

# HEALTHY SOILS STRATEGY FOR THE CITY OF LOS ANGELES

2021





# ACKNOWLEDGEMENTS

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## CALL OUT BOXES

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*Measure W: The Safe Clean Water Program*  
*Managing Food Waste: The LASAN In-Sink Disposal Pilot Program*  
*Managing Food Waste: The LASAN Curb Your Food Waste LA Pilot Program*  
*Community Composting with LA Compost*  
*Composting and Urban Gardening Workshops*  
*Addressing Soil Contaminants in LA: LASAN's Citywide Brownfields Program*  
*Los Angeles is Located in a Biodiversity Hotspot*  
*Getting to Know LA's Soils: LA Soil Survey*  
*Current Community Education Efforts: LASAN*  
*RegenerateLA Pilot Project*







KEY TERMS	
<b>Soil</b>	a natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface, occupies space, and is characterized by horizons, or layers (Soil Survey Staff, 1999)
<b>Healthy Soil</b>	soil with the continued capacity to function as a vital living ecosystem that sustains plants, animals, and humans (NRCS)
<b>Urban Soil</b>	soil that is altered by the presence of humans and by urban environmental and physical changes, such as the deposition of atmospheric pollutants (Effland and Pouyat 1997).
<b>Clean Soil</b>	soil free of contaminants (i.e., compounds and materials that are damaging to the plants and animals above and within the soil, as well as the water flowing through soil to the aquifer below)
<b>Drawdown</b>	a potential point in the future when levels of greenhouse gases in the atmosphere will stop increasing and start to steadily decline
<b>Regenerative Agriculture</b>	agricultural practices that improve soil health and restore soil biodiversity, allowing the soil to sequester carbon from the atmosphere, filter water and recharge water tables, and produce high-quality foods
<b>Pervious Surfaces</b>	surfaces that allow water to pass through into the substrate beneath
<b>Impervious Surfaces</b>	solid surfaces that do not allow water infiltration into the substrate beneath, instead forcing water to run off
<b>Underutilized Sites</b>	properties that are vacant or not being used to their full environmental or economic potential
<b>Climate Resilience</b>	the ability to anticipate and prepare for climate-related events (e.g., sea level rise)
<b>Ecosystem Services</b>	the benefits that ecosystems provide to sustain and fulfill human life
<b>Native Species</b>	species whose presence in a region/area is the result of natural processes
<b>Non-Native Species</b>	species that are living outside their native range because human-mediated transport has facilitated their establishment in new areas
<b>Invasive Species</b>	non-native species that harm their new environment and/or the native species in the ecosystem
<b>Endemic Species</b>	species found in just one geographic region
<b>Biodiversity Hotspot</b>	a region that contains high levels of irreplaceable biodiversity (i.e., has at least 1,500 endemic plant species) and is deeply threatened (i.e., has lost at least 70% of its original native vegetation)

# INTRODUCTION

Globally, soil is gaining increasing attention in the fight for emerging climate solutions. The 68<sup>th</sup> UN General Assembly declared 2015 the [International Year of Soils \(IYS\)](#) to increase awareness and understanding of the importance of soil for food security and essential ecosystem functions. The Food and Agriculture Organization (FAO) of the United Nations was nominated to implement the [IYS 2015](#) within the framework of the Global Soil Partnership and in collaboration with Governments and the Secretariat of the United Nations Convention to Combat Desertification. Furthermore, the [UN Sustainable Development Goal #15](#) calls to protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss.

Additionally, Mayor Eric Garcetti is the current chair of the [C40 Cities](#), a collaborative network of global megacities working to address climate change. As such, it is a particularly opportune time to join and lead the global community in urban soil health management and to learn and share best practices from cities, states, and countries across the globe.

On a policy level, there is a global argument over emissions reduction goal deadlines and potential solutions related to the rapidly-worsening climate emergency. In an effort to mitigate the causes of climate change, reduce environmental pollutants, and build a more resilient Los Angeles, Mayor Eric Garcetti signed Executive Directive No.7 in 2015 and introduced the Sustainable City pLAn. The pLAn is a roadmap to a carbon free environment and mandates a major update every four years. In 2019, the Sustainable City pLAn was updated and branded as LA's [Green New Deal](#).





The Green New Deal presented benchmarks to:

- Reduce greenhouse gas emissions, particularly methane;
- Increase composting;
- Divert more solid waste from landfills;
- Promote urban agriculture; and
- Implement zero emission transportation corridors.

Mayor Garcetti's Green New Deal is an innovative document that out distances initiatives put forward by leaders, advocates, and policy makers in cities around the nation. The pLAn outlines a number of Healthy Soils Goals (2019 Sustainability pLAn; pg 112), including:

- Developing a healthy soil strategy for the City to support urban agriculture, address carbon sequestration, and increase water capture;
- Piloting two healthy soil projects by 2021;
- Exploring incentives for regenerative agricultural practices, including water conservation; and
- Amplifying community education campaigns on the benefits of healthy soils, biodiversity, and regenerative agriculture.

The pLAn also includes several organics and composting goals, including:

- Eliminating organic waste going to landfills by 2028;
- Establishing food waste drop off stations at all farmers markets;
- Partnering with local organizations to ensure food scraps are composted locally;
- Launching Citywide residential food scraps collection;
- Developing a composting master plan to expand community and regional composting infrastructure; and
- Analyzing diversion strategies for other organic waste including food-soiled paper, carpets, palm fronds, organic textiles, etc.

City Councilmember Paul Koretz introduced "RegenerateLA," a [Healthy Soils Initiative](#), which builds on the healthy soils goals in LA's Green New Deal, to City Council (CF# 20-1225) on September 23, 2020. RegenerateLA was adopted by the City Council on June 15, 2021. The initiative calls for interdepartmental collaboration between:

- LA Sanitation & Environment,
- Economic and Workforce Development Department,
- Department of Transportation,
- Department of Recreation and Parks,
- StreetsLA,
- Fire Department,
- Library Department,
- General Services Department,
- Department of Water & Power,
- The Office of Climate Emergency Mobilization, and
- Other relevant departments and proprietaries.

The motion also calls for the involvement of Los Angeles Trade Tech, or other job development organizations such as LA Conservation Corps and Homeboy Industries, as well as the Neighborhood Council Sustainability Alliance and other relevant community organizations. Collectively, these departments and groups are directed to:

- Research opportunities to develop small- and mid-scale compost operations on public lands;
- Research opportunities for unpaving underutilized spaces and using them for composting/mulching operations and/or to create healthy soil;
- Research opportunities to reduce chemical and water use in parks through the application of compost and mulch and the implementation of regenerative land and tree management techniques in public green spaces;
- Determine the current use and any excess availability of mulch from City forestry and landscaping operations across all departments, including proprietaries, and green-bin collection to support healthy soil in the City;
- Determine the current and future availability of anaerobic digested “cake” that can be used to support healthy soil;
- Explore opportunities for increased soil carbon and risk mitigation (e.g., flooding, drought) by increasing water infiltration and holding capacity on managed lands;
- Work with the Departmental Chief Sustainability Officers to educate new and existing staff and other relevant managers on soil health, regenerative land management, and integrated pest management;
- Explore public and private funding sources, including grants, for projects that will help the City expand its healthy soils efforts;
- Research best practices to protect soil health during necessary fire prevention-related brush clearance activities;
- Explore opportunities for public-awareness efforts on the importance of healthy soil and regenerative land management for communities throughout Los Angeles and the feasibility of a Victory Garden-style campaign;
- Expand training for the City’s landscaping workers across relevant departments on how to care for native plants and use integrated landscape management; and
- Research opportunities to create and improve local, “green” employment opportunities linked to healthy soil and compost projects and programs.

Additionally, and often in partnership with the Mayor, the Los Angeles City Council has championed related aggressive environmental measures, including:

- The launch of the world’s first [Office of Climate Emergency Mobilization](#), which played a significant role in inspiring the now over 2,000 [climate emergency declarations by jurisdictions](#) around the world;
- A [100% renewable energy effort](#) led by the Department of Water & Power;
- Adoption of the [Good Food Purchasing Program](#), which has won a [2018 Future Policy Award for Scaling Up Agroecology](#) from the United Nations Food and Agriculture Organization, the World Future Council, and the International Federation of Organic Agriculture Movements; and
- The creation of the first [City Biodiversity Index](#) in the United States and the ongoing development of a biodiversity protection implementation plan.

All of these efforts are centered around environmental justice, equity, and improving the lives and well-being of all Angelenos by improving the quality of air, water, food, and, germane to this report, soil.

In order to achieve the goals set forth in LA’s Green New Deal and the RegenerateLA Motion, LA Sanitation & Environment (LASAN), the lead department on the majority of the healthy soils initiatives outlined above, created a Healthy Soils Advisory Panel and an Interdepartmental Healthy Soils Group. The Healthy Soils Advisory Panel, which was initiated in August 2020, is an advocacy group consisting of experts and committed parties that intend to advance the mandates of the Green New Deal as well as legislation proposed by the City Council. The Interdepartmental Healthy Soils Group, created in July 2021

after the City Council adopted the RegenerateLA Motion, will collaborate to research the feasibility of all of the items outlined in the Motion and work to incorporate and implement the strategies and supporting actions included in this document.

## **HISTORICAL CONTEXT**

In order to look forward, we are compelled to recognize the importance of what has preceded us. The current condition of local soils must be filtered through the lens of the previous practices and traditions of Indigenous people. Although systemically disenfranchised, Indigenous people continue to inhabit the land and participate in the stewardship of land, water, and soil. The methods they incorporate to sustain and regenerate the land are important reference points for restoring soils to a healthy state.

The area around Los Angeles was inhabited by the Payomkawichum, Tataviam, Kizh, Acjachemen, Serrano, Tongva/Gabrielino, and Ivilyuqaletem. When the Europeans arrived, approximately 5,000-10,000 Tongva and Chumash people inhabited Southern California. The legacy of Jesuit expansion into the fertile land of Indigenous people is an unpleasant chapter of Los Angeles history. The Chumash had a very specific system of burning the land in order to manage the vegetation and the deer and rabbits on which they subsisted. The Chumash deemed large scale agriculture an inefficient use of lands. Today, our soils are suffering from overuse of land by industrial agriculture, human encroachment on the natural environment, chemical fertilizers, and environmental pollution that is severely disrupting natural cycles. The environmental impact of pollution is negatively affecting humanity at a great cost, and at a rate much faster than scientists expected. Large tracts of land in the greater Los Angeles area are scorched by uncontrollable fires exacerbated by development, land erosion, climate change, and drought.

## **BACKGROUND ON SOILS**

“Like snowflakes, no two soils are the same. Each different kind of soil is called a series. These soil series are named for towns or local landmarks. More than 17,000 soil series have been named and described in the U.S. and more are being defined each year. Much of our life’s activities and pursuits are influenced by the soil beneath our houses, roads, sewage systems, airports, parks, recreational sites, farms, forests, schools and shopping centers. What is put on the land should be guided by the soil that is beneath it. A behavior, once known, is true for that type of soil no matter where the soil is located. Different soils, with great differences in properties, can occur within the same subdivision or field” (USDA, NRCS, 2007).

“Soils develop in layers. These layers, called horizons, can be seen where roads have been cut through hills and other areas where the soil is exposed. The presence and thickness of each horizon varies with location. Under disturbed conditions, such as intensive agriculture, building sites, or where there is severe erosion, some horizons may not be present” (USDA, NRCS, 2007).

Soil conditions in urban areas generally correspond to anthropogenic impacts. Urbanization can impact soils directly, through disturbance (e.g., trampling) and management (e.g., irrigation) and indirectly, via changes in the environment (e.g., increased pollution or the urban heat island effect) (Pouyat et al., 2010). Highly impacted urban soils can be disturbed, contain human-transported materials, often referred to as “fill”, or be “sealed” (i.e., covered by impervious surfaces like asphalt and concrete) (Scalenghe and Marsan 2009).

## **COMPOSITION OF SOILS**

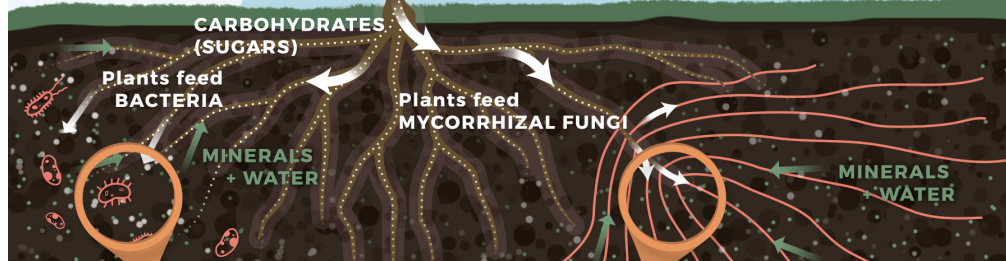
Soil composition depends on five soil-forming factors: parent material, climate, living organisms, topography, and time (Jenny, 1941). In urban environments, where human activity influences soil formation, a sixth “anthropogenic” factor becomes important (Pouyat et al., 2010).



# BUILDING HEALTHY SOIL SOLVES EVERYTHING!

PLANTS GROW BY MAKING CARBOHYDRATES (sugars) FROM CARBON DIOXIDE (CO<sub>2</sub>) AND WATER (H<sub>2</sub>O).

THEY SHARE THESE SUGARS WITH SOIL MICROBES WHO, IN EXCHANGE, FEED THE PLANT. THIS PROCESS BUILDS SOIL.



Roots exude sugars to feed **BACTERIA** who, in turn, use enzymes to extract minerals from soil particles and organic matter, allowing the minerals to become plant available.

Bacterial substances, and consumption of bacteria by nematodes, protozoa, earthworms, and arthropods, create smaller carbon based soil aggregates.

**BACTERIA AGGREGATES**

**MYCORRHIZAL FUNGI** attach to roots to be fed carbohydrates. In return they supply nutrients and water to the plant, increasing roots capacity x1000s

Through consumption of carbohydrates and production of a sticky protein called glomalin, the fungi produce soil aggregates and humus that can last for decades as soil carbon.

**MYCORRHIZAL AGGREGATES**



## HEALTHY SOIL:

- ✓ **Increased Soil Carbon**  
(Reverses climate change)
- ✓ **Increased Water Holding Capacity and Infiltration**  
(Improves drought tolerance and restores water supplies)
- ✓ **Increased Soil Aggregation and Soil Life**  
(More fertility and ability to feed the world)
- ✓ **Increased Nutrient Availability and Retention**

## UNHEALTHY (DEAD) SOIL:

- ✗ **Decreased Soil Carbon**  
(Contributes to climate change)
- ✗ **Decreased Water Holding and Infiltration**  
(Increases water runoff and drought)
- ✗ **Decreased Aggregation and Soil Life**  
(Less fertility and more soil erosion causes desertification)
- ✗ **Decreased Nutrient Availability and Retention**

*Healthy Soil  
Infographic  
(Graphic: Kiss the  
Ground)*

## SOIL PROPERTIES

Soils are very diverse and can exhibit a wide range of characteristics. Soils and their various uses are often discussed in terms of the following soil properties (NRCS, 2007):

- Soil texture/grain size (e.g., sand, silt, clay)
- Structure (e.g., granular, blocky)
- Color
- Depth (i.e., depth to high water table, depth to bedrock, and depth classes)
- Permeability/saturated hydraulic conductivity (i.e., how easily water moves through soil)
- Rock fragments (i.e., number/percentage of rock fragments on the surface and/or within the soil)
- Slope
- Available water capacity
- Flooding and ponding

## DEFINITION OF SOIL

[What is soil?](#) The USDA Natural Resource Conservation Service (NRCS) defines **soil** as a natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface, occupies space, and is characterized by horizons, or layers (Soil Survey Staff, 1999).

## DEFINITION OF URBAN SOILS

Urban soils are those found within cities, largely built environments, or areas with a high population density. These soils may be significantly altered, containing human-transported and/or human-altered materials, and tend to display a wide variety of properties and conditions (Zemlyanitskiy, 1963, Craul, 1992). Urban soils also have the potential to provide important ecosystem services, including climate regulation, stormwater management, and biodiversity support, among others. As such, understanding and caring for the health of urban soils is paramount, and detailed and up-to-date soil surveys and mapping efforts are key.

## DEFINITION OF HEALTHY SOIL

For the purposes of this document, we rely on the NRCS definition of healthy soils: “Soil health is the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.”

Healthy soils, from the perspective of supporting human needs and interests, are often rich in organic matter, have pore space, which allows movement and infiltration of air and water, have the capacity to hold water, and are structured (i.e., not compacted).

Healthy urban soils provide ecosystem services that are appropriate for their local environment and use. Healthy urban soils support plants and contribute to, rather than harm, human health. Indicators of urban soil health include: presence of native plant communities, physical, chemical, and biological characteristics that are similar to appropriate reference or native soils, and the ability to support a biologically complex plant community with minimal intervention. Additionally, understanding past land uses can indicate soil health. For instance, sites with a minimal history of construction, topsoil scraping, dumping, or contamination will often have healthy soils.

## DEFINITION OF CLEAN SOILS

Healthy soils are, by definition, clean soils. That is, they are free of compounds and materials that are damaging to the plant root zone (rhizosphere), plants and animals above the surface, and the water flowing through soil to the aquifer below.



## DEFINITION AND IMPORTANCE OF DRAWDOWN

Drawdown is a potential point in the future when levels of greenhouse gases in the atmosphere will stop increasing and start to steadily decline. If achieved, drawdown will begin the process of stopping further climate change and averting potentially catastrophic warming. It will be a critical turning point for life on Earth. [Drawdown solutions](#) related to land use and agriculture (e.g., improving soil health to increase its capacity for carbon sequestration) have the potential to sequester over 320 gigatons of carbon dioxide (CO<sub>2</sub>) globally and are some of the most promising ways to address climate change (Project Drawdown, 2020).

## BEST PRACTICES FROM AROUND THE WORLD

Sustainable land and soil management practices tried in other regions serve as guiding frameworks that can be implemented here in the City of Los Angeles. Successful strategies to preserve or improve soil health and use regenerative land management techniques are highlighted below.

### URBAN HEALTHY SOIL MANAGEMENT EFFORTS:

#### Getting to Know LA's Soils: the LA Soil Survey

Early soil surveys performed by the Natural Resources Conservation Agency avoided urban areas, and even today, many cities remain unmapped. The City of Los Angeles is fortunate to have a complete soil survey available (USDA, NRCS, 2017). Every acre of Los Angeles has been visited or correlated and visual soil samples taken that allow interpretation of how the soil will react under different types of treatments. The survey provides text, tables, and soil maps that are designed to help practitioners better understand the potentials and limitations of soils across the region. The information included in the survey can serve as valuable baseline data for researchers and practitioners.

The [Urban Soil Management Strategy](#) (URBAN SMS) is a project in Central Europe focused on managing and protecting urban soils during urban development projects. URBAN SMS specifically seeks to increase soil consideration when planning development projects and to reduce soil sealing (i.e., covering soil with impermeable materials, such as concrete or asphalt) (Petra et al., 2012). URBAN SMS outlines strategies for municipal and government authorities involved in urban planning and has developed a guidance document and several software tools to help ensure that soil is seen as an environmental resource and is not overlooked in environmental assessment or spatial planning. The project has also tested those strategies in 15 pilot sites in various European cities, providing valuable best practice information. Lastly, URBAN SMS developed an "Awareness Raising Package," a collection of materials (reports with facts and arguments, media materials, action items, etc.) designed to educate stakeholders and the general public on the role and importance of soil in urban areas (Petra et al., 2012).

The [New York City Urban Soils Institute](#) (NYC USI) works to "advance the understanding and promote sustainable use of urban soils" (Morin). NYC USI achieves this mission by providing soil testing, interpretation, and field technical services; soil science and conservation training; a platform for soil data storing and sharing; urban soil research coordination; and opportunities for international soils-related collaboration.

The [NYC Clean Soil Bank](#) is a no-cost soil exchange program that re-purposes clean, native soil excavated at construction sites for use at other construction sites, public or private (NYC OER). Parties

participate by simply submitting soil availability or soil request surveys to the Clean Soil Bank. By keeping clean, affordable soil in the city rather than disposing of it and importing new soil, this soil exchange program produces a number of environmental and economic benefits, including a reduction in truck miles driven for soil transport and an associated reduction in greenhouse gases. The recycled soil may also be used to facilitate brownfields remediation and improve climate change resilience by raising land elevation, amending wetlands, and fortifying shorelines. In just 7 years, the Clean Soil Bank has been responsible for recycling over 600,000 tons of clean soil.

## **SUSTAINABLE AGRICULTURE APPROACHES TO BUILDING HEALTHY SOILS:**

In 2018, the Food and Agriculture Organization partnered with PhosAgro, a phosphate-based fertilizer producer in Russia, with the goal of promoting sustainable soil management (FAO, 2019). Together, they help farmers increase their ability to assess soil conditions and make informed soil management decisions. [Their partnership](#) will provide ten national soil condition assessment workshops, along with Soil Doctors Testing Kits, to 5,000 farmers globally. This initiative has already been successfully implemented in Thailand, where thousands of farmers received access to soil management technologies. This collaboration also established new soil testing laboratories, allowing for increased regional coverage, as well as globally standardized Standard Operating Procedures for testing.

In 2017, the State of Hawai'i enacted [HB 1578](#), creating a Carbon Farming Task Force meant to identify agricultural and aquacultural activities that “promote greenhouse gas benefits, build healthy soils, sequester carbon, increase water-holding capacity, and increase crop yields” (Haw. H.B. 1578). The Task Force will also develop land use and agricultural policies, as well as financial incentives (e.g., loans, tax credits, grants), to encourage those positive agricultural activities. Once those carbon-negative practices are identified and the related policies and incentives are developed, the State can establish a carbon farming certification program that farmers may qualify for to receive carbon credit subsidies.

Farmers in Kenya have implemented the use of micro-basins, small pools dug into the soil and lined with stone walls or soil ridges on all sides (Cherlet et al., 2018). These small-scale water harvesting systems catch and store rainfall and surface water runoff, resulting in more water infiltrating the soil and less soil erosion (Waelti & Spuhler, 2019). This technique proves especially advantageous in dry regions where water is scarce. When micro-basins are used in combination with permanent soil cover (i.e., keeping crop residues and/or mulch on the soil in between crop rotations), soil moisture is further retained.

## **SOILS-RELATED DATA COLLECTION AND SHARING:**

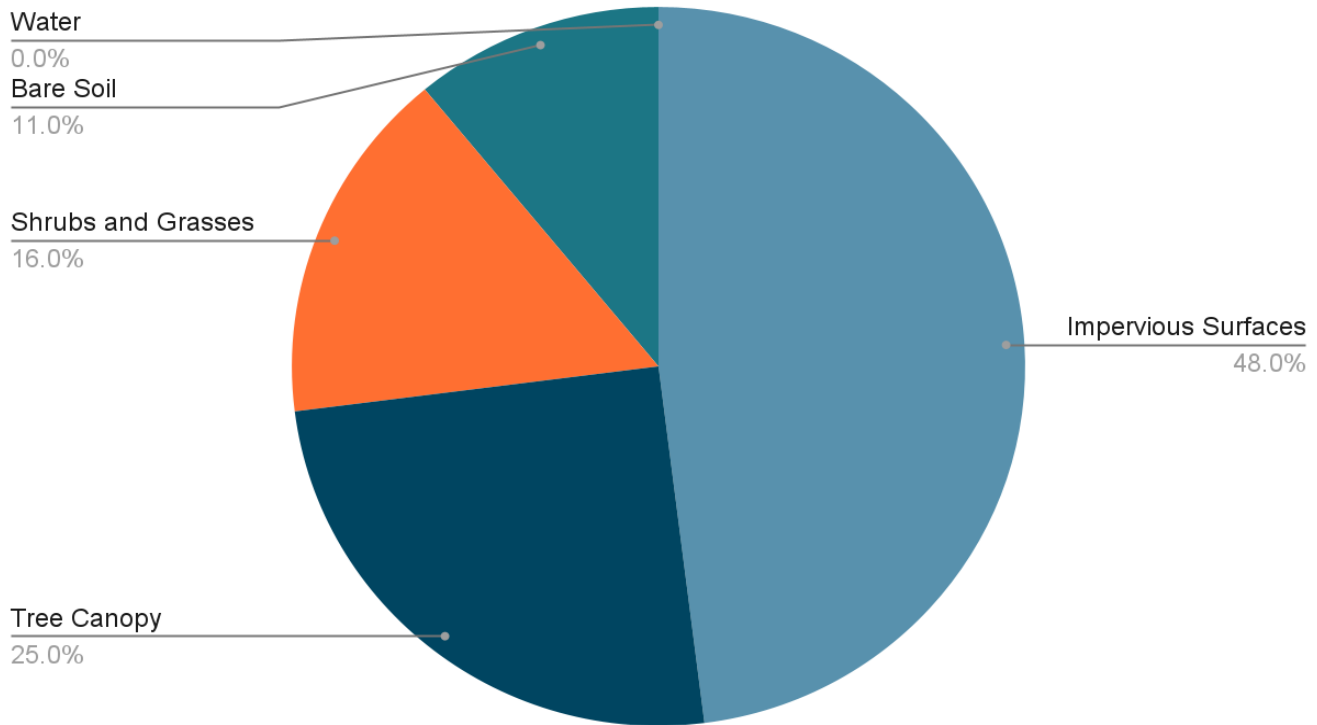
Several Western European countries, including Germany, Belgium, the Netherlands, and France, have mapped their soils at a high resolution. This data provides both the soil degradation status and the soil organic carbon (SOC) levels in a given area, and can be used to aid with soil management and climate mitigation strategies. Access to this data is currently restricted, but once the data becomes more widely available, it will help planners implement large-scale SOC sequestration programs. These maps stand in contrast to those available in many developing countries, where maps of soil degradation status are either lacking or at a resolution too poor to develop soil management plans. High-quality and reliable maps made available in those regions will help site planners and farmers create plans to improve food security and SOC sequestration (Amelung et al., 2020).

The Trust for Public Land (TPL) is developing a [Decision Support Tool](#) designed to help users identify carbon sequestration opportunities that can be achieved in urban areas through the proper management of natural resources. The tool brings mapping resources, datasets, and models into a single platform where users can apply different natural resource management approaches and view the resulting carbon sequestration effects. The tool has been developed for eight U.S. cities, including two in California (San Francisco and San Luis Obispo). The TPL and the Urban Drawdown Institute (UDI) are currently collaborating to make the tool available to several other cities.



## EXISTING LAND CONDITIONS IN LOS ANGELES

Analysis of aerial imagery performed by TreePeople, Loyola Marymount University, and the University of Vermont (link to [full report](#), link to [canopy viewer](#)) shows the percentages of the various components of the City of Los Angeles:



These findings are important as they provide a breakdown of pervious surfaces, which allow water to pass through, and impervious surfaces across the City and, more importantly, locations of where regenerative agriculture (i.e., farming practices that improve soil health and restore soil biodiversity), healthy soil practices, and restoration could occur to enhance soil health, and ultimately, environmental health in the City of Los Angeles.

## SOIL IN LOS ANGELES AND EXISTING INITIATIVES

There are a number of initiatives focused on soils in the Los Angeles area. One prominent example is TreePeople's "[Healthy Soils for Healthy Communities](#)" initiative. TreePeople launched this new initiative in 2020 to:

- Elevate healthy soils as the "brown" in green infrastructure policy, planning, management, and investments in both the built and natural environment;
- Increase public and policy-maker awareness of the importance and potential of healthy soils in building climate resilience (i.e., the ability to anticipate and prepare for climate-related events), sustaining urban ecosystem functions, such as climate regulation, and enhancing public health;
- Conduct cutting-edge science and research that gets used to fill information gaps;
- Facilitate policy changes to promote and support healthy urban soil projects; and
- Empower communities with science-based information, best management practices, and practical tools.

During the first phase of the initiative, TreePeople conducted a needs assessment of LA soils based on online surveys, focus groups, and a literature review, funded by Accelerate Resilience LA, a sponsored project of Rockefeller Philanthropy Advisors. It aimed to:

1. Determine the current status of Los Angeles’s urban soil health;
2. Identify the most pressing urban soil issues and community needs through community consultation and outreach; and
3. Provide a framework for future work regarding urban soil research, policy, public education and community engagement in the region.

Some of the highlights from the needs assessment (Chen et al., 2021) are included in the tables below (the full report is available [here](#)):

<b>CURRENT STATUS OF LA’S SOILS:</b>	
LA’s Land and Soils	11% of the City of LA is covered by bare soil, which represents a great opportunity for employing best soil management strategies and restoration efforts (see figure above).
	Soil sealing is an issue in LA’s urban areas. For example, almost 50% of City land is covered by impervious surfaces such as buildings, roads, and other paved surfaces.
	LA County soils have been highly modified. An NRCS soil survey found that 45% of the surface area was composed of human-altered soils.
Literature Review	In literature published between 1903 and 2020 on LA soils, soil properties and soil contamination were the most studied topics. A focus of public health and community concern is the presence of soil lead (Pb) throughout the LA metro region, where Pb concentrations in surface soils increased roughly fivefold from the early 20th century to the late 20th century.

<b>NEEDS ASSESSMENT - ONLINE SURVEYS:</b>	
LA County Residents	LA County residents value green space: 85% of respondents currently maintain a lawn, landscaped area, or green space, and maintain that space by watering and weeding. Furthermore, 73% of respondents use the “green bin” for their green waste or allow green waste to compost in some form on the property.
	Respondent knowledge about factors that affect soil health was low: 70% reported being not at all or only slightly knowledgeable.
	The majority (76%) of respondents are very or extremely concerned about soil contaminants and pollution in their communities; however, only 12% of them have ever tested their soils.
	Interest in soil-related issues is high, with 76% of participants being either extremely or very interested.
LA County Educators	79% of educators reported that their school has a green space or garden.
	Almost half of educators said they are not at all or only slightly knowledgeable about composting, and when asked about specific factors that influence soil, 63% said they are not at all or only slightly knowledgeable.
	Educators expressed high interest in learning about soil: 81% are very or extremely interested in learning more.



Policymakers	77% of policy-makers are highly concerned about contamination and pollution. However, only 40% believe their constituents feel the same way, when, in reality, 76% do.
	Compost and mulching facilities are present in less than 40% of the jurisdictions surveyed, and less than 70% of those facilities are maintained by the municipality.
	Interest in learning more about soil-related topics is quite high.
LA County Soil-Related Professionals	Like policy-makers, 77% of soil-related professionals are highly concerned about soil contamination, but only 17% believe their customers feel the same way.
	85% of professionals typically use turf grass in their designs.
	Despite 70% of professionals using mulch, only 30% use the green waste from their projects as mulch or compost.
	Stated barriers to composting include: no facility available (48%), insufficient time (19%), and cost (14%).

NEEDS ASSESSMENT - FOCUS GROUPS:	
Identified Needs	Accessible and transparent soil data and testing.
	Effective community engagement and streamlined communication that targets underserved communities.
	Building alliances among community, policy, and science professionals and leveraging organizations/individuals/agencies already doing the work (e.g., coordinating composting/food waste diversion).
High Priority Areas	Developing a holistic soil strategy that includes social and ecological dimensions of soil and centers on racial justice in urban soil work.
	Demonstration projects that address legacy pollution and improved communication strategies for researchers and communities.
	Effective engagement that centers communities and emphasizes community leadership through shared power in decision making and resource allocation.

The findings of this assessment are valuable as the City looks to raise public-awareness on the importance of healthy soil and regenerative land management. In particular, the high priorities listed in the last table coincide nicely with the healthy soil goals set forth in LA's Green New Deal, the RegenerateLA motion, and the work that the LASAN Healthy Soils Team is doing.

## IMPORTANCE OF HEALTHY SOILS/SOIL CONSERVATION

Healthy soils assist with nutrient cycling, regulate water and chemicals, support urban biodiversity, prevent erosion/stabilize banks and cliffs, modify the climate, and provide a number of other soil functions and services. Management practices can directly affect soil health and alter the ability of soils to provide these important ecosystem services. Minimizing the use of fertilizers/manure, planting cover crops, and increasing plant diversity on a site can all benefit, or degrade, soils. To protect soil health under urban conditions, it is recommended to adhere to the following four management principles: minimizing soil disturbances (e.g., tilling), maximizing soil cover through planting, maximizing biodiversity, maximizing water infiltration, and maximizing the presence of living roots.

## DOCUMENT STRUCTURE:

This document details relevant urban soil topics and provides strategies and supporting actions that LASAN, other City departments, community groups, stakeholders, and residents can take to conserve, test, restore, and properly manage healthy soils. Additionally, the document discusses strategies to support training and careers related to healthy soils and regenerative land management and to promote public education. The strategy document includes dedicated sections on: ecosystem services, composting, contamination and pollution, agriculture, biodiversity, testing/metrics/reporting, community education and outreach, and economic benefits. There is also a collection of resources and toolkits related to soil health, soil testing, and soil initiatives included at the end.

The City's unique, collaborative approach to healthy soils and regenerative agriculture puts LA at the forefront of this issue and provides a framework that other local, national, or global municipalities can look to for inspiration.





*A mulch berm is built for a newly planted street tree (Image: City Plants)*



# ECOSYSTEM SERVICES

## ECOSYSTEM SERVICES DEFINITION AND CLASSIFICATION:

Ecosystem services are defined as the benefits that ecosystems provide to sustain and fulfill human life. Costanza et al. (1997) estimated the economic worth of 17 of the earth's major ecosystem services (e.g., climate regulation and soil formation) to be worth approximately double that of global GDP (gross domestic product).

While ecosystem services can be categorized in multiple different ways, we classify ecosystem services according to the Millennium Ecosystem Assessment into categories of provisioning, regulating, cultural, and supporting services.

Types of Ecosystem Services		
Provisioning	Regulating	Cultural
<i>Products obtained from ecosystems</i>	<i>Benefits obtained from ecosystems regulating key ecosystem processes</i>	<i>Non-material benefits obtained from ecosystems</i>
Examples: food, fresh water, and fiber	Examples: climate regulation (e.g., carbon sequestration and storage), water purification, air purification, and pollination	Examples: spiritual, religious, aesthetic, educational, and recreational benefits
Supporting		
<i>The ecosystem services necessary for the production of other ecosystem services</i>		
Examples: soil formation, nutrient cycling, primary production, and other processes that support the production of the other services mentioned above		

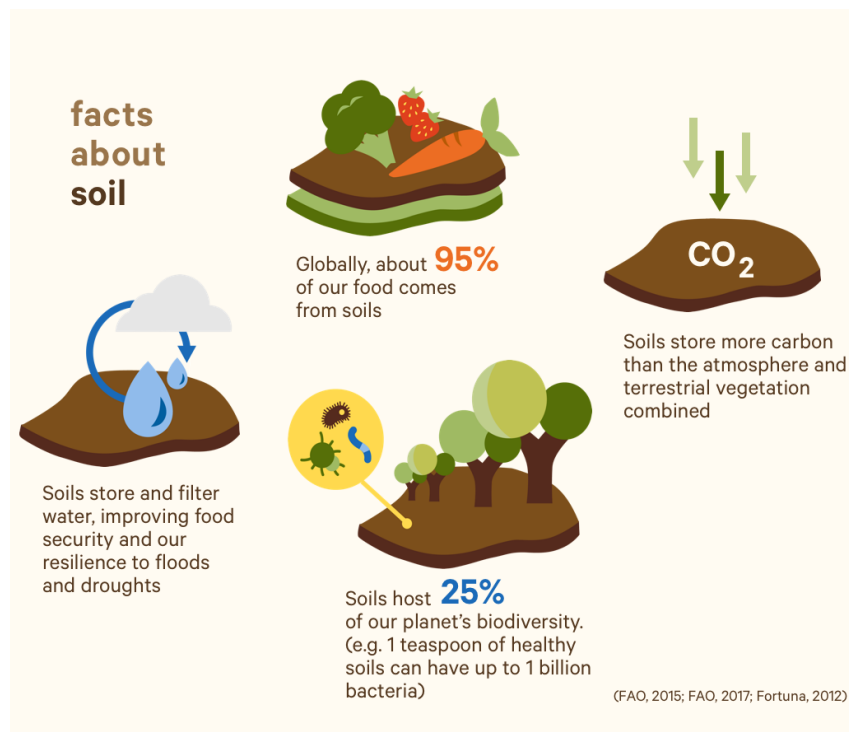


## SOIL AND ECOSYSTEM SERVICES

Soil is the foundation of life. Healthy soils support all the types of ecosystem services mentioned above. For example, about 95% of our global food supply comes from organisms that require soils (FAO, 2015a). Soils store and filter water, improving food security and mitigating floods and droughts (FAO, 2015c), and store more carbon than the atmosphere and terrestrial vegetation combined (FAO, 2017). In addition, soils host about 25% of our planet's biodiversity (FAO, 2015b). Estimates suggest that 1 teaspoon (1 gram) of healthy soils can contain up to 1 billion bacteria (Fortuna, 2012). However, and from a biodiversity perspective, the most important role soils play is providing the medium to grow plants, both of which (soil and plants) form the foundation of most ecosystem services (supporting services).

Despite providing life-sustaining ecosystem services, soils, and particularly urban soils, are often underappreciated. Urban soils are often viewed as altered or degraded, and thus not capable of providing ecosystem services, but in reality urban soils provide many of the same ecosystem services as non-urban soils (Morel et al. 2015). In fact, the importance of ecosystem services in urban areas may actually be enhanced since they are associated with high population densities and thus can benefit more people (Pouyat et al. 2020).

This section will briefly discuss some of the key ecosystem services provided and supported by healthy soils. This section is not intended to be an exhaustive list of all the ecosystem services provided by soils, and will largely focus on regulating services, but instead highlights the City's reliance on healthy soils and shows that improved soil management can enhance ecosystem services in the urban environment.



*Soil ecosystem services (Image: TreePeople)*

## SOIL PROVISIONING SERVICES

Healthy soils provide numerous goods that are critical to society (Wall, 2004). Soils provide food, drinking water, timber and other construction materials, and other products (e.g., oils, fiber, and medicines). In urban areas, soils also provide physical support for roads, structures, and utilities.

## SOIL REGULATING SERVICES

### CLIMATE REGULATION

Soils play an important role in the global carbon (C) cycle and climate regulation because they have the ability to process and store C. The amount of C present in soil varies, and is dependent on soil properties such as texture and depth, as well as the factors of soil formation (e.g., climate, organisms, relief, parent material, and time). While some soils naturally store a great deal of C, other soils naturally store less. In order to change the amount of C that a soil stores, one must change something about the soil's properties or the factors that control its formation.

The C in soil is found in both soil organic matter (SOM) and carbonate minerals and enters soil in several ways. One way that this occurs is through litter (e.g., fallen leaves, sticks, branches, and even roots that die below ground), which decomposes and becomes incorporated into the soil. Another way that soils receive C is in the form of root exudates from living plants. Plants take up carbon dioxide (CO<sub>2</sub>) from the atmosphere through their leaves, convert it via photosynthesis into C-containing sugars and carbohydrates, and then these compounds travel down through the plant's stem and out through the tips of the plant's roots into the soil. Once in the soil, the C compounds are processed by various soil biota. Detritivores, including microbes (bacteria and fungi), protozoa, nematodes, earthworms, and arthropods, break up and decompose dead organic matter.

Carbon can cycle quickly or slowly between the atmosphere, plants and animals, soils, and water. Some of the C that enters soil quickly leaves it again because C can be quickly leached out of soils and into nearby water bodies. Additionally, microbes and other soil biota respire as they do the work of decomposition; they take up oxygen and use it to convert sugars into CO<sub>2</sub>, which diffuses from the soil into the atmosphere. In contrast with this quickly cycling C, some C entering the soil remains there for a long time. This occurs when C occurs as part of complex compounds in soil organic matter. Soil organic matter is composed of decomposing plants and animals, microbial cells and tissues, and enzymes produced by microbes. Some of the C-containing compounds are so complex that they are relatively stable; they take microbes more time and energy to process and may therefore remain in the soil for hundreds or thousands of years. The ability of soils to process and store C for different lengths of time means that soils serve an important role in regulating global atmospheric CO<sub>2</sub>, and therefore, global climate.

Urban soils are important in storing and regulating C. Pouyat et al. (2006) estimated the total above- and below-ground C storage, including soil C, in California urban land cover to be 177 metric tons. In general, soil C is lost when natural areas are disturbed and converted to urban or suburban space. However, over time soil C storage in urban areas may increase due to management intensity and inputs (Pouyat et al., 2010). Management inputs including water, fertilizer, and organic matter may actually lead to higher rates of C sequestration and storage (Pouyat et al., 2010, Golubiewski, 2006). However, irrigated and fertilized urban soils have been associated with higher greenhouse gas emissions when compared to natural soils, which offsets some traditional gains of carbon sequestration in urban soils (Kaye et al., 2004). Full urban C accounting that addresses emissions associated with soil management (e.g., irrigation, fertilizer, and transport) in urban areas, like LA, still needs to be done (Pataki et al. 2006).



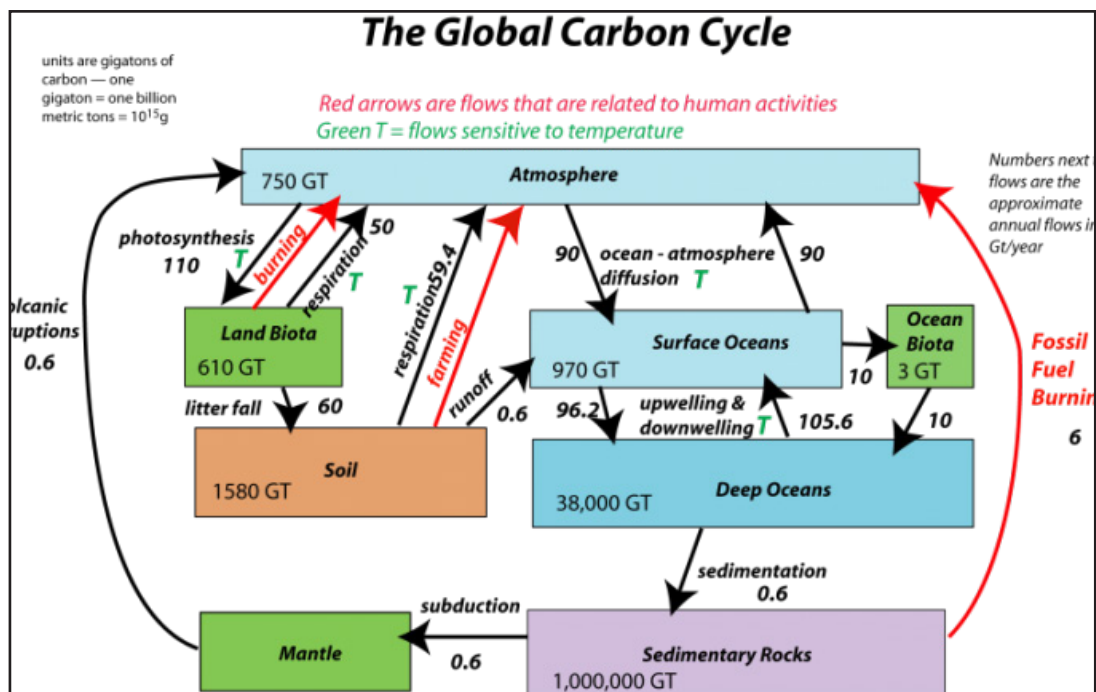
Urban soils have great potential to regulate climate and store C, but landscape modifications, such as paving, deplete the ability of soils to store C. In New York City, Raciti et al. (2012) found that the carbon content in the topsoil under impervious surfaces was 66% lower compared to that of open area soils. Depaving urban areas and restoring soil health can increase the capacity of urban soils to regulate climate and store carbon.

## AIR PURIFICATION

Degraded soils contribute to air pollution by funneling dust into the air, releasing volatile compounds into the atmosphere, and releasing greenhouse gases. This can be particularly problematic when soils are polluted and chemicals are released into the atmosphere (Seiyaboh & Izah, 2019). Degraded soils are also more susceptible to wind erosion, which can cause particles of soil to become suspended in the air and subsequently increase local air pollution (Pimentel & Kounang, 1998). Soils are also degraded through deforestation and conventional agricultural practices, causing large amounts of carbon dioxide and nitrous oxide, two common greenhouse gases (GHGs), to be released into the atmosphere (IUCN, 2018). To put this into context, in 2018, agricultural soil management was responsible for 78% of the U.S. nitrous oxide emissions (EPA, 2020a). Improving soil health and management can directly address air pollution and erosion issues.

## WATER INFILTRATION AND FILTRATION

Soils also store and retain water. Specifically, porous soils rich in organic matter capture and infiltrate water, recharging groundwater aquifers. Soils also regulate water quality via filtration. Intact soils are able to filter water, ensuring that clean waters flow into the streams that support aquatic and riparian species (Parker, 2010). Degraded, compact soils have limited pore space and reduced capacity to infiltrate and filter water. In this way, soil integrity is crucial to clean water and proper hydrologic cycling.



This figure depicts global flows and exchanges of carbon, in gigatons per year. The black arrows represent natural carbon transfers; the red arrows indicate carbon transfers induced by human activity (Image: Bice, 2021)

### **Measure W: The Safe Clean Water Program**

In LA County, the [Safe Clean Water Program](#) (Measure W) continues the tradition of flood safety, while protecting water quality and delivering multi-benefit community projects. These projects will provide new sources of water for current and future generations. The passage of Measure W in 2018 created a comprehensive, regional plan to address how we capture water and how we can reduce our reliance on imported water. Developed in collaboration with public health, environmental groups, cities, businesses, and community-based organizations, the goals of the Safe Clean Water Program are to:

- Implement a new plan for LA's water system to capture billions of gallons of water each year.
- Protect coastal waters and beaches from the trash and contaminants in stormwater that make people sick and threaten marine life.
- Modernize stormwater infrastructure using a combination of nature, science, and new technology.
- Protect public health, ensuring safer, greener, healthier, and more livable spaces for all.
- Prepare the LA region for the effects of a changing climate — including recurring cycles of drought, wildfire, and flooding.

As the City designs and implements Safe Clean Water Program projects, opportunities to pursue multi-benefit projects that integrate green, blue, and brown infrastructure elements can and should be prioritized.

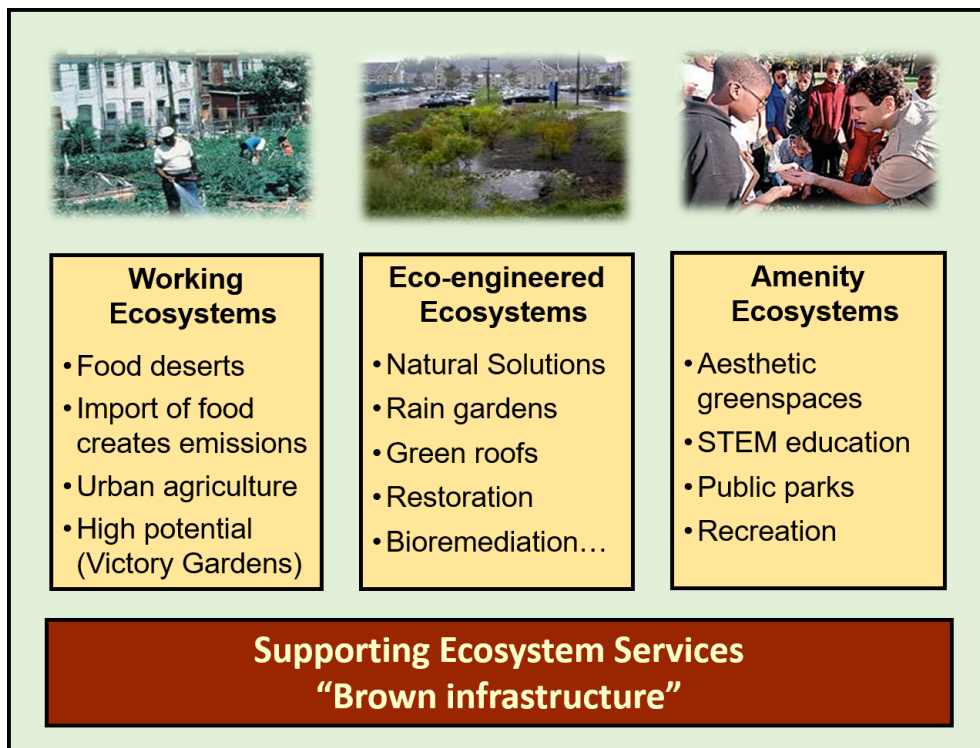


## SOIL CULTURAL SERVICES:

Healthy, productive soils provide a variety of cultural ecosystem services. Soils provide recreational benefits in parks and open spaces used for hiking, biking, sports, and social gatherings. Soils in Los Angeles also provide aesthetic benefits as they create beautiful, iconic landscapes. Via urban agriculture, healthy soils can increase access to healthy, local produce and increase food security. Healthy soils also provide public health benefits. Carbon-rich soils can help control pests and pathogens (Wall, 2004), and soil microbes can reduce allergies and have other benefits for human health (Six et al., 2017).

## SOIL SUPPORTING SERVICES:

Soils provide important supporting services that enable plants to grow and soil organisms to live, both of which are necessary to support provisioning, cultural, and regulating ecosystem services (e.g., providing space for recreation and providing habitat for soil microbes). Soils provide the medium to grow plants, including those that are used for food, fiber, and other goods (Parker, 2010). Soils play a role in the carbon and nitrogen cycles and are integral to processes like decomposing litter and recycling nutrients. Many of these processes are dependent on soil organisms and plants, and soils provide habitat and living spaces to support the diverse array of species involved. It is important to recognize how soils are fundamental in supporting industries (e.g., agriculture, logging, etc.) and providing the substrate for plants, animals, fungi, and other microbes to live.



*The Supporting Ecosystem Services of Soil (Graphic: Richard Pouyat)*

Strategies	Supporting Actions
Promote research and pilot projects that quantify ecosystem services associated with healthy soils.	<ul style="list-style-type: none"> <li>• Create adaptive management practices to monitor how decisions in soil systems influence ecosystem services and be prepared to modify actions based on monitoring results. Research the ability of various landscaping strategies and soil amendments to enhance carbon storage and other ecosystem services. Study plant-soil interactions in urban/suburban settings to understand how to best landscape Los Angeles with an ecosystem services perspective.</li> <li>• Encourage long-term monitoring initiatives that would provide data that demonstrate how various soil management practices support ecosystem services.</li> <li>• Create experimental landscaping plots to gather data on how to enhance ecosystem services in urban areas of LA.</li> <li>• Gather data on the impact of soil sources, such as dust, on air pollution in LA.</li> <li>• Research the role of healthy soils in meeting the City's greenhouse gas targets.</li> </ul>
Apply an ecosystems approach to soil management.	<ul style="list-style-type: none"> <li>• Elevate soil as brown infrastructure for urban planning, climate resilience, public health, and other critical issues.</li> <li>• Promote multi-benefit projects that integrate brown, blue, and green infrastructure elements.</li> <li>• Increase political support, such as policies and incentives, for healthy soil efforts.</li> <li>• Create adaptive management practices to monitor how decisions in soil systems influence ecosystem services and be prepared to modify actions based on monitoring results.</li> </ul>



# COMPOSTING

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Compost is decomposed organic matter. Composting naturally recycles organic waste (e.g., tree branches, vegetable trimmings, dead leaves, cardboard, and other green waste) and turns it into a nutrient-rich soil amendment.

Applying compost to soil can add nutrients, benefit soil microorganisms, increase organic matter, and enhance carbon sequestration. Composting also diverts organic waste from landfills, which reduces greenhouse gas emissions. Composting builds healthy soils, supports local food production, and enhances community well-being.

Compost application supports water conservation, soil carbon (C) sequestration, soil microbial health, urban agriculture, erosion control, and bioremediation. Additionally, composting provides air quality benefits. Applying compost or biosolids offers an alternative to synthetic and nitrogen-based fertilizers with less environmental impact. Synthetic and nitrogen-based fertilizers can lead to the release of GHGs (e.g., nitrous oxide) and form gaseous pollutants (e.g., ammonia), which can have adverse consequences for human health and the environment.

Alternatively, compost application is known to increase carbon and nitrogen sequestration (Hu et al., 2018) and can reduce GHG emissions when it is produced using organic waste that has been diverted from a landfill. By diverting the organic waste and applying derived compost to soil, methane emissions are reduced, tonnage going to landfill is reduced, nutrients are recycled, and both soil and air quality are improved (EPA, 2020b).

Making and applying compost locally within the community helps mitigate climate change and build soil health and food sovereignty locally, within communities, while reducing or eliminating emissions associated with transportation. Organic soil amendments can also replace synthetic fertilizers. Community education on soil health and composting techniques is essential to enhance and promote ecological land stewardship.

Composting occurs at a variety of scales within the City of Los Angeles to serve the needs of different sectors. Composting operations range from community composting, which serves private residents to large generator composting, mid-size urban composting, and large-scale municipal operations, which serve businesses and municipalities. This document will focus on municipal operations and community composting.

## **MUNICIPAL COLLECTION/COMPOSTING:**

LASAN is responsible for the collection of residential waste from 750,000 single-family households and small apartment complexes of 4-units or less. The current green-bin program collects approximately 1,600 tons per day of green waste, yard trimming waste, and incidental amounts of fruits and vegetables from residential gardens. The current green-bin program does not accept food waste as a majority of the City's operated and contracted facilities for green-bin processing are mulching operations and do not have the ability to process food waste.

LASAN has piloted two programs on the residential side for the management of food waste, the In-Sink Disposal pilot and the Curb Your Food Waste LA pilot programs. Expansion of these programs would allow for the increased diversion of food waste from landfills and would result in the increased production of renewable energy at the water reclamation plant in the form of renewable natural gas and increased compost production. These programs are still being evaluated based on the availability of processing capacity.

### **Managing Food Waste: The LASAN In-Sink Disposal Pilot Program**

The In-Sink Disposal pilot program was launched in 2017 and offered to 522 homes in the West LA neighborhood of Westchester. The pilot program was conducted to study the effects of utilizing household in-sink disposal units for managing food waste through the wastewater system. Residents were offered new, high-power in-sink disposal units and trained on what food materials could be processed. The program ran for two years, performing surveys of the participating residents, conducting waste characterization studies of pilot area black-bins, sampling and surveying of the wastewater conveyance system, laboratory testing, and simulation modeling.



*LASAN's Curb Your Food Waste LA pilot program distributed countertop pail for collecting food waste (Image: LASAN)*

### **Managing Food Waste: The LASAN Curb Your Food Waste LA Pilot Program**

The Curb Your Food Waste LA pilot program was launched in 2018 and offered to 18,000 residential homes throughout 25 neighborhoods across the City. This program focused first on educating residents on food waste prevention including smarter shopping, food storage, and understanding of date labeling. Pilot participants were provided with a 2-gallon kitchen countertop pail for collecting food waste throughout the week and instructed to place the material in their residential green-bin, commingled with their yard waste. The program has conducted education and outreach events, surveys of participants, and waste characterization of the black-bin and green-bin materials to measure the amount of food waste diverted.



# COMMUNITY COMPOSTING INFRASTRUCTURE:

Community composting involves public food scrap drop-off and the repurposing of that organic waste to enrich soils in the communities where the waste was collected. By diverting organic waste away from landfills, community composting reduces transportation associated with hauling while keeping the benefits of composting within the local community. This closed-loop approach has the added benefits of increasing local access to compost, raising public knowledge of composting and healthy soils, and empowering communities to “greenify” their local spaces. Enhancing community composting infrastructure is crucial as it will enable communities to minimize food waste and improve the quality of their soils.

## Composting and Urban Gardening Workshops

It is important to not only raise public awareness regarding the benefits of composting, but also provide resources and training. LASAN hosts free [Composting and Urban Gardening Workshops](#) (temporarily cancelled due to COVID-19) at locations across the City: Griffith Park, Lopez Canyon, South LA Wetlands, and, soon, in San Pedro. These workshops teach residents how to turn kitchen scraps and yard trimmings into nutrient-rich compost and provide tips for growing beautiful urban gardens. LASAN also has a [four-part composting series available on-demand on YouTube](#).

Community compost and garden sites can be integrated on school and park lands. Community composting fosters trust, connection, and resiliency that contributes to a sense of community well-being. Community-based research has documented the dual benefits of community composting on soil health and community well-being.





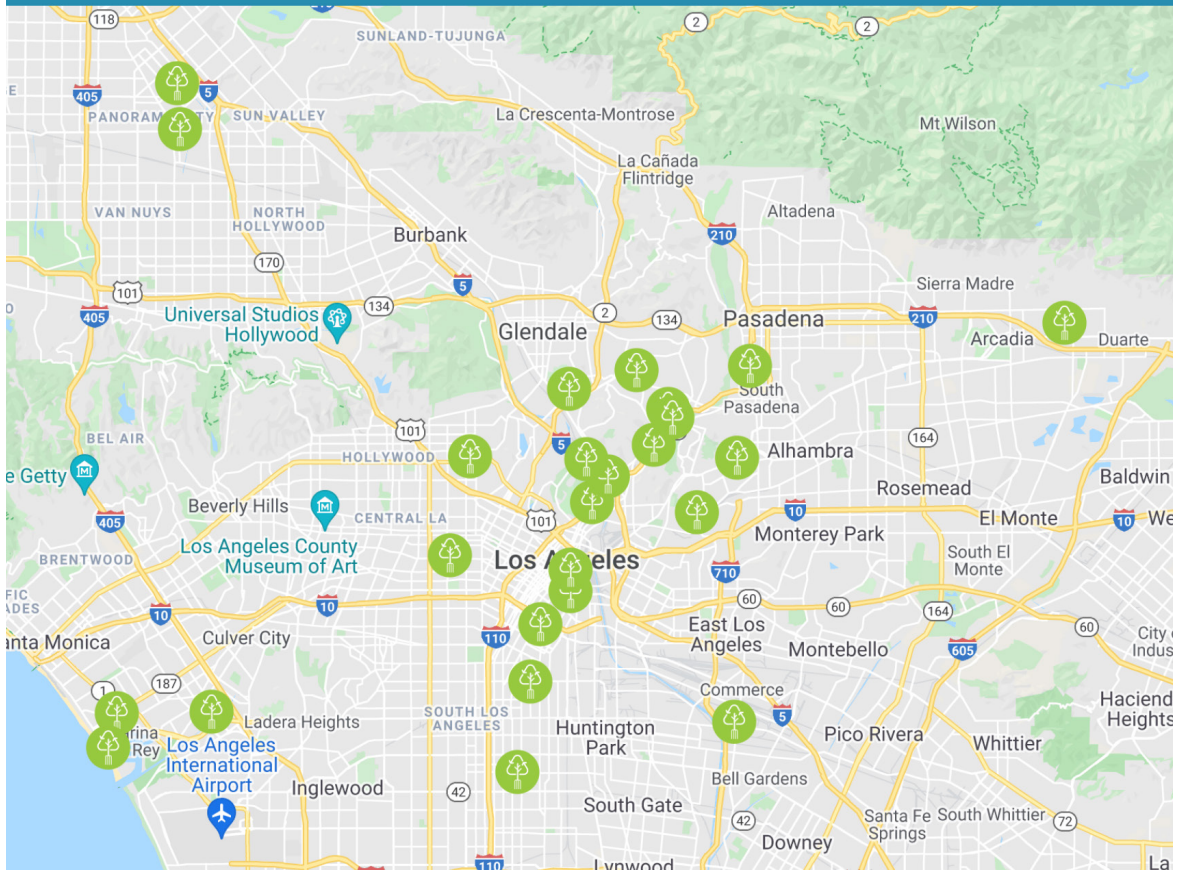
## Community Composting with LA Compost

Community compost drop-off sites in Los Angeles, such as those managed by the nonprofit, [LA Compost](#), increase organic waste diversion and can complement municipal composting activities.

LA Compost is a community-based nonprofit dedicated to creating spaces for local compost access, reducing food waste, and building healthier soils in the Los Angeles community. In addition to having multiple permanent compost hubs spread across the City, LA Compost also collects food scraps at local farmers markets. LA Compost currently has 34 locations across the greater LA region (see map for details).

In 2020 alone, LA Compost helped divert 739,050 pounds of organic waste away from landfills, instead repurposing it to improve soil health in our City!

## LA Compost's Hub Network



LA Compost's Hub Network (Graphic: LA Compost)

## REDUCE CONTAMINANTS:

To create high-quality compost, it is important to reduce or eliminate contaminants and ensure that all added components will promote healthy soils. While fruit and vegetable trimmings (“green items”), yard waste, including dried leaves, and newspaper (“brown items”) are all appropriate additions, invasive weed materials, plastics, and compostable containers should be avoided.



*What materials can be composted? This graphic shows green and brown items that can be composted and lists items that should be sent to landfill (Graphic: [LA Compost](#)).*

Bioplastics and compostable plastics can be particularly problematic. These products are single-use materials that are branded as being more environmentally-friendly than standard plastics. While compostable plastics are designed to biodegrade in a composting environment, in reality, these materials are often laced with contaminants or do not contribute positively to soil microbial ecology. Examining existing materials, assessing post-consumer demand, and making recommendations based on the most ecologically sound materials is a good starting point for improving bioplastics use. Other compostable materials can be explored and recommended for mass use, such as mycelium-based products, or pure plant fiber-based products with minimal processing.

### Composting Developments: the California Recycling Market Development Act

In 2019, Governor Newsom signed the California Recycling Market Development Act, [AB 1583](#), into law. Amongst other things, AB 1583 will help the State:

- Stimulate market demand for post-consumer material,
- Lead to policy recommendations to achieve waste reduction goals, and
- Support public messaging to encourage proper recycling and minimize contamination.

## **RAISING PUBLIC AWARENESS:**

Public education and messaging are a vital part of any program for managing food waste. Consistent messaging and information must be provided to residents to ensure that the proper materials are placed in the appropriate bins. This will help to minimize contamination that will ease the processing of materials and improve the production and quality of finished compost.

Major public education and outreach efforts are needed to overcome barriers and myths around composting (e.g., that they produce odors and attract pests), and to teach skills on waste sorting and source separation. Emphasizing compost quality and soil health helps people value the need for source separation, minimize contamination, and create cleaner streams of organic waste for composting.

## **COMPREHENSIVE COMPOSTING STRATEGY:**

In 2016, Governor Brown signed SB 1383, California's Short-Lived Climate Pollutant Reduction Strategy, into law. As organics make up half of what Californians send to landfills, SB 1383 sets targets for reducing organic waste in landfills. The bill requires a 50% reduction in statewide disposal of organic wastes by 2020 and a 75% reduction by 2025. Composting and beneficial reuse of organic materials are key to achieving these goals.

The City of Los Angeles has made important strides in diverting organic waste from landfill and promoting composting in recent years. Still, composting practices within the City could be improved and expanded. A comprehensive composting strategy for LA would increase the reach of LASAN's organics programs, support community-based organizations to expand community compost infrastructure, and build residential capacity for backyard and neighborhood composting, diverting a large volume of food waste.

## **GUIDELINES FOR APPLYING ORGANIC SOILS AMENDMENTS IN THE CITY OF LOS ANGELES:**

On July 27, 2021, the City of Los Angeles held a Soil Amendment Roundtable Discussion to craft guidelines on where, when, and how organic soil amendments, specifically compost and mulch, should be applied in the City of Los Angeles. The goal of the roundtable was to develop easy to use guidelines to share with various City Departments, especially Recreation & Parks, and community groups. The resulting document aims to provide clear guidance to City staff and residents on the proper use of soil amendments (i.e., where, when, and how to best utilize them).



*LASAN's Griffith Park composting facility (Image: LASAN)*



Strategies	Supporting Actions
Initiate community outreach to raise awareness about composting, soil health, and waste management and incentivize behavior change.	<ul style="list-style-type: none"> <li>● Support the creation of a tool that tracks food waste diversion and communicates impact to incentivize home composting/drop-off at community compost centers and/or farmers markets.</li> <li>● Incentivize composting: <ul style="list-style-type: none"> <li>○ Enable people/communities to receive compost in exchange for diverting their food scraps.</li> <li>○ Explore other incentives, like access to community garden plots.</li> <li>○ Develop a new market system around compost.</li> </ul> </li> </ul>
Expand community composting and beneficial reuse of organic waste.	<ul style="list-style-type: none"> <li>● Collaborate with community groups, such as LA Compost, Proyecto Jardín, and RootDownLA, to increase food scrap drop-off sites.</li> <li>● Expand the infrastructure that supports community composting by installing backyard compost systems and supporting neighborhood composting programs.</li> <li>● Assess vacant City lands and parks as potential sites for community compost and garden projects. Share the resulting list with community partners to encourage healthy soil activities on these parcels.</li> <li>● Encourage residents and professional gardeners that service private parcels to retain green waste on site. Yard trimmings, dead leaves, and other organic waste can be used as in-situ mulch or used to create hugels to grow food.</li> <li>● Consider expanding composting permitting.</li> </ul>
Expand municipal composting.	<ul style="list-style-type: none"> <li>● Expand LASAN organics pilots to serve a greater share of the City.</li> <li>● Work to ensure beneficial reuse of organic waste within the City.</li> <li>● Continue to create mid-scale compost sites on park land (e.g., the new LA Compost site at Griffith Park) in conjunction with residential/commercial hauling collections program.</li> <li>● Develop small and mid scale compost operations at parks, schools, community centers, and on public lands.</li> <li>● Promote the installation and use of on-site biodigesters for large waste generators, like restaurants and grocery stores.</li> <li>● Promote coordination at all scales of composting within the LA generation and product use markets.</li> </ul>

Strategies	Supporting Actions
Expand use of compost and mulch within the City.	<ul style="list-style-type: none"> <li>• Expand application of compost at parks, on medians, and at other City facilities by City departments in compliance with the <a href="#">Guidelines for Applying Organic Soils Amendments in the City of Los Angeles</a>.</li> <li>• Apply City-produced compost and/or mulch at City or community sites used for food production (i.e., agricultural sites, urban farms, community gardens, and orchards), recreation (i.e., gardens and landscaped urban parks), and land remediation (i.e., brownfields and contaminated sites).</li> <li>• Facilitate utilization of municipally-produced compost and mulch by expanding delivery services and forging connections with potential end-users.</li> </ul>
Utilize maps and data-sharing.	<ul style="list-style-type: none"> <li>• Create a public-facing, dynamic map that shows where residents can get compost and drop off food scraps and yard trimmings (e.g., ShareWaste App).</li> <li>• Identify underutilized parcels within the database of City-owned properties (LA Controller's <a href="#">Property Panel</a>) that could be used for composting/mulching operations and/or to create healthy soil. Ideally, these spaces can be mapped and prioritized (e.g., <a href="#">City of San Francisco's Unprotected Lands Data</a>).</li> </ul>
Conduct further research.	<ul style="list-style-type: none"> <li>• Assess the success of various compost collection methods.</li> <li>• Organize working groups to strategize the best plans and practices for composting at different scales and with various collection types.</li> <li>• Research what community members want and need in terms of waste management and soil health.</li> </ul>

# ADDRESSING CONTAMINATION/ POLLUTION

While urban soils can provide some of the same benefits as non-urban soils, the process of urbanization and the concentration of industrial activities in cities can result in both contemporary and legacy pollution of soil (Pouyat et al., 2020, Schwarz et al., 2016). Testing soil is the only way to determine if contaminants are present. Contaminants that are commonly found in urban areas include pesticides, petroleum products, radon, asbestos, lead, chromated copper arsenate, and creosote (Soil Science Society of America). However, bioplastics/compostable single-use containers and pharmaceuticals can also contaminate urban soils. While soil contamination can pose public health challenges within cities, soil amendments, soil exchange and composting programs, and community engagement in remediation practices present promising solutions.

Accumulation of pollutants in soils poses health risks to humans, plants, and animals. Because pollutants in soil have the potential to enter the food chain, it's incredibly important to understand not only which pollutants may increase soil toxicity, but also to understand the mechanisms by which they enter the food chain. Unfortunately, understanding the fate of pollutants in soils and identifying pollutant sources is very complex because there are many different soil types and compositions.



*A soil core is taken for testing (Image: LASAN)*



*Contaminants are removed from green waste (Image: LASAN)*

After pollutants are released into the atmosphere, their transport, dispersion, and transformation are governed by atmospheric processes, terrain characteristics, wet and dry deposition rates, and certain chemical properties of the pollutant itself. The U.S. Environmental Protection Agency has several models to formulate pollutant transport and fate. These models can help predict pollutant concentrations in multiple environmental media and biota, as well as biota and pollutant intakes that provide exposure estimates for human and ecological receptors.



## Addressing Soil Contaminants in LA: LASAN's Citywide Brownfields Program

[LASAN's Citywide Brownfields Program](#) provides technical assistance and resources to combat challenges associated with known or suspected contaminated properties (brownfields), typically abandoned or underutilized, and primarily in underserved areas of the City. The goal of the Citywide Brownfields Program is to assist in removing barriers to enable the reuse and redevelopment of brownfields and to transform brownfields into vibrant, new commercial, residential, or recreational opportunities. The program works directly with property owners, nonprofits, community organizations, and City departments to help them assess, clean up, and revitalize brownfields.

The Citywide Brownfields Program also maintains an inventory of vacant/underutilized sites throughout the City. This is done through visual inspections and/or notifications from partner organizations or community members. Vacant sites create financial strain for the City: decreased tax revenue, greater maintenance costs, increased safety and crime issues (which require more spending), and blight that lowers the value of nearby properties, negatively impacting the environment and health of local communities.

The inventory is updated annually and provides valuable information on sites that may later be redeveloped for local communities' beneficial use. The Program assists with the due diligence process through screening the sites and conducting environmental investigations to ensure the sites are safe for redevelopment.

*In collaboration with the Citywide Brownfields Program, the Office of Councilmember Monica Rodriguez, nonprofit partners, and community members, a former vacant lot was transformed into the [North Hills Community Space and Garden](#).*



Images: LASAN

## REDUCTION/ELIMINATION OF TOXIC CHEMICALS AT CITY PARKS AND FACILITIES:

Pesticides are commonly employed to manage pests in parks and open spaces. However, many commonly used pesticides and herbicides, including glyphosate (marketed as RoundUp), have been correlated with short- and long-term human health issues and can have negative impacts on soil ecosystems. The [Organic Parks initiative](#), which requires the Department of Recreation and Parks to establish organic landscaping pilot programs in three parks, the [City's glyphosate ban](#), and the push for integrated pest management called for in LA's Green New Deal, will help make communities and soils healthier.

[Bioremediation](#), using plants and microorganisms to break down toxic substances and compounds and clean up contaminated soils and groundwater, and phytoremediation, a specific type of bioremediation that uses plants, can be explored/piloted to clean up contaminated City parks and facilities. Applying organic soil amendments (e.g., compost and mulch) to urban parklands can also help reduce chemical and water use.



*The Department of Recreation and Parks manages facilities sustainably using recycled water and integrated pest management (Image: Recreation and Parks)*



Strategies	Supporting Actions
Reduce and eliminate current contaminant inputs.	<ul style="list-style-type: none"> <li>• Support the elimination of persistent toxic substances to soil, such as lead, pesticides, and glyphosate/ RoundUp.</li> <li>• Monitor emerging constituents of concern that are under review by the U.S. EPA, California Air Resources Board, and/or the State/Regional Water Quality Control Boards and take measures to limit their use/release into the environment.</li> </ul>
Increase soil testing, monitoring, and remediation resources to address legacy pollution.	<ul style="list-style-type: none"> <li>• Integrate efforts to test, map, monitor, and remediate contaminated soils across different scales and jurisdictions. (See <a href="#">Testing/metrics/reporting</a>)</li> <li>• Prioritize soil testing in vulnerable communities (e.g., close to potential sources of contamination), in residential areas, and in areas frequently visited by children.</li> <li>• Provide communities with educational resources to implement best management practices to preserve valuable soil resources.</li> <li>• Support access to clean compost, clean fill, and ground cover (e.g., vegetation, pavers, mulch, and stone) to support local remediation.</li> <li>• Support research that explores innovative ways to remediate soils, such as using special bacteria to bioremediate soils.</li> </ul>
Adopt an ecosystem approach to soil health.	<ul style="list-style-type: none"> <li>• Understand that soil health is connected to air quality, water quality, and overall environmental health.</li> <li>• Ensure policy interventions consider soil impacts across large spatial and temporal scales.</li> <li>• Use and promote sustainable urban landscape design principles.</li> </ul>
Keep environmental justice considerations at the forefront.	<ul style="list-style-type: none"> <li>• Ensure fair treatment and fair involvement of impacted communities regardless of race or income.</li> <li>• Partner with organizations working to ensure environmental justice while implementing soil remediation efforts, such as the <a href="#">California Environmental Justice Alliance</a>, <a href="#">Liberty Hill</a>, and the EPA's <a href="#">Los Angeles Area Environmental Enforcement Collaborative</a>. (See <a href="#">Testing/metrics/reporting</a>)</li> </ul>
Encourage collaboration among relevant agencies.	<ul style="list-style-type: none"> <li>• Promote regional coordination between agencies that impact/have influence over the air, soil, water, and presence of toxins in Los Angeles, such as the Army Corp of Engineers, the California Department of Transportation (Caltrans), and the California Department of Toxic Substances Control.</li> <li>• Partner with entities seeking to improve the health and safety of Angelenos, such as <a href="#">Physicians for Social Responsibility</a> and <a href="#">California Safe Schools</a>.</li> </ul>
Explore opportunities to repurpose soils.	<ul style="list-style-type: none"> <li>• Research opportunities to repurpose clean, native soil excavated at construction sites for use at other construction sites, public or private, taking inspiration from the NYC Clean Soil Bank.</li> </ul>

# AGRICULTURE

## BENEFITS OF URBAN AGRICULTURE

Urban agriculture involves the growing of consumable goods, such as fruits and vegetables, within the context of a developed city environment. Financially, urban agriculture can be expensive as urban land is typically more scarce and divided into smaller parcels when compared to rural land. Furthermore, the resources needed to grow food (e.g., water, labor, and land) cost more in urban areas than in rural areas. Fortunately, urban agriculture can bolster local economies and communities, supporting physical and mental health, food security, pride of place, community identity, and, in some cases, financial compensation. Additionally, urban agriculture offers several ecological benefits by providing urban habitats for animals and microbes, improving climate stability, reducing erosion, and addressing water conservation.



*Raised garden beds at a Los Angeles elementary school (Image: Michelle Barton)*

Many people in underserved communities lack access to healthy organic food and experience food insecurity, an issue exacerbated during the COVID-19 pandemic. The 2019 Sustainable City pLAn includes a goal to increase urban agriculture sites 25% by 2025 and 50% by 2035. It also includes goals to leverage public property for urban agriculture by increasing the number of edible gardens in City parks and at public libraries by 50% and to expand urban agriculture in the [City's Promise Zones](#). Another mechanism to enable urban agriculture is the [Urban Agriculture Incentive Zone \(UAIZ\) Ordinance](#), which allows landowners to enter into a contract allowing the use of vacant parcels for agricultural purposes in exchange for a property tax reduction. All of these initiatives and incentives expand access to space for urban agriculture and promote equitable access to fresh produce.

Orienting urban agriculture towards food security and environmental justice breaks down barriers of inequality due to intersectionality including racism and classism. Community engagement and outreach is essential to ensure that urban farms are designed and managed by or in partnership with the community and that they support community empowerment and education. Urban farms can serve as platforms for education and social gathering, enhancing community resilience and mutual aid during difficult times.



# REGENERATIVE AGRICULTURE

Regenerative agriculture involves agricultural practices that remove carbon from the atmosphere and put it back in the soil. Regenerative agriculture practices include rotating crops, planting cover crops, applying compost, avoiding application of chemical fertilizers, and minimizing/eliminating soil tilling to build up soil fertility, soil carbon, and organic matter over time, rather than depleting it. These practices lead to healthier, more fertile soils that can hold more water and prevent excessive nutrient runoff, which can damage sensitive ecosystems. Regenerative practices can also build resilience and mitigate climate change.

## INTEGRATING COMMUNITY COMPOSTING AND URBAN AGRICULTURE

Urban agriculture sites can also serve as a support system for community composting. Many urban farms in Los Angeles currently provide space for LA Compost community compost hubs. Urban farms and gardens produce both “green waste” (fruits, vegetables) and “brown waste” (leaves, stems, woody materials) that are required for a healthy compost system. Urban farms and community gardens often have owners or managers who can educate the community about composting methods. The finished compost is conveniently used to enrich the soil of the farm or garden on-site, with no need for vehicular transportation unless distributed to other community members. Expanding composting programs, particularly small-scale community composting programs with good quality control and accountability, will increase the supply of natural fertilizer for urban farmers and gardeners.

## BIOSOLIDS APPLICATION

Studies have demonstrated the beneficial reuse of biosolids on agricultural land to improve soil fertility and boost plant production. Biosolids can increase crop yields and soil organic stocks. Soil carbon increases are observed in deep soil layers, where it is likely to be stored for longer periods of time. This indicates carbon sequestration potential when applying biosolids. However, the studies do suggest that while applying biosolids has many benefits, it may be more beneficial if the material is composted (Ryals & Villa, 2019).



*Applying compost (Image: LASAN)*



*Many urban farms in LA provide space for compost hubs (Image: LA Compost)*



*Biosolids being covered by mulch (Image: LASAN)*

## LOCAL MARKET ACCESS

Urban agriculture promotes local and nutritious food production and increases access to healthful foods. In many instances, urban agriculture and fruit trees can produce excess fruits and vegetables that can be shared with the community via crop swap programs, such as [Crop Swap LA](#), preventing these nutritious foods from going to waste and ensuring local access to healthy foods. Mid-size and large-scale operations can even be turned into small community enterprises that sell seedlings, fruits, and/or vegetables at micro-markets (e.g., neighborhood farmer's markets). Connections can also be made with food gleaner organizations, like [Food Forward](#).

## TECHNICAL & FINANCIAL RESOURCES

Landowners interested in healthy soils and urban agriculture can receive technical assistance and participate in financial cost-share programs via the United States Department of Agriculture- Natural Resources Conservation Service (NRCS) office located in the Lancaster area of Los Angeles County. The NRCS visits local landowners, farmers, tenants and government agencies and offers advice on how to solve resource concerns for production agriculture and other natural resource problems. Additionally, NRCS offers soils information/data via the [Web Soil Survey](#). Every acre of Los Angeles has been visited or correlated and visual soil samples taken that allow interpretation of how the soil will react under different types of treatments. The NRCS can provide interpretations about crop production, available water holding capacity, typical organic matter, and more. Information, technical assistance, and field visits are all free. Contact the local office at 661-945-2604 ext 3 if services are needed.

Funding is available from the Natural Resources Conservation Service and the Farm Service Agency. The NRCS administers the [Environmental Quality Incentives Program](#) (EQIP) that shares the costs of installing high tunnels with shade cloths, irrigation needs, and other conservation practices that are used in the urban setting. To qualify, applicants must be actively growing crops, vegetables, or other agriculture products. Numerous conservation practices have been installed in the Los Angeles Area through this program including high tunnels (i.e., greenhouses with shade coverings), water pumps, irrigation systems, mulching operations, tree breaks, cover crops, native weed control, and crop rotation. The Farm Service Agency also provides support for urban agriculture via [farm ownership and operating loans](#). There is not an acreage limit to qualify as a farm, so small land units can participate. A garden can be considered a farm if it meets all the requirements. For more information, contact the NRCS at the number listed above.



Strategies	Supporting Actions
Support regenerative agriculture efforts in Los Angeles.	<ul style="list-style-type: none"> <li>• Educate urban farmers about soil health and regenerative practices.</li> <li>• Expand urban agriculture by encouraging applications to LA County's <a href="#">Urban Agriculture Incentive Zone Program</a>.</li> <li>• Expand procurement from local farms.</li> <li>• Identify an urban agriculture coordinator within the City who can involve other departments in regenerative urban agriculture efforts.</li> <li>• Decrease regulatory barriers to promote market access for on-site produce sales.</li> <li>• Incentivize and encourage urban farmers to sell produce at Farmers' Markets in Los Angeles.</li> </ul>
Simplify access to water at urban farms.	<ul style="list-style-type: none"> <li>• Collaborate with the Los Angeles Department of Water and Power (LADWP), the Metropolitan Water District, and California Department of Water Resources to update the <a href="#">Model Water Efficient Landscape Ordinance</a> program to promote water efficient landscapes and mechanisms to support urban farming. Explore the possibility of implementing an agricultural water rate for food-growing sites (e.g., the City of Riverside).</li> <li>• Explore the possibility of installing water systems at vacant sites to strengthen the Urban Agriculture Incentive Zone (<a href="#">UAIZ</a>) program.</li> <li>• Educate urban farmers on water-wise irrigation and sustainable practices including rainwater capture, reuse, gray water, aquaponics, efficient irrigation, and biofiltration.</li> </ul>
Support demonstration projects that integrate community composting, urban farming, food security, environmental justice, and community engagement.	<ul style="list-style-type: none"> <li>• Work with community groups to establish urban farming and composting demonstration projects on underutilized City lands.</li> <li>• Share grant and incentive information with local groups interested in pursuing multi-benefit demonstration projects.</li> <li>• Partner with researchers to assess and analyze the impact of multi-benefit projects.</li> </ul>
Encourage and/or incentivize local food sourcing.	<ul style="list-style-type: none"> <li>• Expand programs like the <a href="#">Good Food Purchasing Program</a> to incentivize sourcing from local, regenerative farms to help farmers establish new market relationships and encourage new urban farms.</li> <li>• Facilitate a Victory Garden-style campaign to establish urban gardens at public parks and encourage gardens at private residences to increase local food production.</li> </ul>

# BIODIVERSITY

## ***BIODIVERSITY:***

**the plants, animals, and ecosystems that sustain and enrich LA**

Scientists use the following metrics to compare biodiversity among areas or over time:

### ***Species Richness:***

**the total number of different species in an area**

### ***Species Evenness:***

**the relative distribution of individuals among a species**

Species diversity is high when the number of species (richness) and the relative abundance of individuals of those species (evenness) are both high.

While both of these metrics allow users to quickly compare two areas or examine how biodiversity has changed following a management or restoration action, they do not provide information on which species are present.




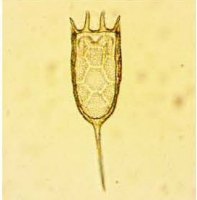


*Great horned owl owlets (Image: Nurit Katz)*



Understanding which species are present, their origins, and distributions will paint a more complete picture and enable better management and protection of biodiversity. In particular, conservation practitioners are often interested in where species of conservation concern reside. Local conservation biologists are focused on protecting native species, especially those that are endemic to that specific region. Conservation practitioners are not typically concerned with the viability of non-native species, and, in the case of invasive species, tend to focus on their removal as they often expatriate native species and modify key ecosystem processes and services.

## BIODIVERSITY AND SOIL

Biodiversity and healthy soils are interconnected. Soil contains an abundance of life, and soil health is dependent in large part on the organisms that it contains, also called soil biodiversity (Laban et. al., 2018). Soil biota are varied and numerous, and constitute a significant percentage of the biodiversity on planet Earth. In fact, it is estimated that soils contain roughly 25% of the planet's biodiversity. Healthy soils support vertebrates (e.g., mammals, birds, reptiles, and amphibians), numerous invertebrates (e.g., earthworms, nematodes, gastropods, and arthropods), and a diverse microbiota. Soil biota are categorized by their body width:

Microbiota	Microfauna	Mesofauna	Macrofauna
 (Image: Grundling, 2021)	 (Image: Kneidel, 2021)	 (Image: Geurts, 2021b)	 (Image: Geurts, 2021a)
Single-celled organisms	Animals < 100µm in width	Animals between 100µm and 2 mm in width	Animals > 2 mm in width
Includes bacteria, fungi, and protists	Includes animals like nematodes (roundworms) and rotifers	Includes mites, springtails and other small arthropods	Includes oligochaetes (earthworms), gastropods (snails and slugs), and arthropods (insects, myriapods, isopods, spiders, etc.)

These soil organisms help perform vital functions such as detoxifying soils, decomposing organic matter, cycling nutrients, soil aeration, and maintaining soil structure (FAO, 2015b). Further, healthy soils are key to the way whole ecosystems function (Laban et. al., 2018). Soil organisms are a critical component of the broader food web, providing food for birds and other animals. Greater soil biodiversity also enhances nutrient uptake and plant resilience to global climate change and biotic stressors (Blum et. al., 2019).

Healthy soils are also beneficial to soil biodiversity. Soil biodiversity can be affected by soil structure and chemical properties such as pH, bulk density, organic matter content/carbon inputs, and texture (Griffiths & Philipot, 2013). Organisms in an ecosystem gain immunity to local pathogens and allergens, and experience greater health from interactions with soil microbiota, incorporating the beneficial genes or bacteria into their own genetic materials and gut microbiomes (Blum et. al., 2019). Loss of biodiversity is a major threat to healthy soils stability and, ultimately, to public health and the environment.

In cities, there are diverse soil conditions that create a patchwork of habitats for soil organisms. While some urban soil conditions are suboptimal for biodiversity, it should be noted that diverse soil microbial communities can, and often do, exist in urban settings. Joimel et al. (2017) assessed the topsoil of five different land uses and found that arable land and vineyards, not urban areas, demonstrated the lowest biodiversity. Protecting and managing soil biodiversity is essential to maintaining long-term soil health in the urban environment.

**CONSERVATION SIGNIFICANCE:**

**Los Angeles is Located in a Biodiversity Hotspot**

Biodiversity hotspots are small areas of the world designated because of their importance for the conservation of unique plant and animal biodiversity. Biodiversity hotspots by definition have lost at least 70% of their original native vegetation (by area), and harbor at least 1,500 endemic (regionally unique, found nowhere on earth) plant species (Conservation International).

Los Angeles is located within the California Floristic Province, one of 36 global biodiversity hotspots. For context, the California Floristic Province has 2,125 endemic plant species. Estimates suggest that half of these species are currently threatened, and that the combination of climate change and increased development may lead to as many as two thirds of California’s endemic species (plant and animal) being lost by 2100, highlighting the urgent need for informed conservation strategies to address these challenges.





*Mule deer (top) and California quail (bottom) (Images: Nurit Katz)*





*Examples of California sage scrub habitat in the Santa Monica Mountains (Images: Michelle Barton)*

Low elevation areas, like the City of Los Angeles, were once dominated by the California sage scrub ecosystem. However, the mild Mediterranean climate has attracted human residents, and the resulting development and habitat modification make southern California ecosystems some of the most threatened in the world (Underwood et al., 2009; Riordan and Rundel, 2014). The sage scrub ecosystem is now listed as endangered (85-98% lost) by the U.S. Geological Survey, and as critically endangered by the World Wildlife Fund. Unfortunately, much of the remaining California sage scrub is damaged, requiring restoration efforts (Burger et al., 2003), and found in small isolated patches, elevating local extinction rates (Soule et al., 1988).

The sage scrub ecosystem and the California Floristic Province harbor exceptional plant and animal diversity and are habitat for a number of animal species of conservation concern. Although sage scrub vegetation contains some 50 widespread shrub species, more than half of its approximately 550 understory herbs are listed as species of conservation concern. Modification of natural areas to urban landscapes does not just impact plant diversity, it also significantly impacts animal diversity as natural areas support many native species not found in urban areas (Soule et al., 1988). While urban areas can support a subset of native species, urban areas, particularly those with water subsidies (e.g., irrigation), facilitate the establishment and spread of non-native species (Staubus et al., 2019). As many animal species are endemic to low-elevation areas of Southern California (Spear et al., 2017), providing sufficient habitat for their survival is an imperative to preserving native biodiversity within our region and City.



## Improving Biodiversity & Soil Health in Los Angeles: Test Plot

[Test Plot](#) is a community-based ecological restoration experiment in Los Angeles. Community members, gardeners, ecologists, soil scientists, teachers, and students combine efforts to improve underfunded and neglected public parks and landscapes. In working to restore public parkland ecology, Test Plot fights invasive species, supports and expands the native seed stock, and monitors soil health to enhance it over time. Test Plots also provide an opportunity to test soil management practices, such as amendment types and planting strategies, to find effective ways of improving soil health.

Test Plot currently has two locations in Los Angeles: Elysian Park and Rio de Los Angeles State Park, but the Test Plot team is working to encourage the development of Test Plot sites across the City. The team is also exploring the possibility of a grant program that would provide resources to practitioners interested in establishing new Test Plots.



The Test Plot site in Elysian Park (Image: Jenny Jones)



## MANAGING NATIVE SOILS

While there are many benefits to applying organic soil amendments in the built environment, improper application of compost and mulch can have adverse impacts on intact native soils and native biodiversity, including native microbiota. Soil amendments are not recommended in areas where the primary goal is to support native plants and ecosystems (i.e., sage scrub, chaparral, urban areas where you wish to establish native plants). Naturally occurring soils are not necessarily high in organic matter or nutrients, and many native plants thrive in soils that are naturally low in organic matter and nutrients. Amending native soils that are naturally low in carbon and nutrients could artificially increase the organic matter present at the site, which could favor non-native species of plants that thrive with high-nutrient conditions. It could also change the biodiversity of the soil fauna, which could cause a trophic cascade and impact native biodiversity. More research is needed to understand the impacts of compost and mulch on native plants and to California ecosystems. Until there is scientific consensus, the precautionary principle should be used (see [Guidelines For Applying Organic Soil Amendments](#)).



Strategies	Supporting Actions
Protect and conserve native ecosystems.	<ul style="list-style-type: none"> <li>● Avoid disturbing existing native ecosystems and intact native soils to protect biodiversity and soil health.</li> </ul>
Promote the use of native groundcovers to promote healthy soils and prevent erosion.	<ul style="list-style-type: none"> <li>● Encourage projects to use diverse, native planting palettes to support native biodiversity, like pollinators. Native plants such as lupines, members of the pea family (e.g., deerweed), and coyote brush can rebuild soil quality.</li> <li>● Encourage the use of locally collected native seeds in restoration projects to increase diversity in the soil and minimize the introduction of invasive weeds.</li> <li>● Utilize the following resources to determine appropriate native groundcover plants and trees: <ul style="list-style-type: none"> <li>○ Calscape <a href="#">Native Planting Guide</a> and <a href="#">Advanced Search Tool</a></li> <li>○ CalFlora <a href="#">Planting Guide</a></li> <li>○ UC Berkeley <a href="#">Jepson eFlora</a></li> <li>○ Cal Poly <a href="#">SelectTree Tool</a></li> </ul> </li> <li>● Promote and distribute the LASAN and the Department of City Planning's plant selection tool (still in development) to help the public to select appropriate plants for their location.</li> </ul>
Eradicate and control the spread of non-native plant species.	<ul style="list-style-type: none"> <li>● Restore and re-landscape areas invaded with invasive species and consider beneficial reuses of the removed invasive plant materials (e.g., food for zoo animals).</li> <li>● Eradicate the "<a href="#">Dirty Dozen</a>" identified by Recreation &amp; Parks from City lands, and manage those identified by Cal-IPC for Los Angeles County.</li> <li>● Encourage residents and businesses to eradicate common invasive species.</li> <li>● Document distributions of invasive species on a landscape level by posting observations on the CalFlora webpage.</li> <li>● Promote soil preparation practices, such as solarization, before planting to prevent weed issues.</li> </ul>
Promote integrated pest management.	<ul style="list-style-type: none"> <li>● Stop/minimize the use of pesticides and herbicides at City facilities that degrade soil and water resources and harm soil biodiversity.</li> <li>● Use organic pesticides or traps, or other structural solutions, to deal with pests and/or rodents.</li> <li>● Plant for <a href="#">beneficial insects</a>, like native ladybugs, that can control and prevent insects and fungal infections.</li> </ul>
Increase infiltration of runoff into City soils where water can be stored in plants and soils.	<ul style="list-style-type: none"> <li>● Encourage and incentivize project managers and residents to include permeable surfaces (e.g., permeable pavement) in landscape designs to allow on-site infiltration into local soils. Avoid nonpermeable materials (e.g., concrete, asphalt) and remove when feasible.</li> <li>● Employ Low Impact Development (<a href="#">LID</a>) strategies.</li> <li>● Promote and employ plans that promote healthy soils, infiltration, and biodiversity (e.g., Greenways to Rivers Arterial Stormwater System (GRASS) II).</li> </ul>

Strategies	Supporting Actions
Restore degraded soils in built, urban areas.	<ul style="list-style-type: none"> <li>● Unseal and restore soils to increase habitat, cover, and sources of food for wildlife.</li> <li>● Employ practices that promote microbial health and diversity.</li> </ul>
Promote multi-benefit projects.	<ul style="list-style-type: none"> <li>● Better integrate urban forestry, biodiversity, healthy soils, and watershed management activities across City departments to maximize project benefits.</li> <li>● Promote projects that effectively integrate green, blue, and brown infrastructure.</li> <li>● Promote projects that engage the community, particularly youth, in soil and biodiversity remediation efforts.</li> </ul>
Promote academic research on soil biodiversity.	<ul style="list-style-type: none"> <li>● Research which soil types and soil landscaping techniques best support native animal species and which facilitate the spread of invasives.</li> <li>● Identify how various plant species (native and non-native) influence soil microbial assemblages and how such modifications influence soil ecological functioning.</li> <li>● Identify which native plants sequester the most carbon, best enhance water collection and storage, and provide the most habitat for native species.</li> </ul>



# TESTING, METRICS, & REPORTING

Consistent, sustained, transparent, and spatially intensive soil testing is needed to support healthy soils capable of supporting life and providing desired ecosystem services. Through a combination of on-the-ground testing and remotely sensed data, urban soils surveys provide more detailed data on the physical, chemical, and mineralogical properties of urban soils (Pouyat et al., 2020).

## URBAN SOIL TESTING

When considering whether or not to test soil, and which contaminants to test for, it is important to understand the context and past uses of the site. Sites should be mapped in order to identify areas with distinct characteristics, as each of these areas should be sampled and tested separately. Once a sampling protocol has been developed, soil samples should be taken and sent to testing labs. Testing labs will provide comprehensive, reliable results and can also recommend specific tests based on site history and planned site use. The cost of soil testing will depend on the size of the garden, the number of samples, and the types of soil analyses to be performed (Surls et. al., 2016; LA County Public Health).



*Soil samples collected for testing at an LASAN Brownfield site  
(Image: Brownfields)*

## URBAN SOIL HEALTH METRICS

Various chemical (e.g., soil pH, electrical conductivity), physical (e.g., [aggregate stability](#), available water capacity, bulk density), and biological (e.g., organic matter, soil respiration, soil enzymes, earthworms) soil health metrics can be tested for. The NRCS has [soil quality indicator sheets](#), designed to assist with soil health assessments, that provide background information on individual soil properties and detail how testing is performed.

In urban environments, testing for pollutants and hazardous materials (e.g., lead), is an important aspect of soil testing that can inform decisions/site use. Soils known to contain high levels of contaminants may need rehabilitation or restoration, and impaired soils should continue to be monitored, especially if sites are going to be used to produce food for human consumption.

## COMMUNITY RESOURCES:

In order to promote more widespread soil testing, raise awareness of potential soil contaminants, and empower communities to make informed decisions about land use, soil testing information should be made public and easily accessible. In addition, information about resources/financial assistance to perform soils testing should be shared widely.

Understanding the spatial distribution of soil properties and level of contaminants on site can help individuals and community groups make decisions about land use. Additionally, understanding what drives the spatial distribution of soil lead can inform the transition of underutilized urban space into gardens and other desirable land uses while protecting human health.

## SOIL LEAD CONTAMINATION MANAGEMENT:

A proposed framework for management considers three factors:

1. The level of contamination;
2. The desired land use; and
3. The community's preference in implementing the desired land use.

The goal of the framework is to promote dialogue and resultant policy changes that support consistent and clear regulatory guidelines for soil lead, without which urban communities will continue to be subject to the potential for lead exposure.

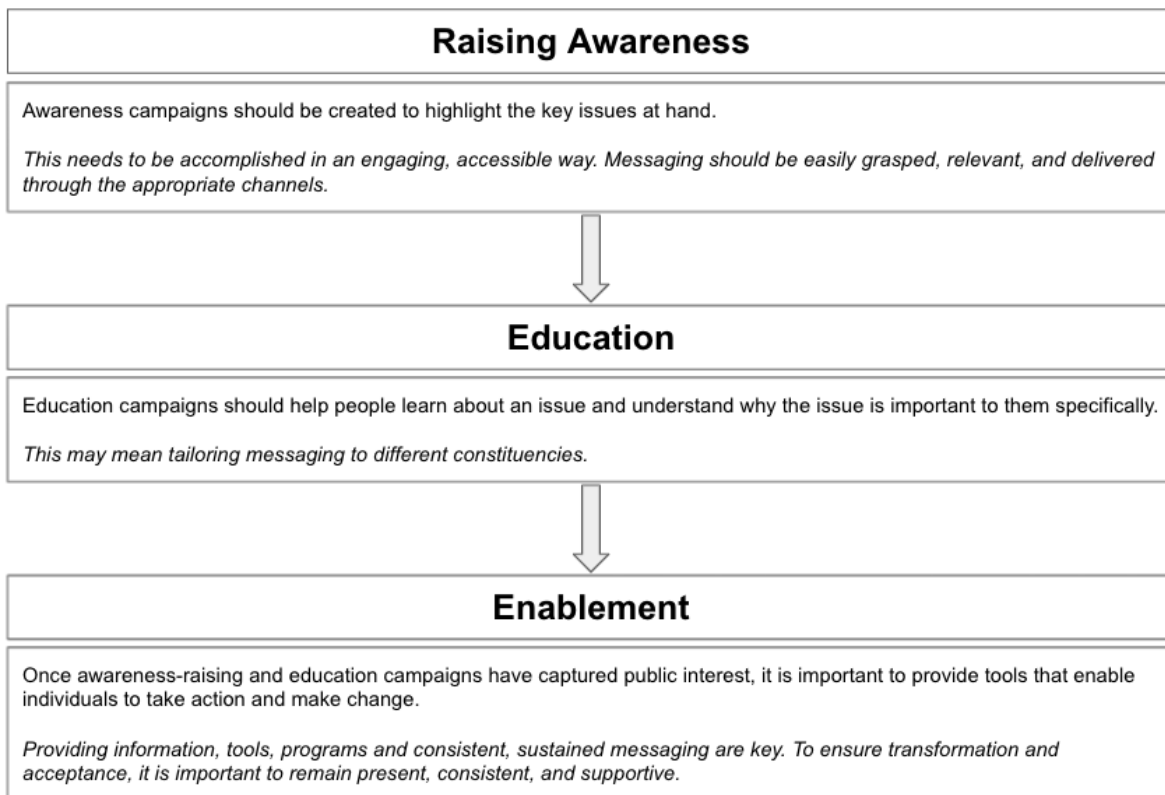


Strategies	Supporting Actions
Improve soil testing accessibility.	<ul style="list-style-type: none"> <li>• Provide educational, and perhaps financial, resources that allow for increased frequency of soil testing and reporting, such as providing training, establishing public-private partnerships or creating soil test kit lending libraries.</li> <li>• Provide contact information, training, and resources to communities to encourage soil testing and help community members interpret soil testing results.</li> </ul>
Promote data sharing.	<ul style="list-style-type: none"> <li>• Create an online portal to collect and share real-time soil health metrics with communities.</li> <li>• Translate collected data into digestible, accessible, visualized statistics for public consumption and accountability.</li> </ul>
Engage the community in soil testing efforts.	<ul style="list-style-type: none"> <li>• Collaborate with nonprofit organizations and community groups to engage communities in soil testing and foster public understanding of local soils.</li> <li>• Establish a community hub/community science initiative for assessing compost quality and soil health. A community soil testing program can be developed in partnership with the NRCS, the U.S. Forest Service, relevant City Departments, and local universities.</li> <li>• Develop and distribute a list of preferred partners to aid with soil quality testing, reporting, and data sharing.</li> </ul>

# COMMUNITY EDUCATION & OUTREACH

Engaging the community and associated stakeholders in regards to healthy soils will be key to achieving healthy soils goals. Without the full support of the communities that are impacted, a City healthy soils initiative is far less likely to succeed.

A sustained healthy soils engagement/education effort that raises awareness and changes behavior patterns is necessary. Several key actions can be taken to gain community and stakeholder support and encourage behavior and mindset change. In general, the most effective outreach strategies include three phases:





## STRATEGIES:

In order to reach the largest number of people, flexible, varied, and multi-modal healthy soils outreach strategies are needed. Outreach should be done in multiple languages and formats (e.g., digital, social media, print, etc.) to ensure that it is accessible to the public at large, including environmental justice communities. Materials can further be tailored to residents, soil professionals, policy makers, and teachers/educators.

There are many avenues for outreach/engagement/education. A few possibilities include:

- Local businesses
- Local schools
- Apartment buildings/homeowner associations (i.e., buildings could nominate ambassadors)
- Community hubs/gathering places (e.g., farmers' markets, community garden centers, museums, events, etc.)
- Neighborhood Councils
- Special City-sponsored events (e.g., LASAN's Earth Day and Arbor Day celebrations)



*Community members plant a tree in a local park to celebrate Arbor Day (Image: City Plants)*

Community engagement can be promoted through canvassing or workshops/symposia. Workshops could be done in partnership with any of the above groups or with other partners/programs (e.g., the Neighborhood Council Sustainability Alliance (NCSA), Cool Blocks Program). Where possible, participation should be linked to incentives and emphasize the economic and public health benefits of healthy soils. Events could include seed and plant give-aways, revolve around field trips that demonstrate successful projects or practices, or share toolkits with the community. A list of resources and tools is included at the end of the document that compiles great information for both practitioners and the general public (e.g., TreePeople's [LA Urban Soil Toolkit](#)).

Schools provide one of the greatest opportunities to provide education on healthy soils. Healthy soils, biodiversity, and environmental science should be formally integrated into STEM (Science, Technology, Engineering, and Mathematics) curriculum in California. Existing soil-related curricula can be implemented in Los Angeles schools or used as guidance for soil health curriculum. For instance, the U.S. Fish and Wildlife Service's [Schoolyard Habitat Program](#) provides an opportunity for students to develop and maintain ecologically beneficial habitats at their school while integrating environmental stewardship principles into the curricula. Schools can also provide similar hands-on learning/training by incorporating composting programs on campuses as part of California's Next Generation Science Standards. Students should also learn to creatively approach environmental issues and be rewarded for proposing compelling environmental solutions (e.g., [Bedford's Greenlight Award](#)).

### **Current Community Education Efforts: LASAN**

LASAN is working hard to amplify community education campaigns on the benefits of healthy soils, biodiversity, and regenerative agriculture. Several of their efforts are highlighted below.

LASAN has created a [Healthy Soils webpage](#) that is intended to serve as a hub to distribute information to the community on healthy soil practices and has basic information about LASAN's program. LASAN has also created a [Biodiversity webpage](#) containing information on the City's efforts to protect and promote biodiversity in the City, including soil biodiversity.

The LASAN Healthy Soils Team, in collaboration with the Healthy Soils Advisory Panel, developed a [comprehensive database](#) of 30+ incentive and grant programs intended to fund healthy soils work.

A [flyer](#) has been developed that lists simple actions City residents can take to protect biodiversity and promote healthy soils.

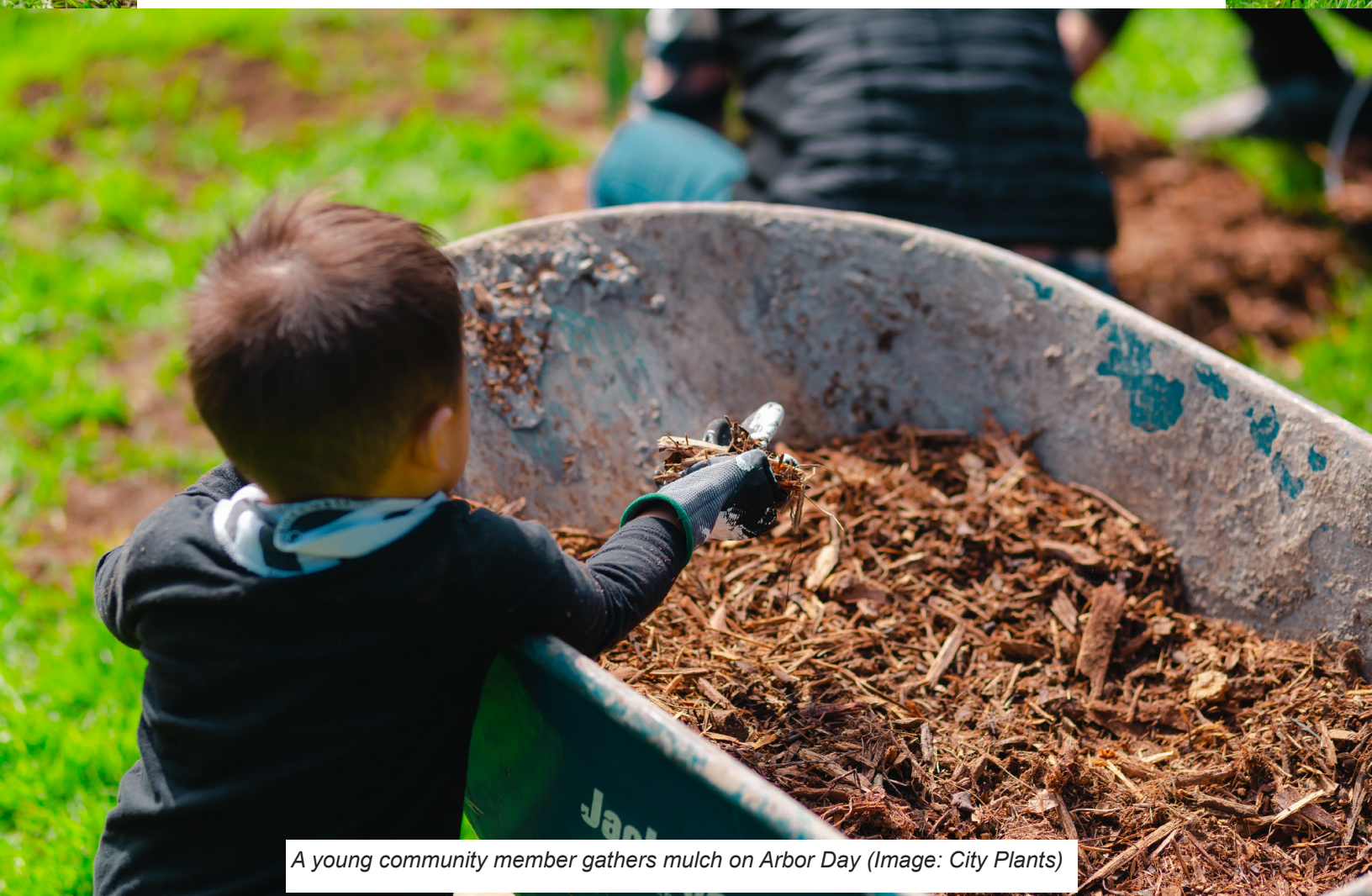
Multiple public presentations to a wide variety of audiences (e.g., the Ecological Society of America, the Association of Professional Landscape Designers, a Cal Poly Pomona Environmental Engineering Class, etc.) have been given to share knowledge with landscapers, students, scientists, and the general public about biodiversity and healthy soils.

[A three minute video about LASAN's Healthy Soils program](#) (and actions residents can take to promote healthy soils) was also created for LASAN's virtual 2021 Earth Day event and is uploaded on LASAN's YouTube channel.





*Community members mulch a newly planted tree in a local park to celebrate Arbor Day (Image: City Plants)*



*A young community member gathers mulch on Arbor Day (Image: City Plants)*



Strategies	Supporting Actions
Engage and educate the public.	<ul style="list-style-type: none"> <li>• Launch a public awareness campaign that makes soil education fun and accessible, teaches people about common actions to prevent or eliminate common soil issues (e.g., soil contamination, soil compaction, soil sealing), and educates society to place a greater value on green and brown infrastructure.</li> <li>• Disseminate soil <a href="#">Resources and Toolkits</a> widely.</li> <li>• Establish a healthy soil web page to educate and engage the LA community.</li> <li>• Partner with the new <a href="#">Climate Emergency Mobilization Office</a> to engage with the public.</li> <li>• Facilitate community-driven collaborations on soil.</li> </ul>
Facilitate community-driven collaborations.	<ul style="list-style-type: none"> <li>• Host events or design programming related to soil health and soil biodiversity, such as a celebration to promote healthy soils in the City of LA.</li> </ul>
Promote individual actions that protect and enhance soil health and soil biodiversity.	<ul style="list-style-type: none"> <li>• Encourage observations of soil biodiversity and other organisms on the iNaturalist app.</li> <li>• Involve the public in monitoring and mapping soil health indicators.</li> <li>• Encourage City residents and property managers to certify their landscapes as <a href="#">Certified Wildlife Habitat</a> with the National Wildlife Federation or as <a href="#">Ocean Friendly Gardens</a> with the Surfrider Foundation.</li> <li>• Encourage the public to dispose of chemicals and pollutants responsibly at <a href="#">LASAN S.A.F.E. Centers</a>.</li> </ul>
Incorporate soils in school curriculum	<ul style="list-style-type: none"> <li>• Work with LAUSD and nonprofit groups to integrate study of soil health and soil biodiversity in K-12 education as part of California's Next Generation Science Standards. Create inquiry-based curriculum and run teacher training sessions to empower the teachers to utilize the curriculum. <a href="#">TreePeople has online soil lessons</a> that can be shared with educators.</li> </ul>



# ECONOMIC BENEFITS, JOB CREATION, & TRAINING

Participants in the June 2020 [Virtual Los Angeles Urban Soil Symposium](#), hosted by TreePeople, noted that in order to promote healthy soils in the City of Los Angeles, it is vital to engage communities, bridge the gap between scientists and communities, and build political support. Clearly communicating the economic benefits that healthy soils can bring to the City of Los Angeles and its constituents will help on all three fronts. The economic benefits of healthy soils come in many forms (e.g., valuation of ecosystem services, jobs, training, etc.), some of which are more tangible to the general public than others.

## JOB CREATION & JOB TRAINING:

The most visible economic benefit associated with healthy soils is job creation. The City's Department of Economic & Workforce Development can promote workforce training and help provide access to good jobs in the regional economy. Prioritizing regenerative agriculture, composting, and healthy soil practices will expand the green economy and create job opportunities via local-nonprofits, such as the [LA Conservation Corps](#) and [HomeBoy Industries](#). Job training, such as that offered by LA Trade Tech, can be expanded to meet growing demand for green jobs related to soil. As the global economy and local economy recover from the COVID-19 pandemic, job training in this field will provide promising skills and careers to Angelenos and opportunities to rebuild a regional green economy.



*A variety of opportunities exist to create jobs associated with healthy soils (Image: City Plants)*

Providing training for the City's landscaping workers across relevant departments, particularly Recreation & Parks, on how to care for native plants and use integrated landscape management techniques will be crucial to soil health at City facilities across Los Angeles. The RegenerateLA Pilot Project has developed a training course that will help the City's successful transition to regenerative landscape management practices that promote healthy soils.

### **RegenerateLA Pilot Project**

To achieve the healthy soils goals set forth in LA's Green New Deal, multiple pilot projects that create healthy soils are being pursued. RegenerateLA is one such project. This project was imagined by three nonprofits on the Healthy Soils Advisory Panel: [Kiss the Ground](#), [LA Compost](#), and [Common Table Creative](#). Their project will consist of the following components:

- Building compost facilities at local parks to collect organic waste, produce compost, and in some cases distribute compost. As the number of these facilities increases, the goal is to create a "compost network" across LA's parks.
- Establishing demonstration sites or test plots to show the effectiveness of regenerative practices.
- Developing and administering a training program for Recreation & Parks grounds maintenance staff and other relevant City staff.
- Establishing pollinator habitats to help address the dwindling pollinator populations and support biodiversity.
- Monitoring and collecting data on soil health.
- Conducting a public awareness campaign.

The objective of the training component is to familiarize all LA grounds maintenance staff on organic regenerative land maintenance techniques. The initial courses will be offered in-person, however, the intention is to film trainings and turn them into engaging, digital courses as well. Planned curricula topics include:

- What is soil? What is compost?
- Why compost and regenerative approach are important for the soil and climate mitigation
- Biodiversity
- Soil testing
- Compost science and management
- Sourcing organic material
- Application of compost to green spaces
- Environmental justice and community engagement



## VALUATION:

Environmental valuation, the idea of directly or indirectly determining the worth of ecosystem services, can be used to convey the future benefits of environmental actions. This process brings to light some less apparent yet equally important economic benefits of healthy soils, several of which are highlighted below.

- Healthy soils are known to increase crop yields and thus lead to larger profits for farmers. Furthermore, food grown in healthy soils has more nutrient value and thus can benefit public health.
- Intact ecosystems with healthy soils can mitigate the impacts from natural disasters, such as flood, drought, and fire, bringing immense value to cities and states.
- Healthy soils can have immense climate benefits as they sequester carbon dioxide. Tax credits are even available via the Internal Revenue Code ([Title 26, Section 45Q](#)) for businesses and individuals who sequester carbon dioxide (up to \$20/metric ton CO<sub>2</sub>).
- Implementing healthy soils practices can lead to cost savings by diverting organic materials from landfills.
- Small-scale urban agriculture enables local food production, increasing food security in vulnerable communities. In this way, urban agriculture can work against cycles of poverty, improving community health, wellness, and resilience, all of which can be assessed in terms of economic impacts.
- Using organic soil amendments like compost and mulch in urban parks can help retain water and limit the need for chemical pesticides, yielding cost savings for park managers.

Associating economic value with these services will not only help healthy soils garner attention, but will convey the benefits of nature-based (green or brown) infrastructure when weighed against built (gray infrastructure) alternatives.



*The brand new RegenerateLA compost facility at Griffith Park  
(Image: LA Compost)*

Strategies	Supporting Actions
Promote training for jobs related to healthy soils, regenerative agriculture, and composting.	<ul style="list-style-type: none"> <li>• Support job training at local institutions (e.g., LA Trade Tech) related to healthy soils, composting, and regenerative agriculture.</li> <li>• Work with the City's Department of Economic &amp; Workforce Development and job development organizations (e.g., LA Conservation Corps) to promote workforce training related to composting, healthy soils, and regenerative agriculture and help provide access to good "green" and "brown" jobs in the regional economy.</li> </ul>
Engage and educate City staff.	<ul style="list-style-type: none"> <li>• Expand training for staff across relevant City departments on how to care for native plants and use integrated landscape management. Coordinate with the Healthy Soils Interdepartmental Group and/or Departmental Chief Sustainability Officers to embed and/or assign training to relevant staff.</li> </ul>
Promote data that demonstrates the economic value of healthy soils practices and policies to inspire behavioral changes.	<ul style="list-style-type: none"> <li>• Stress the importance of valuation data to community members and City staffers when weighing project proposals.</li> <li>• Emphasize the environmental risk mitigation benefits (e.g., flood, drought, and fire) associated with healthy soils.</li> </ul>
Emphasize the economic benefits of composting to encourage increased application.	<ul style="list-style-type: none"> <li>• Better track, measure, and monitor amounts of food waste, food waste diversion, and compost creation to show the impact and economic benefits of these practices.</li> <li>• Create a transparent marketplace for getting compost to local farms.</li> </ul>
Aid farmers in improving soil health while achieving economic benefits.	<ul style="list-style-type: none"> <li>• Communicate the economic benefits of improving soil health to farmers. Share related case studies available on the <a href="#">Land Core</a> and <a href="#">NRCS</a> websites.</li> <li>• Incentivize soil health practices with better rates on crop insurance, loans, etc.</li> <li>• Encourage farmers to apply for financial assistance programs available through the <a href="#">NRCS</a>.</li> </ul>





Mulch (Image: City Plants)



# RESOURCES & TOOLKITS

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1. [Compost Guide](#)  
A visual and informative guide explaining the basics and benefits of composting, frequently asked questions, and resources for additional information. Visit LA Compost's [How To Compost](#) page for details on ways to apply compost to gardens.  
(LA Compost)
2. [Composting Guide](#)  
A project guide developed for students (grades 6-12) to learn about composting. The guide is designed to address education standards related to "Energy and Matter". (TreePeople)
3. [Grants and Incentives for Healthy Soils](#)  
This is a comprehensive database of financial assistance opportunities intended to help fund healthy soils work. The database currently contains over 30 incentives and grant programs and is continuously updated as more opportunities become available. Visit the [Healthy Soils webpage](#) for the most up-to-date list.  
(LASAN Healthy Soils; Healthy Soils Advisory Panel)
4. [Healthy Soils for Healthy Communities Phase 1: Needs Assessment Infographic](#)  
Condensed version of the Needs Assessment Report (below).  
(TreePeople)
5. [Healthy Soils for Healthy Communities Phase 1: Needs Assessment Report](#)  
Summarizes the current status of soils in Los Angeles with a focus on the issues affecting LA's urban soils, identifies related community needs, and outlines a strategy of activities, projects, outreach, and collaboration to address those issues and needs.  
(TreePeople)
6. [LA County Tree Canopy Data Viewer](#)  
Map showing the existing and possible tree canopy cover in Los Angeles. Provides 8 different land cover classes including bare soils.  
(TreePeople)
7. [LandPKS Mobile App](#)  
The LandPKS mobile app aids users in determining the potential use and value of their land. It allows users to identify their soil and land type, monitor soil health and vegetation, and keep track of land management activities.  
(Land Potential)
8. [Liberated Roots](#)  
This article highlights the importance of cultural sensitivity when discussing urban and community agriculture as well as school gardening. Several culturally responsive school gardeners provide insight on equity in school garden programs to create this toolkit for culturally responsive practices.  
(Learning for Justice)
9. [Los Angeles Urban Soil Toolkit](#) - available in [English](#) and [Spanish](#)  
A guide with information, tools, and resources to help readers better understand soil and its role in ecosystems as well as how to support soil health in Los Angeles.  
(TreePeople)
10. [Natural Resources Conservation Service \(NRCS\) Soil Resources](#)  
The NRCS provides a host of resources aimed at educating on and facilitating the implementation of healthy soil management practices. The NRCS website provides soil information and data (e.g., [Web Soil Survey](#)) as well as a variety of helpful [tools](#). The NRCS also administers [financial assistance](#) (e.g., [Environmental Quality Incentives Program](#)) as well as technical assistance (e.g., field visits and aid from specialists, such as soil scientists, free of charge).  
(NRCS, USDA)



11. [Soil Health Management Manual](#)  
Provides research-based information on the soil properties, functions, and services essential to maintaining sustainable agricultural systems.  
(Iowa State University)
12. [Soil Quality Test Kit Guide](#)  
This page offers links to soil quality testing guides, available in [English](#) and [Spanish](#), as well as step-by-step instructions for performing several different soil test types,  
(NRCS, USDA)
13. [Soil and Water Testing Guidelines for Home and Community Gardens](#)  
A guide to help individuals determine the urgency of testing their soil and water prior to starting a home or community garden. Provides testing recommendations and best practices.  
(LA County)
14. [Soils in Urban Agriculture: Testing, Remediation, and Best Management Practices.](#) Great resource on testing and remediating urban soils. The document also has a comprehensive list of other useful resources at the end.  
(University of California, Agriculture and Natural Resources)
15. [University of California's Master Gardener Program](#)  
Master Gardeners are trained by University of California specialists and aid the general public with implementing sound gardening practices in their homes and communities. Master Gardeners provide [informative brochures](#), answer garden-related questions, and even offer [gardening classes](#) to help individuals start their own garden.  
(UC Cooperative Extension)
16. [Urban Drawdown Resource Database](#)  
This growing resource database contains informational resources, data, case studies, and tools intended to support cities with adopting and scaling-up drawdown actions (i.e., actions that increase carbon sequestration).  
(Urban Drawdown Institute)

# CONCLUSION

Together, LASAN, members of the Healthy Soils Interdepartmental Group, and the Healthy Soils Advisory Panel will work to research, incorporate, and implement the various activities outlined in this Healthy Soils Strategy document, as well as items in the RegenerateLA Healthy Soils Motion. These groups will also continue to solicit, incubate, and execute pilot projects related to Healthy Soils in LA, such as the RegenerateLA Pilot Project.

To minimize its ecological footprint, the City of Los Angeles should fully embrace healthy soils practices that lead to a local, self-sustaining, regenerative, circular economy. As this document demonstrates, there are a variety of actions and solutions that can be employed. Practices like encouraging regenerative agriculture in urban areas, which is a valuable local food source, and utilizing organic waste materials for composting, rather than sending them to landfill, are straightforward solutions that will have climate, public health, and ecosystem health benefits. While many of these activities are already being carried out by various City departments, certain activities may require additional dedicated staff and/or resources. With its unique collaborative approach to healthy soils and regenerative agriculture and this innovative Healthy Soils Strategy Document, the City of LA has established itself as a global leader on the topic of healthy soils.



*LA Compost staff and volunteers tend to the compost pile at the brand new Griffith Park composting site (Image: LA Compost)*



# LITERATURE CITED

- Amelung, W., Bossio, D., de Vries, W., Kögel-Knabner, I., Lehmann, J., Amundson, R., Bol, R., Collins, C., Lal, R., Leifeld, J., Minasny, B., Pan, G., Paustian, K., Rumpel, C., Sander, J., van Groenigen, J. W., Mooney, S., van Wesemael, B., Wander, M., & Chabbi, A. (2020). Towards a global-scale soil climate mitigation strategy. *Nature Communications*, 11(1). <https://doi.org/10.1038/s41467-020-18887-7>.
- Bice, D. (2021). Overview of the carbon cycle from a system's perspective. The Pennsylvania State University. <https://www.e-education.psu.edu/earth103/node/1019>.
- Blum, W., Zechmeister-Boltenstern, S., & Keiblinger, K. M. (2019). Does soil contribute to the human gut microbiome?. *Microorganisms*, 7(9), 287. <https://doi.org/10.3390/microorganisms7090287>.
- Burger, J. C., Redak, R. A., Allen, E. B., Rotenberry, J. T., & Allen, M. F. (2003). Restoring arthropod communities in coastal sage scrub. *Conservation Biology*, 17(2), 460–467. <https://doi.org/10.1046/j.1523-1739.2003.01325.x>.
- Chen, Y., Pouyat, R.V., Day, S.D., Wohldmann, E.L., Schwarz, K., Rees, G.L., Gonez, M., de Guzman, E. B., & Mao, S. (2021). Healthy soils for healthy communities, Phase 1: Needs assessment. TreePeople. <https://www.treepeople.org/wp-content/uploads/2021/03/Healthy-Soils-for-Healthy-Communities-Phase-1-Needs-Assessment-Report.pdf>.
- Cherlet, M., Hutchinson, C., Reynolds, J., Hill, J., Sommer, S., & von Maltitz, G. (Eds.). (2018). World Atlas of Desertification, Publication Office of the European Union, Luxembourg. [https://wad.jrc.ec.europa.eu/sites/default/files/atlas\\_pdf/Solutions\\_pdf/SolutionSuccessStories.pdf](https://wad.jrc.ec.europa.eu/sites/default/files/atlas_pdf/Solutions_pdf/SolutionSuccessStories.pdf).
- Conservation International. (n.d.). What are biodiversity hotspots? <https://www.conservation.org/priorities/biodiversity-hotspots>.
- Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin, R. G., Sutton, P., & Belt, M. van den. (1997). The value of the world's ecosystem services and natural capital. *Nature* 387, 253–260. <https://doi.org/10.1038/387253a0>.
- Craul, P. J. (1992). *Urban soil in landscape design*. Wiley, New York.
- Effland, W.R., Pouyat, R.V. The genesis, classification, and mapping of soils in urban areas. (1997). *Urban Ecosystems* 1, 217–228. <https://doi.org/10.1023/A:1018535813797>.
- EPA. (2020a). Overview of greenhouse gases. <https://www.epa.gov/ghgemissions/overview-greenhouse-gases>
- EPA. (2020b). Reducing the impact of wasted food by feeding the soil and composting. <https://www.epa.gov/sustainable-management-food/reducing-impact-wasted-food-feeding-soil-and-composting>
- Food and Agriculture Organization of the United Nations. (2015a). Healthy soils are the basis for healthy food production. [http://www.fao.org/fileadmin/user\\_upload/soils-2015/docs/EN/EN\\_Print\\_IYS\\_food.pdf](http://www.fao.org/fileadmin/user_upload/soils-2015/docs/EN/EN_Print_IYS_food.pdf).
- Food and Agriculture Organization of the United Nations. (2015b). Soils and biodiversity. <http://www.fao.org/resources/infographics/infographics-details/en/c/285727/>.
- Food and Agriculture Organization of the United Nations. (2017). Soil organic carbon: The hidden potential. <http://www.fao.org/3/i6937e/i6937e.pdf>.
- Food and Agriculture Organization of the United Nations. (2015c). Soils store and filter water: Improving food security and our resilience to floods and drought. <http://www.fao.org/3/i4890e/i4890e.pdf>.

- Food and Agriculture Organization of the United Nations. (2019). Sustainable soil management. <http://www.fao.org/3/ca6147en/ca6147en.pdf>.
- Fortuna, A. (2012). The soil biota. *Nature Education Knowledge*, 3(10):1.
- Griffiths, B.S., & Philippot, L. (2013). Insights into the resistance and resilience of the soil microbial community. *FEMS Microbiology Reviews*, 37(2), 112–129. <https://doi.org/10.1111/j.1574-6976.2012.00343.x>.
- Geurts, E. (2021a). Arion slugs [photograph]. iNaturalist. <https://www.inaturalist.org/observations/86835634>.
- Geurts, E. (2021b). Family dicrytomidae [photograph]. iNaturalist. <https://www.inaturalist.org/observations/86503083>.
- Grundling, J. (2021). Slime molds (phylum mycetozoa) [photograph]. iNaturalist. <https://www.inaturalist.org/observations/91198262>.
- H.B. 1578, 29th Leg. (Haw. 2017). [https://www.capitol.hawaii.gov/session2017/bills/HB1578\\_.HTM](https://www.capitol.hawaii.gov/session2017/bills/HB1578_.HTM).
- Hu, C., Xia, X., Chen, Y., & Han, X. (2018). Soil carbon and nitrogen sequestration and crop growth as influenced by long term application of effective microorganism compost. *Chilean Journal of Agricultural Research*, 78(1), 13-22. <https://doi.org/10.4067/S0718-58392018000100013>.
- IUCN. (2018). Land degradation and climate change. <https://www.iucn.org/resources/issues-briefs/land-degradation-and-climate-change>.
- Joimel, S., Schwartz, C., Hedde, M., Kiyota, S., Krogh, P. H., Nahmani, J., Peres, G., Vergnes, A., & Cortet, J. (2017). Urban and industrial land uses have a higher soil biological quality than expected from physicochemical quality. *Science of the Total Environment*, 584, 614-621.
- Jenny, H. (1941). *Factors of soil formation: a system of quantitative pedology*. McGraw-hill, New York.
- Kaye, J. P., Burke, I. C., Mosier, A. R., & Pablo Guerschman, J. (2004). Methane and nitrous oxide fluxes from urban soils to the atmosphere. *Ecological Applications*, 14(4), 975-981.
- Kneidel, K. (2021). Keratella americana [photograph]. iNaturalist. <https://www.inaturalist.org/observations/76335348>.
- Koteen, L., Baldocchi, D., & Harte, J. (2011). Invasion of non-native grasses causes a drop in soil carbon storage in California grasslands. *Environmental Research Letters*, 6(4). <https://doi.org/10.1088/1748-9326/6/4/044001>
- Laban, P., Metternicht, G., & Davies, J. (2018). *Soil biodiversity and soil organic carbon: Keeping drylands alive*. Gland, Switzerland: IUCN. viii + 24p
- LA County Public Health. Soil and water testing guidelines for home and community gardens. [http://publichealth.lacounty.gov/eh/docs/ab1990\\_soilwatertestingguidelines.pdf](http://publichealth.lacounty.gov/eh/docs/ab1990_soilwatertestingguidelines.pdf).
- Morel, J., Chenu, C., & Lorenz, K. (2015). Ecosystem services provided by soils of urban, industrial, traffic, mining, and military areas (SUITMAS). *Journal of Soils and Sediments*. 15. 1659-1666.
- NYC Office of Environmental Remediation (OER). (n.d.). Clean Soil Bank. <https://www1.nyc.gov/site/oer/safe-land/clean-soil-bank.page>.
- Parker, S. S. (2010). Buried treasure: Soil biodiversity and conservation. *Biodiversity Conservation*, 19(13), 3743-3756.
- Petra, B., Kircholtes, H. J., Schweiker, M., Wolf, G., Schug, B., Wieshofer, I., Huber, S., Parolin, M., Villa, F., Zelioli, A., Biasioli, M., Medved, P., Vernik, T., Vrščaj, B., Siebielec, G., Kozák, J., Galuskova, I., Fulajtar, E., Sobocká, J., & Jaensch, S. (2012). Soil in the city. Urban soil management strategy. City of Stuttgart, Dep. for Environmental Protection. [https://www.researchgate.net/publication/280919874\\_Soil\\_in\\_the\\_City\\_Urban\\_Soil\\_Management\\_Strategy](https://www.researchgate.net/publication/280919874_Soil_in_the_City_Urban_Soil_Management_Strategy).
- Pimentel, D. & Kounang, N. (1998). Ecology of soil erosion in ecosystems. *Ecosystems*, 1(5), 416-426.



- Pouyat, R. V., Page-Dumroese, D. S., Patel-Weynand, T., & Geiser, L. H. (2020). Forest and rangeland soils of the United States under changing conditions: A comprehensive science synthesis (1st ed.). Springer International Publishing. <https://doi.org/10.1007/978-3-030-45216-2>.
- Pouyat, R. V., Yesilonis, I. D., & Nowak, D. J. (2006). Carbon storage by urban soils in the United States. *Journal of Environmental Quality*, 35, 1566–1575.
- Pouyat, R. V., Szlavecz, K., Yesilonis, I. D., Groffman, P. M., & Schwarz, K. (2010). Chemical, physical and biological characteristics of urban soils. Chapter 7. In: Aitkenhead-Peterson, J., & Volder, A. (2010). *Urban ecosystem ecology*. Madison: American Society of Agronomy: 119-152.
- Project Drawdown. (2020). Table of Solutions. <https://drawdown.org/solutions/table-of-solutions>.
- Raciti, S. M., Hutyla, L., & Finzi, A. C. (2012). Depleted soil carbon and nitrogen pools beneath impervious surfaces. *Environmental Pollution*, 164, 248-251. <https://doi.org/10.1016/j.envpol.2012.01.046>.
- Riordan, E. C., & Rundel, P. W. (2014). Land use compounds habitat losses under projected climate change in a threatened California ecosystem. *PLoS ONE*, 9(1). <https://doi.org/10.1371/journal.pone.0086487>.
- Ryals, R., & Villa, Y. (2019). Carbon sequestration from biosolids application. Lecture presented in University of California Merced, School of Natural Sciences.
- Scalenghe, R., & Marsan, F. A. (2009). The anthropogenic sealing of soils in urban areas. *Landscape and urban planning*, 90(1-2), 1-10.
- Schwarz, K., Pouyat, R. V., and Yesilonis, I. D. (2016). Legacies of lead in charm city's soil: lessons from the Baltimore Ecosystem Study. *International Journal of Environmental Research and Public Health* 13(209).
- Seiyaboh, E. I., & Izah, S. C. (2019). Impacts of soil pollution on air quality under Nigerian setting. *Journal of Soil and Water Science*, 3(1), 45–53. <https://scholars.direct/Articles/soil-and-water-science/jsws-3-006.php?jid=soil-and-water-science>
- Six, J., Pereg, L., & Brevik, E. (2017). Soil biodiversity and human health. *Geophysical Research Abstracts* Vol. 19, EGU2017-19207, 2017 EGU General Assembly 2017. <https://meetingorganizer.copernicus.org/EGU2017/EGU2017-19207.pdf>.
- Soil Survey Staff. (1999). *Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys*. 2nd edition. Natural Resources Conservation Service. U.S. Department of Agriculture Handbook 436. [https://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_051232.pdf](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051232.pdf).
- Soil Science Society of America. (n.d.). Soil contaminants. <https://www.soils.org/about-soils/contaminants/>.
- Soule, M., Bolger, D., Alberts, A., Wright, J., Sorice, M., & Hill, S. (1988). Reconstructed dynamics of rapid extinctions of chaparral-requiring birds in urban habitat islands. *Conservation Biology*, 2(1), 75-92. <http://www.jstor.org/stable/2386274>.
- Spear, D. M., Adams, T. A., Boyd, E. S., Dipman, M. M., Staubus, W. J., & Meyer, W. M. (2017). The effects of development, vegetation-type conversion, and fire on low-elevation Southern California spider assemblages. *Invertebrate Biology*. <https://doi.org/10.1111/ivb.12163>.
- Staubus, W., Bird, S., Meadors, S., & Meyer, W. (2019). Distributions of invasive arthropods across heterogeneous urban landscapes in southern california: Aridity as a key component of ecological resistance. *Insects*, 10(1), 29. <https://doi.org/10.3390/insects10010029>.
- Surls, R., Borel, V., & Biscaro, A. (2016). Soils in urban agriculture: Testing, remediation, and best management practices. <http://dx.doi.org/10.3733/ucanr.8552>.
- Waelti, C., & Spuhler, D. (2019). Factsheet: Micro basins. Sustainable Sanitation and Water Management Toolbox. <https://sswm.info/sswm-solutions-bop-markets/improving-water-and-sanitation-services-provided-public-institutions-0/micro-basins>.

- Wall, D. (2004). Sustaining biodiversity and ecosystem services in soils and sediments. SCOPE Series. Island Press, Washington, DC.
- Underwood, E. C., Viers, J. H., Klausmeyer, K. R., Cox, R. L., & Shaw, M. R. (2009). Threats and biodiversity in the Mediterranean biome. *Diversity and Distributions*, 15(2), 188–197. <https://doi.org/10.1111/j.1472-4642.2008.00518.x>.
- United States Department of Agriculture, Natural Resources Conservation Service. (2007). From the ground down: An introduction to Iowa soil surveys. [https://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_006038.pdf](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_006038.pdf).
- United States Department of Agriculture, Natural Resources Conservation Service. (2010). From the surface down: An introduction to soil surveys for agronomic use. (2nd ed.). <https://efotg.sc.egov.usda.gov/references/public/WV/FromtheSurfaceDown.pdf>.
- United States Department of Agriculture, Natural Resources Conservation Service. (2017). Supplement to the soil survey of Los Angeles County, California, southeastern part. [http://soils.usda.gov/survey/printed\\_surveys/](http://soils.usda.gov/survey/printed_surveys/).
- Urban Soils Institute. Our vision & philosophy. <https://urbansoils.org/our-vision>.
- Zemlyanitskiy, L. T. (1963) Characteristics of the soils in the cities. *Soviet Soil Sci* 5:468–475.





*Preparing soil to plant a tree (Image: City Plants)*





## Contact Us

LASAN is dedicated to protecting public health and the environment for all Angelenos. For more information about the Healthy Soils Program, please contact [michelle.barton@lacity.org](mailto:michelle.barton@lacity.org) or visit us at [lacitysan.org/healthysoils](http://lacitysan.org/healthysoils).

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Image: City Plants

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