Using Historical Records to Assess Environmental Conditions at Community Gardens

Robert Hersh
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We tend to think of cities as paved over, built up, with little room to spare, but a closer look reveals that growing food in urban areas is widespread. Roughly a third of American households (41 million) have vegetable gardens. Many city residents grow food on patios, balconies, and in backyards, while others have joined together to develop community gardens on vacant land or on rooftops, or in the unusable space between development corridors. In the past decade the number of community gardens in the U.S. increased from 6,000 to 18,000, and the trend is accelerating. Even brownfield sites, such as abandoned warehouses and former steel mills, have been retrofitted to grow produce hydroponically at a commercial scale or to become wholesale horticultural nurseries.[2]

Urban gardening is gaining momentum. In the U.S. and abroad, city officials and urban planners are trying to re-integrate food production into the metabolism of city life. The reasons for doing so are diverse and include: 1) increasing access to fresh, nutritious food in underserved communities; 2) reducing the energy requirements and carbon footprint of food production by growing more food locally rather than transporting it from distant farms; 3) supporting urban agriculture as an entrepreneurial activity to promote community development; and 4) creating interim uses for vacant and abandoned properties to reduce municipalities' costs of maintaining the properties.

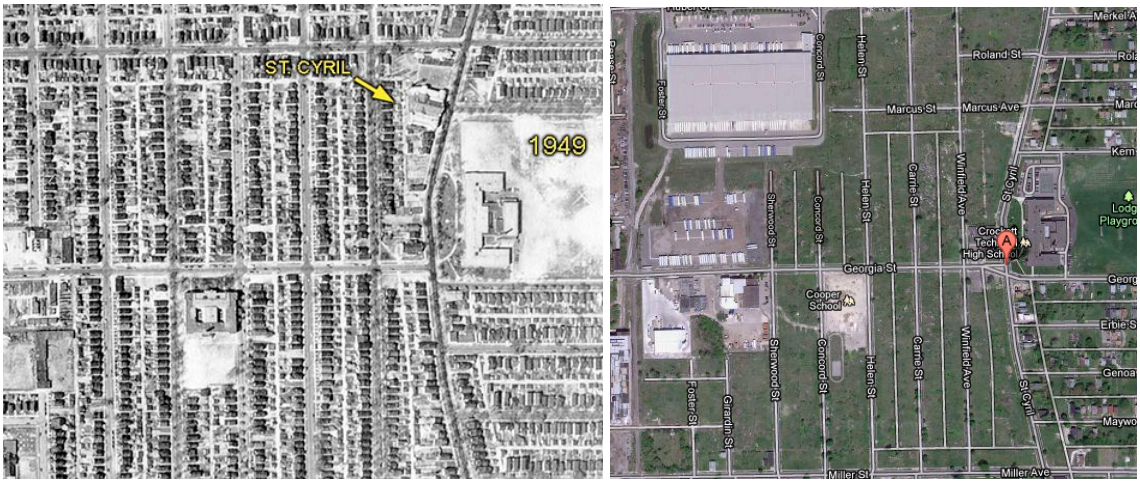

Figure 1: Detroit's St. Cyril Parish, 1949 and 2010[3]

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[2] http://www.greensgrow.org/farm/overview/history.html (accessed April 3, 2012)

[3] http://www.detroityes.com/webisodes/2004/13-UrbanPrairie/St-Cyril.htm (accessed June 13, 2012)

Vacant and abandoned properties occupy about 15 percent of the area of the typical large city, and in some cities, such as Detroit, more than 40% of city parcels are vacant, amounting to thousands of acres.[4] See the example of St. Cyril parish in Figure 1.

Such large swaths of land are an underutilized resource, and non-profit organizations, land trusts, neighborhood groups, and social justice organizations are finding ways to purchase, lease, or receive donated land. Growing food at this scale can help address issues of food security. In many American cities, particularly in poorer neighborhoods, local residents do not have adequate access to food of sufficient quality to provide a nutritionally adequate diet. Even before the economic crisis of 2008, food security was a growing problem in the United States. According to a United States Department of Agriculture 2010 study, 14.7 percent of U.S. households were food insecure at least some time during that year, up from 11.1 percent in 2007. This was the highest recorded prevalence rate of food insecurity since 1995, when the first national food security survey was conducted.[5]

Urban Soils and Contamination

Despite the health and community benefits of urban gardening—fresh and nutritious food, physical activity, more attractive neighborhoods—growing food in urban soils poses potential risks. In older urban neighborhoods, before zoning segregated different land uses, housing for workers was often built within walking distance of chrome plating shops, leather tanners, mills, and so on. For decades, toxic emissions from these factories, such as cancer-causing hexavalent chromium, were carried in the air and deposited on urban surfaces and in the soil.

In some cases, contaminated waste material, such as lead-laced sand from foundry casting operations, was used to fill low lying areas on which housing was later built. More routine industrial practices also led to widespread contamination. For example, operators at manufactured gas plants would routinely spread spent oxide waste on the ground, thus adding a layer of contaminants to the upper topsoil in older neighborhoods. Similarly, sewage sludge, animal wastes, and other industrial byproducts containing heavy metals and other pollutants were routinely spread on land later developed into commercial and residential neighborhoods.

Contamination from factories and other point sources is only part of the story. For decades, flaking lead paint from old homes and buildings concentrated in urban soils. Lead compounds were valued for the depth of color they added to paint, and because lead is highly insoluble in water, lead paint was prized for its durability. But lead is also a

[4] Michael A. Pagano and Ann O'M. Bowman, *Vacant Land in Cities: An Urban Resource,* Brookings Institution, 2000, and Cleveland Urban Design Collaborative, *2008 Re-Imagining a More Sustainable Cleveland*, 2008, http://www.scribd.com/doc/64257913/Re-Imagining-A-More-Sustainable-Cleveland-Report (accessed April 5, 2012)

[5] *Household Food Security in the United States—2009,* U.S Department of Agriculture, Economic Research Service, 2010

neurotoxin, and the scale of exposure is immense. The Centers for Disease Control estimates that some 21 million pre-1940s homes contain lead paint.[6]

A second source of lead contamination is particulate deposits from gasoline, which contained tetraethyl lead as an anti-knock agent. From 1920 until leaded gasoline was phased out in the early 1990s, automobiles emitted lead-rich particles that settled on urban soils near roads. Lead contamination is urban soils is widespread and persistent. Background concentrations of lead in agricultural soils average 10 parts per million (ppm).[7] In urban soils, however, lead levels typically are much higher. For example, soil tests done on Michelle Obama's White House garden detected a level of 93 ppm. While this created something of an outcry, is it not unusual to find lead levels of 400 ppm or more in urban soils.[8]

Despite the pervasiveness of soil contamination in urban areas, few backyard growers or community gardeners test their soil for contaminants or conduct a historical review of the properties past uses to identify potential sources of contamination. Gardeners are more likely to test the soil for pH and nutrient levels (*e.g.*, nitrogen, phosphorus, and potassium) rather than to test for heavy metals such as lead, arsenic, chromium, and cadmium. *Without systematic soil sampling, there is little evidence to determine to what extent backyard and community gardeners are growing food in contaminated soil*.

While the evidence base is limited, studies that have collected soil samples from community gardens indicate soil contamination is a significant problem, particularly in urban garden plots. In Montreal, Canada, which has one of North America's most extensive community garden networks, city public health officials took soil samples from the city's 100 community gardens and found that 30 gardens had high levels of lead and arsenic. Elevated levels of lead and arsenic were also found in produce in nine community gardens and, in response, the city closed those gardens. Many of the contaminated gardens were built on former dump sites.[9]

In Syracuse, New York soil sampling conducted by university researchers found high levels of lead and arsenic in five out of six community gardens in low-income and minority neighborhoods where residents grew much of their own fresh vegetables during the summer months. (See Figure 2 below.) The gardens were located on plots where abandoned homes had been razed. Lead paint from the demolished houses contaminated the soil, and lead-rich exhaust from passing traffic built up in the soil over decades. In

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[6] *Impact of Lead-Contaminated Soil on Public Health,* U.S. Department of Health and Human Services, Centers for Disease Control, Agency for Toxic Substances and Disease Registry, 1992

7 Holmgren, G.G., M.W. Meyer, R.L. Chaney, and R.B. Daniels, "Cadmium, Lead, Copper, and Nickel in Agricultural Soils of the United States of America," *Journal of Environmental Quality,* 1993, 22:335-348.

[8] A 1998 study collected soil samples from 422 vegetable gardens located in a 30 miles radius from the center of Baltimore. The median soil-lead level was 100 ppm, and 20% of the samples exceeded 400 ppm. See *Sources of Lead in Soil; a Literature Review,* U.S. EPA, 747-R98-001a, 1998.

[9] http://spacingmontreal.ca/2008/04/01/more-community-gardens-to-be-closed/#comments (accessed April 3, 2012)

addition, arsenic-contaminated fill, supplied by municipal workers and which typically is not screened for contaminants, was used as a soil additive by gardeners.[10]

Figure 2: The West Newell Street community garden in Syracuse[11]

As these examples indicate, community gardens can become contaminated in many ways. Figure 3 below provides a series of conceptual site models (CSMs) to help community gardeners better understand how different activities and past uses can determine the areal extent, concentration, and depth of soil contamination at community gardens and other sites.

CSM 1, for example, shows the pollution contours from airborne emissions from a point source such as foundries, chromium electroplating facilities, smelters, etc. In this example, contamination levels are greatest closest to the source and, taking into account the prevailing wind direction, decrease with distance. Since the airborne emissions settle on surfaces, the highest levels of contamination are found in the topsoil and decrease with depth.

CSM 2, the line model, represents contamination contours along a road or railway. Here too, pollution decreases with distance and depth. By contrast, CSM 3 shows contamination levels from past activities related to spreading contaminated materials, such as coal ash, from industrial furnaces, with high levels of lead, zinc, and other heavy metals. The concentration levels tend to be highest in the upper topsoil and decrease with depth.

[10] http://www.syracuse.com/news/index.ssf/2009/05/syracuses_community_gardens_ar.html (accessed Arpil 4, 2012)

[11] Delen Goldberg, "Syracuse's community gardens are tainted with lead and arsenic," *Post-Standard*, May 8, 2009, http://www.syracuse.com/news/index.ssf/2009/05/syracuses_community_gardens_ar.html (accessed April 13, 2012).

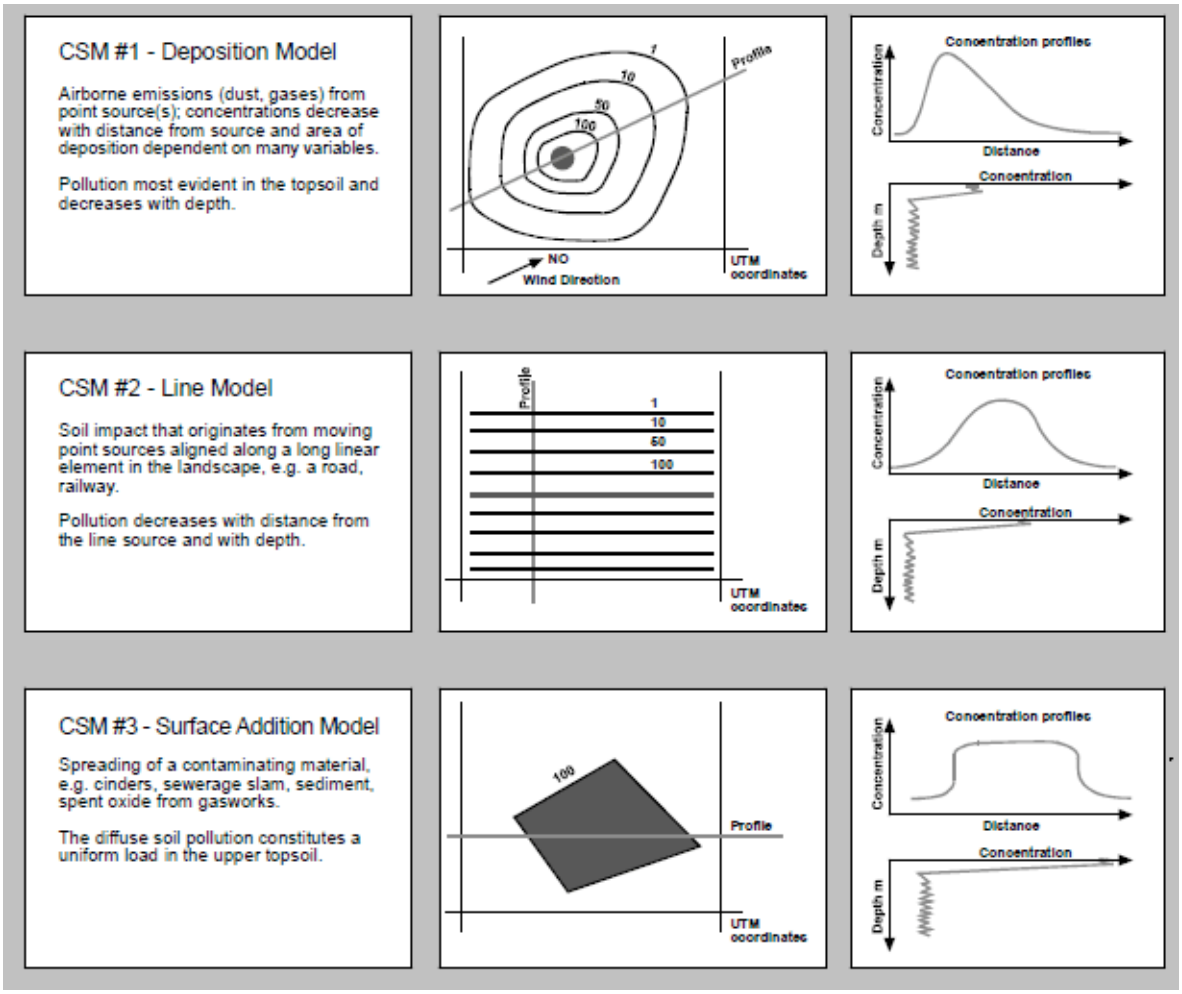

Figure 3: Conceptual Site Models of soil contamination[12]

CSM 4 illustrates how construction and demolition cycles in the life of a city, as well as historic disposal practices, can lead to diffuse and variable levels of soil contamination. Here construction and demolition debris, dredged sediments, refuse and land-clearing debris, and municipal solid waste dumping create a more varied concentration profile than the earlier examples.

CSM 5 recognizes that many industries filled low-lying areas with byproducts from their production processes, such as slag and foundry sand. This means that in some instances urban areas are laced with elevated levels of contaminants such as polycyclic aromatic hydrocarbons (PAHs), petroleum constituents, and heavy metals, and that contamination levels at different depths are quite variable.

[12] *Using the Triad Approach to Streamline Brownfield Site Assessment and Cleanup,* U.S. EPA, 2003, p. 17

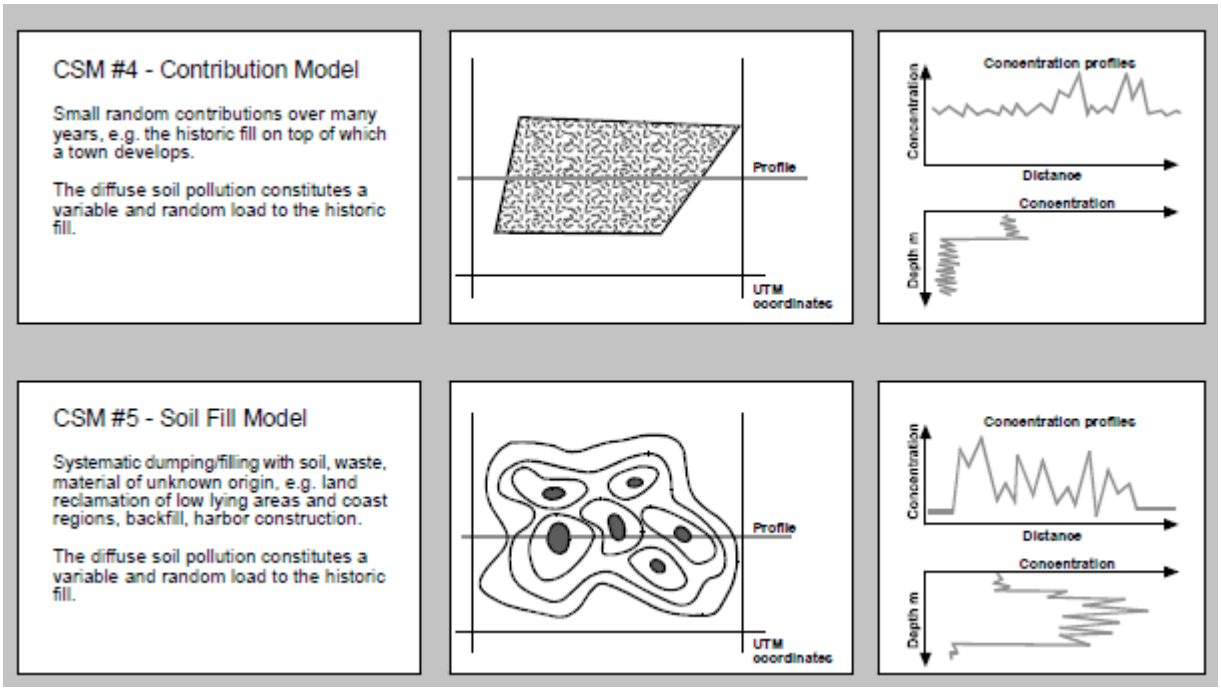

Figure 4: More Conceptual Site Models[13]

Investigating Past Uses: Site History Research

What steps can prospective community gardeners take to convert vacant urban land into food-producing public amenities. By what means can food production be steered to urban sites where the soil is less likely to be contaminated? What questions should urban gardeners ask to help determine if a site is suitable for gardening? What sources and documents can help piece together the history and past uses of a potential garden?

Community groups can learn much about a site by addressing four questions:

1. How was a property used?
2. What substances were used on the property?
3. Were wastes managed or disposed there?
4. Has contamination from nearby properties migrated onto the property?

Maps and Photographs

One of the most valuable sources of land use information is fire insurance maps made and published by the Sanborn Map Company. These maps are detailed and beautifully illustrated, and at a scale of 50-feet-to-one-inch they show building footprints, gas lines, underground storage tanks, pipelines, prevailing wind direction, railway corridors, and other information for some 12,000 U.S towns and cities starting in 1867

[13] *ibid*.

and continuing to the present. Perhaps the most important feature to locate on these maps are the drains, where facilities released effluent that may have contained heavy metals, solvents, and other contaminants from production processes. No other published maps show such detailed urban land use information.

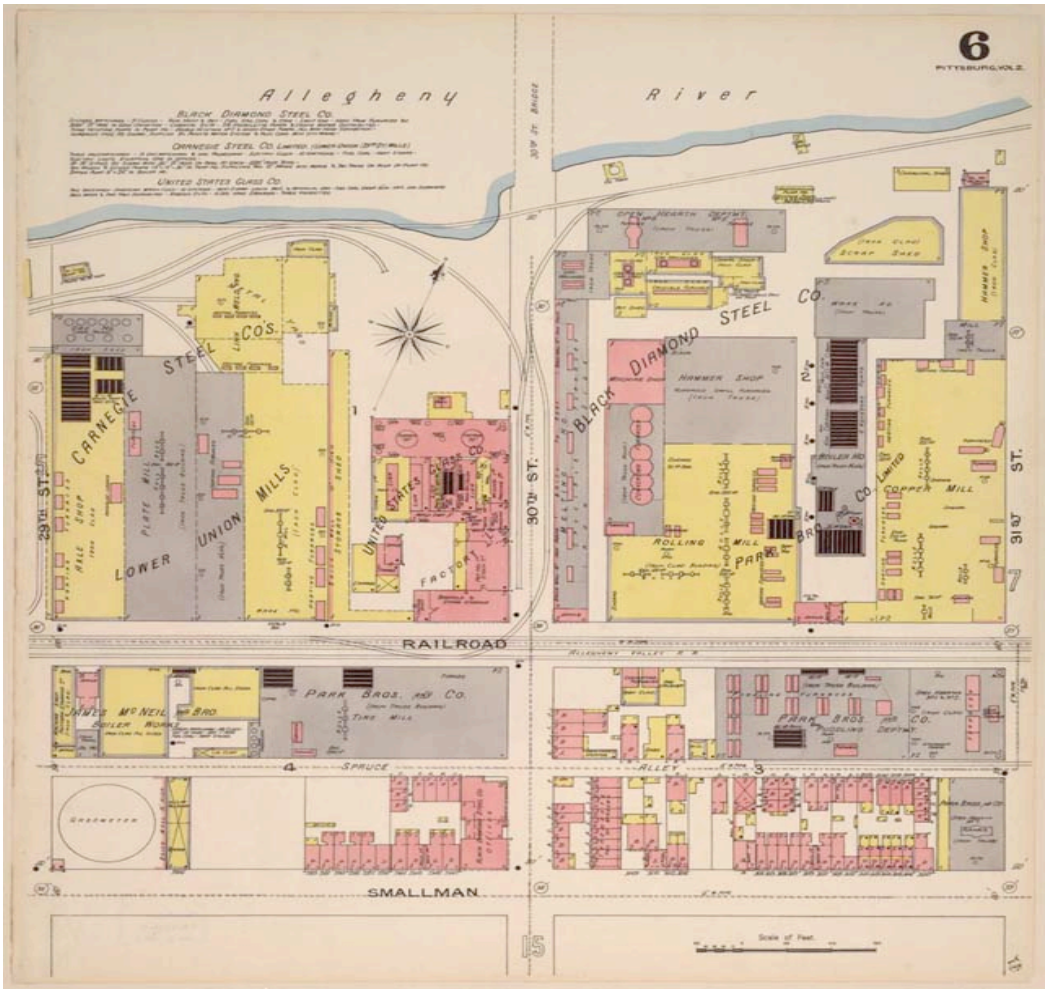

Figure 5: Sanborn Map of Black Diamond Steel Company, Pittsburgh, PA[14]

Historic Sanborn maps can be accessed in a number of ways. They are typically found in the archives and special collections of city halls or in public and university libraries. Most Sanborn maps have also been digitized by Environmental Data Resources, and can be searched online through latitudinal and longitudinal coordinates for a fee. See http://www.edrnet.com/environmental-services/sanborn-maps.

Changes in land use can also be detected through aerial and historic photographs. The oldest available aerial photography dates back to the 1920s, and the most common sources are the U.S. Geological Survey's Urban Dynamic Research Program, state natural resources and transportation departments, and regional, county, and city planning agencies. In addition, there are numerous commercial aerial photography studios that have large archives, but their rates are high compared to government agencies.

[14] http://sanborn.umi.com/

New technologies, however, make it easier to access historical images. The "time slider" feature in Google Earth allows one to compare satellite images of a city's built environment at different points in time. Currently Google Earth has made images available from the mid-1970s to the present, though the time period varies with location. For example, Figure 6 below shows two images of "the Point" in Pittsburgh, where the Monongahela and the Allegheny rivers meet to form the Ohio River. The image on the left was taken in 1993 and the one on the right 17 years later. Changes in the built environment, at least for the past two decades, can be easily studied at various scales.

Figure 6: Pittsburgh, PA, 1993 and 2010.

In addition to aerial photographs and satellite images, historical photographs can also be used to identify changes in land use. Some universities and public libraries have digitized portions of their collections and have made them available free of charge online. For example, The New York Public Library's digital collection is a virtual treasure trove of images.[15] The collection, "Photographic Views of New York City, 1870s-1970s," provides at one's fingertips more than 54,000 archived images of the city arranged by borough and street, a fabulous resource to examine changes in urbanization and land use. Not every library or university, of course, has the resources to digitize photographic images from their archives. In many cases libraries, universities, and non-profits such as state, county, or local historical societies will have repositories of historic photographs that one can consult.

City Directories

City directories can also be used to research past uses of a property. They are not telephone directories, but rather indexes that provide a record of changes in property occupancy at specific addresses going as far back as the late 19th century in many cities. Starting with the most recent directory and working backward, it is possible to develop a list of business operations at single address over decades. One could determine, for example, that a vacant lot that looks suitable for a community garden was previously used as a gas station after having been an auto body shop, or a dry cleaners, or some other

[15] http://digitalgallery.nypl.org/nypldigital/index.cfm

use that might have led to soil contamination. One can broaden a search to include business operations on nearby properties if there is reason to believe that contamination from these properties may have migrated onto the target site.

City directories are often overlooked in researching the historical uses of a property, but they show the dynamic nature of urban development—that is, the boom and bust cycles of urban history. They can identify how these broad changes played out at specific addresses. City directories can be found in many major public libraries, as well as state archives.

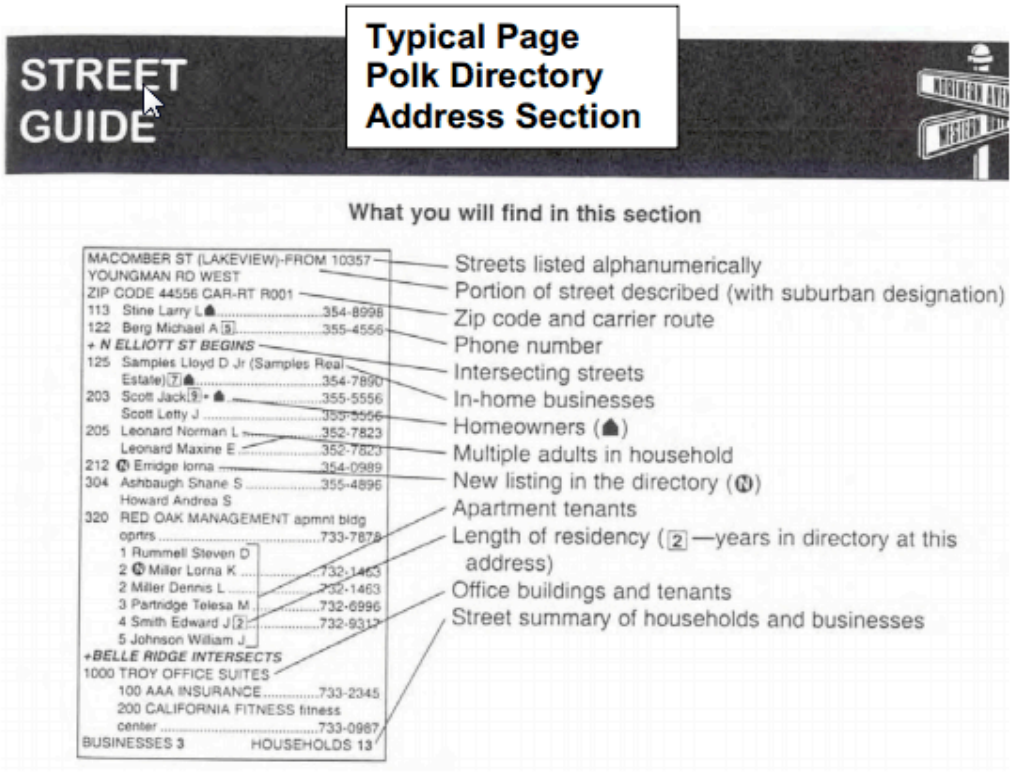

Figure 7: Example of City Directory[16]

Environmental Data

In addition to researching past uses of property through maps, photographs, and directories, one can search environmental databases to locate records about the past uses of a site as well as nearby environmental hazards that may have impacted the property. Unfortunately there is no one master list or inventory to consult. Since 2002 U.S. EPA has required states and tribal government to inventory brownfields within their boundaries to receive federal funding for site assessment and cleanup programs. Under federal statute, a brownfield "means real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant."[17]

[16] *Historical Property Data Inventory,* City Planning and Development Department, Kansas City, 2009
[17] Public Law 107-118 (H.R. 2869) "Small Business Liability Relief and Brownfields Revitalization Act"

This flexible definition applies to many properties that have been or could be redeveloped into community gardens. The idea behind the inventories was to capture those sites that had eluded regulatory efforts and were not included in any regulatory databases of contaminant releases. But for many reasons—such as concern from property owners about site stigma, shortages of staff to conduct resource-intensive property background checks, and the lack of community input to identify sites—state and local inventories have tended to focus on larger, marketable sites close to infrastructure and more attractive to private investment. Less visible brownfields are not as likely to be on the inventories.

While no comprehensive list of contaminated properties is available, one can search a number of online environmental databases. For example, the Right-to-Know Network's website—rtknet.org—provides access to site-specific information on chemical and oil spills, as well as the locations of illegal dumping, through the Emergency Response Notification System database (ERNS).

Figure 8[18]

The RTKNet site also links to CERCLIS (Comprehensive Environmental Response, Compensation, and Liability Information System), an EPA-maintained database that contains information on preliminary assessments, potential and actual

[18] http://rtknet.ombwatch.org/db/other

hazardous waste sites, site inspections, and cleanup activities at thousands of sites across the country. Similarly, EPA's Resource Conservation and Recovery Act Information System (RCRIS), contains extensive data on hazardous-waste-handler permits and activities, which can be searched by address and or zip code.

A wealth of environmental information can be found online at the state level. For example, New Jersey's GeoWeb integrates a variety of spatial data layers, including known contaminated sites, groundwater contamination areas, deed-notice areas, land-cover and land-use information, soil characteristics, and public/community water-supply areas. The intent of GeoWeb is to distill this wealth of information, provide public access in an appealing format, and to make it "part of the public culture" so the information is not forgotten.[19]

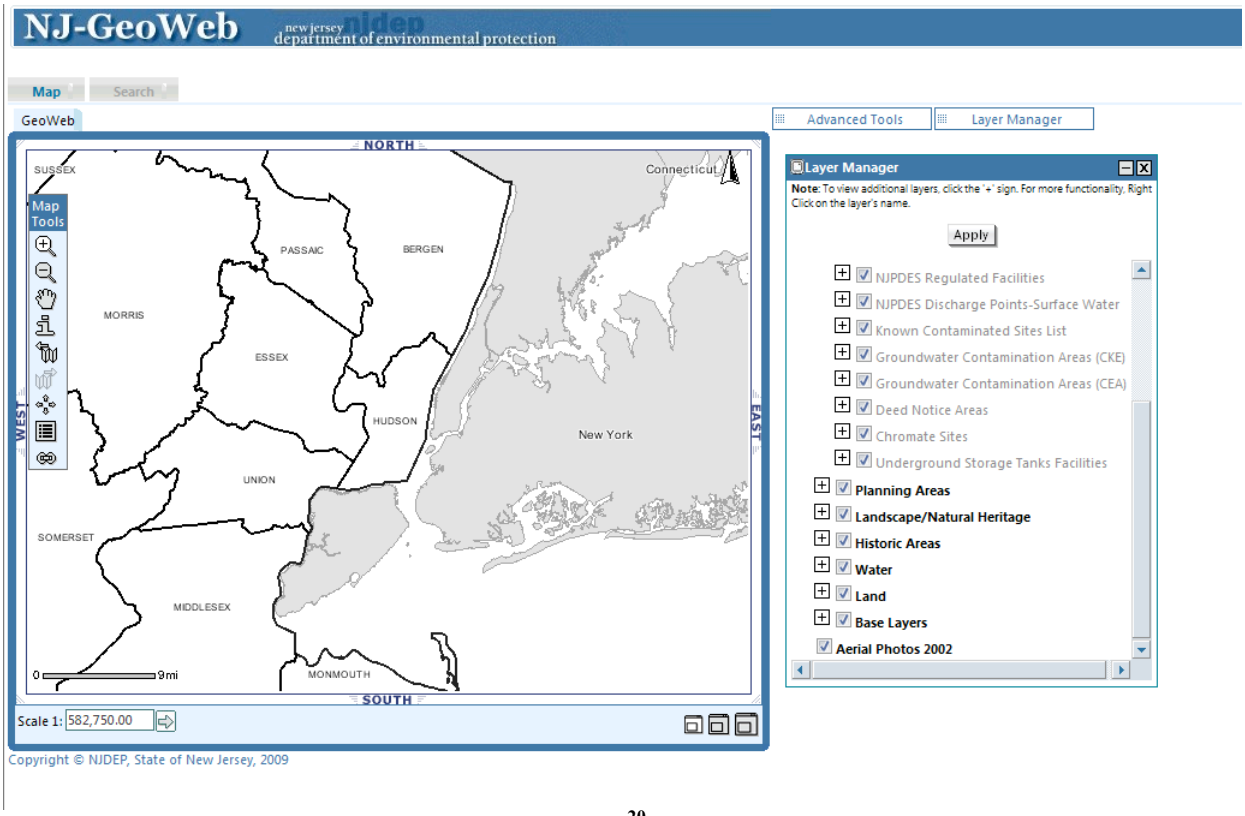

Figure 9[20]

Interviews and Site Inspection

Historical documents as well as environmental databases are key components of a site investigation. But in many cases, there may be limitations or gaps in the historical and regulatory record. One way to address these limitations is to find out about the property from persons who live nearby. Neighbors are likely to have a wealth of knowledge about a potentially contaminated site, particularly if the property was used for

[19] Moore, Michael, "New Jersey's Institutional Control Database Experience," 2007. Available at http://www.epa.gov/superfund/policy/ic/pdfs/moore.pdf (accessed April 6, 2012)
[20] See http://www.nj.gov/dep/gis/geowebsplash.htm

unregulated activities, such as midnight dumping, illegal auto repairs, etc. In addition, one can interview local planners, town historians, previous site owners, and others who have some connection with the property.

Perhaps the most critical step in the process is to walk through and inspect the site thoroughly. One often finds conditions not reflected in official records and photographs. The site can be checked for indications of illegal dumping or the burning of garbage. The presence of building rubble, old foundations, backfilled areas, and subsidence all indicate areas potentially requiring further assessment. The property can also be checked for soil staining and chemical and gasoline smells.

Establishing a Level of Concern

Together, the investigative process described above is often referred to as a "Phase 1 Environmental Site Assessment." Such assessments are routinely conducted by environmental consulting firms for a few thousand dollars. The industry standard is typically a desktop based investigation that includes a record search (e.g. Sanborn maps, historical photos, city directories), a review of environmental databases, interviews with owners and occupants of the site, and a site reconnaissance. It does not include taking and analyzing soil and water samples. Should community groups looking for garden sites rely on the same protocol (Phase 1 Environmental Site Assessment) to assess infill sites as private-sector developers use for brownfields? Or should they sample their soil? What is reasonable in terms of cost, time, and safety?

EPA's recent report, *Brownfields and Urban Agriculture: Interim Guidelines for Safe Gardening Practices* addresses these questions head on.[21] The guidance divides sites into two categories: low-risk and high-risk sites. Low-risk previous uses for a site include residential housing, green space, traffic corridors and parking areas. *Even for low-risk areas, the agency recommends community groups test soil samples for a range of heavy meals, and polycyclic aromatic hydrocarbons (PAHs),* a group of chemicals formed during incomplete coal combustion. High risk sites, such as former gas stations, dry cleaners, printing and auto-body shops, rail lines or depots, and land with indications of dumping or burning or the presence of gasoline odors and/or staining of the soil require more rigorous sampling strategies—more samples, at different depths, etc.

Managing Risk If Soil Is Contaminated

In some cases, soil tests will come back from the lab showing that the soil is suspect for lead, cadmium, arsenic and other contaminants. How should the results be interpreted? What standards should be used to determine if the soil is safe for the gardening activities and food production? Currently there are no federal soil standards for

[21] *Brownfields and Urban Agriculture: Interim Guidelines for Safe Gardening Practices,* U.S. EPA, http://www.epa.gov/brownfields/urbanag/pdf/bf_urban_ag.pdf. See also *Assessing Urban Impacted Soil for Urban Gardening: Decision Support Tool—Technical Report and Rationale.* Toronto (Ontario) Public Health, May 2011. http://www.toronto.ca/health/hphe/pdf/urban_gardening_assessment.pdf

growing food in urban soils. However, the EPA and state regulatory agencies have set soil cleanup standards for various contaminants based on the anticipated future use of the site. EPA's recent guidelines for safe gardening practices note that if soil contamination levels are below levels for residential use, it is safe to assume the site is safe for gardening.[22]

If contamination exceeds residential levels, gardeners can take a number of precautions to reduce risk from soil contamination. First, installing raised beds and using clean topsoil from certified soil sources can eliminate potential exposure. Landscape fabric or a plastic liner, placed at the bottom of the bed can in most cases, prevent existing soil from coming into contact with plants. Increasing the organic matter content of garden soil through composting and using soil amendments to maintain neutral pH can limit the amount of contamination taken up by the crops. To block dust from potential sources of contamination, such as highways or railroad tracks, a fence or hedge can be used as a barrier. Vegetables such as tomatoes, eggplants, squash, and cucumber are less likely to take up contaminants compared to root vegetables or green leafy vegetable such as spinach or chard. In any case all produce should be washed well in a 1% vinegar solution to remove soil particles, and root crops should be peeled. By taking adequate precautions gardeners can enjoy the many benefits from growing their own food and minimize risks from contaminated soil.

[22] *ibid.*, p 11.