Landscape Architecture Solutions to Extreme Heat

Executive Summary

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OJB Landscape Architecture reimagined a 9-acre brownfield site to reflect its New England context. The site addresses urban heat, incorporates many natural features, detains stormwater on site, and adapts to sea-level rise.

ASLA 2022 Professional General Design Honor Award. From Brownfield to Green Anchor in the Assembly Square District. Somerville, Massachusetts. OJB Landscape Architecture / Kyle Caldwell

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Extreme heat is the deadliest of all weather-related disasters and creates both acute and chronic health risks. Climate change and urban heat islands (UHIs)—in which temperature tends to be higher in urban zones than surrounding suburban and rural areas—both contribute to extreme heat.

[1] IPCC, 2023
[2] Kovats & Hajat, 2008
[3] Watts et al., 2018
[4] Zander et al., 2015
[5] Santamouris et al., 2015
[6] Guhathakurta & Gober, 2007
[7] Golden, 2004
[8] Grimm et al., 2013

There is high confidence among researchers that heat and other associated heat impacts will result in

▸ **250,000** excess deaths per year by 2050[1]

Vulnerable populations are especially at risk of heat-related impacts:

▸ **Children • Older adults • Low-income households**[2]

In 2017, an estimated

▸ **153,000,000,000**

hours of labor was lost globally due to extreme heat[3]

Heat increases are projected to decrease global economic productivity by

▸ **↓20%** during hot months by 2050[4]

Extreme heat can also

▸ **raise energy demands,[5] increase water use,[6] impact the functionality of urban infrastructure,[7] and cause additional stress to urban ecosystems[8]**

Heat severity is disproportionately experienced by lower-income, minority, and marginalized community members.[9] Recent research in the Southwest U.S. found low-income communities in urban areas were 4°F (2.2°C) hotter than their wealthier counterparts.[10]

Nature-based solutions (NbS) can mediate the impacts from extreme heat caused by climate change and urbanization.[11] The Federal Emergency Management Agency (FEMA) defines NbS as "sustainable planning, design, environmental management and engineering practices that weave natural features or processes into the built environment to promote adaptation and resilience."

In contrast, the term "green infrastructure" is sometimes limited to urban areas or is defined as simply "an interconnected network of green space".[12] NbS more accurately describes the types of physical projects that can transform built environments to address extreme heat.

For landscape architects and allied professionals, there remains uncertainty about precisely which site design and community-wide planning strategies provide the greatest reductions in temperature. To address this uncertainty, we analyzed peer reviewed literature.

[9] Jesdale et al., 2013
[10] Dialesandro et al., 2021
[11] Keith & Meerow, 2022
[12] Tzoulas et al., 2007

The Windhover Contemplative Center connects indoor and outdoor spaces with large trees. The trees throughout the site provide shade and shelter from extreme heat while allowing light to enter.

ASLA 2017 Professional General Design Honor Award. Windhover Contemplative Center. San Francisco, California / Marion Brenner.

Based on this work, we find a few important strategies from the neighborhood to city scales that deliver positive results:

First, it is clear that increasing the number of nature-based solutions within a city, the size of these solutions, and the amount of greenery or trees will decrease urban heat islands. While there is not a direct relationship between every tree and degree of temperature reduction, it's clear from the literature that more greenery produces greater temperature benefits.

Second, we find the way NbS are distributed throughout a neighborhood or city makes a difference. Research shows that the more green spaces are connected to one another the greater temperature reductions benefits they provide. The shape of NbS can also play a role in their temperature reduction benefits. However, more research is needed to clearly understand this role.

When it comes to site design, we find these strategies consistently yield positive results:

► Increase Tree Percentage

in parks and green spaces to reduce temperature and increase thermal comfort

► Provide Shade

on sites, which decreases solar radiation, to reduce local temperatures and increase thermal comfort

► Reduce Hardscape

and use plant material and water instead to improve local cooling benefits

► Switch to Green Ground Cover

such as grasses and shrubs, which have a positive impact on local temperatures

Though these general findings apply across geographies, greater specificity is needed to design sites. Proper and thorough site and context analysis is necessary for finding the best design solutions.

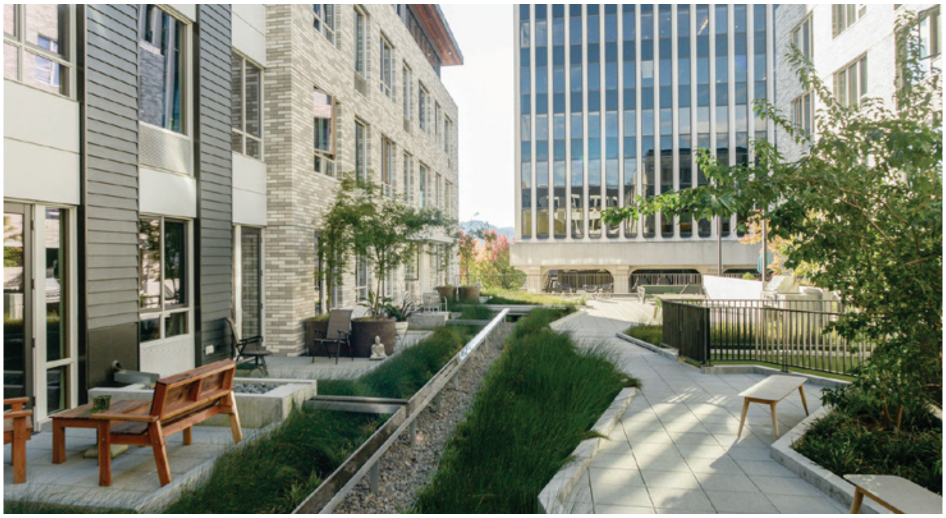
Landscape architects can use on-site measurements or simulation tools such as ENVI-met to help them understand the best trees for their particular site. They may need to collaborate with other experts, but should lead teams.

Klyde Warren Park in Dallas, Texas demonstrates multiple strategies to reduce urban heat, including shade producing trees, trees arranged to reduce solar radiation, and multiple plant materials that replace hard impervious surfaces.

ASLA 2017 Professional General Design Award of Excellence. Klyde Warren Park - Bridging the Gap in Downtown Dallas. Dallas, Texas. OJB Landscape Architecture / Gary Zonkovic Photography

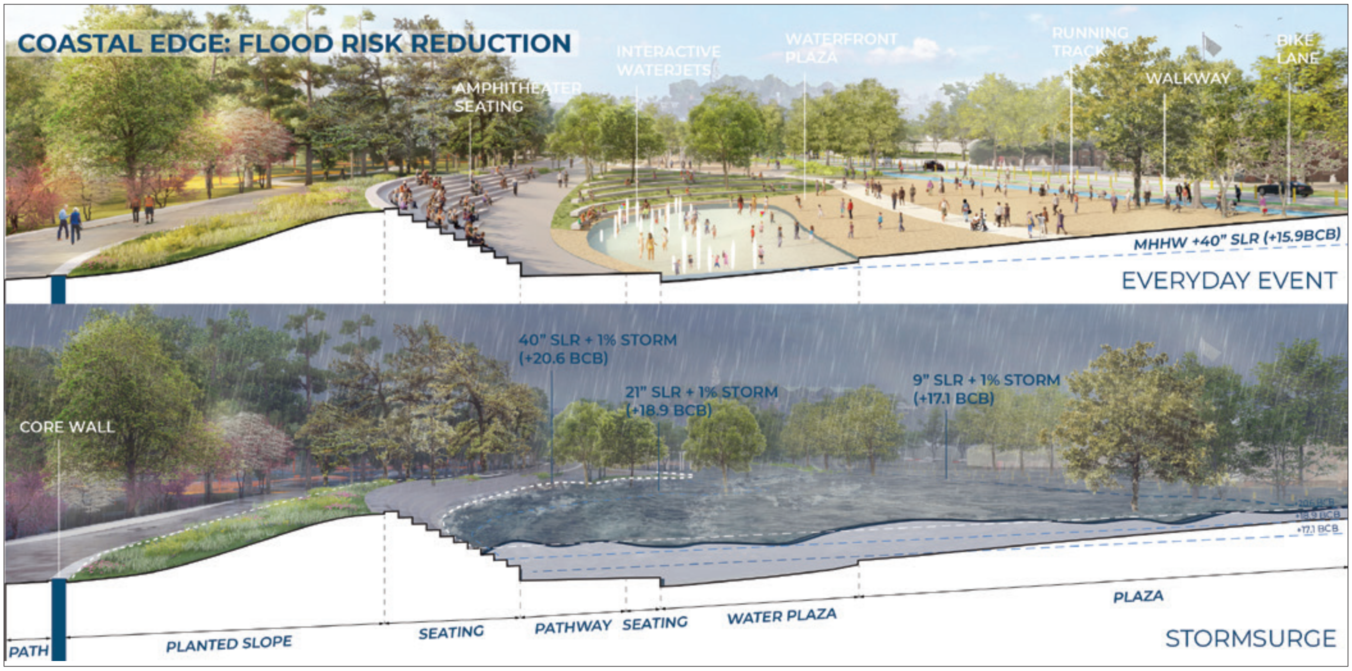
Cloud Song houses the Indigenous Scholars Institute and Cultural Center and Business School on the Scottsdale Community College (SCC) campus in Scottsdale, Arizona. The 8-acre development was designed through a collaborative process with an Indigenous lens. It intentionally mimics regional washes. All condensate, surface, and roof run-off are captured and held onsite, irrigating the indigenous plant palette. The "weeping wall", located contiguous to the Cultural Center's main entry, is integrated into the building façade. The design was inspired by the streaking, patinated patterns on the Salt River Canyon walls after monsoon rains. This innovative use of water provides a cooling experience.

ASLA 2023 Professional General Design Honor Award. Cloud Song: SCC Business School + Indigenous Culture Center. Scottsdale, Arizona / Dror Baldinger, FAIA



PLACE created a vision for American Assets Trust to develop a LEED Platinum neighborhood in a currently underdeveloped urban commercial zone. The design weaves natural features or processes into the built environment to promote resilience. The project includes eco-roofs to mitigate the urban heat island effect.

ASLA 2019 Professional Residential Design Honor Award. Hassalo on Eighth | From Urban Blight to LEED Platinum Neighborhood. Portland, Oregon / Coque Gamboa



The Moakley Park Resilience Plan by Stoss Landscape Urbanism would introduce over 500 new trees to Boston, which would contribute to the reduction of heat, improve the urban forest, and increase biodiversity. The project is also designed to be resilient to storm surges.

ASLA 2022 Professional Analysis and Planning Honor Award. Moakley Park Resilience Plan. Boston, Massachusetts. Stoss Landscape Urbanism

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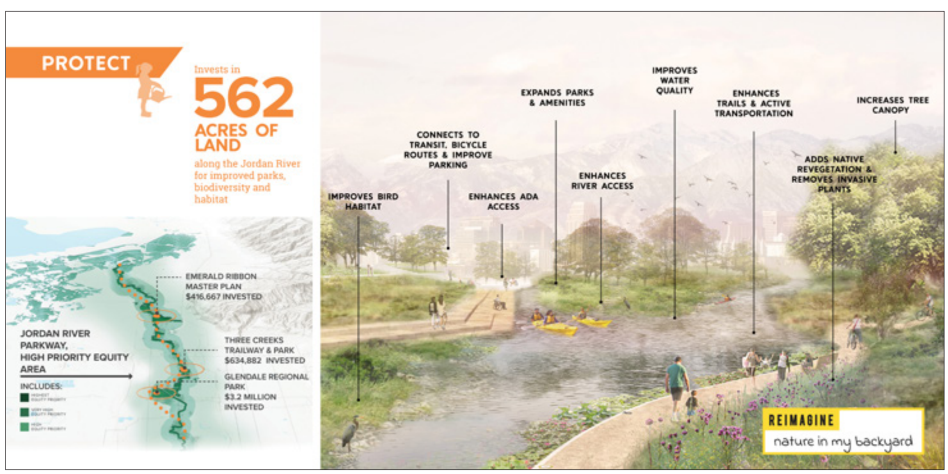
For the Salt Lake City Public Lands Department, Design Workshop Inc., an international design firm, developed a transformative vision. Using processes to engage citizens and lift up their voices, the plan tackles a broad suite of issues—urban heat, racial justice, air quality, environmental degradation, and homelessness—by bringing nature back into the city and building an urban forest.

ASLA 2022 Professional Analysis and Planning Honor Award. Reimage Nature and Inclusion for Salt Lake City. Salt Lake City, Utah. Design Workshop, Inc.

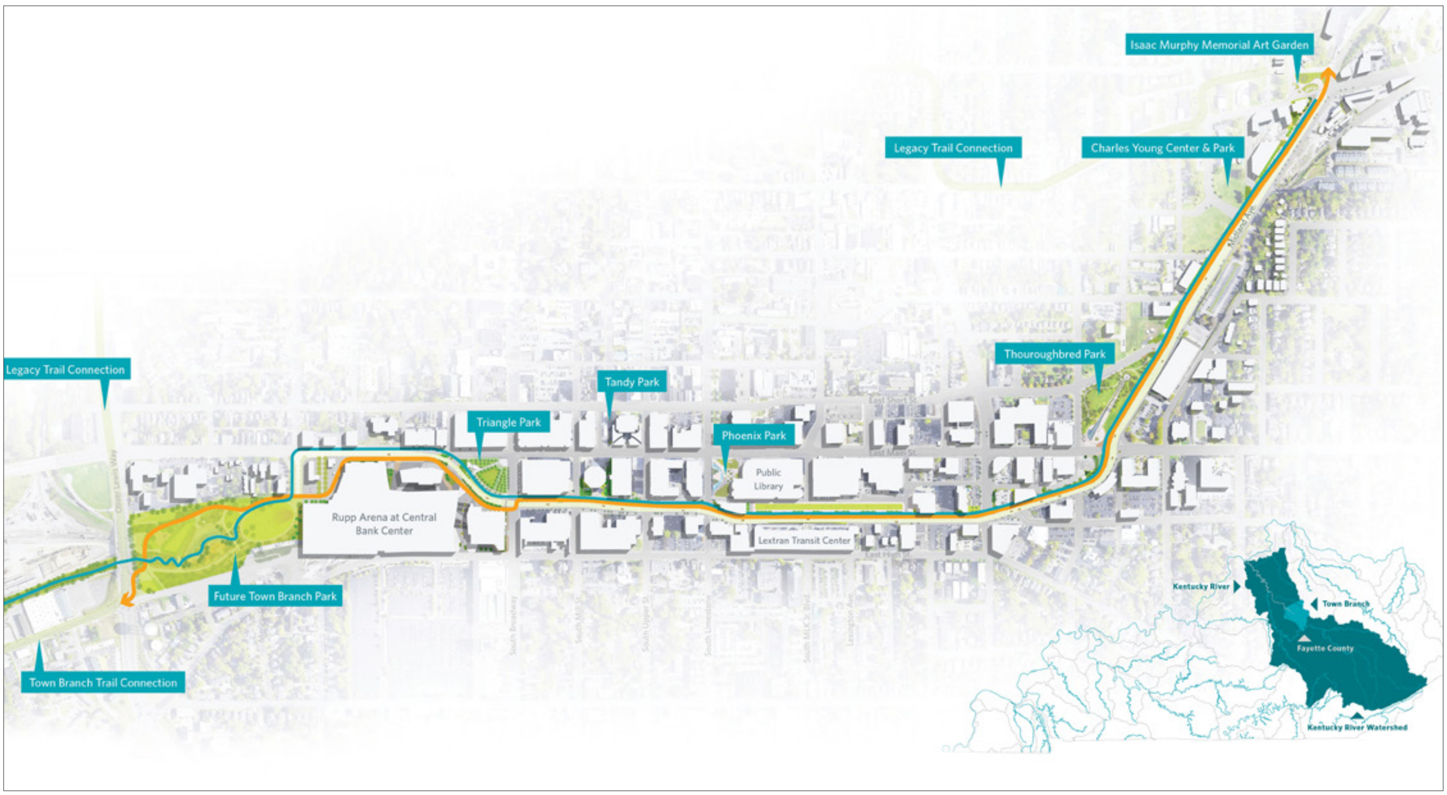


New Orleans endures the worst urban heat island effect in the country. Over half of the 72 neighborhoods in the city have less than 10% tree canopy. The New Orleans Reforestation Plan puts equity at the center and proposes solutions that both increase the number of trees and the distribution of trees throughout the city.

ASLA 2023 Professional Analysis and Planning Honor Award. The New Orleans Reforestation Plan: Equity in the Urban Forest. New Orleans, Louisiana. Spackman Mossop Michaels

CASE STUDY

Town Branch Commons: An Urban Transformation in Lexington, Kentucky



For the Lexington-Fayette Urban County government in Kentucky, SCAPE, an urban design and landscape architecture firm, and Gresham Smith, a multidisciplinary firm, demonstrated important planning strategies, including increased tree canopy cover and connectivity between green spaces.

ASLA 2022 Professional General Design Honor Award. Town Branch Commons: An Urban Transformation in Lexington. Kentucky, Lexington, Kentucky. SCAPE

Dealing with the threats of extreme heat requires transformation of urban environments and collaborative work that brings many partners together. The Town Branch Commons Regional Multimodal Trail in Lexington, Kentucky, stands as a shining example of such work.

In a project for the Lexington-Fayette Urban County Government, SCAPE and Gresham Smith for used planning strategies aligned with our research findings:

1. **Increased Green Space and Tree Canopy**
   By weaving 2.5 miles of a multi-modal transit through downtown, this project significantly increases the green space of the city. Additionally, it expands the city's tree canopy. The trail, stretching through the heart of the city, strategically incorporates parks and tree-lined pathways, transforming once neglected areas into vibrant, eco-friendly zones. The project not only contributes to the aesthetic appeal of Lexington but also mitigates the urban heat island effect, fosters biodiversity, and provides residents with accessible, rejuvenating natural spaces.

2. **Improved Connectivity**
   A primary objective of the Town Branch Commons trail is to improve connectivity within the city and with nearby rural areas. The trail not only serves as a pathway for pedestrians and cyclists but also acts as a green corridor, linking parks and open spaces. This intentional connectivity of green areas not only enhances the overall urban landscape but also maximizes the heat reduction benefits associated with increased vegetation. Strategically-placed green spaces provide refuge from the heat, creating inviting pockets of shade.

3. **Incorporated Natural Features**
   The project draws inspiration from Lexington's unique karst geology, integrating natural features that pay homage to the region's distinctive landscape. Karst-influenced elements, such as limestone formations and natural water features, are seamlessly integrated into the trail design. These features not only celebrate the town's geological heritage but also serve functional purposes, enhancing stormwater management and providing educational opportunities about the local ecosystem.

This project prioritizes green spaces, connectivity, and the preservation of natural heritage. Through the deliberate increase in green spaces and tree canopy, improvements in connectivity, and the incorporation of natural features inspired by karst geology, the trail has become a model for sustainable urban development.

Children playing in a natural water feature that was seamlessly integrated into the trail design.

ASLA 2022 Professional General Design Honor Award. Town Branch Commons: An Urban Transformation in Lexington. Kentucky, Lexington, Kentucky. SCAPE & Ty Cole

CASE STUDY

University of Arizona Environment + Natural Resource II, Tucson, Arizona

For the University of Arizona, Colwell Shelor Landscape Architecture demonstrated important design strategies, including the use of groundcover, vertical plant materials, water features, and shade to create a cooler microclimate in a dense, hot urban environment.

ASLA 2023 Professional General Design Honor Award. University of Arizona Environment + Natural Resource II. Tucson, Arizona. Colwell Shelor Landscape Architecture / Marion Brenner

In the face of escalating temperatures, university campuses can serve as a source of innovation and inspiration for landscape architecture strategies that address extreme heat. In a project for the University of Arizona, Colwell Shelor Landscape Architecture used design strategies aligned with our research findings:

1. **Designed Vertical Ecosystems**
   Landscape architects used plants to create a vertical ecosystem. Ferns and mosses are located in deep shade, native sun-loving plants on higher levels, and vines cascade down from each terrace into the open courtyard. The design increases biodiversity and reduces temperatures through the evapotranspiration of the plants.

2. **Incorporated Natural Ground Cover Materials**
   The design uses a mixture of permeable ground cover materials, including gravel, grass, and native plants. These materials help with both the innovative water design and reduction of temperatures.

3. **Leveraged Plot Studies to Understand Plants**
   Engaging students in the project, the landscape architects conducted comprehensive plot studies to understand the vegetation's ability to adapt to different soil types, soil depth, and light conditions. Simulating the shade and light conditions of the building allowed the design team to tailor the selection of vegetation and ensure the project's long-term viability. This research provided valuable insights for future sustainable urban planning.

4. **Integrated Water Features**
   This project incorporates innovative water features inspired by the region to provide cooling benefits—all without using any potable water. At ground level, the project includes a "tinaja," which is a water basin carved into the rock to store water, and smaller "eddies" to create social space and cooling. In the summer months, each of the five floors is cooled through evapotranspiration and the thread of water falling from one level to another.

5. **Adopted Canyon-Like Ventilation**
   Inspired by the natural wonder of slot canyons in Arizona, the design aimed to replicate their cooling effects. By strategically orienting buildings and designing narrow pathways to emulate the canyons' natural ventilation, the urban heat is dissipated through convection currents. This technique harnesses the principles of passive cooling, promoting airflow and optimizing shade to create a comfortable microclimate within an urban environment.

This project shows how small spaces can cool dense urban settings grappling with rising temperatures. It offers a blueprint for sustainable landscape design that uses nature-based solutions to improve human well-being.

ASLA 2023 Professional General Design Honor Award. University of Arizona Environment + Natural Resource II. Tucson, Arizona. Colwell Shelor Landscape Architecture / Marion Brenner

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