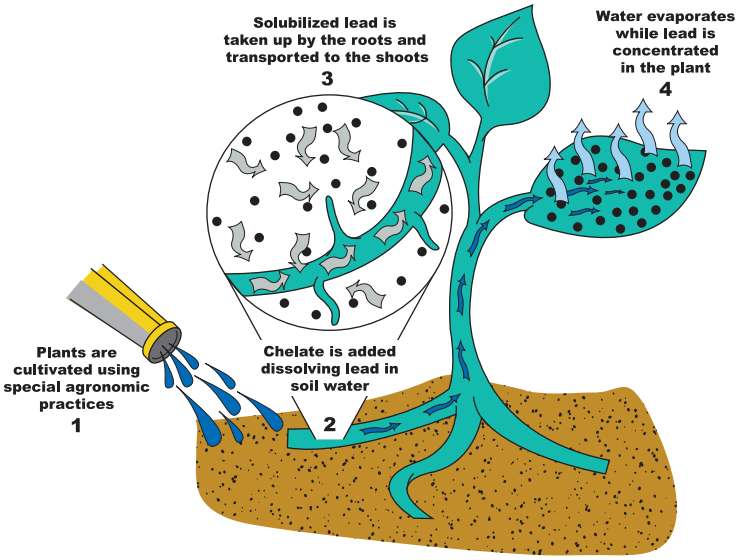
Appendix C

Future Options—Using Plants to Treat Lead-Contaminated Soils

This handbook focuses on measures that can keep children safe by reducing their risk of exposure to lead. The fact is, though, that unless the lead is permanently removed, exposure can reoccur (for example, if landscaping measures are not maintained).

The most frequently used method of removing the lead is to dig up the contaminated soil and haul it to a hazardous waste facility. This method is costly and requires intensive labor. However, some promising and innovative experiments explore how to minimize lead exposure by actually extracting it from the soil. This angle of research explores how nature itself, through a process called phytoextraction, might hold a potent solution for removing lead and other hazardous metals from contaminated soils.

Phytoextraction involves using living green plants for removing contaminants, such as lead, from soil and water. The term refers to the uptake of metal contaminants by the plant's roots and the subsequent transport of the contaminants to various parts of the plant. In general, plants do not absorb or accumulate lead.[19] But certain plants, such as the sunflower and Indian mustard, absorb remarkably large amounts of metals compared to other plants and actually survive. After the plants are allowed to grow on a contaminated site for a period of time with proper soil amendments to mobilize the metal, they are harvested. After this, they are either disposed of as a hazardous waste or incinerated (and the metals recycled). The schematic below illustrates phytoextraction processes (adapted from http://aspp.org/public_affairs/briefing/phytoremediation.htm).



[19] Carl Rosen and Robert Munter. 1998. *Lead in the Home Garden and Urban Soil Environment.* University of Minnesota Extension Service. FO-2543-GO. http://www.extension.umn.edu/distribution/horticulture/DG2543.html

Scientists have studied phytoremediation (the use of plants to recover contaminated soils and water) extensively. It is slowly becoming an acceptable, and even preferred, technology. Numerous demonstration projects have shown the promise of phytoremediation. For example:

- In Trenton, New Jersey, the Gould National Battery site was home to commercial lead-acid battery manufacturers from the 1930s to the 1980s. In those years, the land became heavily contaminated with lead. Under the Brownfields Initiative, the U.S. Environmental Protection Agency awarded Trenton a grant to restore the site. In 1995, Phytotech Inc. (now Edenspace Systems Corporation) approached the city about using "green technology" to clean up the site. Three crops of plants over a summer reduced lead levels on 75 percent of the treated area to below the New Jersey residential standard of 400 parts per million. See http://www.edenspace.com/CaseStudies.htm.

- In Chernobyl, a team of scientists from Rutgers University headed by plant biologist Ilya Raskin tested phytoextraction to remove radioactive cesium and strontium from a contaminated pond. Sunflowers were set floating on small polystyrene rafts so that their roots dangled in the water. Despite the poisons, the plants thrived. So far, Raskin has used phytoextraction techniques in sites in New Jersey, Massachusetts, and Connecticut.

Only a handful of demonstration projects focused on removal of lead from residential soils. Here's an example from the Boston metro area:

- The Boston Health Department sought a comprehensive strategy to remove lead from a small Dorchester neighborhood that hosted a cluster of childhood lead poisoning cases. Excavation and removal simply cost too much, so the department sought other methods. They teamed with Edenspace Systems Corporation to explore phytoextraction using Indian mustard plants on a 1,000-square-foot test site in the neighborhood. They spread a soil amendment that would loosen the lead so it dissolves in the moisture. They planted Indian mustard, which is well suited for metal removal because it accumulates the metal in its leaves rather than its roots. After six weeks, they harvested the plants and analyzed the soil. Lead concentrations decreased 47 percent, and after a second growing, the overall lead reduction was 63 percent (from 1,500 ppm to under 300 ppm). The harvested plants were incinerated, and the metals in the ash were recycled. Based on the results of the demonstration, Tom Plante of the Boston Health Department feels this method is very effective in reducing lead levels in soil and has the potential for a wide array of applications including brownfields—and now urban residences (if there is enough sunlight and moisture). For more information on this demonstration project, visit the Boston Childhood Lead Poisoning Prevention Program at http://www.tiac.net/users/bdph/oeh/leadhome.htm.

Edenspace Systems Corporation is continuing research on residential soil-lead remediation. One of the challenges of lead remediation in residences is that the plantings can put an entire yard out of use and out of sight for months or even years. Therefore, the company is researching the potential of turf grasses to extract lead from the soil. Making the technology affordable, ensuring proper sunlight and irrigation, bringing heavy machinery into residential neighborhoods, and reaching lead that is too far for plant roots to reach might pose additional challenges. However, research will continue to build on existing knowledge of phytoextraction and help address the potential challenges.

For more information on phytoextraction and other forms of phytoremediation, see the following online resources:

Edenspace Systems Corporation
Edenspace now owns or licenses an array of proprietary techniques used in removing lead, arsenic and other metals from the environment. The resources page provides many useful links to articles on phytoremediation.
http://www.edenspace.com/newpage4.htm

Phytoremediation: using plants to remove pollutants from the environment
An overview of phytoremediation written by Rutgers University plant biologist Ilya Raskin.
http://aspp.org/public_affairs/briefing/phytoremediation.htm

Rutgers University Center for Agriculture and Environmental Technology
One of the pioneer research institutions for phytoremediation.
http://aesop.rutgers.edu/~biotech/brochure/index.html

U.S. EPA Citizen's Guide to Phytoremediation
http://www.epa.gov/swertio1/products/citguide/phyto2.htm