EPA

BROWNFIELDS AND URBAN AGRICULTURE:

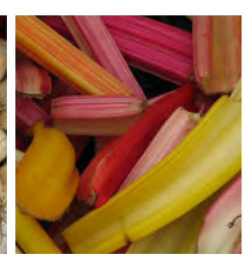
Interim Guidelines for Safe Gardening Practices

Summer 2011

TABLE OF CONTENTS





INTRODUCTION

This document is a condensation of the input of 60 experts from academia, state and local government, and the nonprofit sector who gathered in Chicago on October 21 and 22, 2010 to outline the range of issues which need to be addressed in order to safely grow food on former brownfield sites. A list of the participants in this workshop is available in Appendix A.

In short, there are three major issues:

1. Before deciding whether to garden on a site, it is important to research its history, because a site may have a range of contaminants depending on its past uses;
2. Once the past uses have been determined, there are options for testing, cleanup or exposure-management approaches which prospective urban farmers can utilize in order to garden safely; and
3. Although a wealth of experience has been gained through brownfields cleanup over the last 15 years, the cleanup standards in existence are designed to protect people on the site from ingestion and inhalation of contaminants in the soil, water and air, but do not address consumption of food grown on the site. Over time, we expect that standards will be updated to address this gap. In the interim, existing residential cleanup standards can be used as a benchmark for safe gardening.

Overview of the Issue: Brownfields and Urban Agriculture

Across the country, communities are adopting the use of urban agriculture and community gardens for neighborhood revitalization. Sites ranging from former auto-manufacturing sites, industrial complexes, and whole neighborhoods, down to small individual lots, including commercial and residential areas, are being considered as potential sites for growing food. As an interim (less than five years) or long-term use, greening a parcel by implementing agricultural practices can improve the environment, build amenities, revitalize neighborhoods, and have direct benefits to residents' food access and nutrition.

Redeveloping any potentially contaminated urban property (often referred to as *brownfields*), brings up questions about the site's environmental history and the risks posed by proposed reuse. Current brownfield and contaminated land risk-based cleanup approaches establish cleanup levels based on proposed reuses. For residential, commercial or industrial brownfield redevelopment, individual states have set rules and standards for how to conduct an investigation and clean-up activities through what are known as Voluntary Cleanup Programs. Residential reuse requires the most stringent cleanup as it assumes children and families will live on the property.

The benefits of urban agriculture vary from health and environmental to economic and social. Gardening in urban areas:

- Increases surrounding property values, beautifies vacant properties, increases a sense of community, and provides recreational and cultural uses.
- Increases infiltration of rainwater, reducing stormwater overflows and flooding, decreases erosion and topsoil removal, improves air quality, and reduces waste by the reuse of food and garden wastes as organic material and compost.
- Increases physical activity and educates new gardeners on the many facets of food production from food security to nutrition and preparation of fresh foods.

Kids who garden are more likely to try and like vegetables and eat more of them, and the combination of the social connection of gardening with the increased access to fruit and vegetables creates a new norm in children who continue to make healthier choices (Robinson-O'Brien, 2009, Alaimo, K et al., 2008).

However, the rise of agriculture as infill redevelopment creates new questions about the risks associated with agricultural uses, particularly where food crop or animal forage production is concerned. In many parts of the country, advisory standards and practices for agricultural redevelopment simply do not exist.

U.S. Environmental Protection Agency (EPA) Brownfields and Land Revitalization, in cooperation with programs within the Office of Solid Waste and Emergency Response (OSWER), and our State and Tribal program counterparts from around the country are working with communities on many of these on-the-ground redevelopment projects. In addition, the EPA Region 5 (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin) Community and Land Revitalization Branch began working with local and regional stakeholders and a national committee in mid-2010 to learn more about implementing urban agriculture and community gardens in the safest way possible. These guidelines are intended to protect public health by informing communities about safe gardening practices when creating gardens on vacant lands or structures that may have an environmental history.

The committee quickly identified a number of policy gaps contributing to the uncertainty around gardening on former brownfield sites. The first is that at this time, there are no definitive standards for soil contaminant levels safe for food production that reflect the soil site conditions and management practices common at agriculture sites. EPA has long-established soil screening levels for contaminated site cleanup but these threshold-screening levels frequently serve as a starting point for further property investigation and do not factor in plant uptake or bioavailability. Nonetheless, the application of these contaminated land analysis and screening approaches can provide support to emerging operations and reassure consumers and markets about food risks from environmental contaminants.

Another policy gap surrounds the connection between soils and food safety issues. US Food and Drug Administration (FDA) and US Department of Agriculture (USDA) regulate certain elements of food safety and material application in food production areas, such as biosolids or sewage sludge application on farmed land. Farms seeking organic certification also have restrictions on materials use and application. USDA also regulates the international import of soils. There are also agreed international standards on levels of contaminants in final food products (FAO, Codex Alimentarius)[1] but neither FDA nor USDA have standards that regulate the quality of soil as a growing medium.

There are also gaps in practice. The extent of contamination on sites and properties that have been selected for urban agriculture isn't clear. Many community gardening and developing farm organizations test for agronomic parameters – nitrogen, phosphorus, and potassium (N-P-K) as well as pH and organic content. A smaller subset of organizations may test for environmental contaminants, although often only for lead. Other organizations and USDA extension agents encourage full metal panel testing which incurs greater costs to the gardener. A recent compendium of urban agriculture practice and planning by the American Planning Association (see Resources and References section) noted few local requirements for soil testing and very few examples of locally driven testing on behalf of community organizations.

This document is designed to fill the identified gaps presented above by presenting a process and set of recommendations for developing agricultural reuse projects on sites with an environmental history. Potential gardeners, state environmental agencies and regulators can use this process to determine how to address the risks inherent to redeveloping brownfields for agricultural reuses while being protective of human health. There is a large body of ongoing research as concern about contamination emerges and urban gardening becomes a common practice, particularly in communities with limited economic activity. This document can be used as an interim

1 The Codex Alimentarius Commission was created in 1963 by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) to develop food standards, guidelines and related texts such as codes of practice under the Joint FAO/WHO Food Standards Programme. The main purposes of this Programme are protecting health of the consumers and ensuring fair trade practices in the food trade, and promoting coordination of all food standards work undertaken by international governmental and non-governmental organizations.

guideline until such research can provide more definitive standards and policies for agricultural reuse on these sites. Although the guide was developed in the Midwest, it may be used to benefit tribes and communities throughout the country wishing to utilize urban agriculture on brownfield sites and vacant properties.

Process: Development of these Guidelines

While creating urban agriculture projects, local governments and community non-profits have identified gaps in knowledge and policy that create unintentional roadblocks to completion of agriculture redevelopment projects on brownfield sites, particularly for food production.

To address the identified gaps in a meaningful way, our first task was to inform each other on the current state of knowledge on agricultural redevelopment. Two webinars in Fall 2010 presented a snapshot of the state of science and policy issues in urban agriculture:

1. The *State of Science and Research Needs*, included contaminant exposure routes, bioavailability, and plant uptake; and
2. *Policy Barriers and Incentives to Reusing Brownfields for Community Gardens and Urban Agriculture*, included stability of land tenure and the lack of clear cleanup standards.
3. These webinars were widely attended by practitioners and local governments across the country, and are available for viewing on the U.S. EPA's Urban Agriculture website at:
4. *http://www.epa.gov/brownfields/urbanag*.

The webinars provided the foundation for the Brownfields and Urban Agriculture Midwest Summit October 21 and 22, 2010, which brought together over 60 invited experts from non-profits, community groups, academia, and various forms of government to develop a decision protocol for safe urban agriculture.

Overview of Recommendations

Just as conventional agriculture can pose risks to farmers, neighbors, and the environment, each urban agriculture scenario poses its own risks. The convened experts developed a list of ideas and a process for addressing these risks so that growers can be aware they have selected a brownfield and brownfields can be redeveloped safely and efficiently into agriculture projects. They found that the underlying question in this strategy becomes: How clean is clean? This somewhat simple question becomes complex when considering the scientific data required and policies that need to be in place in order to answer this question fully.

Complicating factors

When focusing on food production, determining the ideal conditions for developing agriculture reuses on brownfields is challenging due to the high number of exposure and risk assessment variables. These include: soil type, likely contaminants, crop type, garden size, climate, who enters the garden, individual gardener/farmer practice, how long they spend in the garden, growing for individual or family use, donation or market, state regulations, etc. Our attention has focused on environmental contaminants likely to be found in soils or soil material brought on site rather than biological risks from urban growing.

Exposure routes and risk assessment

Most states have risk-based cleanup standards, which means the amount of contamination allowed to remain on a remediated site is based upon the planned reuse and possible exposure that a person would encounter while participating in that reuse. An industrial reuse would not need to have the strict standards for cleanup that a residential reuse would, simply because the amount of time a person is on site and the kinds of activities he or she would participate in (exposures) are completely different.

Determining exposure is based on the amount of time spent onsite as well as the three major exposure routes: inhalation (breathing), direct contact (touching), or ingestion (a child's hand-to-mouth play or the accidental ingestion of soil by gardeners while eating, drinking or smoking with unwashed hands). In many cases, the best management practices discussed below can significantly reduce the possibility of exposure to contaminants at urban agriculture sites, therefore reducing risk.

Making health-related determinations about how to implement gardening and farming practices at a site must take into account: specific knowledge about contaminants and human contact with the soil that occurs preparing the site and during gardening/farming work; during the periodic application of soil amendments, pesticides or other materials used in growing; and finally, the uptake of contaminants by plants and any health risks that could be associated with using the plants as a source of food for people or livestock.

Modifying existing policies would require state-by-state assessments of risk criteria, soil cleanup standards, voluntary brownfields programs, and health agency standards, as well as coordination on a level that is easily translatable to neighborhood gardener and emerging small scale urban farms. Ongoing research to advance these efforts is being conducted across many different disciplines, answering questions about amounts of contamination taken up by various crops and working with states as they determine risk-based standards for soil cleanup or stabilization for agriculture. While we don't have the answers to all of these questions yet, following the guidelines included in the subsequent section will provide a clear process for organizations to identify and reduce risks, reassure gardeners, and yield safer, more efficient growing scenarios.

How clean is clean for gardening activities?

Clean-up and reuse of any brownfield site is based on risk assessment and exposure scenarios – the levels of contamination present and how a person can be exposed to that contaminant, based on the intended reuse. These criteria for residential, commercial and industrial reuse are based on potential exposure: length of time spent on the site, types of activities performed on the site, and potential contamination pathways such as inhalation, ingestion, or possible dermal contact with contamination.

Urban agriculture is a new category of land use with different patterns of exposure – people are in closer contact with the soil than for any other category, for different time periods. While residential use is based on living, sleeping and eating in a dwelling on a property, the overall time and proximity to soil and potential contaminants make gardening and farming somewhat different from residential or commercial use. A commercial-scale urban agriculture scenario would have yet another set of exposure criteria to the workforce and potential neighbors. While these risk scenarios still require refinement based upon additional research and policy discussion, it is clear that a separate category of use should be established.

However, as with all reuse categories, there are potential best management practices (BMPs) that can significantly reduce risk from multiple exposure pathways. Uncertainty about specific cleanup and reuse standards serves as a recognized policy barrier to implementing agriculture projects, but we also must recognize the health benefits from eating locally grown food and balance this with the manageable risk associated with using brownfield sites. While clean up levels were not the focus of the workshop efforts, they are a known policy issue that should be resolved in the future.

Exposure pathways

Direct exposure to contamination.

Inhalation of contamination.

Uptake by plants and subsequent consumption.

How clean is clean for plants to be safe for consumption?

The high degree of variability in soils, limited control of public spaces and unique characteristics of how crops (species and variety, edible portions of plants) and humans respond (age, precautions taken) makes issuing blanket statements of safety virtually impossible. Plant uptake of contaminants is a concern to urban gardeners and those who would like to include locally grown food on their menus. While many of the uptake risks from urban soils can be controlled by demonstrated BMPs discussed in further detail below, ongoing research on plant uptake and bioavailability continues to bridge knowledge gaps.

Success in brownfield redevelopment across the country, and success in other gardens intuitively tells us that gardening in populated areas is not a new idea, nor is it impossible to do safely. EPA has developed a simple logic model, included below, that is based on the results of our working session and BMPs identified at successful larger scale agriculture projects. This does not answer every question that has been raised; rather it poses the questions you should ask in order to garden safely, and discusses what information you should collect in order to make decisions.

This model describes the process by which a gardener should consider safely implementing a garden of any type (hoop houses or greenhouses, farm stand, vertical, aquaculture, community gardening plots) on a piece of property that has potential contamination.

The process for assessing properties for the presence or potential presence of environmental contamination often is referred to as "environmental due diligence," or "environmental site assessment." Phase I Environmental Site Assessments (ASTM 1520) and All Appropriate Inquiry (ASTM 312) are the industry standards for identifying potential environmental concerns according to previous uses of the property. These methods require desktop-based investigation like looking at Sanborn maps, historical aerial photos, city and county records and reviewing environmental databases, as well as conducting interviews of neighbors and previous owners, and visiting the site to assess any visual cues for contamination, such as evidence of storage tanks. Potential property owners have an environmental professional prepare a report containing this type of information prior to most real estate transactions, but historical information is commonly available to anyone wishing to do the research on the internet, at a local library, or county records office.

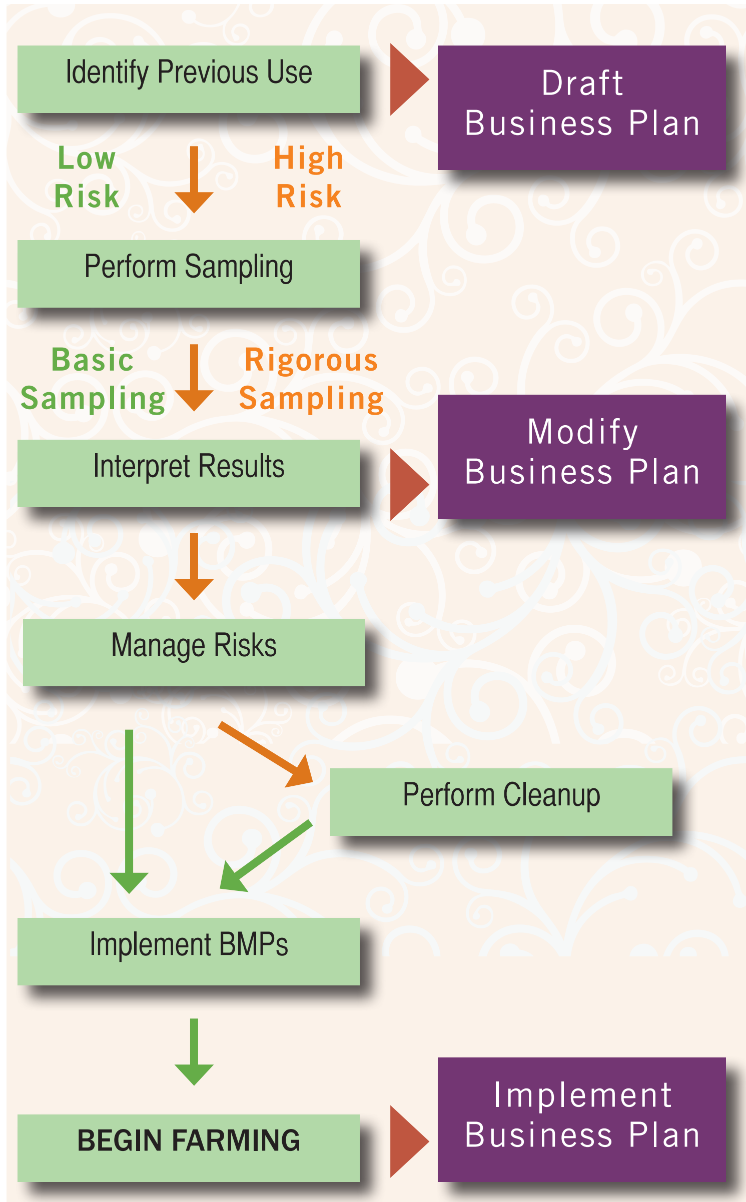
The following logic process proposes a series of questions you need to ask and the information you need to gather in order to make decisions while implementing an urban agriculture project. Each of these steps has multiple sub-steps and issues that you may want to look into further. However, this model may be applied to any urban agriculture project on any brownfield site, and may be of value for other reuses where contact with soil may be higher, such as parks or recreational areas.

1. Identify Previous Use

What is the history of your proposed site?

The previous use of the property and those surrounding it will be the major deciding factor on how cautious you should be before gardening. It is important to gather enough information about the site prior to beginning actual gardening activities so that you may tailor additional site investigation to the likely contamination left behind. Special environmental assessments are commonly required prior to purchasing most commercial and industrial properties, but those simply leasing the land from the owner or local landbank, or those receiving donated land should also plan to do some level of research.

The more historical information learned about a site's previous uses, the more informed decisions can be made during garden development. If you plan to sell produce or value-added products, now is the time to draft a business plan for your garden. Farm design and duration (short or long term use), types of crops planted and expected costs for construction or remediation will all be informed by the site's previous uses and the expected condition of existing soils. The business plan should be revisited throughout this process to ensure the potential for success of your garden. More information on developing a business plan and its ties to the redevelopment process is presented in the final section of this document.



Determine Whether Previous use is High or Low Risk to Site Soil and Water

What does the site history suggest about the likelihood of contamination and potential site risks to food production?

No two vacant parcels are alike. However, we can infer possible types of contamination based on the previous use of the property. For example, residential areas may have unsafe concentrations of lead where the presence of older housing stock or structures indicates lead-based paint was present. Polycyclic aromatic hydrocarbons (PAHs), a group of chemicals formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, can be found at former residential properties as well as commercial and industrial properties from fires or combustion processes. PAHs stick to soil particles and are found in coal tar, crude oil roofing tar, wood smoke, vehicle exhaust, and asphalt roads. Sites previously used for parking may have high concentrations of petroleum from leaking oils and fuel, and gas stations may have had leaking underground storage tanks that can cause contaminated groundwater and soils, or poor indoor air quality. Even greenspace or agricultural uses may have hotspots from over-fertilized ground, pesticides, or animal feed spills. The table below presents some example contaminants of concern found on brownfield sites.

Land Use	Common Contaminants
Agriculture, green space	Nitrate, pesticides/herbicides
Car wash, parking lots, road and maintenance depot, vehicle services	Metals, PAHs, petroleum products, sodium, solvents, surfactants
Dry cleaning	Solvents
Existing commercial or industrial building structures	Asbestos, petroleum products, lead paint, PCB caulks, solvents
Junkyards	Metals, petroleum products, solvents, sulfate
Machine shops and metal works	Metals, petroleum products, solvents, surfactants
Residential areas, buildings with lead-based paint, where coal, oil, gas or garbage was burned	Metals, including lead, PAHs, petroleum products creosote
Stormwater drains and retention basins	Metals, pathogens, pesticides/herbicides, petroleum products, sodium, solvents
Underground and aboveground storage tanks	Pesticides/herbicides, petroleum products, solvents
Wood preserving	Metals, petroleum products, phenols, solvents, sulfate
Chemical manufacture, clandestine dumping, hazardous material storage and transfer, industrial lagoons and pits, railroad tracks and yards, research labs	Fluoride, metals, nitrate, pathogens, petroleum products, phenols, radioactivity, sodium, solvents, sulfate

(Adapted from Boulding and Ginn, 2004)

Each of the above constituents may be present at levels that pose no risk or, if present in high concentrations, may be harmful to those doing the initial site preparation, to the gardener, or to the quality of the plants that you are hoping to grow.

Once you feel you have an understanding of the previous uses of the site, determine whether that use is high or low risk for agriculture reuses, the likely crops or garden design, and sample the site accordingly. As a rule of thumb, recreational or residential previous uses are typically lower risk while commercial and industrial uses can be considered higher risk, although you may find information in your research that suggests otherwise for your particular site. Consult with your state environmental agency, local health department, or county's USDA Cooperative Extension office to determine what kinds of samples you should take to accurately represent the conditions at your site.

Finding your ag extension

The USDA National Institute of Food and Agriculture funds the Cooperative Extension System – a nationwide educational network staffed by experts in agriculture working to identify and address current issues and problems. Extension offices are located in each US state and territory at its land-grant university, as well as in local and regional networks often in each county. Find your local Extension office at: *http://www.csrees.usda.gov/Extension*.

2. Perform Sampling

What additional information is needed to determine soil quality? What additional information is needed to identify or rule out potential contamination risks?

Two types of soil quality sampling are recommended for every site: soil as a growing medium, and soil contaminant concentrations for safety. Because each parcel of land is unique, each sampling approach should be considered individually. However, given that not all previous uses are created equal, we can make some assumptions about the relative risk of the previous use, and this will guide our sampling strategy. Low risk previous uses like residential areas, green space, traffic corridors and parking areas generally have a narrow band of likely contamination that allows for a basic sampling strategy. High risk uses, like manufacturing or railyards, open up the possibility of many types of contamination over a wide area of the site, and requires a more rigorous sampling strategy. Some organizations can provide technical assistance for soil testing, including the EPA and state brownfields programs, and USDA Natural Resources Conservation Service (EPA 2009).

Sampling methodology

How do you decide where to sample and how deep to go? Sampling methodologies will vary slightly depending on what you are sampling for or the type of crop you are planning to grow because some plant root systems are deeper and more extensive than others. Refer to the University of Louisville's *Urban Agriculture and Soil Contamination: An Introduction to Urban Gardening* and Purdue University's factsheet entitled, *Collecting Soil Samples for Testing* for more information on sampling frequency, collection, location, and the best time to take your samples. Don't forget to call ahead of time to have utilities marked before digging anywhere on your site. Find your local "Call before you dig" service at *http://www.call811.com*.

Low risk uses – basic sampling

Sampling for soil quality should include a composite sample that represents the on-site soil structure and composition and reflects the preferred growing area. This type of sampling and analysis is simple to perform and relatively inexpensive to do. Sampling for pH, organic matter, nutrients (nitrogen, phosphorus, potassium), soil composition (sandy, clayey, etc) and texture will determine what types of improvements should be made or amendments added so that plants can thrive in your garden.

Sampling for soil safety should include, at a minimum, composite sample(s) which would be tested for a wide range of metals (including heavy metals, iron, and salts, some of which are necessary plant nutrients, such as magnesium, potassium, calcium, sodium), PAHs, and additional constituents based on likely contaminants associated with the site's previous use. Any area that appears out of the ordinary, is suspicious looking (including stained or discolored soils, or the lack of plant growth in soils), or indicates a potential for contamination, should be submitted with additional discrete samples in each area. This will allow you to identify the type and extent of existing contamination and to estimate if cleanup is required or if you only need to have special considerations when designing your garden.

For your records, you may wish to draw, photograph or note soil sample collection locations on a map depicting the site. If you collected five samples to combine into one composite sample, you should note their individual locations. For example, you would identify that sample #3, was taken from the top 2 inches of material at a location 2 feet from the north (left) side of the path and 5 feet east of the entrance. You may also wish to flag or mark sample locations until your results come back; typical lab turnaround time is approximately two weeks.

High risk uses – more rigorous sampling

Any large parcel with multiple historical uses will require more rigorous sampling in addition to the methods mentioned above. This should include multiple composite or discrete samples for any suspected contaminant in each area of the site. Additional discrete samples should be collected where contamination is suspected. If groundwater contamination is likely, or if a spill is suspected, deeper soil sampling and groundwater sampling is strongly suggested.

3. Interpret Results

What do the sampling results mean for risk to growers or healthy plant growth? What contaminant levels are low, frequently seen, easily addressed and can be managed with good practices? What levels are too high and require involvement of environmental experts?

While the EPA prescribes groundwater/drinking water guidelines, no hard and fast rules for agricultural soils exist on the federal level. Most states set guidelines for soil cleanup with risk-based standards based on anticipated reuse of the property. Residential clean-up levels are the most restrictive, so if contaminant levels are below residential use levels, it is safe to assume your site is safe for gardening and will be protective of public health. We recognize, however, some communities may want to seek levels lower than residential reuse levels in the interests of precaution.

Because no agricultural reuse standards exist as discussed above, contamination levels falling within the commercial and industrial reuse categories warrant a site-specific risk determination and mitigation. If you don't have a qualified environmental professional on staff and you are concerned about your sampling results, you should get help interpreting the results of your sampling effort. State and local health agencies, state environmental agencies and USDA Cooperative extension offices, located in most counties, are good places to start for help in determining what safe gardening levels in your soil may be.

Not all types of contamination will have the same effect on you as a gardener or on your crops. Research on soil metal chemistry and plant uptake conducted at the USDA has found that most metals are so insoluble or so strongly attached (i.e. adsorbed) to the actual soil particles or plant roots, that they do not reach the edible portions of most plants in levels which would compromise human health when eating grown crops. Maintaining a neutral soil pH can control much of the risk of exposure via plant uptake. For example, lead is known to be toxic to humans, and can be found in extremely high concentrations in some urban soils where extensive lead-based paint was used or where historical lead industry activity occurred. The risk to the gardener, inhaling dust or ingesting actual soil from dirty hands is much higher than the risk of the consumer eating the properly washed crops grown from this soil. Important exceptions to the strategy of keeping a neutral pH include soils with high concentrations of cadmium and cobalt, which can be toxic to humans, and sometimes molybdenum and selenium, which are more of a concern for livestock (Chaney, 1984).

Other soil metals, such as copper, are phytotoxic and will kill the plant before the metal concentration in the soil would be harmful to a gardener. In these cases, accidental ingestion of the actual soil during initial preparation or as part of ongoing gardening activities would have the greatest negative health effect.

It is important to know which areas of the site are contaminated in levels that are unsafe for in-ground gardening activities and what that means for your garden design. Additional testing may be necessary to determine the extent of contamination if a hotspot is found.

A note on analysis

Most tests for soil contaminants use extraction methods (i.e., the sample is digested in acid and then diluted prior to analysis) yielding a total contaminant concentration. The amount of that contaminant that is bioavailable or bioaccessible (i.e. the ability of ingested contaminants to be absorbed by the body) to plants or people will be less than the resulting total contaminant level – actually a fraction of the total value. Often in the case of lead in urban soils, a small fraction of the total lead concentration is found to be bioavailable, likely due to the historic applications of fertilizers, manures and composts, which change the characteristics of soil and can cause inactivation of lead in soils over time. Because determining bioavailability is costly and because regulating a total concentration is the most protective of human health, test result interpretation frequently focuses on total concentrations.

4. Manage Risks

Perform Clean-Up

When is clean-up necessary? Which remediation techniques are best for agriculture reuses?

If results indicate that the existing soil is not safe for gardening activities and you are planning to plant in-ground, remediation may be necessary. Work with your state environmental agency's Voluntary Cleanup Program to determine which remediation technique would be most effective for your site. Consider cost, accessibility, the timeframe needed, environmental effects, and effectiveness for agriculture before choosing a remediation technique (RUAF 2006). Techniques most applicable for agriculture projects include physical (excavation, installing geotextiles, soil washing or soil vapor extraction) or biological (microbial, phytoremediation, or application of soil amendments).

Will phytoremediation work for my site?

Phytotechnologies are long-term remedial solutions that use plants to remediate soil and water impacted with different types of contaminants. Organic contamination including: oils, solvents, and some pesticides, and inorganic contaminants like salts (salinity), and heavy metals, especially nickel and arsenic are well suited to a long-term phytoremediation or phytoextraction approach. Using plants to stabilize soils, keeping an appropriate pH, and controlling metal mobility, as well as keeping dust down, is a proven strategy for reducing exposure to contaminated soils. However, not all contaminants react the same way to phytoremediation, and some metals like lead, cadmium and zinc, just aren't mobile enough to benefit from phytotechnologies. Get more information on phytoremediation and other phytotechnologies in the Interstate Technology Regulatory Council document, "Phytotechnology Technical and Regulatory Guidance and Decision Trees, Revised," available at: *www.itrcweb.org/Documents/PHYTO-3.pdf.*

Many non-remedial options exist for sites with low levels of contamination, or sites with contamination exposure risks which can be controlled by planting *above ground*, including installing raised beds, gardening in containers, green walls or rooftop growing, and aquaponics. More information on Best Management Practices and alternative growing techniques is presented on the following page.

Each remediation technique has unique benefits and drawbacks. Digging away the contaminated soil and disposing it in a landfill is the most effective technique for removing contaminants but can discard valuable topsoil. This is also the most expensive method, and replacing the contaminated soil with clean, non-industrial fill (that has been sampled for contaminants or has been certified as safe) can be cost-prohibitive to a non-profit gardener or community group. In-situ or on site remediation techniques or biological strategies may take multiple growing seasons or multiple applications, costly monitoring, and maintenance. Even remediation by amending with compost may be more involved than it sounds since composting needs to have preceded growing to create sufficiently healthy soil. In one EPA pilot project, yard waste compost added to a waste site for agriculture reuse used 20 tons of compost per acre for corn fields and 120 tons of compost per acre for peanut crops (EPA 1997). Not all projects will require this level of remediation, but working closely with your state Voluntary Cleanup Program will ensure that your urban agriculture development achieves the proper cleanup goals.

Implement Best Management Practices (BMPs)

Are there things I can do to garden safely without performing a full remediation? What are everyday practices that will reduce risk?

Regardless of the degree of brownfields contamination or scale, every urban garden should implement BMPs to ensure continued protection from urban soils. In most instances, simply following these BMPs will bypass any potential exposure pathways from existing site contamination. However, projects should still be vetted with the state Voluntary Cleanup Program or local health officials to address any possible environmental and public health concerns. Because research has found that the predominant exposure routes of concern are direct contact with or ingestion of potentially contaminated soils, many of the BMPs presented below focus on separating you as a gardener from existing soils. In many cases, implementing BMPs such as those suggested below will allow safer gardening in a wider range of site conditions. Not every BMP is necessary for every single site, but a combination of BMPs appropriate for your particular site will provide better health outcomes.

Construct physical controls

Risk is based on the extent of hazard or contaminant present and the potential for exposure to the hazard. Actions to remove or reduce hazard (amend soil) and reduce exposure (cover soil), reduce risks. Many good gardening practices, like adding compost and soil amendments, improve the soil while reducing the amount of contaminants and exposure to them.

- Build your garden away from existing roads and rail, or build a hedge or fence to reduce windblown contamination from mobile sources and busy streets.
- Cover existing soil and walkways with mulch, landscape fabric, stones, or bricks.
- Use mulch in your garden beds to reduce dust and soil splash back, reduce weed establishment, regulate soil temperature and moisture, and add organic matter.
- Use soil amendments to maintain neutral pH and add organic matter and improve soil structure.
    - Not all amendments are the same; be sure to choose the right amendments for your soil. For more information on choosing the right soil amendment, refer to the Colorado State University Extension webpage on soil amendments at *http://www.ext.colostate.edu/pubs/garden/07235.html.*
    - Keep in mind that each amendment type will have different application rates and techniques (e.g. rototilling), and may need to be maintained and reapplied annually.
    - Be sure to work with your local or state regulatory agency, and ask if your municipality provides free compost or mulch. Some amendments, such as Class A biosolids from sewage sludge, may be regulated under various regulatory programs.
- Add topsoil or clean fill from 'certified soil sources' to ensure the soil is safe for handling by children or gardeners of all ages and for food production. Your state or local environmental program, extension service, or nursery may be able to direct you to providers of safe certified soils, or to recommended safe sources for gardening soil.

- Build raised beds or container gardens
    - Raised beds help improve water drainage in heavy clay soils or low-lying areas. They also create accessible gardening locations for many users and allow for more precise soil management.
    - Foot traffic should not be necessary in the bed, so the soil does not become compacted and soil preparation in the coming years is minimized.
    - Your state or local city agency may recommend using a water permeable fabric cover or geotextile as the bottom layer of your raised bed to further reduce exposure to soils of concern.
    - Raised beds can be made by simply mounding soil into windrows or by building containers. Sided beds can be made from wood, synthetic wood, stone, concrete block, brick or naturally rot-resistant woods such as cedar and redwood.

Emphasize good habits

Wear gloves and wash hands after gardening and before eating.

Take care not to track dirt from the garden into the house.

Clean produce before storing or eating.

Peel root crops, and remove outer leaves of leafy vegetables.

Teach kids to wash fruits and vegetables before eating.

5. Begin Farming

Whether it is a long-term or an interim use, simply greening a once-blighted or vacant property and improving the soil structure has real effects on the economic and social value of land and community health. It can also reduce the runoff of urban soil, silt and contaminants into stormwater systems by allowing greater infiltration of rain into soils improved with added compost and soil amendments. The ability to grow food or horticultural crops such as flowers or trees on this newly greened area will produce multiple beneficial effects to those who may farm it. Healthy eating, increased physical activity, reduction of blight, improved air quality and improved quality of life are all nearly immediate health benefits from urban agriculture.

WHY INCLUDE A BUSINESS PLAN?

Urban agriculture exists in various forms and scales. From community gardens to commercial enterprises, from edible landscapes to beekeeping, on a residential lot or on a former industrial site, there is no one-size-fits all to urban agriculture. However, most successful and sustainable urban agriculture projects do share one thing in common: a business plan. The urban agriculture business plan provides a road map to the garden's activities, an internal planning tool, and a way to communicate the project to external stakeholders and potential funders. Nearly every section of a business plan has strategic items that may be altered due to the condition of existing soils. Many farmers will find a new site before they make too many changes to their business plan, or will choose a new site based on remediation costs; but contingencies such as these also need to be addressed and communicated with investors and stakeholders via a well-designed business plan.

EPA, HUD and DOT have been working together under the Partnership for Sustainable Communities to ensure that federal investments, policies and actions support development that is efficient and sustainable. In one such brownfield pilot project in Toledo, OH, the EPA provided technical assistance to develop the *Urban Farm Business Plan Handbook*. This handbook provides a complete framework for developing an urban farm business plan and describes what information should be collected, evaluated, and presented in each section of the business plan, once the site is cleaned and ready for growing. The *Urban Farm Business Plan Handbook* is available for download at:
http://www.epa.gov/brownfields/urbanag.

The level of cleanup required and the costs for implementing that cleanup, such as transportation and disposal of dirty soils or clean fill, may have huge implications on the viability of your garden as originally planned. The business plan should be modified to address any changes from the original farm design after determining what level of cleanup may be required. The state of existing site soils may require a fresh look at the marketing, operating and financial aspects of your urban agriculture project, depending on whether your urban agriculture site is an interim or long-term use. A simple modification of garden type to save remediation costs, such as moving from in-ground planting to raised beds, may have implications on farm function or crop plans. While the risks of gardening on brownfield sites do exist, the end goal does not change. Gardening safely on sites with an environmental history is possible and economically feasible if planned properly.

SUMMARY

Implementing urban agricultural practices on brownfield sites addresses and mitigates public health concerns, reduces blight and preserves neighborhoods, while directly improving food access and nutrition. Communities wishing to redevelop brownfield sites into urban agriculture projects are faced with a unique problem because no set cleanup standard exists for urban agriculture reuse. In order to understand the issues surrounding urban agriculture redevelopment, EPA convened a group of experts that work on different aspects of urban agriculture and asked how communities should approach the redevelopment process, and what they need to know to develop urban agriculture safely.

What we found is that investigation into historical uses of the property and consideration of how existing contamination changes the gardening strategies available to you improves the likelihood for success of your urban agriculture project. Although urban lands are generally affected by previous activities with impacts on existing soils, using safe gardening practices and BMPs will control a wide range of contamination issues. Working with your state environmental agencies to properly addresses risk and, where BMPs are not enough, set cleanup goals, will result in a garden that brings benefits to the community for years to come.

Additional work continues to describe relationships between plant uptake and contamination, and to begin setting risk-based criteria for urban agriculture on the state level. ASTSWMO, the Association of State and Tribal Solid Waste Management Officials, has named urban agriculture standards and practices a priority topic for discussion in 2011, and EPA will continue to work with the states, other Federal Agencies, academics, and other partners as they examine possible urban agriculture reuse standards. Until more data is available, these Interim Guidelines can be used to identify types of information needed to make decisions in order to garden safely at a site that has potential contamination.

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