Community Gardening on Brownfields Toolbox

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I. Introduction

Purpose of this Toolbox

Community gardening is becoming more commonplace throughout the country as communities seek to increase their access to healthy, nutritious and affordable produce. The development of community gardens in urban areas raises questions about potential contamination since many inner city areas are near current and former industrial and commercial facilities. Older neighborhoods face concerns about historic soil contaminant deposition caused by pre-1978 vehicle traffic burning leaded gasoline, lead-based paint, house fires, burn pits, etc….

Citizens and community organizations are asking State and Territorial State brownfield and voluntary cleanup program officials the age - old question of "how clean is clean" with a twist – how clean is clean to ensure our community garden is safe? In response, the Association of State and Territorial Solid Waste Management Officials (ASTSWMO) Brownfields Focus Group has put together a toolbox of safe community gardening information and practices employed throughout the country in order to assist State officials in dealing with these challenging questions.

The purpose of this document is to give guidance to Ohio's local governments, private and non-governmental organizations and individual community gardeners who have concerns about the potential for contamination at properties used or proposed for gardens. The document provides helpful information on what works for some States and local communities in areas such as helpful ordinances, good sampling practices and risk management techniques that are relatively easy and economical to implement and links to other useful resources.

Toolbox Concept

This document is set up in what we call a "toolbox" format. By toolbox format, we mean that the document provides different options or tools that are based on the latest research, practices and procedures that other entities have successfully utilized. This allows the reader the ability to compare the various "tools" to determine what fits best given the situation.

Focus of this Toolbox

The focus of this toolbox is to provide options for safe gardening at community gardens based on the experiences of State environmental cleanup programs with urban and rural contaminated properties. For purposes of this document, a community garden is defined as a food-producing plot(s) of land, located on public or private property in and around residential areas, which is gardened and managed collectively by a group. Some of the safe gardening options provided by this document may also be helpful for single family backyard gardens or urban agriculture operations, i.e., larger market garden or farming operations that have a continuously operating market or other commercial operations, including livestock. The document is specifically geared toward issues that arise when community gardening is contemplated or occurring on contaminated or potentially contaminated sites.

Benefits of Community Gardening

At first glance, it may seem counterintuitive to promote growing crops in older, urban areas with potential historical contamination. In the past, many State brownfield officials would have recommended using these properties for commercial developments or recreational spaces.

However, an increasing number of community gardens on vacant lots and suspected brownfields are providing researchers with information regarding the significant benefits of community gardening. Detailed discussion of the benefits* of community gardens are beyond the scope of this report. In summary, some of the benefits that have been noted include:

- Community gardens provide access to nutritionally rich foods that might otherwise be unavailable to low-income families and individuals.
- Community gardens and urban agriculture have been shown to be 3-5 times more productive per acre than traditional large-scale farming.
- Studies have shown that community gardeners and their children have healthier diets than non-gardening families.
- Eating locally produced foods reduces asthma rates because children are able to consume manageable amounts of local pollen and develop immunities.
- Studies have shown that community gardens increase property values in the immediate vicinity of where they are located.
- Community gardening is recognized by many urban police departments as an effective community crime prevention strategy.
- Community gardens help filter rainwater, which in turn helps keep lakes, rivers and groundwater clean.
- Community gardens can reduce both soil erosion and the heat island effect prevalent in urban areas.

(from "Multiple Benefits of Community Gardening", The Green Institute, 1 21st Ave S, Suite 110, Minneapolis, MN 55407 www.gardenworksMN.org)

*Additional references that reflect the benefits highlighted above can be found in the reference section at the end of this document

U.S. Environmental Protection Agency's "Interim Guidelines for Safe Gardening Practices"

In the summer of 2011, U.S. EPA published its "Interim Guidelines for Safe Gardening Practices," providing guidance on critical issues that need to be addressed to safely garden on brownfield sites. Although this toolbox has not been created specifically as a companion to U.S. EPA's Guidelines, the ASTSWMO Brownfields Focus Group did consult with many of the same experts and this toolbox follows a similar organizational structure. This document provides additional detailed information specifically targeted to Ohio's local governments, community organizations and individual community gardeners who have concerns about how to safely garden on urban sites with possible contamination. You will note if you have read the "Interim Guidelines for Safe Gardening Practices" that, throughout the document, it states "for additional information you may want to contact your State environmental agency."

While brownfields have long been assessed and cleaned for a range of reuses, including gardens, urban farms, and other food production purposes, the recent explosion of interest has prompted many individual and community organizations to use or plan to use vacant land or structures without an explicit focus or management process to identify and manage environmental risks. Given limited, though increasing, local government activity in this area, Ohio EPA's Division of Environmental Response and Revitalization

may be contacted to provide technical support by community organizations interested in brownfields for community gardens and urban agriculture with limited brownfield experience or understanding. This toolbox is designed to provide you with the guidance on the "state of the research" and "state of best safe gardening practices" to help you determine how suitable a property may be for a community garden.

II. Getting Started

Below are questions that you might ask before developing urban property for gardening. These are followed by links to the portions of the toolbox that address that question.

- **Do you own or simply have use of the property where the community garden is located?** Section III discusses the considerations associated with ownership or use of a property
- **What should you understand about your Community Garden property before you turn the first shovel of dirt?** Section IV: Know Your Property provides guidance for evaluating a property's past use and environmental conditions.
- **How do I decide whether or not to collect soil samples? If I do collect soil samples, how many should I collect and what should they be analyzed for?** See Section V: Sampling and Other Considerations.
- **Once I understand the history and use of the property, how do I evaluate the potential health risk to users of the Community Garden?** If I collected soil samples how does this affect my evaluation? See Section VI: Potential Exposure Concerns.
- **If there are concerns about contamination do I have to find another property? Are there Best Management Practices that I can use to make gardening safe?** See Section VII: Risk Management and Section VIII: Common Sense Approaches.
- **Can this really work? Are there examples of sites where a community garden has been created on a brownfields site safely**? See Section IX: Case Studies.

III. Utilizing an Urban Property for Gardening

Look for Potential Environmental Contaminants

Before a property is purchased, donated, or borrowed for a community garden, it is highly recommended that an environmental assessment of the property be conducted. This is standard practice in property transactions but could be very helpful to community organizations to help ensure safe sites are selected for growing. The process of assessing properties for the presence or potential presence of environmental contamination is often referred to as ''environmental due diligence" or "All Appropriate Inquiry" (http://www.epa.gov/brownfields/aai/index.htm). All Appropriate Inquiry (AAI), also known as a Phase I Environmental Site Assessment (ESA), includes a review of historical property uses, interviews with neighbors, review of government records and maps, and a visual inspection. A Phase I ESA will help you determine if the property of interest has the potential for environmental contamination and will recommend whether an additional assessment may be necessary. The recognized standard for a Phase I ESA includes the procedures of the American Society for Testing and Materials (ASTM) Standard E1527 (entitled "Standard Practice for Environmental Site Assessment: Phase 1 Environmental Site Assessment Process"). A Phase II ESA continues the environmental site assessment process and typically includes soil and groundwater sampling and analysis to confirm the presence, types and levels of contamination on the property. For more information on Phase I ESAs, specifically ASTM E1527, see www.ASTM.org. Ohio EPA's Voluntary Action Program (VAP) also has rules outlining requirements for Phase I ESAs

similar to ASTM. If the intent is to address the property with the VAP, a Phase I ESA compliant with VAP's rules will be required. Rules for VAP Phase I ESAs are located at http://epa.ohio.gov/Portals/30/rules/2012/Rule%203745-300-06.pdf. Questions should be directed to Martin Smith at 614-644-4829 or martin.smith@epa.ohio.gov.

IV. Know Your Property

The more that is known about a property and its past uses, the better a group can plan for a safe community garden. Many properties throughout the country have an industrial or commercial past that may have resulted in contamination. This could include manufacturing operations, auto repair shops, gas stations, and a wide variety of other historical uses. A historical review can help glean information about potentially contaminated areas and thus re-direct the gardening away from those areas. There are many resources available for identifying the historical uses of a property and the potential for contamination. Information about Ohio EPA's VAP is located at http://epa.ohio.gov/derr/volunt/volunt.aspx. Questions should be directed to Martin Smith at 614-644-4829 or martin.smith@epa.ohio.gov or Eric Sainey at 614-644-2309 or eric.sainey@epa.ohio.gov.

There is some information that community gardeners can easily find at the local level. Information can be obtained in the deed records for the property that will be gardened. This information will provide names of past owners and may provide information on past uses. For example, if the property was used by "XYZ Auto Service," one can deduce that gas pumps, waste oil tanks, batteries and solvents may have been present. A property with a long and varied history may potentially have multiple kinds of contamination.

There are many additional resources that can be evaluated with a little footwork and/or a computer. These resources are outlined below:

- Long-time establishments, business owners, town clerks, fire fighters and residents in the community who may be able to identify former businesses.
- Sanborn insurance maps. These maps were created by fire insurance companies in the 19th and 20th centuries to help assess insurance risk. Specific industrial features, such as tanks, warehouses, machine shops, etc., are identified on these maps, and again, could help to identify areas with greater potential for gardening without any modifications to the land. Many libraries hold Sanborn insurance maps in their collections. These libraries and information on their holdings can be found in the *Union List of Sanborn Fire Insurance Maps Held by Institutions in the United States and Canada*. Also, Sanborn maps were transferred from the Library of Congress to specific State institutions. A listing of these institutions can be found at http://www.loc.gov/rr/geogmap/sanborn/.
- Various federal, State and local agencies may have aerial photographs that can be used to identify historical uses on a property or within an area. This information is particularly important in identifying areas of concern that are harder to locate because of demolition of old industrial/commercial buildings. This is even more important on properties that are vacant and have been vacant for several generations. Aerial photographs can also help to determine if fill material was brought to the property. In certain instances, contaminants such as petroleum constituents or heavy metals have been identified in fill material. Additionally, debris from houses or buildings that have been demolished could have been buried in or around the former footprint of the structure. Depending on the

year the demolition occurred, the State program may have records identifying the ultimate disposal of on-site solid waste materials.

- Local or county libraries may contain a wealth of historical information about a property or a specific area of the community. Also, local historical societies may have photographs, including aerial photographs, or records unlocking the past. Do not underestimate the value of older community residents that have lived in the area all their life as they often can provide valuable information about operations in a town from long ago.

You may contact the following individuals to find information the state may have on file for specific properties. For BUSTR, contact Nancy Caldwell at 614-387-7412. For Ohio EPA, contact persons are available at http://www.epa.state.oh.us/portals/47/facts/records.pdf.

- U.S. EPA provides federal assessment grants to communities to help them identify the likelihood of contamination. You may want to check this information to see if your community has received a U.S. EPA assessment grant for the site you are interested in gardening. A list of communities which have received grants is available at www.epa.gov/brownfields. This may be a resource for finding existing data on a site or as a possible funding source in the future to assess and/or clean your site(s).
- U.S. EPA Regional offices also provide targeted brownfield assessments (TBA) on a first come, first served basis based on application and demonstrated community need. Learn more about TBA at: http://www.epa.gov/brownfields/grant_info/tba.htm.
- U.S. EPA periodically funds organizations, whether academic or community-based organizations to provide a range of technical support to brownfields communities. Information on Technical Assistance to Brownfields (TAB) grant recipients and contact details can be found at: http://www.epa.gov/superfund/community/pdfs/toolkit/techassist-tab.pdf .
- Funding for assessment through a State's 128(a) brownfields program may be available for a Phase I ESA and/or Phase II ESA on the property. Many States will conduct the sampling/assessment to determine if a property has been environmentally impacted. The Phase I ESA process would commonly include many of the resources and items discussed above.
- In addition, many State regulatory programs identify and track underground storage tanks, waste generation/storage/handling and industrial facilities operation/closure. This information identifies areas that have already been sampled, which can save money and time. You may contact the following individuals to find information the state may have on file for specific properties. For Ohio EPA, contact persons are available at http://www.epa.state.oh.us/portals/47/facts/records.pdf. For BUSTR, contact Nancy Caldwell at 614-387-7412.

At properties where sampling is planned, it is strongly recommended that past uses and potential areas of concern are identified beforehand. This allows the sampling to be focused on the most likely contaminants and contaminated areas.

V. Sampling and Other Considerations

In order to grow healthy crops, it is important to test the soil to make sure it contains the proper soil nutrients, pH, and organic matter content. Local USDA Cooperative Extension offices (http://www.csrees.usda.gov/qlinks/partners/state_partners.html) routinely conduct this level of soil testing for gardeners and provide advice for soil amendments prior to planting. But soil condition is not the only concern. The risk to human health from potential contaminants in the soil should be equally important to gardeners. While extension staff are often experts in soil science, plant health, nutrition and health issues, their understanding about environmental contaminants may vary. Prior to gardening on potentially contaminated properties it may be prudent to collect soil samples to determine the average concentrations of contaminants deposited in the past. These types of soil samples should be sent to analytical laboratories experienced in analyzing for a wide variety of potential soil contaminants using methods approved by U.S. EPA. The VAP has a certification program for laboratories approved to analyze contaminants in soil and water. A list of certified laboratories is located at http://epa.ohio.gov/derr/vap/pro_lab/labs.aspx.

Former commercial and industrial properties, former orchards, former dump or landfill sites, former incinerator or smelter sites, as well as transportation corridors, ports, areas near bridges, historic residential neighborhoods constructed prior to 1978, and land adjacent to these areas may be contaminated due to past or present uses in ways which can harm human health.

Table 1 contains general information about common sources of potential contamination and land uses which can lead to contamination, and associated contaminants of concern. The previous section "Know Your Property" contains valuable information for determining the past uses of a potential garden site and adjacent properties.

Table 1: Potential Soil Contaminants by Source

Source of Potential Contamination	**Contaminant(s) of Concern Associated with Source(s) and Use(s)**	**Uses Leading to Potential Contamination**
Asbestos and Asbestos containing materials	Asbestos	Residential, commercial, and industrial construction demolition sites (structures erected pre-1989), manufacturers and processors of asbestos materials, illegal dumping sites of asbestos containing materials
Biosolids and sewage sludge	Metals, Pharmaceuticals, Pesticides, Endocrine Disrupting Compounds	Waste water treatment facilities, Livestock
Burning (primarily burning of waste)	Polycyclic Aromatic Hydrocarbons (PAHs), Dioxins, Metals	Open dump burning, landfill incinerators, residential burn barrels
Coal ash	Metals, Dioxins	Coal-fired power plants
Dry cleaning and industrial laundry facilities	Stoddard Solvent and Chlorinated solvents	Cleaning of garments, uniforms, rugs, and other textiles
Concrete plants and ore smelters	Metals	Rock crushing and activities, materials mixing, concrete kiln operations, ore smelting

Industrial or commercial facilities	Volatile and Semi-volatile organic compounds (VOCs and SVOCs) , PAHs, Metals, Petroleum products and constituents, PCBs, Dioxins	Any process occurring on industrial or commercial zoned property
Lead-based Paint	Lead	Buildings (including residential) constructed prior to 1978. Although banned for residential use, lead-based paint is still available for some industrial uses on bridges, at ports, and in roadway striping. Water tanks/towers, etc.
Petroleum	Multiple petroleum constituents, PAHs, Lead, VOCs and SVOCs	Gas stations, bulk fuel distribution sites, refineries, auto service repair, and above and below-ground storage tanks (gasoline/diesel, home heating oil tanks, waste oil tanks), spills from petroleum use
Pesticides and herbicides	Arsenic, Lead, and many varieties of chlorinated and organophosphate pesticides and herbicides	Orchards, agricultural fields, weed and pest abatement facilities, aerial spraying facilities, feed packing/shipping/storage, exterminators, nurseries, lawn care facilities.
Transportation corridors	Lead, Metals, Petroleum, PAHs, VOCs, SVOCs	Roadways traveled prior to the late 1970s were subject to lead deposition from car exhaust and lead wheel weights thrown from tires. Rail corridors transport a vast array of hazardous materials. Pesticides may also have been sprayed in transportation corridors.
Old transformers	PCBs	Soil and contaminated concrete, cement block or brick beneath old PCB containing transformers may be contaminated if the transformers leaked.
Wood treatment	Arsenic, Chromium, Copper, Dioxins, PAHs, Pentachlorophenol, VOCs, SVOCs	Facilities treating lumber (pressure treated), railroad ties, telephone poles, furniture and flooring manufacture. Also, residential use of railroad ties and treated lumber.

A basic understanding of contaminant fate and transport is helpful when deciding if, how, and where to collect soil samples. In addition to the State regulatory agency, local public health and environmental quality officials, environmental consultants, and environmental engineering or geoscience departments at universities can be a good resource if there are questions about whether to collect soil samples and how to develop sampling and analysis plans. In order to obtain the best possible assistance, it is helpful to have a scale drawing of the proposed garden layout including size and location of beds, and size and location of footpaths, as well as the layout of other features you may plan for your garden, such as a child's play area, picnic spots, or meditation areas.

In the event that those resources are not available for your project, **Table 2** below provides some generic suggestions for areas to sample for common soil contaminants based on the structural features and past uses of the property. If soil sampling and analysis is not an option for your project, Table 2 may be used as a general guide for areas where you may want to avoid or remediate prior to use as a garden.

Table 2: Areas to Sample, Avoid, or Remediate Prior to use as a garden
(Due to Past Use and Potential Contaminant Type)

Potential Source	Contaminants of Concern	Distance from Source*
Painted structures (pre-1978) or current industrial sites	Lead	Test within twenty (20) feet of source
Transportation corridors	Lead, Metals, Petroleum, PAHs, VOCs, SVOCs	Test within one-hundred feet (100) feet of source
Residential burn barrels	Polycyclic Aromatic Hydrocarbons (PAHs), Dioxins, Metals	Test immediately downwind
Fences and other treated wood structures	Arsenic, Chromium, Copper, Dioxins, PAHs, Pentachlorophenol, VOCs, SVOCs	Test within five (5) feet of the fence line
Fossil fuel burning power plants, concrete plants, smelters, industrial incinerators, refineries	Volatile and Semi-volatile organic compounds (VOCs and SVOCs) , PAHs, Metals, Petroleum products and constituents, PCBs, Dioxins	Test or avoid areas within one (1) mile of these facilities or plan to mitigate potential exposure
Orchards and pesticide sites	Arsenic, Lead, and many varieties of chlorinated and organophosphate pesticides	Test area of potential application and immediately downwind
Other sites such as petroleum, dry cleaning, wood treatment, above or underground storage tanks, or old transformers	Volatile and Semi-volatile organic compounds (VOCs and SVOCs) , PAHs, Metals, Petroleum products and constituents, PCBs	Test or avoid visibly stained areas, suspect areas with no vegetation, and areas of known operation and/or spills, or plan to mitigate potential exposure

*http://www.origen.net/Gardening.pdf

Ultimately, the sampling and analysis plan for your proposed garden will depend upon how the design developed for the garden compares to past uses of the property. Your State may have information on professionals such as environmental consultants, analytical labs, public health agencies, agricultural extension offices, public health agencies, and universities that can help develop sampling and analysis plans to fit the proposed garden design while taking into account potential areas of contamination. If cost or accessibility prevent using those resources for projects, it may be wise to move directly to risk management strategies, discussed in detail in Section VII.

It is also possible for the community gardener to design and implement their own sampling and analysis plan. In order to begin developing an appropriate plan, it is important to know how the property was used in the past. In addition, any potential area of contamination and types of suspected contaminants should be identified as discussed in Section IV and Section V. An example site diagram of the proposed layout and use of your garden will be needed. See Appendix B for an example. Contact an analytical

laboratory for instructions regarding the collection, storage, and transport of soil samples based on the type of analysis needed to obtain the proper sampling containers.

A typical community garden could have walking paths, raised beds, and a children's play area, and, with forethought, such as building garden paths at least 3 feet wide, will also allow wheelchair access and become accessible to all members of the community. Each of these areas and associated uses carries its own set of potential risks with respect to soil contaminants. These risks and techniques for mitigating risks are discussed below. Regardless, each of these areas should be considered as their own "decision units" and samples should be collected and analyzed from each of these areas. Environmental sampling may be different from the sampling instructions provided by the soil extension service that focus on soil and plant health. Environmental sampling tries to identify 'hot spots' and may focus on areas where contamination is most likely to occur (near buildings covered with lead based paint, where soil staining occurs or changes are visible or areas of high contamination). It is important to convey the different focus of sampling when providing advice to gardeners or their organizations.

For foot traffic or play areas where digging is not likely to occur, sample collection should focus on the first few inches of soil. For locations where crops will be planted, sample collection should focus on both surface soil and the root zone (typically 6 to 12 inches below the surface, possible up to 18 inches, and deeper for fruit or nut trees). Multiple soil samples should be collected from each "decision unit" and then combined (composited) into a single container such as a large freezer bag or a stainless steel container and then mixed until the sub-samples are evenly mixed (homogenized) into a single sample. If the property has two distinctly different types of soil, such as fill soil in one area and native soil in another area, consider sampling those areas separately by designating them as distinct "decision units." It will be helpful and it is strongly recommended to mark the site map with the approximate areas from which you collected your soil samples. Fill the appropriate sample container, label the sample, and prepare it for transport to the laboratory. Repeat this process for every "decision unit" in your proposed sampling plan.

Once the laboratory analysis is complete, you will receive the results of your sampling event. The same professionals that helped you develop your sampling and analysis plan can help interpret the results of your soil analysis. The sections below also present information helpful in deciphering the laboratory results.

Table 3: State Specific Resources

Resource	**Website**	**Telephone / Email**
Environmental Consultants/ Licensed Site Professional	http://epa.ohio.gov/Portals/30/vap/docs/CP%20list.pdf	See contact information on website
Analytical Laboratories	http://epa.ohio.gov/portals/30/vap/docs/LAB/VAP%20Certified%20Laboratories.pdf	See contact information on website
State Environmental Authority	Ohio EPA http://epa.ohio.gov	(614) 644-3020
Brownfield/Response Program	Ohio EPA Division of Environmental Response and Revitalization http://epa.ohio.gov	(614) 644-2924
Public Health Agency	Ohio Dept of Agriculture http://www.agri.ohio.gov/ Ohio Dept. of Health (private wells) http://www.odh.ohio.gov/odhprograms/eh/water/PrivateWaterSystems/main.aspx	See website (614) 466-3543
Agricultural Extension Office	Ohio State University Extension offices http://extension.osu.edu/	See contact information on website
University Resources (Geosciences, Agricultural Sciences, Health Sciences, Environmental Engineering Department)	Ohio State University School of Environment and Natural Resources http://senr.osu.edu/facview.asp?id=3251 Otterbein College – Kevin Svitana KSvitana@otterbein.edu	See contact information on OSU's website. e-mail address for Kevin Svitana: KSvitana@otterbein.edu

More information on the RSLs

Twice a year, the U.S. EPA publishes the Regional Screening Level (RSL) table on the following website: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm. The table presents screening values for various media for residential and industrial (which also include commercial) exposure scenarios. The RSLs are single-chemical concentrations that are protective of a one-in-one million (10^{-6}) excess lifetime cancer risk or a non-cancer hazard quotient of 1. In addition, the RSL calculator has the ability to calculate site-specific screening levels based on the residential and industrial scenarios as well as other exposure scenarios including recreational exposure to sediments/soil and surface water. For each scenario involving soil exposure the direct exposure routes of incidental ingestion, dermal contact, and inhalation are taken into account as part of the screening level calculation.

Residential RSLs are considered appropriate for assessing community gardens, in part, because community gardening often involves children accompanying adults and participating in gardening activities. Additionally, community gardens are often located in residential areas, with residences nearby or adjacent to the garden. As a result, soils and dust from the garden can be readily transported into residences by adults, children, and pets.

If a concentration of a contaminant is below its corresponding residential RSL, unrestricted use is generally considered appropriate. Therefore, if contaminants are below their respective residential RSLs in a potential community/urban gardening plot, the area in question would typically be considered safe for gardening. However, the RSLs do not directly take into account the consumption of fruits and vegetables grown in a community garden that have potentially accumulated site contaminants. Although this exposure pathway is assumed to be minimal for most community gardens, it may need to be evaluated depending on the contaminant, and contaminant levels. In addition, any subsistence farming exposure scenarios would need to be evaluated separately.

In the absence of nationally recognized community gardening specific soil screening values, either regulatory or risk-based, it appears that the residential RSLs are a legitimate option when a screening value is needed. For inorganic chemicals, such as arsenic, often the naturally occurring background levels of these chemicals are determined either through the literature or from nearby sampling in areas that are known not to be contaminated. These levels can be another legitimate source of a screening value. For additional information you can contact Martin Smith Ohio EPA at 614-644-4829. Another available resource from Ohio EPA is the report titled "Evaluation of Background Metal Soil Concentrations in Cuyahoga County – Cleveland Area, March 2013." Additional county reports are anticipated in the future. Report summaries can be found at the following link:
http://epa.ohio.gov/portals/30/vap/docs/Evaluation%20of%20Background%20Metal%20Soil%20Concentrations.pdf

Uptake of Contaminants into Plants

To support this project, the English scientific literature for field studies of contaminant uptake in food crops was reviewed and experts were consulted to learn about the current consensus around plant uptake among practicing and academic agronomists. Independent greenhouse studies were not included.
The environmental and plant research literature reflects uptake research on a narrower range of contaminants and only select food crops. By contrast, environmental cleanup programs address a wide range of environmental contaminants at varying levels in soil and groundwater from corner gas stations to mine scarred lands in urban, suburban and rural locations nationwide. From the literature, the following information was gleaned:

- Additional research is needed to fill the information gaps across the range of conventional and unconventional food crops now under cultivation by individual and community garden participants and urban farmers. There is more extensive research on lead, arsenic and cadmium uptake by food crops than most other contaminants encountered by environmental cleanup programs.

- As a general rule, environmental agencies are concerned about direct exposure to soil and particularly for sensitive populations, such as children. Our risk and cleanup procedures are directed at understanding and reducing exposure to soil with a primary focus on the incidental ingestion of soil (+ contaminant). Other routes of exposure, such as dermal exposure and potential inhalation, can be of concern, too. There is concern that gardeners do not consider the potential for historical contamination in vacant lots proposed for gardens or other growing options. It is strongly encouraged that continued partnerships between environmental agencies and their plant and soil science counterparts are strengthened to more fully understand risks and sound management practices for the growing communities.

- Cadmium uptake in plants is well recognized. Steps to control pH, add soil amendments and improve soil structure can modify or reduce uptake (while also reducing bioavailability). Arsenic and Lead are less likely to be taken into plants than cadmium, where soil pH is neutral. However, where cadmium, arsenic or lead contamination is likely or suspected, testing is encouraged and planting root crops, such as carrots, beets, and parsnips, should be avoided.

- Steps taken to improve compacted and poor quality urban soils by adding soil amendments (compost or leaf mulch) and controlling pH have been found to bind and reduce the availability of contaminants for plant uptake. If a large volume of amendments are added, this can also decrease the amount or volume of contaminant. The addition of phosphate and other amendments have been studied to bind contaminants, primarily metals. Soil amendments as well as phytoremediation and ecological restoration remain areas of active research.

A full list of the literature reviewed is located in Appendix A.

VII. Risk Management Practices - Local Zoning, Ordinances or Other Local Government Controls

Local Zoning and Ordinances

As more and more citizens engage in community gardening, city and local government officials are taking note and looking for ways to improve community gardening siting and practices. These officials are realizing that, when properly sited, community gardens can help support economic and community development and contribute to a positive community image. Many zoning changes and ordinances that cities have adopted focus on issues such as livestock, site structures, market gardens and size. In addition to those issues, a few cities have come to understand the potential contamination problems that might exist on properties that are developed as community gardens. A few cities that have adopted controls to deal with potential contamination at community gardens are listed below.

Milwaukee

Milwaukee has enacted the following community gardening requirements when gardens are being developed on city-owned property:

- Raised garden beds must be constructed for the growing of any food crops.
- Raised garden beds must be constructed to hold a minimum depth of 12 inches of soil.
- Raised garden beds must be constructed of non-toxic materials such as untreated lumber.
- Raised garden beds constructed of any materials other than untreated lumber must be approved by the Department of City Development.
- A root barrier, such as landscape fabric, must be placed between existing soil and the soil in a raised garden bed.
- Raised garden beds must be filled with soil that is uncontaminated and safe for the growing of food crops.

In addition, in Milwaukee, a clay cap raised garden bed is allowed with the permission of the Department of City Development and must meet the following requirements:

- Cap must consist of a minimum of 18 inches of clay.
- A minimum of eight inches of soil must be placed on top of the clay cap.
- All clay and soil must be graded to minimize runoff onto neighboring properties, streets, alleys and sidewalks.
- A minimum 10 foot buffer of undisturbed grass must remain between the tilled garden area and any neighboring property, streets and sidewalks.

Chicago

Another city that is trying to implement safe gardening practices using ordinances or local controls is Chicago. In Chicago, when the city is selling or leasing land to be used for urban agriculture, they will attempt to partner with the urban grower to evaluate the property. If contamination is present, the City will evaluate the costs associated with remediation and attempt to procure cleanup services or place conditions upon the use of the property, such as the need for engineered barriers, or land use restrictions (see Figure 1 for examples of some of the engineered barriers the City recommends).

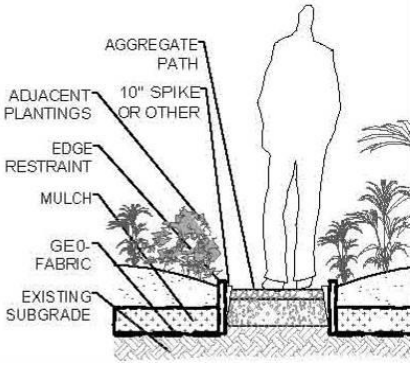


Figure 1: Figure from "Urban Agriculture: Growing Healthy, Sustainable Places", American Planning Association. 2008

Baltimore

The City of Baltimore has adopted, as part of their zoning code, community gardening requirements. Under Title 14-305 of the Baltimore zoning code, the City specifies what plants may be cultivated, prohibits permanent structures and requires that soil testing to measure nutrients, heavy metals and any

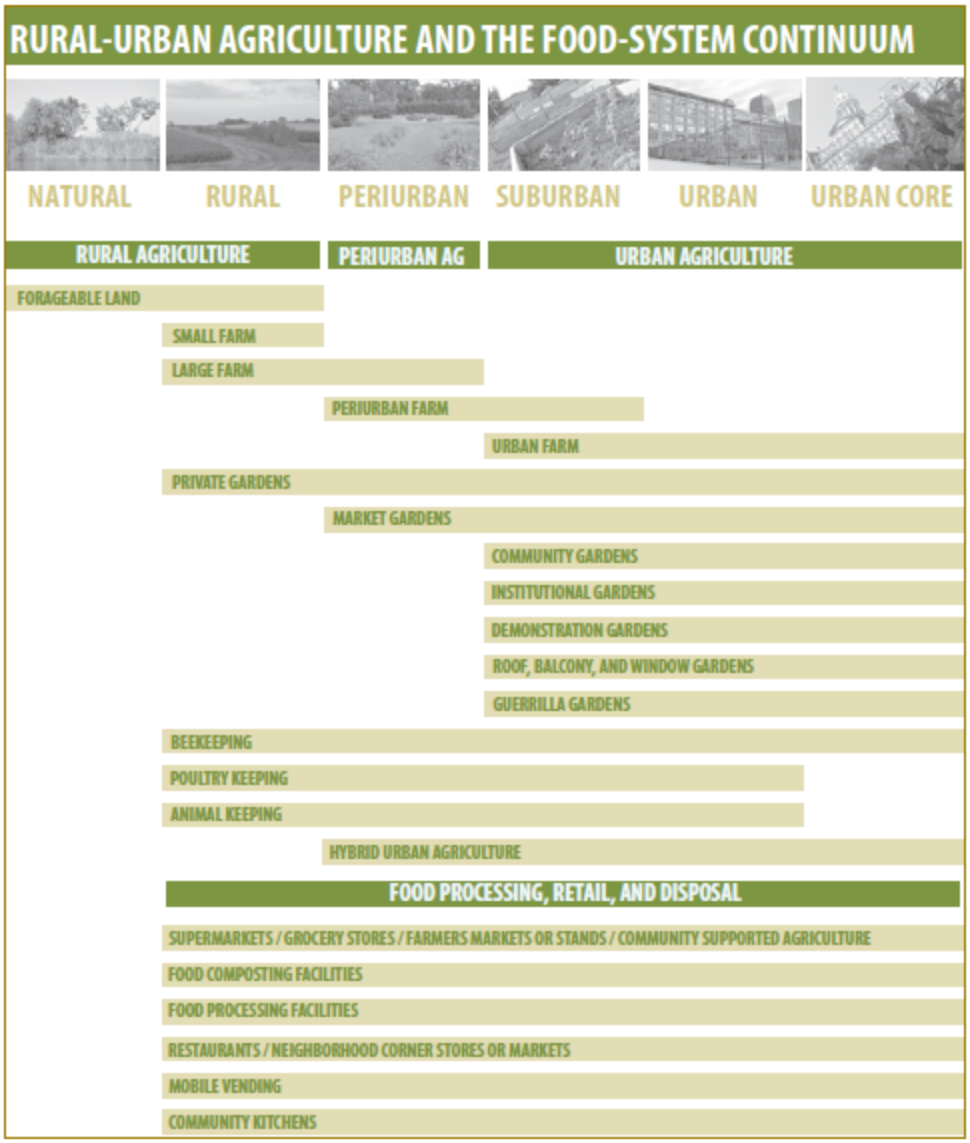
other harmful contaminants that may be present be done prior to the establishment of a community garden. In order to obtain a use permit for a community garden, the applicant must present the soil testing results and proposed remediation methodology, if needed. As an alternative to remediation, the applicant may use raised planter boxes for all plants.

Seattle

The City of Seattle adopted Resolution 31019, April 2008, establishing goals, creating a policy framework, and identifying planning, analysis and actions for the purpose of strengthening Seattle's food system sustainability and security. For a copy of the resolution, please see:
http://clerk.seattle.gov/~scripts/nph-brs.exe?s1=&s2=&s3=31019&s4=&Sect4=AND&l=20&Sect2=THESON&Sect3=PLURON&Sect5=RESN1&Sect6=HITOFF&d=RES3&p=1&u=%2F~public%2Fresn1.htm&r=1&f=G.

For updated information on their food action activities, please see:
http://www.seattle.gov/council/conlin/attachments/food_act_initiative2011handout2page.pdf.

The American Planning Association (APA) has developed a number of resources for planners and those interested in supporting urban agriculture and improving food systems.



Kimberley Hodgson, from a concept by Andres Duany; design by John Reinhardt

Alternative Gardening Approaches

There are many approaches to alternative gardening methods. These include soil augmentation, raised beds and hydroponics . A great deal of literature is available that outline these specific techniques. Generally recognized approaches can be found at the following websites:

- http://www.sunset.com/garden/perfect-raised-bed-00400000039550/
- http://eartheasy.com/grow_raised_beds.htm
- http://www.popularmechanics.com/home/how-to-plans/lawn-garden/4308264
- http://www.rodale.com/hydroponics-farming?page=0%2C1
- http://www.epa.gov/epawaste/conserve/rrr/composting/basic.htm

VIII. Common Sense Practices

There are many common sense practices which should be incorporated into any gardening project but the need for some precautions may be heightened for community gardens located in urban areas in some situations.

Potential Exposure to Site Contamination

As referenced above in the Human Health Direct Contact to Soil Section, the most likely route of exposure to contaminants is the ingestion of contaminated soil or dust. Exposure to airborne dust through inhalation is the second most common exposure route. There are various common sense practices which can be undertaken to minimize these exposures regardless of whether or not contamination is suspected to be present at the site. Measures can be taken to minimize dust, especially while undertaking certain tasks such as tilling, by lightly sprinkling the garden with water. This may not be practical in all situations such as when mowing or other similar tasks are undertaken, so a properly fitted disposable dust mask can be utilized to minimize inhalation. Using a dust mask will also minimize inhalation of pollen which may trigger allergic reactions in certain people.

A thorough washing of all vegetables prior to consumption is strongly recommended in all circumstances. Consumption of unwashed raw vegetables whether in the garden or at home is not recommended and studies have demonstrated that thorough washing of vegetables greatly reduces the concentrations of any potential contaminants as well as pathogens. Root crops have a greater exposure to contaminants in the soil and particular care should be taken when washing these vegetables. In situations like these, washing may not removal all contaminants (see section VI). Using a vegetable brush to wash root crops is strongly recommended. There are also special soaps which can be used for vegetable washing. While cooking should eliminate pathogens found in soils and adhered to vegetables, boiling may not eliminate contaminants which are not washed from the produce.

Safety

While working on a community garden site, it is of paramount importance to be safe, practice safety measures, and follow equipment and manufacturer's instructions for safety. The Center for Disease Control and Prevention (CDC) has a number of tips to help keep a gardener safe and healthy and these recommendations can be found at the following link http://www.cdc.gov/family/gardening/index.htm.
Many safety precautions can also help to minimize exposure to potential site contaminants. Community gardening does involve manual labor, hand tools, and at times power tools, therefore the potential for injury is present.

While working in a garden, one should always keep in mind this land is often previously used property and may have sharp debris such as nails, rebar, metal pipe or other sharp steel or debris remaining on the property from a prior use which could cause puncture wounds or entangle with equipment. The CDC recommends tetanus/diphtheria (Td) vaccination for gardeners and more information can be found at the link in the paragraph above. Always remember the potential for injury is present and precautions should be taken.

Hygiene

Thorough hand washing after gardening, before contact with one's mouth or before contact with food, should further minimize potential exposure to soil contaminants. Caution should be taken when eating or drinking while working in the garden. Care should be taken to remove soiled clothing, boots and gloves

prior to entering the living or cooking areas of the house. Simple laundering of the clothing should remove soils and potential contaminants.

Excavation on the Urban Garden Site

When undertaking excavation beyond that which is normally required for planting vegetables, certain precautions should be taken, such as having the utilities marked and cleared (this is often a requirement by local or State law). The "Know Your Site" section plays heavily into any work requiring excavations. Even excavations for a post hole can easily be deep enough to encounter a utility line. Cutting into a utility line such as an electrical or natural gas line can be extremely dangerous and damaging. Cutting any of these lines, especially a line such as optical fiber, can result in penalties, fines, and repair costs.

In certain situations, cover material such as top soil may have been used to cap the property, so precautions should be taken to return soils to the area of excavation and to replace the clean cover material. If the property has been assessed by one of the various regulatory programs or voluntary cleanup programs, there may be a mandatory requirement for the soil cap/cover to be maintained or a prohibition on excavations. In these situations it is extremely important that any excavations only be undertaken in accordance with what is allowed by the restrictions or prohibitions.

Call before you dig – Ohio Utilities Protection Program - http://www.oups.org/ and the Ohio Oil and Gas Producers Underground Protection Service http://www.ogpups.org/

Both organizations request that you call 8-1-1 or 1-800-362-2764 before you dig: It's the law!

By law, everyone MUST contact the Ohio Utilities Protection Service, 8-1-1 or 1-800-362-2764, at least 48 hours but no more than 10 working days (excluding weekends and legal holidays) before beginning ANY digging project.

During any site work on previously used properties there is the chance of encountering unknown conditions, such as rubble, relic structures, historic utilities, covered pits, voids, or unknown objects/containers/vessels. If something is encountered which causes concern, work should cease and the situation should be evaluated. There could be situations in which local or State authorities must be contacted.

If you encounter buried waste or if soils appear discolored or have an odor you should not continue excavating in the area. If you are working with an environmental professional, be sure to let this person know about the issue, or contact the Ohio EPA hotline at 1-800-282-9378.

Irrigation

Most gardens will require irrigation at some time during the year and if reclaimed/non-potable water is used then precautions should be taken to prevent consumption. Any water sources which are not potable or "city water" should be labeled with precautions and warning against consumption. The groundwater in urban areas may be contaminated due to historic uses and if the property has been through a cleanup program there is a much greater chance of a prohibition on use of groundwater.

We recommend you contact the local health department or consult local zoning regulations to determine if there are restrictions on using ground water.

Salvaged Material for Garden Use

As with many projects, there is a temptation to salvage material for reuse whenever possible. However, caution should be taken when accepting used or salvaged construction materials because they could introduce contamination. Any surface painted before 1978 could have significant concentrations of lead in the paint. There are simple lead paint tests available at some hardware and home supply stores. Historic caulking could contain PCBs and treated wood could have creosote, chromium, or arsenic used as a preservative. If fill soils are needed as cover or top soil, know the source of this material and do not accept soils which may be contaminated. The State regulatory or brownfields office can provide guidance on appropriate test methods. If there are concerns with respect to the integrity of either salvaged material or questionable soils, it would be better to refuse this material rather than risk a bigger problem.

The Sustainable Sites Initiative (SSI) has been developing resources and has been working with landscape architects and environmental professionals to identify and promote the selection and use of more environmentally-responsible materials. For more information about materials for hardscapes and softscapes please go to http://www.sustainablesites.org/materials.

Child Safety/Kiddie Management

Urban agriculture and community gardening can be a wonderful, fun family experience and can unify a neighborhood; however, safety for children is critical. This document briefly discusses the need for safe practices around children. For example, exposure of children to potentially contaminated soils is a great concern and should be minimized as much as possible. There are other hazards such as toxic plants, insects, and animals, such as poison ivy, black widow spiders, and snakes. Care should be taken with power tools, sharp implements, and motorized vehicles and equipment around children. One incident of exposure to a contaminant can damage the experience of the entire community gardening project.

Due to the issues discussed, it is recommended that a designed area be set aside for children where they are allowed to play or even garden. A fenced area which has cover material consisting of clean material would be ideal.

Composting

The use of composting to break-down natural plants serves two purposes to gardeners. It allows organic material to be reused on site and the breakdown product. Compost can be used as a beneficial soil amendment to develop good organic soils and to enhance the soils with nutrients and organic material. The U.S. EPA website is an excellent resource to learn more about composting. http://www.epa.gov/epawaste/conserve/rrr/composting/index.htm.

A tremendous amount of information is available both on line and in various books and periodicals on proper composting and making and using compost. A word of caution: know your sources of material if the organic material or compost is generated from off-site sources or if the compost is purchased. Ground-up treated wood, material generated from construction debris, and certain manures are materials that should not be incorporated into compost. For example, treated wood often contains metals which can be toxic in high concentrations and could contaminate the garden soils. Reading available literature will give a good idea of materials to avoid as well as organic material which can yield the best compost.

Both state and local regulations should be consulted governing composting. There could be a general prohibition against composting in certain areas depending upon zoning, maximum quantities allowed, importing off-site material, or required set back from property lines, for example. Again, know your site and the regulations governing its use. Ohio EPA's Division of Materials and Waste Management

(DMWM) has information covering many issues relevant to urban gardening. A link to more information is located at http://epa.ohio.gov/dmwm/Home/Composting.aspx. A guidance document titled "Urban Agriculture, Composting and Zoning" is a good reference for persons interested in urban gardening issues. It covers relevant state regulations and discusses local issues as well. A copy is located at http://epa.ohio.gov/portals/34/document/guidance/GD%201011_UrbanAgCompostingZoning.pdf.

Maintenance

As has been discussed, the community garden property may have a mandatory capping requirement for example, with a layer of soil to prevent potential exposure to soils and contaminants and, if so, this cap must be maintained according to the use agreement. Restrictions should be known and followed by garden workers. The property may not have a mandatory cover requirement but may have a cap of clean soil that was placed on the site to provide organic growing soils suitable for producing vegetables. In both situations these caps should be maintained. Other areas may be capped and could include areas such as walkways and other areas of the site beyond the designated gardening area. Any capped areas must be maintained as such. As has been mentioned earlier in this document, know your property, and if there are any questions regarding a capped area, consult the regulatory program to ensure that the property is being maintained in accordance with any use restrictions.

IX. Case Studies

Gardening on brownfields is a rapidly growing trend with interest from many gardeners and researchers across the country about techniques, locations of existing gardens and availability of space. The following five case studies provide insight into how communities, federal and State governments and other stakeholders are working together to better understand the issues associated with the use of brownfields as community gardens.

The case studies were taken from successful community garden projects across the county and highlight the role that different groups are playing in devising creative solutions to utilize known brownfields for community gardening. These case studies demonstrate that every situation can be different, but through coordination and understanding, transforming a brownfields property into something productive is achievable. Each case study tells a story that may be transferable to other brownfields sites with future community gardening plans.

The Greensgrow Philadelphia Project

Although the Greensgrow Project is a commercial gardening venture, it is an excellent example of how a site with extensive contamination may be redeveloped into a safe and thriving urban garden.

The Greensgrow Philadelphia Project (Greensgrow) is a nationally recognized center for research, development, and dissemination of urban agricultural technology. Located on the site of a former steel-galvanizing plant in the Kensington neighborhood of north Philadelphia, Greensgrow has become a remarkable example of successful transformation of blighted, vacant property into a productive enterprise.

Project Background

A key to the success of Greensgrow has been its innovative environmental risk management strategies. The farm itself started with pilot funds provided by the U.S. EPA in 1998 as part of its brownfields reuse program. Greensgrow had formerly been a galvanizing plant for nearly a century that resulted in areas

contaminated by coal ash and fuel oil, and heavy metals such as zinc and lead. A Phase One ESA was conducted in 1990 following complaints by a local community organization to the U.S. EPA. This Phase One ESA discovered the contamination, and over the next three years, the U.S. EPA conducted extensive investigation of the soil and groundwater and eventually hauled away several tons of contaminated soil. Although this work removed some of the worst contamination, some was left behind.

Following this removal action, much of the site was covered by paving and a fence was erected to prevent entry. The property stayed this way for years, unused and vacant, until Mary Corboy and her partner Tom Sereduk chose it as the location for Greensgrow. Knowing that the site still had some potential environmental impact to its soil, they decided to use only innovative farming methods, such as hydroponics and raised beds, rather than risk contact with the native soil. Areas of exposed soil were covered by plastic and semi-permeable ground cover to reduce dust, and municipal water was piped in to avoid the use of on-site water.

These engineering controls have gone a long way to reducing the environmental risks to manageable levels. The site is now stabilized and presents no risks to users or visitors. Greensgrow has also taken the unusual step of partnering with a local university that periodically tests on farm produce to check for bioaccumulation of contaminants– none has ever been detected.

Constructing and operating an urban farm is challenging and managing the environmental risks is only one of the issues you have to deal with as you redevelop your brownfield. Although extensive and expensive soil and groundwater remediation may be possible for well-funded and extensive urban redevelopment projects, this type of work is not always appropriate for an urban farm where resources must be used wisely and all risks (not just the environmental risks) must be balanced and addressed equitably. The stabilization techniques discussed in this article can effectively address these environmental issues. For temporary property users, stabilizing the environmental impact may be the best option for urban agriculture.

For more information, please see: http://www.greensgrow.org/farm/index.php.

The Washington-Wheatley Community Garden

The Washington Wheatley Community Garden provides an example of how a community can work together with various stakeholders, including Kansas State University (KSU), to successfully demonstrate how a local brownfield property can be scientifically assessed and safely utilized as a community garden. Washington – Wheatley is a historic neighborhood in Kansas City, Missouri, not far from the historic Jazz district. The neighborhood is located in a low-income, mostly African-American community on the east side of the city. Blighted, vacant lots are common in this neighborhood and attract illegal dumping activities and crime. One of these properties, accommodating at one time four residences before the structures were demolished, was converted by the Washington Wheatley Neighborhood Association into a community garden.

Project Background

KSU received five years of grant funding from the U.S. EPA to evaluate garden sites around the country to ensure that growing crops in urban settings is safe for gardeners and consumers. The Washington-Wheatley Community Garden is one of the sites evaluated by KSU.

KSU researchers established the property's past uses, screened the site soils in-situ via X-Ray Fluorescents (XRF) for metals and collected and analyzed various soil samples for nutrients, organic matter, metals and chlordane. Discrete soil samples were obtained from depths of 0-15 cm and 15-30cm. Chlordane was non-detect but DDT (**d**ichloro**d**iphenyl**t**richloroethane, one of the most well-known synthetic insecticides) and DDE (a breakdown product of DDT) were detected in some soil samples at very low levels, not high enough to be of concern. Lead concentrations in garden soils ranged from 60 mg/kg to 352 mg/kg. Based on the results of soil screening and analyses, KSU's recommendation was to add compost to the garden area to get the soil pH and nutrient concentrations to optimal levels. After applying the compost, KSU and the gardeners established test plots and, over two growing seasons, grew

Swiss chard, sweet potatoes, tomatoes, and carrots. Once the crops were mature, KSU analyzed tissue samples for lead. They also compared results of standard kitchen cleaning versus thorough laboratory cleaning procedures for produce. Lead levels in all crop species were well below the maximum permissible limits established by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO), with the exception of lead levels in carrots, which were slightly above the concentrations recommended by the WHO. Adding the compost diluted lead concentrations in soil and also made the lead less bioavailable, as evidenced by the lower lead concentrations of produce grown in test plots with compost added.

KSU continues to evaluate the produce from the Washington-Wheatley Garden. Final recommendations include continuing to add compost to bring pH levels and nutrients to the optimal level, encouraging gardeners to wash their hands after working in the garden and making sure all produce from the site is thoroughly washed before consumption.

The Washington-Wheatley neighborhood is now in their fourth year of gardening. The neighborhood continues to work together to improve their neighborhood and the community garden sets an important example of what the conversion of a blighted lot to community garden can do for the neighborhood image. As soon as the community garden was established in 2009, the vacant and dilapidated residence next to it was renovated and occupied. The neighborhood attributes this to the establishment of the garden and hopes more improvements like this one will follow in other parts of their neighborhood.

Frazer Park Community Garden, Portland, OR

The development of the community garden in Frazer Park is the fruition of a dream of the neighborhood residents association lobbied the city parks and recreation department for the facility for many years. The discovery of lead contamination on this property, based on the site and local neighborhood history, was somewhat surprising and demonstrated the need for a thorough investigation of any potential garden site. The fact that the initial soil sample collected was by City of Portland Parks and Recreation Department staff and that this sample indicated an anomalously high level of lead contamination serves to remind planners of the importance of working with qualified professionals when planning and implementing environmental site studies and investigations. Although the results of the initial sample were not again replicated by more complete and systematic sampling events, the knowledge of that sample's result culminated in an intensive and somewhat costly site preparation and cleanup action prior to constructing the planned garden.

Frazer Park Community Garden is located in the northeast section of Portland, OR, in the city's Frazer Park. The public park is a 3.8 acre multi-use facility that includes basketball courts, a dog off-leash area, picnic tables, and a playground. The property lies in a residential area approximately 250 feet north of Interstate 84. Adjoining properties to the north, south, and east are used for residential purposes and the Albina Head Start Program. Along the south side of the east half of Frazer Park there is an asphalt paved drive and parking area, which is utilized by the Albina Head Start Program. A parking lot is also present to the west of the park, and to the immediate southwest of the southwest corner of the property there is the First Call Plus facility, which is a crematory. A community garden at this location had long been the desire of the local neighborhood association. Prior to the development of a community garden in Frazer Park, the City collected a composite soil sample from the vicinity of the planned garden that tested high in lead contamination.

The history of the land where the park is located is one of somewhat modest development from the perspective of potential contamination. The long history of the property includes the former Frazer Detention Home for Youth, consisting of four wood frame structures including a dormitory, a dwelling, class room, and a storage building. These facilities were in existence and active from about 1910 to

sometime in the 1940s. There is also evidence that a tree orchard occupied the western half of the property during much of this time. Surrounding properties in this period were primarily residential or vacant. In 1950, the Frazer Detention Home property was turned over to the City of Portland for use as a park. By the end of the decade, all the former detention home facilities had been razed.

Since that time, the property has been used continually as a park and the surrounding area has remained residential with light commercial use. Interstate 84 was constructed approximately 50 years ago. The importance of this history to the community garden is to demonstrate the numerous potential sources for lead that exist in an urban setting, even when that setting is almost exclusively limited to residential and non-industrial commercial development. The potential sources of contamination include lead-based paint from the former detention home facilities, possible lead arsenate contamination, if ever used as a pesticide in the former orchard, the deposition of lead from leaded-gasoline as the result of the site's proximity to the interstate highway, and the deposition of lead-containing ash from the nearby crematory.

An employee of the City of Portland Parks and Recreation Department collected a composite soil sample from three locations beneath asphalt pavement in the approximate location of the proposed community garden. This composite sample yielded results for cadmium concentration of 2.44 ppm and lead concentration of 1,410 ppm in the soil. Based on these results, the City of Portland Brownfields program funded Phase I and Phase II environmental site assessments performed on the property.

The Phase II assessment performed a comprehensive sampling program across the approximate 90 feet x 115 feet dimension of the proposed garden. This sampling program divided the area into 18 subdivisions of 20 feet x 20 feet. A total of 40 soil samples were collected, 2 samples from each subdivision at approximate depths 0.5 to 1.0 foot below ground surface and 1.5 to 2.0 feet below ground surface (approximately 6 inches of asphalt pavement had to be removed from each sample location). There were also duplicate samples from two randomly selected locations. These samples were analyzed for total lead concentrations using USEPA Method 6020. The results of these analyses found lead concentrations above the Oregon Department of Environmental Quality (DEQ) background level of about 17 ppm lead in 20 of the samples. The range of detections from all 40 analyzed samples was 7.11 to 309 ppm, well below the 1,410 ppm lead concentration detected in the City-collected sample. While the reason for this anomalously high value can never be known for sure, one explanation might be the possible presence of lead in the drill bit used to core through the asphalt at the original three sample locations.

The Oregon DEQ Generic Risk-Based Concentrations (RBCs) for residential receptor exposure to lead through soil ingestion, dermal contact and/or inhalation (RBCss1) is 400 ppm. All of the Phase II samples were below this level, but the City of Portland performed remedial activities on the site to further reduce any potential exposure to lead contamination prior to garden development. The upper 1-foot of soil was removed and properly disposed after excavation of the asphalt surface and underlying drainage rock during the construction phase of the community garden. Because detected lead concentrations generally decreased with depth, the excavation of additional soil was limited to the southwestern and mid-northern portions of the site, which showed the highest concentrations in the Phase II study. The additional soil excavation in the mid-northern portion of the site was excavated to an approximate depth of 2.5 feet below ground surface. The southwestern portion of the site was over-excavated to 1.5 feet below ground surface.

A portion of the asphalt pavement surrounding the perimeter of the garden was left in place and undisturbed during the garden's construction. This was done at the community's request. Because this impervious asphalt surface tends to drain into the garden, a 4-foot wide buffer was left around the garden's perimeter to allow run-off from the pavement to drain into the garden area and infiltrate the soil before it reaches the planted area. Clean topsoil was placed to suit the needs of the garden within the excavation to provide a clean and homogeneous base to the community garden. Approximately 6-inches

of certified organic compost was also roto-tilled in to amend the topsoil. The clean topsoil base buffers the garden from possible remaining elevated lead concentrations after the removal of the pre-existing soil. The Parks and Recreation Department does not put any restrictions on the types of plants grown, only that they be annuals and that organic gardening techniques be used. The cost of remediating and constructing the garden area was $40,000 to $50,000.

Figure 2: Frazer Park Garden Site Pre-Construction

Treat Commons Community Garden, San Francisco, CA

Parque Ninos Unidos is a fine example of a State brownfield program at work. Collaboration between neighborhood residents, a non-profit organization, and the local municipality created a vibrant public space that builds a sense of community from an abandoned vacant commercial facility, a facility that posed environmental and safety threats prior to its redevelopment. While a comprehensive investigation and remedial action was fully warranted on this site, close review of the various phases of environmental site assessment indicates that some chemical analyses were repeated from one investigation to the next when the analytical results did not reveal the presence of certain contaminants. Since the proper collection and analyses of environmental samples can be a substantial cost in the development of any site, reducing the focus to the potential contaminants of concern as any site investigation progresses is an invaluable tool in saving resources.

Treat Commons Community Garden is located in Parque Ninos Unidos in the Mission District section of San Francisco, CA. Parque Ninos Unidos is a city park that was constructed in 2003 on former commercial land formerly serviced by a spur of the Union Pacific Railroad. In addition to the Treat Commons Community Garden, the park also contains a playground, gazebo, open grass area and 1,200 square feet clubhouse. The park is triangular in shape, occupying the city block along the north side of 23rd Street between Treat Street and Folsom Street. A diagonal defines the back property line running from the corner of Folsom and 23rd Streets northeastward approximately 300 feet to its termination at Treat Street. The alignment of the former railroad spur cutting across the general alignment of the city streets and blocks is the reason for this atypical parcel shape.

In 1992, The Trust for Public Land acquired the parcel now occupied by the park under the Trust's "Parks for People" program. The Trust had a Phase I environmental site assessment (ESA) performed on the property that included some soil sampling. The Phase I ESA found aerial photographic evidence to indicate that the railroad spur was in use until at least 1975. The Phase I ESA found that in addition to the railroad spur, the parcel was the location of a two-story wood-frame warehouse since about 1926. It is stated that the on-site structure had been used by a building materials supplier from 1927 until about 1987 and that the warehouse and outdoor space around the building were used for bulk storage of materials like sand, rock and dry cement as well as building materials, hardware and supplies. From 1987 until about 1991, records show the building was occupied by a drilling company and a tool and machinery shop. Two 1,000-gallon underground storage tanks (USTs) were previously located on the property and those tanks were removed in 1992. An earlier geotechnical investigation on the site indicated that there was previously a below-grade sump on the property, possibly related to a sand-washing process conducted by the building materials supply business.

The Phase I ESA indicated that the area surrounding the park has a history of mixed industrial, commercial and residential use. Besides the tanks removed from the site, 12 other UST sites were identified within one-half mile of the site. These included the Dutro Mat Manufacturer facility located opposite the property across Folsom Street to the north and four other potentially up-gradient UST cases. These sites were exclusively related to petroleum fuel storage. Regulatory records and on-site sampling indicate that the Dutro Mat Manufacturer USTs had a negative impact on soil and groundwater. Other non-petroleum sites in the vicinity were believed to be down gradient, cross gradient, or too far from the site to have an impact.

On-site soil sampling for potential chemical contamination was conducted in several investigations on the site. These investigations were a 1990 geotechnical investigation, the Phase I ESA conducted in 1992 and 1993, sampling as part of the UST removal in 1992, and the subsurface soil and groundwater investigation conducted for the City of San Francisco Public Works Department (Phase II ESA) in 1996. Additional soil sampling was performed as part of the construction and remediation efforts made in 2003 this sampling was to assure the quality of off-site soil used to cap the on-site impacted soil and also to protect on-site worker and nearby residential health and safety.

According to the Phase I ESA, a geotechnical investigation conducted on the site in 1990 included the excavation of a trench approximately 9 feet in length to a depth of approximately 8.5 feet below ground surface (bgs) adjacent to the two-story warehouse standing at that time. Three soil samples were collected from the trench walls at depths of 1 foot, 5.5 feet, and 8.5 feet bgs and analyzed for poly aromatic hydrocarbons (PAHs). All three samples indicated no detection of these chemicals. The 1992 UST removal required that samples from the tank excavation be collected and analyzed for total petroleum hydrocarbons to determine if the tanks released petroleum products to the surrounding soil and/or groundwater. According to the Phase I ESA, soil sample results for these samples below the two tanks ranged from 2,000 to greater than 5,000 ppm for TPH, triggering regulatory criteria to perform additional soil and groundwater investigation on the site.

The Phase I ESA included the collection and analyses of 15 soil samples. Near surface soil samples from up to 1 foot bgs were collected at 5 locations distributed across the proposed park parcel and 6 other locations equally spaced along the alignment of the former railroad spur. Also, 4 samples were collected at depth in the vicinity of the former sump and the geotechnical investigation trench. Included in the list of constituents that were analyzed for were pH; total petroleum hydrocarbons (TPH); heavy metals; benzene, toluene, ethyl benzene, and xylene (BTEX); halogenated volatile organic compounds (VOCs); and semi-volatile organic compounds (SVOCs). Not all locations were analyzed for all constituents.

The results of these chemical analyses indicated detections of TPH and metals only; the range of soil pH was considered within normal limits and halogenated VOCs, which are essentially chlorinated solvents, SVOCs, and BTEX were not detected in these soil samples. The range of TPH detected was from 45 ppm to 1,300 ppm and lead was the only metal detected above natural background levels. The range of lead concentrations detected in these Phase I samples were 20.9 ppm to 229 ppm. The USGS published reference cited in the Phase I report indicated that up to 200 ppm lead might be expected in background concentrations.

As stated previously, TPH levels detected in samples collected from the on-site UST removal necessitated additional investigation of site soil and groundwater contamination. This additional investigation was carried out in 1995 and involved the performance of 16 soil borings and the collection of 33 additional soil samples and 3 groundwater samples. Analyses of these soil samples included TPH, BTEX, lead (soluble and total), metals, pesticides and PCBs, VOCs, and PAHs. Not all samples were analyzed for all constituents. The findings of this investigation indicated that lead in the soil and TPH in the soil and groundwater impacted the site. Lead was detected in soil samples in the range of 5.4 ppm to 910 ppm.

Risk analyses performed using the analytical results of 226 ppm and 910 ppm lead indicated that incidental ingestion of the lead-contaminated soil on site could potentially be harmful to children. To address that problem, the San Francisco Department of Public Works used encapsulation of the impacted soil on site to reduce contact with the probable at-risk population. This was accomplished by grubbing the remaining debris from the previous site facilities and having clean soil hauled to the site and placed to a nominal depth of 2 feet thickness across the site. Orange vinyl fencing material was laid on the existing grade surface in the vicinity of the proposed community garden prior to the placement of the clean imported fill to serve as an indicator barrier. The bright orange fencing material will serve to warn future community gardeners when they have dug through the clean soil cap.

After remediation activities were completed on the site, the community garden was built on top of the new soil cap by placing an additional 2 feet of clean fill in raised beds framed by redwood boxes. The garden includes approximately 1,780 square feet. Crushed granite was placed between the 17 garden plots created by the redwood box construction, making the whole garden ADA-accessible. Plots are available to all community members on a first come first served basis with no restrictions on the type of vegetable or produce that can be planted. A small orchard was planted along the south facing fence and recently this orchard was expanded by an additional 500 square feet. The orchard is planted with both ornamental and fruit trees. These trees were also planted in 2 feet of clean fill placed over the 2 feet of soil encapsulation layer.

Figure 3: Treat Commons Community Garden, San Francisco, CA

Fremont Community Garden, Sacramento, California

The Fremont Community Garden may be looked at as a cautionary tale for existing gardens. Simply because the most recent use has been as a garden does not mean that historical uses for the property are not an issue. The environmental concerns were properly addressed, and the community garden is now a thriving part of the community.

This project also addresses the Americans with Disabilities Act (ADA)-accessible plots.

The Fremont Community Garden is located in one of the oldest neighborhoods in Sacramento. The garden, formerly the Ron Mandella Community Garden, had a 30-year history of informal gardening use and served as a central gathering point for gardeners, residents, children, and State workers on their lunch hour. The property was once a collection of residential structures built between 1880 and 1920. Although it was purchased by the State for the 1960 Capitol Area Plan, a community garden was established on the property in the mid-1960s by local residents and workers. The property was designated for housing in 1978, but remained undeveloped. In 2001, the Capitol Area Development Authority (CADA) initiated residential development of the property. An environmental site assessment was undertaken of the garden and surrounding area which was to be redeveloped into apartments. The assessment revealed that the soil was contaminated with poly-aromatic hydrocarbons (PAHs), lead and pesticides which created an obstacle for the community's effort to preserve the garden and central gathering place.

A U.S. EPA Brownfields Cleanup grant for $200,000 helped to leverage over $423,000 for cleanup and redevelopment. The cleanup initiative to remove the contamination included the removal of 24 to 48 inches of topsoil (1,700 cubic yards) and the placement of clean soil suitable for gardening. CADA also tested the new fill and soil that was brought in before donating the site to the Parks Department for further development, maintenance and management. The whole process from redevelopment planning to garden opening took over three years. When cleanup was complete at Fremont gardens, the site received a no further action letter from the County.

Today, the Fremont community enjoys a well-used garden, and former brownfields surrounding the property have been redeveloped into contemporary apartments. The garden includes 52 garden plots, (including 28 small plots (10X10), 20 large (10X20), and 4 Americans with Disabilities Act (ADA)-accessible plots), ADA compliant walkways, compost bins, two orchards, public art, two entrances, decorative shrubs, and two bocce ball courts. Community gardeners agree to use only natural or organic fertilizers and pest control.

There are 52 plots in the garden that are 'rented' on a yearly basis by residents of the City for the purpose of enjoying the pleasures of organic gardening and reaping the harvest. There are 28 small plots (10X10), 20 large (10X20) and 4 ADA raised plots. The garden has been successful, and currently there is a long wait list for plots.

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