LEGACY LEAD AND ARSENATE SOIL CONTAMINATION AT CHILDCARE CENTERS IN THE YAKIMA VALLEY, CENTRAL WASHINGTON

A Thesis

Presented in Partial Fulfillment of the Requirement for the

Degree of Master of Science

with a

Major in Environmental Science

in the

College of Graduate Studies

University of Idaho

by

Jenna Lynn Durkee

Major Professor: Gregory Möller, Ph. D.

Committee Members: Beth Price, Ph.D.; Dojin Ryu, Ph.D.; Daniel Strawn, Ph.D.

Department Administrator: Robert L. Mahler, Ph.D.

July 2016

Authorization to Submit Thesis

The thesis of Jenna Lynn Durkee, submitted for the degree of Master of Science with a major in Environmental Science and title, "LEGACY LEAD AND ARSENATE SOIL CONTAMINATION AT CHILDCARE CENTERS IN THE YAKIMA VALLEY, CENTRAL WASHINGTON," has been reviewed in final form. Permission, as indicated by the signatures and dates given below, is now granted to submit final copies to the College of Graduate Studies for approval.

Major Professor: ______________________________ Date: ____________
Gregory Möller, Ph.D.

Committee Members: ______________________________ Date: ____________
Beth Price, Ph.D.

______________________________ Date: ____________
Dojin Ryu, Ph.D.

______________________________ Date: ____________
Daniel Strawn, Ph.D.

Department Administrator: ______________________________ Date: ____________
Robert Mahler, Ph.D.

Abstract

From the early 1900s to the 1950s, Yakima Valley orchards were commonly treated with lead arsenate insecticides. Lead (Pb) and arsenic (As) soil contamination has been identified on former orchard lands throughout Central Washington and pose a threat to human health and the environment. The levels of Pb and As in soil and interior dust at participating childcare centers in the Upper Yakima Valley (Yakima County), Washington were sampled to explore exposure potential for young children. Maximum Pb and As X-ray fluorescence spectrometer (XRF) results indicated that 4 (21%) and 8 (42%) of the 19 childcare centers surveyed exceeded the Washington State regulatory standard for Pb (250 mg/kg) and As (20 mg/kg), respectively. Interior dust loadings were below U.S. Environmental Protection Agency guidelines. Childcare centers are areas of intensive use for children and when coupled with potential residential exposure in their homes, the total daily exposure suggests a potential hazard.

Acknowledgements

I want to thank Casey Bartrem and Dr. Gregory Möller for all of their invaluable help, guidance, and patience with me during this project. I also want to thank the childcare centers who participated in this study, Matthew Durkee for his assistance with geographic information system (GIS) mapping and manuscript editing, William Price for his assistance with statistical analyses, Norman Hepner for his knowledge and guidance, TerraGraphics International Foundation of Moscow, Idaho for the use of the field-portable X-ray fluorescence spectrometer (XRF), and the University of Idaho Analytical Sciences Laboratory. This work was supported by the U.S. Department of Agriculture Research Hatch Project IDA01457 and the Idaho Agricultural Experiment Station.

Dedication

I want to thank my husband Matt for his help, guidance, motivation, and understanding through this process. For our kids John, Sadie, and Bergen (who is in my belly right now), for their patience and understanding. Also, thank you to my parents John and Judy Delashaw, in-laws John and Karen Durkee, and Grandma Vivian France for their support of my continuing education.

Table of Contents

Table of Contents

List of Tables

List of Figures

List of Figures

List of Figures

Chapter 1: Introduction

The effects of lead (Pb) and arsenic (As) contamination in Washington State is widespread. This thesis focuses on the Pb and As contamination that occurred from historical lead arsenate (LA) pesticide use in orchards, mainly east of the Cascade Mountains. Lead and As contamination also occurred west of the Cascade Mountains. The contamination west of the Cascade Mountains is mainly due to metal smelter operations in the cities of Tacoma and Everett. These historic operations have contaminated millions of acres of land in Washington with Pb and As. However, the actions taken to educate the public and remediate land greatly differ west of the Cascades verses east of the Cascades.

Historic Orchard Lead Arsenate Use

The use of LA pesticides on fruit orchards in the U.S. began in the early 1900s and continued until the 1950s or 1960s, when chlorinated pesticides, including DDT, became available as a more preferred option (Peryea 1998). Lead arsenate was more commonly used on orchards (Figure 1) rather than other agricultural fields because of its high efficacy at reducing codling moths, which are common pests of apple trees (Veneman et al. 1983). Lead arsenate was the most popular arsenical insecticide and was used worldwide in two forms, basic LA and acidic LA (Peryea 1998).

As insect populations developed a resistance to As, application dosages and frequencies increased, as did soil contamination levels (Peryea 1998). Application amounts were dependent upon species and persistence of insect populations, species of fruit tree, time of year, and use of any alternative pesticides (Peryea 1998). Subsequently, many orchard lands were converted to residential or public use areas, where potential for exposure to Pb and As, especially for children, is amplified (Figure 2).

Figure 1. Workers spraying in orchards (Yakima Valley Museum 2015). Courtesy of the Yakima Valley Museum.

This research focused on historic LA use in the Upper Yakima Valley, Washington State, but the compound was used throughout Central Washington, the U.S., and globally. In New York, soils historically used for apple orchards were found to contain As concentrations ranging from 31-109 mg/kg (average=72 mg/kg) and Pb concentrations ranging from 171-512 mg/kg (average=339 mg/kg) (Aten et al. 1980). These orchards were sprayed with LA (Figure 3) until 1965, usually at a rate of two (2) applications per year totaling 2,236 pounds of pesticide in a 12 year period, or approximately 21 pounds of pesticide per acre per year (Aten et al. 1980).

Studies of former orchard sites in Massachusetts confirmed elevated Pb and As concentrations as a result of LA use (Veneman et al. 1983). Orchard soils in southern Ontario, Canada were found to have average soil concentrations of 774 mg/kg and 121 mg/kg Pb and As, respectively (Frank et al. 1976a). Lead and As concentrations tend to be highest in former apple orchards, followed by cherry orchards and peach orchards (Frank et al. 1976a). Former orchard lands in Tasmania and Australia were examined for heavy metal concentrations and found to have levels of copper, Pb, and As 25-35 times the levels in comparable non-treated agricultural soils (Merry et al. 1983).

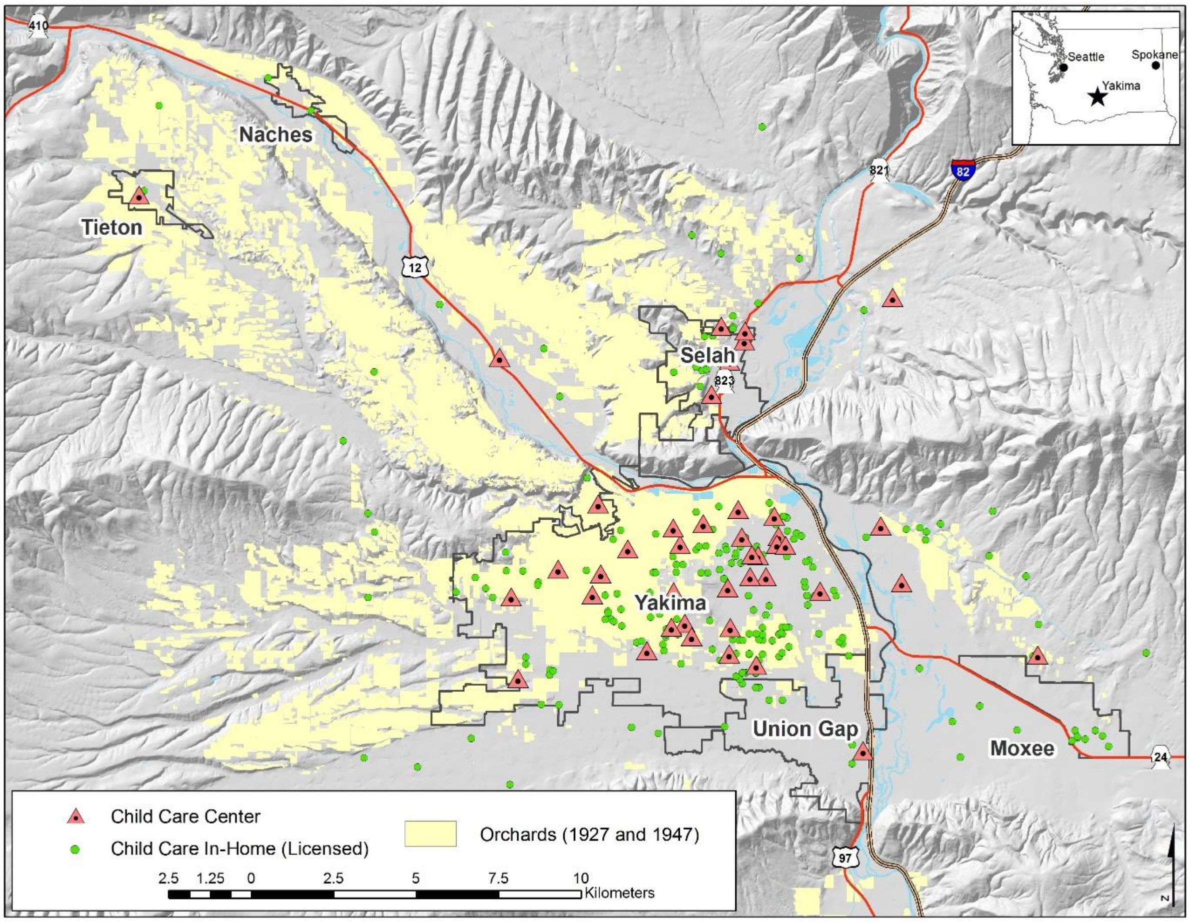


Figure 2. Map of historic Upper Yakima Valley orchard areas and current childcare centers.

Figure 3. Man spraying orchard tree (Yakima Valley Museum 2015). Courtesy of the Yakima Valley Museum.

The association between Pb and As levels are strongly correlated in most LA studies, though some authors have found decreased levels of As, suggesting that As undergoes more leaching than Pb (Merry et al. 1983; Veneman et al. 1983; Peryea 1998). Arsenic, also capable of biomethylation, is more environmentally mobile than Pb, hence Pb/As concentration ratios tend to decrease with increasing depth (Peryea 1998). As part of soil pesticide contamination studies in Ontario, Canada, Frank et al. (1976a) found that not only does land use correlate with soil concentrations of Pb and As, but soil type is also a factor (Frank et al. 1976b). Loam and clay soils had higher concentrations of As than sandy or organic soils, and higher Pb concentrations were found in loam or sandy soils than clay soils (Frank et al. 1976b).

Exposure Risks

The principal exposure route for children living and/or playing in LA contaminated soils is the incidental ingestion of soils and dusts. Indoor dusts may have elevated contaminant concentrations due to tracking in from outdoor locations. In the same way that exposure to soils occurs outdoors, exposure to contaminated dusts occurs indoors. Woltz et al. (2003) were the first to study household dust concentrations in Washington homes built on former orchard land contaminated with LA. They found that As and Pb concentrations of indoor dusts were correlated to soil loading levels, and that these indoor concentrations were elevated compared to areas without a history of LA application. Further analysis of the data indicated that intakes of contaminated dusts resulted in an exceedance of Agency for Toxic Substances & Disease Registry's (ATSDR) minimum risk level. Soil concentrations ranged from <2.5 to 103 mg/kg and 1.2 to 594 mg/kg, for As and Pb, respectively, and house dust concentrations ranged from 2.3 to 49 mg/kg and 15 to 890 mg/kg for As and Pb, respectively. Thirteen (13) of the 58 homes included in the study exceeded the Washington State Model Toxics Control Act (MTCA) Method A soil cleanup levels for unrestricted land uses (MTCA cleanup level), 250 mg/kg Pb and 20 mg/kg As (Wolz et al. 2003).

The health impacts of ingestion exposures to Pb and As are well documented. Early childhood Pb exposure is directly linked to neuro-cognitive deficits and social problems in adulthood (ATSDR 2007; Lanphear et al. 2005; Needleman et al. 1990). An estimated one to five IQ points are lost for each increase of 10 µg/dL in blood Pb level (BLL) (Hubbs-Tait et al. 2005). Centers for Disease Control and Prevention confirm that there is no safe threshold for Pb in blood (Centers for Disease Control and Prevention 2012). Arsenic, in addition to being a developmental neurotoxin, is a known human carcinogen in its inorganic form. The overlap of toxic endpoints of the two metals indicates a potential for interaction in co-exposure settings, increasing risk for children exposed to LA contaminated soils and dusts. Limited studies exist examining toxicities resulting from simultaneous exposure, but some indicate synergistic interactions at low doses (Bae et al. 2001; Mejia et al. 1997).

Unfortunately, there is limited data to determine if exposures are resulting in direct health impacts in Central Washington residents (Hood 2006). The Washington State Department of Health (DOH) conducted a study which included assessment of BLLs for children throughout Washington. A total of 50,000 tests were conducted, 2% of which had BLLs above 10 µg/dL, which was the level of concern at the time of the study. The Centers for Disease Control and Prevention abandoned the term "BLL of concern" for a reference value that is currently 5 µg/dL, and is based on the 97.5th percentile of the National Health and Nutrition Examination Survey generated BLL distribution in children 1-5 years old (Centers for Disease Control and Prevention 2012). The DOH identifies older homes, lower household incomes, Hispanic ethnicity, and Central Washington residency to be significant predictors of elevated BLLs (Community, Trade, and Economic Development 2005).

LA Use and Regulation in Washington State

The economy of Central Washington is largely agriculturally based. Yakima County has been the largest producer of apples in the U.S. since 1964. Jobs in agriculture, forestry, and fishing account for more than 26% of jobs in Yakima County (Yakima County Development Association 2013). Recently, as populations increased in Central Washington, homes, schools, and businesses were built on land that previously was orchard.

In Washington, LA was used from 1905 to 1947 (Wolz et al. 2003). On a per hectare basis, application rates reached 215 kg/year of Pb and 80 kg/year of As during this time period (Davenport and Peryea 1991). Up to 188,000 acres of land in Washington may be affected (Hood 2006). In 2002, an Area-Wide Task Force was assigned by the Washington State Departments of Agriculture, Ecology, Health, and Community, Trade and Economic Development to investigate the Pb and As contamination in Washington and recommend actions to reduce the health risk to residents. The recommendations released in 2005 included prioritization of education and outreach for residents, use of soil covers, mandatory soil testing for new child use areas, and voluntary certification programs for childcare centers (CCs). Specifically mentioned in the recommendations was their concern for children's exposure to contaminated soils (Ecology 2003).

Following these recommendations in 2005, the first version of Washington State House Bill 1605 directed state and local agencies to assist schools and CCs throughout Washington in areas impacted by area-wide contamination to reduce the exposure of children to contaminated soil. However, the version of the House Bill that was signed into law did not include a provision for the area-wide contamination east of the Cascades in Central Washington (areas in Central Washington that contain formerly orchard land primarily include the Yakima Valley, areas in and around the City of Wenatchee, and surrounding areas). Instead, the amended House Bill included enhancements on efforts for Western Washington, where the Pb and As contamination originated primarily from smelters. The law enlisted the technical and financial help of state and local agencies to assist schools and childcare facilities to reduce the exposure potential for children (Engrossed Second Substitute House Bill 1605 2005).

After House Bill 1605 was signed into law in April 2005, remediation efforts began in both Central and Western Washington. Extensive mapping and remediation of the contamination began in Western Washington, including schools, CCs, parks, and qualified residential properties. In Central Washington, 26 public schools and two (2) parks were remediated (Ecology 2015). "During cleanup activities in Central Washington, maximum concentration levels for Pb and As were found to be 1,650 mg/kg and 1,100 mg/kg, respectively. The highest concentrations were found in the Manson and Wenatchee areas of Central Washington. Levels of Pb and As in the City of Yakima are also well above the MTCA standards, averaging 1080 mg/kg and 124 mg/kg, respectively" (N. Hepner, personal communication).

The Washington State MTCA regulatory standard for soil Pb in unrestricted land use areas is 250 mg/kg, significantly lower than the U.S. Environmental Protection Agency (EPA) screening level of 400 mg/kg. The MTCA regulatory standard and the EPA screening level were based off of different studies looking at BLL outcomes. The EPA screening level was derived using national background averages and the EPA's Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) (U.S. Environmental Protection Agency 1994). The MTCA standard was established after considering alternate cleanup levels based on a range of approaches including studies correlating BLLs with soil concentrations (Ecology 1991). One of the approaches discussed included the New Jersey Department of Environmental Protection developing an interim soil action level for lead of 250 mg/kg for residential properties based on a study of observed correlations between ambient soil lead levels and BLLs (Ecology 1991). The MTCA standard for As is currently 20 mg/kg, however it is important to note that 20 mg/kg is greater than background levels in

Washington, which have been found not to exceed 12.8 mg/kg. The average soil background level for As in Washington is 7 mg/kg, 5 mg/kg in the Yakima Basin. Statewide average Pb concentrations are 17 mg/kg, in the Yakima Basin specifically the background average concentration are less, around 11 mg/kg (Ecology 1994).

Everett and Tacoma Smelters

On the west side of the Cascade Mountains the Everett and Tacoma Smelters have caused widespread Pb and As contamination. The Everett and Tacoma Smelters were in operation in the early 1900's, the ASARCO Company operated both of these metal smelters. Not only were the smelter sites themselves left with significant Pb and As contamination, the wind dispersion had carried the contamination to surrounding areas. Over 1,000 square miles surrounding the Tacoma Smelter are considered contaminated and is now known as the Tacoma Smelter Plume. The Everett Smelter Plume Area covers 1 square mile.

In 1993, the Washington State Department of Ecology (Ecology) and the EPA began to clean up the most contaminated properties, and the cleanup of the Everett and Tacoma Smelter Plume areas continue to this day. In 2009, Ecology obtained money through the bankruptcy settlement of ASARCO to use towards cleanup of the Smelter Plume Areas.

Ecology has conducted extensive work on educating the public and remediating the Everett and Tacoma Smelter Plume Area. There is an interactive map that allows the public to search properties to see if they are in the perimeter of the contaminated smelter plume area. There is a cleanup database that allows the public to look up properties and see the soil sampling results and cleanup records available. There is also detailed information available to the public on what actions to take to keep kids and anyone living on or working in contaminated soil safe, called the Soil Safety Program (Ecology 2011b).

Remediation in the Everett and Tacoma Smelter Plume Areas

Beginning in 1993, Ecology and the EPA began remediation efforts for the Everett and Tacoma Smelter Plume Areas. Areas of high child use were targeted for remediation such as schools, CCs, parks, and multi-family public housing. Also, the most contaminated private residences will also be remediated. The action level for Ecology to remediate residential yards in soil levels at or greater than 100 ppm As or 500 ppm Pb (Ecology 2013a).

Study Objective

The objective of this study was to identify As and Pb soil and dust concentrations at participating CCs in the Upper Yakima Valley in Washington, and to raise awareness for CC owners. More broadly, the goal is also to increase the level of awareness concerning the contamination throughout the affected area.

Children at these sites may be exposed to Pb and As in the soils during daily play activities. Schools in the affected area have been previously been tested and remediated as needed, but no data exists for childcare facilities and no testing program has been provided by government or private organizations. Results of this study were used to educate the owners/operators of the voluntarily participating childcare facilities on the levels of Pb and As found in their soil and indoor dust. Educational materials provided included information on the health risks of Pb and As exposure for themselves, their employees, and the children in their care.

Chapter 2: Methods

The following are the methods used to recruit, sample soil and dust, and analyze samples for 19 CCs in and around the City of Yakima, Washington. In addition, these methods describe the statistical analysis and the analysis conducted using geographic information system (GIS).

Childcare Center Selection

Nineteen (19) CCs volunteered for and were included in the study from Yakima and surrounding communities. Thirteen (13) of the CCs were located in the City of Yakima and close surrounding areas. The other six (6) CCs were located in the nearby communities of East Valley, Terrace Heights, Union Gap, Selah, and Tieton. All of the licensed CCs (as of 2014) are shown in Figure 2. The yellow shading on Figure 2 represents the land thought to previously be orchard land, determined from analysis of digital 1927 and 1947 historical aerial photographs obtained from Yakima County. Childcare centers that volunteered for the study were recruited at a monthly meeting of a community group of childcare providers in the Yakima area and individual visits to CCs. Nearly 200 childcare providers were contacted with educational materials and offered the opportunity to be included in this study. The majority of those contacted were in-home providers. Childcare centers were a priority for recruitment due to the high number of children served at these facilities. Each CC was provided and asked to complete a survey regarding site history, children’s daily activities, cleaning frequency, and types of soil barriers in place in play areas.

Prior to sampling, the project and sampling plan were approved through the University of Idaho’s (UI) Institutional Review Board (IRB) (Appendix E). Included in the IRB application and sampling plan were provisions to guarantee confidentiality of CCs sampling results. The participating and non-participating CCs were kept confidential, and all results were de-identified in any reports and presentations.

Sample Collection

Soil sampling methodology was based on the strategy employed by Ecology during their sampling of area schools in 2002 (Washington Department of Ecology 2011a).

Prior to sampling CCs were surveyed about their facilities and grounds, construction/landscaping history, operations, child ages, interior cleaning frequency, and outside play activity. Each CC's outdoor play area (Figure 4) was divided into exposure units (EU), which are discreet areas that children access daily.

Figure 4. Childcare center play yard.

The number of samples taken in each EU were determined by total EU area (Table 1). The number of samples taken per EU were dependent upon area size and intensity of use by children (Ecology 2002). EUs were drawn on aerial images of the CC and sampling locations were noted.

Table 1. Number of samples taken per EU.

Exposure Unit Size (m^2)	**Low Use**	**Casual Use**	**Intensive Use**
0 – 400	0	4	8
400 – 4,000	0	6	10
4,000 – 28,000	0	6 – 12[1]	N/A[2]

[1]Six samples for the first 4,000 m^2, one additional sample for each additional 4,000 m^2. [2]Not applicable, intensive use areas assumed to be <4,000 m^2.

Following removal of surface barriers (e.g. bark chips or sod), soil samples were collected from a freshly dug pit wall at 0-5 cm and 5-15 cm depths (Figure 5). These depth intervals were used in Ecology LA sampling (MTCA Science Advisory Board 2005). Organic material, gravel, woodchips, and other non-soil particles were avoided. Samples were placed in Ziplock® polyethylene bags, labeled, and refrigerated.

Figure 5. Example of sample pit.

Indoor dust wipe samples were collected from at least one windowsill and one floor surface following Housing and Urban Development (HUD) guidelines "Wipe Sampling of Settled Dust for Lead Determination" (U.S. Department of Housing and Urban Development 2012). Disposable wipes meeting standards outlined in 40 CFR 745.63 were used (5"x7.75", lanolin free, professional use Lead Dust Sampling Wipe, meeting ASTM E1792 standards). Samples were stored in hard-shell, non-sterilized, re-sealable containers. Samplers were trained in the appropriate methodology prior to sampling. Areas of high use were targeted, especially areas where children frequently placed their hands. At a minimum, one floor wipe sample and one windowsill wipe sample were taken unless a windowsill sample was not feasible/available, in which case two floor wipe samples were taken. At CCs where additional dust samples were collected, areas of high use were targeted, such as toy surfaces and book shelf ledges. The template used was reusable plastic and met HUD and EPA requirements. If a template could not be placed on the sample area (e.g., on the windowsill), the area to be sampled was delineated with masking tape and carefully measured.

Soil Sample Analysis

Refrigerated samples were transported to the UI Environmental Toxicology and Chemistry Laboratory for analysis. There were 356 individual soil samples collected from CCs. Soil samples were air dried in a fume hood with continuous air circulation for approximately 12-24 hours until no visible moisture was present. At a minimum, soil sample had to contain less than 20% moisture for accurate XRF analysis. After drying, the soil samples were homogenized by placing each sample bag in an additional Ziplock® polyethylene bag to avoid breakage. Then, manually breaking up any soil clumps by hand and thoroughly mixing the sample. A Niton XL3 Handheld X-ray fluorescence spectrometer

(XRF) analyzer was used to analyze soil samples for heavy metal content. After performing instrument calibration checks and testing standard reference materials, soil samples were tested 3 times for 30 seconds each test, a total of 1,068 XRF readings (Figure 6). Results were imported into Microsoft Excel® and subsequently into SAS®. Samples with Pb >250 mg/kg and As >20 mg/kg were sieved to 250 µm and tested again using the same methodology. 150-250 µm is the soil fraction that is known to adhere to hands, to encompass all of this soil fraction 250 µm was used. All sieved samples that tested for Pb >250 mg/kg and/or As >20 mg/kg in either the sieved or bulk fractions were analyzed for As and Pb via inductively coupled plasma mass spectrometry (ICP-MS) at the UI Analytical Sciences Laboratory.

Figure 6. XRF analysis.

Laboratory Analysis

Additional laboratory analyses were performed by the UI Analytical Sciences Laboratory on samples with Pb and As XRF detections over MCTA cleanup levels. A total of 99 samples were analyzed by ICP-MS for Pb and As. Additional laboratory analysis were also conducted on 29 of these samples which showed detections for mercury (Hg) during XRF analysis using EPA Standard Method 1631B (acid digestion and determination by cold vapor atomic fluorescence). Forty (40) soil and interior dust wipes were analyzed using EPA Standard Methods (SM) 3050 and 200.7 (ICP-MS).

Statistical Analyses

X-ray fluorescence spectrometry and ICP-MS results were imported into SAS® (Version 9.3). Average Pb and As concentrations were calculated for each sample and used for further analyses as the standard deviations were lower than limits of detection. Linear regression was run to compare bulk As to sieved As, bulk Pb to sieved Pb, Pb to As in both bulk and sieved fractions, and XRF to ICP-MS results in bulk and sieved fractions for both As and Pb. Lead and As were also plotted against each other in the bulk fractions to graphically assess associations. Regression was also performed on bulk As and Pb results by site history and sample depth using method of least squares to fit general linear models.

The XRF produces data for 18 elements during a 30 second test. A principal component analysis (PCA) was performed to explore multivariate relationships. The PCA that accounted for the most variability in the first two axes was selected. Plots were created for the first two axes and the potential for groupings due to sample depth, site history, and location were evaluated.

GIS Analyses

Using aerial photographs from 1927 and 1947 of the Yakima Valley and surrounding areas, former orchard land was digitized and displayed on an ESRI GIS map. Licensed CC locations and in-home CCs locations were plotted on the map. Childcare centers that were sampled were not distinguished from those that were not sampled in order to protect identity of participating CC locations (Figure 2).

Four additional maps were created plotting the extrapolated maximum and mean soil concentrations for Pb and As within the City of Yakima and adjacent areas. Also indicated on the map were maximum Pb and As concentrations from the school remediation projects conducted by Ecology. This data was acquired from the Ecology Environmental Information Management Database. Using the soil concentration values, the ESRI Inverse Distance Weighting (IDW) geostatistical tool was used to extrapolate this data creating the contours. Contours are estimates and may not accurately predict the soil contamination at any given point. Lead and As concentrations can vary significantly, even within a particular location.

Chapter 3: Results

Results of this project include individual site specifics results that were provided to the CC owners/operators and discussed (Appendix B), summary statistics, land usage, and survey results (Appendix A). Analysis of the complete data set includes comparisons of XRF bulk and sieved samples for As and Pb, comparisons between XRF results both bulk and sieved for As and Pb, comparisons between laboratory and XRF results, As and Pb concentrations with former land usage, and As and Pb concentrations by depth. A PCA was conducted to explore the correlations between As, Pb, Manganese (Mn), Iron (Fe), and former land usage (Appendix C). Geographic information system analysis was conducted to create a visual data display of the study area. Arsenic and Pb maximums and median values were plotted, creating contours with former orchard land boundaries.

Site Specific Results

Table 2 includes an XRF data summary by site, displaying both the maximum and mean concentrations for As and Pb (Appendix B). Table 2 also displays the maximum and mean concentrations for As and Pb found from laboratory ICP-MS analysis, and if the site was found in possible former orchard land based off of air photos from 1927 and/or 1947. Arsenic and Pb concentrations above MTCA cleanup levels are shown in red.

Table 2. Summary of XRF, laboratory data, and former orchard land. Red values are exceedances of the MTCA cleanup levels.

Site #	XRF Max As (mg/kg)	XRF Mean As (mg/kg)	XRF Max Pb (mg/kg)	XRF Mean Pb (mg/kg)	Lab Max As (mg/kg)	Lab Mean As (mg/kg)	Lab Max Pb (mg/kg)	Lab Mean Pb (mg/kg)	Former Orchard Land
1	53.1	36.3	418	165.5	44	30.2	360	155	Y
2	12.2	5.7	358	51.5	7.8	4.77	370	132	N
3	24.4	17	178	110	19	17.5	170	115	N
4	38.9	21	127	57.4	35	22.49	110	66.5	Y
5	17.6	16	79.5	71.7	NA	NA	NA	NA	Y
6	15	7.7	124	56.9	NA	NA	NA	NA	N
7	12.2	6.2	159	59.4	4	3.7	140	118	Y
8	16.7	11	103	82.6	6.6	6.6	75	75	N
9	6.8	4.4	27.8	16.5	NA	NA	NA	NA	N
10	7.3	5.1	74.2	46.9	4	3.7	50	36	N
11	7.2	5.5	69	32.2	NA	NA	NA	NA	N
12	27.8	19	103	68.7	26	21.5	130	84	N
13	67.9	24.7	507	159	46	30.77	430	235	Y
14	53.4	21	389	134	45	22.21	420	174	Y
15	7.2	4.7	14.4	11.9	4.1	3.83	8.1	7.87	N
16	34.7	18	120	68.9	24	17.33	100	72	Y
17	5.6	4.4	22.4	20.8	NA	NA	NA	NA	N
18	33	15	149	61.8	33	22.67	130	93.3	Y
19	7.2	4.7	19.9	15.9	3.3	3.15	8.4	10.2	N

Statistical Analyses

Based on maximum Pb and As results for discrete sample locations, 21% and 42% of the 19 CCs surveyed exceeded the MTCA cleanup levels for Pb and As, respectively (Table 3).

Analyzing XRF As and Pb concentration data using Excel, correlations between bulk and sieved As and bulk and sieved Pb results show a strong positive linear correlation (R^2=0.8667, slope=1, intercept = 0.39, and R^2 = 0.9782, slope=1.06, intercept = 2.95 respectively; Figure 7 and Figure 8).

When comparing concentrations from the same location for As and Pb in both the bulk and sieved fraction a weak correlation was found. Comparison of Pb to As in the bulk fraction demonstrate a weak linear correlation (R^2= 0.61, slope=.12, intercept = 5.22) (Figure 9). Comparison of sieved Pb to As also demonstrate a weak linear correlation (R^2 = 0.42, slope=.067, intercept = 19.28) (Figure 10).

Statistically significant differences between average metal values at non-orchard and former orchard lands were found (Figure 11). Mean bulk Pb concentrations at sites known to be former orchard land were found to be 109 mg/kg, As concentrations on known former orchard land were 21 mg/kg. Mean bulk Pb concentrations on land not identified as former orchard land were 46 mg/kg, mean bulk As concentrations were 7 mg/kg.

Comparing Pb and As concentrations based off of sample depth (0-5 cm) and (5-15 cm), there were no significant difference in either As or Pb by sample depth (Figure 12). The mean Pb concentration for the 0-5 cm depth was 72 mg/kg, the mean As concentration for the 0-5 cm depth was 14 mg/kg. For the 5-15 cm depth the mean Pb concentration was 82 mg/kg for Pb and 15 mg/kg for As.

Table 3. Count of soil sample XRF results exceeding MTCA cleanup levels for Pb and As.

	Total Count	**Bulk**		**Sieved**	
		Pb >250 mg/kg	**As >20 mg/kg**	**Pb >250 mg/kg**	**As >20 mg/kg**
No. CC Sites	19	4	8	4	8
No. Sample Locations	187	13	55	13	49
No. Samples	356	18	90	19	73

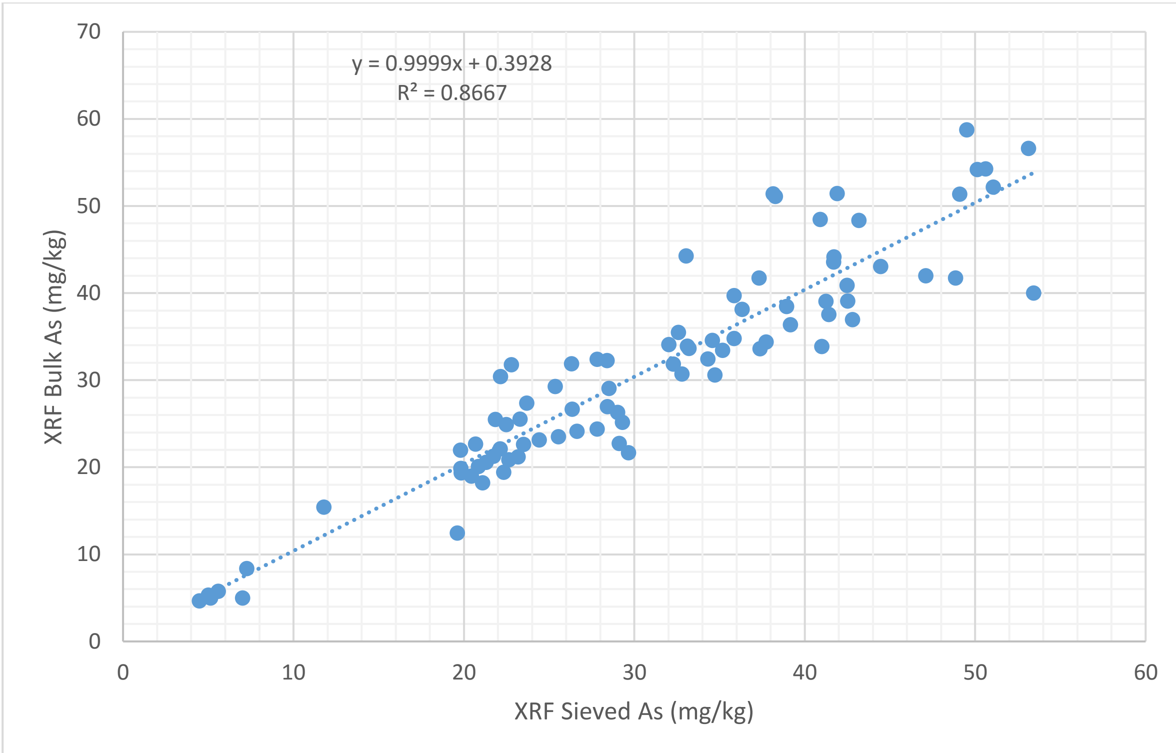


Figure 7. Bulk vs sieved As XRF results.

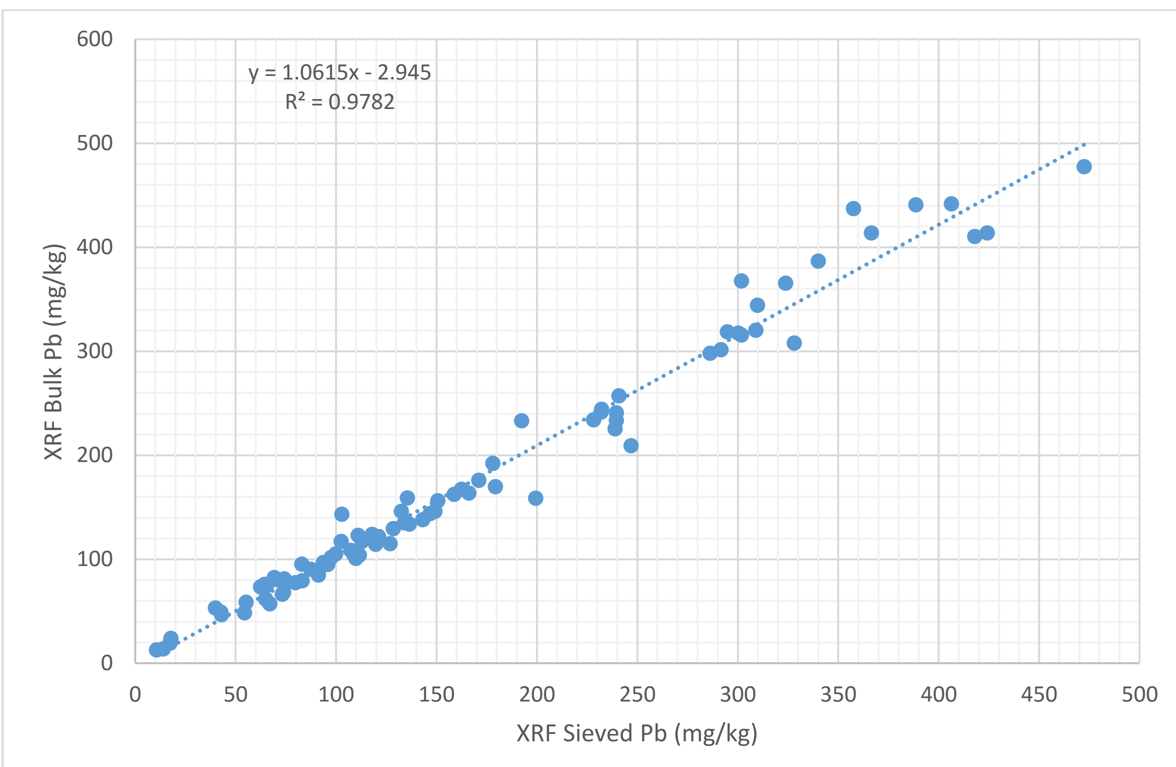


Figure 8. Bulk vs sieved Pb XRF results.

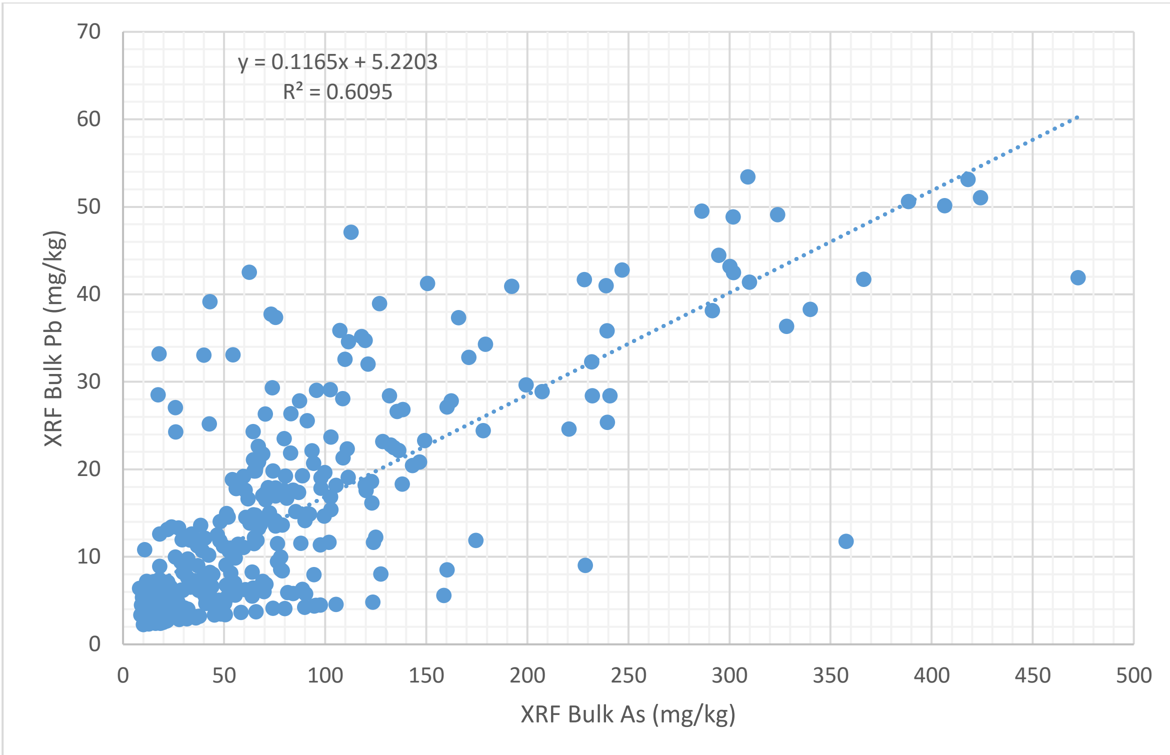


Figure 9. Bulk Pb vs bulk As XRF results.

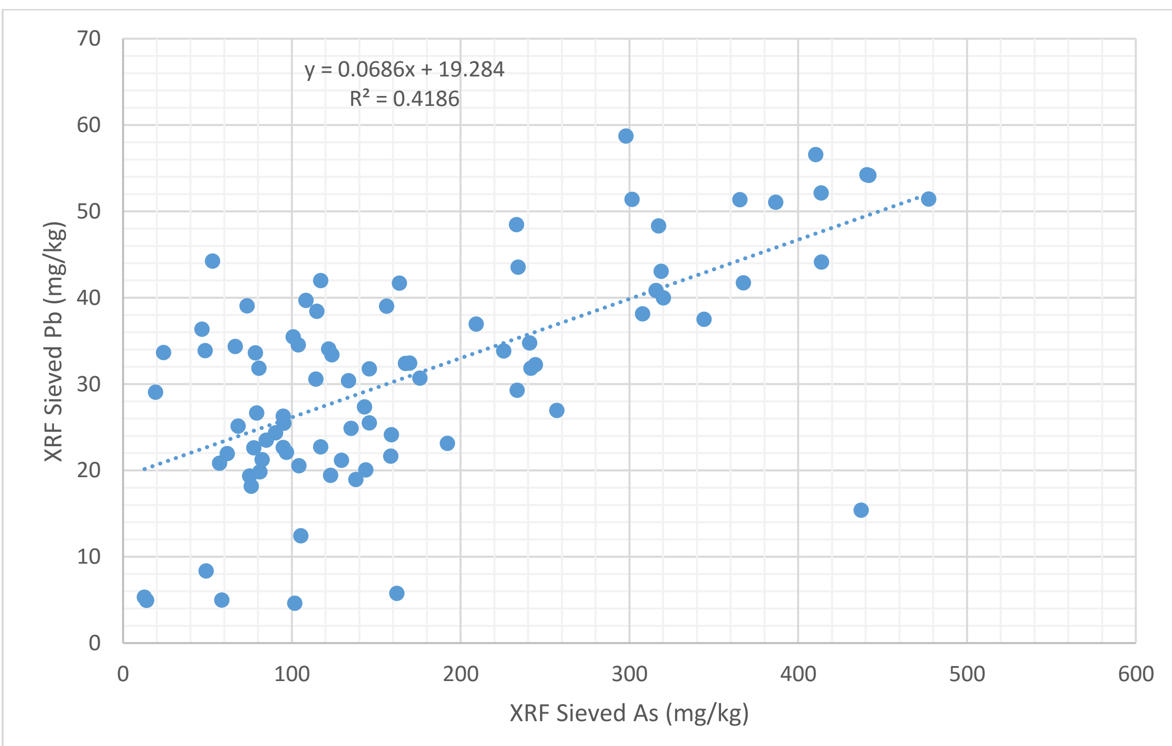


Figure 10. Sieved Pb vs sieved As XRF results.

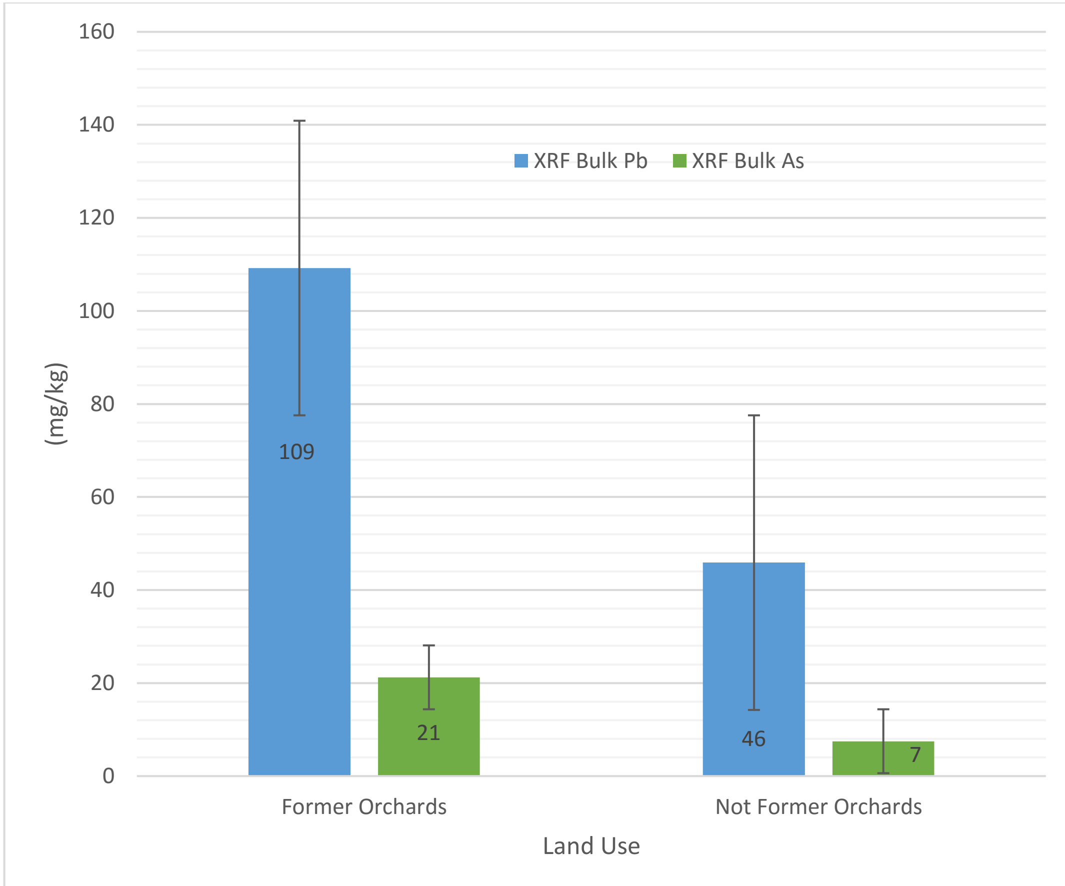


Figure 11. Mean bulk Pb and As XRF concentrations based on land use.

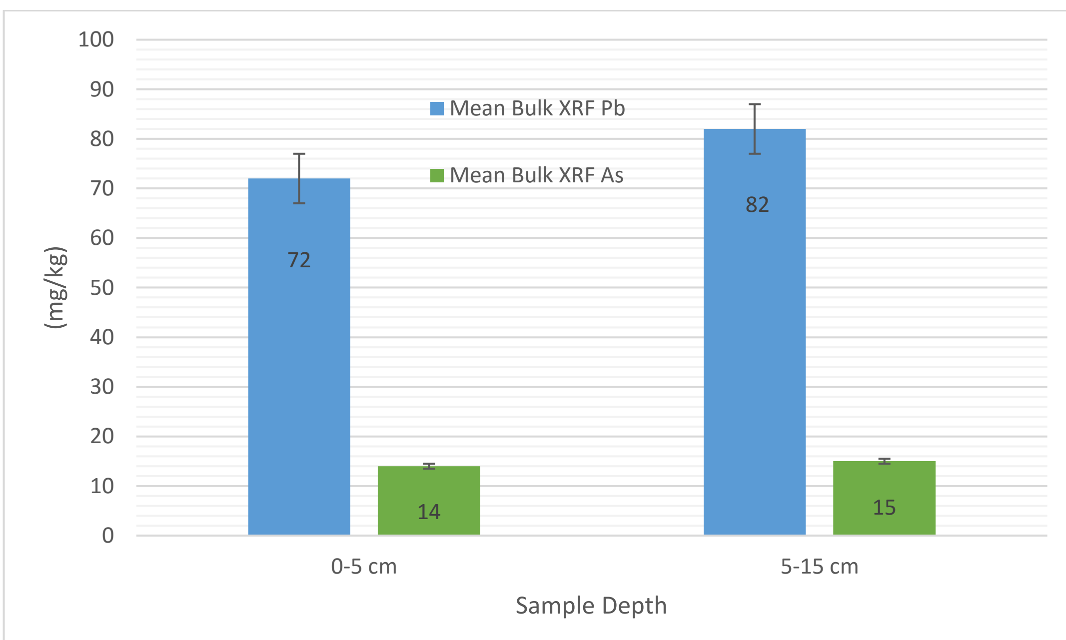


Figure 12. Mean of bulk As and Pb XRF concentrations based on depth.

Similar to the XRF data the laboratory ICP-MS verses the XRF data compared well with the concentration found between the ICP-MS and XRF Pb, and the ICP-MS and XRF As in both the bulk and sieved fractions.

For Pb, ICP-MS compared well to XRF in both bulk (slope=1.02, R^2=0.98, intercept=7.14) and sieved (slope=1.10, R^2=0.99, intercept=2.67) fractions (Figure 13 and 14). The relationship was slightly less favorable for As, with bulk (slope=1.14, R^2=0.93, intercept=1.78) and sieved (slope=1.19, R^2=0.94, intercept=1.14) slopes further from 1. However, intercepts were closer to 0 (Figure 15 and 16).

Dust loading of wipe samples ranged from 0.4 to 6.3 µg/ft^2 for Pb, well below the EPA limits of 40 µg/ft^2 and 250 µg/ft^2 for floors and windows, respectively. Arsenic levels were below the limit of detection (1.5 µg/ft^2) for all wipe samples (Table 4). Lead dust concentrations were received from the lab in mg/L due to the laboratory digestion method. The dust concentration was then converted into µg/ft^2 for comparison against EPA limits. If the site was or was not on former orchard land or not is also indicated in Table 4.

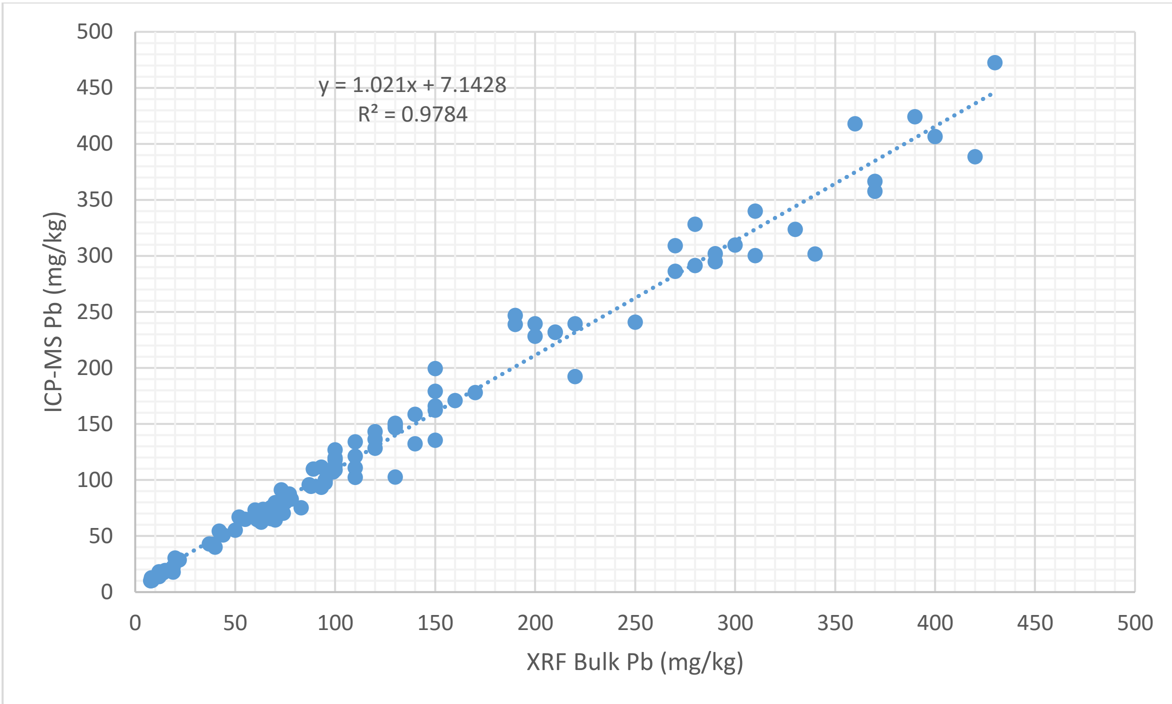


Figure 13. Pb ICP-MS and Pb XRF bulk results.

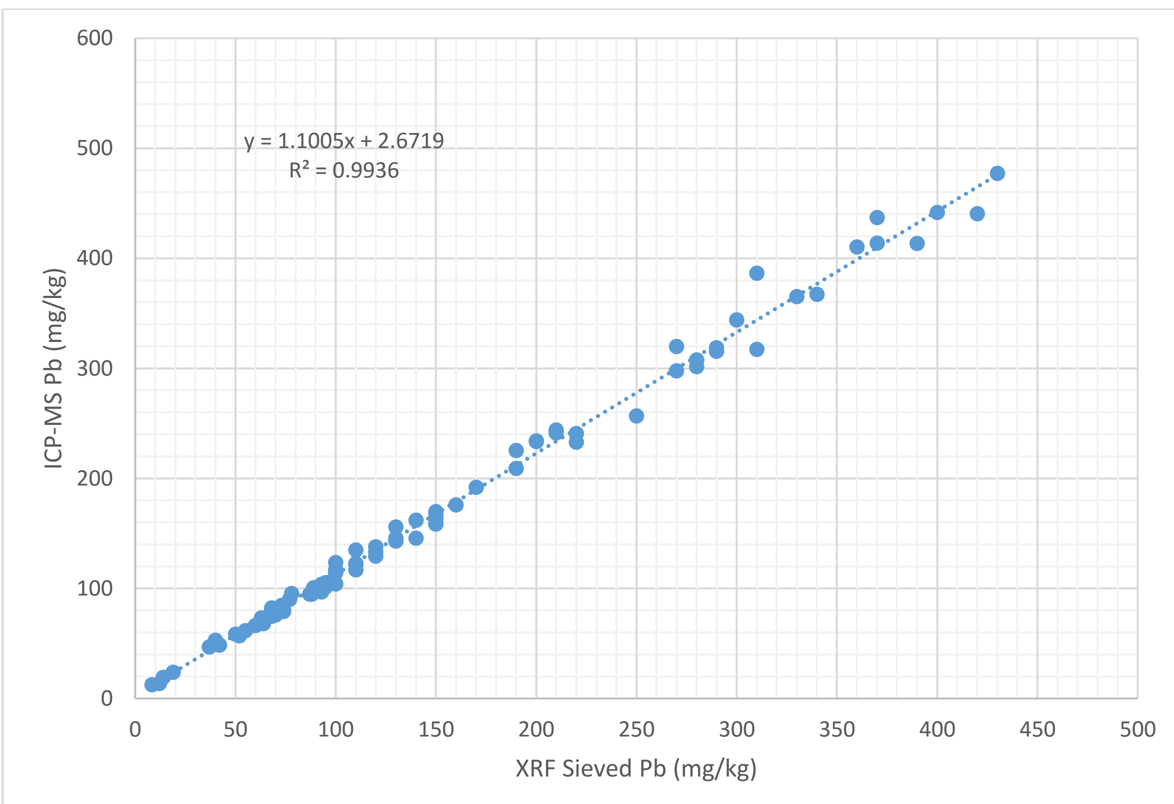


Figure 14. Pb ICP-MS and Pb XRF sieved results.

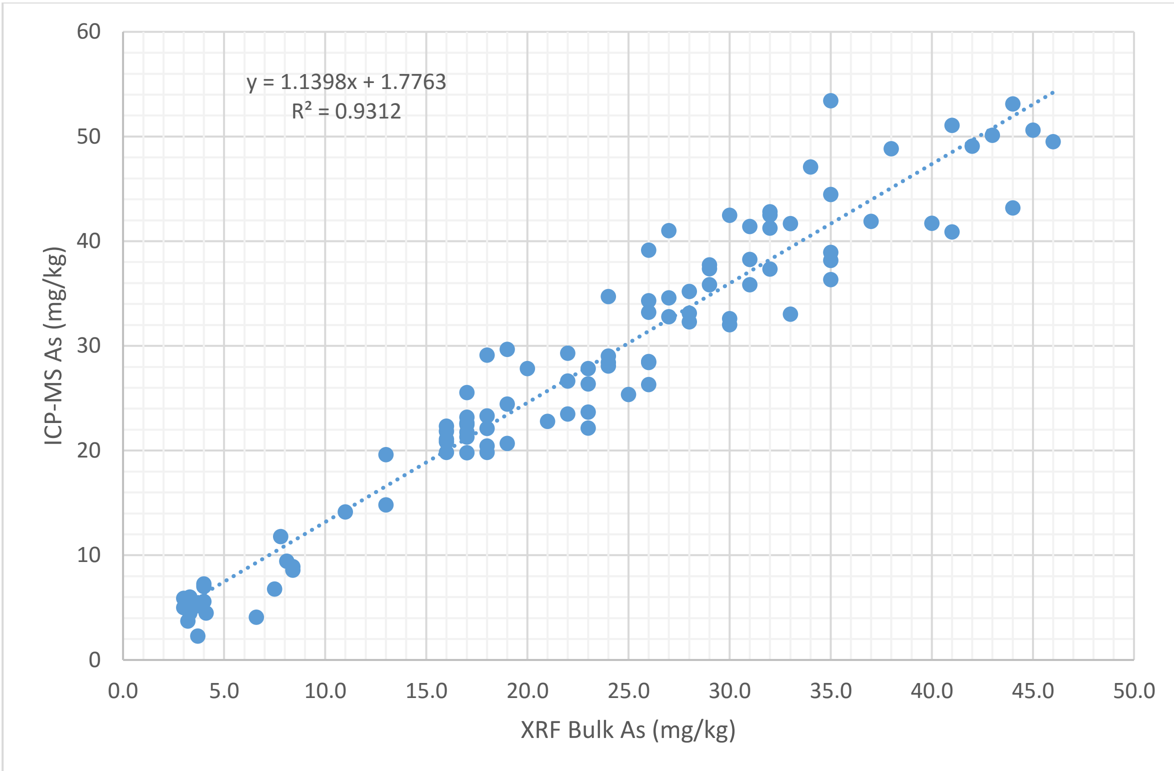


Figure 15. As ICP-MS and As XRF bulk results.

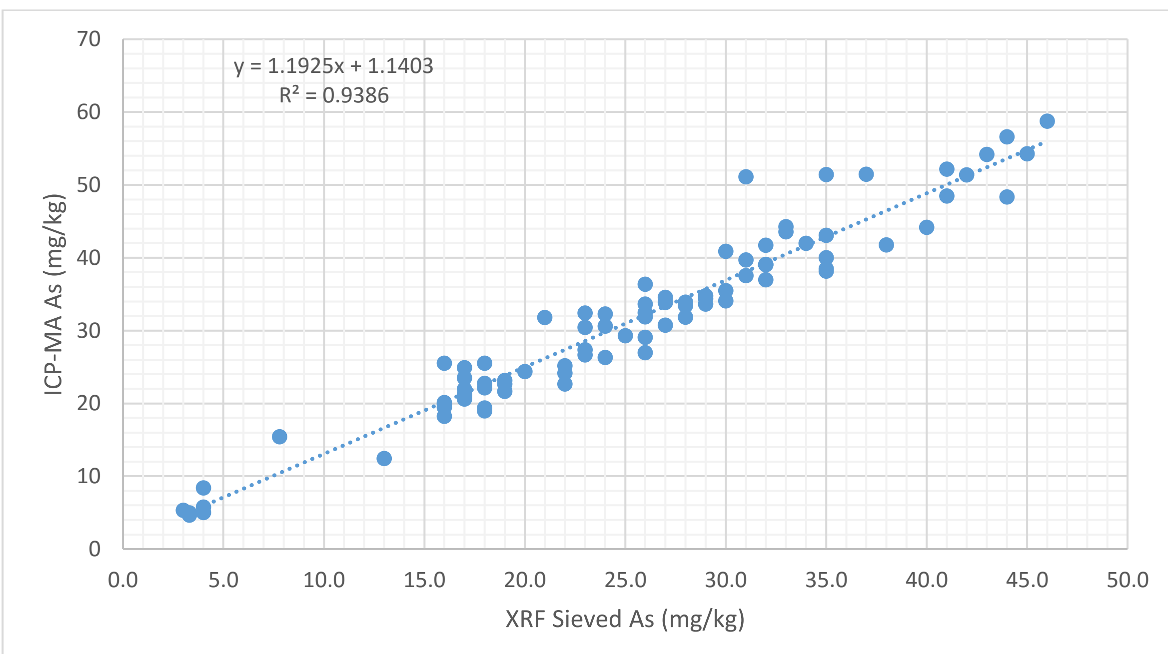


Figure 16. As ICP-MS and As XRF sieved results.

Table 4. Dust wipe ICP-MS results summary.

Sample ID	As Dust (mg/L)	Pb Dust (mg/L)	Pb Calc. (µg/ft^2)	Former Orchard Land
YAK-01-DW-01	ND	0.0045	1.35	Y
YAK-01-DW-02	ND	0.0094	2.82	Y
YAK-01-DW-03	ND	0.007	2.1	Y
YAK-02-DW-02	ND	0.0061	2.73	N
YAK-02-DW-03	ND	0.0015	0.45	N
YAK-02-DW-1	ND	0.0025	0.75	N
YAK-03-DW-01	ND	0.012	3.6	N
YAK-03-DW-02	ND	0.01	3	N
YAK-03-DW-03	ND	0.0082	2.46	N
YAK-03-DW-04	ND	0.012	3.6	N
YAK-04-DW-01	ND	0.0082	2.46	Y
YAK-04-DW-02	ND	0.021	6.31	Y
YAK-04-DW-03	ND	0.0038	1.14	Y
YAK-07-DW-02	ND	0.002	0.6	Y
YAK-07-DW-03	ND	0.0019	0.57	Y
YAK-08-DW-2	ND	ND	NA	N
YAK-10-DW-01	ND	0.001	3.3	N
YAK-10-DW-03	ND	0.0014	0.42	N
YAK-10-DW-2	ND	0.0015	0.45	N
YAK-12-DW-03	ND	0.0045	1.35	N
YAK-12-DW-04	ND	0.0021	0.63	N
YAK-13-DW-01	ND	0.0038	1.14	Y
YAK-13-DW-02	ND	0.0046	1.38	Y
YAK-13-DW-03	ND	0.016	4.8	Y
YAK-13-DW-04	ND	0.0046	1.38	Y
YAK-14-DW-01	ND	0.005	1.50	Y
YAK-14-DW-02	ND	0.01	3.00	Y
YAK-14-DW-03	ND	0.014	4.20	Y
YAK-14-DW-04	ND	0.0086	2.58	Y
YAK-15-DW-1	ND	0.0043	1.29	N
YAK-16-DW-01	ND	0.0018	0.54	Y
YAK-16-DW-02	ND	0.0018	0.54	Y
YAK-16-DW-03	ND	0.0071	2.13	Y
YAK-16-DW-04	ND	0.0048	1.44	Y
YAK-18-DW-04	ND	0.0015	0.45	Y
YAK-18-DW-05	ND	0.011	3.3	Y
YAK-19-DW-01	ND	0.0018	0.54	N
YAK-19-DW-02	ND	0.0015	0.45	N
YAK-19-DW-03	ND	0.0074	2.22	N
YAK-19-DW-04	ND	ND	NA	N

GIS Analyses

The extent of former orchard land in the Upper Yakima Valley is expansive, encompassing much of the area that is now residential. Using the 1927 and 1947 aerial photographs to define former orchard land, 8 out of 19 CCs (42%) that were sampled were on former orchard land, and 12 of 23 CCs (52%) that were not sampled were on former orchard land. A total 20 of 42 CCs (48%) were in former orchard land (Figure 2). Of the ~150 in-home CCs total, ~68 (45%) of those were in former orchard land (Figure 2).

Contours were generated using the ESRI IDW geostatistical tool and maximum and mean bulk XRF soil concentrations for Pb and As collected at CCs. These contours are extrapolations, they are estimates and may not accurately represent soil concentrations at a given point. X-ray fluorescence spectrometry data from school investigations and remediations conducted by Ecology were also used to create the contours.

The patterns of these contours indicate a relationship between former orchard lands and elevated concentration values (Figures 17 and 18). Areas that show elevated As values tend to also show elevated Pb values (Figures 17 and 18). Mean concentrations of As and Pb are also elevated in former orchard areas (Figures 19 and 20). The greater concentrations of As and Pb will show from blue (lower concentration) to red (higher concentration).

There were CCs included in this study that are located outside of the City of Yakima, but there was not enough data points in these areas to create meaningful IDW contours. Therefore, the GIS analysis only includes a large portion of the City of Yakima.

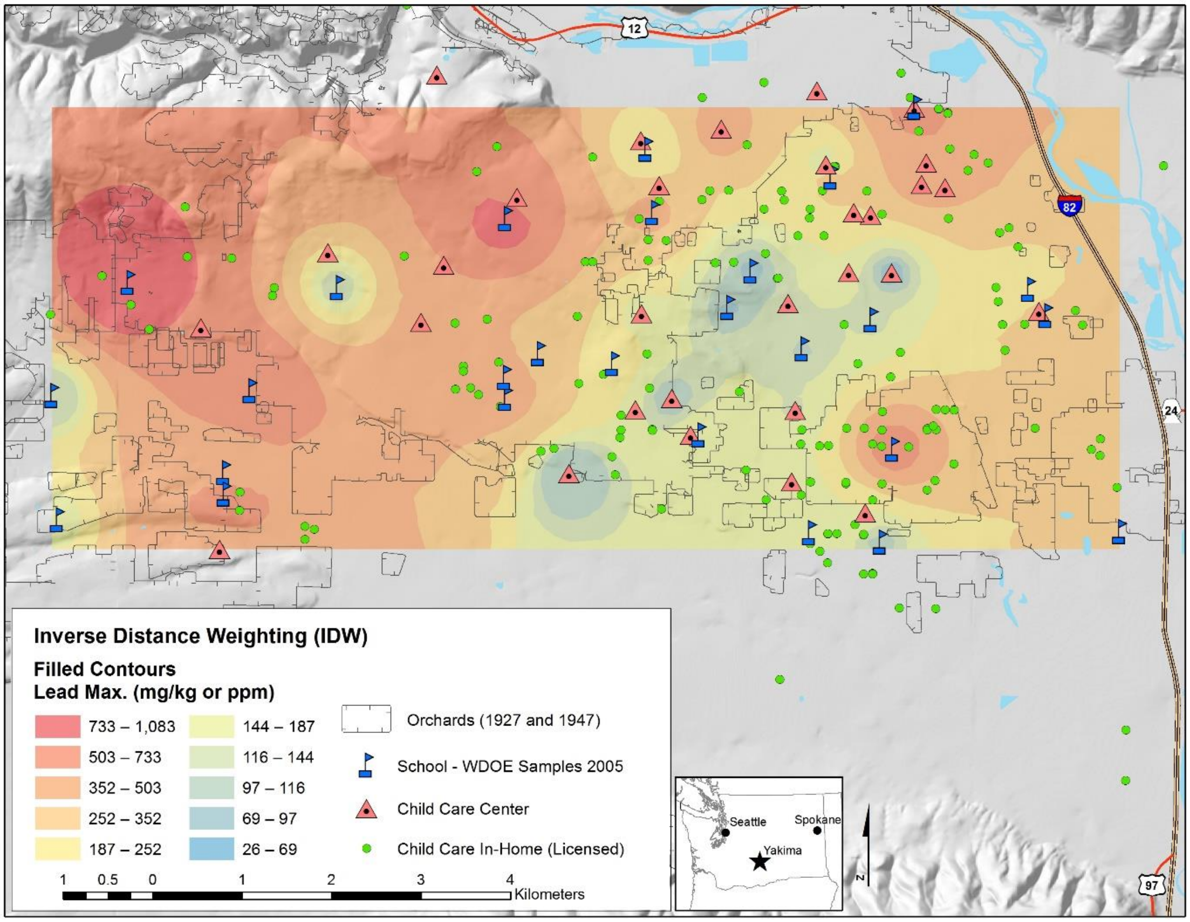


Figure 17. IDW contours based on maximum soil Pb concentrations.

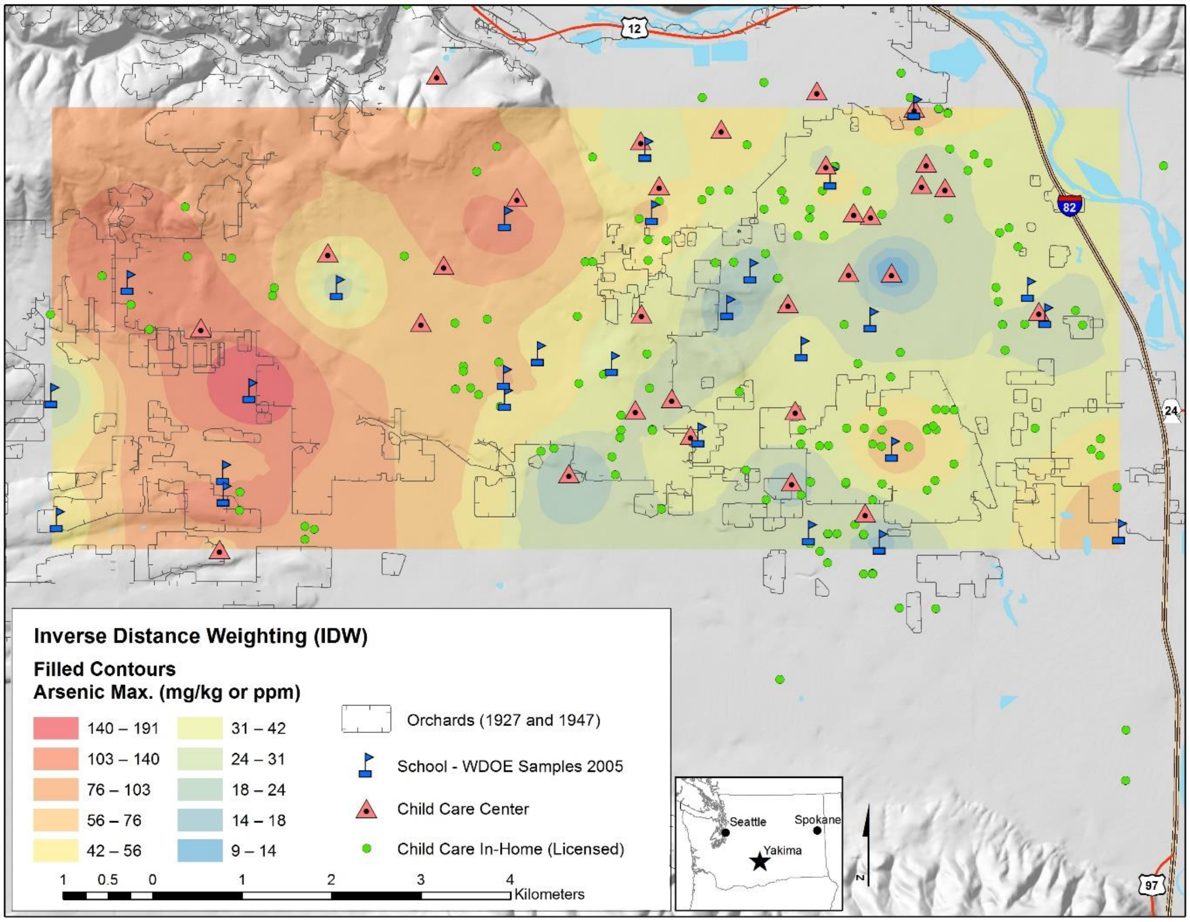


Figure 18. IDW contours based on maximum soil As concentrations.

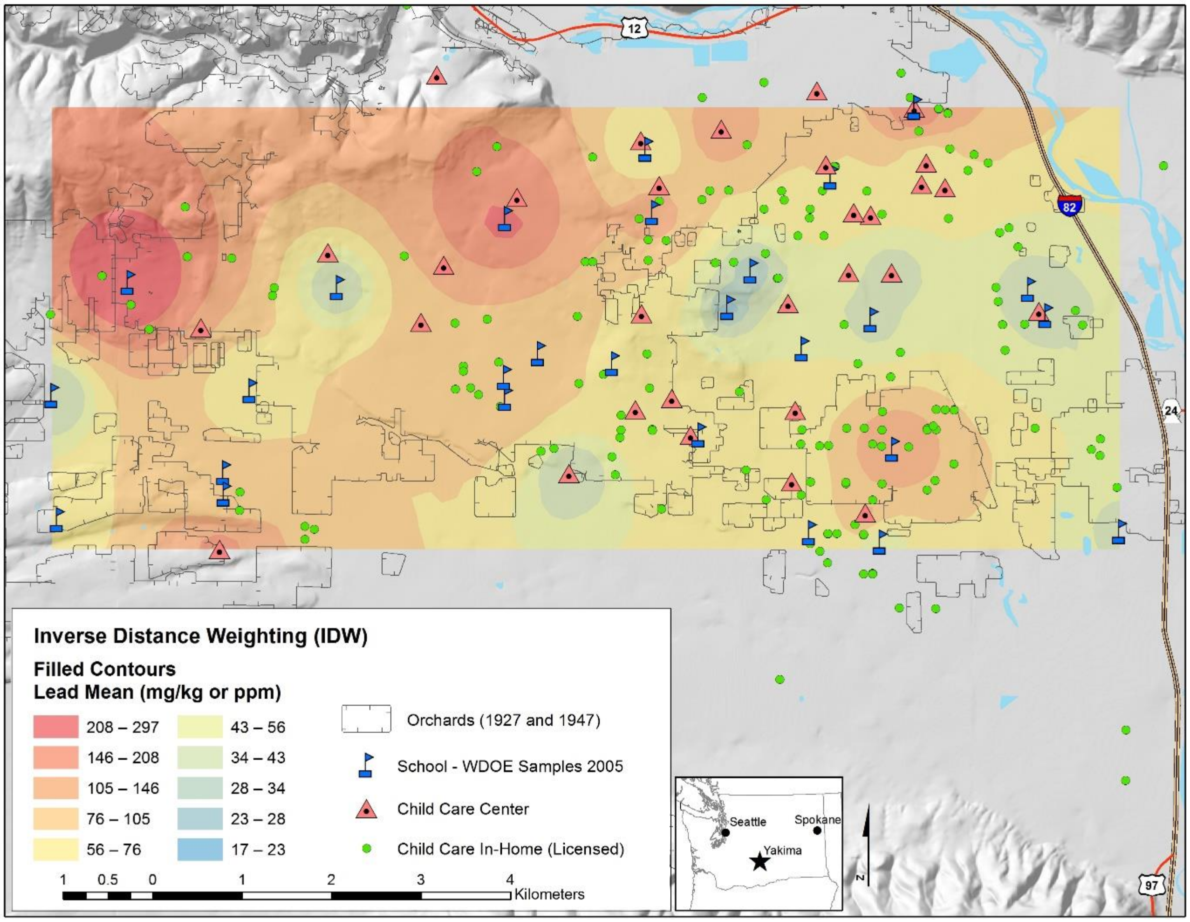


Figure 19. IDW contours based on mean soil Pb concentrations.

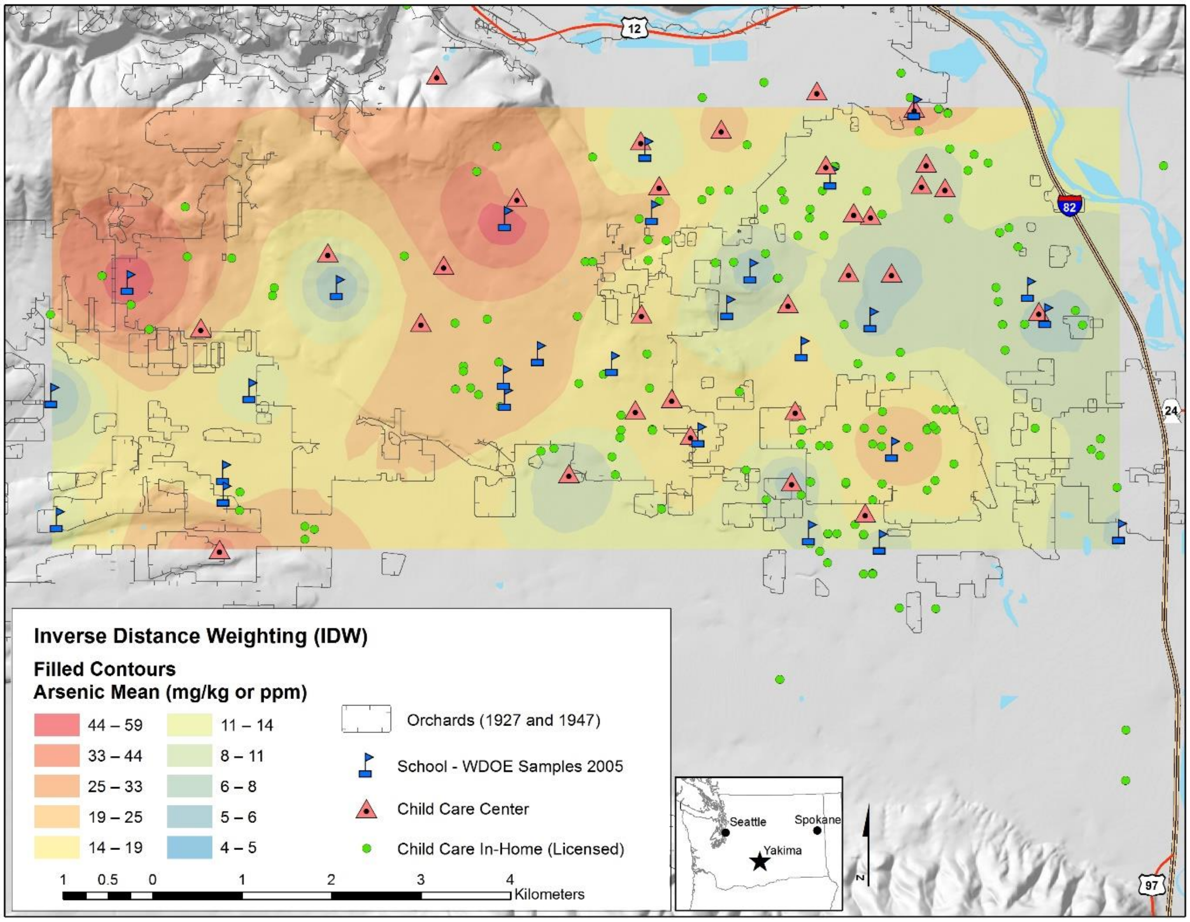


Figure 20. IDW contours based on mean soil As concentrations.

Survey Results

Fifteen (15) of 19 CCs completed a survey, though some fields were omitted (Table 5a and 5b). Average CC age was 11.7 years (SD ± 6), the number of children on site ranged from 5 to 400 (average 83.9, SD ± 93), and children's ages ranged from 1 month to 16 years. Time outdoors in summer and winter averaged 108.5 (SD ± 64) and 52 (SD ± 24) minutes, respectively. Total time at the CCs each day averaged 502 (SD ± 78) minutes. Cleaning frequencies were reported for wet mopping, dusting, and vacuuming at 9.5 (SD ± 4), 3.7 (SD ± 4), and 6.2 (SD ± 2) times per week, respectively. Ten (10) CCs reported no new soil introduction, 11 use sprinkler systems in the play area, nine (9) use some type of soil barrier or cover such as mulch or gravel, 13 reported no interior or exterior lead-based paint, six (6) reported some type of previous excavation had been completed (often for the initial CC construction), and seven (9) reported interior remodeling within the last 22 years or less. When asked if they were aware of the possibility of Pb and As soil contamination in the area none of the respondents had heard of the issue. Due to the low number of complete surveys (questions left blank or surveys not returned at all), regression analysis of questionnaire results against soil metal concentrations was not possible.

Table 5a. CC site survey summary - demographics and cleaning information.

Survey Question	**Responses #**	**Range**	**Average**	**Std Dev**	**Max**	**Min**
Site Age (Years)	15	24	11.7	6	26	2
Years Since Remodeling	3	19	14.3	10	22	3
Child Count	15	394.5	83.9	93	400	5.5
Age Range Of Children	15	30 days to 16 years				
Minutes Outside, Summer	15	218	108.5	64	240	22
Minutes Outside, Winter	14	98	52.6	24	210	22
Total Indoor Play (Minutes)	15	683	377.6	177	720	37
Total Time At Center (Minutes)	15	270	502	78	600	330
Days Per Week At Center	14	1.5	4.8	1	5	3.5
Wet Mop Freq (Times/ Week)	15	11	9.5	4	14	3
Dusting Freq (Times/ Week)	13	13.75	3.7	4	14	0.25
Vacuum Freq (Times/ Week)	14	6	6.2	2	7	1

Table 5b. CC site survey summary - facility information.

Survey Question	**Response #**	**Yes**	**No**
Any Soil Introduced	11	1	10
Sprinkler System In Play Area	13	11	2
Soil Cover Used	14	9	5
Enviro. Testing Done	11	1	10
Presence Of Lead Paint	13	0	13
Excavation On Site	8	4	4
Remodeling Done	14	9	5
Aware Of Pb-As Issue	8	0	8

Chapter 4: Discussion

Ecology asked the DOH to evaluate short term exposure risks of As in soil. They found that regular exposure of As in soil for a child at 37 mg/kg or greater could result in adverse health effects, infrequent exposure of 162 mg/kg or above for a child could result in death, and regular exposure for an adult at 175 mg/kg could result in adverse health effects (Washington State Department of Health 1999). Four of the maximum XRF data values collected as part of this study for As exceed the 37 mg/kg concentration that the DOH estimates could produce health effects.

Site Specific Discussion

Site 1

Site 1 is located in former orchard land according to the 1947 air photo analysis. It is unclear if this site was former orchard land in 1927. This site showed elevated concentrations above the MTCA cleanup level for both As and Pb. The maximum As concentration from the bulk XRF data was 53.1 mg/kg and the mean was 36 mg/kg. This was the only site where all of the As results for this site were over the MTCA cleanup level. The maximum XRF Pb concentration for this site was 418 mg/kg and the mean was 165.5 mg/kg. Dust wipe ICP-MS analysis was conducted at this site due to exceedances for both As and Pb. The maximum Pb concentration in the dust was found to be 2.82 mg/ft^2 which is well below the limit set by the EPA of 40 ug/ft^2.

A distinguishing factor of this site was that it was the only in-home CC that was included in this study. The owner was the very first respondent to an initial e-mail for participants. She was very interested and concerned about the possibility of contamination especially because it was her home and she has young children. In addition, because this was an in-home CC there were only a few children that attended the facility, by far the least amount of any other CC sampled in this study. This CC was also cleaned least often. The maximum Pb dust concentration for the site was above the average about 1.92 ug/ft^2, however it was not even half the amount of the maximum Pb dust concentration found 6.31 (ug/ft^2).

At the follow up meeting where the in-home CC owner was given the results the home owner was quite upset with the results from the soil at her home. She seemed to be upset that the developer of the housing development where her home was located did not inform her or other homes buyers that the soil their homes were built on was possibly contaminated. She also informed me that they were in the process of selling their home. She was concerned that the information that I was giving her would impact the finalization of the sale of her home. She said that she would be disclosing to the potential buyers the contamination that was found in the soil.

Site 2

Site 2 is not located on former orchard land according to the 1927 and 1947 air photos. The maximum bulk XRF data for As was 12.2 mg/kg and the mean was 5.7 mg/kg which was under the MTCA cleanup level. The maximum bulk XRF data for Pb was above the MTCA cleanup level at 358 mg/kg and the mean was 51.5 mg/kg. Due to the soil exceedance for Pb at this CC, dust samples were sent in for laboratory analysis. The maximum concentration for Pb in the dust at this site was found to be 2.73 ug/ft^2.

This site was not located on former orchard land and the As soil concentration maximum was near the natural background level found for Washington State (7 mg/kg). This indicates the possibility of a different source of Pb contamination. This site is located in an older part of Yakima with homes that could still have lead paint. During sampling at the site it was noted that the neighboring home seemed to be showing some recent fire damage. Sampling locations near this adjacent fire damaged property showed the highest levels of Pb contamination. Other areas on the property showed much lower concentrations of Pb.

Site 3

In the 1927 and 1947 air photos Site 3 did not appear to be on former orchard land. However, the soil sampling at this site did show MTCA cleanup level exceedances. The maximum As bulk XRF concentration was 24.4 mg/kg and the mean was 17 mg/kg. There were no exceedances for Pb as the maximum Pb concentration was 178 mg/kg and the mean was 110 mg/kg.

In the survey results, the CC owner indicated that some excavation had been conducted at the site during construction and some landscaping excavation had also occurred. Since both As and Pb were elevated at this site (Pb did not exceed the MTCA cleanup level), there may have been orchards at this site that were not represented in the 1927 or 1947 air photos. Another possibility is that with excavation activities there is a possibility of contaminated soil being introduced to the site or there may be another unknown source.

Laboratory results for Pb in dust showed a maximum 3.6 ug/ft^2. This site had the fourth highest concentration for Pb dust. This was interesting since the maximum XRF soil Pb concentration was not a MTCA cleanup level exceedance and many of the other CC centers had greater Pb soil exceedances and less Pd dust concentrations. This indicates a possible difference in cleaning activities, or another non soil source of Pb at the facility.

This site like many of the CCs included in this study had a large play area covered in woodchips. The majority of the play area at this CC was covered in multiple centimeters of woodchips. Samples were taken in areas where the woodchip depth was not as thick, or where the soil was exposed.

Site 4

Site 4 was located on former orchard land. It had a maximum As concentration of 38.9 mg/kg and a mean of 21.3 mg/kg which were both above the MTCA cleanup level. The maximum Pb concentration was 127 mg/kg and the mean was 57.4 mg/kg, both under the MTCA cleanup level, but elevated above estimated background concentrations. This site also had the greatest dust Pb concentration at 6.31 ug/ft^2 and the mean was 3.03 ug/ft^2, both under the EPA level of concern.

This was one of the many sites that did not return a survey. However, when collecting the samples, one observation that was concerning was that this site was one of the few that had relatively no soil barriers. There was a large area of sand and an area with woodchips, but the coverage was not good. In the rest of the play area there was mostly dead, sparse grass coverage. For young children playing here there was not sufficient barriers to protect them from contaminated soil.

Site 5

This site did not have any exceedances above the cleanup levels, however the concentrations of As and Pb were above the estimated background levels. Maximum As at this site was 17.6 mg/kg and the mean was 15.5 mg/kg. Maximum Pb was 79.5 mg/kg and the mean was 71.7 mg/kg. The play area at this location was quite small and the majority was covered with thick woodchips. One small area of grass that about 160 sq. ft. was available for sampling. This site was on former orchard land, however the majority of the property was covered in asphalt for parking, and the majority of the surrounding properties were commercial business, where minimal to no bare soil was present.

Site 6

Site 6 did not have any exceedances above the MTCA cleanup level with a maximum As concentration of 15 and a mean of 7.7 mg/kg. The maximum Pb concentration was 123.5 mg/kg and the mean was 56.9 mg/kg. This site was not on former orchard land according to the 1927 and 1947 air photos.

Site 7

Site 7 did not have any exceedances above the MTCA cleanup level with a maximum As concentration of 12.2 mg/kg and a mean of 6.2 mg/kg. The maximum Pb concentration was 158.8 mg/kg and the mean was 59.4 mg/kg. The As concentrations found were near the background levels, however the Pb concentrations were elevated above background levels. This site was on former orchard land according to the 1927 and 1947 air photos, and was one of the two sites that did not have As or Pb exceedances above the MTCA cleanup levels on sites that were identified as former orchard land.

When conducting sampling, the majority of the samples at this site were taken in the grass covered play yard. There was another yard with deep woodchips that was not sampled. Three locations were also sampled in another large back area. This area was not currently used as a play yard for the CC, but the owner was interested in expanding and using as a play area, there were a few older orchard trees still growing in this area. The two highest concentration for Pb (158.8 mg/kg and 97.6 mg/kg) were found in this back area, but two of the lowest concentrations for Pb were also found in the back area (36.7 mg/kg and 30.3 mg/kg).

Site 8

Site 8 is the one site permission to disclose sampling data was allowed. This site is located in the City of Yakima. This site did not appear to have been built on old orchard land according to the 1927 and 1947 air photos, and did not show concentrations of Pb and As over the MTCA cleanup levels. However, there were concentrations of As and Pb over the estimated background levels. The As maximum for this site was 16.7 mg/kg and the mean was 10.9 mg/kg, the Pb maximum was 102.9 mg/kg and the mean was 82.6 mg/kg.

The owner of this site not only decided to bring in clean soil as a cap over the contamination, but he also was interviewed by Oregon Public Broadcasting/Northwest Public Radio. The story about the soil contamination aired on multiple radio stations and is also available on the internet.

Site 9

Site 9 was one of the sites that had the lowest concentrations of both As and Pb. The maximum concentration of As was 6.8 mg/kg and the mean was 4.4 mg/kg. The maximum concentration for Pb was 27.8 mg/kg, the mean was 16.5 mg/kg. These concentrations were close to the estimated background levels. This site was also not identified as former orchard land based off of the historic air photos. It was however located near the Yakima River, it had extremely rocky soil, mainly with small river rock. This impeded sampling at some locations on the site, samples at the 5-15 cm depth were in many cases unable to collect due to the rocky soil.

Site 10

Site 10 was not on former orchard land, and the concentrations of Pb and As did not exceed the MTCA cleanup levels. The maximum for As at this site was 7.3 mg/kg and the mean was 5.1 mg/kg, which is near the estimated background level. The maximum Pb was 74.2mg/kg, the mean was 46.9 mg/kg, exceeding the estimated background level.

Site 11

Site 11 was not on former orchard land, and the concentrations of Pb and As did not exceed the MTCA cleanup levels. The maximum for As at this site was 7.2 mg/kg and the mean was 5.5 mg/kg, which is near the estimated background level. The maximum Pb was 69 mg/kg, the mean was 32.2 mg/kg, exceeding the estimated background level.

This site was in a commercial part of Yakima with a lot of heavily compacted soil and asphalt surfaces in surrounding properties. The majority of the play yard was compacted soil mixed with pea gravel. This proved difficult to get soil samples much further than surface samples. There was a smaller grass area, but the layer directly under the grass was heavily compacted and mixed with pea gravel.

Site 12

Site 12 was another site with extremely rocky soil that was positioned close to the river. This site was in former orchard land. The maximum As value exceeded the MTCA cleanup level at 27.8 mg/kg, the mean was 19.2 mg/kg. Then concentration for Pb did not exceed the MTCA cleanup level but were above estimated background levels. The maximum Pb concentration was 102.8 mg/kg, and the mean was 68.7 mg/kg.

Site 13

Site 13 was one of the more contaminated sites. This site is on former orchard land. The maximum As concentration at the site was 67.9 mg/kg, and the mean was 24.7 mg/kg both exceeding the MTCA cleanup level. This site also had the highest concentration found for Pb at 506.7 mg/kg, over twice the MTCA cleanup level. The Pb mean was 158.7 mg/kg. The Pb results for dust at this site ranked second highest at 4.8 ug/ft^2.

Site 14

Site 14 was in an old orchard area. It had MTCA cleanup level exceedances for both As at 53.4 mg/kg for the maximum, and 21.4 mg/kg for the mean. The maximum for lead was 388.6 mg/kg which was the second highest Pb concentration from this study, the mean Pb for the site was 133.5 mg/kg. The maximum Pb dust concentration was 4.2 ug/ft^2. This site had a good amount of play area with deep woodchip coverage, asphalt coverage, and grass.

Site 15

Site 15 was not in former orchard area based on the 1927 and 1947 air photos. It was also one of the sites with the lowest concentration levels of As and Pb, nearing the estimated background levels. The maximum As concentration at the site was 7.2 mg/kg, the mean was 4.7 mg/kg. The maximum Pb concentration was 22.4 mg/kg with a mean of 20.8 mg/kg.

Site 16

Site 16 was a site mixed with heavily wood chipped play areas, concrete, and grass play areas. This site is on former orchard land and had MTCA cleanup level exceedances for As, but not for Pb. The maximum As concentration was 34.7 mg/kg with a mean of 17.6

mg/kg. The maximum for Pb was 119.8 mg/kg, the mean was 68.9 mg/kg. The Pb dust results were a non-detect.

Site 17

Site 17 was a newer construction right near a local creek. The site was set much higher than the creek indicating fill soil was possibly brought into the site prior to construction. However, the survey indicated unknown for major excavating or landscaping. This site was not on former orchard land and did not have any MTCA cleanup level exceedances for either Pb or As. The maximum concentrations are near the estimated background levels. The maximum As at the site was 5.6 mg/kg, the mean was 4.4 mg/kg, the maximum concentration for Pb was 22.4 mg/kg with a mean of 20.8 mg/kg.

Site 18

Site 18 is in an older residential area that was formerly orchard land. This site had exceedances above the MTCA cleanup level for As. The maximum As concentration was 33 with a mean of 14.7 (mg/kg). The Pb maximum concentration 149.2 with a mean of 61.8 (mg/kg) which exceeded the estimated background levels.

Site 19

Site 19 has good woodchip or concrete coverage on over half of the play area. The rest of the play area is grass. This site was not in a former orchard area and did not have exceedances above the cleanup standard for either As or Pb. The As maximum concentration was 7.2 mg/kg and the mean was 4.7 mg/kg. The Pb maximum concentration was 19.9 mg/kg, with a mean of 15.9 mg/kg which is near the estimated background level.

Statistical Analysis Discussion

The strong correlation between former land use and Pb and As levels in both the PCA (Appendix C) and data analyses (Figure 11) supports the hypothesis that most of the Pb and As in the soils is a result of historic LA pesticide application. Sample depth does not appear to play an important role (Figure 12), perhaps due in part to leaching of As through the soil column over time. The observed association of Pb and As with Fe and Mn is most likely due to soil mineral adsorption (Appendix C). This association between land use history and Pb and As concentrations could be used in future education efforts in the region.

The correlation between bulk and sieved results demonstrate strong correlation for both metals (Figures 7 and 8) indicating that Pb and As concentrations are similar in soil grain sizes larger than 250 μm and less than 250 μm. The correlation between the two metals is not as strong (Figures 9 and 10), indicating potential differences in contaminant fate and transport mechanisms. This is in agreement with findings from other authors that found that As tended towards greater downward leaching into deeper soils in comparison with Pb (Merry et al. 1983; Veneman et al. 1983; Peryea 1998). Site history is the strongest indicator of contamination both in data analysis and in PCA groupings.

Laboratory ICP-MS results compared well with both the XRF sieved and bulk results for both As and Pb. The ICP-MS Pb results compared with the Bulk XRF Pb results had an R^2 value of 0.98 (Figure 13), ICP-MS Pb compared with a XRF sieved Pb had an R^2 value of 0.99 (Figure 14). Similar correlations were found for the As concentrations. Inductively coupled plasma mass spectrometry As results compared with the bulk XRF As results had an R^2 value of 0.93 (Figure 15). The ICP-MS As results compared with the sieved XRF As results had an R^2 value of 0.94 (Figure 15).

GIS Discussion

Figures 17, 18, 19 and 20 display the maximum and mean As and Pb data values for CCs included in this study and school cleanup data from Ecology sampling. For sizing, visual purposes, and data availability, only the areas in and around the City of Yakima are included in these figures.

While there are outliers in both the mean and maximum concentrations the greater concentrations for both Pb and As (orange and red), on both the maximum concentration and mean concentration maps, occur in areas established to be former orchard land based on 1927 and 1947 air photos (area inside the grey lined boundary). The area on Figures 17-20 where the majority of the blue contours are is the downtown Yakima area which was originally residential, but surrounded by orchard land.

While this study mainly focused on CCs, the green dots on the maps represent in-home CCs, which far outnumber the number of large CCs. As shown on the maps the majority of the land in and around Yakima show elevated levels of As and Pb above the estimated background levels. Areas further away from the city center show levels above the MTCA cleanup levels. Some CCs and schools are located in the downtown Yakima area. However, most of the schools and CCs (both in-home and larger CCs) are located outside of downtown Yakima in areas that had been former orchards and contain elevated levels of As and Pb.

Survey Discussion

The most alarming result of the survey that was handed out to the CCs was the question on if the person filling out the survey (mostly the CC owner or manager) was aware of the possibility of contamination at the facility. Out of the 15 returned surveys returned, none were returned with a “yes” to this question. Eight of the surveys said no and the other five received back were left blank. This is very troubling since this shows an obvious lack of community outreach and education on this issue. Especially because it would be expected that people that own, manage, or even work in the childcare field would have an increased knowledge of issues that had increase relevance to young children. If people in the childcare field are unaware of this potential issue that raises even more concerns for the general public that have young children and the possibility of contamination on their own yards.

On the positive side, the majority of the facilities, 9 out of 14 (1 survey did not answer), had some sort of soil cover that they used. From observations during sampling activities, most of the centers had thick woodchip areas where children would not likely come in contact with any soil without extensive digging. Another positive for the larger CCs were that they are dusted, wet mopped, and vacuumed frequently. Survey data shows that the on average CCs were wet mopped 9.5 times per week, with a maximum of 14 times per week and a minimum of 3. Dusting took place on average 3.7 times per week, with a maximum of 14 and a minimum of 0.25. Vacuuming took place an average of 6.2 times per week with a maximum of 7 and a minimum of 1. One item to note here is that there was one in home CC that was included in this study and filled out a survey. The in-home CC did have much fewer children than the larger CCs, however the frequency of dusting, wet mopping, and vacuumed was much greater than the large CCs. This would have an effect of the average cleaning frequencies.

These larger facilities serve a large number of children with a wide age range. On average each facility serves 83.9 children, with a maximum of 400 and a minimum of 5.5. The children range in age from 30 days to 16 years. One of the facilities sampled also offers some gymnastics classes. They included children from their gymnastics classes in their age range and child count which effected the group average and ranges.

Options for Remediation

Several options exist to reduce exposures for Upper Yakima Valley residents (and others). Some environmental Pb remediation methodologies promote the use of phosphorus to bind to Pb in the soil and make it less bioavailable to human and animal digestion (Peryea 1998). However, As has been shown to become more mobile in Pb contaminated soils remediated with phosphorus, increasing the risk of both surface and groundwater contamination (Peryea 1998; Davenport and Peryea 1991). The addition of phosphate-based fertilizers have the same effect on As mobility (Davenport and Peryea 1991).

Another remediation option that was explored for the Everett and Tacoma Smelter Plume areas was a study of fern phytoremediation. Ecology conducted the study in 2005-2007 to examine the possibility of using Chinese brake fern to remediate soil contaminated by Pb and As. The Chinese brake fern was found to hyper accumulate As concentrations 100 times what was found in the soil. However, the levels of As found in the soil did not decrease as much as excepted and the Chinese brake fern did not uptake Pb. There were some additional limitations found with this technique. There were concerns about protecting the public from the highly toxic fern fronds, after the fern fronds were used for remediation they had to be disposed of at a hazardous waste facility. Also the Chinese brake fern does not grow well if soil was too dry or the temperatures are too cold. Due to the climate of Eastern Washington, the Chinese brake fern would have growing difficulties if used for former orchard remediation (Ecology 2013b).

Physical removal of contaminated soil is a common mitigation measure in many areas, including remediation of schools in Central Washington (Peryea 1998). Capping of soils (encapsulation) is another option for reducing exposure risks (Peryea 1998), although this involves long-term maintenance and control to keep the barrier intact. Capping of the contaminated soil may include a fabric demarcation barrier. This not only keeps the contaminated soil separate from the clean soil brought into the site, it also provides a barrier as a reminder to workers that they have reached the contaminated soil.

Mixing contaminated soils with “clean” soils is an additional option, one that is more viable with lower contaminant levels (Hood 2006). A pilot study exploring this remediation option was conducted at Kissel Park in Yakima, Washington in 2001. In this pilot study different methods of deep tilling were tested including motor grader, switch plow, road reclaimer, ripper/rototiller, and rototiller. Looking at the depth of tilling, field mixing efficiency, and dust generation, it was found that the rototiller and road reclaimer methods have the best mixing effectiveness. However, because of the high concentrations of As and Pb at the site, the mixed soil concentrations were still above the MTCA cleanup levels. Therefore, the site was capped with either asphalt or a fabric barrier and clean soil (Floyd Snider McCarthy, Inc. 2001).

Reduction of exposure can also be achieved by reducing children’s contact with contaminated soils and dust, where possible. The majority of CCs employed some degree of wood chip cover, four had wood chips covering the majority of the play area. Eleven (11) CCs reported watering lawns via a sprinkler system, improving grass cover. Given the contamination concentrations, these factors reduce the risk of soil exposure to children at those locations, a point which was discussed with facility owners. The lack of elevated Pb and As in indoor dusts may be explained by the frequent cleaning reported by facilities on the questionnaires.

Priorities for Public Health

Former orchard lands encompass up to 188,000 acres of land in Washington (Hood 2006), because of this large scale and cost of remediation total remediation will not be feasible. Instead, focusing on education campaigns and remediating areas in which young children live and play should be the top priority to limit exposure to Pb and As.

Currently, there is not a sufficient education and outreach campaign for the public in Central Washington that may be affected by contamination on former orchard lands. Ecology has information on their website http://www.ecy.wa.gov/programs/tcp/area_wide/2012/former-orch-lands.html pertaining to the contamination found in former orchard lands as well as information on the school and park cleanups that have been completed. This website contains information on how to have your soil tested, and a rudimentary map of the location of former orchard lands in Central Washington.

Along with this information is a Healthy Actions webpage and Dirt Alert pamphlet (Appendix D) that describes what to do to limit exposure to Pb and As for former orchard soil. Items listed on this webpage include: reducing exposure to soil by covering bare soil with grass, clean soil, or some other barrier, washing hands frequently to avoid ingestion of soil from working or playing in contaminated soil, taking shoes off before entering the house, this reduces soil tracked into the home, frequent dusting, mopping, vacuuming, especially wet dusting and mopping, frequent washing of bedding, children’s toys, pacifiers or anything young children frequently put in their mouth, wash, wipe, and comb pets frequently, eating a well-balanced diet rich in iron, calcium, and vitamin C, which will decrease the absorption of Pb into the body.

All of this information is helpful and great to have available to the public, however many people are not even aware of the possibility that their soil is contaminated. Looking at the surveys that were handed out to the participating CCs, not a single person indicated having any prior knowledge of the possibility of contamination, and when the public is not aware of an issue they will not be searching out information that is available to them to protect themselves and their children from contact with contaminated soil.

Much like the Area-Wide Task Force recommended in 2005 for the public throughout Washington, education on decreasing exposure to contamination as well as remediating high child use areas should be the top priority in Central Washington as it is in Western Washington. Currently, in Central Washington there is no outreach being conducted. There have been state funded remediation efforts at many schools and a few parks in Chelan, Douglas, Okanogan, Spokane, and Yakima County (Table 6).

However, there is currently no purposed action to educate or remediate CCs located on former orchard land. The Washington State Department of Early Learning that licenses and inspects CCs refers to Ecology guidance on contaminated soil. Currently Ecology does not have a standardized plan for dealing with this contamination. Regarding the potential public health risks of LA contaminated soils Central Washington CCs, there is an apparent pattern of inaction and non-responsiveness by both Ecology, the Department of Early Learning, and the DOH.

Table 6. Remediated schools by county.

County	School Name
Chelan	Foothills Middle School
	John Newberry Elementary
	Lewis and Clark Elementary
	Lincoln Elementary
	Manson Elementary
	Orchard Middle School
	Peshastin Dryden Elementary
	Sunnyslope Elementary
	Washington Elementary
	West Side High
Douglas	Bridgeport Elementary
	Eastmont Junior High
	Lee Elementary
	Orondo Elementary
Okanagan	Brewster Elementary
	Brewster School District
	North Omak Elementary
	Tonasket School District
Spokane	Progress Elementary
Yakima	Apple Valley Elementary
	Barge Lincoln Elementary
	Gailleon Park
	Garfield Elementary
	Gilbert Elementary
	Hoover Elementary
	Kissel Park
	McKinley Elementary
	Naches Valley Intermediate
	Robertson Elementary
	Terrace Heights Elementary
	East Valley Elementary

Populations in Central Washington have characteristics that put them at an increased risk of negative effects from contact with contaminated soil. The DOH identifies older homes, lower household incomes, Hispanic ethnicity, and Central Washington residency to be significant predictors of elevated BLLs (Community, Trade, and Economic Development 2005). Lower household income can lead to nutrient deficiency in the body from lack of healthy foods. This can lead to an increase in lead uptake, into the body from contaminated soil. In addition, 30.1% of Yakima County's population is under the age of 18. There are only 89 counties in the U.S. that have a higher percentage of the population under the age of 18 (Yakima County 2016). Given these characteristics former orchard As and Pb contamination is an important environmental justice issue in Central Washington.

Post Study Remediation and News Media Coverage

Following the completion of sampling and lab work each CC owner was given a copy of their center's results, and the results were thoroughly discussed at individual meetings. At least one CC owner decided to remediate his CC. In addition, he also contributed to a news story produced by Oregon Public Broadcasting and Northwest Public Radio through a grant from the fund for Environmental Journalism. The news story is available at http://earthfix.info/news/article/contaminated-soil-lingers-where-apples-once-grew/.

As part of this interview, Ecology was invited out to the CC. They retested the soil with a XRF and confirmed that the clean cap soil was below the MTCA cleanup levels for As and Pb. Ecology confirmed that the original soil, below the new clean soil cap, showed elevated levels of Pb and As.

Study Bias

It is possible that the recruitment method resulted in a sample bias towards facilities with good hygiene practices and grounds maintenance; i.e., facilities with less stringent cleaning regimens and without grass cover or established play areas may have been more reluctant to participate in the study. This could result in the data here biasing towards CCs with lower exposure risks for children.

In addition, there were some CCs that were approached to be involved in this study that were aware they were on former orchard land, and because of this they did not want to be involved in the study. They were concerned if they knew about the contamination that they would have to take action, and spend money to remediate their facility.

There was also a sample bias towards the larger CCs verses in-home CCs. All of the ~190 licensed CCs in the Upper Yakima Valley (as of 2014) were contacted by e-mail to participate in the study. Only one (1) in-home CC out of ~150 replied and agreed to participate. Most of the larger (non-home) CCs and school CCs were visited on site to recruit participation. Eighteen (18) out of the 42 larger/pre-school CCs agreed to allow sampling.

Some areas that have been converted from orchard use do not appear to have elevated levels of As and Pb. This could be the result of misinterpretations of the historic aerial photographs, landscaping/movement of soils, weathering, construction activities, and different soil tilling and LA application patterns during agricultural use.

Confidentiality

Confidentiality was an important part of this study. Many of the CCs in this study were small privately run centers, liability and financial burden were a concern for them when they were initially approached with the opportunity to participate in this study. During the recruitment process it was made clear to each CC owner that the results for their center would only be given to them and that in any publication, poster, or paper the results would be de-identified, so that the results would not be tied to the specific CC. The de-identification of these results did present some challenges when writing this thesis, articles, and posters, and presenting this information in a complete manner.

Chapter 5: Conclusions

Based on maximum Pb and As results for discrete sample locations, 4 (21%) and 8 (42%) of the 19 CCs sampled exceeded the MTCA cleanup levels for unrestricted land uses for Pb and As, respectively (Table 3). The MTCA cleanup levels for Pb and As are regularly exceeded in soil samples from former orchard lands analyzed in this study, consistent with previous observations of widespread contamination of former orchard lands in the Yakima Valley (Ecology 2015). Using the 1927 and 1947 aerial photographs to define former orchard land, 8 out of the 19 CCs (42%) that were sampled were on former orchard land, and 12 out of the 23 CCs (52%) that were not sampled were on former orchard land. A total 20 of the 42 CCs (48%) were in former orchard land (Figure 2). Of the ~150 in-home CCs total, ~68 (45%) of those were in former orchard land (Figure 2).

Lead concentrations were strongly correlated between bulk XRF, sieved XRF, and ICP-MS analysis. Arsenic concentration were also strongly correlated between bulk XRF, sieved XRF, and ICP-MS analysis. Correlations between As and Pb were not strongly correlated. Dust analysis returned non-detects for all As concentrations, and Pb concentrations came back well below the EPA limits of concern 40 $\mu g/ft^2$ and 250 $\mu g/ft^2$ for floors and windows, respectively. The maximum Pb dust concentration found was 6.31 ug/ft^2.

Elevated As and Pb concentrations were found to be related to former orchard land and were consistently elevated in former orchard land in results of this study. Lead and As are associated with negative health effects. Lead and As have a common pathology in neurotoxicity, and thus are of particular concern in children's environmental health. Childcare centers are areas of intensive use for children and when coupled with potential residential exposure in their homes, the total daily exposure suggests a hazard to children. Heavy metals in dusts are a major exposure risk to infants and children who exhibit greater hand to mouth activity (U.S. Environmental Protection Agency 2013).

Because of these risk factors and behaviors high child use areas in former orchard areas need to be remediated to protect the health of the children that frequent them. The large expanse of land that this contamination effects also makes it a top priority to educate the public, especially parents on how to keep children safe from soil exposure. All responding CC facility operators surveyed in this study were unaware of the LA contamination in the Yakima Valley, this is not acceptable. Educating the public on this issue should be a top priority because many homes are located on former orchard land. There are many cleaning, hygienic activities, and other behaviors that can be followed to decrease exposure. However, parents and all residents in general need to be aware of the issue and practices to prevent exposure.

Previous remediation and assessment activities in the region targeted schools, but did not address other areas where children spend significant amounts of time outdoors. This study suggests the need for further review and action in addressing targeted public outreach and education and in reducing children's exposure to legacy LA in impacted areas.

References

Aten, C. F., Bourke, J. B., Martini, J. H. and Walton, J. C. (1980). Arsenic and Lead in an Orchard Environment. Bulletin of Environmental Contamination and Toxicology 24(1): 108-115.

Agency for Toxic Substance and Disease Registry (ATSDR). (2007). Toxicological Profile for Arsenic. Agency for Toxic Substances and Disease Registry. U.S. Department of Health and Human Services, Public Health Service, Atlanta, Georgia.

Bae, D. S., Gennings, C., Carter, WH., Yang, RSH, and Campain, JA. (2001). Toxicological Interactions among Arsenic, Cadmium, Chromium, and Lead in Human Keratinocytes. Toxicological Sciences 63: 132–42.

Centers for Disease Control and Prevention. (2012). Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention. Centers for Disease Control and Prevention. 2012.

Community Trade and Economic Development. (2005). Study: Lead Hazards in Housing. Childhood Lead Exposure in Washington's Communities. July 2015. http://www.commerce.wa.gov/Documents/HIP-Lead-Based-Paint-Lead-Hazards-in-Housing-Children.pdf

Davenport, J. R., and Peryea, Frank J. (1991). Phosphate Fertilizers Influence Leaching of Lead and Arsenic in a Soil Contaminated with Pb Arsenate. Water, Air, and Soil Pollution (1): 101–10.

Engrossed Second Substitute House Bill 1605 or (2005). L. 1605, 59th Leg. (2005).

Floyd Snider and McCarthy, Inc. (2001). Kissel Park Remedial Investigation/Feasibility Study and Cleanup Action Plan. https://fortress.wa.gov/ecy/gsp/CleanupSiteDocuments.aspx?csid=507.

Frank, R., Braun, H. E., Ishida, K., and Suda, P. (1976a). Persistent Organic and Inorganic Pesticide Residues in Orchard Soils and Vineyards of Southern Ontario. Canadian Journal of Soil Science 56(4): 463–84.

Frank, R., Ishida, and Suda, P. (1976b). Metals in Agricultural Soils of Ontario. Canadian Journal of Soil Science 56: 181–196.

Hood, E. (2006). The Apple Bites Back: Claiming Old Orchards for Residential Development. Environmental Health Perspectives 114 (8): A470–76.

Hubbs-Tait, Laura. Nation, Jack R., Krebs, Nancy F., and Bellinger, David C. (2005). Neurotoxicants, Micronutrients, and Social Environments. Psychological Science in the Public Interest 6(3): 57–121.

Mejia, J.J., Diaz-Barriga, F., Calderon, J., and Jimenez-Capdeville, ME. (1997). Effects of Lead and Arsenic Combined Exposure on Central Monoaminergic Systems. Neurotoxicology and Teratology 19: 489–97.

Merry, R. H., Tiller, K. G., and Alston, A. M.. (1983). Accumulation of Copper, Lead and Arsenic in Some Australian Orchard Soils. Soil Research 21 (4): 549–61.

Model Toxics Control Act Science Advisory Board. (2005). Arsenic-Contaminated Soils, Questions and Discussion Materials. http://www.ecy.wa.gov/programs/tcp/SAB/SAB_mtg_info/mtg_051215/02%20Arsenic%20SAB%20December%202005%20Materials.pdf.

Peryea, F. J. (1998). Historical Use of Lead Arsenate Insecticides, Resulting Soil Contamination and Implications for Soil Remediation. Proceedings, 16th World Congress of Soil Science, Montpellier, France, 20–26. Aug. 1998.

U.S. Department of Housing and Urban Development. (2012). Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing (2012 Edition). http://portal.hud.gov/hudportal/HUD?src=/program_offices/healthy_homes/lbp/hudguidelines.

U.S. Environmental Protection Agency. (1994). Memorandum: OSWER Directive: Revised Interim Soil Lead Guidance For CERCLA Sites and RCRA Corrective Action Facilities. https://semspub.epa.gov/work/HQ/175347.pdf.

U.S. Environmental Protection Agency. (2013). Integrated Science Assessment for Lead (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-10/075F.

Veneman, P. L. M., Murray, J. R., and Baker, J. H. (1983). Spatial Distribution of Pesticide Residues in a Former Apple Orchard. Journal of Environment Quality 12 (1): 101–104.

Washington Department of Ecology. (1991). Responsiveness Summary for the Amendments to the Model Toxics Control Act Cleanup Regulation Chapter 173-340 WAC. http://www.ecy.wa.gov/programs/tcp/regs/1991%20Responsiveness%20Summary.pdf.

Washington Department of Ecology. (1994). Natural Background Soil Metals Concentrations in Washington State. https://fortress.wa.gov/ecy/publications/documents/94115.pdf.

Washington Department of Ecology. (2002). Field Sampling Plan: Soil Sampling, EPA Grant Project. Yakima, WA Washington State Department of Ecology. 2002.

Washington Department of Ecology. (2003). Area-Wide Soil Contamination Strategy: Implementation of Task Force Recommendations. 03-09-102. http://www.ecy.wa.gov/programs/tcp/area_wide/implementation_plan/Implementation_Plan.pdf.

Washington Department of Ecology. (2011a). Dirt Alert Soil Sampling Guidance. Yakima, WA Washington State Department of Ecology. 2011.

Washington Department of Ecology. (2011b). Toxics Cleanup Program, Living With a Toxic Legacy. http://www.ecy.wa.gov/programs/tcp/sites_brochure/tacoma_smelter/2011/ts-hp.htm.

Washington Department of Ecology. (2013a). Frequently Asked Questions Tacoma Smelter Plume. https://fortress.wa.gov/ecy/publications/documents/1309086.pdf .

Washington Department of Ecology. (2013b). Fern Phytoremediation Study. http://www.ecy.wa.gov/programs/tcp/sites_brochure/tacoma_smelter/Phyto/index.html.

Washington Department of Ecology. (2015). Former Orchard Lands. http://www.ecy.wa.gov/programs/tcp/area_wide/2012/former-orch-lands.html.

Washington Department of Health. (1999). Hazards of Short-Term Exposure to Arsenic Contaminated Soil. http://www.doh.wa.gov/Portals/1/Documents/Pubs/334-284.pdf.

Wolz, S, Fenske, R. A., Simcox, N. J., Palcisko, G., and Kissel, J. C. (2003). Residential Arsenic and Lead Levels in an Agricultural Community with a History of Lead Arsenate Use. Environmental Research 93 (3): 293–300.

Yakima County. (2016). Yakima County Community Indicators Report. http://www.yakimacounty.us/DocumentCenter/View/9635.

Yakima County Development Association. (2013). ECONOMY, A Regional Center for Commerce and Industry. http://www.liveyakimavalley.com/about/economy.html.

Yakima Valley Museum. http://yakimamemory.org/index.php (accessed 2015).

Appendices

Appendix A

Site Sampling Diagrams and Surveys

Figure numbers do not correlate with site numbers for confidentiality.

Figure A1. Site sampling diagram (completed survey not received).

Figure A2.1. Site sampling diagram.

Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location? 1995
- Do you know anything about the site from before it was a child care center? No
- Has there been any excavating, landscaping, or soil brought to the site that you are aware of? Yes, we bought the property next door and tore down a house to add on to the facility. I do not think there was any soil brought in.
- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted? Yes, the front part of the building was in 1995 and back part of the building 2008.
- Has any soil cover (such as sod or mulch) ever been placed at the site? Yes, in 1995 and 2008.
- Has any environmental testing ever been done at the facility (inside or outside)? Not that I know of.
- Is there any other information you feel is important for us to know about your location, building, or the surrounding area? Very rocky.

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility? No

Figure A2.2. Site survey results.

- Has there been any remodeling conducted? If so, when and what was done. Yes, we remodeled the front entry way and added changing table and added a sink in the back room. 2010.

Facility Attendance:

- How many children attend your facility? Licensed for 77. We currently run approximately 55 children a day.
- What is the age range of the children attending your facility? 8wks. – 6yrs.
- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter. 1hr. to 1 ½ hrs., a day. Winter time is less, depending on the temperature.
- On average what is the amount of inside play time for the children that attend your facility? approximately 3hrs.
- What is the average total time per day a child would be at your facility? 8hrs.
- How many days per week on average does a child attend your facility? 5 days a week.
- Is there any other information you would like to tell us about attendance at your facility? N/A

Cleaning Practices:

- How often is the facility wet mopped inside? Every day Lunchtime and in the evening.
- How often is the facility dusted? I don't know. We have a cleaning service. Hopefully once a week.
- How often is the facility vacuumed? Every day.

- Is there any additional information about your facilities cleaning practices that you would like to add? No

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know?

Figure A2.3. Site survey results.

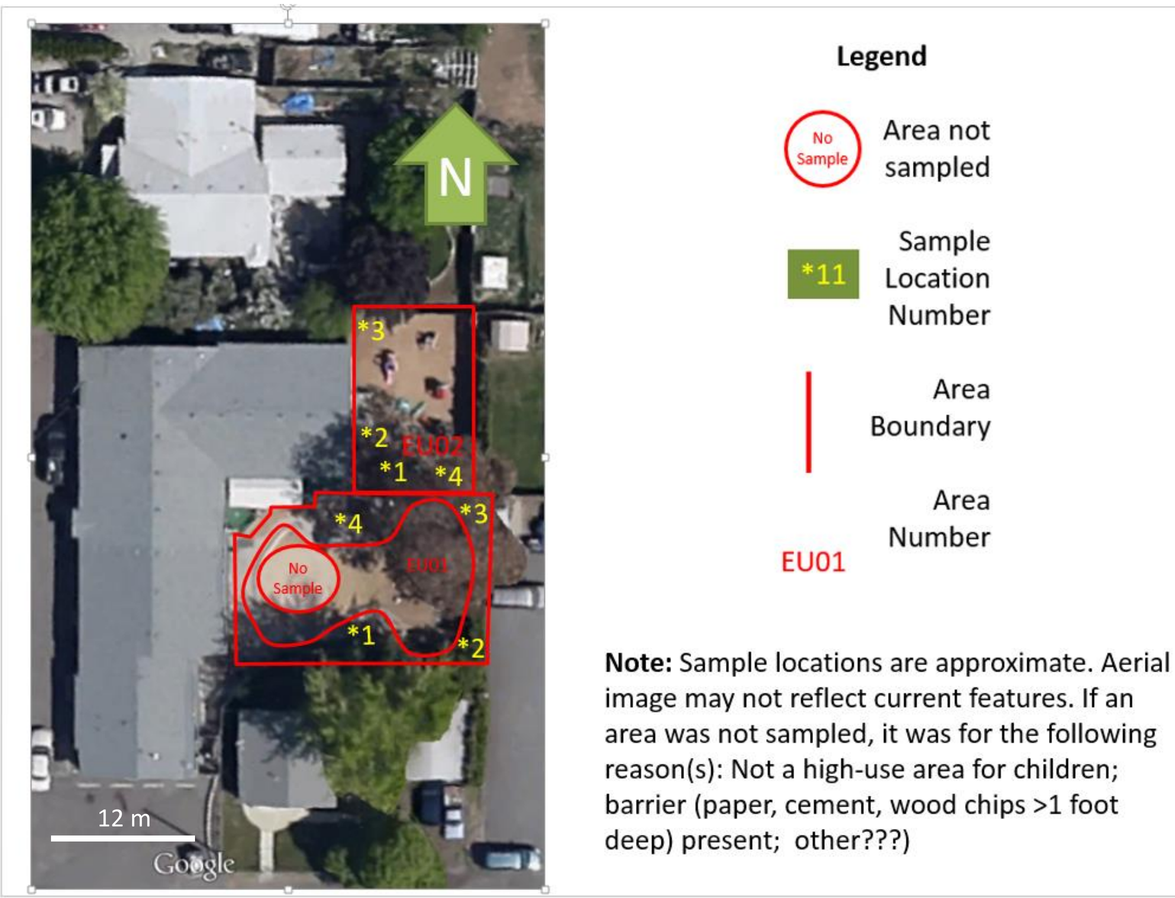


Figure A3.1. Site sampling diagram.

Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location?
  September of 1990/expansion October 1994

- Do you know anything about the site from before it was a child care center?
  Prior to childcare center it was an empty lot adjacent to a small house. The expansion lot had also had a small house on it.

- Has there been any excavating, landscaping, or soil brought to the site that you are aware of?
  Yes, this building was site built which included excavation. Landscaping is minimal. It includes some flower beds and a wood chip pit.

- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted?
  Not in the children's areas. The flower beds in the front of the building have an automatic drip line system which was installed about 5 years ago.

- Has any soil cover (such as sod or mulch) ever been placed at the site?
  Yes, initially there was grass on the playground but it could not withstand the traffic and died. We tried to re-sod the area in 1994 but it failed.

- Has any environmental testing ever been done at the facility (inside or outside)?
  no

- Is there any other information you feel is important for us to know about your location, building, or the surrounding area?
  no

Figure A3.2. Site survey results.

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility?
  no
- Has there been any remodeling conducted? If so, when and what was done.
- After the expansion only general maintenance.

Facility Attendance:

- How many children attend your facility?
  Up to 92 at one time
- What is the age range of the children attending your facility?
  30 days-12 years

- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter.
  Winter 30-60 minutes / summer 2+ hours depending on the day
- On average what is the amount of inside play time for the children that attend your facility?
  6-8

- What is the average total time per day a child would be at your facility?
  8 hours
- How many days per week on average does a child attend your facility?
  4-5 days

- Is there any other information you would like to tell us about attendance at your facility?
  no

Cleaning Practices:

- How often is the facility wet mopped inside?
  Every day
- How often is the facility dusted?
  Main surfaces daily/ sills, shelves etc
  Weekly and monthly
- How often is the facility vacuumed?
  Every day that our vacuum isn't broken ☺

- Is there any additional information about your facilities cleaning practices that you would like to add?
  no

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know?

Not aware

Figure A3.3. Site survey results.

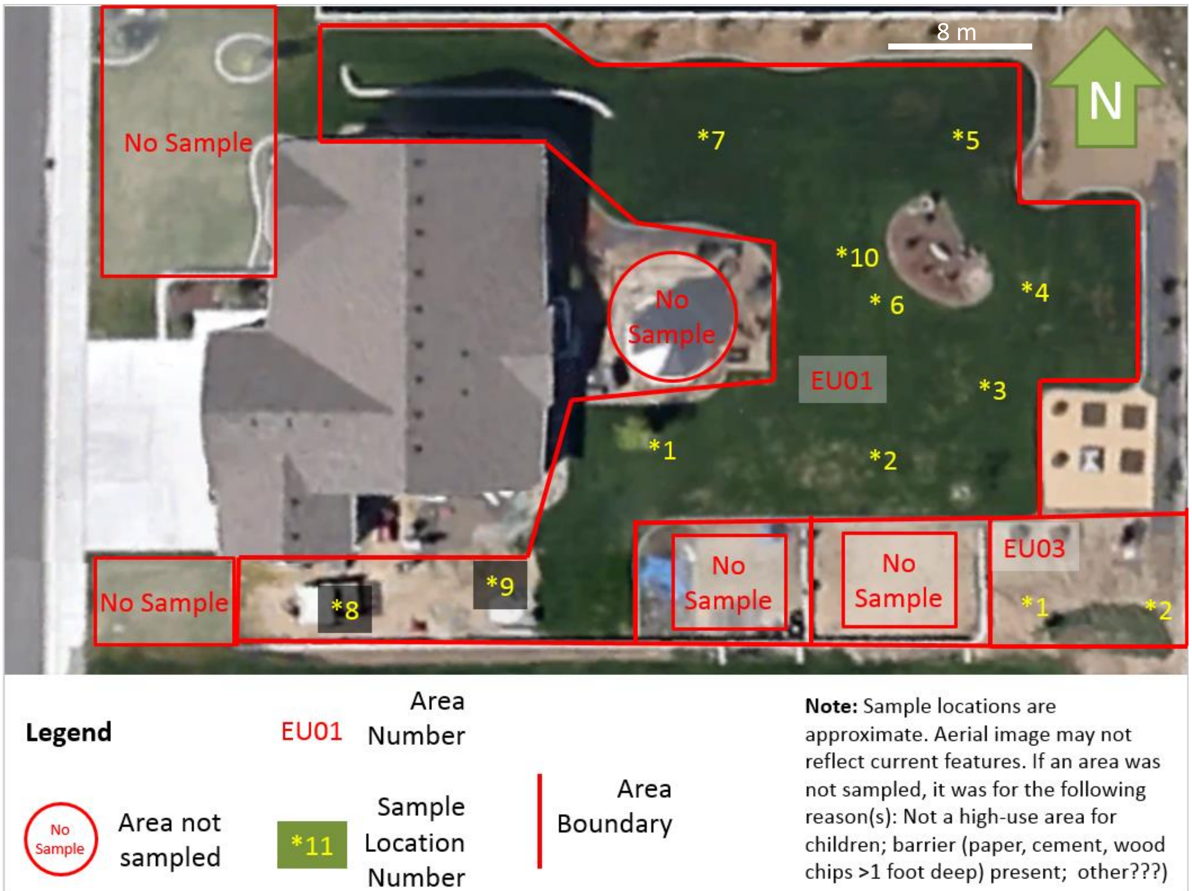
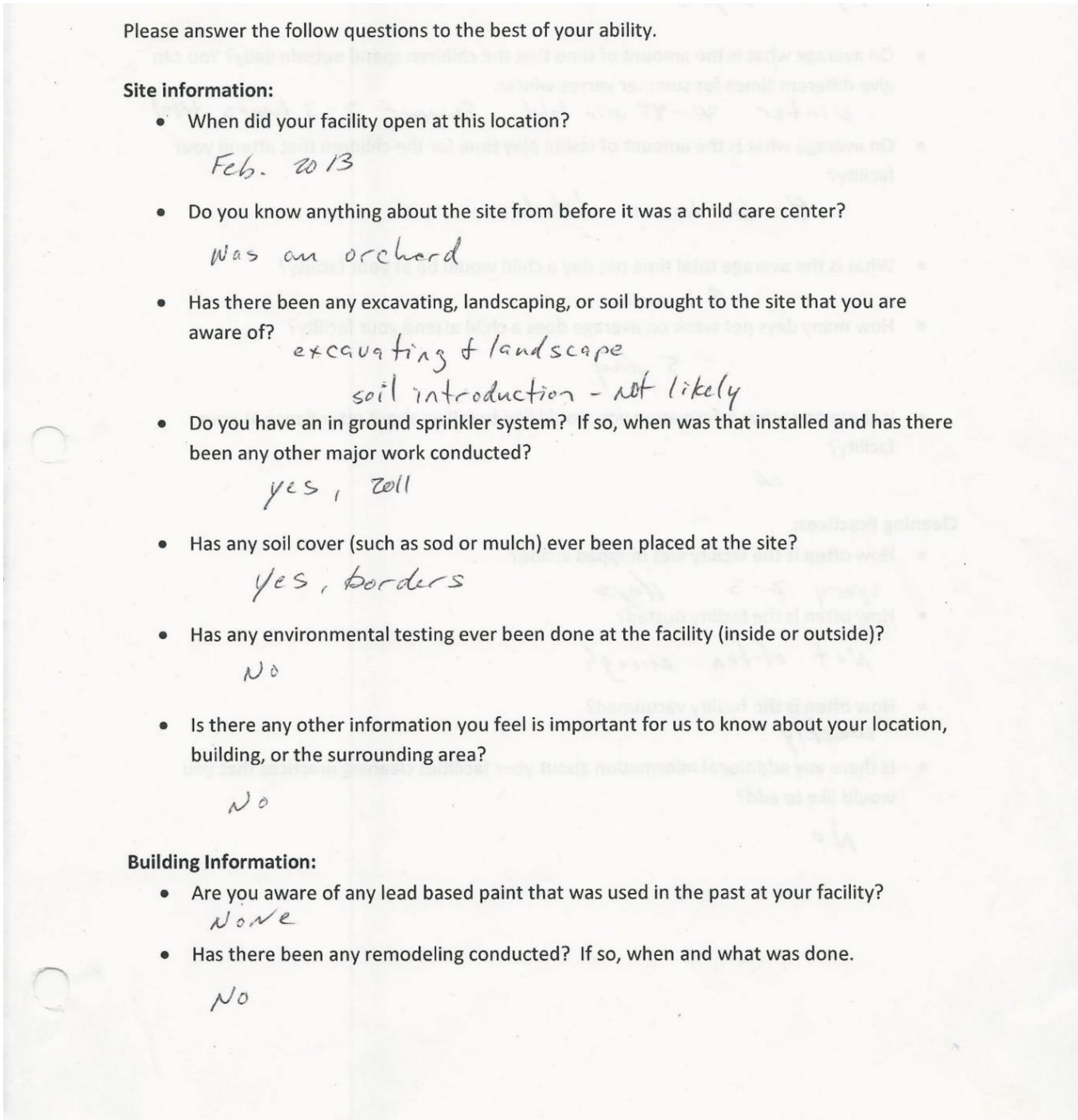


Figure A4.1. Site sampling diagram.



Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location?
  Feb. 2013
- Do you know anything about the site from before it was a child care center?
  Was an orchard
- Has there been any excavating, landscaping, or soil brought to the site that you are aware of?
  excavating & landscape
  soil introduction - not likely
- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted?
  yes, 2011
- Has any soil cover (such as sod or mulch) ever been placed at the site?
  yes, borders
- Has any environmental testing ever been done at the facility (inside or outside)?
  No
- Is there any other information you feel is important for us to know about your location, building, or the surrounding area?
  No

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility?
  None
- Has there been any remodeling conducted? If so, when and what was done.
  No

Figure A4.2. Site survey results.

Facility Attendance:

- How many children attend your facility?
  5 - 6
- What is the age range of the children attending your facility?
  1 yr – 12 yrs
- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter.
  winter 30 – 45 min total Summer 2 – 3 hours total
- On average what is the amount of inside play time for the children that attend your facility?
  4 – 6 hours total
- What is the average total time per day a child would be at your facility?
  8 hours
- How many days per week on average does a child attend your facility?
  5 day
- Is there any other information you would like to tell us about attendance at your facility?
  NO

Cleaning Practices:

- How often is the facility wet mopped inside?
  every 2-3 days
- How often is the facility dusted?
  Not often enough
- How often is the facility vacuumed?
  weekly
- Is there any additional information about your facilities cleaning practices that you would like to add?
  No

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know?

  No

Figure A4.3. Site survey results.

Figure A5.1. Site sampling diagram.

Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location?

  Nov. 2011

- Do you know anything about the site from before it was a child care center?

  NO

- Has there been any excavating, landscaping, or soil brought to the site that you are aware of? Not that I know

- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted? NO.

- Has any soil cover (such as sod or mulch) ever been placed at the site?

  NO

- Has any environmental testing ever been done at the facility (inside or outside)?

  NO

- Is there any other information you feel is important for us to know about your location, building, or the surrounding area? NO

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility?

  NO

- Has there been any remodeling conducted? If so, when and what was done.

  I know there has been some remodeling within the last 7 years but not sure about the dates

Figure A5.2. Site survey results.

Facility Attendance:

- How many children attend your facility?
  an average of 37 daily
- What is the age range of the children attending your facility?
  from 1 month to 13 years old.
- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter.
  About 2 hours winter
  About 4 hours summer
- On average what is the amount of inside play time for the children that attend your facility? 5 hrs.
- What is the average total time per day a child would be at your facility?
  7. hrs.
- How many days per week on average does a child attend your facility?
  5 days a Week
- Is there any other information you would like to tell us about attendance at your facility? NO

Cleaning Practices:

- How often is the facility wet mopped inside?
  Everyday
- How often is the facility dusted?
  Once a Week
- How often is the facility vacuumed?
  Every day
- Is there any additional information about your facilities cleaning practices that you would like to add? NO

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know? NO
  I got the info from our Director's meeting

Figure A5.3. Site survey results.

Figure A6. Site sampling diagram (completed survey not received).

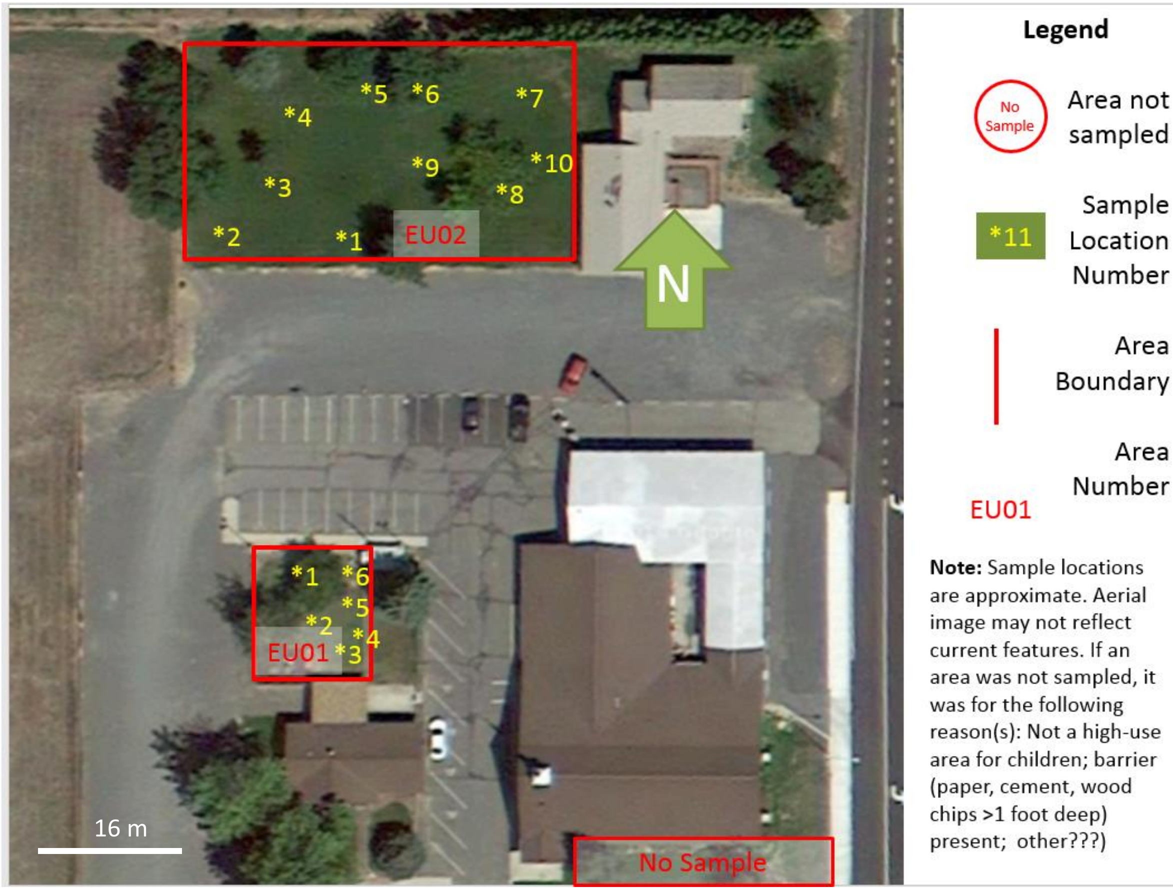
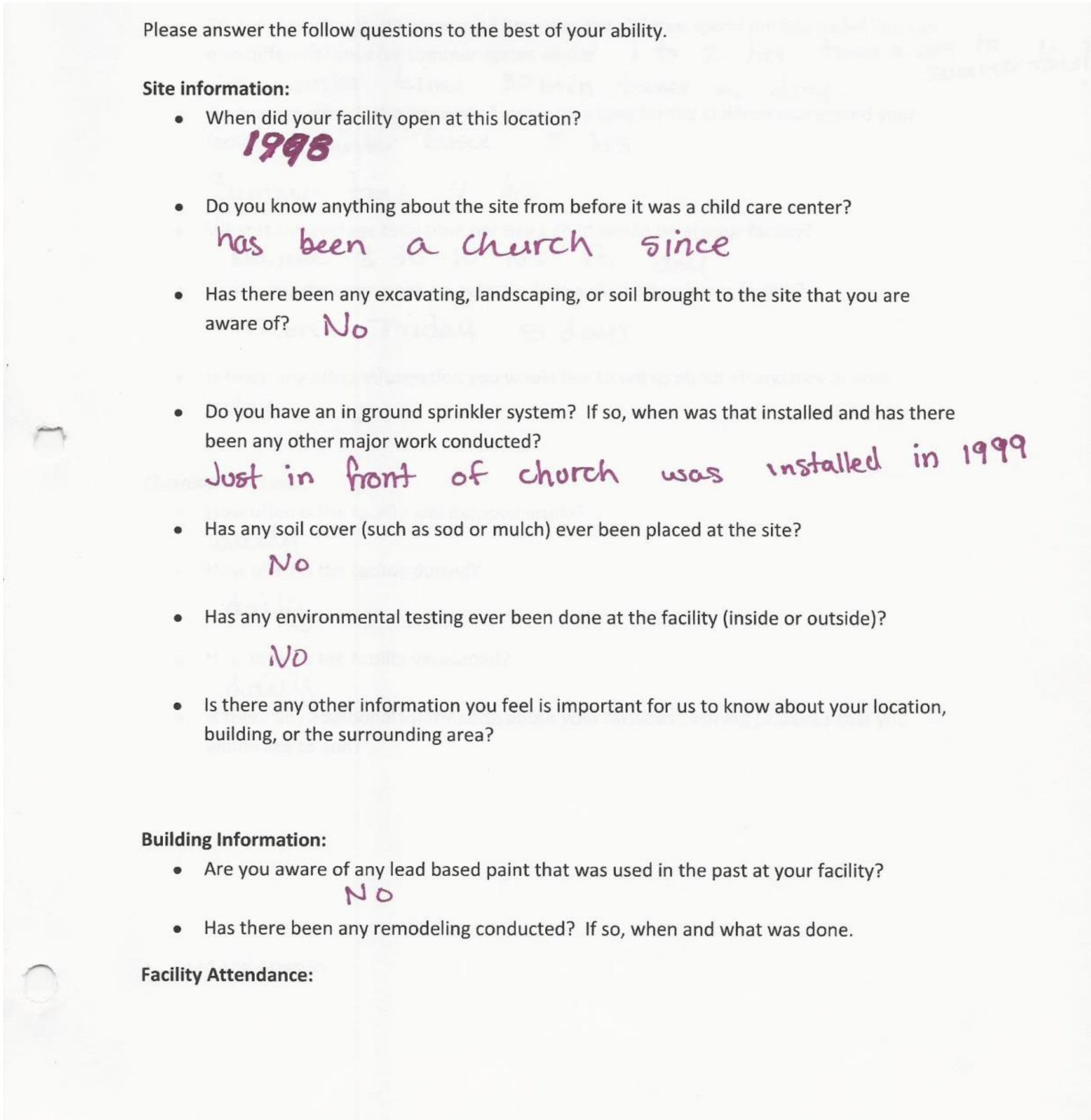


Figure A7.1. Site sampling diagram.



Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location?
  1998
- Do you know anything about the site from before it was a child care center?
  has been a church since
- Has there been any excavating, landscaping, or soil brought to the site that you are aware of? No
- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted?
  Just in front of church was installed in 1999
- Has any soil cover (such as sod or mulch) ever been placed at the site?
  No
- Has any environmental testing ever been done at the facility (inside or outside)?
  No
- Is there any other information you feel is important for us to know about your location, building, or the surrounding area?

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility?
  No
- Has there been any remodeling conducted? If so, when and what was done.

Facility Attendance:

Figure A7.2. Site survey results.

- How many children attend your facility?

  32

- What is the age range of the children attending your facility?

  1 year to 12

- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter. 1 to 2 hrs twice a day in summer time!

  In winter time 30 min twice a day.

- On average what is the amount of inside play time for the children that attend your facility? winter time 8 hrs

  Summer time 4 hrs

- What is the average total time per day a child would be at your facility?

  betwene 8 to 10 hrs Per day

- How many days per week on average does a child attend your facility?

  Mon – Friday 5 days

- Is there any other information you would like to tell us about attendance at your facility?

Cleaning Practices:

- How often is the facility wet mopped inside?

  daily

- How often is the facility dusted?

  daily

- How often is the facility vacuumed?

  daily

- Is there any additional information about your facilities cleaning practices that you would like to add?

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know?

  No

Figure A7.3. Site survey results.

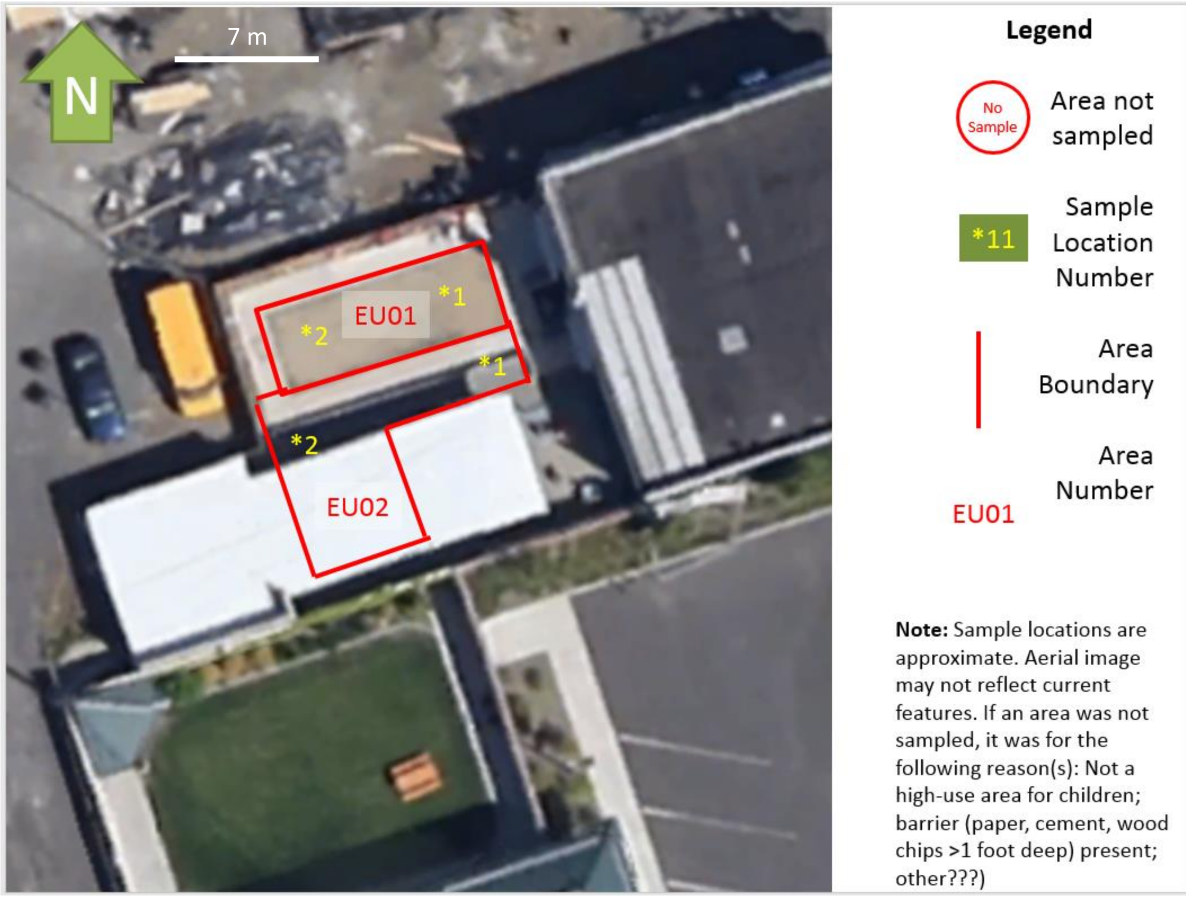


Figure A8.1. Site sampling diagram.

Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location? may 26, 2011
- Do you know anything about the site from before it was a child care center? Book store/ Drycleaner
- Has there been any excavating, landscaping, or soil brought to the site that you are aware of? not sure
- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted? no
- Has any soil cover (such as sod or mulch) ever been placed at the site? gravel 2011
- Has any environmental testing ever been done at the facility (inside or outside)? yes
- Is there any other information you feel is important for us to know about your location, building, or the surrounding area? no

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility? no
- Has there been any remodeling conducted? If so, when and what was done. 2011

Facility Attendance:

- How many children attend your facility? 39
- What is the age range of the children attending your facility? 12 month- 5yrs.
- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter. Summer 1hr. winter 1/2hr.
- On average what is the amount of inside play time for the children that attend your facility? Range of time? 6 30 - 600
- What is the average total time per day a child would be at your facility? Range of time? 8hrs.
- How many days per week on average does a child attend your facility? Range of time? mon-fri.
- Is there any other information you would like to tell us about attendance at your facility? no

Cleaning Practices:

- How often is the facility wet mopped inside? twice a day
- How often is the facility dusted? twice a week
- How often is the facility vacuumed? once a day
- Is there any additional information about your facilities cleaning practices that you would like to add? no

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know? not sure.

Figure A8.2. Site survey results.

Figure A9.1. Site sampling diagram.

Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location?

  2002, january

- Do you know anything about the site from before it was a child care center?

  · it was a childcare before me
  · play where people came to play cards

- Has there been any excavating, landscaping, or soil brought to the site that you are aware of? no

- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted?

  yes, June 2001

- Has any soil cover (such as sod or mulch) ever been placed at the site?

  Yes June 2001

- Has any environmental testing ever been done at the facility (inside or outside)?

  NO

- Is there any other information you feel is important for us to know about your location, building, or the surrounding area?

  NO

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility?

  NO

- Has there been any remodeling conducted? If so, when and what was done.

  NO

Figure A9.2. Site survey results.

Facility Attendance:

- How many children attend your facility?

  24

- What is the age range of the children attending your facility?

  1 yr to 8 yrs

- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter. On hour in Summer 30 min in Winter

- On average what is the amount of inside play time for the children that attend your facility? ~~60 min to 1 hour~~ 8 to 9 hours

- What is the average total time per day a child would be at your facility?

  9 to 10 hours

- How many days per week on average does a child attend your facility?

  35 – 45

- Is there any other information you would like to tell us about attendance at your facility? NO

Cleaning Practices:

- How often is the facility wet mopped inside?

  2 a day

- How often is the facility dusted?

  2 a day

- How often is the facility vacuumed?

  2 time a week

- Is there any additional information about your facilities cleaning practices that you would like to add?

  NO

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know?

Figure A9.3. Site survey results.

Figure A10. Site sampling diagram (completed survey not received).

Figure A11.1. Site sampling diagram.

Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location? 10/2004
- Do you know anything about the site from before it was a child care center?

  It was just land
- Has there been any excavating, landscaping, or soil brought to the site that you are aware of?

  no
- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted? yes
- Has any soil cover (such as sod or mulch) ever been placed at the site?

  yes
- Has any environmental testing ever been done at the facility (inside or outside)?

  no
- Is there any other information you feel is important for us to know about your location, building, or the surrounding area?

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility?

  no
- Has there been any remodeling conducted? If so, when and what was done.

  no

Figure A11.2. Site survey results.

Facility Attendance:

- How many children attend your facility? 90 Families
- What is the age range of the children attending your facility?
  4weeks to 12years
- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter. 2hrs.
- On average what is the amount of inside play time for the children that attend your facility?
  6hrs.
- What is the average total time per day a child would be at your facility?
  8hrs
- How many days per week on average does a child attend your facility?
  5days
- Is there any other information you would like to tell us about attendance at your facility?

Cleaning Practices:

- How often is the facility wet mopped inside?
  2 x daily
- How often is the facility dusted?
  once per week (high shelves)
  Toys down low daily
- How often is the facility vacuumed?
  daily
- Is there any additional information about your facilities cleaning practices that you would like to add?

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know?

Figure A11.3. Site survey results.

Figure A12. Site sampling diagram (completed survey not received).

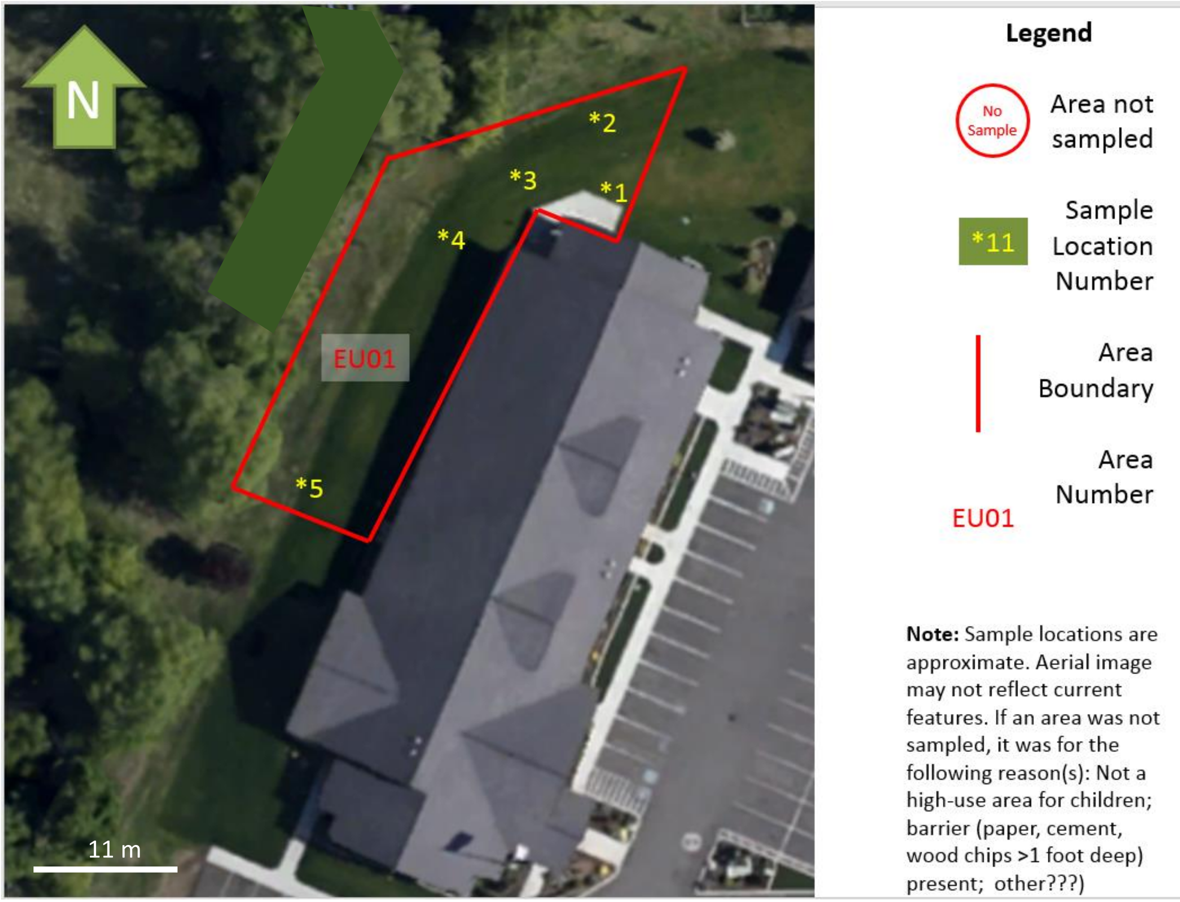


Figure A13.1. Site sampling diagram.

Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location?

  January 6, 2014

- Do you know anything about the site from before it was a child care center?

  It was occupied by Cascade Women Clinic

- Has there been any excavating, landscaping, or soil brought to the site that you are aware of?

  not sure

- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted?

  Yes, prior to our moving in

- Has any soil cover (such as sod or mulch) ever been placed at the site?

  yes

- Has any environmental testing ever been done at the facility (inside or outside)?

  not that I know of

- Is there any other information you feel is important for us to know about your location, building, or the surrounding area?

  no

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility?

  not that I know of

- Has there been any remodeling conducted? If so, when and what was done.

  yes, prior to us moving in, walls taken down

Figure A13.2. Site survey results.

Facility Attendance:

- How many children attend your facility?

  approx. 55

- What is the age range of the children attending your facility?

  3 – 6

- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter.

  Summer – 1.5 hours approx. winter – 45 min to 1 hr

- On average what is the amount of inside play time for the children that attend your facility?

  3/4 of the day 6:15 am to 6pm

- What is the average total time per day a child would be at your facility?

  no more than 12 hours due to hospital employee hours

- How many days per week on average does a child attend your facility?

  2 to 5 days/wk

- Is there any other information you would like to tell us about attendance at your facility?

  no

Cleaning Practices:

- How often is the facility wet mopped inside?

  daily

- How often is the facility dusted?

  monthly

- How often is the facility vacuumed?

  daily

- Is there any additional information about your facilities cleaning practices that you would like to add?

  no

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know?

Figure A13.3. Site survey results.

Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location?

  1967

- Do you know anything about the site from before it was a child care center?

  It is a church, and was the location of another child care before we moved here.

- Has there been any excavating, landscaping, or soil brought to the site that you are aware of?

  No.

- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted?

  yes, not sure of dates

- Has any soil cover (such as sod or mulch) ever been placed at the site?

  yes, playground cover

- Has any environmental testing ever been done at the facility (inside or outside)?

  not sure

- Is there any other information you feel is important for us to know about your location, building, or the surrounding area?

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility?
- Has there been any remodeling conducted? If so, when and what was done.

  yes - rooms have been remodeled over the years

Facility Attendance:

Figure A14.1. Site survey results (no site sampling diagram due to confidentiality concerns).

- How many children attend your facility? 76- child care 25- elementary
- What is the age range of the children attending your facility? 3yrs - 12 yrs
- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter. 1 hour minimum
- On average what is the amount of inside play time for the children that attend your facility? 30 - 45 min
- What is the average total time per day a child would be at your facility? 6.5 hrs
- How many days per week on average does a child attend your facility? 5 days
- Is there any other information you would like to tell us about attendance at your facility?

Cleaning Practices:

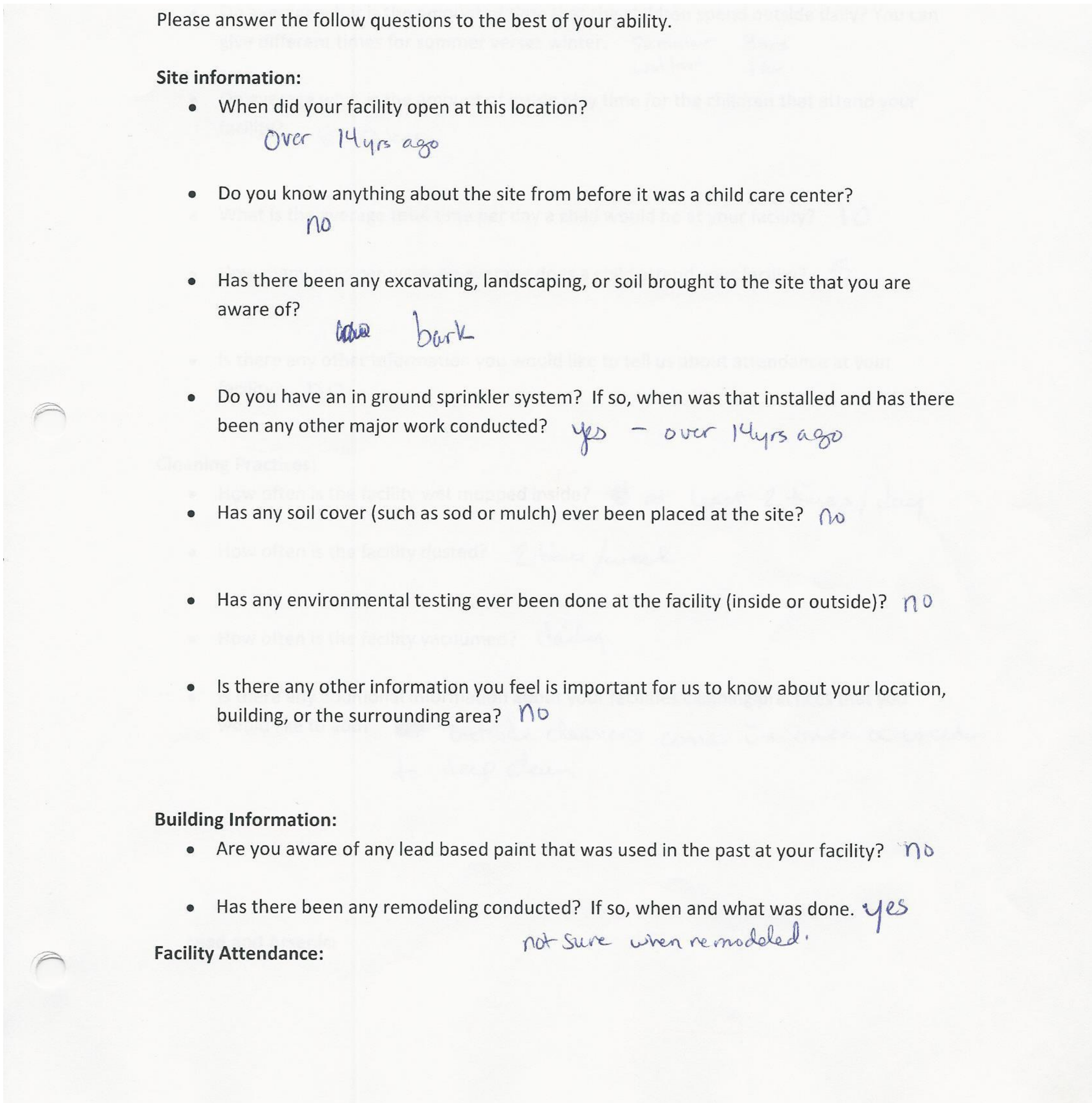
- How often is the facility wet mopped inside? Daily
- How often is the facility dusted? Daily
- How often is the facility vacuumed? Daily
- Is there any additional information about your facilities cleaning practices that you would like to add?

Lead and Arsenic:

- <u>Prior to being contacted about this project</u> were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know?

Figure A14.2. Site survey results.

Figure A15.1. Site sampling diagram.



Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location?
  Over 14yrs ago
- Do you know anything about the site from before it was a child care center?
  no
- Has there been any excavating, landscaping, or soil brought to the site that you are aware of?
  bark
- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted? yes – over 14yrs ago
- Has any soil cover (such as sod or mulch) ever been placed at the site? no
- Has any environmental testing ever been done at the facility (inside or outside)? no
- Is there any other information you feel is important for us to know about your location, building, or the surrounding area? no

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility? no
- Has there been any remodeling conducted? If so, when and what was done. yes
  not sure when remodeled.

Facility Attendance:

Figure A15.2. Site survey results.

- How many children attend your facility? 110
- What is the age range of the children attending your facility? 4wk – 12yrs
- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter. Summer 3hrs winter 1hr.
- On average what is the amount of inside play time for the children that attend your facility? 8–10 hrs
- What is the average total time per day a child would be at your facility? 10
- How many days per week on average does a child attend your facility? 5
- Is there any other information you would like to tell us about attendance at your facility? no

Cleaning Practices:

- How often is the facility wet mopped inside? at least 2 times / day
- How often is the facility dusted? 2 times /week
- How often is the facility vacuumed? daily
- Is there any additional information about your facilities cleaning practices that you would like to add? outside cleaners come in once a week to deep clean

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know? no

Figure A15.3. Site survey results.

Figure A16.1. Site sampling diagram.

Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location?
  over 14 years ago
- Do you know anything about the site from before it was a child care center?
  No
- Has there been any excavating, landscaping, or soil brought to the site that you are aware of? Bark
- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted? Yes - over 14 years ago
- Has any soil cover (such as sod or mulch) ever been placed at the site?
  no
- Has any environmental testing ever been done at the facility (inside or outside)?
  no
- Is there any other information you feel is important for us to know about your location, building, or the surrounding area?
  no

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility? no
- Has there been any remodeling conducted? If so, when and what was done.
  no

Facility Attendance:

Figure A16.2. Site survey results.

- How many children attend your facility? 105
- What is the age range of the children attending your facility? 4wks - 12yrs.
- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter. Summer - 3hrs Winter - 1hr
- On average what is the amount of inside play time for the children that attend your facility? 8 - 10 hrs.
- What is the average total time per day a child would be at your facility? 10hrs
- How many days per week on average does a child attend your facility? 5
- Is there any other information you would like to tell us about attendance at your facility? No

Cleaning Practices:

- How often is the facility wet mopped inside? Multiple times per day
- How often is the facility dusted? 2X per week
- How often is the facility vacuumed? daily
- Is there any additional information about your facilities cleaning practices that you would like to add? We have outside cleaners come in for deep cleaning 1X per week

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know? No

Figure A16.3. Site survey results.

Figure A17.1. Site sampling diagram.

Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location?

  1981

- Do you know anything about the site from before it was a child care center?

  residential home

- Has there been any excavating, landscaping, or soil brought to the site that you are aware of?

  unknown

- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted?

  yes in grassy area

- Has any soil cover (such as sod or mulch) ever been placed at the site?

  unknown

- Has any environmental testing ever been done at the facility (inside or outside)?

  unknown

- Is there any other information you feel is important for us to know about your location, building, or the surrounding area?

  no

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility?

  unknown

- Has there been any remodeling conducted? If so, when and what was done.

  yes, 9-2013 , walls taken down

Figure A17.2. Site survey results.

Facility Attendance:

- How many children attend your facility?

  72

- What is the age range of the children attending your facility?

  4wks – 3yrs

- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter.

  summer - 15min – half hour winter – 15 - half hour

- On average what is the amount of inside play time for the children that attend your facility?

  4-6 hrs

- What is the average total time per day a child would be at your facility?

  8-9 hrs

- How many days per week on average does a child attend your facility?

  2-5 days/wk

- Is there any other information you would like to tell us about attendance at your facility?

  no

Cleaning Practices:

- How often is the facility wet mopped inside?

  daily

- How often is the facility dusted?

  Monthly

- How often is the facility vacuumed?

  daily

- Is there any additional information about your facilities cleaning practices that you would like to add?

  no

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know?

Figure A17.3. Site survey results.

Figure A18.1. Site sampling diagram.

Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location? Sept. 1998
- Do you know anything about the site from before it was a child care center? yes It was a Sports Bar
- Has there been any excavating, landscaping, or soil brought to the site that you are aware of? yes, top soil for grass in Back Area
- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted? yes, 2002, No
- Has any soil cover (such as sod or mulch) ever been placed at the site? Sod in Back in 2002
- Has any environmental testing ever been done at the facility (inside or outside)? Possibly before we opened
- Is there any other information you feel is important for us to know about your location, building, or the surrounding area? No

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility? No
- Has there been any remodeling conducted? If so, when and what was done. yes, In 1998 we did some remodeling before opening Business

Facility Attendance:

- How many children attend your facility? Approx 400
- What is the age range of the children attending your facility? 18 mos – 16 years
- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter. 30 – 60 min.
- On average what is the amount of inside play time for the children that attend your facility? Range of time? 6 HRS 9:00 Am – 6:00 pm
- What is the average total time per day a child would be at your facility? Range of time? 7 HRS 8 – 6:00
- How many days per week on average does a child attend your facility? Range of time? 5 Days 9 – 6
- Is there any other information you would like to tell us about attendance at your facility? We also have gymnasts that attend approx 1 HR per week

Cleaning Practices:

- How often is the facility wet mopped inside? ~~[illegible]~~ Every day in Rooms Hallways 3 x WK
- How often is the facility dusted? 3 x Week
- How often is the facility vacuumed? Rooms = every Day Big Floor Areas 3 x WK
- Is there any additional information about your facilities cleaning practices that you would like to add? We use bleach water to sanitize Tables & Mats regularly. Tables 2-3 x's a day Mats 3 x WK

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know? No

Figure A18.2. Site survey results.

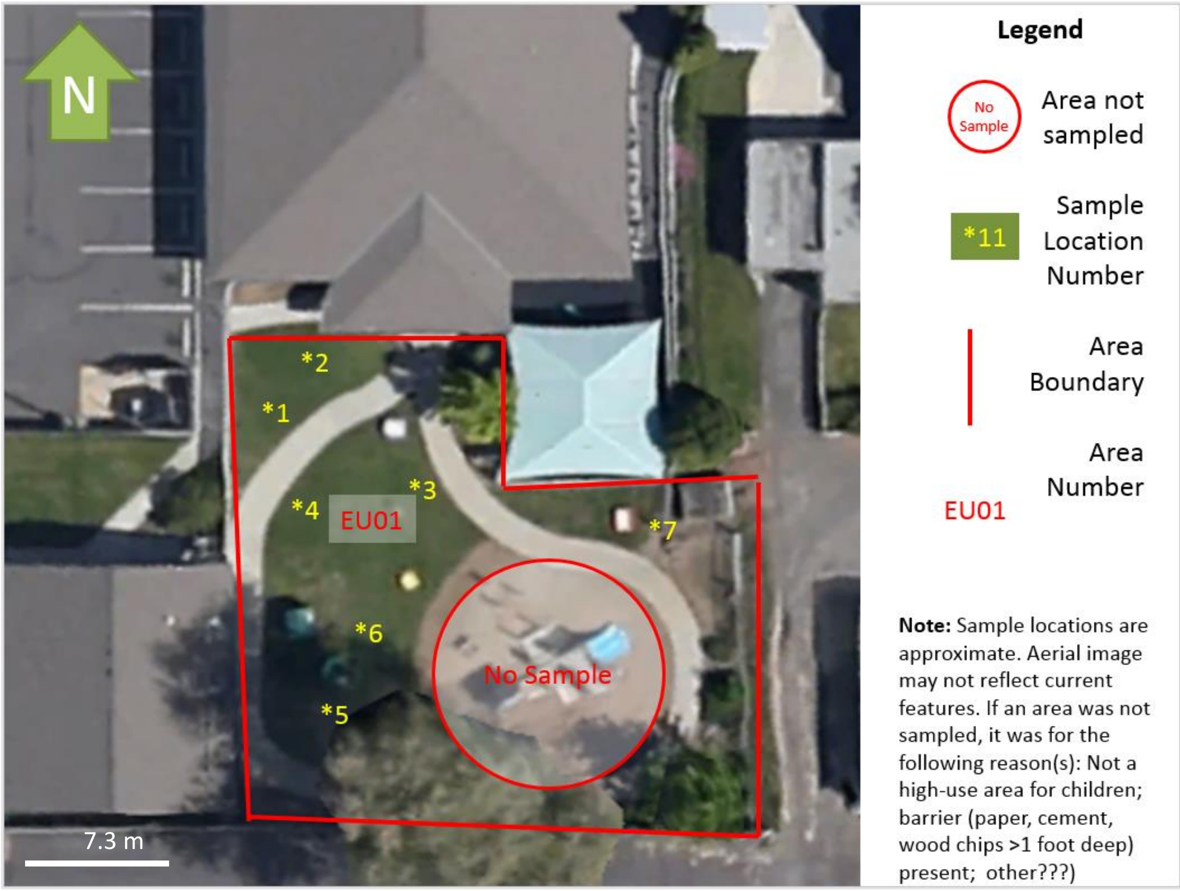


Figure A19.1. Site sampling diagram.

Please answer the follow questions to the best of your ability.

Site information:

- When did your facility open at this location?

  Sept. 23, 2002

- Do you know anything about the site from before it was a child care center?

  No – new building built to be a childcare!

- Has there been any excavating, landscaping, or soil brought to the site that you are aware of?

  No – Playground put in @ the time building was built!

- Do you have an in ground sprinkler system? If so, when was that installed and has there been any other major work conducted?

- Has any soil cover (such as sod or mulch) ever been placed at the site?

  NOT SOD – The Teachers do plant gardens in two different areas on the playground + have brought in soil for this!

- Has any environmental testing ever been done at the facility (inside or outside)?

  *Not That I am Aware OF!

- Is there any other information you feel is important for us to know about your location, building, or the surrounding area?

  Good location for our families being right next to the college!

Building Information:

- Are you aware of any lead based paint that was used in the past at your facility?

  NO

- Has there been any remodeling conducted? If so, when and what was done.

  NO

Figure A19.2. Site survey results.

Facility Attendance:

- How many children attend your facility?
  66
- What is the age range of the children attending your facility?
  6 weeks – 5 yrs.
- On average what is the amount of time that the children spend outside daily? You can give different times for summer verses winter. Summer 1 1/2 – 2 hrs. Winter try to do have
- On average what is the amount of inside play time for the children that attend your facility? 4 hours of learning activities + play
- What is the average total time per day a child would be at your facility?
  8 hours
- How many days per week on average does a child attend your facility?
  5 Days – we are a full time center
- Is there any other information you would like to tell us about attendance at your facility? Good attendance – we are usually full!

Cleaning Practices:

- How often is the facility wet mopped inside?
  Daily
- How often is the facility dusted?
  Daily
- How often is the facility vacuumed?
  Daily
- Is there any additional information about your facilities cleaning practices that you would like to add?
  Our Closers clean our center Daily @ the end of the day Teachers + Assistants in the classrooms do light cleaning through out the day – As needed!

Lead and Arsenic:

- *Prior to being contacted about this project* were you aware of the possibility for lead and arsenic soil contamination at your facility? If so, where did you get this information and what did you know? No – I never really thought about it! I have heard of it though!

Figure A19.3. Site survey results.

Table A1. Dust sample descriptions.

Sample ID	Site #	Location
YAK-01-DW-2	1	toy shelf near floor ~1.5'
YAK-01-DW-3	1	back sliding door floor
YAK-02-DW-1	2	front room floor @ back under table
YAK-02-DW-2	2	cubbie @ back of front room, 6'' from floor
YAK-02-DW-3	2	floor of back room under rolling table
YAK-02-DW-4	2	window sill of back room 3'' X 12''
YAK-03-DW-1	3	windowsill, near back of bldg, near door
YAK-03-DW-2	3	lower book shelf, near floor
YAK-03-DW-3	3	floor of crib room ,under table
YAK-03-DW-4	3	windowsill in room @ end of building
YAK-04-DW-1	4	bench
YAK-04-DW-2	4	kitchen floor
YAK-04-DW-3	4	doll house
YAK-05-DW-1	5	on bookshelf top window sill area
YAK-05-DW-2	5	on linoleum floor near kitchen
YAK-05-DW-3	5	on play surface plastic toy table top
YAK-06-DW-1	6	dining area filing cabinet top
YAK-06-DW-2	6	toddler room in cubby
YAK-06-DW-3	6	age 4 plus room top of low bookshelf
YAK-07-DW-1	7	older kid room cubby
YAK-07-DW-2	7	toddler room cubby
YAK-07-DW-3	7	infant room floor
YAK-08-DW-1	8	window sill play room 3'' X 12''
YAK-08-DW-2	8	floor of playroom
YAK-08-DW-3	8	cubby toddler room
YAK-08-DW-4	8	infant room floor
YAK-08-DW-5	8	adjacent building windowsill older kid room
YAK-09-DW-1	9	windowsill playroom
YAK-09-DW-2	9	older child room floor near door to outside
YAK-09-DW-3	9	younger child room floor by door
YAK-10-DW-1	10	window sill 2 X 12''
YAK-10-DW-2	10	floor near exit
YAK-10-DW-3	10	floor near toddler area entrance
YAK-11-DW-1	11	3'' X 12'' window sill front room
YAK-11-DW-2	11	floor by back door
YAK-11-DW-3	11	floor in toddler area
YAK-12-DW-1	12	infant windowsill 6'' x 6''
YAK-12-DW-2	12	toddler floor by door

Table A1. Dust sample descriptions (cont.).

Sample ID	**Site #**	**Location**
YAK-12-DW-3	12	toddler floor by door
YAK-12-DW-4	12	older toddler windowsill 6'' X6''
YAK-13-DW-1	13	room 10 window sill 3'' X 12''
YAK-13-DW-2	13	room 10 floor
YAK-13-DW-3	13	room 21 floor
YAK-13-DW-4	13	room 21 windowsill
YAK-14-DW-1	14	nap room floor by back door
YAK-14-DW-2	14	main room floor by back door
YAK-14-DW-3	14	windowsill (tile)
YAK-14-DW-4	14	windowsill (cement)
YAK-15-DW-1	15	infant room floor by door
YAK-15-DW-2	15	infant room table window sill 4'' X 9''
YAK-15-DW-3	15	painted windowsill
YAK-15-DW-4	15	floor under cabinet
YAK-16-DW-1	16	windowsill toddler room
YAK-16-DW-2	16	windowsill preschool room
YAK-16-DW-3	16	no description
YAK-16-DW-4	16	no description
YAK-17-DW-1	17	windowsill 3'' X 12'' main room
YAK-17-DW-2	17	main room floor by sink
YAK-17-DW-3	17	windowsill north room 3'' X 12''
YAK-17-DW-4	17	north room floor by sink
YAK-18-DW-1	18	infant floor eating area
YAK-18-DW-2	18	infant cubby
YAK-18-DW-3	18	infant windowsill
YAK-18-DW-4	18	"waddler room" windowsill
YAK-18-DW-5	18	"bumble bee room" floor by bathroom
YAK-19-DW-1	19	main entry windowsill 6'' X 6''
YAK-19-DW-2	19	floor exit to play yard 6'' X 6''
YAK-19-DW-3	19	door from morning room floor 6'' X 6''
YAK-19-DW-4	19	play center surface 6'' X 6''

Appendix B

Results by Site

SITE 5
Based on review of 1927 and 1947 historical aerial imagery, your location was likely orchard land at one time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.
Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm, mg/kg)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm, mg/kg)	
Washington Limit for Mercury in Soils	2 parts per million (ppm, mg/kg)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
62.8	79.5	71.7	13.5	17.6	15.5

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	2.0	62.8	75.4	69.1	13.5	13.8	13.7
2-6"	2.0	69.1	79.5	74.3	17.0	17.6	17.3

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	4.0	62.8	79.5	71.7	13.5	17.6	15.5

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	75.4	13.5	.	.	ND
1.0	1.0	2-6"	79.5	17.6	.	.	ND
1.0	2.0	0-2"	62.8	13.8	.	.	ND
1.0	2.0	2-6"	69.1	17.0	.	.	ND

SITE 10

Based on review of 1927 and 1947 historical aerial imagery, it does not appear that your location was orchard land at that time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

In addition to lead-arsenate, organo-mercury pesticides were also used on fruit orchards. Soil mercury contamination is suspected in some samples, but needs laboratory confirmation.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
22.5	74.2	46.9	3.5	7.3	5.1

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	5.0	26.7	65.8	45.7	3.5	7.0	4.8
2-6"	5.0	22.5	74.2	48.2	4.1	7.3	5.5

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	10.0	22.5	74.2	46.9	3.5	7.3	5.1

Results by Sample (parts per million)							
Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.							
Exposure Unit	**Sample Location**	**Depth**	**Lead Content, Bulk Fraction**	**Arsenic Content, Bulk Fraction**	**Lead Content, Sieved Fraction**	**Arsenic Content, Sieved Fraction**	**Mercury Content (lab confirmation pending)**
1.0	1.0	0-2"	32.1	4.0	.	.	ND
1.0	1.0	2-6"	74.2	4.1	.	.	ND
1.0	2.0	0-2"	26.7	5.7	.	.	ND
1.0	2.0	2-6"	22.5	5.9	.	.	9.0
1.0	3.0	0-2"	48.6	3.5	.	.	ND
1.0	3.0	2-6"	50.3	4.7	.	.	ND
1.0	4.0	0-2"	55.2	7.0	58.5	5.0	ND
1.0	4.0	2-6"	42.6	7.3	49.2	8.4	ND
1.0	5.0	0-2"	65.8	3.7	.	.	ND
1.0	5.0	2-6"	51.3	5.4	.	.	ND

SITE 15

Based on review of 1927 and 1947 historical aerial imagery, it does not appear that your location was orchard land at that time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

In addition to lead-arsenate, organo-mercury pesticides were also used on fruit orchards. Soil mercury contamination is suspected in some samples, but needs laboratory confirmation.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
8.1	14.4	11.9	2.3	7.2	4.7

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	13.0	9.1	13.4	11.7	2.3	5.4	4.5
2-6"	13.0	8.1	14.4	12.2	2.5	7.2	4.9

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	10.0	11.7	14.4	12.7	2.5	7.2	4.8
2.0	8.0	9.1	14.3	11.4	2.3	5.4	3.9
3.0	8.0	8.1	13.0	11.5	3.5	6.4	5.3

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	13.4	3.5	.	.	ND
1.0	1.0	2-6"	12.0	5.1	.	.	ND
1.0	2.0	0-2"	12.4	4.7	.	.	ND
1.0	2.0	2-6"	12.7	5.1	.	.	ND
1.0	3.0	0-2"	12.9	5.4	.	.	ND
1.0	3.0	2-6"	13.1	5.1	.	.	ND
1.0	4.0	0-2"	11.7	4.3	.	.	ND
1.0	4.0	2-6"	14.4	2.5	.	.	ND
1.0	5.0	0-2"	13.0	4.9	.	.	ND
1.0	5.0	2-6"	11.7	7.2	.	.	ND
2.0	1.0	0-2"	13.0	4.6	.	.	ND
2.0	1.0	2-6"	14.3	3.5	.	.	ND
2.0	2.0	0-2"	9.1	4.5	.	.	ND
2.0	2.0	2-6"	12.2	3.2	.	.	ND
2.0	3.0	0-2"	9.6	5.4	.	.	ND
2.0	3.0	2-6"	10.2	4.5	.	.	10.0
2.0	4.0	0-2"	10.1	2.3	.	.	10.4
2.0	4.0	2-6"	12.9	3.4	.	.	ND
3.0	1.0	0-2"	11.2	5.1	.	.	ND
3.0	1.0	2-6"	11.4	6.4	.	.	ND
3.0	2.0	0-2"	10.2	3.5	.	.	ND
3.0	2.0	2-6"	8.1	6.4	.	.	ND
3.0	3.0	0-2"	12.6	5.2	.	.	9.2
3.0	3.0	2-6"	12.7	5.1	.	.	ND
3.0	4.0	0-2"	12.6	5.3	.	.	ND
3.0	4.0	2-6"	13.0	5.8	.	.	ND

SITE 1

Based on review of 1927 and 1947 historical aerial imagery, your location was likely orchard land at one time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

In addition to lead-arsenate, organo-mercury pesticides were also used on fruit orchards. Soil mercury contamination is suspected in some samples, but needs laboratory confirmation.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm, mg/kg)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm, mg/kg)	
Washington Limit for Mercury in Soils	2 parts per million (ppm, mg/kg)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
17.8	418.0	165.5	25.2	53.1	36.3

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	12.0	43.0	418.0	191.6	26.8	53.1	38.9
2-6"	12.0	17.8	328.2	139.4	25.2	42.8	33.8

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	20.0	26.0	328.2	171.9	25.2	47.1	35.7
3.0	4.0	17.8	418.0	133.3	33.1	53.1	39.6

Note: No samples taken in exposure unit 2.

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	294.8	44.4	318.7	43.1	ND
1.0	1.0	2-6"	328.2	36.3	307.8	38.1	ND
1.0	2.0	0-2"	75.4	37.4	78.4	33.6	ND
1.0	2.0	2-6"	26.0	27.1	.	.	ND
1.0	3.0	0-2"	239.5	35.8	240.9	34.8	ND
1.0	3.0	2-6"	42.6	25.2	.	.	ND
1.0	4.0	0-2"	232.2	28.4	244.2	32.3	9.6
1.0	4.0	2-6"	239.6	25.4	233.5	29.3	8.8
1.0	5.0	0-2"	138.5	26.8	.	.	ND
1.0	5.0	2-6"	207.4	28.9	.	.	ND
1.0	6.0	0-2"	238.9	41.0	225.5	33.9	ND
1.0	6.0	2-6"	179.3	34.3	169.8	32.4	ND
1.0	7.0	0-2"	228.2	41.7	234.1	43.6	ND
1.0	7.0	2-6"	246.8	42.8	209.2	37.0	ND
1.0	8.0	0-2"	166.0	37.3	163.7	41.7	ND
1.0	8.0	2-6"	150.6	41.2	156.1	39.0	ND
1.0	9.0	0-2"	112.8	47.1	117.1	42.0	8.8
1.0	9.0	2-6"	62.4	42.5	73.4	39.1	10.6
1.0	10.0	0-2"	111.5	34.6	103.8	34.6	ND
1.0	10.0	2-6"	118.0	35.2	123.8	33.4	8.8
3.0	1.0	0-2"	43.0	39.2	46.8	36.4	ND
3.0	1.0	2-6"	17.8	33.2	23.9	33.7	ND
3.0	2.0	0-2"	418.0	53.1	410.4	56.6	9.4
3.0	2.0	2-6"	54.4	33.1	48.6	33.9	8.9

SITE 3

Based on review of 1927 and 1947 historical aerial imagery, it does not appear that your location was orchard land at that time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm, mg/kg)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm, mg/kg)	
Washington Limit for Mercury in Soils	2 parts per million (ppm, mg/kg)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
64.5	178.1	110.1	8.5	24.4	17.4

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	8.0	64.5	123.9	98.7	11.7	21.3	17.6
2-6"	8.0	75.4	178.1	121.4	8.5	24.4	17.1

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	8.0	85.3	143.1	112.2	14.7	21.3	18.2
2.0	8.0	64.5	178.1	107.9	8.5	24.4	16.6

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	119.7	18.2	.	.	ND
1.0	1.0	2-6"	143.1	20.4	137.9	19.0	ND
1.0	2.0	0-2"	85.3	15.2	.	.	ND
1.0	2.0	2-6"	99.6	14.7	.	.	ND
1.0	3.0	0-2"	105.3	18.2	.	.	ND
1.0	3.0	2-6"	97.9	19.0	.	.	ND
1.0	4.0	0-2"	108.9	21.3	104.2	20.6	ND
1.0	4.0	2-6"	138.1	18.3	.	.	ND
2.0	1.0	0-2"	98.0	17.8	.	.	ND
2.0	1.0	2-6"	178.1	24.4	192.1	23.2	ND
2.0	2.0	0-2"	64.5	21.1	75.9	18.2	ND
2.0	2.0	2-6"	75.4	17.9	.	.	ND
2.0	3.0	0-2"	84.2	17.6	.	.	ND
2.0	3.0	2-6"	78.8	13.6	.	.	ND
2.0	4.0	0-2"	123.9	11.7	.	.	ND
2.0	4.0	2-6"	160.3	8.5	.	.	ND

SITE 7

Based on review of 1927 and 1947 historical aerial imagery, your location was likely orchard land at one time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
30.3	158.8	59.4	3.2	12.2	6.2

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	11.0	30.3	97.6	53.7	3.2	11.4	5.8
2-6"	11.0	36.7	158.8	65.1	3.2	12.2	6.6

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	16.0	35.6	94.4	54.5	3.2	12.2	6.8
2.0	6.0	30.3	158.8	72.5	3.2	5.6	4.7

Results by Sample (parts per million)
Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	37.7	3.2	.	.	ND
1.0	1.0	2-6"	43.4	4.6	.	.	ND
1.0	2.0	0-2"	78.0	8.6	.	.	ND
1.0	2.0	2-6"	53.3	8.1	.	.	ND
1.0	3.0	0-2"	35.6	7.3	.	.	ND
1.0	3.0	2-6"	40.0	7.2	.	.	ND
1.0	4.0	0-2"	56.9	11.4	.	.	ND
1.0	4.0	2-6"	65.0	12.2	.	.	ND
1.0	5.0	0-2"	48.4	3.5	.	.	ND
1.0	5.0	2-6"	60.6	6.3	.	.	ND
1.0	6.0	0-2"	70.7	6.9	.	.	ND
1.0	6.0	2-6"	94.4	8.0	.	.	ND
1.0	7.0	0-2"	43.2	5.4	.	.	ND
1.0	7.0	2-6"	55.6	5.6	.	.	ND
1.0	8.0	0-2"	45.2	3.4	.	.	ND
1.0	8.0	2-6"	43.9	6.6	.	.	ND
2.0	1.0	0-2"	97.6	4.5	101.7	4.6	ND
2.0	1.0	2-6"	158.8	5.6	162.2	5.8	ND
2.0	2.0	0-2"	30.3	4.2	.	.	ND
2.0	2.0	2-6"	36.7	3.2	.	.	ND
2.0	3.0	0-2"	47.5	5.0	.	.	ND
2.0	3.0	2-6"	64.0	5.5	.	.	ND

SITE 9

Based on review of 1927 and 1947 historical aerial imagery, it does not appear that your location was orchard land at that time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
11.3	27.8	16.5	2.3	6.8	4.4

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	9.0	11.3	27.8	17.5	2.3	6.8	4.5
2-6"	3.0	11.3	14.8	13.6	3.7	5.5	4.3

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	4.0	11.3	14.7	12.5	2.3	6.8	4.6
2.0	8.0	13.9	27.8	18.5	3.4	6.2	4.4

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	12.8	2.3	.	.	ND
1.0	1.0	2-6"	14.7	3.8	.	.	ND
1.0	2.0	0-2"	11.3	6.8	.	.	ND
1.0	2.0	2-6"	11.3	5.5	.	.	ND
2.0	1.0	0-2"	26.0	4.4	.	.	ND
2.0	2.0	0-2"	18.0	4.9	.	.	ND
2.0	3.0	0-2"	13.9	3.4	.	.	ND
2.0	4.0	0-2"	27.8	4.1	.	.	ND
2.0	5.0	0-2"	17.7	3.5	.	.	ND
2.0	6.0	0-2"	14.4	6.2	.	.	ND
2.0	7.0	0-2"	15.4	4.5	.	.	ND
2.0	7.0	2-6"	14.8	3.7	.	.	ND

SITE 11

Based on review of 1927 and 1947 historical aerial imagery, it does not appear that your location was orchard land at that time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
14.9	69.0	32.2	4.6	7.2	5.5

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	4.0	14.9	69.0	32.2	4.6	7.2	5.5

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	2.0	14.9	17.6	16.2	4.6	5.3	5.0
2.0	2.0	27.2	69.0	48.1	4.8	7.2	6.0

Results by Sample (parts per million)
Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	17.6	4.6	.	.	ND
1.0	2.0	0-2"	14.9	5.3	.	.	ND
2.0	1.0	0-2"	27.2	4.8	.	.	ND
2.0	2.0	0-2"	69.0	7.2	.	.	ND

SITE 17

Based on review of 1927 and 1947 historical aerial imagery, it does not appear that your location was orchard land at that time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
19.2	22.4	20.8	2.8	5.6	4.4

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	5.0	19.2	21.5	20.4	3.5	5.6	4.4
2-6"	5.0	20.0	22.4	21.1	2.8	5.6	4.4

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	10.0	19.2	22.4	20.8	2.8	5.6	4.4

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	19.2	3.8	.	.	ND
1.0	1.0	2-6"	22.0	2.8	.	.	ND
1.0	2.0	0-2"	21.5	5.6	.	.	ND
1.0	2.0	2-6"	22.4	4.9	.	.	ND
1.0	3.0	0-2"	19.3	3.8	.	.	ND
1.0	3.0	2-6"	20.2	4.8	.	.	ND
1.0	4.0	0-2"	20.6	5.1	.	.	ND
1.0	4.0	2-6"	20.0	3.8	.	.	ND
1.0	5.0	0-2"	21.2	3.5	.	.	ND
1.0	5.0	2-6"	21.1	5.6	.	.	ND

SITE 19

Based on review of 1927 and 1947 historical aerial imagery, it does not appear that your location was orchard land at that time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
10.5	19.9	15.9	2.4	7.2	4.7

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	10.0	10.5	19.9	16.2	2.4	6.8	4.2
2-6"	10.0	13.7	19.1	15.7	3.3	7.2	5.1

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	8.0	14.5	19.9	17.3	2.5	6.8	4.9
2.0	12.0	10.5	18.5	15.0	2.4	7.2	4.5

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	19.9	2.5	.	.	ND
1.0	1.0	2-6"	14.5	5.6	.	.	ND
1.0	2.0	0-2"	19.2	6.1	.	.	ND
1.0	2.0	2-6"	15.6	4.0	.	.	ND
1.0	3.0	0-2"	18.0	4.9	.	.	ND
1.0	3.0	2-6"	19.1	3.6	.	.	ND
1.0	4.0	0-2"	15.9	6.8	.	.	ND
1.0	4.0	2-6"	15.8	6.0	.	.	ND
2.0	1.0	0-2"	12.5	4.6	.	.	ND
2.0	1.0	2-6"	13.8	3.3	.	.	ND
2.0	2.0	0-2"	17.1	4.0	.	.	ND
2.0	2.0	2-6"	13.7	5.1	.	.	ND
2.0	3.0	0-2"	16.7	2.5	.	.	ND
2.0	3.0	2-6"	16.6	4.9	.	.	ND
2.0	4.0	0-2"	18.5	2.4	.	.	ND
2.0	4.0	2-6"	15.1	7.2	.	.	ND
2.0	5.0	0-2"	13.5	3.1	.	.	ND
2.0	5.0	2-6"	18.4	6.8	.	.	ND
2.0	6.0	0-2"	10.5	5.0	12.7	5.3	ND
2.0	6.0	2-6"	14.0	5.1	13.9	5.0	ND

SITE 2

Based on review of 1927 and 1947 historical aerial imagery, it does not appear that your location was orchard land at that time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

In addition to lead-arsenate, organo-mercury pesticides were also used on fruit orchards. Soil mercury contamination is suspected in some samples, but needs laboratory confirmation.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm, mg/kg)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm, mg/kg)	
Washington Limit for Mercury in Soils	2 parts per million (ppm, mg/kg)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
12.4	357.6	51.5	2.4	12.2	5.7

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	18.0	12.4	127.5	36.0	2.4	8.1	4.9
2-6"	18.0	13.6	357.6	66.9	2.5	12.2	6.5

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	16.0	12.4	357.6	77.1	2.4	12.2	5.9
2.0	20.0	13.6	69.8	31.0	2.7	8.0	5.6

Results by Sample (parts per million)							
Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.							
Exposure Unit	**Sample Location**	**Depth**	**Lead Content, Bulk Fraction**	**Arsenic Content, Bulk Fraction**	**Lead Content, Sieved Fraction**	**Arsenic Content, Sieved Fraction**	**Mercury Content (lab confirmation pending)**
1.0	1.0	0-2"	16.1	2.4	.	.	ND
1.0	1.0	2-6"	14.0	6.0	.	.	8.6
1.0	2.0	0-2"	12.4	4.5	.	.	ND
1.0	2.0	2-6"	19.2	5.1	.	.	ND
1.0	3.0	0-2"	17.1	3.6	.	.	ND
1.0	3.0	2-6"	19.2	3.7	.	.	8.6
1.0	4.0	0-2"	20.3	4.6	.	.	ND
1.0	4.0	2-6"	18.2	2.5	.	.	ND
1.0	5.0	0-2"	95.4	4.5	.	.	ND
1.0	5.0	2-6"	228.7	9.0	.	.	ND
1.0	6.0	0-2"	50.7	3.4	.	.	ND
1.0	6.0	2-6"	76.3	9.5	.	.	ND
1.0	7.0	0-2"	127.5	8.1	.	.	ND
1.0	7.0	2-6"	357.6	11.8	437.2	15.4	ND
1.0	8.0	0-2"	36.0	3.0	.	.	ND
1.0	8.0	2-6"	125.0	12.2	.	.	ND
2.0	1.0	0-2"	22.1	7.1	.	.	ND
2.0	1.0	2-6"	18.6	4.6	.	.	ND
2.0	2.0	0-2"	17.9	7.4	.	.	ND
2.0	2.0	2-6"	16.2	5.0	.	.	ND
2.0	3.0	0-2"	26.7	4.7	.	.	ND
2.0	3.0	2-6"	14.6	6.8	.	.	ND
2.0	4.0	0-2"	27.5	4.4	.	.	ND
2.0	4.0	2-6"	13.6	4.8	.	.	ND
2.0	5.0	0-2"	23.3	6.6	.	.	ND
2.0	5.0	2-6"	17.0	5.5	.	.	ND
2.0	6.0	0-2"	33.4	6.5	.	.	ND
2.0	6.0	2-6"	64.3	6.4	.	.	ND
2.0	7.0	0-2"	28.9	6.2	.	.	ND
2.0	7.0	2-6"	40.5	5.6	.	.	ND
2.0	8.0	0-2"	44.8	4.5	.	.	ND
2.0	8.0	2-6"	44.4	8.0	.	.	ND
2.0	9.0	0-2"	21.4	2.7	.	.	ND
2.0	9.0	2-6"	69.8	6.0	.	.	ND
2.0	10.0	0-2"	27.3	4.6	.	.	ND
2.0	10.0	2-6"	47.6	4.6	.	.	ND

SITE 4

Based on review of 1927 and 1947 historical aerial imagery, your location was likely orchard land at one time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

In addition to lead-arsenate, organo-mercury pesticides were also used on fruit orchards. Soil mercury contamination is suspected in some samples, but needs laboratory confirmation.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm, mg/kg)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm, mg/kg)	
Washington Limit for Mercury in Soils	2 parts per million (ppm, mg/kg)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
10.7	127.0	57.4	8.6	38.9	21.3

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	13.0	18.2	107.2	58.6	9.4	35.9	20.9
2-6"	13.0	10.7	127.0	56.3	8.6	38.9	21.8

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	6.0	21.9	38.4	30.4	8.6	13.6	11.6
2.0	20.0	10.7	127.0	65.5	8.9	38.9	24.3

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	34.0	12.6	.	.	ND
1.0	1.0	2-6"	21.9	13.1	.	.	ND
1.0	2.0	0-2"	28.6	9.4	.	.	9.1
1.0	2.0	2-6"	29.3	12.0	.	.	ND
1.0	3.0	0-2"	38.4	13.6	.	.	ND
1.0	3.0	2-6"	30.5	8.6	.	.	9.0
2.0	1.0	0-2"	107.2	35.9	108.4	39.7	ND
2.0	1.0	2-6"	127.0	38.9	114.8	38.5	ND
2.0	2.0	0-2"	95.8	29.0	94.9	26.3	ND
2.0	2.0	2-6"	109.8	32.6	100.8	35.5	ND
2.0	3.0	0-2"	79.8	23.5	77.5	22.6	ND
2.0	3.0	2-6"	83.0	26.4	79.1	26.7	ND
2.0	4.0	0-2"	73.9	29.3	68.2	25.2	ND
2.0	4.0	2-6"	73.2	37.7	66.4	34.4	ND
2.0	5.0	0-2"	64.3	24.3	.	.	ND
2.0	5.0	2-6"	18.1	8.9	.	.	9.5
2.0	6.0	0-2"	27.5	13.3	.	.	ND
2.0	6.0	2-6"	24.0	13.4	.	.	ND
2.0	7.0	0-2"	102.5	29.1	117.1	22.7	ND
2.0	7.0	2-6"	121.2	32.0	121.8	34.1	ND
2.0	8.0	0-2"	65.5	14.8	.	.	ND
2.0	8.0	2-6"	65.7	20.4	.	.	ND
2.0	9.0	0-2"	18.2	12.6	.	.	ND
2.0	9.0	2-6"	10.7	10.8	.	.	ND
2.0	10.0	0-2"	26.1	24.3	.	.	ND
2.0	10.0	2-6"	17.4	28.5	19.3	29.1	ND

SITE 6

Based on review of 1927 and 1947 historical aerial imagery, it does not appear that your location was orchard land at that time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
19.1	123.5	56.9	2.8	15.0	7.7

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	16.0	27.8	123.5	59.5	2.8	13.7	7.4
2-6"	16.0	19.1	94.6	54.3	2.9	15.0	8.0

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	12.0	26.4	105.4	65.1	4.2	8.2	5.5
2.0	20.0	19.1	123.5	52.0	2.8	15.0	9.1

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	88.8	6.3	.	.	ND
1.0	1.0	2-6"	94.6	4.4	.	.	ND
1.0	2.0	0-2"	40.9	4.7	.	.	ND
1.0	2.0	2-6"	26.4	4.9	.	.	ND
1.0	3.0	0-2"	105.4	4.6	.	.	ND
1.0	3.0	2-6"	81.4	5.9	.	.	ND
1.0	4.0	0-2"	46.0	4.4	.	.	ND
1.0	4.0	2-6"	43.0	8.2	.	.	ND
1.0	5.0	0-2"	39.4	7.4	.	.	ND
1.0	5.0	2-6"	41.2	4.9	.	.	ND
1.0	6.0	0-2"	89.8	4.2	.	.	ND
1.0	6.0	2-6"	84.2	5.8	.	.	ND
2.0	1.0	0-2"	42.4	10.2	.	.	ND
2.0	1.0	2-6"	40.5	12.1	.	.	ND
2.0	2.0	0-2"	31.9	7.7	.	.	ND
2.0	2.0	2-6"	31.6	2.9	.	.	ND
2.0	3.0	0-2"	32.1	9.8	.	.	ND
2.0	3.0	2-6"	38.1	7.3	.	.	ND
2.0	4.0	0-2"	40.9	6.7	.	.	ND
2.0	4.0	2-6"	40.2	8.0	.	.	ND
2.0	5.0	0-2"	123.5	4.8	.	.	ND
2.0	5.0	2-6"	78.8	8.4	.	.	ND
2.0	6.0	0-2"	27.8	2.8	.	.	ND
2.0	6.0	2-6"	19.1	6.5	.	.	ND
2.0	7.0	0-2"	29.8	8.2	.	.	ND
2.0	7.0	2-6"	30.5	9.0	.	.	ND
2.0	8.0	0-2"	68.0	13.7	.	.	ND
2.0	8.0	2-6"	72.4	15.0	.	.	ND
2.0	9.0	0-2"	47.8	11.8	.	.	ND
2.0	9.0	2-6"	55.5	9.9	.	.	ND
2.0	10.0	0-2"	97.6	11.4	.	.	ND
2.0	10.0	2-6"	91.1	14.9	.	.	ND

SITE 8

Based on review of 1927 and 1947 historical aerial imagery, it does not appear that your location was orchard land at that time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

In addition to lead-arsenate, organo-mercury pesticides were also used on fruit orchards. Soil mercury contamination is suspected in some samples, but needs laboratory confirmation.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
59.7	102.9	82.6	4.1	16.7	10.9

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	5.0	63.9	102.9	80.8	4.1	16.7	11.2
2-6"	5.0	59.7	101.9	84.4	5.8	14.9	10.7

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	10.0	59.7	102.9	82.6	4.1	16.7	10.9

Results by Sample (parts per million)							
Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.							
Exposure Unit	**Sample Location**	**Depth**	**Lead Content, Bulk Fraction**	**Arsenic Content, Bulk Fraction**	**Lead Content, Sieved Fraction**	**Arsenic Content, Sieved Fraction**	**Mercury Content (lab confirmation pending)**
1.0	1.0	0-2"	76.4	11.5	.	.	ND
1.0	1.0	2-6"	78.0	10.0	.	.	ND
1.0	2.0	0-2"	80.1	4.1	.	.	9.4
1.0	2.0	2-6"	90.4	5.8	.	.	ND
1.0	3.0	0-2"	80.9	16.7	.	.	ND
1.0	3.0	2-6"	92.2	14.9	.	.	ND
1.0	4.0	0-2"	63.9	8.3	.	.	ND
1.0	4.0	2-6"	59.7	11.1	.	.	ND
1.0	5.0	0-2"	102.9	15.4	.	.	ND
1.0	5.0	2-6"	101.9	11.7	.	.	ND

SITE 12

Based on review of 1927 and 1947 historical aerial imagery, it does not appear that your location was orchard land at that time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
26.5	102.8	68.7	4.8	27.8	19.2

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	8.0	26.5	102.8	68.7	4.8	27.8	19.2

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	3.0	56.0	70.4	63.8	17.8	26.3	21.3
2.0	5.0	26.5	102.8	71.7	4.8	27.8	18.0

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	70.4	26.3	80.5	31.9	ND
1.0	2.0	0-2"	64.9	19.8	61.7	22.0	ND
1.0	3.0	0-2"	56.0	17.8	.	.	ND
2.0	1.0	0-2"	61.5	14.4	.	.	ND
2.0	2.0	0-2"	80.3	19.2	.	.	ND
2.0	3.0	0-2"	102.8	23.7	143.1	27.4	ND
2.0	4.0	0-2"	87.4	27.8	90.3	24.4	ND
2.0	5.0	0-2"	26.5	4.8	.	.	ND

SITE 14

Based on review of 1927 and 1947 historical aerial imagery, your location was likely orchard land at one time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

In addition to lead-arsenate, organo-mercury pesticides were also used on fruit orchards. Soil mercury contamination is suspected in some samples, but needs laboratory confirmation.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
29.6	388.6	133.5	5.6	53.4	21.4

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	10.0	51.0	301.8	125.6	6.8	48.8	20.6
2-6"	10.0	29.6	388.6	141.4	5.6	53.4	22.3

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	14.0	29.6	388.6	147.9	6.2	53.4	23.6
2.0	6.0	41.6	162.4	99.9	5.6	27.8	16.3

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	52.6	10.7	.	.	ND
1.0	1.0	2-6"	37.4	6.2	.	.	ND
1.0	2.0	0-2"	301.8	48.8	367.5	41.7	ND
1.0	2.0	2-6"	388.6	50.6	440.7	54.3	ND
1.0	3.0	0-2"	51.0	6.8	.	.	13.1
1.0	3.0	2-6"	29.6	6.2	.	.	ND
1.0	4.0	0-2"	199.5	29.7	158.5	21.7	ND
1.0	4.0	2-6"	309.0	53.4	320.1	40.0	ND
1.0	5.0	0-2"	110.9	22.3	122.9	19.4	ND
1.0	5.0	2-6"	135.6	26.6	159.0	24.1	9.1
1.0	6.0	0-2"	120.3	17.6	.	.	ND
1.0	6.0	2-6"	146.7	20.8	143.7	20.1	9.8
1.0	7.0	0-2"	99.9	19.6	105.3	12.4	ND
1.0	7.0	2-6"	88.0	11.6	.	.	ND
2.0	1.0	0-2"	132.4	22.8	145.9	31.8	ND
2.0	1.0	2-6"	162.4	27.8	167.3	32.4	ND
2.0	2.0	0-2"	64.8	11.5	.	.	ND
2.0	2.0	2-6"	41.6	5.6	.	.	ND
2.0	3.0	0-2"	123.1	16.2	.	.	ND
2.0	3.0	2-6"	75.3	14.2	.	.	9.3

SITE 16

Based on review of 1927 and 1947 historical aerial imagery, your location was likely orchard land at one time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

In addition to lead-arsenate, organo-mercury pesticides were also used on fruit orchards. Soil mercury contamination is suspected in some samples, but needs laboratory confirmation.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
22.9	119.8	68.9	3.7	34.7	17.6

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	7.0	58.3	119.8	81.6	3.7	34.7	19.0
2-6"	7.0	22.9	82.9	56.1	4.7	22.6	16.2

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	14.0	22.9	119.8	68.9	3.7	34.7	17.6

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	119.8	34.7	114.3	30.6	10.4
1.0	1.0	2-6"	60.4	17.6	.	.	ND
1.0	2.0	0-2"	91.1	25.5	84.8	23.5	ND
1.0	2.0	2-6"	64.5	14.8	.	.	10.1
1.0	3.0	0-2"	86.8	17.3	.	.	ND
1.0	3.0	2-6"	66.9	22.6	57.2	20.8	ND
1.0	4.0	0-2"	67.1	13.3	.	.	ND
1.0	4.0	2-6"	25.9	10.0	.	.	ND
1.0	5.0	0-2"	59.6	19.2	.	.	ND
1.0	5.0	2-6"	69.2	21.7	82.4	21.2	8.9
1.0	6.0	0-2"	58.3	3.7	.	.	ND
1.0	6.0	2-6"	22.9	4.7	.	.	ND
1.0	7.0	0-2"	88.7	19.3	.	.	ND
1.0	7.0	2-6"	82.9	21.8	95.4	25.5	ND

SITE 18

Based on review of 1927 and 1947 historical aerial imagery, your location was likely orchard land at one time. The use of lead-arsenate pesticides was common in fruit orchards world-wide during that time period.

Results were obtained using handheld X-ray fluorescence spectrometry. Each individual sample was tested three times. All results are in parts per million (ppm) unless otherwise stated.

Washington Limit for Lead in Soils	250 parts per million (ppm)	Any results over these limits are indicated in RED.
US EPA Limit for Arsenic in Soils	20 parts per million (ppm)	
Washington Limit for Mercury in Soils	2 parts per million (ppm)	

Summary Data (parts per million)

Min Lead for site	Max Lead for site	Average Lead for site	Min Arsenic for site	Max Arsenic for Site	Average Arsenic for site
9.7	149.2	61.8	4.4	33.0	14.7

Results by Depth (parts per million)

DEPTH	Number of Samples	Min Lead Result	Max Lead Result	Average Lead Result	Min Arsenic Result	Max Arsenic Result	Average Arsenic Result
0-2"	9.0	9.7	134.1	55.3	5.3	33.0	15.1
2-6"	9.0	21.7	149.2	68.2	4.4	23.3	14.3

Results by Exposure Unit (parts per million)

Exposure Unit (EU)	Number of Samples	EU Min Lead	EU Max Lead	EU Average Lead	EU Min Arsenic	EU Max Arsenic	EU Average Arsenic
1.0	10.0	9.7	149.2	65.7	4.4	33.0	17.1
2.0	8.0	36.9	90.1	56.8	9.0	14.5	11.7

Results by Sample (parts per million)

Note: Two samples were taken at every location, one from the 0-2" depth and one from the 2-6" depth. Some samples were sieved to 250 um and re-tested to determine if differences exist within smaller soil fraction. ND = not detected.

Exposure Unit	Sample Location	Depth	Lead Content, Bulk Fraction	Arsenic Content, Bulk Fraction	Lead Content, Sieved Fraction	Arsenic Content, Sieved Fraction	Mercury Content (lab confirmation pending)
1.0	1.0	0-2"	75.4	17.0	.	.	ND
1.0	1.0	2-6"	70.2	17.2	.	.	ND
1.0	2.0	0-2"	40.0	33.0	53.0	44.3	ND
1.0	2.0	2-6"	54.0	18.8	.	.	ND
1.0	3.0	0-2"	51.9	14.6	.	.	ND
1.0	3.0	2-6"	51.3	15.0	.	.	ND
1.0	4.0	0-2"	9.7	5.3	.	.	ND
1.0	4.0	2-6"	21.7	4.4	.	.	ND
1.0	5.0	0-2"	134.1	22.5	135.1	24.9	ND
1.0	5.0	2-6"	149.2	23.3	145.9	25.5	ND
2.0	1.0	0-2"	36.9	9.0	.	.	ND
2.0	1.0	2-6"	90.1	14.2	.	.	ND
2.0	2.0	0-2"	49.6	11.2	.	.	ND
2.0	2.0	2-6"	60.7	14.5	.	.	ND
2.0	3.0	0-2"	46.7	12.5	.	.	ND
2.0	3.0	2-6"	66.2	11.9	.	.	ND
2.0	4.0	0-2"	53.2	11.0	.	.	ND
2.0	4.0	2-6"	50.9	9.1	.	.	ND

Laboratory Chain of Custody

University of Idaho Analytical Sciences Laboratory

ASL Case #

Holm Research Center, 2222 West Sixth Street, P.O. Box 442203, Moscow, ID 83844-2203 (208) 885-7081 FAX (208) 885-8937

Date Rec.	Check/PO/Budget #	Amount	TESTS REQUESTED	OTHER INFORMATION
Name Casey Bartrem (for Dr. Greg Moller)	E-mail Address caseylynbartrem@gmail.com , bart1432@vandals.uidaho.edu , gmoller@uidaho.edu		Please Use Test Codes (i.e. WNAN; STES) Refer to test fee list	
Agency/Company Univeristy of Idaho - Food Science / Environmental Science				
Address 204 Food Research Center, University of Idaho	County			
City Moscow	**State** ID	**ZIP** 83843	**Mail Code**	
Phone 517 899 5932	**FAX**			

ASL LIMS # (Lab use only)	Submitter Sample ID	Sample Type: Plant	Soil	Water	Other *	ICP-MS: As, Pb	Meth 1631 - CVAF: Hg	Preser-vation Used	Remarks
	YAK-01-01-01-02		x			x			sample previously dried and sieved to 250 um
	YAK-01-01-01-26		x			x			sample previously dried and sieved to 250 um
	YAK-01-01-02-02		x			x			sample previously dried and sieved to 250 um
	YAK-01-01-03-02		x			x			sample previously dried and sieved to 250 um
	YAK-01-01-04-02		x			x	x		sample previously dried and sieved to 250 um
	YAK-01-01-04-26		x			x	x		sample previously dried and sieved to 250 um
	YAK-01-01-06-02		x			x			sample previously dried and sieved to 250 um
	YAK-01-01-06-26		x			x			sample previously dried and sieved to 250 um
	YAK-01-01-07-02		x			x			sample previously dried and sieved to 250 um
	YAK-01-01-07-26		x			x			sample previously dried and sieved to 250 um
	YAK-01-01-08-02		x			x			sample previously dried and sieved to 250 um
	YAK-01-01-08-26		x			x			sample previously dried and sieved to 250 um
	YAK-01-01-09-02		x			x	x		sample previously dried and sieved to 250 um
	YAK-01-01-09-26		x			x	x		sample previously dried and sieved to 250 um
	YAK-01-01-10-02		x			x			sample previously dried and sieved to 250 um
	YAK-01-01-10-26		x			x	x		sample previously dried and sieved to 250 um
	YAK-01-03-01-02		x			x			sample previously dried and sieved to 250 um
	YAK-01-03-01-26		x			x			sample previously dried and sieved to 250 um
	YAK-01-03-02-02		x			x	x		sample previously dried and sieved to 250 um
	YAK-01-03-02-26		x			x	x		sample previously dried and sieved to 250 um
	YAK-02-01-07-26		x			x			sample previously dried and sieved to 250 um
	YAK-03-01-01-26		x			x			sample previously dried and sieved to 250 um
	YAK-03-01-04-02		x			x			sample previously dried and sieved to 250 um
	YAK-03-02-01-26		x			x			sample previously dried and sieved to 250 um
	YAK-03-02-02-02		x			x			sample previously dried and sieved to 250 um
	YAK-04-02-01-02		x			x			sample previously dried and sieved to 250 um
	YAK-04-02-01-26		x			x			sample previously dried and sieved to 250 um
	YAK-04-02-02-02		x			x			sample previously dried and sieved to 250 um
	YAK-04-02-02-26		x			x			sample previously dried and sieved to 250 um
	YAK-04-02-03-02		x			x			sample previously dried and sieved to 250 um
	YAK-04-02-03-26		x			x			sample previously dried and sieved to 250 um

	YAK-04-02-03-26		x			x								sample previously dried and sieved to 250 um
	YAK-04-02-04-02		x			x								sample previously dried and sieved to 250 um
	YAK-04-02-04-26		x			x								sample previously dried and sieved to 250 um
	YAK-04-02-07-02		x			x								sample previously dried and sieved to 250 um
	YAK-04-02-07-26		x			x								sample previously dried and sieved to 250 um
	YAK-04-02-10-26		x			x								sample previously dried and sieved to 250 um
	YAK-07-02-01-02		x			x								sample previously dried and sieved to 250 um
	YAK-07-02-01-26		x			x								sample previously dried and sieved to 250 um
	YAK-10-01-04-02		x			x								sample previously dried and sieved to 250 um
	YAK-10-01-04-26		x			x								sample previously dried and sieved to 250 um
	YAK-12-01-01-02		x			x								sample previously dried and sieved to 250 um
	YAK-12-01-02-02		x			x								sample previously dried and sieved to 250 um
	YAK-12-02-03-02		x			x								sample previously dried and sieved to 250 um
	YAK-12-02-04-02		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-01-02		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-01-26		x			x	x							sample previously dried and sieved to 250 um
	YAK-13-01-02-26		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-03-02		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-03-26		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-04-02		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-06-26		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-07-02		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-07-26		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-08-02		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-08-26		x			x	x							sample previously dried and sieved to 250 um
	YAK-13-01-10-02		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-11-02		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-11-26		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-12-26		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-14-02		x			x	x							sample previously dried and sieved to 250 um
	YAK-13-01-14-26		x			x								sample previously dried and sieved to 250 um
	YAK-13-01-15-26		x			x	x							sample previously dried and sieved to 250 um
	YAK-13-01-16-26		x			x								sample previously dried and sieved to 250 um
	YAK-13-02-01-26		x			x								sample previously dried and sieved to 250 um
	YAK-13-02-02-26		x			x								sample previously dried and sieved to 250 um
	YAK-14-01-02-02		x			x								sample previously dried and sieved to 250 um
	YAK-14-01-02-26		x			x								sample previously dried and sieved to 250 um
	YAK-14-01-04-02		x			x								sample previously dried and sieved to 250 um
	YAK-14-01-04-26		x			x								sample previously dried and sieved to 250 um
	YAK-14-01-05-02		x			x								sample previously dried and sieved to 250 um
	YAK-14-01-05-26		x			x	x							sample previously dried and sieved to 250 um
	YAK-14-01-06-26		x			x	x							sample previously dried and sieved to 250 um
	YAK-14-01-07-02		x			x								sample previously dried and sieved to 250 um

	YAK-14-02-01-02		x			x									sample previously dried and sieved to 250 um
	YAK-14-02-01-26		x			x									sample previously dried and sieved to 250 um
	YAK-16-01-01-02		x			x	x								sample previously dried and sieved to 250 um
	YAK-16-01-02-02		x			x									sample previously dried and sieved to 250 um
	YAK-16-01-03-26		x			x									sample previously dried and sieved to 250 um
	YAK-16-01-05-26		x			x	x								sample previously dried and sieved to 250 um
	YAK-16-01-07-26		x			x									sample previously dried and sieved to 250 um
	YAK-18-01-02-02		x			x									sample previously dried and sieved to 250 um
	YAK-18-01-05-02		x			x									sample previously dried and sieved to 250 um
	YAK-18-01-05-26		x			x									sample previously dried and sieved to 250 um
	YAK-19-02-06-02		x			x									sample previously dried and sieved to 250 um
	YAK-19-02-06-26		x			x									sample previously dried and sieved to 250 um
	YAK-02-01-01-26		x			x	x								sample previously dried and sieved to 250 um
	YAK-02-01-03-26		x			x	x								sample previously dried and sieved to 250 um
	YAK-04-01-02-02		x			x	x								sample previously dried and sieved to 250 um
	YAK-04-01-03-26		x			x	x								sample previously dried and sieved to 250 um
	YAK-04-02-05-26		x			x	x								sample previously dried and sieved to 250 um
	YAK-08-01-02-02		x			x	x								sample previously dried and sieved to 250 um
	YAK-10-01-02-26		x			x	x								sample previously dried and sieved to 250 um
	YAK-13-01-04-26		x			x	x								sample previously dried and sieved to 250 um
	YAK-14-01-03-02		x			x	x								sample previously dried and sieved to 250 um
	YAK-14-02-03-26		x			x	x								sample previously dried and sieved to 250 um
	YAK-15-02-03-26		x			x	x								sample previously dried and sieved to 250 um
	YAK-15-02-04-02		x			x	x								sample previously dried and sieved to 250 um
	YAK-15-03-03-02		x			x	x								sample previously dried and sieved to 250 um
	YAK-16-01-02-26		x			x	x								sample previously dried and sieved to 250 um
	YAK-01-DW-01				x	x									dust wipe
	YAK-01-DW-02				x	x									dust wipe
	YAK-01-DW-03				x	x	x								dust wipe
	YAK-02-DW-02				x	x									dust wipe
	YAK-02-DW-03				x	x									dust wipe
	YAK-03-DW-01				x	x									dust wipe
	YAK-03-DW-02				x	x									dust wipe
	YAK-03-DW-03				x	x									dust wipe
	YAK-03-DW-04				x	x									dust wipe
	YAK-04-DW-01				x	x									dust wipe
	YAK-04-DW-02				x	x	x								dust wipe
	YAK-04-DW-03				x	x									dust wipe
	YAK-07-DW-02				x	x									dust wipe
	YAK-07-DW-03				x	x									dust wipe
	YAK-10-DW-01				x	x									dust wipe
	YAK-10-DW-03				x	x									dust wipe

	YAK-12-DW-03				x	x									dust wipe
	YAK-12-DW-04				x	x									dust wipe
	YAK-13-DW-01				x	x	x								dust wipe
	YAK-13-DW-02				x	x									dust wipe
	YAK-13-DW-03				x	x									dust wipe
	YAK-13-DW-04				x	x									dust wipe
	YAK-14-DW-01				x	x	x								dust wipe
	YAK-14-DW-02				x	x									dust wipe
	YAK-14-DW-03				x	x									dust wipe
	YAK-14-DW-04				x	x									dust wipe
	YAK-16-DW-01				x	x									dust wipe
	YAK-16-DW-02				x	x									dust wipe
	YAK-16-DW-03				x	x	x								dust wipe
	YAK-16-DW-04				x	x									dust wipe
	YAK-18-DW-04				x	x									dust wipe
	YAK-18-DW-05				x	x									dust wipe
	YAK-19-DW-01				x	x									dust wipe
	YAK-19-DW-02				x	x									dust wipe
	YAK-19-DW-03				x	x									dust wipe
	YAK-19-DW-04				x	x									dust wipe
	YAK-15-DW-1				x	x	x								dust wipe
	YAK-08-DW-2				x	x	x								dust wipe
	YAK-10-DW-2				x	x	x								dust wipe
	YAK-02-DW-1				x	x	x								dust wipe

CHAIN OF CUSTODY:

	Signature	Time/Date		Signature	Time/Date
Relinquished By:			Relinquished By:		
Received By:			Received By:		

Storage Requirements: ____________ Storage Location: ____________

Reporting Requirements

All reports are sent by mail

Additional Reports:

___ Verbal Results *

___ FAX Results *

_X_ e-mail Results *

University of Idaho

Laboratory Results

University of Idaho Analytical Sciences Laboratory
Electronic Data Delivery
Client: **Casey Bartrem**
Case ID: **ESEP14-005**

ESEP14-005	Sample ID	As µg/g	Pb Soil (µg/g) Dust (mg/L)	Hg µg/Kg
	RLs	0.38	0.075	19
E1403000	YAK-01-03-02-02	44	360	24
E1402982	YAK-01-01-01-02	35	290	NA
E1402983	YAK-01-01-01-26	35	280	NA
E1402985	YAK-01-01-03-02	29	220	NA
E1402986	YAK-01-01-04-02	24	210	28
E1402990	YAK-01-01-07-02	33	200	NA
E1402987	YAK-01-01-04-26	25	200	28
E1402991	YAK-01-01-07-26	32	190	NA
E1402988	YAK-01-01-06-02	27	190	NA
E1402992	YAK-01-01-08-02	32	150	NA
E1402989	YAK-01-01-06-26	26	150	NA
E1402993	YAK-01-01-08-26	32	130	NA
E1402994	YAK-01-01-09-02	34	100	20
E1402997	YAK-01-01-10-26	28	100	20
E1402996	YAK-01-01-10-02	27	93	NA
E1402984	YAK-01-01-02-02	29	68	NA
E1402995	YAK-01-01-09-26	32	63	20
E1403001	YAK-01-03-02-26	28	42	< 19
E1402998	YAK-01-03-01-02	26	37	NA
E1402999	YAK-01-03-01-26	26	19	NA
E1403002	YAK-02-01-07-26	7.8	370	NA
E1403006	YAK-03-02-02-02	16	70	NA
E1403004	YAK-03-01-04-02	17	100	NA
E1403003	YAK-03-01-01-26	18	120	NA
E1403005	YAK-03-02-01-26	19	170	NA
E1403016	YAK-04-02-07-26	30	110	NA

ESEP14-005	Sample ID	As µg/g	Pb Soil (µg/g) Dust (mg/L)	Hg µg/Kg
E1403015	YAK-04-02-07-02	18	110	NA
E1403008	YAK-04-02-01-26	35	100	NA
E1403007	YAK-04-02-01-02	31	99	NA
E1403010	YAK-04-02-02-26	30	89	NA
E1403009	YAK-04-02-02-02	24	87	NA
E1403012	YAK-04-02-03-26	23	74	NA
E1403011	YAK-04-02-03-02	22	70	NA
E1403013	YAK-04-02-04-02	22	64	NA
E1403014	YAK-04-02-04-26	29	60	NA
E1403132	YAK-04-01-02-02	8.1	22	22
E1403019	YAK-07-02-01-26	4.0	140	NA
E1403018	YAK-07-02-01-02	3.3	95	NA
E1403020	YAK-10-01-04-02	4.0	50	NA
E1403021	YAK-10-01-04-26	4.0	39	NA
E1403022	YAK-12-01-01-02	26	74	NA
E1403024	YAK-12-02-03-02	23	130	NA
E1403025	YAK-12-02-04-02	20	77	NA
E1403023	YAK-12-01-02-02	17	55	NA
E1403044	YAK-13-01-16-26	37	430	NA
E1403032	YAK-13-01-06-26	43	400	NA
E1403027	YAK-13-01-01-26	41	390	33
E1403030	YAK-13-01-03-26	40	370	NA
E1403034	YAK-13-01-07-26	42	330	NA
E1403039	YAK-13-01-11-26	44	310	NA
E1403026	YAK-13-01-01-02	31	310	NA
E1403029	YAK-13-01-03-02	31	300	NA
E1403036	YAK-13-01-08-26	30	290	49
E1403033	YAK-13-01-07-02	35	280	NA
E1403042	YAK-13-01-14-26	46	270	NA
E1403035	YAK-13-01-08-02	26	250	NA
E1403041	YAK-13-01-14-02	41	220	31
E1403038	YAK-13-01-11-02	28	210	NA
E1403045	YAK-13-02-01-26	27	160	NA
E1403037	YAK-13-01-10-02	23	120	NA
E1403046	YAK-13-02-02-26	17	120	NA
E1403137	YAK-13-01-04-26	24	99	40
E1403031	YAK-13-01-04-02	18	93	NA
E1403028	YAK-13-01-02-26	19	88	NA
E1403040	YAK-13-01-12-26	18	68	NA
E1403048	YAK-14-01-02-26	45	420	NA

ESEP14-005	Sample ID	As µg/g	Pb Soil (µg/g) Dust (mg/L)	Hg µg/Kg
E1403047	YAK-14-01-02-02	38	340	NA
E1403050	YAK-14-01-04-26	35	270	NA
E1403056	YAK-14-02-01-26	23	150	NA
E1403052	YAK-14-01-05-26	22	150	27
E1403049	YAK-14-01-04-02	19	150	NA
E1403055	YAK-14-02-01-02	21	140	NA
E1403053	YAK-14-01-06-26	16	130	28
E1403051	YAK-14-01-05-02	16	110	NA
E1403054	YAK-14-01-07-02	13	95	NA
E1403057	YAK-16-01-01-02	24	100	< 19
E1403058	YAK-16-01-02-02	17	73	NA
E1403059	YAK-16-01-03-26	17	52	NA
E1403060	YAK-16-01-05-26	17	68	26
E1403061	YAK-16-01-07-26	16	78	NA
E1403064	YAK-18-01-05-26	18	130	NA
E1403063	YAK-18-01-05-02	17	110	NA
E1403062	YAK-18-01-02-02	33	40	NA
E1403065	YAK-19-02-06-02	3.0	8.4	NA
E1403066	YAK-19-02-06-26	3.3	12	NA
E1403067	YAK-01-DW-01	ND	0.0045	NA
E1403068	YAK-01-DW-02	ND	0.0094	NA
E1403069	YAK-01-DW-03	ND	0.007	NA
E1403070	YAK-02-DW-02	ND	0.0061	NA
E1403071	YAK-02-DW-03	ND	0.0015	NA
E1403072	YAK-03-DW-01	ND	0.012	NA
E1403073	YAK-03-DW-02	ND	0.01	NA
E1403074	YAK-03-DW-03	ND	0.0082	NA
E1403075	YAK-03-DW-04	ND	0.012	NA
E1403076	YAK-04-DW-01	ND	0.0082	NA
E1403077	YAK-04-DW-02	ND	0.021	NA
E1403078	YAK-04-DW-03	ND	0.0038	NA
E1403079	YAK-07-DW-02	ND	0.002	NA
E1403080	YAK-07-DW-03	ND	0.0019	NA
E1403081	YAK-10-DW-01	ND	0.001	NA
E1403082	YAK-10-DW-03	ND	0.0014	NA
E1403083	YAK-12-DW-03	ND	0.0045	NA
E1403084	YAK-12-DW-04	ND	0.0021	NA
E1403085	YAK-13-DW-01	ND	0.0038	NA
E1403086	YAK-13-DW-02	ND	0.0046	NA
E1403087	YAK-13-DW-03	ND	0.016	NA

ESEP14-005	Sample ID	As µg/g	Pb Soil (µg/g) Dust (mg/L)	Hg µg/Kg
E1403088	YAK-13-DW-04	ND	0.0046	NA
E1403089	YAK-14-DW-01	ND	0.005	NA
E1403090	YAK-14-DW-02	ND	0.01	NA
E1403091	YAK-14-DW-03	ND	0.014	NA
E1403092	YAK-14-DW-04	ND	0.0086	NA
E1403093	YAK-16-DW-01	ND	0.0018	NA
E1403094	YAK-16-DW-02	ND	0.0018	NA
E1403095	YAK-16-DW-03	ND	0.0071	NA
E1403096	YAK-16-DW-04	ND	0.0048	NA
E1403097	YAK-18-DW-04	ND	0.0015	NA
E1403098	YAK-18-DW-05	ND	0.011	NA
E1403099	YAK-19-DW-01	ND	0.0018	NA
E1403100	YAK-19-DW-02	ND	0.0015	NA
E1403101	YAK-19-DW-03	ND	0.0074	NA
E1403102	YAK-19-DW-04	ND	ND	NA
E1403130	YAK-02-01-01-26	3.3	11	< 19
E1403131	YAK-02-01-03-26	3.2	15	26
E1403133	YAK-04-01-03-26	8.4	20	23
E1403017	YAK-04-02-10-26	26	14	NA
E1403134	YAK-04-02-05-26	8.4	12	21
E1403135	YAK-08-01-02-02	6.6	75	58
E1403136	YAK-10-01-02-26	3.0	19	< 19
E1403043	YAK-13-01-15-26	16	68	61
E1403139	YAK-14-02-03-26	11	83	22
E1403138	YAK-14-01-03-02	7.5	44	< 19
E1403140	YAK-15-02-03-26	4.1	7.7	26
E1403141	YAK-15-02-04-02	3.7	7.8	26
E1403142	YAK-15-03-03-02	3.7	8.1	23
E1403143	YAK-16-01-02-26	13	61	22
E1403144	YAK-15-DW-1	ND	0.0043	NA
E1403145	YAK-08-DW-2	ND	ND	NA
E1403146	YAK-10-DW-2	ND	0.0015	NA
E1403147	YAK-02-DW-1	ND	0.0025	NA

Appendix C

Principal Component Analysis

Table A2. PCA simple statistics and correlation matrix.

Observations	85
Variables	8

Simple Statistics				
	BULK_PBMEAN	BULK_ASMEAN	BULK_MNMEAN	BULK_FEMEAN
Mean	165.8323333	30.76603922	718.3043137	35001.51512
StD	111.2825424	11.78772211	103.9869482	3748.17243

Simple Statistics				
	SIEVED_PBMEAN	SIEVED_ASMEAN	SIEVED_MNMEAN	SIEVED_FEMEAN
Mean	173.0791765	31.15452941	736.3250196	36016.93776
StD	119.4302126	12.66005831	80.6614771	3696.73973

Correlation Matrix				
	BULK_PBMEAN	BULK_ASMEAN	BULK_MNMEAN	BULK_FEMEAN
BULK_PBMEAN	1.0000	0.6176	-.0864	-.0969
BULK_ASMEAN	0.6176	1.0000	-.0985	-.1479
BULK_MNMEAN	-.0864	-.0985	1.0000	0.8009
BULK_FEMEAN	-.0969	-.1479	0.8009	1.0000
SIEVED_PBMEAN	0.9890	0.5984	-.0855	-.1107
SIEVED_ASMEAN	0.6558	0.9310	-.1296	-.2233
SIEVED_MNMEAN	0.1071	-.2043	0.7366	0.6862
SIEVED_FEMEAN	-.0014	-.1696	0.7169	0.8971

Correlation Matrix				
	SIEVED_PBMEAN	SIEVED_ASMEAN	SIEVED_MNMEAN	SIEVED_FEMEAN
BULK_PBMEAN	0.9890	0.6558	0.1071	-.0014
BULK_ASMEAN	0.5984	0.9310	-.2043	-.1696
BULK_MNMEAN	-.0855	-.1296	0.7366	0.7169
BULK_FEMEAN	-.1107	-.2233	0.6862	0.8971
SIEVED_PBMEAN	1.0000	0.6470	0.1499	0.0188
SIEVED_ASMEAN	0.6470	1.0000	-.1496	-.1848
SIEVED_MNMEAN	0.1499	-.1496	1.0000	0.8003
SIEVED_FEMEAN	0.0188	-.1848	0.8003	1.0000

Table A3. PCA eigenvalues and eigenvectors.

Eigenvalues of the Correlation Matrix				
	Eigenvalue	Difference	Proportion	Cumulative
1	3.64792407	0.70825042	0.4560	0.4560
2	2.93967365	2.17464500	0.3675	0.8234
3	0.76502865	0.45350955	0.0956	0.9191
4	0.31151910	0.09031192	0.0389	0.9580
5	0.22120718	0.16023959	0.0277	0.9857
6	0.06096759	0.01415095	0.0076	0.9933
7	0.04681665	0.03995355	0.0059	0.9991
8	0.00686310		0.0009	1.0000

Eigenvectors								
	Prin1	Prin2	Prin3	Prin4	Prin5	Prin6	Prin7	Prin8
BULK_PBMEAN	-.289773	0.430369	-.402700	-.088307	-.294123	0.007279	0.090037	-.682774
BULK_ASMEAN	-.347799	0.328630	0.528232	-.067358	0.048954	0.473602	-.509701	-.031341
BULK_MNMEAN	0.376022	0.298289	0.277080	0.550035	-.537112	-.276843	-.158701	0.001367
BULK_FEMEAN	0.409185	0.290678	0.209224	-.477554	-.270790	0.370195	0.497863	0.134175
SIEVED_PBMEAN	-.282252	0.433338	-.439582	-.029312	-.153114	-.060231	-.093958	0.708915
SIEVED_ASMEAN	-.362924	0.335759	0.419997	0.125375	0.334336	-.413622	0.529188	0.023085
SIEVED_MNMEAN	0.348629	0.349913	-.261844	0.465153	0.549452	0.399327	0.082064	-.054739
SIEVED_FEMEAN	0.391561	0.332205	-.008000	-.473416	0.334899	-.477274	-.404280	-.093503

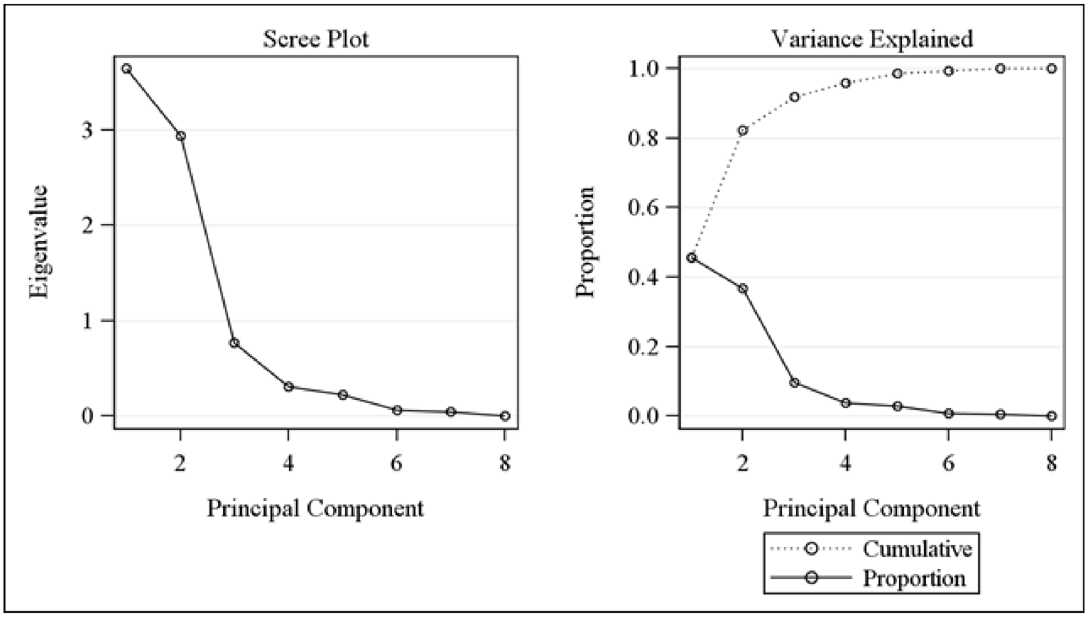


Figure A20. PCE scree plot and variance explained.

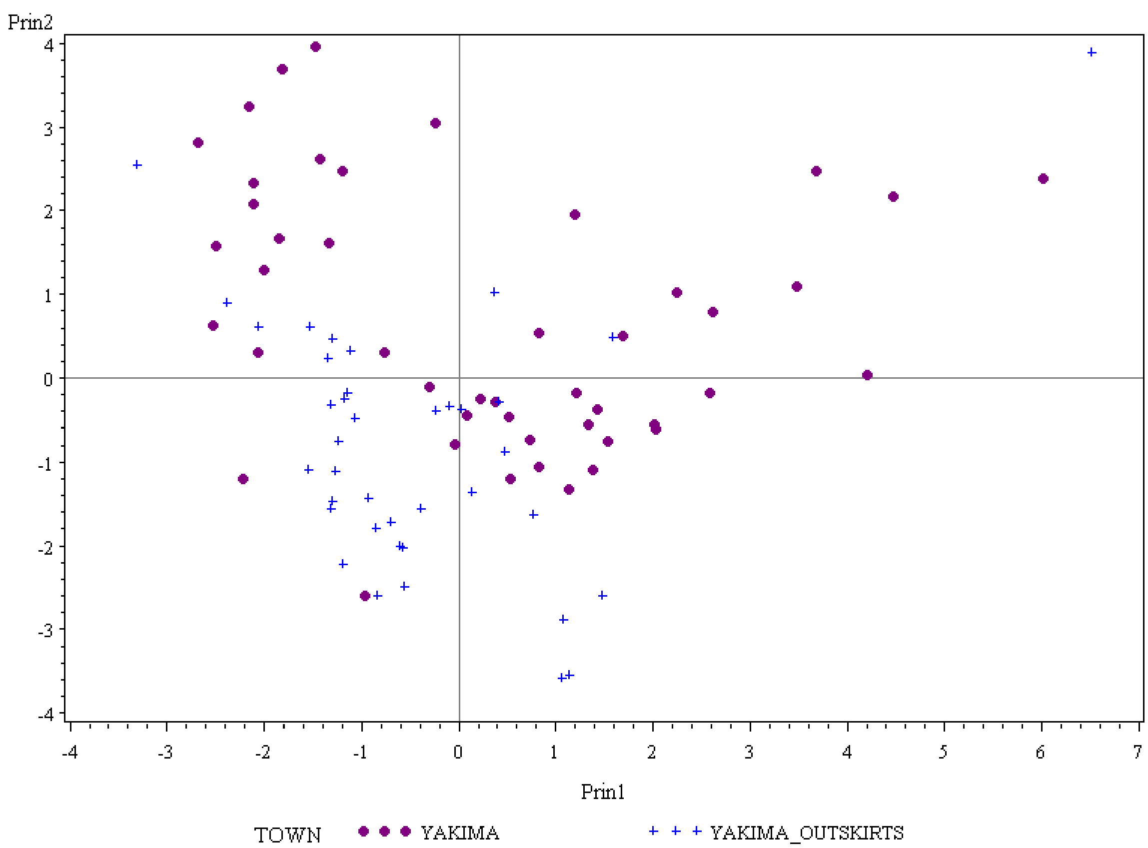


Figure A21. PCA by town.

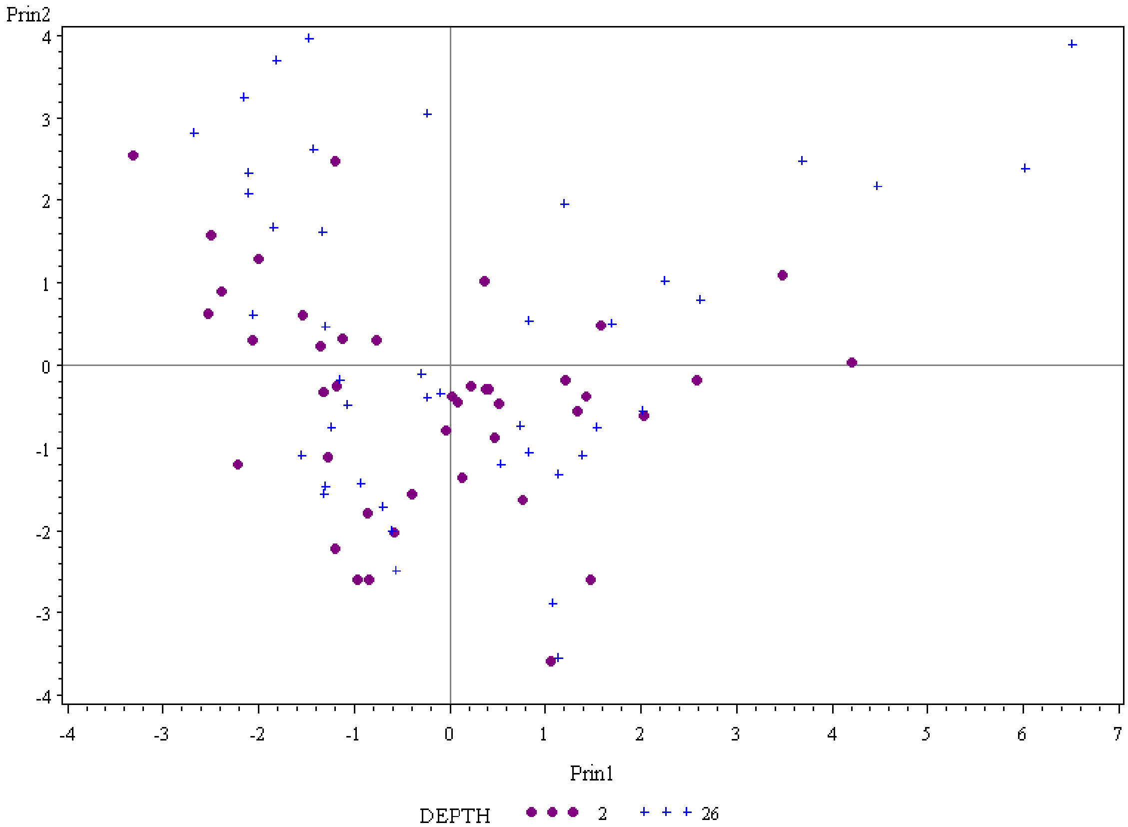


Figure A22. PCA by depth.

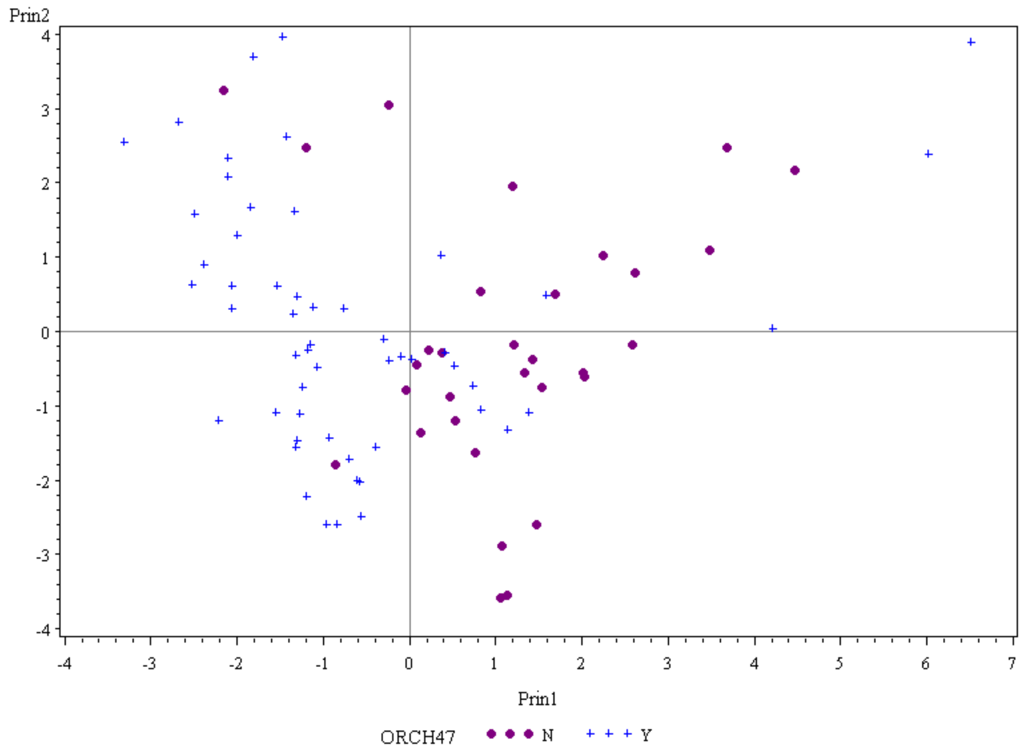


Figure A23. PCA by 1947 land use classification.

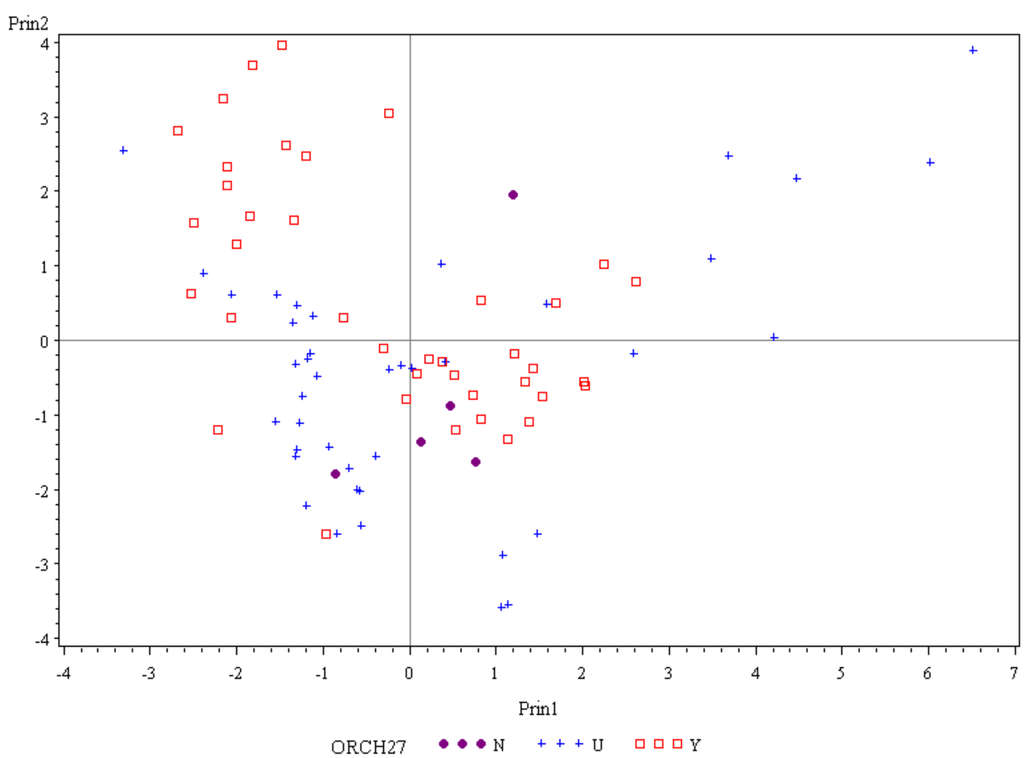


Figure A24. PCA by 1927 land use classification.

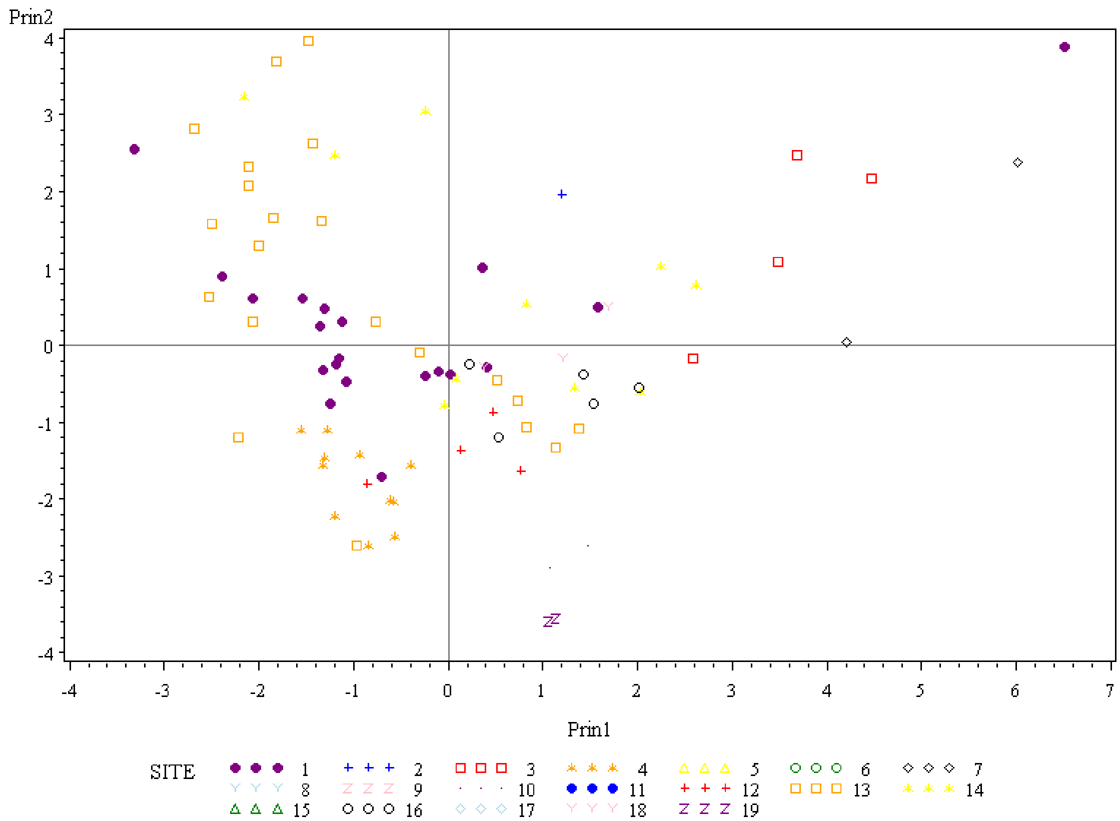


Figure A25. PCA by site.

Table A4. PCA MEANS procedure.

The MEANS Procedure

Variable	Mean	Lower 95% CL for Mean	Upper 95% CL for Mean	Range	Variance	Quartile Range	Median	N Miss
BULK_PBMEAN	76.4874883	68.0440116	84.9309650	464.2933333	6561.91	73.5050000	51.6250000	0
BULK_ASMEAN	14.1335686	12.8732889	15.3938483	51.1500000	146.1912483	14.7477083	9.0058333	0
SIEVED_PBMEAN	173.0791765	147.3186764	198.8396765	464.6500000	14263.58	158.5000000	133.6166667	271
SIEVED_ASMEAN	31.1545294	28.4238181	33.8852407	54.0950000	160.2770764	16.4400000	31.8433333	271

Variable	t Value	Minimum	Maximum	Std Dev	5th Pctl	95th Pctl
BULK_PBMEAN	17.82	8.1100000	472.4033333	81.0056035	12.1666667	286.2733333
BULK_ASMEAN	22.06	2.2766667	53.4266667	12.0909573	3.2916667	41.4033333
SIEVED_PBMEAN	13.36	12.7100000	477.3600000	119.4302126	46.7833333	413.8500000
SIEVED_ASMEAN	22.69	4.6416667	58.7366667	12.6600583	5.7600000	52.1533333

Appendix D

Ecology Dirt Alert Brochure

Garden Safely

- Wash fruits and vegetables before eating them.
- Peel carrots, potatoes and other root crops. Throw the peelings away instead of composting.
- Use raised beds constructed with arsenic-free materials. Fill them with clean soil.
- Dampen dusty soils before gardening in soil.
- Wear gardening gloves.
- Keep gardens away from old painted structures and treated wood.
- Do not plant food crops under the overhang of your home.
- Cover bare patches of soil with grass, a mulch product or imported clean soil.

For more information about lead and arsenic contamination in your area, please contact:

Jeff Newschwander
Department of Ecology
Central Regional Office, Yakima
509-454-7842

Or visit our website:

http://www.ecy.wa.gov/programs/tcp/sites/dirt_alert/dirt_alert_hp.html

To learn more about the health effects of lead and arsenic, contact:

Rob Banes
Washington State Dept. of Health
360-236-3243

You can also contact your **County Health District**:

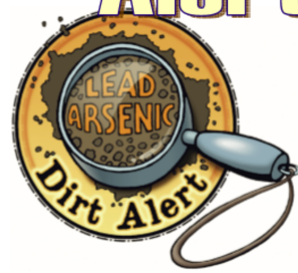
Chelan and Douglas counties
(509) 886-6400
www.cdhd.wa.gov/index.asp

Okanogan County
(509) 422-7140
www.okanogancounty.org/ochd/index.htm

Yakima County
(509) 575-4040
www.co.yakima.wa.us/health/

If you need this publication in an alternate format, please contact the Toxics Cleanup Program at 509-454-7886. For persons with a speech or hearing impairment call 711 for relay service or 877-833-6341 for TTY.

Dirt Alert



Look inside to discover simple ways to protect your family

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Publication #05-09-013 Revised March 2007

Orchards are a common sight throughout central Washington. In fact, many homes and schools are located on former orchard lands.

From about 1905 through the 1940's, lead arsenate was commonly used as a pesticide. This means past orchard lands have the potential of being contaminated with lead and arsenic. Over time, exposure to this contaminated soil can lead to health problems.

Children are especially vulnerable because they eat, drink and breathe more in relation to their body size than adults. They tend to put their hands in their mouths and play on the floor where dirt and dust from outside activities gets tracked into the home. Adults, especially pregnant women and those who work with soil, should also be careful about their exposure to lead and arsenic.

The Department of Ecology has sampled the soil at schools throughout central Washington to determine lead and arsenic levels. If contaminated soil is found, we will work with schools to reduce children's exposure. This often includes simple solutions, such as covering bare ground with mulch or seeding an area properly so grass can grow.

This brochure contains simple methods to help you reduce your exposure to lead and arsenic.

Stay Safe at Home

Keep dirt out of your home

- **Take off your shoes.**
- **Use sturdy rubber doormats.**
- **Damp mop and dust regularly.**
- **Wash your hands with soap and water.**

- **Keep children's toys and pacifiers clean.**

Lead and arsenic found in the dirt outside can be easily tracked into the home by dirty shoes. When children play on the floor and put toys in their mouth, they are exposed to this dirt.

It's more likely you'll swallow contaminated soil than inhaling it.

Mop and Dust

- **Take your shoes off before entering the house.**
- **Damp-mop floors and dust all surfaces at least once a week. Don't sweep or blow on the surface.**

Eat a Healthy Diet

- **A balanced, healthy diet creates a stronger immune system and helps adults and children resist the health effects of toxins.**

Keep Pets Clean

- **Bathe pets regularly.**
- **Wash your hands after handling your pet.**
- **Wipe off excess mud and soil before your pet comes into your home.**
- **Give pets their own sleeping places.**

Kids, Stay Safe at School!

- **Keep your desk free of dust and dirt.**
- **Wipe off your shoes before going into the school.**
- **Wash your hands with soap and water.**
- **Stay in play areas.**

Appendix E

Institutional Review Board Approval

University *of* Idaho
Office of Research Assurances
Institutional Review Board
875 Perimeter Drive, MS 3010
Moscow ID 83844-3010
Phone: 208-885-6162
Fax: 208-885-5752
irb@uidaho.edu

To: Gregory Moller

From: Traci Craig, Ph.D.,
Chair, University of Idaho Institutional Review Board
University Research Office
Moscow, ID 83844-3010

Date: 4/29/2014 1:29:32 PM

Title: Washington Soil Lead Arsenate Study

Project: 14-142
Approved: April 29, 2014
Renewal: April 28, 2015

On behalf of the Institutional Review Board at the University of Idaho, I am pleased to inform you that the protocol for the above-named research project is approved as offering no significant risk to human subjects.

This study may be conducted according to the protocol described in the application without further review by the IRB. As specific instruments are developed, each should be forwarded to the ORA, in order to allow the IRB to maintain current records. Every effort should be made to ensure that the project is conducted in a manner consistent with the three fundamental principles identified in the Belmont Report: respect for persons; beneficence; and justice.

This IRB approval is not to be construed as authorization to recruit participants or conduct research in schools or other institutions, including on Native Reserved lands or within Native Institutions, which have their own policies that require approvals before Human Participants Research Projects can begin. This authorization must be obtained from the appropriate Tribal Government (or equivalent) and/or Institutional Administration. This may include independent review by a tribal or institutional IRB or equivalent. It is the investigator's responsibility to obtain all such necessary approvals and provide copies of these approvals to ORA, in order to allow the IRB to maintain current records.

As Principal Investigator, you are responsible for ensuring compliance with all applicable FERPA regulations, University of Idaho policies, state and federal regulations.

This approval is valid until April 28, 2015.

Should there be significant changes in the protocol for this project, it will be necessary for you to submit an amendment to this protocol for review by the Committee using the Portal. If you have any additional questions about this process, please contact me through the portal's messaging system by clicking the 'Reply' button at the top of this message.

Traci Craig, Ph.D.

University of Idaho Institutional Review Board: IRB00000843, FWA00005639

National Institutes of Health Certificate of Completion

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Jenna Durkee** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 03/15/2014

Certification Number: 1428100