Health Consultation

Lead Shot in Soils

BRENTWOOD ESTATES SUBDIVISION

FAIRFIELD TOWNSHIP, BUTLER COUNTY, OHIO

EPA FACILITY ID: OHN000509195

MARCH 27, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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HEALTH CONSULTATION

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Prepared by:

Ohio Department of Health
Health Assessment Section
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation

PURPOSE AND STATEMENT OF THE ISSUES

The Health Assessment Section (HAS) at the Ohio Department of Health was asked by the United States Environmental Protection Agency (US EPA) to evaluate site information associated with lead-contaminated soils at the Brentwood Estates subdivision in Fairfield Township, Butler County, Ohio. Specifically, HAS staff were asked to review and evaluate the results of sampling of surface and shallow subsurface soils (0-6" in depth) on residential lots in the subdivision and provide US EPA with a clean-up action level for the lead contamination detected in these soils. HAS comments and recommendations were forwarded to the US EPA On-Scene Coordinator on 10/07/04. This evaluation led to a US EPA Time-Critical Removal Action, consisting of removal of visibly contaminated soil from 11 properties in the subdivision March-June, 2005. This Health Consultation documents the initial HAS evaluation and the results of the US EPA Removal Action.

HISTORY AND BACKGROUND

The Brentwood Estates subdivision is in a mixed residential-rural portion of Fairfield Township, roughly two miles east of the city of Hamilton, in Butler County, Ohio. The subdivision consists of 40 acres containing roughly 80 homes off of Mindy Drive, north of Milliken Road, south of State Rt. 4, and west of the intersection with Liberty-Fairfield Road. Lots are situated along Mindy Drive, Elenor Drive, Penelope Drive, and Cassandra Court. All of the homes get their drinking water from the local public water supply. The area surrounding the neighborhood consists of additional residential communities to the east, south, and west and undeveloped agricultural land to the north. An open grassy field separates the western edge of the subdivision from the adjacent Butler Tech/D. Russell Lee Technical Center complex (Figure 1).

The subdivision is on the north slope of a bedrock hill at an elevation of 790 feet above Mean Sea Level. The land in the area slopes down to the northeast toward the valley of the Great Miami River and run-off from the subdivision flows off to two northward-trending streams that discharge to the Great Miami River roughly a mile north of the site. The subdivision is underlain by a thin layer (<35 feet thick) of clay-rich glacial till that overlies groundwater-poor shale and thin limestone bedrock (Schmidt, 1993). Soils in the area are typically moderately alkaline (carbonate-rich) and fine-textured with low to moderate permeabilities and a clay-rich, gravelly till subsoil (N.K. Lerch et al., 1980). These types of soils do not readily absorb and transmit water and are easily erodible if soil surfaces are exposed and left bare.

The Brentwood Estates subdivision was built in the late 1970's on a parcel of land that previously was the site of a trap-shooting range that operated on the property during the 1960's and 1970's (US EPA, per. comm., 2004). Homes consist of single-family bricks, either ranches or split-levels. Yards are typically large, up to 1/2 acre in area. Drainage, consisting of open ditches or covered culverts, follows Mindy Drive, curving down to the north and east prior to discharging to a storm sewer at the distal terminus of Mindy Drive. Lots are well-landscaped, grass-covered with a mix of shrubs and mature trees. Many residences have above-ground

pools, some have vegetable gardens, and flower beds typically surround most homes.

Ohio EPA Investigation

In August 2003, the Ohio Environmental Protection Agency (Ohio EPA) received information that a shooting range once existed at the property near the intersection of Mindy Drive and Millikin Road. Aerial photographs obtained by Ohio EPA verified that a trap-shooting range operated at the site during the 1960's and into the early 1970's with the property developed into a subdivision in the late 1970's. In January, 2004, Ohio EPA obtained permission from Fairfield Township to collect soil samples along the county's right-of-way within the subdivision. During sampling, clay target fragments were observed in the soils and lead levels, while below the 400 parts lead per million parts soil (ppm) residential standard for surface soils, were above typical background levels for lead in soil for the area (= 11 to 16 ppm lead; Logan and Miller, 1983).

In March, 2004, Ohio EPA requested access to sample 14 lots in the subdivision. These lots were within the suspected shot drop zone based on the aerial photographs and were the lots most likely to be impacted by past shooting activities. May and June, 2004, Ohio EPA collected soil samples from 11 of these lots. Composite soil samples were collected from intervals 0-3 inches and 3-6 inches below the ground surface at 143 sample sites, and from 6-12 inches below the ground surface at 38 of these sample sites. A total of 324 samples were collected from 143 sample sites across the 11 residential lots. On August 24, 2004, Ohio EPA and US EPA staff collected an additional 274 samples from 137 sample sites on 10 additional previously unsampled lots. A total of 598 soil samples were collected from 280 sample sites on 21 lots within the Brentwood Estates subdivision. Soils samples were collected from depth intervals of 0-3 inches and 3-6 inches below the ground surface at all 598 sampling points in 21 lots. Soils samples were not sieved prior to laboratory analyses.

Laboratory results indicated that 11 of the 21 lots sampled had total lead levels above the 400 ppm action level established by US EPA and the Ohio Department of Health at previous lead-shot contaminated sites (HAS, 2003B and 2003C). Results of this sampling (Tables 1-3) indicated elevated lead levels (>400 ppm lead) in 33 out of 280 (11.8%) surface soil samples (0-3 inches bgs) from eight residential lots, with the highest lead detections being at 24,100 ppm. Elevated lead levels were detected in 24 out of 280 (8.5 %) shallow subsurface soil samples (3-6 inches bgs) from eight lots with the highest level detected being 91,500 ppm lead. Elevated lead levels were detected in four samples out of 62 (6.5%) samples collected from the 6-12 inches bgs interval at four lots, with the highest lead level detected being at 515 ppm. Elevated lead levels (> 400 ppm) in surface and shallow subsurface soils in the subdivision tended to fall within the predicted shot drop zone, forming a broad arc extending from the west to the east just north of the intersection of Mindy and Elenor Drives (Figure 2).

HAS Site Visit

The Health Assessment Section (HAS) received the results of the Ohio EPA soil sampling the end of July, 2004. HAS staff visited the Brentwood Estates site the morning of August 24, 2004, accompanied by Ohio EPA and Tetra Tech staff. HAS staff did a walk-through of the most impacted properties, noting presence/absence of exposed dirt, presence/absence of gardens and flower beds, looked for indications of any stressed vegetation, and evidence of children playing in the yards. Most all of the yards observed in the subdivision were well-landscaped, with a thick, healthy grass cover and a mix of shrubs and mature trees. Vegetable gardens were noted in three of the lead-impacted yards. Many residences had flower beds flanking their homes. Most of these flower beds were, however, raised and covered with mulch. Backyard swimming pools and play sets were observed in about 1/3 of residences in the area of concern along Mindy and Elenor Drives.

U.S. EPA Public Meeting

U.S. EPA and HAS staff participated in a public meeting November 4, 2004, at the Fairfield Township Administration Building to meet with residents and discuss the results of soil sampling at the Brentwood Estates subdivision and the proposed U.S. EPA Time-Critical Removal Action. Prior to the public meeting, U.S. EPA and HAS staff met privately on a one-on-one basis with the eight residents with most lead-impacted properties. Individual sampling results were provided to each resident and the proposed plan to remove lead-contaminated soils from these properties was discussed. At the public meeting, U.S. EPA presented the results of the soil sampling to the public and discussed the proposed time-critical removal action.

HAS staff talked about lead toxicity and answered health-related questions from the audience. Fact sheets on lead toxicity and lead exposure from gardening were provided to the residents attending the meeting (Appendix A) . It was determined from conversations with the residents that all of the impacted residences with swing sets in the yard no longer had children living at home, being home to empty-nesters or new homeowners without any children. HAS, with the support of the Butler County Health Department, offered to conduct free blood-leading screenings of area children. No residents in the subdivision have shown any interest in participating in such a lead screening.

US EPA Time-Critical Removal Action

Upon receiving permission from residents with lead-impacted soils in their yards to carry out the proposed time-critical removal action, US EPA and its contractors initially mobilized at the subdivision site in February, 2005. Due to wet weather in the area, start-up of the actual removal action was delayed until March, 2005. US EPA contractors remobilized equipment at the site on March 28, 2005. Site work was completed June 27, 2005.

Contaminated soils in excess of the 400 ppm lead action level were identified in 41 grids encompassing 11 different properties. Sod was stripped off, and all visibly-contaminated soils (lead shot) were removed at depths from 0 to 24 inches below the ground surface. Ultimately, 3,730 tons of soil were removed from these 11 properties (US EPA, pers. comm., 2005). Lead-contaminated soils were treated with TSP and disposed of off-site at the Rumpke Landfill in Cincinnati. Twenty-eight composite confirmation samples were collected from excavated areas in the 11 properties and analyzed for lead. All of the samples collected had lead levels significantly below the 400 ppm lead action level (Table 4). Several confirmation samplings required additional excavation of several properties to insure removal of all lead-contaminated soils. Upon receipt of "clean" sample results (less than 400 ppm lead), excavated areas were backfilled with clean topsoil, regraded, and hydro seeded. All lot restorations were completed as of June 20, 2005.

During active excavation of the lead-contaminated properties, US EPA contractors carried out personal and perimeter air monitoring 2-3 times a week. Collected samples were sent to a laboratory for lead analysis. Sixty-eight samples were collected. Lead was not detected in any of the samples.

Final data packages were sent to the owners of the 11 properties, including sample data (pre and post-removal action), maps, and photos. HAS received the results of confirmation sampling carried out as part of the Time-Critical Removal Action July, 2005.

DISCUSSION

Importance of a Completed Exposure Pathway

Area residents have to come into physical contact with the lead-contaminated soils or *be exposed* to the lead in the soil in order for the lead to impact their health. In order for the residents to come into contact with the lead in the soils, there must be a *completed exposure pathway*. A completed exposure pathway consists of *five main parts* that must be present for exposure to lead to occur. These include:

- A Source of the lead in the soils (i.e., lead shot);
- A method of Environmental Transport which allows the lead to move from the shot in the soil and bring it into contact with the residents (surface soils, entrained dust, vegetables from area gardens);
- A Point of Exposure where the resident comes into direct contact with the lead;
- A Route of Exposure which is how the resident comes into contact with the lead (eating it, breathing it, touching it); and
- A Population at Risk which are the people near the site who could possibly come in

physical contact with the lead (people on the properties within the former lead shot drop zone).

Exposure pathways can also be characterized by when the exposure occurred or might occur in the *Past, Present,* or the *Future.*

Physical contact with the lead in and by itself *does not* necessarily result in adverse health effects. A chemical's ability to affect the resident's health is also controlled by a number of other factors including:

- How much of the lead a person is exposed to (the *Dose*).
- How long a person is exposed to the lead (duration of exposure).
- How often a person is exposed to the lead (acute versus chronic).

Other factors affecting the likelihood of the lead causing adverse health effects upon contact include the resident's:

- Personal habits
- Diet
- Age and sex
- Current health status
- Past exposure to lead or other metals (occupational, hobbies, etc.)

Lead Toxicity

Children (especially infants and toddlers) are the primary concern when it comes to exposure to lead because their bodies tend to absorb more lead than adults. About 99% of the lead taken into the body of an adult will leave the body as waste within a couple of weeks, but only about 32% of the lead taken in by a child will be eliminated by the body in the same manner (ATSDR, 1999). Children also appear to more sensitive to the effects of lead exposure than adults. Even at low levels, lead can affect a child's mental and physical development, in part because their brains and nervous systems are still developing. The major adverse health effect from exposures to excessive amounts of lead is damage to the nervous system potentially resulting in prolonged or permanent neuro-behavioral disorders (ATSDR, 2000).

The main exposure routes with regard to lead poisoning are via ingestion (eating or drinking it) or inhalation (breathing it in). The major pathway of concern, especially with regard to infants and toddlers, is via incidental ingestion of lead-contaminated soils/dust resulting from repeated hand-to-mouth action. Small children and infants are closer to and spend more time on the ground where they may come into contact with lead-contaminated soil and dust outdoors and lead paint chips and dust indoors. In addition, gastro-intestinal absorption of lead is five to 10 times greater in infants and young children than in adults. Inhalation of lead-contaminated dust is another major route for exposure to lead in the environment, but more commonly affects adults in specific occupational settings rather than small children in their homes or outdoors in their yards.

Recommended Lead Action Level for lead in soils

At other lead sites in Ohio, HAS and U.S. EPA have used the 400 parts per million lead residential soils standard as the action level for lead soil removal actions. These included removal actions associated with the Lewisburg Drum site in Preble County (HAS, 1998), the Norwood Radiator site in Cincinnati (HAS, 2001), the Eagle-Picher foundry site in Fulton County (HAS, 2002, 2003A), Lexington Manor subdivision in Butler County (HAS, 2003B), the Kings Mills Junior High School site in Warren County (HAS, 2003C), and at the Cincinnati Country Day School site (HAS, 2004). The 400 ppm lead levels has been used as a screening level, an action level, and/or a clean-up goal at all of these sites. The rationale for the use of this number is found in US EPA Office of Solid Waste and Emergency Response Directive #9355.4-12 (US EPA, 1994) which determined that a residential soil lead screening level of 400 ppm lead was protective of children. Exposure to lead levels of 400 ppm or less in soils is not expected to result in increased blood lead levels in children. It is believed that this conservative clean-up level is fully protective of public health, including sensitive segments of the population like small children.

Evaluation of the Health Hazard posed by Lead in Soils at the Brentwood Estates Subdivision

Lead levels detected in surface and shallow subsurface soils in 11 residential yards in the Brentwood Estates subdivision exceeded the HAS-recommended 400 parts per million lead action level for residential properties (Tables 1-3). This action level also corresponds to the US EPA Generic Screening Level for lead and was back-calculated based on blood levels of lead that could result in deleterious effects in people exposed to lead in excess of this level (US EPA, 1996). In general, if lead levels found in soils are below this level, there should be no cause for concern from a public health perspective.

As indicated above, the recommended 400 ppm lead action level was exceeded in 11.8% of the surface soil sampled collected (0-3" bgs interval), 8.5 % of the shallow subsurface soil samples collected (3-6" bgs interval) and in 6.5% of the deeper subsurface soil samples collected (6-12 " bgs interval). Elevated lead levels (> 400 ppm) were found in 11 of the 21 properties whose soils were sampled by Ohio EPA and US EPA staff in the summer of 2004. However, residents

had to come into direct contact with these soils in order to be exposed to lead levels high enough to cause the development of adverse health effects. Based on the condition of the yards in the 11 lead-impacted properties observed by HAS staff in their August 24th site visit (good grass cover and minimal exposed bare soils), the likelihood of residents being currently exposed to the lead in these soils at levels that would adversely impact their health presently was low.

Conditions at the site in the past, particularly when the Brentwood Estates subdivision was first being built in the late 1970's, are largely unknown. Area residents, especially children, may have been at risk of exposure to elevated lead levels in surface soils prior to lots being fully developed and planted with grass. As several decades have elapsed since the initial development of the subdivision, it is difficult or impossible to determine if children developed adverse health effects from lead exposures in the subdivision at that time.

Identified potential exposure pathways prior to the completion of the US EPA Removal Action included those residents whose yards had elevated lead levels and who had vegetable gardens and/or flower beds where they might have come into direct contact with the lead in the soils. These potential exposures can be greatly reduced by the use of mulch in flower beds and the addition of "clean" topsoil to gardens and flower beds. Lead up-take by vegetables is usually minimal, especially if soil pH is high as it typically is in southwest Ohio. Lettuce, spinach, and carrots are more likely to uptake lead from lead-contaminated soils compared to other vegetables (Table 5). Corn, cauliflower, asparagus, celery, beans, peas, tomatoes, melons and other fruits are least likely to absorb lead from soils (Lead Group, Inc., 2004; Shepard and Logan, 1993). Adding organic matter to garden soils and maintaining a neutral pH (> 6.5) will also cause lead to be bound to soil particles, preventing its absorption by growing crops. The potential risk from lead-contaminated soils to area gardeners can be further reduced by wearing gloves when gardening, thoroughly washing hands after working in the garden, and thoroughly washing produce prior to eating it. Many gardeners enrich the fertility of their gardens by adding topsoil to the native soils. Sampling of soils from gardens in one of the impacted lots (#32), by Ohio EPA indicated lead concentrations below levels of concern (29 and 62 ppm lead).

Other potential exposure pathways of concern prior to the completion of the Removal Action, included infants and toddlers playing in bare dirt in the properties with elevated lead levels in surface soils. Swing sets and play sets were observed in the backyards of several of the properties where Ohio EPA detected elevated lead levels (>400 ppm). However, HAS staff saw little evidence of much bare dirt exposed in any of these yards, suggesting that the likelihood of exposure was minimal. Conversations with residents also indicated a lack of small children currently in impacted yards with swing sets. To be on the safe side, parents in impacted portions of the subdivision were advised to limit contact between their children and exposed soils on their properties and to insure that hands are washed when children come in from playing outdoors. With the completion of the US EPA Time-Critical Removal Action in June, 2005, the threat of exposure to elevated levels of lead in soils on the 11 residential properties was eliminated by the removal of the lead-contaminated soils and back-filling of the excavated areas with clean topsoil. Lead in surface soils no longer poses a real or potential public health threat to residents of the 11 properties that were the sites of the US EPA Removal Action.

CHILDRENS HEALTH CONCERNS

ATSDR and HAS consider children in the assessment of all sites that pose a potential or real public health hazard. ATSDR and HAS use public health guidelines that are specifically developed to be protective of children. As indicated above, children are at a greater risk of developing adverse health effects from exposures to elevated lead levels in their environment than are adults. As such, the potential threat to the health of area children is the main focus of this health consultation.

CONCLUSIONS

- Due to the removal of the identified lead-contaminated soils from the 11 residential properties in the Brentwood Estates Subdivision as part of the US EPA Time-Critical Removal Action completed June 27, 2005, the soils at the site *currently* pose *No Public Health Hazard* to area residents.
- When the subdivision was first being developed in the late 1970's, exposed lead-contaminated soils may have posed a public health hazard to residents.
- Due to the removal of the lead contaminated soils from the subdivision, soils in the subdivision will pose *No Public Health Hazard* to subdivision residents *in the future.*

RECOMMENDATIONS (Made prior to the US EPA Removal Action)

1. The selected clean-up goal/action level of 400 ppm for lead in soils at the Brentwood Estates site is thought to be fully protective of the public health, including sensitive elements of the population like small children.

2. The occurrence of exposed, bare soils in lots determined to have elevated levels of lead in surface soils (> 400 ppm) should be minimized to prevent incidental exposure to the lead in these soils. Children should avoid contact with exposed soil in the lots with surface soils with lead concentrations > 400 ppm.

3. Residents should use good housekeeping activities to reduce their chance of exposure to lead-contaminated soils or dust. Residents should encourage frequent hand-washing following outdoor activities that might bring contact with exposed soils.

4. People with vegetable gardens are encouraged to grow produce that is less likely to absorb lead from soils, including corn, beans, peas, tomatoes, melons, and other fruits. Following gardening activities, hands should be washed thoroughly and produce should be washed prior to consumption.

5. The chances for lead exposure can be reduced further by adding clean topsoil to gardens, adding organic material to garden soils, maintaining a soil pH of neutral or higher (>6.5),

and covering exposed soils with mulch.

6. The potential for future exposures to lead-contaminated soils can be eliminated by removing soils with lead levels in excess of the 400 ppm residential clean-up standard.

PUBLIC HEALTH ACTION PLAN

Ohio EPA and US EPA completed sampling of soils in the Brentwood Estates subdivision and determined the full extent of the lead contamination in 2004. The U.S. EPA time-critical removal action to remove lead-contaminated soils from residential lots in the subdivision commenced March 28, 2005. U.S. EPA contractors removed soils with lead concentrations in excess of 400 ppm from impacted lots, back-filled them with clean topsoil, and then graded and re-seeded the properties. Removal actions were completed at all 11 lead-impacted properties June 27, 2005 (US EPA, pers. comm., 2005). Confirmation sampling indicates that lead-contaminated soils no longer pose a public health hazard to the residents of the 11 properties that were the subject of the removal action.

Previous to the completion of the removal action, HAS: 1) provided educational materials to residents with regard to potential adverse health effects from lead exposure; 2) suggested ways to reduce exposure to lead in the environment; and 3) actions to take to reduce exposure from produce grown in lead-contaminated soils. HAS participated in the November 4, 2004 public meeting with area residents and answered health-related questions posed by concerned residents. HAS reviewed the confirmation sample results collected by US EPA from the 11 properties and has determined here that the soil on these properties no longer pose a public health hazard to residents of these homes. No further HAS actions are currently planned for this site.

PREPARED BY

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Greg Stein–Health Education and Community Involvement Coordinator

CERTIFICATION

This Health Consultation for the Brentwood Estates Subdivision was prepared by the Ohio Department of Health under cooperative agreement with the Agency for Toxic Substances and Disease Registry. It is in accordance with approved methodology and procedures existing at the time the exposure investigation report was begun. Editorial review was completed by Cooperative Agreement Partner.

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CAT, SPAB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation and concurs with the findings.

Alan W. Yarbrough, M.S.
Team Leader-Cooperative Agreement Program
CAT, SPAB, DHAC, ATSDR

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TABLE 1
Lead in surface soil samples (0-3 inches in depth) from residential lots, Brentwood Estates Subdivision, Fairfield Township, Butler County (Ohio EPA, May, 2004)

Lot Number	Number of Samples Collected	Lead detects > 400 parts per million in soil (ppm)
#19	10	ND
#20	16	ND
#21	14	21-06 = 599
#22	10	22-01 = 402
#23	13	ND
#30	11	ND
#31	14	ND
#32	11	32-01 = 552 32-04 = 1,282 32-08 = 1,533 32-10 = 1,366
#33	13	33-04 = 1,217 33-05 = 1,871 33-06 = 4,895 33-08 = 1,424 33-10 = 798 33-13 = 3,747
#34	16	34-01 = 1,150 34-03 = 1,590 34-04 = 24,100 34-05 = 2,030 34-06 = 515 34-08 = 1,980 34-09 = 18,200 34-12 = 2,190 34-13 = 2,820
#74	11	ND
#75	10	ND

#76	14	76-10 = 982
#77	11	77-01 = 1,287 77-02 = 2,825 77-03 = 1,660 77-04 = 1,612 77-05 = 924 77-06 = 480 77-09 = 707 77-10 = 432 77-11 = 570
#78	16	78-11 = 544 78-16 = 847
#79	15	ND
#84	12	ND
#89	16	ND
#90	19	ND
#91	12	ND

ND = Lead not detected or detected at levels below 400 parts lead per million parts soil (ppm)

TABLE 2
Lead in shallow subsurface soil samples (3-6 inches in depth) from residential lots, Brentwood Estates Subdivision, Fairfield Township, Butler County (Ohio EPA, May, 2004)

Lot Number	Number of Samples Collected	Lead detects >400 parts per million in soil (ppm)
#19	10	ND
#20	18	ND
#21	15	ND
#22	8	ND
#23	14	ND
#30	11	ND
#31	16	ND
#32	11	32-02 = 1,350
#33	13	33-05 = 904 33-06 = 682 33-09 = 588 33-11 = 1,920
#34	18	34-03 = 451 34-03 = 418 (DUP) 34-04 = 694 34-08 = 1,211 34-09 = 1,202 34-12 = 991 34-13 = 894
#74	11	ND
#75	10	ND
#76	14	76-02 = 44,400 76-10 = 725
#77	11	77-01 = 91,500 77-02 = 1,590 77-04 = 51,900 77-05 = 501

		77-10 = 618 77-11 = 475
#78	16	78-11 = 972 78-14 = 639
#79	15	79-04 = 613
#84	13	ND
#89	17	ND
#90	19	90-10 = 970
#91	12	ND

ND = Lead not detected or detected at levels below 400 parts lead per million parts soil (ppm)

TABLE 3
Lead in subsurface soils (6-12 inches in depth) from residential lots, Brentwood Estates Subdivision, Fairfield Township, Butler County (Ohio EPA, May, 2004)

Lot Number	Numbers of Samples Collected	Lead detects > 400 parts per million in soil (ppm)
#32	3	ND
#33	3	33-10 = 404
#74	3	ND
#75	3	ND
#76	4	ND
#77	3	77-05 = 515
#78	3	78-14 = 499
#79	3	ND
#90	6	ND
#91	4	91-02 = 404/406

ND = Lead not detected or detected at levels below 400 parts lead per million parts soil (ppm)

TABLE 4
Lead in composite soil samples from excavated areas from 11 residential lots. Post-removal action confirmation samples, Brentwood Estates Subdivision, Fairfield Township, Butler County (US EPA, July, 2005)

Lot Number	Number of samples collected	Lead detects in soil (ppm)
#21	1	158
#22	1	31.8
#32	1	13.7
#33	4	10.6-132
#34	6	17.2-288
#76	2	8.3-66
#77	7	11.1-162
#78	3	8.5-186
#79	1	89.9
#90	1	8.1
#91	1	67.2

Lead in soil Action Level = 400 ppm
ppm = Parts per million

TABLE 5
Generalized Comparison of the Ability of Vegetables and Fruit to Up-take Lead from Lead-contaminated Soils

Ability to Up-take Lead from Soils	Produce
HIGH up-take of lead from soil	Lettuce, Spinach, Carrots, Endive
MODERATE up-take of lead from soil	Onions, Mustard, Potatoes, Radishes
LOW up-take of lead from soil	Corn, Cauliflower, Asparagus, Celery, Berries
VERY LOW up-take of lead from soil	Beans, Peas, Melons, Tomatoes, Fruit in general

Sources: Lead Group, Inc., 2004; Shepard & Logan, 1993

FIGURES

APPENDIX A

[Fact Sheets for Lead distributed at November 4, 2004 Public Meeting]

Figure 1. Site Location Map
Brentwood Estates
May 2004

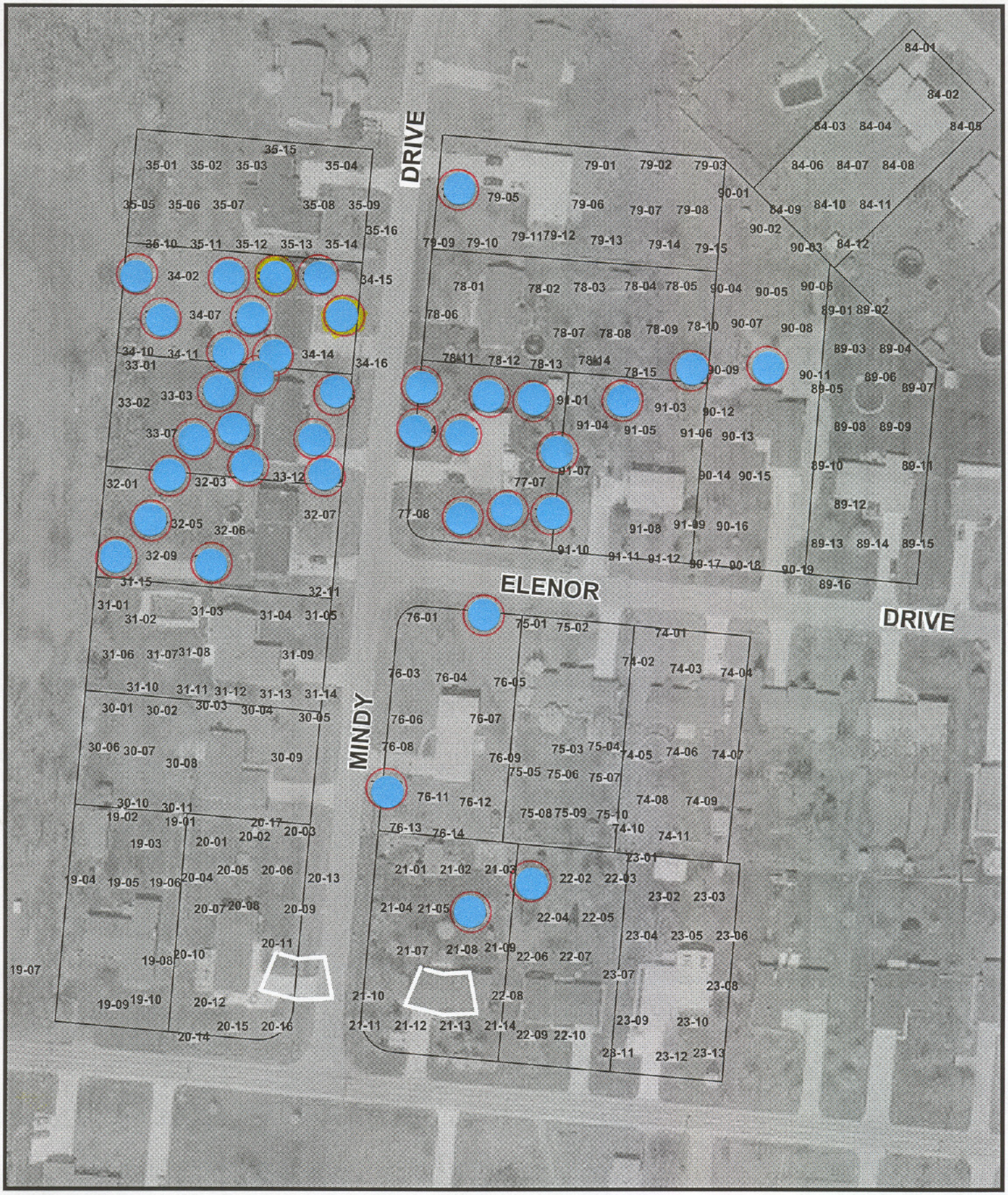

Figure 2. Soil Sample Locations (All Depths)
Brentwood Estates
September 2004

● = Lead > 400 ppm

Bureau of Environmental Health
Health Assessment Section

"To protect and improve the health of all Ohioans"

Lead

Answers to Frequently Asked Health Questions

What is lead?

Lead is a naturally occurring bluish-gray metal found in small amounts of the earth's crust. Prior to our current knowledge of the health hazards of lead, it was widely found in many of the products we used every day. Products such as gasoline, paints, batteries, metal products and ammunition just to name a few. Because lead is toxic, its use has been dramatically reduced since the 1980's.

Lead in the environment:

Lead does not break down in the environment. And although lead occurs naturally in the environment, most of the high levels of lead found come from human activities.

Once lead falls on to soil, it usually sticks to the soil particles. If the soil is uncovered and open to the air or becomes disturbed, lead-contaminated dust is created and carried by the wind. This dust is easily breathed in or swallowed. With construction activities, the possibility of lead-contaminated dust is an important concern.

Gardens grown in lead-contaminated soils may contain lead. Produce of fruits, grains and vegetables (especially root vegetables such as beets, carrots, parsnips, radishes, turnips, and rutabagas) absorb some of the lead through their roots. There is also the possibility of lead-contaminated dust falling onto crops.

Inside the house, lead can be found in lead-based paint, lead-contaminated dust, older lead pipes that carry water and some glazed pottery. A child can easily eat lead paint chips, breathe or ingest the dust on their fingers.

How does lead get in your body?

You may be exposed to lead by breathing (inhalation), eating/drinking (ingestion) or by skin contact (dermal contact). However, only very small amounts of lead can get into your body through dermal contact. Inhalation and ingestion of lead-contaminated dust and soil are the main health concerns.

How does lead affect your health?

The harmful effects of lead are the same whether it is breathed or swallowed. The main target for lead toxicity is the nervous system, including the brain. But lead can negatively affect every organ of the body.

Children are most vulnerable to lead poisoning because they play outside, close to the ground or in the dirt. Small children also put their fingers in their mouths. Compared to adults, a bigger proportion of the amount of lead swallowed will enter the blood in children. About 99% of the amount of lead taken into the body of an adult will leave in the waste within a couple of weeks. But only about 32% of the lead taken into the body of a child will leave in the waste.

Lead exposure in the womb, in infancy, or in early childhood may also slow mental development and lower intelligence later in childhood. Lead can cause irritability and aggressive behavior in children. If pregnant women have high levels of lead in their bodies, fetuses exposed to lead in the womb may be born prematurely and have lower weights at birth. In some cases, pregnant women with high levels of exposure to lead may have miscarriages.

Some other harmful health effects of lead include damaged kidneys, damaged male reproductive system, severe "stomachaches," a poor appetite, sleep disorders, and hearing problems. Lead can also decrease reaction time and affect the memory.

Is there a medical test to determine whether I have been exposed to lead?

Yes, there is a test to see if you have been exposed to lead. The primary screening method is the measurement of total lead in the blood. This test can tell if you have been recently exposed to lead.

Also, exposure to lead can be evaluated by measuring the erythrocyte protoporphyrin (EP) in the blood sample. EP is a part of red blood cells known to increase when the amount of lead in the blood is high. However, the EP level is not sensitive enough to identify children with elevated blood lead levels below about 25 micrograms per deciliter (µg/dL). For this reason, total lead is the primary method of screening.

Lead can also be measured lead in teeth or bones by X-ray techniques. These tests can tell about long-term exposure but are not widely available..

How can families reduce the risk of exposure to lead?

The most important way a family can lower exposures to lead is to avoid exposure to lead-contaminated soil and dust sources, avoid lead-based paint chips, avoid water from lead-lined pipes and avoid some plastic products made outside the United States.

The swallowing of lead-contaminated soil or dust is a very important exposure pathway for children. This problem can be reduced in many ways. Regular hand and face washing to remove lead dust and soil, especially before meals, can lower the possibility that lead on the skin is accidentally swallowed while eating. Families can lower exposures to lead by regularly cleaning the home of dust and tracked-in soil. Door mats can help lower the amount of soil that is tracked into the home and removing your shoes before you enter the house will also help. Planting grass and shrubs over bare soil areas in the yard can lower contact that children and pets may have with soil and the tracking of soil into the home. Also, wash all produce grown in lead-contaminated soils before eating.

Families whose members are exposed to lead-contaminated soil and dust can minimize the exposure to children by changing and bagging their work clothes before they are brought into the home for cleaning. Also, they should immediately wash their hands or shower.

It is important that children have proper nutrition and eat a balanced diet of foods that supply adequate amounts of vitamins and minerals, especially a diet high in calcium and iron. Good nutrition lowers the amount of swallowed lead that passes to the bloodstream and also may lower some of the toxic effects of lead.

Has the federal government made recommendations to protect human health?

The Centers for Disease Control and Prevention (CDC) considers children to have an elevated level of lead if the amount of lead in the blood is at least 10 µg/dL. Medical evaluation and environmental investigation and remediation should be done for all children with blood lead levels equal to or greater than 20 µg/dL. Medical treatment may be necessary in children if the lead concentration in blood is higher than 45 µg/dL.

The Environmental Protection Agency (EPA) requires that the concentration of lead in air that the public breathes be no higher than 1.5 micrograms per cubic meter ($\mu g/m^3$) averaged over 3 months. EPA regulations no longer allow lead in gasoline. The Clean Air Act Amendments (CAAA) of 1990 banned the sale of leaded gasoline as of December 31, 1995.

The EPA regulations also limit lead in drinking water to 0.015 milligrams per liter (mg/L). The 1988 Lead Contamination Control Act requires the Consumer Product Safety Commission (CPSC), EPA, and the states to recall or repair water coolers containing lead. This law also requires new coolers to be lead-free. In addition, drinking water in schools must be tested for lead, and the sources of lead in this water must be removed.

To help protect small children, CPSC requires that the concentration of lead in most paints available through normal consumer channels be not more than 0.06%. The Federal Hazardous Substance Act (FHSA) bans children's products containing hazardous amounts of lead.

The EPA has also developed standards for lead paint hazards, lead in dust, and lead in soil. To educate parents, homeowners, and tenants about lead hazards, lead poisoning prevention in the home, and the lead abatement process, EPA has published several general information pamphlets. Copies of these pamphlets can be obtained from the National Lead Information Center or from various Internet sites, including http://www.epa.gov/opptintr/lead.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 1997. Toxicological profile for lead. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

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Bureau of Environmental Health
Health Assessment Section

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Lead Contamination in Gardens

Answers to Frequently Asked Health Questions

What is lead?

Lead is a naturally occurring bluish-gray metal found in small amounts of the Earth's crust. Prior to our current knowledge of the health hazards of lead, it was widely found in many of the products we used every day. Products such as gasoline, paints, batteries, metal products and ammunition just to name a few. Because lead is toxic, its use has been dramatically reduced since the 1980s.

Lead in the environment:

Lead does not biodegrade (break down) in the environment. Once lead falls on the soil it usually sticks and remains a long-term source of lead exposure.
If the soil is uncovered and open to the air or becomes disturbed, lead-contaminated dust is created and carried by the wind. This dust is easily breathed in and/or swallowed.

The possibility of dust being created at a lead-contaminated site is an important health concern. Activities such as construction, where you are moving dirt and disturbing large areas, are very concerning because construction sites often create a lot of dust.

Other activities such as gardening also disturb and expose soils and may create small amounts of dust. But more importantly, some garden vegetables grown in lead-contaminated soils may contain lead. Certain vegetables (especially root vegetables such as beets, carrots, turnips, radishes, potatoes and rutabagas) easily absorb (uptake) some of the lead through their roots. There is also the possibility of lead-contaminated dust falling onto crops such as lettuce, spinach or other leafy vegetables.

How does lead get in your body?

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How does lead affect your health?

The harmful effects of lead are the same whether it is breathed or swallowed. The main target for lead toxicity is the body's nervous system, including the brain. But lead can harm every organ of the body.

Children are most vulnerable to lead poisoning because they play outside, close to the ground or in the dirt. Small children also put their fingers in their mouths. Compared to adults, a bigger proportion of the amount of lead swallowed will enter the blood in children. About 99% of the amount of lead taken into the body of an adult will leave in the waste within a couple of weeks. But only about 32% of the lead taken into the body of a child will leave in the waste.

Lead exposure in the womb, in infancy or in early childhood may also slow mental development and lower intelligence later in childhood. Lead can cause irritability and aggressive behavior in children. If pregnant women have high levels of lead in their bodies, fetuses exposed to lead in the womb may be born prematurely and have lower weights at birth. In some cases, pregnant women with high levels of exposure to lead may have miscarriages.

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Is there a medical test to determine whether I have been exposed to lead?

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Lead can also be measured lead in teeth or bones by X-ray techniques. These tests can tell about long-term exposure but are not widely available.

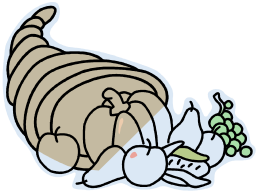
How can families reduce the risk of exposure to lead?

One important way a family can lower their exposure to lead is to avoid exposure to lead-contaminated soil and dust sources. The swallowing of lead-contaminated soil or dust is a very important exposure pathway for children and gardeners.

Helpful hints:

- Washing your hands to remove lead dust and soil, especially before meals, can lower the possibility that lead on the skin is accidentally swallowed while eating.
- Families can lower exposures to lead by regularly cleaning the home of dust and tracked-in soil.
- Door mats can help lower the amount of soil that is tracked into the home and removing your shoes before you enter the house will also help.
- Covering bare soil with clean sand, wood chips, gravel or grass can lower contact that children and pets may have with soil and the tracking of soil into the home.
- Bag gardening-work clothes before they are brought into the home for cleaning.
- Immediately wash your hands or shower after working with lead-contaminated soils.

It is important that children have proper nutrition and eat a balanced diet of foods that supply adequate amounts of vitamins and minerals, especially a diet high in calcium and iron. Good nutrition lowers the amount of swallowed lead that passes to the bloodstream and also may reduce some of the toxic effects of lead.



The Ohio Department of Health has a cooperative agreement with the Agency for

This pamphlet was created by the Ohio

Good Gardening Practices:

- Plant gardens away from roads, driveways and old painted structures that may contain lead-based paints.
- Protect gardens against air-borne lead by erecting a fence or plant a hedge between your garden and bare soils.
- Grow crops in raised beds or containers with lead-free soil.
- Estimate the amount of soil in your garden and mix one-third the total volume of soil with organic material such as peat moss, compost and manure. Organic mulch worked into soil, especially fresh manure, binds the lead so it is not available to be taken up by plants. Note: Avoid the use of bone meal.
- Plant fruiting crops such as tomatoes, peppers, squash, cucumbers, peas, beans, corn, melons, strawberries, etc.
- Limit planting leafy vegetables such as lettuce, spinach or greens. Avoid planting root crops such as carrots, beets, turnips, potatoes and radishes. If you grow leafy vegetables, discard old and outer leaves of the vegetable and scrub and peel any root crops before eating. **Do not** compost these materials!
- Wash vegetables with I% vinegar in water solution (1 - 2 ounces vinegar per gallon of water). Use a stiff brush to scrub vegetables before eating.
- Lime the soil as recommended by your soil test to obtain a pH of 6.5. Lime can be found at farm and garden supplies stores.
- If you are worried about gardening in lead-contaminated soils, bring in lead-free soil, install raised beds, try container gardening and/or mix the soil with organic material. Fresh fruits and vegetables not only taste good, they are good for you. You don't have to stop gardening!

References:

Agency for Toxic Substances and Disease Registry (ATSDR). 1997. Toxicological profile for lead.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

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