Evaluation of Urban Soils for Green Infrastructure or Urban Agriculture

An Online Continuing Education Course for Engineers

Course Number: C-3035

Credit: 3 Hours / 3 PDH / 3 CPD

Evaluation of Urban Soils for Green Infrastructure or Urban Agriculture

Summary

Many urban areas are experiencing a significant increase in the number of vacant properties and a corresponding underutilization of substantial tracts of land. As part of efforts to revitalize these areas, communities are looking at *green* reuses of vacant properties, including parks, green infrastructure, and urban agriculture. The poor condition of the soils on these properties, however, can often be a significant impediment to green infrastructure and urban agriculture uses. The soils are often severely compacted, lack sufficient organic matter, and can contain large amounts of construction debris, making them unsuitable as a growing medium.

This course provides a concise, practical, and scientifically-based overview of the typical conditions of urban soils, and offers recommendations for how such soils can be rehabilitated or reconditioned to support green infrastructure or urban agriculture. Reconditioning methods for improving poor quality soils will vary depending on soil conditions and the intended use of the site. In general, the objective is to restore disturbed urban soils to a condition more consistent with the functions and services of native soils. Sites intended for urban agriculture might need considerable reconditioning to achieve the characteristics needed to grow certain crops, whereas areas intended for recreation (e.g., parks, playgrounds, hiking trails) might need only moderate improvement to allow for vegetation.

Reconditioning of urban soils is intended to adjust drainage characteristics, improve soil structure, add organic matter, and mitigate compaction. Examples of soil reconditioning techniques include:

- Raking out construction debris and using a subsoiler to break up compacted soils
- Adding compost and tilling
- Altering the soil chemistry to achieve desired parameters (e.g., pH)
- Manipulating organism populations to achieve a desired change in soil characteristics (e.g., using earthworms to promote easier air, water, and nutrient penetration into the soil profile).

In many cases, reconditioning of soils on vacant parcels involves raking out rubble and debris and tilling in compost or topsoil. In procuring compost or topsoil, care should be taken to bring in materials from sources where the origin of the compost or soil is known and the quality of the materials is certified or otherwise ensured. This is important to make certain there are not undesirable characteristics in the soil or compost being brought to the site, such as contaminants or seeds from invasive plant species.

In some cases urban soils may have concentrations of contaminants from past land uses or air deposition. Possible soil contamination issues should be considered when planning reuses of urban parcels. This course does not specifically address assessment or remediation of contaminated soils. This course focuses on assessing and reconditioning soils to provide good drainage and support plant growth.

Soil quality and characteristics should be assessed during the project planning phase, and initial reconditioning should be done before vegetation is established. Project planners need to understand that long-term management of the soils is needed to ensure success. Soil management is a dynamic process that usually requires a large initial effort followed by smaller sustained efforts to achieve a lasting beneficial result.

Introduction

Many urban areas, especially within the industrial Midwest, are experiencing a significant increase in the number of vacant properties and underutilization of substantial tracts of land. In an effort to revitalize these areas, communities are looking at using vacant properties as locations for green infrastructure and urban agriculture. The poor conditions of soils on these properties, however, can often be a significant impediment to successfully implementing green infrastructure or urban agriculture projects. Soils are often lacking organic matter and/or are severely compacted, and may contain large amounts of construction debris, making them unsuitable as a growing medium.

This course provides a concise, practical, and scientifically-based overview of the typical conditions of urban soils, and offers recommendations for how such soils can be rehabilitated or reconditioned to support green infrastructure or urban agriculture. The focus of the course is on conditions within the Great Lakes Basin, although many of the principles apply to urban environments throughout the U.S.

The U.S. EPA defines *green infrastructure* as "an adaptable term used to describe an array of products, technologies, and practices that use natural systems—or engineered systems that mimic natural processes–to enhance overall environmental quality and provide utility services. Green infrastructure can be used as a component of a stormwater management system when soils and vegetation are used to infiltrate, evapotranspire, or recycle stormwater runoff." Rain gardens, permeable pavement, trees and urban forestry, downspout disconnection from storm sewers, vegetated swales, green parking and green streets, and riparian buffers are examples of green infrastructure. Many communities and neighborhood groups are working to implement green infrastructure on vacant properties.

Figure 1. Community garden in Detroit

Green infrastructure has the potential to provide the following benefits:

- Reduced and delayed stormwater runoff volumes;
- Enhanced groundwater recharge;
- Stormwater pollutant reduction;
- Reduced sewer overflow events;
- Increased carbon sequestration;
- Urban heat island mitigation;
- Reduced energy demand;
- Improved air quality;
- Additional wildlife habitat and recreational space;
- Improved human health; and
- Increased land values.

Urban agriculture is the cultivation of crops in urban or suburban areas for local consumption or sale.

While individuals may develop backyard gardens or begin a for-profit venture, the focus of this course is on community gardens that can be established on a vacant parcel or at a school or another communal location in a neighborhood. Urban agriculture can provide many benefits, including:

- Improving the quality of life for people living near the garden;
- Providing a catalyst for neighborhood and community development and neighborhood stabilization;
- Stimulating social interaction;
- Beautifying neighborhoods;
- Producing nutritious food;
- Reducing family food budgets;

- Conserving resources, including those which would otherwise be needed to transport food from remote areas to urban dwellers;
- Creating an opportunity for recreation, exercise, therapy, and education;
- Preserving green space;
- Creating income opportunities and economic development;
- Reducing city heat from streets and parking lots;
- Reducing impervious urban land area; and
- Providing opportunities for intergenerational and cross-cultural connections.

The use of certain green infrastructure practices and the development of urban agriculture can be challenging in an urban environment due to a number of factors, including the poor condition of the soils.

This course provides information on the characteristics of urban soils (Section 2), summarizes how urban soils should be assessed before initiating a project (Section 3), and provides recommendations for reconditioning urban soils (Section 4). The course concludes with a description of a case study.

Characteristics of Urban Soils

Soil is the unconsolidated mineral or organic material on the immediate surface of the Earth that serves as a natural medium for the growth of plants. Soil characteristics reflect the effects of climate (including water and temperature effects) and macro- and microorganisms acting on parent material over time. An *urban soil* on a parcel in a metropolitan area has typically been moved, graded, and/or or compacted over time, often as a result of construction and demolition activity at the site. Movement of soil and addition of non-native soils is relatively common in developed areas. As low areas are filled and hills are graded, soils are shifted and relocated, resulting in mixing of the soil profile or placement in a different order. Fill is often brought on-site from nearby areas and frequently has characteristics different from the native soils on site. Because of the ways soils have been altered, there can be great variation in the characteristics of soils within an urban land parcel.

Soil studies in urban areas have found that soil compaction, low organic matter content, and low levels of contamination, usually from air deposition or from historical uses on site, are common attributes of urban soils. The issue of assessing soil quality becomes two-fold: the health of the soil as a growing medium needs to be addressed as well as the possible contamination that may be present.

The history of a vacant parcel can provide valuable information to help identify possible soil contamination.

In industrial areas, historical contaminates might include heavy metals, hydrocarbons, or chemicals used during the manufacturing process. In residential areas built before the early

1980s, contaminants generally include lead paint residues, and may have asbestos, coal and wood ash deposits, fuel oil, used motor oil residues, or pesticides.

Remnants of abandoned septic systems, cisterns, and wells are also often uncovered during redevelopment of residential sites. Residential areas tend to have relatively less compaction and better-quality soils than more heavily urbanized areas. Knowing the development history of a parcel is key to determining what type of soil testing should be done, if any, prior to redevelopment or reuse.

Some vacant parcels in an urban environ wnfields. Brownfield sites are properties that are avail ent is complicated by the presence or poten groundwater. U.S. EPA's Brownfield Progra ment and clean-up of Brownfields throu d other vacant properties have been successf y gardens and stormwater parks (U.S. EPA, 20

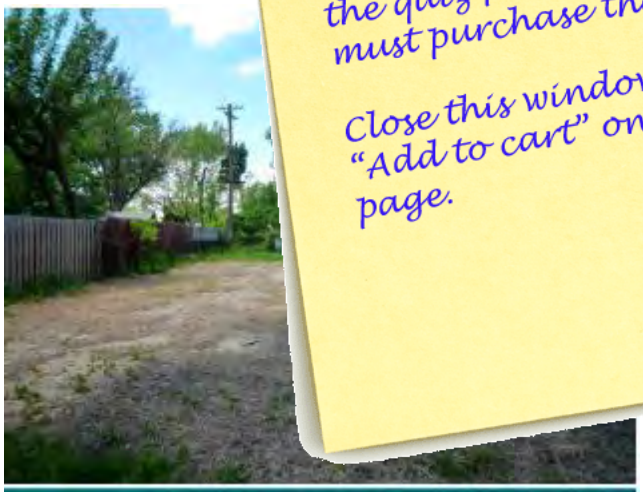

Figure 2. Vacant residential lot, Cleveland, Ohio
Photo: William Shuster (U.S. EPA)

This course does not specifically address how to assess or remediate contaminated soils. U.S. EPA Brownfields Program and/or State Brownfield, Voluntary Clean-up Programs, or health agencies should be consulted for technical information on assessing sites and addressing soil contamination. The focus in this course is on improving urban soils so that they provide an adequate growing medium for urban agriculture or native plants, and/or so the soils are suitable to support green infrastructure strategies for managing stormwater.