

Final Report submitted to the NJDEP
On Exposure and Health Assessment within the
Community Surrounding the Martin Luther King/Jefferson
School Construction Site

Submitted by

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Revised March 2008

Executive Summary

The construction activities around the building of a new school (since demolished) at the Martin Luther King/Jefferson school site, Trenton, NJ in 2004-2005, resulted in the generation of dust that was reportedly spread through the neighborhood. Nearby residents voiced concerns that the dust was a health hazard. NJ DEP responded to the community by requesting scientists at the Environmental and Occupational Health Sciences Institute to determine the potential exposure to contaminants originating from the site and potential health risks. To address these concerns soil samples were collected from the site, dust samples from inside and outside the adjacent school buildings and surrounding residences. Also air samples were obtained during demolition of the superstructure which allowed access to the underlying contaminated soil.

The measurements of lead and PAHs made on the soil indicated that minimal risk would be presented to the community from these agents from soil that had blown off-site. As expected from the type of material used, which was a composite of concrete and soil, small particles of carbonate minerals were present in the soil and in dust samples collected from the outside of window sills of surrounding residences indicative of the transport of the soil off site during the construction activities.

An evaluation of the spatial pattern and an hierarchical clustering of the sweep samples collected from the homes based on the metal concentrations (for metals from concrete and soil) suggest that the spread of the material from the site was limited to within the one block distance immediately adjacent to the construction area on Evans Avenue and Southard Street., with a possible impact on Race Street. The concentration of lead across

the residences was highly variable without a clear spatial pattern indicating that the soil at the construction site was not the primary source of lead for the dust around residences, but rather that lead came from leaded paint existing at the residences or from historical lead deposited in the soil from leaded gasoline used decades ago.

No consistent spatial pattern of metal concentrations was identified in the dust from the wipe samples collected within the residences or the unused rooms in the school buildings and the levels did not match soil or the outdoor samples. Thus, no evidence of the soil or soil contamination was currently identified in the dust collected from inside the homes or school buildings.

Prior to demolishing the partially completed building, dust suppression activities were planned to prevent dust from the site reaching nearby residences. The air samples collected during the demolition of the superstructure had mass and metal concentrations consistent with background levels in an urban, industrial setting. Thus, appropriate the dust suppression methods in place during the demolition activities were effective in minimizing spread of dust to the neighborhood.

Rationale for Project

The construction activities around the new school building being built at the Martin Luther King/Jefferson school site, Trenton, NJ in 2004-2005, resulted in the generation of dust that was reportedly spread through the neighborhood prompting the NJ DEP to request that additional dust suppression steps be put into place (http://www.nj.gov/dep/newsrel/2005/05_0113.htm accessed 9-25-2007). Subsequently, additional concerns were raised about the dust generated from fill used to support the foundation of the new structure since some fill samples contained polyaromatic hydrocarbons (PAHs) above the NJDEP residential standard. The fill, a composite of soil that had been originally removed from the site and mixed with recycled concrete aggregate material could also yield exposures to a potential respiratory irritant (alkaline components of cement).

At the request of NJDEP in response to the community concerns, the Environmental and Occupational Health Sciences Institute undertook a study to determine whether it was possible to identify the extent of the spread of particles from the construction site to the neighboring homes based on samples collected in the summer of 2006. In addition, since the decision was made to demolish the partly completed superstructure of the school building and remove the contaminated fill from the site, air samples were collected for PM10 mass to determine if adequate dust suppression techniques were used to minimize any dust blown offsite during that phase of the operation.

Neighborhood Inhalation Exposure Assessment to Contaminated Soil from The Martin Luther King/Jefferson School Site

To assess potential inhalation exposure to alkali compounds to residents in the area and the children attending the schools the following samples were collected:

soil samples on-site;

dust samples in Jefferson School and classrooms in the Martin Luther King school that were not used in 2006-2007 school year; and

dust or sweep samples from inside and outside homes in the surrounding neighborhood.

The morphology of the samples was analyzed by Scanning Electron Microscopy and the trace metal content by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) and Emission Spectroscopy (ICP-ES) (Millette et al. 2004). To evaluate the extent of the chemical contamination on site, polycyclic aromatic hydrocarbon concentration of the soil samples were analyzed by Gas Chromatography/Mass Spectrometry (May and Gill 1999) and trace metals by ICP-MS and ICP-ES.

Methodology:

Surface soil samples were taken approximately 5 feet from the edge of the building superstructure, near the Jefferson School building and in the open field area as indicated in Figure 1 and Table 1. The soil samples were taken from a depth of 7 to 8 inches, where the soil typically changed color or composition to a brownish color with more rocks compared to the top layer of soil. A top soil was placed on the site after most of the fill was deposited as part of the effort to increase dust suppression. The soil samples were collected using a metal Bulb Digger to make a circular hole to the desired depth and remove the top layer of soil. A metal trowel was then use to collect the sample which was place in a new glass jar with a screw cap. The samples were stored at room temperature until analyzed.

Dust samples were collected using either a wipe sampler (Lioy et al. 1993) from interior samples or a sweep method from sample collected from exterior window sills. Briefly, the wipe sampling method is accomplished by wiping a Polyethylene 50x55mm drain disc (Whatman-Nuclepore) held securely on a block, wetted with distilled water, within an $\sim 150\text{cm}^2$ template that controls the pressure applied to the surface. The wiping is repeated with three filters to collect $>90\%$ of the dust from the surface. The surfaces in the schools that were sampled were either the top of the ceiling light fixtures or the top of built in shelves or cabinets. These areas were selected since all other surfaces had been cleaned by the school staff in preparation for the expected school term and were the only places that had obvious loadings of historic dust from the previous year. The areas sampled inside homes were areas that had not been disturbed over the previous year, such as windowsills, the tops of cabinets and the top shelf in book cases. It is likely that the

collected dust had accumulated over several years, not just the previous year, in the locations selected but would contain material generated by the construction activities if that dust had entered the school buildings or nearby residences.

The sweep samples were predominantly collected from the outside window sills of residences that were sheltered from rain so would reflect long term deposition of ambient dust. In some cases material from the sill between the interior window and the exterior of the house was also collected. This was done by using a clean, small paint brush to sweep the material into a small scoop and then transferring the material to a new plastic, labeled zip-lock bag. Between 150 and 600 cm² surface area was sampled. The sampled surfaces were generally between 1 and 2 meters above the ground or floor, but some surfaces were as low as 0.5m and others as high as 3m above the ground. The type of surface (metal, wood, painted wood, plastic, brick) and its condition (good, moderate, deteriorated) were recorded as well as whether the area sampled was facing the construction site or in a section of the house facing away from the construction site.

Air Sample Collection:

The air samples were collected using high volume Stapler PM10 Sampler High Volume Air samplers provide by NJ DEP. This sampler meets the EPA's PM-10 performance specifications in Federal Reference Method (RFPS1287-063). The samplers were placed in backyards of two homes, one adjacent to the northern and a second on the southwestern side of the area. Eight-hour samples were collected twice a week, typically once at the beginning of the week (Monday or Tuesday) and the second at the end of the week (Thursday or Friday), during the work day, starting at 7am. The samples were started

using a timer. Days that had rain or predicted rain were not sampled since the on-site demolition activities were limited and the rain suppressed any dust generation. The timer did not start the pump on several days during the early part of the study. Filters mounted on those days were used as a field blank. A numbered, pre-weighed 8x10 inch quartz fiber filter was used to collect the dust samples.

Sample Analysis:

Selected soil and sweep samples were separated into subsamples and weighed for subsequent analyses: morphology by Scanning Electron Microscope, multi-elemental trace metal analysis by Inductively-Coupled Plasma/Mass Spectrometry, calcium and aluminum by Inductively-Coupled Plasma/Emission Spectrometry, and polycyclic aromatic hydrocarbons (PAH) by Gas Chromatography/Mass Spectrometry (soil samples only).

Scanning Electron Microscopy:

Several grams of soil or several hundred milligrams of sweep samples were sent to MVA Scientific Consultants, Duluth, GA for microscopical analyses. The samples were dry sieved into three fractions >300 μm , 75-300 μm , and <75 μm and analyzed using Polarized light microscopy to classify the particle type and morphology and then by scanning electron microscopy (SEM) using a JEOL 6400 coupled with a Noran Voyager x-ray energy dispersive spectrometry (EDS) system to determine mineral type and elemental composition of individual particles.

Elemental Analysis:

The soil, sweep and wipe samples were digested in closed Teflon vessels (6 mL, Savillex Corp, Minnetonka MN), cleaned in a microwave with 0.5 mL Optima HNO₃ (Thermo-Fisher Scientific, Waltham MA), followed by 0.5 mL deionized water, in closed 50-mL centrifuge tubes (VWR, Westchester PA). The samples were placed in 1 mL Optima HNO₃ (Thermo-Fisher Scientific), and 0.5 mL Utrex II H₂O₂ (JT Baker, Phillipsburg NJ) in individual Teflon vessels. The vessel was sealed with a socket-type cap (Savillex Corp) designed for high-pressure applications. The digestion protocol had eight stages (500 watts; 5 min/stage; 10% power increments from 40% to 70% for the first four stages and 60% for the last four stages). Samples were digested in a microwave oven (MDS-2000, CEM Corporation, Matthews NC) operated under time–power control mode. In each batch, blanks, one urban PM standard (NIST 1648), a standard aqueous solution (NIST 1643), were digested. After digestion, samples were cooled and transferred to precleaned 15-mL centrifuge tubes.

Multi-elemental analyses of the samples and controls were completed with a Thermo Elemental Plasma Quad3 ICP–MS and ASX-500 autosampler (CETAC Technologies, Omaha NE). For every batch of six to eight samples, a 10-ppb solution made from NIST traceable SM- 1811-001 and SM-1811-002 (high-purity element solutions containing 23 elements) was run as a quality control sample. If the quality control sample was not within $\pm 20\%$ of the certified value for target elements, the instrument was recalibrated and the batch was reanalyzed. Accuracy was determined by comparisons with certified results from standard solution (NIST 1643) and urban PM standard (NIST 1648) to

reflect digestion and matrix-extraction recoveries, respectively. Recoveries for most “extractable” elements were between 91% and 103% with ICP–MS.

Calcium and aluminum were analyzed on a Varian Vista Radial View Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES) and concentrations calculate using an Yttrium internal standard and external calibration curve repeated every 12th sample. Final concentrations were typically accurate and precise to $< + 10\%$ (RSD). The instrument blank levels were < 0.1 ppm

PAH analyses:

A PAH analysis method was adapted and verified in the EOHSI laboratories based on EPA Method 3540. The soil sample was sieved into two size fractions $< 75\mu\text{m}$ and between 75 and $200\mu\text{m}$. Each subsample of sieved soil was homogenized and dried with one size fraction from the 23 samples analyzed for the 16 common PAHs typically present in contaminated soil. The PAHs were extracted from the soil using a Soxhlet extraction method. One gram of the soil subsample was placed into a quartz extraction thimble which was inserted into the upper section of the Soxhlet assembly (50 ml). A 15 ml round-bottom flask was attached to the assembly after adding 10 ml of 1:1 Hexane: Acetone mixture and the soil was extracted for 24 h by heating the extraction fluid at 90°C , which resulted in several extraction cycles per minute. After the extraction was complete, the solvent containing the PAHs were cooled and reduced to less than 1 milliliter under a gentle nitrogen stream at 30°C for subsequent GC/MS analysis.

The GC/MS analyses, based on EPA Method 8270, were performed on a Hewlett-Packard 5890 GC system equipped with a HP-5MS column (30 m×0.25 mm, 0.32 µm id) from Agilent Technologies, coupled to a Hewlett-Packard 5973 MSD mass spectrometer operated in full scan mode. The temperature conditions used were: GC inlet at 200 °C, the oven temperature program started at 70 °C for 1 min, then ramped at 10 °C min⁻¹ up to 170 °C, followed by a ramp of 25 °C min⁻¹ up to 275 °C with the final temperature held for 15 min. The transfer line was set at 280 °C. An 1 µl aliquot of each sample was injected into a split-less injector (60 s of equilibrium time) using an autosampler. Helium was used as the carrier gas at a constant flow rate of 1.5 ml min⁻¹.

Filter weighing:

Filters were weighed using a Sartorius Analytic Balance Model A120S which has a capacity of 120 grams and a readability of 0.1mg. A specially designed holder for weighing 8x10in filters on this balance was used. The filters were placed in a controlled temperature (20-23°C) and relative humidity (30-40%) weighing room to allow the filter material and/or collected dust to equilibrate for 24 hours immediately prior to weighing before and after sampling. The balance, however, was in an open laboratory area during the weighing. The weighing took less than a minute and no observable change in weight at the analytical precision was observed due to uptake or release of water from the filter.

Results and Discussion:

Soil Analyses:

A summary of the SEM characterization of the soil samples are given in Table 2a and b. Detailed analysis results are provided in Appendix A. The samples were dry sieved into three size fractions, $>300\mu\text{m}$, $75\text{-}300\mu\text{m}$ and $<75\mu\text{m}$. In addition to polarized light microscopy (PLM) analysis, a micro-chemical test for carbonate using 10% HCl was also used to identify the presence of cement or other calcium carbonate binder material. Representative portions of the soil were also analyzed by SEM and x-ray energy dispersive spectrometry. The particle size distribution across the samples was 33% of particles $>300\mu\text{m}$, 53% in the range $75\text{-}300\mu\text{m}$ and 14% $<75\mu\text{m}$. The soil samples were composed of granular soil minerals and mixture of fine clay, mica, quartz and organic debris coating sand grains, common components of soil. In addition, the presence of coal and coke were identified in most soil samples, not a particle type typically found in soil. While individual Portland cement particles were not identified in the soil, a number of samples had identified amounts of carbonate. The SEM of soil particles identified calcium particles or calcium coated particles in those samples containing carbonate, suggesting the presence of calcium carbonate, a component of cements and mortars. Trace amounts or small percentages of metal flakes or fragments, predominantly iron were present in the soil. Other metals detected included copper, zinc, lead, tin, chromium, nickel, yttrium and barium. These findings are consistent with the soil being a mixture of soil from an urban/industrial area and recycled concrete aggregate.

The summary statistics for the metal concentration measured in the soil samples are given Table 3 and histograms of metal concentrations that were above detection in the majority

of the samples are given in Figures 2a to 2x for two size fractions, $<75\mu\text{m}$ and 75 to $500\mu\text{m}$. The concentration distributions approximate normal distributions for most elements. A normal distribution is what would result from random sampling from a relatively uniform soil material. A few compounds did have a single sample with high concentration that appears to be an outlier. This is not uncommon for the very small sample amount used in the analysis, as a few particles enriched in a particular metal can result in a high sample concentration. A slight shift to higher concentrations in the small size fraction is evident for almost all elements. This is likely due to the larger particle size containing more organic material which contributes to the mass without increasing the metal concentration. The elements that appeared to be log normally distributed were calcium, strontium and possible magnesium. These are the metals that would be part of concrete aggregate suggesting an uneven distribution of this material in the soil samples collected across the site with some higher concentrations probably due to the concrete

Correlation matrix of the elemental analyses in the soil samples were calculated to evaluate whether a consistent group of compounds varied together in the soil at the site that could be used as a signature for the aggregate. The soil concentration of calcium, a key component of cement and concrete, was most strongly, positively correlated with magnesium ($r=0.81$) and strontium ($r=0.95$) followed by selenium ($r=0.73$) and titanium ($r=0.43$). The correlations between calcium and magnesium, strontium and titanium were present in the 75-500 μm fraction but not in $<75\mu\text{m}$ fraction, consistent with the cement and concrete being larger particles than soil. The $<75\mu\text{m}$ had the majority of the trace metals (Li, Be, Ti, V, Cr, Mn, Ce, Ni, Cu, Ga, As, Rb, , Cd, Cs, Ba, Tl, Pb and U) significantly correlated suggesting that the soil portion across the samples had a common

source consistent with the samples being taken from general area of the school grounds. These data confirm the observations made from the SEM results suggesting that there was less off-site distribution of the concrete aggregate than the soil component because of the differences in size of the particles. Based upon the above, it would be expected that the concrete aggregate, which contains more of a respiratory irritant than the soil, would be deposited close to the site.

Sweep and Dust Samples:

A summary of the SEM characterization of ten sweep samples are given in Table 4a and b. Detailed analyses of the results are provided in Appendix B. Only the sweep samples were analyzed by SEM as there was insufficient material from the wipe dust samples for that type of analysis. The samples were prepared in the same manner as the soil samples. The particle size distribution across the samples is 24% of particles $>300\mu\text{m}$, 28% in the range $75\text{-}300\mu\text{m}$ and 49% $<75\mu\text{m}$, which is shift to smaller particle sizes than observed for the soil consistent with these samples collected from window sill requiring that they be wind blown. The most abundant components of the sweep samples were granular soil minerals and plant fragments. Some samples did contain brick dust and fragments of building materials which could have come from the construction site or from the exterior of the homes themselves from which they were collected. As was the case for the soil samples collected from the school construction site, no Portland cement particles were identified but particles containing carbonate were present. The SEM of soil particles identified calcium particles or calcium coated particles in those samples containing carbonate, suggesting the presence of calcium carbonate, along with metal flakes and fragments. Besides iron, the elements of copper, zinc, lead, tin, chromium and nickel

were identified in some particles but not in high quantities. These analyses indicate that while there was a spread of some cement from the site it did not dominate the gross mineralogy of the material in the neighborhood.

The metal concentration of the sweep samples (overall summary statistics in Table 5) were analyzed to evaluate whether their spatial concentration from the construction site would show a clear trend with distance from the construction site that could indicate which homes and residents were most impacted by the dust generated during the construction (Table 6 and Figures 3a to j). The homes were grouped by which block they were on and how close to the site they were to determine an average concentration for the sweep and wipe samples collected. The groupings were: 1) Evans Avenue opposite the construction area, 2) Evans Avenue away from the construction towards Martin Luther King Blvd; 3) Southard Street opposite the construction area; 4) Southard Street away from the construction towards Martin Luther King Blvd; 5) On Martin Luther King Blvd opposite MLK School; 6) on Race Street; 7) on Burton Avenue, and 8) on Martin Luther King Blvd one block away from the school; and 9) on Brunswick Avenue. If dust was transported off the site then the signature of the elements associated with cement and concrete (such as Calcium, Magnesium, and Strontium) or associated with soil (Manganese and Aluminum) should be observable in the dust sweep samples collected from the outside of homes nearest the site. In addition, trace metals that did not have sources near the homes but might vary by soil composition should show a similar pattern across the sites and in the soil. Nickel, titanium, cobalt and copper were used as target trace metals as there were measurable in the majority of the samples and should some

variability in concentration. These distributions are compared to lead, which was a health concern to the community.

The mean metal concentrations for the sweep samples from the homes located in the nine groupings identified in the previous paragraph are given in Table 6, Figure 3 a to j which are maps showing the spatial variations and Figures 4 a to n are box and whisker plots of the data. These figures are used to determine if there appears to be a spatial pattern that can be used to statistically evaluate whether mean differences of homes closer to the site might be different than homes more distant. The compounds which appear to show similar concentrations in the average concentrations at the four grouping on the blocks adjacent to the site but different concentration in the home groups more distant include: magnesium, strontium, calcium, nickel, cobalt and copper. These metals may be markers of the wind blown soil from the site, but the variability in their concentration for different soils and cement could introduce different levels in the soil blown off site at different time periods during the construction since the fill and aggregates were not from one unique source. Therefore, no single metal may serve as a marker and the metal concentrations measured in the soil samples collected near the top of the fill may not match the metal concentrations in the sweep samples collected near the homes which would have been deposited over time and include contributions from other sections of the fill. The metals that appeared to have similar concentrations in the groupings near the site, but whose concentrations more distance included the range observed near the site include: manganese and aluminum.

One metal of particular interest because of its toxicity and that was present in the fill is lead. However, lead showed no consistency in concentration in the samples collected from the outside the homes either spatially or within the any group, as evident by the standard deviation for all but one group being larger than the mean value. The levels measured around the residences are generally higher than the levels in the soil or concrete aggregate samples on site. That, combined with the high variability suggests highly localized sources around many of the residence, most likely from old exterior leaded paint on the windows. There may also be some contribution from soil previously contaminated with leaded gasoline. This is common for an area containing pre-World War II homes of the age of this community. Thus, the transport of soil and dust from the site during construction was not a major source of lead to the community.

However, the range of manganese and aluminum concentration at the more distant sites encompassed the values near the site so that these metals could not be used to determine the extent that transport of wind blown materials from the site, but the pattern is consistent with the spatial distribution suggested by other metals. In particular the manganese concentration in the soil was higher than all of sweep sample concentrations while the reverse was observed for the aluminum. Thus, for the soil components the variable contribution from soil around the residents support a single source for the homes nearest the site but cannot be used to estimate the extent that the material was transported and still would be present.

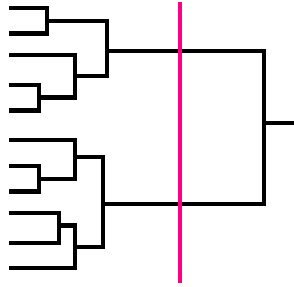
To determine if the suggested trends observed in the figures showed statistical differences in metal concentration with distance from the site, the sweep samples were grouped into

three near categories reflecting what appeared to be the spatial pattern. The samples collected on Evans Avenue and Southard Street were placed in one category as the locations closest to the site, the samples collected on Race Street were placed in a second category and those collected at all other sites were placed in a third category as being furthest from the site. After the concentration data were log transformed to produce a normal distribution, One Way Analysis of Variance (ANOVA) were run to see if the mean concentrations of the metal were statistically different (Table 7) and post-hoc tests were run (both Student-Newman-Keuls and Tukey-b for unequal size samples) to evaluate which categories of metal that were identified as having statistically different means were different (Table 7 b – only SNK are presented as both post-hoc test gave identical results). The following metals were identified as having statistical differences among sites at significance of 0.05: lithium, magnesium, titanium, vanadium, chromium, manganese, nickel, arsenic, cadmium, barium, lead, aluminum and calcium. For the majority of the metals, the post-hoc tests identified either all three grouping as different or the most distant sites different from the samples collected from Evans Avenue, and Southard Street, except of chromium and cadmium. For some metals, the metal concentrations in the sweep samples from Race Street differed more from those collected at Evans Avenue and Southard Street than the most distance sample. These included copper and bismuth, suggesting some very localized sources for these compound.

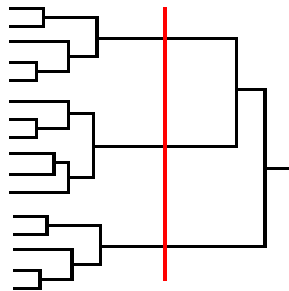
To further determine if metal concentrations in the sweep samples could be used to classify individual home into grouping that suggested an impact from the soil from the site a Hierarchal Clustering was done using the metals that showed differences across the three categories. Cluster analysis classifies a set of observations into two or more groups

by searching for similarities among measurements or variables for each observation. The purpose of cluster analysis is to identify a way to organize the observations into groups that were not predetermined based on shared common properties of the measurements. The key in using cluster analysis is to provide sufficient information that allows classification into useful groups. For the sweep samples, each house is considered an observation and the metal concentrations the measurements used to determine the groupings. If the soil from the construction site was deposited primarily at homes near the site but not at more distant sites then the sweep samples from homes near the school construction site will be placed into one group and homes more distance in different groups, dependant upon what the sources of the metals to those samples were. Hierarchical clustering uses a step wise approach by dividing the objects into groups, successively subdividing the groups and presents the results in a two dimensional diagram, known as a dendrogram or binary tree showing the division of each cluster. The observations or homes in the dedogram are represented as nodes and the branches illustrate when different subgroups join each other to form larger groups. The ordering of the observations indicates how the group is formed, with adjacent observations being classified as more similar than more distant ones. The length of the branch between observations or groups indicates how similar (shorter branch) or different (longer) observations or groups are to one another.

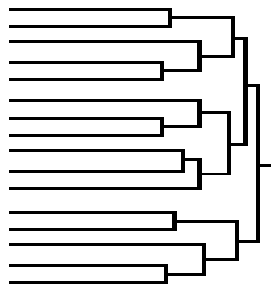
Examples of dendograms are given below. The following example dendogram illustrates ideal separation of two groups.



The following dendrogram ideally illustrates a clear grouping into three groups.



Whereas dendrograms that have long branches, such as the one below, suggest that the cluster analysis was not effective in grouping the observations and any association among the observations should be viewed with caution.



The dendrogram from the cluster analysis for the sweep samples using the metals that had differences in the ANOVA analysis with distance from the site (Li Mg Ti V Cr Mn Ni As

Cd Ba Al and Ca) is given in figure 5, Even though lead also had difference from the ANOVA analysis, it was excluded due to the lead contribution from outdoor paint which was not expected to be related to construction soil and could dominate the lead concentrations in sweep samples at individual houses. The Location Group number (1-9) assigned by location are given in two columns next to sample number. The right column contains the group closest to the site (1 and 2 being on Evans Avenue, 3 and 4 on Southard Street and 6 on Race Street) while the left column the groups further from the site (5 and 9 on MLK Blvd, 8 on Brunswick Ave and 7 near Burton Avenue). A major cluster of 32 homes are grouped at the top of the dendrogram. Of these 32 homes, 26 are in the near group. Two of the homes on MLK Blvd were on the corner of MLK Blvd and Evans Avenue so are adjacent to the homes in group 2. Two other homes were next door to each other, though several blocks away. The samples towards the bottom of the dendrogram were not grouped closely together suggesting that they had more contributions from local source, such as material from around individual homes. Thus, the cluster analyses grouped a large number of samples collected from homes closest to the site together, consistent with a common source for the sweep dust collected there. The homes in that cluster were, with three exceptions within one block of the site.

Overall, there is a strong suggestion that the sweep samples collected from the outside of the homes nearest the construction site was influenced by the activities that occurred there due to the similarities of the composition in those samples. The differences observed with the concentrations measured in the soil samples collected at the site could be a function of the soil being collected by digging to 10 to 20 centimeters down to be below the top soil that had been placed on the site to act to suppress soil transport, while

the materials blown off the site included not only the new material but other soil and concrete aggregate that had been placed much deeper into the ground during construction.

A similar evaluation was made of the wipe dust samples collected from inside homes and unoccupied school classrooms in both Thomas Jefferson School and Martin Luther King School (Figures 6 a to j). No consistent trend is observed for any of the metal examined. Thus, there is no clear signal that material blown from the site was present in the neighboring homes or schools. Since the samples in the homes and schools were collected from areas that had not been disturbed in the recent past, it should have contained material that penetrated into the structures. It is possible that the concentration could be different in the home/school if they had different dust settling rates, but an evaluation of the ratios of the metals also did not reveal any consistent pattern.

Soil that might be expected to be at higher concentrations near the site, if large amounts of soil were transported off-site, should have a smaller gradient than the elements associated with cement since soil has more sources and the ratio of the elements from cement to signature soil elements would also be expected to be higher near the sources. The highest concentration of elements expected to be prevalent in cement was not found to be higher near the construction area, suggesting that any impact the construction activities had on the nearby residents did not have a long term impact the material present around the homes. Thus, no clear assignment of exposure to dust could be made due to deposition of soil/cement aggregate that was mobilized by the construction activities.

Air Samples during Demolition:

Air samples collected during the demolition of the super-structure were analyzed for total mass Table 8. The total mass levels were well below NIOSH standards for nuisance dust. The values also did not exceed the 24 hr annual average PM10 standard of $150 \mu\text{g}/\text{m}^3$. Thus, the dust suppression techniques put in place limited the amount of dust that was being generated and are not expected to present an inhalation exposure hazard to the surrounding community. A subset of the collected samples was also analyzed for trace metal concentrations with no metal above a value of $1 \mu\text{g}/\text{m}^3$ (Table 9). The only trace metal that has a regulatory environmental air standard is lead, which has a quarterly average value of $1.5 \mu\text{g}/\text{m}^3$.

PAH Analysis of Soil Samples:

The PAH concentrations for the soil samples collected are given in Table 10. The sample numbers refer to the locations where the samples were taken. Samples 1 to 5 were from the east side of the superstructure, 6 and 7 from the north side, 8 to 10 from the west side, 11 to 13 from the south side, 14 to 16 near the fence that separated the site from the Thomas Jefferson School, 17 to 19 the west side of the site, and 20 to 23 the middle and north side of the site (figure 1). Two samples (samples 4 and 5, both near the superstructure construction on the east side) had Benzo(a)anthracene concentrations of 1.2 and 0.99 ppm which slightly above the Residential Direct Contact Cleanup criteria of 0.9ppm but below the Non-Residential Direct Contact Soil Cleanup Criteria of 4ppm (Table 11). None of the other PAH concentrations in any sample exceeded the Residential or Non-Residential Cleanup values. Thus, soil did not appear to source of

concern for PAHs being blown off site and PAHs were not analyzed in any samples collected off site.

Conclusions:

There was evidence that soil and concrete aggregate material spread off the construction site affecting, on average, the levels of dust outside homes within one block of the site, but not inside these homes. Thus, individuals who were outside their homes during the construction would have been exposed to those materials. The lead levels in dust collected inside and outside homes are apparently related to local sources rather than offsite soil or dust transport from the school construction site. The PAH levels were sufficiently low that they are not expected to present an exposure/health risk. During the demolition and removal of the structure sufficient dust suppression steps were taken so that additional exposure to the fill material did not occur.

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Table 1 Description and Location of Soil Samples Collected on Site			
Sample Number	Location	Depth	Soil Color/Location
1	Eastside	7 in.	Light brown-rock increase compared to surface 15 ft from NE corner of building, 5ft. from building wall.
2	Eastside	8 in.	Increase rock and “brick” like stones 120 ft. from NE corner 7ft from foundation
3	Eastside	7-8 in.	Lighter brown- 240 ft from NE corner 7ft from foundation
4	Eastside	7-8 in.	15ft from SE corner 10 ft from building 7in from fence
5	Eastside	3 in.	Very rocky open area of construction
6	Northside	8-9 in.	Light brown-35ft NE corner 10 ft from building foundation
7	Northside	7in.	10ft from NW corner, 10ft from building/foundation
8	Westside	7 in.	Brown-75ft from NW corner 15ft from foundation
9	Westside	7 in.	Rocky but no color change-175 ft from NW corner 15 ft from foundation
10	Westside	7-8 in.	Rocky but no color change-20 ft end of building (on south indentation) 15ft from foundation
11	Southside	3 in.	Rocky and light brown-20 ft SW protrusion, no change in soil
12	Southside	3 in.	Rocky and evidences of brick fill 20 ft from edge of building, 20ft from foundation
13	Southside	1-2 in.	Rocky and light brown soil- Inside South foundation wall
14	Southside	7-8 in.	Deep grey and rocky-Even with South foundation 10ft. from fence by school
15	Southside		Very rocky 20ft from asphalt by NE corner of school
16	Southside	9 in.	Rocky minor color change (gray)-by barrier 30 ft from west fence 40ft from edge of asphalt
17	Southside	3 in.	Rocky some light brown 20 ft from fence Opposite side of finish section
18	Southside	8 in.	Light brown soil-Opposite edge of construction building 20 ft from fence
19	Southside		20 ft from fence by MLK School 20 from west side of barrier
20	Southside	9-10 in.	No visible change in soil- Near sewer cover 15 ft from ground and off trailer
21	Southside	7 in.	Little change in soil- NE corner /(away) 10 ft from fence
22	Southside	3 in.	Light brown all the way through the soil By pipes opposite vertical support beam of building
23	Southside	3 in.	Brown soil- By old steel beams

Table 2 a
Particle Size Data for 24 Soil Samples from Microscope Analysis

MVA #	Client ID	>300um	75-300	<75um
R1176	1	31%	63%	7%
R1177	2	39%	53%	8%
R1178	3	39%	49%	11%
R1179	4	35%	58%	7%
R1180	5	31%	51%	18%
R1181	6	38%	50%	12%
R1182	7	32%	48%	19%
R1183	8	31%	58%	11%
R1184	9	31%	54%	15%
R1185	10	32%	53%	15%
R1186	11	34%	53%	13%
R1187	12	28%	55%	17%
R1188	13	28%	51%	22%
R1189	14	32%	59%	9%
R1190	15	32%	53%	15%
R1191	16	25%	63%	12%
R1192	17	38%	48%	14%
R1193	18	35%	47%	18%
R1194	19	35%	50%	14%
R1195	20	36%	51%	13%
R1196	21	34%	52%	14%
R1197	22	36%	45%	19%
R1198	23	28%	47%	25%
R1199	Topsoil	33%	52%	15%
	Mean	33%	53%	14%
	Std dev	4%	5%	4%
	Min	25%	45%	7%
	Max	39%	63%	25%

Table 2 b
Descriptive Summary 24 Soil Samples from Microscope Analysis

MVA #	Client ID	PLM Metal flakes/fragments	PLM Coke/Coal	PLM Brick Dust Building materials	PLM Evidence of Carbonate	SEM Metals Found**	SEM Calcium Found***
R1176	1	1-3%	Trace	Not found	Trace	Pb, Cu	No
R1177	2	Trace	2-3%	Not found	Trace	Not found	No
R1178	3	Trace – 1%	1-2%	Not found	Trace	Ni, Cu/Zn	No
R1179	4	Trace – 2%	2-3%	5-10%	Yes	Cu/Zn	Yes
R1180	5	Trace	2-5%	Not found	20-40%	Cu/Zn, Cr/Zn/Pb	Yes
R1181	6	Not found	1-2%	Not found	Trace	Pb	No
R1182	7	2-3%	Trace – 2%	Not found	Trace	Cu/Zn, Sn	No
R1183	8	Not found	1-5%	Trace	15-25%	Sn	Yes
R1184	9	Trace – 1%	2-5%	Not found	No	Rare Earth, Cu/Zn	No
R1185	10	1-2%	3-6%	Not found	No	Rare Earth	No
R1186	11	Trace – 1%	1-5%	1-3%	10-20%	Cu/Cr	Yes
R1187	12	1-3%	3-5%	Not found	No	Rare Earth	No
R1188	13	Trace – 1%	Not found	Not found	20-30%	Pb, Cr/Ni	Yes
R1189	14	1-2%	1-3%	Not found	10-20%	Cu/Zn, Ba	Yes
R1190	15	Trace	1-3%	Trace – 1%	5-15%	Cu/Zn, Sn, Ni, Pb/Sn	Yes
R1191	16	Trace – 1%	1-2%	Not found	Trace	Pb/Sn	Yes
R1192	17	Not found	1-5%	Trace	Trace-1%	Not found	Yes
R1193	18	Trace	1-5%	Trace	Trace	Rare Earth	Yes
R1194	19	Trace – 1%	1-5%	Trace	No	Rare Earth	No
R1195	20	Trace – 1%	1-5%	Not found	No	Ba	No
R1196	21	Trace – 1%	1-5%	Not found	No	Not found	Yes
R1197	22	Trace - 1%	1-5%	Not found	1-3%	Rare Earth	Yes
R1198	23	Trace	1-5%	1-5%	1-3%	Not found	Yes
R1199	Topsoil	Trace	1-5%	Not found	Trace	Cu/Zn Rare Earth	Yes

*All samples contained granular soil minerals and a fine mixture of clay, mica, quartz and organic debris coating sand grains.

** Other than or in addition to iron (Fe)

*** Either as particles or in aggregates

Table 3
Summary of Metal Concentrations (ppm) in Soil Samples

		Li	Be	Mg	Tl	V	Cr	Mn
Number of Samples		48	48	48	48	48	48	48
Number below MDL		0	0	0	0	0	0	0
Mean		26	1.2	3783	624	53	41	347
Std. Deviation		8	0.5	1684	222	15	21	102
Range		46	3.3	7536	1114	90	139	454
Minimum		14	0.7	1789	284	29	21	178
Maximum		61	4.0	9325	1397	119	160	632
Percentiles	10	17	0.7	1965	341	35	24	220
	25	20	0.9	2585	473	42	30	271
	50	25	1.1	3305	617	54	39	328
	75	30	1.3	4858	739	59	44	401
	90	33	1.4	5668	900	67	51	510
		Ce	Ni	Cu	Ga	As	Se	Rb
Number of Samples		48	48	45	48	45	9	48
Number below MDL		0	0	3	0	3	39	0
Mean		11	25	151	17	16	1.1	30
Std. Deviation		3	7	92	5	7	0.3	9
Range		17	41	438	30	33	1.0	49
Minimum		6	13	49	10	5	1.0	15
Maximum		23	54	486	40	38	2.0	64
Percentiles	10	7	17	66	12	8	0.8	18
	25	8	19	82	14	11	0.9	24
	50	11	24	122	18	15	1.0	30
	75	12	29	207	20	22	1.3	34
	90	16	35	261	23	26	1.9	40
		Sr	Ag	Cd	In	Cs	Ba	Hg
Number of Samples		48	32	46	0	48	48	1
Number below MDL		0	16	2	48	0	0	47
Mean		104	0.4	0.7		1.7	227	1.1
Std. Deviation		90	0.2	0.2		0.5	65	
Range		375	1.0	1.0		2.3	364	
Minimum		31	0.0	0.0		1.0	132	
Maximum		406	1.0	1.0		3.3	497	
Percentiles	10	39	0.2	0.4		1.1	156	
	25	44	0.3	0.5		1.3	174	
	50	68	0.4	0.7		1.7	228	
	75	140	0.4	0.8		1.9	257	
	90	226	0.7	1.0		2.3	285	
		Tl	Pb	Bi	U	Al	Ca	
Number of Samples		35	48	0	48	48	48	
Number below MDL		13	0	48	0	0	0	
Mean		0.35	326		1.52	32000	18000	
Std. Deviation		0.11	392		0.44	30000	28000	
Range		1.00	2803		2.30	218000	147000	
Minimum		0.00	98		0.90	0	0	
Maximum		1.00	2900		3.20	218000	147000	
Percentiles	10	0.22	151		0.99	14000	2000	
	25	0.28	203		1.19	17000	4000	
	50	0.35	269		1.57	27000	6000	
	75	0.39	318		1.66	36000	21000	
	90	0.45	426		1.98	50	53	

Table 4 a
Particle Size Data for 10 Sweep Dust Samples from Microscope Analysis

MVA #	Client ID	>300um	75-300µm	<75um
S0598	TSDV005	2%	20%	78%
S0599	TSDV011	5%	20%	75%
S0600	TSDV015	34%	12%	54%
S0601	TSDV019	15%	13%	72%
S0602	TSDV023	58%	42%	<1%
S0603	TSDV033	58%	34%	8%
S0604	TSDV034	14%	43%	42%
S0605	TSDV046	8%	24%	68%
S0606	TSDV048	32%	33%	35%
S0607	TSDV029	10%	35%	55%
	Mean	24%	28%	49%
	Std dev	21%	31%	59%
	Min	2%	12%	<1%
	Max	58%	43%	78%

Table 4 b
Descriptive Summary 10 Sweep Dust Samples from Microscope Analysis

MVA #	Client ID	PLM Metal flakes/fragments	PLM Brick Dust Building materials	PLM Evidence of Carbonate	SEM Metals Found*	SEM Calcium Found**
S0598	TSDV005	2-5%	Tr-1%	Tr-1%	Fe, Pb/Cl, PbSn	Yes
S0599	TSDV011	3-7%	Trace	Tr-1	Fe, Fe/Ti	Yes
S0600	TSDV015	1-5%	Not found	1-2%	Pb, Fe, Fe/Ti	Yes
S0601	TSDV019	1-5%	Tr-1	1-3%	Pb, Fe, Sn	Yes
S0602	TSDV023	1-5%	Trace	Trace	Fe, Fe/Ti, W, Pb, Cu/Zn (brass)	No
S0603	TSDV033	1-5%	Not found	5-10%	Fe, Pb, Fe/Ni/Cu/Sn	Yes
S0604	TSDV034	1-5%	5-10%	10-20%	Fe, Ti, Cu/Zn (brass), Fe/Ti	Yes
S0605	TSDV046	1-5%	Tr-1%	1-5%	Fe, Fe/Ti, Zn, Pb	Yes
S0606	TSDV048	1-2%	Not found	3-7%	Fe, Pb, Sn, Fe/Ti	Yes
S0607	TSDV029	1-2%	Not found	Trace	Fe, Pb, Fe/Ti	No

* Other than or in addition to iron (Fe)

** Either as particles or in aggregates

Table 5
Summary of Metal Concentrations (ppm) in Sweep Dust Samples

		Li	Be	Mg	Ti	V	Cr	Mn	
N	Valid	50	42	50	50	50	50	50	50
	Missing	0	8	0	0	0	0	0	0
Mean		9	0.3	4335	373	27	60	190	
Std. Deviation		4	0.1	2852	194	14	42	86	
Percentiles	10	5	0.2	1707	158	12	18	91	
	25	7	0.2	2301	258	16	27	122	
	50	9	0.3	3574	334	26	48	180	
	75	12	0.5	5763	457	37	95	259	
	90	16	0.5	7977	604	50	118	304	
		Co	Ni	Cu	Zn	Ga	As	Se	
N	Valid	50	50	50	50	50	50	23	
	Missing	0	0	0	0	0	0	27	
Mean		10	29	127	1729	31	6	0.32	
Std. Deviation		15	19	130	2812	55	3	0.17	
Percentiles	10	3	11	38	185	5	2	0.12	
	25	5	15	58	401	7	3	0.15	
	50	7	27	96	700	11	5	0.32	
	75	11	37	143	1358	24	8	0.37	
	90	17	51	239	7666	111	11	0.63	
		Rb	Sr	Ag	Cd	In	Cs	Ba	
N	Valid	50	50	45	49	18	47	50	
	Missing	0	0	5	1	32	3	0	
Mean		10	72	0.6	11	0.24	0.7	819	
Std. Deviation		5	49	0.6	34	0.37	0.3	1526	
Percentiles	10	4	30	0.2	1	0.07	0.4	89	
	25	7	39	0.3	2	0.10	0.4	152	
	50	9	63	0.4	4	0.12	0.7	224	
	75	13	94	0.7	7	0.25	1.0	701	
	90	18	114	1.0	17	0.47	1.2	3396	
		Hg	Tl	Pb	Bi	U	Al	Ca	
N	Valid	40	19	50	48	48	48	48	
	Missing	10	31	0	2	2	2	2	
Mean		2	0.16	3488	1.3	0.6	60401	102298	
Std. Deviation		4	0.11	9267	2.4	0.2	38835	87677	
Percentiles	10	0	0.10	119	0.3	0.3	30286	34345	
	25	0	0.11	221	0.4	0.4	37449	57138	
	50	0	0.15	395	0.6	0.6	48390	80440	
	75	1	0.17	2194	1.1	0.8	72344	114576	
	90	8	0.24	7717	2.6	1.0	96024	173525	

Table 6
Mean and Median By Location Chosen for Proximity to Construction Site.

Location		Mg	Cr	Mn	Ni	Cd	Pb	Al
Evans Street nearest Site	Mean	3.7	42.2	0.18	25.8	4.6	3.5	62.7
	N	10	10	10	10	10	10	10
	Std. Dev.	1.2	24.8	0.06	10.6	5.4	8.0	36.3
	Median	3.7	35.3	0.18	23.7	2.2	0.2	50.2
Evans Street Down Block	Mean	8.3	55.4	0.23	32.3	3.0	1.9	58.4
	N	4	4	4	4	4	4	4
	Std. Dev.	5.9	36.5	0.09	17.9	1.9	2.3	26.9
	Median	6.6	56.0	0.25	34.1	3.4	1.3	54.6
Southard St Near Site	Mean	3.0	43.0	0.19	24.9	2.6	1.2	41.3
	N	7	7	7	7	7	7	7
	Std. Dev.	2.0	28.4	0.08	17.0	2.0	2.3	12.4
	Median	2.5	30.7	0.17	17.1	2.5	0.3	38.7
Southard St Down Block	Mean	4.0	57.0	0.21	24.4	3.2	0.4	52.6
	N	4	4	4	4	4	4	4
	Std. Dev.	1.4	20.7	0.07	9.9	2.0	0.1	13.9
	Median	4.5	64.4	0.23	28.4	2.9	0.4	52.9
Race Street	Mean	4.4	63.4	0.21	46.9	48.2	1.2	107.5
	N	6	6	6	6	6	6	5
	Std. Dev.	2.5	27.7	0.10	38.2	92.0	1.3	74.7
	Median	4.2	58.8	0.22	35.2	7.9	0.6	84.8
MLK Blvd Across School	Mean	2.3	56.0	0.11	15.9	6.2	1.5	40.1
	N	8	8	8	8	8	8	8
	Std. Dev.	0.9	63.6	0.06	10.4	7.0	2.6	24.7
	Median	2.1	30.4	0.10	13.3	3.9	0.2	41.7
Burton Ave	Mean	6.4	89.3	0.19	29.8	13.2	17.4	48.0
	N	5	5	5	5	5	5	4
	Std. Dev.	3.2	49.7	0.08	8.9	17.6	24.3	15.5
	Median	6.1	119.0	0.22	31.5	7.1	3.4	51.3
Brunswick Ave	Mean	2.0	23.5	0.10	13.7	1.1	0.5	73.1
	N	1	1	1	1	1	1	1
	Std. Dev.	.	.	.	.	.	.	.
	Median	2.0	23.5	0.10	13.7	1.1	0.5	73.1
MLK Blvd Away from School	Mean	6.2	109.2	0.29	44.9	5.7	3.1	83.1
	N	5	5	5	5	5	5	5
	Std. Dev.	2.0	37.5	0.11	15.8	3.1	3.4	43.2
	Median	6.9	112.0	0.30	49.2	5.1	1.2	75.6
All Data Together	Mean	4.3	60.3	0.19	29.1	10.5	3.5	60.4
	N	50	50	50	50	50	50	48
	Std. Dev.	2.9	42.0	0.09	19.4	33.3	9.3	38.8
	Median	3.6	48.2	0.18	26.6	3.5	0.4	48.4

Table 7a One-Way ANOVA of Log Transformed Concentrations in Sweep Samples						
		Sum of Squares	df	Mean Square	F	Sig.
InLi	Between Groups	3.826	2	1.913	7.015	.002
	Within Groups	12.818	47	.273		
	Total	16.644	49			
InMg	Between Groups	3.410	2	1.705	5.726	.006
	Within Groups	13.994	47	.298		
	Total	17.404	49			
InTi	Between Groups	2.301	2	1.150	4.753	.013
	Within Groups	11.375	47	.242		
	Total	13.676	49			
InV	Between Groups	7.078	2	3.539	11.396	.000
	Within Groups	14.596	47	.311		
	Total	21.675	49			
InCr	Between Groups	4.181	2	2.091	4.446	.017
	Within Groups	22.099	47	.470		
	Total	26.280	49			
InMn	Between Groups	4.064	2	2.032	6.734	.003
	Within Groups	14.183	47	.302		
	Total	18.247	49			
InCo	Between Groups	1.736	2	.868	1.254	.295
	Within Groups	32.530	47	.692		
	Total	34.266	49			
InNi	Between Groups	4.665	2	2.332	8.594	.001
	Within Groups	12.756	47	.271		
	Total	17.421	49			
InCu	Between Groups	2.717	2	1.359	2.135	.130
	Within Groups	29.905	47	.636		
	Total	32.622	49			
InGa	Between Groups	7.537	2	3.769	3.138	.053
	Within Groups	56.447	47	1.201		
	Total	63.984	49			
InAs	Between Groups	6.930	2	3.465	9.942	.000
	Within Groups	16.380	47	.349		
	Total	23.310	49			
InSr	Between Groups	1.946	2	.973	2.804	.071
	Within Groups	16.314	47	.347		
	Total	18.261	49			
InCd	Between Groups	13.821	2	6.911	5.670	.006
	Within Groups	57.285	47	1.219		
	Total	71.107	49			

Table 7a Continued One-Way ANOVA of Log Transformed Concentrations in Sweep Samples						
		Sum of Squares	df	Mean Square	F	Sig.
lnBa	Between Groups	9.428	2	4.714	3.244	.048
	Within Groups	68.301	47	1.453		
	Total	77.729	49			
lnPb	Between Groups	20.958	2	10.479	4.277	.020
	Within Groups	115.144	47	2.450		
	Total	136.102	49			
LnAl	Between Groups	3.340	2	1.670	5.795	.006
	Within Groups	12.966	45	.288		
	Total	16.305	47			
LnCa	Between Groups	2.981	2	1.491	3.687	.033
	Within Groups	18.192	45	.404		
	Total	21.173	47			

Table 7b
Post-Hoc Tests of Metals that were Statistically Different in the ANOVA Analyses

InLi				
	NearFar	N	Subset for alpha = .05	
		1	2	1
Student-Newman-Keuls(a,b)	3.00	8	1.4729	
	1.00	25		2.1941
	2.00	17		2.2644
	Sig.		1.000	.729
InMg				
	NearFar	N	Subset for alpha = .05	
		1	2	1
Student-Newman-Keuls(a,b)	3.00	8	7.6619	
	1.00	25		8.1943
	2.00	17		8.4536
	Sig.		1.000	.225
InTi				
	NearFar	N	Subset for alpha = .05	
		1	2	1
Student-Newman-Keuls(a,b)	3.00	8	5.4159	
	1.00	25	5.7433	5.7433
	2.00	17		6.0476
	Sig.		.092	.116
InV				
	NearFar	N	Subset for alpha = .05	
		1	2	1
Student-Newman-Keuls(a,b)	3.00	8	2.3137	
	1.00	25		3.2149
	2.00	17		3.4347
	Sig.		1.000	.313
InCr				
	NearFar	N	Subset for alpha = .05	
		1	2	1
Student-Newman-Keuls(a,b)	3.00	8	3.5087	
	1.00	25	3.6993	
	2.00	17		4.2473
	Sig.		.476	1.000
InMn				
	NearFar	N	Subset for alpha = .05	
		1	2	1
Student-Newman-Keuls(a,b)	3.00	8	4.4686	
	1.00	25		5.2092
	2.00	17		5.2865
	Sig.		1.000	.717

Table 7b (continued)
Post-Hoc Tests of Metals that were Statistically Different in the ANOVA Analyses

InCo				
	NearFar	N	Subset for alpha = .05	
		1	1	
Student-Newman-Keuls(a,b)	3.00	8	1.7892	
	1.00	25	1.8165	
	2.00	17	2.2027	
	Sig.		.410	
InNi				
	NearFar	N	Subset for alpha = .05	
		1	2	1
Student-Newman-Keuls(a,b)	3.00	8	2.6064	
	1.00	25		3.1582
	2.00	17		3.5257
	Sig.		1.000	.074
InCu				
	NearFar	N	Subset for alpha = .05	
		1	1	
Student-Newman-Keuls(a,b)	1.00	25	4.3219	
	3.00	8	4.5253	
	2.00	17	4.8400	
	Sig.		.223	
InGa				
	NearFar	N	Subset for alpha = .05	
		1	1	
Student-Newman-Keuls(a,b)	1.00	25	2.3277	
	3.00	8	2.3682	
	2.00	17	3.1566	
	Sig.		.134	
InAs				
	NearFar	N	Subset for alpha = .05	
		1	2	1
Student-Newman-Keuls(a,b)	3.00	8	.8210	
	1.00	25		1.5968
	2.00	17		1.9496
	Sig.		1.000	.128

Table 7b (continued)
Post-Hoc Tests of Metals that were Statistically Different in the ANOVA Analyses

Post Hoc Tests of Metals that Were Statistically Different in the ANOVA Analysis

InSr				
	NearFar	N	Subset for alpha = .05	
		1	1	
Student-Newman-Keuls(a,b)	3.00	8	3.8728	
	1.00	25	3.9772	
	2.00	17	4.3613	
	Sig.		.091	

InCd				
	NearFar	N	Subset for alpha = .05	
		1	2	1
Student-Newman-Keuls(a,b)	1.00	25	.8282	
	3.00	8	1.3559	1.3559
	2.00	17		1.9960
	Sig.		.222	.140

InBa				
	NearFar	N	Subset for alpha = .05	
		1	1	
Student-Newman-Keuls(a,b)	1.00	25	5.4302	
	3.00	8	5.5213	
	2.00	17	6.3665	
	Sig.		.121	

Means for groups in homogeneous subsets are displayed.

a Uses Harmonic Mean Sample Size = 13.403.

b The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

InPb			
	NearFar	N	Subset for alpha = .05
		1	1
Student-Newman-Keuls(a,b)	3.00	8	6.0158
	1.00	25	6.1276
	2.00	17	7.4647
	Sig.		.053

LnAl			
	NearFar	N	Subset for alpha = .05
		1	2
			1
Student-Newman-Keuls(a,b)	3.00	8	10.3615
	1.00	25	10.8164
	2.00	15	11.1558
	Sig.		1.000
			.115

LnCa			
	NearFar	N	Subset for alpha = .05
		1	1
Student-Newman-Keuls(a,b)	3.00	8	11.1063
	1.00	25	11.1415
	2.00	15	11.6699
	Sig.		.073

Table 8 Mass Concentration in Ambient Air during Demolition of Superstructure				
Collection Date	Site ID *	Comments	Mass collected (g)	Mass Air Concentration ($\mu\text{g}/\text{m}^3$)
8/11/2006	7		0.0236	41.8
8/11/2006	8		0.0246	45.3
8/12/2006	7		0.033	58.5
8/12/2006	8		0.0406	68.3
8/22/2006	7		0.0391	69.3
8/22/2006	8		0.0166	32.0
8/24/2006	7	rained 3 previous days	0.0313	55.8
8/24/2006	8	rained	0.0335	61.7
8/28/2006	7		0.0125	22.4
8/28/2006	8		0.0102	18.8
9/1/2006	7	pump failure		
9/1/2006	8	pump failure		
9/6/2006	7		0.0136	25.5
9/6/2006	8	pump failure		
9/12/2006	7		0.0191	33.8
9/12/2006	8		0.0203	36.0
9/13/2006	7	Rainy all day	0.0024	4.3
9/13/2006	8	Rainy all day	0.0062	10.9
9/15/2006	7		0.0182	32.2
9/15/2006	8		0.0228	42.0
9/21/2006	7		0.0272	48.2
9/21/2006	8		0.0275	51.2
9/24/2006	7		0.0285	49.9
9/24/2006	8	pump failure		
9/28/2006	7		0.0072	12.9
9/28/2006	8		0.0074	13.6
9/29/2006	7		0.0207	37.7
9/29/2006	8		0.0245	44.7
10/4/2007	7		0.0099	18.3
10/4/2007	8		0.0059	10.9
10/12/2006	7		0.0072	13.0
10/12/2006	8		0.0089	17.2
10/15/2007	7		0.0113	20.8
10/15/2007	8		0.0109	21.3
10/19/2006	7		0.0111	20.9
10/19/2006	8		0.0132	24.7
10/22/2006	7	invalid sample		
10/22/2006	8		0.0287	28.9
10/26/2006	7		0.0359	68.7
10/26/2006	8		0.0233	45.5
10/29/2006	7		0.0206	37.2

Table 8 (continued) Mass Concentration in Ambient Air during Demolition of Superstructure				
Collection Date	Site ID *	Comments	Mass collected (g)	Not Blank Corrected Air Conc ($\mu\text{g}/\text{m}^3$)
10/29/2006	8		0.0367	72.4
11/5/2006	7		0.077	148.5
11/5/2006	8		0.0063	11.8
1/21/2007	7		0.0138	25.1
1/21/2007	8		0.0223	40.8
1/24/2007	7		0.019	35.3
2/11/2007	8		0.0167	15.6
2/16/2007	7		0.0158	28.9
2/16/2007	8		0.0038	7.0
2/20/2007	7		0.0212	39.1
2/20/2007	8		0.0134	23.9
2/23/2007	7		0.0104	19.7
2/23/2007	8		0.0156	27.7
2/28/2007	7		0.0081	15.2
2/28/2007	8		0.0032	5.6
3/3/2007	7		0.0149	27.8
3/3/2007	8		0.0042	7.5
3/8/2007	7		0.0149	27.6
3/8/2007	8		0.0199	38.0
3/12/2007	7		0.0184	34.1
3/12/2007	8	pump failure		
3/13/2007	7		0.0353	65.9
3/13/2007	8		0.0358	66.2
3/18/2007	7		0.0105	19.4
3/18/2007	8		0.0443	40.6
3/22/2007	7		0.0199	34.6
3/22/2007	8		0.0248	45.9

*Site ID 7 on Evans St, Site 8 on Southard St

Table 9
Trace Metal Air Concentration (ng/m³) During Super Structure Demolition

Date	Sampler	Li	Mg	Ti	V	Cr	Mn	Fe	Ce	Ni	Cu
8/11/2006	7	0.04	15	1.08	<0.11	0.74	1.07	<40	<0.04	0.53	10.13
8/11/2006	8	<0.04	12	1.54	<0.11	0.39	0.75	<40	<0.04	0.30	43.79
8/12/2006	7	0.04	28	2.22	0.54	0.63	2.75	95	0.05	0.62	7.22
8/12/2006	8	<0.03	18	0.54	0.27	0.46	1.35	<40	<0.03	0.31	6.40
8/24/2006	7	<0.04	21	2.17	0.59	0.72	1.36	60	<0.04	0.52	4.33
8/24/2006	8	0.05	22	2.27	0.61	0.72	1.76	69	0.04	0.62	13.50
9/12/2006	7	<0.04	36	1.97	0.24	0.49	1.73	81	<0.04	0.36	4.99
9/12/2006	8	0.06	44	1.62	0.31	0.79	2.11	73	0.04	0.55	10.46
9/15/2006	7	<0.04	20	1.83	0.23	0.62	2.15	73	0.05	0.29	4.14
9/15/2006	8	0.04	22	1.77	0.28	0.66	2.71	105	0.05	0.33	9.50
9/21/2006	7	0.07	36	1.88	0.28	0.69	2.42	74	0.06	0.41	4.18
9/21/2006	8	0.08	36	2.83	0.31	0.81	2.75	117	0.06	0.49	7.24
9/28/2006	7	<0.04	<11	0.29	<0.11	0.31	0.53	<40	<0.04	0.16	1.99
9/28/2006	8	<0.04	<11	0.60	<0.11	0.35	0.49	<40	<0.04	0.30	3.42
9/29/2006	8	0.04	22	2.53	0.77	0.65	1.86	83	0.04	0.41	7.23
10/12/2006	7	<0.04	<11	0.48	<0.11	0.29	0.37	<40	<0.04	0.12	2.41
10/12/2006	8	<0.04	<12	0.35	<0.12	0.26	0.37	<40	<0.04	0.12	2.64
10/29/2006	7	<0.04	<11	0.42	<0.11	0.33	0.53	<40	<0.04	0.28	3.37
10/4/2007	7	<0.04	<11	0.65	0.13	0.48	0.36	<40	<0.04	0.26	5.49
10/4/2007	8	<0.04	<11	0.65	0.17	0.46	0.41	<40	<0.04	0.28	7.67
10/15/2007	7	<0.04	17	0.93	<0.11	0.39	0.52	<40	<0.04	0.18	4.55
10/15/2007	8	<0.04	18	0.66	<0.12	0.43	0.68	<40	<0.04	0.22	4.18

Date	Sampler	Zn	Ga	As	Se	Sr	Cd	Ba	Pb	Bi
8/11/2006	7	<10	<0.04	<0.11	<0.11	0.25	<0.04	0.89	1.49	0.04
8/11/2006	8	<11	0.07	<0.11	<0.11	0.31	<0.04	2.05	0.83	0.04
8/12/2006	7	73	0.11	0.12	0.11	0.47	0.06	2.76	1.60	0.04
8/12/2006	8	<10	<0.03	<0.1	<0.1	<0.17	0.04	0.77	0.79	<0.03
8/24/2006	7	<11	0.07	0.11	0.46	0.37	<0.04	1.90	0.82	<0.04
8/24/2006	8	<11	0.12	0.20	0.56	0.51	<0.04	3.43	1.28	0.08
9/12/2006	7	<12	0.09	<0.12	<0.12	0.57	<0.04	2.47	0.98	0.04
9/12/2006	8	<11	0.15	0.11	<0.11	0.81	<0.04	4.00	1.42	0.05
9/15/2006	7	<12	0.12	0.20	<0.12	0.53	0.04	3.26	1.40	0.14
9/15/2006	8	<11	0.22	0.29	0.11	0.65	0.06	5.94	2.01	0.19
9/21/2006	7	<11	0.10	<0.11	<0.11	0.63	0.04	2.47	2.08	0.11
9/21/2006	8	<11	0.19	<0.11	0.19	1.05	0.04	4.78	2.77	0.15
9/28/2006	7	<11	<0.04	<0.11	<0.11	<0.18	<0.04	0.58	0.39	0.06
9/28/2006	8	<11	0.04	<0.11	<0.11	<0.19	<0.04	1.34	0.39	0.04
9/29/2006	8	<11	0.16	0.19	0.31	0.46	0.05	4.33	1.78	0.04
10/12/2006	7	<11	<0.04	<0.11	<0.11	<0.18	<0.04	0.67	0.26	0.04
10/12/2006	8	<12	<0.04	<0.12	<0.12	<0.19	<0.04	0.78	0.23	<0.04
10/29/2006	7	<11	<0.04	<0.11	0.13	<0.18	<0.04	0.92	0.59	<0.04
10/4/2007	7	<11	0.04	<0.11	<0.11	<0.19	<0.04	1.38	0.50	0.05
10/4/2007	8	<11	0.05	<0.11	<0.11	<0.19	<0.04	1.50	0.63	0.09
10/15/2007	7	<11	0.05	<0.11	<0.11	0.19	<0.04	1.43	0.73	0.05
10/15/2007	8	<12	0.07	<0.12	<0.12	0.72	<0.04	1.96	0.95	0.07

Metals below detection (MDL) were: Be (<0.04), Al (<110), Rb (<0.11), Hg (<0.04), In (<0.04), Cs(<0.04)

Table 10
PAH Concentration (ppm) in Soil Samples Collected On MLK-Jefferson Schools Construction Site

	<75um	x			x	x	x			x		x
	75-200um		x	x	x			x	x		x	
Sample ID	1	2	3	4	5	6	7	8	9	10	11	12
Naphthalene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Acenaphthylene	0.08	0.09	0.13	0.15	0.11	0.05	0.07	0.08	0.10	0.08	0.05	N.D.
Acenaphthene	N.D.	N.D.	0.07	0.21	0.09	N.D.	N.D.	0.04	N.D.	N.D.	N.D.	N.D.
Flourene	N.D.	N.D.	0.08	0.07	0.09	N.D.	N.D.	0.06	N.D.	N.D.	N.D.	0.03
Anthracene	0.27	0.49	0.93	1.88	1.21	0.22	0.34	0.59	0.55	0.30	0.33	0.07
Phenanthrene	0.38	0.69	1.32	0.87	1.69	0.31	0.48	0.83	0.78	0.40	0.47	0.09
Fluranthene	0.48	0.78	1.34	2.71	2.44	0.39	0.69	1.05	0.79	0.51	0.50	0.26
Pyrene	0.42	0.61	1.02	2.50	1.76	0.34	0.54	0.77	0.62	0.43	0.39	0.22
Benzo(a) anthracene	0.25	0.38	0.57	1.23	0.99	0.17	0.34	0.48	0.38	0.24	0.25	0.10
Chrysene	0.20	0.31	0.46	0.96	0.78	0.16	0.28	0.35	0.31	0.21	0.21	N.D.
Benzo(b)fluranthene	N.D.	0.32	0.48	0.46	0.87	N.D.	0.21	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(k)fluranthene	N.D.	0.17	0.06	0.65	0.44	N.D.	0.07	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo(a)pyrene	N.D.	0.21	0.32	0.81	0.53	N.D.	0.16	0.12	N.D.	0.12	N.D.	N.D.
Indeno(1,2,3-c,d)Pyrene	N.D.	N.D.	0.10	0.19	0.18	N.D.	N.D.	N.D.	N.D.	N.D.	0.03	N.D.
Dibenz[a,h]anthracene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Benzo[g,h,i]perylene	N.D.	N.D.	N.D.	0.12	0.15	N.D.	N.D.	N.D.	N.D.	N.D.	0.03	N.D.
Benzo[g,h,i]perylene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

	<75um		x	x	x		x	x			x	
	75-200um	x	x			x			x	x		
Sample ID	13	14	15	16	17	18	19	20	21	22	23	MDL
Naphthalene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.25
Acenaphthylene	N.D.	N.D.	N.D.	N.D.	0.03	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.08
Acenaphthene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.08
Flourene	N.D.	N.D.	N.D.	N.D.	N.D.	0.03	N.D.	N.D.	0.03	N.D.	N.D.	0.05
Anthracene	0.24	0.17	0.21	0.13	0.11	0.10	0.12	0.04	0.18	0.11	0.18	0.10
Phenanthrene	0.34	0.23	0.28	0.18	0.16	0.14	0.17	0.06	0.26	0.15	0.24	0.08
Fluranthene	0.83	0.50	0.55	0.28	0.24	0.17	0.25	0.13	0.39	0.18	0.34	0.10
Pyrene	0.67	0.46	0.52	0.25	0.22	0.15	0.23	0.13	0.33	0.18	0.32	0.10
Benzo(a) anthracene	0.45	0.35	0.41	0.01	0.20	0.13	0.18	N.D.	0.30	0.08	0.32	0.08
Chrysene	0.39	0.29	0.41	0.16	0.18	0.12	0.19	N.D.	0.25	N.D.	0.26	0.13
Benzo(b)fluranthene	0.29	N.D.	0.08	0.14	0.11	N.D.	N.D.	N.D.	N.D.	N.D.	0.15	0.10
Benzo(k)fluranthene	0.22	N.D.	0.23	0.11	N.D.	0.03	N.D.	N.D.	N.D.	N.D.	N.D.	0.10
Benzo(a)pyrene	0.25	0.22	0.29	0.15	0.07	N.D.	N.D.	N.D.	N.D.	N.D.	0.03	0.13
Indeno(1,2,3-c,d)Pyrene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.03	N.D.	N.D.	0.10
Dibenz[a,h]anthracene	N.D.	N.D.	N.D.	N.D.	0.03	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.13
Benzo[g,h,i]perylene	0.08	N.D.	N.D.	N.D.	N.D.	N.D.	0.03	N.D.	0.03	N.D.	N.D.	0.10
Benzo[g,h,i]perylene	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.25

N.D. – compound not detected in sample

Table 11
NJ DEP Soil Criteria Cleanup Values

This listing represents the combination of Tables 3-2 and 7-1 from the Department of Environmental Protection and Energy's February 3, 1992 proposed rule entitled Cleanup Standards for Contaminated Sites, N.J.A.C. 7:26D, as corrected based upon errors identified by the Department during or subsequent to the comment period as well as new toxicological or other information obtained since the rule proposal. Please refer to the respective footnotes for more detail. Notwithstanding, where the following criteria are based on human health impacts, the Department shall still consider environmental impacts when establishing site specific cleanup criteria. This along with other site-specific factors including background conditions may result in site specific cleanup criteria which differ from the criteria listed below. Therefore, this list shall not be assumed to represent approval by the Department of any remedial action or to represent the Department's opinion that a site requires remediation.

Contaminant	CASRN	Residential Direct Contact Soil Cleanup Criteria (a) (b) (RDCSCC)	Non- Residential Direct Contact Soil Cleanup Criteria (a) (b) (NRDCSCC)	Impact to Ground water Soil Cleanup Criteria (b) (IGWSCC)
Acenaphthene	83-32-9	3400	10000(c)	100
Anthracene	120-12-7	10000(c)	10000(c)	100
Benzo(b)fluoranthene	205-99-2	0.9	4	50
Benzo(a)anthracene	56-55-3	0.9	4	500
Benzo(a)pyrene (BaP)	50-32-8	0.66(f)	0.66(f)	100
Benzo(k)fluoranthene	207-08-9	0.9	4	500
Chrysene	218-01-9	9	40	500
Dibenz(a,h)anthracene	53-70-3	0.66 (f)	0.66 (f)	100
Fluoranthene	206-44-0	2300	10000 (c)	100
Fluorene	86-73-7	2300	10000 (c)	100
Indeno(1,2,3-cd)pyrene	193-39-5	0.9	4	500
Naphthalene	91-20-3	230	4200	100
Pyrene	129-00-0	1700	10000 (c)	100

Footnotes:

- (a) Criteria are health based using an incidental ingestion exposure pathway except where noted below.
- (b) Criteria are subject to change based on site specific factors (e.g., aquifer classification, soil type, natural background, environmental impacts, etc.).
- (c) Health based criterion exceeds the 10,000 mg/kg maximum for total organic contaminants.
- (d) Health based criterion exceeds the 1000 mg/kg maximum for total volatile organic contaminants.
- (e) Cleanup standard proposal was based on natural background.
- (f) Health based criterion is lower than analytical limits; cleanup criterion based on practical quantitation level.
- (g) Criterion based on the inhalation exposure pathway.
- (h) The impact to ground water values for inorganic constituents will be developed based upon site specific chemical and physical parameters.
- (i) Site specific determination required for SCC for the allergic contact dermatitis exposure pathway.
- (j) Contaminant not regulated for this exposure pathway.
- (k) Criteria based on inhalation exposure pathway, which yielded a more stringent criterion than the incidental ingestion exposure pathway.
- (l) No criterion derived for this contaminant.
- (m) Criterion based on ecological (phytotoxicity) effects.
- (n) Level of the human health based criterion is such that evaluation for potential environmental impacts on a site by site basis is recommended.
- (o) Level of the criterion is such that evaluation for potential acute exposure hazard is recommended.
- (p) Criterion based on the USEPA Integrated Exposure Uptake Biokinetic (IEUBK) model utilizing the default parameters. The concentration is considered to protect 95% of target population (children) at a blood lead level of 10 ug/dl.
- (q) Criteria were derived from a model developed by the Society for Environmental Geochemistry and Health (SEGH) and were designed to be protective for adults in the workplace.
- (r) Insufficient information available to calculate impact to ground water criteria.
- (s) Criterion based on new drinking water standard.

From http://www.state.nj.us/dep/srp/regs/scc/scc_0599.doc October 10, 2007

Figure 1: Location of the soil samples collected from on-site

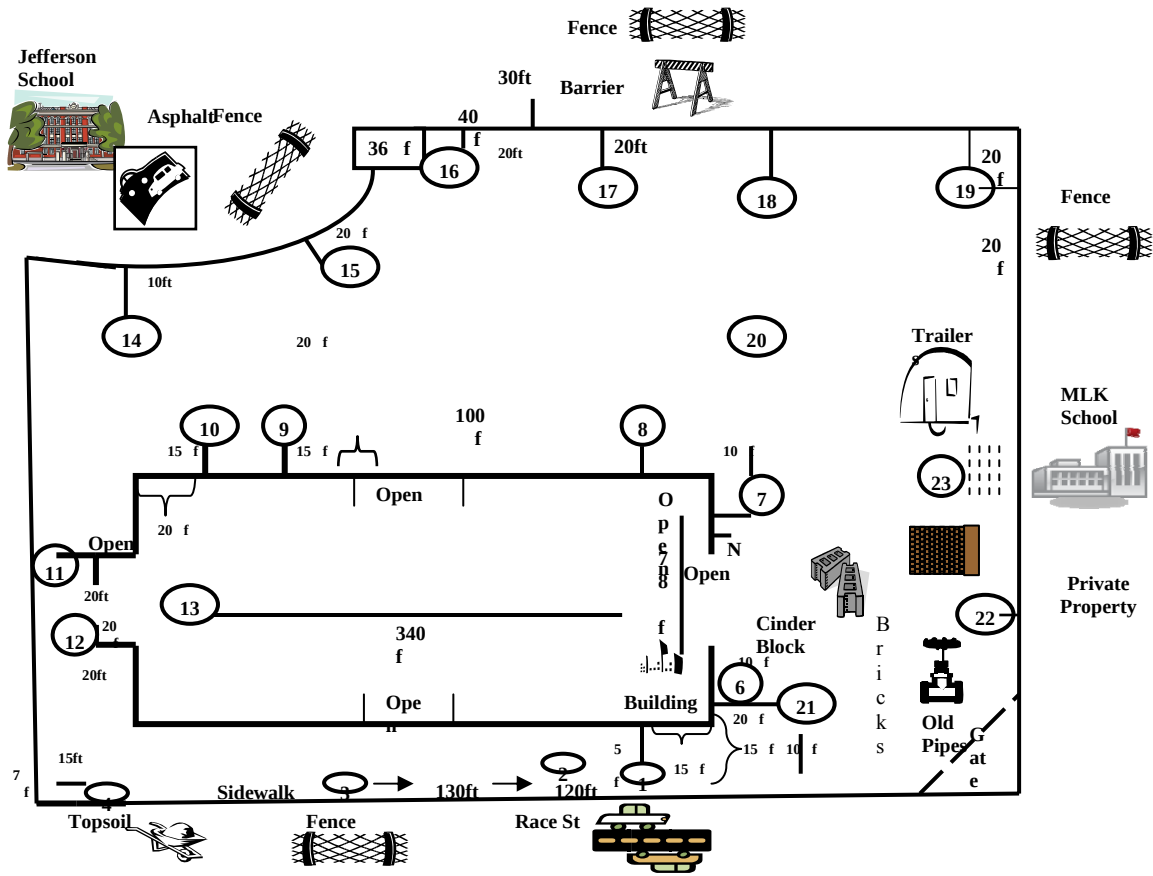


Figure 2a to 2k Distribution of Metals Concentration (ppm) in Soil Samples by Size Fraction
Figure 2a Nickel Concentration (ppm)

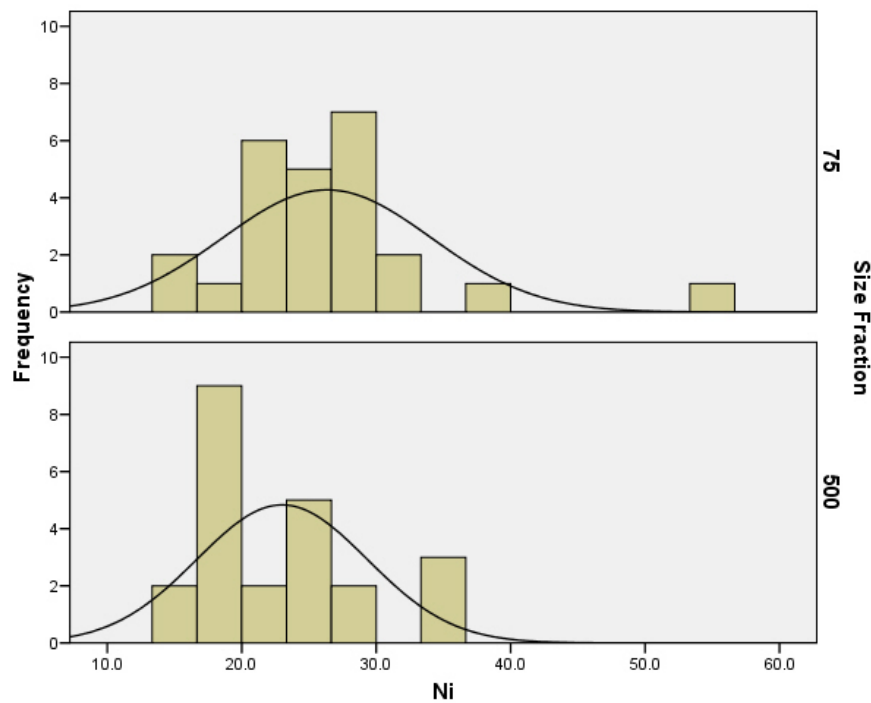


Figure 2b Strontium Concentration (ppm)

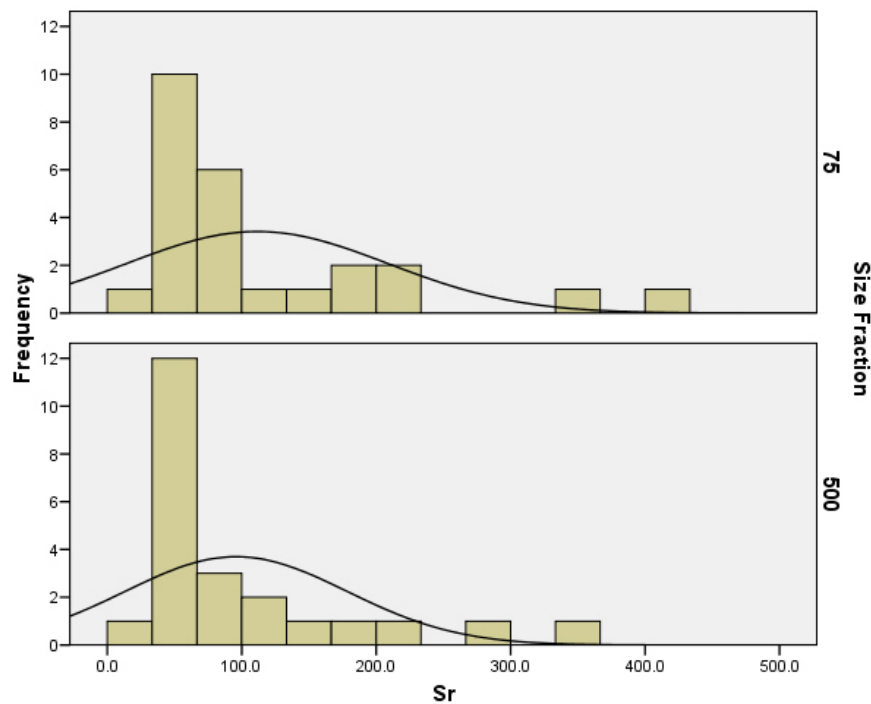
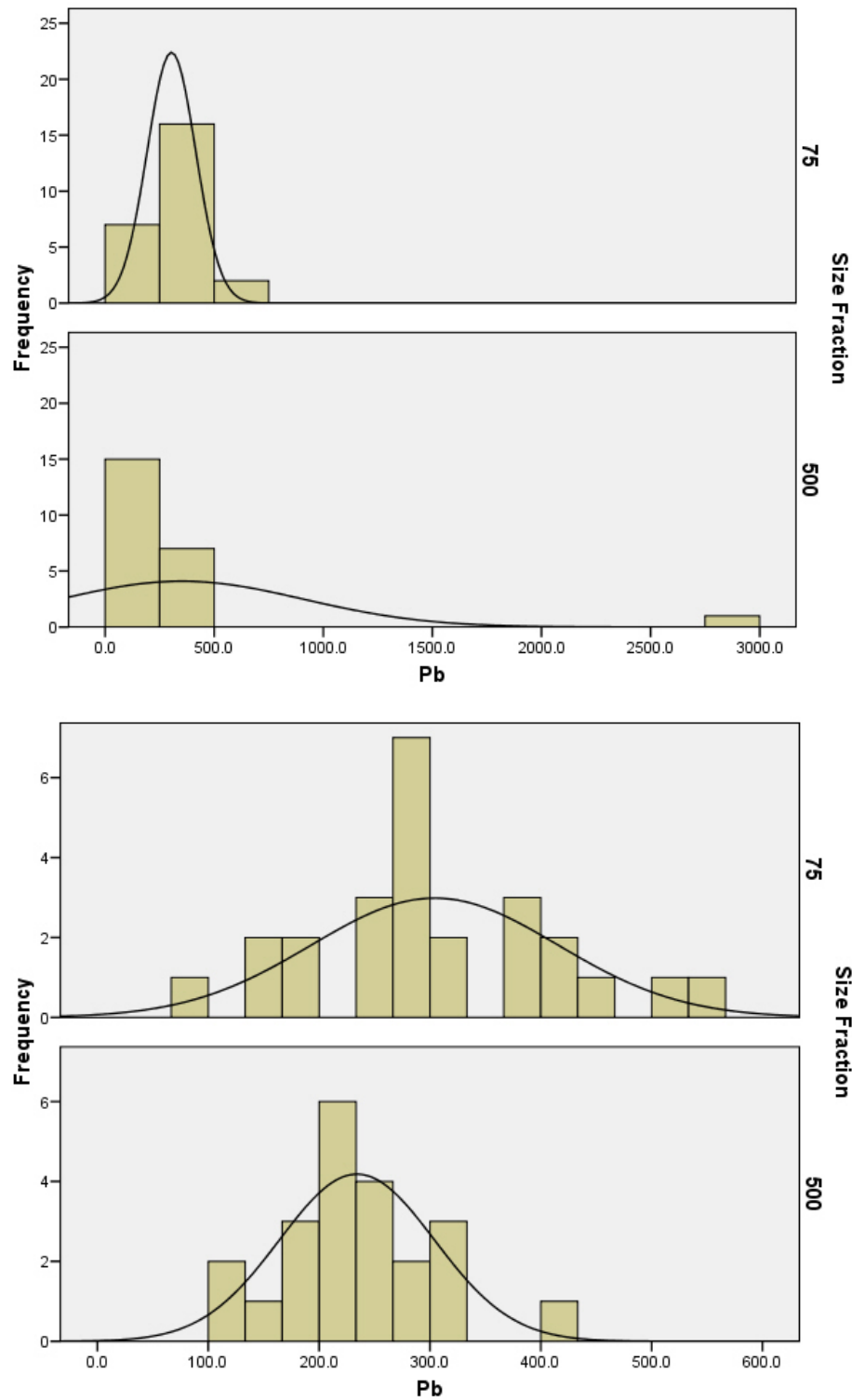


Figure 2c Lead Concentration (ppm)



Bottom pair of figures show the lead distribution excluding the single high (3000ppm) lead sample

Figure 2d Beryllium Concentration (ppm)

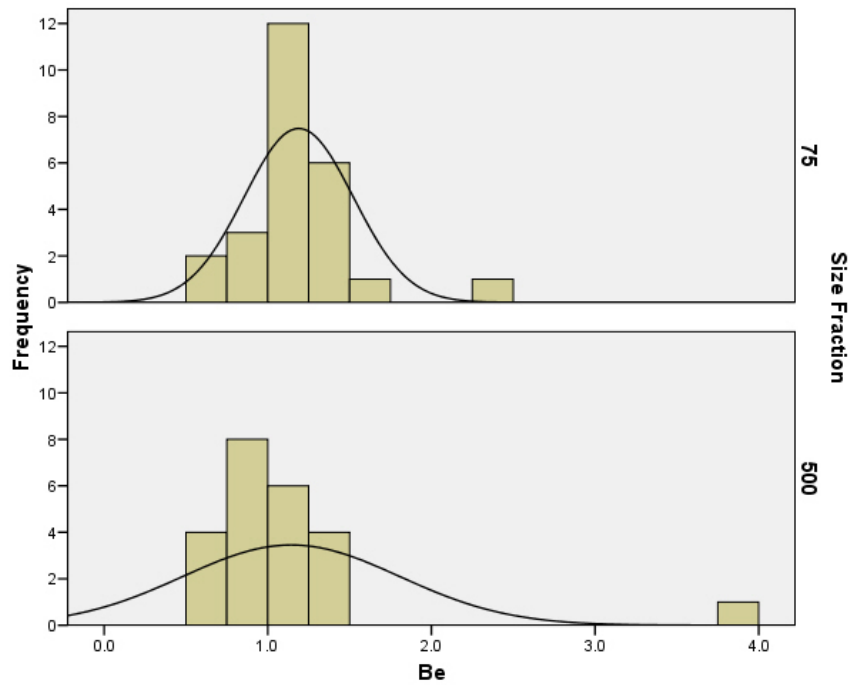


Figure 2e Lithium Concentration (ppm)

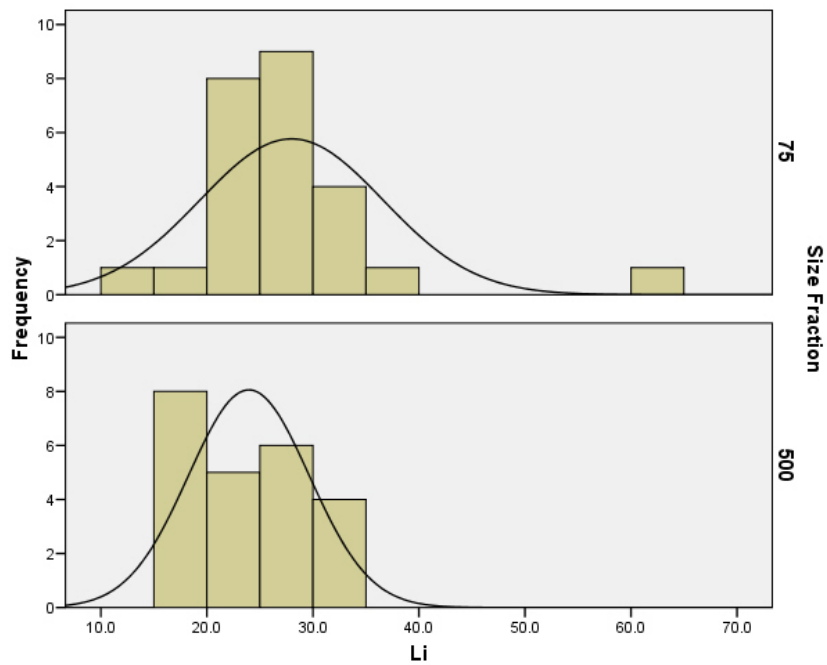


Figure 2f Magnesium Concentration (ppm)

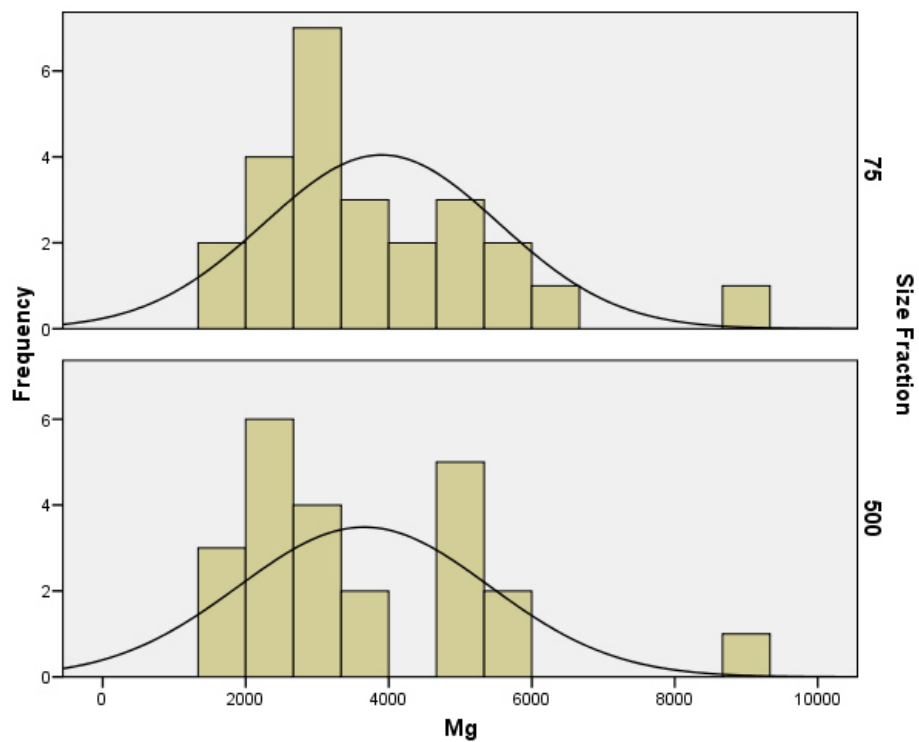


Figure 2g Vanadium Concentration (ppm)

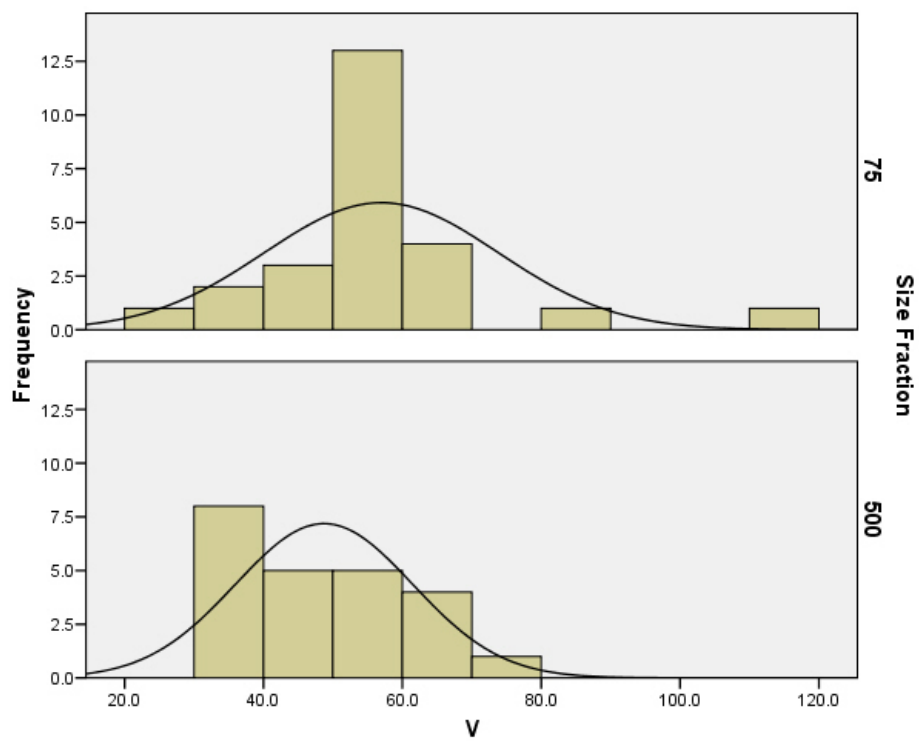


Figure 2h Chromium Concentration (ppm)

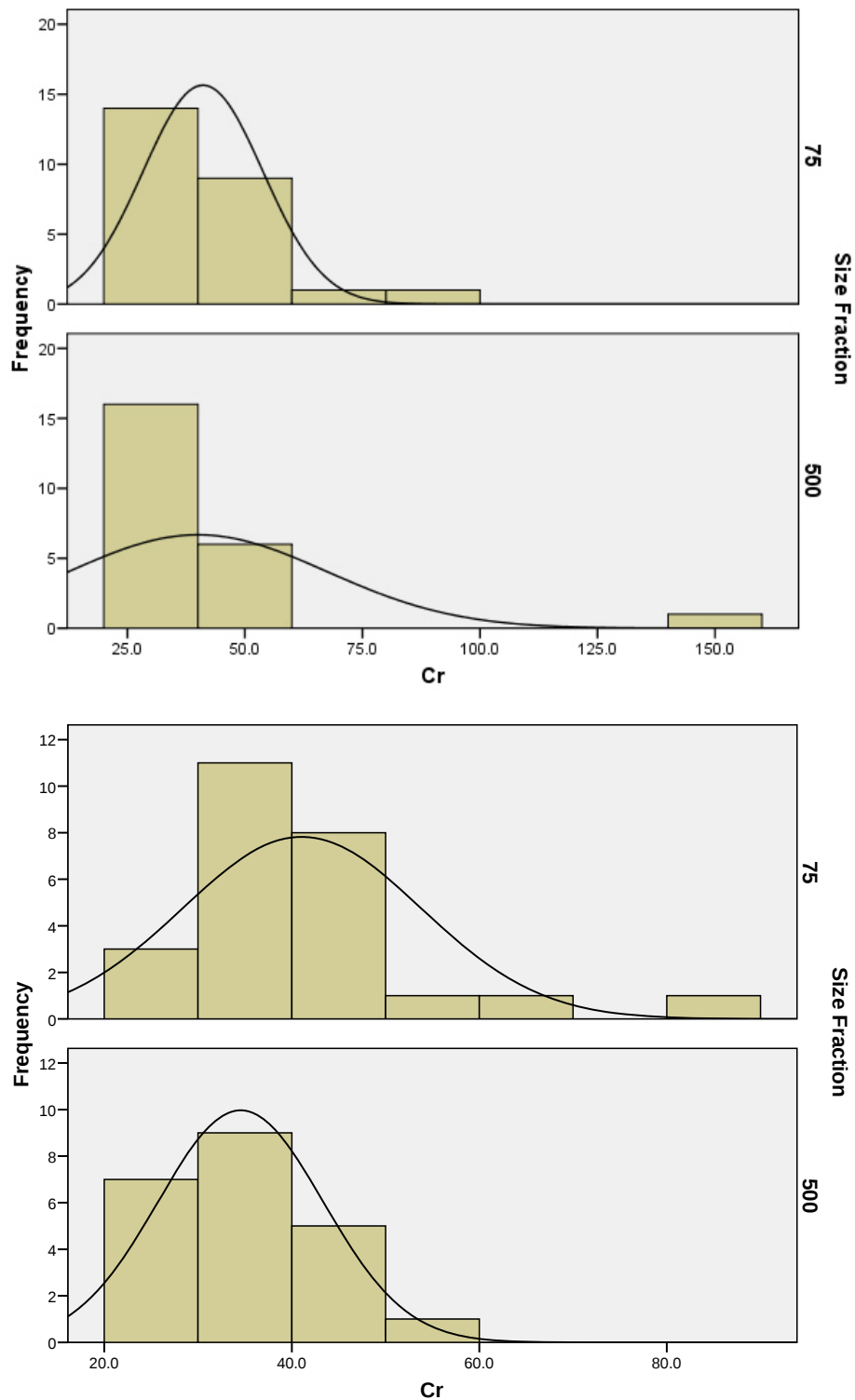


Figure 2 a

Bottom pair of figures show the chromium distribution excluding the single high (150ppm) chromium sample

Figure 2 Manganese Concentration (ppm)

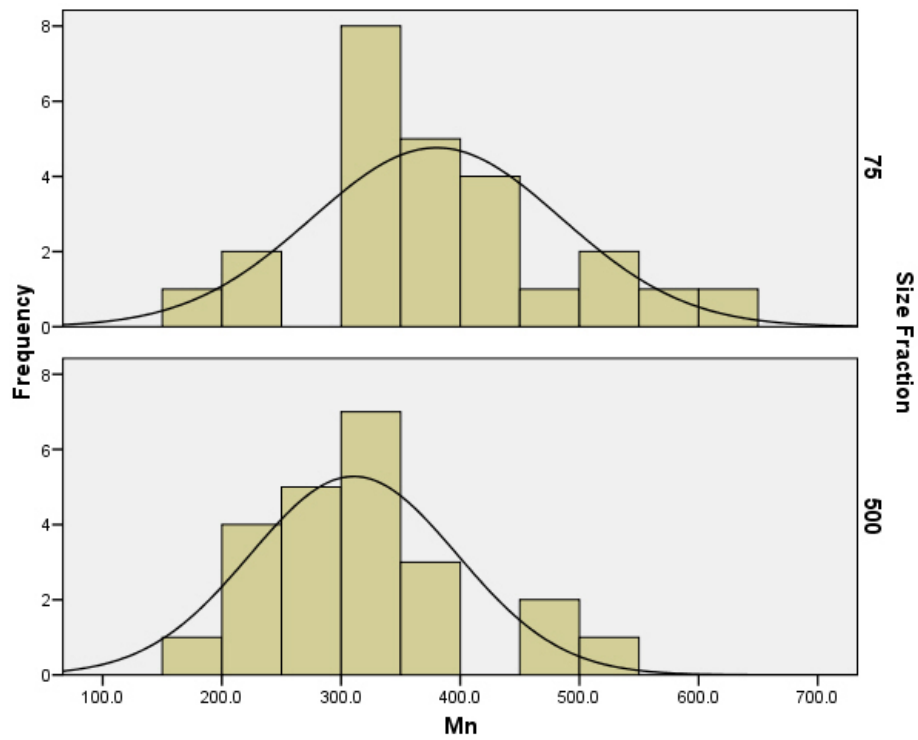


Figure 2j Aluminum Concentration (ppm)

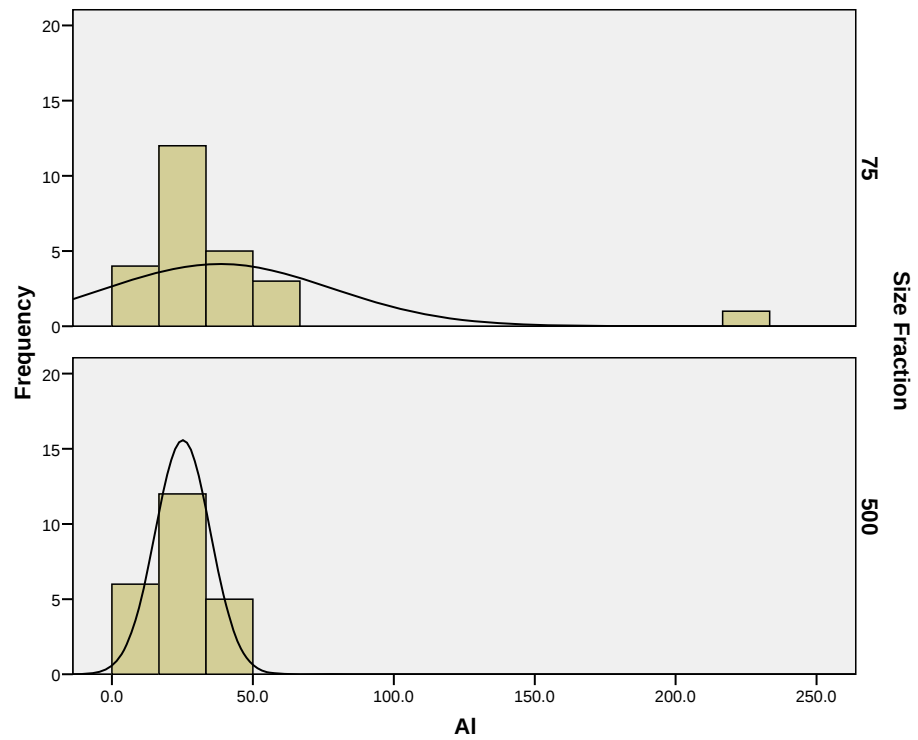
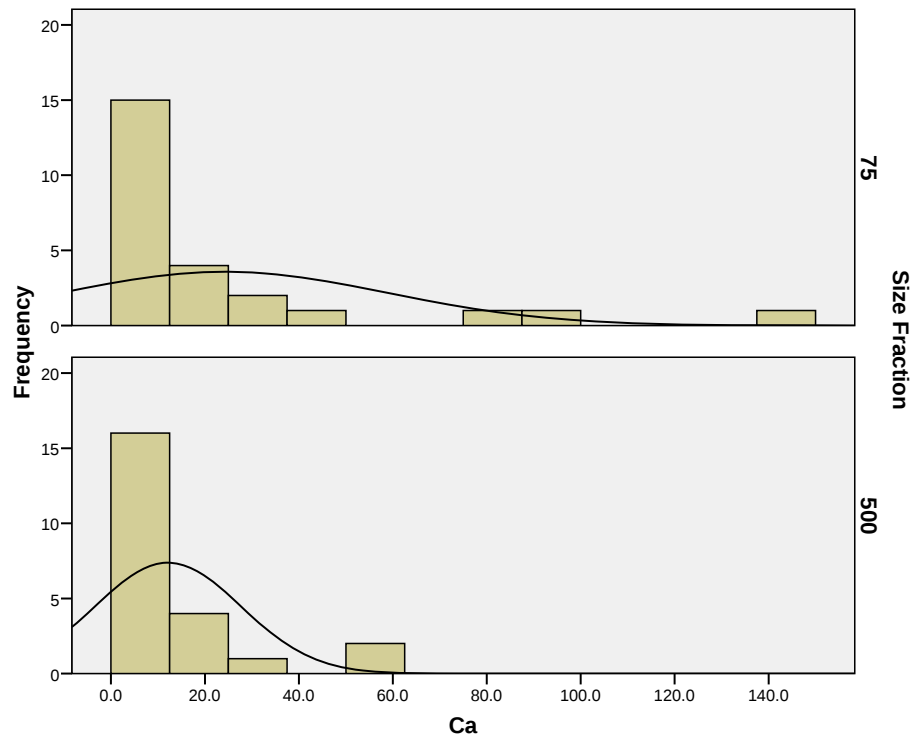


Figure 2k Calcium Concentration (ppm)



Figures 3 a to j
Sweep Sample Metal Concentrations by Location

Magnesium Dust Sweep Concentrations (ppm)



Strontium Dust Sweep Concentrations (ppb)



Calcium Dust Sweep Concentrations (ppm)



Manganese Dust Sweep Concentrations (ppm)



Aluminum Dust Sweep Concentrations (ppm)



Nickel Dust Sweep Concentrations (ppb)



Titanium Dust Sweep Concentrations (ppb)



Cobalt Dust Sweep Concentrations (ppb)



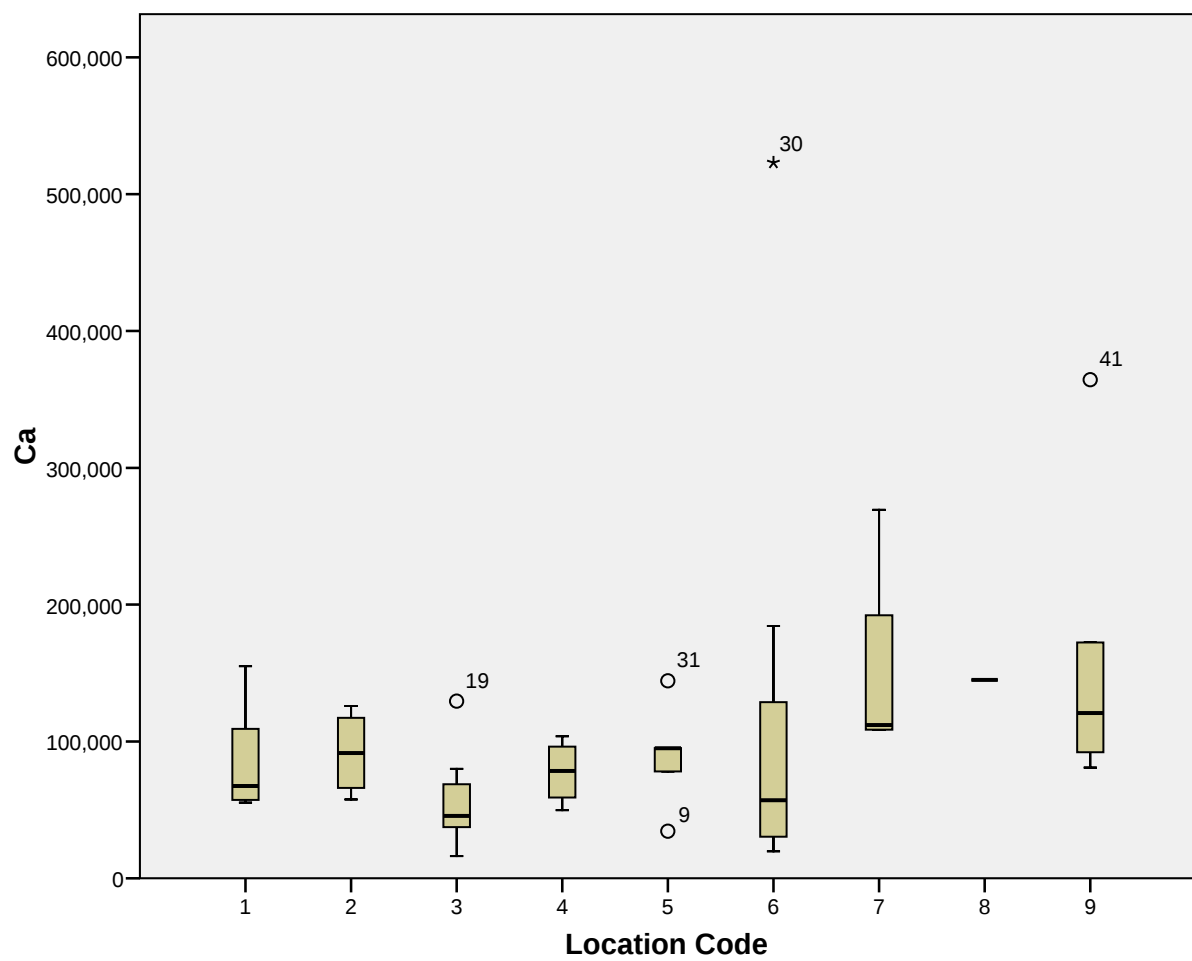
Copper Dust Sweep Concentrations (ppb)

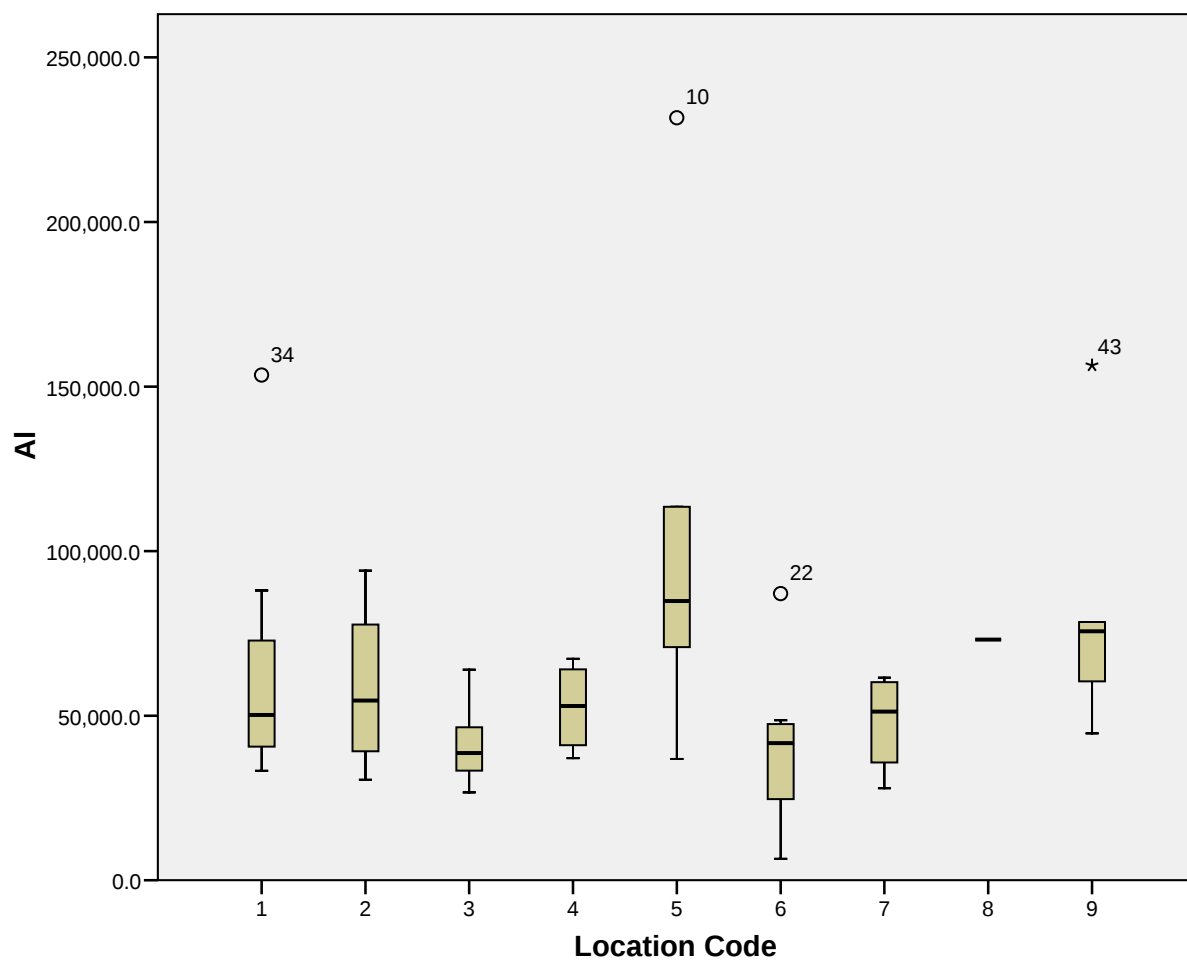


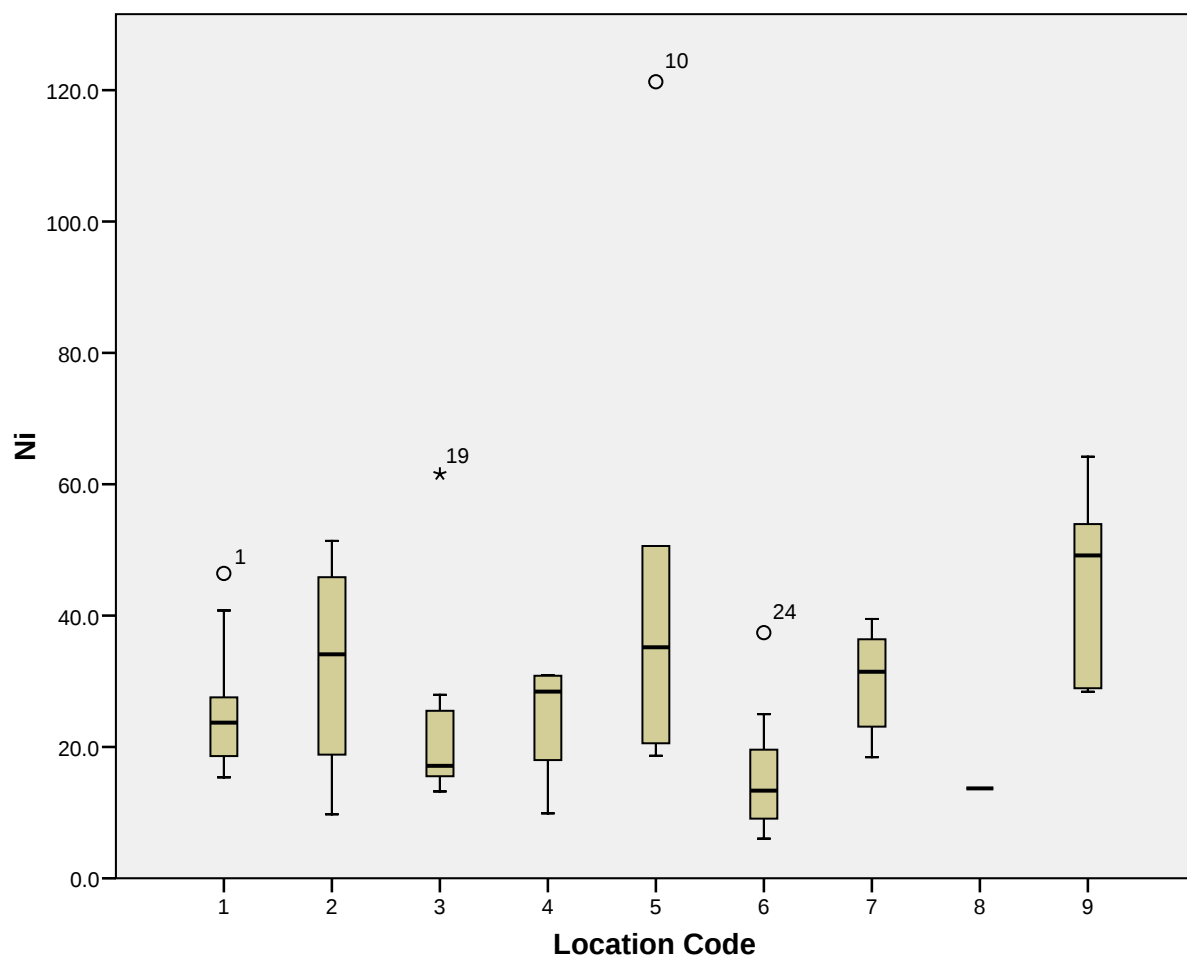
Lead Dust Sweep Concentrations (ppm)

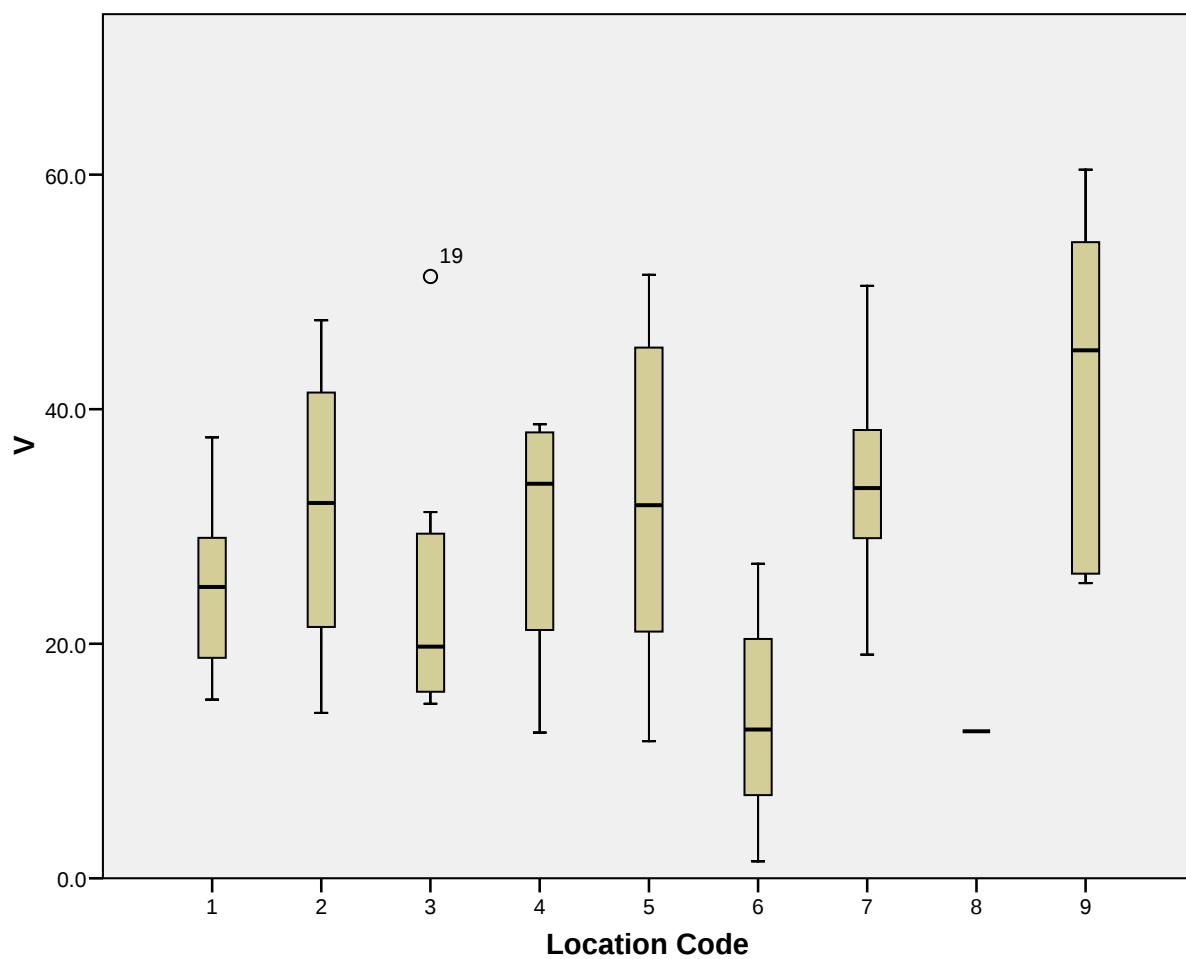


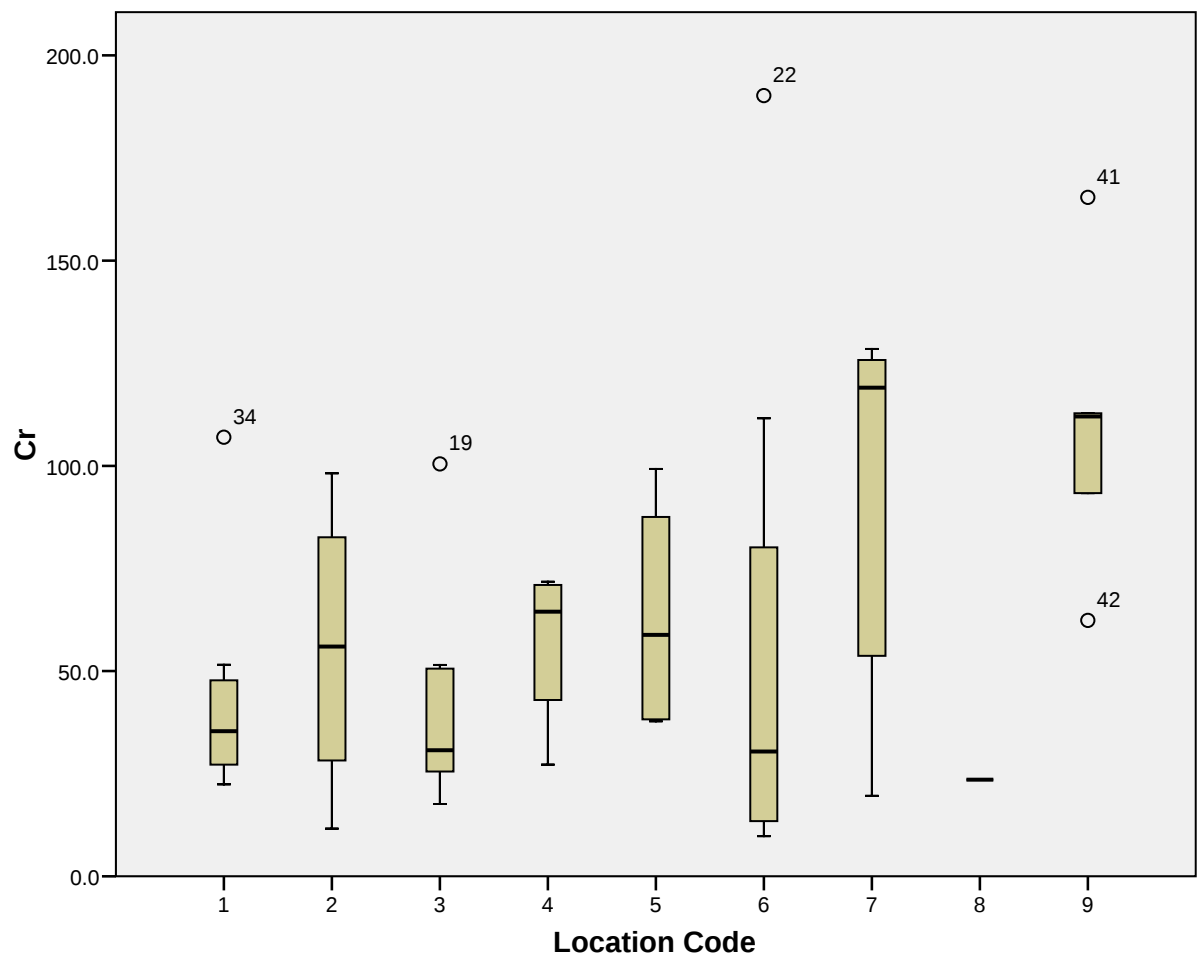
Figured 4a to n
Box and Whisker Plots of Sweep Dust Sample Metal
Concentrations
for the Nine Groups of Homes

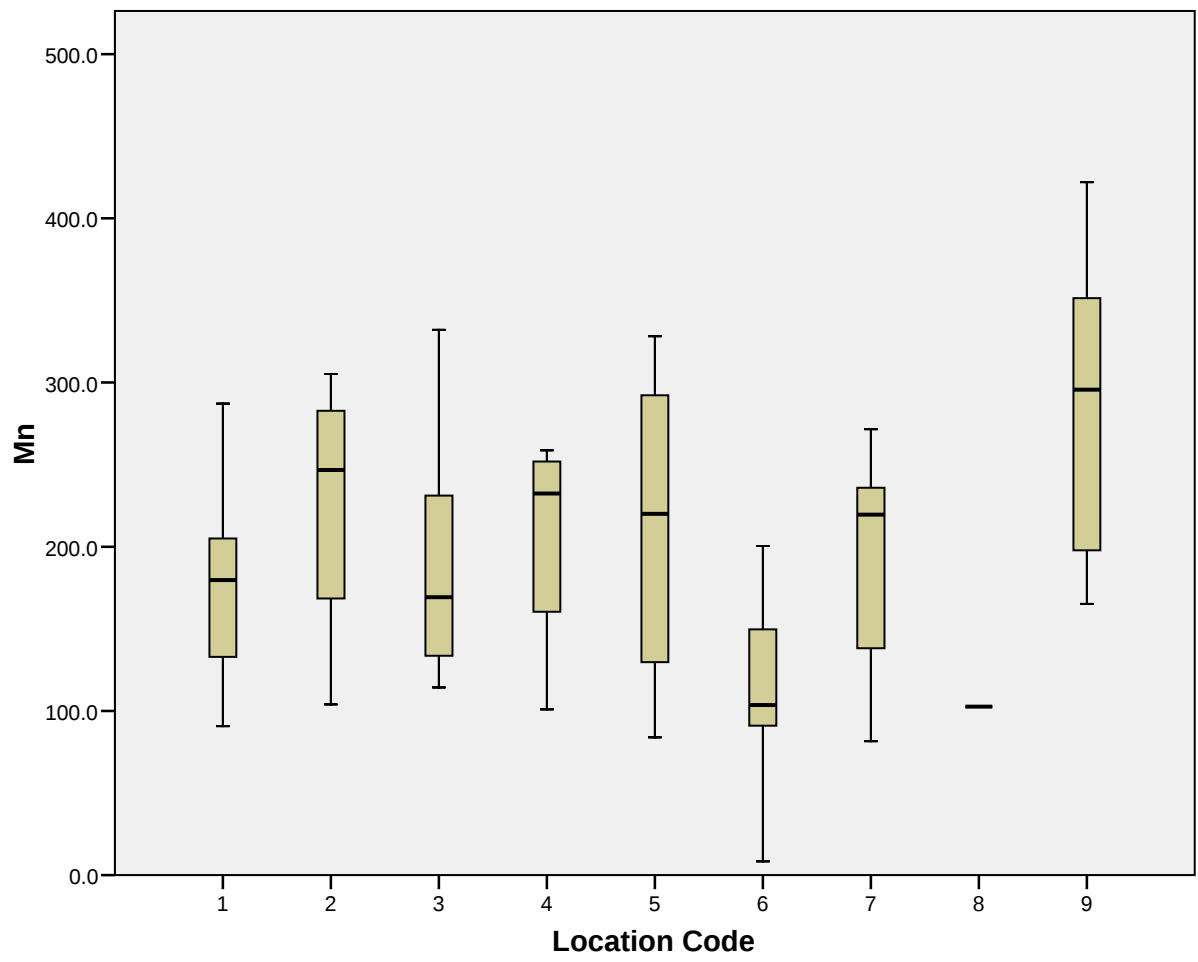


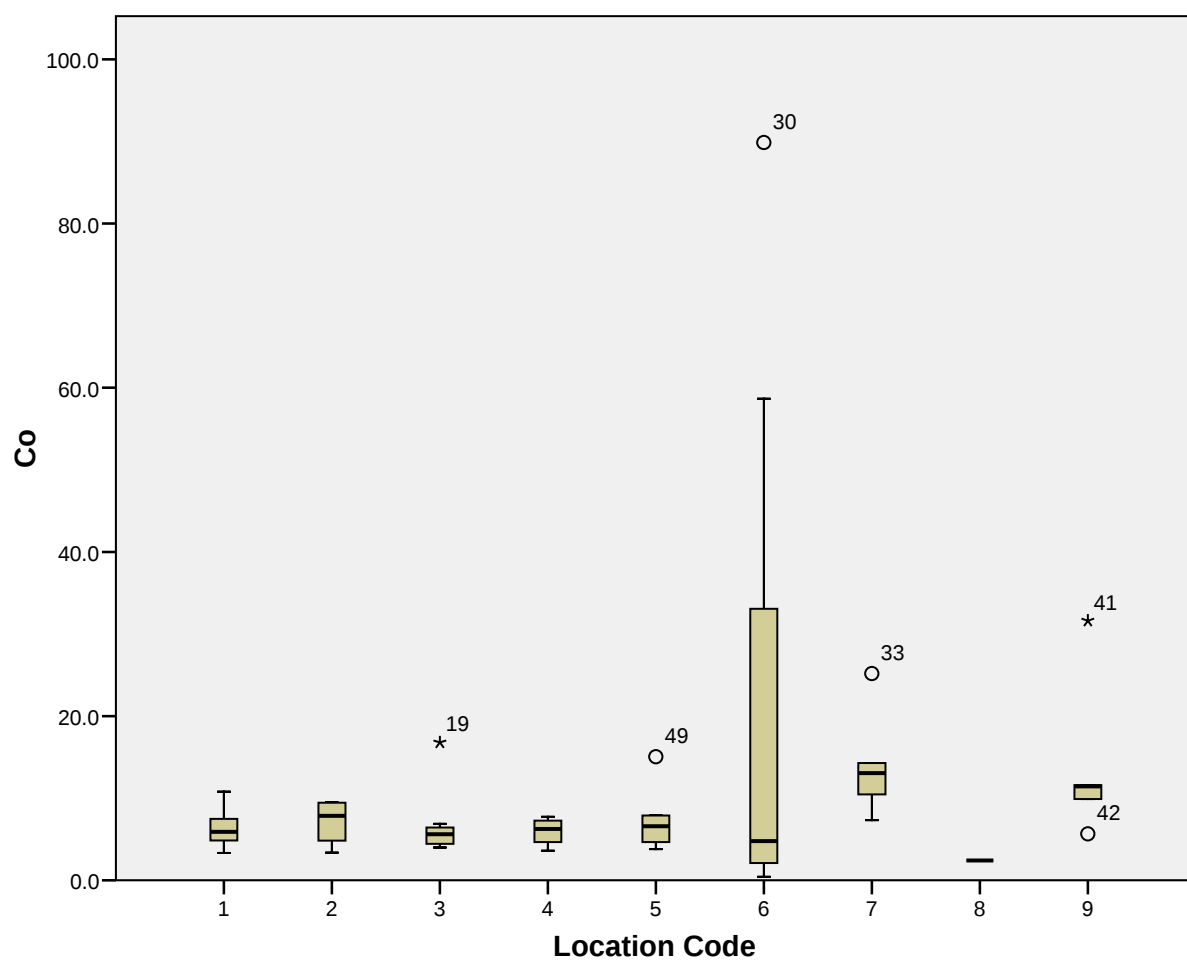


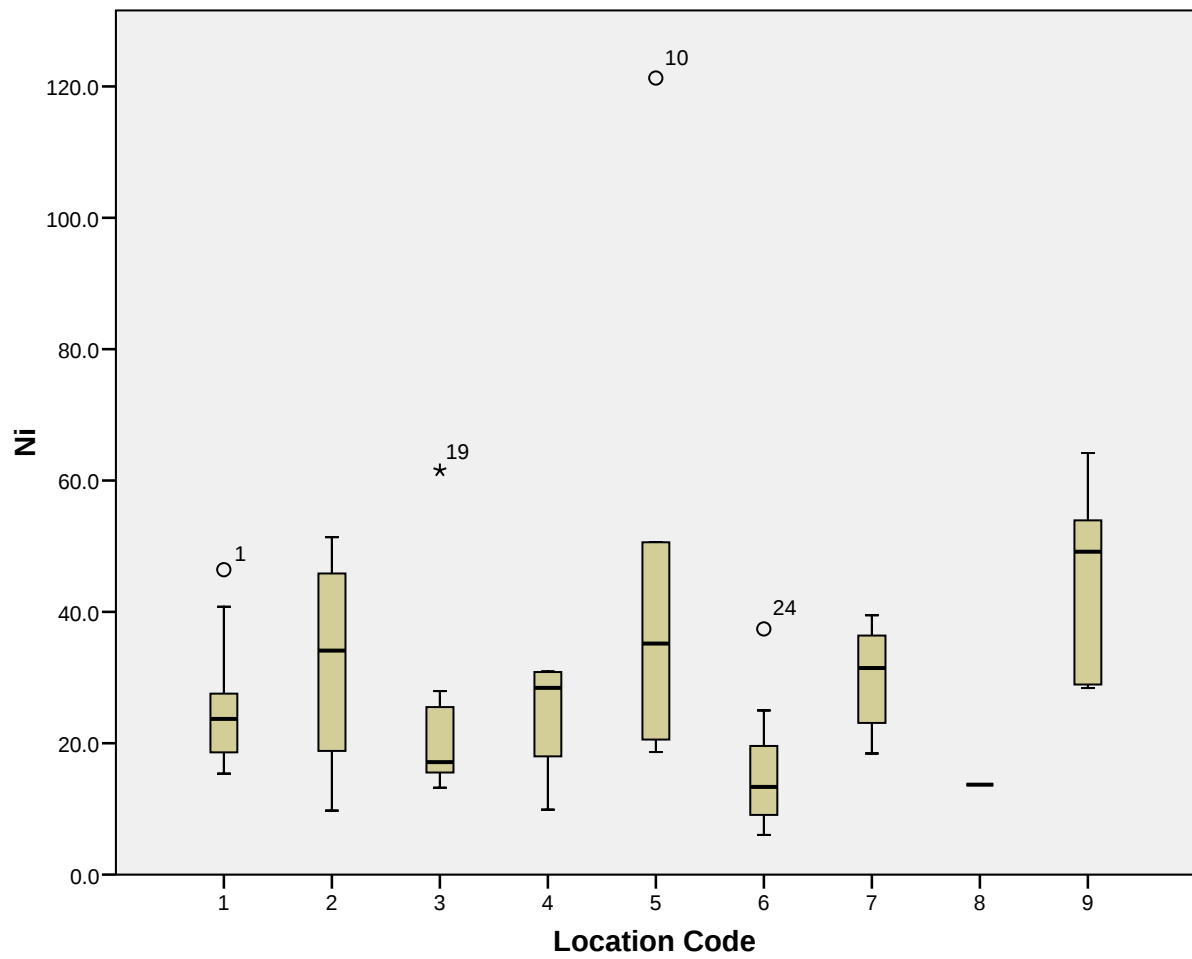


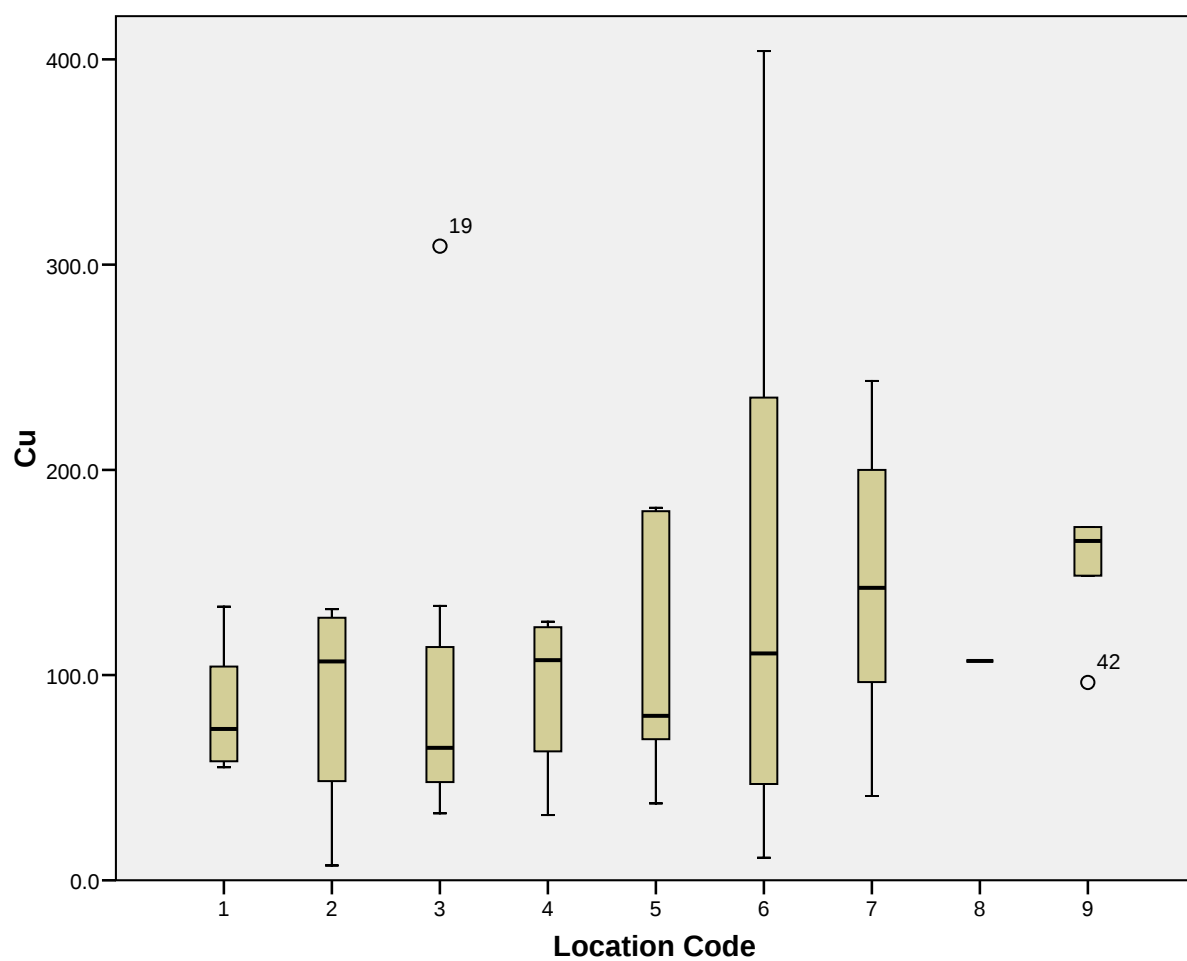


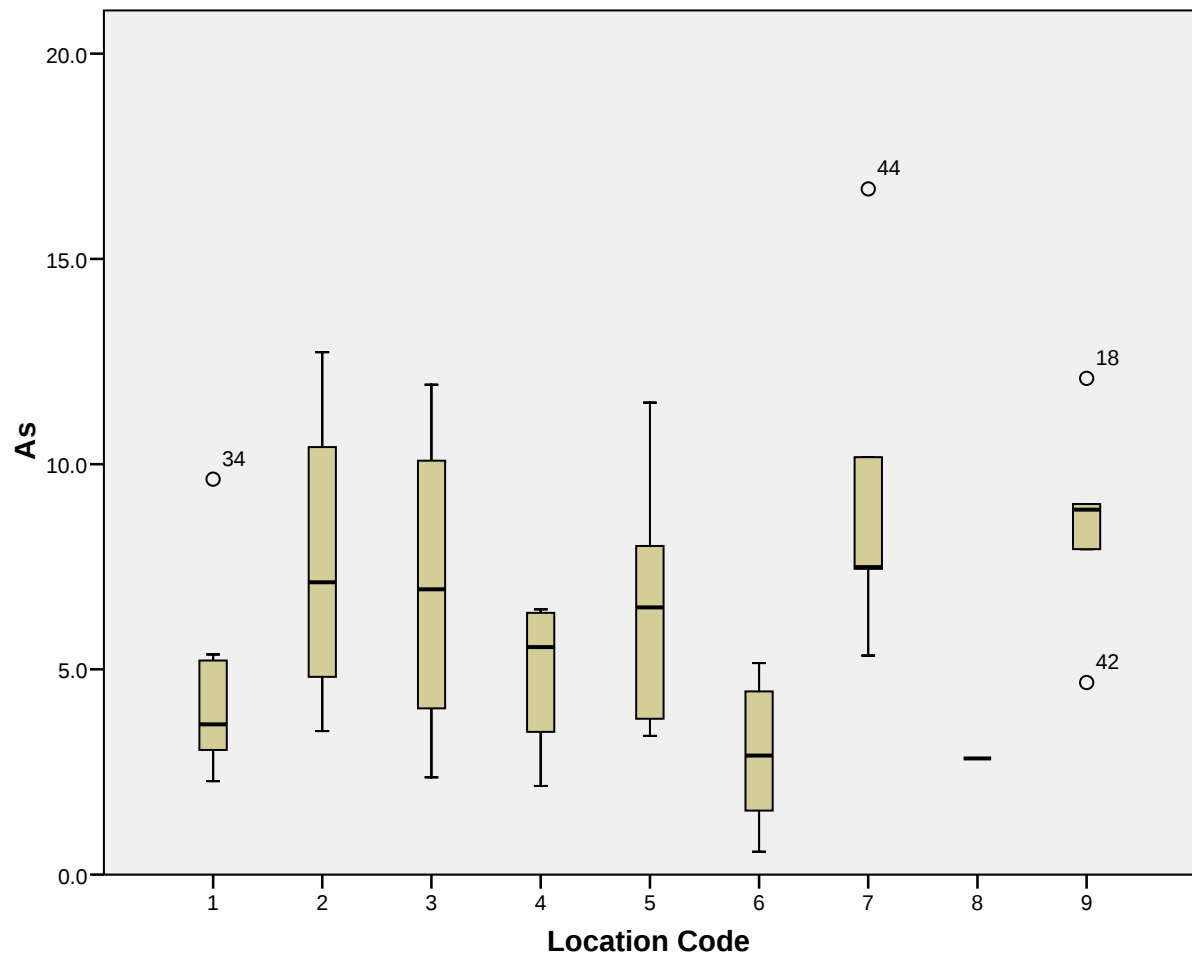


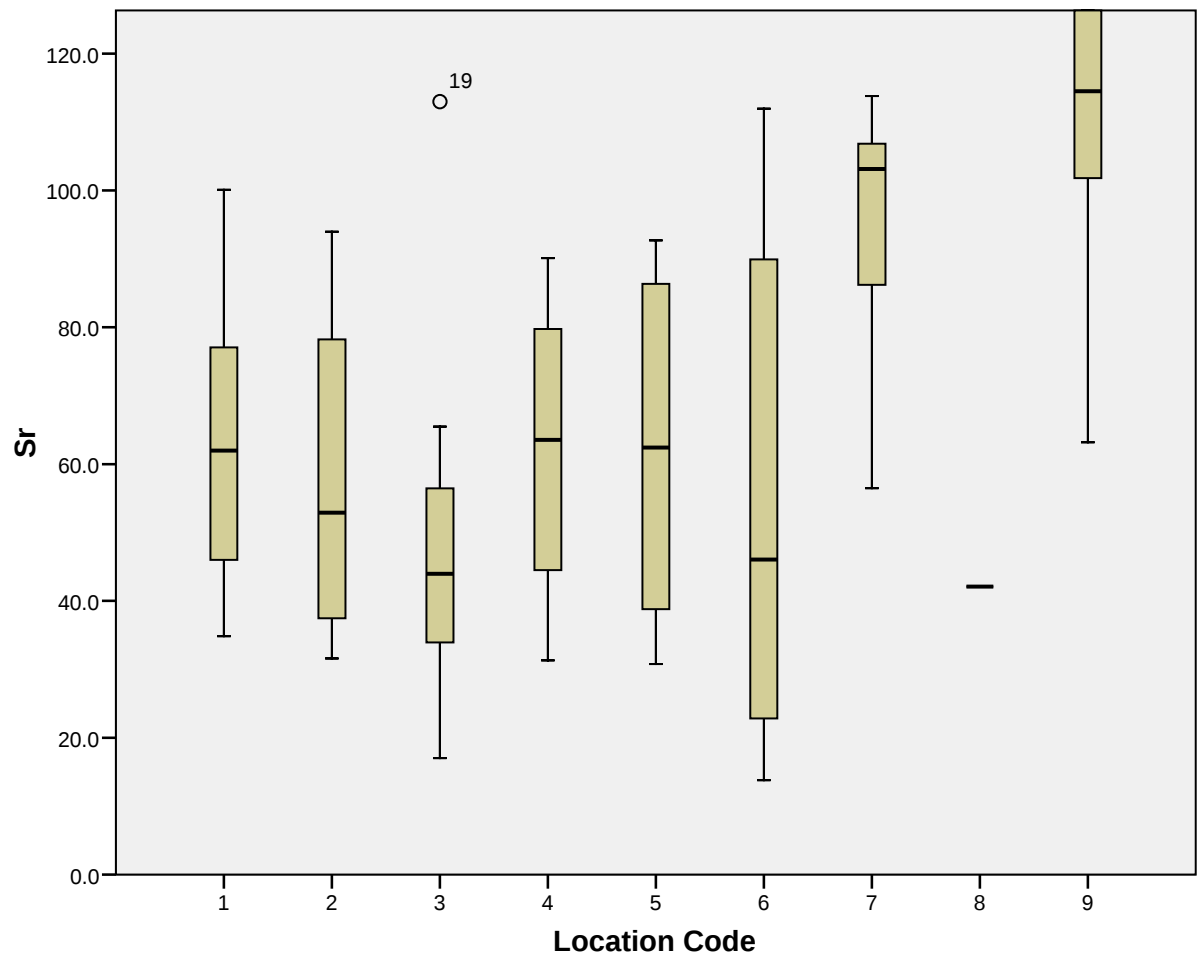


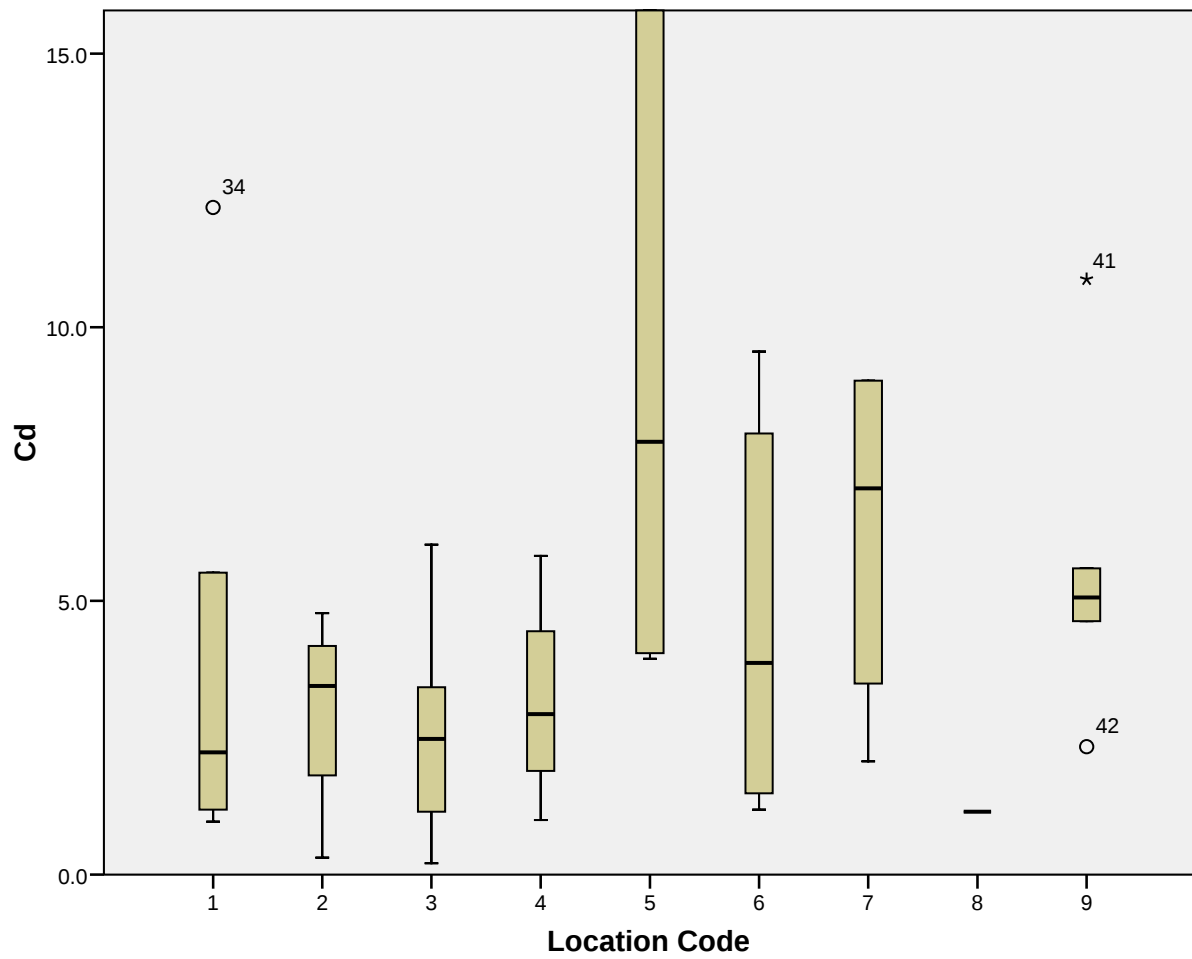


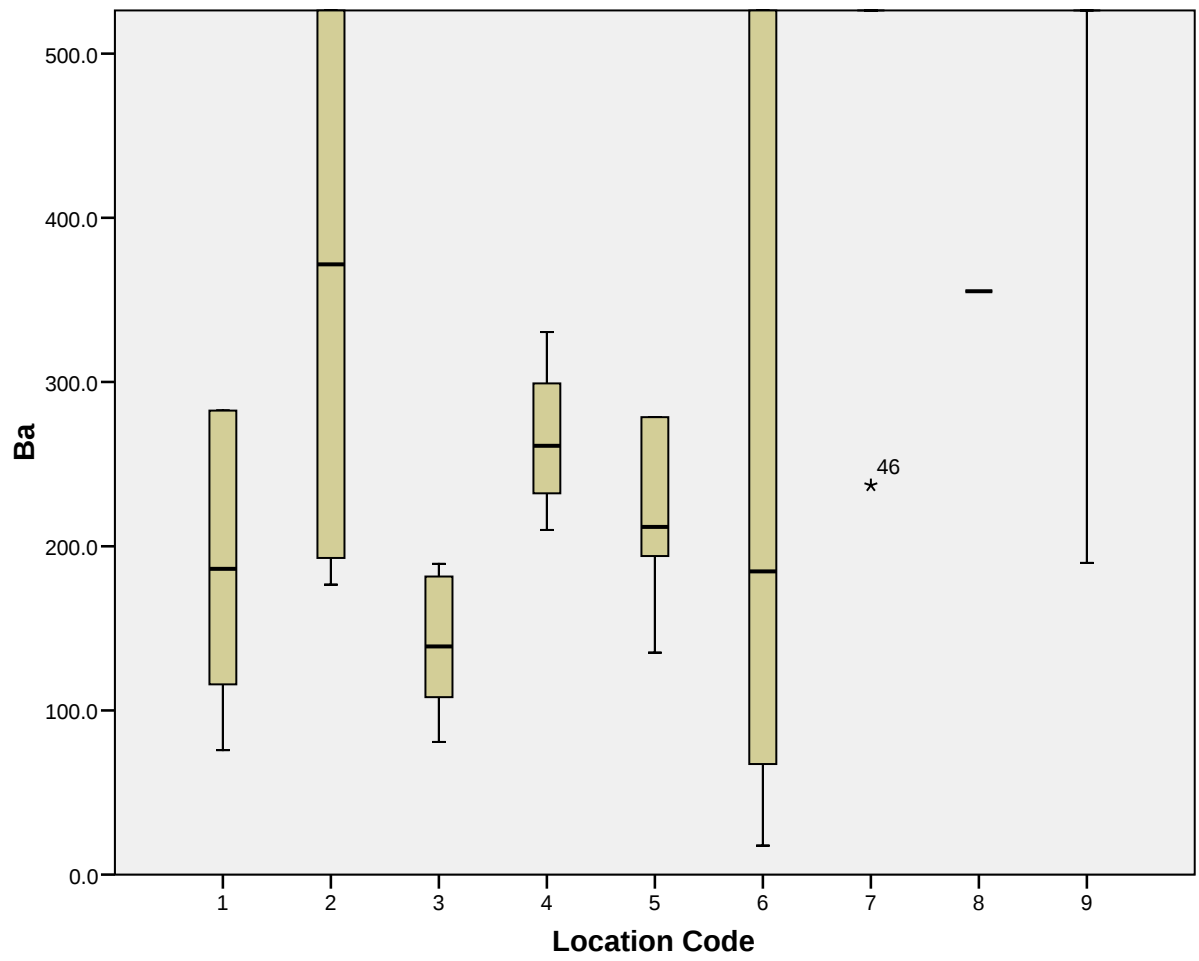


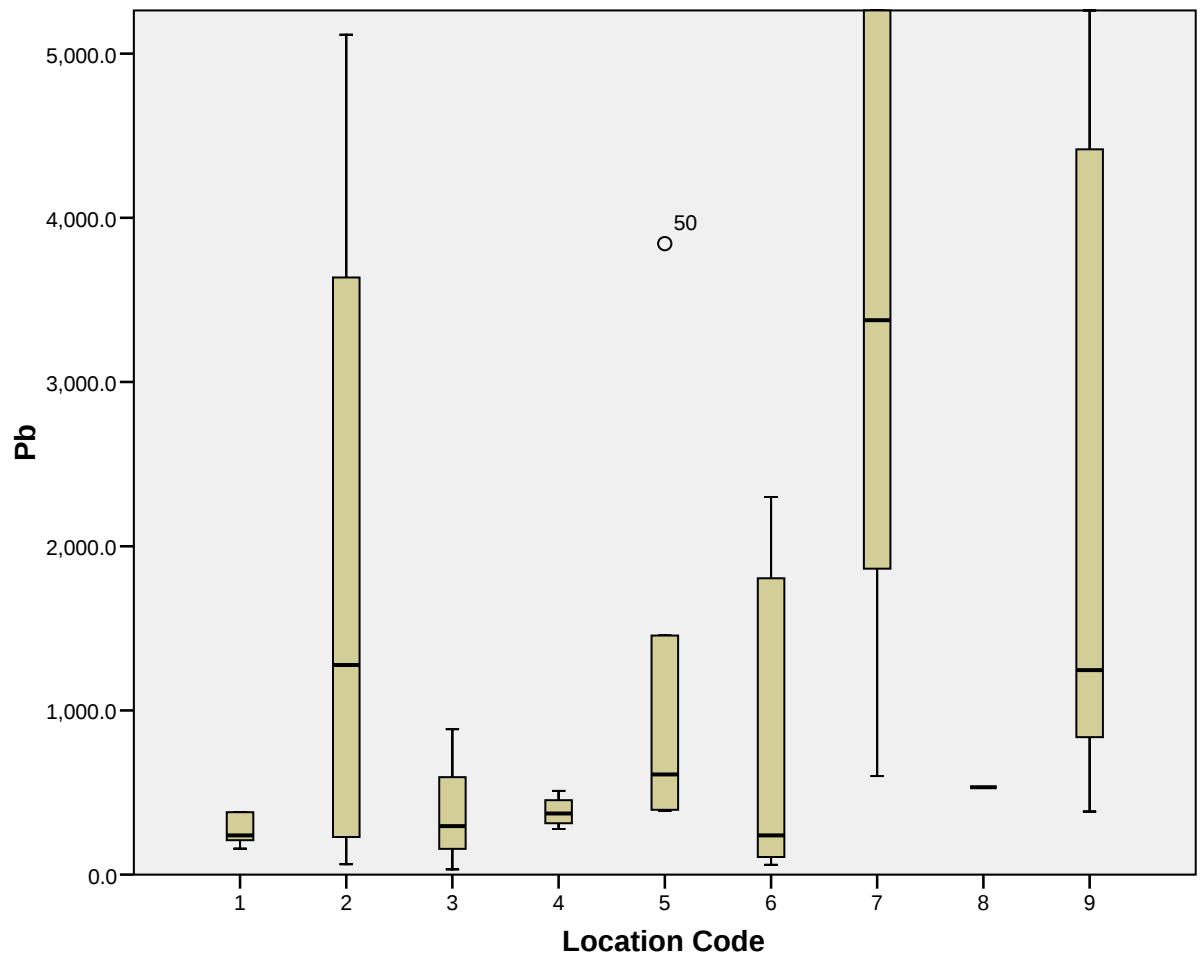






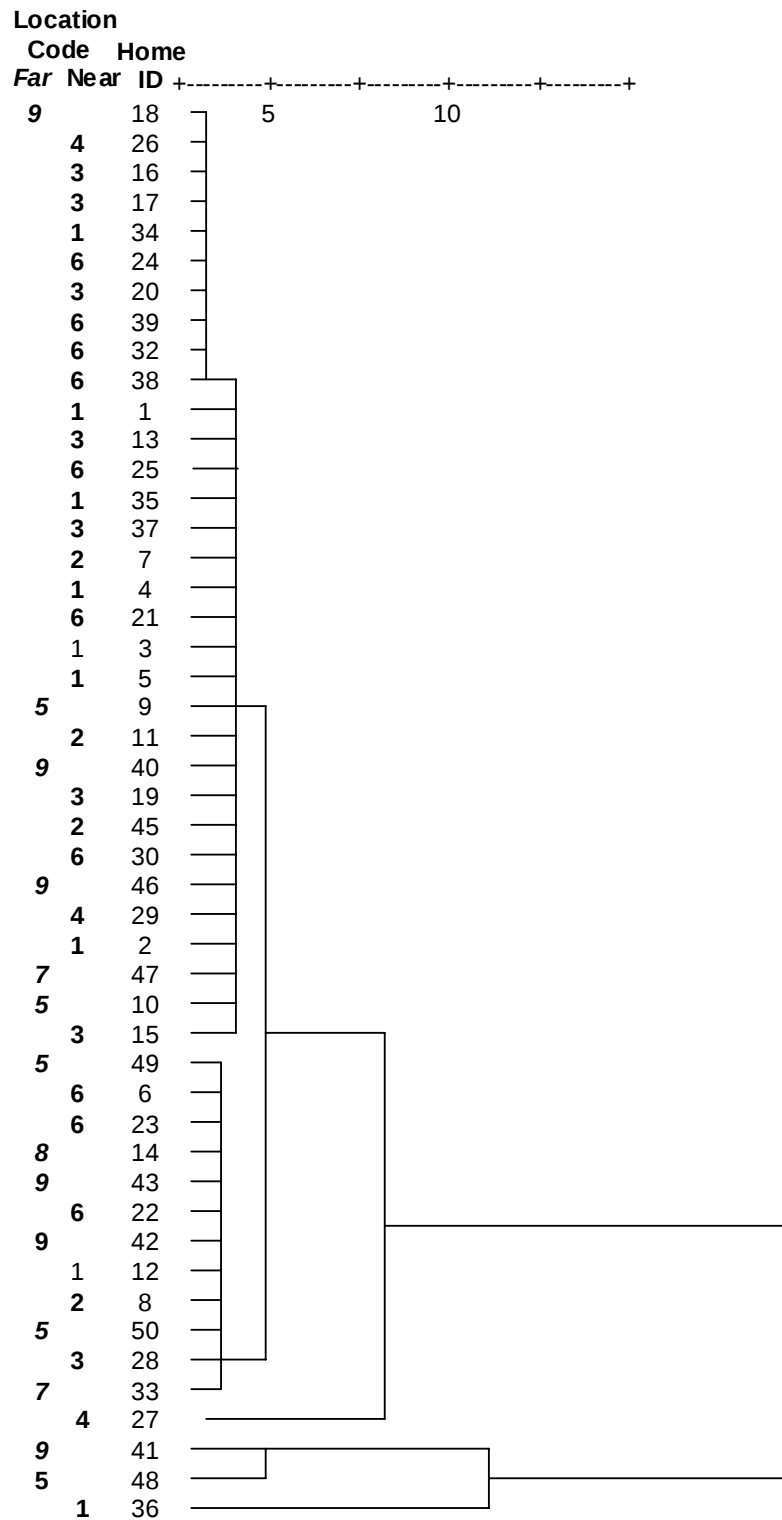






Figured 5
Dendrogram of Hierarchical Cluster Analysis of Sweep Dust Samples
from Each Home Based on Metal Concentrations

(redrawn from SPSS output for clarity – location codes define on page 15)



Figured 6a to j
Wipe Dust Sample Metal Concentrations by Location

Magnesium Dust Wipe Concentrations (ppm)



Calcium Dust Wipe Concentrations (ppm)



Strontium Dust Wipe Concentrations (ppb)



Manganese Dust Wipe Concentrations (ppm)



Aluminum Dust Wipe Concentrations (ppm)



Nickel Dust Wipe Concentrations (ppb)



Titanium Dust Wipe Concentrations (ppb)



Cobalt Dust Wipe Concentrations (ppb)



Copper Dust Wipe Concentrations (ppb)



Lead Dust Wipe Concentrations (ppm)

