MEMORANDUM

PLANNING DIVISION
DEPARTMENT *of* COMMUNITY *and* NEIGHBORHOODS

To: Salt Lake City Planning Commission

From: Laura Bandara, Urban Designer
(801) 535-6188 or laura.bandara@slcgov.com

Date: January 26, 2021

Re: Urban Forest Action Plan and associated future zoning amendment

DOCUMENT TYPE: Information Item

RECOMMENDATION: Review only

PROJECT DESCRIPTION:

The Planning Division is developing an Urban Forest Action Plan and a future zoning code amendment related to the preservation and promotion of trees on public and private lands and within the public right-of-way.

Action Plan

The Urban Forest Action Plan will provide goals, objectives, and actions to realize the vision for the urban forest established in Plan Salt Lake, adopted in 2015. Under the guiding principle of "Beautiful City," the Salt Lake City's general plan asserts:

> Salt Lake City residents and visitors recognize our green network, including our urban forest, parks, and street trees, as one of our greatest assets. … We will continue to make its maintenance and expansion a priority (31).

The Urban Forest Action Plan will assist in the development and implementation of clear policy directives to maintain and expand Salt Lake City's urban forest in the current context of a changing climate and record levels of development.

Planning is collaborating closely with the Urban Forestry Division on this effort, along with the Departments of Sustainability and Public Utilities. All other City departments and divisions that work in the right of way are represented on steering committees.

Draft Action Plan Outline

Executive Summary

Chapter 1: Introduction

Chapter 2: SLC Urban Forest Analysis: Strengths, Vulnerabilities, Opportunities, + Constraints

Chapter 3: Livability + the Urban Forest in Salt Lake City

Chapter 4: Best Management Practices for a Thriving Urban Forest

Chapter 5: Growing + Sustaining an Equitable Urban Forest in Salt Lake City

Works Cited

Future Zoning Code Amendment

The Planning Division has identified the need to update existing tree regulations to align with Salt Lake City's sustainability, equity, and urban design goals. Currently, the ordinance is vague regarding the requirement for trees to be provided or preserved during development and redevelopment. The analysis performed for the Urban Forest Action Plan will inform a future amendment to sections of the zoning ordinance that pertain to street and private lands trees.

It is anticipated that the future code amendment will clarify existing regulations, and may incorporate criteria related to air quality, water quality, energy conservation and urban design. The Planning Commission will be briefed in the future on the text amendment associated with this action plan.

PROJECT PURPOSE:

To "continue to make [the Urban Forest's] maintenance and expansion of a priority," and ensure the Urban Forest's benefits are distributed equitably citywide, Salt Lake City needs to plan for both preservation and growth of the urban forest.

The urban forest is a modified natural system that is a public good and has long term value like constructed systems such as public utilities and streets. The urban forest provides a wide range of benefits, including:

- Mitigation of adverse environmental impacts.
- Reduction of energy consumption.
- Improvement in public health outcomes.
- Urban design improvement in neighborhoods and business districts.

A well planned and maintained urban forest can mitigate environmental conditions known to contribute to respiratory disease and heat-related illness. To address adverse impacts to public health that have been created by an inequitable treatment of some neighborhoods within Salt Lake City, staff is conducting a reassessment of existing policies and practices related to the urban forest.

ANTICIPATED OUTCOMES:

1. Alignment of Salt Lake City's Urban Forest policies, regulations, and practices with City goals for sustainability and equity. This will be accomplished through developing policy recommendations to:

    - Ensure effective protection of the urban forest as a public good through land use policy and land management practice.
    - Incorporate economic valuation of ecosystem benefits provided by the urban forest into City practice.
    - Provide solutions in the right-of-way that will accommodate trees, access, and utilities where they compete for the same space.
    - Provide guidance on urban forest priorities and preservation.
    - Provide a range of strategies to expand the urban forest in high-need areas.

2. Establishment of a prioritized approach to urban forest distribution and maintenance to redress specific, persistent adverse public health impacts. This will be accomplished through developing policy recommendations to:

    - Prioritize tree planting in Salt Lake City neighborhoods to redress inequities in the distribution of tree canopy on public streets.
    - Prioritize tree planting and preservation in areas that would benefit most from additional trees based on correlations between the number of existing trees, public health criteria, and the types of surrounding land uses.

ATTACHMENTS

A. **Public Engagement**
    1. Project Page
    2. Urban Forest Action Plan Survey (English) / Encuesta de plan de acción para el bosque urbano (Español)
    3. Summer Planning Series 2019: Seeing the Urban Forest for the Trees (SLC TV segment)
B. **Steering Committee Information**
C. **Next Steps**
D. **DRAFT Urban Forest Action Plan: Chapters 1-4**

B. STEERING COMMITTEES

An internal City working group and a Technical Advisory Committee (TAC) have been established to provide guidance on the deliverables of the plan as it is developed. The TAC consists of people within and outside of the city government.

Technical Advisory Committee Representatives

SLC CORPORATION	NON-PROFIT/PROFESSIONAL	ACADEMIC (U OF U)
Development Review	TreeUtah	Urban Ecology
Economic Development	ReLeaf	Atmospheric Sciences
Golf	Utah ASLA	Mechanical Engineering
Water Conservation (PU)	Utah Society for Environmental Education (USEE)	
Streets	University Neighborhood Partners (UNP)	
	Hawk Watch	
	The Nature Conservancy	

Working Group Committee Representatives (Internal to Salt Lake City)

Engineering	Redevelopment Authority
Housing Stability	**Sustainability**
Transportation	Public Lands
Public Utilities (water quality)	**Urban Forestry**

*__bold text__ indicates project team member

C. NEXT STEPS

1. Brief Planning Commission on Draft Urban Forest Action Plan
2. Public Input Period
    a. Online open house
    b. Citywide survey (English and Spanish versions, *in process*)
    c. Focus group meetings
        - Community Councils with low tree canopy cover (*in process*)
        - Developers (Downtown Development Committee, ULI Utah)
        - Designers (Urban Design Utah, AIA Utah Equity x Design Committee, Utah ASLA)
3. Prepare Draft Street and Private Lands Trees Zoning Code Amendment for work session with Planning Commission
4. Present Final Draft Action Plan to Planning Commission in spring or summer 2022
5. Pending Planning Commission recommendation, transmit Draft Action Plan to City Council

SALT LAKE CITY

URBAN FOREST ACTION PLAN

PLANNING DIVISION // JANUARY 2022

DRAFT

SALT LAKE CITY

URBAN FOREST ACTION PLAN

CONTENTS

NO. 1

INTRODUCTION

Urban forests are vital contributors to thriving cities. When properly planned, planted, and protected, urban forests promote both public and environmental health and can mitigate some effects of climate change. Our urban forest is an asset that Salt Lake City residents treasure. In the City's 25-year general plan, Plan Salt Lake (2015), residents named the urban forest as one of our greatest assets and called for its continued preservation and expansion.

Urban forests are composed of all trees, including those in riparian and wetland areas, within a city. Unlike their natural area counterparts, urban forests regularly interact with all aspects of city life, including pavement, pollutants, auto emissions, salt and sand, urban heat island, construction impacts, and above and underground utilities, among others. A growing, thriving urban forest is only possible with a careful combination of planning, policy, and design. That combination must balance the imperative of water conservation with a comprehensive, equity-based approach to the role of trees in the watershed and air quality. At the same time, City policies should account for the full range of benefits and costs of urban forests.

Salt Lake City's history as an urban place is closely tied to the history of its urban forest. When emigrants arrived in the Salt Lake Valley in 1847, their first concern was water. The second was shade. Settlers quickly planted vines to grow shade over their first, simple earthen homes. Then they planted and cultivated trees to transform the first streets and canals of the Plat of Zion into a livable city. By caring for our urban forest, we continue a positive legacy of those city-makers and embrace our urban heritage.

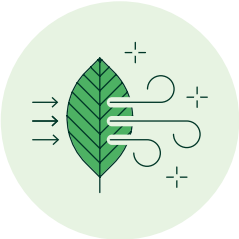
URBAN FOREST CONTRIBUTIONS

An increase in canopy coverage, appropriate tree selection, and emphasis on the importance of tree care can support a wide range of Salt Lake City's economic, environmental, public health, planning, community cohesion, and urban design goals, including improvements to:

- **Air Quality**
- **Water Quality**
- **Energy Conservation**
- **Carbon Sequestration**
- **Urban Heat Island Effect Mitigation**
- **Retail Sales**
- **Employee Satisfaction**
- **Public Health**
- **Mental Health**
- **School Performance**
- **Environmental Equity**
- **Transportation**
- **Urban Design**
- **Community Cohesion**

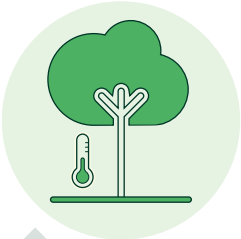
These improvements are briefly summarized below. Except where noted, this information was gathered from the Vibrant Cities Lab, a joint project of the US Forest Service, American Forests, and the National Association of Regional Councils. The Vibrant Cities Lab website has detailed information, research, and supporting data.

ENVIRONMENTAL BENEFITS



AIR QUALITY

Trees reduce air pollution through the uptake of ozone, carbon dioxide, nitrogen dioxide, sulfur dioxide, and particulate matter less than 2.5 microns wide (PM2.5). Strategically locating tree plantings can reduce the impacts of air pollution. For example, vegetation barriers along roadways encourage the mixing of air strata and can reduce ground-level pollution.

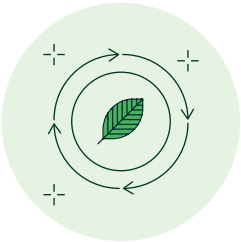


URBAN HEAT ISLAND EFFECT MITIGATION

Shade trees mitigate urban heat island effects created by impervious, paved surfaces. The shade and transpiration (the process by which tree leaves give off water) properties of trees can reduce peak summer temperatures between 2 – 9 degrees Fahrenheit.

WATER QUALITY

Urban forests slow stormwater flows and reduce peak discharge during storms by holding water in the canopy and root system, allowing stormwater to slowly infiltrate into the ground. Slowed stormwater contributes to a healthier hydrologic system and aquatic ecology, because stormwater in pipes flows quickly which raises the water temperature and can negatively impact life downstream. Trees also filter pollutants from water, including nitrogen and phosphorus (typically found in fertilizer and pet waste).



CARBON SEQUESTRATION

According to the U.S. Geologic Survey, carbon sequestration is the “process of capturing and storing atmospheric carbon dioxide. It is one method of reducing the amount of carbon dioxide in the atmosphere with the goal of reducing global climate change.” (USGS, 2021) Trees sequester and store carbon dioxide (CO_2); adding trees in cities (in combination with other strategies) can reduce the amount of atmospheric CO_2.

ENERGY CONSERVATION

Trees reduce the energy consumption of commercial and residential buildings. According to the Lawrence Berkeley Lab Heat Island Group, “each one-degree F increase in peak summertime temperature leads to an increase in peak demand of 225 megawatts,” resulting in $100 million in annual costs to customers. (Center for Neighborhood Technology, 2010).

ECONOMIC BENEFITS

Tree-lined streets are correlated with increased retail sales, customers remaining in business districts longer, and patron visitation from further away (Wolf, 2009). Studies have also demonstrated that trees and plants boost employee productivity and job satisfaction. Trees and plants also have a well-known positive impact on property values.

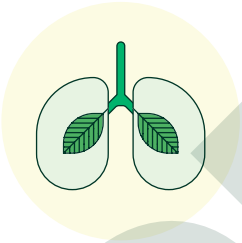
URBAN HEAT ISLAND HEALTH IMPACTS

Cities generally have a significant amount of paved or built surfaces with a low solar reflectance (albedo), such as asphalt, leading to higher temperatures. Urban spatial organization, urban form, lack of vegetation, and waste heat also contribute significantly to the heat island effect. A 2015 University of Georgia study found that the **Salt Lake City metro area ranked among the top 4 of 50 U.S. metropolitan areas for intensity of urban heat island (UHI) effect.**

Salt Lake City's UHI creates several public health impacts. Heat, especially days over 90° F, is the primary driver of weather-related deaths in the United States (Climate Central, 3). Higher summer temperatures increase concentrations of ground-level ozone, contributing to air pollution. Higher temperatures and air pollution increase the incidence of respiratory diseases, heat exhaustion, heat stroke, and heat-related mortality.

Ozone pollution causes a range of respiratory problems. Sensitive groups, such as children, older adults, and people with health conditions are at higher risk during heat waves, which are exacerbated by UHI effects. The Center for Disease Control and Prevention estimates that during the 24-year period from 1979-2003, "excessive heat exposure contributed to more than 8,000 premature deaths in the United States. This figure exceeds the number of mortalities resulting from [all natural disasters] combined." (https://www.epa.gov/heat-islands/heat-island-impacts, accessed July 2019)

COMMUNITY BENEFITS



PUBLIC HEALTH

Numerous studies demonstrate the connection between the ability to experience nature and improved mental and physical health. Urban forests reduce the incidence of respiratory disease, cardiovascular disease, heat-related illness, and skin cancer.

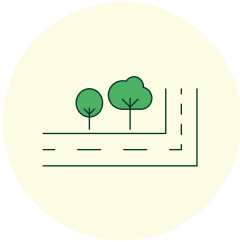
Walking through areas with trees and other vegetation and even viewing vegetated areas through windows has been demonstrated to reduce anxiety, stress, depression, and aggression. Studies of trees and vegetated spaces in cities also showed improved school performance and reduced ADHD symptoms.

URBAN DESIGN

Street trees and urban forests also make vital contributions to the urban design identity of neighborhoods and districts. In Salt Lake City, we can implement urban forest design to increase the number and quality of human-scale spaces in our oversized streetscapes. By creating inviting, pedestrian-scaled places in the city using street trees to mediate between the width of our streets and the height of our buildings, we can make places that encourage positive interactions between residents.

ENVIRONMENTAL EQUITY

Numerous studies have shown that lower-income, historically marginalized groups, and renters tend to live in urban areas with the fewest street trees in public rights of way. Careful planning of the urban forest is needed to ensure an equitable distribution of its benefits.



TRANSPORTATION

The appropriate use of trees in streetscape design results in traffic calming, reduced collision risk, and an inviting environment for walking and biking, promoting active transportation and recreation activities.

COMMUNITY COHESION

Trees enhance neighborhoods by creating inviting gathering places and providing more opportunities for neighbors to socialize and build community. Studies demonstrate an association between the number of trees and community cohesion in urban neighborhoods.

SALT LAKE CITY'S URBAN FOREST

As Salt Lake City undergoes record growth and development during the era of climate change, our urban forest faces new threats. When we add more paving to our city, without planning for adequate environmental and social mitigation, livability decreases. As the city heats up and air and water quality decline, our sidewalks and public spaces become unpleasant places that we avoid. Avoiding these places will deprive us of the city's most critical purpose: the ability to interact with our fellow residents and visitors.

Salt Lake City's Urban Forest Action Plan aims to:

- **assess existing policies, plans, and practices,**
- **gather best practices and solutions,**
- **provide strategic, prioritized recommendations to preserve and grow our urban forest equitably.**

The Urban Forest Action Plan will contribute to Salt Lake City's resilience ecologically, economically, and socially by increasing the number, health, growing conditions, and longevity of trees in the urban landscape.

Most of the trees in Salt Lake City were planted by hand.

URBAN FOREST ACTION PLAN PURPOSE

Salt Lake City's urban forest is critical to our quality of life but is currently an underutilized and an undervalued asset (see chapter 2 and chapter 3 for details). An action plan will address and prioritize the urban forest's multiple opportunities and challenges and engage a full range of agency, institutional, private, and community stakeholders.

Action plans address interconnected challenges, develop priorities, find solutions, and build a long-term plan of action. **Policymakers, planners, and community members create and implement action plans to unite a broad range of stakeholders around a shared cause.**

These stakeholders include community members, non-profit organizations, private interests, institutions, and governmental agencies. As subsequent chapters detail, the expansion of the urban forest can play an important part in addressing many of the interconnected challenges that Salt Lake City faces. However, it will take a joint government, institutional, private sector, and community effort to grow and maintain our urban forest.

Challenging growing conditions in cities (from compacted soils to numerous utilities) call for careful planning and design of the urban forest.

Unshaded asphalt and concrete on Salt Lake City's roadways and sidewalks exacerbate high temperatures in the summer.

NO.2

SALT LAKE CITY URBAN FOREST ANALYSIS:
STRENGTHS, VULNERABILITIES, OPPORTUNITIES, + CONSTRAINTS

Salt Lake City's urban forest is critical to our quality of life. However, it is currently an undervalued and underused asset. In the past decade, Salt Lake City's record growth has impacted the urban forest. Development has contributed new trees to our streets and private lands. Yet, we have also lost established trees due to tree removal or root damage incurred in the process of accommodating growth.

New construction, changes in technology, and the need to provide services to more residents have increased competition to locate utilities within the park strip. Despite available solutions, these utilities often assume the space required for trees to thrive.

This chapter assesses Salt Lake City's urban forest's current strengths, vulnerabilities, opportunities, and constraints. This analysis creates a baseline for comparison to evaluate the effectiveness of the Urban Forest Action Plan's future implementation strategies.

The rate at which Salt Lake City loses public trees doubled every decade between 2008 and 2018. The hurricane-force windstorm in September 2020 decimated over 1,500 public trees, including many older specimens. Between the Mayor's 1,000 trees initiative and Urban Forestry's scheduled planting, Salt Lake City planted more than 2,000 new trees in 2020.

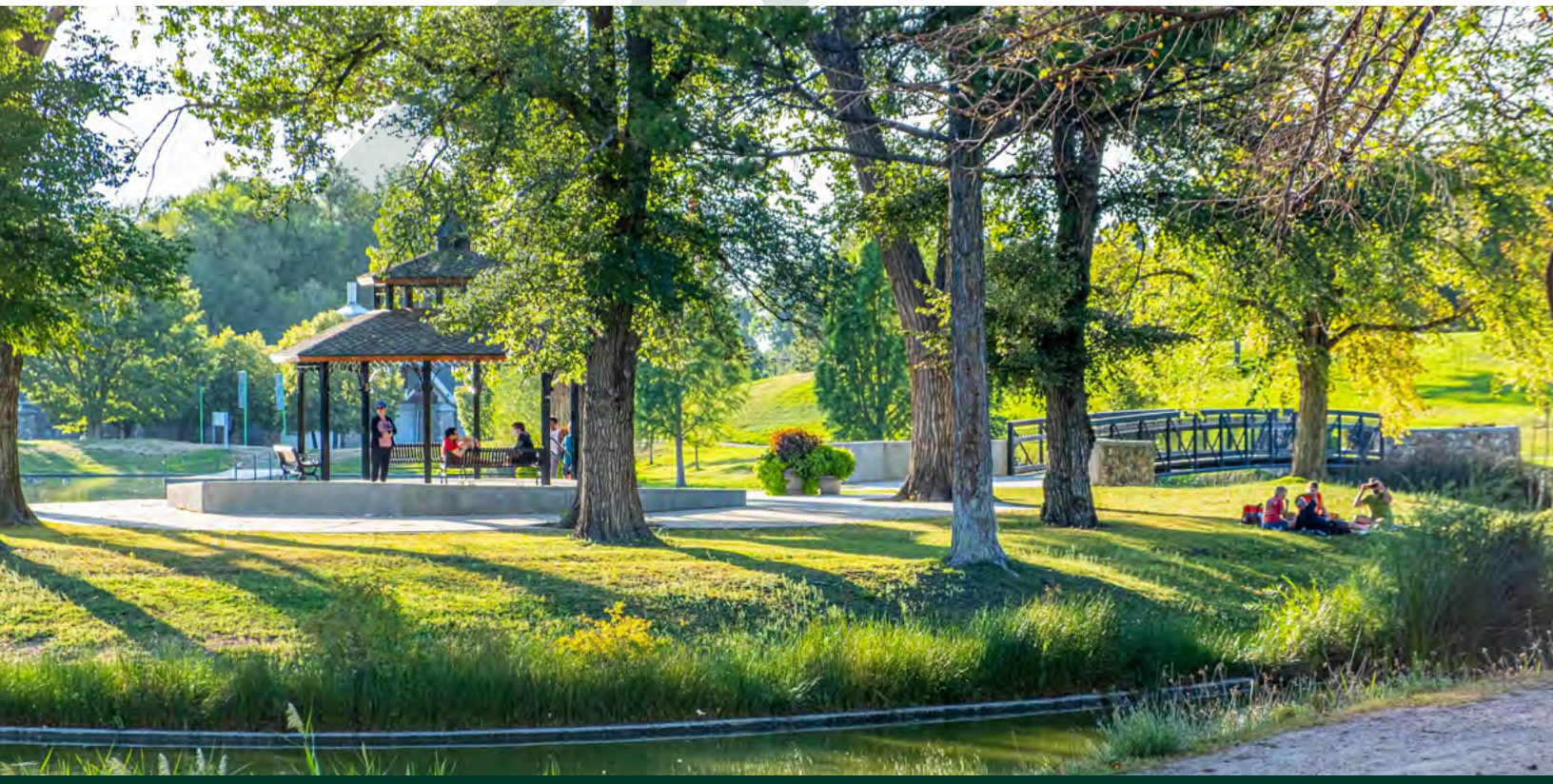
However, replacements for mature, large trees take decades to provide comparable air and water quality mitigation capacity. With continued development and climate change, adverse environmental impacts will increase. At the same time, declines in the City's urban forest impair its ability to mitigate these impacts.

The urban forest has numerous strengths, including existing tree stands, code and policy provisions, public support, and public appreciation for its many benefits. Building upon these strengths can address the vulnerabilities that occur primarily due to a fragmented approach to planning and managing the urban forest.

The urban forest is a living infrastructure system that requires sustained interdepartmental collaboration to optimize its benefits. The urban forest also needs land managers to implement solutions when conflicts occur between infrastructure systems. The handful of constraints on the City's urban forest, while significant, can be addressed through careful planning and mitigation measures and strategic investment in irrigation infrastructure.

The City's existing urban forest cannot effectively meet climate change challenges and growth opportunities without significant, strategic intervention, paired with ongoing planning for the future.

While other means of mitigating environmental impacts are available, most are more expensive than tree planting. And few (if any) of these mitigation measures provide the multiple ecological, social, and urban design benefits that trees do. By prioritizing the many opportunities available to preserve and grow the urban forest, Salt Lake City can build resilience into its urban fabric while fostering healthy communities.



Liberty Park is Salt Lake City's most visited park, and over one-third of visitors describe the trees as their paramount reason for visiting.

STRENGTHS

This plan defines strengths as factors that support the goal of growing and preserving the urban forest. These factors include existing assets, ordinances, policies, skill sets, or other municipal or resident practices.

EXISTING URBAN FOREST

When considering the City's urban forest, it is valuable to note that people intentionally planted nearly all trees throughout Salt Lake City (except those along waterways).

Salt Lake City's **publicly owned urban forest comprises roughly 86,500 individual trees; approximately 75% of these are street trees in the right-of-way (ROW).** The remaining 21,000 grow in City parks and other public lands.

According to a 2019 analysis, these trees create 1,455 acres of canopy cover, or just over 2% of Salt Lake City's total land area of 111.1 square miles (SLC Urban Forest Resource Analysis).

Geographic Information System (GIS) analysis from 2014 EPA Meter Scale Urban Land data that includes private lands expands the City's canopy coverage to 15% of the City's land area (10,778 acres).

PUBLIC APPRECIATION OF TREES

One of Salt Lake City's urban forest's greatest strengths is the community's high regard for it. The value residents place on the urban forest has been demonstrated through public engagement (see appendix for detail) and current tree care practices.

Plan Salt Lake, adopted in 2015, demonstrates the appreciation residents have for the urban forest, noting: **"Salt Lake City residents and visitors recognize our green network, including our urban forest, parks, and street trees, as one of our greatest assets"** (31).

The Salt Lake City Urban Forestry Division receives between 4,000 and 5,000 requests for service annually. New tree planting requests have also increased in recent years, demonstrating residents' expanding interest in the urban forest.

Salt Lake City requires residents to water street trees. The significant number of thriving trees demonstrate that many residents are willing and able to support the urban forest with time and money.

SALT LAKE CITY PLANS

Plan Salt Lake includes initiatives for incorporating trees in City rights-of-way in nearly one-third of its guiding principles: Neighborhoods, Transportation and Mobility, Air Quality, and Beautiful City.

The Transportation Division's current plans also highlight the need for trees to implement successful, well-used transit routes. These plans also call for more shade trees to create comfortable, beautiful pathways for walking and other active transportation.

The Salt Lake City Transit Master Plan recommends investing in street trees on Frequent Transit Networks as a near-term, high priority strategy related to placemaking and design (SLC Transit Master Plan, 6-8, 2017).

The Salt Lake City Bike and Pedestrian Master Plan (2015) notes that street trees have a "profound effect" on improving street corridors for pedestrians. The plan recommends that the City include street trees, particularly shade trees, in its streetscape designs (43). Additionally, it notes that trees create an important functional and aesthetic buffer between the sidewalk and the roadway (57).

Several Salt Lake City Community Plans also note the importance of street trees, notably the **Downtown Plan** (2016), which emphasizes their importance in establishing district design identity:

> Trees...contribute to the image and identity of districts. Street trees strengthen the image of Downtown, contribute to the character of individual districts, provide comfort and amenity to public spaces, and perform essential ecological services that make a healthy urban environment. ...Street trees that provide a regular, continuous canopy reinforce the formal symmetry, regularity and "grand" landscape-scale of Downtown's main streets. (21)

The Salt Lake City Streets and Intersection Typologies (ongoing) will assist the City in creating place-based streets that work for all users. The guide proposes new classifications and prototypes for a range of Salt Lake City street types. The typologies consider land use, City, and neighborhood goals and allocate the public right-of-way to prioritize people.

Street trees play a significant role in the design guide. The guide acknowledges the urban forest's considerable environmental, transportation safety, retail district improvement, and community functions in making streets attractive, accessible, and equitable places for people.

The Salt Lake City Street Lighting Master Plan (2020) expands upon the Transportation Division's 2006 policy of coordinating new streetlight locations with new trees. The plan recommends using pedestrian lighting in addition to street lights in areas where street trees create shadows to support a safer and more visually comfortable environment (45).

On streetscapes with trees, lighting vehicle and pedestrian pathways at night enhances safety and visual comfort for pedestrians.

Salt Lake City's Urban Forest currently provides a range of air quality, stormwater management, aesthetic, urban design, cooling, and energy-use reduction benefits to the City, along with public health benefits, both physical and mental. While some of the urban forest's benefits can be quantified, others are qualitative and have a significant impact on Salt Lake City's goals for livability, emissions reduction, and placemaking.

QUANTITATIVE BENEFITS

Davey Resources Group extensively detailed and quantified many specific benefits of trees on Salt Lake City property in the 2019 Salt Lake City Urban Forest Resource Analysis. (See Appendix A for details).

The analysis found that **the total estimated benefits provided by Salt Lake City's public trees are worth nearly $7.5 million annually.**

ENVIRONMENT

Salt Lake City's public trees currently provide $1.7 million in environmental services annually:

- **Improved air quality** ($140K): Trees absorb pollutants (ozone, sulfur dioxide, nitrogen dioxide) through leaf surfaces, intercept particulate matter (dust and smoke), produce oxygen via photosynthesis, and provide cooling, which reduces ozone formation.
- **Stormwater management** ($330K): Leaves and root masses work to intercept rainfall, which decreases the amount of stormwater flowing into storm drains. Trees also increase soil infiltration capacity, recharging groundwater supplies, reducing stormwater volumes, and improving water quality through pollutant uptake. Soil infiltration provides ecological benefits by filtering water before it enters rivers and streams and economic benefits to the City by reducing the need to invest in gray stormwater infrastructure.
- **Carbon Reduction (**$92K): Trees accomplish this directly via carbon uptake in leaves and biomass. They indirectly reduce carbon by providing shade and passive solar benefits, reducing emissions associated with building energy consumption.
- **Energy Savings** ($1 million): The urban forest reduces energy consumption for heating and cooling in multiple ways. The urban forest:
    - Provides shade, reducing both surface and ambient temperatures on concrete, asphalt, and other paving materials (heat island effect);
    - Transpires (releases water vapor), cooling the surrounding air;
    - Provides passive solar heating, allowing sunlight to reach interior spaces in winter after deciduous leaves fall;
    - Reduces wind speeds and the movement of wind into buildings; and
    - Reduces heat loss on surfaces with high thermal conductivity (21-32).

ECONOMY

Property values and commercial rental rates increase as trees mature and canopies become large. The Salt Lake City Urban Forestry Division compared neighborhoods with many trees to those with few or none. **The analysis estimated that public trees provide a range of socio-economic benefits equaling nearly $6 million annually.** (33)

A national survey of business districts found healthy urban forests correlate with increased retail sales and spending and customers remaining in business districts longer. In addition, patrons are willing to travel longer distances and spend approximately 10% more in business districts with trees. (Wolf, 2009). Salt Lake City's Economic Development department considers the 9th and 9th neighborhood the "showcase" retail district. It has many mature trees both within the right-of-way and on adjacent private property.

RETURN ON INVESTMENT (ROI)

The City invests $2.2 million annually in the urban forest by planting, pruning, irrigation, administration, and other infrastructure management. According to the 2019 assessment, the total annual benefit (environmental and socio-economic) that the urban forest provides is $7.5 million, for a net yearly gain of $5.3 million.

Put simply, **for every $1 Salt Lake City invest directly in the urban forest, it receives $3.40 in benefits** (38).

Urban residents in early Salt Lake City understood that trees were fundamental to a livable city. *(Utah State Historical Society, circa 1877-1880)*

QUALITATIVE BENEFITS

CULTURAL VALUES

Salt Lake City's history as an urban place is closely tied to its urban forest. When emigrants arrived in the Salt Lake Valley in 1847, their first concern was water. The second was shade for thermal comfort. Settlers first planted vines to grow shade over their early, simple earthen homes quickly. They just as promptly planted and cultivated trees to transform the streets and canals of the Plat of Zion into a livable city.

There are notable trees with cultural value throughout Salt Lake City. The locust tree planted near the Beehive House in Temple Square (at the State Street entrance). Harriet Page Wheeler Decker, mother-in-law to Brigham Young, arrived with the first pioneer company in the Salt Lake Valley on July 24, 1847. She carried a locust tree seed on the Mormon Pioneer Trail and planted it near the Beehive House kitchen door. Reputed to be the first residential landscape tree in the Valley, photographs show that a locust tree has remained in that location since the 1850s, even withstanding the impacts of an addition to the house in 1889.

Even tree locations have cultural importance to Utahns. On 600 East, just south of the intersection with 300 South, a center median contains a monument to "The Lone Cedar Tree," erected by the Daughters of the Utah Pioneers (DUP) in 1960. The Lone Cedar may have been a landmark in grasslands that characterized the mid-nineteenth century Salt Lake Valley. In the immense vistas of the western United States, landmarks were critical navigation tools used during the overland migration.

The DUP resolved to memorialize the Lone Cedar Tree after it was "thoughtlessly" cut down (as the plaque notes). Their efforts demonstrate its cultural and historical reputation to residents more than a century after Salt Lake City's founding.

Mayor Erin Mendenhall created a campaign to plant 1,000 trees on Salt Lake City's West Side in 2020 and secured private funding for this effort. The planting kick-off was held on Arbor Day in April 2020, even while the administration addressed the combined emergencies of the global COVID-19 pandemic and a magnitude 5.7 earthquake a month prior. After a hurricane-force windstorm in September 2020, the Mayor worked with non-profit and private sector partners to replant the nearly 2,000 trees lost on City-owned land. (See September 2020 Windstorm below).

RECREATION + ACTIVE TRANSPORTATION

Trees play a critical role in recreation and active transportation activities in Salt Lake City. For example, the 2019 Salt Lake City Parks and Public Lands Needs Assessment surveyed residents and visitors to parks. The Assessment found that Liberty Park is the most visited park in the City, and one-third of survey respondents noted that their primary reason for visiting Liberty Park is the trees (xiii).

The Salt Lake City Bikeways Map recommends selecting routes based in part on street trees and available shade. This guidance demonstrates trees' importance in providing comfort and shade when making active transportation choices.

TREE AGE DISTRIBUTION IN THE URBAN FOREST

Age distribution is critical in the urban forest because single-age tree stands are more likely to die simultaneously. Arborists typically describe a tree's age using its size, or DBH (diameter at breast height). DBH is the standard method used to describe the width a tree trunk at 4.5 feet above the ground. By ensuring trees have a range of DBH, managers can plan for urban forest succession. Planning ensures that new trees have sufficient time to establish to replace mature trees with more extensive canopies.

The current age distribution of Salt Lake City's public trees is nearly optimal from a resource management perspective. 41% of trees are eight inches or less DBH, while 12% are larger than twenty-four inches DBH. This age distribution generally allows Urban Forest managers to anticipate annual maintenance costs and plan the expenditure rate from year to year.

SALT LAKE CITY CODE

The Salt Lake City Urban Forestry Ordinance (Chapter 2.26.210 of the Salt Lake City Code) requires a permit to plant, maintain, or remove trees on public land. It also requires replacements or remuneration for any tree removed. (Removal fees, however, do not capture the value of ecosystem services trees provide).

The zoning code contains provisions to protect some trees on private land (21A.48.135), namely healthy, viable "specimen trees." Specimen trees are defined as either single trees or tree groups that measure at least 10" in DBH (see Tree Age Distribution, above) or more. The code states, "specimen trees shall be preserved to the maximum extent practicable as determined by the city forester, in consultation with the zoning administrator." However, there are some instances where developers can provide cash instead of replacement trees. Salt Lake City Code also preserves and protects urban forests on specific parcels of private land through the Planned Development process detailed in 21A.55.010.A.

Some zoning districts and overlays protect natural lands and riparian corridors that the City could amend to include provisions to preserve trees. Namely, the Natural Open Space District, Open Space District, Foothills Protection District, Riparian Corridor Overlay, and the Lowland Conservancy Overlay. That said, currently, the text does not mention protections for forest stands or individual trees specifically.

CITY POLICIES

In January 2020, Mayor Erin Mendenhall updated City policy to incorporate sustainability into operational decision-making. She requested all department directors to submit memoranda detailing how their operations could mitigate adverse environmental impacts or improve environmental quality.

PRIORITIZING TREES IN PARK STRIPS

A car-dominated city, Salt Lake allowed paved parking spaces or driveways to occupy prime spots for trees in the public right-of-way for decades. Before 2020, the City regularly granted permits to remove trees to make space for cut-in parking stalls within park strips or to create driveways to existing homes.

At the same time, new parking stalls induce demand for driving, thereby increasing emissions. In 2020, the Community and Neighborhoods Department led an effort supported by other City Departmental stakeholders to address the inconsistency between the environmental impacts of parking policy and the City's commitment to air and water quality. The consensus recommendation was to create a new Salt Lake City policy to eliminate the practice of replacing park strips with parking or any other impervious surface, with rare exceptions.

VULNERABILITIES

The goal of the Urban Forest Action Plan is to develop strategies to preserve and grow the Urban Forest; this plan defines vulnerability in Salt Lake City's Urban Forest as:

- **Unresolved conflicts,**
- **Gaps (in ordinance, policy, guidance, enforcement, or other City practices), or**
- **Loss or absence of skill,**

That undermines the goal of growing and preserving the urban forest.

Chapter 4 of this plan examines best practices in other cities that address these vulnerabilities, and chapter 5 recommends actions to address and correct vulnerabilities and prioritize solutions.

ACCELERATING RATE OF TREE LOSS

The rate at which Salt Lake City is losing urban forest trees has doubled every decade over the past twenty years. Salt Lake City removed 300 trees in 1998, 600 trees in 2008, and 1200 trees in 2018. Salt Lake is not unique in its loss of trees. A recent Nature Conservancy study looked at 27 US cities and found that 85% had declines in canopy cover between 2004-2014. (Kroeger, 2018)

While the City has replaced many of these trees, replacement plantings for a single large tree will take 75 to 100 years to provide enough canopy to mitigate air and water quality impacts and heavy stormwater flows (PAS, 2014). Additionally, many of the City's fastest-developing areas, such as Downtown, are also those that are already the most heavily paved. Thus, tree loss in these locations exacerbates the urban heat island (UHI) effect and localized flooding.

LACK OF COMPREHENSIVE PLANNING FOR THE URBAN FOREST

Salt Lake City lacks an urban forest master or management plan, which would provide comprehensive, prioritized guidance to equitably deliver the benefits trees provide. A master plan focused on the urban forest could address maintenance, management, long-term funding, staffing, disaster response, and mitigation, and provide robust strategies and best management practices to maximize the urban forest's return on investment (ROI).

URBAN FOREST ORDINANCE + POLICY CONFLICTS

Over the past decade, the City has developed at a rapid pace. The pace and scale of development has sometimes left City policies and practices unable to meet current needs. The City has, at times, found itself unable to strike an effective compromise between urban forest preservation and development activity.

Existing policies related to land use in the right-of-way (ROW) sometimes conflict with City policies for the urban forest and make it difficult to plant trees in many areas. For example, Public Utilities Department policy directs trees to be planted at least 10 feet away from water and sewer lines. A recent analysis of tree planting spots in the ROW found that approximately 24,000 suitable locations exist (Davey Resource Group, 2019). When this spatial analysis was paired locations of water and sewer lines using GIS, however, the number of planting locations dropped by more than half -- to 10,000 viable tree sites in the ROW. When sustainability criteria (energy use reduction) are applied to potential tree locations, however, that number drops to less than 200, or 0.8% of the total number of planting locations identified.

While products exist that can direct tree root growth away from pipes, they add additional costs to project budgets. Currently, these are not a line item in either Public Utilities or Urban Forestry's budgets.

Private property owners whose land abuts park strips are responsible for watering and fertilizing trees and protecting them from damage caused by lawnmowers and similar equipment (Section 2.26.190). Yet, Salt Lake City has no mechanism to enforce this policy. The City would need additional revenue streams to enforce this policy equitably, or the cost burden would be more significant on lower-income owners. Additionally, this policy assumes that residents know their responsibilities and have adequate information and experience with tree irrigation, which is not always the case.

Existing city code has conflicting regulations for street trees. If an adjacent property owner challenged the City, it would have limited ability to maintain its public infrastructure. For example, the Urban Forestry chapter (2.26.210) states, "The urban forester must approve any permit for removal of public trees." Permit approval is conditioned on the provision of replacement trees or compensation.

Yet the regulations for existing street trees in the Landscaping and Buffers chapter (21A.48.050) state, “the removal of trees within the street right of way is prohibited without the approval of the zoning administrator in consultation with the urban forester.” Without reconciliation, these inconsistencies leave the City open to challenge by property owners who do not accept trees as a public benefit.

Additionally, the City has yet to establish clear, definitive thresholds for conserving the urban forest. Without clear conservation guidance, it is more challenging to preserve and maintain the collective benefit they provide. The code typically regulates individual trees rather than the entire urban forest as a modified natural system.

INADEQUATE TREE REMOVAL MITIGATION POLICY

Currently, Salt Lake City’s tree replacement policy does not account for a tree’s total ecosystem value. City ordinance requires replacements for trees removed for construction or that the cash value of the timber is paid into a revenue account to plant and preserve the urban forest. Therefore, the City does not receive the full benefit when cash or replacement trees are provided for removed trees.

Small trees (2-inch caliper) are the best to establish in Salt Lake City’s difficult growing conditions. Bigger trees are generally more costly and prone to early mortality when transplanted. Therefore, if a large tree is removed, the “in-kind” replacement is made with an equal number of 2-inch caliper trees. For example, a 20-inch caliper tree replacement consists of ten 2-inch caliper trees. However, ten young trees can take decades to provide similar ecosystem services as a single mature tree. Given the challenges and stresses of urban growing conditions and climate change, new trees may never offer the same ecosystem services as those they replaced.

While Salt Lake City’s urban forest’s age distribution is generally healthy, 56% of trees in Salt Lake City are on the younger end of the spectrum. These young trees require adequate care and water to ensure they reach maturity and provide maximum benefits.

With the growth and construction rate Salt Lake City has undergone in the past decade and climate change impacts, the urban forest is becoming younger. As a result, the urban forest is less equipped to mitigate the environmental impacts of rapid development and increased emissions related to population growth.

NEED FOR MORE PLAN REVIEW CAPACITY

There is inconsistent attention to tree roots’ size and location in site plan review, notably in demolition and construction staging plans. Plan reviewers outside the Urban Forestry division are not trained to assess conditions for tree growth and survival. Evaluation and correction by a qualified reviewer during these initial stages are critical to ensure that trees need not die unnecessarily. Furthermore, Urban Forestry has limited resources to allocate to plan review, presenting real challenges to tree preservation given the expanding pace of development in Salt Lake City.

City ordinance (21A.48.050) prohibits “the removal of trees within the street right of way … without the approval of the zoning administrator in consultation with the urban forester.” Yet, in most cases, when tree removal is requested, the application does not come before the zoning administrator for consideration, breaking a vital link between Planning and Urban Forestry.

UTILITY + URBAN FOREST CONFLICTS

Conflicts between overhead and underground utilities and trees have become increasingly frequent during the City current period of rapid development. While many utilities are located underneath the roadway, the City permits others to be installed the park strip, where they compete for space with tree roots. Trees are regularly removed or damaged to accommodate underground utilities in the park strip.

The most significant tree and utility conflicts in the Salt Lake City area are between root systems and water and sewer lines and between tree canopies and above-ground electricity infrastructure. These conflicts occur frequently and lead to tree removal and damage, unaesthetic pruning, and loss of (otherwise viable) tree planting sites.

Overhead utility lines often prevent appropriately scaled trees from being planted along Salt Lake City’s wide streets. Electric transmission lines are costly to bury and are typically only cost-effective to place underground when there is at least a mile-long section. Typical development on a single parcel is a much smaller scale. Currently, transmission lines prevent the City from planting trees that can adequately shade our large rights-of-way.

INADEQUATE SOIL VOLUMES

Areas that are most heavily paved, such as Downtown streets, require more shade to offset the increase in pavement surface and ambient temperatures. The same is true of bus shelters built on concrete pads. However, standard paving practices reduce the amount of available soil required to provide sufficient root space for large shade trees. Salt Lake City has made advances by introducing structural soils under the pavement in some areas. However, soil cell (or suspended pavement) systems are generally preferable. They tend to produce sizable, healthier trees while also managing stormwater. (See Chapter 4, Suspended Pavement Systems, for additional details).

NEED FOR MORE SUSTAINABLE APPROACHES TO FIRE ACCESS

Both life safety and sustainability are the foremost priorities in Salt Lake City. Still, the City has yet to fully explore the wide range of solutions to create a both/and approach to fire access requirements and sustainability.

Requirements for unobstructed area for fire apparatus (ladders, etc) access have led to developers removing large trees and soil, and the introduction of more pavement into the right-of-way (ROW). The Department of Community and Neighborhoods and the Fire Department worked closely to find a range of alternative means of fire prevention. However, these are optional to the developer and typically cost more than simply paving more area for fire truck access. The result is often large volumes of surface soil that once grew trees are paved over to support a fire truck's weight.

LIMITS ON ENFORCEMENT CAPACITY

The lack of a consistent City-wide approach to tree protection during construction has led to a decline in the urban forest. Although the City has policies to protect trees during construction, these are too often overlooked during construction. Building inspectors who examine the trees on installation and civil enforcement officers are not arborists trained to spot potential tree problems. Thus, they are at a significant disadvantage in detecting issues that may lead to early tree mortality.

Although required by ordinance (2.26.300: Protection of Public Trees Near Construction Activities), construction sites often lack fencing or signage related to tree protection. Both Civil Enforcement and Urban Forestry need additional capacity to monitor and enforce regulations actively or issue stop-work orders to correct the situation.

NON-COMPLIANCE WITH PROTOCOLS FOR NEW TREES

When the zoning code requires new or replacement trees, the new plantings are often subject to severe stress because applicants do not follow tree health and irrigation protocols. Inspectors only determine if the correct number of trees have been installed and are not trained to evaluate tree health or planting conditions.

When trees are planted at the height of summer, heat stress creates difficult growing conditions, resulting in more significant disease and mortality. Furthermore, once planted, contractors often do not water during the establishment period, leading to excessive rates of new tree mortality.

RIGHT-OF-WAY CONFLICTS

Multiple City departments are charged with overseeing land uses related to public health, safety, and welfare in the right-of-way (ROW). When land use policies conflict (for example, tree roots with water lines), insufficient funding means trees often lose out. Tree loss occurs despite potential solutions which might accommodate a robust urban forest alongside other land uses.

Simultaneously, there is no clear arbiter for final decisions in the ROW nor a straightforward process by which different land uses are allocated. Given the wide streets in many parts of the City's ROWs, ample space for trees exists. However, tree planting locations are sometimes lost due to lack of communication or clear decision-making authority regarding allocating space in the ROW.

INADEQUATE IRRIGATION

Irrigation considerations are always prominent in Utah's arid climate. With a growing population and climate change concerns, the need for water conservation is ever-present. Currently, the City will plant trees in park strips at resident request, provided residents agree to irrigate them. Additionally, the City requires trees to be preserved or planted for all new development. The developer is also required to irrigate the trees. In many cases, however, irrigation never happens or happens for a short period, leading to the decline and death of trees.

It is challenging to enforce watering requirements. People move, developers sell properties, and new residents may not be aware, inclined, or able to meet their responsibilities. As a result, healthy, viable trees go without sufficient water and never establish and have a dramatically shortened lifespan.

Furthermore, City maintenance budgets currently limit the amount of usable irrigation from precipitation, which will be increasingly important as climate change brings more rain. For example, the City lacks funds to support the cost of maintaining previous paving, which would benefit both trees and groundwater supplies.

CAPACITY CONSTRAINTS ON URBAN FOREST MAINTENANCE

Because the urban forest is living infrastructure, its maintenance needs, while generally predictable, are becoming less so with climate change. Summer thunderstorms can break tree limbs and create debris in the right of way, and winter ice storms do the same – both are increasing as the climate changes. In turn, this can increase impacts on other infrastructure, such as streets and aboveground utilities.

LIMITED URBAN FOREST DATA GATHERING + SHARING

The City lacks a defined schedule for urban forest surveys. Using GIS and aerial photography, the City has the tools to create and update canopy cover maps regularly; however, this requires investment or agreement to share resources with other Utah government agencies.

The City is possesses reasonably comprehensive and accurate tree inventory data. However, as this inventory data changes daily, it is imperative that inventory update strategies be developed and implemented to ensure lasting data accuracy.

When applicants look at Salt Lake City Maps to determine project needs and requirements, existing tree and planting spots are not available.

Additionally, the Urban Forestry Division requires permits for tree planting and removal, but currently these are difficult to track for a given year because of past inconsistencies. Further, residents are often unaware permits are required for park strip trees, and when they plant or remove trees without a permit, the Urban Forestry Division does not have a means to track these.

LIMITED RESIDENT ENGAGEMENT

Salt Lake City lacks a balanced public outreach effort that educates and motivates the community around the urban forest citywide from residents to business owners.

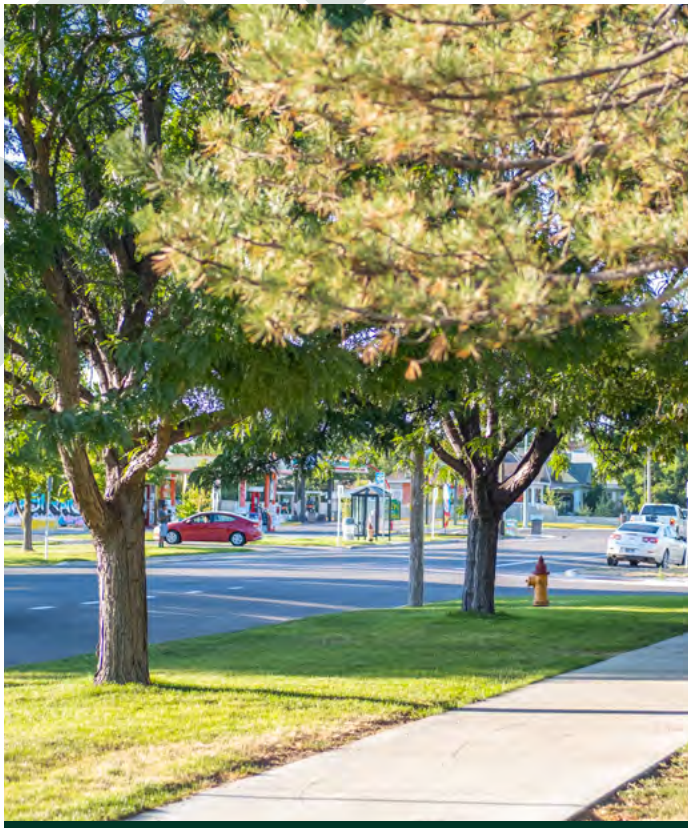
The City needs data regarding the most effective means of public outreach and engagement to our residents, including the approximate number of residents informed about our Urban Forestry Division's services and their responsibilities related to watering street trees.

Many residents are eager to be good stewards of their neighborhood trees, but the City's lack of data and capacity to provide effective outreach creates missed opportunities.

SPECIES OVER-REPRESENTATION

When private property is included, too many Norway maples (*Acer platanoides*) are present in the urban forest. The urban forest also has many green ash (*Fraxinus pennsylvanica*) and Modesto ash (*F. velutina*) trees.

A generally accepted rule is that a single species should never exceed 10% of the urban forest as a whole and that no genus should exceed 20%. Norway maple exceeds this rule at the species level, and the *Acer* (maple) genus represents 19.9% of Salt Lake City public trees.



Large park strips can provide ample space for tree roots to grow when underground utilities are carefully co-located.

LOSS OF CLIMATE-RESPONSIVE DESIGN CULTURE

In the era before air conditioning, the people of Salt Lake understood the need for shade during the summer months and planned and legislated accordingly. In 1923, Salt Lake City passed an ordinance creating a Shade Tree Department, overseen by the Shade Tree Commission. The Shade Tree Department had authority over tree planting, pruning, and removal on City lands. The penalty for violating the ordinance was a $299.00 fine (nearly $5,000 in 2020) or six months in jail, or both. In the early 20th century, City officials understood trees as critical components of Salt Lake City's urban life.

The loss of climate-responsive design approaches is not unique to Salt Lake City but has occurred worldwide. Architects abandoned design responses intended to mitigate weather impacts or harness the cooling properties of shade and breezes. When climate control became prevalent, architects designed buildings where temperatures could adjust with the touch of a dial.

By the 1960s, the widespread adoption of air conditioning contributed to the notion that urban forests were only aesthetic and served no real function in US cities.

ENVIRONMENTAL INEQUITY

A significant weakness in Salt Lake City's Urban Forest is related to a sparser tree-canopy in working-class and industrial areas of the City, as well as business districts. The lack of trees is most evident in the West Side (with less than half the canopy cover of neighborhoods on the east side) and downtown.

Lower tree canopy can intensify adverse public and environmental health impacts and increase energy costs. Inequity in the urban forest is common throughout US cities, which several are now trying to remedy (Los Angeles and Tempe, AZ, for example).

In Salt Lake City, inequity is inadvertently exacerbated because residents must both request a tree in their park strip and are required to water it. While this program has many positive outcomes, this policy generally privileges homeowners. Renters may feel they need to ask their landlord's permission or may not have ready access to a means of irrigation.

For those already cost-burdened by housing, the cost of a sprinkler system or the time and planning needed to water by hand simply adds to the burden. And while shade trees can significantly reduce both energy and water costs to residents, this is not common knowledge. It is typically 10-15 years from planting until trees provide adequate shade to houses.

Cost-burdened households then end up in a vicious cycle of inequity, as they incur physical and economic costs related to adverse health impacts from hotter summer temperatures and localized spikes in air pollution. Furthermore, to access trees' emotional and social benefits, cost-burdened residents are often required to travel to parks or public lands. In contrast, higher-income residents are more likely to have trees available when they look out the window or open the door.

Today, natural systems are increasingly understooded as cost-effective solutions in cities to enhance both environmental and public health.

OPPORTUNITIES

This plan defines opportunity in Salt Lake City's Urban Forest as factors contributing to growing and preserving the urban forest. These factors have yet to be explored, acquired, funded, or implemented. They include assets, policies, skill sets, and other municipal or resident practices.

Subsequent chapters of this Action Plan will assess some of these opportunities in more detail and prioritize strategies for decision-making and implementation.

TREES ARE PUBLIC INFRASTRUCTURE

Cities with thriving urban forests, such as Minneapolis, understand that trees are critical public infrastructure and plan and protect them accordingly. Salt Lake City has an opportunity to investigate and apply a range of policies and practices that could achieve the goal of elevating the urban forest to the level of public infrastructure. When trees are valued on par with our storm-water pipes or streetlights, the City can more easily ensure an equitable distribution of its benefits.

STRENGTHENING OF TREE PRESERVATION STRATEGIES + REQUIREMENTS

There are conflicting directives related to tree preservation in the Salt Lake City Code. Few fully account for trees' social and environmental health benefits. Reassessing these codes and amending them to remove conflicts and inconsistencies could resolve these conflicts. In addition, creating urban forest regulations intended to improve growing conditions, urban design, and public health would provide multiple environmental and social benefits.

There are multiple ways to amend the ordinance to strengthen tree protection and codify ecosystem service value.

The Salt Lake City Open Space Acquisition Strategy, last updated in 2010, could be revisited to incorporate more specific guidance related to trees. This guidance should be based on the findings of more recent analyses of the administration's urban forest and goals set. In partnership with scientists and environmental managers, the City could identify an approach to urban forest expansion that cleans both the air and the urban watershed.

EXISTING PLANTING LOCATIONS

The Urban Forestry Division's recent inventory identified 36,000 vacant planting sites on City-owned land. A City-led initiative in partnership with other government agencies and non-profits could fill those spots. Partners can identify low-water-use tree species and irrigation infrastructure funding sources to provide the greatest equity and water conservation benefits. **These planting locations represent the potential to increase the tree canopy by 600 acres and grow our urban forest by 40%.**

CREATE COOLING ISLANDS IN GOLF COURSES + PARKS

Salt Lake City has several opportunities to maximize the "cooling island effect," created by parks and golf courses through planting trees in optimal locations. Research demonstrates that parks cool ambient temperatures in neighborhoods surrounding them.

Strategically locating large trees on the borders of parks and golf courses, in collaboration with urban ecologists and atmospheric scientists, could help mitigate urban heat island impacts as summers grow hotter.

PLANTING "RIGHT-SIZED" TREES: CONSIDERING ABOVE + BELOW GROUND NEEDS

Overhead utility lines often prevent the use of appropriately scaled trees. In Downtown areas with buildings above three stories, the City needs taller trees to mediate between the human and tower scale. Trees do this, and with appropriate selection can create human-scaled spaces the ROW. In Salt Lake City's expansive rights of way, towering trees with generous canopies promote better urban design and needed shade for summer cooling.

Electric distribution lines are relatively inexpensive to bury, and existing trees are usually removed and replaced to bury these lines. Developing a policy to accommodate buried electric lines, adequate soil volumes, and soil quality improvement to grow large trees would add value to developers and residents.

THE URBAN FOREST'S ROLE IN URBAN DESIGN + PLACEMAKING

Salt Lake City can link its Urban Forest with urban design and placemaking to strengthen the City's image and identity. Introducing urban forest districts with species selection based on form and scale would help to define neighborhood character. Integrating aesthetics and ecological function into plans for the Urban Forest can creating inviting community spaces.

With a comprehensive approach, planting requirements can consider physical characteristics, growing needs, regular spacing for the creation of continuous canopies, visual separation from moving vehicles for improved perception of safety, and alignment of street trees to add definition and imageability to neighborhoods and business districts.

CREATING A RESILIENT URBAN FOREST

Salt Lake City can create a resilient urban forest that addresses multiple impacts created by climate change. In addressing climate change at the local level through urban forest design and planning, Salt Lake City has a national opportunity to lead by example.

PUBLIC HEALTH IMPACT MITIGATION + ENVIRONMENTAL JUSTICE

Salt Lake City has an opportunity to link the urban forest with a broad range of public health outcomes, including improved outcomes for mental and physical health, and specifically with respiratory disease. Explicitly relating the urban forest to public health also presents an opportunity to implement environmental justice and systemic racism. Trees are an important part of a strategy to address adverse impacts among historically marginalized groups disproportionally impacted by poor health. The City could develop metrics to quantify the effects of tree plantings on these public health objectives, providing transparent data to assess whether it is meeting its goals.

ENVIRONMENTAL EQUITY

More shade trees in lower-income neighborhoods can save energy consumption and address public health concerns related to urban heat islands and air pollution. The City's existing tree planting program can be expanded and revisited to ensure equitable outcomes. (See Chapter 3, Equity in the Urban Forest, for examples from other US cities).

INCREASED ACTIVE TRANSPORTATION USE

Introducing shade trees at transit stops and on critical active transportation routes can make walking, biking, and transit the most attractive, obvious, and comfortable choice. Making non-auto transportation modes attractive can reduce the stigma often associated with taking public transit or walking. More shade could also make cycling and walking more appealing during the hot summer months, reducing emissions from private vehicle use.

ENERGY SAVINGS

The 2019 Resource analysis found that SLC saves $1.1 million in energy consumption annually. As our summers get hotter because of climate change, the City has an opportunity to locate trees strategically and increase energy savings substantially.

FOOD ACCESS

Urban forests can be a source of fresh, accessible produce and an opportunity for education on food and nutrition. Incorporating collections of food-bearing trees, either as a supplement to landscaping in parks and playgrounds, as street trees, or in an orchard format (commonly called a food forest), can be an added layer of long-term support for communities.

INTEGRATING THE URBAN FOREST INTO STORMWATER MANAGEMENT STRATEGIES

By storing rainfall on the leaves and branches, trees reduce or eliminate localized flooding. Tree roots retain soil in place so that it is not washed away in severe storms. The tree roots keep soil in place so that it is not washed away in severe storms. Trees also clean water as it flows through roots and into groundwater. One hundred mature trees can retain approximately 250,000 gallons of rainwater per year, decrease polluted runoff, and decrease erosion, improving water quality. Integrating trees fully into Salt Lake City Stormwater Management practices would make the City more resilient to climate change-induced summer precipitation events.

EXPANDING BIODIVERSITY IN SALT LAKE CITY'S PARKS + STREETSCAPES

While there are 200 species of trees within Salt Lake City's urban forest inventory, nearly 50% of all public trees consist of seven species. Salt Lake City can expand the biodiversity of its urban forest further, providing both habitat and urban design benefits. Increased biodiversity provides additional insurance against the risk of large areas of tree die-off created by species-specific threats due to pests and climate change impacts. Many of the over-planted species are now nearing removal age. New plantings provide an opportunity to expand biodiversity on public lands and educate landowners about the importance of maintaining diverse tree species on private lands.

IMPROVING HABITAT FOR BIRDS

The City could assess its existing bird habitat, with focus on important migratory flyways, like the Jordan River, using commercially available GIS tools, or through partnerships with institutions or nonprofits. When the assessment is complete, and habitat revitalization opportunities are identified, the City could look to the model created by Vancouver, B.C., an "adopt and promote voluntary Bird Friendly [Urban Forest and] Landscape Design Guidelines for developers, planners and designers and public and private landowners." (City of Vancouver, 2015)

EDUCATION ON IRRIGATION COSTS + WATER CONSERVATION

Salt Lake City can educate residents on the costs of tree irrigation. The City can also disseminate information on which species are low water use and contribute to City water conservation goals. While the cost of watering varies by tree species, they are typically lower than expected. Based on the recommended watering schedule Urban Forestry prescribes, the total cost of watering trees during the 6-month growing season works out to two dollars per month. An average, healthy tree uses 225 gallons of water a week for about half the year. In comparison, a single person typically uses 700 gallons of water per week all year round.

EDUCATING RESIDENTS ON URBAN FOREST BENEFITS

Providing education on the urban forest can assist Salt Lake City with its stewardship. With some education, many residents could help care for our urban forest. Urban Forestry staff could provide training like a "Master Gardener" program that results in neighborhood-based volunteer foresters. These "tree stewards "could assist with minor tree care, provide best practice advice to neighbors, and help flag more extensive tree care needs to urban forestry staff.

INTEGRATING URBAN FORESTRY INTO SALT LAKE CITY GIS

The Urban Forestry Division maintains a tree inventory in a proprietary geographic information system (GIS), accessible to the public on the division's web page but maintained by a national arboriculture consultancy.

The City would benefit from improved integration of a tree inventory data layer into Citymap, Salt Lake City's publicly accessible GIS. Ideally, tree inventory data updates should automatically push to the City's other GIS mapping software. That way, applicants and reviewers can consider trees and planting spaces in the earliest stages of project planning. Sharing the inventory updates on a regular basis with utility companies, could help the City anticipate and avoid conflicts.

Currently, no accurate maps of park strip dimensions and other tree planting locations exist in the City GIS. An accurate survey of these areas would assist multiple City departments by providing precise measurements to plan tree planting and additional sustainable infrastructure measures, including proactive planning for areas where additional soil volumes are needed.

RETHINKING THE ROW: PLANNING EARLY + ALWAYS FOR THE URBAN FOREST

Salt Lake City's rights-of-way represent our largest and most widely distributed public spaces throughout the municipality. Integrating space for trees to prioritize the quality of life in these public spaces could be transformative, both socially and environmentally.

We have many existing large park strips that would give ample space for large trees, even alleés (double rows) of trees. Additionally, removing asphalt during road reconstruction and planting trees could significantly reduce the extent of paved surfaces and increase asphalt lifespan.

A critical opportunity for the City is to assess all plans and implementation projects in or adjacent to the ROW alongside the tree inventory. Proactive planning between the departments should incorporate the total value of the urban forest. A proper appraisal of our living infrastructure will retain trees and tree-planting locations and maintain adequate soil volumes as the City grows and changes.

DEVELOP AN URBAN FOREST MANAGEMENT PLAN THAT INTEGRATES ECOSYSTEM SERVICES

The urban forest's ecosystem services are incidental to tree regulations in the Salt Lake City Code and policy. A comprehensive urban forest management plan that strategically considers all the benefits trees provide could address environmental impacts. A management plan could also evaluate multiple factors to prioritize tree plantings where they are needed most.

PUBLIC-PRIVATE PARTNERSHIPS

The City can continue to explore a range of public-private partnerships with institutions, corporations, schools, health care providers, and non-profit organizations. More broadly, communicating the broad range of the urban forest's benefits widens the range of potential partners whose goals may also be addressed by planting trees. These partnerships present opportunities to pursue a wide range of grant funding to implement the recommendations of this action plan.

SEPTEMBER 2020 WINDSTORM

On September 8, 2020, a windstorm brought hurricane-force winds that felled more than 1,500 public trees and many more private trees. While catastrophic, this spotlighted the importance of the urban forest. People across the City recognized the loss of large, older trees in parks and neighborhoods. Residents were moved to donate or volunteer to replant trees. This event may motivate more residents to become involved in the preservation and growth of the urban forest and actively seek education on tree maintenance practices.

CONSTRAINTS

This plan defines Salt Lake City's Urban Forest constraints as external or structural factors inherent to planting and managing trees in urban conditions.

These factors limit the urban forest's growth and preservation and may also restrict the City's ability to effectively utilize the urban forest's ecosystem services.

WATER QUALITY IMPACTS

Increasing the number of trees in Salt Lake City can increase the volume of leaf litter in our waterways, depriving the aquatic life of needed dissolved oxygen. Because the Jordan River is a heavily engineered system in a highly urbanized area located at the base of a closed watershed, adverse impacts to water quality can be magnified.

ARID CLIMATE

Salt Lake City's arid climate, with its hot summers and cold, snowy winters, creates stressful growing conditions for trees. The City's trees need additional irrigation to thrive, unlike those in cities with abundant precipitation. Our urban forest is mainly hand-planted, except for along riparian corridors, and requires climate-specific care to thrive.

WATER CONSERVATION CONCERNS

Water conservation, however, remains vital in Salt Lake City's arid climate, and the Urban Forest requires careful planning and management to achieve adequate protection. Many well-meaning residents have reduced landscape irrigation to conserve water, which has resulted in tree death in some cases. **Xeriscaping, the practice of planting primarily low water use vegetation and zoning plants by water usage, has too often been misinterpreted as "zero-scaping."** Zero-scaping consists of placing rocks and perhaps a few plants within park strips and yards--or laying petroleum-based artificial turf over the soil.

While xeriscaping works with many tree species, "zero-scaping" and artificial turf increase the urban heat island (UHI) effect, leading to tree stress. Ultimately, lack of water often results in early mortality. Much of the discussion of water use and conservation has been oversimplified as few to no plants providing conservation benefits.

In addition, residents often desire "no-maintenance" landscapes or see neighboring "zero-scapes" as a model for their land. These perceptions will likely continue to result in tree damage and death in the near term, along with increased UHI.

Educating the public on the role of the urban forest in water conservation, and importance of tree watering (deeper but less frequently) is necessary. Shade provided by tree canopy reduces evaporation, particularly over turf grass, reduces waste and evaporation and plays a critical part in water conservation.

While a concerted education campaign is essential, the realities of cost and competing budget priorities impose limits on the City's ability to mitigate impacts from "zero-scaping."

CLIMATE CHANGE

As the climate changes and summer temperatures increase, stress on trees will also increase. Climate change can contribute to tree mortality through increased exposure to disease, pests, and extreme weather events.

To adapt to climate change and increased urban heat island impacts, the City may need to evaluate its list of preferred species and make updates on an as-needed basis. Climate change could also impact the amount of water some public trees require or require designed microclimates in specific locations to accommodate beloved species better.

BIOGENIC VOLATILE ORGANIC COMPOUNDS

Some tree species are high biogenic volatile organic compound (BVOC) emitters, which can contribute to ozone pollution during the summer months. According to the City's recent resource analysis, "Over 11,173 pounds of BVOCs are emitted annually from Salt Lake City's public trees, reducing annual benefits to air quality by -$2,123."

While this is a naturally occurring constraint, arborists and ecologists can mitigate these impacts through species selection and careful attention to planting locations of BVOC-emitting species.

PROPERTY DAMAGE

Some degree of property damage is inevitable with trees (and with precipitation patterns fluctuating due to climate change, this may increase). And while Urban Forestry removes dead or dangerous trees, commitment to funding adequate pruning and maintenance cycles can minimize tree damage and decline.

NO. 3

LIVABILITY + THE URBAN FOREST IN SALT LAKE CITY

Livability is a place-based term, defined in Salt Lake City's Downtown Plan (2016) as the capacity of a place to fulfill both daily needs and quality of life needs for residents. Daily needs are basics required for survival, like food, water, housing, transportation, public health and safety, sanitation. Quality of life needs must be met for residents to thrive. Quality of life encompasses the tangible and intangible elements that increase resident happiness, including arts and culture, recreation, social interaction, community, education, social equality, and access to nature. Underpinning both daily needs and quality of life needs is the ability of the community to provide access to good jobs and support a resilient economy. A livable city is one that provides access and choice to both daily and quality of life needs to residents and visitors. (Downtown Plan, 2016)

The urban forest contributes to livability by meeting both daily and quality of life needs, including public health and safety, equity, access to nature, active transportation routes, and fostering places for social interaction. Without a healthy urban forest, life in Salt Lake City would be drastically different.

EQUITY

Equity is foundational to livability, as attention to both the daily and quality of life needs of marginalized communities typically provides benefit to all. The American Planning Association, describes equity as "just and fair inclusion into a society in which all can participate, prosper, and reach their full potential." The APA notes that "equity is responsive to difference; equitable policies actively mitigate the disproportionate harm faced by certain communities." (APA, 2021)

As the national non-profit Partners for Livable Communities notes, "A community that satisfies the full range of its residents' needs is more attractive as a place to live, work and do business and, therefore, more likely to be economically successful." (Partners for Livable Communities, 2021)

The distribution of tree canopy cover is a useful frame of reference to evaluate urban equity. Given the wide range of benefits the urban forest provides, from improved local air quality and public health to increased property values and retail sales, the distribution of canopy cover is a useful metric to assess which neighborhoods have the greatest and least access to those benefits.

Planning undertook GIS analysis of canopy cover per 10-acres of land area (the size of a downtown city block) based on U.S. Environmental Protection Agency land cover data from 2014.*

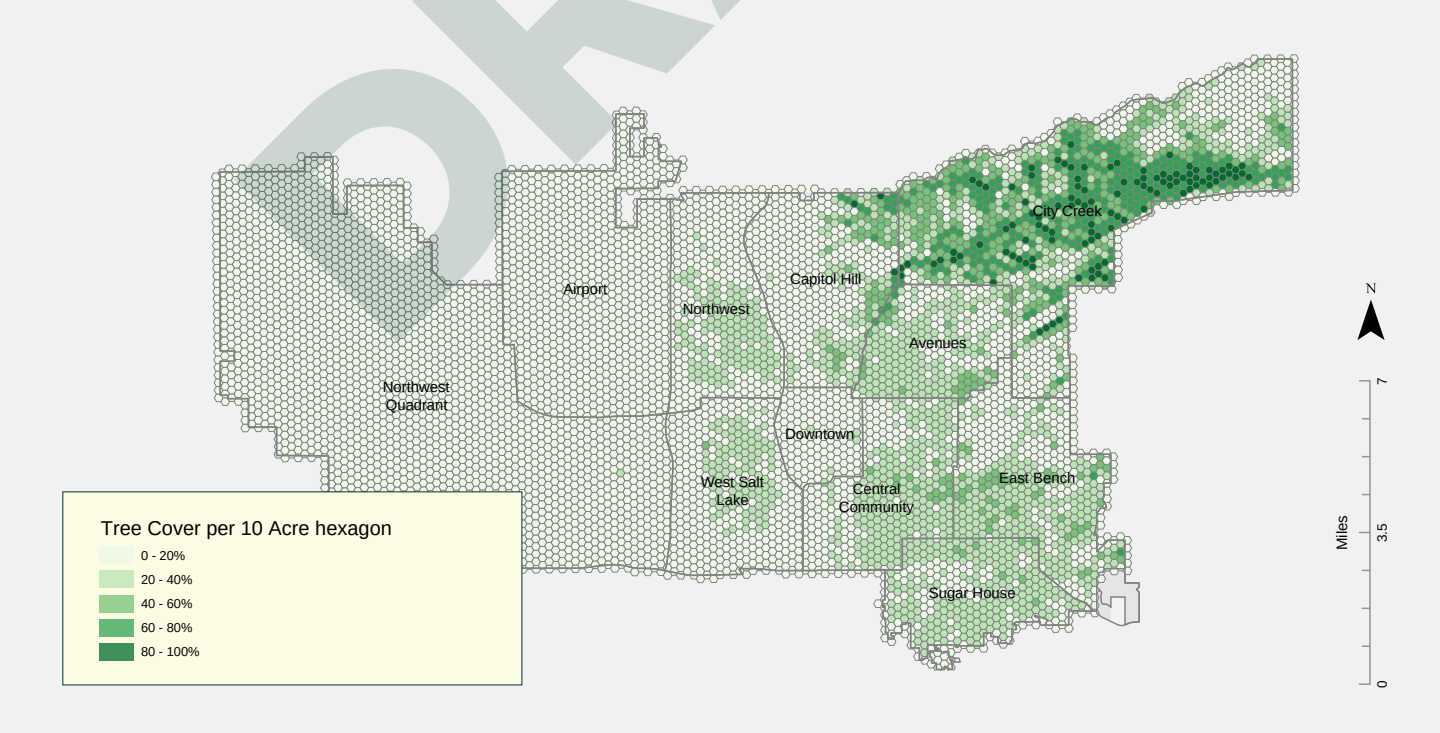
*2014 the most recent publicly available data set at the time this plan was created. Given the slow rate at which tree canopy expands, the data remained applicable in 2021.

The analysis reveals an uneven distribution of tree canopy across the city, and one that correlates closely to other documented inequities in Salt Lake City.

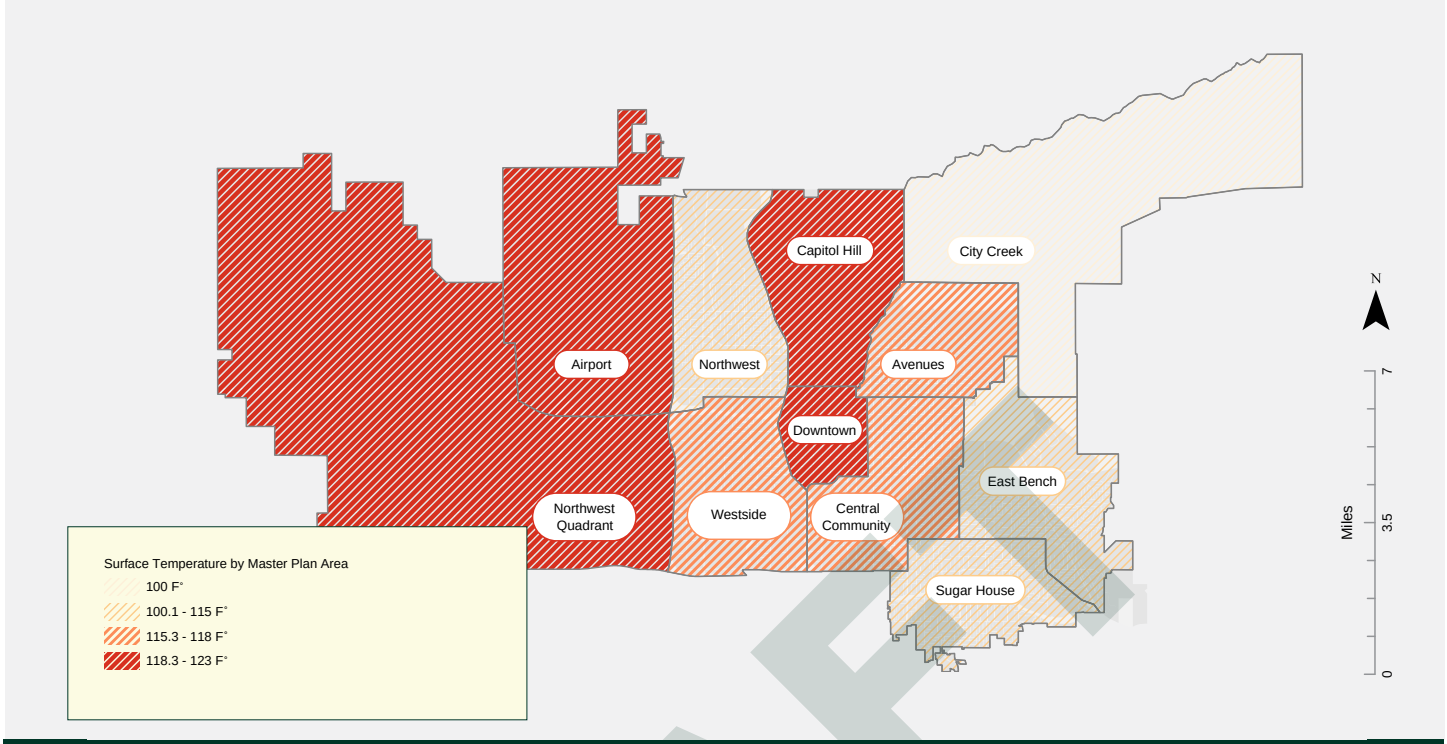
While some of the distribution of trees may be attributed to their "natural" pattern of growing predominantly along waterways and north-facing slopes this eco-region, it cannot account for most of it. Note that urban-scale tree planting in Salt Lake City began nearly two centuries ago, and multiple factors influence when and where trees are planted in the city.

The GIS analysis at right divides the city into master plan areas for the purposes of comparing primarily residential districts. Tree canopy cover was notably greater in residential areas east of approximately State Street with the prominent exception of the Downtown Plan area.

The Downtown Plan area is one of the most heavily paved in the city, with the most difficult growing conditions for trees. Downtown has seen an unprecedented rate of new development in the past decade, which often leads to tree removal and replacement with young trees and may be a contributing factor to its low canopy level.



Salt Lake City Tree Canopy Cover by Master Plan Area (2014 EPA vegetation data). East side areas have approximately twice the canopy as the those on the west side, and an average of four times the canopy present in the Downtown Plan area.



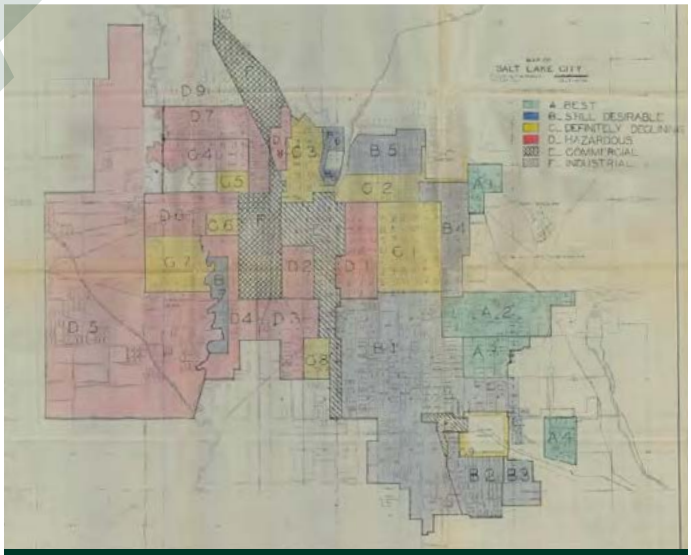
Salt Lake City Surface Temperature by Master Plan Area (temperature measured on July 31, 2020 at 5:05 pm local time by NASA's ECOSTRESS satellite). Lower temperatures correlate to areas with more tree canopy, and vice versa.

THE LEGACY OF REDLINING IN SALT LAKE CITY'S URBAN FOREST

In cities throughout the United States, persistent socio-economic divides in investment and development patterns correlate to the historic practice of redlining. Briefly, redlining is the term commonly used to describe federal, state, and local government policy during the New Deal era of the 1930s, in which policy-makers designated the "quality" of areas for loans provided via the Home Owners Loan Corporation (or HOLC). In practice, this was used to reinforce segregation and discrimination in neighborhood patterns by designating areas of residential settlement based on race, ethnicity, and socioeconomic class. Areas consigned to "the wrong side of the tracks," were labeled "D-hazardous" and shown in red on maps, hence the term "redlining."

The legacy of these discriminatory practices is present in the inequitable distribution of wealth and access in cities throughout the United States, and Salt Lake City is no exception. Households with the highest median income live on the east side of the city, while the lowest income households are located predominantly on the formerly redlined west side.

Just as the pattern of racial, ethnic, and economic inequalities persist in urban areas nearly a century after redlining policies were created in the US, the distribution of urban forest cover often reflects those same inequities. Typically, wealthier communities have greater tree canopy, and therefore more access to the range of benefits the urban forest provides.



Salt Lake City redlining map, c. 1935 (Mapping Inequality)

A 2020 study of 37 US cities looked at urban forest distribution and HOLC (or redlining) maps, found that areas designated "A" (typically reserved for US-born white populations) had nearly double the tree canopy cover than those designated "D" for people of color. (Locke, 2021)

This phenomenon is apparent in Salt Lake City as well, with some “A” areas having more than six times the tree canopy of those once designated “D.” For a fuller accounting of inequities in urban forest distribution in the United States see the American Forests Tree Equity Score website.

Salt Lake City’s street tree planting policy is to provide them free of charge to residents, on the condition that they agree to water them. This is a popular program for residents who are aware of and appreciate the benefits trees provide, but still leave a significant number of street tree planting locations vacant and assume that residents are aware of the needs and costs associated with watering.

An equitable distribution of free trees in Salt Lake City will likely require a significant campaign on both the importance of the urban forest as well as water use and costs to maintain healthy trees. Trees generally use much less water than people assume, while also conserving water by reducing evaporation for the vegetation that they shade.

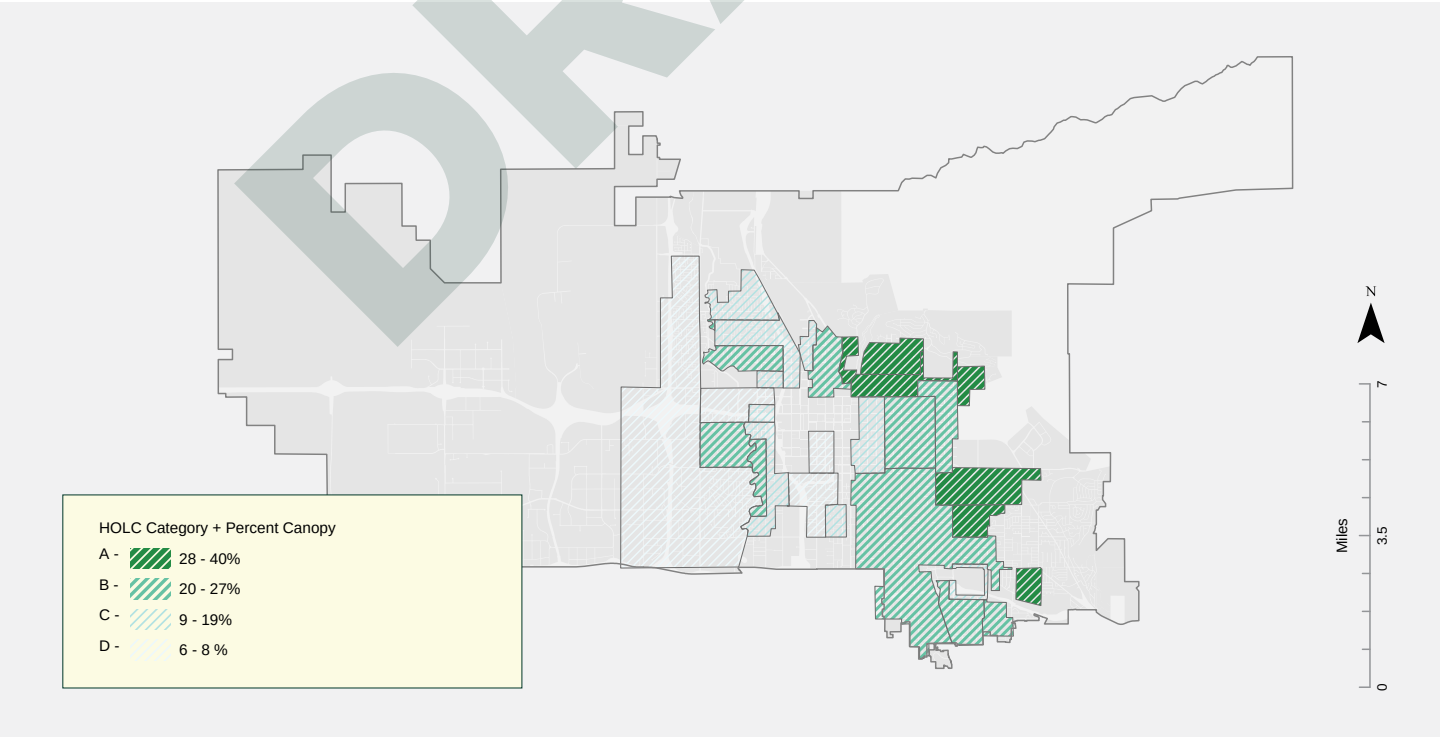
An average mature tree uses 70 gallons of water weekly, while an average adult uses ten times that amount. During the 8-month growing season, monthly costs to water a tree range from $0.10 for a young tree to $ 0.70 for a mature tree.

Sprinkler costs, however, can create a larger burden on low-income residents, as installation and power expenses are a larger share of their income than higher income residents. For those who do not have sprinkler systems, the time required to provide the deep, slow watering that helps trees thrive can also represent a burden.

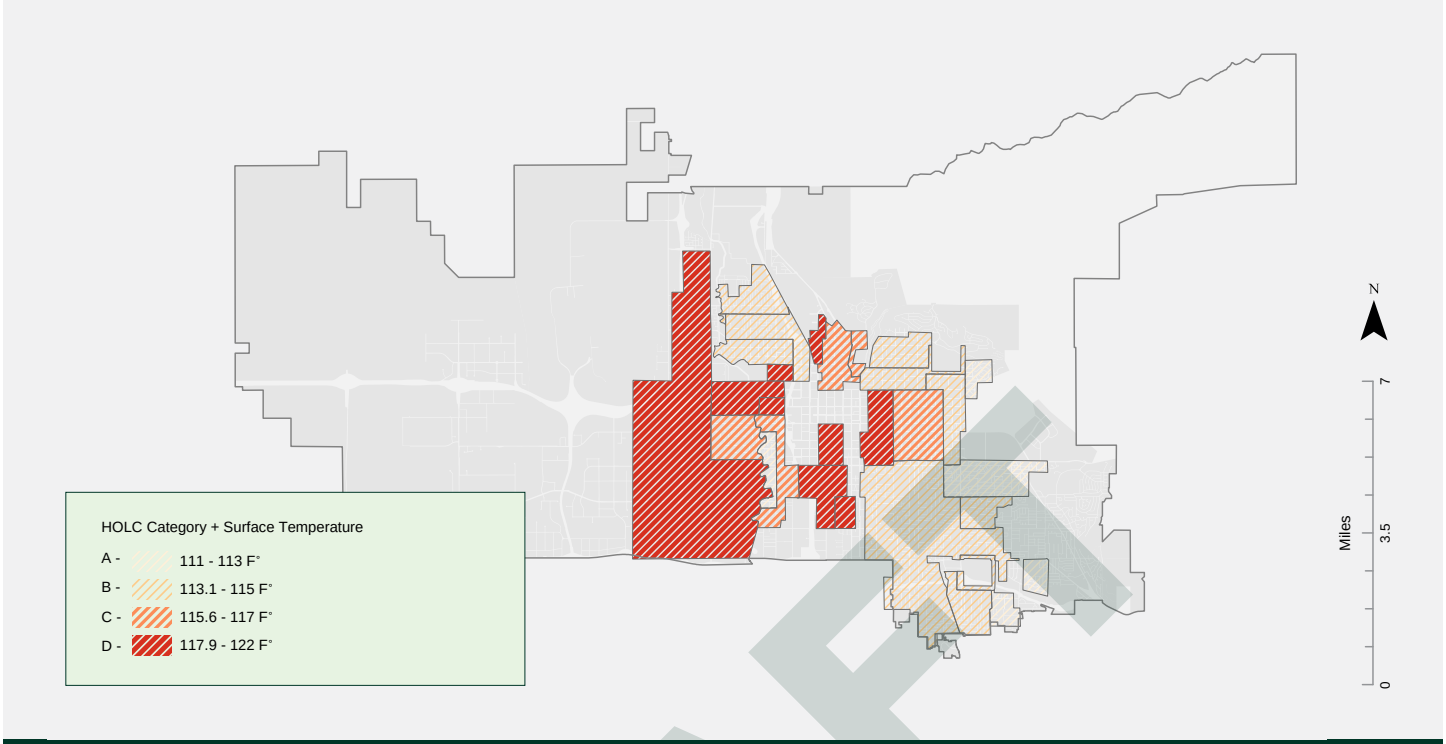
Rising housing rates and rents have made resident turn over more frequent in Salt Lake City. As home ownership or rentals change occupants, new residents may not be aware of their irrigation responsibilities. Further, renters may assume that tree requests and irrigation are the responsibility of the landlord, leading to trees going without water for prolonged periods, resulting in decline and death.

LEGACY OF REDLINING ON THE URBAN HEAT ISLAND EFFECT

Increasing temperatures due to climate change have a direct impact on livability, as do temperature impacts created by many urban surface materials, notably asphalt. Land Surface Temperature is measured by satellite and is a measurement of how hot a given surface feels to the touch, the data is made available by NASA. The difference in Land Surface Temperature



Percent tree cover (EPA, 2014) by HOLC graded areas in Salt Lake City. Redlined areas (D) have the lowest amounts of tree canopy.



Land surface temperature by Salt Lake City HOLC graded areas (NASA ECOSTRESS, July 31, 2020 at 5:05). Areas that were redlined (grade D) and grade C ("definitely declining") have the highest surface temperatures nearly a century later.

(LST) shown in the map below is the difference in mean temperature for within formerly HOLC-graded (or redlined) areas from the mean temperature for all HOLC-graded areas in Salt Lake City. Again, as with other cities in the US, there is a correlation between higher temperatures and redlined areas.

Although air temperature is the gold standard for demonstrating thermal comfort and increased potential for adverse health impacts, this data was not available at the neighborhood or block scale in Salt Lake City.

Although land surface temperatures do not directly correlate to thermal comfort (which requires local air temperature measurements), it does provide some guidance to understand which areas of the city may be likely to have increased heat-related impacts and demonstrate which locations are most in need of shade. Land surface temperature is also an indicator of areas where vegetation is likely to experience heat stress, which has significant impacts on the health and longevity of the urban forest.

Furthermore, the impact of rising temperatures due to climate change are magnified by urban heat island effect and have significant adverse impacts on human health.

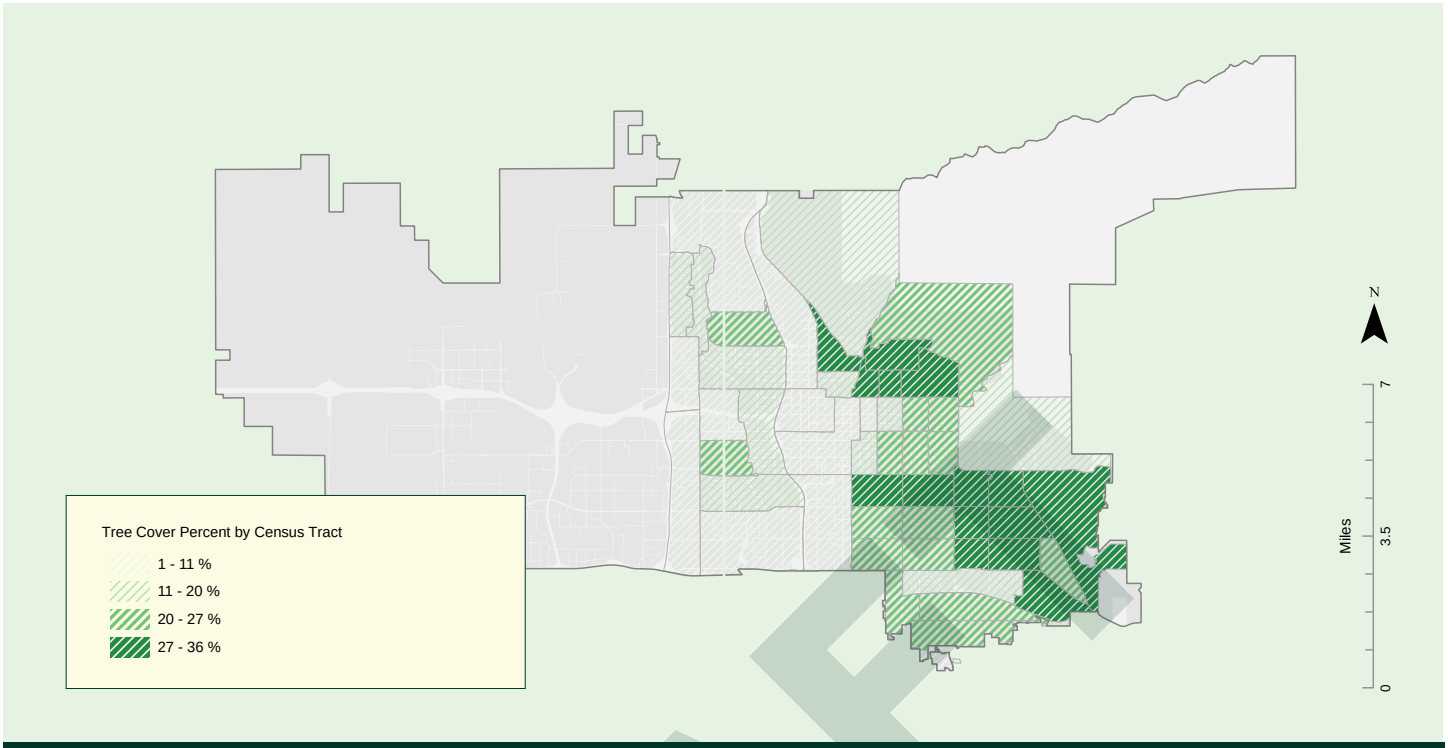
Salt Lake City's poor winter air quality tends to get a greater share of the public's attention, in part because of the visible smog created by particulate matter ($PM_{2.5}$). **Summer air quality, and its relationship to the urban heat island, however, is of increasing concern in the city.**

Nitrogen oxides (NOx), primarily caused by vehicle emissions, react with volatile organic compounds (VOCs) during sunny, hot weather and lead to the creation of ozone (O_3). (https://www.epa.gov/heat-islands/heat-island-impacts, accessed July 2019)

Ozone pollution can trigger respiratory problems, including lung inflammation and asthma attacks, along with heart attacks.

The EPA's current air quality standard for ozone is 0.075 ppm, although some EPA scientists recommend lowering this to 0.06 ppm to protect children's developing lungs from its negative effects. The World Health Organization recommends an even lower ozone standard of 0.053 ppm. (Kenward, 2014)

Although the Clean Air Act has provided improvements in ozone levels, these gains may be threatened by increased heat caused by climate change.



Salt Lake City tree canopy cover EPA 2014) by census tract. Tracts: U.S. Census Bureau 2019 American Community Survey (ACS).

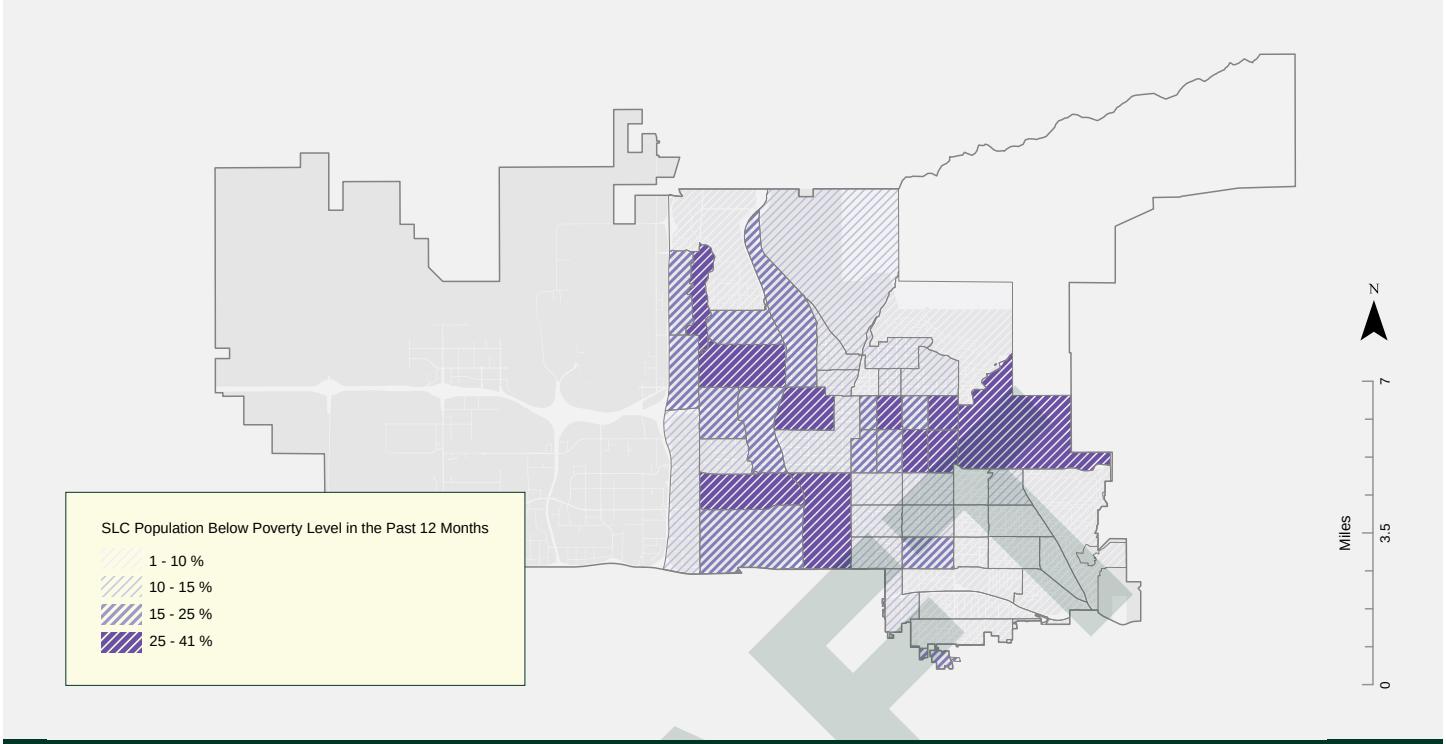
DEMOGRAPHICS

Demographic analysis demonstrates that a lack of tree cover is correlated to neighborhoods with higher concentrations of people living in poverty, people of color, and numbers of children in Salt Lake City.

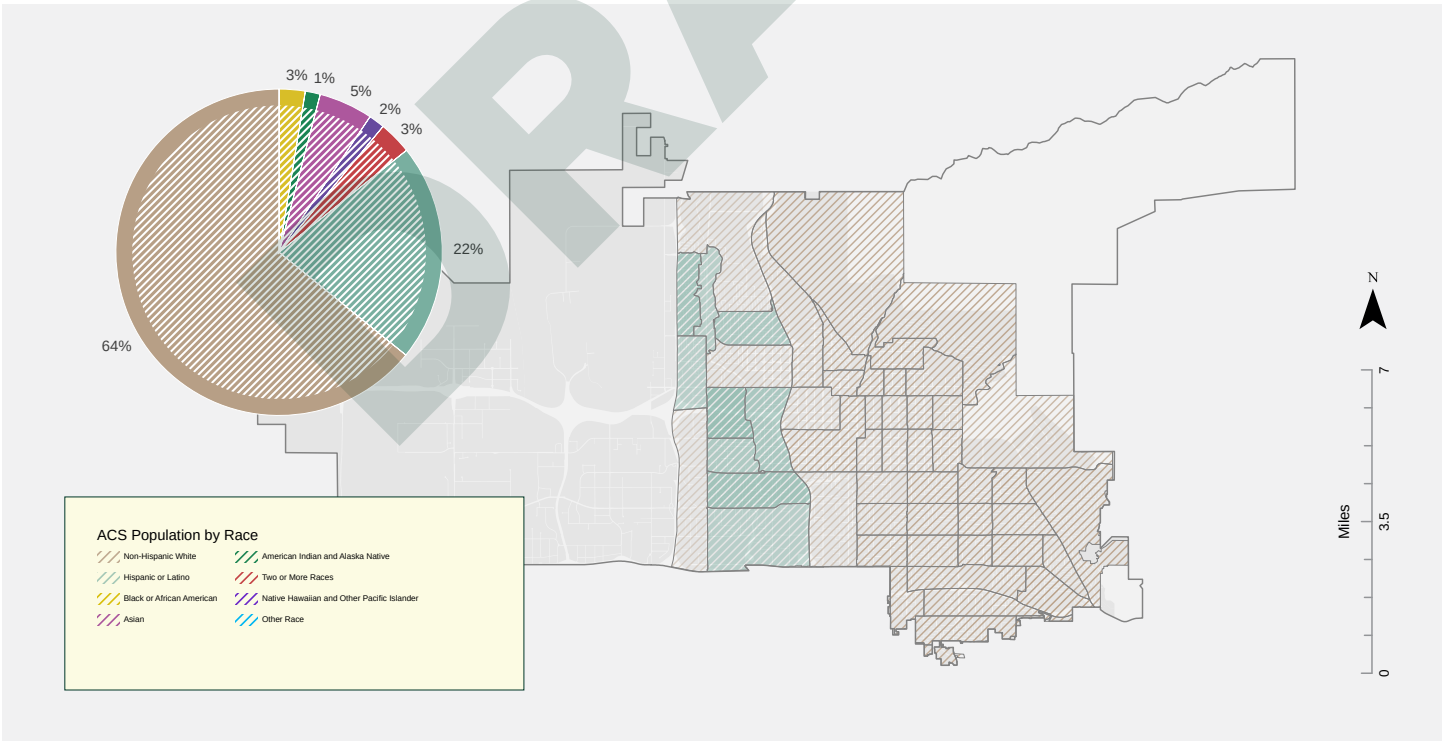
Access to tree cover in residential areas is generally less in areas with higher concentrations of poverty (see above right), meaning the livability factors enhanced by trees are inequitably distributed.

The pattern in Salt Lake City mirrors that found in cities throughout the United States, where wealthier areas have twice the canopy of their lower-income counterparts. This holds true in neighborhoods with higher numbers of people of color as well.

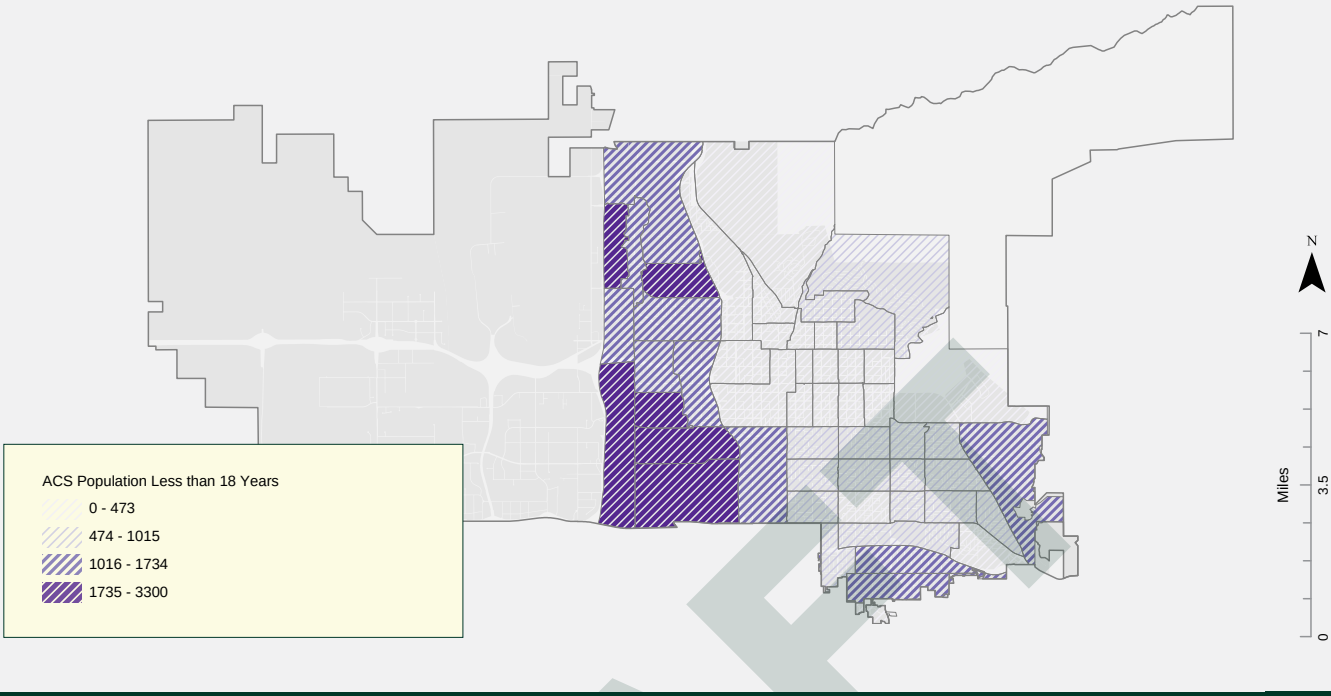
Poverty and systemic racism are both contributors to poor health outcomes, up to and including shorter life spans, as they are significant stressors. Enhanced livability through an expanded urban forest will not, on its own, solve these problems, but can become an significant part of the solution through the many benefits it provides.



Percent of population whose income was below the poverty level in the past 12 months, by census tract (2019 ACS).



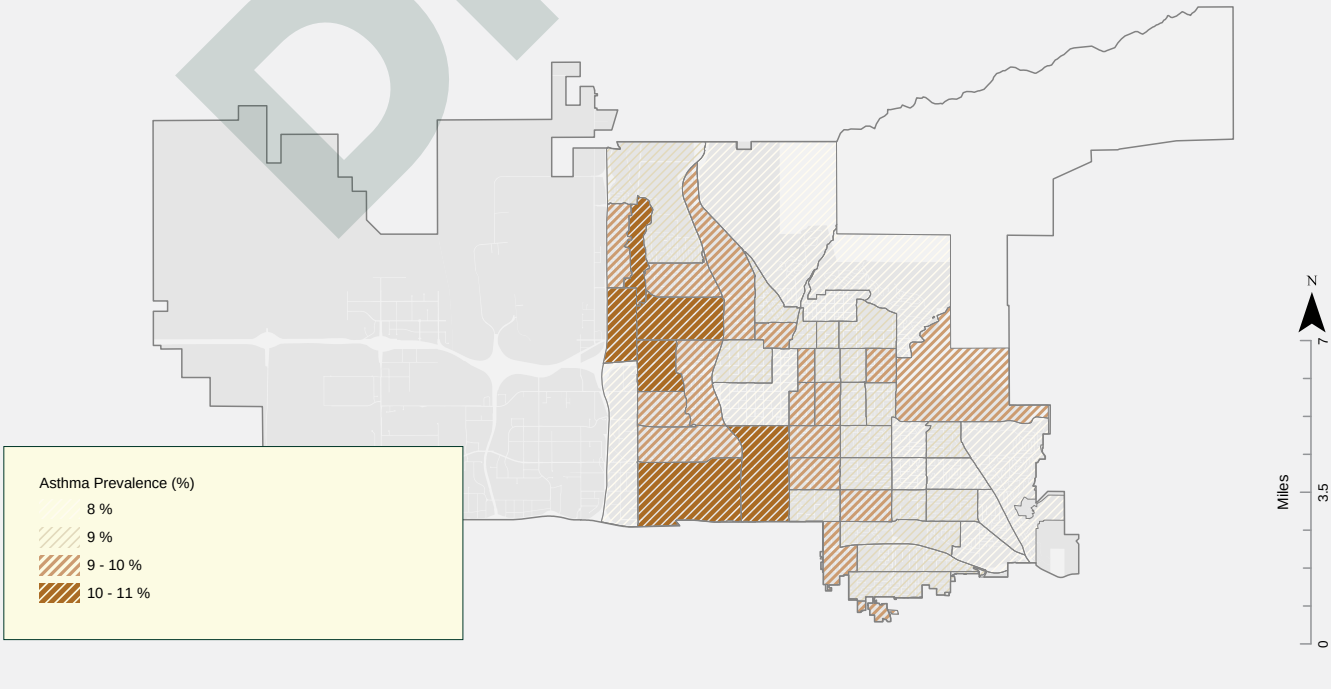
Predominant racial or ethnic group by census tract (2019 ACS).



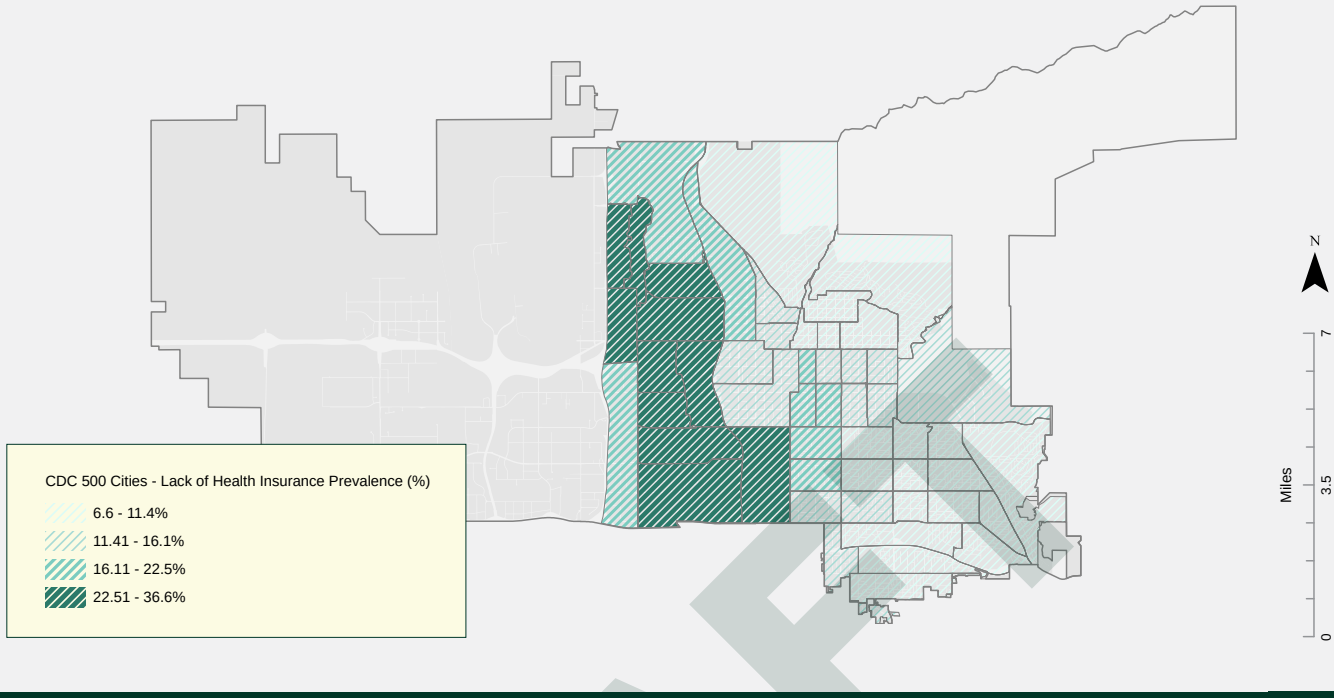
Percent of population under 18 years old by census tract (2019 ACS).

The greatest numbers of children in Salt Lake City live on the west side and are therefore more likely than their east side counterparts to experience the adverse impacts to livability associated with lower canopy cover.

Asthma rates are also significantly higher in areas with fewer trees, higher poverty, and more children. Studies have shown a relationship between lower rates of childhood asthma in neighborhoods with more trees (Vibrant Cities Lab).



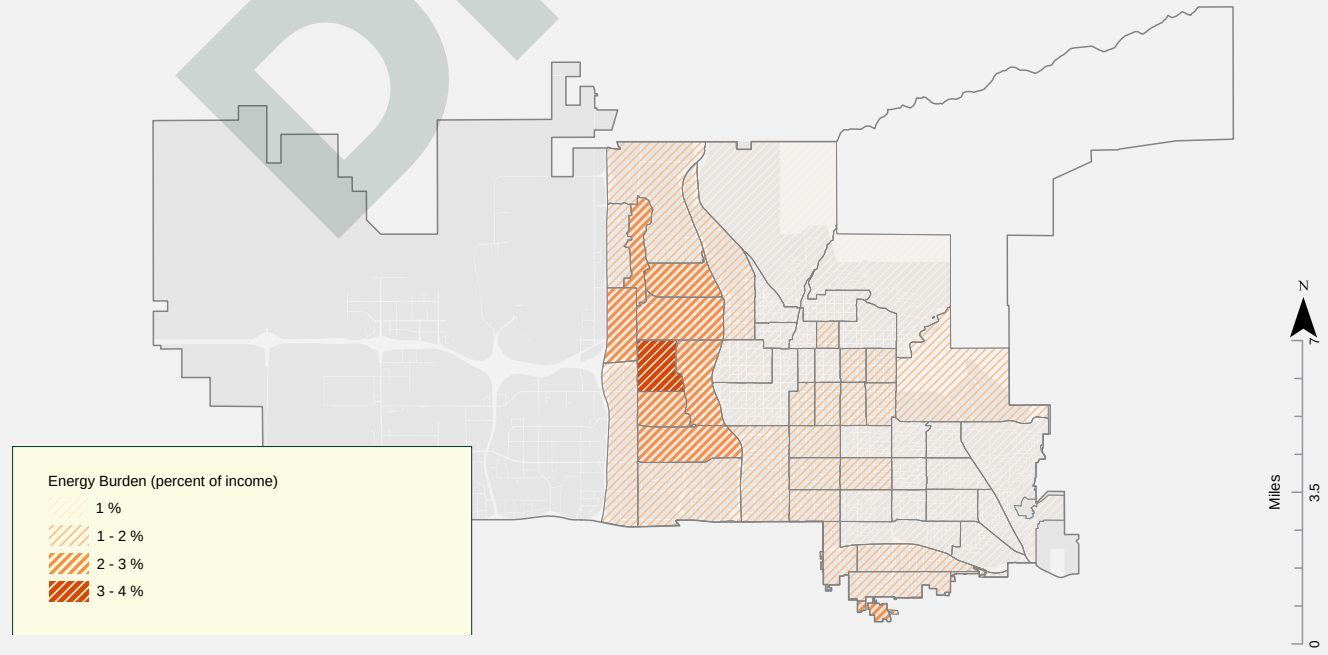
Percent of population with asthma by census tract, from the Center for Disease Control's (CDC) 500 Cities program.



Percent of population without health insurance by census tract (CDC's 500 Cities program).

The prevalence of pulmonary disease on the west side is compounded by a lack of health insurance. Strategic tree planting guided by demographic information, and using species known to mitigate targeted pollutants may provide improved health outcomes for many in these communities.

Energy burden, or the costs of energy as a percentage of gross income, also creates strain on lower income households that could be mitigated through tree planting. Strategic placement of trees near buildings lowers energy usage, contributing to fewer greenhouse gas emissions an average of 5% savings on energy costs (Vibrant Cities Lab, 2014).

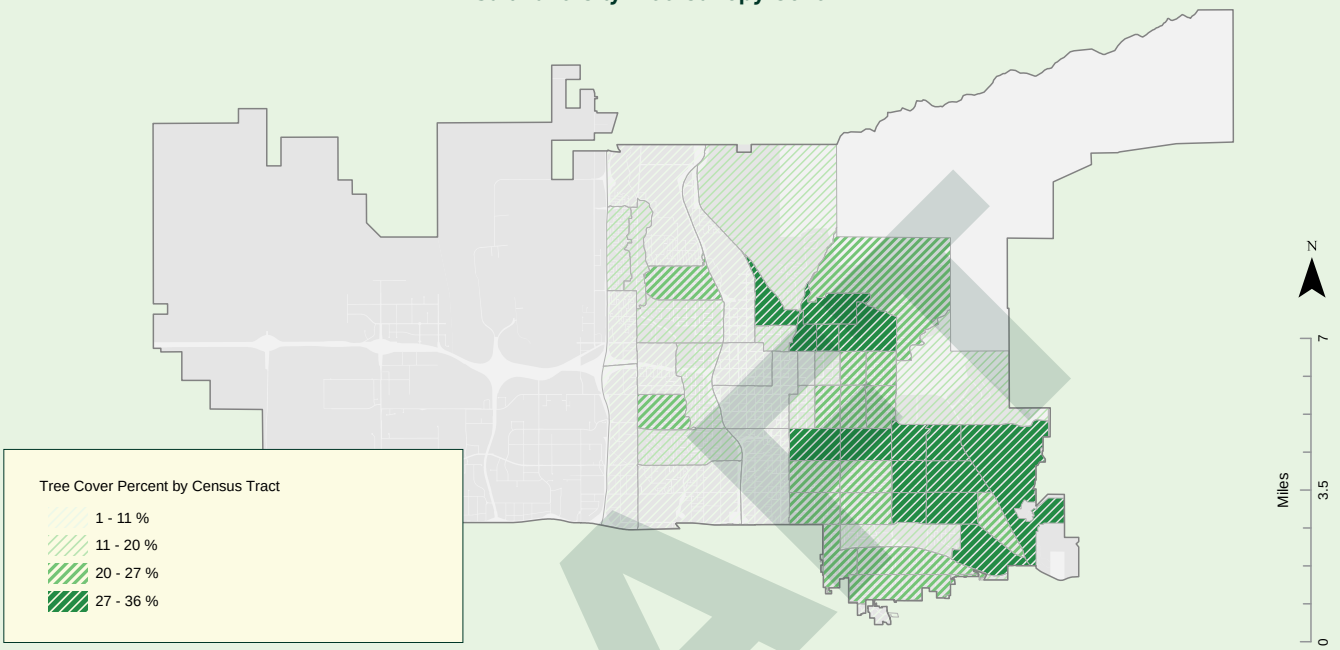


Energy Burden (cost of energy relative to household income) by census tract (2020 energy data; 2019 ACS census tracts)

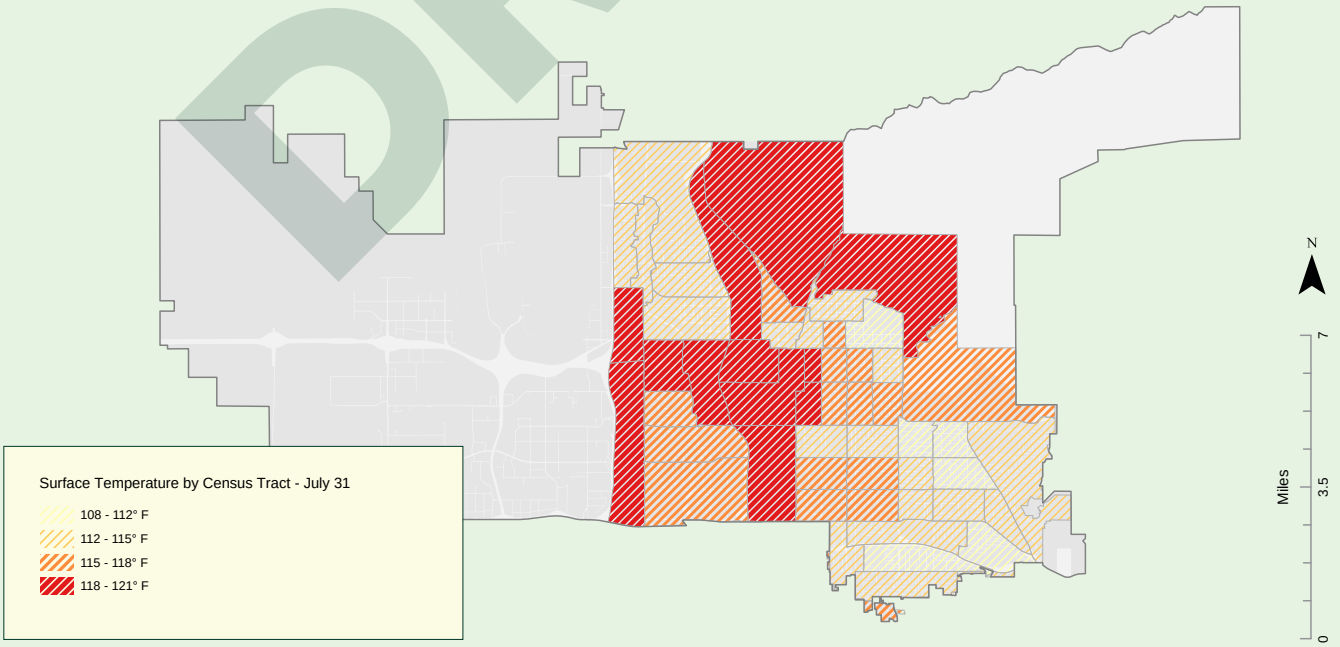
SALT LAKE CITY CENSUS TRACT ANALYSIS

2019 AMERICAN COMMUNITY SURVEY (ACS) TRACT DATA

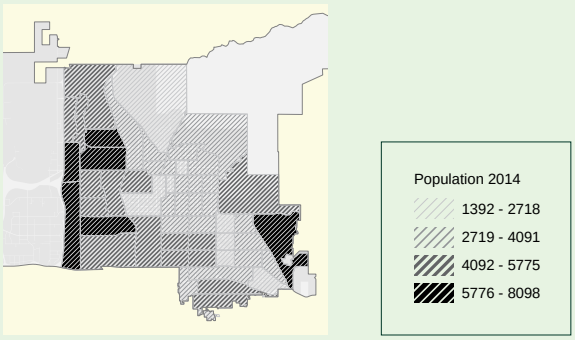
Salt Lake City Tree Canopy Cover



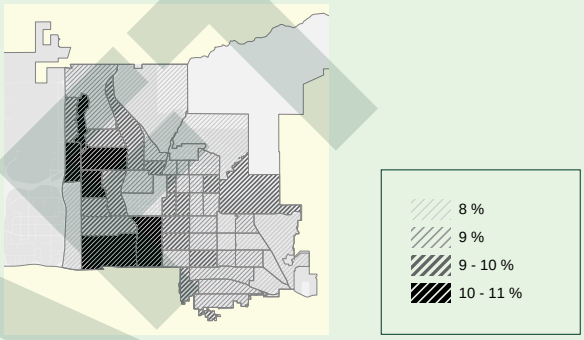
Salt Lake City Surface Temperature (5:05 p.m. MDT, July 31, 2020)



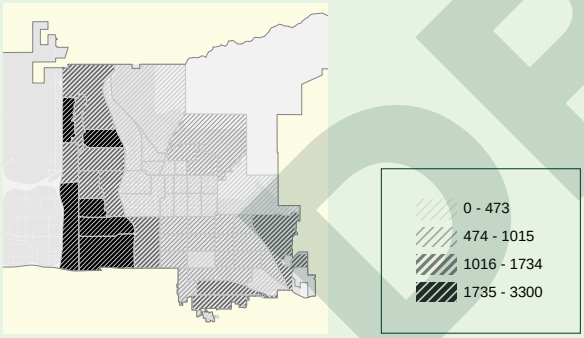
Salt Lake City Total Population



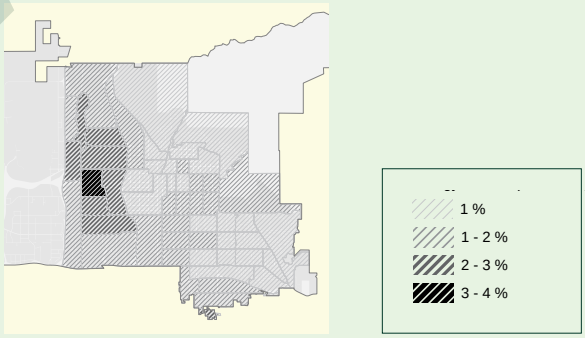
Asthma Prevalence (%)



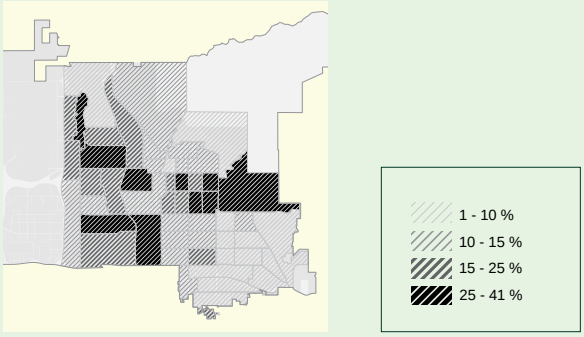
Population Less than 18 Years



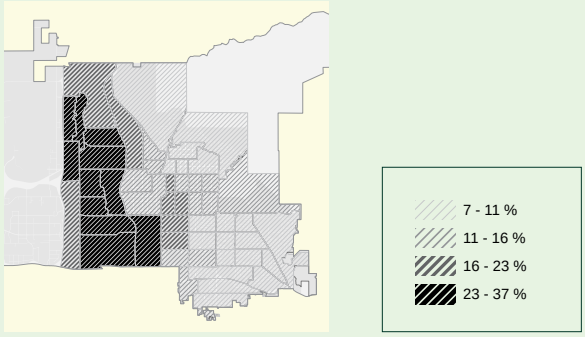
Energy Burden (% Income)



Population Below Poverty Level (Last 12 Months)



CDC 500 Cities - Lack of Health Insurance



ENVIRONMENT

The urban forest has an important role to play in many aspects of livability, but for cities one of the greatest returns on investment can come in the form of improved public health outcomes. To determine the scale and ongoing commitment to investment necessary to equitably distribute these improved outcomes, it is first necessary to quantify the number of trees and other vegetation required.

TREES NEEDED TO MITIGATE URBAN HEAT ISLAND EFFECT

Trees help cool urban areas by physically shading spaces and by cooling the air as they release moisture through transpiration. Selecting the right tree is important as its physical form determines how much sunlight can pass through to hit the ground below the canopy. Researchers at the University of Wisconsin found that a typical city block needs to have at least 40% canopy coverage to reduce the daytime summer air temperature. (Ziter, 2019) The 40% canopy threshold resulted in a temperature decrease of 7-9 degrees Fahrenheit.

TREES NEEDED TO MITIGATE AIR POLLUTION

According to data published by the American Lung Association, the Salt Lake City-Provo-Orem area ranked No. 11 for ozone pollution and No. 7 for short-term particulate pollution in the United States. According to the nonprofit organization Saving Nature, it takes roughly 1,025 trees to offset the average American's yearly emissions, with each tree absorbing about 31 pounds of carbon dioxide per year. (Add citation)

With approximately one of every nine deaths being contributed to poor air quality, a robust and diverse urban forest is one means to offset pollution and in turn, promote human health (World Health Organization, 2016). The amount of pollutants and particulates filtered by each tree vary depending on its placement and composition. Cities need to consider multiple variables including the tree's mature size, growth rate, and the architecture of the tree such as its canopy structure, leaf size and the texture of the leaves. By integrating these criteria into urban design and urban forestry policies and ordinances, Salt Lake City could demonstrably address poor air quality impacts while also enhancing multiple quality of life needs.

TREES NEEDED TO MITIGATE STORMWATER IMPACTS

Trees are important in stormwater management due to their ability to take up water through their roots and leaves and slow the flow of stormwater through the utility system. As detailed in Chapter 2, there are roughly 86,500 publicly owned trees in Salt Lake City, which cover just over 2% of the City's total land area.

A University of Utah study found that stormwater runoff could be reduced by 12% if every house in a typical Salt Lake City single-family home neighborhood collected 2,500 gallons of rain water per year (Steffen, 2013), which is about the equivalent interception capacity, or "the sum of canopy surface water storage and evaporation," of one medium-sized tree (Center for Urban Forest Research, 2002).

Planting trees in just half of the currently available locations on City streets would intercept 30 million gallons (or 4 million cubic feet) of rainwater. This would dramatically reduce the amount of stormwater runoff entering the stormwater system, which is one of the most significant polluters of our waterways. Clean water is vital to livability, one that obviously meets daily needs but also greatly enhances quality of life needs related to recreation, in particular the lake effect impact on winter sports opportunities among the Wasatch peaks.

WATER CONSERVATION + THE URBAN FOREST

Trees can be an important part of water conservation strategies provided there is education as to which species are water wise, or drought tolerant, and how best to water trees. For example, shaded lawn uses much less water than unshaded lawns, resulting in efficient water use.

With the pressing need for water conservation due to increased population and climate change, models can be used to forecast which areas should receive the most sustained investment in the urban forest, and which methods of urban heat mitigation and water conservation will provide greater return on investment (Jones, 2018). In all cases, trees should be considered an important tool in the water conservation toolkit, while evaluating how to pair the urban forest with other types of infrastructure to conserve water.

ORDINANCE

HISTORY OF SALT LAKE CITY'S URBAN FORESTRY + TREE RELATED ORDINANCE

Several city policy documents guide tree protection, preservation, and maintenance within Salt Lake City (See Appendix # for documents). Standards and specifications for the City's Urban Forest are contained in the Urban Forestry Ordinance and the Zoning Ordinance.

SALT LAKE CITY URBAN FORESTRY ORDINANCE

In September of 1988, Salt Lake City amended Chapter 2.26 of the Salt Lake City Code to be entitled the "Salt Lake City Urban Forestry Ordinance", defining responsibilities and establishing standards and specifications for the City's Urban Forest.

Chapter 2.26 aimed to generate coordinated intra-department regulatory efforts and provide a single point of contact for residents to consult with any tree related concerns or questions. The implementation of the amended urban forestry code resulted in new regulations surrounding the protection and responsibility of street trees, public nuisance, and designation of responsible party, while maintaining regulations on all street, park, and City trees.

TREES IN SALT LAKE CITY'S ZONING ORDINANCE

In April of 1995, Salt Lake City adopted a new Zoning Ordinance that established certain standards for landscaping and encouraged the use of drought-tolerant plants. The intent of these changes was to encourage sustainable design in all aspects of landscape planning, from residential and commercial, to public and institutional.

In 2003, after five years of continuous drought, best management practices (BMPs) were developed to increase water efficiency in the landscape, incorporating new technologies in irrigation, and identifying measurable water-use goals and practices. The plant list was also updated to reflect current availability and clarify species identification.

In April 2016, Salt Lake City amended sections of the City's landscaping requirements under Chapter 21A.48 to establish water-efficient landscaping, park strip landscaping, landscape yards, and tree protection regulations. The adopted amendments were designed to:

Reduce water consumption through grouping plants with similar watering needs together and ensure efficiencies in the irrigation system design upon installation.

Require the protection of existing trees in landscaping for the design of large projects,

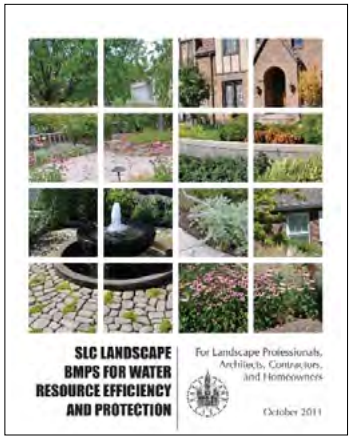
Address the health of street trees and height limits for both plants and structures in park strips.

The Landscape BMPs and Plant List documents are referenced within the amended landscaping regulations to provide clarification on the landscaping standards, including how to achieve greater water efficiencies, improve stormwater quality, and enhance water resource protection.

Additionally, Chapter 21A.48 set in motion a coordinated effort for permitting landscape plans in development situations between other city departments and Urban Forestry. Under Chapter 21A.48, tree preservation requirements in development situations were expanded to be more inclusive to all types of development. Tree protection and preservation requirements on private development are reviewed and approved by Urban Forestry. On development projects Urban Forestry issues and inspects tree preservation requirements.

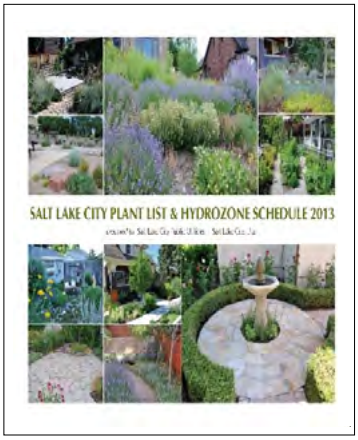
RELATED DOCUMENTS

The following page shows examples from supporting documents intended to aid Salt Lake City in the evaluation of landscaping requirements throughout the city to ensure urban forestry resources are managed carefully and efficiently.



LANDSCAPE BMPs for WATER RESOURCE EFFICIENCY AND PROTECTION

The Landscape Best Management Practices manual identifies and outlines standards to enhance water efficiency, reduce landscape chemical dependence, and eliminate water waste for landscapers or contractors working within the Salt Lake City area.



PLANT LIST AND HYDROZONE

The Salt Lake City Plant List serves as a guide to the public and landscape professionals for selection of a wide variety of plants suitable for water-wise and sustainable landscapes, while fostering creativity in planting design.

TREE PROTECTION AND PRESERVATION POLICY

A set of guidelines for implementation of tree protection and preservation prior to construction work.

CENTER FOR WATERSHED PROTECTION RECOMMENDATIONS

The Center for Watershed Protection (CWP), a national non-profit focused on stormwater management and watershed planning, with expertise on the impacts of development on urban waterways, created a tool to audit municipal ordinances. This worksheet, "Making Your Community Forest-Friendly," is based on best practices in the urban forest, with an understanding that the urban forest plays a critical role in maintaining the health of waterways. The tool is intended "to help communities evaluate their local development regulations to identify revisions that will better promote protection and management of trees and forests as well as tree planting." (CWP, 2018)

While Salt Lake City's Code employs best practices in roughly 70% of the areas the CWP identified, a few sections of the code (below) that could be amended to provide stronger protections to sustain and grow Salt Lake City's urban forest.

The bulk of CWP's recommended code and related policy updates fall within the purview of the Zoning Chapter (Title 21A), while the others may potentially apply to the Streets and Sidewalks (Title 14), Parks and Recreation (Title 15), and Public Services (Title 17) chapters.

STREETS + SIDEWALKS (TITLE 14)

- Consider specifications for street trees that require trees with large canopies, provided they do not interfere with overhead utilities.
- Any requirements for large trees should include related ordinance for soil volume and soil quality to be effective.
- Consider requiring above ground utilities to be placed below ground, under the carriageway, to reduce conflict with trees and allow cities to maximize the benefits the urban forest provides.
- Consider requiring landscape islands in cul-de-sacs to reduce stormwater runoff impacts to water quality and provide a neighborhood amenity.

PARKS + RECREATION (TITLE 15)

- Consider developing or enhancing definitions for priority natural resources to conserve, and creating an ordinance addressing access between neighborhood open spaces and natural lands (e.g., trails).

PUBLIC SERVICES (TITLE 17)

DIVISION III: STORMWATER SEWER SYSTEM

- Consider providing credits for green infrastructure or low-impact development practices that include tree planting. (These credits are typically based on the overall volume of stormwater reduced on-site or mitigated through investment off-site).
- Consider providing credits for forest conservation or to increase vegetative buffers along waterways (which has the added benefit of creating options to develop parcels that have challenges to treat stormwater on-site).
- Consider incorporating trees into stormwater BMPs to reduce runoff, enhance water quality, and provide habitat.
- Consider developing stormwater design manuals that include requirements for species selection and relevant planting practices to address difficult growing conditions created by stormwater impacts.

ZONING (TITLE 21)

BUFFERS (21A.34: RIPARIAN CORRIDOR/LOWLAND CONSERVANCY OVERLAY)

- Consider amending minimum stream buffers in all areas to 50 feet (this applies to Area A in the Riparian Corridor Overlay and the Natural Vegetation Buffer Strip in the Lowland Conservancy Overlay)
- The buffer ordinance should specify that a minimum percentage of the buffer be maintained with tree cover suited to the conditions of the growing site.
- Specify enforcement mechanisms within the ordinance.

PARKING LOTS (21A.44)

- A minimum width of 6 feet or greater is recommended for standard parking lot islands.
- Ensure sufficient space remains available for large trees by specifically allowing alternative layouts that cluster trees and provide for shared soil space.
- Allow flush curbs and/or curb cuts and depressed landscaped areas so that runoff can be directed into landscaped islands.
- Allow vegetated stormwater management areas to count toward required landscape minimums.

LANDSCAPING (21A.48)

- Ensure all landscape areas required by zoning include trees.
- Provide a planting formula for trees, which “may take the form of a minimum number of trees, number of trees per parking area, trees per square feet of developed space or building footprint, density of trees, or percent canopy coverage.” (CWP, 2018)
- Develop tree planting guidelines (like SLC’s Engineering Design Guidelines) referenced in the landscaping chapter that include specifications and standards for:
    - tree selection,
    - planting,
    - size requirements,
    - soil type,
    - soil volume,
    - nursery stock,
    - selection, and
    - long-term maintenance.

SUSTAINABLE CODE REVIEW RECOMMENDATIONS FOR THE URBAN FOREST

The recommendations of the 2020 Sustainable City Code Review are organized into five goals, all of which have a relationship to the urban forest. The three goals that are most directly relevant, however, are discussed here.

GOAL 1: REDUCE URBAN HEAT ISLAND EFFECT

The document recommends preserving and expanding the urban forest to address urban heat island impacts, specifically:

- Expanding tree protections in City code
- Improve parking lot shading standards

Sacramento, CA uses a performance-based parking lot shading ordinance to mitigate heat islands. In addition to the standards in the ordinance, Sacramento also employs design guidelines to provide additional direction related to trees in parking lots.

GOAL 2: INCREASE EFFECTIVENESS OF PUBLIC RIGHTS-OF-WAY

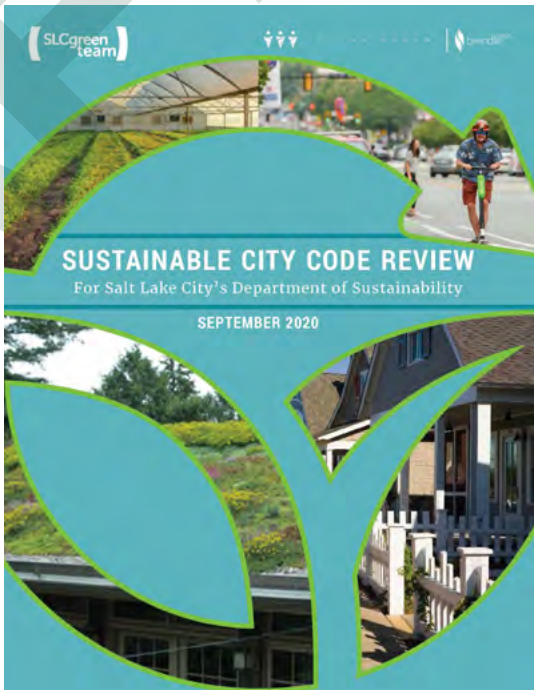
The document examines the multiple opportunities for expanding sustainable practices in Salt Lake City's large rights-of way, including specifics related to the urban forest:

- Incorporating tree trenches into the City Complete Streets Ordinance, which "direct stormwater runoff beneath the surface to gravel pits that allow water to slowly infiltrate" into groundwater sources.
- Co-locating or vaulting utilities to minimize conflicts with tree root zones.
- Using San Antonio's ROW tree protection ordinance as a model to expand existing tree protections in Salt Lake City's code.

GOAL 5: PROMOTE ECOSYSTEM CONSERVATION DESIGN

The document recommends consolidating information related to the urban forest in a single chapter and references the Longmont Colorado City Code as a model. Longmont code has a chapter dedicated to Trees and Plants, under Title 13: Streets, Sidewalks and Public Places. The chapter incorporates requirements related to:

- spacing between trees and utilities
- disease inspection and survey
- tree protection and preservation, and
- replacement or mitigation of removed trees.
(Salt Lake City Department of Sustainability, 2020)



URBAN DESIGN

Urban design that integrates the urban forest into streets and publics enhances livability for all residents of a city, both through principles of environmental psychology and biophilia put into practice by design, and through incorporating and enhancing the ecosystem services trees provide.

Of particular importance to Salt Lake City is **incorporating human scale elements into our wide streets**, which the urban forest does, along with providing visual interest and much needed shade to mitigate the impacts of urban heat island effect.

STREET TREE FORM + SCALE

Given Salt Lake City's large scale right of ways and oversized blocks in many parts of the city, the scale and form of trees becomes more significant. For example, on a narrow street with limited solar access, columnar trees may provide effective streetscape design. On very wide streets, however, columnar trees appear small and out of place, and do not provide adequate shade unless planted very closely together. However, a hedgerow of street trees is impractical and difficult to maintain, in addition to being poor urban design.

Scale requirements for trees also have cost saving implications, such as providing shade to streets to extend the lifespan of the asphalt.

COMPARATIVE STREETSCAPES BY MASTER PLAN AREA

The photographic comparisons on the following pages were developed by the Planning and Urban Forestry Divisions. Streets photographed were selected to represent the "average" streetscape for both high and low canopy areas in each of Salt Lake City's Master Plan areas. The photos were taken by Planning Division staff in August and September 2021.

There are significant differences between areas, particularly with the provision of shade between high canopy areas. Consistent with the GIS map analysis, high canopy streets on the east side have a more extensive, fuller canopy than their counterparts on the west side. **When looking at the comparative photos, note factors such as:**

- **tree height**
- **width and fullness of canopy**
- **ground area in shade or sun**
- **size of park strip (soil volumes available for street trees)**
- **number of trees on private property**
- **presence or absence of aboveground utility lines**

Vase-shaped or spreading canopies shade sidewalks, creating a comfortable, human-scale sense of enclosure.

The scale and proportion of columnar species is unsuited to the urban context and they typically provide little or no shade.

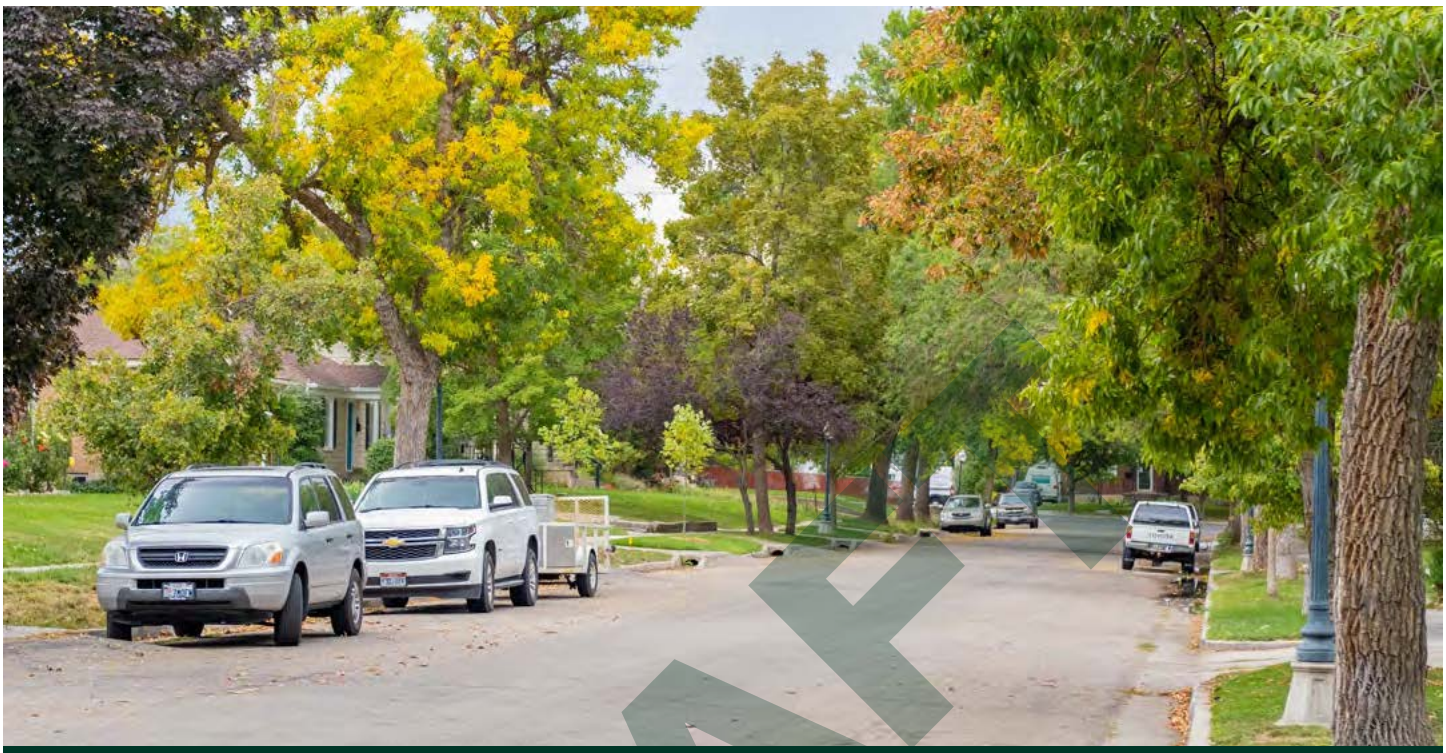
STREETSCAPES BY MASTER PLAN AREA

East Bench Community Master Plan Area - High Canopy *(Michigan Ave)*

East Bench Community Master Plan Area - Low Canopy *(Ambassador Way)*

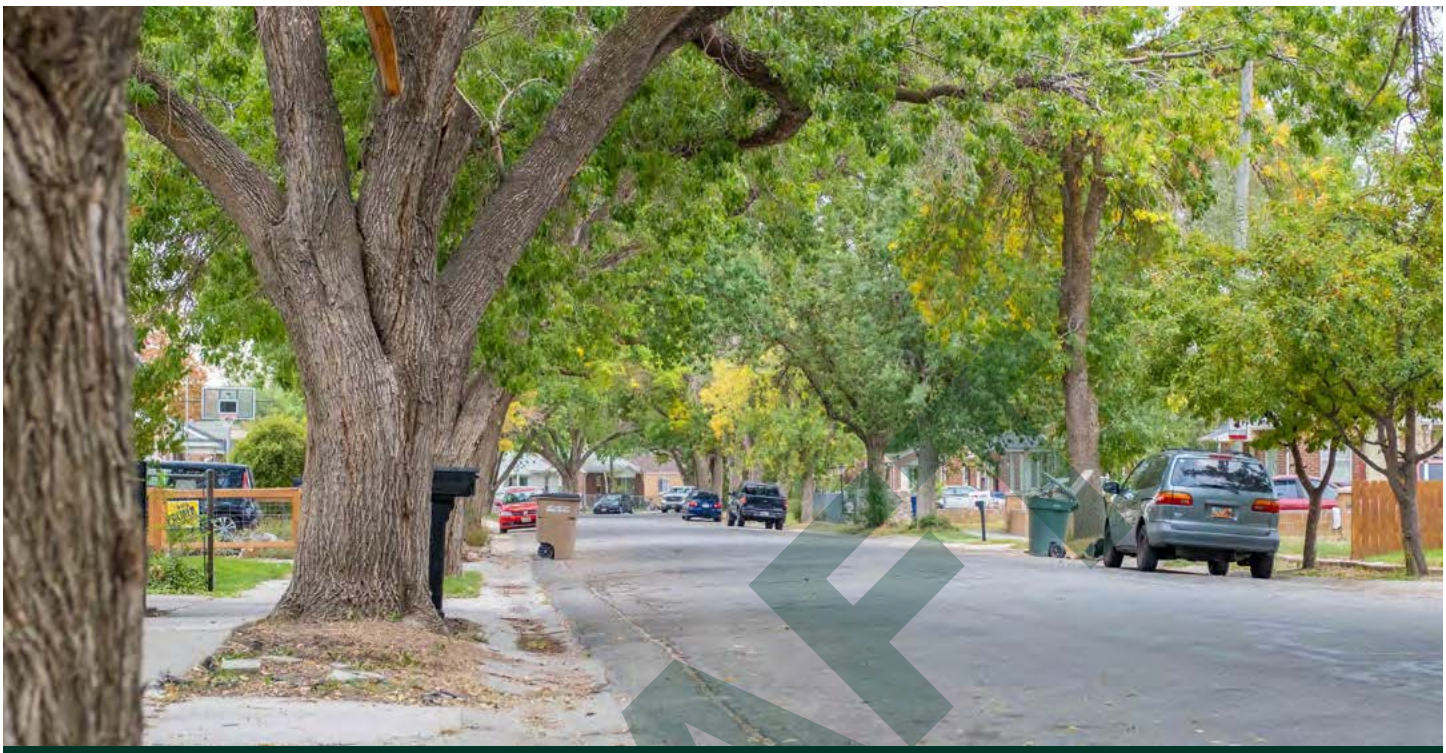
Northwest Master Plan Area - High Canopy *(Prosperity Avenue)*

Northwest Master Plan Area - Low Canopy *(Rose Park Lane)*

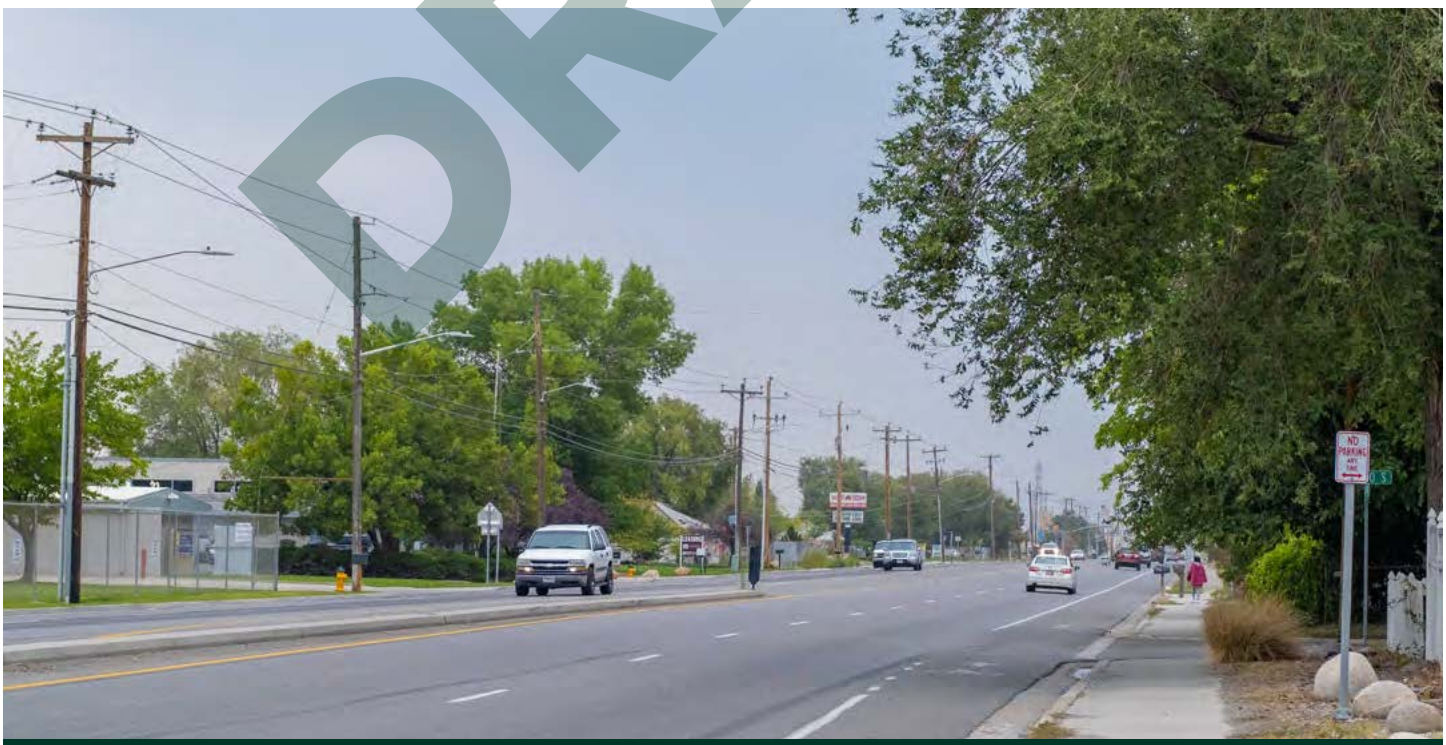


Sugar House Master Plan Area - High Canopy *(1800 East)*

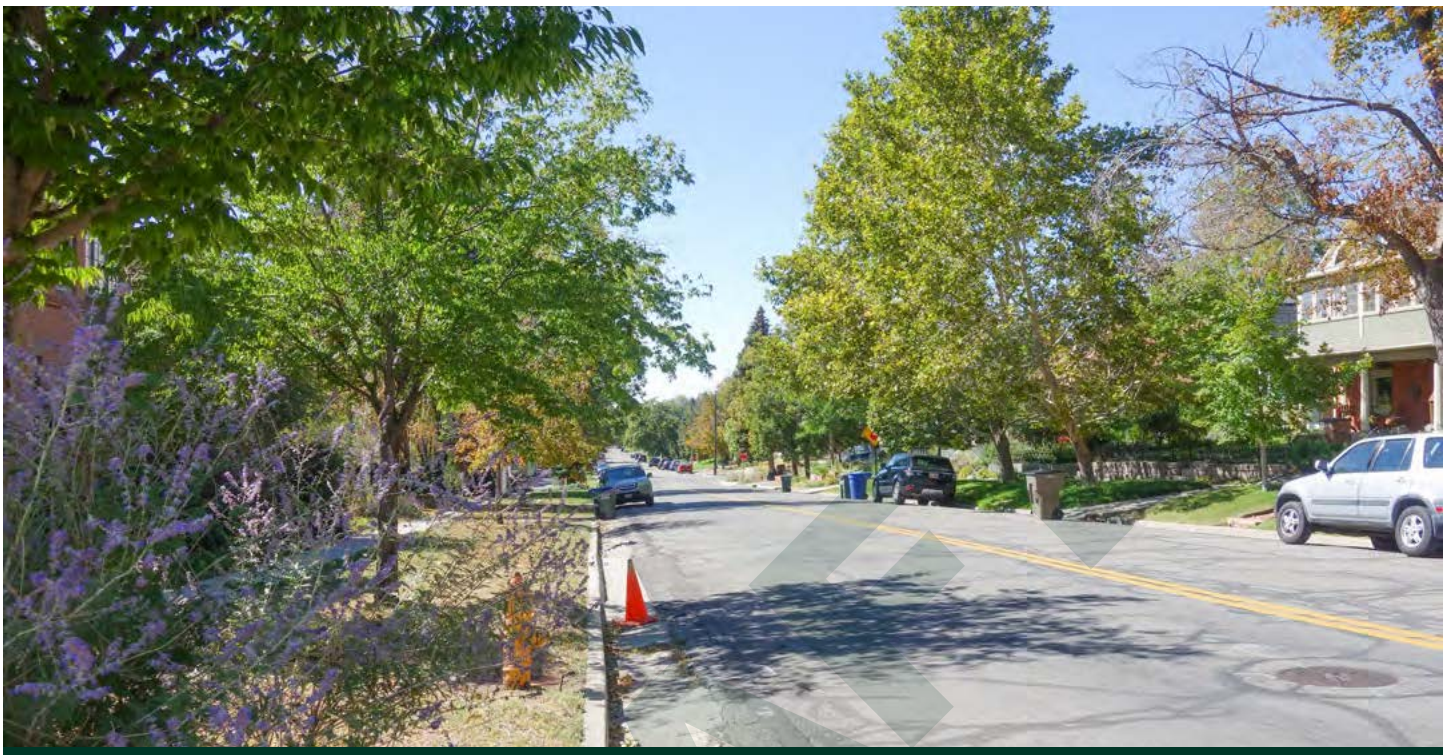
Sugar House Master Plan Area - Low Canopy *(2700 South)*



Westside Master Plan Area - High Canopy *(1000 South)*



Westside Master Plan Area - Low Canopy *(Redwood Road)*



Avenues Master Plan Area - High Canopy *(Second Avenue)*

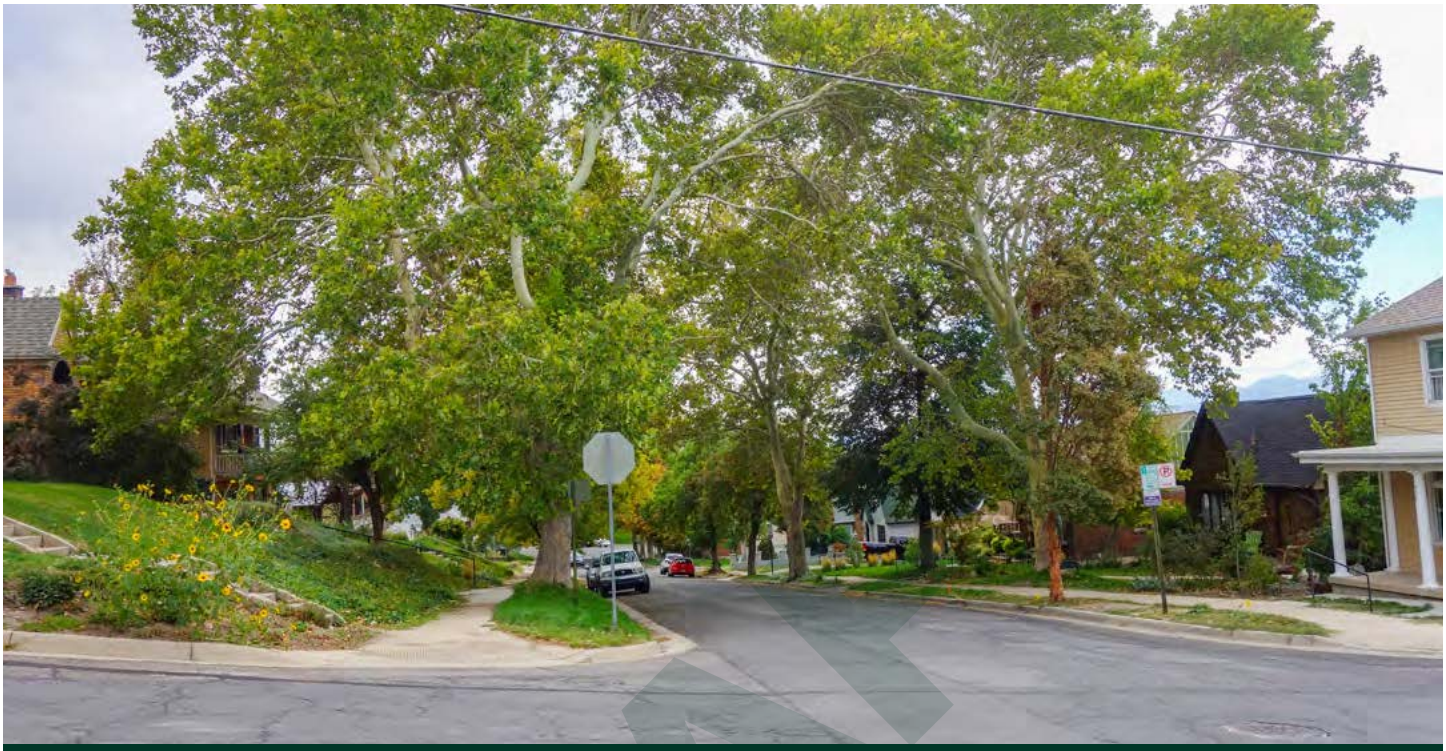
Avenues Master Plan Area - Low Canopy *(Twelfth Avenue)*

Downtown Master Plan Area - High Canopy *(Main Street)*

Downtown Master Plan Area - Low Canopy *(700 South)*

Central Community Master Plan Area - High Canopy *(Yale Avenue)*

Central Community Master Plan Area - Low Canopy *(Grove Avenue)*



Capitol Hill Master Plan Area - High Canopy *(De Soto Street)*

Capitol Hill Master Plan Area - Low Canopy *(800 North)*

NO. 4

BEST MANAGEMENT PRACTICES FOR A THRIVING URBAN FOREST

The Best Management Practices explored in this chapter relate to Planning, Urban Design, and Land Use policy and practice. They intentionally fall outside Salt Lake City's Urban Forestry Division's remit and do not address tree care. These best practices are models Salt Lake City can use to develop the urban forest as public infrastructure and effectively reap the multiple benefits it provides.

This chapter provides evidence-based solutions for future land use and urban design decision-making related to the urban forest in Salt Lake City, with adaptation to local conditions. In addition, many of the practices and policies described here provide examples of solutions that other cities have enacted to address land-use conflicts related to the urban forest.

Best practices were selected from urban areas identified in a U.S. Forest Service-funded study of the ten best urban forests in the United States. The most significant commonalities in these ten cities were sustained investment in urban forest health, partnerships with nonprofit organizations, and community participation.

In alphabetical order, the best municipal forests in the United States, according to a 2013 American Forests assessment are:

- **Austin, TX**
- **Charlotte, NC**
- **Denver, CO**
- **Milwaukee, WI**
- **Minneapolis, MN**
- **New York, NY**
- **Portland, OR**
- **Sacramento, CA**
- **Seattle, WA, and**
- **Washington, D.C.**

For specific issues related to Urban Heat Island Effect mitigation, the Planning Division reviews best practices from cities in the United States desert southwest.

POLICY

The authors selected city ordinance and planning documents based on both environmental and political factors. Climate was a key component used to evaluate ecological criteria, along with stormwater and air pollution impacts.

Sacramento, California shares two essential characteristics with Salt Lake City; both are state capitols and receive similar annual precipitation volumes. Both cities have an area of approximately 100 square miles, although Sacramento has 2.5 times the number of residents. The findings and purpose of Sacramento's tree planting and conservation ordinance (Chapter 12.56) of Sacramento's ordinance foreground the role of trees in public and environmental health:

> The city council finds that trees are a signature of the City and are an important element in promoting the well-being of the citizens of Sacramento...When proper arboricultural practices are applied, trees enhance the natural scenic beauty of the City; increase oxygen levels; promote ecological balance; provide natural ventilation and air filtration; provide temperature and erosion controls; increase property values; and improve the quality of life.
>
> The city council also finds and determines that it is in the public interest to protect and manage tree resources within the City to preserve and maintain the benefits they provide to the community.

Minneapolis, Minnesota, is also known for its thriving, robust urban forests. The first line of the Minneapolis 2016 revision to its urban forestry policy states: **"The urban forest is an integral part of the Minneapolis infrastructure"** (Board, 2016). In this way, the City makes clear that the urban forest will be planned and managed on par with other types of city infrastructure. While ordinance and public policy are critical to the urban forest, departmental policies and guidance play an equally central role.

As the American Public Works Association Notes:

> **The adoption and enforcement of urban forest management policies and guidelines can support a change ... from a problem-specific, crisis management, and reactive approach to a more proactive, professional management response.** The lack of such useful policy statements and guidelines can allow agencies to act independently without regard to efficiency or effectiveness, hinder attempts to coordinate the action of public agencies regarding the proper management of public trees, and can confuse interaction of the public works agency with citizens, businesses, utilities, and other outside entities when dealing with public trees (APWA, n.d.)

URBAN FOREST OVERSIGHT

Portland, Oregon, has an 11-member Urban Forestry Commission, whose members are appointed to 4-year terms by the mayor in consultation with the Parks and Recreation Commissioner and approved by City Council.

At least three commission members "have experience and expertise in arboriculture, landscape architecture or urban forestry." The remaining seven members represent a wide range of neighborhoods. There is also an Urban Forestry Appeals Board which hears appeals related to the City Code provisions for the Trees and Urban Forestry (Title 11).

The Portland Urban Forestry Commission meets at least ten times annually, and its' responsibilities include:

1. Assisting with the development, reviews, and updates to the urban forest plan.
2. Providing review and input on plans, policies, and implementation projects that affect urban forestry.
3. Advising the City Forester, Parks and Recreation Commissioner, and the Citizen's Budget Advisory Committee on annual Forestry Division budget requests.
4. Making recommendations to the city council relating to amendments to the Urban Forestry Program, the urban forestry Code, heritage tree nominations, and other City department budget requests that substantially affect urban forest programming.

PLANNING THE URBAN FOREST

The American Planning Association recommends that planners collaborate with urban foresters to create:

- Requirements for detailing tree-planting plans in site plan submissions.
- Regulations regarding tree preservation procedures in the development process.
- Management guidelines for tree issues arising in the public hearing process on proposed developments.
- Review of site plans, including having an arborist check the plans for compliance on tree-related issues.
- Requirements for tree-planting and tree-preservation requirements in subdivision regulations.
- Development and enforcement of standards for tree planting and maintenance in parking lots.
- Monitoring of tree protection and proper planting during site development. (APA, 2009)

5. Preparing an annual report that addresses relationships with and City Forester concerns with other city departments. The report includes "an evaluation of the opportunities and barriers to effective management of the urban forest, and assessment of progress on these issues identified in prior annual reports." (City of Portland, Oregon, 2021)

URBAN FOREST PLANNING

According to the Vibrant Cities Lab, the best urban forest master (or management) plans address multiple subjects and priorities to manage and sustain the urban forest. In particular:

- Planting strategies for public sites that deliver benefits to neighborhoods where needed;
- Policies and incentives that promote tree preservation and planting on private lands;
- Systematic monitoring;
- Regular, scheduled maintenance;
- Pro-active risk assessment and management;
- Long-term funding and staffing;
- Active support from municipal agencies, volunteers, nonprofits; and
- Disaster response, mitigation, and remediation. (USFS et al., n.d.)

The American Public Works Association series on Urban Forestry Best Management Practices (BMPs) for Public Works Managers notes the importance of creating an Urban Forest Management Plan, stating:

> The existence of an urban forest management plan in a community indicates a high level of commitment to protecting trees, and it indicates a higher level of education and knowledge about natural resource issues in general. The benefits of trees can be maximized when both professional management resources and an educated public coexist.
>
> With a tree inventory and urban forest management plan, a public works agency can objectively consider each specific issue and balance these pressures with a knowledgeable understanding of trees and their needs. (APWA, n.d.)

Urban forest planning (along with other types of green infrastructure) should collaborate between municipalities and counties within a single ecosystem boundary to maximize urban forest benefits, particularly improvements to water quality. Watershed-level tree canopy goals, for example, can be set through regional councils to improve water quality (APA, 2009).

PERFORMANCE METRICS

Urban forest plans should include metrics developed to assess whether or not the urban forest is performing effectively to achieve a targeted outcome. Performance outcomes of the urban forest can consist of many different criteria, such as the "amount of carbon sequestered, localized temperature improvements, reductions in the number of bike accidents," and increased stormwater storage capacity during peak precipitation events. (Canfield J., 2018)

Assessing performance and creating targets can provide data to guide decision-making on future projects and produce findings that demonstrate the urban forest's return on investment (ROI). Sharing this data with partner agencies and the public can effectively justify consistent expenditures for tree stewardship (see Funding, below, for additional details).

EQUITY IN THE URBAN FOREST

Urban forestry programs in the United States tend to be most effective in more affluent areas, creating inequities in urban forest distribution and its' associated benefits. The most successful programs to implement equity in the urban forest employ policies and practices that:

- **Develop strong partnerships between municipalities and nonprofits;**
- **Reduce the responsibility of residents for City-owned trees;**
- **Focus planning in smaller, highly targeted areas; and**
- **Use publicly owned property whenever feasible. (Vibrant Cities Lab, n.d.)**

Research on equity outcomes in cities with high-performing urban forests demonstrates that highly integrated partnerships have the best results. When municipalities supply funding, technical assistance, and labor, and partner nonprofits are deeply embedded in cities and provide volunteers, outreach, and education, equitable distribution of public trees is more likely to be achieved. (Ketcham, 2015)

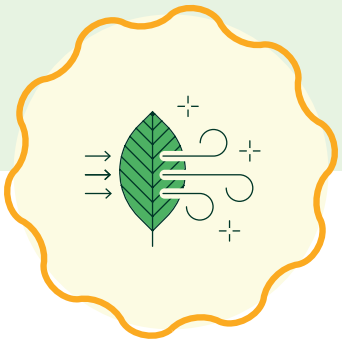
Cities in arid regions have had success planting drought-resistant, heat-tolerant tree varieties in financially stressed areas. In Tucson, Arizona, the Sonora Environmental Research Institute piloted a grant-funded project with a local nonprofit, Trees for Tucson, to increase canopy cover in low-income areas. The Pima Association of Governments identified South Metropolitan Tucson as having significantly fewer parks and vegetation, and the area received new plantings. Working with *promotoras* (community health workers) and volunteers, the researchers conducted extensive community outreach to enroll residents and distribute both trees and tree stewardship information in English and Spanish to area residents, including tree care classes. (Foley, 2019)

Equity also requires a more significant investment in the urban forest on the part of municipalities. A recent cost assessment of the urban forest in Portland, OR, found that the City needed to make a more considerable investment to ensure equity. The consultant team, Davey Resource Group, noted that the City needed to make "an investment in a programmatic shift of tree care responsibilities. With the unequal distribution of trees and burdens for the costs of tree care left to property owners, the City will be challenged to improve the condition of its street tree populations in lower-income, and lower canopy neighborhoods." (City of Portland, Oregon Parks and Recreation, 2019)

ENVIRONMENTAL IMPACT MITIGATION

Robust urban forest policy and planning should include quantifiable strategies to mitigate negative environmental impacts and associated adverse public health outcomes. (Urban forest planning should also provide approaches to reduce the negative social implications of poor urban design, see Placemaking, below, for detail).

Planting broadleaf trees on the east side of streets to shade buildings can reduce air conditioning costs significantly.



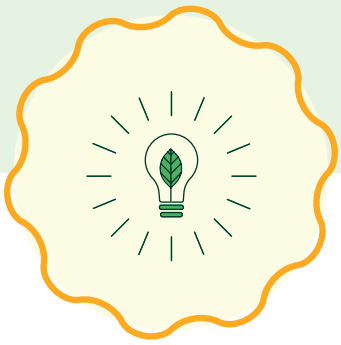
AIR QUALITY IMPROVEMENT

Air quality mitigation measures need to be calibrated to specific pollutants of concern and balanced with needs to reduce energy consumption, manage stormwater, and provide a safe, walkable urban realm. In the broadest sense, this means "planting the right tree in the right place," and following up with testing and analysis to measure outcomes.

According to the US Forest Service, some recommended urban forest management strategies to improve air quality include:

- Sustain the existing tree cover and increase the number of healthy trees,
- Use low biogenic volatile organic compound (BVOC) emitting trees to reduce ozone and CO_2 formation,
- Use long-lived trees to reduce long-term emissions from planting and removing cycle,
- Reduce fossil fuel use in vegetation maintenance,
- Plant trees in energy-conserving locations,
- Plant trees to shade parked cars to reduce vehicle VOC emissions,
- Supply ample water for tree growth - fosters pollution removal and temperature reduction,
- Plant trees in polluted or heavily populated areas, and
- Avoid pollutant-sensitive species. (Nowak, 2002)

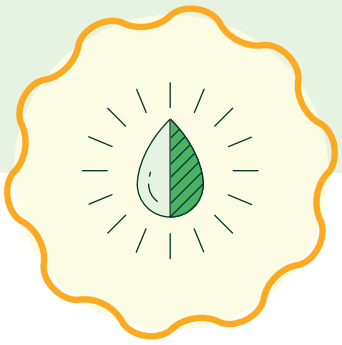
Some evergreen trees can remove particulates year-round when planted strategically as buffers in locations with high particulate matter concentrations. However, due to safety issues caused by reduced visibility, evergreens generally are not appropriate street trees. Further, typical evergreens do not produce adequate canopy to achieve comfortably shaded sidewalks. Evergreens can provide too much shade to sidewalks in winter, preventing sunlight from reaching sidewalks, and resulting in loss of human comfort and potentially icy (slippery) conditions. Cities should consider evergreens for strategic planting on public or private property bordering freeways (or other high-emissions traffic routes), provided that safety concerns are addressed.



ENERGY CONSERVATION

Planting deciduous trees to shade windows can provide significant reductions in energy use. "In a study of the impacts of street trees in California, Lawrence Berkeley National Laboratory and Sacramento Municipal Utility District found that trees placed around houses to shade windows yielded between 7 and 47% energy savings. Other studies suggest energy savings from properly planted trees may be closer to 5–10%." (American Rivers et al., 2012)

Trees Charlotte, a North Carolina public/nonprofit partnership, recommends planting deciduous trees on residential buildings' southern and western facades. Strategically locating trees reduces air conditioning use in summer and decreases the need for heating in winter via passive solar gain. "Strategically placed shade trees – a minimum of three large trees around [a] home – can reduce air conditioning costs up to 30 percent." Evergreen trees, when correctly located, can block winter winds and reduce energy consumption for heating between 10 and 50 percent. (Trees Charlotte, 2015).



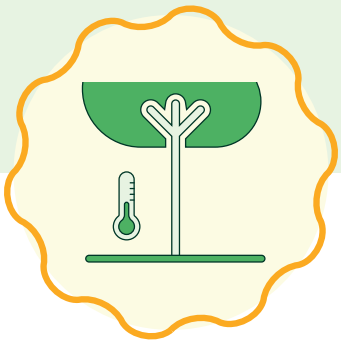
WATER QUALITY + STORMWATER MANAGEMENT

Like Salt Lake City, Boise is a Mountain West capitol, the largest city in the state, and has a similar climate. Boise experiences air pollution associated with winter temperature inversions and often has high summer ozone levels. Although it receives less annual precipitation than Salt Lake, Boise has made the urban forest the centerpiece of its stormwater management strategy.

Boise's 2015 Urban Forest Management Plan incorporates water quality and stormwater management goals by increasing canopy cover to intercept rainfall and subsurface stormwater retention and infiltration. The plan prescribes large trees to achieve a 15% increase in canopy cover from existing conditions.

Large trees require a greater soil volume, which can be challenging to achieve in highly paved areas. Boise used suspended pavement systems downtown to address this problem, supporting large trees and creating underground areas for root mass and stormwater retention and infiltration. (Vibrant Cities Lab, 2015)

(See Suspended Pavement Systems, below, for more information.)



URBAN HEAT ISLAND

In the desert Southwest, metropolitan governments have expanded their urban forests to address the interconnected issues of livability and equity in their cities. One of the guiding principles of Tempe, Arizona's 2017 Urban Forest Master Plan is "Expand Shade to Maximize Urban Cooling." Shade is the central strategy for Tempe's 2040 General Plan Goal of becoming a "20-Minute City." In this type of city, all services and amenities are accessible to residents within a 20-minute walk, bike ride, or transit ride from their neighborhood. The Urban Forest Master Plan directs the City of Tempe to: "Create a vibrant, walkable 20-Minute City that benefits public health and economic development by planting trees and building structured shade. Designers can augment this principle by planting trees [on private property] and using construction materials that reduce the urban heat island (UHI) effect." (ASU Sustainability Solutions Initiatives, 2017).

Tempe's big-city neighbor, Phoenix, developed a Tree and Shade Master Plan in 2010, demonstrating the critical importance of providing shade in arid, sunny urban climates. The plan examined regulatory hurdles preventing shade structures over public sidewalks to quickly add shade to pedestrian routes and outlined strategies to increase the tree canopy. The vision set forth is for shade canopy coverage over 25% of the City in the two decades between 2010 and 2030. (Phoenix, 2010)

The City of Phoenix's Zoning Ordinance's general landscaping standards (Chapter 13, Walkable Urban Code - Section 1309.A) requires street trees to be planted in the public right-of-way, with exceptions for public utility easements. When projects cannot include trees, they must use architecturally or artistically integrated public amenities to provide shade. Public amenities can include structural shade, seating, artwork, and wayfinding signage. See Transitional Elements, below, for more detail and examples of public amenities used to provide shade.

The Downtown Code includes shade standards, which require that building orientation minimize heat gain and consider the impact of shade on adjacent areas. Buildings over 5,000 square feet or building additions of over 500 square feet are required to provide shade over 75% of the public sidewalk, 50% of which must be provided by trees or trellised vines. The shade calculation is based on the summer solstice and may include shade cast from a building. (Phoenix, Zoning Ordinance, n.d.)

PRESERVATION

The American Planning Association (APA) advocates a balanced approach to preservation and development. The APA recommends ordinances recognizing which trees require protection and reasonably account for all the benefits trees provide when removing healthy trees.

> The best tree preservation ordinances recognize that it is unnecessary to preserve all trees to allow for desired types of development. These ordinances place significant trees in the site design and review process.
>
> ...When trees are destroyed during development, a good tree preservation ordinance provides methods for quantifying the value of the lost benefits provided by those trees and creates a mechanism for that value to be returned to the community (APA, 2009).

The (APA) recommends that to preserve trees and maximize the urban forest's performance; municipalities should:

1. Integrate tree protection and planting requirements into the zoning ordinance and not rely on a separate tree or urban forestry ordinance;
2. Foster collaboration between planners, interdisciplinary city-staff, decision-makers, developers, environmental advocates, and other community stakeholders to draft ordinances;
3. Develop performance standards for Planned Development approvals; and
4. Create clear, realistic means to enforce tree preservation regulations with a process driven by internal city department collaboration. (APA, 2009)

URBAN ECOSYSTEM HEALTH

The urban forest should be considered holistically in terms of its relationship to built systems and other parts of the urban ecosystem, including waterways, wildlife, and social spaces.

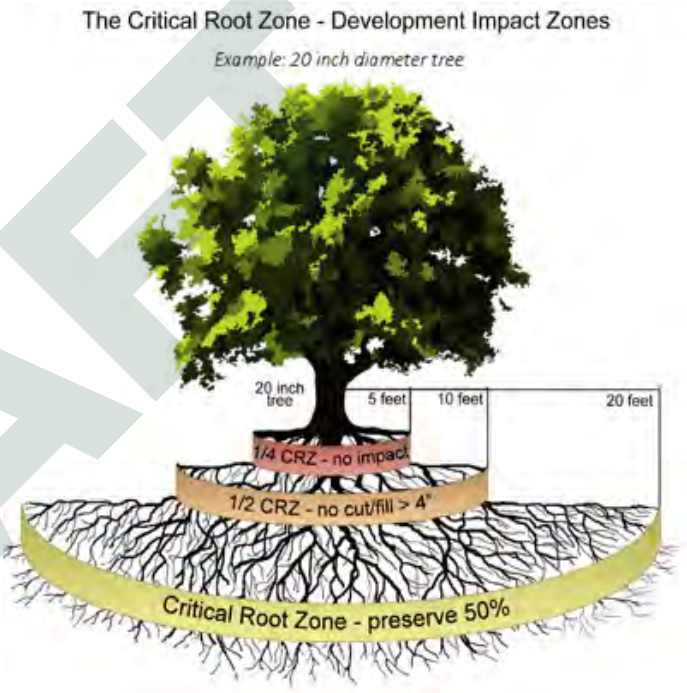
MINIMUM SOIL VOLUME ORDINANCE

Adequate soil volume is critical to the size, health, and longevity of urban trees. Although some cities regulate planting space with surface area, many cities now require minimum soil volumes by ordinance, guidelines, or streetscape specifications. These cities include Boise, Denver, San Diego, Seattle, Chicago, New York, and the state of Minnesota requires minimum soil volumes. (Marritz L., 2020).

In areas with extensive pavement, such as downtowns, cities increasingly use suspended pavement systems to maximize growing conditions and comply with required soil volumes. (See Suspended Pavement Systems below for more information and examples of this technology).

ROOT PRESERVATION ZONE

The Arborist for the City of Austin, Texas, notes that "Tree preservation is effectively defined as root system preservation," and assigns a "Critical Root Zone (CRZ) Area "to each tree based on the diameter of its trunk. Austin requires that 50% of the CRZ remain undisturbed to ensure minimum compliance with its Environmental Criteria Manual (3.5.2 – Tree Preservation Criteria), adopted as part of its city code. (City of Austin, Texas, 2020).



City of Austin Tree Preservation Guidance
http://austintexas.gov/page/tree-and-natural-area-preservation

LEAF LITTER REMOVAL + WATER QUALITY

City land managers can mitigate the impacts of urban forest leaf litter on water quality (described in Chapter 2) through various means, the most common practice being street cleaning paired with robust leaf litter removal programs. (Selbig, 2016)

Sacramento designates a "leaf season," between November and January, when people are allowed to rake leaves into the street, along the curb, in addition to using yard waste bins. During leaf season, Sacramento's Recycling and Solid Waste division have "10 to 15 crews using 'The Claw' and rear loader trucks to scoop over 26 million pounds of leaves and yard waste debris off of city streets. Crews work up to six days a week, rain or shine, including holidays." (City of Sacramento, 2017). During leaf season, the Recycling and Waste Division will collect up to 13 containers of leaves from houses. Each street gets a visit from "the claw" 7 times to collect curbside leaf litter. (City of Sacramento Public Works, 2020)

Minneapolis does not permit leaves to be swept into the street and requires yard waste to be bagged or bundled. In addition to yard waste bins, the City allows residents to use kraft paper bags and BPI-certified compostable plastic bags. Conventional plastic bags are prohibited for yard waste. (Minneapolis, MN, n.d.)

The City of Boise uses a combination of yard waste bins and large paper bags for leaf litter collected through its unlimited compost program. Boise then composts the material and provides the finished product to residents for free. (City of Boise, n.d.)

Denver's street sweeping program has a monthly schedule. It enforces posted parking restrictions so that both sides of the street are cleaned. Denver's Department of Transportation and Infrastructure (DOTI) notes: "Street sweeping plays a critical role in keeping Denver's streets, air and water clean. DOTI's street sweeping program removes dirt, leaves and debris from city streets, which reduces air and water pollution and supports a clean environment." (Denver, 2020)

INCENTIVES

Many cities provide incentives to developers to enhance and protect the urban forest or provide other types of green infrastructure. These include:

- **Density bonuses;**
- **Flexible development standards;**
- **Reduced development fees;**
- **Streamlined approval processes; and**
- **Permit fast-tracking.**

The APA notes that "In practice, localities often provide these incentives to projects that qualify for specific green building or neighborhood certifications." (American Planning Association Green Communities Center, 2016)

Another preservation incentive that many cities provide is a Tree Memorial program, which can also serve as a funding source for urban forestry programs. Boise, for example, runs a Tree and Bench adoption program which focuses on resources in City parks. The adoptions have a 20-year term, are renewable for a second 20-year term, and can commemorate people, dates, and events.

A personalized plaque (designed using City standards) is attached to a tree or bench in either a neighborhood or "premiere" park. Plaque pricing is based on location, tree size, or bench material. Eligible trees must be at least two years old, ensuring that the tree will thrive for the adoption period. (City of Boise, 2020)

By associating a tree with a person or event, it becomes imbued with cultural and personal meaning. It is, therefore, more likely to be quickly understood as an essential resource and preserved.

ENFORCEMENT

Many municipalities use tree Protection (or Preservation) Bonds throughout the United States to protect trees during construction activities.

According to Alpha Surety and Insurance Brokerage,

> A Tree Preservation Surety Bond is a license. It permits surety bond required by certain jurisdictions for individual and commercial property developers. The bond typically ensures one of two things. It guarantees that the construction project will not harm specific trees considered to be protected, and, if damaged, the developer will reimburse the jurisdiction for [its] loss. Two, it guarantees that the developer will plant replacement trees for protected trees that they must tear down for the construction project. Once the project is complete and the jurisdiction verifies protected trees are unharmed and [healthy] replacement trees are in place, a municipality can release the bond.

Bonds are often held for two to three years after a Certificate of Occupancy is issued. This time span gives new trees time to establish and incentivize the developer to water and care for the plantings.

Fines assessed for violations of Tree-related ordinances can be relatively high in some cities. In Sacramento, for example, breaches of the Tree Planting, Maintenance and Conservation Code incur civil penalties between $ 250 and $ 25,000 per day. (City of Sacramento)

Case studies demonstrate that cities are most effective in protecting the urban forest when they take a collaborative, interdisciplinary approach between departments to creating and enforcing ordinances. (APA, 2009)

TREE REPLACEMENT MITIGATION

According to arborist Dr. R.J. Laverne, Manager of Education and Training for Davey Tree, the best approaches to tree replacement costs factor ecosystem services and public health benefits into their fees. He notes:

> An inventory of the trees lost during construction can be used to calculate a monetary value that fairly represents the lost benefits to the community. Cities can then require the developer to pay the "lost benefit" sum into a community fund to plant and maintain trees. It is necessary to develop a method that fairly translates the environmental, social, and economic value of trees into a dollar amount. (APA, 2009)

Sacramento requires that private protected trees and all public trees be replaced either on or off-site. Fees in lieu of replacement are only permitted through a resolution adopted by City Council. Those fees and civil penalties for violations are deposited into a Tree Planting and Replacement Fund, which can only be used for that purpose. (City of Sacramento)

Some municipalities use a different approach when developers cannot provide the required number of trees on private property to establish an off-site mitigation bank. In Fulton County, Georgia, these are referred to as "tree banks," and defined as "a site such as a school or public park, where the owner/developer shall donate and plant the required trees when it is not feasible to plant the required trees within their site's project area." (Fulton County, 2020)

SOLUTIONS FOR UTILITY + TREE CONFLICTS

Conflicts between trees and utilities (both above and below ground) are commonplace in municipalities. There are various ways to either avoid or mitigate conflict. First, avoiding conflict by proactive planning for utility and tree placement during the project design phase. Proactive approaches ensure trees are located and sized appropriately and are generally the most cost-effective approach; this is common practice for above-ground utilities. However, avoiding utility conflict is not always possible for below-ground utilities, particularly with urban infill projects.

Cities can develop a geographic information system (GIS) analysis of utility locations to model the outcome of their current policies to determine if canopy or tree stocking goals can be met using those criteria.

For example, Salt Lake City's current policy is that trees must be located at least 10 feet from existing or proposed water lines. The city also requires street trees to be planted (or replaced) at approximately every 30 feet based on zoning code requirements related to building frontage.

By spatially locating both on a map, areas of conflict become evident. These areas can then be overlaid with maps of proposed projects or city code amendments, along with priority areas for tree preservation and expanded planting.

In high-priority tree planting locations where utility conflicts are unavoidable, there are a variety of technologies and techniques to either resolve disputes or mitigate potential problems. These costs should be factored into project planning in locations where tree planting or preservation is highly prioritized. Additionally, city land managers can further analyze utility lines scheduled for abandonment to plan for trees in those locations on the appropriate timeline.

MITIGATION TECHNIQUES

Mitigation measures for underground utilities include a range of actions and technologies:

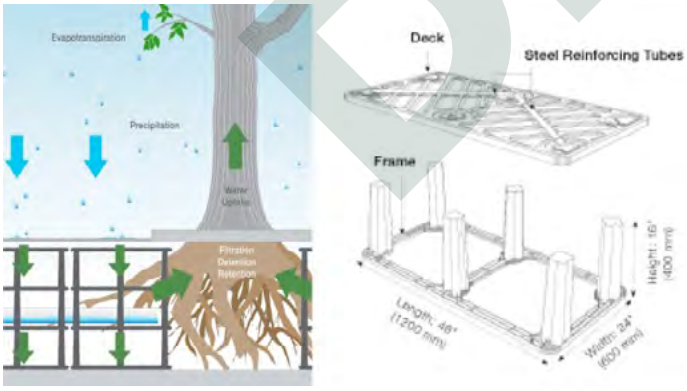
1. Locate utilities in a designated utility corridor that will not conflict with tree roots.
2. Place utility lines in the street instead of the park strip (particularly as opportunities become available during road reconstruction projects).
3. If cities must locate utilities in park strips (without existing trees, they should place utilities directly behind the curb and not in the center of the park strip, where trees are typically planted.
4. Place conduit that resists tree-roots during new construction to accommodate current and future proposals for utility lines as technologies change.
5. Plant trees with non-invasive roots or trees with a small root ball.
6. Use physical or (non-toxic) chemical barriers near utility lines to inhibit root growth. (Teske, 2013)
7. Combine utilities by using suspended pavement systems for stormwater management and planting trees. (In locations with clayey subsoils, an underdrain for overflow stormwater can be placed below the tree root zone).
8. Consolidate utilities and stack them vertically in one predictable location (City & County of San Francisco, 2015).
9. Place utilities in precast concrete vaults underground.

Suspended pavement systems allow roots to thrive, growing large, healthy trees, while also storing overflow stormwater. Photo above shows a Silva Cell™ System being installed in Toronto, Canada 2010 *(Deeproot.com)*

SUSPENDED PAVEMENT SYSTEMS

In densely paved urban areas where soils are typically heavily compacted, suspended pavement systems have become a go-to solution to providing soil volumes that support healthy, large trees.

Suspended pavement systems, often referred to by the brand name Silva Cell, support pavement loads while creating space for tree roots without soil compaction. **These systems also store overflow stormwater, which eventually waters the tree and infiltrates into the soil, recharging groundwater supplies and improving water quality.**



Silva Cell™ System
(*Ecological Engineering, Vol. 82, September 2015*).

A 10-year study in a commercial area in Toronto demonstrated that supported pavements systems:

- Increased the tree canopy while using a small surface area;
- Provided stormwater management through reduced water volumes;
- Improved water quality through increased infiltration and pollutant removal by soil; and
- Promoted Low-Impact Development (LID), or Green Infrastructure, without the higher maintenance costs incurred by surface bioretention swales. (Sustainable Technologies Evaluation Program (STEP), 2018)

A 2006 study that compared structural soils, non-compacted soils, and suspended pavement systems found that

> "Suspended pavement over non-compacted soils provided the greatest amount of tree growth and health and should be considered when designing urban planting sites for trees."

Trees in suspended pavement systems were also "larger, faster-growing, had better color, and more root growth." (Smiley, 2006)

PROMOTION

FUNDING

Urban forestry programs require stable, adequate funding sources to maintain the benefits trees provide throughout their lifespan. The American Planning Association notes that urban forestry programs are most often underfunded based "on perceptions of its benefits to the community," which are usually only considered in terms of aesthetics. One of the best ways to ensure stable funding is to document the multiple benefits of the urban forest over the long term and ensure that those benefits are regularly and effectively communicated to the public. (APA, 2009)

In the past urban forests were viewed as expensive aesthetic benefits, in which individual trees were relatively disposable resources. Now, however, municipalities are increasingly quantifying the value of the ecosystem, public health, and social benefits urban forests provide, as well as their contribution to economic development. The urban forest becomes a profit center by viewing the urban forest as infrastructure that generates follow-on economic benefit (in the same manner as roads, light rail, and other infrastructure).

While general fund allocations are typically the primary funding source for urban forestry programs, there are other possibilities for consistent funding streams dedicated to the expansion and preservation of the urban forest. For example:

- Olympia, Washington uses a capital improvement plan fund derived from real estate excise taxes and utility taxes, with interest, to underwrite its program.
- Salem, Oregon funds its care of street trees through the municipal portion of the state motor fuel tax while funding some tree preservation through fines and donations.
- Urbana, Illinois, also uses fines to aid its program, particularly for motorists who damage trees in crashes.
- Other cities have carved out a role for nonprofit organizations in supplementing tree funding. For example, the Sacramento Tree Foundation is substantially funded by the local Municipal Utility District. (APA, 2009)

Development and impact fees can also play a role in funding tree programs, supported by regulations that "establish fees related to permit processing and enforcement." By including these fees in the zoning, subdivision, and landscaping codes and then linking these to the parts of the urban forestry program that benefit redevelopment or new development, cities can leverage growth to expand the urban tree canopy. Given the demonstrable evidence that urban forests add value to further economic development, "another option is to dedicate a portion of revenue from a tax increment financing district to urban forestry improvements." (APA, 2009)

Partnerships between cities, chambers of commerce, and philanthropists are another route to generate funds for urban forest expansion and maintenance. Denver, Colorado, has created an Urban Forest Initiative to grow the downtown area's urban forest canopy from 4% to 10% cover. The Initiative is jointly funded by the Downtown Denver Partnership, City and County of Denver, Downtown Denver Business Improvement District, property owners, and the philanthropic community. It provides grants to property owners to improve tree-growing conditions.

Another method to provide funding for the expansion and ongoing maintenance of urban forests is creating Community Benefit Districts or CBDs (known as Business Improvement Districts in Salt Lake City). Cities can create these districts in commercial areas and mixed-use neighborhoods, developing a public/nonprofit partnership to supplement existing public funds used to maintain and improve those areas. Communities vote to establish CBDs, and then "local property owners are levied a special assessment to fund improvements [and maintenance in] their neighborhoods. The funds are administered by a nonprofit organization established by the neighborhood." (City and County of San Francisco, n.d.)

INVESTING IN THE URBAN FOREST IS INVESTING IN PUBLIC HEALTH

A 2016 Nature Conservancy white paper, Planting Healthy Air, found that street trees are a cost-competitive solution to reducing concentrations of particulate matter (PM) as well as lowering temperatures.

> The benefits that trees deliver, in terms of $ per ton of PM removed or $ per degree of temperature mitigation, are in the same range as major built infrastructure alternatives. More importantly, street trees are able to deliver benefits both to PM and temperature mitigation, while grey infrastructure alternatives generally are not. (McDonald, 2016)

The return on investment is greatest when neighborhoods with the highest residential density are targeted for tree planting. For example, in Los Angeles, researchers found that by investing an additional $6.4 million annually in street tree planting in central LA, Santa Monica, and Long Beach, an estimated 400,000 residents could experience a reduction of 2.7° F (1.5°C) in summertime temperatures. (McDonald, 2016)

Investigating cities across the globe, the Nature Conservancy found that approximately $4 per city resident spent on urban forests can significantly mitigate air pollution and provide urban cooling.

COMMUNICATION

Communication and education about the urban forest and its benefits is a crucial aspect of gaining public participation in the stewardship work. Information about the Urban Forest's value to multiple parts of community building should be disseminated to all City departments, plan reviewers, developers, and Salt Lake City residents.

The Salt Lake City-based nonprofit TreeUtah incorporates education into every aspect of its work. Volunteers run workshops, guided tree identification hikes, and provides curriculum to second-grade students through their Discovering Trees program. The organization has approximately 30 team leaders and would like to increase the volunteer group to 50.

Volunteers range from one-day participants to team leaders and professional arborists. TreeUtah plans to expand its online presence by recording online workshops, live streaming in-person events, and educating the public through social media storytelling to reach a broader and more diverse audience. (Personal Communication, May, 2021)

The Sacramento Tree Foundation (SacTree) plays a significant role in the success of the City's urban forest. Pamela Frickmann Sanchez, the Education Programs Manager for the Sacramento Tree Foundation, attributes the organization's success to forming partnerships with utility companies, which has allowed them to expand their educational outreach efforts. The organization works closely with Sacramento Municipal Utility District (SMUD), a publicly owned utility company, and Sacramento's water company.

The water company uses its platform to invite residents to classes on tree irrigation and tree care conducted by SacTree. The ongoing partnership and SMUD funding allow SacTree to provide professional consultations to property owners who receive free shade trees through the Sacramento Shade program. SacTree assists the owners in picking out an appropriate tree, delivers the trees, and plants them. Working with the utility companies ensures the trees are planted in proper locations and do not conflict with existing or planned infrastructure, provides a free service to residents, and promotes the mission of the Sacramento Tree Foundation. (Sanchez, 2021)

Cities can also use graphic design, social media, and place-based campaigns to communicate the benefits of and threats to the urban forest. For example, The City of Denver uses a tongue-in-cheek marketing campaign (below) to educate its residents about the danger of Emerald Ash Borer, an invasive pest introduced in 2002 which has decimated millions of Ash trees, primarily east of the Mississippi River. (Ash is a widespread species for street trees and timber use whose presence was first detected in Colorado in 2013).

URBAN FOREST + ECONOMIC DEVELOPMENT: ADDED VALUE

A healthy urban forest adds value to both retail and residential development in cities of all sizes, as demonstrated by numerous studies and surveys (for additional information, see the University of Washington's website on the Human Dimensions of Urban Forestry).

A combination of user-friendly regulations and effective communication of added value to developers, investors, and nonprofits is key to creating the partnerships needed to sustain a thriving urban forest.

Retaining trees during development can be an effective way for developers to increase profit margins. As multiple studies cited on the Green Cities: Good Health website demonstrate:

> "Understanding potential market values in different forest conditions is an important step in understanding the economics of urban forest protection. Market price studies of treed versus untreed lots show a range of value enhancements:

Price Increase	Condition
18%	Building lots with substantial mature tree cover
22%	Tree-covered undeveloped acreage
19-35%	Lots bordering suburban wooded preserves
37%	Open land that is two-thirds wooded

> Generally, trees and forest cover in development growth areas add value to parcels. One study found that development costs were 5.5% greater for lots where trees were conserved. Given increased lot and home valuations, builders have reported that they were able to recover the extra costs of preserving trees through a higher sales price for a house, and that homes on wooded lots sell sooner than homes on unwooded lots."

Communicating this to decision-makers and developers can assist both in the ordinance amendment process and demonstrate that existing trees are often an asset to the development and should be managed and protected.

The City of Boise aims to become "the most livable city in the country." It has made street trees a centerpiece of their LIV district strategy (LIV is an acronym for Lasting environments, Innovative enterprises, and Vibrant communities).

Boise's central addition LIV district, a 50-acre area downtown, used a combination of pervious paving and Silva Cells™ (see Suspended Pavement Systems, above, for details) for stormwater management as a strategy to attract development by adding amenity (large trees) and increasing developable land area.

Boise requires private property owners to manage all stormwater volumes from 50- or 100-year storms on-site, while the Ada County Highway District manages stormwater runoff from rights-of-way and public streets in Boise. Stormwater is typically infiltrated into soils due to local soil characteristics and low annual precipitation levels.

The Urban Land Institute (ULI) interviewed Boise's stormwater program coordinator, Steven Hubble, about the economic benefits of using suspended pavement in the right-of-way.
He noted:

> "In the Central Addition, we adopted the idea of using space in the public right-of-way for stormwater management both for [City] and private property, given that there would be a benefit to the public by treating the roadway runoff and allowing an opportunity for private development to focus their stormwater in those areas. [This allows] an easier pathway to more vertical development on those sites." (Urban Land Institute, 2018)

ULI's recent assessment of the impact of rising temperatures and heatwaves on urban development examines the growing risk posed by extreme heat. The authors note that "Widespread adoption of mitigation strategies could help reduce the urban warming trends currently occurring in cities, leaving them to contend with a more manageable 1-degree to 2- degree Fahrenheit increase, rather than the 5-degree to 10-degree increase currently projected for some cities due to the urban heat island effect." (Burgess, 2019)

The report explores a range of heat mitigation practices, including providing additional shade through canopy, and note the significant return on investment, including:

- Improved tenant experience,
- Reduced operating costs,
- Enhanced likelihood of business continuity,
- Enhanced branding, and
- Additional foot traffic in pedestrian and retail environments.

In addition, ULI notes that

> Being "heat-resilient" can reduce the likelihood of construction delays caused by extreme heat, increase support from investors, public officials, and other stakeholders, and reduce stress on public infrastructure. ...Heat resilient projects can reinforce the developer's reputation for high-quality, green design; and they can become heavily patronized places of refuge during extreme-heat events, leading to enhanced asset value, higher rent premiums and lower vacancy rates.
>
> ...Operating costs can decline due to less frequent replacement of heat-damaged materials, lower utility costs, and higher chance of sustained operations during extreme heat events. (Burgess, 2019)

PUBLIC/NONPROFIT PARTNERSHIPS

Our City Forest, a San Jose, California nonprofit urban forestry and environmental stewardship organization, works closely with the municipality to provide native and drought-tolerant trees, shrubs, and grasses at wholesale pricing. Our City Forest runs a community nursery and training center where certified arborists and tree experts assist residents in choosing the right tree for their property and obtain a planting permit from the City if the tree is to be planted in the park strip. The nonprofit also has an award-winning partnership with AmeriCorps, where service members are trained to be urban forestry and outreach specialists who go into the broader community to educate residents on best practices.

The Sugar House Park Authority, a local nonprofit, has a successful 50-year partnership with Salt Lake City and County. The Park Authority was deeded the park property, in trust, from Salt Lake City and Salt Lake County after Utah relocated its State Prison in the 1950s. The Board of Trustees consists of seven volunteers and one representative from Salt Lake City and Salt Lake County agencies.

The Park Authority has a 99-year lease to own, maintain, and operate the park with funding provided by the government. (Authority, n.d.) TreeUtah partners with the Park Authority to plant trees as a part of their Commemorative and Memorial Tree Program. The Park Authority maintains a list of preferred trees, and residents work with TreeUtah to select and plant the tree in memory of a loved one.

Vancouver, British Columbia, has a popular and successful Green Streets program where residents volunteer to maintain small gardens in traffic circles, medians, and other small plots created for traffic calming in neighborhood rights-of-way. The City provides the capital investment, and all maintenance, including pruning and weeding, is performed by the volunteers.

PARTNERSHIPS FOR FOOD ACCESS + URBAN AGRICULTURE

Urban forests can be a source of fresh, accessible produce and an opportunity for education on food and nutrition. Incorporating collections of food-bearing trees, either as a supplement to landscaping in parks and playgrounds, as street trees, or in an orchard format (commonly called a food forest), can be an added layer of long-term support for communities.

Another aspect of urban forestry programming that can support food access is providing shade on sidewalks and bike lanes. Shaded pathways for short trips to grocery stores and farmers' markets are more comfortable and inviting, particularly in low-income neighborhoods.

Currently, most fruit tree programming in cities across the United States (including Salt Lake) is through the collection of fruit on private property. Independent nonprofits typically manage fruit harvests with some support from the municipal government, such as the local Green Urban Lunch Box. In Salt Lake City, Green Urban Lunchbox volunteers also pick fruit from trees on government properties.

Municipal fruit trees and edible landscapes are predominantly located in city parks or small, publicly accessible orchards. These are often managed via partnerships with community garden organizations. The City of Durham, North Carolina, has a 5-acre City-owned park in their downtown that a nonprofit organization entirely operates. The park has an edible public garden that grows publicly accessible fruit trees along with other edible plants. While a 501c3 organization manages Durham Central Park, the City of Durham and other partners provide funding support. (Durham Central Park, 2013). Programs like this allow for long-term funding support and management while including public partners with a broad community reach.

Additionally, it is vital to have an appropriate policy supporting the public use of these trees, as exemplified by Minneapolis' recent ordinance change to allow the foraging of fruits in most public spaces (Minneapolis Parks, 2018). Alternatively, some cities have taken on most of the funding and management of planting fruit trees and other food plants in public spaces throughout the City (Vicenti, 2020). Copenhagen is implementing municipal fruit trees and shrubs in parks, playgrounds, sports fields, and churchyards throughout the City (Geddo, 2019).

The key to having fruit trees become an integrated and utilized part of the community is making information available both digitally and on-site for education purposes and creating opportunities for communities to engage with the trees. Workshops, cooking lessons, tree planting and maintenance classes, harvest festivals, and art creation can bring a deeper connection to the landscape and disseminate information about publicly available food resources.

PLACEMAKING

URBAN DESIGN

Urban design that integrates the urban forest into streets and publics enhances livability for all residents of a city, both through principles of environmental psychology and biophilia put into practice by design, and through incorporating and enhancing the ecosystem services trees provide.

Thoughtful urban design plays an essential role in creating livable cities, in large part by responding to wide streetscapes and tall buildings in downtowns through the creation of human-scale spaces. Trees play an essential role in urban design, particularly when planted to subdivide larger areas. Street trees create a "linear sequence," making an architectural (or spatial) rhythm for passers-by. (Gehl, 2010)

This linear sequence of tree trunks serves as a visual vertical plane and separates pedestrians from other modes of transportation, promoting a pedestrian's sense of safety from moving vehicles. The regular spacing of trees builds continuous tree canopies over sidewalks and streets, creating a ceiling plane and providing shade for pedestrians. Both offer a reassuring sense of enclosure and human comfort on city streets and in neighborhoods.

Trees in parks, plazas, and other public spaces are also significant contributors to urban environments and are typically included holistically in the initial design of those places; in contrast, streetscapes tend to evolve with changing development. Street trees provide a wide range of urban design benefits.

These benefits include:

- **The creation or continuation of vistas;**
- **Establishing a more human scale at street level in cities where the built scale is very large;**
- **Providing a visual contrast in form, texture, color and seasonal changes to the buildings; or**
- **Contributing to the element of mystery by hiding and revealing city elements. (Bell, 2005)**

Trees can also provide windbreaks either from downdrafts from tall buildings or protection from cold winter winds.

SCALE + FORM

The scale and form of trees play a significant role in creating a balanced streetscape and inviting places for people to socialize and gather. Typically, large trees with broad canopies are best in both dense urban centers and neighborhoods because their height balances that of tall buildings, creating the effect of a "step-back," and the broad trunks and spreading canopies tend to create more human-scaled spaces, as described above.

Most tree forms are appropriate in streetscapes, with a significant exception being columnar trees. These do not create a ceiling plane or provide adequate shade on sidewalks and streets and are generally better suited for specific purposes, such as creating hedges on private property or within parks.

By evaluating the permitted building heights, form-based codes, and available soil volumes for tree planting, designers can propose a range of tree scales, forms, and species to meet municipal design and environmental goals. (See Neighborhood Urban Forest Districts, below, for additional information).

In areas where existing soil volumes are small, such as highly-paved downtowns, suspended pavement systems provide opportunities to achieve the best urban design outcomes. Boise, Idaho, has used this approach in their Downtown Streetscape Standards & Specifications Manual.

Trees mediate between tall buildings and human-scale spaces in Salt Lake City's Downtown, and help reduce glare impacts.

STREET TREE SCALE

By requiring street trees of a specific scale related to urban design criteria, such as building height and street width, Salt Lake City's public realm can become more livable and inviting.

Building height in residential and commercial areas follows a predictable pattern in Salt Lake City, with the greatest heights allowed in the Downtown and Sugar House Business District areas (Height Zone C, below), where most buildings are permitted a height of 6-10 stories, and up to 25 stories at block corners. Intermediate heights of 3-5 stories are generally permitted along major corridors leading from downtown and in East Downtown (Height Zone B). Typical single-family districts (Height Zone A) are one to two stories.

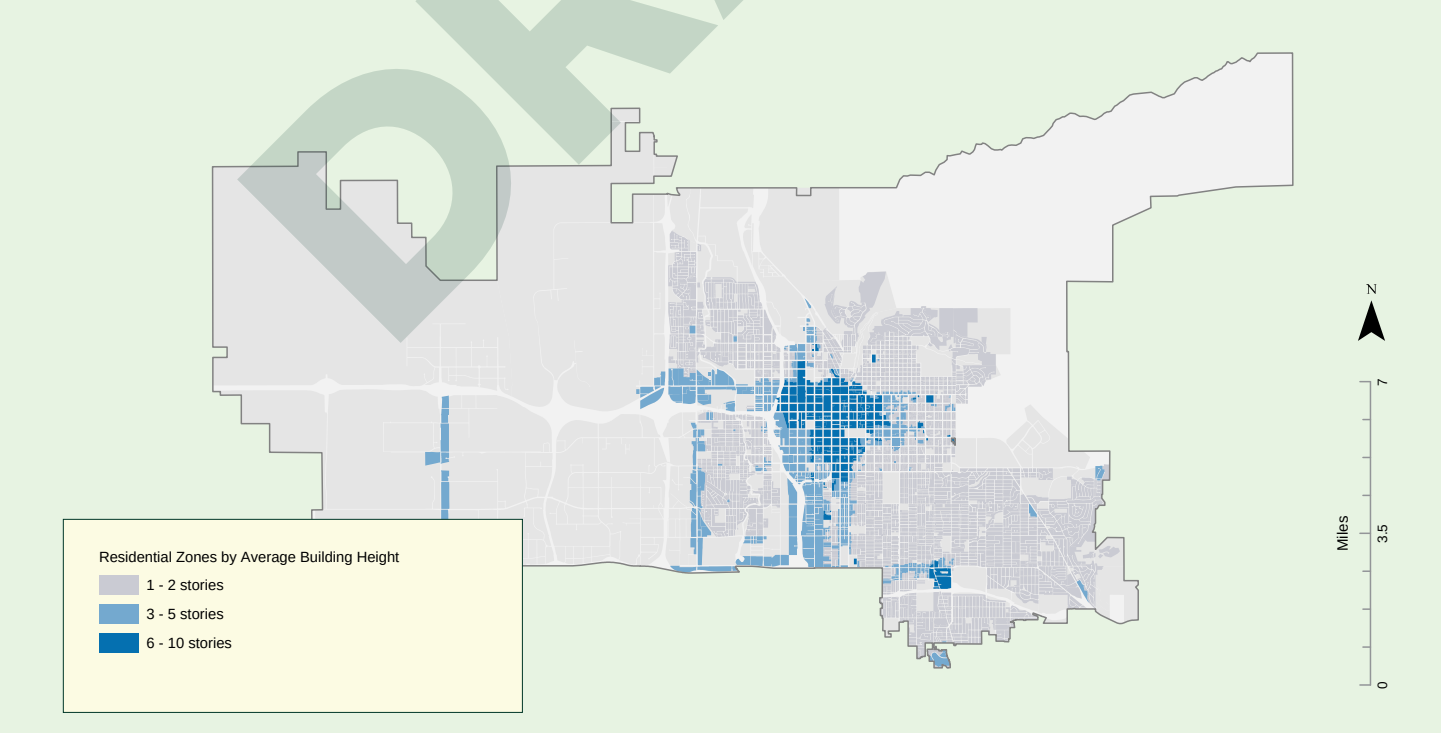
Street width also impacts scale requirements for trees, both for urban design and practical considerations, such as providing shade to asphalt streets to extend their lifespan. See the drawings at right and on the following page for proposed tree scale by height zones.

TREE SPACING

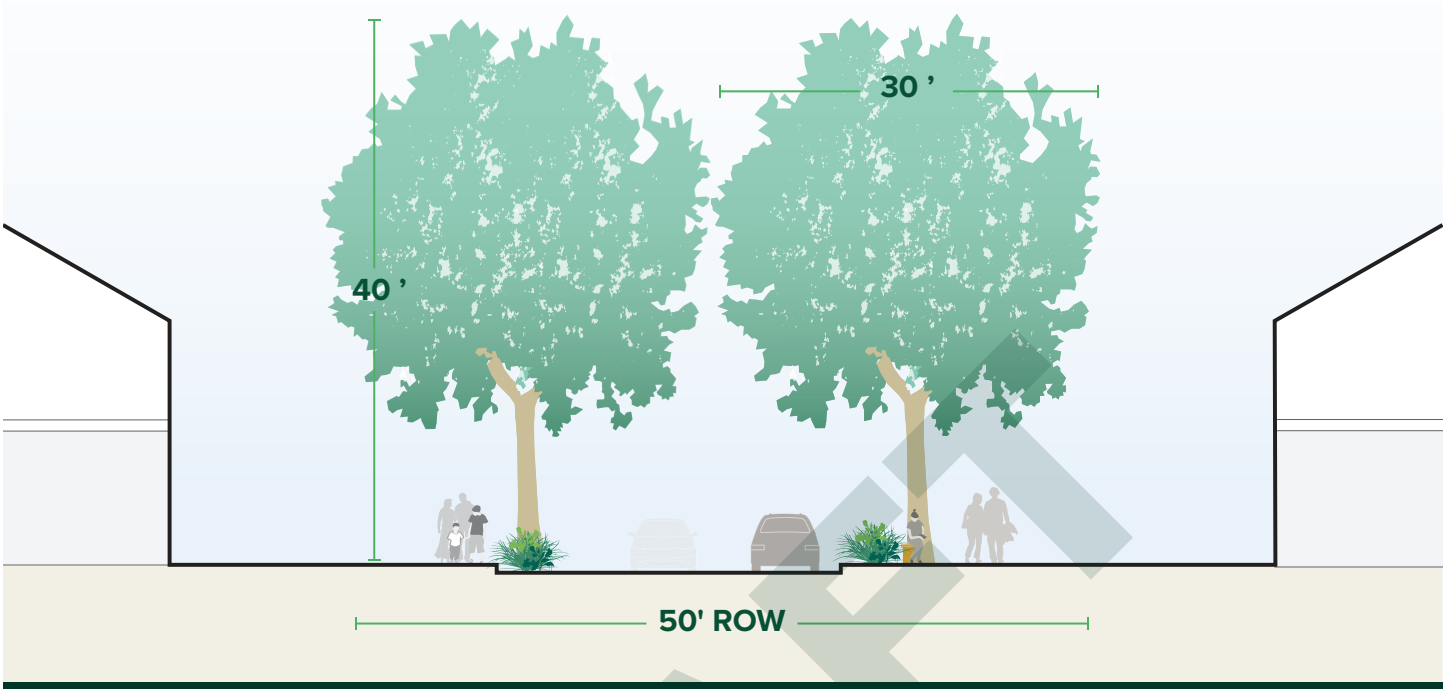
Trees spacing requirements range considerably, from 15 to 40 feet apart in different cities. Criteria for tree planting are often created without attention to the impact of street trees on urban design or resident perceptions of safety and accessibility.

> To be effective, street trees need to be reasonably close together. If one objective is to create a line of columns that separates visually and psychologically one pathway from another, and if a further objective is to provide a canopy of branches and leaves to walk under, then the trees have to be planted close enough to do that. (Jacobs, 1995)

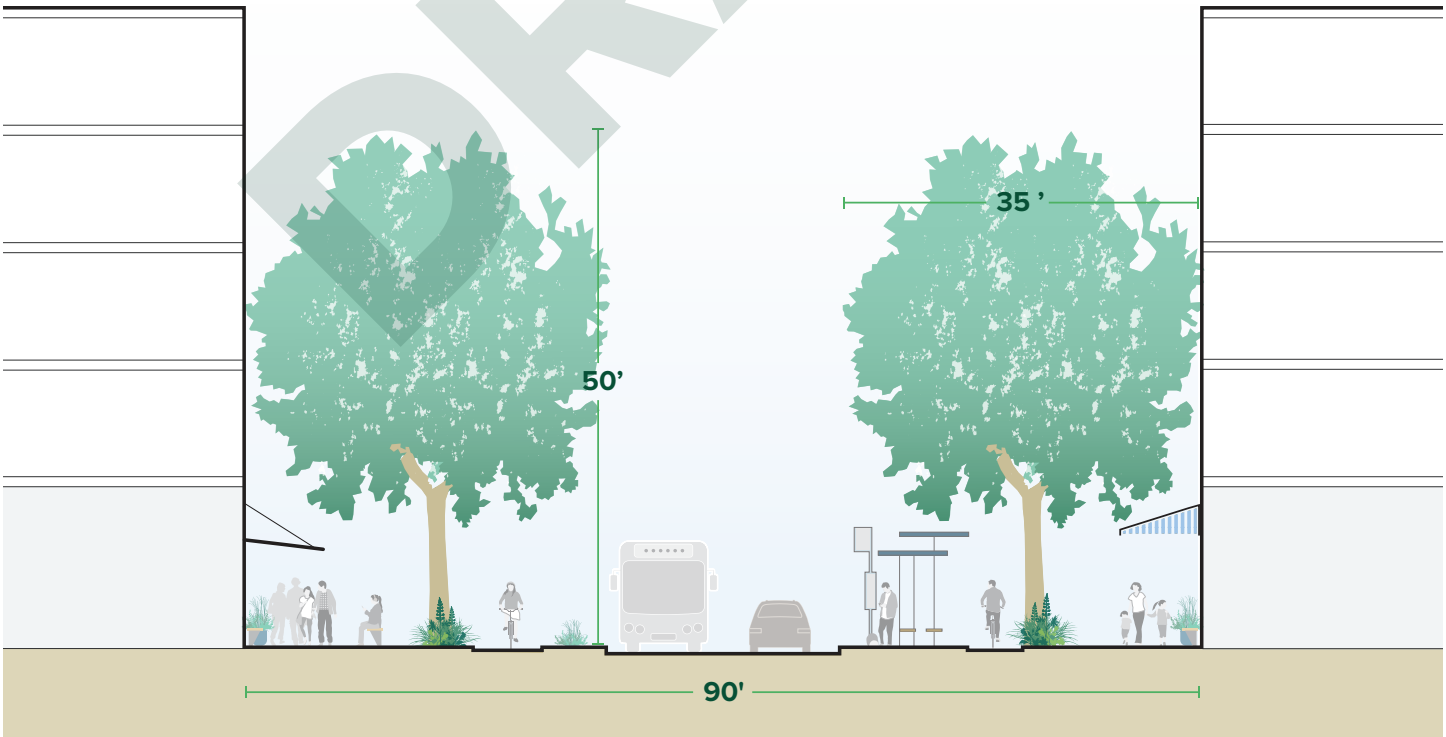
James Urban, a landscape architect and expert in urban arboriculture and soils, recommends using 20-foot on center spacing for trees as a general rule (James Urban, 2003). Tree canopy, longevity, and land-use and urban design contexts should also be considered when developing spacing guidelines.



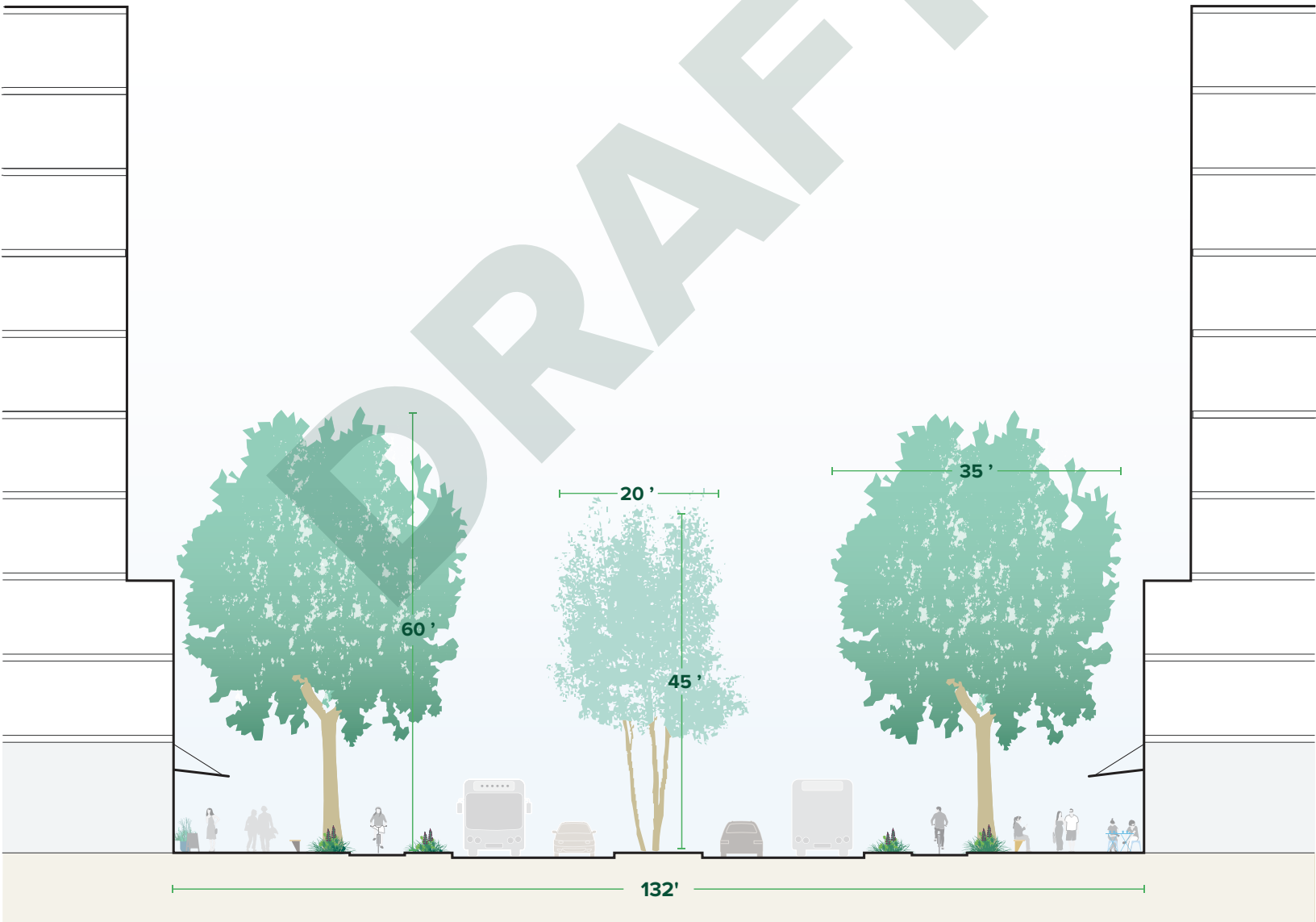
Residential Zones by Average Building Height



Recommended Minimum Mature Tree Scale for Height Zone A (1 - 2 story buildings)



Recommended Minimum Mature Tree Scale for Height Zone B (3 - 5 story buildings)



Recommended Minimum Mature Tree Scale for Height Zone C (6 - 10 story buildings)

TRANSITIONAL ELEMENTS

All urban forestry programs plan for "succession," to achieve a balance of differently-aged trees throughout the City. However, thoughtful, well-designed structural elements can perform similar functions in areas where many new trees need to go in or even where a pronounced "gap" in a row of street trees occurs. Judicious use of these elements can provide a transition as young trees mature over decades or become more permanent elements in locations where tree planting is simply impossible.

While no single structural element can simultaneously provide the multiple benefits that a tree can, there some single functions that can be replicated, namely:

1. Providing shade for energy conservation and cooling (enhanced by misters, when feasible)
2. Creating vibrant, human-scaled social gathering places to improve public health and community cohesion
3. Imbuing spaces with cultural meaning or "sense of place" (public art, for example)
4. Enhancing active transportation routes and traffic calming by adding visual interest and diversity to the streetscape
5. Growing vines on structures can provide limited air quality and carbon sequestration benefits.

However, it is notable that there is a difference in the quality of shade provided by trees and that supplied by structures. Trees contribute to the enjoyment and complexity of the public realm through movement, leaf patterns, and modulation of light. (Jacobs, 1995) While some materials can mimic the translucence of leaves, the biophilic response created by tree canopies is practically impossible to replicate with built shade elements.

In response to the City's immense need for shade and its goal of achieving 25% canopy coverage by 2030, Phoenix, Arizona, requires trees to be planted in what it calls the "Streetscape Zone." Phoenix defines the streetscape zone as the area located behind the right-of-way curb with either landscaping or public amenities. If a public utility easement prohibits trees from being planted in the Streetscape Zone, then architecturally or artistically compatible public amenities, including structural shade elements, must be provided for the area (Section 1207).

Shade elements may include trellises, covered walkways attached to buildings, or detached, architecturally compatible shade structures. Structures must contain at least one side that is 50% open. (Phoenix, Zoning Ordinance, n.d.)

When new development cannot include trees, or when newly planted trees are too small to provide shade or other benefits, public amenities can act as either permanent or temporary installations to provide similar aesthetic, environmental, and community benefits.

The Phoenix Office of Arts and Culture has commissioned multiple public art installations that act as shade canopies and are typically included in more extensive infrastructure or urban design projects. Commissioned works include bus shelters, pedestrian bridges, and seating areas.

Matter Architecture Practice and landscape architects Gavan & Barker Inc. integrated landscape architecture and civil engineering to create "Bloomcanopy," a hybrid public art/shade structure. The canopy provides shade, and the plaza below was designed to accommodate stormwater runoff. (Bloomcanopy, 2021)

Bloomcanopy. Photo by Matt Winquist

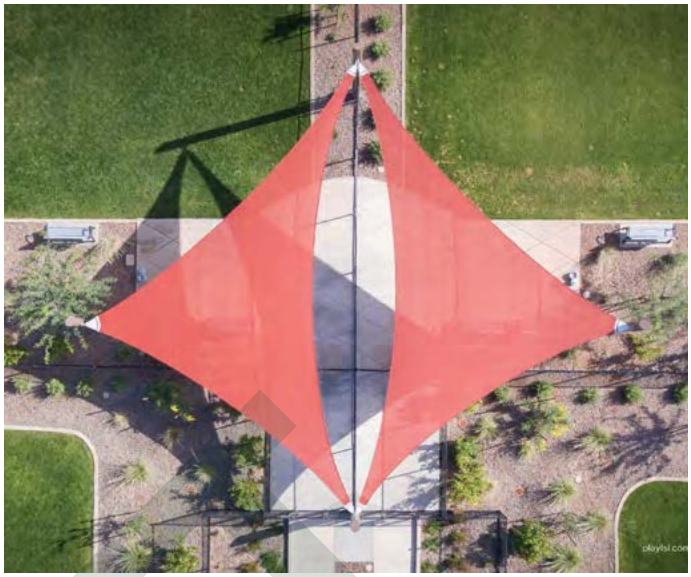
Bloomcanopy. Photo by Matt Winquist

Shadow Play. Photo by Matt Winquist

The 2018 American Institute of Architects (AIA) Small Project Award winner, “Shadow Play” sculpture (above) designed by Howeler + Yoon Architecture, is a cluster of shade structures placed in a former traffic median, providing pedestrians shade and seating in the daytime and solar-powered light at night. (AIA, 2021)

Cities can also use temporary public art installations to provide shade for city residents in areas where planting trees is not feasible due to conflicts with public utilities or narrow street rights-of-way. Originating in Portugal, the Umbrella Sky Project is an open-air museum that its creators describe as “A simple idea that brings color and protection to public spaces while transporting us into a fantasy world!” (Impact Plan, 2021) The project has traveled from Paris and Stockholm to Pittsburgh and Miami, creatively providing city dwellers with both shade and public art.

Shadow Play at dusk. Photo by Matt Winquist



Shade structure, photo by Landscape Structures 2021

The Umbrella Sky Project, 2021

Commercially available shade structures may also be appropriate for some locations, particularly to provide shade as young trees mature. Shade structures should be sited carefully so that they can be removed without damaging adjacent infrastructure. Once the tree provides adequate shade, structures can be removed and relocated where they are needed.

Whimsical shade structure, Landscape Structures 2021

NEIGHBORHOOD URBAN FOREST DISTRICTS

Developing a range of tree species (selected for form, scale, color, and other characteristics) to plant in specific areas of a city can enhance the character of city neighborhoods and urban districts. Economic success and community investment are often linked to an identifiable character, or image, of a place or neighborhood. The 9th & 9th neighborhood in Salt Lake City is an excellent local example of this phenomenon.

Urban designers, landscape architects, and urban foresters can collaborate to develop a selection of street trees defined by shared aesthetic and ecologic characteristics that provide a sense of place and emphasize transitions between different city areas. At the same time, grouping trees in this way can encourage biodiversity while simplifying irrigation and maintenance regimes by creating streetscape tree stands with similar water needs.

A connected grouping of trees selected using form, scale, color, and texture criteria (what designers call a "plant palette,") protects the urban forest's longevity by establishing context-appropriate, durable, easy to maintain, and aesthetically pleasing. The "palette approach" avoids excessive focus on particular species (which can often devolve into preferences and opinions or leave streetscapes vulnerable to species-specific pests and diseases).

Melbourne, Australia, developed Urban Forest Precinct Plans for each of its ten districts (or precincts) to achieve its citywide goals for the urban forest. These plans allowed for greater resident participation in the selection of design and performance characteristics, as well as prioritizing planting areas.

A plant palette can be tailored to a specific project or define neighborhood centers or even street types. Melbourne's Urban Forest Diversity Guidelines provide street tree recommendations based on street location and characteristics. The matrix of tree selection criteria considers street characteristics such as street and sidewalk width, typical building height, number of traffic lanes, and parking. (Melbourne, 2013)

URBAN FOREST STORIES

The City of Melbourne, Australia, adopted a heritage overlay designation and an Exceptional Tree Register, which requires developers to protect and retain trees with assessed cultural significance. New buildings cannot impact the health of existing trees and must be placed far enough away on the site to ensure the tree is protected during construction. (Heritage Design Guide, page 49). To be nominated for the "exceptional tree register," the tree must have aesthetic and horticultural value and be rare or localized to the region. Each tree must be nominated and then assessed by a third-party arborist who provides the assessment to an expert panel to review for accuracy.

The City recognizes each tree designation by adding it to an online interactive map that shows each tree's location and provides details on its significance and age.

Melbourne's urban forest has received considerable attention in recent years, as residents and visitors have been sending e-mail "love letters" to individual trees. The City assigned individual trees identification numbers and associated e-mail addresses to allow more efficient reporting and assignment of maintenance needs or problems. The City soon began receiving e-mail messages to the trees on various topics, some even sent from other countries. One typical example of an e-mail to a Melbournian tree:

> To: Algerian Oak, Tree ID 1032705
> 2 February 2015
>
> Dear Algerian oak, Thank you for giving us oxygen. Thank you for being so pretty. I don't know where I'd be without you to extract my carbon dioxide. (...Probably in heaven) Stay strong, stand tall amongst the crowd. You are the gift that keeps on giving.
>
> We were going to speak about wildlife but don't have enough time and have other priorities, unfortunately.
>
> Hopefully, one day our environment will be our priority. (LaFrance, 2015)

The "positive unintended consequences" of the e-mail ID underscores the connections many city residents find with trees and how much they value them, as one City Councilor noted. And, time permitting, some of the messages get a response from the "tree," which gives residents some insight into the commitment of civil servants who keep the City running. (LaFrance, 2015)

Artists have also used trees in creative placemaking strategies by developing fruit tree sharing programs to reimagine the public realm and revitalize public participation in urban spaces. Fallen Fruit, for example, is a pair of artists who create site-specific installations of fruit trees in public spaces to share. They have also developed "Endless Orchard," a website where participants can map public fruit trees anywhere in the world. Currently, most of the fruit tree locations mapped are in North America, but there are also many locations mapped in South America, Australia, Europe, and the Middle East.

These examples demonstrate how the urban forest provides residents with opportunities to find and make meaning in the places they inhabit and contribute to the stories that give urban places their rich history. Telling and celebrating these stories is another essential way to steward the urban forest.

Trees and other vegetation in Jordan Park create a “cooling island effect,” reducing ambient temperatures on nearby neighborhood streets.