Los Angeles Urban Forest Equity:
Assessment, Tools, and Recommendations

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Prepared by the Los Angeles Urban Forest Equity Collective

Primary Authors: Dana Hellman, Edith de Guzman & Rachel O'Leary
Contributing Authors: Cindy Chen, Krystle Yu & Vivek Shandas

Land Acknowledgement

The Urban Forest Equity Collective (UFEC) acknowledges our presence in the ancestral territory of Tovaangar. This is unceded land. Their homes and livelihoods were destroyed. The Gabrieleño Kizh, Tataviam, Ferdandeño and Tongva peoples and nations are the traditional land caretakers, and we pay our respects to their Ancestors, Elders, and Relatives past, present, and emerging. Acknowledgement is a simple, powerful way of showing respect and a step toward correcting the stories and practices that erase Indigenous people's history and culture and toward inviting and honoring the truth.

Executive Summary

The Urban Forest Equity Collective (UFEC) is a consortium of forestry experts, Los Angeles (LA) City staff, community-based organizations, researchers, and consultants aiming to create holistic strategies to advance urban forest equity in the lowest-canopied neighborhoods. By conducting a holistic analysis and creating strategies to advance urban forest equity in LA, UFEC presents methods to address decades of systemic disinvestment and planning decisions that have resulted in poor public health outcomes, limited access to green spaces, and a host of related consequences ranging from heat exposure and poor air quality, to food insecurity and reduced ecosystem services.

This report offers a summary of assessments conducted, tools created, knowledge gained, partners engaged, and recommendations developed during Phase II of UFEC's work, which took place from 2021 to 2023. This report is one of five outputs resulting from Phase II:

1. Los Angeles Urban Forest Equity: Assessment, Tools, and Recommendations
2. Los Angeles Urban Forest Equity Neighborhood Strategy: Central Alameda
3. Los Angeles Urban Forest Equity Neighborhood Strategy: Sylmar
4. Los Angeles Urban Forest Equity Design Guidebook
5. Urban Forest Equity Community Action Toolkit

In a prior phase (Phase I), UFEC introduced a novel system of classifying urban space, the Planting Tiers Framework, which allows planners and decision makers to consider varying levels of planting difficulty based on constraints in the built environment, where Tier 1 is lowest difficulty and Tier 3 is highest. This framework was initially developed and discussed in 2021 via two key publications: the 'Los Angeles Urban Forest Equity Assessment Report' and the 'Los Angeles Urban Forest Equity Streets Guidebook.' In Phase II, we sought to contribute new knowledge pertaining to urban forest equity and canopy expansion within the three planting tiers; develop an evidence-based decision-making framework to guide urban forest equity investments; and co-create community-driven visions for neighborhood transformation. Phase II activities included in this report are as follows.

Neighborhood Selection Process: UFEC developed a decision-making framework which allows practitioners to functionally identify priority forest equity areas within Los Angeles. This process incorporates quantitative factors such as existing canopy cover, impervious surface cover, income, exposure to urban heat and air pollution, and select socio-demographic indicators. The final step relies on a qualitative assessment of community readiness and feasibility. Using this replicable selection process, the UFEC team narrowed down 1,722 census tracts in Los Angeles to 155 tracts with a high need for forestry interventions, representing 30 neighborhood councils, and ultimately identified two pilot neighborhoods for community-engaged urban forest planning.

Policy Analysis & Discussion: UFEC identified possible interventions that could be implemented across each of the three planting tiers, including challenges and tradeoffs associated with each, and case study examples. We also reviewed relevant codes and policies which might support, inhibit, or otherwise interact with tree canopy expansion efforts. This segment of the report also addresses another facet of urban forestry equity: mature tree preservation. We introduce a 'Preservation Tiers Framework' which complements the Planting Tiers Framework and offers guidance on how to incorporate and balance preservation with planting.

GIS Analysis & Discussion: UFEC GIS analysts refined existing models and developed new ones to determine how close to its 'Green New Deal' (Sustainable City pLAn) goal of 50% canopy increase in areas of greatest need the City of LA could get by planting in select Tier 1 sites (parkways and private yards). The assessment showed that desired canopy increases could be achieved in nearly all LA council districts through Tier 1 planting, though limitations on private planting affirm the need to incorporate Tier 2 and Tier 3 sites. Analysts also explored the cost of tree planting and establishment maintenance, as well as canopy change over time. This section also offers a calculation of excess roadway space in LA, which could accommodate Tier 3 tree planting, and discusses an interactive web-based mapping tool where practitioners can explore the neighborhood selection process.

Equity Metrics & Indicators: With the input of diverse partners from research and practice, UFEC articulated a clear set of site selection indicators and equity metrics to guide the operationalization of urban forest equity. These account for multiple types of equity (distributional, recognitional, and procedural), and suggest relevant targets, thresholds, and data sources. We also offer guidance, informed by case study literature, on maximizing the benefits of tree canopy for specific aims such as heat mitigation or air quality improvement.

Phase II Recommendations:

1. Foster diverse partnerships and build upon existing and emerging resources and knowledge
2. Account for multiple facets of equity, not just distributional
3. Be transparent and systematic in urban forestry-related decision making
4. Lead with evidence — including evidence embedded in community perspectives and experiences — when designing planting projects, and track impacts and outcomes
5. Actively engage community members in goal setting, data collection, project planning, and project design
6. Plan for shade trees at the beginning stages of public works, capital improvement, and active transportation projects, especially in neighborhoods where available space for public trees does not currently exist
7. Apply urban forest equity concepts to local policy and plan development
8. Develop programs to incentivize and support tree planting on private property
9. Integrate preservation in urban forestry work
10. Acknowledge the persistence of insufficient resources and proceed with available resources

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Introduction

[1] All references to Los Angeles (LA) within this document refer to Los Angeles City, not County, unless explicitly noted otherwise.

The Urban Forest Equity Collective (UFEC) has recently concluded Phase II of a multi-year project focused on tree canopy equity in Los Angeles (LA). [1] This report serves to remind readers of UFEC's overall structure, purpose, and activities in Phase I; summarize and discuss our processes and findings from Phase II; and offer future recommendations. This report is intended for any individuals or organizations with a role or interest in urban forest equity, both in Los Angeles and beyond. The contents are descriptive – both reflective and prospective – and may serve as a base upon which urban foresters, policymakers, researchers, community-based organizations and others conceive of or advance the critical and urgent work of ensuring equal access to trees and their benefits. We acknowledge that this work is ongoing: there is much to be done on the fronts of community engagement, policymaking, and planning to achieve urban forest equity across LA, and the tools and resources we provide here can and should be revisited and refined.

The Los Angeles Urban Forest Equity Collective Model

Vision Statement

Los Angeles communities and leaders recognize the systemic causes and impacts of urban forest inequity and work together to dismantle the physical, political, and social barriers that perpetuate it. Los Angeles is actively growing, protecting, and prioritizing an accessible, inclusive, and adequately funded urban forest for all Angelenos. By advancing urban forest equity, Los Angeles will build climate resilience and enduring protection for our frontline communities.

Who is UFEC?

The Urban Forest Equity Collective (UFEC) is a consortium of urban greening experts, City of Los Angeles staff, community-based organizations, researchers, and consultants. This collaboration among interdisciplinary, cross-sectoral partners imbues UFEC's work with a uniquely holistic, multi-faceted lens on urban forestry issues spanning ecological and social concerns, spatial characteristics, community buy-in, implementation, and policy. Organizations represented in the UFEC include City Plants; LA Office of Forest Management; LA Bureau of Street Services (StreetsLA); LA Bureau of Sanitation & Environment (LASAN); LA Department of Public Works (DPW); LA Department of Water and Power; LA Department of Recreation & Parks (RAP); University of California Los Angeles Luskin Center for Innovation (UCLA); University of California Division of Agriculture & Natural Resources (UC ANR); University of Southern California Urban Trees Initiative (USC Trees); TreePeople (TP); North East Trees (NET); South LA Tree Coalition (SLAT); California Climate Action Corps; CAPA Strategies (CAPA); STOSS Landscape Urbanism (STOSS); and others.

Primary Goals

The UFEC project aims to create a holistic analysis and strategy to advance urban forest equity in LA's lowest-canopied neighborhoods.

We aim to address decades of systemic disinvestment and misinvestment that have resulted in poor public health outcomes, limited access to green spaces, and a host of related consequences ranging from heat exposure and poor air quality, to food insecurity and reduced ecosystem services.

This is to be done in a manner that enables co-production of knowledge; integration of theory, research and practice; meaningful community engagement and resident input; and the identification of pathways from research and analysis to planning and implementation.

UFEC is intended to provide a replicable framework that can be used regionally and beyond Los Angeles.

Our Approach

UFEC's approach features several novel qualities which are well-suited to the complexity of Los Angeles urban forestry. First, the 'collective' nature of this group ensures co-production of knowledge which accounts for multiple, potentially conflicting perspectives among stakeholders. By capturing many relevant perspectives in each step of our process and adjusting accordingly, UFEC's outputs and recommendations are grounded in reality, and may be more practical than recommendations conceived in a vacuum. For example, UFEC consultants and researchers share best practices from literature, or community groups capture residents' goals, while LA City staff check those ideas against local implementability or anticipated political challenges.

Second, the UFEC approach seeks out and centers community voices in strategy development. Past urban greening efforts in LA and beyond have tended to either take a top-down approach, through which decision makers set priorities and conduct planting without the meaningful input of those who are affected both by lack of current canopy and new planting projects, or to take a bottom-up approach, where resources are often insufficient to support long-term, evidenced-based strategies. To advance urban forest equity, it is essential for efforts to draw from both top-down and bottom-up knowledge and resources. Plans for canopy expansion must account for and respond to the stated needs of localized communities that trees are meant to serve, and plans must be informed by the best-available science and policy methods.

Third, UFEC's work is not limited to the confines of a specific group or

Introduction

[2] National Association of Colleges and Employers (2023). What is equity? https://www.naceweb.org/about-us/equity-definition

[3] Grant, A., Millward, A. A., Edge, S., Roman, L. A., & Teelucksingh, C. (2022). Where is environmental justice? A review of US urban forest management plans. Urban Forestry & Urban Greening, 77, 127737.

funding timeline. Throughout the process, membership in UFEC has been flexible, with new consultants, advocates, and partners added at various stages. Furthermore, the UFEC team has consciously sought opportunities to integrate their work with ongoing projects led by the City, County, or partner organizations. UFEC's approach and outputs are structured such that they may be indefinitely adopted and adapted by others working in the forest equity space.

Defining 'Urban Forest Equity'

The concept of social equity may generally be defined as follows: "Equity refers to fairness and justice and is distinguished from equality. Whereas equality means providing the same to all, equity means recognizing that we do not all start from the same place and must acknowledge and make adjustments to imbalances. The process is ongoing, requiring us to identify and overcome intentional and unintentional barriers arising from bias or systemic structures." [2] This definition is informative, but leaves some uncertainty about the concept of equity, how it applies to an urban forestry context, and how it could be integrated into UFEC processes. The team articulated a nuanced definition of 'urban forest equity' to guide our work.

Our definition of urban forest equity relied primarily on a three-pronged conception encompassing distributional, recognitional, and procedural components. [3] For UFEC this included, respectively: the distribution of trees and access to tree benefits targeted to marginalized or disinvested communities; meaningful involvement of those communities and a recognition of historical context in urban forest planning, implementation and stewardship; and access to information and decision-making processes for underserved communities, transparency, and impartiality in decision making or the provision of services.

The definition requires that those disinvested target communities, also known as 'forest equity areas,' be identified. UFEC defined equity areas as those census tracts and neighborhoods in LA with the greatest physical, economic, and socio-demographic need. Specifically, our approach to equity prioritized areas that feature low tree canopy and a high proportion of impervious surface, have below average income, and feature the socio-demographic characteristics often shown to be associated with lower rates of greenery, and higher rates of air pollution and urban heat exposure. Greater detail on this approach is provided in the section Neighborhood Selection Process.

Background

Background

Why Does Urban Forest Inequity Persist in Los Angeles?

Urban forest equity is affected by numerous factors ranging from biophysical conditions to sociocultural processes.[4 5 6] Biophysical factors include climate zone, precipitation patterns and averages, soil type, and topography, among others, and the Los Angeles region is unusually diverse across all of these categories. In arid and semi-arid regions like Southern California, where summers are typically dry, trees must receive supplemental watering during the multi-year establishment period in order to survive, which presents a significant challenge in many neighborhoods.

Establishing, maintaining, and preserving the urban forest requires long periods that can span years or decades, and thus current conditions may be inherited and serve as reflections of past preferences and processes rather than current forces.[5 7 8] Many of these forces have led to systemic segregation and have important implications for health.[9] One such historical driver is redlining, a federal government practice of refusing home loans and insurance based on neighborhood safety and desirability rankings tied to race, leading to neighborhoods with high concentrations of minority residents receiving little investment relative to white communities. The practice was in place from the 1930s until the passage of the Fair Housing Act of 1968, yet more than half a century later, the legacy patterns of disinvestment are still evident today and continue to be perpetuated by ongoing discriminatory practices evident in racial gaps in loan denial and mortgage cost,[10] as well as problematic urban planning policies such as urban renewal. A 2020 peer-reviewed article co-authored by Dr. Vivek Shandas (advisor for CAPA Strategies and a member of UFEC) made a seminal contribution to our understanding of the legacy impacts of redlining on urban forest equity. The spatial assessment of 108 urban areas in the U.S., including LA, found that in 94% of cases formerly redlined neighborhoods presently have two to three times less tree cover and are on average 2.6°C (4.7°F), and up to 7°C (12.6°F), hotter than their non-redlined counterparts.[11] Another assessment of the impact of redlining on cities including LA found that redlined neighborhoods receiving the lowest grade of "D" had an average 23% canopy, while neighborhoods with an "A" grade had an average 43% canopy.[8] Currently, in many cities, trees also lack protection in the face of redevelopment trends and unprecedented housing demand, which favor larger homes and higher ratios of hardscape, all while urban forest inequity persists between higher- and lower-income neighborhoods.[12 13] Urban forest equity depends not only on strategic new tree planting and care, but perhaps more importantly, on mature tree preservation.

[4] Volin, E., Ellis, A., Hirabayashi, S., Maco, et al. (2020). Assessing macro-scale patterns in urban tree canopy and inequality. Urban Forestry and Urban Greening, 55.

[5] Schwarz, K., Fragkias, M., Boone, C., et al. (2015). Trees grow on money: Urban tree canopy cover and environmental justice. PLoS ONE, 10(4).

[6] Riley, C.B. & Gardiner, M.M. (2020). Examining the distributional equity of urban tree canopy cover and ecosystem services across United States cities. PLoS ONE 15(2):e0228499.

[7] Boone, C. G., Cadenasso, M. L., Grove, J. M., et al. (2010). Landscape, vegetation characteristics, and group identity in an urban and suburban watershed: Why the 60s matter. Urban Ecosystems, 13, 255–271.

[8] Locke, D. H., Hall, B., Grove, J. M., et al. (2021). Residential housing segregation and urban tree canopy in 37 US Cities. NPJ Urban Sustainability, 1(1), 15.

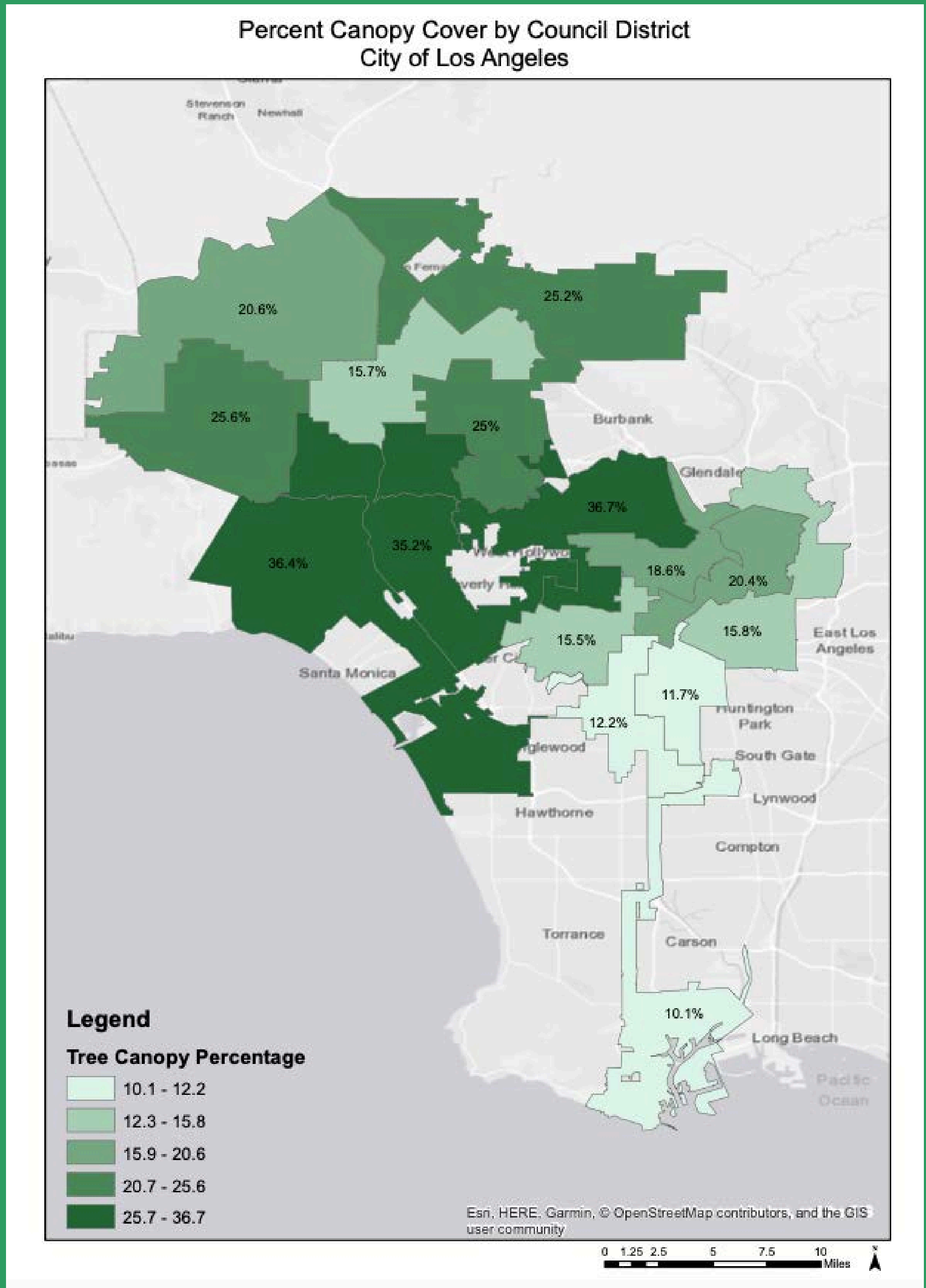
[9] Jesdale, B.M., Morello-Frosch, R. & Cushing, L. (2013). The Racial/Ethnic Distribution of Heat Risk-Related Land Cover in Relation to Residential Segregation. Environmental Health Perspectives, 121(7), 811–817.

[10] Quillian, L., Lee, J. J., & Honoré, B. (2020). Racial discrimination in the US housing and mortgage lending markets: a quantitative review of trends, 1976–2016. Race and Social Problems, 12, 13-28.

[11] Hoffman, J. S., Shandas, V., & Pendleton, N. (2020). The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas. Climate, 8(1), 12.

[12] Lee, S. J., Longcore, T., Rich, C. & Wilson, J.P (2017). Increased home size and hardscape decreases urban forest cover in Los Angeles County's single-family residential neighborhoods. Urban Forestry & Urban Greening, 24, 222-235.

[13] Pincetl, S. (2010). Implementing municipal tree planting: Los Angeles million-tree initiative. Environmental Management, 45(2), 227–38.

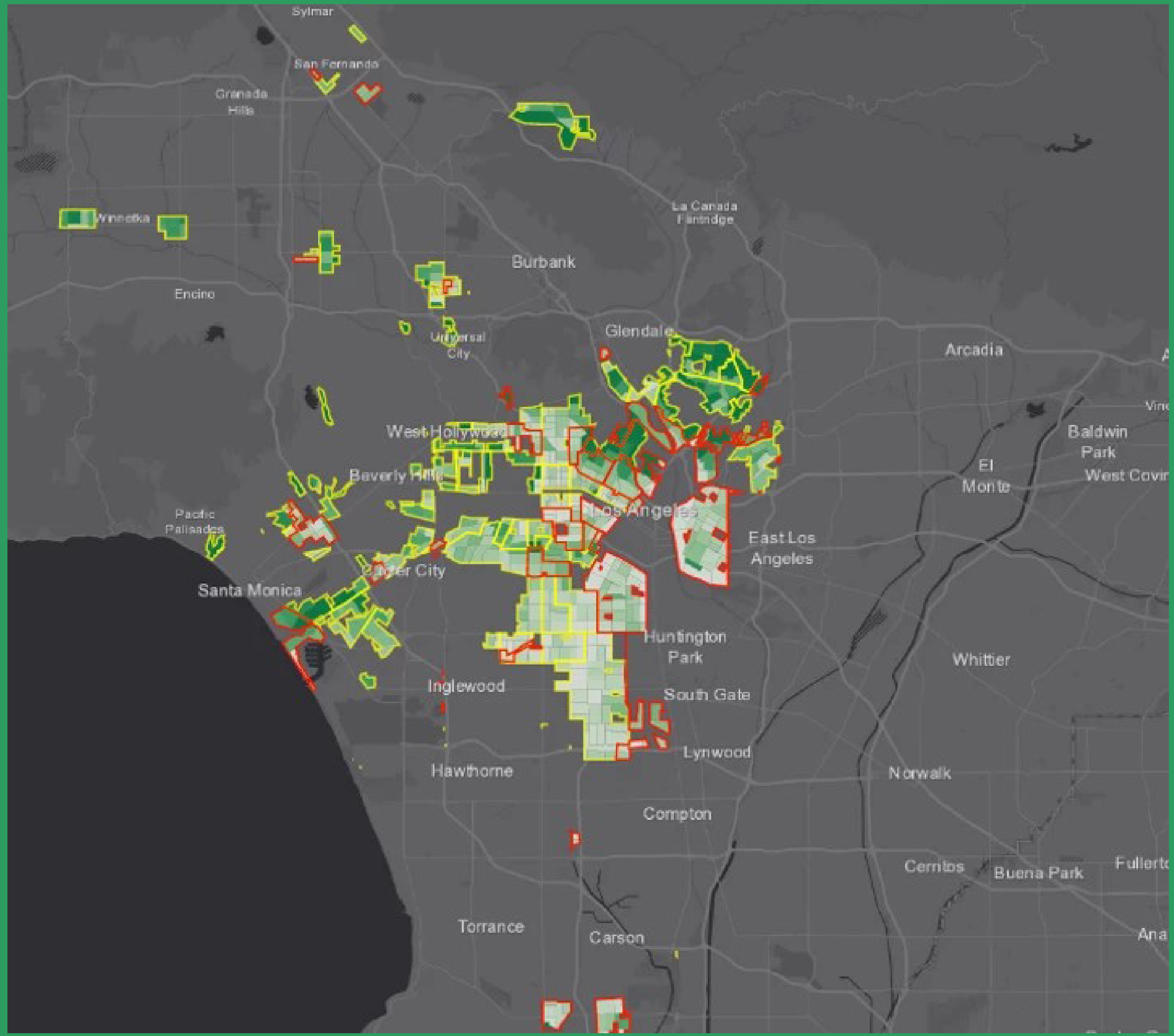


Map of the City of LA's tree canopy cover by council district, using data from TreePeople and Loyola Marymount University Los Angeles County Tree Canopy Viewer (https://www.treepeople.org/los-angeles-county-tree-canopy-map-viewer/)

Wide-scale, successful advancement of urban forest equity faces significant social, ecological, political, and economic barriers, ranging from invasive pests, to urban development pressures, to entrenched drivers that led to the inequitable distribution of a mature, healthy canopy. In LA and elsewhere, low-income neighborhoods enjoy a fraction of the urban forest cover that their wealthier counterparts have.[5,14] In LA, tree canopy is negatively correlated with percent Black and percent Latino/a population but positively correlated with the percent of Asian residents.[5] LA neighborhoods that have lower incomes and where educational attainment levels are low have significantly lower canopy than their wealthier counterparts.[6,17]

Achieving equitable distribution of urban trees is further complicated by additional reasons, including lack of program oversight resulting in haphazard progress; limited funding availability; and physical and ecological constraints (Figure 2) in more densely built-out parts of the city that provide limited readily plantable sites.[18,19] This matters because planting only in available sites is insufficient from an urban forest equity perspective. Limiting tree planting to presently-available spaces and not expanding efforts to spaces that require removal of impervious surfaces or other site modifications will not result in substantial canopy increase in neighborhoods that could benefit most from additional trees.[20,21] Many of LA's tree planting programs have shifted to prioritizing low-canopy areas while continuing to face perpetual physical, social, and funding challenges entrenched in these neighborhoods that are the result of decades of political decision-making.

How residents think about trees also impacts the distribution of the urban forest. Perceptions are highly variable, and assorted reasons exist for why residents may be unenthusiastic about tree planting. In Detroit, for instance, an evaluation of a nonprofit-led initiative to plant trees in low-income neighborhoods found that one-quarter of residents declined an offer for free tree planting because of a host of negative associations including feeling that residents' values were not adequately considered and a perceived lack of assistance with tree maintenance such as deferred pruning or removal of dead trees.[23] Other concerns may also emerge. Trees can cause problems (i.e., disservices) even as they provide benefits, and in certain cases, maintenance costs can exceed those benefits or the capacity of local residents to provide sufficient maintenance, particularly on mature trees.[5] Survey work conducted during UFEC Phase II in LA provides further support for the relevance of perceptions to tree acceptance and enthusiasm among residents; results of those surveys can be viewed in this report, and in accompanying 'LA Urban Forest Equity Neighborhood Strategy' documents. Given the historical lack of funding for public trees during their entire life-cycle in LA City, the burden and cost of deferred maintenance falls on low-income residents and can understandably result in negative perceptions of trees. Those who cannot afford tree maintenance are the ones who stand to benefit the most from the public health protections of an urban forest.



A map showing tree canopy cover in areas that formerly received a Home Owners' Loan Corporation (HOLC) grade of C (yellow outline) or D (red outline). These areas feature noticeably lower canopy (indicated by a lighter shade of green) than non-redlined surroundings.

14 Galvin, M., O'Neil-Dunne, J., Locke, D., & Romolini, M. (2019). Los Angeles County Tree Canopy Assessment. SavATree Consulting Group.

15 Los Angeles Times (n.d.). Neighborhoods: Southeast LA. http://maps.latimes.com/neighborhoods/region/southeast/

16 Los Angeles Times (n.d.). Neighborhoods: Bel-Air. https://maps.latimes.com/neighborhoods/neighborhood/bel-air/

17 McPherson, E.G., Simpson, J.R, Xiao Q., & Wu, C. (2008). Los Angeles one million tree canopy cover assessment. Department of Agriculture, Forest Service, Pacific Southwest Research Station, Center for Urban Forestry Research, Albany, CA.

18 Danford, R. S., Cheng, C., Strohbach, M. W., et al. (2014). What does it take to achieve equitable urban tree canopy distribution? A Boston case study. Cities and the Environment, 7(1), Article 2.

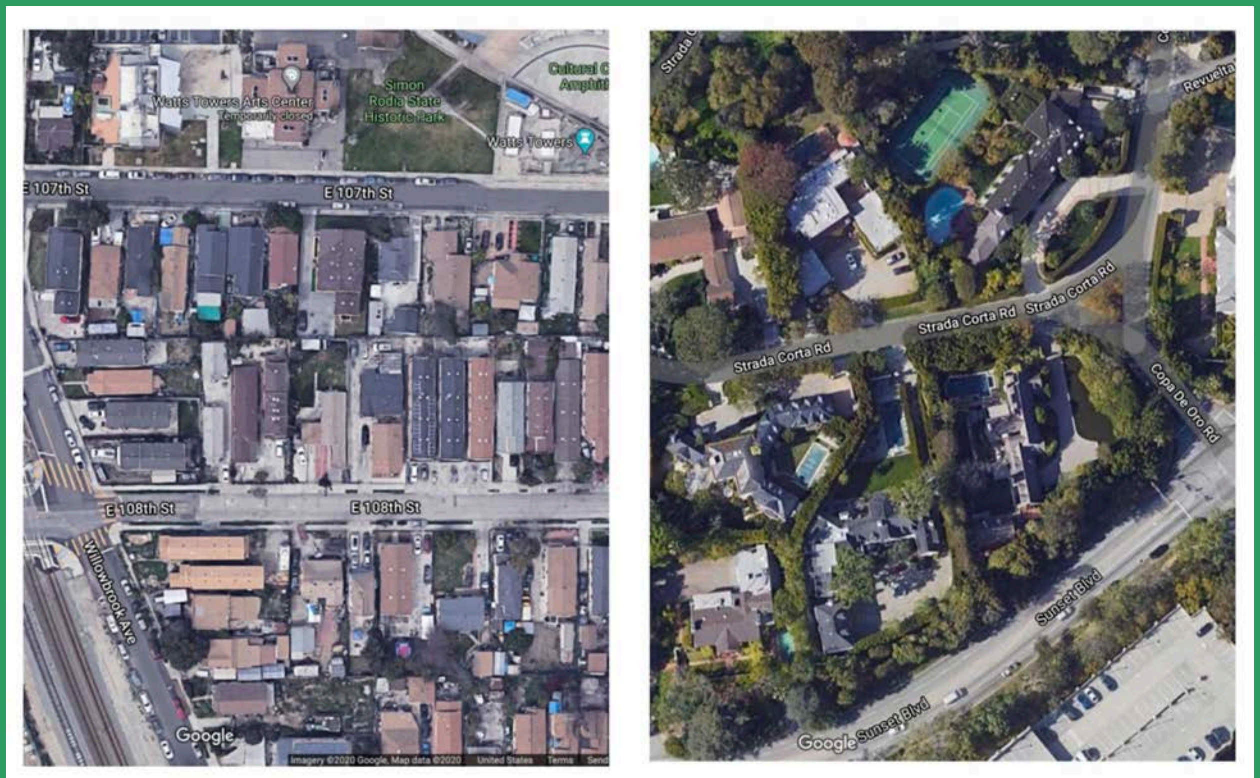
19 Pincetl, S., Gillespie, T., Pataki, D. et al. (2013). Urban tree planting programs, function or fashion? Los Angeles and urban tree planting campaigns. GeoJournal, 78(3), 475-493.

20 CAPA Strategies (2021). Los Angeles Urban Forest Equity Assessment Report. City Plants.

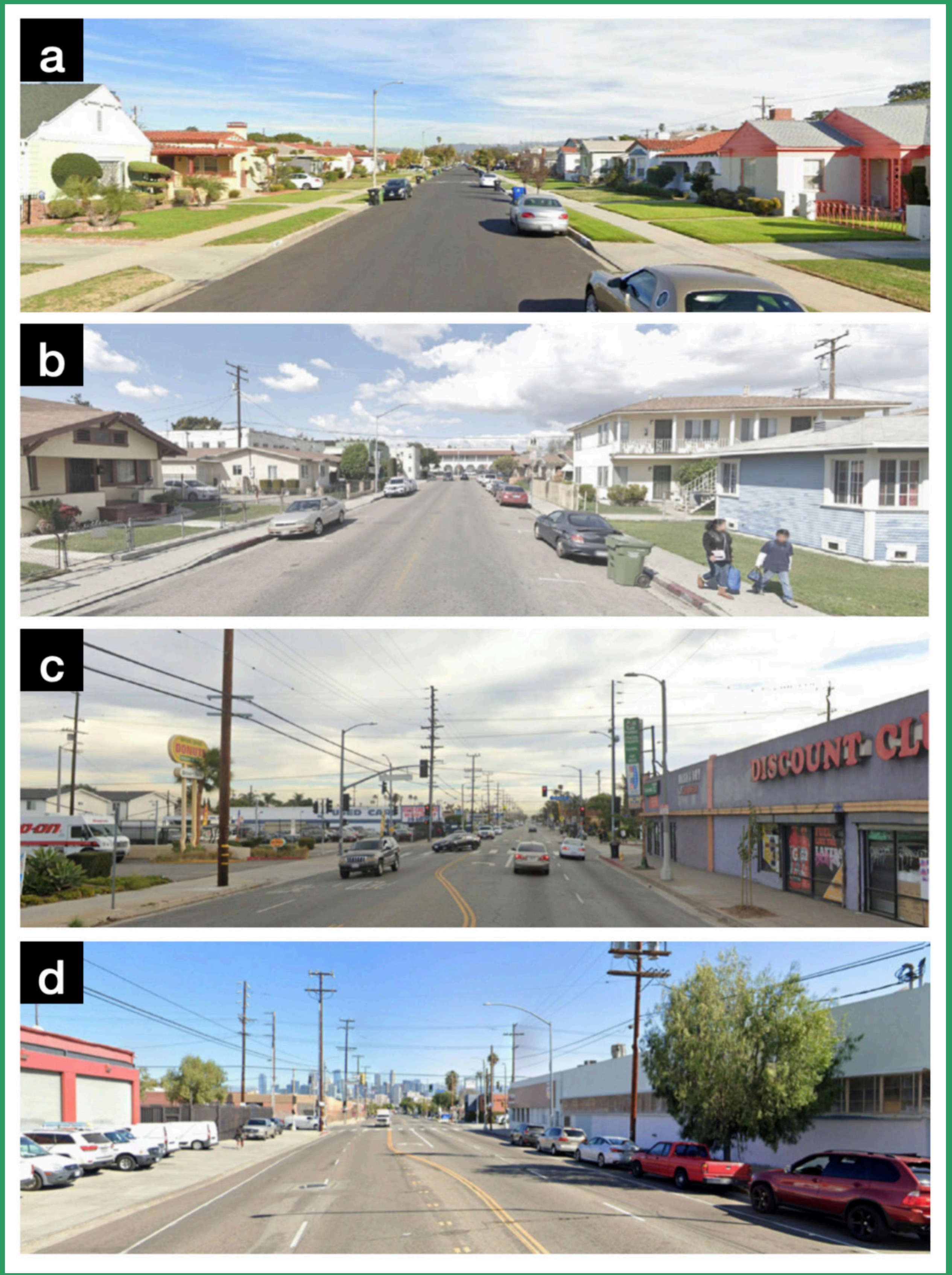
21 McPherson, E. G., Simpson, J. R., Xiao, Q., & Wu, C. (2011). Million trees Los Angeles canopy cover and benefit assessment. Landscape and Urban Planning, 99(1), 40-50.

22 CAPA Strategies (2021). Los Angeles Urban Forest Equity Streets Guidebook. City Plants.

23 Carmichael, C. E. & McDonough, M. H. (2019). Community Stories: Explaining Resistance to Street Tree-Planting Programs in Detroit, Michigan, USA. Society & Natural Resources, 32, 588-605.



Disparities in distribution of urban forest cover (UFC) in two Los Angeles neighborhoods. On the left, Watts is a formerly redlined LA neighborhood graded "D." It has a population that is 60% Latino/a and nearly 40% Black and a median household income of around $25,000/year. The UFC in Watts is 10%. On the right, Bel-Air, which had a mix of "A" and "B" grades, has a UFC of 35% and is 83% white. Median household income is more than $200,000/year. [14 15 16] (Image: Google Maps)



Tree planting site conditions commonly encountered in Los Angeles. (a) A middle class single-family neighborhood with available planting spaces in both the public parkway and on private yards. (b) A multi-family neighborhood with narrow sidewalks and no parkways. The street is an active walking path to a local elementary school. (c) A commercial street with limited tree-planting options due to narrow sidewalks, overhead utilities, driveways, and lighting/utility/street sign infrastructure. (d) An industrial street with large driveway aprons that limit potential tree planting to the right side of the street, where large trees are not suitable due to power line conflict. [22]

In order to address these inequities, young trees must receive establishment care to help them reach maturity to, at a minimum, keep up with the loss of trees that die or are removed. Providing establishment care, particularly for street trees in the public right-of-way, remains a monumental challenge and a time- and resource-intensive commitment, necessitating funding that often lacks.[24] This barrier is especially pronounced in drier climates like LA's, where months-long periods of hot, dry weather require supplemental watering to bring young trees to maturity, when they can begin to provide maximum benefit.

[24] Jack-Scott, E., M. Piana, B. Troxel, C. Murphy-Dunning, & M. S. Ashton. (2013). Stewardship success: How community group dynamics affect urban street tree survival and growth. Arboriculture & Urban Forestry 39(4), 189–196.

How Does UFEC Seek To Advance Urban Forest Equity?

UFEC takes an integrated approach to advance urban forest equity that is driven by community-level needs and preferences, and uses the best available policy, science, and spatial data. While all members of UFEC are invited to meet regularly to discuss and contribute to the work, the bulk of the contributions shared in this report occurred as a result of three teams, each focused either on Policy, GIS, or Community Engagement. Each team conducted a deep dive into how urban forest equity could be advanced from their particular angle, using the most suitable tools available.

The Policy team developed a tiered planting system that considers level of achievable greening and imagines a full suite of interventions that apply where planting space is and is not available. The Policy team also developed a decision-making framework to aid in prioritizing urban forest equity activities by neighborhood, and a method to evaluate success toward urban forest equity.

The Community Engagement team used this framework to select two pilot neighborhoods to work in. This team collected surveys and conducted preliminary workshops with community members in order to capture community needs and preferences for their urban forest. The results of these engagement activities inform the designs presented in the two Neighborhood Strategy documents that accompany this report.

The GIS (geographic information systems) team conducted a first-of-its-kind spatial assessment projecting the degree to which urban forest equity would be advanced — in both target neighborhoods and in the City of Los Angeles as a whole — if all presently-available planting spaces not requiring physical or structural modifications were planted.

Phase I, 2020-2021: Where Did We Leave Off?

UFEC Phase I concluded in 2021 with two key outputs: the 'Los Angeles Urban Forest Equity Assessment Report'[20] and the 'Los Angeles Urban Forest Equity Streets Guidebook.'[22] Our initial assessment captured the diverse perspectives of individuals and organizations actively involved in the management of LA's urban forest via a series of interviews; examined the historical and physical context of LA which has produced uneven distribution of trees and green space, such a redlining; introduced a tiered planting system based on planting space availability; and articulated key themes for future consideration. Barriers to forest equity identified in Phase I included lack of funding; difficulty with coordination; problems getting underserved communities actively engaged in forestry-related planning, planting and care; and maintenance limitations due to water access and the allocation of long-term responsibilities.

Phase I Recommendations (from the 'Los Angeles Urban Forest Equity Assessment Report'):

1. Equitable financing: By the City's own admission, it needs to take the lead on pinpointing sustainable funding sources and streams for tree planting, young tree establishment, mature tree care, and tree preservation. A forthcoming study, 'Financing LA's Urban Forest,' identifies an $88 million annual gap in funding the City of LA's urban forestry programs according to best management practices and standards. The current lack of funding may reflect a low prioritization and statement of value in relation to expanding and preserving tree canopy, though it may also suggest a need to find creative means for improving funding options. Lower income areas with greater amounts of impervious surfaces, greater development densities, and fewer areas for immediately planting trees pose greater infrastructure constraints, which can exacerbate inequities in the consideration of costs when expanding tree canopy.[25] The removal of asphalt and/or concrete requires financial and labor resources, while the higher ambient temperatures in highly sealed areas may decrease survivorship of newly planted trees without adequate water and/or maintenance.

2. Maintenance and co-ownership: In a semi-arid climate that is expected to increase in temperatures, watering is the determining factor in the ultimate success or failure of a planting program.[26] The lack of clarity about who will maintain newly planted trees can pit the City against residents and community-based organizations. Additionally, with limited funding for establishment care, plans to expand canopy will need to consider alternative options for ensuring adequate maintenance and explicitly identify responsibilities.[27] With a generally understood 'establishment period' for new street

[25] Drescher, M. (2019). Urban heating and canopy cover need to be considered as matters of environmental justice. Proceedings of the National Academy of Sciences, 116(52), 26153–26154.

[26] de Guzman, E., Malarich, R., Large, L., & Danoff-Burg, S. (2018). Inspiring Resident Engagement: Identifying Street Tree Stewardship Participation Strategies in Environmental Justice Communities Using a Community-Based Social Marketing Approach. Arboriculture & Urban Forestry, 44(6).

[27] Vogt, J., Hauer, R., & Fischer, B. (2015). The Costs of Maintaining and Not Maintaining the Urban Forest: A Review of the Urban Forestry and Arboriculture Literature. Arboriculture & Urban Forestry, 41(6).

trees suggesting a minimum five years, expanding tree canopy into disinvested areas of the City will also require a time-horizon that integrates responsibilities with an enforcement plan.

3. Trees as inclusive infrastructure: Well understood across the country, and further corroborated by UFEC interviewees is the notion that street trees are one of the most overlooked strategies for improving public health.[28] A city with compelling climate goals should view trees not just as an environmental priority, but as a crucial public health investment.[29,30] If trees can be treated as an essential part of the street—much like the city's similarly sized network of street lamps, which have a dedicated installation, maintenance, and replacement budget—then they can more effectively be coupled with other infrastructure programs.

4. What's realistic? Replicability and scalability: Central to this issue are questions about how to expand work being done on the individual tree, and scale to the whole urban forest. Doing so will require consideration about the short, medium, and long-term plans for achieving the overarching goals. Begin with a series of 'easy wins' with existing projects, where different city bureaus identify potential mechanisms for expanding tree canopy. Another opportunity for scaling and replicating tree planting efforts is to start small and grow big. While advancing a city or region-wide program can be daunting on many levels, perhaps beginning with a neighborhood association or within a council district with a 'pilot program' is a means for attracting attention. Ensuring a robust (social and ecological) data collection process during such pilot programs will be important, as will formative and summative evaluations of such programs.

5. Building multi-generational coalitions: Even with the limited lifespan of an urban tree, most will live to see at least one, and in some cases two or more generations of people. At the same time, a tree planted today must survive decades of hotter and drier conditions, making its survivorship relatively challenging. Multigenerational coalition-building may be a means for anchoring a youth-led engagement program that supports curricular needs while preserving the canopy for years to come. Enlisting younger members of the community to engage community members may be an effective approach, and might include several programs and resulting benefits such as: Create a youth-centered Urban Tree Corps, representative of own communities; Enlist in door-to-door campaigns; Engagement should feed into education and economic (job) opportunities; Opening new career pathways; Youth will drive approach and spread awareness; Attach cultural significance and meaning to work; Expand the definition of green jobs and workforce training.

6. Reclaiming the right-of-way: Neighborhoods that have been historically marginalized from funding and/or disinvested can have

[28] McDonald, R., Aljabarm, L., Aubuchon, C., et al. (2016). Funding Trees for Health. The Nature Conservancy.

[29] Walker, A. (2018). You Can't Be a 'Climate Mayor' If You're Making More Room for Cars. archive.curbed.com/2018/4/6/17010042/climate-change-mayor-infrastructure-highwaysparking.

[30] The Nature Conservancy (2016). How Urban Trees Can Save Lives. The Nature Conservancy.

narrow parkway areas, and limited spaces for expanding canopy. The amount of space dedicated to vehicles has only grown over time, adding to the challenge of finding suitable planting spaces. Some cities have experimented with removing concrete and widening sidewalks, which allow for larger tree wells; others have integrated safety measures, such as curb 'bump outs' or extensions to allow for trees. Such programs could be coupled with innovations that increase the experience of ownership among neighboring residents, such as Levers and/or incentives that support a favorable water rate or subsidy for qualifying households; Investment in the creation of time-based, 'green equity districts', which aim to accelerate the expansion of tree canopy into disinvested areas

In addition to the recommendations above, Phase I yielded a novel 'planting tiers framework.' This allows decision makers to classify streets and sites based on physical characteristics and expected difficulty in planting. In Phase I, our team modeled the potential for the City of LA to fill gaps in the urban forest and advance canopy goals established in the Green New Deal by planting first in 'Tier 1' locations, which are the most accessible and readily plantable. The tiered system is covered in greater detail in the Planting Tiers Framework section below.

Phase II, 2021-2023: What Did We Set Out To Accomplish?

Having established a greater understanding of historical and present, physical and socio-political conditions influencing LA's urban forest in Phase I, the UFEC endeavored to move closer to implementation and specific, actionable forest equity strategies in Phase II.

UFEC had five clear goals:

Goal #1: Expand, refine and embed the new and novel framework developed in Phase I — the 'Planting Tiers Framework' — into regional policy to close the urban forest equity gap in Los Angeles.

Goal #2: Build a robust coalition of urban forest equity champions amongst government, nonprofit, academia, and community partners, integrating the model and framework within existing and upcoming long-term planning, policies, and projects.

Goal #3: Define the metrics needed to measure tangible progress toward regional tree canopy equity goals and work with the city to set up tracking methods.

[28] McDonald, R., Aljabarm, L., Aubuchon, C., et al. (2016). Funding Trees for Health. The Nature Conservancy.

[29] Walker, A. (2018). You Can't Be a 'Climate Mayor' If You're Making More Room for Cars. archive.curbed.com/2018/4/6/17010042/climate-change-mayor-infrastructure-highwaysparking.

[30] The Nature Conservancy (2016). How Urban Trees Can Save Lives. The Nature Conservancy.

Goal #4: Identify select neighborhoods for tree planting prioritization and investment based on defined equity and climate resiliency urgency and need.

Goal #5: Develop and deploy a community-driven process in forestry planning to empower Los Angeles' most vulnerable communities, center the voices of historically disinvested communities, and accelerate regional climate resilience within frontline communities.

Goal #	Corresponding Report Section
1	Policy Analysis & Discussion; GIS Analysis & Discussion
2	The Los Angeles Urban Forest Equity Collective Model
3	Urban Forest Equity Metrics Analysis & Discussion
4	Neighborhood Selection Process: Decision-Making Framework
5	Neighborhood Selection Process: Pilot Neighborhoods

The final outputs of Phase II include two 'LA Urban Forest Equity Neighborhood Strategy' products (one for each of two pilot neighborhoods: Central Alameda and Sylmar); the 'LA Urban Forest Equity Design Guidebook', a guidebook of intervention strategies suited to different tiers and urban contexts; and an 'LA Urban Forest Equity Community Action Toolkit,' which includes resources for community-based groups and other stakeholders to replicate UFEC's community engagement process in any neighborhood.

Additionally, all of the outcomes of UFEC Phase II, including collaborative discussions, relationship-building, and written reports, are intended to generate, share, and advance knowledge on the subject of urban forest equity. By sharing our processes, successes, and challenges with stakeholders across sectors, we seek to inspire future research, action, ideation, and policymaking that builds and improves upon the work we have begun here, both in Los Angeles and beyond.

Planting Tiers Framework

The planting tiers framework is a significant contribution of UFEC's work in Phase I, which the team refined and crystalized throughout Phase II. This novel system of classifying urban space allows planners and decision makers to consider varying levels of planting difficulty, and accounts for the limitation imposed on canopy expansion in areas that have been highly developed and where a preponderance of impervious surfaces limits planting opportunities. Articulating a common language and enacting a targeted, coordinated prioritization and action plan can facilitate progress toward urban forest equity in areas where physical constraints exist. The tiered model presented here emerged from a necessity for scalability, and it seeks to codify new terminology for measuring levels of investment, trade offs, and opportunities to reach meaningful solutions to the systemic problem of urban forestry inequity. The tiers reflect types of interventions and levels of investments needed to reach a more equitably distributed tree canopy, from individual streets to council districts and larger political jurisdictions throughout Los Angeles.

This framework includes three distinct tiers, reflecting an increase in planting difficulty and required investment. The delineation between tiers is based on spatial constraints in the built environment, such as the absence of open space, the presence of concrete, or the placement of overhead utilities.

Tier 1 - Available

No site modification is needed. Tree canopy goals can be achieved by planting vacant existing vacant locations.

Tier 2 - Moderate

Minimal site modifications needed. Tree canopy goals can be achieved with additional financial resources and possible site modifications within current City and County standards.

Tier 3 - Hard

Drastic site modifications needed. Significant tree canopy increase cannot be achieved with exisiting infrastructure and policy modifications are needed to reach canopy equity and public health targets.

Tier 1 Sites

Tier 1 sites are the most readily plantable; no site modification is needed, and trees can be planted with minimal effort or added resources from the City. These sites may include vacant street tree wells that can be backfilled; open, grassy or soil parkways (also known as 'planting stips') that are wide enough to accommodate trees; and parks with available, unpaved open space for public trees. Tier 1 also encompasses private tree planting in residential yards, though this is farther outside the direct purview of the City or government agencies and traditionally relies on the efforts of nonprofits and community-based organizations.

Photo credit: TreePeople

Tier 2 Sites

Tier 2 sites pose moderate planting difficulty or a slightly higher investment of resources. This refers to sites where there is space to plant, but where there may be a need for minimal pavement removal, such as by cutting new tree wells. Examples of Tier 2 sites include planting strips that are paved and lack existing tree wells, or paved spaced within parks. In the case of parks, some reallocation of space may also be required, increasing the investment associated with planting; for example, if open recreational space is occupied by newly planted trees. Tier 2 Planting can be achieved with additional financial resources (i.e. grant funding) and/or slight physical modifications within current City and County standards.

Tier 3 Sites

Tier 3 sites are the most difficult to plant, where more significant site modifications are needed to overcome spatial restrictions. Significant tree canopy increase cannot be achieved in these areas with existing infrastructure, and policy modifications are needed to reach canopy and public health targets. Tier 3 sites include those that are densely developed with little open space and a high proportion of concrete/pavement; have overhead or underground utilities; and/or cannot accommodate planting goals without a transformation of physical space, such as by reducing parking to allow the addition of bumpouts, or reducing street width in order to increase sidewalk and planting strip width. While Tier 1 and 2 sites may be plantable after some coordination and/or reallocation of funds, planting Tier 3 sites requires a significant shift in policy and/or the built environment.

Photo credit: Council for Watershed Health

Photo credit: Alissa Walker

Outputs of Phase II have referred to and built upon this core framework. In Phase II GIS analysis, our team revisited and updated the Tier 1 planting projections from Phase I, including both parkway and private property trees, for the City of Los Angeles and two pilot neighborhoods (see the section GIS Analysis & Discussion). During Phase II, our team refined the process for calculating Tier 1 canopy possibilities and quality checking outputs, identified limitations and opportunities for improvement in our existing models, and set the stage for similar Tier 2 or 3 projections in future phases of UFEC. Community engagement teams in pilot neighborhoods incorporated resident feedback to select Tier 2 and Tier 3 project sites and model possible interventions, moving the city closer to a vision of transformative change in those locations (see 'LA Urban Forest Equity Neighborhood Strategy' documents). The 'LA Urban Forest Equity Design Guidebook' provides a variety of planting options for the city characterized according to tiers, while our Policy Analysis & Discussion explores relevant intersections between codes/policies and the most challenging Tier 3 interventions.

Neighborhood Selection Process

Neighborhood Selection Process

The UFEC was tasked with selecting two pilot neighborhoods — and within those, specific Tier 2 or Tier 3 sites — for urban forest interventions. Due to the overwhelming need for canopy in many parts of Los Angeles, it has been an ongoing struggle for planners to determine which neighborhoods and sites to prioritize. Existing tools identify areas of socio-economic need and/or environmental risk exposure. Yet, these tools do not consider prioritization from an urban forest equity perspective. These do not help planners systematically narrow down to a manageable set of priority options, or offer guidance on how to move beyond equity or exposure scores into more qualitative and practical considerations.

To facilitate our group's selection of two priority neighborhoods, wherein we could identify need and a realistic chance of program success, CAPA Strategies led the development of an urban forest equity decision-making framework. This framework includes a refined set of indicators which are common in practice and have been validated through case study literature, and focuses on conditions that relate directly to the urban forest. The framework has the potential to be scaled, tailored and replicated, though is specific to the context of Los Angeles in its current form.

Decision-Making Framework

Before developing our own decision-making framework, we reviewed existing literature on urban forest equity — including accounts of indicators, barriers, and assessment methods — and synthesized findings to better understand what factors are most relevant to this topic. Notably, we sought an approach which emphasized *urban forest equity* specifically; not climate or environmental equity, exposure, or vulnerability more broadly. While trees are arguably intertwined with other environmental exposures, sensitivities, and vulnerabilities, narrowing the scope allowed us to move toward an actionable selection process. Influential findings from the literature review included the following:

1. Income is consistently and strongly related to urban forest (in)equity.[31 32 33 34 35 36 37] Income (low-income to poverty) and race (non-white) both appear often as socio-demographic indicators of inequity and correlates of low tree canopy, as do education and housing tenure. Across studies however, income is a stronger predictor of canopy access overall.[5 38 39 40 41] Higher-income communities, often regardless of racial makeup or other factors, are likely to have more trees than their low-income neighbors. Similarly, when controlled for income, the effects of race on forest equity become less salient.[42] This suggests that income should be elevated among other relevant socio-demographic factors, including race, education and housing tenure, when identifying priority areas for tree planting.
2. Our approach is based on parsing *need* with regard to urban canopy, as indicated in emergent literature.[43 44 45] Urban forest equity is not synonymous with equality, and establishing a need-based prioritization framework may direct limited resources to locations that would potentially benefit the most. For example, consider that two census tracts have 10% canopy and similar socio-economic conditions; one has extremely poor air quality and high temperatures while the other does not. The urgency for urban forest improvements is arguably not the same in those two locations, and the former has more to gain from an urban forest intervention.

Our framework focuses on three quantitative factors (steps) at the census tract scale, and these were considered successively in the decision-making process, with each step building upon and narrowing down from the last. Step 4 applies qualitative criteria to ensure practicability of any proposed interventions. Our team first considered conditions at the census tract scale. Findings were then translated to the neighborhood council scale to foster productive discussion and area selection with UFEC members.

Step 1: Establish physical and economic need

Determining an appropriate baseline and/or target for canopy was a logical first step in this process. It is typical for tools to set a value based on an established citywide target (Los Angeles does not have such a target), or based on the ideal and feasible maximum for a given climate or built environment (see for example the American Forests Tree Equity Score tool). In a city like Los Angeles, using an ideal threshold does very little to narrow down the list of possible intervention sites. So much of the city is well below idealized targets that such a metric would be essentially useless for the purposes of this project. Rather than approach this indicator from a general and ideal perspective, all tracts in Los Angeles were assessed for their canopy coverage relative to the citywide average (20%).

Secondly, tracts were assessed for the percentage of impervious cover, including buildings, roads, and other impervious surfaces. Those tracts with a high proportion of open space, whether planted with trees or not, display high potential for planting and fall into what we have previously described as Tier 1 sites. The intent of this initiative is to prioritize localities with a large proportion of Tier 2 and Tier 3 sites which are highly built out. Tracts were assessed for their impervious surface coverage relative to the citywide average (60%).

Finally, income was considered as a critical determinant of urban forest equity, and tracts were assessed based on their median household income relative to the citywide figure ($67,418 in 2019). The rationale here is that even if a tract or neighborhood has low canopy and is highly built out, residents in high income areas more likely have the financial means to increase their canopy coverage if desired.[36 46] In other words, the absence of trees is not a sufficient indicator of need if

31 Escobedo, F. J., Clerici, N., Staudhammer, C. L., & Corzo, G. T. (2015). Socio-ecological dynamics and inequality in Bogotá, Colombia's public urban forests and their ecosystem services. Urban Forestry & Urban Greening, 14(4), 1040–1053.

32 Gerrish, E., & Watkins, S. L. (2018). The relationship between urban forests and income: A meta-analysis. Landscape and Urban Planning, 170, 293–308.

33 Heynen N. C. (2002). "The Social Processes Contributing to Urban EnvironmentalChange: Indianapolis' Inner-City Urban Trees, 1962–1993." PhD dissertation, Indiana University.

34 Heynen, N. C. (2003). The Scalar Production of Injustice within the Urban Forest. Antipode, 35(5), 980–998.

35 Heynen, N., Perkins, H. A., & Roy, P. (2006). The Political Ecology of Uneven Urban Green Space: The Impact of Political Economy on Race and Ethnicity in Producing Environmental Inequality in Milwaukee. Urban Affairs Review, 42(1), 3–25.

36 Nyelele, C., & Kroll, C. N. (2020). The equity of urban forest ecosystem services and benefits in the Bronx, NY. Urban Forestry & Urban Greening, 53, 126723.

37 Pedlowski, M. A., Da Silva, V. A. C., Adell, J. J. C., & Heynen, N. C. (2002). Urban forest and environmental inequality in Campos dos Goytacazes, Rio de Janeiro, Brazil. Urban Ecosystems, 6(1/2), 9–20.

38 Landry, S. M., & Chakraborty, J. (2009). Street Trees and Equity: Evaluating the Spatial Distribution of an Urban Amenity. Environment and Planning A: Economy and Space, 41(11), 2651–2670.

39 Nesbitt, L., Meitner, M. J., Girling, C., Sheppard, S. R. J., & Lu, Y. (2019). Who has access to urban vegetation? A spatial analysis of distributional green equity in 10 US cities. Landscape and Urban Planning, 181, 51–79.

40 Tooke, T. R., Klinkenber, B., & Coops, N. C. (2010). A geographical approach to identifying vegetation-related environmental equity in Canadian cities. Environment and Planning B: Planning and Design, 37(6), 1040–1056.

41 Watkins, S. L., Mincey, S. K., Vogt, J., & Sweeney, S. P. (2017). Is Planting Equitable? An Examination of the Spatial Distribution of Nonprofit Urban Tree-Planting Programs by Canopy Cover, Income, Race, and Ethnicity. Environment and Behavior, 49(4), 452–482.

42 Watkins, S. L., & Gerrish, E. (2018). The relationship between urban forests and race: A meta-analysis. Journal of Environmental Management, 209, 152–168.

43 Broadbent, A. M., Declet-Barreto, J., Krayenhoff, E. S., et al. (2022). Targeted implementation of cool roofs for equitable urban adaptation to extreme heat. Science of The Total Environment, 811, 151326.

44 Heckert, M., & Rosan, C. D. (2016). Developing a green infrastructure equity index to promote equity planning. Urban Forestry & Urban Greening, 19, 263–270.

45 Zhu, Z., Ren, J., & Liu, X. (2019). Green infrastructure provision for environmental justice: Application of the equity index in Guangzhou, China. Urban Forestry & Urban Greening, 46, 126443.

46 Li, X., Ma, X., Hu, Z., & Li, S. (2021). Investigation of urban green space equity at the city level and relevant strategies for improving the provisioning in China. Land Use Policy, 101, 105144.

residents are not also experiencing relatively low incomes.

In order to be considered for prioritization within this framework, census tracts have to feature lower than average canopy, higher than average impervious cover, and median household incomes below the citywide rate. The intent of step 1 is to establish physical and economic need with regard to urban forestry. Regardless of any other factors, if a tract or neighborhood has less than 20% canopy and less than the median income for the city, we can assume it's an area which could use more trees, and which likely lacks sufficient financial resources to attain them without outside assistance.

Step 2: Establish environmental exposure

Establishing need via environmental exposure pathways was the next step. As noted above, a location may have low canopy but minimal exposure to environmental hazards, creating different degrees of need. At this point and moving forward, the decision-making framework examines tract-level conditions against other tracts still under consideration, rather than continuing to compare tracts to citywide conditions. This was necessary to narrow down the list of tracts to a point of operationality. If we assessed all other indicators (steps 2 and 3) only in relation to citywide averages, we would again generate a huge list of high-need areas and no practical way to choose between them.

For environmental exposure, we limited the scope only to those hazards which could be directly mitigated by the presence of trees; namely, heat and air pollution.[47 48 49] Similar tools such as CalEnviroScreen 4.0 refer to a wide range of environmental hazards, from lead and pesticide exposure to the presence of brownfields, though these were not deemed directly applicable to an urban forest equity decision-making framework. Initially, our assessment looked at projected days over 90 degrees Fahrenheit as a measure of urban heat exposure; and particulate matter (PM 2.5) as well as Ozone as measures of air pollution. However, after an initial run-through, it became apparent that Ozone was not a meaningful indicator within the context of Los Angeles. Furthermore, several neighborhoods known to receive pollution from transportation corridors and industrial activity were being missed by the assessment. To correct this, we adjusted air pollution indicators to include Diesel PM as well as PM 2.5, and removed Ozone. PM 2.5 is a fine particle type, with particles measuring 2.5 microns or less in diameter. This type is particularly harmful as it can get deep into the lungs and possibly the bloodstream. Diesel PM comes from the exhaust of trucks, trains, ships, and diesel-powered equipment and is common in urban environments near major roadways and ports.

In order to be considered for further prioritization within this framework, tracts have to display exposure within the upper 50th percentile (when compared against other tracts still under consideration) for heat and PM 2.5 or Diesel PM. In other words, only tracts experiencing relatively high exposure to both heat and air pollution will pass through this step.

47 Nowak, D. J., Hirabayashi, S., Bodine, A., & Hoehn, R. (2013). Modeled PM2.5 removal by trees in ten U.S. cities and associated health effects. Environmental Pollution, 178, 395–402.

48 Rahman, M. A., Stratopoulos, L. M. F., Moser-Reischl, A., et al. (2020). Traits of trees for cooling urban heat islands: A meta-analysis. Building and Environment, 170, 106606.

49 Wang, H., Maher, B. A., Ahmed, I. A., & Davison, B. (2019). Efficient Removal of Ultrafine Particles from Diesel Exhaust by Selected Tree Species: Implications for Roadside Planting for Improving the Quality of Urban Air. Environmental Science & Technology, 53(12), 6906–6916.

Step 3: Establish socio-demographic conditions

Literature on urban forest and green equity has identified and examined a range of socio-demographic indicators thought to influence the presence of trees, or correlate with the absence of trees and increased exposure to environmental hazards. As noted above, income and race are the most commonly used and show relatively strong relationships with urban forest access and equity, though income is shown to be more indicative than race in several studies. Others which have been significantly associated with urban forest equity in literature and have been included in this framework include: poverty as an extension of the income variable;[50 51] housing tenure for renters versus homeowners;[51 52] educational attainment;[39] population density;[52 53] and residence in a formerly redlined area.[54 55] Based on our team's familiarity with Los Angeles and factors which locally limit access to institutional representation, wealth, and greening, we also added primary language spoken (non-English) and internet access into the framework. Race/ethnicity was incorporated to identify the proportion of individuals who are either non-white and/or Hispanic.

Notably, this decision-making framework is not meant to serve as a vulnerability index or assessment. Although some steps 1 and 2 cover two key facets of vulnerability[56] – exposure and adaptive capacity (variably understood as financial capacity) – the framework is not intended to identify vulnerable populations. It is intended to identify locations where tree canopy is lacking, and where disinvestment has led to a systemic lack of the economic resources and/or institutional political representation which could advance urban tree canopy cover. Existing studies and literature,[54 55] as well as forest equity tools (e.g. American Forests Equity Score), incorporate sensitivity (the third facet of vulnerability per Turner et al., 2003) indicators alongside other equity metrics; for example, tools might show the proportion of residents with pre-existing health conditions, and residents under 5 or over 65 years old, all of whom are considered sensitive to heat and air pollution. For this framework, we did not seek to locate environmentally sensitive populations. The presence of such populations does not directly indicate limited access to canopy. On the contrary, any of the noted populations may be wealthy and/or reside in well-canopied neighborhoods. Rather than rely on sensitivity indicators, we selected characteristics which are known to make tree access difficult. Our chosen socio-demographic indicators are associated with social marginalization, limited access to funding and political representation, and difficulty in accessing forestry-related resources, all of which are directly relevant to this UFEC initiative. Vulnerability assessments, including physical/medical sensitivity, are undeniably worthwhile as cities pursue environmental justice and equity-based work. However, we view these as strategies to guide interventions once priority areas are identified. USC Trees researchers have conducted complementary work assessing vulnerability and prioritizing specific sites within LA neighborhoods (see Appendices & Tools).

Other indicators which were considered by this group but ultimately excluded include number of hospital visits (especially for heat-related

50 Garrison, J. D. (2021). Environmental Justice in Theory and Practice: Measuring the Equity Outcomes of Los Angeles and New York's "Million Trees" Campaigns. Journal of Planning Education and Research, 41(1), 6–17.

51 Koo, B. W., Boyd, N., Botchwey, N., & Guhathakurta, S. (2019). Environmental Equity and Spatiotemporal Patterns of Urban Tree Canopy in Atlanta. Journal of Planning Education and Research, 0739456X1986414

52 Frey, N. (2017). Equity in the distribution of urban environmental amenities: The case of Washington, D.C. Urban Geography, 38(10), 1534–1549.

53 Nowak, D. J., Hoehn, R. E., III, Crane, D. E., et al. (2007). Assessing urban forest effects and values, New York City's urban forest (No. NRS-RB-9; p. NRS-RB-9). Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station.

54 Bikomeye, J. C., Namin, S., Anyanwu, C., et al. (2021). Resilience and Equity in a Time of Crises: Investing in Public Urban Greenspace Is Now More Essential Than Ever in the US and Beyond. International Journal of Environmental Research and Public Health, 18(16), 8420.

55 Jennings, V., Browning, M.H.E.M., & Rigolon, A. (2019). Urban Green Space at the Nexus of Environmental Justice and Health Equity. In V. Jennings, M.H.E.M. Browning, & A. Rigolon, Urban Green Spaces (pp. 47–69).

56 Turner, B. L., Kasperson, R. E., Matson, P. A., et al. (2003). A framework for vulnerability analysis in sustainability science. Proceedings of the National Academy of Sciences, 100(14), 8074–8079.

illness), proximity to traffic, and proximity to parks, playgrounds, or green space. It was determined that all of these factors would be redundant, as heat exposure, pollution (including diesel) exposure, and the presence of canopied and impervious spaces were identified in steps 1 and 2. Additionally, such indicators may be unnecessarily complicating and misleading, as it is not clear that hospital visits are due to residential neighborhood exposure, or that parks, playgrounds, and green spaces are well-canopied. As with sensitivity indicators, these are considerations which could better guide UFEC interventions after priority neighborhoods have been identified.

In order to be considered for further prioritization within this framework, tracts have to score within the upper 50th percentile (when compared against other tracts still under consideration) for at least four of the following eight socio-demographic indicators:

- Percent of the population below the poverty line
- Percent of the adult population with less than a high school diploma
- Percent of the population that is non-white and/or Hispanic
- Percent of the population that speaks a language other than English at home
- Percent of the population that rents their home
- Percent of the population that has no home internet access
- Population density
- Residence in an area that was formerly redlined with a grade of C or D (this indicator is exempt from the upper-50th-percentile threshold; any tract that was formerly redlined with a grade of C or D is considered passing in this category)

Any tracts that scored high on at least four of eight indicators were moved to the next step. No additional weighting was done between those that scored higher or lower (i.e., those that scored high on seven or eight indicators were not considered higher priority than those that scored high on four or five indicators).

Step 4: Establish feasibility and community readiness

This is a departure from prior steps, as it moves away from quantitative physical and socio-demographic indicators and into consideration of qualitative factors. Once tracts have made it through steps 1-3, need has been established and they are ostensibly on equal footing in that regard. However, it is essential that UFEC members (and others planning for urban forest interventions) consider the feasibility and readiness of communities in which they intend to work. The analytical processes of steps 1-3 reveal need, while step 4 reveals the extent to which projects in those areas are realistic and likely to succeed. There is no specific numerical threshold for this step, though users of the framework are encouraged to meet with partners and collaborators who have place-based experience, conduct site visits, and begin community engagement in locations of interest. Establishing feasibility and community readiness is an effort toward enabling action and operationalizing goals, considerations which are often lacking in conventional decision-making or prioritization tools of this sort. We have identified four areas which could be explored, and should be considered a starting point in familiarizing oneself with a potential project neighborhood or site.

1. Level of nonprofit or partner involvement: Like many urban forestry projects, the UFEC has limited funding and time to achieve its goals. By selecting locations where nonprofit groups or other partners are already doing complementary work, UFEC planners can more easily enter the space, connect with collaborators and community members, and access supportive resources, thus maximizing the chances for success in a relatively short time frame. On the other hand, project leaders may choose to avoid neighborhoods or tracts that display high need, but are already well served by ongoing programs and funding streams. In order to be effective, UFEC should direct attention to areas which are not already saturated with assistance.

2. Presence of suitable sites for intervention: The goal of UFEC is to prioritize Tier 2 and Tier 3 planting sites – those areas which would face significant physical barriers to getting trees in the ground – while also striving for some success in planting. High-priority areas can be further assessed for the presence of suitable sites which offer the right balance of challenge and possibility. Neighborhood site visits are a recommended option to familiarize oneself with conditions on the ground.

3. Community interest in being engaged: Above all, pilot projects conducted by the UFEC are meant to benefit underserved communities, and improve health outcomes and quality of life. It is not appropriate for UFEC or any urban forest champions to force projects in areas where communities are not interested. Additionally, it will be challenging for UFEC to find success in locations where community groups are not already engaged with the topic of urban forestry. This would require significant interest-building and the identification of local champions which could take up limited time and reduce the chances of project implementation and success.

4. Extent to which an area is utilized by residents: Once census tracts have passed through steps 1-3, users should examine what kinds of land uses those tracts contain, and whether they represent areas which are well used by residents. For example, tracts which feature a high proportion of residences, schools, and/or commercial centers would conceivably be more occupied and utilized than, say, an industrial corridor. As the intent of this work is to make a positive impact on a large number of Angelenos, it is logical to position efforts in places where people are; where they live, play, and learn, and are concurrently exposed to environmental hazards and insufficient canopy.

Framework components and operational matrix

Table 1 shows the operational matrix followed through each step of the framework. All indicators, thresholds, and data sources which were ultimately included in the decision-making framework are listed in Table 2. For all socio-demographic indicators (with the exception of formerly redlined areas), we utilized American Community Survey (ACS) 2019 data. This was the most recent year for which all needed datasets, including physical environment and exposure data, were available. Specifically, tree canopy and impervious surface data, air pollutant data, and heat data were based on 2010-2019 census boundaries. Los Angeles added over 100 new tracts with the 2020 redrawing of boundaries. While we were able to access ACS data for 2020, those data points did not match up with the boundaries used in other datasets.

Table 1. Operational matrix for working the steps of the urban forest decision-making framework.

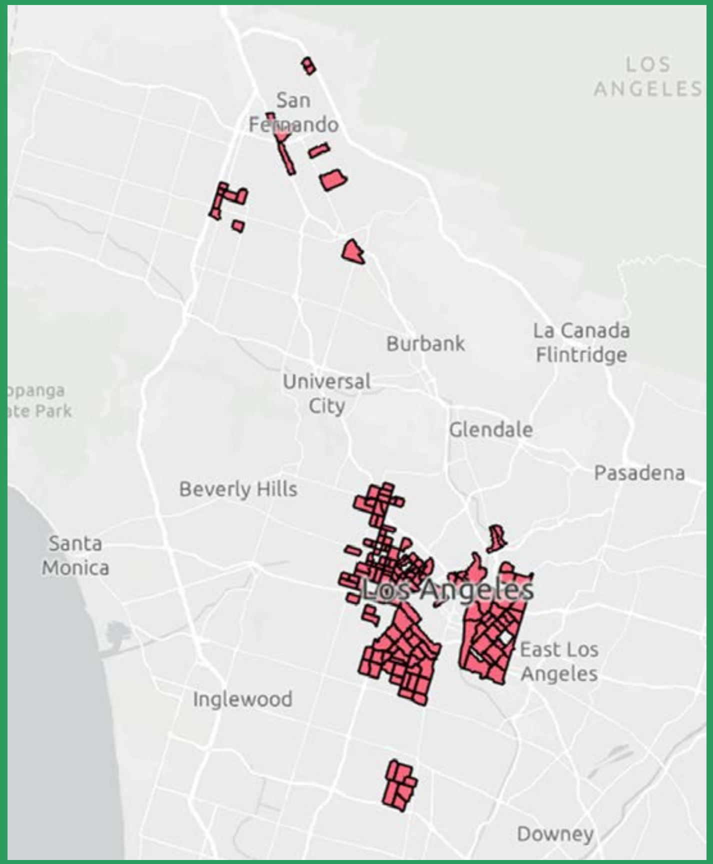
	QUALIFICATION	YES	NO
STEP 1	Does the tract meet physical and economic need conditions? [Explanation: Does the tract have <=20% canopy AND >=60% impervious surface cover AND median household income <=$67,418?]	Move on to step 2.	Remove tract from further consideration.
STEP 2	Does the tract experience high environmental exposure? [Explanation: Does the tract score in the upper 50th percentile (compared to other tracts under consideration in Step 2) for projected days over 90 degrees AND PM 2.5 AND/OR Diesel PM?]	Move on to step 3.	Remove tract from further consideration.
STEP 3	Does the tract exhibit relevant socio-demographic conditions? [Explanation: Does the tract score in the upper 50th percentile (compared to other tracts under consideration in Step 3) for AT LEAST four of eight indicators?]	Move on to step 4.	Remove tract from further consideration.
STEP 4	Does the neighborhood council representing the tract meet a qualitative threshold for feasibility?	Validate findings through community engagement or partner/ professional consultation.	Consider if/how feasibility factors could be improved to prepare tracts for future projects.

Table 2. Indicators, thresholds, and data sources used in the decision-making framework.

FRAMEWORK STEP	DATA SET	METRIC	THRESHOLD	SOURCE	SCALE
STEP 1 Physical & Economic Need 3/3 Required	Tree cover	%	<=20%	TreePeople/LMU	Census tract
	Impervious surface (buildings, roads, other paved)	%	>=60%	TreePeople/LMU	Census tract
	Median household income	$	$67,418	ACS 5 year, 2019 Table 1901	Census tract
STEP 2 Environmental Exposure Heat + 1 Air Pollutant Required	Days projected over 90F	Number of days/ year	Upper 50th percentile	Healthy Places Index	Census tract
	PM 2.5	µg/m³	Upper 50th percentile	CalEnviroScreen 4.0	Census tract
	Diesel PM	Tons/year	Upper 50th percentile	CalEnviroScreen 4.0	Census tract
STEP 3 Socio- Demographic Conditions 4/8 Required	Poverty	%	Upper 50th percentile	ACS 5 year, 2019 Table S0601	Census tract
	Adults with education <= high school	%	Upper 50th percentile	ACS 5 year, 2019 Table S0601	Census tract
	Non-white and/or Hispanic	%	Upper 50th percentile	ACS 5 year, 2019 Table S0601	Census tract
	Non-English language spoken at home	%	Upper 50th percentile	US Census ACS 5 year, 2019 Table S0601	Census tract
	Renters	%	Upper 50th percentile	ACS 5 year, 2019 Table B25003	Census tract
	No internet access at home	%	Upper 50th percentile	ACS 5 year, 2019 Table B28002	Census tract
	Population density	People/sq meter	Upper 50th percentile	ACS 5 year, 2019 Calculated from Table S0601	Census tract
	Formerly Redlined	Y/N	YES	University of Richmond, Mapping Inequality Project	Census tract
STEP 4 Feasibility & Community Readiness	Level of nonprofit or partner involvement	These metrics are qualitative and will be assessed through collaborative discussion between those working in the remaining census tracts/ neighborhoods. There is no particular requirement here, though ideally the neighborhoods selected will have stated community interest, some existing activity, some amount of plantable space or clear sites for interventions (balance of Tier 2 and Tier 3 sites), and should be residential areas or areas used regularly by residents to ensure the greatest impact on Angelenos' health and quality of life through interventions.			

Results

We began with a list of 1,722 census tracts in Los Angeles, all of which were run through the process detailed in the operational matrix. Step 1 resulted in a reduction from 1,722 to 481 tracts; step 2, from 481 to 243 tracts; and step 3, from 243 to 155 tracts. These final 155 selections were then aggregated according to neighborhood council (i.e., neighborhood), resulting in 30 neighborhoods. (Table 3). Thirteen of these neighborhoods had previously been nominated by UFEC members for consideration as pilot neighborhoods for this project, independent of the decision-making framework; the remaining 17 had not been specifically nominated by any UFEC members. Notably, seven neighborhoods which had been nominated by a UFEC member were not generated through this decision-making process. At this point, it was helpful to switch from a discussion of census tracts to one of neighborhoods for two reasons: (1) neighborhood is a more comfortable and familiar scale for UFEC members which is easier to visualize and discuss, and (2) the goal of this process was ultimately to identify two priority neighborhoods for intervention. However, once neighborhoods are selected, the intention is to focus site-specific interventions within those tracts which were generated by the decision-making process.



Map showing the 155 highest-priority census tracts identified by the decision-making process. This map is available in an online tool, the Los Angeles Urban Forest Equity Prioritization Map, which is described in the GIS Analysis & Discussion section of this report.

Table 3. Neighborhoods represented by the tracts selected through the decision-making framework.

Selected by framework and UFEC nominated		Selected by framework, not UFEC nominated			UFEC nominated, not selected by framework
Boyle Heights	Sun Valley	Central Alameda	Historic Cultural North	Pico Union	Empowerment Congress SE and W
Empowerment Congress N	United Neighborhoods	Downtown LA	Hollywood Studio District	Rampart Village	Reseda
LA-32	Watts	East Hollywood	Macarthur Park	Sylmar	Van Nuys
Lincoln Heights	Westlake North	Echo Park	Mission Hills	Voices of 90037	Wilmington
Pacoima	Westlake South	Greater Cypress Park	North East Hills	Wilshire Center-Koreatown	West Adams
South Central	Zapata King	Greater Wilshire	Olympic Park		Winnetka

The selection of 30 neighborhoods (and the 155 high-priority tracts within them) were brought to the UFEC for a collaborative exploration of step 4 criteria. UFEC members shared their particular experiences with and knowledge of each of these neighborhoods. Some were eliminated because they did not meet criteria for community interest or active nonprofit or other partner engagement; others, such as Boyle Heights, were eliminated because it was determined that there were already considerable funds and programs directed there. While the decision-making process found need to be clustered in the areas of central and south Los Angeles, some UFEC members expressed a desire to choose neighborhoods in different parts of the city; particularly in the San Fernando Valley area. Built environmental characteristics (land use) and political considerations were also taken into account at this stage.

After some initial review and elimination, the selections were presented to our two primary community engagement partners, TreePeople and North East Trees. Representatives from these two organizations made final recommendations based on their current level of experience and involvement with the options. Our final neighborhood selections are Central Alameda, which is fully covered by high-priority census tracts, and Sylmar, which includes two such tracts and is considerably less high-need overall; however Sylmar is located in a geographic area of interest to UFEC partners and was considered to have greater political accessibility and readiness that other communities in the San Fernando Valley area. These selections reflect outputs of the decision-making framework, which are analytical in nature, combined with practical considerations and personal preferences of involved stakeholders.

Comparison to existing tools

Prior to developing this decision-making framework, our team reviewed several existing resources which seemed to serve a similar function. However, none were found to be quite right for this initiative. The most common and significant shortcoming of existing tools is that none provided a clear opportunity for users (UFEC members, in this case) to meaningfully narrow down a large field of candidates to two neighborhoods. Resources such as CalEnviroScreen 4.0[57] and the LA Mayor's Office Tree Equity Priority Map[58] allow users to view tree canopy, environmental hazards, and socio-demographic conditions additively, but do not offer guidance on how to weight those factors or think about them in relation to one another, or in relation to the broader issue of forest equity. Others, including the Trust for Public Land Climate Smart Cities Tool[59], the LA Controller Equity Index[60], the LA County Climate Vulnerability Assessment[61] focus too broadly on climate equity or socio-environmental equity, and/or focus divergently on vulnerability to hazards. Again, these tools do not allow the user to hone in on urban forest equity specifically, contain indicators which have been deemed superfluous for that purpose, and are missing essential indicators identified through our literature review and development process.

The most comparable tool is the American Forests Tree Equity Score[62], which ranks census blocks on a scale of 0 to 100. This would be a feasible option for prioritizing sites and neighborhoods, as city planners and partners could choose to work with the lowest-scoring tracts first. Overall, the American Forests framework is one way to quantitatively compare existing tree equity between neighborhoods. The most notable shortcoming from the UFEC perspective is the lack of qualitative factors – including community readiness and feasibility – which would impact practitioners' selection of neighborhoods for future projects and their ability to take action on interventions. Additionally, the American Forests approach offers a prioritization index based on a composite of equally weighted factors including income, race, employment, age and health, and environmental exposure via the urban heat island effect. The equal weighting and the particular selection of socio-demographic and environmental ("climate") metrics is not fully in alignment with recent literature on the subject of urban forest/tree equity, or suitable for our purposes.

Our work required a tool or process that incorporated a tailored set of urban forest equity indicators, allowed for systematic eliminations, and accounted for quantitative/ physical as well as practical, qualitative/ socio-political conditions. Beyond the unique set of indicators used in our decision-making framework, the inclusion of step 4, which calls for non-standard collaboration and community engagement, sets this process apart from other available tools and matrices.

57 CalEnviroScreen 4.0, https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40

58 LA Mayor's Office Tree Equity Priority Map, ArcGIS StoryMap

59 Climate Smart Cities Los Angeles, https://web.tplgis.org/csc_losangeles/

60 LA Controller Equity Index, ArcGIS StoryMap

61 LA County Climate Vulnerability Assessment, https://ceo.lacounty.gov/cva-report/

62 American Forests Tree Equity Score, https://www.treeequityscore.org/

Notes and considerations

Although this framework employs a process of comparing tracts to others, it is not our intention to create a competition of need. This is necessary, particularly in a city as large as Los Angeles, so that we can effectively narrow down an intractable list of places, and make decisions which will set us on a path to action. That said, we recognize that all tracts identified through this process, from step 1 onward, have a need for attention, support, and canopy improvements. By selecting two neighborhoods to begin this work, we do not suggest that others are less worthy, and hope to bring attention to all areas of need through this process.

It became apparent as we entered step 4 that the analytical outputs of this framework cannot fully override existing biases and preferences among stakeholders. In this instance, our decision-making process did not strongly favor the San Fernando Valley. While some tracts in that area made it through step 3, many UFEC-nominated neighborhoods in that area were not represented. Those that did make the list featured only a handful of high-priority tracts, accounting for a small portion of overall neighborhood area. Compared to others in south and central LA which were fully covered, locations in the Valley seemed like less obvious candidates for final selection. In spite of this, a collective decision was reached among UFEC members to include one Valley site due the members' preferences for that region and belief that conditions there, particularly the factor of extreme heat vulnerability, warranted intervention. Once the decision was made to include a Valley site, the list of possible sites was reviewed for feasibility and some candidates (Sun Valley, Panorama City) were removed. This is not a shortcoming of the framework, but an acknowledgement that any decision-making process, even when grounded in objective data, must ultimately contend with the subjectivities and nuances of practice.

Pilot Neighborhoods

After selecting Central Alameda and Sylmar as UFEC's two pilot neighborhoods, the team conducted a deeper review of local conditions including site visits to assess the local landscape, and creation of neighborhood profiles with essential summary information. Both neighborhoods contained ample opportunities for Tier 2 and Tier 3 planting, as shown in site visit photos. While Central Alameda faces expected challenges associated with a highly built-out and densely populated urban space, Sylmar has unique challenges such as reverse parkways (which are often used for resident parking) and a lack of conventional parkway planting strips.

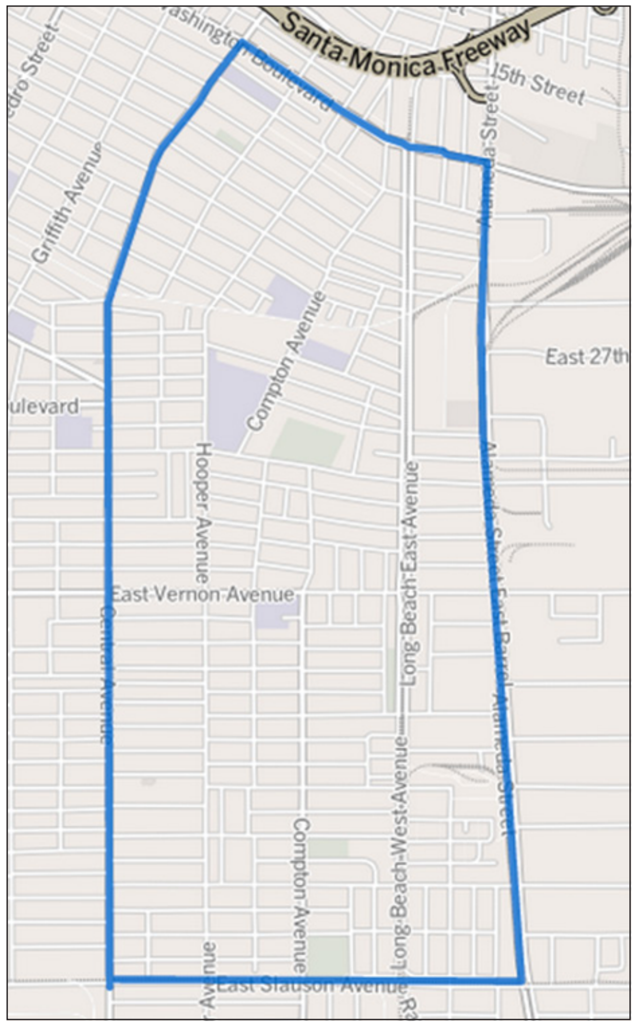
Table 4 shows the average of each indicator for each of the census tracts within the two pilot neighborhoods selected by the UFEC. There were a total of two (2) census tracts in Sylmar and twelve (12) census tracts in Central Alameda selected by the UFEC decision-making process.

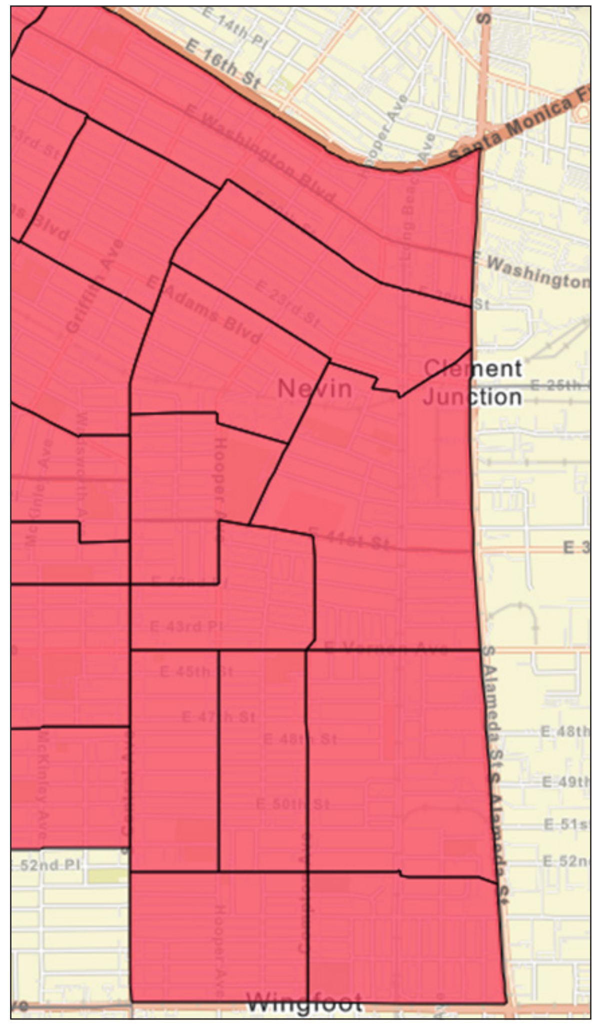
Table 4. Neighborhood profile summary for Central Alameda and Sylmar neighborhoods.

Factor	Indicator	Central Alameda	Sylmar
Physical & Economic Factors	Urban Tree Canopy Cover	13.49%	16.57%
	Impervious Surface	72.98%	69.68%
	Median Household Income	$40,554	$47,263
Environmental Exposure Factors	Days Projected Over 90F	48.4 days / year	110 days / year
	Number of Excess Emergency Room Visits (per day, per zip code)	24	24
	Number of Emergency Room Visits Due to Extreme Heat	11,184	14,877
	Ozone	0.067 ppm	0.067 ppm
	PM 2.5	~12 μg/m^3	~11 μg/m^3
	Diesel PM	0.19 Tons/year	0.35 Tons/year
Socio-Demographic Factors	Poverty %	30.06%	25.85%
	Non-English Speaking %	88.71%	75.65%
	Population Density	0.005-0.011 people/ square meter	0.016 people/ square meter
	No Internet Access %	27.44%	21.47%
	High School or Equivalent Education	80.70%	67.20%
	Redlining HOLC Grade	D – "Hazardous"	Not Graded
	Renter Population	72.15% renters	79.47% renters
	Non-White Population	99.64%	91.75%
Land Use Breakdown by Neighborhood Council	Multi-Family	46.50%	59.09%
	Single Family	0.00%	48.60%
	Open Space	2.78%	2.33%
	Commercial	7.58%	17.03%
	Industrial	11.30%	0.00%
	Public Facilities	5.98%	6.56%
Tree Growth Factors & Site Conditions	Sunset Climate Zone	Zone 10a: 30F to 35F	Zone 22
	Soil Condition / Type	Various	Sandy
	Average Precipitation	14.66 inches (average for 1877 - 2021)	11.07 inches (average for 1998 - 2021)

Central Alameda
South Los Angeles

Council District 9 – Central Alameda Neighborhood Council
Total Neighborhood Size: 2.18 Square Miles
Total Population: 43,638





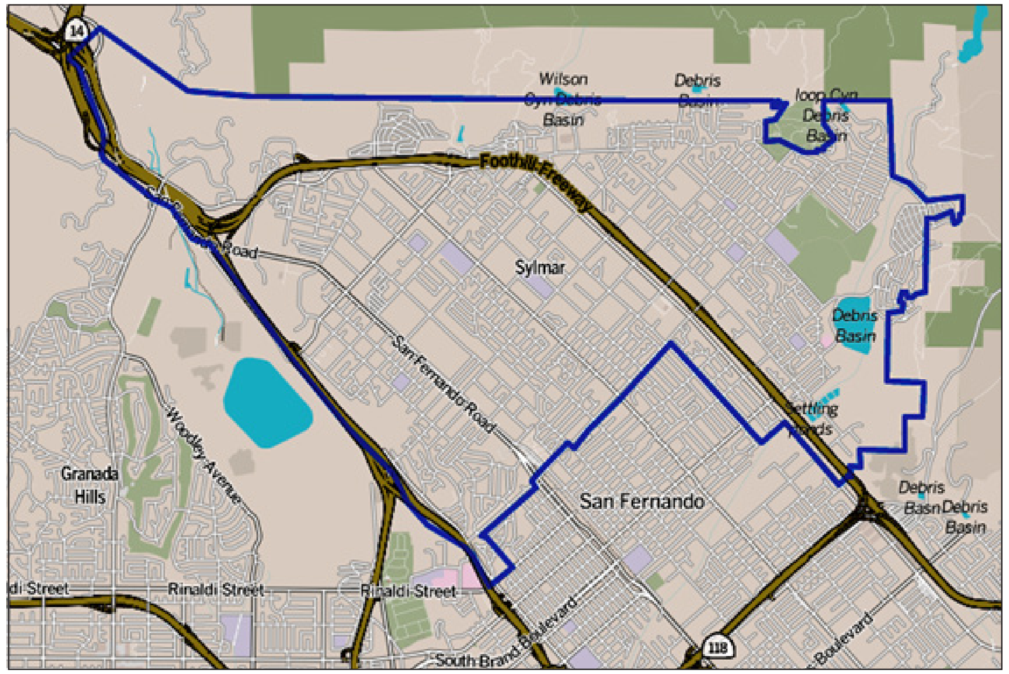
Left: the boundary of the Central Alameda neighborhood council (NC); Right: high-priority tracts within the NC identified through the decision-making process

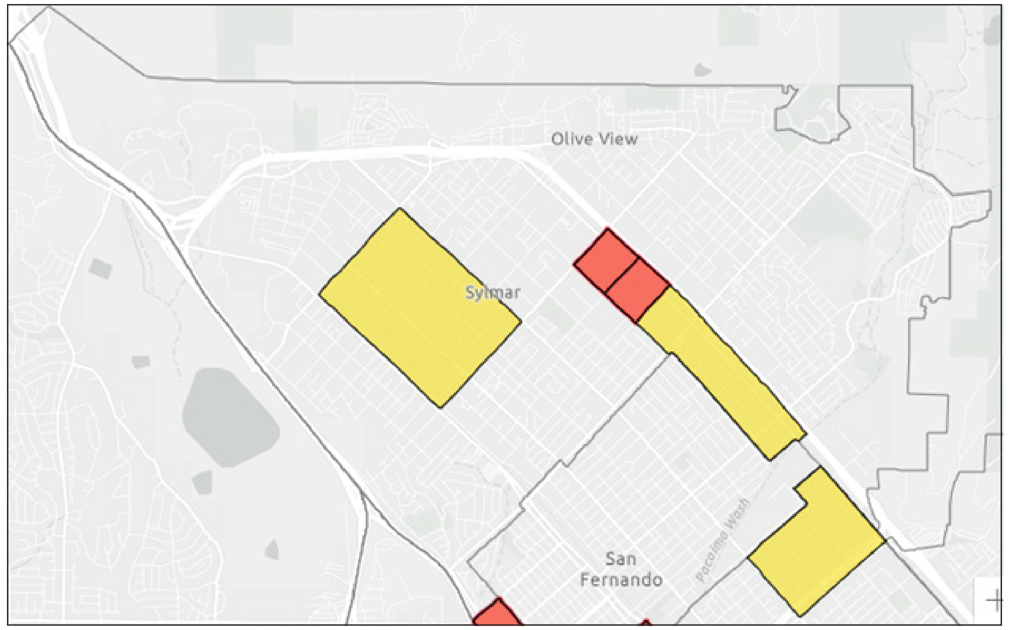
The following pages show site visit photos, depicting common conditions in Central Alameda.


Compton Ave

Sylmar

Council District 7 – Sylmar Neighborhood Council
Total Neighborhood Size: 12.46 Square Miles
Total Population: 81,628 in 2019, according to the City of LA's Dept. of City Planning





Top: the boundary of the Sylmar neighborhood council (NC); Bottom: high-priority (red) and medium-priority (yellow) tracts within the NC identified through the decision-making process

The following pages show site visit photos, depicting common conditions in Sylmar.





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Strong partnerships with community-based organizations (CBOs) were essential for UFEC to advance work in these two neighborhoods. This is because our equity-centered process calls for the substantive engagement of local residents in the assessment of forestry issues and development of solutions. While many UFEC partners have expertise in forestry, urban planning, and related fields more generally, CBOs have the relationships, trust, and deeply place-based knowledge to bring community members to the table. The nonprofit TreePeople has a significant presence in Sylmar and led community engagement efforts for UFEC in that neighborhood, including distributing surveys, hosting two community workshops, and advancing complementary Tier 1 planting projects. In Central Alameda, UFEC relied on the expertise of both North East Trees, which distributed surveys and has been conducting Tier 1 planting in the area, as well as South LA Tree Coalition, which convened neighborhood residents for a community workshop and led the development of a neighborhood planting strategy.

UFEC Community Engagement teams, led by local community-based organizations TreePeople, North East Trees, and South LA Tree Coalition, deployed a social survey in both pilot neighborhoods. The results of these surveys and subsequent community engagement can be found in the Neighborhood Strategy documents, while the tables below offer an overview of survey results comparing attitudes and preferences between the two neighborhoods.

Respondent characteristics

Characteristics	Central Alameda	Sylmar
Live in the neighborhood	82%	81%
Rent / Own	71 / 19%	23 / 65%
Tenure 15+ years	41%	49%

Value of trees

Strongly Agree or Agree with the following statements	Central Alameda	Sylmar
Trees are good for my neighborhood	85%	87%
Shade will encourage people to be outdoors more	85%	87%
Trees are beautiful to look at	86%	89%

Barriers

Strongly Agree or Agree with the following statements	Central Alameda	Sylmar
I have a problem with the mess that trees can cause	19%	17%
Watering a young tree is expensive	24%	32%
Trees damage infrastructure and property	20%	24%
The trees in my neighborhood are poorly maintained	33%	48%
It is the responsibility of the city to care for trees that line the streets.	60%	80%
I disapprove of the job the city does making my neighborhood livable	25%	34%

Top benefits of interest to respondents

Selected benefits	Central Alameda	Sylmar
Beautify	69.1%	64.64%
Outdoor Activities	50.0%	45.30%
Improve AQ	73.5%	74.59%
Reduce noise	11.8%	18.78%
Prevent flooding	14.7%	16.02%
Provide habitat	29.4%	49.72%
Reduce crime	8.1%	13.81%
Reduce heat	63.2%	70.72%

New tree location

Strongly Agree or Agree with having more trees....	Central Alameda	Sylmar
In my neighborhood	80%	87%
At my home	71%	69%

Preferred location for new trees	Central Alameda	Sylmar
Private yards in homes	32.4%	33.70%
Common areas in apts, public housing, other multi-family	47.1%	59.67%
Residential streets	55.1%	73.48%
Businesses and comm. properties	22.8%	39.78%
Parks	71.3%	66.85%
Alleys	16.2%	8.29%
Schools	56.6%	50.83%

Trade Offs

Strongly Agree or Agree with the statement, "I would be willing...."	Central Alameda	Sylmar
For the City to remove 1-2 parking spots on my street	46%	56%
For the City to remove 3+ parking spots on my street	35%	42%
For the City to narrow some streets in my neighborhood	43%	49%
To water newly planted trees on my street once per week	76%	73%

More details about community engagement work conducted by these partners, as well as results, potential planting interventions, and recommendations can be found in the two 'LA Urban Forest Equity Neighborhood Strategy' documents produced in Phase II.

Policy Analysis & Discussion

Policy Analysis & Discussion[63]

[63] All "case study examples" linked in Table 5c, and all policies and codes referenced in Table 6, will be fully cited in the References section at the end of this report under the header "Policy Analysis & Discussion References."

Interventions and Policy Scan

In classifying street segments according to planting tiers, and working with diverse stakeholders to better understand feasibility, UFEC's work has, from the beginning, been geared toward implementation. In other words, all possible interventions considered or put forth by UFEC have been vetted for implementability. Our team has thought through questions such as: What kinds of interventions are physically possible in the urban space of Los Angeles? Have these ideas been implemented successfully in LA or in other, comparable cities? What are the tradeoffs of various planting strategies that might limit their uptake? What existing codes, policies or plans may enable or interfere with each intervention? A summary of feasible interventions across all three tiers, based on a review of current conditions in LA as well as case studies from other regions, is presented in Table 5a-c.

Table 5a. Tier 1 Interventions

Intervention	Roadway Designation	Challenges & Tradeoffs	Case Study Examples
Planting in existing plantable space: Parks	N/A	Planting trees may require the reallocation of some open recreational space	Department of Parks and Recreation City Parks Reforestation Program
Planting in existing plantable space: Open parkways	N/A	Parkway sizes in historically disinvested neighborhoods are often smaller and can only fit small trees, resulting in fewer community & health benefits; programs requiring residents to water street trees can be burdensome in low-income/high renter neighborhoods	City Plants and LADWP "Free Trees" - Street Tree Program CAL FIRE Urban & Community Forestry Grant Program
Planting in existing plantable space: Private property	N/A	Difficult for dense neighborhoods with high multi-unit housing / zoning; Difficult for renters, which can also impact tree survival rates	City Plants and LADWP "Free Trees" - Residential Tree Adoption Program City Plants and LADWP "Free Trees" - Residential Tree Delivery & Private Property Planting Pilot Program City Plants Tree Ambassador / Promotor Forestal Program
Planting in existing plantable space: Parks created with new residential developments	N/A	Space may not be easily accessible to the public	Downtown Los Angeles Community Plan, Open Space requirements
Planting in existing plantable space: School campuses	N/A	Maintenance resources are often limited; space conflicts can arise to accommodate recreation activities that require hard surfaces	LA Unified School District's Sustainable Environment Enhancement Developments for Schools program
Planting in existing plantable space: Public housing properties	N/A	Debunked perceptions that trees provide spaces for criminals to hide can prevent approval for greening projects	Pueblo del Rio (South Los Angeles) public housing development greening project led by North East Trees

Table 5b. Tier 2 Interventions

Intervention	Roadway Designation	Challenges & Tradeoffs	Case Study Examples
Creating a new tree well/ concrete cut (one side of sidewalk)	Avenue II Avenue III Industrial Collector Local Standard Local Limited	Addresses low soil volume in sidewalk; Accessibility concerns (potentially narrowing the sidewalk); Potential for subgrade utility or power line conflict	CAL FIRE Urban & Community Forestry Grant Program
Creating a new tree well/ concrete cut (both sides of sidewalk)	Boulevard I Boulevard II Avenue I Avenue II	Addresses low soil volume in sidewalk; Accessibility concerns (potentially narrowing the sidewalk); Potential for subgrade utility conflict or power line conflict	City of Los Angeles, 7th Street and Westmoreland Avenue, (Koreatown)
Expanding an existing tree well	Depends on site conditions	Addresses low soil volume in sidewalk; Accessibility concerns (potentially narrowing the sidewalk); Potential for subgrade utility conflict or power line conflict	Centinela Avenue north of Wilshire Boulevard, City of Santa Monica
Planting in a reverse parkway	Depends on site conditions	Reducing residential parking space; Community buy-in may be difficult in densely populated multi-unit housing areas, where parking is scarce and public transit is lacking	Sylmar and other neighborhoods in the San Fernando Valley have many reverse parkways
Removing dead standing tree	N/A	Grinding down existing stump and roots would be required to make space for new planting	S. Bundy Drive and Dorothy Street (SE corner), Los Angeles
Planting in parking lots / vacant lots	N/A	Space limitations due to competing needs	Los Angeles Zoo parking lot
Removing tree well obstructions (e.g., tree well covers and agroperm)	All designations	Accessibility concerns (potentially narrowing the sidewalk)	Foothill Blvd. between Polk Street and Astoria Street, Sylmar (City of Los Angeles)

Table 5c. Tier 3 Interventions

Intervention	Roadway Designation	Challenges & Tradeoffs	Case Study Examples
Green Streets and Alleys	Alleys Local Standard Other, depending on site conditions	Accessibility concerns (potentially narrowing the sidewalk); Potential for subgrade utility conflict or power line conflict	Elmer Avenue Neighborhood Retrofit led by Council for Watershed Health, Sun Valley (City of Los Angeles); Avalon Green Alley Network led by Trust for Public Land, South Los Angeles
Attached curb extension (Type 1)	Avenue II Avenue III Industrial Collector Collector Local Standard Pedestrian Enhanced Network SRTS Programming	Potential traffic volume management concerns; Impact stormwater drainage facilities if on site; Reducing parking; Reducing traffic lanes	500 block of Whittier Blvd, Montebello; City of Los Angeles Supplemental Street Design Guideline
Floating curb extension (Type 2)	Avenue II Avenue III Industrial Collector Collector Local Standard Pedestrian Enhanced Network SRTS Program	Potential traffic volume management concerns; Reducing residential parking space; Reducing traffic lanes	City of Los Angeles Supplemental Street Design Guidelines
Bus bulbs	Collector Local Street Standard Transit enhanced network (TEN)	Reducing travel lanes; Affecting stormwater infrastructure	LA Metropolitan Transportation Agency plan for enhanced station stop at the Roscoe Blvd/Van Nuys Blvd intersection, Van Nuys (City of Los Angeles)
Gateway	Collector Local Street Standard Pedestrian Enhanced Network SRTS Program	Potential traffic volume management concerns Impact stormwater drainage facilities if on site; Reducing residential parking space; Reducing traffic lanes	National Association of City Transportation Officials (NACTO) Example
Pinch point/ Midblock curb extensions	Collector Local Street Standard Pedestrian Enhanced Network SRTS Program	Potential traffic volume management concerns	National Association of City Transportation Officials (NACTO) Example
Chicane	Collector Local Street Standard	Potential traffic volume management concerns	Austin, Texas
Crossing Island	Boulevard I Boulevard II Pedestrian Enhanced Networks	Potential traffic volume management concerns; Driveway access concerns; Reducing residential parking space; Reducing traffic lanes	Wilshire Boulevard, City of Santa Monica
Planted median / diverter	Boulevard I Boulevard II	Reducing traffic lanes	Wilshire Boulevard, City of Santa Monica
Mini-roundabout	Collector Local Street Standard	Cannot be implemented in areas with high car traffic volume; May impede pedestrian or bicyclist flow of traffic	Redondo Beach traffic circles
Pedestrian Plaza	N/A	Reducing the public roadway	43rd Place between Degnan Boulevard and Leimert Boulevard, Los Angeles
Shifting the sidewalk	TBD	Reducing public roadway; Affecting stormwater facilities if on site	111 W Ave 29, Los Angeles
Protected Bicycle Lane (Class IV)	Bicycle enhanced networks (Specifically the Tier 1 recommendations proposed in the 2035 Mobility Plan)	Potential traffic volume management concerns; Driveway access; Reducing residential parking space; Reducing traffic lanes	Spring Street, Down-town Los Angeles
Sidewalk extension	Avenue II Avenue III Industrial Collector Collector Local Standard	Reducing public roadway; Affecting stormwater facilities if on site	National Association of City Transportation Officials (NACTO) Example
Creating a new public park via land acquisition	N/A	Land acquisition	City of Los Angeles Open Space and Conservation Broadway Civic Center Park Project, 126 N. Broadway, Los Angeles
Creating new community gardens via land acquisition	N/A	Land acquisition	111th Street and Avalon Boulevard, Los Angeles

During this analysis, in an effort to capture the overall policy environment of LA and its potential impacts on canopy-related initiatives, UFEC identified relevant rules and plans and classified them as either 'supportive' or 'limiting/intersecting' (Table 6). Those reviewed here capture two facets of urban forestry work: new tree planting, and existing tree preservation. Supportive rules make accommodations for tree planting or preservation, particularly in difficult areas targeted by Tier 2 and Tier 3 which are of greatest interest to UFEC. Limiting/intersecting policies could hinder advancements in planting or preservation and/or create requirements and rules of use that may conflict with the presence of trees. In practice, urban foresters must leverage supportive options while working within the confines of limiting ones, at least for the time being. Although UFEC's work to date has focused on tree planting, we acknowledge that canopy expansion and forest equity require a careful combination of new tree planting and mature tree preservation, and accordingly included policies relevant to both aspects for further consideration by practitioners.

Table 6. Relevant codes, plans and policies that may intersect with urban greening initiatives

Supportive Plans, Codes & Policies (planting-related)	Limiting / Intersecting Plans, Codes & Policies
Complete Streets Design Guide of Los Angeles	SEC. 62.61. WORK WITHIN OR ON A PUBLIC STREET OR RIGHT-OF-WAY, OBSTRUCTION OF A PUBLIC STREET OR RIGHT-OF-WAY (municipal code)
City of Los Angeles Supplemental Street Design Guide	SEC. 62.02. EXCAVATIONS IN AND ADJACENT TO STREETS – PERMITS. (municipal code)
Step by Step: Pedestrian Plans for Unincorporated Counties	SEC. 62.169. PERMIT REQUIRED TO PLANT IN STREETS. (municipal code)
LA City's Mobility Plan 2035	SEC. 12.21. GENERAL PROVISIONS.(municipal code; see parking requirements)
SEC. 12.04.05. "OS" OPEN SPACE ZONE. (municipal code)	SEC. 17.05. DESIGN STANDARDS. (municipal code; see right-of-way, streets width, Complete Streets)
SEC. 62.175. TREE MAINTENANCE. (municipal code)	LADOT - Landscaping-Trees and other objects (MPP Section 531)
Landscape Ordinance (City of LA Planning)	UFD's Street Tree Spacing Guidelines
Article 6: Preservation of Protected Trees (municipal code)	SEC. 12.37. HIGHWAY AND COLLECTOR STREET DEDICATION AND IMPROVEMENT. (municipal code)
City of LA's Protected Tree Ordinance	Article 1: Lighting District Procedures (municipal code)
SEC. 62.170. CONDITIONAL PERMIT TO REMOVE OR DESTROY TREES. and SEC. 62.171. PERMIT FEES FOR TREE REMOVAL. (municipal code)	SEC. 56.08. SIDEWALKS – STREETS – OBSTRUCTIONS. (municipal code)
SEC. 62.177. ESTABLISHMENT OF TREE REPLACEMENT AND PLANTING IN-LIEU FEE. (municipal code)	ADA compliance including even (unbroken) and low-slope sidewalks
Wildlife Ordinance (City of LA Planning, in progress)	

[64] Yu, K. (2023). Greening the divide: Identifying community-driven policy and planning pathways to advance urban forest equity in Los Angeles. University of California Los Angeles.

Supportive documents such as the Complete Streets Design Guide and LA City's Mobility Plan reflect a future vision that is compatible with UFEC's goals: safe, accessible urban environments for all residents, including pedestrians and cyclists. In the case of Complete Streets, street trees are an important component of that environment. The guide makes recommendations for where to plant trees and what varieties to choose, while highlighting the benefits and importance of trees in public space. The Mobility Plan calls for trees less explicitly, though notes their importance for improving the appeal of pedestrian environments and controlling flooding. However, this plan emphasizes changes to the built environment such as protected bike lanes and traffic calming measures, which could create space for and/or be combined with physical transformations needed for Tier 2 and Tier 3 plantings . The LA Landscape Ordinance requires that at least one tree (non-palm) be planted for every 500 square feet of landscaped area in a project; SEC 62.175 provides for five year of public tree maintenance by the City of LA, including watering, pruning, replacing and general care; and SEC 12.04.05 obligates the City to preserve "natural resources," "natural features" and "environmental characteristics" on open space, which may be supportive of tree preservation, particularly in parks. Tree preservation is further supported by provisions in the Protected Tree Ordinance (PTO), proposed Wildlife Ordinance, SEC 62.170 and SEC 62.177. The PTO establishes protections for specific species of trees and regulates their removal for development or other purposes, while municipal codes establish special permits and fees associated with tree removal. Conversely, tree planting may be limited, or at least informed by, other City codes governing details such as sidewalk width and pedestrian obstructions, tree spacing and landscape design, and interactions between trees and utilities or other forms of 'public good' development such as housing.

As we consider Tier 3 planting possibilities and the reallocation and transformation of urban space, it will be beneficial for planting initiatives to integrate with existing policies and guidelines that pertain to transformative visions more broadly. Those that address changes to the public right-of-way are particularly relevant. Several examples, from Yu, 2023[64] are summarized below:

- Sidewalk Repair Program: The Sidewalk Repair Program is an initiative by the City of Los Angeles aimed at improving the condition of sidewalks. The program outlines guidelines for repairing and maintaining sidewalks, addressing issues such as cracks, uneven surfaces, and accessibility barriers. It also establishes procedures for residents and property owners to report sidewalk damage and request repairs.

- Vision Zero: Vision Zero is a citywide initiative in Los Angeles focused on eliminating traffic-related fatalities and severe injuries. The program sets policies and targets for improving street safety, including pedestrian safety. It promotes the implementation of traffic calming measures, enhanced crosswalks, and other design interventions to create safer streets for all road users.

- Green Streets Policy: The Green Streets Policy in Los Angeles emphasizes the integration of sustainable stormwater management practices into street design. It encourages the use of green infrastructure techniques, such as permeable pavements, bioswales, and tree planting, to capture and treat stormwater runoff, reducing the strain on the city's stormwater system and improving water quality.

- The LA 2035 Mobility Plan: The plan is a comprehensive long-term transportation strategy that sets forth a vision for the future mobility of Los Angeles. This plan aims to create a more sustainable, equitable, and efficient transportation system by the year 2035. It emphasizes the principles of complete streets, active transportation, transit-oriented communities, and Vision Zero. The plan promotes the expansion of the bicycle network, enhancement of pedestrian infrastructure, and improvement of public transit options to reduce reliance on private vehicles.

- The Los Angeles Complete Streets Design Guide: The Los Angeles Complete Streets Design Guide serves as a comprehensive resource for urban planners and designers, providing guidance on creating streets that prioritize the needs of all users, including pedestrians, cyclists, and transit riders. The guide emphasizes the concept of "complete streets," where the design integrates various modes of transportation to promote safety, accessibility, and a sense of community. It covers a wide range of topics, including street typologies, intersection design, bicycle infrastructure, and pedestrian amenities (City of Los Angeles Complete Streets Design Guide, 2021).

This policy and code review reveals opportunities for forest equity as well as barriers which might be addressed through future decision-making and policy-setting processes. Later efforts by politicians, city staff, and communities may focus on ways to overcome or alter limiting policies, add to the number of supporting ones, and/or tap into complementary urban design guidelines.

Preservation Tiers Framework

UFEC Phase II began as a planting-oriented initiative, and much of our work has been structured around the Planting Tiers Framework generated during Phase I. However, during the course of our work, it became clear that urban forest equity and urban canopy goals in general cannot be achieved without addressing tree preservation as well as planting. Accordingly, our team began exploring a Preservation Tiers Framework to complement the tiered planting framework already in use. Here, 'preservation' refers to keeping a tree in the ground and avoiding damage to that tree. This framework offers a way to conceptualize preservation potential within the high planting-priority neighborhoods/tracts already identified by UFEC. This complementary framework will help practitioners understand (a) the likelihood of success with regard to preservation in priority neighborhoods, and (b) the appropriate balance of preservation and planting in each location. Even if preservation is found to be infeasible or irrelevant in a project location, classifying sites according to these tiers will show due diligence in examining preservation as an option. Our team developed this framework in response to feedback from our UFEC community partners, who identified this as a needed addition to the process. It is in preliminary form and we see potential to further refine the details and methods around the framework for future use by practitioners.

Why consider preservation?

Mature urban trees face a range of threats related to climate change (heat, drought, flooding), pests and disease, development, and fire.[65] From 2000 to 2021, Los Angeles City lost 11% of its overall tree canopy.[66] From 2000-2009, some parts of Los Angeles County experienced a 14-55% loss of "green cover," which includes trees, shrubs and grass.[67] If planting initiatives fail to keep up with local rates of tree loss, there may be no net positive impact on overall canopy coverage in LA. Without significant canopy gains from a blend of planting and preservation, the City can at best expect to maintain the status quo, which still leaves dozens of neighborhoods under-canopied and yields deficiencies in tree size and quality.

Mature trees provide up to 70 times the ecological and health benefits of small, immature trees.[68] Larger, established trees are more effective than new plantings at mitigating air pollution, sequestering carbon, providing shade, retaining stormwater, and cooling the ambient environment; they are more tolerant of heatwaves and drought.[71 72] It takes years for a new tree to match the ecosystem services provided by a mature one. Trees are most vulnerable in the first few years of life, meaning that newly planted trees facing urban-environmental stressors may not survive to maturity. Mortality of young trees is particularly likely with inadequate maintenance.

If the City of LA attempts to add new trees without properly caring for those that are already there, that action may foster confusion, doubt, and frustration among urban residents. If City-sponsored maintenance of trees has been unsatisfactory in the past, residents may be reluctant to accept planting. Privately-hired tree pruners, who may or may not be trained to prune using industry standards, may be under orders of the property owner to prune aggressively, resulting in trees that are unsightly and structurally compromised. Due to long pruning cycles that are the result of limited funding, City crews, too, may prune more aggressively than prescribed by industry standards. These issues are especially pronounced in disinvested or underserved neighborhoods, which are the focus of UFEC's efforts. Residents in these places could be concerned about the disservices brought by trees which are not well maintained by the City, such as yard debris, fallen limbs, and property damage.[73 74] In order to build trust and interest in planting, project partners may need to first address any lingering concerns about care and responsibility for mature trees.

Preservation tiers

The UFEC recognizes that while planting is a needed approach in some instances, tree preservation is also important and should be factored into our thinking, as well as future projects and plans. One idea has been to add a "tier 0" to the existing Planting Tiers Framework, which would encompass tree preservation broadly. However, this has some possible shortcomings: (1) it complicates and dilutes a framework that was only created for planting applications, (2) it misses the nuances of preservation which would be relevant for practitioners, and (3) simply encouraging the recognition of "preservation" as an option provides little practical guidance to shift away from business-as-usual. As an alternative, we propose a separate three-tier preservation framework that complements the existing planting tiers.

Planting tiers 1-3 represent escalating degrees of difficulty and physical transformation associated with tree planting. Likewise, this new framework acknowledges that there are differences in feasibility with regard to preservation; it is easier to preserve a tree under certain conditions than others. These differences in difficulty are based primarily on variations in property ownership and the physical environment where trees exist, not the type of tree in question. Tree type is not centered here because, although LA's Protected Tree Ordinance offers protections to some species, permits still allow for removal of those species under certain circumstances. Land type and ownership have been shown to influence tree preservation outcomes and will be centered in this framework.[74 75 76] A breakdown of preservation tiers is shown in Table 7 below.

Table 7. The preservaton tiers, including types of trees included, needs for success, and further explanation

	TREES	NEEDS	EXPLANATION
TIER 1	Trees on public park land or in protected natural areas; Trees on City-owned and occupied property (government offices, etc.)	Preservation may be achieved with little to no new action, or some additional resources for City staff	Trees within this tier can be preserved with relatively low difficulty and a high chance of success
TIER 2	Trees on owner-occupied residential property; Trees on public or private property facing low development pressure	Preservation may be achieved by providing some maintenance support, education, and/or outreach to property owners	Trees within this tier can be preserved with moderate difficulty and a moderate chance of success
TIER 3	Street trees; Trees on public and private property facing high development pressure; Trees on non owner-occupied residential property	Preservation may be achieved by limiting removal permits, limiting development, increasing fines/fees, or strengthening/expanding existing protections	Trees within this tier can be preserved with relatively high difficulty and a low chance of success

65 Nowak, D. J., & Greenfield, E. J. (2018). Declining urban and community tree cover in the United States. Urban Forestry & Urban Greening, 32, 32–55.

66 Global Forest Watch (2023). Los Angeles, United States. Forest Change. Retrieved from: https://www.globalforestwatch.org/dashboards/

67 Lee, S. J., Longcore, T., Rich, C., & Wilson, J. P. (2017). Increased home size and hardscape decreases urban forest cover in Los Angeles County's single-family residential neighborhoods. Urban Forestry & Urban Greening, 24, 222–235.

68 Isaifan, R. J., & Baldauf, R. W. (2020). Estimating Economic and Environmental Benefits of Urban Trees in Desert Regions. Frontiers in Ecology and Evolution, 8, 16.

69 Kim, G., & Coseo, P. (2018). Urban Park Systems to Support Sustainability: The Role of Urban Park Systems in Hot Arid Urban Climates. Forests, 9(7), 439.

70 Stecker, T. (2014). E&E: Old trees store more carbon, more quickly, than younger trees. Pacific Forest Trust.

71 Au, T. F., Maxwell, J. T., Robeson, S. M., et al. (2022). Younger trees in the upper canopy are more sensitive but also more resilient to drought. Nature Climate Change, 12(12), 1168–1174.

72 Van Wing, Sage (2021). Researchers study effects of extreme heat on Pacific Northwest trees. Oregon Public Broadcasting (OPB).

73 Carmichael, C. E., & McDonough, M. H. (2018). The trouble with trees? Social and political dynamics of street tree-planting efforts in Detroit, Michigan, USA. Urban Forestry & Urban Greening, 31, 221–229.

74 Riedman, E., Roman, L. A., Pearsall, H., Maslin, M., Ifill, T., & Dentice, D. (2022). Why don't people plant trees? Uncovering barriers to participation in urban tree planting initiatives. Urban Forestry & Urban Greening, 73, 127597.

75 Hilbert, D. R., Roman, L. A., Koeser, A. K., et al. (2019). Urban tree mortality: What the literature shows us. Arborist News, Oct: 22-26.

76 Roman, L., Catton, I., Greenfield, E., et al. (2021). Linking Urban Tree Cover Change and Local History in a Post-Industrial City. Land, 10(4), 403.

Tier 1: Trees on public park land or in protected natural areas; Trees on City-owned and occupied property

Trees situated in a City park or protected natural area will be some of the easiest to preserve. Past studies have shown that urban tree canopy is more persistent in protected open space than outside of it;[76] that government ownership of land has a positive impact on tree cover;[77] and that trees protected in parks experience fewer threats and higher survivability than those that are not.[78] City maintenance plans already allow for the care of trees on parkland, and insufficient resources for maintenance can be addressed internally. Preservation in these environments can likely be solved with little to no new action, particularly if there are sufficient staff resources for tree maintenance and appropriate inclusion of staff arborists in capital project planning and oversight. One caveat is that park trees are sometimes removed by the City when they interfere with other recreational amenities and aesthetics, such as play equipment or clear walking paths.[76]

Trees on City-owned and occupied property include those surrounding municipal office buildings. These may be slightly more at risk than trees in a park or protected natural area. However, such properties receive regular landscape maintenance and, as above, preservation and maintenance decisions can be made internally among City staff and will presumably adhere to protective municipal codes.

Tier 2: Trees on owner-occupied residential property; Trees on public or private property facing low development pressure

Some residential trees are protected by LA's Tree Protection Ordinance, but homeowners and landlords can obtain removal permits for trees that interfere with planned construction, that pose a risk, or that are in poor health. Homeowners who are not interested in caring for trees may neglect to do so, intentionally expedite tree decline, or exaggerate risk to obtain a removal permit. As noted above, no permit is needed to remove species not on the protected list, with the exception of additional protections for "significant trees" in certain Specific Plan areas and in the proposed Wildlife Ordinance area. Significant trees are defined by the City as those measuring 12" diameter at standard height (DSH).

There are many reasons a homeowner or landlord may not want a tree: aversion to maintenance costs, concerns about property damage, allergies, and aesthetics, to name a few.[74] According to Pike et al.,[79] "studies find that homeowners' preferences for low maintenance trees can be at odds with the goals of municipalities and can therefore hinder the long-term sustainability of urban forests." Homeowners often opt for small ornamentals, or remove potentially large trees before they reach maturity.[79] A study by Lorenzo et al. (2000)[80] found that residents who were not likely to contribute to a tree preservation program cited lack of information and lack of financial resources as major contributing reasons. Experts typically agree that tree preservation on residential property can be improved through outreach and education; informing residential property owners about the benefits and services trees provide, building support for trees among homeowners, and providing supportive resources when needed.[80 81] This approach will not convince every homeowner or landlord to keep their trees, but could make a significant impact in residential settings. This option is most feasible for owner-occupied homes which are primarily, though not exclusively, single-family structures.

This tier also includes trees on any private or public property (excluding those listed under Tier 1) facing minimal development pressure. That includes, for example, trees surrounding commercial properties and City-owned trees on vacant lots. Trees could conceivably be protected with some outreach, education, or additional resources for property owners or, in the case of City-owned assets, via internal communication. If trees are already in place, and if those properties are not facing much development pressure, it may be feasible to work with owners to ensure trees are retained and cared for.

Tier 3: Streets trees; Trees on public and private property facing high development pressure; Trees on non owner-occupied residential property

In Tiers 1 and 2, preservation could potentially be achieved through conversation and, perhaps, some redistribution of resources. Conversely, trees included under Tier 3 face multiple threats which are difficult to counteract, including vandalism, traffic accidents, climate change, inadequate growth space, and development.[75] Street trees, for example, are thought to have a relatively high mortality risk due to the environment in which they typically exist.[82] Furthermore, Tier 3 trees in areas facing high development pressure may be tied to political and financial outcomes.

Development, construction, and urban densification account for a significant portion of urban tree loss generally.[83 84] Trees on any property experiencing development pressure and construction activity are susceptible to intentional removal and/or unintentional damage. This applies to both private and public land; for example, vacant land held by a developer, a residential property undergoing expansion, or a City-owned property that is wanted for housing or other public goods. Such was the case when the City of LA opted to remove over 40 trees to build the mixed-use Crenshaw Crossing Project.[85] It is unlikely that property owners would act to preserve Tier 3 trees without a significant incentive or directive to do so;[86] for example, stricter rules, higher fines, and fewer permits issued. When trees are pitted against other public or economic goods, or simply left out of planning processes altogether, chances of preservation success are slim.

Finally, this tier includes trees on any residential property that is not owner-occupied, whether under low or high development pressure. That typically includes multi-family residential rental property, but may

77 Lynch, A. J. (2022). Predictors of tree cover in residential open space: A multi-scale analysis of suburban Philadelphia. Urban Ecosystems, 25(5), 1515–1526.

78 Miller, K. M., Dieffenbach, F. W., Campbell, J. P., et al. (2016). National parks in the eastern United States harbor important older forest structure compared with matrix forests. Ecosphere, 7(7).

79 Pike, K., O'Herrin, K., Klimas, C., & Vogt, J. (2021). Tree preservation during construction: An evaluation of a comprehensive municipal tree ordinance. Urban Forestry & Urban Greening, 57, 126914.

80 Lorenzo, A., Blanche, C., Qi, Y., & Guidry, M. (2000). Assessing Residents' Willingness to Pay to Preserve the Community Urban Forest: A Small-City Case Study. Arboriculture & Urban Forestry, 26(6), 319–325.

81 Clark, C., Ordóñez, C., & Livesley, S. J. (2020). Private tree removal, public loss: Valuing and enforcing existing tree protection mechanisms is the key to retaining urban trees on private land. Landscape and Urban Planning, 203, 103899.

82 Roman, L. A., & Scatena, F. N. (2011). Street tree survival rates: Meta-analysis of previous studies and application to a field survey in Philadelphia, PA, USA. Urban Forestry & Urban Greening, 10(4), 269–274.

83 Hostetler, A. E., Rogan, J., Martin, D., et al. (2013). Characterizing tree canopy loss using multi-source GIS data in Central Massachusetts, USA. Remote Sensing Letters, 4(12), 1137–1146

84 Hostetler, A. E., Rogan, J., Martin, D., et al. (2013). Characterizing tree canopy loss using multi-source GIS data in Central Massachusetts, USA. Remote Sensing Letters, 4(12), 1137–1146

85 LA City (2019). Appendix B: Tree Report. Crenshaw Crossing Tree Report.

86 Brunner, J., & Cozens, P. (2013). 'Where Have All the Trees Gone?' Urban Consolidation and the Demise of Urban Vegetation: A Case Study from Western Australia. Planning Practice and Research, 28(2), 231–255

include single-family rental properties as well. Off-site owners are not present to monitor or maintain trees, or to receive outreach and education about preservation. There may also be less interest in trees among off-site owners because they are not benefiting directly from the presence of trees on the property in the same way that residents might be. However, this latter point is an assumption without strong data to support it.

Integration with the Planting Tiers Framework

We propose that the Preservation Tiers Framework be deployed alongside the Planting Tiers Framework in high-priority areas when selecting urban forestry strategies or project sites. This could be a useful tool for organizing feedback heard during community engagement, as practitioners shared that outreach around tree planting frequently segues into conversations about mature tree maintenance and preservation. A framework that identifies these components allows practitioners to capture information and priorities at the neighborhood level about the investments most beneficial to and desired by the community. By crosswalking each site's planting and preservation potential, a project team can identify and emphasize the appropriate balance of those two activities in future plans. If a site is far more favorable for preservation than planting, or vice versa, it could make sense to pursue the direction with the greatest chance of success. Likewise, if a site presents with similar potential for both activities, a blended approach should be pursued. This crosswalk approach may assist in developing a holistic approach to urban forest management and expansion. An example of the crosswalk, including sample recommendations, is shown below.

	Planting Tier 1	Planting Tier 2	Planting Tier 3
Preservation Tier 1	Site D		Site B
Preservation Tier 2		Site C	
Preservation Tier 3	Site A		Site E

Sample recommendations based on the matrix above:

- Site A = preservation falls in the highest tier of difficulty, but planting will be relatively feasible; prioritize planting
- Site B = planting falls in the highest tier of difficulty, but preservation will be relatively feasible; emphasize preservation of existing trees while working toward smaller advances in planting
- Site C = planting and preservation will be of equal, moderate difficulty; aim to prioritize both equally unless hyper-local conditions suggest a reason to lean more heavily in one direction
- Site D = planting and preservation will be of equal, low difficulty; this site may not be suitable for UFEC intervention given the favorable conditions
- Site E = both preservation and planting will be extremely challenging; balance the two options and look for any opportunity with a reasonable chance of success

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87 [Los Angeles Urban Forest Equity Prioritization Map]

88 City of Los Angeles (2019). Green New Deal. https://plan.lamayor.org/

Los Angeles Urban Forest Equity Prioritization Map

The UFEC GIS team, led by GIS Specialist Cindy Chen, adapted steps 1 through 3 of the decision-making framework (described in Neighborhood Selection Process above) to an interactive, online platform. The Los Angeles Urban Forest Equity Prioritization Map[87] is available through ArcGIS Online and allows users to visualize each quantitative step of the prioritization process.

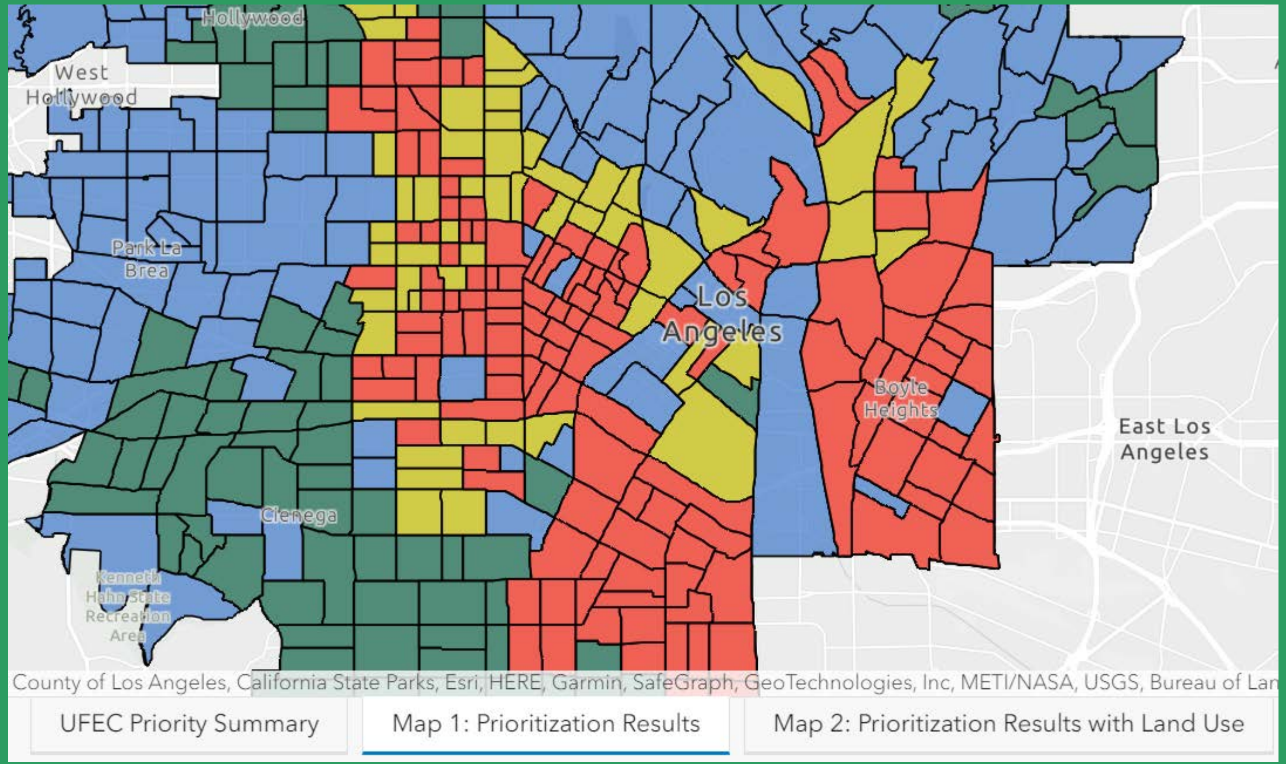
The first tab, "UFEC Priority Summary" provides background information on the selection framework and the UFEC project, as well as instructions on how to navigate the mapping tool. The second tab, "Map 1: Prioritization Results" shows which tracts made it through each step of the prioritization process. All eligible census tracts are represented in blue (1,722); those that passed Step 1: Physical & Economic Need are represented in green (481); those that passed Step 2: Environmental Exposure are represented in yellow (243); and those that passed Step 3: Socio-Demographic Conditions are represented in red (155). The final selection of 155 red tracts were further analyzed using Step 4: Feasibility & Community Readiness, and grouped according to the Neighborhood Council, the boundaries of which are also viewable in the Prioritization Map. This public resource is intended for use by LA City or County staff, community based organizations, and others who may benefit from access to prioritization guidance when planning urban forestry interventions and/or community engagements.

Tier 1 Analysis: Parkways and Private Property

Methodology and data

In Phase I, the UFEC team calculated the number of trees that could be planted in two types of Tier 1 sites: unpaved soil or grass parkways, and plantable space on private property. LA's Green New Deal[88] calls for a relative canopy increase of 50% in areas of greatest need, and this analysis allowed us to determine how far the City could get in planting the most accessible locations first. Utilizing GIS, the team built models to automate the process of locating viable planting sites in the public right-of-way and project possible canopy increase over time. For the purposes of this modeling, certain assumptions were made regarding tree spacing in relation to other critical city infrastructure and modeled trees were assigned a standard crown spread of 15 feet, the size of an average small stature tree. The City of Los Angeles' Street Tree Spacing Guidelines served as the backbone for this analysis, as it provided a list of existing infrastructure that must be taken into consideration when planting new trees. The first model identified viable planting locations along streets and within private property and

Los Angeles Urban Forest Equity Prioritization Dashboard



Screenshot of the Prioritization Map – blue represents all tracts in LA City, green represents tracts that passed Step 1, yellow represents tracts that passed Step 2, and red represents tracts that passed Step 3

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the second model planted "trees" to project possible canopy increase over time. The full results of the Phase I analysis can be viewed in the 'Los Angeles Urban Forest Equity Streets Guidebook.'

In Phase II, the UFEC continued to refine this modeling process by taking into account different tree sizes, which was done through the creation of a supplemental model. Rather than assume that all projected trees are a standard 15 feet in diameter, our updated process relies on a modeled canopy buffer to "plant" small (15 feet crown spread), medium (30 feet crown spread) and large (50 feet crown spread) trees. Furthermore, in addition to updating our citywide Tier 1 projections from Phase I, our team conducted the same Tier 1 analyses for each of the two pilot neighborhoods: Central Alameda and Sylmar. As in Phase I, this process utilized GIS data from GeoHub (Table 8), adhered to the City of LA's Street Tree Spacing Guidelines, and drew in part on the planting assessment methodology of McPherson et al. (2011).[21] A detailed description of the methodology used by the UFEC team can be found as an appendix to this report.

Table 8. Datasets used in Phase II Tier 1 Analysis

GIS Data	
Dataset	**Source**
Council Districts	LA Geohub
Neighborhood Councils	LA Geohub
Sidewalk Data - Driveways, Alleys, Parkways, Curbs, Ramps	LA Geohub
Catch Basins	LA Geohub
Transit Shelters	StreetsLA
Fire Hydrants	LA Geohub
Street Lights	LA Geohub
Intersections	LA Geohub
Railroad Tracks	LA Geohub
Tree Inventory	StreetsLA
Electrical Power Poles (not all of LA City)	SoCal Edison
Tree Canopy & Land Use	TreePeople/LMU

Parkways Analysis

The Parkways Analysis identified the parkways in LA that are available for planting. Following StreetsLA's Tree Spacing Guidelines, projected "tree" points were placed within available parkways if they complied with required infrastructure distances. Based on the parkway size and overhead utilities, the "tree" points were assigned sizes of small (15 ft canopy), medium (30 ft canopy), and large (50 ft canopy) trees. Parkway trees are also referred to as "street trees." The Parkways Analysis consists of three models:

- Model 1, Parkway Selection: This model uses UFD's Tree Spacing Guidelines to identify which parkways have space for tree planting. However, water meters, gas meters, and most electrical power poles are excluded from the analysis due to the inability to obtain the GIS data.
- Model 2, Dropping "Tree" Points: This model uses the selected parkways from Model 1 and creates "tree" points inside the parkway that are equally spaced and aligned.
- Model 3, Tree Canopy Projection: This model uses the "tree" points and creates a "canopy" buffer based on parkway width. The tree sizes breakdown follows:
  - Small (15 ft canopy): Parkway width: < 3 ft, 3-4 ft, any overhead existing wires, and null values. There are null values because the StreetsLA Tree Inventory was not completed as of June 2023.
  - Medium (30 ft canopy): Parkway width: 5-6 ft
  - Large (50 ft canopy): 7-10 ft, > 10 ft
- Manual Work: There was some manual work done to the analysis to organize and prepare the layers for the analysis. The layers were projected, duplicated features were removed, features had some geoprocessing, and some joins were conducted.

Private Property Analysis

The Private Property Analysis focuses on identifying available planting space in residential lots. It uses the Land Use Classification raster layer from TreePeople/LMU, converts it to vector, and plots "tree" points where there is available planting space on private property. The Private Property Analysis consists of two models:

- Model 4: This model uses land classification data to determine available private property land. Existing tree canopy and buildings are buffered and the buffered layer is erased from a grass and soil layer. The remaining grass and soil land are considered "available" and can be planted.
- Model 5: This model uses the results from Model 4 and assigns tree sizes based on remaining lot size. Each lot size represents one "tree" point and then it gets projected to represent "tree canopy cover." The tree sizes breakdown follows:
  - Small (15 ft canopy): Grass/soil lot size is >= 16 sq ft and < 36 sq ft
  - Medium (30 ft canopy): Grass/soil lot size is >= 36 sq ft and < 100 sq ft
  - Large (50 ft canopy): Grass/soil lot size is >= 100 sq ft
  - Sites that are smaller than 16 sq ft were excluded
  - Parks, open spaces, and parkways were removed from the results
- Manual Work: The analysis also included manual work to prepare the datasets for the model such as reclassifying the raster data and then converting the layers to vector.

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Results: Central Alameda

According to the Parkways and Private Property analyses, there are 4,077 trees in Tier 1 sites that can potentially be planted in Central Alameda (Table 9a). If all of those trees were planted, the neighborhood's tree canopy cover would increase by a relative 87.2%, from 12.7% to 23.8% total cover. Street trees account for 13% of this increase and private property trees for 87%.

Table 9a. Tier 1 parkways ("street") and private property analysis results for Central Alameda

Current Tree Canopy Cover %	Central Alameda Boundaries Area (2022) (sq ft)	Existing Tree Canopy Cover Area (sq ft)	Street Trees Projected Area (sq ft)	Private Trees Projected Area (sq ft)	Combined Projected Area (sq ft)	Estimated New Tree Canopy Cover Area (sq ft) (Existing + Projected)	Projected Canopy Increase (Relative Change)	Projected Tree Canopy Cover %	Total Possible Tier 1 Trees
12.7%	37,496,923.65	4,762,388.70	526,766.55	3,623,866.40	4,150,632.94	8,913,021.64	87.15%	23.77%	4,077

Snapshot of model projections for Central Alameda; the light green circles represent projected parkway trees and the dark green circles represent projected private property trees

Table 9b. Tier 1 parkway trees analysis results for Central Alameda

Parkway Trees							
Number of Small Trees	Number of Medium Trees	Number of Large Trees	Total Trees	Area Small Trees (sq ft)	Area Medium Trees (sq ft)	Area Large Trees (sq ft)	Total Projected Area (sq ft)
1,312	95	116	1,523	231,849.54	67,151.54	227,765.47	526,766.55

Table 9c. Breakdown of Tier 1 parkways trees by tree size and area for Central Alameda

% of Total S New Trees	% of Total Area by S Trees	% of Total M New Trees	% of Total Area by M Trees	% of Total L New Trees	% of Total Area by L Trees
86.15%	44.01%	6.24%	12.75%	7.62%	43.24%

Table 9d. Tier 1 private trees analysis results for Central Alameda

Private Trees							
Number of Small Trees	Number of Medium Trees	Number of Large Trees	Total Trees	Area Small Trees (sq ft)	Area Medium Trees (sq ft)	Area Large Trees (sq ft)	Total Projected Area (sq ft)
322	649	1,583	2,554	56,902.10	458,751.07	3,108,213.23	3,623,866.40

The Parkways Analysis found that 1,523 parkway trees could be planted throughout Central Alameda, including 1,312 small trees, 95 medium trees, and 116 large trees (Table 9b). Small trees make up 82.2% of the total trees projected and 44% of the total projected canopy area. Medium trees make up 6.2% of the total trees and 12.8% total projected canopy area, and large trees are 7.6% of total trees and 43.2% of the total projected canopy area (Table 9c).

The Private Property Analysis found that 2,554 private property trees could be planted in Central Alameda, including 322 small trees, 649 medium trees, and 1,583 large trees (Table 9d).

While much of the neighborhood appears to have available Tier 1 planting space, there is notably more space available in the western three quarters of Central Alameda. The east side of the neighborhood, in contrast, features fewer residential lots and a high proportion of impervious surface cover, indicating that Tier 2 or 3 interventions may be needed in this area.

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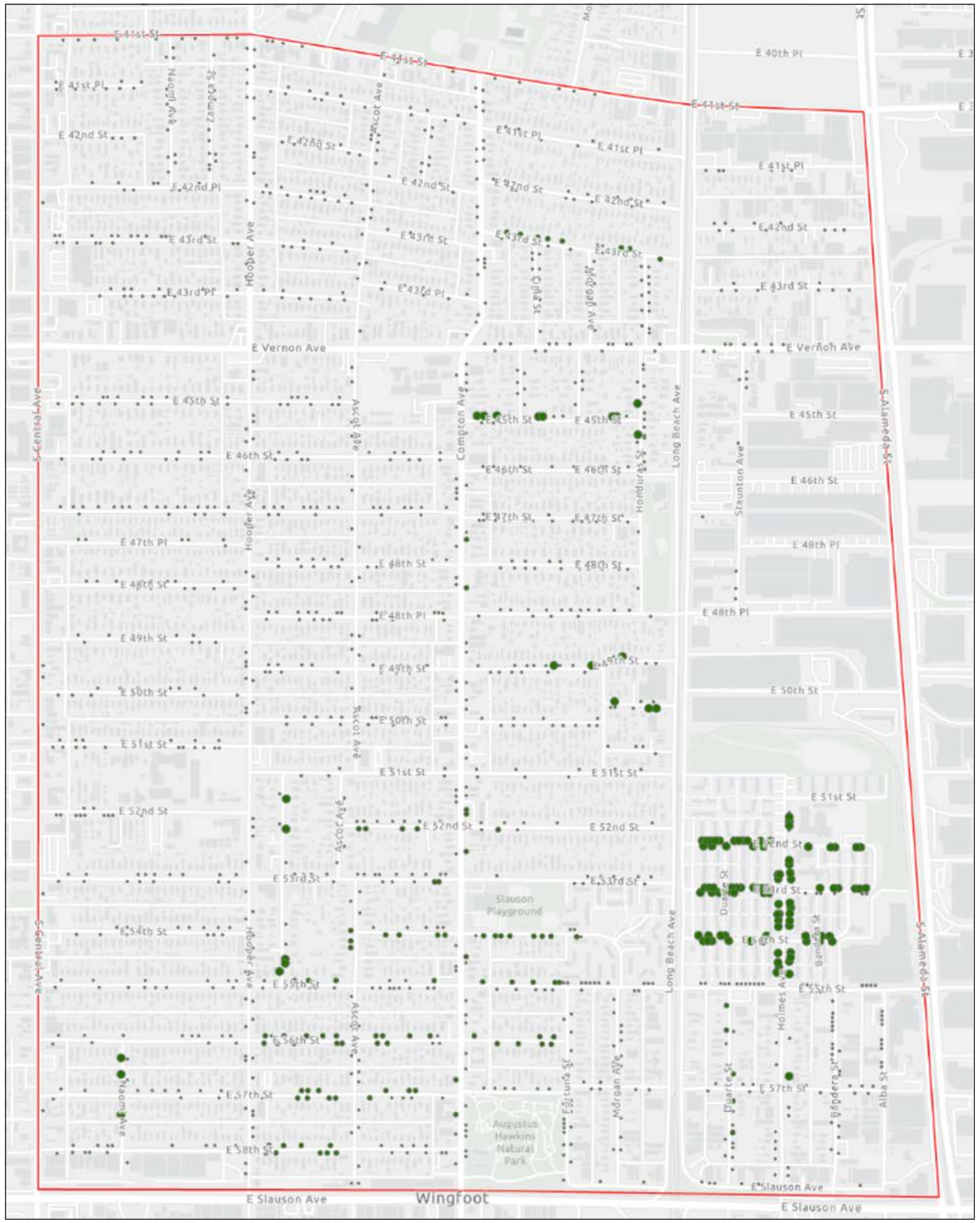
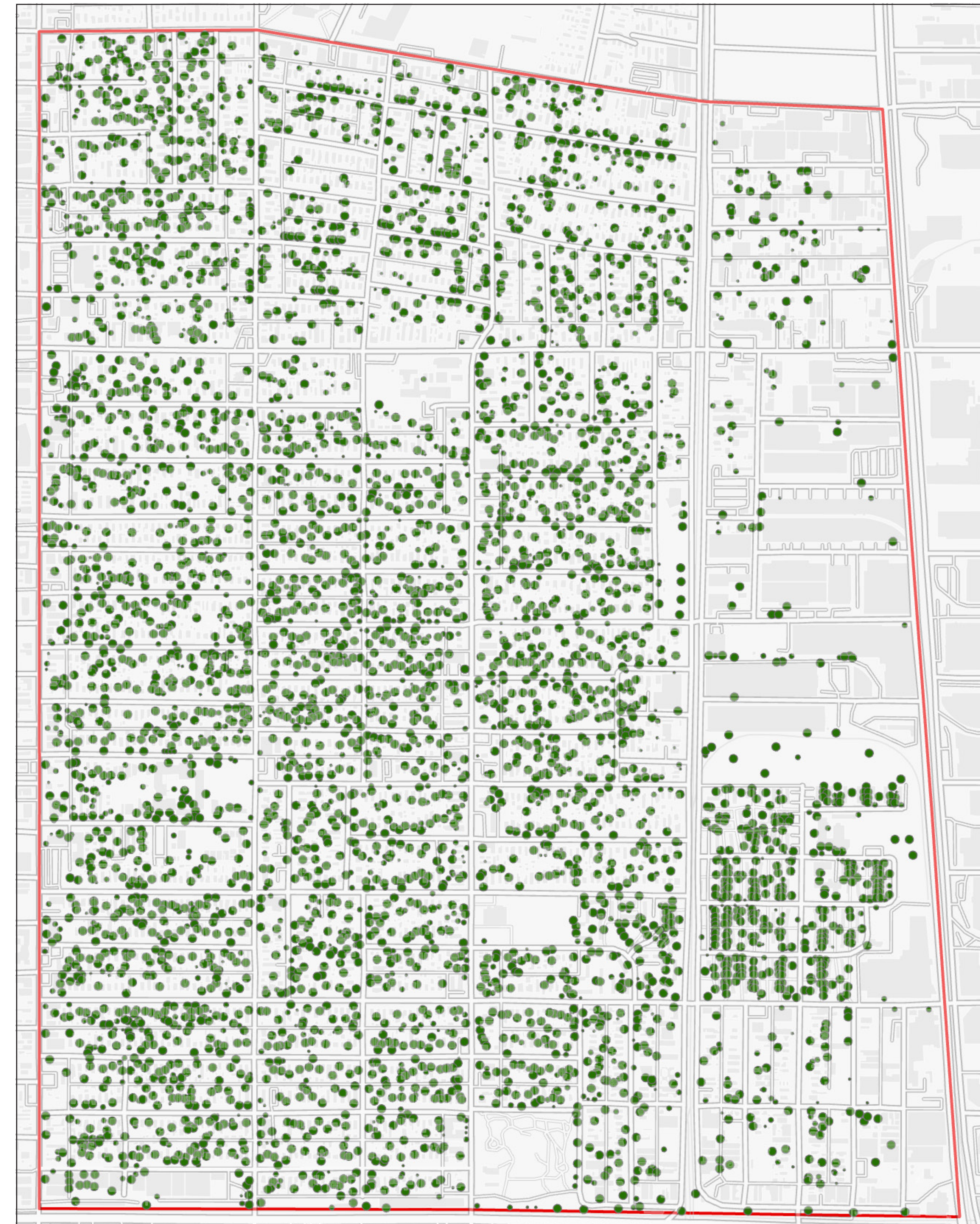


Projected parkway trees for Central Alameda displayed within the red neighborhood council boundary.



Projected private property trees for Cental Alameda displayed within the red neighborhood council boundary.

GIS Analysis & Discussion

Results: Sylmar

According to the Parkways and Private Property analyses, there are 32,484 trees in Tier 1 sites that can potentially be planted in Sylmar (Table 10a). If all of the trees were planted, tree canopy cover would increase by a relative 67.9%, from 17.6% to 29.5% total cover. Street trees account for 7% of this increase and private property trees for 93%. Although Sylmar's potential increase in total trees is higher than Central Alameda's, the projected increase in canopy is lower. This is because Sylmar is a larger neighborhood, meaning each tree has a relatively lower impact on total canopy coverage.

Table 10a. Tier 1 parkways ("street") and private property analysis results for Sylmar

Current Tree Canopy Cover %	Central Alameda Boundaries Area (2022) (sq ft)	Existing Tree Canopy Cover Area (sq ft)	Street Trees Projected Area (sq ft)	Private Trees Projected Area (sq ft)	Combined Projected Area (sq ft)	Estimated New Tree Canopy Cover Area (sq ft) (Existing + Projected)	Projected Canopy Increase (Relative Change)	Projected Tree Canopy Cover %	Total Possible Tier 1 Trees
17.57%	344,985,646.95	60,613,228	2,954,628.62	38,183,781.04	41,138,409.66	101,751,637.66	67.87%	29.49%	32,484

Snapshot of model projections for Sylmar; the light green circles represent projected parkway trees and the dark green circles represent projected private property trees

Table 10b. Tier 1 parkway trees analysis results for Sylmar

Parkway Trees							
Number of Small Trees	Number of Medium Trees	Number of Large Trees	Total Trees	Area Small Trees (sq ft)	Area Medium Trees (sq ft)	Area Large Trees (sq ft)	Total Projected Area (sq ft)
4,162	1,595	556	6,313	735,486.11	1,127,439.06	1,091,703.45	2,954,628.62

Table 10c. Breakdown of Tier 1 parkways trees by tree size and area for Sylmar

% of Total S New Trees	% of Total Area by S Trees	% of Total M New Trees	% of Total Area by M Trees	% of Total L New Trees	% of Total Area by L Trees
65.93%	24.89%	25.27%	38.16%	8.81%	36.95%

Table 10d. Tier 1 private trees analysis results for Sylmar

Private Trees							
Number of Small Trees	Number of Medium Trees	Number of Large Trees	Total Trees	Area Small Trees (sq ft)	Area Medium Trees (sq ft)	Area Large Trees (sq ft)	Total Projected Area (sq ft)
3,040	6,184	16,947	26,171	537,212.34	4,371,212.02	33,275,356.68	38,183,781.04

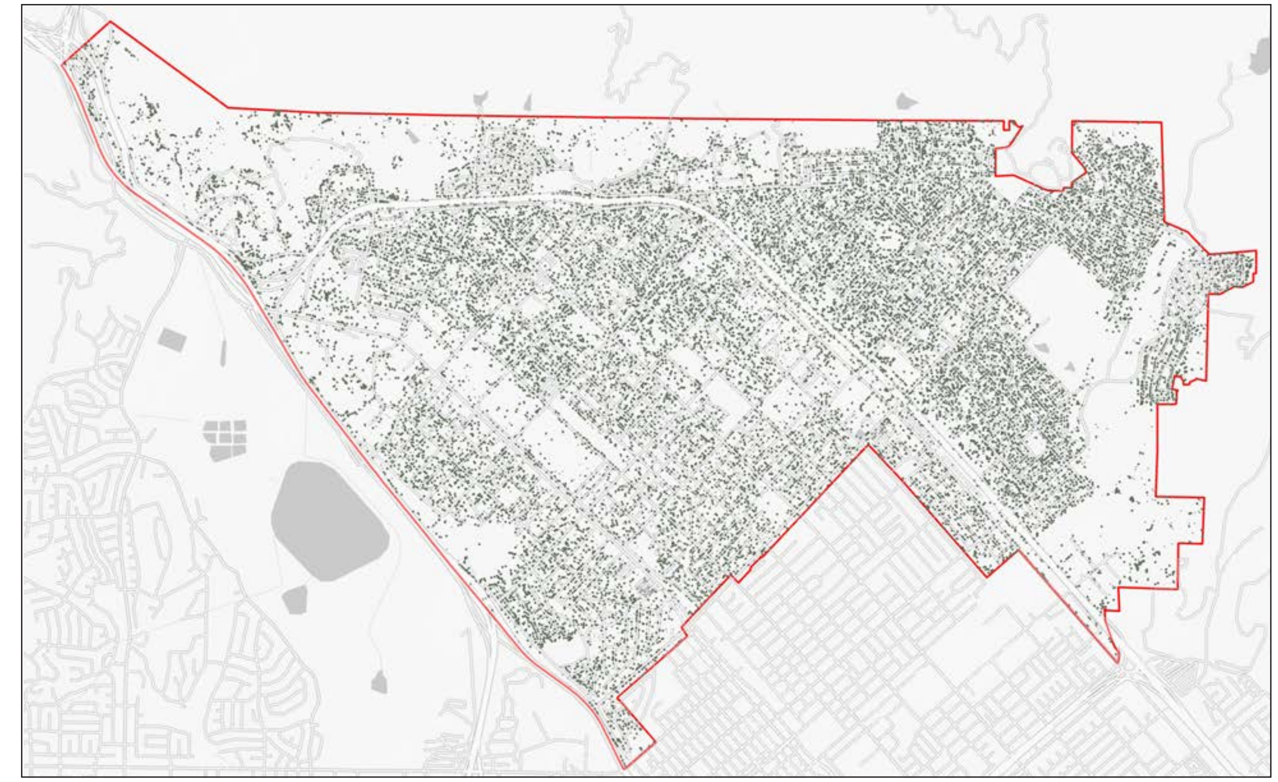
The Parkways Analysis found that 6,313 parkway trees could be planted throughout Sylmar, including 4,162 small trees, 1,595 medium trees, and 556 large trees (Table 10b). Small trees make up 65.93% of the total trees and 24.89% of the total projected canopy area. Medium trees make up 25.27% of the total trees and 38.16% of the total projected canopy area and large trees make up 8.81% of the total trees and 36.95% of the total projected canopy area (Table 10c).

The Private Property Analysis found that 26,171 private property trees could be planted in Sylmar, including 3,040 small trees, 6,184 medium trees, and 16,947 large trees (Table 10d).

Much of Sylmar is covered by plantable Tier 1 space. The area features a high proportion of unpaved "reverse parkways" in residential areas.

GIS Analysis & Discussion

Projected parkway trees for Sylmar displayed within the red neighborhood council boundary.



Projected private property trees for Sylmar displayed within the red neighborhood council boundary.

GIS Analysis & Discussion

Results: Citywide projections

The average total canopy cover (TCC) in Los Angeles is around 21.63%. According to the Parkways and Private Property analyses, there are 1,358,316 trees in Tier 1 sites that can potentially be planted citywide, including 57,261 parkway trees and 1,301,055 private property trees (Table 11a). If all of those trees were planted, citywide tree canopy cover would increase by a relative 84.07%, from 21.63% to 37.39%. Street trees account for 1% of this increase and private property trees for 99%. The tables below offer a snapshot of the citywide results, and complete figures are linked as an appendix to this report.

Table 11a. Tier 1 parkways ("street") and private property analysis results for the City of LA, broken down by Council District (CD)

CD	TCC Area (sq ft)	Tree Canopy Cover %	Estimated New Tree Canopy Area (Existing + Projected)	Projected Canopy Increase (Relative Change)	Projected Tree Canopy Cover	Number of Street Trees	Number of Private Trees	Total Trees
1	85,415,805.70	20.31%	145,428,472	70.26%	34.58%	1,710	38,082	39,792
2	123,847,249.80	20.59%	248,683,539	100.80%	41.34%	3,549	76,926	80,475
3	252,110,981.10	25.71%	423,959,378	68.16%	43.24%	6,011	103,111	109,122
4	502,150,144.80	36.81%	785,750,137	56.48%	57.60%	4,166	172,449	176,615
5	332,293,360.20	36.20%	499,246,940	50.24%	54.39%	4,002	105,173	109,175
6	118,789,819.90	15.68%	229,475,394	93.18%	30.28%	3,821	68,683	72,504
7	379,335,826.50	25.18%	609,744,198	60.74%	40.47%	4,141	145,350	149,491
8	54,627,320.90	12.22%	116,439,217	113.15%	26.04%	1,915	37,501	39,416
9	42,489,199.40	11.69%	90,671,629	113.40%	24.94%	1,613	30,247	31,860
10	63,335,995.10	15.34%	130,466,470	105.99%	31.60%	1,709	42,589	44,298
11	645,208,257.30	36.37%	818,303,160	26.83%	46.12%	5,250	108,689	113,939
12	330,726,656.30	20.54%	644,831,945	94.97%	40.05%	10,953	188,763	199,716
13	90,572,079.40	20.04%	162,522,798	79.44%	35.96%	1,917	46,013	47,930
14	107,594,331.30	15.66%	217,620,996	102.26%	31.68%	2,208	69,146	71,354
15	89,544,426.20	10.00%	201,567,612	125.10%	22.50%	4,296	68,333	72,629
				84.07%	37.39%	57,261	1,301,055	1,358,316

The models projected 57,261 parkway trees to be planted citywide. This includes 43,516 small trees, 8,836 medium trees, and 4,909 large trees (Table 11b). As seen in neighborhood-level projections for Central Alameda and Sylmar, street trees make up a relatively small number of potential plantings citywide. Furthermore, at the city scale, street trees would account for a lower absolute percentage of projected canopy increase (1% citywide compared to 13% and 7% in Central Alameda and Sylmar, respectively). This suggests that there is less available, plantable public space in the city overall than in the two neighborhoods. This is perhaps due to the fact that in higher-canopy areas, more parkway space has already been populated with trees.

Table 11b. Parkways analysis results for the City of LA, broken down by Council District (CD)

	Parkway Trees							
CD	# of S Trees	# of M Trees	# of L Trees	Total Public	Area S Public	Area M Public	Area L Public	Total Public Area
1	1,603	49	58	1,710	283,273.48	34,636.06	113,882.73	431,792
2	2,608	722	219	3,549	460,871.64	510,351.73	430,005.49	1,401,229
3	4,125	1,357	529	6,011	728,947.67	959,206.78	1,038,689.07	2,726,844
4	3,162	458	546	4,166	558,771.52	323,741.12	1,072,068.49	1,954,581
5	3,474	264	264	4,002	613,906.48	186,610.60	518,362.79	1,318,880
6	2,779	630	412	3,821	491,089.84	445,320.76	808,960.11	1,745,371
7	3,010	842	289	4,141	531,910.91	595,174.73	567,450.17	1,694,536
8	1,198	369	348	1,915	211,704.08	260,830.73	683,296.40	1,155,831
9	1,351	71	191	1,613	238,741.41	50,186.94	375,027.62	663,956
10	1,178	221	310	1,709	208,169.78	156,215.69	608,683.58	973,069
11	4,364	412	474	5,250	771,182.46	291,225.64	930,696.82	1,993,105
12	7,570	2,749	634	10,953	1,337,729.42	1,943,153.60	1,244,856.09	4,525,739
13	1,651	95	171	1,917	291,755.78	67,151.54	335,757.71	694,665
14	1,984	114	110	2,208	350,601.74	80,581.85	215,984.49	647,168
15	3,459	483	354	4,296	611,255.76	341,412.58	695,077.37	1,647,746
Total	43,516	8,836	4,909	57,261				23,574,511

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As with the parkway models, the private property models prioritized the largest possible tree for each planting site. The private property models projected 1,301,055 trees that can be planted citywide. This includes 77,832 small trees, 264,556 medium trees, and 958,667 large trees (Table 11c). Citywide, as in both pilot neighborhoods, there is significantly more opportunity to expand tree canopy through private rather than public (parkway) planting.

Table 11c. Private property analysis results for the City of LA, broken down by Council District (CD)

	Private Trees							
CD	# of S Trees	# of M Trees	# of L Trees	Total Private	Area S Private	Area M Private	Area L Private	Total Private Area
1	2,641	8,335	27,106	38,082	466,703.22	5,891,664.32	53,222,506.53	59,580,874.08
2	4,680	15,316	56,930	76,926	827,024.27	10,826,242.44	111,781,793.58	123,435,060.29
3	5,718	18,398	78,995	103,111	1,010,454.01	13,004,779.87	155,106,319.75	169,121,553.63
4	8,451	33,309	130,689	172,449	1,493,414.97	23,544,744.68	256,607,251.38	281,645,411.03
5	5,774	24,315	75,084	105,173	1,020,350.03	17,187,260.71	147,427,089.21	165,634,699.95
6	4,879	13,688	50,116	68,683	862,190.47	9,675,477.05	98,402,535.87	108,940,203.39
7	9,924	30,994	104,432	145,350	1,753,715.56	21,908,367.61	205,051,752.45	228,713,835.62
8	2,256	7,119	28,126	37,501	398,668.11	5,032,124.57	55,225,271.85	60,656,064.53
9	2,036	6,552	21,659	30,247	359,790.90	4,631,335.89	42,527,347.04	47,518,473.83
10	3,169	9,393	30,027	42,589	560,008.53	6,639,520.45	58,957,876.62	66,157,405.60
11	6,303	24,706	77,680	108,689	1,113,832.04	17,463,642.32	152,524,323.29	171,101,797.66
12	10,277	33,974	144,512	188,763	1,816,095.81	24,014,805.48	283,748,648.40	309,579,549.69
13	3,225	10,606	32,182	46,013	569,904.54	7,496,939.63	63,189,209.22	71,256,053.39
14	4,516	14,578	50,052	69,146	798,043.07	10,304,580.98	98,276,872.16	109,379,496.22
15	3,983	13,273	51,077	68,333	703,854.20	9,382,130.84	100,289,454.95	110,375,439.99
Total	77,832	264,556	958,667	1,301,055				2,083,095,918.89

LA's Green New Deal has established a goal of 50% relative increase in tree canopy in areas of greatest need. Based on our analysis, all of the city's council districts (CDs) except for CD 10 could achieve that goal by planting all available Tier 1 parkway and private property space. In doing so, districts would ostensibly end up with total tree canopy cover ranging from 22.5% to 57.6%. This suggests that disparities in LA's urban forest could hypothetically be remedied in most CDs through Tier 1 planting alone. However, the overwhelming majority of potential canopy is on private property, which the City and its tree planting partners have limited influence over. Additionally, while private property trees are a critical part of the urban forest, the benefits and protection provided by trees in public spaces are broadly accessible to all. As such, Tier 2 and Tier 3 interventions are also needed to advance urban forest equity in underserved, over-paved, and low-canopy areas.

Given the outcomes shown in the first projections graph below are overwhelmingly dependent on private property planting, it is likely that without an increase in incentive programs or other widespread uptake in private property planting, the outcomes shown in the chart may not be feasible. Additionally, they are contingent on the property owner/manager utilizing the largest appropriate species for their site, rather than tending toward smaller ornamentals, as is more frequently seen.

Secondly, while the 50% relative increase goal could be met at the CD scale, this does not mean that the lowest-canopy neighborhoods or most built-out, paved areas within those CDs will benefit equally. Parkway and private property trees as described go where Tier 1 space already exists. The potential impact of Tier 1 planting may look greater at a coarser scale (CD) than a more granular one (block group).

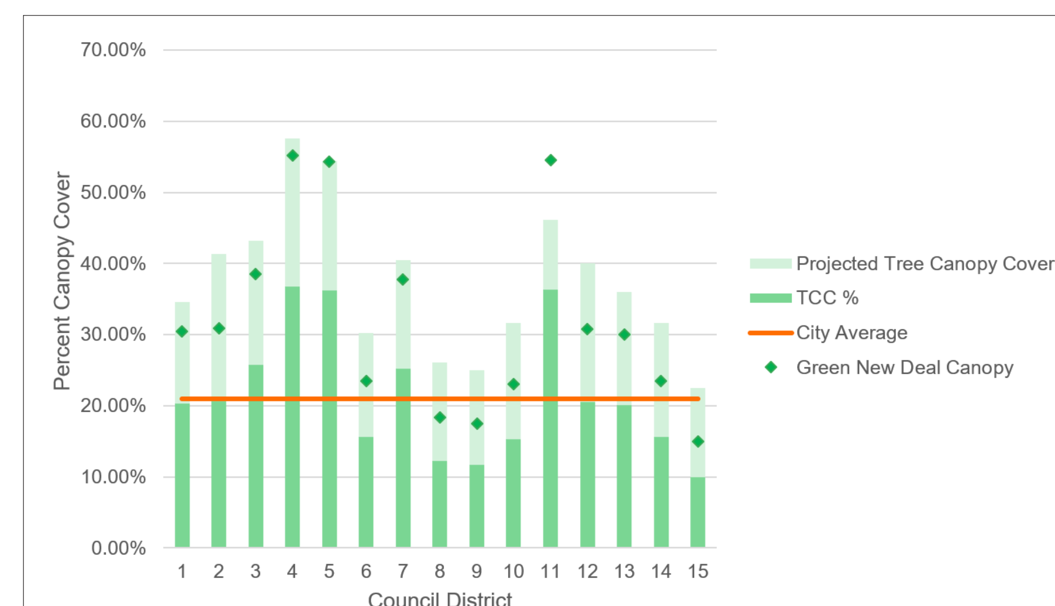

Chart showing the potential increases in canopy, by Council District, that could be achieved through Tier 1 planting on both private property and in parkways. Notably, some projections, such as those for Council Districts 4 and 5, likely exceed advisable canopy cover for LA's' semi-arid climate.

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Thirdly, the projections shown are for discussion purposes only. In validating the models, we found that the private property outputs reached 20% and 64% accuracy in the two pilot neighborhoods. More detail on model accuracy and our quality check process can be found in the next section. Furthermore, due to data constraints, UFEC's GIS modeling did not incorporate assumptions regarding projected canopy cover loss. While there is clearly much higher potential for canopy expansion on private property than in parkways, the specific extent of that potential cannot be stated with high confidence at this time.

The second graph reflects potential canopy increases based on parkway planting alone, a measure for which we have significantly higher confidence and model accuracy. This is a more realistic reflection of what the City of LA could achieve through Tier 1 planting, given that there are limited pathways for the City to influence tree planting on private property. While the planting and maintenance of street trees brings its own challenges, parkway planting is arguably the more feasible option. As demonstrated, planting all available Tier 1 parkway space would not make significant progress toward Green New Deal goals and offers only marginal increases overall. This affirms the need for greater attention on Tier 2 and Tier 3 sites if LA is to address

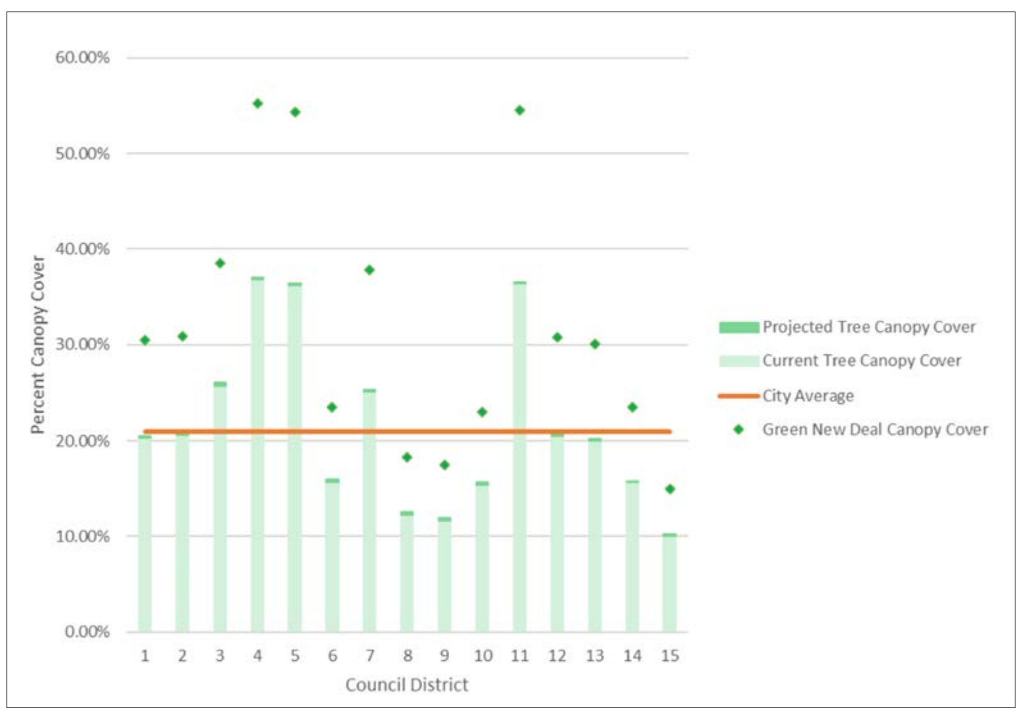

Chart showing the potential increases in canopy, by Council District, that could be achieved through Tier 1 planting in parkways only.

Quality check and model accuracy

To test the accuracy of the Parkways Analysis models, our team compared data on vacant sites from the StreetsLA Tree Inventory to tree points identified by the model. Manual work to clean up the vacant sites data included removing all vacant sites that were not in the parkway and snapping the sites to the nearest parkway, since some of the points were not placed within a parkway when previously geocoded by StreetsLA. When comparing the proximity between the model "tree" points and the vacant tree sites, ~85% (84.95%) of the model trees align with the vacant tree sites.

To test the accuracy of the Private Property models, a random sample of streets was selected within each pilot neighborhood and subjected to further review. Manual work was performed to remove any tree projections that were not deemed plantable. Trees were removed if they were placed on any impervious land cover, placed in parkway space that had already been accounted for in the Parkways Analysis, or placed fully or mostly on top of a residential structure. In some cases,the model planted overlapping trees, represented by two overlapping circles. When this occurred, the tree with the most centralized midpoint (i.e., a centroid most aligned with the center of the plantable space) was retained and any overlapping trees were deleted. The results show accuracy rates of 20% and 64% for Central Alameda and Sylmar, respectively.

The quality check on our Private Property Analysis shows that there is room for model improvement and refinement in future phases. When conducting the accuracy check for Central Alameda, we found that a majority of the trees were placed on impervious surfaces or on residential structures. Trees were also placed which were not appropriately sized for the lot they were in. This may be due to issues with the original land cover raster dataset used by our model; perhaps, we suspect, this dataset was incorrectly digitized for the Central Alameda neighborhood prior to receipt by the UFEC team. This outcome illustrates the potential challenges of working with datasets which change hands and may be edited by various users without standardized oversight. Additionally, private residential canopy data is notoriously difficult to capture and we encountered some limitations in our Phase II efforts. We recommend that further ground-truthing on the land cover dataset be conducted, and that our models be revised in the future, to improve the accuracy of residential projections.

Tree planting costs

Following the outputs of Tier 1 models, the UFEC team calculated the cost of implementing all projected plantings. These calculations were made using local, nonprofit rates for both private and public ("street/parkway") trees. In the case of the latter, the total cost may be assessed with or without contracted maintenance and both options

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are calculated below. The cost of a private tree is estimated at $56.50, the cost of a public parkway tree without maintenance (NM) at $331, and the cost of a public parkway tree with five years of contracted maintenance (M) at $2,971 (Tables 12a-b).

Notably, the cost of public tree planting without contracted or city-serviced maintenance is significantly lower than the alternative. This may signal to some that widespread public planting without five years of contracted maintenance is more affordable, more attainable, and therefore more desirable. However, pursuing the less expensive option could have significant drawbacks in practice. First, trees without sufficient early maintenance may simply die, which will not advance citywide canopy goals or improve local environmental conditions, breaks community trust, and wastes the initial funds invested. Secondly, City of LA residents and community groups have historically assisted the City in caring for public street trees, often securing outside grant funds to care for newly planted trees in historically dis-invested neighborhoods; there is an unspoken expectation that the residents or community-based organizations interested in planting trees will fill gaps in establishment watering or routine maintenance. While this system of "shared maintenance" may be effective in some cases, it is unfair to place the onus of public tree care on those groups, particularly in communities which are chronically underserved and under-resourced. An equitable approach to urban forestry must allow for individuals to become involved in tree care through volunteerism or job training (forms of 'representational justice' which will be described in Equity Metrics & Indicators Discussion). Still, those residents should not be burdened by a responsibility that arguably could or should belong to the City.

Table 12a. Cost of tree planting estimates using figures from the Tier 1 Parkways and Private Property analysis; citywide estimates broken down by Council District

CD	# Projected Parkway Trees	Cost of Street Tree, no Contracted Maintenance ($331)	Cost of Street Tree, with 5-year Contracted Maintenance ($2,971)	# Projected Private Trees	Cost of Private Tree ($56.50)	Cost of Public Trees (NM) & Private Trees	Cost of Public Trees (M) & Private Trees
1	1,710	$566,010	$5,080,410	38,082	$2,151,633	$2,717,643	$7,232,043
2	3,549	$1,174,719	$10,544,079	76,926	$4,346,319	$5,521,038	$14,890,398
3	6,011	$1,989,641	$17,858,681	103,111	$5,825,771.50	$7,815,413	$23,684,453
4	4,166	$1,378,946	$12,377,186	172,449	$9,743,368.50	$11,122,315	$22,120,555
5	4,002	$1,324,662	$11,889,942	105,173	$5,942,274.50	$7,266,937	$17,832,217
6	3,821	$1,264,751	$11,352,191	68,683	$3,880,589.50	$5,145,341	$15,232,781
7	4,141	$1,370,671	$12,302,911	145,350	$8,212,275	$9,582,946	$20,515,186
8	1,915	$633,865	$5,689,465	37,501	$2,118,806.50	$2,752,672	$7,808,272
9	1,613	$533,903	$4,792,223	30,247	$1,708,955.50	$2,242,859	$6,501,179

Table 12a. continued Cost of tree planting estimates using figures from the Tier 1 Parkways and Private Property analysis; citywide estimates broken down by Council District

CD	# Projected Parkway Trees	Cost of Street Tree, no Contracted Maintenance ($331)	Cost of Street Tree, with 5-year Contracted Maintenance ($2,971)	# Projected Private Trees	Cost of Private Tree ($56.50)	Cost of Public Trees (NM) & Private Trees	Cost of Public Trees (M) & Private Trees
10	1,709	$565,679	$5,077,439	42,589	$2,406,278.50	$2,971,958	$7,483,718
11	5,250	$1,737,750	$15,597,750	108,689	$6,140,928.50	$7,878,679	$21,738,679
12	10,953	$3,625,443	$32,541,363	188,763	$10,665,109.50	$14,290,553	$43,206,473
13	1,917	$634,527	$5,695,407	46,013	$2,599,734.50	$3,234,262	$8,295,142
14	2,208	$730,848	$6,559,968	69,146	$3,906,749	$4,637,597	$10,466,717
15	4,296	$1,421,976	$12,763,416	68,333	$3,860,814.50	$5,282,791	$16,624,231
City Total	57,261	$18,953,391	$170,122,431	1,301,055	$73,509,607.50	$92,462,999	$243,632,039

Table 12b. Cost of tree planting estimates using figures from the Tier 1 Parkways and Private Property analysis; estimates for two pilot neighborhoods, Central Alameda and Sylmar.

Neighbor-hood	Number of Street Trees	Cost of Street Tree without	Cost of Street Tree with	Number of Private Trees	Cost of Private Tree ($56.50)	Cost of Public Trees (NM) & Private Trees	Cost of Public Trees (M) & Private Trees
Sylmar	6,313	$2,089,603	$18,755,923	26,171	$1,478,661.50	$3,568,264.50	$20,234,584.50
Central Alameda	1,523	$504,113	$4,524,833	2,554	$144,301	$648,414	$4,669,134

NASA Canopy Change Data

The NASA Jet Propulsion Laboratory (JPL) recently released satellite-derived tree canopy data for Los Angeles collected in 2022. These represent the most current canopy data available for the region. The UFEC team compared total canopy coverage data from 2022 to the next most recent dataset available, 2016, also provided by the NASA JPL, in order to assess total canopy percentage change over that time period. To do so, we first averaged the absolute canopy cover percentage across all census tracts in each neighborhood and the city as a whole. We then compared the 2016 average against the 2022 average at each scale to determine the absolute canopy change (Table 13). If the comparison showed net canopy loss between 2016 and 2022, our team intended to adjust our Tier 1 Parkways and Private Property Analyses accordingly.

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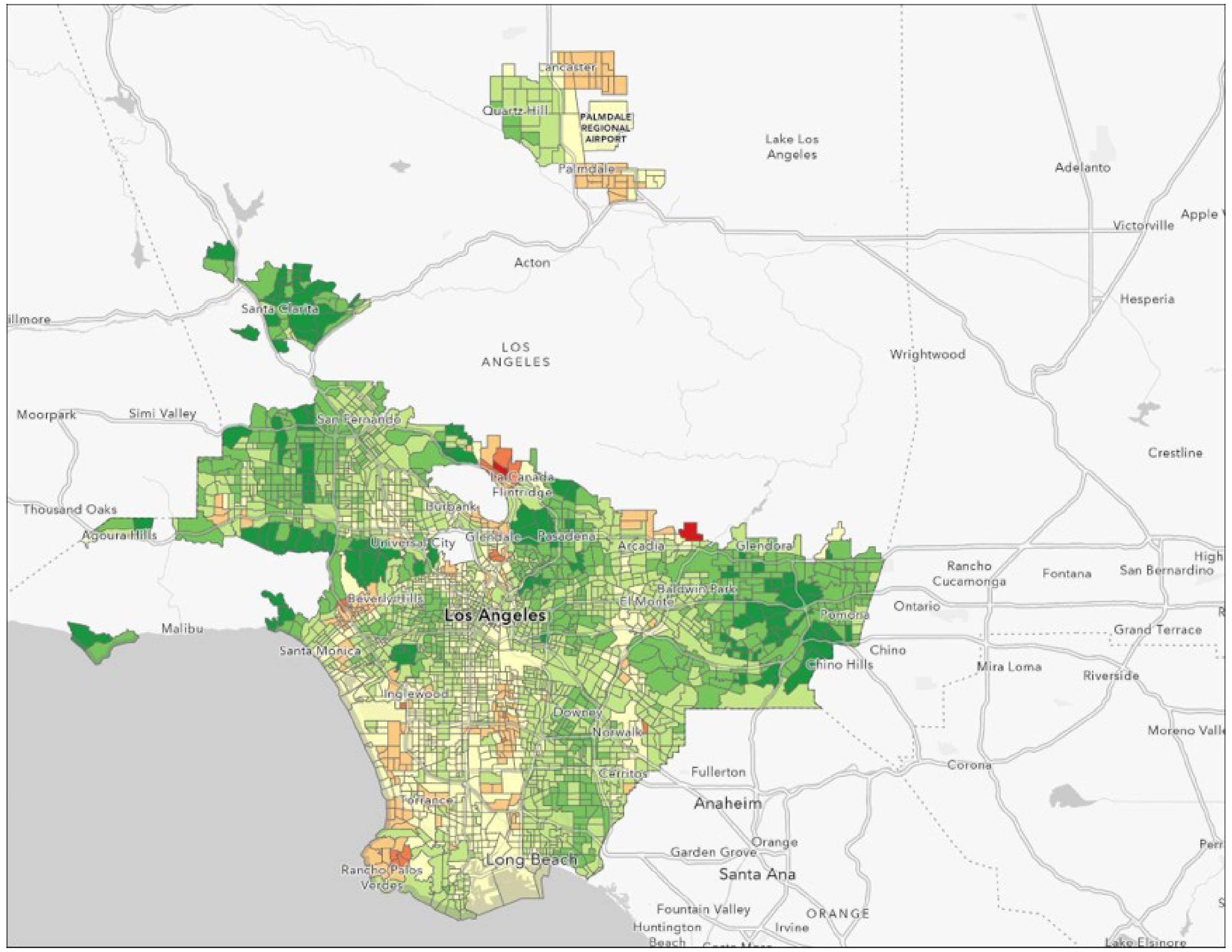

Canopy image produced by the NASA JPL's intern team. Dark red tracts have displayed the greatest negative change in canopy (i.e., canopy loss) and dark green tracts have displayed the greeatest positive change (i.e., canopy gain) from 2016 to 2022.

Table 13. Canopy change results for LA City, Central Alameda and Sylmar between 2016 and 2022

Scale	Average Canopy Cover % in 2016	Average Canopy Cover % in 2022	Absolute Canopy Change
LA City	12.7%	15.4%	+2.7%
Central Alameda	9.6%	10.4%	+0.8%
Sylmar	11.7%	16.4%	+4.6%

Instead, our calculations indicated that there was no net canopy loss between 2016 and 2022, either citywide or in the two pilot neighborhoods. On the contrary, there had been gains in all three instances. Given that the Tier 1 models already accounted for all plantable space, and increases in canopy would not affect the amount of available space, our projections were not impacted by these results.

Excess Roadway Space Analysis

UFEC collaborator Krystle Yu completed an additional GIS analysis which draws on the Planting Tiers Framework and is directly relevant to the identification of Tier 3 planting sites for intervention. Complete information on the background, methods, and results of this work can be found in *Greening the divide: Identifying community-driven policy and planning pathways to advance urban forest equity in Los Angeles*,[64] linked in the appendix. Here we offer an overview of key points and outputs for UFEC's two pilot neighborhoods. This analysis represents one of many options for identifying Tier 3 planting locations where action might be taken. Notably, UFEC's work in Phase II drew on community feedback and guidance to select Tier 3 planting sites, which were then further investigated and designed. However, we recommend that this GIS analysis be added to the toolbox of forestry practitioners and researchers.

The Excess Roadway Space Analysis aimed to establish a methodology for identifying excess roadway space that could be repurposed for Tier 3 recommendations in the pilot neighborhoods of Central Alameda and Sylmar. The primary objective was to determine the available area on roadways that could be allocated to Tier 3 recommendations without fundamentally altering the street's configuration. To put it another way, if a street initially consisted of two parking lanes and two travel lanes, the goal was to identify areas where this configuration could be maintained while reallocating some space for Tier 3 improvements. The analysis utilized a GIS data layer obtained from StreetsLA, also known as the LA Bureau of Street Services, which provided the most recent assessment of street segment widths across the City of Los Angeles. This methodology allows users to make projections about the potential percentage canopy cover that can be achieved through the reallocation of roadway space without street reconfiguration.

Taking into account the city's smallest tree well size requirement of three feet, the excess roadway analysis was conducted to determine the amount of excess roadway space in the two pilot neighborhoods under two scenarios: 10 feet and 11 feet wide travel lanes. Excess roadway space in Central Alameda was determined to be 1,633,895 sq ft under the 10-foot lanes scenario and 1,154,345 sq ft under the 11-foot lanes scenario; in Sylmar, the figures were 2,980,687 and 2,209,101 sq ft, respectively, indicating substantial opportunity for Tier 3 planting in excess roadway space. The results for each neighborhood were further cross-referenced against the LA 2035 Mobility Plan, which offers a comprehensive perspective on the City's future vision for its streets, to determine where segments with excess roadway space align with the City's designated pedestrian, bicyclist, and transit priority corridors. The underlying assumption is that Tier 3 recommendations that correspond with the travel modality and location of existing City transportation plans would have a higher likelihood of being implemented.

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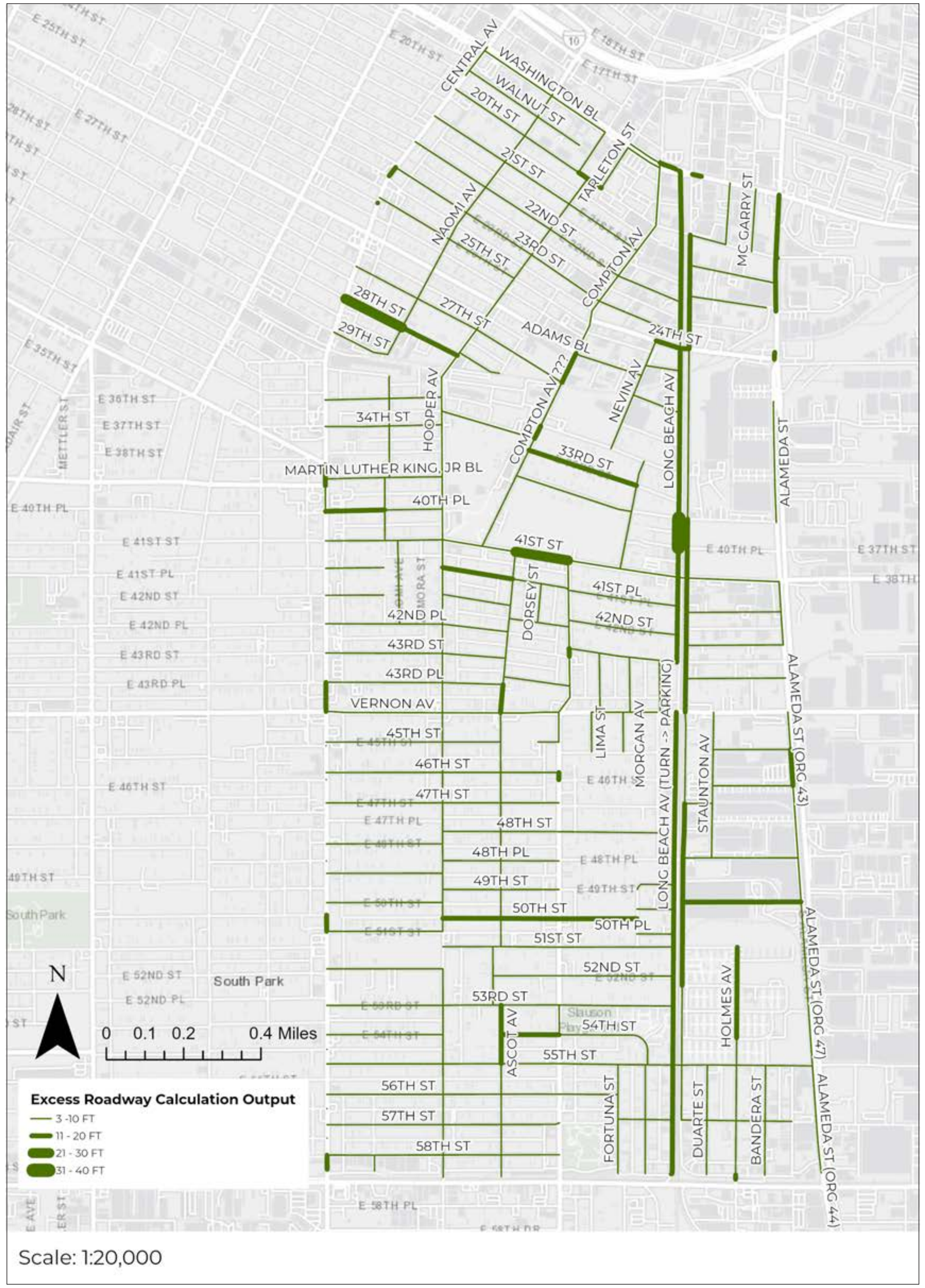

Map showing excess roadway space in Central Alameda

Map showing excess roadway space in Sylmar

Equity Metrics & Indicators Discussion

Equity Metrics & Indicators Discussion

Overview of Metrics and Indicators

As an offering to a broader audience of forestry practitioners who may build upon the work begun by UFEC in Phase II, we sought to develop a clear list of forest equity metrics and indicators that could guide future initiatives. While the UFEC team will have some opportunity to apply these metrics and indicators in Phase II, the intention is to provide something that can be integrated with upcoming City, County, or other partner efforts. Notably, the UFEC team worked closely with the LA City Forest Officer, Rachel Malarich, to ensure that the indicators and metrics identified here will tie into the upcoming LA Urban Forest Management Plan. While that plan and other local initiatives are committed to addressing equity, it is not always clear to practitioners how to put those values into action.

The set of site selection indicators and equity metrics detailed below are based on literature review, collaborative discussions, and UFEC expertise; they highlight tracking opportunities which are feasible given the availability of data; and they provide some preliminary guidance on possible thresholds/targets. It is important to note that these metrics are crafted for a practitioner or researcher audience and may not be suitable for direct use by community members, or even smaller CBOs. It is our hope that future phases of the UFEC or other initiatives might yield an adapted version of this content for community use. Additionally, the thresholds and targets shown below should be viewed as a starting point and may be adjusted based on the particular context around a specific project. These indicators and metrics serve two functions: (1) to guide practitioners or researchers toward high-need areas in service to an equity-forward approach, and (2) to help define what "success" looks like in an urban forestry project where equity is a stated goal. They are divided into five categories: (1) Tree quality & quantity, (2) Environmental hazard exposure, (3) Equitable provision of services, (4) Public health, (5) Community engagement & capacity.

The metrics and indicators within each category are provided with details about targets and data sources. Additionally, each metric is categorized by the facets of equity it potentially addresses (distributional, recognitional, and procedural), and the type of intervention that it potentially refers to (planting, preservation, maintenance, governance, and education/capacity building). These delineation helps to highlight that not all indicators and metrics are suitable for all projects, intervention types, and components of equity.

Site Selection Indicators help decision makers identify priority sites that are suitable for urban forestry interventions. In the context of UFEC, this could mean identifying specific US census tracts or blocks within pre-identified priority neighborhoods that are appropriate for a planting project. Beyond UFEC, indicators may be used by the City, some CBOs, or other decision-making entities to identify priority neighborhoods, census tracts, or blocks for a variety of interventions. Indicators in this "site selection" category point to an existing lack of tree canopy, high exposure to environmental hazards, disinvestment, and poor health outcomes. Indicators are considered early in a project when setting

priorities. Some of these indicators may also be tracked as metrics (see below) after a specific forestry project to assess short- or long-term effects on local conditions.

Project Success Metrics indicate how successful a forestry intervention was at improving on baseline conditions, and/or meeting desired environmental and social targets. While several of the metrics identified here are applicable to UFEC, some are beyond the scope of the present project. Those outside the UFEC scope are trackable metrics which may be useful in future projects by the City or other entities. Metrics are considered at the conclusion of a particular activity or project when evaluating outcomes through an equity lens.
Based on the definition of 'urban forest equity' established earlier in this report, we suggest that success in this realm means a project in which all three facets of equity (distributional, recognitional, and procedural) and consciously considered and factored into project planning and execution, and one in which the goals set around those facets are met.

General notes about metrics and indicators:

- Indicators show users where need exists or where to focus their efforts. Metrics are a way to track progress and performance, often in relation to indicators. Both can operate under the same "target" criteria.
- A metric or indicator was only included on this list if there is an existing and accessible dataset available, or other feasible means of quantifying or tracking it. Several metrics and indicators of interest, especially under the category Public Health, were excluded due to a lack of current and reliable data.
- Environmental indicators emphasize heat and air pollution, which were identified by the LA City Forest Officer as the most important hazards mediated by trees.
- Datasets for metrics and indicators listed below are available at various scales (block group, census tract, neighborhood) and may need to be aggregated depending on the scale of assessment.
- This document offers a comprehensive menu of choices that may be germane to urban forest equity-related projects, though all metrics and indicators will not be suitable for all projects.
- Choosing applicable metrics and indicators from this menu of options and aggregating them as needed is at the discretion of the user. Setting targets for more variable and/or qualitative indicators (e.g., 'community representation in planning, decision-making') is at the discretion of the user and should be considered at the start of each new application.
- The definition of "tree" and the source of data used to measure trees and canopy are at the discretion of the user. Whatever the selections, it is important for the user to define "tree" and to identify preferred data source(s) at the beginning of any project, then maintain consistency throughout a project tracking period.
- We recognize that all decisions come with tradeoffs, and elevating one metric may come at the expense of another. The appropriate prioritization of metrics and tolerance for tradeoffs is at the discretion of the user, though such tradeoffs should be articulated in any case.

Equity Metrics & Indicators Discussion

Key definitions:

- Equity includes three dimensions of access, representation, and inclusion including (1) targeted distribution of trees and corresponding benefits to areas with the greatest social-environmental need (distributional equity); (2) meaningful involvement of underserved/ under-canopied communities and a recognition of historical context in urban forest planning, implementation and stewardship (recognitional equity); and (3) access to information and transparency for underserved communities, access to decision making, and impartiality in decision making or the provision of services (procedural equity).
- Forest Equity Areas refers to priority areas identified through the UFEC decision-making process, which narrowed down census tracts (and later neighborhoods) in the city based on the following criteria: (1) Less than average canopy cover; higher than average impervious surface cover; lower than average median household incomes; (2) Comparatively high exposure to air pollution and heat; and (3) Comparatively high proportions of residents who are non-white, non-English speaking, have an income below the poverty line, have less than a high school education, do not have home internet access, rent their homes, live in formerly redlined areas, and live in an area with high population density.
- Interventions refer to any activity relevant to forest equity including planting new trees; removing hazardous, declining, or dead trees; maintaining new trees; preserving mature trees; and educating or building capacity among communities to support planting, maintenance, and preservation of trees. Within the context of UFEC, planting new trees is the only intervention under consideration.
- Sensitive Areas are discrete locations (e.g., a block, a school, a nursing facility, a transit stop, a worksite) where (1) people spend a lot of time outdoors and might face particularly high environmental exposure, and/or (b) heat- or air pollution-sensitive populations tend to congregate (i.e., sensitive receptor sites).

A note on canopy cover targets:

Canopy cover is the first metric shown below, and is a common go-to for urban foresters. Practitioners often seek clear guidance on appropriate canopy targets: how much is enough to impact health outcomes, how much is enough to lower ambient temperature, how much is too much, and so forth. In LA, the Green New Deal established a goal of increasing canopy by a relative 50% over baseline conditions in areas of greatest need, while the upcoming LA City and County Urban Forest Management Plan will likely suggest an absolute target percentage, still to be determined. Using either approach, canopy targets can be problematic in practice. Relative increases may leave communities with little improvement if they are starting from a place of very low canopy (say, increasing total coverage from 5% to 7.5%, which represents a 50% relative increase or 2.5 percentage point absolute increase). Ambitious canopy coverage goals over 20%, as proposed by some outlets[89], may simply not be possible in a dense city like LA. Additionally, the scale of assessment is not always made clear: is the intention to reach a target percentage on each block, in each neighborhood, or in the city as a whole? Citywide targets may do little to correct forest inequity if most canopy expansion ends up in wealthy, sparsely populated, or already well-canopied areas. On the other hand, reaching lofty goals at granular scales can prove difficult in practice. There is a need to balance aspiration with feasibility in setting targets for any of these metrics or indicators.

We offer two possible targets for canopy coverage that may be useful to practitioners in LA: one that aligns with the Green New Deal (relative 50% increase in areas of greatest need) and one range of absolute canopy coverage (20-40%) which is based on case studies reviewed for this report.[90 91 92] Notably, there is no clear consensus in literature on an absolute canopy target that is ideal for a Mediterranean climate, though 20% has been cited as a preferred minimum generally.[93] We advise that practitioners refer to these targets as a starting point for exploring what might be both possible and desirable in specific locations and set their own targets accordingly. Additionally, in each new project or application, it is important to specify the geographic scale of assessment and/or intended impact, recognizing that different scales may require different targets.

89 Leahy, I. (2017). Why we no longer recommend a 40% urban tree canopy goal. American Forests. https://www.americanforests.org/article/why-we-no-longer-recommend-a-40-percent-urban-tree-canopy-goal/

90 Living Adelaide (2017). The 30-Year Plan for Greater Adelaide. Government of South Australia.

91 Speak, A. F., & Salbitano, F. (2022). Summer thermal comfort of pedestrians in diverse urban settings: A mobile study. Building and Environment, 208, 108600.

92 City of Tacoma (2019). Urban Forest Management Action Plan.

93 Urban Forestry and Woodland Committee Advisory Network (2022). England's Urban Forests: Using tree canopy cover data to secure the benefits of the urban forest.

94 TreePittsburgh (2023). ReLeaf Manchester & Chateau: How are we doing?

95 Arbor Day Foundation (n.d.) How to Measure Progress. Tree City USA Bulletin No. 89.

96 Clark, J.R., Matheny, N.P., Cross, G., & Wake, V. (1997). A model of urban forest sustainability. Journal of Arboriculture, 23(1), 17-30.

97 Ordóñez, C., Grant, A., Millward, A.A., et al. (2019). Developing Performance Indicators for Nature-Based Solution Projects in Urban Areas: The Case of Trees in Revitalized Commercial Spaces," Cities and the Environment (CATE), 12(1), Article 1.

98 Ball, J., Mason, S., Kiesz, A., McCormick, D., & Brown, C. (2007). Assessing the Hazard of Emerald Ash Borer and Other Exotic Stressors to Community Forests. Arboriculture & Urban Forestry, 33(5), 350–359.

99 An urban tree population should include no more than 5-10% of any one species, 10-20% of any one genus, or 20-30% of any family to avoid potentially catastrophic results from pest infestation. In practice, tree type is largely determined by nursery capacity and availability. As with total canopy coverage, there is a need for practitioners to clarify the scale at which they are assessing tree diversity (e.g., block, neighborhood, or city).

100 Roman, L. A., Battles, J. J., & McBride, J. R. (2016). Urban tree mortality: A primer on demographic approaches (NRS-GTR-158; p. NRS-GTR-158). U.S. Department of Agriculture, Forest Service, Northern Research Station.

101 Casey Trees (2021). The 14th Annual Tree Report Card. https://caseytrees.org/treereportcard2021/

102 Healy, M., Rogan, J., Roman, L. A., Nix, S., Martin, D. G., & Geron, N. (2022). Historical Urban Tree Canopy Cover Change in Two Post-Industrial Cities. Environmental Management, 70(1), 16–34.

Tree quality & quantity

Metric/ Indicator	Target/ Selection Cutoff	Site Selection	Project Success	Primary Equity Facet	Intervention Type	Dataset + Source
Canopy cover (%) [94 95]	50% increase over baseline conditions (Green New Deal) -OR - 20-40% canopy cover total	✓	✓	Distributional	Planting, Maintenance, Preservation	LiDAR, City of LA
Impervious surface cover (%)	0-59%	✓	✓	Distributional	Planting, Governance (limits on development)	LiDAR, City of LA
Tree type/ diversity (% species breakdown) [96 97 98]	5/10/20 -OR- 10/20/30 rule [99]	✓	✓	Distributional	Planting, Maintenance, Preservation	City Urban Forestry Division data
5-year survival rate of new trees (%)[100]	70%	✓	✓	Distributional	Maintenance	Recreation & Parks data; Urban Forestry Division data
Annual net canopy loss (%) [101 102]	0%	✓	✓	Distributional	Planting,	LiDAR, City of LA

Equity Metrics & Indicators Discussion

Tree quality & quantity (cont.)

Metric/ Indicator	Target/ Selection Cutoff	Site Selection	Project Success	Primary Equity Facet	Intervention Type	Dataset + Source
Annual tree loss due to housing development (#)	Steady or decreasing	✓	✓	Distributional	Maintenance, Preservation	Recreation & Parks data; Urban Forestry Division data
Annual tree loss due to non-housing development (#)	Steady or decreasing	✓	✓	Distributional	Maintenance, Preservation	Recreation & Parks data; Urban Forestry Division data
Annual tree loss due to pests and/or disease (#)	Steady or decreasing	✓	✓	Distributional	Maintenance, Preservation	Recreation & Parks data; Urban Forestry Division data
Annual tree loss due to wind/ storms (#)	Steady or decreasing	✓	✓	Distributional	Maintenance, Preservation	Recreation & Parks data; Urban Forestry Division data
Permits for tree removal (#)	Steady or decreasing	✓	✓	Distributional	Preservation	Urban Forestry Division data

Environmental hazard exposure

Metric/ Indicator	Target/ Selection Cutoff	Site Selection	Project Success	Primary Equity Facet	Intervention Type	Dataset + Source
PM 2.5 (mg/ m3)	<12 mg/ m3 for PM 2.5 (EPA standard)	✓	✗	Distributional	Indirect effect through Planting, Maintenance, Preservation	CalEnviro Screen
Days over 90 degrees F (#)	64 or fewer days per year over 90 F (Citywide average)	✓	✗	Distributional	Indirect effect through Planting, Maintenance, Preservation	NOAA Climate.gov (zip code level)

[103] Karps, J. (2018). Can Equity Metrics Help Achieve Equity Goals? City of Portland Environmental Services.

[104] Nesbitt, L., Meitner, M. J., Sheppard, S. R. J., & Girling, C. (2018). The dimensions of urban green equity: A framework for analysis. Urban Forestry & Urban Greening, 34, 240–248.

Equitable provision of services

Metric/ Indicator	Target/ Selection Cutoff	Site Selection	Project Success	Primary Equity Facet	Intervention Type	Dataset + Source
Public planting resources directed to forest equity areas (%) [103] [104]	75%	✗	✓	Distributional	Planting Governance	City/County Forestry budget
Public partnership with CBOs working in forest equity areas (yes/no)	Yes	✓	✓	Procedural	Governance	Primary, Collected by project team
Average (residential) proximity to cooling center (m)	Project specific	✓	✗	Distributional	N/A	LA County Cooling Centers Map
Shade (tree) coverage near sensitive areas (%)	20% or more surrounding sensitive receptor site	✓	✓	Distributional	Planting Maintenance, Preservation	LiDAR & Census or ACS data
Average (residential) proximity to transportation corridor (m)	Project specific	✓	✗	Distributional	N/A	LA City GeoHub 'streets'
Use of 311 system by geographic unit (%)	Proportional use across all geographies	✓	✓	Procedural	Governance	MyLA311
Grid prioritization for annual tree trimming (spatial distribution)	Equal distribution across locations -OR- In proportion to % of City's total canopy	✓	✓	Procedural	Governance	Urban Forestry Division data
Use of tree removal decision tool including equity exceptions (yes/no)	Yes	✗	✓	Recognitional	Governance	Urban Forest Management Plan

Equity Metrics & Indicators Discussion

Public health

Metric/ Indicator	Target/ Selection Cutoff	Site Selection	Project Success	Primary Equity Facet	Intervention Type	Dataset + Source
Asthma	<51.9 ED visits/10,000 people	✓	✗	Distributional	Indirect effect through Planting, Maintenance, Preservation	CalEnviro Screen
Cardio-vascular disease	<24.3 heart attacks/ 10,000 people	✓	✗	Distributional	Indirect effect through Planting, Maintenance, Preservation	CalEnviro Screen
Low birth weight	<8.52% occurrence of low weight births	✓	✗	Distributional	Indirect effect through Planting, Maintenance, Preservation	CalEnviro Screen
Population under 15 years old (%)	<16%	✓	✗	Distributional	N/A	American Community Survey
Population over 65 years old (%)	<14%	✓	✗	Distributional	N/A	American Community Survey

Community engagement & capacity

Metric/ Indicator	Target/ Selection Cutoff	Site Selection	Project Success	Primary Equity Facet	Relevant Intervention Type	Dataset + Source
Community volunteers engaged in planting and maintenance (#)*[105 106]	Project specific	✗	✓	Recognitional	Education/ Capacity Building	Primary, Collected by project team
Diverse makeup of community participants (% of various demographic groups)	Project specific	✗	✓	Recognitional	Education/ Capacity Building	Primary, Collected by project team
Community representation in planning, decision-making (Y/N)[107]	Yes	✗	✓	Procedural	Governance	Primary, Collected by project team
Workforce development (Y/N)	Yes	✗	✓	Recognitional	Education/ Capacity Building	Primary, Collected by project team

Community engagement & capacity (cont.)

Metric/ Indicator	Target/ Selection Cutoff	Site Selection	Project Success	Primary Equity Facet	Relevant Intervention Type	Dataset + Source
Educational opportunities, including tree care, and benefits[108]	Project Specific	✗	✓	Procedural	Education/ Capacity Building	Primary, Collected by project team

***Note:** While community involvement is an important aspect of ownership and recognitional equity, all responsibility for maintenance should not fall to (overburdened) communities; the City also has a role to play and should support and/or subsidize resident-led stewardship whenever possible.[109]

The work of UFEC is concerned with all facets of equity, and multiple dimensions of urban forestry as detailed in the tables above. Still, so much of urban forestry work concerns 'trees in the ground': how many are planted, what species, survivability, and mature tree preservation. As a complement to the metrics and indicators analysis, our team reviewed relevant literature for guidance on the ideal configuration of new plantings to increase the chances of long term success in canopy expansion. Again, the content focuses on planting to maximize benefits related to heat and air pollution exposure, given the City of LA's particular interest in these two topics.

Planting Strategies for Success: Pedestrian-Level Thermal Comfort and Ambient Air Temperature

Trees cool the environment via shading and evapotranspiration, and ideally take the place of/cover impervious surfaces that would contribute to the urban heat island effect. Even a single tree can impact the absorption of solar radiation and surface temperature in that spot, though clustered trees are more effective for improving thermal comfort in a Mediterranean climate like LA's. The suggestions below maximize pedestrian-level thermal comfort, and most refer to studies done in Mediterranean climates.

Maximize shading, limit humidity, and maintain windflow

Numerous studies have indicated that trees offer significant cooling benefits in Mediterranean climates, particularly due to shading which reduces solar radiation exposure and uptake by buildings, roads, and other impervious surfaces. Tree shade is a particularly influential factor in improving thermal comfort conditions at the pedestrian level.[110 111 112]

105 Nguyen, L. (2018). A Case Study Analysis of Strategies, Challenges and Metrics of Success for Large-Scale Municipal Tree Planting Campaigns in Ontario. University of Toronto.

106 Roman, L. A., Walker, L. A., Martineau, C. M., et al. (2015). Stewardship matters: Case studies in establishment success of urban trees. Urban Forestry & Urban Greening, 14(4), 1174–1182.

107 Nesbitt, L., Meitner, M. J., Girling, C., & Sheppard, S. R. J. (2019). Urban green equity on the ground: Practice-based models of urban green equity in three multicultural cities. Urban Forestry & Urban Greening, 44, 126433.

108 Elmendorf, W.F., Cotrone, V.J., & Mullen, J.T. (2003). Trends in urban forestry practices, programs and sustainability: Contrasting a Pennsylvania, U.S. study. Journal of Arboriculture, 29(4), 237-248.

109 Kenney, W. A., van Wassenaer, P., & Satel, A. (2011). Criteria and Indicators for Strategic Urban Forest Planning and Management. Arboriculture & Urban Forestry, 37(3), 108–117.

110 Antoniadis, D., Katsoulas, N., & Kittas, C. (2018). Simulation of schoolyard's microclimate and human thermal comfort under Mediterranean climate conditions: Effects of trees and green structures. International Journal of Biometeorology, 62(11), 2025–2036.

111 Antoniadis, D., Katsoulas, N., & Kittas, C. (2018). Simulation of schoolyard's microclimate and human thermal comfort under Mediterranean climate conditions: Effects of trees and green structures. International Journal of Biometeorology, 62(11), 2025–2036.

112 Potchter, O., Cohen, P., & Bitan, A. (2006). Climatic behavior of various urban parks during hot and humid summer in the mediterranean city of Tel Aviv, Israel. International Journal of Climatology, 26(12), 1695–1711.

Equity Metrics & Indicators Discussion

When feasible, planting should favor clusters or rows of trees which offer contiguous shade. This works best with high and wide-canopied trees, though can also be effectively done with medium-sized trees.[112] Deciduous trees with both a high leaf area index (LAI) and vertical leaf area density (LAD) provide the best shading.[110] A downside of medium-sized shade trees is that they may generate more humidity and impede windflow at the pedestrian level, adding to thermal discomfort.[111] Additionally, trees that are too densely clustered may yield a decrease in evapotranspiration and the loss of associated air cooling benefits.[113] However, the cooling benefit of shade far outweighs that of evapotranspiration so this should not be a significant concern in LA.[114] Overall, it is recommended that trees be clustered for maximum shading, but be far enough apart to allow windflow. The type of ground surface cover under tree shade does not make a significant difference to thermal comfort, whether the shaded surface is soil, grass, or pavement - tree shade over any ground cover is an effective cooler

In street canyons: Trees planted on the east side of a street offer more cooling benefits via solar radiation protection than those planted on the west side, and planting pattern of double rows (both sides) rather than in the center of the street provides greater temperature reduction.[115] In high density urban areas with minimal green space, trees should be planted in wind paths to increase cooling power.[116]

Reduce sky view

Multiple studies on the cooling power of trees refer to the "sky view factor" (SVF); the proportion of open sky visible from a single point (including Antoniadis et al.[110] and Speak & Sabitano,[91] both of which are specific to Mediterranean climates). Tan et al.[116] found that low to medium sky view resulted in an increase in thermal comfort, as trees which obscure sky view provide shade and block solar radiation to ground surfaces. Sky view can be reduced by buildings or other structures, though tree canopy is also influential.

Optimize maintenance

Clustered trees may be easier to maintain because they can share materials, equipment, and irrigation; maintenance is more feasible when trees are close together rather than dispersed widely across an area.[106]

Planting Strategies for Success: Air Quality

Trees partially reduce air pollution by decreasing ambient temperatures, as some pollutants are temperature dependent, and cooler temperatures may decrease the formation of ozone.[117] Configuration suggestions as noted above may reduce heat as well as some air pollution.

Amorim et al.[118] found that trees planted in street canyons that are in alignment with wind flow reduced CO air pollutants by up to 16% due to ventilation in the street canyon. However, trees in canyons not aligned with air flow increased CO 12% over a no-tree scenario. This aligns with the recommendation above to align tree planting in high-density urban areas with wind paths to increase cooling.[116]

Hagler et al.[119] found that trees used as a traffic noise barrier on major roads (e.g., a highway) sometimes reduced downwind concentrations of air pollutants, though the effect was not consistent. The opposite effect was also observed, likely due to gaps that are common in roadside tree barriers, allowing pollutants to get through; in other words, high density tree stands may make more effective pollution barriers along major roadways.

Trees can negatively impact air quality via biogenic volatile organic compounds (BVOCs).[120 121] Selecting species for cooling/shading that are low emitters of BVOCs and pollen is recommended, as is widely dispersing high BVOC-emitting species that are commonly in use: "All parts of the tree produce such BVOCs, which vary in chemical properties and may have different impacts; BVOCs are already known to play a role in the formation of O3, secondary organic aerosols, and PM in urban environments (Calfapietra et al. 2013a). As trees respond to elevated urban temperatures, pollutant levels, and atmospheric carbon dioxide (CO2) concentrations projected under future climate-change scenarios, their associated BVOC emissions may intensify substantially (Calfapietra et al. 2013b). In addition, primary organic particles such as pollen may act as allergens and are possibly more potent in combination with other urban pollutants (Beck et al. 2013)."[122]

Tree species that are known to be effective pollutant absorbers, and which can provide shade to reduce ambient temperatures are ideal for improving air quality conditions. However, in dense urban areas, trees should be planted with care to ensure that they are not reducing ventilation and blocking pollutant dispersal (i.e., trees should be planted in alignment with wind paths and on the windward aka east side of a street canyon). When possible, species should be selected which meet the above criteria, but are low emitters of BVOCs and pollen. High BVOC-emitting species should be planted at wide intervals.

113 Zhou, W., Wang, J., & Cadenasso, M. L. (2017). Effects of the spatial configuration of trees on urban heat mitigation: A comparative study. Remote Sensing of Environment, 195, 1–12.

114 US Environmental Protection Agency (2023). Using Trees and Vegetation to Reduce Heat Islands. Heat Islands. https://www.epa.gov/heatislands/using-trees-and-vegetation-reduce-heat-islands

115 Morakinyo, T. E., & Lam, Y. F. (2016). Simulation study on the impact of tree-configuration, planting pattern and wind condition on street-canyon's micro-climate and thermal comfort. Building and Environment, 103, 262–275.

116 Tan, Z., Lau, K. K.-L., & Ng, E. (2016). Urban tree design approaches for mitigating daytime urban heat island effects in a high-density urban environment. Energy and Buildings, 114, 265–274.

117 Nowak, D.J., McHale, P.J., Ibarra, M., Crane, et al. (1998). Modeling the Effects of Urban Vegetation on Air Pollution. Air Pollution Modeling and Its Application, XII, 399-407.

118 Amorim, J. H., Rodrigues, V., Tavares, R., Valente, J., & Borrego, C. (2013). CFD modelling of the aerodynamic effect of trees on urban air pollution dispersion. Science of The Total Environment, 461–462, 541–551.

119 Hagler, G. S. W., Lin, M.-Y., Khlystov, A., et al. (2012). Field investigation of roadside vegetative and structural barrier impact on near-road ultrafine particle concentrations under a variety of wind conditions. Science of The Total Environment, 419, 7–15.

120 Grote, R., Samson, R., Alonso, R., Amorim, et al. (2016). Functional traits of urban trees: Air pollution mitigation potential. Frontiers in Ecology and the Environment, 14(10), 543–550.

121 Eisenman, T. S., Churkina, G., Jariwala, S. P., et al. (2019). Urban trees, air quality, and asthma: An interdisciplinary review. Landscape and Urban Planning, 187, 47–59.

122 Fischetti, M. (2014). The Paradox of Pollution-Producing Trees. Scientific American.

Recommendations & Next Steps

Recommendations & Next Steps

UFEC's work has involved an assortment of activities intended to synthesize, share, produce, and deepen knowledge on the subject of urban forest equity. This includes collaborations with partners across sectors and topic areas, reviewing the literature, community engagement and social research, spatial modeling, and the development of novel frameworks and tools. At the culmination of these activities, our team has compiled a list of recommendations which can be applied by practitioners to advance forest equity in whatever capacity they are operating. We present these in the spirit of improving upon successes while learning from challenges. Learning from successes and failures will be critical to expanding this work effectively.

These recommendations are primarily geared toward planners, decision makers, and policy makers in local government, but may also be applied to community-based, nonprofit, academic, or other sectors. They are framed around two core goals: (1) expanding tree canopy in Los Angeles, and (2) doing so in an equitable manner that prioritizes underrepresented and under-canopied communities.

Recommendation 1: Foster diverse partnerships and build upon existing and emerging resources and knowledge

The UFEC team, the assessments, and the tools shared in this report could not exist without partnership, collaboration across sectors, and the disparate areas of expertise each partner brings. As such, we urge urban forestry practitioners, decision makers, community based groups, researchers, and others to cultivate diverse partnerships to conceptualize the problems associated with urban forest equity, brainstorm solutions, and exchange resources. A complex, intractable issue like urban forest (in)equity cannot be solved by any one entity alone, and efforts to advance equity will benefit by the inclusion of multiple perspectives, experiences, and contributions. Working cross-sectorally, for example, may increase efficiency by bringing relevant partners to the table and proactively addressing challenges. Working across scales of influence (e.g., County, City, and community) means that concepts, like those presented in this report, may be taken up more broadly.

Additionally, in the interest of maximizing impact and covering all bases, we recommend that practitioners make use of existing knowledge, tools, and other resources to avoid duplication of efforts and promote efficiency with each new project. This may refer to previously underutilized information or techniques offered by other partners, or resources identified through a preliminary literature review or scan of related tools. There is a wealth of information and skills already available which can be applied to local urban forest equity efforts, and which practitioners can build upon moving forward.

[123] Nelson, J. R., Grubesic, T. H., Miller, J. A., & Chamberlain, A. W. (2021). The equity of tree distribution in the most ruthlessly hot city in the United States: Phoenix, Arizona. Urban Forestry & Urban Greening, 59, 127016.

Recommendation 2: Account for multiple facets of equity, not just distributional

The concept of urban forest equity has gained traction in academia and practice, with individuals and local governments increasingly acknowledging that the benefits of urban trees are not shared equally. Numerous cities and programs have identified discrepancies in tree cover, leading some to broader discussions of environmental vulnerability and remediation. Typically, studies and proposed solutions emphasize one aspect of forest equity: distribution.[18 123] This may refer to the equal allocation of trees in all places (i.e., a common canopy goal for each neighborhood), or, more often, prioritizing new planting in areas that have historically been under-canopied and underserved. However, planting trees in high-need areas does not necessarily yield the expected benefits, as there are usually other socio-economic challenges at play in those communities.[6] Of the three types of equity addressed in this report – distributional, recognitional, and procedural – distributional is arguably the easiest to operationalize and the most visible.

While the physical distribution of trees is significant, we recommend that practitioners consider opportunities to integrate recognitional and procedural equity into their work as well. On the former point, this may mean conducting background research on socio-environmental conditions to better understand ongoing challenges and their root causes; meaningfully engaging residents when identifying greening interventions to capture and address their goals, needs, and concerns; and involving interested community members in project design, tree planting or stewardship. Although these activities take additional time and resources, they are attainable pathways toward recognitional equity.

Procedural equity is perhaps the most difficult to incorporate; this includes transparency in decision making, access to information and decision making for community members, and the fair, impartial distribution of services. While some practitioners have the ability to dictate where trees are planted and who is consulted, their control over decision making or follow-up services may be restricted by available funding, existing policies, or internal capacity. Even if an organization's abilities are limited in this respect, we recommend that practitioners consider procedural equity at the start of any new project, and seek opportunities to build toward it wherever possible. One relatively accessible option is to provide community members with information during tree planting initiatives on topics including: what your group is doing, why you are doing it, and any results or data that you collect. Beyond basic bi-directional communication, actively listening to community needs, honoring residents' lived experience as expertise, and co-designing projects and interventions that actively respond to and address those needs is critical. It also ensures broader project success.

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Recommendation 3: Be transparent and systematic in urban forestry-related decision making

This recommendation further builds upon the topic of procedural equity. Transparency and intentional methods are essential, whether a city department is setting a new canopy target, forestry policy, or tree maintenance schedule, or a community-based organization is undertaking a hyper-local planting project. First, those with the ability to do so should develop and apply a standardized process (such as the prioritization and community engagement frameworks introduced in this report) to identify project locations, allocate funding, or direct resources. The processes employed should be clearly described and made available to the public either automatically or upon request. While not everyone will agree with chosen methods, standardizing the process provides a clear justification and a degree of impartiality. Additionally, in community engagement, practitioners should be clear in communicating their aims, abilities and limitations to residents so they know what to expect and do not feel disappointed or misled.

Recommendation 4: Lead with evidence — including evidence embedded in community perspectives and experiences — when designing planting projects, and track impacts and outcomes

Following on Recommendations #2 and 3, any new planting projects should lead with evidence. A best practice is to plant trees where there is evidence to suggest that a project will be successful, sustainable, and well-received by the communities a project is meant to benefit. Data to review or collect during project planning might include local history, community attitudes, existing canopy coverage, existing community-based tree planting efforts, tree survival rates, mature tree preservation stressors, and the presence of sensitive receptor sites. As well, it is important to acknowledge that trees cannot solve all socio-economic disparities or broader inequities, and that planting projects should focus on issues that can realistically be ameliorated by an increase in canopy, such as high temperatures, air pollution, and neighborhood aesthetics.

We further recommend that practitioners: incorporate the multiple facets of equity discussed in Recommendation 2; employ equity metrics (those presented in this report or others) to track project goals, progress, challenges and successes; and then publicize that information. This will contribute to a larger community of practice, allow others to build upon a shared evidence base, and improve plans and outcomes over time.

Recommendation 5: Actively engage community members in goal setting, data collection, project planning, and project design

As indicated throughout this report, urban forestry initiatives that occur without community input and approval have limited prospects for long-term success. Urban forestry efforts that do not align with community interests may never get off the ground due to lack of buy-in; newly planted trees may not survive without the support of community members. At worst, misaligned efforts can exacerbate inequities, for example by imposing an unwanted maintenance burden on under-resourced communities. It is important for practitioners to capture and understand community perspectives to ensure that forestry projects are suitable and welcome. Notably, the requested community input should not be tokenistic. To the extent possible, practitioners should find ways to incorporate that input into their emerging plans and/or adjust existing plans as appropriate. In addition to providing feedback or guidance for project plans, community members may appreciate the opportunity to share their expertise and experiences. Those who live with the effects of limited tree cover and high environmental exposure (for example, to heat and air pollution) are well-positioned to advise practitioners about current conditions and needs, and provide or contextualize data and information. Engaging communities in this role, as well as in project development, planning, and goal-setting, is in service to procedural and recognitional equity, so long as those contributions are valued and compensated. Community members engaged in a data collection or consultation role should be remunerated for their time and expertise, building from the successful Tree Ambassadors program in LA.[124]

Recommendation 6: Plan for shade trees at the beginning stages of public works, capital improvement, and active transportation projects, especially in neighborhoods where available space for public trees does not currently exist

Phase I revealed that financing urban forestry efforts is a common barrier. While we argue that trees should be viewed by local governments as critical infrastructure, this is not the current reality in Los Angeles and elsewhere. Funding and political will for Tier 1 tree planting projects – for example, private tree giveaways and neighborhood park or street tree planting events – are relatively accessible to nonprofits and government agencies, though not guaranteed. In contrast, rarely do project plans factor space for large shade trees in the early stages of development. It is extremely difficult for a Tier 3 planting effort to gain approval and funding if the only stated goal is tree planting or canopy expansion. Ostensibly, the cost and disruptive transformation associated with Tier 3 planting do not correspond with conventional attitudes about the value of trees. In the absence of policies that recognize trees as critical infrastructure, it is possible to transform Tier 2 and 3 areas by integrating planting with larger public works projects creating opportunities for multi-benefit projects. For example, if major roadway transformations are underway based on the LA 2035 Mobility Plan or Complete Streets Design Guide, trees can

[124] de Guzman, E. B., Escobedo, F. J., & O'Leary, R. (2022). A socio-ecological approach to align tree stewardship programs with public health benefits in marginalized neighborhoods in Los Angeles, USA. Frontiers in Sustainable Cities, 4, 944182.

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125 Metro (2023). Rail to Rail Active Transportation Corridor. https://www.metro.net/projects/railtorivera/

126 Dudek (2018). First Step: Developing an Urban Forest Management Plan for the City of Los Angeles.

be introduced as part of the final design. The 'Rail to Rail Active Transportation Corridor Project' currently under construction in Los Angeles aims to revive a disadvantaged area with amenities including walking and bike paths, and also includes planting thousands of new trees along the corridor. [125] Likewise, planned upgrades to or restructuring of utility lines or roadways may serve as opportunities to implement planting on Tier 3 sites.

Recommendation 7: Apply urban forest equity concepts to local policy and plan development

The UFEC team recognizes that plans for canopy expansion must account for and respond to the interests of local residents, highlighting the need for a community-informed, bottom-up approach to urban forestry. At the same time, equity principles must come from the top down in order to influence local policy and planning. This ensures that the concept of urban forest equity has widespread uptake and institutional backing, and that bottom-up efforts are better supported by governance structures. The concepts, tools, and recommendations generated by UFEC and shared in this report have practical applications and can move the needle toward equitable forestry on the ground by informing policy and decision making at the top. For example, the neighborhood prioritization framework can help decision makers systematically prioritize equity areas for investments of state and federal funds.

Specific opportunities to integrate UFEC's work into local policy and plan development include the following, among others:

- Apply equity metrics and considerations in the development of equity goals for the upcoming LA City and County Urban Forest Management Plan.
- Improve current requirements for capital projects that necessitate the inclusion of tree planting and preservation of mature trees in new developments.
- Apply the UFEC prioritization framework in the upcoming LA County depaving study and subsequent planning for unincorporated areas.
- Introduce concepts to the LA Community Forest Advisory Committee to identify pathways for advancing the three components of equity (distributional, recognitional and procedural).

Recommendation 8: Develop programs to incentivize and support tree planting on private property

As illustrated through the GIS analysis of Tier 1 planting, reaching neighborhood and citywide canopy goals will depend primarily on the expansion of private property trees. Currently in Los Angeles, trees and plants on private property account for 90% of the urban forest.[126] While City government can more readily plant on public property including streets and parks, creative solutions may be needed to reach private property owners. We recommend that practitioners at all levels – government agencies, nonprofits, community forestry champions – consider strategies to increase tree planting and care on private property.[127] Options which are not legally binding include tree giveaways, free tree care training sessions, water rebate programs, or complimentary maintenance checks by a certified arborist or other professional. As an example, with funding from the LA Department of Water and Power, City Plants and its partners currently adopt out and deliver 17,000 trees per year for planting on private property. This group is also piloting a private property planting program for disadvantaged communities. At the level of governance, the City or County may establish laws or policies pertaining to the expansion of privately-owned trees.

127 Nguyen, V. D., Roman, L. A., Locke, D. H., et al. (2017). Branching out to residential lands: Missions and strategies of five tree distribution programs in the U.S. Urban Forestry & Urban Greening, 22, 24–35.

Recommendation 9: Integrate preservation in urban forestry work

Typically, urban forestry is heavily focused on planting, and to a lesser extent maintaining new trees. However, mature trees provide up to 70 times the ecological and health benefits of small, immature trees.[65] They are more effective than young trees at mitigating air pollution, sequestering carbon, providing shade, retaining stormwater, and cooling the ambient environment; and they are more tolerant of heatwaves and drought.[69 70] Mature trees face a variety of threats including pests, storms, and development and they are not easily replaced by new plantings which take years to reach their full potential. Therefore, plans and policies aimed at increasing urban tree canopy should account for planting as well as preservation for maximum benefit.

If care of mature trees has been unsatisfactory in the past, residents may be reluctant to accept new plantings. This issue is especially pronounced in disinvested or underserved neighborhoods, where residents are sometimes concerned about the disservices brought by trees, such as yard debris, fallen limbs, buckled sidewalks, and property damage.[73 74] In order to build trust and interest in planting, practitioners may need to first address any lingering concerns about care and responsibility for mature trees.

Recommendation 10: Acknowledge the persistence of insufficient resources and proceed with available resources

Urban forest inequity is not an issue that can be solved in one funding cycle, over the life of one project, by one collective. Achieving equity in practice and outcomes is an ongoing, incremental, iterative process. Those operating in this space can expect a persistent dearth of funding, information, political will, and capacity which can make progress slow. Those working toward the critical and audacious goal of urban forest equity for all communities in Los Angeles and beyond can acknowledge the limitations and challenges inherent to this work, and yet commit to doing what they can in spite of the limitations. Starting small with a single community or neighborhood can offer an accessible entry point to a broader

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impact. Leading with principles of equity, even when they are not easy to operationalize, moves the practitioner community closer to a common awareness of those principles. Sharing tools and research results, even when incomplete or imperfect, builds collective knowledge and creates a path for improvements. Remember that no contribution or amount of progress is insignificant.

In addition to these external-facing recommendations, the UFEC has articulated a list of priorities for potential future phases of this initiative. With additional time and resources, our collective envisions opportunities for improvement and expansion which will move LA toward equitable, implementable, and data-informed forestry projects. While Phase II yielded significant findings and outputs, there are still questions unanswered, research directions unexplored, and tools undeveloped which comprise our next steps.

Next Step 1 : Improve upon the GIS models for Tier 1 residential analysis, expand the parameters of the Tier 1 public tree models, and expand to Tier 2 analysis

There is an opportunity to refine the GIS models used in our Tier 1 analysis. Notably, the quality of the private property analysis could be improved by revisiting the accuracy of underlying datasets and/or our modeling methods. The Tier 1 GIS analysis could also be expanded to include public plantable spaces like parks and medians in addition to parkway trees. Doing so will yield deeper insight into the potential for canopy expansion on publicly owned Tier 1 sites. While data constraints prevented a similar analysis of Tier 2 sites in this phase, those constraints may not be overcome in the future.

Next Step 2: Design and implement more planting interventions in pilot neighborhoods and beyond

The scope of UFEC Phase II enabled our team to identify two pilot neighborhoods, each of which received Tier 3 planting designs, created by STOSS, for two street segments of interest to the community. At the conclusion of this phase, designs and results of community surveys and workshops elucidating community concerns, goals, and attitudes regarding trees are available to those championing urban forest equity in the two neighborhoods, including the community-based organizations that work in these regions. The intent is to provide the resources and information needed for local leaders to move toward implementation in these locations. With additional resources, the UFEC recommends expanding this process to additional high-priority neighborhoods while focusing on implementation, including how to move ambitious Tier 3 designs forward, access funding, and fill gaps in capacity.

Next Step 3: Refine and apply a Preservation Tiers Framework

UFEC began as a planting-oriented initiative, and much of our work

has been structured around the Planting Tiers Framework generated during Phase I. During the course of Phase II, it became clear that urban forest equity and urban canopy goals in general cannot be achieved without considering tree preservation as well. The UFEC team has begun developing a complementary Preservation Tiers Framework which could be applied alongside the Planting Tiers Framework in urban forestry decision making. We see great value in continuing to refine this framework and explore opportunities for its application to local practice.

Next Step 4: Adapt equity metrics and guidance for community use

The content of the report and most of UFEC's products are structured for a professional or practitioner audience, whether City or County staff, university researchers, or nonprofit organizations. One exception is the 'Community Action Toolkit,' which includes accessible engagement materials for general use. As a next step in making this work meaningful and useful to a wide audience, the UFEC team hopes to adapt some of our outputs for community members, local forestry champions, and/or community-based organizations that do not have expertise in urban forestry. Specifically, the site selection indicators and equity metrics presented in this report could be made more user-friendly, incorporate less technical language, and be accompanied by additional guidance and examples so that any user can operationalize them.

Next Step 5: Model the heat mitigation, water retention and other ecosystem services potential of trees in various scenarios

It is widely understood that trees can offer a multitude of ecosystem services and environmental benefits, including heat mitigation, stormwater retention, wildlife habitat, and air quality improvement. However, general knowledge may not be sufficiently compelling to decision makers allocating funding, or community groups striving to measurably improve local conditions. By modeling the ecosystem services resulting from tree planting in various quantities, locations, and surrounding conditions, we can better understand how and to what extent trees might address environmental problems. This knowledge would not only establish a clear justification for funding or other resources, but would enable practitioners to develop plans which target the ecosystem services of greatest importance and achieve maximum benefits.

Next Step 6: Explore opportunities to leverage other relevant efforts and use complementary tools and resources

The tiered planting system can be readily applied to inform planning, design and implementation where opportunities exist to incorporate urban greening elements into capital improvement projects and place-based investments. For example, the LA region has been the recipient

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128 Accelerate Resilience LA Living Infrastructure Toolkit, https://acceleratela.org/fieldkit/

129 ReDesignLA, https://www.redesign.la/

of several Transformative Climate Communities Program grants from the California Strategic Growth Council, including grants to transform communities adjacent to the two UFEC pilot neighborhoods. One of these projects, dubbed the South LA Eco-Lab, is located just west of Central Alameda and offers an opportunity to extend application of the urban forest equity methods presented in this report.

The tiered planting system, decision-making framework, and other resources are also meant to complement and be applied in concert with other tools available in the LA region. These include efforts such as: Accelerate Resilience LA's Living Infrastructure Field Kit, which is a series of community engagement and collaborative planning tools to support living infrastructure projects;[128] and ReDesignLA, a program operated by the Council for Watershed Health which provides technical assistance and capacity building with small municipalities, school districts, and community-based organizations to develop and implement multi-benefit projects that integrate stormwater capture and climate resiliency.[129]

Next Step 7: Explore and develop legal options for private property planting requirements and preservation

As noted above, private property accounts for the vast majority of available Tier 1 planting space, and planting those sites is seemingly essential to meet the canopy goals set out by LA's Green New Deal. We have already recommended that practitioners develop programs to incentivize voluntary planting on private property, and offered some hopeful examples. There is also potential to pursue legal options for expanding canopy and/or improving preservation outcomes on private property. This is an issue that the UFEC team feels primed to explore, given the diverse makeup of collective participants including those working in local government, those with expertise in case study and policy research, and those interfacing directly with home/property owners. There is also a need for further analysis on the optimal balance of planting on public versus private land from a canopy-expansion standpoint.

Next Step 8: Perform a cost-benefit analysis of tree projections incorporating findings from the forthcoming study, 'Financing LA's Urban Forest'

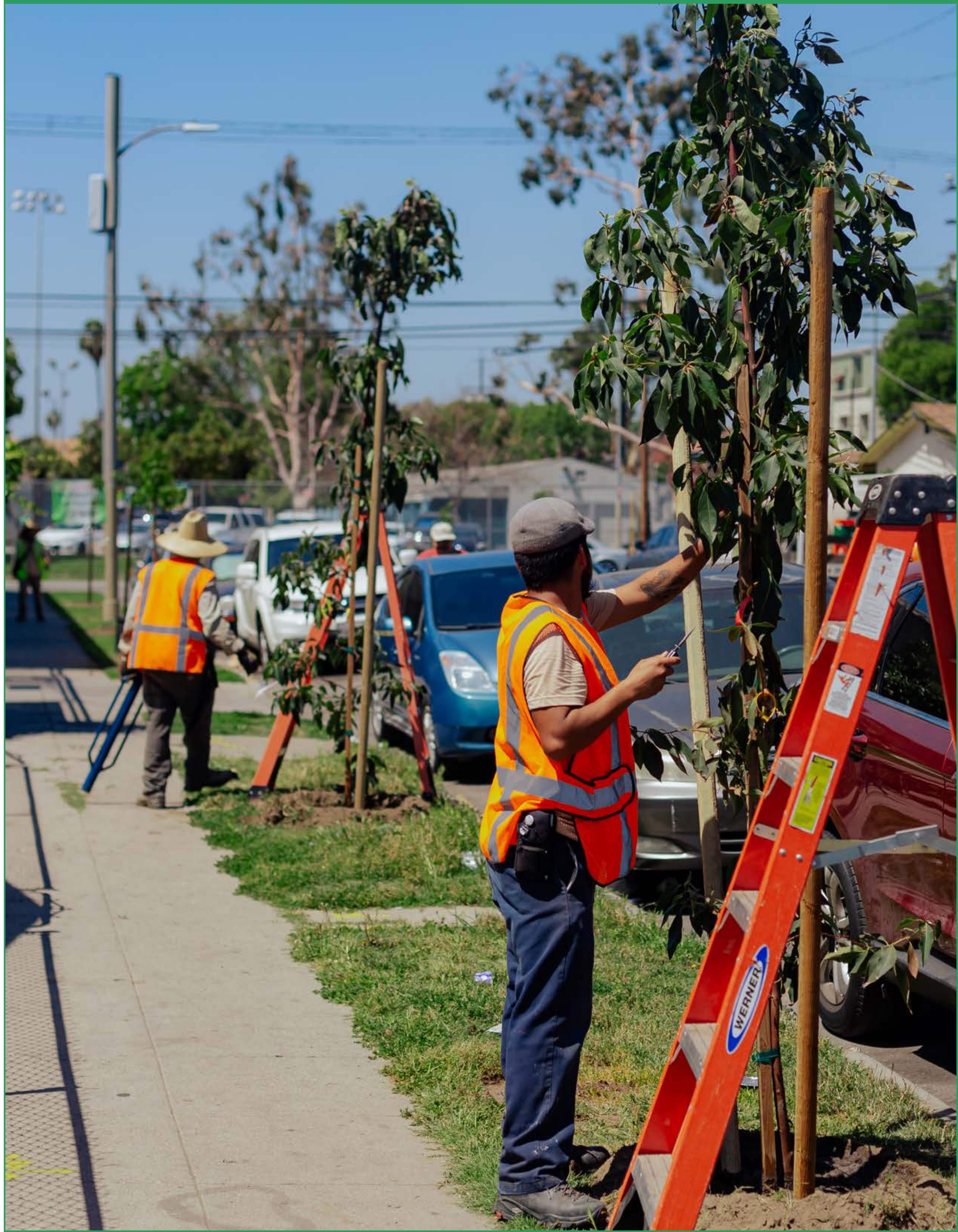
This report includes preliminary cost projections for Tier 1 planting on private property and in parkways. These figures may seem daunting, particularly when they are not weighted against the anticipated benefits of planting. Our team did not have access to reliable cost-benefit information at the time of this writing, though the information will be available with the release of the 'Financing LA's Urban Forest' report. Incorporating current cost-benefit data into our analysis and recommendations could soften the impact of planting price estimates and highlight the value of trees for decision makers.

Conclusion

Conclusion

Throughout the last two years, the Los Angeles Urban Forest Equity Collective sought to bridge theory with practice and turn research into action. Through an integrated and holistic approach of policy analysis, data visualization, and community empowerment, the UFEC set out to broaden and deepen momentum and ease implementation pathways to achieve urban forest equity in LA's lowest-canopied neighborhoods. Building upon the findings of 'LA's Urban Forest Equity Assessment' and 'LA's Urban Forest Equity Streets Guidebook', this project facilitated the co-production of community-centered designs in just two pilot neighborhoods, including 23 of the 155 highest-priority census tracts the UFEC identified. For this work to be expanded and these findings to take root, fierce champions are needed.

By better defining urban forest equity, determining gaps, identifying metrics of success, and centering community voices in this work, the UFEC hopes these findings will support the necessary urban forest management planning throughout the region to bring greener, cooler neighborhoods to all Angelenos. Still, we recognize that overcoming centuries of systemic harm and disinvestment – and the trauma both people and land carry as a result – cannot happen overnight. Rectifying the current socio-political landscape of Los Angeles requires deliberate and deeply collaborative action. As evidenced by the Tier 3 interventions suggested here, such an undertaking arguably requires a paradigm shift, and in many ways, a radical reimagining of how we prioritize nature-based solutions and center the protection of human health amidst our current climate crisis. We are reminded that this work is rooted in healing and trust-based relationship building, and it is ever-evolving. There is much more to learn, more neighborhoods to support, more stakeholders to involve, more coalitions to build, more methods to refine, and more tools to develop. By committing to this challenge and advancing urban forest equity, Los Angeles will build climate resilience and enduring protection for our frontline communities.



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Policy Analysis & Discussion References
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Relevant codes, plans and policies that may intersect with urban greening initiatives

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Appendices & Tools

Appendices & Tools

The following Appendices and Tools are available online at
https://www.cityplants.org/urban-forest-equity-collective/

- UFEC's Los Angeles Urban Forest Equity Prioritization Map
- NASA DEVELOP Tree Canopy Change Analysis (2016 - 2022)
- Los Angeles Urban Forest Equity Neighborhood Strategy: Central Alameda
- Los Angeles Urban Forest Equity Neighborhood Strategy: Sylmar
- Los Angeles Urban Forest Equity Design Guidebook
- Urban Forest Equity Community Action Toolkit
- Tier 1 GIS Full Citywide Parkway Results
- GIS Tier 1 Analysis Methods Document
- Greening the Divide: Identifying community-driven policy and planning pathways to advance urban forest equity in Los Angeles
- USC's Urban Trees Initiative