

**Soil Assessment Guide
for New City Allotment and
Community Gardens -
Summary**

Toronto Public Health

April 2011

Soil Assessment Guide for New City Allotment and Community Gardens

Toronto Public Health (TPH), in collaboration with Parks, Forestry and Recreation (PF&R) and in consultation with the Toronto Environment Office (TEO), developed guidance for assessing the soil for urban gardens. This document provides an overview of the guide. More detailed instructions are being developed by TPH in consultation with stakeholders.

The soil assessment guide for new City allotment and community gardens endeavours to address concerns related to gardening in urban soils that are potentially contaminated. The aim of the guide is to:

1. Encourage urban food production while minimizing unnecessary soil assessment and exposure reduction measures;
2. Address the questions, concerns and needs of communities relating to soil contaminants and urban gardening; and,
3. Remove barriers to urban gardening by providing a flexible tool that is relatively inexpensive to use.

The following criteria were used to provide direction to the development of the soil assessment guide. The guide should:

- Be health-protective;
- Provide guidance on soil sampling, analysis and interpretation, all specifically targeted for urban gardening; and,
- Be flexible, easy and relatively inexpensive to implement.

TPH followed best practices for using evidence in informed decision-making in public health developed by the National Collaborating Centre for Tools and Methods. TPH developed the guide using a risk-benefit approach, literature reviews, guidance from other jurisdictions, consultations with internal and external experts, information on soils in the City of Toronto, and a pilot study on five proposed gardens. The methods, rationale and evidence that informed the development of the Guidance are summarized in the report: *Assessing Urban Impacted Soil for Urban Gardening: Decision Support Tool Technical Report and Rationale*, available at: www.toronto/health.ca.

The guide provides a step-wise process for City staff to follow when establishing new community and allotment gardens. The guide starts with establishing a Level of Concern and concludes with developing an exposure reduction plan for a proposed garden site.

The guidance is comprised of four steps:

- Step 1 - Establish a Level of Concern
- Step 2 - Sample and Test the Soil (if needed)
- Step 3 - Interpret the Soil Tests using Soil Screening Values (SSVs)
- Step 4 - Mitigate the Risks

These steps are shown in Figure A.1 and summarized in the following sections.

Figure A.1: Soil Assessment Guide for New City Allotment and Community Gardens



- a* **Low concern:** Site is and has always been residential land, parkland (green space used for recreational purposes), farmland, child care centre, school land uses, **except for sites where any indicators of higher levels of concern apply.**
- b* **Medium Concern:** Site is or has once been risk-managed park, orchard, hydro corridor, commercial land uses (excluding gas stations, dry cleaners, print and autobody shop), infill area, former landfill, former lead reduction zone, any land within 30 metres of a rail line or a major arterial road.
- c* **High Concern:** Site is or has once been industrial land uses, gas station, dry cleaner, printing and autobody shops, rail line or depot, lands with indications of dumping or burning, or, presence of smells or staining of the soil.
- d* Small garden: dimensions less than or equal to 4 x 4 m (13 x 13 ft), or total area less than or equal to 16 m² (170 ft²). Larger gardens in the Medium Concern category should follow Step 2 and 3.
- e* Soil Screening Values (SSVs)
- f* **Tier 1 Exposure Reduction:** Use good gardening practices: Wash hands after gardening and particularly before eating and wash produce with soap and water.
- g* **Tier 2 Exposure Reduction:** Use good gardening practices (see above); and, reduce exposure pathways: dilute soil concentrations by adding clean soil and organic matter (compost and manure); lower bioavailability of contaminants by adding organic matter and raising pH; reduce dust by covering bare soil with mulch; peel root vegetables before cooking and eating; and, avoid or restrict growing of produce that accumulate contaminants.
- h* **Tier 3 Exposure Reduction:** Use good gardening practices (see above); and, reduce dust by covering bare soil surrounding garden with ground cover or mulch; and, eliminate exposure pathways: build raised bed gardens (minimum of 40 cm over a geotextile barrier), or use container gardens, and, add clean soil and

organic matter annually (compost and manure); OR grow only nut and fruit trees (do not grow other types of produce).

A.1 Step 1 – Establish a *Level of Concern*

The initial step of the guidance is to assess the likelihood that the soil quality for a garden may be of concern due to contamination from past activities. The appropriate Level of Concern is identified by conducting a site visit and researching the land use history to determine if various indicators are present¹.

- A site visit is conducted by walking through and inspecting the site thoroughly. The site is walked through and checked for indications of illegal dumping or burning of garbage. The soil is turned over with a shovel in the areas intended for gardening and checked for soil staining (discolouration, usually dark patches) and odours (chemical and gasoline smells).
- A site history is researched by searching the City Archives, available City records², and asking local neighbours for information about the past and current use of the site and adjacent properties.

Each indicator is associated with a level of concern. The indicator of greatest concern defines the level of concern for the site as a whole. Table A.1 lists the various indicators, the appropriate Level of Concern, and the recommended next steps for the garden site.

In the Province of Ontario, brownfields are regulated by Ontario Regulation 153/04 (updated in 2009, O. Reg. 511/09), under Part XV.1 of the Environmental Protection Act. During Step 1 of the guidance, the site should be assessed for whether there are any requirements for the site under O.Reg 153/04. In addition to any provincial requirements, the guide is intended to be used on all lands that the City is considering for gardening and food production.

For sites that have been characterized as Medium Concern, for which the planned garden is larger than 16 m², go to Step 2. For all other gardens, go to Step 4.

¹ TPH developed a list of indicators for soil contamination for the City of Toronto based on a literature review of urban soil contaminants, the current limited information on Toronto's soil, and a pilot study on five proposed community and allotment gardens on Toronto parkland.

² Toronto Public Health developed the Historical Land Use Inventory; Parks, Forestry and Recreation has information on risk managed parks; Technical Services has information on former landfills.

Table A.1: Land Use and other Indicators for Establishing the Level of Concern for Urban Garden

Level Of Concern	Indicators	Next Step/ Soil Testing
Low Concern	<p>Site is and has <u>always</u> been:</p> <ul style="list-style-type: none"> • Residential; • Parkland; • Farmland; or, • Child care centre and school. <p>And, site is <u>not</u> located within:</p> <ul style="list-style-type: none"> • Former lead reduction zone; or, • 30 metres of a rail line or major arterial road. <p>And, site visit does <u>not</u> reveal:</p> <ul style="list-style-type: none"> • Indications of dumping or burning; • Smells in the soil; or, • Staining of the soil. 	<p>Soil testing not required.</p> <p>Go to Step 4 - Tier 1 Exposure Reduction.</p> <p>Use good gardening practices.</p>
Medium Concern	<p>Site is or <u>has once been</u>:</p> <ul style="list-style-type: none"> • Risk-managed park; • Orchard; • Hydro corridor; • Infill area; or, • Commercial land uses (excluding gas station, dry cleaner, printing or autobody shop). <p>Or, site is located within:</p> <ul style="list-style-type: none"> • Former landfill; • Former lead reduction zone; or, • 30 metres of a rail line or major arterial road. 	<p>If the garden is small (less than 16 m² or 170 ft²) it is not cost effective to conduct soil sampling, instead adopt exposure reduction strategies to eliminate exposure pathways. Go to Step 4 (Tier 3 Exposure Reduction).</p> <p>For gardens larger than 16m² Go to Step 2. Sample and analyze the soil; the results of the soil testing will then indicate the appropriate exposure reduction measures to be taken.</p>
High Concern	<p>Site is or <u>has once been</u>:</p> <ul style="list-style-type: none"> • Gas station; • Dry cleaner; • Printing shop; • Autobody shop; • Rail line or rail yard; or, • Industrial land uses. <p>Or, site visit reveals:</p> <ul style="list-style-type: none"> • Indications of dumping or burning; • Smells in the soil; or, • Staining of the soil. 	<p>Eliminate exposures.</p> <p>Go to Step 4 -Tier 3 Exposure Reduction</p>

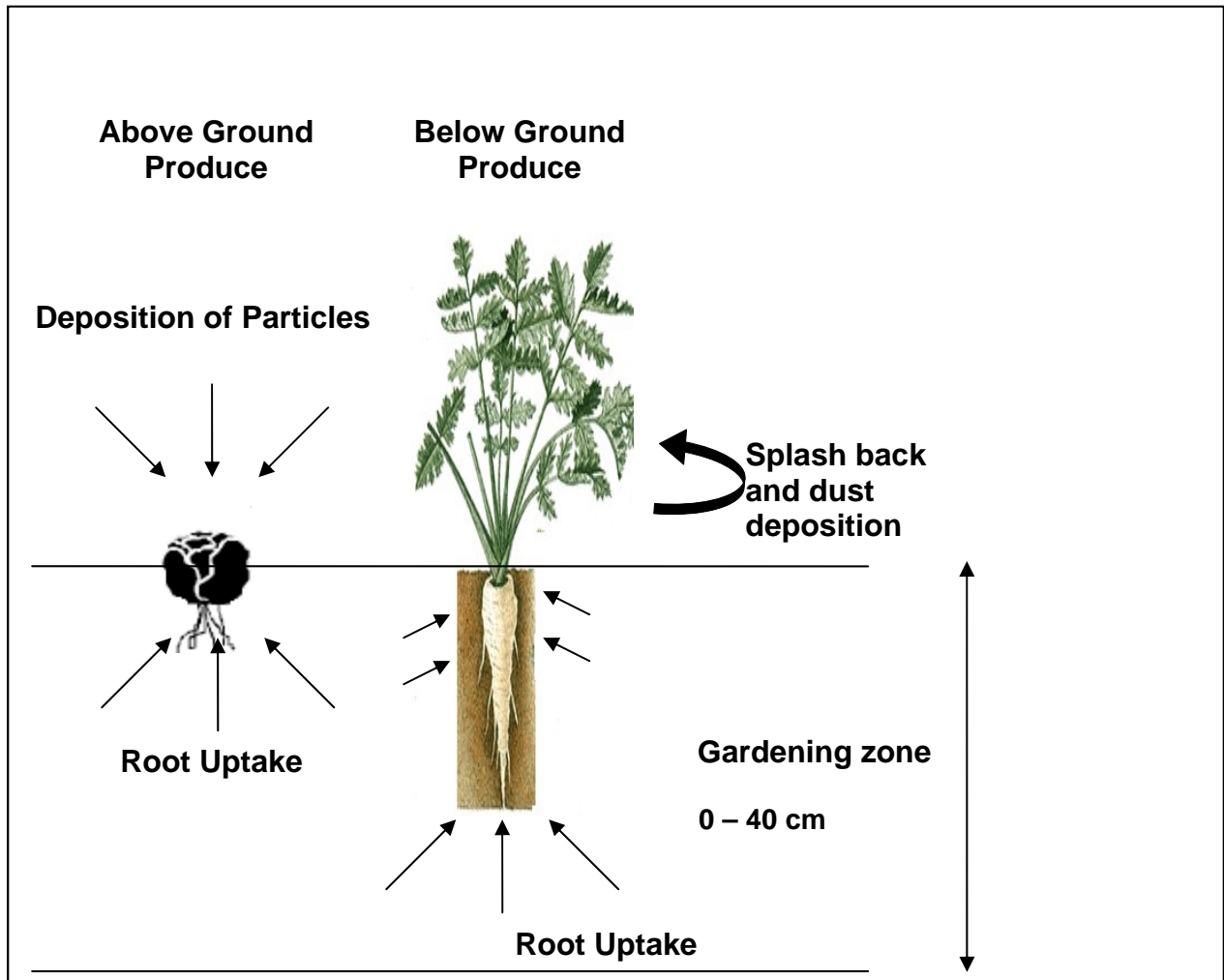
A.2 Step 2 – Test the Soil

A.2.1 Sampling the Soil

If the planned garden on a Medium Concern site is larger than 16 m² (170 ft²) or 4 by 4 m (13 by 13 ft), TPH recommends that the soil be tested to determine the concentrations of soil contaminants. Based on the costs to build small raised bed gardens, it is not cost effective to conduct soil testing for gardens that are smaller than this size. TPH recommends that small gardens in the Medium Concern category go to Step 4.

Figure A-2 depicts the depth of soil to be sampled is (0 to 40 cm), and the movement of soil contaminants into and onto garden produce.

Figure A-2: Gardening Zone Depth of Soil and Movement of Contaminants into and onto Urban Garden Produce



Sampling strategies reflect how the gardeners use the garden. Community gardeners have unrestricted movement in the whole garden, whereas, allotment gardeners are restricted to a small garden plot within the larger garden area. In order to reflect these differences in the way that people use gardens, TPH recommends different sampling strategies for allotment and community gardens:

- For an allotment garden, nine individual sub-samples are taken in an X or Z pattern for every 10 by 10 metre area. Each sub-sample is combined and mixed into one composite sample. This composite sample is placed in a clean, labelled container.
- For a community garden, nine individual sub-samples are taken in an X or Z pattern for every 15 x 15 metres of land. Each sub-sample is combined and mixed into one composite sample. This composite sample is placed in a clean, labelled container.

A.2.2 Analyzing the Soil

The Ontario Brownfields Regulation O. Reg 153/04 provides a list of over 300 potential soil contaminants of concern (COCs)³. It is neither economically feasible nor necessary to analyze the urban impacted soils for this entire list of contaminants. TPH developed a streamlined list of COCs for the Medium Concern sites (see Table A.2). The cost to analyze each composite sample for all the parameters listed in Table A.2 is approximately \$250. The number of required composite samples is determined by the size of the garden (see A.2.1 - Sampling the Soil).

Table A.2 Chemicals of concern for Medium Concern garden sites

<u>Metals:</u>	<u>Polycyclic Aromatic Hydrocarbons (PAHs):</u>
Arsenic (As)	Acenaphthene
Cadmium (Cd)	Acenaphthylene
Cobalt (Co)	Anthracene
Chromium, total (Cr)	Benz(a)anthracene
Chromium, VI (Cr VI)	Benzo(a)pyrene
Copper (Cu)	Benzo(b)fluoranthene
Mercury (Hg)	Benzo(g,h,i)perylene
Molybdenum (Mo)	Benzo(k)fluoranthene
Nickel (Ni)	Chrysene
Lead (Pb)	Dibenz(a,h)anthracene
Selenium (Se)	Fluoranthene
Zinc (Zn)	Fluorene
	Indeno(1,2,3-c,d)pyrene
	Phenanthrene
	Pyrene

If the indicators identified during the site visit and site history suggest that the soil might be contaminated by other soil contaminants not on TPH's streamlined list of COCs, then the site should be treated as a site of *High Concern* (Go to Step 4). Guidance on how to find an appropriate laboratory is being developed in consultation with PF&R staff.

³ <http://www.ene.gov.on.ca/envision/land/decomm/condition.htm>

A.3 Step 3 – Interpret the Soil Tests

In Step 3, the Exposure Reduction Tier for the garden is determined by comparing the soil concentration of each COC with the Soil Screening Values (SSVs) (see Table A.3).

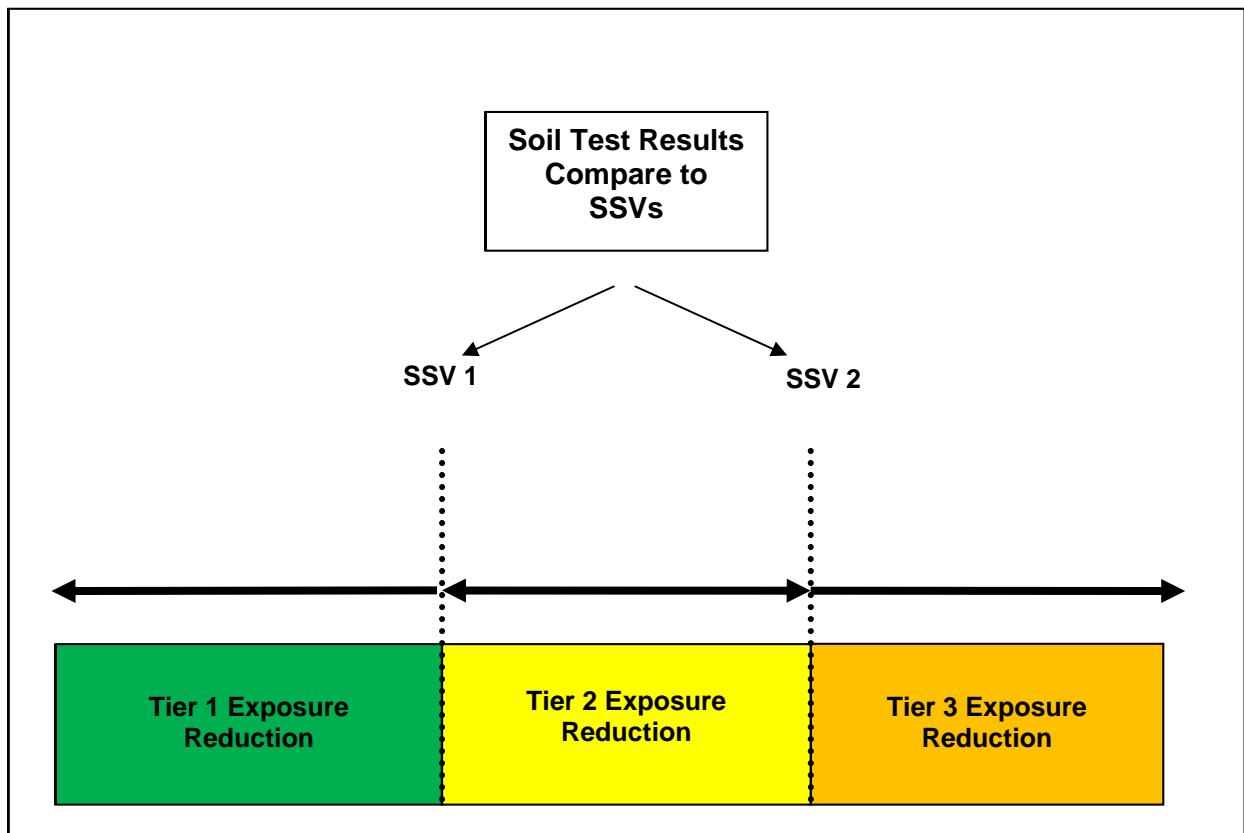
Table A.3: Urban Gardening Soil Screening Values (mg/kg)

Metals	Soil Screening Value (SSV)	
	SSV 1	SSV 2
Arsenic	11	110
Cadmium	1.0	10
Cobalt	23	170
Chromium, total	390	630
Chromium, VI	5.0	^b
Copper	180	660
Mercury	2.7	^b
Molybdenum	13	^b
Nickel	34	340
Lead	34	340
Selenium	10	11
Zinc	500	1800
PAHs		
Acenaphthene	0.050	0.32
Acenaphthylene	0.093	0.47
Anthracene	0.58	0.58
Benz(a)anthracene	0.23	2.3
Benzo(a)pyrene	2.3	3
Benzo(b)fluoranthene	0.23	2.3
Benzo(g,h,i)perylene	0.10	1.0
Benzo(k)fluoranthene	0.23	2.3
Chrysene	0.099	0.99
Dibenz(a,h)anthracene	0.77	^b
Fluoranthene	0.14	1.4
Fluorene	0.39	^b
Indeno(1,2,3-c,d)pyrene	0.23	2.3
Phenanthrene	3.1	^b
Pyrene	0.11	1.1
^b	Only Level 1 SSV was derived for this parameter. The Level 1 SSV is based on 10 times urban background – the maximum value allowed in the guidance.	

The SSVs define the three risk levels, and are used to interpret the soil test data as follows (Figure A-3):

- If the concentrations of *all of the COCs* are below the respective SSV 1, then the site requires Tier 1 Exposure Reduction;
- If the concentration of *any COC* is above the SSV 1 but does not exceed the SSV 2, then the site requires Tier 2 Exposure Reduction; or,
- If the concentration of *any COC* is above the SSV 2, then the site requires Tier 3 Exposure Reduction.

Figure A-3: Determining the Risk Level for the garden by comparing the soil concentrations to the SSVs



A.4 Step 4 – Develop Exposure Reduction Plan for Site

There are many simple and inexpensive actions gardeners can easily take to reduce their exposure to urban soil contaminants depending on the risk level for the site. Table A-4 summarizes the recommended exposure reduction measures for the gardens that are required for Tier 1, 2 or 3 Exposure Reduction.

Table A-4: Recommended Actions to Reduce Gardeners' Exposures to Soil Contaminants

Risk Level	Recommended Actions
Tier 1 Exposure Reduction	<p>Use good gardening practices:</p> <ul style="list-style-type: none"> • Wash hands after gardening and particularly before eating; and • Wash produce with soap and water.
Tier 2 Exposure Reduction	<p>Use good gardening practices (see above); and,</p> <p>Reduce exposure pathways:</p> <ul style="list-style-type: none"> • Dilute soil concentrations by adding clean soil and organic matter (compost and manure); • Lower bioavailability of contaminants by adding organic matter and raising pH; • Reduce dust by covering bare soil with ground cover or mulch; • Peel root vegetables before eating or cooking; and, • Avoid or restrict growing produce that accumulate contaminants.
Tier 3 Exposure Reduction	<p>Use good gardening practices (see above); and,</p> <ul style="list-style-type: none"> • Reduce dust by covering bare soil surrounding the garden with ground cover or mulch; and, <p>Eliminate exposure pathways:</p> <ul style="list-style-type: none"> • Build raised bed gardens (minimum of 40 cm over a geotextile barrier), or use container gardens, and, • Add clean soil and organic matter annually (compost and manure). <p>OR</p> <ul style="list-style-type: none"> • Grow only nut and fruit trees (do not grow other types of produce).

A.5 Existing Gardens

Through regular gardening practices gardeners already do many of the activities outlined in Tier 1 and 2 Exposure Reduction risk levels. For example, gardeners add soil and organic matter to their gardens on an annual basis to improve the yield of their garden. These behaviours, year after year, result in a reduction in both the concentration and bioavailability of soil contaminants. In addition, gardeners turn over their soil at least twice a year, aerating their soils and exposing

deeper soil to sunlight (two mechanisms to degrade and reduce organic soil contaminants). These practices reduce the concentration and the bioavailability of soil contaminants.

Existing gardens on lands that are in the Low Concern category should continue to use Tier 1 Exposure Reduction measures. Existing gardens in the Medium Concern category should use Tier 2 Exposure Reduction measures. There is no need to test the soils. Existing gardens in the High Concern category should follow the soil testing indicated for Medium Concern sites.

A.6 Feedback

The guidance will be updated periodically, as required, due to stakeholder feedback and changes in the evidence.

For further information and to provide feedback on this approach please contact Josephine Archbold, Research Consultant, Healthy Public Policy, Toronto Public Health at (416) 338-8082 or (416) 392-6788, or via e-mail at jarchbo@toronto.ca