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Impacts of Residential Demolition and the Sustainable Reuse of Vacant Lots (Cleveland, Ohio)

Background

Post-industrial cities share the problems of aging civic and water infrastructure, a depleted tax base, and underserved neighborhoods that lack basic environmental services. For example, due to the recent spike in foreclosures coupled with continued blight within U.S. urban cores, the number of residential demolitions has increased, and so has the amount of vacant land. The demolition of residences changes urban landform, and the social and economic fabric of a neighborhood.

In many urban cores, stormwater combines with septic flows in combined sewers. These combined sewer systems overflow to streams, rivers and lakes. The Clean Water Act (1972) regulates combined sewers. Enforcement of this law has inspired local wastewater managers to manage storm flows by complementing traditional wastewater infrastructure (e.g., sewer pipes and wastewater treatment plants) with green infrastructure. Green infrastructure (e.g., rain gardens) uses plants, soils and storage systems to capture rainfall, prevent runoff, and keep stormwater out of the combined wastewater system.

Vacant lots can function as green infrastructure. The soils that underlay vacant lots can infiltrate, store, and act as a sink for excess stormwater runoff. To areas historically without green space, green infrastructure can also provide ecosystem services such as pollinator activity, heat relief through evaporative cooling, and more pleasant surroundings.

Project Overview

EPA researchers are studying vacant lots and their soils. One benefit of vacant lots is that they are found among viable residences and distributed through most neighborhoods. However, little is known about urban soils, much less their capacity to support green infrastructure and other techniques to soak up excess urban runoff.

This research takes a comprehensive look at the nature of urban soils by measuring how fast water moves into the soil, taking deep soil cores, and using soil taxonomy and the cores to understand how water moves through various depths. The research expands our knowledge of how demolition affects vacant lots and their utility for reuse. The work generates science-based recommendations on restoring vacant lot soils, and revising demolition practices to ensure that we are not wasting opportunities to preserve natural resources.

Objective

The objective of this work is to quantify physical, chemical and hydrologic characteristics of vacant lot soils. This knowledge will expand the understanding of how these soils may support vegetation, and will be applied to suggesting ways to manage urban soils for stormwater management and other ecosystem services.

A typical vacant lot in Cleveland, Ohio.

Methods

In a sampling of vacant lots and city parks in the cities of Cincinnati and Cleveland, Ohio, researchers assessed soils from both undisturbed (back yard right-of-way) and disturbed (where the residence previously stood) places in vacant lots. They measured the amount of buried rubble left behind at the time of demolition, canopy cover, and ease of water movement. They analyzed soil nutrients, described soils using soil taxonomy, and reached depths approaching bedrock (usually 3-4 m.).

Results and Discussion

Researchers observed that even for the more thorough post-1996 demolitions, debris removal was usually incomplete, leaving much large debris (concrete, brick, wood, etc.). This means that vacant lots will require additional fill soil and preparation prior to further improvements. Observations also indicated that demolition contractors do not typically adhere to the requirements in Cleveland, Ohio.

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The fertility of vacant lot soils was generally sufficient to support vegetation, especially in the parts of the lot around the house. Fill soils tended to be finer in texture and slaked over, restricting water infiltration and support for vegetation. Soil restoration in residential filled areas should start with a tilth-building program that adds raw or composted organic matter and incorporates serial cover-cropping with deep-rooted species, and may include other approaches to initiate organic matter cycling and promote water infiltration and redistribution.

If water that has infiltrated into surface soils cannot move downward or elsewhere, it can saturate soils and cause problems for neighbors. In vacant lots, there were at least two controls on subsurface hydraulic conductivity, which measures ease of water movement. Soils in Cleveland that are closer to Lake Erie were sandy, and water passed through these soils easily. Even if subsoils were not permeable, it was often the case that incompletely-filled rubble deposits or basement areas filled with rubble would pass water very quickly.

Overall, vacant lot soils supported some vegetation, and had some capacity for infiltrating stormwater. With improvements, vacant lots may offer other benefits to local communities. Vacant lots can be turned into vibrant green spaces that offer a venue for local agriculture, pocket parks or other uses. Another important use for vacant lots that are properly managed is stormwater infiltration. In cities like Detroit, Cleveland, Cincinnati, vacant lots are interspersed with residential housing, and provide a ready sink for stormwater volume from streets and the roofs of houses. Eliminating this stormwater volume from combined or separated sewer systems could save sewer districts money and provide benefits. Yet, getting the vacant lot into shape can be a big job. We are currently looking into the costs and benefits of a thorough versus an incomplete demolition.

The data suggest that demolition practice requires adjustment to preserve existing soil and hydrologic attributes of vacant lots, and to maximize future reuse potential. The study lays the groundwork for learning how to conduct a demolition that creates the opportunity for the flexible reuse of vacant land.

Future Work

The next step is to test the effectiveness of green infrastructure in improving ecosystem-level processes by restoring and monitoring vacant lots. Researchers will use principles of adaptive management to guide a green-infrastructure retrofit of a neighborhood block in the Slavic Village Development Corporation area in Cleveland, Ohio. Implementing green infrastructure, among other applications, may foster more sustainable stormwater management and extend quality ecosystem services to areas historically lacking these attributes.

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Reference

Moving beyond the udorthent – a proposed protocol for surveying urban soils to service data needs for contemporary urban ecosystem management. WD Shuster, A Barkasi, P Clark, S Dadio, P Drohan, B Furio, T Gerber, T Houser, A Kelty, R Losco, K Reinbold, J Shaffer, J Wander, and M Wigington. *Soil Survey Horizons*. Spring 2011.

A vacant lot in Cleveland, Ohio before any improvements.

After extensive post-demolition debris removal, soil management, and plantings, the same vacant lot is now an attractive, functional addition to the neighborhood.

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