 |
| Control Target (mg/L) | 2.0 | 4.0 | 4.0 | 8.0 | 40.0 | 3.0 | 15.0 |
| % Recovery | 100, 100 | 107 | 99 | 98 | 100 | 107 | 99 |
| Control (mg/L) | 18.8 ; 19.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| Control Target (mg/L) | 20 | n/a | n/a | n/a | n/a | n/a | n/a |
| % Recovery | 94, 96.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| Duplicates | RSD % Hg | RSD % As | RSD % Cd | RSD % Cu | RSD % Pb | RSD % Se | RSD % Zn |
| CS104F P1 | no calc | n/a | n/a | n/a | n/a | n/a | n/a |
| FF278F P1 | no calc | n/a | n/a | n/a | n/a | n/a | n/a |
| FF201F P2 | 2.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| FF278F P2 | 0.0 | n/a | n/a | n/a | n/a | n/a | n/a |

no calc = %RSD not calculated because at least one value in the duplicate pair is below detection

ESG Bioaccessibility Report ASD0809d

Site: Flin Flon
 Analyst: Jessica Harris, Kim House (ESG)
 Extraction Date: July 28 2008
 Analysis Date: August 18, Sept 02, 2008
 Report Date: September 03 2008
 Method: PBET method <250 µm soil particle size 100:1

AMENDED REPORT

Results

| Sample Name | Bioaccessible Hg (mg -kg) | Total Hg (mg -kg) | % Bioaccessible Hg (%) | Bioaccessible As (mg -kg) | Total As (mg -kg) | % Bioaccessible As (%) | Bioaccessible Cd (mg -kg) | Total Cd (mg -kg) | % Bioaccessible Cd (%) | Bioaccessible Cu (mg -kg) | Total Cu (mg -kg) | % Bioaccessible Cu (%) |
|-------------|---------------------------|-------------------|------------------------|---------------------------|-------------------|------------------------|---------------------------|-------------------|------------------------|---------------------------|-------------------|------------------------|
| PHASE 1 | | | | | | | | | | | | |
| CS104F P1 | <0.2 | 38.8 | <0.5 | 27 | 314 | 8.6 | 16 | 20.5 | 76 | 546 | 1270 | 43 |
| FF201F P1 | <0.2 | 45 | <0.4 | <5.0 | 18.9 | <26 | 5.8 | 7.22 | 81 | 232 | 640 | 36 |
| FF206B P1 | <0.2 | 100 | <0.2 | 23 | 49.2 | 46 | 20 | 21 | 97 | 863 | 1610 | 54 |
| FF210B P1 | <0.2 | 101 | <0.2 | 19 | 88.5 | 21 | 20 | 26.8 | 76 | 905 | 2120 | 43 |
| FF225B P1 * | <0.2 | 90.0 | <0.2 | 28 | 77.9 | 36 | 21 | 24 | 89 | 752 | 1830 | 41 |
| FF239F P1 | <0.2 | 127 | <0.2 | 27 | 104 | 26 | 49 | 57.9 | 85 | 1614 | 3770 | 43 |
| FF258F P1 | <0.2 | 42 | <0.5 | 27 | 139 | 19 | 26 | 35.1 | 73 | 936 | 2310 | 41 |
| FF278F P1 | <0.2 | 71 | <0.3 | 16 | 138 | 12 | 16 | 25.4 | 64 | 865 | 2920 | 30 |
| PHASE 2 | | | | | | | | | | | | |
| CS104F P2 | 1.8 | 38.8 | 4.7 | 48 | 314 | 15 | 3.9 | 20.5 | 19 | 482 | 1270 | 38 |
| FF201F P2 | 0.71 | 45 | 1.6 | <5.0 | 18.9 | <26 | 2.9 | 7.22 | 41 | 186 | 640 | 29 |
| FF206B P2 | 4.2 | 100 | 4.2 | 24 | 49.2 | 48 | 11 | 21 | 52 | 645 | 1610 | 40 |
| FF210B P2 | 2.9 | 101 | 2.8 | 35 | 88.5 | 40 | 16 | 26.8 | 59 | 700 | 2120 | 33 |
| FF225B P2 * | 2.0 | 90 | 2.2 | 26 | 77.9 | 34 | 14 | 24 | 57 | 704 | 1830 | 38 |
| FF239F P2 | 3.1 | 127 | 2.4 | 28 | 104 | 27 | 23 | 57.9 | 40 | 1135 | 3770 | 30 |
| FF258F P2 | 1.3 | 42 | 3.0 | 29 | 139 | 21 | 15 | 35.1 | 41 | 693 | 2310 | 30 |
| FF278F P2 | 3.0 | 71 | 4.2 | 23 | 138 | 17 | 11 | 25.4 | 42 | 767 | 2920 | 26 |

| Sample Name | Bioaccessible Pb (mg -kg) | Total Pb (mg -kg) | % Bioaccessible Pb (%) | Bioaccessible Se (mg -kg) | Total Se (mg -kg) | % Bioaccessible Se (%) | Bioaccessible Zn (mg -kg) | Total Zn (mg -kg) | % Bioaccessible Zn (%) |
|-------------|---------------------------|-------------------|------------------------|---------------------------|-------------------|------------------------|---------------------------|-------------------|------------------------|
| PHASE 1 | | | | | | | | | |
| CS104F P1 | 101 | 394 | 26 | <10 | 20.4 | <49 | 743 | 1690 | 44 |
| FF201F P1 | 47 | 81.5 | 57 | <10 | 10.2 | <98 | 995 | 1280 | 78 |
| FF206B P1 | 135 | 209 | 65 | <10 | 32.4 | <31 | 3258 | 4410 | 74 |
| FF210B P1 | 266 | 420 | 63 | <10 | 26.5 | <38 | 2491 | 4260 | 58 |
| FF225B P1 * | 211 | 274 | 77 | <10 | 28.4 | <35 | 3053 | 4520 | 68 |
| FF239F P1 | 407 | 638 | 64 | <10 | 43.3 | <23 | 6035 | 8780 | 69 |
| FF258F P1 | 269 | 476 | 56 | <10 | 30.5 | <33 | 3977 | 7210 | 55 |
| FF278F P1 | 219 | 461 | 47 | <10 | 25.2 | <40 | 2328 | 5670 | 41 |
| PHASE 2 | | | | | | | | | |
| CS104F P2 | 31 | 394 | 7.9 | <10 | 20.4 | <49 | 160 | 1690 | 9.5 |
| FF201F P2 | 4.9 | 81.5 | 6.0 | <10 | 10.2 | <98 | 315 | 1280 | 25 |
| FF206B P2 | 18 | 209 | 8.5 | <10 | 32.4 | <31 | 1478 | 4410 | 34 |
| FF210B P2 | 31 | 420 | 7.5 | <10 | 26.5 | <38 | 1693 | 4260 | 40 |
| FF225B P2 * | 36 | 274 | 13 | <10 | 28.4 | <35 | 1215 | 4520 | 27 |
| FF239F P2 | 41 | 638 | 6.4 | <10 | 43.3 | <23 | 2228 | 8780 | 25 |
| FF258F P2 | 22 | 476 | 4.6 | <10 | 30.5 | <33 | 1739 | 7210 | 24 |
| FF278F P2 | 28 | 461 | 6.1 | <10 | 25.2 | <40 | 1194 | 5670 | 21 |

* Average of the duplicate is reported

QA/QC

| QC Samples | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg |
|------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Blank | [Hg] | [As] | [Cd] | [Cu] | [Pb] | [Se] | [Zn] |
| Blank P1 | <0.20 | <5.0 | <2.0 | <1.0 | 1.0 | <10 | <100 |
| Blank P2 | <0.20 | <5.0 | <2.0 | 2.0 | 5.0 | <10 | <100 |
| | | | | | | | |
| Duplicates | RSD % Hg | RSD % As | RSD % Cd | RSD % Cu | RSD % Pb | RSD % Se | RSD % Zn |
| FF225B P1 | no calc | 0.8 | 0.8 | 2.7 | 0.2 | no calc | 0.3 |
| FF225B P2 | 11 | 8.6 | 15 | 27 | 36 | no calc | 13 |

no calc = %RSD not calculated because at least one value in the duplicate pair is below detection

Control

| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
|---------------------|---------------|---------|---------|---------|---------|---------------|---------|
| 2710 P1 results (%) | no result | 46 | 75 | 65 | 71 | not certified | 28 |
| Accepted Range (%) | not available | 19-55 | 53-85 | 53-75 | 58-81 | NA | 23-30 |
| Acceptable | NA | Yes | Yes | Yes | Yes | NA | Yes |
| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
| 2710 P2 results (%) | 12 | 36 | 36 | 54 | 9.2 | not certified | 7.5 |
| Average | not available | 22-47 | 40-53 | 45-60 | 9.6-17 | NA | 10-16 |
| Acceptable | NA | Yes | No | Yes | No | NA | No |

ESG control limits for NIST 2710 100:1

NA = not applicable

Matrix Spikes

| | |
|---------------------------------------|---------------------------------------|
| Hg P1 expected conc. 0.047 ppm | Hg P2 expected conc. 0.042 ppm |
| Actual Hg concentration 0.0378 ppm | Actual Hg concentration 0.0327 ppm |
| Recovery 80 % | Recovery 78 % |

QA/QC from ASU

| | Hg (ug/L) | As | Cd | Cu | Pb | Se | Zn |
|-----------------------|-------------|----------|----------|----------|----------|----------|----------|
| Blank (mg/L) | <2.0 , <2.0 | <0.05 | <0.02 | <0.01 | <0.005 | <0.1 | <1.0 |
| Control (mg/L) | 2.0 ; 2.0 | 4.3 | 3.9 | 7.8 | 40.0 | 3.2 | 14.8 |
| Control Target (mg/L) | 2.0 | 4.0 | 4.0 | 8.0 | 40.0 | 3.0 | 15.0 |
| % Recovery | 100, 100 | 107 | 99 | 98 | 100 | 107 | 99 |
| Control (mg/L) | 18.8 ; 19.3 | n/a | n/a | n/a | n/a | n/a | n/a |
| Control Target (mg/L) | 20 | n/a | n/a | n/a | n/a | n/a | n/a |
| % Recovery | 94, 96.5 | n/a | n/a | n/a | n/a | n/a | n/a |
| Duplicates | RSD % Hg | RSD % As | RSD % Cd | RSD % Cu | RSD % Pb | RSD % Se | RSD % Zn |
| CS104F P1 | no calc | n/a | n/a | n/a | n/a | n/a | n/a |
| FF278F P1 | no calc | n/a | n/a | n/a | n/a | n/a | n/a |
| FF201F P2 | 2.0 | n/a | n/a | n/a | n/a | n/a | n/a |
| FF278F P2 | 0.0 | n/a | n/a | n/a | n/a | n/a | n/a |

no calc = %RSD not calculated because at least one value in the duplicate pair is below detection

ESG Bioaccessibility Report ASD0809e

Site: Flin Flon
Analyst: Jessica Harris, Kim House (ESG)
Extraction Date: July 30 2008
Analysis Date: August 14 -15, Sept 02, 2008
Report Date: September 03 2008
Method: PBET method <250 µm soil particle size 100:1

Results

| Sample Name | Bioaccessible Hg (mg/kg) | Total Hg (mg/kg) | % Bioaccessible Hg (%) | Bioaccessible As (mg/kg) | Total As (mg/kg) | % Bioaccessible As (%) | Bioaccessible Cd (mg/kg) | Total Cd (mg/kg) | % Bioaccessible Cd (%) | Bioaccessible Cu (mg/kg) | Total Cu (mg/kg) | % Bioaccessible Cu (%) |
|-------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|
| PHASE 1 | | | | | | | | | | | | |
| CS108F P1 | <0.2 | 30.5 | <0.66 | 12 | 97.3 | 13 | 14 | 20.1 | 68 | 560 | 1200 | 47 |
| CS125F P1 | <0.2 | 20.7 | <0.97 | 19 | 152 | 13 | 20 | 31.8 | 63 | 644 | 1800 | 36 |
| CS129F P1 | <0.2 | 19.8 | <1.0 | 29 | 220 | 13 | 6.8 | 12.2 | 56 | 635 | 1320 | 48 |
| FF232F P1 | 0.74 | 25 | 3.0 | 13 | 33.9 | 37 | 14 | 12.2 | 111 | 840 | 1290 | 65 |
| FF254F P1 | <0.2 | 22 | <0.91 | 48 | 142 | 34 | 32 | 46.7 | 68 | 964 | 2190 | 44 |
| FF341F P1 | <0.2 | 32 | <0.63 | 7.3 | 34.2 | 21 | 24 | 30.5 | 80 | 622 | 1770 | 35 |
| FF343F P1 * | <0.2 | 21.4 | <0.93 | 16 | 49.7 | 33 | 23 | 30.4 | 77 | 739 | 1640 | 45 |
| FF344F P1 | <0.2 | 17.9 | <1.1 | 6.2 | 29 | 21 | 25 | 30.9 | 81 | 905 | 1950 | 46 |
| PHASE 2 | | | | | | | | | | | | |
| CS108F P2 | 0.96 | 30.5 | 3.1 | 14 | 97.3 | 14 | 8.1 | 20.1 | 40 | 328 | 1200 | 27 |
| CS125F P2 | 0.50 | 20.7 | 2.4 | 26 | 152 | 17 | 12 | 31.8 | 37 | 391 | 1800 | 22 |
| CS129F P2 | 1.8 | 19.8 | 9.0 | 50 | 220 | 23 | 3.1 | 12.2 | 26 | 432 | 1320 | 33 |
| FF232F P2 | 0.74 | 25 | 3.0 | 14 | 33.9 | 41 | 7.2 | 12.2 | 59 | 510 | 1290 | 40 |
| FF254F P2 | 0.76 | 22 | 3.5 | 68 | 142 | 48 | 21 | 46.7 | 45 | 679 | 2190 | 31 |
| FF341F P2 | 0.26 | 32 | 0.82 | 9.5 | 34.2 | 28 | 12 | 30.5 | 38 | 449 | 1770 | 25 |
| FF343F P2 * | 0.32 | 21.4 | 1.5 | 17 | 49.7 | 35 | 14 | 30.4 | 45 | 474 | 1640 | 29 |
| FF344F P2 | <0.2 | 17.9 | <1.1 | 7.1 | 29 | 24 | 12 | 30.9 | 39 | 501 | 1950 | 26 |

| Sample Name | Bioaccessible Pb (mg/kg) | Total Pb (mg/kg) | % Bioaccessible Pb (%) | Bioaccessible Se (mg/kg) | Total Se (mg/kg) | % Bioaccessible Se (%) | Bioaccessible Zn (mg/kg) | Total Zn (mg/kg) | % Bioaccessible Zn (%) |
|-------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|
| PHASE 1 | | | | | | | | | |
| CS108F P1 | 165 | 287 | 57 | <10 | 13 | <77 | 1514 | 2810 | 54 |
| CS125F P1 | 219 | 456 | 48 | <10 | 15 | <67 | 2103 | 4660 | 45 |
| CS129F P1 | 201 | 392 | 51 | <10 | 16.3 | <61 | 389 | 1600 | 24 |
| FF232F P1 | 112 | 121 | 93 | <10 | 7.6 | BND | 1321 | 1520 | 87 |
| FF254F P1 | 558 | 820 | 68 | <10 | 18.1 | <55 | 5683 | 9310 | 61 |
| FF341F P1 | 202 | 357 | 56 | <10 | 11.6 | <86 | 4491 | 5650 | 79 |
| FF343F P1 * | 350 | 552 | 63 | <10 | 10.4 | <96 | 6355 | 8240 | 77 |
| FF344F P1 | 275 | 380 | 72 | <10 | 11 | <91 | 3532 | 5400 | 65 |
| PHASE 2 | | | | | | | | | |
| CS108F P2 | 33 | 287 | 12 | <10 | 13 | <77 | 779 | 2810 | 28 |
| CS125F P2 | 25 | 456 | 5.6 | <10 | 15 | <67 | 987 | 4660 | 21 |
| CS129F P2 | 32 | 392 | 8.3 | <10 | 16.3 | <61 | 132 | 1600 | 8.2 |
| FF232F P2 | 19 | 121 | 15 | <10 | 7.6 | BND | 584 | 1520 | 38 |
| FF254F P2 | 67 | 820 | 8.1 | <10 | 18.1 | <55 | 2274 | 9310 | 24 |
| FF341F P2 | 29 | 357 | 8.3 | <10 | 11.6 | <86 | 1346 | 5650 | 24 |
| FF343F P2 * | 58 | 552 | 10 | <10 | 10.4 | <96 | 2668 | 8240 | 32 |
| FF344F P2 | 21 | 380 | 5.6 | <10 | 11 | <91 | 1200 | 5400 | 22 |

* Average of the duplicate is reported

BND = total initial concentration is less than the detection limit of bioaccessible fraction, therefore % bioaccessibility cannot be calculated

QA/QC

| QC Samples | Bioaccessible mg/kg [Hg] | Bioaccessible mg/kg [As] | Bioaccessible mg/kg [Cd] | Bioaccessible mg/kg [Cu] | Bioaccessible mg/kg [Pb] | Bioaccessible mg/kg [Se] | Bioaccessible mg/kg [Zn] |
|------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| Blank P1 | <0.2 | <5.0 | <2.0 | <1.0 | <0.5 | <10 | <100 |
| Blank P2 | <0.2 | <5.0 | 2 | 1 | | <10 | <100 |
| | | | | | | | |
| Duplicates | RSD % Hg | RSD % As | RSD % Cd | RSD % Cu | RSD % Pb | RSD % Se | RSD % Zn |
| FF209B P1 | no calc | 0.5 | 6.1 | 6.8 | 3.1 | no calc | 2.0 |
| FF209B P2 | 10 | 0.6 | 2.7 | 2.1 | 8.8 | no calc | 20 |

no calc = %RSD not calculated because at least one value in the duplicate pair is below detection

Control

| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
|----------------------------|---------------|---------|---------|---------|---------|---------------|---------|
| 2710 P1 results (%) | no result | 48 | 70 | 67 | 71 | not certified | 29 |
| Accepted range (%) | not available | 19-55 | 53-85 | 53-75 | 58-81 | NA | 23-30 |
| Acceptable | NA | yes | yes | yes | yes | NA | yes |
| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
| 2710 P2 results (%) | no result | 46 | 46 | 60 | 14 | not certified | 12 |
| Accepted range (%) | not available | 22-47 | 40-53 | 45-60 | 9.6-17 | NA | 10.0-17 |
| Acceptable | NA | yes | yes | yes | yes | NA | yes |

ESG control limits for NIST 2710 100:1

NA = not applicable

Matrix Spikes

| | |
|--------------------------------------|--------------------------------------|
| Hg P1 expected conc. 0.043 ppm | Hg P2 expected conc. 0.037 ppm |
| Actual Hg concentration 0.031 ppm | Actual Hg concentration 0.023 ppm |
| % Recovery 72 % | % Recovery 62 % |

QA/QC from ASU

| | Hg (ug/L) | As | Cd | Cu | Pb | Se | Zn |
|-----------------------|-------------|----------|----------|----------|----------|----------|----------|
| Blank (mg/L) | <2.0 , <2.0 | <0.05 | <0.02 | <0.01 | <0.005 | <0.1 | <1.0 |
| Control (mg/L) | 1.8 , 1.9 | 4.3 | 3.9 | 7.8 | 40.0 | 3.2 | 14.8 |
| Control Target (mg/L) | 2.0 | 4.0 | 4.0 | 8.0 | 40.0 | 3.0 | 15.0 |
| % Recovery | 90, 95 | 107 | 99 | 98 | 100 | 107 | 99 |
| Control (mg/L) | 18.1, 17.1 | 4.5 | 4.09 | 8.14 | 41.95 | 3.29 | 15.65 |
| Control Target (mg/L) | 20 | 4.0 | 4.0 | 8.0 | 40.0 | 3.0 | 15.0 |
| % Recovery | 91, 86 | 112 | 102 | 102 | 105 | 110 | 104 |
| Duplicates | % RSD Hg | % RSD As | % RSD Cd | % RSD Cu | % RSD Pb | % RSD Se | % RSD Zn |
| CS129F P2 | no calc | NA | NA | NA | NA | NA | NA |

no calc = %RSD not calculated because at least one value in the duplicate pair is below detection

ESG Bioaccessibility Report ASD0809e

Site: Flin Flon
 Analyst: Jessica Harris, Kim House (ESG)
 Extraction Date: July 30 2008
 Analysis Date: August 14 -15, Sept 02, 2008
 Report Date: September 03 2008
 Method: PBET method <250 µm soil particle size 100:1

AMENDED REPORT

Results

| Sample Name | Bioaccessible Hg (mg/kg) | Total Hg (mg/kg) | % Bioaccessible Hg (%) | Bioaccessible As (mg/kg) | Total As (mg/kg) | % Bioaccessible As (%) | Bioaccessible Cd (mg/kg) | Total Cd (mg/kg) | % Bioaccessible Cd (%) | Bioaccessible Cu (mg/kg) | Total Cu (mg/kg) | % Bioaccessible Cu (%) |
|-------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|
| PHASE 1 | | | | | | | | | | | | |
| CS108F P1 | <0.2 | 30.5 | <0.66 | 12 | 97.3 | 13 | 14 | 20.1 | 68 | 560 | 1200 | 47 |
| CS125F P1 | <0.2 | 20.7 | <0.97 | 19 | 152 | 13 | 20 | 31.8 | 63 | 644 | 1800 | 36 |
| CS129F P1 | <0.2 | 19.8 | <1.0 | 29 | 220 | 13 | 6.8 | 12.2 | 56 | 635 | 1320 | 48 |
| FF232F P1 | 0.74 | 25 | 3.0 | 13 | 33.9 | 37 | 14 | 12.2 | 111 | 840 | 1290 | 65 |
| FF254F P1 | <0.2 | 22 | <0.91 | 48 | 142 | 34 | 32 | 46.7 | 68 | 964 | 2190 | 44 |
| FF341F P1 | <0.2 | 32 | <0.63 | 7.3 | 34.2 | 21 | 24 | 30.5 | 80 | 622 | 1770 | 35 |
| FF343F P1 * | <0.2 | 21.4 | <0.93 | 16 | 49.7 | 33 | 23 | 30.4 | 77 | 739 | 1640 | 45 |
| FF344F P1 | <0.2 | 17.9 | <1.1 | 6.2 | 29 | 21 | 25 | 30.9 | 81 | 905 | 1950 | 46 |
| PHASE 2 | | | | | | | | | | | | |
| CS108F P2 | 0.96 | 30.5 | 3.1 | 14 | 97.3 | 14 | 8.1 | 20.1 | 40 | 328 | 1200 | 27 |
| CS125F P2 | 0.50 | 20.7 | 2.4 | 26 | 152 | 17 | 12 | 31.8 | 37 | 391 | 1800 | 22 |
| CS129F P2 | 1.8 | 19.8 | 9.0 | 50 | 220 | 23 | 3.1 | 12.2 | 26 | 432 | 1320 | 33 |
| FF232F P2 | 0.74 | 25 | 3.0 | 14 | 33.9 | 41 | 7.2 | 12.2 | 59 | 510 | 1290 | 40 |
| FF254F P2 | 0.76 | 22 | 3.5 | 68 | 142 | 48 | 21 | 46.7 | 45 | 679 | 2190 | 31 |
| FF341F P2 | 0.26 | 32 | 0.82 | 9.5 | 34.2 | 28 | 12 | 30.5 | 38 | 449 | 1770 | 25 |
| FF343F P2 * | 0.32 | 21.4 | 1.5 | 17 | 49.7 | 35 | 14 | 30.4 | 45 | 474 | 1640 | 29 |
| FF344F P2 | <0.2 | 17.9 | <1.1 | 7.1 | 29 | 24 | 12 | 30.9 | 39 | 501 | 1950 | 26 |

| Sample Name | Bioaccessible Pb (mg/kg) | Total Pb (mg/kg) | % Bioaccessible Pb (%) | Bioaccessible Se (mg/kg) | Total Se (mg/kg) | % Bioaccessible Se (%) | Bioaccessible Zn (mg/kg) | Total Zn (mg/kg) | % Bioaccessible Zn (%) |
|-------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|
| PHASE 1 | | | | | | | | | |
| CS108F P1 | 165 | 287 | 57 | <10 | 13 | <77 | 1514 | 2810 | 54 |
| CS125F P1 | 219 | 456 | 48 | <10 | 15 | <67 | 2103 | 4660 | 45 |
| CS129F P1 | 201 | 392 | 51 | <10 | 16.3 | <61 | 389 | 1600 | 24 |
| FF232F P1 | 112 | 121 | 93 | <10 | 7.6 | BND | 1321 | 1520 | 87 |
| FF254F P1 | 558 | 820 | 68 | <10 | 18.1 | <55 | 5683 | 9310 | 61 |
| FF341F P1 | 202 | 357 | 56 | <10 | 11.6 | <86 | 4491 | 5650 | 79 |
| FF343F P1 * | 350 | 552 | 63 | <10 | 10.4 | <96 | 6355 | 8240 | 77 |
| FF344F P1 | 275 | 380 | 72 | <10 | 11 | <91 | 3532 | 5400 | 65 |
| PHASE 2 | | | | | | | | | |
| CS108F P2 | 33 | 287 | 12 | <10 | 13 | <77 | 779 | 2810 | 28 |
| CS125F P2 | 25 | 456 | 5.6 | <10 | 15 | <67 | 987 | 4660 | 21 |
| CS129F P2 | 32 | 392 | 8.3 | <10 | 16.3 | <61 | 132 | 1600 | 8.2 |
| FF232F P2 | 19 | 121 | 15 | <10 | 7.6 | BND | 584 | 1520 | 38 |
| FF254F P2 | 67 | 820 | 8.1 | <10 | 18.1 | <55 | 2274 | 9310 | 24 |
| FF341F P2 | 29 | 357 | 8.3 | <10 | 11.6 | <86 | 1346 | 5650 | 24 |
| FF343F P2 * | 58 | 552 | 10 | <10 | 10.4 | <96 | 2668 | 8240 | 32 |
| FF344F P2 | 21 | 380 | 5.6 | <10 | 11 | <91 | 1200 | 5400 | 22 |

* Average of the duplicate is reported

BND = total initial concentration is less than the detection limit of bioaccessible fraction, therefore % bioaccessibility cannot be calculated

QA/QC

| QC Samples | Bioaccessible mg/kg [Hg] | Bioaccessible mg/kg [As] | Bioaccessible mg/kg [Cd] | Bioaccessible mg/kg [Cu] | Bioaccessible mg/kg [Pb] | Bioaccessible mg/kg [Se] | Bioaccessible mg/kg [Zn] |
|------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| Blank P1 | <0.2 | <5.0 | <2.0 | <1.0 | <0.5 | <10 | <100 |
| Blank P2 | <0.2 | <5.0 | 2 | 1 | | <10 | <100 |
| | | | | | | | |
| Duplicates | RSD % Hg | RSD % As | RSD % Cd | RSD % Cu | RSD % Pb | RSD % Se | RSD % Zn |
| FF343B P1 | no calc | 0.5 | 6.1 | 6.8 | 3.1 | no calc | 2.0 |
| FF343B P2 | 10 | 0.6 | 2.7 | 2.1 | 8.8 | no calc | 20 |

no calc = %RSD not calculated because at least one value in the duplicate pair is below detection

Control

| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
|---------------------|---------------|---------|---------|---------|---------|---------------|---------|
| 2710 P1 results (%) | no result | 48 | 70 | 67 | 71 | not certified | 29 |
| Accepted range (%) | not available | 19-55 | 53-85 | 53-75 | 58-81 | NA | 23-30 |
| Acceptable | NA | yes | yes | yes | yes | NA | yes |
| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
| 2710 P2 results (%) | no result | 46 | 46 | 60 | 14 | not certified | 12 |
| Accepted range (%) | not available | 22-47 | 40-53 | 45-60 | 9.6-17 | NA | 10.0-17 |
| Acceptable | NA | yes | yes | yes | yes | NA | yes |

ESG control limits for NIST 2710 100:1

NA = not applicable

Matrix Spikes

| | |
|--------------------------------------|--------------------------------------|
| Hg P1 expected conc. 0.043 ppm | Hg P2 expected conc. 0.037 ppm |
| Actual Hg concentration 0.031 ppm | Actual Hg concentration 0.023 ppm |
| % Recovery 72 % | % Recovery 62 % |

QA/QC from ASU

| | Hg (ug/L) | As | Cd | Cu | Pb | Se | Zn |
|-----------------------|-------------|----------|----------|----------|----------|----------|----------|
| Blank (mg/L) | <2.0 , <2.0 | <0.05 | <0.02 | <0.01 | <0.005 | <0.1 | <1.0 |
| Control (mg/L) | 1.8 , 1.9 | 4.3 | 3.9 | 7.8 | 40.0 | 3.2 | 14.8 |
| Control Target (mg/L) | 2.0 | 4.0 | 4.0 | 8.0 | 40.0 | 3.0 | 15.0 |
| % Recovery | 90, 95 | 107 | 99 | 98 | 100 | 107 | 99 |
| Control (mg/L) | 18.1, 17.1 | 4.5 | 4.09 | 8.14 | 41.95 | 3.29 | 15.65 |
| Control Target (mg/L) | 20 | 4.0 | 4.0 | 8.0 | 40.0 | 3.0 | 15.0 |
| % Recovery | 91, 86 | 112 | 102 | 102 | 105 | 110 | 104 |
| Duplicates | % RSD Hg | % RSD As | % RSD Cd | % RSD Cu | % RSD Pb | % RSD Se | % RSD Zn |
| CS129F P2 | no calc | NA | NA | NA | NA | NA | NA |

no calc = %RSD not calculated because at least one value in the duplicate pair is below detection

ESG Bioaccessibility Report ASD0809f

Site: Flin Flon
Analyst: Jessica Harris, Kim House (ESG)
Extraction Date: July 31 2008
Analysis Date: August 21, September 02 2008
Report Date: September 03 2008
Method: PBET method <250 µm soil particle size 100:1

| Sample Name | Bioaccessible Hg (mg/kg) | Total Hg (mg/kg) | % Bioaccessible Hg (%) | Bioaccessible As (mg/kg) | Total As (mg/kg) | % Bioaccessible As (%) | Bioaccessible Cd (mg/kg) | Total Cd (mg/kg) | % Bioaccessible Cd (%) | Bioaccessible Cu (mg/kg) | Total Cu (mg/kg) | % Bioaccessible Cu (%) |
|----------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|
| PHASE 1 | | | | | | | | | | | | |
| CS104B P1 | <0.2 | 8.9 | <2.2 | 35 | 285 | 12 | 21 | 22 | 96 | 668 | 1380 | 48 |
| CS112B P1 | <0.2 | 10.5 | <1.9 | 8.5 | 60.4 | 14 | 18 | 20 | 91 | 434 | 960 | 45 |
| FF302F P1 | <0.2 | 7.4 | <2.7 | <5.0 | 17.4 | <29 | 22 | 21 | 105 | 562 | 1100 | 51 |
| FF305B P1* | <0.2 | 7.2 | <2.8 | <5.0 | 18 | <28 | 13 | 15 | 88 | 408 | 1020 | 40 |
| FF307F P1 | <0.2 | 10.2 | <2.0 | <5.0 | 20 | <25 | 27 | 27 | 97 | 547 | 1360 | 40 |
| FF323F P1 | <0.2 | 9.93 | <2.0 | 6.5 | 27 | 24 | 17 | 20 | 85 | 501 | 970 | 52 |
| FF406F P1 | <0.2 | 7 | <2.9 | 6.9 | 31 | 22 | 16 | 21 | 76 | 255 | 700 | 36 |
| PHASE 2 | | | | | | | | | | | | |
| CS104B P2 | 0.19 | 8.9 | 2.2 | 39 | 285 | 14 | 6.8 | 22 | 31 | 514 | 1380 | 37 |
| CS112B P2 | <0.2 | 10.5 | <1.9 | 17 | 60.4 | 27 | 8.3 | 20 | 42 | 376 | 960 | 39 |
| FF302F P2 | <0.2 | 7.4 | <2.7 | <5.0 | 17.4 | <29 | 6.6 | 21 | 32 | 368 | 1100 | 33 |
| FF305B P2* | 0.21 | 7.2 | 2.9 | <5.0 | 18 | <28 | 3.7 | 15 | 25 | 292 | 1020 | 29 |
| FF307F P2 | <0.2 | 10.2 | <2.0 | <5.0 | 20 | <25 | 9.1 | 27 | 33 | 393 | 1360 | 29 |
| FF323F P2 | <0.2 | 9.93 | <2.0 | 5.9 | 27 | 22 | 6.9 | 20 | 35 | 386 | 970 | 40 |
| FF406F P2 | <0.2 | 7 | <2.9 | 8.1 | 31.4 | 26 | 7.6 | 21 | 37 | 244 | 700 | 35 |

| Sample Name | Bioaccessible Pb (mg/kg) | Total Pb (mg/kg) | % Bioaccessible Pb (%) | Bioaccessible Se (mg/kg) | Total Se (mg/kg) | % Bioaccessible Se (%) | Bioaccessible Zn (mg/kg) | Total Zn (mg/kg) | % Bioaccessible Zn (%) |
|----------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|--------------------------|------------------|------------------------|
| PHASE 1 | | | | | | | | | |
| CS104B P1 | 153 | 365 | 42 | <10 | 15 | <67 | 1290 | 1900 | 68 |
| CS112B P1 | 165 | 249 | 66 | <10 | 5.5 | BND | 550 | 707 | 78 |
| FF302F P1 | 389 | 304 | 128 | <10 | 5.1 | BND | 3525 | 4160 | 85 |
| FF305B P1* | 207 | 221 | 94 | <10 | 6.0 | BND | 2501 | 3790 | 66 |
| FF307F P1 | 250 | 275 | 91 | <10 | 8.6 | BND | 4473 | 5490 | 81 |
| FF323F P1 | 293 | 289 | 102 | <10 | 6.3 | BND | 2208 | 3290 | 67 |
| FF406F P1 | 203 | 266 | 76 | <10 | 4.0 | BND | 3358 | 5680 | 59 |
| PHASE 2 | | | | | | | | | |
| CS104B P2 | 19 | 365 | 5.1 | <10 | 15 | <67 | 186 | 1900 | 10 |
| CS112B P2 | 31 | 249 | 13 | <10 | 5.5 | BND | 177 | 707 | 25 |
| FF302F P2 | 17 | 304 | 5.6 | <10 | 5.1 | BND | 569 | 4160 | 14 |
| FF305B P2* | 17 | 221 | 7.7 | <10 | 6.0 | BND | 371 | 3790 | 9.8 |
| FF307F P2 | 17 | 275 | 6.2 | <10 | 8.6 | BND | 1025 | 5490 | 19 |
| FF323F P2 | 31 | 289 | 11 | <10 | 6.3 | BND | 502 | 3290 | 15 |
| FF406F P2 | 18 | 266 | 6.8 | <10 | 4.0 | BND | 1214 | 5680 | 21 |

*average of duplicate pair

BND = total initial concentration is less than the detection limit of bioaccessible fraction, therefore % bioaccessibility cannot be calculated

QA/QC

| QC Samples | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg | Bioaccessible mg/kg |
|------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Blank | [Hg] | [As] | [Cd] | [Cu] | [Pb] | [Se] | [Zn] |
| Blank P1 | <0.20 | <5.0 | <2.0 | <1.0 | <0.5 | <10 | <100 |
| Blank P2 | <0.20 | <5.0 | <2.0 | 1.0 | <0.5 | <10 | <100 |
| Duplicates | RSD % Hg | RSD % As | RSD % Cd | RSD % Cu | RSD % Pb | RSD % Se | RSD % Zn |
| FF305B P1 | no calc | no calc | 5.3 | 4.3 | 2.1 | no calc | 8.8 |
| FF305B P2 | 3.0 | no calc | 3.0 | 2.3 | 34 | no calc | 6.0 |

no calc = %RSD not calculated because at least one value in the duplicate pair is below detection

Control

| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
|------------------------|---------------|---------|---------|---------|---------|---------------|---------|
| 2710 P1 results | no result | 60% | 81% | 77% | 84% | not certified | 33% |
| Accepted range (%) | not available | 19-55 | 53-85 | 53-75 | 58-81 | NA | 23-30 |
| Acceptable | NA | no | yes | no | no | NA | no |
| | % BA Hg | % BA As | % BA Cd | % BA Cu | % BA Pb | % BA Se | % BA Zn |
| 2710 P2 results | 8.1 | 47% | 40% | 59% | 8.6% | not certified | 8.3% |
| Accepted range (%) | not available | 22-47 | 40-53 | 45-60 | 9.6-17 | NA | 10.0-17 |
| Acceptable | NA | yes | yes | yes | no | NA | no |

ESG control limits for NIST 2710 100:1

NA = not applicable

Matrix Spikes

| | |
|-------------------------|-------------------------|
| Hg P1 expected conc. | Hg P2 expected conc. |
| 0.0379 ppm | 0.0453 ppm |
| Actual Hg concentration | Actual Hg concentration |
| 0.0285 ppm | 0.0238 ppm |
| Recovery | Recovery |
| 75 % | 53 % |

QA/QC from ASU

| | Hg (ug/L) | As | Cd | Cu | Pb | Se | Zn |
|-----------------------|------------|----------|----------|----------|----------|----------|----------|
| Blank (mg/L) | <2.0, <2.0 | <0.05 | <0.02 | <0.01 | <0.005 | <0.1 | <1.0 |
| Control (mg/L) | 1.9, 1.9 | 4.5 | 4.1 | 8.1 | 42.0 | 3.3 | 15.7 |
| Control Target (mg/L) | 2.0 | 4.0 | 4.0 | 8.0 | 40.0 | 3.0 | 15.0 |
| % Recovery | 95, 95 | 112 | 102 | 102 | 105 | 110 | 104 |
| Control (mg/L) | 18.0, 17.7 | 8.1 | 4.1 | 42 | 16 | 4.5 | 3.3 |
| Control Target (mg/L) | 20 | 8.0 | 4.0 | 40 | 15 | 4.0 | 3.0 |
| % Recovery | 90, 89 | 102 | 102 | 105 | 104 | 112 | 110 |
| Duplicates | RSD % Hg | RSD % As | RSD % Cd | RSD % Cu | RSD % Pb | RSD % Se | RSD % Zn |
| CS112B P1 | no calc | n/a | n/a | n/a | n/a | n/a | n/a |
| FF406F P2 | no calc | n/a | n/a | n/a | n/a | n/a | n/a |

no calc = %RSD not calculated because at least one value in the duplicate pair is below detection

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ANALYSIS REPORT COVER LETTER

Report Number: ASD0819
Report Date: November 4, 2008
Sample(s) reported: 2 (reruns)
Issue Status: complete
Analysis commenced on: September 20, 2008

Sample and Analysis Details

Samples were obtained from leftover (previously sieved) samples from the original analysis.

To obtain the bioaccessible metal and metalloid contents for the human receptor, a two phase (stomach and intestine) physiologically based extraction test (PBET) method was employed. The soils previously sieved to <250 um fraction were subjected to a ratio of 100:1 extraction fluid:soil mass. To simulate stomach conditions a portion of each (0.2 g) was extracted at body temperature (37°C) in Teflon® extraction vessels with 20 ml of simulated gastric solution at pH 1.8 for 1 hour. To simulate gastric+intestinal conditions a portion of each sample was subjected to the stomach extraction described above, and then the conditions were altered to simulate those approximating the small intestine. Intestinal extraction conditions were applied for 4 hours. The filtered (0.45 um) resulting extracts were analyzed by ICP-OES (As, Cd, Cu, Pb, Se, Zn).

Table 1. Summary of methods and instrumentation used.

| Analytes | Test Method | Sample Matrix |
|------------------------|-----------------------------------|-------------------------|
| As, Cd, Cu, Pb, Se, Zn | ICP-OES | Bioaccessibility (PBET) |
| As, Cd, Cu, Pb, Se, Zn | Aqua regia digestion – ICP-OES | Soil |

To calculate % bioaccessibility, the following equation was used for each element:

$$\% \text{Bioaccessibility} = \text{Bioaccessible Concentration (mg/kg)} / \text{Total Concentration (mg/kg)} \times 100\%$$

The Analytical Service Division does not accept responsibility for the validity of procedures used to obtain or preserve the samples provided to the Laboratory and does not accept any liability for the consequences of any acts taken or omissions made on the basis of the analysis or advice or interpretation provided. The results given relate only to the items tested.

Total metal and metalloid contents for the <250 um fraction were analyzed by ASU. Differences were observed for most elements, with an average relative percent difference (RPD¹) of 22% for As, Cu, Cd, and Zn between the ASU results and the results provided by Intrinsik. These differences are within reasonable estimates of sample heterogeneity. The differences noted were larger for Pb: 37 % RPD for FF302F and 108% for FF310F (i.e. the ASU results were 3x higher than the results provided by Intrinsik for this sample). The resulting percent bioaccessibilities were therefore lower than in the original report (Table 2).

Table 2. Percent bioaccessibility results for Pb in the two samples.

| Sample | This report | Previous report |
|--------|---------------------------------|----------------------------------|
| FF302F | 56% (Phase 1) 6.4% (Phase 2) | 128% (Phase 1) 5.6% (Phase 2) |
| FF310F | 54% (Phase 1) 7.1% (Phase 2) | 177% (Phase 1) 19% (Phase 2) |

The phase 2 blanks have Cu, Cd and Pb contamination and indicate that the phase 2 values are questionable for these elements. The blank contamination may not have been systematic, however, since the standard reference material results were within control limits.

Because of limitations with the current software used for reporting data, the number of significant figures quoted in the attached tables may not be representative of the actual uncertainty. Data should be considered accurate to no more than two significant figures.

This report is issued under complete status. All analyses requested for the first phase of the study have been completed and results are issued with full compliance of data verification.

Report authorised by:Iris Koch.....

Date: ...Nov 4, 2008

¹ RPD = (absolute value of (value 1 – value 2)/average of value 1 and 2) x 100%

ESG Bioaccessibility Report ASD0819

Site: Flin Flon **# Samples:** 2 reruns
Analyst: Jessica Harris **Reference Reports:** ASU 11571 (2 reports)
Extraction Date: 30-Sep-08 **ESG Request #:** 08-906
Method: PBET **Report Date:** 04-Nov-08
Ratio: 100 to 1

RESULTS

| SAMPLE ID | Bioaccessible conc (mg/kg) | Initial conc in soil (mg/kg) | % Bioaccessibility (%) | Bioaccessible conc (mg/kg) | Initial conc in soil (mg/kg) | % Bioaccessibility (%) | Bioaccessible conc (mg/kg) | Initial conc in soil (mg/kg) | % Bioaccessibility (%) |
|-----------|----------------------------|------------------------------|------------------------|----------------------------|------------------------------|------------------------|----------------------------|------------------------------|------------------------|
| | As | As | As | Cd | Cd | Cd | Cu | Cu | Cu |
| PHASE 1 | | | | | | | | | |
| FF302F | 6.5 | 25 | 26 | 20 | 30 | 65 | 372 | 1140 | 33 |
| FF310F | 7.6 | 22 | 35 | 10 | 18 | 58 | 180 | 747 | 24 |
| PHASE 2 | | | | | | | | | |
| FF302F | 6.7 | 25 | 27 | 11 | 30 | 35 | 291 | 1140 | 26 |
| FF310F | 8.1 | 22 | 37 | 6.9 | 18 | 38 | 197 | 747 | 26 |

BND = total initial concentration and the bioaccessible fraction are less than the detection limit, therefore % bioaccessibility cannot be calculated

ESG Bioaccessit

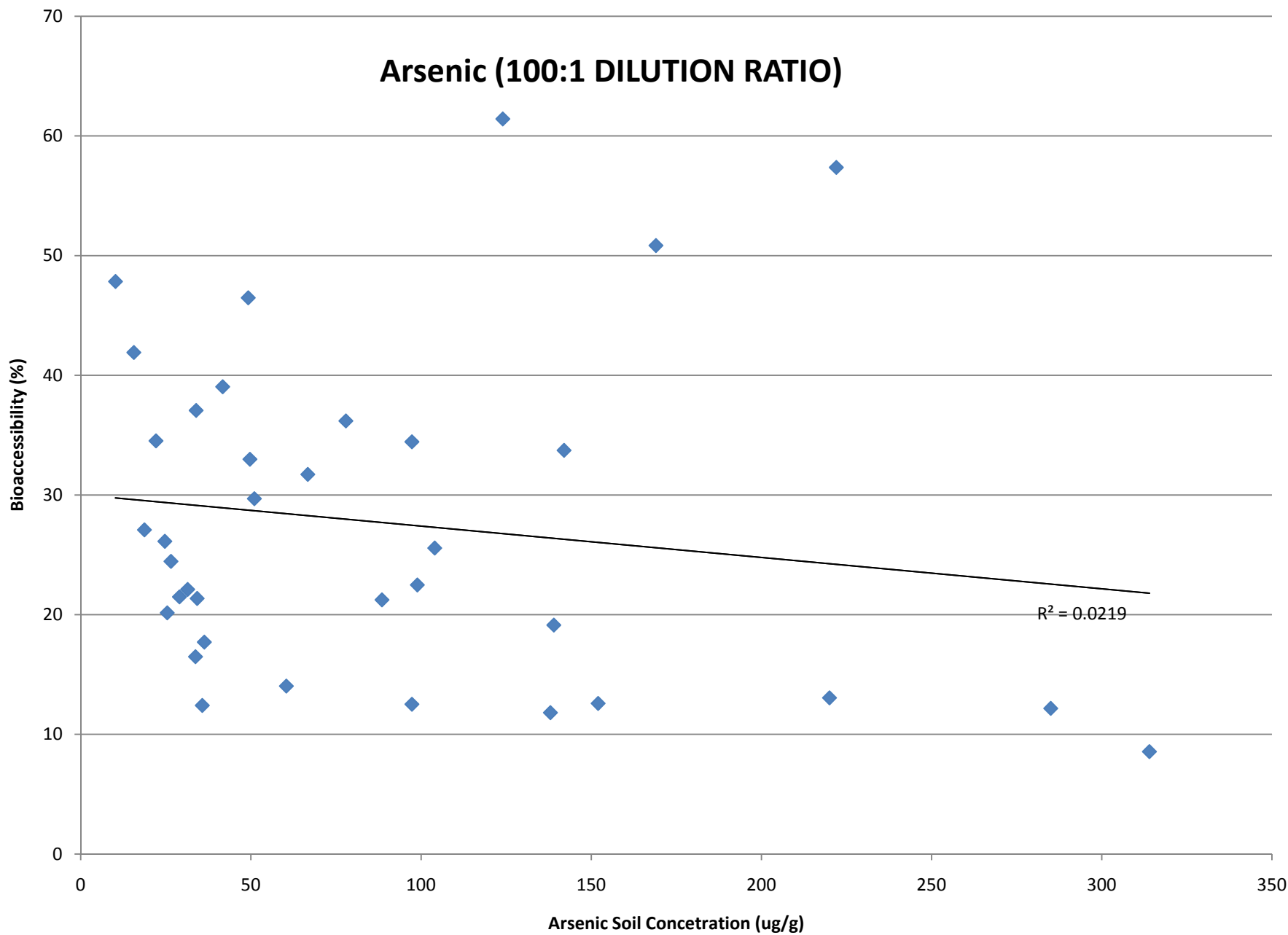
Site:
Analyst:
Extraction Date:
Method:
Ratio:

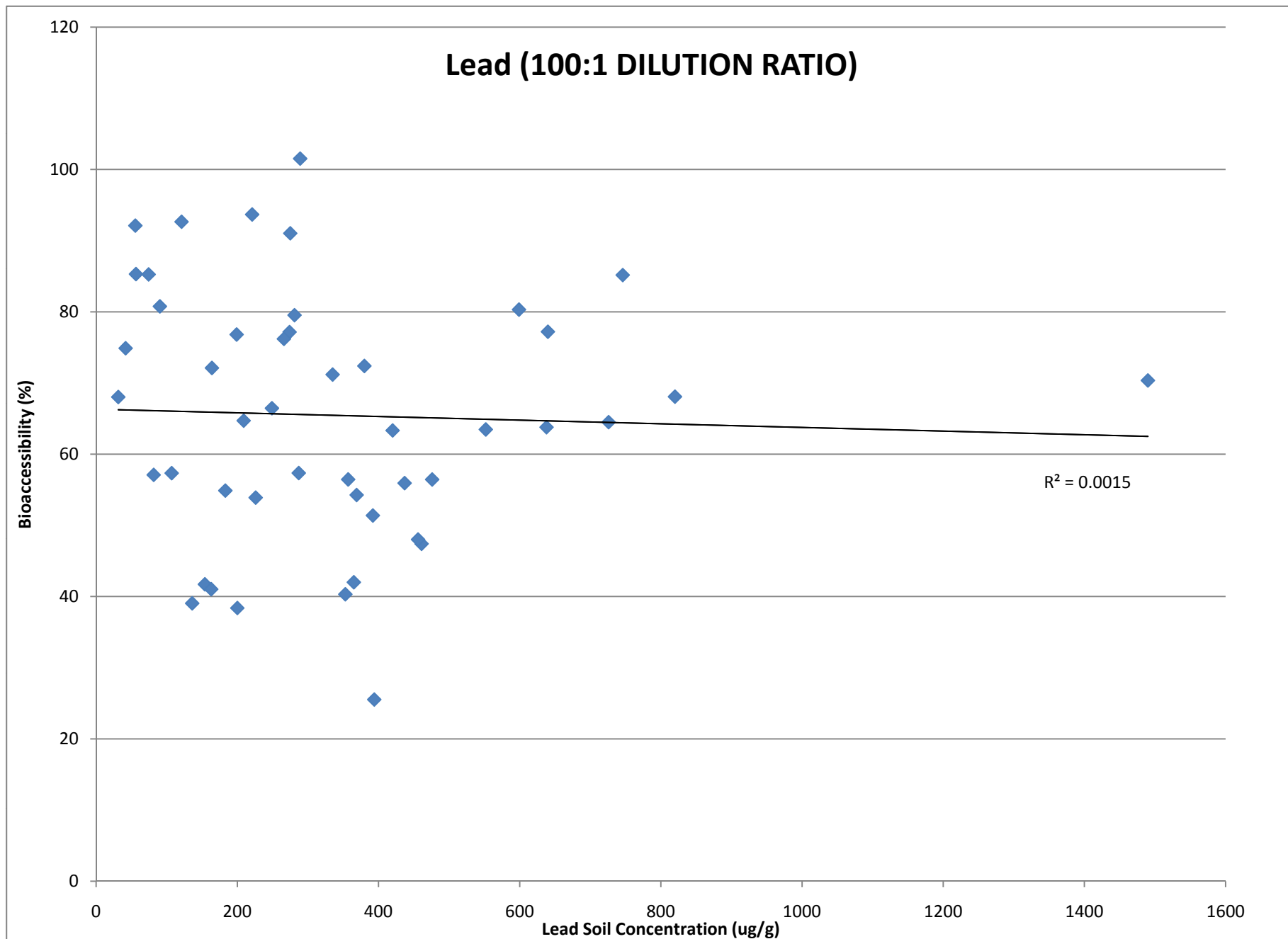
RESULTS

| SAMPLE ID | Bioaccessible conc (mg/kg) | Initial conc in soil (mg/kg) | % Bioaccessibility (%) | Bioaccessible conc (mg/kg) | Initial conc in soil (mg/kg) | % Bioaccessibility (%) | Bioaccessible conc (mg/kg) | Initial conc in soil (mg/kg) | % Bioaccessibility (%) |
|-----------|----------------------------|------------------------------|------------------------|----------------------------|------------------------------|------------------------|----------------------------|------------------------------|------------------------|
| | Pb | Pb | Pb | Se | Se | Se | Zn | Zn | Zn |
| PHASE 1 | | | | | | | | | |
| FF302F | 244 | 437 | 56 | <10 | <10 | BND | 3207 | 4220 | 76 |
| FF310F | 200 | 369 | 54 | <10 | <10 | BND | 2174 | 3520 | 62 |
| PHASE 2 | | | | | | | | | |
| FF302F | 28 | 437 | 6.4 | <10 | <10 | BND | 1039 | 4220 | 25 |
| FF310F | 26 | 369 | 7.1 | <10 | <10 | BND | 780 | 3520 | 22 |

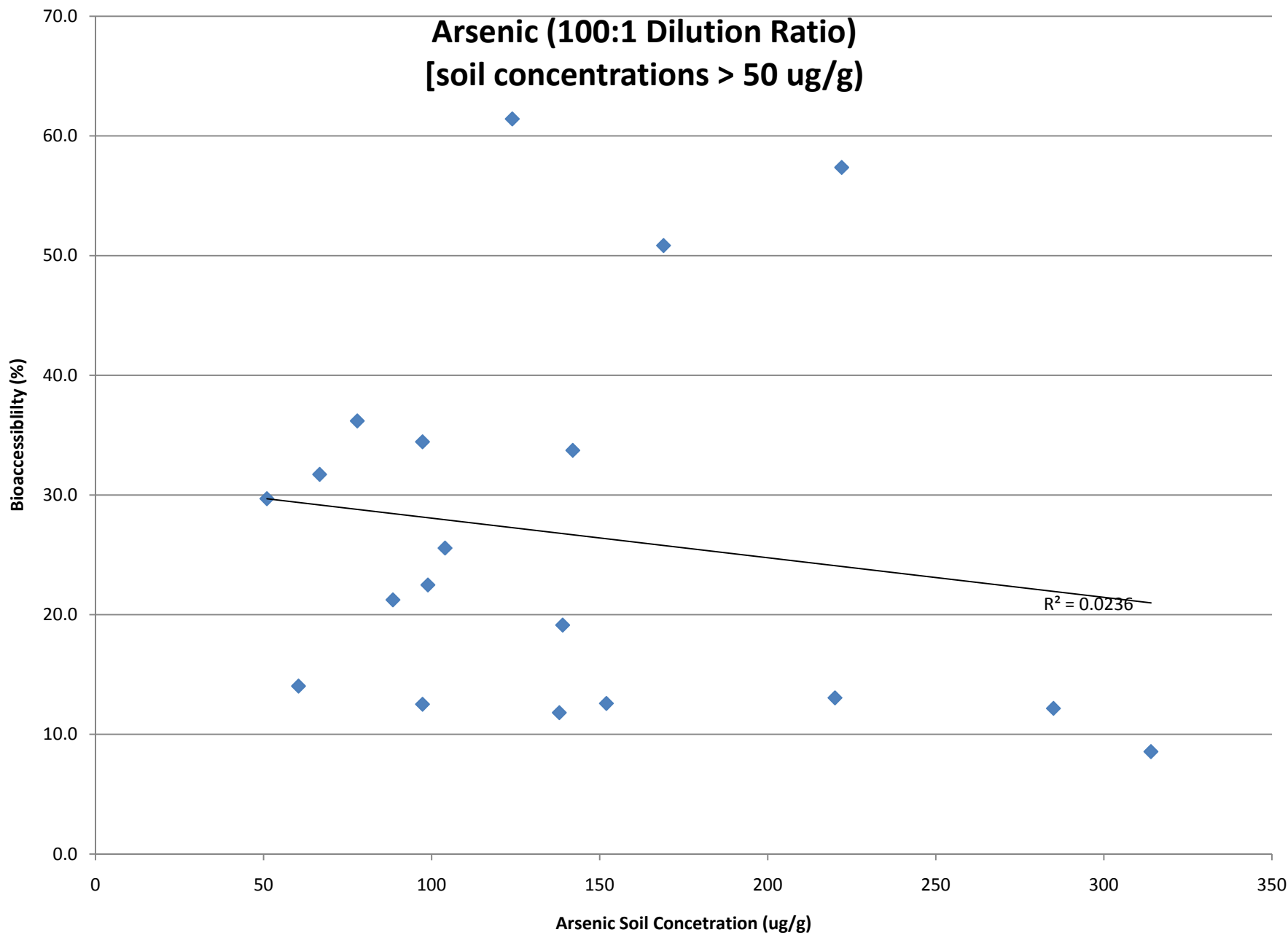
BND = total initial con

Arsenic (100:1 DILUTION RATIO)





Arsenic (100:1 Dilution Ratio)
[soil concentrations > 50 ug/g]



$R^2 = 0.0236$