



The **Hazard Evaluation and Emergency Response Office (HEER Office)** is part of the Hawai'i Department of Health Environmental Health Administration whose mission is to protect human health and the environment. The HEER Office provides leadership, support, and partnership in preventing, planning for, responding to, and enforcing environmental laws relating to releases or threats of releases of hazardous substances.

Lead in Hawaiian Soils: Questions and Answers

This fact sheet provides landowners, private citizens, farmers, developers, realtors, and others with an overview of the potential human health concerns associated with lead in soils in Hawai'i. Additionally, this fact sheet discusses methods for reducing exposure to lead and provides resources for further information.

What is lead and how does it get in the soil?

Lead is a naturally occurring element that occurs in all soils, including Hawaiian soils, at low levels. Natural background levels of lead in soils are typically 10 to 75 mg/kg (milligrams of lead per kilogram of soil) but elevations in the range of 100-200 mg/kg, levels still considered below a significant long-term health hazard risk, can be found in isolated cases due to additional inputs from historic human activity. Higher lead levels in soils (e.g. >200 mg/kg) may be present from a variety of pollution sources related to historic or current human activities. Exposure to very high levels of lead can be toxic to humans and animals, causing serious health effects. Most childhood exposures to lead can be traced to lead-based paint or lead in batteries, jewelry, and other household items. Exposure to lead in soil can also be important, however.



Lead shot at a firing range. There are several sources of human-caused lead contamination that affect Hawai'i's soil and groundwater.

There are two main human-caused sources of lead in soils: the past use of lead-based paint in homes and the past use of leaded gasoline. Although lead in gasoline was phased out starting in the 1970s, years of leaded gasoline use means the soils adjacent to highways and roads have elevated lead levels. Studies in urban areas have shown that soil lead levels are highest around building foundations and within a few feet of busy streets. Lead from leaded gasoline is also found in soils affected by past releases from storage tanks and pipelines at gas station sites. Other human-caused sources of lead in soil include pipes and plumbing materials, roofing nails, and batteries. Some industrial sources of lead contaminate the soil as well. Lead shot at former and active firing ranges, scrap metal yards, and ash from burning lead-bearing wastes like painted wood and batteries can all contribute to lead contamination in soils. When lead is released to the air from industrial sources or vehicles, it may travel long distances attached to fine particles before settling to the ground, where it mixes with soil particles. Lead does not biodegrade in soils, but can be dispersed through natural or human soil disturbances over time or could be transported by erosion to adjacent areas.



The State of Hawai'i Department of Health's (HDOH) Hazard Evaluation and Emergency Response Office (HEER Office) is responsible for responding to releases of lead and other hazardous substances into the soil or groundwater, and overseeing cleanup efforts. Other state and federal agencies have complementary roles in helping to prevent and address lead contamination and exposure. Additional information for these other resources are included at the end of this fact sheet.

How are people exposed to lead in the soil?

Ingesting the soil is the primary source of exposure to lead in soil. Lead can also be inhaled with very fine soil particles during outdoor tasks (e.g. dust from yard work or construction work) or carried into houses as airborne dust, or on shoes, clothing, and pets where it gets on floors or other objects that residents then come in contact with.



Children are at risk of lead exposure from unintentional ingestion of soil through normal play activities.

Lead was added to paint as early as the Medieval ages to speed up drying and increase durability. The use of lead in house paint was banned by 1978 but it still exists in the interior and/or exterior paint of many older homes in Hawai'i. As a result, real estate sales must disclose the potential presence of lead based paint on buildings built before 1978. As the paint chips off, it falls to the ground where the lead-contaminated chips persist in the soil near the foundation. In addition, some older type roofing nails contain lead. Roofing nails have wide, flat heads and short shanks. Similar to the paint chips, as the roofing nails fall off and land adjacent to the foundation, lead can be leached from the nails and mix with soil.



Lead-based paint is still present in many homes in Hawai'i. Children are at risk from eating paint chips and flakes. The paint chips can also fall off the house exterior and get in the soil adjacent to the foundation where children may play.

People, and especially young children, may unintentionally swallow very small amounts of lead-contaminated soil through gardening or other normal outdoor work or play activities. Children frequently put their hands, toys, or other objects in their mouths, and these can often have small amounts of soil and dust on them that the child then swallows.

Exposure to lead can also result from eating produce grown in gardens with elevated soil lead levels, such as gardens near building foundations where deteriorated lead-paint may be present or gardens adjacent to busy roadways. In general, plants do not absorb or accumulate lead. A greater concern is the accidental ingestion of lead in soil or dust particles found on unwashed produce. Thorough washing of produce is especially important for root crops such as taro, carrots or sweet potatoes and leafy vegetables like fern heads, kale and lettuce due to the tendency of soil particles or dust to adhere to the surface of this produce.



What are the human health concerns of lead exposure?

Lead can be particularly harmful to pregnant women and young children. According to the U.S. Centers for Disease Control (CDC) lead poisoning is the most common and serious “environmental” disease affecting children. Children’s bodies absorb more lead than adults do and their brains and nervous systems are more sensitive to the damaging effects of lead.

Lead can affect most every organ and system in the human body. Ingestion of large amounts of lead can cause seizures, coma and even death. Adults exposed to high levels of lead have had health symptoms that include: cardiovascular problems, increased blood pressure and incidence of hypertension; decreased kidney function; and reproductive problems (in both men and women).

Significant lead exposure to young children is typically traced to lead-based paint, batteries, jewelry, or other household articles rather than lead in soil. Exposure of children to even low levels of lead has been shown to result in behavior and learning problems, lower IQ and hyperactivity, slowed growth, hearing problems, insomnia, and anemia. Once absorbed by the human body, lead is difficult to remove. Consequently, limiting exposure to lead wherever possible is recommended.

How can I test to see if I have been exposed to lead?

If you have evidence or documentation of lead contaminated soils on your property (i.e. soils that exceed the state lead action levels) or if you think you or a family member may be experiencing symptoms of lead poisoning, you can contact your physician or local health department for information on blood lead testing. Any lead exposure testing should be recommended and conducted by a doctor or trained medical professional. A simple blood test is available to measure lead levels. Testing can determine if the level of lead in the body is higher or lower than the average person. The U.S. Center for Disease Control has updated its recommendations on children’s blood lead level of concern for young children to 5 micrograms per deciliter of lead in the blood. The testing cannot determine the origin of the lead (for example soil or food) or whether the lead levels in the body will affect the person’s health.

When should testing for soil lead be conducted?



This picture shows soil sample collection from a small garden. Gardens grown near house foundations or near busy roadways have the potential for elevated soil lead concentrations.

Residential or commercial buildings that were built before 1978 or are located near busy roadways may potentially have elevated lead in soil surrounding the foundation area or in soil near the busy roadway due to former use of lead-based paint on the structures or the former use of lead-containing gasoline by vehicles. If you suspect elevated levels of lead in your soil, you may want to have the soil tested. You can hire an environmental professional to conduct testing, or call the HEER Office for advice on sampling and laboratory analysis of any samples collected.

Lead in soil may be very unevenly distributed and therefore, a “Multi Increment” sampling approach for soil lead testing is advised. Multi Increment samples are typically large (weighing between 500-2,000 grams, or filling at least one-half of a gallon-size plastic bag) as each sample is made by combining many small soil increments that are collected from the area of interest. Lead tends to accumulate in the upper few inches of soil and does not move to any great extent in soils unless the soil has been disturbed by activities such as excavation for building or



tillage for landscaping and gardening (a low soil pH may also enhance the mobility of lead). Surface soil samples are typically collected using a small diameter (approximately 1 inch) hand-coring tool from the ground surface down to about 2 to 6 inches in depth, targeting the surface soil depth where exposure may be most likely for you or your family.

Soil testing is the only option to know for certain if levels are elevated, to what extent, and to what depth. Laboratories in Hawai'i that have facilities to analyze soils for lead content can be found in internet directories or in the phone book under "Environmental Analysis Laboratories" or "Analytical Laboratories". Laboratories should be contacted to confirm the services provided and to coordinate on sample collection and delivery details. Laboratories should dry and sieve the Multi Increment sample(s) they receive to analyze the ≤ 2 millimeter (mm) particle size soil fraction for total lead content.

How are soil lead testing data evaluated?

A professional environmental consultant can be hired or the HEER Office can be consulted for questions regarding the evaluation of your data and to provide recommendations. The HEER Office has established environmental action levels or standards for lead in soil. Total lead in soil concentrations should not exceed 200 mg/kg for residential properties and 800 mg/kg for commercial and industrial properties. The HEER Office environmental action levels were developed taking into consideration potential health risk determinations based on predicted bioaccessible lead levels. Bioaccessible lead levels take into account only the estimated proportion of total lead that will be absorbed in the digestive system and potentially contribute to human health risks (a portion of the lead stays tightly bound to soil particles and will not be absorbed).

If soil results show estimated total lead levels are above 200 mg/kg, young children and pregnant women should avoid contact with the bare soil. Cleanup actions may be warranted for residential properties where soil lead levels exceed 200 mg/kg. Total lead levels above 800 mg/kg are considered a potential concern even for commercial or industrial uses of a property, and warrants action to further evaluate lead levels in soil or evaluate and pursue cleanup options. Contact the HDOH HEER Office if testing indicates soil lead levels are above the applicable environmental action levels, and for specific advice on lead control or removal measures that should be taken.

How can I remove lead from the soil?

Currently, the best ways of dealing with high lead soils are to (1) if feasible, eliminate the lead exposure risk by physically removing the contaminated soil to an approved landfill, or (2) covering the lead-containing soils with clean soils. An additional potential method of reducing the hazard of lead in soils is geochemical fixation. Geochemical fixation uses a non-toxic chemical mixed into the contaminated soil to convert the potentially toxic form of lead into a compound less likely to be absorbed by the body if accidentally ingested or inhaled. Soil removal or remediation actions at sites where lead in soil exceeds HEER Office environmental action levels should be conducted by qualified individuals such as professional environmental consultants.

What can I do to prevent exposure to lead-contaminated soil?

If testing reveals elevated soil lead levels on your property, or you live or work in an area that may have elevated soil lead levels, the potential for exposure can be minimized through the following actions:

- Wash hands and face thoroughly after working or playing in the soil, especially before meals and snacks.



- Keep dense groundcover or permanent cover close to the house, roads, and driveways to prevent children from playing in soil where higher lead levels may be found.
- Keep children from playing in bare dirt. Keep toys, pacifiers, and other items that go into children's mouths clean.
- Plant gardens away from house foundations, roads, and driveways where lead levels in the soil may be higher. Have your garden soil tested for lead before you plant. Lime soils as recommended by a soils test; a soil pH of 6.5 to 7.0 will minimize lead mobility.
- Bring in clean sand for sandboxes and add soil known to be free of contamination to food garden areas. Raised garden beds with clean soils should be used if you know your soil has elevated lead concentrations.
- Wash fruits and vegetables from the garden with water before bringing them in the house. Wash again carefully with a 1% vinegar solution or soapy water to remove any remaining soil particles. Discard outer leaves before eating leafy vegetables. Pare root and tuber vegetables before eating. Do not compost the produce peelings and unused plant parts for use back in the vegetable garden.
- Avoid tracking soil into the home and clean up right away if soil is tracked in. Leave shoes at the door or use door mats. Keep pets from tracking soil into your home.

Further Information

For questions related to lead in soils and groundwater, lead sampling, lab analysis and lead testing reports, contact:

Hawai'i Department of Health,
Hazard Evaluation and Emergency Response Office
919 Ala Moana Boulevard, Room 206
Honolulu, Hawai'i 96814

Telephone: (808) 586-4249
Website: <http://hawaii.gov/doh/heer>

On Hawai'i Island: call the Hilo HEER Office at 808-933-9921

State of Hawai'i Indoor and Radiological Health Branch's lead program helps: (1) prevent exposure to lead and lead-based paint, and (2) maintains the State of Hawaii lead abatement accreditation, certification, and registration systems for lead abatement entities and individuals: <http://health.hawaii.gov/irhb/lead/>

State of Hawai'i Solid and Hazardous Waste Branch provides guidance on disposal of lead based paint waste and how to manage used lead acid batteries: <http://health.hawaii.gov/shwb/files/2013/06/lbpwaste.pdf> and <http://health.hawaii.gov/shwb/files/2013/06/oldcbats1.pdf>

State of Hawai'i Children with Special Health Needs Branch has a Childhood Lead Poisoning Prevention Program: <http://health.hawaii.gov/cshcn/home/leadpp/>

State of Hawai'i, Safe Drinking Water Branch provides subsidized lead and copper testing for individual homes served by catchment systems: <http://health.hawaii.gov/sdwb/raincatchment/>

Workplace exposures to Lead

Preventing lead exposures for workers such as those in construction, manufacturing, or other businesses is the



responsibility of the employer through compliance with applicable workplace safety and health regulations.

U.S. Environmental Protection Agency's (EPA) Lead Renovation, Repair and Painting Certification requires that companies performing projects that disturb lead-based paint in homes, child care facilities and pre-schools built before 1978 have their company certified by EPA or the State of Hawai'i, use certified renovators who are trained by EPA-approved training providers, and follow lead-safe work practice:

<http://www2.epa.gov/lead/renovation-repair-and-painting-program>

State of Hawai'i Occupational Safety and Health Division (HIOSH) oversees safe and healthful working conditions for workers in Hawai'i. This includes inspecting workplaces to ensure workers are protected:

<http://labor.hawaii.gov/hiosh/> . For construction workers, see the guidance on OSHA's Lead in Construction Standard: <https://www.osha.gov/Publications/OSHA3142.pdf>

Other Resources for Lead Exposure:

Agency for Toxic Substances and Disease Registry's ToxFAQs website is a federal government website providing information and recommendations regarding lead: <http://www.atsdr.cdc.gov/toxfaqs/index.asp>

Centers for Disease Control (CDC) Lead Poisoning Prevention Program has information to help eliminate childhood lead poisoning in the United States: <https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=93&tid=22>

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