RE-DEFINING BROWNFIELDS

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SAFE URBAN GARDENING

Why Test Soil?

A wide variety of health risks relating to soil contamination have been identified; however, it is important to know which types of contaminants and the level to which the contaminants are present in the soil to understand the particular health risks of any property. Soil testing is an effective way of addressing these concerns and can be the first step in ensuring the health and safety of everyone involved. Efforts to improve garden quality and protect the public health of a community should begin with soil testing.

Sources of Soil Contamination

See the table below for a list of common sources of contamination and the specific contaminants associated with their use. Information regarding the toxicological profiles of specific contaminants is available through the Agency for Toxic Substances and Disease Registry (ATSDR) (http://www.atsdr.cdc.gov/).

Common Sources of Contamination

General Source	Specific Contaminant
Paint (‹ 1978)	lead
High Traffic Areas	lead, zinc, PAHs*
Treated Lumber	arsenic, chromium, copper
Burning Wastes	PAHs, dioxins
Manure	coppers, zinc
Coal Ash	molybdenum, sulfur
Sewage Sludge	cadmium, copper, zinc, lead, PBTs**
Petroleum Spills	PAHs, benzene, toluene, xylene
Commercial/Industrial Site Use	PAHs, petroleum products, solvents, lead, other heavy metals
Pesticides	lead, arsenic, mercury (historical use), chlordane and other chlorinated pesticides

* Polycyclic aromatic hydrocarbons (PAHs) are chemicals that are formed during the burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat.

** Persistent, bioaccumulative, and toxic pollutants (PBTs) are highly toxic and long-lasting chemicals that can build up in the environment and are harmful to human and ecosystem health. They are associated with a range of adverse human health effects.

Testing Your Soil: Sampling Procedures & Collection Strategies

There is no best, one-size-fits-all strategy for collecting soil samples. To determine an appropriate and helpful strategy, it is important to consider what type of information you hope to learn from testing the soil.

General Collection Procedures

1. *Select the collection sites* based on what information you hope to learn from the test results. It is important to consider what information is needed relative to the cost of analysis so that you can get the most information with the resources you have.
2. *Make a map or diagram* to record where the samples are collected and how they were collected (including the depth of soil collected). Labels on each sample should correspond with the diagram for easy reference. This information will be useful for interpreting the test results from the laboratory.

3. *Collect the samples* from each sampling location. It is important to remove any surface vegetation and use a clean trowel, scoop or spoon to collect the sample to avoid cross-contamination. Use a different trowel, scoop or spoon for each sample or wash your tool with soap and water between samples. For composite samples, it is fine to use the same sampling instrument to take the 5–10 samples.
4. *Package the samples.* For individual (not composite) samples, put each sample into a different container (as recommended by the laboratory). For composite samples, mix the individual samples in a clean container (such as a clean plastic bag placed inside a bucket) and then transfer the mixed sample to the container that will be sent to the laboratory. To ensure accurate and timely results, it is important to carefully follow the instructions provided by the laboratory regarding how to package and label the soil samples.
5. *Send the sample(s) to the laboratory as instructed.* Again, to ensure accuracy and timeliness, carefully follow the shipping instructions provided by the laboratory. Also take note of the how long it takes to receive the results so samples that need to be analyzed within a certain timeframe will be processed.

What Do You Hope to Learn?	Strategy
What are the contaminant levels in a specific area, i.e. children's play area?	Collect separate samples of the top 1–2 inches of soil.
What are the average levels of contaminants in surface soil?	Collect multiple composite samples of the top one to two inches of soil from across the site. To determine if the concentrations vary throughout the property, collect a separate sample from each area.
What are the contaminant levels in my garden's soil?	Collect deeper samples (about six inches) from multiple locations (between 5–10 spots) and mix them together to create a composite sample. Because the levels of a particular contaminant can vary throughout a site, it is important to collect and test at least three composite samples. To find out if certain areas have higher concentrations than others, reserve a small amount of each separate sample for discrete testing.

Soil Testing Laboratories

Soil and Plant Tissue Testing Lab
West Experiment Station
682 North Pleasant Street
University of Massachusetts
Amherst, MA 01003
Phone: (413) 545-2311
Email: soiltest@psis.umass.edu

The goal of the Soil and Plant Tissue Testing Laboratory, located on the campus of the University of Massachusetts at Amherst, is to provide test results and recommendations that lead to the safe and cost-effective use of soils and soil amendments. To test for lead and to measure the levels of major nutrients in soil, the Soil and Plant Tissue Testing Lab charges $9. An online list of their services as well as a brochure and order form is available at the University of Massachusetts Amherst Department of Plant and Soil Sciences website (http://www.umass.edu/plsoils/soiltest).

Microbac Laboratories Inc.
3323 Gilmore Industrial Blvd
Louisville, KY 40213-2174
(502) 962-6400
http://www.microbac.com

Microbac is a national commercial testing and analytical laboratory group and offers services in environmental testing, environmental monitoring, and environmental analysis. Its laboratories are equipped to test for contaminants, such as mercury and arsenic that are often not included in routine analyses. Microbac charges $20 per sample to test for mercury and $15 per sample to test for arsenic.

Soil Testing Costs

The cost of testing depends on the number of samples tested (more samples will be more expensive), whether the samples are analyzed for one contaminant or many (tests for multiple contaminants will be more expensive), and which contaminants are being tested for (analyses for some contaminants are more complex and cost more than others). Costs also vary from lab to lab due to the use of different analytical methods and pricing structures.

The Soil Test Results

Laboratory results report the amount of a particular substance measured in a soil sample and can help people decide if changes in land use, gardening practices, or other behaviors might help reduce exposure to contaminants or improve soil health. The most common soil tests report the total amount of a particular contaminant. For example, the test for most metals involves the use of strong acids to digest the soils and bring all or most of the metal into solution for measurement. The resulting metal concentration is reported as "total metal" (for example, "total lead").

Other tests measure a chemically extractable portion of the contaminant and to estimate the total amount of contaminant in the sample. Results are often given in soil concentration units as parts per million (ppm) of the contaminant being measured. A value of 1 ppm would mean that for every million "parts" of soil (by dry weight), there would be 1 part of the contaminant. These values can also be expressed as mg/kg (milligrams of contaminant per kilogram of soil) or µg/g (micrograms of contaminant per gram of soil).

Interpreting Soil Test Results

While soil testing can provide information to help guide efforts to improve the quality of gardens and protect public health, there is no clear standard of what is considered "safe." The EPA's soil screening levels (SSLs) for Residential Scenarios are the federal screening levels at which the EPA recommends further study to determine whether cleanup is needed at a particular site. More information, including a Quick Reference Fact Sheet, User Guide, and tables of all SSL values, is available at: http://www.epa.gov/superfund/health/conmedia/soil/index.htm.

Urban Agriculture Best Practices

General Gardening & Land Use

- Incorporate clean materials such as uncontaminated soil, compost, manure, or peat moss into garden areas.
- Adjust soil pH to near neutral. Acid soils increase the 'bioavailability' of many heavy metals and can harm plants and animals.
- Mulch walkways and other areas to reduce dust and soil splashback onto crops, or maintain healthy grass or other ground cover.
- Don't grow edible produce directly adjacent to buildings where lead levels are likely highest.
- Build raised beds with clean soil and a layer of landscape fabric to grow food crops in more contaminated areas.
- Don't use treated lumber for raised beds or other projects that may have chemicals that will further contaminate the soil.
- If it is not possible to protect crops from contamination with raised beds or splashback reduction measures, consider growing crops that are less likely to be contaminated.

Contamination Resistant Crops: Which Garden Crops Are Suitable to Grow in Contaminated Soils?

Due to their natural resistance to heavy metal transfer, some garden crops are more or less suitable for growth in contaminated soils.

Most Suitable	Vegetable Fruits & Seeds	Trees	
	tomatoes, eggplant, peppers, okra (seed pods only), squash, corn, cucumber, melons, peas, beans (shelled), onions (bulbs only)	apples, pears	
Least Suitable	Green Leafy Vegetables	Other Vegetables	Root Crops
	lettuce, spinach, Swiss chard, beet leaves, cabbage, kale, collards	broccoli, cauliflower, green beans, snow peas	carrots, potatoes, turnips

EPA Assistance

The process of expanding, redeveloping, or reusing any property can be complicated immensely if there are any hazardous substances, pollutants, or contaminants on or in close proximity to the site. The EPA provides technical and financial assistance designed to empower states, communities, and other interested parties to work together in a timely manner to manage the challenge associated with these types of properties, known as brownfields. Through its Targeted Brownfields Assessment (TBA) program, the EPA contracts with local agencies to conduct environmental assessments, evaluate cleanup options, and provide cost estimates based on future uses and redevelopment plans. More information, including a TBA fact sheet and a listing of regional contacts, is available at the EPA's Brownfields and Land Revitalization website (http://www.epa.gov/brownfields/tba.htm).

Sustainable City Series Speakers

Ann Carroll
Senior Policy Analyst
Office of Brownfields & Land Revitalization
Environmental Protection Agency
carroll.ann@epa.gov

Wayne Long
Agriculture Agent Office Coordinator
Jefferson County Cooperative Extension
Phillip.Long@uky.edu

Sarah Fritschner
Board President
Breaking New Grounds
http://www.breakingnewgrounds.org

Additional Resources

Agency for Toxic Substances and Disease Registry, Department of Health and Human Services, Atlanta. Provides information to prevent harmful exposures and diseases related to toxic substances. Accessible at: *http://www.atsdr.cdc.gov/*

California Office of Environmental Health Hazard Assessment. A database with toxicity information on many chemicals. Accessible at: *http://www.oehha.ca.gov/risk/ChemicalDB/index.asp*

Cleanup Levels for hazardous waste sites. Links to many federal, state and international websites that address soil clean up levels. Accessible at: *http://cleanuplevels.com/*

Cornell Waste Management Institute. Provides resources intended to help people who are interested in soil testing, interpreting test results, and best practices for healthy soils. Accessible at: http://cwmi.css.cornell.edu/soilquality.htm

National Pesticide Information Center. Provides information about pesticides and related topics. Accessible at: *http://npic.orst.edu/*

New York State Department of Environmental Conservation. Brownfield and Superfund Regulation, 6 NYCRR Part 375 - Environmental Remediation Programs. Accessible at: *http://www.dec.ny.gov/chemical/34189.html*

Penn State University. Agronomy Fact Sheets: Environmental Soil Issues. Information about lead in residential soils, garden use of treated lumber, and other issues. Accessible at: *http://cropsoil.psu.edu/extension/esi.cfm*

US Environmental Protection Agency. Office of Solid Waste and Emergency Response. Soil Screening Guidance: Quick Reference Fact Sheet, EPA/540/F-95/041. Accessible at: *http://www.epa.gov/superfund/health/conmedia/soil/pdfs/fact_sht.pdf*

US Environmental Protection Agency. Integrated Risk Information System (IRIS). Searchable database with information on the toxicity of numerous chemicals. Accessible at: *http://cfpub.epa.gov/ncea/iris/index.cfm*

Washington State University Cooperative Extension. Gardening on Lead- and Arsenic-Contaminated Soils. Additional information about arsenic and lead in garden soils. Accessible at: *http://cru.cahe.wsu.edu/CEPublications/eb1884/eb1884.pdf*