BUNKER HILL HOUSE DUST PILOT
FINAL REMEDIAL EFFECTIVENESS REPORT

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SECTION 1.0 INTRODUCTION

1.1 Background

The Bunker Hill Superfund Site (BHSS) is a twenty-one square mile area surrounding the old Bunker Hill Company lead and zinc smelting complex in Kellogg, Idaho (Figure 1-1). Superfund activities were initiated under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) following findings of widespread lead poisoning among local children. Environmental response, public health intervention, and cleanup activities have been underway since the smelter closure in 1981. Remedial Investigation and Feasibility Study (RI/FS) activities began in 1984. A Record of Decision (ROD) for residential soils in the Populated Areas was completed in 1991, and a ROD encompassing the remainder of the Site was filed in 1992 (United States Environmental Protection Agency (USEPA) 1991, 1992).

Response activities have included health and environmental investigations, public health interventions, emergency removals, and a comprehensive cleanup plan. Interim response actions were prioritized based on: i) environmental media metals concentrations; ii) presence of young children or pregnant women; and iii) observed blood lead levels of children. These response measures were implemented to minimize exposure to contaminated materials during investigatory and remedial action activities. In 1985, the allied Lead Health Intervention Program (LHIP) was initiated to minimize lead absorption through health education, parental awareness, and biological monitoring efforts. The LHIP, sponsored by the Centers for Disease Control (CDC) and the Agency for Toxic Substances and Disease Registry (ATSDR), is implemented by the local Panhandle Health District (PHD) under the auspices of the Idaho Department of Health and Welfare (IDHW). Removals were undertaken, including the cleanup of area parks, playgrounds, and roadsides in 1986, smelter stabilization efforts from 1989 to 1993, and hillsides re-vegetation and fugitive dust control efforts from 1990 to 1992. Beginning in 1989 to current, the Yard Soil Removal Program removed and replaced contaminated soils in residential yards of young children at highest risk of lead poisoning. During the entire health intervention and Superfund effort, a comprehensive database has been maintained that relates children's blood lead levels, media contaminant concentrations, environmental exposures, health intervention, and remedial activities on an individual basis.

The pathways and human health effects associated with exposure to heavy metals have been studied extensively since the early 1970s (ATSDR 1999, TerraGraphics 2000a). Over the past 15 years, more than 4000 blood lead samples have been obtained from children living within the BHSS. Analyses of these data in conjunction with the RI/FS effort resulted in an integrated risk management and BHSS cleanup strategy designed to monitor and minimize children’s exposures as remediation occurred over several years (TerraGraphics 1997).

The cleanup strategy adopted in the 1991 Populated Areas ROD was based on site-specific analysis of the relationship between observed blood lead levels among children and environmental media lead concentrations at the Site. Site-wide Remedial Action Objectives (RAOs) are defined in the two RODs. The blood lead RAOs seek to reduce the incidence of lead poisoning in the community to the following levels:

- less than 5% of children with blood lead levels of 10 micrograms per deciliter (µg/dl) or greater, and

- no individual child exceeding 15 µg/dl (nominally, <1% of population).

These objectives are to be achieved by a strategy that includes:

- remediation of all yards, commercial properties, and rights-of-way (ROWs) that have lead concentrations greater than 1000 milligrams per kilogram (mg/kg);

- achieving a geometric mean yard soil lead concentration of less than 350 mg/kg for each community in the site;

- controlling fugitive dust and stabilizing and covering contaminated soils throughout the site; and

- achieving geometric mean interior house dust lead levels for each community of 500 mg/kg or less, with no individual house dust level exceeding 1000 mg/kg.

House dust has long been recognized as a primary source of lead intake and subsequent absorption among children in numerous populations (Lanphear et al. 1998, PHD 1986). House dusts are the predominant source of exposure for young children at the BHSS (Yankel et al. 1977, TerraGraphics 2000a). Previous analyses have suggested that the success of the overall cleanup strategy ultimately depends on reduction of interior house dust lead levels to concentrations comparable to post-remedial soils. The Populated Areas ROD states, "All homes with house dust lead concentrations equal to or exceeding 1000 ppm lead will have a one time cleaning of residential interiors after completion of site-wide remedial actions. If interior house dust sampling indicates that house dust lead concentrations exceed a site-wide average of 500 ppm lead the need for additional cleaning will be evaluated" (USEPA 1991).

This cleanup strategy was developed in response to studies suggesting that interior dust remediation was not effective in permanently reducing dust lead concentrations prior to completion of exterior source controls. Interiors of houses that were completely remediated in 1990 were recontaminated by outdoor sources within one year (CH2M HILL 1991). As a result, remediation efforts were directed toward residential yard soils, commercial properties, and ROWs. In the interim, monitoring of blood lead levels and interior dust concentrations continued through the LHIP. Parents were counseled regarding house and personal hygiene and were encouraged to clean frequently. Access to high efficiency particulate air (HEPA) vacuums was provided for families not having access to vacuum cleaners.

House dust lead exposures to children participating in the LHIP have decreased considerably since 1974 when average levels in Smelterville neared 11,000 mg/kg. Since fugitive dust control and yard soil removal efforts were initiated in 1988 and 1989, house dust lead exposures have continued to decrease. In 1988, dust exposures to children ranged from 1200 mg/kg in Smelterville to 1500 mg/kg in Kellogg and from 300 mg/kg to 370 mg/kg, respectively, in 2001 (see Figure 1-2, Pinehurst, Page, and Wardner have a few number of observations). In Smelterville, geometric mean blood lead levels measured 11.6 µg/dl in 1988 and 2.6 µg/dl in 2002. The Five Year Review conducted for the Populated Areas of the BHSS concluded that significant reductions in both house dust lead concentrations and blood lead levels have occurred at the BHSS since 1988, but that interior cleaning should be investigated as a remedial measure that may be necessary to further reduce dust lead concentrations (TerraGraphics 2000a). The purpose of this Pilot Cleaning Project is to assess the effectiveness of cleaning and sampling methods and the feasibility of conducting a large-scale interior dust remediation, following completion of exterior remedial actions.

Currently, Smelterville is the only community within the Site where soil remediation is complete, and soil RAOs have been achieved (TerraGraphics 1999a, 2000b). For this reason, Smelterville was selected for this dust pilot project. Residential and commercial property and rights-of-way soil removal and replacements were completed in 1997 and the cleanup in Smelterville was certified as complete in 1998. Interior dust data from the 2001 sampling season indicate that mean dust lead levels for Smelterville are slightly higher (530 mg/kg) than the RAO with 10% of the houses exceeding 1000 mg/kg (TerraGraphics 2002). These data, as well as from previous years, indicate that interior lead levels are nearing the RAO in Smelterville, although the objectives have not been completely achieved.

1.2 Previous House Dust Remediation Studies

Although HUD has promulgated lead-based paint abatement guidelines (HUD 1995), a review of house dust remediation projects accomplished at other lead sites suggests there is no universally accepted standard methodology for house dust lead abatement or remediation. Much of the difficulty in implementing permanent and effective remediation of house dusts is related to the ultimate sources of the lead in dust. This is because houses, and particularly carpets and soft surfaces, are reservoirs for house dust that subsequently serve as common exposure vehicles to young children. Effective reduction of house dust lead levels requires control of both the reservoir and those exterior and interior sources contributing lead to house dust.

A brief summary of previous studies and reports of clean-up efforts involving interior remediation of house dusts applicable or similar to the BHSS is discussed below. This review does not include efforts relating to sampling methodologies, dust speciation and source apportionment, or any studies investigating dust / blood lead relationships. However, in most studies, the critical endpoint is usually the blood lead level rather than the dust lead concentration or a loading variable. This is likely because the ultimate goal is to reduce exposure to young children and the sampling methodology for blood lead testing is fairly straightforward, while sampling methods for interior house dusts vary widely across studies, making comparisons difficult.

A 1978 study by Milar and Mushak (1982) cleaned houses of children with blood lead levels ranging from 20 to 58 µg/dl (average of 44 µg/dl); dust lead concentrations ranged from 970 to 7171 mg/kg (average 3000 mg/kg). Cleaning included vacuuming carpets with a vacuum that had a beater bar and steam cleaning first with a high-phosphate solution, then 24 hours later with regular steam cleaning detergents. Cleaning of bare floors included sweeping and then a high-phosphate detergent wash and rinse. Ventilation system filters were also replaced. Lead dust concentration decreased by 61%, and lead loading decreased by 91% for houses cleaned with the high-phosphate wash and another wash 24 hours later.

An investigation at a site similar to the BHSS was the 1984-1992 investigation by Calder et al. (1994) at Port Pirie, South Australia. This site has an active lead smelter with significant rail traffic and ore/tailings spills throughout the community due to historical use of tailings and slags. Since 1984, air lead concentrations have ranged from 1.5 $\mu g/m^3$ to 8 $\mu g/m^3$. Community-wide remedial efforts at the site during this time consisted of education, placing soil barriers, replacing soil that had lead concentrations greater than 5000 mg/kg, planting grass, paving dirt areas, baghouse improvement, worker hygiene control, a taller stack, slag pile covering, surface watering and vehicle washing at the smelter. Individual house remedial efforts included exterior surface cleaning, removal of lead-based painted surfaces and replacement, or repainting. Interior dust abatement consisted of lead-based painted surface covering, removal and replacement, or repainting, vacuuming of the ceiling, sealing of cracks, and cleaning of carpets and furniture. House remedial efforts were based upon the resident child's blood lead level. In general, a 20% reduction of blood lead levels was observed during this program; 42% of the children tested had blood lead levels >20 µg/dl in 1984; in 1991, 18% of children reported blood lead levels >20 µg/dl.

The 1988–1991 USEPA Three City Urban Soil Lead Abatement Project (USEPA 1993) in Cincinnati remediated areas with soil lead concentrations ranging from 300 mg/kg to 800 mg/kg; street dust concentrations were slightly higher. Neighborhood-wide remediation included sweeping of paved surfaces and common area soil abatement. Individual house remediation included vacuuming and wet mopping of floors and replacement of one to three carpets and two pieces of furniture per house. Conclusions from the study indicated that interior dust abatement may reduce blood lead levels but observed differences were not significant; no effect was seen on blood lead levels from soil or exterior dust abatement.

From 1989 –1990, Aschengrau et al. (1994) performed a two-phase study in Boston involving soil and interior dust remediation and loose paint stabilization (Phase I) followed by soil remediation and paint deleading (Phase II). Study houses had soil lead concentrations of >1500 mg/kg and loose paint on <30% of the exterior surface. Soil remediation included removal and replacement of the top 6 inches. Interior dust remediation consisted of a one-time HEPA vacuuming of carpets, wet wiping of walls, wood and window wells and oil wiping of furniture. Paint remediation involved HEPA vacuuming and a trisodium phosphate (TSP) wash of loose paint areas followed by painting with primer in Phase I and removal of all lead-based paints below 5 feet in height on both interior and exterior surfaces in Phase II. Dusts were sampled using the Sirchee-Spittler vacuum sampler. Results of the studies indicated that, in general, blood lead declines of 2.25 µg/dl to 2.7 µg/dl were observed for soil lead concentration reductions of 2000 mg/kg but children in houses with high floor dust lead concentrations received almost no benefit from soil remediation. Another report on this study by Weitzman et al. (1993) indicated that soil lead concentration reductions led to blood lead declines of 0.8 µg/dl to 1.6 µg/dl; soil and dust remediation combined resulted in blood lead declines of 1.2 µg/dl to 1.6 µg/dl. Upon one-year follow up, most houses remained at some level of reduced lead levels. A reanalysis of the Phase II data by Aschengrau et al. (1994) indicated that lead abatement was more effective when more interior areas were treated, when removal and replacement was used and when multiple cleanings were performed. Costs for this project averaged $9600 per property.

Phase II Results from the Boston Lead-in-soil Demonstration Project concluded, "children living in apartments with consistently elevated floor dust lead loading levels derived almost no benefit from the soil abatement," because that "eliminated only one of many sources of interior dust lead" (Aschengrau et al. 1994). As a result, many attempts to remediate house dusts result in only short-term reductions. Investigators and public health authorities often debate whether it is more practical (considering the results and costs of remediation) to replace or clean carpets and furniture in contaminated houses. For example, Ewers et al. (1994) believe an exposure source may be reintroduced after remediation by placing items contaminated prior to lead abatement back in the house. Repetitive experiments conducted by Ewers et al. suggested that cleaning "chronically contaminated" carpets might actually increase lead exposure, whereas cleaning of "acutely contaminated" carpets may be effective in reducing exposure. Several studies reported that deleading is associated with a significant "transient" elevation of blood lead level in many children (Amitai et al. 1987, 1991). In the case of carpet remediation, not conducting vacuum cleaning for a sufficient time could increase the amount of the lead dust at the surface, that is the most accessible by children (Ewers et al. 1994, Adgate et al. 1995).

Two other pertinent studies were the 1988–1989 study by Langlois et al. (1996) and the 1989 study by Concord Scientific et al. (1989) at the South Riverdale, Toronto site. This community is the site of an operational secondary lead smelter. Soil remediation occurred during 1988 if the soil lead concentration was >500 mg/kg; soil was replaced to a depth of 30 inches. Interior dust remediation occurred in 1989; 1000 houses were cleaned. Ducts were HEPA vacuumed; walls, sills, all horizontal surfaces, moldings, trim, window coverings, basement ceilings, floors and upholstered furniture were suction (only) vacuumed with exhaust to the exterior during vacuuming; walls, sills, moldings, trim, floors, carpets and upholstered furniture were washed twice with a TSP detergent. Sampling by the dust vacuum method during the interior remediation indicated that 50%-60% of the interior house dusts were from exterior soil and that vacuuming removed 42% of the lead from floors, 16% from horizontal surfaces, 30% from ducts; wet washing removed 1% of the lead removed from floors, 7% from carpets, 3% from walls and 1% from upholstered furniture. Lead loading decreased from 9 mg/m^2 to 4 mg/m^2 during the study. Dust concentrations and lead loading remained lower at a repeat sampling four months after the remediation. In general, blood lead levels at the site decreased from 14 µg/dl to 4 µg/dl during the 1988–1992 period; overall Ontario blood lead levels decreased from 12 µg/dl to 4 µg/dl during that time. Analysis indicated that without remediation, blood lead levels would have reached 7 µg/dl in that time period. During the study period, site-wide blood lead levels decreased faster than controls.

Another study occurred from 1991-1996 at an active lead smelter site in Trail, British Columbia (Hilts et al. 1995). At that time, smelter emissions averaged 300 kg/day; soil lead concentrations ranged from 700 mg/kg to 800 mg/kg over 1977–1992. Community-based remediation included education, ground cover, street cleaning, road dust abatement and paving dirt areas. Individual house remediation at the site included placing of entrance mats, new sandboxes, house cleaning supplies (vacuums, mops, buckets, detergent) for vacuuming and wet mopping, and a HEPA vacuuming program of floors every six weeks for ten months. Sampling during the HEPA vacuuming program was by the DVM method; carpet lead and dust loading were reduced by 40%-50% after each cleaning cycle; dust lead concentrations did not change. Lead loading returned to pre-cleaning conditions within 2.5 to 3 weeks of cleaning. Carpet age had no effect on lead loading but houses with power nozzle vacuums had lower lead loading. Changes in children's blood lead levels during this study showed no significant decrease, although the remediation appears to generally have eliminated the seasonal rise in blood lead levels. Blood lead correlated positively with pets in the house, negatively with removal of shoes, and did not correlate with change in lead loading or dust lead concentration. By 1992, blood lead levels at the site averaged 10 µg/dl.

The 1992 CLEARS study by Lioy et al. (1998) in Jersey City, NJ cleaned houses of children with blood lead levels between 8 µg/dl and 20 µg/dl with lead-based paint present in the house. Approximately 2/3 of the study houses received interior cleaning ten times over a 9 to 15 month period; the other 1/3 of the houses were cleaned less than ten times. Cleaning consisted of detergent cleaning of floors and smooth surfaces, and HEPA vacuuming of carpets. Homeowners received educational materials and were advised to wet scrape and repaint loose paint. Results from wipe sampling indicated that lead loading and lead concentration were 35% and 24%, respectively, lower than the control group; no change in dust loading was observed. Vacuum sampling indicated that dust loading decreased in the study group, lead concentration was unchanged, lead loading decreased but was not significantly lower between the groups.

Control and intervention groups were compared by Rhoads et al. (1999), in the Jersey City, NJ study. The presence of lead-based paint in the house was a necessary criteria for inclusion in the one year study. The houses in the intervention group were cleaned every two weeks. The cleaning protocol included vacuuming of floors and carpets with a HEPA vacuum, mopping of bare floors with a low phosphorus detergent, and educational seminars. Samples were obtained by wipe and vacuum sampling. The average blood lead level before the intervention was 12 µg/dl for the study children. Results of the study indicated that in houses cleaned more than twenty times, a 34% decrease in blood lead level was seen. Dust loading on floors, sills and carpets generally decreased after cleaning.

Goulet et al. (1996) reports another study in 1990 in St. Jean sur Richelieu, Quebec. This site had an active battery plant that was closed during the study period. Soil lead concentrations ranged from 200 mg/kg to 600 mg/kg and dust lead concentrations averaged 1200 mg/kg to 2500 mg/kg; the dust lead background concentration was approximately 163 mg/kg. Community-wide remediation included paving, street and sidewalk sweeping and education efforts. Soil remediation included replacement of all bare soils with 10 cm to 30 cm of new soil, replacement of all soils (including graveled/grassed areas) if the concentration was >500 mg/kg. In a lesser contaminated area, bare soils were replaced if the concentration was >400 mg/kg and of all soils if the concentration was >1000 mg/kg. Interior remediation included HEPA vacuuming of the clothes in closets, ceiling, walls, ducts, floors, window sills, carpets and furniture, steam cleaning or mopping (twice) of carpets, furniture, floors, and household accessories. Twenty-nine percent (29%) of the children with blood lead levels >20 µg/dl lived in houses with peeling lead-based paints. In general, blood lead levels decreased from 9 µg/dl to 5 µg/dl during the study.

The main goal of a study by Farfel et al. (1991, 1994b) was to evaluate experimental abatement practices used for lead-based paint abatement with the goal of long-term reduction of interior dust lead levels. All painted surfaces were treated by replacement and enclosure methods, floors were sealed, strict occupant and personal belonging protection practices from dust during abatement were performed, offsite disposal of debris occurred, and HEPA vacuuming and wet scrubbing after abatement activities was performed. Floors, window sills, and window wells were measured for dust lead loading (mg/m^2) pre-abatement, post-abatement, 6-9 months and 1.5-3.5 years post-abatement. Results revealed significant lead loading reduction post-abatement through 1.5-3.5 years. Floors, window sills and wells were 16%, 10%, and 4% of pre-abatement levels, respectively, at the 1.5-3.5 years sampling (Farfel et al. 1994b).

A seven-month long study by Lanphear et al. (1996) in Rochester, NY provided lead poisoning and prevention information, cleaning information and supplies (spray bottles, paper towels, and a detergent specifically developed to clean up lead contaminated house dust) to homeowners where children with blood lead levels <25 µg/dl resided. Cleaning instructions were to clean the entire house once every three months, to clean sills, window wells and nearby floors once per month, and to vacuum carpets once per week. A control group was provided with an informational brochure only. No difference was seen in blood lead levels of the two groups.

More recent studies involving lead dust control techniques have focused on dust and lead loadings as an end-point, rather than blood lead levels. A Hoover Self Propelled Vacuum with Embedded Dirt Finder was used to determine if lead loadings, as measured by a high-volume surface sampler, was effective in reducing dust, lead, dust mites, bacteria, and fungi in carpets from homes and small offices in Seattle and Redmond, Washington. After six to 45 minutes/square meter of vacuuming, lead loadings were reduced by 82% (Roberts et al. 1999). Houses in Vermont were used in an investigation to determine if walls and ceilings should still be included as part of the HUD guidelines for lead hazard control. The results support post-intervention cleaning and the current HUD guidelines. Median dust wipe loading results increased by 4 µg/ft^2 post-intervention and after the walls had been cleaned, as opposed to dust wipe results that increased by 32 µg/ft^2 from walls post-intervention but before they were cleaned (Tohn et al. 2000). Northern New Jersey high-risk homes were part of a randomized, controlled trial where non-HEPA vacuums and low-phosphate solutions were compared to cleanings with a HEPA vacuum and high-phosphate solution. Three surface types from each of the houses were cleaned: uncarpeted floors, window sills, and window troughs. The findings varied across the surface types and suggest that using low-phosphate detergents and non-HEPA vacuums is warranted, but further investigation is necessary. In comparisons of high-phosphate/HEPA vacuum versus low-phosphate/non-HEPA vacuum, larger reductions in lead loadings were observed on window sills and window troughs using the low-phosphate/non-HEPA vacuum, but the high-phosphate/HEPA vacuum produced larger reductions on hard floors (Rich et al. 2002).

The majority of the sites involving interior house dust lead contamination from an exterior source (i.e., not exclusively from painted surfaces) had remedial approaches consistent with that seen at the BHSS. Exterior soil remediation plus other exterior techniques such as paving and creating barriers have been used at nearly every site. Providing educational information about lead poisoning and its prevention is also a common approach; the LHIP relies on a similar strategy.

The studies generally indicate that interior cleaning temporarily reduces house dust lead concentration and lead loadings, and at least in some cases, blood lead levels. However, in several instances these efforts indicate that long term house dust lead reductions are not maintained as long as the source of the contamination remains present.

1.3 House Dust Remediation Efforts at the Bunker Hill Superfund Site

The BHSS encompasses a larger geographical area and population than any of the sites mentioned previously. The BHSS strategy for addressing house dust contamination was to make maximum effort to minimize exterior soil sources through remediation of residential soils, parks, playgrounds, commercial properties, roadsides and industrial areas throughout the Site. This cleanup was implemented on the fastest practicable schedule determined in negotiation between the USEPA and the Site PRPs. As observed in Smelterville in Figure 1-3, this strategy of reducing exterior soil sources that contribute to interior lead concentrations has been effective in also decreasing community-wide house dust lead levels. In the meantime, monitoring of both children's blood lead levels and house dust lead concentrations is conducted through the LHIP, and follow-up services are offered to those children exhibiting high levels. HEPA vacuums are also available to the local residents and individuals are reminded of the importance of good personal and household hygiene through education and outreach programs implemented by the local health department.

One major investigation of interior remediation at the BHSS was undertaken in 1990, following the first year of residential soil cleanup. A pilot interior cleaning study was conducted at six houses by removing and replacing the main living area carpets, drapes and one piece of upholstered furniture (CH2M HILL 1991). Prior to removal, carpets and furniture were vacuumed and steam cleaned up to three times. Average lead loading decrease during the cleaning was 8% for carpets and 18% for furniture. Floors were then wet washed after removal of the carpet. Sampling of the removed carpets and furniture indicated that most of the lead was found in the carpet rather than the pad or underlying floor. This investigation indicated that the cost of cleaning approximately equaled the cost of replacing the materials. Subsequent dust lead monitoring at these houses showed that dust lead concentrations one year later were similar to both pre-remediation levels and other un-remediated houses in the community.

1.4 Review of House Dust Sampling

1.4.1 Seasonal Effects

Seasonal effects on house dust lead levels are not clearly understood and may affect sampling. However, seasonal fluctuations in blood lead levels, particularly among children, have been studied and well documented (USEPA 1995, Barton and Huster 1987, Schell et al. 1997, Hunter 1977). However, the reason for seasonal variations is not clear. Blood lead variations could be a result of seasonal fluctuations of lead levels in environmental media, differences in exposure pathways and behaviors, or of altered human physiology (USEPA 1995, Barton and Huster 1987, Schell et al. 1997, Hunter 1977).

A 1979-1983 investigation in Boston of seasonal variations in blood lead levels also included environmental sampling. This investigation reported significant seasonal variations of lead levels in air, floor dust, furniture dust, and window sill dust. The peaks of air, floor and furniture dust lead measures in July were close to June peaks in blood lead levels. The window sill lead levels peaked in November. Soil and water lead concentrations were unaffected by the seasonal variations. It was suggested that floor dust and air lead variations could contribute significantly, but not totally, to seasonal changes in blood lead levels among young children (USEPA 1995). Yiin et al. (2000) reported blood and house dust (floor, window sill, and carpet) peak lead concentrations during the summer months in Jersey City, New Jersey. Conversely, another investigation observed peaks in blood lead levels during December to March among poor, pregnant women who received care at two medical facilities in Albany, New York (Schell et al. 1997).

These few investigations focused more on blood lead levels than on house dust lead variations due to seasonal effects. There has been one investigation in northern Idaho focused on seasonal effects in dust lead levels. Sampling methods used were similar to those at the BHSS. Vacuum bags and dust mats were collected from homes in five towns throughout northern Idaho, unaffected by any past heavy metal mining activities (Petrosyan 2000). Results were difficult to interpret due to the low number of participating houses and differences between towns. However, addressing each of the five towns separately, mat dust and lead loading rates show significantly increased loading rates in spring (March-May) for one of the towns (Petrosyan 2000). This town had mostly dirt/gravel roads and no paved sidewalks and did have the most snow in any of the towns sampled. Two of the towns showed significantly higher vacuum bag lead concentrations in the spring (March) and fall (November), with lowest concentrations observed in summer (July). However, dust mat concentrations were observed to be highest in summer months (July-September) in one town (Petrosyan 2000).

1.4.2 Sampling Methods

There is no clear consensus regarding the most appropriate methodology for sampling house dust. Historically, lead concentration in house dust has been the most common measurement. Generally, these sampling methodologies collect dust in a solid matrix form by vacuum or surface wipe techniques and report results in mass of lead/area. Current efforts are focusing more on measurement of lead loading (e.g., mg/m^2) or loading rates (e.g., $mg/m^2/day$). Collecting loading versus concentration measurements greatly affects sampling methodology. To determine concentrations, only a sufficient quantity of dust must be collected. However, to determine loading, dust must be collected from a specific area and/or time period. No standard or universally accepted house dust sampling technique has been developed to assess dusts inside the house, although HUD uses the dust wipe method for lead paint clearance standards. There is a general consensus, however, that the interior of the house serves as a reservoir for lead, especially soft surfaces (i.e., carpets and furniture), and that these media are most difficult to sample (CH2M HILL 1991, Adgate et al. 1995, Farfel et al. 2001, Lioy et al. 2002).

Methods developed to sample house dust vary among researchers. Vacuuming techniques and wipe methods have been studied. Lanphear et al. (1995) compared three dust collection methods in a side-by-side approach. The objectives of the study were threefold: i) to statistically determine whether lead loading or concentration was a better predictor of children's blood lead levels, ii) to statistically determine which dust collection method was a better predictor of children's blood lead levels, and iii) to determine which surface location within the house should be consistently sampled. Lead loading (µg/ft^2), as opposed to lead concentration (µg/g), showed a significantly higher correlation with children's blood lead levels. Of the three methods compared (wipe, Baltimore repair and maintenance (BRM), and dust vacuum method (DVM)), the BRM and wipe methods were more highly correlated with children's blood lead levels.

The effectiveness of vacuum dust collection methods depends on many factors, such as vacuum suction rate, carpet type, and lead distribution in the carpet. A study to determine relationships between wipe and vacuum collection methods observed difficulties with an in-line filter vacuum collection device containing a mixed cellulose ester filter and support pad attached to the air mover. Sample losses were noted due to the nozzle attracting dust particles to the rim and inner surface, the nozzle visibly pushed particulate matter beyond the edges of the sampling template, and visible particles and paint chips remained on sample surfaces after vacuuming (Farfel et al. 1994a). The same vacuum collection device (as the one discussed in Farfel et al. 1994a) showed the poorest percent collection efficiency in a study comparing three different vacuuming collection devices (Lim et al. 1995). In that same study by Lim et al. (1995), it was found that two of the three vacuum dust collection methods (Blue-nozzle and cyclone dust collectors) had greater than 85% collection efficiencies for all smooth and hard surfaces. However, collection efficiencies for carpeted surfaces were less than the 85% collection efficiency goal. A study by Bero et al. (1997) confirms the need for uniformity and reproducibility when sampling for lead in house dust. Under controlled laboratory conditions, three carpet types and six vacuum cleaner devices were tested for efficacy using three different soil lead concentrations. Mass removal efficiencies were greater for high volume vacuum devices than for low volume devices, ranging from 50-65% and 4-19%, respectively.

1.4.3 Sampling Location

A standard protocol for sampling interior dust predictive of childhood blood lead levels has not yet been promulgated, although the USEPA Technical Review Workgroup for Lead has identified this as a risk assessment priority. Some researchers have investigated different sampling areas inside the house, but have yet to agree on a standard house dust sampling location. Lanphear et al. (1995) suggests sampling non-carpeted floors and interior window sills or window wells as standardized sampling locations (using the BRM or wipe methods). Others have suggested that carpeted floors better represent exposures inside the house. Kim and Fergusson (1993) claim that carpeted floors make better sampling surfaces than hard surfaces because the dust on hard surfaces can move around easier, creating areas that may be unrepresentative of the dust lead in the house. In an analysis of twelve epidemiological studies, floor dust lead loading was determined to be the best environmental predictor of children's blood lead levels (Lanphear et al. 1998). These studies illustrate how important floor surfaces are to the sampling of house dust. Floor surfaces representing the area of the house where a child spends most of his/her time, or a composite of those areas (Farfel and Rohde 1995) will likely be the most useful for risk assessment purposes.

1.4.4 Standards for House Dusts

The USEPA to date has not defined a risk-based house dust lead standard. However, they have adopted the U.S. Department of Housing and Urban Development (HUD) post-abatement clearance standards for lead in house dust: 40 $\mu g/ft^2$ for floors, 250 $\mu g/ft^2$ for interior window sills, and 400 $\mu g/ft^2$ for window troughs, using the dust wipe collection method (Federal Register 2001 <http://www.epa.gov/lead/leadhaz.htm>). The USEPA uses these clearance standards as interim guidance levels for residential interior lead dust. However, the clearance standards are not risk-based and may not be protective of human health.

1.4.5 Previous Sampling Methods Employed at the BHSS

House dusts have been monitored at the Site as part of the Lead Health Intervention Program (LHIP) offered by the Panhandle Health District (PHD) since 1974. House dust lead concentrations have been determined for houses site-wide with young children by collecting a sample from the homeowner's vacuum cleaner bag during the annual blood lead census in July/August as a measure of exposure. Since 1996, house dust lead concentrations have also been sampled by a dust mat sampling technique. This method also measures an index of dust and lead loading rates at entryways into the houses (mass/area/time). This same dust mat technique was recently used by Farfel et al. (2001) in pre-1950 and new urban houses.

1.5 Purpose and Objectives

The primary purpose of the House Dust Pilot Project is to assess the feasibility of instituting an interior cleaning program in order to achieve and maintain low dust lead levels in the house (i.e., achieve the dust RAO for the Site). Available funding was insufficient to support an experimental design that could comprehensively compare all treatment and sampling techniques. Instead, the project was designed to gather information to assess the long-term effectiveness and efficiency of various levels of cleaning and to identify potential costs and logistical problems associated with any comprehensive community-wide cleanup that might be required.

The main objective of this project is to provide practical observations and baseline data to support managers in evaluating certain parameters (i.e., cost effectiveness, lead reduction, and logistical challenges) associated with implementing interior cleaning at the BHSS. This information will be used to assist in designing and implementing a large-scale or targeted response, if such an effort is required. That determination will be based on an assessment of health and environmental data to be conducted in conjunction with the 2002 LHIP survey.

The following specific objectives are defined for this project:

- To determine the cost, effort, and effectiveness of commercial house cleaning services versus a complete removal of permanent reservoirs of lead dust in addition to house cleaning.
- To determine the rate and magnitude of recontamination and dust and lead loading.
- To identify logistical, public health and safety, and contracting difficulties that may be encountered in a large scale cleaning effort.
- To assess sampling techniques for house dust.
- To identify other sources of lead exposure in houses that could be amenable to cleaning.

1.6 Project Scope and Limitations

This project involved the interior cleaning of 18 houses in Smelterville, selected through previous sampling and questionnaire results, and confirmed in subsequent interviews. Cleaning was limited to areas with potential for exposure (accessible portions of the residence, but including air ducts). Attics, basements and crawl spaces were not cleaned if these areas were not used by the residents in everyday activities (i.e., used for storage, unfinished, etc.). Five additional control houses in Smelterville were not cleaned but were sampled using the same methodologies as the houses undergoing interior remediation. Lead-based paint was not included in the remediation process; however, an assessment of the interior paint was completed by a certified HUD lead risk assessor. The remediation was to intended to clean reservoirs of lead-contaminated dust from past mining and smelting activities.

The project is limited to measuring dust lead concentrations and dust and lead loading rates in the 23 houses. Blood lead measurements were not collected as part of this project. However, families with young children were encouraged to participate in the 2000 and 2001 LHIP that monitors blood lead levels for the BHSS.

SECTION 2.0 PROJECT DESIGN

Smelterville houses that had previously participated in summer house dust surveys were eligible to participate in the House Dust Pilot Project. Initially, residences that had exhibited previous lead concentrations greater than 1000 mg/kg were solicited by explaining the project using a door-to-door approach. However, due to the mobile population and limited number of houses with high lead concentrations from 1997-2000, this subgroup of Smelterville was quickly exhausted. Houses with previous lead concentrations greater than 500 mg/kg were then added to the solicitation list. If a resident agreed to participate, a "Screening Interview Questionnaire" was completed (Appendix A). After a sufficient number of residents agreed to participate, a meeting (including State, EPA, and U.S. Army Corps of Engineers (USACE) representatives) was held to determine if certain characteristics were inappropriate for this project. It was agreed that houses or trailers recently built or moved into the area (i.e., within the last 3 years) would not be eligible.
The eligible participants were randomly assigned to one of the cleaning treatments or the Control Group. The USACE would then visit the house to gather information for relocation and explain the details of the HUD and Commercial cleaning processes. Information furnished and agreements provided to the residents by the USACE included Access Agreements, Relocation and Benefits Letter, Information Sheets, Replacement Value Sheet of Disposed Items, Furniture Replacement Sheet, Moving Instructions and Checklist, and a Key Release Sheet (Appendix B). The State's Consultant provided information to the residents regarding the samples that would be collected and secured a signed Participant Consent Form (Appendix C). Some participants dropped out of the program after they were informed of the assigned treatment and one participant withdrew prior to the cleaning. Cleaning Treatment C (Spring Cleaning) was added after the project was initiated, in order to cover a broad base of professional cleanings and costs. A second solicitation process was completed to replace the drop-outs and fill the new treatment. By this time, the annual summer sampling was completed and the 2000 vacuum bag and dust mat results were used to solicit new houses with lead concentrations greater than 1000 mg/kg and 500 mg/kg. The State's Consultant explained the details of the new cleaning treatment to the residents assigned to Treatment C and provided them with the Checklist of Cleaning Services to be completed at the house and Access Agreements (Appendix D). They also were provided with information regarding sample collection and signed a Participant Consent Form (Appendix C).

Details of the overall project (except for the Spring Cleaning Treatment) can be found in the *Interior House Dust Pilot Cleaning Work Plan* (TerraGraphics 2000c), and details pertaining to the sampling can be found in the *Field Work Plan for the House Dust Pilot Project Interior Dust Sampling* (TerraGraphics 2000d). Both these work plans are included in Appendix E.

2.1 Cleaning Treatments

Treatment Group A (6 houses) received a complete cleaning (including air ducts), with carpet and furniture replacement as described below. A certified HUD cleaning contractor performed this cleaning. Treatment Group B (6 houses) also received a complete cleaning (including air ducts), with carpet and soft furniture steam cleaning (rather than replacement) as described below. The residents from Treatments A and B were temporarily relocated for the duration of the cleaning. Treatment Group C (6 houses) received a one-day cleaning, without air ducts, steam cleaning, or using federal oversight. Two different commercial cleaning contractors were used for Groups B and C. For Groups A and B, an average of two houses per week (one HUD and one Commercial House) were cleaned. One house was cleaned per day for Group C, as the goal of this cleaning treatment was to measure the effectiveness of professional cleaning services completed in one day without direct oversight. The entire cleaning process for all houses occurred during the months of September and October, 2000.

The certified HUD Cleaning Contractor provided a cleaning outline (Appendix F). The HUD cleaning outline was used to check the cleaning outline created for Treatment B (Appendix G). Treatment B was modified for Treatment C to include one day's worth of cleaning (Appendix H). Separate cleaning methods were developed by Treatment Group for each of the house elements discussed in the following sections.

2.1.1 Treatment A - HUD Cleaning

The cleaning work plan prepared by the USACE's Contractor is in Appendix F and contains a detailed description of the services performed. All surfaces were cleaned in an orderly manner, progressing throughout the house from back to front in order to avoid recontamination of rooms already cleaned. High phosphate solutions were used to wet wash hard surfaces. The following briefly summarizes the cleaning process.

Carpets, Window Coverings and Upholstered Furniture: The HUD cleaning contractor removed and disposed of all rugs, carpets and underlayment early on the first cleaning day, after all the other furniture and personal items were moved out by professional movers. Carpet tack strip and any upholstered furniture being replaced was removed and disposed of early on the first cleaning day. Toss pillows or blankets/quilts/afghans, etc. that typically lay on the furniture were vacuumed or washed. Box springs and mattresses were cleaned (vacuumed) by the cleaning contractor. Mattresses were not replaced because they are not considered to be a repository of lead dust, since they are usually covered with bedding (i.e., sheets and blankets). All window coverings were removed and replaced under direction of the cleaning contractor.

Air Ducts: Ducts were cleaned by a sub-contractor under supervision of the cleaning contractor and the USACE to assure that lead hazards were not exacerbated during the cleaning. Ducts were cleaned on the first day after furnishings were removed from the house.

Walls, ceilings, and windows: Ceilings, light fixtures, and fans were cleaned first, followed by walls and windows. Ceilings and walls were first HEPA vacuumed and then wet washed. Windows were opened and storm windows removed so that the entire window trough and well area could be completely cleaned. If the window was sealed due to painting and not normally opened, the window was not opened for cleaning, in order to minimize paint breakage and the need for repainting.

Appliances, cupboards, and countertops: The cupboards and closet interior and exterior surfaces were cleaned in the same manner as walls, as were countertops. All exterior surfaces of appliances were cleaned; moveable appliances were moved in order to clean behind and under them. Special attention was given to refrigerator coils and undercarriages.

Floors: Floors were cleaned last after the other areas of the room had been cleaned. If the floor was carpeted, the carpets were removed. If the floors were vinyl or hardwood, the cleaning described in *Hard Surfaces* occurred.

Attics and Basements: Attics, basements, and crawl spaces were cleaned only if they were used as living space by the residents. Determination as to accessibility and whether they were cleaned was made at the time of the pre-cleaning interview.

2.1.2 Treatment B - Commercial Cleaning

The cleaning process created for the Commercial Cleaning Treatment is in Appendix G. Also located in Appendix G is the cleaning checklist used by the USACE during their oversight of this cleaning treatment. The following briefly summarizes the cleaning.

Carpets, Window Coverings and Upholstered Furniture: All carpets were initially cleaned using a HEPA filter vacuum and then steam cleaned using a high phosphate detergent, followed by HEPA vacuuming after they dried. Upholstered furniture was cleaned in the same manner. Box springs/mattresses were cleaned (vacuumed) by the cleaning contractor. All window coverings were removed and dry-cleaned at a local merchant under direction of the cleaning contractor.

Air Ducts: Ducts were cleaned by a sub-contractor under supervision of the cleaning contractor and the USACE to assure that lead hazards were not exacerbated during the cleaning. Ducts were cleaned on the first day before carpet and furniture cleaning.

Hard Surfaces: Hard surfaces (i.e., bookshelves, tables, etc.) were cleaned in an orderly manner, progressing throughout the house from back to front in order to avoid recontamination of rooms already cleaned. A high phosphate solution was used to wash all hard surfaces.

Walls, ceilings, and windows: Ceilings, light fixtures, and fans were cleaned first, followed by walls and windows. Ceilings and walls were first HEPA vacuumed and then wet washed. Windows were opened and storm windows removed so that the entire window trough and well area could be completely cleaned. If the window was sealed due to painting and not normally opened, the window was not opened for cleaning in order to minimize paint breakage and the need for repainting.

Appliances, cupboards, and countertops: The cupboards and closet interior and exterior surfaces were cleaned in the same manner as walls, as were countertops. All exterior surfaces of appliances were cleaned; moveable appliances were moved in order to clean behind and under them. Special attention was given to refrigerator coils and undercarriages.

Floors: Floors were cleaned last after the other areas of the room had been cleaned. If the floor was carpeted, cleaning described in the *Carpet* section occurred. If the floors were vinyl or hardwood, the cleaning described in *Hard Surfaces* occurred.

Attics and Basements: Attic, basement, and crawl spaces were cleaned only if they were used as living space by the residents. Determination as to accessibility and whether they were cleaned was made at the time of the pre-cleaning interview.

2.1.3 Treatment C - Spring Cleaning

The solicitation for bids describing the "Spring Cleaning", as well as the detailed cleaning protocol, is in Appendix H. The Spring Cleaning Treatment is a modified version of the Commercial Cleaning Treatment, intended to be completed in one day. The cleaning checklist provided to the cleaners and residents is contained in Appendix D.

Carpets, Window Coverings and Upholstered Furniture: All carpets, upholstered furniture, and window coverings were vacuumed using a HEPA filter vacuum.

Air Ducts: Air ducts were not cleaned as part of this treatment.

Hard Surfaces: Hard surfaces were cleaned in an orderly manner, progressing throughout the house from back to front in order to avoid recontamination of rooms already cleaned. Common cleaning household products were used by the cleaners.

Walls, ceilings, and windows: Ceilings, light fixtures, and fans were cleaned first, followed by walls and windows. Ceilings and walls were either HEPA vacuumed or wet washed. Windows were opened so that the entire window trough and well area could be completely cleaned. If the window was sealed due to painting and not normally opened, the window was not opened for cleaning, in order to minimize paint breakage and the need for repainting. Storm windows and screens were HEPA vacuumed and windows washed using common household products.

Appliances, cupboards, and countertops: Only the exterior surfaces of cupboards and closets were cleaned in the same manner as walls, as were countertops. All exterior surfaces of appliances were cleaned; moveable appliances were moved in order to clean behind and under them. Special attention was given to refrigerator coils and undercarriages.

Floors: Floors were cleaned after the other room areas had been cleaned. If the floor was carpeted, HEPA vacuuming occurred. If the floors were vinyl or hardwood, HEPA vacuuming or wet washing occurred. Furniture was moved in order to vacuum the floor underneath.

Attics and Basements: Attic, basement, and crawl spaces were cleaned only if they were used as living space by the residents. Determination as to accessibility and whether they were cleaned was made at the time of the pre-cleaning interview.

2.1.4 Treatment D - Control

No professional cleaning services were provided to the participants in the Control Treatment.

2.2 Sampling Protocols

Four sampling techniques were adapted for evaluating the treatment methods in this investigation. In addition, a separate methodology was developed to sample the dust removed during duct cleaning. Each is briefly discussed in the following sections. A complete description of the sampling protocols used is included in Appendix E, *Final Field Work Plan for the House Dust Pilot Project, Interior Dust Sampling* (TerraGraphics 2000d).

2.2.1 Vacuum Bag

The vacuum dust sample is intended to represent lead exposure to individuals inside the house. This method has the advantage of being quick, easy, and relatively inexpensive. A vacuum sample was obtained by collecting the disposable bag or the entire contents of permanent bags; provided the resident had not used the vacuum in a car, outdoors, or at another house since the bag was last changed. No sample was collected from vacuum cleaners that did not meet this criterion.

2.2.2 Dust Mat

A carpeted floor mat for dust collection was placed at all houses participating in the survey to quantify lead concentration, lead loading rate, and dust loading rates. Except for unusual circumstances, floor mats were placed just inside the main entry of each house. Instructions were left with the resident not to vacuum, shake or move the mat. After approximately three weeks, the mat was retrieved and carefully placed and stored right-side-up in a clean sealed envelope. The mat is vacuumed in a special laboratory to collect the dust retained on the mat. The mass of dust collected is used to determine the dust and lead loading rates (mg dust/ m^2/day).

2.2.3 Baltimore Repair and Maintenance (BRM)

The BRM floor sampling methodology is intended to represent the dust that has accumulated in the carpet (or hard floor) over time. This methodology was selected to better analyze the cleaning treatments and measure the dust and lead content in the carpets. Each room was separated into a twelve grid system, and three numbers were chosen at random. Three different one square foot areas from the floor in the kitchen, child's bedroom, and living room were randomly selected for sampling (EPA 1997). The sample was collected from the middle of each of the three grids selected. If furniture was in the way of the sample, then another grid was chosen randomly. One sample from each square foot area was collected sequentially in one sample container for a total of three floor composite samples for each house: the living room, a child's bedroom, and the kitchen. In four houses where children did not reside, the master bedroom was sampled.

2.2.4 Duct Sampling

For the HUD and Commercial Cleaning Treatments, the filter was collected from the cleaning equipment and sealed in a clean cardboard box immediately after the professional contractor finished cleaning the ducts. The box and filter were weighed prior to the cleaning and again after the cleaning, but before collecting the dust sample in order to determine the mass of dust removed from the air ducts. A grab sample from the filters represents a general lead concentration found in the ducts of the house. The purpose of the duct cleaning and sampling was to characterize and remove this potential reservoir of lead dust in the house.

2.2.5 Attic and Basement Sampling

Attics and basements were not part of the cleaning for this pilot project because the Screening Interview Questionnaire indicated several of the attics and basements were rarely used or accessed, no problems with the attics and basements have been indicated in the LHIP, and logistical problems associated with accessibility and asbestos could have been encountered.

Samples of the attic and basement dust provide a general representation of that potential reservoir of lead. A composite sample was collected only from houses where the attic and/or basement was not used for living space and accessible. If the attic or basement was used for living space, then it was assumed the vacuum bag sample would also represent that living area. No attic samples were obtained from insulation. A modification to the collection method used for attic/basement samples was made. After field sampling began, it was determined that using the BRM in the attics and basements was more effective than using the camel hair brush as the work plan specified. Prescribed areas in the attic and/or basement were measured and BRM sampling occurred as described in Section 2.2.3.

2.2.6 HUD Lead Risk Assessment
A certified HUD lead risk assessor (HUDRA) was contracted by the USACE to perform a lead risk assessment and collect dust wipe samples. The HUDRA's work plan is located in Appendix I, where a more detailed description of the sampling activities is provided.

2.2.6.1 Lead Paint Risk Assessment
According to HUD, "A risk assessment is an onsite investigation of a residential building to determine the location, severity, and nature of lead-based paint hazards..." (HUD 1995). Paint condition was assessed and, using a portable x-ray fluorescence (XRF), lead content in the paint was determined. The purpose of the risk assessment was to identify those houses in the HUD, Commercial, and Control Treatments that may contain lead-paint hazards (i.e., lead-based paint in deteriorating condition). Most houses built prior to 1970 contain lead-based paint.

2.2.6.2 Dust Wipe Sampling
Dust wipe sampling determines the mass of lead in dust per square foot of surface area. Dust wipe samples were collected from one window in the living room and one window in the child's bedroom (same rooms sampled using the BRM), from both the window sill and window well as described in Appendix I. The dust wipe is a controlled sampling method, but because windows are friction surface areas, samples may be influenced by chalking, chipping, or erosion of lead-based paint.

2.2.7 Indoor Air Monitoring
The USACE provided indoor air monitoring of dust during the HUD and Commercial Cleaning Treatments. This sampling was performed to determine indoor dust levels during the cleaning process to monitor health and safety of the workers. MIE DataRAMs were used to continuously monitor all of the Treatment A and B houses during the furniture removal, cleaning, and any construction/remodeling operations.

2.3 Sampling Frequency

Sampling was conducted at several times during the project including pre- and post cleaning, during cleaning activities, and at six and twelve months following cleaning. Table 2.1 summarizes the method, location, and frequency of sampling in each of the Treatment Groups. Attics and basements were only sampled at the beginning of the project to measure the lead concentration from known reservoirs of dust/soil. The rationale for sampling these areas once was that they are rarely used or inaccessible, and the lead concentration was assumed to remain the same over the course of the project. Air ducts were only sampled after the cleaning because of the sampling method. The duct sample was intended to represent dust from deep inside the air duct system (i.e., the reservoir). A different sampling method would have been required had duct samples been collected during pre-, post-, 6-month, and 12-month sampling. However, the rationale was that after the ducts were cleaned, the reservoir would have been removed and the dust settling back into the duct system over the course of the project would not be much different from the other samples collected from that house or exterior soil concentrations. The HUDRA's lead paint assessment was also only performed at the beginning of the project, assuming the condition of the paint would not change considerably over the course of the year.

SECTION 3.0 SUMMARY OF HOUSING CHARACTERISTICS

The Screening Interview Questionnaire (Appendix A) completed at each participating residence during the pre-cleaning interview included questions about the age of the house and the carpet, length of residence, frequency of cleaning, condition of carpet and window treatments, number of people living in the house, presence of pets, etc. This section summarizes the characteristics of all participating houses determined from the questionnaire and house visit.

3.1 Age of Houses

Table 3.1 summarizes the general housing characteristics described in Sections 3.1 through 3.4. Of the six houses in the HUD Cleaning Treatment, the oldest was built in 1938 (62 years old at the time of cleaning), the newest was built in 1978 (22 years old at the time of cleaning), and the average age of the HUD Cleaned houses was 52 years. Of the six houses Commercially Cleaned, the oldest was built in 1930 (70 years at the time of cleaning), the newest was built in 1971 (29 years old at the time of cleaning), and the average age of the Commercially Cleaned houses was 57 years. Of the six Spring Cleaned residences, the oldest was built in 1900, the newest was built in 1993 (7 years old at the time of cleaning), and the average age of the Spring Cleaned houses was 54 years old. Of the five houses in the Control Treatment, the oldest was built in 1930, the newest was built in 1976 (24 years old), and the average age of the Control houses was 44 years (Table 3.1). Overall, the oldest house sampled was 100 years old, the newest was 7, and the average for all the houses was 52 years old.

3.2 Owner vs. Renter Occupancy

Five out of the six houses of both the HUD and Commercially Cleaned houses were occupied by the homeowner, and 1 house was occupied by renters (Table 3.1). The Spring Cleaned houses were evenly split between owners and renters. All five of the Control houses were occupied by the homeowners.

3.3 Interior Remodeling

Two out of the six houses in the HUD Treatment had experienced some degree of interior remodeling, such as sanding or removing/remodeling of window sills (Table 3.1). Four out of the six houses in the

Commercial Treatment had been remodeled on the interior. One out of the six houses in the Spring Treatment have had some interior remodeling. Finally, two out of the five Control houses had interior remodeling (Table 3.1).

3.4 Rugs at Entrances

The presence of a throw rug or some form of dust mat at the entrances to a house generally decreases the amount of dust and dirt that is brought into the house (TerraGraphics 2000a). Five out of six houses in the HUD Cleaning Treatment had some kind of rug present at one or more entrances (Table 3.1). Two out of six Commercial Cleaned houses had a rug at one or more entrances, the remaining four had a rug at all the entrances. Four out of six of the Spring Cleaned houses had a rug at one or more entrances, the remaining two had one at all the entrances. Three out of five Control houses had a rug at one or more entrances, and the remaining two had a rug at all entrances (Table 3.1).

3.5 Carpet Age

Table 3.2 summarizes the age of the carpets in each treatment group. Few of the houses in the project had carpet in the kitchen. One HUD Cleaned house had a 10 year old carpet in the kitchen, two Commercial houses had kitchen carpet, one was five years old, and one was seven years old. One of the Spring Cleaned houses had six month old carpet in the kitchen, and one of the Control houses had 20 year old carpet in the kitchen (Table 3.2).

All of the houses had carpeted living rooms (Table 3.2). The average age of the living room carpet in the HUD Cleaned houses was 9.7 years, the oldest was 20 and the newest was two years. The average age of the living room carpet in the Commercial houses was 6.8 years, the oldest was 20 and the newest was two years. The average age of the living room carpet in the Spring Cleaned houses was 12.3 years, the oldest was 30 years and the newest was five months. The average age of the living room carpet in the Control houses was 15.2 years, the oldest was 30 and the newest was one year.

Few houses had carpet in the dining area (Table 3.2). Two of the Commercial houses had dining room carpet, one was four years old and the other was seven. One of the Control houses had 20 year old carpet in the dining room.

All of the houses except for one Commercial house had carpet in the master bedroom (Table 3.2). The average age of the master bedroom carpet in the HUD Cleaned houses was 11.8 years, the oldest was 20 and the newest was two years. The average age of the master bedroom carpet in the Commercial houses was 2.8 years, the oldest was five years and the newest was three months. The average age of the master bedroom carpet in the Spring Cleaned houses was 14.2 years, the oldest was 30 and the newest was four years old. The average age of the master bedroom carpet in the Control houses was 12.9 years, the oldest was 20 and the newest was four.

Among the HUD Cleaned houses, there were six other bedrooms that were carpeted (Table 3.2). The average age of the carpet in a non-master bedroom among the HUD Cleaned houses was 10 years old, the oldest was 20 years, and the newest was two years. The average age of the carpet in a non-master bedroom among the Commercially Cleaned houses (nine other bedrooms were present in the Commercial category) was 6.3 years old, the oldest was 15 years, and the newest was one year. The average age of the carpet in a non-master bedroom among the Spring Cleaned houses (seven other bedrooms) was 14.4 years old, the oldest was 30 years, and the newest was four years. The average age of the carpet in a non-master bedroom among the Control houses (eight other bedrooms) was 13.7 years old, the oldest was 20 years, and the newest was six years.
One of the Commercial houses had another room with five year old carpet, and one of the Spring Cleaned houses had another room with five year old carpet, as well. On average, the Commercially Cleaned houses had the newest carpets of all treatments.

3.6 Carpet Condition

The carpets in the houses were visually inspected by trained technicians performing the Screening Interview. The condition was determined based on the appearance of the carpet (tears, "bald spots", stains, etc.). The condition codes used to characterize the carpet included "Good Condition", "Slightly dirty, frayed, etc", "Moderately dirty, frayed, etc", and "Poor Condition". Table 3.3 summarizes the condition of the carpets in each treatment.

The average kitchen carpet in the HUD Cleaned and Control houses was ranked as "Moderately Dirty", the average kitchen carpet in the Commercial houses was "Slightly Dirty", and the average kitchen carpet in the Spring Cleaned houses was in "Good Condition" (Table 3.3). The average living room carpet in all of the houses was ranked as "Slightly Dirty". The average dining room carpet in the Commercial houses was "Slightly Dirty", and the Control house was "Moderately Dirty". The average bedroom (both master and other) carpet for the Commercial houses was determined to be "Slightly Dirty", and the HUD Cleaned, Spring Cleaned, and Control houses were "Moderately Dirty". The carpets in the other rooms in the Commercial and Spring Cleaned house were in "Good Condition".

3.7 Carpet Types

The type of carpet in each of the rooms was also classified as either Shag, Berber, Indoor/ outdoor, Sculptured, or Plush. All of the kitchen carpets were classified as Indoor/outdoor. Table 3.4 summarizes the types of carpets observed in each house.

The living room carpet in the HUD Cleaned houses was 17% Shag, 17% Berber, 33% Sculptured, and 33% Plush. The living room carpet in the Commercial Cleaned houses was 17% Indoor/outdoor, 67% Sculptured, and 17% Plush. The living room carpet in the Spring Cleaned houses was 33% Sculptured and 67% Plush. The living room carpet in the Control houses was 20% Shag, 60% Sculptured, and 20% Plush (Table 3.4).

Of the two Commercially Cleaned houses that had carpet in the dining room, one was Indoor/outdoor, and the other was Plush. The carpeted dining room in the Control house was Indoor/outdoor.

Seventeen percent of the HUD master bedrooms were Shag, 50% were Sculptured, and 33% were Plush (Table 3.4). Twenty percent of the master bedrooms with carpet in the Commercial houses had Shag, 20% were Berber, and 60% were Plush. Sixty percent of the Spring Cleaned master bedrooms were Sculptured and 40% were Plush. Twenty percent of the Control houses master bedrooms were Shag, 40% were Sculptured, and 40% were Plush.

Seventeen percent of the HUD other bedrooms were Shag, 17% were Indoor/outdoor, 33% were Sculptured, and 33% were Plush (Table 3.4). Eleven percent of the Commercial other bedrooms were Shag, 22% were Indoor/outdoor, 44% were Sculptured, and 22% were Plush. Fourteen percent of the Spring Cleaned other bedrooms were Indoor/outdoor, 43% were Sculptured, and 43% were Plush. Thirty-eight percent of the other bedrooms in the Control houses were Shag, 13% were Berber, 13% were Sculptured, and 38% were Plush.

The other room in the Commercially Cleaned house was Indoor/outdoor, and the other room in the Spring Cleaned house was Berber.

3.8 Number and Age of Residents

The total number of people living in a house has been observed to affect the amount of dust entering a house (TerraGraphics 2000a). The age of the residents is also a factor, as children may track more dust into the house due to their play activities outside. For the purposes of this report, a resident was considered an adult if he or she was 18 years of age or older.

Table 3.5 summarizes the number and age of residents in each house. A total of 14 adults and nine children (average age of 6) lived in the six houses that received the HUD cleaning, 13 adults and six children (average age of 8) occupied the six Commercial houses, 13 adults and nine children (average age of 10) lived in the Spring Cleaned houses, and 10 adults and eight children (average age of 11) occupied the five Control houses.

3.9 Smoking Habits

Table 3.6 summarizes the smoking habits of residents. Four of the six HUD Cleaned houses had residents who smoked an average of 1.1 packs of cigarettes per day. Two of the six Commercially Cleaned houses had residents who smoked an average of 1.3 packs per day. Two of the six Spring Cleaned houses had residents who smoked an average of 1.0 pack per day. Four of the five Control houses had residents who smoked an average of 1.1 packs per day.

3.10 Ductwork

If a house had a heating or cooling system involving ducts in the HUD and Commercial Cleaning Treatments, the ducts were professionally cleaned. Table 3.7 summarizes the centralized heating and air conditioning ducts in the houses of each treatment group. Three out of six HUD Cleaned houses have Centralized Heating/Air Conditioning. All of the Commercially Cleaned houses, two out of four Spring Cleaned houses, and three out of five Control houses had ducts.

The average age of the ducts in the HUD Cleaned houses is 7.5 years, although at one house, the resident was unsure of the age (Table 3.7). The residents at all of the HUD Cleaned houses reported that they never clean the ducts. The average age of the ducts in the Commercially Cleaned houses is 7 years. Four out of six participants said they never clean the ducts, while the remaining two reported that they cleaned them at an interval of “other”. The choices were: more than two times per year, once a year, never, or other. The average age of the ducts in the Spring Cleaned houses is 11.8 years. All of the participants said they cleaned their ducts once a year. The average age of the ducts in the Control houses is 5 years, and one participant was unsure of the age. All of the Control participants said they never cleaned the ducts.

3.11 Basements and Attics

Although many of the houses had either an attic, basement, or both, these areas were only cleaned if they were used as living space. However, samples were collected whether they received a cleaning or not. If a basement or attic is determined to be contributing to high dust lead, the data may help to explain any recontamination that may be observed.

Table 3.8 summarizes the basement and attic characteristics. Of the six HUD Cleaned houses, four had accessible basements, and three had accessible attics. Only one of these four basements was used for living area, while the remaining three were unfinished. Three out of four basements had dirt floors. Two of the three attics were unfinished, and the remaining one was used for other purposes.

Of the six Commercially Cleaned houses, four had accessible basements, and three had accessible attics (Table 3.8). One of the basements was unfinished, while the remaining three were used for storage. One had dirt floor. One of the three attics was unfinished and the remaining two were used for other purposes.

Of the six Spring Cleaned houses, one had an accessible basement, and three had accessible attics (Table 3.8). The basement was used for storage. Two of the three attics were unfinished. One was used for storage, and one for other purposes. One of the attics was reported as both unfinished and storage area.

Of the five Control houses, one had an accessible basement (used as a living area), and two had accessible attics. Both attics were used as storage, and one of them was unfinished as well.

SECTION 4.0 RESULTS AND DISCUSSION

Interim data summary memos prepared by the State's Consultant were completed after the post-cleaning sampling and the 6-month sampling events for the vacuum, dust mat, BRM, attic/basement, and air duct. These data summary memos are included in Appendix J. The following summarizes all data through the 12-month sampling and discusses these results by sampling method and treatment. As discussed in Section 1.5, this project was not designed to statistically test hypotheses, but to gather as much information as possible for decision-makers. Consequently, these data are presented graphically, rather than performing rigorous statistical analysis.

Three additions/modifications to the sampling plan were added after the project was initiated. One modification was the sampling of couches from three houses that, upon visual inspection in the field, yielded inadequate sample volume for the kitchen BRM. The couch samples were collected using the described BRM method from the work plan and are discussed in Section 4.1.3.4 (TerraGraphics 2000d). The second addition was the collection of carpet samples from the HUD Cleaned houses. The carpet samples underwent the Toxicity Characteristic Leaching Procedure (TCLP) to characterize waste for the ICP Landfill and are discussed in Section 4.4. The third modification was to the collection method used for attic/basement samples. In the field, it was determined that using the BRM in the attics/basements was more effective than using the camel hair brush. Attic and basement results are discussed in Section 4.1.5.

4.1 House Dust Sample Results

4.1.1 Mat Dust

Dust mat data are presented in Tables 4.1a-c and Figures 4-1 through 4-4c. Figures 4-1 through 4-3 show box plots of the data by treatment, while Figures 4-4a-c show line plots of all data. Appendix K presents Figures 4-4a-c individually by treatment for ease of reading. Box plots show the 5th, 25th, 50th, 75th, and 95th percentiles of the data as well as any outliers. The 50th percentile is represented as the middle line inside the "box". Figure 4-4a also presents participating houses' mat lead concentration data from years prior to this pilot project.

The dust mat sampling methodology may not be the best indicator of remedial effectiveness as this sampling methodology reflects the mass of dust and lead entering the house and may not be affected by a one time cleaning of the home interior. The dust mat loading rates may also reflect seasonal variations (Figures 4-4b and 4-4c). Figures 4-2a-d and Table 4.1b show the highest dust loading rates were from the 6-month sampling which took place in spring (April 2001). The average dust loading rate for the Control houses was also highest in the Spring at 1899 mg/m^2/day compared to summer levels of 651 mg/m^2/day at the time of pre-cleaning sampling and 557 mg/m^2/day at the time of 12-month sampling (Table 4.1b).

HUD Cleaned Houses: Dust mats were collected from five of the six HUD Cleaned houses during the 12-month sampling event. The lead concentration in the mats did not decrease after the cleaning, but on average, concentrations were lowest at the time of the 12-month sampling (Figure 4-1a and 4-4a). The average 6-month dust loading rate (818 $mg/m^2/day$) was highest, while pre- and post-cleaning rates remained nearly equal (Table 4.1b). Figures 4-3a and 4-4c show the lead loading rates were also highest at the time of the 6-month sampling (average of 0.845 $mg/m^2/day$ - Table 4.1c).

Commercially Cleaned Houses: Dust mats were collected from all six Commercially Cleaned houses during the 12-month sampling event; however, one sample yielded insufficient volume for analysis. On average, the highest mat lead concentrations for the Commercial houses were observed at the time of post-cleaning and 6-month sampling (Table 4.1a and Figure 4-1b). Excluding the 6-month data outlier from one house in Figures 4-2b and 4-3b, dust and lead loading rates for the Commercial houses showed the least variation throughout the four sampling events and compared to the other treatments.

Spring Cleaned Houses: Dust mats were collected from five of the six Spring Cleaned houses during the 12-month sampling event; one participant moved away, and the house was empty for both the 6- and 12-month sampling events. The Spring Cleaned houses showed the most variation in concentrations and loading rates compared to the other treatments (Figures 4-1 through 4-3). Figure 4-1c shows the mat lead concentration increased after the cleaning. On average, lead concentrations were highest at the post-cleaning and 12- month sampling (1130 mg/kg and 1365 mg/kg, respectively - Table 4.1a). The mat dust and lead loading rates fluctuated throughout the sampling events but were highest in spring at the 6-month sampling (Figures 4-4b and 4-4c).

Control Houses: Of the original five Control houses, one participant moved away soon after pre-cleaning sampling, leaving four houses, and one house had a different (new) resident after pre-cleaning sampling. Dust mats were collected from four Control houses with sufficient volume for laboratory analysis for the 6- and 12-month sampling events. These houses were not sampled at post-cleaning, assuming that dust levels would not change substantially in the 3 month time period the cleanings took place. In Figures 4-4a-c for the Control houses, the pre-cleaning results were assumed to be the same for post-cleaning. Control houses, in general, showed little change in lead loading rates, except for slight increases at the 6-month sampling event (Figures 4-3b and 4-4c). Figure 4-4a shows mat lead concentrations in one Control house had markedly decreased by the time of 6- and 12-month sampling.

4.1.2 Vacuum Bag Dust

Table 4.2 and Figures 4-5 through 4-6 present vacuum bag dust lead concentrations. Appendix L contains Figure 4-6 separated into 4 graphs by treatment for ease of reading. Vacuum bag data generally represent the lead concentration found inside a house; however, if the vacuum was used somewhere outside the house, then the bag was not collected. No vacuum samples were obtained from houses where the resident did not have a vacuum, had a rainbow (wet) vacuum, or had used the vacuum outside the house. There were more unavailable vacuum bags toward the 6- and 12-month sampling events as participants either moved away or new residents moved in.

In general, lead concentrations have decreased in the city of Smelterville, including the participating households. Figure 4-6 shows line graphs for the participating households, as well as their data from previous years prior to the Dust Pilot Project.

HUD Cleaned Houses: Vacuum dust was collected from all six HUD Cleaned houses during the Six-month sampling event. However, only four vacuum bag samples were collected during the 12-month sampling event. Figure 4-5a shows no trend in lead concentrations from vacuum bags in the HUD Cleaned houses, except at 12-months, the least variation was observed. The highest average concentration of 723 mg/kg was observed at the time of the post-cleaning sampling event (Table 4.2).

Commercially Cleaned Houses: One participant in the Commercial Treatment had a rainbow vacuum, and no samples were collected from this home. At the time of the 12-month sampling, three more participants had unavailable vacuum bags. In general, there is little variation in the lead concentrations from the Commercial Treatment compared to the other treatments as observed in Figures 4-5 and 4-6. A slight decrease in average lead concentrations was observed post-cleaning. The pre-cleaning average was 507 mg/kg, the post-cleaning average was 415 mg/kg, the 6-month average was lower at 378 mg/kg, and the 12-month concentrations averaged 445 mg/kg (Table 4.2).

Spring Cleaned Houses: One resident had a rainbow vacuum and a dustbuster vacuum, but the dustbuster broke after the pre-cleaning sampling, so a dust sample was not collected from that participant for the remainder of the sampling events. As observed in Figure 4-6 (or Figure 4-6-L3 in Appendix L), significant decreases in lead concentrations have occurred in the Spring Cleaned houses since 1988, with only slight decreases occurring since the dust pilot cleaning. The average pre-cleaning concentration for the Spring Cleaned houses was 598 mg/kg, and the post-cleaning average was 471 mg/kg (Table 4.2). As seen in Figure 4-6, there was one outlier that skewed the 6-month average, but the 12-month concentration averaged 570 mg/kg, near pre-cleaning levels (Table 4.2).

Control Houses: One participant had a rainbow (wet) vacuum and dust samples were not collected. One participant moved away after the pre-cleaning sampling, so a total of four vacuum samples were collected at the time of the 6- and 12-month sampling events. Only ranges are discussed because there are only a few vacuum samples for the Control houses; the four pre-cleaning results ranged from 224-2200 mg/kg, the three 6-month results ranged from 910-2100 mg/kg, while the 12-month results ranged from 400-1030 mg/kg (Table 4.2). Pre-cleaning concentrations were used for the post-cleaning concentrations in Figure 4-6.

4.1.3 BRM Dust

4.1.3.1 Living Room BRM

Tables 4.3a-c and Figures 4-7 through 4-10c present all BRM Living Room results. Figures 4-10a-c are presented in Appendix M separated by treatment for easy viewing. The BRM sampling methodology is likely the most appropriate method to determine remedial effectiveness. BRM carpet samples were the most controlled sampling methodology used in this project, meaning the samplers could document all aspects of the sampling. Whereas, vacuum bag and dust mat sample results may be unknowingly influenced by the resident, and do not remain under control of the sampler.

BRM sampling has not been used at the BHSS prior to this project, so there are no data from previous years to compare or analyze trends. As expected, lead concentration decreased in the HUD Treatment, as those houses received new carpeting (Figures 4-7a and 4-10a). Although there are only 6 houses per treatment, living room BRM results show that the HUD Treatment was most effective at reducing lead concentrations and dust and lead loadings.

HUD Cleaned Houses: The HUD Cleaned houses received new carpet, and while most samples contained a large volume of carpet fibers at the time of post-cleaning sampling, all but one contained sufficient dust volume for analysis. All six of the living room BRM samples yielded sufficient volume for laboratory analysis during the 6-month sampling event. One participant was never home at the time of the 12-month sampling, but the five samples collected contained sufficient volume for analysis. The average lead concentration in the living room carpets was 673 mg/kg pre-cleaning, and the average new carpet post-cleaning lead concentration decreased to 194 mg/kg (Table 4.3a). However, the 6- and 12-month average lead concentrations increased to near pre-cleaning levels of 670 mg/kg and 720 mg/kg, respectively (Table 4.3a). As seen in Figure 4-10a (or more clearly in Figure 4-10a-M1), one HUD Cleaned house contained a lead concentration greater than 1000 mg/kg at the time of pre-cleaning, decreased by 84% at post-cleaning, and remained below pre-cleaning levels at the 6- and 12-month sampling. This house remained at about half the pre-cleaning lead concentration for the year after the cleaning.

Figure 4-8a shows dust loading substantially decreased after the cleaning, but on average, slowly increased within the year. Twelve-month dust loading results averaged 10.74 g/m^2 compared to pre-cleaning levels that averaged 22.83 g/m^2 (Table 4.3b). This same trend is observed in the lead loading for the HUD Treatment, as observed in Figures 4-9a and 4-10c. However, one house had a high lead loading at the time of the 12-month sampling, skewing the results. Figure 4-9a shows the 50^{th} percentile (as the middle line inside the box) for 12-month sampling nearing the pre-cleaning 50^{th} percentile.

Commercially Cleaned Houses: All six houses for every sampling event yielded sufficient volume for laboratory analysis. On average, lead concentrations did not decrease after the cleaning (Figures 4-7b and 4-10a). Pre-cleaning results averaged 409 mg/kg, post-cleaning results averaged 528 mg/kg, 6-

month sampling averaged 483 mg/kg, and 12-month sampling results averaged 440 mg/kg (Table 4.3a).

Figure 4-10b (or Figure 4-10b-M6 in Appendix M) graphically shows decreased dust loadings in all houses after the cleaning, as expected. Lead loadings also slightly decreased after the cleaning (Figure 4-10c), but increased to or above pre-cleaning levels by the time of the 6- and 12-month sampling events (Figure 4-9b and 4-10c).

Spring Cleaned Houses: One participant moved away before the 6-month sampling event, and no person moved into that house afterwards. This resulted in six samples for pre- and post-cleaning and five samples for 6- and 12-month. Two of the six houses had substantially decreased lead concentrations after the cleaning, and one of those houses remained at concentrations below pre-cleaning levels; the other house is where the participant moved away (Figure 4-10a or see Appendix M). However, at the one home where lead concentrations remained below pre-cleaning levels, these concentrations were greater than 1000 mg/kg.

Pre- and post-cleaning dust loading results averaged around 13 g/m^2, while 6- and 12-month results averaged around 18 g/m^2 (Table 4.3b). Figures 4-8c and 4-9c show dust as well as lead loadings were not affected by this cleaning treatment. Figures 4-10c shows one of the six homes with decreased lead loadings post-cleaning; however, this is the house where the participant moved away and no samples were collected at 6- and 12-months.

Control Houses: All four living room BRM samples from the Control houses yielded sufficient sample volume for laboratory analysis during the 6-month and 12-month sampling events. In general, lead concentrations fluctuated as observed in Figure 4-10a (also see Appendix M) or slightly increased as observed in Figure 4-7d. Dust and lead loadings generally remained about the same throughout the year. However, the pre-cleaning and 12-month results were highest among all treatment groups (Tables 4.3b-c).

4.1.3.2 Child's Bedroom BRM

Tables 4.4a-c and Figures 4-11 through 4-14c show all the BRM child's bedroom data. Figures 4-11 through 4-13 show box plots of the data by treatment and Figures 4-14a-c show line graphs of the data. Appendix N contains Figures 4-14a-c individually by treatment. The bedroom BRM results again support the HUD Treatment as being most effective at reducing dust and lead loadings.

HUD Cleaned Houses: Lead concentrations and dust and lead loadings all decreased post-cleaning (Figures 4-11a, 4-12a, and 4-13a). However, lead concentrations increased by the 6-month sampling (Figure 4-14a - also see Appendix N). Pre-cleaning concentrations averaged 583 mg/kg and 12-month concentrations averaged 486 mg/kg (Table 4.4a).

Dust loadings significantly decreased after the cleaning, as expected, and remained low throughout the following year (Figure 4-12a). Lead loadings also decreased post-cleaning from a pre-cleaning average of 6.85 mg/m^2 to a post-cleaning average of 0.25 mg/m^2 and remained low at about 3 mg/m^2 at 6- and 12-months (Table 4.4c). Figures 4-12a, 4-13a and 4-14b-c (see also Appendix N) show that the HUD Treatment was effective at reducing and maintaining dust and lead loadings throughout the year.

Commercially Cleaned Houses: Three of the six Commercially Cleaned houses showed increases in lead concentrations in the bedroom post-cleaning (Figure 4-14a - or see Appendix N), two of the six houses showed decreases in lead concentration post-cleaning (Figure 4-14a - or see Appendix N), and one remained approximately the same throughout the year. The average 12-month lead concentration was the highest (1125 mg/kg) of the sampling events and of the other Treatment Groups (Table 4.4a). Dust and lead loadings were both affected by this cleaning treatment and decreased post-cleaning (Figures 4-12b and 4-13b). However, lead loadings increased to about pre-cleaning levels by the 12-month sampling (Figure 4-14c - see also Appendix N).

Spring Cleaned Houses: The Spring Cleaning Treatment did the least to affect lead concentration and dust and lead loadings (see Figures 4-11c through 4-13c). As observed in Figures 4-14a-c (see also Appendix N), lead concentrations, dust loadings, and lead loadings in the bedrooms in this treatment remained nearly equal in each of the five houses throughout the year.

Control Houses: Figure 4-14a also shows the same trend as the Spring Cleaned houses; concentrations remained nearly equivalent throughout the year. One house did show a substantial decrease in both dust and lead loadings at the time of the 6-month sampling. A sample was not collected at 12-months as remodeling was underway in this bedroom. Except for the 12-month results, average BRM lead concentrations were lowest among the Treatment Groups (Table 4.4a). However, average lead loadings in the Control bedrooms were highest among Treatment Groups, excluding one 12-month outlier in the Commercial Treatment (Table 4.4c).

4.1.3.3 Kitchen BRM

Tables 4.5a-c and Figures 4-15 through 4-17 show all BRM kitchen lead concentrations and dust and lead loadings by treatment. Line graphs were not made for the kitchen samples because too many contained insufficient sample volume for lead analysis. The BRM sampling technique is not as effective on hard surfaces in living areas cleaned at certain intervals versus the carpets. It was difficult in many cases to vacuum enough sample, even after increasing the square footage vacuumed. If the randomly selected square foot to be vacuumed landed on a floor mat the resident normally keeps in the kitchen, the mat was vacuumed.

HUD Cleaned Houses: Only pre-cleaning and 6-month samples contained enough volume for analysis. Lead concentrations remained about the same with an average of 767 mg/kg for pre-cleaning and an average of 640 mg/kg for 6-month (Table 4.5a). The HUD Treatment was the only cleaning treatment where no samples from the post-cleaning contained enough volume for lab analysis (Figures 4-15 and 4-17). However, it is also the only treatment with no carpeting or floor mats in the kitchens.

Dust loadings decreased post-cleaning and remained below pre-cleaning levels throughout the year (Figure 4-16a). Pre-cleaning dust loadings averaged 8.44 g/m^2, while post-cleaning levels decreased to an average of 0.20 g/m^2 (Table 4.5b). The average lead loading for the 6-month sampling was 0.99 mg/m^2 and remained below the pre-cleaning average of 4.49 mg/m^2 (Table 4.5c).

Commercially Cleaned Houses: During the post-cleaning sampling event, five floors yielded a large enough sample for analysis, while only four had a detectable amount of lead. Lead concentrations did not decline post-cleaning and remained about the same throughout the year (Figure 4-15b). Dust loadings decreased in the kitchens from an average of 13.14 g/m^2 pre-cleaning to 3.34 g/m^2 post-cleaning (Table 4.5b). However, dust loadings increased to pre-cleaning levels by the 6- and 12-month sampling events (Figure 4-16b).

Spring Cleaned Houses: Two to three kitchen BRM samples from the Spring Cleaned houses yielded sufficient sample volume for laboratory analysis from the post-cleaning, 6- and 12-month sampling events. Lead concentration and dust and lead loadings decreased in the kitchens during the post-cleaning, but all increased to pre-cleaning levels by the 6- and 12-month sampling events (Figures 4-15 through 4-17).

Control Houses: As observed in the Spring Cleaning Treatment, only two to three samples from all three sampling events yielded sufficient sample volume for laboratory analysis. However, these two to three houses show decreased dust and lead loadings for the 6- and 12-month sampling events (Figures 4-16d and 4-17d).

4.1.3.4 Couch BRM

Early in the project while collecting pre-cleaning samples, a few houses appeared by visual inspection of the sample volume, to yield insufficient dust for analysis from the kitchen BRM samples, even though five or more square feet were vacuumed. Because it was thought that these houses would be missing a BRM sample, a decision was made in the field to also try to collect dust from the couch. The couch samples were collected in the same manner as the other BRM samples as described in the field work plan in Appendix E (TerraGraphics 2000d). Two of the three couches sampled were in the HUD Treatment and the other was from the Control Treatment. The one couch from the Control Treatment exhibited lead concentrations around 200 mg/kg throughout the duration of the project. The two couches from the HUD Treatment were around 1000 mg/kg at the time of pre-cleaning sampling. One of these couches was 720 mg/kg at post-cleaning sampling (due to some miscommunication, this couch was sampled approximately 3 weeks after being moved into the house), 800 mg/kg at 6-month sampling, and back to near pre-cleaning levels of 930 mg/kg at the time of the 12-month sampling. The other couch contained insufficient sample volume at the time of post-cleaning sampling, was 720 mg/kg at 6-month sampling, and 350 mg/kg at 12-month sampling. The lead loadings on both the HUD couches remained below pre-cleaning levels. In general, soft furniture can also be a reservior of leaded dust, and results follow similar patterns as the other BRM results.

4.1.4 Mat, Vacuum, and BRM Paired Analysis

Using pre-cleaning data only, correlations were performed on the lead concentrations and dust and lead loadings (for mats, dust and lead loading *rates*). Table 4.6a shows the lead concentration correlations. The highest correlations were observed between the kitchen BRM lead concentration and the living room lead concentration (r=0.86) and the living room BRM lead concentrations and the vacuum bag lead concentration (r=0.83), as well as the mat concentration and the kitchen BRM concentration (r=0.77) and the mat concentration and the living room concentration (r=0.72). Table 4.6b presents the dust and lead loading (rate) correlations. The most significant dust loadings were between the living room and child's bedroom (r=0.68). The only significant lead loadings were between the child's bedroom and the living room (r=0.50) and the child's bedroom and the kitchen (r=0.57).

Another analysis was performed using the pre-cleaning data only by examining whether the carpet age or condition classifications used in the Screening Interview Questionnaire (Appendix A) made a difference in lead concentrations or dust and lead loadings. Only living room and child's bedroom BRM pre-cleaning data were used, because all these samples were collected from carpets (as opposed to hard floors). The only significant difference observed from this analysis was with dust loading and carpet condition. Table 4.7 shows that the better the condition the carpet was in, the lower the dust loading level was. The carpet condition had no effect on lead loadings (p-values > 0.05). The carpet age had no observed effect on BRM lead concentrations or lead loadings (p-values > 0.05). These results support the current methods used to categorize the condition of the carpet and may be effective in qualitatively determining dust loading; however, the age of the carpet does not aid in determining lead concentrations (i.e., older carpets do not necessarily contain higher lead concentrations).

4.1.5 Attics, Basements, and Ducts

Tables 4.8a-b summarize the lead concentration and loading data collected from the attics, basements, and ducts. Some houses did not have attics, basements, or ducts, and a few houses had attics and basements that were not accessible for sampling due to near winter conditions (e.g., icy, metal roofs). Because of the few number of samples, results were not broken out by treatments. Four attics were sampled for lead. Three of these samples were collected using the BRM and the other was collected by using a camel hair brush to sweep dust into a Whirlpak. The average lead concentration in the attics was 6,665 mg/kg (minimum 890 mg/kg, maximum 11,600 mg/kg), average dust loading was 24 g/m^2

(minimum 5 g/m^2, maximum 40 g/m^2), and the average lead loading was 123 mg/m^2 (minimum 36 mg/m^2, maximum 272 mg/m^2) (Table 4.8a).

Seven basements were sampled for lead. One basement had two samples collected; one soil sample from the crawl space area and then one BRM dust sample from the cemented floor area. Four basements were sampled with the BRM and the other four were soil samples collected with a decontaminated stainless steel bowl and spoon. The average lead concentration in the basements was 2,138 mg/kg (minimum 128 mg/kg, maximum 6,980 mg/kg), average dust loading was 11 g/m^2 (minimum 6 g/m^2, maximum 15 g/m^2), and the average lead loading was 16 mg/m^2 (minimum 9 mg/m^2, maximum 29 mg/m^2) (Table 4.8a).

Nine houses had air ducts that were cleaned, but only seven yielded sufficient sample volume for lead analysis. The average lead concentration from the ducts was 3,430 mg/kg, minimum concentration was 230 mg/kg, and the maximum concentration was 10,600 mg/kg (Table 4.8a). Table 4.8b summarizes the amount of dust collected during the duct cleaning. Two houses did not have detectable amounts of dust collected by the duct cleaners. Due to the size and shape of the duct filters, the scale used weighed out to ±0.01 kg. The average mass of dust collected from the nine houses that received a duct cleaning was 156 grams, ranging from a minimum of <10 grams to a maximum of 420 grams.

4.2 HUD Risk Assessment and Dust Wipe Sample Results

A HUD risk assessment (RA) was performed on the HUD, Commercial, and Control houses. This sampling was performed by a certified lead paint risk assessor under contract to the USACE, and the data presented in this report are based on those sampling results, as reported by the USACE. A lead based paint analysis was performed and dust wipe samples were collected from the window sills and wells of the living room and a child's bedroom (i.e., the same rooms sampled with the BRM). Table 4.9 presents the lead based paint analysis. The results were categorized as to whether a lead paint hazard existed at the time of inspection. A hazard is defined as detected lead based paint ($\geq$ 1.0 mg lead/cm^2) in poor condition. If paint is in stable condition, an immediate hazard does not exist whether or not lead paint is detected. Tables 4.10 through 4.12 and Figures 4-18a through 4-19b present the dust wipe data from the four sampling events. The dotted lines in Figures 4-18a through 4-19b represent the houses with detected interior lead-based paint. Appendix O displays Figures 4-18a through 4-19b by treatment for ease of reading. For some houses, the HUDRA was unable to collect post-cleaning dust wipe samples within 24 hours after the cleaning. Spring Cleaned houses did not receive a RA as this treatment was the lowest (and least expensive) level of treatment applied to the houses.

4.2.1 HUD Cleaned Houses

No interior lead paint hazards were observed in the six HUD Cleaned houses (Table 4.9). One house did have detected lead based paint on surfaces where there is friction such as window and door trims. However, five of the six houses have an exterior lead paint hazard (Table 4.9). One of the five houses has a detached structure in the yard that had lead paint in poor condition; however, a lead paint hazard was not observed on the exterior of this house.

Table 4.10 and Figures 4-18a through 4-19b show that all lead loadings from dust wipes decreased post-cleaning. All loadings remained below pre-cleaning levels by the 6- and 12-month sampling, except for one living room window sill that significantly increased at the time of the 12-month sampling (Figure 4-19b).

4.2.2 Commercially Cleaned Houses

Five of the six Commercially Cleaned houses had no observed interior lead paint hazard (Table 4.9). In the one house with an interior hazard, only the stair stringer was identified as having lead based paint in poor condition. Five of the six houses also had no exterior lead paint hazard (Table 4.9). It was observed that the one house with an exterior hazard had lead paint in poor condition only on the cellar windows.

Table 4.11 summarizes the dust wipe sample results for the Commercially Cleaned houses. Again, all window wells and window sills show decreased loadings at post-cleaning and generally tended to remain below pre-cleaning levels throughout the year (Figures 4-18a through 4-19b). One extreme level in a child's bedroom window well skewed the average of 16,854 $\mu g/ft^2$ (Table 4.11). However, the geometric means from the window wells in the children's bedrooms show a significant mean decrease from pre- to post-cleaning.

4.2.3 Control Houses

No interior lead based paint hazards were observed in the five Control houses, although one house was identified with lead paint on surfaces where friction occurs such as window and door trims (Table 4.9). Two of the five houses have exterior lead paint hazards. One house has a detached structure in the yard identified with lead paint in poor condition, although the exterior of the house was not observed to have a lead paint hazard. One house had lead paint detected on the exterior, but is currently in stable condition.

Table 4.12 summarizes the dust wipe data for the Control houses. As observed in Figures 4-18a through 4-19b (see also Appendix O), decreased lead loadings were observed by the 6-month sampling or remained near pre-cleaning results. Two houses had increased levels at the time of the 6-month sampling; however, decreased by the time of the 12-month sampling (see Figures 4-18a and 4-19a). Because average concentrations also decreased in the Control houses compared the other treatments, it is difficult to determine how much levels decreased due to the cleanings. Six-month lead levels in the window wells and sills may have decreased because the windows would most likely be closed throughout the winter months.

4.3 Air Monitoring Results

In general, dust levels were highest during carpet removal. However, the highest BRM carpet concentration multiplied by the highest air dust level was well below the OSHA standard of 0.05 mg/m^3. Please see Appendix P for a complete data summary memo by the USACE pertaining to the indoor air particulate results.

4.4 Carpet TCLP Waste Characterization

Prior to the removal of carpets in the HUD Cleaned houses, it was recommended that the carpet waste be characterized for the ICP Landfill. Carpet samples were collected from the middle of each room in the house, and analyzed for the Toxicity Characteristic Leaching Procedure (TCLP). The TCLP sampling procedures and results are documented in memoranda located in Appendix Q. All carpets in the six houses did not leach any detectable amount of lead. This is contradictory to a previous opportunistic sampling completed in two houses in Kellogg. Carpets removed from houses in the BHSS should be better characterized if carpet removal were to be applied in a large-scale remedial effort.

4.5 Data Quality Assurance/Quality Control (QA/QC)

Appendix R contains the 12-month QA/QC memorandums for the Mat, Vacuum, and BRM sampling performed by the State's Consultant and the laboratory data sheets. The QA/QC summaries for pre- and post- and 6-month sampling events for Mat, Vacuum, and BRM can be found in Appendix J. Two changes were made to the pre-cleaning and 6-month data since the data summary reports documented in Appendix J were produced. One pre-cleaning living room BRM sample from the Commercial Treatment was replaced with its duplicate result in this final report. The scale malfunctioned on the original sample's bottle and no loading data could be calculated. The duplicate sample collected at that house was the same concentration (i.e., zero relative percent difference), so the dust and lead loading from the duplicate sample were used in this final report. The second change was to one 6-month mat lead concentration. The concentration was reported as <80 mg/kg; however the true concentration was <160 mg/kg (i.e., below detection limit). In the 6-month data summary report, half the detection limit was used (40 mg/kg); however, in this final report, half the true detection limit was used (80 mg/kg). The QA/QC performed on the dust wipe samples collected by the HUD RA was ultimately the HUD RA's responsibility; however, the State's Consultant and the USACE reviewed the work and provided comments to the HUD RA about the quality of those data. Most of the questions pertaining to the data were corrected.

Twenty houses in Smelterville were sampled using three distinct sample collection methods for the 12-month sampling event. Vacuum dust, Mat dust, and BRM sampler dust were collected. Based on a complete review of the field duplicates, standards, LCS, prep blanks, and laboratory MS/MSD analyses, the final completeness for the study was assessed at 96%.

4.5.1 Vacuum and BRM Data

All vacuum dust and BRM dust samples were submitted to Northern Analytical Laboratories, Inc. for analysis. A total of 89 samples (including QA/QC) were collected from 20 Smelterville houses during this event. Field QA/QC samples consisted of eight field duplicates and six rinsate blanks. Four National Institute of Standards and Technology (NIST) standards were also included in the sample train. All samples were banked and recorded on a master log, and chain of custody forms were completed and checked before samples were shipped to the lab. All dust samples were sieved to -80 mesh at the lab prior to analysis.

A check of field decontamination procedures was assessed using rinsate blanks. One laboratory preparation blank was inserted per batch of samples to ensure no bias was introduced during sample preparation. Six rinsate blanks were collected during the sampling event. No significant concentrations of lead were found in the rinsate blanks. No qualifiers were placed on the data based on rinsate blank results.

Field duplicates were analyzed to assess field and laboratory variability. A total of four duplicates were collected in the field and submitted to the laboratory for analysis. BRM dust duplicate percent recovery indicated high field variability. No qualifiers were placed on the data based on duplicate results.

An external check of laboratory accuracy was assessed using NIST soil standards. All percent recoveries were within the acceptable range and no qualifiers were placed on the data based on BRM and vacuum dust standards results.

An internal check of laboratory accuracy was assessed using laboratory control samples (LCS). An aqueous and soil LCS was analyzed for each batch. All LCS results were within acceptable limits. Laboratory precision was assessed using MS/MSD analyses. All MS/MSDs displayed acceptable RPD values. Lead concentrations in all laboratory prep blanks were below instrument detection limits.

4.5.2 Dust Mat Data

A total of 28 dust mat samples (including QA/QC) were collected and analyzed for the 12-month sampling event. All dust mat samples were analyzed for total lead by Inland Environmental Laboratories (IEL) in Spokane, Washington. Field QA/QC samples consisted of one standard, 4 field duplicates, and 3 rinsate blanks. All samples were banked and recorded on a master log, and chain of custody forms were completed and checked before samples were shipped to the lab. All samples were sieved to -80 mesh at IEL prior to analysis.

Laboratory QA/QC was checked externally by the use of duplicate samples in the field and by submitting dust mat standards blind to the laboratory for lead analysis. IEL provided a copy of their internal QA/QC results for blanks, LCS, and matrix spike/matrix spike duplicates (MS/MSD). Field and lab variability was assessed using duplicate samples. Analysis of dust mat duplicates indicates relatively high variability which is attributable to the sampling methodology.

An external check of IEL's accuracy was determined using soil standards of known concentration loaded onto a new mat and inserted blind with the field samples. Pre-loaded mats had 10 grams of a NIST standard containing 432 mg/kg lead. The standards were used to evaluate the dust recovery of the vacuum, as well as the accuracy of IEL. Decreased (<100%) percent recoveries were observed on many of the NIST standard mat samples. These decreased percent recoveries were likely a result of fiber dilution of vacuum samples or a portion of the standard sticking to the vinyl surface or vacuum bag surface. However, the average percent recoveries by lead concentration and lead mass were higher than they have been in the previous years. No qualifiers were placed on the data based on NIST standard results.

Internal checks of IEL's accuracy were assessed by analyzing one soil and one aqueous laboratory control sample (LCS) per batch. All results were within the specified limits. Internal checks of laboratory precision at IEL were assessed using MS/MSD analysis. All MS/MSD displayed acceptable RPD values. Other checks of the data showed that IEL analyzed mat samples that contained insufficient sample volume. They used "non-standard methodology" to run these samples. Due to this, four mat samples from the House Dust Pilot Project were rejected but were indicated as insufficient sample volume in the data summaries. All laboratory blanks were below the detection limit.

SECTION 5.0 COST AND LOGISTICAL CONSIDERATIONS

5.1 Project Design

5.1.1 House Selection

Many difficulties arose when soliciting houses for this pilot project. The purpose stated in the ROD was to remediate houses with interior lead concentrations greater than 1000 mg/kg. Using data from 1996-2000 was useful in identifying potential houses that could require remediation. However, some homes that had high lead concentrations in past years exhibited lower lead concentrations at the time of pre-cleaning sampling. This could be due to the sampling methodologies, natural variation of house dust lead concentrations, or the effects of personal influences, i.e., the number of people living in the house, personal hobbies and activities, the number of hours spent outside, whether shoes are removed prior to entering, etc. (TerraGraphics 2000a.). Also, as a result of the soil remediation program, most homes in Smelterville have lower dust lead levels than in previous years, and only a small percentage of houses have high lead concentrations (≥1000 mg/kg) in recent years. The population is also mobile and data from previous years may have been for a different family living in the house at that time. Most people were cooperative, but they had concerns about the logistics of leaving their house for a certain number of days, leading to some people refusing. Some residents dropped out of the project after learning which cleaning treatment they were to receive. One participant asked to be part of the Control Treatment only and did not want to be bothered with leaving their house for a cleaning. Smelterville's population is small and mobile with seemingly few young children (≤ 6 years old). As a result, it was difficult to recruit the target population for this pilot project.

5.1.2 Sampling and Monitoring

After the cleaning was complete, sampling was to occur within the next 24 hours before the residents moved back into their houses. Sampling efforts were effective using on-site field crews in constant contact with the USACE and coordinated post-sampling efforts well. The HUD risk assessor (HUDRA) was not from the area and would fly over to perform the sampling on separate occasions. The HUDRA had difficulties being on-site 24 hours after a cleaning, and therefore, some houses were not sampled according to protocol.

5.1.3 Health and Safety

The USACE placed indoor air monitors for dust at the HUD and Commercially Cleaned houses during cleaning activities. Each contractor was responsible for their own health and safety plans.

5.2 Program Implementation and Contract Mechanisms

Services used in this project were solicited by the State of Idaho and their Representative and by the USACE acting for the federal government, USEPA. The State's Consultant was responsible for recruitment and selection of houses, design of cleaning and sampling protocols, the Spring Cleaning Contractor (Treatment C), and report preparation. The USACE was responsible for acquisition and oversight of all other contracts and all logistic arrangements with residents and property owners for the HUD and Commercially Cleaned homes.

In order to obtain the specific services of a HUD Risk Assessor, HUD Cleaner, and Commercial Cleaners, the USACE and the State's Consultant decided to use a simplified acquisition strategy for each of the contractor types, rather than using a Prime Contractor to procure the services through subcontractors. All contracts were fixed price or not-to-exceed. Individual scopes of work were prepared for each: HUD Risk Assessor, HUD Cleaner, Commercial Cleaner, Moving Contractor, Carpet Supplier and Installer, and Spring Cleaner. Simplified acquisition allows for expedited procurement through reduction of the requirements for notification to the contract community. For each of the contract types, potential bidders were identified and contacted to determine their interest in submitting a bid for the work.

5.2.1 HUD Risk Assessor

Potential HUD Risk Assessors were identified and contacted. The contract was awarded with little difficulty to the low bidder, a highly recommended contractor. The technical qualifications of a HUDRA are established by HUD. However, problems encountered with this contractor were related to project scheduling and quality control.

The HUDRA did not perform within the project schedule and eventually became one of the two factors that impacted ability to meet project schedule. There were numerous reasons identified including an already booked schedule, illness, and family emergency. The lesson learned from this problem was to specify equally strict schedule impact penalties for professional service type contract work, similar to that used for the other contracts.

The other problem with this contract was that the HUDRA did not fully understand the purpose or scope of the services requested. Several times the HUDRA focused on the lead paint issues, as expected for a risk assessment performed to meet the HUD regulatory requirement. This is not an uncommon occurrence, where a professional with a focus on one regulatory requirement is asked to perform a service related to another regulatory requirement. As a result, the HUDRA stressed the importance that lead paint may play in the overall success in any house dust remediation program.

Finally, the scope of the work of the contract required competency in technical quality control quality assurance (QA/QC). The State's Consultant and the USACE identified numerous typographical, transcription, and calculation errors in data reporting, suggesting little care in overall quality. Several cycles of data review were required prior to acceptance of the work products. Generally, simplified procurement reduces the number of contract clauses that penalize contractors for poor performance.

The lesson learned from this problem is to minimize the use of simplified procurement when using professional services or to write strict specifications regarding data quality.

Overall, the HUDRA met the project need of collecting dust wipe data. However, a specific goal of using an independent person with specific training in this area was to obtain their insights and ideas on how to better do the cleaning. Little benefit in this area was obtained due to the difficulties described above.

5.2.2 HUD Cleaner

Potential HUD Cleaners were identified and contacted. After a reasonable bid period, no contractors submitted proposals, stating their reasons to be either they were not in the HUD cleaning business or they were not interested. A list of all HUD certified contractors within Region 10 were contacted individually to determine qualifications and interest in bidding. Only a few certified and interested contractors were identified. The final bid period was closed and the contract was awarded to the low bidder.

Generally, the contract itself was easily managed, and the Contractor performed with a high level of technical competence. The two main lessons learned related to this contract were availability of qualified contractors in the region and costs associated with uncertainty. The community of HUD certified contractors is limited in this region, and a large scale remediation may want to look at alternative qualification requirements. Also, the Contractor included a large amount of contingency in their bid (although the lowest bid) because they were unsure of the scope of the project. Methods of addressing this issue may be to better define each residence requirements and/or use a cost reimbursable contract method rather than fixed price.

5.2.3 Commercial Cleaner

Potential Commercial Cleaners were identified and contacted. The contract was awarded to the lowest bidder. Generally, this contractor was competent and willing to work through any issues.
The main lesson learned related to this contract was the Contractor must not have realized the magnitude of the work involved. The Contractor worked long hours to meet the requirements of the contract, probably incurring costs well beyond the contract amount.

The Commercial Contractor was over-cleaning at the beginning of the project. They were vacuuming shoes in closets until directed that this would not be required. At one of the first houses, the Contractor carried furniture out of the house and cleaned it on the front yard, then carried it back into the house without wiping it off. They were directed that furniture must be wiped off prior to reentering the house. After the carpet was cleaned, the contractor also felt that as long as they "wiped" their shoes off, they could walk on the "clean" carpet. They did not want to follow the policy of wearing "booties" after the carpeting had been cleaned. The purpose of this requirement was to minimize tracking of dust until after the post-cleaning sampling was completed. They were directed that all personnel must continue to wear the booties inside until after the post-cleaning sampling occurred.

Although the Contractor worked long hours, an 8 hour day might have sufficed. It was explained to them that the objective was to remove the dust, but the Commercial cleaner, accustomed to cleaning houses for a living, seemed to think that it was a typical cleaning project. It was difficult to make it clear that the purpose was to remove dust, and not to clean grime. Generally, it was a learning process, but the Contractors did make the required adjustments throughout the project, sometimes much to their chagrin.

5.2.4 Moving Contractor

Potential Moving Companies were identified and contacted. Due to the small scope of the effort, the USACE was able to sole source to the only local moving contractor. A larger scale project might require more rigid procurement requirements; however, there might be more logistical issues using a non-local moving contractor. Also, residents may feel uneasy if the contents of their house were being moved out-of-town, albeit temporarily. Generally, moving went quickly, without incident, and this contractor was competent and easy to schedule.

5.2.5 Carpet Supplier and Installer

Potential Carpet Suppliers and Installers were identified and contacted. The contract was awarded to the lowest bidder. The main lesson learned was related to an incident with the preparation of the floor in one house for carpet and linoleum. After the house had been cleaned by the HUD Cleaner, the carpet layer came into the house and sanded and prepared the floor for carpet and linoleum. Upon entry, the floor was covered in sawdust. Although not technically a lead loading issue, this required a re-cleaning of surfaces to assure homeowners the cleanliness standard they were expecting. Analysis of this problem revealed that the people involved did not understand the purpose of the work being performed. A person who fully understands the purpose of the work should be present on-site during all work or at key times. To accomplish this, a meeting should be held with all primes and potentially with all subcontractors to clearly communicate the project objectives.

5.2.6 Spring Cleaner

A modified version of the Commercial Cleaning contract was prepared after the HUD and Commercial cleanings began. Other local, professional cleaning contractors, besides the one already contracted for the Commercial Cleaning, were contacted and provided with a scope of work and solicitation for bids. Three contractors provided bids. The lowest bidder declined the contract after deliberations with both owners. The next lowest bidder was awarded the contract. This was a not-to-exceed type contract and worked well for different size houses.

In general, the Contractor completed cleaning each house in one day with little oversight. The problems encountered with this type of cleaning were related to thoroughness. Although the Contractor was provided estimates of square footage and the number of rooms in each house and also visited the houses prior to cleaning, the smaller houses were completed according to the scope of work, while there seemed to be more difficulty with completing the larger houses in time. The Contractor always sent one team of two people to clean each house, and not necessarily the same two people. Because the residents were not moved out of the house for the day (they were only asked to be absent as much as possible), time became critical when the families would want to eat dinner and the Contractor was still in the house completing the cleaning. Some items on the scope of work may have been missed due to time constraints in the larger houses where there was more to clean.

5.3 Cleaning Methods

5.3.1 HUD Cleaning

The HUD Cleaned houses were easier to clean than the Commercial houses. The houses were emptied of all household belongings. The HUD cleaner had several questions at the beginning of the project:

1. Do they clean the dirt and grime or just clean for dust?
2. Do they remove the baseboard molding or would the carpet contractor be responsible for that? The scope of work addressed preparing the floor for the carpet contractor but did not address the baseboard molding.
3. Who would move appliances in the kitchens for carpeting and/or flooring replacement?
4. Who was responsible for structural damage discovered during the cleaning process?
5. Who would clean the furniture when it was returned from storage?

These questions and/or concerns were addressed at the first house. With the cooperation of the HUD Contractor and the Moving Contractor, everything was agreed upon and the procedure was established. These procedural adjustments added little time because the Moving Contractor would bring the furniture off the truck and place it on plastic where the HUD Contractor would clean the furniture. Then the Moving Contractor would bring it back into the house. One problem with this process was the weather; on two occasions it rained. The Moving Contractor allowed the HUD Contractor to come into the truck, as a courtesy, to clean the furniture when it was raining. However, there may be some liability issues that would have to be worked through if this process were to occur.

The HUD Contractor worked between an 8-10 hours/day. They typically started at 7:00 a.m. and worked until 5:00 p.m., with an hour lunch break. The cleaning was usually accomplished in two days. If problems arose, then more than two days would be needed. For example, one house needed a water heater replaced because it leaked and the flooring in the master bedroom, laundry area and hallway was saturated and new carpeting could not be installed until the flooring was replaced. This delayed the cleaning by two days and created extra expenses.

The Duct Cleaning Contractor was a subcontractor to the HUD Cleaners. There were two instances when they were not available when needed which caused a delay in the cleaning. However, they did their best to accommodate.

The Moving Contractor was the easiest to schedule because they were local and always available when needed. Oversight could be kept to a minimum for the moving contractor as all that was necessary was to open the house, perform inventory control while loading the truck, and to secure the property. Upon return of household goods, oversight would only be necessary for inventory control again.

Problems encountered for this cleaning treatment were with wallpaper as it could only be vacuumed, and not wet washed. Also, paperboard ceilings, especially in trailers, could not be wet washed, just vacuumed.

Recommendations: Oversight for the HUD Contractor could be kept at a minimum if the same contractors were used again. A representative would only need to be at the house a few times a day to resolve problems and/or questions. A representative would need to be present to open the house in the morning and to secure the house in the evening.

The HUD Contractor recommended disposing of box springs and mattresses to be consistent with the idea of disposing of all cloth furnishings in the house. Although sheets, mattress covers and blankets are on the beds, not everyone cleans the mattresses and box springs often. The HUD Contractor also recommended the HUDRA sample within 8 hours of the cleaning, before anything else is done in the house. If the post cleaning dust wipe samples had been collected sooner, the issue of where the carpet installer could work may not have arose. However, the carpet cleaner would either have to clean after they were done or require the HUD Cleaner to come back into the house with their vacuums and re-clean.

The carpet installers did not work full days, sometimes they only worked 5-6 hour days. If they had worked full eight hour days, in a couple of instances, they may have been able to install the carpet in one day instead of two.

5.3.2 Commercial Cleaning

The Commercial houses were a little more difficult to clean than the HUD Cleaned houses because all the household furnishings remained in the homes. Several had waterbeds that had to be drained, moved, and refilled. The Commercial Contractor had several questions at the beginning of the project:

1. Can windows be opened during cleaning?

2. Do they clean crawl spaces?
3. Do they wet wipe the wallpapered walls and ceilings?
4. What happens if the drapes fall apart during the cleaning? Several houses had drapes that were in need of replacing. However, all drapes were cleaned and replaced without incident.
5. Can blinds and small furniture be taken outside to clean?

These questions and/or concerns were addressed at the beginning. However, the Commercial Cleaner had to be reminded several times that the purpose of the project was to eliminate lead dust, and not to clean dirt, grime, wall markings, etc. In some cases at the beginning, they were "over cleaning" to the extent of vacuuming shoes. This was corrected immediately.

The Commercial Cleaning Contractor worked between 12-14 hour days. They had two cleaning crews; one from 7:00 a.m. to 4:00 p.m. and the second one from 4:00 p.m. to 10 or 11:00 p.m. One of the problems with this contractor was that most of the employees had full time jobs and were doing this as a side job. If the contractor had a dedicated crew, a typical 8-10 hour day would have sufficed. In a few instances, the contractor was late to the site, not prepared, and had to leave the site to gather supplies. This delayed the cleaning.

Problems encountered with this cleaning treatment were again with wallpaper. This could only be vacuumed and not wet washed. And again, as with the HUD Treatment, paperboard ceilings, especially in trailers, could not be wet washed, just vacuumed. In one case, a house had an inordinate amount of storage boxes. The moving company was hired to take these boxes out in order clean the house. The boxes were wiped off upon return.

Waterbeds were a problem because if they leaked there may be mold issues. In one case, a waterbed was extremely old and leaking. Mold was found as well as a nail; the liner was also wet. When the bed was reassembled, the liner was still leaking. Fortunately, the Commercial Cleaner was able to repair the liner, however, the liner would had to have been replaced if they were unable to repair it.

Liability was also an issue. For example, in one of the houses, valuable jewelry was found in a drawer, and needed to be inventoried. Also, in several of the properties, drug paraphernalia was found. This created health and safety and liability concerns for the contractors.

Recommendations: More oversight for the Commercial Cleanings are necessary than HUD Cleanings because personal items and property are still in the house. Existing damages and valuables would need to be documented as well as any damage to the property. A commercial cleaning of this type would be easier if personal items (i.e., clothes, knick-knacks, books, etc.) were moved out of the house prior to any cleaning. Curtains, drapes, and throw rugs in the Commercial Cleaned properties should be looked at on a case by case basis. In some instances, it would have been easier to dispose of these items and reimburse the homeowner. There was a high possibility that these items would be destroyed during dry cleaning. However, no damages were incurred.

5.3.3 Spring Cleaning

This treatment was easiest in terms of oversight because there was no moving or relocating involved. The small amount of oversight by the State's Consultant was for liability issues due to contractual reasons, rather than oversight for the cleaning process, although, the cleaning checklist was reviewed with the cleaners at the end of the day. The cleaning occurred in one 6-10 hour day.

The main problem encountered with this cleaning treatment was thoroughness. It was difficult in an eight hour work day for two people to complete a large house (i.e., more than 3 bedrooms, 1 bathroom, 1 family room, and a kitchen). Although some families were able to leave the house for most of an 8 hour work day, it was a disturbance for the families when they arrived home and the cleaners were still there. Vice versa, the cleaners would try to finish more quickly when the families arrived back to the house and most likely were not as thorough. There was one reported instance where the resident walked past the cleaners in one of the rooms and heard them discussing that they would not clean the picture or the wall in order to hurry up and finish.

Recommendations: The amount of time it takes to clean a house, even at the lowest level, depends on the size of the house. Without a larger crew, it is not recommended to clean in one day for a large-scale effort. It would be advisable to have more of an oversight role to make sure the cleaning is being performed properly. It may not be necessary to be present all day, but at least for some time in the morning and few times throughout the day to keep tabs on the progress and thoroughness.

5.3.4 Overall Observations

At the beginning of the project, a meeting with all the contractors and subcontractors should have been held. The scope and purpose of the project needs to be made clear, and contractors and subcontractors should be introduced and made aware of each persons role. Sometimes there were too many oversight representatives in the house at one time. This is expected for a pilot project, but a full-scale effort should only need one knowledgeable oversight representative at the house. Schedules should start on weekdays, and cleaning only authorized on the weekend when finishing a residence. Local, on-site contractors were more accessible than contractors from out-of-town, and in a full-scale effort, contractors should be local and/or accessible. All the residences were videotaped before any cleaning or moving began and would be highly recommended for a full-scale project. It might also be prudent to videotape the furniture as it is brought out of the house because it could appear to be okay, but once lifted and moved, may exhibit unseen damage. This would add a day to the actual move but would also be proof of condition of property in case of damage claim. Lead-based paint causing a lead-hazard should be remediated prior to any house interior being cleaned in order to prevent recontaminatic

5.4 Homeowner/Resident Issues

Unusual expectations were discovered with the residents of the HUD and Commercially Cleaned homes. Some participants were under the impression that their house was going to be polished. The USACE explained at the time of the pre-cleaning interview that the purpose was to clean dust. The marks on the wall were not going to be scrubbed, the bath tub rings would still be there, etc. If a cleaning checklist of what was to happen at the house was provided to the participant, their expectations may not have been as high. The cleaning checklist for the Spring Cleaning was provided to the participant at the time of the pre-cleaning interview and reviewed and explained to the resident, and no unusual expectations were encountered.

A post-cleaning questionnaire was mailed to the participants afterwards in order to identify problems and overall satisfaction. There were some complaints from each of the three cleaning treatments. For the HUD and Commercial Cleaning Treatments, the complaints were about the walls. The homeowners complained that the walls were streaked after the cleaning. Streaking of greasy walls or smoke stained walls was a concern from the beginning. These issues were resolved by having the cleaners either go back to the house and re-clean to the satisfaction of the homeowner, or an estimate for painting was obtained from the homeowner and compensation was provided. In one HUD Cleaned house, the homeowner also complained that the carpeting was not replaced with equal quality carpeting as the original, and that it was not installed properly. A meeting was held between the homeowner, the USACE, and the Contractor. It was determined the carpet was that selected by the homeowner, but installation was defective. Consequently, the decision was made to allow the owner to select another carpet and it was reinstalled. The main complaint with the Spring Cleaning was with thoroughness. An incident was noted where the homeowner passed by a room and overheard the cleaners discussing that they were not going to clean certain items in the room in order to finish quickly. This was discouraging to the homeowner, as they knew their walls and wall-hangings were to either be vacuumed or wet-washed. One other participant in the Spring Cleaning felt the cleaners were not very thorough because their desk and tabletop were not cleaned.

5.4.1 Participation

Most people seemed willing to participate; however, when they were told which cleaning treatment they were to receive, some dropped out upon learning they did not receive the HUD Cleaning. Participation was not as difficult for the Spring Cleaning because at that time, only one cleaning treatment was being offered. If interior remediation were to occur site-wide, one cleaning treatment would be selected and residents would not drop out due to expectations for a different cleaning treatment.

5.4.2 Relocation

Relocation issues arose in houses that had renters. In one case, the homeowner also happened to own a hotel in the area and would not allow either the HUD or Commercial Cleaning because the residents were not being relocated to his hotel. Most relocation efforts went smoothly.

5.4.3 Scheduling

Scheduling difficulties arise when a participant decided to drop-out after they had been scheduled. The back-up list of homes was small and used early in the project. Filling that spot took another solicitation effort, and would slow the schedule down or cause a week's worth of no work for the cleaning contractors.

5.5 Sampling Logistics

Pre- and post-cleaning sampling needs to be well coordinated with the progress of the cleanings. The USACE would call the State's Consultant when the cleaning was over and post-cleaning sampling was initiated within 24-hours of the cleaning. The HUDRA was sometimes unavailable and some of the post-cleaning dust wipe samples were not collected within a 24-hour period after the cleaning. On-site, local contractors were most accessible and easier to coordinate post-cleaning sampling.

5.6 Project Costs

Table 5.1 shows many of the costs incurred by each cleaning treatment. The Spring Cleaning cost and average of $832.00/house, the Commercial Cleaning cost an average of $4548.00/house, and the HUD Cleaning cost $9833.00/house. There were added costs to the HUD Treatment, for carpet/furniture replacement at $1512.00/house. However, this average cost also included some time spent on moving household items (i.e., heating stove) or repair of already damaged property. The initial HUD risk assessment and dust wipe sampling (pre-cleaning sampling only) cost $1480.00/house. Relocation costs were minimal; much of the cost was associated with hotel rental rates as participants were only allotted $2.00/day per family member for meals and other incidental expenses. Oversight costs for the USACE were not individually tracked and are estimates of the actual cost per house. The State's Consultant oversight costs were minimal because they were not tasked for continuous oversight. Oversight for the Spring Cleaning Treatment was more for liability issues as the purpose of that treatment was to have minimal federal/state oversight. Total oversight costs ranged from $332.00/house for the Spring Cleaning Treatment to $13,035.00/house for the HUD and Commercial Treatments. Total costs per house per treatment (not including sampling costs) ranged from $1164.00 for the Spring Cleaning Treatment to $26,323.00 for the HUD Treatment.

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SECTION 6.0 SUMMARY AND CONCLUSIONS

6.1 Purpose and Objectives

Purpose of the Investigation: The ROD for the BHSS requires that, following completion of the residential soils remedy, the need for additional interior dust cleanup be assessed and appropriate sampling and cleaning protocols be developed. The purpose of the House Dust Pilot Project was threefold: i) to develop information to assess the long-term effectiveness and efficiency of various levels of cleaning, ii) to assess sampling and measurement techniques that could be used in implementing an interior cleanup program, and iii) to identify potential costs and logistical problems associated with any comprehensive community-wide interior dust cleanup that might be required.

Study Objectives: Available resources and the small number of homes that exhibit high dust lead concentrations limited the number of houses that could be cleaned. Because there are numerous factors that influence house dust, remedial effectiveness, and measurement techniques; rigorous statistical design and comparative analysis of cleaning and measurement techniques were precluded. As a result, the overall goal of this investigation was to obtain and present practical observations regarding the implementation and thoroughness of cleaning techniques and quantitative measurements of pre- and post-cleaning exposure indices. Specific objectives were to i) determine the cost, effort, and effectiveness of commercial house cleaning services versus a complete removal of permanent reservoirs of lead dust from the home; ii) assess the rate and magnitude of recontamination and dust and lead loading; iii) identify logistical, public health and safety, and contracting difficulties that may be encountered in a large scale cleaning effort; iv) assess sampling techniques for house dust; and v) identify other sources of lead exposure in houses that could be amenable to cleaning.

6.2 Project Overview

House Selection: A total of 23 households in Smelterville participated in the project. Homes were selected from those that had previously participated in house dust surveys, based on a cross section of demographic and housing characteristics and house dust lead concentrations. Difficulties were encountered with pre-cleaning lead levels and soliciting homes with young children. Few homes in the community have had high dust lead levels in recent years and the eligibility criteria was lowered from 1000 mg/kg to 500 mg/kg lead in dust to recruit a sufficient number of homes. Some houses that were selected for cleaning based on high lead concentrations in past years exhibited low lead levels in pre-cleaning samples. Because Smelterville's population is small and mobile with few young children ($\leq$ 6 years old), it was difficult to recruit young families for the pilot project.

After a resident agreed to participate and the screening process was complete, houses were randomly assigned to the various treatment groups. After learning which cleaning treatment each participant was to receive, one resident dropped out of the study. This residence was replaced using one of the Control houses. Another participant dropped out of the study soon after pre-cleaning sampling occurred, and this home was also replaced with another Control house. One resident that had previously declined to have the house cleaned, agreed to serve as a substitute Control home. One resident moved away after the post-cleaning, and the home was vacant for the 6-and 12-month sampling, resulting in no data available for that house for those two sampling events. Two participants moved away before 12-month sampling occurred; however, new residents moved in and allowed the sampling to take place. Different family dynamics, however, may have impacted subsequent sampling events to some degree.

House Characteristics: A questionnaire addressing basic housing and resident characteristics was completed for each house during the screening process. The characteristics of the participating residents and their houses were reasonably similar among the treatment groups. Most of the residences were older homes. The average year of construction for the HUD, Commercial and Spring Cleaned houses was 1948, 1943 and 1946, respectively. The average year of construction for the Control Treatment was 1956. The majority of houses in each group were owner occupied and about half were recently remodeled. The typical carpet in all treatments was characterized as slightly to moderately dirty or frayed. The average age of living room carpets in the HUD, Commercially, and Spring Cleaned houses was 10, 7 and 12 years, respectively. Control carpets averaged 15 years old. Carpet types ranged from indoor/outdoor to sculptured and plush. The Commercially Cleaned houses averaged one child, while the other cleaning treatments and Control houses averaged two children per household. A total of 14 participating households reported having centralized heating/air conditioning ducts. There were a total of 10 basements and 11 attics. However, the number of basement and attics easily accessible in near winter conditions for sampling was 7 basements and 4 attics.

Cleaning Methods and Costs: Three levels of cleaning and a no action Control Treatment were included. Six houses were cleaned by a HUD certified cleaning contractor; six were comprehensively cleaned by a Commercial Cleaner; six houses received a typical Spring Cleaning by a different commercial cleaning service; and five houses served as Controls. HUD Cleaned houses received a thorough cleaning (including air ducts) and new carpet and soft furnishings at an average cost $9833.00 per house. Commercially Cleaned houses received a thorough cleaning (including air ducts) and steam cleaning of carpets and soft furnishings and cost an average of $4548.00 per house. Residents were relocated to a local hotel for 2-5 days for both the HUD and comprehensive Commercial Cleaning procedures. Spring Cleaned houses were cleaned as thoroughly as possible in a single day by a commercial maid service and received no steam cleaning or duct cleaning. Residents from the Spring Cleaning Treatment were not relocated and the average cost was $832.00 per house.

Sampling and Monitoring: The houses that were cleaned were sampled prior to and within 24 hours following the completion of the cleaning activities, and at 6-months and 12-months after the cleaning activities. Control houses were sampled during the pre-cleaning sampling event time frame, and at 6-months and 12-months. Four sampling methods were used including dust mat, vacuum bag, BRM (a specialized vacuum sampling device), and dust wipes. Each method is briefly described in the following paragraphs.

House Vacuum Sampling: Samples have been collected from residents' home vacuum cleaners at the BHSS since 1974. Although this methodology is largely uncontrolled and subject to the individual bias of each user, these data have proven useful in monitoring exposures in the community. The sample is collected directly from the vacuum cleaner or the bag is collected and replaced. If the owner indicates the vacuum has been used outside the home, no sample is collected. This sampling methodology is useful in determining a general lead concentration inside the house, is logistically easy, inexpensive, and is comparable to the many years of house dust samples collected at the BHSS.

Dust Mat Sampling: A carpeted floor mat for dust collection was placed at all houses to quantify lead concentration, dust loading rate, and lead loading rates. Except for unusual circumstances, floor mats were placed just inside the main entry of each house. Homeowners are instructed not to clean the mat and it was retrieved from the home after approximately three weeks. The sample is collected by vacuum in a laboratory. Of the techniques used, dust mats are most influenced by exterior sources. The dust mat technique may not be the most suitable for determining the effectiveness of an interior remediation because it is most influenced by dust and soils being tracked into the house.

BRM Sampling: The BRM method measures dust and lead loading by vacuuming a prescribed floor area. BRM samples were collected in the kitchens, living rooms, and one child's bedroom at each house. Most kitchens had vinyl flooring, while all living rooms and bedrooms were carpeted. Each room was separated into a twelve grid system and three different one square foot areas from the floor in each of the rooms were randomly selected for sampling. One composite sample from the three grids was collected sequentially in one sample container for a total of three floor composite samples for each house: the living room, a child's bedroom, and the kitchen. The BRM sampling technique directly monitors remedial effectiveness as opposed to the vacuum bag or dust mat sampling techniques because the sample is collected directly from the floor, before and immediately after the cleaning, by a trained technician.

HUD Dust Wipe Sampling: Dust wipe samples were collected from one window in the living room and one window in the child's bedroom (the same rooms sampled using the BRM), from both the window sill and window well. The dust wipe is a controlled sampling method intended to reflect cleaning effectiveness and rate of recontamination. However, because windows are friction surface areas, dust wipe sampling may be influenced by chalking, chipping or erosion of lead-based paint.

Air Duct Sampling: For the HUD and Commercial Treatments, the filters were collected from cleaning equipment and sealed in a box immediately after the professional contractor finished cleaning the ducts. The box and filter were weighed prior to the cleaning and again after the cleaning. A grab sample from the filters was collected to represent the general lead concentration found in the ducts of the house. Both lead concentration and the mass of dust removed from the duct work was determined. The ducts were not sampled at the 6- and 12-month sampling interval.

Attic and Basement Sampling: Attics and basements were sampled, where possible, using the BRM method by measuring prescribed areas to be vacuumed. Samples of the attic and basement dust provide a general representation of the lead concentration. A sample was only collected from houses where the attic and/or basement was not used for living space and accessible to the sampler. If the attic or basement is used for living space, then it is assumed the vacuum bag sample will also represent that living area. Attics and basements were each sampled once at the time of pre- or post-cleaning sampling, depending on availability.

6.3 Logistical and Contracting Considerations

Several lessons were learned regarding contracting mechanisms, contractor control, cleaning methods, and homeowner/resident relations. Both cost and logistical problems were related to the complexity, invasiveness and level of effort required by the sampling, risk assessment and cleaning treatment protocols.

Homeowners/Residents: Recruitment and scheduling problems were encountered due to a variety of reasons, most often associated with changing family situations and/or home environment conditions. The “backup” list of houses was exhausted early during the screening phase and further solicitation was required. Scheduling was difficult as some participants dropped out, moved, or had difficulties unrelated to the study that required rescheduling. Some problems were experienced with homeowner expectations in the HUD and Commercial Cleaning protocols. Although the USACE explained at the pre-cleaning interview that the purpose was to clean dust and not scrub off markings or repaint, some participants were under the impression that their house was going to be polished and repaired. In the Spring Cleaning protocol, a cleaning checklist was provided, reviewed and explained to the homeowner/resident at the pre-cleaning interview and no unusual expectations were encountered. Relocation issues occurred in houses that had renters. In one case, the homeowner also owned a hotel in the area and refused to participate because the renters were not being relocated to that particular hotel. However, most relocation efforts went smoothly.

Contractors: The main lesson learned was that local, on-site contractors were more accessible than contractors from out-of-town. For example, the HUD risk assessor’s on-site availability impacted the project schedule because this consultant lived out-of-town. This problem could be resolved by specifying equally strict schedule impact penalties for professional service type contract work, similar to that used for the other contracts. Due to the small scope of the effort, the USACE was able to sole source to the only local moving contractor. This contractor was the easiest to schedule because they were local and always available when needed. The knowledge gained from this project strongly supports the use of local contractors or establishing a requirement for a consistent on-site presence. Generally, simplified procurement reduces the number of contract clauses that penalize contractors for poor performance.

HUD Cleaning Contract: The two main lessons learned relating to the HUD Cleaning contract were the lack of availability of qualified contractors in the region and costs associated with uncertainty. The HUD Cleaning was logistically easier than the Commercial Cleaning because all personal belongings were removed and a process between the HUD Contractor and the Moving Contractor was established. The weather became a factor in this process because as the moving contractor brought the furniture back, it would be wiped clean prior to entering the house, and if it was raining it made this process difficult. The Duct Cleaning Contractor was a subcontractor to the HUD Cleaners, and was also reported as being difficult to schedule due to availability. Problems encountered for all the cleaning treatments were with wallpaper as it could only be vacuumed, and not wet washed. Also, paperboard ceilings could not be wet washed, only vacuumed.

Commercial Cleaning Contract: For the Commercial Cleaning contractor, it was difficult to make it clear that the purpose was to remove dust, and not to clean grime. The Commercially Cleaned houses were a little more difficult to clean than the HUD Cleaned houses because all the furnishings remained in the homes. Several had waterbeds that had to be drained, moved, and refilled. Liability was an issue because valuables were left in the residences. Also, in several of the properties, drug paraphernalia was found. This created health and safety and liability concerns for the contractors.

***Spring Cleaning Contract*:** The Spring Cleaning contract was a not-to-exceed contract, as opposed to a fixed price used with the HUD and Commercial Cleaning Treatments. The Spring Cleaning Treatment was logistically easiest in terms of oversight because there was no moving or relocating involved. The small amount of oversight exercised was for liability issues due to contractual reasons. However, because this was a not-to-exceed contract, larger homes were not as thoroughly cleaned as smaller homes.

Costs: The average cost per house for the HUD Cleaning, including carpet/furniture replacement and the initial HUD risk assessment, was $12,825. Commercial Cleaning including this initial HUDRA averaged $6028/house. Spring Cleaning services were $832/house. Relocation costs were minimal; much of the cost was associated with hotel rental rates as participants were only allotted $2.00/day per family member for meals and other incidental expenses. Total oversight costs ranged from $332/house for Spring Cleaning to $13,035/house for Commercial and HUD Cleaners. Total costs per house per treatment (not including sampling costs) ranged from $1164 for Spring Cleaning to $26,323 for the HUD Cleaning.

6.4 Results

Pre-cleaning Sampling: Several of the houses were selected because high (i.e., > 500 mg/kg) lead concentrations (from the vacuum bag and/or the dust mat) were observed in previous years' sampling. However, pre-cleaning sampling indicated that lead levels are more reflective of a snapshot in time and can vary from previous results. Pre-cleaning mean lead concentrations and dust and lead loadings were similar across treatments, and were representative of the city of Smelterville as a whole. The geometric mean vacuum dust lead concentration for Smelterville in 2000 was 479 mg/kg, compared to the overall pre-cleaning geometric mean for Dust Pilot houses of 498 mg/kg. The geometric mean mat lead concentration for Smelterville in 2000 was 591 mg/kg, compared to 617 mg/kg for Dust Pilot houses. The geometric mean dust loading rate for Smelterville in 2000 and the pre-cleaning dust mats placed at Dust Pilot houses were both 486 mg/m^2/day. The geometric mean lead loading rate for Smelterville in 2000 was 0.287 mg/m^2/day, compared to 0.346 mg/m^2/day for Dust Pilot pre-cleaning mats. Lead concentrations from all the accessible attics, basements, and ducts were high, with averages for all houses of 6,665 mg/kg, 2,138 mg/kg, and 3,430 mg/kg, respectively.

There are no residential BRM data from the BHSS with which to compare results. However, the BRM lead concentrations were highly correlated with both vacuum bag and dust mat lead concentrations. The correlation coefficient (r) between the vacuum bag and living room BRM is 0.83 ($p<0.0001$); vacuum bag and kitchen BRM is 0.71 ($p=0.0014$); vacuum bag and bedroom BRM is 0.55 ($p=0.0117$). The correlation coefficient between the dust mat and living room BRM is 0.72 ($p=0.0003$); dust mat and kitchen BRM is 0.77 ($p=0.0003$); dust mat and bedroom BRM is 0.50 ($p=0.025$). BRM dust and lead loadings were not significantly correlated to dust mat loading rates.

Post-Cleaning Sampling: Lead concentrations from the vacuum bags and dust mats were similar to pre-cleaning levels and showed no consistent pattern. However, lead concentrations from the BRM living rooms and bedrooms decreased in the HUD Cleaned houses, but showed no consistent pattern for the Commercially and Spring Cleaned houses. As expected, the amount of dust from carpeted floors was reduced in all houses by the HUD and Commercial Treatments post-cleaning (as sampled with the BRM and dust wipe). The dust and lead loadings in the Spring Cleaning Treatment showed no consistent pattern. The kitchen floors yielded the least dust post-cleaning, likely due to the hard flooring. All six kitchen BRM samples in the HUD Treatment yielded insufficient sample volume for laboratory analysis. Dust loading in the carpeted rooms decreased by a higher percentage in the HUD and Commercially Cleaned houses compared to the Spring Cleaned houses.

Six-month Sampling: No consistent pattern was observed for lead concentrations in vacuum bags and dust mats. Lead concentrations in BRM living rooms and bedrooms also showed no consistent pattern for the Commercial and Spring Cleaned houses. However, the BRM concentrations in the HUD Cleaned houses either began to increase or reached levels near or exceeding pre-cleaning concentrations. Although, BRM dust and lead loadings were increasing, these generally had not reached pre-cleaning levels in the HUD Cleaned houses. In the Commercially Cleaned houses, BRM dust and lead loadings either increased to pre-cleaning levels or increased from post-cleaning levels. HUD dust wipe loadings from the window wells remained about the same as post-cleaning levels. However, dust wipe loadings in window sills showed no consistent pattern. Dust and lead loading rates from the dust mats generally increased at the time of 6-month sampling (which occurred in the Spring), and may suggest a seasonal effect.

Twelve-month Sampling: Twelve-month results were similar to pre-cleaning and community-wide levels for 2001. The 2001 geometric mean lead concentration in vacuum cleaners for Smelterville was 530 mg/kg, while the geometric mean from the Dust Pilot houses was 503 mg/kg. The geometric mean dust mat lead concentration for the city of Smelterville in 2001 was 564 mg/kg, while the geometric mean from the four treatment groups was 560 mg/kg. The geometric mean dust loading rate for Smelterville in 2001 was 370 mg/m^2/day, and the mean from the four treatments was 377 mg/m^2/day. The 2001 Smelterville lead loading rate mean was 0.24 mg/m^2/day, and the mean from the four treatment groups was 0.28 mg/m^2/day.

HUD Cleaning Results: The lead concentration in floor mat dust did not decrease after the cleaning. Both mat dust and lead loading rates were highest at the time of the 6-month sampling which occurred in Spring. Pre-, post-, and 12-month sampling occurred in late summer/early fall resulting in nearly equal loading rates between the pre- and post-cleaning and 12-month sampling. Little variation in the vacuum bag lead concentrations was observed. However, average concentrations were lower by the 6-month and 12-month sampling.

As expected because of new carpet, BRM lead concentrations, lead and dust loadings were substantially reduced between pre- and post-cleaning in houses where concentrations were initially greater than 500 mg/kg. However, in most HUD Cleaned houses concentrations and loadings increased to near pre-cleaning levels by the 12-month sampling. One HUD Cleaned home with a relatively high BRM living room pre-cleaning lead concentration, remained at low levels (<1000 mg/kg) through the 12-month sampling period. Although the BRM is difficult to use on frequently cleaned hard surfaces such as the kitchen, it is important to note that all post-cleaning kitchen samples contained insufficient sample volume for laboratory analysis. These floors, however, did not contain any area rugs and were not carpeted.

No interior lead paint hazards were observed in the six HUD Cleaned houses; however, five of the six houses had an exterior lead paint hazard. Lead loadings from dust wipes decreased between pre- and post-cleaning. All loadings (except for one living room window sill) remained below pre-cleaning levels by the 6- and 12-month sampling.

Commercial Cleaning Results: Mat lead concentrations fluctuated in four of the six houses; however, average mat concentrations increased during the post-cleaning and 6-month sampling events. Excluding one home with increased 6-month loadings, dust and lead loading rates for the Commercially Cleaned houses showed the least variation during the four sampling events compared to the other treatments. In general, there was little variation in vacuum bag lead concentrations from the Commercial Treatment compared to the other treatments.

BRM lead concentrations did not decrease greatly after the cleaning, but dust and lead loadings generally decreased in all houses after the cleaning. Most of the dust and lead loadings increased to near pre-cleaning levels by the 6- and 12-month sampling events; however, in two of the six bedrooms, dust and lead loadings remained at least 40% below pre-cleaning levels. Two of the six kitchen samples did not contain sufficient sample volume for lab analysis post-cleaning; the other four kitchens in the Commercial Treatment contained area rugs and one was carpeted, as opposed to the HUD Cleaned kitchens.

One Commercially Cleaned house had an interior lead paint hazard and one house had an exterior lead paint hazard. All window wells and window sills showed decreased dust wipe loadings post-cleaning and generally remained below pre-cleaning levels throughout the year.

Spring Cleaning Results: The mat concentrations, and dust and lead loading rates showed the most variation in the Spring Cleaned houses compared to the other treatments with levels fluctuating throughout the sampling events. With the exception of one outlier in the 6-month data, vacuum bag lead concentrations did not vary greatly. One of the six houses had decreased BRM living room lead concentrations after the cleaning and remained at concentrations below pre-cleaning levels; however, these levels remained above 1000 mg/kg. Overall lead concentrations, dust loadings, and lead loadings in the Spring Cleaning Treatment remained about the same in each of the houses throughout the year. This treatment had little effect on dust and lead loadings.

Control House Results: Higher mat dust and lead loading rates were observed in the Control houses at the 6-month sampling, indicating a possible seasonal effect due to more mud being tracked into the house because of spring weather conditions. Average vacuum bag lead concentrations were highest among the Control houses compared to the three cleaning treatments' concentrations. However, few samples (i.e., 3-4 samples per sampling event) were available for comparison. Lead concentrations in one Control house were high, but they asked to not be included in any of the cleaning treatments.

However, their levels decreased at the time of 6- and 12-month sampling. The measurable decrease may be due to the participant's repeated cleaning. This participant expressed concern about the high levels of lead in the home and was informed that repeated cleaning with a steam cleaner may help to reduce levels in the carpets, while the remainder of the house should be thoroughly cleaned.

In general, BRM carpet lead concentrations fluctuated in the Control houses similar to those in the Spring Cleaned houses. Dust and lead loadings generally remained about the same levels throughout the year. No interior lead paint hazards were observed in the Control houses; however, two of the five houses had an exterior lead paint hazard.

6.5 Discussion and Conclusions

Cleaning Methods, Rate of Recontamination and Long-term Effectiveness: Generally, interior dust lead concentrations in Dust Pilot houses reflected those of the community. This was observed with respect to pre-cleaning and 12-month levels, for all treatments and for the vacuum bag, dust mat, and BRM sampling methods. In recent years, only a few houses in the community exceed the 1000 mg/kg dust lead concentration criteria (by vacuum bag sampling), and no definitive pattern is evident for houses exhibiting the higher levels. Houses with high concentrations in one year may show lower levels in following years, with or without intervention. General trends in dust lead levels for Smelterville indicate interior dust lead concentrations are reflective of outdoor soil and dusts.

Dust and lead loadings measured inside the houses by the BRM methodology showed marked reductions in post-cleaning results for the HUD carpet replacement houses and modest reductions for the Commercial Cleaning. Little change in dust lead concentration or loading was noted in the Spring Cleaned houses. Dust and lead loading reductions in most of the HUD Cleaned houses extended to the 6-month sampling. However, by 12-months, these loadings had returned to near pre-cleaning levels in living rooms and were similar to the other treatments. Dust lead loadings in the HUD bedrooms remained below pre-cleaning levels throughout the year. BRM dust and lead loadings in the living rooms and bedrooms in the Commercially Cleaned houses increased to pre-cleaning levels by 6-months. Dust wipe samples in HUD and Commercially Cleaned houses generally showed reductions in window sill and window well loadings that persisted through the 12-month sampling.

The results from dust mats placed at the entryways to the houses showed little change with respect to cleaning method. Lead concentrations were similar to the greater community across all treatments, except for the 12-month Spring Treatment samples. Mat dust and lead loading rates tended to increase at the 6-month sampling, perhaps indicating a seasonal effect associated with wet spring conditions tracking more dirt and mud into the homes.

In summary, as measured by BRM and dust wipe sampling methodologies, the HUD cleaning (and to a lesser extent the aggressive Commercial cleaning), was effective in reducing lead loadings in the short-term for residents with initial high lead concentrations. Except for vacuum bags, lead concentrations measured by all methods did not substantially differ from the Control Group or those observed throughout the community. One Control house continuously exhibited high vacuum bag levels. Dust mat loading rates indicate that the movement of dust and lead into the house was largely unaffected by the cleaning. Results from all the sampling methods (except dust wipe) indicate that dust and lead loadings/levels had returned to (or for HUD BRM results were approaching) pre-cleaning levels within one year. Achieving long-term reductions through interior cleaning would require a sustained effort by either the HUD carpet replacement and/or comprehensive Commercial cleaning protocols. Intervention and more frequent cleaning may still be necessary to produce long-term, effective reductions.

Sampling Methods, Hazard Identification, House Selection, and Effectiveness Measures: Each of the sampling methods provide useful information reflective of different elements of the house dust lead exposure pathway. The BRM and dust wipe sampling methods are most controlled and demonstrated pre- and post-cleaning reductions in loading in areas where young children are likely exposed. These techniques also showed the effect was not persistent with respect to floor loadings for the Commercial and Spring Cleaning methods, but showed reductions up to 12-months for window wipes (except two HUD living room sills). Mat dust and vacuum bag sampling are not as useful in evaluating cleaning effectiveness. Dust lead concentrations did not change except for BRM samples collected from new carpets. Because mat dust likely reflects material being tracked into the houses from outdoor sources, this sampling methodology is useful in assessing the continuing contribution of outdoor and entryway sources to the house. Vacuum bag sampling continues to show the actual material being managed in the house by the resident. When compared to typical levels throughout the community, these samples can be used to identify houses with atypical lead sources.

As a result, the BRM and wipe techniques are likely the most appropriate for measuring interior loading and current exposure in a house. The dust mat technique is likely the best indicator of continuing outdoor source contribution to dust lead in the house, and the vacuum bag remains the simplest intervention tool. Which sampling method most appropriate for identifying houses that may require interior cleaning remains unresolved. The BRM technique is cumbersome and would be expensive to implement on a community-wide scale. Dust mats are easier to implement but have a substantial labor requirement to distribute and recover the mat and to collect the sample by vacuuming. The dust wipe technique is easier to implement than the BRM, but the results could be easily influenced by chalking and/or chipping paint. The vacuum bag is the simplest, but least controlled sampling method, and dependent on homeowner habits. It is not clear what level measured by any of these techniques represents a risk-based action criteria, although the ROD cites 1000 mg/kg based on historic studies using the vacuum bag technique. Houses were screened for this study using vacuum bag and dust mat results, but pre-cleaning measurements showed that houses with high levels in previous years sometimes showed lower results in subsequent samples and by different sampling techniques.

Other Exposure Sources: Attics, basements, air ducts, and crawl spaces are all potential contributors to lead in house dust and exposure sources to children, although there is no indication these are current, active pathways. Similarly, air ducts were a reservoir as concentrations were high and an average of 156 grams of dust were removed. Most basements were not cemented and were unused. However, a few houses contained cemented floors in the basement and were used for storage and shop work. These types of basements may be amenable to cleaning, but are also exposed to the dust and dirt under the house because of exposed crawl spaces. The dust and dirt under these houses could be potential contributors to lead in dust that is tracked into the house and potential exposure sources if accessible by children or pets. Soil removal in dirt basements and crawl spaces is likely infeasible and sealing accesses may be the preferred remedy, if required. Attics are also reservoirs of leaded dust, but would also be difficult to clean if insulated because of asbestos.

Logistical, Contractual, and Safety Concerns: Local certified HUD Cleaning contractor services were difficult to obtain in the area. However, in future remedial efforts of this type local commercial cleaners could be used with appropriate supplemental training. These contractors were sufficiently competent to clean the houses. The USACE believes the HUD cleaners over-bid, and the Commercial cleaners under-bid the project under fixed price contracts. The Spring cleaners worked under a not-to-exceed contract. A not-to-exceed or cost reimbursable contract would likely be preferable in future efforts due to the varying size and complexity of different houses. Schedule difficulties arose when either a contractor was unable to schedule time or if a participant dropped out. The main logistical lesson learned was that on-site, local contractors worked well and were easiest to schedule. No worker hazards were identified by indoor air monitoring. Except in houses where the belongings were removed, hazards associated with drug paraphernalia were a concern.

Recruitment for the study was difficult. Criteria for participation was lowered to obtain a sufficient number of homes. This resulted in some homes being cleaned at dust lead concentrations less than that indicated in the ROD, although these homes had exhibited high levels in previous years. If future interior remedial efforts were to occur at the BHSS, more residents might be willing to participate if there was one established cleaning process. This would reduce residents unwilling to participate due to not receiving the cleaning treatment they desired.

SECTION 7.0 RECOMMENDATIONS

Sampling Methodologies and Hazard Identification

- The findings of the house dust pilot project should be re-evaluated in conjunction with other BHSS yard soil, rights-of-way (ROW), house dust, and blood lead data in order to determine the appropriateness of the house dust RAOs established in the ROD.

- The dust mat is the most appropriate sampling methodology to employ in assessing the movement of lead into the home from exterior sources.

- The BRM is the most appropriate sampling methodology to apply in assessing remedial effectiveness and the reservoir of lead dust on soft surfaces within the home. But the BRM method is useful when sampling attics or basements where dust has accumulated on hard surfaces such as cement or joists.

- The vacuum bag sampling technique is the simplest and easiest method to employ and should be continued to be used as an intervention tool.

Contracting and Logistics

- The project manager should be on-site during all work, if possible, or at key times. An intial meeting should be held with all primes and all subcontractors to clearly communicate the project objectives. Schedules should start on weekdays, and cleaning on the weekend should only be authorized when finishing a residence.

- In general, for contracting with cleaning contractors, a cost reimbursable or not-to-exceed contract method would work better than fixed price.

- The HUD Contractor recommended disposing of box springs and mattresses to be consistent with the idea of disposing of all cloth furnishings in the house. The HUD Contractor also recommended the HUD RA sample within at least 8 hours of the cleaning, before any further action is taken in the house.

- Curtains, drapes, and throw rugs in the Commercially Cleaned houses should be looked at on a case by case basis. In some instances, it would have been easier to dispose of these items and reimburse the homeowner.

- Air ducts should be cleaned by a professional service and furnace filters changed often. Cemented basements with exposed crawl spaces that are occasionally used may need to be remodeled to seal dirt under the house and then cleaned with the rest of the house.

- Instead of high-phosphate cleaners prone to degrading the environment, especially in a water system, a phosphate-free, biodegradable cleaner should be used to reduce environmental impacts.

- A larger scale project might require more rigid procurement requirements.

- The use of local, on-site contractors is strongly recommended. Contract procurement should either require use of local contractors or establishment of a contract requirement to store house furnishings locally within a specified distance.

- Lead paint hazards should be remediated prior to any interior cleaning in order to prevent recontamination due to lead-based paint.

Cleaning Techniques and Remedial Effectiveness

- The HUD Cleaning method is the most effective as it removes the soft surface reservoirs from the home and requires thorough cleaning prior to reinstalling new carpets. This method is expensive, cumbersome and requires substantial oversight. Because loadings and concentrations were approaching typical community levels after 12-months, it should be considered for applications to reduce extreme exposure in individual situations.

- Unless the application of HUD Cleaning involves paint abatement, HUD certification and training may not be required. Specialized protocols and training of local commercial cleaners with appropriate oversight would likely be sufficient to implement interior dust cleaning.

- The Commercial Cleaning method also shows short-term effectiveness in reducing lead loading in soft reservoirs. However, the effect is less than that achieved initially with the HUD Cleaning and it should be considered commensurate with cost. As this effect is also transient and loading and concentrations return to typical community levels by 12-months, the applicability of this technique should be evaluated accordingly.

- The Spring Cleaning method did not effectively reduce lead in soft surface reservoirs. However, this technique likely had positive effects in reducing access to dust in the short term. It should be considered as an appropriate intervention method for individuals needing housekeeping assistance.

- For the public residing in the BHSS, the results of this pilot project continue to support frequent cleaning, mopping, vacuuming, and steam cleaning of the house to reduce dust exposure. All the cleaning techniques used in this pilot project either remove a reservoir of lead (i.e., duct cleaning, carpet removal) or help to break the dust exposure pathway to young children.

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Table 2.1 All Data Collected for the House Dust Pilot Project

Data Type	HUD Cleaning Houses				Commercial Cleaning Houses				Spring Cleaning Houses				Control Houses			
	Pre-cleaning	Post-cleaning	6-month	12-month	Pre-cleaning	Post-cleaning	6-month	12-month	Pre-cleaning	Post-cleaning	6-month	12-month	Pre-cleaning	Post-cleaning	6-month	12-month
Vacuum Bag																
(mg lead/kg dust)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
Dust Mat																
(mg lead/kg dust)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
(mg dust/m^2/day)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
(mg lead/m^2/day)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
Kitchen BRM[a]																
(mg lead/kg dust)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
(g dust/m^2)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
(mg lead/m^2)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
Living Room BRM																
(mg lead/kg dust)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
(g dust/m^2)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
(mg lead/m^2)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
Child's Bedroom BRM																
(mg lead/kg dust)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
(g dust/m^2)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
(mg lead/m^2)	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
Attic[b]																
(mg lead/kg dust)	x				x				x				x			
Basementb																
(mg lead/kg dust)	x				x				x				x			
Air Duct																
(mg lead/kg dust)	x				x											
TCLP																
(ug lead/L)	x															
Indoor Air Monitoring (during cleaning operations)																
(ug lead/m^3 air)	x				x											
Lead Paint Assessment																
(> 1.0 mg/cm^2)	x				x								x			
Living Room Well Wipe																
(ug lead/ft^2)	x	x	x	x	x	x	x	x					x		x	x
Living Room Sill Wipe																
(ug lead/ft^2)	x	x	x	x	x	x	x	x					x		x	x
Bedroom Well Wipe																
(ug lead/ft^2)	x	x	x	x	x	x	x	x					x		x	x
Bedroom Sill Wipe																
(ug lead/ft^2)	x	x	x	x	x	x	x	x					x		x	x

[a] Three couches were also sampled using the BRM at pre-, post-, 6-months, and 12-months; 2 from the HUD Treatment and 1 from the Control Treatment

[b] Some attics and basements were inaccessible

Table 3.1 General Housing Characteristics

	TREATMENT			
	HUD	COMMERCIAL	SPRING	CONTROL
Number of Houses	6	6	6	5
YEAR BUILT				
Average	1948	1943	1946	1956
Median	1940	1938	1945	1954
Minimum	1938	1930	1900	1930
Maximum	1978	1971	1993	1976
OWN/RENT				
Own	5	5	3	5
Rent	1	1	3	0
INTERIOR REMODELING*				
Yes	2	4	1	2
No	4	2	5	3
HOUSE REMODELING**				
Yes	1	3	4	3
No	5	3	2	2
RUGS AT ENTRANCES				
At None	1	0	0	0
At One to Some	5	2	4	3
At All	0	4	2	2
REMOVING SHOES				
Yes	1	1	2	0
No	3	5	4	5
Sometimes	2	0	0	0

* Interior remodeling refers to painting the interior of the house, sanding or removing/remodeling window sills

** House remodeling refers to remodeling the house, installing new carpet/furniture

Table 3.2 Carpet Age (years)

	TREATMENT			
	HUD	COMMERCIAL	SPRING	CONTROL
KITCHEN				
Number of Kitchens with Carpet	1	2	1	1
Average	10.0	6.3	0.5	20.0
Median	-	6.3	-	-
Minimum	-	5.0	-	-
Maximum	-	7.5	-	-
LIVING ROOM				
Number of Living Rooms with Carpet	6	6	6	5
Average	9.7	6.8	12.3	15.2
Median	7.0	4.5	9.8	10.0
Minimum	2.0	2.0	0.4	1.0
Maximum	20.0	20.0	30.0	30.0
DINING ROOM				
Number of Dining Rooms with Carpet	0	2	0	1
Average	-	5.5	-	20.0
Median	-	5.5	-	-
Minimum	-	4.0	-	-
Maximum	-	7.0	-	-
MASTER BEDROOM				
Number of Master Bedrooms with Carpet	6	5	6	5
Average	11.8	2.8	14.2	12.9
Median	12.5	2.5	10.0	13.8
Minimum	2.0	0.3	4.0	4.0
Maximum	20.0	5.0	30.0	20.0
OTHER BEDROOM				
Number of Other Bedrooms with Carpet	6	9	7	8
Average	10.0	6.3	14.4	13.7
Median	7.0	5.0	10.0	15.0
Minimum	2.0	1.0	4.0	6.0
Maximum	20.0	15.0	30.0	20.0
OTHER ROOM				
Number of Other Rooms with Carpet	0	1	1	0
Average	-	5.0	5.0	-
Median	-	-	-	-
Minimum	-	-	-	-
Maximum	-	-	-	-

Table 3.3 Carpet Condition

	TREATMENT			
	HUD	COMMERCIAL	SPRING	CONTROL
KITCHEN				
Number of Kitchens with Carpet	1	2	1	1
Average	Moderately Dirty	Slightly Dirty	Good Condition	Moderately Dirty
Minimum	-	Good Condition	-	-
Maximum	-	Slightly Dirty	-	-
LIVING ROOM				
Number of Living Rooms with Carpet	6	6	6	5
Average	Slightly Dirty	Slightly Dirty	Slightly Dirty	Slightly Dirty
Minimum	Good Condition	Good Condition	Good Condition	Good Condition
Maximum	Poor Condition	Moderately Dirty	Poor Condition	Poor Condition
DINING ROOM				
Number of Dining Rooms with Carpet	0	2	0	1
Average	-	Slightly Dirty	-	Moderately Dirty
Minimum	-	Slightly Dirty	-	-
Maximum	-	Slightly Dirty	-	-
MASTER BEDROOM				
Number of Master Bedrooms with Carpet	6	5	5	5
Average	Moderately Dirty	Slightly Dirty	Moderately Dirty	Moderately Dirty
Minimum	Good Condition	Good Condition	Good Condition	Slightly Dirty
Maximum	Poor Condition	Moderately Dirty	Poor Condition	Moderately Dirty
OTHER BEDROOM				
Number of Other Bedrooms with Carpet	6	9	7	8
Average	Moderately Dirty	Slightly Dirty	Moderately Dirty	Moderately Dirty
Minimum	Slightly Dirty	Good Condition	Good Condition	Moderately Dirty
Maximum	Poor Condition	Moderately Dirty	Poor Condition	Moderately Dirty
OTHER ROOM				
Number of Other Rooms with Carpet	0	1	1	0
Average	-	Good Condition	Good Condition	-
Minimum	-	-	-	-
Maximum	-	-	-	-

Carpet condition codes were: 1) good condition, 2) slightly dirty, frayed, etc., 3) moderately dirty, frayed, etc., and 4) poor condition

Table 3.4 Carpet Types

	TREATMENT			
	HUD	COMMERCIAL	SPRING	CONTROL
KITCHEN				
Number of Kitchens with Carpet	1	2	1	1
Indoor/outdoor	17%	100%	100%	100%
LIVING ROOM				
Number of Living Rooms with Carpet	6	6	6	5
Shag	17%	-	-	20%
Berber	17%	-	-	-
Indoor/outdoor	-	17%	-	-
Sculptured	33%	67%	33%	60%
Plush	33%	17%	67%	20%
DINING ROOM				
Number of Dining Rooms with Carpet	0	2	0	1
Indoor/outdoor	-	50%	-	100%
Plush	-	50%	-	
MASTER BEDROOM				
Number of Master Bedrooms with Carpet	6	5	5	5
Shag	17%	20%	-	20%
Berber	-	20%	-	-
Sculptured	50%	60%	60%	40%
Plush	33%	-	40%	40%
OTHER BEDROOM				
Number of Other Bedrooms with Carpet	6	9	7	8
Shag	17%	11%	-	38%
Berber	-	-	-	13%
Indoor/outdoor	17%	22%	14%	-
Sculptured	33%	44%	43%	13%
Plush	33%	22%	43%	38%
OTHER ROOM				
Number of Other Rooms with Carpet	0	1	1	0
Berber	-	-	100%	-
Indoor/outdoor	-	100%	-	-

Table 3.5 Number and Age of Residents in Each House

	TREATMENT			
	HUD	COMMERCIAL	SPRING	CONTROL
Number of Houses	6	6	6	5
ADULTS PER HOUSE				
Number of Adults*	14	13	13	10
Average	2	2	2	2
Minimum	2	1	2	1
Maximum	4	4	3	4
CHILDREN PER HOUSE				
Number of Children**	9	6	9	8
Average	2	1	2	2
Minimum	0	0	0	0
Maximum	3	2	4	3
CHILDREN AGE				
Number of Children**	9	6	9	8
Average Age (years)	6	8	10	11
Minimum Age (years)	0.4	0.6	2	0.8
Maximum Age (years)	13	15	15	15

*An adult was considered to be any person 18 years or older.

**A child was considered to be any person younger than 18 years old.

Table 3.6 Smoking Habits of Residents

	TREATMENT			
	HUD	**COMMERCIAL**	**SPRING**	**CONTROL**
Number of Houses	6	6	6	5
SMOKERS				
Number of Houses with Smokers	4	2	2	4
NUMBER OF PACKS PER DAY				
Average	1.1	1.3	1.0	1.1
Minimum	0.5	0.5	0.5	0.5
Maximum	2.0	2.0	1.5	2.0

Table 3.7 Number and Age of Air Ducts

	TREATMENT			
	HUD	COMMERCIAL	SPRING	CONTROL
CENTRALIZED HEATING / AIR CONDITIONING				
Number of Houses	6	6	6	5
Yes	3	6	2	3
No	3	0	4	2
DUCT AGE (YEARS)				
Number of Houses	3[a,b]	6	2	3[a]
Average	7.5	7.0	11.8	5.0
Median	7.5	5.8	11.8	5.0
Minimum	7.5	0.3	7.5	2.5
Maximum	7.5	20.0	16.0	7.5
DUCT CLEANING				
Number of Houses	3	6	2	3
More than two times a year	0	0	0	0
One time a year	0	0	2	0
Never	3	4	0	3
Other	0	2	0	0

[a] One resident did not know the age of the ducts, so only 2 responses could be used.

[b] Both responses were the same.

Table 3.8 Basement and Attic Characteristics

	TREATMENT			
	HUD	COMMERCIAL	SPRING	CONTROL
Number of Houses	6	6	6	5
BASEMENT				
Number of Accessible Basements	4	4	1	1
Dirt Floor	3	1	0	0
Unfinished	3	1	0	0
Storage	0	3	1	0
Living	1	0	0	1
ATTIC				
Number of Accessible Attics	3	3	3	2
Unfinished	2	1	2	1
Storage	0	0	1	2
Living	0	0	0	0
Other	1	2	1	0

* Some residents responded to more than one choice (i.e., some basements were unfinished with a dirt floor).

Table 4.1a Dust Mat Lead Concentrations and Loading Rates

	HUD**	Commercial	Spring*	Control*
	Concentration (mg/kg)			
PRE-CLEANING				
N of NA	-	-	-	-
N of IS	1	1	-	-
N	5	5	6	5
Min	253	264	198	241
Max	1380	1310	950	2320
Average	824	675	612	1000
Std. Dev	481	500	245	833
Geometric Mean	685	535	555	729
POST-CLEANING				
N of NA	-	-	-	-
N of IS	2	2	-	-
N	4	4	6	-
Min	460	280	400	-
Max	1140	3040	1980	-
Average	845	1375	1130	-
Std. Dev	308	1177	614	-
Geometric Mean	797	1001	972	-
SIX-MONTH				
N of NA	-	-	1	1
N of IS	-	-	-	-
N	6	6	5	4
Min	300	210	200	540
Max	2900	2900	1700	750
Average	1108	1065	886	600
Std. Dev	925	982	583	100
Geometric Mean	870	737	705	594
TWELVE-MONTH				
N of NA	1	-	1	1
N of IS	2	1	1	-
N	3	5	4	4
Min	262	267	192	435
Max	711	1350	2910	730
Average	506	509	1365	607
Std. Dev	227	471	1170	136
Geometric Mean	467	403	914	595

NA = not applicable/no sample collected.

IS = insufficient sample volume for lead analysis.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.1b Dust Mat Lead Concentrations and Loading Rates

	HUD**	Commercial	Spring*	Control*
	Dust Loading Rate ($mg/m^2/day$)			
PRE-CLEANING				
N of NA	-	-	-	-
N of IS	-	-	-	-
N	6	6	6	5
Min	133	87	313	261
Max	1124	1011	2698	1372
Average	503	394	1331	651
Std. Dev	357	376	984	449
Geometric Mean	396	266	984	547
POST-CLEANING				
N of NA	-	-	-	-
N of IS	-	-	-	-
N	6	6	6	-
Min	38	53	117	-
Max	1213	1064	886	-
Average	497	252	392	-
Std. Dev	440	399	325	-
Geometric Mean	306	129	294	-
SIX-MONTH				
N of NA	-	-	1	1
N of IS	-	-	-	-
N	6	6	5	4
Min	349	188	228	1329
Max	1939	4361	4122	2291
Average	818	1012	2039	1899
Std. Dev	593	1644	1788	452
Geometric Mean	684	501	1231	1856
TWELVE-MONTH				
N of NA	1	-	1	1
N of IS	-	-	-	-
N	5	6	5	4
Min	143	107	46	164
Max	2259	1057	3086	859
Average	666	390	908	557
Std. Dev	894	345	1249	295
Geometric Mean	393	299	400	474

NA = not applicable/no sample collected.

IS = insufficient sample volume for lead analysis.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.1c Dust Mat Lead Concentrations and Loading Rates

	HUD**	Commercial	Spring*	Control*
	Lead Loading Rate ($mg/m^2/day$)			
PRE-CLEANING				
N of NA	-	-	-	-
N of IS	1	1	-	-
N	5	5	6	5
Min	0.125	0.083	0.171	0.192
Max	1.089	0.270	2.563	0.975
Average	0.465	0.193	0.921	0.463
Std. Dev	0.409	0.078	0.945	0.304
Geometric Mean	0.337	0.178	0.546	0.398
POST-CLEANING				
N of NA	-	-	-	-
N of IS	2	2	-	-
N	4	4	6	-
Min	0.273	0.059	0.047	-
Max	0.804	0.391	1.170	-
Average	0.509	0.221	0.520	-
Std. Dev	0.228	0.151	0.513	-
Geometric Mean	0.471	0.175	0.286	-
SIX-MONTH				
N of NA	-	-	1	1
N of IS	-	-	-	-
N	6	6	5	4
Min	0.171	0.101	0.123	0.744
Max	1.912	12.648	7.008	1.675
Average	0.845	2.281	2.449	1.155
Std. Dev	0.708	5.080	3.110	0.406
Geometric Mean	0.595	0.369	0.868	1.103
TWELVE-MONTH				
N of NA	1	-	1	1
N of IS	2	1	1	-
N	3	5	4	4
Min	0.068	0.063	0.061	0.092
Max	1.606	0.417	2.487	0.601
Average	0.616	0.197	1.336	0.343
Std. Dev	0.859	0.157	1.268	0.211
Geometric Mean	0.267	0.148	0.627	0.281

NA = not applicable/no sample collected.

IS = insufficient sample volume for lead analysis.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.2 Vacuum Bag Lead Concentrations

	HUD**	Commercial	Spring*	Control*
	Concentration (mg/kg)			
PRE-CLEANING				
N of NA	-	1	-	1
N	6	5	6	4
Min	100	206	149	224
Max	903	787	1100	2200
Average	552	507	598	1024
Std. Dev	333	229	309	950
Geometric Mean	425	459	514	664
POST-CLEANING				
N of NA	1	1	1	-
N	5	5	5	-
Min	170	264	158	-
Max	1750	490	1040	-
Average	723	415	471	-
Std. Dev	656	91	350	-
Geometric Mean	513	405	380	-
SIX-MONTH				
N of NA	-	1	2	2
N	6	5	4	3
Min	70	300	44	910
Max	670	500	3200	2100
Average	357	378	1029	1537
Std. Dev	258	81	1471	598
Geometric Mean	261	371	374	1451
TWELVE-MONTH				
N of NA	2	4	2	2
N	4	2	4	3
Min	410	330	180	400
Max	450	560	1070	1030
Average	433	445	570	813
Std. Dev	17	163	381	358
Geometric Mean	432	430	469	747

NA = not applicable/no sample collected.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.3a Living Room BRM Lead Concentrations and Loadings

	HUD**	Commercial	Spring *	Control*
	Concentration (mg/kg)			
PRE-CLEANING				
N of NA	-	-	-	-
N of IS	-	-	-	-
N	6	6	6	5
Min	116	194	142	197
Max	1370	572	1690	5020
Average	673	409	889	1271
Std. Dev	489	137	550	2099
Geometric Mean	487	386	700	549
POST-CLEANING				
N of NA	-	-	-	-
N of IS	1	-	-	-
N	5	6	6	-
Min	60	260	140	-
Max	360	950	1260	-
Average	194	528	762	-
Std. Dev	119	263	456	-
Geometric Mean	161	476	599	-
SIX-MONTH				
N of NA	-	-	1	1
N of IS	-	-	-	-
N	6	6	5	4
Min	30	120	160	180
Max	1600	640	1200	1300
Average	670	483	778	675
Std. Dev	704	200	407	500
Geometric Mean	284	425	640	523
TWELVE-MONTH				
N of NA	1	-	1	1
N of IS	-	-	-	-
N	5	6	5	4
Min	130	260	180	390
Max	1940	610	1260	1470
Average	720	440	738	808
Std. Dev	702	136	446	463
Geometric Mean	506	421	602	720

NA = not applicable/no sample collected.

IS = insufficient sample volume for lead analysis.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.3b Living Room BRM Lead Concentrations and Loadings

	HUD**	Commercial	Spring *	Control*
	Dust Loading (g/m^2)			
PRE-CLEANING				
N of NA	-	-	-	-
N of IS	-	-	-	-
N	6	6	6	5
Min	7.25	2.05	6.94	6.82
Max	68.03	75.39	20.17	41.48
Average	22.83	21.94	13.13	27.00
Std. Dev	24.74	27.52	4.64	12.72
Geometric Mean	14.96	11.41	12.43	23.22
POST-CLEANING				
N of NA	-	-	-	-
N of IS	-	-	-	-
N	6	6	6	-
Min	0.73	1.08	5.38	-
Max	4.70	61.57	21.53	-
Average	2.33	14.41	12.87	-
Std. Dev	1.74	23.49	6.46	-
Geometric Mean	1.83	5.18	11.30	-
SIX-MONTH				
N of NA	-	-	1	1
N of IS	-	-	-	-
N	6	6	5	4
Min	2.66	2.55	6.14	10.48
Max	40.29	117.76	33.12	24.58
Average	11.49	42.91	18.36	19.00
Std. Dev	14.29	54.54	9.88	6.14
Geometric Mean	7.35	14.87	16.01	18.10
TWELVE-MONTH				
N of NA	1	-	1	1
N of IS	-	-	-	-
N	5	6	5	4
Min	3.52	1.97	6.46	4.59
Max	19.56	116.22	24.51	49.19
Average	10.74	27.62	18.16	30.62
Std. Dev	6.15	44.72	7.35	20.60
Geometric Mean	9.20	9.77	16.46	22.16

NA = not applicable/no sample collected.

IS = insufficient sample volume for lead analysis.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.3c Living Room BRM Lead Concentrations and Loadings

	HUD**	Commercial	Spring *	Control*
	Lead Loading (mg/m^2)			
PRE-CLEANING				
N of NA	-	-	-	-
N of IS	-	-	-	-
N	6	6	6	5
Min	3.82	1.17	1.64	5.47
Max	13.33	25.18	21.95	34.22
Average	8.03	7.62	11.64	15.82
Std. Dev	3.65	9.15	7.42	11.79
Geometric Mean	7.28	4.41	8.70	12.74
POST-CLEANING				
N of NA	-	-	-	-
N of IS	1	-	-	-
N	5	6	6	-
Min	0.06	0.59	1.77	-
Max	1.57	18.47	24.76	-
Average	0.46	5.11	10.98	-
Std. Dev	0.63	6.93	10.12	-
Geometric Mean	0.24	2.47	6.77	-
SIX-MONTH				
N of NA	-	-	1	1
N of IS	-	-	-	-
N	6	6	5	4
Min	0.21	1.17	3.04	3.97
Max	5.74	67.66	30.80	20.65
Average	3.02	16.79	15.00	11.35
Std. Dev	1.94	25.62	12.21	7.38
Geometric Mean	2.08	6.33	10.24	9.46
TWELVE-MONTH				
N of NA	1	-	1	1
N of IS	-	-	-	-
N	5	6	5	4
Min	0.90	1.07	2.85	6.75
Max	37.94	48.81	30.88	31.42
Average	10.60	11.07	15.10	18.32
Std. Dev	15.50	18.70	12.29	10.20
Geometric Mean	4.66	4.11	9.91	15.96

NA = not applicable/no sample collected.

IS = insufficient sample volume for lead analysis.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.4a Bedroom BRM Lead Concentrations and Loadings

	HUD**	Commercial	Spring *	Control*
	Concentration (mg/kg)			
PRE-CLEANING				
N of NA	-	-	-	-
N of IS	-	-	1	-
N	6	6	5	5
Min	136	126	108	209
Max	1500	2500	1680	1260
Average	583	879	680	570
Std. Dev	496	911	624	412
Geometric Mean	432	552	461	473
POST-CLEANING				
N of NA	-	-	-	-
N of IS	1	-	1	-
N	5	6	5	-
Min	30	163	60	-
Max	300	1770	2140	-
Average	171	844	790	-
Std. Dev	109	565	837	-
Geometric Mean	133	664	439	-
SIX-MONTH				
N of NA	-	-	1	1
N of IS	-	-	1	-
N	6	6	4	4
Min	80	140	170	360
Max	4500	1600	1700	1200
Average	1252	748	765	603
Std. Dev	1725	557	690	400
Geometric Mean	528	558	535	528
TWELVE-MONTH				
N of NA	1	-	1	2
N of IS	-	-	1	-
N	5	6	4	3
Min	170	330	240	440
Max	1160	1880	1630	1270
Average	486	1125	810	880
Std. Dev	390	671	677	417
Geometric Mean	392	925	584	804

NA = not applicable/no sample collected.

IS = insufficient sample volume for lead analysis.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.4b Bedroom BRM Lead Concentrations and Loadings

	HUD**	Commercial	Spring *	Control*
	Dust Loading (g/m^2)			
PRE-CLEANING				
N of NA	-	-	-	-
N of IS	-	-	-	-
N	6	6	6	5
Min	2.30	3.12	0.08	9.97
Max	51.85	72.01	20.88	69.57
Average	19.91	28.56	9.10	29.86
Std. Dev	19.18	32.68	9.29	23.62
Geometric Mean	12.22	14.35	3.54	23.80
POST-CLEANING				
N of NA	-	-	-	-
N of IS	-	-	-	-
N	6	6	6	-
Min	0.73	1.24	0.07	-
Max	5.62	17.51	18.37	-
Average	1.95	7.44	7.37	-
Std. Dev	1.82	7.02	6.74	-
Geometric Mean	1.53	4.83	3.05	-
SIX-MONTH				
N of NA	-	-	1	1
N of IS	-	-	-	-
N	6	6	5	4
Min	1.26	1.87	0.22	7.07
Max	13.96	41.44	12.56	23.21
Average	4.94	16.77	6.47	15.40
Std. Dev	4.72	19.10	5.18	8.02
Geometric Mean	3.58	8.71	3.37	13.69
TWELVE-MONTH				
N of NA	1	-	1	2
N of IS	-	-	-	-
N	5	6	5	3
Min	2.73	1.36	0.39	8.83
Max	6.67	63.08	18.41	25.91
Average	5.60	18.10	9.79	14.65
Std. Dev	1.69	24.06	7.74	9.75
Geometric Mean	5.32	7.63	5.51	12.82

NA = not applicable/no sample collected.

IS = insufficient sample volume for lead analysis.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.4c Bedroom BRM Lead Concentrations and Loadings

	HUD**	Commercial	Spring *	Control*
	Lead Loading (mg/m^2)			
PRE-CLEANING				
N of NA	-	-	-	-
N of IS	-	-	1	-
N	6	6	5	5
Min	1.65	1.03	0.70	4.93
Max	15.72	36.33	17.37	31.03
Average	6.85	13.46	6.96	15.83
Std. Dev	5.04	13.47	7.71	13.78
Geometric Mean	5.28	7.92	3.48	11.26
POST-CLEANING				
N of NA	-	-	-	-
N of IS	1	-	1	-
N	5	6	5	-
Min	0.10	0.56	0.52	-
Max	0.43	10.98	19.89	-
Average	0.25	4.61	8.33	-
Std. Dev	0.14	3.75	10.21	-
Geometric Mean	0.22	3.20	2.83	-
SIX-MONTH				
N of NA	-	-	1	1
N of IS	-	-	1	-
N	6	6	4	4
Min	0.49	0.52	0.72	3.18
Max	11.30	24.04	16.84	27.86
Average	3.26	8.47	7.41	10.79
Std. Dev	4.05	8.55	7.81	11.63
Geometric Mean	1.89	4.86	3.59	7.23
TWELVE-MONTH				
N of NA	1	-	1	2
N of IS	-	-	1	-
N	5	6	4	3
Min	0.76	0.45	1.26	3.88
Max	7.74	118.59	30.00	32.90
Average	2.91	26.40	13.03	15.12
Std. Dev	2.82	45.70	13.88	15.58
Geometric Mean	2.09	7.06	6.22	10.31

NA = not applicable/no sample collected.

IS = insufficient sample volume for lead analysis.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.5a Kitchen BRM Lead Concentrations and Loadings

	HUD**	Commercial	Spring*	Control*
	Concentration (mg/kg)			
PRE-CLEANING				
N of NA	1	-	-	-
N of IS	-	1	-	2
N	5	5	6	3
Min	197	340	97	139
Max	1580	918	1360	2480
Average	767	488	610	1045
Std. Dev	677	243	495	1257
Geometric Mean	536	452	427	562
POST-CLEANING				
N of NA	1	-	-	-
N of IS	5	2	4	-
N	-	4	2	-
Min	-	281	150	-
Max	-	558	250	-
Average	-	364	200	-
Std. Dev	-	130	71	-
Geometric Mean	-	349	194	-
SIX-MONTH				
N of NA	-	-	1	1
N of IS	4	-	2	1
N	2	6	3	3
Min	80	90	160	230
Max	1200	1400	1800	850
Average	640	635	1020	597
Std. Dev	792	578	823	325
Geometric Mean	310	403	682	518
TWELVE-MONTH				
N of NA	1	-	1	1
N of IS	4	1	3	2
N	1	5	2	2
Min	ND	180	170	170
Max	ND	880	1040	690
Average	ND	414	605	430
Std. Dev	ND	297	615	368
Geometric Mean	ND	342	420	342

NA = not applicable/no sample collected.

IS = insufficient sample volume for lead analysis.

ND = data not available for confidentiality purposes.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.5b Kitchen BRM Lead Concentrations and Loadings

	HUD**	Commercial	Spring*	Control*
	Dust Loading (g/m^2)			
PRE-CLEANING				
N of NA	1	-	-	-
N of IS	-	-	-	-
N	5	6	6	5
Min	1.84	1.29	1.77	1.18
Max	27.81	47.22	9.02	35.88
Average	8.44	13.14	5.47	13.89
Std. Dev	11.14	17.40	2.49	13.02
Geometric Mean	4.58	6.52	4.89	8.79
POST-CLEANING				
N of NA	1	-	-	-
N of IS	-	-	-	-
N	5	6	6	-
Min	0.12	0.13	0.10	-
Max	0.31	6.39	6.28	-
Average	0.20	3.34	1.69	-
Std. Dev	0.08	2.55	2.33	-
Geometric Mean	0.19	1.94	0.73	-
SIX-MONTH				
N of NA	-	-	1	1
N of IS	-	-	-	-
N	6	6	5	4
Min	0.14	3.16	0.29	0.36
Max	8.58	64.33	8.23	8.25
Average	2.10	17.09	3.53	2.90
Std. Dev	3.27	23.54	3.50	3.64
Geometric Mean	0.71	9.49	1.85	1.53
TWELVE-MONTH				
N of NA	1	-	1	1
N of IS	-	-	-	-
N	5	6	5	4
Min	0.0018	0.22	0.0018	0.11
Max	3.05	46.93	4.88	2.80
Average	0.70	12.88	1.67	1.35
Std. Dev	1.32	17.33	2.26	1.43
Geometric Mean	0.10	5.04	0.20	0.57

NA = not applicable/no sample collected.

IS = insufficient sample volume for lead analysis.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.5c Kitchen BRM Lead Concentrations and Loadings

	HUD**	Commercial	Spring*	Control*
	Lead Loading (mg/m^2)			
PRE-CLEANING				
N of NA	1	-	-	-
N of IS	-	1	-	2
N	5	5	6	3
Min	0.57	1.11	0.50	1.75
Max	12.85	16.90	9.38	25.00
Average	4.49	6.09	3.22	15.08
Std. Dev	5.07	6.29	3.26	11.99
Geometric Mean	2.45	4.07	2.09	9.32
POST-CLEANING				
N of NA	1	-	-	-
N of IS	5	2	4	-
N	-	4	2	-
Min	-	0.68	0.27	-
Max	-	2.80	1.57	-
Average	-	1.72	0.92	-
Std. Dev	-	0.87	0.92	-
Geometric Mean	-	1.52	0.65	-
SIX-MONTH				
N of NA	-	-	1	1
N of IS	4	-	2	1
N	2	6	3	3
Min	0.16	1.23	0.98	0.74
Max	1.81	7.92	9.06	1.90
Average	0.99	4.74	4.79	1.38
Std. Dev	1.17	2.82	4.06	0.59
Geometric Mean	0.54	3.82	3.37	1.29
TWELVE-MONTH				
N of NA	1	-	1	1
N of IS	4	1	3	2
N	1	5	2	2
Min	ND	0.82	0.55	0.48
Max	ND	9.86	5.07	1.63
Average	ND	4.55	2.81	1.05
Std. Dev	ND	3.77	3.20	0.82
Geometric Mean	ND	3.24	1.67	0.88

NA = not applicable/no sample collected.

IS = insufficient sample volume for lead analysis.

ND = data not available for confidentiality purposes.

*One participant moved away before the Six-month sampling event.

**One household did not participate in the Twelve-month sampling event.

Table 4.6a Correlations (Number of Pairs) for Lead Concentrations (mg/kg)

	Vacuum	Mat	Living Room BRM	Child's Room BRM	Kitchen BRM
Vacuum	1.00				
Mat	0.58 (19) *	1.00			
Living Room BRM	0.83 (21) **	0.72 (21) **	1.00		
Child's Room BRM	0.55 (20) *	0.50 (20) *	0.35 (22)	1.00	
Kitchen BRM	0.71 (17) *	0.77 (17) **	0.86 (19) **	0.54 (18) *	1.00

* $P < 0.05$

** $P < 0.001$

Table 4.6b Correlations (Number of pairs) for Dust and Lead Loadings [a]

		DUST LOADING				LEAD LOADING			
		Living Room BRM	Kitchen BRM	Child's Room BRM	Mat	Living Room BRM	Kitchen BRM	Child's Room BRM	Mat
DUST LOADING	Living Room BRM	1.00							
	Kitchen BRM	0.04 (21)	1.00						
	Child's Room BRM	0.68 (22) **	0.60 (22) *	1.00					
	Mat	0.03 (22)	-0.16 (22)	-0.16 (23)	1.00				
LEAD LOADING	Living Room BRM					1.00			
	Kitchen BRM					0.39 (18)	1.00		
	Child's Room BRM					0.50 (21) *	0.57 (18) *	1.00	
	Mat					0.35 (20)	0.11 (17)	0.17 (20)	1.00

[a] BRM Loadings in units of g/m^2 for dust and mg/m^2 for lead; Mat Loading Rates in units of mg/m^2/day for dust and mg/m^2/day for lead

* $P < 0.05$

** $P \leq 0.001$

Table 4.7. ANOVA Results for BRM Dust Loading by Carpet Condition Category

	Carpet Condition Categories		
	Good Condition	Slightly/Moderately dirty, frayed, etc.	Poor Condition
N	9	27	7
Min (g/m^2)	2.9	2.3	7.8
Max (g/m^2)	26.6	75.4	68.0
Geometric Mean (g/m^2)	7.2	15.2	24.8
Geometric St. Dev.	1.98	2.55	2.18
	p = 0.0057		

Table 4.8a Concentrations and Dust and Lead Loadings for Attics, Basements, and Ducts

	Attics[a]	Basements[b]	Ducts
Concentration (mg/kg)			
N	4	8*	7**
Average	6,665	2,138	3,430
Standard Dev.	5,298	2,180	4,809
Minimum	890	128	230
Maximum	11,600	6,980	10,600
Geometric Mean	4,425	1,299	1,207
Dust loading (g/m^2)			
N	3	4	NA
Average	24	11	NA
Standard Dev.	18	4	NA
Minimum	5	6	NA
Maximum	40	15	NA
Geometric Mean	17	10	NA
Lead loading (mg/m^2)			
N	3	4	NA
Average	123	16	NA
Standard Dev.	130	9	NA
Minimum	36	9	NA
Maximum	272	29	NA
Geometric Mean	84	15	NA

NA = not applicable/no sample collected
* = 2 samples collected from the same basement (1 soil/1 dust)
** = 2 insufficient sample volumes for laboratory analysis
[a]1 camel hair brush sample and 3 BRM samples
[b]4 soil samples and 4 BRM samples

Table 4.8b Dust Extracted from Duct Cleanings

	Dust (g)
House #1	420
House #2	340
House #3	150
House #4	220
House #5	110
House #6	60
House #7*	0.0
House #8*	0.0
House #9	100
AVERAGE	156

* = Insufficient mass for measurement,
scale was in kg, therefore the sample weight is <0.01 kg

Table 4.9 Interior and Exterior Lead Paint Hazards

	Interior Paint Pb Hazard	Exterior Paint Pb Hazard
HUD		
House #1	1	2
House #2	1[a]	2
House #3	1	2[b,c]
House #4	1[b]	2
House #5	1	2
House #6	1	1
Commercial		
House #1	1	1
House #2	2[d]	1
House #3	1	1
House #4	1	1
House #5	1	2[e]
House #6	1	1
Control		
House #1	1[a]	2
House #2	1	1[b]
House #3	1	1
House #4	1	1
House #5	1	2[c]

1- No Lead Hazard

2- Lead Hazard

[a] Detected lead based paint on friction surfaces (windows and interior doors).

[b] Detected lead based paint, but paint is currently in stable condition.

[c] Lead hazard on detached structure

[d] Detected only on stair stringer

[e] Detected only on exterior cellar windows

Table 4.10 HUD Dust Wipe Lead Loadings

	Window Well Child's Bedroom	Window Sill Child's Bedroom	Window Well Living Room	Window Sill Living Room
	Loading (ug/ft^2)			
Pre-Cleaning				
N	5	6	3	6
Min	1591	121	2254	31.3
Max	49200	25570	99560	301
Average	16008	4558	37585	158
Std. Dev	19290	10296	53848	129
Geometric Mean	8671	591	13490	105
Post-Cleaning				
N	6	5	3	6
Min	1459	31.3	480	19.7
Max	6978	2189	3014	177
Average	2965	515	1753	83
Std. Dev	2091	937	1267	62
Geometric Mean	2516	158	1367	63
Six-Month				
N	6	6	3	9
Min	196	12	445	6.8
Max	5856	1484	2740	375
Average	3256	435	1593	61
Std. Dev	2249	937	1148	118
Geometric Mean	2092	147	1248	27
Twelve-Month				
N	4	5	2	8
Min	333	12.9	771	4.6
Max	3060	1130	1920	2110
Average	1278	251	1346	301
Std. Dev	1219	492	812	732
Geometric Mean	925	54	1217	43

Table 4.11 Commercial Dust Wipe Lead Loadings

	Window Well Child's Bedroom	Window Sill Child's Bedroom	Window Well Living Room	Window Sill Living Room
	Loading (ug/ft^2)			
Pre-Cleaning				
N	5	6	4	7
Min	134	7	53.3	8.02
Max	72000	2375	749	692
Average	16854	609	403	348
Std. Dev	31155	890	335	291
Geometric Mean	2113	170	261	180
Post-Cleaning				
N	5	7	4	8
Min	3	2.1	6.4	2.4
Max	819	1735	44.2	146
Average	229	277	18	27
Std. Dev	342	644	17	48
Geometric Mean	61	28	14	12
Six-Month				
N	5	5	4	8
Min	44	9.1	35.3	8.7
Max	3971	307	342	227
Average	1463	85	118	48
Std. Dev	1952	126	149	75
Geometric Mean	279	39	72	23
Twelve-Month				
N	5	7	4	8
Min	39.2	10.8	52.5	6
Max	3770	233	466	93.3
Average	1269	74	164	31
Std. Dev	1731	95	201	36
Geometric Mean	268	34	104	18

Table 4.12 Control Dust Wipe Lead Loadings

	Window Well Child's Bedroom	Window Sill Child's Bedroom	Window Well Living Room	Window Sill Living Room
	Loading (ug/ft^2)			
Pre-Cleaning				
N	4	5	5	5
Min	2554	46.1	528	125
Max	63490	826	37440	4176
Average	25355	279	9289	1682
Std. Dev	28771	339	15825	1640
Geometric Mean	11738	144	2866	971
Post-Cleaning				
N	NA	NA	NA	NA
Min	NA	NA	NA	NA
Max	NA	NA	NA	NA
Average	NA	NA	NA	NA
Std. Dev	NA	NA	NA	NA
Geometric Mean	NA	NA	NA	NA
Six-Month				
N	4	3	4	4
Min	1101	37.3	110	112
Max	62280	340	40320	1108
Average	16792	156	10200	403
Std. Dev	30329	162	20080	475
Geometric Mean	3937	104	606	253
Twelve-Month				
N	4	4	4	4
Min	1390	133	80.8	31.7
Max	9860	208	6250	1210
Average	5538	162	2923	509
Std. Dev	3805	35	3263	501
Geometric Mean	4342	159	809	277

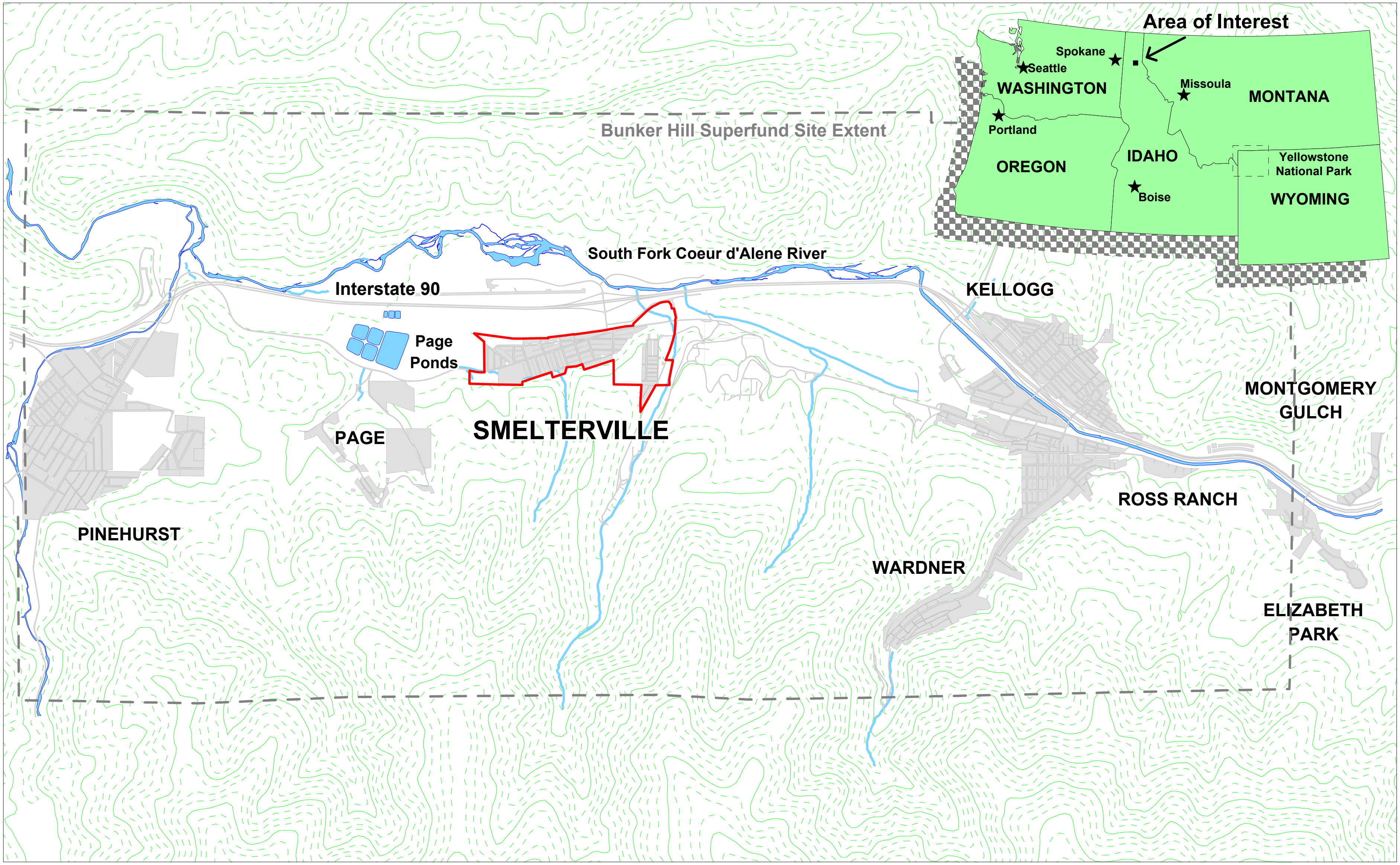
NA - not applicable/no samples collected

Table 5.1 Project Costs - Average Cost/House/Treatment

	HUD CLEANING	COMMERCIAL CLEANING	SPRING CLEANING
USACE OVERSIGHT[a]	$ 13,000.00	$ 13,000.00	$ -
STATE CONSULTANT OVERSIGHT[b]	$ 35.00	$ 35.00	$ 332.00
TOTAL OVERSIGHT COSTS	$ 13,035.00	$ 13,035.00	$ 332.00
CLEANING SERVICES	$ 9,123.00	$ 3,838.00	$ 832.00
(air duct cleaning)	$ 710.00	$ 710.00	$ -
TOTAL CLEANING COSTS	$ 9,833.00	$ 4,548.00	$ 832.00
RELOCATION (including hotel room(s) and per diem)	$ 463.00	$ 240.00	$ -
REPLACEMENT/REPAIR (Carpet, furniture and repair of damage/moving household goods)	$ 1,512.00	$ -	$ -
HUD RISK ASSESSOR (initial pre-cleaning XRF and wipe sample inspection - does not include post-cleaning, 6-month, and 12-month sampling)	$ 1,480.00	$ 1,480.00	$ -
TOTAL COST PER HOUSE	**$ 26,323.00**	**$ 19,303.00**	**$ 1,164.00**

[a] USACE Oversight was not individually tracked. However, average costs to arrange for cleaning, move families out, evaluate residence for pre and post conditions, compensate for furniture, replacement of carpet and oversight were calculated and found to be near the average for 16 total residences. The cost to handle replacement costs for HUD cleaned homes is offset by the cost for additional oversight time needed in commercial homes.

[b] State Consultant Oversight was intended to be minimal in all cleaning treatments.



0 0.5 1.0 miles

Scale 1 : 50,000

N W E S

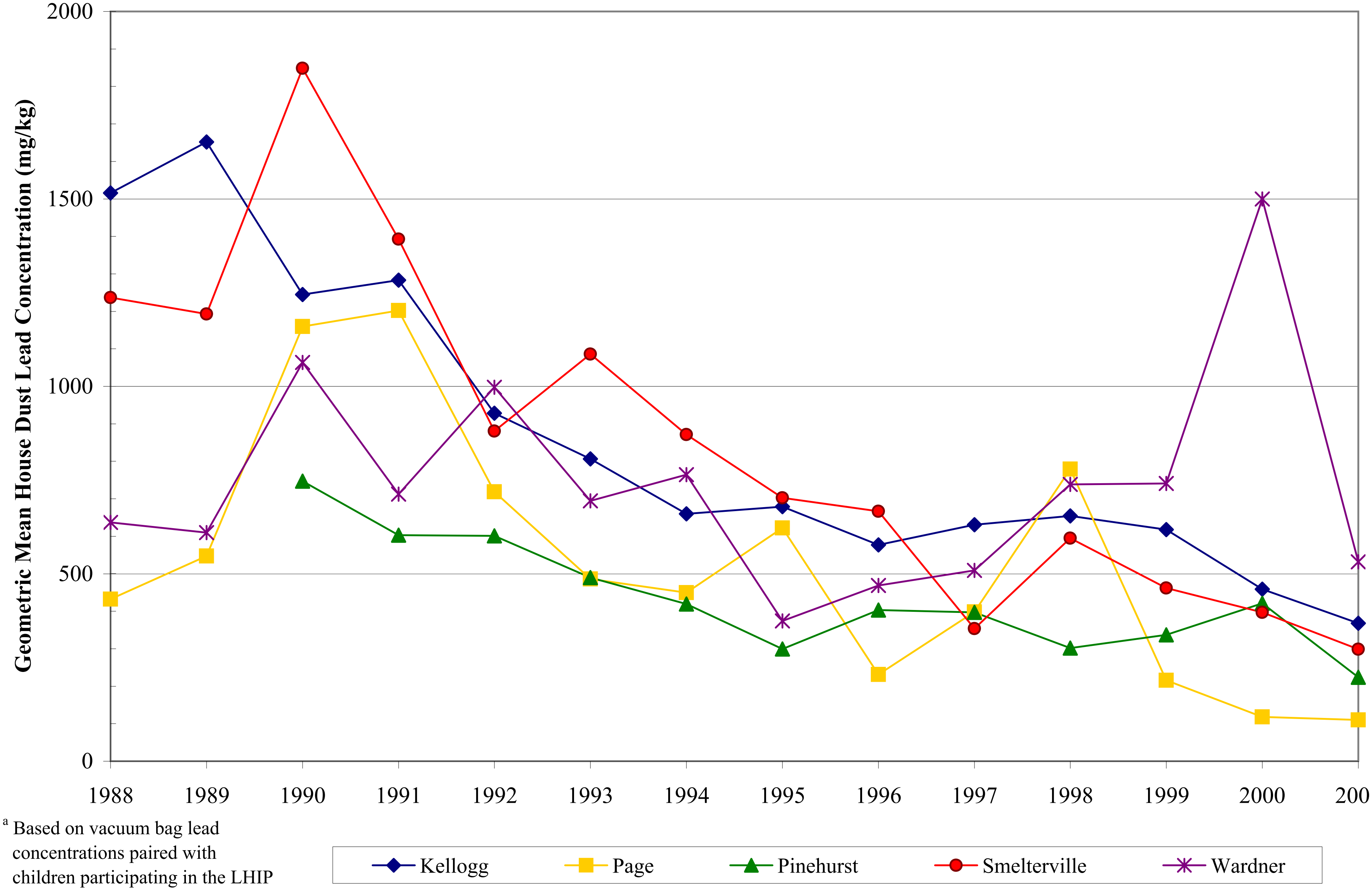
Terra Graphics
Environmental Engineering, Inc.

Main Roads
Topography

Figure 1-1

Bunker Hill Superfund Site

Figure 1-2
House Dust Lead Exposure by City, 1988-2001[a]



[a] Based on vacuum bag lead concentrations paired with children participating in the LHIP

Figure 1-3
Yard Soil and House Dust Lead Exposures and Concentrations for Smelterville, 1988-2001

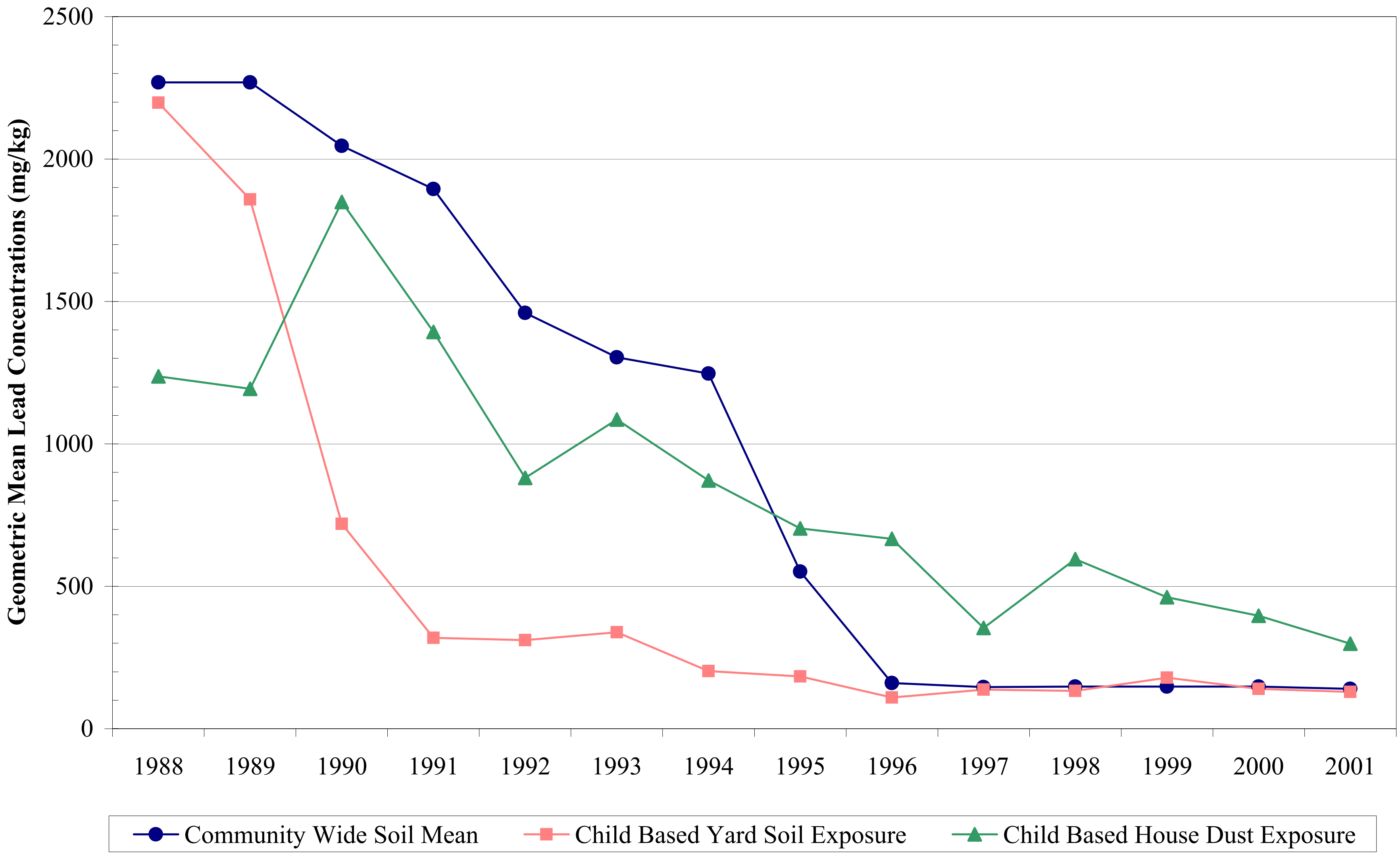


Figure 4-1. Box Plots of Mat Lead Concentrations by Treatment

FIGURE 4-1a. HUD

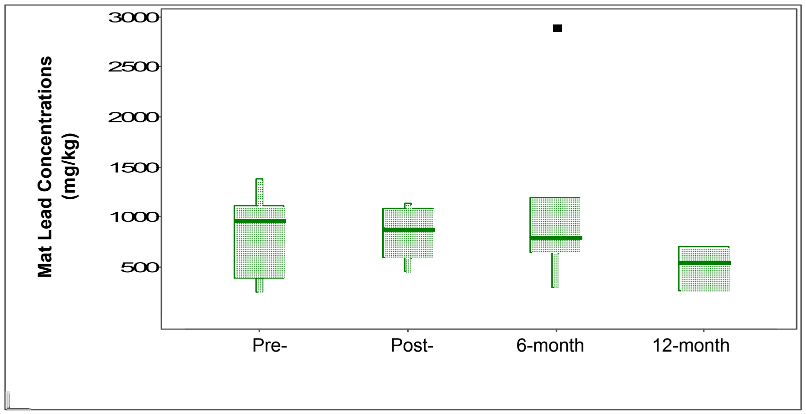


FIGURE 4-1b. COMMERCIAL

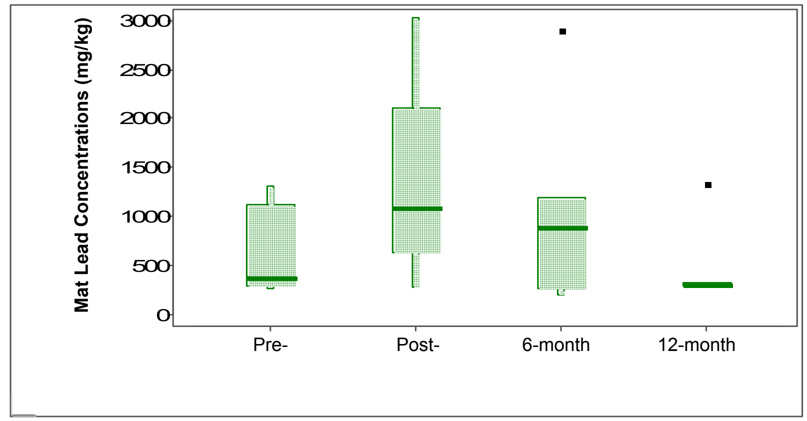


FIGURE 4-1c. SPRING

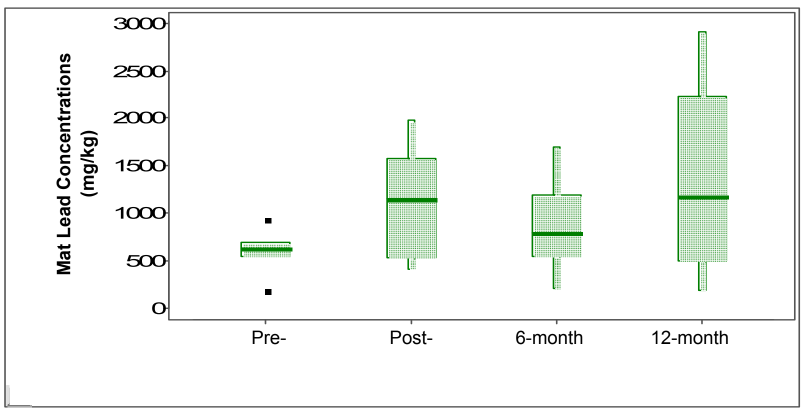
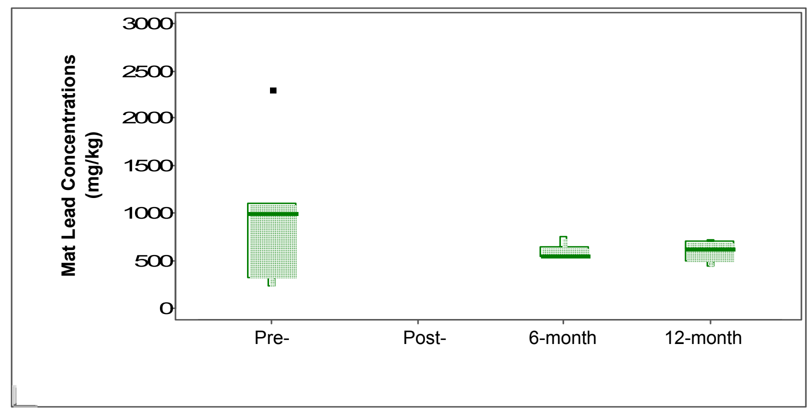


FIGURE 4-1d. CONTROL



Note:

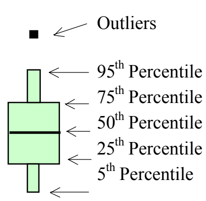


Figure 4-2. Box Plots of Mat Dust Loading Rate by Treatment

FIGURE 4-2a. HUD

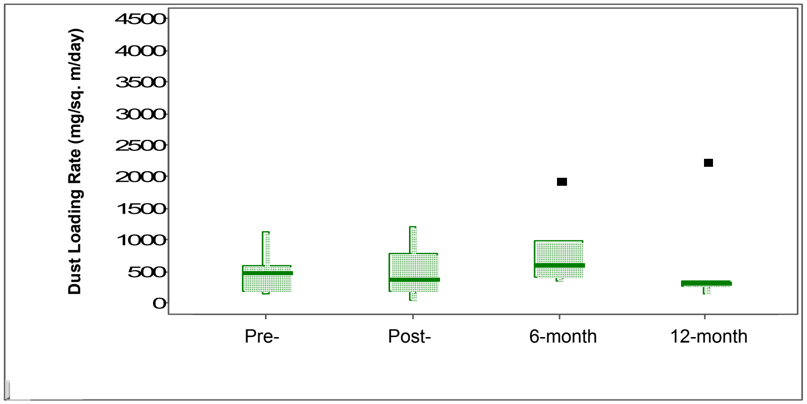


FIGURE 4-2b. COMMERCIAL

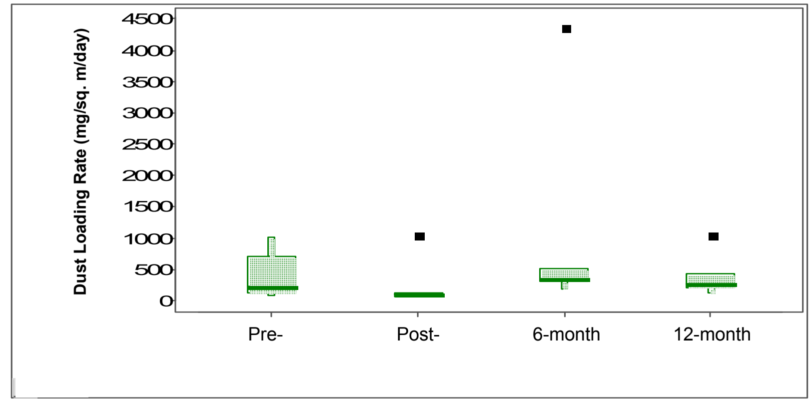


FIGURE 4-2c. SPRING

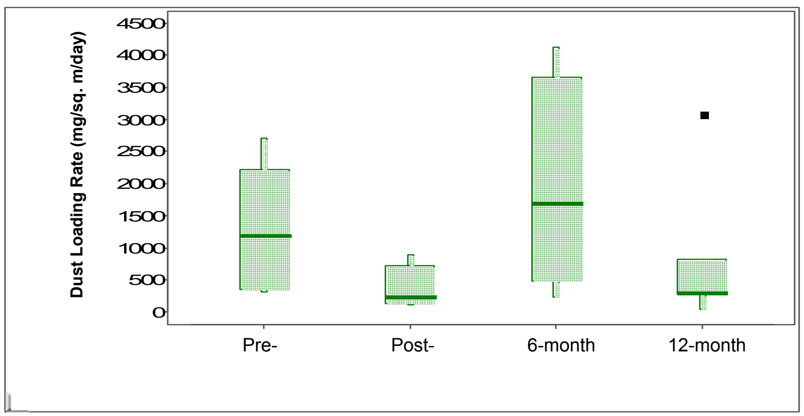
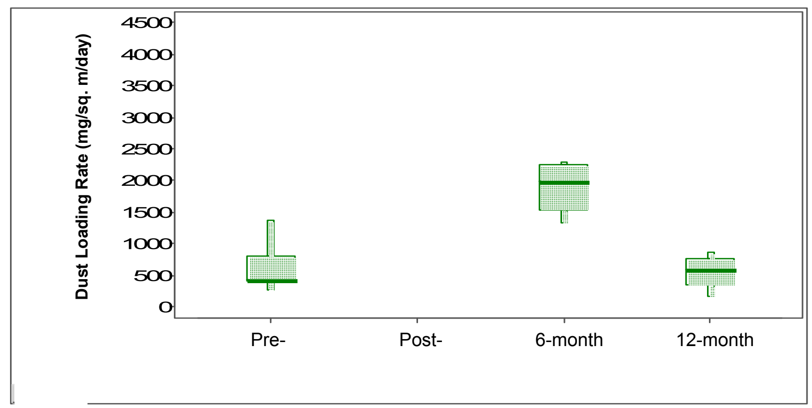


FIGURE 4-2d. CONTROL



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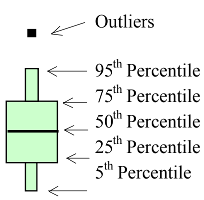


Figure 4-3. Box Plots of Mat Lead Loading Rate by Treatment

FIGURE 4-3a. HUD

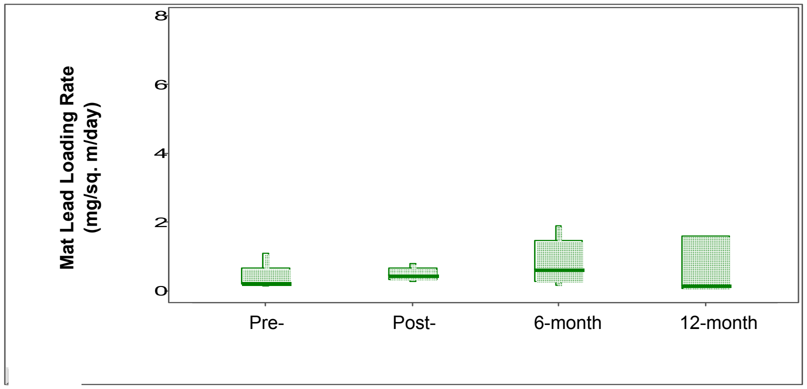


FIGURE 4-3b. COMMERCIAL

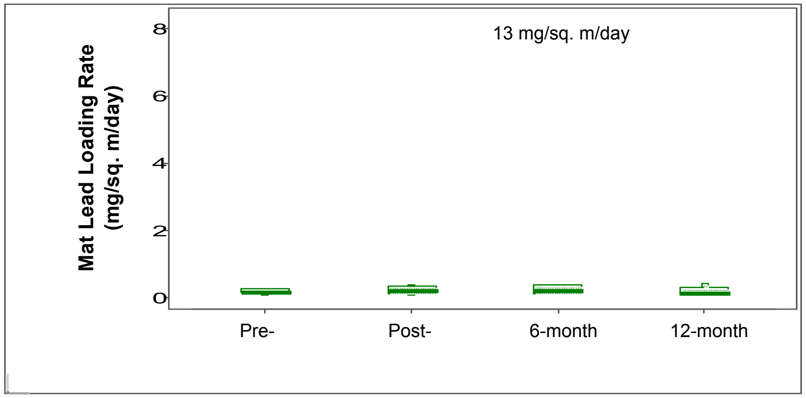


FIGURE 4-3c. SPRING

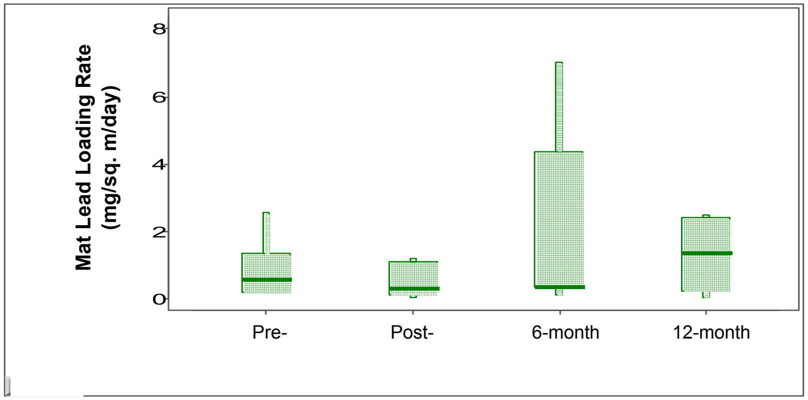
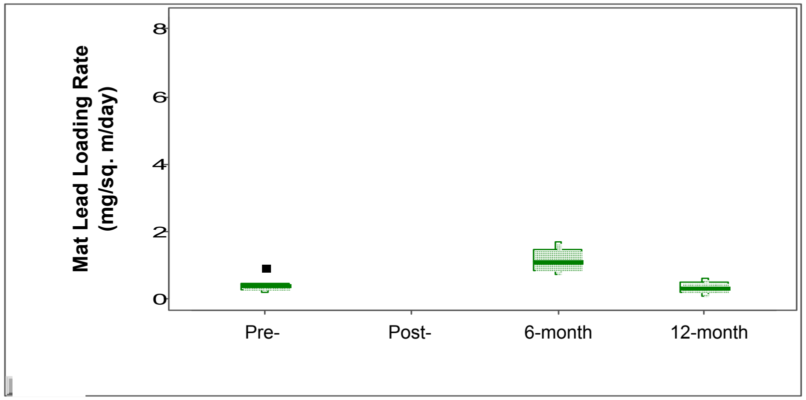


FIGURE 4-3d. CONTROL



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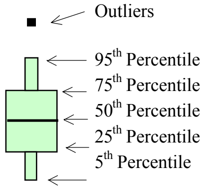


Figure 4-4a. Line Plot of Mat Lead Concentrations

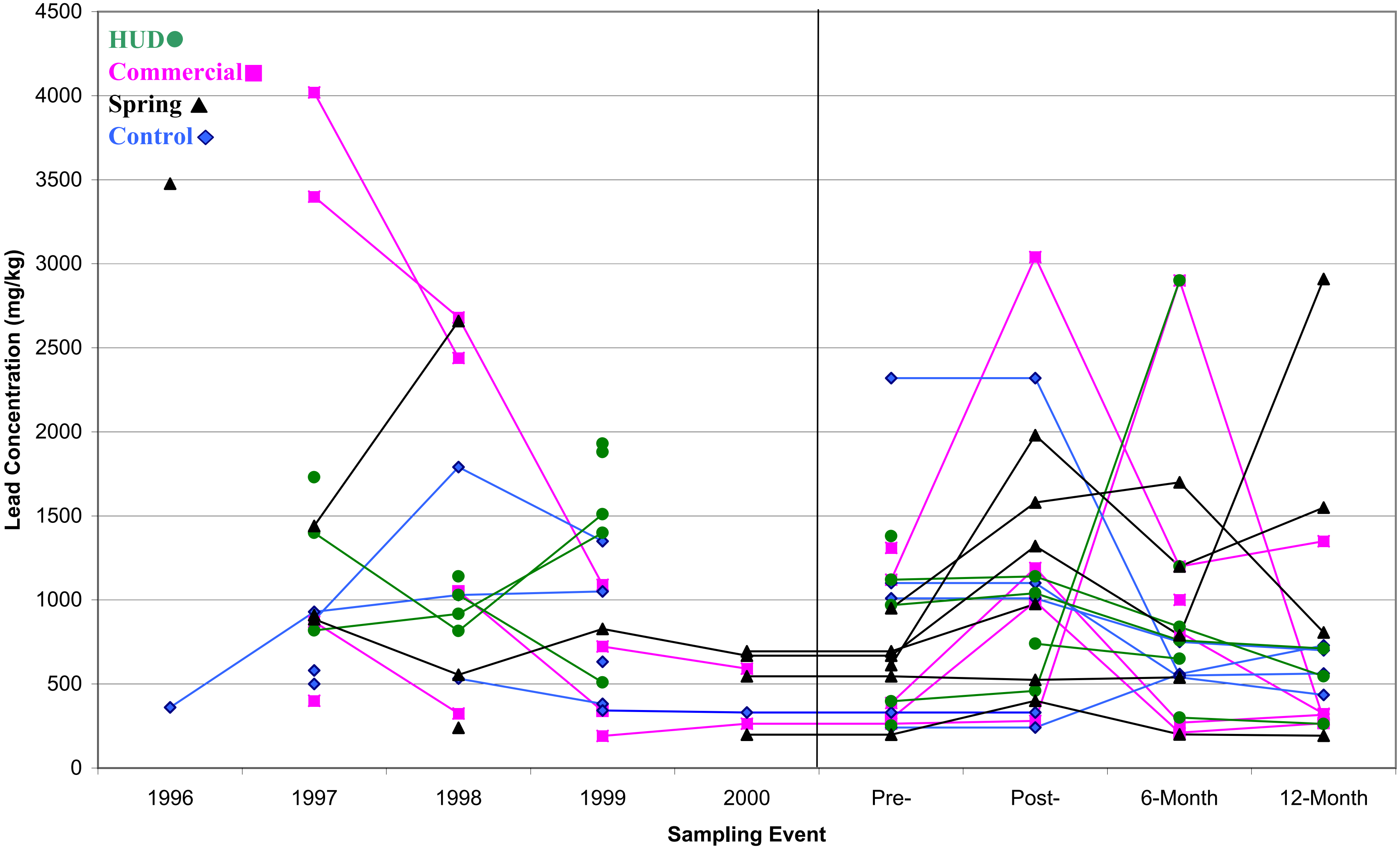


Figure 4-4b. Line Plot of Mat Dust Loading Rates

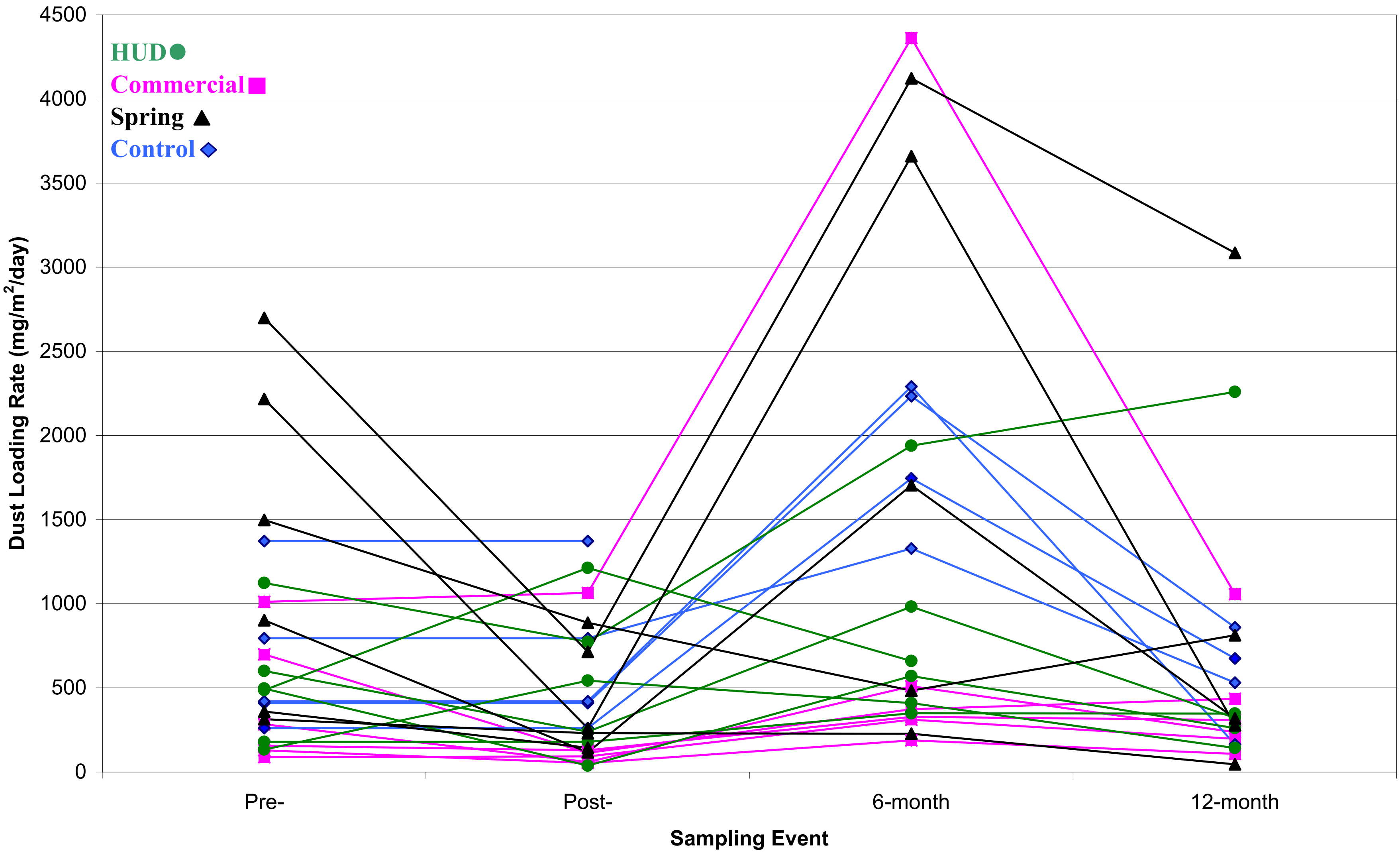


Figure 4-4c. Line Plot of Mat Lead Loading Rates

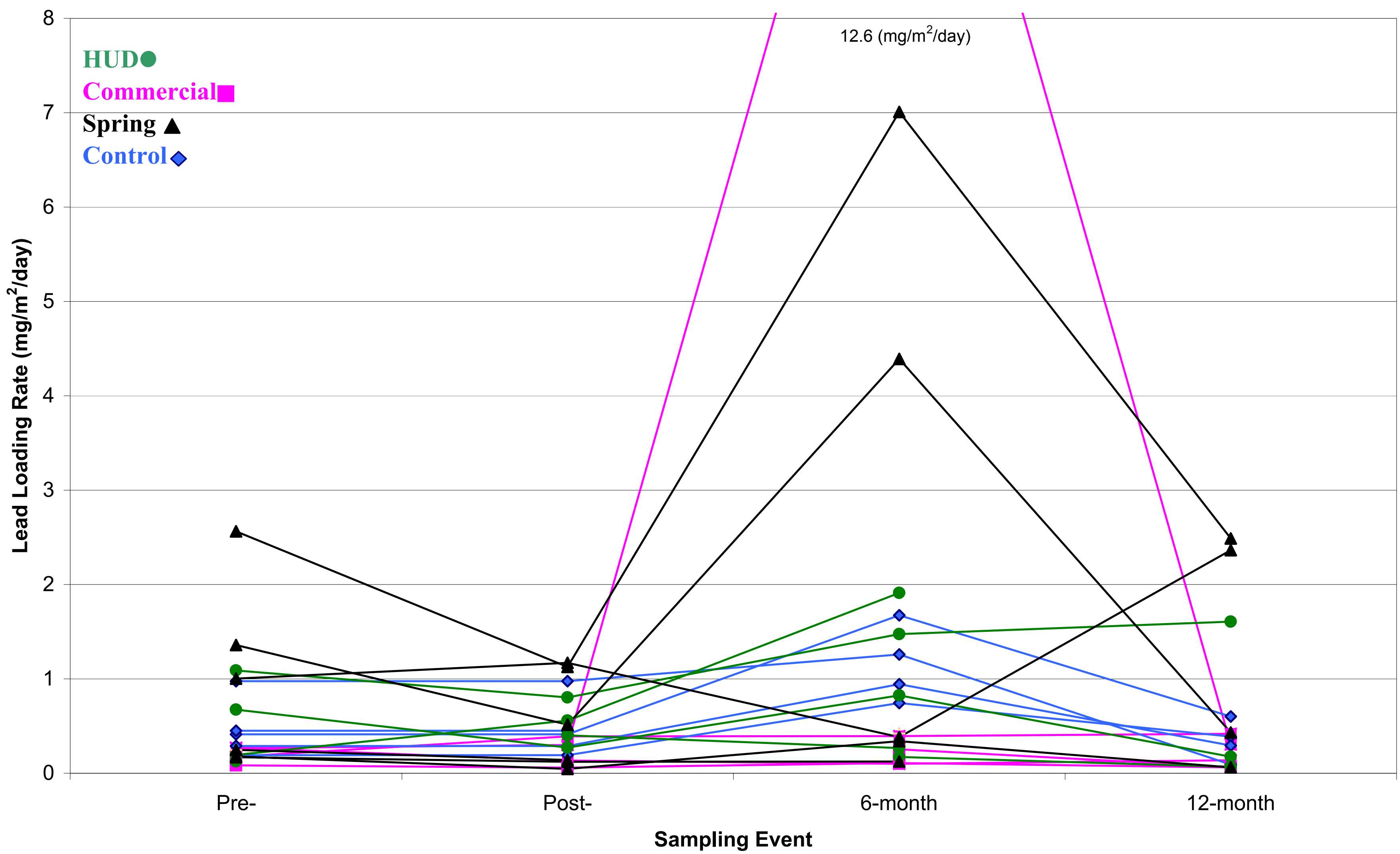


Figure 4-5. Box Plots of Vacuum Lead Concentrations by Treatment

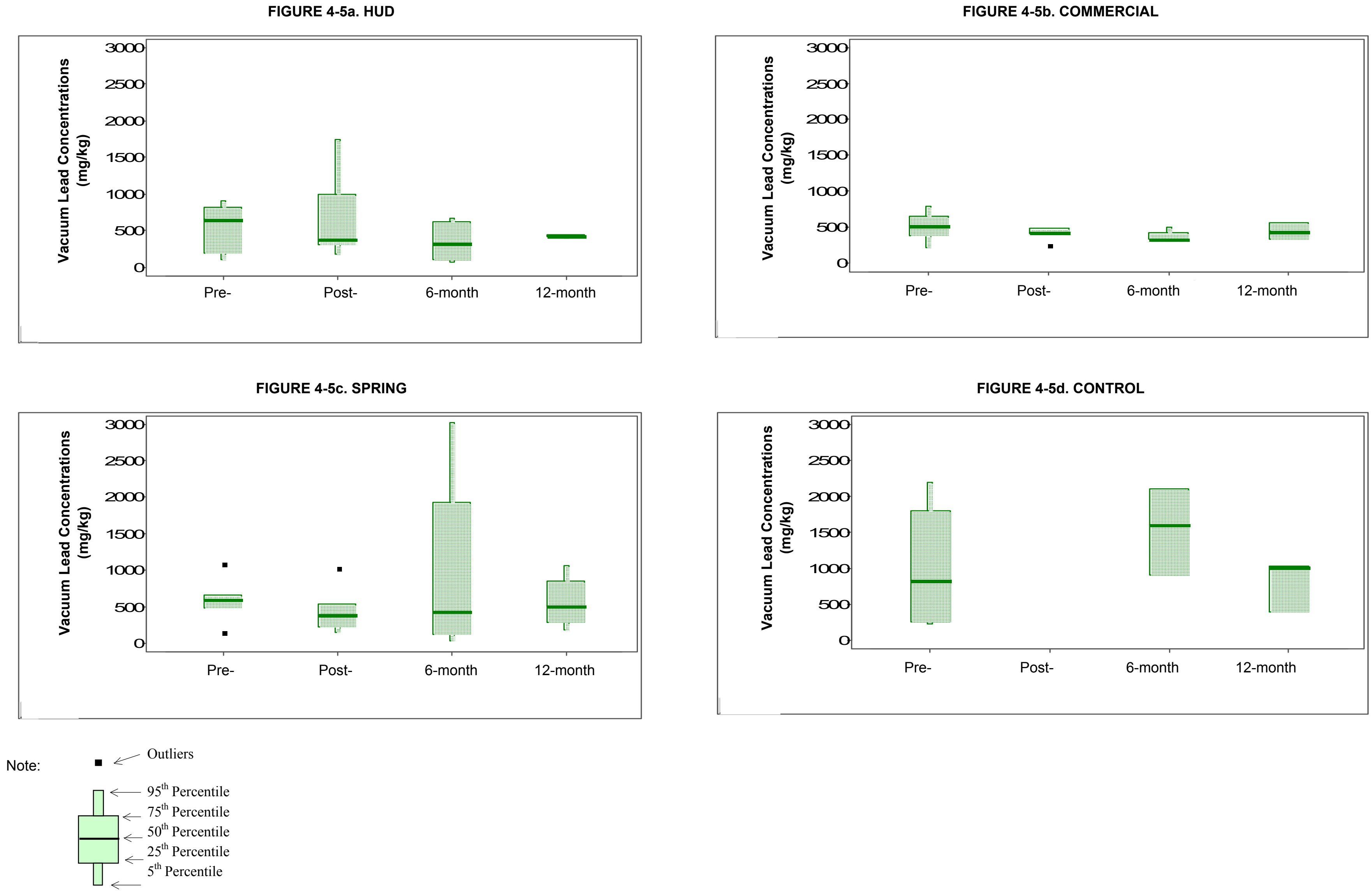


Figure 4-6. Line Plot of Vacuum Lead Concentrations

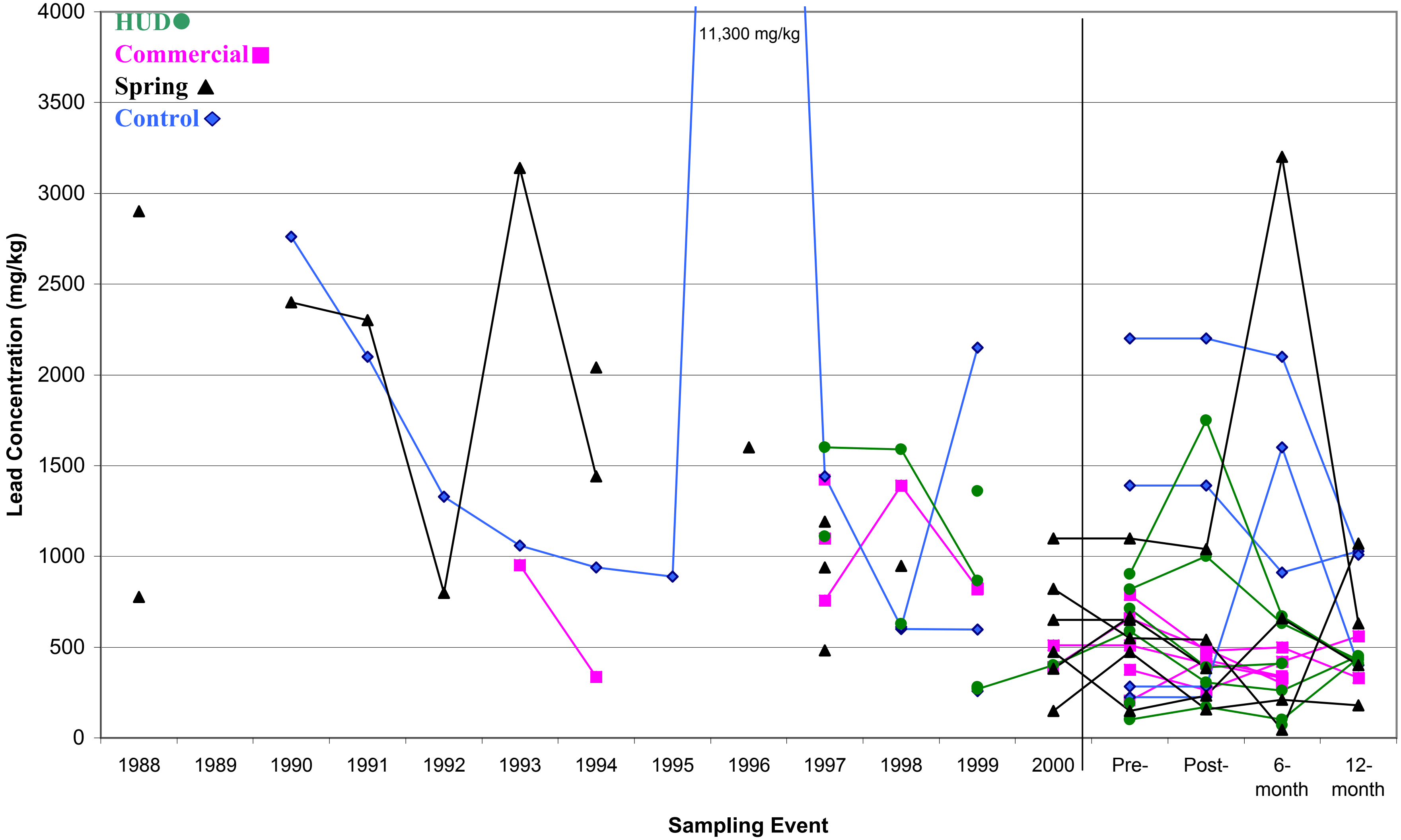


Figure 4-7. Box Plots of BRM Living Room Lead Concentrations by Treatment

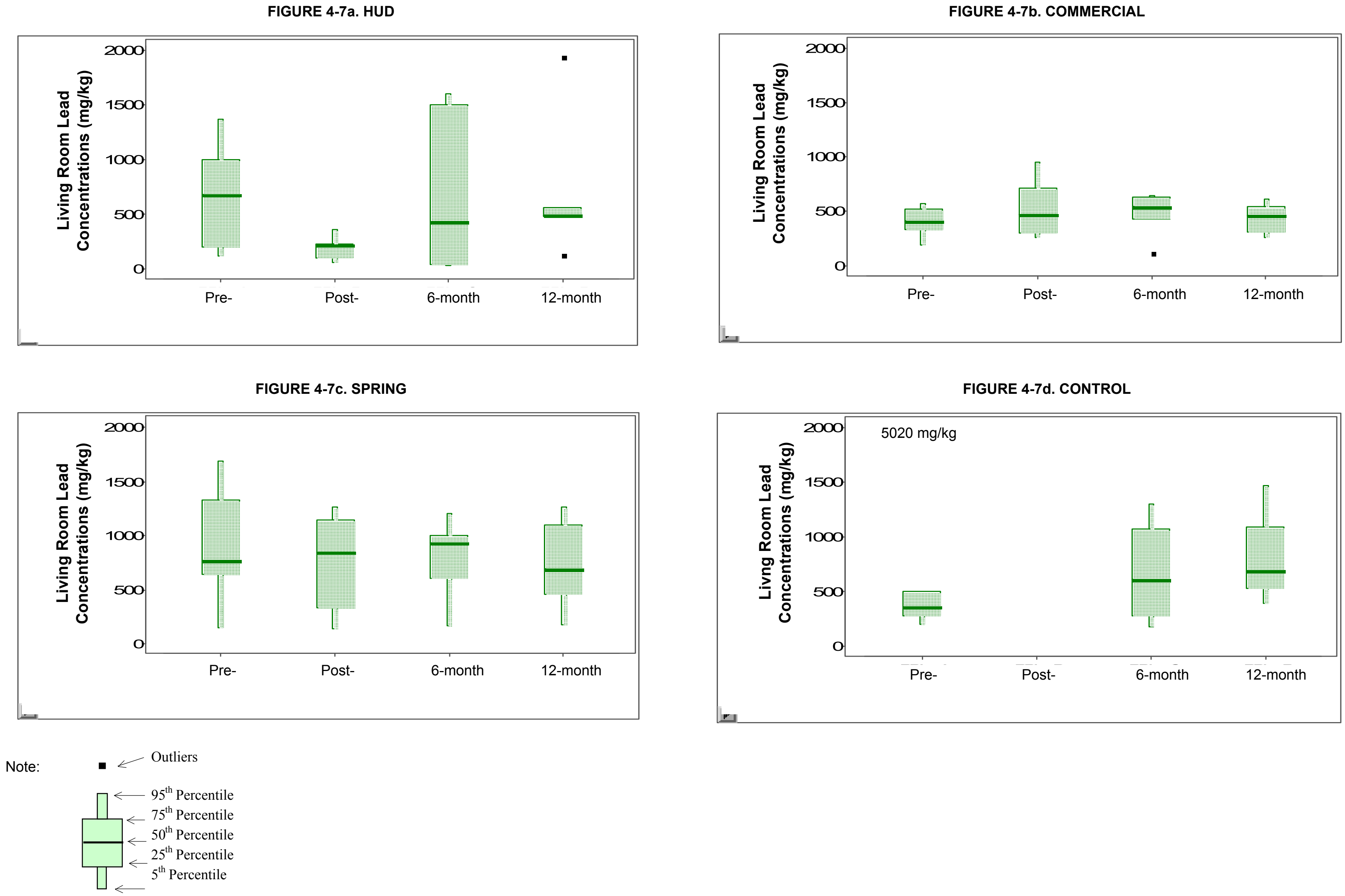


Figure 4-8. Box Plots of BRM Living Room Dust Loading by Treatment

FIGURE 4-8a. HUD

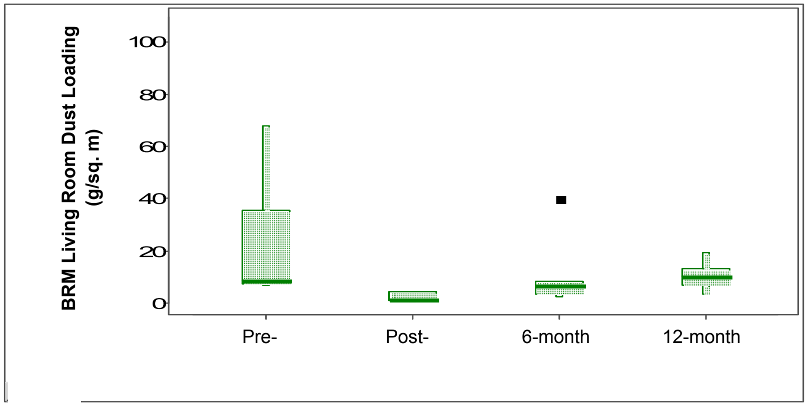


FIGURE 4-8b. COMMERCIAL

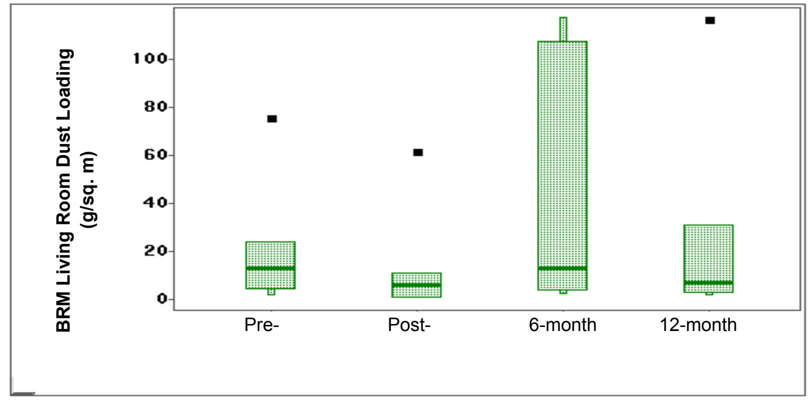


FIGURE 4-8c. SPRING

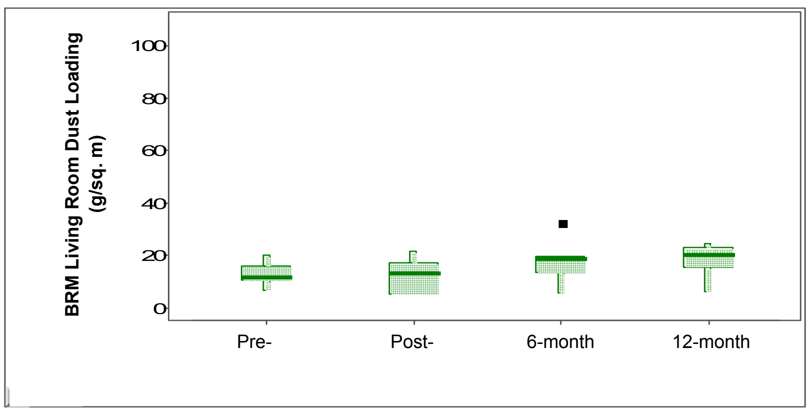
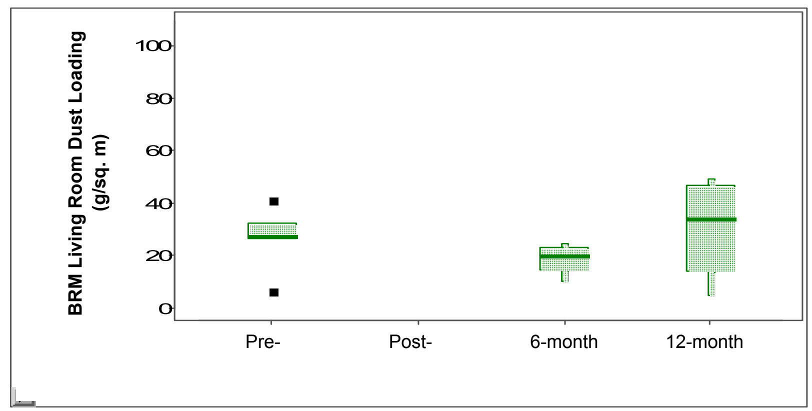


FIGURE 4-8d. CONTROL



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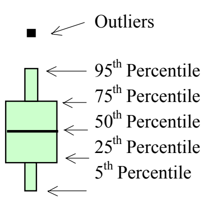


Figure 4-9. Box Plots of BRM Living Room Lead Loading by Treatment

FIGURE 4-9a. HUD

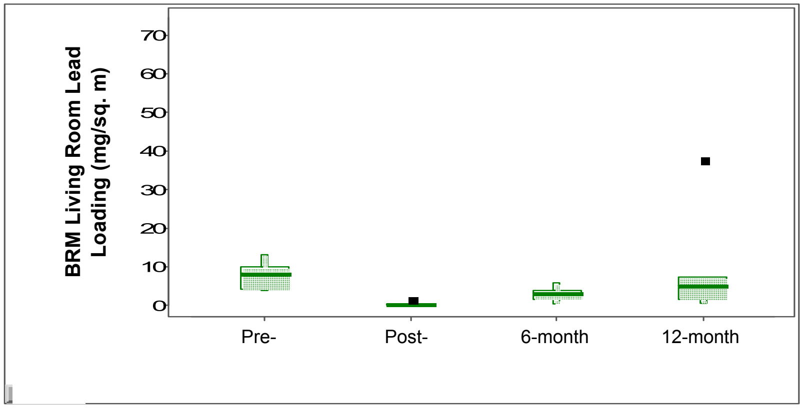


FIGURE 4-9b. COMMERCIAL

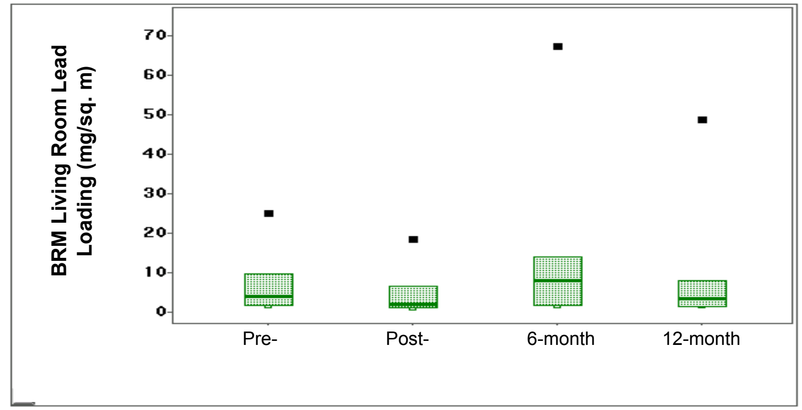


FIGURE 4-9c. SPRING

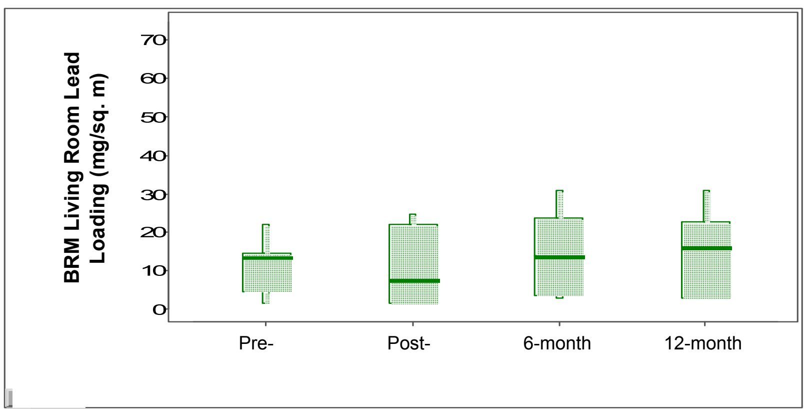
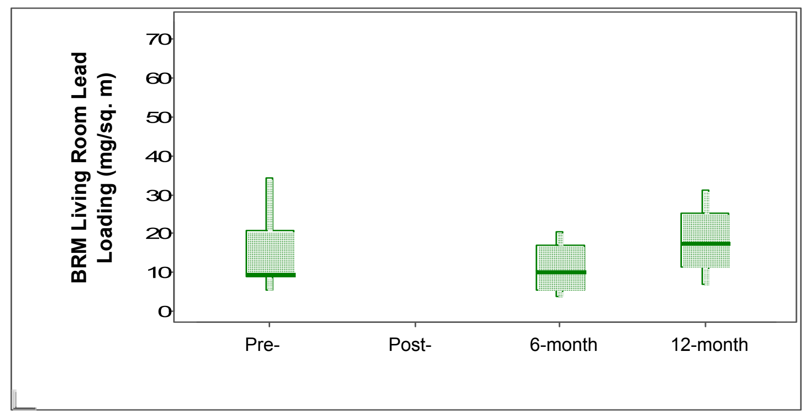


FIGURE 4-9d. CONTROL



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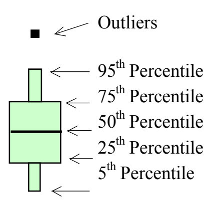


Figure 4-10a. Line Plot of Living Room BRM Lead Concentrations

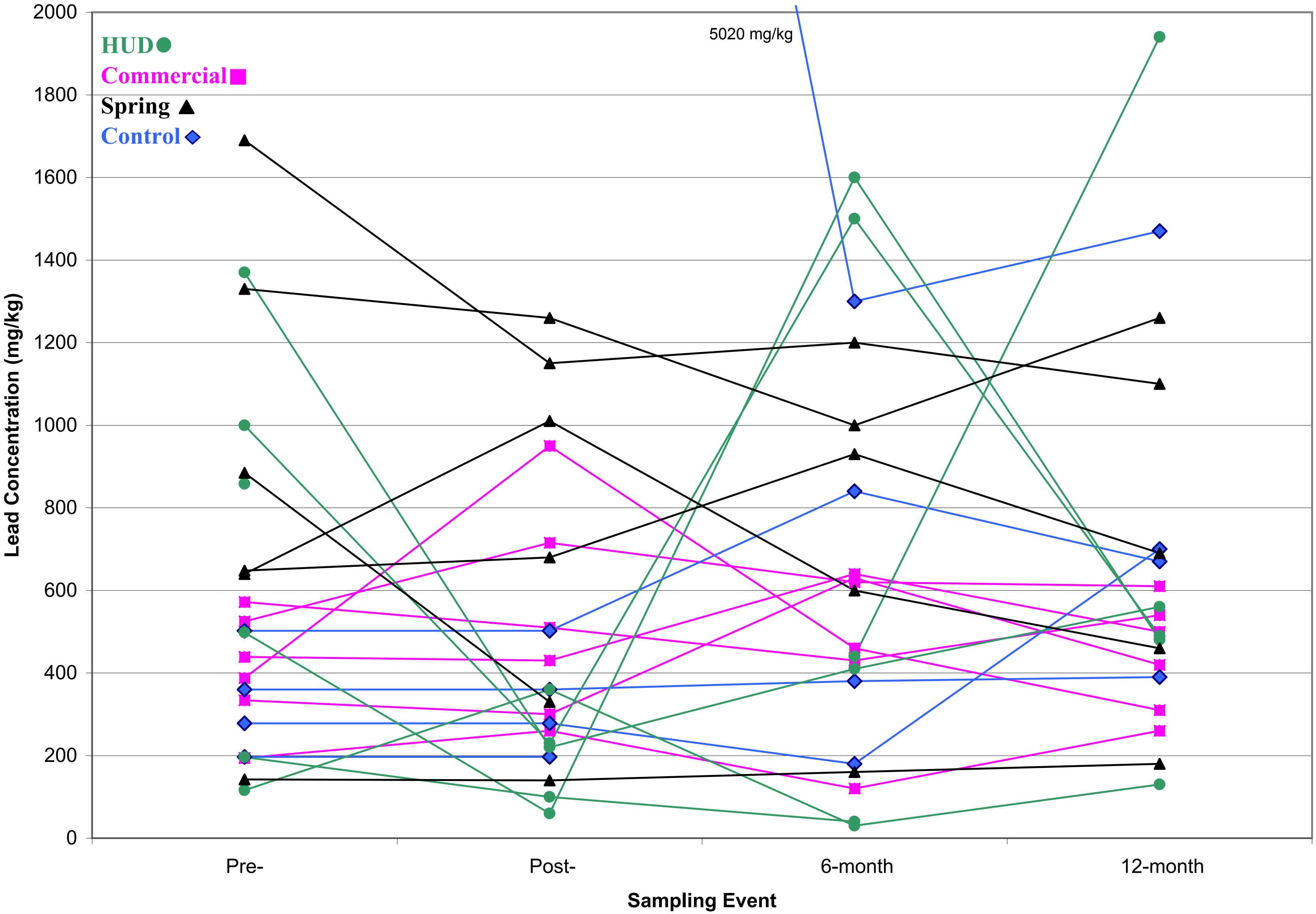


Figure 4-10b. Line Plot of Living Room BRM Dust Loadings

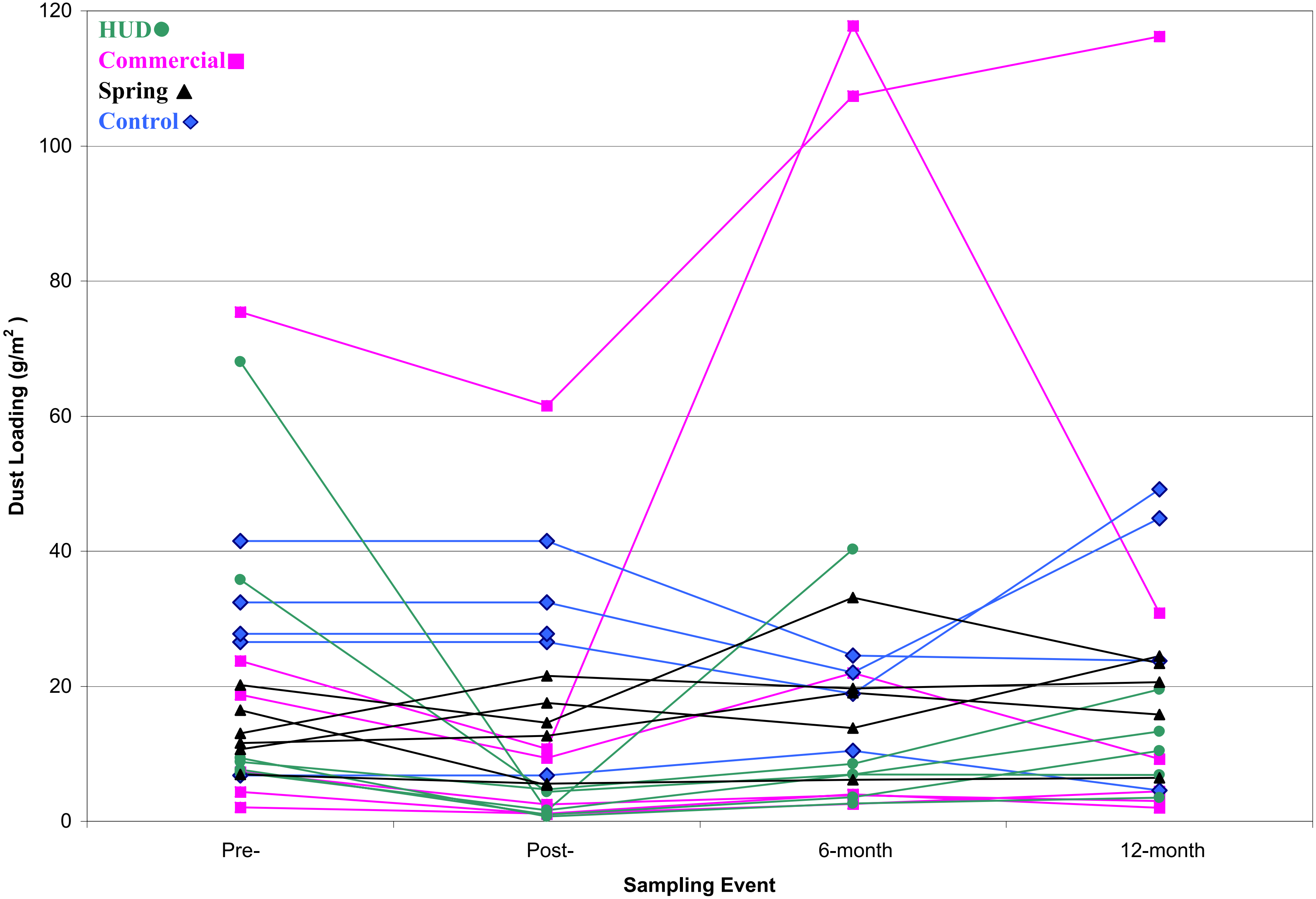


Figure 4-10c. Line Plot of Living Room BRM Lead Loadings

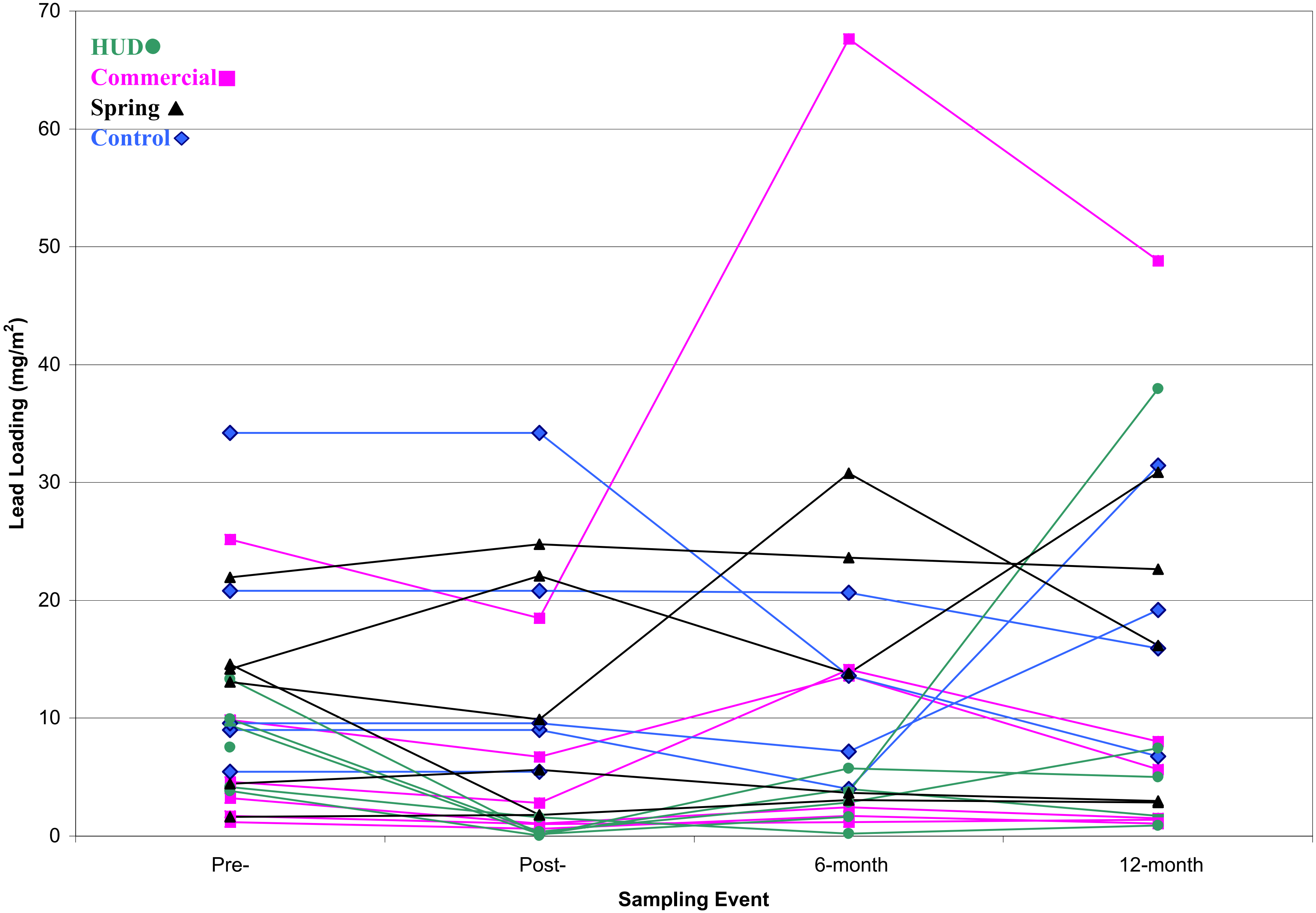


Figure 4-11. Box Plots of BRM Child's Bedroom Lead Concentration by Treatment

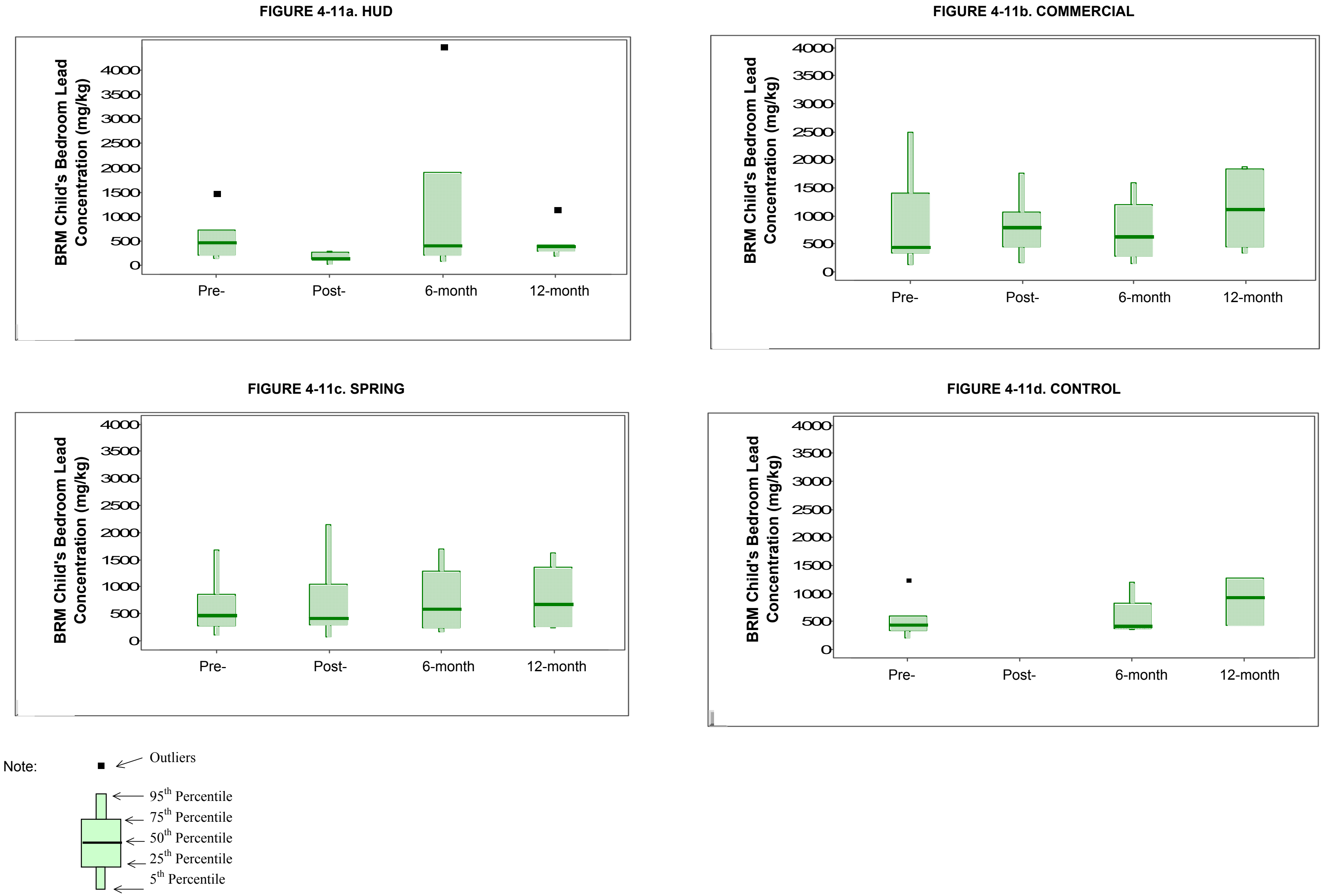
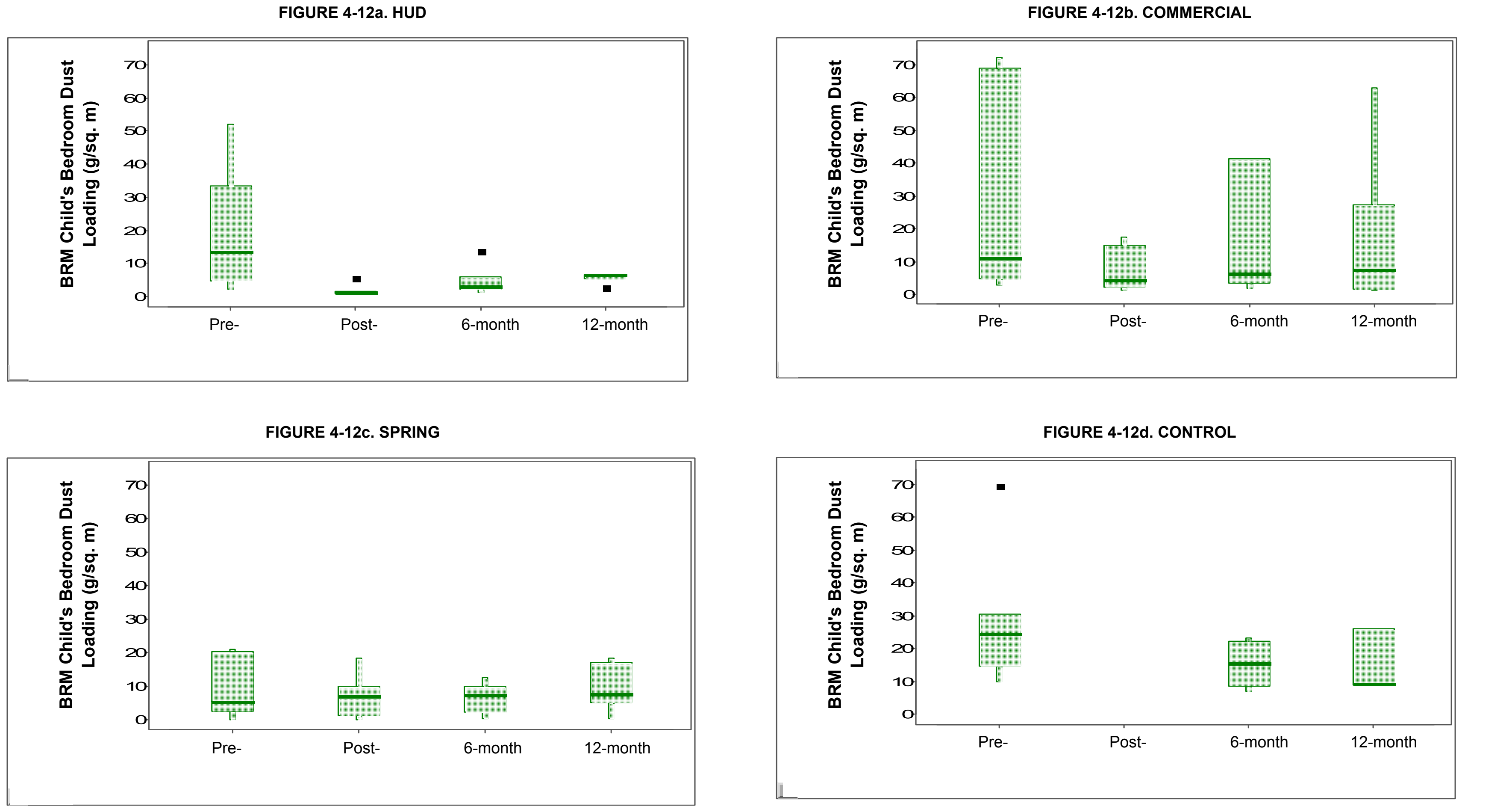


Figure 4-12. Box Plots of BRM Child's Bedroom Dust Loading by Treatment



Note:

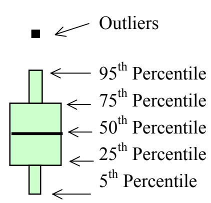


Figure 4-13. Box Plots of BRM Child's Bedroom Lead Loading by Treatment

FIGURE 4-13a. HUD

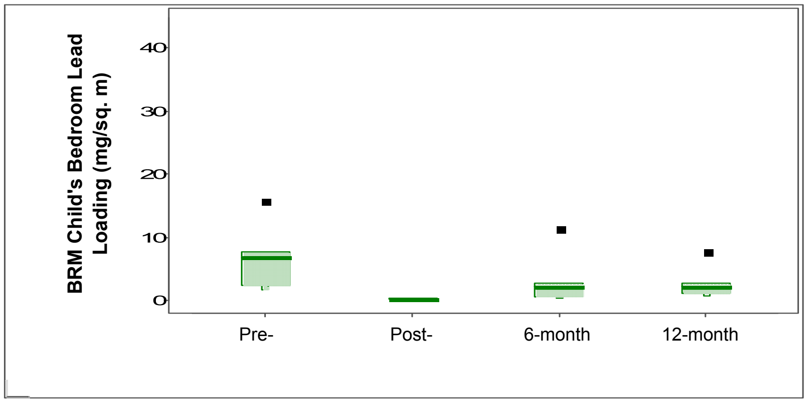


FIGURE 4-13b. COMMERCIAL

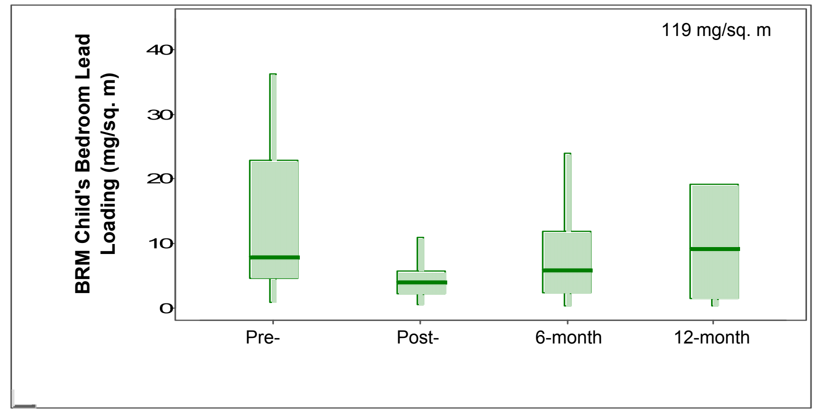


FIGURE 4-13c. SPRING

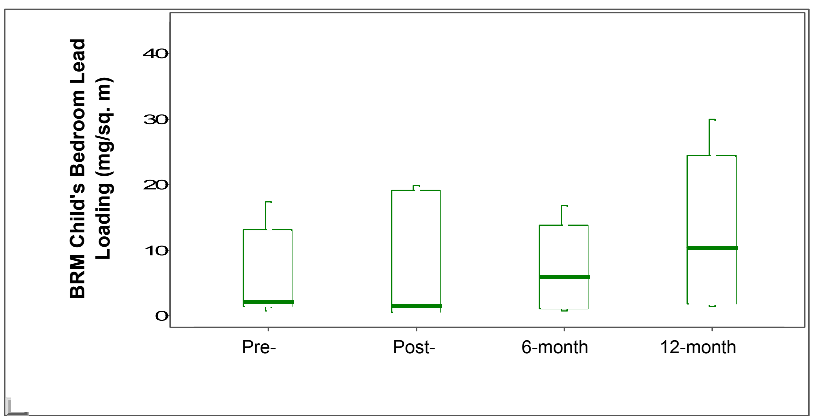
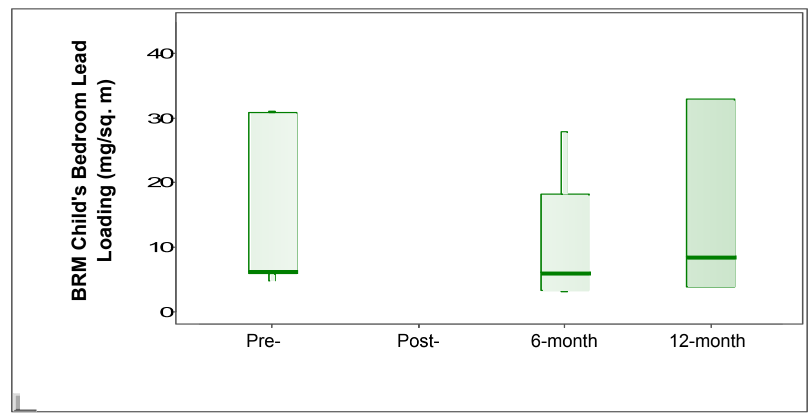


FIGURE 4-13d. CONTROL



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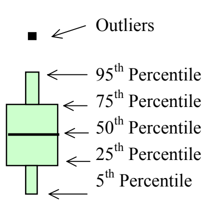


Figure 4-14a. Line Plot of Bedroom BRM Lead Concentrations

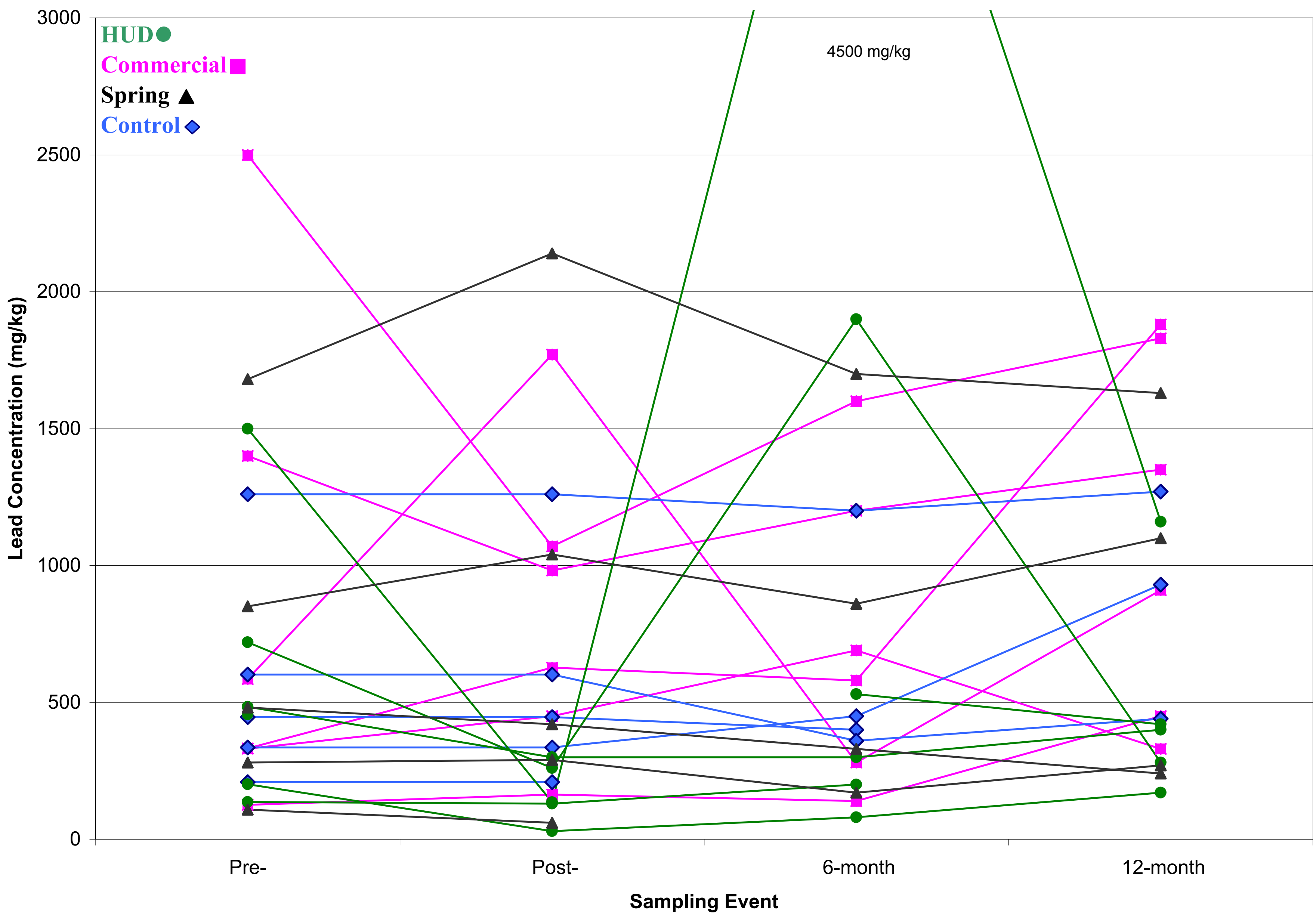


Figure 4-14b. Line Plot of Bedroom BRM Dust Loadings

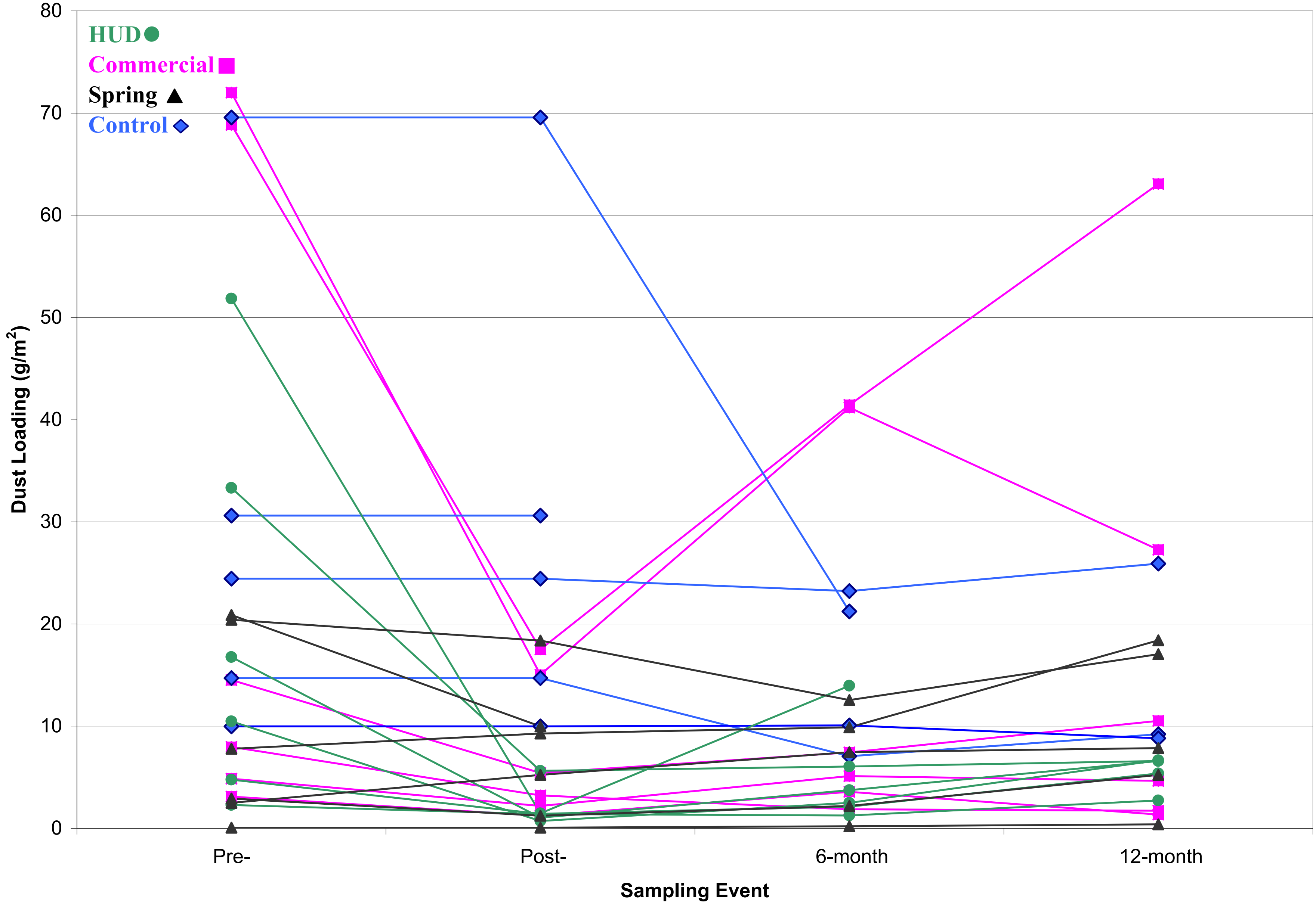


Figure 4-14c. Line Plot of Bedroom BRM Lead Loadings

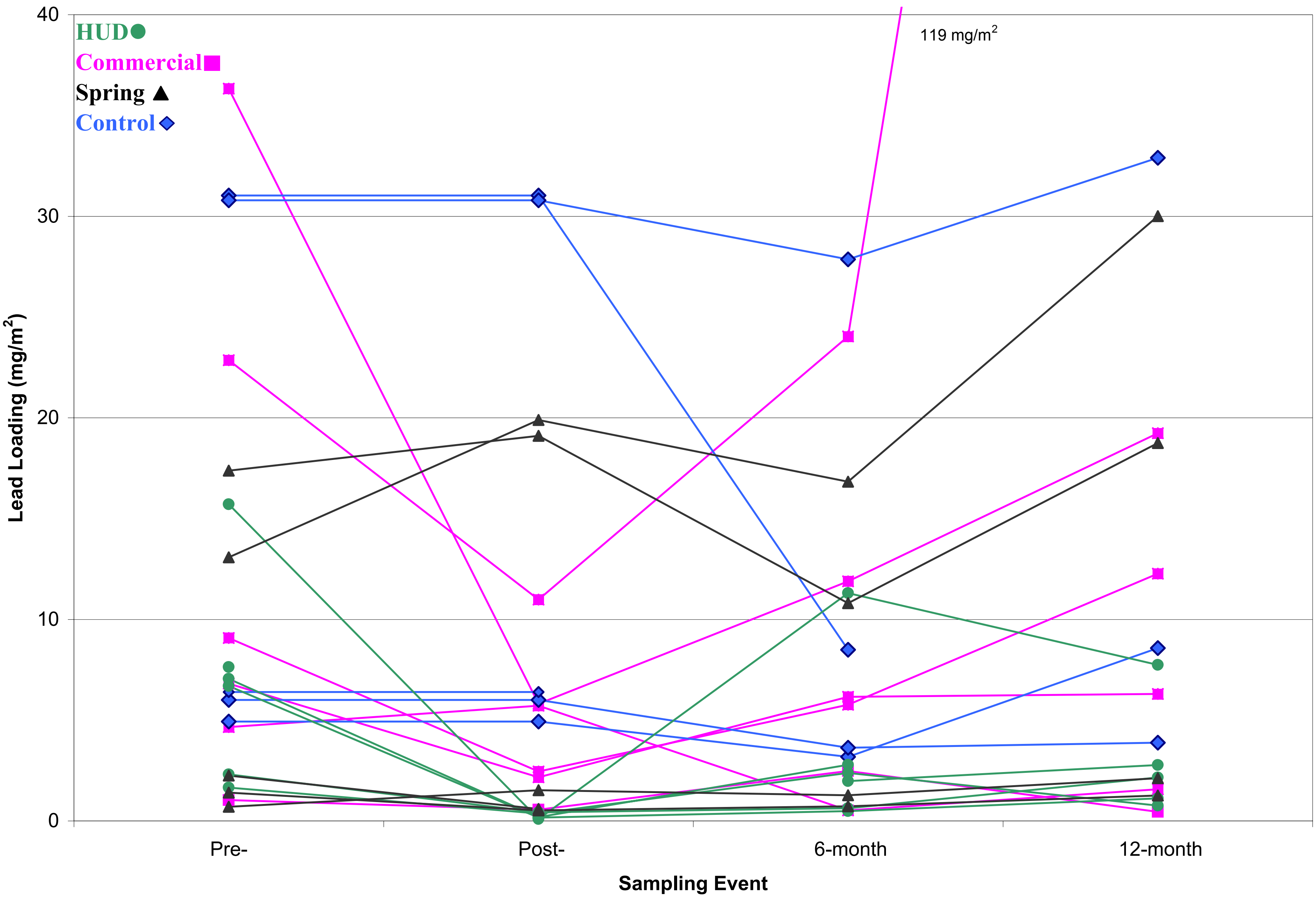


Figure 4-15. Box Plots of BRM Kitchen Lead Concentration by Treatment

FIGURE 4-15a. HUD

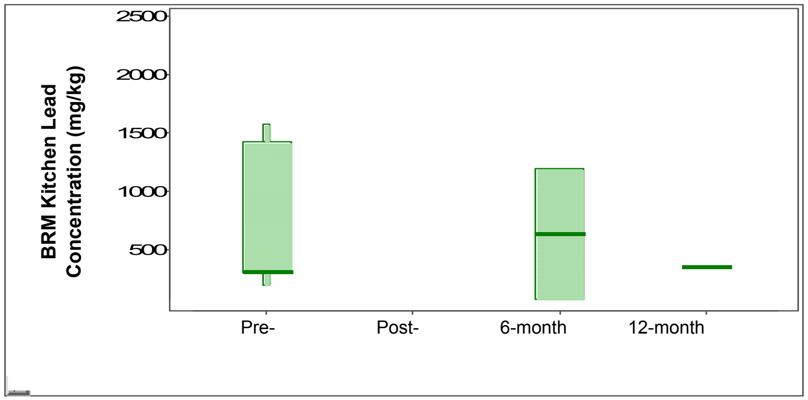


FIGURE 4-15b. COMMERCIAL

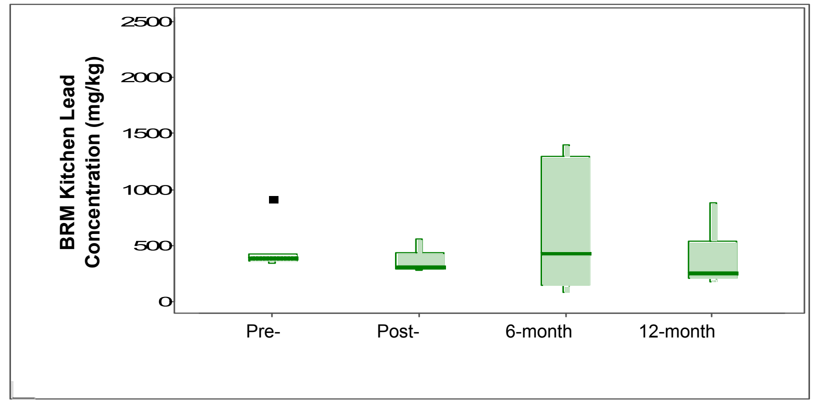


FIGURE 4-15c. SPRING

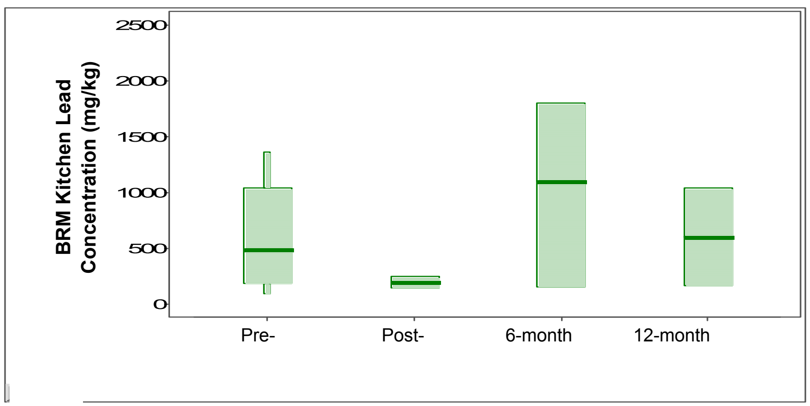
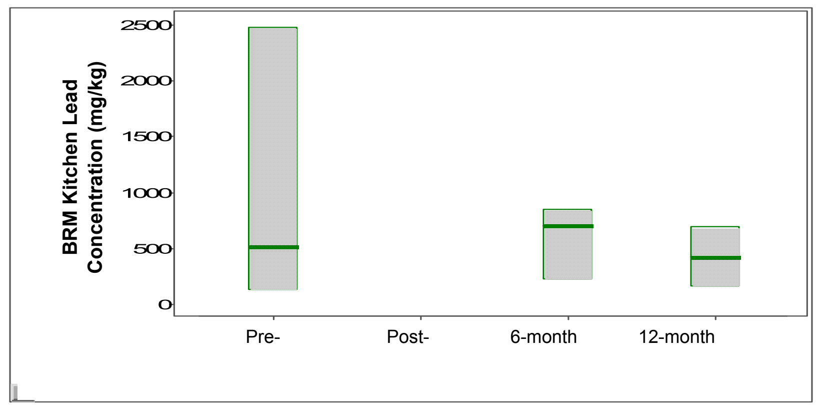


FIGURE 4-15d. CONTROL



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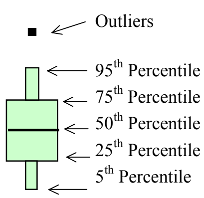


Figure 4-16. Box Plots of BRM Kitchen Dust Loading by Treatment

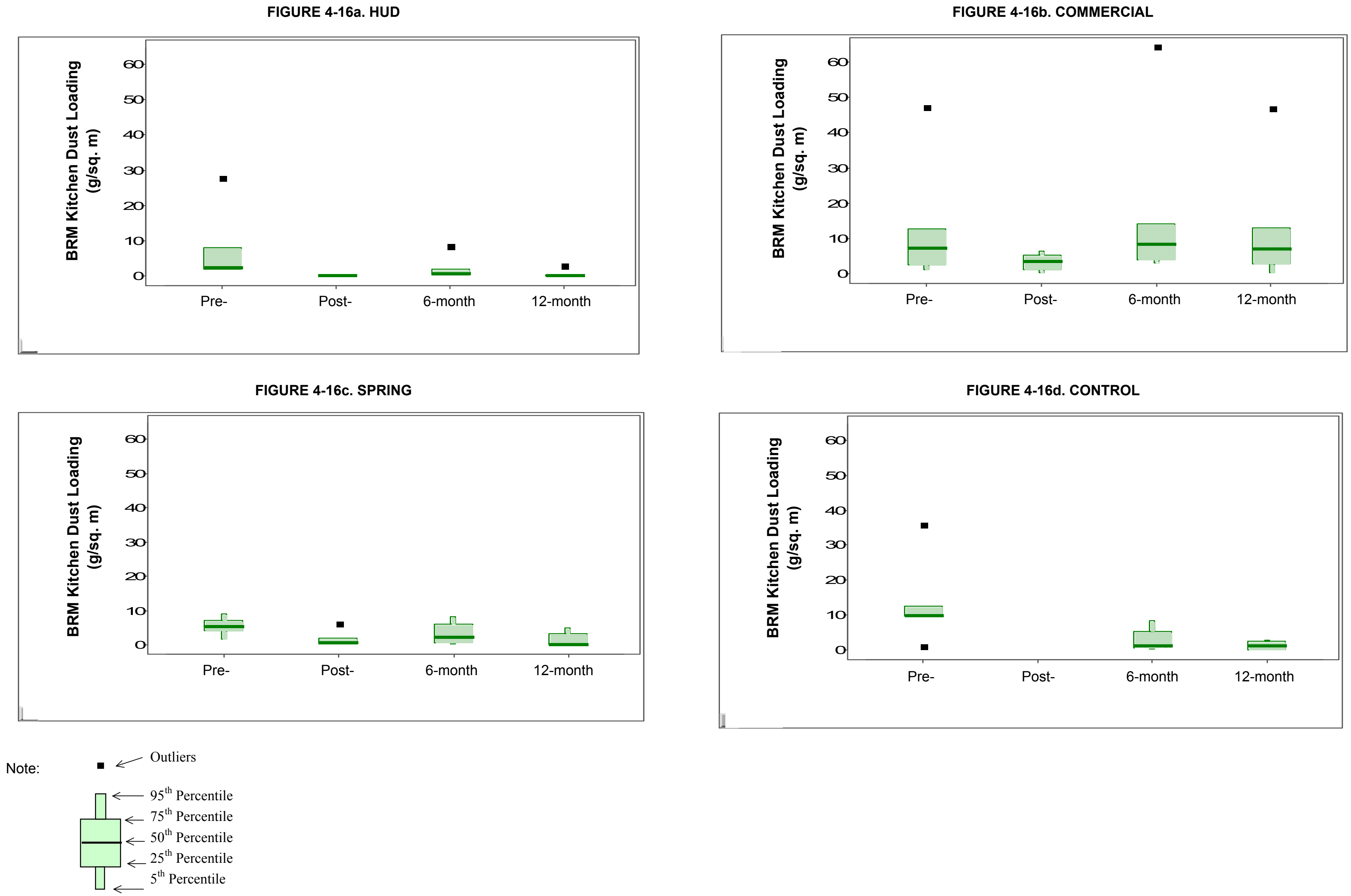


Figure 4-17. Box Plots of BRM Kitchen Lead Loading by Treatment

FIGURE 4-17a. HUD

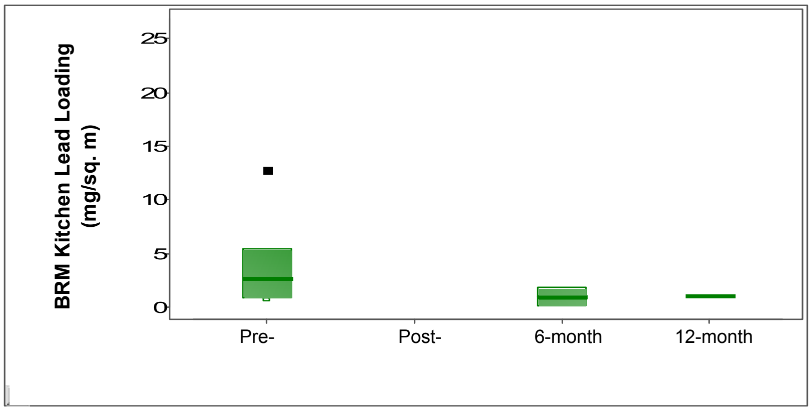


FIGURE 4-17b. COMMERCIAL

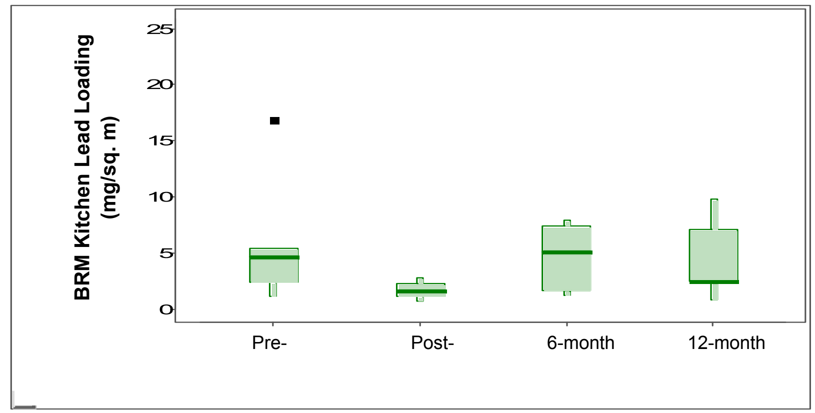


FIGURE 4-17c. SPRING

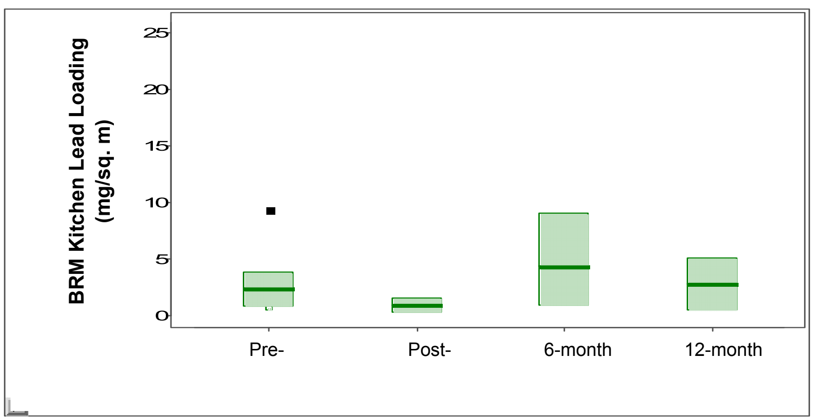
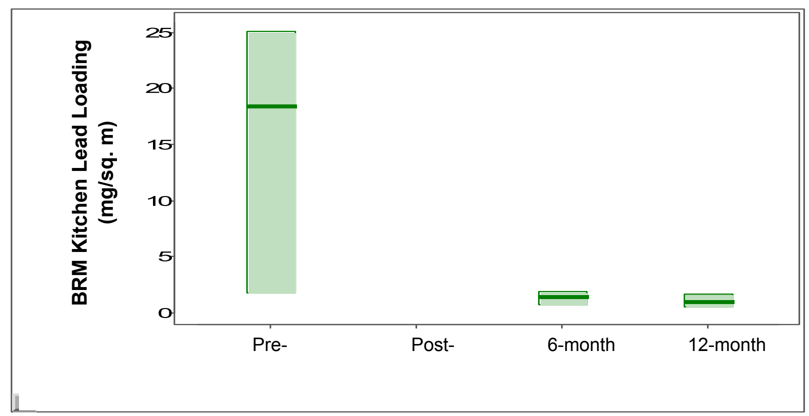


FIGURE 4-17d. CONTROL



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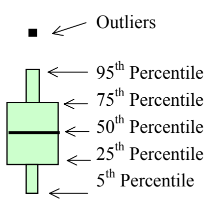
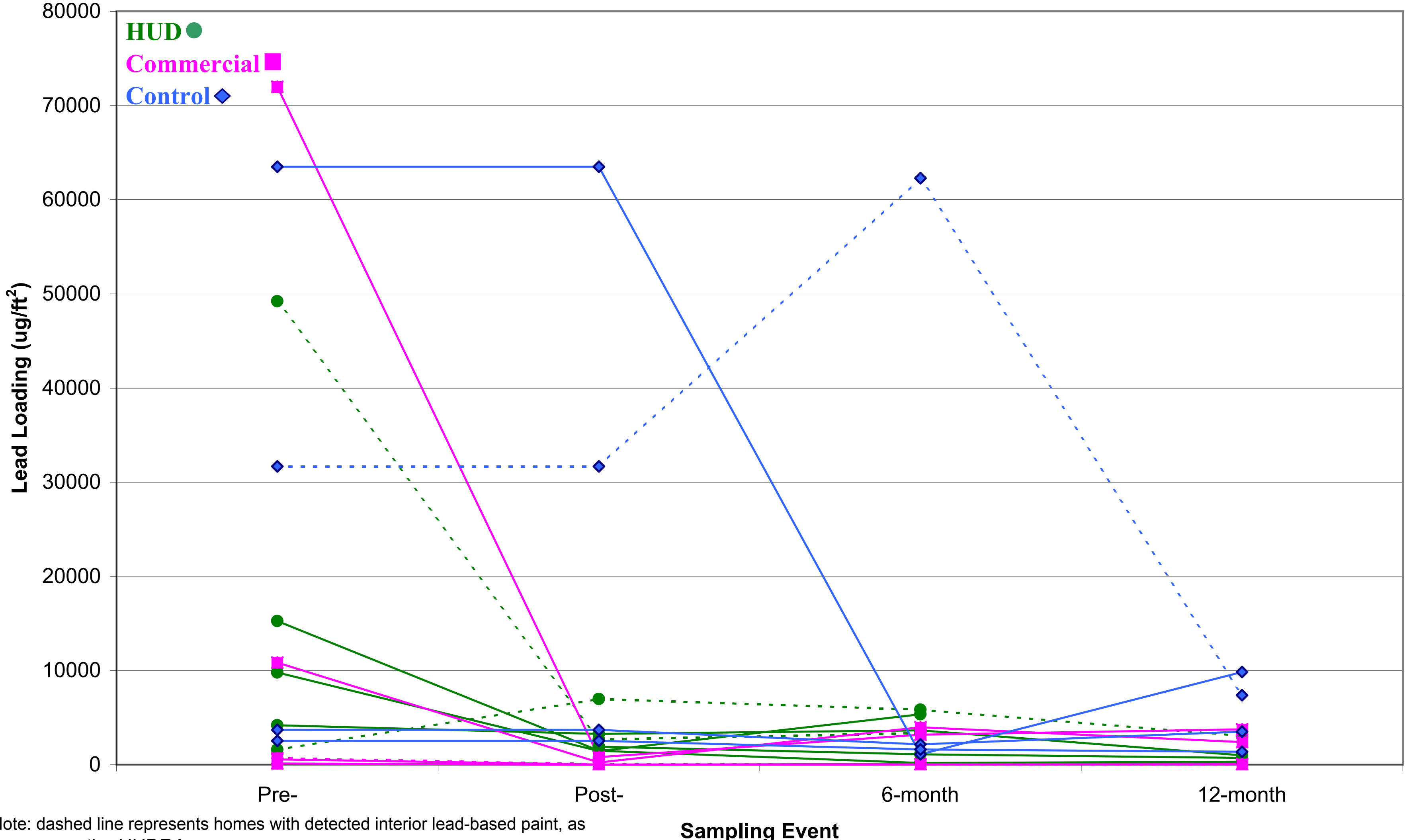
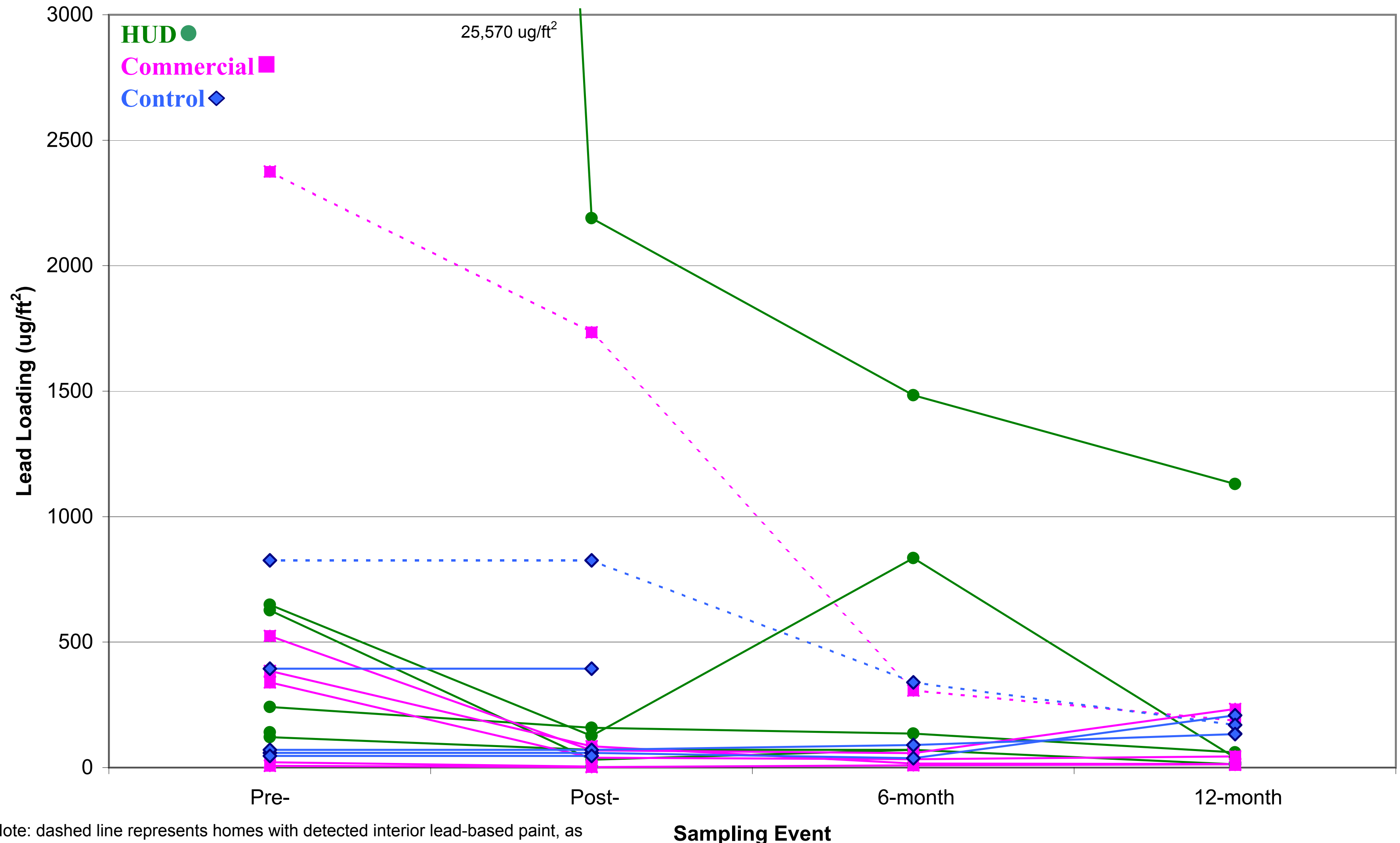


Figure 4-18a. Line Plot of Dust Wipe Lead Loadings for Bedroom Window Wells



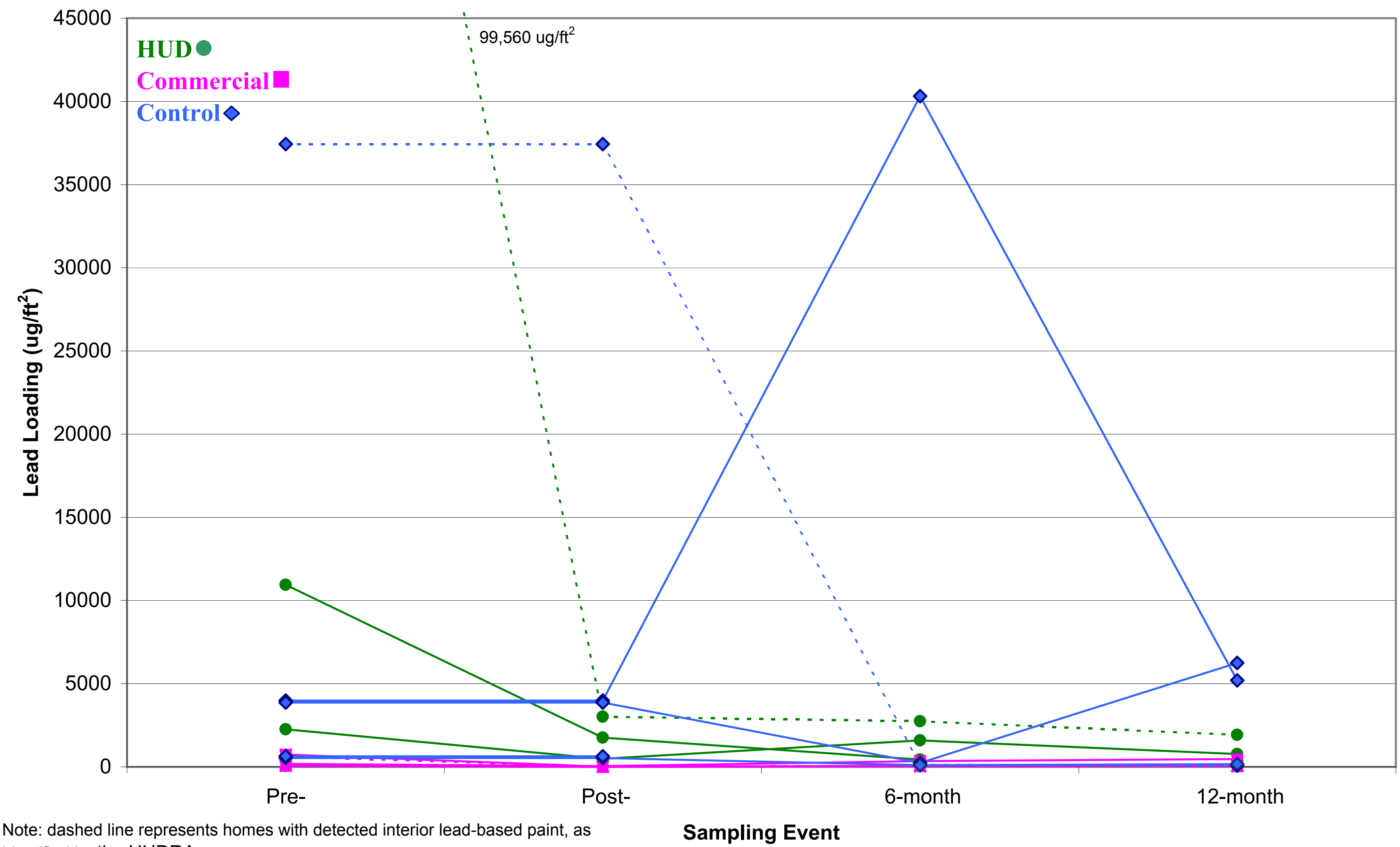
Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-18b. Line Plot of Dust Wipe Lead Loadings for Bedroom Window Sills



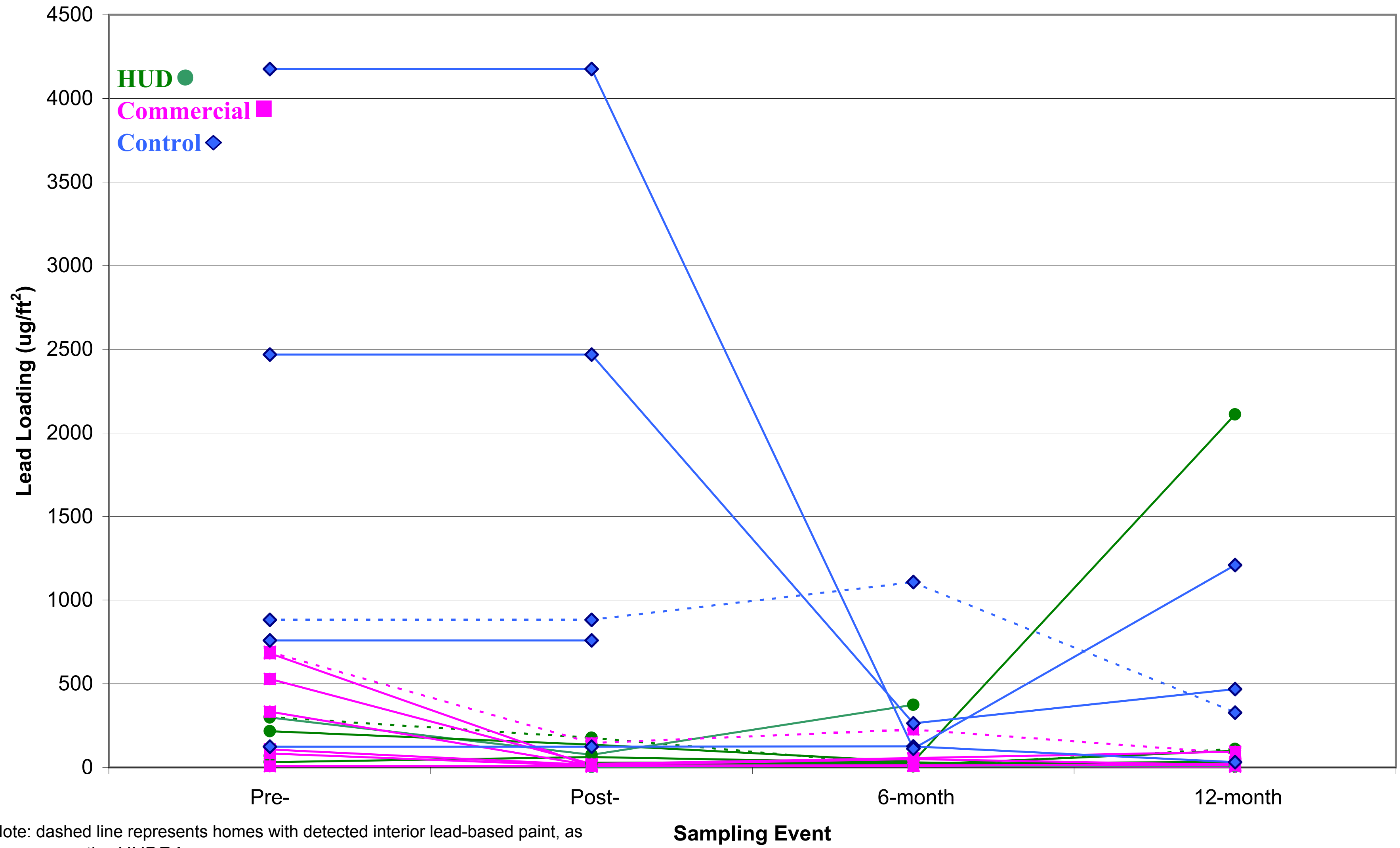
Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA.

Figure 4-19a. Line Plot of Dust Wipe Lead Loadings for Living Room Window Wells



Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-19b. Line Plot of Dust Wipe Lead Loadings for Living Room Window Sills



Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Screening Interview Questionnaire

Date:	**Interviewer:**
Street Address: **Mailing Address:**	
Phone Number: (208)	

Prior to asking interview questions, explain the pilot cleaning study - purpose, procedures, time frame, etc. Mention that there will be three treatment groups and briefly explain each. Be sure to tell the homeowner that their home has been preselected based on dust mat and/or vacuum bag sample results from the 1998 and 1999 sampling events.

1. What is your name?____

2. What year was this home built? (oldest part)

1 before 1960
2 1960 through 1978
3 1979 or later
9 don't know

3. Do you own or rent your home?

1 rent
2 own

4. How long have you lived in this home?

1 <1 month
2 1-2 months
3 2-3 months
4 3-6 months
5 6-12 months
6 1-5 years
7 >5 years
9 don't know

4b. IF A TRAILER HOME: Do you know where the mobile home was located before Smelterville (here)? (Write down any notes.)

5. Do you know of any lead paint existing in or outside of your home?

1 yes 2 no 9 don't know

If yes: Where? Is there a report/any data?

6. Has any of the home interior been painted or window sills been sanded or removed/remodeled while your family has lived in the home?

1 yes 2 no 9 don't know

If 'yes' ask questions 7 and 8:

7. When ?

1	within the last year	3	more than 2 years ago
2	one to two years ago	9	don't know

8. Which rooms?

1	kitchen	5	master bedroom
2	living room	6	child bedroom
3	dining room	7	bathroom
4	TV room	8	other

9. Do you have any windows in your home that are painted shut and are never opened?

1 yes 2 no

If yes: where?

10. Has your home been remodeled or new carpet/furniture installed while your family has lived in this home?

1 yes 2 no 9 don't know

If 'yes,' ask questions 11 and 12:

11. When ?

1	within the last year	3	more than 2 years ago
2	one to two years ago	9	don't know

12. Which rooms?

1	kitchen	5	master bedroom
2	living room	6	child bedroom
3	dining room	7	bathroom
4	TV room	8	other

13. How many throw rugs/entrance mats are there at the entrances in this home?

1	none	3	at some of entrances
2	one at one of the entrances	4	at all entrances

14. How many throw rugs/area rugs are there inside this home?

1	none	3	three to five
2	one or two	4	more than five

If 'yes,' ask question 15:

15. Where are these throw rugs/area rugs located?

1	kitchen	5	master bedroom
2	living room	6	child bedroom
3	dining room	7	bathroom
4	TV room	8	other

16. What type of window treatment does this home have?

1	drapes	3	both drapes and blinds
2	blinds	9	don't know

17. Does this home have top treatment or valances for the windows?

1 yes   2 no   9 don't know

18. Do people generally remove their shoes before entering the home?

1 yes   2 no

19. How many people regularly ***live*** in the home?

Adults ___________ Children _____________

20. Where do the children residing in this home sleep?

1	own bedroom	3	parent bedroom
2	share bedroom	4	other

21. Where in the home do the children play the most?

1	kitchen	5	master bedroom
2	living room	6	child bedroom
3	dining room	7	bathroom
4	TV room	8	other

22. How often do you dust and/or clean hard blinds in your home?

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo.

23. How often do you wash fabric drapes in your home?

1	more than 1x/year	3	within the past 5 years
2	1x/year	4	never

24. How often do you dust your window sills and wells in your home?

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo.

25. How often do you dust hard furniture and other items in your home?

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo.

26. How do you dust the house?

1 vacuum
2 oil/water soaked rag
3 feathers
4 other: note:_______

27. How often do you clean the linoleum/hardwood floors in your home?

1 every 1-7 days
2 every 7-14 days
3 every month
4 less than 1x per mo.

28. How often do you wash the walls of your home?

1 more than two times a year
2 one time a year
3 never
4 other

29. How often do you wash the ceiling of your home?

1 more than two times a year
2 one time a year
3 never
4 other

30. How often do you clean the coils of your refrigerator and/or full size freezer?

1 more than two times a year
2 one time a year
3 never
4 other

31a. Do you have centralized heating/air conditioning in your home?
1. Yes 2. No _________(baseboards?)

If yes:(answer questions 30b-33)

31b. How old are the furnace and ducts in your home?

1 <5 years
2 5-10 years
3 11-15 years
4 as old as home

31c. How often do you clean the ducts of your home?

1 more than two times a year
2 one time a year
3 never
4 other

(Has a professional duct cleaner cleaned your ducts? If so, when?)

____

32. What are the ducts in your home made of?

1 metal
2 fiberglass
3 duct board
4 interior insulated

33. When was the furnace filter of your home last changed?

1	within the past month	3	within the past year
2	within the past six months	4	within the past five years
		9	don't know

34. How often do you vacuum the soft furniture in your home?

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo.

35. How often do you steam clean the furniture in your home?

1	more than two times a year	3	never
2	one time a year	4	other

(When was the last time your furniture was steam cleaned?)

____

36. How often do you vacuum the following carpets?

Frequency codes:

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo. (Once/yr or couple yrs)
5	never	6	NA (=no carpet in room)

(Cross out room name if the room does not exist in the home)

Room	**Frequency code**
Kitchen	________
Living room	________
Dining room	________
TV room	________
Master bedroom	________
Child bedroom 1	________
Chid bedroom 2	________
Child bedroom 3	________
Bathroom 1	________
Bathroom 2	________
Other (provide rooms)	________

37. How often do you steam clean the following carpets?

Room	**Frequency code**
Kitchen	________
Living room	________
Dining room	________
TV room	________
Master bedroom	________
Child bedroom 1	________

Chid bedroom 2 ________
Child bedroom 3 ________
Bathroom 1 ________
Bathroom 2 ________
Other (provide rooms) ________
____
____

38. What type of vacuum cleaner do you use to vacuum your carpets and furniture? Provide year, brand, model, condition, beater bar. (Ask to look at the vacuum if they do not know, and describe in as much detail as possible - model and make/flip it over to see if it has a beater bar)

____
____
____

39. What type of steam cleaner (or who is the professional doing the cleaning) do you use to clean your carpets and furniture? (Rainbow vacuums do not count as steam cleaners).

____
____

40. Can any pets or outside animals access any crawl spaces (i.e., crawl under the house)?

1 yes 2 no

41. Does your home have an accessible basement?

1 yes 2 no

If 'yes,' ask question 42:

42. What is the basement in your home used for?

1 unfinished 3 living
2 storage 4 other/note:_______

43. Does you basement have a dirt floor?

1 yes 2 no

44. Does your home have an accessible attic?

1 yes 2 no 9 don't know

If 'yes,' ask question 40:

45. What is the main use of your attic?

1 unfinished 3 living
2 storage 4 other/note:_______

46. Are there any other accessible areas in your home such as crawl spaces?

1 yes 2 no 9 don't know

If 'yes,' where is it located and how do you access it?

---

47. Describe any renovation or remodeling that has occurred in this home:

48. Are there any screen doors or windows that are left open all summer?
1 yes 2 no

49. Do you have any antiques or other extremely valuable items that would preclude you from being involved in this cleaning project?

1 yes 2 no

50. Do you agree to be a part of this study if selected as a control, Treatment A, or Treatment B?

1 yes 2 no

51. Is there a planned renovation for your home within the next full year?

1 yes 2 no

52. Is there a planned relocation for you and your family within the next full year?

1 yes 2 no

53. Are there any heavy or bulky items in your home that may be difficult to move?

1 yes 2 no

54. List carpet characteristics and condition by room:

Condition codes

1 good condition
2 slightly dirty, frayed, etc.
3 moderately dirty, frayed, etc.
4 poor condition

Carpet type codes

1 shag
2 Berber
3 indoor/outdoor
4 sculptured
5 plush
6 other

Room	Age (yrs)	Condition	Type	Thickness (any notes)
Kitchen	_________	___________	_____	__________
Living room	_________	__________	_____	_________
Dining room	_________	__________	______	__________
Master bedroom	_________	__________	_____	__________
Child bedroom 1	_________	__________	_____	__________
Chid bedroom 2	_________	__________	_____	__________
Child bedroom 3	_________	__________	_____	__________
Bathroom 1	_________	__________	_____	__________
Bathroom 2	_________	__________	_____	__________
Other (provide rooms)	_________	__________	_____	__________

55. List the number and condition of the **drapes** for each room.

Condition codes:

1	good condition	3	moderately dirty, ripped, etc.
2	slightly dirty, ripped, etc.	4	poor condition

Room	Number	Condition	Top Treatment
Kitchen	________	__________	____________________
Living room	________	__________	____________________
Dining room	________	__________	____________________
Master bedroom	________	__________	____________________
Child bedroom 1	________	__________	____________________
Chid bedroom 2	________	__________	____________________
Child bedroom 3	________	__________	____________________
Bathroom 1	________	__________	____________________
Bathroom 2	________	__________	____________________
Other (provide rooms)	________	__________	____________________

56. List the number, type, and condition of the **blinds** for each room.

Condition codes:

1	good condition	3	moderately dirty, bent, some missing, etc.
2	slightly dirty, bent, etc.	4	poor condition

Type codes for blinds:

1	mini	3	pleated shades
2	vertical	4	other

Room	Number	Type	Condition	Top Treatment	Pb
Kitchen	________	_____	__________	_________________	___
Living room	________	_____	__________	_________________	___
Dining room	________	_____	__________	_________________	___
Master bedroom	________	_____	__________	_________________	___
Child bedroom 1	________	_____	__________	_________________	___
Chid bedroom 2	________	_____	__________	_________________	___

Child bedroom 3	________	_____	__________	__________________	___
Bathroom 1	________	_____	__________	__________________	___
Bathroom 2	________	_____	__________	__________________	___
Other (provide rooms)	________	_____	__________	__________________	___

57. Does any member of the household regularly smoke cigarettes inside the home?

1. Yes 2. No

if yes: How many packs/cigarettes per day?

CONSENT FOR ENTRY AND ACCESS TO PROPERTY

Owner Name:

Address:

Phone:

I consent to officers, employees and authorized representatives of the United States Environmental Protection Agency (EPA), acting through the U.S. Army Corps of Engineers (COE), entering and having continued access to my property for a 24 month period beginning ________ thru _______ for the following purposes:

1. cleaning/decontamination of structure and furnishings contaminated by lead dust.

2. removal and disposal of carpets, cloth furniture and/or drapes, blinds, curtains and other window dressings pursuant to health department recommendations;

3. installation of carpet;

4. replacement of cloth furniture;

5. replacement of window dressings such as drapes, curtains and blinds, as needed;

6. painting of walls, as needed;

7. such other actions as the EPA On-Scene Coordinator determines necessary to protect human health or welfare or the environment.

I understand that this is a one-time cleaning and that access to my property after the cleaning is for purposes of sampling only.

I realize that these actions by EPA are undertaken pursuant to its response authorities under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 as amended (CERCLA), 42 U.S.C. Section 9601 et seq.

I also realize that there may be loss or damage to property required by these actions which will be reimbursed by COE, with the exception of loss of or damage to items already in poor condition. In addition, I realize COE will be using my utilities, including heat, water and electricity, the cost of which will also be reimbursed by COE upon submittal of paid receipts.

I understand and agree that should the cleanup and restoration process expose pre-existing damage or substandard workmanship (electrical, plumbing, etc.) EPA bears no responsibility to identify or correct such conditions.

To the extent that the EPA installs any item during the decontamination and restoration process, I acknowledge and agree that EPA makes no representations or warranties about the quality, esthetics, safety use or characters of such item or its installation, including but not limited to warranties or merchantabilty or fitness for purpose.

I also consent to local and state officials reviewing this work, not otherwise covered by this agreement, entering and having access for the purpose of determining the safety and habitability of this property.

Upon completion of the cleaning and restoration of this residence by COE, the relocations benefits will be terminated. At that time, I will be required to vacate the temporary lodging and relocation benefits will end. Any pre-existing code violations which prevent me from returning to my home are not the responsibility of the EPA.

This written permission is given by me voluntarily with knowledge of my right to refuse and without threats or promises of any kind.

I certify that this Consent for Entry and Access is entered into voluntarily and constitutes unconditional consent and grant of permission for access to the property by officers, employees and authorized representatives of EPA at reasonable times.

DATE

OWNER SIGNATURE

FURNITURE REPLACEMENT

NAME: **SSN:**
ADDRESS:

ITEMS	VALUE	APPROVED
LR sofa – 3 cushion	$	______________
LR – recliner	$	______________
LR mini blinds 2 @ $	$	______________
LR valance 4@ $ (2 ea window)	$	______________
Bathroom throws 2@ $	$	______________
Bathroom curtains	$	______________
Bathroom toilet seat cover	$	______________
Master bedroom mini blinds	$	______________
2nd bedroom curtains	$	______________
Kitchen valance 3@ $	$	______________
TOTAL PAGE 1	$	

____
Owner Initial

____
Corps Rep

ITEMS	VALUE	APPROVED
Kitchen curtain	$ ______	______
TOTAL PAGE 2	$	______
TOTAL PAGES 1 AND 2	$	______
5% sale tax	$ ______	______
TOTAL DUE OWNER	$	______

Accepted By:

______________________________ ______________
Date

______________________________ ______________
Corps Representative **Date**

BUNKER HILL SUPERFUND
LEAD DUST CLEANUP

CONTACT DATE: ______________________

NAME: ____________________________ OWNER: ______

TENANT: ______

ADDRESS: ____________________________

____

HOME PHONE: ____________________________

WORK PHONE: ____________________________

FAMILY: NUMBER OF FAMILY MEMBERS: ______

COUPLE ______

MALE AND AGE ______ ______

______ ______

______ ______

______ ______

FEMALE AND AGE ______ ______

______ ______

______ ______

______ ______

SPECIAL NEEDS: (CRIB, WHEEL CHAIR RAMP, ETC) ____________________________

____

____

DISABLED FAMILY MEMBERS: ______ ______

PETS: YES ______ NO ______

TYPE: CAT, DOG, BIRD, FISH, ETC. ____________________________

APPOINTMENT DATE: ______________________ TIME: __________

RELEASE

BUNKER HILL HOUSE DUST PILOT STUDY
SMELTERVILLE, IDAHO

I hereby release the Environmental Protection Agency, acting through the U.S. Army Corps of Engineers, from any loss or damage that may occur to my premises as a result of not providing keys to properly secure my home.

______________________	______________________
Homeowner	**Date**
______________________	______________________
Witness	**Date**

MOVING CHECKLIST

HOUSEHOLD PREPARATION

Any knick-knacks, statues, pictures, etc., that you do not want anyone to touch or move, please remove it from the residence. Since your homes have been videotaped, please make a list of any items that you remove from their place and submit your listing to the Army Corps of Engineers representative.

Your refrigerator will be moved so that the contractors can clean the coils as well as underneath the refrigerator. Please ensure that any items such as milk, jars, bowls, etc., are removed so that no breakage or spills will occur when the refrigerator is moved.

______ *Dishes/pots/pans: Do not leave dirty dishes/pots/pans in the sink. Ensure that all dishes are washed and put away in the cupboards.*

______ *Laundry: Do not leave dirty laundry lying around. Ensure that all clothing is put away in closets, drawers, etc.*

______ *Trash: Ensure that all trash cans in the house are emptied and that trash has been taken out of the house.*

______ *Pet Dishes and Litter Boxes: Ensure that all pet dishes are empty and clean. Ensure that all litter boxes are clean.*

______ *Electronic Equipment: Unplug ALL electronic equipment and wrap the cords up. This equipment will be moved around during the cleaning of your residence.*

______ *Appliances: Unplug ALL small appliances and wrap the cords up. These will be moved around during the cleaning of your residence. NOTE: DO NOT unplug refrigerators, freezers or stoves.*

______ *Beds: Strip ALL beds of bed linens. Your mattresses and box springs will be cleaned.*

______ *Plants*: Remove all plants from your residence. We are not responsible for watering your plants.

______ *Firearms*: Remove all firearms from your residence.

Non-compliance with this checklist may cause a delay in the cleanup of your residence.

I have complied with the requirements of this checklist and have give one (1) set of my house keys to the Corps of Engineers representative below.

__________________ ____________________________________

DATE *NAME*

ADDRESS:

I received one (1) set of house keys for the above listed property.

__________________ ____________________________________

DATE *CORPS REPRESENTATIVE*

PERSONAL ITEMS

PLEASE REMEMBER: You will not have access to your residence during your relocation period. This is for the health and safety of you and the contractors.

Examples of personal items to be moved to your temporary location are:

1. *For commercially cleaned residences: Clothing and toiletries for approximately 3-5 days.*

2. *For HUD cleaned residences: Clothing and toiletries for Approximately 5-7 days.*

3. *Important personal documents.*

4. *Valuable jewelry.*

5. *Medicines (prescriptions).*

U.S. ARMY CORPS OF ENGINEERS REPRESENTATIVES AND PHONE NUMBERS:

786-0410	*Susan Hill*	*Cell: 208-699-1666*
786-0710	*Lynn Walters*	

{DATE}

{NAME AND ADDRESS}

Dear :

As you know, the U.S. Environmental Protection Agency (U.S. EPA) is cleaning your residence because it contains lead dust. You and your family will be temporarily relocated for approximately 5-7 days during the cleanup process.

This letter is to inform you that the necessity for Superfund Temporary Relocation Assistance has been reviewed and approved by the U.S. EPA. As a result of this approval, U.S. EPA, through the U.S. Army Corps of Engineers (USACE), will provide the following benefits to you and your family during your period of temporary relocation:

1. A daily allotment for meals and/or incidental expenses. This daily allotment is based on the Federal Per Diem rate and is $2.00 per day per family member.

NOTE: This cost may vary depending upon availability of lodging.

PLEASE NOTE:

(a) If similar or equivalent assistance is provided to you from another source, U.S. EPA will not duplicate such benefits. You must notify the USACE immediately of such assistance.

(b) If there is a change in your household size **prior** to moving or while in your temporary lodging, you are obligated to inform USACE immediately. Failure to do so may adversely affect your relocation benefits.

c In order to be eligible for U.S. EPA temporary housing benefits, you must continue your tenant or ownership status at your primary residence.

2. Costs for essential utilities (gas, water and electricity) at your primary residence during your temporary relocation period will be reimbursed to you.

PLEASE NOTE: You are responsible for paying the utilities at your primary residence during your temporary relocation. Upon return to your permanent residence, you must submit original bills and paid receipts to the USACE for reimbursement. A claim form for reimbursement of utilities is enclosed. ALL CLAIMS FOR REIMBURSEMENTS MUST BE SUBMITTED WITHIN THIRTY (30) DAYS OF YOUR RELOCATION TERMINATION DATE.

Your temporary relocation benefits will begin on the date of your relocation and will terminate upon notice from USACE that you may move back to your home.

Please be advised that if USACE determines at a later date that you have received an inappropriate amount of that the information upon which these amounts were based is incomplete, inadequate or incorrect, USACE may change their determination and could possibly seek a refund of money disbursed upon notice.

If you have any questions regarding the above temporary relocation benefits, please feel free to call me at 208-699-1666.

Sincerely,

Susan M. Hill
U.S. Army Corps of Engineers

REPLACEMENT VALUE SHEET OF DISPOSED ITEMS FOR:

NAME AND ADDRESS

ITEM	ESTIMATE FROM	REPLACEMENT VALUE	SETTLEMENT

TOTAL VALUE OF ITEMS FOR PAGE 1: $____________

{NAME)

ITEM	ESTIMATE FROM	REPLACEMENT VALUE	SETTLEMENT

TOTAL PAGE 1 $____________

TOTAL PAGE 2 $____________

TOTAL VALUE FOR DISPOSAL ITEMS $________________

DATE	OWNER SIGNATURE	DATE	COE REPRESENTATIVE

INFORMED PARTICIPANT CONSENT

PROJECT TITLE: House Dust Pilot Project

House Address (location):________________________________ House ID# ___________
Mailing Address (if diff.):________________________________

You are being asked to participate in a study conducted by TerraGraphics Environmental Engineering, Inc., the State of Idaho Department of Environmental Quality, and the Panhandle Health District. The purpose of the study is to determine if house dust lead concentrations will be reduced within the Bunker Hill Superfund Site by interior abatements. You must give your signed agreement to participate in this study. Participation in this study is entirely voluntary and is being done at no cost to you.

Participation in the study will consist of the following samples collected by TerraGraphics:

1) Vacuum bag, dust mat, BRM, attic, and basement dust samples will be collected from your home and analyzed for lead levels for all participating homes.

2) Air duct samples will be collected from the 12 homes receiving the cleaning treatments.

Each dust sample will be collected at 4 different time periods:

- pre-cleaning
- post-cleaning (this sampling will only occur for the homes receiving cleaning treatments)
- 6 months after the cleaning
- 12 months after the cleaning

Results of your sample analyses and an interpretation will be mailed to you.

CONFIDENTIALITY: I understand that all personal information will be kept in strict confidence in accordance with Idaho code 9-340 (23), which exempts these records from public disclosure with the Privacy Act of 1974. Individually identified data will be available only to authorized personnel. Any published data from this study will not identify specific individuals and will only give group information.

PARTICIPANT CONSENT: I understand why this study is being done and why I am being asked to participate. I voluntarily agree to this study and consent to participation. I understand that I can stop participation at any time. I understand that I may decline to answer any specific question and that I may withdraw from the study at any time, without penalty. I understand that the investigators are not obligated to treat, or further evaluate any problems that may be found. If I have any further questions, I can contact Mr. Jerry Cobb, Panhandle Health District, at 783-0707.

Participant Name (print):____

Participant Signature:____

Witness/Interviewer Signature:___________________________________

Date:____________________

HOUSE ID:_______________

CHECKLIST OF CLEANING SERVICES FOR HOUSE ADDRESS:

	Ceilings - vacuum/wet wash
	Ceiling fans - vacuum/wet wash
	Light fixtures - take apart and vacuum/wet wash
	Wall hangings - take down to wash walls and vacuum/wet wash
	Walls - vacuum/wet wash
	Inside windows, sills, wells, and trim - vacuum/wet wash
	Outside windows, sills, wells, and screens - wet wash (only if window opens)
	Blinds - vacuum/wet wash
	Curtains and Drapes - vacuum (if possible)
	Cupboards - vacuum/wet wash tops and outsides only
	Furniture - vacuum all soft furniture except mattresses (e.g., couches, chairs, etc.), and move to vacuum floors and edges behind and underneath
	- dust tops of hard furniture (e.g., bookshelves, TV and stand, etc.)
	Appliances - wet wash outside only and then pull out to vacuum coils, etc. behind and underneath, also vacuum/wet wash floors and walls behind:
	Refrigerators
	Stoves
	Washers/Dryers
	Freezers
	Floors - vacuum/mop all hard floors, vacuum all carpeting, along edges and floorboards using accessories, and underneath furniture and appliances

* Vacuum/wet mop means one or the other (whichever would be appropriate).

CONSENT FOR ACCESS TO PROPERTY
BUNKER HILL POPULATED AREAS CERCLA SITE

I hereby give my consent to the Service Master Merry Maids under their contract for cleaning with TerraGraphics and the Idaho Department of Environmental Quality (IDEQ), U.S. Environmental Protection Agency (EPA), their officers, employees, representatives, and persons acting at their request to have access to and enter the property at the below location(s) for cleaning, sampling house dust, and inspection and review of the Service Master Merry Maids work to the extent deemed necessary by IDEQ and EPA. I understand that this sampling is part of the House Dust Pilot Project within the Bunker Hill CERCLA site. I further understand that my participation is entirely voluntary and that I may withdraw my consent at any time.

I understand that to the extent permitted by law, personal identifying information and the location of my residence will be kept confidential by IDEQ, and EPA. Neither I, nor any number of my family, will be identified by name in publicly available reports. I understand that IDEQ, EPA, and TerraGraphics may exchange sampling results as deemed necessary by IDEQ and EPA.

I understand that I may request and receive the results of this sampling at any time and if I have further questions, information can be obtained by contacting TerraGraphics or one of its representatives at 108 W. Idaho, Kellogg or at (208) 786-1206.

I further understand Service Master Merry Maids will be performing all of the cleaning activities listed on the attached Checklist of Cleaning Services and Service Master Merry Maids are primarily responsible for the actual cleaning and any damages that arise from the cleaning activities. Any complaints can be directed to TerraGraphics at the number provided above.

Resident Signature:____________________________________ **Date**:__________________

Name (print):____

Street Address:____

Mailing Address:______________________________________

FINAL
Field Work Plan for the House Dust Pilot Project
Interior Dust Sampling

FINAL
Field Work Plan for the House Dust Pilot Project
Interior Dust Sampling

Prepared for:

State of Idaho
Idaho Department of Environmental Quality
Boise, Idaho

Prepared by:

TerraGraphics Environmental Engineering, Inc.
121 South Jackson Street
Moscow, Idaho

August 2000

Table of Contents

LIST OF FIGURES

LIST OF TABLES

SECTION 1.0 INTRODUCTION

1.1 Site Location and Background

The Bunker Hill Superfund Site is located in Shoshone County, north Idaho, approximately 40 miles east of Coeur d'Alene, Idaho. The site encompasses approximately 21 square miles in the Silver Valley of the South Fork of the Coeur d'Alene River (SFCDR) (Figure 1). The cities of Kellogg, Wardner, Smelterville, Page, and Pinehurst are located within its borders and are home to over 7000 people (Figure 2). A century of discharges from mining and smelting activities had left several thousand acres barren and contaminated with heavy metals. Among the most significant contaminants are antimony, arsenic, cadmium, copper, lead, mercury, and zinc. The communities were the scene of a severe lead poisoning epidemic in the 1970s resulting from the smelter being operated with improper air pollution control equipment. Nearly every child in the community was lead poisoned at that time due to air pollution and subsequent contamination of site wide soils and dusts. The smelter closed in 1981, and remedial actions, focusing on contaminated public and residential soils, were initiated. Public health monitoring and environmental monitoring of ambient air, soils, and interior household dusts for lead have been ongoing since the early 1970s.

As part of the Record of Decision (ROD) (EPA 1991, 1992), a Remedial Action Objective (RAO) was established for house dust lead concentrations. The ROD states that "*all homes with house dust lead concentrations equal to or exceeding 1000 ppm will have a one time cleaning of residential interiors after completion of remedial actions that address fugitive dust. If subsequent interior house dust sampling indicates that house dust lead concentrations exceed a site wide average of 500 ppm lead, the need for additional cleaning will be evaluated*" (EPA 1991). The rationale for this derived from a 1990 pilot cleaning study in which several homes at the site received comprehensive interior cleaning, yet carpets in the home became recontaminated within one year (CH2M Hill 1991). As a result, it was determined that home interiors could not be permanently remediated until exterior contamination sources were addressed. Because interior dust lead concentrations are highly correlated with exterior soil lead concentrations, the cleanup at the site has focused on reducing yard and community soil lead concentrations to the soil RAO, which is "*to achieve community mean soil lead concentrations of approximately 350 ppm by removal of soils exceeding the threshold level of 1000 ppm lead*" (EPA 1991). House dust lead concentrations were expected to subsequently decrease as the exterior-to-interior path was reduced. Studies monitoring interior dust lead concentrations indicate that this reduction is indeed occurring, but interior cleaning may still be necessary to further reduce dust lead concentrations (TerraGraphics 1997, 2000a).

Smelterville is the only community within the site where soil remediation is complete, and soil RAOs have been achieved (TerraGraphics 1999a, 2000b). Interior dust data from the 1998 Panhandle Health District (PHD) sampling season indicate that mean dust lead levels for Smelterville are slightly higher (570 mg/kg) than the RAO with 10% of the homes exceeding 1000 mg/kg (TerraGraphics 1999b). Results of the 1999 PHD interior dust data for Smelterville reveal a geometric mean lead concentration of 595 mg/kg with 30% of the homes exceeding 1000 mg/kg (TerraGraphics 2000c). Recent data indicate that lead levels are nearing the RAO in Smelterville, although the objectives have not been completely achieved.

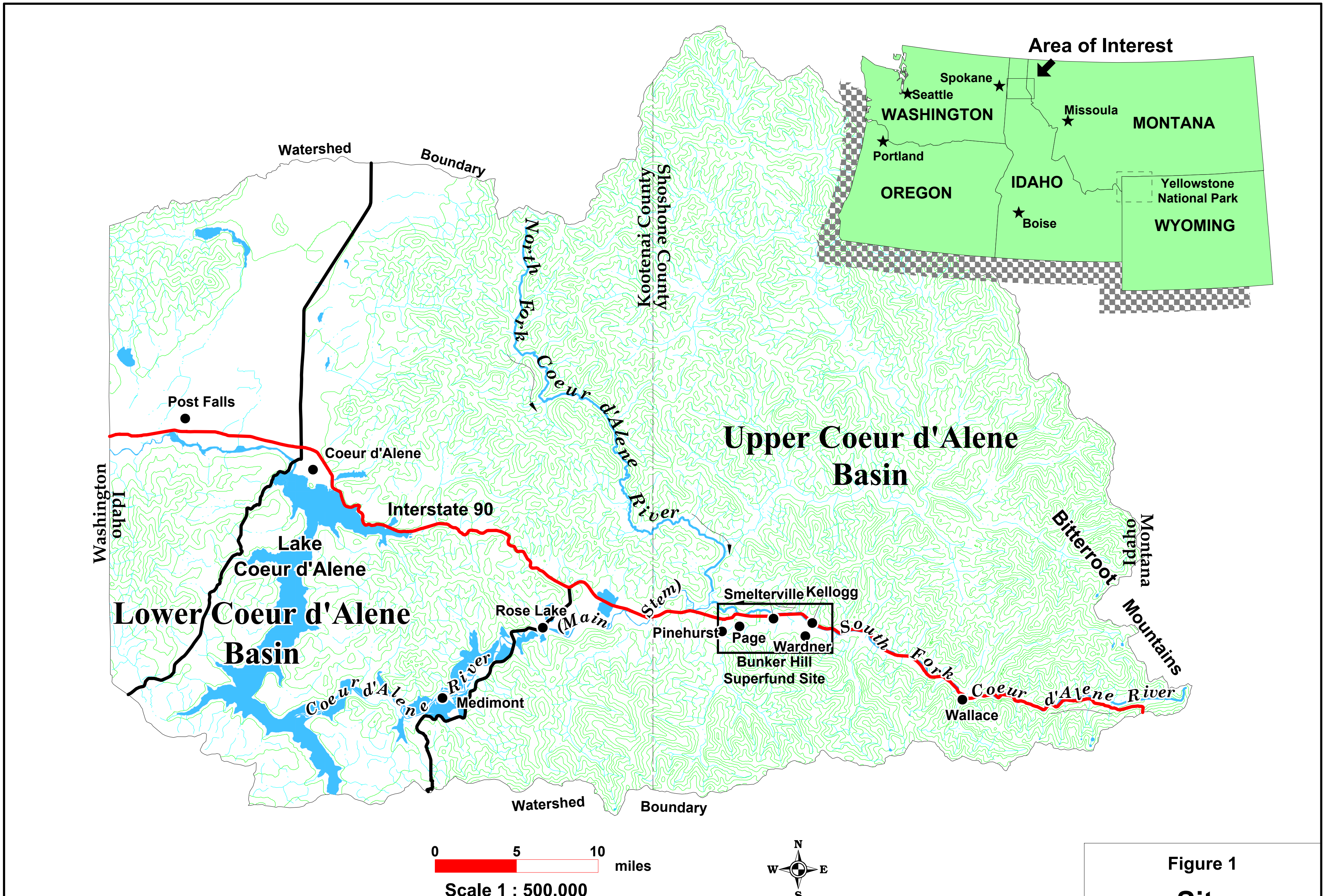
1.2 Existing Information

Although HUD has promulgated lead-based paint abatement guidelines (HUD 1995), a review of house dust remediation projects accomplished at other lead sites suggests there is no universally accepted methodology for house dust lead abatement or remediation. Much of the difficulty in implementing permanent and effective remediation of house dusts is related to the ultimate sources of the lead in dust. This is because homes, and particularly carpets and soft surfaces, are large reservoirs for house dust that subsequently serve as common exposure vehicles to young children. Effective reduction of house dust lead levels requires control of both the reservoir and those exterior and interior sources contributing lead to house dust.

The Bunker Hill Superfund Site (BHSS) strategy for addressing house dust contamination was to make maximum effort to minimize exterior soil sources through remediation of residential soils, parks, playgrounds, commercial properties, roadsides and industrial areas throughout the Site. This cleanup was effected on the fastest, practicable schedule determined in negotiation between the USEPA and the Site PRPs. In the meantime, monitoring of both children's blood lead levels and house dust lead concentrations is conducted through the local health department, and follow-up services are offered to those children exhibiting high concentrations. HEPA vacuums are also available to the local residents and individuals are reminded of the importance of good personal and home hygiene through education and outreach programs.

The 1990 CH2M Hill pilot cleaning study at the BHSS cleaned six homes by removing and replacing the main living area carpet and one piece of upholstered furniture (CH2M Hill 1991). Prior to removal, carpets and furniture were vacuumed and steam cleaned up to three times. Floors were wet washed after removal of the carpet. Sampling of the removed carpets and furniture indicated that most of the lead was found in the carpet rather than the pad or underlying floor. Average lead loading decrease was 8% for carpets and 18% for furniture. This study indicated that the cost of cleaning approximately equaled the cost of replacing the materials. Subsequent dust lead monitoring at these homes showed that dust lead concentrations one year later were similar to both pre-remediation levels and other un-remediated homes in the community.

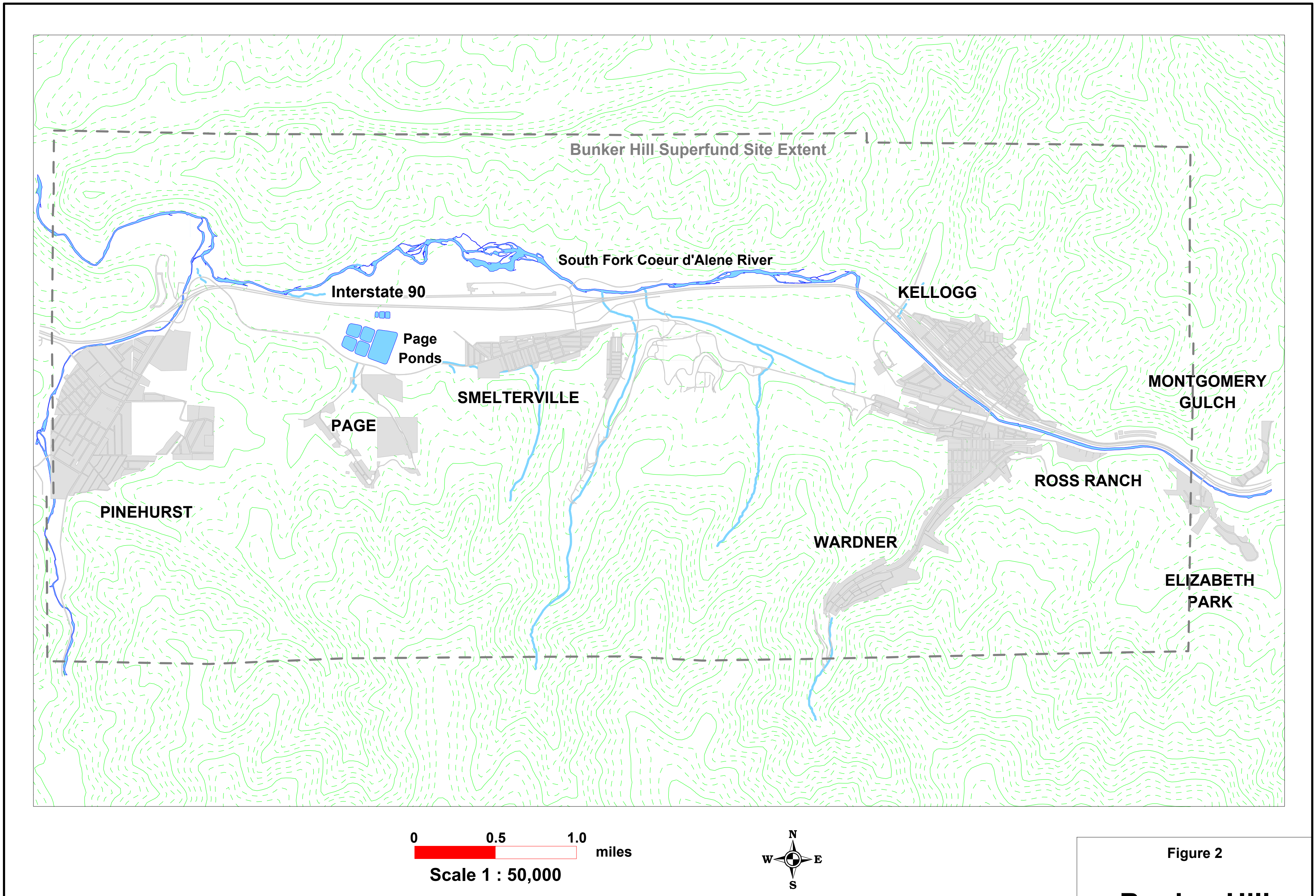
A brief summary of previous studies and reports of clean-up efforts involving interior remediation of house dusts applicable or similar to the BHSS, as well as sampling methodologies, sources of lead to house dust, and standards for lead in house dusts are discussed in the *Interior Dust Cleaning Work Plan* (TerraGraphics 2000d). A more detailed discussion of lead in house dusts at the BHSS can be found in the *1999 Five Year Review Report* (TerraGraphics 2000a).



Terra Graphics Environmental Engineering, Inc.

Figure 1

Site Location Map



Terra Graphics
Environmental Engineering, Inc.

Figure 2

Bunker Hill Superfund Site

SECTION 2.0 PROJECT DESCRIPTION

The main goal of the House Dust Pilot Project is to determine if interior remediation will reduce interior house dust lead concentrations. Fifteen houses in the BHSS will be part of this project in which six houses will be sampled and receive a HUD cleaning (i.e., carpet and soft furniture removal and replacement), six houses will be sampled and receive a commercial cleaning (i.e., carpet and soft furniture steam cleaning), and three control houses will be sampled without any cleaning. A complete description of the project can be found in the *Interior Dust Cleaning Work Plan* (TerraGraphics 2000d).

2.1 Purpose and Objectives

The primary purpose of this project is to determine the feasibility of instituting home interior cleaning in order to achieve and maintain a low dust lead level in the home (i.e., achieve the dust RAO for the site). This project is not designed as a scientific experiment to compare treatment techniques. Instead, the purpose is to assess the effectiveness and efficiency of long-term solutions for the BHSS, as well as to identify logistical problems associated with any comprehensive community-wide cleanup that might be required. This Work Plan outlines the sampling protocols to be used for the interior dust sampling required to quantify masses and concentrations of lead in the participating homes.

The main objective of this project is to learn about certain parameters (i.e., cost effectiveness, lead reduction, and logistical challenges) associated with interior cleaning so that a large-scale home interior cleaning project can be scoped. The dust sampling associated with this project will be completed in support of the main purpose and objectives for the project.

The following specific objectives are defined for the sampling effort:

- To determine the rate and magnitude of lead recontamination, and dust and lead loading.
- To assess sampling techniques for house dust.
- To identify other sources of lead exposure in homes that could be amenable to cleaning.

2.2 Project Scope and Limitations

This project will involve the cleaning of twelve homes in Smelterville selected through previous sampling and questionnaire results, and confirmed in subsequent interviews. Cleaning will be limited to areas with potential for exposure (accessible portions of the residence, including ducts). Three additional control homes in Smelterville will not be cleaned but will be sampled by the same methodologies as the cleaned homes.

Of the twelve homes that will be cleaned, six will be cleaned by a certified HUD lead-based paint contractor (Treatment Group A) and six will be cleaned by a commercial cleaning company (Treatment Group B). The purpose of utilizing two cleaning contractors is to generate information on cost versus effectiveness should large scale cleaning be warranted. Additionally, three control homes (Treatment Group C) will be monitored for effectiveness comparisons.

Although HUD Lead-based Paint Risk Assessment may identify lead-based paint hazards in some of the homes, lead-based paint abatement is beyond the scope of this project. However, the risk assessment will identify potential abatement measures and help refer homeowners to the appropriate agencies for assistance to address identified abatement needs.

The project is limited to measuring dust lead concentrations and dust and lead loading rates in the 15 participating houses. Blood lead measurements will not be collected as part of this project. However, families with young children will be encouraged to participate in the 2000 and 2001 Lead Health Intervention Program that monitors blood lead levels for the BHSS.

The overall sampling process includes the following:

- Pre-cleaning sampling for all participating houses will occur prior to the scheduled cleaning.

- Post-cleaning sampling will be performed in the twelve houses that were cleaned, soon after the scheduled cleaning has occurred.

- Long-term effectiveness sampling will be performed in all participating houses at approximately six and twelve months after completion of the cleanups.

Tables 1 and 2 summarize the method, location, and time of the dust samples to be collected for the participating houses in the project.

Table 1 Sampling Summary for Cleaning Treatment Homes

Sample Detail	Pre-cleaning	During cleaning	Post-cleaning	6 months	12 months
1. Carpet (BRM)[1]					
child bedroom	X		X	X	X
living room	X		X	X	X
2. Kitchen floor (BRM)[1]	X		X	X	X
3. Windows: sill, well (wipe)[2]					
child bedroom	X		X	X	X
living room	X		X	X	X
4. Floor dust mat[1]	X		X	X	X
5. Household vacuum cleaner bag[1]	X		X	X	X
6. Basement[1]		X			
7. Attic[1]		X			
8. Duct[1]		X			

[1] Sampled by TerraGraphics.
[2] Sampled by HUD RA contractor.

Table 2 Sampling Summary for Control Homes

Sample Detail	Pre-cleaning	During cleaning	Post-cleaning	6 months	12 months
1. Carpet (BRM)[1]					
child bedroom	X			X	X
living room	X			X	X
2. Kitchen floor (BRM)[1]	X			X	X
3. Windows: sill, well (wipe)[2]					
child bedroom	X			X	X
living room	X			X	X
4. Floor dust mat[1]	X			X	X
5. Household vacuum cleaner bag[1]	X			X	X
6. Basement[1]	X				
7. Attic[1]	X				

[1] Sampled by TerraGraphics.
[2] Sampled by HUD RA contractor.

SECTION 3.0 PROJECT ORGANIZATION AND MANAGEMENT

3.1 Organization and Responsibility

A list of key personnel and their responsibilities for this project are outlined below:

DEQ Project Officer:	Scott Peterson, DEQ Kellogg
Project Manager:	Jerry Lee, TerraGraphics
Field Operations Manager:	Susan Spalinger, TerraGraphics
Site Manager:	Lisa Hall, TerraGraphics
QA Manager:	Shanda LeVan, TerraGraphics
Site Safety Officer:	Susan Spalinger, TerraGraphics

3.2 Reporting and Documentation

TerraGraphics will keep the State Project Officer informed and updated on activities during field work by:

- weekly summary reports and/or calls or meetings
- written monthly reports, and
- reports on any internal QA and Health and Safety audits

Additional meetings and reports will be scheduled or submitted as conditions change and new issues arise. Interim data summary memos will be submitted as data become available. A final summary report will also be submitted at the end of the project.

SECTION 4.0 SCHEDULE OF TASKS AND MILESTONES

Table 3 provides a summary of the anticipated schedule of tasks and milestones for the interior dust sampling efforts. The sampling schedule may shift depending on the cleaning schedule for individual homes. The six and twelve month sampling events will be performed under a separate Task Order.

Table 3 Task Plan Milestone Chart

Activity	**June 2000**	**July 2000**	**Aug. 2000**	**Sept. 2000**	**Oct. 2000**	**Nov. 2000**	**Dec. 2000**
Work Plan	XX						
Field Crew Training		XX					
Pre-cleaning Sampling*		XX	XX				
Cleaning*			XX	XX			
Post-cleaning Sampling*			XX	XX			
Laboratory Analysis*				XX	XX		
Data Org/QA/QC**					XX		
Data Eval/Reduction**						XX	
Draft Data Summary Memo						XX	XX

Activity	**Feb. 2001**	**March 2001**	**Apr. 2001**	**Aug. 2001**	**Sept. 2001**	**Oct. 2001**	**Nov. 2001**	**Dec. 2001**
6-month Sampling*	XX	XX						
12-month Sampling*				XX	XX			
Laboratory Analysis*			XX		XX			
Data Org/QA/QC**			XX			XX		
Data Eval/Reduction**			XX			XX	XX	
Draft Final Report							XX	
Final Report								XX

*Contingent upon cleaning schedule.
**Contingent upon receipt of data from the lab and QA review as specified.

SECTION 5.0 SAMPLING AND ANALYSIS PLAN

This sampling and analysis plan (SAP) describes the sampling strategy, techniques, and quality control (QC) procedures necessary to perform the House Dust Pilot Project sampling. These procedures are meant to ensure the precision, accuracy, and documentation of data generated during sampling activities.

Fifteen residences will be sampled in Smelterville, where soil remediation is complete. Six types of samples will be collected at each residence in an attempt to quantify the lead concentrations and lead and dust loading in the home:

- A vacuum cleaner dust sample will be obtained whenever possible to quantify lead concentrations in house dust.

- Dust mats will be placed, retrieved after approximately three weeks, and sampled to determine lead loading into the home during daily activities.

- Floor samples will be collected using the BRM sampler to quantify lead concentrations and loadings in floor dust.

- Attic and basement grab samples will be collected when these areas are not finished or used daily and accessible to quantify lead concentrations.

- Air duct samples will be collected from the houses receiving cleaning treatments to quantify lead concentrations in the air duct systems.

- Window sill and well samples will be collected using wet wipes by a HUD risk assessor contracted by the U.S. Army Corps of Engineers.

Procedures for sampling, sample handling, documentation, and transport are described in the following subsections.

5.1 Vacuum Dust Samples

The vacuum dust sample is meant to be representative of lead exposure to individuals inside the home. Therefore, prior to sample collection the sampler must verify that the vacuum has not been used anywhere outside the home since the bag was last changed. No sample will be collected from vacuum cleaners that do not meet this criterion.

5.1.1 Vacuum Dust Sampling Procedures

The dust sample will be collected from a household vacuum cleaner bag as follows.

1. The vacuum cleaner will be removed from the house and taken outside to prevent spread of dust when the sample is collected.

2. The sampler will wear clean latex gloves while handling the vacuum cleaner bag and collecting the sample. A new pair of gloves will be used for each sample.

3. The vacuum cleaner bag will be removed from the vacuum and placed in a large Ziploc® bag. The entire bag will then be sent to the laboratory for analysis.

4. If the resident has provided a vacuum bag, the sampler will offer to install a new bag if the resident has one available.

5. The vacuum cleaner will be reassembled and returned to the resident.

6. All sample bags, tags, the site description form, and the field log book will be filled out as the sample is collected. The sample tag will be attached to the sample at the time of collection.

7. Relevant information will be recorded in the field log book or on the site description form.

5.2 Floor Mat Dust Samples

A carpeted floor mat for dust collection will be placed at all homes participating in the survey in an attempt to quantify lead concentration, lead loading, and dust loading. Except for unusual circumstances, floor mats will be placed just inside the main entry of each house.

5.2.1 Floor Mat Placement Procedures

The following procedure will be used for placing floor mats.

1. The mat will be labeled with the house identification number in permanent ink on the back and topside edge and placed in a high traffic area, preferably inside the house and as close to the main entry as possible.

2. A site description form (Figure 3) will be completed to identify the sample, and a sketch will be made showing the dust mat location in relation to the rest of the residence. The sketch will also show the position of the house relative to nearby streets. The site description form will be replaced with the Army Corps of Engineers' house layout plan

if available. The site description form will include the street and mailing addresses, house identification number, number of people living in the home, number of pets, samplers' initials, the placement date, and whether a dust sample was taken from the household vacuum.

3. A sample tag (Figure 4) will be filled out for each mat as it is placed. The information on the tag will include the house identification number and site address. Comments relevant to the sample will be recorded in the comments section at this time. The tag will be stapled to the site description form. The remainder of the tag will be completed when the mat is sampled.

4. A mat instruction sheet will be provided to the resident and explained when the mat is placed (Figure 5).

5. The site description form and sample tag will be placed in the mat collection file.

5.2.2 Floor Mat Collection Procedures

The mat will be collected from the residence approximately three to four weeks after placement. A questionnaire (Appendix A) will be administered at the time the mat is picked up. To provide consistency in the dust mat collection and to ensure that the mats are handled such that the sample volume is not compromised, the procedure below will be followed.

1. Confirm sample numbers, the house address, and the resident's name prior to retrieval.

2. A questionnaire will be administered at the time of mat collection to obtain information pertinent to the household that may be influencing dust lead concentrations and loading rates. The questionnaire is provided in Appendix A.

3. Using an indelible ink marker, label the outside of a collection envelope with the sample number, house address, date placed, and date retrieved. The mat will be handled and stored with the mat fiber side facing up.

4. Write the pick up date on the site description form and on the sample tag. Attach the sample tag to the mat.

5. Put on clean latex gloves before placing the collection envelope on the floor at one end of the mat.

6. Slide the mat into the open end of the envelope, being careful not to disturb or shake dust from the mat.

7. Tape the collection envelope shut, making sure that all seams are sealed to prevent dust from getting into or out of the envelope.

8. Place the cardboard collection box on the floor next to the envelope. Slide the envelope into the box. The mat will be handled such that the fiber side remains up and that no material is disturbed or lost. Write the sample number on the box.

9. Up to six envelopes may be placed in one box storage container.

10. Strict chain of custody of all samples will be maintained at all times. Each box will be sealed with an appropriate custody seal prior to transporting the mats to the sample processing area. All boxes must be labeled "This Side Up" to ensure that the dust mats remain fiber side up.

11. All storage containers will be transported to the sample processing area by project personnel to ensure that the containers remain level and mats are fiber side up.

5.2.3 Dust Mat Sample Collection Protocol

1. Mats will be kept flat, fiber side up, and sealed in boxes at all times prior to sample processing.

2. All mats will be brought to a designated storage area for processing.

3. Prior to mat processing, the processing room shall be inspected for proper operation:

    - Interior surfaces (floors, shelves, vacuuming surface) clean and free of dust (clean if necessary)

    - Blower functioning properly and vented to exterior hood; hood functioning (contact designated supervisor if necessary)

    - Door fitting and seal functional; exterior walls sealed with no holes or openings (repair if necessary)

    - Sampling and vacuum apparatus assembly areas clear and free of obstructions

    - Tacks and fittings available and in working condition

4. Prior to mat processing, inventory and check condition of health and safety equipment:

- Respirator, if required (clean, adequate filter, fit tested). On the first day of mat processing, personal air monitors will be used to assess airborne concentrations of lead. Respirators will be used during mat processing only if required by OSHA standards.

- Gloves, head cover, coveralls (clean, fit)
- Fire extinguisher (know location, operational)

- Emergency power switch

- Notify supervisor or appropriate lab personnel of activities and schedule

5. Prior to mat processing, inventory and check condition of all sampling equipment and supplies:

- Appropriate log and sample description forms and clipboards

- Utility knife for cutting boxes, envelopes, and tape

- Scales clean and operational

- Vacuum cleaners (sample collectors) clean and operational
  - main body of machine
  - sample bag attachment area
  - hoses and fittings
  - nozzle

- Adequate supply of filter bags in manufacturer's packaging

- Tape and fitting materials

- Ziploc® bags

- Compressed air hose clean and operational

- Sanitary vacuum clean and operational

- Disposable wipes

- Paper towels

- Spray mist

- Wooden rod

6. Place equipment in appropriate locations in processing area.

7. Inventory one box of mats from storage to processing area. Record each sample in the box:

    - Record transfer to mat sampling log (Figure 6) and master log (Figure 7).

    - Place mat boxes in processing area.

8. Put on required safety equipment:

    - Respirator (if required), lab coat or coveralls, and gloves; a new pair of gloves will be worn for each mat sampled.

    - Turn on processing area ventilation blower; enter processing area; minimize exits and entries; keep blower on until decontamination is complete.

9. Mat Preparation Procedure:

    - Open box along one end with razor edge.

    - Remove each mat individually, always keeping mat flat and fiber side up; check sample numbers against mat sampling log and box label; note any discrepancies in box and sample numbers. If any mats are misnumbered or mislabeled, put all mats back in the box and set aside for supervisor inspection; proceed to next box.

    - Note any broken seals or dirt in box. If seals have broken and there is dirt or dust in box, return all mats to box and set aside for supervisory inspection; proceed to next box.

    - Set box in location appropriate to receive cleaned mats after vacuuming.

    - Maintaining flat and fiber side up position, place mat (still in envelope) on vacuuming table; use utility knife to slice open envelope along facing edge and two sides; fold top of envelope over 180^{o} to lay flat on table, inside surface up; tack mat in each corner.

    - Note any discoloration, obvious spills, cuts, fraying or other unusual characteristics on mat sampling log.

10. Mat Vacuuming Procedure:

- Wear clean latex gloves while handling vacuuming equipment and while vacuuming the mat.

- Check that vacuum, hoses, and nozzle are clean; assemble machine.

- Open vacuum filter bag package; remove 1 vacuum bag; place remaining filters in clean, sealed plastic bag.

- Label the vacuum filter bag with the sample number, place in a Ziploc® bag, and weigh Ziploc® plus filter bag on scales; record to nearest 0.01 grams on the mat sampling log and on the outside of the Ziploc® bag.

- Place vacuum filter bag in vacuum.

- Close and secure vacuum housing.

- Vacuum mat with direct contact of nozzle, making nozzle-width passes from right to left over the length of the entire mat and rubber edges (approximately 1 minute for full coverage); repeat procedure across the width of the mat; vacuum any areas on the mat with visible remaining dust for 30 seconds; turn the mat over (fiber side down on the envelope); strike the back of the mat five times with flat side of the wooden rod provided for this purpose (this causes additional soil still in the mat to fall onto the surface of the envelope); remove the mat; vacuum the inside of the envelope for 15 seconds, ensuring full coverage and removing any visible dirt or dust that fell from the mat during the procedure; place mat in original box for disposal; remove envelope and crush and place in garbage can with trash bag and close lid. Do not raise dust in any disposal operation.

- Disassemble vacuum in specified area; open housing and remove filter bag, being careful not to damage the bag or lose bag material or contents. If a proper seal was maintained, the inside housing will be relatively clean. Note on mat sampling log if seal was broken and inside of machine was soiled.

- Carefully expel air from filter bag by folding over cardboard facing and gently squeezing the bag. Place entire bag in its labeled quart-sized Ziploc® bag andseal. Check that the filter bag and Ziploc® have the same sample number as sample tag.

- Weigh the filter bag on the scale. Note filled bag weight on mat sampling log and on Ziploc®. The difference in weight before and after vacuuming the dust mat is the total dust weight.

11. Decontamination/Disposal Procedure:

- Wipe out interior vacuum housing and port with dry disposable wipes. Be sure to clean both inside and outside of the apparatus. If dust is obvious or wipes show soiling, vacuum with sanitary vacuum. Wipe with damp disposable wipe, and blow dry with compressed air. Repeat until dry disposable wipe shows no soiling.
- Clean hose and nozzle by washing with soap and water, passing wire bottle brush down the hose and nozzle until clean. Be sure to clean both inside and outside of the hose and nozzle. Rinse hose and nozzle with distilled water, and dry with compressed air.

- Clean vacuum table area between each sampling with damp disposable wipe until clean.

- Clean all general areas with sanitary vacuum, including accessible clothing, if necessary. Dispose of all cleaning materials in a lined garbage can with a closing cover. Remove and dispose of gloves between each sample.

- At end of sampling session, double bag and seal all mat boxes in heavy duty trash bags. Seal, remove, and double bag trash bags from garbage cans; clean interior of can with sanitary vacuum; vacuum and damp mop processing area. Clean the laboratory; clean all sampling equipment; dispose of sanitary vacuum bag (when necessary) with other materials; notify supervisor of any problems or material requiring disposal.

12. Records:

- Double check all logs and inventory forms for accuracy, completeness, and legibility. Make two copies of all records. Return originals to secure storage as directed. Bring two copies to supervisor, one for inspection and one for data entry.

- Disposal of all materials shall be in accordance with the processing lab and TerraGraphics' procedures and policies.

13. Preparing Samples for Shipment:

- All Ziploc® bags will be checked for proper seal (reseal or re-bag any leaking bags), compared to the mat sampling log for accuracy, and entered by sample number on the chain of custody form (Figure 8). A chain of custody form will be completed and signed for each box or container shipped. One copy of the form will be enclosed in a plastic bag in each package. One copy will be placed in the project file, and one copy will be provided to the supervisor. All containers will be sealed in accordance with sample transport and shipping procedures.

14. Forms Required:

- Mat sampling log

- Master log
- Chain of custody forms

5.3 Floor Sampling Procedure using the BRM Sampler

Floor samples will be taken from the living room, a child's bedroom, and the kitchen. Three different one-square foot areas from the floor in each of the rooms will be randomly selected for sampling (EPA 1997). Each room to be sampled will be separated into a twelve grid system. Three numbers will be picked randomly using a random number generator, and the sample will be collected from the middle of each of the three grids selected. If furniture is in the way of the sample, then another grid will be chosen randomly using the same random number method. One composite sample from the three grids will be collected sequentially into one sample container for a total of three floor composite samples for each home.

Carpets and hard floor surfaces will be sampled using the Baltimore Repair and Maintenance Method (BRM).

The floor samples will be collected with the BRM as follows:

1. Three one-square foot areas will be identified in the room being sampled as outlined above. If the three one-square foot sections do not provide enough sample, add more one-square foot sections, keeping track of the sample area so that loading may be calculated. Draw the house layout on the site description form (Figure 3) and label each room sampled and mark the one-square foot areas that were sampled. The site description form will be replaced with the Army Corps of Engineers' house layout plan if available. It will also be noted the last date the homeowner vacuumed the floor being sampled.

2. The sampler will wear clean latex gloves while handling vacuuming equipment and while vacuuming the floor surface.

3. Check that the vacuum, hoses, and all the parts are clean; assemble the cyclone and connect it to the Dirt Devil® vacuum, and attach a clean tygon tube/sample nozzle. Make sure that the vacuum has a fresh filter bag installed between each home being sampled.

4. Label a clean catch bottle with the sample identification number, weigh the catch bottle on the scale with the cap on; record to the nearest 0.01 grams.

5. Attach the catch bottle to the bottom of the cyclone securely.

6. Place the one-square foot frame on the area to be sampled or tape off a square foot section using masking tape. Holding the cyclone vertical at all times, vacuum the carpet/hard floor surface with direct contact of the nozzle in a vertical motion, making nozzle-width passes from right to left over the one-square foot carpet; then make nozzle-width passes horizontally from top to bottom; repeat procedure three times in each direction. When finished sampling let the vacuum run another 10 seconds and then turn off the power.

7. Remove the catch bottle and replace the cap. Weigh the bottle and cap on the scale. Note filled bottle weight in the log book. The difference in weight before and after vacuuming the floor is the total dust weight.

8. Attach the sample tag to the sample bottle. Check that the bottle has the same sample number as the sample tag.

9. Between each composite sample, disassemble the BMR Sampler in a well-ventilated cleaning area that is free from dust; with new gloves clean the inside surface of the cyclone (cone and body) and all attached parts with a clean wet wipe and discard the wipe. Use a clean wet wipe for each section of the cyclone and a separate wipe for the rings and gaskets. Dry surfaces using a clean Kimwipe. Use the “tongue depressor” for pushing the wipe into hard to reach areas. A new catch bottle will be used for each composite sample.

10. Prior to sampling a new house, the cyclone sampler and its parts will be completely decontaminated with a small bottle brush, soap, and water. The cyclone sampler will then be rinsed with distilled water and dried with compressed air. The vacuum bag contained in the Dirt Devil® will also be replaced.

5.4 Air Duct Samples

Except for control homes, air duct samples will be collected from cleaning equipment filters immediately after the professional contractor has finished cleaning the ducts. A grab sample from the filters will represent a general lead concentration found in the ducts of the home. The purpose of the duct cleaning and sampling is to remove a potential reservoir of dust lead in the home and to determine the concentration of lead found in this potential reservoir. The air ducts will only be sampled at the time of cleaning. No samples from ducts will be collected during the pre-cleaning, six month, or twelve month sampling events.

5.4.1 Air Duct Cleaning Equipment

A portable vacuum unit with a HEPA filter will be used to clean the air ducts by the professional contractor. The professional HVAC cleaning contractor will follow Source Removal methods in accordance with NADCA Standard 1992-01 (NADCA 1995). The portable vacuum unit along with its pieces and equipment will need to be decontaminated between each house. Decontamination procedures can be found under Section 5.7 Equipment Decontamination.

5.4.2 Air Duct Sample Collection Protocol

To provide consistency in the air duct dust sample collection and to ensure that the air duct filters are handled such that the sample volume is not compromised, the procedure below will be followed.

1. Using an indelible ink marker, label the outside of a collection box with "this side up," the sample number, house address, and date.

2. Prior to the air duct cleaning, the contractor will provide the clean, unused middle filter to TerraGraphics. The filter along with the box used to collect the filter will be weighed prior to any cleaning.

3. Following the cleaning, contents of the lint trap/first stage screen will be carefully emptied into the second stage/middle filter bag. The filter will then be provided to TerraGraphics for weighing and analysis.

4. The used filter will then be placed in the box and both will be weighed again to quantify the amount of dust cleaned from the home's air ducts.

5. The box will be taped securely in order to ensure no dust enters or escapes, then custody seals will be used to secure the box until the sample is collected. Care will be taken so the box does not get shaken or otherwise disturbed. The box will always be stored such that the correct side is facing up.

6. A sample tag (Figure 4) will be filled out for each air duct sample to be collected. The information on the tag will include the house identification number and site address. Comments relevant to the sample will be recorded in the comments section at this time. The tag will be taped to the box. The remainder of the tag will be completed when the sample is collected.

7. The box and filter will be brought to a secure location and carefully opened. A new pair of gloves will be used for each home's filter sample. Five subsamples will be collected from each filter. One subsample from each of the five loops in the filter. Each subsample will be collected by picking or scraping dust from the filter loop. Samples

will be placed in a 18 oz. Whirl-Pak® for shipment to the lab for lead analysis. Each subsample will be collected such that the fine dust is obtained along with the larger debris found in the filter. After collecting the subsamples, the box will then be taped, secured, and archived for possible future analyses. The rest of the sample tag will be filled out at this time and placed with the composite sample.

5.5 Attic/Basement Samples

A composite sample of the attic and basement dust gives a general representation of the lead concentration. A composite sample will only be collected from homes where the attic and/or basement is unfinished (i.e., not used for living space) and is accessible. If the attic or basement is used for living space, then it is assumed the vacuum bag sample will also represent that living area.

5.5.1 Attic and Basement Dust Sample Collection Protocol

Attic: Observe the attic and note the description in the log book. Each attic will be different, some will have a floor, some may just have insulation between joists, others might have extra insulation which covers the joists. Thus, each attic will be sampled and handled differently and professional judgement will be used to locate the area to be sampled. No samples will be obtained from insulation. A camel hair brush will be used to gently brush dust from a joist, a planking, or other hard surface of the attic area. The sample will be placed into an 18 oz. Whirl-Pak® with a fine stainless steel spatula or with the camel hair brush until enough sample is collected (approximately 1-2 grams). At least 4 subsamples will be collected or as many as needed to obtain sufficient volume. Each subsample will be approximately equal in proportion. The first 2-4 subsamples will be collected from around the entry to the attic, the next 2-4 samples will be collected from increasing radii from the initial subsamples. Caution will be exercised when moving throughout attics, only step on the joists or planks, and solid surfaces composed of ceiling materials will be avoided at all times. Subsamples will not be collected from an area that has been disturbed by the sampler while moving through the attic.

Basement: If the basement floor is finished with a hard surface (i.e., cement, wood, etc.), then a camel hair brush will be used to gently brush enough sample into the Whirl-Pak® in the same manner as the attic sample. If the basement floor is earth, then a stainless steel spoon and bowl will be used to collect at least 4 subsamples from the top inch of soil. The floor will be gridded so the subsample will be collected from the middle of each grid. Each subsample will be of the same proportion, placed into the bowl, mixed for homogeneity, and then placed into the Whirl-Pak®.

5.6 Window Sill/Well Dust Samples

Window wells and sills will be sampled with wipes by the HUD Risk Assessor contracted by the U.S. Army Corps of Engineers. Appropriate procedures from the HUD Guidelines will be followed for obtaining these samples. SAPs and QAPPs will be prepared in support of this sampling by the HUD Risk Assessor.

5.7 Equipment Decontamination

The following information describes the general decontamination procedures for field equipment that comes into contact with lead-bearing dust or soil. Non-disposable sampling equipment will be decontaminated between sample collection points to avoid contaminant migration and cross contamination between samples.

Field personnel will wear disposable gloves while decontaminating equipment at the project site. Personnel will be required to take precautions to prevent contaminating themselves with the wash water and rinse water used in the decontamination process.

The following procedures will be followed to ensure that sampling equipment is thoroughly decontaminated:

1. Visually inspect sampling equipment for dust or soil; a stiff brush will be used to remove any visible material.

2. Wash the field equipment with phosphate-free soap and water, rinse with distilled water, and air dry, dry with forced air, or wipe with disposable paper towels.

3. All disposable items such as paper towels, disposable gloves, and wet-wipes will be deposited into a garbage bag and disposed in a solid waste landfill.

Decontamination of BRM and vacuum equipment is described in the BRM floor dust sampling and dust mat sampling protocol sections.

5.8 Log Books

A field and lab log book will be maintained on a daily basis to document all sampling activities. All notes will be made in indelible ink. Entries on each page will be initialed at the end of each page by the sampling crew member who entered the information. If any changes are made to the record, the original notation will be crossed out with a single line and initialed.

At a minimum, log book entries will include:

- Date and time at the start of work and sampling conditions

- Names of sampling crew

- Project name and number

- Description of site conditions and any unusual circumstances

- Location of sample sites, including map reference

- Equipment identification

- Details of actual work effort, including deviations from the specified methods

- Time work terminated for the day

- Details of photo documentation, if any

5.9 Sample Identification (Field Sample ID Number)

Each sample location will be assigned a unique identification number, and each sample collected will have a unique identification code that will identify the home from which the sample was collected and the sample type. The field sample ID number will be coded as follows:

- The first two characters identify the project (HP= House Pilot)
- The third character represents one of the four sampling events (A= pre-cleaning sampling, B= post cleaning sampling, C= 6 month sampling, and D= 12 month sampling)
- Characters 5 and 6 identify the house number (01=first house visited, 02=second house visited, etc.)
- Character 7 indicates the type of sample (V - Vacuum Dust, M - Mat Dust, A - Attic Dust, B - Basement Dust, F - BRM Floor Dust, and D - Duct Dust)
- Character 8 indicates the location of the Floor Dust samples if applicable (L - Living Room, C - Children's Room, K - Kitchen Room)
- Characters 9 through 11 or 10 through 12 indicate a quality control sample if applicable (RB - Rinsate Blank, DUP - Duplicate, SPL - Split, STD - Standard)

Example: HPA-01-FL-DUP

5.10 Sample Tags and Labels

Samples and sample tags will be assigned serial numbers according to a predetermined sequence. Each sample will be tagged at time of collection. Duplicates, blanks, and special purpose samples will be identified in the "remarks" section of the tag and correspond to a specific identification code number. An example sample tag is presented in Figure 4.

After samples have been transferred to the sample bank, they will be assigned a lab sample number as they are recorded onto the master log (Figure 7). The bottom portion of the tag will be removed as the sample is banked and kept in the custody of the sample bank. Assigning laboratory identification numbers enables all of the samples, including duplicate samples and QC samples, to be submitted blind to the analytical laboratory. The banking process will ensure traceability of the samples from collection to analysis by cross indexing the field sample identification number with the lab sample number.

5.11 Sample Banking Procedures

The sample bank is the custodian for all records pertaining to the sampling, sample preparation, and shipment of samples to analytical laboratories. The responsibility of the sample bank extends to sample storage and dispensing containers, sampling equipment, and all custody documents (such as chain-of-custody forms and sample collection and analytical tags) as required. Other responsibilities include updating and maintaining the project's master log book, auditing the records as required, generating sample bank QC samples, scheduling the collection of all samples, and ensuring that all chain-of-custody requirements pertaining to all sampling, shipping, and banking operations are adhered to, as outlined below:

1. Issuing Supplies:

    - On a daily basis, or as appropriate, the sample bank will issue sample containers, sample tags, and chain-of-custody forms.

    - The sample bank will store sampling equipment in a suitable environment. Sampling equipment will be issued to the sampling teams on a daily basis or as required.

2. Accepting and Logging Samples:

    - Transfer of sample custody from the sampler to sample bank personnel will normally occur at the sample bank.

    - Before accepting custody of any samples, sample bank personnel must check all tags and forms for legibility and completeness.
        - All individual samples must be properly tagged.
        - Any discrepancy will be corrected before the sample bank personnel will assume custody. If a discrepancy exists that cannot be resolved to the satisfaction of the sample bank personnel, re-sampling, and/or filling out

additional tags and forms, may be required.

- After the sampler relinquishes custody and the sample bank personnel assume custody of the samples, each sample must be logged onto the master log form (Figure 7).

3. Sample documentation for all house dust pilot dust samples:

- All sample bank numbers for dust samples will be serially numbered, beginning with “001". The sample number will be prefaced with the year and the project (00HP). For instance, the first vacuum sample logged into the log book will be “00HP001"; the second vacuum sample number will be “00HP002", etc.

- After assigning and logging the lab sample number, record in the master log the lab sample number and all other information from the sample tag, including field sample identification number, the type of sample, the owner/resident, the street address, the town, the sample date, the sampler, and any relevant comments. Record the banking and data entry dates on the master log.

- After checking to ensure correctness, the bottom portion of the sample tag will be clipped from the sample. The upper portion of the sample tag, which has the lab identification number on it, remains with the sample. The bottom portion will remain in custody of the sample bank to allow cross indexing of the lab sample number and the field sample identification number.

- A chain-of-custody form (Figure 8) will be filled out, identifying the analytical laboratory to which the samples are to be sent, the project name and number, the work order number, the lab sample number of each sample in the shipment, the sample description (dust, water), the analysis type (Pb), and any relevant remarks concerning the sample.

- Remarks concerning the condition of a sample or other sample information can be useful, especially during data interpretation. Any appropriate information will be recorded in the log book.

- The following documentation forms and their disposition for each sample (e.g., 00HP001) from collection to the analytical laboratory is as follows:

<u>Form</u> <u>Disposition</u>

Sample Tag	Bottom Portion - Sample Bank Upper Portion - Analytical Lab
Master Log	Sample Bank
Field Log Book	Sample Bank
Chain-of-Custody Form	Original - Analytical Lab Copy - Sample Bank
Site Description Form	Sample Bank

5.12 Sample Transfer Procedures/Chain-of-custody

Customized chain-of-custody forms (Figure 8) will be completed by the sample bank for transferring the samples from the sample bank to the laboratory. The chain-of-custody forms will be used for a packaged lot of samples; several samples can be recorded on one form. More than one chain-of-custody form may be used for one package, if necessary. Chain-of-custody forms are used to document the transfer of a group of samples traveling together. If the group of samples changes, a new form will be initiated. The original chain-of-custody form always travels with the samples; the initiator of the record will retain a copy for the sample bank. In all cases, transfer of custody must be clearly documented. Samples are not to be left unattended unless in a secure area. The following procedures will be followed when completing a chain-of-custody form:

1. The originator enters the lab identification number on the chain-of-custody form.

2. The person receiving custody checks information on the sample bag and the sample tag against information on the chain-of-custody form. He or she also inspects sample condition and notes anything unusual under "remarks" on the form.

3. The originator signs in the "relinquished by" box.

4. The person receiving custody signs in the adjacent "received by" box and keeps the original; the sample bank keeps a copy.

The sample bank will retain copies and/or original shipping papers and other records pertaining to the shipment of samples. The person receiving custody will document discrepancies between sample tag numbers and custody record listings and will properly store the samples. The samples will not be analyzed until any problems are resolved by the field supervisor or project manager.

The responsible person receiving custody will attempt to resolve problems by checking all available information (other markings on sample container, type of sample, etc.). He or she will then document the situation in the project logbook and notify the on-scene coordinator as soon as possible. Any break in the chain-of-custody protocol that cannot be resolved to the satisfaction of the field supervisor and project manager will result in rejection of the sample. All resolved discrepancies must be supported by appropriate log entries.

Changes may be written in the "remarks" section of the chain-of-custody form and will be initialed and dated. The copy of this record will accompany the written notification to the field supervisor and project manager.

Custody seals (Figure 9) will be required when shipping samples by commercial carriers. The seals are narrow strips of adhesive tape used to demonstrate that no tampering has occurred. Each seal must be signed and dated when used. They are intended for use on sample transport containers that are not secured by a padlock. They are not intended for use on individual sample containers.

When a group of samples with its custody form is to be shipped by a commercial carrier, the shipper (e.g., sample bank personnel) accompanies the package to the carrier (e.g., Federal Express) so that, if requested, the number and identification of the samples in the container can be verified. The commercial carrier is not required to verify the contents of the shipping container.

The package will be closed with strapping tape and custody seals so that the carrier is transporting a secure container. The recommended procedure for custody seal use on shipping boxes is as follows:

1. Place samples and chain of custody forms in shipping container.

2. Close the container.

3. Place a signed and dated custody seal across the seam between the lid and the body of the shipping container.

4. Wrap strapping tape around the shipping container at least twice and in two different places. At least one wrap will cross the signed chain of custody seal.

The person receiving custody of shipped samples must document the condition of the strapped and sealed shipping box on arrival. The container must be checked to confirm that neither the tape nor the custody seals have been cut or otherwise tampered with. If the paper seal has been damaged in shipping, but it is clear that the shipping box has not been opened, further handling of the samples may proceed. If tampering is suspected, the designated sample custodian will notify the sample bank supervisor.

Figure 3 Site Description Form

SITE DESCRIPTION FORM

House Dust Mat Location

House ID # ________________ Placement Date ________ Sampler Initials ____

Vacuum Dust Collected? Yes No Pickup Date __________ Sampler Initials ____

Figure 4 Example Sample Tag

BUNKER HILL

SAMPLE TAG

Sample Type ______________________________

Analysis ________________________________

Lab ID# _______ __________________________

Lab ID# _____________ ____________________

Field Sample ID # _________________________

Location ________________________________

Analysis (Circle)

Metals ____________________________

Type (Circle)

Bore Profile

Auger Grab

Composite Other

Soil Vacuum Dust Mat Dust Water

Date ___/___/___

Time ________

Sampler _____ ____________________________

Remarks ____ ____________________________

Portion to be attached to sample sent to analytical laboratory

Portion to be retained in project files

Figure 5 Dust Mat Instructions

INSTRUCTIONS FOR DUST MATS

These mats are being placed in your home in an attempt to quantify the amount of lead carried into your home from soil and dust during daily activities. The mat will be placed near the main entryway to the home, and the location will be documented for our records. We will retrieve the mat in 20-30 days for vacuuming and subsequent analysis of the dust collected. All data obtained from the mats will be sent to you at no charge.

To collect data that represents the actual amount of soil and dust carried into the home, we ask that you follow a few rules regarding handling of the mat.

1. Please do not vacuum or clean the mat while it is in your home.

2. Please do not move the mat for any length of time. If the area under the mat needs to be cleaned then carefully set the mat to the side while cleaning takes place.

3. Do not allow children to play directly on the mat.

4. Do not use the mat to wipe your feet on. Continue to use the method you currently use for entering the home. For instance if you currently wipe your feet on an exterior mat before entering the house, then continue to do so.

If you have any questions about the mats, or are going to be away for an extended period of time, please feel free to call Kay or Jane, TerraGraphics, at 786-1206. We thank you in advance for your participation and cooperation.

Figure 6 Participant Sample Summary Sheet

House Dust Samples to be Collected for the House Dust Pilot Project

Your participation in this project is greatly appreciated. The data collected for each home from both cleaning treatments and the control homes are very important in determining whether interior cleanings will further reduce house dust lead concentrations in homes throughout the Bunker Hill Superfund Site.

The samples that will be collected from your home are:

1. A vacuum sample from your vacuum cleaner - we ask that the vacuum bag that is in your vacuum cleaner has not been used outside your home, such as in your car, or at a friend or relative's house.

2. A dust mat will be placed inside the main entrance to your home for about 3-4 weeks and will then be collected - instructions for the dust mat will be given to you.

3. BRM (vacuum) samples from 3 rooms - a special vacuum cleaner will be used to vacuum dust from the main areas of the living/family room, a child's bedroom, and the kitchen/entry way. ***It is extremely important that you do not vacuum these rooms at least two days before the sample is to be collected.***

4. If you have an unfinished basement and/or attic, a grab sample will also be collected from these areas. We will need to know where to access these areas.

5. A grab sample will be collected from the air ducts from the homes receiving the cleaning. These samples are collected from the air duct cleaner's equipment once the ducts have been cleaned.

We will be back in approximately 3 weeks to collect the dust mat, the vacuum cleaner bag (or sample), the BRM (vacuum) samples, and the attic/basement samples. We will call you at least 3 days before sampling is to take place.

If you have any questions or concerns please feel free to call Jane or Kay at 786-1206.

Figure 7 Mat Sampling Log

Page ______

Dust Mat Sample Log

Lab Sample Number	Field Sample ID Number	Sampliers Initials	Weight of Bag (g)	Weight of Bag + Dust (g)	Comments

Figure 8 Master Log

MASTER LOG

Project: House Dust Pilot Sampling 2000

LAB SAMPLE ID	FIELD SAMPLE ID	TYPE	STREET ADDRESS	TOWN	SAMPLE DATE	SAMPLER INITIALS	DATE ENTERED	COMMENTS
00HP001		DUST						
00HP002		DUST						
00HP003		DUST						
00HP004		DUST						
00HP005		DUST						
00HP006		DUST						
00HP007		DUST						
00HP008		DUST						
00HP009		DUST						
00HP010		DUST						
00HP011		DUST						
00HP012		DUST						
00HP013		DUST						
00HP014		DUST						
00HP015		DUST						
00HP016		DUST						
00HP017		DUST						
00HP018		DUST						
00HP019		DUST						
00HP020		DUST						

Figure 9 Chain of Custody Sheet

TerraGraphics
ENVIRONMENTAL ENGINEERING
121 S. Jackson Street
Moscow, Idaho 83843
(208) 882-7858 Fax (208) 883-3785

CHAIN OF CUSTODY RECORD

Page # ______

Proj. No.	Project Name					Analysis	REMARKS
TO:							
Sample No.	Sample Date	SAMPLE DESCRIPTION: Water	Soil	Sediment	Other		

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Relinquished By: (Signature)	Date/Time	Received for Sample Bank By: (Signature)	Date/Time	Remarks	

Custlog.p65

Figure 10 Custody Seal

CUSTODY SEAL	TerraGraphics Environmental Engineering, Inc. 121 S. Jackson St. Moscow, ID 83843 (208) 882-7858
SIGNATURE ______________________________	
DATE	

SECTION 6.0 HEALTH AND SAFETY

The Field Operations and Site Managers and Site Safety Officer will have, at a minimum, completed the OSHA approved 40-hour Health and Safety training course. Other personnel will be under the constant supervision of 40-hour trained personnel. Personnel will be monitored by the assigned site Health and Safety Officer. Personnel will have read and signed the site-specific Health and Safety Plan (HASP) prior to conducting any sampling. A copy of the HASP will be kept in the field office at all times for quick reference.

SECTION 7.0 QUALITY ASSURANCE PLAN

7.1 Purpose

An important part of an effective field investigation program is a definitive quality assurance (QA) program coupled with efficient use of personnel and physical resources. A comprehensive and well documented QA program is required to obtain data that are scientifically and legally defensible, and to meet the requisite levels of precision and accuracy.

This section addresses the major quality assurance/quality control (QA/QC) considerations and guidelines for the field and laboratory work to support the dust sampling program. The procedures and guidelines outlined in this document are based on TerraGraphics' standard QA/QC program and are consistent with the QA goals of this project which are to:

- Collect high-quality, verifiable data,
- Ensure cost-effective use of resources, and
- Ensure that data are usable for future actions.

7.2 Objectives For Measurement

The overall QA objective for data is to ensure that data of known and acceptable quality are provided. All measurements will be made to yield accurate and precise results representative of the media and conditions of interest. QA objectives for precision, accuracy, and completeness have been established for each measurement variable and are presented in Table 2.

The procedures and guidelines outlined in this document will be used to evaluate quantitative data that will be obtained during this investigation. Consistency in methods of sampling, analysis, data validation, data evaluation, and reporting will be a high priority. Data quality objectives for laboratory analyses will follow guidelines published in the *Test Methods for Evaluating Solid Waste, SW-846* (USEPA 1986) and *USEPA Contract Laboratory Program Functional Guidelines for Inorganic Analyses* (USEPA 1994).

Project reports will include a section or appendix on quality assurance review. The QA review will summarize field documentation, field audits, field duplicate sample and confirmational split results, field equipment blank and transport blank results, sample holding times, laboratory duplicate results, laboratory control standard (LCS) results, and laboratory blank results.

7.3 Data Quality Objectives

Consideration of data quality begins with the identification of data uses and data types. EPA Data Quality Objective (DQO) levels are defined as follows:

1. Level I - Field screening or analyses using portable instruments. Results are often not compound-specific and not quantitative, but are available in real-time.

2. Level II - Field analyses using more sophisticated portable analytical instruments. In some cases, the instruments may be set up in a mobile laboratory on site. There is a wide range in the quality of data that can be generated, depending on the use of suitable calibration standards, reference materials, sample preparation equipment, and operator training. Results are available in real-time or within several hours.

3. Level III - All analyses are performed in an off-site analytical laboratory. Level III analyses may or may not use EPA Contract Laboratory Program (CLP) procedures, but do not usually use the validation or documentation procedures required of CLP Level IV analysis. The laboratory may or may not be a CLP laboratory.

4. Level IV - CLP Routine Analytical Services (RAS). All analyses are performed in an off-site CLP analytical laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation.

Sample analyses for this project will meet the DQOs listed in Table 2 for each task.

7.4 Sampling Procedures

The quality of the data collected in an environmental study depends on the quality of the sampling activities. Field operations must be well conceived and carefully implemented. Detailed procedures and protocols for site selection and sample collection, handling, preservation, shipment, and storage must be specified and documented. The sampling program in Section 5.0 describes the proposed site selection, sampling procedures, and other field activities.

7.4.1 Sample Container Preparation and Preservatives

All sample containers will be prepared and provided by either a commercial vendor or the analytical laboratory. Samples will be preserved consistent with recommendations given in *Test Methods for Evaluating Solid Waste, SW-846* (USEPA 1986). Table 3 summarizes sample handling requirements, including number of samples collected, the proposed analytical parameters, recommended containers, sample preservation requirements, and holding times. The type and size of container used for each parameter and the type of preservative added, if any, will be recorded in the field log book.

7.4.2 Sample Handling

Sample containers will be kept closed and maintained under custody of a TerraGraphics employee until analysis. Samples will be labeled as they are collected. Sample collection data, including label information, will be recorded in the log book as the samples are collected. Samples will be placed in a stable container immediately after sample collection. Except for rinsate blanks, samples do not require preservation, so containers need only be adequate for

transportation and sealing with custody seals. Rinsate blanks will be placed in a hard shell container for delivery to the laboratory.

7.4.3 Quality Control (QC) Samples

Quality Control (QC) samples will be used to check the precision and accuracy of analyses completed by the analytical laboratory. The sampling team will strive to maintain uniformity in the sampling techniques and preparation of QC samples to limit potential sampling errors.

QC samples will consist of rinsate blanks, field duplicates, field splits, and lab standards. All samples will have coded sample numbers such that they are submitted "blind" to the analytical laboratory. These QC samples will be clearly identified in the field log book and master log.

One duplicate and one split dust sample will be collected and submitted for analysis for every 10 dust samples. One standard will be submitted for analysis for every 20 dust samples. One duplicate and one standard mat will be placed and sampled for every 5 mat dust samples collected. One rinsate blank will be collected per day from selected batches of decontaminated sample equipment during the project. The QC samples will be defined as follows:

1) Duplicate vacuum dust, floor dust, attic/basement dust, and duct dust samples will consist of a second sample collected in the same manner as the original.

2) A dust mat duplicate will be composed of a second mat placed and handled in the same manner as the original.

3) Split vacuum dust, floor dust, attic/basement dust, and duct dust samples will be composed of one-half of a dust sample that has been homogenized in the field. No dust mat splits will be collected.

4) A standard with a known lead concentration will be submitted to the laboratory as a blind field sample. A mat dust standard will consist of a pre-loaded mat handled in the same manner as a field sample.

5) A rinsate (equipment) blank will be a de-ionized or distilled water rinse over decontaminated sampling equipment, collected into a sample bottle.

Table 4 Data Quality Objectives for Measurement

Variable	Matrix	Units	# of Samples (includes QA/QC)	DQO Level	Limit of Detection [a]	Accuracy	Precision (RPD)[b]	Completeness	Method	Reference [c]	Maximum Holding Time
Pb	Vacuum[e] Dust	mg/kg [d]	76	III	2 mg/kg	±20%	±30%	90%	Extraction and/or digestion ICP or FAA	SW-846	6 months
Pb	Mat[e] Dust	mg/kg[d]	76	III	2 mg/kg	±20%	±30%	90%	Extraction and/or digestion ICP or FAA	SW-846	6 months
Pb	Floor[e] Dust	mg/kg[d]	225	III	2 mg/kg	±20%	±30%	90%	Extraction and/or digestion ICP or FAA	SW-846	6 months
Pb	Duct[e] Dust	mg/kg[d]	20	III	2 mg/kg	±20%	±30%	90%	Extraction and/or digestion ICP or FAA	SW-846	6 months
Pb	Attic/ Basement[e] Dust	mg/kg[d]	150	III	2 mg/kg	±20%	±30%	90%	Extraction and/or digestion ICP or FAA	SW-846	6 months
Pb	Rinsate Water	ug/l	20-30	III	5 ug/l	±20%	±30%	90%	ICP or FAA	SW-846	6 months

a) Detection limits will be elevated if matrix interferences are a problem.

b) (RPD) Relative Percent Difference

c) SW-846 provides routine analyses for these substances.

d) Dry-weight basis

e) Samples are screened to - 80 mesh size fraction prior to analysis.

Table 5 Sample Handling Requirements

Parameter	Sample Matrix	Anticipated # of Samples Collected [a]	Sample Container Volume Required	Preservation Technique	Maximum Holding Time [b]
Inorganic Elements	Vacuum Dust	76	1 Two Gallon Sized Ziploc® Bag	None	6 months
Inorganic Elements	Mat Dust	76	1 Quart Sized Ziploc® Bag	None	6 months
Inorganic Elements	Floor Dust	225	1 8 oz Nalgene® Bottle	None	6 months
Inorganic Elements	Duct Dust	20	1 18 oz. Whirl-Pak® bag	None	6 months
Inorganic Elements	Attic/Basement Dust	150	1 18 oz. Whirl-Pak® bag	None	6 months
Inorganic Elements	Water	20-30	1 0.5 liter polyethylene bottle	$HN0_3$ to pH <2.0	6 months

a) Includes QA/QC samples

b) Maximum holding time prior to extraction

7.4.4 Changes In Procedures

Any changes in the sampling procedures as outlined in either the Sampling and Analysis Plan (Section 5.0) or the Quality Assurance Plan will be documented and described in the field log book. Approval from the TerraGraphics project manager or the field operations manager will be required to implement on-site changes. Major modifications of the sampling design or procedures must be approved in advance by the TerraGraphics project manager.

7.5 Sample Custody

Sample custody is a vital aspect of field investigation programs that generate data for possible regulatory action. The traffic records for samples must be traceable from the time of sample collection until the time the analytical laboratory reports the results of chemical analyses to the appropriate parties.

7.5.1 Field Operations

The key aspect of documenting sample custody is thorough record keeping. A log book will be maintained on a daily basis to document all field and lab activities, including the collection of every sample and field survey information associated with each sampling location. All notes will be made in indelible ink. Each day's entries will be initialed and dated at the end of each day by the sampling crew member who entered the information. If any changes are made to the record, the original notation will be crossed out with a single line and initialed.

Log books will remain with the sampling crew at all times during the work day. Upon completion of the sampling, log books will be filed in a secure manner and kept on file at TerraGraphics for a minimum of five years.

Sample containers will be labeled with secure sample tags prior to or immediately following the time of sampling.

At the time of sampling, the appropriate sample containers will be selected, and the appropriate field identification number will be recorded in the log book. Samples will then be placed in a container. At the end of each day on which samples were collected, and prior to transfer to a laboratory, chain-of-custody documentation will be completed for each sample. The chain-of-custody will be used to document sample custody and to identify the type of analyses required for a particular sample. Information on the sample tags will be verified to ensure that the information provided is consistent with information on the chain-of-custody form and in the field log book.

7.5.2 Chain-of-Custody

Once a sample is collected it will remain in TerraGraphics' custody until shipment to the laboratory. If this is not possible, samples will be stored in containers with signed custody seals and kept in a secure area. Upon transfer of sample possession to subsequent custodians, a chain-of-custody form will be signed by the persons transferring custody of the sample containers. Signed and dated chain-of-custody seals will be placed on all containers prior to shipping. Upon receipt of samples at the laboratory, the shipping container seal will be broken and the condition of the samples will be recorded by the laboratory custodian. Complete chain-of-custody records will be included in the analytical report prepared by each laboratory. TerraGraphics will retain copies of the chain-of-custody records on file.

7.5.3 Shipping

Dust samples and rinsate blanks will be delivered to the analytical laboratory or archived within 10 days of collection. Mat dust samples will be shipped or hand-delivered to the analytical laboratory within ten working days of collection, if not archived. Packaging and shipment will follow the procedures listed below:

- Sample containers will be preserved (water samples only) and transported in a sealed, insulated cooler or similar container;

- All sample shipments will be accompanied by a chain-of-custody/laboratory analysis request form. The completed chain-of-custody form will be sealed in a plastic bag and taped to the inside lid of the container; and

- Signed and dated chain-of-custody seals will be placed on all containers prior to shipment.

7.5.4 Laboratory

The sample custodian at each laboratory will sign the chain-of-custody record upon receipt of the samples. The condition of each sample container received and questions or observations concerning sample integrity will be recorded on the form. The custodian will also maintain a sample-tracking record that will follow each sample through all stages of laboratory processing. The sample-tracking record must show the dates of sample extraction or preparation and sample analysis for each sample. These records will be used to determine compliance with specified holding times.

7.5.5 Archived Samples

Sample container preparation, sample handling, and sample documentation procedures for archived samples will be identical to the procedures used for samples sent to the laboratory for analysis. Samples will be archived at TerraGraphics' warehouse in Moscow or Kellogg, Idaho.

7.6 Analytical Procedures

This section details the procedures used for analysis and quality control for all the samples obtained in the field.

7.6.1 Laboratory Analyses

Samples will be prepared by sieving through U.S. number 80 mesh sieves and then analyzed for lead using methods detailed in the most current edition of *Test Methods for Evaluating Solid Wastes*, SW-846 (USEPA 1986). Samples will be digested in accordance with SW-846 method 3050. After digestion, all samples will be analyzed for lead by flame atomic absorption spectrophotometry (Flame AA) or inductively coupled plasma (ICP) in accordance with SW-846 method 7420.

The Quality Assurance Plan used by the analytical laboratory will be obtained and examined by TerraGraphics. The plan will provide details on relevant equipment, personnel, QA/QC checks, and other elements necessary to the QAP. Any QC or procedural details not specified in the laboratory's Quality Assurance Plan will follow the protocol described in *Test Methods for Evaluating Solid Waste, SW-846* (USEPA 1986).

7.7 Calibration Procedures and Frequency

Calibration procedures, calibration frequency, and standards for measurement variables for laboratory equipment will be in accordance with the protocol described in SW-846.

7.8 Internal Quality Control Procedures

The laboratory will follow internal QA/QC procedures as outlined in their most current QAPs.

The laboratory will use Level III reporting, which includes dedicated QC on the samples submitted and a separate laboratory QC report, but does not include the rigorous QC reporting required for CLP analysis. The data will be evaluated by TerraGraphics based on the following criteria (as appropriate for inorganic chemical analyses):

- Performance on method tests:
    - Blanks
    - Precision and accuracy of calibration, laboratory control samples, and matrix spikes
- Adequacy of detection limits obtained

7.9 Data Management

This section addresses issues related to data sources, data processing, and data evaluation. Raw data generated in the field or received from analytical laboratories will be validated in the office, entered into a computerized data base, and verified for consistency and correctness. Computers used for data management will be PC desktop or portable (IBM compatible). DBase V and Excel software will be used for data storage and calculation.

The laboratory will fax completed analytical results to TerraGraphics Environmental Engineering. Results will also be provided electronically and can be accessed by modem. An account and password will be set up with the lab, and the results will be available for downloading in the format specified for 180 days after they are first made available. Once accessed for the first time they will be available for another seven days. Using this system will avoid time consuming and error prone data entry by hand.

7.9.1 Data Validation

Criteria for analytical data validation/verification include checks for internal consistency, transmittal errors, laboratory protocol, and laboratory quality control. Quality control sample results and information documented in field notes will be used to interpret and evaluate laboratory analytical results.

Laboratory validation procedures will conform, where applicable, to the *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses* (USEPA 1988). Data validation will incorporate the following elements:

- Proofing analyses requested with analyses performed;
- Preliminary data proofing for anomalies with investigation and corrections where necessary and possible;
- Proofing laboratory data sheets and check-in sheets for detection limits, holding times, sample container condition, etc.; and
- Double checking computerized data entry.

Information supplied by the laboratory, in addition to raw data, is summarized in Table 4.

Table 6 Recommended Documentation for Independent QA Review of Data on Inorganic Substances

Analysis of the requested inorganic compounds will be reported as follows:
! Sample concentrations reported in mg/l or mg/kg dry weight basis as appropriate
! Method (FAA, ICP) and method detection limit
! Method blank data associated with each sample
! Field duplicate, confirmational split, and associated control sample results
! Summary of all deviations from the prescribed quality control objectives
! Background corrections used (e.g., Zeeman)
! A statement of any problems associated with the analyses or deviations from quality

7.9.2 Evaluation of Data Precision, Accuracy, Representativeness, Completeness and Comparability

Routine procedures to be used for measuring precision and accuracy include use of procedural blanks, laboratory control samples (LCS), duplicate analyses, and standards. The minimum frequencies are as follows:

- Blanks - One preparation blank will be analyzed for each digestion batch.
- LCS - One LCS will be analyzed for each digestion batch.
- MS/MSD - One MS/MSD will be analyzed for each digestion batch.
- Duplicates - One duplicate will be analyzed for every 10 samples.
- Standards - One soil standard with a known lead concentration will be submitted for every 20 field samples.

In addition, one in every 10 samples collected in the field will be a duplicate sample. These samples will be submitted blind to the analytical laboratory. Quality assurance goals for precision, accuracy, representativeness, completeness, and comparability (PARCC) have been developed for all analytical parameters identified in this work plan. Specific PARCC categories for this project are defined as follows.

Precision

Precision is a measure of data variation when more than one measurement is taken on the same sample. The precision estimate for duplicates is expressed as the relative percent difference (RPD):

$$RPD = \frac{(C_1 - C_2)\ x\ 100\%}{c}$$

where: C_1 = concentration for duplicate #1
C_2 = concentration for duplicate #2
c = mean concentration

Acceptable precision limits are based on past data bases, as defined by the USEPA. Laboratory duplicate measurements will be obtained for each set of samples submitted and analyzed. The acceptable range for RPD in this study is ±30%.

Accuracy

Accuracy of laboratory analysis is assessed by measuring a standard reference material. Standard reference materials are utilized to calibrate laboratory measurement instruments.

Accuracy is expressed as percent recovery:

$$SRM\ Percent\ Recovery = \frac{Reported\ Conc.}{Actual\ Conc.}\ x\ 100\%$$

Acceptable recovery limits are based on past data sets as defined by USEPA.

Representativeness

This term expresses the degree to which the data accurately and precisely represent actual conditions or characteristics of the site. For this study the acceptable range for spike recovery is ±20%.

Completeness

Completeness is an estimate of the amount of valid data obtained from the analytical measurement system for a given set of data. The percent completeness is defined as the number of samples analyzed that meet the data quality goals divided by the total number of samples analyzed, multiplied by 100. The completeness goal for this project is $\geq 90\%$.

Comparability

Using standard EPA accepted protocols, all matrix-specific samples will be collected, processed, and analyzed at sufficient detection limits, precision, and accuracy for correlation with previous available data.

7.9.3 Data Reduction

As an extension of the data evaluation program, data will be reduced in order to statistically describe particular data sets. In addition, geostatistical techniques, such as kriging, may be applied to testing results. These techniques will aid in determining the representativeness, comparability, accuracy, and completeness of the data sets. The reduced data sets will be used in reporting the overall accuracy of the assessment; however, full data reports will be appended or held on file as necessary for documentation.

7.9.4 Corrective Actions

Corrective action measures generally lie within three areas of project management:

1. Concerns associated with sample collection, sample handling, and equipment failures;

2. Data processing, data management, and/or data analysis; and

3. Non-conformance or non-compliance of analytical laboratories with QA requirements.

The TerraGraphics project manager will be kept informed of all potential quality assurance problems by the project team. The project manager will be notified immediately should a field or laboratory QA problem arise that could jeopardize the use of collected data. Corrective action will be taken by the project manager when field methods are determined to be inappropriate or analytical data are found to be outside predetermined limits of acceptability. The data set of concern will be flagged and evaluated accordingly. Corrective actions may include procedural changes, re-sampling and/or additional data collection, additional performance and system audits, meeting with laboratory personnel, and, in extreme cases, obtaining a new subcontractor. The State will be informed of potential QA problems as early as possible. The State will be notified via technical memorandum should corrective action become necessary.

7.10 Preventive Maintenance

Preventative equipment maintenance is essential if project resources are to be used cost-effectively. Preventive maintenance comprises two principal elements:

- A schedule for preventive maintenance activities to minimize downtime and ensure accuracy of measurement systems, and

- Availability of critical spare parts and backup systems and equipment.

The preventive maintenance approach for certain instruments or equipment used for sampling and monitoring will follow manufacturers' specifications and sensible field and laboratory practices. The maintenance procedures performed will be documented in the field log book, as appropriate.

SECTION 8.0 REFERENCES

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APPENDIX A
HOUSEHOLD DUST MAT QUESTIONNAIRE

2000 House Dust Pilot Household Mat Questionnaire

[Interviewer: Pick the mat up first! Then complete this questionnaire on all households in which a mat is picked up.]

Mat Retrieved? _____ Date __________ Vacuum Bag?______

House ID #:	**Date:**	**Interviewer Initials:**
Name:		
Street Address: **Mailing Address:**		
Phone Number: (208)		

Questions About the Mat

1. Did you vacuum the mat?

1 yes 2 no 9 don't know

2. Did you pick up or shake the mat----how many times?

1 only once
2 2-4 times
3 More than 4 times
9 None

3. Did you move it from its original location to a new location?

1 yes 2 no

4. Did the mat get wet?

1 yes 2 no

5. Did the mat get physically damaged: by animals or otherwise?

1 yes 2 no

6. How many days did you go on vacation/ stay away from the house since the mat was placed?

1 never
2 ____days

7. How many hours per day does the most active or oldest child spend outside?

	hours (summer)	hours (winter)
Oldest or most active Child:	____	____

8. Do you have dogs or cats or any other pets that go in and out of the house? How many?

1 yes, 1 animal
2 yes, 2 or more animals

4 no
9 Don't know

9. Did the pets regularly use the door at which the mat was placed?

1 yes 2 no

10. Was the yard (or ground immediately surrounding this residence) or the inside of this home flooded in recent years?

1 yes 2 no 9 don't know

11. Is there a daycare run out of this home?

1 Yes 2 No

If yes, go to question 12. If no, go to question 14.

12. How many children are on site each day?

1 1-4
2 5-8
3 9-16
4 >16
9 don't know

13. For how many days each week?

1 1-2
2 3-5
3 6-7
9 don't

14. Children's on site or adjacent play areas:

Location	**Condition**
Sandbox	_____
play area or day care	_____
Neighbors	_____
Vacant Lot	_____
Hillsides	_____
Relatives	_____

Condition codes:
1= grassy, clean, no dirt,
2= some dirt, remediated, partly grassy,
3= moderate amount of dirt, gravel, dust,
4= area is almost or totally dirt, garden, all gravel, riverbed

9=N/A

15. Do any members of the household participate in any dirt-intensive summer activities?: (following are examples, or add to list)

dirt biking 4-wheeling mountain biking

mudding boating camping

Total number of activities____________.

16. Has any member of this household been employed in one or more of these jobs during the last 3 months?

		Yes	No	Unknown
milling or concentrating ore	1	2	9	
carpentry or remodeling work	1	2	9	
foundry work		1	2	9
professional plumbing/plumber	1	2	9	
mining	1	2	9	
landscaping/excavation	1	2	9	

17. Within the last 3 months has any member of this household done any of the following activities in this home more than once:

		Yes	No	Don't Know
painted pictures with artist's paints?	1	2	9	
sanded parts of the house or furniture?		1	2	9
worked with stained glass or made metal jewelry?		1	2	9
cast lead into fishing sinkers, bullets or anything else?		1	2	9
worked with soldering in electronics or plumbing?	1	2	9	
worked in a vegetable or flower garden around the home?	1	2	9	
made pottery?		1	2	9
made tole paintings?		1	2	9

The following blanks are to be filled out by the interviewer upon inspection of the home.

Condition of paint:
Look at:

Inside:	1	good condition	2	chipping, chalking, peeling or bite marks
Outside:	1	good condition	2	chipping, chalking, peeling or bite marks

Rate the grass coverage in yard?

1 mostly soil/dirt 2 mostly grass

Interviewer: Rate General Household Hygiene

1 poor, a lot of noticeable dust, odor, dirt 2 good

FINAL

Interior House Dust Pilot Cleaning Work Plan

Submitted by:

TerraGraphics Environmental Engineering
121 S. Jackson St.
Moscow, ID 83843

Submitted to:

State of Idaho
Dept. of Environmental Quality
Boise, ID

August 2000

Table of Contents

SECTION 1.0 INTRODUCTION

1.1 Background and History

Interior dust lead concentrations have been monitored annually at the Bunker Hill Superfund Site for more than ten years (TerraGraphics 2000a). As part of the Record of Decision (ROD) (EPA 1991, 1992), a Remedial Action Objective (RAO) was established for dust lead concentrations. The ROD states that "*all homes with house dust lead concentrations equal to or exceeding 1000 ppm will have a one time cleaning of residential interiors after completion of remedial actions that address fugitive dust. If subsequent interior house dust sampling indicates that house dust lead concentrations exceed a site wide average of 500 ppm lead, the need for additional cleaning will be evaluated*" (EPA 1991). The rationale for this derived from a 1990 pilot cleaning study in which several homes at the site received comprehensive interior cleaning, yet carpets in the home became recontaminated within one year (CH2M Hill 1991). As a result, it was determined that home interiors could not be permanently remediated until exterior contamination sources were addressed. Because interior dust lead concentrations are highly correlated with exterior soil lead concentrations, the cleanup at the site has focused on reducing yard and community soil lead concentrations to the soil RAO, which is "*to achieve community mean soil lead concentrations of approximately 350 ppm by removal of soils exceeding the threshold level of 1000 ppm lead*" (EPA 1991). House dust lead concentrations were expected to subsequently decrease as the exterior-to-interior path was reduced. Studies monitoring interior dust lead concentrations indicate that this reduction is indeed occurring, but interior cleaning may still be necessary to further reduce dust lead concentrations (TerraGraphics 1997, 2000a). This feasibility Pilot Cleaning Project details a plan to respond to this mandate under the ROD.

Smelterville is the only community within the site where soil remediation is complete, and soil RAOs have been achieved (TerraGraphics 1999a, 2000b). Interior dust data from the 1998 Panhandle Health District (PHD) sampling season indicate that mean dust lead levels for Smelterville are slightly higher (570 mg/kg) than the RAO with 10% of the homes exceeding 1000 mg/kg (TerraGraphics 1999b). Results of the 1999 PHD interior dust data for Smelterville reveal a geometric mean lead concentration of 595 mg/kg with 30% of the homes exceeding 1000 mg/kg (TerraGraphics 2000c). Recent data indicate that lead levels are nearing the RAO in Smelterville, although the objectives have not been completely achieved. One possible explanation, along with others discussed below in Section 1.2, 1.3, and 1.6, is that residual smelter dust has remained in reservoirs within homes.

1.2 Sources of Lead in House Dust

There are numerous sources of lead in the environment. Many of these sources contribute directly or indirectly to house dust. At the BHSS, lead has been released to the environment principally by historic mining, milling, smelting activities, and product usage (i.e., paint and gasoline additives). These contaminants have settled in soil and dust repositories in or near residential areas and continue to contribute to house dust. The primary residual contamination sources include area soils and dust and interior and exterior paint found at homes.

Investigators generally agree that exterior sources, such as soil and street dust, become entrained in house dust via airborne routes or tracking of these exterior media into the home. Interior lead based paint contributes directly to house dust inside the home through chalking and chipping of the paint. Recent studies have been undertaken to apportion exterior and interior lead-containing media as sources of house dust lead. Adgate et al. (1998) confirmed findings from other studies showing that outdoor lead-containing media (i.e., soils and street dust) are large sources of lead in house dust. Using a chemical mass balance method, their findings suggest soil and street dust contribute approximately two thirds of lead mass in house dust, while lead based paints largely account for the other third. Using scanning electron microscopy, results from a study by Hunt et al. (1992) suggest that paint, street dust, and garden soil are the major sources of lead in house dust. Other research performed in Christchurch, New Zealand, apportioned lead in house dust to paints (45%), soil (3-5%), street dust (15-20%), and settled aerosols (15-25%) (Fergusson and Schroeder 1985). The Cincinnati Lead Study explained fifty-two percent of the variation in surface house dust lead concentrations by interior lead in paint and exterior surface dust lead (Bornshein et al. 1986).

1.3 House Dust Sampling Methods

There is no clear consensus on the most appropriate methodology for sampling house dust. Historically, lead concentration (µg/g) in house dust has been the most common measurement. Generally, sampling methodologies collect dust in a solid matrix form by vacuum or surface wipe techniques and report results in mass of lead/area. Current efforts are focusing more on measurement of lead loading (e.g., $\mu g/ft^2$) or loading rates (e.g., $mg/m^2/day$). Collecting loading versus concentration measurements greatly affects sampling methodology. To determine concentrations, only a sufficient quantity of dust must be collected. However, to determine loading, dust must be collected from a specific area and/or time period. No standard or universally accepted house dust sampling technique has been developed to assess dusts inside the home. There is a general consensus, however, that the interior of the house serves as a reservoir for lead, especially soft surfaces (i.e., carpets and furniture), and that these media are most difficult to sample (CH2M Hill 1991, Adgate et al. 1995).

Methods developed to sample house dust vary among researchers. Vacuuming techniques and wipe methods have been studied. Lanphear et al. (1995) compared three dust collection methods in a side-by-side approach. The objectives of the study were threefold: i) to statistically determine whether lead loading or concentration was a better predictor of children's blood lead levels, ii) to statistically determine which dust collection method was a better predictor of children's blood lead levels, and iii) to determine which surface location within the home should be consistently sampled. Lead loading ($\mu g/ft^2$), as opposed to lead concentration (µg/g), showed a significantly higher correlation with children's blood lead levels. Of the three methods compared (wipe, Baltimore repair and maintenance

(BRM), and dust vacuum method (DVM)), the BRM and wipe methods were more highly correlated with children's blood lead levels.

The effectiveness of vacuum dust collection methods depends on many factors, such as vacuum suction rate, carpet type, and lead distribution in the carpet. A study to determine relationships between wipe and vacuum collection methods observed difficulties with an in-line filter vacuum collection device containing a mixed cellulose ester filter and support pad attached to the air mover. Sample losses were noted due to the nozzle attracting dust particles to the rim and inner surface, the nozzle visibly pushed particulate matter beyond the edges of the sampling template, and visible particles and paint chips remained on sample surfaces after vacuuming (Farfel et al. 1994a). The same vacuum collection device (as the one discussed in Farfel et al. 1994) showed the poorest percent collection efficiency in a study comparing three different vacuuming collection devices (Lim et al. 1995). In that study, Lim et al. showed that two of the three vacuum dust collection methods (Blue-nozzle and cyclone dust collectors) had greater than 85% collection efficiencies for all smooth and hard surfaces (1995). However, collection efficiencies for carpeted surfaces were less than the 85% collection efficiency goal. A study by Bero et al. (1997) confirms the need for uniformity and reproducibility when sampling for lead in house dust. Under controlled laboratory conditions, three carpet types and six vacuum cleaner devices were tested for efficacy using three different soil lead concentrations. Mass removal efficiencies were greater for high volume vacuum devices than for low volume devices, ranging from 50%-65% and 4%-19%, respectively.

1.4 Sampling Location

A standard protocol for sampling interior dust predictive of childhood blood lead levels has not yet been promulgated, although the USEPA Technical Review Workgroup for Lead has identified this as a risk assessment priority. Some researchers have investigated different sampling areas inside the home, but have yet to agree on a standard house dust sampling location. Lanphear et al. (1995) suggest sampling non-carpeted floors and interior window sills or window wells as standardized sampling locations (using the BRM or wipe methods). Others have suggested that carpeted floors better represent exposures inside the home. Kim and Fergusson (1993) claim that carpeted floors make better sampling surfaces than hard surfaces because the dust on hard surfaces can move around easier, creating areas that may be unrepresentative of the dust lead in the house. According to a recent analysis of twelve epidemiological studies, floor dust lead loading was determined to be the best environmental predictor of children's blood lead levels (Lanphear et al. 1998). These studies illustrate how important floor surfaces are to the sampling of house dust. Floor surfaces representing the area of the house where a child spends most of his/her time, or a composite of those areas (Farfel and Rohde 1995), will likely be the most useful for risk assessment purposes.

1.5 Standards for House Dusts

The USEPA to date has not defined a house dust lead standard. However, the U.S. Department of Housing and Urban Development (HUD) has set post-abatement clearance standards for lead in house dust: 100 Fg/ft^2 for floors, 500 Fg/ft^2 for interior window sills, and 800 Fg/ft^2 for window troughs, all using the wipe dust collection method (HUD 1995, Lanphear et al. 1998). The USEPA has recently adopted HUD's clearance standards as interim guidance levels for residential interior lead dust. However, the clearance standards are not risk-based and may not be protective of human health.

1.6 Previous House Dust Remediation Studies

Although HUD has promulgated lead-based paint abatement guidelines (HUD 1995), a review of house dust remediation projects accomplished at other lead sites suggests there is no universally accepted methodology for house dust lead abatement or remediation. Much of the difficulty in implementing permanent and effective remediation of house dusts is related to the ultimate sources of the lead in dust. This is because homes, and particularly carpets and soft surfaces, are large reservoirs for house dust that subsequently serve as common exposure vehicles to young children. Effective reduction of house dust lead levels requires control of both the reservoir and those exterior and interior sources contributing lead to house dust.

The Bunker Hill Superfund Site (BHSS) strategy for addressing house dust contamination was to make maximum effort to minimize exterior soil sources through remediation of residential soils, parks, playgrounds, commercial properties, roadsides and industrial areas throughout the Site. This cleanup was effected on the fastest, practicable schedule determined in negotiation between the USEPA and the Site PRPs. In the meantime, monitoring of both children's blood lead levels and house dust lead concentrations is conducted through the local health department, and follow-up services are offered to those children exhibiting high concentrations. HEPA vacuums are also available to the local residents and individuals are reminded of the importance of good personal and home hygiene through education and outreach programs.

The 1990 CH2M Hill pilot cleaning study at the BHSS cleaned six homes by removing and replacing the main living area carpet and one piece of upholstered furniture (CH2M Hill 1991). Prior to removal, carpets and furniture were vacuumed and steam cleaned up to three times. Floors were wet washed after removal of the carpet. Sampling of the removed carpets and furniture indicated that most of the lead was found in the carpet rather than the pad or underlying floor. Average lead loading decrease was 8% for carpets and 18% for furniture. This study indicated that the cost of cleaning approximately equaled the cost of replacing the materials. Subsequent dust lead monitoring at these homes showed that dust lead concentrations one year later were similar to both pre-remediation levels and other un-remediated homes in the community.

A brief summary of previous studies and reports of clean-up efforts involving interior remediation of house dusts applicable or similar to the BHSS is discussed below. This review does not include efforts relating to sampling methodologies, dust speciation and source apportionment, or any studies investigating dust / blood lead relationships. However, in most studies, the critical study endpoint is usually the blood lead level and not the dust lead concentration or loading variable. This is likely because the sampling methodology for blood lead testing is fairly straightforward, while sampling methods for interior house dusts vary widely across studies, rendering comparisons difficult.

A study at a site similar to the BHSS was the 1984–1992 study by Calder et al. (1994) at Port Pirie, South Australia. This site has an active lead smelter with significant rail traffic and ore/tailings spills throughout the community due to historical use of tailings and slags. Since 1984, air lead concentrations have ranged from 1.5 Fg/m^3 to 8 Fg/m^3. Community-wide remedial efforts at the site during this time consisted of education, placing soil barriers, replacing soil that had lead concentrations greater than 5000 mg/kg, planting grass, paving dirt areas, baghouse improvement, worker hygiene control, a taller stack, slag pile covering, surface watering and vehicle washing at the smelter. Individual home remedial efforts included exterior surface cleaning, removal of lead-based painted surfaces and replacement, or repainting. Interior dust abatement consisted of lead-based painted surface covering, removal and replacement, or repainting, vacuuming of the ceiling, sealing of cracks, and cleaning of carpets and furniture. Home remedial efforts were based upon the resident child's blood lead level. In general, a 20% reduction of blood lead levels was seen during this program; 42% of the children tested had blood lead levels >20 Fg/dl in 1984; in 1991, 18% of children reported blood lead levels >20 Fg/dl.

Phase II Results from the Boston Lead-in-soil Demonstration Project concluded, "children living in apartments with consistently elevated floor dust lead loading levels derived almost no benefit from the soil abatement," because that "eliminated only one of many sources of interior dust lead" (Aschengrau 1994). As a result, many attempts to remediate house dusts result in only short-term reductions. Investigators and public health authorities often debate whether it is more practical (considering the results and costs of remediation) to replace or clean carpets and furniture in contaminated homes. For example, Ewers et al. (1994) believe an exposure source may be reintroduced after remediation by placing items contaminated prior to lead abatement back in the house. Repetitive experiments conducted by Ewers et al. suggested that cleaning "chronically contaminated" carpets might actually increase lead exposure, whereas cleaning of "acutely contaminated" carpets may be effective in reducing exposure. Several studies reported that deleading is associated with a significant "transient" elevation of blood lead level in many children (Amitai et al. 1987, 1991). In the case of carpet remediation, not conducting vacuum cleaning for a sufficient time could increase the amount of the lead dust at the surface, that is the most accessible by children (Ewers et al. 1994, Adgate et al. 1995).

Two other pertinent studies were the 1988–1989 study by Langlois et al. (1996) and the 1989 study by Concord Scientific et al. (1989) at the South Riverdale, Toronto site. This community is the site of an operational secondary lead smelter. Soil remediation occurred during 1988 if the soil lead concentration was >500 mg/kg; soil was replaced to a depth of 30 inches. Interior dust remediation occurred in 1989; 1000 homes were cleaned. Ducts were HEPA vacuumed; walls, sills, all horizontal surfaces, moldings, trim, window coverings, basement ceilings, floors and upholstered furniture were suction (only) vacuumed with exhaust to the exterior during vacuuming; walls, sills, moldings, trim, floors, carpets and upholstered furniture were washed twice with a trisodium phosphate detergent. Sampling by the dust vacuum method during the interior remediation indicated that 50%-60% of the interior house dusts were from exterior soil and that vacuuming removed 42% of the lead from floors, 16% from horizontal surfaces, 30% from ducts; wet washing removed 1% of the lead removed from floors, 7% from carpets, 3% from walls and 1% from upholstered furniture. Lead loading decreased from 9 mg/m^2 to 4 mg/m^2 during the study. Dust concentrations and lead loading remained lower at a repeat sampling four months after the remediation. In general, blood lead levels at the site decreased from 14 Fg/dl to 4 Fg/dl during the 1988–1992 period; overall Ontario blood lead levels decreased from 12 Fg/dl to 4 Fg/dl during that time. Analysis indicated that without remediation, blood lead levels would have reached 7 Fg/dl in that time period. During the study period, site-wide blood lead levels decreased faster than controls.

Another study occurred from 1991-1996 at an active lead smelter site in Trail, British Columbia (Hilts 1995). At that time, smelter emissions averaged 300 kg/day; soil lead concentrations ranged from 700 mg/kg to 800 mg/kg over 1977–1992. Community-based remediation included education, ground cover, street cleaning, road dust abatement and paving dirt areas. Individual home remediation at the site included placing of entrance mats, new sandboxes, housecleaning supplies (vacuums, mops, buckets, detergent) for vacuuming and wet mopping, and a HEPA vacuuming program of floors every six weeks for ten months. Sampling during the HEPA vacuuming program was by the DVM method; carpet lead and dust loading were reduced by 40%-50% after each cleaning cycle; dust lead concentrations did not change. Lead loading returned to pre-cleaning conditions within 2.5 to 3 weeks of cleaning. Carpet age had no effect on lead loading but homes with power nozzle vacuums had lower lead loading. Changes in children's blood lead levels during this study showed no significant decrease, although the remediation appears to generally have eliminated the seasonal rise in blood lead levels. Blood lead correlated positively with pets in the home, negatively with removal of shoes, and did not correlate with change in lead loading or dust lead concentration. By 1992, blood lead levels at the site averaged 10 Fg/dl.

Goulet et al. (1996) reports another study in 1990 in St. Jean sur Richelieu, Quebec. This site had an active battery plant that was closed during the study period. Soil lead concentrations ranged from 200 mg/kg to 600 mg/kg and dust lead concentrations averaged 1200 mg/kg to 2500 mg/kg; the dust lead background concentration was approximately 163 mg/kg. Community-wide remediation included paving, street and sidewalk sweeping and education efforts. Soil remediation included replacement of all bare soils with 10 cm to 30 cm of new soil, replacement of all soils (including graveled/grassed areas) if the concentration was >500 mg/kg. In a lesser contaminated area, bare soils were replaced if the concentration was >400 mg/kg and of all soils if the concentration was >1000 mg/kg. Interior remediation included HEPA vacuuming of the clothes in closets, ceiling, walls, ducts, floors, window seals, carpets and furniture, steam cleaning or mopping (twice) of carpets, furniture, floors, and household accessories. Twenty-nine per cent (29%) of the children with blood lead levels >20 Fg/dl lived in homes with peeling lead-based paints. In general, blood lead levels decreased from 9 Fg/dl to 5 Fg/dl during the study.

The main goal of a study by Farfel et al. (1991, 1994b) was to evaluate experimental abatement practices used for lead-based paint abatement with the goal of long-term reduction of interior dust lead levels. All painted surfaces were treated by replacement and enclosure methods, floors were sealed, strict occupant and personal belonging protection practices from dust during abatement were performed, offsite disposal of debris occurred, and HEPA vacuuming and wet scrubbing after abatement activities was performed. Floors, window sills, and window wells were measured for dust lead loading (mg/m^2) pre-abatement, post-abatement, 6-9 months and 1.5-3.5 years post-abatement. Results revealed significant lead loading reduction post-abatement through 1.5-3.5 years. Floors, window sills and wells were 16%, 10%, and 4% of pre-abatement levels, respectively, at the 1.5-3.5 years sampling (Farfel 1994b).

Control and intervention groups were compared by Rhoads et al. (1999), in a study conducted in Jersey City, NJ. The presence of lead-based paint in the house was a necessary criteria for inclusion in the one year study. The houses in the intervention group were cleaned every two weeks. The cleaning protocol included vacuuming of floors and carpets with a HEPA vacuum, mopping of bare floors with a low phosphorus detergent, and educational seminars. Samples were obtained by wipe and vacuum sampling. The average blood lead level before the intervention was 12 Fg/dl for the study children. Results of the study indicated that in homes cleaned more than twenty times, a 34% decrease in blood lead level was seen. Dust loading on floors, sills and carpets generally decreased after cleaning.

A seven-month long study by Lanphear et al. (1996) in Rochester, NY provided lead poisoning and prevention information, cleaning information and supplies (spray bottles, paper towels, and a detergent specifically developed to clean up lead contaminated house dust) to homeowners where children with blood lead levels <25 Fg/dl resided. Cleaning instructions were to clean the entire house once every three months, to clean sills, window wells and nearby floors once per month, and to vacuum carpets once per week. A control group was provided with an informational brochure only. No difference was seen in blood lead levels of the two groups.

A 1978 study by Milar and Mushak (1982) cleaned homes of children with blood lead levels ranging from 20 to 58 Fg/dl (average of 44 Fg/dl); dust lead concentrations ranged from 970 to 7171 mg/kg (average 3000 mg/kg). Cleaning included vacuuming carpets with a vacuum that had a beater bar and steam cleaning first with a high-phosphate solution, then 24 hours later with regular steam cleaning detergents. Cleaning of bare floors included sweeping and then a high-phosphate detergent wash and rinse. Ventilation system filters were also replaced. Lead dust concentration decreased by 61%, and lead loading decreased by 91% for homes cleaned with the high-phosphate wash and another wash 24 hours later.

The 1988–1991 USEPA Three City Urban Soil Lead Abatement Project (USEPA 1993) in Cincinnati remediated areas with soil lead concentrations ranging from 300 mg/kg to 800 mg/kg; street dust concentrations were slightly higher. Neighborhood-wide remediation included sweeping of paved surfaces and common area soil abatement. Individual home remediation included vacuuming and wet mopping of floors and replacement of one to three carpets and two pieces of furniture per home. Conclusions from the study indicated that interior dust abatement may reduce blood lead levels but differences seen were not significant; no effect was seen on blood lead levels from soil or exterior dust abatement.

The 1992 CLEARS study by Lioy et al. (1998) in Jersey City, NJ cleaned homes of children with blood lead levels between 8 Fg/dl and 20 Fg/dl with lead-based paint present in the home. Approximately 2/3 of the study homes received interior cleaning ten times over a 9–15 month period; the other 1/3 of the homes were cleaned less than ten times. Cleaning consisted of detergent cleaning of floors and smooth surfaces, and HEPA vacuuming of carpets. Homeowners received educational materials and were advised to wet scrape and repaint loose paint. Results from wipe sampling indicated that lead loading and lead concentration were 35% and 24%, respectively, lower than the control group; no change in dust loading was observed. Vacuum sampling indicated that dust loading decreased in the study group, lead concentration was unchanged, lead loading decreased but was not significantly lower between the groups.

From 1989 –1990, Aschengrau et al. (1994) performed a two-phase study in Boston involving soil and interior dust remediation and loose paint stabilization (Phase I) followed by soil remediation and paint deleading (Phase II). Study homes had soil lead concentrations of >1500 mg/kg and loose paint on <30% of the exterior surface. Soil remediation included removal and replacement of 6 inches. Interior dust remediation consisted of a one-time HEPA vacuuming of carpets, wet wiping of walls, wood and window wells and oil wiping of furniture. Paint remediation involved HEPA vacuuming and a TSP wash of loose paint areas followed by painting with primer in Phase I and removal of all lead-based paints below 5 feet in height on both interior and exterior surfaces in Phase II. Dusts were sampled using the Sirchee-Spittler vacuum sampler. Results of the studies indicated that, in general, blood lead declines of 2.25 Fg/dl to 2.7 Fg/dl were observed for soil lead concentration reductions of 2000 mg/kg but children in homes with high floor dust lead concentrations received almost no benefit from soil remediation. Another report on this study by Weitzman et al. (1993) indicated that soil lead concentration reductions led to blood lead declines of 0.8 Fg/dl to 1.6 Fg/dl; soil and dust remediation combined resulted in blood lead declines of 1.2 Fg/dl to 1.6 Fg/dl. Upon one-year follow up, most homes remained at some level of reduced lead levels. A reanalysis of the Phase II data by Aschengrau et al. (1994) indicated that lead abatement was more effective when more interior areas were treated, when removal and replacement was used and when multiple cleanings were performed. Costs for this project averaged $9600 per property.

The majority of the sites involving interior house dust lead contamination from an exterior source (i.e., not exclusively from painted surfaces) had remedial approaches consistent with that seen at the BHSS. Exterior soil remediation plus other exterior techniques such as paving and creating barriers have been used at nearly every site. Providing educational information about lead poisoning and its prevention is also a common approach; the PHD’s Intervention Program relies on a similar strategy.

The studies generally indicate that interior cleaning temporarily reduces house dust lead concentration and lead loadings, and at least in some cases, blood lead levels. However, in several instances these efforts indicate that long term house dust lead reductions are not maintained as long as the source of the contamination remains present.

The BHSS is much larger in geographical area and population affected than any of the other sites mentioned above. A great deal of demographic/socioeconomic data are available for the Site. Additionally, data on lead in blood, soil, dust, water, air, streets, rights-of-way and hillsides are extensive and are available for many years. The house dust lead concentrations observed in 1988 ranged from 1200 mg/kg to 1500 mg/kg and from 300 mg/kg to 600 mg/kg in 1999. In Smelterville, the geometric mean blood lead levels were measured at 11.6 µg/dl in 1988 and 3.6 µg/dl in 1999. These data indicate that significant reductions in both house dust lead concentrations and blood lead levels have occurred at the BHSS since 1988.

1.7 Purpose and Objectives

The primary purpose of this project is to determine the feasibility of instituting home interior cleaning in order to achieve and maintain a low dust lead level in the home (i.e., achieve the dust RAO for the site). This project is not designed as a scientific experiment to compare treatment techniques. Instead, it is to assess the effectiveness and efficiency of long-term solutions for the BHSS, as well as to identify logistical problems associated with any comprehensive community-wide cleanup that might be required. This Work Plan details the procedures to be used. In many cases, HUD Guidelines for Lead-Based Paint Abatement and the literature discussed in Section 1.6 have been consulted and will serve as the basis for the procedures used in this project (HUD 1995).

The main objective of this project is to learn about certain parameters (i.e., cost effectiveness, lead reduction, and logistical challenges) associated with interior cleaning so that a large-scale home interior cleaning project can be scoped.

The following specific objectives are defined for this project:

- To determine the cost, effort, and effectiveness of commercial housecleaning services versus a complete removal of permanent reservoirs of lead dust in addition to housecleaning.
- To determine the rate and magnitude of recontamination and dust and lead loading.
- To identify logistical, public health and safety, and contracting difficulties that may be encountered in a large scale cleaning effort.
- To assess sampling techniques for house dust.
- To identify other sources of lead exposure in homes that could be amenable to cleaning.

1.8 Project Scope and Limitations

This project will involve the cleaning of twelve homes in Smelterville selected through previous sampling and questionnaire results, confirmed in subsequent interviews. Cleaning will be limited to areas with potential for exposure (accessible portions of the residence, including ducts). Three additional control homes in Smelterville will not be cleaned but will be sampled by the same methodologies as the cleaned homes.

Of the twelve homes that will be cleaned, six will be cleaned by a certified HUD lead-based paint contractor (Treatment Group A) and six will be cleaned by a commercial cleaning company (Treatment Group B). The purpose of utilizing two cleaning contractors is to generate information on cost versus effectiveness should large scale cleaning be warranted. Additionally, three control homes (Treatment Group C) will be monitored for effectiveness comparisons.

The project is limited to measuring dust lead concentrations and dust and lead loading rates in the 15 homes. Blood lead measurements will not be collected as part of this project. However, families with young children will be encouraged to participate in the 2000 and 2001 Lead Health Intervention Program that monitors blood lead levels for the BHSS.

The Panhandle Health District (PHD) will assist with identification of approximately 20-30 homes from which the 15 project homes will be chosen. The overall process that will be performed includes the following steps:

- A Screening interview to establish that the home meets the requirements of the project and to ascertain that the homeowners are agreeable to the terms of the project. All homes identified will go through the screening process; after the screening process, 15 homes will be selected for the project.

- A pre-cleaning interview to establish cleaning dates and scheduling and to go over the planned protocols with the homeowner so that homeowner compliance is assured. The homeowner will sign an agreement with the government at this time.

- A HUD Lead-based Paint Risk Assessment will be performed to identify all potential sources of lead exposure in all 15 homes. Also at this time, pre-cleaning sampling will occur.

- Actual cleaning for the twelve selected homes.

- A Post-cleaning interview to review the work done with the homeowner and to receive homeowner comments regarding the level of satisfaction with the work, to discuss and resolve any complaints or problems that occurred.

- C Short-term effectiveness sampling will be performed in the twelve homes that were cleaned. The HUD Lead-based Paint Risk Assessor will also re-sample window sills and wells.

- C Long-term effectiveness sampling will be performed in all 15 homes at approximately six and twelve months after completion of the cleanups.

Although HUD Lead-based Paint Risk Assessment may identify lead-based paint hazards in some of the homes, lead-based paint abatement is beyond the scope of this project. However, the risk assessment will identify potential abatement measures and help refer homeowners to the appropriate agencies for assistance to address identified abatement needs.

1.9 Project Management, Contractor Qualifications, and Associated Tasks

The following entities will be involved in this Pilot Cleaning Project:

1. The State of Idaho will be responsible for project management through the Department of Environmental Quality.

2. TerraGraphics Environmental Engineering (TG), under contract to the State of Idaho, is responsible for designing the study, providing the technical leadership during the study, and preparing the final pilot study report.

3. PHD will assist TG in preliminary identification of homes.

4. EPA Region X will coordinate contract activities and will provide input during project design phases through its participation in the Interior Dust Cleaning Sub-group of the Lead Remediation Review Group (LRRG).

5. The U.S. Army Corps of Engineers will manage the moving and housing of the residents, issue and manage the contracts for cleaning and the HUD RA contract, and compensation to homeowners for damages caused by this project. Details/specifications for bidding this job are found in Appendix C.

6. Two different certified lead-based paint abatement contractors with substantial experience working in residential environments will be used for two different tasks (risk assessment and cleaning) as described below in order to avoid potential conflicts of interest and to assure data integrity. These contractors are referred to as the “HUD RA contractor” and the “HUD cleaning contractor” in this document.

7. A local commercial cleaning contractor will also be used for house cleaning. This contractor will be referred to as the “commercial cleaning contractor” in this document.

8. A local moving contractor will be hired to help move residents during the cleaning efforts.

The following Tasks will be performed under this Work Plan. The contractor assigned to each Task is also identified.

Task 1: Preparation of Work Plan

The overall project Work Plan (this document) has been prepared by TG and will be revised based upon comments from the LRRG which includes representatives from IDEQ, PHD, EPA Region X, the Corps, and URS-Greiner and CH2M-Hill.

Task 2: Preparation of a Request for Proposals and HUD Contractor Work Plans

This Work Plan will serve as the basis for a Request for Proposal (RFP) in order to select the HUD RA contractor, the HUD cleaning contractor, and the commercial cleaning contractor. EPA Region X will retain the U.S. Army Corps of Engineers for assistance in preparing the RFP and assigning the contracts. Guidelines for developing the RFP are found in Appendix 7.1 of the HUD 1995 guidelines and in Appendix C of this document.

Each of the selected HUD contractors will prepare their own Work Plan under their contracts. The HUD RA contractor will prepare a Work Plan describing procedures needed to perform the HUD Lead-based Paint Risk Assessments. The HUD cleaning contractor will prepare a Work Plan describing the procedures that will be used in the actual cleaning portion of the project. The HUD cleaning contractor's Work Plan will be used to modify the Commercial Cleaning Protocol outlined in Appendix D; if modifications are required, they will be approved by TG, the Corps, IDEQ, and EPA.

Task 3: Identification and Screening of Homes

TG will work with PHD to identify 20-30 potential homes for the project. TG and the Corps will perform an initial screening interview with homeowners and, based upon the results of the 15 interviews, homes will be selected in consultation with the LRRG. More screening interviews may be necessary to obtain 15 final participants.

Task 4: HUD Lead-Based Paint Risk Assessment

The selected HUD RA contractor will perform the HUD Lead-based Paint Risk Assessments as described in their Work Plan. Some sampling activities are included in this task.

Task 5: Pre- and Post-cleaning Interviews

TG and the Corps, with the assistance of the HUD RA contractor will conduct the Pre-cleaning Interview. TG, the Corps, and the two cleaning contractors will conduct the Post-cleaning Interview. More than one visit may be required.

Task 6: Cleaning

The selected cleaning contractors will perform all cleaning activities as described in Section 4 below. Group A homes will receive cleaning by the HUD cleaning contractor and carpet replacement. Group B homes will be cleaned by the commercial cleaning contractor and will receive carpet cleaning. HUD Guidelines state that the use of a HEPA vacuum is required for all vacuuming activities; a Nilfisk or equivalent high quality HEPA vacuum is specified for use in this project.

The Corps will perform oversight of the cleaning contractors during cleaning to assure contract compliance. To assure technical issues are addressed, TG will provide technical assistance to the Corps. The Corps will also coordinate responses to any complaints/problems that may have occurred. The Corps will also assure timely and fair compensation to homeowners for any damages caused by the project.

Task 7: Assessment Sampling

TG and the HUD RA contractor will perform sampling to evaluate the effectiveness of the cleaning. Homeowner vacuum bag samples and dust mat samples will be obtained as well as samples from other soft and hard floor surfaces and windows. Sampling will occur prior to and immediately after (short-term) the cleaning, and again at six and twelve months after the cleaning (long-term). TG and the HUD RA contractor will prepare separate SAPs and QAPPs to support this effort. Sampling details are found in Section 3.4; Tables 1a and 1b summarize the sampling schedule and details.

Task 8: Reporting

TG will prepare an interim report after results are obtained from the short-term sampling. This report will include all summary details from the HUD RA results, cleaning and certification information, results of the interviews and data and analysis of sampling results. TG will also prepare the final report after all long-term sampling is completed; this report will discuss the rationale for performing the chosen procedures, include results and conclusions from the project, and recommendations for future action.

The HUD RA contractor will prepare a report for inclusion in the interim report detailing results from the HUD RA.

The HUD cleaning contractor will provide information detailing costs and efforts of the cleaning procedures to TG for inclusion in the interim report.

The Corps will prepare a report documenting costs for damages and management of the cleaning effort.

Additional detail on the content of these reports is found in Section 5.

Table 1a Sampling Summary for Treatment Groups A & B

Sample Detail	Pre-cleaning	During cleaning	Post-cleaning	6 months	12 months
1. Carpet (BRM)[1]					
child bedroom	X		X	X	X
living room	X		X	X	X
2. Kitchen floor (BRM)[1]	X		X	X	X
3. Windows: sill, well (wipe)[2]					
child bedroom	X		X	X	X
living room	X		X	X	X
4. Floor dust mat[1]	X		X	X	X
5. Household vacuum cleaner bag[1]	X		X	X	X
6. Basement[1]		X			
7. Attic[1]		X			
8. Duct[1]		X			

[1] Sampled by TG.
[2] Sampled by HUD RA contractor.

Table 1b Sampling Summary for Treatment Group C

Sample Detail	Pre-cleaning	During cleaning	Post-cleaning	6 months	12 months
1. Carpet (BRM)[1]					
child bedroom	X			X	X
living room	X			X	X
2. Kitchen floor (BRM)[1]	X			X	X
3. Windows: sill, well (wipe)[2]					
child bedroom	X			X	X
living room	X			X	X
4. Floor dust mat[1]	X			X	X
5. Household vacuum cleaner bag[1]	X			X	X
6. Basement[1]	X				
7. Attic[1]	X				

[1] Sampled by TG.
[2] Sampled by HUD RA contractor.

SECTION 2.0 PILOT CLEANING PROJECT DESIGN

This section details the specific requirements of the homes that will be included in the Pilot Cleaning Project. Fifteen homes will be selected in the city of Smelterville for this project.

2.1 Identification of Population – Task 3

2.1.1 Housing characteristics

The primary criterion for home selection for this project is that the home will have had a prior interior dust sample taken. In 1998 and 1997, TG and PHD sampled homes in Smelterville by both the dust mat household vacuum bag method.

Selection criteria for the homes will also include the following:

- Type of residence: single family homes
- Age of residence: will be representative of the general housing stock
- Condition of homes: will be representative of the general housing stock; homes in both good and poor repair will be selected
- Size of homes: will be representative of the general housing stock

2.1.2 Resident characteristics

There will be no specific requirements / limitations on resident characteristics for this project. Project homes will be selected randomly without regard to age, sex, or occupation.

2.2 Pilot Cleaning Project Overview – Task 6

This project will consist of a one-time cleaning. Every attempt will be made to perform a thorough cleaning so that the objectives are achieved. Of the twelve homes that will be cleaned, six will be cleaned by the HUD cleaning contractor and six will be cleaned by the commercial cleaning contractor. Each home under each cleaning treatment will be cleaned in a similar fashion. In general, only accessible living spaces plus heating and A/C ducts will be cleaned. Attics, basements and crawl spaces will only be cleaned if they are accessible and used as living space. Personal possessions other than furniture and fixed appliances will not be cleaned and will be moved or removed during the cleaning process. Complete cleaning parameters for each home will be ascertained in the Pre-cleaning interview. Every effort will be made to minimize disruption to the homeowner during cleaning and sampling. The Corps will be responsible for oversight of the cleaning contractors and timely, immediate payment to all participating homeowners and merchants.

Complete details on planned cleanup activities are found in Section 4.0.

SECTION 3.0 PRE-PROJECT TASKS

3.1 Screening Interview – Task 3

The purpose of the Screening Interview is to identify homes for the study. Initially, PHD assistance will be used to identify approximately 20-30 potential homes. TG and the Corps will meet with the homeowners. At that time, the purpose of the project and cleaning methods will be discussed. If the homeowner is agreeable, a questionnaire will be completed to obtain characteristics of the home. A copy of the Screening Interview Questionnaire is included in Appendix A. Once this process is completed for all potential homes, the Dust Sub-group of the LRRG will meet with TG staff and the Corps to select the 15 homes that will be included in the project. When the selection has been made, the Corps will coordinate with the homeowners, TG, and the contractor(s), to arrange dates and times for the pre-cleaning Interview.

3.2 Pre-cleaning Interview – Task 5

The purpose of the pre-cleaning Interview is threefold: to go over with the homeowner the actual procedures that will be used in their home, to obtain Real Estate Agreements, to conduct the HUD Lead-based Paint Risk Assessment and to obtain pre-cleaning samples. TG and the Corps will be present at this interview, which will take place in the home. Dates for the assessment and cleaning will be selected. Specific details on how personal possessions will be handled, relocation during the assessment and cleaning, and furnishing replacement are in Sections 3.2.1-3.2.3, below. At this interview, the pre-cleaning Checklist (Appendix B) will be completed which will detail the actual procedures that will be performed, handling of the personal possessions, and scheduling of sampling and cleaning. The homeowner will also be asked to sign an agreement with the Corps to address compensation and study agreements. A video tape/pictures of the layout and condition of the furnishings will be made for documentation purposes by the Corps.

During this visit, the HUD Lead-based Paint Risk Assessment will be performed on all 15 homes. Details on this activity are in Section 3.3, below.

Also, the HUD RA contractor and TG will perform pre-cleaning sampling. Details on this activity are in Section 3.4, below. More than one visit to the residence may be required to complete this task.

3.2.1 Control of Household Personal Possessions

Household personal possessions will be managed in such a manner that protection from both damage and recontamination are of greatest concern. Feedback on the most effective procedures to accomplish this objective will be obtained from the HUD cleaning contractor. In general, personal possessions such as clothing and other goods stored in closets, kitchen/bathroom cabinets and cupboards, knickknacks, paintings, and toys will not be cleaned but will be removed from their storage spaces to allow for a complete cleaning of the home. The Corps will contract with a local moving contractor to package this material in boxes under the direction of the homeowner. The homeowners may also opt to perform this activity themselves. It is expected that this procedure will take place two days before the cleaning will occur. Possessions that cannot be stored in the home during the cleaning will be secured by the moving contractor. Possessions will be replaced in the home by the moving contractor after the cleaning is complete under the direction of the homeowner.

Large furniture items will either be moved within the home or removed from the home and stored with the personal possessions. Wooden furniture and box springs/mattresses will be cleaned during return to the home as described in Section 4.0. Upholstered furniture and draperies will be cleaned as part of the cleaning process as described in Section 4.0 or replaced as described in Section 3.2.3 below.

Appliances such as refrigerators, washers, and dryers will be cleaned as described in Section 4.0. They will not be removed from the house, but moved within the home as needed. Fixed appliances such as stoves and dishwashers will not be moved.

Carpeting and rugs will be handled as described in Section 3.2.3 below.

3.2.2 Relocation Needs

During the cleaning, the residents of the home will be relocated to a local hotel; a 3-7 night stay will be required. It is expected that the residents will assist with packing their personal possessions, two days prior to cleaning. Duct cleaning, furniture moving/removal and, if required, carpet removal will be done on the first day. Cleaning will start that day, and will continue into the second and possibly third day. The third or fourth day will be for carpet/furniture replacement if required (see Section 3.2.3). Return of packaged possessions by the moving company will take place on the fourth or fifth day or once carpet is replaced or cleaned. Residents can return to the home once cleaning and carpet replacement is complete. Every effort will be made to minimize disruption to the home residents.

3.2.3 Furnishing Replacement Allowance

For homes to be cleaned by the HUD cleaning contractor, all carpeting and underlayment will be replaced with materials of equal or better quality that what currently exists in the home. All rugs will also be replaced. The Corps will work with local merchants who will estimate yardage needed and assign a replacement value to the existing carpet. The local merchant will visit the home after the pre-cleaning Interview but before the cleaning date to review replacement options and make replacement selections with the homeowner. Efforts will be made to replace carpets with materials that facilitate maintenance of low dust levels. An option for upgrading to a more expensive carpet will exist; the replacement value determined by the local merchant can be used towards this type of purchase. The Corps will directly manage costs associated with the replacements.

Furniture replacement costs will also be managed by the Corps. Soft furniture will be replaced in the six homes receiving the HUD cleaning. The furniture to be replaced will be determined during the pre-cleaning Interview by the Corps and TG.

In a similar manner, any window coverings that appear to be uncleanable or potential reservoirs of dust will be replaced. TG, the Corps, and contract staff will make these determinations during the pre-cleaning Interview. A monetary allowance schedule for different types of window coverings will be developed by the Corps; homeowners will be given a check to replace window coverings at a time convenient to them.

3.3 HUD Lead-based Paint Risk Assessment – Task 4

The HUD RA contractor will perform a risk assessment of the 15 project homes and the paint condition of the home according to HUD standard protocols. Anticipated changes from the HUD protocols would be limited to excluding media which have already been sampled, including tap water and yard soil. Sampling may be required as part of this process; if required, window sills and wells, floors and painted cabinets may be sampled. A SAP and QAPP will be prepared as part of the HUD Risk Assessment Work Plan to support sampling activities. Sampling will be performed according to HUD protocols; analysis will be for lead in mass/area, and concentrations if possible.

3.4 Pre-cleaning Sampling – Task 7

As part of the assessment process, baseline data must be gathered on dust and lead loadings and lead concentrations within the home. The purpose of sampling is to obtain baseline data on the general dustiness and lead loading and concentration of each home prior to the cleaning. The same sampling protocol will be followed immediately after cleaning, and again at 6 and 12 months to gauge the effectiveness of the cleaning procedures, the goal of which is to reduce lead loads and concentration in the home. This sampling structure is designed to quantify recontamination. All 15 project homes will be sampled with the exception of short-term effectiveness sampling for the 3 control homes (Tables 1a and 1b).

The following sections detail the sampling procedures that will be followed.

3.4.1 Surfaces to be Sampled and Location of Samples

Samples will be taken from the following surfaces at the following locations:

- Floors
  - Living room
  - Child's bedroom
  - Kitchen
- Windows – sill and well
  - Living room

  - Child’s bedroom
- Ducts
- Basements
- Attics

3.4.2 Number and Type of Samples

Three different areas from the floor in each of the rooms to be sampled will be identified; one composite sample from the three areas will be obtained. For example, three one square foot areas will be identified on the living room carpet, child’s bedroom carpet, and kitchen, respectively, and sampled sequentially into one sampling container using the Baltimore Repair and Maintenance Method (BRM) method.

Because dust mats have been used at the site to assess dust and lead movement into homes, the “dust mat” sampling procedure will also be used. Dust mat samples will be collected over three week periods as part of each sampling session. Additionally, a sample from the homeowner’s vacuum cleaner bag will also be obtained during each sampling event; vacuum bag samples have historically been obtained at the site and will be used in this project to facilitate comparison to the RAO and previous data. Both lead concentration and lead and dust loading data can be obtained from mat samples.

For window sills, the entire sill will be sampled and the area will be measured. The same procedure will occur for window wells. Lead loading data will be obtained from these samples for each sampling event.

3.4.3 Sampling Techniques

A separate SAP and QAPP will be produced by TG to outline the specific sampling techniques employed to collect all interior dust samples collected by TG. The following samples will be collected as part of this project.

3.4.3.1 Floors - TG

It is expected that floors will be sampled using the Baltimore Repair and Maintenance Method (BRM), as this method is a reliable, well-characterized technique used in conjunction with lead-based paint assessments (Farfel 1994c). Both concentration and lead and dust loading can be obtained from BRM vacuum samples. Carpets and hard floor surfaces such as linoleum and hardwood will be sampled using the BRM.

Dust mats will be placed in each home near the most commonly used entryway three weeks prior to cleaning. Immediately after cleaning, another mat will be placed for three weeks for short-term effectiveness sampling. Additional mats will be placed for the six and twelve month long-term sampling efforts.

Household vacuum bags will also be collected during each sampling effort.

3.4.3.2 Painted surfaces – TG and HUD RA contractor

Window wells and sills will be sampled with wipes during sampling events. Appropriate procedures from the HUD Guidelines will be followed for obtaining these samples. SAPs and QAPPs will be prepared in support of this sampling by the HUD Risk Assessor.

3.4.3.3 Ducts - TG

Ducts samples will be obtained immediately after the professional contractor has finished cleaning the ducts. This sampling technique will be specified in the separate SAP and QAPP produced by TG.

3.4.3.4 Basements - TG

One grab sample will be collected in unfinished basements, if accessible. This sample will be collected the same day as duct cleaning and sampling is performed. If a basement is used as living space, then it may be sampled using the BRM method if it is the main living room or a child's bedroom, otherwise it will be assumed that the vacuum bag sample also represents the basement.

3.4.3.5 Attics - TG

One grab sample will be collected in unfinished attics, if accessible. This sample will be collected the same day as duct cleaning and sampling, and basement sampling is performed. If the attic is used as living space, then it may be sampled using the BRM method if it is the main living room or a child's bedroom, otherwise it will be assumed that the vacuum bag sample also represents the attic.

3.4.3.6 Analytical Techniques - TG

Household vacuum bag and mat dust samples will be prepared by sieving through U.S. number 80 mesh sieves. BRM dust samples will also be sieved. All samples will be analyzed for lead using methods detailed in the most current edition of Test Methods for Evaluating Solid Wastes, SW-846. Dust samples will be digested in accordance with SW-846 method 3050. After digestion, all samples will be analyzed for lead by inductively coupled plasma atomic emission spectroscopy (ICP) in accordance with SW-846 method 6010.

SECTION 4.0 CLEANUP ACTIVITIES – TASK 6

Treatment Group A (6 homes) will receive full cleaning with carpet and furniture replacement as described below. The HUD cleaning contractor will perform this cleaning. Treatment Group B (6 homes) will receive full cleaning with carpet steam cleaning (rather than replacement) as described below. The commercial cleaning contractor will perform this cleaning. The commercial cleaning contractor shall follow the cleaning procedures contained in Appendix D. Video taping of some of the work will be done by the oversight contractors for documentation purposes.

4.1 Removal and Cleaning of Carpets, Window Coverings and Upholstered Furniture

Treatment A

The HUD cleaning contractor will remove and dispose of all rugs, carpets and underlayment early on the first cleaning day. Carpet tack strip will also be removed and disposed of. Any upholstered furniture that is to be replaced will be removed and disposed of early on the first cleaning day. Toss pillows or blankets/quilts/afghans/that typically lay on the furniture should be cleaned. Box springs/mattresses will be cleaned by the cleaning contractor. Mattresses are not being replaced because they are not considered to be a repository of lead dust since they are usually covered with bedding (i.e., sheets and blankets). All window coverings will be prepared for cleaning. Window coverings will be dry-cleaned at a local merchant under direction of the cleaning contractor.

Treatment B

All carpets will initially be vacuumed using a HEPA filter vacuum and then steam cleaned using a high phosphate detergent, followed by HEPA vacuuming after drying. Upholstered furniture will be cleaned in the same manner. Box springs/mattresses will be cleaned by the cleaning contractor. All window coverings will be prepared for cleaning. Window coverings will be dry-cleaned at a local merchant under direction of the cleaning contractor.

4.2 Cleaning of Ducts

Ducts will be cleaned by a sub-contractor under supervision of the cleaning contractor and the Corps to assure that lead hazards are not exacerbated during the cleaning. Ducts will be cleaned on the first day after furnishings have been moved from the house for both Treatments A and B. The duct cleaning will follow the protocol outlined in Appendix E.

After duct cleaning, TG will obtain a sample of the material removed from the ducts (to determine the lead concentration) and will estimate the overall mass removed from the ducts, if possible.

4.3 Cleaning of Hard Surfaces

Hard surfaces will be cleaned in an orderly manner, progressing throughout the home as described in HUD Guidance and the Commercial Cleaning Protocol (Appendix D).

4.3.1 Walls, ceilings, and windows

Ceilings and light fixtures will be cleaned first, followed by walls and windows. Windows will be cleaned thoroughly; windows will be opened and storm windows removed so that the entire window trough and well area can be completely cleaned. If the window is sealed due to painting and is not normally opened, the window need not be opened for cleaning, in order to minimize paint breakage and the need for repainting.

4.3.2 Appliances, cupboards, and countertops

The cupboards and closet interior and exterior surfaces will be cleaned in the same manner as walls, as will countertops. All exterior surfaces of appliances will be cleaned; moveable appliances will be moved in order to clean under them. Special attention will be given to refrigerator coils and undercarriages.

4.3.3 Floors

Floors will be cleaned after the other room areas have been cleaned.

4.4 Cleaning of Attics and Basements

Attic, basement and crawl spaces will be cleaned if they are used as living space by the residents. Determination as to accessibility and whether they will be cleaned will be made by TG at the time of the pre-cleaning Interview.

4.5 Replacement of Carpets and Window Coverings

On the day after the cleaning, new carpets and underlayment will be installed, new window coverings may be installed or cleaned ones will be reinstalled. Carpets may be replaced with linoleum if the homeowner prefers.

4.6 Return of Wood Furniture and Other Household Possessions

After the carpets are completely dry and cleaned (Treatment B) or upon reinstallation of carpet (Treatment A), furniture will be returned to the home or replaced in its original location. As wood furniture and box springs/mattresses are being returned, they will also be cleaned of dust by the cleaning contractor. Other boxed possessions will be returned to the home by the moving contractor; the family can return to assist with this procedure if desired. The moving contractors will take precautionary measures to prevent exterior soils from re-entering the home as furniture and possessions are replaced (i.e., wiping shoes off at the door's exterior and wiping any boxes or furniture that may have been placed on the yard or soils outside the home).

Homeowners will also be supplied with new entryway mats if old ones cannot be cleaned.

4.7 Documentation of Returned Possessions

After all of the household possessions are returned to the home, the Corps will document receipt of all items through use of video tape/pictures. The homeowner will be asked to identify any damaged or missing possessions. The Corps will evaluate the losses or damages and will compensate the homeowner for any compensatable losses.

4.8 Indoor Air Monitoring

Personal/DataRAM air monitoring equipment will be used to measure airborne particulate concentrations in real-time. The DataRAM monitor passively detects airborne particulate concentrations and records this data in detail for subsequent retrieval, analysis, and archiving through a computer interface. Analysis of this data and correlation with lab results will help us gain an understanding of what impacts various cleaning activities would have on potential exposure.

SECTION 5.0 POST-REMEDIAL ACTIVITIES

5.1 Certification of work- Task 6

Certification of the project will be based upon the confirmation that all cleaning work has been performed according to procedures defined by the contract. It will be the responsibility of the Corps and TG to certify that the work performed by the cleaning contractors has conformed to all Work Plans and specifications. The Corps will prepare a QAPP in order to document the certification process.

5.2 Post-cleaning Interview – Task 5

A Post-cleaning interview will be performed to describe the actual work at each home. This interview will take place as soon as possible, preferably within 24 hours of the cleaning and will be conducted by TG, the Corps, and the cleaning contractors. Comments from the homeowner regarding their level of satisfaction with the work and details of any problems that they might have will be obtained. Notes from these interviews will be included in the final reports for the project. Also, short-term effectiveness sampling will take place at this time by TG and the HUD RA contractor.

5.3 Effectiveness Assessment – Task 7

Effectiveness of the cleaning procedures will be determined by comparing short-term (post-cleaning) dust levels at specified locations with baseline (pre-cleaning) levels. A long-term effectiveness determination, including information on re-contamination, will be made by sampling the same specified areas at six and twelve months after the cleaning. All sampling will use the same procedures as the pre-cleaning sampling.

TG and the HUD RA contractor will perform these sampling activities and will prepare appropriate SAPs and QAPPs to support these activities. The 3 control homes that are not cleaned will also undergo both long-term sampling events. The HUD RA contractor will provide its data to TG for analysis purposes. TG will analyze the data obtained and will prepare a report on effectiveness of the methods used.

5.4 Reports –Task 8

5.4.1. Effort and costs

The HUD RA contractor will prepare a report detailing the outcomes of each Lead-based Paint Risk Assessment performed at each home.

The HUD cleaning contractor will prepare a Summary Memorandum detailing specific activities performed during the cleaning, emphasizing costs for each activity and effort (time and technique). This report will include a section on problems and/or liability issues that occurred and how they were handled, and recommendations as to how this type of project could be transferred to local, non-professional crews.

The Corps will prepare a summary report documenting the cost for compensation of damages and losses to homeowners and costs for management of this project.

TG will receive these reports from the contractors and combine them with results of the short-term effectiveness sampling and provide an Interim Draft Report.

5.4.2 Overall Effectiveness and Recommendations

A Final report incorporating the results of the long-term effectiveness sampling with conclusions and recommendations will be prepared by TG.

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APPENDIX A: Screening Interview Questionnaire

Screening Interview Questionnaire

Date:	**Interviewer:**
Street Address: **Mailing Address:**	
Phone Number: (208)	

Prior to asking interview questions, explain the pilot cleaning study - purpose, procedures, time frame, etc. Mention that there will be three treatment groups and briefly explain each. Be sure to tell the homeowner that their home has been preselected based on dust mat and/or vacuum bag sample results from the 1998 and 1999 sampling events.

1. What is your name?____

2. What year was this home built? (oldest part)

1	before 1960	3	1979 or later
2	1960 through 1978	9	don't know

3. Do you own or rent your home?

1 rent
2 own

4. How long have you lived in this home?

1	<1 month	5	6-12 months
2	1-2 months	6	1-5 years
3	2-3 months	7	>5 years
4	3-6 months	9	don't know

4b. IF A TRAILER HOME: Do you know where the mobile home was located before Smelterville (here)? (Write down any notes.)

5. Do you know of any lead paint existing in or outside of your home?

1 yes 2 no 9 don't know

If yes: Where? Is there a report/any data?

6. Has any of the home interior been painted or window sills been sanded or removed/remodeled while your family has lived in the home?

1 yes 2 no 9 don't know

If 'yes' ask questions 7 and 8:

7. When ?

1	within the last year	3	more than 2 years ago
2	one to two years ago	9	don't know

8. Which rooms?

1	kitchen	5	master bedroom
2	living room	6	child bedroom
3	dining room	7	bathroom
4	TV room	8	other

9. Do you have any windows in your home that are painted shut and are never opened?

1 yes 2 no

If yes: where?

10. Has your home been remodeled or new carpet/furniture installed while your family has lived in this home?

1 yes 2 no 9 don't know

If 'yes,' ask questions 11 and 12:

11. When ?

1	within the last year	3	more than 2 years ago
2	one to two years ago	9	don't know

12. Which rooms?

1	kitchen	5	master bedroom
2	living room	6	child bedroom
3	dining room	7	bathroom
4	TV room	8	other

13. How many throw rugs/entrance mats are there at the entrances in this home?

1	none	3	at some of entrances
2	one at one of the entrances	4	at all entrances

14. How many throw rugs/area rugs are there inside this home?

1	none	3	three to five
2	one or two	4	more than five

If 'yes,' ask question 15:

15. Where are these throw rugs/area rugs located?

1	kitchen	5	master bedroom
2	living room	6	child bedroom
3	dining room	7	bathroom
4	TV room	8	other

16. What type of window treatment does this home have?

1	drapes	3	both drapes and blinds
2	blinds	9	don't know

17. Does this home have top treatment or valances for the windows?

1 yes   2 no   9 don't know

18. Do people generally remove their shoes before entering the home?

1 yes   2 no

19. How many people regularly ***live*** in the home?

Adults __________ Children ____________

20. Where do the children residing in this home sleep?

1	own bedroom	3	parent bedroom
2	share bedroom	4	other

21. Where in the home do the children play the most?

1	kitchen	5	master bedroom
2	living room	6	child bedroom
3	dining room	7	bathroom
4	TV room	8	other

22. How often do you dust and/or clean hard blinds in your home?

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo.

23. How often do you wash fabric drapes in your home?

1	more than 1x/year	3	within the past 5 years
2	1x/year	4	never

24. How often do you dust your window sills and wells in your home?

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo.

25. How often do you dust hard furniture and other items in your home?

1 every 1-7 days
2 every 7-14 days
3 every month
4 less than 1x per mo.

26. How do you dust the house?

1 vacuum
2 oil/water soaked rag
3 feathers
4 other: note:_______

27. How often do you clean the linoleum/hardwood floors in your home?

1 every 1-7 days
2 every 7-14 days
3 every month
4 less than 1x per mo.

28. How often do you wash the walls of your home?

1 more than two times a year
2 one time a year
3 never
4 other

29. How often do you wash the ceiling of your home?

1 more than two times a year
2 one time a year
3 never
4 other

30. How often do you clean the coils of your refrigerator and/or full size freezer?

1 more than two times a year
2 one time a year
3 never
4 other

31a. Do you have centralized heating/air conditioning in your home?
1. Yes 2. No _________(baseboards?)

If yes:(answer questions 30b-33)

31b. How old are the furnace and ducts in your home?

1 <5 years
2 5-10 years
3 11-15 years
4 as old as home

31c. How often do you clean the ducts of your home?

1 more than two times a year
2 one time a year
3 never
4 other

(Has a professional duct cleaner cleaned your ducts? If so, when?)

____

32. What are the ducts in your home made of?

1	metal	3	duct board
2	fiberglass	4	interior insulated

33. When was the furnace filter of your home last changed?

1	within the past month	3	within the past year
2	within the past six months	4	within the past five years
		9	don't know

34. How often do you vacuum the soft furniture in your home?

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo.

35. How often do you steam clean the furniture in your home?

1	more than two times a year	3	never
2	one time a year	4	other

(When was the last time your furniture was steam cleaned?)

____

36. How often do you vacuum the following carpets?

Frequency codes:

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo. (Once/yr or couple yrs)
5	never	6	NA (=no carpet in room)

(Cross out room name if the room does not exist in the home)

Room	**Frequency code**
Kitchen	________
Living room	________
Dining room	________
TV room	________
Master bedroom	________
Child bedroom 1	________
Chid bedroom 2	________
Child bedroom 3	________
Bathroom 1	________
Bathroom 2	________
Other (provide rooms)	________

37. How often do you steam clean the following carpets?

Room	**Frequency code**

Kitchen ________
Living room ________
Dining room ________
TV room ________
Master bedroom ________
Child bedroom 1 ________
Chid bedroom 2 ________
Child bedroom 3 ________
Bathroom 1 ________
Bathroom 2 ________
Other (provide rooms) ________
____
____

38. What type of vacuum cleaner do you use to vacuum your carpets and furniture? Provide year, brand, model, condition, beater bar. (Ask to look at the vacuum if they do not know, and describe in as much detail as possible - model and make/flip it over to see if it has a beater bar)

____
____
____

39. What type of steam cleaner (or who is the professional doing the cleaning) do you use to clean your carpets and furniture? (Rainbow vacuums do not count as steam cleaners).

____
____

40. Can any pets or outside animals access any crawl spaces (i.e., crawl under the house)?

1 yes 2 no

41. Does your home have an accessible basement?

1 yes 2 no

If 'yes,' ask question 42:

42. What is the basement in your home used for?

1 unfinished 3 living
2 storage 4 other/note:_______

43. Does you basement have a dirt floor?

1 yes 2 no

44. Does your home have an accessible attic?

1 yes 2 no 9 don't know

If 'yes,' ask question 40:

45. What is the main use of your attic?

1 unfinished 3 living
2 storage 4 other/note:_______

46. Are there any other accessible areas in your home such as crawl spaces?

1 yes 2 no 9 don't know

If 'yes,' where is it located and how do you access it?

____

____

47. Describe any renovation or remodeling that has occurred in this home:

48. Are there any screen doors or windows that are left open all summer?
1 yes 2 no

49. Do you have any antiques or other extremely valuable items that would preclude you from being involved in this cleaning project?

1 yes 2 no

50. Do you agree to be a part of this study if selected as a control, Treatment A, or Treatment B?

1 yes 2 no

51. Is there a planned renovation for your home within the next full year?

1 yes 2 no

52. Is there a planned relocation for you and your family within the next full year?

1 yes 2 no

53. Are there any heavy or bulky items in your home that may be difficult to move?

1 yes 2 no

54. List carpet characteristics and condition by room:

Condition codes
1 good condition 3 moderately dirty, frayed, etc.

2	slightly dirty, frayed, etc.	4	poor condition

Carpet type codes

1	shag	4	sculptured
2	Berber	5	plush
3	indoor/outdoor	6	other

Room	Age (yrs)	Condition	Type	Thickness (any notes)
Kitchen	________	________	____	________
Living room	________	________	____	________
Dining room	________	________	____	________
Master bedroom	________	________	____	________
Child bedroom 1	________	________	____	________
Chid bedroom 2	________	________	____	________
Child bedroom 3	________	________	____	________
Bathroom 1	________	________	____	________
Bathroom 2	________	________	____	________
Other (provide rooms)	________	________	____	________

55. List the number and condition of the **drapes** for each room.

Condition codes:

1	good condition	3	moderately dirty, ripped, etc.
2	slightly dirty, ripped, etc.	4	poor condition

Room	Number	Condition	Top Treatment
Kitchen	________	________	________________
Living room	________	________	________________
Dining room	________	________	________________
Master bedroom	________	________	________________
Child bedroom 1	________	________	________________
Chid bedroom 2	________	________	________________
Child bedroom 3	________	________	________________
Bathroom 1	________	________	________________
Bathroom 2	________	________	________________
Other (provide rooms)	________	________	________________

56. List the number, type, and condition of the **blinds** for each room.

Condition codes:

1	good condition	3	moderately dirty, bent, some missing, etc.
2	slightly dirty, bent, etc.	4	poor condition

Type codes for blinds:

1	mini	3	pleated shades
2	vertical	4	other

Room	Number	Type	Condition	Top Treatment	Pb
Kitchen	________	____	________	______________	__

Living room	________	_____	__________	__________________	___
Dining room	________	_____	__________	__________________	___
Master bedroom	________	_____	__________	__________________	___
Child bedroom 1	________	_____	__________	__________________	___
Chid bedroom 2	________	_____	__________	__________________	___
Child bedroom 3	________	_____	__________	__________________	___
Bathroom 1	________	_____	__________	__________________	___
Bathroom 2	________	_____	__________	__________________	___
Other (provide rooms)	________	_____	__________	__________________	___

57. Does any member of the household regularly smoke cigarettes inside the home?

1. Yes
2. No

if yes: How many packs/cigarettes per day?

APPENDIX B: Pre-cleaning Checklist

PRE-CLEANING CHECKLIST

House address:___________________________________
Date:___________
Resident Name:__________________________________

Scheduling (**Sampling=TG**, all else=Corps)

Event	*Date (s)*	*Time*
Pre-sampling (mat pick-up, collect vacuum bag, BRM)		
HUD Risk Assessment		
Duct Cleaning		
Check into hotel		
Carpet and furnishing removal, begin cleaning (including ducts)		
Complete cleaning		
Move furnishings back into home		
Residents move back into home		
Post-cleaning sampling and interview		

(TG) Place dust mat. Schedule the date and time for dust mat pick up (they must be placed for at least 3 weeks before cleaning can take place).
Date: **Time:**

APPENDIX C: Additional Information for Contractor RFP

ADDITIONAL INFORMATION FOR CONTRACTOR RFP

For HUD RA Contractor:

This contractor will be requested to provide a bid for the following services:

1. To perform an HUD Lead-based Paint Risk Assessment in the 15 homes in the program. This RA will be performed in accordance with HUD Guidelines with the exception of the investigation of water and exterior soil routes, which have been well characterized at the site. The RA will be performed during the Pre-cleaning Interview, and necessary samples will be taken at that time.
2. Prepare a Work Plan, SAP and QAPP in order to accomplish the above task. These documents will be provided to the Project Officer (Idaho DEQ-Scott Peterson) for review and approval.
3. Follow-up with additional sampling will also be performed soon after completion of the cleaning.
4. Prepare a report summarizing their work and results. This report will be delivered to TerraGraphics in final form (after review by TG, Corps, IDEQ, EPA, and LRRG members) in a compatible word processing format (Word Perfect or Word) for inclusion in the Interim Report.

For HUD Cleaning Contractor:

This contractor will be requested to provide a bid for the following services:

1. Clean 6 project homes as identified by the oversight contractor per the project Work Plan. The following housing characteristics are provided as estimates to assist in preparing the bid:
    - C Living space average = 1000 ft^2
    - C Typical layout:
        - C kitchen
        - C 2 bathrooms
        - C 1 living rooms
        - C 2 bedrooms
        - C 1 utility room
    - C Number of window treatments: 8
    - C Carpeted area: 600 ft^2
2. Prepare a Work Plan and QAPP in order to accomplish the above task. These documents will be provided to the Project Officer (Idaho DEQ) for review and approval.
3. Arrange sub-contracting with a duct cleaning provider and ascertain that the procedures that will be used are consistent with approved cleaning practices. This contractor will be responsible for ducts cleaned at the 12 homes that are going to be cleaned.
4. Arrange sub-contracting with a dry cleaning provider for cleaning of fabric window treatments. This contractor will be responsible for dry cleaning services provided for the 12 homes.
5. Arrange sub-contracting with a carpet and window treatment provider for carpet and window treatment replacement. This contractor will be responsible for window treatment replacement, if

necessary, at the 12 homes cleaned by the commercial cleaning contractor.

7. Prepare a report summarizing their work and results. This report will be delivered to TerraGraphics in final form (after review by TG, Corps, IDEQ, EPA, and LRRG members) in a compatible word processing format (WordPerfect or Word) for inclusion in the Interim Report.

For the Commercial Cleaning Contractor:

This contractor will be requested to provide a bid for the following services:

1. Clean 6 project homes as identified by the oversight contractor per the project Work Plan. The following housing characteristics are provided as estimates to assist in preparing the bid:
   - Living space average = 1000 ft^2
   - Typical layout:
     - kitchen
     - 2 bathrooms
     - 1 living rooms
     - 2 bedrooms
     - 1 utility room
   - Number of window treatments: 8
   - Carpeted area: 600 ft^2
2. Review and follow the Commercial Cleaning Protocol in Appendix D, which also might be modified by the HUD Cleaning Contractor, and work with the Corps and TerraGraphics to modify any specific details on cleaning protocols as required. This document will be provided to the Project Officer (Idaho DEQ) for review and approval.

For the Moving Contractor:

This contractor will be requested to provide a bid for the following services:

1. Assistance to the homeowner in boxing household personal possessions as needed for the 12 project homes.
2. Moving boxed personal possessions and furniture from the home as directed by the homeowner and cleaning contractor. During the process, provide video documentation of procedures.
3. Storage of boxed personal possessions and furniture during the cleaning in a secure location.
3. Returning boxed personal possessions and furniture to the home as directed by the homeowner and cleaning contractor. Provide video documentation of procedures used (optional).

APPENDIX D: Commercial Cleaning Protocol

COMMERCIAL CLEANING PROTOCOL

RULES OF THUMB:

1. Always clean from ***top to bottom***.
2. Always ***remove all visible dirt and dust***.
3. All ***wet washing*** should be done with ***trisodium phosphate (TSP) or equivalent soap***, ***except in cases where this soap may damage paint***, then a detergent other than TSP should be used to clean.
4. Always ***follow manufacturers instructions***.
5. All dry vacuuming should be done with ***a HEPA filter vacuum***.

DEFINITIONS:

Wet Washing: Do not pressure-wash or use strong jets for the cleanup of lead-containing materials when wet washing. Damp cotton rags, mops, and cellulose sponges should be used, or else use equipment that will produce a mist, like a water spray bottle. Once the rag, mop, or sponge is moist, it should be rung out so water is not dripping, but that it is only damp. Rinse the area after washing with clean warm water.

High-phosphate Wash Water: Should contain at least 5% trisodium phosphate (TSP). Read the manufacturer's instructions. Common dishwasher detergent typically contains phosphates. A possible beginning dilution might be 1/8th of a cup of TSP in a gallon of hot water. High-phosphate solutions will strip latex paint and remove old varnish, so waterproof gloves should be worn. Fold the gloves back to prevent the fluid from running down your arms, and keep away from the eyes, nose, and mouth. Test small patches first. The TSP solution can damage deteriorated painted walls and floors (Lead Free Kids 1990, PHD 1992, Conlin et al. 1994).

HEPA: High Efficiency Particulate Air filter. HEPA filters can remove fine dust particulates greater than 0.3 microns in diameter with 99.97% efficiency (Conlin et al. 1994, Farfel and Chisolm 1991). A HEPA vacuum cleaner will be required with a beater bar attachment for carpets and other attachments for walls, corners, etc.

Soft Furniture: Any furniture that is not wood, chrome, glass, or other non-absorbent material. Soft furniture refers to any furniture made of cloth, etc.

SPECIFIC PROCEDURES:

After residents have packed and moved for the duration of the cleaning, and all air duct cleaning has been completed, commercial cleaners will follow the specific procedures outlined below and following the “Rules of Thumb” mentioned above. Initially, a dry HEPA vacuuming of the entire home will be performed starting with the ceiling and proceeding down to the walls and floors, vacuuming all knickknacks, books, the tops of clothes hanging in closets, window sills and wells, furniture, and carpets (Milar and Mushak 1982, Farfel and Chisolm 1991, Goulet et al. 1996, Dixon et al. 1999). When the initial vacuuming is done, then follow the following specific vacuuming and cleaning procedures outlined below.

1. *Ceilings*: Vacuum then wet wash ceilings. Only vacuum drop and acoustical ceilings. Asbestos ceilings will not be cleaned. Wet wash all ceiling fans and vacuum the outside of the motor or any other parts that cannot be wet washed. Light fixtures should also be taken down and wet washed. When cleaning ceiling fans and light fixtures, all electrical switches should be turned off or unplugged. Cracks or leaks to the living area should be reported to oversight personnel and the homeowner will be advised.

2. *Walls*: Remove all wall hangings first. Wet wash all painted and smooth (wallpapered and painted) walls, doors and door trim, vacuum wood paneled walls. Vacuum books and remove from shelves, remove and wet wash knickknacks, and then wet wash all flat surfaces (bookshelves, etc.). Replace all knickknacks and books after cleaning. Any light fixtures on the walls should also be removed and wet washed. Wall hangings (i.e., pictures, etc.) should be carefully cleaned so as no damage occurs (i.e., the frame lightly dusted with a wet sponge or cloth and if the picture is not covered by glass, then lightly vacuumed) and replaced. When wet washing wallpapered surfaces, caution should be used so no damage occurs to the wallpaper, especially around seams. Test a small inconspicuous area first.

3. *Windows*: Remove and dry clean drapes and curtains; wet wash blinds. Wet wash all interior window wells, sills, and trim; wet wash window (inside and out) then wash again using window cleaner; remove and wet wash screens. Follow these procedures for sliding glass doors also. Replace blinds and drapes after cleaning.

4. *Furniture*: Vacuum (5 seconds for a one foot pass), in one direction (horizontally) and then the opposite (vertically), all soft surface furniture (couches, recliners, etc.) and then steam clean in the same manner (move the nozzle in one direction and then go over again but in the opposite direction). Couch cushions should be cleaned on both sides (i.e., all outside edges). Removable covers on cushions or pillows should be taken off and washed, along with any quilts, blankets, or afghans that normally lay on the furniture. Follow all manufacturers instructions for pillows, quilts, blankets, and afghans Toss pillows should either be washed in a washing machine or cleaned in

the same manner as furniture. Procedures and techniques should follow the Institute of Inspection Cleaning and Restoration (IICRC) S300 upholstery cleaning standard. Hot water extraction is preferred, using a high-phosphate wash. Hot water injection rate must be greater than or equal to 300 psi, the water temperature must be greater than or equal to 200 degrees F, and water recovery must be 75% or greater. If hot water extraction is not the preferable method for the fabric type then the IICRC S300 standard will be followed. Mattresses and box springs will be dry vacuumed on all outer surfaces. All hard furniture (wood, glass, chrome, etc.) should first be vacuumed then wet washed from top to bottom.

5. *Appliances*: TVs, VCRs, stereos, computers, etc. should be vacuumed (and wet washed if possible) on all sides and underneath. Appliances should be moved in order to vacuum and wet clean underneath. Larger appliances such as refrigerators, washers, dryers, dishwashers, etc. should be wet washed on the outer surfaces, and coils and motors should be vacuumed. Lint traps in dryers should be cleaned and then vacuumed. These appliances should also be moved in order to clean underneath and behind. *Again, all appliances should be unplugged prior to any cleaning!*

6. *Wall Hangings and Lampshades etc., and Fireplaces and Wood Stoves*: These should all be vacuumed (and wet washed if a hard smooth surface). Wood boxes and stacked wood piles should be moved, and the floor underneath cleaned (according to this protocol) and the pile replaced when the floor is dry. Any mirrors on the walls should also be cleaned first by wet washing, then washed again with window cleaner.

7. *Cupboards, Drawers, and Closets*: Remove all belongings and valuables from kitchen, bathroom, and other room cupboards, drawers, and closets. Vacuum the tops, outside surfaces and inside surfaces of the cupboards and drawers, then wet wash. Closets should be cleaned in the same manner as walls, floors and bookshelves.

8. *Floors*: All furniture will be moved to allow thorough cleaning of the floor underneath and then replaced to its original position. All carpets should be vacuumed first and then cleaned using hot water extraction(i.e., steam cleaning). Vacuuming should occur first in one direction (horizontally) and again in the opposite direction (vertically). Detergents used for steam cleaning should also contain a high-phosphate solution. The IICRC S001 Carpet Cleaning Standard should be followed. Hot water injection rate must be greater than or equal to 300 psi, the water temperature must be greater than or equal to 200 degrees F, and water recovery must be 75% or greater. If hot water extraction (including high-phosphate) is not possible for the carpet type then the carpet should be cleaned according to the IICRC S001 standard protocols. Hard wood and linoleum floors should first be dry vacuumed and then wet mopped with the high-phosphate solution, again in one direction and then the opposite direction, and then mopped again with a clean water rinse. All throw rugs will be laundered.

9. *Basements/Attics*: If the basement or attic is used for living space, then it should also be cleaned

according the protocols above.

10. *Enclosed porches and mudrooms*: These should also be vacuumed and wet cleaned if used for anything besides storage. This includes moving any woodpiles, etc., cleaning underneath, and replacing to original position.

11. *Bathrooms:* Bathrooms should be cleaned according to the protocols above. Tile and/or linoleum should be vacuumed and then wet mopped in one direction and then the other. Mirrors and fans should also be wet washed. The outside of medicine cabinets and cupboards/towel storage should also be wet washed.

12. *Pet Furniture*: If the pet furniture has a removable cover, then it will be taken off and laundered. Cat perches and carpeted scratching pads should also be vacuumed and steam cleaned. All other soft pet furniture should at least be vacuumed.

13. *Miscellaneous:* All heater registers, bathroom fans, kitchen fans, lint traps should be cleaned and then vacuumed. If wheelchair ramps are present inside the home, they should also be cleaned according to the protocols above. Stair banisters should also be vacuumed and wet washed. Stairs should be cleaned according to the protocol for floors. Baseboard heaters should also be vacuumed then wet washed. It is recommended that all electricity be turned off prior to cleaning baseboard heaters.

14. *Attached garages:* Any throw rugs present in an attached garage should be laundered. If throw rugs are not available for the door to the garage, they will be provided.

15. *Disposal of cleaning supplies:* Dirty wash water shall be flushed down the toilet. Used mop heads and rags shall be thrown away and taken to the PHD disposal site with the rest of the household waste from this project. New mop heads, rags, sponges, and gloves will be used at each house.

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Appendix E: Duct Cleaning Protocol

AIR DUCT CLEANING PROTOCOL

1. Cleaning contractors shall be National Air Duct Cleaners Association, Inc. (NADCA) certified and/or meet NADCA codes and standards with regard to cleaning methods and outcome. All work must meet National Air Duct Cleaners Association, Inc. (NADCA) Standard 1992-01.

2. A portable vacuum unit capable of meeting NADCA standards shall be used for the cleaning.

3. The post-cleaning consumer checklist will be used to evaluate the project.

4. The vacuum unit will be fully cleaned (see 5 below) prior to the project and an unused middle filter will be installed. The middle filter will be provided to TerraGraphics to be weighed prior to the cleaning. Following the cleaning, contents of the lint trap/first stage screen will be emptied into the second stage/ middle filter bag and the filter will be provided to TerraGraphics for weighing and analysis.

5. The vacuum unit will need to be decontaminated between each home (i.e., lint trap vacuumed and wet washed, wet wash the hose, and use baby wipes to clean the rest of the unit until no dust shows up on a new baby wipe). All pieces to the unit shall be completely dry before the next use and new secondary filters will be used for each home. The decontamination procedures should be outlined by the duct cleaning contractor.

6. Specifications on the filters shall be provided to TerraGraphics. Pore size, material type and characteristics must be provided at a minimum.

7. In addition to duct cleaning, the plenum, drain pans, burner, and heat exchanger will be cleaned. The blower motor will be removed and be cleaned and de-greased. If applicable, the condensing fan, compressor, humidifier, and evaporation coil will also be cleaned.

8. The duct work shall be photographed or video taped prior to and after cleaning to verify all work.

9. Following the cleaning, new furnace filters will be replaced in-kind.

10. Copies of certifications, licenses, insurance and bonding will be provided to the oversight contractors prior to the cleaning.

11. A copy of any warranties shall also be provided to the oversight contractors.

12. Prior to cleaning, the successful bidder shall be licensed by the Institutional Controls Program (ICP) at the Bunker Hill Site. Licensing includes a 2-3 hour training course provided by ICP staff. A license will be issued to those who successfully complete the

training. The license is issued immediately following the course. No fees are charged for training or licensing.

13. TerraGraphics/ICP staff and Corps will be on-site to observe cleaning and record the activities as appropriate.

14. Day to day activity, progress and project completion will be reported to TerraGraphics and the Corps. The final inspection will be conducted by Corps personnel in conjunction with the cleaning contractor.

15. Older homes in which asbestos was used in initial construction may have collected asbestos dust within their HVAC systems. It is the responsibility of the duct cleaner to determine if hazardous materials are present in the HVAC systems prior to cleaning either from the homeowner or from a quick inspection of materials in the home in order to take appropriate precautions (i.e., personal protective equipment).

Alpha Environmental, Inc.
OSHA Written Compliance Plan For
Interior Dust Cleaning
Bunker Hill Pilot Study
Smelterville, Idaho

Date: August 21, 2000

This plan has been developed to comply with the OSHA Construction Lead Standard (29 CFR 1926.62), the HUD Guidelines, and the recommended interior dust cleaning work plan developed by Terragraphics Environmental Engineering,

A. Location of Project:

This project will take place in six different residences in Smelterville, Idaho.
A previous lead inspection of these residences by Terragraphics Environmental Engineering revealed that a house dust lead concentration is present that represents a potential hazard to occupants and workers who may disturb it during routine maintenance or lead reduction control activities.

B. Brief Description of Job:

This job will involve the following lead hazard reduction measures:

1. Remove and replace all rugs, carpets, carpet pads, tack strips and cloth furnishings (couches, chairs, draperies, etc.) in the living spaces of the above residences.
2. Clean duct work in all six homes that meet NADCA Standard 1992-01.
3. Clean all hard surfaces (ceiling and light fixtures, walls, windows, window wells/troughs, cupboards, exterior surfaces of appliances, refrigerator coils and undercarriages, floors, etc.) in living spaces (including attics and basements) using HEPA vacuuming and wet washing methods.

C. Schedule:

This job is expected to start on August 28, 2000 and end on September 30, 2000. The compliance plan will take immediate effect on August 28, 2000. The competent person, Roy Gotzman, will conduct work site visual inspections on a daily basis.

Work will proceed according to the following schedule:

1. 8/29/00 – House number 1: Remove carpet and cloth furniture, clean ducts, clean all

hard surfaces using HEPA vacuuming and wet wash methods.

2. 9/3/00 - House number 2: Remove carpet and cloth furniture, clean ducts, clean all hard surfaces using HEPA vacuuming and wet wash methods.
3. 9/6/00 - House number 3: Remove carpet and cloth furniture, clean ducts, clean all hard surfaces using HEPA vacuuming and wet wash methods.
4. 9/11/00- House number 4: Remove carpet and cloth furniture, clean ducts, clean all hard surfaces using HEPA vacuuming and wet wash methods.
5. 9/15/00 - House number 5: Remove carpet and cloth furniture, clean ducts, clean all hard surfaces using HEPA vacuuming and wet wash methods.
6. 9/22/00 - House number 6: Remove carpet and cloth furniture, clean ducts, clean all hard surfaces using HEPA vacuuming and wet wash methods.

D. Equipment and Materials:

HEPA vacuums, air filtration machines (if necessary), protective clothing (for some phases of the work), appropriate respirators (for some phases of the work), work gloves, mops, buckets, rags, TSP solution and other necessary cleaning items will be used during the lead reduction work process.

E. Crew:

A crew of 4 – 6 workers will complete the work crew. Each worker will be involved in all phases of the lead reduction process. The names of the workers are listed in section M.

F. Competent Person:

Roy Gotzman, an EPA/HUD certified lead abatement supervisor, will be on site at all times and will act as the competent person for occupational, health and safety issues. His lead certification number is 1014. Roy will conduct daily inspections of the work to ensure that the control measures, work practices, personal protective equipment, and hygiene facilities/procedures are being properly used.

G. Control Measures:

Removal, replacement, HEPA vacuuming and wet wash methods will be the primary control measures used for this project. Following is a step-by-step sequence of events and procedures that will be used to reduce the lead dust levels at the six home sites.

1. Removal of Rugs, Carpets and Cloth Furnishings. On the first day of cleaning and prior to performance of any other work, Alpha Environmental will remove and dispose of all rugs, carpets, carpet pads, and carpet tack strips using the following procedures:

   a. HEPA vacuum the entire surface area of the carpet.
   b. Mist the entire surface of the carpet with water to keep dust down.
   c. Roll the carpet inward to avoid spreading dust to other areas.

d. Wrap carpet and pad in 6 ml. Polyethylene plastic sheeting. Tape the seams closed with duct tape.
e. Vacuum floor with a HEPA filter equipped vacuum cleaner after the carpet is wrapped, but before it is removed.
f. HEPA vacuum the floor again after the carpet is removed from the work area.
g. Workers will be in protective clothing and respiratory protection during the carpet removal process.

Upholstered furniture shall be HEPA vacuumed, misted with water, wrapped in 6 ml plastic and removed from the home ready for disposal. Box springs and mattresses shall be cleaned using HEPA vacuum and wet wipe methods. Window coverings and drapes shall be prepared (HEPA vacuum, wet wiped and wrapped in plastic) for disposal.

2. Duct Work Cleaning. Upon completion of removal of rugs, carpets, and cloth furnishings, Alpha Environmental shall proceed with duct work cleaning via Parrott Mechanical (Duct Work Cleaning Sub Contractor for this project). Parrott Mechanical will provide air duct cleaning as the first cleaning activity in the home. Their work will meet NADCA Standard 1992-01 and the procedures out lined by Terragraphic Environmental Engineering in Appendix F of the Interior Dust Cleaning Work Plan.

3. Cleaning of Hard Surfaces. Upon completion of cleaning the duct work, Alpha Environmental will proceed with cleaning of all hard surfaces in all living areas. Attics and basements will only be cleaned if they are used for living space. Alpha Environmental will proceed in an orderly manner, progressing throughout the house as described in Appendix E of the Terragraphics Interior Dust Cleaning Work Plan. Alpha Environmental will follow the "rules of thumb" protocol as out lined in Appendix E. They are:

- Always clean from top to bottom.
- Always remove all visible dirt and dust.
- All wet washing will be done with trisodium (TSP) or equivalent soap, except in cases where this soap may damage paint.
- All dry vacuuming will be done with a HEPA filter vacuum.
- The cleaning sequence should be conducted in a manner that once a room is final cleaned it will not be re-entered by the cleaning crew.

a. Ceilings: Ceilings will be vacuumed first then wet washed. Asbestos containing ceilings will not be cleaned. Ceiling fans will be wet washed and the outside of the motor or any other part that cannot be wet washed will be HEPA vacuumed. Light fixtures will be taken down and wet washed.

b. Walls: Walls will be HEPA vacuumed and wet washed. Care will be taken so as not to damage wall papered surfaces.

c. Windows: Drapes and curtains will be HEPA vacuumed, misted with water, wrapped in plastic and disposed of. Blinds will be HEPA vacuumed and wet wiped. Interior windows, window wells, troughs and trim will be HEPA vacuumed and wet washed. Sliding glass doors will also be wet washed.

d. Large Appliances: Refrigerators, washers, dryers and dishwashers will be wet washed on the outer surfaces. Coils and motors will be HEPA vacuumed and wet washed.

e. Cupboards, Drawers and Closets: The tops, outside surfaces and inside surfaces will be HEPA vacuumed and wet washed.

f. Floors: Hardwood and linoleum floors will be HEPA vacuumed, then wet mopped with a high phosphate solution in one direction and then again in the opposite direction, then mopped again with clean rinse water. This will be done after the other room areas have been cleaned.

g. Basements/Attics: If the basement or attic is used for living space, then it will be cleaned according to the protocols above.

h. Enclosed Porches and Mudrooms: These areas will be HEPA vacuumed and wet cleaned if used for anything besides storage.

i. Bathrooms: Bathrooms will be cleaned according to the protocols above. Tile and/or linoleum will be HEPA vacuumed and then wet mopped in one direction and then the other, then rinsed with clean water.

j. Miscellaneous: All heater registers, bathroom fans, kitchen fans, lint traps will be cleaned according to the protocols above.

k. Disposal of cleaning supplies: Dirty wash water will be flushed down the toilet. Used mop heads and rags will be placed in lead labeled disposal bags and taken to the Pan Handle District (PHD) disposal site with the rest of the household waste from this project. Wash water will be changed after every room. New mop heads, rags, sponges and gloves will be used at each house.

H. Respirators:

All individuals in the work area will be provided with a NIOSH/MSA approved half mask, air purifying respirator equipped with HEPA cartridges or a powered air purifying respirator (if so requested).

Respirators will be provided in the context of a complete respiratory protection program.

Respirators will be required during the carpet removal process and the initial HEPA vacuuming sequence.

Respirator use during wet washing and the final HEPA vacuuming process will not be required.

I. Protective Clothing:

Disposable clothing will be worn during the carpet removal process and the initial HEPA vacuuming sequence. If visible contaminated with dust, protective clothing will be HEPA vacuumed before it is removed. Disposable clothing will be placed in lead labeled disposal bags and disposed of at the PHD disposal site for this project.

J. Hygiene Facilities:

Hand washing facilities (bath room sink or kitchen sink) will be used to decontaminate workers since the lead dust levels are expected to be low (a three stage decon with shower is used on job sites that generate high dust levels). Hot water, soap and towels (provided by Alpha Environmental) will be available. Hands and face will be washed before all breaks and at the end of each day. Waste water will simply be rinsed down the sink.

K. Air Monitoring Data:

Initial OSHA personal air monitoring will be conducted on a representative number of employees to determine exposure levels. Results of air monitoring will be made available as soon as possible.

L. Medical Surveillance Program:

A medical surveillance program is already in place for this work crew. It is supervised by Dr Floyd Naugl. Worker blood levels are measured initially before the onset of work, each month for the first six months of employment, and every six months thereafter, unless specified by Dr. Naugle. Blood levels for current employees who will be assigned to this job are between 0 ug/dl and 19 ug/dl. Worker blood level increases of 10 ug/dl or greater or any blood level greater than 25 ug/dl will trigger an investigation of protective equipment and work practices.

M. Training:

The following workers have been trained using EPA/HUD Worker Training Curriculum. The training was conducted by Oregon State University Western Regional Training Center.

Roy Gotzman, Lead Supervisor Cert. # 1474
John Miller, Lead Worker Cert. # 952
Mark Kemmerer, Lead Worker Cert. # 951
Jonathan Bennett, Lead Worker Cert. # 1101
Dave Vasquez, Lead Worker Cert. # 955
Skip Bennett, Lead Worker Cert. # 1100

Plan Completed By:

Roy Gotzman 8/21/00

Signature Date

COMMERCIAL CLEANING PROTOCOL

RULES OF THUMB:

1. Always clean from ***top to bottom***.
2. Always ***remove all visible dirt and dust***.
3. All ***wet washing*** should be done with ***trisodium phosphate (TSP) or equivalent soap***, ***except in cases where this soap may damage paint***, then a detergent other than TSP should be used to clean.
4. Always ***follow manufacturers instructions***.
5. All dry vacuuming should be done with ***a HEPA filter vacuum***.

DEFINITIONS:

Wet Washing: Do not pressure-wash or use strong jets for the cleanup of lead-containing materials when wet washing. Damp cotton rags, mops, and cellulose sponges should be used, or else use equipment that will produce a mist, like a water spray bottle. Once the rag, mop, or sponge is moist, it should be rung out so water is not dripping, but that it is only damp. Rinse the area after washing with clean warm water.

High-phosphate Wash Water: Should contain at least 5% trisodium phosphate (TSP). Read the manufacturer's instructions. Common dishwasher detergent typically contains phosphates. A possible beginning dilution might be 1/8th of a cup of TSP in a gallon of hot water. High-phosphate solutions will strip latex paint and remove old varnish, so waterproof gloves should be worn. Fold the gloves back to prevent the fluid from running down your arms, and keep away from the eyes, nose, and mouth. Test small patches first. The TSP solution can damage deteriorated painted walls and floors (Lead Free Kids 1990, PHD 1992, Conlin et al. 1994).

HEPA: High Efficiency Particulate Air filter. HEPA filters can remove fine dust particulates greater than 0.3 microns in diameter with 99.97% efficiency (Conlin et al. 1994, Farfel and Chisolm 1991). A HEPA vacuum cleaner will be required with a beater bar attachment for carpets and other attachments for walls, corners, etc.

Soft Furniture: Any furniture that is not wood, chrome, glass, or other non-absorbent material. Soft furniture refers to any furniture made of cloth, etc.

SPECIFIC PROCEDURES:

After residents have packed and moved for the duration of the cleaning, and all air duct cleaning has been completed, commercial cleaners will follow the specific procedures outlined below and following the "Rules of Thumb" mentioned above. Initially, a dry HEPA vacuuming of the entire home will be performed starting with the ceiling and proceeding down to the walls and floors, vacuuming all knickknacks, books, the tops of clothes hanging in closets, window sills and wells, furniture, and carpets (Milar and Mushak 1982, Farfel and Chisolm 1991, Goulet et al. 1996, Dixon et al. 1999). When the initial vacuuming is done, then follow the following specific vacuuming and cleaning procedures outlined below.

1. *Ceilings*: Vacuum then wet wash ceilings. Only vacuum drop and acoustical ceilings. Asbestos ceilings will not be cleaned. Wet wash all ceiling fans and vacuum the outside of the motor or any other parts that cannot be wet washed. Light fixtures should also be taken down and wet washed. When cleaning ceiling fans and light fixtures, all electrical switches should be turned off or unplugged. Cracks or leaks to the living area should be reported to oversight personnel and the homeowner will be advised.

2. *Walls*: Remove all wall hangings first. Wet wash all painted and smooth (wallpapered and painted) walls, doors and door trim, vacuum wood paneled walls. Vacuum books and remove from shelves, remove and wet wash knickknacks, and then wet wash all flat surfaces (bookshelves, etc.). Replace all knickknacks and books after cleaning. Any light fixtures on the walls should also be removed and wet washed. Wall hangings (i.e., pictures, etc.) should be carefully cleaned so as no damage occurs (i.e., the frame lightly dusted with a wet sponge or cloth and if the picture is not covered by glass, then lightly vacuumed) and replaced. When wet washing wallpapered surfaces, caution should be used so no damage occurs to the wallpaper, especially around seams. Test a small inconspicuous area first.

3. *Windows*: Remove and dry clean drapes and curtains; wet wash blinds. Wet wash all interior window wells, sills, and trim; wet wash window (inside and out) then wash again using window cleaner; remove and wet wash screens. Follow these procedures for sliding glass doors also. Replace blinds and drapes after cleaning.

4. *Furniture*: Vacuum (5 seconds for a one foot pass), in one direction (horizontally) and then the opposite (vertically), all soft surface furniture (couches, recliners, etc.) and then steam clean in the same manner (move the nozzle in one direction and then go over again but in the opposite direction). Couch cushions should be cleaned on both sides (i.e., all outside edges). Removable covers on cushions or pillows should be taken off and washed, along with any quilts, blankets, or afghans that normally lay on the furniture. Follow all manufacturers instructions for pillows, quilts, blankets, and afghans   Toss pillows should either be washed in a washing machine or cleaned in the same manner as furniture. Procedures and techniques should follow the Institute of Inspection Cleaning and Restoration (IICRC) S300 upholstery

cleaning standard. Hot water extraction is preferred, using a high-phosphate wash. Hot water injection rate must be greater than or equal to 300 psi, the water temperature must be greater than or equal to 200 degrees F, and water recovery must be 75% or greater. If hot water extraction is not the preferable method for the fabric type then the IICRC S300 standard will be followed. Mattresses and box springs will be dry vacuumed on all outer surfaces. All hard furniture (wood, glass, chrome, etc.) should first be vacuumed then wet washed from top to bottom.

5. *Appliances*: TVs, VCRs, stereos, computers, etc. should be vacuumed (and wet washed if possible) on all sides and underneath. Appliances should be moved in order to vacuum and wet clean underneath. Larger appliances such as refrigerators, washers, dryers, dishwashers, etc. should be wet washed on the outer surfaces, and coils and motors should be vacuumed. Lint traps in dryers should be cleaned and then vacuumed. These appliances should also be moved in order to clean underneath and behind. *Again, all appliances should be unplugged prior to any cleaning!*

6. *Wall Hangings and Lampshades etc., and Fireplaces and Wood Stoves*: These should all be vacuumed (and wet washed if a hard smooth surface). Wood boxes and stacked wood piles should be moved, and the floor underneath cleaned (according to this protocol) and the pile replaced when the floor is dry. Any mirrors on the walls should also be cleaned first by wet washing, then washed again with window cleaner.

7. *Cupboards, Drawers, and Closets*: Remove all belongings and valuables from kitchen, bathroom, and other room cupboards, drawers, and closets. Vacuum the tops, outside surfaces and inside surfaces of the cupboards and drawers, then wet wash. Closets should be cleaned in the same manner as walls, floors and bookshelves.

8. *Floors*: All furniture will be moved to allow thorough cleaning of the floor underneath and then replaced to its original position. All carpets should be vacuumed first and then cleaned using hot water extraction(i.e., steam cleaning). Vacuuming should occur first in one direction (horizontally) and again in the opposite direction (vertically). Detergents used for steam cleaning should also contain a high-phosphate solution. The IICRC S001 Carpet Cleaning Standard should be followed. Hot water injection rate must be greater than or equal to 300 psi, the water temperature must be greater than or equal to 200 degrees F, and water recovery must be 75% or greater. If hot water extraction (including high-phosphate) is not possible for the carpet type then the carpet should be cleaned according to the IICRC S001 standard protocols. Hard wood and linoleum floors should first be dry vacuumed and then wet mopped with the high-phosphate solution, again in one direction and then the opposite direction, and then mopped again with a clean water rinse. All throw rugs will be laundered.

9. *Basements/Attics*: If the basement or attic is used for living space, then it should also be cleaned according the protocols above.

10. *Enclosed porches and mudrooms*: These should also be vacuumed and wet cleaned if used for anything besides storage. This includes moving any woodpiles, etc., cleaning underneath, and replacing to original position.

11. *Bathrooms:* Bathrooms should be cleaned according to the protocols above. Tile and/or linoleum should be vacuumed and then wet mopped in one direction and then the other. Mirrors and fans should also be wet washed. The outside of medicine cabinets and cupboards/towel storage should also be wet washed.

12. *Pet Furniture*: If the pet furniture has a removable cover, then it will be taken off and laundered. Cat perches and carpeted scratching pads should also be vacuumed and steam cleaned. All other soft pet furniture should at least be vacuumed.

13. *Miscellaneous:* All heater registers, bathroom fans, kitchen fans, lint traps should be cleaned and then vacuumed. If wheelchair ramps are present inside the home, they should also be cleaned according to the protocols above. Stair banisters should also be vacuumed and wet washed. Stairs should be cleaned according to the protocol for floors. Baseboard heaters should also be vacuumed then wet washed. It is recommended that all electricity be turned off prior to cleaning baseboard heaters.

14. *Attached garages:* Any throw rugs present in an attached garage should be laundered. If throw rugs are not available for the door to the garage, they will be provided.

15. *Disposal of cleaning supplies:* Dirty wash water shall be flushed down the toilet. Used mop heads and rags shall be thrown away and taken to the PHD disposal site with the rest of the household waste from this project. New mop heads, rags, sponges, and gloves will be used at each house.

References

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Checklist for Cleaning Contractor

Accident Prevention Plan approved___

Cleaning Supplies

All new mop heads, rags, sponges and gloves ____
Vacuum Cleaner is HEPA filter vacuum
Wet washing with TSP or equivalent (except where can damage) ____
Clean top to bottom ____
Remove all visible dirt and dust ____
UNPLUG APPLIANCES ____

Duct Work Cleaning

Copies of NADCA certification provided __
Copy of ICP license__
Vacuum cleaner NADCA approved_

Vacuum cleaner cleaned prior to starting in home ___
Unused middle filter installed prior to cleaning in each home__
Lint trap vacuumed and wet washed ___
Baby wipes to clean rest of unit ___
Final baby wipes show no dirt ___
All vacuum pieces completely dry__

Middle filter weighed by TG prior to cleaning__
Asbestos Survey completed__
Video tape prior to cleaning__

Ductwork cleaned ____
Plenum cleaned____
Drain pans cleaned____
Burner and heat exchanger cleaned____
Blower motor cleaned and degreased____
Condensing fan cleaned ____
Compressor cleaned____
Humidifier cleaned___
Evaporation coil cleaned____
New furnace filters installed_
Videotape cleaned ductwork ____

Lint trap/first stage screen emptied into middle filter and weighed by TG__

Cloth Furnishings and Hard Surfaces

Dry HEPA vacuuming of entire home completed __
Ceilings first____
Walls to Floor____
Knickknacks/books/tops of cloths hanging in closets______
Window sills/wells___
Furniture_____
Carpets______

Ceilings (asbestos ceilings shall not be cleaned)

- All cracks and leaks reported to the Government prior to cleaning___
- All electrical switches to lights and fans turned off___
- Ceiling vacuumed___
- Ceiling wet Washed (N/A on acoustical ceilings)___
- Ceiling fans vacuumed and wet washed____
- Light fixtures removed and washed____

Walls

- All wall hangings removed and carefully cleaned___
- All painted and wallpapered walls wet washed_____
- Wood walls vacuumed______
- All shelves wet washed______
- All knickknacks wet washed and replaced ____
- All books vacuumed and replaced___
- Light fixtures removed and washed_
- All wall hangings replaced___

Windows and sliding glass doors

- Storm windows removed and cleaned____
- Windows opened and thoroughly wet washed____
- Windows cleaned again with window cleaner ____
- Blinds wet washed___
- Window coverings dry cleaned_____
- Window sills and trim wet washed__
- Window screens removed and wet washed__
- Blinds and drapes replaced__
- Sliding glass doors wet washed and cleaned ___

Furniture

- Soft Furniture
  - Vacuum in 5 sec/ft pass horizontally____
  - Vacuum in 5 sec/ft pass vertically___
  - Steam clean
    - High Temp/High Phosphate wash___
    - Steam Clean horizontally____
    - Steam Clean vertically____
  - Clean pillows ____
  - Remove covers of cushions pillows and wash _____
  - Wash per mfg inst quilts/afghans/blankets that sit on furniture ____

Appliances

- Unplugged___
- Large Appliances moved to get to undercarriage.
- Large appliance coils and motors vacuumed____
- All exterior surfaces wet washed____
- Refrigerator coil and undercarriage cleaned ____
- TV/VCR/Stereos/Computers etc Vacuumed ____
- TV/VCR/Stereos/Comp. Wet washed (If possible) on all sides and bottom_______
- Washer/dryer/dishwasher cleaned___
- Lint trap cleaned then vacuumed ___

Wall hangings/lampshades/fireplaces/wood boxes

- Vacuumed___
- Wet wash hard smooth surfaces_____
- Wood piles moved to clean floor____
- Woodpile replaced after floor dried____
- Wet wash mirrors____
- Wash mirrors with window cleaner____

Cupboards/Drawers/Closets

- Remove Contents from Kitchen/bathroom other room cupboards ________
- Vacuum tops/outside surfaces/inside surfaces______
- Wet Wash tops/outside surfaces/inside_____
- Clean Closets same as Walls/floors/bookshelves____

Floors

- All other areas cleaned ____
- Furniture removed to allow cleaning ____
- Carpets
  - Vacuum carpets_____
  - Steam Clean Carpet__
    - Detergent is high phosphate
    - Hot water greater than 300 psi, 200 deg_____
    - Water recovery is 75%______
  - Dry Carpet___
  - Vacuum again in one direction______
  - Vacuum again in other direction____
- Hard Wood Floors/Linoleum
  - Dry Vacuum____
  - Wet mop w/high phosphate solution in one direction______
  - Wet mop w/high phosphate in other direction______
  - Mop again with clean water rinse___
- Launder throw rugs ____

Basement/Attic (if living space) cleaned as above __

Enclosed Porches/Mudrooms

- Vacuum_____
- Wet cleaned__

Bathrooms cleaned as above

- Tile/linoleum vacuumed_____
- Tile/Linoleum wet mopped in one direction ____
- Tile/Linoleum wet mopped in other direction______

Pet Furniture

- Remove and launder cover from any pet furniture__
- Cat perches and carpet scratch pads vacuumed_____
- Cat perches and carpet scratch pads steam cleaned____
- All other pet furniture vacuumed____

Miscellaneous

ALL ELECTRICITY TURNED OFF When Working on heaters ____

Heat registers cleaned and vacuumed____

Bathroom fans cleaned and vacuumed______

Kitchen fans cleaned and vacuumed ____

Lint traps cleaned and vacuumed____

Wheel chair ramps cleaned as above ____

Stair banisters vacuumed and wet washed___

Stairs cleaned as floors______

Baseboard heaters vacuumed then wet washed_____

Attached garages

Throw rugs laundered____

Cleaning supplies disposal

Dirty water flushed down toilets____

Used mop heads rags disposed at PHD disposal site____

SOLICITATION FOR BIDS:
HOUSE DUST PILOT PROJECT (PHASE II)
FOR A COMMERCIAL "SPRING CLEANING"

Six houses in Smelterville, Idaho will be selected for cleaning. The average size of each house is approximately 1300 $ft.^2$ (ranging from approximately 800-1900 $ft.^2$), with an average of 3 bedrooms, 1 living room, and 1 kitchen. The cleaning should last approximately one day and cover the following checklist:

- # Ceilings - vacuum/wet wash
- # Ceiling fans - vacuum/wet wash
- # Light fixtures - take apart and vacuum/wet wash
- # Wall hangings - take down to wash walls and vacuum/wet wash
- # Walls - vacuum/wet wash
- # Inside windows, sills, wells, and trim - vacuum/wet wash
- # Outside windows, sills, wells, and screens - wet wash (*only if window opens*)
- # Blinds - vacuum/wet wash
- # Curtains and Drapes - vacuum (*if possible*)
- # Cupboards - vacuum/wet wash tops and outsides only
- # Furniture - vacuum all soft furniture except mattresses (e.g., couches, chairs, etc.), dust tops of hard furniture (e.g., bookshelves, TV and stand, etc.), and move to vacuum floors and edges behind and underneath
- # Appliances (i.e., refrigerators, stoves, freezers, washers, dryers) - wet wash outside only and then pull out to vacuum coils, etc. behind and underneath, also vacuum/wet wash floors and walls behind
- # Floors - vacuum/mop all hard floors, vacuum all carpeting, along edges and floorboards using accessories and underneath furniture and appliances

Note: Vacuum/wet wash is used to mean both, or either or. For example, vinyl blinds can be wet washed while cloth blinds can be vacuumed.

The estimated dates of the cleaning will occur between November 1- 15, 2000.

Please state any dates you would not be available for cleaning______________________________

Please state what kind of vacuum cleaner would be used (HEPA, triple filter, etc.)_____________

Please state how many crews would be available to clean (1/day, 2/day, etc)__________________

Please state a bid per house: Insured and bonded? Yes No

$____________________________________

Please state a bid per house if steam cleaning carpets was added to the checklist:

(with carpet covering an average of 60% of floor)

$___________________________________

__

“SPRING CLEANING” PROTOCOL

RULES OF THUMB:

1. Always clean from ***top to bottom***.
2. Always ***remove all visible dirt and dust***.
3. Always ***follow manufacturer’s instructions***.
4. All dry vacuuming should be done with ***a HEPA filter vacuum***.

SPECIFIC PROCEDURES

1. *Ceilings*: Vacuum then wet wash ceilings. Only vacuum drop and acoustical ceilings. Asbestos ceilings will not be cleaned. Clean all ceiling fans, light fixtures, etc. When cleaning ceiling fans and light fixtures, all electrical switches should be turned off or unplugged.

2. *Walls*: Remove all wall hangings first. Wet wash all painted and smooth (wallpapered and painted) walls, doors and door trim, vacuum wood paneled walls. Vacuum books, knickknacks, and flat shelf areas. Any light fixtures on the walls should be cleaned as well. Wall hangings (i.e., pictures, etc.) should be carefully cleaned so as no damage occurs (i.e., the frame lightly dusted with a wet sponge or cloth and if the picture is not covered by glass, then lightly vacuumed) and replaced. When wet washing wallpapered surfaces, caution should be used so no damage occurs to the wallpaper, especially around seams. Test a small inconspicuous area first.

3. *Windows*: Remove and clean any mini-blinds, and vacuum or shake out drapes and/or curtains. Wet wash all interior window wells, sills, and trim; wash window (inside and out); remove and wet wash screens. Follow these procedures for sliding glass doors also. Replace blinds and drapes after cleaning.

4. *Furniture*: Vacuum in one direction and then the opposite, all soft surface furniture (couches, recliners, etc). Couch cushions should be cleaned on both sides (i.e., all outside edges). Any quilts, blankets, or afghans that normally lay on the furniture should be taken outside and shaken. Toss pillows should be vacuumed as well. All hard furniture (wood, glass, chrome, etc.) should be cleaned.

5. *Appliances*: Large appliances, such as refrigerator and stove, should be moved in order to clean underneath, and cleaned on the outside. Coils and motors should be vacuumed. Lint traps in dryers should be cleaned. *Unplug any appliance prior to cleaning!*

6. *Wall Hangings and Lampshades etc., and Fireplaces and Wood Stoves*: These should be cleaned to remove all dust, but wood piles need not be moved. Any mirrors on the walls should be cleaned.

7. *Cupboards, Drawers, and Closets*: The outsides of cupboards and drawers should at least be vacuumed and/or wet washed. The contents do not need to be cleaned. Closet walls and ceilings should be vacuumed like other walls, without removing the contents, and the tops of hanging clothes should be vacuumed.

8. *Floors*: All furniture will be moved to allow thorough cleaning of the floor underneath and then replaced to its original position. All carpets should be vacuumed first in one direction and again in the opposite direction. Vacuum cleaner attachments should be used to vacuum edges and corners of floors. Hard wood and linoleum floors should first be dry vacuumed and then wet mopped, again in one direction and then the opposite direction. All throw rugs will be thoroughly vacuumed.

9. *Basements/ Attics*: If the basement or attic is used for living space, then it should also be cleaned according to the protocols above.

10. *Enclosed porches and mudrooms*: These should be cleaned if used for anything besides storage.

11. *Bathrooms*: Bathrooms should be cleaned according to the protocols above. Tile and/or linoleum should be mopped in one direction and then the other to remove dust. Mirrors and fans should be cleaned, as well as the outside of medicine cabinets and cupboards/towel storage.

12. *Pet Furniture*: Soft covered pet furniture should at least be vacuumed.

13. *Miscellaneous*: All heater registers, bathroom fans, kitchen fans, and lint traps should be cleaned according to the above protocols, as well as any wheelchair ramps, stair banisters, stairs and baseboard heathers. It is recommended that all electricity be turned off prior to cleaning baseboard heaters.

14. *Attached garages*: Any throw rugs present in an attached garage should be cleaned.

15. *Disposal of cleaning supplies*: Dirty wash water shall be flushed down the toilet. Used mop heads and rags shall be thrown away and taken to the PHD disposal site with the rest of the household waste from this project. New mop heads, rags, sponges, and gloves will be used at each house.

FINAL

(1)

SAMPLING AND ANALYSIS DATA PLAN
(SAP)

HUD Lead-Based Paint Risk Assessment Support for
Bunker Hill House Dust Pilot Study
Smelterville, Idaho

DACW67-00-P-1159

Authority:
HUD RA- HOUSE DUST PILOT

Date of Preparation:
August 1, 2000

Revised Aug 27, 2000

CONTRACTORS COMMITMENT TO IMPLEMENTING THE SAP
Dodds Envirotech Corporation
565 W Arlington
Gladstone, Oregon 97027

Signed By: ______________________
Douglas S. Dodds - President

Table of Contents

(3)

FIELD SAMPLING PLAN

HUD Lead-Based Paint Assessment Support for
Bunker Hill House Dust Pilot Study
Smelterville, Idaho

August 27, 2000

SECTION 1.0

INTRODUCTION

Summary of Existing Site Data
1.1

Interior dust lead concentrations have been monitored annually at the Bunker Hill Superfund Site for more than ten years (Terra Graphics 2000a). As part of the Record of Decision (ROD) (EPA 1992), a Remedial Action Objective (RAO) was established for dust lead concentrations. The ROD states that "all homes with house dust lead concentrations equal to or exceeding 1000 ppm will have a one time cleaning of residential interiors after completion of remedial actions that address fugitive dust. If subsequent interior house dust sampling indicates that house dust lead concentrations exceed a site wide average of 500 ppm lead, the need for additional cleaning will be evaluated" (EPA 1991). The rationale for this derived from a 1990 pilot cleaning study in which several homes at the site received comprehensive interior cleaning, yet carpets in the home became re-contaminated within one year (CH2M Hill 1991). As a result, it was determined that home interiors could not be permanently remediated until exterior contamination sources were addressed. Because interior dust lead concentrations are highly correlated with exterior soil lead concentrations, the cleanup at the site has focused on reducing yard and community soil lead concentrations to the soil RAO, which is "to achieve community mean soil lead concentrations of approximately 350 ppm by removal of soils exceeding the threshold level of 1000 ppm lead" (EPA 1991). House dust lead concentrations were expected to subsequently decrease as the exterior-to-interior path was reduced. Studies monitoring interior dust lead concentrations indicate that this reduction is indeed occurring, but interior cleaning may still be necessary to further reduce dust lead concentrations (TerraGraphics 1997, 2000a). This feasibility Pilot Cleaning Project details a plan to respond to this mandate under the ROD.

Smelterville is the only community within the site where soil remediation is complete, and soil RAO's have been achieved (TerraGraphics 1999a, 2000b). Interior dust data from the 1998 Panhandle Health District (PHD) sampling season indicate that mean dust lead levels for Smelterville are slightly higher (570 mg/kg) than the RAO with 10% of the homes exceeding 1000 mg/kg (TerraGraphics 1999b). Results of the 1999 PHD interior dust data for Smelterville reveal a geometric mean lead concentration of 595 mg/kg with 30% of the homes exceeding 1000 mg/kg (Terra Graphics 2000c). Recent data indicate that lead levels are nearing the RAO in Smelterville, although the objectives have not been completely achieved. One possible explanation, along with others discussed is that residual smelter dust has remained in reservoirs within homes.

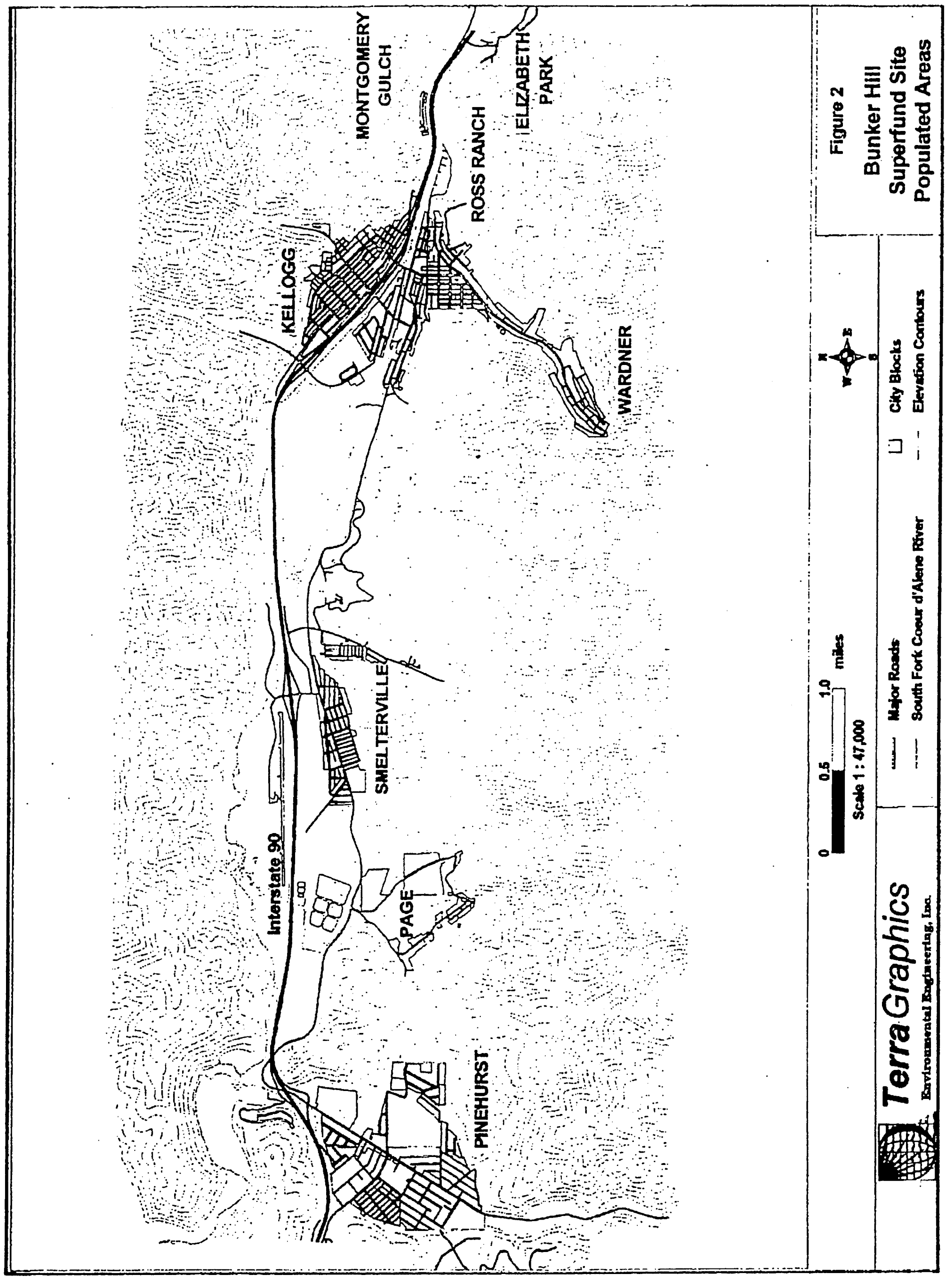

Figure 2
Bunker Hill Superfund Site Populated Areas

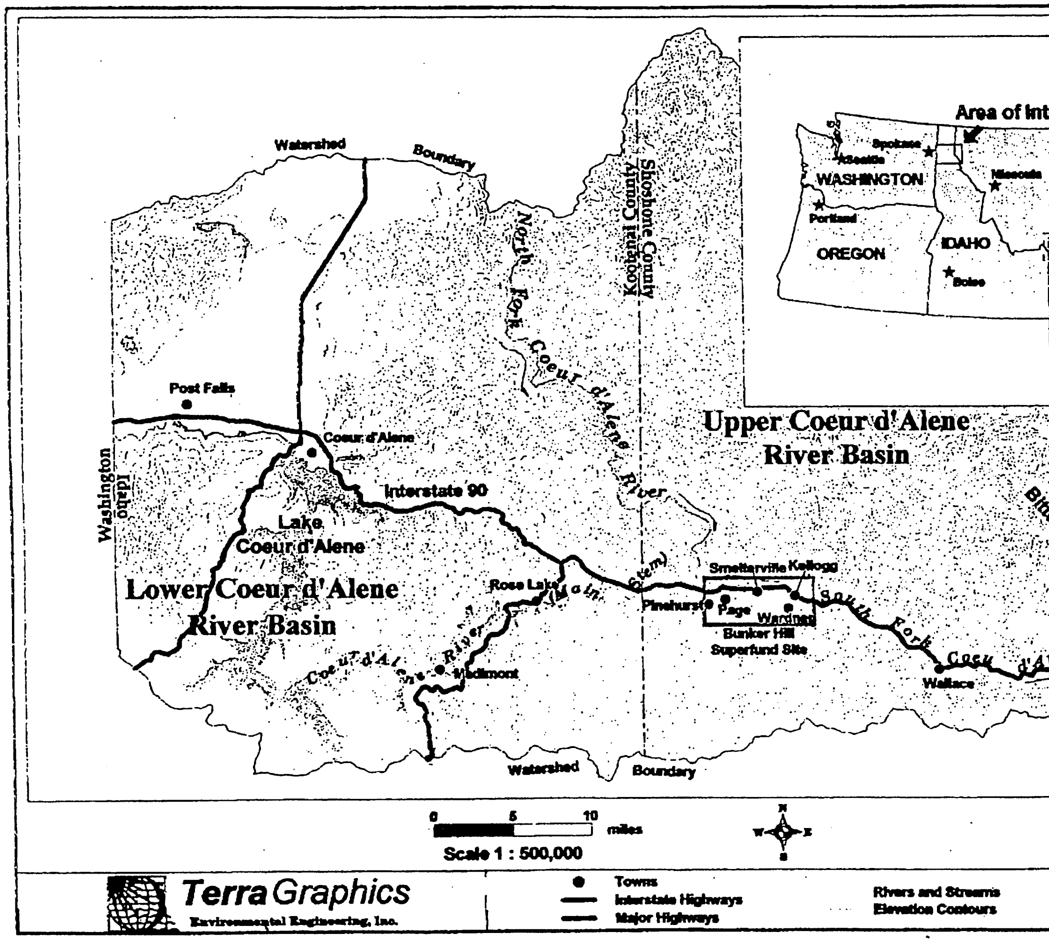

Figure 1
Site
Location Map

Existing Information
1.2

Site Specific Sampling and Analysis Problems.

On-Site observation, inspection and inquiry of the resident's occupation, house cleaning techniques, children's play areas, care and maintenance of housing units, and structural conditions that may impact the deterioration of existing lead-based paint shall be combined to establish possible sources of lead dust.

SECTION 2.0
Project Description

2.1
Purpose and Objectives

Dodds Envirotech Corporation will share information with TerraGraphics Environmental Engineering in their efforts to determine the feasibility of instituting home interior cleaning in order to achieve and maintain a low dust lead level in the home. The primary purpose of the study is to assess the effectiveness and efficiency of long-term remedial solutions for the "Bunker Hill House Dust Pilot Study". A secondary purpose is to identify logistical problems associated with any comprehensive community-wide cleanup that might be required. Dodds Envirotech Corporation shall conduct a Lead-Based Paint Risk Assessment in all 16 homes and conduct lead-dust wipe sampling of the window wells and sills in the child's bedroom and living room in all of the pre-selected housing units as well as any additional environmental samples that Dodds Envirotech Corporation might determine to benefit the assessment of lead-dust hazards. The Risk Assessment shall be based upon the methods outlined in the HUD Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing – 1995 (including the 1997 up-dates). The sampling shall occur at the time of the project Pre-Cleaning Interview, upon completion of the cleaning effort (within 24 hours), again in six months and again in twelve months (the focus will be on measurement of lead loading (e.g., ug/ftsq). Efforts will be made to identify other sources of lead exposure in the homes that could be amenable to cleaning. The entire surface of the window wells and window sills will be sampled and the area of each will be measured. Lead loading data will be obtained from these samples for each sampling event. Effectiveness of the Project Cleaning Procedures will be determined by comparing short-term (post cleaning) dust levels at specified locations with baseline (pre-cleaning) levels. A long-term effectiveness determination, including information on re-contamination, will be made by sampling the same specified areas at six and twelve months after the cleaning. All sampling will use the same procedures used in the pre-cleaning sampling. Dodds Envirotech Corporation will perform these sampling activities and have prepared appropriate SAPS and QAPPS to support these sampling events. Dodds Envirotech Corporation will share data with TG. TG will perform an advisory role related to the data obtained and will prepare a report on effectiveness of the methods used. After Dodds prepares a detailed Lead-Based Paint Risk Assessment report for each of the homes, the report should be submitted to TG for incorporation in the final report. All wipe samples shall be analyzed for lead using methods detailed in the most current edition of Test Methods for

Evaluating Solid Wastes, SW-846. Dust samples shall be digested in accordance with SW-846 method 3050m. After digestion, all samples shall be analyzed for lead by inductively coupled plasma atomic emission spectroscopy (ICP) in accordance with SW-846 method 6010. In order to maintain Quality Control and Quality Assurance in dust sampling Albertsons Unscented baby wipes shall be used as the sampling wipe. The Inspector/Risk Assessor will don new gloves prior to each sample taken and shall wet the wipe sufficiently to ensure the capture of all possible lead-dust. The entire surface (carefully measured and noted) shall be wiped and placed in a new 50ml tube, capped, and labeled. The sample shall then be placed in a secure case for transport by the Risk Assessor to the lab with the appropriate chain of custody report. The glove shall be removed and placed in a waste disposal bag and a new glove put on prior to the acquisition of the next sample. Unmarked spiked wipe samples shall be introduced during the project and submitted for analysis with regular field samples in order to ascertain the efficiency of the laboratory digestion procedure (see Chapter 5, Section IV and appendix 14.3, HUD Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing). The hard centrifuge tubes shall be triple rinsed in the laboratory to ensure quantitative transfer. Dry wipes will not be used. At no time will the surface area to be wiped be touched except by the prepared wet wipe. On the window wells and sills it is not possible to wipe in one direction and then another in a "S" motion as is recommended for floor sampling, however two side to side passes shall be made over this surface, the contaminated side folded so that it faces inward prior to the second pass. Other portions of the sill or well are to be avoided. Paint chips or gross debris in the area shall be gathered on the wipe. A second wipe shall be used if necessary to include as much dust and debris as possible. If the dust and debris is excessive, half of the wipe surface shall be taped off and the remaining area measured before testing. The wipe will be folded in on itself so that the contaminated side does not contact the exterior of the centrifuge tube. A master log should be filled out with the chain-of-custody report for each centrifuge tube label ensuring that the sample numbers and identifying numbers match. The field sampling form will be filled out (Form 5.4 - Appendix F) including notes regarding the type of wipe used, lot number, collection protocol, etc.. All waste such as tape and gloves shall be placed in a waste bag and removed from the location to ensure that no children come in contact with hazards or plastic that could result in a suffocation hazard.

The Risk Assessment will determine the presence of or absence of Lead-Dust Hazards and suggest appropriate hazard control measures. This assessment shall consist of: Visual Assessment, Dust Sampling, Historical Evidence, Previous Lead-Inspection and Lead-in-Soil Historical Data. Care will be taken to identify the pathways of exposure, location of children and areas they frequent, residential use patterns, and occupational relationships that may impact the evaluation of pathways of the presence of lead dust. Special attention will focus on finding hidden lead reservoirs, or the identification of external sources of lead contamination such as pets, workers whose employment may result in the contamination of clothing or play areas external to the home that may be contaminating the children's clothing.

2.2
Scope and Limitations

This project will involve the cleaning of twelve homes in Smelterville randomly selected through previous sampling and questionnaire results, and confirmed in subsequent interviews. Cleaning will be limited to areas with potential for exposure (accessible portions of the residence, including ducts). Four additional control homes in Smelterville will not be cleaned but will be sampled by the same methodologies as the cleaned homes.

The effort to attain useful analytical data necessary to evaluate cleaning techniques and time weighted averages related to re-contamination will be made according the the standard of care for the industry (HUD Guidelines for the Evaluation and Control of Lead-Based-Paint Hazards in Housing - 1995) and the Coordinated Effort of TG and Dodds Envirotech Corporation. This joint sharing of data and the observations of both teams, combined with historical and physiological information should result in a useful study. The limitations that exist will most likely be related to a lack of information about use patterns, surrounding community hazards, and contaminated objects entering the housing area (carrying lead dust that may become airborne or fall into and/or around the home).

SECTION 3.0
PROJECT ORGANIZATION AND MANAGEMENT

3.1
Project Organization and Responsibility

Douglas S. Dodds - Risk Assessor

Dodds Envirotech Corporation
565 W. Arlington
Gladstone, Oregon 97027
Certification Number #1029

Douglas Sherwood Dodds
Lead-Based-Paint Risk Assessor
Certification #1006

Leslie Marie Dodds
CEO/Principle Owner

Douglas Sherwood Dodds
Shall conduct all field investigative activities and conduct the Risk Assessment for this project.

3.2
Reporting and Documentation

Dodds Envirotech Corporation will keep the TerraGraphics Project Officer informed and updated on activities during field work by:

- **weekly summary reports and/or calls or meetings**
- **written monthly reports, and**

Any additional meetings and reports will be scheduled or submitted as conditions change and new issues arise. Interim data summary memos will be submitted as data become available. A final summary report will be submitted at the end of the project.

4.0
SCHEDULE OF TASKS AND MILESTONES

1. **Coordinate the Start Date:_____________**

2. **Conduct the Initial Window Sill and Window Trough Wipe Sampling and Risk Assessment Survey at the time of the Pre-Cleaning Interview.**
3. **HUD Lead-Based Paint Risk Assessment**
4. **Re-Visit sights and re-sample upon completion of Cleaning (24 hours turn around)**
5. **Re-Visit sights and re-sample at end of six months**
6. **Re-Visit sights and re-sample at end of one year**
7. **Coordinate final results with TerraGraphics and Final Risk Assessment.**

5.0
SAMPLING AND ANALYSIS PLAN

The sampling and analysis plan (SAP) describes the sampling strategy, techniques, and quality control (QC) procedures necessary to perform the House Dust Pilot Project sampling. These procedures are meant to ensure the precision, accuracy, and documentation of data generated during sampling activities.

Sixteen residences will be sampled in Smelterville, where soil remediation is complete. Wipe samples of the Window Wells and Sills will be collected at each residence in an attempt to quantify the lead concentrations and lead and dust loading in the home. It is important to note that in residences that have window components (sash, Sill, trough, and stops) that are painted with Lead-Based Paint (paint that is at or above 1.0 mg/cm2), over time that paint will breakdown due to friction between window components such as sash and stops, generating quantities of hazardous Lead-Dust. Other conditions may exist even though the window components may not be painted with Lead-Based Paint. Airborn Lead-Containing dust can have settled in the window trough or on the window sill, resulting from activities outside the home in the mining community. Trucks passing by, dust from road beds blown by the wind or contaminated dust from a near-by residence that has severely deteriorating lead-based paint on the exterior of a structure. The Smelterville community is currently being exposed to unusually high amounts of airborne dust due to a remediation process just east of town where massive amounts of refining materials and soil are being moved (some of this material is known to specifically be waste product from the processing of lead). Such collection of Lead Dust in or on window components is know to EPA and HUD to be one of the largest pathways of exposure to young children resulting in elevated blood lead. Assessment samples will be taken in the troughs and sills of a child's bedroom (children between 6 months and two years of age are most vulnerable to exposure) and the living room / common area where the family gathers frequently and children are likely to spend a large amount of time. In mobile homes this process can only be adapted to the structure as these units are not constructed in the same manner as traditional housing (i.e.; there may be a window sill but the only window well or trough may be a 3/8" grove that an aluminum sash window rides in).

The Window Sill and Window Well samples will be collected using wet wipes by a HUD Risk Assessor (Dodds Envirotech Corporation) contracted by the U.S. Army Corps of Engineers.

5.1
Window Sill / Window Well Dust Samples will be collected as follows:

1. In order to ensure quality assurance in dust sampling, Baby wipes shall be used (Albertsons Unscented - non aloe).
2. All Baby wipes shall be moist - no dry wipes shall be used in sampling.
3. The Inspector / Risk Assessor will don new gloves prior to each sample taken and shall wet the wipe sufficiently to ensure the capture of all possible lead-dust.
4. The entire surface (carefully measured and noted) shall be wiped and placed in a new 50ml centrifuge tube, capped and labeled.
5. The sample number shall be noted in the log book along with the location of the sample and any comments the Risk Assessor feels necessary.
6. The sample shall be placed in a secure transport case for transport by the Risk Assessor to the lab with the chain of custody form.
7. The glove shall be removed and placed in a waste disposal bag.
8. A new glove shall be donned by the Risk Assessor prior to the acquisition of the next sample.
9. During the initial Risk Assessment three unmarked spiked wipe samples shall be introduced during the project and submitted for analysis with regular field samples in order to ascertain the efficiency of the laboratory digestion procedure (see Chapter 5, Section IV and appendix 14.3, HUD Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing - 1995).
10. The hard centrifuge tubes shall be triple rinsed in the laboratory to ensure quantitative transfer.
11. Dry wipes will not be used.
12. At no time will the surface area to be wiped be touched except by the prepared wet wipe.
13. On the window wells and sills, it is not possible to wipe in one direction and then another in an "S" motion as is recommended for floor sampling. However, two side to side passes shall be made over this surface, the contaminated side folded so that it faces inward prior to the second pass.
14. Other portions of the sill or well are to be avoided.
15. Paint chips or gross debris in the area shall be gathered on the wipe.
16. A second wipe shall be used if necessary to include as much dust and debris as possible. If the dust and debris is excessive, half of the wipe surface shall be taped off and the remaining area measured before testing.
17. The wipe shall be folded in on itself so that the contaminated side does not contact the lip or exterior of the centrifuge tube.
18. The wipe shall be recorded by sample number and building component in the log book sample log, chain of custody report and on the tube label.
19. Field sampling form (Form 5.4).
20. Information including notes regarding the type of wipe used, lot number, collection protocol, and location shall be noted in the log book.

21. All waste such as tape and gloves shall be placed in a waste bag and removed from the residence to ensure that no children come in contact with hazards or plastic that could result in a suffocation hazard.
22. The Risk Assessor will personally deliver the samples and chain of custody to "Sound Analytical Laboratory".
23. All sample data shall be communicated to TerraGraphics upon receipt.

5.2
Equipment Decontamination

1. All centrifuge tubes shall be cleaned with a baby wipe on the outside prior to being placed in the transport container.
2. Rulers shall be cleaned with a baby wipe upon completion of each sampling.
3. The Risk Assessor shall wash hands thoroughly upon the completion of sampling.

5.3
Log Books

A field and lab log book will be maintained on a daily basis to document all sampling activities. All notes will be make in indelible ink. Entries on each page will be initialed at the end of each page by the Risk Assessor. If any changes are made to the record, the original notation will be crossed out with a single line and initialed.

At a minimum, log book entries will include:

- Date and time at the start of work and sampling conditions
- Names of sampling crew
- Project name and Number
- Description of site conditions and any unusual circumstances
- Location of sample sites, including map reference
- Equipment identification
- Details of actual work effort, including deviation from the specified methods

5.4
Sample Identification

00=Year if before S
001=sample number and log number
S=Smelterville
WS=window sill
WW=window well

L=living room
C=childs bedroom

Note: Spikes and field blanks shall be submitted to lab as one of above samples

Example: 00S001WSC = Year, Smelterville, sample #001, Window Sill, Child's Room

5.5
Sample Tags and Labels

Sample #______________Date:__________
Location:______________Surface:_______
Area in Inches:_________Condition______
House #_________Street:_______________

5.6
Sample Banking Procedures

The sample bank is the custodian for all records pertaining to the sampling, sample preparation, and shipment of samples to analytical laboratories. The responsibility of the sample bank extends to sample storage and dispensing containers, sampling equipment, and all custody documents (such as chain of custody forms and sample collection and analytical tags) as required. Other responsibilities include updating and maintaining the project's master log book, auditing the records as required, generating sample bank QC samples, scheduling the collection of all samples, and ensuring that all chain of custody requirements pertaining to all sampling, shipping, and banking operations are adhered to, as outlined below:

1. Issuing Supplies

   - On a daily basis, or as appropriate, the sample bank will issue sample containers, sample tags, and chain of custody forms.
   - The sample bank will store sampling equipment in a suitable environment. Sampling equipment will be issued to the sampling personnel on a daily basis as required.

2. Accepting and Logging Samples:

   - Transfer of sample custody from the sampler to sample bank personnel will normally occur at the sample bank.
   - Before accepting custody of any samples, sample bank personnel must check all tags and forms for legibility and completeness. All samples must be properly tagged.

Any discrepancy will be corrected before the sample bank personnel will assume custody. If a discrepancy exists that cannot be resolved to the satisfaction of the sample bank personnel, re-sampling and or filling out additional tags and forms may be required.

- After the sampler relinquishes custody and the sample bank personnel assume custody of the samples, each sample must be logged onto the master log form.

3. Sample documentation for all house dust pilot dust samples:

    - All sample bank numbers for dust samples will be serially numbered, beginning with "001". The sample number will be prefaced with the year and the project (00S). For instance, the first wipe sample logged into the log book will be "00S001".

5.7
Chain of Custody Procedures

Chain of Custody forms shall be provided by "Sound Analytical Laboratory". All appropriate areas of these forms shall be filled out:

- Ensure that sample number matches the information on the sample label, the sample log book.
- Ensure that the address of the property is correct and matches the information in the sample log book and sample label.
- Ensure that the area of the measurements from where the sample was taken are on all documents and match.
- Ensure that the Date is correct and the time of the sample recorded
- Ensure that the Transfer is signed by the recipient and by the person who is transferring the samples.

SECTION 6.0 HEALTH AND SAFETY PLAN

Care will be taken to ensure that occupants are prevented access to or exposure from any sampling methods, procedures or disturbance of Lead-Based Paint Dust. Additionally all sampling derived waste will be carefully handled to prevent small children from having access to any such material or plastic that could cause contact with lead dust or a smothering hazard. The Risk Assessor shall at all times wash hands before and after sampling. Protective gloves shall be worn during sampling to ensure lack of contact with the lead-dust hazards but prevent the cross contamination of samples. If any XRF Testing is required all measures will be taken to ensure the safety of occupants in the area. At no time will any measurements be made from room to room without first determining that the adjoining room is vacant. Dodds Envirotech Personnel will consult the HASP prior to conducting any sampling to ensure that the site safety plan will be adhered to.

SECTION 7.0

QUALITY ASSURANCE PROJECT PLAN

HUD Lead-Based Paint Risk Assessment Support for Bunker Hill House Dust Pilot Study Smelterville, Idaho

7.1 Purpose

To ensure that all window wells and window sills are sampled following the procedures outlined in the HUD Guidelines and all samples shall be properly collected, transported and received and analyzed using methods detailed in the most current edition of Test Methods for Evaluating Solid Wastes, SW-846. Dust samples must be digested in accordance with SW-846 method 3050. After digestion

all samples must be analyzed for lead by inductively coupled plasma atomic emission spectroscopy (ICP) in accordance with SW method 6010. The Laboratory of choice shall be required to provide quality control parameters, check standards and controls, and provide interference check samples.

Sound Analytical Laboratory is aware of the requirements for precision, accuracy, representativeness, completeness, comparability and sensitivity.

Laboratory Quality Assurance Manager or Director:

Signature:__________________________________
Print Name:_________________________________
Date:______________________________________

See Appendix A for "Sound Analytical" QC Methods

7.2
Objectives

The primary purpose of this project is to determine the feasibility of instituting home interior cleaning in order to achieve and maintain a low dust lead level in the home (i.e., achieve the dust RAO for the site). The main objective of this project being to learn about certain parameters (i.e., cost effectiveness, lead reduction, and logistical challenges) associated with interior cleaning so that a large-scale home interior cleaning project can be scoped. Hence, it is necessary that all sample data be gathered by the most stringent and effective methods available, carefully handled and accounted for (sample management) and analyzed with the greatest scrutiny possible utilizing qualified laboratories capable of providing the correct methods and Quality Control Procedures. Only then can TerraGraphics and Dodds Envirotech Corporation jointly evaluate and assess the data gleaned from this project in order that a meaningful Risk Assessment be written.

7.3
Data Quality Objectives for Measurement

Variable	Matrix	Units	# of samples incl. QA/QC	DQO	Limit of	Accuracy	Precision	Completeness	Method	Reference	Maximum

Pb	Win Sill	ug/ftsq	4	ug/per wipe	+/-15%	+/- 15%	90%	ICP	SW-846	6 Months

7.4
Sampling Procedures

The quality of the data collected in an environmental study depends on the quality of the sampling activities. Field operations must be well conceived and carefully implemented. Detailed procedures and protocols for site selection and sample collection, handling, preservation, shipment, and storage must be specified and documented. The sampling program in Section 5.0 describes the proposed site selection, sampling procedures, and other field activities.

7.4.1
Sample Container Preparation and Preservatives

All sample containers will be prepared and provided by either a commercial vendor or the analytical laboratory. Samples will be preserved consistent with recommendations given in "Test Methods for Evaluating Solid Waste, SW-846 (USEPA 1986).

7.4.2
Sample Handling

Sample containers will be kept closed and maintained under custody of a Dodds Envirotech Employee until analysis. Samples will be labeled as they are collected. Sample collection data, including label information, will be recorded in the log book as the samples are collected. Except for rinsate blanks, samples do not require preservation, so containers need only be adequate for safe and secure transport to the laboratory.

7.4.3
Quality Control Samples

Control sample (CS) is a sample of known value, usually from a source different from the calibration standards, used to validate the analytical procedure. One CS is analyzed with every batch of twenty or fewer samples or each matrix type, whichever is more frequent. Sample batches containing CSs that are out of control limits are re-prepared. Control limits for solid CSs are set by the supplier. Water or other aqueous CSs have control limits of 80% to 120% , or as specified in the standard operating procedure.

7.4.4
Changes in Procedures

No changes in procedures shall take place without the consent of the field operations manager. All such changes must be approved, logged into the Job Log Book and reported in writing to the Project Manager.

7.5
Sample Custody

Sample custody is a vital aspect of field investigation programs that generate data for possible regulatory action. The traffic records for samples must be traceable from the time of sample collection until the time the analytical laboratory reports the results of chemical analyses to the appropriate parties.

7.5.1
Field Operations

The key aspect of documenting sample custody is thorough record keeping. A log book will be maintained on a daily basis to document all field and lab activities, including the collection of every sample and field survey information associated with each sampling location. All notes will be made in indelible ink. Each day's entries will be initialed and dated at the end of each day by the sampling crew member who entered the information. If any changes are made to the record, the original notation will be crossed out with a single line and initialed.

Log books will be filed in a secure manner and kept on file at Dodds Envirotech for a minimum of five years.

Sample containers will be labeled with secure sample tags prior to or immediately after the time of sampling.

At the time of sampling, the appropriate sample containers will be selected, and the appropriate field identification number will be recorded in the log book. Samples will then be placed in a container. At the end of each day master log and chain of custody documentation will be completed for each sample. The chain of custody will be used to document sample custody and to identify the type of analyses required for a particular sample. Information on the sample tags will be verified to ensure that the information provided is consistent with information on the chain of custody form and in the field log book.

7.5.2
Chain of Custody

Once a sample is taken it will remain in Dodds Envirotech Corporations' custody until Douglas S. Dodds delivers the sample to the Laboratory. If this is not possible, sample will be stored in containers with signed custody seals and kept in a secure area. Upon transfer of sample possession to the Laboratory, a chain of custody form will be signed and received by the responsible laboratory recipient and the relinquishing person from Dodds Envirotech Corporation.

7.5.3
Shipping

All Samples collected by Dodds Envirotech Corporation will be transported directly to "SLV" by Douglas S. Dodds, Risk Assessor. Mr. Dodds will collect and transport all samples taken from the window sills and window wells in the housing units.

7.5.4
Laboratory

SLV
"Silver Valley Laboratory"

One Government Gulch
Kellogg, ID 83837-0929

Phone: (208) 784-1258
Fax: (208) 783-0891

7.6
Analytical Procedures

See Appendix A - analytical procedures (SLV)

7.6.1
Laboratory Analysis

All samples shall be analyzed for lead using methods detailed in the most current edition of Test Methods for Evaluating Solid Wastes, SW - 846. Dust samples shall be digested in accordance with SW-846 method 3050m. After digestion, all samples shall be analyzed for lead by inductively coupled plasma atomic emission spectroscopy (ICP) in accordance with SW-846 method 6010.

See Appendix A - laboratory analytical procedures

7.7
Calibration Procedures and Frequency

For organic analysis, a calibration check standard is analyzed at regular intervals as specified by the method usually every twelve hours of run time. The results of the calibration check standard are evaluated to ensure that instrument calibration is within acceptable limits. This standard is prepared from the same reference materials as the initial calibration standards.

7.8
Internal Quality Control Procedures

The laboratory will follow internal QA/QC procedures as outlined in their most current QAPs.

The laboratory will use level III reporting, which includes dedicated QC on the samples submitted and a separate laboratory QC report, but does not include the rigorous QC reporting required for CLP analysis. The data will be evaluated by Dodds Envirotech based on the following criteria (as appropriate for inorganic chemical analyses):
Performance on method tests:

- **Blanks**
- **Precision and assurance of calibration, laboratory control samples, and matrix spikes**
- **Adequacy of detection limits obtained**

7.9
Data Management

This section addresses issues related to data sources, data processing, and data evaluation. Raw data generated in the field or received from analytical laboratories will be validated in the office, entered into a computerized data base, and verified for consistency and correctness. Computers used for data management will be PC desktop or portable (IBM Compatible).D Base V and Excel software will be used for data storage and calculation.

7.9.1
Data Validation

All Samples taken are labled at the time of the sampling. This information is noted daily in the project log book by address of the property sampled, sample number and all of the information on the centrifuge sample tube to include any unusual conditions that may apply to a specific sample. Upon completion of the logging of information in the sample log book, a chain of custody report (by sample number) is filed out and accompanies all samples transferred directly to the laboratory. At no time are the samples out of the possession of Douglas Dodds / Risk Assessor, Dodds Envirotech Corporation from the time of sampling, logging, chain of custody and direct delivery to the laboratory who has agreed to the sampling method 6010 and Digestion methods SW 846 3050m. SLV laboratory's will sign for receipt of all samples and chain of custody forms and perform all laboratory analysis according to the prescribed quality control measures outlined in Appendix A. These procedures guarantee the collection, delivery and proper analysis necessary to conduct appropriate information for a Risk Assessment based on the HUD Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing 1995. Upon receipt of laboratory analysis results from SLV laboratory Doug Dodds will evaluate the analysis results, create a data base of information in Excel format for both Risk Assessment and Time based analytical comparison.

7.9.2
Evaluation of Data Precision Accuracy, Representativeness, Completeness and Comparability

Routine procedures to be used for measuring precision, and accuracy include use of procedural blanks, laboratory control samples (LCS), duplicate analyses, and standards. The minimum frequencies are as follows:

- **Blanks - One preparation blank will be analyzed for each digestion batch.**
- **LCS - One LCS will be analyzed for each digestion batch.**
- **MS/MSD - One MS/MSD will be analyzed for each digestion batch.**
- **Duplicates - One duplicate will be analyzed for every 10 samples.**
- **Standards - One per twenty**

In addition, one in every 10 samples collected in the field will be a duplicate sample. These samples will be submitted blind to the analytical laboratory. Quality assurance goals for precision, accuracy, representativeness, completeness, and comparability (PARCC) have been developed for all analytical parameters

identified in this work plan. Specific PARCC categories for this project are defined as follows.

Precision

Precision is a measure of data variation when more than one measurement is taken on the same sample. The precision estimate for duplicates is expressed as the relative percent difference (RPD):

$$RPD = \frac{(C_1 - C_2) \times 100\%}{c}$$

where C_1 = concentration for duplicate #1

C_2= concentration for duplicate #2

c = mean concentration

Acceptable precision limits are based on past data bases, as defined by the USEPA. Laboratory duplicate measurements will be obtained for each set of samples submitted and analyzed. The acceptable range for RPD in this study is +-30%.

Accuracy

Accuracy of laboratory analysis is assessed by measuring a standard reference material. Standard reference materials are utilized to calibrate laboratory measurement instruments.

7.9.3 Corrective Actions

Dodds Envirotech Corporation shall, after notifying the CO of any and all deviations or non-compliance events relating to chemical data quality management requirements or receipt of such notice from the CO, immediately take corrective actions. If the Dodds fails to comply promptly, the CO may issue an order to stop all or part of the work until satisfactory corrective action has been taken. Such an order shall encompass activities of both the Contractor and Subcontractors. No part of such time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the contractor.

7.10 Preventative Maintenance

Preventative equipment maintenance is essential if project resources are to be used cost-effectively. Preventative maintenance is composed of two principle elements:

- **A schedule for preventative maintenance activities to minimize downtime and ensure accuracy of measurement systems, and**
- **Availability of critical spare parts and backup systems and equipment.**

The preventative maintenance approach for certain instruments or equipment used for sampling and monitoring will follow manufacturers' specifications and sensible field and laboratory practices. The maintenance procedures performed will be documented in the field log book, as appropriate.

SECTION 8.0

REFERENCES

CH2M Hill. 1991. Final House Dust Remediation Report for the Bunker Hill CERCLA Site Populated Areas RI/FS. BHPA-HDR-F-RO-052091. Prepared for the Idaho Department of Health and Welfare, Boise, ID, May 1991.

EPA Methods 6010, 6020, 7420, and 7421 (Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846, Third Edition, revised November 1986, EPA Publications PB88-239223 and PB89-148076)

Standard Operating Procedures for Lead by Hotplate - or Microwave-Based Acid Digestion and Atomic Absorption or Inductively Coupled Plasma Emission Spectrometry, September 1991, NTIS Publication PB92-114172 (EPA 600/8-91/231

TerraGraphics Environmental Engineering, Inc. 2000. DRAFT FINAL Interior Dust Cleaning Work Plan. June 2000

U.S. Environmental Protection Agency (USEPA), 1986. Test Methods for Evaluating Solid Waste, SW - 846, 3rd ed. Washington D.C.

U.S. Department of Housing and Urban Development (HUD) 1995. Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing.

APPENDIX

For organic analysis, a calibration check standard is analyzed at regular intervals as specified by the method, usually every twelve hours of run time. The results of the calibration check standard are evaluated to ensure that instrument calibration is within acceptable limits. This standard solution is prepared from the same reference materials as the initial calibration standards.

5.6.5 Matrix Spikes and Surrogates

A matrix spike is prepared by adding a known amount of a pure compound to the sample prior to digestion or extraction. The calculated percent recovery of the matrix spike is considered to be a measure of the relative accuracy of the total analytical method, i.e., sample preparation and analytical procedure.

An analytical spike is prepared by adding a known amount of analyte to a digestate or extract of a sample for which the analyte concentration has been determined. This spike reveals the interferences found in the prepared sample matrix. The calculated percent recovery of the analytical spike is considered to reflect the accuracy of the analytical procedure only. Both the matrix spike and the analytical spike are also an indication of the effect of the sample matrix on the ability of the methodology to detect the specific analyte. When no change in volume due to the spike occurs, it is calculated as follows:

$$\% \text{ Recovery} = \frac{(SSR - SR)}{SA} \times 100$$

where SSR = Spiked Sample Result
SR = Sample Result
SA = Spike Added

Tolerance limits for percent recoveries are established by clients data quality objectives, but are usually 80-120% or 75-125%. Matrix spike samples are prepared for every batch of twenty or fewer samples.

Surrogates measure extraction or preparation efficiency. They must be a compound not expected to be present in the sample. The recovery of a surrogate compound must meet the control limits specified in the standard operating procedure.

5.6.6 Low Level Standards

As detection limits continue to drop and risk-assessment based criteria are used more frequently, it is increasingly important to have reliable data near the instruments detection limit (IDL). Very low level standards (LLS) are employed to better assess the quality of data at these near IDL concentrations. These LLSs are detection limit standards (USEPA CRA & CRI) which are run at the beginning and end of instrument analytical runs. Due to the low concentration levels of these standards, no guidelines for their recoveries have been established other than detection. The practice of performing low level standards does not apply to organic analysis.

5.6.7 Interference Check Samples

For analytes determined by ICP spectroscopy, an interference check sample (ICS) is analyzed at the beginning and at the end of an analysis sequence. This sample consists of elements (usually Ca, Mg, Al, and Fe) at elevated levels to check for interferences due to common matrix elements. In cases where no analyte is present in the ICS, instrumental values should be ±5x the IDL, otherwise the instrumental value should be within ±20% of the true value.

5.6 Quality Control Parameters

SVL offers three levels of data report packages. A Level 1 report consists of analytical results; associated QC data is not included in this report. A Level 2 report consists of a standard report of analytical results with associated QC data (blank, replicate, spike, and control standard, as appropriate). A Level 3 report is virtually identical to a USEPA CLP data package.

5.6.1 Blanks

Preparation blanks are analyzed with every batch of twenty or fewer samples or each matrix type, whichever is more frequent. A preparation blank consists of laboratory pure water that is processed through all procedures, materials, and labware used for sample preparation and analysis.
In cases of non-aqueous samples, reagent blanks serve as preparation blanks. Sample batches that contain contaminated blanks are routinely re-prepared.

5.6.2 Laboratory Control Samples

A laboratory control sample (LCS) is a sample of known value, usually from a source different from the calibration standards, used to validate the analytical procedure. One LCS is analyzed with every batch of twenty or fewer samples or each matrix type, whichever is more frequent. Sample batches containing LCS's that are out of control limits are re-prepared. Control limits for solid LCS's are set by the supplier. Water or other aqueous LCS's have control limits of 80% to 120%, or as specified in the standard operating procedure.

5.6.3 Sample Replicates

These are aliquots made in the laboratory of the same sample, each aliquot is treated exactly the same throughout the analytical method. The relative percent difference (RPD) between the values of the duplicates, as calculated below, is taken as a measure of the precision of the analytical method.

$$\text{RPD} = \frac{|S - D|}{(S + D) \div 2} \times 100$$

where RPD = Relative Percent Difference
S = First Sample Value (original)
D = Second Sample Value (duplicate)

One duplicate sample or matrix spike duplicate is analyzed with every batch of twenty or fewer samples or each matrix type, whichever is more frequent. The tolerance limit for RPD is typically less than 20%. However, the duplicate is also a measure of the homogeneity of the sample matrix. An abnormally high RPD may be an indication of a non-homogeneous sample.

5.6.4 Check Standards and Controls

A check standard is prepared in the same manner as a calibration standard. The concentration is usually mid-range for the specific calibration curve. Controls are used to validate an existing calibration curve, and also typically fall mid-range on the calibration curve. The control is from a different source than that of the calibration standards or check standard. The USEPA CLP program identifies a "control" as the "initial calibration verification standard" (ICV) and the "check standard" as the "continuing calibration verification standard" (CCV). Check standards are run at a frequency of 10%. The check standard provides information on the accuracy of instrumental performance and response consistency independent of sample matrix and preparation.

APPENDIX B

CHAIN OF CUSTODY RECORD

Page _____ of _____

Client:

Contact:

Address:

Phone Number:

FAX Number:

NOTES:

1) Ensure proper container packaging.

2) Ship samples promptly following collection.

* 3) Designate Sample Reject Disposition

PO#:

Project Name:

Table 1. -- Matrix Type
1 = Surface Water, 2 = Ground Water
3 = Soil/Sediment, 4 = Rinsate, 5 = Oil
6 = Waste, 7 = Other (Specify) _______

Samplers Signature:

FOR SVL USE ONLY

SVL JOB #

Lab Name: SVL Analytical, Inc. (208) 784-1258 FAX (208) 783-0891

Address: One Government Gulch, Kellogg, ID 83837-0929

Sample ID	Collection		Miscellaneous				Preservative(s)						Analyses Required									Comments
	Date	Time	Collected by: (Init.)	Matrix Type From Table 1	No. of Containers	Sample Filtered ? Y/N	Unpreserved (Ice Only)	HNO3	HCL	H2SO4	NAOH	Other (Specify)										
1.																						
2.																						
3.																						
4.																						
5.																						
6.																						
7.																						
8.																						
9.																						
10.																						

Relinquished by:	Date:	Time:	Received by:	Date:	Time:
Relinquished by:	Date:	Time:	Received by:	Date:	Time:

* Sample Reject: [ ] Return [ ] Dispose [ ] Store (30 Days)

White: LAB COPY Yellow: CUSTOMER COPY SV[illegible]-COC 12/9[illegible]

APPENDIX C: Table 1 Sampling Summary for Cleaning Treatment Homes

Table 1 Sampling Summary for Cleaning Treatment Homes

Sample Detail	Pre-cleaning	During cleaning	Post-cleaning	6 months	12 months
1. Carpet (BRM)[1]					
child bedroom	X		X	X	X
living room	X		X	X	X
2. Kitchen floor (BRM)[1]	X		X	X	X
3. Windows: sill, well (wipe)[2]					
child bedroom	X		X	X	X
living room	X		X	X	X
4. Floor dust mat[1]	X		X	X	X
5. Household vacuum cleaner bag[1]	X		X	X	X
6. Basement[1]		X			
7. Attic[1]		X			
8. Duct[1]		X			

[1] Sampled by TerraGraphics.
[2] Sampled by HUD RA contractor.

Data Summary Report
for Six-Month Sampling Results
House Dust Pilot Project 2000

Prepared for:
Department of Environmental Quality
Boise, Idaho

Prepared by:
TerraGraphics Environmental Engineering, Inc.
121 South Jackson, Moscow, Idaho 83843
(208) 882-7858

August 2001

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SECTION 1.0 INTRODUCTION

This report summarizes the results of the Six-month sampling event as part of the House Dust Pilot Project at the Bunker Hill Superfund Site. Twenty-one houses in the town of Smelterville were sampled for house dust by using the BRM method, vacuum bags, and dust mats (Lanphear et al. 1995, Farfel et al. 1994). Sampling occurred in early April, 2001. All samples were sent to Northern Analytical Laboratories Inc., in Billings, Montana for analysis. Details of sampling protocols can be found in the *Final Field Work Plan for the House Dust Pilot Project Interior Dust Sampling* (TerraGraphics 2000). Initial findings can be found in the *Interim Data Summary Report for the Pre- and Post-Cleaning Results, House Dust Pilot Project 2000* (TerraGraphics 2001). A more complete analysis of remedial effectiveness, sampling procedures and results, and the cost and logistical feasibility of implementing site-wide interior remediation will be contained in the final report following the 12- month sampling event (scheduled October, 2001).

SECTION 2.0 RESULTS AND DISCUSSION

2.1 Treatment A— HUD Cleaning Houses

2.1.1 Dust Mats

Dust mat data are shown in Table 1 and Figures 1 through 2a-b. Dust mats were collected from all six HUD Cleaning Houses during the Six-month sampling event. The average lead concentration was 1108 mg/kg (870 mg/kg geometric mean), average dust loading rate was 818 mg/m^2/day (684 mg/m^2/day geometric mean), and average lead loading rate was 0.845 mg/m^2/day (0.595 mg/m^2/day geometric mean). The Six-month dust loading rate approximately doubled from pre- and post-cleaning rates; the lead concentration increased from pre- and post-cleaning levels; and the mean lead loading rate also increased from pre- and post-cleaning rates.

2.1.2 Vacuum Dust

Vacuum dust data are shown on Table 2 and Figure 1. Vacuum dust was collected from all six HUD Cleaning Houses during the Six-month sampling event. The average lead concentration was 357 mg/kg (261 mg/kg geometric mean). On average, lead concentration decreased from pre- and post-cleaning levels.

2.1.3 BRM Dust

Kitchen Samples

Table 3 and Figures 3 through 5 show kitchen BRM data. During the Six-month sampling event, only two of the kitchens from the HUD Cleaning Houses yielded sufficient sample volume for laboratory analysis. The average lead concentration was 620 mg/kg (219 mg/kg geometric mean), average dust loading (for all six kitchens) was 2.10 g/m^2 (0.71 g/m^2 geometric mean), and average lead loading was 0.94 mg/m^2 (0.38 mg/m^2 geometric mean). Both dust and lead loadings and lead concentration (from the Six-month sampling) slightly increased from post-cleaning levels, but remain below pre-cleaning levels.

Living Room Samples

Table 4 and Figures 3 through 5 present living room BRM data. All six of the living room BRM samples from the HUD Cleaning Houses yielded sufficient volume for laboratory analysis during the Six-month sampling event. The average lead concentration was 670 mg/kg (284 mg/kg geometric mean), average dust loading was 11.49 g/m^2 (7.35 g/m^2 geometric mean), and average lead loading was 3.02 mg/m^2 (2.08 mg/m^2 geometric mean). Again, as observed with the kitchen data, dust and lead loadings and lead concentration (from the Six-month sampling) have increased from post-cleaning results, but remain below pre-cleaning levels.

Bedroom Samples

Table 5 and Figures 3 through 5 present all bedroom BRM data. All six of the bedroom BRM samples from the HUD Cleaning Houses yielded sufficient volume for laboratory analysis from the Six-month sampling event. The average lead concentration was 1252 mg/kg (528 mg/kg geometric mean), average dust loading was 4.94 g/m^2 (3.58 g/m^2 geometric mean), and average lead loading was 3.26 mg/m^2 (1.89 mg/m^2 geometric mean). On average, both dust and lead loadings were higher than post-cleaning levels, but less than pre-cleaning levels; however, average concentration was slightly higher than pre- and post-cleaning levels.

2.2 Treatment B— Commercial Cleaning Houses

2.2.1 Dust Mats

Dust mats were collected from all six Commercial Cleaning Houses during the Six-month sampling event. The average lead concentration was 1065 mg/kg (737 mg/kg geometric mean), average dust loading rate was 1012 mg/m^2/day (501 mg/m^2/day geometric mean), and average lead loading rate was 2.281 mg/m^2/day (0.369 mg/m^2/day geometric mean) (Table 1). Both dust and lead loading rates approximately doubled from pre- and post-cleaning levels; however, average lead concentration (from Six-month sampling) was lower than post-cleaning levels (Figures 1 - 2a-b).

2.2.2 Vacuum Dust

Vacuum dust was collected from five Commercial Cleaning Houses during the Six-month sampling event. The average lead concentration was 378 mg/kg (371 mg/kg geometric mean) (Table 2) and slightly less than pre- and post-cleaning lead levels.

2.2.3 BRM Dust

Kitchen Samples

During the Six-month sampling event, all six of the kitchens from the Commercial Cleaning Houses yielded sufficient sample volume for laboratory analysis. The average lead concentration was 635 mg/kg (403 mg/kg geometric mean), average dust loading was 17.09 g/m^2 (9.49 g/m^2 geometric mean), and average lead loading was 4.74 mg/m^2 (3.82 mg/m^2 geometric mean) (Table 3). Dust loadings (from the Six-month sampling) were higher than pre- and post-cleaning levels, but lead loadings and concentration were similar to pre-cleaning levels (Figures 3-5).

Living Room Samples

All six of the living room BRM samples from the Commercial Cleaning Houses yielded sufficient volume for laboratory analysis during the Six-month sampling event. The average lead concentration was 483 mg/kg (425 mg/kg geometric mean), average dust loading was 42.91 g/m^2 (14.87 g/m^2 geometric mean), and average lead loading was 16.79 mg/m^2 (6.33 mg/m^2 geometric mean) (Table 4). On average, dust and lead loadings and concentration (from the Six-month sampling) were similar to pre-cleaning levels (Figures 3-5).

Bedroom Samples

All six of the bedroom BRM samples from the Commercial Cleaning Houses yielded sufficient volume for laboratory analysis. The average lead concentration was 748 mg/kg (558 mg/kg geometric mean), average dust loading was 16.77 g/m^2 (8.71 g/m^2 geometric mean), and average lead loading was 8.47 mg/m^2 (4.86 mg/m^2 geometric mean) (Table 5). Both dust and lead loadings were higher than post-cleaning levels, but lower than pre-cleaning levels. Average lead concentration was similar to pre-cleaning levels (Figures 3-5).

2.3 Treatment C— Spring Cleaning Houses

2.3.1 Dust Mats

Dust mats were collected from five Spring Cleaning Houses during the Six-month sampling event; one participant moved away, and the house was empty. The average lead concentration was 886 mg/kg (705 mg/kg geometric mean), average dust loading rate was 2039 mg/m^2/day (1231 mg/m^2/day geometric mean), and average lead loading rate was 2.449 mg/m^2/day (0.868 mg/m^2/day geometric mean) (Table 1). Again, dust and lead loading rates (from the Six-month sampling) were higher than pre- and post-cleaning rates, but dust mat concentration was lower then post-cleaning levels (Figures 1 - 2a-b).

2.3.2 Vacuum Dust

Vacuum dust was collected from four of the five Spring Cleaning Houses during the Six-month sampling event. One resident has a rainbow vacuum and a dust sample was not collected. The average lead concentration was 1029 mg/kg (374 mg/kg geometric mean) (Table 2) and similar to post-cleaning levels (Figure 1).

2.3.3 BRM Dust

Kitchen Samples

During the Six-month sampling event, three of the five kitchens from the Spring Cleaning Houses yielded sufficient sample volume for laboratory analysis. The average lead concentration was 1020 mg/kg (682 mg/kg geometric mean), average dust loading (for all five kitchens) was 3.53 g/m^2 (1.85 g/m^2 geometric mean), and average lead loading was 4.79 mg/m^2 (3.37 mg/m^2 geometric mean) (Table 3). Dust loading was lower than pre-cleaning levels, but the lead concentration increased by approximately 60% from pre-cleaning levels, therefore, lead loading almost doubled pre-cleaning levels (Figures 3-5).

Living Room Samples

All five of the living room BRM samples from the Spring Cleaning Houses yielded sufficient volume for analysis. The average lead concentration was 778 mg/kg (640 mg/kg geometric mean), average dust loading was 18.36 g/m^2 (16.01 g/m^2 geometric mean), and average lead loading was 15.00 mg/m^2 (10.24 mg/m^2 geometric mean) (Table 4). On average, dust and lead loading increased from pre- and post-cleaning levels. Average lead concentration was slightly higher than post-cleaning levels, but remain below pre-cleaning levels (Figures 3-5).

BRM Bedroom Samples

Four of the five bedroom BRM samples from the Spring Cleaning Houses yielded sufficient volume for analysis. The average lead concentration was 765 mg/kg (535 mg/kg geometric mean), average dust loading was 6.47 g/m^2 (3.37 g/m^2 geometric mean), and average lead loading was 7.41 mg/m^2 (3.59 mg/m^2 geometric mean). Dust and lead loadings were similar to pre- and post-cleaning levels, while concentration slightly increased from pre- and post-cleaning levels (Figures 3-5).

2.4 Control Houses

2.4.1 Dust Mats

Of the original five Control Houses, one participant moved away, leaving four homes, and one house had a different (new) resident after pre-cleaning sampling. Dust mats were collected from four Control

Houses with sufficient volume for laboratory analysis. The average lead concentration was 600 mg/kg (594 mg/kg geometric mean), average dust loading rate was 1899 mg/m^2/day (1856 mg/m^2/day geometric mean), and average lead loading rate was 1.155 mg/m^2/day (1.103 mg/m^2/day geometric mean) (Table 1). Dust and lead loading rates (from the Six-month sampling) increased, while the average lead concentration remains below pre-cleaning rates (Figures 1 - 2a-b).

2.4.2 Vacuum Dust

Vacuum dust was collected from three of the four Control Houses during the Six-month sampling event. One participant has a rainbow vacuum and a dust sample was not collected. The average lead concentration was 1537 mg/kg (1451 mg/kg geometric mean) and more than doubled from pre-cleaning levels (Table 2 and Figure 1). However, this result is based on three samples ranging from 910-2100 mg/kg, while the four pre-cleaning results ranged from 224-2200 mg/kg.

2.4.3 BRM Dust

Kitchen Samples

During the Six-month sampling event, three of the four kitchens of the Control Houses yielded sufficient sample volume for laboratory analysis. The average lead concentration was 597 mg/kg (518 mg/kg geometric mean), average dust loading (for all four kitchens) was 2.90 g/m^2 (1.53 g/m^2 geometric mean), and average lead loading was 1.38 mg/m^2 (1.29 mg/m^2 geometric mean) (Table 3). Dust and lead loadings (from the Six-month sampling) decreased, while concentration remains similar to pre-cleaning levels (Figures 3-5).

Living Room Samples

Four of the living room BRM samples from the Control Houses yielded sufficient sample volume for laboratory analysis during the Six-month sampling event. The average lead concentration was 675 mg/kg (523 mg/kg geometric mean), average dust loading was 19.00 g/m^2 (18.10 g/m^2 geometric mean), and average lead loading was 11.35 mg/m^2 (9.46 mg/m^2 geometric mean) (Table 4). As observed with kitchen samples, dust and lead loadings decreased, while concentration remains similar to pre-cleaning levels (Figures 3-5).

Bedroom Samples

All four of the bedroom BRM samples from the Control Houses yielded sufficient sample volume for laboratory analysis. The average lead concentration was 603 mg/kg (528 mg/kg geometric mean), average dust loading was 15.40 g/m^2 (13.69 g/m^2 geometric mean), and average lead loading was 10.79 mg/m^2 (7.23 mg/m^2 geometric mean) (Table 5). Again, on average, dust and lead loadings decreased (from the Six-month sampling), while concentration remains similar to pre-cleaning levels (Figures 3-5).

2.5 HUD Risk Assessment Results

A certified HUD Risk Assessor was contracted to perform a one-time lead paint inspection and collect dust wipe samples from window wells and sills for each sampling event. Lead-based paint results are summarized in Table 15 of the *Interim Data Summary Report for Pre- and Post-Cleaning Results, House Dust Pilot Project 2000* (TerraGraphics 2001). However, dust wipe results for pre-cleaning, post-cleaning, and six-month sampling events are unavailable at this time.

SECTION 3.0 DATA QUALITY ASSURANCE / QUALITY CONTROL SUMMARY

A data Quality Assurance/Quality Control (QA/QC) review was completed to evaluate the precision, accuracy, completeness, and representativeness of the data obtained from both the field and the laboratory. A complete QA/QC review of Dust Pilot data collected during the Six-month sampling event is found in Appendix B . Laboratory data sheets are found in Appendix C. A total of 128 samples (including QA/QC) were collected from the twenty-one Smelterville houses during the Six-month sampling event. Mat dust, vacuum dust, and BRM dust were collected and submitted to Northern Analytical Laboratories, Inc. in Billings, Montana for lead analysis.

Field QA/QC samples consisted of 9 field duplicates, 4 rinsate blanks and 7 National Institute of Standards and Technology (NIST) soil standards. The average relative percent difference (RPD) was 26.0% for the BRM dust duplicates (ranging from 2.5 to 44.4%), 8.6% for vacuum duplicates, and 32.8% for dust mats. All rinsate blanks were below detection for lead.

External laboratory QA/QC was evaluated using NIST soil standards submitted blind to Northern Analytical. Seven dust standards were submitted; one standard was included in every batch of samples submitted to the lab. Five of the standards were sent with BRM and vacuum samples, and two of the standards were sent with mat dust samples. The average percent recovery for the non-mat standards was 84.6%. A total of two standards were recovered from the mats and submitted blind to Northern Analytical. Mat standard results were rejected because an unknown standard was used, and the concentration and loading mass could not be determined. See Appendix A for further explanation.

Internal laboratory QA/QC precision was assessed using laboratory control samples (LCS), matrix spike/matrix spike duplicate samples (MS/MSD), and prep blank analysis. All laboratory QA/QC results were within the acceptable control limits. Based on a complete review of field duplicates, field splits, rinsate blanks, standards, prep blanks, LCS, and MS/MSD analysis, the final completeness for this survey was assessed at 100%.

SECTION 4.0 REFERENCES

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Figure 1 Dust Mat and Vacuum Bag Lead Concentrations for Pre-, Post-, and Six-Month Samples

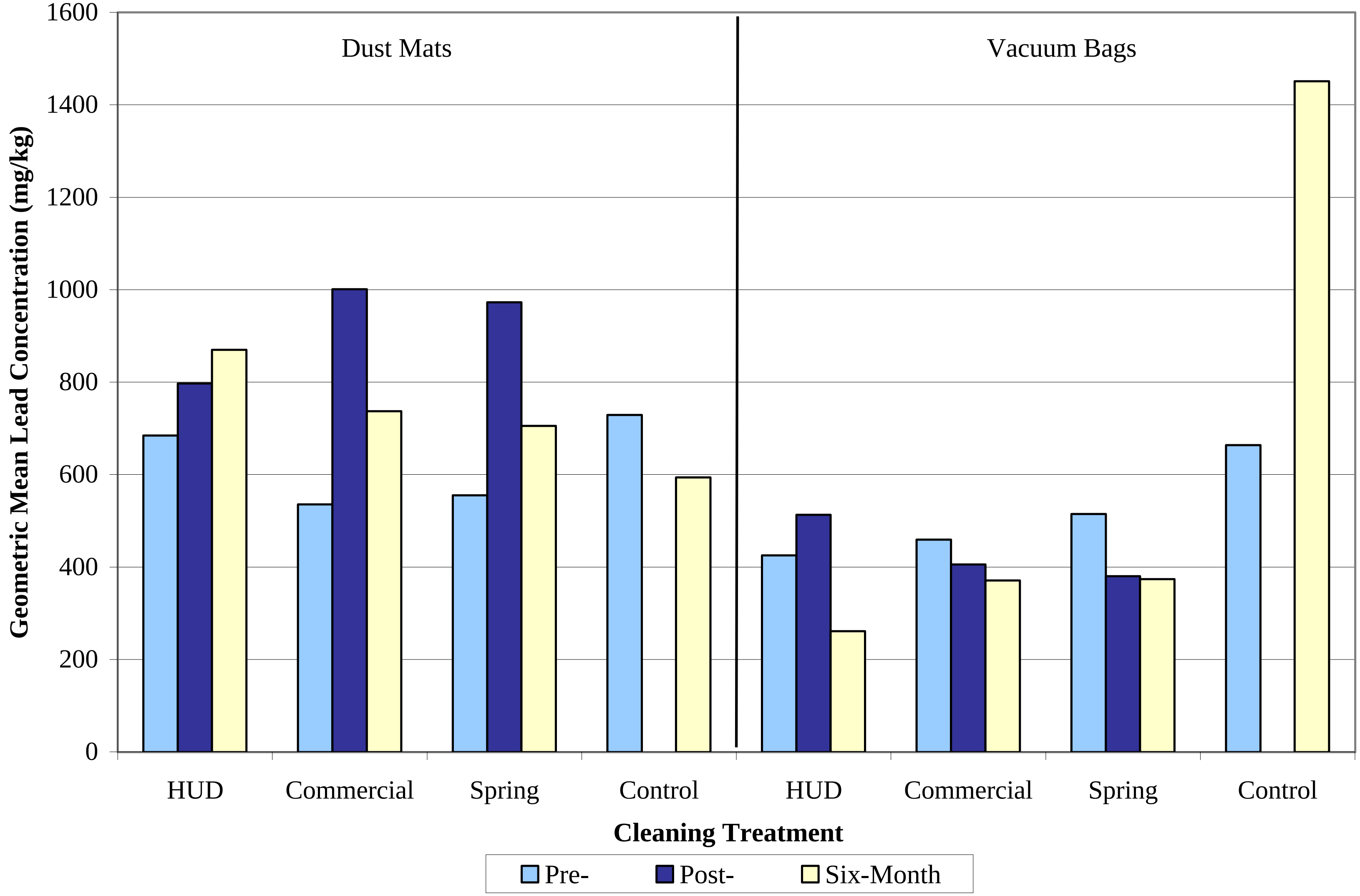


Figure 2a Dust Loading Rates for Dust Mats for Pre-, Post-, and Six-Month Samples

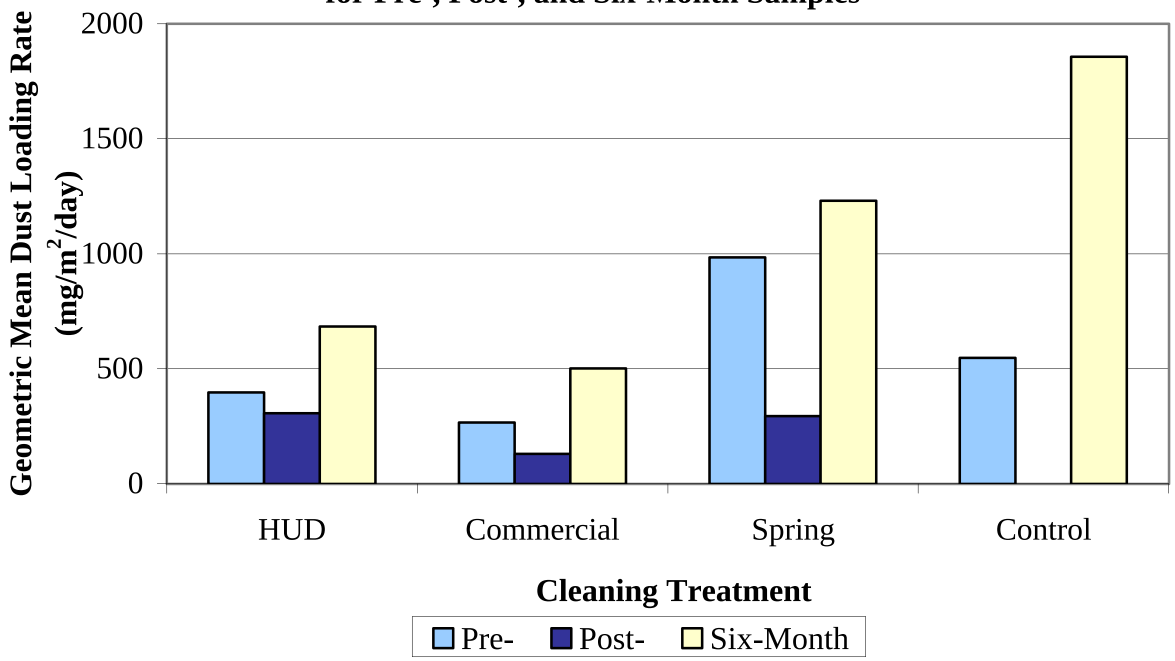


Figure 2b Lead Loading Rates for Dust Mats for Pre-, Post-, and Six-Month Samples

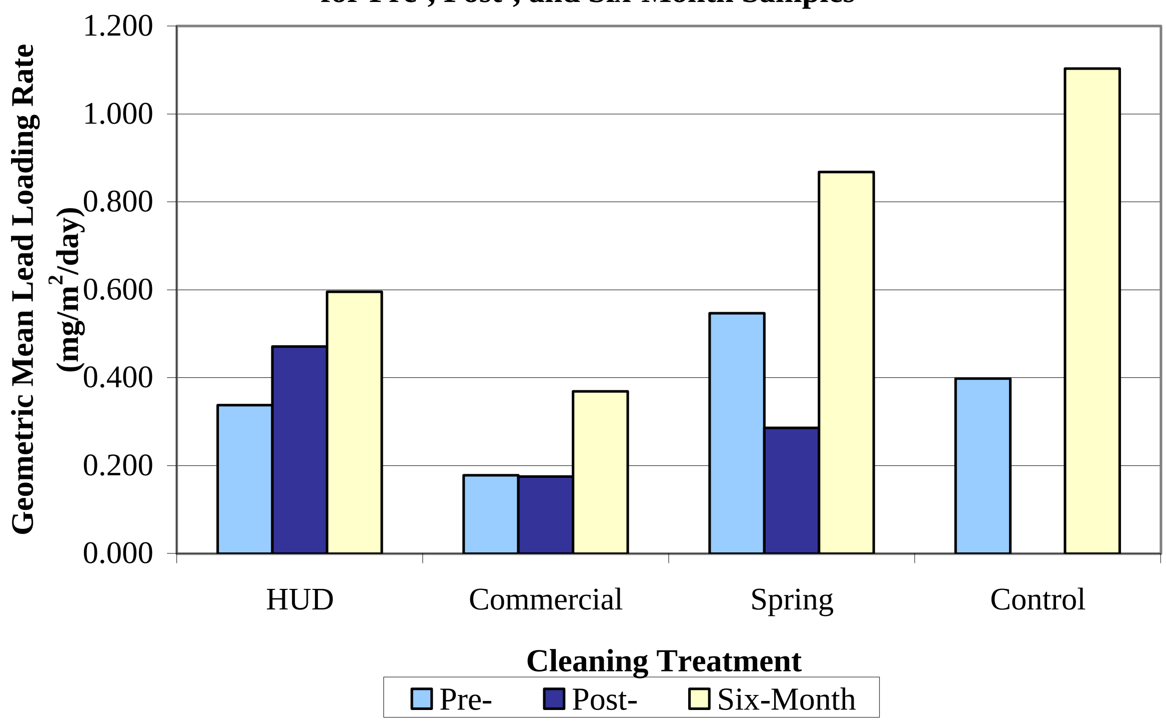
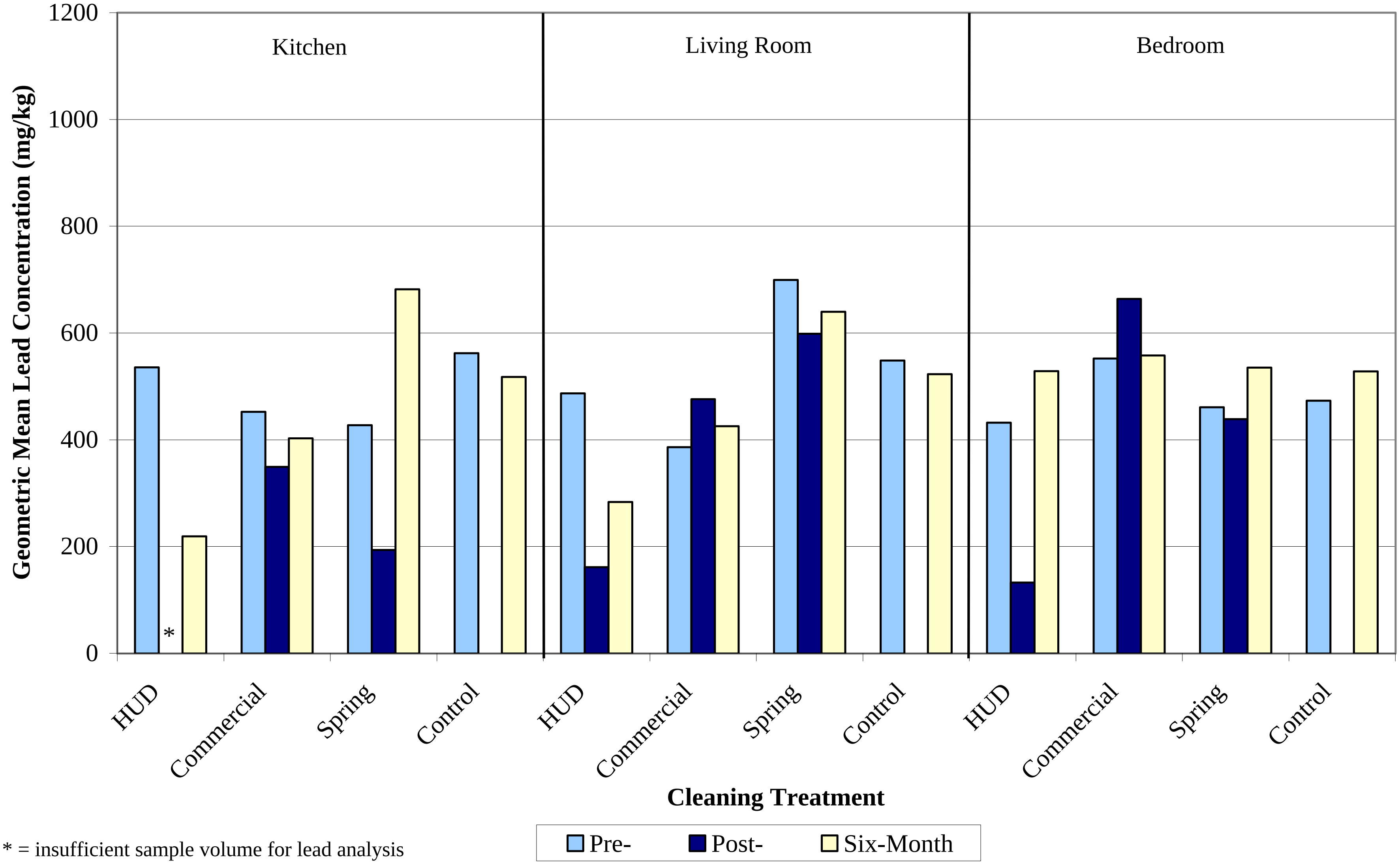


Figure 3 BRM Lead Concentrations for Pre-, Post-, and Six-Month Samples



* = insufficient sample volume for lead analysis

Figure 4 BRM Dust Loadings for Pre-, Post-, and Six-Month Samples

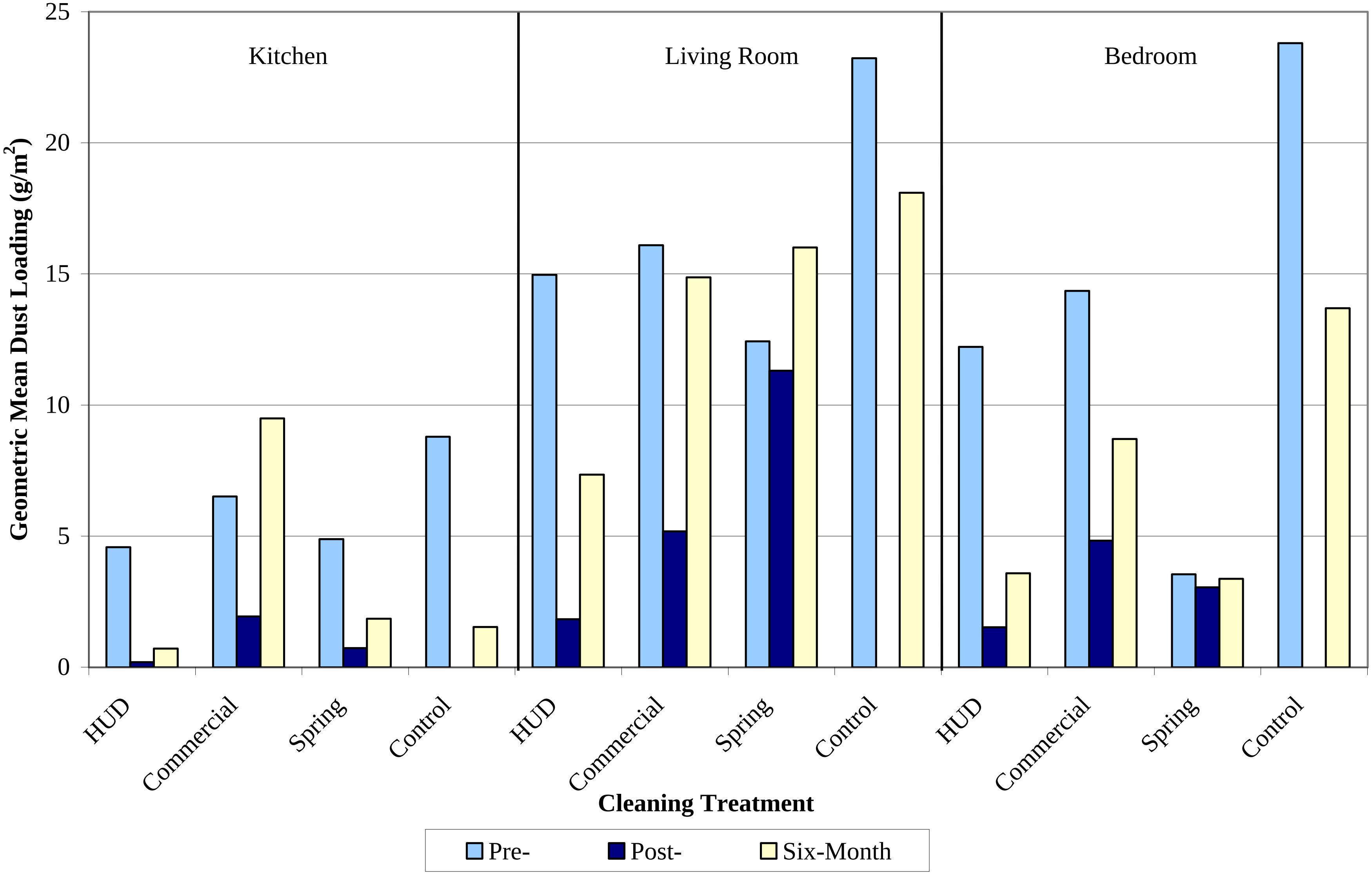
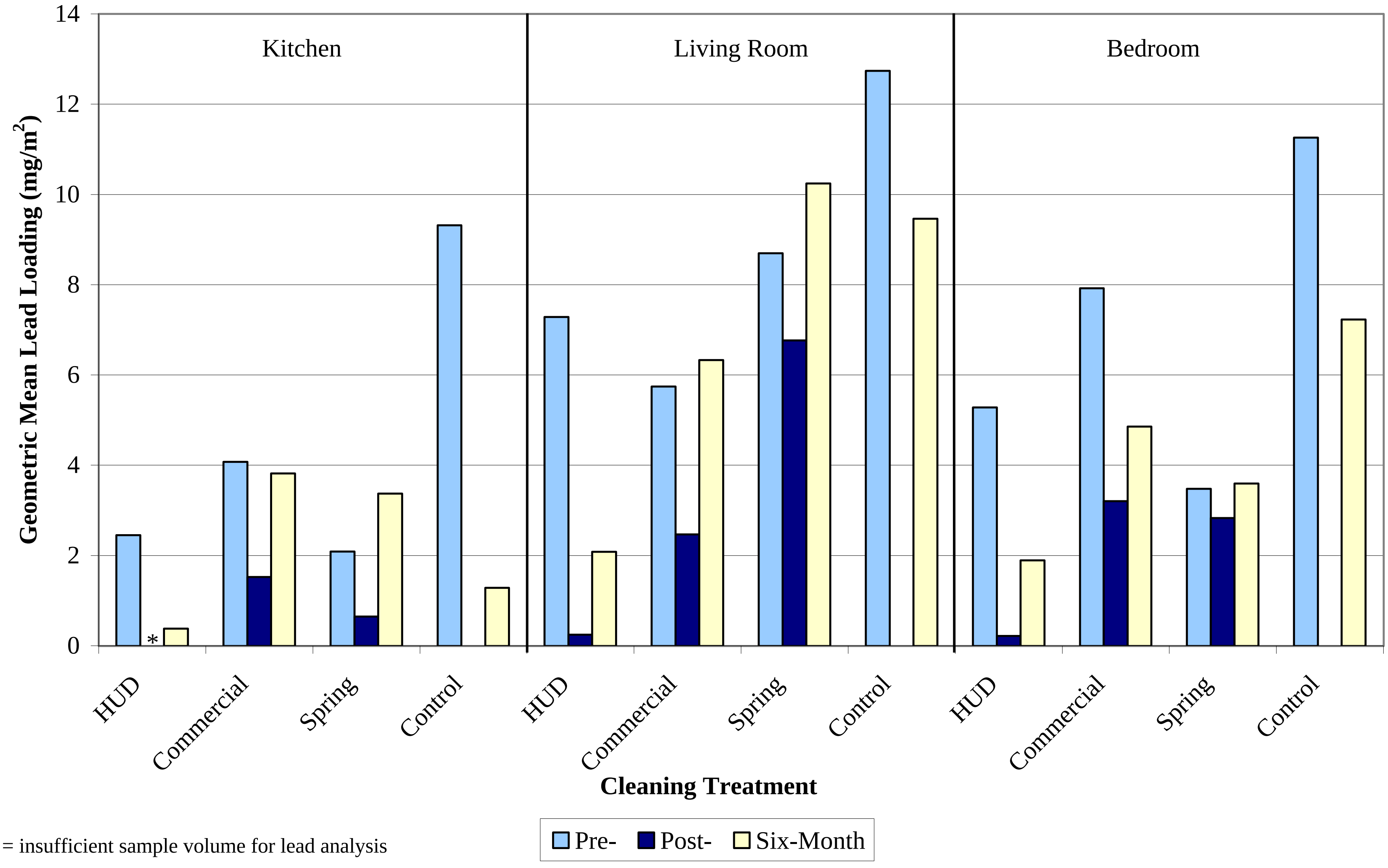


Figure 5 BRM Lead Loadings for Pre-, Post-, and Six-Month Samples



* = insufficient sample volume for lead analysis

Table 1 Dust Mat Lead Concentrations and Loading Rates

	HUD	Commercial	Spring	Control*
	Concentration (mg/kg)			
PRE-CLEANING				
N	5	5	6	5
Min	253	264	198	241
Max	1380	1310	950	2320
Average	824	675	612	1000
Std. Dev	481	500	245	833
Geometric Mean	685	535	555	729
POST-CLEANING				
N	4	4	6	--
Min	460	280	400	--
Max	1140	3040	1980	--
Average	845	1375	1130	--
Std. Dev	308	1177	614	--
Geometric Mean	797	1001	972	--
SIX-MONTH				
N	6	6	5	4
Min	300	210	200	540
Max	2900	2900	1700	750
Average	1108	1065	886	600
Std. Dev	925	982	583	100
Geometric Mean	870	737	705	594
	Dust Loading Rate ($mg/m^2/day$)			
PRE-CLEANING				
N	6	6	6	5
Min	133	87	313	261
Max	1124	1011	2698	1372
Average	503	394	1331	651
Std. Dev	357	376	984	449
Geometric Mean	396	266	984	547
POST-CLEANING				
N	6	6	6	--
Min	38	53	117	--
Max	1213	1064	886	--
Average	497	252	392	--
Std. Dev	440	399	325	--
Geometric Mean	306	129	294	--
SIX-MONTH				
N	6	6	5	4
Min	349	188	228	1329
Max	1939	4361	4122	2291
Average	818	1012	2039	1899
Std. Dev	593	1644	1788	452
Geometric Mean	684	501	1231	1856
	Lead Loading Rate ($mg/m^2/day$)			
PRE-CLEANING				
N	5	5	6	5
Min	0.125	0.083	0.171	0.192
Max	1.089	0.270	2.563	0.975
Average	0.465	0.193	0.921	0.463
Std. Dev	0.409	0.078	0.945	0.304
Geometric Mean	0.337	0.178	0.546	0.398
POST-CLEANING				
N	4	4	6	--
Min	0.273	0.059	0.047	--
Max	0.804	0.391	1.170	--
Average	0.509	0.221	0.520	--
Std. Dev	0.228	0.151	0.514	--
Geometric Mean	0.471	0.175	0.286	--
SIX-MONTH				
N	6	6	5	4
Min	0.171	0.101	0.123	0.744
Max	1.912	12.648	7.008	1.675
Average	0.845	2.281	2.449	1.155
Std. Dev	0.708	5.080	3.110	0.406
Geometric Mean	0.595	0.369	0.868	1.103

*One participant moved away before the Six-month sampling event.

Table 2 Vacuum Bag Lead Concentrations

	HUD	Commercial	Spring	Control*
	Concentration (mg/kg)			
PRE-CLEANING				
N	6	5	6	4
Min	100	206	149	224
Max	903	787	1100	2200
Average	552	507	598	1024
Std. Dev	333	229	309	950
Geometric Mean	425	459	514	664
POST-CLEANING				
N	5	5	5	--
Min	170	264	158	--
Max	1750	490	1040	--
Average	723	415	471	--
Std. Dev	656	91	350	--
Geometric Mean	513	405	380	--
SIX-MONTH				
N	6	5	4	3
Min	70	300	44	910
Max	670	500	3200	2100
Average	357	378	1029	1537
Std. Dev	258	81	1471	598
Geometric Mean	261	371	374	1451

*One participant moved away before the Six-month sampling event.

Table 3 Kitchen BRM Lead Concentrations and Loadings

	HUD	Commercial	Spring	Control*
	Concentration (mg/kg)			
PRE-CLEANING				
N	5	5	6	3
Min	197	340	97	139
Max	1580	918	1360	2480
Average	767	488	610	1045
Std. Dev	677	243	495	1257
Geometric Mean	536	452	427	562
POST-CLEANING				
N	NA	4	2	--
Min	NA	281	150	--
Max	NA	558	250	--
Average	NA	364	200	--
Std. Dev	NA	130	71	--
Geometric Mean	NA	349	194	--
SIX-MONTH				
N	2	6	3	3
Min	40	90	160	230
Max	1200	1400	1800	850
Average	620	635	1020	597
Std. Dev	820	578	823	325
Geometric Mean	219	403	682	518
	Dust Loading (g/m^2)			
PRE-CLEANING				
N	5	6	6	5
Min	1.84	1.29	1.77	1.18
Max	27.81	47.22	9.02	35.88
Average	8.44	13.14	5.47	13.89
Std. Dev	11.14	17.40	2.49	13.02
Geometric Mean	4.58	6.52	4.89	8.79
POST-CLEANING				
N	5	6	6	--
Min	0.12	0.13	0.10	--
Max	0.31	6.39	6.28	--
Average	0.20	3.34	1.69	--
Std. Dev	0.08	2.55	2.33	--
Geometric Mean	0.19	1.94	0.73	--
SIX-MONTH				
N	6	6	5	4
Min	0.14	3.16	0.29	0.36
Max	8.58	64.33	8.23	8.25
Average	2.10	17.09	3.53	2.90
Std. Dev	3.27	23.54	3.50	3.64
Geometric Mean	0.71	9.49	1.85	1.53
	Lead Loading (mg/m^2)			
PRE-CLEANING				
N	5	5	6	3
Min	0.57	1.11	0.50	1.75
Max	12.85	16.90	9.38	25.00
Average	4.49	6.09	3.22	15.08
Std. Dev	5.07	6.29	3.26	11.99
Geometric Mean	2.45	4.07	2.09	9.32
POST-CLEANING				
N	NA	4	2	--
Min	NA	0.68	0.27	--
Max	NA	2.80	1.57	--
Average	NA	1.72	0.92	--
Std. Dev	NA	0.87	0.92	--
Geometric Mean	NA	1.52	0.65	--
SIX-MONTH				
N	2	6	3	3
Min	0.08	1.23	0.98	0.74
Max	1.81	7.92	9.06	1.90
Average	0.94	4.74	4.79	1.38
Std. Dev	1.22	2.82	4.06	0.59
Geometric Mean	0.38	3.82	3.37	1.29

NA = not applicable; insufficient sample volume for lead analysis

*One participant moved away before the Six-month sampling event.

Table 4 Living Room BRM Lead Concentrations and Loadings

	HUD	Commercial	Spring	Control*
	Concentration (mg/kg)			
PRE-CLEANING				
N	6	6	6	5
Min	116	194	142	197
Max	1370	572	1690	5020
Average	673	409	889	1271
Std. Dev	489	137	550	2099
Geometric Mean	487	386	700	549
POST-CLEANING				
N	5	6	6	--
Min	60	260	140	--
Max	360	950	1260	--
Average	194	528	762	--
Std. Dev	119	263	456	--
Geometric Mean	161	476	599	--
SIX-MONTH				
N	6	6	5	4
Min	30	120	160	180
Max	1600	640	1200	1300
Average	670	483	778	675
Std. Dev	704	200	407	500
Geometric Mean	284	425	640	523
	Dust Loading (g/m^2)			
PRE-CLEANING				
N	6	5	6	5
Min	7.25	4.39	6.94	6.82
Max	68.03	75.39	20.17	41.48
Average	22.83	25.92	13.13	27.00
Std. Dev	24.74	28.78	4.64	12.72
Geometric Mean	14.96	16.09	12.43	23.22
POST-CLEANING				
N	6	6	6	--
Min	0.73	1.08	5.38	--
Max	4.70	61.57	21.53	--
Average	2.33	14.41	12.87	--
Std. Dev	1.74	23.49	6.46	--
Geometric Mean	1.83	5.18	11.30	--
SIX-MONTH				
N	6	6	5	4
Min	2.66	2.55	6.14	10.48
Max	40.29	117.76	33.12	24.58
Average	11.49	42.91	18.36	19.00
Std. Dev	14.29	54.54	9.88	6.14
Geometric Mean	7.35	14.87	16.01	18.10
	Lead Loading (mg/m^2)			
PRE-CLEANING				
N	6	5	6	5
Min	3.82	1.70	1.64	5.47
Max	13.33	25.18	21.95	34.22
Average	8.03	8.91	11.64	15.82
Std. Dev	3.65	9.60	7.42	11.79
Geometric Mean	7.28	5.74	8.70	12.74
POST-CLEANING				
N	5	6	6	--
Min	0.06	0.59	1.77	--
Max	1.57	18.47	24.76	--
Average	0.46	5.11	10.98	--
Std. Dev	0.63	6.93	10.12	--
Geometric Mean	0.24	2.47	6.77	--
SIX-MONTH				
N	6	6	5	4
Min	0.21	1.17	3.04	3.97
Max	5.74	67.66	30.80	20.65
Average	3.02	16.79	15.00	11.35
Std. Dev	1.94	25.62	12.21	7.38
Geometric Mean	2.08	6.33	10.24	9.46

*One participant moved away before the Six-month sampling event.

Table 5 Bedroom BRM Lead Concentrations and Loadings

	HUD	Commercial	Spring	Control*
	Concentration (mg/kg)			
PRE-CLEANING				
N	6	6	5	5
Min	136	126	108	209
Max	1500	2500	1680	1260
Average	583	879	680	570
Std. Dev	496	911	624	412
Geometric Mean	432	552	461	473
POST-CLEANING				
N	5	6	5	--
Min	30	163	60	--
Max	300	1770	2140	--
Average	171	844	790	--
Std. Dev	109	565	837	--
Geometric Mean	133	664	439	--
SIX-MONTH				
N	6	6	4	4
Min	80	140	170	360
Max	4500	1600	1700	1200
Average	1252	748	765	603
Std. Dev	1725	557	690	400
Geometric Mean	528	558	535	528
	Dust Loading (g/m^2)			
PRE-CLEANING				
N	6	6	6	5
Min	2.30	3.12	0.08	9.97
Max	51.85	72.01	20.88	69.57
Average	19.91	28.56	9.10	29.86
Std. Dev	19.18	32.68	9.29	23.62
Geometric Mean	12.22	14.35	3.54	23.80
POST-CLEANING				
N	6	6	6	--
Min	0.73	1.24	0.07	--
Max	5.62	17.51	18.37	--
Average	1.95	7.44	7.37	--
Std. Dev	1.82	7.02	6.74	--
Geometric Mean	1.53	4.83	3.05	--
SIX-MONTH				
N	6	6	5	4
Min	1.26	1.87	0.22	7.07
Max	13.96	41.44	12.56	23.21
Average	4.94	16.77	6.47	15.40
Std. Dev	4.72	19.10	5.18	8.02
Geometric Mean	3.58	8.71	3.37	13.69
	Lead Loading (mg/m^2)			
PRE-CLEANING				
N	6	6	5	5
Min	1.65	1.03	0.70	4.93
Max	15.72	36.33	17.37	31.03
Average	6.85	13.46	6.96	15.83
Std. Dev	5.04	13.47	7.71	13.78
Geometric Mean	5.28	7.92	3.48	11.26
POST-CLEANING				
N	5	6	5	--
Min	0.10	0.56	0.52	--
Max	0.43	10.98	19.89	--
Average	0.25	4.61	8.33	--
Std. Dev	0.14	3.75	10.21	--
Geometric Mean	0.22	3.20	2.83	--
SIX-MONTH				
N	6	6	4	4
Min	0.49	0.52	0.72	3.18
Max	11.30	24.04	16.84	27.86
Average	3.26	8.47	7.41	10.79
Std. Dev	4.05	8.55	7.81	11.63
Geometric Mean	1.89	4.86	3.59	7.23

*One participant moved away before the Six-month sampling event.

APPENDIX A
QA/QC Review for the House Dust Pilot Project Six-Month Sampling Event

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INTERNAL MEMORANDUM

To: Susan Spalinger, TerraGraphics, Moscow

From: Lisa Hall, TerraGraphics, Moscow

Date: July 20, 2001

Subject: QA/QC Review for the House Dust Pilot Project Six-Month Sampling Event

Introduction

The following memorandum provides a summary of the quality assurance/quality control (QA/QC) review for the House Dust Pilot Six-Month Sampling Event using guidelines set forth in *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA 1994) and *Guidance on Environmental Data Verification and Data Validation: EPA QA/G-8* (USEPA 2001). Twenty-one houses in Smelterville were sampled using three distinct sample collection methods. Mat dust, vacuum dust, and Baltimore Repair and Maintenance (BRM) sampler dust were collected. All samples were submitted to Northern Analytical Laboratories, Inc. for analysis.

General

A QA/QC review was completed to evaluate the precision, accuracy, completeness, and representativeness of the data obtained from both the field and the laboratory. Definitions and QC objectives for these parameters are described in the *FINAL Field Work Plan for the House Dust Pilot Project Interior Dust Sampling* (TerraGraphics 2000a) and the *Final Interior House Dust Pilot Cleaning Work Plan* (TerraGraphics 2000b). Procedures for sample labeling, handling, and analysis were as described in the Work Plans. All laboratory data and master logs were entered into Access database files. Forms were checked and reviewed to ensure that samples were labeled and tracked correctly, including chain of custody and master log forms. All sample holding times were met.

Field Sampling QA/QC Results

A total of 128 samples (including QA/QC) were collected from 21 Smelterville homes during this event (Table 1). Field QA/QC samples consisted of 9 field duplicates and 4 rinsate blanks. Seven National

Institute of Standards and Technology (NIST) standards were also included in the sample train. All samples were banked and recorded on a master log, and chain of custody forms were completed and checked before samples were shipped to the lab. All dust samples were sieved to -80 mesh at Northern Analytical prior to analysis.

Duplicates

A total of nine duplicates were collected in the field and submitted to the laboratory for analysis. Duplicate samples were used to examine variability in the field and in laboratory procedures. Four BRM dust duplicates, one vacuum duplicate, and four mat dust duplicates were sampled and analyzed. The BRM field duplicates were sampled in the same manner as the original, placing the template next to the location of the original. The duplicate vacuum bag samples were collected in the same manner as the original, but placed in a separate container.

Results for the nine duplicate analyses are presented in Table 2. The average relative percent difference (RPD) was 26.0% for the BRM dust duplicates (which ranged between 2.5 and 44.4), 8.6% for vacuum duplicate, and 32.8% for the dust mat duplicates (which ranged between 0.0 and 103.7). There is no required review criteria for field duplicates, therefore no samples were qualified as estimates based on the duplicate results.

Rinsate Blanks

Rinsate blanks were collected to ensure decontamination procedures were effective, and that cross-contamination was not significant during field sampling. Rinsate blanks consisted of commercially available distilled water poured over a representative batch of decontaminated sampling equipment. Rinsate blanks were collected into 500 ml plastic bottles and preserved with nitric acid. The bottles were supplied by Northern Analytical and were delivered to Northern Analytical for analysis.

Four rinsate blanks were collected during the sampling event. Rinsate blank results are presented in Table 3. All of the rinsate blanks were below detection for lead, therefore no qualifiers were placed on the data based on rinsate blank results.

Laboratory Analysis

A total of 108 samples (excluding QA/QC samples) were collected from Smelterville homes during the project. Laboratory QA/QC was checked externally by the use of duplicate samples in the field and by submitting soil standards blind to the laboratory for lead analysis. One field duplicate was collected and one standard was submitted for every batch of samples (approximately 20) submitted to the lab. Northern Analytical provided a copy of their internal QA/QC results for laboratory preparation blanks, aqueous and soil laboratory control samples (LCS), and matrix spike/matrix spike duplicates (MS/MSD).

External QA/QC

Standards

Standards were used to evaluate the accuracy of Northern Analytical. Non-mat standard results are presented in Table 4. Seven dust standards were submitted blind to Northern Analytical; one standard was included in every batch of samples submitted to the lab. Five of the standards were sent with BRM and vacuum samples, and two of the standards were sent with mat dust samples. The average percent recovery for the non-mat standards was 84.6%. One standard had insufficient sample volume for analysis, and is not included in the average. No sample results were qualified based on non-mat standard results.

Mat Dust Standards

A pre-loaded mat standard was inserted at the University of Idaho mat dust extraction laboratory for every batch of mat dust samples (approximately 1 in 20). A total of two standards were recovered from the mats and submitted blind to Northern Analytical. When the data were received from the lab, it was clear that a different standard had been applied to the mats than was thought. Upon inspection of the pre-made standard mats present in the lab, the lead concentration of the standard could not be determined. The loaded mass was also uncertain as greater mass was recovered than what was thought to have been applied. As a result, the mat standard results had to be rejected. The dust mat standards are normally used to evaluate the dust recovery of the vacuum, as well as the accuracy of Northern Analytical. Historic use of the mat standards has yielded fairly consistent results, and there is no reason to believe the results of this sampling would be any different.

Internal QA/QC

Northern Analytical inserted one laboratory preparation blank per batch of samples to ensure no bias was introduced during sample preparation. Prep blank results are displayed in Tables 5a and 5b. All prep blanks were below the instrument detection limit for lead. No qualifiers were placed on the data based on the prep blank results.

Internal checks of Northern Analytical's accuracy were assessed by analyzing laboratory control samples (LCS). Results for aqueous LCS are presented in Tables 6a and b, results for soil LCS are presented in Tables 7a and b. An aqueous and soil LCS was analyzed for each batch. All LCS samples were within the acceptable percent recovery ranges specified by Northern Analytical. No qualifiers were placed on the data based on the LCS results.

Internal checks of laboratory precision at Northern Analytical were assessed using matrix spike/matrix spike duplicate (MS/MSD) analysis on one sample from each sample batch. Tables 8a and b contain the MS/MSD analysis results. RPDs ranged from 0% to 10%, with an average of 4.4%. All spike percent recoveries were within the acceptable range specified by Northern Analytical, thus no qualifiers were placed on the data based on the laboratory MS/MSD results.

Conclusions

A check of field decontamination procedures was assessed using rinsate blanks. No significant concentrations of lead were found in the rinsate blanks. No qualifiers were placed on the data based on rinsate blank results.

Field duplicates were analyzed to assess field and laboratory variability. The BRM dust duplicate percent recovery indicated high field variability. No qualifiers were placed on the data based on duplicate results.

An external check of Northern Analytical laboratory accuracy was assessed using NIST soil standards. All percent recoveries were within the acceptable range and no qualifiers were placed on the data based on BRM and vacuum dust standards results. Mat standard results were rejected because an unknown standard was used, and the concentration and loading could not be determined. All other checks on the mat data were within acceptable limits, so there is no reason to suspect the mat data.

An internal check of Northern Analytical laboratory accuracy was assessed using LCS. All LCS results were within acceptable limits. Laboratory precision was assessed using MS/MSD analyses. All MS/MSDs displayed acceptable RPD values. Lead concentrations in all laboratory prep blanks were below instrument detection limits.

Based on a complete review of the rinsate blanks, field duplicates, field splits, standards, prep blanks, LCS, and MS/MSD analyses, the final completeness for the study was assessed at 100%.

References Cited

TerraGraphics Environmental Engineering, Inc. 2000a. *Final Field Work Plan for the House Dust Pilot Project Interior Dust Sampling.* August 2000.

TerraGraphics Environmental Engineering, Inc. 2000b. *Final Interior House Dust Pilot Cleaning Work Plan.* August 2000.

U.S. Environmental Protection Agency (USEPA). 2001. *Guidance on Environmental Data Verification and Data Validation: EPA QA/G-8 Peer Review Draft*. June 2001.

______. 1994. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*.

Table 1 House Dust Pilot Data

Sample ID	Field ID	Sample Type	Lead Concentration	units
01M001	HP-20-C-M	Mat	1700	mg/kg
01M002	HP-12-C-M	Mat	1200	mg/kg
01M003	HP-23-C-M	Mat	540	mg/kg
01M004	HP-08-C-M	Mat	270	mg/kg
01M005	HP-10-C-M	Mat	2900	mg/kg
01M006	HP-24-C-M	Mat	200	mg/kg
01M007	HP-11-C-M	Mat	1000	mg/kg
01M008	HP-09-C-M	Mat	560	mg/kg
01M009	HP-04-C-M	Mat	810	mg/kg
01M010	HP-02-C-M	Mat	760	mg/kg
01M011	HP-15-C-M	Mat	540	mg/kg
01M012	HP-14-C-M	Mat	300	mg/kg
01M013	HP-22-C-M	Mat	1200	mg/kg
01M014	HP-03-C-M	Mat	650	mg/kg
01M016	HP-07-C-M	Mat	1200	mg/kg
01M017	HP-19-C-M	Mat	2900	mg/kg
01M019	HP-06-C-M	Mat	750	mg/kg
01M021	HP-21-C-M	Mat	790	mg/kg
01M022	HP-17-C-M	Mat	550	mg/kg
01M024	HP-01-C-M	Mat	840	mg/kg
01M026	HP-05-C-M	Mat	210	mg/kg
00HP228	HP-C-05-F-L	BRM	120	mg/kg
00HP229	HP-C-05-F-C	BRM	140	mg/kg
00HP230	HP-C-05-F-K	BRM	90	mg/kg
00HP231	HP-C-21-F-L	BRM	1000	mg/kg
00HP232	HP-C-21-F-C	BRM	860	mg/kg
00HP233	HP-C-21-F-K	BRM	1100	mg/kg
00HP235	HP-C-06-F-C	BRM	400	mg/kg
00HP236	HP-C-06-F-K	BRM	<1700	mg/kg
00HP237	HP-C-06-F-L	BRM	180	mg/kg
00HP238	HP-C-19-F-K	BRM	150	mg/kg
00HP240	HP-C-19-F-C	BRM	580	mg/kg
00HP241	HP-C-19-F-L	BRM	630	mg/kg
00HP242	HP-C-17-F-L	BRM	1300	mg/kg
00HP243	HP-C-17-F-C	BRM	1200	mg/kg
00HP244	HP-C-17-F-K	BRM	710	mg/kg
00HP245	HP-C-07-F-C	BRM	1600	mg/kg
00HP248	HP-C-07-F-K	BRM	1400	mg/kg
00HP249	HP-C-07-F-L	BRM	620	mg/kg
00HP250	HP-C-01-F-L	BRM	1600	mg/kg
00HP251	HP-C-01-F-C	BRM	300	mg/kg
00HP252	HP-C-01-F-K	BRM	NA	-----
00HP253	HP-C-03-F-C	BRM	530	mg/kg
00HP254	HP-C-03-F-L	BRM	410	mg/kg
00HP255	HP-C-03-F-K	BRM	1200	mg/kg
00HP256	HP-C-22-F-L	BRM	1200	mg/kg

NA= insufficient sample volume for laboratory analysis

Table 1 House Dust Pilot Data (continued)

Sample ID	Field ID	Sample Type	Lead Concentration	units
00HP257	HP-C-22-F-C	BRM	1700	mg/kg
00HP258	HP-C-22-F-K	BRM	1800	mg/kg
00HP259	HP-C-02-F-K	BRM	NA	-----
00HP260	HP-C-02-F-L	BRM	1500	mg/kg
00HP261	HP-C-02-OTH	Couch	720	mg/kg
00HP262	HP-C-02-F-C	BRM	1900	mg/kg
00HP263	HP-C-15-F-K	BRM	230	mg/kg
00HP264	HP-C-15-F-C	BRM	360	mg/kg
00HP265	HP-C-15-F-L	BRM	380	mg/kg
00HP268	HP-C-09-F-K	BRM	NA	-----
00HP269	HP-C-09-F-L	BRM	840	mg/kg
00HP270	HP-C-09-F-C	BRM	450	mg/kg
00HP271	HP-C-04-F-C	BRM	1200	mg/kg
00HP272	HP-C-04-F-K	BRM	560	mg/kg
00HP273	HP-C-04-F-L	BRM	640	mg/kg
00HP274	HP-C-14-F-K	BRM	<80	mg/kg
00HP275	HP-C-14-F-C	BRM	80	mg/kg
00HP276	HP-C-14-F-L	BRM	30	mg/kg
00HP277	HP-C-20-F-L	BRM	930	mg/kg
00HP279	HP-C-20-F-K	BRM	NA	-----
00HP280	HP-C-20-F-C	BRM	NA	-----
00HP281	HP-C-11-F-L	BRM	430	mg/kg
00HP282	HP-C-11-F-C	BRM	690	mg/kg
00HP283	HP-C-11-F-K	BRM	310	mg/kg
00HP284	HP-C-24-F-L	BRM	160	mg/kg
00HP285	HP-C-24-F-C	BRM	170	mg/kg
00HP288	HP-C-19-V	Vacuum	330	mg/kg
00HP289	HP-C-02-V	Vacuum	670	mg/kg
00HP291	HP-C-09-V	Vacuum	910	mg/kg
00HP292	HP-C-22-V	Vacuum	3200	mg/kg
00HP293	HP-C-15-V	Vacuum	1600	mg/kg
00HP294	HP-C-05-V	Vacuum	340	mg/kg
00HP295	HP-C-01-V	Vacuum	260	mg/kg
00HP296	HP-C-04-V	Vacuum	300	mg/kg
00HP297	HP-C-14-V	Vacuum	100	mg/kg
00HP298	HP-C-17-V	Vacuum	2100	mg/kg
00HP299	HP-C-11-V	Vacuum	420	mg/kg
00HP300	HP-C-17-SS	Soil	400	mg/kg
00HP302	HP-C-24-V	Vacuum	210	mg/kg
00HP303	HP-C-20-V	Vacuum	44	mg/kg
00HP304	HP-C-12-V	Vacuum	630	mg/kg
00HP305	HP-C-10-V	Vacuum	70	mg/kg
00HP306	HP-C-08-V	Vacuum	500	mg/kg
00HP307	HP-C-23-V	Vacuum	660	mg/kg
00HP308	HP-C-24-F-K	BRM	160	mg/kg
00HP309	HP-C-12-F-L	BRM	440	mg/kg

NA= insufficient sample volume for laboratory analysis

Table 1 House Dust Pilot Data (continued)

Sample ID	Field ID	Sample Type	Lead Concentration	units
00HP311	HP-C-12-F-C	BRM	4500	mg/kg
00HP312	HP-C-12-F-K	BRM	NA	-----
00HP313	HP-C-12-OTH	Couch	<1600	mg/kg
00HP314	HP-C-10-F-K	BRM	NA	-----
00HP315	HP-C-10-F-L	BRM	40	mg/kg
00HP316	HP-C-10-F-C	BRM	200	mg/kg
00HP317	HP-C-23-F-L	BRM	600	mg/kg
00HP318	HP-C-23-F-C	BRM	330	mg/kg
00HP319	HP-C-23-F-K	BRM	NA	-----
00HP320	HP-C-08-F-U-S	BRM	140	mg/kg
00HP321	HP-C-08-F-L	BRM	460	mg/kg
00HP324	HP-C-08-F-K	BRM	1300	mg/kg
00HP325	HP-C-08-F-C	BRM	280	mg/kg
00HP326	HP-C-03-V	Vacuum	410	mg/kg

NA= insufficient sample volume for laboratory analysis

Table 2 - Field Duplicates

Type	Original sample ID	Duplicate sample ID	Analyte	Original Concentration	Duplicate Concentration	RPD
BRM						
	00HP235	00HP234	Lead	400	410	2.5
	00HP241	00HP239	Lead	630	990	44.4
	00HP277	00HP278	Lead	930	820	12.6
	00HP309	00HP310	Lead	440	280	44.4
					Average	*26.0*
Vacuum						
	00HP289	00HP290	Lead	670	730	8.6
Mats						
	01M017	01M018	Lead	2900	920	103.7
	01M020	01M019	Lead	950	750	23.5
	01M021	01M023	Lead	790	760	3.9
	01M024	01M025	Lead	840	840	0.0
					Average	*32.8*

RPD = ABS(X1-X2)/((X1+X2)/2)

X1 = ORIGINAL SAMPLE

X2 = DUPLICATE SAMPLE

<: Concentration below instrument detection limit.

Table 3 - Rinsate Blanks

Lab ID	Sample ID	Lead Concentration	Units
2001040121-1	00HP246	<0.003	mg/l
2001040121-2	00HP266	<0.003	mg/l
2001040182-1	00HP286	<0.003	mg/l
2001040182-2	00HP322	<0.003	mg/l

<: Concentration below instrument detection limit.

Table 4 - Non-mat Standards

Sample ID	Analyte	Units	Measured Value	True Value	Percent Recovery
00HP247	Lead	mg/kg	NA	1162	--
00HP267	Lead	mg/kg	980	1162	84.3%
00HP287	Lead	mg/kg	1100	1162	94.7%
00HP301	Lead	mg/kg	1000	1162	86.1%
00HP323	Lead	mg/kg	850	1162	73.1%
				Average	*84.6%*

NA=insufficient sample volume for laboratory analysis

Table 5a - Laboratory Prep Blanks

LabID	Units	Lead Concentration
2001040178-18	mg/L	<0.1
2001040120-20	mg/L	<0.1
2001040181-2	mg/L	<0.1
2001040182-3	mg/L	<0.003
2001040180-20	mg/L	<0.1
2001040119-20	mg/L	<0.1
2001040179-20	mg/L	<0.1
2001040121-3	mg/L	<0.003

<: Concentration below instrument detection limit.

Table 5b - Lab Prep Blanks for Mats

LabID	Units	Lead Concentration
2001060026-16	mg/L	<0.1
2001060025-14	mg/L	<0.1

<: Concentration below instrument detection limit.

Table 6a Aqueous Laboratory Control Samples

Lab ID	Analyte	Units	Measured Value	True Value	Percent Recovery	Allowable Range
2001040182-4	Lead	mg/L	4.97	5.0	99%	80-120%
2001040178-19	Lead	mg/L	10	10.0	100%	80-120%
2001040120-21	Lead	mg/L	9.6	10.0	96%	80-120%
2001040120-21	Lead	mg/L	10.4	10.0	104%	80-120%
2001040181-3	Lead	mg/L	10.6	10.0	106%	80-120%
2001040180-21	Lead	mg/L	10.2	10.0	102%	80-120%
2001040119-21	Lead	mg/L	10.2	10.0	102%	80-120%
2001040179-21	Lead	mg/L	10.6	10.0	106%	80-120%
2001040121-4	Lead	mg/L	0.499	0.5	100%	80-120%
				Average	102%	

Table 6b Aqueous Laboratory Control Samples for Mat Dust

Lab ID	Analyte	Units	Measured Value	True Value	Percent Recovery	Allowable Range
2001060026-17	Lead	mg/L	10.3	10.0	103%	80-120%
2001060025-15	Lead	mg/L	10.6	10.0	106%	80-120%
				Average	105%	

Percent Recovery = (Found Conc.)/(Known Conc.)* 100

Table 7a Soil Laboratory Control Samples

Lab ID	Analyte	Units	Measured Value	True Value	Percent Recovery	Allowable Range
2001040178-20	Lead	mg/kg	1125	982.9	114%	78-122%
2001040120-22	Lead	mg/kg	1017	982.9	103%	78-122%
2001040120-22	Lead	mg/kg	1096	982.9	112%	78-122%
2001040181-4	Lead	mg/kg	1067	982.9	109%	78-122%
2001040180-22	Lead	mg/kg	1052	982.9	107%	78-122%
2001040119-22	Lead	mg/kg	415	413.9	100%	74-126%
2001040179-22	Lead	mg/kg	1118	982.9	114%	78-122%
				Average	108%	

Table 7b Soil Laboratory Control Samples for Mat Dust

Lab ID	Analyte	Units	Measured Value	True Value	Percent Recovery	Allowable Range
2001060026-18	Lead	mg/kg	40.5	29	140%	30-170%
2001060025-16	Lead	mg/kg	161	139	116%	76-124%
				Average	128%	

Percent Recovery = (Found Conc.)/(Known Conc.)* 100

Table 8a Laboratory Matrix Spike/Matrix Spike Duplicates

MS Lab ID	MSD Lab ID	Analyte	Units	MS Concentration	MSD Concentration	RPD %
2001040182-5	2001040182-6	Lead	mg/kg	0.492	0.508	3
2001040178-21	2001040178-22	Lead	mg/kg	1800	1900	5
2001040120-23	2001040120-24	Lead	mg/kg	1100	1100	0
2001040181-5	2001040181-6	Lead	mg/kg	1300	1400	7
2001040180-23	2001040180-24	Lead	mg/kg	1900	2100	10
2001040119-23	2001040119-24	Lead	mg/kg	1600	1600	0
2001040179-23	2001040179-24	Lead	mg/kg	1900	1800	5
2001040121-5	2001040121-6	Lead	mg/kg	0.447	0.471	5
					Average	4.58

Table 8b Laboratory Matrix Spike/Matrix Spike Duplicates for Mat Dust

MS Lab ID	MSD Lab ID	Analyte	Units	MS Concentration	MSD Concentration	RPD %
2001060026-19	2001060026-20	Lead	mg/kg	2690	2750	2
2001060025-17	2001060025-18	Lead	mg/kg	2770	2590	7
					Average	4.46

APPENDIX B
Laboratory Data Sheets

(available upon request)

Interim Data Summary Report
for Pre- and Post -Cleaning Results
House Dust Pilot Project 2000

Prepared for:
Department of Environmental Quality
Boise, Idaho

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May 2001

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SECTION 1.0 INTRODUCTION

1.1 Background and History

The Bunker Hill Superfund Site (BHSS) is located in Shoshone County, north Idaho, approximately 40 miles east of Coeur d'Alene, Idaho. The site encompasses approximately 21 square miles in the Silver Valley of the South Fork of the Coeur d'Alene River (SFCDR) (Figure 1). The cities of Kellogg, Wardner, Smelterville, Page, and Pinehurst are located within its borders and are home to over 7000 people (Figure 2). A century of discharges from mining and smelting activities had left several thousand acres barren and contaminated with heavy metals. Among the most significant contaminants are antimony, arsenic, cadmium, copper, lead, mercury, and zinc. The communities were the scene of a severe lead poisoning epidemic in the 1970s resulting from the smelter being operated with improper air pollution control equipment. Nearly every child in the community was lead poisoned at that time due to air pollution and subsequent contamination of soils and dusts. The smelter closed in 1981, and remedial actions, focusing on contaminated public and residential soils, were initiated. Public health monitoring and environmental monitoring of ambient air, soils, and interior household dusts for lead have been ongoing since the mid 1970s.

Interior dust lead concentrations have been monitored annually at the BHSS for more than ten years (TerraGraphics 2000a). As part of the Record of Decision (ROD) (EPA 1991, 1992), a Remedial Action Objective (RAO) was established for house dust lead concentrations. The ROD states that "*all homes with house dust lead concentrations equal to or exceeding 1000 ppm will have a one time cleaning of residential interiors after completion of remedial actions that address fugitive dust. If subsequent interior house dust sampling indicates that house dust lead concentrations exceed a site wide average of 500 ppm lead, the need for additional cleaning will be evaluated*" (EPA 1991). The rationale for this derived from a 1990 pilot cleaning study in which several houses at the site received comprehensive interior cleaning, yet subsequent testing revealed that the houses became recontaminated within one year (CH2M Hill 1991). As a result, it was determined that home interiors could not be permanently remediated until exterior contamination sources were addressed. Because interior dust lead concentrations are highly correlated with exterior soil lead concentrations, the cleanup at the site has focused on reducing yard and community soil lead concentrations to the soil RAO, which is "*to achieve community mean soil lead concentrations of approximately 350 ppm by removal of soils exceeding the threshold level of 1000 ppm lead*" (EPA 1991). House dust lead concentrations were expected to subsequently decrease as the exterior-to-interior path was reduced. Studies monitoring interior dust lead concentrations indicate that this reduction is indeed occurring, but interior cleaning may still be necessary to further reduce dust lead concentrations (TerraGraphics 1997, 2000a). This House Dust Pilot Project is being conducted to respond to this mandate under the ROD.

Smelterville is the only community within the site where soil remediation is complete, and soil RAOs have been achieved (TerraGraphics 1999a, 2000b). Interior dust data from the 1998 Panhandle Health District (PHD) sampling season indicate that mean dust lead levels for

Smelterville are slightly higher (570 mg/kg) than the RAO with 10% of the houses exceeding 1000 mg/kg (TerraGraphics 1999b). Results of the 1999 PHD interior dust data for Smelterville reveal a geometric mean lead concentration of 595 mg/kg with 30% of the houses exceeding 1000 mg/kg (TerraGraphics 2000c). The 2000 PHD interior dust data for Smelterville indicate a geometric mean lead concentration of 416 mg/kg with 7% of the houses exceeding 1000 mg/kg (TerraGraphics 2001). Recent data indicate that lead levels are nearing the RAO in Smelterville, although the objectives have not been completely achieved. One possible explanation is that residual smelter dust has remained in reservoirs within homes.

1.2 Purpose and Objectives

The primary purpose of the House Dust Pilot Project is to determine the feasibility of instituting home interior cleaning in order to achieve and maintain a low dust lead level in the home (i.e., achieve the dust RAO for the site). This project is not designed as a scientific experiment to compare treatment techniques. Instead, it is to assess the effectiveness and efficiency of long-term solutions for the BHSS, as well as to identify logistical problems associated with any comprehensive community-wide cleanup that might be required.

The main objective of this project is to assess certain parameters (i.e., cost effectiveness, lead reduction, and logistical challenges) associated with interior cleaning so that a large-scale home interior cleaning project can be scoped.

The following specific objectives are defined for this project:

- To determine the cost, effort, and effectiveness of commercial housecleaning services versus a complete removal of permanent reservoirs of lead dust in addition to housecleaning.
- To determine the rate and magnitude of recontamination and dust and lead loading.
- To identify logistical, public health and safety, and contracting difficulties that may be encountered in a large scale cleaning effort.
- To assess sampling techniques for house dust.
- To identify other sources of lead exposure in houses that could be amenable to cleaning.

This report is the first Interim Data Summary of the pre- and post-cleaning sample results. The purpose of this report is to summarize the cleaning treatments, the characteristics of the participating houses, and the dust sampling results before and after the cleaning.

1.3 Project Scope and Limitations

This project involved the cleaning of 18 houses in Smelterville selected through previous sampling and questionnaire results, and confirmed in subsequent interviews. Cleaning was limited to areas with potential for exposure (accessible portions of the residence, including ducts). Five additional control houses in Smelterville were not cleaned but were sampled by the same methodologies as the cleaned houses.

Of the 18 houses that were cleaned, six were cleaned by a certified HUD lead-based paint contractor (Treatment Group A), six were thoroughly cleaned by a commercial cleaning company (Treatment Group B), and six were "Spring Cleaned" by a different commercial cleaning company (Treatment Group C). The purpose of using three cleaning contractors was to generate information on cost versus effectiveness should large scale cleaning be warranted. Additionally, five control houses were monitored for effectiveness comparisons.

SECTION 2.0 PROJECT DESIGN

Smelterville houses that have previously participated in summer house dust surveys were eligible to participate in the House Dust Pilot Project. Residents were solicited by explaining the project using a door-to-door approach. If a resident agreed to participate, a "Screening Interview Questionnaire" was completed (Appendix A). After enough residents agreed to participate, a meeting was held to determine if certain characteristics were undesirable for this project. It was agreed that houses (or trailers) recently built or moved into the area (i.e., within the last 3 years) would not be eligible. The eligible participants were then randomly assigned to one of the cleaning treatments or the control group. The Corps of Engineers would then visit the house to gather information for relocation and to explain the details of the process. Some participants dropped out of the program after all the participants were contacted, and even after the cleaning had begun. Cleaning Treatment C was added to the project later to cover a broad base of professional cleanings and costs. Another solicitation process was completed to replace the drop-outs and fill the new treatment.

Treatment Group A (6 houses) received full cleaning (including ducts) with carpet and furniture replacement as described below. A certified HUD cleaning contractor performed this cleaning. Treatment Group B (6 houses) received full cleaning (including ducts) with carpet and soft furniture steam cleaning (rather than replacement) as described below. The residents were temporarily relocated for the duration of the cleaning for both Treatments A and B. Treatment Group C (6 houses) referred to as "Spring Cleaning" had a full home cleaning without duct or steam cleaning. Groups B and C were cleaned by different commercial cleaning contractors. An average of two houses per week were cleaned and the entire cleaning process for all houses occurred in the months of September through November, 2000. The average cost per house for the HUD cleaning was $9,609.00. The average cost per house for the Commercial cleaning was $4,548.00. The average cost per house for the Spring cleaning was $832.00.

2.1 Carpets, Window Coverings and Upholstered Furniture

Treatment A

The HUD cleaning contractor removed and disposed of all rugs, carpets and underlayment early on the first cleaning day, after all the other furniture and personal items were moved out by professional movers. Carpet tack strip and any upholstered furniture being replaced was removed and disposed of early on the first cleaning day. Toss pillows or blankets/quilts/afghans that typically lay on the furniture were vacuumed or washed. Box springs and mattresses were cleaned (vacuumed) by the cleaning contractor. Mattresses were not replaced because they are not considered to be a repository of lead dust since they are usually covered with bedding (i.e., sheets and blankets). All window coverings were removed and dry-cleaned at a local merchant under direction of the cleaning contractor.

Treatment B

All carpets were initially cleaned using a HEPA filter vacuum and then steam cleaned using a high phosphate detergent, followed by HEPA vacuuming after drying. Upholstered furniture was cleaned in the same manner. Box springs/mattresses were cleaned (vacuumed) by the cleaning contractor. All window coverings were removed and dry-cleaned at a local merchant under direction of the cleaning contractor.

Treatment C

All carpets, upholstered furniture, and window coverings were vacuumed using a HEPA filter vacuum.

2.2 Ducts

Ducts were cleaned by a sub-contractor under supervision of the cleaning contractor and the Corps of Engineers to assure that lead hazards were not exacerbated during the cleaning. Ducts were cleaned on the first day after furnishings were moved from the house for Treatment A and before carpet and furniture cleaning for Treatment B. Samples were collected from the duct filters used by the cleaners. Treatment C did not receive duct cleaning.

2.3 Hard Surfaces

Hard surfaces were cleaned in an orderly manner, progressing throughout the home from back to front in order to avoid recontamination of rooms already cleaned. Treatments A and B used high phosphate solutions to wash hard surfaces, while Treatment C used common household products to wash.

2.3.1 Walls, ceilings, and windows

Ceilings, light fixtures, and fans were cleaned first, followed by walls and windows. Ceilings and walls were first HEPA vacuumed and then wet washed. Windows were opened and storm windows removed so that the entire window trough and well area could be completely cleaned in Treatments A and B. If the window was sealed due to painting and not normally opened, the window was not opened for cleaning, in order to minimize paint breakage and the need for repainting. In Treatment C, storm windows and screens were HEPA vacuumed and windows washed using common household products.

2.3.2 Appliances, cupboards, and countertops

The cupboards and closet interior and exterior surfaces were cleaned in the same manner as walls, as were countertops for Treatments A and B. Only the exterior surfaces were cleaned in Treatment C. All exterior surfaces of appliances were cleaned; moveable appliances were moved in order to clean behind and under them. Special attention was given to refrigerator coils and undercarriages.

2.3.3 Floors

Floors were cleaned after the other room areas had been cleaned. If the floor was carpeted, cleaning described in Section 2.1 occurred. If the floors were vinyl or hardwood, the cleaning described in Section 2.3 occurred.

2.4 Attics and Basements

Attic, basement, and crawl spaces were cleaned only if they were used as living space by the residents. Determination as to accessibility and whether they were cleaned was made at the time of the pre-cleaning interview. These areas were sampled once even when they were not cleaned.

SECTION 3.0 SUMMARY OF HOUSING CHARACTERISTICS

The Screening Interview Questionnaire (Appendix A) completed at each participating residence included questions about the age of the home and the carpet, length of residence, frequency of cleaning, condition of carpet and window treatments, number of people living in the home, presence of pets, etc. This section summarizes the characteristics of the houses determined from the questionnaire and home visit.

3.1 Age of Houses

Table 1 summarizes the general housing characteristics for Sections 3.1-3.4. Of the six houses in Treatment Group A, the oldest was built in 1938, making it 62 years old at the time of cleaning, the newest was built in 1978 (22 years old at the time of cleaning), and the average age of the HUD cleaned houses was 52 years (built in 1948). Of the six houses in Treatment Group B, the oldest was built in 1930, making it 70 years at the time of cleaning, the newest was built in 1971 (29 years old at the time of cleaning), and the average age of the Commercially cleaned houses was 57 years (built in 1943). Of the six houses in Treatment Group C, the oldest was built in

1900, making it 100 years old at the time of cleaning, the newest was built in 1993 (7 years old at the time of cleaning), and the average age of the Spring cleaned houses was 54 years old (built in 1946). Of the five houses in the Control group, the oldest was built in 1930, making it 70 years old, the newest was built in 1976 (24 years old), and the average age of the control houses was 44 years (built in 1956) (Table 1). Overall, the oldest house sampled was 100 years old, the newest was 7, and the average for all the houses was 52 years old.

3.2 Own vs. Rent

Eighty-three percent (or five out of the six houses) of both the HUD and Commercial cleaned houses were occupied by the homeowner, and 17% (or 1 house) were occupied by renters (Table 1). The Spring cleaned houses were evenly split between owners and renters. All five of the Control houses were occupied by the homeowners.

3.3 Interior Remodeling

Thirty-three percent (or two of the six houses) in the HUD group had gone through some interior remodeling, such as sanding or removing/remodeling of window sills (Table 1). Sixty-seven percent (or four of the six houses) in the Commercial group had been remodeled on the interior. Seventeen percent (or one of the six houses) have had some interior remodeling. Forty percent (or two of the five houses) in the Control group had interior remodeling (Table 1).

3.4 Rugs at Entrances

The presence of a throw rug or some form of dust mat at the entrances to a home generally decreases the amount of dust and dirt that is brought into the home (TerraGraphics 2000a). Eighty-three percent (5 out of 6) of the HUD cleaning houses had some kind of rug present at one or more entrances (Table 1). Thirty-three percent (2 out of 6) of the Commercial cleaning houses had a rug at one or more entrances, and 67% (4 out of 6) had a rug at all entrances. Sixty-seven percent (4 out of 6) of the Spring cleaning houses had a rug at one or more entrances, and 33% (2 out of 6) had one at all entrances. Sixty percent (3 of the 5) of the Control houses had a rug at one or more entrances, and 40% (2 out of 5) had a rug at all entrances (Table 1).

3.5 Carpet Age

Table 2 summarizes the age of the carpets in each treatment group. Few of the houses in the project had carpet in the kitchen. One HUD Cleaning house had 10 year old carpet in the kitchen, two Commercial houses had kitchen carpet, one was five years old, and one was seven and a half years old. One of the Spring cleaning houses had six month old carpet in the kitchen, and one of the Control houses had 20 year old carpet in the kitchen (Table 2).

All of the houses had carpeted living rooms (Table 2). The average age of the living room carpet in the HUD Cleaning houses was 9.7 years, the oldest was 20 and the newest was two years. The average age of the living room carpet in the Commercial houses was 6.8 years, the oldest was 20 and the newest was two years. The average age of the living room carpet in the Spring cleaning houses was 12.3 years, the oldest was 30 years and the newest was five months. The average age of the living room carpet in the Control houses was 15.2 years, the oldest was 30 and the newest was one year.

Few houses had carpet in the dining area (Table 2). Two of the Commercial houses had dining room carpet, one was four years old and the other was seven. One of the Control houses had 20 year old carpet in the dining room.

All of the houses except for one Commercial home had carpet in the master bedroom (Table 2). The average age of the master bedroom carpet in the HUD houses was 11.8 years, the oldest was 20 and the newest was two years. The average age of the master bedroom carpet in the Commercial houses was 2.8 years, the oldest was five years and the newest was three months. The average age of the master bedroom carpet in the Spring cleaning houses was 14.2 years, the oldest was 30 and the newest was four years old. The average age of the master bedroom carpet in the Control houses was 12.9 years, the oldest was 20 and the newest was four.

Among the HUD cleaning houses, there were six other bedrooms that were carpeted (Table 2). The average age of the carpet in a non-master bedroom among the HUD cleaned houses was 10 years old, the oldest was 20 years, and the newest was two years. The average age of the carpet in a non-master bedroom among the Commercial cleaning houses (nine other bedrooms were present in the Commercial category) was 6.3 years old, the oldest was 15 years, and the newest was one year. The average age of the carpet in a non-master bedroom among the Spring cleaning houses (seven other bedrooms) was 14.4 years old, the oldest was 30 years, and the newest was four years. The average age of the carpet in a non-master bedroom among the Control houses (eight other bedrooms) was 13.7 years old, the oldest was 20 years, and the newest was six years.

One of the Commercial houses had another room with five year old carpet, and one of the Spring cleaning houses had another room with five year old carpet, as well. On average, the Commercial cleaned houses had the newest carpets of all treatment groups.

3.6 Carpet Condition

The carpets in the houses were visually inspected by the personnel performing the Screening Interview. The condition was determined based on the condition of the carpet (tears, “bald spots”, stains, etc.). The condition codes used to characterize the carpet included “Good Condition”, “Slightly dirty, frayed, etc”, “Moderately dirty, frayed, etc”, and “Poor Condition”. Table 3 summarizes the condition of the carpets in each treatment group.

The average kitchen carpet in the HUD and Control houses was ranked as “Moderately Dirty”, the average kitchen carpet in the Commercial houses was “Slightly Dirty”, and the average kitchen carpet in the Spring cleaning houses was in “Good Condition” (Table 3). The average living room carpet in all of the houses was ranked as “Slightly Dirty”. The average dining room carpet in the Commercial houses was “Slightly Dirty”, and the average Control home was “Moderately Dirty”. The average bedroom (both master and other) carpet for the Commercial houses was determined to be “Slightly Dirty”, and the HUD, Spring cleaning, and Control houses were “Moderately Dirty”. The carpets in the other rooms in the Commercial and Spring cleaning house were in “Good Condition”.

3.7 Carpet Types

The type of carpet in each of the rooms was also classified as either Shag, Berber, Indoor/outdoor, Sculptured, or Plush. All of the kitchen carpets were classified as Indoor/outdoor. Table 4 summarizes the types of carpets observed in each home.

The living room carpet in the HUD cleaned houses was 17% Shag, 17% Berber, 33% Sculptured, and 33% Plush. The living room carpet in the Commercial cleaned houses was 17% Indoor/outdoor, 67% Sculptured, and 17% Plush. The living room carpet in the Spring cleaning houses was 33% Sculptured and 67% Plush. The living room carpet in the Control houses was 20% Shag, 60% Sculptured, and 20% Plush (Table 4).

Of the two Commercially cleaned houses that had carpet in the dining room, one was Indoor/outdoor, and the other was Plush. The carpeted dining room in the Control home was Indoor/outdoor.

Seventeen percent of the HUD master bedrooms were Shag, 50% were Sculptured, and 33% were Plush (Table 4). Twenty percent of the master bedrooms with carpet in the Commercial houses had Shag, 20% were Berber, and 60% were Plush. Sixty percent of the Spring cleaning master bedrooms were Sculptured and 40% were Plush. Twenty percent of the Control houses master bedrooms were Shag, 40% were Sculptured, and 40% were Plush.

Seventeen percent of the HUD other bedrooms were Shag, 17% were Indoor/outdoor, 33% were Sculptured, and 33% were Plush (Table 4). Eleven percent of the Commercial other bedrooms were Shag, 22% were Indoor/outdoor, 44% were Sculptured, and 22% were Plush. Fourteen percent of the Spring cleaning other bedrooms were Indoor/outdoor, 43% were Sculptured, and 43% were Plush. Thirty-eight percent of the other bedrooms in the Control houses were Shag, 13% were Berber, 13% were Sculptured, and 38% were Plush.

The other room in the Commercially cleaned home was Indoor/outdoor, and the other room in the Spring cleaning home was Berber.

3.8 Number and Age of Residents

The total number of people living in a house has been observed to affect the amount of dust entering a home (TerraGraphics 2000a). The age of the residents is also a factor, as children may track more dust into the house due to their play activities outside. For the purposes of this report, a resident was considered an adult if he or she was 18 years of age or older.

Table 5 summarizes the number and age of residents in each house. A total of 14 adults and nine children (average age of 6) lived in the six houses that received the HUD cleaning, 13 adults and six children (average age of 7.9) occupied the six Commercial houses, 13 adults and nine children (average age of 9.7) lived in the Spring Cleaning houses, and 10 adults and eight children (average age of 11.4) occupied the five Control houses.

3.9 Smoking Habits

Table 6 summarizes the smoking habits of residents. Four of the six HUD Cleaning houses had residents who smoked an average of 1.1 packs of cigarettes per day. Two of the six Commercial Cleaning houses had residents who smoked an average of 1.3 packs per day. Two of the six Spring Cleaning houses had residents who smoked an average of 1.0 pack per day. Four of the five Control houses had residents who smoked an average of 1.1 packs per day.

3.10 Ducts

If a home had a heating or cooling system involving ducts in the HUD and Commercial Cleaning Treatments, the ducts were commercially cleaned. Table 7 summarizes the centralized heating and air conditioning ducts in the houses of each treatment group. Fifty percent of the HUD Cleaning houses have Centralized Heating/Air Conditioning. All of the Commercial Cleaning houses, 33% of the Spring Cleaning houses, and 60% of the Control houses had ducts.

The average age of the ducts in the HUD Cleaning houses is 7.5 years, although at one home, the resident was unsure of the age (Table 7). The residents at all of the HUD Cleaning houses reported that they “never” clean the ducts. The average age of the ducts in the Commercial Cleaning houses is 7.0 years. Sixty-seven percent of the participants said they never clean the ducts, while 33% reported that they cleaned them at an interval of “other”. The choices were: more than two times per year, once a year, never, or other. The average age of the ducts in the Spring Cleaning houses is 11.8 years. All of the participants said they cleaned their ducts once a year. The average age of the ducts in the Control houses is 2.5 years, and one participant was unsure of the age. All of the Control participants said they “never” cleaned the ducts.

3.11 Basements and Attics

Although many of the houses had either an attic, basement, or both, these areas were only cleaned if they were used as living space. However, samples were collected whether they received a cleaning or not. If a basement or attic is determined to be contributing to a reservoir of high dust lead, the data may help to explain any recontamination that may be observed.

Table 8 summarizes the basement and attic characteristics. Of the six HUD Cleaning houses, four had accessible basements, and three had accessible attics. Twenty-five percent of the basements were used for living area and 75% were unfinished. Seventy-five percent also had dirt floors. Sixty-seven percent of the attics were unfinished, and 33% were used for other purposes.

Of the six Commercial Cleaning houses, four had accessible basements, and three had accessible attics (Table 8). Twenty-five percent of the basements were unfinished and 75% were used for storage. Twenty-five percent had dirt floors. Thirty-three percent of the attics were unfinished and 67% were used for other purposes.

Of the six Spring Cleaning houses, one had an accessible basement, and three had accessible attics (Table 8). The basement was used for storage. Sixty-seven percent of the attics were unfinished, 33% were used for storage, and 33% were used for other purposes. One of the attics was reported as both unfinished and storage area.

Of the five Control houses, one had an accessible basement (used as living area), and two had accessible attics. Both attics were used as storage, and one of them was unfinished as well.

SECTION 4.0 RESULTS AND DISCUSSION

Dust samples were collected from all 23 houses included in the project prior to any cleaning. The 18 houses that received a cleaning were sampled again within 24 hours after the cleaning. The control houses will be sampled again during the 6 and 12 month sampling event. Samples collected before and after cleaning included dust mats, vacuum bags, BRM samples from the living room, kitchen, and bedroom. Attics, basements and ducts were also sampled, but were only sampled once. A certified HUD risk assessment was also completed on all houses except in Treatment C. Dust wipe samples from the windows were collected before and after cleaning by the HUD risk assessor. A complete description of the sampling protocols used can be found in the *Final Field Work Plan for the House Dust Pilot Project, Interior Dust Sampling* (TerraGraphics 2000d).

4.1 Treatment A— HUD Cleaning Houses

4.1.1 Dust Mats

Table 9 summarizes all the dust mat results (see also Figures 3 and 4). During the pre-cleaning sampling event, mats were collected from all six HUD Cleaning houses, but one had insufficient sample volume for laboratory analysis. The average lead concentration was 824 mg/kg (685 mg/kg geometric mean), average dust loading rate was 503 mg/m^2/day (396 mg/m^2/day geometric mean), and average lead loading rate was 0.465 mg/m^2/day (0.337 mg/m^2/day geometric mean). During the post-cleaning sampling event, two of the six mats had insufficient sample volume for lead analysis. Average lead concentration from the mats was 845 mg/kg (797 mg/kg geometric mean), average dust loading rate was 497 mg/m^2/day (306 mg/m^2/day geometric mean), and average lead loading rate was 0.509 mg/m^2/day (0.471 mg/m^2/day geometric mean) (Table 9).

The lead concentrations from the dust mats at the HUD houses increased an average of 8%, with the greatest increase being 16%, and no decreases were observed. Dust loading rates increased an average of 91%, with the greatest increase being 307%, and the greatest decrease being 60%. Lead loading rates increased an average of 34%, with the greatest increase being 189%, and the greatest decrease being 59%.

4.1.2 Vacuum Dust

A vacuum bag was collected from all six HUD Cleaning houses during the pre-cleaning sampling event. Table 10 summarizes all the vacuum bag samples collected (see also Figure 3). The average lead concentration from the vacuum bags was 552 mg/kg (425 mg/kg geometric mean). During the post-cleaning sampling event, one of the participants had loaned out the vacuum, so it was ineligible for sampling. Of the five that were collected, the average lead concentration was 723 mg/kg (513 mg/kg geometric mean) (Table 10).

4.1.3 BRM Dust

4.1.3.1 BRM Kitchen Samples

During the pre-cleaning sampling event, five of the six kitchen floors yielded sufficient sample volume with the BRM for analysis. See Table 11 for a summary of results (see also Figures 5, 6, and 7). The average pre-cleaning lead concentration was 767 mg/kg (536 mg/kg geometric mean), average dust loading was 8.44 g/m^2 (4.58 g/m^2 geometric mean), and average lead loading was 4.49 mg/m^2 (2.45 mg/m^2 geometric mean). Post-cleaning, none of the floors had sufficient dust for the lab to analyze.

4.1.3.2 BRM Living Room Samples

All six of the living room BRM sample volumes were sufficient in the pre-cleaning sampling event. See Table 12 for a summary of results (see also Figures 5, 6, and 7). The average lead concentration was 673 mg/kg (487 mg/kg geometric mean), average dust loading was 22.83 g/m^2 (14.96 g/m^2 geometric mean), and average lead loading was 8.03 mg/m^2 (7.28 mg/m^2 geometric mean). The HUD Cleaning houses received new carpet, and while most samples contained a large volume of carpet fibers, all but one contained sufficient dust volume for analysis. The average post-cleaning lead concentration was 194 mg/kg (161 mg/kg geometric mean), average dust loading was 2.33 g/m^2 (1.83 g/m^2 geometric mean), and average lead loading was 0.46 mg/m^2 (0.24 mg/m^2 geometric mean).

For the HUD Cleaning home living rooms, lead concentration decreased an average of 18%, with the greatest decrease being 88%, and one home increased 210%. Dust loading decreased an average of 81%, with the greatest decrease being 98%, and no houses increased. Lead loading decreased an average of 91%, with the greatest decrease being 98%, and none of the houses increasing.

4.1.3.3 BRM Bedroom Samples

All six of the bedroom BRM sample volumes were sufficient in the pre-cleaning sampling event. See Table 13 for a summary of results (see also Figures 5, 6, and 7). The average lead concentration was 583 mg/kg (432 mg/kg geometric mean), average dust loading was 19.9 g/m^2 (12.2 g/m^2 geometric mean), and average lead loading was 6.8 mg/m^2 (5.3 mg/m^2 geometric mean). As in the living room samples, one of the bedroom BRM samples had a lead concentration below instrument detection limit during the post-cleaning sampling. The average post-cleaning lead concentration was 171 mg/kg (133 mg/kg geometric mean), average dust loading was 1.9 g/m^2 (1.5 g/m^2 geometric mean), and average lead loading was 0.3 mg/m^2 (0.2 mg/m^2 geometric mean).

For the HUD Cleaning home bedrooms, lead concentration decreased an average of 56%, with the greatest decrease being 91%, and no houses increasing. Dust loading decreased an average of 79%, with the greatest decrease being 97%, and no houses increased. Lead loading decreased an average of 91%, with the greatest decrease being 99%, and none of the houses increasing.

4.1.3.4 Overall BRM Samples

Overall for the BRM samples from the HUD Cleaning houses, from the 10 samples with a detectable lead concentration, there was an average decrease of 37% (from 669 mg/kg pre-cleaning to 183 mg/kg post-cleaning); the greatest decrease was 91%, and one home experienced an increase of 210%. Seventeen BRM samples showed an overall dust loading average decrease of 85%, with the greatest decrease being 99%, and no increases. Ten BRM samples with detectable lead had an average lead loading decrease of 91%, with the greatest decrease being 99%, and no increases.

4.2 Treatment B— Commercial Cleaning Houses

4.2.1 Dust Mats

Mats were collected from all six Commercial Cleaning houses, but one had insufficient sample volume for laboratory analysis from the pre-cleaning sampling event. The average lead concentration was 675 mg/kg (535 mg/kg geometric mean), average dust loading rate was 394 mg/m^2/day (266 mg/m^2/day geometric mean), and average lead loading rate was 0.193 mg/m^2/day (0.178 mg/m^2/day geometric mean) (Table 9). During the post-cleaning sampling event, two of the six mats had insufficient sample volume. Average lead concentration from the mats was 1375 mg/kg (1001 mg/kg geometric mean), average dust loading rate was 252 mg/m^2/day (129 mg/m^2/day geometric mean), and average lead loading rate was 0.221 mg/m^2/day (0.175 mg/m^2/day geometric mean) (Table 9).

The average lead concentration from the dust mats at the HUD Cleaning houses increased 156%, with the greatest increase being 237%, and no houses decreasing. Average dust loading rate decreased 44%, with the greatest decrease being 84%, and the greatest increase being 5%. Average lead loading rate increased 14%, with the greatest increase being 123%, and the greatest decrease being 50%.

4.2.2 Vacuum Dust

A vacuum bag was collected from five of the six Commercial Cleaning houses during the pre-cleaning sampling event. One of the houses uses the “Rainbow” type vacuum that is bagless. The average lead concentration from the vacuum bags was 507 mg/kg (459 mg/kg geometric mean) (Table 10 and Figure 3). All five bags were collected again during the post-cleaning sampling event, the average lead concentration was 415 mg/kg (405 mg/kg geometric mean).

4.2.3 BRM Dust

4.2.3.1 BRM Kitchen Samples

During the pre-cleaning sampling event, five of the six kitchen floors in the Commercial Cleaning houses had a detectable lead concentration. The average pre-cleaning lead concentration was 488 mg/kg (452 mg/kg geometric mean), average dust loading was 13.14 g/m^2 (6.52 g/m^2 geometric mean), and average lead loading was 6.09 mg/m^2 (4.07 mg/m^2 geometric mean) (Table 11). During the post-cleaning sampling event, five floors yielded a large enough sample for analysis, while only four had a detectable amount of lead. The average post-cleaning lead concentration of those four samples was 364 mg/kg (349 mg/kg geometric mean), average dust loading was 3.34 g/m^2 (1.94 g/m^2 geometric mean), and average lead loading was 1.72 mg/m^2 (1.52 mg/m^2 geometric mean).

For the Commercial Cleaning home kitchens, lead concentration decreased an average of 5%, with the greatest decrease being 29%, and the largest increase being 31%. Dust loading decreased an average of 63%, with the greatest decrease being 92%, and no houses increased. Lead loading decreased an average of 60%, with the greatest decrease being 91%, and none of the houses increasing.

4.2.3.2 BRM Living Room Samples

All six of the living room BRM sample volumes were sufficient in the pre-cleaning sampling event. One of the bottles was mis-weighed, however, so loading data is only available for five of the samples. The average lead concentration was 409 mg/kg (386 mg/kg geometric mean), average dust loading was 25.92 g/m^2 (16.09 g/m^2 geometric mean) and average lead loading was

8.91 mg/m^2 (5.74 mg/m^2 geometric mean) (Table 12). In the post-cleaning sampling event, all six living rooms again had a sufficient sample volume for analysis. The average post-cleaning lead concentration was 528 mg/kg (476 mg/kg geometric mean), average dust loading was 14.41 g/m^2 (5.18 g/m^2 geometric mean), and average lead loading was 5.11 mg/m^2 (2.47 mg/m^2 geometric mean).

For the Commercial Cleaning home living rooms, lead concentration increased an average of 32%, with the greatest decrease being 11%, and the greatest increase being 145%. Dust loading decreased an average of 53%, with the greatest decrease being 75%, and no houses increased. Lead loading decreased an average of 41%, with the greatest decrease being 67%, and none of the houses increasing.

4.2.3.3 BRM Bedroom Samples

All six of the bedroom BRM sample volumes were sufficient in the pre-cleaning sampling event. The average lead concentration was 879 mg/kg (552 mg/kg geometric mean), average dust loading was 28.6 g/m^2 (14.3 g/m^2 geometric mean) and average lead loading was 13.5 mg/m^2 (7.9 mg/m^2 geometric mean) (Table 13). In the post-cleaning sampling event, all six bedrooms again had a sufficient sample volume for analysis. The average post-cleaning lead concentration was 844 mg/kg (664 mg/kg geometric mean), average dust loading was 7.4 g/m^2 (4.8 g/m^2 geometric mean), and average lead loading was 4.6 mg/m^2 (3.2 mg/m^2 geometric mean).

For the Commercial Cleaning home bedrooms, lead concentration increased an average of 45%, with the greatest decrease being 57%, and the greatest increase being 203%. Dust loading decreased an average of 65%, with the greatest decrease being 79%, and no houses increasing. Lead loading decreased an average of 50%, with the greatest decrease being 84%, and the greatest increase being 23%.

4.2.3.4 Overall BRM Samples

Overall for the BRM samples from the Commercial Cleaning houses, from the 16 samples with a detectable lead concentration, there was an average increase of 27%; the greatest decrease was 57%, and the greatest increase was 203%. Seventeen BRM samples showed an overall dust loading average decrease of 61% , with the greatest decrease being 92%, and no increases. Fifteen BRM samples with detectable lead had an average lead loading decrease of 50%, with the greatest decrease being 91%, and a greatest increase of 23%.

4.3 Treatment C— Spring Cleaning Houses

4.3.1 Dust Mats

Mats were collected from all six Spring Cleaning houses during the pre-cleaning sampling event. The average lead concentration was 612 mg/kg (555 mg/kg geometric mean), average dust loading rate was 1331 mg/m^2/day (984 mg/m^2/day geometric mean), and average lead loading rate was 0.921 mg/m^2/day (0.546 mg/m^2/day geometric mean) (Table 9 and Figures 3 and 4). During the post-cleaning sampling event, average lead concentration from the mats was 1130 mg/kg (972 mg/kg geometric mean), average dust loading rate was 392 mg/m^2/day (294 mg/m^2/day geometric mean), and average lead loading rate was 0.520 mg/m^2/day (0.286 mg/m^2/day geometric mean) (Table 9 and Figures 3 and 4).

The average lead concentration from the dust mats at the Spring Cleaning houses increased 88%, with the greatest increase being 223%, and the greatest decrease being 4%. Average dust loading rate decreased 63%, with the greatest decrease being 88%, and no houses increasing. Average lead loading rate decreased 41%, with the greatest decrease being 74%, and the greatest increase being 17%.

4.3.2 Vacuum Dust

A vacuum bag was collected from all six Spring Cleaning houses during the pre-cleaning sampling event. The pre-cleaning vacuum lead concentration for some of the houses in Treatment C was obtained from the sample collected during the summer survey by either TerraGraphics or PHD. The average lead concentration from the vacuum bags was 598 mg/kg (514 mg/kg geometric mean) (Table 10). Five bags were collected again during the post-cleaning sampling event, the average lead concentration was 471 mg/kg (380 mg/kg geometric mean) (Figure 3).

4.3.3 BRM Dust

4.3.3.1 BRM Kitchen Samples

During the pre-cleaning sampling event, all six kitchen floors in the Spring Cleaning houses had a detectable lead concentration. The average pre-cleaning lead concentration was 610 mg/kg (427 mg/kg geometric mean), average dust loading was 5.47 g/m^2 (4.89 g/m^2 geometric mean), and average lead loading was 3.22 mg/m^2 (2.09 mg/m^2 geometric mean) (Table 11). During the post-cleaning sampling event, four samples had sufficient volume for analysis, and only two samples had a detectable amount of lead. The average post-cleaning lead concentration of those two samples was 200 mg/kg (194 mg/kg geometric mean), average dust loading was 1.69 g/m^2 (0.73 g/m^2 geometric mean), and average lead loading was 0.92 mg/m^2 (0.65 mg/m^2 geometric mean).

For the Spring Cleaning home kitchens, lead concentration increased an average of 6%, with the greatest increase being 55%, and no houses decreasing. Dust loading decreased an average of 65%, with the greatest decrease being 98%, and the greatest increase being 12%. Lead loading decreased an average of 41%, with the greatest decrease being 47%, and none of the houses increasing.

4.3.3.2 BRM Living Room Samples

All six of the living room BRM sample volumes were sufficient in the pre-cleaning sampling event. The average lead concentration was 889 mg/kg (700 mg/kg geometric mean), average dust loading was 13.13 g/m^2 (12.43 g/m^2 geometric mean), and average lead loading was 11.64 mg/m^2 (8.70 mg/m^2 geometric mean) (Table 12). In the post-cleaning sampling event, all six living rooms again had a sufficient sample volume for analysis. The average post-cleaning lead concentration was 762 mg/kg (599 mg/kg geometric mean), average dust loading was 12.87 g/m^2 (11.30 g/m^2 geometric mean), and average lead loading was 10.98 mg/m^2 (6.77 mg/m^2 geometric mean).

For the Spring Cleaning home living rooms, lead concentration decreased an average of 6%, with the greatest decrease being 63%, and the greatest increase being 58%. Dust loading decreased an average of 4%, with the greatest decrease being 67%, and the greatest increase being 65%. Lead loading decreased an average of 2%, with the greatest decrease being 88%, and the greatest increase being 56%.

4.3.3.3 BRM Bedroom Samples

Five of the six bedroom BRM samples had detectable lead in the pre-cleaning sampling event. The average lead concentration was 680 mg/kg (461 mg/kg geometric mean), average dust loading was 9.1 g/m^2 (3.5 g/m^2 geometric mean), and average lead loading was 7.0 mg/m^2 (3.5 mg/m^2 geometric mean) (Table 13). In the post-cleaning sampling event, five bedrooms again had a detectable lead level. The average post-cleaning lead concentration was 790 mg/kg (439 mg/kg geometric mean), average dust loading was 7.4 g/m^2 (3.0 g/m^2 geometric mean), and average lead loading was 8.3 mg/m^2 (2.8 mg/m^2 geometric mean).

For the Spring Cleaning home bedrooms, lead concentration decreased an average of 1%, with the greatest decrease being 44%, and the greatest increase being 27%. Dust loading increased an average of 3%, with the greatest decrease being 56%, and the greatest increase being 113%. Lead loading decreased an average of 2%, with the greatest decrease being 88%, and the greatest increase being 56%.

4.3.3.4 Overall BRM Samples

Overall for the BRM samples from the Spring Cleaning houses, from the 13 samples with a detectable lead concentration, there was an average decrease of 2%; the greatest decrease was 63%, and the greatest increase was 58%. Seventeen BRM samples showed an overall dust loading average decrease of 21%, with the greatest decrease being 98%, and the greatest increase being 113%. Thirteen BRM samples with detectable lead had an average lead loading decrease of 4%, with the greatest decrease being 88%, and a greatest increase of 116%.

4.4 Control Houses

4.4.1 Dust Mats

Mats were collected from all five Control houses. The average lead concentration was 1000 mg/kg (729 mg/kg geometric mean), average dust loading rate was 651 mg/m^2/day (547 mg/m^2/day geometric mean), and average lead loading rate was 0.463 mg/m^2/day (0.398 mg/m^2/day geometric mean) (Table 9 and Figures 3 and 4).

4.4.2 Vacuum Dust

A vacuum bag sample was collected from four of the five Control Houses during the one sampling they have received so far. The average lead concentration was 1024 mg/kg (664 mg/kg geometric mean). The minimum concentration was 224 mg/kg and the maximum was 2200 mg/kg (Table 10 and Figure 3).

4.4.3 BRM Dust

4.4.3.1 BRM Kitchen Samples

Of the five kitchens sampled, all had sufficient sample and three had detectable lead levels. The average lead concentration of the BRM sample from the Control home kitchens was 1045 mg/kg (562 mg/kg geometric mean) (Table 11). The minimum concentration was 139 mg/kg and the maximum was 2480 mg/kg. Average dust loading was 13.89 g/m^2 (8.79 g/m^2 geometric mean), average lead loading was 15.08 mg/m^2 (9.32 mg/m^2 geometric mean).

4.4.3.2 BRM Living Room Samples

All five living rooms sampled had sufficient sample with detectable lead levels. The average lead concentration of the BRM sample from the Control home living rooms was 1271 mg/kg (549 mg/kg geometric mean) (Table 12). The minimum concentration was 197 mg/kg and the maximum was 5020 mg/kg. Average dust loading was 27.00 g/m^2 (23.22 g/m^2 geometric mean), average lead loading was 15.82 mg/m^2 (12.74 mg/m^2 geometric mean).

4.4.3.3 BRM Bedroom Samples

All five bedrooms sampled had sufficient sample with detectable lead levels. The average lead concentration of the BRM sample from the Control home bedrooms was 570 mg/kg (473 mg/kg geometric mean) (Table 13). The minimum concentration was 209 mg/kg and the maximum was 1260 mg/kg. Average dust loading was 29.9 g/m^2 (23.8 g/m^2 geometric mean), average lead loading was 15.8 mg/m^2 (11.3 mg/m^2 geometric mean).

4.4.3.4 Overall BRM Samples

Overall for the BRM samples from the Control houses, from the 14 samples with a detectable lead concentration, there was an average concentration of 896 mg/kg. Fourteen BRM samples showed an overall dust loading average of 23.79 g/m^2. Thirteen BRM samples with detectable lead had an average lead loading of 15.65 mg/m^2.

4.5 Attics, Basements, and Ducts

Table 14a summarizes the lead concentration and loading data collected from the attics, basements, and ducts. Some houses did not have attics, basements, or ducts, and a few houses had attics and basements that were not accessible for sampling. Because of the few number of samples, results were not broken out by treatment groups. Four attics were sampled for lead. Three of these samples were collected using the BRM and the other was collected by using a camel hair brush to sweep dust into a Whirlpak. The average lead concentration in the attics was 6,665 mg/kg (minimum 890 mg/kg, maximum 11,600 mg/kg), average dust loading was 21 g/m^2 (minimum 5 g/m^2, maximum 32 g/m^2) , and the average lead loading was 111 mg/m^2 (minimum 0.004 mg/m^2, maximum 272 mg/m^2).

Seven basements were sampled for lead. One basement had two samples collected; one from a soil area and then dust from the floor area. Four of these were sampled with the BRM and the other four were soil samples collected with a decontaminated bowl and spoon. The average lead concentration in the basements was 2,138 mg/kg (minimum 128 mg/kg, maximum 6,980 mg/kg), average dust loading was 11 g/m^2 (minimum 6.4 g/m^2, maximum 15 g/m^2), and the average lead loading was 16 mg/m^2 (minimum 9 mg/m^2, maximum 29 mg/m^2) (Table 14a).

Seven houses had ducts that were sampled for lead. The average lead concentration from the ducts was 3,430 mg/kg, minimum concentration was 230 mg/kg and the maximum was 10,600 mg/kg (Table 14a). Table 14 b summarizes the amount of dust collected during the duct cleaning. Two houses did not have detectable amounts of dust collected by the duct cleaners. Due to the size and shape of the duct filters, the scale used weighed out to the 0.01 kg. The average mass of dust collected from the nine houses that received a duct cleaning was 156 grams, ranging from a minimum of <10 grams to a maximum of 420 grams.

4.6 HUD Risk Assessment Results

A HUD risk assessment (RA) was performed on the HUD, Commercial, and Control houses as part of the pilot project. A lead based paint analysis was performed and dust wipe samples were collected from the window sills and wells of the living room and a child’s bedroom (i.e., the same rooms sampled with the BRM). The pre- and post-cleaning dust wipe data have not been finalized to date. These data, as well as the 6-month dust wipe results, will be presented in the next Interim Data Summary Report or when results are finalized. Table 15 presents the lead based paint analysis. The results were categorized as to whether a lead paint hazard existed at the time of inspection. A hazard is defined as identified lead based paint ($\geq$ 1.0 mg lead/cm^2) in poor condition. If paint is in stable condition, an immediate hazard does not exist whether or not lead paint is identified. Spring Cleaning houses did not receive a HUD RA as this treatment was the lowest (and least expensive) level of treatment applied to the houses.

4.6.1 Treatment A - HUD Cleaning Houses

No interior lead paint hazards were observed in the six HUD Cleaning houses (Table 15). One house did have detected lead based paint on surfaces where there is friction such as window and door trims. However, five of the six houses have an exterior lead paint hazard (Table 15). One of the five houses has a detached structure in the yard that had lead paint in poor condition; however, a lead paint hazard was not observed on the exterior of this house.

4.6.2 Treatment B - Commercial Cleaning Houses

Five of the six Commercial Cleaning houses had no observed interior lead paint hazard (Table 15). It was identified in the one house with an interior hazard, that only the stair stringer has lead based paint in poor condition. Five of the six houses also had no exterior lead paint hazard (Table 15). It was observed that the one house with an exterior hazard had lead paint in poor condition only on the cellar windows.

4.6.3 Control Houses

No interior lead based paint hazards were observed in the five Control houses, although one house was identified with lead paint on surfaces where friction occurs such as window and door trims (Table 15). Two of the five houses have exterior lead paint hazards. One house has a detached structure in the yard identified with lead paint in poor condition, although the exterior of the house was not observed to have a lead paint hazard. One house has detected lead paint on the exterior, but is currently in stable condition.

SECTION 5.0 DATA QUALITY ASSURANCE / QUALITY CONTROL SUMMARY

A data Quality Assurance/Quality Control (QA/QC) review was completed to evaluate the precision, accuracy, completeness, and representativeness of the data obtained from both the field and the laboratory. A complete QA/QC review of Dust Pilot data collected during the pre- and post-cleaning sampling events is found in Appendix B . Laboratory data sheets are found in Appendix C. A total of 276 samples (including QA/QC) were collected from the twenty-three Smelterville houses during these events. Mat dust, vacuum dust, and BRM dust were collected and submitted to Northern Analytical Laboratories, Inc. in Billings, Montana for lead analysis.

Field QA/QC samples consisted of 17 field duplicates, 8 field splits, and 13 rinsate blanks and 18 National Institute of Standards and Technology (NIST) soil standards. The average relative percent difference (RPD) was 29.5% for the BRM dust duplicates (one calculated RPD was 100%, indicating high field variability, while the rest were between 0.0 and 26.7), 31.5% for Vacuum duplicates (ranging from 3.1 to 87.2), 32.8% for duct samples, 44.8% for dust mats, and

22.4% for the attic dust duplicate. Twelve of the thirteen rinsate blanks were below detection for lead. One rinsate blank had a lead concentration of 0.009 mg/l. This rinsate blank was collected from a hose used with the BRM sampling equipment. The lowest lead concentration detected from the BRM samples was 30 mg/kg. This concentration is significantly higher than 10 times the rinsate concentration, therefore, it was determined that decontamination procedures were adequate for the project and no qualifiers were placed on the data.

External laboratory QA/QC was evaluated using NIST soil standards submitted blind to Northern Analytical. Eighteen dust standards were submitted; one standard was included in every batch of samples submitted to the lab. Twelve of the standards were sent with BRM and vacuum samples, and six of the standards were sent with mat dust samples. The average percent recovery for the non-mat standards was 91.8%. A total of six standards were recovered from the mats and submitted blind to Northern Analytical. The dust mat standards were used to evaluate the dust recovery of the vacuum, as well as the accuracy of Northern Analytical. The average percent recovery on dust mass for the standards was 84%. The average percent recovery on lead concentration was 66%. The average percent recovery on lead mass was 55%. The percent recovery results for mat dust standards are consistent with previous BHSS residential mat dust surveys. The reduced percent recoveries are likely attributable to mat fiber dilution of vacuumed dust mat samples or a portion of the standard sticking to the vinyl backing of the mat.

Internal laboratory QA/QC precision was assessed using laboratory control samples (LCS), matrix spike/matrix spike duplicate samples (MS/MSD), and prep blank analysis. All laboratory QA/QC results were within the acceptable control limits. Based on a complete review of field duplicates, field splits, rinsate blanks, standards, prep blanks, LCS, and MS/MSD analysis, the final completeness for this survey was assessed at 100%.

SECTION 6.0 SUMMARY AND CONCLUSIONS

A total of 23 houses in Smelterville participated in the Dust Pilot Project; six were cleaned by a HUD cleaning contractor; six were cleaned by a Commercial cleaner; six were cleaned by a different commercial cleaner; and five houses served as controls.

Houses were selected from those that had previously participated in house dust surveys. These houses were then randomly assigned to the various treatment groups. HUD Cleaning houses received a thorough cleaning (including ducts) as well as new carpet and soft furnishings and cost an average of $9609.00 per house. Commercial Cleaning houses received a thorough cleaning (including ducts) and steam cleaning of carpets and soft furnishings and cost an average of $4548.00 per house. Residents were relocated to a local hotel during this process, which took approximately 2-5 days. Spring Cleaning houses were thoroughly cleaned, but received no steam cleaning or duct cleaning. Residents were not relocated, as the process was designed to take only a single day and cost an average of $832.00 per house. Control houses were sampled during the pre-cleaning sampling event time frame. The other houses were sampled prior to and within 24 hours after the completion of the cleaning activities.

A questionnaire was completed for each participating house to determine some basic characteristics and resident habits. The characteristics examined were fairly similar between each of the treatment groups. The average HUD Cleaning house was built in 1948, the average Commercial Cleaning house was built in 1943, the average Spring Cleaning house was built in 1946, and the average Control house was built in 1956. The majority of residents are also the homeowner. Approximately half of the houses have recently been remodeled. The average age of carpets in the living rooms of HUD Cleaning houses was approximately 10 years old, Commercial Cleaning houses average approximately 7 years old, Spring Cleaning houses were approximately 12 years old, and Control houses were approximately 15 years old. The age of carpets in other rooms in the HUD Cleaning houses ranged from 2 years to over 20 years old. The age of carpets in other rooms in the Commercial Cleaning houses ranged from a few months to 15 years old. The age of carpets in other rooms in the Spring Cleaning houses ranged from 6 months to over 30 years old. The age of carpets in other rooms in the Control houses ranged from 4 years to over 30 years old. The average carpet appeared to be slightly to moderately dirty or frayed. Carpet types ranged from indoor/outdoor to sculptured and plush. The average number of children in the Commercial Cleaning houses was one, while the other cleaning treatments had an average of two children per household. A total of 14 participating households had centralized heating/air conditioning ducts. There were a total of 10 accessible basements and 11 accessible attics.

Methods used for sampling included mat dust, vacuum bag, and BRM. Attics, basements and ducts were also sampled. The dust mat protocol not only provides a measure of lead concentration, but also of dust and lead loading rates. Of the techniques used, dust mats are most influenced by exterior sources. Between the pre- and post-cleaning sampling events, dust mat mean lead concentrations increased in all three remedial treatments, while dust loading rates decreased (see Figures 3 and 4a). Lead loading rates remained approximately constant for the Commercial Cleaning houses, decreased for the Spring Cleaning houses, and increased for the HUD Cleaning houses (see Figure 4b). The dust mat technique may not be the most suitable for determining the effectiveness of an interior remediation because it measures exterior dust and soils being tracked into the house.

Vacuum bag sampling indicated a slight decrease in mean lead concentration for the Commercial and Spring Cleaning houses, and a slight increase in the HUD Cleaning houses (see Figure 3). Vacuum bag sampling is not as controlled a technique as others because homeowners have different cleaning habits, carpet types and area, vacuum types and efficiencies, etc.

BRM sampling occurred in the kitchens, living rooms, and one child's bedroom at each house. Most kitchens had vinyl flooring, while all living rooms and bedrooms were carpeted. The mean lead concentration in the kitchens decreased for all three cleaning treatments. The mean lead concentration in the living rooms greatly decreased in the HUD Cleaning houses, as expected due to the new carpeting. The Spring Cleaning houses also showed a decrease, while the Commercial Cleaning houses showed a slight increase. The mean lead concentration in the bedrooms showed the same trend as the living room (see Figure 5).

As expected, the amount of dust (as sampled with the BRM) was reduced by all cleaning treatments. The kitchen floors yielded the least dust post-cleaning, likely due to the hard flooring. Dust loading in the carpeted rooms decreased by a higher percentage in the HUD and Commercial Cleaning houses compared to the Spring Cleaning houses (see Figure 6). BRM lead loading followed the same trend as dust loading; significant decreases were observed in the HUD and Commercial Cleaning houses, with slightly smaller decreases in the carpeted rooms in the Spring Cleaning houses (see Figure 7). Lead concentrations in all the accessible attics, basements, and ducts were high, with averages for all houses of 6,665 mg/kg, 2,138 mg/kg, and 3,430 mg/kg, respectively (Table 14).

Pre-cleaning mean lead concentrations were nearly equivalent across treatment groups, as well as being representative of the city of Smelterville as a whole. The geometric mean vacuum dust lead concentration for Smelterville in 2000 was 479 mg/kg, compared to the overall pre-cleaning geometric mean for Dust Pilot houses of 498 mg/kg. The geometric mean mat dust lead concentration for Smelterville in 2000 was 591 mg/kg, compared to the overall pre-cleaning geometric mean for Dust Pilot houses of 617 mg/kg. The overall pre-cleaning BRM lead concentration for the Dust Pilot houses was 493 mg/kg. There are no BRM data for the BHSS available for comparison; however, this concentration is similar to the city of Smelterville's concentrations for vacuum bags and dust mats (479 mg/kg and 591 mg/kg, respectively). The geometric mean dust loading rate for both Smelterville in 2000 and the pre-cleaning dust mats placed at Dust Pilot houses was 486 mg/m^2/day. The geometric mean lead loading rate for Smelterville in 2000 was 0.287 mg/m^2/day, compared to 0.346 mg/m^2/day for Dust Pilot pre-cleaning dust mats.

There are no residential BRM data from the BHSS with which to compare results. However, the BRM lead concentrations were highly correlated with both vacuum bag and dust mat lead concentrations. The correlation coefficient (r) between the vacuum bag and living room BRM is 0.83 ($p<0.0001$); vacuum bag and kitchen BRM is 0.71 ($p=0.0014$); vacuum bag and bedroom BRM is 0.55 ($p=0.0117$). The correlation coefficient between the dust mat and living room BRM is 0.72 ($p=0.0003$); dust mat and kitchen BRM is 0.77 ($p=0.0003$); dust mat and bedroom BRM is 0.50 ($p=0.025$). BRM dust and lead loadings were not significantly correlated to dust mat loading rates.

The post-cleaning sampling event was the first of three opportunities to determine the effectiveness of the various interior remedial treatments. These houses will be sampled again 6 and 12 months after the cleaning. Changes in concentration and loading may occur throughout these sampling events as time of year may affect the results. The final report, following the 12 month sampling event, will contain a complete analysis of sampling procedures and results, remedial effectiveness, and also the cost and logistical feasibility of implementing a site-wide interior remediation as required by the ROD.

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Table 1 General Housing Characteristics

	TREATMENT			
	HUD	COMMERCIAL	SPRING	CONTROL
Number of Houses	6	6	6	5
YEAR BUILT				
Average	1948	1943	1946	1956
Median	1940	1938	1945	1954
Minimum	1938	1930	1900	1930
Maximum	1978	1971	1993	1976
OWN/RENT				
Own	83%	83%	50%	100%
Rent	17%	17%	50%	0%
INTERIOR REMODELING*				
Yes	33%	67%	17%	40%
No	67%	33%	83%	60%
HOUSE REMODELING**				
Yes	17%	50%	67%	60%
No	83%	50%	33%	40%
RUGS AT ENTRANCES				
At None	17%	0%	0%	0%
At One to Some	83%	33%	67%	60%
At All	0%	67%	33%	40%
REMOVING SHOES				
Yes	17%	17%	33%	0%
No	50%	83%	67%	100%
Sometimes	33%	0%	0%	0%

* Interior remodeling refers to painting the interior of the house, sanding or removing/remodeling window sills

** House remodeling refers to remodling the house, installing new carpet/furniture

Table 2 Carpet Age (years)

	TREATMENT			
	HUD	**COMMERCIAL**	**SPRING**	**CONTROL**
KITCHEN				
Number of Kitchens with Carpet	1	2	1	1
Average	10.0	6.3	0.5	20.0
Median	-	6.3	-	-
Minimum	-	5.0	-	-
Maximum	-	7.5	-	-
LIVING ROOM				
Number of Living Rooms with Carpet	6	6	6	5
Average	9.7	6.8	12.3	15.2
Median	7.0	4.5	9.8	10.0
Minimum	2.0	2.0	0.4	1.0
Maximum	20.0	20.0	30.0	30.0
DINING ROOM				
Number of Dining Rooms with Carpet	0	2	0	1
Average	-	5.5	-	20.0
Median	-	5.5	-	-
Minimum	-	4.0	-	-
Maximum	-	7.0	-	-
MASTER BEDROOM				
Number of Master Bedrooms with Carpet	6	5	6	5
Average	11.8	2.8	14.2	12.9
Median	12.5	2.5	10.0	13.8
Minimum	2.0	0.3	4.0	4.0
Maximum	20.0	5.0	30.0	20.0
OTHER BEDROOM				
Number of Other Bedrooms with Carpet	6	9	7	8
Average	10.0	6.3	14.4	13.7
Median	7.0	5.0	10.0	15.0
Minimum	2.0	1.0	4.0	6.0
Maximum	20.0	15.0	30.0	20.0
OTHER ROOM				
Number of Other Rooms with Carpet	0	1	1	0
Average	-	5.0	5.0	-
Median	-	-	-	-
Minimum	-	-	-	-
Maximum	-	-	-	-

Table 3 Carpet Condition

	TREATMENT			
	HUD	**COMMERCIAL**	**SPRING**	**CONTROL**
KITCHEN				
Number of Kitchens with Carpet	1	2	1	1
Average	Moderately Dirty	Slightly Dirty	Good Condition	Moderately Dirty
Minimum	-	Good Condition	-	-
Maximum	-	Slightly Dirty	-	-
LIVING ROOM				
Number of Living Rooms with Carpet	6	6	6	5
Average	Slightly Dirty	Slightly Dirty	Slightly Dirty	Slightly Dirty
Minimum	Good Condition	Good Condition	Good Condition	Good Condition
Maximum	Poor Condition	Moderately Dirty	Poor Condition	Poor Condition
DINING ROOM				
Number of Dining Rooms with Carpet	0	2	0	1
Average	-	Slightly Dirty	-	Moderately Dirty
Minimum	-	Slightly Dirty	-	-
Maximum	-	Slightly Dirty	-	-
MASTER BEDROOM				
Number of Master Bedrooms with Carpet	6	5	5	5
Average	Moderately Dirty	Slightly Dirty	Moderately Dirty	Moderately Dirty
Minimum	Good Condition	Good Condition	Good Condition	Slightly Dirty
Maximum	Poor Condition	Moderately Dirty	Poor Condition	Moderately Dirty
OTHER BEDROOM				
Number of Other Bedrooms with Carpet	6	9	7	8
Average	Moderately Dirty	Slightly Dirty	Moderately Dirty	Moderately Dirty
Minimum	Slightly Dirty	Good Condition	Good Condition	Moderately Dirty
Maximum	Poor Condition	Moderately Dirty	Poor Condition	Moderately Dirty
OTHER ROOM				
Number of Other Rooms with Carpet	0	1	1	0
Average	-	Good Condition	Good Condition	-
Minimum	-	-	-	-
Maximum	-	-	-	-

Table 4 Carpet Types

	TREATMENT			
	HUD	COMMERCIAL	SPRING	CONTROL
KITCHEN				
Number of Kitchens with Carpet	1	2	1	1
Indoor/outdoor	17%	100%	100%	100%
LIVING ROOM				
Number of Living Rooms with Carpet	6	6	6	5
Shag	17%	-	-	20%
Berber	17%	-	-	-
Indoor/outdoor	-	17%	-	-
Sculptured	33%	67%	33%	60%
Plush	33%	17%	67%	20%
DINING ROOM				
Number of Dining Rooms with Carpet	0	2	0	1
Indoor/outdoor	-	50%	-	100%
Plush	-	50%	-	
MASTER BEDROOM				
Number of Master Bedrooms with Carpet	6	5	5	5
Shag	17%	20%	-	20%
Berber	-	20%	-	-
Sculptured	50%	60%	60%	40%
Plush	33%	-	40%	40%
OTHER BEDROOM				
Number of Other Bedrooms with Carpet	6	9	7	8
Shag	17%	11%	-	38%
Berber	-	-	-	13%
Indoor/outdoor	17%	22%	14%	-
Sculptured	33%	44%	43%	13%
Plush	33%	22%	43%	38%
OTHER ROOM				
Number of Other Rooms with Carpet	0	1	1	0
Berber	-	-	100%	-
Indoor/outdoor	-	100%	-	-

Table 5 Number and Age of Residents in Each House

	TREATMENT			
	HUD	COMMERCIAL	SPRING	CONTROL
Number of Houses	6	6	6	5
ADULTS PER HOUSE				
Number of Adults*	14	13	13	10
Average	2	2	2	2
Minimum	2	1	2	1
Maximum	4	4	3	4
CHILDREN PER HOUSE				
Number of Children**	9	6	9	8
Average	2	1	2	2
Minimum	0	0	0	0
Maximum	3	2	4	3
CHILDREN AGE				
Number of Children	9	6	9	8
Average	6	8	10	11
Minimum	0.4	0.6	2	0.8
Maximum	13	15	15	15

*An adult was considered to be any person 18 years or older.
**A child was considered to be any person younger than 18 years old.

Table 6 Smoking Habits of Residents

	TREATMENT			
	HUD	COMMERCIAL	SPRING	CONTROL
Number of Houses	6	6	6	5
SMOKERS				
Number of Houses with Smokers	4	2	2	4
PACK PER DAY				
Average	1.1	1.3	1.0	1.1
Minimum	0.5	0.5	0.5	0.5
Maximum	2.0	2.0	1.5	2.0

Table 7 Duct Characteristics

	TREATMENT			
	HUD	COMMERCIAL	SPRING	CONTROL
CENTRALIZED HEATING / AIR CONDITIONING				
Number of Houses	6	6	6	5
Yes	50%	100%	33%	60%
No	50%	0%	67%	40%
DUCT AGE (YEARS)				
Number of Houses	2*	6	2	2*
Average	7.5	7.0	11.8	2.5
Median	7.5	5.8	11.8	2.5
Minimum	7.5	0.3	7.5	2.5
Maximum	7.5	20.0	16.0	2.5
DUCT CLEANING				
Number of Houses	3	6	2	3
More than two times a year	0%	0%	0%	0%
One time a year	0%	0%	100%	0%
Never	100%	67%	0%	100%
Other	0%	33%	0%	0%

* One House resident did not know age of the ducts

Table 8 Basement and Attic Characteristics

	TREATMENT			
	HUD	**COMMERCIAL**	**SPRING**	**CONTROL**
Number of Houses	6	6	6	5
BASEMENT				
Number of Accessible Basements	4	4	1	1
Dirt Floor	75%	25%	0%	0%
Unfinished	75%	25%	0%	0%
Storage	0%	75%	100%	0%
Living	25%	0%	0%	100%
ATTIC				
Number of Accessible Attics	3	3	3*	2*
Unfinished	67%	33%	67%	50%
Storage	0%	0%	33%	100%
Living	0%	0%	0%	0%
Other	33%	67%	33%	0%

* One control house and one spring house reported usage as both unfinished and storage.

Table 9 Dust Mat Lead Concentrations and Loading Rates for Pre- and Post-Cleaning Samples

	HUD	Commercial	Spring	Control
	Concentration (mg/kg)			
PRE-CLEANING				
N	5	5	6	5
Min	253	264	198	241
Max	1380	1310	950	2320
Average	824	675	612	1000
Std. Dev	481	500	245	833
Geometric Mean	685	535	555	729
POST-CLEANING				
N	4	4	6	--
Min	460	280	400	--
Max	1140	3040	1980	--
Average	845	1375	1130	--
Std. Dev	308	1177	614	--
Geometric Mean	797	1001	972	--
	Dust Loading Rate ($mg/m^2/day$)			
PRE-CLEANING				
N	6	6	6	5
Min	133	87	313	261
Max	1124	1011	2698	1372
Average	503	394	1331	651
Std. Dev	357	376	984	449
Geometric Mean	396	266	984	547
POST-CLEANING				
N	6	6	6	--
Min	38	53	117	--
Max	1213	1064	886	--
Average	497	252	392	--
Std. Dev	440	399	325	--
Geometric Mean	306	129	294	--
	Lead Loading Rate ($mg/m^2/day$)			
PRE-CLEANING				
N	5	5	6	5
Min	0.125	0.083	0.171	0.192
Max	1.089	0.270	2.563	0.975
Average	0.465	0.193	0.921	0.463
Std. Dev	0.409	0.078	0.945	0.304
Geometric Mean	0.337	0.178	0.546	0.398
POST-CLEANING				
N	4	4	6	--
Min	0.273	0.059	0.047	--
Max	0.804	0.391	1.170	--
Average	0.509	0.221	0.520	--
Std. Dev	0.228	0.151	0.514	--
Geometric Mean	0.471	0.175	0.286	--

Table 10 Vacuum Bag Lead Concentrations for Pre- and Post-Cleaning Samples

	HUD	Commercial	Spring	Control
	Concentration (mg/kg)			
PRE-CLEANING				
N	6	5	6	4
Min	100	206	149	224
Max	903	787	1100	2200
Average	552	507	598	1024
Std. Dev	333	229	309	950
Geometric Mean	425	459	514	664
POST-CLEANING				
N	5	5	5	--
Min	170	264	158	--
Max	1750	490	1040	--
Average	723	415	471	--
Std. Dev	656	91	350	--
Geometric Mean	513	405	380	--

Table 11 Kitchen BRM Lead Concentrations and Loadings for Pre- and Post-Cleaning Samples

	HUD	Commercial	Spring	Control
	Concentration (mg/kg)			
PRE-CLEANING				
N	5	5	6	3
Min	197	340	97	139
Max	1580	918	1360	2480
Average	767	488	610	1045
Std. Dev	677	243	495	1257
Geometric Mean	536	452	427	562
POST-CLEANING				
N	NA	4	2	--
Min	NA	281	150	--
Max	NA	558	250	--
Average	NA	364	200	--
Std. Dev	NA	130	71	--
Geometric Mean	NA	349	194	--
	Dust Loading (g/m^2)			
PRE-CLEANING				
N	5	6	6	5
Min	1.84	1.29	1.77	1.18
Max	27.81	47.22	9.02	35.88
Average	8.44	13.14	5.47	13.89
Std. Dev	11.14	17.40	2.49	13.02
Geometric Mean	4.58	6.52	4.89	8.79
POST-CLEANING				
N	5	6	6	--
Min	0.12	0.13	0.10	--
Max	0.31	6.39	6.28	--
Average	0.20	3.34	1.69	--
Std. Dev	0.08	2.55	2.33	--
Geometric Mean	0.19	1.94	0.73	--
	Lead Loading (mg/m^2)			
PRE-CLEANING				
N	5	5	6	3
Min	0.57	1.11	0.50	1.75
Max	12.85	16.90	9.38	25.00
Average	4.49	6.09	3.22	15.08
Std. Dev	5.07	6.29	3.26	11.99
Geometric Mean	2.45	4.07	2.09	9.32
POST-CLEANING				
N	NA	4	2	--
Min	NA	0.68	0.27	--
Max	NA	2.80	1.57	--
Average	NA	1.72	0.92	--
Std. Dev	NA	0.87	0.92	--
Geometric Mean	NA	1.52	0.65	--

NA = not applicable; insufficient sample volume for lead analysis

Table 12 Living Room BRM Lead Concentrations and Loading for Pre- and Post-Cleaning Samples

	HUD	Commercial	Spring	Control
	Concentration (mg/kg)			
PRE-CLEANING				
N	6	6	6	5
Min	116	194	142	197
Max	1370	572	1690	5020
Average	673	409	889	1271
Std. Dev	489	137	550	2099
Geometric Mean	487	386	700	549
POST-CLEANING				
N	5	6	6	--
Min	60	260	140	--
Max	360	950	1260	--
Average	194	528	762	--
Std. Dev	119	263	456	--
Geometric Mean	161	476	599	--
	Dust Loading (g/m^2)			
PRE-CLEANING				
N	6	5	6	5
Min	7.25	4.39	6.94	6.82
Max	68.03	75.39	20.17	41.48
Average	22.83	25.92	13.13	27.00
Std. Dev	24.74	28.78	4.64	12.72
Geometric Mean	14.96	16.09	12.43	23.22
POST-CLEANING				
N	6	6	6	--
Min	0.73	1.08	5.38	--
Max	4.70	61.57	21.53	--
Average	2.33	14.41	12.87	--
Std. Dev	1.74	23.49	6.46	--
Geometric Mean	1.83	5.18	11.30	--
	Lead Loading (mg/m^2)			
PRE-CLEANING				
N	6	5	6	5
Min	3.82	1.70	1.64	5.47
Max	13.33	25.18	21.95	34.22
Average	8.03	8.91	11.64	15.82
Std. Dev	3.65	9.60	7.42	11.79
Geometric Mean	7.28	5.74	8.70	12.74
POST-CLEANING				
N	5	6	6	--
Min	0.06	0.59	1.77	--
Max	1.57	18.47	24.76	--
Average	0.46	5.11	10.98	--
Std. Dev	0.63	6.93	10.12	--
Geometric Mean	0.24	2.47	6.77	--

Table 13 Bedroom BRM Lead Concentrations and Loadings for Pre- and Post-Cleaning Samples

	HUD	Commercial	Spring	Control
	Concentration (mg/kg)			
PRE-CLEANING				
N	6	6	5	5
Min	136	126	108	209
Max	1500	2500	1680	1260
Average	583	879	680	570
Std. Dev	496	911	624	412
Geometric Mean	432	552	461	473
POST-CLEANING				
N	5	6	5	--
Min	30	163	60	--
Max	300	1770	2140	--
Average	171	844	790	--
Std. Dev	109	565	837	--
Geometric Mean	133	664	439	--
	Dust Loading (g/m^2)			
PRE-CLEANING				
N	6	6	6	5
Min	2.30	3.12	0.08	9.97
Max	51.85	72.01	20.88	69.57
Average	19.91	28.56	9.10	29.86
Std. Dev	19.18	32.68	9.29	23.62
Geometric Mean	12.22	14.35	3.54	23.80
POST-CLEANING				
N	6	6	6	--
Min	0.73	1.24	0.07	--
Max	5.62	17.51	18.37	--
Average	1.95	7.44	7.37	--
Std. Dev	1.82	7.02	6.74	--
Geometric Mean	1.53	4.83	3.05	--
	Lead Loading (mg/m^2)			
PRE-CLEANING				
N	6	6	5	5
Min	1.65	1.03	0.70	4.93
Max	15.72	36.33	17.37	31.03
Average	6.85	13.46	6.96	15.83
Std. Dev	5.04	13.47	7.71	13.78
Geometric Mean	5.28	7.92	3.48	11.26
POST-CLEANING				
N	5	6	5	--
Min	0.10	0.56	0.52	--
Max	0.43	10.98	19.89	--
Average	0.25	4.61	8.33	--
Std. Dev	0.14	3.75	10.21	--
Geometric Mean	0.22	3.20	2.83	--

Table 14a Concentrations and Dust and Lead Loadings for Attics, Basements, and Ducts

	Attics	Basements	Ducts
Concentration (mg/kg)			
N	4	8*	7**
Average	6,665	2,138	3,430
Standard Dev.	5,298	2,180	4,809
Minimum	890	128	230
Maximum	11,600	6,980	10,600
Geometric Mean	4,425	1,299	1,207
Dust loading (g/m^2)			
N	3	4	NA
Average	20.95	10.83	NA
Standard Dev.	14.10	3.86	NA
Minimum	5.17	6.35	NA
Maximum	32.29	15.44	NA
Geometric Mean	17.43	10.29	NA
Lead loading (mg/m^2)			
N	3	4	NA
Average	110.69	16.29	NA
Standard Dev.	142.90	9.12	NA
Minimum	0.004	8.78	NA
Maximum	272.01	28.71	NA
Geometric Mean	83.72	14.55	NA

NA = not applicable
* = 2 samples collected from the same basement (1 soil/1 dust)
** = 2 insufficient sample volumes for laboratory analysis

Table 14b Dust Extracted from Duct Cleanings

	Dust (g)
House #1	420
House #2	340
House #3	150
House #4	220
House #5	110
House #6	60
House #7*	0.0
House #8*	0.0
House #9	100
AVERAGE	156

* = Insufficient mass for measurement,
scale was in kg, therefore the samlpe weight is <0.01 kg

Table 15 Interior and Exterior Lead Paint Hazards

	Interior Paint Pb Hazard	Exterior Paint Pb Hazard
HUD		
House #1	1	2
House #2	1[a]	2
House #3	1	2[b,c]
House #4	1[b]	2
House #5	1	2
House #6	1	1
Commercial		
House #1	1	1
House #2	2*	1
House #3	1	1
House #4	1	1
House #5	1	2**
House #6	1	1
Control		
House #1	1[a]	2
House #2	1	1[b]
House #3	1	1
House #4	1	1
House #5	1	2[c]

1- No Lead Hazard

2- Lead Hazard

[a] Detected lead based paint on friction surfaces (windows and interior doors).

[b] Detected lead based paint, but paint is currently in stable condition.

[c] Lead hazard on detached structure

* Detected only on stair stringer

** Detected only on exterior cellar windows

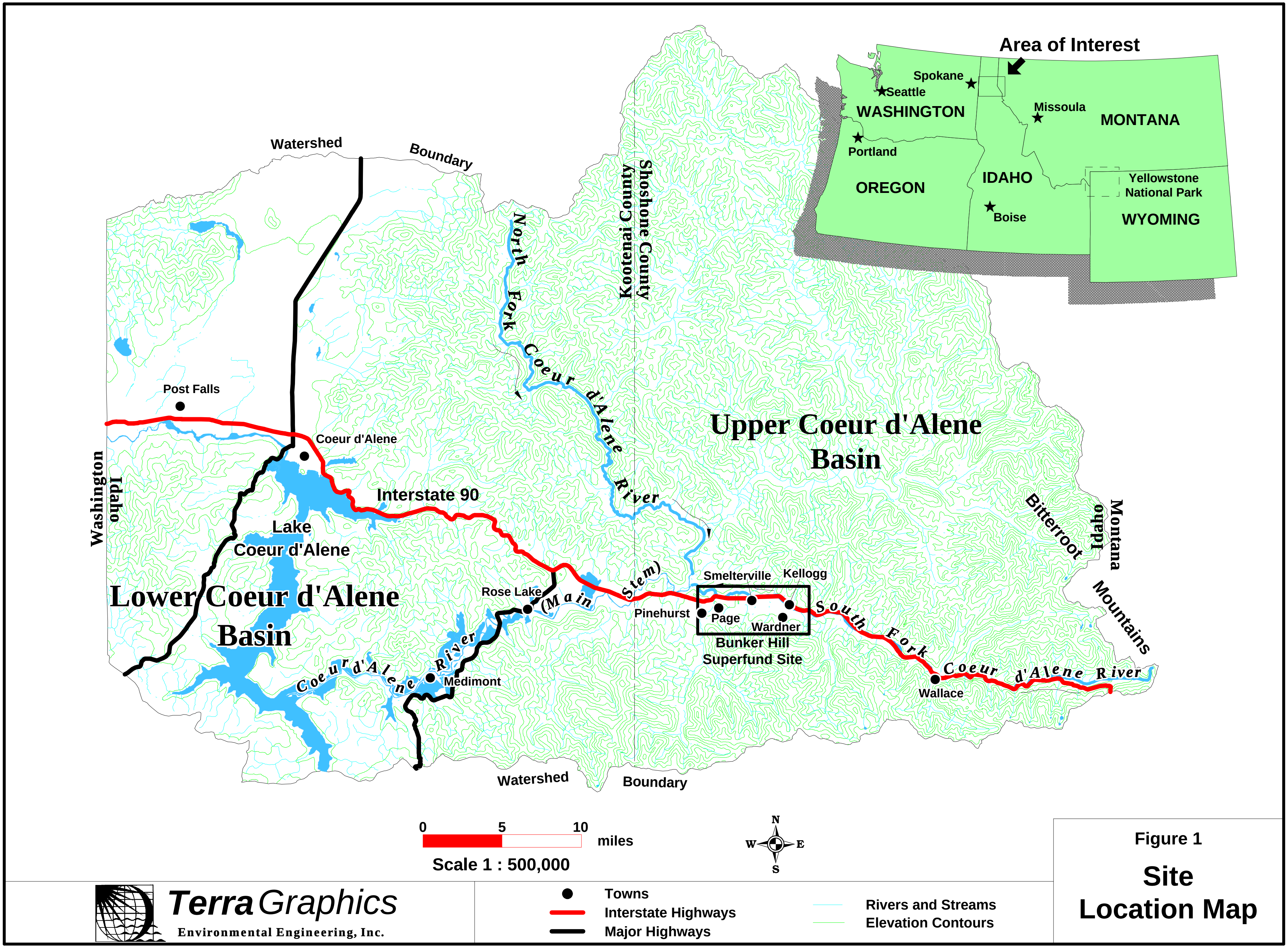
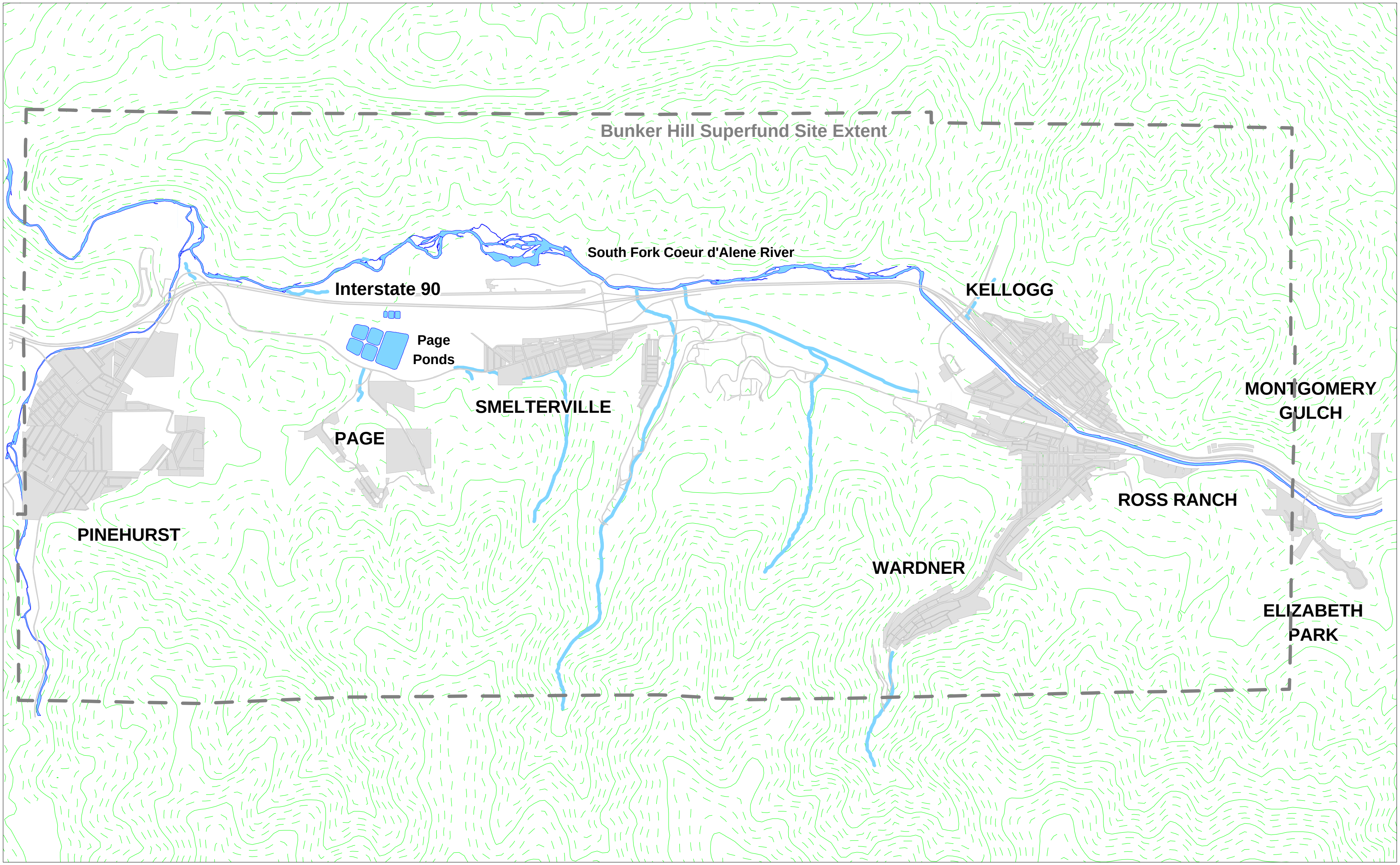


Figure 1

Site Location Map



0 0.5 1.0 miles

Scale 1 : 50,000

N W E S

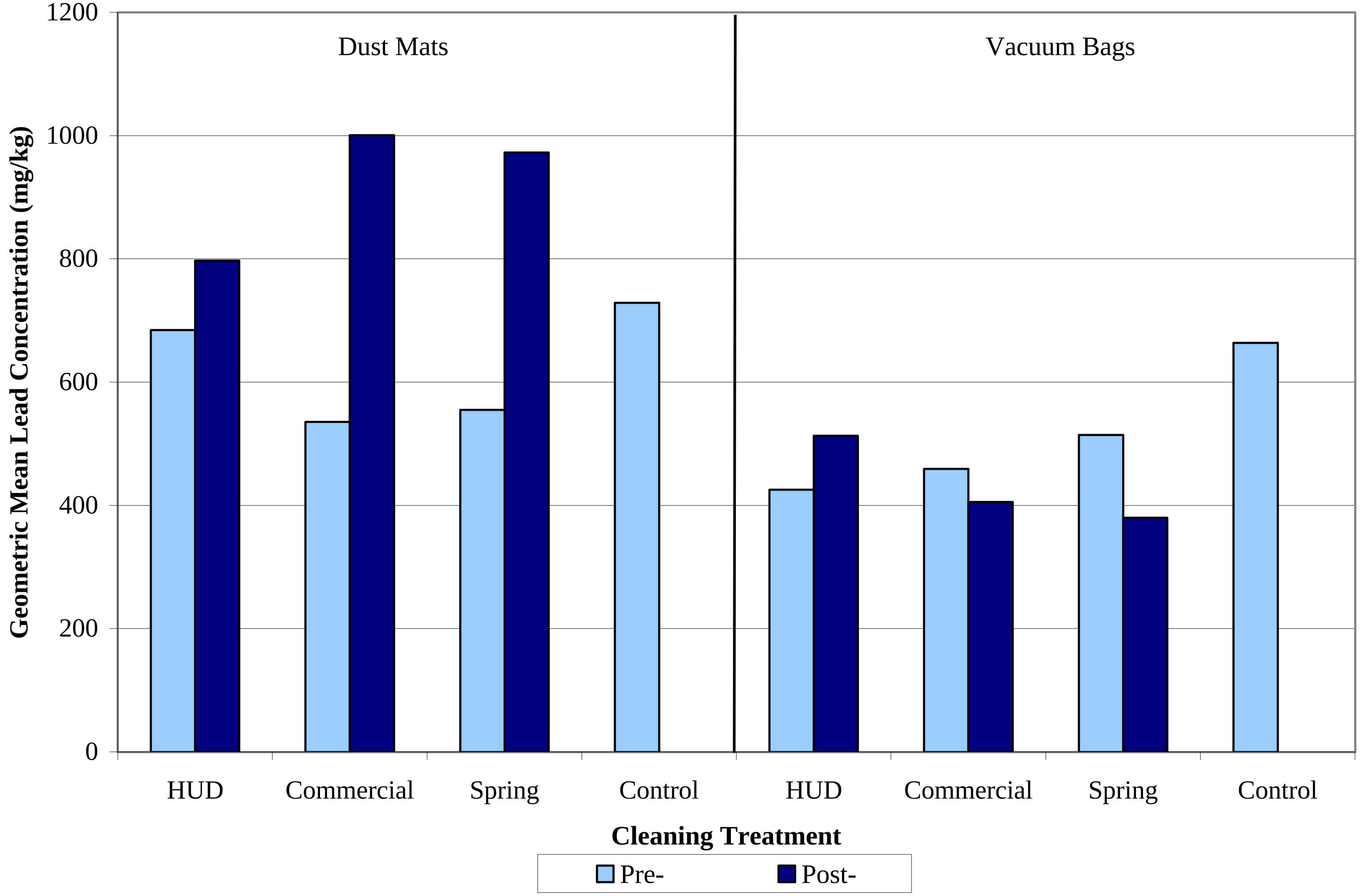
Figure 2

TerraGraphics
Environmental Engineering, Inc.

Main Roads
Topography

Bunker Hill Superfund Site

Figure 3 Dust Mat and Vacuum Bag Lead Concentrations for Pre- and Post- Samples



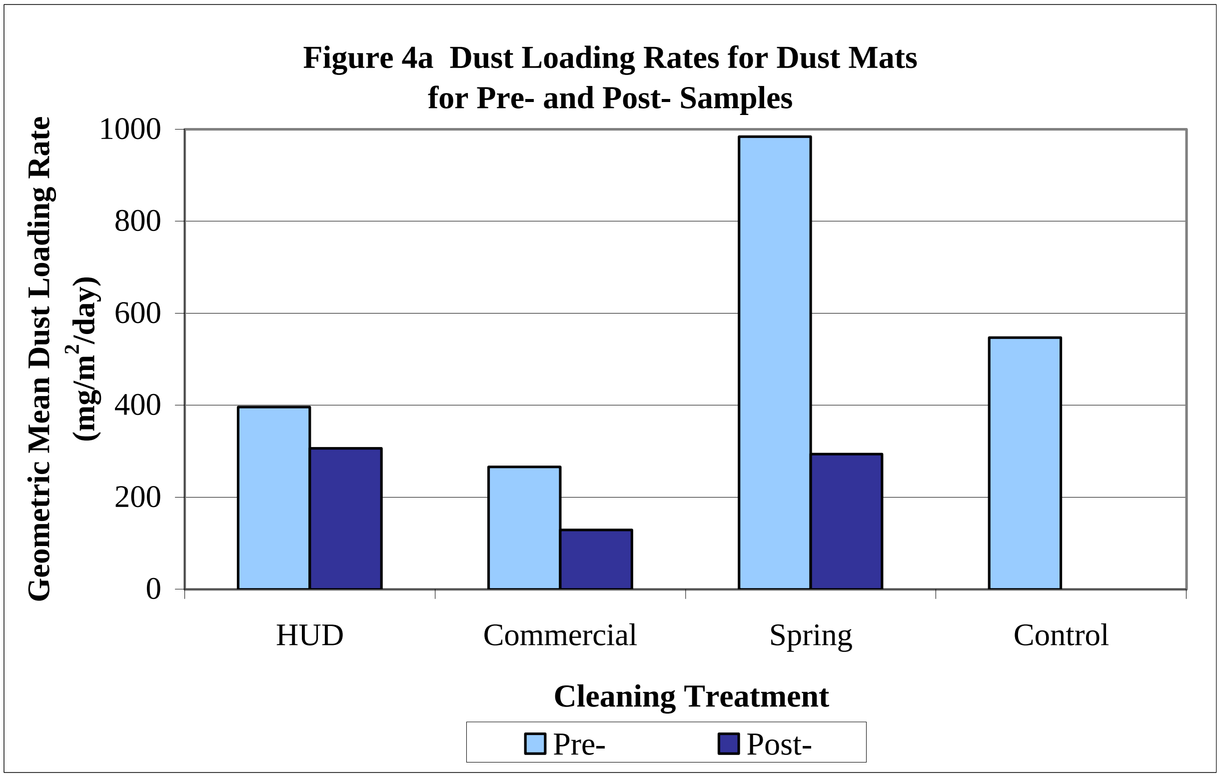


Figure 4a Dust Loading Rates for Dust Mats
for Pre- and Post- Samples
Geometric Mean Dust Loading Rate
(mg/m2/day)
1000
800
600
400
200
0
HUD
Commercial
Spring
Control
Cleaning Treatment
Pre-
Post-

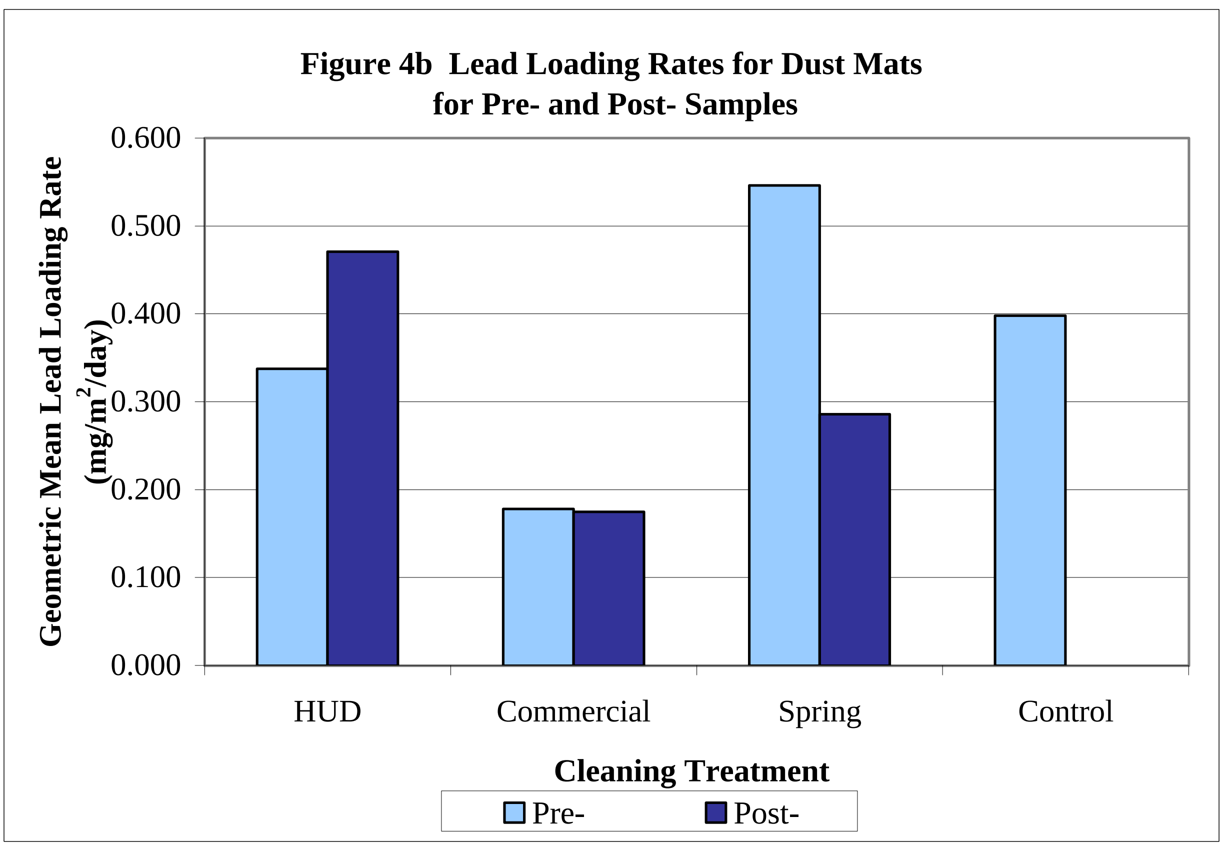
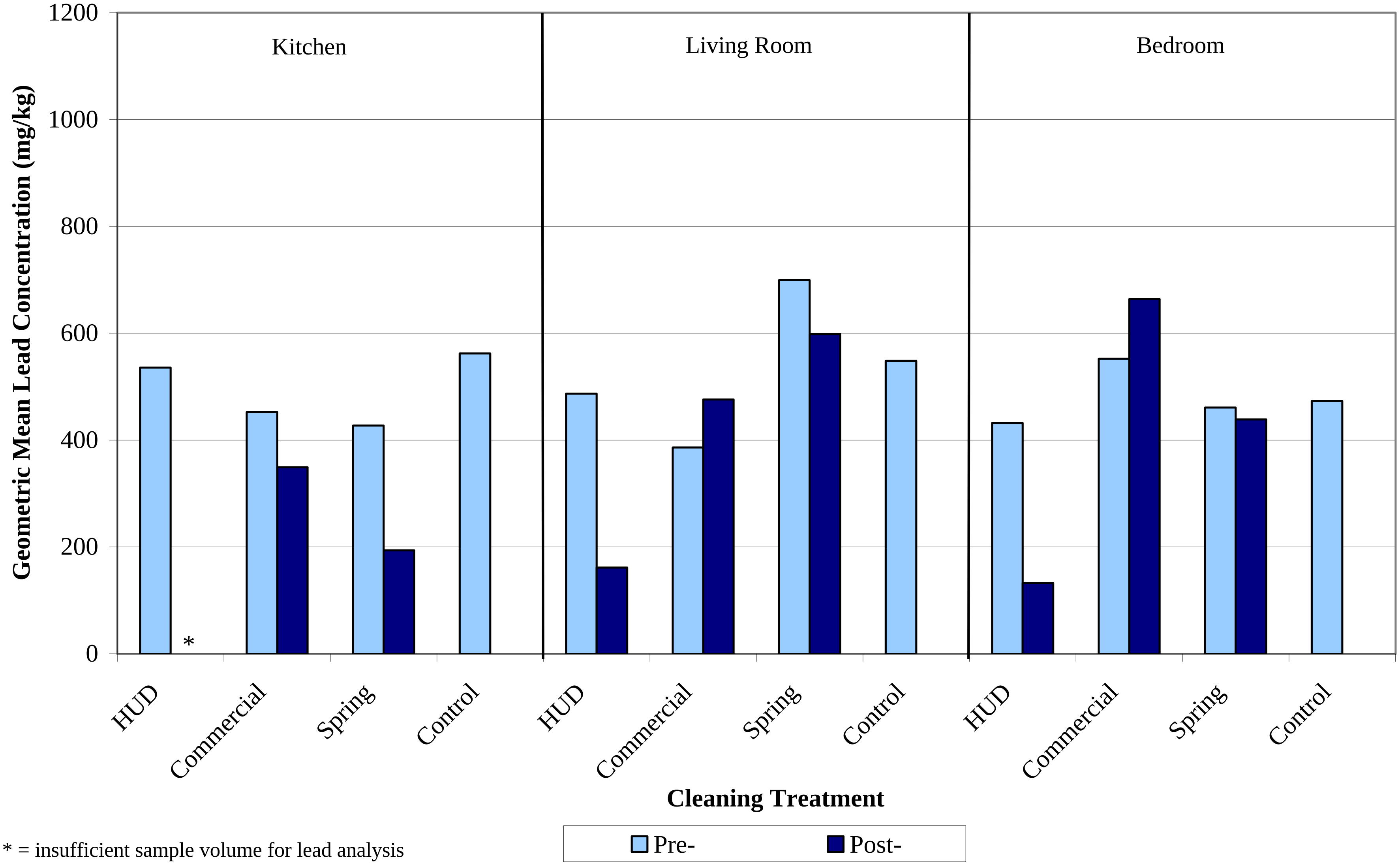


Figure 4b Lead Loading Rates for Dust Mats
for Pre- and Post- Samples
Geometric Mean Lead Loading Rate
(mg/m2/day)
0.600
0.500
0.400
0.300
0.200
0.100
0.000
HUD
Commercial
Spring
Control
Cleaning Treatment
Pre-
Post-

Figure 5 BRM Lead Concentrations for Pre- and Post- Samples



* = insufficient sample volume for lead analysis

Figure 6 BRM Dust Loadings for Pre- and Post- Samples

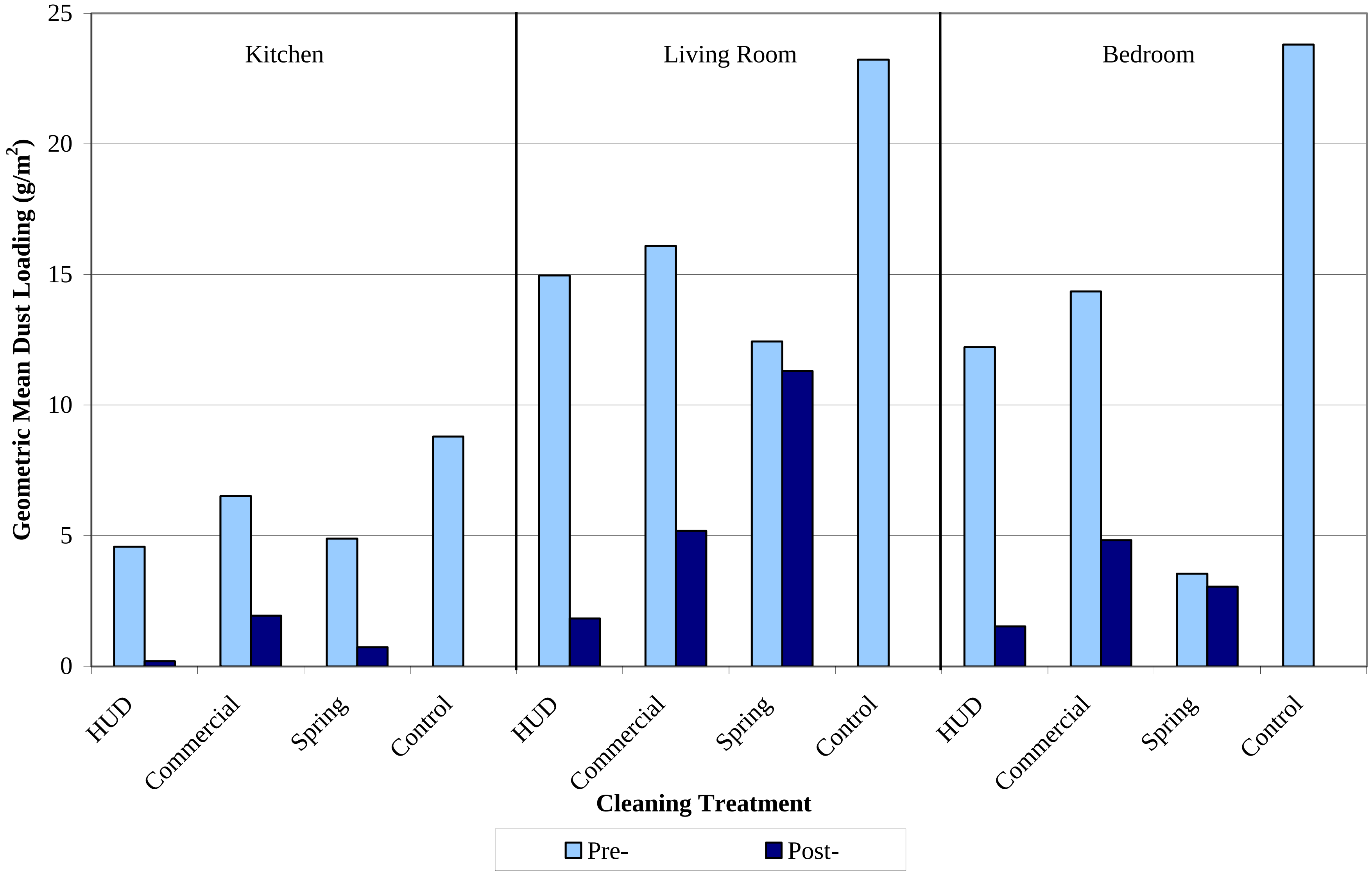
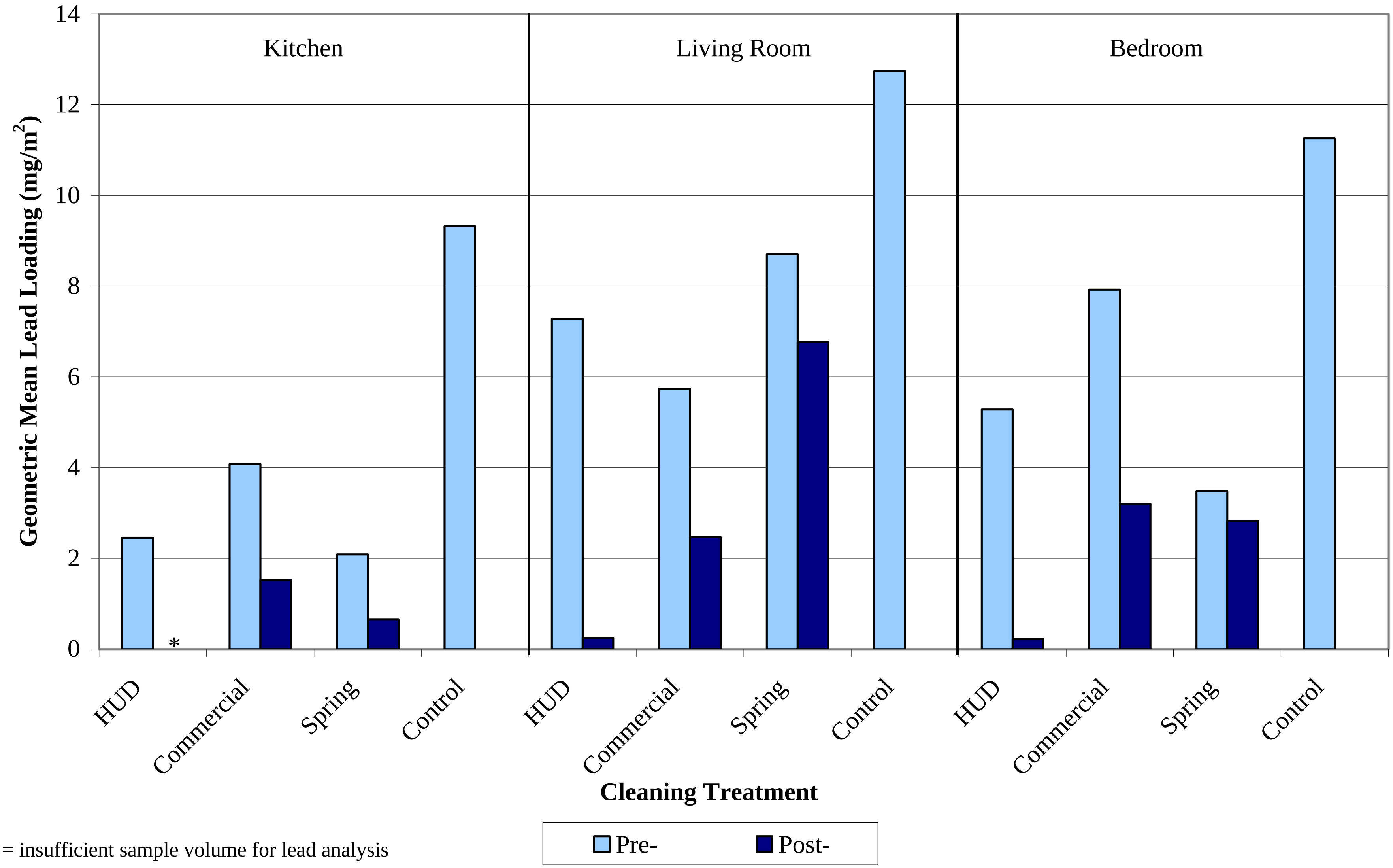


Figure 7 BRM Lead Loadings for Pre- and Post- Samples



* = insufficient sample volume for lead analysis

APPENDIX A:
Screening Interview Questionnaire

Screening Interview Questionnaire

Date:	**Interviewer:**
Street Address: **Mailing Address:**	
Phone Number: (208)	

Prior to asking interview questions, explain the pilot cleaning study - purpose, procedures, time frame, etc. Mention that there will be three treatment groups and briefly explain each. Be sure to tell the homeowner that their home has been preselected based on dust mat and/or vacuum bag sample results from the 1998 and 1999 sampling events.

1. What is your name?____

2. What year was this home built? (oldest part)

1	before 1960	3	1979 or later
2	1960 through 1978	9	don't know

3. Do you own or rent your home?

1 rent
2 own

4. How long have you lived in this home?

1	<1 month	5	6-12 months
2	1-2 months	6	1-5 years
3	2-3 months	7	>5 years
4	3-6 months	9	don't know

4b. **IF A TRAILER HOME:** Do you know where the mobile home was located before Smelterville (here)? (Write down any notes.)

5. Do you know of any lead paint existing in or outside of your home?

1 yes 2 no 9 don't know

if yes: Where? Is there a report/any data?

6. Has any of the home interior been painted or window sills been sanded or removed/remodeled while your family has lived in the home?

1 yes 2 no 9 don't know

If 'yes' ask questions 7 and 8:

7. When ?

1 within the last year
2 one to two years ago
3 more than 2 years ago
9 don't know

8. Which rooms?

1 kitchen
2 living room
3 dining room
4 TV room
5 master bedroom
6 child bedroom
7 bathroom
8 other

9. Do you have any windows in your home that are painted shut and are never opened?

1 yes
2 no

if yes: where?

10. Has your home been remodeled or new carpet/furniture installed while your family has lived in this home?

1 yes
2 no
9 don't know

If 'yes,' ask questions 11 and 12:

11. When ?

1 within the last year
2 one to two years ago
3 more than 2 years ago
9 don't know

12. Which rooms?

1 kitchen
2 living room
3 dining room
4 TV room
5 master bedroom
6 child bedroom
7 bathroom
8 other

14. How many throw rugs/entrance mats are there at the entrances in this home?

1 none
2 one at one of the entrances
3 at some of entrances
4 at all entrances

15. How many throw rugs/area rugs are there inside this home?

1 none
2 one or two
3 three to five
4 more than five

If 'yes,' ask question 16:

16. Where are these throw rugs/area rugs located?

1 kitchen
2 living room
5 master bedroom
6 child bedroom

3	dining room	7	bathroom
4	TV room	8	other

17. What type of window treatment does this home have?

1	drapes	3	both drapes and blinds
2	blinds	9	don’t know

18. Does this home have top treatment or valances for the windows?

1 yes 2 no 9 don’t know

21. Do people generally remove their shoes before entering the home?

1 yes 2 no

22. How many people regularly ***live*** in the home?

Adults __________ Children ____________

23. Where do the children residing in this home sleep?

1	own bedroom	3	parent bedroom
2	share bedroom	4	other

24. Where in the home do the children play the most?

1	kitchen	5	master bedroom
2	living room	6	child bedroom
3	dining room	7	bathroom
4	TV room	8	other

25. How often do you dust and/or clean hard blinds in your home?

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo.

26. How often do you wash fabric drapes in your home?

1	more than 1x/year	3	within the past 5 years
2	1x/year	4	never

27. How often do you dust your window sills and wells in your home?

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo.

28. How often do you dust hard furniture and other items in your home?

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo.

29. How do you dust the house?

1	vacuum	3	feathers

2 oil/water soaked rag   4 other: note:_______

30. How often do you clean the linoleum/hardwood floors in your home?

1 every 1-7 days   3 every month
2 every 7-14 days   4 less than 1x per mo.

31. How often do you wash the walls of your home?

1 more than two times a year   3 never
2 one time a year   4 other

32. How often do you wash the ceiling of your home?

1 more than two times a year   3 never
2 one time a year   4 other

33. How often do you clean the coils of your refrigerator and/or full size freezer?

1 more than two times a year   3 never
2 one time a year   4 other

34a. Do you have centralized heating/air conditioning in your home?
1. Yes   2. No _________(baseboards?)

If yes:(answer questions 34b-37)
34b. How old are the furnace and ducts in your home?

1 <5 years   3 11-15 years
2 5-10 years   4 as old as home

35. How often do you clean the ducts of your home?

1 more than two times a year   3 never
2 one time a year   4 other

(Has a professional duct cleaner cleaned your ducts? If so, when?)

____

36. What are the ducts in your home made of?

1 metal   3 duct board
2 fiberglass   4 interior insulated

37. When was the furnace filter of your home last changed?

1 within the past month   3 within the past year
2 within the past six months   4 within the past five years
9 don't know

38. How often do you vacuum the soft furniture in your home?

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo.

39. How often do you steam clean the furniture in your home?

1	more than two times a year	3	never
2	one time a year	4	other

(When was the last time your furniture was steam cleaned?)

____

40. How often do you vacuum the following carpets?

Frequency codes:

1	every 1-7 days	3	every month
2	every 7-14 days	4	less than 1x per mo. (Once/yr or couple yrs)
5	never	6	NA (=no carpet in room)

(Cross out room name if the room does not exist in the home)

Room	Frequency code
Kitchen	________
Living room	________
Dining room	________
TV room	________
Master bedroom	________
Child bedroom 1	________
Chid bedroom 2	________
Child bedroom 3	________
Bathroom 1	________
Bathroom 2	________
Other (provide rooms)	________
	________
	________

41. How often do you steam clean the following carpets?

Room	Frequency code
Kitchen	________
Living room	________
Dining room	________
TV room	________
Master bedroom	________
Child bedroom 1	________
Chid bedroom 2	________
Child bedroom 3	________
Bathroom 1	________
Bathroom 2	________
Other (provide rooms)	________
	________
	________

40. What type of vacuum cleaner do you use to vacuum your carpets and furniture? Provide year, brand, model, condition, beater bar. (Ask to look at the vacuum if they do not know, and describe in as much detail as possible - model and make/flip it over to see if it has a beater bar)

---

41. What type of steam cleaner (or who is the professional doing the cleaning) do you use to clean your carpets and furniture? (Rainbow vacuums do not count as steam cleaners).

---

42. Can any pets or outside animals access any crawl spaces (i.e., crawl under the house)?

1 yes 2 no

43. Does your home have an accessible basement?

1 yes 2 no

If 'yes,' ask question 42:
44. What is the basement in your home used for?

1 unfinished 3 living
2 storage 4 other/note:_______

45. Does you basement have a dirt floor?

1 yes 2 no

46. Does your home have an accessible attic?

1 yes 2 no 9 don't know

If 'yes,' ask question 40:
47. What is the main use of your attic?

1 unfinished 3 living
2 storage 4 other/note:_______

48. Are there any other accessible areas in your home such as crawl spaces?

1 yes 2 no 9 don't know

If 'yes,' where is it located and how do you access it?

---

49. Describe any renovation or remodeling that has occurred in this home:

50. Are there any screen doors or windows that are left open all summer?

1 yes 2 no

51. Do you have any antiques or other extremely valuable items that would preclude you from being involved in this cleaning project?

1 yes 2 no

52. Do you agree to be a part of this study if selected as a control, Treatment A, or Treatment B?

1 yes 2 no

53. Is there a planned renovation for your home within the next full year?

1 yes 2 no

54. Is there a planned relocation for you and your family within the next full year?

1 yes 2 no

55. Are there any heavy or bulky items in your home that may be difficult to move?

1 yes 2 no

13. List carpet characteristics and condition by room:

Condition codes

1 good condition
2 slightly dirty, frayed, etc.
3 moderately dirty, frayed, etc.
4 poor condition

Carpet type codes

1 shag
2 Berber
3 indoor/outdoor
4 sculptured
5 plush
6 other

Room	**Age (yrs)**	**Condition**	**Type**	**Thickness (any notes)**
Kitchen	________	________	_____	________
Living room	________	________	_____	________
Dining room	________	________	_____	________
Master bedroom	________	________	_____	________
Child bedroom 1	________	________	_____	________
Chid bedroom 2	________	________	_____	________
Child bedroom 3	________	________	_____	________
Bathroom 1	________	________	_____	________
Bathroom 2	________	________	_____	________
Other (provide rooms)	________	________	_____	________

19. List the number and condition of the **drapes** for each room.

Condition codes:

1	good condition	3	moderately dirty, ripped, etc.
2	slightly dirty, ripped, etc.	4	poor condition

Room	Number	Condition	Top Treatment
Kitchen	________	__________	____________________
Living room	________	__________	____________________
Dining room	________	__________	____________________
Master bedroom	________	__________	____________________
Child bedroom 1	________	__________	____________________
Chid bedroom 2	________	__________	____________________
Child bedroom 3	________	__________	____________________
Bathroom 1	________	__________	____________________
Bathroom 2	________	__________	____________________
Other (provide rooms)	________	__________	____________________
	________	__________	____________________
	________	__________	____________________

57. List the number, type, and condition of the **blinds** for each room.

Condition codes:

1	good condition	3	moderately dirty, bent, some missing, etc.
2	slightly dirty, bent, etc.	4	poor condition

Type codes for blinds:

1	mini	3	pleated shades
2	vertical	4	other

Room	Number	Type	Condition	Top Treatment	Pb
Kitchen	________	_____	__________	_________________	___
Living room	________	_____	__________	_________________	___
Dining room	________	_____	__________	_________________	___
Master bedroom	________	_____	__________	_________________	___
Child bedroom 1	________	_____	__________	_________________	___
Chid bedroom 2	________	_____	__________	_________________	___
Child bedroom 3	________	_____	__________	_________________	___
Bathroom 1	________	_____	__________	_________________	___
Bathroom 2	________	_____	__________	_________________	___
Other (provide rooms)	________	_____	__________	_________________	___
	________	_____	__________	_________________	___
	________	_____	__________	_________________	___

58. Does any member of the household regularly smoke cigarettes inside the home?

1. Yes 2. No

if yes: How many packs/cigarettes per day?

APPENDIX B
QA/QC MEMORANDUM

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I N T E R N A L M E M O R A N D U M

To: Shanda LeVan, TerraGraphics, Moscow

From: Lisa Hall, TerraGraphics, Moscow

Date: February 21, 2001

Subject: QA/QC Review for the House Dust Pilot Project Pre- and Post-Cleaning Sampling Events

Introduction

The following memorandum provides a summary of the quality assurance/quality control (QA/QC) review for the House Dust Pilot Pre- and Post-Cleaning Sampling Events. Twenty-three houses in Smelterville were sampled using three distinct sample collection methods. Mat dust, vacuum dust, and Baltimore Repair and Maintenance (BRM) sampler dust were collected. All samples were submitted to Northern Analytical Laboratories, Inc. for analysis.

General

A QA/QC review was completed to evaluate the precision, accuracy, completeness, and representativeness of the data obtained from both the field and the laboratory. Definitions and QC objectives for these parameters are described in the *FINAL Field Work Plan for the House Dust Pilot Project Interior Dust Sampling* (TerraGraphics 2000a) and the *Final Interior House Dust Pilot Cleaning Work Plan* (TerraGraphics 2000b). Procedures for sample labeling, handling, and analysis were as described in the Work Plans. All laboratory data and master logs were entered into Access database files. Forms were checked and reviewed to ensure that samples were labeled and tracked correctly, including chain of custody and master log forms. This data validation review indicated one sample was mislabeled, the lab caught the mistake, and we informed them of the correct sample ID. All sample holding times were met.

Field Sampling QA/QC Results

A total of 276 samples (including QA/QC) were collected from 23 Smelterville homes during these events (Table 1). Field QA/QC samples consisted of 17 field duplicates, 8 field splits, and

13 rinsate blanks. Eighteen National Institute of Standards and Technology (NIST) standards were also included in the sample train. All samples were banked and recorded on a master log, and chain of custody forms were completed and checked before samples were shipped to the lab. All dust samples were sieved to -80 mesh at Northern Analytical prior to analysis.

Duplicates

A total of 17 duplicates were collected in the field and submitted to the laboratory for analysis. Duplicate samples were used to examine variability in the field and in laboratory procedures. Five BRM dust duplicates, three vacuum duplicates, two duct sample duplicates, six mat dust and one attic dust duplicate were sampled and analyzed. The BRM field duplicates were sampled in the same manner as the original, placing the template next to the location of the original. The duplicate vacuum bag samples were collected in the same manner as the original, but placed in a separate container. The duplicate duct samples were collected in the same manner as the original, but placed in a separate container. The duplicate attic sample was collected with the BRM in the same manner as the original, from different beams in the attic.

Results for the 17 duplicate analyses are presented in Table 2. The average relative percent difference (RPD) was 29.5% for the BRM dust duplicates (one calculated RPD was 100%, indicating high field variability, while the rest were between 0.0 and 26.7), 31.5% for Vacuum duplicates (ranging from 3.1 to 87.2), 32.8% for duct samples, 44.8% for dust mats, and 22.4% for the attic dust duplicate. There is no required review criteria for field duplicates, therefore no samples were qualified as estimates based on the duplicate results.

Field Splits

A total of eight field splits were collected and submitted to the laboratory for analysis. Split samples were used to examine variability in the field and in laboratory procedures. Two BRM dust splits, three vacuum splits, and three basement splits were sampled and analyzed. The BRM splits were created when a large volume of dust was collected. The sample was homogenized and poured into two sample bottles. The split vacuum bag samples were collected by homogenizing the vacuum bag contents and placing them in separate containers. Basement splits were collected when a soil sample was taken. A sample was collected with decontaminated bowl and spoon, homogenized, and placed in two Whirlpaks.

Results for the eight split analyses are presented in Table 3. The average relative percent difference (RPD) was 24.8% for the BRM dust splits (ranging between 5.5 and 44.2), 7.1% for Vacuum splits (ranging from 2.2 to 10.9), and 6.0% for the basement splits (ranging from 1.6 to 9.7). There is no required review criteria for field splits, therefore no samples were qualified as estimates based on the split results.

Rinsate Blanks

Rinsate blanks were collected to ensure decontamination procedures were effective, and that cross-contamination was not significant during field sampling. Rinsate blanks consisted of commercially available distilled water poured over a representative batch of decontaminated sampling equipment. Rinsate blanks were collected into 500 ml plastic bottles and preserved with nitric acid. The bottles were supplied by Northern Analytical and were delivered to Northern Analytical for analysis.

Thirteen rinsate blanks were collected during the sampling event. Rinsate blank results are presented in Table 4. Twelve of the thirteen rinsate blanks were below detection for lead. Rinsate blank with sample identification number 00HP054 had a lead concentration of 0.009 mg/l. This rinsate blank was collected from a hose used with the BRM sampling equipment. The lowest lead concentration detected from the BRM samples was 30 mg/kg. This concentration is significantly higher than 10 times the rinsate concentration, therefore, it was determined that decontamination procedures were adequate for the project and no qualifiers were placed on the data.

Laboratory Analysis

A total of 238 samples (excluding QA/QC samples) were collected from Smelterville homes during the project. Laboratory QA/QC was checked externally by the use of duplicate and split samples in the field and by submitting soil standards blind to the laboratory for lead analysis. One field duplicate was collected and one standard was submitted for every batch of samples (approximately 20) submitted to the lab. Northern Analytical provided a copy of their internal QA/QC results for laboratory preparation blanks, aqueous and soil laboratory control samples (LCS), and matrix spike/matrix spike duplicates (MS/MSD).

External QA/QC

Standards

Standards were used to evaluate the accuracy of Northern Analytical. Non-mat standard results are presented in Table 5a. Eighteen dust standards were submitted blind to Northern Analytical; one standard was included in every batch of samples submitted to the lab. Twelve of the standards were sent with BRM and vacuum samples, and six of the standards were sent with mat dust samples. The average percent recovery for the non-mat standards was 91.8%. No sample results were qualified based on non-mat standard results.

Mat Dust Standards

A pre-loaded mat standard was inserted at the University of Idaho mat dust extraction laboratory for every batch of mat dust samples (approximately 1 in 20). A total of six standards were recovered from the mats and submitted blind to Northern Analytical (Table 5b). Three of the mats were loaded with 10 g of a NIST standard containing 432 mg/kg lead; the other three were loaded with 10 grams of another NIST standard containing 1162 mg/kg lead. The dust mat standards were used to evaluate the dust recovery of the vacuum, as well as the accuracy of Northern Analytical. The average percent recovery on dust mass for the standards was 84%. The average percent recovery on lead concentration was 66%. The average percent recovery on lead mass was 55%.

As was the case in previous BHSS residential dust mat surveys, standard percent recoveries on dust mass, lead concentration, and lead mass were very similar. A NIST standard was used during this survey with less than half of the lead concentration used in all previous surveys, showing that the change in the standard's lead concentration did not affect percent recoveries. Mass balance calculations on the mats using the NIST soil standards indicate that fiber dilution of mat dust extraction samples is a possible cause of reduced percent recovery on concentration for low mass recovery samples. The sieved portion of many of the dust mat samples in previous projects contained significant amounts of fibers. Numerous mat fibers were clearly visible in 1997 and 1998 laboratory photographs of the sieved portion of the samples. Another possible explanation for the decreased percent recovery on concentration is preferential retention of the clays on the somewhat sticky vinyl surface, thereby reducing the total amount of lead available for vacuum sample removal. Based on these findings, no qualifiers were placed on the data based on the mat dust standard results.

Internal QA/QC

Northern Analytical inserted one laboratory preparation blank per batch of samples to ensure no bias was introduced during sample preparation. Prep blank results are displayed in Tables 6a and 6b. All prep blanks were below the instrument detection limit for lead. No qualifiers were placed on the data based on the prep blank results.

Internal checks of Northern Analytical's accuracy were assessed by analyzing laboratory control samples (LCS). Results for aqueous LCS are presented in Tables 7a and b, results for soil LCS are presented in Tables 8a and b. An aqueous and soil LCS was analyzed for each batch. All LCS samples were within the acceptable percent recovery ranges specified by Northern Analytical. No qualifiers were placed on the data based on the LCS results.

Internal checks of laboratory precision at Northern Analytical were assessed using matrix spike/matrix spike duplicate (MS/MSD) analysis on one sample from each sample batch. Tables 8a and b contain the MS/MSD analysis results. RPDs ranged from 0% to 8%, with an average of 2.3%. All spike percent recoveries were within the acceptable range specified by Northern Analytical, thus no qualifiers were placed on the data based on the laboratory MS/MSD results.

Conclusions

A check of field decontamination procedures was assessed using rinsate blanks. No significant concentrations of lead were found in the rinsate blanks. No qualifiers were placed on the data based on rinsate blank results.

Field duplicates and splits were analyzed to assess field and laboratory variability. The BRM dust duplicate percent recovery indicated high field variability. No qualifiers were placed on the data based on duplicate or split results.

An external check of Northern Analytical laboratory accuracy was assessed using NIST soil standards. All percent recoveries were within the acceptable range and no qualifiers were placed on the data based on BRM dust, vacuum dust, and mat dust standards results. Percent recoveries were low for the three mat dust NIST standard results. Based on previous mat dust survey results, these low percent recoveries were likely a result of fiber dilution of vacuum samples or a portion of the standard sticking to the vinyl surface. No qualifiers were placed on the data based on mat dust standard results.

An internal check of Northern Analytical laboratory accuracy was assessed using LCS. All LCS results were within acceptable limits. Laboratory precision was assessed using MS/MSD analyses. All MS/MSDs displayed acceptable RPD values. Lead concentrations in all laboratory prep blanks were below instrument detection limits.

Based on a complete review of the rinsate blanks, field duplicates, field splits, standards, prep blanks, LCS, and MS/MSD analyses, the final completeness for the study was assessed at 100%.

References Cited

TerraGraphics Environmental Engineering, Inc. 2000a. *Final Field Work Plan for the House Dust Pilot Project Interior Dust Sampling*. August 2000.

TerraGraphics Environmental Engineering, Inc. 2000b. *Final Interior House Dust Pilot Cleaning Work Plan.* August 2000.

Table 1 House Dust Pilot Data

Sample ID	Field ID	Sample Type	Lead Concentration	units
00D002	HP-A-18-V	vacuum	380	mg/kg
00D009	HP-A-22-V	vacuum	1100	mg/kg
00D015	HP-A-19-V	vacuum	510	mg/kg
00HP001	HP-A-03-V	vacuum	712	mg/kg
00HP002	HP-A-03-F-L	BRM	1370	mg/kg
00HP003	HP-A-03-F-C	BRM	456	mg/kg
00HP004	HP-A-03-F-K	BRM	1580	mg/kg
00HP005	HP-A-05-V	vacuum	206	mg/kg
00HP006	HP-A-14-V	vacuum	100	mg/kg
00HP007	HP-A-11-V	vacuum	376	mg/kg
00HP008	HP-A-10-V	vacuum	191	mg/kg
00HP009	HP-A-01-V	vacuum	588	mg/kg
00HP010	HP-A-02-V	vacuum	903	mg/kg
00HP011	HP-A-11-F-K	BRM	340	mg/kg
00HP012	HP-A-11-F-L	BRM	572	mg/kg
00HP013	HP-A-14-F-C	BRM	201	mg/kg
00HP014	HP-A-11-F-C	BRM	331	mg/kg
00HP016	HP-A-14-F-K	BRM	197	mg/kg
00HP017	HP-A-14-F-L	BRM	116	mg/kg
00HP018	HP-A-10-F-L	BRM	196	mg/kg
00HP019	HP-A-05-F-C	BRM	126	mg/kg
00HP020	HP-A-10-F-C	BRM	136	mg/kg
00HP021	HP-A-05-F-L	BRM	194	mg/kg
00HP022	HP-A-10-F-K	BRM	<620	mg/kg
00HP023	HP-A-05-F-K	BRM	358	mg/kg
00HP024	HP-A-09-V	vacuum	1390	mg/kg
00HP026	HP-A-04-V	vacuum	658	mg/kg
00HP028	HP-A-08-V	vacuum	787	mg/kg
00HP029	HP-A-04-F-K	BRM	397	mg/kg
00HP030	HP-A-09-F-L	BRM	502	mg/kg
00HP031	HP-A-04-F-L	BRM	439	mg/kg
00HP032	HP-A-04-F-C	BRM	1400	mg/kg
00HP033	HP-A-08-F-C	BRM	585	mg/kg
00HP034	HP-A-02-F-C	BRM	720	mg/kg
00HP035	HP-A-08-F-L	BRM	388	mg/kg
00HP036	HP-A-09-F-C	BRM	335	mg/kg
00HP037	HP-A-02-F-L	BRM	1000	mg/kg
00HP038	HP-A-02-F-K	BRM	964	mg/kg
00HP039	HP-A-01-F-C	BRM	484	mg/kg
00HP040	HP-A-08-F-K	BRM	427	mg/kg
00HP041	HP-A-01-F-K	BRM	320	mg/kg
00HP042	HP-A-09-F-K	BRM	139	mg/kg
00HP043	HP-A-01-F-L	BRM	498	mg/kg
00HP044	HP-A-12-V	vacuum	819	mg/kg
00HP045	HP-A-17-V	vacuum	2200	mg/kg
00HP046	HP-A-12-F-L	BRM	858	mg/kg

NA= insufficient sample volume for laboratory analysis

Table 1 House Dust Pilot Data (continued)

Sample ID	Field ID	Sample Type	Lead Concentration	units
00HP047	HP-A-12-F-K	BRM	1430	mg/kg
00HP048	HP-A-12-F-01	BRM	1200	mg/kg
00HP049	HP-A-12-F-C	BRM	1500	mg/kg
00HP050	HP-A-17-F-L	BRM	5020	mg/kg
00HP051	HP-A-17-F-K	BRM	2480	mg/kg
00HP052	HP-A-17-F-C	BRM	1260	mg/kg
00HP058	HP-A-16-V	vacuum	224	mg/kg
00HP059	HP-A-15-V	vacuum	283	mg/kg
00HP060	HP-A-07-F-L	BRM	525	mg/kg
00HP061	HP-A-15-F-L	BRM	360	mg/kg
00HP063	HP-A-15-F-K	BRM	196	mg/kg
00HP064	HP-A-17-A	attic	3470	mg/kg
00HP065	HP-A-07-B	basement	1860	mg/kg
00HP066	HP-A-07-F-C	BRM	2500	mg/kg
00HP067	HP-A-16-F-C	BRM	209	mg/kg
00HP068	HP-A-07-F-K	BRM	918	mg/kg
00HP069	HP-A-16-F-L	BRM	197	mg/kg
00HP070	HP-A-15-F-C	BRM	602	mg/kg
00HP071	HP-A-06-F-C	BRM	446	mg/kg
00HP072	HP-A-06-F-L	BRM	278	mg/kg
00HP073	HP-A-06-A	attic	890	mg/kg
00HP074	HP-A-06-F-K	BRM	515	mg/kg
00HP082	HP-A-11-B	basement	848	mg/kg
00HP083	HP-B-05-B	basement	2750	mg/kg
00HP084	HP-B-05-D	duct	5020	mg/kg
00HP085	HP-B-11-D	duct	10,600	mg/kg
00HP086	HP-B-02-B	basement	2800	mg/kg
00HP087	HP-B-11-F-C	BRM	450	mg/kg
00HP088	HP-B-05-F-K	BRM	302	mg/kg
00HP089	HP-B-11-F-L	BRM	510	mg/kg
00HP090	HP-B-11-F-K	BRM	314	mg/kg
00HP091	HP-B-05-F-L-01	BRM	260	mg/kg
00HP092	HP-B-05-F-L	BRM	226	mg/kg
00HP093	HP-B-07-A	attic	11,600	mg/kg
00HP094	HP-B-05-F-C	BRM	163	mg/kg
00HP095	HP-B-02-F-K-01	BRM	NA	-----
00HP096	HP-B-02-F-L	BRM	230	mg/kg
00HP097	HP-B-02-F-C	BRM	260	mg/kg
00HP099	HP-B-07-D	duct	590	mg/kg
00HP100	HP-B-03-D	duct	10,300	mg/kg
00HP101	HP-B-07-F-C	BRM	1070	mg/kg
00HP104	HP-B-07-F-K	BRM	NA	-----
00HP105	HP-B-07-F-L	BRM	715	mg/kg
00HP106	HP-B-03-F-C	BRM	NA	-----
00HP107	HP-B-03-F-K	BRM	NA	-----
00HP108	HP-B-03-F-L	BRM	220	mg/kg

NA= insufficient sample volume for laboratory analysis

Table 1 House Dust Pilot Data (continued)

Sample ID	Field ID	Sample Type	Lead Concentration	units
00HP109	HP-B-14-F-K	BRM	NA	-----
00HP111	HP-B-14-F-L	BRM	360	mg/kg
00HP112	HP-B-14-F-C	BRM	<60	mg/kg
00HP113	HP-B-01-A	attic	10,700	mg/kg
00HP115	HP-B-12-F-K	BRM	NA	-----
00HP116	HP-B-10-D	duct	230	mg/kg
00HP117	HP-B-12-F-C	BRM	<270	mg/kg
00HP118	HP-B-12-F-L	BRM	NA	-----
00HP119	HP-B-01-B	basement	804	mg/kg
00HP121	HP-A-15-F-K-01	BRM	NA	-----
00HP123	HP-B-01-F-L	BRM	<120	mg/kg
00HP125	HP-B-01-F-C	BRM	<600	mg/kg
00HP126	HP-B-10-F-K	BRM	NA	-----
00HP127	HP-B-10-F-L	BRM	100	mg/kg
00HP128	HP-B-10-F-C	BRM	<260	mg/kg
00HP129	HP-B-01-F-K	BRM	NA	-----
00HP130	HP-B-01-D	duct	719	mg/kg
00HP131	HP-B-08-D	duct	1300	mg/kg
00HP132	HP-B-08-B	basement	6980	mg/kg
00HP134	HP-B-08-F-K	BRM	558	mg/kg
00HP136	HP-A-16-F-K	BRM	NA	-----
00HP138	HP-B-08-F-L	BRM	950	mg/kg
00HP139	HP-B-08-F-C	BRM	1770	mg/kg
00HP146	HP-A-18-V	vacuum	666	mg/kg
00HP148	HP-A-18-F-C	BRM	108	mg/kg
00HP149	HP-A-18-F-K	BRM	432	mg/kg
00HP150	HP-A-18-F-L	BRM	885	mg/kg
00HP151	HP-B-19-F-C	BRM	627	mg/kg
00HP152	HP-A-19-F-K	BRM	NA	-----
00HP153	HP-B-19-F-K	BRM	NA	-----
00HP154	HP-A-19-F-L	BRM	334	mg/kg
00HP155	HP-B-19-F-L	BRM	300	mg/kg
00HP157	HP-A-19-F-C	BRM	332	mg/kg
00HP159	HP-B-14-V	vacuum	170	mg/kg
00HP161	HP-B-12-V	vacuum	1000	mg/kg
00HP162	HP-B-02-V	vacuum	1750	mg/kg
00HP163	HP-A-24-F-L	BRM	142	mg/kg
00HP165	HP-B-19-D	duct	270	mg/kg
00HP167	HP-B-04-D	duct	NA	-----
00HP168	HP-A-22-F-C	BRM	1680	mg/kg
00HP169	HP-A-22-F-L	BRM	1690	mg/kg
00HP170	HP-A-22-F-K	BRM	1360	mg/kg
00HP172	HP-A-24-F-K	BRM	97	mg/kg
00HP173	HP-A-24-F-C	BRM	280	mg/kg
00HP174	HP-A-23-F-C	BRM	481	mg/kg
00HP175	HP-A-23-F-K	BRM	190	mg/kg

NA= insufficient sample volume for laboratory analysis

Table 1 House Dust Pilot Data (continued)

Sample ID	Field ID	Sample Type	Lead Concentration	units
00HP176	HP-A-23-F-L	BRM	640	mg/kg
00HP177	HP-B-01-V	vacuum	306	mg/kg
00HP178	HP-B-08-V	vacuum	480	mg/kg
00HP179	HP-B-11-V	vacuum	264	mg/kg
00HP180	HP-B-04-F-K	BRM	281	mg/kg
00HP182	HP-B-04-F-C	BRM	982	mg/kg
00HP184	HP-B-04-F-L	BRM	430	mg/kg
00HP185	HP-A-21-F-K	BRM	1040	mg/kg
00HP186	HP-A-20-F-C	BRM	NA	-----
00HP187	HP-A-20-F-L	BRM	648	mg/kg
00HP188	HP-B-12-F-OTH	BRM	720	mg/kg
00HP189	HP-A-20-F-K	BRM	541	mg/kg
00HP191	HP-A-23-B	basement	128	mg/kg
00HP193	HP-A-21-F-C	BRM	851	mg/kg
00HP194	HP-A-21-F-L	BRM	1330	mg/kg
00HP195	HP-B-18-F-L	BRM	330	mg/kg
00HP196	HP-B-18-F-C	BRM	60	mg/kg
00HP197	HP-B-18-F-K	BRM	250	mg/kg
00HP198	HP-B-20-F-C	BRM	NA	-----
00HP199	HP-B-20-F-L	BRM	680	mg/kg
00HP200	HP-B-20-F-K	BRM	NA	-----
00HP201	HP-B-21-F-C	BRM	1040	mg/kg
00HP202	HP-B-21-F-L	BRM	1260	mg/kg
00HP203	HP-B-21-F-K	BRM	NA	-----
00HP204	HP-B-22-F-C	BRM	2140	mg/kg
00HP205	HP-B-23-B-01	basement	930	mg/kg
00HP206	HP-B-22-F-L	BRM	1150	mg/kg
00HP207	HP-B-22-F-K	BRM	NA	-----
00HP208	HP-B-23-F-L	BRM	1010	mg/kg
00HP209	HP-B-23-F-C	BRM	420	mg/kg
00HP210	HP-B-23-F-K	BRM	NA	-----
00HP211	HP-B-24-F-C	BRM	290	mg/kg
00HP212	HP-B-24-F-L	BRM	140	mg/kg
00HP213	HP-B-24-F-K	BRM	150	mg/kg
00HP214	HP-A-20-V	vacuum	550	mg/kg
00HP215	HP-B-19-V	vacuum	410	mg/kg
00HP216	HP-B-03-V	vacuum	390	mg/kg
00HP217	HP-B-05-V	vacuum	430	mg/kg
00HP218	HP-B-04-V	vacuum	490	mg/kg
00HP222	HP-B-18-V	vacuum	384	mg/kg
00HP223	HP-B-20-V	vacuum	541	mg/kg
00HP224	HP-B-24-V	vacuum	158	mg/kg
00HP225	HP-B-22-V	vacuum	1040	mg/kg
00HP226	HP-B-23-V	vacuum	232	mg/kg
00M225	HDPA-017-MD	mat	2320	mg/kg
00M227	HDPA-010-MD	mat	397	mg/kg

NA= insufficient sample volume for laboratory analysis

Table 1 House Dust Pilot Data (continued)

Sample ID	Field ID	Sample Type	Lead Concentration	units
00M228	HDPA-011-MD	mat	1310	mg/kg
00M229	HDPA-004-MD	mat	NA	mg/kg
00M231	HDPA-008-MD	mat	386	mg/kg
00M232	HDPA-009-MD	mat	241	mg/kg
00M233	HDPA-002-MD	mat	969	mg/kg
00M234	HDPA-001-MD	mat	1120	mg/kg
00M235	HDPA-014-MD	mat	253	mg/kg
00M240	HDPA-003-MD	mat	NA	mg/kg
00M241	HDPA-006-MD	mat	1010	mg/kg
00M242	HDPA-007-MD	mat	1120	mg/kg
00M244	HDPA-015-MD	mat	1100	mg/kg
00M245	HDPA-012-MD	mat	1380	mg/kg
00M430	HDPA-005-MD	mat	294	mg/kg
00M450	HP-B-19-M	mat	280	mg/kg
00M451	HP-B-04-M	mat	NA	-----
00M452	HP-A-20-M	mat	950	mg/kg
00M453	HP-B-01-M	mat	1140	mg/kg
00M455	HP-B-08-M	mat	1190	mg/kg
00M456	HP-B-11-M	mat	NA	-----
00M457	HP-B-10-M	mat	460	mg/kg
00M473	HP-B-03-M	mat	740	mg/kg
00M474	HP-B-07-M	mat	3040	mg/kg
00M475	HP-B-12-M	mat	NA	-----
00M476	HP-B-14-M	mat	NA	-----
00M477	HP-B-05-M	mat	990	mg/kg
00M506	HP-B-02-M	mat	1040	mg/kg
00M509	HP-21-M	mat	1320	mg/kg
00M510	HP-24-M	mat	400	mg/kg
00M512	HP-22-M	mat	1980	mg/kg
00M513	HP-20-M	mat	1580	mg/kg
00M514	HP-23-M	mat	524	mg/kg
00M515	HP-18-M	mat	977	mg/kg
00V012	HP-21-A-V	vacuum	651	mg/kg
00V022	HP-A-23-V	vacuum	149	mg/kg
00V053	HP-A-24-V	vacuum	474	mg/kg

NA= insufficient sample volume for laboratory analysis

Table 2 - Field Duplicates

Type	Original sample ID	Duplicate sample ID	Analyte	Original Concentration	Duplicate Concentration	RPD
BRM						
	00HP012	00HP015	Lead	572	572	0.0
	00HP101	00HP102	Lead	1070	1400	26.7
	00HP111	00HP110	Lead	360	120	100.0
	00HP134	00HP135	Lead	558	480	15.0
	00HP182	00HP183	Lead	982	925	6.0
					Average	*29.5*
Vacuum						
	00HP024	00HP025	Lead	1390	3540	87.2
	00HP028	00HP027	Lead	787	822	4.4
	00HP058	00HP062	Lead	224	231	3.1
					Average	*31.5*
Mats						
	00M227	00M226	Lead	397	383	3.6
	00M244	00M243	Lead	1100	929	16.9
	00M511	00M510	Lead	400	136	98.5
	00M473	00M472	Lead	740	600	20.9
	00M455	00M454	Lead	1190	NA	NA
	00M430	00M429	Lead	294	719	83.9
					Average	*44.8*
Duct						
	00HP116	00HP124	Lead	230	160	35.9
	00HP165	00HP166	Lead	270	200	29.8
					Average	*32.8*
Attic						
	00HP113	00HP114	Lead	10,700	13,400	22.4

RPD = ABS(X1-X2)/((X1+X2)/2)

X1 = ORIGINAL SAMPLE

X2 = DUPLICATE SAMPLE

<: Concentration below instrument detection limit.

Table 3- Field Splits

Type	Original sample ID	Split sample ID	Analyte	Original Concentration	Split Concentration	RPD
BRM						
	00HP154	00HP156	Lead	334	316	5.5
	00HP155	00HP158	Lead	300	470	44.2
					Average	*24.8*
Vacuum						
	00HP007	00HP078	Lead	376	368	2.2
	00HP008	00HP076	Lead	191	213	10.9
	00HP045	00HP077	Lead	2200	2390	8.3
					Average	*7.1*
Basement						
	00HP191	00HP192	Lead	128	126.0	1.6
	00HP132	00HP133	Lead	6980	7690	9.7
	00HP119	00HP120	Lead	804	751	6.8
					Average	*6.0*

RPD = ABS(X1-X2)/((X1+X2)/2)

X1 = ORIGINAL SAMPLE

X2 =SPLIT SAMPLE

<: Concentration below instrument detection limit.

Table 4 - Rinsate Blanks

Lab ID	Sample ID	Lead Concentration	Units
2000080091-1	00HP075	<0.003	mg/l
2000080091-2	00HP053	<0.003	mg/l
2000080091-3	00HP054	0.009	mg/l
2000080091-4	00HP056	<0.003	mg/l
2000080091-5	00HP055	<0.003	mg/l
2000100217-3	00M425	<0.003	mg/l
2001010015-11	00M460	<0.003	mg/l
2001010016-19	00M508	<0.003	mg/l
2000100289-19	00HP098	<0.003	mg/l
2000100291-16	00HP137	<0.003	mg/l
2000100378-17	00HP164	<0.003	mg/l
2000100379-4	00HP171	<0.003	mg/l
2000120023-6	00HP219	<0.003	mg/l

<: Concentration below instrument detection limit.

Table 5a - Non-mat Standards

Sample ID	Analyte	Units	Measured Value	True Value	Percent Recovery
00HP057	Lead	mg/kg	1050	1162	90.4%
00HP079	Lead	mg/kg	1090	1162	93.8%
00HP080	Lead	mg/kg	1090	1162	93.8%
00HP081	Lead	mg/kg	1080	1162	92.9%
00HP122	Lead	mg/kg	1080	1162	92.9%
00HP147	Lead	mg/kg	1040	1162	89.5%
00HP160	Lead	mg/kg	1060	1162	91.2%
00HP181	Lead	mg/kg	1070	1162	92.1%
00HP190	Lead	mg/kg	1020	1162	87.8%
00HP220	Lead	mg/kg	1080	1162	92.9%
00HP221	Lead	mg/kg	1090	1162	93.8%
00HP227	Lead	mg/kg	1050	1162	90.4%
				Average	*91.8%*

Table 5b Percent Recovery Results for Mat Dust Standards

Lab ID		Sample ID	Pre-loading Sample Weight (g)	Sample Conc. (ug/g)	Amount Lead Applied to mat (ug)	Recovered Sample Weight (g)	Recovered Sample Conc. (ug/g)	Amount Lead in Sample (ug)	Percent Recovery Dust (mass)	Percent Recovery Lead (conc.)	Percent Recovery Lead (mass)
2000100052 -	8	00M230	10	1162	11620	8.40	786	6602	84%	68%	57%
2000100053 -	6	00M248	10	1162	11620	8.17	738	6029	82%	64%	52%
2000100217 -	10	00M432	10	1162	11620	7.80	766	5975	78%	66%	51%
2001010015 -	10	00M459	10	432	4320	8.66	290	2511	87%	67%	58%
2001010016 -	18	00M507	10	432	4320	8.79	260	2285	88%	60%	53%
2001010017 -	1	00M470	10	432	4320	8.64	300	2592	86%	69%	60%
								Average	84%	66%	55%

Table 6a - Laboratory Prep Blanks

LabID	Units	Lead Concentration
2000100378-21	mg/L	< 0.05
2000100379-16	mg/L	< 0.05
2000100380-13	mg/L	< 0.05
2000100289-21	mg/L	< 0.05
2000100290-21	mg/L	< 0.05
2000100291-21	mg/L	< 0.05
2000120024-21	mg/L	< 0.05
2000120023-8	mg/L	< 0.05
2000080093-21	mg/L	< 0.05
2000080090-20	mg/L	< 0.05
2000080089-17	mg/L	< 0.05
2000080088-22	mg/L	< 0.05
2000080093-23	mg/L	< 0.05
2001010217-7	mg/L	< 0.05

<: Concentration below instrument detection limit.

Table 6b - Lab Prep Blanks for Mats

LabID	Units	Lead Concentration
2000100052-21	mg/L	< 0.05
2000100053-19	mg/L	< 0.05
2001010196-8	mg/L	< 0.05
2001010016-20	mg/L	< 0.05
2001010017-21	mg/L	< 0.05
2001010015-21	mg/L	< 0.05
2000100217-21	mg/L	< 0.05

<: Concentration below instrument detection limit.

Table 7a Aqueous Laboratory Control Samples

Lab ID	Analyte	Units	Measured Value	True Value	Percent Recovery	Allowable Range
2000100378-22	Lead	mg/L	5.23	5.0	105%	80-120%
2000100379-17	Lead	mg/L	5.05	5.0	101%	80-120%
2000100380-14	Lead	mg/L	5.29	5.0	106%	80-120%
2000100289-22	Lead	mg/L	5.05	5.0	101%	80-120%
2000100290-22	Lead	mg/L	5.32	5.0	106%	80-120%
2000100291-22	Lead	mg/L	4.99	5.0	100%	80-120%
2000120024-22	Lead	mg/L	5.33	5.0	107%	80-120%
2000120023-9	Lead	mg/L	5.53	5.0	111%	80-120%
2000080090-21	Lead	mg/L	2.55	2.5	102%	80-120%
2000080089-18	Lead	mg/L	2.59	2.5	104%	80-120%
2000080088-23	Lead	mg/L	2.17	2.5	87%	80-120%
2001010217-8	Lead	mg/L	4.93	5.0	99%	80-120%
2000080093-22	Lead	mg/L	2.52	2.5	101%	80-120%
				Average	102%	

Table 7b Aqueous Laboratory Control Samples for Mat Dust

Lab ID	Analyte	Units	Measured Value	True Value	Percent Recovery	Allowable Range
2000100052-22	Lead	mg/L	4.83	5.0	97%	80-120%
2000100053-20	Lead	mg/L	4.75	5.0	95%	80-120%
2001010196-9	Lead	mg/L	4.64	5.0	93%	80-120%
2001010015-22	Lead	mg/L	5.14	5.0	103%	80-120%
2001010016-21	Lead	mg/L	4.9	5.0	98%	80-120%
2001010017-22	Lead	mg/L	5.07	5.0	101%	80-120%
2000100217-22	Lead	mg/L	5.18	5.0	104%	80-120%
				Average	99%	

Percent Recovery = (Found Conc.)/(Known Conc.)* 100

Table 8a Soil Laboratory Control Samples

Lab ID	Analyte	Units	Measured Value	True Value	Percent Recovery	Allowable Range
2000100378-23	Lead	mg/kg	407	372	109%	80-120%
2000100379-18	Lead	mg/kg	364	372	98%	80-120%
2000100380-15	Lead	mg/kg	130	114	114%	70-130%
2000100289-23	Lead	mg/kg	1540	1521	101%	83-117%
2000100290-23	Lead	mg/kg	1649	1521	108%	83-117%
2000100291-23	Lead	mg/kg	109	114	96%	70-131%
2000120024-23	Lead	mg/kg	130	119	109%	76-124%
2000120023-10	Lead	mg/kg	91.6	119	77%	76-124%
2000080090-22	Lead	mg/kg	208	197	106%	74-126%
2000080089-19	Lead	mg/kg	1446	1380	105%	81-119%
2001010217-9	Lead	mg/kg	123	119	103%	76-124%
2000080088-24	Lead	mg/kg	1490	1380	108%	81-119%
2000080093-23	Lead	mg/kg	1430	1380	104%	81-119%
				Average	103%	

Table 8b Soil Laboratory Control Samples for Mat Dust

Lab ID	Analyte	Units	Measured Value	True Value	Percent Recovery	Allowable Range
2000100052-23	Lead	mg/kg	768	735	104%	82-118%
2000100053-21	Lead	mg/kg	746	735	101%	82-118%
2001010196-10	Lead	mg/kg	127	119	107%	76-124%
2001010015-23	Lead	mg/kg	413	372.2	111%	80-120%
2001010016-22	Lead	mg/kg	138	137.7	100%	75-125%
2001010017-23	Lead	mg/kg	131	119	110%	76-124%
2000100217-23	Lead	mg/kg	1560	1521	103%	83-117%
				Average	105%	

Percent Recovery = (Found Conc.)/(Known Conc.)* 100

Table 9a Laboratory Matrix Spike/Matrix Spike Duplicates

MS Lab ID	MSD Lab ID	Analyte	Units	MS Concentration	MSD Concentration	RPD %
2000100378-24	2000100378-25	Lead	mg/kg	1379	1332	3
2000100379-19	2000100379-20	Lead	mg/kg	784	790	1
2000100380-16	2000100380-17	Lead	mg/kg	498	484	3
2000100289-24	2000100289-25	Lead	mg/kg	3320	3350	1
2000100290-24	2000100290-25	Lead	mg/kg	1212	1291	6
2000100291-24	2000100291-25	Lead	mg/kg	7140	7100	1
2000120024-24	2000120024-25	Lead	mg/kg	1610	1480	8
2000120023-11	2000120023-12	Lead	mg/kg	1090	1050	4
2000080090-23	2000080090-24	Lead	mg/kg	638	639	0
2000080089-20	2000080089-21	Lead	mg/kg	2490	2475	1
2001010217-10	2001010217-11	Lead	mg/kg	1560	1520	3
2000080088-25	2000080088-26	Lead	mg/kg	376	352	7
2000080093-24	2000080093-25	Lead	mg/kg	1510	1560	3
					Average	3.09

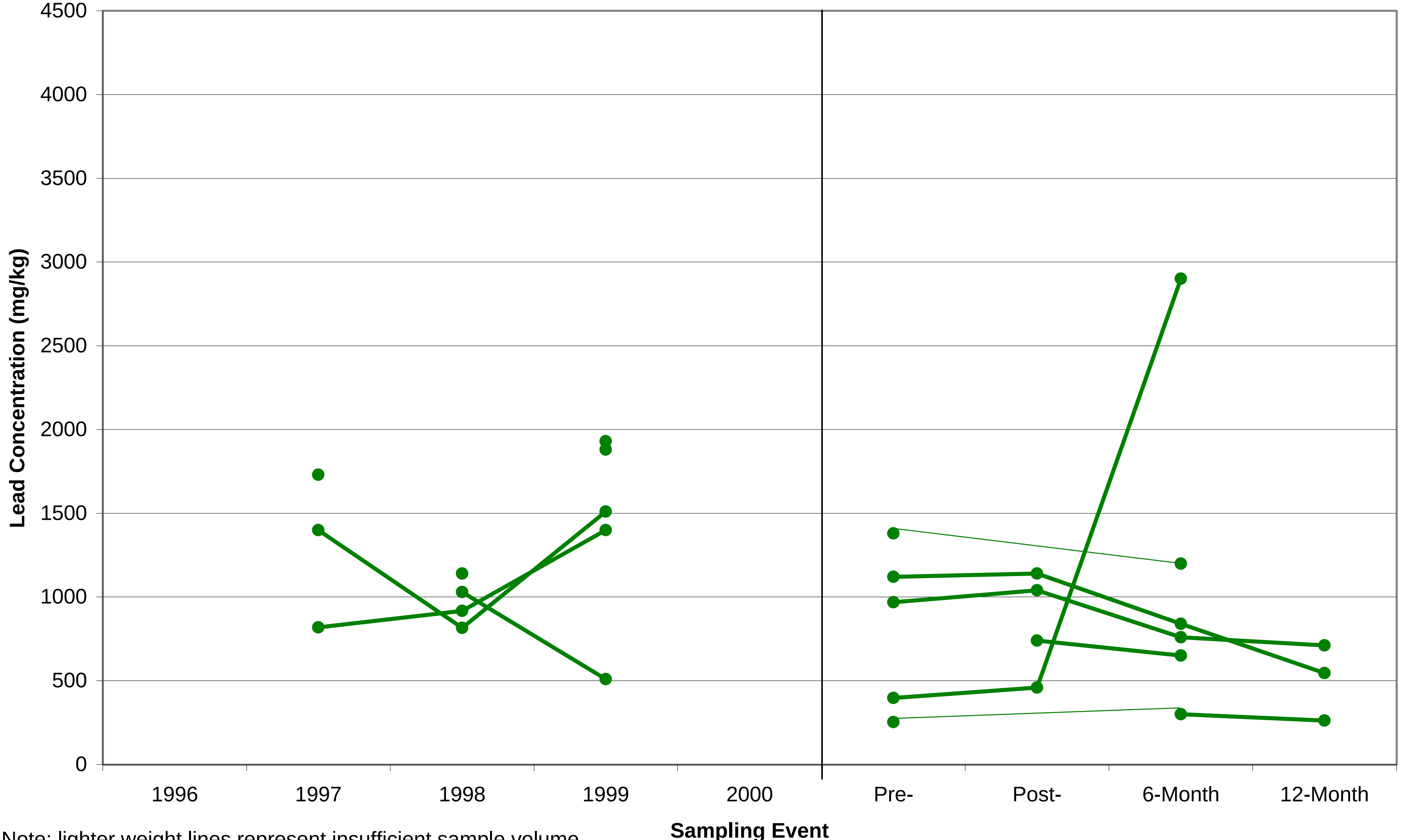
Table 9b Laboratory Matrix Spike/Matrix Spike Duplicates for Mat Dust

MS Lab ID	MSD Lab ID	Analyte	Units	MS Concentration	MSD Concentration	RPD %
2000100052-24	2000100052-25	Lead	mg/kg	972	1026	5
2000100053-22	2000100053-23	Lead	mg/kg	1660	1660	0
2001010196-11	2001010196-12	Lead	mg/kg	2470	2480	0
2001010015-24	2001010015-25	Lead	mg/kg	1340	1400	4
2001010016-23	2001010016-24	Lead	mg/kg	1180	1210	3
2001010017-24	2001010017-25	Lead	mg/kg	1480	1510	2
2000100217-24	2000100217-25	Lead	mg/kg	2620	2660	2
					Average	2.32

APPENDIX C
Laboratory Data Sheets

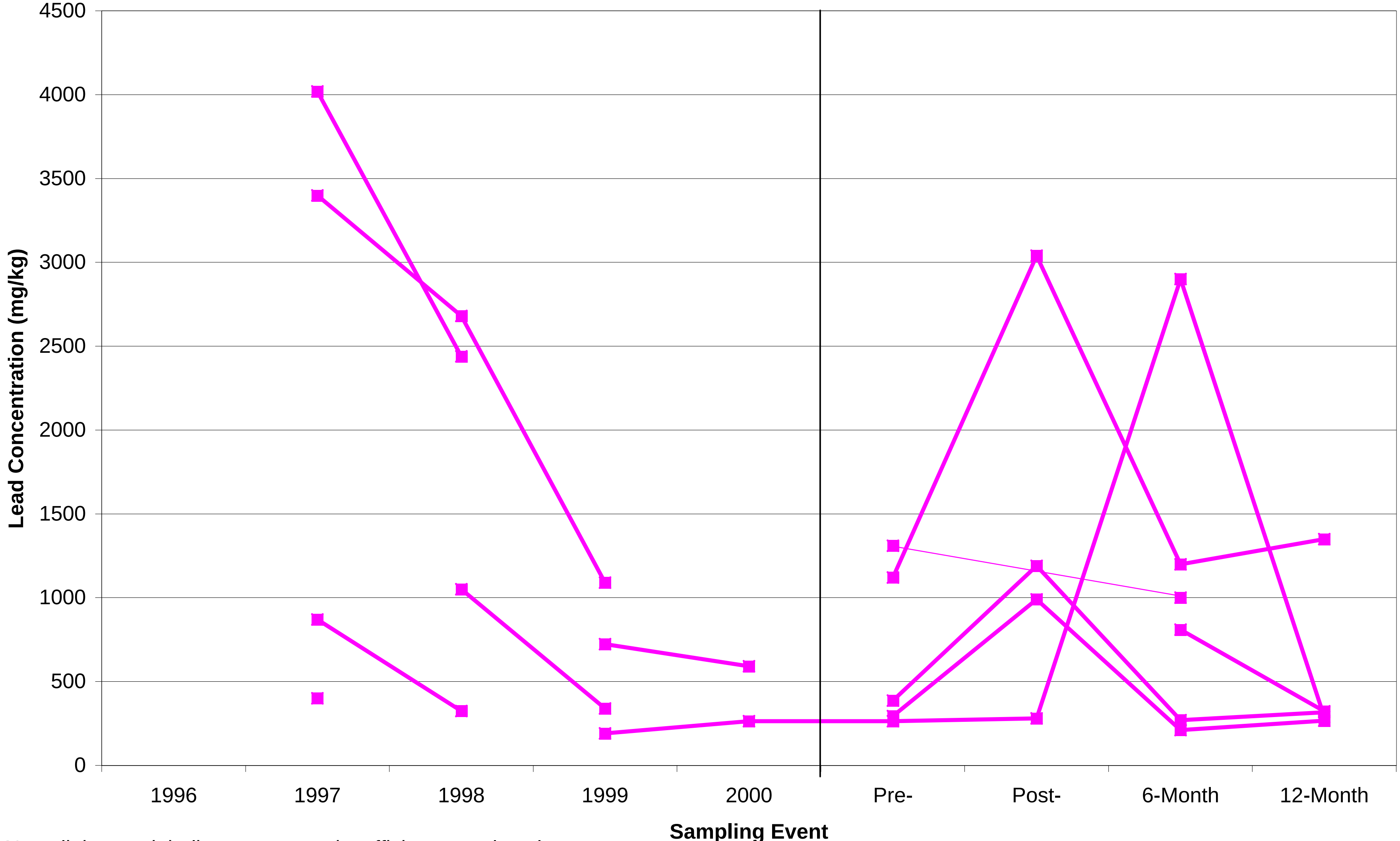
(available upon request)

Figure 4-4a-K1. Line Plot of Mat Lead Concentrations for the HUD Treatment



Note: lighter weight lines represent insufficient sample volume

Figure 4-4a-K2. Line Plot of Mat Lead Concentrations for the Commercial Treatment



Note: lighter weight lines represent insufficient sample volume

Figure 4-4a-K3. Line Plot of Mat Lead Concentrations for the Spring Treatment

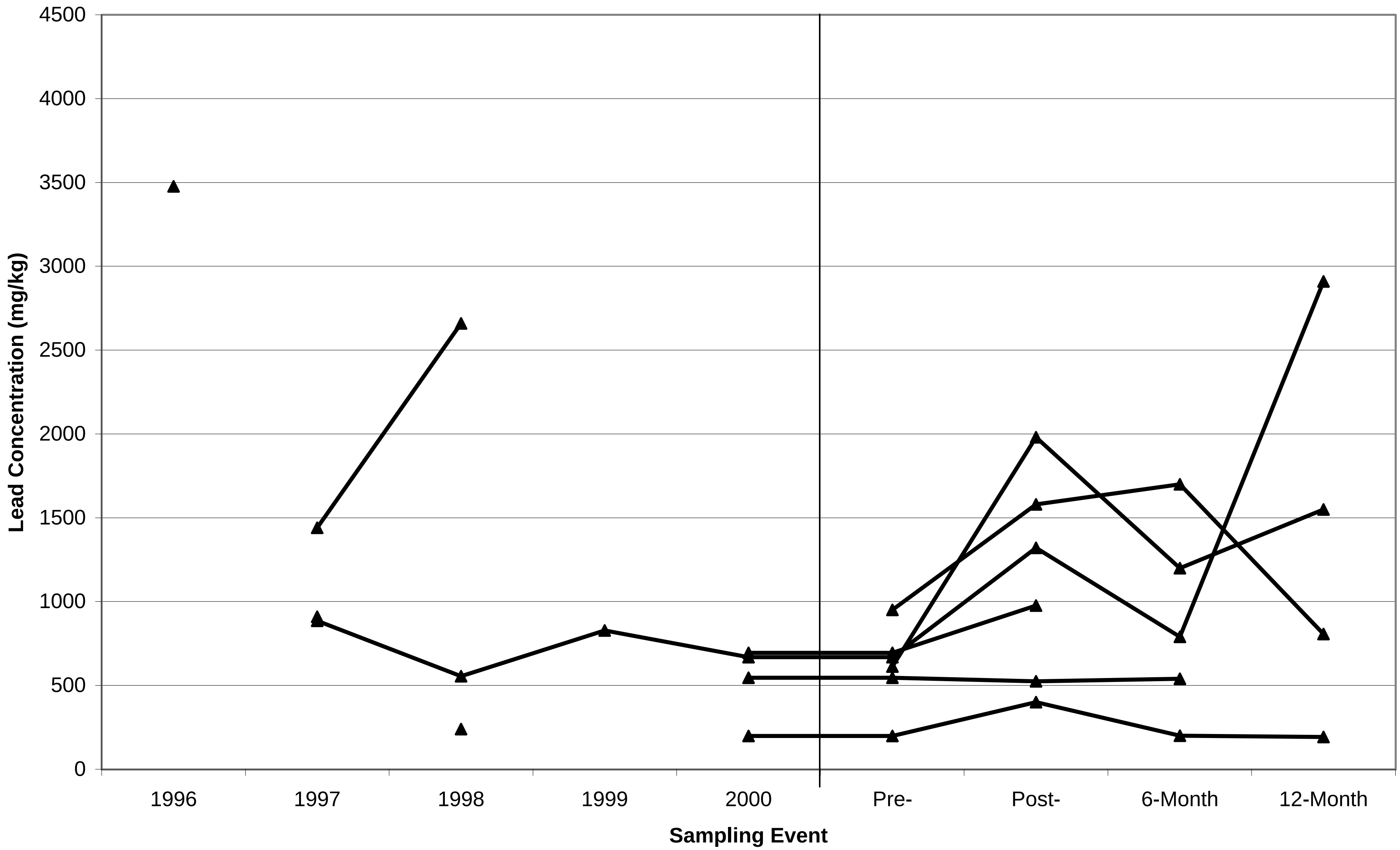


Figure 4-4a-K4. Line Plot of Mat Lead Concentrations for the Control Treatment

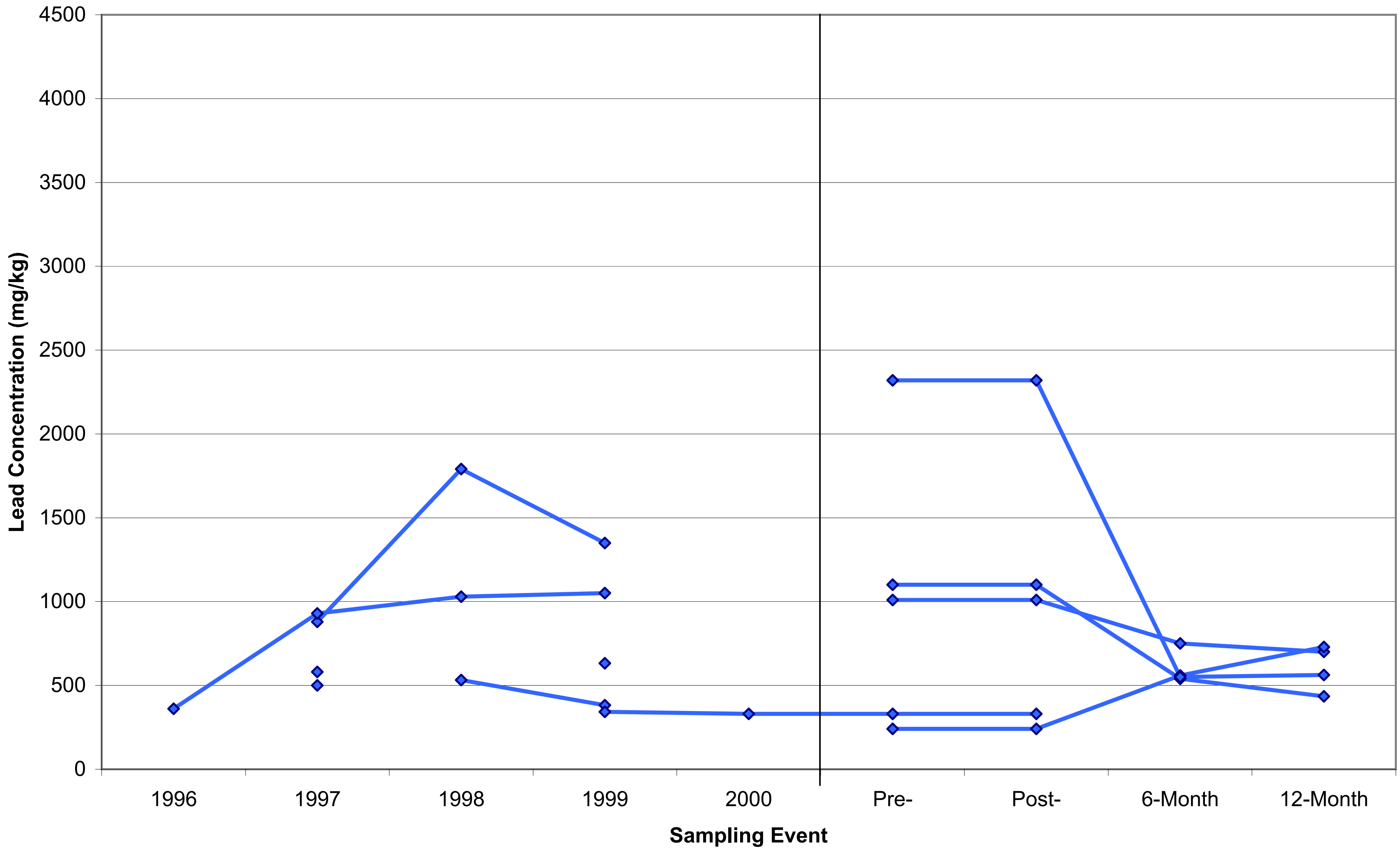


Figure 4-4b-K5. Line Plot of Mat Dust Loading Rates for the HUD Treatment

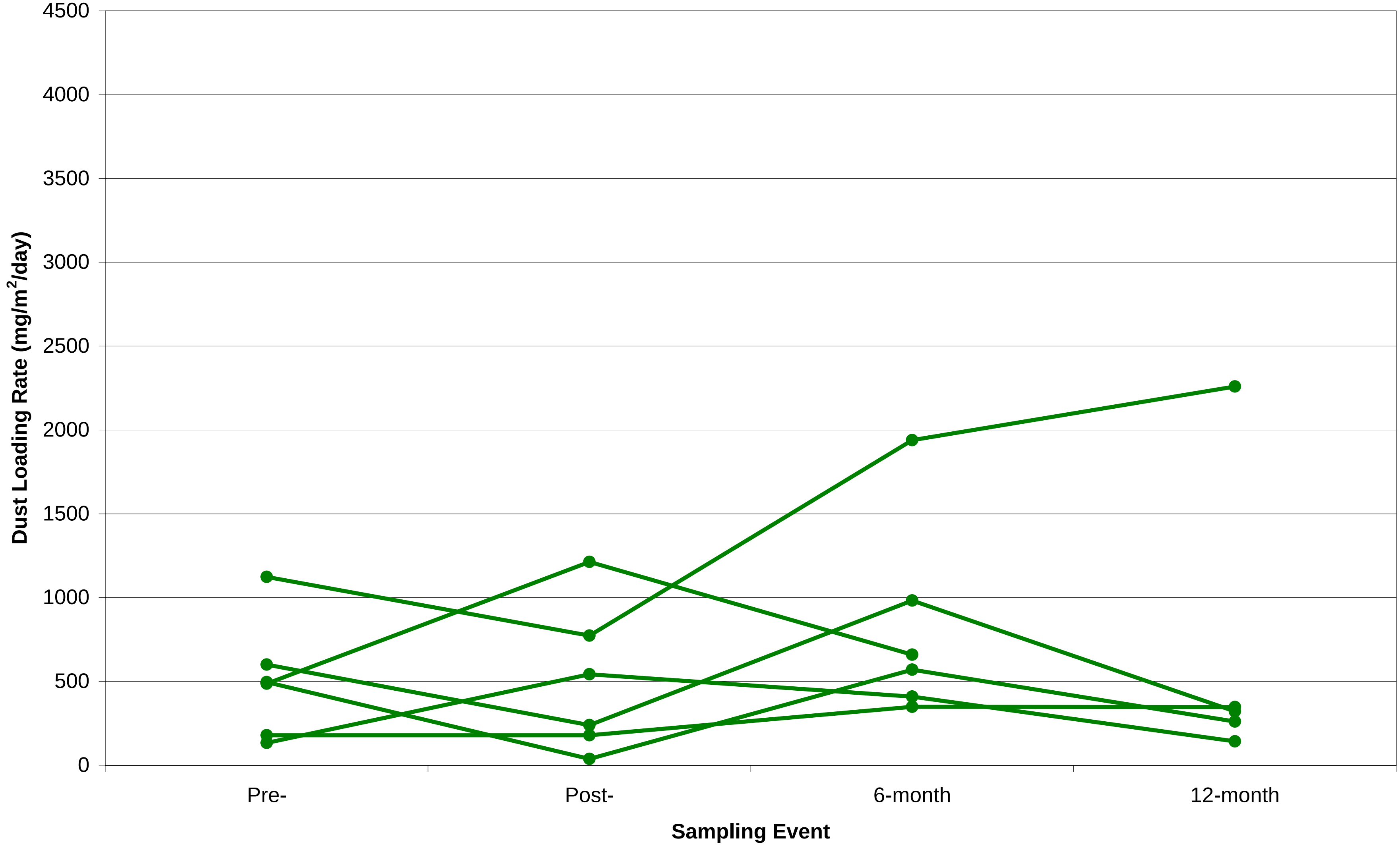


Figure 4-4b-K6. Line Plot of Mat Dust Loading Rates for the Commercial Treatment

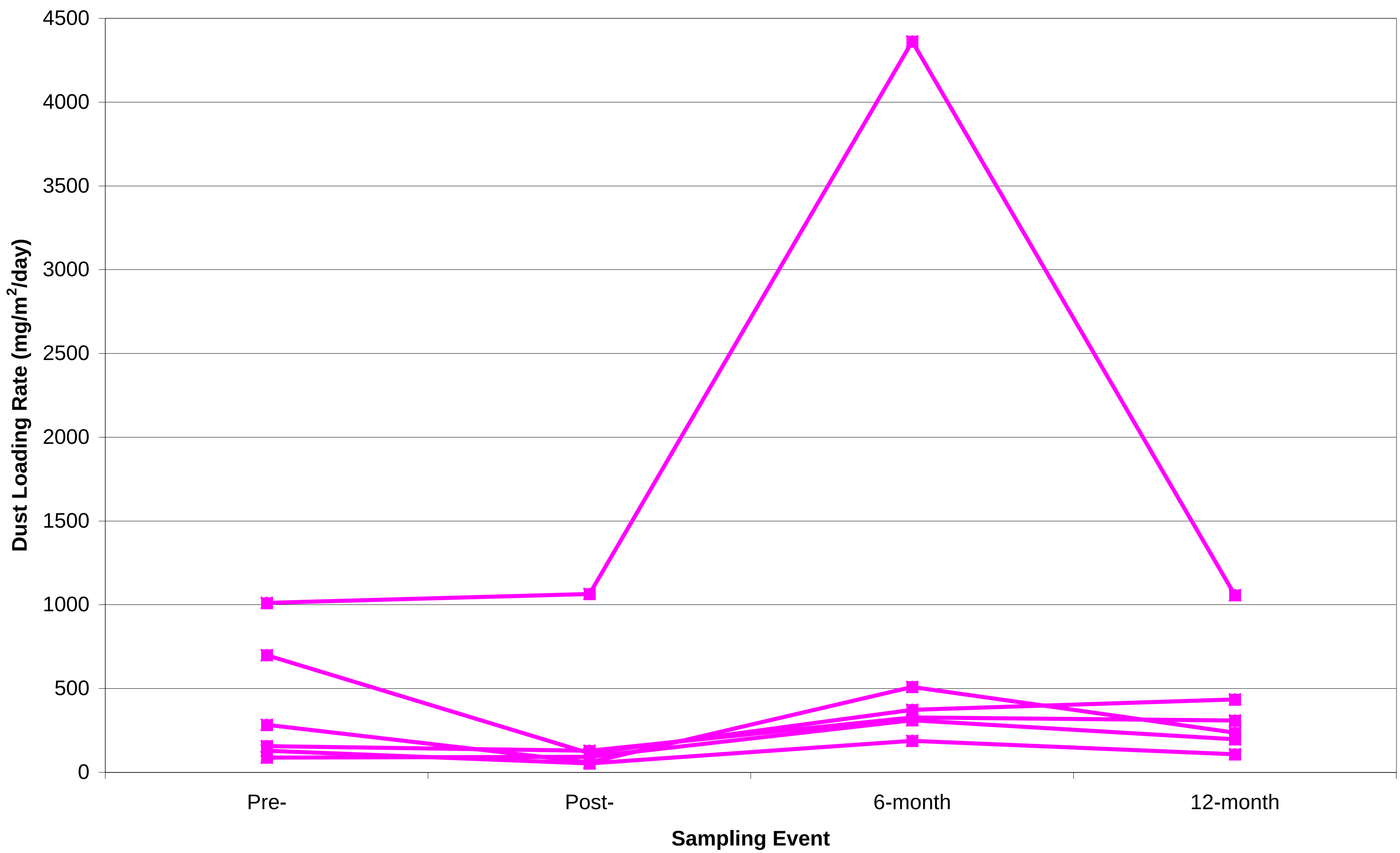


Figure 4-4b-K7. Line Plot of Mat Dust Loading Rates for the Spring Treatment

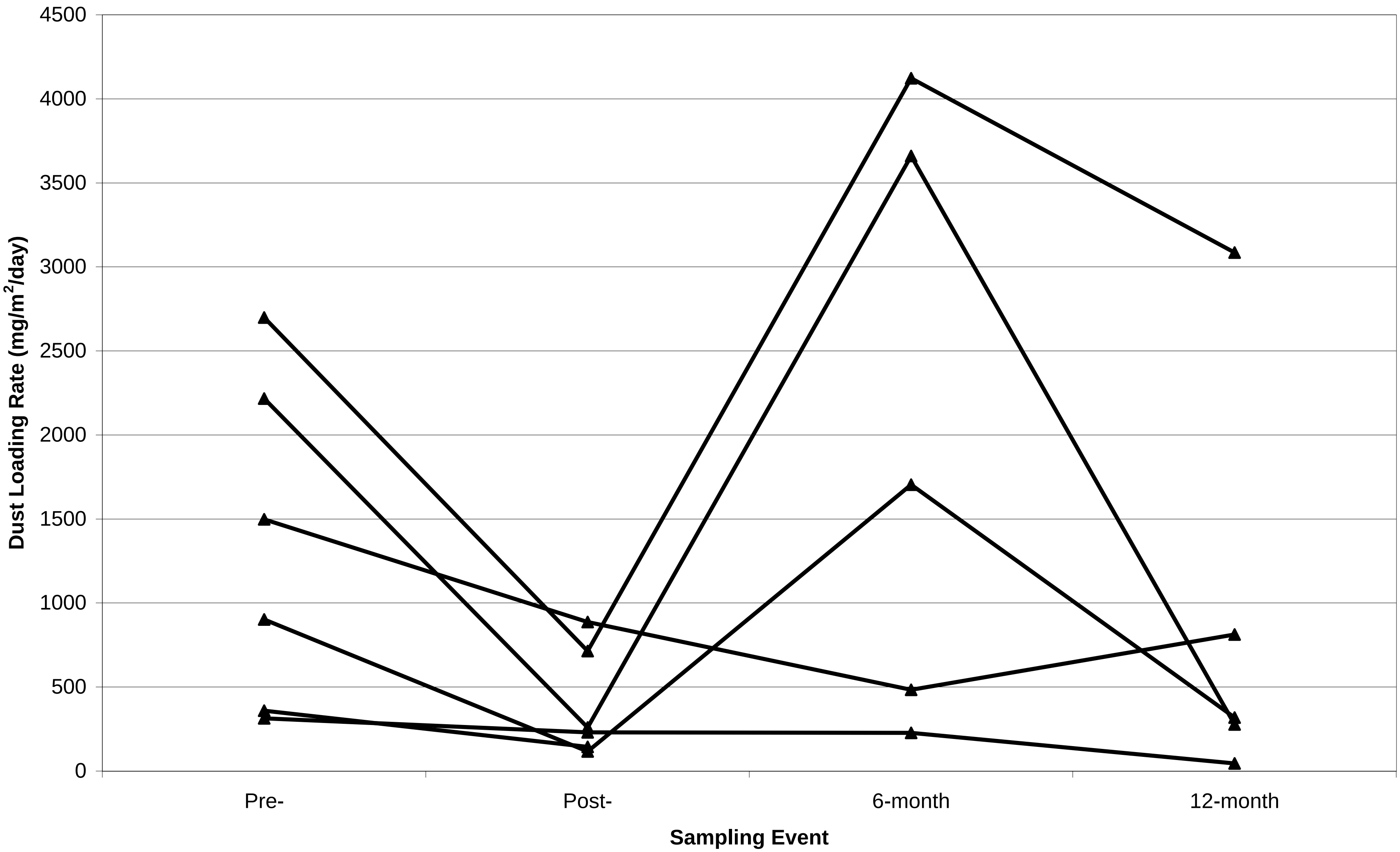


Figure 4-4b-K8. Line Plot of Mat Dust Loading Rates for the Control Treatment

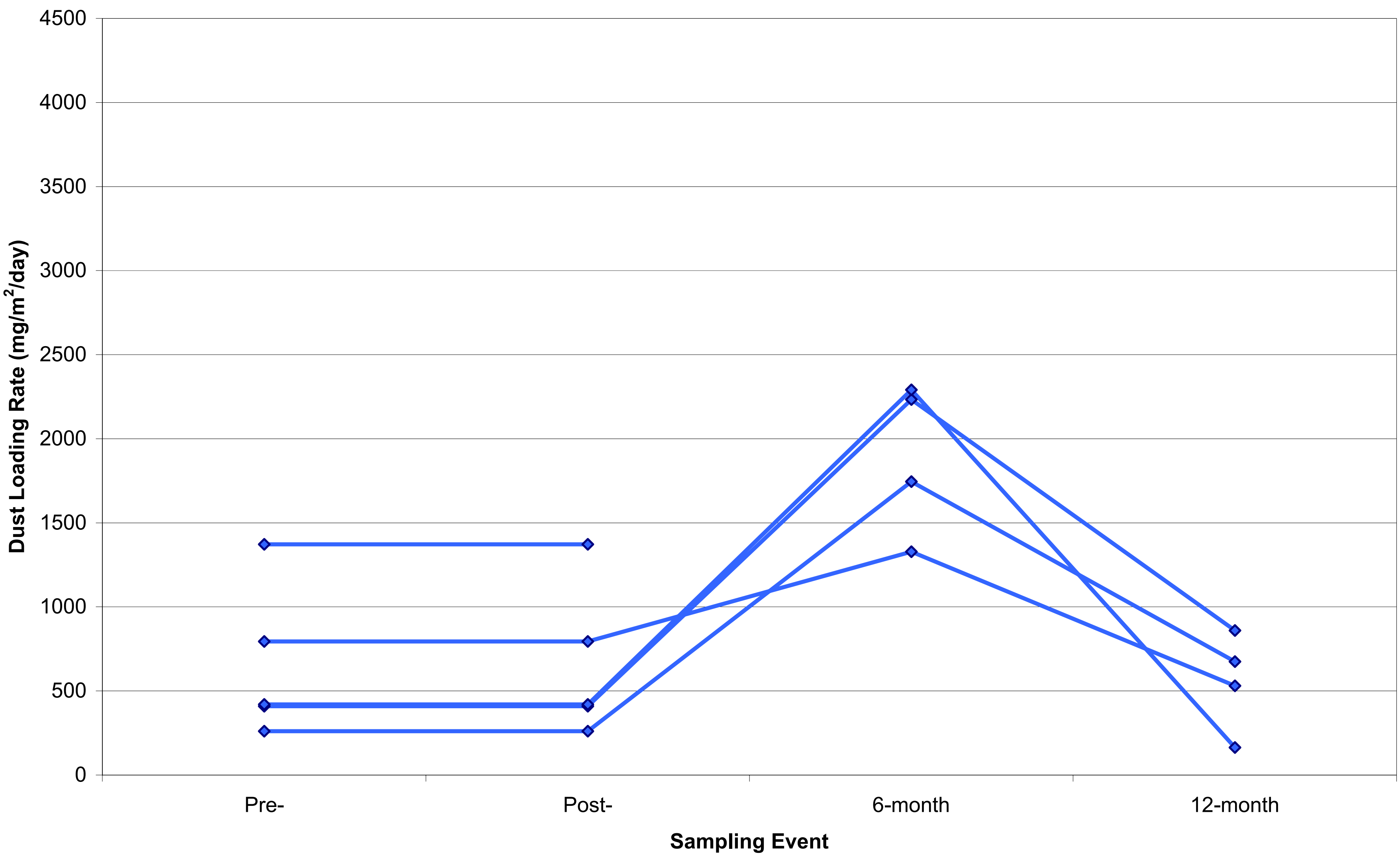
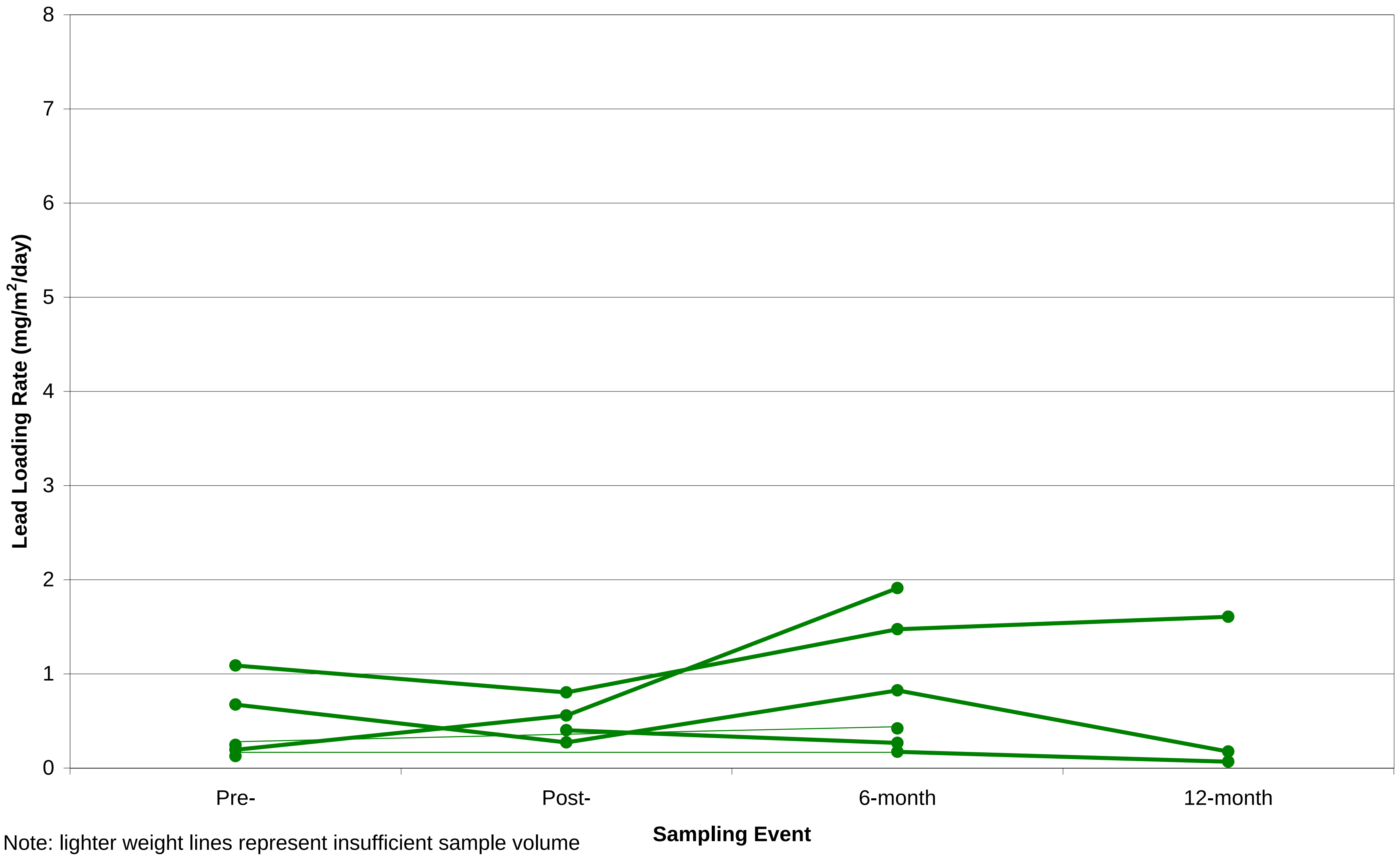
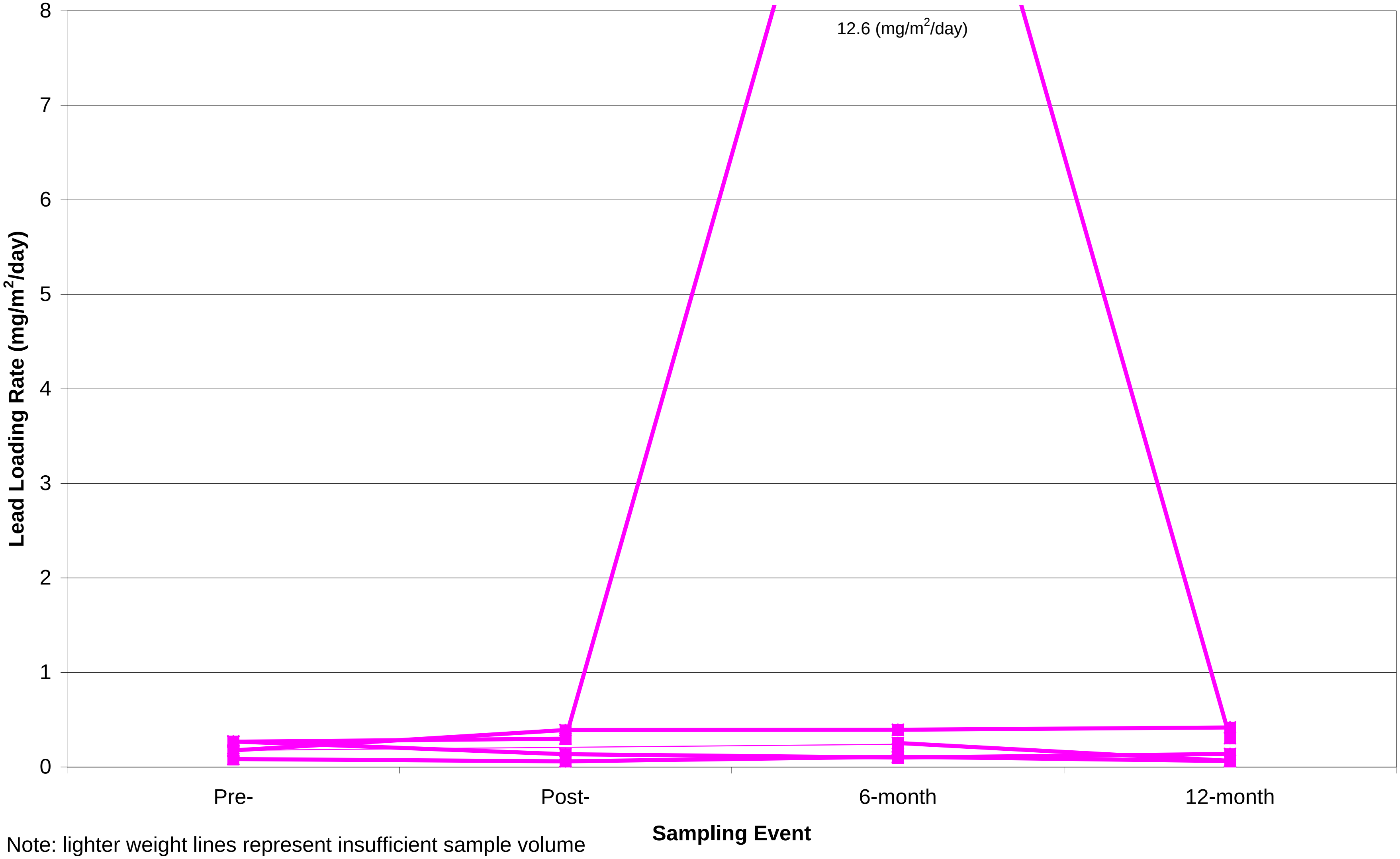


Figure 4-4c-K9. Line Plot of Mat Lead Loading Rates for the HUD Treatment



Note: lighter weight lines represent insufficient sample volume

Figure 4-4c-K10. Line Plot of Mat Lead Loading Rates for Commercial Treatment



Note: lighter weight lines represent insufficient sample volume

Figure 4-4c-K11. Line Plot of Mat Lead Loading Rates for the Spring Treatment

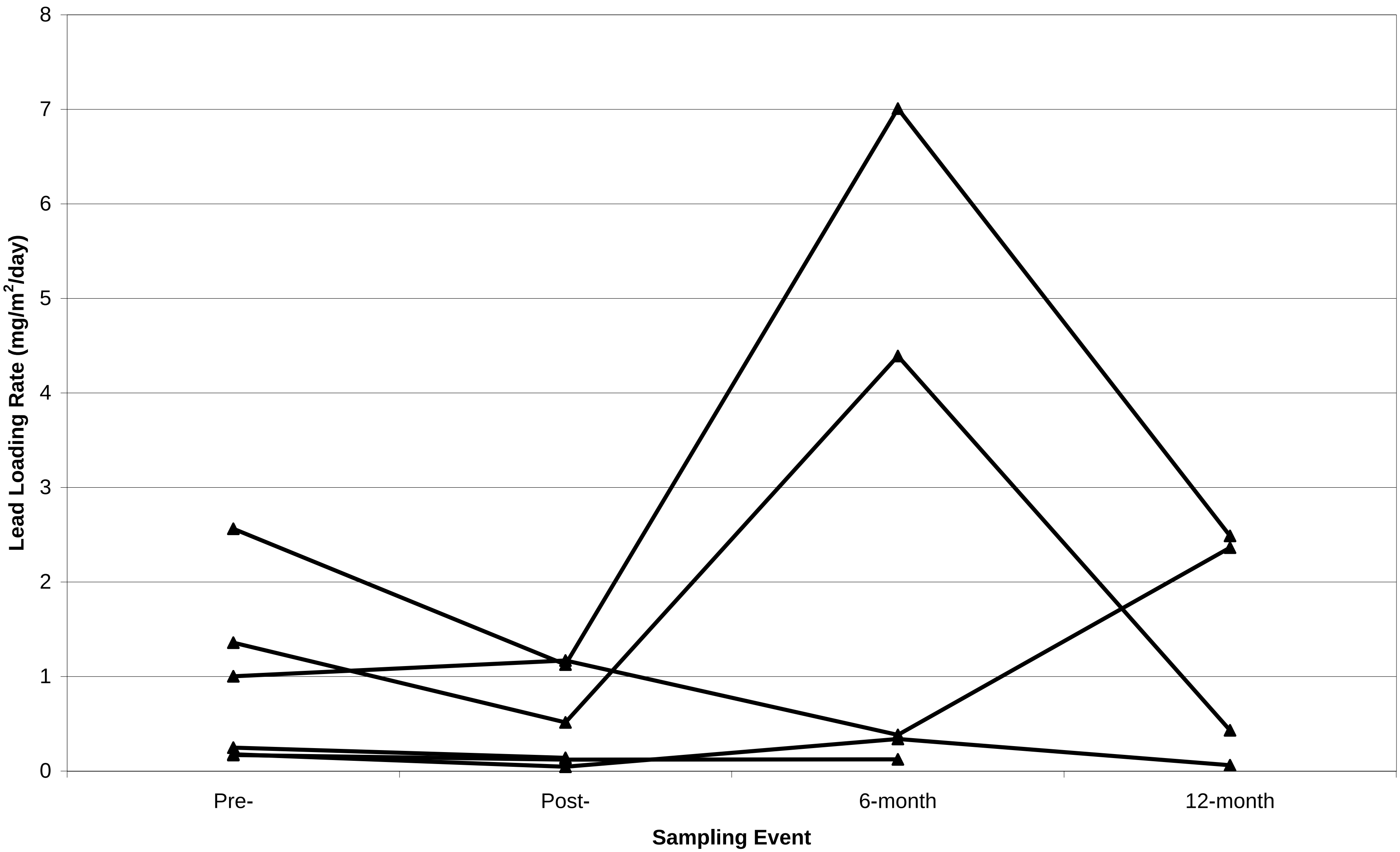


Figure 4-4c-K12. Line Plot of Mat Lead Loading Rates for the Control Treatment

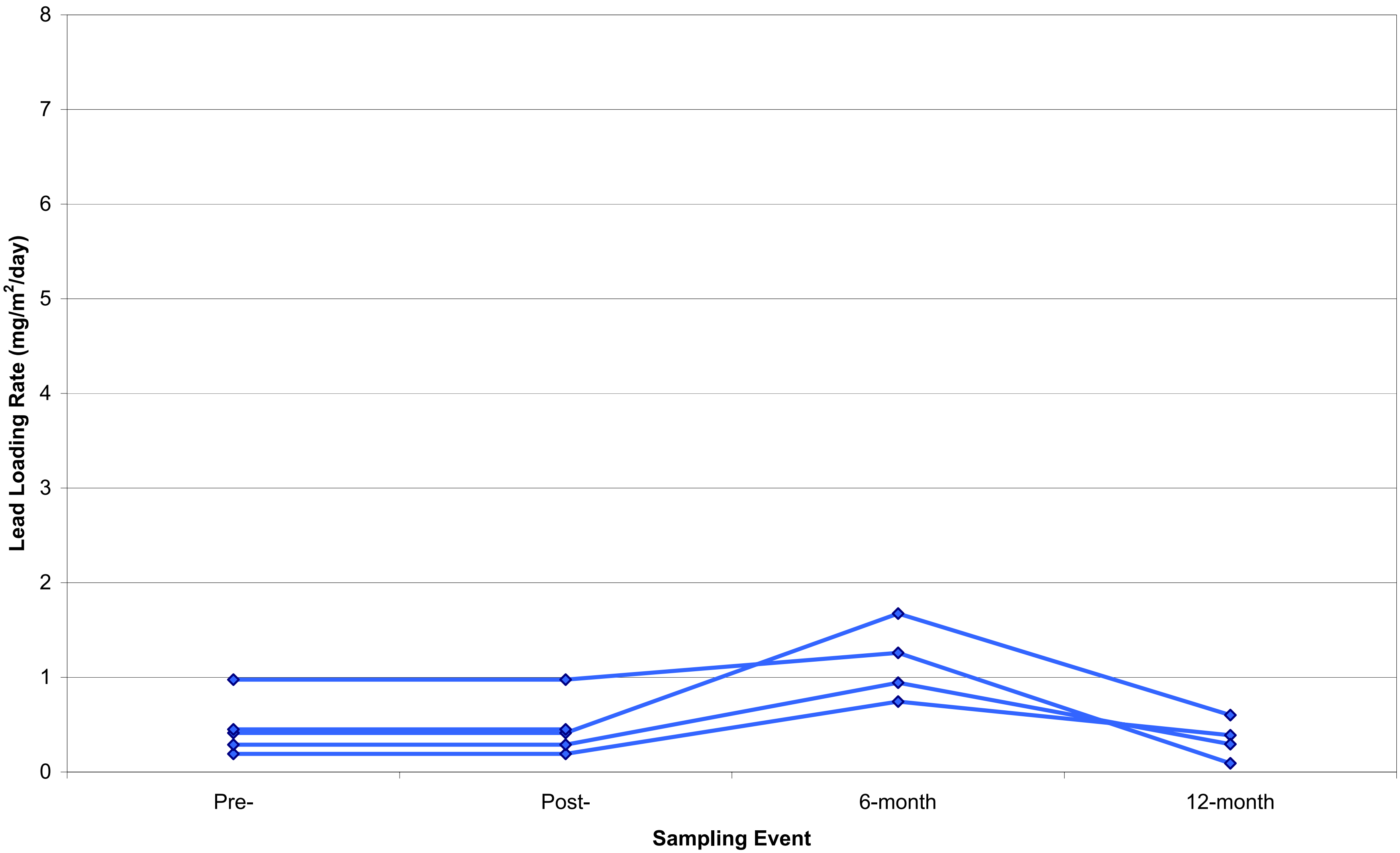
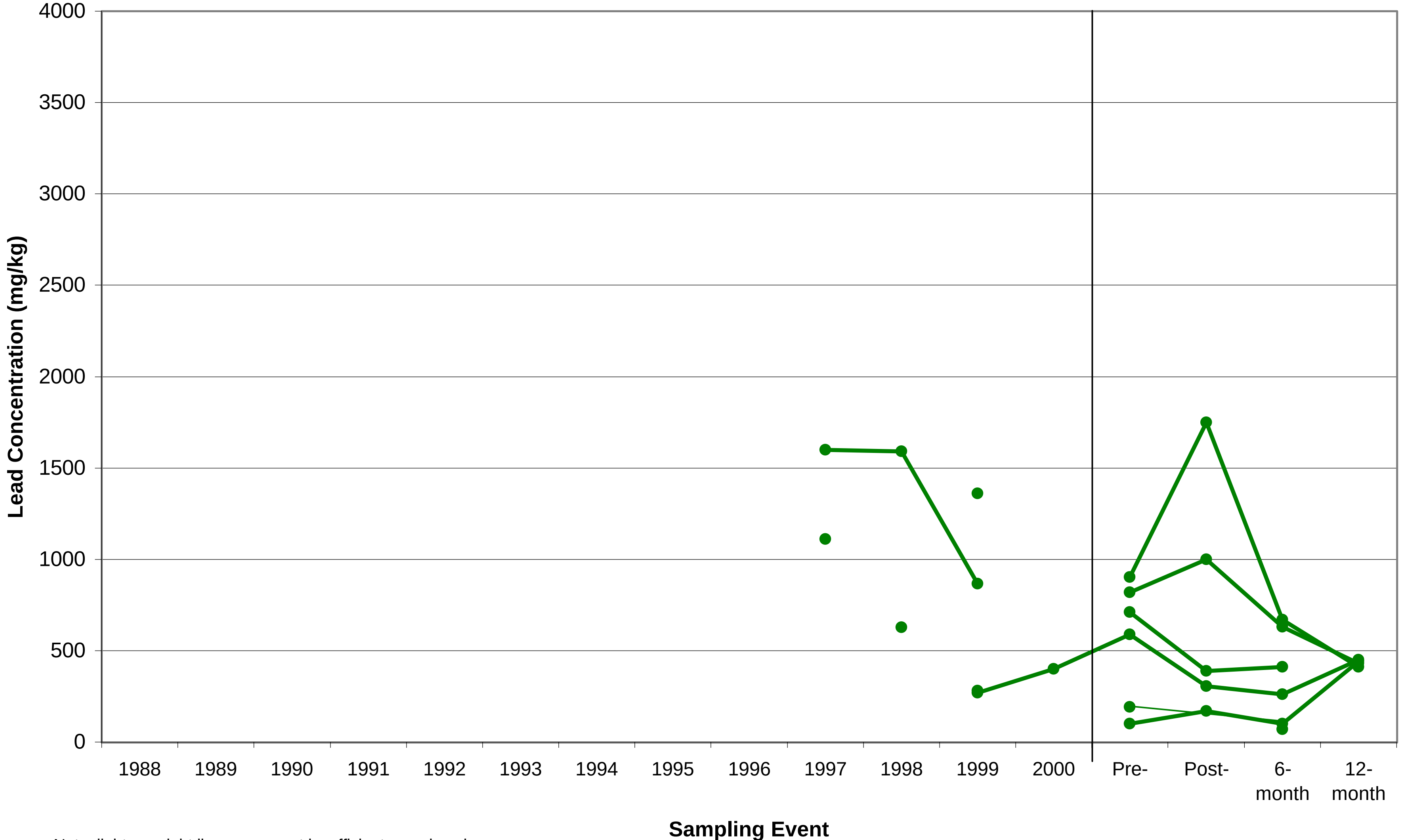


Figure 4-6-L1. Line Plot of Vacuum Lead Concentrations for the HUD Treatment



Note: lighter weight lines represent insufficient sample volume

Figure 4-6-L2. Line Plot of Vacuum Lead Concentrations for the Commercial Treatment

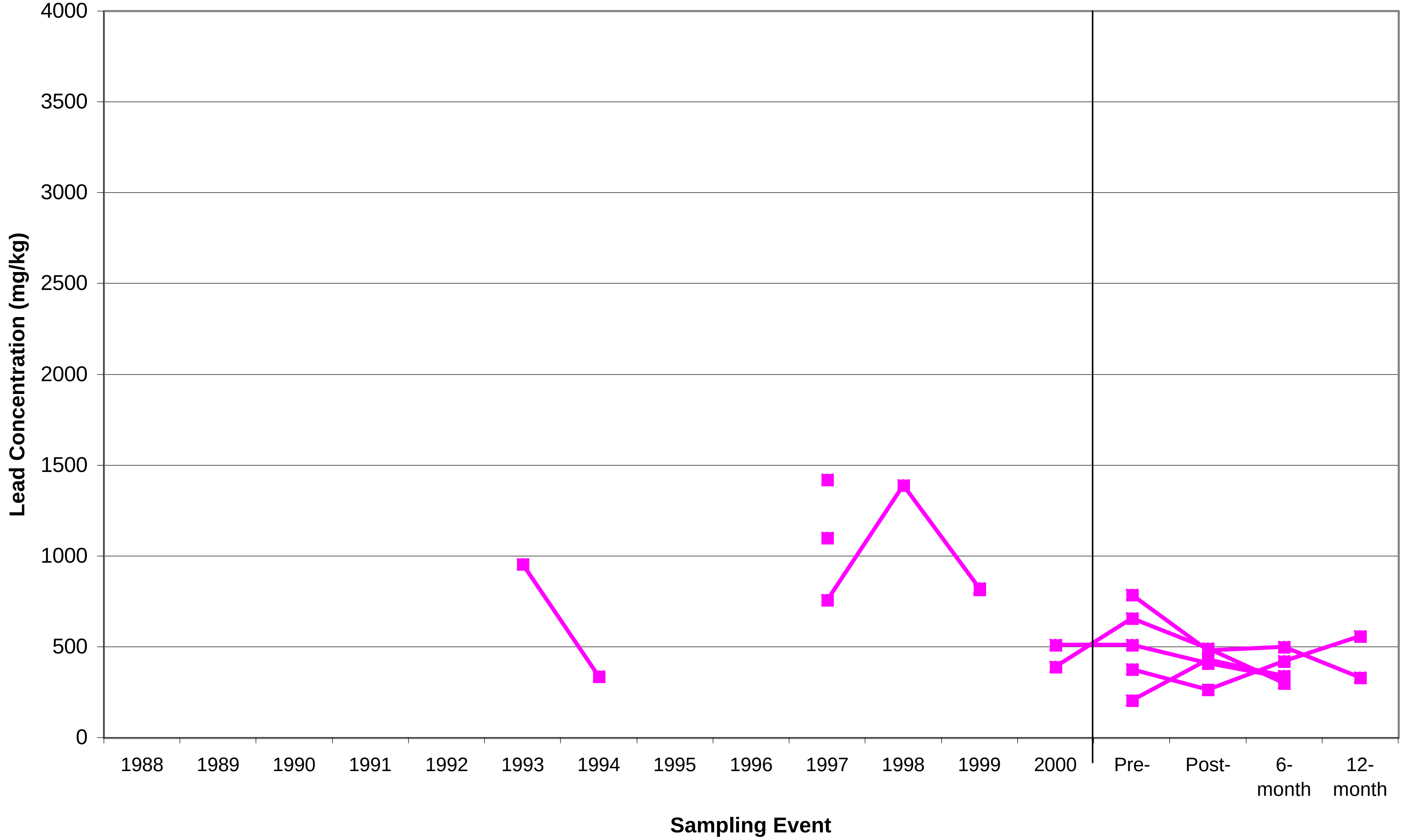


Figure 4-6-L3. Line Plot of Vacuum Lead Concentrations for the Spring Treatment

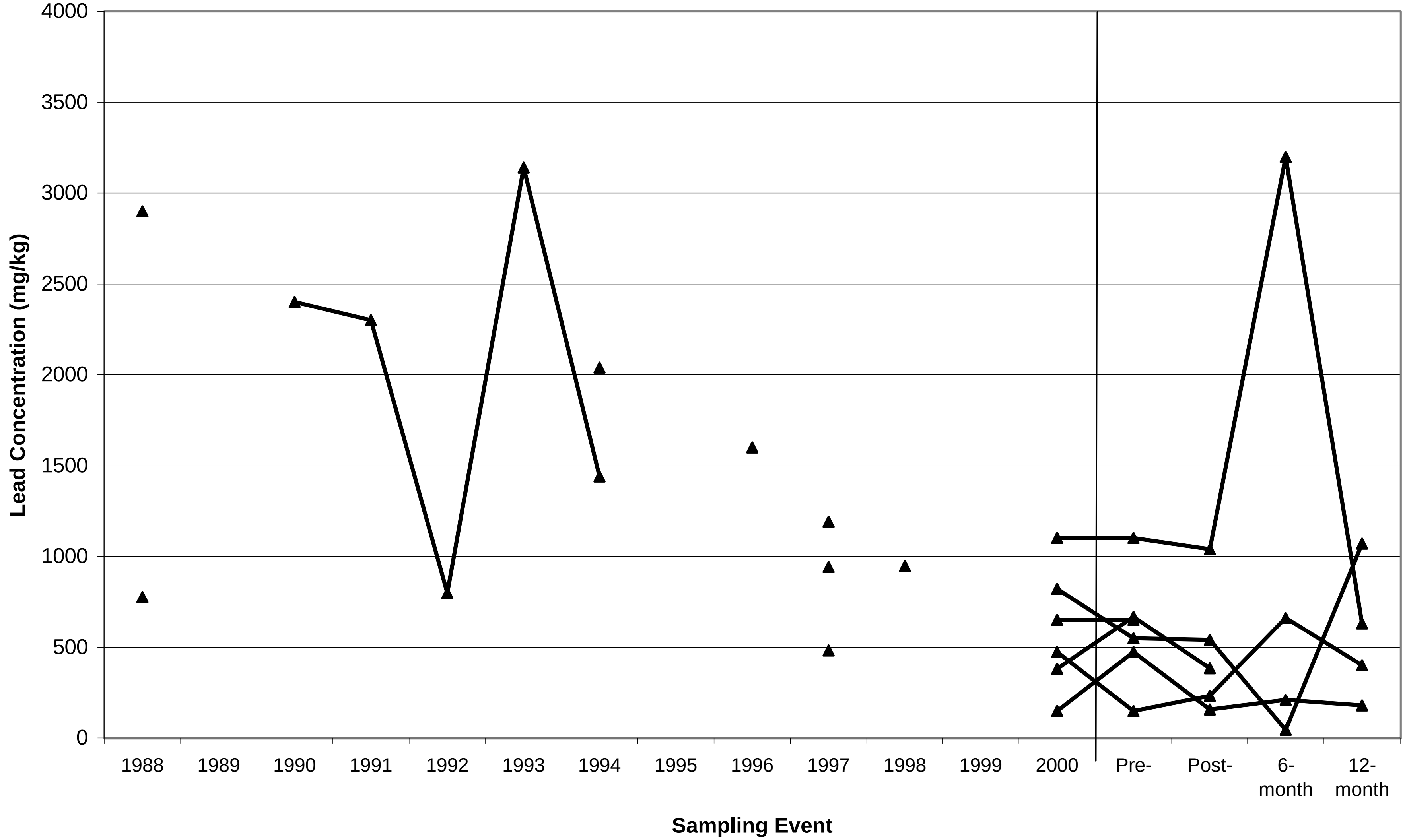


Figure 4-6-L4. Line Plot of Vacuum Lead Concentrations for the Control Treatment

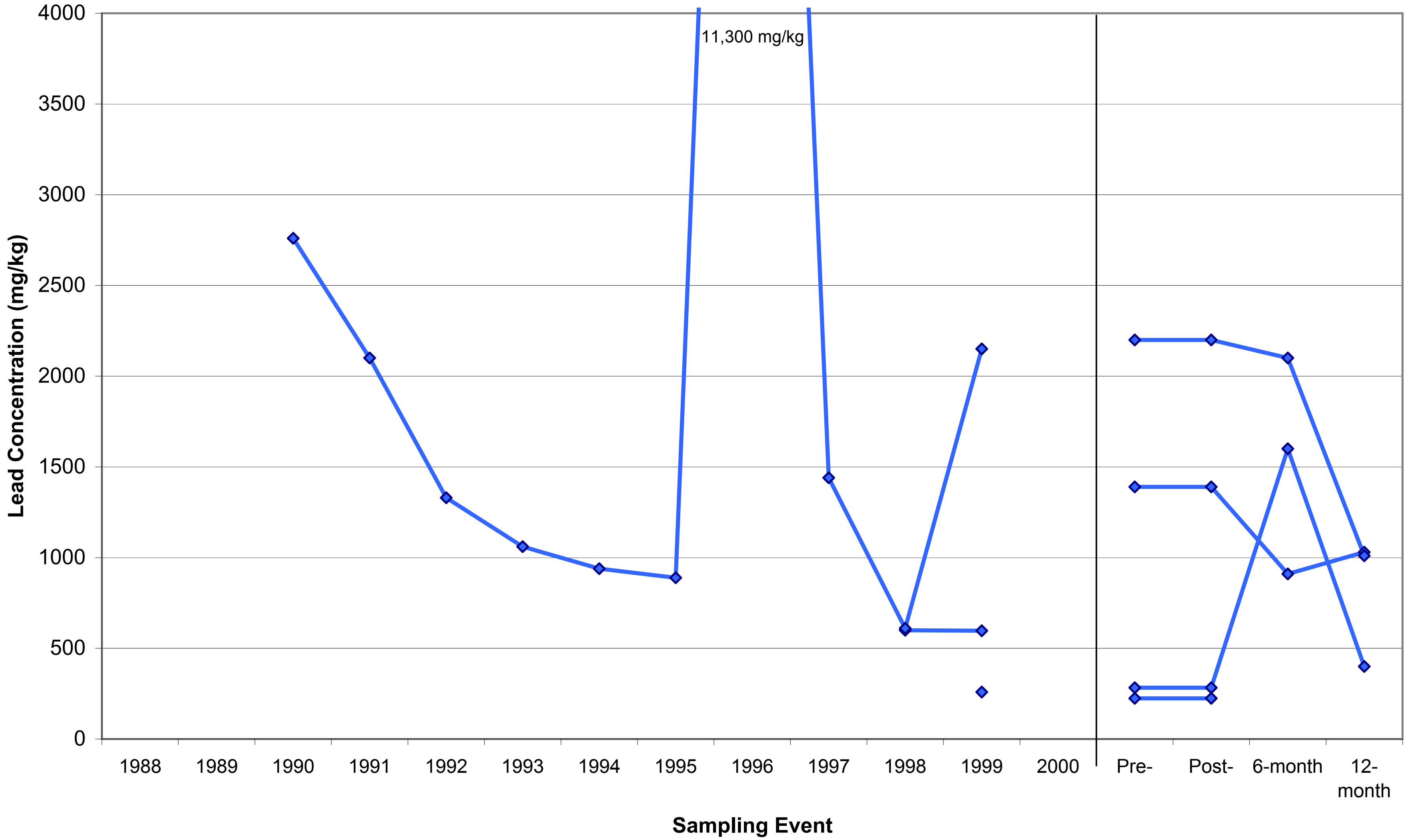
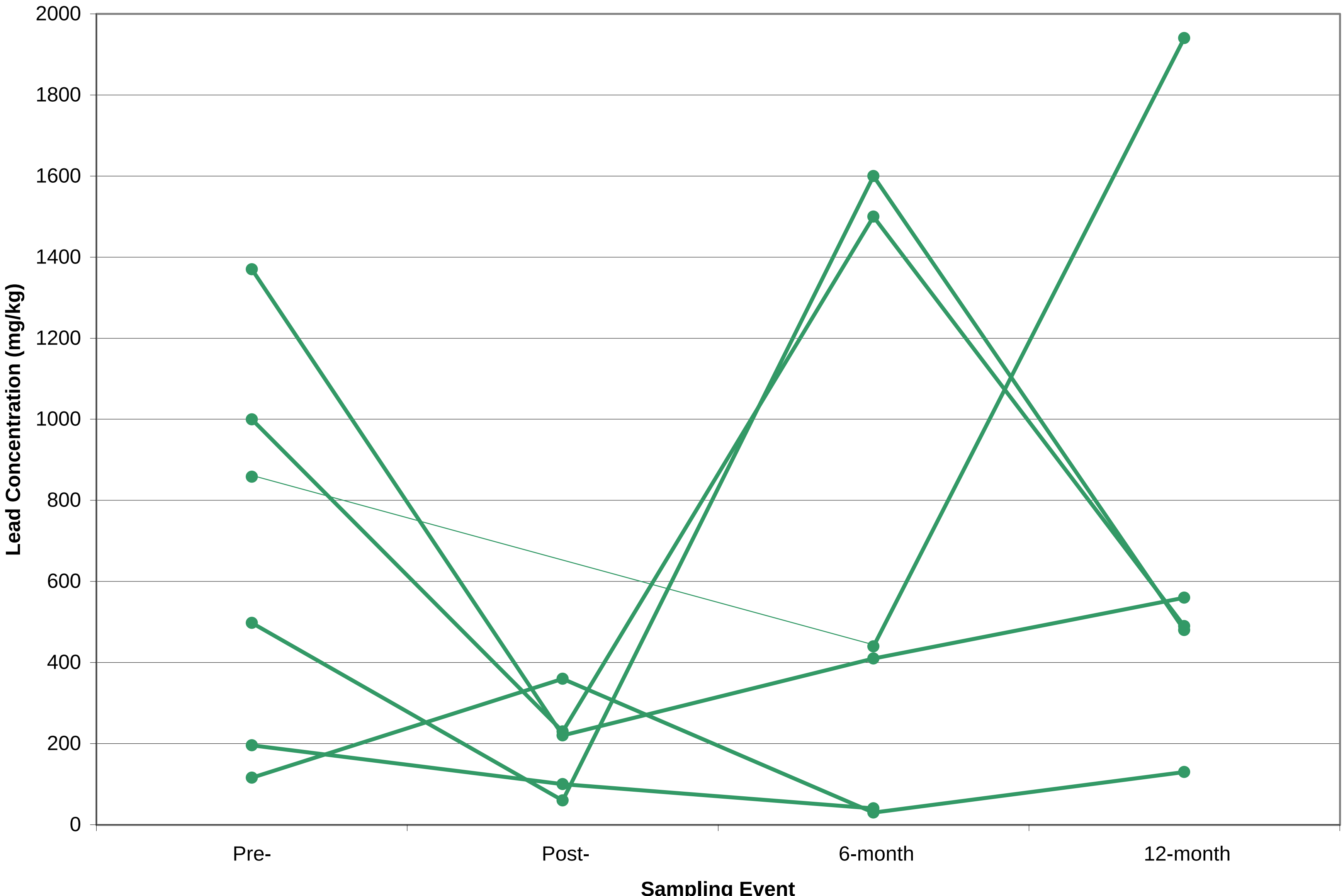


Figure 4-10a-M1. Line Plot of Living Room BRM Lead Concentrations for the HUD Treatment



Note: lighter weight lines represent insufficient sample volume

Figure 4-10a-M2. Line Plot of Living Room BRM Lead Concentrations for the Commercial Treatment

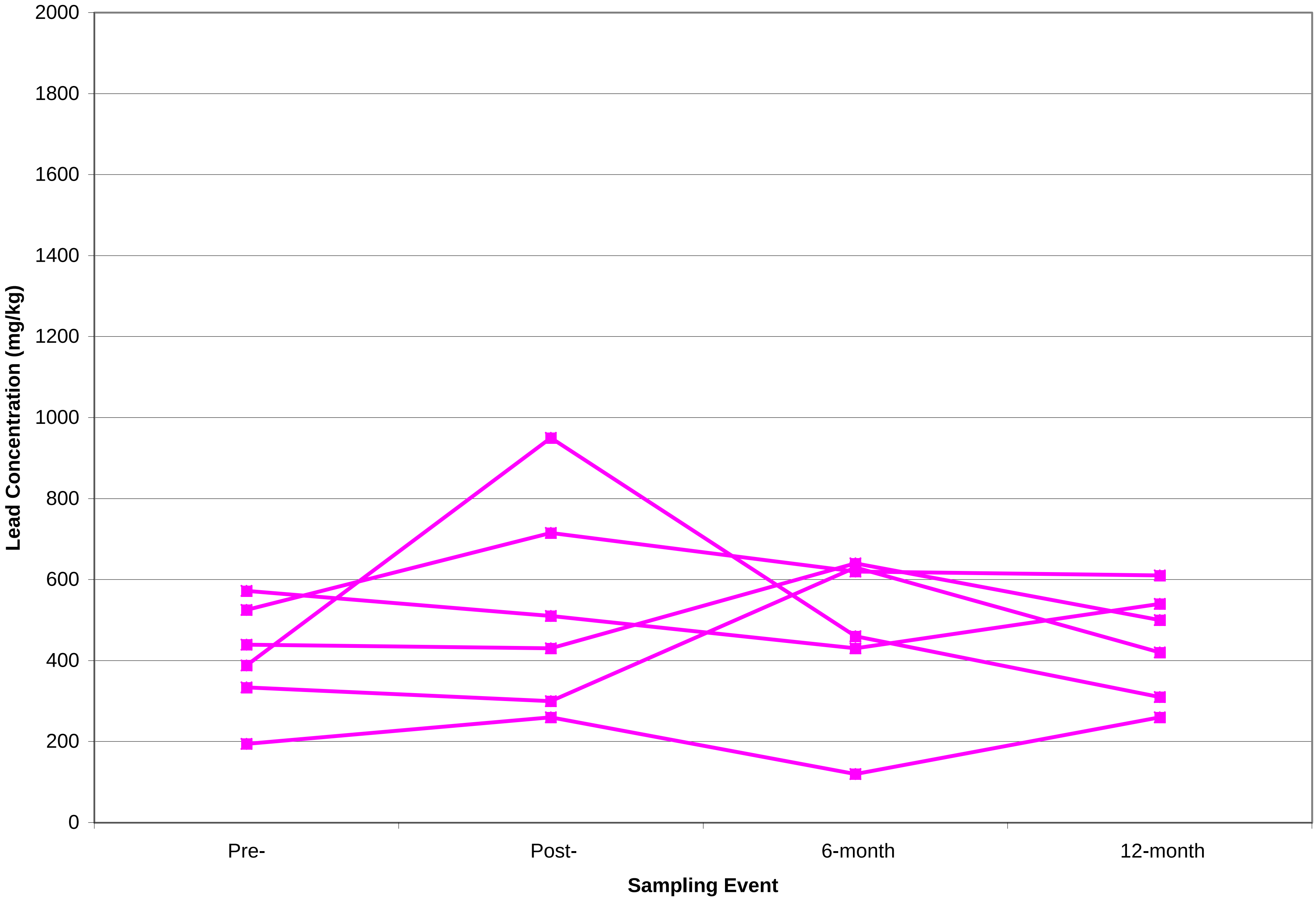


Figure 4-10a-M3. Line Plot of Living Room BRM Lead Concentrations for the Spring Treatment

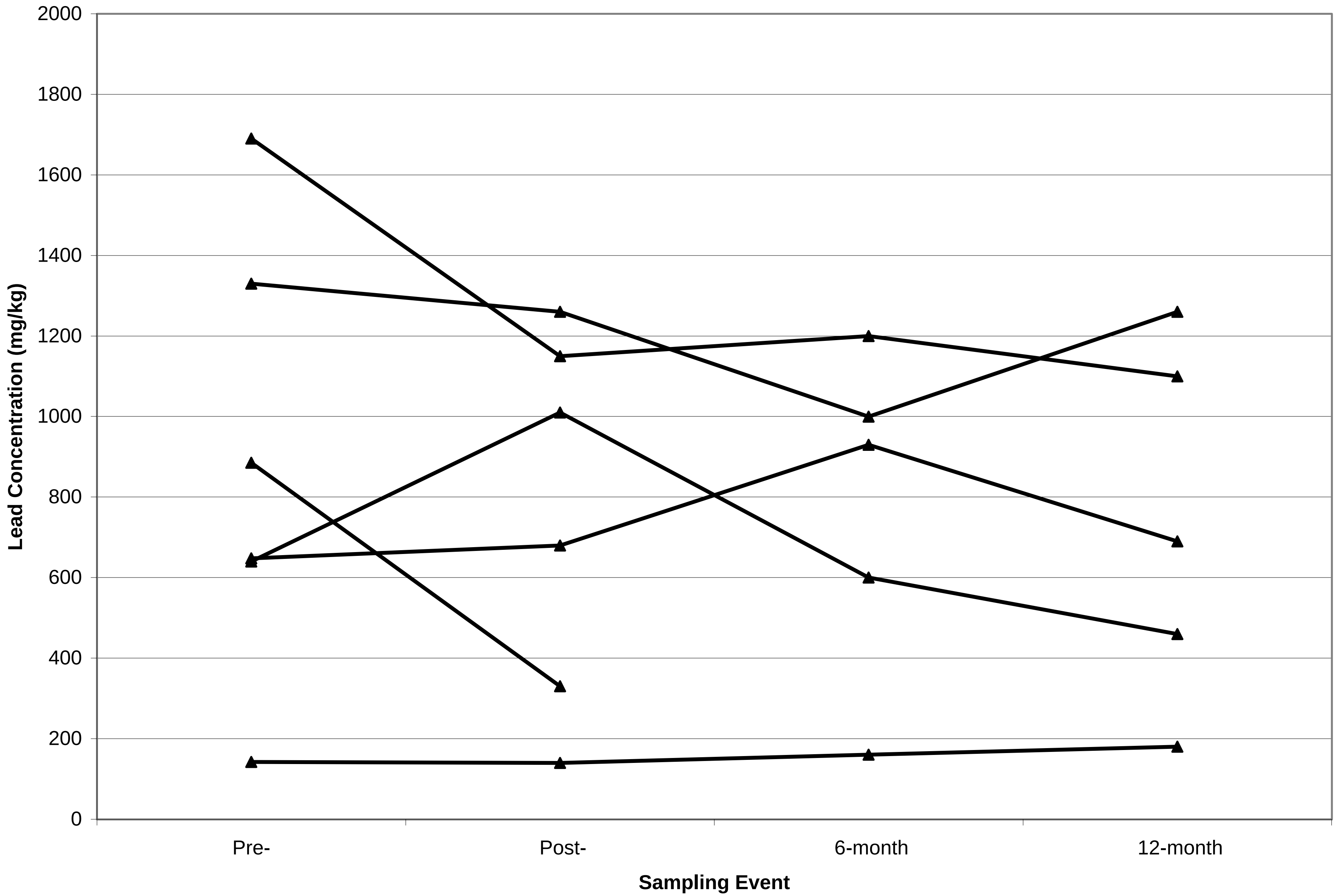


Figure 4-10a-M4. Line Plot of Living Room BRM Lead Concentrations for the Control Treatment

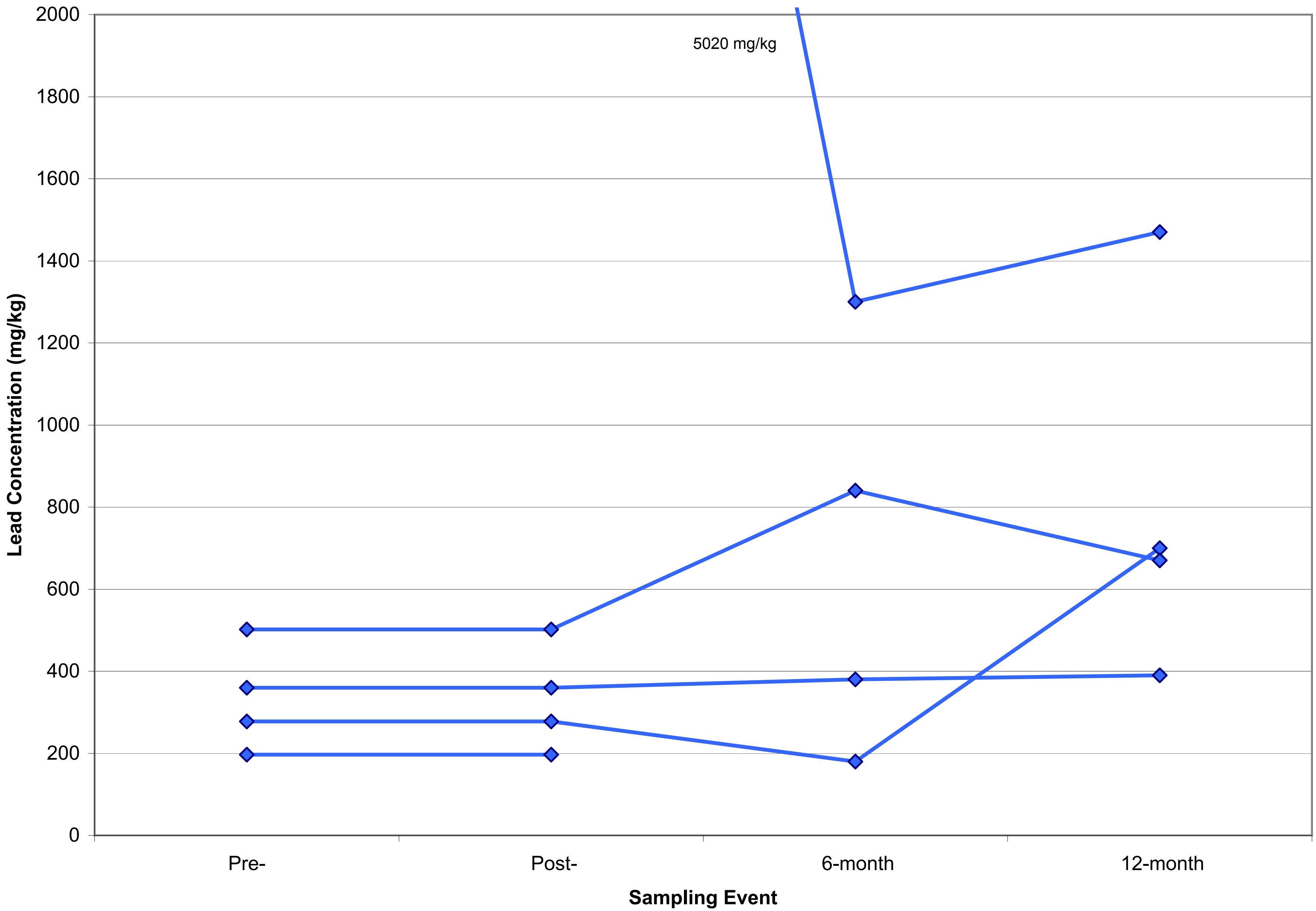


Figure 4-10b-M5. Line Plot of Living Room BRM Dust Loadings for the HUD Treatment

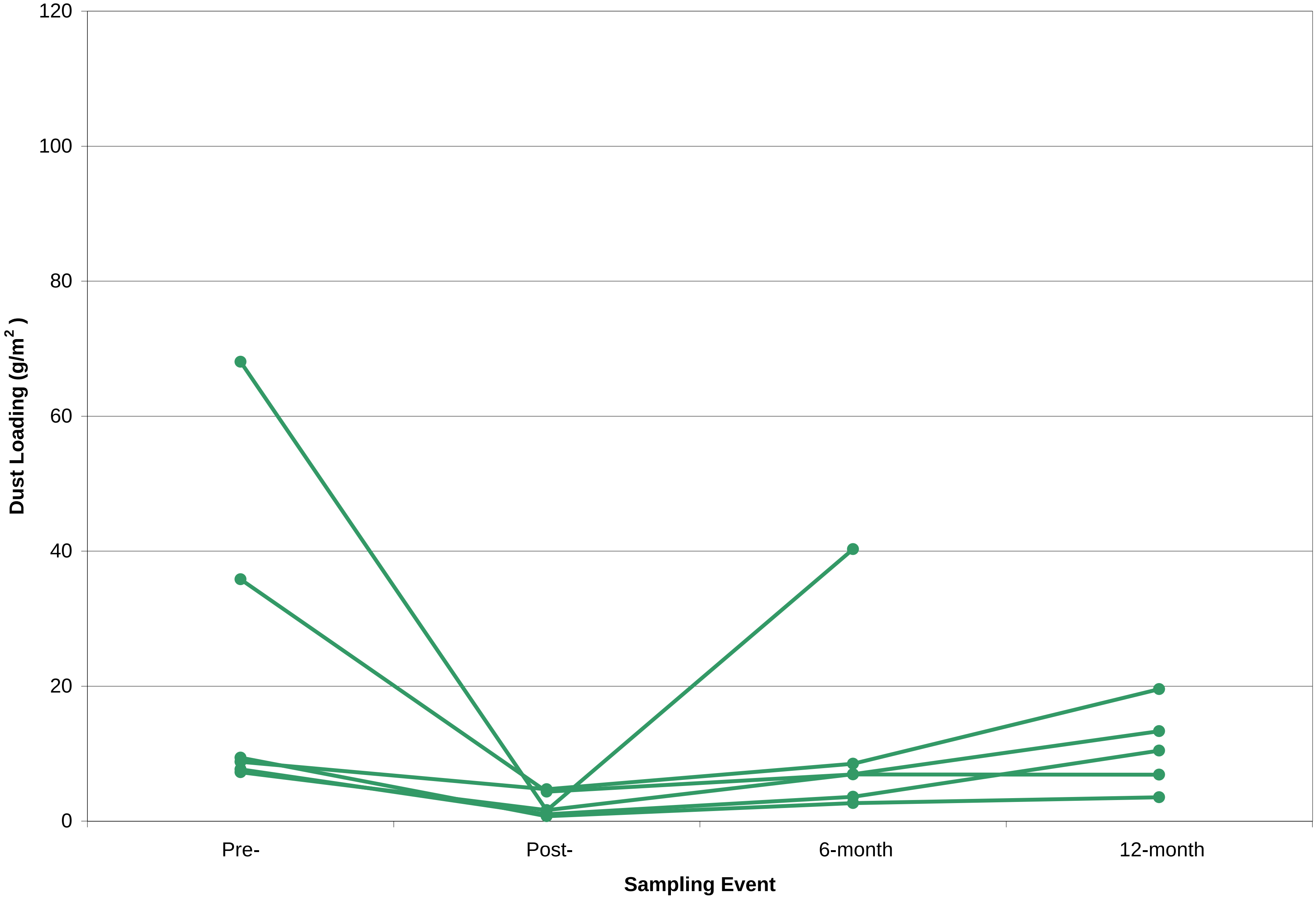


Figure 4-10b-M6. Line Plot of Living Room BRM Dust Loadings for the Commercial Treatment

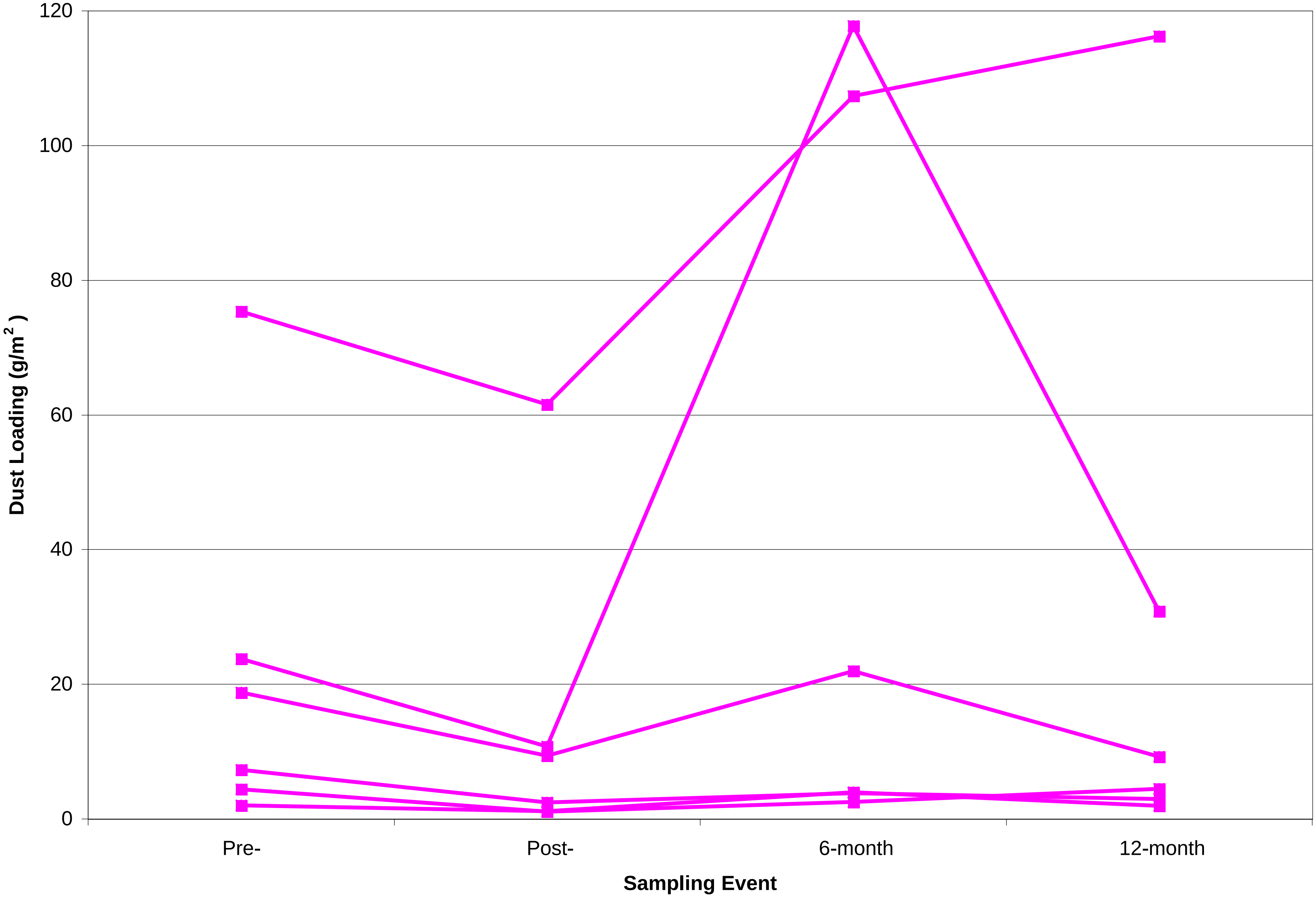


Figure 4-10b-M7. Line Plot of Living Room BRM Dust Loadings for the Spring Treatment

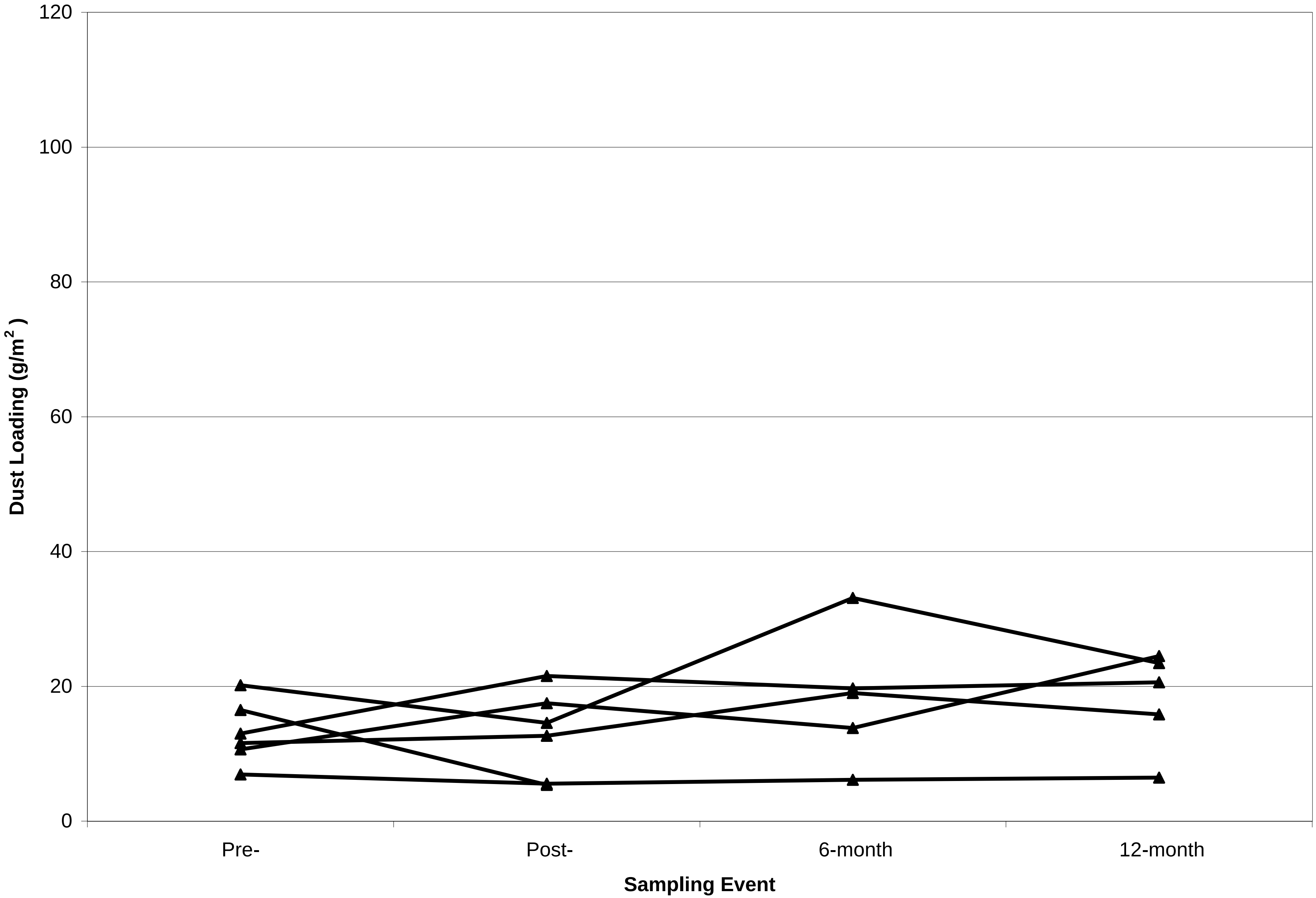


Figure 4-10b-M8. Line Plot of Living Room BRM Dust Loadings for the Control Treatment

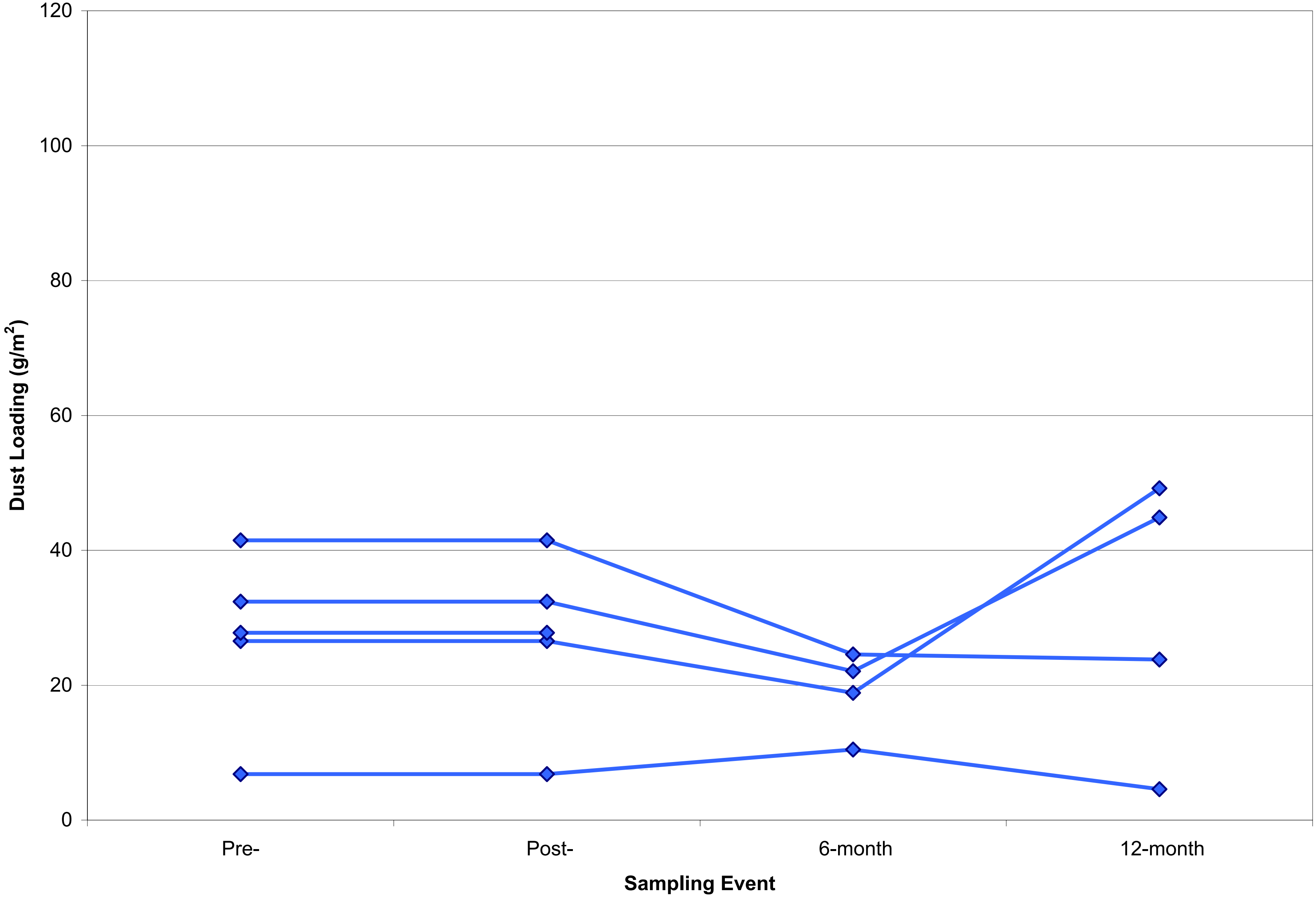
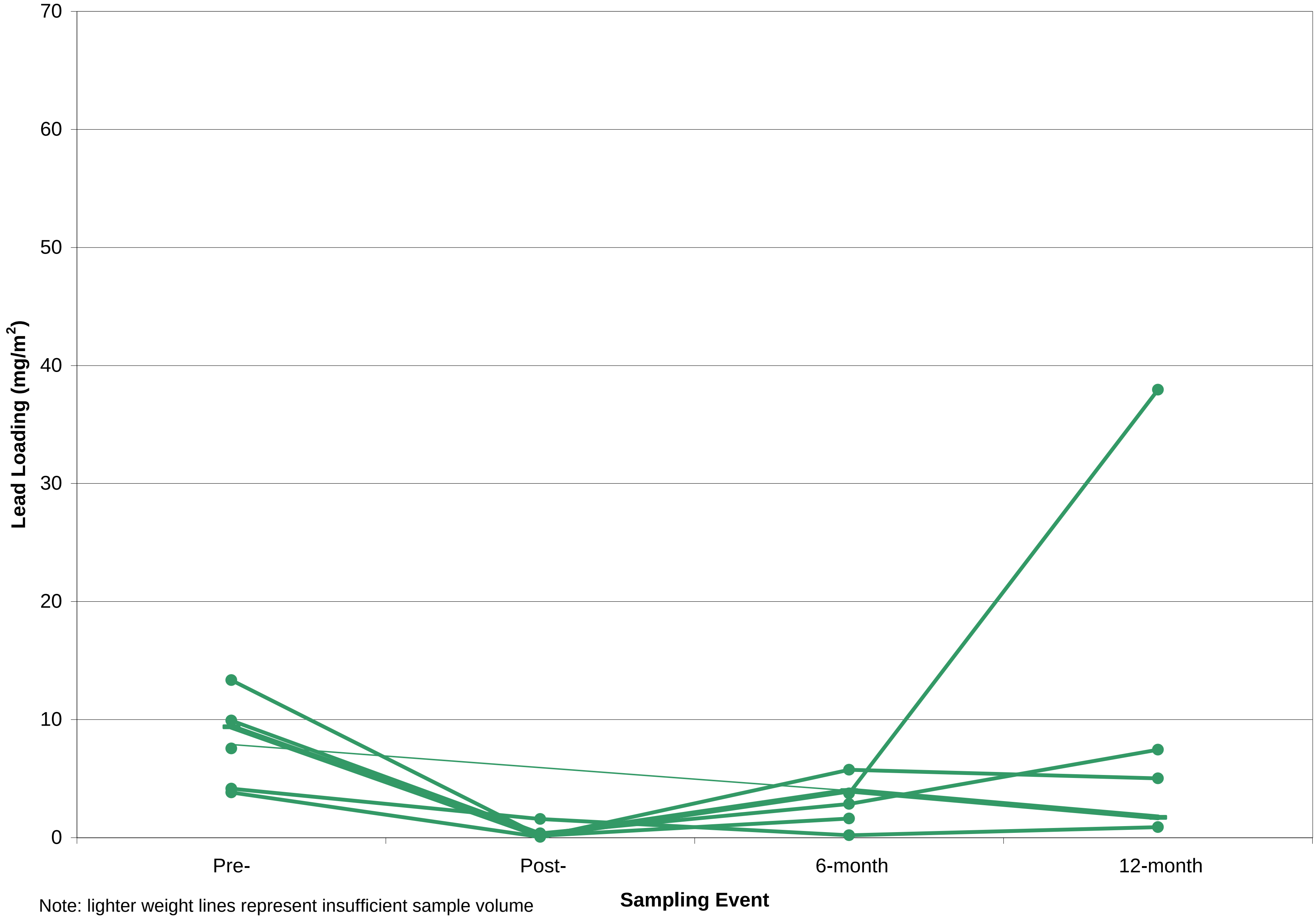


Figure 4-10c-M9. Line Plot of Living Room BRM Lead Loadings for the HUD Treatment



Note: lighter weight lines represent insufficient sample volume

Figure 4-10c-M10. Line Plot of Living Room BRM Lead Loadings for the Commercial Treatment

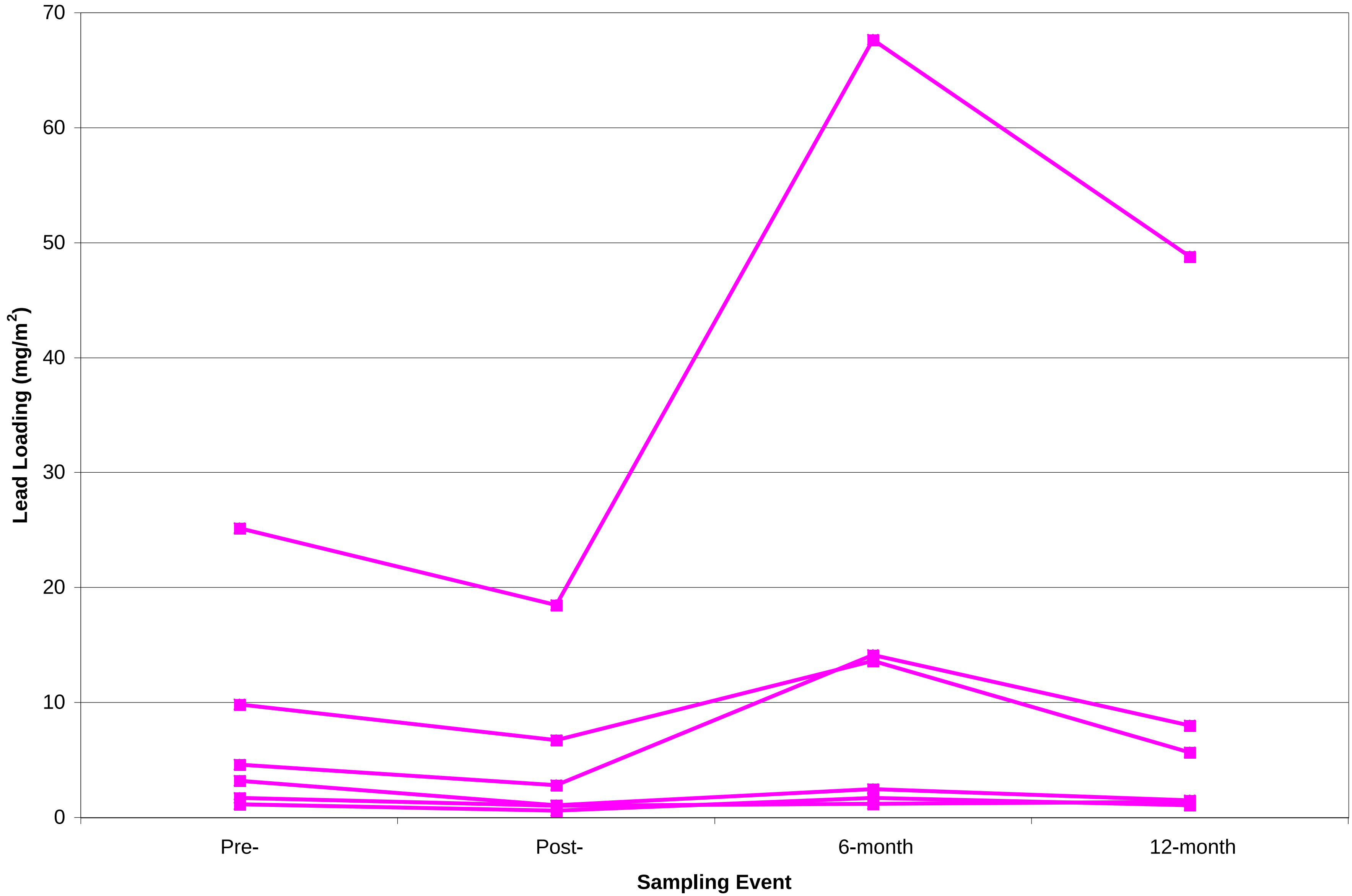


Figure 4-10c-M11. Line Plot of Living Room BRM Lead Loadings for the Spring Treatment

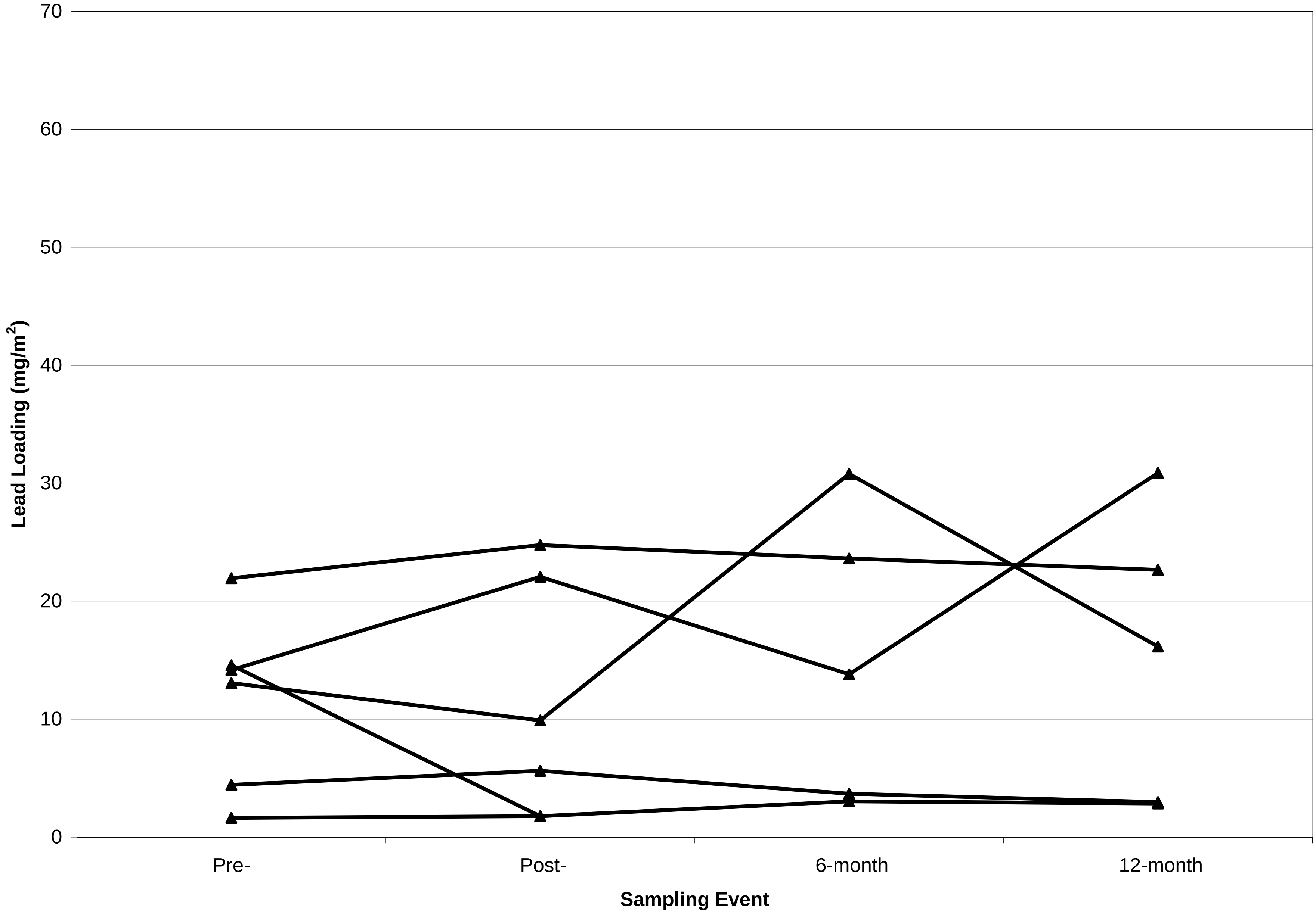


Figure 4-10c-M12. Line Plot of Living Room BRM Lead Loadings for the Control Treatment

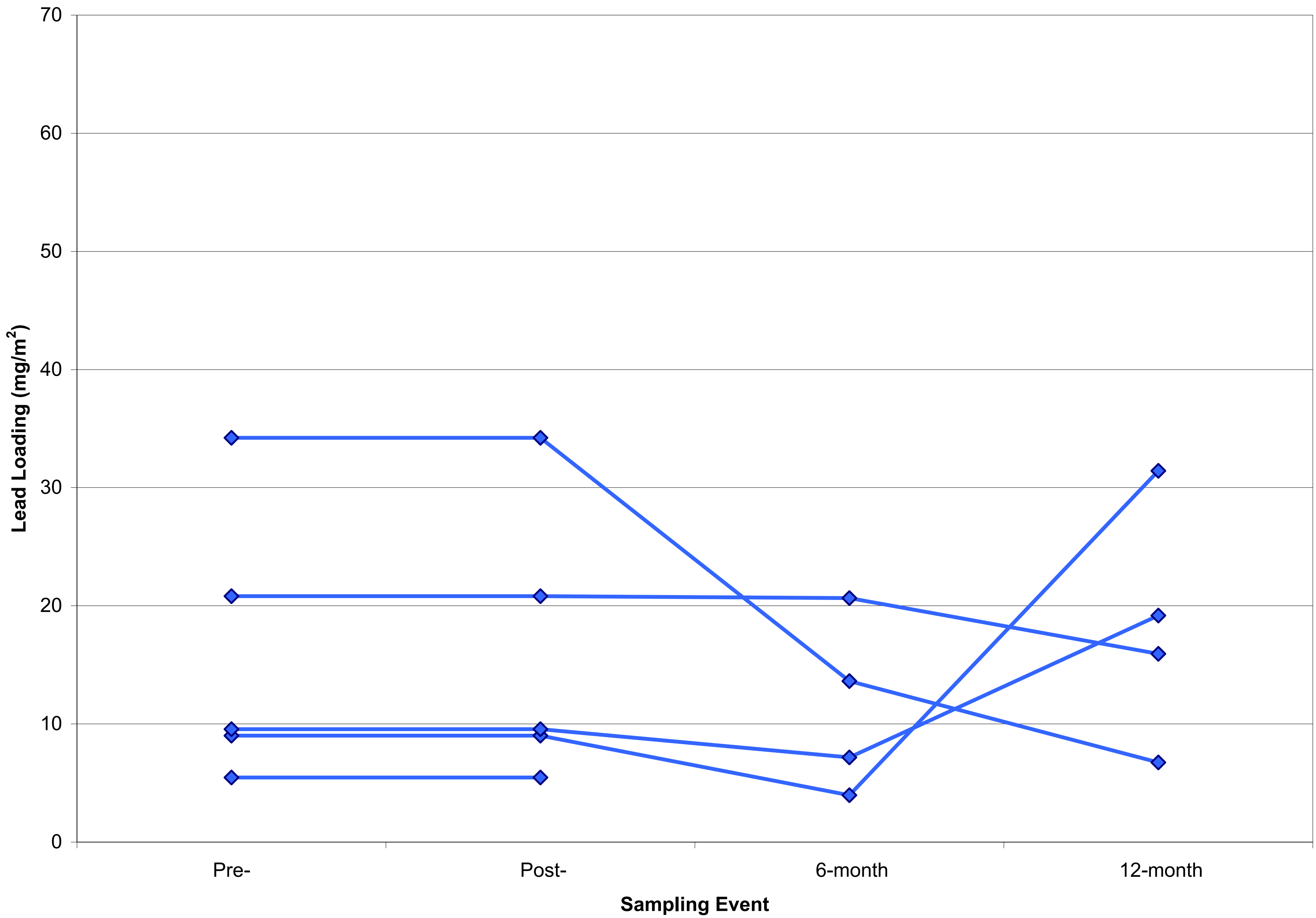
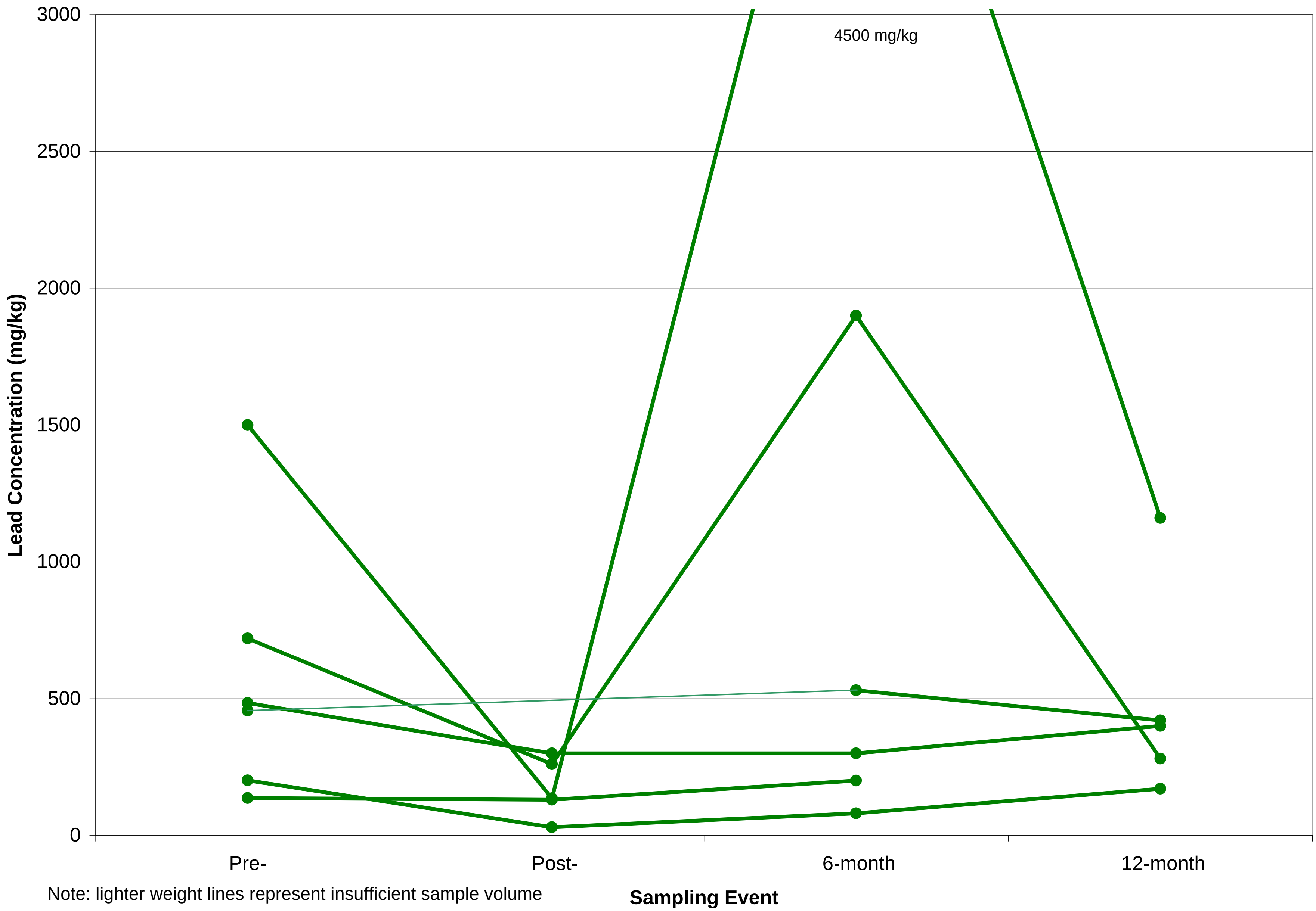


Figure 4-14a-N1. Line Plot of Bedroom BRM Lead Concentrations for the HUD Treatment



Note: lighter weight lines represent insufficient sample volume

Figure 4-14a-N2. Line Plot of Bedroom BRM Lead Concentrations for the Commercial Treatment

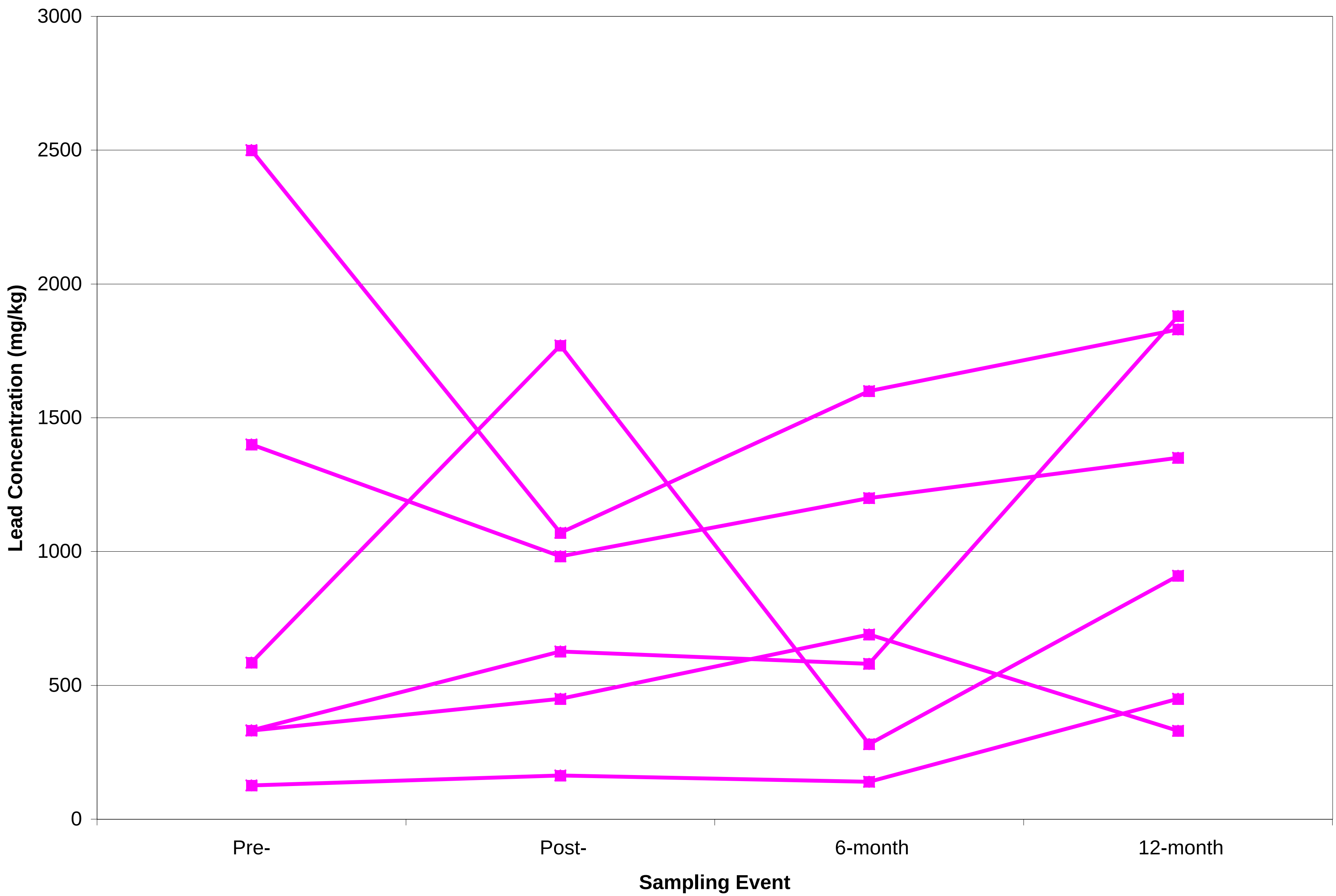


Figure 4-14a-N3. Line Plot of Bedroom BRM Lead Concentrations for the Spring Treatment

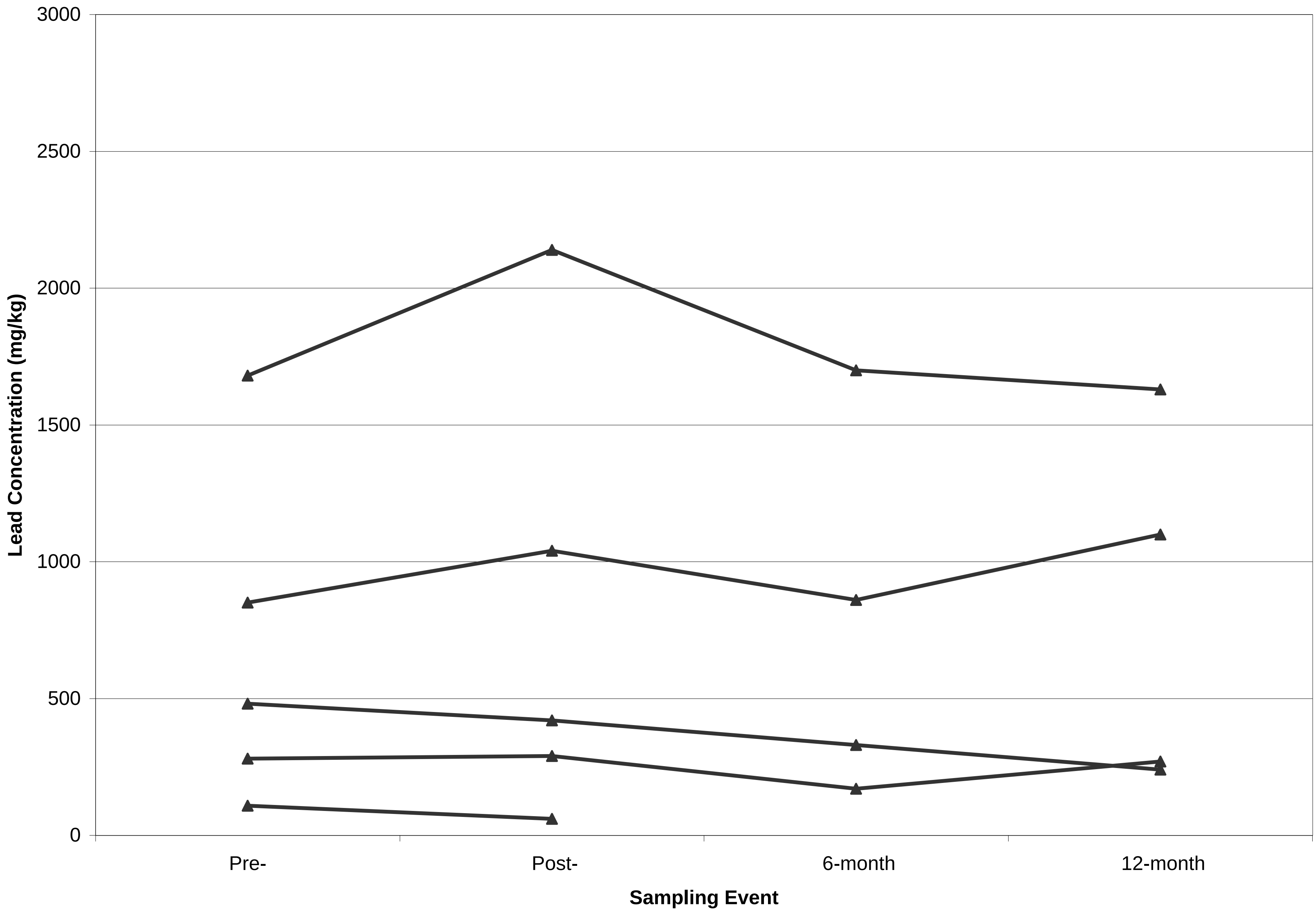


Figure 4-14a-N4. Line Plot of Bedroom BRM Lead Concentrations for the Control Treatment

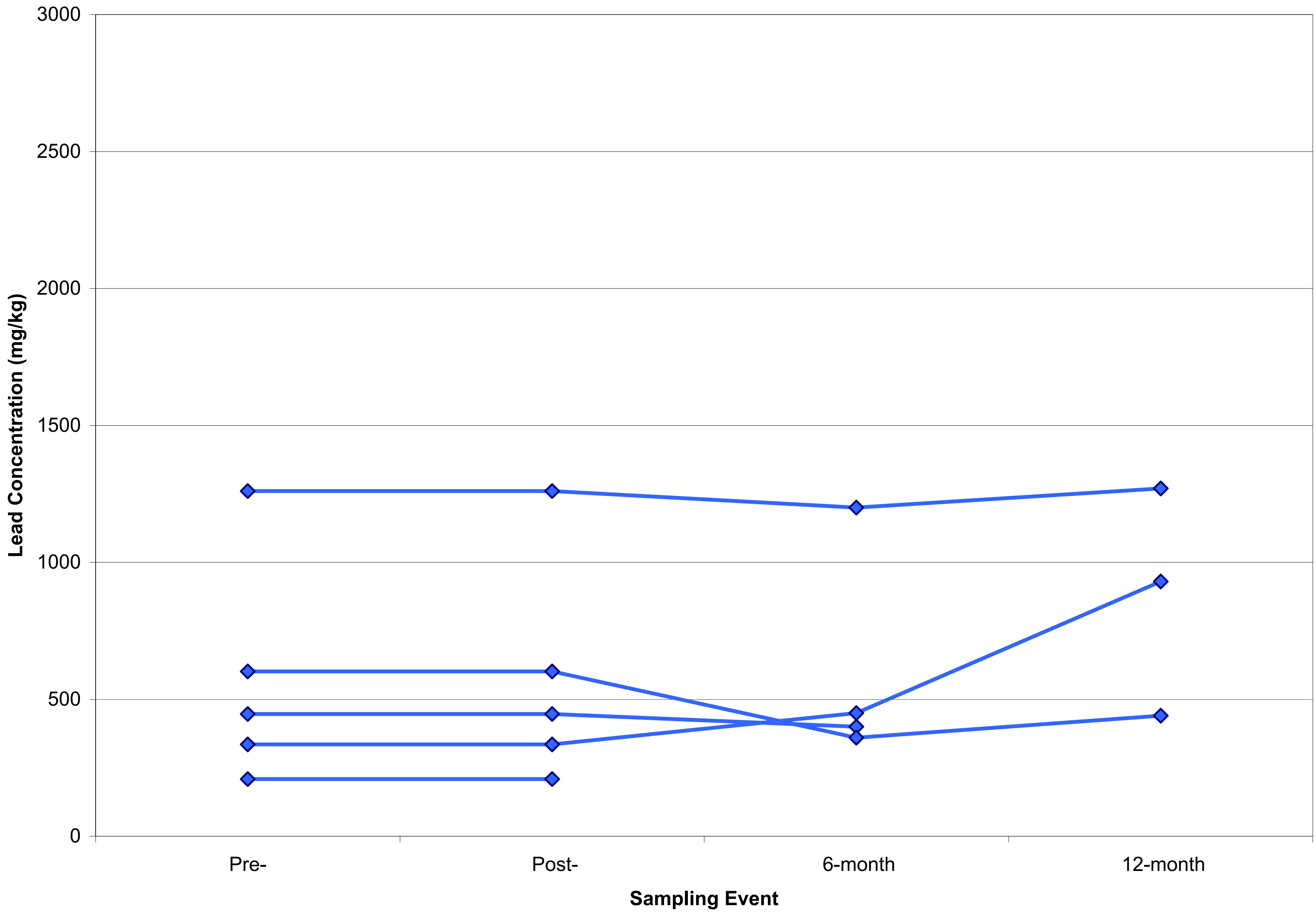


Figure 4-14b-N5. Line Plot of Bedroom BRM Dust Loadings for the HUD Treatment

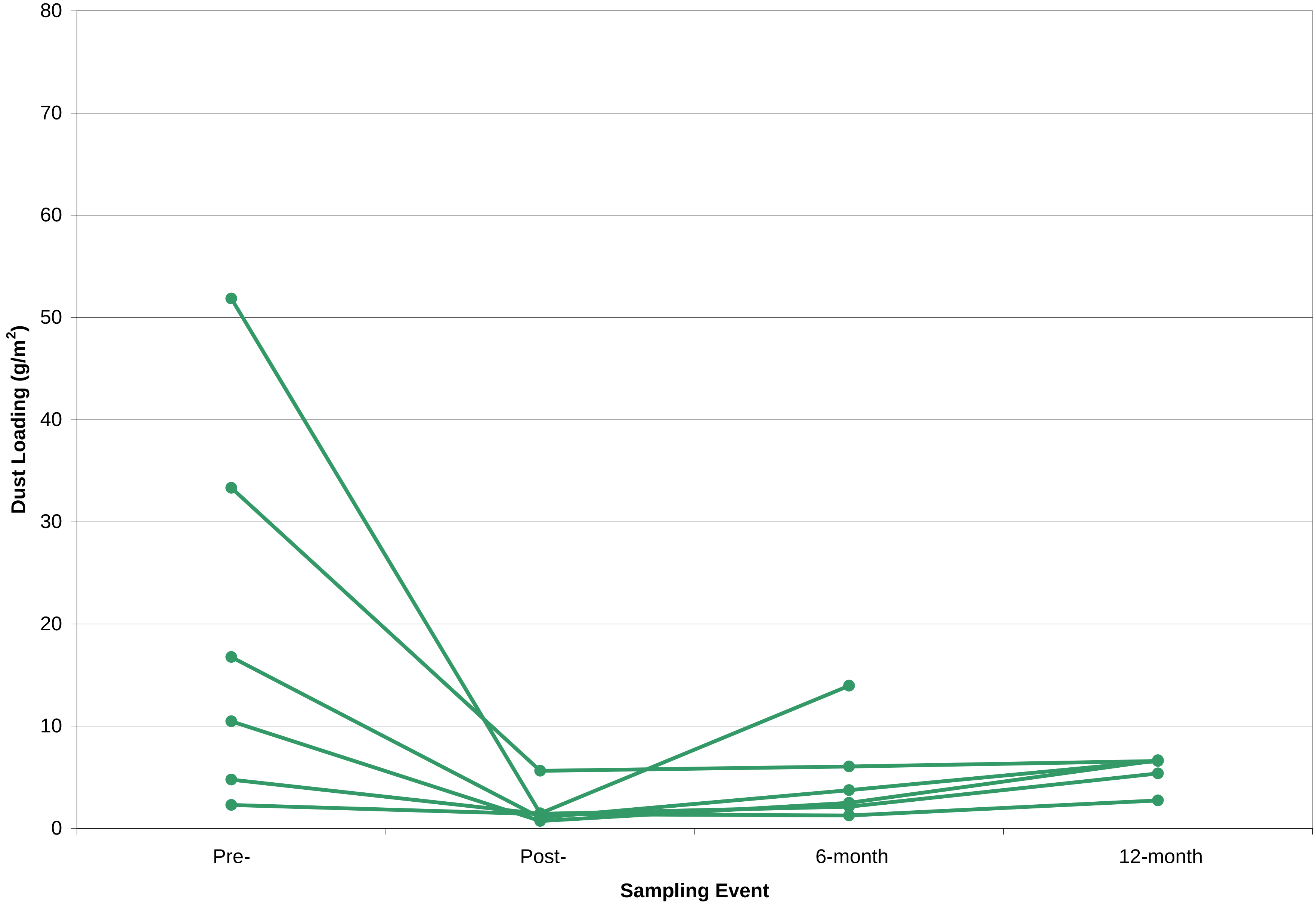


Figure 4-14b-N6. Line Plot of Bedroom BRM Dust Loadings for Commercial Treatment

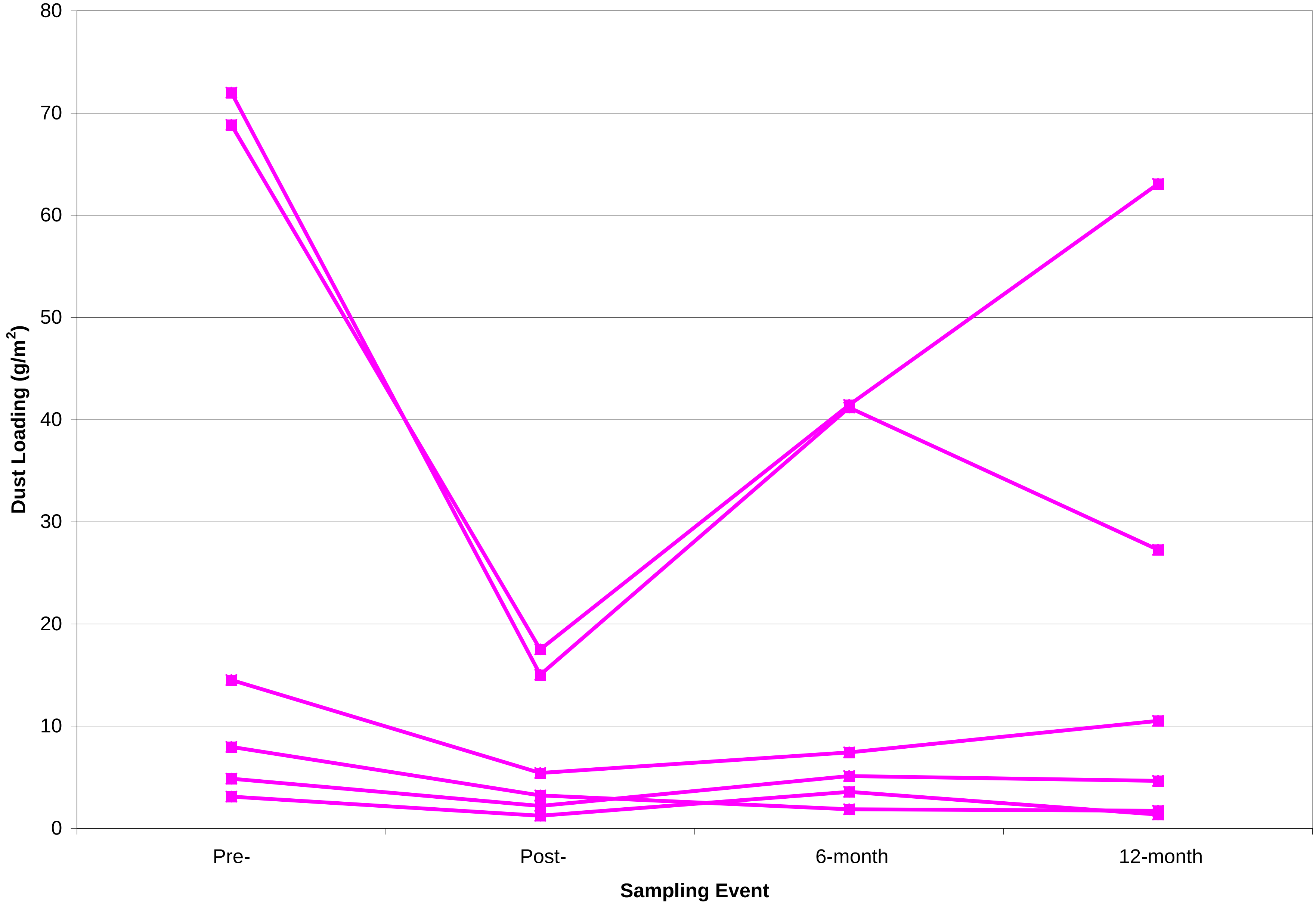


Figure 4-14b-N7. Line Plot of Bedroom BRM Dust Loadings for the Spring Treatment

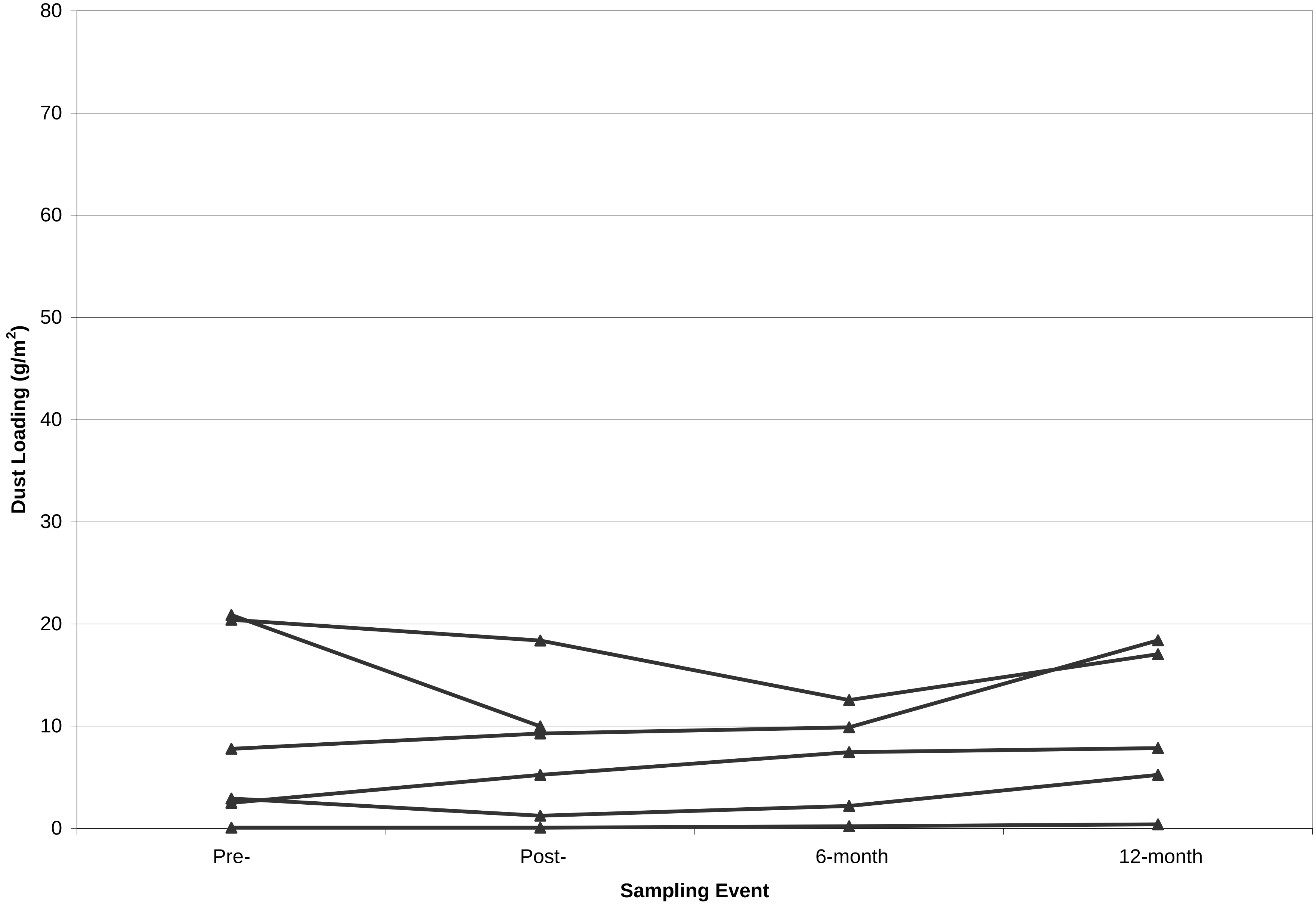


Figure 4-14b-N8. Line Plot of Bedroom BRM Dust Loadings for the Control Treatment

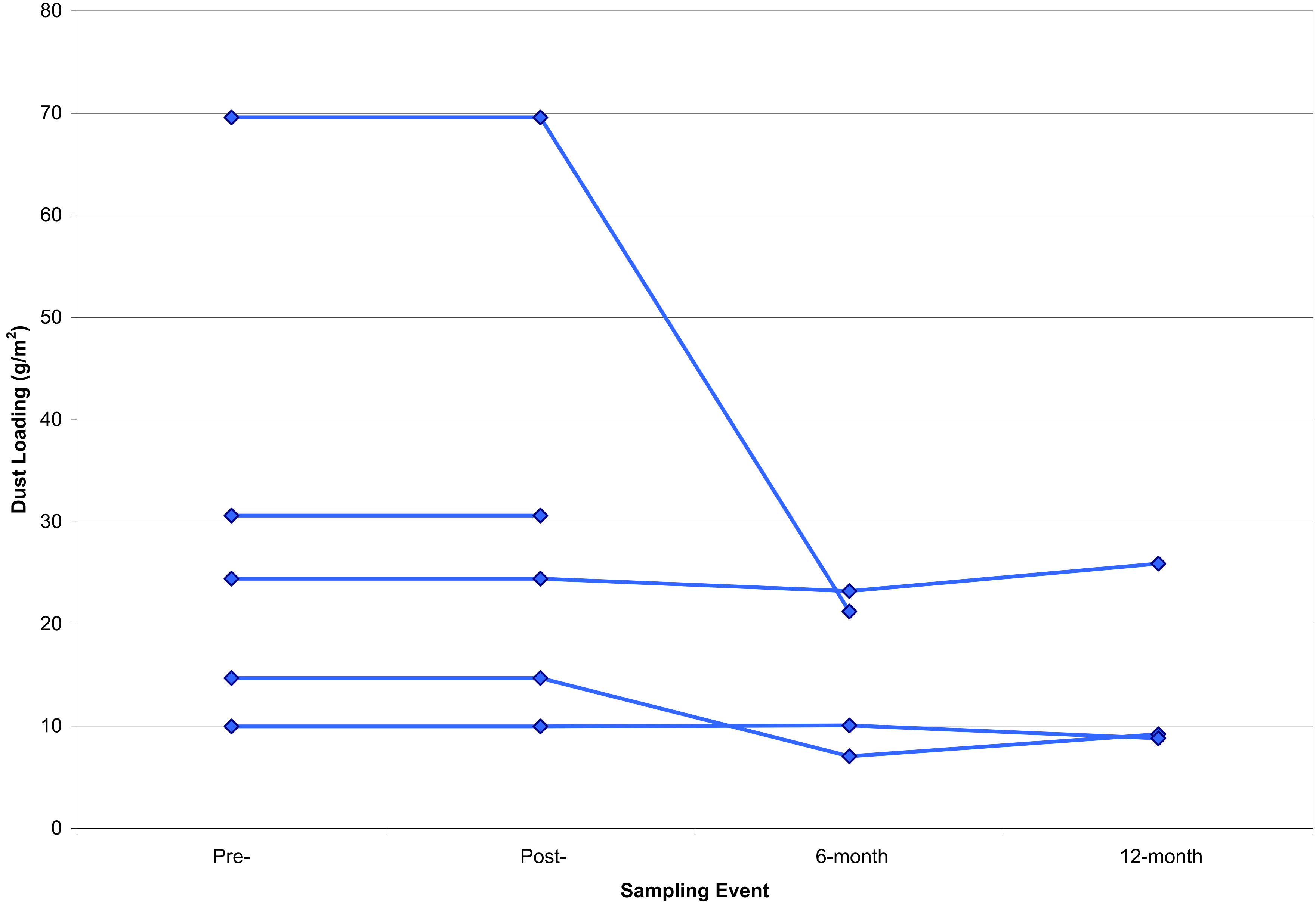
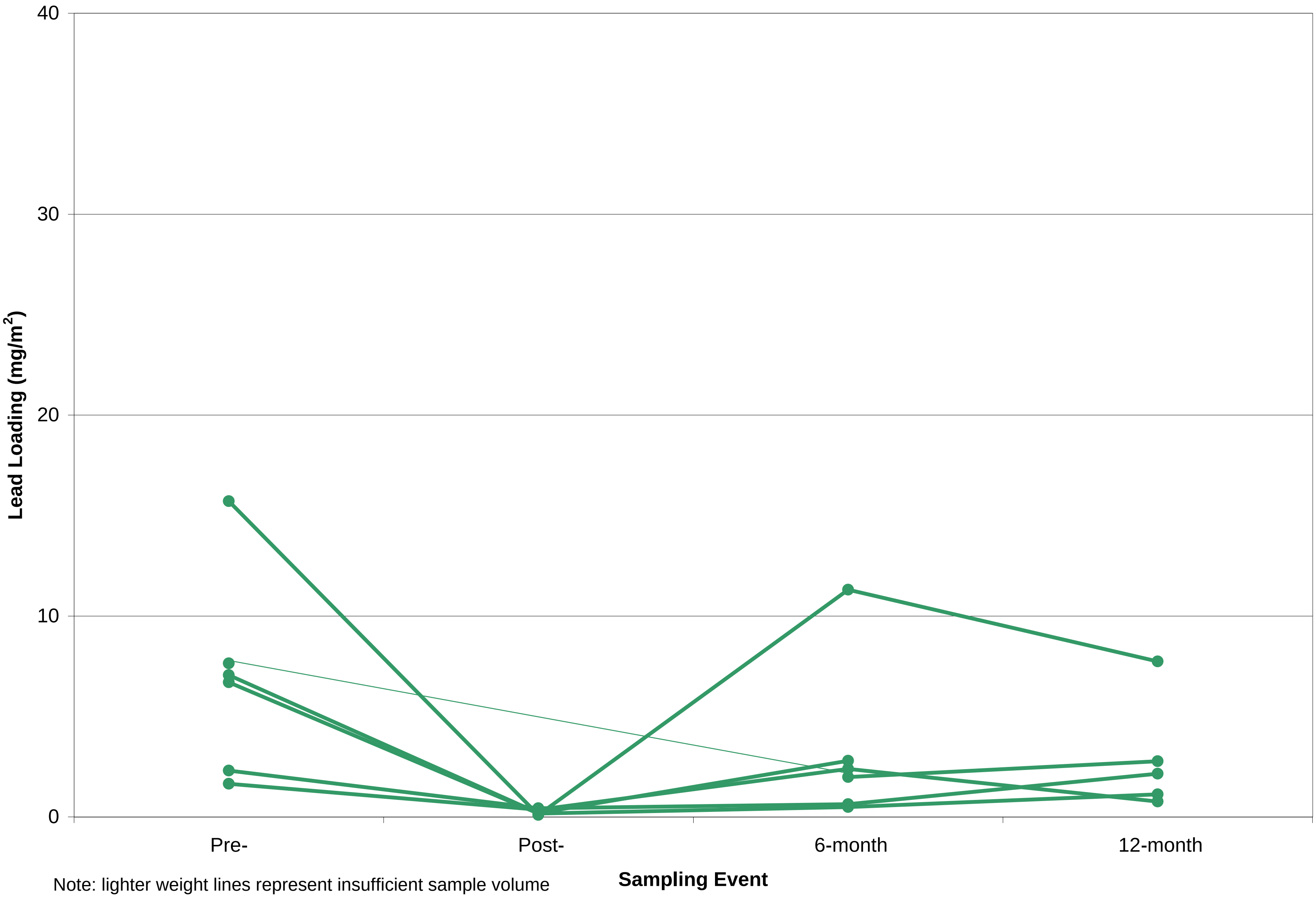


Figure 4-14c-N9. Line Plot of Bedroom BRM Lead Loadings for the HUD Treatment



Note: lighter weight lines represent insufficient sample volume

Figure 4-14c-N10. Line Plot of Bedroom BRM Lead Loadings for the Commercial Treatment

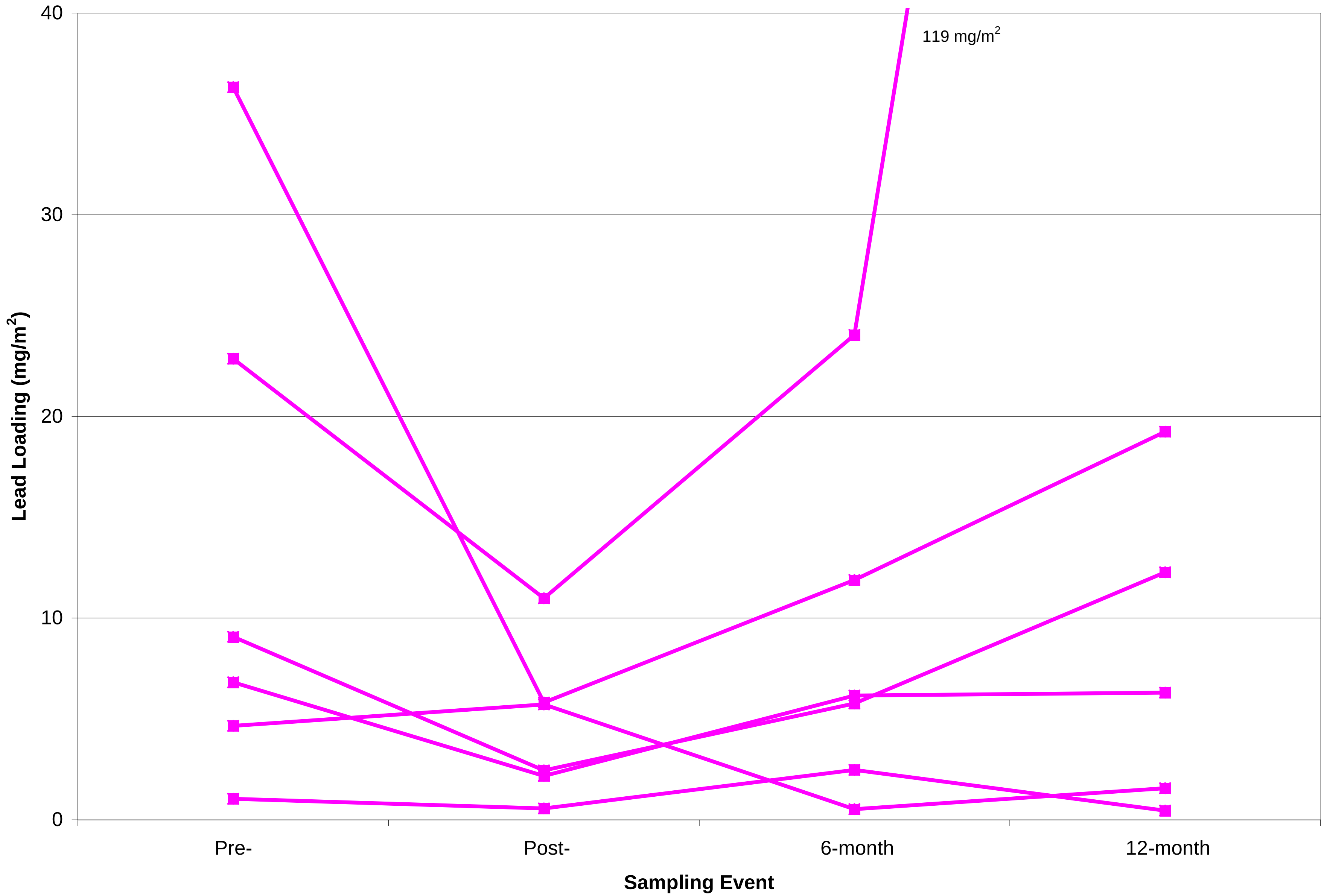


Figure 4-14c-N11. Line Plot of Bedroom BRM Lead Loadings for the Spring Treatment

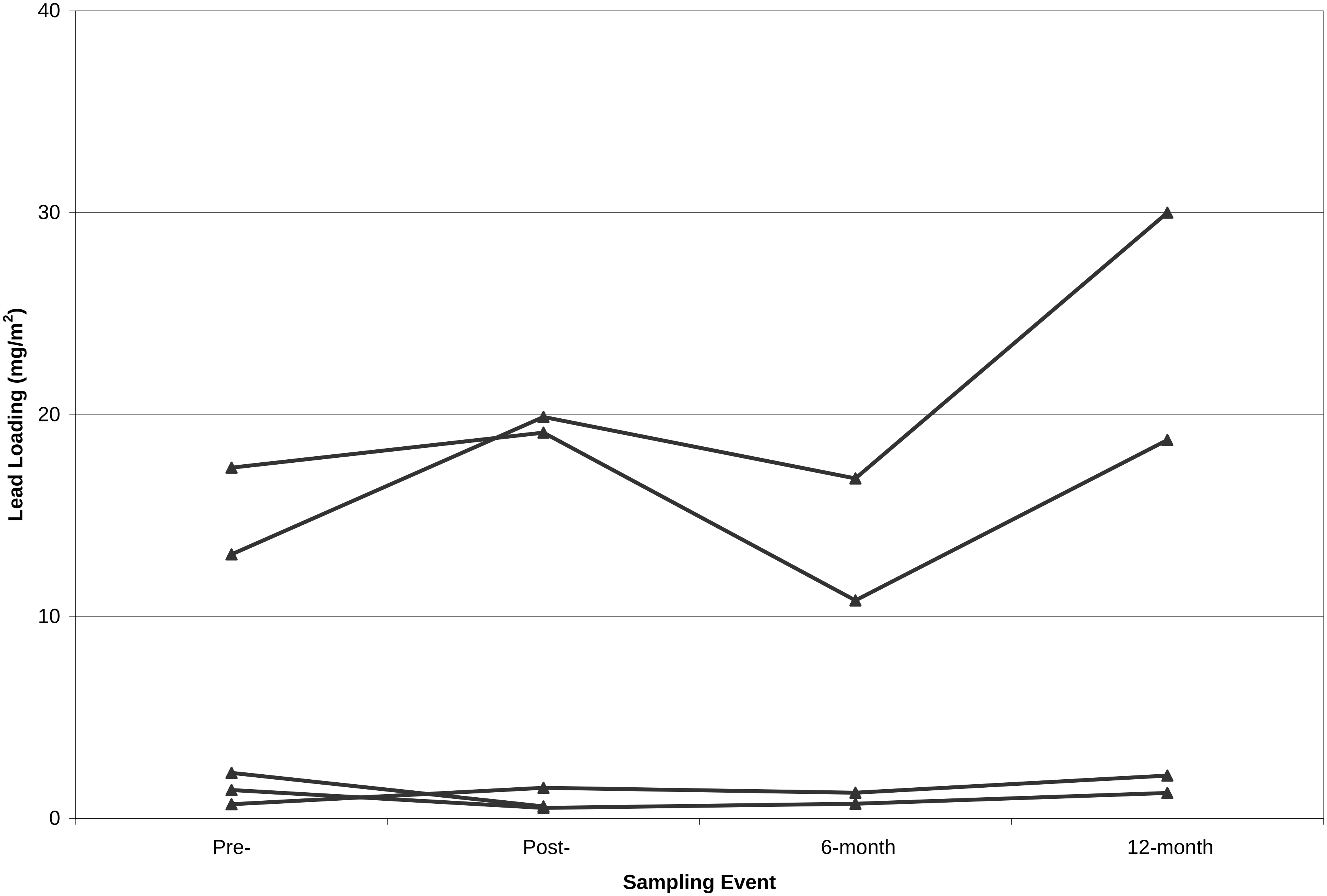


Figure 4-14c-N12. Line Plot of Bedroom BRM Lead Loadings for the Control Treatment

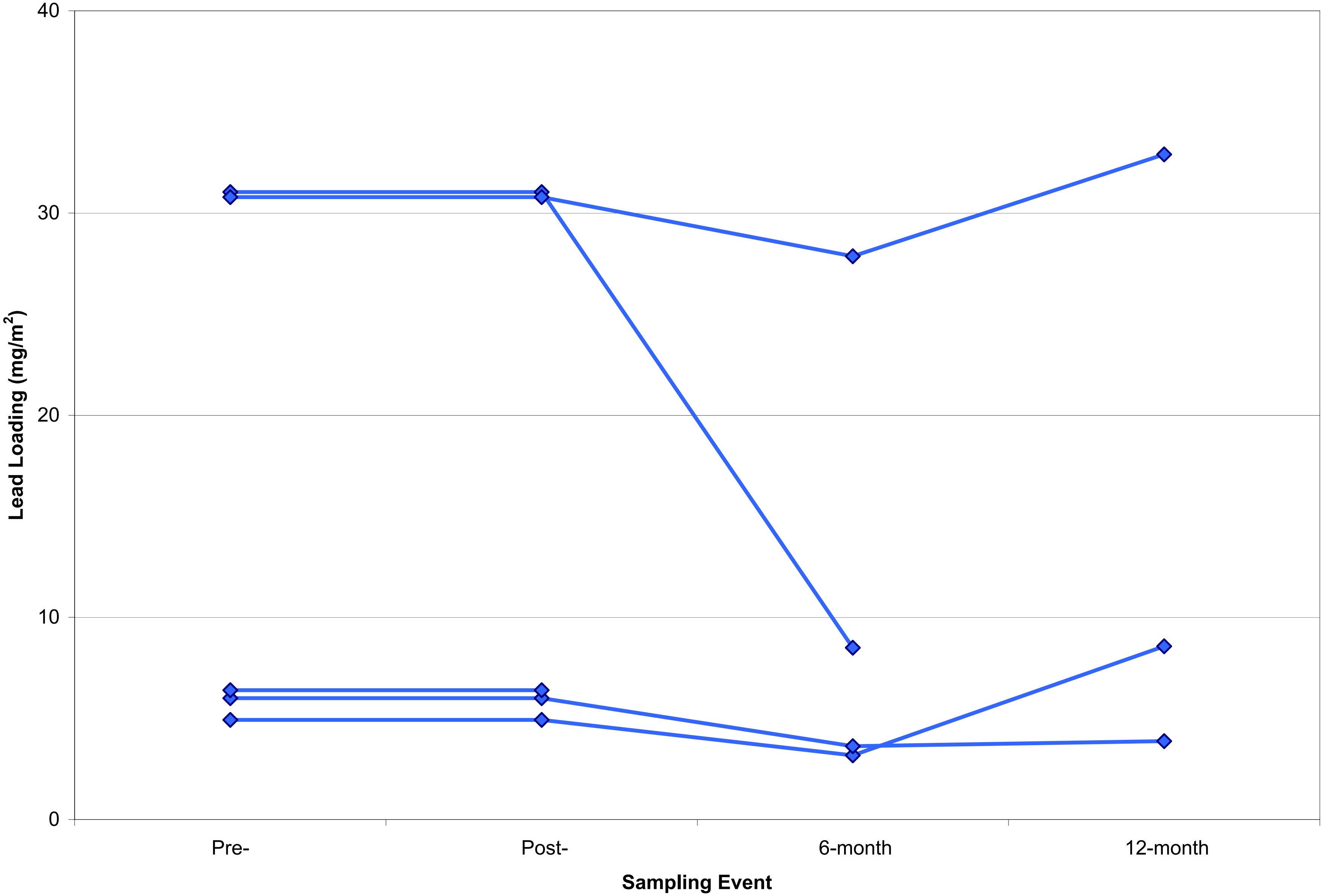
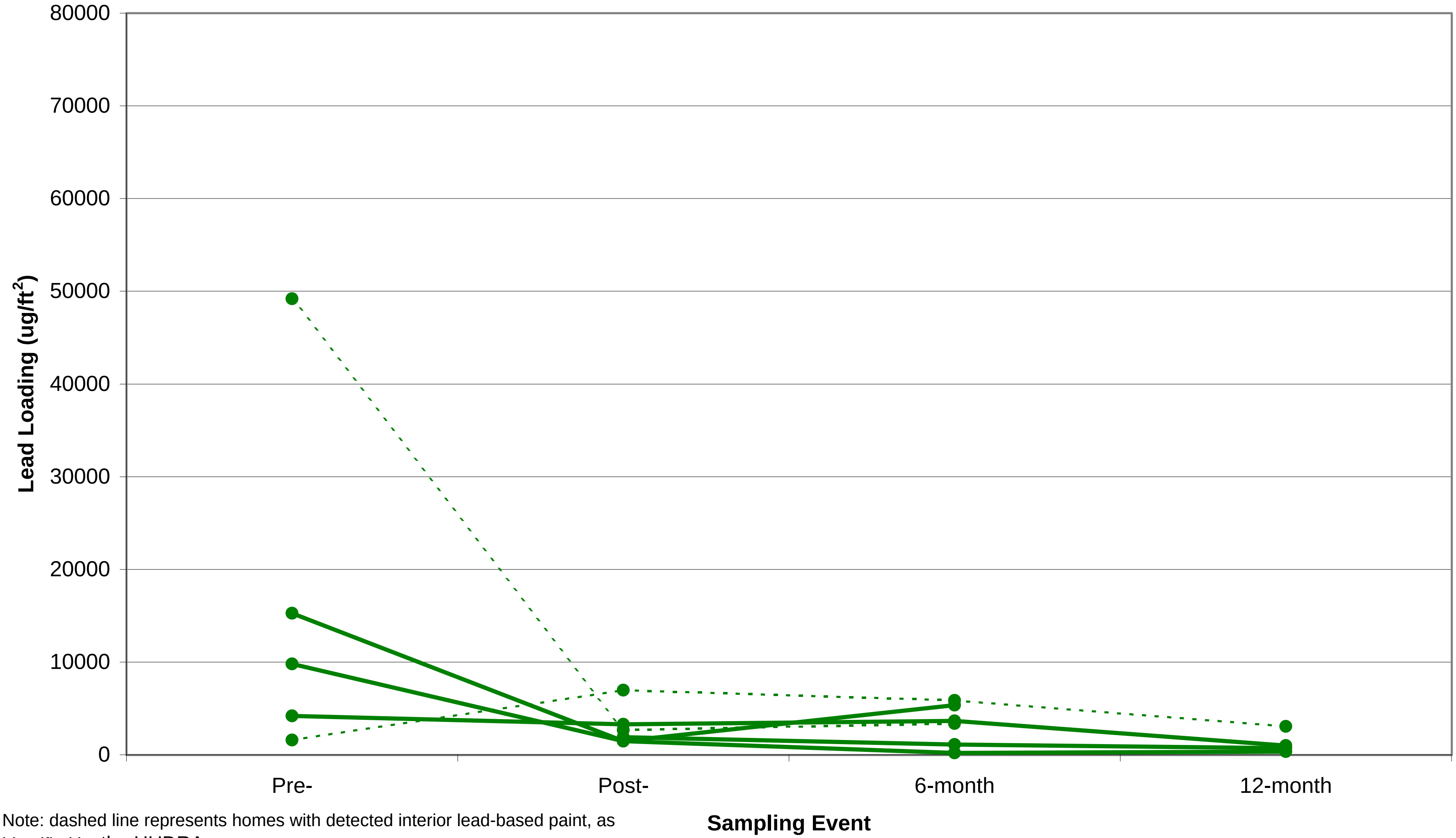
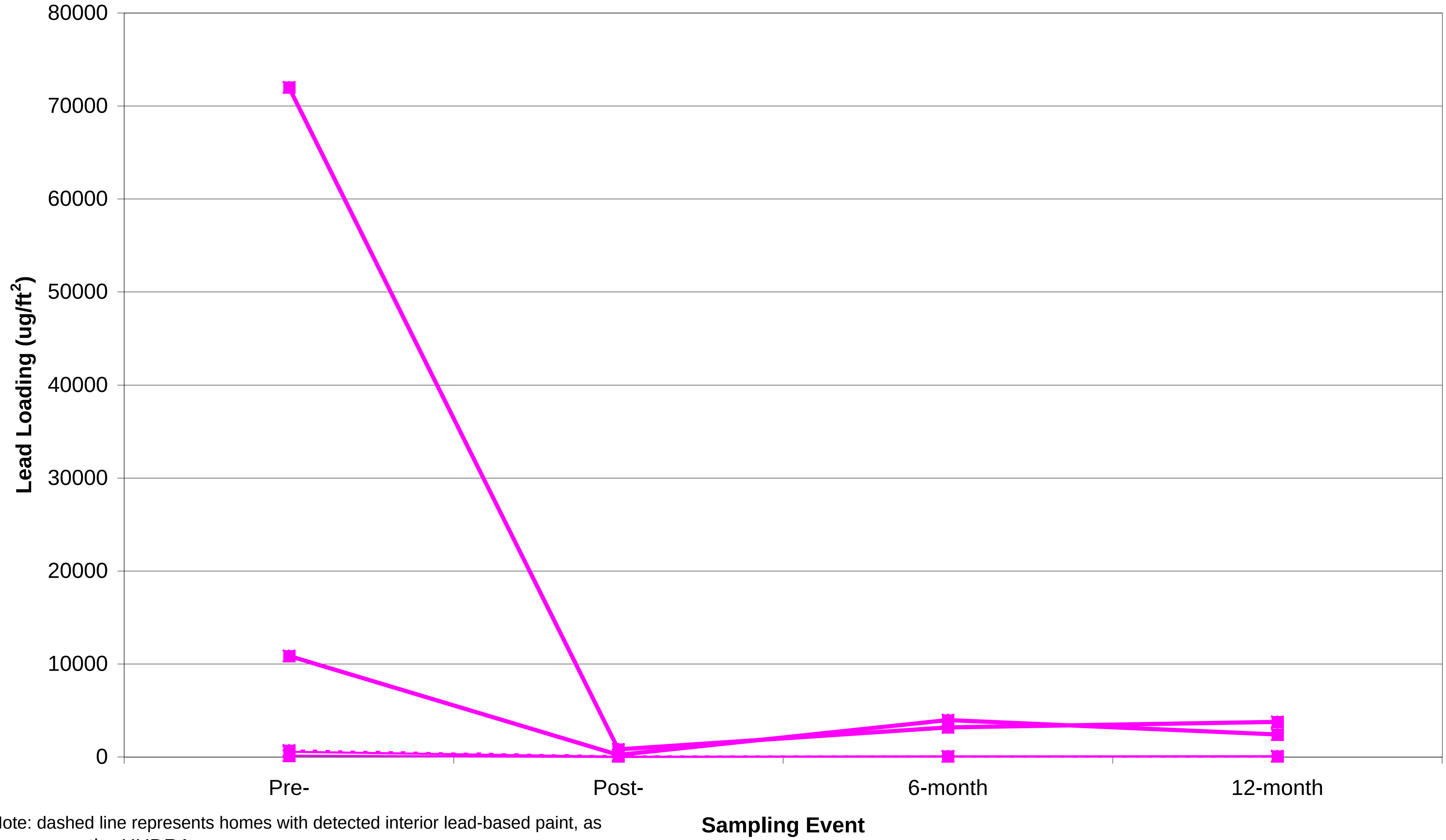


Figure 4-18a-O1. Line Plot of Dust Wipe Lead Loadings for Bedroom Window Wells for the HUD Treatment



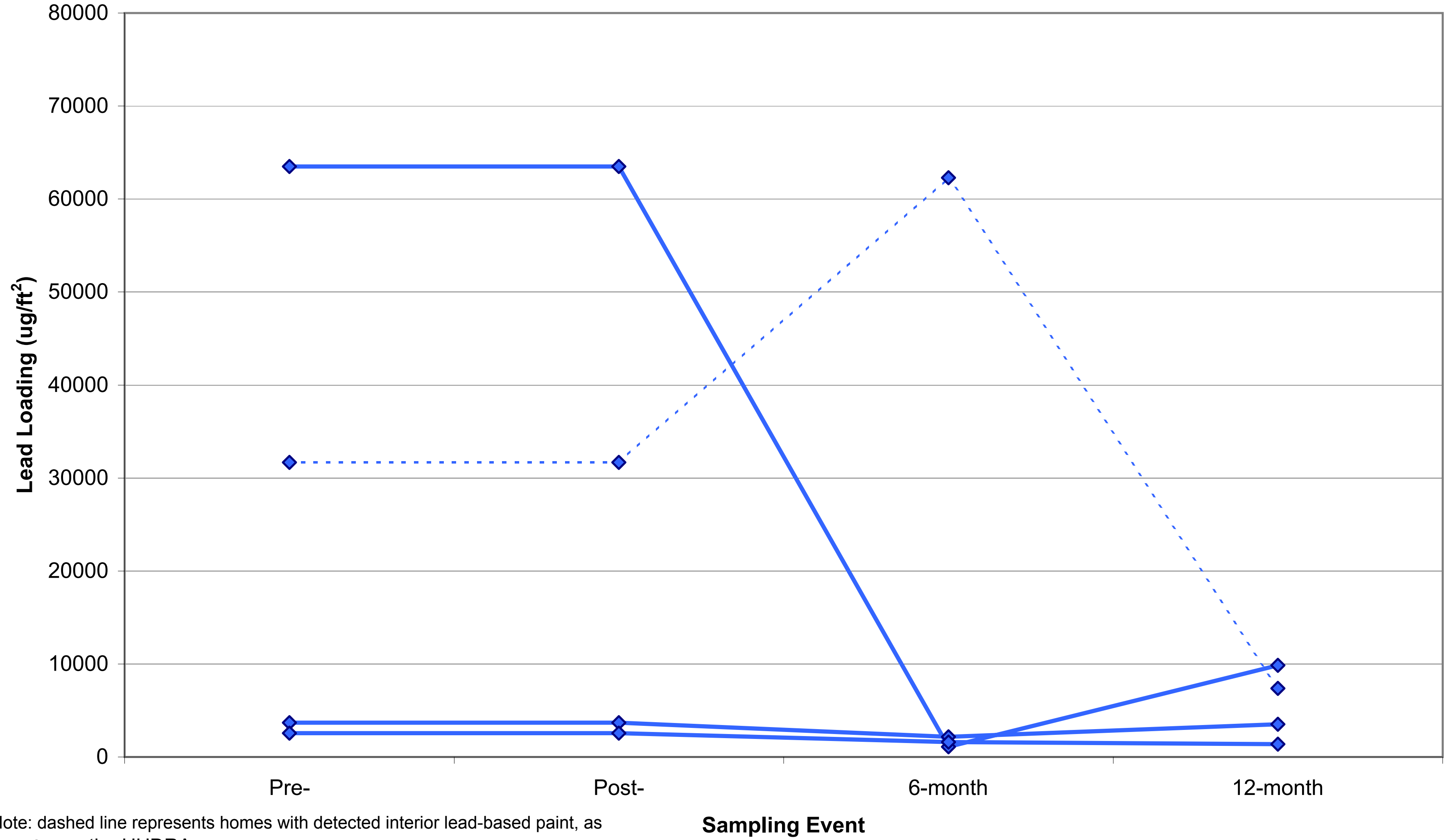
Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-18a-O2. Line Plot of Dust Wipe Lead Loadings for Bedroom Window Wells for the Commercial Treatment



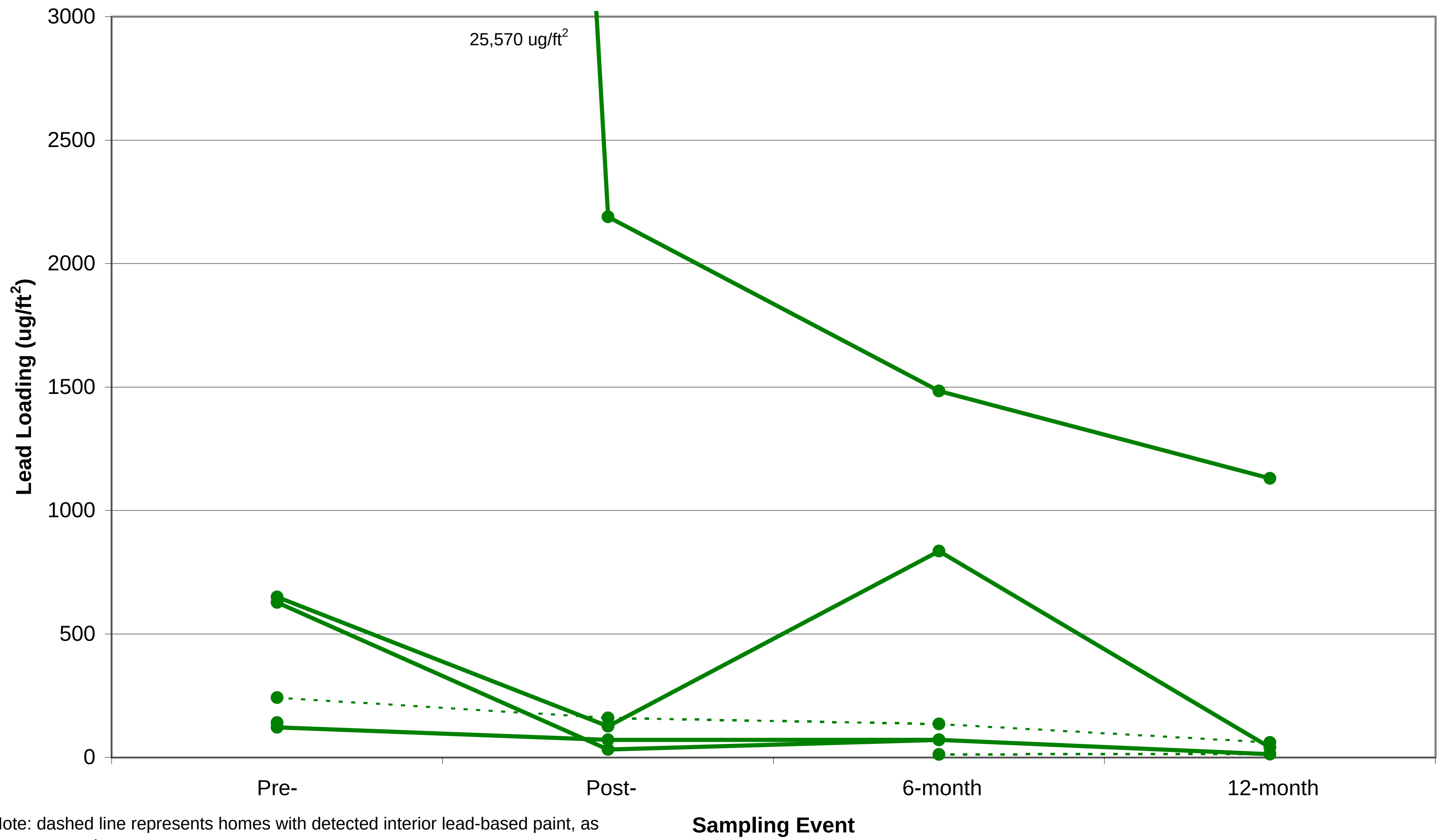
Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-18a-O3. Line Plot of Dust Wipe Lead Loadings for Bedroom Window Wells for the Control Treatment



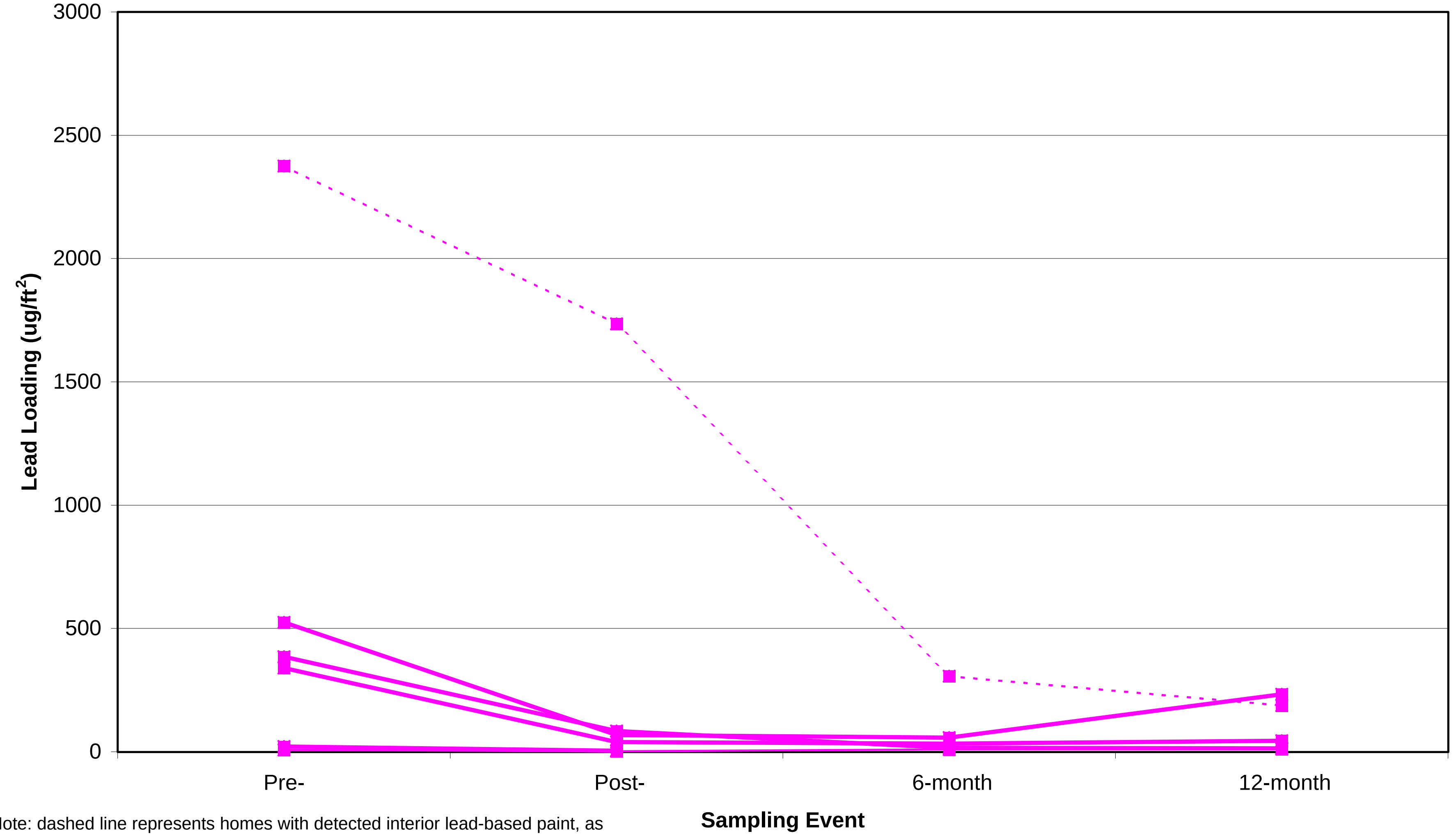
Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-18b-O4. Line Plot of Dust Wipe Lead Loadings for Bedroom Window Sills for the HUD Treatment



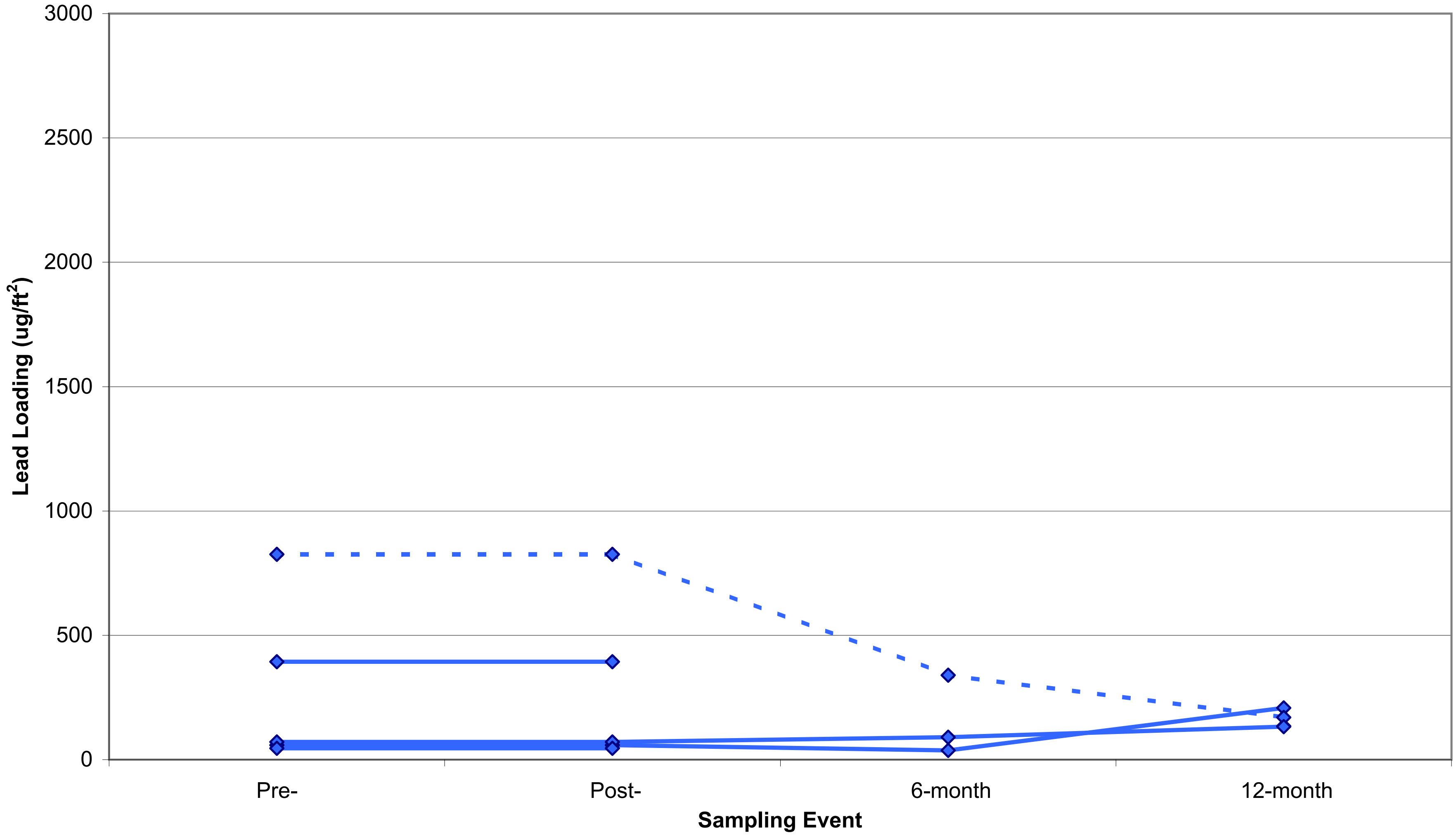
Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-18b-O5. Line Plot of Dust Wipe Lead Loadings for Bedroom Window Sills for the Commercial Treatment



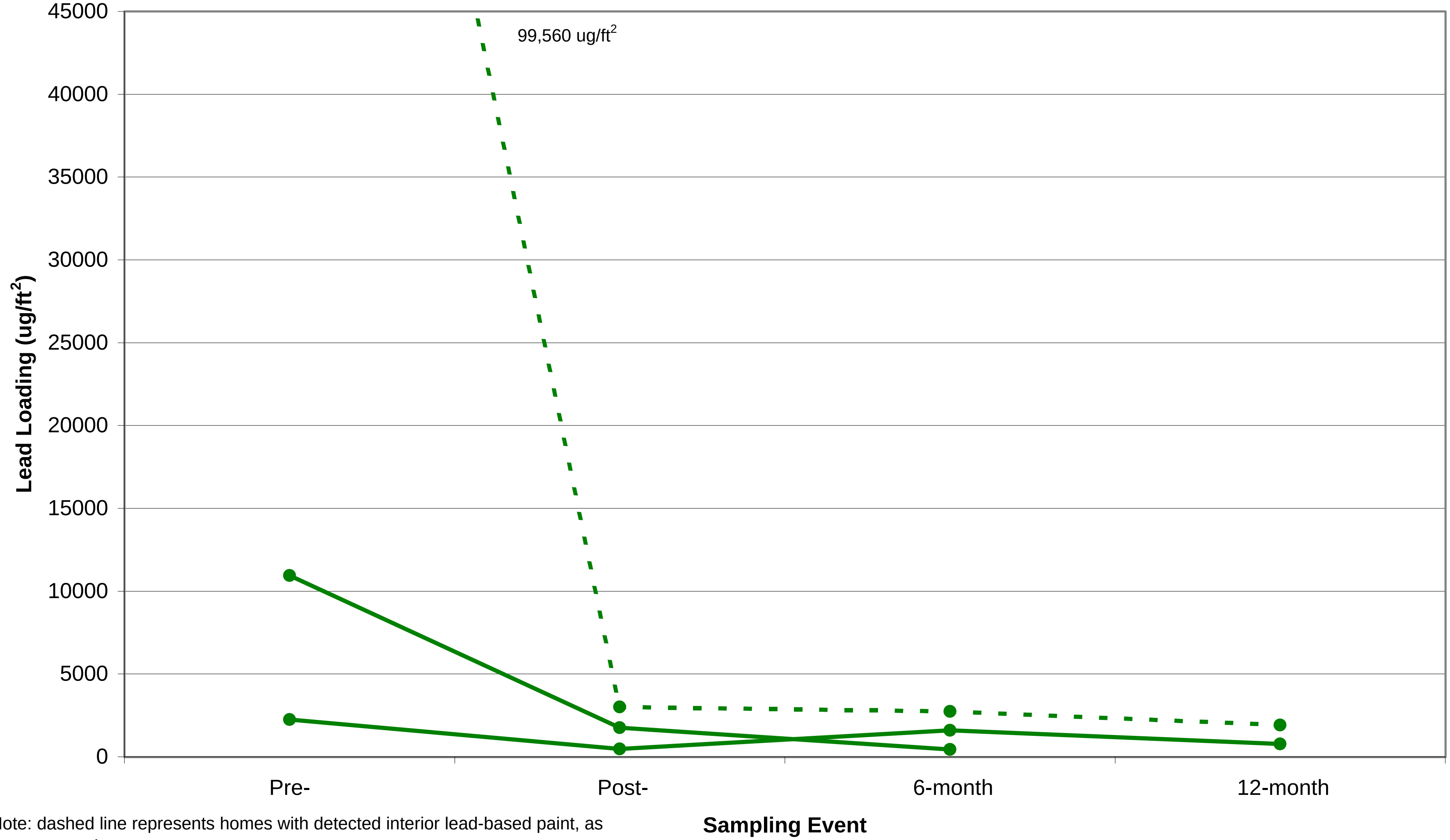
Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-18b-O6. Line Plot of Dust Wipe Lead Loadings for Bedroom Window Sills for the Control Treatment



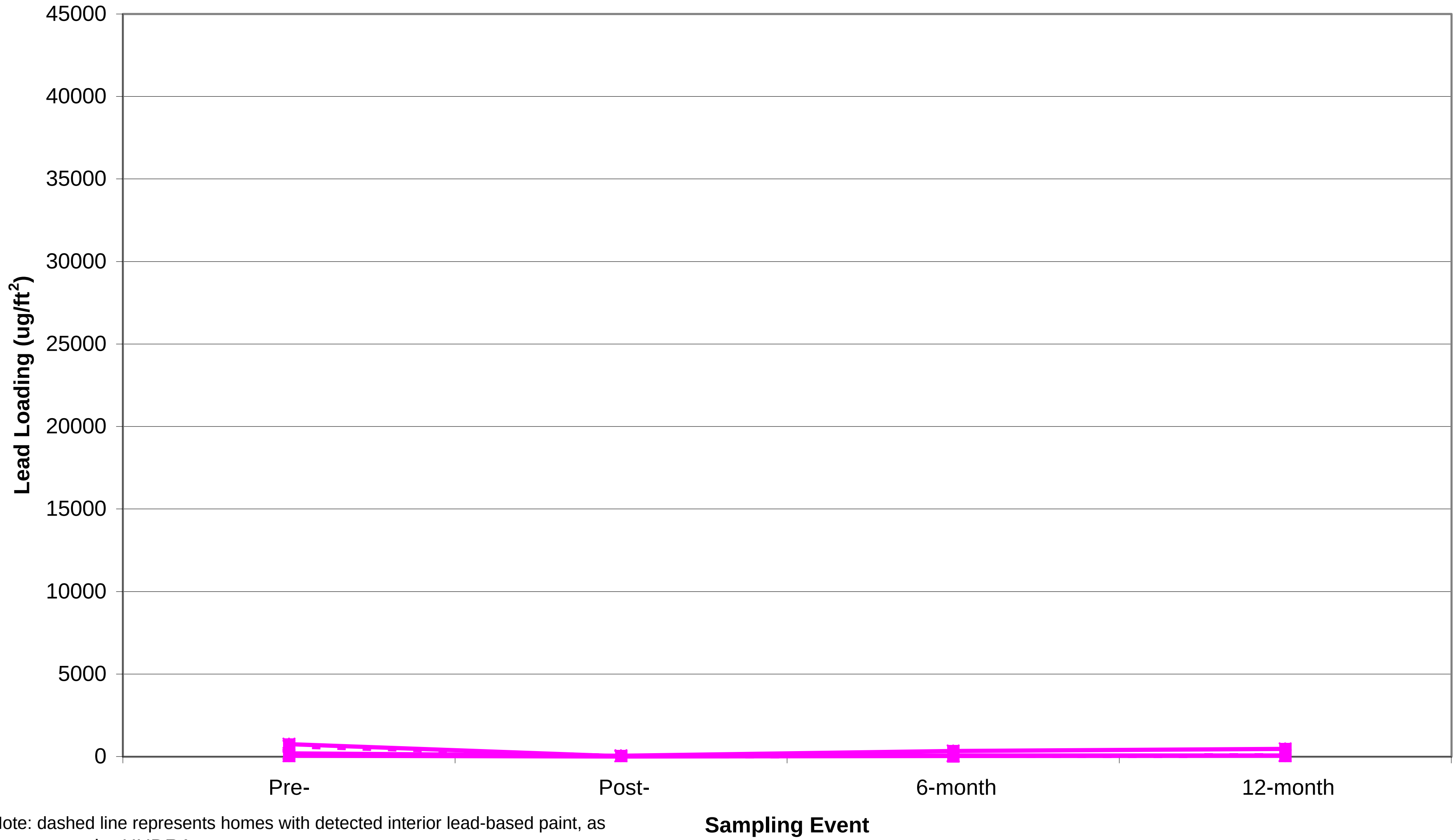
Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-19a-O7. Line Plot of Dust Wipe Lead Loadings for Living Room Window Wells for the HUD Treatment



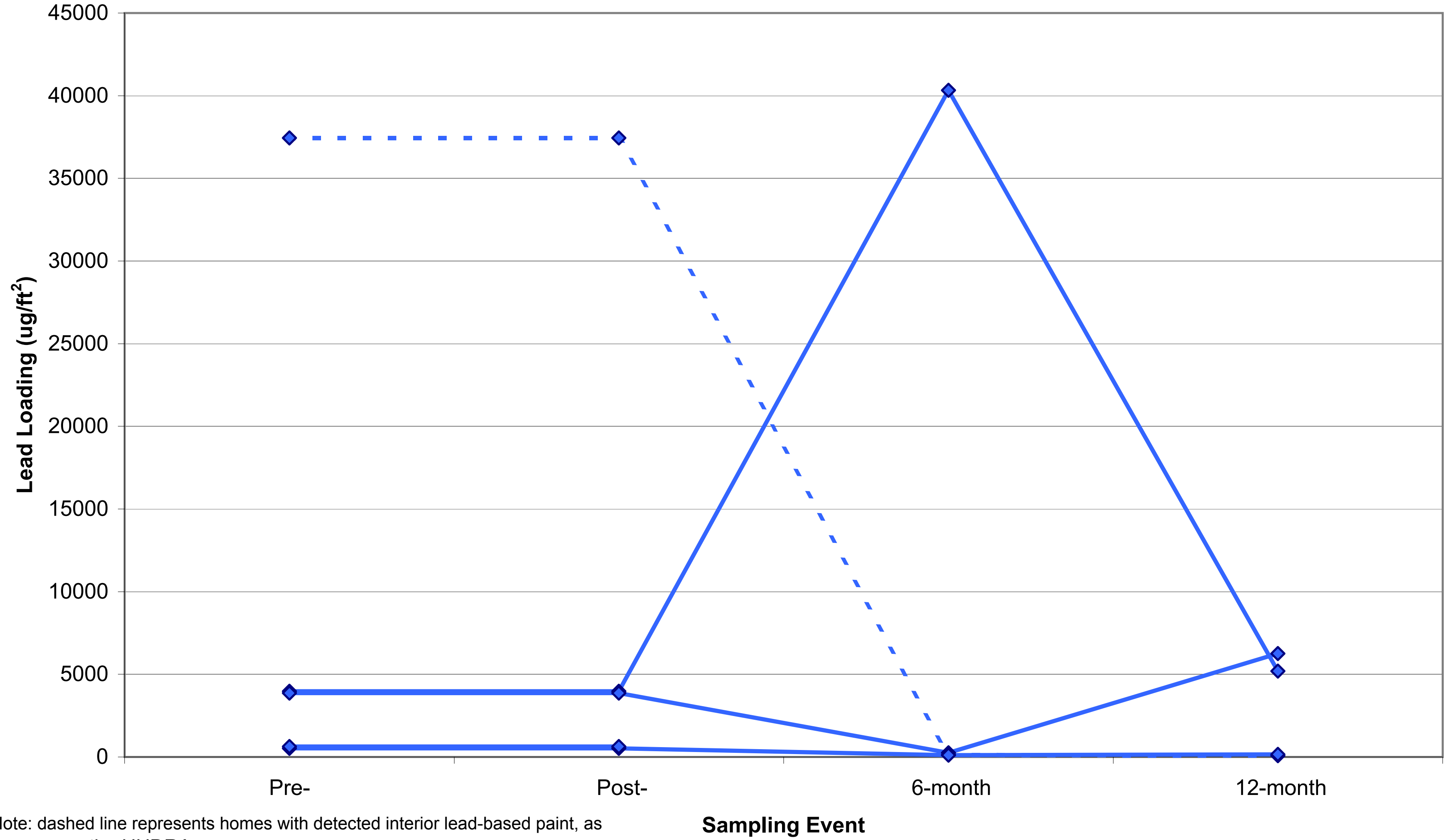
Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-19a-O8. Line Plot of Dust Wipe Lead Loadings for Living Room Window Wells for the Commercial Treatment



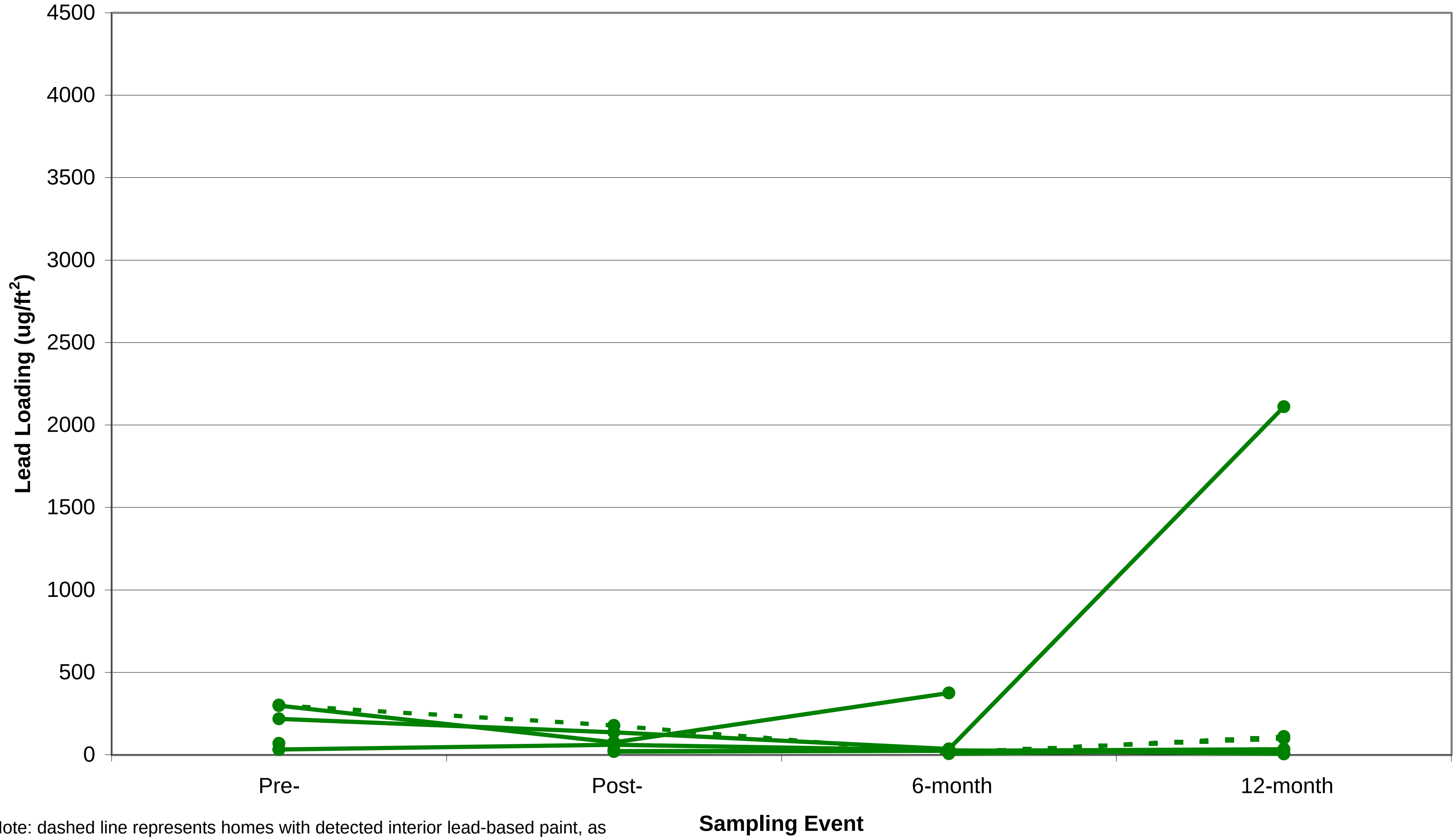
Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-19a-O9. Line Plot of Dust Wipe Lead Loadings for Living Room Window Wells for the Control Treatment



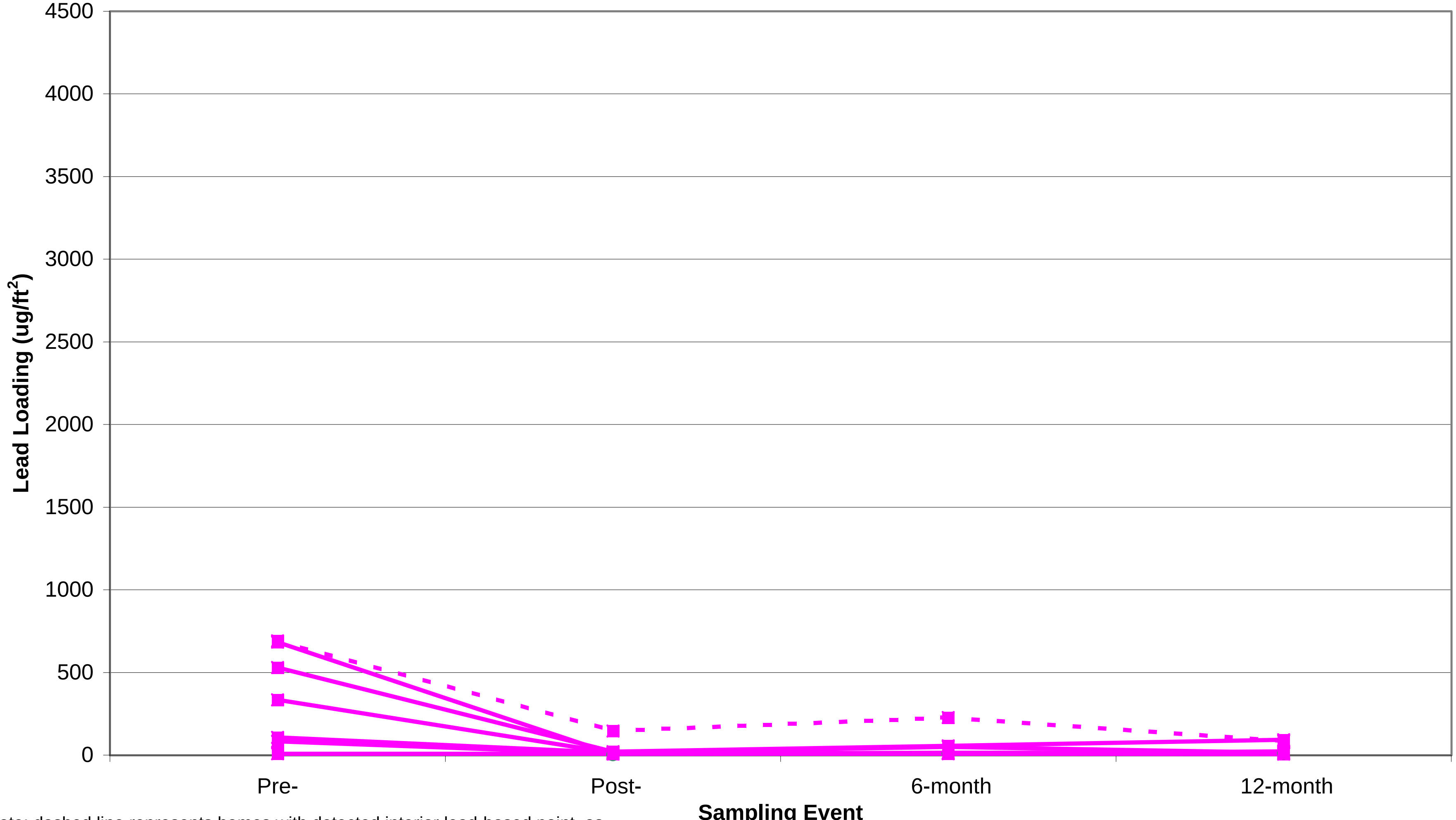
Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-19b-O10. Line Plot of Dust Wipe Lead Loadings for Living Room Window Sills for the HUD Treatment



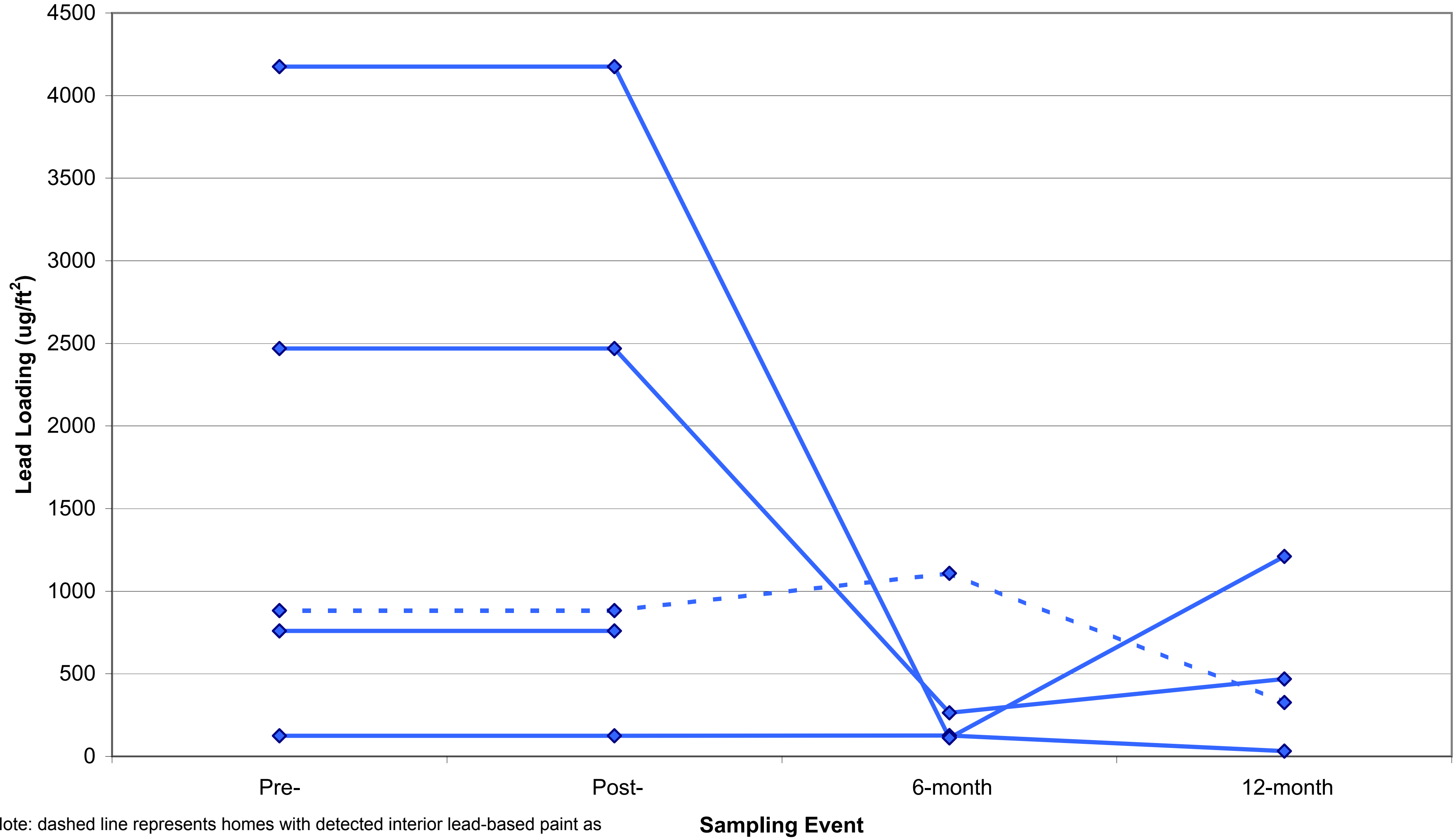
Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-19b-O11. Line Plot of Dust Wipe Lead Loadings for Living Room Window Sills for the Commercial Treatment



Note: dashed line represents homes with detected interior lead-based paint, as identified by the HUDRA

Figure 4-19b-O12. Line Plot of Dust Wipe Lead Loadings for Living Room Window Sills for the Control Treatment



Note: dashed line represents homes with detected interior lead-based paint as identified by the HUDRA

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

February 2, 2001

REPLY TO
ATTENTION OF

MEMORANDUM FOR: The Record

SUBJECT: Interior Air Data Evaluation from the 2000 Smelterville Dust Study.

Background

Interior dust lead concentrations have been monitored annually at the Bunker Hill Superfund Site for more than ten years [TG, 1997]. As part of the Record of Decision (ROD) [EPA, 1992], a Remedial Action Objective (RAO) was set for dust. This documents states that "all homes with house dust lead concentrations equal to or exceeding 1000 ppm will have a one time cleaning of residential interiors after completion of remedial actions that address fugitive dust. If subsequent interior house dust sampling indicates that house dust lead concentrations exceed a site wide average of 500 ppm lead, the need for additional cleaning will be evaluated." Because interior dust lead concentrations are highly correlated with exterior soil lead concentrations, the cleanup at the site has focused upon reducing yard and community soil lead concentrations to the soil RAO, which is "to achieve community mean soil lead concentrations of approximately 350 ppm by removal of soils exceeding the threshold level of 1000 ppm lead" [EPA, 1991]. Housedust lead levels were expected to subsequently fall as the exterior-to-interior path was reduced. Studies monitoring interior dust lead concentrations indicate that this reduction is indeed occurring, but interior cleaning may still be necessary for some homes [TG, 1997, 1999a].

Smelterville is the only community within the site that has been fully remediated, and soil RAOs have been achieved [TG, 1999a]. Interior dust data from the 1998 sampling season indicate that mean dust lead levels for Smelterville are slightly higher than the RAO (604 mg/kg) [TG, 1999b]. It is possible that residual smelter dust has remained in reservoirs within homes, or that another source of lead, such as lead-based paint, is present. A Pilot Cleaning Project was conducted during the summer of 2000.

The Purpose and Objective of the 2000 Dust Study—Pilot Cleaning Project

The primary purpose of the pilot cleaning project was to determine the feasibility of instituting home interior cleaning in order to achieve and maintain a low level of dust in the home (the dust RAO for the site). In many cases, HUD Guidelines for Lead-Based Paint Abatement have been consulted and served as the basis for the procedures used in this project [HUD, 1995, 1997].

Since the lead concentration of interior dust remains approximately in equilibrium with that of the exterior general community and other interior sources, one of the more effective ways to reduce exposure to leaded dusts is to reduce the dust loading, or amount of dust, within the home. When this project is complete, it is expected that certain parameters associated with cleaning effectiveness can be estimated so that a large-scale home interior cleaning project can be scoped.

The following specific objectives are defined for this project:

- To determine the cost and effort (hours, techniques) required to remove dust from residential interiors.
- To identify other sources of lead exposure in homes that could be amenable to cleaning.

Twelve homes were cleaned, six were cleaned by a certified HUD lead-based paint contractor (Treatment Group A) and six were cleaned by a commercial cleaning company (Treatment Group B). The purpose of utilizing two cleaning contractors is to generate information on cost versus effectiveness should large scale cleaning be warranted. Additionally, three control homes (Treatment Group C) were monitored for effectiveness comparisons.

Interior Air Quality During Cleaning

There were concerns that during cleaning contaminated dust levels in the air could become unsafe for workers. Air quality was continuously monitored in a majority of the homes during furniture removal, cleaning, and any construction/remodeling operations. The air quality was monitored using several MIE DataRAMs, which continuously monitored total suspended particulates (TSP) in the air. The monitors were collocated in the same area of the heaviest activity.

Dust levels, also know as TSP, are detailed in table 1.

	(mg/m^3)
Mean	0.027646
Standard Error	0.000677
Median	0.012
Mode	0
Standard Deviation	0.052722
Sample Variance	0.00278
Range	1.801
Minimum	0
Maximum	1.801
Sum	167.45
Count	6057

Table 1: Dust Level Analysis

Anecdotal notes taken during the cleaning indicate the highest concentrations were detected during carpet removal.

Analytical Results

As part of the assessment process, baseline data was gathered on dust loadings and lead concentrations within the study homes. The purpose of sampling was to obtain baseline data on the general dustiness and lead concentrations of each home. The same sampling protocols were followed immediately after cleaning, and will be tested again at 6 and 12 months to gauge the effectiveness of the cleaning procedures, the goal of which is to reduce dust loads in the home. This sampling structure is designed to quantify recontamination, which will inevitably occur after cleaning as the home returns to equilibrium with its environment. All fifteen project homes will be sampled with the exception of short-term effectiveness sampling for the three control homes.

Initial pre-cleaning data are detailed in table 2 and 3. Table 2 gives statistical details of the analytical results for samples taken from test homes cleaned by HUD criteria. Table 3 gives statistical details of the analytical results for samples taken from test homes cleaned by Commercial criteria.

HUD TREATMENT			
BRM (Lead - mg/kg)			
	Bedrooom	Kitchen	Living Rm
N	6	5	6
Min	136	10**	116
Max	1500	1580	1370
Mean	582.8	707.4	673.0
Stdev	496.3	738.3	489.0
Median	470	320	678
Geomean	432.2	269.6	486.8

Table 2: HUD Pre-Cleaning Sampling Data

COMMERCIAL TREATMENT			
BRM (Lead - mg/kg)			
	Bedrooom	Kitchen	Living Rm
N	6	5	6
Min	126	340	194
Max	2500	918	572
Mean	879.0	488.0	408.7
Stdev	911.3	242.7	136.5
Median	458.5	397.0	413.5
Geomean	552.2	452.4	386.1

Table 3: Commercial Pre-Cleaning Sampling Data

Conclusions

The Occupational Safety and Health Administration (OSHA) and National Institute for Occupational Safety and Health (NIOSH) acceptable exposure limits for lead via inhalation are $0.050 mg/m^3$ and $0.100 mg/m^3$, respectively. Based on the highest dust level and lead concentration, the worse case lead concentration in the air would be $0.0045 mg/m^3$, one-tenth the acceptable limit.

The OSHA exposure limits for particulates via inhalation are $15 mg/m^3$ (total) and $5 mg/m^3$ (resp). Neither of these limits were exceeded during the study.

The activity with the greatest potential to generate dust was carpet removal. Workers wet down the carpet prior to and during removal, thus assuring dust levels were minimized. Future house interior remediation should assume this wetting down is needed to assure lead exposures are avoided. No other special precautions appear to be necessary.

David S. Rees

David S. Rees
Environmental Scientist

MEMORANDUM

To: Scott Peterson, IDEQ - Kellogg
Rob Hanson, IDEQ - Boise

From: Susan Spalinger, TG - Moscow

Date: August 31, 2000

Subject: Carpet Samples for TCLP Analysis for the House Dust Pilot Project

Introduction

The main purpose of the House Dust Pilot Project is to determine if house dust lead concentrations will be reduced after a house has been cleaned. Six houses participating in this project will be cleaned by HUD certified cleaners. These houses will have the carpet and upholstered furniture removed and replaced. Sampling the carpet for TCLP analysis for lead has been proposed for these six houses.

In the summer of 1999, a property undergoing renovation was sampled by TCLP analysis for lead to characterize waste that may enter the ICP Landfill Site. Pieces of the carpet from this property were collected and resulted in an exceedance of the 5.0 mg/l standard. The House Dust Pilot Project provides another opportunity to characterize carpets in the Bunker Hill Superfund Site.

Protocol

The laboratory (Northern Analytical) will need approximately 250 grams of carpet and underlayment and will grind the sample to less than quarter inch pieces for TCLP analysis for lead. In order for the results to be useful, the carpet pieces must be representative of the carpeting in the entire house. The protocol for collecting the carpet and underlayment is to slice a 6 inch by 6 inch square from the middle of each carpeted room inside the house.

The middle of the room is chosen as the sampling location, and assumed to be representative of the carpeting in the room, as it may not be the most used (such as the entryway to the room) but it may also not be the least used (such as the carpet under a couch or bed). A piece of carpet in every room will be collected because in many cases different rooms contain carpet of varying types and ages (i.e., the bedroom carpet is shag and 25 years old versus the living room carpet that is berber and 5 years old). Therefore, the carpet pieces from each of the carpeted rooms in the house will be composited into one representative carpet sample from each of the 6 houses receiving new carpeting in the Dust Pilot Project.

The summer 1999 renovation project where the carpet sample exceeded the TCLP standard for lead did not have a written protocol because the decision to sample was made after renovation had begun. Therefore, this protocol may not be the same as was followed for prior carpet TCLP sampling. However, this protocol is meant to provide a representative sample of interior carpeting that would enter a landfill.

If you have any questions or comments, please feel free to call at (208) 882-7858.

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INTERNAL MEMORANDUM

To: Andrea Brooks, TerraGraphics, Moscow

From: Lisa Hall, TerraGraphics, Moscow

Date: April 23, 2001

Subject: TCLP Analysis on Interior Carpet Samples and other Household Materials

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Introduction

The State of Idaho, through TerraGraphics, has completed two separate sampling efforts to determine heavy metal Toxic Characteristic Leaching Procedure (TCLP) properties of household materials. The two sampling events took place in May 1999 and October 2000, and had different outcomes. The purpose of TCLP sampling is to provide data for waste management protocols that affect disposal at the ICP Landfill.

May 1999 Sampling

Building materials such as sheetrock, wood, insulation, concrete, stone, brick, asphalt siding, and carpet were collected from two houses in Kellogg in May 1999. One of these houses was being demolished, and the other was being remodeled. Samples were submitted to Maxim Laboratory in Billings, Montana. TCLP analysis was performed for arsenic, antimony, cadmium, copper, lead, mercury, and zinc in accordance with SW-846 methods.

The two samples from the demolished house consisted of concrete, stone, brick, attic insulation, exterior wood from the garage and house, basement sheetrock, and asphalt siding. Both samples were below detection for most analytes, and were within regulatory limits. See Table 1 for a summary of lead results.

The two samples from the remodeled house consisted of insulation, exterior painted wood, and small amounts of interior and exterior carpet. One sample had a lead concentration of 17.6 mg/l (regulatory action level for lead is 5.0 mg/l) and was within acceptable limits for all other analytes (Table 1). To determine the source of the lead, the building materials were then re-sampled individually. These included exterior painted wood, basement, ceiling, and wall insulation, and interior carpet. Re-analysis showed the wall and ceiling insulation and exterior painted wood to be below detection for lead. The basement insulation leached 0.3 mg/l lead, and the interior carpet leached 115 mg/l lead (TerraGraphics 1999).

October 2000 Sampling

In light of these results, the House Dust Pilot Project provided an excellent opportunity for a second sampling event. Six houses in Smelterville were scheduled to have the interior carpet removed and replaced. Before the carpet was removed, TerraGraphics collected a 12" x 12" sample of the carpet and padding from each carpeted room in the houses. These samples were then cut down to 6" x 6" squares and the subsamples from each room were combined to create one sample from each house. This sampling method slightly differs from the original methods memorandum (TerraGraphics 2000). The change allowed for extra carpet to be archived for possible future use. The carpet samples were submitted to Northern Analytical Laboratory in Billings, Montana (formerly Maxim) for TCLP analysis. Samples were analyzed using SW-846 methods (6010B, 3010A, and 1311). All six samples were determined to be below detection for lead (Table 1). The lab data sheet is attached as Appendix A.

Table 1 TCLP Analysis Results

Sample ID	Sample Date	Lead (mg/l)	Regulatory Action Level (mg/l)
ICPGH1B	May 1999	0.4	5.0
ICPGH2B	May 1999	0.5	5.0
ICPMF1B	May 1999	17.6	5.0
ICPMF2B	May 1999	1.6	5.0
carpet from ICPMF1B	May 1999	115	5.0
00HP140	October 2000	<0.2	5.0
00HP141	October 2000	<0.2	5.0
00HP142	October 2000	<0.2	5.0
00HP143	October 2000	<0.2	5.0
00HP144	October 2000	<0.2	5.0
00HP145	October 2000	<0.2	5.0

Conclusion

The results from the Dust Pilot sampling appear to contradict those found in May 1999. One of the differences between the two events are that the carpets sampled during October 2000 were from houses in Smelterville, while those sampled in May 1999 were from Kellogg. Currently, it appears that the TCLP properties of interior carpet at the Bunker Hill Superfund Site are poorly understood and further research is warranted for decisions regarding waste management.

References Cited

TerraGraphics Environmental Engineering, Inc. 1999. Memorandum - Summary of ICP Landfill Inventory and Analysis. August 2, 1999.

TerraGraphics Environmental Engineering, Inc. 2000 Memorandum - Carpet Samples for TCLP Analysis for the House Dust Pilot Project. August 31, 2000.

Appendix A
Laboratory Data Sheets

order_number	sample_number	sample_description	date_collected	parameter	analytical_value	units	date_of_analysis	method_code
2000100292	1	00HP140	9/22/2000	Extraction Date-TCLP	-----	-----	11/7/2000 0:00	1311
2000100292	1	00HP140	9/22/2000	ICP/AA Digestion Date	-----	-----	12/14/2000 0:00	3010A
2000100292	1	00HP140	9/22/2000	Lead as Pb	<0.2	mg/l	12/19/2000 0:00	6010B
2000100292	2	00HP141	9/22/2000	Extraction Date-TCLP	-----	-----	11/7/2000 0:00	1311
2000100292	2	00HP141	9/22/2000	ICP/AA Digestion Date	-----	-----	12/14/2000	3010A
2000100292	2	00HP141	9/22/2000	Lead as Pb	<0.2	mg/l	12/19/2000	6010B
2000100292	3	00HP142	9/22/2000	Extraction Date-TCLP	-----	-----	11/7/2000	1311
2000100292	3	00HP142	9/22/2000	ICP/AA Digestion Date	-----	-----	12/14/2000	3010A
2000100292	3	00HP142	9/22/2000	Lead as Pb	<0.2	mg/l	12/19/2000	6010B
2000100292	4	00HP143	9/22/2000	Extraction Date-TCLP	-----	-----	11/7/2000	1311
2000100292	4	00HP143	9/22/2000	ICP/AA Digestion Date	-----	-----	12/14/2000	3010A
2000100292	4	00HP143	9/22/2000	Lead as Pb	<0.2	mg/l	12/19/2000	6010B
2000100292	5	00HP144	9/22/2000	Extraction Date-TCLP	-----	-----	11/7/2000	1311
2000100292	5	00HP144	9/22/2000	ICP/AA Digestion Date	-----	-----	12/14/2000	3010A
2000100292	5	00HP144	9/22/2000	Lead as Pb	<0.2	mg/l	12/19/2000	6010B
2000100292	6	00HP145	9/22/2000	Extraction Date-TCLP	-----	-----	11/7/2000	1311
2000100292	6	00HP145	9/22/2000	ICP/AA Digestion Date	-----	-----	12/14/2000	3010A
2000100292	6	00HP145	9/22/2000	Lead as Pb	<0.2	mg/l	12/19/2000	6010B
2000100292	7	PREPARATION BLANK	1/2/1900	Extraction Date-TCLP	-----	-----	11/7/2000	1311
2000100292	7	PREPARATION BLANK	1/2/1900	ICP/AA Digestion Date	-----	-----	12/14/2000	3010A
2000100292	7	PREPARATION BLANK	1/2/1900	Lead as Pb	<0.2	mg/l	12/19/2000	6010B
2000100292	8	AQUEOUS LAB CONTROL SAMPLE	1/2/1900	Extraction Date-TCLP	NA	-----	1/2/1900	-----
2000100292	8	AQUEOUS LAB CONTROL SAMPLE	1/2/1900	ICP/AA Digestion Date	-----	-----	12/14/2000	3010A
2000100292	8	AQUEOUS LAB CONTROL SAMPLE	1/2/1900	Lead as Pb	99	% [81-117]	12/19/2000	6010B
2000100292	9	MATRIX SPIKE OF 100292-1	1/2/1900	Extraction Date-TCLP	-----	-----	11/7/2000	1311
2000100292	9	MATRIX SPIKE OF 100292-1	1/2/1900	ICP/AA Digestion Date	-----	-----	12/14/2000	3010A
2000100292	9	MATRIX SPIKE OF 100292-1	1/2/1900	Lead as Pb	82	%	12/19/2000	6010B

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INTERNAL MEMORANDUM

To: Susan Spalinger, TerraGraphics, Moscow

From: Lisa Hall, TerraGraphics, Moscow

Date: November 20, 2001

Subject: QA/QC Review for the House Dust Pilot Project Twelve-Month Sampling Event

Introduction

The following memorandum provides a summary of the quality assurance/quality control (QA/QC) review for the House Dust Pilot Twelve-Month Sampling Event using guidelines set forth in *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (USEPA 1994) and *Guidance on Environmental Data Verification and Data Validation: EPA QA/G-8* (USEPA 2001). Twenty houses in Smelterville were sampled using three distinct sample collection methods. Vacuum dust, Baltimore Repair and Maintenance (BRM) sampler dust, and dust mats were collected; however, the vacuum and BRM dust are the focus of this memorandum as the mats are included in another QA/QC memorandum. All vacuum and BRM samples were submitted to Northern Analytical Laboratories, Inc. for analysis.

General

A QA/QC review was completed to evaluate the precision, accuracy, completeness, and representativeness of the data obtained from both the field and the laboratory. Definitions and QC objectives for these parameters are described in the *FINAL Field Work Plan for the House Dust Pilot Project Interior Dust Sampling* (TerraGraphics 2000a) and the *Final Interior House Dust Pilot Cleaning Work Plan* (TerraGraphics 2000b). Procedures for sample labeling, handling, and analysis were as described in the Work Plans. All laboratory data and master logs were entered into Access database files. Forms were checked and reviewed to ensure that samples were labeled and tracked correctly, including chain of custody and master log forms. All sample holding times were met.

Field Sampling QA/QC Results

A total of 89 samples (including QA/QC) were collected from 20 Smelterville homes during this event (Table 1). Field QA/QC samples consisted of eight field duplicates and six rinsate blanks.

Four National Institute of Standards and Technology (NIST) standards were also included in the sample train. All samples were banked and recorded on a master log, and chain of custody forms were completed and checked before samples were shipped to the lab. All dust samples were sieved to -80 mesh at the labs prior to analysis.

Duplicates

A total of four duplicates were collected in the field and submitted to the laboratory for analysis. Duplicate samples were used to examine variability in the field and in laboratory procedures. The BRM field duplicates were sampled in the same manner as the original, placing the template next to the location of the original.

Results for the four duplicate analyses are presented in Table 2. The average relative percent difference (RPD) was 38.0% for the BRM dust duplicates (which ranged between 3.4 and 88.7). The relatively high RPD from one of the BRM sample pairs likely indicates high field variability. There is no required review criteria for field duplicates, therefore no samples were qualified as estimates based on the duplicate results.

Rinsate Blanks

Rinsate blanks were collected to ensure decontamination procedures were effective, and that cross-contamination was not significant during field sampling. Rinsate blanks consisted of commercially available distilled water poured over a representative batch of decontaminated sampling equipment. Rinsate blanks were collected into 500 ml plastic bottles and preserved with nitric acid. The bottles were supplied by Northern Analytical and were delivered to Northern Analytical for analysis.

Six rinsate blanks were collected during the sampling event. Rinsate blank results are presented in Table 3. Four of the rinsate blanks were below detection for lead, while two had concentrations of 0.008 mg/l lead. No qualifiers were placed on the data based on rinsate blank results because the lowest result reported was greater than 10 times the level detected in the rinsate blanks.

Laboratory Analysis

A total of 75 samples (excluding QA/QC samples) were collected from Smelterville homes during the project. Laboratory QA/QC was checked externally by the use of duplicate samples in the field and by submitting soil standards blind to the laboratory for lead analysis. One field duplicate was collected and one standard was submitted for every batch of samples (approximately 20) submitted to the lab. Northern Analytical provided a copy of their internal QA/QC results for laboratory preparation blanks, aqueous and soil laboratory control samples (LCS), and matrix spike/matrix spike duplicates (MS/MSD).

External QA/QC

Standards

Standards were used to evaluate the accuracy of the labs. Non-mat standard results are presented in Table 4. Four dust standards were submitted blind; one standard was included in every batch of samples submitted to the lab. The standards were sent with BRM and vacuum samples. The average percent recovery for the non-mat standards was 99.5%. No sample results were qualified based on non-mat standard results.

Internal QA/QC

One laboratory preparation blank was inserted per batch of samples to ensure no bias was introduced during sample preparation. Prep blank results are displayed in Tables 5. All prep blanks were below the instrument detection limit for lead. No qualifiers were placed on the data based on the prep blank results.

Internal checks of the labs' accuracy were assessed by analyzing laboratory control samples (LCS). Results for aqueous LCS are presented in Table 6 and results for soil LCS are presented in Table 7. An aqueous and soil LCS was analyzed for each batch. All LCS samples were within the acceptable percent recovery ranges specified by Northern Analytical. No qualifiers were placed on the data based on the LCS results.

Internal checks of laboratory precision were assessed using matrix spike/matrix spike duplicate (MS/MSD) analysis on one sample from each sample batch. Table 8 contain the MS/MSD analysis results. RPDs ranged from 0% to 6%, with an average of 3.65%. All spike percent recoveries were within the acceptable range specified by Northern Analytical, thus no qualifiers were placed on the data based on the laboratory MS/MSD results.

Conclusions

A check of field decontamination procedures was assessed using rinsate blanks. No significant concentrations of lead were found in the rinsate blanks. No qualifiers were placed on the data based on rinsate blank results.

Field duplicates were analyzed to assess field and laboratory variability. The BRM dust duplicate percent recovery indicated high field variability. No qualifiers were placed on the data based on duplicate results.

An external check of laboratory accuracy was assessed using NIST soil standards. All percent recoveries were within the acceptable range and no qualifiers were placed on the data based on BRM and vacuum dust standards results.

An internal check laboratory accuracy was assessed using LCS. All LCS results were within acceptable limits. Laboratory precision was assessed using MS/MSD analyses. All MS/MSDs displayed acceptable RPD values. Lead concentrations in all laboratory prep blanks were below instrument detection limits.

Based on a complete review of the rinsate blanks, field duplicates, standards, prep blanks, LCS, and MS/MSD analyses, the final completeness for the study was assessed at 100%.

References Cited

TerraGraphics Environmental Engineering, Inc. 2000a. *Final Field Work Plan for the House Dust Pilot Project Interior Dust Sampling.* August 2000.

TerraGraphics Environmental Engineering, Inc. 2000b. *Final Interior House Dust Pilot Cleaning Work Plan.* August 2000.

U.S. Environmental Protection Agency (USEPA). 2001. *Guidance on Environmental Data Verification and Data Validation: EPA QA/G-8 Peer Review Draft*. June 2001.

______. 1994. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*.

Table 1 House Dust Pilot Data

Sample ID	Field ID	Sample Type	Lead Concentration	units
00HP327	HP-D-12-OTH	BRM	930	mg/kg
00HP328	HP-D-12-F-L	BRM	1940	mg/kg
00HP329	HP-D-12-F-K	BRM	360	mg/kg
00HP330	HP-D-12-F-C	BRM	1160	mg/kg
00HP332	HP-D-05-F-C	BRM	450	mg/kg
00HP333	HP-D-05-F-K	BRM	210	mg/kg
00HP334	HP-D-05-F-L	BRM	260	mg/kg
00HP335	HP-D-03-F-L	BRM	560	mg/kg
00HP336	HP-D-03-F-K	BRM	NA	---
00HP337	HP-D-03-F-C	BRM	420	mg/kg
00HP338	HP-D-09-F-L	BRM	670	mg/kg
00HP339	HP-D-09-F-C	BRM	930	mg/kg
00HP340	HP-D-09-F-K	BRM	NA	---
00HP341	HP-D-07-F-C	BRM	1830	mg/kg
00HP342	HP-D-07-F-L	BRM	610	mg/kg
00HP343	HP-D-07-F-K	BRM	880	mg/kg
00HP344	HP-D-21-F-L	BRM	1260	mg/kg
00HP345	HP-D-21-F-K	BRM	1040	mg/kg
00HP347	HP-D-21-F-C	BRM	1100	mg/kg
00HP348	HP-D-06-F-L	BRM	700	mg/kg
00HP350	HP-D-06-F-K	BRM	NA	---
00HP351	HP-D-01-F-K	BRM	NA	---
00HP352	HP-D-01-F-L	BRM	480	mg/kg
00HP353	HP-D-01-F-C	BRM	400	mg/kg
00HP354	HP-D-02-F-K	BRM	NA	---
00HP355	HP-D-02-F-L	BRM	490	mg/kg
00HP356	HP-D-02-F-C	BRM	280	mg/kg
00HP357	HP-D-02-OTH	BRM	350	mg/kg
00HP358	HP-D-23-F-L	BRM	460	mg/kg
00HP359	HP-D-23-F-K	BRM	NA	---
00HP360	HP-D-23-F-C	BRM	240	mg/kg
00HP361	HP-D-24-F-C	BRM	270	mg/kg
00HP362	HP-D-24-F-L	BRM	180	mg/kg
00HP363	HP-D-24-F-K	BRM	170	mg/kg
00HP364	HP-D-19-F-K	BRM	NA	---
00HP365	HP-D-19-F-C	BRM	1880	mg/kg
00HP367	HP-D-19-F-L	BRM	420	mg/kg
00HP368	HP-D-04-F-K	BRM	540	mg/kg
00HP369	HP-D-22-F-C	BRM	1630	mg/kg
00HP371	HP-D-04-F-L	BRM	500	mg/kg
00HP372	HP-D-22-F-K	BRM	NA	---
00HP373	HP-D-22-F-L	BRM	1100	mg/kg
00HP374	HP-D-04-F-C	BRM	1350	mg/kg
00HP375	HP-D-14-F-L	BRM	130	mg/kg
00HP376	HP-D-14-F-C	BRM	170	mg/kg
00HP377	HP-D-14-F-K	BRM	NA	---

NA= insufficient sample volume for laboratory analysis

Table 1 House Dust Pilot Data (continued)

Sample ID	Field ID	Sample Type	Lead Concentration	units
00HP378	HP-D-20-F-L	BRM	690	mg/kg
00HP379	HP-D-20-F-C	BRM	NA	---
00HP380	HP-D-20-F-K	BRM	NA	---
00HP381	HP-D-17-F-K	BRM	690	mg/kg
00HP382	HP-D-17-F-L	BRM	1470	mg/kg
00HP383	HP-D-17-F-C	BRM	1270	mg/kg
00HP384	HP-D-08-F-C	BRM	910	mg/kg
00HP385	HP-D-08-F-K	BRM	260	mg/kg
00HP387	HP-D-08-F-L	BRM	310	mg/kg
00HP389	HP-D-15-F-L	BRM	390	mg/kg
00HP390	HP-D-15-F-K	BRM	170	mg/kg
00HP391	HP-D-15-OTH	BRM	280	mg/kg
00HP392	HP-D-15-F-C	BRM	440	mg/kg
00HP393	HP-D-11-F-C	BRM	330	mg/kg
00HP394	HP-D-11-F-K	BRM	180	mg/kg
00HP395	HP-D-11-F-L	BRM	540	mg/kg
00HP396	HP-D-14-V	Vacuum	440	mg/kg
00HP397	HP-D-22-V	Vacuum	630	mg/kg
00HP398	HP-D-23-V	Vacuum	400	mg/kg
00HP399	HP-D-20-V	Vacuum	1070	mg/kg
00HP400	HP-D-09-V	Vacuum	1030	mg/kg
00HP401	HP-D-01-V	Vacuum	450	mg/kg
00HP402	HP-D-12-V	Vacuum	430	mg/kg
00HP403	HP-D-02-V	Vacuum	410	mg/kg
00HP404	HP-D-15-V	Vacuum	400	mg/kg
00HP405	HP-D-17-V	Vacuum	1010	mg/kg
00HP407	HP-D-08-V	Vacuum	330	mg/kg
00HP408	HP-D-24-V	Vacuum	180	mg/kg
00HP409	HP-D-11-V	Vacuum	560	mg/kg

NA= insufficient sample volume for laboratory analysis

Table 2 - Field Duplicates

Type	Original sample ID	Duplicate sample ID	Analyte	Original Concentration	Duplicate Concentration	RPD
BRM						
	00HP330	00HP331	Lead	1160	1200	3.4
	00HP348	00HP349	Lead	700	270	88.7
	00HP373	00HP370	Lead	1100	780	34.0
	00HP385	00HP388	Lead	260	200	26.1
					Average	*38.0*

RPD = ABS(X1-X2)/((X1+X2)/2)

X1 = ORIGINAL SAMPLE

X2 = DUPLICATE SAMPLE

<: Concentration below instrument detection limit.

Table 3- Rinsate Blanks

Lab ID	Sample ID	Lead Concentration	Units
00HP410	HP-RB-001	0.008	mg/l
00HP411	HP-RB-002	<0.003	mg/l
00HP412	HP-RB-003	0.008	mg/l
00HP413	HP-RB-004	<0.003	mg/l
00HP414	HP-RB-005	<0.003	mg/l
00HP415	HP-RB-006	<0.003	mg/l

<: Concentration below instrument detection limit.

Table 4 - Non-mat Standards

Sample ID	Analyte	Units	Measured Value	True Value	Percent Recovery
00HP346	Lead	mg/kg	470	432	108.8%
00HP366	Lead	mg/kg	440	432	101.9%
00HP386	Lead	mg/kg	430	432	99.5%
00HP406	Lead	mg/kg	420	432	97.2%
				Average	*99.5%*

Table 5- Laboratory Prep Blanks

LabID	Units	Lead Concentration
2001100122-21	mg/L	<0.1
2001100123-21	mg/L	<0.1
2001100164-21	mg/L	<0.1
2001100165-16	mg/L	<0.1
2001100166-9	mg/L	<0.1
2001100151-7	mg/L	<0.003

<: Concentration below instrument detection limit.

Table 6 Aqueous Laboratory Control Samples

Lab ID	Analyte	Units	Measured Value	True Value	Percent Recovery	Allowable Range
2001100122-22	Lead	mg/L	5.3	5.0	106%	80-120%
2001100123-22	Lead	mg/L	5.49	5.0	110%	80-120%
2001100164-22	Lead	mg/L	5.53	5.0	111%	80-120%
2001100165-17	Lead	mg/L	5.3	5.0	106%	80-120%
2001100166-10	Lead	mg/L	5.0	5.0	100%	80-120%
2001100151-8	Lead	mg/L	0.518	0.5	104%	80-120%
				Average	106%	

Table 7 Soil Laboratory Control Samples

Lab ID	Analyte	Units	Measured Value	True Value	Percent Recovery	Allowable Range
2001100122-23	Lead	mg/kg	1005	959	105%	74-126%
2001100123-23	Lead	mg/kg	1115	959	116%	74-126%
2001100164-23	Lead	mg/kg	1096	959	114%	74-126%
2001100165-18	Lead	mg/kg	1040	959	108%	74-126%
2001100166-11	Lead	mg/kg	993	959	104%	74-126%
				Average	109%	

Table 8 Laboratory Matrix Spike/Matrix Spike Duplicates

MS Lab ID	MSD Lab ID	Analyte	Units	MS Concentration	MSD Concentration	RPD %
2001100122-24	2001100122-25	Lead	mg/kg	1220	1220	0
2001100123-24	2001100123-25	Lead	mg/kg	1150	1220	6
2001100164-24	2001100164-25	Lead	mg/kg	870	920	6
2001100165-19	2001100165-20	Lead	mg/kg	508	498	2
2001100166-12	2001100166-13	Lead	mg/kg	508	542	6
2001100151-9	2001100151-10	Lead	mg/kg	513	503	2
					Average	3.65

LABORATORY DATA SHEETS

NORTHERN
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NOV 01 2001

REPORT TO: IDAHO DEPT OF HEALTH AND WELFARE
DIVISON OF ENVIRONMENTAL QUALITY
1005 W McKINLEY
KELLOGG ID 83837-2506

DATE: October 24, 2001
JOB NUMBER: 97-935-6
PAGE: 1 of 5
INVOICE NO.: 100122

REPORT OF: House Dust Analysis – Dust Pilot - 2001-2113

CASE NARRATIVE:

On October 11, 2001, these house dust samples (laboratory numbers 2001100122-1 through 20) were received in our laboratory for analysis. Tests were conducted in accordance with USEPA Contract Laboratory Program, *"Statement of Work for Inorganic Analysis"* IML04.0 and SW-846 *"Test Methods for Evaluating Solid Waste"*, 3rd Edition, updates I, II, IIA, IIB, III. The samples were sieved to obtain the –80 mesh material. The –80 fraction was acid digested on 10/17/01 by Method CLPB-1.

The condition of the samples upon receipt at the laboratory is noted on the attached sample receipt checklist. Chain of custody documentation is enclosed.

The results of the analysis are shown on the following pages.

A < sign indicates the value reported was the practical quantitation limit for this sample using the method described. Concentrations of analyte, if present, below this were not quantifiable.

Footnote:
(1) The sample was not analyzed due to insufficient sample volume.

Reviewed by [signature]
Denise Jensen - Quality Assurance Coordinator

Attachments: Chain of Custody
Sample Receipt Checklist

cai

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/11/2001
Matrix: DUST
Order No.: 2001100122

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
Lead Dry Basis							
1	00HP327	10/01/2001	930	mg/kg	6020	20.00	10/22/2001
2	00HP328	10/01/2001	1940	mg/kg	6020	20.00	10/22/2001
3	00HP329	10/01/2001	360	mg/kg	6020	20.00	10/22/2001
4	00HP330	10/01/2001	1160	mg/kg	6020	20.00	10/22/2001
5	00HP331	10/01/2001	1200	mg/kg	6020	20.00	10/22/2001
6	00HP332	10/01/2001	450	mg/kg	6020	20.00	10/22/2001
7	00HP333	10/01/2001	210	mg/kg	6020	20.00	10/22/2001
8	00HP334	10/01/2001	260	mg/kg	6020	20.00	10/22/2001
9	00HP335	10/01/2001	560	mg/kg	6020	20.00	10/22/2001

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/11/2001
Matrix: DUST
Order No.: 2001100122

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
10	00HP336	10/01/2001	NA (1)	-----	-----	20.00	
11	00HP337	10/01/2001	420	mg/kg	6020	20.00	10/22/2001
12	00HP338	10/02/2001	670	mg/kg	6020	20.00	10/22/2001
13	00HP339	10/02/2001	930	mg/kg	6020	20.00	10/22/2001
14	00HP340	10/02/2001	NA (1)	-----	-----	20.00	
15	00HP341	10/02/2001	1830	mg/kg	6020	20.00	10/22/2001
16	00HP342	10/02/2001	610	mg/kg	6020	20.00	10/22/2001
17	00HP343	10/02/2001	880	mg/kg	6020	20.00	10/22/2001
18	00HP344	10/03/2001	1260	mg/kg	6020	20.00	10/22/2001
19	00HP345	10/03/2001	1040	mg/kg	6020	20.00	10/22/2001

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/11/2001
Matrix: DUST
Order No.: 2001100122

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
20	00HP346	09/28/2001	470	mg/kg	6020	20.00	10/22/2001
21	PREPARATION BLANK	-----	<0.1	mg/kg	6020	20.00	10/22/2001
22	AQUEOUS CONTROL SAMPLE	-----	106	% [80-120]	6020	20.00	10/22/2001
23	SOIL CONTROL SAMPLE	-----	105	% [74-126]	6020	20.00	10/22/2001
24	MATRIX SPIKE OF 100122-12	10/02/2001	110	% [75-125]	6020	20.00	10/22/2001
25	MATRIX SPIKE DUPLICATE OF 100122-12	10/02/2001	110	% [75-125]	6020	20.00	10/22/2001

NORTHERN
Analytical Laboratories, Inc.

QUALITY CONTROL SUMMARY

SDG # 2001100122

AQUEOUS LABORATORY CONTROL SAMPLE

	Measured Value mg/l	True Value (Allowable Range) mg/l	Recovery %	Allowable Range %
Lead	5.30	5.00 (4.00 - 6.00)	106	80-120

SOIL LABORATORY CONTROL SAMPLE

	Measured Value mg/kg	True Value (Allowable Range) mg/kg	Recovery %	Allowable Range %
Lead	1005	959 (707 - 1212)	105	74-126

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

	Measured Value mg/kg MS / MSD	RPD %	Recovery % MS / MSD	Allowable Range %
Lead	1220 / 1220	0	110 / 110	75-125

ATTACHMENTS

121 S. Jackson Street
Moscow, Idaho 83843
(208) 882-7858 Fax (208) 883-3785

CHAIN OF CUSTODY RECORD

Proj. No. 2001-2113

Project Name: Dust Pilot

TO: Northern Analytical

Archive all Samples

Sample No.	Sample Date	Water	Soil	Sediment	Other	Pb						REMARKS
				2001 100122	Dust							
00HP327	10-01-01			1	X	X						~~Soil~~ JB Sieve to 80 mesh
00HP328	10-01-01			2	X	X						Sieve to 80 mesh
00HP329	10-01-01			3	X	X						Sieve to 80 mesh
00HP330	10-01-01			4	X	X						Sieve to 80 mesh
00HP331	10-01-01			5	X	X						Sieve to 80 mesh
00HP332	10-01-01			6	X	X						Sieve to 80 mesh
00HP333	10-01-01			7	X	X						Sieve to 80 mesh
00HP334	10-01-01			8	X	X						Sieve to 80 mesh
00HP335	10-01-01			9	X	X						Sieve to 80 mesh
00HP336	10-01-01			10	X	X						Sieve to 80 mesh
00HP337	10-01-01			11	X	X						Sieve to 80 mesh
00HP338	10-02-01			12	X	X						Sieve to 80 mesh
00HP339	10-02-01			13	X	X						Sieve to 80 mesh MS/MSD
00HP340	10-02-01			14	X	X						Sieve to 80 mesh
00HP341	10-02-01			15	X	X						Sieve to 80 mesh

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Jamie Bravo	10-05-01 11:15	UPS			

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
UPS	10/11/01 0915				

Relinquished By: (Signature)	Date/Time	Received for Sample Bank By: (Signature)	Date/Time	Remarks
		[illegible]		

121 S. Jackson Street
Moscow, Idaho 83843
(208) 882-7858 Fax (208) 883-3785

CHAIN OF CUSTODY RECORD

Proj. No.: 2001-2113

Project Name: Dust Pilot

TO: Northern Analytical

Archive all Samples

Sample No.	Sample Date	Water	Soil	Sediment	Other: Dust	Analysis: Pb						REMARKS
				2001 100122								
00HP 342	10-02-01			16	X	X						Sieve to 80 mesh
00HP 343	10-02-01			17	X	X						Sieve to 80 mesh
00HP 344	10-03-01			18	X	X						Sieve to 80 mesh
00HP 345	10-03-01			19	X	X						Sieve to 80 mesh
00HP 346	9-28-01			20	X	X						Sieve to 80 mesh
		PB		21								
		ALCS		22								
		SLCS		23								
		MS #12		24								
		MSD +		25								

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Jane Bravo	10-05-01 11:15	UPS			
Relinquished By: (Signature) UPS	Date/Time 10/11/01 0915	Received By: (Signature) M Walton	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Relinquished By: (Signature)	Date/Time	Received for Sample Bank By: (Signature)	Date/Time	Remarks	

NORTHERN
Analytical Laboratories, Inc.

SAMPLE RECEIPT CHECKLIST

Dear Valued Client: This checklist documents the condition of your sample(s) as it (they) arrived at our lab. Please review it and familiarize yourself with its contents. Should you have any questions or comments, please contact us. Thank you for your use of our services.

Client Name: IDEQ
Date/Time Received: 10/11/01 0915 (Date / Time)
Project: Dust Pilot
Received by: MW
Laboratory Number(s): 100122 & 123
Carrier Name: UPS
Checklist Completed by: MW 10/11/01 (Initials / Date)
Sample Type: Dust

	YES	NO
1. Shipping container in good condition?	✓	
2. Custody seals present on shipping container? Condition: Intact X Broken ___	✓	
3. Chain of custody present?	✓	
4. Chain of custody signed when relinquished and received?	✓	
5. Chain of custody agrees with sample labels?	✓	
6. Custody seals on sample bottles? Condition: Intact ___ Broken ___		✓
7. Samples in proper container/bottle?*	✓	
8. Sample containers intact?*	✓	
(9.) Sufficient sample volume for indicated test?*	✓	✓
10. Ice/Frozen Blue Ice present in shipping container? (circle one)		✓
container temperature 1.___ 2.___ 3.___ * (if <0 or>10)		
11. All samples rec'd within holding time?*	✓	
12. VOA vials have zero headspace? * (if contains >5mm headspace)	NA	
13. Trip Blank received?		

	YES	NO
14. pH check performed by: ___		
15. Metals bottle(s) pH <2?	NA	
16. Nutrient bottle(s) pH <2?		
17. Cyanide bottle(s) pH >12?		
18. Sulfide bottle(s) pH >9?		
19. TOC bottle(s) pH <2?		
20. Phenolics bottle(s) pH <2?		
21. Oil & grease bottle(s) pH <2? (checked by analyst)		
22. DRO/418.1 bottle(s) pH <2? (checked by analyst)		
23. Volatiles (VOA) pH <2? (VOA pH checked by analyst)		
24. Herbicides (515) pH <2? (checked by analyst)		
25. Semivolatiles (525) pH <2? (checked by analyst)		
26. Client contacted?		
27. Person contacted		
28. Date contacted		

NOTES: Samples may be affected when not transported at the temperature recommended by the EPA for the test you've selected. Please contact the lab if you have concerns about the temperature of your samples.

*** Critical item - if marked "NO" contact lab manager.**

COMMENTS: ______________________

QA 347-366 EC

NORTHERN
Analytical Laboratories, Inc.

NOV 01 2001

602 South 25th Street
P O Box 30315
Billings, MT 59107
Telephone: (406) 254-7226
Fax: (406) 254-1389

REPORT TO:	IDAHO DEPT OF HEALTH AND WELFARE DIVISON OF ENVIRONMENTAL QUALITY 1005 W McKINLEY KELLOGG ID 83837-2506	**DATE:** **JOB NUMBER:** **PAGE:** **INVOICE NO.:**	October 24, 2001 97-935-6 1 of 5 100123

REPORT OF: House Dust Analysis – House Pilot - 2001-2113

CASE NARRATIVE:

On October 11, 2001, these house dust samples (laboratory numbers 2001100123-1 through 20) were received in our laboratory for analysis. Tests were conducted in accordance with USEPA Contract Laboratory Program, *"Statement of Work for Inorganic Analysis"* IML04.0 and SW-846 *"Test Methods for Evaluating Solid Waste"*, 3rd Edition, updates I, II, IIA, IIB, III. The samples were sieved to obtain the –80 mesh material. The –80 fraction was acid digested on 10/18/01 by Method CLPB-1.

The condition of the samples upon receipt at the laboratory is noted on the attached sample receipt checklist. Chain of custody documentation is enclosed.

The results of the analysis are shown on the following pages.

A < sign indicates the value reported was the practical quantitation limit for this sample using the method described. Concentrations of analyte, if present, below this were not quantifiable.

Footnote:
(1) The sample was not analyzed due to insufficient sample volume.

Reviewed by Denise Jensen
Denise Jensen - Quality Assurance Coordinator

Attachments: Chain of Custody
Sample Receipt Checklist

caj

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/11/2001
Matrix: DUST
Order No.: 2001100123

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
Lead Dry Basis							
1	00HP347	10/03/2001	1100	mg/kg	6020	20.00	10/22/2001
2	00HP348	10/02/2001	700	mg/kg	6020	20.00	10/22/2001
3	00HP349	10/02/2001	270	mg/kg	6020	20.00	10/22/2001
4	00HP350	10/02/2001	NA (1)	-----	-----	20.00	
5	00HP351	10/03/2001	NA (1)	-----	-----	20.00	
6	00HP352	10/03/2001	480	mg/kg	6020	20.00	10/22/2001
7	00HP353	10/03/2001	400	mg/kg	6020	20.00	10/22/2001
8	00HP354	10/03/2001	NA (1)	-----	-----	20.00	
9	00HP355	10/03/2001	490	mg/kg	6020	20.00	10/22/2001

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/11/2001
Matrix: DUST
Order No.: 2001100123

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
10	00HP356	10/03/2001	280	mg/kg	6020	20.00	10/22/2001
11	00HP357	10/03/2001	350	mg/kg	6020	20.00	10/22/2001
12	00HP358	10/04/2001	460	mg/kg	6020	20.00	10/22/2001
13	00HP359	10/04/2001	NA (1)	-----	-----	20.00	
14	00HP360	10/04/2001	240	mg/kg	6020	20.00	10/22/2001
15	00HP361	10/04/2001	270	mg/kg	6020	20.00	10/22/2001
16	00HP362	10/04/2001	180	mg/kg	6020	20.00	10/22/2001
17	00HP363	10/04/2001	170	mg/kg	6020	20.00	10/22/2001
18	00HP364	10/04/2001	NA (1)	-----	-----	20.00	
19	00HP365	10/04/2001	1880	mg/kg	6020	20.00	10/22/2001

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/11/2001
Matrix: DUST
Order No.: 2001100123

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
20	00HP366	09/28/2001	440	mg/kg	6020	20.00	10/22/2001
21	PREPARATION BLANK	-----	<0.1	mg/l	6020	20.00	10/22/2001
22	AQUEOUS CONTROL SAMPLE	-----	110	% [80-120]	6020	20.00	10/22/2001
23	SOIL CONTROL SAMPLE	-----	116	% [74-126]	6020	20.00	10/22/2001
24	MATRIX SPIKE OF 100123-02	10/02/2001	94	% [75-125]	6020	20.00	10/22/2001
25	MATRIX SPIKE DUPLICATE OF 100123-2	10/02/2001	109	% [75-125]	6020	20.00	10/22/2001

NORTHERN
Analytical Laboratories, Inc.

QUALITY CONTROL SUMMARY

SDG # 2001100123

AQUEOUS LABORATORY CONTROL SAMPLE

	Measured Value mg/l	True Value (Allowable Range) mg/l	Recovery %	Allowable Range %
Lead	5.49	5.00 (4.00 - 6.00)	110	80-120

SOIL LABORATORY CONTROL SAMPLE

	Measured Value mg/kg	True Value (Allowable Range) mg/kg	Recovery %	Allowable Range %
Lead	1115	959 (707 - 1212)	116	74-126

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

	Measured Value mg/kg MS / MSD	RPD %	Recovery % MS / MSD	Allowable Range %
Lead	1150 / 1220	6	94 / 109	75-125

ATTACHMENTS

ENVIRONMENTAL ENGINEERING
121 S. Jackson Street
Moscow, Idaho 83843
(208) 882-7858 Fax (208) 883-3785

CHAIN OF CUSTODY RECORD

Proj. No. 2001-2113

Project Name: Dust Pilot

TO: Northern Analytical

Archive all Samples

Sample No.	Sample Date	Water	Soil	Sediment 2001 100123	Other Dust	Pb						REMARKS
00HP 347	10-03-01			1	X	X						Sieve to 80 mesh
00HP 348	10-02-01			2	X	X						Sieve to 80 mesh ms/msD
00HP 349	10-02-01			3	X	X						Sieve to 80 mesh
00HP 350	10-02-01			4	X	X						Sieve to 80 mesh
00HP 351	10-03-01			5	X	X						Sieve to 80 mesh
00HP 352	10-03-01			6	X	X						Sieve to 80 mesh
00HP 353	10-03-01			7	X	X						Sieve to 80 mesh
00HP 354	10-03-01			8	X	X						Sieve to 80 mesh
00HP 355	10-03-01			9	X	X						Sieve to 80 mesh
00HP 356	10-03-01			10	X	X						Sieve to 80 mesh
00HP 357	10-03-01			11	X	X						Sieve to 80 mesh
00HP 358	10-04-01			12	X	X						Sieve to 80 mesh
00HP 359	10-04-01			13	X	X						Sieve to 80 mesh
00HP 360	10-04-01			14	X	X						Sieve to 80 mesh
00HP 361	10-04-01			15	X	X						Sieve to 80 mesh

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Jane Bravo	10-05-01 11:15	UPS			

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
UPS	10/11/01 0915	M Wallace			

Relinquished By: (Signature)	Date/Time	Received for Sample Bank By: (Signature)	Date/Time	Remarks

ENVIRONMENTAL ENGINEERING
121 S. Jackson Street
Moscow, Idaho 83843
(208) 882-7858 Fax (208) 883-3785

CHAIN OF CUSTODY RECORD

Proj. No. 2001-21 13

Project Name: Dust Pilot

TO: Northern Analytical

ARChive all Samples

Sample No.	Sample Date	Water	Soil	Sediment 2001 100123	Other Dust	Analysis: Pb						REMARKS
00HP362	10-04-01			16	X	X						Sieve to 80 mesh
00HP363	10-04-01			17	X	X						Sieve to 80 mesh
00HP364	10-04-01			18	X	X						Sieve to 80 mesh
00HP365	10-04-01			19	X	X						Sieve to 80 mesh
00HP366	9-28-01			20	X	X						Sieve to 80 mesh
		PB		21								
		ALCS		22								
		SLCS		23								
		MS #2		24								
		MSD #2		25								

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Jane Bravo	10-05-01 11:15	UPS			
Relinquished By: (Signature)	**Date/Time**	**Received By: (Signature)**	**Relinquished By: (Signature)**	**Date/Time**	**Received By: (Signature)**
UPS	10/11/01 0915	M Wallace			
Relinquished By: (Signature)	**Date/Time**	**Received for Sample Bank By: (Signature)**	**Date/Time**	**Remarks**	

NORTHERN
Analytical Laboratories, Inc.

SAMPLE RECEIPT CHECKLIST

Dear Valued Client: This checklist documents the condition of your sample(s) as it (they) arrived at our lab. Please review it and familiarize yourself with its contents. Should you have any questions or comments, please contact us. Thank you for your use of our services.

Client Name	IDEQ	Date/Time Received	10/11/01 0915 (Date / Time)
Project	Dust Pilot	Received by	MW
Laboratory Number(s)	100122 & 123	Carrier Name	UPS
Checklist Completed by	MW 10/11/01 (Initials / Date)	Sample Type	Dust

	YES	NO
1. Shipping container in good condition?	✓	
2. Custody seals present on shipping container? Condition: Intact X Broken ___	✓	
3. Chain of custody present?	✓	
4. Chain of custody signed when relinquished and received?	✓	
5. Chain of custody agrees with sample labels?	✓	
6. Custody seals on sample bottles? Condition: Intact ___ Broken ___		✓
7. Samples in proper container/bottle?*	✓	
8. Sample containers intact?*	✓	
9. Sufficient sample volume for indicated test?*	✓	✓
10. Ice/Frozen Blue Ice present in shipping container? (circle one)		✓
container temperature 1.___ 2. ___ 3. ___ * (if <0 or>10)		
11. All samples rec'd within holding time?*	✓	
12. VOA vials have zero headspace? * (if contains >5mm headspace)	NA	
13. Trip Blank received?	NA	

	YES	NO
14. pH check performed by: ___		
15. Metals bottle(s) pH <2?	NA	
16. Nutrient bottle(s) pH <2?	NA	
17. Cyanide bottle(s) pH >12?	NA	
18. Sulfide bottle(s) pH >9?	NA	
19. TOC bottle(s) pH <2?	NA	
20. Phenolics bottle(s) pH <2?	NA	
21. Oil & grease bottle(s) pH <2? (checked by analyst)	NA	
22. DRO/418.1 bottle(s) pH <2? (checked by analyst)	NA	
23. Volatiles (VOA) pH <2? (VOA pH checked by analyst)	NA	
24. Herbicides (515) pH <2? (checked by analyst)	NA	
25. Semivolatiles (525) pH <2? (checked by analyst)	NA	
26. Client contacted?	NA	
27. Person contacted	NA	
28. Date contacted	NA	

NOTES: Samples may be affected when not transported at the temperature recommended by the EPA for the test you've selected. Please contact the lab if you have concerns about the temperature of your samples.

*** Critical item - if marked "NO" contact lab manager.**

COMMENTS: ______________________________

NORTHERN
Analytical Laboratories, Inc.

602 South 25th Street
P O Box 30315
Billings, MT 59107
Telephone: (406) 254-7226
Fax: (406) 254-1389

REPORT TO: IDAHO DEPT OF HEALTH AND WELFARE
DIVISON OF ENVIRONMENTAL QUALITY
1005 W McKINLEY
KELLOGG ID 83837-2506

DATE: November 12, 2001
JOB NUMBER: 97-935-6

INVOICE NO.: 100151

REPORT OF: Water Analysis – Dust Pilot - 2001-2113

CASE NARRATIVE:

On October 15, 2001, these water samples (laboratory numbers 2001100151-1 through 6) were received in our laboratory for analysis. Tests were conducted in accordance with EPA/600/R-94-111 *"Methods for the Determination of Metals in Environmental Samples"*, Supplement I and SW-846 *"Test Methods for Evaluating Solid Waste"*, 3rd Edition, updates I, II, IIA, IIB, III. The samples were acid digested on 10/17/01 by Method 3020A.

The condition of the samples upon receipt at the laboratory is noted on the attached sample receipt checklist. Chain of custody documentation is enclosed.

The results of the analysis are shown on the following pages.

A < sign indicates the value reported was the practical quantitation limit for this sample using the method described. Concentrations of analyte, if present, below this were not quantifiable.

Reviewed by ____________________
Kathleen A. Smit - Laboratory Manager

Attachments: Chain of Custody
Sample Receipt Checklist

caj

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/15/2001
Matrix: WATER
Order No.: 2001100151

Lead as Pb (Total)

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
1	00HP410	10/01/2001	0.008	mg/l	200.8	0.003	11/06/2001
2	00HP411	10/02/2001	<0.003	mg/l	200.8	0.003	11/06/2001
3	00HP412	10/03/2001	0.008	mg/l	200.8	0.003	11/06/2001
4	00HP413	10/04/2001	<0.003	mg/l	200.8	0.003	11/06/2001
5	00HP414	10/08/2001	<0.003	mg/l	200.8	0.003	11/06/2001
6	00HP415	10/09/2001	<0.003	mg/l	200.8	0.003	11/06/2001
7	PREPARATION BLANK	-----	<0.003	mg/l	200.8	0.003	11/06/2001
8	AQUEOUS CONTROL SAMPLE	-----	104	% [80-120]	200.8	0.003	11/06/2001
9	MATRIX SPIKE OF 100151-1	10/01/2001	101	% [75-125]	200.8	0.003	11/06/2001

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/15/2001
Matrix: WATER
Order No.: 2001100151

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
10	MATRIX SPIKE DUPLICATE OF 100151-1	10/01/2001	99	% [75-125]	200.8	0.003	11/06/2001

NORTHERN
Analytical Laboratories, Inc.

QUALITY CONTROL SUMMARY

SDG # 2001100151

AQUEOUS LABORATORY CONTROL SAMPLE

	Measured Value mg/l	True Value (Allowable Range) mg/l	Recovery %	Allowable Range %
Lead	0.518	0.500 (0.425 – 0.575)	104	80-120

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

	Measured Value mg/kg MS / MSD	RPD %	Recovery % MS / MSD	Allowable Range %
Lead	513 / 503	2	101 / 99	75-125

ENVIRONMENTAL ENGINEERING
121 S. Jackson Street
Moscow, Idaho 83843
(208) 882-7858 Fax (208) 883-3785

CHAIN OF CUSTODY RECORD

Proj. No. 2001-2113

Project Name: Dust Pilot

TO: Northern Analytical

Sample No.	Sample Date	Water	Soil	Sediment	Other	Analysis: Pb						REMARKS 2001 100151
00 HP 410	10-01-01	X				X						1
00 HP 411	10-02-01	X				X						2
00 HP 412	10-03-01	X				X						3
00 HP 413	10-04-01	X				X						4
00 HP 414	10-08-01	X				X						5
00 HP 415	10-09-01	X				X						6
									PB 1"			7
									ALCS			8
									MS #1			9
									MSD #1			10

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Jane Bravo	10-11-01 9:00	UPS			
Relinquished By: (Signature)	**Date/Time**	**Received By: (Signature)**	**Relinquished By: (Signature)**	**Date/Time**	**Received By: (Signature)**
UPS	10/15/01 1000	[signature]			
Relinquished By: (Signature)	**Date/Time**	**Received for Sample Bank By: (Signature)**	**Date/Time**	**Remarks**	

KS 10/15

NORTHERN
Analytical Laboratories, Inc.

SAMPLE RECEIPT CHECKLIST

Dear Valued Client: This checklist documents the condition of your sample(s) as it (they) arrived at our lab. Please review it and familiarize yourself with its contents. Should you have any questions or comments, please contact us. Thank you for your use of our services.

Client Name: IDEQ
Project: Dust pilot
Laboratory Number(s): 100131
Checklist Completed by: MEW 10/15/01 (Initials / Date)

Date/Time Received: 10/15/01 1000 (Date / Time)
Received by: MEW
Carrier Name: UPS
Sample Type: H_2O

	YES	NO
1. Shipping container in good condition?	✓	
2. Custody seals present on shipping container? Condition: Intact ✓ Broken ____	✓	
3. Chain of custody present?	✓	
4. Chain of custody signed when relinquished and received?	✓	
5. Chain of custody agrees with sample labels?	✓	
6. Custody seals on sample bottles? Condition: Intact ____ Broken ____		✓
7. Samples in proper container/bottle?*	✓	
8. Sample containers intact?*	✓	
9. Sufficient sample volume for indicated test?*	✓	
10. (Ice)/Frozen Blue Ice present in shipping container? (circle one) container temperature 1. 8.4C 2. ____ 3. ____ * (if <0 or>10)	✓	
11. All samples rec'd within holding time?*	✓	
12. VOA vials have zero headspace? * (if contains >5mm headspace)	N/A	
13. Trip Blank received?	N/A	

	YES	NO
14. pH check performed by: ____________		
15. Metals bottle(s) pH <2?	✓	
16. Nutrient bottle(s) pH <2?	N/A	
17. Cyanide bottle(s) pH >12?	N/A	
18. Sulfide bottle(s) pH >9?	N/A	
19. TOC bottle(s) pH <2?	N/A	
20. Phenolics bottle(s) pH <2?	N/A	
21. Oil & grease bottle(s) pH <2? (checked by analyst)	N/A	
22. DRO/418.1 bottle(s) pH <2? (checked by analyst)	N/A	
23. Volatiles (VOA) pH <2? (VOA pH checked by analyst)	N/A	
24. Herbicides (515) pH <2? (checked by analyst)	N/A	
25. Semivolatiles (525) pH <2? (checked by analyst)	N/A	
26. Client contacted?	N/A	
27. Person contacted	N/A	
28. Date contacted	N/A	

NOTES: **Samples may be affected when not transported at the temperature recommended by the EPA for the test you've selected. Please contact the lab if you have concerns about the temperature of your samples.**

*** Critical item - if marked "NO" contact lab manager.**

COMMENTS: ____

367-386

EC

NORTHERN
Analytical Laboratories, Inc.

NOV 01 2001

602 South 25th Street
P O Box 30315
Billings, MT 59107
Telephone: (406) 254-7226
Fax: (406) 254-1389

REPORT TO: IDAHO DEPT OF HEALTH AND WELFARE
DIVISON OF ENVIRONMENTAL QUALITY
1005 W McKINLEY
KELLOGG ID 83837-2506

DATE:	October 24, 2001
JOB NUMBER:	97-935-6
PAGE:	1 of 5
INVOICE NO.:	100164

REPORT OF: House Dust Analysis – Dust Pilot - 2001-2113

CASE NARRATIVE:

On October 15, 2001, these house dust samples (laboratory numbers 2001100164-1 through 20) were received in our laboratory for analysis. Tests were conducted in accordance with USEPA Contract Laboratory Program, *"Statement of Work for Inorganic Analysis"* IML04.0 and SW-846 *"Test Methods for Evaluating Solid Waste"*, 3rd Edition, updates I, II, IIA, IIB, III. The samples were sieved to obtain the –80 mesh material. The –80 fraction was acid digested on 10/18/01 by Method CLPB-1.

The condition of the samples upon receipt at the laboratory is noted on the attached sample receipt checklist. Chain of custody documentation is enclosed.

The results of the analysis are shown on the following pages.

A < sign indicates the value reported was the practical quantitation limit for this sample using the method described. Concentrations of analyte, if present, below this were not quantifiable.

Footnote:
(1) The sample was not analyzed due to insufficient sample volume.

Reviewed by Denise Jensen
Denise Jensen - Quality Assurance Coordinator

Attachments: Chain of Custody
Sample Receipt Checklist

caj

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/15/2001
Matrix: DUST
Order No.: 2001100164

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
Lead Dry Basis							
1	00HP367	10/04/2001	420	mg/kg	6020	20.00	10/22/2001
2	00HP368	10/05/2001	540	mg/kg	6020	20.00	10/22/2001
3	00HP369	10/05/2001	1630	mg/kg	6020	20.00	10/22/2001
4	00HP370	10/05/2001	780	mg/kg	6020	20.00	10/22/2001
5	00HP371	10/05/2001	500	mg/kg	6020	20.00	10/22/2001
6	00HP372	10/05/2001	NA (1)	-----	-----	20.00	
7	00HP373	10/05/2001	1100	mg/kg	6020	20.00	10/22/2001
8	00HP374	10/05/2001	1350	mg/kg	6020	20.00	10/22/2001
9	00HP375	10/08/2001	130	mg/kg	6020	20.00	10/22/2001

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/15/2001
Matrix: DUST
Order No.: 2001100164

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
10	00HP376	10/08/2001	170	mg/kg	6020	20.00	10/22/2001
11	00HP377	10/08/2001	NA (1)	-----	-----	20.00	
12	00HP378	10/08/2001	690	mg/kg	6020	20.00	10/22/2001
13	00HP379	10/08/2001	NA (1)	-----	-----	20.00	
14	00HP380	10/08/2001	NA (1)	-----	-----	20.00	
15	00HP381	10/08/2001	690	mg/kg	6020	20.00	10/22/2001
16	00HP382	10/08/2001	1470	mg/kg	6020	20.00	10/22/2001
17	00HP383	10/08/2001	1270	mg/kg	6020	20.00	10/22/2001
18	00HP384	10/09/2001	910	mg/kg	6020	20.00	10/22/2001
19	00HP385	10/09/2001	260	mg/kg	6020	20.00	10/22/2001

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/15/2001
Matrix: DUST
Order No.: 2001100164

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
20	00HP386	09/28/2001	430	mg/kg	6020	20.00	10/22/2001
21	PREPARATION BLANK	-----	<0.1	mg/l	6020	20.00	10/22/2001
22	AQUEOUS CONTROL SAMPLE	-----	111	% [80-120]	6020	20.00	10/22/2001
23	SOIL CONTROL SAMPLE	-----	114	% [74-126]	6020	20.00	10/22/2001
24	MATRIX SPIKE OF 100164-1	10/04/2001	108	% [75-125]	6020	20.00	10/22/2001
25	MATRIX SPIKE DUPLICATE OF 100164-1	10/04/2001	120	% [75-125]	6020	20.00	10/22/2001

NORTHERN
Analytical Laboratories, Inc.

QUALITY CONTROL SUMMARY

SDG # 2001100164

AQUEOUS LABORATORY CONTROL SAMPLE

	Measured Value mg/l	True Value (Allowable Range) mg/l	Recovery %	Allowable Range %
Lead	5.53	5.00 (4.00 - 6.00)	111	80-120

SOIL LABORATORY CONTROL SAMPLE

	Measured Value mg/kg	True Value (Allowable Range) mg/kg	Recovery %	Allowable Range %
Lead	1096	959 (707 - 1212)	114	74-126

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

	Measured Value mg/kg MS / MSD	RPD %	Recovery % MS / MSD	Allowable Range %
Lead	870 / 920	6	108 / 120	75-125

ATTACHMENTS

ENVIRONMENTAL ENGINEERING
121 S. Jackson Street
Moscow, Idaho 83843
(208) 882-7858 Fax (208) 883-3785

CHAIN OF CUSTODY RECORD

Proj. No. 2001-2113

Project Name: Dust Pilot

TO: Northern Analytical

Archive all Samples

Sample No.	Sample Date	Water	Soil	Sediment 2001 100164	Other Dust	Analysis: Pb						REMARKS
00HP367	10-04-01			1	X	X						Sieve to 80 mesh ms/
00HP368	10-05-01			2	X	X						Sieve to 80 mesh
00HP369	10-05-01			3	X	X						Sieve to 80 mesh
00HP370	10-05-01			4	X	X						Sieve to 80 mesh
00HP371	10-05-01			5	X	X						Sieve to 80 mesh
00HP372	10-05-01			6	X	X						Sieve to 80 mesh
00HP373	10-05-01			7	X	X						Sieve to 80 mesh
00HP374	10-05-01			8	X	X						Sieve to 80 mesh
00HP375	10-08-01			9	X	X						Sieve to 80 mesh
00HP376	10-08-01			10	X	X						SIEVE to 80 MESH
00HP377	10-08-01			11	X	X						SIEVE to 80 MESH
00HP378	10-08-01			12	X	X						SIEVE TO 80 MESH
00HP379	10-08-01			13	X	X						SIEVE TO 80 MESH
00HP380	10-08-01			14	X	X						SIEVE TO 80 MESH
00HP381	10-08-01			15	X	X						SIEVE TO 80 MESH

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Jane Bravo	10/10/01 4:15	UPS			

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
UPS	10/15/01 1000	McWatters			

Relinquished By: (Signature)	Date/Time	Received for Sample Bank By: (Signature)	Date/Time	Remarks

ENVIRONMENTAL ENGINEERING
121 S. Jackson Street
Moscow, Idaho 83843
(208) 882-7858 Fax (208) 883-3785

CHAIN OF CUSTODY RECORD

Proj. No. 2001-2113

Project Name: DUST PILOT

TO: NORTHERN ANALYTICAL

Sample No.	Sample Date	Water	Soil	Sediment / 2001 100164	Other: DUST	Analysis: Pb						REMARKS: ARCHIVE ALL SAMPLES
00HP382	10-08-01			16	x	x						SIEVE TO 80 MESH
00HP383	10-08-01			17	x	x						SIEVE TO 80 MESH
00HP384	10-09-01			18	x	x						SIEVE TO 80 MESH
00HP385	10-~~10~~-01 9 JAN			19	x	x						SIEVE TO 80 MESH
00HP386	9-28-01			20	x	x						SIEVE TO 80 MESH
		PB		21								
		ALCS		22								
		SLCS		23								
		MS #1		24								
		MSD #1		25								

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Jane Bravo	10-10-01 4:15	UPS			
Relinquished By: (Signature)	**Date/Time**	**Received By: (Signature)**	**Relinquished By: (Signature)**	**Date/Time**	**Received By: (Signature)**
UPS	10/15/01 1000	M Wallace			
Relinquished By: (Signature)	**Date/Time**	**Received for Sample Bank By: (Signature)**	**Date/Time**	**Remarks**	

NORTHERN
Analytical Laboratories, Inc.

SAMPLE RECEIPT CHECKLIST

Dear Valued Client: This checklist documents the condition of your sample(s) as it (they) arrived at our lab. Please review it and familiarize yourself with its contents. Should you have any questions or comments, please contact us. Thank you for your use of our services.

Client Name: ADEQ
Project: Dust Pilot
Laboratory Number(s): 100164, 65, 66
Checklist Completed by: MW 10/15/01 (Initials / Date)

Date/Time Received: 10/15/01 1000 (Date / Time)
Received by: MW
Carrier Name: UPS
Sample Type: Dust

Item	YES	NO
1. Shipping container in good condition?	✓	
2. Custody seals present on shipping container? Condition: Intact X Broken ___	✓	
3. Chain of custody present?	✓	
4. Chain of custody signed when relinquished and received?	✓	
5. Chain of custody agrees with sample labels?	✓	
6. Custody seals on sample bottles? Condition: Intact ___ Broken ___		✓
7. Samples in proper container/bottle?*	✓	
8. Sample containers intact?*	✓	
(9.) Sufficient sample volume for indicated test?*	✓	✓
10. Ice/Frozen Blue Ice present in shipping container? (circle one)		✓
container temperature 1.___ 2.___ 3.___ * (if <0 or>10)		
11. All samples rec'd within holding time?*	✓	
12. VOA vials have zero headspace? * (if contains >5mm headspace)	NA	
13. Trip Blank received?		

Item	YES	NO
14. pH check performed by: ___		
15. Metals bottle(s) pH <2?	NA	
16. Nutrient bottle(s) pH <2?		
17. Cyanide bottle(s) pH >12?		
18. Sulfide bottle(s) pH >9?		
19. TOC bottle(s) pH <2?		
20. Phenolics bottle(s) pH <2?		
21. Oil & grease bottle(s) pH <2? (checked by analyst)		
22. DRO/418.1 bottle(s) pH <2? (checked by analyst)		
23. Volatiles (VOA) pH <2? (VOA pH checked by analyst)		
24. Herbicides (515) pH <2? (checked by analyst)		
25. Semivolatiles (525) pH <2? (checked by analyst)		
26. Client contacted?		
27. Person contacted		
28. Date contacted		

NOTES: Samples may be affected when not transported at the temperature recommended by the EPA for the test you've selected. Please contact the lab if you have concerns about the temperature of your samples.

*** Critical item - if marked "NO" contact lab manager.**

COMMENTS: ___

387-401

NORTHERN
Analytical Laboratories, Inc.

EC

NOV 16 2001

602 South 25th Street
P O Box 30315
Billings, MT 59107
Telephone: (406) 254-7226
Fax: (406) 254-1389

REPORT TO:	IDAHO DEPT OF HEALTH AND WELFARE DIVISON OF ENVIRONMENTAL QUALITY 1005 W McKINLEY KELLOGG ID 83837-2506	**DATE:** **JOB NUMBER:** **PAGE:** **INVOICE NO.:**	November 5, 2001 97-935-6 1 of 5 100165

REPORT OF: Dust Pilot Analysis – Dust Pilot - 2001-2113

CASE NARRATIVE:

On October 15, 2001, these dust samples (laboratory numbers 2001100165-1 through 15) were received in our laboratory for analysis. Tests were conducted in accordance with USEPA Contract Laboratory Program, *"Statement of Work for Inorganic Analysis"* IML04.0 and SW-846 *"Test Methods for Evaluating Solid Waste"*, 3rd Edition, updates I, II, IIA, IIB, III. The samples were sieved to obtain the –80 mesh material. The –80 fraction was acid digested on 10/18/01 by Method CLPB-1.

The condition of the samples upon receipt at the laboratory is noted on the attached sample receipt checklist. Chain of custody documentation is enclosed.

The results of the analysis are shown on the following pages.

A < sign indicates the value reported was the practical quantitation limit for this sample using the method described. Concentrations of analyte, if present, below this were not quantifiable.

Reviewed by Denise Jensen
Denise Jensen - Quality Assurance Coordinator

Attachments: Chain of Custody
Sample Receipt Checklist

caj

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/15/2001
Matrix: DUST
Order No.: 2001100165

Lead Dry Basis

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
1	00HP387	10/09/2001	310	mg/kg	6020	20.00	11/02/2001
2	00HP388	10/09/2001	200	mg/kg	6020	20.00	11/02/2001
3	00HP389	10/09/2001	390	mg/kg	6020	20.00	11/02/2001
4	00HP390	10/09/2001	170	mg/kg	6020	20.00	11/02/2001
5	00HP391	10/09/2001	280	mg/kg	6020	20.00	11/02/2001
6	00HP392	10/09/2001	440	mg/kg	6020	20.00	11/02/2001
7	00HP393	10/09/2001	330	mg/kg	6020	20.00	11/02/2001
8	00HP394	10/09/2001	180	mg/kg	6020	20.00	11/02/2001
9	00HP395	10/09/2001	540	mg/kg	6020	20.00	11/02/2001

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/15/2001
Matrix: DUST
Order No.: 2001100165

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
10	00HP396	10/08/2001	440	mg/kg	6020	20.00	11/02/2001
11	00HP397	10/05/2001	630	mg/kg	6020	20.00	11/02/2001
12	00HP398	10/05/2001	400	mg/kg	6020	20.00	11/02/2001
13	00HP399	10/08/2001	1070	mg/kg	6020	20.00	11/02/2001
14	00HP400	10/02/2001	1030	mg/kg	6020	20.00	11/02/2001
15	00HP401	10/03/2001	450	mg/kg	6020	20.00	11/02/2001
16	PREPARATION BLANK	-----	<0.1	mg/l	6020	20.00	11/02/2001
17	AQUEOUS CONTROL SAMPLE	-----	106	% [80-120]	6020	20.00	11/02/2001
18	SOIL CONTROL SAMPLE	-----	108	% [74-126]	6020	20.00	11/02/2001
19	MATRIX SPIKE OF 100165-3	10/09/2001	104	% [75-125]	6020	20.00	11/02/2001

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: TERRAGRAPHICS
Date Received: 10/15/2001
Matrix: DUST
Order No.: 2001100165

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
20	MATRIX SPIKE DUPLICATE OF 100165-3	10/09/2001	102	% [75-125]	6020	20.00	11/02/2001

NORTHERN
Analytical Laboratories, Inc.

QUALITY CONTROL SUMMARY

SDG # 2001100165

AQUEOUS LABORATORY CONTROL SAMPLE

	Measured Value mg/l	True Value (Allowable Range) mg/l	Recovery %	Allowable Range %
Lead	5.3	5.00 (4.00 - 6.00)	106	80-120

SOIL LABORATORY CONTROL SAMPLE

	Measured Value mg/kg	True Value (Allowable Range) mg/kg	Recovery %	Allowable Range %
Lead	1040	959 (707 - 1212)	108	74-126

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

	Measured Value mg/kg MS / MSD	RPD %	Recovery % MS / MSD	Allowable Range %
Lead	508 / 498	1	104 / 102	75-125

ATTACHMENTS

ENVIRONMENTAL ENGINEERING
121 S. Jackson Street
Moscow, Idaho 83843
(208) 882-7858 Fax (208) 883-3785

CHAIN OF CUSTODY RECORD

Proj. No.: 2001-2113

Project Name: DUST PILOT

TO: NORTHERN ANALYTICAL

Sample No.	Sample Date	Water	Soil	Sediment 2001 100165	Other DUST	Analysis: Pb						REMARKS
00HP387	10-9-01			1	X	X						SIEVE TO 80 MESH
00HP388	10-9-01			2	X	X						SIEVE TO 80 MESH
00HP389	10-9-01			3	X	X						SIEVE TO 80 MESH MS/MSD
00HP390	10-9-01			4	X	X						SIEVE TO 80 MESH
00HP391	10-9-01			5	X	X						SIEVE TO 80 MESH
00HP392	10-9-01			6	X	X						SIEVE TO 80 MESH
00HP393	10-9-01			7	X	X						SIEVE TO 80 MESH
00HP394	10-9-01			8	X	X						SIEVE TO 80 MESH
00HP395	10-9-01			9	X	X						SIEVE TO 80 MESH
00HP396	10-8-01			10	X	X						SIEVE TO 80 MESH
00HP397	10-5-01			11	X	X						SIEVE TO 80 MESH
00HP398	10-5-01			12	X	X						SIEVE TO 80 MESH
00HP399	10-8-01			13	X	X						SIEVE TO 80 MESH
00HP400	10-2-01			14	X	X						SIEVE TO 80 MESH
00HP401	10-3-01			15	X	X						SIEVE TO 80 MESH

VB 10/11

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Jane Bravo	10-10-01 4:15	UPS			
UPS	10/15/01 1000				
Relinquished By: (Signature)	Date/Time	Received for Sample Bank By: (Signature) M Walton	Date/Time	Remarks	

PB 14
ALCS 17
SLCS 18
MS 19
MSD 20

NORTHERN
Analytical Laboratories, Inc.

SAMPLE RECEIPT CHECKLIST

Dear Valued Client: This checklist documents the condition of your sample(s) as it (they) arrived at our lab. Please review it and familiarize yourself with its contents. Should you have any questions or comments, please contact us. Thank you for your use of our services.

Client Name: IDEQ

Date/Time Received: 10/15/01 1000 (Date / Time)

Project: Dust Pellet

Received by: MW

Laboratory Number(s): 100164, 65, 66

Carrier Name: UPS

Checklist Completed by: MW 10/15/01 (Initials / Date)

Sample Type: Dust

	YES	NO
1. Shipping container in good condition?	✓	
2. Custody seals present on shipping container? Condition: Intact X Broken ___	✓	
3. Chain of custody present?	✓	
4. Chain of custody signed when relinquished and received?	✓	
5. Chain of custody agrees with sample labels?	✓	
6. Custody seals on sample bottles? Condition: Intact ___ Broken ___		✓
7. Samples in proper container/bottle?*	✓	
8. Sample containers intact?*	✓	
(9.) Sufficient sample volume for indicated test?*	✓	✓
10. Ice/Frozen Blue Ice present in shipping container? (circle one)		✓
container temperature 1.___ 2.___ 3.___ * (if <0 or>10)		
11. All samples rec'd within holding time?*	✓	
12. VOA vials have zero headspace? * (if contains >5mm headspace)	NA	
13. Trip Blank received?		

	YES	NO
14. pH check performed by: ___		
15. Metals bottle(s) pH <2?	NA	
16. Nutrient bottle(s) pH <2?		
17. Cyanide bottle(s) pH >12?		
18. Sulfide bottle(s) pH >9?		
19. TOC bottle(s) pH <2?		
20. Phenolics bottle(s) pH <2?		
21. Oil & grease bottle(s) pH <2? (checked by analyst)		
22. DRO/418.1 bottle(s) pH <2? (checked by analyst)		
23. Volatiles (VOA) pH <2? (VOA pH checked by analyst)		
24. Herbicides (515) pH <2? (checked by analyst)		
25. Semivolatiles (525) pH <2? (checked by analyst)		
26. Client contacted?		
27. Person contacted		
28. Date contacted		

NOTES: Samples may be affected when not transported at the temperature recommended by the EPA for the test you've selected. Please contact the lab if you have concerns about the temperature of your samples.

*** Critical item - if marked "NO" contact lab manager.**

COMMENTS: ______________________________

402-409

EC

NORTHERN
Analytical Laboratories, Inc.

NOV 1 6 2001

602 South 25th Street
P O Box 30315
Billings, MT 59107
Telephone: (406) 254-7226
Fax: (406) 254-1389

REPORT TO:	IDAHO DEPT OF HEALTH AND WELFARE DIVISON OF ENVIRONMENTAL QUALITY 1005 W McKINLEY KELLOGG ID 83837-2506	**DATE:** **JOB NUMBER:** **PAGE:** **INVOICE NO.:**	November 5, 2001 97-935-6 1 of 4 100166

REPORT OF: Dust Pilot Analysis – Dust Pilot - 2001-2113

CASE NARRATIVE:

On October 15, 2001, these dust samples (laboratory numbers 2001100166-1 through 8) were received in our laboratory for analysis. Tests were conducted in accordance with USEPA Contract Laboratory Program, *"Statement of Work for Inorganic Analysis"* IML04.0 and SW-846 *"Test Methods for Evaluating Solid Waste"*, 3rd Edition, updates I, II, IIA, IIB, III. The samples were sieved to obtain the –80 mesh material. The –80 fraction was acid digested on 10/18/01 by Method CLPB-1.

The condition of the samples upon receipt at the laboratory is noted on the attached sample receipt checklist. Chain of custody documentation is enclosed.

The results of the analysis are shown on the following pages.

A < sign indicates the value reported was the practical quantitation limit for this sample using the method described. Concentrations of analyte, if present, below this were not quantifiable.

Reviewed by [signature]
Denise Jensen – Quality Assurance Coordinator

Attachments: Chain of Custody
Sample Receipt Checklist

caj

Project No.: 2001-2113

Project Name: DUST PILOT

Collected by: TERRAGRAPHICS

Date Received: 10/15/2001

Matrix: DUST

Order No.: 2001100166

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
Lead Dry Basis							
1	00HP402	10/01/2001	430	mg/kg	6020	20.00	11/02/2001
2	00HP403	10/03/2001	410	mg/kg	6020	20.00	11/02/2001
3	00HP404	10/10/2001	400	mg/kg	6020	20.00	11/02/2001
4	00HP405	10/08/2001	1010	mg/kg	6020	20.00	11/02/2001
5	00HP406	09/28/2001	420	mg/kg	6020	20.00	11/02/2001
6	00HP407	10/09/2001	330	mg/kg	6020	20.00	11/02/2001
7	00HP408	10/04/2001	180	mg/kg	6020	20.00	11/02/2001
8	00HP409	10/09/2001	560	mg/kg	6020	20.00	11/02/2001
9	PREPARATION BLANK	-----	<0.1	mg/l	6020	20.00	11/02/2001

Northern Analytical Laboratories, Inc.

Client Name: IDAHO DEPARTMENT OF HEALTH AND WELFARE
Project No.: 2001-2113
Project Name: DUST PILOT
Collected by: PREPARED BY LAB
Date Received: 10/15/2001
Matrix: DUST
Order No.: 2001100166

Sample Number	Description	Date Collected	Measured Value	Test Units	Test Method	PQL Value	Date of Analysis
10	AQUEOUS CONTROL SAMPLE	-----	100	% [80-120]	6020	20.00	11/02/2001
11	SOIL CONTROL SAMPLE	-----	104	% [74-126]	6020	20.00	11/02/2001
12	MATRIX SPIKE OF 100166-3	10/10/2001	103	% [75-125]	6020	20.00	11/02/2001
13	MATRIX SPIKE DUPLICATE OF 100166-3	10/10/2001	109	% [75-125]	6020	20.00	11/02/2001

NORTHERN
Analytical Laboratories, Inc.

QUALITY CONTROL SUMMARY

SDG # 2001100166

AQUEOUS LABORATORY CONTROL SAMPLE

	Measured Value mg/l	True Value (Allowable Range) mg/l	Recovery %	Allowable Range %
Lead	5.00	5.00 (4.00 - 6.00)	100	80-120

SOIL LABORATORY CONTROL SAMPLE

	Measured Value mg/kg	True Value (Allowable Range) mg/kg	Recovery %	Allowable Range %
Lead	993	959 (707 - 1212)	104	74-126

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

	Measured Value mg/kg MS / MSD	RPD %	Recovery % MS / MSD	Allowable Range %
Lead	508 / 542	4	103 / 109	75-125

ATTACHMENTS

ENVIRONMENTAL ENGINEERING
121 S. Jackson Street
Moscow, Idaho 83843
(208) 882-7858 Fax (208) 883-3785

CHAIN OF CUSTODY RECORD

Proj. No. 2001-2113

Project Name: DUST PILOT

TO: NORTHERN ANALYTICAL

Sample No.	Sample Date	Water	Soil	Sediment 2001/100166	Other DUST	Analysis: Pb						REMARKS
00HP402	10-01-01			1	X	X						SIEVE TO 80 MESH
00HP403	10-03-01			2	X	X						SIEVE TO 80 MESH
00HP404	10-10-01			3	X	X						SIEVE to 80 MESH
00HP405	10-8-01			4	X	X						SIEVE TO 80 MESH
00HP406	9/28/01			5	X	X						SIEVE to 80 MESH
00HP407	10-09-01			6	X	X						SIEVE to 80 MESH
00HP408	10-4-01			7	X	X						SIEVE to 80 MESH
00HP409	10-9-01			8	X	X						SIEVE to 80 MESH
			PB	9								
			ALCS	10								
			SLCS	11								
			MS #3	12								
			MSD 3	13								

Relinquished By: (Signature)	Date/Time	Received By: (Signature)	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Jane Bravo	10-10-01 4:15	UPS			
Relinquished By: (Signature) UPS	Date/Time 10/15/01 1000	Received By: (Signature) M Walter	Relinquished By: (Signature)	Date/Time	Received By: (Signature)
Relinquished By: (Signature)	Date/Time	Received for Sample Bank By: (Signature)	Date/Time	Remarks	

NORTHERN
Analytical Laboratories, Inc.

SAMPLE RECEIPT CHECKLIST

Dear Valued Client: This checklist documents the condition of your sample(s) as it (they) arrived at our lab. Please review it and familiarize yourself with its contents. Should you have any questions or comments, please contact us. Thank you for your use of our services.

Client Name	ADEQ	Date/Time Received (Date / Time)	10/15/01 1000
Project	Dust Pilot	Received by	MW
Laboratory Number(s)	100164, 65, 66	Carrier Name	UPS
Checklist Completed by (Initials / Date)	MW 10/15/01	Sample Type	Dust

Item	YES	NO
1. Shipping container in good condition?	✓	
2. Custody seals present on shipping container? Condition: Intact X Broken ____	✓	
3. Chain of custody present?	✓	
4. Chain of custody signed when relinquished and received?	✓	
5. Chain of custody agrees with sample labels?	✓	
6. Custody seals on sample bottles? Condition: Intact ____ Broken ____		✓
7. Samples in proper container/bottle?*	✓	
8. Sample containers intact?*	✓	
(9.) Sufficient sample volume for indicated test?*	✓	✓
10. Ice/Frozen Blue Ice present in shipping container? (circle one)		✓
container temperature 1.____ 2. ____ 3. ____ * (if <0 or>10)		
11. All samples rec'd within holding time?*	✓	
12. VOA vials have zero headspace? * (if contains >5mm headspace)	NA	
13. Trip Blank received?		

Item	YES	NO
14. pH check performed by: ____________		
15. Metals bottle(s) pH <2?	NA	
16. Nutrient bottle(s) pH <2?		
17. Cyanide bottle(s) pH >12?		
18. Sulfide bottle(s) pH >9?		
19. TOC bottle(s) pH <2?		
20. Phenolics bottle(s) pH <2?		
21. Oil & grease bottle(s) pH <2? (checked by analyst)		
22. DRO/418.1 bottle(s) pH <2? (checked by analyst)		
23. Volatiles (VOA) pH <2? (VOA pH checked by analyst)		
24. Herbicides (515) pH <2? (checked by analyst)		
25. Semivolatiles (525) pH <2? (checked by analyst)		
26. Client contacted?		
27. Person contacted		
28. Date contacted		

NOTES: **Samples may be affected when not transported at the temperature recommended by the EPA for the test you've selected. Please contact the lab if you have concerns about the temperature of your samples.**

*** Critical item - if marked "NO" contact lab manager.**

COMMENTS: ____

INTERNAL MEMORANDUM

To: Jerry Lee, TerraGraphics

From: Susan Spalinger and Lisa C. Hall, TerraGraphics

Date: August 8, 2002

Subject: Final QA/QC Review for 2001 TerraGraphics and Panhandle Health District Dust Mat Sampling

Introduction

The following memorandum provides a summary of the quality assurance/quality control (QA/QC) review for the 2001TerraGraphics and Panhandle Health District (PHD) dust mat sampling in Kellogg, Smelterville, Wardner, Page, and Pinehurst. Also included is a review of data from the twelve-month dust mat sampling for the House Dust Pilot.

In late summer 2001, the State of Idaho contracted with a new analytical laboratory, Inland Environmental Laboratory (IEL) in Spokane, Washington. Initial dust mat results indicated some problems with percent recovery. This was discovered when standards with a known lead concentration were reported as non-detects. A problem with the ICP was discovered and corrected after the first batch of dust samples was analyzed. However, the next two batches of dust mat samples continued to show decreased percent recoveries with the standards. DEQ submitted five National Institute of Standards and Technology (NIST) standards inserted blind with soil samples to IEL in February and those standards returned a 92-105% lead concentration recovery. Because these soil standards returned acceptable percent recoveries, DEQ and TerraGraphics decided to submit four more dust mat standards and additional soil standards. IEL analyzed the samples using both the inductively coupled plasma (ICP) and the gas furnace atomic aborsption (GFAA) instruments. The dust mat samples run by GFAA were closer in concentration to the results observed in past years, while the ICP results were again decreased. Mary Wolther, Laboratory Manager, from IEL explained that they could not run soil and dust samples on the GFAA for two reasons: 1) it is not recommended to run soil/dust on that type of instrument, and 2) many dilutions are required, reducing the precision of the concentration value to one significant digit. The four dust samples were reanalyzed using all three wavelengths available on the ICP. The first wavelength had previously been used to analyze all soil and dust samples. Results showed suppression on the first wavelength, the second wavelength had interference with iron, but the output from the third wavelength was clear. The percent recoveries from the dust mat standards using the third wavelength were in the range of concentrations observed in the past. After this discovery, IEL reanalyzed DEQ' s soil samples on the third wavelength as well as three other dust mat standards they had previously analyzed. Results of the three dust mat standards rerun on the third wavelength also fell into the expected range of percent recoveries. The DEQ soil standards were also reanalyzed using the third wavelength and lead concentration recoveries were acceptable, ranging from 96%-110%. Arsenic and cadmium were also tested for DEQ; percent recoveries for detectable levels of arsenic were 96%, and cadmium recoveries ranged from 85%-103%. IEL will now analyze all soil and dust samples using the third wavelength on the ICP. The problem with decreased percent recoveries seems to have been resolved by using the third ICP wavelength.

General

A QA/QC review was completed to evaluate the precision, accuracy, completeness, and representativeness of the data obtained from both the field and the laboratory. Definitions and QC objectives for these parameters are described in the *2001 Draft Field Work Plan for Environmental Sampling, Bunker Hill Superfund Site* (TerraGraphics 2001). Procedures for sample labeling, handling, and analysis were as described in the Work Plan. All laboratory data and master logs were entered into a MS Access database and checked to ensure that samples were labeled and tracked correctly. Chain of custody forms were reviewed. All sample holding times were met. Dust mat data (excluding QA/QC samples) are shown in Table 1. Twenty-nine (29) samples contained insufficient volumes. IEL stated they used non-standard methods on those samples to obtain a result. Those 29 sample results were rejected and marked as insufficient sample volume for data summary purposes.

Thirty-nine (39) loading rates were qualified as estimates based on residents' answers to the questionnaire upon retrieval of the dust mats. Loading calculations for 4 samples were considered estimates because the residents indicated that they were gone from the home 10 or more days. Five dust mat samples had been vacuumed by the resident at least once, 16 samples had been moved from one location to another, and 6 dust mats had been shaken out one or more times. Eight dust mat samples had a combination of two or more of the above. In all of these cases, the loading rates were qualified as estimates.

Field Sampling QA/QC Results

A total of 272 dust mat samples (including QA/QC) were collected and analyzed. Samples were collected from homes in Smelterville, Kellogg, Wardner, Page, and Pinehurst. All dust mat samples were analyzed for total lead by Inland Environmental Laboratories in Spokane, Washington. Field QA/QC samples consisted of 14 field duplicates. Fourteen (14) standards loaded onto a blank mat were inserted blind into the sample train. Eleven rinsate blanks were also collected. All samples were banked and recorded on a master log, and chain of custody forms were completed and checked before samples were shipped to the lab. All samples were sieved to -80 mesh at IEL prior to analysis.

Field Duplicates

Field duplicates consisted of a second dust mat being placed directly next to the original dust mat. Duplicate samples were used to examine variability in the field and in laboratory procedures. A total of 14 duplicates were collected in the field and submitted to the laboratory for analysis. Field duplicates were collected at a rate of approximately one for every 20 samples.

Results for the 14 duplicate analyses are presented in Table 2. The relative percent difference (RPD) ranged from 4.7% to 87.8%, with an average of 22.1%. The degree of variability is consistent with previous dust mat sampling programs. Three of the duplicate mats and four of the original mats were rejected due to insufficient sample volume. IEL analyzed these samples using non-standard methods, and the results were rejected.

Rinsate Blanks

Rinsate blanks were collected to ensure decontamination procedures were effective, and that cross-contamination was not significant during field sampling. Rinsate blanks consisted of laboratory available deionized water poured over a representative batch of decontaminated sampling equipment. Rinsate blanks were collected into 500 ml plastic bottles and preserved with nitric acid. The bottles were supplied by Northern Analytical and were delivered to IEL for analysis.

Eleven rinsate blanks were collected during the sampling event and results are presented in Table 3. Nine of eleven rinsate blanks were below detection for lead. The rinsate blank with sample identification number DEQ032202-5 had a lead concentration of 0.0045 mg/l and the rinsate blank with sample identification number DEQ032202-8 had a lead concentration of 0.0025 mg/l. The lowest dust mat lead concentration detected was 6.96 mg/kg. This concentration is significantly higher than 10 times the rinsate concentration; therefore, it was determined that decontamination procedures were adequate for the project and no qualifiers were placed on the data.

Laboratory Analysis

A total of 232 samples (excluding QA/QC samples) were collected from dust mats. Laboratory QA/QC was checked externally by the use of duplicate samples in the field and by submitting dust mat standards blind to the laboratory for lead analysis. IEL provided a copy of their internal QA/QC results for blanks, laboratory control samples (LCS), and matrix spike/matrix spike duplicates (MS/MSD).

External QA/QC

A pre-loaded mat standard was inserted at the University of Idaho vacuum lab for approximately every 20th dust mat sample collected. A total of 14 standards were recovered from the mats and submitted blind to IEL. Pre-loaded mats had 10 g of a NIST standard containing 432 mg/kg lead. The standards were used to evaluate the dust recovery of the vacuum, as well as the accuracy of IEL. Standard dust mass, lead concentration, and lead mass percent recovery results are presented in Table 4.   The average percent recovery by dust mass for the standards was 84%. The average percent recovery by concentration was 73%. The average percent recovery on lead mass was 62%.

The average percent recoveries for concentration and lead mass were slightly higher than they have been in previous years. In 1998, concentration recoveries reached 74% on average, but in general (1998-2000), lead concentration and mass recoveries average 68% and lead mass recoveries average 56%. The slightly higher lead concentration and mass recoveries observed in 2001 data may be due to the change in laboratories and their use of ICP instead of ICP-Mass Spectrometry used in the past. However, standard percent recoveries on dust mass, lead concentration, and lead mass are still decreased (<100%). Reasons for decreased percent recoveries observed on mat standards may be due to the mats themselves and/or the vacuum bags used to vacuum the mats. The sieved portion of many of the dust mat samples in previous projects contained significant amounts of fibers. Numerous mat fibers were clearly visible in 1997 and 1998 laboratory photographs of the sieved portion of the samples. Another possible explanation for the decreased percent recovery on concentration is preferential retention of the clays on the somewhat sticky vinyl surface, thereby reducing the total amount of lead available for vacuum sample removal. The fine fraction of the dust may also pass through the pores in the vacuum bags used to vacuum the mats. No qualifiers were placed on the data based on the mat dust standard results.

Internal QA/QC

IEL inserted one prep blank per batch of samples to ensure no bias was introduced during sample preparation. As seen in Table 5, all blanks were below the instrument detection limit. No qualifiers were placed on the data based on the prep blank results.

Internal checks of IEL’ s accuracy were assessed by analyzing one soil and one aqueous laboratory control sample (LCS) per batch, for a total of 24 LCS. Results for aqueous LCS are presented in Table 6. Results for soil LCS are presented in Table 7. All LCS samples were within the acceptable range specified by IEL. No qualifiers were placed on the data based on the LCS results.

Internal checks of laboratory precision at IEL were assessed using matrix spike/matrix spike duplicate (MS/MSD) analysis on 13 of the 272 samples submitted for analysis. Results are presented in Table 8. RPDs ranged from 0.9% to 8.2%, with an average of 3.9%. No qualifiers were placed on the data based on the laboratory MS/MSD results.

Conclusions

A total of 29 samples (plus three duplicates) were rejected due to insufficient sample volumes for the laboratory to analyze by standard SW-846 methods. Thirty-nine samples were qualified as estimates for the calculated loading portion of the study, based on residents' answers to the questionnaire filled out when the dust mats were retrieved.

Field and lab variability was assessed using duplicate samples. Analysis of dust mat duplicates indicates relatively high variability which is attributable to the sampling methodology.

An external check of IEL's accuracy was determined using soil standards of known concentration loaded onto a new mat and inserted blind with the field samples. Decreased (<100%) percent recoveries were observed on many of the NIST standard mat samples. These decreased percent recoveries have also been observed from previous years However, the average percent recoveries by lead concentration and lead mass were higher than they have been in the previous years. No qualifiers were placed on the data based on NIST standard results.

An internal check of IEL's accuracy was assessed using aqueous and soil LCS. All results were within the specified limits. Laboratory precision was assessed using MS/MSD analyses. All MS/MSD displayed acceptable RPD values. The other checks on that batch were acceptable, so no qualifiers were placed on the data. All laboratory blanks were below the detection limit. Based on a complete review of the field duplicates, standards, LCS, prep blanks, and IEL MS/MSD analyses, the final completeness for the study was assessed at 88%.

Table 1 - 2001 Panhandle Health District and TerraGraphics' Combined Dust Mat Data (Shaded Data are House Dust Pilot Results)

Lab ID	Sample ID	Type	Lead Concentration	Lead Qualifier	Units
DEQ103101 - 1	01M001	Dust	485		mg/kg
DEQ103101 - 2	01M002	Dust	462		mg/kg
DEQ103101 - 3	01M003	Dust	191		mg/kg
DEQ103101 - 4	01M004	Dust	1680		mg/kg
DEQ103101 - 5	01M005	Dust	995		mg/kg
DEQ103101 - 6	01M006	Dust	1750		mg/kg
DEQ103101 - 7	01M007	Dust	929	R*	mg/kg
DEQ103101 - 8	01M008	Dust	1750		mg/kg
DEQ103101 - 10	01M010	Dust	360		mg/kg
DEQ103101 - 12	01M012	Dust	1320		mg/kg
DEQ103101 - 13	01M013	Dust	1150	R*	mg/kg
DEQ103101 - 14	01M014	Dust	985		mg/kg
DEQ103101 - 15	01M015	Dust	710		mg/kg
DEQ103101 - 16	01M016	Dust	1020		mg/kg
DEQ103101 - 17	01M017	Dust	271		mg/kg
DEQ103101 - 18	01M018	Dust	284		mg/kg
DEQ103101 - 19	01M019	Dust	249	R*	mg/kg
DEQ103101 - 20	01M020	Dust	510		mg/kg
DEQ120401 - 21	01M021	Dust	462		mg/kg
DEQ120401 - 22	01M022	Dust	321		mg/kg
DEQ120401 - 23	01M023	Dust	367		mg/kg
DEQ120401 - 24	01M024	Dust	148	R*	mg/kg
DEQ120401 - 25	01M025	Dust	156		mg/kg
DEQ120401 - 26	01M026	Dust	193		mg/kg
DEQ120401 - 27	01M027	Dust	3590		mg/kg
DEQ120401 - 28	01M028	Dust	667		mg/kg
DEQ120401 - 29	01M029	Dust	664		mg/kg
DEQ120401 - 31	01M031	Dust	59.1		mg/kg
DEQ120401 - 32	01M032	Dust	307		mg/kg
DEQ120401 - 33	01M033	Dust	277		mg/kg
DEQ120401 - 34	01M034	Dust	181		mg/kg
DEQ120401 - 36	01M036	Dust	262		mg/kg
DEQ120401 - 37	01M037	Dust	1550		mg/kg
DEQ120401 - 38	01M038	Dust	323		mg/kg
DEQ120401 - 39	01M039	Dust	192		mg/kg
DEQ120401 - 40	01M040	Dust	467	R*	mg/kg
DEQ120401 - 1	01M041	Dust	435		mg/kg
DEQ120401 - 2	01M042	Dust	423	R*	mg/kg
DEQ120401 - 4	01M044	Dust	317		mg/kg
DEQ120401 - 5	01M045	Dust	806		mg/kg
DEQ120401 - 6	01M046	Dust	562		mg/kg
DEQ120401 - 7	01M047	Dust	730		mg/kg
DEQ120401 - 8	01M048	Dust	700		mg/kg
DEQ120401 - 9	01M049	Dust	318	R*	mg/kg
DEQ120401 - 12	01M052	Dust	293	R*	mg/kg

*Rejected. Insufficient sample volume - laboratory used non-standard methods to obtain a result.

Table 1 (cont'd) Panhandle Health District and TerraGraphics' Combined Dust Mat Data (Shaded Data are House Dust Pilot Results)

Lab ID	Sample ID	Type	Lead Concentration	Lead Qualifier	Units
DEQ120401 - 13	01M053	Dust	267		mg/kg
DEQ120401 - 14	01M054	Dust	289		mg/kg
DEQ120401 - 15	01M055	Dust	2910		mg/kg
DEQ120401 - 17	01M057	Dust	546		mg/kg
DEQ120401 - 18	01M058	Dust	1350		mg/kg
DEQ120401 - 19	01M059	Dust	711		mg/kg
DEQ120401 - 20	01M060	Dust	336		mg/kg
DEQ032102 - 3	01M061	Dust	721		mg/kg
DEQ032102 - 1	01M065	Dust	560	R*	mg/kg
DEQ032102 - 4	01M067	Dust	1050		mg/kg
DEQ032102 - 5	01M068	Dust	136	R*	mg/kg
DEQ032102 - 6	01M069	Dust	703		mg/kg
DEQ032102 - 7	01M070	Dust	664		mg/kg
DEQ032102 - 8	01M071	Dust	739		mg/kg
DEQ032102 - 9	01M072	Dust	294		mg/kg
DEQ032102 - 10	01M073	Dust	226		mg/kg
DEQ032102 - 12	01M075	Dust	562		mg/kg
DEQ032102 - 13	01M076	Dust	393	R*	mg/kg
DEQ032102 - 14	01M077	Dust	349		mg/kg
DEQ032102 - 15	01M078	Dust	715		mg/kg
DEQ032102 - 16	01M079	Dust	428		mg/kg
DEQ032102 - 17	01M080	Dust	896		mg/kg
DEQ032102 - 18	01M081	Dust	689		mg/kg
DEQ032102 - 19	01M082	Dust	232		mg/kg
DEQ032102 - 20	01M083	Dust	610		mg/kg
DEQ032102 - 22	01M085	Dust	252		mg/kg
DEQ032102 - 23	01M086	Dust	2420		mg/kg
DEQ032102 - 24	01M087	Dust	978		mg/kg
DEQ032102 - 25	01M088	Dust	721		mg/kg
DEQ032102 - 26	01M089	Dust	583		mg/kg
DEQ032102 - 27	01M090	Dust	855		mg/kg
DEQ032102 - 28	01M091	Dust	4150		mg/kg
DEQ032102 - 29	01M092	Dust	454		mg/kg
DEQ032102 - 30	01M093	Dust	392		mg/kg
DEQ032102 - 32	01M095	Dust	221		mg/kg
DEQ032102 - 33	01M096	Dust	671		mg/kg
DEQ032102 - 34	01M097	Dust	791		mg/kg
DEQ032102 - 35	01M098	Dust	1030		mg/kg
DEQ032102 - 36	01M099	Dust	451		mg/kg
DEQ032102 - 37	01M100	Dust	478		mg/kg
DEQ032102 - 38	01M101	Dust	388	R*	mg/kg
DEQ032102 - 40	01M103	Dust	864		mg/kg
DEQ032102 - 41	01M104	Dust	441		mg/kg
DEQ032102 - 42	01M105	Dust	764		mg/kg
DEQ032102 - 43	01M106	Dust	1080	R*	mg/kg

*Rejected. Insufficient sample volume - laboratory used non-standard methods to obtain a result.

Table 1 (cont'd) Panhandle Health District and TerraGraphics' Combined Dust Mat Data (Shaded Data are House Dust Pilot Results)

Lab ID	Sample ID	Type	Lead Concentration	Lead Qualifier	Units
DEQ032102 - 44	01M107	Dust	289	R*	mg/kg
DEQ032102 - 45	01M108	Dust	265	R*	mg/kg
DEQ032102 - 46	01M109	Dust	434		mg/kg
DEQ032102 - 47	01M110	Dust	565		mg/kg
DEQ032102 - 48	01M111	Dust	269	R*	mg/kg
DEQ032102 - 50	01M113	Dust	1250		mg/kg
DEQ032102 - 52	01M115	Dust	906		mg/kg
DEQ032102 - 54	01M117	Dust	599		mg/kg
DEQ032102 - 55	01M118	Dust	251		mg/kg
DEQ032102 - 56	01M119	Dust	396		mg/kg
DEQ032102 - 57	01M120	Dust	452		mg/kg
DEQ032102 - 58	01M121	Dust	385		mg/kg
DEQ032102 - 59	01M122	Dust	221		mg/kg
DEQ032102 - 60	01M123	Dust	127		mg/kg
DEQ032102 - 61	01M127	Dust	6.96		mg/kg
DEQ032102 - 62	01M128	Dust	544	R*	mg/kg
DEQ032102 - 63	01M129	Dust	544		mg/kg
DEQ032102 - 64	01M130	Dust	1270		mg/kg
DEQ032102 - 65	01M131	Dust	278		mg/kg
DEQ032102 - 66	01M132	Dust	401		mg/kg
DEQ032102 - 67	01M133	Dust	233		mg/kg
DEQ032102 - 68	01M134	Dust	253		mg/kg
DEQ032102 - 69	01M135	Dust	522		mg/kg
DEQ032102 - 70	01M136	Dust	335		mg/kg
DEQ032102 - 72	01M138	Dust	1470		mg/kg
DEQ032102 - 73	01M139	Dust	504		mg/kg
DEQ032102 - 74	01M140	Dust	671		mg/kg
DEQ032102 - 75	01M141	Dust	4980		mg/kg
DEQ032102 - 76	01M142	Dust	647		mg/kg
DEQ032102 - 77	01M143	Dust	2460		mg/kg
DEQ032102 - 78	01M144	Dust	595		mg/kg
DEQ032102 - 79	01M145	Dust	1070		mg/kg
DEQ032102 - 80	01M146	Dust	266	R*	mg/kg
DEQ032102 - 81	01M147	Dust	1330		mg/kg
DEQ032102 - 82	01M148	Dust	1730		mg/kg
DEQ032102 - 83	01M149	Dust	1080		mg/kg
DEQ032102 - 84	01M150	Dust	569		mg/kg
DEQ032102 - 85	01M151	Dust	652		mg/kg
DEQ032102 - 86	01M152	Dust	1820		mg/kg
DEQ032102 - 87	01M153	Dust	253		mg/kg
DEQ032102 - 89	01M155	Dust	330		mg/kg
DEQ032102 - 90	01M156	Dust	390	R*	mg/kg
DEQ032102 - 92	01M158	Dust	888		mg/kg
DEQ032102 - 93	01M159	Dust	1240	R*	mg/kg
DEQ032102 - 94	01M160	Dust	325		mg/kg
DEQ032102 - 95	01M161	Dust	661		mg/kg

*Rejected. Insufficient sample volume - laboratory used non-standard methods to obtain a result.

Table 1 (cont'd) Panhandle Health District and TerraGraphics' Combined Dust Mat Data (Shaded Data are House Dust Pilot Results)

Lab ID	Sample ID	Type	Lead Concentration	Lead Qualifier	Units
DEQ032102 - 96	01M162	Dust	795		mg/kg
DEQ032102 - 97	01M163	Dust	1070		mg/kg
DEQ032102 - 98	01M164	Dust	45		mg/kg
DEQ032102 - 99	01M165	Dust	929		mg/kg
DEQ032102 - 100	01M166	Dust	448		mg/kg
DEQ032102 - 101	01M167	Dust	859		mg/kg
DEQ032102 - 102	01M168	Dust	455		mg/kg
DEQ032102 - 103	01M169	Dust	1010		mg/kg
DEQ032102 - 104	01M170	Dust	595		mg/kg
DEQ032102 - 106	01M172	Dust	314		mg/kg
DEQ032102 - 107	01M173	Dust	2170		mg/kg
DEQ032102 - 108	01M174	Dust	583		mg/kg
DEQ032102 - 109	01M175	Dust	404		mg/kg
DEQ032102 - 110	01M176	Dust	340		mg/kg
DEQ032102 - 112	01M178	Dust	360	R*	mg/kg
DEQ032102 - 113	01M179	Dust	662	R*	mg/kg
DEQ032102 - 114	01M180	Dust	598		mg/kg
DEQ032102 - 115	01M181	Dust	403		mg/kg
DEQ032102 - 116	01M182	Dust	883		mg/kg
DEQ032102 - 117	01M183	Dust	829		mg/kg
DEQ032102 - 118	01M184	Dust	1190		mg/kg
DEQ032102 - 119	01M185	Dust	932		mg/kg
DEQ032102 - 120	01M186	Dust	1340		mg/kg
DEQ032102 - 121	01M187	Dust	1800		mg/kg
DEQ032102 - 122	01M188	Dust	9700		mg/kg
DEQ032102 - 123	01M189	Dust	722		mg/kg
DEQ032102 - 124	01M190	Dust	183		mg/kg
DEQ032102 - 125	01M191	Dust	520		mg/kg
DEQ032102 - 126	01M192	Dust	503		mg/kg
DEQ032102 - 127	01M193	Dust	720		mg/kg
DEQ032102 - 128	01M194	Dust	493		mg/kg
DEQ032102 - 129	01M195	Dust	727		mg/kg
DEQ032102 - 130	01M196	Dust	818		mg/kg
DEQ032102 - 132	01M198	Dust	293		mg/kg
DEQ032102 - 133	01M199	Dust	426		mg/kg
DEQ032102 - 134	01M200	Dust	1070		mg/kg
DEQ032102 - 135	01M201	Dust	653		mg/kg
DEQ032102 - 136	01M202	Dust	888	R*	mg/kg
DEQ032102 - 137	01M203	Dust	852		mg/kg
DEQ032102 - 138	01M204	Dust	340		mg/kg
DEQ032102 - 139	01M205	Dust	99.8		mg/kg
DEQ032102 - 141	01M207	Dust	331		mg/kg
DEQ032102 - 142	01M208	Dust	454		mg/kg
DEQ032102 - 143	01M209	Dust	121		mg/kg
DEQ032102 - 144	01M210	Dust	142		mg/kg
DEQ032102 - 145	01M211	Dust	300		mg/kg

*Rejected. Insufficient sample volume - laboratory used non-standard methods to obtain a result.

Table 1 (cont'd) Panhandle Health District and TerraGraphics' Combined Dust Mat Data (Shaded Data are House Dust Pilot Results)

Lab ID	Sample ID	Type	Lead Concentration	Lead Qualifier	Units
DEQ032102 - 147	01M213	Dust	345		mg/kg
DEQ032102 - 148	01M214	Dust	567		mg/kg
DEQ032102 - 149	01M215	Dust	1350		mg/kg
DEQ032102 - 150	01M216	Dust	506		mg/kg
DEQ032102 - 152	01M218	Dust	648		mg/kg
DEQ032102 - 153	01M219	Dust	132		mg/kg
DEQ032102 - 154	01M220	Dust	272		mg/kg
DEQ032102 - 155	01M221	Dust	665		mg/kg
DEQ032102 - 156	01M222	Dust	720		mg/kg
DEQ032102 - 157	01M223	Dust	507		mg/kg
DEQ032102 - 158	01M224	Dust	369		mg/kg
DEQ032102 - 159	01M225	Dust	572	R*	mg/kg
DEQ032102 - 160	01M226	Dust	176		mg/kg
DEQ032102 - 161	01M227	Dust	603		mg/kg
DEQ032102 - 162	01M228	Dust	332		mg/kg
DEQ032102 - 163	01M229	Dust	<40	R*	mg/kg
DEQ032102 - 164	01M230	Dust	505		mg/kg
DEQ032102 - 165	01M231	Dust	281	R*	mg/kg
DEQ032102 - 166	01M232	Dust	690		mg/kg
DEQ032102 - 167	01M233	Dust	227		mg/kg
DEQ032102 - 168	01M234	Dust	382		mg/kg
DEQ032102 - 169	01M235	Dust	403		mg/kg
DEQ032102 - 170	01M236	Dust	344		mg/kg
DEQ032102 - 172	01M238	Dust	386		mg/kg
DEQ032102 - 173	01M239	Dust	1840		mg/kg
DEQ032102 - 174	01M240	Dust	786		mg/kg
DEQ032102 - 175	01M241	Dust	15100		mg/kg
DEQ032102 - 176	01M242	Dust	763		mg/kg
DEQ032102 - 177	01M243	Dust	464		mg/kg
DEQ032102 - 178	01M244	Dust	780		mg/kg
DEQ032102 - 180	01M246	Dust	176		mg/kg
DEQ032102 - 181	01M247	Dust	<12.7	R*	mg/kg
DEQ032102 - 182	01M248	Dust	964		mg/kg
DEQ032102 - 183	01M249	Dust	577		mg/kg
DEQ032102 - 184	01M250	Dust	2050		mg/kg
DEQ032102 - 185	01M251	Dust	1250	R*	mg/kg
DEQ032102 - 186	01M252	Dust	733		mg/kg
DEQ032102 - 187	01M253	Dust	794		mg/kg
DEQ032102 - 188	01M254	Dust	1390		mg/kg
DEQ032102 - 189	01M255	Dust	1150		mg/kg
DEQ032102 - 190	01M256	Dust	431		mg/kg
DEQ032102 - 192	01M258	Dust	95.6		mg/kg
DEQ032102 - 193	01M259	Dust	360		mg/kg
DEQ032102 - 194	01M260	Dust	293		mg/kg
DEQ032102 - 195	01M261	Dust	432		mg/kg
DEQ032102 - 196	01M262	Dust	297		mg/kg

*Rejected. Insufficient sample volume - laboratory used non-standard methods to obtain a result.

Table 1 (cont'd) Panhandle Health District and TerraGraphics' Combined Dust Mat Data (Shaded Data are House Dust Pilot Results)

Lab ID	Sample ID	Type	Lead Concentration	Lead Qualifier	Units
DEQ032102 - 197	01M263	Dust	362		mg/kg
DEQ032102 - 198	01M264	Dust	137		mg/kg
DEQ032102 - 199	01M265	Dust	510		mg/kg
DEQ032102 - 200	01M266	Dust	2690		mg/kg

*Rejected. Insufficient sample volume - laboratory used non-standard methods to obtain a result.

Table 2 - Field Duplicates

Original Lab ID	Duplicate Lab ID	Original Sample ID	Duplicate Sample ID	Original Lead Conc.	Duplicate Lead Conc.	RPD
DEQ120401 - 6	DEQ120401 - 35	01M046	01M035	562	589	4.7
DEQ120401 - 2	DEQ120401 - 3	01M042	01M043	R*	R*	NA
DEQ120401 - 9	DEQ120401 - 11	01M049	01M051	R*	R*	NA
DEQ120401 - 15	DEQ120401 - 16	01M055	01M056	2910	3050	4.7
DEQ032102 - 69	DEQ032102 - 2	01M135	01M066	522	941	57.3
DEQ032102 - 22	DEQ032102 - 21	01M085	01M084	252	315	22.2
DEQ032102 - 38	DEQ032102 - 39	01M101	01M102	R*	552	NA
DEQ032102 - 30	DEQ032102 - 49	01M093	01M112	392	339	14.5
DEQ032102 - 52	DEQ032102 - 53	01M115	01M116	906	845	7.0
DEQ032102 - 87	DEQ032102 - 88	01M153	01M154	253	235	7.4
DEQ032102 - 112	DEQ032102 - 105	01M178	01M171	R*	R*	NA
DEQ032102 - 141	DEQ032102 - 140	01M207	01M206	331	129	87.8
DEQ032102 - 57	DEQ032102 - 146	01M120	01M212	452	495	9.1
DEQ032102 - 180	DEQ032102 - 179	01M246	01M245	176	188	6.6
					Average	22.1

RPD = ABS(X1-X2)/((X1+X2)/2)

X1 = ORIGINAL SAMPLE

X2 = DUPLICATE SAMPLE

* Sample result rejected due to insufficient sample volume

Table 3 - Rinsate Blanks

Lab ID			Sample ID	Lead Concentration	Units
DEQ103101	-	21	01M062	<0.002	mg/l
DEQ103101	-	22	01M063	<0.002	mg/l
DEQ103101	-	23	01M064	<0.002	mg/l
DEQ032202	-	1	01M124	<0.002	mg/l
DEQ032202	-	2	01M125	<0.002	mg/l
DEQ032202	-	3	01M126	<0.002	mg/l
DEQ032202	-	4	01M268	<0.002	mg/l
DEQ032202	-	5	01M269	0.0045	mg/l
DEQ032202	-	6	01M270	<0.002	mg/l
DEQ032202	-	7	01M271	<0.002	mg/l
DEQ032202	-	8	01M272	0.0025	mg/l

<:Concentration below instrument detection limit.

Table 4 - Percent Recovery Results

Lab ID	Sample ID	Pre-loading Sample Weight (g)	Sample Conc. (ug/g)	Amount Lead Applied to mat (ug)	Recovered Sample Weight (g)	Recovered Lead Conc. (ug/g)	Amount Lead in Sample (ug)	Percent Recovery Dust (mass)	Percent Recovery Lead (conc.)	Percent Recovery Lead (mass)
DEQ103101 - 11	01M011	10.01	432	4324	8.47	285	2414	85%	66%	56%
DEQ120401 - 30	01M030	10.01	432	4324	8.42	336	2829	84%	78%	65%
DEQ120401 - 10	01M050	10.02	432	4329	8.42	299	2518	84%	69%	58%
DEQ032102 - 11	01M074	10.01	432	4324	8.77	335	2938	88%	78%	68%
DEQ032102 - 31	01M094	10.02	432	4329	8.60	299	2571	86%	69%	59%
DEQ032102 - 51	01M114	10.01	432	4324	8.24	337	2777	82%	78%	64%
DEQ032102 - 71	01M137	10.02	432	4329	8.04	306	2460	80%	71%	57%
DEQ032102 - 91	01M157	10.01	432	4324	8.29	298	2470	83%	69%	57%
DEQ032102 - 111	01M177	10.01	432	4324	8.23	281	2313	82%	65%	53%
DEQ032102 - 131	01M197	9.99	432	4316	8.24	316	2604	82%	73%	60%
DEQ032102 - 151	01M217	10.00	432	4320	7.97	335	2670	80%	78%	62%
DEQ032102 - 171	01M237	10.00	432	4320	9.28	345	3202	93%	80%	74%
DEQ032102 - 191	01M257	10.00	432	4320	8.32	319	2654	83%	74%	61%
DEQ032102 - 201	01M267	10.01	432	4324	8.18	348	2847	82%	81%	66%
							Average	84%	73%	62%

Table 5 - Laboratory Prep Blanks

Lab ID	Lead Concentration	units
DEQ032102 - 01-20	<0.04	mg/l
DEQ032102 - 21-40	<0.04	mg/l
DEQ032102 - 41-60	<0.04	mg/l
DEQ032102 - 61-80	<0.04	mg/l
DEQ032102 - 81-100	<0.04	mg/l
DEQ032102 - 101-120	<0.04	mg/l
DEQ032102 - 121-140	<0.04	mg/l
DEQ032102 - 141-160	<0.04	mg/l
DEQ032102 - 161-180	<0.04	mg/l
DEQ032102 - 181-201	<0.04	mg/l
DEQ103101 - 01-20	<0.04	mg/l
DEQ120401 - 01-40	<0.05	mg/l

<: Concentration below instrument detection limit.

Table 6 - Aqueous LCS

Lab ID	Measured Value (mg/L)	True Value (mg/L)	Percent Recovery	Acceptable % Range
DEQ032102 - 01-20	0.92	1	92%	80-120%
DEQ032102 - 21-40	1.02	1	102%	80-120%
DEQ032102 - 41-60	1.81	2	91%	80-120%
DEQ032102 - 61-80	1.93	2	97%	80-120%
DEQ032102 - 81-100	1.76	2	88%	80-120%
DEQ032102 - 101-120	1.81	2	91%	80-120%
DEQ032102 - 121-140	2.17	2	109%	80-120%
DEQ032102 - 141-160	1.95	2	98%	80-120%
DEQ032102 - 161-180	1.73	2	87%	80-120%
DEQ032102 - 181-201	1.89	2	95%	80-120%
DEQ103101 - 01-20	1.04	1	104%	80-120%
DEQ120401 - 21-60	1.9	2	95%	80-120%

Percent Recovery = (IEL Conc.)/(Known Conc.)*100

Table 7 - Soil LCS

Lab ID	Measured Value (mg/kg)	True Value (mg/kg)	Percent Recovery	Acceptable % Range*
DEQ032102 - 01-20	5790	5111	113%	73-127%
DEQ032102 - 21-40	5250	5111	103%	73-127%
DEQ032102 - 41-60	5940	5111	116%	73-127%
DEQ032102 - 61-80	5980	5111	117%	73-127%
DEQ032102 - 81-100	5940	5111	116%	73-127%
DEQ032102 - 101-120	5180	5111	101%	73-127%
DEQ032102 - 121-140	6080	5111	119%	73-127%
DEQ032102 - 141-160	5140	5111	101%	73-127%
DEQ032102 - 161-180	5590	5111	109%	73-127%
DEQ032102 - 181-201	5540	5111	108%	73-127%
DEQ103101 - 01-20	5480	5111	107%	73-127%
DEQ120401 - 21-60	5390	5111	105%	73-127%

Percent Recovery = (IEL Conc.)/(Known Conc.) * 100

* as reported by IEL

Table 8 - Laboratory Matrix Spike (MS)/Matrix Spike Duplicates (MSD)

Lab ID MS	Lab ID MSD	Units	MS Concentration	MSD Concentration	RPD
DEQ032102 - 9	DEQ032102 - 9	mg/kg	479	467	2.5
DEQ032102 - 23	DEQ032102 - 23	mg/kg	3340	3370	0.9
DEQ032102 - 57	DEQ032102 - 57	mg/kg	618	661	6.7
DEQ032102 - 78	DEQ032102 - 78	mg/kg	749	730	2.6
DEQ032102 - 87	DEQ032102 - 87	mg/kg	426	421	1.2
DEQ032102 - 108	DEQ032102 - 108	mg/kg	795	781	1.8
DEQ032102 - 130	DEQ032102 - 130	mg/kg	1050	984	6.5
DEQ032102 - 146	DEQ032102 - 146	mg/kg	714	680	4.9
DEQ032102 - 180	DEQ032102 - 180	mg/kg	373	350	6.4
DEQ032102 - 197	DEQ032102 - 197	mg/kg	535	559	4.4
DEQ103101 - 20	DEQ103101 - 20	mg/kg	7.83	8.5	8.2
DEQ120401 - 19	DEQ120401 - 19	mg/kg	8.71	8.84	1.5
DEQ120401 - 31	DEQ120401 - 31	mg/kg	2.51	2.44	2.8
				Average RPD	3.9

RPD = ABS(X1-X2)/((X1+X2)/2)

X1 = ORIGINAL SAMPLE

X2 = DUPLICATE SAMPLE