DRAFT

FINAL REPORT

REGIONAL APPLIED RESEARCH (RARE) PROJECT: FINAL REPORT FOR INVESTIGATION OF CHANGES IN LEAD RELATIVE BIOAVAILABILITY FOLLOWING WEATHERING OF ORE CONCENTRATE-SOIL MIXTURES FROM THE HERCULANEUM, MISSOURI, SMELTER SITE

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NOTICE

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FOREWORD

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Sally Gutierrez, Director
National Risk Management Research Laboratory

EXECUTIVE SUMMARY

A study using juvenile swine as test animals was performed by Casteel et al. (2006a and 2006b) to measure the gastrointestinal absorption of lead from a test soil collected from the Herculaneum Lead Smelter Site in Herculaneum, Missouri after 12 months and 24 months of weathering. The test soil, designated "HER-2930," was collected from the Herculaneum Lead Smelter test plot in late May 2005 after 12 months of weathering and contained an acid extractable lead concentration of 2021 μg/g. The test soil, designated as "HER-3201, was collected after 24 months of weathering and contained an acid extractable lead concentration of 2,131 μg/g. The relative bioavailability of lead in these test soils was assessed by comparing the absorption of lead from the test soil to that of a reference material (lead acetate).

Groups of five swine were given oral doses of lead acetate or the test soil twice a day for 15 days during the study with both the 12-month and 24-month samples. The amount of lead absorbed by each animal was evaluated by measuring the amount of lead in the blood (measured on days 0, 1, 2, 3, 5, 7, 9, 12, and 15) and the amount of lead in liver, kidney, and bone (measured on day 15 at study termination). The amount of lead present in blood or tissues of animals exposed to test soil was compared to that for animals exposed to lead acetate, and the results were expressed as relative bioavailability (RBA). The RBA results for the 12-month test soil and the 24-month test soil in this study are summarized below:

Measurement Endpoint	Estimated Soil RBA (90% Confidence Interval)
Results of soil weathered for 12-months	
Blood Lead AUC*	0.75 (0.62 – 0.93)
Liver Lead	1.01 (0.76 – 1.34)
Kidney Lead	0.84 (0.69 – 1.04)
Femur Lead	0.69 (0.61 – 0.79)
Point Estimate	0.82 (0.63 – 1.15)
Results of soil weathered for 24-months	
Blood Lead AUC	0.90 (0.68 - 1.15)
Liver Lead	0.78 (0.65 - 0.95)
Kidney Lead	0.77 (0.64 - 0.94)
Femur Lead	0.82 (0.68 - 1.00)
Point Estimate	0.82 (0.65 – 1.02)

*Blood area under the curve (AUC) data were fit to the linear model for the 12-month and 24-month samples.

As seen, using lead acetate as a relative frame of reference, the RBA point estimate is approximately 82% for both test soils. This relative bioavailability estimate may be used to improve accuracy and decrease uncertainty in estimating human health risks from exposure to these test soils.

A split of these same soil materials was used by Drexler (2005 and 2006) for in vitro bioaccessibility (IVBA) determinations at the University of Colorado's Laboratory for Environmental and Geological Studies. The IVBA mean ± 1 standard deviation for triplicate analysis was 0.687 ± 0.015, using Dr. Drexler's soil Pb analytical mean value of 2,491 mg/kg. Given Dr. Yang's analytical mean result of 2,021 mg/kg (as used by Dr. Casteel in the swine study), the IVBA result is 0.843 ± 0.015. The prediction interval (i.e., "best estimate" plus 5% and 95% confidence limits) has been published by the

USEPA (2004a; Figure 3-6). Interpolation of the 12-month IVBA data (above) results in best estimates and 95% upper confidence limit (UCL) values of:

- 65.4% and 88.4% for soil Pb level of 2,491 mg/kg; and
- 81.6% and 105.2% for soil Pb level of 2,021 mg/kg.

Dr. Yang's 24-month mean soil Pb result of 2,131 mg/kg was used by Dr. Drexler and by Dr. Casteel. The IVBA mean ± 1 standard deviation for triplicate analysis was 0.887 ± 0.015. These results translate to RBA best estimate and 95% UCL values of 86.1% and 109.7%, respectively.
Given the results for the geochemical modeling (Section 5), plus above analytical data, MSE Technology Applications, Inc. suggests that an overall RBA of ≤ 82% (75%-85% plausible range) appears reasonable for the 12-month soil sample and an overall RBA of ≥ 82% (80%-90% plausible range) for the 24-month sample. The overall upper bound RBA appears to about 90%, well within the range for the cerussite group RBA shown in Figure 2-7 of EPA's RBA estimation report (EPA, 2004a). Such exceedance of the integrated exposure uptake biokinetic (IEUBK) model default RBA value (0.60) may be due to: 1) initial conversion of the small (< 2 μm) galena particles to pyromorphite, followed by 2) surface oxidation of the pyromorphite particles to such biologically available forms of Pb as cerussite.

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ACRONYMS AND ABBREVIATIONS

AA	atomic absorption
ABA	absolute bioavailability
AFo	oral absorption fraction
AUC	area under the curve
BAF	bioaccessible fraction
CDCP	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EDTA	ethylenediaminetetra-acetic acid
EPA	U.S. Environmental Protection Agency
IAG	Interagency Agreement
ICP	inductively coupled plasma
ICP-AES	inductively coupled plasma - atomic emission spectrography
ID	identification
IVBA	in vitro bioaccessibility
kg	kilogram
µg/g	micrograms per gram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
MSE	MSE Technology Applications, Inc.
ng/mg	nanogram per milligram
ng/mL	nanogram per milliliter
NIST	National Institute of Standards and Testing
NRMRL	National Risk Management Research Laboratory
Pb	lead
ppm	parts per million
QA	quality assurance
QAPP	quality assurance project plan
RARE	Regional Applied Research Effort
RBA	relative bioavailability
RPD	relative percent difference
SOP	standard operating procedure
SRM	Standard Reference Material
TCLP	Toxicity Characteristic Leaching Procedure
TSA	technical systems audit
UM/VMDL	University of Missouri Veterinary Medical Diagnostic Laboratory
XRF	x-ray fluorescence

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- Dr. John Yang (Lincoln University of Missouri) for timely preparation, analysis, and shipping of the test materials;
- Dr. Stan Casteel (University of Missouri) and Dr. Bill Brattin (Syracuse Research Corp.) for their performance and statistical analysis, respectively, of the swine dosing study;
- Dr. John Drexler (University of Colorado) for performing the in vitro (bioaccessibility) study; and
- EPA Mine Waste Technology Program and EPA Region 7 personnel for background technical and administrative support.

1. INTRODUCTION

1.1 PROJECT BACKGROUND

EPA Region VII is the location of one of the largest historic lead (Pb) mining and smelting areas in the nation, if not the world. Lead mining activities in Region VII occurred in a broad band more than 50 miles wide stretching from St. Louis, Missouri southwestward into southeastern Kansas. More than 3,000 historic mine sites and over 130 primary smelters have been identified in Missouri alone. Approximately 20 smelters were located in southeastern Kansas, and one of the largest secondary Pb smelters in the nation was located in Omaha, Nebraska. Many of these mines and smelters are located in populated areas, and present a significant health risk to humans.

The Herculaneum Lead Smelter site in Herculaneum, Missouri contains the largest active Pb smelter of its kind in the United States. The site consists of three main areas: the smelter plant, the slag storage pile, and office buildings. The site encompasses approximately 52 acres. It is bordered on the east by the Mississippi River and on the north and west by residential areas. The Herculaneum Lead Smelter site is owned by Doe Run Company (Figure 1-1).

In September 2001, Pb ore concentrate, also referred to as milled ore, was discovered on the streets of Herculaneum. Extensive removal actions were initiated in the fall of 2001 and remain ongoing. Residential yard soil replacement, home interior cleaning, street cleaning, and significant changes to concentrate handling procedures have been implemented.

Lead ore concentrate is a Pb production intermediary that is processed at milling facilities and subsequently trucked to smelting facilities where it is processed into pure Pb product. Concentrate is a fine-grained, powder-like material that consists of approximately 70% Pb. Government regulators discovered that copious amounts of Pb concentrate were being spilled from trucks and/or being tracked out of the storage areas at the Doe Run smelter facility and spreading to the yards in Herculaneum.

Although the Doe Run Company has conducted most of the removal actions at the site to date, EPA has incurred significant oversight and monitoring expenditures. Doe Run is contending that Pb ore concentrate has an extremely low bioavailability potential and therefore, presents a minimal public health threat. EPA has maintained that Pb in the form of mill concentrate can readily oxidize and become more bioavailable over time when exposed to the environment. Presently, EPA is not aware of any specific studies that have quantified the bioavailability of Pb ore concentrate after being exposed to the environment.

The amount of Pb absorption by the body when ingested is referred to as "bioavailability". Each of the 240 different mineralogical species of Pb has a different bioavailability depending on the elements combined with the Pb in the individual species or mineral. Measuring the relative bioavailability (RBA) of Pb in soil is accomplished using an EPA Immature Swine Study (in vivo bioavailability analysis), where young weanling swine are dosed with either the test soil containing a known quantity of Pb or the control soil containing the equivalent concentration of Pb, but essentially in a 100% bioavailable form. Blood, venous blood, soft tissue, and bone samples are obtained to measure the respective adsorption rates of the test and reference Pb compounds into the exposed swine. The tissue-specific differences in Pb concentrations in these two exposure groups are used to calculate the overall Pb-RBA of the particular test soil (Casteel et al., 1996).

Figure 1-1. Herculaneum Smelter site location map.

In vitro methods that simulate Pb behavior in mammalian gastrointestinal tracts have also been developed over the past 10 years (e.g., Ruby et al., 1999). Such approach to estimating Pb bioaccessibility is attractive as it is less time- and money-consuming than swine feeding studies. Furthermore, previous (site-specific) investigations that employed both in vitro and in vivo approaches show promising correlations between the two types of results (USEPA, 2004a). Consequently, this dual-approach was used in this Herculaneum ore concentrate-soil weathering study.

1.2 PROJECT GOALS AND OBJECTIVES

The purpose of this study was to document changes in the relative bioavailability and in vitro bioaccessibility (IVBA) of Pb in ore concentrate-soil mixtures allowed to weather in test plots established in the Herculaneum area. Representative samples of soils were collected after 12 and 24 months of environmental exposure. The dried, sieved (< 250 μm) materials were used for the time-specific determinations of relative bioavailability (RBA) and in vitro bioaccessibility (IVBA). This report presents the results from the sample weathered for 12 months and the sample weathered for 24 months.

Dr. Stan Casteel of the University of Missouri (Columbia), Veterinary Medical Diagnostic Laboratory (UM/VMDL) was the Principal Investigator for the in vivo Pb bioavailability studies that dosed young swine with lead ore concentrate from the field test plots at Herculaneum. Sections of this report discussing the in vivo bioavailability are taken verbatim from Casteel et al. (2006a and 2006b). Physicochemical characterization of the samples was performed by Dr. John Yang at Lincoln University of Missouri (Jefferson City, Missouri). The in vitro Pb bioaccessibility extractions and subsequent chemical analyses were performed by Dr. John Drexler of the University of Colorado (Boulder). His data is found in Appendix B for the 12-month sample and Appendix D for the 24-month sample. Quality assurance oversight, project management, as well as general review and interpretation of all available data were performed by MSE in Butte, Montana.

1.3 OVERVIEW OF BIOAVAILABILITY

Reliable analysis of the potential hazard to humans from ingestion of lead depends upon accurate information on a number of key parameters, including lead concentration in environmental media (e.g., soil, dust, water, food, air, paint), intake rates of each medium, and the rate and extent of lead absorption by the body from an ingested medium ("bioavailability"). Knowledge of lead bioavailability is important because the amount of lead that actually enters the body from an ingested medium depends on the physical-chemical properties of the lead and of the medium. For example, lead in soil may exist, at least in part, as poorly water-soluble minerals, and may also exist inside particles of inert matrix such as rock or slag of variable size, shape, and association; these chemical and physical properties may influence the absorption (bioavailability) of lead when ingested. Thus, equal ingested doses of different forms of lead in different media may not be of equal health concern.

Bioavailability is normally described as the fraction or percentage of a chemical that is absorbed by the body following an exposure of some specified amount, duration, and route (usually oral). Bioavailability of lead in a particular medium may be expressed either in absolute terms (absolute bioavailability) or in relative terms (relative bioavailability). Absolute bioavailability (ABA) is the ratio of the amount of lead absorbed compared to the amount ingested:

$$ABA = (\text{Absorbed Dose}) / (\text{Ingested Dose})$$

This ratio is also referred to as the oral absorption fraction (AFo). Relative bioavailability is the ratio of the absolute bioavailability of lead present in some test material compared the absolute bioavailability of lead in some appropriate reference material:

$$RBA = ABA(\text{test}) / ABA(\text{reference})$$

Usually the form of lead used as reference material is a soluble compound such as lead acetate that is expected to completely dissolve when ingested.

For example, if 100 micrograms (μg) of lead dissolved in drinking water were ingested and a total of 50 μg entered the body, the ABA would be 50/100, or 0.50 (50%). Likewise, if 100 μg of lead contained in soil were ingested and 30 μg entered the body, the ABA for soil would be 30/100, or 0.30 (30%). If the lead dissolved in water were used as the frame of reference for describing the relative amount of lead absorbed from soil, the RBA would be 0.30/0.50, or 0.60 (60%).

For additional discussion about the concept and application of bioavailability, see Gibaldi and Perrier (1982), Goodman et al. (1990), Mushak (1991), and/or Klaassen et al. (1996).

1.4 USING BIOAVAILABILITY DATA TO IMPROVE EXPOSURE CALCULATIONS FOR LEAD

When reliable data are available on the bioavailability of lead in soil, dust, or other soil-like waste materials at a site, this information can be used to improve the accuracy of exposure and risk calculations at that site. For example, the basic equation for estimating the site-specific ABA of a test soil is as follows:

$$ABA_{soil} = ABA_{soluble} \cdot RBA_{soil}$$

where:

ABA_{soil}	=	Absolute bioavailability of lead in soil ingested by a human
$ABA_{soluble}$	=	Absolute bioavailability in children of some dissolved or fully soluble form of lead
RBA_{soil}	=	Relative bioavailability of lead in soil as measured in swine

Based on available information on lead absorption in humans and animals, the U.S. Environmental Protection Agency (USEPA) estimates that the absolute bioavailability of lead from water and other fully soluble forms of lead is usually about 50% in children (USEPA, 1991) and about 20% in adults (USEPA, 2003). Thus, when a reliable site-specific RBA value for soil is available, it may be used to estimate a site-specific absolute bioavailability in that soil, as follows:

$$ABA_{soil}\,(\text{child}) = 50\% \cdot RBA_{soil}$$
$$ABA_{soil}\,(\text{adult}) = 20\% \cdot RBA_{soil}$$

The default RBA used by USEPA for lead in soil and dust compared to lead in water is 60% for both children and adults. When the measured RBA in soil or dust at a site is found to be less than 60% compared to some fully soluble form of lead, it may be concluded that exposures to and hazards from lead in these media at that site are probably lower than the typical default assumptions. If the measured RBA is higher than 60%, absorption of and hazards from lead in these media may be higher than usually assumed.

2. LEAD BIOAVAILABILITY AND BIOACCESSIBILITY STUDIES

2.1 IN VIVO STUDY

2.1.1 Study Design

The study design was patterned after the standardized study protocol for measuring relative bioavailability of lead (USEPA, 2004a) using the juvenile swine model. The basic design for the 12-month and 24-month test samples is presented in Table 2-1. As shown, the study investigated lead

absorption from lead acetate (the reference material) and one soil sample (the test material). Each material was administered to groups of five animals at three different dose levels for 15 days (a detailed schedule for the 12-month study is presented in Appendix A, Table A-1, and a detailed schedule for the 24-month study is presented in Appendix C, Table A-1). Additionally, both the 12-month and 24-month studies included a non-treated group of three animals to serve as a control for determining background lead levels. All doses were administered orally. The study was performed as nearly as possible within the spirit and guidelines of Good Laboratory Practices (GLP: 40 CFR 792).

Table 2-1. In vivo study design.

Study design for test material weathered for 12-months				
Group	**Number of Animals**	**Dose Material Administered**	**Lead Dose (µg/kg-day)**	
			Target	**Actual [a]**
1	3	Control	0	0
2	5	Lead Acetate	25	25.3
3	5	Lead Acetate	75	76.3
4	4 [b]	Lead Acetate	225	226.7
5	5	Test Material	75	77.1
6	5	Test Material	225	230.13
7	5	Test Material	675	685.91
Study design for test material weathered for 24-months				
1	3	Control	0	0.0
2	5	Lead Acetate	25	25.7
3	5	Lead Acetate	75	77.5
4	5	Lead Acetate	225	230.9
5	5	Test Material	75	77.4
6	5	Test Material	225	230.7
7	5	Test Material	675	693.0

Notes: [a] Calculated as the administered daily dose divided by the measured or extrapolated daily body weight, averaged over days 0-14 for each animal and each group.
[b] One pig in group died; value shown is number of animals at completion of study (i.e., number included in data analysis).
Doses were administered in two equal portions given at 9:00 am and 3:00 p.m. each day. Doses were based on the mean weight of the animals in each group, and were adjusted every three days to account for weight gain.

2.1.2 Test Material

2.1.2.1 Sample Description

The test material for the 12-month study consisted of a soil sample designated "HER-2930" collected from the Herculaneum Lead Smelter test plot after 12-months of weathering in May 2005. The test material for the 24-month study consisted of a soil sample designated "HER-3201" collected from the Herculaneum Lead Smelter test plot after 24-months of weathering in May 2006.

2.1.2.2 Sample Preparation

Both the 12-month and 24-month soil samples were air-dried and sieved through a 250-micrometer (µm) sieve prior to test substance analysis and characterization. Only material that passed through the sieve (corresponding to particles smaller than about 250 µm) were used in the bioavailability studies. The

studies were limited to this fine-grained soil fraction because it is believed that soil particles less than about 250 μm are most likely to adhere to the hands and be ingested by hand-to-mouth contact, especially in young children.

2.1.2.3 Lead Concentration

The concentration of lead in the soil test material after it had weathered for 12-months was measured in triplicate by inductively coupled plasma-optical emission spectrometer (after digestion of the material by EPA SW-846 Method 3051). The resulting mean lead value in the sample weathered for 12-months was 2,021 μg/g.

The concentration of lead in the soil test material after weathering for 24-months was also measured in triplicate by inductively coupled plasma-optical emission spectrometer. The resulting mean lead concentration in the 24-month sample was 2,131 μg/g.

2.1.3 Experimental Animals

Juvenile swine were selected for use in both the 12-month and 24-month studies because they were considered to be a good physiological model for gastrointestinal absorption in children (Weis and LaVelle, 1991; Casteel et al., 1996). The animals were intact males of the Pig Improvement Corporation (PIC) genetically defined Line 26, and were purchased from Chinn Farms, Clarence, Missouri for both studies.

The number of animals purchased for each study was several more than required by the protocol. These animals were purchased at an age of about 5-6 weeks (weaning occurs at age 3 weeks) and housed in individual lead-free stainless steel cages. The animals were then held under quarantine for one week to observe their health before beginning exposure to test materials. Each animal was examined by a certified veterinary clinician (swine specialist) and any animals that appeared to be in poor health during this quarantine period were excluded from the study. To minimize weight variations among animals and groups, extra animals most different in body weight (either heavier or lighter) four days prior to exposure (day -4) were also excluded from the study. The remaining animals were assigned to dose groups at random (group assignments are presented in Appendix A, Table A-2 for the 12-month study and Appendix C, Table A-2 for the 24-month study).

When exposure began (day zero) for the 12-month study, the animals were about 6-7 weeks old and weighed an average of about 11.1 kg. The animals were weighed every three days during the course of the study. On average, animals gained about 0.45 kg/day and the rate of weight gain was comparable in all dosing groups, ranging from 0.38 to 0.51 kg/day. These body weight data for the 12-month study are summarized in Figure 2-1a and are also presented in Appendix A, Table A-3.

All animals were examined daily by an attending veterinarian while on study. Most animals (N = 21) exhibited no problems throughout the study. Several animals (N = 12) were treated for illness (e.g., fever, inappetence, diarrhea) with Naxcel (see Appendix A, Table A-4). In addition, one animal died during the course of the 12-month study (see Appendix A, Table A-4); data from this animal was excluded from all data analyses (Casteel et al., 2006).

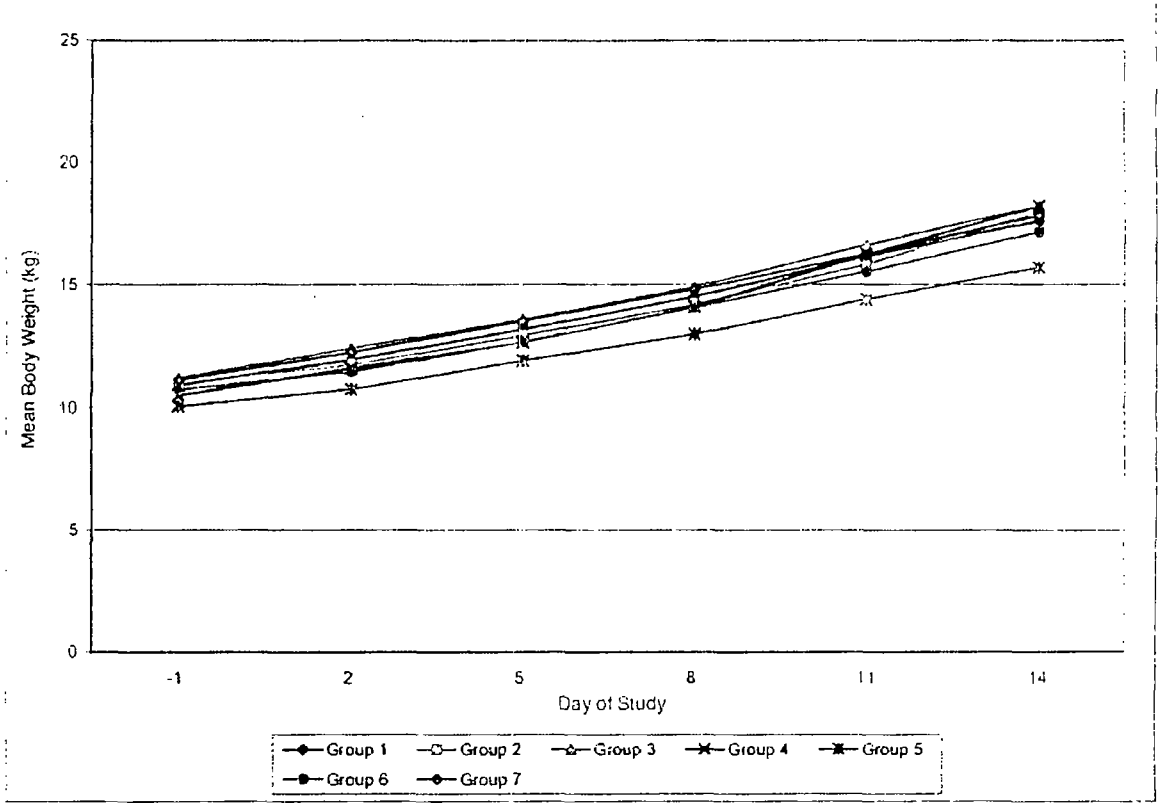


Figure 2-1a. Body weight gain for the 12-month study.

When exposure began (day zero) for the 24-month study, the animals were about 6-7 weeks old and weighed an average of about 11.2 kg. The animals were weighed every three days during the course of the study. On average, animals gained about 0.36 kg/day and the rate of weight gain was comparable in all dosing groups, ranging from 0.26 to 0.47 kg/day. These body weight data are summarized in Figure 2-1b and are also presented in Appendix C, Table A-3.

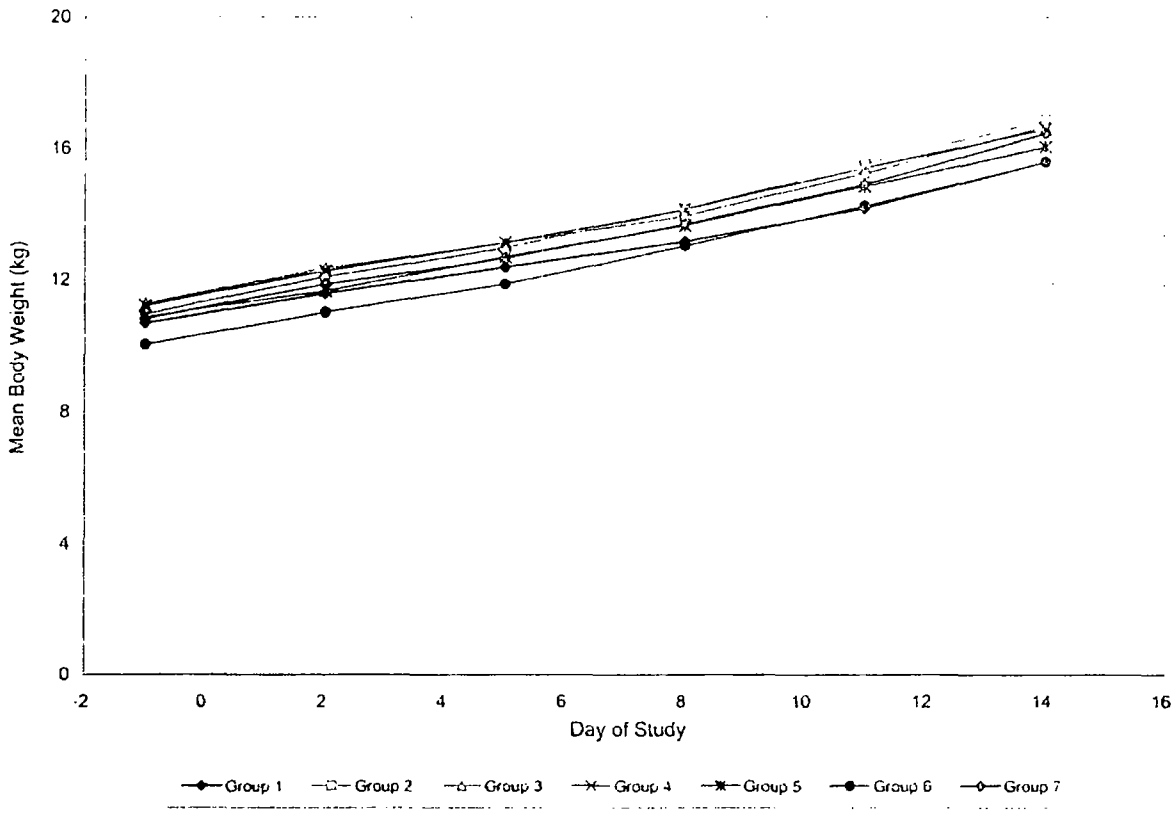


Figure 2-1b. Body weight gain for 24-month study.

All animals were examined daily by an attending veterinarian while on study. Although most animals exhibited no problems throughout the 24-month study, several animals (N = 9) were treated for illness (e.g., fever, inappetence, diarrhea) with Naxcel. Animal health details are presented in Table A-4 of Appendix C.

2.1.4 Diet

For the 12-month study, animals were weaned onto standard pig chow (purchased from MFA Inc., Columbia, Missouri) by the supplier. In order to minimize lead exposure from the diet, the animals were gradually transitioned from the MFA feed to a special low-lead feed (guaranteed less than 0.2 ppm lead, purchased from Zeigler Brothers, Inc., Gardners, Pennsylvania), and this feed was maintained for the duration of the study. The feed was nutritionally complete and met all requirements of the National Institutes of Health–National Research Council. The typical nutritional components and chemical analysis of the feed are presented in Table 2-2a. Each day every animal was given an amount of feed equal to 5% of the mean body weight of all animals on study through day 2; beginning on day 3, the feed portion was changed to 4.5% of the mean body weight of all animals on study, as the animals had not been consuming all their feed. Feed amounts were adjusted every three days, when pigs were weighed. Feed was administered in two equal portions at 11:00 AM and 5:00 PM daily. Analysis of random low-lead feed samples indicated that the lead level did not exceed 0.05 µg/g.

Table 2-2a. Typical feed composition for the 12-month study.

Nutrient Name	Amount	Nutrient Name	Amount
Protein	20.1021%	Chlorine	0.1911%
Arginine	1.2070%	Magnesium	0.0533%
Lysine	1.4690%	Sulfur	0.0339%
Methionine	0.8370%	Manganese	20.4719 ppm
Met+Cys	0.5876%	Zinc	118.0608 ppm
Tryptophan	0.2770%	Iron	135.3710 ppm
Histidine	0.5580%	Copper	8.1062 ppm
Leucine	1.8160%	Cobalt	0.0110 ppm
Isoleucine	1.1310%	Iodine	0.2075 ppm
Phenylalanine	1.1050%	Selenium	0.3196 ppm
Phe+Tyr	2.0500%	Nitrogen Free Extract	60.2340%
Threonine	0.8200%	Vitamin A	5.1892 kIU/kg
Valine	1.1910%	Vitamin D3	0.6486 kIU/kg
Fat	4.4440%	Vitamin E	87.2080 IU/kg
Saturated Fat	0.5590%	Vitamin K	0.9089 ppm
Unsaturated Fat	3.7410%	Thiamine	9.1681 ppm
Linoleic 18:2:6	1.9350%	Riboflavin	10.2290 ppm
Linoleic 18:3:3	0.0430%	Niacin	30.1147 ppm
Crude Fiber	3.8035%	Pantothenic Acid	19.1250 ppm
Ash	4.3347%	Choline	1019.8600 ppm
Calcium	0.8675%	Pyridoxine	8.2302 ppm
Phos Total	0.7736%	Folacin	2.0476 ppm
Available Phosphorous	0.7005%	Biotin	0.2038 ppm
Sodium	0.2448%	Vitamin B12	23.4416 ppm
Potassium	0.3733%		

Feed obtained from and nutritional values provided by Zeigler Bros., Inc.

Drinking water was provided *ad libitum* via self-activated watering nozzles within each cage. Analysis of samples from randomly selected drinking water nozzles indicated the lead concentration did not exceed 3 µg/L.

For the 24-month study, animals were weaned onto standard pig chow (purchased from MFA Inc., Columbia, MO) by the supplier. In order to minimize lead exposure from the diet, the animals were gradually transitioned from the MFA feed to a special purified low-lead feed (purchased from TestDiet®, Richmond, IN) that was different than, but comparable to the feed used during the 12-month study. The transition period began several days before soil dosing began, and this feed was maintained for the duration of the 24-month study. The feed was nutritionally complete and met all requirements of the National Institutes of Health–National Research Council (NRC, 1988); the ingredients and nutritional profile of the feed are presented in Table 2-2b. Each day every animal was given an amount of feed equal to 4% of the mean body weight of all animals on study. Feed amounts were adjusted every three days, when pigs were weighed. Feed was administered in two equal portions at 11:00 AM and 5:00 PM daily. Analysis of random low-lead feed samples indicated that the lead level did not exceed 0.06 µg/g.

Table 2-2b. Typical feed composition for 24-month study.

Test Diet 5TXP: Porcine Grower Purified Diet with Low Lead				
INGREDIENTS				
Corn Starch, %	25.2	Potassium Phosphate, %		0.87
Sucrose, %	20.9648	Calcium Carbonate, %		0.7487
Glucose, %	16	Salt, %		0.501
Soy Protein Isolate, %	14.9899	Magnesium Sulfate, %		0.1245
Casein – Vitamin Free, %	8.5	DL-Methionine, %		0.0762
Powdered Cellulose, %	6.7208	Choline Chloride, %		0.0586
Corn Oil, %	3.4046	Vitamin/Mineral Premix, %		0.0577
Dicalcium Phosphate, %	1.7399	Sodium Selenite, %		0.0433
NUTRITIONAL PROFILE[1]				
Protein, %	**21**	**Fat, %**		**3.5**
Arginine, %	1.42	Cholesterol, ppm		0
Histidine, %	0.61	Linoleic Acid, %		1.95
Isoleucine, %	1.14	Linolenic Acid, %		0.03
Leucine, %	1.95	Arachidonic Acid, %		0
Lysine, %	1.56	Omega-3 Fatty Acids, %		0.03
Methionine, %	0.49	Total Saturated Fatty Acids, %		0.43
Cystine, %	0.23	Total Monounsaturated Fatty Acids, %		0.82
Phenylalanine, %	1.22	Polyunsaturated Fatty Acids, %		1.98
Tyrosine, %	1.03			
Threonine, %	0.88			
Tryptophan, %	0.32	**Fiber (max), %**		**6.8**
Valine, %	1.16			
Alanine, %	0.95	**Carbohydrates, %**		**62.2**
Aspartic Acid, %	2.33			
Glutamic Acid, %	4.96	**Energy (kcal/g)**[2]		**3.62**
Glycine, %	0.79	From:	kcal	%
Proline, %	1.83	Protein	0.84	23.1
Serine, %	1.25	Fat (ether extract)	0.315	8.7
Taurine, %	0	Carbohydrates	2.487	68.3
Minerals		**Vitamins**		
Calcium, %	0.8	Vitamin A, IU/g		1.7
Phosphorus, %	0.72	Vitamin 0-3 (added), IU/g		0.2
Phosphorus (available), %	0.4	Vitamin E, IU/kg		11
Potassium, %	0.27	Vitamin K (as menadione), ppm		0.52
Magnesium, %	0.04	Thiamin Hydrochloride, ppm		1
Sodium, %	0.3	Ribonavin, ppm		3.1
Chlorine, %	0.31	Niacin, ppm		13
Fluorine, ppm	0	Pantothenic Acid, ppm		9
Iron, ppm	82	Folic Acid, ppm		0.3
Zinc, ppm	84	Pyridoxine, ppm		1.7
Manganese, ppm	3	Biotin, ppm		0.1
Copper, ppm	4.9	Vitamin B-12, mcg/kg		15
Cobalt, ppm	0.1	Choline Chloride, ppm		410
Iodine, ppm	0.15	Ascorbic Acid, ppm		0
Chromium, ppm	0			
Molybdenum, ppm	0.01			
Selenium, ppm	0.26			

1 Based on the latest ingredient analysis information. Since nutrient composition of natural ingredients varies, analysis will differ accordingly. Nutrients expressed as percent of ration on an As Fed basis except where otherwise indicated.

2 Energy (kcal/gm) – Sum of decimal fractions of protein, fat, and carbohydrate x 4, 9, 4 kcal/gm, respectively.

Note: Feed obtained and nutritional values provided by TestDiet®

Drinking water was provided *ad libitum* via self-activated watering nozzles within each cage. Analysis of samples from randomly selected drinking water nozzles indicated the lead concentration did not exceed 1.6 μg/L.

2.1.5 Dosing

The protocol for exposing animals to lead is shown in Table 2-1 for both the 12-month study and the 24-month study. The dose levels for lead acetate were based on experience from previous swine investigations that showed that lead doses of 25-225 µg/kg-day resulted in clear and measurable increases in lead levels in all endpoints measured (blood, liver, kidney, and bone). The actual administered doses were calculated based on the lead content of the material administered and the measured group mean body weights. Specifically, doses of lead for the three days following each weighing were based on the group mean body weight adjusted by the addition of 1 kg to account for the expected weight gain over the time interval. After completion of the study, body weights were estimated by interpolation for those days when measurements were not collected and the actual administered doses were calculated for each day and then averaged across all days. The actual mean doses for each dosing group are included in Table 2-1; the actual lead doses administered to each pig are presented in Appendix A, Table A-3 for the 12-month study and Appendix C, Table A-3 for the 24-month study.

Animals were exposed to lead acetate or the test material for 15 days, with the dose for each day being administered in two equal portions beginning at 9:00 AM and 3:00 PM (two hours before feeding), with two minute intervals allowed for individual pig dosing. Dose material was placed in the center of a small portion (about 5 grams) of moistened feed (this is referred to as a "doughball"), and this was administered to the animals by hand[1]. If uneaten portions of doughballs were discovered, these were retrieved and offered again for consumption. Occasionally, some animals did not consume their entire dose. In these instances, the missed doses were estimated and recorded and the time-weighted average dose calculation for each animal was adjusted downward accordingly (see Appendix A, Table A-3 for these details for the 12-month study and Appendix C, Table A-3 for these details for the 24-month study).

2.1.6 Collection of Biological Samples

For both the 12-month and 24-month studies, the protocols used for collection of biological samples were identical. Samples of blood were collected from each animal on the first day of exposure (day 0) and on days 1, 2, 3, 5, 7, 9, 12, and 15 following the start of exposure. All blood samples were collected by vena-puncture of the anterior vena cava, and samples were immediately placed in purple-top Vacutainer® tubes containing EDTA (ethylenediaminetetra-acetic acid) as anticoagulant. Although EDTA is a chelator of metals, the nitric acid digest used in the analysis destroys the organic constituents in the blood, thereby freeing all lead for analysis. Thus, the presence of EDTA in the sampling tubes will not impact the analytical results for lead. Blood samples were collected each sampling day beginning at 8:00 AM, approximately one hour before the first of the two daily exposures to lead on the sampling day and 17 hours after the last lead exposure the previous day. This blood collection time was selected because the rate of change in blood lead resulting from the preceding exposures is expected to be relatively small after this interval (LaVelle et al., 1991; Weis et al., 1993), so the exact timing of sample collection relative to the last dosing is not likely to be critical.

Following collection of the final blood sample on day 15, all animals were humanely euthanized and samples of liver, kidney, and bone (the right femur, defleshed) were removed and stored at -80 °C in lead-free plastic bags for lead analysis.

Samples of all biological samples collected were archived in order to allow for reanalysis and verification of lead levels, if needed. All animals were also subjected to detailed examination at necropsy by a certified veterinary pathologist in order to assess overall animal health.

[1] Doughballs were kept as small as possible. About one-third of the way through the 12-month study, the dose for Group 7 (high dose soil) was split between two doughballs.

2.1.7 Preparation of Biological Samples for Analysis

The preparation of biological samples for analysis was identical for the 12-month and 24-month studies. The procedures used are described in the sections below.

2.1.7.1 Blood

One mL of whole blood was removed from the purple-top Vacutainer® tube and added to 9.0 mL of "matrix modifier," a solution recommended by the Centers for Disease Control and Prevention (CDCP) for analysis of blood samples for lead. The composition of matrix modifier is 0.2% (v/v) ultrapure nitric acid, 0.5% (v/v) Triton X-100, and 0.2% (w/v) dibasic ammonium phosphate in deionized distilled water.

2.1.7.2 Liver and Kidney

One gram of soft tissue (liver or kidney) was placed in a lead-free screw-cap Teflon container with 2 mL of concentrated (70%) nitric acid and heated in an oven to 90 °C overnight. After cooling, the digestate was transferred to a clean lead-free 10 mL volumetric flask and diluted to volume with deionized distilled water.

2.1.7.3 Bone

The right femur of each animal was defleshed, broken, and dried at 100 °C overnight. The dried bones were then placed in a muffle furnace and dry-ashed at 450 °C for 48 hours. Following dry ashing, the bone was ground to a fine powder using a lead-free mortar and pestle, and 200 mg was removed and dissolved in 10.0 mL of 1:1 (v:v) concentrated nitric acid/water. After the powdered bone was dissolved and mixed, 1.0 mL of the acid solution was removed and diluted to 10.0 mL in deionized distilled water.

2.1.8 Lead Analysis

Samples of biological tissue (blood, liver, kidney, and bone) and other materials (e.g., food, water, reagents, solutions) from the 12-month and 24-month study were analyzed for lead by graphite furnace atomic absorption using a Perkin Elmer AAnalyst 800 high-performance atomic absorption spectrometer. Internal quality assurance samples are described in Section 2.3 of this report .

All analytical results were reported in units of μg Pb/L (ng/mL) of prepared sample. The quantitation limit was defined as three-times the standard deviation of a set of seven replicates of a low-lead sample (typically about 2-5 μg/L). The standard deviation was usually about 0.3 μg/L, so the quantitation limit was usually about 0.9-1.0 μg/L. For prepared blood samples (diluted 1/10), this corresponds to a quantitation limit of 10 μg/L (1 μg/dL). For soft tissues (liver and kidney, diluted 1/10), this corresponds to a quantitation limit of 10 μg/kg (ng/g) wet weight, and for bone (diluted 1/500) the corresponding quantitation limit is 0.5 μg/g (ng/mg) ashed weight. All responses below the quantitation limit were evaluated at one-half the quantitation limit.

Lead analytical results for 12-month study samples are presented in Appendix A, Table A-5; the results for quality assurance samples are presented in Appendix A, Table A-6, and are summarized below (Casteel et al., 2006a). Lead analytical results for 24-month study samples are presented in Appendix C, Table A-5; the results for quality assurance samples are presented in Appendix C, Table A-6, and are summarized below (Casteel et al., 2006b) in Section 2.3.

2.2 IN VITRO BIOACESSABILITY STUDY

In addition to the in vivo work using young swine, in vitro determinations were performed by Dr. John Drexler of the University of Colorado on both the 12-month and 24-month test soils. In vitro methods have been developed for measuring the portion of Pb solubilized from soil materials under simulated gastrointestinal conditions (Ruby et al., 1996). These results, often referred to as the bioaccessible fraction (BAF), are thought to be an important determinant of bioavailability. Thus, BAF is not necessarily equal to RBA, but depends on the relation between results from a particular in vitro test system and an appropriate in vivo model/test animal (Ruby et al., 1999).

The in vitro tests simulate the gastrointestinal environment via sequential extraction of Pb (from soil, etc.) using strong acid and paraneutral aqueous solutions; these fluids mimic the pH conditions found in the stomach and small intestine, respectively. The extract is filtered (0.45 μm) and then analyzed for its Pb content. The mass of Pb found in the aqueous phase, divided by the Pb mass introduced in the test, represents the sample-specific BAF. To date, for Pb-contaminated soils, the in vitro method has correlated well with the RBA values (USEPA, 2004a).

The in vitro bioaccessibility portion of the study used an EPA-approved method (extraction) and analysis methodologies, plus quality assurance/quality control guidance (EPA, 2005). Essentially, the extraction step uses 100 mL of pH 1.5 fluid (prepared using concentrated hydrochloric acid and containing 0.4 moles/liter glycine) and 1 gram of soil. The mixture is placed in a 125-mL high-density polyethylene bottle, sealed, and then agitated at 30 revolutions per minute for 1 hour at 37 °C on a modified TCLP extractor. Assuming maintenance of the above pH, the solution is passed through a 0.45-μm disk filter, and then the filtrate is stored at 4 °C until analyzed. The solution is then analyzed for Pb using ICP-AES (SW-846-6010B; USEPA, 2004b).

2.3 QUALITY ASSURANCE FOR THE IN VIVO STUDY

2.3.1 University of Missouri Activities

A number of quality assurance (QA) steps were taken during this project to evaluate the accuracy of the analytical procedures. These activities are discussed below.

2.3.1.1 Spike Recovery

Randomly selected samples were spiked with known amounts of lead (as lead acetate) and the recovery of the added lead was measured. Recovery for individual samples ranged from 83% to 118%, with an average of 99 ± 8.1% (N = 34) for the 12-month study.

During the 24-month study, randomly selected samples were spiked with known amounts of lead (as lead acetate) and the recovery of the added lead was measured. Recovery for individual samples ranged from 85% to 115%, with an average of 98% ± 7.7% (N = 49).

2.3.1.2 Duplicate Analysis of Sample Digestate

Periodically during sample analysis for the 12-month study, samples were randomly selected for duplicate analysis (i.e., the same prepared sample was analyzed twice). All duplicate results (N = 44) agreed within ±15% relative percent difference (RPD) (for analytical results greater than 10 μg/L) or ±1 μg/L (for analytical results less than or equal to 10 μg/L), as required by the analytical protocol.

Similarly, during sample analysis for the 24-month study, samples were randomly selected for duplicate analysis. Nearly all duplicate results (N = 43) agreed within ±15% relative percent difference (RPD) or ±1 times the detection limit, as required by the analytical protocol. Two blood sample duplicates had differences exceeding the detection limit by 1.2 and 2.2 μg/L; one liver sample duplicate had a RPD of 19%.

2.3.1.3 Sample Preparation Replicates

A random selection of about 20% of all tissue samples generated during the 12-month study were prepared for laboratory analysis in duplicate (i.e., two separate subsamples of blood/tissue were prepared for analysis). The results for these replicate preparations are summarized in Figure 2-2a. As seen, the analytical results for replicate pairs of blood samples (Panel A of Figure 2-2a) tend to follow the line of equality, indicating that the replicate pairs are generally in good agreement. The absolute difference between replicate pairs of blood samples ranged from 0 to 3.0 μg/dL with an average of 0.65 μg/dL (N = 27). As seen, there was also good reproducibility between replicate samples for tissues (Panels B and C of Figure 2-2a). The absolute difference between replicate pairs of liver and kidney samples ranged from 0 to 0.03 ng/g with an average of 0.01 ng/g (N = 6). The absolute difference between replicate pairs of femur samples ranged from 0.0 to 0.8 μg/g with an average of 0.33 μg/g (N = 3).

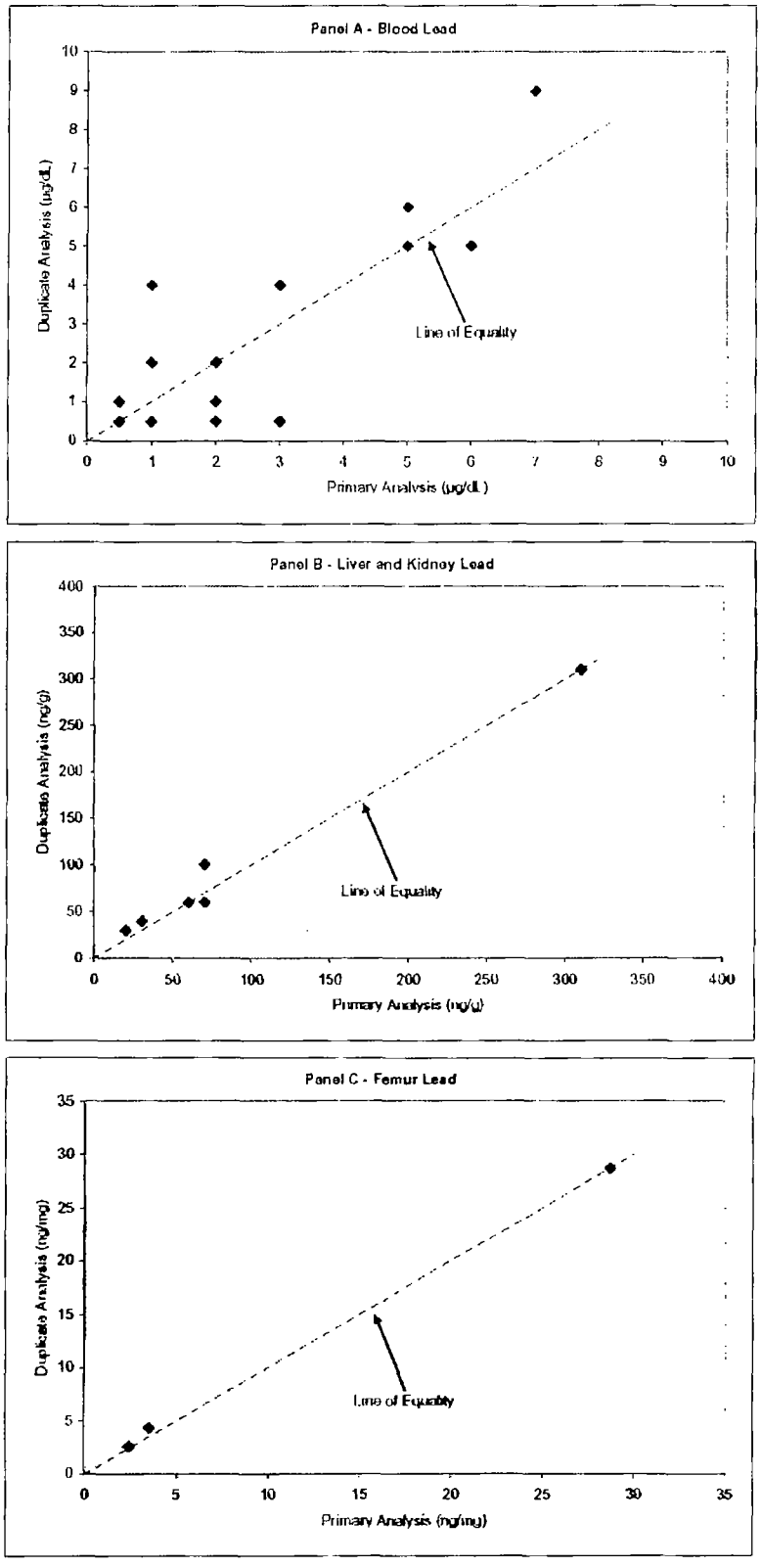


Figure 2-2a. Sample preparation replicates for the 12-month study.

A random selection of about 9% of all tissue samples generated during the 24-month study were prepared for laboratory analysis in duplicate and submitted to the analytical laboratory in a blind fashion. The results for these replicate preparations are summarized in Figure 2-2b. As seen, the analytical results for replicate pairs of blood samples (Panel A of Figure 2-2b) tend to follow the line of equality, indicating that the replicate pairs are generally in good agreement. The absolute difference between replicate pairs of blood samples ranged from 0.0 to 1.4 μg/dL with an average of 0.34 μg/dL (N = 27). As seen, there was also good reproducibility between replicate samples for tissues (Panels B and C of Figure 2-2b). The absolute difference between replicate pairs of liver and kidney samples ranged from 0.0 to 0.05 μg/g with an average of 0.01 μg/g (N = 6). The absolute difference between replicate pairs of femur samples ranged from 0.0 to 1.0 μg/g with an average of 0.40 μg/g (N = 3).

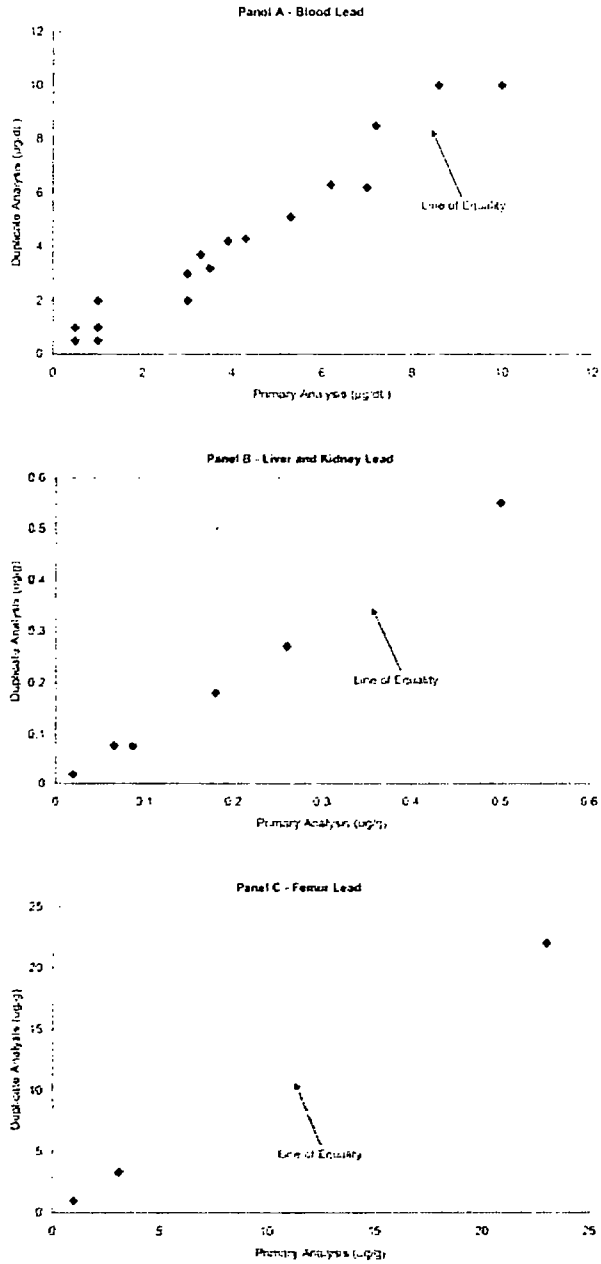


Figure 2-2b. Sample preparation replicates for the 24-month study.

2.3.1.4 Laboratory Control Standards

Laboratory control standards (samples of reference materials for which a certified concentration of lead has been established) were tested periodically during sample analysis for both the 12-month and 24-month studies. Results for the standards are summarized in Table 2-3.

Table 2-3. Summary of laboratory control standards for the in vivo study.

Laboratory control standard results for the sample weathered for 12-months						
Standard	**Target Value (Acceptable Range)**	**Mean**	**Range**	**SD**	**Mean % Recovery**	**N**
ERA Quality Control Std 697, 1/5	17.5 (15.75 – 19.25)	18.2	16.3 – 19.2	0.9	104.2%	17
ERA Quality Control Std 697, 1/10	8.75 (7.9 – 9.6)	8.99	8.2 – 9.6	0.3	102.7%	43
DOLT-3 (dogfish liver)	0.319 (0.274 – 0.365)	0.255	0.24 – 0.27	0.021	79.9%	2
TORT-2 (lobster hepatopancreas)	0.35 (0.22 – 0.48)	0.26	0.24 – 0.27	0.019	72.9%	2
NIST SRM 1400 (bone ash)	9.07 (8.95 – 9.19)	9.09	–	–	100.2%	1
LUTS-1 (lobster hepatopancreas)	0.010 (0.008 – 0.012)	< DL (0.01)	–	–	–	1
Laboratory control standard results for the sample weathered for 24-months						
CDC 294	1.9	2.0	2.0-2	0	105.3	5
CDC 690	4.8	3.98	3.6-4.2	0.21	82.9	11
NIST SRM 1400 (bone ash)	9.07 (8.95 – 9.19)	8.95	8.4-9.5	0.778	98.7	2
DOLT-3 (dogfish liver)	0.319 (0.274 – 0.365)	0.32	0.29-0.34	0.04	98.8	2
TORT-2 (lobster hepatopancreas)	0.35 (0.22 – 0.48)	0.28	0.26-0.30	0.02	80.0	4

As seen, recovery of lead from these standards was generally good and within the acceptable range.

2.3.1.5 Blood Lead Check Samples

The CDCP provides a variety of blood lead "check samples" for use in quality assurance programs for blood lead studies. Several CDCP check samples of different concentrations were analyzed periodically during blood sample analysis for the 12-month and 24-month studies. The results for the 12-month study are summarized in Figure 2-3a.

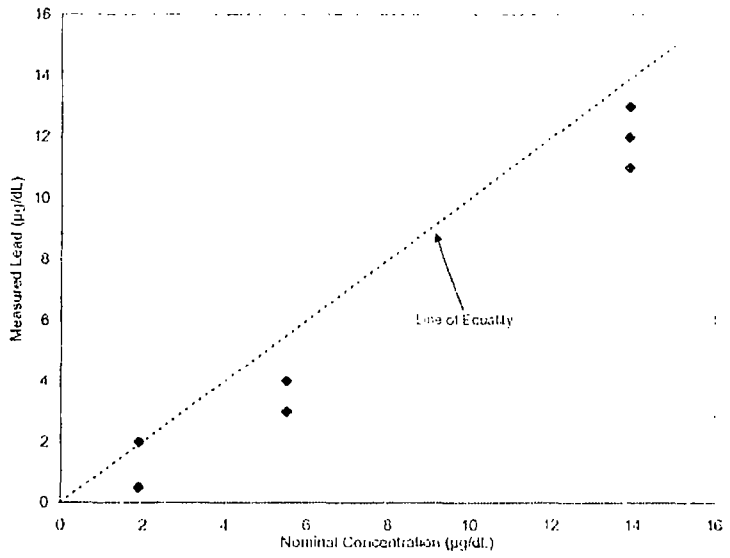


Figure 2-3a. CDCP blood lead check samples for the 12-month study.

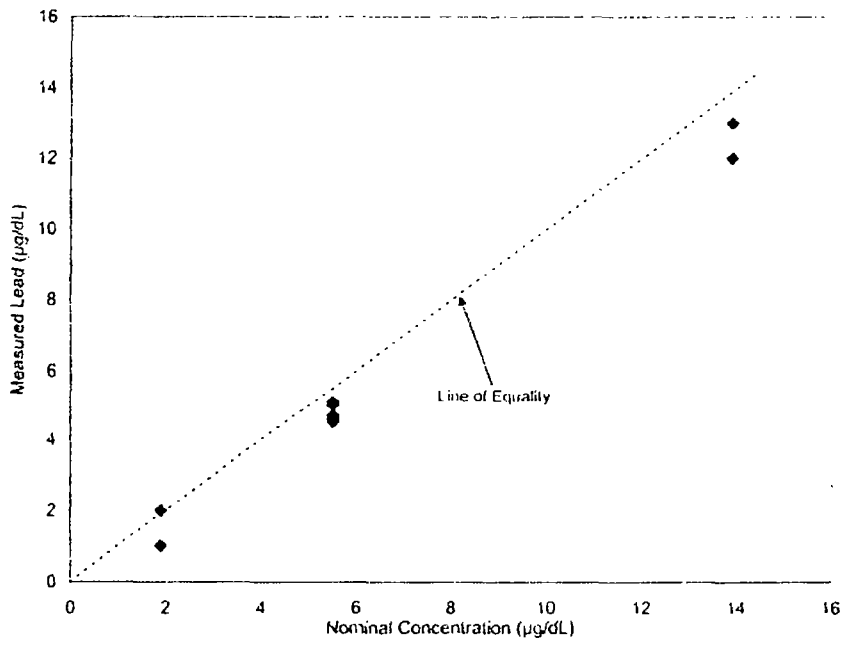


Figure 2.3b. CDCP blood lead check samples for the 24-month study.

The results for all standards for both the 12-month and 24-month studies generally cluster around the line of equality, but tend to be slightly lower than expected; the reason for this is not known.

2.3.1.6 Blanks

Samples of the sample preparation matrix for each endpoint (without added tissue) were routinely analyzed for lead to ensure the absence of lead contamination. These matrix blanks never yielded a

measurable level of lead during the 12-month study, with all values being reported as less than 1 µg/L (N = 60).

Similarly during the 24-month study, these matrix blanks never yielded a measurable level of lead, with all values being reported as less than the detection limit (N = 23).Based on the results of all of the quality assurance samples and steps described above, it is concluded that the analytical results are of sufficient quality for derivation of reliable estimates of lead absorption from test materials.

2.3.2 Technical Systems Audit of the VMDL Activities by MSE

2.3.2.1 Introduction

On June 14, 2005, a technical systems audit (TSA) of procedures for field and subsequent laboratory analytical activities for the *Investigation of Lead-Contaminated Soils and Lead Ore Concentrate Bioavailability Rates, Subtask 2- Determination of Lead Ore Concentrate Bioavailability Rates, Regional Applied Research (RARE) Project* was performed at the UM/VMDL in Columbia, Missouri. The audit was conducted by Ken Reick of MSE Technology Applications, Inc. (MSE). The criterion upon which the TSA was based was the approved project-specific quality assurance project plan (QAPP), as well as universally recognized good field and laboratory practices.

2.3.2.2 Audit Procedures

The TSA commenced at 8:15 AM and concluded at 4:10 PM. The scope of the TSA included:

- personnel;
- equipment;
- documentation (logbooks and chain-of-custody forms);
- sampling procedures;
- analytical procedures; and
- procedural completeness.

There were no TSA findings or observations for any of the above areas. Findings are defined as: non-conformances at the project level that may have a significant adverse effect on quality. Observations are defined as: non-conformances at the project level that may not have a significant adverse effect on quality. Additional technical comments are defined as: items identified during the course of the audit that were not specified in the QAPP, but should be addressed to improve the operation of the project.

2.3.2.3 Audit Results

Personnel

The personnel present during the review were Ken Reick (MSE QA Staff), Dr. Stan W. Casteel, Margaret Dunsmore, Ashley Akeman, John Borzillo, and Dr. Genny Fent. Dr. Casteel is the UM/VMDL representative and is an internationally-recognized veterinary toxicologist. Ms. Dunsmore is the UM/VMDL QA Officer and analytical chemist with extensive experience in these fields. Dr. Fent is a doctor of veterinary medicine, Ms. Akeman is working on her Animal Science degree, and Mr. Borzillo is an Animal Science graduate and will enter Veterinary School in the fall. All of these personnel were well versed in their project responsibilities.

There were no findings, observations, or technical comments for this portion of the TSA.

Equipment Description

The young swine used in the in vivo bioavailability studies are kept in separate stainless steel lead-free cages. The equipment used for obtaining blood samples consists of a syringe and Vacutainer tubes. The equipment used for analyzing the blood, soil, tissue, and bone samples is an AA Analyst – 800 Perkin Elmer THGA graphite furnace atomic absorption spectrophotometer.

Following the collection of blood samples (discussed in Section 2.1.6), swine dosing commenced at 9:00 AM. Each swine was dosed at two-minute intervals. At 11:00 AM, feeding commenced. This was also at two-minute intervals. Equipment used were scales and a feeding tray in front of each cage. There were no findings, observations or technical comments for this portion of the TSA.

Documentation

All sampling information was recorded in a logbook and backed up electronically. Sample labeling information was prerecorded on the Vacutainers.

A chain-of-custody for soil samples delivered to the UM/VMDL from Lincoln University was examined. All of the required information was on the chain-of-custody form.

There were no findings or observations for this portion of the TSA.

Sampling Procedures

The only sampling procedures that were observed during the TSA were obtaining blood samples. The pigs are picked up by their hind legs and placed on their back on a concave pillow underneath a plastic sheet. The person operating the syringe holds the pig's mouth shut as blood is being drawn. The Vacutainer tubes are refrigerated after collection.

The sampling procedures went smoothly and were carried out professionally. There were no findings and or observations in this portion of the TSA.

Laboratory Analytical Procedures

Although there were no analytical laboratory procedures being conducted on the day of the TSA, Ms. Dunsmore, Dr. Casteel and Dr. Fent explained the analytical procedures and provided documentation that is used, including applicable SOPs. Ms. Dunsmore also operated the Perkin Elmer AA and explained the various software programs that operate the instrument.

There were no findings or observations for this portion of the audit.

Procedural Completeness

During the TSA, which included reviews of the SOPs used by the staff, it was discovered that the procedures contained in the project QAPP, particularly the SOPs, are not entirely compatible with the procedures being used at the UM/VMDL. It was apparent that thorough reviews of the various drafts of the QAPP were not adequately performed. This is a technical comment.

Recommended corrective actions resulting from the audit are summarized below:

- Review the QAPP for correctness as drafts become available and inform the person writing the QAPP of any inconsistencies or deficiencies.
- UM/VMDL personnel should make available to MSE QA personnel all the pertinent SOPs being used for this study so that the QAPP can be updated.

2.4 QUALITY ASSURANCE FOR THE IN VITRO STUDY

Quality assurance was a focus of the in vivo studies at UM/VMDL. The in vitro studies also included activities to produce data of documented quality.

2.4.1 Extraction Fluid Analysis

Filtered samples of extraction fluid were stored in a refrigerator at 4 °C until they were analyzed (within 1 week of extraction). Filtered samples were analyzed for lead by ICP-AES or ICP-MS (EPA Method 6010 or 6020). Method detection limits (MDLs) in extraction fluid were calculated to be 19 and 0.1 µg/L for Methods 6010 and 6020, respectively (USEPA, 2004b).

2.4.2 Quality Control/Quality Assurance

Quality assurance for the extraction procedure consisted of the following quality control samples for the 12-month and 24-month studies.

- Reagent Blank – extraction fluid analyzed once per batch.
- Bottle Blank – extraction fluid only (no test soil) run through the complete procedure at a frequency of 1 in 20 samples.
- Blank Spike – extraction fluid spiked at 10 mg/L lead, and run through the complete procedure at a frequency of 1 in 20 samples.
- Matrix Spike – a subsample of each material used for duplicate analyses was used as a matrix spike. The spike was prepared at 10 mg/L and run through the extraction procedure at a frequency of 1 in 10 samples.
- Duplicate Sample – duplicate sample extractions were performed on 1 in 10 samples.
- Control Soil – National Institute of Standards and Testing (NIST) Standard Reference Material (SRM) 2711 (Montana Soil) was used as a control soil. The SRM was analyzed in triplicate.

Control limits for these quality control samples are shown in Table 2-4.

Table 2-4. Summary of quality control limits for the in vitro study.

Analysis	Frequency	Control Limits
Reagent blank	once per batch	< 25 µg/L lead
Bottle blank	5%	< 50 µg/L lead
Blank spike (10 mg/L)	5%	85%-115% recovery
Matrix spike (10 mg/L)	10%	75%-125% recovery
Duplicate sample	10%	± 20% RPD [a]
Control soil (NIST 2711)	5%	± 10% RPD [a]

Note: [a] RPD = relative percent difference

To evaluate the precision of the in vitro bioaccessibility extraction protocol, approximately 67 replicate analyses of both NIST SRM 2710 and 2711 have been conducted over a period of several months. Both

standards yield highly reproducible results, with a mean coefficient of variation of about 6%. All quality control sample results were within acceptable ranges for both the 12-month and 24-month in vitro studies.

2.5 FIELD CONTAMINATION CHECK

In September 2006, preliminary results using a field x-ray fluorescence (XRF) device indicated that the chicken wire that was used to cover the test plots contained approximately 700 ppm Pb. A sample of the chicken wire was then collected and analyzed in the laboratory by method EPA Region 7 RLAB Method 3122.3B. The laboratory results indicated that there was no detectable lead in the chicken wire (<10 mg/kg). The high field results for XRF analysis of the chicken wire may have resulted from an interference with the zinc contained in this galvanized chicken wire.

As further evidence that the using this chicken wire to cover the test plots did not impact the study results, the control plot Pb concentrations did not change significantly during the two-year study period. These results are summarized in Table 2-5.

Table 2-5. Summary of Pb concentrations in control plot before and after study

Sample Description	Date Collected	Sample ID	Total Lead Results (mg/kg)
Herculaneum Pb Smelter Site Control plot soil	5/12/04	HER-2629	36
Herculaneum Pb Smelter Site Control plot soil	9/29/06	101	24.4
Herculaneum Pb Smelter Site Control plot soil	9/29/06	102	28.2

As demonstrated by the results in Table 2-5, the control plot concentrations did not change significantly, which would have been expected if there was a substantial concentration of Pb in the chicken wire used to cover the test plots.

3. DATA ANALYSIS

Data analysis procedures were identical for the 12-month and 24-month studies. These procedures are discussed in the sections below.

3.1 OVERVIEW

The basic approach for measuring lead absorption *in vivo* is to administer an oral dose of lead to test animals and measure the increase in lead level in one or more body compartments (e.g., blood, soft tissue, bone). In order to calculate the RBA value of a test material, the increase in lead in a body compartment is measured both for that test material and a reference material (lead acetate). Because equal absorbed doses of lead (as Pb^{+2}) will produce equal responses (i.e., equal increases in concentration in tissues) regardless of the source or nature of the ingested lead, the RBA of a test material is calculated as the ratio of doses (test material and reference material) that produce equal increases in lead concentration in the body compartment. Thus, the basic data reduction task required to calculate an RBA for a test material is to fit mathematical equations to the dose-response data for both the test material and the reference material, and then solve the equations to find the ratio of doses that would be expected to yield equal responses.

Some biological responses to lead exposure may be non-linear functions of dose (i.e., tending to flatten out or plateau as dose increases). The cause of this non-linearity is uncertain but might be due either to non-linear absorption kinetics and/or to non-linear biological response per unit dose absorbed. However, the principal advantage of the approach described above is that it is not necessary to understand the basis

for a non-linear dose response curve (non-linear absorption and/or non-linear biological response) in order to derive valid RBA estimates; in addition, this approach is general and yields reliable results for both non-linear and linear responses.

A detailed description of the curve-fitting methods and rationale, along with the methods used to quantify uncertainty in the RBA estimates for the test material, are presented in USEPA (2004a) and are summarized below.

3.2 MEASUREMENT ENDPOINTS

Four independent measurement endpoints were evaluated based on the concentration of lead observed in blood, liver, kidney, and bone (femur). For liver, kidney, and bone, the measurement endpoint was simply the concentration in the tissue at the time of sacrifice (day 15). The measurement endpoint used to quantify the blood lead response was the area under the curve (AUC) for blood lead vs. time (days 0-15). AUC was selected because it is the standard pharmacokinetic index of chemical uptake into the blood compartment, and is relatively insensitive to small variations in blood lead level by day. The AUC was calculated using the trapezoidal rule to estimate the AUC between each time point that a blood lead value was measured (days 0, 1, 2, 3, 5, 7, 9, 12, and 15):

$$AUC(d_i \text{ to } d_j) = 0.5 \cdot (r_i + r_j) \cdot (d_j - d_i)$$

where:

d = day number
r = response (blood lead value) on day i (r_i) or day j (r_j)

The areas were then summed across all time intervals in the study to yield the final AUC for each animal.

Occasionally blood lead values are obtained that are clearly different than expected. Blood lead values that were more than a factor of 1.5 above or below the group mean for any given day were flagged as potential outliers and are shaded in Appendix A, Table A-7 for the 12-month study and Table A-7 in Appendix C for the 24-month study. Each data point identified in this way was reviewed and professional judgment was used to decide if the value should be retained or excluded. In order to avoid inappropriate biases, blood lead outlier designations are restricted to values that are clearly aberrant from a time-course and/or dose-response perspective. In both the 12-month and 24-month studies, no values were judged to be a clear outlier; all blood lead data were included in the calculation of AUC.

3.3 DOSE-RESPONSE MODELS

3.3.1 Basic Equations

It has been shown previously (USEPA, 2004a) that nearly all blood lead AUC data sets can be well-fit using an exponential equation and most tissue (liver, kidney, and bone) lead data can be well-fit using a linear equation, as follow:

Linear (liver, kidney, bone): $\text{Response} = a + b \cdot \text{Dose}$
Exponential (blood lead AUC): $\text{Response} = a + b \cdot [1 - \exp(-c \cdot \text{Dose})]$

3.3.2 Simultaneous Regression

Because the data to be analyzed consist of three dose-response curves for each endpoint (the reference material and two test materials) and there is no difference between the curves when the dose is zero, all three curves for a given endpoint must have the same intercept. This requirement is achieved by combining the two dose response equations into one and solving for the parameters simultaneously, resulting in the following equations:

Linear: $y = a + b_r \cdot x_r + b_t \cdot x_t$

Exponential: $y = a + b \cdot [\ (1-\exp(-c_r \cdot x_r)) + (1-\exp(-c_t \cdot x_t))\ ]$

where:

y = response
x = dose
a, b, c = empirical coefficients for the reference material (r) and test material (t).

All linear model fitting was performed in Microsoft® Office Excel using matrix functions. Exponential model fitting was performed using JMP® version 3.2.2, a commercial software package developed by SAS®.

3.3.3 Weighted Regression

Regression analysis based on ordinary least squares assumes that the variance of the responses is independent of the dose and/or the response (Draper and Smith, 1998). It has previously been shown that this assumption is generally not satisfied in swine-based RBA studies, where there is a tendency toward increasing variance in response as a function of increasing dose (heteroscedasticity) (USEPA, 2004a). To deal with heteroscedasticity, the data are analyzed using weighted least squares regression. In this approach, each observation in a group of animals is assigned a weight that is inversely proportional to the variance of the response in that group:

$$w_i = (\sigma^2_i)^{-1}$$

where:

w_i = weight assigned to all data points in dose group i
σ^2_i = variance of responses of animals in dose group i

(Draper and Smith, 1998).

As discussed in USEPA (2004a), there are several alternative strategies for assigning weights. The preferred method identified by USEPA (2004a) and the method used in this study estimates the value of σ^2_i using an "external" variance model based on an analysis of the relationship between variance and mean response using data consolidated from ten different swine-based lead RBA studies. Log-variance increases as an approximately linear function of log-mean response for all four endpoints:

$$\ln(s_i^2) = k1 + k2 \cdot \ln(\bar{y}_i)$$

where:

s_i^2 = observed variance of responses of animals in dose group i
$\bar{y}_i$ = mean observed response of animals in dose group i

Values of k1 and k2 were derived for each endpoint using ordinary least squares minimization, and the resulting values are shown below:

Endpoint	k1	k2
Blood AUC	−1.3226	1.5516
Liver	−2.6015	2.0999
Kidney	−1.8499	1.9557
Femur	−1.9713	1.6560

3.3.4 Goodness-of-Fit

The goodness-of-fit of each dose-response model was assessed using the F-test statistic and the adjusted coefficient of multiple determination (Adj R^2) as described by Draper and Smith (1998). A fit is considered acceptable if the p-value is less than 0.05.

3.3.5 Assessment of Outliers

In biological assays, it is not uncommon to note the occurrence of individual measured responses that appear atypical compared to the responses from other animals in the same dose group. In this study, endpoint responses that yielded standardized weighted residuals greater than 3.5 or less than -3.5 were considered to be potential outliers (Canavos, 1984). When such data points were encountered in a data set, the RBA was calculated both with and without the potential outlier(s) excluded, and the result with the outlier(s) excluded was used as the preferred estimate.

3.4 CALCULATION OF RBA ESTIMATES

3.4.1 Endpoint-specific RBA Estimates

Lead RBA values were estimated using the basic statistical techniques recommended by Finney (1978). Each endpoint-specific RBA value was calculated as the ratio of a model coefficient for the reference material data set and for the test material data set:

Linear endpoints: $RBA_t = b_t / b_r$
Exponential endpoint: $RBA_t = c_t / c_r$

The uncertainly range about the RBA ratio was calculated using Fieller's Theorem as described by Finney (1978).

3.4.2 RBA Point Estimate

Because there are four independent estimates of RBA (one from each measurement endpoint) for a given test material, the final RBA estimate for a test material involves combining the four endpoint-specific RBA values into a single value (point estimate) and estimating the uncertainty around that point estimate. As described in USEPA (2004a), analysis of data from multiple studies suggests that the four endpoint-specific RBA values are all approximately equally reliable (as reflected in the average coefficient of variation in RBA values derived from each endpoint). Therefore, the RBA point estimate for the test material was calculated as the simple mean of all four endpoint-specific RBA values.

The uncertainty bounds around this point estimate were estimated using Monte Carlo simulation. Values for RBA were drawn from the uncertainty distributions for each endpoint with equal frequency. Each endpoint-specific uncertainty distribution was assumed to be normal, with the mean equal to the best estimate of RBA and the standard deviation estimated from Fieller's Theorem (Finney, 1978). The uncertainty in the point estimate was characterized as the range from the 5th to the 95th percentile of the mean across endpoints.

4. RESULTS

4.1 CLINICAL SIGNS

The doses of lead administered in the 12-month and 24-month studies are below a level that is expected to cause toxicological responses in swine, and no clinical signs of lead-induced toxicity were noted in any of the animals used in either study.

4.2 BLOOD LEAD VS. TIME

Blood lead data for individual animals are presented in Appendix A, Table A-7 and Figure A-1 for the 12-month study and Appendix C, Table A-7 for the 24-month study. Group mean blood lead values as a function of time for the 12-month study are shown in Figure 4-1a and the group mean blood lead values as a function of time for the 24-month study are shown in Figure 4-1b.

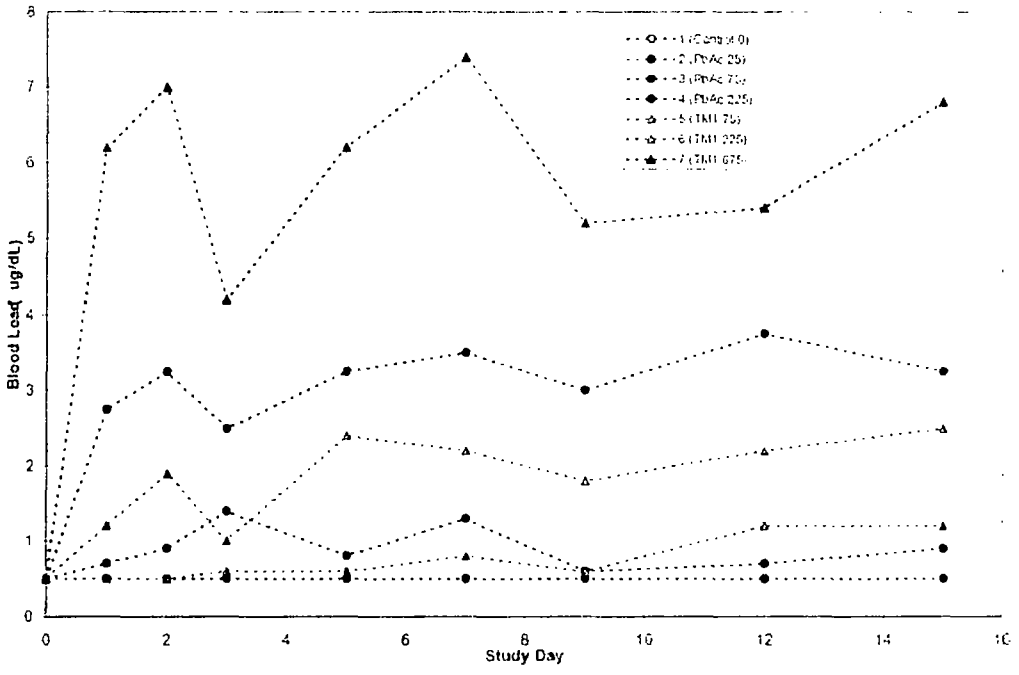


Figure 4-1a. Group mean blood lead by day for the 12-month study.

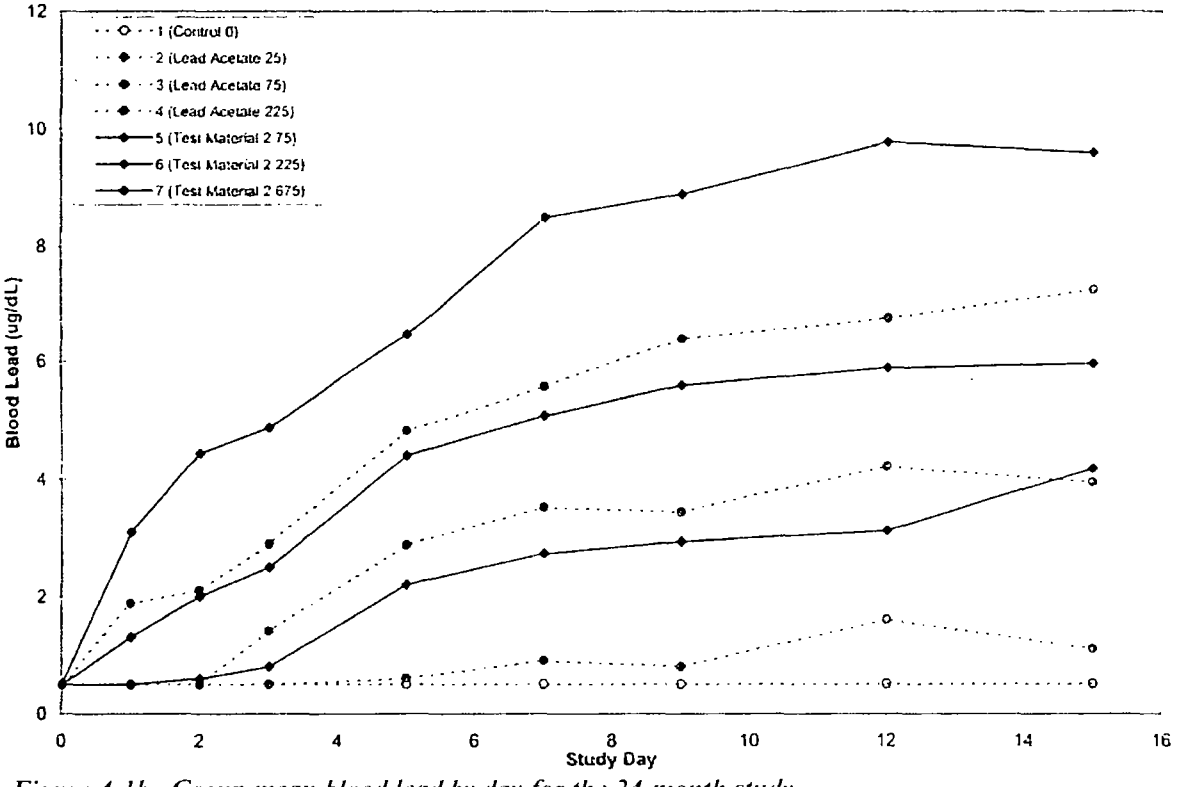


Figure 4-1b. Group mean blood lead by day for the 24-month study.

As seen in both Figure 4-1a and 4-1b, blood lead values began at or below quantitation limits (about 1 μg/dL) in all groups for both the 12-month and 24-month studies, and remained at or below quantitation limits in control animals (Group 1). In animals given repeated oral doses of lead acetate (Groups 2-4) or test soil (Groups 5-7), blood levels began to rise within 1-2 days, and tended to plateau by the end of the study (day 15).

4.3 DOSE-RESPONSE PATTERNS

4.3.1 Variance

As discussed in Section 3.3, the dose-response data are analyzed using weighted least squares regression and the weights are assigned using an "external" variance model (USEPA, 2004). As shown in Figure 4-2a (12-month study) and 4-2b (24-month study), the variance of the data from these studies is generally quite similar to that of the data used to generate the variance model for all four measurement endpoints.

4.3.2 Blood Lead AUC

As discussed in Section 3.2, the measurement endpoint used to quantify the blood lead response was the area under the curve (AUC) for blood lead vs. time (days 0-15). The AUC determinations are presented in Appendix A, Table A-8 for the 12-month study and Appendix C, Table A-8 for the 24-month study.

The blood lead AUC dose-response data were initially modeled using an exponential equation (see Section 3.3); however, a solution could not be obtained with this model for the 12-month study. Although most blood lead AUC data sets can be well-fit using the exponential model, occasionally blood lead AUC data sets do not yield a solution or yield unstable solutions for the exponential model, as was the case here. As discussed in USEPA (2004a), the difficulty in modeling such data sets appears to be due to the fact that the data have relatively less curvature than most blood lead AUC data sets. Because of this lack of curvature, it is not possible to estimate the exponential plateau value (b) with confidence, which in turns makes it difficult to estimate the other parameters of the exponential model. In such cases, there are several alternative evaluation methods, including a) using the model fits from a different nonlinear model (e.g., power, Michaelis-Menton), b) using the fit for the linear model, and c) fitting the data to the exponential model using a defined value for the plateau based on results from other data sets. In USEPA (2004a), it was determined that the results (i.e., the RBA values based on the blood lead AUC endpoint) were generally similar for all three of these approaches and it was concluded that the results from the linear fit were an appropriate alternative to the exponential model in these cases. Therefore, the linear model was used for the blood lead AUC dose-response data for the 12-month study. The results of this fitting are shown in Figure 4-3a.

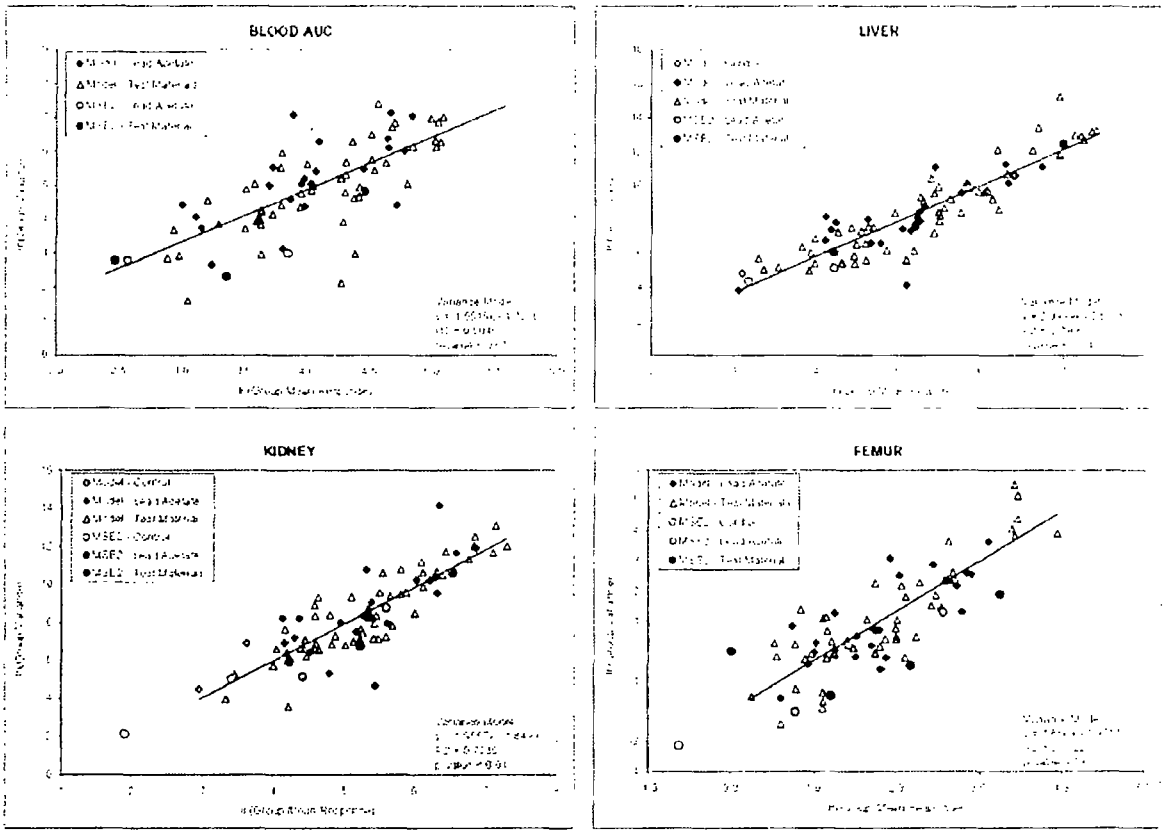


Figure 4-2a. Variance models for 12-month study.

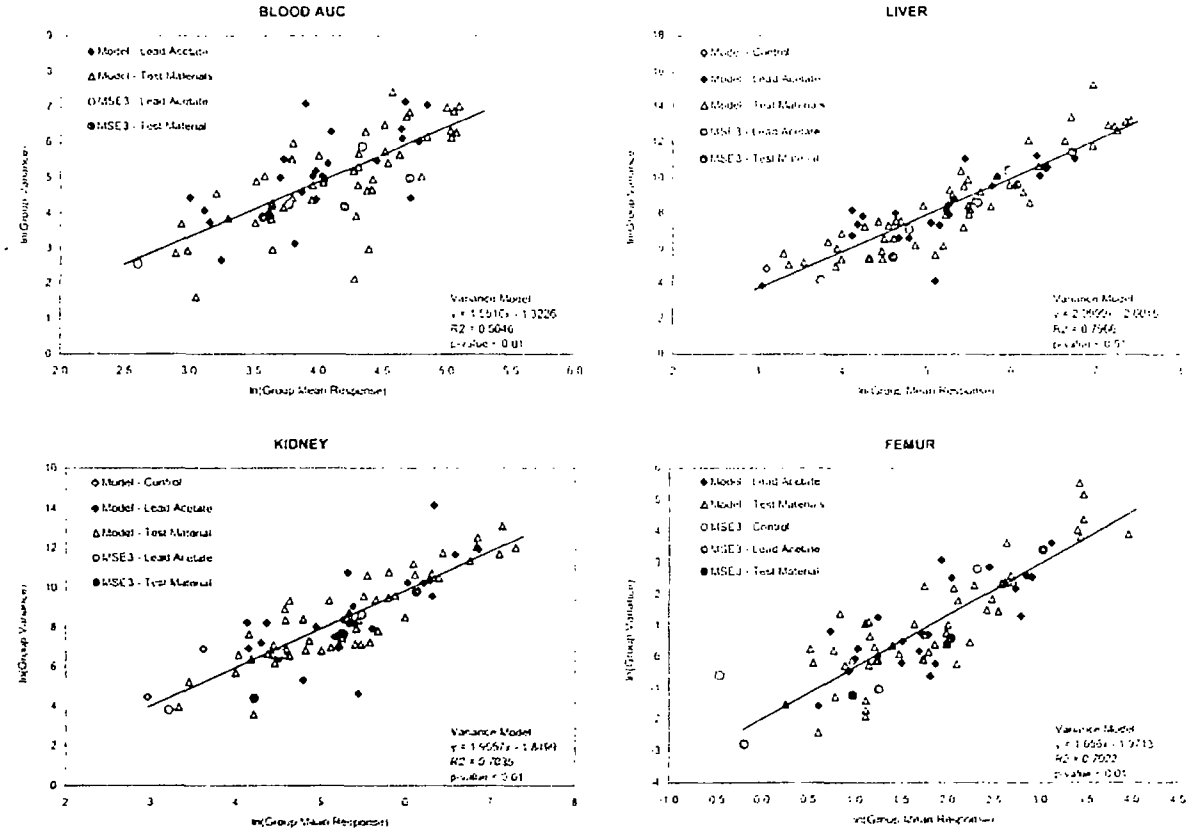


Figure 4-2b. Variance models for 24-month study.

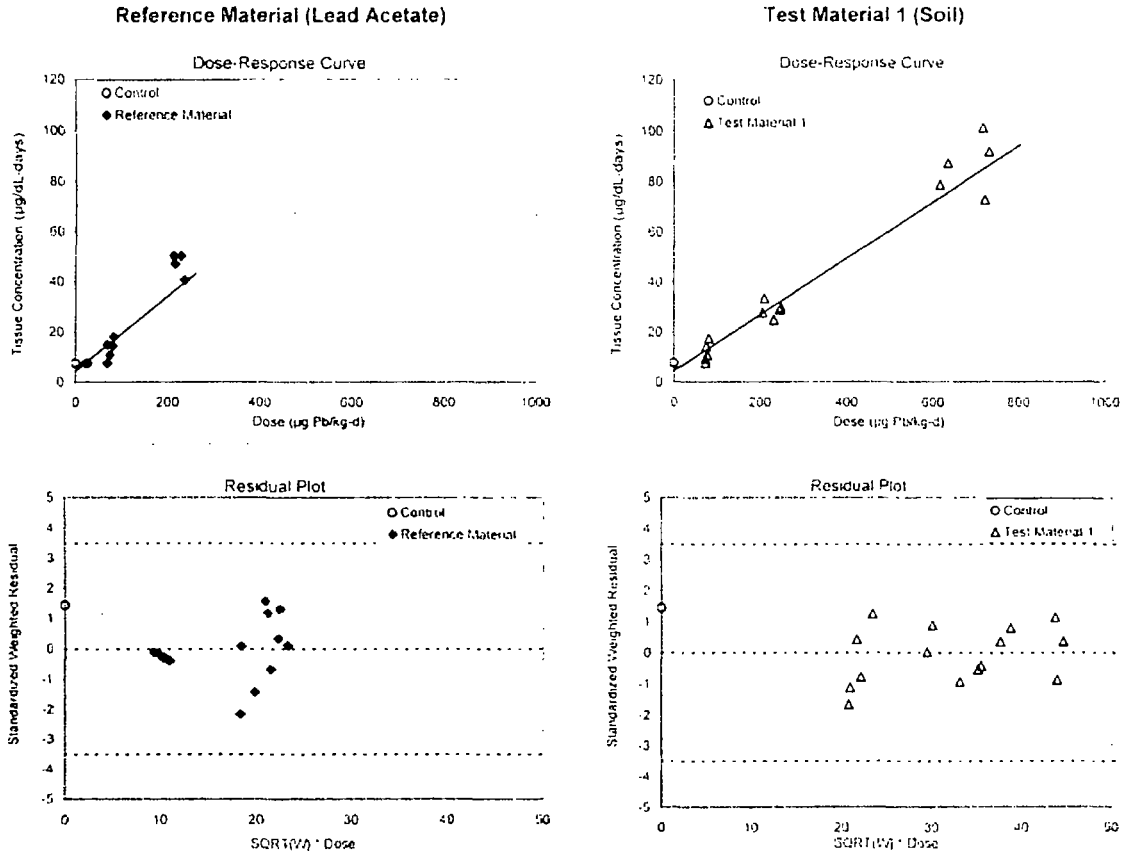
For the 24-month study, the exponential equation in Section 3.3 was used and an appropriate solution was obtained. The results of this fitting are presented in Figure 4-3b. No blood lead AUC outliers were identified in either study; no AUC data were excluded from the final evaluation of blood lead RBA.

4.3.3 Tissue Lead

The dose-response data for lead in liver, kidney, and bone (measured at sacrifice on day 15) were modeled using a linear equation (see Section 3.3). The results of these fittings are shown in Figures 4-4a (liver), 4-5a (kidney), and 4-6a (femur) for the 12-month study and Figures 4-4b (liver), 4-5b (kidney), and 4-6b (femur) for the 24-month study. One endpoint outlier was identified in the femur control group (as indicated in Figure 4-6b) and was excluded for evaluation for lead RBA. The results with this outlier excluded are presented in Figure 4-6c.

4.4 CALCULATED RBA VALUES

Relative bioavailability values for these test soils were calculated for each measurement endpoint (blood lead AUC, liver, kidney, and bone) using the method described in Section 3.4; the suggested point estimate is calculated as the simple mean of the four endpoint-specific estimates. The results are shown in Table 4-1 for both the 12-month and 24-month test soils.



Summary of Fitting[a]

Parameter	Estimate	Standard Error
a	4.38E+00	8.07E-01
b_t	1.49E-01	1.69E-02
b_{t1}	1.12E-01	7.78E-03
b_{t2}	–	–
Covariance (b_t,b_{t1})	0.2511	–
Covariance (b_t,b_{t2})	–	–
Degrees of Freedom	30	–

[a] $y = a + b_t x_t + b_{t1} x_{t1} + b_{t2} \cdot x_{t2}$

ANOVA Results

Source	MSE
Fit	97.17
Error	0.82
Total	7.04

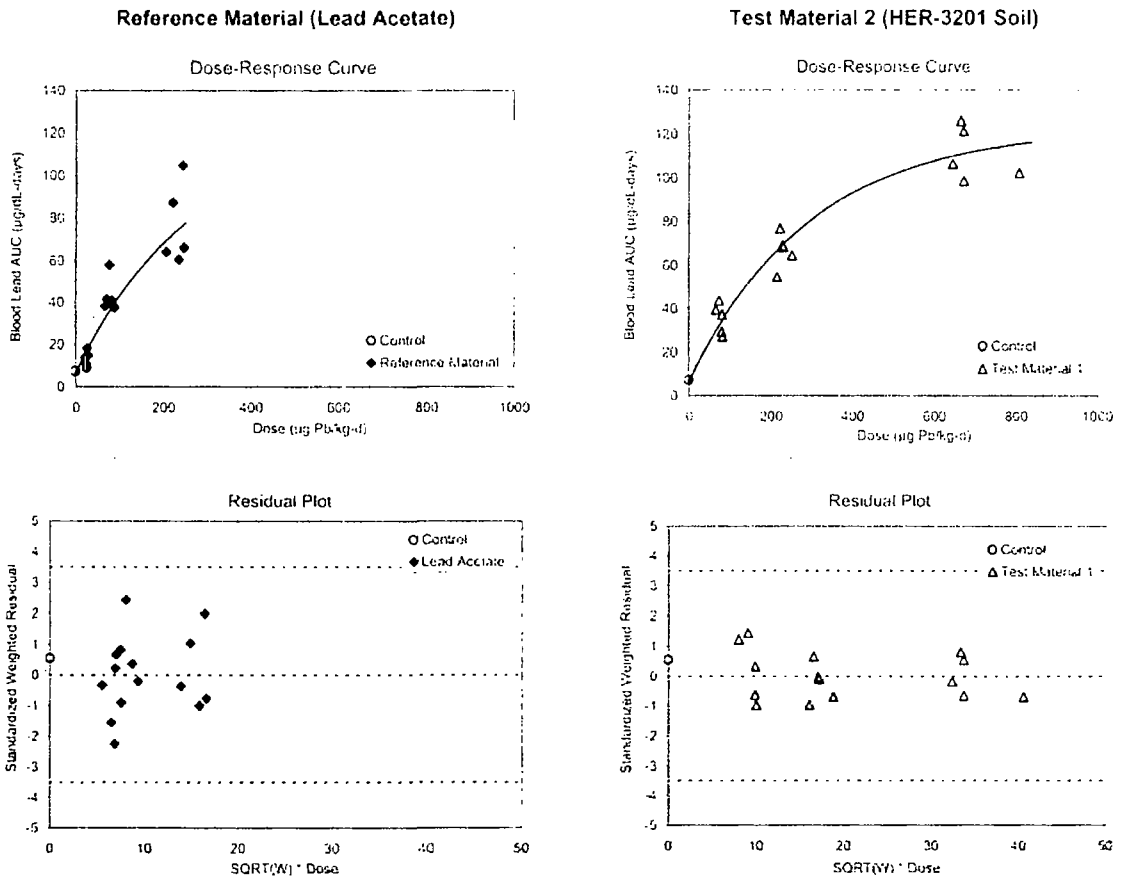
Statistic	Estimate
F	118.171
p	< 0.001
Adjusted R^2	0.6832

RBA and Uncertainty

	Test Material 1
RBA	0.75
Lower bound[b]	0.52
Upper bound[b]	0.93
Standard Error[b]	0.088

[b] Calculated using Fieller's theorem

Figure 4-3a. Blood lead AUC dose-response: linear model (all data) for the 12-month study.



Summary of Fitting[a]

Parameter	Estimate	Standard Error
a	6.19E+00	1.29E+00
b	1.17E+02	1.44E+01
c_1	3.79E-03	7.68E-04
c_{11}	3.41E-03	7.75E-04
Covariance (c_1,c_{11})	0.7788	--
Degrees of Freedom	29	--

[a] $y = a + b\cdot(1-\exp(-c_1\cdot x_1)) + b\cdot(1-\exp(-c_{11}\cdot x_{11}))$

ANOVA

Source	MSE
Fit	179.79
Error	0.97
Total	12.15

Statistic	Estimate
F	184.529
p	< 0.001
Adjusted R^2	0.9198

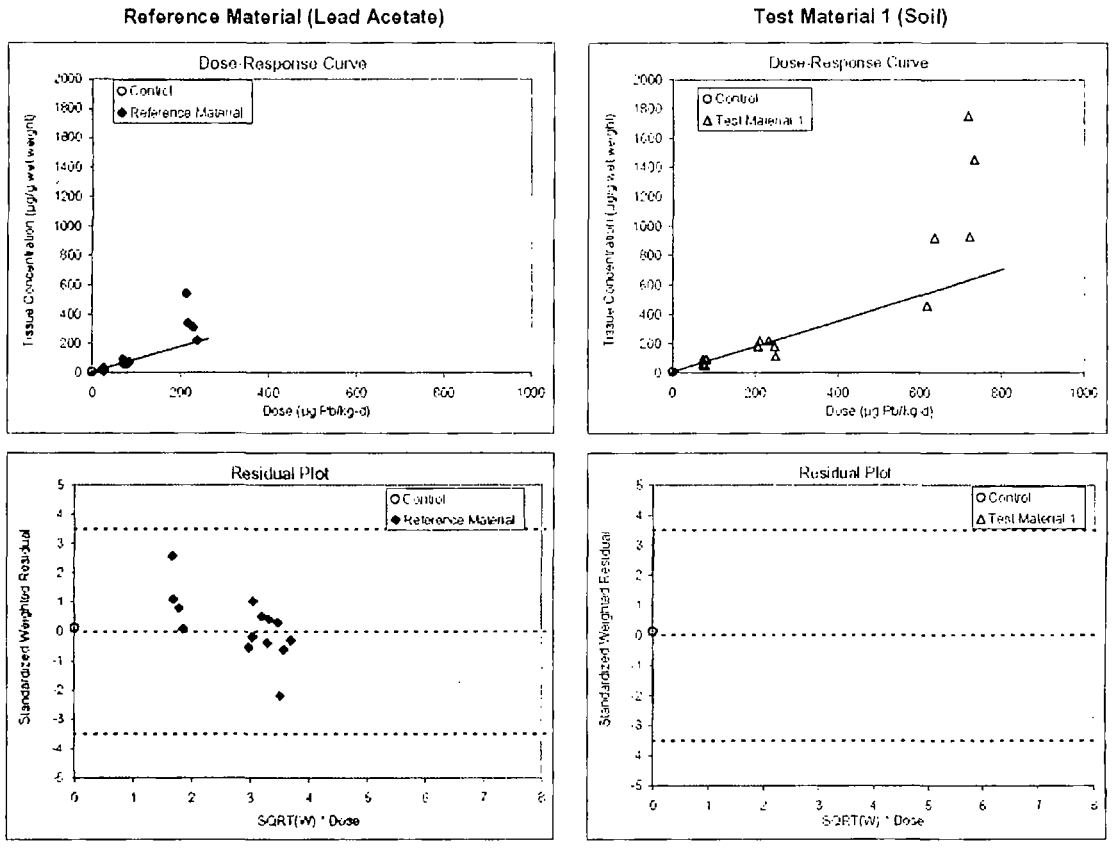
RBA and Uncertainty

	Test Material 2
RBA	0.90
Lower bound	0.68
Upper bound	1.15
Standard Error[b]	0.130[c]

[b] Calculated using Fieller's theorem

[c] g ≥ 0.05, estimate is uncertain

Figure 4-3b. Blood lead AUC dose-response: exponential model for 24-month study.



Summary of Fitting[a]

Parameter	Estimate	Standard Error
a	4.82E+00	9.47E-01
b_r	8.03E-01	1.04E-01
b_{t1}	8.71E-01	9.74E-02
b_{t2}	--	--
Covariance (b_r,b_{t1})	0.0164	--
Covariance (b_r,b_{t2})	--	--
Degrees of Freedom	30	--

[a] $y = a + b_r \cdot x_r + b_{t1} \cdot x_{t1} + b_{t2} \cdot x_{t2}$

ANOVA

Source	MSE
Fit	92.28
Error	1.26
Total	7.13

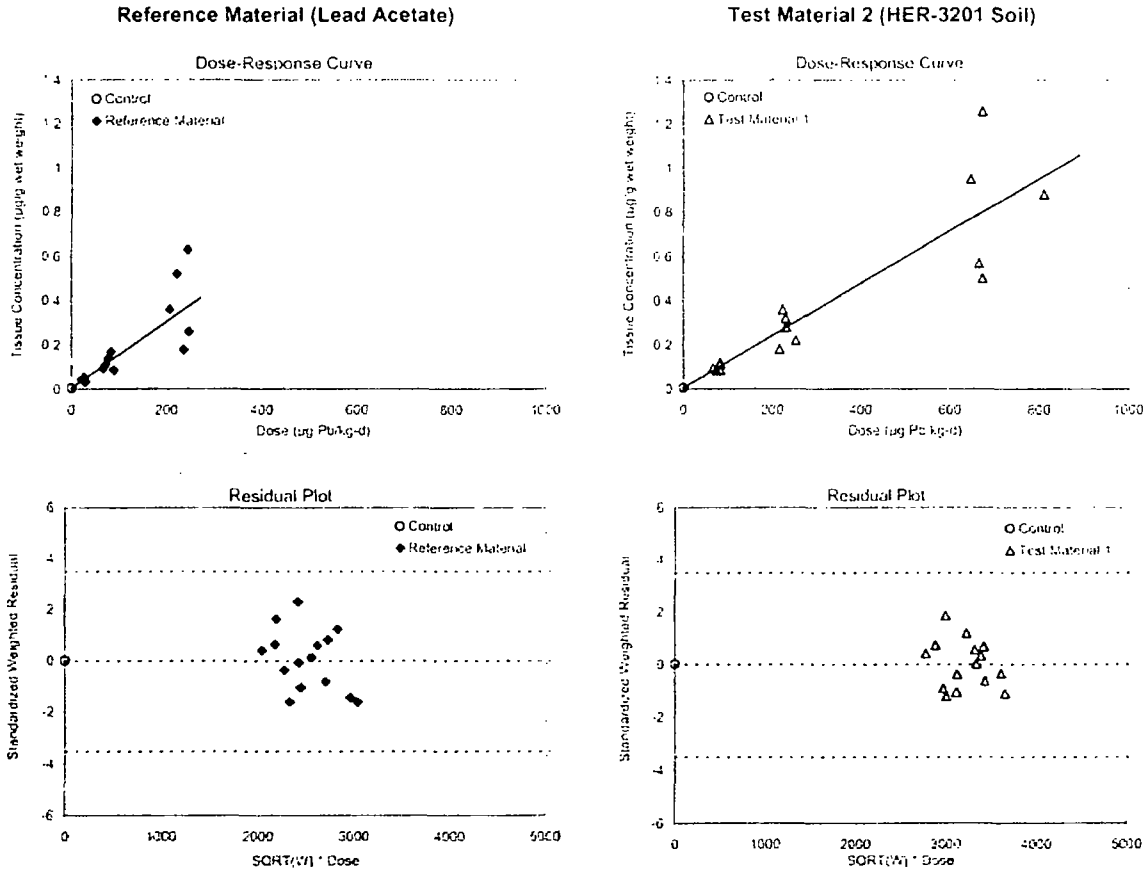
Statistic	Estimate
F	73.187
p	< 0.001
Adjusted R^2	0.8232

RBA and Uncertainty

	Test Material 1
RBA	1.01
Lower bound[b]	0.76
Upper bound[b]	1.34
Standard Error[b]	0.165

[b] Calculated using Fieller's theorem

Figure 4-4a. Liver lead dose-response (all data) for 12-month study.



Summary of Fitting[a]

Parameter	Estimate	Standard Error
a	4.98E-03	6.83E-04
b_r	1.51E-03	1.17E-04
b_{t1}	1.18E-03	9.12E-05
Covariance (b_r,b_{t1})	0.0054	--
Degrees of Freedom	30	--

[a] $y = a + b_r \cdot x_r + b_{t1} \cdot x_{t1}$

ANOVA

Source	MSE
Fit	214.94
Error	1.29
Total	14.64

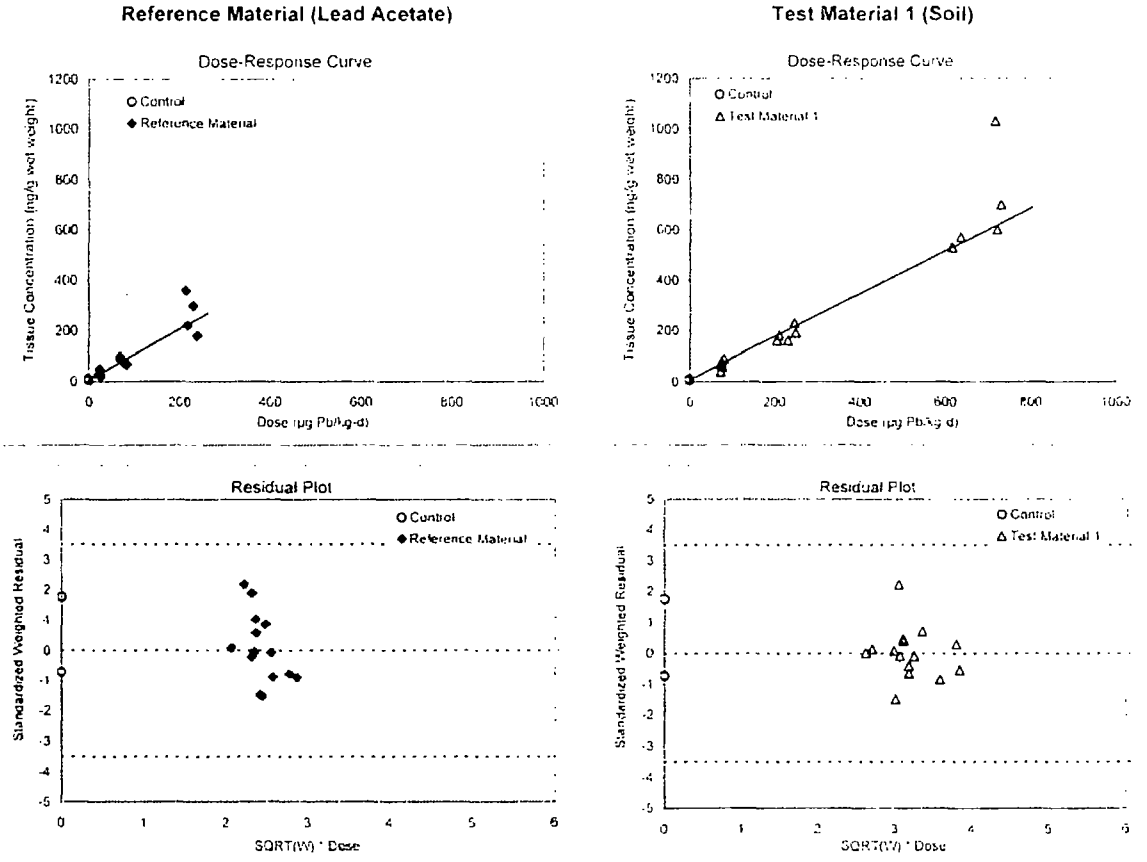
Statistic	Estimate
F	166.467
p	< 0.001
Adjusted R^2	0.9118

RBA and Uncertainty

	Test Material 2
RBA	0.78
Lower bound[a]	0.65
Upper bound[a]	0.95
Standard Error[a]	0.085

[a] Calculated using Fieller's theorem

Figure 4-4b. Liver lead dose-response (all data) for 24-month study.



Summary of Fitting[a]

Parameter	Estimate	Standard Error
a	6.45E+00	1.18E+00
b_1	1.00E+00	9.30E-02
b_{11}	8.46E-01	5.67E-02
b_{12}	--	--
Covariance (b_1,b_{11})	0.0267	--
Covariance (b_1,b_{12})	--	--
Degrees of Freedom	30	--

[a] $y = a + b_1 \cdot x_1 + b_{11} \cdot x_{11} + b_{12} \cdot x_{12}$

ANOVA

Source	MSE
Fit	91.54
Error	0.68
Total	6.54

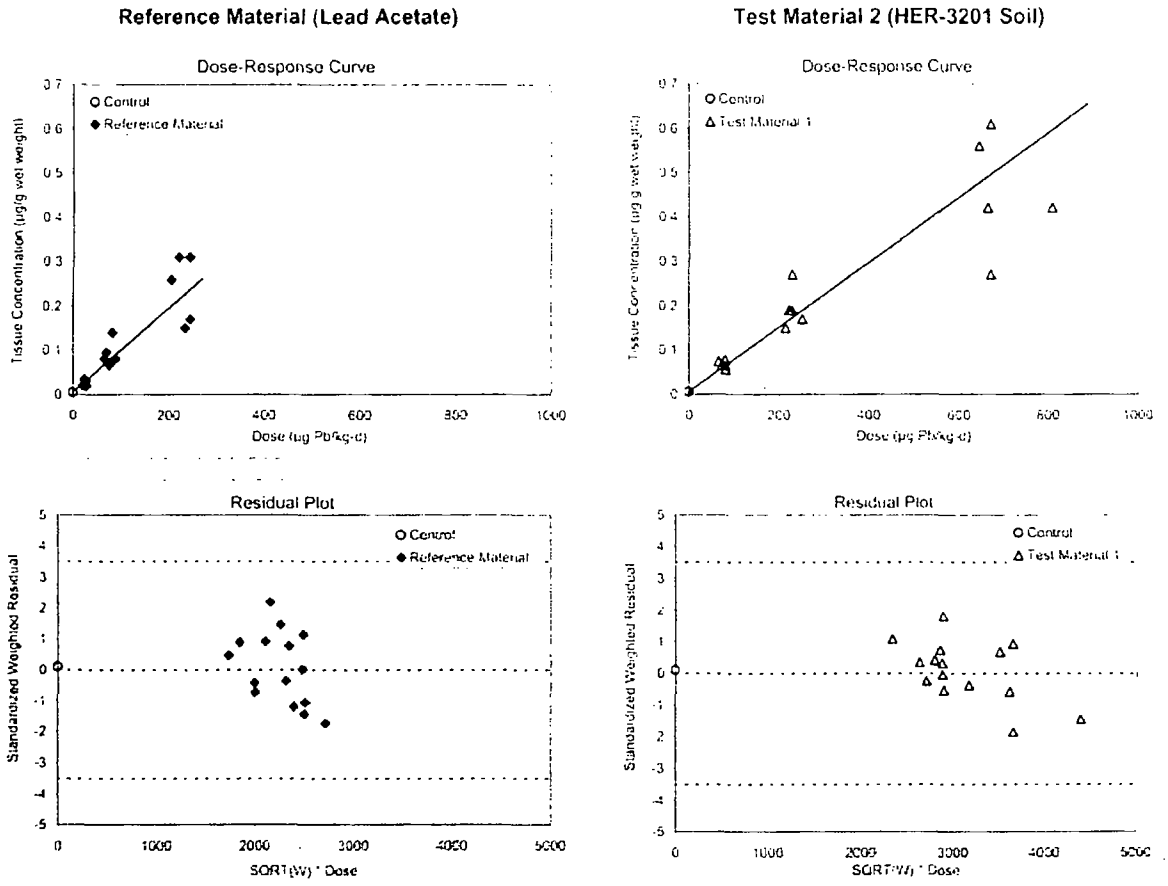
Statistic	Estimate
F	135.338
p	< 0.001
Adjusted R^2	0.8966

RBA and Uncertainty

	Test Material 1
RBA	0.84
Lower bound[a]	0.69
Upper bound[a]	1.04
Standard Error[a]	0.101

[a] Calculated using Fieller's theorem

Figure 4-5a. Kidney lead dose-response (all data) for 12-month study.



Summary of Fitting[a]

Parameter	Estimate	Standard Error
a	4.85E-03	8.70E-04
b_t	9.49E-04	8.01E-05
b_{t1}	7.31E-04	5.62E-05
Covariance (b_t,b_{t1})	0.0166	--
Degrees of Freedom	30	--

[a] $y = a + b_t x_t + b_{t1} \cdot x_{t1}$

ANOVA

Source	MSE
Fit	72.04
Error	0.47
Total	4.95

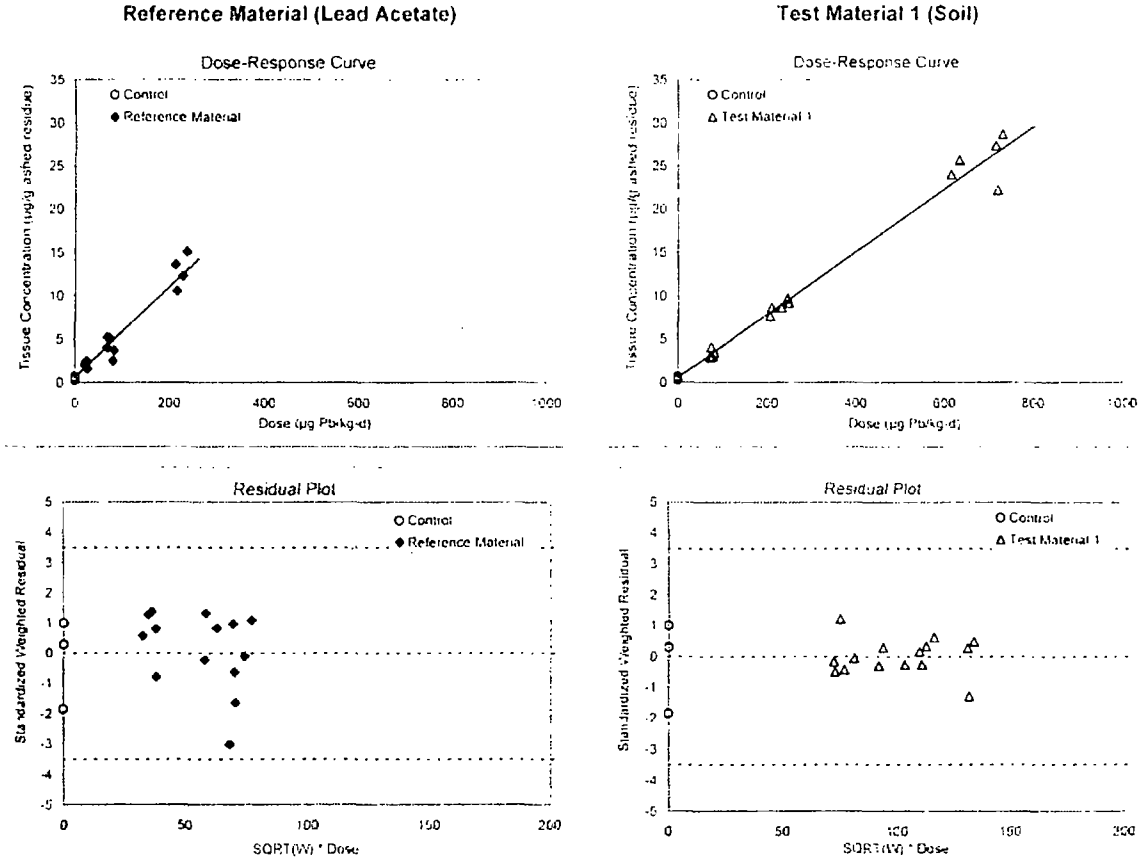
Statistic	Estimate
F	152.226
p	< 0.001
Adjusted R^2	0.9043

RBA and Uncertainty

	Test Material 2
RBA	0.77
Lower bound[a]	0.64
Upper bound[a]	0.94
Standard Error[a]	0.087

[a] Calculated using Fieller's theorem

Figure 4.5b. Kidney lead dose-response (all data) for 24-month study.



Summary of Fitting*

Parameter	Estimate	Standard Error
a	5.60E-01	7.87E-02
b_1	5.21E-02	3.18E-03
b_{t1}	3.61E-02	1.68E-03
b_{c2}	--	--
Covariance (b_1,b_{t1})	0.0664	--
Covariance (b_1,b_{c2})	--	--
Degrees of Freedom	30	--

* $y = a + b_1 \cdot x_1 + b_{t1} \cdot x_{t1} + b_{c2} \cdot x_{c2}$

ANOVA

Source	MSE
Fit	148.66
Error	0.43
Total	10.00

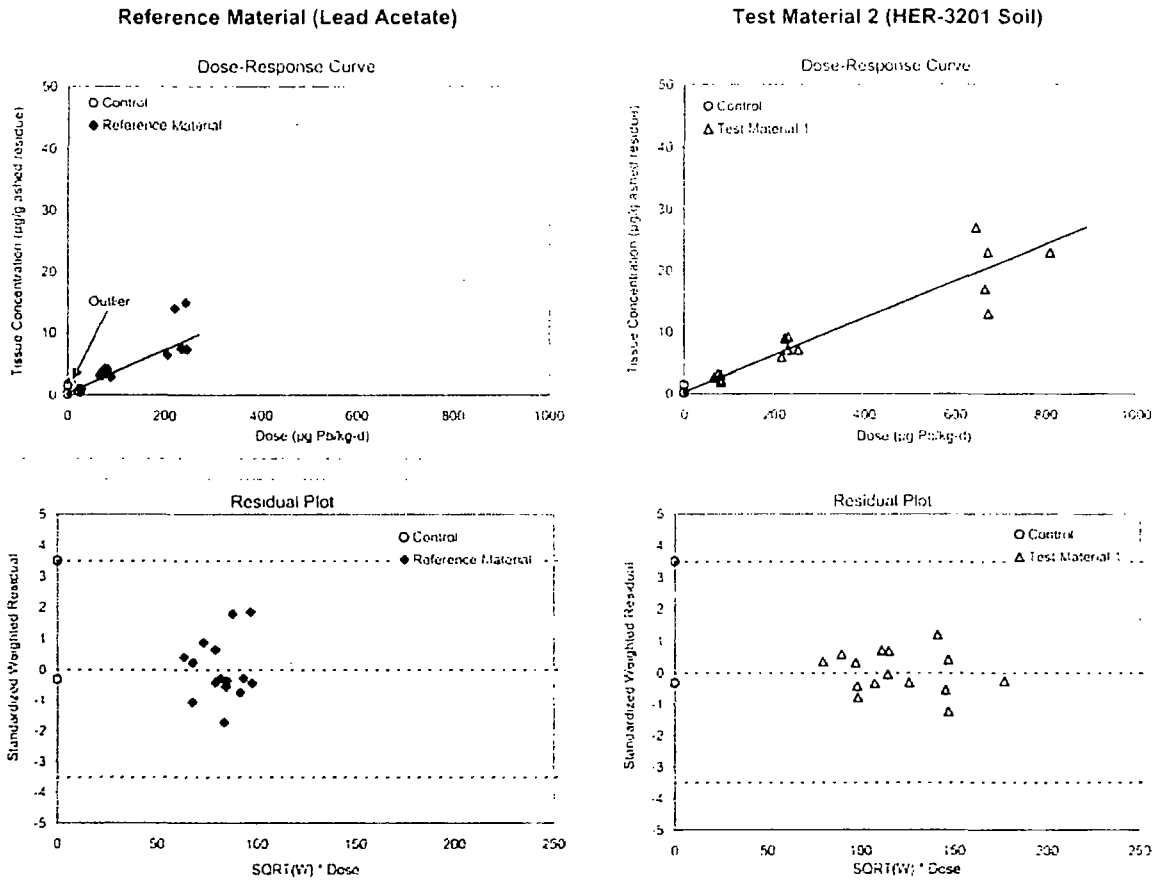
Statistic	Estimate
F	342.920
p	< 0.001
Adjusted R^2	0.9566

RBA and Uncertainty

	Test Material 1
RBA	0.69
Lower bound*	0.61
Upper bound*	0.79
Standard Error*	0.052

* Calculated using Fieller's theorem

Figure 4-6a. Femur lead dose-response (all data) for 12-month study.



Summary of Fitting[a]

Parameter	Estimate	Standard Error
a	3.08E-01	1.61E-01
b_r	3.48E-02	5.16E-03
b_{t1}	3.00E-02	2.99E-03
Covariance (b_r,b_{t1})	0.1330	--
Degrees of Freedom	30	--

[a] $y = a + b_r \cdot x_r + b_{t1} \cdot x_{t1}$

ANOVA

Source	MSE
Fit	123.75
Error	1.90
Total	9.51

Statistic	Estimate
F	65.221
p	< 0.001
Adjusted R^2	0.8005

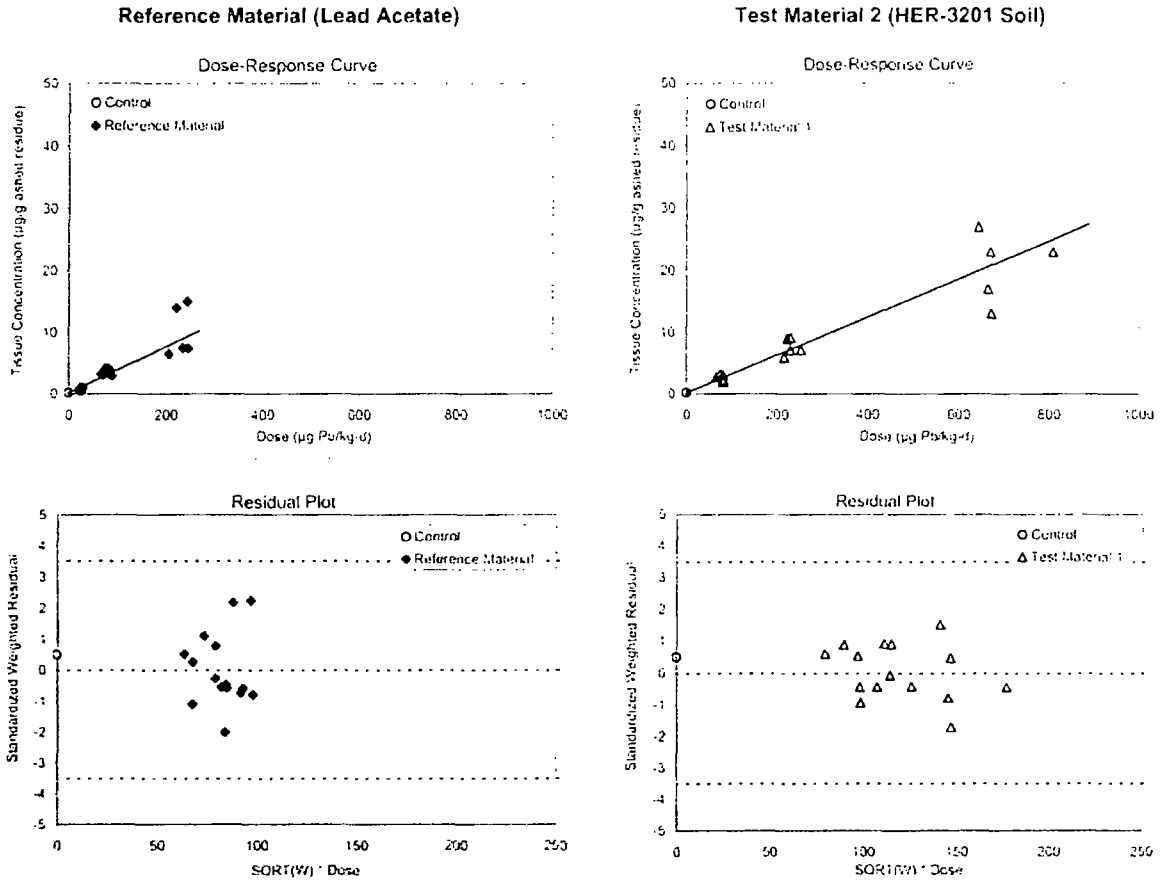
RBA and Uncertainty

	Test Material 2
RBA	0.86
Lower bound[b]	0.66
Upper bound[b]	1.18
Standard Error[c]	0.144*

[b] Calculated using Fieller's theorem

* g ≥ 0.05, estimate is uncertain

Figure 4-6b. Femur lead dose-response (all data) for 24-month study.



Summary of Fitting[a]

Parameter	Estimate	Standard Error
a	1.49E-01	6.80E-02
b_c	3.76E-02	3.46E-03
b_{t1}	3.07E-02	2.21E-03
Covariance (b_c,b_{t1})	0.0478	--
Degrees of Freedom	29	--

[a] $y = a + b_c \cdot x_c + b_{t1} \cdot x_{t1}$

ANOVA

Source	MSE
Fit	160.51
Error	1.08
Total	11.37

Statistic	Estimate
F	148.663
p	< 0.001
Adjusted R^2	0.9050

RBA and Uncertainty

	Test Material 2
RBA	0.82
Lower bound[b]	0.68
Upper bound[b]	1.00
Standard Error[b]	0.093

[b] Calculated using Fieller's theorem

Figure 4-6c. Femur lead dose-response (outlier excluded) for 24-month study.

Table 4-1. Summary of end-point specific RBA estimates.

Measurement Endpoint	Estimated Soil RBA (90% Confidence Interval)
RBA estimates for soil weathered for 12-months	
Blood Lead AUC*	0.75 (0.62 – 0.93)
Liver Lead	1.01 (0.76 – 1.34)
Kidney Lead	0.84 (0.69 – 1.04)
Femur Lead	0.69 (0.61 – 0.79)
Point Estimate	0.82 (0.63 – 1.15)
RBA estimates for soil weathered for 24-months	
Blood Lead AUC	0.90 (0.68 - 1.15)
Liver Lead	0.78 (0.65 - 0.95)
Kidney Lead	0.77 (0.64 - 0.94)
Femur Lead	0.82 (0.68 - 1.00)
Point Estimate	0.82 (0.65 – 1.02)

*Blood AUC data were fit to the linear model for the 12-month sample.

As seen, using lead acetate as a relative frame of reference, the RBA point estimate is approximately 82% for the test soil for both the 12-month and 24-month studies.

4.5 UNCERTAINTY

The bioavailability estimates above are subject to uncertainty that arises from several different sources. One source of uncertainty is the inherent biological variability between different animals in a dose group, which in turn causes variability in the amount of lead in the tissues of the exposed animals. This between-animal variability in response results in statistical uncertainty in the best-fit dose-response curves and, hence, uncertainty in the calculated values of RBA. Such statistical uncertainty is accounted for by the statistical models used above and is characterized by the uncertainty range around the endpoint-specific and the point estimate values of RBA.

However, there is also uncertainty in the extrapolation of RBA values measured in juvenile swine to young children or adults, and this uncertainty is not included in the statistical confidence bounds above. Even though the immature swine is believed to be a useful and meaningful animal model for gastrointestinal absorption in children, it is possible that there are differences in physiological parameters that may influence RBA and that RBA values in swine are not identical to values in children. In addition, RBA may depend on the amount and type of food in the stomach, since the presence of food can influence stomach pH, holding time, and possibly other factors that may influence lead solubilization. In this regard, it is important to recall that RBA values measured in this study are based on animals that have little or no food in their stomach at the time of lead exposure and, hence, are likely to yield high-end values of RBA. Thus, these RBA values may be somewhat conservative for humans who ingest the soils along with food. The magnitude of this bias is not known.

There were a few instances where some animals did not consume their entire dose during the 12-month study (see Appendix A, Table A-3). However, the dosing technician observed each animal and attempted to estimate the fraction of dose not consumed; these estimates of missed doses were then used to adjust the time-weighted average dose calculation for each animal downward. Because these estimates of missed doses are subjective, they introduce some uncertainty; however, the magnitude of this uncertainty is thought to be small. All calculations are based on actual administered doses (not target doses) to

compensate for dosing errors. During the 24-month study, all animals consumed their entire dose on every occasion.

Finally, lower concentrations of both available-P and fiber occurred in the 24-month feed (Table 2-2b), relative to those levels in the 12-month feed (Table 2-2a). Such difference may have allowed higher levels of systemic bioavailable Pb, as indicated by the higher Pb levels in blood and femur tissues in the 24-month study.

4.6 IN VITRO BIOACCESSIBILITY RESULTS

The summary of the in vitro bioaccessibility results is shown in Table 4-2 for the 12-month study and Table 4-3 for the 24-month study. Lead ore concentrate samples were composited and prepared by Dr. Yang and submitted to Dr. Drexler at the University of Colorado for in vitro bioaccessibility testing. Dr. Drexler performed the in vitro extraction in triplicate on -250 µm materials. For the 12-month sample, Dr. Drexler independently determined the total lead in the -250 µm soil. For the 24-month sample, he used the bulk concentration determined by Dr. Yang and did not verify the lead concentration.

Table 4-2. Summary of in vitro bioaccessibility results for the 12-month study.

Sample ID	Weight of Sample	Solution pH prior to extraction	Solution pH after extraction	Pb concentration in <250 µm concentrate (mg/kg)	Calculated Total Pb in soil used (mg Pb)	Pb concentration in fluid following extraction (mg/L)	Amount of Solution (L)	% Pb Bioaccessibility
In Vitro Bioassay Results Summary using Dr. Drexler's Lead Concentrations for Sample weathered 12-months								
HER-2930-1	1.00021	1.54	1.57	2473	2.47	17.32	0.1	70
HER-2930-2	1.00036	1.54	1.57	2465	2.47	17.06	0.1	69
HER-2930-3	1.00036	1.54	1.57	2534	2.53	16.87	0.1	67
Mean ±standard deviation (n=3)								69 ± 1.5
In Vitro Bioassay Results Summary using Average Bulk Lead Concentration for Sample Weathered 12-months								
HER-2930-1	1.00021	1.54	1.57	2021	2.01	17.32	0.1	86
HER-2930-2	1.00036	1.54	1.57	2021	2.02	17.06	0.1	84
HER-2930-3	1.00036	1.54	1.57	2021	2.02	16.87	0.1	83
Mean ±standard deviation (n=3)								84 ± 1.5

Table 4-3. Summary of in vitro bioaccessibility results for the 24-month study.

Sample ID	Weight of Sample	Solution pH prior to extraction	Solution pH after extraction	Pb concentration in <250 µm concentrate (mg/kg)	Calculated Total Pb in soil used (mg Pb)	Pb concentration in fluid following extraction (mg/L)	Amount of Solution (L)	% Relative Pb Bioaccessibility/ Availability
In Vitro Bioassay Results Summary using Average Bulk Lead Concentrations for Sample Weathered 24-months								
HER-3201-1	1.00133	1.51	1.51	2131	2.13	19.17	0.1	90
HER-	1.00205	1.51	1.51	2131	2.14	19.10	0.1	89

3201-2								
HER-3201-3	1.00027	1.51	1.51	2131	2.13	18.63	0.1	87
Mean ±standard deviation (n=3)								89 ± 1.5

For the 12-month soil, IVBA using the Pb concentrations determined at the University of Colorado was 69% ± 1.5% (n=3). Using the bulk lead concentration for the 12-month test soil, the IVBA was 84% ± 1.5% (n=3). For the 24-month study, the IVBA for the test soil using the bulk Pb concentration was 89% ± 1.5% (n=3).

5. DISCUSSION

The analytical results from Wilson (2003) characterize the test plot soils as follows: clay loam texture, slightly acidic (pH 6), low in organic matter (2.1 weight percent) and cation exchange capacity (11.6 meq/100g), plus being very low in total phosphorus (17 lbs/acre). The lead speciation studies performed by Johnson and Abraham (2002) indicate the ore concentrate particles have a geometric mean size of 1.6 μm, and that most of the lead occurs as galena (PbS). Using these data, and various assumptions as judged necessary (e.g., E_H in the +200 to 450 mV range), MSE prepared the following preliminary conceptual model of Pb weathering in the Herculaneum test plot soils.

The chemical reactions included in the model are as follows:

- $PbS(s) + H^+ \leftrightarrows Pb^{+2} + SH^-$;
- $SH^- + 4HOH \leftrightarrows SO_4^{-2} + 9H^+ + 8e^-$;
- $Pb^{+2} + SO_4^{-2} \leftrightarrows PbSO_4(s)$;
- $HCO_3^- + Pb^{+2} \leftrightarrows PbCO_3(s) + H^+$;
- $PbS(s) + H_2CO_3 + O_2 \rightarrow PbCO_3(s) + SO_4^{-2} + 2H^+$; and
- $5Pb^{+2} + 3H_2PO_4^- + Cl^- \rightarrow Pb_5(PO_4)_3Cl(s) + 6H^+$

Solid species of varying crystallinity are designated by "(s)", and all others occur as aqueous (dissolved) species. The first 2 equations do not address the mechanisms or varying rates of production and release of aqueous lead and sulfoxyanions; such details can be found in the papers by Chernyshova (2003), da Silva (2004), Fornasiero et al. (1994), plus Nowak and Laajalehto (2000). Essentially, it is suggested that oxidative dissolution of the small ore concentrate particles occurs very rapidly upon contact with soil (pore) water. da Silva (2004) observed that bacterial oxidation of galena particles < 45 μm in diameter resulted in complete conversion to lead sulfate in about 24 days at 35 °C. Assuming a 10-fold increase in reaction rate for the Herculaneum particles and 100-fold decrease for cooler soil temperatures (i.e., 15 °C), the concentrate particles may be completely reacted within 240 days of incorporation into residential topsoil.

Given the relatively low organic matter level (i.e., about half that commonly seen in humid temperate soils; Brady, 1984), MSE assumes that only a small amount of the total Pb^{+2} is complexed to such organic ligands as humic acids. However, migration of aqueous Pb^{+2} into lower reaches of the soil profile may be slowed by ad(b)sorption to hydrous iron and manganese oxides (Morin et al., 1999). It is further suggested that persistence of solid Pb compounds is determined largely by their respective solubility product (K_{sp}) values; as the log K_{sp} values become more negative, the compounds become less soluble in water (at circumneutral pH and 25 °C). Thus, the solubility of anglesite ($PbSO_4$, −7.7) is > cerussite ($PbCO_3$, −12.8), which is >> chloropyromorphite [$Pb_5(PO_4)_3Cl$, −84.4] (Nriagu, 1994). The latter

compound is probably the most environmentally stable and predominant form of solid Pb species in the Herculaneum test plot soils (Nriagu, 1974). This hypothesis is supported by the observations of Johnson and Abraham (2002) that lead phosphate particle types are predominant in residential soils, as well as by initial geochemical modeling performed by MSE.

The concentration data presented in Table 5-1 were input to the STABCAL model (Huang, 2002). Model output, shown in Figures 5-1 and 5-2, are very similar to those presented in Nriagu (1974; Figure 4-3) for roadside soils. Furthermore, lead carbonate and sulfate appear (in aqueous or solid forms) only in the complete absence of phosphorus; such cases are illustrated in Figures 5-3 through 5-5. These graphs are very similar to P-free stability diagrams found in the papers by Garrels (1954) and Sato (1992). In such instances a 1:1 molar ratio exists between anglesite and cerussite at pH 6 and 300 ± 100 mV (E_H).

Table 5-1. Summary of inputs to the STABCAL modeling exercise.

	Concentration (µg/L) in Soil Pore Water [a]	
Constituent	**Lower Bound**	**Upper Bound**
Cl^{-1}	2,000	10,000
$H_2CO_3^0$	6,500	7,100
HCO_3^{-1}	2,800	3,100
$H_2PO_4^{-1}$	5	50
Pb^{+2}	100	1,000
SO_4^{-2}	10,00	25,000

Note: [a] P_{CO2} is about 10-fold that of atmospheric levels, but represents concentrations expected in soil gas (Lindsay, 1979; Chapter 6). All other concentrations are based on best judgment by MSE.

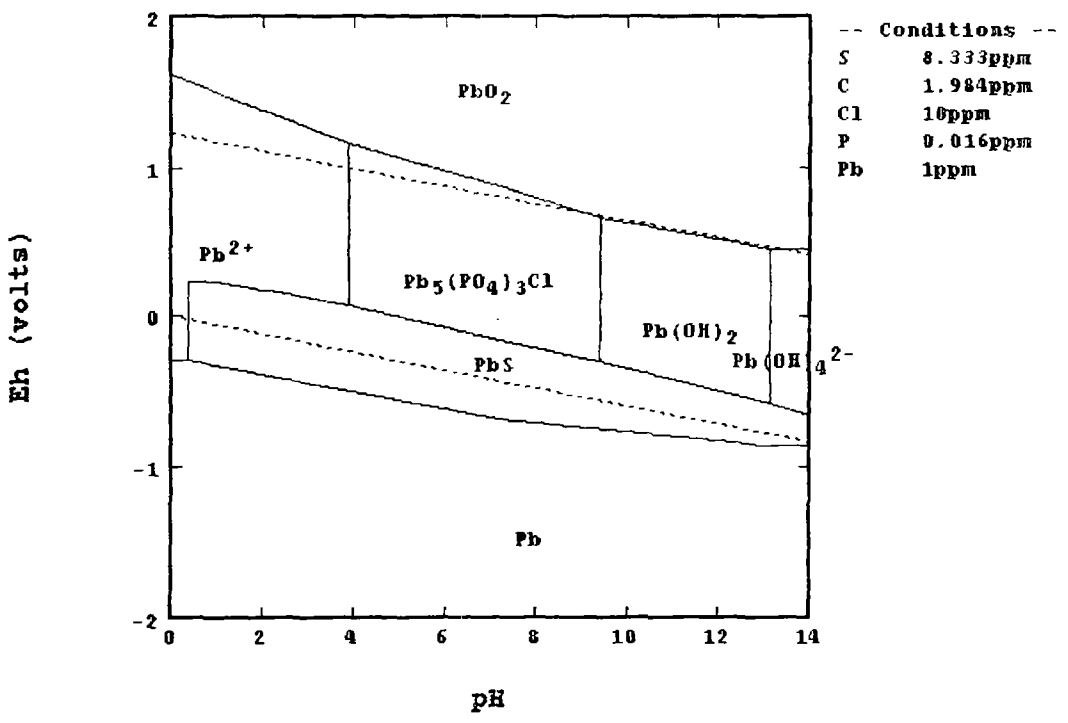


Figure 5-1. STABCAL model results for upper bound concentration limits.

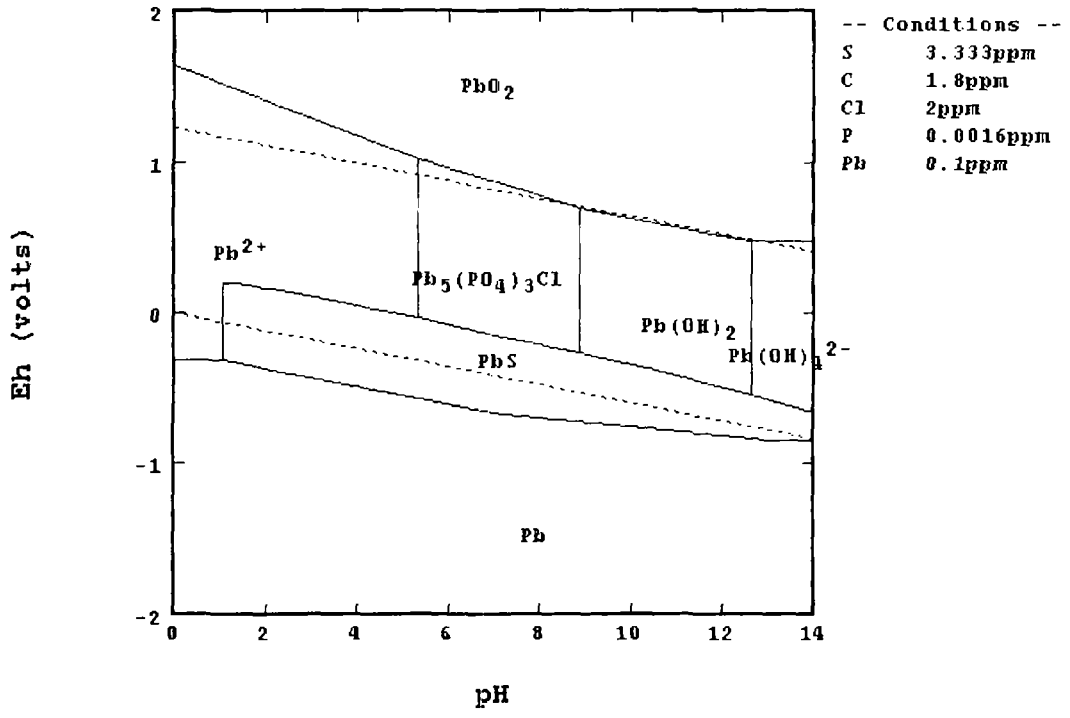


Figure 5-2. STABCAL model results for lower bound concentration limits.

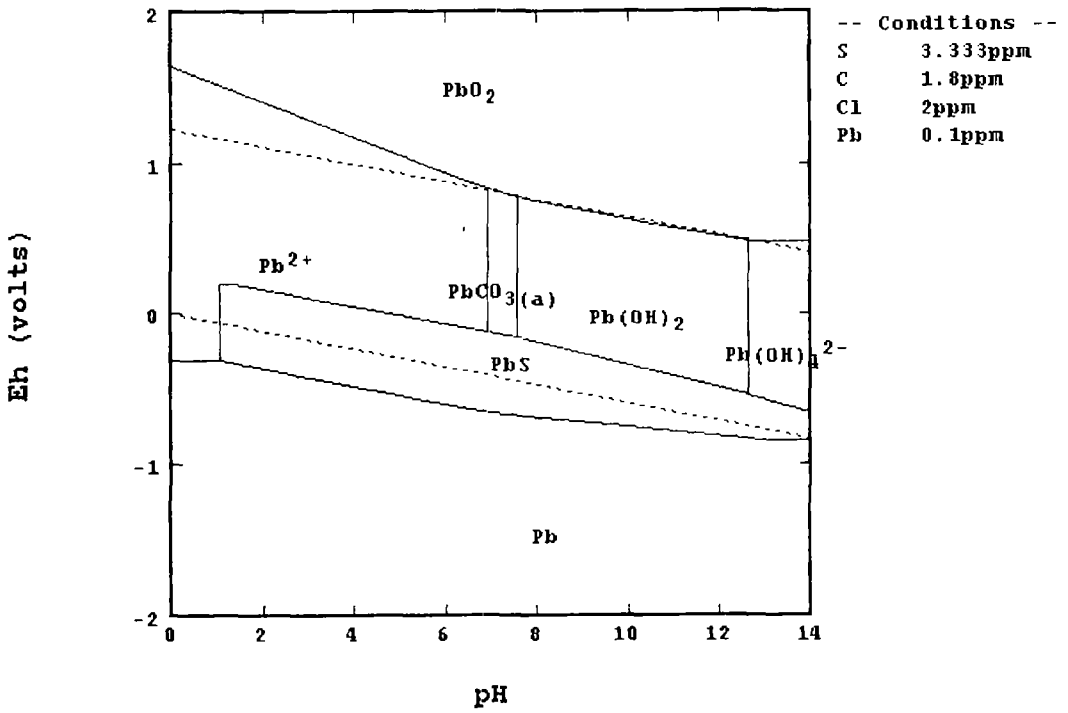


Figure 5-3. STABCAL model results for No-P, low-Pb case.

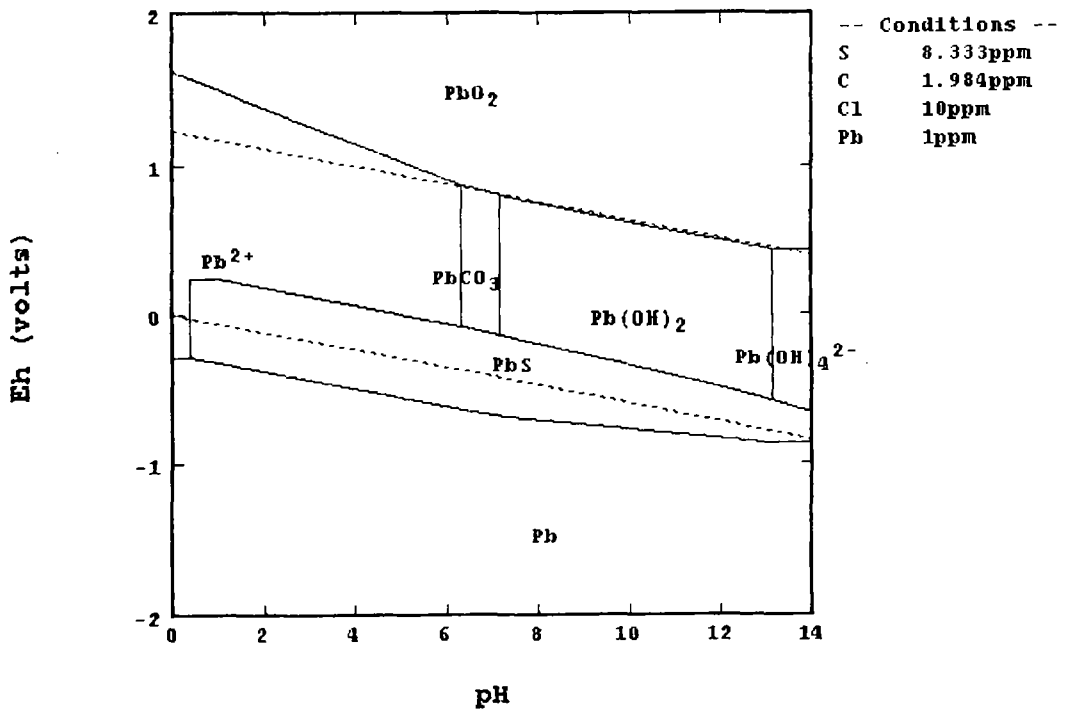


Figure 5-4. STABCAL model results for No-P, moderate-Pb case.

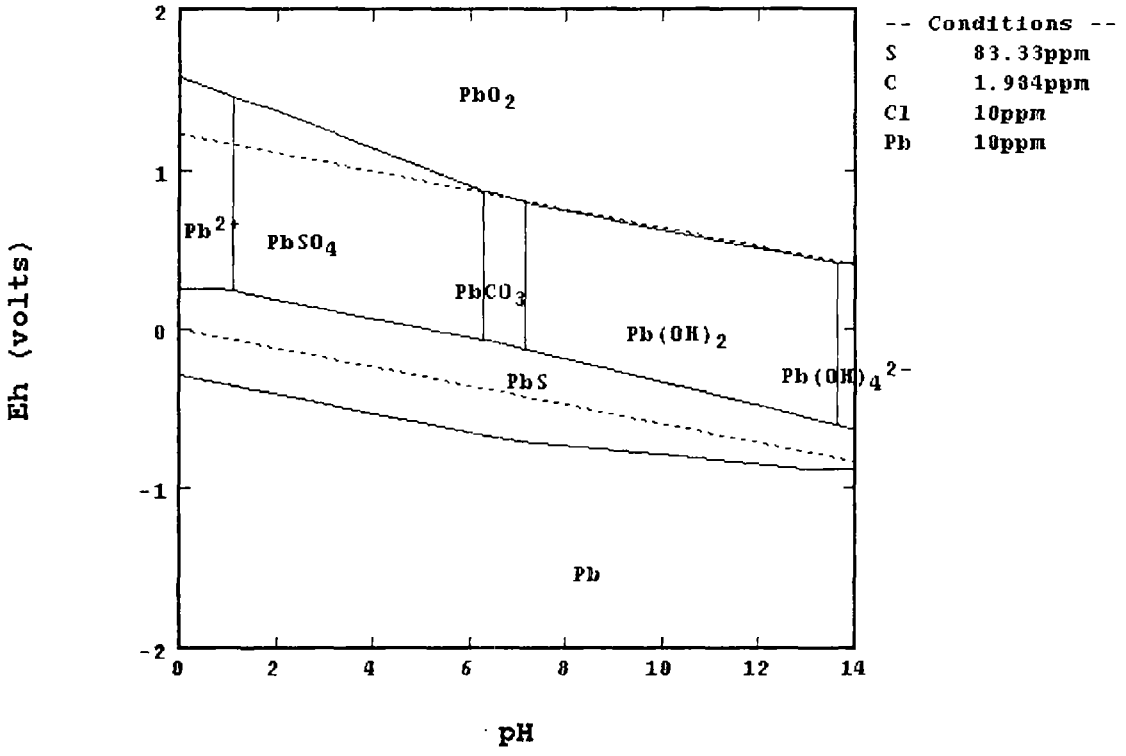


Figure 5-5. STABCAL model results for No-P, high-Pb case.

However, these STABCAL results must be interpreted carefully because:

- they do not address reaction-specific kinetics — concentration-diffusion conditions may result in one reaction proceeding faster than the others (Langmuir, 1997); and
- they do not address the reversibility in the weathering of the solid Pb species (Sato, 1992).

These constraints are certainly relevant to using the model results for the interpretation of the Pb bioaccessibility (in vitro) and Pb-RBA (in vivo, swine) studies results. An example of this problem is discussed below.

The potential change in lead relative bioavailability (RBA) in concentrate-contaminated residential soils can be approximated by noting that Pb mass is independent of its RBA value. For example:

- addition of 500 mg of Pb having an RBA of 0.50 ($RBA_{0.5}$) to 1 kg of Pb-free soil results in 500 mg/kg of $RBA_{0.5}$ soil; while
- addition of another 500 mg of $RBA_{0.5}$ Pb to the above soil will double the Pb concentration (mass), but the $RBA_{0.5}$ remains the same unless the physicochemical state of the soil is changed.

Thus, there will be no change in RBA over time, even after adding the "new" source of Pb, if both materials have the same RBA value. Furthermore, initial bioavailability of Pb (RBA_0) can be approximated in Herculaneum soils as follows: $RBA_0 = RBA_1 - RBA_{PbS}$, where RBA_1 is the swine study result for the May 2005 soil and RBA_{PbS} = the estimated value for galena presented in Figure 2-7 of the

EPA (2004) report. Thus, $RBA_0 \cong 0.82 - 0.05 \cong 0.77$, which exceeds the estimated RBA for "undusted" residential soils (i.e., 0.45) from inspection of the USEPA (2004a) report.

Given MSE's modeling results (Figures 5-1 and 5-2) that show predominance of "lead phosphate", RBA_0 would be at least 0.45. Johnson and Abraham report (2002, Table IV) that many other forms of Pb probably exist in residential soils, as well as the presence of "lead oxide" in the ore concentrate sample. These observations suggest that other, more biologically available, forms of Pb are present in both the concentrate and in concentrate-contaminated soils. In both cases, formation of a cerussite coating on the pyromorphite particles could occur. Although the phosphate salt has a very low solubility, the surface : mass ratio is very high for the original galena particles. Meteoric water would supply a continuous, and potentially increasing, source of carbonic acid as it percolates through the soil profile. Lead oxide is more soluble (K_{sp} of -14.7) than pyromorphite compounds, and could form oxycarbonate [e.g., $Pb_3(CO_3)_2(OH)_2$] precipitates having similar solubilities to that of cerussite (Lindsay, 1979). The relative amounts of these various forms of Pb could be approximated by selective extraction methods (e.g., Chen et al., 2000; Basta and Gradwohl, 2000); such results would provide another "check" on the conceptual model's credibility.

The Phase 1 (May 2005 soil) in vitro and in vivo results of 0.69 and 0.82, respectively, probably reflect the effects of these more bioavailable Pb species on RBA of bulk soils. However, as such species (e.g., cerussite) would occur in "pre-dusted" and "dusted" residential soils, the change in RBA might be relatively small. For example, the percent change in RBA may be equal to ((0.82-0.77)/0.82) * 100 or 6% above background conditions. Given the intrinsic uncertainties in the Phase 1 and Phase 2 in vivo results (Casteel et al., 2006a and 2006b; pp 14-15), it may be difficult to discern such a change with any degree of statistical confidence. Clearly, addition of more PbS-bearing fugitive particulate matter to residential soils is a matter of public health concern; however, the issue is more one of increased contamination levels than of increased RBA. Finally, the "pre-dust" Pb species mix may still be responding to ore concentrate addition, and further data are needed to evaluate the credibility of the MSE model. From the Phase 2 results one could surmise that "equilibrium" has occurred and the RBA results for the Phase 2 (May 2006 soil) are about the same – within experimental error – as those observed in Phase 1. Even more time-interval data is required to refine or replace the present model because "hard" conclusions cannot be drawn on only 2 sample sets.

6. CONCLUSIONS AND RECOMMENDATIONS

When reliable site-specific data are lacking, the USEPA typically employs a default RBA value of 60% for lead in soil compared to soluble lead in water, for both children and adults. The RBA point estimate of 82% for the test soils weathered for 12-months and 24-months used in this study is higher than the default value of 60%, indicating that absorption of and hazards from lead in this soil may be higher than usually assumed. It is appropriate to take this into account when evaluating potential risks to humans from incidental ingestion of this soil.

MSE agrees with the conclusion in Casteel et al. (2006a, p.15 and 2006b, p.15) that the soil/ore concentrate mixture exhibits an RBA that exceeds the IEUBK model default value of 60%. We also suggest that the Pb-RBA's point estimate for both the 12-month and 24-month soils of 82% is conservative. Interpolation of Dr. Drexler's average in vitro bioaccessibility result for the 12-month sample (0.69± 0.015) into Figure 3-6 of the December 2004 USEPA report yields a "best estimate" of 65% for predicted Pb-RBA and a 95% UCL of 88%. However, the respective results for bulk lead (2,021 mg/kg) are 82% and 105%; these values are in very good agreement with those from the swine (in vivo) study. Interpolation of Dr. Drexler's bioaccessibility result for the soil that had weathered for 24-months

(0.89±0.015) in Figure 3-6 of the same USEPA (2004a) report yields a "best estimate" of 86% for predicted Pb-RBA and a 95% UCL of 110%. These values are also in good agreement with the 24-month in vivo study results.

Tetra Tech's QAPP refers to a Pb speciation study by Johnson and Abraham (2002) that observed transformation of lead sulfide to lead sulfate and lead carbonate in soils. Given this observation and group-specific RBA values in the December 2004 USEPA report (Figure 2-7), an RBA in the 75% to 85% range appears reasonable for the 12-month soil sample and an RBA of 80% to 90% range for the 24-month study. These Pb-RBA ranges reflect the hypothesized predominance of lead carbonate (cerussite), which would result in Pb bioavailability levels exceeding the IEUBK's default value of 0.60. Finally, the consistent in vivo point estimate of 0.82 appears to reflect the central tendency of Pb bioavailability throughout the two-year study period.

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APPENDIX A

Detailed Results for 12-Month Sample from
Casteel et al. (2006a)

TABLE A-1 SCHEDULE

Study Day	Day	Date	Bleed	Dose Administration	Feed Special Diet	Weigh	Dose Prep	Cull Pigs/ Assign Dose Group	Sacrifice/ Necropsy
-5	Wednesday	6/8/05			transition	X			
-4	Thursday	6/9/05			transition			X	
-3	Friday	6/10/05			X				
-2	Saturday	6/11/05			X				
-1	Sunday	6/12/05			X	X	X		
0	Monday	6/13/05	X	X	X				
1	Tuesday	6/14/05	X	X	X				
2	Wednesday	6/15/05	X	X	X	X	X		
3	Thursday	6/16/05	X	X	X				
4	Friday	6/17/05		X	X				
5	Saturday	6/18/05	X	X	X	X	X		
6	Sunday	6/19/05		X	X				
7	Monday	6/20/05	X	X	X				
8	Tuesday	6/21/05		X	X	X	X		
9	Wednesday	6/22/05	X	X	X				
10	Thursday	6/23/05		X	X				
11	Friday	6/24/05		X	X	X	X		
12	Saturday	6/25/05	X	X	X				
13	Sunday	6/26/05		X	X				
14	Monday	6/27/05		X	X	X			
15	Tuesday	6/28/05	X						X

MSE2 Appendix A.xls (A-1 Schedule)

TABLE A-2 GROUP ASSIGNMENTS

Pig Number	Dose Group	Material Administered	Target Dose of Lead (µg/kg-day)
804 820 845	1	Control	3
802 803 816 826 838	2	Lead Acetate	25
819 832 834 839 846	3	Lead Acetate	75
801 806 823 835 850*	4	Lead Acetate	225
809 812 817 824 825	5	Test Material	75
813 830 831 833 844	6	Test Material	225
807 808 810 828 840	7	Test Material	675

*Pig 850 died during the study and was excluded from all analyses.

MSE2_Appendix A.xls (A-2_Groups)

TABLE A-3 BODY WEIGHTS AND ACTUAL ADMINISTERED DOSES, BY DAY

Body weights were measured on days -1, 2, 6, 8, 11, and 14. Weights for other days are estimated based on linear interpolation between measured values.

Group	Pig #	Day -1 BW (kg)	Day -1 Pb Dose (µg/kg-d)	Day 0 BW (kg)	Day 0 Pb Dose (µg/kg-d)	Day 1 BW (kg)	Day 1 Pb Dose (µg/kg-d)	Day 2 BW (kg)	Day 2 Pb Dose (µg/kg-d)	Day 3 BW (kg)	Day 3 Pb Dose (µg/kg-d)	Day 4 BW (kg)	Day 4 Pb Dose (µg/kg-d)	Day 5 BW (kg)	Day 5 Pb Dose (µg/kg-d)	Day 6 BW (kg)	Day 6 Pb Dose (µg/kg-d)	Day 7 BW (kg)	Day 7 Pb Dose (µg/kg-d)	Day 8 BW (kg)	Day 8 Pb Dose (µg/kg-d)	Day 9 BW (kg)	Day 9 Pb Dose (µg/kg-d)	Day 10 BW (kg)	Day 10 Pb Dose (µg/kg-d)	Day 11 BW (kg)	Day 11 Pb Dose (µg/kg-d)	Day 12 BW (kg)	Day 12 Pb Dose (µg/kg-d)	Day 13 BW (kg)	Day 13 Pb Dose (µg/kg-d)	Day 14 BW (kg)	Day 14 Pb Dose (µg/kg-d)	Days 0-14 Mean Pb Dose (µg/kg-d)
1	804	9.9	0.00	10.3	0.00	10.7	0.00	11.1	0.00	11.5	0.00	11.9	0.00	12.4	0.00	12.8	0.00	13.2	0.00	13.6	0.00	14.1	0.00	14.7	0.00	15.3	0.00	15.8	0.00	16.4	0.00	16.9	0.00	0.00
1	829	10.9	0.00	11.5	0.00	11.6	0.00	12.0	0.00	12.3	0.00	12.6	0.00	12.7	0.00	13.1	0.00	13.6	0.00	14.0	0.00	14.4	0.00	14.9	0.00	15.4	0.00	15.5	0.00	16.3	0.00	16.8	0.00	0.00
1	846	12.1	0.00	12.9	0.00	12.4	0.00	12.8	0.00	13.4	0.00	14.0	0.00	14.6	0.00	15.0	0.00	16.0	0.00	16.0	0.00	16.6	0.00	17.2	0.00	17.9	0.00	18.7	0.00	19.7	0.00	19.1	0.00	0.00
2	802	10.3	0.00	11.1	27.15	11.3	25.43	11.5	24.13	12.0	24.37	12.4	24.71	12.9	24.81	13.3	25.17	13.6	25.28	14.3	24.46	14.8	25.64	15.4	24.72	15.9	25.87	16.6	25.63	17.1	24.65	17.7	23.84	25.39
2	803	11.0	0.00	11.3	26.59	11.7	26.79	12.0	25.04	12.3	25.64	12.7	25.16	13.0	24.52	13.3	19.65	13.6	25.63	13.9	25.07	14.5	26.11	15.2	25.02	15.8	24.02	17.2	24.39	18.7	22.80	20.2	20.88	24.26
2	816	10.1	0.00	10.4	28.80	10.8	27.91	11.1	27.07	11.6	27.76	11.9	26.86	12.3	26.02	12.6	27.69	13.0	26.77	13.4	26.01	13.9	27.27	14.4	26.29	15.0	25.38	15.8	27.20	16.0	26.32	16.6	25.60	26.98
2	826	12.7	0.00	12.7	23.83	12.8	23.81	12.8	23.39	13.4	23.88	13.9	23.01	14.4	22.21	14.9	23.39	15.6	22.84	15.6	21.78	16.4	23.09	16.9	19.40	17.3	21.94	17.5	23.66	18.3	21.03	18.8	22.44	23.04
2	838	10.4	0.00	10.8	27.83	11.1	27.19	11.7	26.69	11.6	27.44	11.9	29.71	12.3	25.30	12.6	27.42	13.0	24.84	13.4	26.10	14.0	27.17	14.6	26.02	15.2	24.97	15.7	24.74	16.3	26.87	16.9	25.04	26.67
3	819	12.6	0.00	12.3	71.24	13.2	69.38	13.6	67.69	14.1	71.29	14.7	68.60	15.2	69.12	16.5	70.47	16.6	69.06	16.2	67.71	16.7	71.41	17.3	69.13	17.8	66.99	18.5	72.28	18.0	70.42	19.5	68.65	69.40
3	832	11.4	0.00	11.9	77.28	12.3	74.45	12.8	71.02	13.0	77.21	13.3	76.66	13.6	74.17	14.0	78.11	14.5	75.67	14.8	73.39	15.6	77.18	16.0	74.63	16.6	72.05	17.1	77.21	17.7	74.73	18.3	72.41	76.18
3	834	10.3	0.00	10.6	80.26	11.0	83.38	11.4	80.68	11.7	86.27	12.0	84.10	12.3	82.04	12.8	85.52	13.4	81.71	14.0	78.39	14.6	82.15	16.1	79.06	15.7	76.20	16.2	81.66	16.7	79.06	17.3	76.61	82.12
3	839	12.2	0.00	12.6	72.77	13.0	70.62	13.4	68.60	13.8	72.65	14.3	70.20	14.8	67.91	15.2	71.70	15.7	69.65	16.2	67.71	16.8	71.12	17.4	68.40	18.0	66.26	18.6	71.18	19.1	69.07	19.7	67.08	69.93
3	844	9.7	0.00	10.1	90.37	10.6	86.64	11.0	83.26	11.4	89.42	11.7	85.65	12.1	83.06	12.5	87.25	12.9	84.58	13.4	81.91	13.9	86.59	14.6	82.15	15.1	78.97	15.6	84.71	16.1	82.00	16.6	79.41	84.80
4	801	10.1	0.00	10.5	243.18	11.0	234.70	11.5	224.80	11.8	239.26	12.1	232.58	12.5	226.45	13.0	234.98	13.5	225.95	14.0	217.61	14.6	230.26	15.1	221.07	15.7	214.07	16.2	229.48	16.7	221.64	17.2	224.47	231.31
4	806	11.2	0.00	11.5	223.10	11.9	216.91	12.3	210.98	12.6	223.45	13.0	216.31	13.5	209.61	13.9	219.96	14.3	213.79	14.7	207.96	15.2	219.93	15.8	211.62	16.4	204.28	17.4	222.74	18.4	210.63	18.4	199.77	214.61
4	821	11.2	0.00	11.6	223.18	11.9	216.00	12.3	209.27	12.7	221.59	13.1	216.21	13.5	208.83	13.9	219.44	14.3	213.64	14.7	207.95	15.2	220.90	15.7	213.62	16.2	206.81	16.7	232.51	17.2	226.78	17.7	219.68	217.75
4	836	9.6	0.00	9.9	260.88	10.2	252.77	10.5	245.14	10.7	262.42	11.0	257.47	11.2	251.72	11.8	267.81	12.4	245.03	13.1	233.46	14.3	235.11	15.6	216.94	16.7	201.22	17.3	224.45	17.9	215.72	18.5	209.49	243.10
4	860[1]																																	
5	809	10.5	0.00	10.7	77.80	10.9	74.81	11.0	76.75	11.5	74.45	12.1	72.87	12.7	69.60	12.9	74.92	13.2	73.32	13.6	71.78	14.0	74.96	14.8	72.48	15.6	70.13	16.5	75.28	16.7	73.44	16.1	71.69	74.15
5	818	9.7	0.00	9.9	83.65	10.2	81.46	10.6	79.38	10.8	82.94	10.8	81.65	11.0	80.41	11.5	84.13	11.6	80.80	11.9	81.77	12.3	85.59	12.7	82.89	13.1	80.34	13.6	85.18	14.1	82.15	14.6	79.33	82.33
5	817	10.0	0.00	10.2	81.19	10.4	79.50	10.7	77.89	11.0	80.17	11.3	77.81	11.7	75.58	12.0	80.53	12.4	78.04	12.8	76.70	13.2	79.23	13.7	76.72	14.1	74.36	14.4	80.06	14.7	76.34	15.1	75.69	78.46
5	824	10.3	0.00	10.4	79.83	10.6	78.75	10.7	77.89	11.1	78.16	11.5	76.90	11.9	74.30	12.2	79.21	12.6	76.80	13.0	74.54	13.5	77.87	14.0	74.71	14.6	72.06	15.1	76.82	15.6	73.91	16.2	71.47	74.63
5	835	9.9	0.00	10.2	81.04	10.6	78.13	11.0	78.41	11.8	76.67	12.0	73.78	12.5	70.44	13.3	75.02	13.5	72.68	13.8	70.47	14.3	73.49	14.8	70.92	15.3	68.53	15.8	73.29	16.7	71.25	16.7	69.32	72.92
6	813	9.6	0.00	10.0	264.81	10.3	256.41	10.7	246.64	11.0	255.25	11.3	248.83	11.6	242.73	12.0	256.67	12.4	247.71	12.9	239.39	13.4	252.87	14.0	242.99	14.5	233.59	15.1	247.13	15.6	238.41	16.2	230.28	247.77
6	830	9.7	0.00	9.8	258.40	10.0	263.49	10.2	258.75	10.6	263.55	11.1	253.33	11.5	243.78	12.0	256.67	12.4	248.72	13.0	237.51	13.4	252.25	13.9	243.49	14.4	235.31	15.0	248.23	15.6	238.92	16.2	230.29	249.81
6	831	11.8	0.00	12.1	218.42	12.4	213.42	12.7	208.54	13.1	214.28	13.5	207.41	14.0	200.97	14.5	212.12	15.1	204.37	15.6	197.16	16.1	210.68	16.5	204.54	17.1	198.74	17.7	210.72	18.3	203.79	18.9	197.31	207.38
6	833	11.7	0.00	12.0	219.94	12.3	214.57	12.5	209.46	13.0	215.65	13.4	209.22	13.8	202.15	14.3	215.84	14.7	209.23	15.2	203.02	15.6	217.21	16.1	211.12	16.5	205.36	17.1	218.14	17.6	211.32	18.2	204.82	211.21
6	844	10.9	0.00	11.0	240.30	11.1	238.49	11.2	236.70	11.6	241.33	12.1	232.01	12.6	223.19	13.0	237.51	13.4	230.35	13.8	223.49	14.2	238.07	14.7	230.25	15.2	222.93	15.6	238.41	16.0	232.45	16.4	226.78	233.46
7	807	10.5	0.00	10.7	768.23	11.1	739.38	11.5	712.67	11.9	742.53	12.3	729.11	12.7	707.02	13.2	741.54	13.5	711.98	14.0	683.60	14.6	730.48	14.9	713.18	15.1	704.29	15.6	738.50	16.4	708.54	17.1	630.92	722.71
7	808	10.3	0.00	10.7	764.66	11.2	732.74	11.7	702.39	11.9	760.52	12.2	734.10	12.6	718.37	12.9	759.77	13.4	734.16	13.8	710.22	14.0	761.06	14.6	730.48	15.0	711.00	15.6	749.60	16.1	724.71	16.6	701.43	731.94
7	810	10.4	0.00	10.6	752.94	11.4	720.92	11.9	693.52	12.3	730.16	12.7	707.68	13.1	685.54	13.5	739.70	13.6	728.70	13.7	718.02	14.3	745.90	15.0	713.03	15.4	683.45	16.0	729.25	16.3	712.89	16.7	647.23	717.93
7	828	12.6	0.00	12.9	640.20	13.2	623.16	13.5	607.00	14.0	641.13	14.4	621.09	14.9	602.27	15.3	641.29	15.7	623.61	16.2	606.87	16.8	638.45	17.4	612.34	18.1	590.86	18.7	624.33	19.3	604.87	19.9	586.59	616.53
7	840	12.4	0.00	12.5	664.44	12.6	649.50	12.9	642.71	13.4	648.15	14.0	639.60	14.5	612.89	15.1	649.79	15.6	629.51	16.1	619.83	16.5	648.06	17.0	626.74	17.5	609.43	17.6	649.28	18.4	633.93	18.6	619.35	636.55

[1] Pig 860 died during the study and was excluded from all analyses

Incomplete Doses:
Day 6 - Pig 803 did not eat entire AM dose (ate approximately 81%). Daily dose adjusted to 75%
Day 10 - Pig 824 did not eat entire AM dose (ate approximately 75%). Daily dose adjusted to 87.5%.
Day 4 - Pig 844 dropped approximately half its dose on the ground, the dropped portion was refed to the animal around 11:00 a.m. No dose adjustment was made (daily dose remained 100%)

TABLE A-4 ANIMAL HEALTH

Naxcel Treatment for Illness

First Day of Treatment	Treatment Notes*	Pig	Group	Indications
Day -4 (6/09/05)	Treatment duration = 7 days	801	4	Elevated temperature, coughing, anorectic
Day 1 (6/14/05)	Treatment began at 7 PM	844	6	Elevated temperature, anorectic at PM feeding
		809	5	
Day 2 (6/15/05)	Treatment began in PM	820	1	Elevated temperature, diarrhea
Day 4 (6/17/05)		812	5	Elevated temperature, diarrhea
		817	5	
		826	2	
		835	4	Vomiting in morning
Day 6 (6/19/05)	Treatment began at 12 PM	806	4	Elevated temperature, didn't eat all of AM feed
Day 8 (6/21/05)	1.3 mL Naxcel administered	808	7	Elevated temperature, diarrhea in AM
Day 10 (6/23/05)	1.5 mL Naxcel administered	807	7	Elevated temperature
Day 13 (6/26/05)	1.5 mL Naxcel administered	840	7	Elevated temperature, diarrhea

*Treatment consisted of 1cc/10kg body weight of Naxcel for a duration of 3 days, unless otherwise noted.

Animal Deaths

Pig 850 (Group 4) was found dead in on Day 11 (6/24/05); he had shown no signs of inappetance or diarrhea. Bacteriology of necropsy samples indicated *Salmonella*.

TABLE A-5

LEAD ANALYTICAL RESULTS FOR STUDY SAMPLES

Sample Number	Tag Number	Matrix	Group	Material Administered	Target Dose (ug/kg-d)	Pig Number	Collection Day	Actual Dose (ug/d)	Actual BWAdj Dose (ug/d)	Q	Pb Conc	DL	AdjConc	Units
MSE2-804-(0)-B	MSE2-129	blood	1	Control	0	804	0	0	0	<	1	1	0.5	ug/dL
MSE2-820-(0)-B	MSE2-122	blood	1	Control	0	820	0	0	0	<	1	1	0.5	ug/dL
MSE2-845-(0)-B	MSE2-106	blood	1	Control	0	845	0	0	0	<	1	1	0.5	ug/dL
MSE2-802-(0)-B	MSE2-120	blood	2	Lead Acetate	25	802	0	300.5	27.15	<	1	1	0.5	ug/dL
MSE2-803-(0)-B	MSE2-133	blood	2	Lead Acetate	25	803	0	300.5	26.59	<	1	1	0.5	ug/dL
MSE2-816-(0)-B	MSE2-126	blood	2	Lead Acetate	25	816	0	300.5	28.8	<	1	1	0.5	ug/dL
MSE2-826-(0)-B	MSE2-113	blood	2	Lead Acetate	25	826	0	300.5	23.63	<	1	1	0.5	ug/dL
MSE2-838-(0)-B	MSE2-118	blood	2	Lead Acetate	25	838	0	300.5	27.82	<	1	1	0.5	ug/dL
MSE2-832-(0)-B	MSE2-125	blood	3	Lead Acetate	75	832	0	915.75	77.28	<	1	1	0.5	ug/dL
MSE2-834-(0)-B	MSE2-104	blood	3	Lead Acetate	75	834	0	915.75	86.26	<	1	1	0.5	ug/dL
MSE2-839-(0)-B	MSE2-135	blood	3	Lead Acetate	75	839	0	915.75	72.77	<	1	1	0.5	ug/dL
MSE2-846-(0)-B	MSE2-109	blood	3	Lead Acetate	75	846	0	915.75	90.37	<	1	1	0.5	ug/dL
MSE2-819-(0)-B	MSE2-115	blood	3	Lead Acetate	75	819	0	915.75	71.26	<	1	1	0.5	ug/dL
MSE2-801-(0)-B	MSE2-132	blood	4	Lead Acetate	225	801	0	2574	243.98	<	1	1	0.5	ug/dL
MSE2-806-(0)-B	MSE2-130	blood	4	Lead Acetate	225	806	0	2574	223.18	<	1	1	0.5	ug/dL
MSE2-823-(0)-B	MSE2-123	blood	4	Lead Acetate	225	823	0	2574	223.18	<	1	1	0.5	ug/dL
MSE2-835-(0)-B	MSE2-102	blood	4	Lead Acetate	225	835	0	2574	260.88	<	1	1	0.5	ug/dL
MSE2-850-(0)-B	MSE2-103	blood	4	Lead Acetate	225	850	0	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-809-(0)-B	MSE2-114	blood	5	Soil	75	809	0	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-812-(0)-B	MSE2-108	blood	5	Soil	75	812	0	2574	259.56	<	1	1	0.5	ug/dL
MSE2-817-(0)-B	MSE2-136	blood	5	Soil	75	817	0	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-824-(0)-B	MSE2-111	blood	5	Soil	75	824	0	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-825-(0)-B	MSE2-105	blood	5	Soil	75	825	0	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-813-(0)-B	MSE2-112	blood	6	Soil	225	813	0	2.64	0.26	<	1	1	0.5	ug/dL
MSE2-830-(0)-B	MSE2-117	blood	6	Soil	225	830	0	2.64	0.27	<	1	1	0.5	ug/dL
MSE2-831-(0)-B	MSE2-131	blood	6	Soil	225	831	0	2.64	0.22	<	1	1	0.5	ug/dL
MSE2-833-(0)-B	MSE2-110	blood	6	Soil	225	833	0	2.64	0.22	<	1	1	0.5	ug/dL
MSE2-844-(0)-B	MSE2-119	blood	6	Soil	225	844	0	2.64	0.24	<	1	1	0.5	ug/dL
MSE2-807-(0)-B	MSE2-121	blood	7	Soil	675	807	0	8.19	0.77	<	1	1	0.5	ug/dL
MSE2-808-(0)-B	MSE2-127	blood	7	Soil	675	808	0	8.19	0.76	<	1	1	0.5	ug/dL
MSE2-810-(0)-B	MSE2-101	blood	7	Soil	675	810	0	8.19	0.75	<	1	1	0.5	ug/dL
MSE2-828-(0)-B	MSE2-107	blood	7	Soil	675	828	0	8.19	0.64	<	1	1	0.5	ug/dL
MSE2-840-(0)-B	MSE2-124	blood	7	Soil	675	840	0	8.19	0.66	<	1	1	0.5	ug/dL
MSE2-804-(1)-B	MSE2-140	blood	1	Control	0	804	1	0	0	<	1	1	0.5	ug/dL
MSE2-820-(1)-B	MSE2-144	blood	1	Control	0	820	1	0	0	<	1	1	0.5	ug/dL
MSE2-845-(1)-B	MSE2-140	blood	1	Control	0	845	1	0	0	<	1	1	0.5	ug/dL
MSE2-802-(1)-B	MSE2-152	blood	2	Lead Acetate	25	802	1	300.5	26.63	<	1	1	0.5	ug/dL
MSE2-803-(1)-B	MSE2-148	blood	2	Lead Acetate	25	803	1	300.5	25.79	<	1	1	0.5	ug/dL
MSE2-816-(1)-B	MSE2-175	blood	2	Lead Acetate	25	816	1	300.5	27.91	<	1	1	0.5	ug/dL
MSE2-826-(1)-B	MSE2-142	blood	2	Lead Acetate	25	826	1	300.5	23.51	<	1	1	0.5	ug/dL
MSE2-838-(1)-B	MSE2-158	blood	2	Lead Acetate	25	838	1	300.5	27.19	<	1	1	0.5	ug/dL
MSE2-819-(1)-B	MSE2-160	blood	3	Lead Acetate	75	819	1	915.75	69.38	<	1	1	0.5	ug/dL
MSE2-832-(1)-B	MSE2-157	blood	3	Lead Acetate	75	832	1	915.75	74.45		1	1	1	ug/dL
MSE2-834-(1)-B	MSE2-150	blood	3	Lead Acetate	75	834	1	915.75	83.38	<	1	1	0.5	ug/dL
MSE2-839-(1)-B	MSE2-145	blood	3	Lead Acetate	75	839	1	915.75	70.62		1	1	1	ug/dL
MSE2-846-(1)-B	MSE2-146	blood	3	Lead Acetate	75	846	1	915.75	86.66	<	1	1	0.5	ug/dL
MSE2-801-(1)-B	MSE2-165	blood	4	Lead Acetate	225	801	1	2574	234		3	1	3	ug/dL
MSE2-806-(1)-B	MSE2-164	blood	4	Lead Acetate	225	806	1	2574	216.91		2	1	2	ug/dL
MSE2-823-(1)-B	MSE2-163	blood	4	Lead Acetate	225	823	1	2574	216		3	1	3	ug/dL
MSE2-835-(1)-B	MSE2-166	blood	4	Lead Acetate	225	835	1	2574	252.77		3	1	3	ug/dL
MSE2-850-(1)-B	MSE2-153	blood	4	Lead Acetate	225	850	1	0.83	0.08		4	1	4	ug/dL
MSE2-809-(1)-B	MSE2-156	blood	5	Soil	75	809	1	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-812-(1)-B	MSE2-174	blood	5	Soil	75	812	1	2574	252.77	<	1	1	0.5	ug/dL
MSE2-817-(1)-B	MSE2-176	blood	5	Soil	75	817	1	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-824-(1)-B	MSE2-169	blood	5	Soil	75	824	1	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-825-(1)-B	MSE2-151	blood	5	Soil	75	825	1	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-813-(1)-B	MSE2-139	blood	6	Soil	225	813	1	2.64	0.26		2	1	2	ug/dL
MSE2-830-(1)-B	MSE2-168	blood	6	Soil	225	830	1	2.64	0.26	<	1	1	0.5	ug/dL
MSE2-831-(1)-B	MSE2-143	blood	6	Soil	225	831	1	2.64	0.21		1	1	1	ug/dL
MSE2-833-(1)-B	MSE2-154	blood	6	Soil	225	833	1	2.64	0.21		2	1	2	ug/dL
MSE2-844-(1)-B	MSE2-171	blood	6	Soil	225	844	1	2.64	0.24	<	1	1	0.5	ug/dL
MSE2-807-(1)-B	MSE2-173	blood	7	Soil	675	807	1	8.19	0.74		6	1	6	ug/dL
MSE2-808-(1)-B	MSE2-167	blood	7	Soil	675	808	1	8.19	0.73		6	1	6	ug/dL
MSE2-810-(1)-B	MSE2-170	blood	7	Soil	675	810	1	8.19	0.72		5	1	5	ug/dL
MSE2-828-(1)-B	MSE2-155	blood	7	Soil	675	828	1	8.19	0.62		6	1	6	ug/dL
MSE2-840-(1)-B	MSE2-161	blood	7	Soil	675	840	1	8.19	0.65		8	1	8	ug/dL
MSE2-804-(2)-B	MSE2-194	blood	1	Control	0	804	2	0	0	<	1	1	0.5	ug/dL
MSE2-820-(2)-B	MSE2-180	blood	1	Control	0	820	2	0	0	<	1	1	0.5	ug/dL
MSE2-845-(2)-B	MSE2-179	blood	1	Control	0	845	2	0	0	<	1	1	0.5	ug/dL
MSE2-802-(2)-B	MSE2-203	blood	2	Lead Acetate	25	802	2	300.5	26.13	<	1	1	0.5	ug/dL
MSE2-803-(2)-B	MSE2-183	blood	2	Lead Acetate	25	803	2	300.5	25.04	<	1	1	0.5	ug/dL
MSE2-816-(2)-B	MSE2-204	blood	2	Lead Acetate	25	816	2	300.5	27.07	<	1	1	0.5	ug/dL
MSE2-826-(2)-B	MSE2-188	blood	2	Lead Acetate	25	826	2	300.5	23.39	<	1	1	0.5	ug/dL
MSE2-838-(2)-B	MSE2-211	blood	2	Lead Acetate	25	838	2	300.5	26.59	<	1	1	0.5	ug/dL
MSE2-819-(2)-B	MSE2-205	blood	3	Lead Acetate	75	819	2	915.75	67.58	<	1	1	0.5	ug/dL
MSE2-832-(2)-B	MSE2-177	blood	3	Lead Acetate	75	832	2	915.75	71.82		1	1	1	ug/dL

TABLE A-5

Sample Number	Tag Number	Matrix	Group	Material Administered	Target Dose (ug/kg-d)	Pig Number	Collection Day	Actual Dose (ug/d)	Actual BWAdj Dose (ug/d)	Q	Pb Conc	DL	AdjConc	Units
MSE2-834-(2)-B	MSE2-210	blood	3	Lead Acetate	75	834	2	915.75	80.68		1	1	1	ug/dL
MSE2-839-(2)-B	MSE2-195	blood	3	Lead Acetate	75	839	2	915.75	68.6		1	1	1	ug/dL
MSE2-846-(2)-B	MSE2-201	blood	3	Lead Acetate	75	846	2	915.75	83.25		1	1	1	ug/dL
MSE2-801-(2)-B	MSE2-181	blood	4	Lead Acetate	225	801	2	2574	224.8		3	1	3	ug/dL
MSE2-806-(2)-B	MSE2-214	blood	4	Lead Acetate	225	806	2	2574	210.98		3	1	3	ug/dL
MSE2-823-(2)-B	MSE2-182	blood	4	Lead Acetate	225	823	2	2574	209.27		4	1	4	ug/dL
MSE2-835-(2)-B	MSE2-197	blood	4	Lead Acetate	225	835	2	2574	245.14		3	1	3	ug/dL
MSE2-850-(2)-B	MSE2-213	blood	4	Lead Acetate	225	850	2	0.83	0.07		4	1	4	ug/dL
MSE2-809-(2)-B	MSE2-184	blood	5	Soil	75	809	2	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-812-(2)-B	MSE2-206	blood	5	Soil	75	812	2	2574	246.32	<	1	1	0.5	ug/dL
MSE2-817-(2)-B	MSE2-199	blood	5	Soil	75	817	2	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-824-(2)-B	MSE2-187	blood	5	Soil	75	824	2	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-825-(2)-B	MSE2-185	blood	5	Soil	75	825	2	0.83	0.08	<	1	1	0.5	ug/dL
MSE2-813-(2)-B	MSE2-196	blood	6	Soil	225	813	2	2.64	0.25		2	1	2	ug/dL
MSE2-830-(2)-B	MSE2-200	blood	6	Soil	225	830	2	2.64	0.26		2	1	2	ug/dL
MSE2-831-(2)-B	MSE2-178	blood	6	Soil	225	831	2	2.64	0.21		2	1	2	ug/dL
MSE2-833-(2)-B	MSE2-186	blood	6	Soil	225	833	2	2.64	0.21		3	1	3	ug/dL
MSE2-844-(2)-B	MSE2-202	blood	6	Soil	225	844	2	2.64	0.24	<	1	1	0.5	ug/dL
MSE2-807-(2)-B	MSE2-208	blood	7	Soil	675	807	2	8.19	0.71		6	1	6	ug/dL
MSE2-808-(2)-B	MSE2-209	blood	7	Soil	675	808	2	8.19	0.7		7	1	7	ug/dL
MSE2-810-(2)-B	MSE2-207	blood	7	Soil	675	810	2	8.19	0.69		7	1	7	ug/dL
MSE2-828-(2)-B	MSE2-192	blood	7	Soil	675	828	2	8.19	0.61		7	1	7	ug/dL
MSE2-840-(2)-B	MSE2-191	blood	7	Soil	675	840	2	8.19	0.64		8	1	8	ug/dL
MSE2-804-(3)-B	MSE2-241	blood	1	Control	0	804	3	0	0	<	1	1	0.5	ug/dL
MSE2-820-(3)-B	MSE2-220	blood	1	Control	0	820	3	0	0	<	1	1	0.5	ug/dL
MSE2-845-(3)-B	MSE2-222	blood	1	Control	0	845	3	0	0	<	1	1	0.5	ug/dL
MSE2-802-(3)-B	MSE2-231	blood	2	Lead Acetate	25	802	3	318.75	26.67	<	1	1	0.5	ug/dL
MSE2-803-(3)-B	MSE2-224	blood	2	Lead Acetate	25	803	3	318.75	25.84	<	1	1	0.5	ug/dL
MSE2-816-(3)-B	MSE2-236	blood	2	Lead Acetate	25	816	3	318.75	27.76	<	1	1	0.5	ug/dL
MSE2-826-(3)-B	MSE2-246	blood	2	Lead Acetate	25	826	3	318.75	23.88	<	1	1	0.5	ug/dL
MSE2-838-(3)-B	MSE2-240	blood	2	Lead Acetate	25	838	3	318.75	27.44	<	1	1	0.5	ug/dL
MSE2-819-(3)-B	MSE2-250	blood	3	Lead Acetate	75	819	3	1005	71.28	<	1	1	0.5	ug/dL
MSE2-832-(3)-B	MSE2-238	blood	3	Lead Acetate	75	832	3	1005	77.21	<	1	1	0.5	ug/dL
MSE2-834-(3)-B	MSE2-229	blood	3	Lead Acetate	75	834	3	1005	86.27		2	1	2	ug/dL
MSE2-839-(3)-B	MSE2-219	blood	3	Lead Acetate	75	839	3	1005	72.65		2	1	2	ug/dL
MSE2-846-(3)-B	MSE2-221	blood	3	Lead Acetate	75	846	3	1005	88.42		2	1	2	ug/dL
MSE2-801-(3)-B	MSE2-237	blood	4	Lead Acetate	225	801	3	2819.25	239.26		2	1	2	ug/dL
MSE2-806-(3)-B	MSE2-239	blood	4	Lead Acetate	225	806	3	2819.25	223.45		2	1	2	ug/dL
MSE2-823-(3)-B	MSE2-227	blood	4	Lead Acetate	225	823	3	2819.25	221.99		3	1	3	ug/dL
MSE2-835-(3)-B	MSE2-244	blood	4	Lead Acetate	225	835	3	2819.25	262.66		3	1	3	ug/dL
MSE2-850-(3)-B	MSE2-251	blood	4	Lead Acetate	225	850	3	0.88	0.08		3	1	3	ug/dL
MSE2-809-(3)-B	MSE2-226	blood	5	Soil	75	809	3	0.88	0.08		1	1	1	ug/dL
MSE2-812-(3)-B	MSE2-225	blood	5	Soil	75	812	3	2819.25	265.56	<	1	1	0.5	ug/dL
MSE2-817-(3)-B	MSE2-223	blood	5	Soil	75	817	3	0.88	0.08	<	1	1	0.5	ug/dL
MSE2-824-(3)-B	MSE2-243	blood	5	Soil	75	824	3	0.88	0.08	<	1	1	0.5	ug/dL
MSE2-825-(3)-B	MSE2-234	blood	5	Soil	75	825	3	0.88	0.08	<	1	1	0.5	ug/dL
MSE2-813-(3)-B	MSE2-216	blood	6	Soil	225	813	3	2.8	0.26		2	1	2	ug/dL
MSE2-830-(3)-B	MSE2-218	blood	6	Soil	225	830	3	2.8	0.26		1	1	1	ug/dL
MSE2-831-(3)-B	MSE2-247	blood	6	Soil	225	831	3	2.8	0.21		1	1	1	ug/dL
MSE2-833-(3)-B	MSE2-245	blood	6	Soil	225	833	3	2.8	0.22	<	1	1	0.5	ug/dL
MSE2-844-(3)-B	MSE2-235	blood	6	Soil	225	844	3	2.8	0.24	<	1	1	0.5	ug/dL
MSE2-807-(3)-B	MSE2-242	blood	7	Soil	675	807	3	8.94	0.75		5	1	5	ug/dL
MSE2-808-(3)-B	MSE2-232	blood	7	Soil	675	808	3	8.94	0.75		4	1	4	ug/dL
MSE2-810-(3)-B	MSE2-248	blood	7	Soil	675	810	3	8.94	0.73		5	1	5	ug/dL
MSE2-828-(3)-B	MSE2-233	blood	7	Soil	675	828	3	8.94	0.64		4	1	4	ug/dL
MSE2-840-(3)-B	MSE2-228	blood	7	Soil	675	840	3	8.94	0.67		3	1	3	ug/dL
MSE2-804-(5)-B	MSE2-267	blood	1	Control	0	804	5	0	0	<	1	1	0.5	ug/dL
MSE2-820-(5)-B	MSE2-288	blood	1	Control	0	820	5	0	0	<	1	1	0.5	ug/dL
MSE2-845-(5)-B	MSE2-263	blood	1	Control	0	845	5	0	0	<	1	1	0.5	ug/dL
MSE2-802-(5)-B	MSE2-279	blood	2	Lead Acetate	25	802	5	318.75	24.81	<	1	1	0.5	ug/dL
MSE2-803-(5)-B	MSE2-284	blood	2	Lead Acetate	25	803	5	318.75	24.52	<	1	1	0.5	ug/dL
MSE2-816-(5)-B	MSE2-281	blood	2	Lead Acetate	25	816	5	318.75	26.02	<	1	1	0.5	ug/dL
MSE2-826-(5)-B	MSE2-266	blood	2	Lead Acetate	25	826	5	318.75	22.21	<	1	1	0.5	ug/dL
MSE2-838-(5)-B	MSE2-285	blood	2	Lead Acetate	25	838	5	318.75	26.02	<	1	1	0.5	ug/dL
MSE2-819-(5)-B	MSE2-287	blood	3	Lead Acetate	75	819	5	1005	66.12	<	1	1	0.5	ug/dL
MSE2-832-(5)-B	MSE2-275	blood	3	Lead Acetate	75	832	5	1005	74.17	<	1	1	0.5	ug/dL
MSE2-834-(5)-B	MSE2-289	blood	3	Lead Acetate	75	834	5	1005	82.04		1	1	1	ug/dL
MSE2-839-(5)-B	MSE2-271	blood	3	Lead Acetate	75	839	5	1005	67.91		1	1	1	ug/dL
MSE2-846-(5)-B	MSE2-286	blood	3	Lead Acetate	75	846	5	1005	83.06		1	1	1	ug/dL
MSE2-801-(5)-B	MSE2-264	blood	4	Lead Acetate	225	801	5	2819.25	226.45		4	1	4	ug/dL
MSE2-806-(5)-B	MSE2-278	blood	4	Lead Acetate	225	806	5	2819.25	209.61		3	1	3	ug/dL
MSE2-823-(5)-B	MSE2-270	blood	4	Lead Acetate	225	823	5	2819.25	208.83		3	1	3	ug/dL
MSE2-835-(5)-B	MSE2-273	blood	4	Lead Acetate	225	835	5	2819.25	251.72		3	1	3	ug/dL
MSE2-850-(5)-B	MSE2-253	blood	4	Lead Acetate	225	850	5	0.88	0.07		7	1	7	ug/dL
MSE2-809-(5)-B	MSE2-269	blood	5	Soil	75	809	5	0.88	0.07	<	1	1	0.5	ug/dL
MSE2-812-(5)-B	MSE2-274	blood	5	Soil	75	812	5	2819.25	257.47		1	1	1	ug/dL
MSE2-817-(5)-B	MSE2-255	blood	5	Soil	75	817	5	0.88	0.08	<	1	1	0.5	ug/dL
MSE2-824-(5)-B	MSE2-259	blood	5	Soil	75	824	5	0.88	0.07	<	1	1	0.5	ug/dL
MSE2-825-(5)-B	MSE2-283	blood	5	Soil	75	825	5	0.88	0.07	<	1	1	0.5	ug/dL

TABLE A-5

Sample Number	Tag Number	Matrix	Group	Material Administered	Target Dose (ug/kg-d)	Pig Number	Collection Day	Actual Dose (ug/d)	Actual BWAdj Dose (ug/d)	Q	Pb Conc	DL	AdjConc	Units
MSE2-813-(5)-B	MSE2-256	blood	6	Soil	225	813	5	2.8	0.24		1	1	1	ug/dL
MSE2-830-(5)-B	MSE2-265	blood	6	Soil	225	830	5	2.8	0.24		3	1	3	ug/dL
MSE2-831-(5)-B	MSE2-260	blood	6	Soil	225	831	5	2.8	0.2		3	1	3	ug/dL
MSE2-833-(5)-B	MSE2-290	blood	6	Soil	225	833	5	2.8	0.2		3	1	3	ug/dL
MSE2-844-(5)-B	MSE2-268	blood	6	Soil	225	844	5	2.8	0.22		2	1	2	ug/dL
MSE2-807-(5)-B	MSE2-272	blood	7	Soil	675	807	5	8.94	0.71		5	1	5	ug/dL
MSE2-808-(5)-B	MSE2-262	blood	7	Soil	675	808	5	8.94	0.72		6	1	6	ug/dL
MSE2-810-(5)-B	MSE2-254	blood	7	Soil	675	810	5	8.94	0.69		7	1	7	ug/dL
MSE2-828-(5)-B	MSE2-258	blood	7	Soil	675	828	5	8.94	0.6		7	1	7	ug/dL
MSE2-840-(5)-B	MSE2-282	blood	7	Soil	675	840	5	8.94	0.61		6	1	6	ug/dL
MSE2-804-(7)-B	MSE2-294	blood	1	Control	0	804	7	0	0	<	1	1	0.5	ug/dL
MSE2-820-(7)-B	MSE2-320	blood	1	Control	0	820	7	0	0	<	1	1	0.5	ug/dL
MSE2-845-(7)-B	MSE2-304	blood	1	Control	0	845	7	0	0	<	1	1	0.5	ug/dL
MSE2-802-(7)-B	MSE2-311	blood	2	Lead Acetate	25	802	7	348.5	25.28	<	1	1	0.5	ug/dL
MSE2-803-(7)-B	MSE2-308	blood	2	Lead Acetate	25	803	7	348.5	25.63	<	1	1	0.5	ug/dL
MSE2-816-(7)-B	MSE2-306	blood	2	Lead Acetate	25	816	7	348.5	26.77	<	1	1	0.5	ug/dL
MSE2-826-(7)-B	MSE2-301	blood	2	Lead Acetate	25	826	7	348.5	22.56	<	1	1	0.5	ug/dL
MSE2-838-(7)-B	MSE2-293	blood	2	Lead Acetate	25	838	7	348.5	26.84	<	1	1	0.5	ug/dL
MSE2-819-(7)-B	MSE2-317	blood	3	Lead Acetate	75	819	7	1093.5	69.06	<	1	1	0.5	ug/dL
MSE2-832-(7)-B	MSE2-303	blood	3	Lead Acetate	75	832	7	1093.5	75.67		1	1	1	ug/dL
MSE2-834-(7)-B	MSE2-324	blood	3	Lead Acetate	75	834	7	1093.5	81.71		2	1	2	ug/dL
MSE2-839-(7)-B	MSE2-292	blood	3	Lead Acetate	75	839	7	1093.5	69.65		1	1	1	ug/dL
MSE2-846-(7)-B	MSE2-296	blood	3	Lead Acetate	75	846	7	1093.5	84.55		2	1	2	ug/dL
MSE2-801-(7)-B	MSE2-327	blood	4	Lead Acetate	225	801	7	3046.5	225.95		3	1	3	ug/dL
MSE2-806-(7)-B	MSE2-310	blood	4	Lead Acetate	225	806	7	3046.5	213.79		3	1	3	ug/dL
MSE2-823-(7)-B	MSE2-322	blood	4	Lead Acetate	225	823	7	3046.5	213.54		5	1	5	ug/dL
MSE2-835-(7)-B	MSE2-309	blood	4	Lead Acetate	225	835	7	3046.5	245.03		3	1	3	ug/dL
MSE2-850-(7)-B	MSE2-300	blood	4	Lead Acetate	225	850	7	0.97	0.08		7	1	7	ug/dL
MSE2-809-(7)-B	MSE2-298	blood	5	Soil	75	809	7	0.97	0.07		1	1	1	ug/dL
MSE2-812-(7)-B	MSE2-321	blood	5	Soil	75	812	7	3046.5	263.77		1	1	1	ug/dL
MSE2-817-(7)-B	MSE2-297	blood	5	Soil	75	817	7	0.97	0.08		1	1	1	ug/dL
MSE2-824-(7)-B	MSE2-328	blood	5	Soil	75	824	7	0.97	0.08	<	1	1	0.5	ug/dL
MSE2-825-(7)-B	MSE2-316	blood	5	Soil	75	825	7	0.97	0.07	<	1	1	0.5	ug/dL
MSE2-813-(7)-B	MSE2-319	blood	6	Soil	225	813	7	3.08	0.25		2	1	2	ug/dL
MSE2-830-(7)-B	MSE2-318	blood	6	Soil	225	830	7	3.08	0.25		2	1	2	ug/dL
MSE2-831-(7)-B	MSE2-315	blood	6	Soil	225	831	7	3.08	0.2		2	1	2	ug/dL
MSE2-833-(7)-B	MSE2-323	blood	6	Soil	225	833	7	3.08	0.21		3	1	3	ug/dL
MSE2-844-(7)-B	MSE2-312	blood	6	Soil	225	844	7	3.08	0.23		2	1	2	ug/dL
MSE2-807-(7)-B	MSE2-291	blood	7	Soil	675	807	7	9.8	0.71		6	1	6	ug/dL
MSE2-808-(7)-B	MSE2-302	blood	7	Soil	675	808	7	9.8	0.73		7	1	7	ug/dL
MSE2-810-(7)-B	MSE2-325	blood	7	Soil	675	810	7	9.8	0.73		9	1	9	ug/dL
MSE2-828-(7)-B	MSE2-313	blood	7	Soil	675	828	7	9.8	0.62		7	1	7	ug/dL
MSE2-840-(7)-B	MSE2-305	blood	7	Soil	675	840	7	9.8	0.63		8	1	8	ug/dL
MSE2-804-(9)-B	MSE2-349	blood	1	Control	0	804	9	0	0	<	1	1	0.5	ug/dL
MSE2-820-(9)-B	MSE2-343	blood	1	Control	0	820	9	0	0	<	1	1	0.5	ug/dL
MSE2-845-(9)-B	MSE2-332	blood	1	Control	0	845	9	0	0	<	1	1	0.5	ug/dL
MSE2-802-(9)-B	MSE2-333	blood	2	Lead Acetate	25	802	9	379.5	25.64	<	1	1	0.5	ug/dL
MSE2-803-(9)-B	MSE2-362	blood	2	Lead Acetate	25	803	9	379.5	26.11	<	1	1	0.5	ug/dL
MSE2-816-(9)-B	MSE2-361	blood	2	Lead Acetate	25	816	9	379.5	27.27	<	1	1	0.5	ug/dL
MSE2-826-(9)-B	MSE2-356	blood	2	Lead Acetate	25	826	9	379.5	23.09	<	1	1	0.5	ug/dL
MSE2-838-(9)-B	MSE2-355	blood	2	Lead Acetate	25	838	9	379.5	27.17	<	1	1	0.5	ug/dL
MSE2-819-(9)-B	MSE2-335	blood	3	Lead Acetate	75	819	9	1192.5	71.41	<	1	1	0.5	ug/dL
MSE2-832-(9)-B	MSE2-366	blood	3	Lead Acetate	75	832	9	1192.5	77.18		1	1	1	ug/dL
MSE2-834-(9)-B	MSE2-344	blood	3	Lead Acetate	75	834	9	1192.5	82.15	<	1	1	0.5	ug/dL
MSE2-839-(9)-B	MSE2-336	blood	3	Lead Acetate	75	839	9	1192.5	71.12	<	1	1	0.5	ug/dL
MSE2-846-(9)-B	MSE2-360	blood	3	Lead Acetate	75	846	9	1192.5	85.59	<	1	1	0.5	ug/dL
MSE2-801-(9)-B	MSE2-339	blood	4	Lead Acetate	225	801	9	3350.25	230.26		3	1	3	ug/dL
MSE2-806-(9)-B	MSE2-337	blood	4	Lead Acetate	225	806	9	3350.25	219.93		3	1	3	ug/dL
MSE2-823-(9)-B	MSE2-350	blood	4	Lead Acetate	225	823	9	3350.25	220.9		3	1	3	ug/dL
MSE2-835-(9)-B	MSE2-329	blood	4	Lead Acetate	225	835	9	3350.25	235.11		3	1	3	ug/dL
MSE2-850-(9)-B	MSE2-330	blood	4	Lead Acetate	225	850	9	1.05	0.12		6	1	6	ug/dL
MSE2-809-(9)-B	MSE2-353	blood	5	Soil	75	809	9	1.05	0.07	<	1	1	0.5	ug/dL
MSE2-812-(9)-B	MSE2-340	blood	5	Soil	75	812	9	3350.25	273.49		1	1	1	ug/dL
MSE2-817-(9)-B	MSE2-348	blood	5	Soil	75	817	9	1.05	0.08	<	1	1	0.5	ug/dL
MSE2-824-(9)-B	MSE2-347	blood	5	Soil	75	824	9	1.05	0.08	<	1	1	0.5	ug/dL
MSE2-825-(9)-B	MSE2-365	blood	5	Soil	75	825	9	1.05	0.07	<	1	1	0.5	ug/dL
MSE2-813-(9)-B	MSE2-352	blood	6	Soil	225	813	9	3.39	0.25		2	1	2	ug/dL
MSE2-830-(9)-B	MSE2-345	blood	6	Soil	225	830	9	3.39	0.25		2	1	2	ug/dL
MSE2-831-(9)-B	MSE2-351	blood	6	Soil	225	831	9	3.39	0.21		1	1	1	ug/dL
MSE2-833-(9)-B	MSE2-338	blood	6	Soil	225	833	9	3.39	0.22		2	1	2	ug/dL
MSE2-844-(9)-B	MSE2-357	blood	6	Soil	225	844	9	3.39	0.24		2	1	2	ug/dL
MSE2-807-(9)-B	MSE2-364	blood	7	Soil	675	807	9	10.67	0.73		4	1	4	ug/dL
MSE2-808-(9)-B	MSE2-334	blood	7	Soil	675	808	9	10.67	0.75		6	1	6	ug/dL
MSE2-810-(9)-B	MSE2-358	blood	7	Soil	675	810	9	10.67	0.75		6	1	6	ug/dL
MSE2-828-(9)-B	MSE2-359	blood	7	Soil	675	828	9	10.67	0.64		6	1	6	ug/dL
MSE2-840-(9)-B	MSE2-354	blood	7	Soil	675	840	9	10.67	0.65		4	1	4	ug/dL
MSE2-804-(12)-B	MSE2-376	blood	1	Control	0	804	12	0	0	<	1	1	0.5	ug/dL
MSE2-820-(12)-B	MSE2-396	blood	1	Control	0	820	12	0	0	<	1	1	0.5	ug/dL
MSE2-845-(12)-B	MSE2-390	blood	1	Control	0	845	12	0	0	<	1	1	0.5	ug/dL

TABLE A-5

Sample Number	Tag Number	Matrix	Group	Material Administered	Target Dose (ug/kg-d)	Pig Number	Collection Day	Actual Dose (ug/d)	Actual BWAdj Dose (ug/d)	Q	Pb Conc	DL	AdjConc	Units
MSE2-802-(12)-B	MSE2-392	blood	2	Lead Acetate	25	802	12	420.75	25.53	<	1	1	0.5	ug/dL
MSE2-803-(12)-B	MSE2-395	blood	2	Lead Acetate	25	803	12	420.75	24.39	<	1	1	0.5	ug/dL
MSE2-816-(12)-B	MSE2-368	blood	2	Lead Acetate	25	816	12	420.75	27.2	<	1	1	0.5	ug/dL
MSE2-826-(12)-B	MSE2-388	blood	2	Lead Acetate	25	826	12	420.75	23.66	<	1	1	0.5	ug/dL
MSE2-838-(12)-B	MSE2-370	blood	2	Lead Acetate	25	838	12	420.75	26.74	<	1	1	0.5	ug/dL
MSE2-819-(12)-B	MSE2-391	blood	3	Lead Acetate	75	819	12	1321.5	72.28	<	1	1	0.5	ug/dL
MSE2-832-(12)-B	MSE2-374	blood	3	Lead Acetate	75	832	12	1321.5	77.21	<	1	1	0.5	ug/dL
MSE2-834-(12)-B	MSE2-401	blood	3	Lead Acetate	75	834	12	1321.5	81.66	<	1	1	0.5	ug/dL
MSE2-839-(12)-B	MSE2-382	blood	3	Lead Acetate	75	839	12	1321.5	71.18		1	1	1	ug/dL
MSE2-846-(12)-B	MSE2-381	blood	3	Lead Acetate	75	846	12	1321.5	84.71		1	1	1	ug/dL
MSE2-801-(12)-B	MSE2-402	blood	4	Lead Acetate	225	801	12	3875.63	239.48		4	1	4	ug/dL
MSE2-806-(12)-B	MSE2-373	blood	4	Lead Acetate	225	806	12	3875.63	222.74		5	1	5	ug/dL
MSE2-823-(12)-B	MSE2-385	blood	4	Lead Acetate	225	823	12	3875.63	232.31		3	1	3	ug/dL
MSE2-835-(12)-B	MSE2-383	blood	4	Lead Acetate	225	835	12	3875.63	224.46		3	1	3	ug/dL
MSE2-850-(12)-B	MSE2-399	blood	4	Lead Acetate	225	850	12	0	0	NA		1		ug/dL
MSE2-809-(12)-B	MSE2-387	blood	5	Soil	75	809	12	1.15	0.08	<	1	1	0.5	ug/dL
MSE2-812-(12)-B	MSE2-384	blood	5	Soil	75	812	12	3875.63	286.02		2	1	2	ug/dL
MSE2-817-(12)-B	MSE2-369	blood	5	Soil	75	817	12	1.15	0.08		1	1	1	ug/dL
MSE2-824-(12)-B	MSE2-393	blood	5	Soil	75	824	12	1.15	0.08		2	1	2	ug/dL
MSE2-825-(12)-B	MSE2-375	blood	5	Soil	75	825	12	1.15	0.07	<	1	1	0.5	ug/dL
MSE2-813-(12)-B	MSE2-378	blood	6	Soil	225	813	12	3.72	0.25		2	1	2	ug/dL
MSE2-830-(12)-B	MSE2-404	blood	6	Soil	225	830	12	3.72	0.25		2	1	2	ug/dL
MSE2-831-(12)-B	MSE2-394	blood	6	Soil	225	831	12	3.72	0.21		2	1	2	ug/dL
MSE2-833-(12)-B	MSE2-386	blood	6	Soil	225	833	12	3.72	0.22		2	1	2	ug/dL
MSE2-844-(12)-B	MSE2-389	blood	6	Soil	225	844	12	3.72	0.24		3	1	3	ug/dL
MSE2-807-(12)-B	MSE2-379	blood	7	Soil	675	807	12	11.64	0.74		4	1	4	ug/dL
MSE2-808-(12)-B	MSE2-380	blood	7	Soil	675	808	12	11.64	0.75		7	1	7	ug/dL
MSE2-810-(12)-B	MSE2-377	blood	7	Soil	675	810	12	11.64	0.73		6	1	6	ug/dL
MSE2-828-(12)-B	MSE2-372	blood	7	Soil	675	828	12	11.64	0.62		3	1	3	ug/dL
MSE2-840-(12)-B	MSE2-403	blood	7	Soil	675	840	12	11.64	0.65		7	1	7	ug/dL
MSE2-804-(15)-B	MSE2-436	blood	1	Control	0	804	15			<	1	1	0.5	ug/dL
MSE2-820-(15)-B	MSE2-435	blood	1	Control	0	820	15			<	1	1	0.5	ug/dL
MSE2-845-(15)-B	MSE2-422	blood	1	Control	0	845	15			<	1	1	0.5	ug/dL
MSE2-802-(15)-B	MSE2-442	blood	2	Lead Acetate	25	802	15			<	1	1	0.5	ug/dL
MSE2-803-(15)-B	MSE2-407	blood	2	Lead Acetate	25	803	15			<	1	1	0.5	ug/dL
MSE2-816-(15)-B	MSE2-428	blood	2	Lead Acetate	25	816	15			<	1	1	0.5	ug/dL
MSE2-826-(15)-B	MSE2-424	blood	2	Lead Acetate	25	826	15			<	1	1	0.5	ug/dL
MSE2-838-(15)-B	MSE2-419	blood	2	Lead Acetate	25	838	15			<	1	1	0.5	ug/dL
MSE2-819-(15)-B	MSE2-405	blood	3	Lead Acetate	75	819	15			<	1	1	0.5	ug/dL
MSE2-832-(15)-B	MSE2-438	blood	3	Lead Acetate	75	832	15			<	1	1	0.5	ug/dL
MSE2-834-(15)-B	MSE2-406	blood	3	Lead Acetate	75	834	15			<	1	1	0.5	ug/dL
MSE2-839-(15)-B	MSE2-412	blood	3	Lead Acetate	75	839	15				1	1	1	ug/dL
MSE2-846-(15)-B	MSE2-416	blood	3	Lead Acetate	75	846	15				2	1	2	ug/dL
MSE2-801-(15)-B	MSE2-432	blood	4	Lead Acetate	225	801	15				5	1	5	ug/dL
MSE2-806-(15)-B	MSE2-434	blood	4	Lead Acetate	225	806	15				5	1	5	ug/dL
MSE2-823-(15)-B	MSE2-440	blood	4	Lead Acetate	225	823	15				2	1	2	ug/dL
MSE2-835-(15)-B	MSE2-417	blood	4	Lead Acetate	225	835	15				1	1	1	ug/dL
MSE2-850-(15)-B	MSE2-421	blood	4	Lead Acetate	225	850	15			NA		1		ug/dL
MSE2-809-(15)-B	MSE2-423	blood	5	Soil	75	809	15			<	1	1	0.5	ug/dL
MSE2-812-(15)-B	MSE2-411	blood	5	Soil	75	812	15				2	1	2	ug/dL
MSE2-817-(15)-B	MSE2-437	blood	5	Soil	75	817	15				1	1	1	ug/dL
MSE2-824-(15)-B	MSE2-429	blood	5	Soil	75	824	15				2	1	2	ug/dL
MSE2-825-(15)-B	MSE2-415	blood	5	Soil	75	825	15			<	1	1	0.5	ug/dL
MSE2-813-(15)-B	MSE2-425	blood	6	Soil	225	813	15				3	1	3	ug/dL
MSE2-830-(15)-B	MSE2-408	blood	6	Soil	225	830	15				3	1	3	ug/dL
MSE2-831-(15)-B	MSE2-439	blood	6	Soil	225	831	15				3	1	3	ug/dL
MSE2-833-(15)-B	MSE2-431	blood	6	Soil	225	833	15				3	1	3	ug/dL
MSE2-844-(15)-B	MSE2-433	blood	6	Soil	225	844	15			<	1	1	0.5	ug/dL
MSE2-807-(15)-B	MSE2-414	blood	7	Soil	675	807	15				6	1	6	ug/dL
MSE2-808-(15)-B	MSE2-426	blood	7	Soil	675	808	15				7	1	7	ug/dL
MSE2-810-(15)-B	MSE2-418	blood	7	Soil	675	810	15				11	1	11	ug/dL
MSE2-828-(15)-B	MSE2-441	blood	7	Soil	675	828	15				5	1	5	ug/dL
MSE2-840-(15)-B	MSE2-410	blood	7	Soil	675	840	15				5	1	5	ug/dL
MSE2-804-(15)-F	MSE2-546	femur	1	Control	0	804	15				0.6	0.5	0.6	ng/mg
MSE2-820-(15)-F	MSE2-540	femur	1	Control	0	820	15			<	0.5	0.5	0.3	ng/mg
MSE2-845-(15)-F	MSE2-545	femur	1	Control	0	845	15				0.7	0.5	0.7	ng/mg
MSE2-802-(15)-F	MSE2-515	femur	2	Lead Acetate	25	802	15				2.5	0.5	2.5	ng/mg
MSE2-803-(15)-F	MSE2-529	femur	2	Lead Acetate	25	803	15				2.4	0.5	2.4	ng/mg
MSE2-816-(15)-F	MSE2-547	femur	2	Lead Acetate	25	816	15				1.6	0.5	1.6	ng/mg
MSE2-826-(15)-F	MSE2-522	femur	2	Lead Acetate	25	826	15				2	0.5	2	ng/mg
MSE2-838-(15)-F	MSE2-528	femur	2	Lead Acetate	25	838	15				2.3	0.5	2.3	ng/mg
MSE2-819-(15)-F	MSE2-532	femur	3	Lead Acetate	75	819	15				4	0.5	4	ng/mg
MSE2-832-(15)-F	MSE2-519	femur	3	Lead Acetate	75	832	15				5.1	0.5	5.1	ng/mg
MSE2-834-(15)-F	MSE2-534	femur	3	Lead Acetate	75	834	15				2.5	0.5	2.5	ng/mg
MSE2-839-(15)-F	MSE2-521	femur	3	Lead Acetate	75	839	15				5.2	0.5	5.2	ng/mg
MSE2-846-(15)-F	MSE2-539	femur	3	Lead Acetate	75	846	15				3.7	0.5	3.7	ng/mg
MSE2-801-(15)-F	MSE2-526	femur	4	Lead Acetate	225	801	15				12.3	0.5	12.3	ng/mg
MSE2-806-(15)-F	MSE2-543	femur	4	Lead Acetate	225	806	15				13.6	0.5	13.6	ng/mg
MSE2-823-(15)-F	MSE2-516	femur	4	Lead Acetate	225	823	15				10.6	0.5	10.6	ng/mg

TABLE A-5

Sample Number	Tag Number	Matrix	Group	Material Administered	Target Dose (ug/kg-d)	Pig Number	Collection Day	Actual Dose (ug/d)	Actual BWAdj Dose (ug/d)	Q	Pb Conc	DL	AdjConc	Units
MSE2-835-(15)-F	MSE2-518	femur	4	Lead Acetate	225	835	15				15.1	0.5	15.1	ng/mg
MSE2-850-(15)-F	MSE2-520	femur	4	Lead Acetate	225	850	15			NA		0.5		ng/mg
MSE2-809-(15)-F	MSE2-537	femur	5	Soil	75	809	15				2.9	0.5	2.9	ng/mg
MSE2-812-(15)-F	MSE2-542	femur	5	Soil	75	812	15				3.5	0.5	3.5	ng/mg
MSE2-817-(15)-F	MSE2-531	femur	5	Soil	75	817	15				3.1	0.5	3.1	ng/mg
MSE2-824-(15)-F	MSE2-523	femur	5	Soil	75	824	15				4.1	0.5	4.1	ng/mg
MSE2-825-(15)-F	MSE2-550	femur	5	Soil	75	825	15				3.1	0.5	3.1	ng/mg
MSE2-813-(15)-F	MSE2-548	femur	6	Soil	225	813	15				9.7	0.5	9.7	ng/mg
MSE2-830-(15)-F	MSE2-536	femur	6	Soil	225	830	15				9.2	0.5	9.2	ng/mg
MSE2-831-(15)-F	MSE2-533	femur	6	Soil	225	831	15				7.6	0.5	7.6	ng/mg
MSE2-833-(15)-F	MSE2-549	femur	6	Soil	225	833	15				8.6	0.5	8.6	ng/mg
MSE2-844-(15)-F	MSE2-527	femur	6	Soil	225	844	15				8.6	0.5	8.6	ng/mg
MSE2-807-(15)-F	MSE2-538	femur	7	Soil	675	807	15				22.2	0.5	22.2	ng/mg
MSE2-808-(15)-F	MSE2-544	femur	7	Soil	675	808	15				28.7	1	28.7	ng/mg
MSE2-810-(15)-F	MSE2-535	femur	7	Soil	675	810	15				27.4	1	27.4	ng/mg
MSE2-828-(15)-F	MSE2-517	femur	7	Soil	675	828	15				24	0.5	24	ng/mg
MSE2-840-(15)-F	MSE2-524	femur	7	Soil	675	840	15				25.7	0.5	25.7	ng/mg
MSE2-804-(15)-K	MSE2-498	kidney	1	Control	0	804	15			<	10	10	5	ng/g
MSE2-820-(15)-K	MSE2-487	kidney	1	Control	0	820	15			<	20	20	10	ng/g
MSE2-845-(15)-K	MSE2-479	kidney	1	Control	0	845	15			<	10	10	5	ng/g
MSE2-802-(15)-K	MSE2-488	kidney	2	Lead Acetate	25	802	15				30	10	30	ng/g
MSE2-803-(15)-K	MSE2-508	kidney	2	Lead Acetate	25	803	15				50	10	50	ng/g
MSE2-816-(15)-K	MSE2-505	kidney	2	Lead Acetate	25	816	15				20	10	20	ng/g
MSE2-826-(15)-K	MSE2-483	kidney	2	Lead Acetate	25	826	15				30	10	30	ng/g
MSE2-838-(15)-K	MSE2-510	kidney	2	Lead Acetate	25	838	15				20	10	20	ng/g
MSE2-819-(15)-K	MSE2-501	kidney	3	Lead Acetate	75	819	15				100	10	100	ng/g
MSE2-832-(15)-K	MSE2-485	kidney	3	Lead Acetate	75	832	15				80	10	80	ng/g
MSE2-834-(15)-K	MSE2-502	kidney	3	Lead Acetate	75	834	15				70	10	70	ng/g
MSE2-839-(15)-K	MSE2-500	kidney	3	Lead Acetate	75	839	15				90	10	90	ng/g
MSE2-846-(15)-K	MSE2-513	kidney	3	Lead Acetate	75	846	15				70	10	70	ng/g
MSE2-801-(15)-K	MSE2-495	kidney	4	Lead Acetate	225	801	15				300	10	300	ng/g
MSE2-806-(15)-K	MSE2-503	kidney	4	Lead Acetate	225	806	15				360	10	360	ng/g
MSE2-823-(15)-K	MSE2-504	kidney	4	Lead Acetate	225	823	15				220	10	220	ng/g
MSE2-835-(15)-K	MSE2-480	kidney	4	Lead Acetate	225	835	15				180	10	180	ng/g
MSE2-850-(15)-K	MSE2-486	kidney	4	Lead Acetate	225	850	15			NA		10		ng/g
MSE2-809-(15)-K	MSE2-489	kidney	5	Soil	75	809	15				40	10	40	ng/g
MSE2-812-(15)-K	MSE2-493	kidney	5	Soil	75	812	15				90	10	90	ng/g
MSE2-817-(15)-K	MSE2-509	kidney	5	Soil	75	817	15				60	10	60	ng/g
MSE2-824-(15)-K	MSE2-512	kidney	5	Soil	75	824	15				80	10	80	ng/g
MSE2-825-(15)-K	MSE2-496	kidney	5	Soil	75	825	15				70	10	70	ng/g
MSE2-813-(15)-K	MSE2-511	kidney	6	Soil	225	813	15				230	10	230	ng/g
MSE2-830-(15)-K	MSE2-482	kidney	6	Soil	225	830	15				190	10	190	ng/g
MSE2-831-(15)-K	MSE2-514	kidney	6	Soil	225	831	15				160	10	160	ng/g
MSE2-833-(15)-K	MSE2-494	kidney	6	Soil	225	833	15				180	10	180	ng/g
MSE2-844-(15)-K	MSE2-481	kidney	6	Soil	225	844	15				160	10	160	ng/g
MSE2-807-(15)-K	MSE2-491	kidney	7	Soil	675	807	15				600	20	600	ng/g
MSE2-808-(15)-K	MSE2-506	kidney	7	Soil	675	808	15				700	20	700	ng/g
MSE2-810-(15)-K	MSE2-484	kidney	7	Soil	675	810	15				1030	20	1030	ng/g
MSE2-828-(15)-K	MSE2-499	kidney	7	Soil	675	828	15				530	20	530	ng/g
MSE2-840-(15)-K	MSE2-497	kidney	7	Soil	675	840	15				570	20	570	ng/g
MSE2-804-(15)-L	MSE2-477	liver	1	Control	0	804	15			<	10	10	5	ng/g
MSE2-820-(15)-L	MSE2-456	liver	1	Control	0	820	15			<	10	10	5	ng/g
MSE2-845-(15)-L	MSE2-446	liver	1	Control	0	845	15			<	10	10	5	ng/g
MSE2-802-(15)-L	MSE2-466	liver	2	Lead Acetate	25	802	15				30	10	30	ng/g
MSE2-803-(15)-L	MSE2-471	liver	2	Lead Acetate	25	803	15				30	10	30	ng/g
MSE2-816-(15)-L	MSE2-461	liver	2	Lead Acetate	25	816	15				10	10	10	ng/g
MSE2-826-(15)-L	MSE2-453	liver	2	Lead Acetate	25	826	15				20	10	20	ng/g
MSE2-838-(15)-L	MSE2-473	liver	2	Lead Acetate	25	838	15				30	10	30	ng/g
MSE2-819-(15)-L	MSE2-470	liver	3	Lead Acetate	75	819	15				60	10	60	ng/g
MSE2-832-(15)-L	MSE2-467	liver	3	Lead Acetate	75	832	15				60	10	60	ng/g
MSE2-834-(15)-L	MSE2-457	liver	3	Lead Acetate	75	834	15				60	10	60	ng/g
MSE2-839-(15)-L	MSE2-448	liver	3	Lead Acetate	75	839	15				90	10	90	ng/g
MSE2-846-(15)-L	MSE2-472	liver	3	Lead Acetate	75	846	15				70	10	70	ng/g
MSE2-801-(15)-L	MSE2-465	liver	4	Lead Acetate	225	801	15				310	10	310	ng/g
MSE2-806-(15)-L	MSE2-455	liver	4	Lead Acetate	225	806	15				540	20	540	ng/g
MSE2-823-(15)-L	MSE2-451	liver	4	Lead Acetate	225	823	15				340	10	340	ng/g
MSE2-835-(15)-L	MSE2-450	liver	4	Lead Acetate	225	835	15				220	10	220	ng/g
MSE2-850-(15)-L	MSE2-443	liver	4	Lead Acetate	225	850	15			NA		10		ng/g
MSE2-809-(15)-L	MSE2-474	liver	5	Soil	75	809	15				60	10	60	ng/g
MSE2-812-(15)-L	MSE2-444	liver	5	Soil	75	812	15				90	10	90	ng/g
MSE2-817-(15)-L	MSE2-464	liver	5	Soil	75	817	15				50	10	50	ng/g
MSE2-824-(15)-L	MSE2-462	liver	5	Soil	75	824	15				50	10	50	ng/g
MSE2-825-(15)-L	MSE2-447	liver	5	Soil	75	825	15				90	10	90	ng/g
MSE2-813-(15)-L	MSE2-452	liver	6	Soil	225	813	15				180	10	180	ng/g
MSE2-830-(15)-L	MSE2-469	liver	6	Soil	225	830	15				110	10	110	ng/g
MSE2-831-(15)-L	MSE2-459	liver	6	Soil	225	831	15				180	10	180	ng/g
MSE2-833-(15)-L	MSE2-478	liver	6	Soil	225	833	15				220	10	220	ng/g
MSE2-844-(15)-L	MSE2-460	liver	6	Soil	225	844	15				220	10	220	ng/g
MSE2-807-(15)-L	MSE2-445	liver	7	Soil	675	807	15				930	20	930	ng/g

TABLE A-5

Sample Number	Tag Number	Matrix	Group	Material Administered	Target Dose (ug/kg-d)	Pig Number	Collection Day	Actual Dose (ug/d)	Actual BWAdj Dose (ug/d)	Q	Pb Conc	DL	AdjConc	Units
MSE2-808-(15)-L	MSE2-463	liver	7	Soil	675	808	15				1450	50	1450	ng/g
MSE2-810-(15)-L	MSE2-458	liver	7	Soil	675	810	15				1750	50	1750	ng/g
MSE2-828-(15)-L	MSE2-454	liver	7	Soil	675	828	15				460	10	460	ng/g
MSE2-840-(15)-L	MSE2-476	liver	7	Soil	675	840	15				920	50	920	ng/g

Actual Dose and Actual BW Adj Dose: Values presented are for individual dosing days only; average doses over the course of the study are presented in Table A-3, as well as Table 2-1 in the main text

Pb Conc: Accounts for all dilutions in sample preparation and analysis.

AdjConc: Non detects evaluated at 1/2 the quantitation limit (DL)

TABLE A-6

LEAD ANALYTICAL RESULTS FOR QUALITY CONTROL SAMPLES

Analytical Spikes

Sample Number	Matrix	Analyte	Nominal Spike (ug/L)	Conc (spiked sample) ug/L	Original Conc (ug/L)	Percent Recovery
MSE2-122	blood	Pb	4	3.68	<DL	92%
MSE2-142	blood	Pb	4	4.73	<DL	118%
MSE2-164	blood	Pb	4	5.48	2.15	83%
MSE2-185	blood	Pb	4	3.55	<DL	89%
MSE2-196	blood	Pb	4	6.01	2.25	94%
MSE2-207	blood	Pb	4	11	7.49	88%
MSE2-225	blood	Pb	4	5.35	0.94	110%
MSE2-238	blood	Pb	4	4.25	<DL	106%
MSE2-247	blood	Pb	4	5.18	1.08	103%
MSE2-258	blood	Pb	4	11.1	7.11	100%
MSE2-269	blood	Pb	4	4.5	<DL	113%
MSE2-280	blood	Pb	4	3.87	<DL	97%
MSE2-290	blood	Pb	4	6.86	2.81	102%
MSE2-301	blood	Pb	4	3.96	<DL	99%
MSE2-312	blood	Pb	4	6.22	1.98	106%
MSE2-323	blood	Pb	4	6.99	2.99	99%
MSE2-339	blood	Pb	4	7.03	3.38	91%
MSE2-350	blood	Pb	4	6.89	2.95	99%
MSE2-361	blood	Pb	4	3.65	<DL	91%
MSE2-372	blood	Pb	4	7.08	3.34	94%
MSE2-382	blood	Pb	4	5.08	1.08	99%
MSE2-393	blood	Pb	4	5.65	1.68	99%
MSE2-405	blood	Pb	4	5.04	0.78	107%
MSE2-416	blood	Pb	4	5.43	1.53	98%
MSE2-428	blood	Pb	4	3.62	<DL	90%
MSE2-439	blood	Pb	4	7.44	3.25	105%
MSE2-449	liver	Pb	20	24.5	3.71	104%
MSE2-458	liver	Pb	20	56	34.9	106%
MSE2-469	liver	Pb	20	31.2	11.1	101%
MSE2-497	kidney	Pb	20	45.6	28.4	86%
MSE2-506	kidney	Pb	20	56.3	34.8	108%
MSE2-515	femur	Pb	20	24.1	4.97	96%
MSE2-534	femur	Pb	20	22.6	5.03	88%
MSE2-543	femur	Pb	20	42.6	23.7	95%

Analytical Duplicates (Post-Digestion)

Sample Number	Matrix	Analyte	Conc (duplicate) ug/L	Original Conc (ug/L)	Absolute Difference or RPD
MSE2-105	blood	Pb	<DL	<DL	NA
MSE2-115	blood	Pb	<DL	<DL	NA
MSE2-125	blood	Pb	<DL	<DL	NA
MSE2-136	blood	Pb	<DL	<DL	NA
MSE2-145	blood	Pb	1	1	within 1
MSE2-155	blood	Pb	6	6	within 1
MSE2-165	blood	Pb	3	3	within 1
MSE2-175	blood	Pb	<DL	<DL	NA
MSE2-185	blood	Pb	<DL	<DL	NA
MSE2-195	blood	Pb	1	1	within 1
MSE2-205	blood	Pb	<DL	<DL	NA
MSE2-220	blood	Pb	<DL	<DL	NA
MSE2-230	blood	Pb	1	1	within 1
MSE2-240	blood	Pb	<DL	<DL	NA
MSE2-250	blood	Pb	<DL	<DL	NA
MSE2-260	blood	Pb	3	3	within 1
MSE2-270	blood	Pb	3	3	within 1
MSE2-280	blood	Pb	<DL	<DL	NA
MSE2-290	blood	Pb	3	3	within 1
MSE2-300	blood	Pb	7	7	within 1
MSE2-310	blood	Pb	3	3	within 1
MSE2-320	blood	Pb	<DL	<DL	NA
MSE2-332	blood	Pb	<DL	<DL	NA
MSE2-342	blood	Pb	5	5	within 1
MSE2-352	blood	Pb	2	2	within 1
MSE2-362	blood	Pb	<DL	<DL	NA
MSE2-372	blood	Pb	3	3	within 1
MSE2-382	blood	Pb	1	1	within 1
MSE2-392	blood	Pb	<DL	<DL	NA
MSE2-404	blood	Pb	2	2	within 1
MSE2-414	blood	Pb	6	6	within 1
MSE2-425	blood	Pb	2	3	within 1
MSE2-435	blood	Pb	<DL	<DL	NA
MSE2-453	liver	Pb	1.92	1.74	within 1
MSE2-465	liver	Pb	31.1	31.8	2.0%
MSE2-475	liver	Pb	5.46	6.14	within 1
MSE2-485	kidney	Pb	7.7	7.73	within 1
MSE2-496	kidney	Pb	7.35	5.95	within 1
MSE2-504	kidney	Pb	22	23.9	8.5%
MSE2-514	kidney	Pb	15.6	18.8	7.4%
MSE2-523	femur	Pb	4.1	3.9	within 1
MSE2-533	femur	Pb	7.6	8	within 1
MSE2-543	femur	Pb	13.6	11.8	14.2%
MSE2-550	femur	Pb	3.1	3.7	within 1

Laboratory Control Standards

QC Std ID	QC Std Conc	Analyte	Unadjusted Concentration	Percent Recovery
DOLT-3	0.319 µg/g	Pb	0.27 µg/g	84.6%
DOLT-3	0.319 µg/g	Pb	0.24 µg/g	75.2%
TORT-2	0.35 µg/g	Pb	0.27 µg/g	77.1%
TORT-2	0.35 µg/g	Pb	0.243 µg/g	68.6%
NIST 1400	9.07 µg/g	Pb	9.09 µg/g	100.2%
LUTS-1	0.01 µg/g	Pb	< DL (0.01) µg/g	--
ERA 697 1/5	17.5 µg/L	Pb	18.5 µg/L	106.0%
ERA 697 1/5	17.5 µg/L	Pb	18.5 µg/L	105.7%
ERA 697 1/5	17.5 µg/L	Pb	18.8 µg/L	107.6%
ERA 697 1/5	17.5 µg/L	Pb	18.7 µg/L	107.1%
ERA 697 1/5	17.5 µg/L	Pb	19.1 µg/L	109.0%
ERA 697 1/5	17.5 µg/L	Pb	16.3 µg/L	93.0%
ERA 697 1/5	17.5 µg/L	Pb	19.2 µg/L	109.9%
ERA 697 1/5	17.5 µg/L	Pb	18.1 µg/L	103.2%
ERA 697 1/5	17.5 µg/L	Pb	18.3 µg/L	104.8%
ERA 697 1/5	17.5 µg/L	Pb	18.4 µg/L	105.1%
ERA 697 1/5	17.5 µg/L	Pb	19 µg/L	108.5%
ERA 697 1/5	17.5 µg/L	Pb	17.5 µg/L	100.3%
ERA 697 1/5	17.5 µg/L	Pb	17.5 µg/L	99.8%
ERA 697 1/5	17.5 µg/L	Pb	18.9 µg/L	108.2%
ERA 697 1/5	17.5 µg/L	Pb	17.5 µg/L	100.2%
ERA 697 1/5	17.5 µg/L	Pb	16.5 µg/L	94.5%
ERA 697 1/5	17.5 µg/L	Pb	19.1 µg/L	108.9%
ERA 697 1/10	8.75 µg/L	Pb	8.66 µg/L	99.0%
ERA 697 1/10	8.75 µg/L	Pb	8.77 µg/L	100.2%
ERA 697 1/10	8.75 µg/L	Pb	8.21 µg/L	93.8%
ERA 697 1/10	8.75 µg/L	Pb	8.84 µg/L	101.0%
ERA 697 1/10	8.75 µg/L	Pb	9.4 µg/L	107.4%
ERA 697 1/10	8.75 µg/L	Pb	9.5 µg/L	108.6%
ERA 697 1/10	8.75 µg/L	Pb	8.92 µg/L	101.9%
ERA 697 1/10	8.75 µg/L	Pb	8.61 µg/L	98.4%
ERA 697 1/10	8.75 µg/L	Pb	8.88 µg/L	101.5%
ERA 697 1/10	8.75 µg/L	Pb	9.2 µg/L	105.1%
ERA 697 1/10	8.75 µg/L	Pb	9.24 µg/L	105.6%
ERA 697 1/10	8.75 µg/L	Pb	9.3 µg/L	106.3%
ERA 697 1/10	8.75 µg/L	Pb	8.83 µg/L	100.9%
ERA 697 1/10	8.75 µg/L	Pb	9.04 µg/L	103.3%
ERA 697 1/10	8.75 µg/L	Pb	8.99 µg/L	102.7%
ERA 697 1/10	8.75 µg/L	Pb	9.39 µg/L	107.3%
ERA 697 1/10	8.75 µg/L	Pb	8.93 µg/L	102.1%
ERA 697 1/10	8.75 µg/L	Pb	9.1 µg/L	104.0%
ERA 697 1/10	8.75 µg/L	Pb	8.89 µg/L	101.6%
ERA 697 1/10	8.75 µg/L	Pb	9.18 µg/L	104.9%
ERA 697 1/10	8.75 µg/L	Pb	8.82 µg/L	100.8%
ERA 697 1/10	8.75 µg/L	Pb	9.05 µg/L	103.4%
ERA 697 1/10	8.75 µg/L	Pb	9.21 µg/L	105.3%
ERA 697 1/10	8.75 µg/L	Pb	9.03 µg/L	103.2%
ERA 697 1/10	8.75 µg/L	Pb	9.01 µg/L	103.0%
ERA 697 1/10	8.75 µg/L	Pb	9.35 µg/L	106.9%
ERA 697 1/10	8.75 µg/L	Pb	9.56 µg/L	109.3%
ERA 697 1/10	8.75 µg/L	Pb	9.06 µg/L	103.5%
ERA 697 1/10	8.75 µg/L	Pb	8.58 µg/L	98.1%
ERA 697 1/10	8.75 µg/L	Pb	9.39 µg/L	107.3%
ERA 697 1/10	8.75 µg/L	Pb	9.04 µg/L	103.3%
ERA 697 1/10	8.75 µg/L	Pb	9.06 µg/L	103.5%
ERA 697 1/10	8.75 µg/L	Pb	8.23 µg/L	94.1%
ERA 697 1/10	8.75 µg/L	Pb	8.6 µg/L	98.3%
ERA 697 1/10	8.75 µg/L	Pb	8.69 µg/L	99.3%
ERA 697 1/10	8.75 µg/L	Pb	8.9 µg/L	101.7%
ERA 697 1/10	8.75 µg/L	Pb	8.79 µg/L	100.5%
ERA 697 1/10	8.75 µg/L	Pb	9.04 µg/L	103.3%
ERA 697 1/10	8.75 µg/L	Pb	8.87 µg/L	101.4%
ERA 697 1/10	8.75 µg/L	Pb	8.95 µg/L	102.3%
ERA 697 1/10	8.75 µg/L	Pb	9.23 µg/L	105.5%
ERA 697 1/10	8.75 µg/L	Pb	9.16 µg/L	104.7%
ERA 697 1/10	8.75 µg/L	Pb	8.96 µg/L	102.4%

TABLE A-6

Sample Preparation Replicates

Tag Number	Matrix	QC Identifier	Original Pig #	Group	Material Administered	Target Dose (ug/kg-d)	Collection Day	Analyte	Q	DL	Pb Conc	AdjConc	Original AdjConc
MSE2-138	blood	2819	819	3	Lead Acetate	75	0	Pb	<	1	1	0.5 ug/dL	0.5
MSE2-116	blood	2801	801	4	Lead Acetate	225	0	Pb	<	1	1	0.5 ug/dL	0.5
MSE2-137	blood	2807	807	7	Soil	675	0	Pb	<	1	1	0.5 ug/dL	0.5
MSE2-141	blood	2813	813	6	Soil	225	1	Pb		1	1	1 ug/dL	2
MSE2-159	blood	2802	802	2	Lead Acetate	25	1	Pb	<	1	1	0.5 ug/dL	0.5
MSE2-162	blood	2809	809	5	Soil	75	1	Pb	<	1	1	0.5 ug/dL	0.5
MSE2-212	blood	2804	804	1	Control	0	2	Pb	<	1	1	0.5 ug/dL	0.5
MSE2-198	blood	2808	808	7	Soil	675	2	Pb		1	9	9 ug/dL	7
MSE2-189	blood	2832	832	3	Lead Acetate	75	2	Pb		1	2	2 ug/dL	1
MSE2-249	blood	2810	810	7	Soil	675	3	Pb		1	5	5 ug/dL	5
MSE2-217	blood	2806	806	4	Lead Acetate	225	3	Pb		1	1	1 ug/dL	2
MSE2-230	blood	2812	812	5	Soil	75	3	Pb		1	1	1 ug/dL	0.5
MSE2-257	blood	2830	830	6	Soil	225	5	Pb		1	4	4 ug/dL	3
MSE2-280	blood	2803	803	2	Lead Acetate	25	5	Pb	<	1	1	0.5 ug/dL	0.5
MSE2-261	blood	2834	834	3	Lead Acetate	75	5	Pb		1	2	2 ug/dL	1
MSE2-307	blood	2817	817	5	Soil	75	7	Pb	<	1	1	0.5 ug/dL	1
MSE2-299	blood	2823	823	4	Lead Acetate	225	7	Pb		1	6	6 ug/dL	5
MSE2-314	blood	2831	831	6	Soil	225	7	Pb		1	2	2 ug/dL	2
MSE2-346	blood	2820	820	1	Control	0	9	Pb	<	1	1	0.5 ug/dL	0.5
MSE2-363	blood	2816	816	2	Lead Acetate	25	9	Pb	<	1	1	0.5 ug/dL	0.5
MSE2-342	blood	2828	828	7	Soil	675	9	Pb		1	5	5 ug/dL	6
MSE2-371	blood	2839	839	3	Lead Acetate	75	12	Pb	<	1	1	0.5 ug/dL	1
MSE2-397	blood	2824	824	5	Soil	75	12	Pb	<	1	1	0.5 ug/dL	2
MSE2-367	blood	2845	845	1	Control	0	12	Pb	<	1	1	0.5 ug/dL	0.5
MSE2-420	blood	2835	835	4	Lead Acetate	225	15	Pb		1	4	4 ug/dL	1
MSE2-409	blood	2833	833	6	Soil	225	15	Pb	<	1	1	0.5 ug/dL	3
MSE2-430	blood	2826	826	2	Lead Acetate	25	15	Pb	<	1	1	0.5 ug/dL	0.5
MSE2-468	liver	2801	801	7	Soil	675	15	Pb		10	310	310 ng/g	310
MSE2-475	liver	2809	809	3	Lead Acetate	75	15	Pb		10	60	60 ng/g	60
MSE2-449	liver	2838	838	6	Soil	225	15	Pb		10	40	40 ng/g	30
MSE2-492	kidney	2846	846	4	Lead Acetate	225	15	Pb		10	100	100 ng/g	70
MSE2-507	kidney	2825	825	5	Soil	75	15	Pb		10	60	60 ng/g	70
MSE2-490	kidney	2838	838	2	Lead Acetate	25	15	Pb		10	30	30 ng/g	20
MSE2-530	femur	2812	812	5	Soil	75	15	Pb		0.5	4.3	4.3 ng/mg	3.5
MSE2-541	femur	2808	808	7	Soil	675	15	Pb		1	28.7	28.7 ng/mg	28.7
MSE2-525	femur	2803	803	2	Lead Acetate	25	15	Pb		0.5	2.6	2.6 ng/mg	2.4

Blood Lead Check Samples

Tag Number	Matrix	CDC Blood Lead Check Sample	CDC Concentration	Analyte	Q	Pb Conc	DL	AdjConc
MSE2-276	blood	CDC BLLRS sample 294	1.9 µg/dL	Pb	<	1	1	0.5 ug/dL
MSE2-147	blood	CDC BLLRS sample 294	1.9 µg/dL	Pb		2	1	2 ug/dL
MSE2-398	blood	CDC BLLRS sample 294	1.9 µg/dL	Pb	<	1	1	0.5 ug/dL
MSE2-341	blood	CDC BLLRS sample 294	1.9 µg/dL	Pb	<	1	1	0.5 ug/dL
MSE2-215	blood	CDC BLLRS sample 294	1.9 µg/dL	Pb	<	1	1	0.5 ug/dL
MSE2-134	blood	CDC BLLRS sample 294	1.9 µg/dL	Pb		2	1	2 ug/dL
MSE2-128	blood	CDC BLLRS sample 199	5.5 µg/dL	Pb		4	1	4 ug/dL
MSE2-193	blood	CDC BLLRS sample 199	5.5 µg/dL	Pb		4	1	4 ug/dL
MSE2-252	blood	CDC BLLRS sample 199	5.5 µg/dL	Pb		4	1	4 ug/dL
MSE2-326	blood	CDC BLLRS sample 199	5.5 µg/dL	Pb		3	1	3 ug/dL
MSE2-331	blood	CDC BLLRS sample 199	5.5 µg/dL	Pb		4	1	4 ug/dL
MSE2-427	blood	CDC BLLRS sample 199	5.5 µg/dL	Pb		4	1	4 ug/dL
MSE2-413	blood	CDC BLLRS sample 592	13.9 µg/dL	Pb		12	1	12 ug/dL
MSE2-295	blood	CDC BLLRS sample 592	13.9 µg/dL	Pb		12	1	12 ug/dL
MSE2-190	blood	CDC BLLRS sample 592	13.9 µg/dL	Pb		13	1	13 ug/dL
MSE2-172	blood	CDC BLLRS sample 592	13.9 µg/dL	Pb		12	1	12 ug/dL
MSE2-400	blood	CDC BLLRS sample 592	13.9 µg/dL	Pb		11	1	11 ug/dL
MSE2-277	blood	CDC BLLRS sample 592	13.9 µg/dL	Pb		12	1	12 ug/dL

TABLE A-7 IDENTIFICATION OF POTENTIAL BLOOD LEAD OUTLIERS

Material Administered	Group	Pig Number	Target Dose	Actual Dose*	Blood Lead (µg/dL) by Day								
					0	1	2	3	5	7	9	12	15
Control	1	804	0	0.00	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Control	1	820	0	0.00	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Control	1	845	0	0.00	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead Acetate	2	802	25	25.59	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead Acetate	2	803	25	24.26	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead Acetate	2	816	25	26.98	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead Acetate	2	826	25	23.04	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead Acetate	2	838	25	26.67	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead Acetate	3	819	75	69.40	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead Acetate	3	832	75	75.18	0.5	1.0	1.0	0.5	0.5	1.0	1.0	0.5	0.5
Lead Acetate	3	834	75	82.12	0.5	0.5	1.0	2.0	1.0	2.0	0.5	0.5	0.5
Lead Acetate	3	839	75	69.93	0.5	1.0	1.0	2.0	1.0	1.0	0.5	1.0	1.0
Lead Acetate	3	846	75	84.80	0.5	0.5	1.0	2.0	1.0	2.0	0.5	1.0	2.0
Lead Acetate	4	801	225	231.31	0.5	3.0	3.0	2.0	4.0	3.0	3.0	4.0	5.0
Lead Acetate	4	806	225	214.61	0.5	2.0	3.0	2.0	3.0	3.0	3.0	5.0	5.0
Lead Acetate	4	823	225	217.75	0.5	3.0	4.0	3.0	3.0	5.0	3.0	3.0	2.0
Lead Acetate	4	835	225	243.10	0.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	1.0
Lead Acetate	4	850											
Test Material 1	5	809	75	74.15	0.5	0.5	0.5	1.0	0.5	1.0	0.5	0.5	0.5
Test Material 1	5	812	75	82.33	0.5	0.5	0.5	0.5	1.0	1.0	1.0	2.0	2.0
Test Material 1	5	817	75	78.46	0.5	0.5	0.5	0.5	0.5	1.0	0.5	1.0	1.0
Test Material 1	5	824	75	76.63	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2.0	2.0
Test Material 1	5	825	75	73.92	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Test Material 1	6	813	225	247.77	0.5	2.0	2.0	2.0	1.0	2.0	2.0	2.0	3.0
Test Material 1	6	830	225	250.81	0.5	0.5	2.0	1.0	3.0	2.0	2.0	2.0	3.0
Test Material 1	6	831	225	207.38	0.5	1.0	2.0	1.0	3.0	2.0	1.0	2.0	3.0
Test Material 1	6	833	225	211.21	0.5	2.0	3.0	0.5	3.0	3.0	2.0	2.0	3.0
Test Material 1	6	844	225	233.46	0.5	0.5	0.5	0.5	2.0	2.0	2.0	3.0	0.5
Test Material 1	7	807	675	722.71	0.5	6.0	6.0	5.0	5.0	6.0	4.0	4.0	6.0
Test Material 1	7	808	675	731.97	0.5	6.0	7.0	4.0	6.0	7.0	6.0	7.0	7.0
Test Material 1	7	810	675	717.80	0.5	5.0	7.0	5.0	7.0	9.0	6.0	6.0	11.0
Test Material 1	7	828	675	618.53	0.5	6.0	7.0	4.0	7.0	7.0	6.0	3.0	5.0
Test Material 1	7	840	675	638.55	0.5	8.0	8.0	3.0	6.0	8.0	4.0	7.0	5.0

*Average body weight-adjusted dose for each pig over the course of the study (days 0-14).

Note:

Data point flagged as potential outlier (group mean < 5 µg/dL)

Data point flagged as potential outlier (group mean > 5 µg/dL)

Data point judged to be outlier; excluded from further analyses

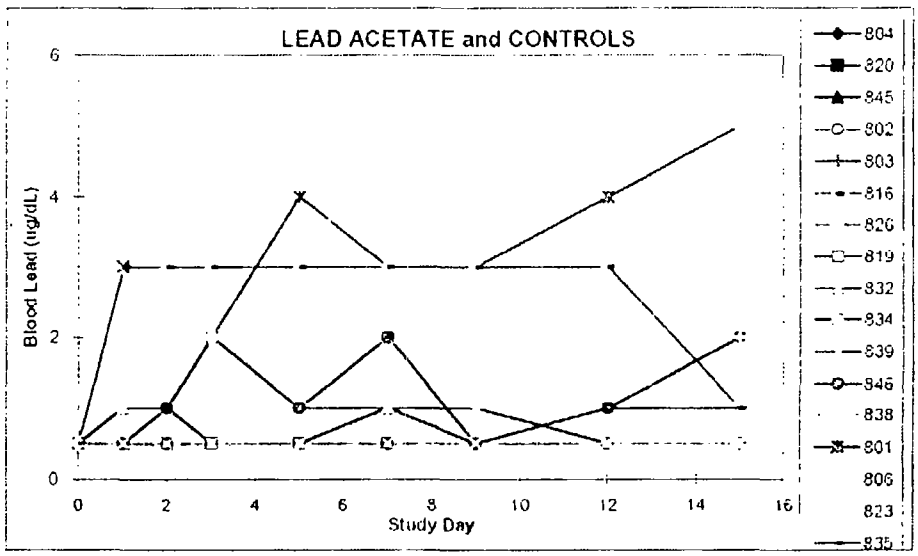
2_MSE2 Analysis.xls (TblA-7_Blood Outliers)

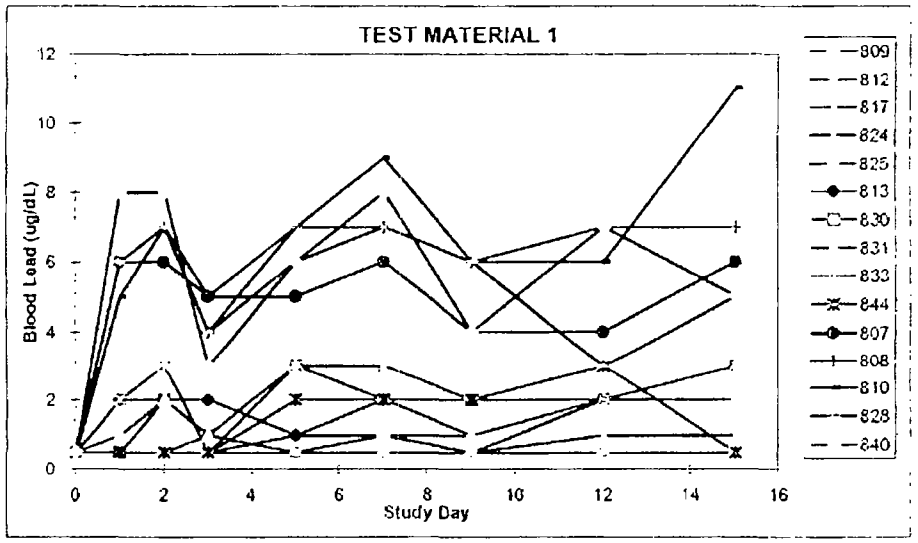
TABLE A-8 AREA UNDER CURVE DETERMINATIONS

Group	Pig Number	AUC (µg/dL-days) for Time Interval Shown								AUC Total (µg/dL-days)
		0-1	1-2	2-3	3-5	5-7	7-9	9-12	12-15	
1	804	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
1	820	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
1	845	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
2	802	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
2	803	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
2	816	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
2	826	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
2	838	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
3	819	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
3	832	0.75	1.00	0.75	1.00	1.50	2.00	2.25	1.50	10.75
3	834	0.50	0.75	1.50	3.00	3.00	2.50	1.50	1.50	14.25
3	839	0.75	1.00	1.50	3.00	2.00	1.50	2.25	3.00	15.00
3	846	0.50	0.75	1.50	3.00	3.00	2.50	2.25	4.50	18.00
4	801	1.75	3.00	2.50	6.00	7.00	6.00	10.50	13.50	50.25
4	806	1.25	2.50	2.50	5.00	6.00	6.00	12.00	15.00	50.25
4	823	1.75	3.50	3.50	6.00	8.00	8.00	9.00	7.50	47.25
4	835	1.75	3.00	3.00	6.00	6.00	6.00	9.00	6.00	40.75
4	850									
5	809	0.50	0.50	0.75	1.50	1.50	1.50	1.50	1.50	9.25
5	812	0.50	0.50	0.50	1.50	2.00	2.00	4.50	6.00	17.50
5	817	0.50	0.50	0.50	1.00	1.50	1.50	2.25	3.00	10.75
5	824	0.50	0.50	0.50	1.00	1.00	1.00	3.75	6.00	14.25
5	825	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
6	813	1.25	2.00	2.00	3.00	3.00	4.00	6.00	7.50	28.75
6	830	0.50	1.25	1.50	4.00	5.00	4.00	6.00	7.50	29.75
6	831	0.75	1.50	1.50	4.00	5.00	3.00	4.50	7.50	27.75
6	833	1.25	2.50	1.75	3.50	6.00	5.00	6.00	7.50	33.50
6	844	0.50	0.50	0.50	2.50	4.00	4.00	7.50	5.25	24.75
7	807	3.25	6.00	5.50	10.00	11.00	10.00	12.00	15.00	72.75
7	808	3.25	6.50	5.50	10.00	13.00	13.00	19.50	21.00	91.75
7	810	2.75	6.00	6.00	12.00	16.00	15.00	18.00	25.50	101.25
7	828	3.25	6.50	5.50	11.00	14.00	13.00	13.50	12.00	78.75
7	840	4.25	8.00	5.50	9.00	14.00	12.00	16.50	18.00	87.25

2_MSE2 Analysis.xls (TblA-8_AUCs)

FIGURE A-1 BLOOD LEAD DATA BY DAY





2_MSE2 Analysis.xls (FigA-1_raw PbB)

APPENDIX B

Data from Drexler—12-Month Sample (2005)

TABLE 1. Laboratory of Environment and Geological Sciences, University of Colorado, Boulder

Project Name: EPA Phosphate

Run #: Date: 6/17/2005 Operator: Drexler

Position in rack	Sample name	Lab#	Wt. Grams	pH start	Starting time	Stopping time	pH stop
1	HER-2930-1	HER-2930-1	1.00021	1.544	9:47	10:47	1.569
2	HER-2930-2	HER-2930-2	1.00036	1.544	9:47	10:47	1.569
3	HER-2930-3	HER-2930-3	1.00036	1.544	9:47	10:47	1.568
4							
5							
6							
7							
8							
9							
10							

Project Name:

Run #: Date: Operator:

Position in rack	Sample name	Lab#	Wt. Grams	pH start	Starting time	Stopping time	pH stop
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

In Vitro

	As ppm	Pb ppm
HER-2930-1 all x20	-0.032	17.322
HER-2930-2	-0.027	17.062
HER-2930-3	-0.011	16.874
HER-2930-3-AD	0.019	16.755

TABLE 2. Preliminary Summary Of In Vitro Bioassay Results

Sample	ID	Pb in <250u bulk soil mg/kg	mass soil (g)	calc Pb #1	ICP Pb (mg/l)	solution amt (l)	% Relative Pb Bioaccessibility	
HER-2930-1		2473	1.00021	2.47	17.322	0.1	70	
HER-2930-2		2465	1.00036	2.47	17.062	0.1	69	
HER-2930-3		2534	1.00036	2.53	16.874	0.1	67	
HER-2930-1		2021	1 00021	2.02	17.322	0.1	86	Using average EPA value for bulk Pb
HER-2930-2		2021	1.00036	2.02	17.062	0.1	84	
HER-2930-3		2021	1.00036	2.02	16.874	0.1	83	
QA/QC								
HER-2930-3-AD					16.755			

3050

	As ppm	Pb ppm
HER-2930-1	2.57	2473
HER-2930-2	2.31	2465
HER-2930-3	2.63	2534
HER-2930-3-AD	4.16	2532
DL	5.00	1.00

APPENDIX C

Detailed Results for 24-Month Sample from
Casteel et al. (2006b)

TABLE A-1 SCHEDULE

Study Day	Day	Date	Bleed	Dose Administration	Feed Special Diet	Weigh	Dose Prep	Cull Pigs/ Assign Dose Group	Sacrifice/ Necropsy
-5	Tuesday	6/13/06			transition	X			
-4	Wednesday	6/14/06			transition			X	
-3	Thursday	6/15/06			X				
-2	Friday	6/16/06			X				
-1	Saturday	6/17/06			X	X	X		
0	Sunday	6/18/06	X	X	X				
1	Monday	6/19/06	X	X	X				
2	Tuesday	6/20/06	X	X	X	X	X		
3	Wednesday	6/21/06	X	X	X				
4	Thursday	6/22/06		X	X				
5	Friday	6/23/06	X	X	X	X	X		
6	Saturday	6/24/06		X	X				
7	Sunday	6/25/06	X	X	X				
8	Monday	6/26/06		X	X	X	X		
9	Tuesday	6/27/06	X	X	X				
10	Wednesday	6/28/06		X	X				
11	Thursday	6/29/06		X	X	X	X		
12	Friday	6/30/06	X	X	X				
13	Saturday	7/1/06		X	X				
14	Sunday	7/2/06		X	X	X			
15	Monday	7/3/06	X						X

TABLE A-2 GROUP ASSIGNMENTS

Pig Number	Dose Group	Material Administered	Target Dose of Lead (µg/kg-day)
409 856 866	1	Control	0
402 405 407 419 857	2	Lead Acetate	25
401 412 416 421 855*	3	Lead Acetate	75
425 851 853 863 867	4	Lead Acetate	225
406 408 418 422 862	5	Test Material	75
417 854 859 861 864	6	Test Material	225
404 411 413 414 860	7	Test Material	675

*Pig 855 replaced pig 865 on Day -2 (6/16/06, pre-dosing).

TABLE A-3 BODY WEIGHTS AND ACTUAL ADMINISTERED DOSES, BY DAY

Daily weights were measured on days -1, 2, 5, 8, 11, and 14. Weights for other days were estimated based on linear interpolation between measured values.

Group	Pig #	Day -1 BW	Day -1 Pb Dose	Day 0 BW	Day 0 Pb Dose	Day 1 BW	Day 1 Pb Dose	Day 2 BW	Day 2 Pb Dose	Day 3 BW	Day 3 Pb Dose	Day 4 BW	Day 4 Pb Dose	Day 5 BW	Day 5 Pb Dose	Day 6 BW	Day 6 Pb Dose	Day 7 BW	Day 7 Pb Dose	Day 8 BW	Day 8 Pb Dose	Day 9 BW	Day 9 Pb Dose	Day 10 BW	Day 10 Pb Dose	Day 11 BW	Day 11 Pb Dose	Day 12 BW	Day 12 Pb Dose	Day 13 BW	Day 13 Pb Dose	Day 14 BW	Day 14 Pb Dose	Days 0-14 Mean Pb Dose
1	409	12.0	0.00	12.1	0.00	12.6	0.00	12.3	0.00	12.5	0.00	13.8	0.00	14.1	0.00	14.4	0.00	14.7	0.00	15.0	0.00	15.3	0.00	15.7	0.00	16.0	0.00	16.3	0.00	17.1	0.00	17.0	0.00	0.00
1	406	12.1	0.00	10.2	0.00	10.4	0.00	10.6	0.00	10.9	0.00	11.1	0.00	11.4	0.00	11.6	0.00	11.8	0.00	12.1	0.00	12.3	0.00	12.6	0.00	12.9	0.00	13.2	0.00	13.6	0.00	11.9	0.00	0.00
1	405	12.1	0.00	10.3	0.00	10.6	0.00	10.9	0.00	11.2	0.00	11.4	0.00	11.7	0.00	12.0	0.00	12.3	0.00	12.5	0.00	12.8	0.00	13.2	0.00	13.6	0.00	14.2	0.00	15.3	0.00	15.3	0.00	0.00
2	407	10.0	0.00	10.9	27.47	11.2	29.05	11.6	28.60	11.8	27.75	12.1	27.19	12.3	26.63	12.6	27.35	12.9	26.46	13.7	25.50	14.1	24.81	14.6	25.35	15.1	25.15	15.5	26.82	16.0	25.82	16.5	25.09	26.42
2	405	11.0	0.00	11.2	26.70	11.4	26.21	11.6	25.78	11.8	27.73	12.0	27.37	12.2	26.95	12.6	27.03	13.1	26.63	13.0	25.08	13.9	27.17	14.3	26.51	14.6	25.92	15.1	27.48	15.5	26.68	16.0	25.92	26.70
2	407	11.1	0.00	11.5	25.96	12.0	24.95	12.5	24.02	12.8	25.02	13.1	24.07	13.5	24.35	13.7	25.46	14.0	24.08	14.1	24.51	14.7	25.03	15.2	24.87	15.7	24.11	16.1	25.74	16.4	25.16	16.8	24.61	25.14
2	410	13.2	0.00	13.6	22.04	14.0	21.38	14.4	20.70	14.8	22.09	15.3	21.45	15.7	20.90	16.1	21.76	16.4	21.30	16.8	20.65	17.3	21.84	17.7	21.13	18.5	20.46	19.0	21.82	19.4	21.11	19.9	20.63	21.32
3	403	9.1	0.00	9.5	31.20	10.0	29.35	10.5	28.46	10.8	30.47	11.0	29.77	11.1	29.11	11.2	29.98	12.1	28.98	12.5	28.05	12.4	29.30	13.4	29.25	13.9	27.33	14.3	28.85	14.8	27.95	15.2	27.03	28.58
3	401	12.8	0.00	13.2	69.63	11.7	67.25	14.2	65.04	14.6	69.31	14.8	67.83	15.1	66.31	15.5	68.52	15.8	66.93	16.2	65.42	16.6	67.41	17.0	65.78	17.5	64.25	18.0	67.41	18.5	65.66	19.0	64.31	66.60
3	412	12.1	0.00	12.6	72.84	13.3	69.49	13.7	67.17	13.9	72.05	14.1	70.05	14.4	69.88	14.5	72.02	14.7	72.01	14.9	71.12	15.1	73.24	15.7	71.47	16.1	69.67	16.6	71.84	17.0	71.60	17.5	69.82	71.23
3	416	11.8	0.00	12.0	76.76	12.2	75.61	12.4	74.51	12.6	78.79	12.8	78.44	13.0	77.13	13.2	80.18	13.4	78.79	13.7	77.64	14.2	79.19	14.7	76.45	15.2	75.90	15.7	77.79	16.2	75.31	16.7	73.96	76.98
3	421	9.0	0.00	10.3	80.49	10.7	80.27	11.1	83.26	11.4	87.83	11.8	85.10	12.2	82.53	12.4	85.35	12.7	84.65	13.0	81.83	13.4	83.82	13.9	80.71	14.4	78.08	14.8	82.16	15.3	79.57	15.8	77.14	81.09
4	453	9.4	0.00	10.1	91.42	10.3	92.06	10.6	94.85	10.8	93.58	10.9	92.00	11.1	90.75	11.4	91.43	11.7	90.71	12.0	88.31	12.4	90.30	12.8	87.54	13.2	84.90	13.6	89.29	14.1	86.64	14.5	84.05	89.23
4	456	10.7	0.00	11.4	237.81	11.5	230.10	11.9	231.84	12.1	244.04	12.4	241.04	12.6	237.14	13.0	243.01	13.5	238.04	13.8	229.72	14.3	237.78	14.7	231.56	15.2	224.70	15.7	235.32	16.3	227.35	16.5	219.91	234.35
4	451	10.0	0.00	10.8	253.58	11.1	245.26	11.3	243.12	11.7	255.30	12.1	248.54	12.5	239.03	12.7	242.06	13.0	245.19	13.2	240.85	13.6	240.70	14.1	242.01	14.5	234.78	14.6	242.96	14.7	230.76	14.9	218.29	240.72
4	453	11.0	0.00	12.2	224.87	12.6	218.61	13.0	212.07	13.1	227.80	13.3	221.10	13.0	220.87	13.0	229.00	13.2	223.63	13.8	218.51	13.0	220.95	16.0	220.34	15.8	214.10	16.1	226.10	16.8	220.75	17.2	214.80	221.51
4	461	10.1	0.00	10.6	252.17	11.1	237.50	11.6	236.81	11.8	252.88	12.0	248.31	12.3	242.82	12.6	242.32	13.0	245.50	13.3	243.04	13.7	246.18	14.1	240.87	14.6	232.97	15.0	240.03	15.5	238.61	16.0	231.03	244.32
4	467	12.8	0.00	13.1	208.06	13.4	204.26	13.8	199.80	14.1	212.37	14.4	207.21	14.6	202.54	15.1	211.01	15.4	209.67	15.7	202.50	16.1	211.01	16.6	206.49	17.0	200.25	17.4	212.51	17.8	207.05	18.2	200.15	206.72
5	404	9.0	0.00	10.0	89.47	10.3	86.43	10.7	83.03	11.1	85.71	11.5	82.92	11.9	79.73	12.3	83.93	12.6	81.74	12.9	79.05	13.3	82.51	13.7	80.01	14.2	77.45	14.6	81.28	15.1	78.75	15.6	76.43	81.02
5	408	9.9	0.00	10.3	80.87	10.7	83.16	11.1	80.57	11.4	83.55	11.7	81.44	12.0	79.39	12.3	83.69	12.6	81.44	13.0	79.34	13.4	82.30	13.8	79.91	14.2	77.65	14.6	81.05	15.0	79.46	15.4	77.19	81.19
5	418	12.3	0.00	13.1	67.00	13.4	64.14	13.7	64.94	14.1	67.53	14.4	65.83	14.8	64.27	15.1	67.07	15.5	65.36	15.9	64.63	16.2	67.32	16.6	66.03	16.9	65.01	17.3	68.27	17.6	67.50	18.3	66.14	68.54
5	422	12.7	0.00	13.7	83.07	13.7	82.34	13.8	82.81	14.1	85.47	14.5	82.80	14.6	80.40	15.1	84.80	15.4	82.64	15.8	80.50	16.1	83.77	16.5	81.45	16.9	79.33	17.2	83.56	17.6	81.46	18.0	79.45	82.23
5	462	11.4	0.00	11.6	76.75	11.9	75.13	12.1	73.42	12.4	76.31	12.6	74.31	12.9	72.34	13.1	75.60	13.6	73.74	13.8	72.46	14.3	77.11	14.7	74.74	15.2	72.52	15.6	76.32	16.0	74.31	16.4	72.41	74.88
6	417	9.0	0.00	10.2	243.35	10.6	234.06	11.0	227.80	11.2	240.74	11.5	234.83	11.8	224.19	12.3	236.07	12.7	227.41	13.2	219.56	13.5	231.81	13.4	228.75	14.1	222.68	14.6	235.07	15.0	229.60	15.5	221.84	231.34
6	454	9.5	0.00	9.7	257.64	9.8	251.70	10.0	249.87	10.2	261.71	10.5	257.38	10.8	251.56	11.1	260.10	11.5	251.44	11.9	241.34	12.2	248.04	12.6	251.20	12.9	244.71	13.3	257.03	13.7	249.03	14.1	242.14	252.72
6	459	9.4	0.00	10.3	241.45	10.5	235.66	11.0	227.05	11.2	240.70	11.4	234.83	11.8	229.19	12.2	237.38	12.9	229.62	11.0	222.75	12.5	233.61	14.0	225.44	14.5	217.71	14.9	229.85	15.3	223.63	15.5	217.71	230.04
6	463	10.6	0.00	10.9	227.12	11.3	221.67	11.6	214.33	11.8	225.87	12.1	224.75	12.1	220.16	12.8	230.43	12.9	224.77	13.2	219.34	13.6	231.61	14.0	224.95	14.5	218.66	15.0	229.11	15.5	223.46	16.0	218.31	223.43
6	464	12.0	0.00	12.3	207.26	11.3	220.35	11.7	213.41	12.0	223.00	12.4	218.40	12.6	214.12	13.1	220.72	13.5	213.27	13.9	209.06	14.3	220.43	14.5	213.14	15.1	207.00	15.7	218.41	16.2	212.32	16.6	208.41	215.00
7	404	12.1	0.00	12.4	643.83	12.8	625.76	13.1	629.95	13.2	653.80	13.4	649.41	13.5	641.03	13.8	667.35	14.1	652.31	14.5	638.10	14.9	666.95	15.3	648.79	15.7	631.56	16.1	667.35	16.5	651.77	16.9	636.94	645.80
7	411	8.7	0.00	9.0	829.07	9.4	842.22	9.8	851.13	10.0	860.01	10.3	848.26	10.5	840.07	10.9	849.51	11.3	837.18	11.7	798.04	12.1	817.23	12.6	789.05	13.0	762.75	13.4	780.15	13.9	755.41	14.3	735.12	799.70
7	412	11.4	0.00	11.7	673.79	12.1	661.00	12.4	643.41	12.0	660.04	12.6	679.33	13.0	670.31	13.3	699.01	13.6	678.01	13.9	663.35	14.3	690.33	14.6	677.61	15.0	664.61	15.3	687.25	15.6	674.34	16.0	662.24	673.8
7	414	10.9	0.00	11.3	797.10	11.7	783.87	12.1	762.12	12.4	798.16	12.8	777.28	13.2	757.61	13.6	790.48	13.9	761.35	14.3	747.05	14.7	774.54	15.2	754.50	15.6	735.62	16.1	772.93	16.5	745.24	17.0	725.60	754.54
7	420	11.1	0.00	11.4	700.80	11.7	683.82	12.0	667.06	12.4	701.03	12.8	679.25	13.2	667.61	13.5	682.16	13.9	666.51	14.2	651.61	14.5	683.81	14.9	667.73	15.3	652.35	15.7	684.31	16.2	661.87	16.7	644.19	672.56

Missed Doses

Day 0 - Pig 411 did not eat entire PM dose (ate approximately 90%). Daily dose adjusted to 95%.

Late Doses (no adjustments necessary):

Day 0 - Pig 422 had not eaten the AM dose by the 11 AM feeding; ate the entire dose by the 3 PM feeding.

Day 0 - Pig 422 ate 40% of the PM dose at feeding time; ate the remaining portion by the next morning.

Day 1 - Pigs 422 and 451 did not eat their PM doses at feeding time; ate the entire dose by the next morning.

Day 2 - Pig 422 had not eaten the PM dose by the 5 PM feeding; ate the entire dose by the next morning.

TABLE A-4 ANIMAL HEALTH

Naxcel Treatment for Illness

First Day of Treatment	Pig	Group	Treatment Duration
Day -2 (6/16/06)	855	3	4 days
	421	3	
	863	4	5 days
Day 0 (6/18/06)	407	2	3 days
	851	4	
	412	3	
	856	1	4 days
Day 1 (6/19/06)	860	7	3 days
	864	6	
Day 12 (6/30/06)	864	6	3 days
Day 13 (7/1/06)	851	4	2 days

Necropsy Notes

Pig 861 (Group 6) had a cyst in his gallbladder; pig 864 (Group 6) had a diffuse pneumonia.

TABLE A-5

LEAD ANALYTICAL RESULTS FOR STUDY SAMPLES

Sample Number	Tag Number	Matrix	Pig Number	Group	Material Administered	Day	Actual Pb BWAdj Dose (ug/kg-d)	Q	Reported Conc (ug/g)	DL	AdjConc (ug/g)	Units
MSE3-409-(15)-L	MSE3-477	liver	409	1	Control	15	0	<	0.01	0	0.005	ug/g
MSE3-856-(15)-L	MSE3-455	liver	856	1	Control	15	0	<	0.01	0	0.005	ug/g
MSE3-866-(15)-L	MSE3-476	liver	866	1	Control	15	0	<	0.01	0	0.005	ug/g
MSE3-402-(15)-L	MSE3-460	liver	402	2	Lead Acetate	15	26.43		0.036	0	0.036	ug/g
MSE3-405-(15)-L	MSE3-446	liver	405	2	Lead Acetate	15	26.7		0.054	0	0.054	ug/g
MSE3-407-(15)-L	MSE3-458	liver	407	2	Lead Acetate	15	25		0.044	0	0.044	ug/g
MSE3-419-(15)-L	MSE3-457	liver	419	2	Lead Acetate	15	21.32		0.044	0	0.044	ug/g
MSE3-857-(15)-L	MSE3-467	liver	857	2	Lead Acetate	15	28.98		0.033	0	0.033	ug/g
MSE3-401-(15)-L	MSE3-465	liver	401	3	Lead Acetate	15	66.8		0.094	0	0.094	ug/g
MSE3-855-(15)-L	MSE3-478	liver	855	3	Lead Acetate	15	89.23		0.087	0	0.087	ug/g
MSE3-421-(15)-L	MSE3-448	liver	421	3	Lead Acetate	15	83.09		0.17	0	0.17	ug/g
MSE3-412-(15)-L	MSE3-450	liver	412	3	Lead Acetate	15	71.21		0.11	0	0.11	ug/g
MSE3-416-(15)-L	MSE3-451	liver	416	3	Lead Acetate	15	76.98		0.14	0	0.14	ug/g
MSE3-425-(15)-L	MSE3-461	liver	425	4	Lead Acetate	15	235.35		0.18	0	0.18	ug/g
MSE3-851-(15)-L	MSE3-456	liver	851	4	Lead Acetate	15	246.72		0.26	0	0.26	ug/g
MSE3-853-(15)-L	MSE3-471	liver	853	4	Lead Acetate	15	221.5		0.52	0	0.52	ug/g
MSE3-863-(15)-L	MSE3-463	liver	863	4	Lead Acetate	15	244.32		0.63	0	0.63	ug/g
MSE3-867-(15)-L	MSE3-462	liver	867	4	Lead Acetate	15	206.5		0.36	0	0.36	ug/g
MSE3-422-(15)-L	MSE3-469	liver	422	5	Test Material 2	15	82.31		0.086	0	0.086	ug/g
MSE3-406-(15)-L	MSE3-444	liver	406	5	Test Material 2	15	81.97		0.12	0	0.12	ug/g
MSE3-862-(15)-L	MSE3-468	liver	862	5	Test Material 2	15	74.88		0.084	0	0.084	ug/g
MSE3-408-(15)-L	MSE3-445	liver	408	5	Test Material 2	15	81.19		0.11	0	0.11	ug/g
MSE3-418-(15)-L	MSE3-473	liver	418	5	Test Material 2	15	66.54		0.095	0	0.095	ug/g
MSE3-417-(15)-L	MSE3-464	liver	417	6	Test Material 2	15	231.04		0.28	0	0.28	ug/g
MSE3-854-(15)-L	MSE3-475	liver	854	6	Test Material 2	15	252.97		0.22	0	0.22	ug/g
MSE3-859-(15)-L	MSE3-470	liver	859	6	Test Material 2	15	230.04		0.32	0	0.32	ug/g
MSE3-861-(15)-L	MSE3-466	liver	861	6	Test Material 2	15	223.43		0.36	0	0.36	ug/g
MSE3-864-(15)-L	MSE3-452	liver	864	6	Test Material 2	15	216		0.18	0	0.18	ug/g
MSE3-411-(15)-L	MSE3-449	liver	411	7	Test Material 2	15	809.26		0.88	0	0.88	ug/g
MSE3-860-(15)-L	MSE3-474	liver	860	7	Test Material 2	15	672.54		0.5	0	0.5	ug/g
MSE3-413-(15)-L	MSE3-453	liver	413	7	Test Material 2	15	672.06		1.26	0	1.26	ug/g
MSE3-404-(15)-L	MSE3-447	liver	404	7	Test Material 2	15	645.85		0.95	0	0.95	ug/g
MSE3-414-(15)-L	MSE3-472	liver	414	7	Test Material 2	15	665.24		0.57	0	0.57	ug/g
MSE3-409-(15)-K	MSE3-485	kidney	409	1	Control	15	0	<	0.01	0	0.005	ug/g
MSE3-856-(15)-K	MSE3-479	kidney	856	1	Control	15	0	<	0.01	0	0.005	ug/g
MSE3-866-(15)-K	MSE3-509	kidney	866	1	Control	15	0	<	0.01	0	0.005	ug/g
MSE3-419-(15)-K	MSE3-498	kidney	419	2	Lead Acetate	15	21.32		0.02	0	0.02	ug/g
MSE3-857-(15)-K	MSE3-496	kidney	857	2	Lead Acetate	15	28.98		0.02	0	0.02	ug/g
MSE3-402-(15)-K	MSE3-495	kidney	402	2	Lead Acetate	15	26.43		0.03	0	0.03	ug/g
MSE3-405-(15)-K	MSE3-508	kidney	405	2	Lead Acetate	15	26.7		0.02	0	0.02	ug/g
MSE3-407-(15)-K	MSE3-505	kidney	407	2	Lead Acetate	15	25		0.034	0	0.034	ug/g
MSE3-412-(15)-K	MSE3-504	kidney	412	3	Lead Acetate	15	71.21		0.095	0	0.095	ug/g
MSE3-416-(15)-K	MSE3-500	kidney	416	3	Lead Acetate	15	76.98		0.067	0	0.067	ug/g
MSE3-421-(15)-K	MSE3-491	kidney	421	3	Lead Acetate	15	83.09		0.14	0	0.14	ug/g
MSE3-855-(15)-K	MSE3-513	kidney	855	3	Lead Acetate	15	89.23		0.08	0	0.08	ug/g
MSE3-401-(15)-K	MSE3-497	kidney	401	3	Lead Acetate	15	66.8		0.08	0	0.08	ug/g
MSE3-863-(15)-K	MSE3-494	kidney	863	4	Lead Acetate	15	244.32		0.31	0	0.31	ug/g
MSE3-425-(15)-K	MSE3-507	kidney	425	4	Lead Acetate	15	235.35		0.15	0	0.15	ug/g
MSE3-853-(15)-K	MSE3-511	kidney	853	4	Lead Acetate	15	221.5		0.31	0	0.31	ug/g
MSE3-867-(15)-K	MSE3-485	kidney	867	4	Lead Acetate	15	206.5		0.26	0	0.26	ug/g
MSE3-851-(15)-K	MSE3-490	kidney	851	4	Lead Acetate	15	246.72		0.17	0	0.17	ug/g
MSE3-406-(15)-K	MSE3-503	kidney	406	5	Test Material 2	15	81.97		0.064	0	0.064	ug/g
MSE3-408-(15)-K	MSE3-489	kidney	408	5	Test Material 2	15	81.19		0.078	0	0.078	ug/g
MSE3-418-(15)-K	MSE3-514	kidney	418	5	Test Material 2	15	66.54		0.074	0	0.074	ug/g
MSE3-422-(15)-K	MSE3-483	kidney	422	5	Test Material 2	15	82.31		0.055	0	0.055	ug/g
MSE3-862-(15)-K	MSE3-501	kidney	862	5	Test Material 2	15	74.88		0.066	0	0.066	ug/g
MSE3-854-(15)-K	MSE3-488	kidney	854	6	Test Material 2	15	252.97		0.17	0	0.17	ug/g
MSE3-864-(15)-K	MSE3-506	kidney	864	6	Test Material 2	15	216		0.15	0	0.15	ug/g
MSE3-861-(15)-K	MSE3-487	kidney	861	6	Test Material 2	15	223.43		0.19	0	0.19	ug/g
MSE3-417-(15)-K	MSE3-481	kidney	417	6	Test Material 2	15	231.04		0.27	0	0.27	ug/g
MSE3-859-(15)-K	MSE3-499	kidney	859	6	Test Material 2	15	230.04		0.19	0	0.19	ug/g
MSE3-860-(15)-K	MSE3-492	kidney	860	7	Test Material 2	15	672.54		0.27	0	0.27	ug/g
MSE3-404-(15)-K	MSE3-510	kidney	404	7	Test Material 2	15	645.85		0.56	0	0.56	ug/g

TABLE A-5

Sample Number	Tag Number	Matrix	Pig Number	Group	Material Administered	Day	Actual Pb BWAdj Dose (ug/kg-d)	Q	Reported Conc (ug/g)	DL	AdjConc (ug/g)	Units
MSE3-411-(15)-K	MSE3-493	kidney	411	7	Test Material 2	15	809 26		0.42	0	0 42	ug/g
MSE3-413-(15)-K	MSE3-482	kidney	413	7	Test Material 2	15	672 06		0 61	0	0 61	ug/g
MSE3-414-(15)-K	MSE3-512	kidney	414	7	Test Material 2	15	665 24		0 42	0	0.42	ug/g
MSE3-866-(15)-F	MSE3-515	femur	866	1	Control	15	0	<	0 4	0 4	0 2	ug/g
MSE3-409-(15)-F	MSE3-531	femur	409	1	Control	15	0	<	0.4	0 4	0 2	ug/g
MSE3-856-(15)-F	MSE3-543	femur	856	1	Control	15	0		1 5	0 4	1 5	ug/g
MSE3-402-(15)-F	MSE3-549	femur	402	2	Lead Acetate	15	26.43		0.5	0 5	0.5	ug/g
MSE3-405-(15)-F	MSE3-518	femur	405	2	Lead Acetate	15	26.7		1	0.4	1	ug/g
MSE3-407-(15)-F	MSE3-539	femur	407	2	Lead Acetate	15	25		1	0.4	1	ug/g
MSE3-419-(15)-F	MSE3-548	femur	419	2	Lead Acetate	15	21.32		0.6	0.5	0 6	ug/g
MSE3-857-(15)-F	MSE3-524	femur	857	2	Lead Acetate	15	28.98		1	0.4	1	ug/g
MSE3-421-(15)-F	MSE3-527	femur	421	3	Lead Acetate	15	83.09		4 1	0.4	4 1	ug/g
MSE3-416-(15)-F	MSE3-526	femur	416	3	Lead Acetate	15	76.98		4.2	0 4	4.2	ug/g
MSE3-401-(15)-F	MSE3-537	femur	401	3	Lead Acetate	15	66 8		3.2	0.4	3.2	ug/g
MSE3-412-(15)-F	MSE3-547	femur	412	3	Lead Acetate	15	71.21		3.1	0.5	3.1	ug/g
MSE3-855-(15)-F	MSE3-533	femur	855	3	Lead Acetate	15	89.23		2.9	0.4	2.9	ug/g
MSE3-425-(15)-F	MSE3-534	femur	425	4	Lead Acetate	15	235.35		7.5	0.4	7.5	ug/g
MSE3-851-(15)-F	MSE3-523	femur	851	4	Lead Acetate	15	246.72		7.4	0.4	7.4	ug/g
MSE3-853-(15)-F	MSE3-529	femur	853	4	Lead Acetate	15	221.5		14	0.4	14	ug/g
MSE3-863-(15)-F	MSE3-521	femur	863	4	Lead Acetate	15	244 32		15	0.4	15	ug/g
MSE3-867-(15)-F	MSE3-541	femur	867	4	Lead Acetate	15	200 5		6.5	0.5	6 5	ug/g
MSE3-406-(15)-F	MSE3-542	femur	406	5	Test Material 2	15	81.97		2.3	0.5	2.3	ug/g
MSE3-862-(15)-F	MSE3-538	femur	862	5	Test Material 2	15	74.88		3.2	0.4	3.2	ug/g
MSE3-422-(15)-F	MSE3-550	femur	422	5	Test Material 2	15	82.31		1 9	0.5	1.9	ug/g
MSE3-408-(15)-F	MSE3-546	femur	408	5	Test Material 2	15	81.19		3 1	0.4	3.1	ug/g
MSE3-418-(15)-F	MSE3-540	femur	418	5	Test Material 2	15	66.54		2.7	0.5	2.7	ug/g
MSE3-417-(15)-F	MSE3-516	femur	417	6	Test Material 2	15	231 04		9.1	0.4	9 1	ug/g
MSE3-854-(15)-F	MSE3-536	femur	854	6	Test Material 2	15	252 97		7.1	0.4	7.1	ug/g
MSE3-859-(15)-F	MSE3-545	femur	859	6	Test Material 2	15	230.04		7.1	0.4	7.1	ug/g
MSE3-861-(15)-F	MSE3-522	femur	861	6	Test Material 2	15	223.43		8 9	0.4	8 9	ug/g
MSE3-864-(15)-F	MSE3-520	femur	864	6	Test Material 2	15	216		5 9	0.4	5.9	ug/g
MSE3-404-(15)-F	MSE3-525	femur	404	7	Test Material 2	15	645 85		27	0.4	27	ug/g
MSE3-414-(15)-F	MSE3-532	femur	414	7	Test Material 2	15	665.24		17	0.4	17	ug/g
MSE3-860-(15)-F	MSE3-519	femur	860	7	Test Material 2	15	672.54		13	0.4	13	ug/g
MSE3-411-(15)-F	MSE3-528	femur	411	7	Test Material 2	15	809.26		23	0.4	23	ug/g
MSE3-413-(15)-F	MSE3-535	femur	413	7	Test Material 2	15	672 06		23	0.4	23	ug/g
MSE3-866-(0)-B	MSE3-112	blood	866	1	Control	0	0	<	1	1	0 5	ug/dL
MSE3-409-(0)-B	MSE3-106	blood	409	1	Control	0	0	<	1	1	0.5	ug/dL
MSE3-856-(0)-B	MSE3-136	blood	856	1	Control	0	0	<	1	1	0.5	ug/dL
MSE3-402-(0)-B	MSE3-108	blood	402	2	Lead Acetate	0	27.47	<	1	1	0.5	ug/dL
MSE3-405-(0)-B	MSE3-137	blood	405	2	Lead Acetate	0	26.7	<	1	1	0 5	ug/dL
MSE3-407-(0)-B	MSE3-107	blood	407	2	Lead Acetate	0	25.96	<	1	1	0 5	ug/dL
MSE3-419-(0)-B	MSE3-121	blood	419	2	Lead Acetate	0	22.04	<	1	1	0 5	ug/dL
MSE3-857-(0)-B	MSE3-125	blood	857	2	Lead Acetate	0	31.36	<	1	1	0 5	ug/dL
MSE3-421-(0)-B	MSE3-109	blood	421	3	Lead Acetate	0	89.49	<	1	1	0 5	ug/dL
MSE3-401-(0)-B	MSE3-118	blood	401	3	Lead Acetate	0	69.63	<	1	1	0.5	ug/dL
MSE3-416-(0)-B	MSE3-114	blood	416	3	Lead Acetate	0	76.79	<	1	1	0 5	ug/dL
MSE3-855-(0)-B	MSE3-138	blood	855	3	Lead Acetate	0	91.42	<	1	1	0 5	ug/dL
MSE3-412-(0)-B	MSE3-130	blood	412	3	Lead Acetate	0	72.84	<	1	1	0 5	ug/dL
MSE3-425-(0)-B	MSE3-131	blood	425	4	Lead Acetate	0	247.87	<	1	1	0.5	ug/dL
MSE3-853-(0)-B	MSE3-102	blood	853	4	Lead Acetate	0	224.57	<	1	1	0.5	ug/dL
MSE3-867-(0)-B	MSE3-122	blood	867	4	Lead Acetate	0	209.98	<	1	1	0.5	ug/dL
MSE3-851-(0)-B	MSE3-113	blood	851	4	Lead Acetate	0	253 59	<	1	1	0.5	ug/dL
MSE3-863-(0)-B	MSE3-126	blood	863	4	Lead Acetate	0	259.17	<	1	1	0.5	ug/dL
MSE3-406-(0)-B	MSE3-123	blood	406	5	Test Material 2	0	89.47	<	1	1	0 5	ug/dL
MSE3-408-(0)-B	MSE3-115	blood	408	5	Test Material 2	0	86.57	<	1	1	0.5	ug/dL
MSE3-418-(0)-B	MSE3-128	blood	418	5	Test Material 2	0	67.96	<	1	1	0.5	ug/dL
MSE3-422-(0)-B	MSE3-111	blood	422	5	Test Material 2	0	83.07	<	1	1	0.5	ug/dL
MSE3-862-(0)-B	MSE3-116	blood	862	5	Test Material 2	0	76.75	<	1	1	0.5	ug/dL
MSE3-854-(0)-B	MSE3-117	blood	854	6	Test Material 2	0	257.64	<	1	1	0.5	ug/dL
MSE3-864-(0)-B	MSE3-135	blood	864	6	Test Material 2	0	227.75	<	1	1	0.5	ug/dL
MSE3-859-(0)-B	MSE3-104	blood	859	6	Test Material 2	0	244.95	<	1	1	0.5	ug/dL
MSE3-417-(0)-B	MSE3-132	blood	417	6	Test Material 2	0	243.35	<	1	1	0 5	ug/dL
MSE3-861-(0)-B	MSE3-119	blood	861	6	Test Material 2	0	227.4	<	1	1	0.5	ug/dL
MSE3-404-(0)-B	MSE3-133	blood	404	7	Test Material 2	0	643.43	<	1	1	0 5	ug/dL
MSE3-411-(0)-B	MSE3-124	blood	411	7	Test Material 2	0	839.07	<	1	1	0.5	ug/dL

TABLE A-5

Sample Number	Tag Number	Matrix	Pig Number	Group	Material Administered	Day	Actual Pb BWAdj Dose (ug/kg-d)	Q	Reported Conc (ug/g)	DL	AdjConc (ug/g)	Units
MSE3-413-(0)-B	MSE3-127	blood	413	7	Test Material 2	0	679.99	<	1	1	0.5	ug/dL
MSE3-414-(0)-B	MSE3-134	blood	414	7	Test Material 2	0	707.1	<	1	1	0.5	ug/dL
MSE3-860-(0)-B	MSE3-105	blood	860	7	Test Material 2	0	700.89	<	1	1	0.5	ug/dL
MSE3-866-(1)-B	MSE3-156	blood	866	1	Control	1	0	<	1	1	0.5	ug/dL
MSE3-856-(1)-B	MSE3-176	blood	856	1	Control	1	0	<	1	1	0.5	ug/dL
MSE3-409-(1)-B	MSE3-165	blood	409	1	Control	1	0	<	1	1	0.5	ug/dL
MSE3-402-(1)-B	MSE3-163	blood	402	2	Lead Acetate	1	26.66	<	1	1	0.5	ug/dL
MSE3-407-(1)-B	MSE3-148	blood	407	2	Lead Acetate	1	24.95	<	1	1	0.5	ug/dL
MSE3-419-(1)-B	MSE3-171	blood	419	2	Lead Acetate	1	21.38	<	1	1	0.5	ug/dL
MSE3-857-(1)-B	MSE3-167	blood	857	2	Lead Acetate	1	29.85	<	1	1	0.5	ug/dL
MSE3-405-(1)-B	MSE3-140	blood	405	2	Lead Acetate	1	26.23	<	1	1	0.5	ug/dL
MSE3-855-(1)-B	MSE3-166	blood	855	3	Lead Acetate	1	89.06	<	1	1	0.5	ug/dL
MSE3-401-(1)-B	MSE3-145	blood	401	3	Lead Acetate	1	67.25	<	1	1	0.5	ug/dL
MSE3-412-(1)-B	MSE3-174	blood	412	3	Lead Acetate	1	69.89	<	1	1	0.5	ug/dL
MSE3-416-(1)-B	MSE3-170	blood	416	3	Lead Acetate	1	75.64	<	1	1	0.5	ug/dL
MSE3-421-(1)-B	MSE3-157	blood	421	3	Lead Acetate	1	86.27	<	1	1	0.5	ug/dL
MSE3-867-(1)-B	MSE3-152	blood	867	4	Lead Acetate	1	204.76		2	1	2	ug/dL
MSE3-863-(1)-B	MSE3-158	blood	863	4	Lead Acetate	1	247.5		2	1	2	ug/dL
MSE3-853-(1)-B	MSE3-172	blood	853	4	Lead Acetate	1	218.61		3.4	1	3.4	ug/dL
MSE3-425-(1)-B	MSE3-173	blood	425	4	Lead Acetate	1	239.59		1	1	1	ug/dL
MSE3-851-(1)-B	MSE3-155	blood	851	4	Lead Acetate	1	248.25		1	1	1	ug/dL
MSE3-406-(1)-B	MSE3-147	blood	406	5	Test Material 2	1	86.43	<	1	1	0.5	ug/dL
MSE3-408-(1)-B	MSE3-160	blood	408	5	Test Material 2	1	83.46	<	1	1	0.5	ug/dL
MSE3-422-(1)-B	MSE3-149	blood	422	5	Test Material 2	1	82.94	<	1	1	0.5	ug/dL
MSE3-418-(1)-B	MSE3-146	blood	418	5	Test Material 2	1	66.44	<	1	1	0.5	ug/dL
MSE3-862-(1)-B	MSE3-159	blood	862	5	Test Material 2	1	75.13	<	1	1	0.5	ug/dL
MSE3-417-(1)-B	MSE3-169	blood	417	6	Test Material 2	1	234.92	<	1	1	0.5	ug/dL
MSE3-854-(1)-B	MSE3-141	blood	854	6	Test Material 2	1	253.7		2	1	2	ug/dL
MSE3-859-(1)-B	MSE3-154	blood	859	6	Test Material 2	1	235.66		1	1	1	ug/dL
MSE3-861-(1)-B	MSE3-164	blood	861	6	Test Material 2	1	220.67		1	1	1	ug/dL
MSE3-864-(1)-B	MSE3-168	blood	864	6	Test Material 2	1	220.35		2	1	2	ug/dL
MSE3-860-(1)-B	MSE3-161	blood	860	7	Test Material 2	1	683.87		3	1	3	ug/dL
MSE3-404-(1)-B	MSE3-151	blood	404	7	Test Material 2	1	625.76		2	1	2	ug/dL
MSE3-411-(1)-B	MSE3-144	blood	411	7	Test Material 2	1	847.27	<	1	1	0.5	ug/dL
MSE3-413-(1)-B	MSE3-142	blood	413	7	Test Material 2	1	661.2		6	1	6	ug/dL
MSE3-414-(1)-B	MSE3-150	blood	414	7	Test Material 2	1	683.87		4	1	4	ug/dL
MSE3-409-(2)-B	MSE3-200	blood	409	1	Control	2	0	<	1	1	0.5	ug/dL
MSE3-856-(2)-B	MSE3-184	blood	856	1	Control	2	0	<	1	1	0.5	ug/dL
MSE3-866-(2)-B	MSE3-207	blood	866	1	Control	2	0	<	1	1	0.5	ug/dL
MSE3-419-(2)-B	MSE3-197	blood	419	2	Lead Acetate	2	20.76	<	1	1	0.5	ug/dL
MSE3-857-(2)-B	MSE3-188	blood	857	2	Lead Acetate	2	28.48	<	1	1	0.5	ug/dL
MSE3-405-(2)-B	MSE3-205	blood	405	2	Lead Acetate	2	25.78	<	1	1	0.5	ug/dL
MSE3-402-(2)-B	MSE3-189	blood	402	2	Lead Acetate	2	25.89	<	1	1	0.5	ug/dL
MSE3-407-(2)-B	MSE3-195	blood	407	2	Lead Acetate	2	24.02	<	1	1	0.5	ug/dL
MSE3-416-(2)-B	MSE3-201	blood	416	3	Lead Acetate	2	74.51	<	1	1	0.5	ug/dL
MSE3-401-(2)-B	MSE3-179	blood	401	3	Lead Acetate	2	65.04	<	1	1	0.5	ug/dL
MSE3-421-(2)-B	MSE3-202	blood	421	3	Lead Acetate	2	83.28	<	1	1	0.5	ug/dL
MSE3-855-(2)-B	MSE3-210	blood	855	3	Lead Acetate	2	86.82	<	1	1	0.5	ug/dL
MSE3-412-(2)-B	MSE3-214	blood	412	3	Lead Acetate	2	67.17	<	1	1	0.5	ug/dL
MSE3-853-(2)-B	MSE3-209	blood	853	4	Lead Acetate	2	212.97		3.4	1	3.4	ug/dL
MSE3-863-(2)-B	MSE3-198	blood	863	4	Lead Acetate	2	236.83		6.8	1	6.8	ug/dL
MSE3-851-(2)-B	MSE3-186	blood	851	4	Lead Acetate	2	243.12		1	1	1	ug/dL
MSE3-425-(2)-B	MSE3-192	blood	425	4	Lead Acetate	2	231.84		2	1	2	ug/dL
MSE3-867-(2)-B	MSE3-203	blood	867	4	Lead Acetate	2	199.8		2	1	2	ug/dL
MSE3-406-(2)-B	MSE3-191	blood	406	5	Test Material 2	2	83.59	<	1	1	0.5	ug/dL
MSE3-408-(2)-B	MSE3-190	blood	408	5	Test Material 2	2	80.57	<	1	1	0.5	ug/dL
MSE3-418-(2)-B	MSE3-187	blood	418	5	Test Material 2	2	64.98	<	1	1	0.5	ug/dL
MSE3-422-(2)-B	MSE3-177	blood	422	5	Test Material 2	2	62.61	<	1	1	0.5	ug/dL
MSE3-862-(2)-B	MSE3-193	blood	862	5	Test Material 2	2	73.57		1	1	1	ug/dL
MSE3-861-(2)-B	MSE3-212	blood	861	6	Test Material 2	2	214.33		3	1	3	ug/dL
MSE3-864-(2)-B	MSE3-211	blood	864	6	Test Material 2	2	213.41		2	1	2	ug/dL
MSE3-854-(2)-B	MSE3-196	blood	854	6	Test Material 2	2	249.87		2	1	2	ug/dL
MSE3-417-(2)-B	MSE3-185	blood	417	6	Test Material 2	2	227.05		1	1	1	ug/dL
MSE3-859-(2)-B	MSE3-199	blood	859	6	Test Material 2	2	227.05		2	1	2	ug/dL
MSE3-404-(2)-B	MSE3-182	blood	404	7	Test Material 2	2	609.05		3.8	1	3.8	ug/dL
MSE3-411-(2)-B	MSE3-178	blood	411	7	Test Material 2	2	814.13		3	1	3	ug/dL

TABLE A-5

Sample Number	Tag Number	Matrix	Pig Number	Group	Material Administered	Day	Actual Pb BWAdj Dose (ug/kg-d)	Q	Reported Conc (ug/g)	DL	AdjConc (ug/g)	Units
MSE3-413-(2)-B	MSE3-206	blood	413	7	Test Material 2	2	643.43		7.1	1	7.1	ug/dL
MSE3-414-(2)-B	MSE3-194	blood	414	7	Test Material 2	2	662.12		5	1	5	ug/dL
MSE3-860-(2)-B	MSE3-204	blood	860	7	Test Material 2	2	667.66		3.3	1	3.3	ug/dL
MSE3-409-(3)-B	MSE3-247	blood	409	1	Control	3	0	<	1	1	0.5	ug/dL
MSE3-856-(3)-B	MSE3-243	blood	856	1	Control	3	0	<	1	1	0.5	ug/dL
MSE3-866-(3)-B	MSE3-230	blood	866	1	Control	3	0	<	1	1	0.5	ug/dL
MSE3-407-(3)-B	MSE3-225	blood	407	2	Lead Acetate	3	25.62	<	1	1	0.5	ug/dL
MSE3-419-(3)-B	MSE3-240	blood	419	2	Lead Acetate	3	22.08	<	1	1	0.5	ug/dL
MSE3-402-(3)-B	MSE3-220	blood	402	2	Lead Acetate	3	27.75	<	1	1	0.5	ug/dL
MSE3-405-(3)-B	MSE3-237	blood	405	2	Lead Acetate	3	27.79	<	1	1	0.5	ug/dL
MSE3-857-(3)-B	MSE3-233	blood	857	2	Lead Acetate	3	30.47	<	1	1	0.5	ug/dL
MSE3-401-(3)-B	MSE3-236	blood	401	3	Lead Acetate	3	69.31		2	1	2	ug/dL
MSE3-412-(3)-B	MSE3-231	blood	412	3	Lead Acetate	3	72.05		1	1	1	ug/dL
MSE3-416-(3)-B	MSE3-232	blood	416	3	Lead Acetate	3	79.79		1	1	1	ug/dL
MSE3-421-(3)-B	MSE3-217	blood	421	3	Lead Acetate	3	87.83		1	1	1	ug/dL
MSE3-855-(3)-B	MSE3-226	blood	855	3	Lead Acetate	3	93.28		2	1	2	ug/dL
MSE3-851-(3)-B	MSE3-244	blood	851	4	Lead Acetate	3	255.38		1	1	1	ug/dL
MSE3-425-(3)-B	MSE3-235	blood	425	4	Lead Acetate	3	246.94		3	1	3	ug/dL
MSE3-867-(3)-B	MSE3-238	blood	867	4	Lead Acetate	3	212.17		3	1	3	ug/dL
MSE3-863-(3)-B	MSE3-242	blood	863	4	Lead Acetate	3	252.86		3.1	1	3.1	ug/dL
MSE3-853-(3)-B	MSE3-246	blood	853	4	Lead Acetate	3	227.8		4.4	1	4.4	ug/dL
MSE3-862-(3)-B	MSE3-222	blood	862	5	Test Material 2	3	76.31		2	1	2	ug/dL
MSE3-406-(3)-B	MSE3-223	blood	406	5	Test Material 2	3	85.73	<	1	1	0.5	ug/dL
MSE3-408-(3)-B	MSE3-241	blood	408	5	Test Material 2	3	83.59	<	1	1	0.5	ug/dL
MSE3-418-(3)-B	MSE3-239	blood	418	5	Test Material 2	3	67.53	<	1	1	0.5	ug/dL
MSE3-422-(3)-B	MSE3-229	blood	422	5	Test Material 2	3	85.47	<	1	1	0.5	ug/dL
MSE3-854-(3)-B	MSE3-251	blood	854	6	Test Material 2	3	264.71		2	1	2	ug/dL
MSE3-859-(3)-B	MSE3-245	blood	859	6	Test Material 2	3	240.76		3.4	1	3.4	ug/dL
MSE3-861-(3)-B	MSE3-216	blood	861	6	Test Material 2	3	228.87		3.1	1	3.1	ug/dL
MSE3-864-(3)-B	MSE3-228	blood	864	6	Test Material 2	3	225.06		2	1	2	ug/dL
MSE3-417-(3)-B	MSE3-252	blood	417	6	Test Material 2	3	240.76		2	1	2	ug/dL
MSE3-413-(3)-B	MSE3-215	blood	413	7	Test Material 2	3	689.84		6.2	1	6.2	ug/dL
MSE3-414-(3)-B	MSE3-248	blood	414	7	Test Material 2	3	698.16		7.3	1	7.3	ug/dL
MSE3-860-(3)-B	MSE3-224	blood	860	7	Test Material 2	3	701.93		4.5	1	4.5	ug/dL
MSE3-404-(3)-B	MSE3-221	blood	404	7	Test Material 2	3	655.96		3.4	1	3.4	ug/dL
MSE3-411-(3)-B	MSE3-250	blood	411	7	Test Material 2	3	866.61		3	1	3	ug/dL
MSE3-409-(5)-B	MSE3-255	blood	409	1	Control	5	0	<	1	1	0.5	ug/dL
MSE3-856-(5)-B	MSE3-276	blood	856	1	Control	5	0	<	1	1	0.5	ug/dL
MSE3-866-(5)-B	MSE3-267	blood	866	1	Control	5	0	<	1	1	0.5	ug/dL
MSE3-402-(5)-B	MSE3-290	blood	402	2	Lead Acetate	5	26.63	<	1	1	0.5	ug/dL
MSE3-405-(5)-B	MSE3-270	blood	405	2	Lead Acetate	5	26.95		1	1	1	ug/dL
MSE3-407-(5)-B	MSE3-278	blood	407	2	Lead Acetate	5	24.35	<	1	1	0.5	ug/dL
MSE3-419-(5)-B	MSE3-257	blood	419	2	Lead Acetate	5	20.86	<	1	1	0.5	ug/dL
MSE3-857-(5)-B	MSE3-277	blood	857	2	Lead Acetate	5	29.11	<	1	1	0.5	ug/dL
MSE3-416-(5)-B	MSE3-280	blood	416	3	Lead Acetate	5	77.13		3.3	1	3.3	ug/dL
MSE3-421-(5)-B	MSE3-269	blood	421	3	Lead Acetate	5	82.53		3	1	3	ug/dL
MSE3-412-(5)-B	MSE3-260	blood	412	3	Lead Acetate	5	69.88		2	1	2	ug/dL
MSE3-401-(5)-B	MSE3-259	blood	401	3	Lead Acetate	5	66.41		3.1	1	3.1	ug/dL
MSE3-855-(5)-B	MSE3-285	blood	855	3	Lead Acetate	5	90.75		3	1	3	ug/dL
MSE3-425-(5)-B	MSE3-265	blood	425	4	Lead Acetate	5	237.14		4	1	4	ug/dL
MSE3-851-(5)-B	MSE3-281	blood	851	4	Lead Acetate	5	239.04		4	1	4	ug/dL
MSE3-853-(5)-B	MSE3-256	blood	853	4	Lead Acetate	5	220.52		5.3	1	5.3	ug/dL
MSE3-863-(5)-B	MSE3-254	blood	863	4	Lead Acetate	5	243.92		6.5	1	6.5	ug/dL
MSE3-867-(5)-B	MSE3-272	blood	867	4	Lead Acetate	5	202.58		4.3	1	4.3	ug/dL
MSE3-406-(5)-B	MSE3-279	blood	406	5	Test Material 2	5	79.73		3	1	3	ug/dL
MSE3-408-(5)-B	MSE3-271	blood	408	5	Test Material 2	5	79.39		2	1	2	ug/dL
MSE3-418-(5)-B	MSE3-258	blood	418	5	Test Material 2	5	64.32		2	1	2	ug/dL
MSE3-422-(5)-B	MSE3-264	blood	422	5	Test Material 2	5	80.4		1	1	1	ug/dL
MSE3-862-(5)-B	MSE3-286	blood	862	5	Test Material 2	5	72.42		3	1	3	ug/dL
MSE3-864-(5)-B	MSE3-266	blood	864	6	Test Material 2	5	212.12		3.5	1	3.5	ug/dL
MSE3-854-(5)-B	MSE3-273	blood	854	6	Test Material 2	5	251.58		4.3	1	4.3	ug/dL
MSE3-861-(5)-B	MSE3-288	blood	861	6	Test Material 2	5	220.78		4.8	1	4.8	ug/dL
MSE3-859-(5)-B	MSE3-268	blood	859	6	Test Material 2	5	229.19		4.3	1	4.3	ug/dL
MSE3-417-(5)-B	MSE3-274	blood	417	6	Test Material 2	5	229.19		5.1	1	5.1	ug/dL
MSE3-404-(5)-B	MSE3-283	blood	404	7	Test Material 2	5	643		6	1	6	ug/dL
MSE3-411-(5)-B	MSE3-263	blood	411	7	Test Material 2	5	830.67		5.9	1	5.9	ug/dL

TABLE A-5

Sample Number	Tag Number	Matrix	Pig Number	Group	Material Administered	Day	Actual Pb BWAdj Dose (ug/kg-d)	Q	Reported Conc (ug/g)	DL	AdjConc (ug/g)	Units
MSE3-413-(5)-B	MSE3-282	blood	413	7	Test Material 2	5	670.31		6.2	1	6.2	ug/dL
MSE3-414-(5)-B	MSE3-287	blood	414	7	Test Material 2	5	657.61		8.6	1	8.6	ug/dL
MSE3-860-(5)-B	MSE3-262	blood	860	7	Test Material 2	5	657.61		5.7	1	5.7	ug/dL
MSE3-409-(7)-B	MSE3-319	blood	409	1	Control	7	0	<	1	1	0.5	ug/dL
MSE3-856-(7)-B	MSE3-321	blood	856	1	Control	7	0	<	1	1	0.5	ug/dL
MSE3-866-(7)-B	MSE3-327	blood	866	1	Control	7	0	<	1	1	0.5	ug/dL
MSE3-402-(7)-B	MSE3-322	blood	402	2	Lead Acetate	7	26.46	<	1	1	0.5	ug/dL
MSE3-405-(7)-B	MSE3-293	blood	405	2	Lead Acetate	7	26.63		2	1	2	ug/dL
MSE3-407-(7)-B	MSE3-302	blood	407	2	Lead Acetate	7	24.98	<	1	1	0.5	ug/dL
MSE3-419-(7)-B	MSE3-305	blood	419	2	Lead Acetate	7	21.3	<	1	1	0.5	ug/dL
MSE3-857-(7)-B	MSE3-316	blood	857	2	Lead Acetate	7	28.98		1	1	1	ug/dL
MSE3-416-(7)-B	MSE3-311	blood	416	3	Lead Acetate	7	78.89		4.9	1	4.9	ug/dL
MSE3-421-(7)-B	MSE3-318	blood	421	3	Lead Acetate	7	83.55		3	1	3	ug/dL
MSE3-401-(7)-B	MSE3-312	blood	401	3	Lead Acetate	7	66.93		3	1	3	ug/dL
MSE3-412-(7)-B	MSE3-323	blood	412	3	Lead Acetate	7	72.01		3	1	3	ug/dL
MSE3-855-(7)-B	MSE3-297	blood	855	3	Lead Acetate	7	90.71		3.7	1	3.7	ug/dL
MSE3-425-(7)-B	MSE3-315	blood	425	4	Lead Acetate	7	236.08		5.2	1	5.2	ug/dL
MSE3-851-(7)-B	MSE3-328	blood	851	4	Lead Acetate	7	245.19		5.1	1	5.1	ug/dL
MSE3-853-(7)-B	MSE3-299	blood	853	4	Lead Acetate	7	223.63		7	1	7	ug/dL
MSE3-863-(7)-B	MSE3-314	blood	863	4	Lead Acetate	7	245.5		6.7	1	6.7	ug/dL
MSE3-867-(7)-B	MSE3-326	blood	867	4	Lead Acetate	7	206.67		3.8	1	3.8	ug/dL
MSE3-408-(7)-B	MSE3-324	blood	408	5	Test Material 2	7	81.44		2	1	2	ug/dL
MSE3-862-(7)-B	MSE3-308	blood	862	5	Test Material 2	7	75.74		3	1	3	ug/dL
MSE3-418-(7)-B	MSE3-298	blood	418	5	Test Material 2	7	66.36		3.5	1	3.5	ug/dL
MSE3-406-(7)-B	MSE3-294	blood	406	5	Test Material 2	7	81.76		3.2	1	3.2	ug/dL
MSE3-422-(7)-B	MSE3-295	blood	422	5	Test Material 2	7	82.64		2	1	2	ug/dL
MSE3-417-(7)-B	MSE3-291	blood	417	6	Test Material 2	7	227.41		5.4	1	5.4	ug/dL
MSE3-854-(7)-B	MSE3-309	blood	854	6	Test Material 2	7	251.44		4.3	1	4.3	ug/dL
MSE3-859-(7)-B	MSE3-300	blood	859	6	Test Material 2	7	229.82		5.3	1	5.3	ug/dL
MSE3-861-(7)-B	MSE3-304	blood	861	6	Test Material 2	7	224.77		4.9	1	4.9	ug/dL
MSE3-864-(7)-B	MSE3-296	blood	864	6	Test Material 2	7	214.77		5.5	1	5.5	ug/dL
MSE3-860-(7)-B	MSE3-301	blood	860	7	Test Material 2	7	666.54		8.4	1	8.4	ug/dL
MSE3-411-(7)-B	MSE3-325	blood	411	7	Test Material 2	7	817.18		7.6	1	7.6	ug/dL
MSE3-413-(7)-B	MSE3-303	blood	413	7	Test Material 2	7	678.81		8.8	1	8.8	ug/dL
MSE3-414-(7)-B	MSE3-306	blood	414	7	Test Material 2	7	663.35		9.6	1	9.6	ug/dL
MSE3-404-(7)-B	MSE3-292	blood	404	7	Test Material 2	7	652.39		8	1	8	ug/dL
MSE3-856-(9)-B	MSE3-344	blood	856	1	Control	9	0	<	1	1	0.5	ug/dL
MSE3-866-(9)-B	MSE3-330	blood	866	1	Control	9	0	<	1	1	0.5	ug/dL
MSE3-409-(9)-B	MSE3-363	blood	409	1	Control	9	0	<	1	1	0.5	ug/dL
MSE3-407-(9)-B	MSE3-357	blood	407	2	Lead Acetate	9	25.69		1	1	1	ug/dL
MSE3-419-(9)-B	MSE3-355	blood	419	2	Lead Acetate	9	21.84		1	1	1	ug/dL
MSE3-405-(9)-B	MSE3-336	blood	405	2	Lead Acetate	9	27.17	<	1	1	0.5	ug/dL
MSE3-402-(9)-B	MSE3-341	blood	402	2	Lead Acetate	9	26.81	<	1	1	0.5	ug/dL
MSE3-857-(9)-B	MSE3-365	blood	857	2	Lead Acetate	9	29.3		1	1	1	ug/dL
MSE3-401-(9)-B	MSE3-353	blood	401	3	Lead Acetate	9	67.43		3	1	3	ug/dL
MSE3-412-(9)-B	MSE3-360	blood	412	3	Lead Acetate	9	73.24		3.3	1	3.3	ug/dL
MSE3-416-(9)-B	MSE3-333	blood	416	3	Lead Acetate	9	79.19		4.8	1	4.8	ug/dL
MSE3-421-(9)-B	MSE3-350	blood	421	3	Lead Acetate	9	83.52		3.1	1	3.1	ug/dL
MSE3-855-(9)-B	MSE3-338	blood	855	3	Lead Acetate	9	90.36		3	1	3	ug/dL
MSE3-851-(9)-B	MSE3-335	blood	851	4	Lead Acetate	9	249.7		5.9	1	5.9	ug/dL
MSE3-867-(9)-B	MSE3-356	blood	867	4	Lead Acetate	9	211.01		5	1	5	ug/dL
MSE3-425-(9)-B	MSE3-331	blood	425	4	Lead Acetate	9	237.78		4.5	1	4.5	ug/dL
MSE3-853-(9)-B	MSE3-343	blood	853	4	Lead Acetate	9	226.95		6.6	1	6.6	ug/dL
MSE3-863-(9)-B	MSE3-349	blood	863	4	Lead Acetate	9	248.18		10	1	10	ug/dL
MSE3-406-(9)-B	MSE3-362	blood	406	5	Test Material 2	9	82.51		3	1	3	ug/dL
MSE3-408-(9)-B	MSE3-354	blood	408	5	Test Material 2	9	82.3		3	1	3	ug/dL
MSE3-418-(9)-B	MSE3-364	blood	418	5	Test Material 2	9	67.82		3	1	3	ug/dL
MSE3-422-(9)-B	MSE3-348	blood	422	5	Test Material 2	9	83.77		2	1	2	ug/dL
MSE3-862-(9)-B	MSE3-339	blood	862	5	Test Material 2	9	77.11		3.7	1	3.7	ug/dL
MSE3-854-(9)-B	MSE3-359	blood	854	6	Test Material 2	9	258.04		5.5	1	5.5	ug/dL
MSE3-864-(9)-B	MSE3-358	blood	864	6	Test Material 2	9	220.49		4.5	1	4.5	ug/dL
MSE3-859-(9)-B	MSE3-347	blood	859	6	Test Material 2	9	233.83		5.6	1	5.6	ug/dL
MSE3-417-(9)-B	MSE3-352	blood	417	6	Test Material 2	9	233.83		5.6	1	5.6	ug/dL
MSE3-861-(9)-B	MSE3-337	blood	861	6	Test Material 2	9	231.83		6.7	1	6.7	ug/dL
MSE3-404-(9)-B	MSE3-345	blood	404	7	Test Material 2	9	666.98		9.4	1	9.4	ug/dL
MSE3-411-(9)-B	MSE3-346	blood	411	7	Test Material 2	9	817.23		9.3	1	9.3	ug/dL

TABLE A-5

Sample Number	Tag Number	Matrix	Pig Number	Group	Material Administered	Day	Actual Pb BWAdj Dose (ug/kg-d)	Q	Reported Conc (ug/g)	DL	AdjConc (ug/g)	Units
MSE3-413-(9)-B	MSE3-334	blood	413	7	Test Material 2	9	695.03		9.5	1	9.5	ug/dL
MSE3-414-(9) B	MSE3-340	blood	414	7	Test Material 2	9	674.54		8.6	1	8.6	ug/dL
MSE3-860-(9)-B	MSE3-329	blood	860	7	Test Material 2	9	683.84		7.6	1	7.6	ug/dL
MSE3-856-(12)-B	MSE3-367	blood	856	1	Control	12	0	<	1	1	0.5	ug/dL
MSE3-409-(12)-B	MSE3-389	blood	409	1	Control	12	0	<	1	1	0.5	ug/dL
MSE3-866-(12)-B	MSE3-378	blood	866	1	Control	12	0	<	1	1	0.5	ug/dL
MSE3-405-(12)-B	MSE3-372	blood	405	2	Lead Acetate	12	27.48		2	1	2	ug/dL
MSE3-857-(12)-B	MSE3-381	blood	857	2	Lead Acetate	12	28.85		2	1	2	ug/dL
MSE3-407-(12)-B	MSE3-396	blood	407	2	Lead Acetate	12	25.74		1	1	1	ug/dL
MSE3-402-(12)-B	MSE3-400	blood	402	2	Lead Acetate	12	26.62		1	1	1	ug/dL
MSE3-419-(12)-B	MSE3-394	blood	419	2	Lead Acetate	12	21.82		2	1	2	ug/dL
MSE3-416-(12)-B	MSE3-368	blood	416	3	Lead Acetate	12	77.79		5.7	1	5.7	ug/dL
MSE3-401-(12)-B	MSE3-401	blood	401	3	Lead Acetate	12	67.9		3.3	1	3.3	ug/dL
MSE3-412-(12)-B	MSE3-404	blood	412	3	Lead Acetate	12	73.64		5	1	5	ug/dL
MSE3-421-(12)-B	MSE3-375	blood	421	3	Lead Acetate	12	82.16		3.9	1	3.9	ug/dL
MSE3-855-(12)-B	MSE3-395	blood	855	3	Lead Acetate	12	89.39		3.2	1	3.2	ug/dL
MSE3-425-(12)-B	MSE3-377	blood	425	4	Lead Acetate	12	235.32		5	1	5	ug/dL
MSE3-851-(12)-B	MSE3-385	blood	851	4	Lead Acetate	12	252.76		6.8	1	6.8	ug/dL
MSE3-867-(12)-B	MSE3-384	blood	867	4	Lead Acetate	12	212.53		5.5	1	5.5	ug/dL
MSE3-853-(12)-B	MSE3-369	blood	853	4	Lead Acetate	12	226.19		6.9	1	6.9	ug/dL
MSE3-863-(12)-B	MSE3-393	blood	863	4	Lead Acetate	12	246.03		9.7	1	9.7	ug/dL
MSE3-406-(12)-B	MSE3-370	blood	406	5	Test Material 2	12	81.28		3.3	1	3.3	ug/dL
MSE3-408-(12)-B	MSE3-376	blood	408	5	Test Material 2	12	81.65		2	1	2	ug/dL
MSE3-418-(12)-B	MSE3-382	blood	418	5	Test Material 2	12	68.87		3.4	1	3.4	ug/dL
MSE3-422-(12)-B	MSE3-392	blood	422	5	Test Material 2	12	83.56		3	1	3	ug/dL
MSE3-862-(12)-B	MSE3-386	blood	862	5	Test Material 2	12	76.32		3.9	1	3.9	ug/dL
MSE3-854-(12)-B	MSE3-390	blood	854	6	Test Material 2	12	257.63		5.7	1	5.7	ug/dL
MSE3-864-(12)-B	MSE3-383	blood	864	6	Test Material 2	12	218.41		3.9	1	3.9	ug/dL
MSE3-859-(12)-B	MSE3-391	blood	859	6	Test Material 2	12	229.88		6.1	1	6.1	ug/dL
MSE3-417-(12)-B	MSE3-402	blood	417	6	Test Material 2	12	235.67		6.7	1	6.7	ug/dL
MSE3-861-(12)-B	MSE3-379	blood	861	6	Test Material 2	12	229.11		7	1	7	ug/dL
MSE3-404-(12)-B	MSE3-374	blood	404	7	Test Material 2	12	667.31		9.6	1	9.6	ug/dL
MSE3-411-(12)-B	MSE3-397	blood	411	7	Test Material 2	12	789.15		9.6	1	9.6	ug/dL
MSE3-413-(12)-B	MSE3-387	blood	413	7	Test Material 2	12	687.25		10	1	10	ug/dL
MSE3-414-(12)-B	MSE3-398	blood	414	7	Test Material 2	12	665.93		11	1	11	ug/dL
MSE3-860-(12)-B	MSE3-399	blood	860	7	Test Material 2	12	684.33		8.7	1	8.7	ug/dL
MSE3-866-(15)-B	MSE3-440	blood	866	1	Control	15	0	<	1	1	0.5	ug/dL
MSE3-409-(15)-B	MSE3-407	blood	409	1	Control	15	0	<	1	1	0.5	ug/dL
MSE3-856-(15)-B	MSE3-438	blood	856	1	Control	15	0	<	1	1	0.5	ug/dL
MSE3-407-(15)-B	MSE3-433	blood	407	2	Lead Acetate	15	25		1	1	1	ug/dL
MSE3-419-(15)-B	MSE3-428	blood	419	2	Lead Acetate	15	21.32		1	1	1	ug/dL
MSE3-857-(15)-B	MSE3-415	blood	857	2	Lead Acetate	15	28.98		1	1	1	ug/dL
MSE3-405-(15)-B	MSE3-431	blood	405	2	Lead Acetate	15	26.7		2	1	2	ug/dL
MSE3-402-(15)-B	MSE3-419	blood	402	2	Lead Acetate	15	26.43	<	1	1	0.5	ug/dL
MSE3-401-(15)-B	MSE3-409	blood	401	3	Lead Acetate	15	66.8		3	1	3	ug/dL
MSE3-421-(15)-B	MSE3-422	blood	421	3	Lead Acetate	15	83.09		4.6	1	4.6	ug/dL
MSE3-855-(15)-B	MSE3-418	blood	855	3	Lead Acetate	15	89.23		2	1	2	ug/dL
MSE3-412-(15)-B	MSE3-420	blood	412	3	Lead Acetate	15	71.21		3.6	1	3.6	ug/dL
MSE3-416-(15)-B	MSE3-405	blood	416	3	Lead Acetate	15	76.98		6.5	1	6.5	ug/dL
MSE3-851-(15)-B	MSE3-434	blood	851	4	Lead Acetate	15	246.72		6	1	6	ug/dL
MSE3-425-(15)-B	MSE3-406	blood	425	4	Lead Acetate	15	235.35		5.5	1	5.5	ug/dL
MSE3-853-(15)-B	MSE3-412	blood	853	4	Lead Acetate	15	221.5		7.9	1	7.9	ug/dL
MSE3-863-(15)-B	MSE3-429	blood	863	4	Lead Acetate	15	244.32		10	1	10	ug/dL
MSE3-867-(15)-B	MSE3-437	blood	867	4	Lead Acetate	15	206.5		6.8	1	6.8	ug/dL
MSE3-862-(15)-B	MSE3-416	blood	862	5	Test Material 2	15	74.88		4	1	4	ug/dL
MSE3-408-(15)-B	MSE3-417	blood	408	5	Test Material 2	15	81.19		4	1	4	ug/dL
MSE3-418-(15)-B	MSE3-430	blood	418	5	Test Material 2	15	66.54		5.9	1	5.9	ug/dL
MSE3-422-(15)-B	MSE3-427	blood	422	5	Test Material 2	15	82.31		3.4	1	3.4	ug/dL
MSE3-406-(15)-B	MSE3-426	blood	406	5	Test Material 2	15	81.97		3.6	1	3.6	ug/dL
MSE3-854-(15)-B	MSE3-441	blood	854	6	Test Material 2	15	252.97		6.2	1	6.2	ug/dL
MSE3-859-(15)-B	MSE3-425	blood	859	6	Test Material 2	15	230.04		6.3	1	6.3	ug/dL
MSE3-861-(15)-B	MSE3-423	blood	861	6	Test Material 2	15	223.43		7.2	1	7.2	ug/dL
MSE3-864-(15)-B	MSE3-424	blood	864	6	Test Material 2	15	216		4.4	1	4.4	ug/dL
MSE3-417-(15)-B	MSE3-435	blood	417	6	Test Material 2	15	231.04		5.7	1	5.7	ug/dL
MSE3-404-(15)-B	MSE3-436	blood	404	7	Test Material 2	15	645.85		10	1	10	ug/dL
MSE3-411-(15)-B	MSE3-413	blood	411	7	Test Material 2	15	809.26		10	1	10	ug/dL

TABLE A-5

Sample Number	Tag Number	Matrix	Pig Number	Group	Material Administered	Day	Actual Pb BWAdj Dose (ug/kg-d)	Q	Reported Conc (ug/g)	DL	AdjConc (ug/g)	Units
MSE3-860-(15)-B	MSE3-421	blood	860	7	Test Material 2	15	672.54		8	1	8	ug/dL
MSE3-413-(15)-B	MSE3-414	blood	413	7	Test Material 2	15	672.06		10	1	10	ug/dL
MSE3-414-(15)-B	MSE3-410	blood	414	7	Test Material 2	15	665.24		10	1	10	ug/dL

Actual BW Adj Dose. Values presented are for individual dosing days only; average doses over the course of the study are presented in Table A-3, as well as Table 2-1 in the main text.

Reported Conc: Accounts for all dilutions in sample preparation and analysis

AdjConc (Adjusted Concentration). Non-detects evaluated at 1/2 the quantitation limit (DL)

TABLE A-6

LEAD ANALYTICAL RESULTS FOR QUALITY ASSURANCE SAMPLES

Laboratory Control Standards

QC Std ID	QC Std Conc	DL	Unadjusted Pb Conc	Percent Recovery
CDC 294	1.9 µg/L	1	< 1 µg/L	NA
CDC 294	1.9 µg/L	1	2 µg/L	105.3%
CDC 294	1.9 µg/L	1	2 µg/L	105.3%
CDC 294	1.9 µg/L	1	2 µg/L	105.3%
CDC 294	1.9 µg/L	1	2 µg/L	105.3%
CDC 294	1.9 µg/L	1	2 µg/L	105.3%
CDC 690	4.8 µg/L	1	4 µg/L	83.3%
CDC 690	4.8 µg/L	1	4.2 µg/L	87.5%
CDC 690	4.8 µg/L	1	4.1 µg/L	85.4%
CDC 690	4.8 µg/L	1	4.2 µg/L	87.5%
CDC 690	4.8 µg/L	1	3.8 µg/L	79.2%
CDC 690	4.8 µg/L	1	3.8 µg/L	79.2%
CDC 690	4.8 µg/L	1	4.2 µg/L	87.5%
CDC 690	4.8 µg/L	1	3.6 µg/L	75.0%
CDC 690	4.8 µg/L	1	4.2 µg/L	87.5%
CDC 690	4.8 µg/L	1	3.8 µg/L	79.2%
CDC 690	4.8 µg/L	1	3.9 µg/L	81.3%
NIST 1400	9.07 ± 0.12 µg/g	0.4	9.5 µg/g	104.7%
NIST 1400	9.07 ± 0.12 µg/g	0.4	8.4 µg/g	92.6%
NRCC Dot-3	0.319 ± 0.045 µg/g	0.01	0.29 µg/g	90.9%
NRCC Dot-3	0.319 ± 0.045 µg/g	0.02	0.34 µg/g	106.6%
NRCC TORT-2	0.35 ± 0.13 µg/g	0.03	0.3 µg/g	85.7%
NRCC TORT-2	0.35 ± 0.13 µg/g	0.03	0.3 µg/g	85.7%
NRCC TORT-2	0.35 ± 0.13 µg/g	0.01	0.26 µg/g	74.3%
NRCC TORT-2	0.35 ± 0.13 µg/g	0.01	0.26 µg/g	74.3%

Analytical Duplicates (Post-Digestion)

Sample Number	Matrix	Units	Pb Conc (duplicate)	Original Conc	Relative Difference
MSE3-102	blood	µg/L	<1	<1	within 1
MSE3-111	blood	µg/L	<1	<1	within 1
MSE3-123	blood	µg/L	<1	<1	within 1
MSE3-132	blood	µg/L	<1	<1	within 1
MSE3-143	blood	µg/L	<1	<1	within 1
MSE3-152	blood	µg/L	2	2	within 1
MSE3-162	blood	µg/L	2	2	within 1
MSE3-172	blood	µg/L	3.5	3.4	within 1
MSE3-182	blood	µg/L	3.5	3.8	within 1
MSE3-192	blood	µg/L	3	2	within 1
MSE3-202	blood	µg/L	<1	<1	within 1
MSE3-212	blood	µg/L	2	3	within 1
MSE3-222	blood	µg/L	2	2	within 1
MSE3-232	blood	µg/L	2	1	within 1
MSE3-242	blood	µg/L	3.4	3.1	within 1
MSE3-252	blood	µg/L	2	2	within 1
MSE3-264	blood	µg/L	1	1	within 1
MSE3-272	blood	µg/L	4.4	4.3	within 1
MSE3-282	blood	µg/L	6.3	4.2	within 1
MSE3-292	blood	µg/L	8	8	within 1
MSE3-302	blood	µg/L	1	<1	within 1
MSE3-312	blood	µg/L	3	3	within 1
MSE3-322	blood	µg/L	<1	<1	within 1
MSE3-332	blood	µg/L	4.4	4.6	within 1
MSE3-342	blood	µg/L	<1	<1	within 1
MSE3-351	blood	µg/L	<1	<1	within 1
MSE3-362	blood	µg/L	3.1	3	within 1
MSE3-371	blood	µg/L	4.3	4.2	within 1
MSE3-382	blood	µg/L	3.7	3.4	within 1
MSE3-391	blood	µg/L	8.3	6.1	**
MSE3-402	blood	µg/L	7.2	6.7	within 1
MSE3-411	blood	µg/L	11	10	9.5%
MSE3-423	blood	µg/L	8.4	7.2	**
MSE3-432	blood	µg/L	12	13	8.0%
MSE3-443	liver	µg/g	0.55	0.55	0.0%
MSE3-452	liver	µg/g	0.17	0.18	5.7%
MSE3-464	liver	µg/g	0.34	0.28	19.4%
MSE3-475	liver	µg/g	0.23	0.22	4.4%
MSE3-482	kidney	µg/g	0.59	0.61	3.3%
MSE3-485	kidney	µg/g	0.27	0.26	3.8%
MSE3-491	kidney	µg/g	0.14	0.14	0.0%
MSE3-509	kidney	µg/g	0.03	0.02	within 1
MSE3-517	femur	µg/g	3.6	3.3	within 1
MSE3-526	femur	µg/g	4.8	4.2	13.3%
MSE3-536	femur	µg/g	7.9	7.1	10.7%
MSE3-544	femur	µg/g	1	1	within 1

** Duplicate difference greater than one times the Detection Limit

Analytical Spikes

Sample Number	Matrix	Nominal Pb Spike (ug/L)	Pb Conc (spiked sample)	Original Conc	Units	Percent Recovery
MSE3-107	blood	20	19	<1	µg/L	95%
MSE3-116	blood	20	20	<1	µg/L	100%
MSE3-126	blood	20	18	<1	µg/L	90%
MSE3-137	blood	20	18	<1	µg/L	90%
MSE3-148	blood	20	18	<1	µg/L	90%
MSE3-157	blood	20	19	<1	µg/L	95%
MSE3-164	blood	20	21	2	µg/L	95%
MSE3-177	blood	20	20	<1	µg/L	100%
MSE3-188	blood	20	20	<1	µg/L	100%
MSE3-197	blood	20	20	<1	µg/L	100%
MSE3-207	blood	20	20	<1	µg/L	100%
MSE3-217	blood	20	21	1	µg/L	100%
MSE3-227	blood	20	23	4.7	µg/L	92%
MSE3-236	blood	20	21	2	µg/L	95%
MSE3-246	blood	20	24	4.4	µg/L	98%
MSE3-257	blood	20	21	<1	µg/L	105%
MSE3-267	blood	20	18	<1	µg/L	90%
MSE3-276	blood	20	18	<1	µg/L	90%
MSE3-286	blood	20	22	3	µg/L	95%
MSE3-296	blood	20	23	5.5	µg/L	88%
MSE3-306	blood	20	28	9.6	µg/L	92%
MSE3-316	blood	20	20	1	µg/L	95%
MSE3-326	blood	20	22	3.8	µg/L	91%
MSE3-336	blood	20	19	<1	µg/L	95%
MSE3-346	blood	20	17	<1.3	µg/L	85%
MSE3-356	blood	20	23	5	µg/L	90%
MSE3-366	blood	20	21	1	µg/L	100%
MSE3-376	blood	20	22	2	µg/L	100%
MSE3-386	blood	20	23	3.9	µg/L	96%
MSE3-396	blood	20	21	1	µg/L	100%
MSE3-406	blood	20	23	5.5	µg/L	88%
MSE3-416	blood	20	21	4	µg/L	85%
MSE3-427	blood	20	21	3.4	µg/L	88%
MSE3-438	blood	20	18	<1	µg/L	90%
MSE3-448	liver	0.288	0.46	0.17	µg/g	101%
MSE3-458	liver	0.304	0.38	0.044	µg/g	111%
MSE3-468	liver	0.266	0.49	0.18	µg/g	109%
MSE3-462	liver	0.291	0.68	0.36	µg/g	**
MSE3-464	liver	0.297	0.62	0.28	µg/g	115%
MSE3-473	liver	0.304	0.42	0.095	µg/g	107%
MSE3-475	liver	0.304	0.55	0.22	µg/g	109%
MSE3-495	kidney	0.304	0.35	0.03	µg/g	105%
MSE3-496	kidney	0.291	0.35	0.02	µg/g	113%
MSE3-498	kidney	0.300	0.35	0.02	µg/g	110%
MSE3-504	kidney	0.297	0.4	0.065	µg/g	103%
MSE3-506	kidney	0.309	0.47	0.15	µg/g	104%
MSE3-510	kidney	0.300	0.92	0.56	µg/g	**
MSE3-511	kidney	0.288	0.47	0.21	µg/g	**
MSE3-521	femur	150	170	15	µg/g	103%
MSE3-531	femur	150	150	<0.4	µg/g	100%
MSE3-539	femur	150	160	1	µg/g	105%
MSE3-548	femur	150	175	9.6	µg/g	111%

** indicates spike too low

TABLE A-6

Sample Preparation Replicates

Tag Number	Matrix	Pig Number	Original Pig #	Group	Material Administered	Target Dose (ug/kg-d)	Collection Day	Q	DL	Pb Conc	AdjConc	Original AdjConc
MSE3-454	liver	2855	855	3	Lead Acetate	75	15		0	0.078	0.078 ug/g	0.087
MSE3-459	liver	2864	864	6	Test Material 2	225	15		0	0.18	0.18 ug/g	0.18
MSE3-443	liver	2860	860	7	Test Material 2	675	15		0	0.55	0.55 ug/g	0.5
MSE3-486	kidney	2857	857	2	Lead Acetate	25	15		0	0.02	0.02 ug/g	0.02
MSE3-502	kidney	2867	867	4	Lead Acetate	225	15		0	0.27	0.27 ug/g	0.26
MSE3-484	kidney	2862	862	5	Test Material 2	75	15		0	0.079	0.079 ug/g	0.060
MSE3-544	femur	2405	405	2	Lead Acetate	25	15		0.4	1	1 ug/g	1
MSE3-517	femur	2408	408	5	Test Material 2	75	15		0.4	3.3	3.3 ug/g	3.1
MSE3-530	femur	2411	411	7	Test Material 2	675	15		0.4	22	22 ug/g	23
MSE3-129	blood	2401	401	3	Lead Acetate	75	0	<	1	1	0.5 ug/dL	0.5
MSE3-120	blood	2425	425	4	Lead Acetate	225	0	<	1	1	0.5 ug/dL	0.5
MSE3-103	blood	2404	404	7	Test Material 2	675	0	<	1	1	0.5 ug/dL	0.5
MSE3-139	blood	2402	402	2	Lead Acetate	25	1	<	1	1	0.5 ug/dL	0.5
MSE3-153	blood	2406	406	5	Test Material 2	75	1		1	1	1 ug/dL	0.5
MSE3-143	blood	2417	417	6	Test Material 2	225	1	<	1	1	0.5 ug/dL	0.5
MSE3-208	blood	2409	409	1	Control	0	2	<	1	1	0.5 ug/dL	0.5
MSE3-183	blood	2412	412	3	Lead Acetate	75	2	<	1	1	0.5 ug/dL	0.5
MSE3-213	blood	2411	411	7	Test Material 2	675	2		1	2	2 ug/dL	3
MSE3-219	blood	2851	851	4	Lead Acetate	225	3		1	1	1 ug/dL	1
MSE3-218	blood	2408	408	5	Test Material 2	75	3		1	1	1 ug/dL	0.5
MSE3-249	blood	2413	413	7	Test Material 2	675	3		1	6.3	6.3 ug/dL	6.2
MSE3-261	blood	2405	405	2	Lead Acetate	25	5		1	2	2 ug/dL	1
MSE3-289	blood	2416	416	3	Lead Acetate	75	5		1	3.7	3.7 ug/dL	3.3
MSE3-275	blood	2854	854	6	Test Material 2	225	5		1	4.3	4.3 ug/dL	4.3
MSE3-307	blood	2853	853	4	Lead Acetate	225	7		1	6.2	6.2 ug/dL	7
MSE3-310	blood	2418	418	5	Test Material 2	75	7		1	3.2	3.2 ug/dL	3.5
MSE3-317	blood	2859	859	6	Test Material 2	225	7		1	5.1	5.1 ug/dL	5.3
MSE3-351	blood	2856	856	1	Control	0	9	<	1	1	0.5 ug/dL	0.5
MSE3-342	blood	2407	407	2	Lead Acetate	25	9	<	1	1	0.5 ug/dL	1
MSE3-361	blood	2414	414	7	Test Material 2	675	9		1	10	10 ug/dL	8.6
MSE3-403	blood	2866	866	1	Control	0	12	<	1	1	0.5 ug/dL	0.5
MSE3-371	blood	2421	421	3	Lead Acetate	75	12		1	4.2	4.2 ug/dL	3.9
MSE3-373	blood	2422	422	5	Test Material 2	75	12		1	3	3 ug/dL	3
MSE3-442	blood	2419	419	2	Lead Acetate	25	15		1	2	2 ug/dL	1
MSE3-411	blood	2863	863	4	Lead Acetate	225	15		1	10	10 ug/dL	10
MSE3-408	blood	2861	861	6	Test Material 2	225	15		1	8.5	8.5 ug/dL	7.2

Blood Lead Check Samples

Tag Number	Matrix	CDC Blood Lead Check Sample	CDC Concentration	Pb Conc	Q	DL	AdjConc
MSE3-253	blood	CDC BLLRS sample 294	1.9 µg/dL	2		1	2 ug/dL
MSE3-162	blood	CDC BLLRS sample 294	1.9 µg/dL	2		1	2 ug/dL
MSE3-380	blood	CDC BLLRS sample 294	1.9 µg/dL	2		1	2 ug/dL
MSE3-366	blood	CDC BLLRS sample 294	1.9 µg/dL	1		1	1 ug/dL
MSE3-181	blood	CDC BLLRS sample 294	1.9 µg/dL	2		1	2 ug/dL
MSE3-110	blood	CDC BLLRS sample 199	5.5 µg/dL	5.1		1	5.1 ug/dL
MSE3-180	blood	CDC BLLRS sample 199	5.5 µg/dL	5		1	5 ug/dL
MSE3-227	blood	CDC BLLRS sample 199	5.5 µg/dL	4.7		1	4.7 ug/dL
MSE3-320	blood	CDC BLLRS sample 199	5.5 µg/dL	4.5		1	4.5 ug/dL
MSE3-332	blood	CDC BLLRS sample 199	5.5 µg/dL	4.6		1	4.6 ug/dL
MSE3-439	blood	CDC BLLRS sample 199	5.5 µg/dL	4.7		1	4.7 ug/dL
MSE3-432	blood	CDC BLLRS sample 592	13.9 µg/dL	13		1	13 ug/dL
MSE3-101	blood	CDC BLLRS sample 592	13.9 µg/dL	13		1	13 ug/dL
MSE3-234	blood	CDC BLLRS sample 592	13.9 µg/dL	13		1	13 ug/dL
MSE3-313	blood	CDC BLLRS sample 592	13.9 µg/dL	12		1	12 ug/dL
MSE3-175	blood	CDC BLLRS sample 592	13.9 µg/dL	13		1	13 ug/dL
MSE3-328	blood	CDC BLLRS sample 592	13.9 µg/dL	12		1	12 ug/dL
MSE3-284	blood	CDC BLLRS sample 592	13.9 µg/dL	12		1	12 ug/dL

AdjConc (Adjusted Concentration): Non-detects evaluated at 1/2 the quantitation limit (DL).

TABLE A-7 IDENTIFICATION OF POTENTIAL BLOOD LEAD OUTLIERS

Material Administered	Group	Pig Number	Target Dose	Actual Dose*	Blood Lead (µg/dL) by Day								
					0	1	2	3	5	7	9	12	15
Lead Acetate	2	402	25	26.43	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5
Lead Acetate	2	405	25	26.70	0.5	0.5	0.5	0.5	1.0	2.0	0.5	2.0	2.0
Lead Acetate	2	407	25	25.00	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0
Lead Acetate	2	419	25	21.32	0.5	0.5	0.5	0.5	0.5	0.5	1.0	2.0	1.0
Lead Acetate	2	857	25	28.98	0.5	0.5	0.5	0.5	0.5	1.0	1.0	2.0	1.0
Lead Acetate	3	401	75	66.80	0.5	0.5	0.5	2.0	3.1	3.0	3.0	3.3	3.0
Lead Acetate	3	412	75	71.21	0.5	0.5	0.5	1.0	2.0	3.0	3.3	5.0	3.6
Lead Acetate	3	416	75	76.98	0.5	0.5	0.5	1.0	3.3	4.9	4.8	5.7	6.5
Lead Acetate	3	421	75	83.09	0.5	0.5	0.5	1.0	3.0	3.0	3.1	3.9	4.6
Lead Acetate	3	855	75	89.23	0.5	0.5	0.5	2.0	3.0	3.7	3.0	3.2	2.0
Lead Acetate	4	425	225	235.35	0.5	1.0	2.0	3.0	4.0	5.2	4.5	5.0	5.5
Lead Acetate	4	851	225	246.72	0.5	1.0	1.0	1.0	4.0	5.1	5.9	6.8	6.0
Lead Acetate	4	853	225	221.50	0.5	3.4	3.4	4.4	5.3	7.0	6.6	6.9	7.9
Lead Acetate	4	863	225	244.32	0.5	2.0	6.8	3.1	6.5	6.7	10.0	9.7	10.0
Lead Acetate	4	867	225	206.50	0.5	2.0	2.0	3.0	4.3	3.8	5.0	5.5	6.8
Test Material 2	5	406	75	81.97	0.5	0.5	0.5	0.5	3.0	3.2	3.0	3.3	3.6
Test Material 2	5	408	75	81.19	0.5	0.5	0.5	0.5	2.0	2.0	3.0	2.0	4.0
Test Material 2	5	418	75	66.54	0.5	0.5	0.5	0.5	2.0	3.5	3.0	3.4	5.9
Test Material 2	5	422	75	82.31	0.5	0.5	0.5	0.5	1.0	2.0	2.0	3.0	3.4
Test Material 2	5	862	75	74.88	0.5	0.5	1.0	2.0	3.0	3.0	3.7	3.9	4.0
Test Material 2	6	417	225	231.04	0.5	0.5	1.0	2.0	5.1	5.4	5.6	6.7	5.7
Test Material 2	6	854	225	252.97	0.5	2.0	2.0	2.0	4.3	4.3	5.5	5.7	6.2
Test Material 2	6	859	225	230.04	0.5	1.0	2.0	3.4	4.3	5.3	5.6	6.1	6.3
Test Material 2	6	861	225	223.43	0.5	1.0	3.0	3.1	4.8	4.9	6.7	7.0	7.2
Test Material 2	6	864	225	216.00	0.5	2.0	2.0	2.0	3.5	5.5	4.5	3.9	4.4
Test Material 2	7	404	675	645.85	0.5	2.0	3.8	3.4	6.0	8.0	9.4	9.6	10.0
Test Material 2	7	411	675	809.26	0.5	0.5	3.0	3.0	5.9	7.6	9.3	9.6	10.0
Test Material 2	7	413	675	672.06	0.5	6.0	7.1	6.2	6.2	8.8	9.5	10.0	10.0
Test Material 2	7	414	675	665.24	0.5	4.0	5.0	7.3	8.6	9.6	8.6	11.0	10.0
Test Material 2	7	860	675	672.54	0.5	3.0	3.3	4.5	5.7	8.4	7.6	8.7	8.0
Control	1	409	0	0.00	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Control	1	856	0	0.00	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Control	1	866	0	0.00	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

*Average body weight-adjusted dose for each pig over the course of the study (days 0-14).

Dose units: ug/kg-d

Data point flagged as potential outlier (group mean < 5 µg/dL)

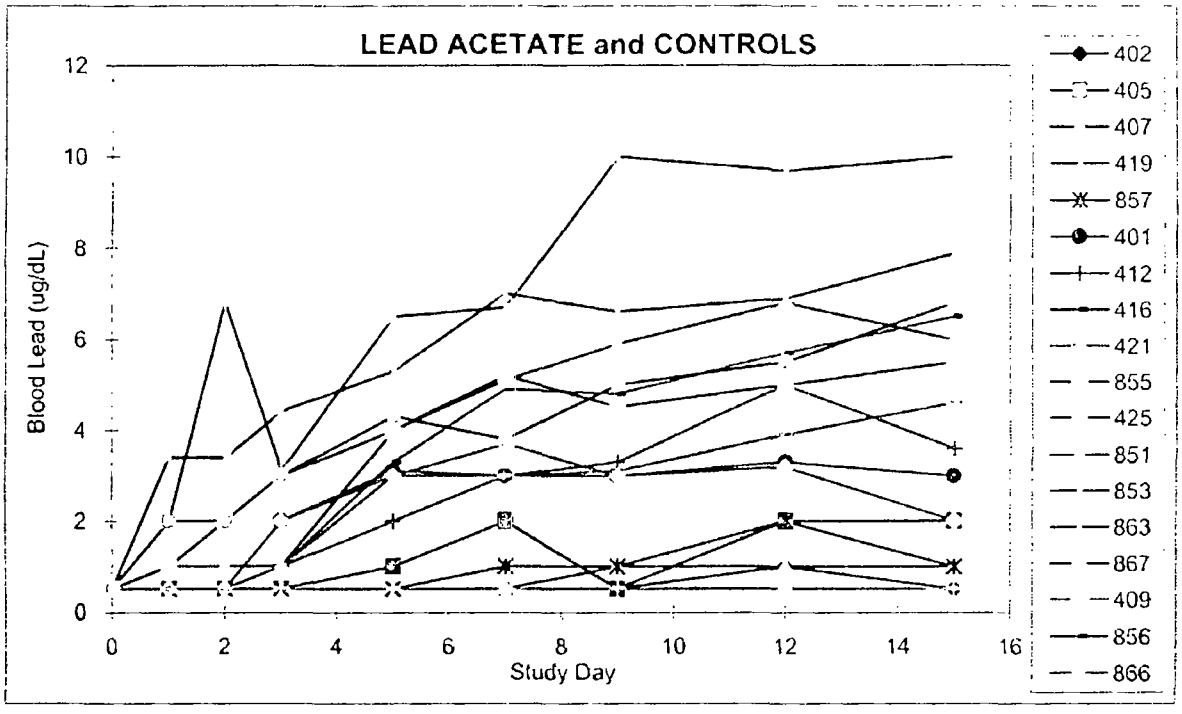
Data point flagged as potential outlier (group mean > 5 µg/dL)

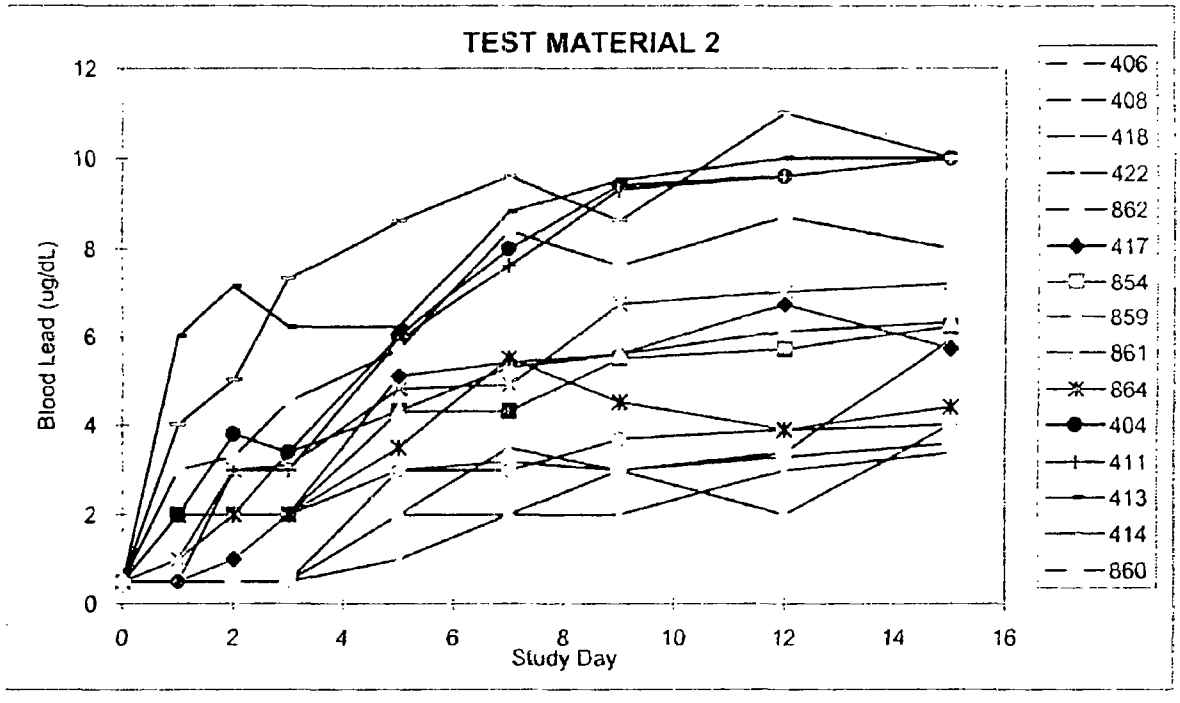
Data point judged to be outlier; excluded from further analyses

TABLE A-8 AREA UNDER CURVE DETERMINATIONS

Group	Pig Number	AUC (µg/dL-days) for Time Interval Shown								AUC Total (µg/dL-days)
		0-1	1-2	2-3	3-5	5-7	7-9	9-12	12-15	
2	402	0.50	0.50	0.50	1.00	1.00	1.00	2.25	2.25	9.00
2	405	0.50	0.50	0.50	1.50	3.00	2.50	3.75	6.00	18.25
2	407	0.50	0.50	0.50	1.00	1.00	1.50	3.00	3.00	11.00
2	419	0.50	0.50	0.50	1.00	1.00	1.50	4.50	4.50	14.00
2	857	0.50	0.50	0.50	1.00	1.50	2.00	4.50	4.50	15.00
3	401	0.50	0.50	1.25	5.10	6.10	6.00	9.45	9.45	38.35
3	412	0.50	0.50	0.75	3.00	5.00	6.30	12.45	12.90	41.40
3	416	0.50	0.50	0.75	4.30	8.20	9.70	15.75	18.30	58.00
3	421	0.50	0.50	0.75	4.00	6.00	6.10	10.50	12.75	41.10
3	855	0.50	0.50	1.25	5.00	6.70	6.70	9.30	7.80	37.75
4	425	0.75	1.50	2.50	7.00	9.20	9.70	14.25	15.75	60.65
4	851	0.75	1.00	1.00	5.00	9.10	11.00	19.05	19.20	66.10
4	853	1.95	3.40	3.90	9.70	12.30	13.60	20.25	22.20	87.30
4	863	1.25	2.28	2.83	9.60	13.20	16.70	29.55	29.55	104.95
4	867	1.25	2.00	2.50	7.30	8.10	8.80	15.75	18.45	64.15
5	406	0.50	0.50	0.50	3.50	6.20	6.20	9.45	10.35	37.20
5	408	0.50	0.50	0.50	2.50	4.00	5.00	7.50	9.00	29.50
5	418	0.50	0.50	0.50	2.50	5.50	6.50	9.60	13.95	39.55
5	422	0.50	0.50	0.50	1.50	3.00	4.00	7.50	9.60	27.10
5	862	0.50	0.75	1.50	5.00	6.00	6.70	11.40	11.85	43.70
6	417	0.50	0.75	1.50	7.10	10.50	11.00	18.45	18.60	68.40
6	854	1.25	2.00	2.00	6.30	8.60	9.80	16.80	17.85	64.60
6	859	0.75	1.50	2.70	7.70	9.60	10.90	17.55	18.60	69.30
6	861	0.75	2.00	3.05	7.90	9.70	11.60	20.55	21.30	76.85
6	864	1.25	2.00	2.00	5.50	9.00	10.00	12.60	12.45	54.80
7	404	1.25	2.90	3.60	9.40	14.00	17.40	28.50	29.40	106.45
7	411	0.50	1.75	3.00	8.90	13.50	16.90	28.35	29.40	102.30
7	413	3.25	6.55	6.65	12.40	15.00	18.30	29.25	30.00	121.40
7	414	2.25	4.50	6.15	15.90	18.20	18.20	29.40	31.50	126.10
7	860	1.75	3.15	3.90	10.20	14.10	16.00	24.45	25.05	98.60
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	409	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
1	856	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50
1	866	0.50	0.50	0.50	1.00	1.00	1.00	1.50	1.50	7.50

FIGURE A-1 BLOOD LEAD DATA BY DAY





APPENDIX D

Data from Drexler—12-Month Sample (2006)

Laboratory of Environment and Geological Sciences, University of Colorado, Boulder

Project Name: *Herculaneum Lead Smelter Test*

Run #: 1 Date: 7/6/2006 Operat0r: RICE

Position in rack	Sample name	Lab#	Wt. Grams	pH start	Starting time	Stopping time	pH stop
1	HER-3201		1.00133	1.511	11:30	12:30	1.509
2	HER-3201 DUP		1.00205	1.511	11:30	12:30	1.51
3	HER-3201 TRIP		1.00027	1.511	11:30	12:30	1.511
4	blank			1.511	11:30	12:30	1.505
5	blank spk			1.511	11:30	12:30	1.497
6							
7							
8							
9							
10							

TABLE 2. Preliminary Summary Of In Vitro Bioassay Results

Sample	ID	Pb in <250u bulk soil mg/kg	mass soil (g)	calc Pb #1	ICP Pb (mg/l)	solution amt (l)	% Relative Pb Bioavail ability	
HER-3201		2131	1.00133	2.13383	19.17	0.1	90	
QA/QC								
HER-3201 DUP		2131	1.00205	2.13537	19.096	0.1	89	
HER-3201 TRIP		2131	1.00027	2.13158	18.626	0.1	87	
Process Blank					0.014			stddev
Blank Spike					2.526			
% Spike Recovery					101.05%			
Machine Detection Limit (MDL)					0.00009			

	Pb ppm
Bulk analysis provided by client	
HER-3201	2131

	Pb ppb	Pb ppm
HER-3201	19170	19.170
HER-3201 DUP	19096	19.096
HER-3201 TRIP	18626	18.626
blank	14	0.014
blank spk	2526	2.526