TreePeople

Healthy Soils for Healthy Communities

Phase 1: Needs Assessment

February 2021

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Table of Contents

Executive Summary

Soil is the foundation of life. To better understand and utilize the potential of soils, we launched the "Healthy Soils for Healthy Communities" Initiative. As the first phase of the initiative, this project aims to determine the current status of Los Angeles (LA) County soils, identify the most pressing urban soil issues and community needs through community consultation and outreach, and provide a framework for future work regarding urban soil research, policy, public education, and community engagement in the region. We conducted online surveys, focus groups, various meetings and events, a review of the literature, and worked with universities, government agencies, non-profit organizations (NGOs), and community groups to achieve these objectives.

Current Status of LA Soils

We analyzed 2016 LA County land cover data, the most recent soil survey of the LA metropolitan area conducted by USDA-Natural Resources Conservation Service (NRCS), synthesized the literature, and analyzed soil samples collected from the region. We found that:

- **LA's land and soils:** Forty-four percent of LA County was covered by bare soil, which represents a great opportunity for employing best soil management strategies and restoration efforts. Soil sealing is another issue in LA's urban areas, for example, almost 50% of LA City's land is covered by impervious surfaces such as buildings, roads, and other paved surfaces. Additionally, LA soils have been highly modified. The NRCS' soil survey found that 45% of the surface area was composed of human altered soils.

- **Literature review:** Among a total of 124 articles, reports, and other 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 from 16 mg/kg between 1919 and 1933 to 79 mg/kg between 1967 and 1970.

- **Soils analysis:** Thirty-nine soil samples, collected by the U.S. Forest Service from random points across the region, were analyzed by California Polytechnic State University. The results suggest localized contamination of soils by several trace metals and relatively high soil pH, carbon/nitrogen (C/N) ratios, and carbon. For all soil properties, the range of test results were wide and variable suggesting the need for additional soil analyses to spatially predict soil properties across the region, especially the potential for soil contamination in areas where vulnerable populations live, including disadvantaged, underrepresented, and underserved communities.

Needs Assessment—Online Surveys

We conducted four county-wide online surveys (in both English and Spanish) with residents, educators, policy-makers, and soil-related professionals. A total of 1,349 participants responded to the four online surveys, including 1,104 to the residential survey, 139 to the educator survey, 19 to the policy-maker survey, and 87 to the professional survey. The main findings include:

- **LA County residents:** LA County residents value green space: 85% of residents currently maintain a lawn, landscaped area, or green space, and maintain that space by watering and weeding. Furthermore, 73% of residents use the "green bin" for their green waste or allow green waste to compost in some form on the property. Resident knowledge about factors that affect soil health was low: 70% reported being not at all or only slightly knowledgeable. The majority of residents (76%) 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 in the topics listed on the survey.

- **LA County educators:** Seventy-nine percent 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. Despite the fact that 88% of educators expressed being concerned about environmental issues, only 48% are concerned about soil contaminants and pollution which is far less than other groups surveyed.

- **Policy-makers:** Seventy percent 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, 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% soil-related professionals are highly concerned about soil contamination, but only 17% of them believe their customers feel the same way. Eight-five percent of professionals typically use turf grass in their designs. Despite 70% of professionals use 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

We also held a series of seven focus groups (virtually due to the COVID-19 pandemic) with key stakeholder groups including 41 individuals from the community to assess perceptions, needs, and concerns regarding LA soils. Two focus groups were held for each of the following stakeholder groups:

1) Technical aspects of soil management including engineering, urban and sustainability planning, and local government.

2) Urban residential landscaping/gardening and urban agriculture.

3) Community non-profits and coalition groups.

The seventh and final focus group involved representatives from previous stakeholder groups to form a cross-disciplinary group to synthesize overarching themes and identify future directions.

- **Cross-cutting themes** identified include a need for:

  - 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 priorities** identified by the synthesis focus group include:

  - Developing a holistic soil strategy that includes social and ecological dimensions of soil and centers 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.

Needs Assessment—Learning from the Community, Experts, and Other Cities

To learn from the community, experts, and other cities, we hosted a virtual Los Angeles Urban Soil Symposium and a Los Angeles Urban Soil Workshop and co-hosted the “Soils: The Living Fabric of Health, 2020 Urban Soils Symposium" with the NYC Urban Soils Institute and RUDN University in 2020.

Framework for Next Steps

To address the identified needs, we developed an overall framework for phase two of this initiative, which proposes to establish an overall strategy for a Los Angeles Urban Soil Collaborative. The strategy will be developed through community, government, NGOs, academia, and the private sector participation. Under this framework, we propose a set of core activities, demonstration projects, community outreach programs, and the scaling up of these activities through the development of local, regional, national, and international collaborations:

- **Strategic planning:** As the first step, we strongly recommend developing an overall strategy working with communities, NGOs, government agencies, the private sector, and academia. This was a high priority identified in the focus groups.
- **Core activities:** Based on survey responses, core activities should include community-based soil testing, data sharing, and establishing an online learning center. These activities will increase community access to soil information and knowledge.
- **Demonstration projects:** To showcase potential solutions for LA soils, we recommend demonstration projects that incorporate green-blue-brown infrastructure, fire prevention and post-fire soil restoration, soil remediation and restoration, the “farming” of carbon, and the creation of edible landscapes in schools. Wherever possible, projects will be accomplished in partnership with existing efforts, but those that have not historically included soil health in their planned activities.
- **Community outreach:** Community outreach was identified as a high priority across the board. We recommend the following activities to raise awareness, to build capacity, and to provide technical and financial support for communities: community small grants programs (where possible), communications and marketing, training and education, community-based science, and community events.
- **Scaling up:** To scale up through partnerships and collaboration, we propose the following ways to create and share ideas and learn from others’ experiences: developing innovative policy recommendations to protect and restore urban soil health; developing new technology and tools, planning and design concepts; conducting multi-city soil online surveys; participating in a global urban soil network that shares information, ideas, and data; and hosting or participating in festivals with other cities and other relevant events.

Healthy Soils for Healthy Communities Initiative

Soil is the foundation of life. Soils can mitigate current and future climate impacts by sequestering carbon, improving water supply and water quality, supporting plant growth, enhancing food production, and maintaining healthy communities (Figure 1). In urban and peri-urban areas where more than 80% of Americans live, work, and play, the potential gains from fostering healthy soils are enormous and far reaching. For this reason, TreePeople launched the first phase of the "Healthy Soils for Healthy Communities" Initiative in 2020, funded by Accelerate Resilience L.A. - a sponsored project of Rockefeller Philanthropy Advisors.

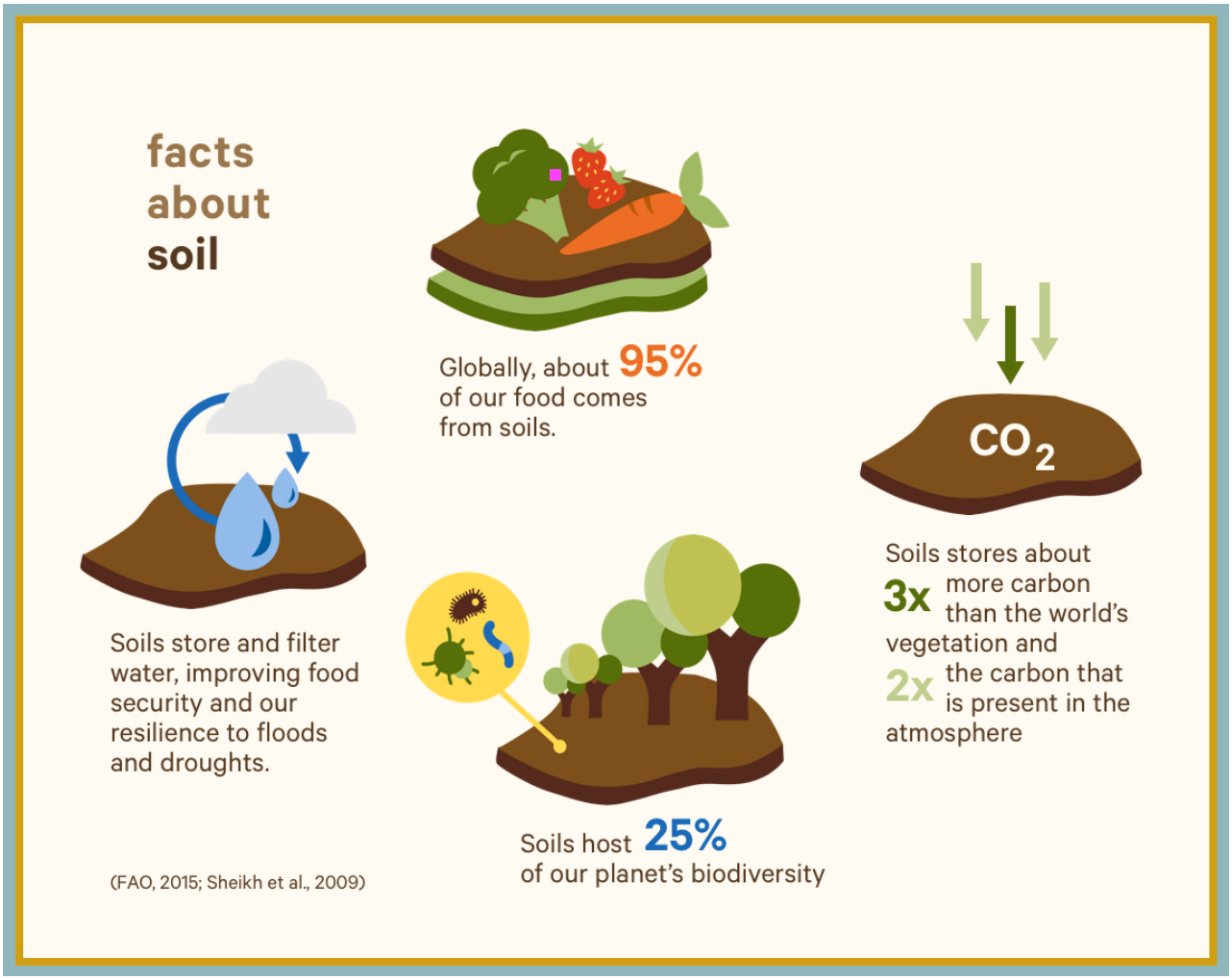


Figure 1. Benefits of soils

The Initiative

The objectives of this initiative include: 1) Elevating healthy soils as the "brown" in green infrastructure policy, planning, management, and investments in both the built and natural environments; 2) Increasing public and policy-maker awareness of the importance and potential of healthy soils in building climate resilience, sustaining urban ecosystem functions, and enhancing public health; 3) Conducting cutting-edge research and community science that gets used to fill the information gaps; 4) Facilitating policy changes to promote and support healthy urban soil projects; and 5) Empowering communities with science-based information (some of which is generated by the community), best management practices, and practical tools.

Needs Assessment

As the first phase of the initiative, we conducted a needs assessment aiming 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 (Figure 2).

Figure 2. The overall framework of phase one: needs assessment

For more information, please visit: https://www.treepeople.org/healthy-soils-for-healthy-communities-initiative/.

Current Status of Los Angeles Soils

To determine the current status of Los Angeles (LA) soils, we analyzed 2016 LA County land cover data, summarized the most recent soil survey of the LA metropolitan area (Soil Survey of Los Angeles County, California, Southeastern Part) conducted by USDA-Natural Resources Conservation Service (NRCS), synthesized literature, and analyzed a total of 39 soil samples collected from the region.

LA County Land Cover in 2016

To better understand the land cover in LA County, we analyzed a total of eight different land cover classes using high-resolution Los Angeles Regional Imagery Acquisition Consortium (LAR-IAC) 4 data acquired in 2016 and provided by the Center for Urban Resilience of LoyolaMarymount University and LA County. In LA County, on average, there were 18% tree canopy, 5% tall shrubs, 14% grass/shrubs, 44% bare soil, 1% water, 6% buildings, 5% roads/railroads, and 7% other paved surfaces in 2016 (Table 1.). We also analyzed 88 cities and unincorporated areas within the County (see Appendix A for details).

Table 1. Land cover of LA County, LA City, and unincorporated areas in 2016

	Tree Canopy	Tall Shrubs	Grass/ Shrubs	Bare Soil	Water	Buildings	Roads/ Railroads	Other Paved
LA County	18%	5%	14%	44%	1%	6%	5%	7%
LA City	24%	4%	12%	11%	0%	18%	11%	19%
Unincorporated Areas	17%	19%	2%	57%	1%	1%	2%	1%

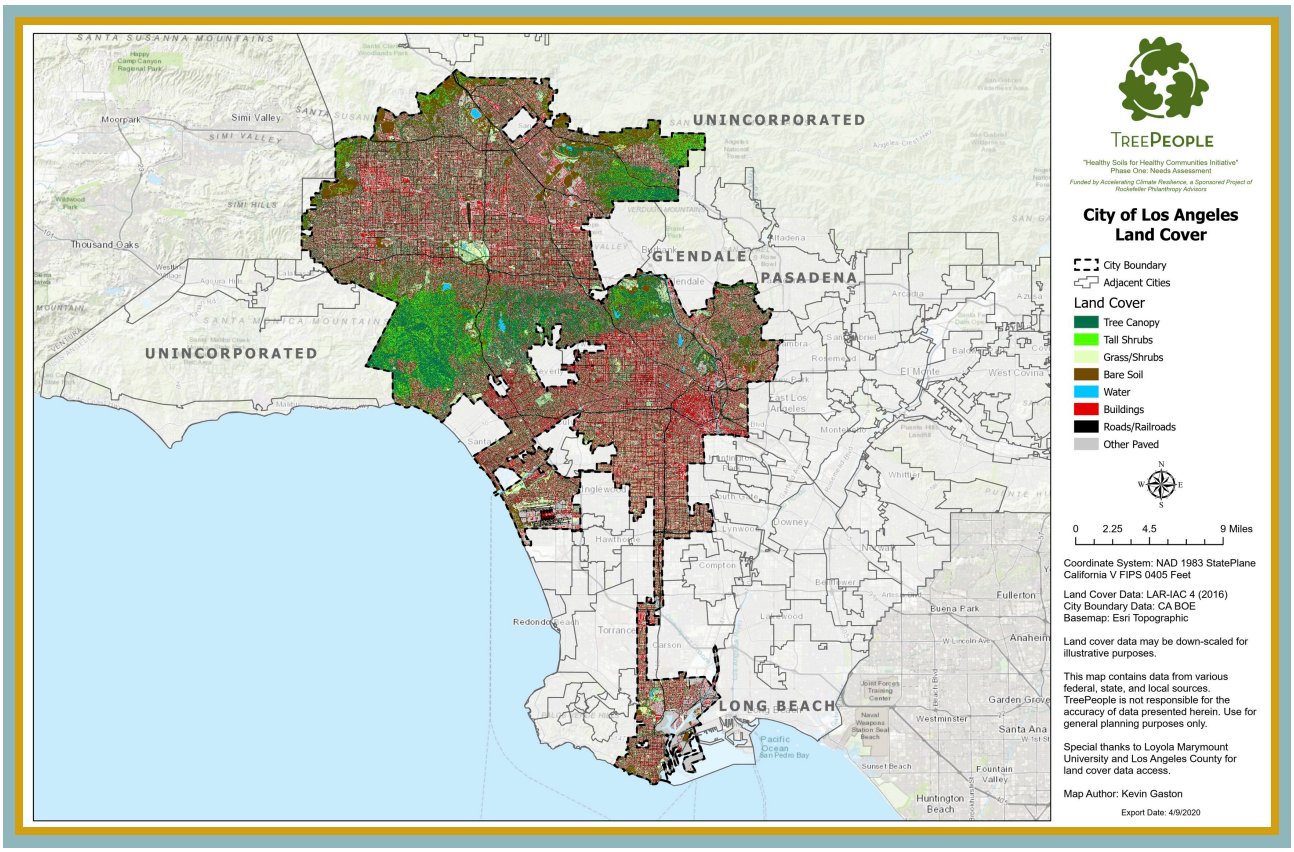


Figure 3. Map of LA City land cover in 2016

It is worth noting that the percentage of impervious surfaces in LA City, including buildings, roads, and other paved surfaces, was 49% in 2016, which was almost half of the land cover in the city (Figure 3). Compared to other cities in the United States, the percentage of impervious surfaces in LA City is lower than Baltimore, Boston, and Chicago, but higher than Atlanta, Oakland, and Syracuse (Table 2).

Table 2. The percentages of impervious surfaces in different cities (source: Pouyat et al., 2006)

City	Percentages of Impervious Surfaces (%)
Atlanta	39.8
Baltimore	50.4
Boston	53.9
Chicago	60.0
Los Angeles	49.0
Oakland	48.0
Syracuse	46.5

Soil Survey of Los Angeles Metropolitan Area

Methodology of Soil Survey

Mapping soils in an urban area, such as Los Angeles County, pose challenges in comparison to mapping in a more natural setting. In urban areas, natural or "native" soils are intermixed with variable depths of human-transported materials and altered soils with little regard to natural landscape position or landforms. Thus, urban soils commonly include human-transported materials, which soil scientists refer to as human-altered/human-transported (HAHT) materials. This creates highly variable soil characteristics across an otherwise highly predictable soil-landform relationship that soil scientists have determined after decades of research for natural soils. Therefore, soil scientists have had, and continue, to develop new soil-landform relationships for mapping soils in urban areas.

The soil survey of Los Angeles is one of only a handful completed for a major metropolitan area in the United States. The survey provides spatially specific information about the soils in the county's metropolitan region. The information includes a description of the soils and their location and a discussion of their suitability, limitations, and management for uses specific to an urban and suburban area. USDA-Natural Resource Conservation Service (NRCS) soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage (where water accumulates and how fast it seeps into the ground); the kinds of crops and native plants; and the kinds of bedrock, or "parent material". They augured or dug many holes to study the soil profile, which is the sequence of natural or human made layers, or horizons, in a soil. In a few cases, soil samples were collected and tested by the NRCS national laboratory in Lincoln, NE.

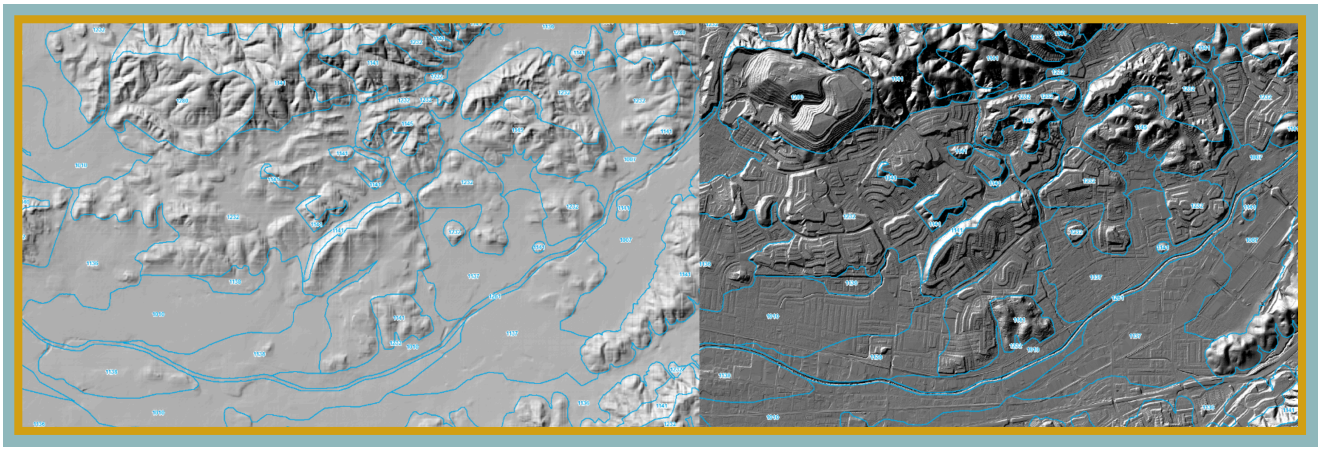


Figure 4. Mapping anthropogenic landforms (left: 10 meter DEM – pre-development; right: 3 meter DEM – post-development) (source: Riddle and Shaw, 2019)

A geodatabase for the data and information accumulated for this survey was developed using a variety of digital reference materials in addition to observations made in the field. With a geographic information system (GIS), a 3-meter LIDAR (Light Detection and Ranging) dataset was used along with other maps for terrain analysis (Figure 4). These data were used to identify areas where HAHT materials are suspected. Additionally, United States Geological Survey (USGS) geologic quad maps were georeferenced and draped over the terrain models along with a set of old reconnaissance soil surveys completed in 1916 and 1919 to investigate long-term changes. These historical documents were helpful in identifying natural landforms and provided generalized descriptions of soil properties observed in the pre-developed environment.

Summary of Soil Survey Results

Current mapping of soils in the Los Angeles Basin reflects the overall alteration of the landscape hydrology or drainage. Twenty-seven anthropogenic (urban) soil types were identified in the survey, resulting in 158 soil mapping units (Table 3.). Of the total soil types identified and delineated, 11% were identified as urban or anthropogenic, 32% with <50 cm of surface amendments, and 12% considered natural or native, while 43% of land surface was sealed by impervious surfaces.

A significant area of urban development is on alluvial plains and coastal plains that have slight or negligible slopes (Figure 5). For example, in sprawling residential neighborhoods, the surface of soils typically has been modified to support site development, including foundations for residential or commercial development, terraces, lawns, community gardens, infrastructure, and other green spaces that support ecological services. Most of the survey area has intact native soil below surface modifications. The natural soil surface is commonly scraped off prior to amendments, and the truncated native subsoil remains below the transported material. Thickness of the human-transported materials varies but is generally less than 50 cm in areas with slopes of less than 5%, especially in lawns and other green spaces. Landscapes with slightly higher slopes require more intense soil modification to prepare and level for construction. Locations with multiple generations of development, commercial, and industrial lands near city centers, such as downtown LA, have higher spatial extent of human-transported materials. In these areas, the native soils are generally covered with human-transported materials to a depth of 1 to 2 meters or have been completely altered (Figure 5). Construction debris is common in areas with multiple generations of development.

Table 3. Summary of Los Angeles County soil survey results (source: USDA-NRCS; 2017)

Soil Survey Results	Soil Types
158 soil-landscape mapping units. 185 soil taxonomic units (unique soil component). 27 anthropogenic soils: ◆ 15 major components. ◆ 5 new anthropogenic Soil Series. 20 new soil series established. 1,439 total soil profile descriptions. Soils were either natural, partially, or completely altered.	43% urban land (sealed soils) 11% anthropogenic soils (USA Soil Taxonomy criteria). 32% impacted soils with <50 cm of surface amendment 12% natural soils (isolated to natural hillsides). 2% other miscellaneous areas.

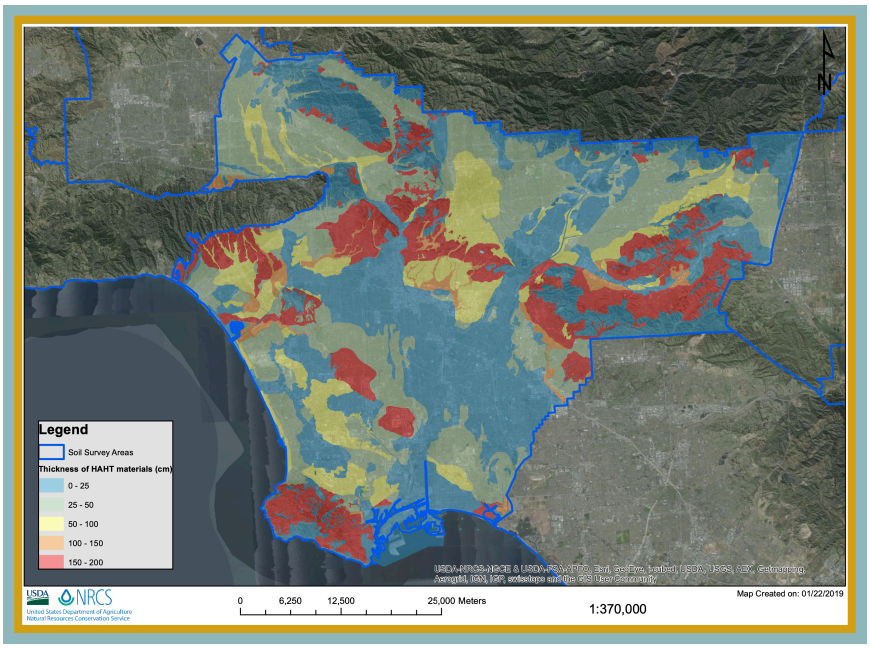


Figure 5. Thickness of human-altered and human-transporated (HAHT) materials for major components of in the Soil Survey of Los Angeles County, California, Southeastern Part (source: USDA-NRCS, 2017)

The age of the residential areas is commonly reflected in the degree of soil landscape alteration. More recent residential projects have extensive alteration where large areas have been scraped, graded, and reshaped by the movement and transport of soil materials. In somewhat older neighborhoods, the foundations and infrastructure have been placed within the landscape without extensive regrading. As a result, many soils in backyards and parks, except in areas of hills, retain much of their natural character and properties. Besides the above mentioned soil-landscape relationships, the spatial heterogeneity of other soil characteristics need to be determined for those characteristics measured during the survey (e.g., soil pH), while additional characteristics, such as trace metal concentrations and soil carbon contents are needed to be made for most of the Los Angeles County region. Compared to New York city, LA has a lower percentage of urban land (sealed soils), a lower percentage of HAHT (fill soils), and a slightly higher percentage of native soils (Table 4.)

Table 4. The comparison of urban soil patterns between Los Angeles and New York City (source: Shaw and Riddle, 2019)

	Los Angeles County, SE Part - Citywide Total	New York City - Citywide Total
Soil Types	**% of Land area**	**% of Land area**
Urban Land (sealed soils)	43	62.7
*HAHT (fill) Soils	11	27.6
**"Native" Soils	12	8.6
Other Misc. Areas	2	1.1
Surface Amended Soils (< 50cm alteration)	32	NA

*Note: *59% spolic, 22% artifactic, 11% dredgic, 6% methanogenic, 2% combustic & ashifactic, HAHT (human-altered and human-transporated) material classes; **On natural hillsides (undeveloped areas).*

Summary of Literature Review

Competing land uses, extensive development, and shifting climatic stressors are significant constraints to maintaining healthy soil in Los Angeles (LA). This review synthesizes a total of 124 literature including peer-reviewed science, geotechnical reports, conference proceedings, and book sections that are published between 1903 and 2020 (Figures 6 and 7) to determine: the state of the current knowledge characterizing the spatial heterogeneity of soil properties and related processes across LA County; soil risks and challenges that have direct and indirect impacts on human and environmental health; management practices that are currently being implemented to restore soil functions; and unresolved questions and debates. Understanding the implications of this research for future policy and planning efforts will be critical, as will the dissemination of this information to key practitioners (see Appendix B for the full report of literature review).

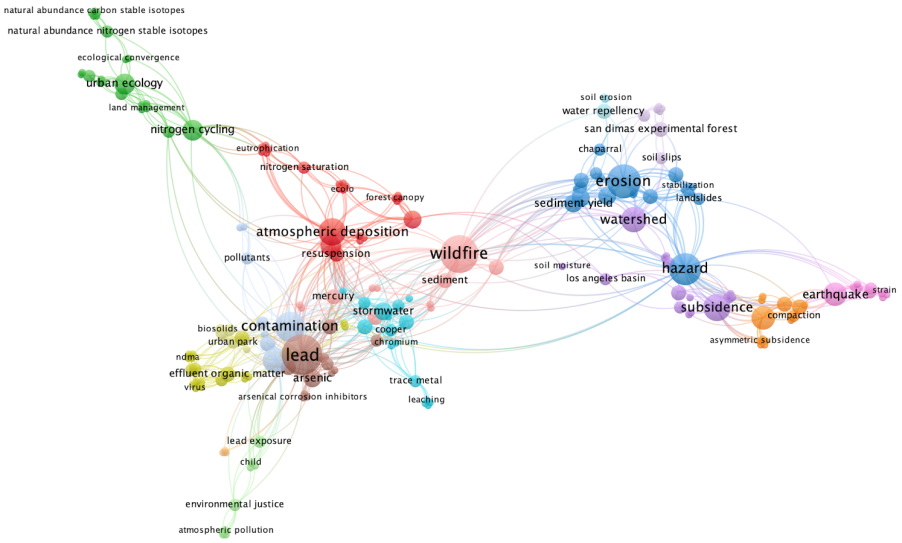


Figure 6. Key word citation burst analysis results of the existing literature of LA soils by themes
(Note: Key nodes include atmospheric deposition, wildfire, lead contamination, and erosion.)

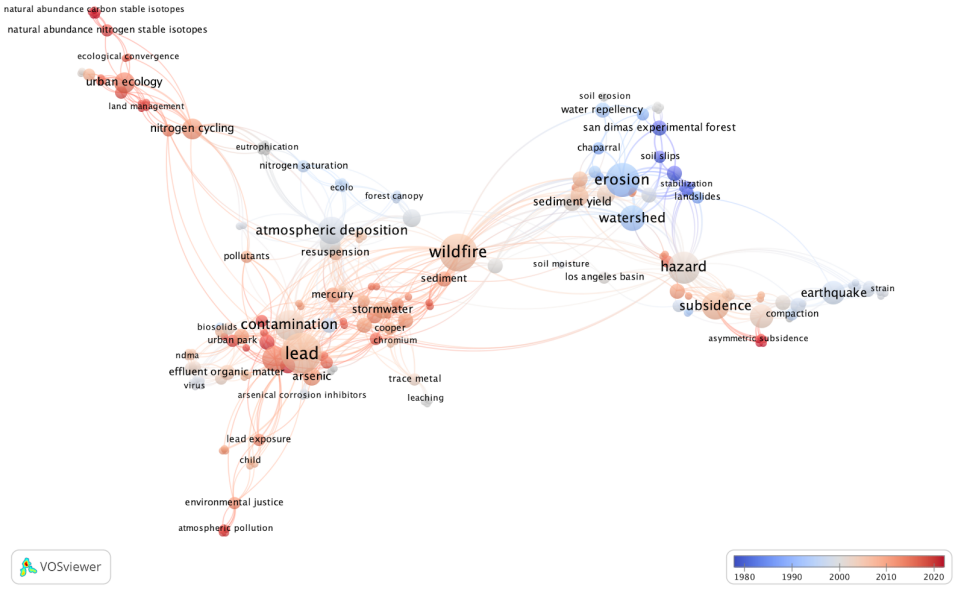


Figure 7. Key word citation burst analysis results of the existing literature of LA soils by years of publication
(Note: Key nodes beginning from most recent include lead contamination, wildfire, erosion, and atmospheric deposition.)

Research Highlights

- Of 124 documents published between 1903 and 2020, we identified research related to soil properties (n=30); soil climatology (n=16); soil contamination (n=31); soil erosion (n=19); subsidence (n=18); and urban soil management (n=5) with more recent publications focused on soil lead (Pb) and wildfire (Figures 6 and 7).
- Soil properties and soil contamination were the most studied topics, whereas the limited range of studies on urban soil management create a significant gap in understanding.
- A focus of public health and community concern is the presence of Pb throughout the LA metro region. Previous research suggests Pb concentrations in surface soils increased from 16 ± 0.5 mg/kg between 1919 and 1933 to 79 ±23 mg/kg between 1967 and 1970.
- Future research should evaluate the influence of soil properties on contaminant speciation and removal, in addition to the impacts of soil amendments and management processes on the stability of co-contaminants. Additionally, there is a need to quantify the impacts of climatic stressors, including drought, extreme heat, and invasive species on soil properties and functions.

Extent of Existing Research

Soil Properties Nature- and human-induced disturbances to soil physical, chemical, and biological properties are well documented in the literature, although observed changes are spatially explicit and not generalizable across the region. Studies analyzing a 41-year old bio-sequence of lysimeter soils at the San Dimas Experimental Forest document the influence of chaparral and pine species on morphological development and physicochemical indicators of soil health, and suggest that changes in vegetation may impact the ability of soils to act as sinks in biogeochemical cycles (Graham and Wood, 1991, 1995; Ulery et al., 1995; Quideau et al., 1996, 1998, 2000). Research also reveals high rates of soil nitrogen (N) across LA, where rapid urbanization and pollution from fossil fuel combustion contribute to the highest regional rates of N deposition in the contiguous USA (Bytnerowicz and Fenn, 1996). Elevated atmospheric NOx loads in the LA Basin have led to soil N enrichment corresponding to an annual input of 33-38 kg N ha^{-1} (or 10-13% emissions), roughly equal to levels of N from over-fertilized agricultural lands (Egerton-Warburton et al., 2001; Allen et al., 2007). Deposition of nitrate pollutants bears serious consequences for the health and stability of soil ecosystems, and has been associated with decline in soil microbial activity and diversity, in addition to causing N saturation (Egerton-Warburton et al., 2001; Riggan et al., 1994). Future research should assess the varying abilities of urban impacted soils to neutralize acidic deposition in addition to the combined effects of elevated carbon dioxide (CO_2) and N saturation on microbial activities.

Soil moisture, which has both a physical and biological effect on microorganism activities, has been shown to induce heat flux and impact microbial activity. Using soil samples from San Dimas, researchers heated soil to various temperature and soil moisture regimes to assess the direct effects of fire-induced heat flux and soil moisture on the survival of microorganisms (Riggan et al., 1994). Mild temperature increases activated germination of dormant forms of fungi, yielding significantly higher population counts than those found in unheated soil. As temperatures increased, decreases in diversity were observed for both heat-stimulated fungi and heterotrophic bacteria. Temperatures beyond the levels which produced the heat-stimulated active populations sterilized the soil. Given the coming effects of global warming, future research should focus on how overlapping climatic stressors such as drought and extreme heat impact microbial community compositions and functions in soil.

Fire-induced soil hydrophobicity, which contributes to reductions in soil infiltration capacity and increased rates of overland flow during precipitation events, has been studied extensively in the Transverse Ranges (Doerr et al., 2000). For this reason, soil water repellency is an issue of increasing concern for regional watershed managers, particularly as fires and erosional responses grow more intense and frequent with climate change. Studies conducted at San Dimas show that soil water repellency is positively correlated with soil depth, and inversely related to post-fire duration and soil moisture content. Research in the Angeles National Forest also attributes soil hydrophobicity in upper horizons to the presence of soluble and highly volatile secondary plant substances, such as decomposed chaparral brush matter and fungal organisms (Teramura, 1980; DeBano, 2000). Research is needed to address fire-induced soil hydrophobicity, particularly in wildland-urban interface (WUI) areas of the LA region.

Soil Contamination. Research on soil contamination reveals persistent accumulation in LA soils of heavy metals, toxic chemical compounds, and disease causing agents occurring in high enough concentrations to pose long-term adverse effects to human and environmental health. Soil contamination is conditioned by proximity to freeways and major arterials, building and parcel age, population density, cultivation and management practices, and proximity to smelters and industrial sites (Wu et al., 2010; Clarke et al., 2015; Hodel et al., 2020; Wu et al., 2019), although empirical evidence within the LA region remains weak in determining any interactive effect between these factors. Young children and working adults from low-income Black and Latino populations disproportionately bear the health risks associated with uptake and absorption of heavy metals. High soil lead (Pb) levels exceeding the state threshold of 80 ppm, for example, have been detected in communities of color situated next to lead battery recycling facilities, including Watts, Boyle Heights, East LA, Maywood, Hacienda Heights, La Puente, and Avocado Heights (Wu et al., 2019; LA County, 2019; Johnston and Hricko, 2017; Johnston et al., 2019). Region-wide soil Pb concentrations also reflect the historic deposition of metal dust from leaded paint and gasoline, with studies showing increases of Pb concentrations in surface soil from 16 ± 0.5 mg/kg between 1919 and 1933 to 79 ± 23 mg/kg between 1967 and 1970 (Harris and Davidson, 2005; Page and Ganje, 1970, 1971). Additionally, surface soils surrounding the nearly 1000 deserted oil and gas wells in the City of LA have been detected for elevated concentrations of Pb, As, Ba, Cr, along with a suite of carcinogens including benzene, formaldehyde, and polycyclic aromatic hydrocarbons, which need to be further studied (LA Times, 2020; Wellman et al., 1999; Chilingar and Endres, 2005).

Soil Erosion. Erosional processes pose an acute threat to communities and critical infrastructure as urban development encroaches onto adjacent foothills and, in many cases, into the mouths of mountain watersheds. Natural erosion in the Transverse Ranges has been augmented, particularly on the southern front, by the disturbances produced by wildfires (see fire-induced soil hydrophobicity discussion above), which have accelerated the rate of erosion up to fourfold within small, steep catchments abutting populous areas (Lavé and Burbank, 2004). Post-fire debris flows in the San Gabriel Mountains may represent up to 80% of the total sediment production in debris basins (Kean et al., 2011).

Subsidence. Historic patterns of ground deformation throughout LA County are principally attributed to groundwater withdrawal and recharge, oil extraction, and tectonic contraction, which often occur in overlapping proximity (Riel et al., 2018; Galloway and Burbey, 2011). Several studies reveal subsidence rates in the LA metro area of up to 12 mm/yr from groundwater withdrawal and injection, with other parts of the region experiencing a broader range from -20 to +10 mm/yr (Bawden et al., 2001; Riel et al., 2018). The most extreme and publicized case is that of Wilmington Oil Field, where a series of interferograms from 1997-1999 shows episodic subsidence of up to 30 mm (Bawden et al., 2001).

Urban Soil Management. Soil degradation can be ameliorated in part by implementing soil amendments and improved management practices. The addition of soil amendments, such as mulch and compost, has been shown to dilute soil Pb concentrations found in community gardens and chemically react with Cd and As to become more or less bioavailable to crops (Clarke et al., 2015). While the use of natural organic substrates is widely accepted by community gardeners as beneficial practices for soil renewal, their effects on site-specific soil properties and soil-groundwater biogeochemical conditions warrant further investigation. Additional research should examine how different soil amendments and remediation processes may mobilize co-contaminants (Bradley et al., 2005).

Research Gaps

The literature review suggests the potential for widespread soil contamination that needs to be measured and mapped for the entire LA region. Future research should assess the influence of various soil physical, chemical, and biological properties on the speciation, absorption capacity, and removal of metals and chemical contaminants found in soils across LA, in addition to their impacts on plant growth. Additionally, there is a need to characterize and quantify the impacts of climatic stressors, including drought, extreme heat, and invasive species on soil properties and functions. Future research should evaluate the effects of soil amendments on soil properties and biogeochemical conditions, with specific attention to how different soil amendments impact the stability of co-contaminants. Finally, systematic research on the success on soil unsealing and associated measures of soil restoration warrants more detailed investigation.

Soil Analysis

To better understand LA soils' characteristics, we performed laboratory analysis to determine an array of soil properties for 39 soil samples collected by the U.S. Forest Service in the Los Angeles, California area. Standard soil testing methods from the Kellogg Soil Survey Laboratory Methods Manual (Soil Survey Staff, 2014) were used to characterize the soil samples. To prepare samples for analysis, air-dry samples were sieved to 2mm. The Air-Dry/Oven-Dry Ratio was determined and used to adjust test results accordingly. The following analyses were run: pXRF total elemental analysis, pH, texture by hydrometer, total carbon and nitrogen, and electrical conductivity (EC) by saturated paste extract. Descriptive statistical parameters including minimum, maximum, mean, and outliers were obtained in Microsoft Excel 2020 (see Appendix C for the full report of soil analysis).

Summary of Main Findings

Soil Texture: The majority of the samples analyzed were in the sandy loam texture class (56.41%) (Figure 8). The next most common class was loam (28.21% of samples). Across the greater Los Angeles area, a wide range of soil textures are present, ranging from sands through clays. The range of soil textures in these soils is in line with this typical range of textures.

pH: In 1:1 DI water, pH values ranged from 3.28-10.38, with an average pH of 6.48. In 2:1 0.1 M $CaCl_2$, pH values ranged from 3.40-10.28, with an average pH of 6.46. The average of LA soils' pH is 6.47. Most plants desire a soil pH range between 5.0-7.0.

Total Carbon and Nitrogen: Carbon (C) values range from 0.665% to 6.125% with an average of 2.65% (Note: These carbon values are similar in range to typical surface carbon values mapped in the area.). Nitrogen (N) values range from 0.034% to 0.576% with an average of 0.201%. Carbon/nitrogen (C/N) ratio values ranged from 8.344 to 56.402.

Electrical Conductivity: Electrical conductivity (EC) values range from 0.73 mS/cm to 15.3 mS/cm with an average of 3.2 mS/cm. Soils with an EC greater than 4.0 mS/cm are typically considered saline, though some crops are more or less salt tolerant than others. Ten of the samples are above that threshold, indicating that salinity may be a common challenge in these soils.

pXRF Total Elemental Analysis: See Table 5 for details.

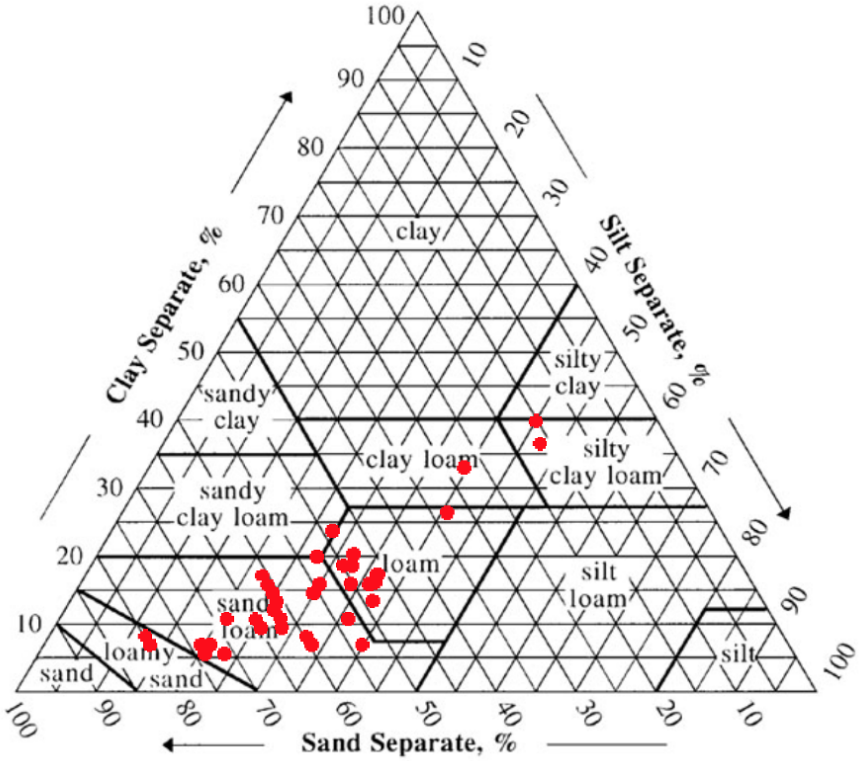


Figure 8. Texture classes for 39 samples plotted on soil texture triangle

Table 5. Heavy metal concentrations in LA County based on pXRF total elemental analysis (n=39)

Soil Heavy Metals*	Range	Average Values
Chromium	0-108.8 mg/kg	53.5 mg/kg
Iron	1.99-7.06%	3.85%
Cobalt*	0 mg/kg	0 mg/kg
Nickel	7.53-61.45 mg/kg	28.51 mg/kg
Copper	1-309.75 mg/kg	53.88 mg/kg
Zinc	10-787.5 mg/kg	224.79 mg/kg
Arsenic**	0-137.5 mg/kg	33.18 mg/kg
Mercury	0 to 1.61 mg/kg	0.1 mg/kg
Lead***	0-667 mg/kg	77 mg/kg

**Cobalt concentrations were not detected in any of the 39 samples.*

***For Arsenic in soils, the California residential human health screening level (HHSL) is 0.7 mg/kg and US EPA soil screening level (SSL) is 0.4 mg/kg (CITE). 26 of the soils measured exceeded both of these thresholds.*

****For lead in soils, the California residential HHSL is 80 mg/kg and US EPA SSL is 400 mg/kg (CITE). 3 of the soils measured exceeded the EPA level, while 9 of the soils met or exceeded the California threshold.*

To determine the needs of LA soils, we conducted four County-wide online surveys with residents, educators, policy-makers, and soil-related professionals. Furthermore, we held a series of seven focus groups virtually with the following stakeholder groups: 1) technical aspects of soil management including engineering, urban and sustainability planning, and local government; 2) urban residential landscaping/gardening and urban agriculture; and 3) and community non-profits and coalition groups. Additionally, we hosted a virtual Los Angeles Urban Soil Symposium and a virtual Los Angeles Urban Soil Workshop and co-hosted the "Soils: The Living Fabric of Health, 2020 Urban Soils Symposium" with the NYC Urban Soils Institute and RUDN University to learn from the community, experts, and other cities.

Online Surveys

Methodology of Online Surveys

Four online surveys (in both English and Spanish) were developed and disseminated to residents, educators, policy-makers, and soil-related professionals in LA County to determine their needs, knowledge, current practices, and priorities:

- Residential Survey: 46 questions assessing knowledge, values, and interests around soil; pro-soil and pro-environmental behaviors (e.g., composting, recycling, gardening, mulching); soil-related and environmental concerns (e.g., contamination, pollution, soil quality in public spaces); and use of public green spaces.
- Educator Survey: 40 questions assessing knowledge, values, and interests around soil; green spaces on campus; use of soil as a teaching tool; and available services on campus (e.g., composting, recycling, gardens).
- Policy-Maker Survey: 28 questions assessing knowledge, values, and interests around soil; available services (e.g., compost facility); dedicated annual funding for soil projects; and jurisdiction needs.
- Professional Survey: 25 questions assessing knowledge, values, and interests around soil; soil-related challenges (e.g., land use conflicts, soil compaction, pollution); and business practices related to soil and green waste.

Due to the size of LA County, we divided it into eight geographic regions using the LA County Department of Public Health service areas. To determine the number of surveys needed from each service area to be representative, the population of each region was calculated, and the population was divided by the total population of LA County (see Appendix D for the full report of online surveys). A total of 1,349 participants participated in the four online surveys including: 1) Residential survey: 1,104; 2) Educator survey: 139; 3) Policy-maker survey: 19; and 4) Professional survey: 87.

Highlights of Online Surveys

Are you concerned with environmental issues?

- In general, the majority of residents, educators, and policy-makers are concerned with environmental issues.
- More than half of policy-makers (67%), residents (63%), and educators (57%) are extremely concerned with environmental issues (Figure 9).

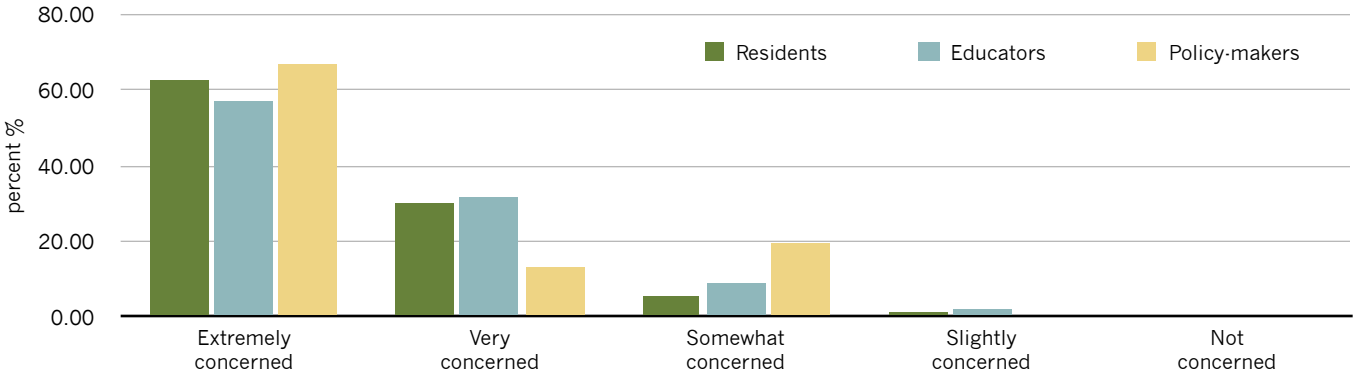


Figure 9. The level of concerns about environmental issues among residents, educators, and policy-makers

What does healthy soils mean to you?

Top four choices by residents, educators, policy-makers, and soil-related professionals are (Figure 10):

- Plants and trees grow well in the soil (n=1149).
- The soil contains organic matter and nutrients (n=1120).
- There are earthworms and insects in the soil (n=1047).
- There are no heavy metals or chemical contaminants (n=1017).

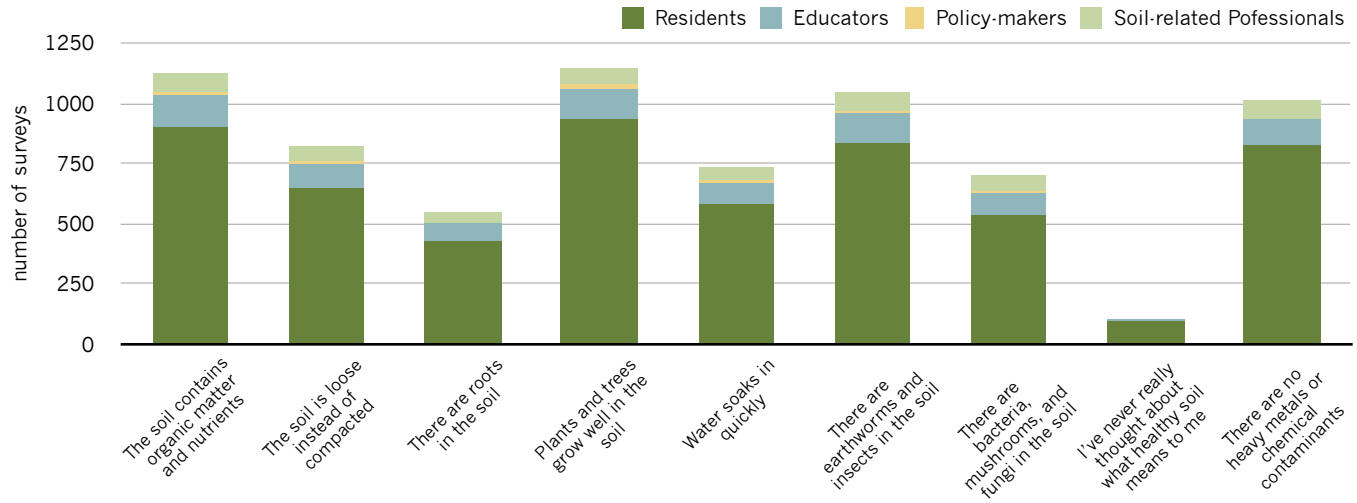
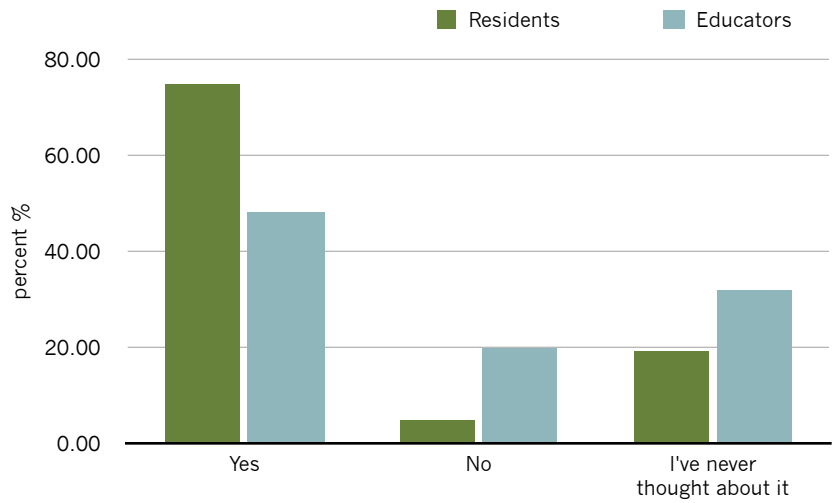


Figure 10. The definition of healthy soils by residents, educators, policy-makers, and soil-related professionals

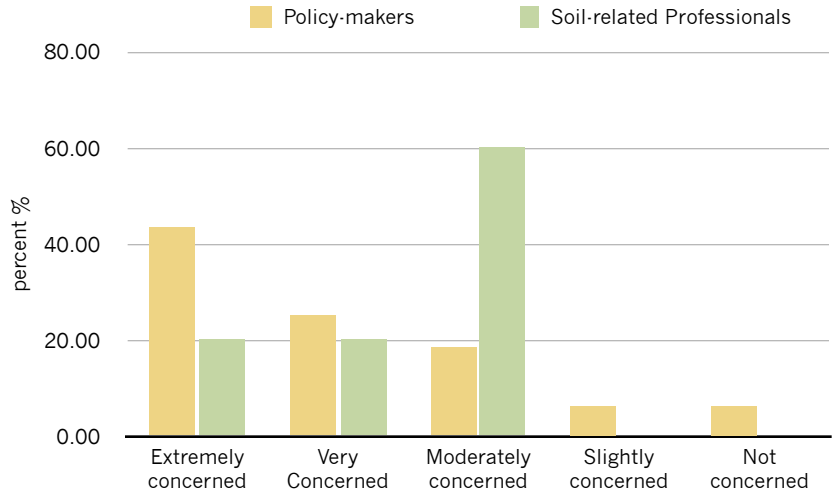
Are you concerned about soil contaminants and pollution?

In general, most of residents, educators, policy-makers, and soil-related professionals are concerned about soil contamination and pollution including (Figure 11):

- Residents: 76% self-reported that they are concerned about soil contaminants and pollution in their communities.
- Educator: 48% self-reported that they are concerned about soil contaminants and pollution on their school campuses.
- Policy-makers: 44% self-reported that they are extremely concerned about soil contaminants and pollution.
- Soil-related professionals: 60% self-reported that they are moderately concerned about soil contaminants and pollution.



Are you concerned about soil contaminants and pollution in your community or on your school campus?



How concerned are you about soil contaminants and pollution?

Figure 11. The level of concerns about soil contaminants and pollution among residents and educators (top), policy-makers and soil-related professionals (bottom)

Soil testing:

- Only 12% LA County residents self-reported that they have tested their soils.
- Only 8% LA County educators self-reported that they know that the soils on their campuses have been tested for contaminants (Figure 12).

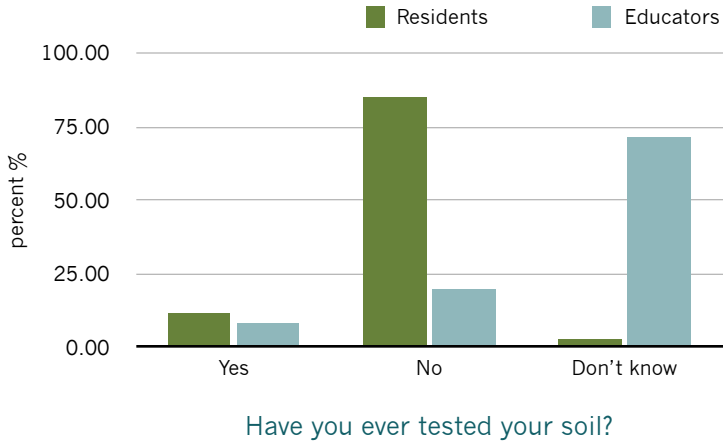


Figure 12. The percentages of residents/educators that have done/know about soil testing

The level of interests in soil-related topics:

- Educators: All of LA County educators self-reported that they are interested in the listed soil-related topics.
- Residents: About 99% LA County residents are interested in the listed soil-related topics.
- Soil-related professionals: Similarly, over 98% LA County soil-related professionals are interested in the listed soil-related topics (Table 6.).

Table 6. The level of interests in soils among residents, educators, and soil-related professionals (Note: the total number of interested includes extremely interested, very interested, moderately interested, and slightly interested)

	Residents		Educators		Soil-related Professionals	
	Not Interested	Interested	Not Interested	Interested	Not Interested	Interested
How soil impacts the nutrition and food security	16	1026	0	149	3	79
How soil stores carbon and slows down climate change	18	1016	0	147	1	82
Improving soil health	12	1013	0	148	1	82
How to control weeds without synthetic pesticides	26	1003	0	147	2	80
Soil water holding capacity and drought resiliency	17	1013	0	148	1	81
The relationship between soil health and human health	8	1021	0	149	0	82
How soil contamination affects environmental health	7	1026	0	149	1	82
How improving your soil quality can benefit your plants/trees	7	1026	0	148	1	80

Summary of Main Findings

Main Findings of Residential Survey

1. Soils-related Activities of LA County Residents:

- People in LA County value green space: 85% currently maintain a lawn, landscaped area, or green space of some sort, and they maintain that space by watering and weeding. They also pay attention to and have observed life such as earthworms and fungi in their soil, fertilize infrequently, and even more rarely use pesticides.
- Furthermore, 73% of them use the green bin for their green waste or, in many cases, allow green waste to compost in some form on the property (e.g., use it as mulch, leave it on the ground, or use a compost bin).
- Not surprisingly, the COVID-19 pandemic increased interest in gardening and spending time in green spaces, more so for renters than for homeowners. However, only 18% of residents said they grew vegetables in their green spaces, and only 15% reported having trees.

2. Soils Knowledge among LA County Residents:

- Among residents, knowledge about factors that affect soil health was low; 70% reported being not at all or only slightly knowledgeable.
- Further, 29% of residents have never attempted to learn about soil, and only 12% have ever tested their soil. The most common characteristics people tested for were soil pH and NPK, not contaminants such as heavy metals and petroleum hydrocarbons that are commonly found in urban soils.

3. Self-reported Soils-related Interests of LA County Residents:

- Interest in soil-related issues is high, with 76% of participants being either extremely or very interested in the topics listed on the survey.
- The top 5 topics (need in order) residents are most interested in learning about include: the relationship between soil and climate change; the relationship between soil and water pollution; geographic areas of LA where high levels of soil contamination exists; contamination risks associated with imported materials such as potting soil and compost; and how to reduce soil contamination exposure when gardening. The fact that 3 of these 5 topics relate to contamination isn't surprising given that 76% of residents are very or extremely concerned about soil contaminants and pollution in their community.

Main Findings of Educator Survey

1. Self-reported School Greening of LA County Educators:

- Seventy-nine percent of educators reported that their school has a green space or garden, and when asked to describe how that space looks, only 65% mentioned "trees."
- The unfortunate reality across LA County is that many children don't have access to a green space, or even to shade, during recess.

2. Soils Knowledge among LA County Educators:

- 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. This lack of knowledge might help to explain why, despite the fact that most teach classes in which lessons around soil could easily be incorporated, only 30% currently do so and only 37% would feel comfortable doing so.
- Educators expressed high interest in learning about soil; 81% are very or extremely interested in learning more.

3. Self-reported Environmental Concerns of LA County Educators:

- Despite the fact that 88% of educators expressed being concerned about environmental issues, only 48% are concerned about soil contaminants and pollution, which is far less than policy-makers (70%), professionals (77%), and residents (76%). In fact, 32% said they had never even thought about this issue.
- Given the fact that 66% of educators use or know another teacher who uses green spaces on campus to teach, their lack of concern about contaminants could mean teachers are inadvertently exposing students to contaminants.

Main Findings of Policy-Maker Survey

1. Soil Contamination Concerns of Policy-makers:

- Soil contamination in LA is wide-spread in many communities. It is no surprise, then, that 70% 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.

2. Self-reported Soils-related Interests of Policy-makers:

- Interest in learning more about soil-related topics is quite high, especially for topics including: soil policy and funding opportunities; the relationship between soil and water pollution; the relationship between soil and climate change; geographic areas of LA where soil contamination is the highest; and the need for soil specifications for particular uses (e.g., street plantings vs. rain gardens).
- One participant said, "soil-health is not as big of a priority as either public safety or health of residents."

3. Self-reported Compost and Mulching Facilities of Policy-makers:

- Compost facilities are present in roughly 33% of the jurisdictions, and 62% of those facilities are maintained by the municipality.
- Mulching facilities are present in 39% of jurisdictions, and 67% of those facilities are maintained by the municipality.

Main Findings of Professional Survey

1. Soil Contamination Concerns of LA County Soil-related Professionals:

- Like policy-makers, 77% of professionals are highly concerned about soil contamination, but only 17% believe their customers feel the same way.

2. Self-reported Landscape Design of LA County Soil-related Professionals:

- Eight-five percent of professionals usually or always use turf grass in their designs. While grass can help prevent urban heat island effects, water consumption for turf grass ranges between 50% and 70% of total urban landscape water consumption, particularly in summer months, making it a less desirable ground cover than drought-tolerant alternatives.

3. Self-reported Compost and Mulching Needs and Facilities of LA County Soil-related Professionals:

- Despite the fact that 70% of professionals use mulch, only 30% use the green waste from their projects as mulch, and only 31% either take green waste from their projects to a city compost facility or compost it at their business.
- Stated barriers to composting include: no facility available (48%), insufficient time (19%), and cost (14%).

Disconnects/Gaps

- Seventy-six percent of LA county residents are very or extremely concerned about soil contaminants and pollution in their community. However, only 12% of them have tested their soils.
- Despite the fact that 88% of LA County educators expressed being concerned about environmental issues, only 48% are concerned about soil contaminants and pollution, which is far less than policy-makers (70%), professionals (77%), and residents (76%). In fact, 32% said they had never even thought about this issue.
- Seventy percent 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.

Focus Groups

Background and Methodology

In support of identifying the most pressing urban soil issues and community needs through community consultation, a series of seven virtual focus groups were held from October-December 2020 to assess perceptions, needs, and concerns regarding urban soil systems. Two focus groups were held for each of the following stakeholder groups: 1) technical aspects of soil management including engineering, urban and sustainability planning, and local government; 2) urban residential landscaping/ gardening and urban agriculture; and 3) and community non-profits and coalition groups. Participants were asked general questions regarding urban soil needs, challenges, solutions, and opportunities, as well as more specific questions related to their stakeholder group. The seventh and final focus group involved representatives from previous stakeholder groups to form a cross-disciplinary group to synthesize overarching themes and identify future directions (see Appendix E for the full report of focus groups).

We engaged with a total of 41 individuals from the community: Twelve individuals participated in the technical aspects of soil management including engineering, urban and sustainability planning, and local government group; seventeen individuals participated in the urban residential landscaping/ gardening and urban agriculture group; and twelve individuals participated in the community non-profits and coalition group. We asked participants to complete a brief exit survey upon completion, 38 (of 41) completed the survey. Of those 34 responded that they were interested in attending a synthesis focus group, three responded maybe, and one was not interested in attending a synthesis focus group. Seventeen participants returned for the final synthesis focus group: five from the community non-profit and coalition group, five from the technical & policy group, and seven from the residential landscaping/gardening and urban agriculture group, for a total of 58 engagements.

> ***And so I just know that while we continue to have these dialogues and meet at the table to talk about policy, we're on our way to making that change.***
>
> ***—Focus Group Participant***

Summary of Focus Group Results

Key themes from the focus groups provide important information about the need and priorities regarding urban soil systems; however, perhaps the most telling are the cross-cutting themes that were present across all groups. The cross-cutting themes emphasized, in particular, the need for a systems approach to healthy soils that integrates both social and ecological concerns and has clearly defined goals and outcomes. The importance of effective and meaningful community engagement was emphasized, including the need to address mistrust and past harm. Overwhelmingly, participants wanted an inclusive approach to healthy soils that recognized, valued, and centered the existing work of BIPOC (Black, Indigenous, and People of Color) communities, including youth and neighborhood councils. There was consistent interest in programming that addressed distributed & coordinated composting/food waste diversion as well as accessible, transparent soil data and testing. Finally, the need for building alliances among community and policy and science professionals was recognized as well as the need for streamlined communication produced for, and in some cases by, underserved communities. Many participants mentioned that they appreciated the opportunity to connect with others in the region around healthy soil goals and expressed interest in continued conversation. Of the respondents that completed the final focus group exit survey, 100% were interested in receiving updates about the project. However, some also voiced frustration over a lack of action-oriented work, insufficient funding, and the need for more inclusive representation from historically minoritized groups.

In the final synthesis focus group, participants were asked to rank action items that were the highest priority or represented the most immediate need. There was interest in several that could be supported in the next phase of this initiative, including working with the City of LA to develop a holistic soil strategy that includes social and ecological dimensions of soil and centers racial justice in urban soil work. Participants also considered support for equitable land access a high priority and specifically prioritized the evaluation of public land to support healthy soils. Demonstration projects that address legacy pollution and improved communication strategies for researchers and communities were also ranked as a high priority or immediate need.

There was a strong desire and consensus around future work needing to effectively engage and center communities, working to build trust and address past harm. Notably, almost all of the big/future soil ideas that were proposed by participants emphasized the role of community. The role of community was not just seen as simply participating, but in defining, implementing, and promoting future urban soil work. Future work should therefore emphasize community leadership through shared power in decision making and resource allocation.

Learning from Others and Communities

To better understand community needs and information gaps and to learn from our cities and experts, we hosted a virtual Los Angeles Urban Soil Symposium and a virtual Los Angeles Urban Soil Workshop and co-hosted the Soils: The Living Fabric of Health, 2020 Urban Soils Symposium in 2020.

Virtual Los Angeles Urban Soil Symposium

As part of the needs assessment, TreePeople hosted a full-day virtual Los Angeles Urban Soil Symposium on June 26, 2020 which was attended by over 150 people. In the morning, we started the symposium with opening remarks by Cindy Montañez (Chief Executive Officer, TreePeople) and keynote Address by Ben Allen (California State Senator, 26th District), Dr. Rita Kampalath (Sustainability Program Director, Los Angeles County Chief Sustainability Office), and Dominique Hargreaves (Deputy Chief Sustainability Officer, Office of Los Angeles Mayor Eric Garcetti). Then we had several experts discuss urban soil in general and LA's soils along with a case study from New York City. During the lunch time, Andy Lipkis (Project Executive, Accelerating Climate Resilience) and Irma R. Muñoz (Founder/President, Mujeres de la Tierra) delivered the keynote address. In the afternoon, we had several experts discuss potential issues and solutions of urban soils. Additionally, we also did breakout group discussions between presentations to provide opportunities for the participants to share their insights about LA soil needs, challenges, and potential solutions and to interact with others from the region and beyond (See Appendix F for the agenda). Here is a summary of the breakout group discussion:

Top five needs:

- Public education to raise awareness of the importance and potential of soils.
- Accurate, accessible, and site-specific soil data and information in LA.
- Community-based actions to enhance/restore soil health and remediate soil contamination;
- Need political support for soil related policies and programs.
- Need more and in-depth research on LA's soil to provide science-based information for the above.

Top five challenges for communities:

- How do we enhance community engagement?
- How do we communicate and collaborate more effectively across different stakeholders?
- How do we increase funding for soil related projects?
- Where and how can the public/communities get access for soil testing over the long term?
- How can we provide accessible public education and actionable research?

Top five potential solutions:

- Engage communities, especially those most impacted communities by soil contamination and other soil related issues, and implement best soil management practices (e.g., soil specifications, compost, mulch, soil protection before, during, and after construction).
- Prioritize communications and collaboration with disadvantaged, minority (e.g., Indigenous-American), and non-English speaking communities.
- Utilize online platforms and social media to raise public awareness and to augment LA's soil information through community science approaches.
- Bridge the gap between scientists and communities.
- Develop policies that recognize and incentivize soil as brown infrastructure and promote "green-blue-brown" infrastructure as a holistic approach to build climate resilience and healthy communities.

Top five potential opportunities:

- Make public education on soils fun and accessible through new media platforms (e.g., podcasts, art, and social media).
- Connect soil health with food production, water supply and water quality, climate resilience, and other regional and global environmental issues.
- Develop mechanisms and policies to monetize ecosystem services provided by soils.
- Establish public-private and cross-sector partnerships including community-based organizations.
- Develop online and public-accessible tools to help communities better utilize LA's soil survey data and information.

Virtual Los Angeles Urban Soil Workshop

A half-day Virtual Los Angeles Urban Soil Workshop was held on October 28, 2020 aiming to share the preliminary findings, identify research gaps, and discuss next steps. It was attended by about 50 people including researchers, policy-makers, NGOs, community groups, and other key stakeholders (see Appendix G for the agenda). We had several leading experts in the field at the workshop and they shared their soil research in the LA regions or the work in other cities that can be applied in the region. Additionally we conducted breakout group discussion regarding the data/information gaps, key research questions, demonstration ideas, and key stakeholders at the end. Here is a summary of the breakout group discussion:

Data/information gaps:

- Need for more spatially and site specific measurements on soil biotic characteristics, water retention, infiltration and use of reclaimed water; soil carbon (inorganic and organic); and soil mineralogy.
- Creation of open access map and archival database of soil measurements, soil interpretations, historic land use, and potential soil contaminant sources.
- Need the ability to predict spatio-temporal changes in soil conditions (i.e. soil formation, chemical, biologic, physical properties) of urban landscapes or urban mosaic?
- Need to define healthy and unhealthy soils as they relate to different uses and create indicators of soil related ecosystem services and health, and do this for different audiences and stakeholders.
- Research on site-specific remediation strategies and use of soil banks to reclaim or restore highly impacted soils.

Key research questions for phase 2:

- Soil contamination and remediation:
  - How do soil contaminants/chemical profile develop "riskscapes"; how is the risk of exposure influenced by watershed runoff, erosion, fire, and how can this understanding inform management practice and project implementation?
  - What soil remediation strategies are suitable for addressing contamination in parkways, and how might these strategies be implemented in ways that are labor- and cost- effective?
- Soil health impacts on human health:
  - How does soil health impact or relate to impacts of human mental health?
  - What is at the intersection between community health, soil/ecosystem health and social limiting factors such as residential conditions/housing status?
  - Relating social demographics to human activities that we predict will affect soil formation.
- What are the ecosystem services of soils specific to Los Angeles; considering the social, economic, and political factors of our region, what services are relevant?
- Soil health measurements:
  - What parameters should we use to quantify urban soil health?
  - What are the effects of climate change on urban soil health?
  - In what ways are increased temperatures and elevated levels of CO_2 affecting soil quality, and how can these effects be overridden by soil management practices?
  - How do these changes compare across land types?

Demonstration project ideas for phase 2:

- Feasibility studies of community-led and community-based mitigation and remediation projects around enhancing soil health.
- Rhizotron and core samples for visualization and monitoring equipment to collect and understand soil dynamics in a "teachable" way.
- Demonstrate how parkland use, development, and management can improve soil health.
- Demonstrate how to effectively communicate with diverse stakeholders about soil contamination and remediation techniques.
- Using public education and community outreach programs to communicate about soil contamination issues.
- Using different communication platforms (e.g., social media, web portals) to communicate about soil contamination issues.
- Pilot composting programs in schools.

Soils: The Living Fabric of Health, 2020 Urban Soils Symposium

In collaboration with NYC Urban Soil Institute (USI) and RUDN University, TreePeople co-hosted Soils: The Living Fabric of Health, 2020 Urban Soils Symposium from October 2 to October 31, 2020. A series of virtual events, including session themed talks, discussions, interactive workshops, performances, entertainment, exhibits, roundtables, and a library of resources on various soil perspectives, were held on every Friday and Saturday in October.

Conclusions of the Needs Assessment

Based on the needs assessment, we identified the following community and informational needs:

Community Needs

Top Three Needs for LA County Residents:

- Given many regions in LA County are considered food deserts, and that extreme heat events have increased dramatically in the past decade, finding ways to encourage food gardens and tree canopy should be prioritized.
- Helping residents get access to soil test kits and/or information about the soils in their community should be a priority.
- With interest high and knowledge low, creating and promoting existing opportunities for residents to learn about soil should be made a priority.

Top Three Needs for LA County Educators:

- Working to increase tree canopy and provide tree maintenance until young trees are established in LA County's primary and secondary schools should be prioritized.
- With interest high and knowledge low, offering soil-related workshops to teachers could increase student educational opportunities around soil, particularly if these workshops are infused into those that offer Continuing Education credit.
- Educating teachers about contaminants and/or offering soil testing on campuses should be made a priority.

Top Three Needs for Policy-makers:

- Advocating for and/or educating policy-makers about the importance of soil health and the necessity of soil-specific funding, protections, and policy.
- Educating policy-makers about the relationship between soil health, public health, and safety could be an effective way to gain budgetary support for soils.
- Expanding the availability of composting and mulching facilities could help municipalities in LA County contribute to LA's waste diversion goals, while also making soil amendments more widely available to residents and developers. Furthermore, requiring all new developments to use compost and mulch would greatly improve soil health and water retention. Advocating for such changes is critical.

Top Three Needs for LA County Soil-related Professionals:

- The disconnect between experts' reported beliefs about residents (i.e., that residents are not concerned about soil contamination) and what residents themselves reported (i.e., that they are highly concerned about soil contamination) may mean soil-related issues are not being communicated clearly and consistently.
- Encouraging professionals to protect and improve soil health can reduce irrigation needs.
- Determining which of the barriers listed are perceived rather than actual barriers would be helpful for increasing the diversion rate for compostable material.

Top Five Priorities Identified by the Synthesis Focus Groups:

- A holistic soil strategy that includes social and ecological dimensions of soil and centers racial justice and environmental justice in urban soil work.
- Equitable land access, especially the evaluation of public land to assess the health of soils.
- Demonstration projects that address legacy pollution and improved communication strategies for researchers and communities.
- Effective engagement that centers communities, working to build trust and address past harm.
- Emphasizing community leadership through shared power in decision making and resource allocation.

Informational Needs

In addition to community needs and priorities, informational needs also emerged, including:

- Building on the existing soil survey to make it more accessible and user-friendly:
  - Need for more data on soil contamination, carbon, organic matter, water holding capacity, and biodiversity.
  - Need for more appropriate soil interpretations for urban uses.
  - Need for long-term monitoring of soil properties (e.g., to evaluate post-fire land restoration or soil contamination remediation).
- Building community and community science for LA soils:
  - Training programs for the public, students, and educators.
  - User friendly soil sensors, smartphone apps, and interactive online maps.
  - Developing accessible and affordable soil testing.
  - Developing data management and sharing systems.
- Exploring and testing potential solutions for soil management.
- Quantifying ecosystems services and benefits of LA soils (e.g., carbon sequestration, stormwater management, climate resilience).
- Developing educational materials for educators, students, and the general public.

Overall Framework

Figure 13. The framework of phase two

To address the identified needs, we developed an overall framework for phase two of this initiative, which proposes to establish an overall strategy for a Los Angeles Urban Soil Collaborative. The strategy will be developed through community, government, NGOs, academia, and the private sector participation. Under this framework, we propose a set of core activities, demonstration projects, community outreach programs, and the scaling up of these activities through the development of local, regional, national, and international collaborations.

Recommendations for Next Steps

Strategic planning: As the first step, we strongly recommend developing an overall strategy working with communities, NGOs, government agencies, the private sector, and academia. This was a high priority identified in the focus groups.

Core activities: Based on survey responses, core activities should include community-based soil testing, data sharing, and establishing an online learning center. These activities will increase community access to soil information and knowledge.

Demonstration projects: To showcase potential solutions for LA soils, we recommend demonstration projects that incorporate green-blue-brown infrastructure, fire prevention and post-fire soil restoration, soil remediation and restoration, the "farming" of carbon, and the creation of edible landscapes in schools. Wherever possible, projects should be accomplished in partnership with existing efforts, but those that have not historically included soil health in their planned activities.

Community outreach: Community outreach was identified as a high priority across the board. We recommend the following activities to raise awareness, to build capacity, and to provide technical and financial support for communities: community small grants programs (where possible), communications and marketing, training and education, employ community-based science projects, and community oriented events.

Scaling up: To scale up through partnerships and collaboration, we propose the following ways to create and share ideas and learn from others' experiences: developing innovative policy recommendations to protect and restore urban soil health; developing new technology and tools, planning & design concepts; conducting multi-city soil online surveys; participating in a global urban soil network that shares information, ideas, and data; and hosting or participating in festivals with other cities and other relevant events.

Appendices

Appendix A: Los Angeles County land cover in 2016

Appendix B: The full report of literature review

Appendix C: The full report of soil analysis

Appendix D: The full report of online surveys

Appendix E: The full report of focus groups

Appendix F: The agenda of Los Angeles Urban Soil Symposium

Appendix G: The agenda of Los Angeles Urban Soil Workshop

Appendix H: References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