Heat Action Planning Guide

FOR NEIGHBORHOODS OF GREATER PHOENIX

Creating Urban Heat Solutions in the Valley of the Sun

A contribution of the Nature's Cooling Systems Project

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Lindo Park-Roesley Park Neighborhood

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Executive Summary

Nature's Cooling Systems Project for Heat Action Planning in Greater Phoenix

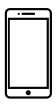
In Greater Phoenix, urban heat is impacting health, safety, and the economy and these impacts are expected to worsen over time. The number of days above 110˚F are projected to more than double by 2060. In May 2017, The Nature Conservancy, Maricopa County Department of Public Health, Central Arizona Conservation Alliance, Urban Resilience to Extremes Sustainability Research Network, Arizona State University's Urban Climate Research Center, and Center for Whole Communities launched a participatory Heat Action Planning process to identify both mitigation and adaptation strategies to reduce heat directly and improve the ability of residents to deal with heat. Community-based organizations with existing relationships in three neighborhoods selected for Heat Action Planning later joined the project team: Phoenix Revitalization Corporation, RAILMesa, and Puente Movement. Beyond building a community Heat Action Plan and completing demonstration projects, this participatory process was designed to develop awareness, agency, and social cohesion in underrepresented communities. Furthermore, the Heat Action Planning process was designed to serve as a model for future heat resilience efforts and create a local, contextual, and culturally appropriate vision of a safer, healthier future. The iterative planning and engagement method used by the project team strengthened relationships within and between neighborhoods, community-based organizations, decision-makers, and the core team, and it combined storytelling wisdom and scientific evidence to better understand current and future challenges residents face during extreme heat events.

As a result of three workshops within each community, the residents brought forth ideas that they want to see implemented to increase their thermal comfort and safety during extreme heat days. As depicted below, residents' ideas intersected around similar concepts, but specific solutions varied across neighborhoods. For example, all neighborhoods would like to add shade to their pedestrian corridors but preferences for the location of shade improvements differed. Some

Strategic Themes

Advocate and Educate | **Improve Comfort/Ability to Cope** | **Improve Safety** | **Build Capacity**

Mesa Care
Using social media and hashtags to highlight child safety and bus route issues



Lindo-Roesley
Planting vegetation for empty lots to reduce dust

Edison-Eastlake
Create signage for heat safety and wayfinding could reduce risk

Heat action in neighborhoods should be supported through strengthened relationships between various levels of organization and governance.

neighborhoods prioritized routes to public transportation, others prioritized routes used by children on their way to school, and others wanted to see shaded rest stops in key places. Four overarching strategic themes emerged across all three neighborhoods: **advocate and educate; improve comfort/ability to cope; improve safety; build capacity**. These themes signal that there are serious heat safety challenges in residents' day-to-day lives and that community, business, and decision-making sectors need to address those challenges.

Heat Action Plan elements are designed to be incorporated into other efforts to alleviate heat, to create climate-resilient cities, and to provide public health and safety. Heat Action Plan implementation partners are identified drawing from the Greater Phoenix region, and recommendations are given for supporting the transformation to a cooler city.

To scale this approach, project team members recommend a) continued engagement with and investments into these neighborhoods to implement change signaled by residents as vital, b) repeating the heat action planning process with community leaders in other neighborhoods, and c) working with cities, urban planners, and other stakeholders to institutionalize this process, supporting policies, and the use of proposed metrics for creating cooler communities.

Comments on Heat Action Planning

"I ride the bus and sometimes I go to the bus stop and it is really hot. Also, my apartment, it's also really hot in there....I have to go to bus stations and there is no shade structure. There is nothing. There are no trees along the way...I wish that there were more trees where I live...because there is nothing."

- Edison-Eastlake Resident

"With conversations with neighbors in South Phoenix, what is very interesting to me is that they say, "Oh it's hot, that's normal." And I think that's the interesting part of the conversation. It is hot, but it's not normal. There is something that we can do."

- Community Organizing Partner

"What makes this project unique is that we're focused on improving quality of life, we're not just recording facts about heat and shade, etc., you need people's experiences to drive the process of change"

- Core Team Partner

© Rick Triana/TNC

The Challenge of Urban Heat

In cities like Mesa or Phoenix, temperatures are often higher in the city center than at the edges of the city, and this is especially true at night. The difference in temperatures between the middle of the city and the edge depends on a lot of factors, like wind, but it can be more than 10°F or 5ºC hotter in the city under certain conditions. We can also have some big temperature differences even across short distances, like a few city blocks. Areas without green space are about 5°F or 3°C warmer than areas like parks with lots of plants and trees.

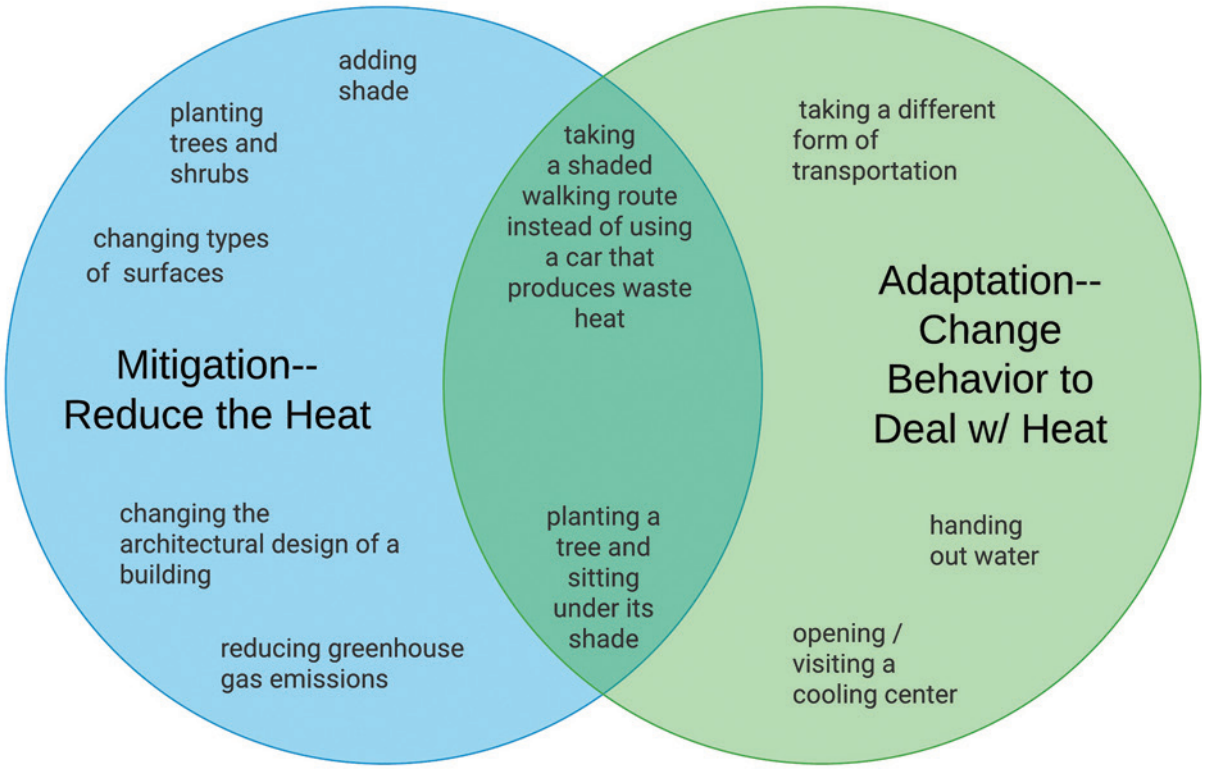
Why do we see these patterns in temperature? Imagine that you were going to go for a walk outside barefoot on a hot day and that you are a giant - yes, a giant! You would probably try to step on neighborhoods where there are more trees and shade and fewer roads and parking lots. It is not only a matter of what materials or surfaces exist in a neighborhood, but also important is how the buildings are arranged, how the landscape is arranged, and how much heat is given off by machines like air conditioning units and cars.

The choices we make as a community and as a city about the types of surfaces and materials we use can make a big difference in how we experience heat. We know that the city has changed a lot in the past few decades. Long-term records tell us that nighttime temperatures in the city are about 10°F (5°C) higher than they were 50-60 years ago, and that's mostly because of how much the cities have grown. Daytime temperatures have also increased by a couple of degrees and that's partially a result of the global-scale warming

that is also occurring. So, we have warming from building our cities - a lot of it! - and global warming, both of which are working to make our summers hotter.

Every year, people are getting ill and even dying from heat. Existing illnesses like asthma and diabetes can grow worse in hot weather. The elderly may not be aware of the response of their bodies to the heat, making them especially vulnerable. Illnesses and death can occur at temperatures in the 90s and we can expect to see spikes in illnesses and deaths when temperatures reach 104-106°F. We already see those temperatures every year and much higher. It is projected that Phoenix may experience over 100 days per year over 105˚F by 2040 (UREx SRN). By contrast, from 1951-2000 Phoenix experienced only about 44 days over 105˚F.

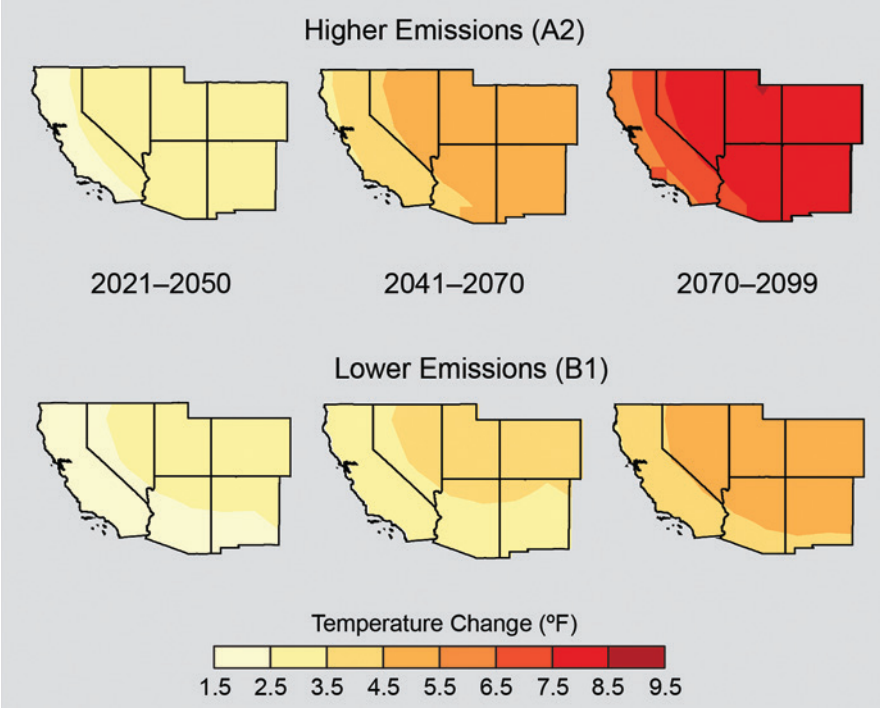
Urban Heat Solutions



Did you know?

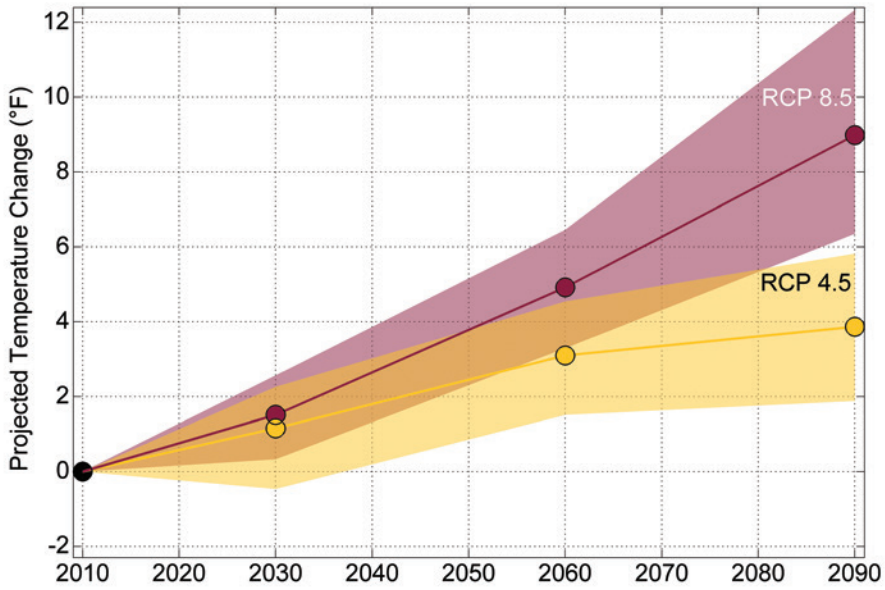
While average daytime high temperatures in Phoenix have increased 4˚F in the past 90 years, the average nighttime low temperatures have increased 17˚F. Compare that to measurements at Casa Grande National Monument, where average high temperatures have stayed flat and average lows are up just 6˚F.

PROJECTED TEMPERATURE INCREASES



Adapted from Kunkel, et al., 2013. http://nca2014.globalchange.gov/report/regions/southwest/graphics/projected-temperature-increases

PROJECTED CHANGE IN THE TEMPERATURE OF THE 10TH HOTTEST DAY OF THE YEAR. ARIZONA STATEWIDE AVERAGE



Arizona State University and Arizona Department of Health Services BRACE Project, 2018

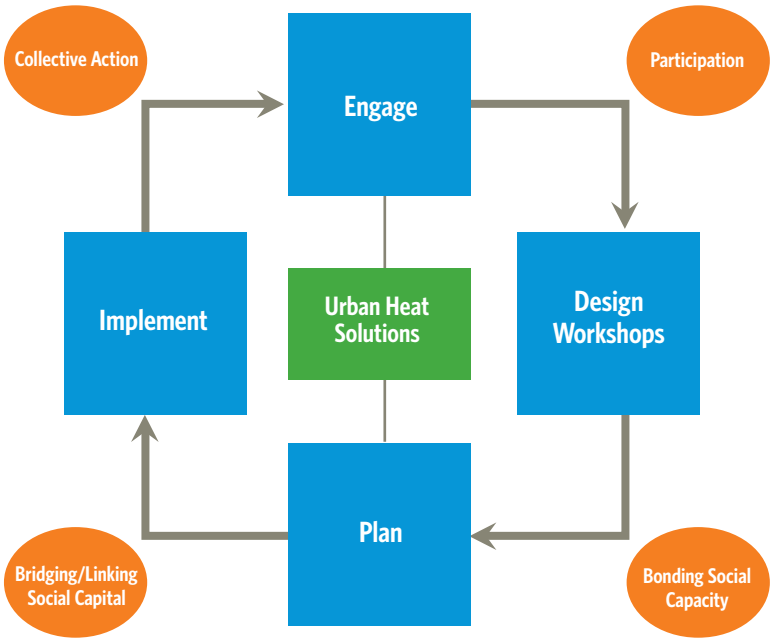
Increasing temperatures are impacting health, safety, comfort, and economic development in Greater Phoenix, and this is projected to worsen over time.

"For me living in the desert is something really exasperating. I have dealt with situations; I've cleaned houses during a time where it was 118 degrees outside. I had to clean outside while my coworkers were inside. The feeling of having to work outside to get what we need. But my employer did not care that I had to be outside cleaning...and now that we are here I'm realizing that we can do so much if we come together to find a solution for this."

- Resident, Mesa Care Neighborhood

Heat Action Planning Approach

The methodology used for Heat Action Planning was adapted from Semenza et al. (2007) who addressed urban blight by increasing social capital and improving well-being through community projects. Beyond building a community Heat Action Plan and completing demonstration projects, this participatory process is designed to develop awareness, agency, and social cohesion in underrepresented communities. Furthermore, the Heat Action Planning process can serve as a model for future development of urban heat solutions and create a common vision for a more thermally comfortable, cooler future. This iterative method builds on strengthening relationships within and between neighborhoods, community-based organizations, decision-makers, and the core team,



Heat Action Planning Process methodology adapted from Semenza, et al. (2007)

and it combines storytelling wisdom and scientific evidence to understand current and future challenges residents face during extreme heat events.

Three neighborhood communities, two in Phoenix and one in Mesa, were selected for Heat Action Planning. The three neighborhoods were chosen, among other factors, due to their relatively high surface temperatures and average to lower than average vegetation index, presence of outdoor public spaces and public transit, and history of heat-related illnesses and deaths. Furthermore, community agency and receptivity to working with the core team were key elements to cementing initial partnerships. The neighborhoods selected featured some investment or large project underway into which heat mitigation and adaptation elements could be integrated.

In each selected neighborhood, an active community-based organization was identified to be the bridge between the core team and residents. These community-based organizations were responsible for workshop recruitment, gathering of stories prior to workshops, collaborating on the workshop process, deciding on the location for the workshops, and facilitating demonstration projects. Community notices (available in Spanish and English) and an informative recruiting pamphlet, were distributed throughout the neighborhood by the community-based organization partners.

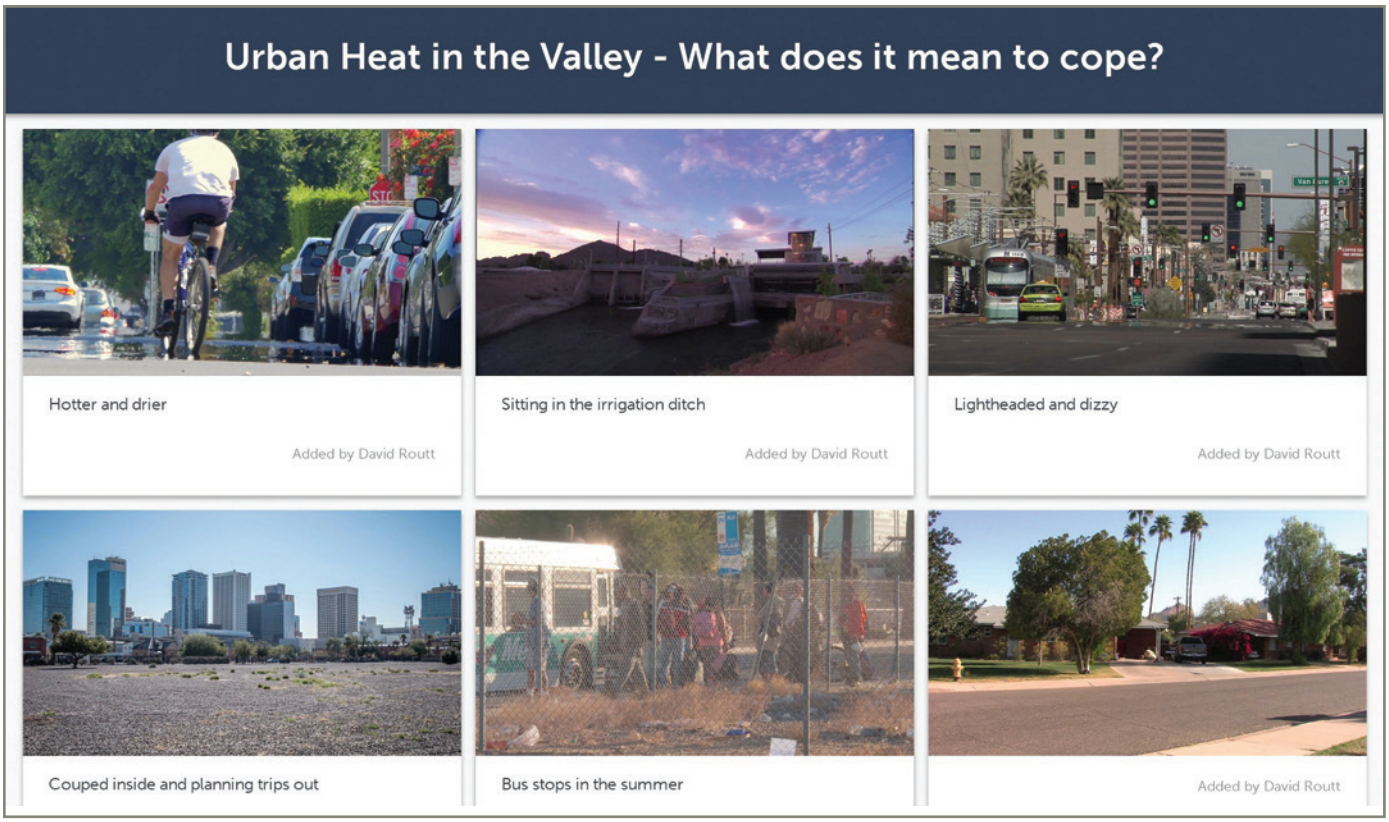
Educational brochures developed for canvassing during the Nature's Cooling Systems project.

During recruitment for the workshops, community-based organizations gathered stories from residents about coping with urban heat. These were compiled on a website (https://www.kudoboard.com/boards/mpb1QKHB) and used during the planning process. Storytelling became the cornerstone for workshops as well. Storytelling by all participants during the workshops honored different forms of expertise, equaled the playing field between residents, organizations, and experts, and facilitated the understanding of complex ideas. Decision-makers better understood the challenges underserved communities face in dealing with urban heat. Telling stories helped to nest multiple community goals together with urban heat mitigation and adaptation within a personal context.

Workshops

Three workshops were held in each community. The first workshop borrows concepts from Phadke, Manning, & Burlager (2015) in climate adaptation planning efforts, and it served to personalize the effects of increasing urban heat so that community members understood the local implications. The goal was to provide a detailed, local, contextual accounting of how residents currently and historically cope with rising temperatures. This was accomplished through storytelling from residents, the core team, and advisors. All workshops were conducted simultaneously in English and Spanish using whisper translation. In the first workshop, the core team learned what residents value, what resources are available or unavailable, and how they cope on very hot days. Researchers provided scientific information about urban heat and mitigation in a story format. The day culminated with residents discussing concerns, mapping cooling assets and intervention points in their neighborhood, and exploring potential solutions.

Using the stories from recruiting and the first workshop, residents learned how to transform concerns into actionable strategies and design interventions in their neighborhoods in the second workshop. Cool spots and



Storyboard on coping with heat developed for the Nature's Cooling Systems project. Available online: https://www.kudoboard.com/boards/mpb1QKHB

hot spots maps were further developed based on local knowledge that clearly detailed where the community places of respite and extreme heat were located. Designers and decision-makers synthesized the locally agreed-upon priorities and provided technical support and best practices. Advisors included professionals from county and city agencies, landscape designers, architects, politicians, and emergency service providers.

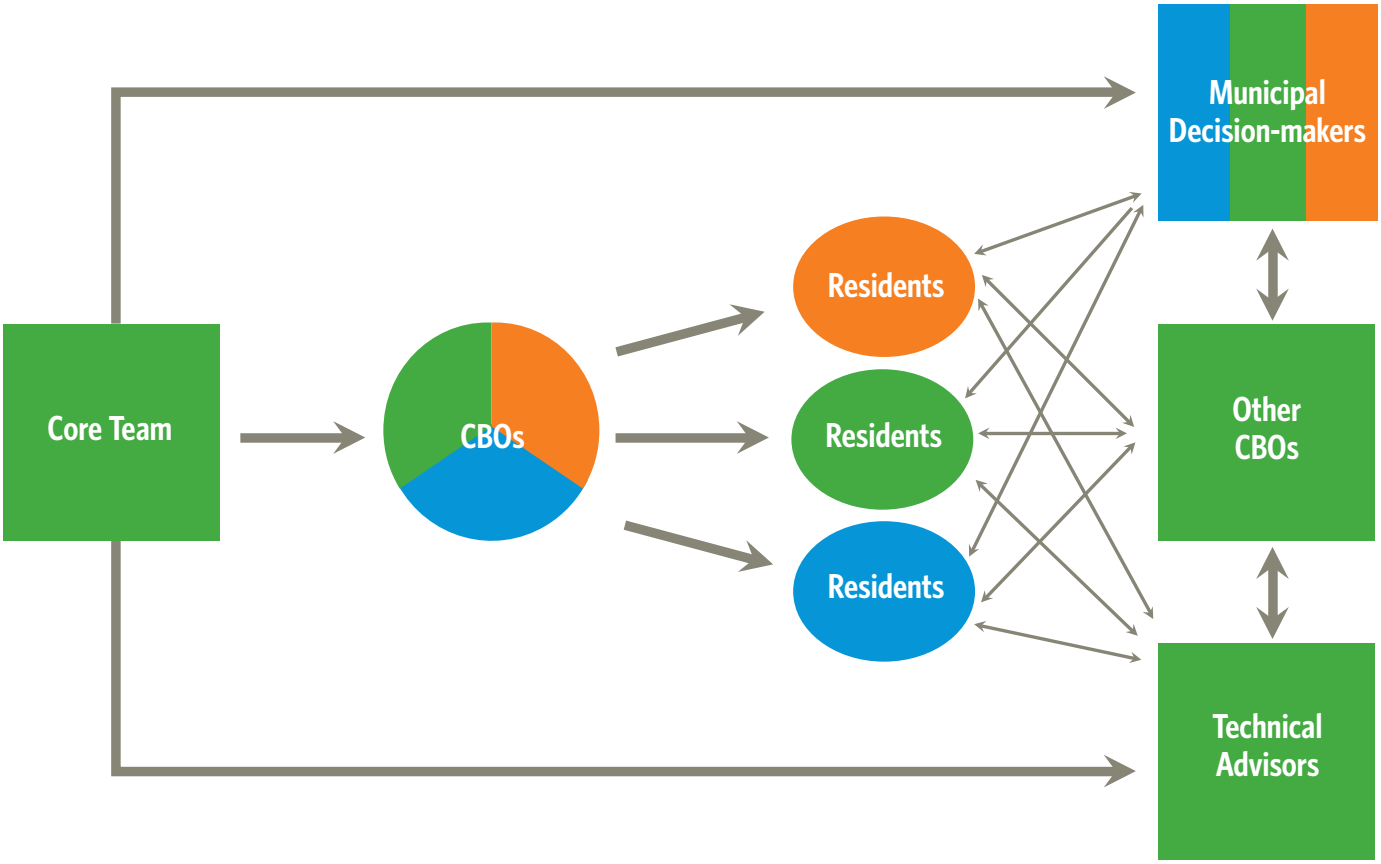
The final workshop included advisors from previous workshops and new advisors and helped to further refine ideas and feasibility. Residents were asked to consider their "concept of cool," noting culturally significant practices, color palettes, and big ideas. Drawings of street-level cooling changes to neighborhoods were generated to give the community a chance to provide additional feedback and an opportunity to share knowledge and skills.

Post-Workshop

Workshop materials were reviewed and analyzed to co-develop a community Heat Action Planning framework. This draft was circulated within communities to gain momentum and agreement on heat action priorities and solutions.

Community-based organizations, along with self-selected resident leaders and the core team, will present their Heat Action Plans to city officials and county planners in 2019. The goal for these plans is that their components be implemented as pilot projects for mitigating urban heat and that they become part of the larger heat mitigation efforts currently underway in Greater Phoenix municipalities and through Maricopa Association of Governments. This process will be evaluated based upon input from process participants, and that feedback will be used to design future programs and policies for reducing and managing urban heat, including the City of Phoenix HeatReady Program and a Valley-wide urban heat leadership program. During the Heat Action Planning process, technical and design guidelines for shade and thermal comfort were developed by core team members and other subject matter experts to introduce quantifiable ways of assessing changes to heat and comfort in urban planning and policy, beginning with the Maricopa Association of Governments Active Transportation Plan Toolkit (see Appendix B).

Heat Action Planning Relationship Diagram



Core project team members worked with community-based organizations to engage residents in creating Heat Action Plans. New community-based organizations, decision-makers, and technical advisors came into the process in each of the three neighborhoods.

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Neighborhood Selection

The Heat Action Planning core team considered many potential criteria to select neighborhoods. The team weighted each criterion based on importance and used the top five criteria for selecting neighborhoods. By consensus, the core team selected three neighborhoods with challenges and opportunities for growth. Table 1 shows the five criteria and data indicators that were used in the selection process.

The team selected three neighborhoods that tended to have higher environmental temperatures and residents with higher risk of heat-related illness, compared to other places in Maricopa County:

- Edison-Eastlake Community, Central Phoenix, AZ
- Lindo Park-Roesley Park Neighborhood, South Phoenix, AZ
- Mesa Care Neighborhood (Water Tower Improvement District), Mesa, AZ

The maps on page 15 show the boundaries of each neighborhood with vegetation coverage and land surface temperatures in the Phoenix Metropolitan Area. The first shows the presence of trees and shrubs across the metropolitan area, and the selected neighborhoods have fewer trees and shrubs than many others in central Maricopa County. The second shows the surface temperature of the land during the overnight hours when the urban heat island effect is strongest. Hard and dark surfaces, like roads, parking lots, and some buildings, are especially evident on the surface temperature map because they are slow to release heat at night. Portions of the selected neighborhoods have surface temperatures that are well above those observed across much of the rest of central Maricopa County.

Table 1

Criteria for Selection of Neighborhoods

Heat
- Low vegetation coverage
- Low vegetation index
- High surface temperature

Usage
- High use of public spaces
- High transit use

History & Opportunity
- High % vacant lots
- Invitation from community
- Slated housing, renovation, or capital improvement projects

Community
- Strong sense of community identity
- Potential for mutual learning (residents stakeholders)
- Previously surveyed

Health & Vulnerability
- High rate heat deaths/ heat-related illnesses
- Low-income
- High rates of self-reported heat concerns
- Lack of A/C

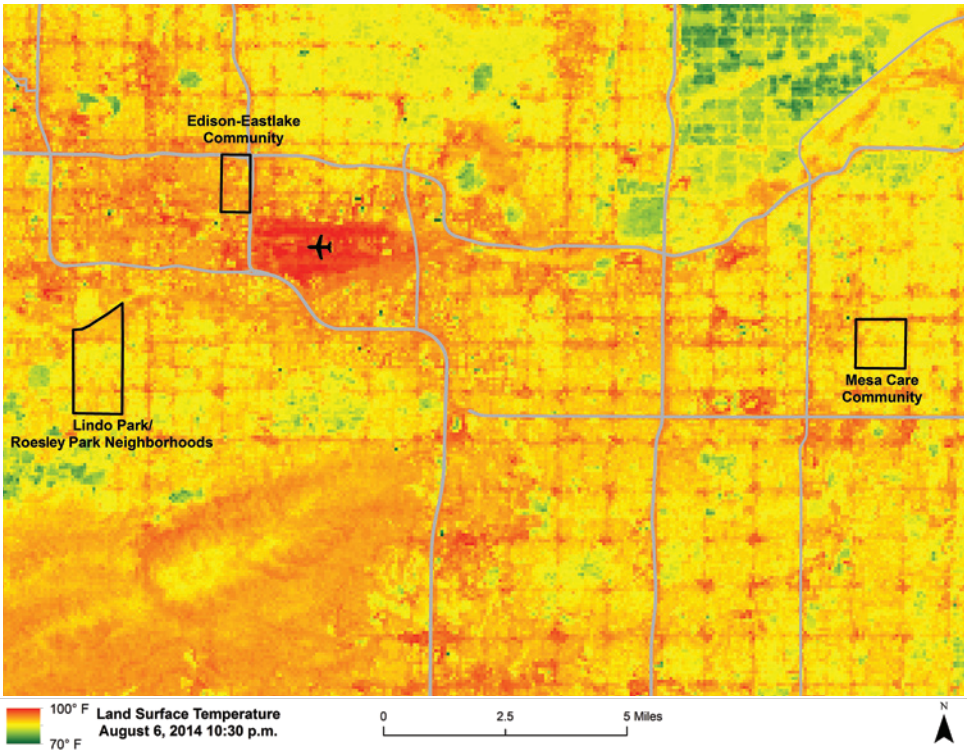
Just like Maricopa County overall, the Nature's Cooling Systems neighborhoods are characterized by high variability in environmental conditions from place to place. In some parts of the three neighborhoods, land surface temperatures, vegetation, and greenness are similar to, or even better than, those observed elsewhere across the comparison region. These cool and green spots are local assets that also provide optimism that even more green space, more access to and use of green space, and more cooling, are possible in these neighborhoods. However, it is also the case that parts of the neighborhoods are home to some of the highest land surface temperatures and lowest vegetation cover and greenness observed anywhere in central Maricopa County.

Table 2 provides additional comparisons between each neighborhood and Maricopa County as a whole.

Table 2. Demographic Characteristics of Neighborhoods - Census Data 2013, 2015

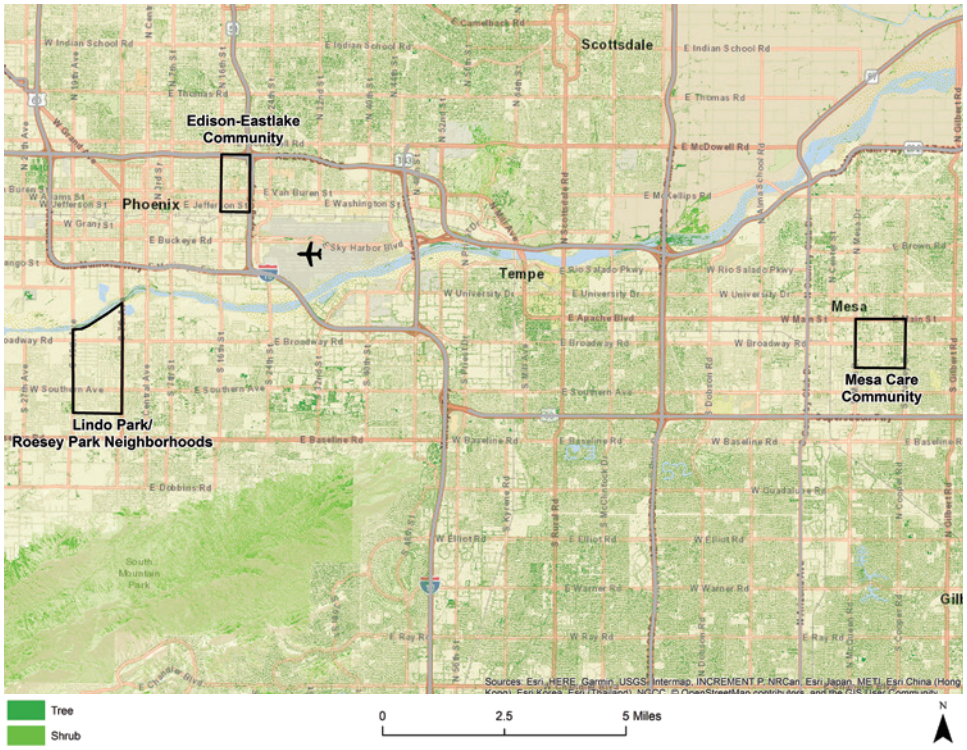
	EDISON-EASTLAKE	MESA CARE	LINDO PARK-ROESLEY PARK	MARICOPA COUNTY
HOUSEHOLDS				
Number of households	1,884	2,935	2,765	1,442,518
Median income	$ 10,708	$29,870	$37,345	$53,596
Owner occupied	16%	35%	58%	63%
RESIDENTS				
Total Population	6,134	10,439	11,440	4,018,143
Aged 65+	5%	5%	7%	13%
White	51%	75%	62%	80%
Black	7%	1%	18%	5%
Hispanic (ethnicity)	76%	70%	71%	30%
Foreign Born	29%	35%	28%	15%
Use public transportation	7%	3%	3%	2%

Land surface temperatures across the valley reflect factors like urban development, imperviousness, and tree canopy cover.



Source: NASA LANDSAT satellite imagery

Land cover map of central Maricopa County highlighting locations with trees (dark green) and shrubs (light green).



Source: CAP LTER land cover classification using 2010 National Agriculture Imagery Program (NAIP) Imagery

© Osama Alghamdi

Heat Action Plan for Edison-Eastlake Community, Phoenix


© Mathieu Feagan

Executive Summary

Nature's Cooling Systems Project for Heat Action Planning in Edison-Eastlake Community

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As a result of three workshops within each community, residents brought forth ideas that they would like to see implemented to increase their thermal comfort and safety during extreme heat days. As depicted on page 18, residents' ideas intersected around similar concepts, but specific solutions varied across neighborhoods. For example, all neighborhoods would like to add shade to their pedestrian corridors but preferences for the location of shade improvements differed. Some neighborhoods prioritized routes to public transportation, others prioritized routes used by children on their way to school, and others wanted to see shaded rest stops in

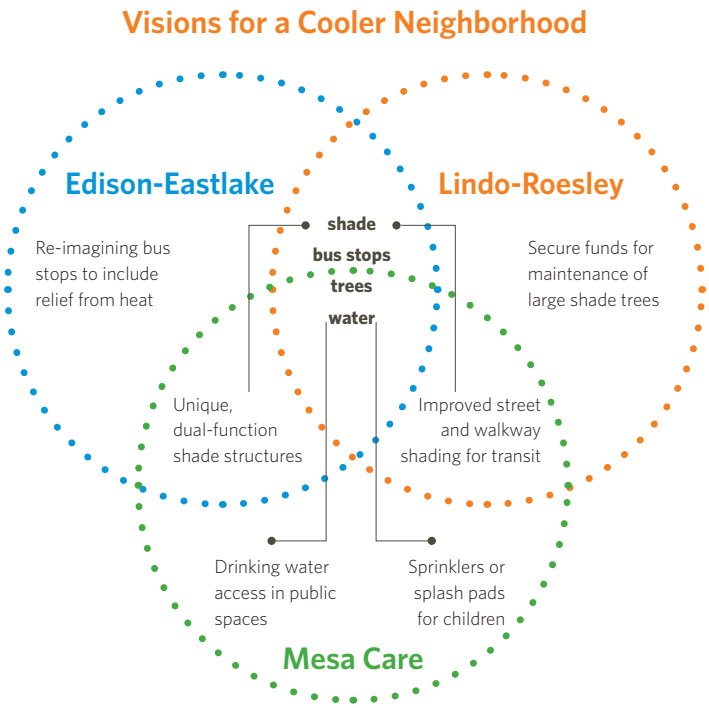
key places. Four overarching themes emerged across all three neighborhoods — **advocate and educate; improve comfort / ability to cope; improve safety; build capacity** — signaling that residents experience serious safety challenges in their day-to-day lives with heat and that community, business, and decision-making sectors can and should work to address those challenges.

Primary concerns in the Edison-Eastlake Community residents identified during workshops include:

1. Lack of shade on walking routes, at bus stops, and vacant lots
2. Lack of access to drinking water
3. Lack of services and amenities for people with disabilities and the elderly
4. Household costs of coping with heat, especially high electricity bills

Solutions envisioned by residents include access to drinking water at one-mile walking intervals; a complete streets approach with improved signaling where pedestrians are shielded from traffic along major streets; shade structures that can be moved around to shelter commuters from the sun at different times of the day along with amenities like fans (similar to those found at light rail stations); trees or other vegetation installed at bus stops and parks; an expanded warning system that alerts people to hours that are unsafe to be outdoors; and a first aid certification program that would qualify residents as a "certified heat responder". Heat Action Plans include residents' proposals for who should be involved in creating cooler and heat-adapted neighborhoods and how those changes can be supported by decision-makers, community organizations, and others.

Heat Action Plans may be used by any resident or community leader to advocate for the integration of urban heat solutions into future changes and programming in the Edison-Eastlake Community.



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"I ride the bus and sometimes I go to the bus stop and it is really hot. Also, my apartment, it's also really hot in there....I have to go to bus stations and there is no shade structure. There is nothing. There are no trees along the way...I wish that there were more trees where I live...because there is nothing."

- Edison-Eastlake Resident

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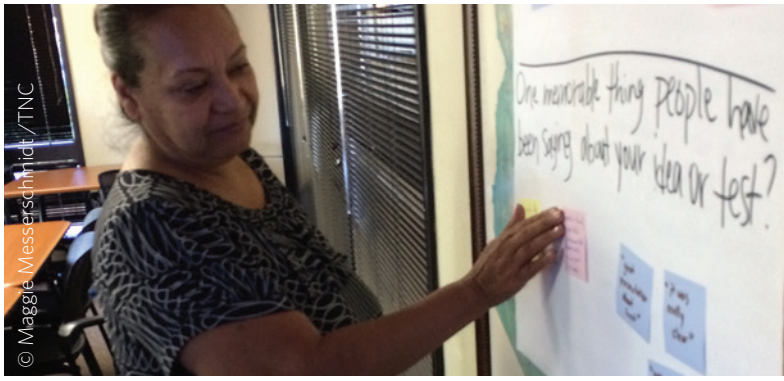


Who We Are

This neighborhood is just east of downtown Phoenix and bordered on the north and east by Interstate 10 (extending from 16th Street in the west and the Union Pacific Railroad in the south). The neighborhood has a lot of vacant properties and three public housing sites, with one currently under construction. It has one park in the north and one park just outside the neighborhood boundary in the southwest. Edison Elementary School and St. Luke's Medical Center are both near the center of the neighborhood.

Historically, the Edison-Eastlake Community has been home to a majority Latino population and today more than three quarters of its residents are Latino. In the late 1930's to the 1950's it was subject to redlining such that none of the residents were able to get loans to buy their property. Thus, home ownership today is low (16%). As in other predominantly minority neighborhoods in Central and South Phoenix, a history of neglect and discrimination against Latinos and other minorities led to the progressive impoverishment of the neighborhood (median household income in the neighborhood is just $10,708).

From 1942 to 1963, four large public housing developments were built in Edison-Eastlake. However, recently the neighborhood has been selected to receive federal HUD funding for redevelopment as a Choice Neighborhoods community, meaning residents should have an important say in changes to be undertaken in their neighborhood in terms of housing, streets, public transit, and greening. This neighborhood has a relatively high sense of community: nearly two thirds of residents surveyed by the City of Phoenix Housing Department believe that in their neighborhood "people generally get along with each other" and over half feel that "people help each other out" and "we watch out for each other's children."

© Kristin Rothballer

Poem by: Martha Ortiz, 2019 Resident Leadership Council Member

Uniting our voices in one vision

projecting our vision towards the future

we are a united community with our knowledge of food, different cultures, and languages,

sharing ideas

We are an example for the generations that follow what we see now tomorrow will be different

A clean safe and green community

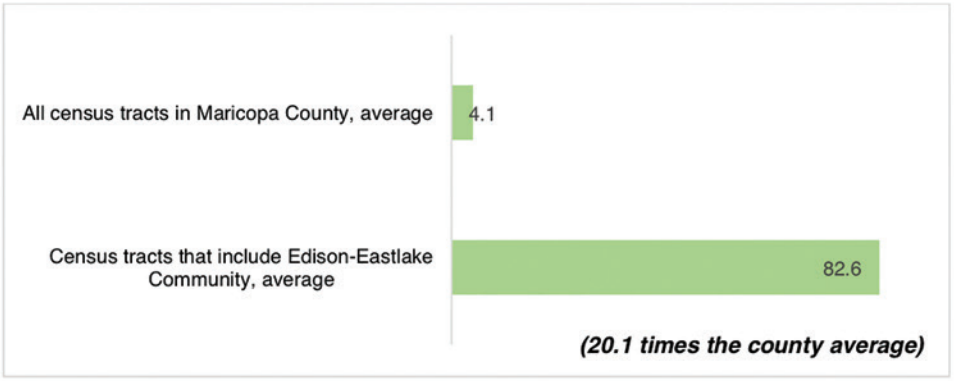
the children could run play and enjoy the clean air without any danger

Neighborhood Baselines
Edison-Eastlake Community

The following data provide a baseline reference for the Edison-Eastlake Community. Tracking these indicators over time will help neighborhoods and those involved in planning decisions understand whether their heat mitigation and adaptation initiatives are helping to improve (or hurt) the current situation.

Health

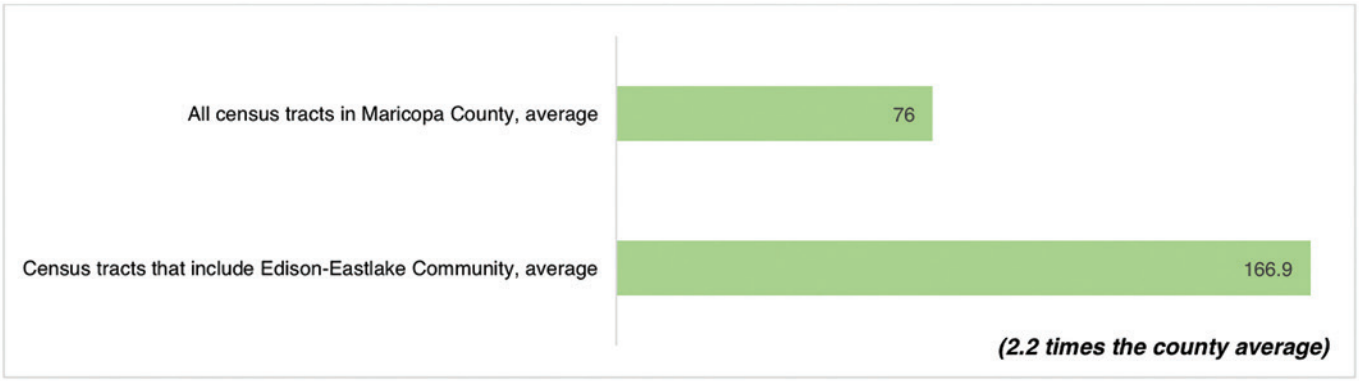
Average annual heat-associated death rate per 1,000,000 population, 2012-2017



99.4% of Maricopa County census tracts had lower heat-associated death rates than the Edison-Eastlake Neighborhood, 2012-17

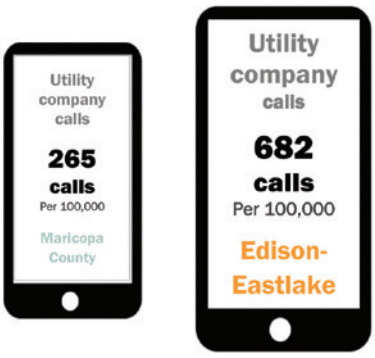
* Reasons for exceedingly high rates of heat deaths are not currently known.

Average annual heat-associated illness rate per 1,000,000 population, 2012-2017



95% of Maricopa County census tracts had lower heat-related illness rates than the Edison-Eastlake neighborhood, 2012-17.

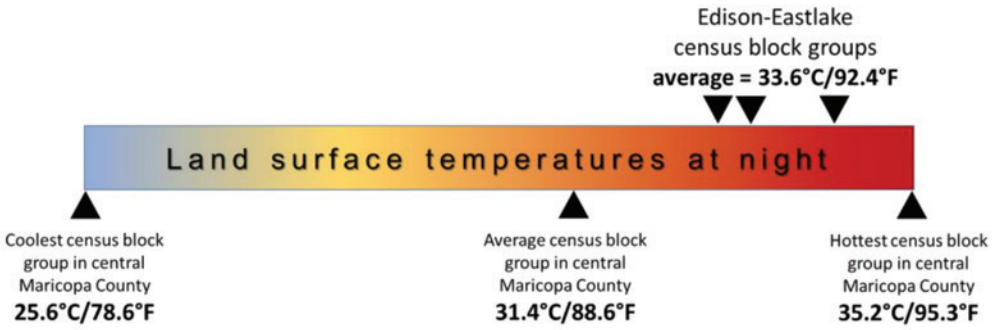
Utility Issues



Environmental characteristics

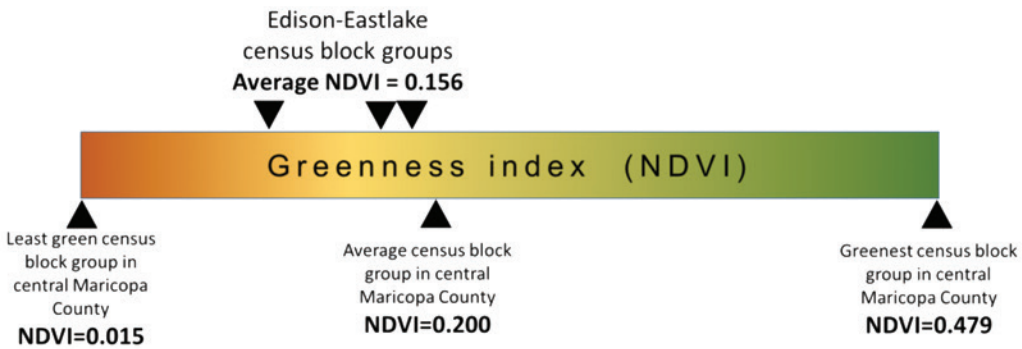
Land surface temperature on 8/6/2014 at night

Regional land surface temperature comparison

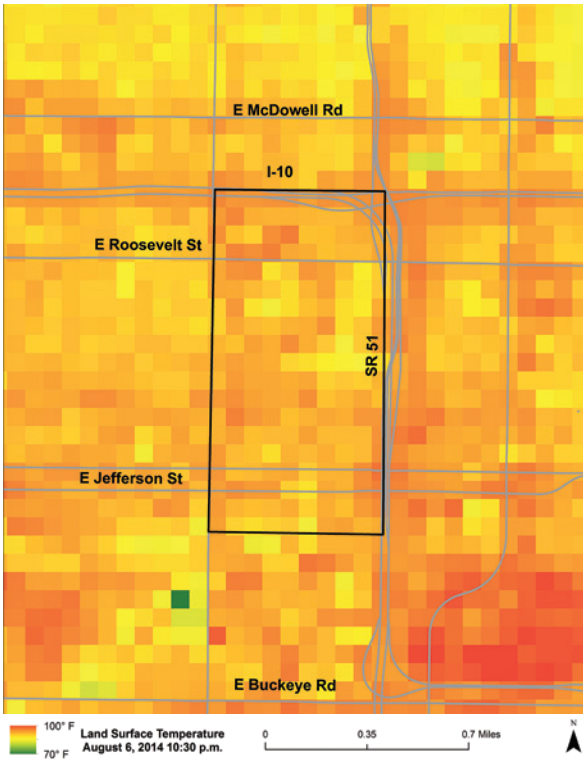


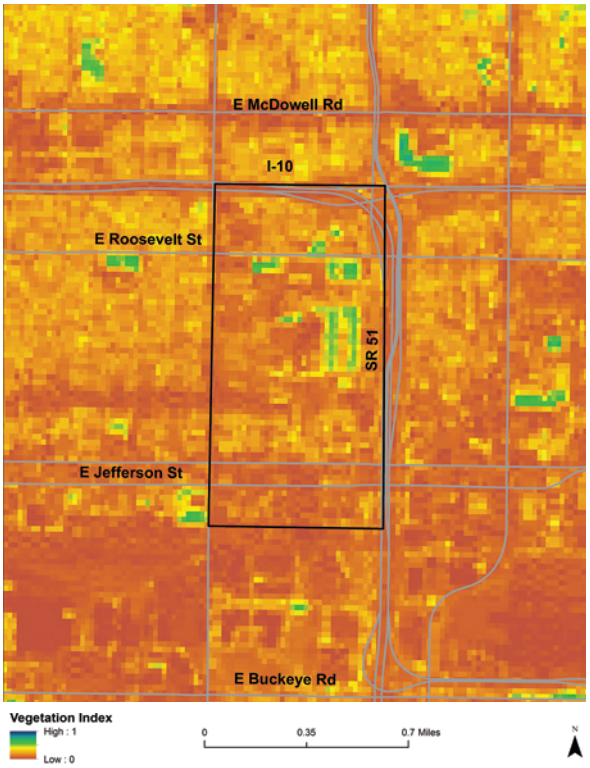
Tree coverage 5.3% • County average 8.8%

Census Block Groups



Land Surface Temperature (top) and NDVI (bottom) within Edison-Eastlake Community.





Summary of Environmental Characteristics: Edison-Eastlake

Surface temperatures: All parts of the neighborhood rank among the hottest in central Maricopa County. In particular, the southern part of the neighborhood, below Van Buren Street, has especially high surface temperatures.

Vegetation coverage: The neighborhood has very low tree coverage compared to others in central Maricopa County. Some parts of the neighborhood benefit from a relatively high amount of grass coverage, including the central portion of the neighborhood between Van Buren and Roosevelt that has nearly twice the regional average grass cover.

Greenness: All parts of the neighborhood rank below the regional average in terms of greenness, with the southern part of the neighborhood, below Van Buren, especially lacking.

Methods

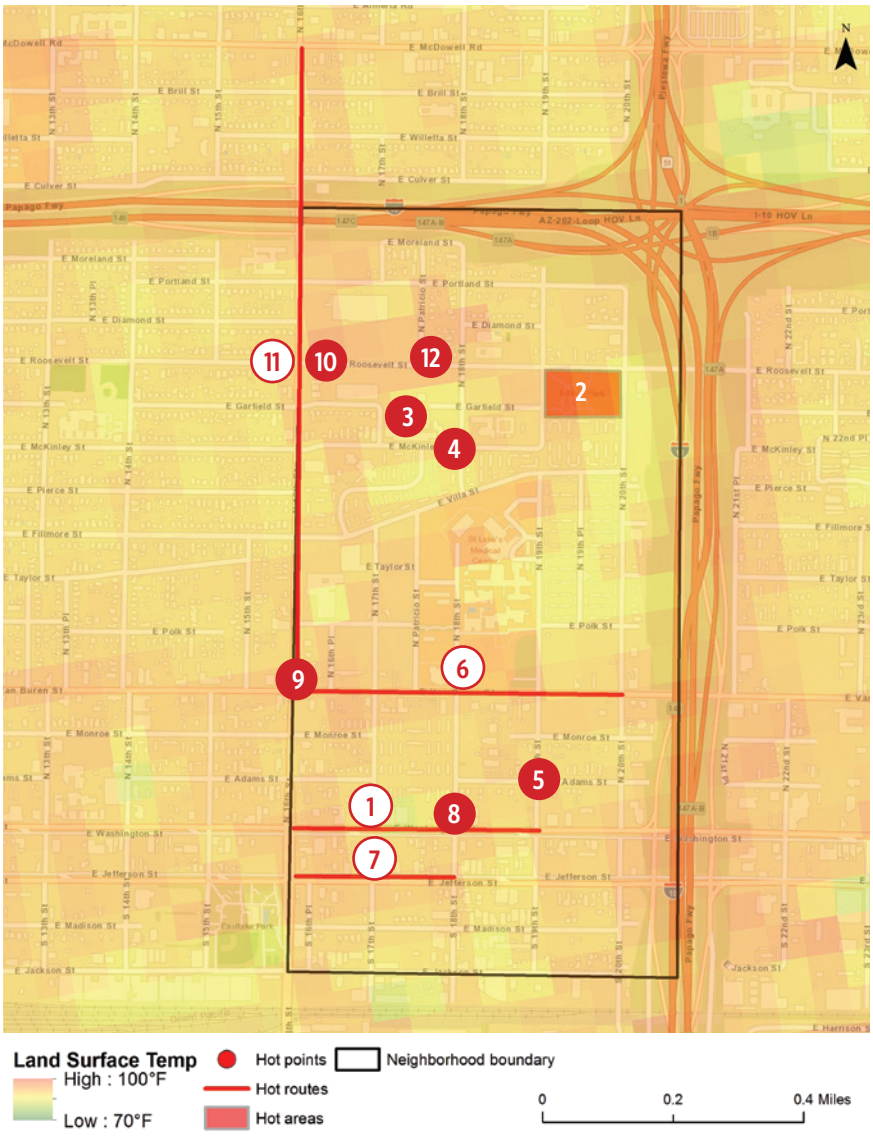
Baseline data were sourced from the following databases: Maricopa County Department of Public Health (MCDPH) heat mortality surveillance, MCDPH heat morbidity surveillance, Arizona 2-1-1, NASA ASTER satellite imagery, NASA LANDSAT satellite imagery, the National Agriculture Imagery Program (NAIP), and the US Census Bureau. Some of the variables were measured at the census tract level, some were measured at the census block group level, and some were measured at the zip code level. Census tracts are regions that include 2,500 to 8,000 people. Census tracts are divided into multiple census block groups. Tracts and block groups were selected based on neighborhood boundary lines. Individuals were counted in these rate calculations if they had an address that could be geocoded to a Maricopa County census tract. Neighborhood-specific rates were calculated by average rates of census tracts included within the neighborhood's boundaries. To request additional public health data, contact the Maricopa County Department of Public Health, Office of Epidemiology at https://www.maricopa.gov/3511/Request-Data. Environmental data sets were provided by Arizona State University and can be made available through ASU's Urban Climate Research Center at https://sustainability.asu.edu/urban-climate/.

Edison-Eastlake Community Hot Spot Intervention Points

Hot spot maps were developed through a process of identifying areas where community members have experienced difficulty with the heat while moving through their neighborhood. The core team recommends that they be used to define points of intervention for improving thermal comfort.

ID NOTES

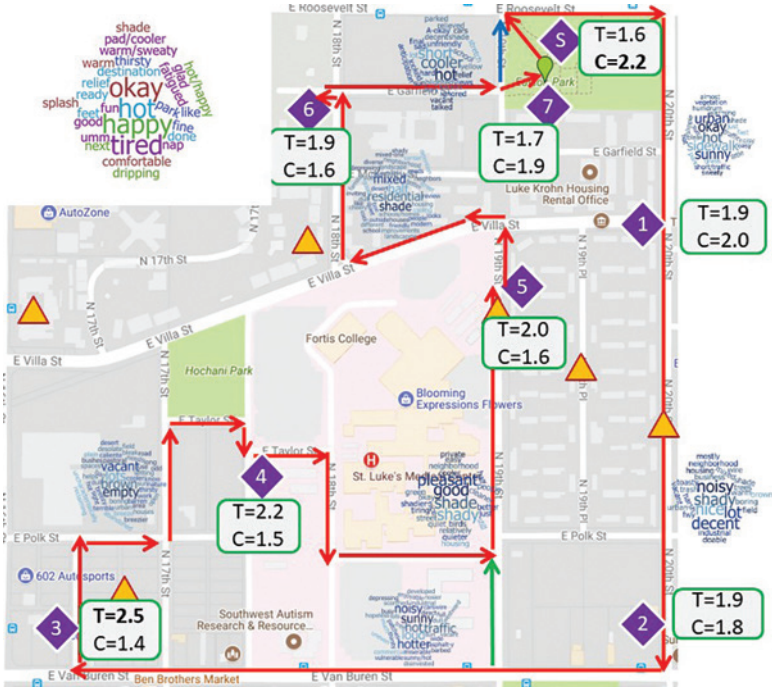
1 Hot route - Washington St. from 16th to 19th St
2 Edison Park - needs buildings and programming, needs light, benches and activation for safety
3 Edison Elementary School - for after school programs but not accessible when school is not in session
4 The hot, underutilized asphalt lot across the street across the street from 1741 E. McKinley
5 Adams and 18th st - street runoff pools here
6 Hot route - Van Buren corridor - 16th st to 20th st - scarce vegetation and shade
7 Hot route - Jefferson St. from 16th to 18th
8 18th St. & Washington NW corner
9 Van Buren & N. 16th St.
10 Hot Bus Stop on Roosevelt
11 N. 16th St. to McDowell Bus Stops
12 Roosevelt St. and Patricio St.

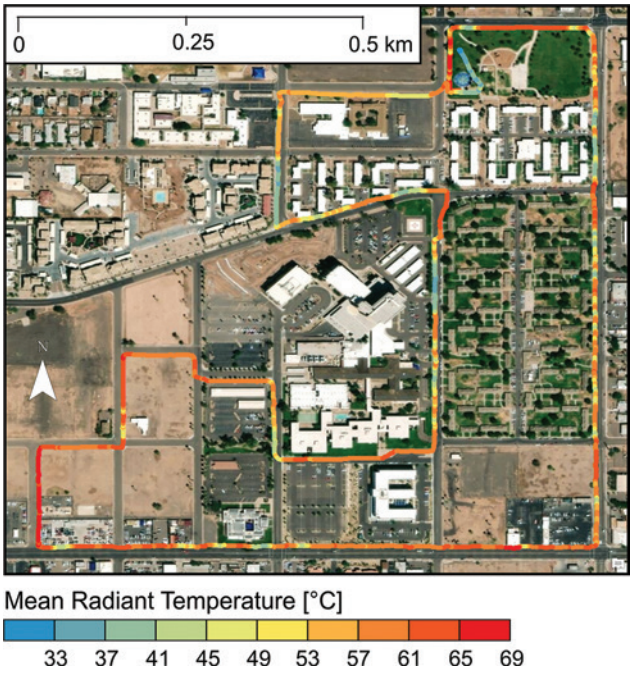


HeatMappers Walk Results in Edison-Eastlake Community

The map shows the results from the HeatMappers Walk, a public science event held in Edison-Eastlake Community on September 29th, 2018 at 4 p.m., a day which reached 105˚F (40.5˚C). This event was another attempt to understand "hot spots" in the neighborhood and learn what key factors influence residents' perceptions of comfort and heat. The point with the highest/hottest thermal sensation vote and lowest comfort vote was at the corner of Van Buren and 16th Place. This point corresponds to a mean radiant temperature reading of 148˚F (64˚C) and a surface temperature of 113˚F (45˚C). Meanwhile Edison Park, with a mean radiant temperature reading of 99˚F (37˚C) under tree shade, had the lowest/coolest thermal sensation vote and the highest comfort vote, and this held true even after participants walked the entire 2.4 mile/3.9 km route. Word clouds show descriptions that the public used to describe sites along the route.

Comfort (C): 0 (very uncomfortable) to 3 (very comfortable)
Thermal sensation vote (T): -4 (very cold) to +4 (very hot)





Edison-Eastlake Community Cool Spots

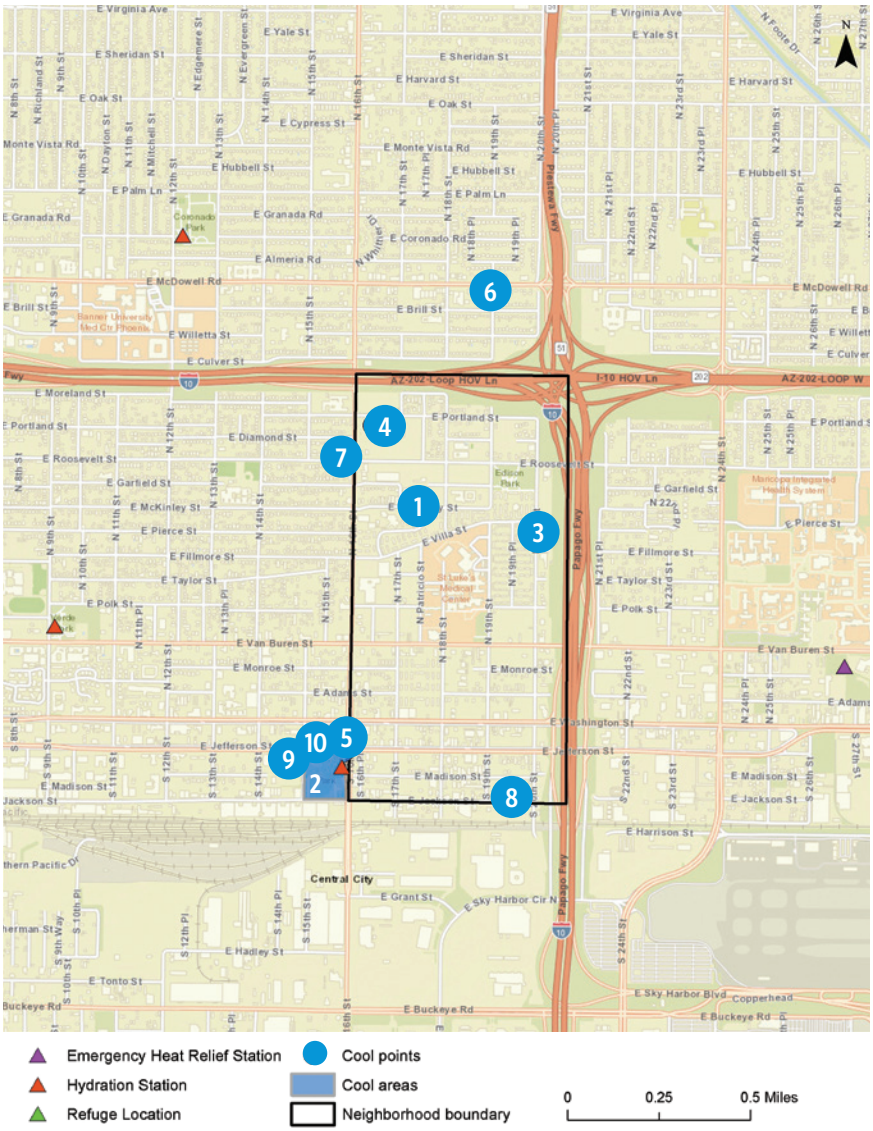
Cool spots represent cooling assets that residents identified during workshops or existing emergency heat relief stations, hydration stations, or cooling centers / refuge locations.

ID NOTES

1 Aeroterra Community Center - but not open to public, not open from S. side, not well known by residents, education and training resource
2 Eastlake Park - with community center and community pool (9 & 10)
3 Saint Philip-Deacon Catholic Church
4 Los Altos Ranch Market - seating inside with deli
5 Salvation Army Pop Up Tents - water distribution
6 McDowell Place Senior Center - neighborhood taxicab that charges $1 - city car
7 Church's Chicken
8 East Jackson Street
9 Eastlake Community Center
10 Eastlake Swimming Pool

"The heat really does affect your psyche and your calmness. It makes you just angry."

- Resident, Edison-Eastlake

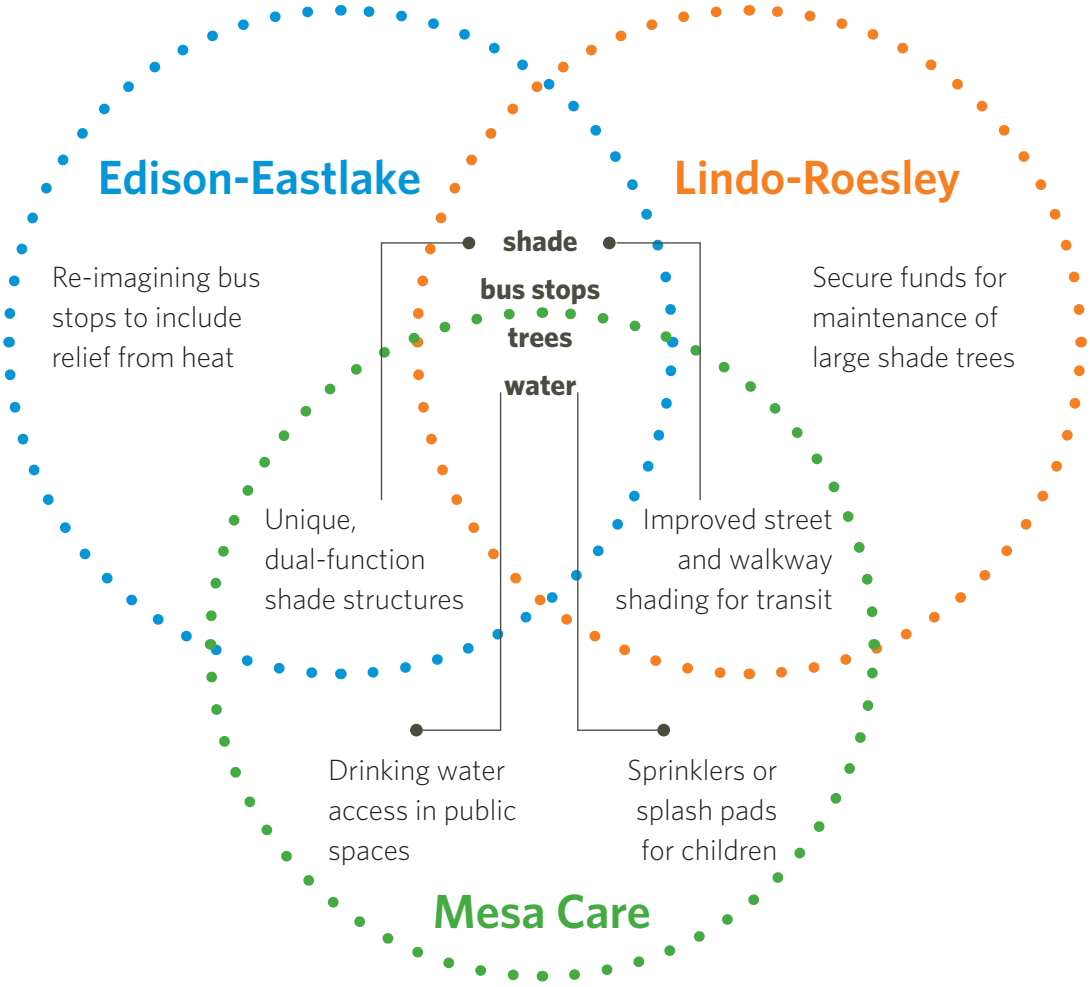


© Peter Conden

Resident Visions for a Cooler Neighborhood

As a result of three workshops within each community, the residents brought forth ideas that they would like to see implemented to increase their thermal comfort and safety during extreme heat days. The ideas were similar across different neighborhoods, but specific applications of solutions varied across neighborhoods. For example, all neighborhoods would like to add shade to their walksheds but preferences for shade implementation differed, as some neighborhoods prioritized routes to public transportation, others prioritized routes used by children on their way to school, and others wanted to see shaded rest stops in key places.

Timing is an issue for the city decision-makers and residents alike. Residents would like to see improvements within a very short time, as in the next year. Yet, the planning and funding cycle for capital improvement projects can be five to ten years in the future. The adaptation and mitigation strategies developed from these workshops seek to balance a long time horizon with immediate, grave needs.



Edison-Eastlake Community in Central Phoenix:

Primary Concerns:

1. Lack of shade on walking routes, at bus stops, and vacant lots
2. Access to drinking water
3. Services and amenities for people with disabilities and the elderly
4. Household costs of air conditioning

Solution Story

Residents in this Central Phoenix neighborhood are concerned about the lack of shade and subsequent exposure during extreme heat and the dearth of options for obtaining drinking water when leaving home. Further, residents are interested in learning how to handle heat health emergency situations and requested a preventative warning system beyond what is currently available and a first aid certification program specifically for heat situations. This community is particularly concerned about services and amenities for people with

disabilities and the elderly. It is a challenge for residents to manage the high cost of summer electricity bills and to keep indoor spaces cool enough while staying within their budget. Higher average temperatures for this neighborhood make this situation worse.

Another area of concern identified by residents are the hot walking routes around the Edison-Eastlake Community that have no vegetation or engineered shade, and are along vacant lots, which kick up dust during windy weather. Residents requested desert-appropriate trees be planted along identified highly used, and barren access routes. Sidewalks, many in disrepair, could be replaced with cooler materials. Access to drinking water at one-mile intervals will provide a needed heat safety element. A complete streets approach, with improved signaling, where pedestrians are shielded from traffic was highly requested along the major roads encircling the neighborhood.

Compounding the issue of unshaded streets, the majority of residents in this community rely on public transportation and, after a hot, dusty walk, have no reprieve once they get to the bus stop. A bus stop sign post does not offer any relief. In a complete re-imagining of what a bus stop could be, residents would like to have a structure that provides shade elements that can be moved around to shelter commuters from the sun at different times of the day, along with amenities like misters (already being tested within the City of Phoenix), fans (similar to those found at light rail stations), and drinking fountains. Seats at bus stops that can be reversed to take advantage of shade were also mentioned. The shade structure for a bus stop would not have to be made from solid material; an inverted "V" or angled roof over the stop that is covered in flowering vines and vegetation would provide shade and a sense of beauty to the community. To ensure safety, residents would like panic buttons, safety lights, and a configuration that allows for brief rest but discourages encampment. They felt that misuse of bus stops by some homeless people has limited or prevented bus stop use for their original purpose. Signage about heat training and safety information, along with wayfinding, can be posted at bus stops. Trees or other vegetation installed at bus stops would require access to irrigation. Stormwater could be captured for this purpose for supplemental irrigation. A drinking fountain could be included in the planning stages.

Edison-Eastlake

"I ride the bus and sometimes I go to the bus stop and it is really hot. Also, my apartment, it's also really hot in there....I have to go to bus stations and there is no shade structure. There is nothing. There are no trees along the way...I wish that there were more trees where I live, ...because there is nothing."

- Edison-Eastlake Resident

"In the cars, they get really hot and we have the child seat for my grandson and when they buckle the child seat, it burnt his legs because it was really hot."

- Edison-Eastlake Resident

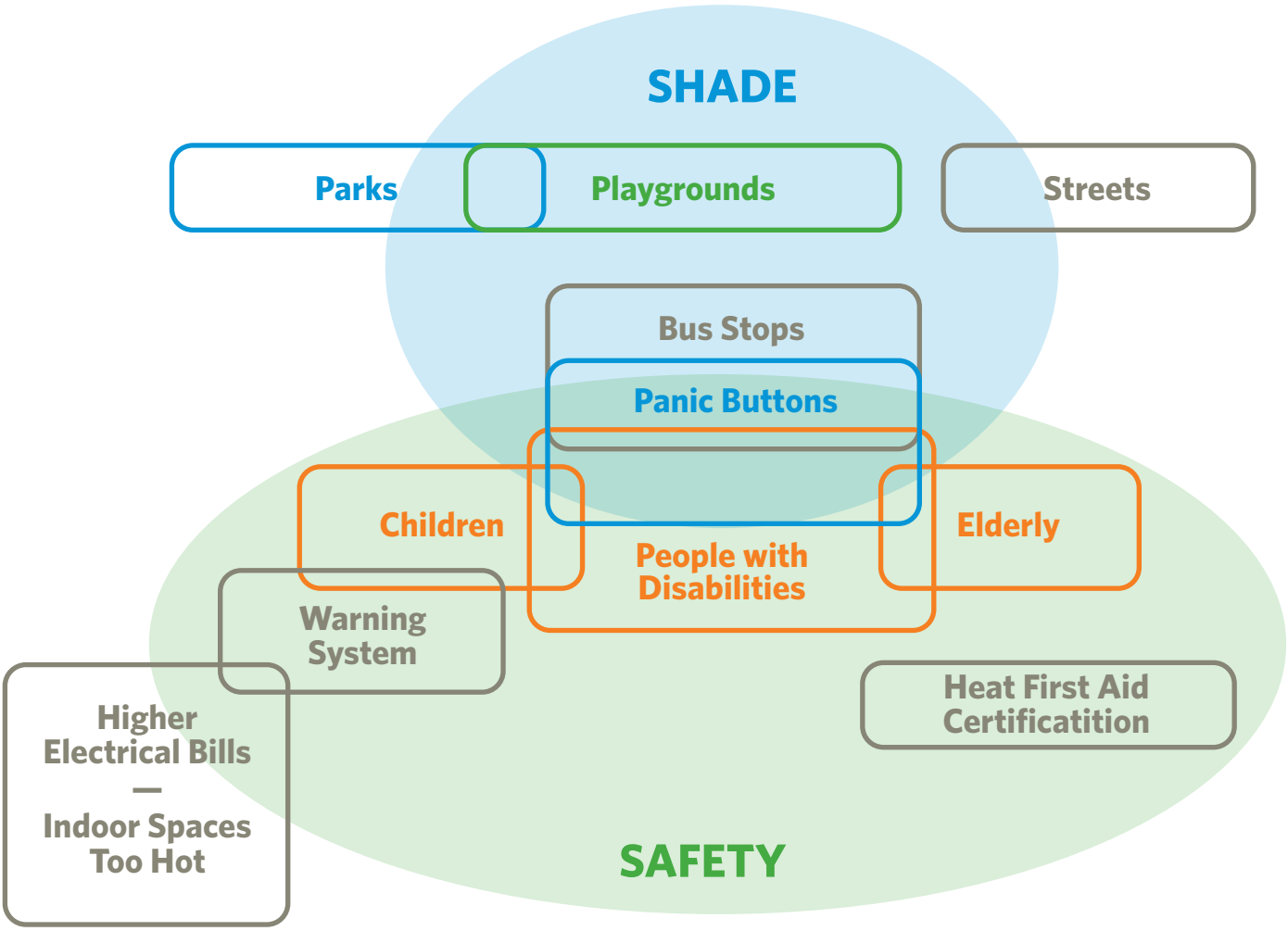
The current HUD Choice Neighborhood Plans call for a linear park to be installed along 19th St. Residents would like this park to have "talking spaces" where neighbors can catch up and chat with each other, lots of trees where people congregate and walk, seats at the edge of the proposed playground, shade structures, barbecue pits, and tables with a lot of seating to encourage the community to mingle with each other. Some residents recalled a time when sprinklers were available for the kids to play in during the summer months and would like to bring sprinklers back to different parts of the neighborhood. They requested that nearby pools stay open later because it is too hot to go to the pool midday and yet it is still hot in the early evening. Pools could open earlier in the morning, too.

To help keep neighbors safe from heat-related health issues, residents want an expanded warning system that alerts people to hours that are unsafe to be outdoors and other preventative measures. This could be part of an Arizona Heat Awareness Day and could be disseminated through text messaging and public service announcements on television. Heat distress symptoms could be posted in lobbies, laundry rooms, restrooms, and schools. Residents were surprised to learn that pavements can reach upwards of 150°F during the summer. Therefore, it would be unsafe to lay someone on the pavement if they felt ill. They requested a first aid certification program that would qualify residents as a "certified heat responder." These heat responders would know how to distinguish between heat stress and heat stroke, and how to respond in emergency situations.

They could also educate neighbors on how to stay safe in extreme heat, to always carry water, and explain how extreme heat impacts your life. A version of this training could be for "end of school" training for K-12 students so they stay safe during the summer and do simple things like freezing water bottles before leaving home.

Residents of Edison-Eastlake would like to have grand entrances into their community that reflect neighborhood identity and character. Signage on bus stops and wayfinding signs could provide information and be done in a way that signals you are in the Edison-Eastlake Community, while assisting you in getting to your destination via the coolest or most shaded route.

Residents' proposed heat solutions fell primarily into categories of shade and safety, with variations on how to implement.



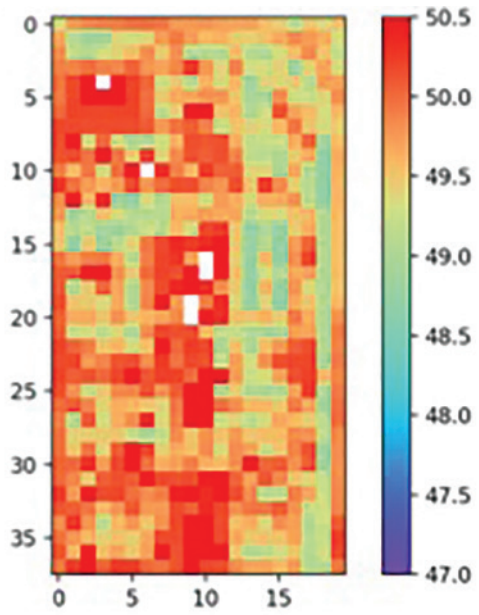
Modeled Changes to Urban Heat

Edison-Eastlake Community

Using data from June 2017 and land cover data (2010 NAIP) to study the potential impact of these heat actions on the neighborhood, the existing land cover was simulated along with representations of proposed changes to the neighborhood. Specifically, the neighborhood was conceptualized with increased tree coverage. In this tree coverage scenario, we increased percentage of tree canopy within the neighborhood to 30%. These simulations are shown in the associated figures: the baseline, and then the cooling scenario which uses a "relative-to-baseline" legend to highlight the maximum cooling effect.

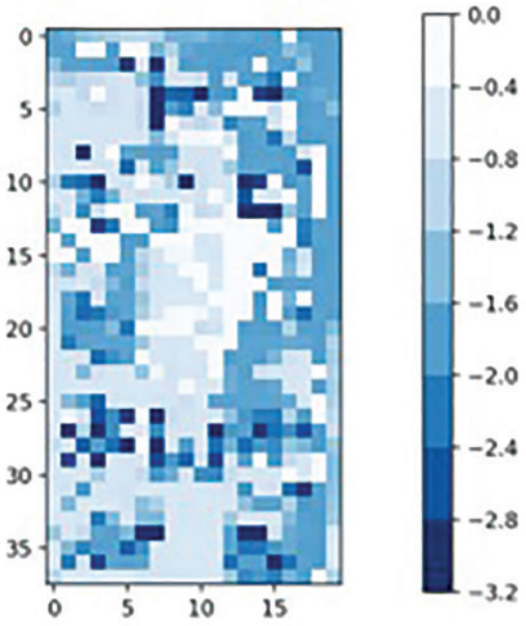
Similarly to Mesa and South Phoenix neighborhoods, increasing the tree canopy to 30%, we see widespread cooling across the Edison-Eastlake Community (~2° F for most of the neighborhood). This cooling will certainly be more localized in reality; however, this map shows the potential for significant cooling in the neighborhood. Some areas already show significant cooling in certain pockets of Edison-Eastlake, specifically in areas that were some of the hottest in the baseline and had the least amount of shade (around the parking lot of the grocery store and near the hospital). This cooling could then be prioritized to these warmest locations, as well as near bus stops and along common active transit routes to provide increased shade for individuals spending time outdoors. Note: areas with no change in temperature are areas where the tree canopy in the 30 m by 30 m cell was at or above 30%.

Baseline



Simulated 4pm near surface air temperature (C) of the Edison-Eastlake Community on June 20, 2017.

Cooling Scenario



Simulated 4pm near surface air temperature (C) of the Edison-Eastlake Community with added trees on June 20, 2017.

Drawings of a Cooler Neighborhood

Walkability/Roosevelt (street section)

Walkability/shade/linear park (plan)

This graphic demonstrates changes that can be made in the public right of way that can aid in creating a cooler environment for pedestrians along this street.

Bus stop/shade/cooling/18th St Washington NW Corner (perspective)

An increase of shade at bus stops as well as the safety elements of accessible water and a blue light system can ensure that public transit users have a more comfortable experience.

© Source: Ivan Martinez/TNC

Heat Action Plan for Mesa Care Neighborhood

Water Tower Improvement District

© Source: Van Martinez/TNC

Executive Summary

Nature's Cooling Systems Project for Heat Action Planning in the Mesa Care Neighborhood / Water Tower Improvement District

In Greater Phoenix, urban heat is impacting health, safety, and the economy and these impacts are expected to worsen over time. The number of days above 110˚F are projected to more than double by 2060. In May 2017, The Nature Conservancy, Maricopa County Department of Public Health, Central Arizona Conservation Alliance, Urban Resilience to Extremes Sustainability Research Network, Arizona State University's Urban Climate Research Center, and Center for Whole Communities launched a participatory Heat Action Planning effort to identify both strategies to reduce heat and improve the ability of residents to deal with heat. Community-based organization RAILMesa joined the project after the Mesa Care Neighborhood was selected as one of three neighborhoods for the project. Catholic Charities Care Campus soon became another key collaborator. Beyond building a community Heat Action Plan and completing demonstration projects, this project was designed to develop awareness of urban heat and to build better relationships between neighbors, organizations, community leaders, and decision-makers to do something about the issue of increasing heat. Storytelling wisdom and scientific evidence were used to understand the challenges that residents face during the hot summer months.

As a result of three workshops within each community, residents shared ideas that they would like to see implemented to increase their thermal comfort and safety during extreme heat days. As depicted on page 37, residents' ideas intersected around similar concepts, but specific solutions varied across neighborhoods. For example, all neighborhoods would like to add shade to their pedestrian corridors but how and where to put these shade improvements into place differed. Some neighborhoods prioritized routes to transit, others prioritized routes used by children on their way to school, and others wanted to see shaded rest stops in key places. Four overarching themes emerged across all three

neighborhoods—**advocate and educate; improve comfort/ability to cope; improve safety; build capacity**. Extreme heat causes residents to experience serious safety challenges in their day-to-day lives. Communities, businesses, and decision-makers can, and should, work to address those challenges.

Primary concerns voiced by residents in the Mesa Care Neighborhood during workshops include:

1. The need for shade, especially along routes to school or during long wait times at traffic lights
2. Access to drinking water
3. Connectivity from community to broader transportation routes
4. Safety for children and elderly, especially those living alone
5. Need for advocacy for urban heat solutions

Residents want advocacy training on how to educate decision-makers on the effects of extreme heat in their community. They want to know how to speak up about heat as a health and safety crisis and share the potential for improvements to thermal comfort and public health. Community members proposed pedestrian-oriented design changes to transit, such as shorter wait intervals at traffic lights or diagonal crosswalks. Another suggestion to increase thermal comfort at corners is to install shade. Residents would like to see vertical shade and shading that can move with the sun or vine covered walkways like those at the Desert Botanical Garden or on Southern Avenue in South Phoenix. Residents also proposed an Emergency Summer Plan for students in K-12 and adults in the community.

Heat Action Plans may be used by any resident or community leader to advocate for the integration of urban heat solutions in plans or projects in their neighborhood.

Comments on Heat Action Planning

"I am here [at the Heat Action Planning workshop] because I want to try to help so everything changes."

– Mesa Resident

"With conversations with neighbors in South Phoenix, what is very interesting to me is that they say, "Oh it's hot, that's normal." And I think that's the interesting part of the conversation. It is hot, but it's not normal. There is something that we can do."

- Community Organizing Partner

"What makes this project unique is that we're focused on improving quality of life, we're not just recording facts about heat and shade, etc., you need people's experiences to drive the process of change"

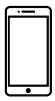
- Core Team Partner

Strategic Themes

Advocate and Educate | **Improve Comfort/Ability to Cope** | **Improve Safety** | **Build Capacity**

Mesa Care

Using social media and hashtags to highlight child safety and bus route issues



Lindo-Roesley

Planting vegetation for empty lots to reduce dust

Edison-Eastlake

Create signage for heat safety and wayfinding could reduce risk

Who We Are

Southeast of downtown Mesa, bordered by East Main Street and East 8th Avenue on the north and south and South Mesa Drive and South Stapley Drive on the west and east, the Mesa Care Neighborhood is known as the "Water Tower Improvement District." Redevelopment of a former junior high school into a community center and the surrounding grounds into Eagle Park will be a centerpiece of this neighborhood and is presently underway. That redevelopment is part of a redesign of the Broadway Corridor.

The Catholic Charities Care Campus is located in the center of the Mesa Care Neighborhood. The poem on the right was developed by kids in the Care after-school program.

Moving-Walking People

Our neighborhood is sweet tasty smells like pan
from the panadería or Patty's house

The scent of charcoal and carne asada that means
it's the weekend

Family: mom and dad, abuela, tíos y tías,
brothers, sisters, cousins, and friends who are family
Fill the yard with love
And kindness and yelling and music

Out in the sun
On our scooters, bikes
Or with the soccer ball
In empty lots and on big sidewalks

Jumping over fences
when the food is ready
churros, tamales, or spaghetti,
maruchanes, orange chicken, or frijoles charro

Our streets are busy with people moving-walking, on bikes
full of pickup trucks and parked cars
and the sound of tires and horns.

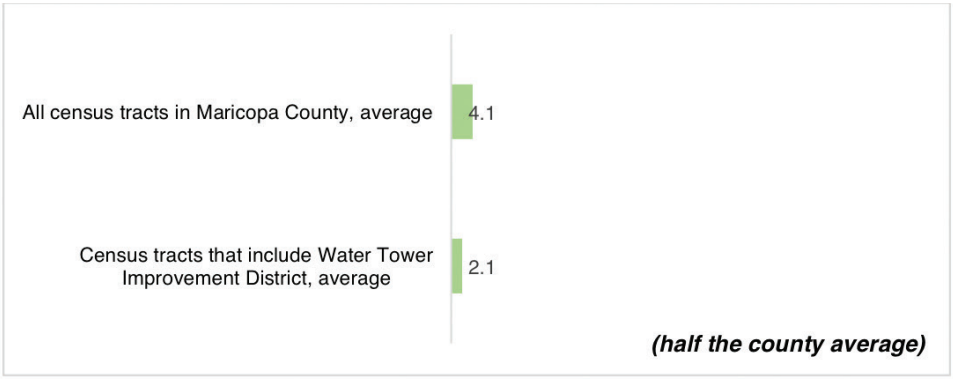
Our neighborhood means family and home.

Neighborhood Baselines
Mesa Care Neighborhood

The following data provide a baseline for reference for the Mesa Care Neighborhood/Water Tower Improvement District. Tracking these indicators over time will help neighborhoods and those involved in planning decisions understand whether their heat mitigation and adaptation initiatives are helping to improve (or hurt) the current situation.

Health

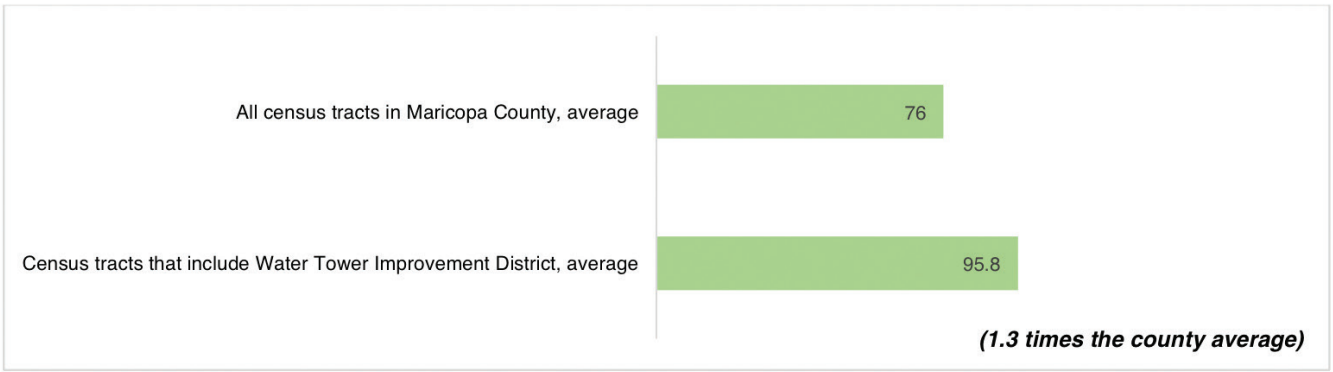
Average annual heat-associated death rate per 1,000,000 population, 2012-2017



62% of Maricopa County census tracts had lower heat-associated death rates than the Water Tower Improvement District, 2012-17

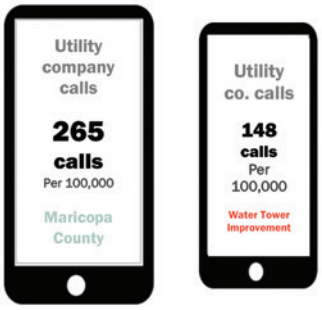
* Reasons for exceedingly high rates of heat deaths are not currently known.

Average annual heat-related illness rate per 1,000,000 population, 2012-2017



72.2% of Maricopa County census tracts had lower heat-related illness rates than the Water Tower Improvement District, 2012-17.

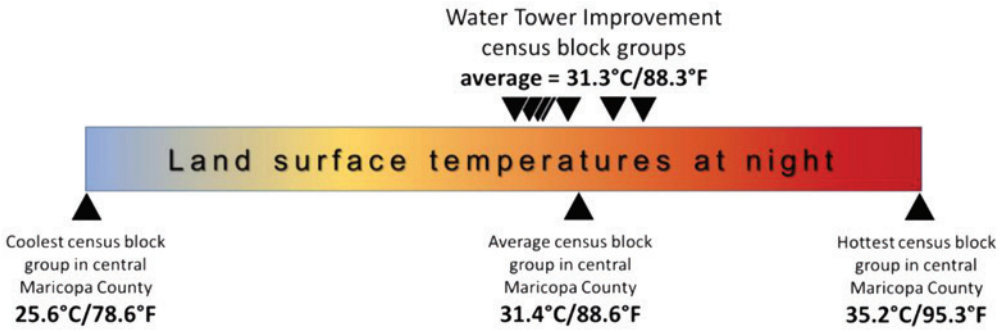
Utility Issues



Environmental characteristics

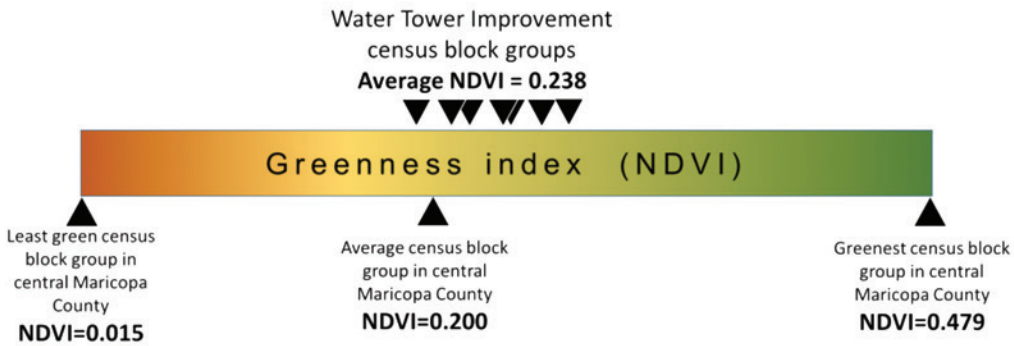
Land surface temperature on 8/6/2014 at night

Regional land surface temperature comparison

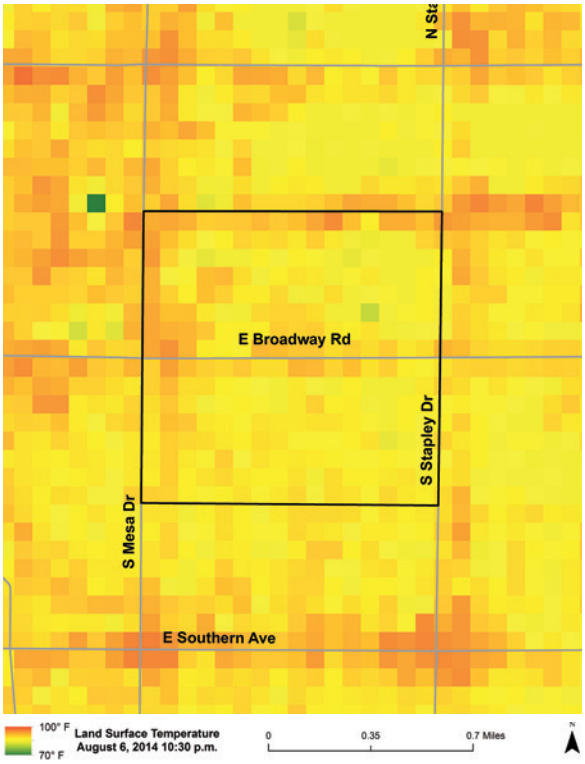


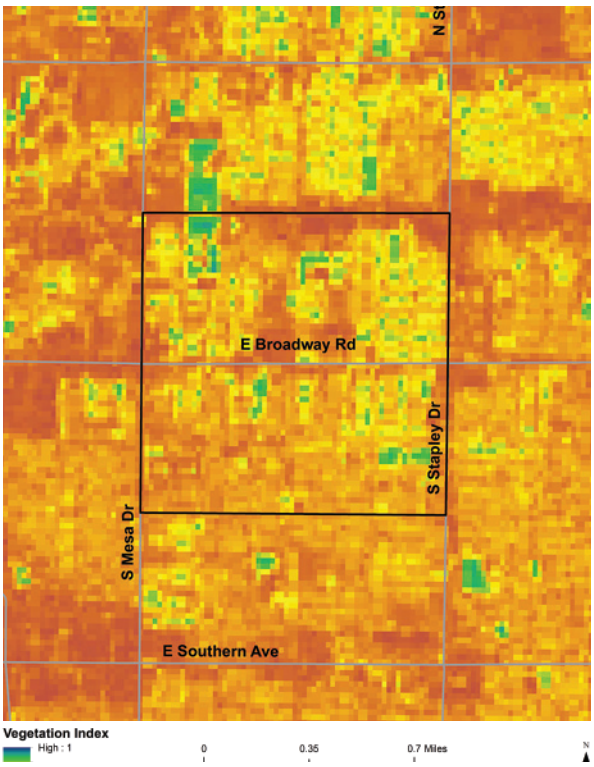
Tree coverage 10.5% • County average 8.8%

Census Block Groups



Land Surface Temperature (top) and NDVI (bottom) within Mesa Care Neighborhood / Water Tower Improvement District.





Summary of Environmental Characteristics: Water Tower Improvement

Surface temperatures: Most of the neighborhood has surface temperatures that are near or even below the regional average. However, the northwest part of the neighborhood, west of Hobson and above Broadway, is notably warm.

Vegetation coverage: Southwestern parts of the neighborhood, west of Horne and below Broadway, fall below the regional average in terms of tree and grass coverage.

Greenness: The neighborhood is relatively green compared to many others in central Maricopa County, but still falls well below the region's greenest neighborhoods.

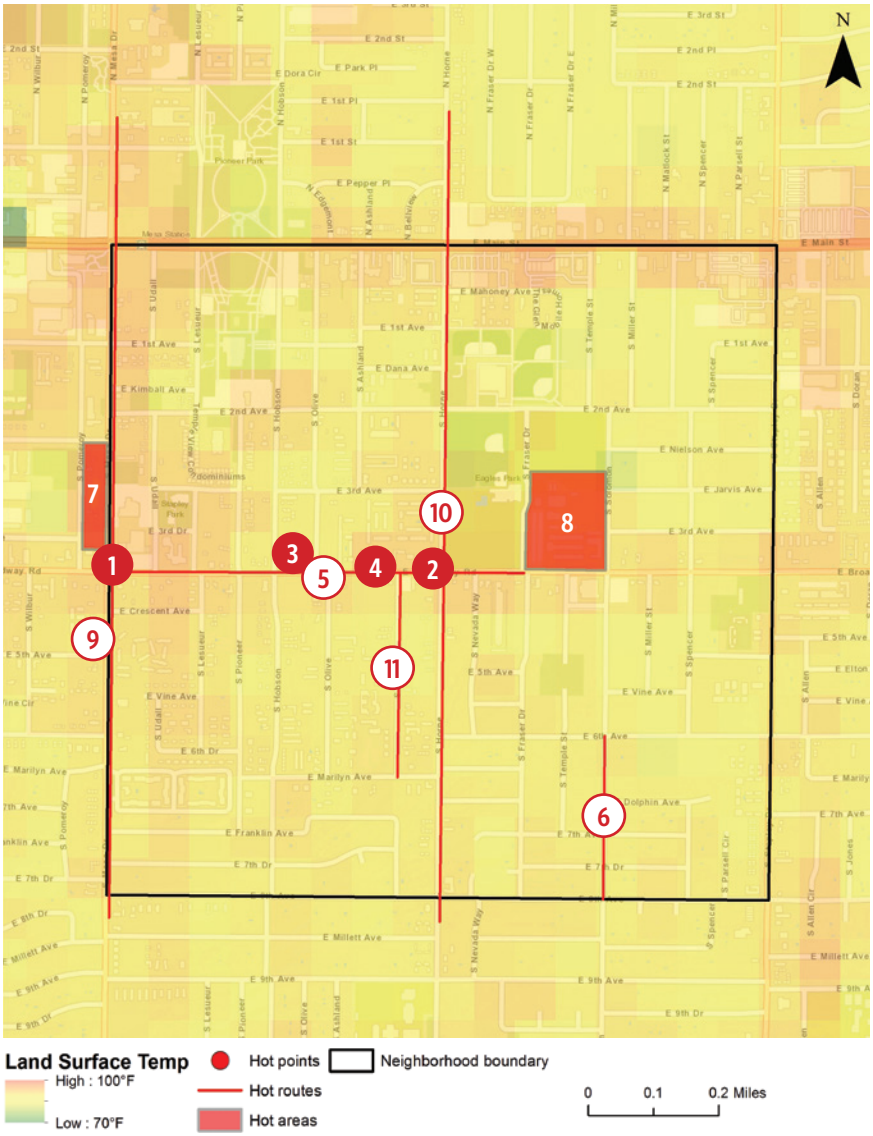
Methods

Baseline data were sourced from the following databases: Maricopa County Department of Public Health (MCDPH) heat mortality surveillance, MCDPH heat morbidity surveillance, Arizona 2-1-1, NASA ASTER satellite imagery, NASA LANDSAT satellite imagery, the National Agriculture Imagery Program (NAIP), and the US Census Bureau. Some of the variables were measured at the census tract level, some were measured at the census block group level, and some were measured at the zip code level. Census tracts are regions that include 2,500 to 8,000 people. Census tracts are divided into multiple census block groups. Tracts and block groups were selected based on neighborhood boundary lines. Individuals were counted in these rate calculations if they had an address that could be geocoded to a Maricopa County census tract. Neighborhood-specific rates were calculated by average rates of census tracts included within the neighborhood's boundaries. To request additional public health data, contact the Maricopa County Department of Public Health, Office of Epidemiology at https://www.maricopa.gov/3511/Request-Data. Environmental data sets were provided by Arizona State University and can be made available through ASU's Urban Climate Research Center at https://sustainability.asu.edu/urban-climate/.

Mesa Care Hot Spot Intervention Points

Hot spot maps were developed through a process of identifying areas where community members have experienced difficulty with the heat while moving through their neighborhood. The core team recommends that they be used to define points of intervention for improving thermal comfort.

ID	NOTES
1	Bus Stop - Hot area
2	Bus Stop -High use bus stop
3	Mil Amores Tires - old tire place
4	Mesa Deli - Hot problem area
5	Broadway Problem Area - Hot problem area. Broadway and S Mesa Dr to Broadway and S Fraser Dr. Kids walking across street and more bikes on Broadway compared to Main
6	S. Solomon 8th-6th Ave - Hot problem area.
7	Day Laborers - Hot area. No shade. Laborers are here 6am-4pm
8	Lowell Elementary: open during summer months.
9	Mesa Dr. - Need shade and bump outs down the whole street
10	S. Horne - Entire route needs shade and bump outs
11	Bellview to Main - After School Program walking route that could use more shade



"We didn't know how to deal with AC. We had a conversation about some housing, they are not very friendly to the heat, right? Cheap apartments, cheap houses, cheap walls, and that makes everything worse."

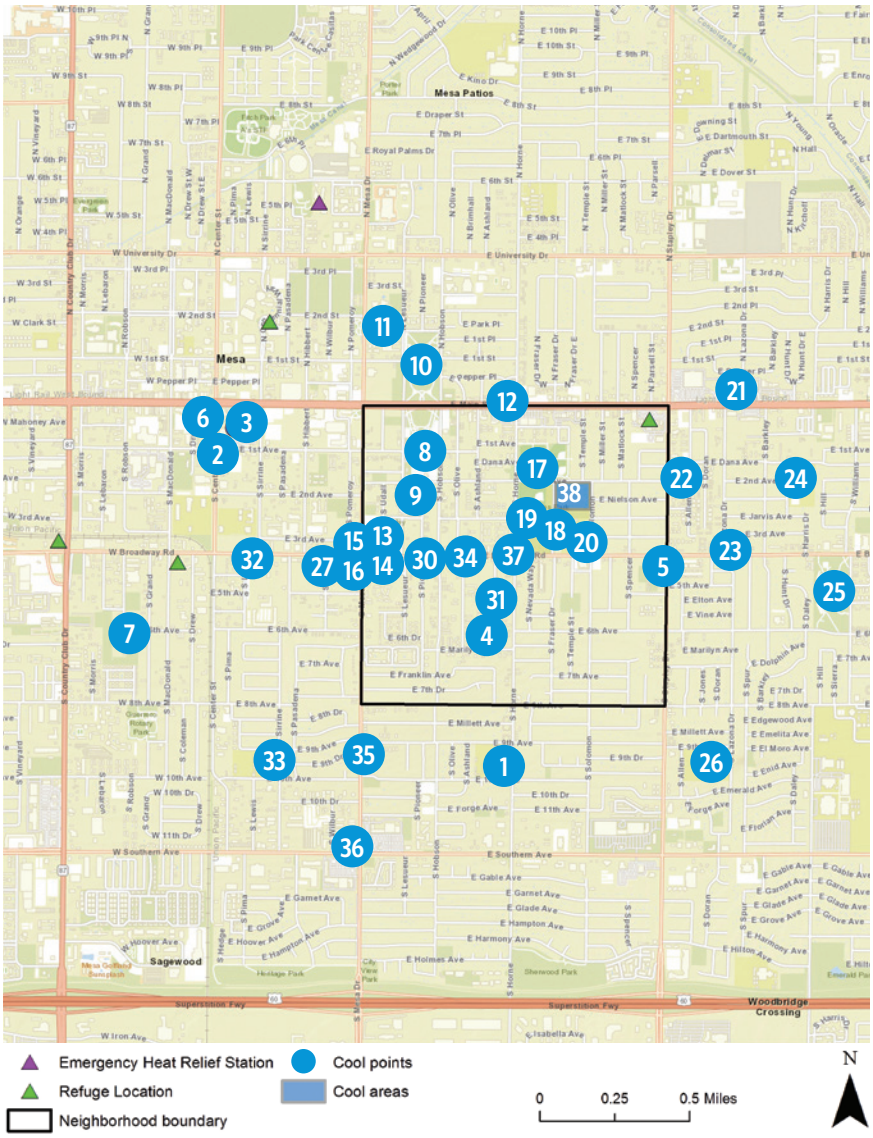
- Resident, Mesa Care Neighborhood

Mesa Care Cool Spots

Cool spots represent cooling assets that residents identified during workshops or existing emergency heat relief stations, hydration stations, or cooling centers / refuge locations.

ID NOTES

1 Holmes Elementary School and Headstart - Cool
2 First United Methodist Church of Mesa - Cool resource. Coolers, place to get water, food and clothing.
3 Mesa Arts Center - Cool resource. Cooling center, blackouts/extreme heat events
4 Community Bridges Health Services (rehabilitation) Shelter
5 QuikTrip - Restroom and water
6 Heritage Academy Charter School - 7-12
7 Boys & Girls Clubs of the East Valley
8 Mesa Arizona Temple - Grass, contemplative space, visitor center. Cool resource.
9 Church of Jesus Christ of LDS - Cool resource
10 Pioneer Park - New splash pad and covered play area. Cool resource.
11 First Presbyterian Church - Cool resource
12 Paletas Ice Cream - Cool resource
13 Kerby's Furniture - Cool resource.
14 El Bigo Taco - Cool resource. Tent.
15 Circle K - Gives out water
16 Deliciosos Super Hot Dogs - Tent. Cool Resource.
17 Mesa InterStake Center - Cool resource.
18 Lowell Elementary School - Cool resource.
19 Future Park - Park planned in 2019. Currently bulldozing.
20 Head Start - Cool resource
21 Food City - Cool resource.
22 Clinica Adalante - Cool resource.
23 Taco Stand - Cool resource. Tables in parking lot.
24 Christ the King Mission of Mercy - Cool resource.
25 Reed Skate Park - Cool resource. Skate park and soccer practice.
26 Lindbergh Elementary School - Cool resource. Head start program.
27 Los Tres Amigos - Cool resource. Benches with shade.



28 Maricopa County WIC - Cool resource
29 Mesa Community Action Network - Cool resource. WIC, immunizations, business development
30 Mesa Church - Cool resource. Used to be irrigated. Access to irrigation.
31 Mesa Care Partnership - Cool resource. Kids/ after school care. Water available. Community garden open. Mom Mobile (mobile maternity unit).
32 Broadway Recreation Center - Cool resource. Boxing gym.
33 Lincoln Elementary School - Cool resource. Head start program.
34 A New Leaf
35 Bus Stop - M-F Bus limited service
36 Clinic - Cool Resource. Clinic - Mesa and Southern
37 Moreno's Mexican Grill - Cool resource. Neighborhood staple
38 Soccer Fields - Cool resource

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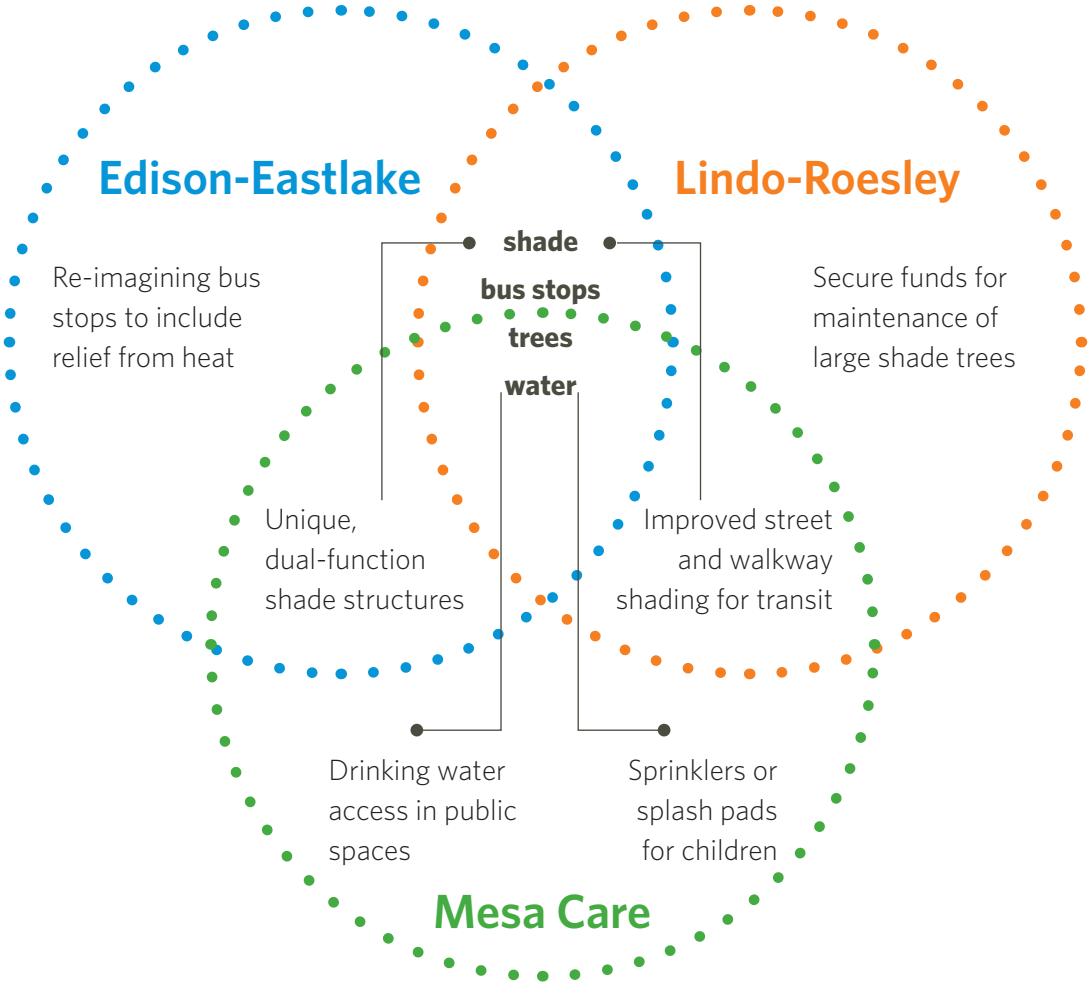
Resident Visions for a Cooler Neighborhood

As a result of three workshops within each community, the residents brought forth ideas that they would like to see implemented to increase their thermal comfort and safety during extreme heat days. The ideas were similar across different neighborhoods, but specific applications of solutions varied across neighborhoods. For example, all neighborhoods would like to add shade to their walksheds but preferences for shade implementation differed, as some neighborhoods prioritized routes to public transportation, others prioritized routes used by children on their way to school, and others wanted to see shaded rest stops in key places.

Timing is an issue for the city decision-makers and residents alike. Residents would like to see improvements within a very short time, as in the next year. Yet, the planning and funding cycle for capital improvement projects can be five to ten years in the future. The adaptation and mitigation strategies developed from these workshops seek to balance a long time horizon with immediate, grave needs.



Mesa Care Neighborhood/Water Tower Improvement District

Primary Concerns:

1. Amount and quality of shade, especially along routes to school or during long wait times at traffic lights
2. Access to drinking water
3. Connectivity from community to broader transportation routes
4. Safety for children and elderly, especially those living alone
5. Need for advocacy for urban heat solutions

Solution Story

Residents in Mesa expressed dissatisfaction with the amount and quality of shade in their community. They are particularly concerned about children walking on Broadway to and from elementary school. Compounding this issue is the car-centric traffic light pattern that has very long wait times for pedestrians at shadeless corners. One way to lessen exposure is to reduce wait times by changing the timing of the traffic light to allow for shorter wait intervals or to allow for traffic to stop in all directions so that pedestrians can cross diagonally as well as directly across the street.

The other way to increase thermal comfort at corners is to install shade. Shade can be in the form of structural shade or trees and most community members felt that structural shade at corners would be more appropriate to ensure visibility and safety both for pedestrians and vehicular drivers. Structural shade that expands beyond overhead coverage can be incorporated into bus stops, which is only useful during the midday heat and sun. Residents would like to see vertical shade and shading that can move with the sun or vine covered walkways similar to those at the Desert Botanical Garden or on Southern Avenue in South Phoenix.

A bus stop can be transformed into more than a place to wait for transit. They can be areas where residents can rest as they walk to their destination or be developed into micro parks. Misters and fans could provide relief from the heat. They can become an information booth for heat safety and a placemaking tool to direct residents to community cool spots and resources. These bus stops/micro parks could reflect the neighborhood character in their designs. The bus stop can have a "panic button" similar to those found on the light rail and college campuses that would directly connect to the emergency services.

Access to water for drinking is a concern in the Mesa Care Neighborhood/Water Tower Improvement District and access pathways leading out of the community (to work, transportation routes, etc.). Drinking fountains at bus stops, rest stops, or in parks are highly requested. Artistic public water fountains, such as that at Mesa Arts Center, were greatly desired as just looking at them made residents feel cooler and reminded many of fountains found in public squares in other parts of the world. Water features, such as pools or splash pads, were mentioned often as these amenities do not exist in this neighborhood but were available in the more affluent neighborhoods nearby. As with access to green spaces, residents would like to see a water feature available within a ten minute walk in their community. Residents who had small children proposed a low-tech sprinkler set up that could be placed in a public park, pocket park, or community center, and run at regular times during the summer so that the kids (and adults) could gather and cool off. Wherever the city is watering grass and trees, a sprinkler can be used so that the kids can play and keep cool.

This water feature could also benefit vegetation with its runoff. Residents cited the cost of water and expense of tree maintenance; they see opportunities for increasing the vegetation in the community for people who own land but do not have the resources to install shade features such as trees, rest stops, and pocket parks. A community fund could be developed that helps residents with tree maintenance and planting so that mature trees can thrive, and barren land can be transformed into a community oasis. Trees could also be planted in retention areas to take advantage of the stormwater runoff and the community noted that trees planted in those areas grow much faster and appear to be healthier. In the Broadway corridor and roads leading

Mesa Care Neighborhood

"With conversations with neighbors in South Phoenix, what is very interesting to me is that they say, 'Oh it's hot, that's normal' And I think that's the interesting part of the conversation. It is hot, but it's not normal. There is something that we can do"

- Mesa Resident/CBO

"Mesa used to have irrigation ditches along each house, and it was much cooler. My mother was a girl here in Mesa. When they got hot, they'd go sit in the irrigation ditch and that was how they lived through the summer. They had fruit trees, citrus trees, palm trees all over."

- Mesa Resident

into it, the public right of way also holds potential for cooling features. Access roads could be re-designed to incorporate bump-outs for trees and curb cuts to help capture stormwater. Wide roads could be narrowed, and the space gained is an opportunity area for adding greenery and providing extra safety for pedestrians. Just seeing trees and other vegetation makes residents feel better and cooler.

Residents are concerned about their safety on extreme heat days for both children and adults. The elderly residents who have been in the community for twenty to thirty years, especially those living alone, are of particular concern due to the lack of amenities, their limited income, and decreased mobility. Residents feel that they are a fountain of wisdom in how to cope with the heat and would like to involve these elders to share their coping strategies and to ensure that they are cared for during extremely hot days.

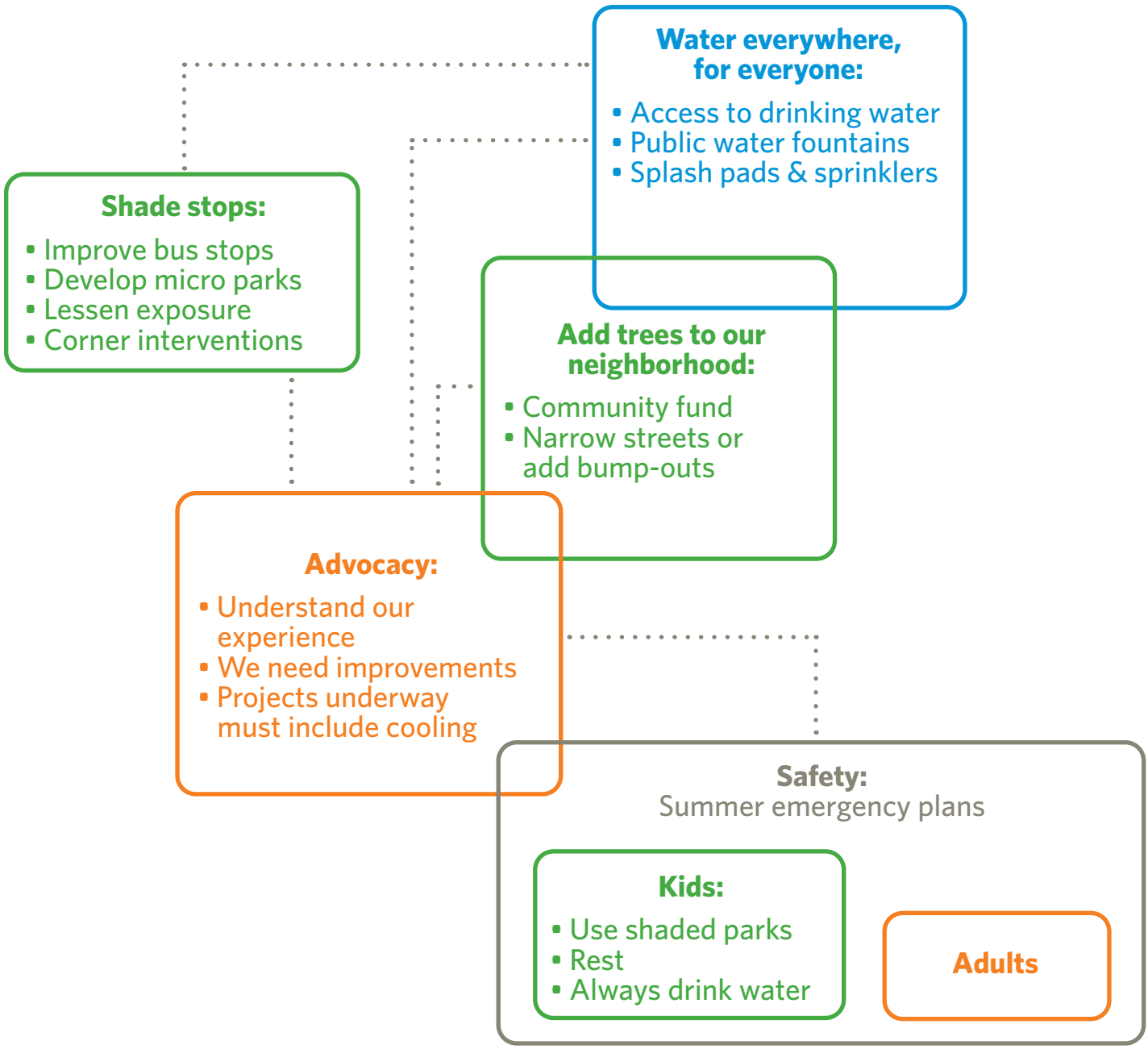
Residents proposed an Emergency Summer Plan for students in K-12 and adults in the community. For adults, they would be made aware of the cool spots and official cooling centers, be able to use an app or live map on the bus stop shelter that would let them know the bus arrival times to avoid needless waiting in the hot sun and have access to water throughout their outdoor activity. For children, a program can be developed with teachers to educate students on heat safety, provide information about cool routes and spaces and the importance of rest while outside in high temperatures, and train them to always carry water. Reusable water bottles can be distributed at school (with safety information on the side) so that teachers do not let any child outside without a full bottle of water. Older students can use this safety information as the basis of an advocacy program to lobby for more cooling features in the community.

These mitigation and adaptation strategies must be shared with elected officials and city departments in order to be implemented. Residents feel that they need advocacy training, especially since these workshops were, in many cases, their first interactions with governmental officials. Advocacy for this community entailed educating decision-makers on the effect that extreme heat has on their community, the fact that this is a health and safety crisis, and they need improvements to increase thermal comfort and public health outcomes. The advocacy training could help them to effectively communicate their position and take advantage of projects that are already underway to ensure that they include cooling features desired by this community. Neighborhood Services within the City of Mesa offered to coach residents through the neighborhood registration and capacity building process.


© Kristin Rothballer

Other ideas for advocacy included launching a Twitter campaign for heat entitled #ArmyofMoms that would highlight how heat affects mothers with small children and operation of the circulator bus, The Buzz, on roads that have no shade during the hot summer months. Residents that use public transportation from this community could be trained so that they could serve on the transit advisory board as there are currently no board members serving who rely solely on public transportation. Both residents and city officials felt that more involvement on both sides was needed as there are misconceptions that 1) city officials assume residents don't want to be involved if they don't show up to planned community outreach events and 2) residents have limited knowledge of the process, timelines, and access points to have their voice heard and acknowledged.

Residents' proposed heat solutions fell primarily into categories of shade, safety, advocacy, and water, with variations on how and where to implement.



Modeled Changes to Urban Heat

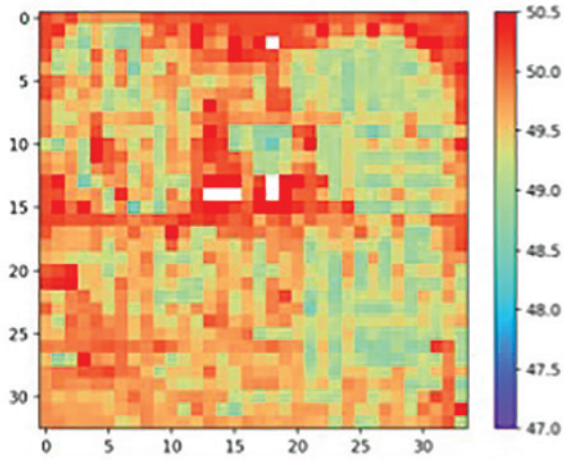
Mesa Care Neighborhood/Water Tower Improvement District

Using data from June 2017 and land cover data (2010 NAIP) to study the potential impact of these heat actions on the neighborhood, the existing land cover was simulated along with representations of proposed changes to the neighborhood. Specifically, the neighborhood was conceptualized with increased tree coverage. In this tree coverage scenario, we increased percentage of tree canopy within the neighborhood to 30%.

These simulations are shown in the associated figures: the baseline, and then the cooling scenario which uses a "relative-to-baseline" legend to highlight the maximum cooling effect.

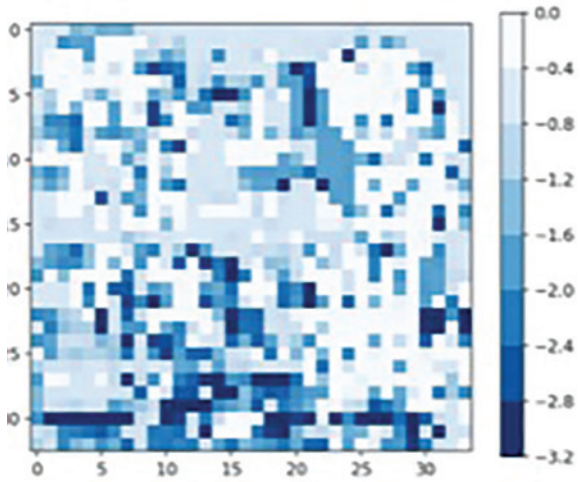
Modestly increasing the tree canopy to 30% results in widespread cooling across the Mesa Care Neighborhood (as much as 6° F). This cooling will certainly be more localized in reality; however, this map shows the potential for significant cooling in the neighborhood. Some areas already show significant cooling in certain pockets of Mesa, specifically in areas that were some of the hottest in the baseline and had the least amount of shade. This cooling could then be prioritized to these warmest locations, as well as near bus stops and along common active transit routes to provide increased shade for individuals spending time outdoors. Note: areas with no change in temperature are areas where the tree canopy in the 30 m by 30 m cell was at or above 30%.

Baseline



Simulated 4pm near surface air temperature (C) of the Mesa Care Neighborhood on June 20, 2017.

Cooling Scenario



Simulated 4pm near surface air temperature (C) of the Mesa Care Neighborhood with added trees on June 20, 2017.

Drawings of a Cooler Neighborhood

Enhancing shaded pathways along the perimeters of parks can help to encourage use and care of park amenities like those at Eagles Park, while improving walkability in the neighborhood.

Incorporating structural shade where trees cannot be planted, such as under power lines, is an alternative for providing heat relief along Broadway Road.

Pathways to schools S. Horne (plan)

Eliminating harsh environmental conditions near schools can create a more inviting atmosphere. Tree placement should be prioritized along paths to schools.

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Heat Action Plan for Lindo Park-Roesley Park Neighborhood, South Phoenix

© Maggie Messerschmidt/TNC

Executive Summary

Nature's Cooling Systems Project for Heat Action Planning in Lindo Park-Roesley Park Neighborhood

In Greater Phoenix, urban heat is impacting health, safety, and the economy and these impacts are expected to worsen over time. The number of days above 110˚F are projected to more than double by 2060. In May 2017, The Nature Conservancy, Maricopa County Department of Public Health, Central Arizona Conservation Alliance, Urban Resilience to Extremes Sustainability Research Network, Arizona State University's Urban Climate Research Center, and Center for Whole Communities launched a participatory Heat Action Planning process to identify both mitigation and adaptation strategies to reduce heat directly and improve the ability of residents to deal with heat. Community-based organization Puente Movement joined the project team after the Lindo Park-Roesley Park Neighborhood was selected as one of three communities for Heat Action Planning. Beyond building a community Heat Action Plan and completing demonstration projects, this participatory process was designed to develop awareness of urban heat and to build agency and relationships between neighborhoods, organizations, community leaders, and decision-makers for doing something about the issue of increasing heat. Storytelling wisdom and scientific evidence were used to understand the challenges that residents face during the hot summer months.

As a result of three workshops within each community, residents brought forth ideas that they would like to see implemented to increase their thermal comfort and safety during extreme heat days. As depicted on page 55, residents' ideas intersected around similar concepts, but specific solutions varied across neighborhoods. For example, all neighborhoods would like to add shade to their pedestrian corridors but preferences for the location of shade improvements differed. Some neighborhoods prioritized routes to public transportation, others prioritized routes

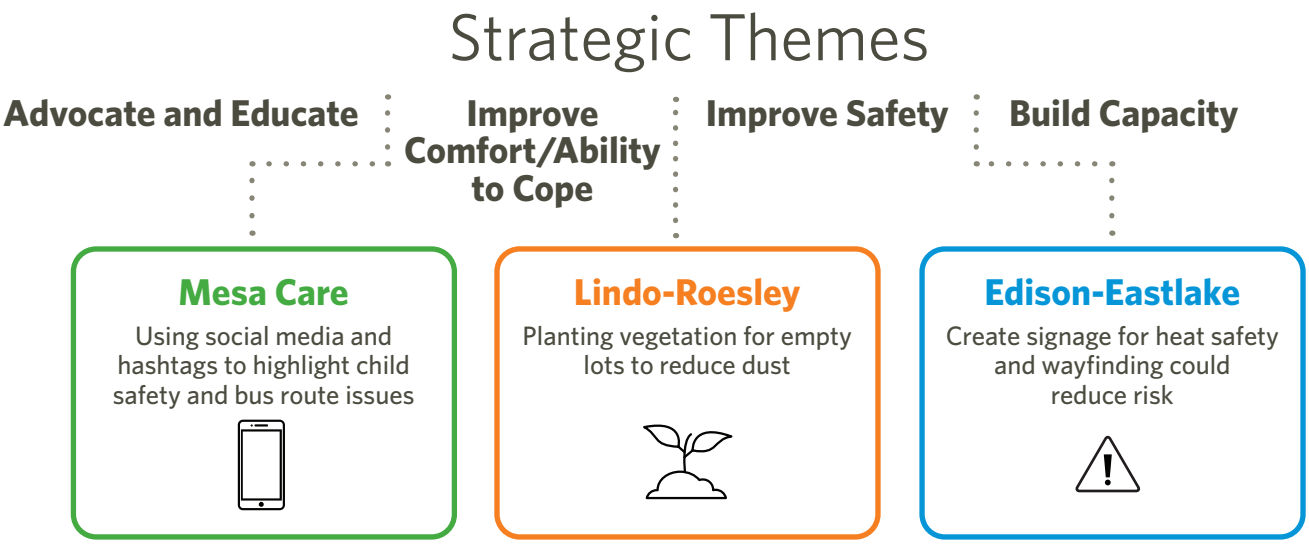
used by children on their way to school, and others wanted to see shaded rest stops in key places. Four overarching themes emerged across all three neighborhoods—**advocate and educate; improve comfort / ability to cope; improve safety; build capacity**—signaling that residents experience serious safety challenges in their day-to-day lives with heat and that community, business, and decision-making sectors can and should work to address those challenges.

Primary concerns in the Lindo Park-Roesley Park Neighborhood that were identified by residents during workshops include:

1. Financial burden and lack of resources for tree planting and shade
2. Risk of heat-related illness and the need to create safety during the heat, especially for students and seniors living alone
3. Children often stay inside during the summer months
4. Vacant lots and dust
5. High electricity bills made worse by poor quality housing materials and lack of insulation in homes
6. Need to develop advocacy skills to promote the heat mitigation and adaptation strategies

Residents would like to see a fund developed that would help to maintain shade trees, assist with the financial burden of removing dead trees, and the purchase of replacement trees. Shade along walking routes, especially for children on their way to school, is a priority for Lindo Park-Roesley Park Neighborhood. Residents expressed an interest in approaching shade, water, and access to bus routes as a system, especially along 7th Avenue and Alta Vista and Roeser Road between 7th and 15th Avenues. Walking paths that have amenities like shade, drinking fountains, and benches would allow for protection from the heat while outdoors and the ability to rest and cool off on the way to a destination. Installing better insulation would also help to lower bills.

Heat Action Plans also include residents' proposals for improved communication with decision-makers and advocacy for urban heat solutions by community organizations and others. Heat Action Plans may be used by any resident or community leader to advocate for the integration of urban heat solutions into future changes or programming in the Lindo Park-Roesley Park Neighborhood.



Who We Are

This neighborhood lies entirely south of the Salt River, from the northern bank of the Salt River to Southern Avenue in the south and from its western edge at 23rd Avenue to the east at 7th Avenue. The Lindo Park/Roesley Park neighborhood thus is near, but not in, the planned Valley Metro Light Rail expansion along Central Avenue. The community is over two-thirds Latino but has a sizeable Black population (18%) as well. Beginning in the early part of the 20th century when Mexican immigrants moved to Phoenix they were largely conscripted to agricultural labor, and Latinos and Blacks were required to live south of the river (but these two groups were segregated from each other). Owing to the expansion of manufacturing in the 1950's, the area has mixed land uses, brownfields, and contaminated sites along with pockets of agriculture. Median household income in the Lindo Park-Roesley Park Neighborhood is $37,345 and over half of the homes are owner-occupied.

Roesley Park is near the center of the neighborhood and Lindo Park is at the extreme western edge on Roeser Road; CJ Jorgensen Elementary School is to the east on Roeser Road near the middle of the neighborhood. A community garden just south of the neighborhood (Spaces of Opportunity) has the goal of providing fresh produce for South Phoenix families.

Puente Movement, the Community-Based Organization that organized around Heat Action Planning in South Phoenix, worked with parents and children in the area to respond to the question of what green spaces mean to develop the poem (originally in Spanish on page 57.)

Comments on Heat Action Planning

"With conversations with neighbors in South Phoenix, what is very interesting to me is that they say, "Oh it's hot, that's normal." And I think that's the interesting part of the conversation. It is hot, but it's not normal. There is something that we can do."

- Community Organizing Partner

"What makes this project unique is that we're focused on improving quality of life, we're not just recording facts about heat and shade, etc., you need people's experiences to drive the process of change"

- Core Team Partner

"There's no place to keep cool, so we all talk about all that kinda stuff, we talked about how it's a cycle, where the kids don't really go outside to play because it's too hot. So, they'd rather stay indoors and watch movies, and play on Xbox, watch Netflix, and that brings about illnesses, or obesity, and that kinda stuff."

S. Phoenix Resident

Everyone Tells Something to the Park

The parks of the community are our Disneyland. If you live in an apartment, it's your yard where you can play freely. They are always available and there is space for us.

It is the way that we relax and we can walk, run, and breathe.

A park can be our community center where we see friends, family, and those who we wish to call family.

In these neighborhood parks we can enjoy a bit of nature, we can remember that in this concrete jungle there are places where we can touch the earth with our bare feet. You can run and not burn yourself. You can yell and not wake anyone up.

When I arrived in Phoenix the only place that I felt free was in the park, where I felt welcome.

When I don't want to talk to anyone, I just come here to walk. There is noise but the noise isn't mine. And when I want to see someone, or be with someone, or talk with someone that I don't know well, I come to the park and I find what I need.

It is the community gathering space that we don't have, it is the center where we have events and everyone knows what it is and where to find it. No one is intimidated and it's a place for everyone.

The park has happy, sad, and profound stories, and everyone tells something to the park.

The park is a prize for our children. Its convenience and open admission make the park something special at the center of our economy.

"Here in this neighborhood we've had some issues with the power (with Salt River Project – SRP) because everyone wants to crank up their AC, or have on all the fans, or have on their coolers, and it's too much power being used. So, the power falls off, the power, it's just too much. The SRP has control over the circuit over the heat, and there's no power. So sometimes this goes on for hours, it could be minutes, but we don't know how long it's going to last. So, we've had to make sure to keep our kids and our elderly people safe, and I think that's one of the concerns that we have. There's no pool areas in this neighborhood, the parks are hot, there's no shade over the playground."

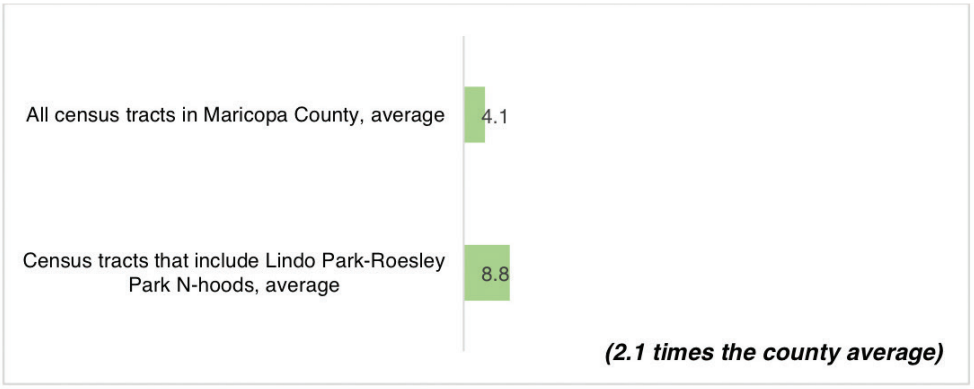
- Resident, Lindo Park-Roesley Park

Neighborhood Baselines
Lindo Park-Roesley Park Neighborhood

The following data provide a baseline reference for the Lindo Park-Roesley Park Neighborhood. Tracking these indicators over time will help neighborhoods and those involved in planning decisions understand whether their heat mitigation and adaptation initiatives are helping to improve (or hurt) the current situation.

Health

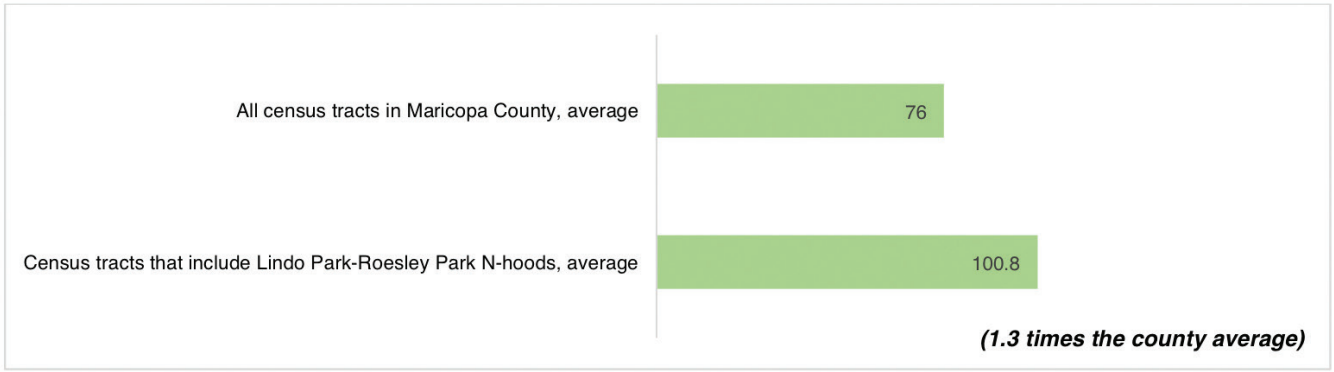
Average annual heat-associated death rate per 1,000,000 population, 2012-2017



81.2% of Maricopa County census tracts had lower heat-associated death rates than the Lindo/Roesely Park Neighborhoods, 2012-17

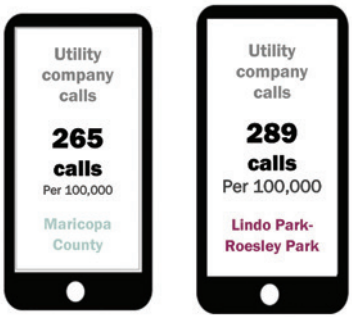
ˆ Reasons for exceedingly high rates of heat deaths are not currently known.

Average annual heat-related illness rate per 1,000,000 population, 2012-2017



75.1% of Maricopa County census tracts had lower heat-related illness rates than the Lindo/Roesely Park Neighborhoods, 2012-17.

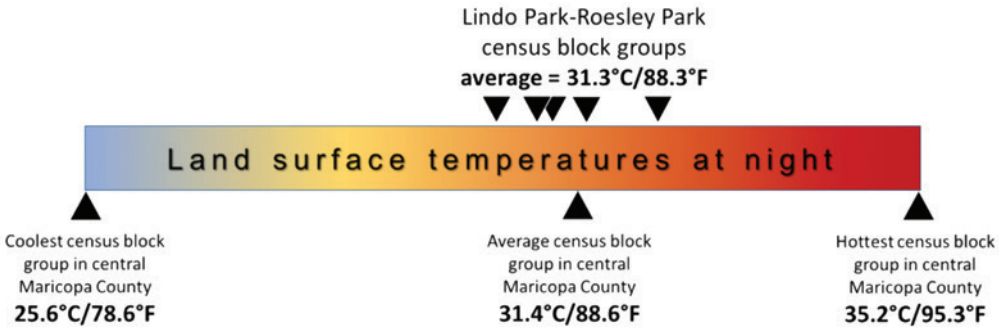
Utility Issues



Environmental characteristics

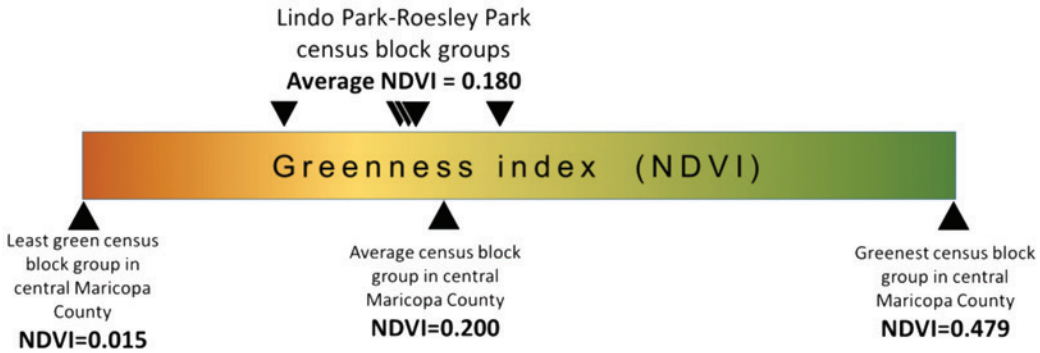
Land surface temperature on 8/6/2014 at night

Regional land surface temperature comparison

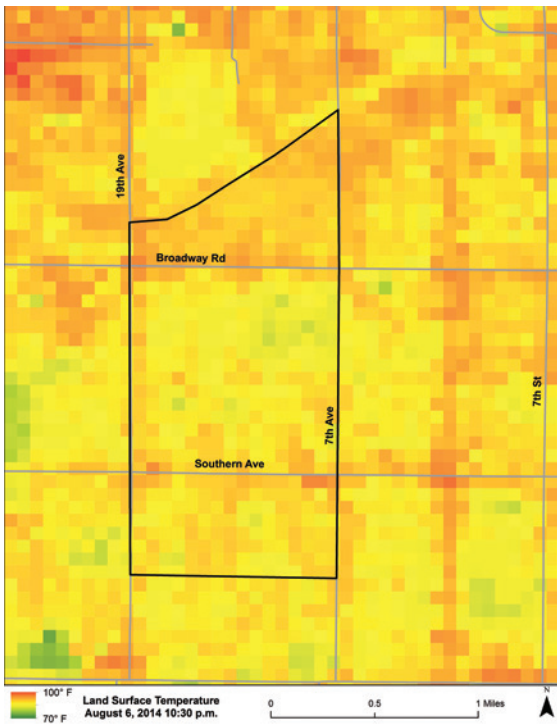


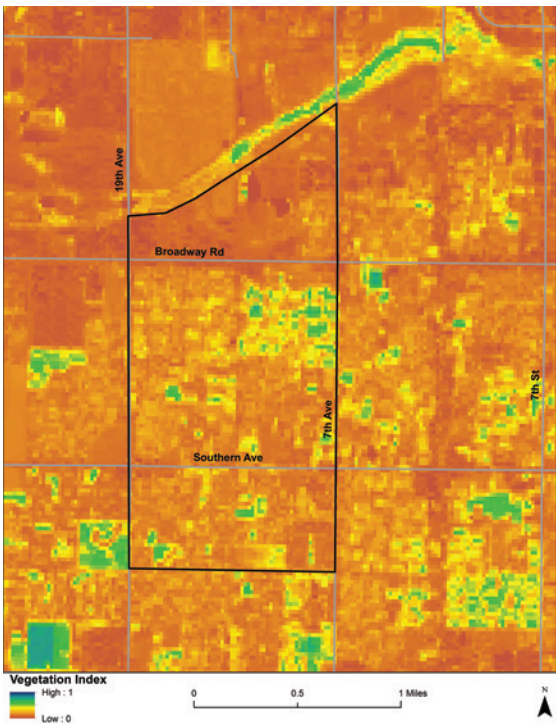
Tree coverage 2.0% • County average 8.8%

Census Block Groups



Land Surface Temperature (top) and NDVI (bottom) within Lindo Park-Roesley Park





Summary of Environmental Characteristics: Lindo Park-Roesley Park

Surface temperatures: The neighborhood as a whole has surface temperatures similar to the regional average. However, the northern part of the neighborhood, above Broadway Road, has surface temperatures that rank in the hottest 25% of central Maricopa County. Conversely, the eastern part of the neighborhood, between Broadway Road and Southern Avenue, is comparatively cool.

Vegetation coverage: Most parts of the neighborhood are characterized by very high grass coverage compared to others in central Maricopa County. However, the entire neighborhood is also characterized by very low tree coverage. The northern and western parts of the neighborhood have some of the lowest tree coverage observed anywhere in the region.

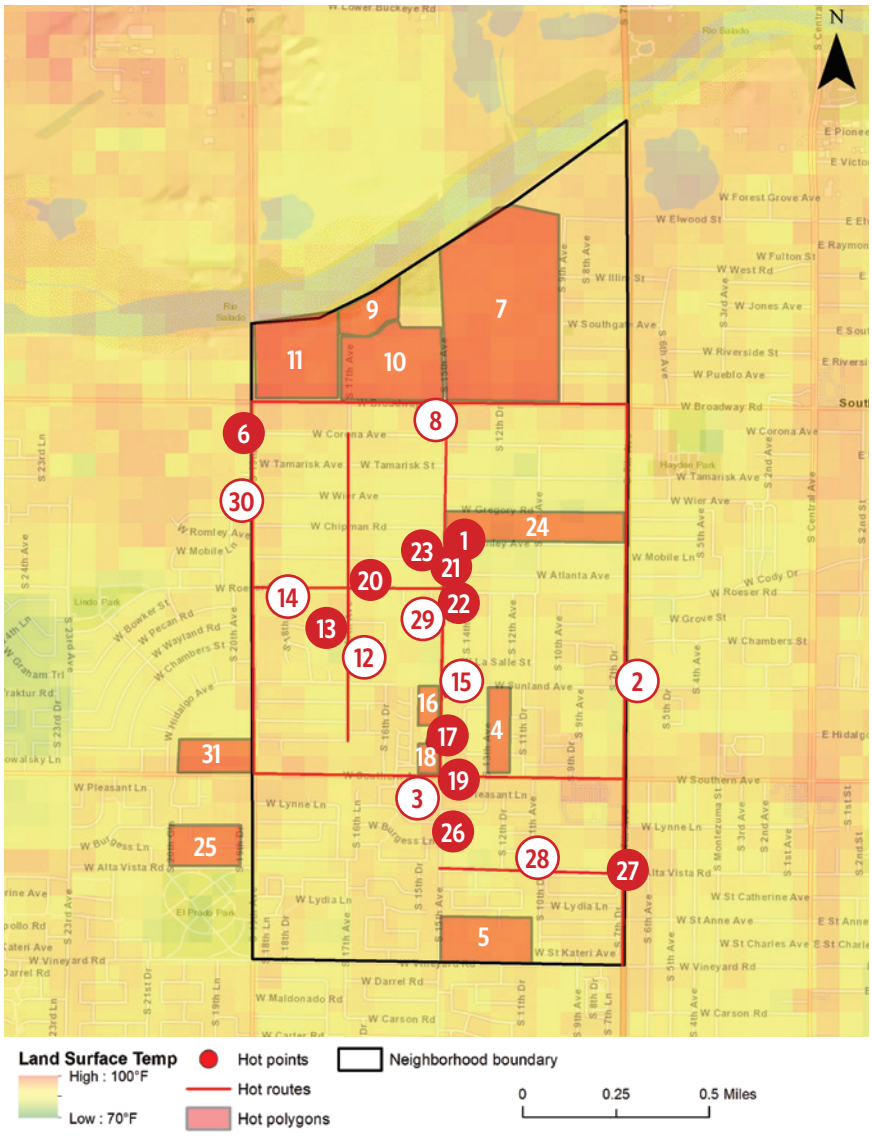
Greenness: The neighborhood has a lower greenness score than the regional average. The part of the neighborhood north of Broadway Road has a greenness value that is in the lowest 10% of central Maricopa County.

Methods

Baseline data were sourced from the following databases: Maricopa County Department of Public Health (MCDPH) heat mortality surveillance, MCDPH heat morbidity surveillance, Arizona 2-1-1, NASA ASTER satellite imagery, NASA LANDSAT satellite imagery, the National Agriculture Imagery Program (NAIP), and the US Census Bureau. Some of the variables were measured at the census tract level, some were measured at the census block group level, and some were measured at the zip code level. Census tracts are regions that include 2,500 to 8,000 people. Census tracts are divided into multiple census block groups. Tracts and block groups were selected based on neighborhood boundary lines. Individuals were counted in these rate calculations if they had an address that could be geocoded to a Maricopa County census tract. Neighborhood-specific rates were calculated by average rates of census tracts included within the neighborhood's boundaries. To request additional public health data, contact the Maricopa County Department of Public Health, Office of Epidemiology at https://www.maricopa.gov/3511/Request-Data. Environmental data sets were provided by Arizona State University and can be made available through ASU's Urban Climate Research Center at https://sustainability.asu.edu/urban-climate/.

Lindo Park-Roesley Park Hot Spot Intervention Points

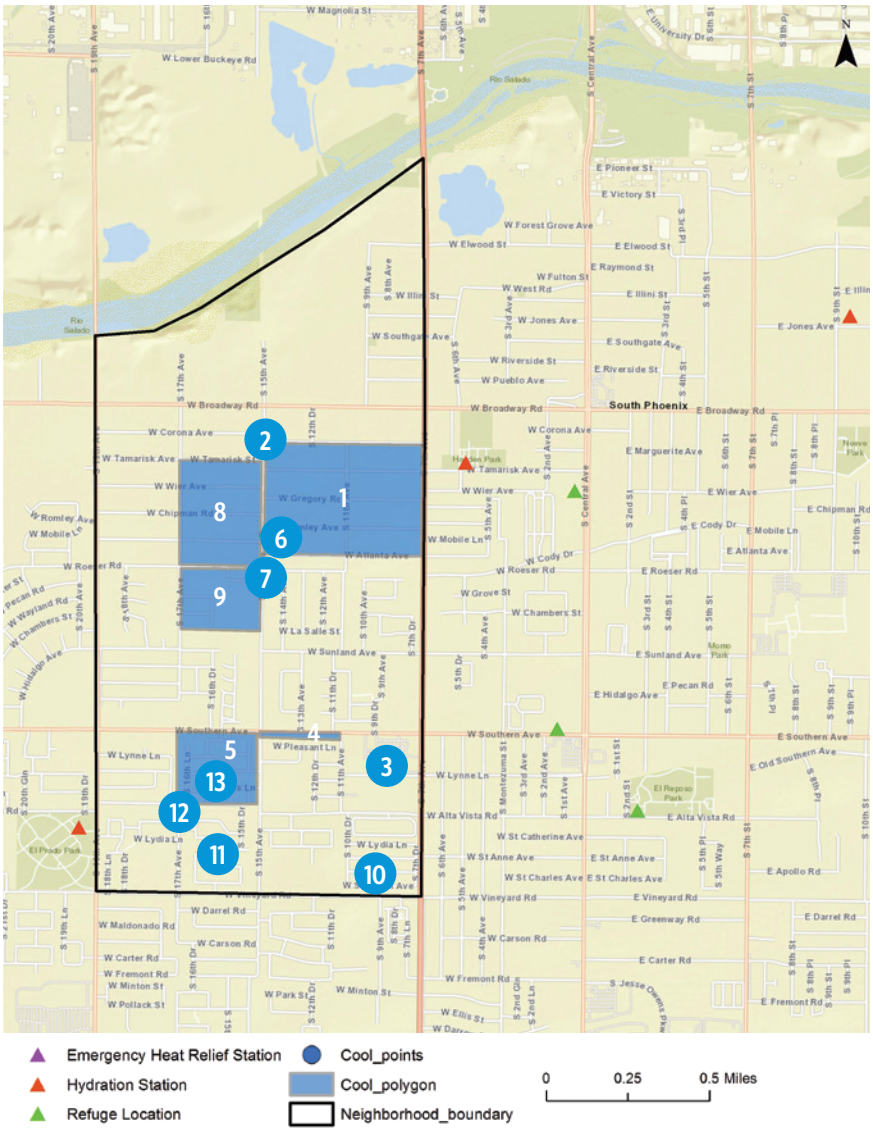
ID	NOTES
1	Roesley Park - No Trees
2	7th Ave
3	Southern - S 7th Ave to S 19th Ave
4	Hot Spot
5	Hot Spot
6	Carniceria Mexico Lindo - Humo y mal olor/ Smokey and bad smell
7	Hot Spot
8	Hot Spot - W Broadway S 19th Ave to 7th Ave
9	Cerrado - Closed to the public
10	Industrial
11	Industrial
12	Walk to School
13	C J Jorgensen Elementary School
14	Walk to School - W Roeser S 19th to S 15th St
15	Hot Spot - 15th Ave W Roeser to W Southern
16	Vacant
17	Way of Life Church Parking Lot
18	Vacant
19	Bus Stop
20	Bus Stop
21	Bus Stop
22	Must buy water here
23	Church
24	Horse Properties
25	New Community
26	John R Davis School - priority for shade
27	7th Ave & Alta Vista Rd - Bus Stop
28	Alta Vista from 7th Ave. to 15th Ave. - Priority route for cooling
29	Broadway to Southern - Priority route for cooling
30	19th Ave from Broadway to Southern - Priority route for cooling and traffic safety
31	Southern & 19th Ave. - Vacant lot behind Circle K



Lindo Park-Roesley Park Cool Spots

Cool spots represent cooling assets that residents identified during workshops or existing emergency heat relief stations, hydration stations, or cooling centers / refuge locations.

ID	NOTES
1	1-acre lots; flood, irrigated
2	John's Rancho Market
3	Food City - grocery, courtesy ride home
4	New parkway - shaded
5	new community
6	Roesley park - Ramada
7	Soon's Market/liquor store
8	irrigated 1/4 acre lots
9	Ranch properties
10	Small HOA park - 8 trees, 2 benches
11	cool park, private HOA
12	cool park, private HOA
13	cool park, private HOA



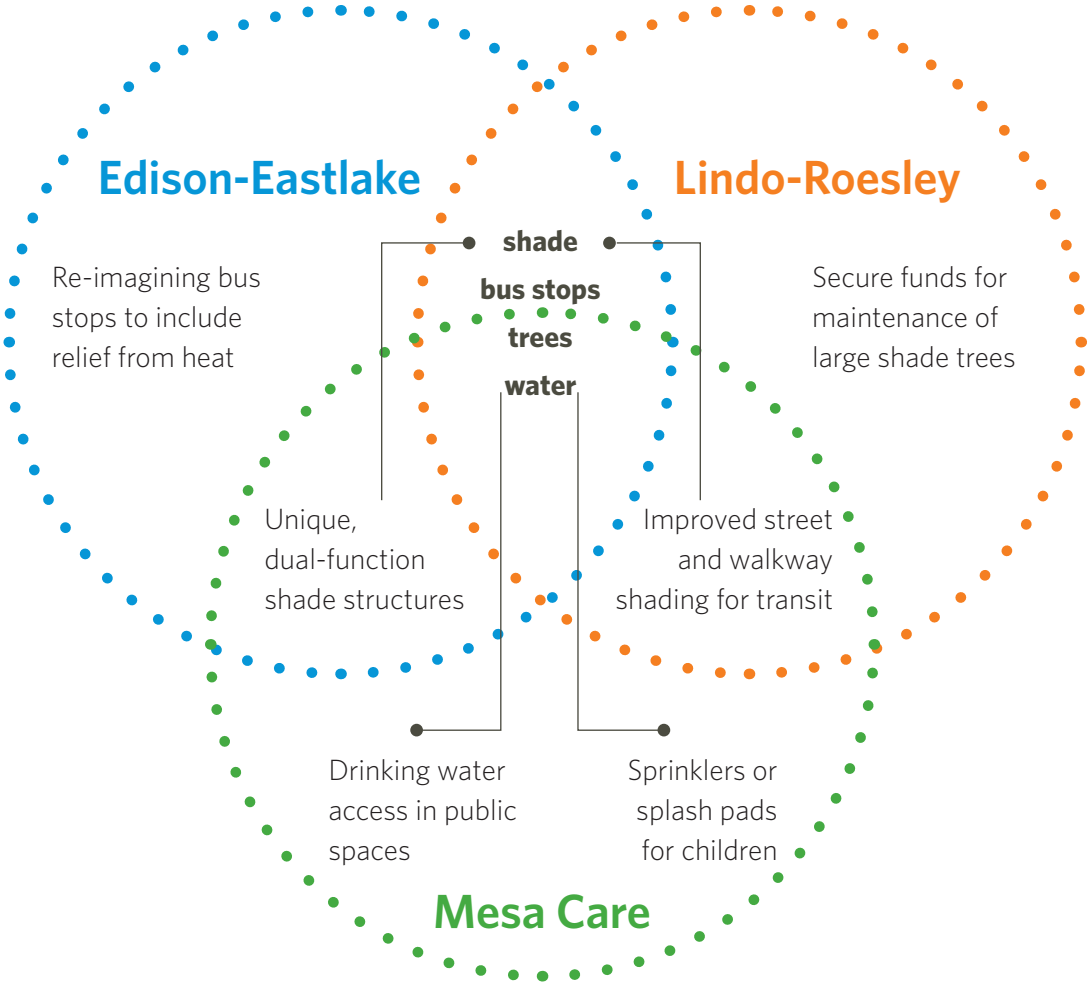
"I am here [at the Heat Action Planning workshop] because I want to try to help so everything changes."

"Well, I'm a native Phoenician, been here all my life and I remember when I was little, I lived on 7th Avenue and Vineyard and we didn't even wear shoes in the summer. We would just run from shade to shade to get to the park, to the school for recreation in summer. But today, it just feels unbearable and I don't know if it's because I'm older...but it's like I can't remember it being so intensely hot here like it is today. I think it's probably the one thing I know, I clearly feel, Arizona feels much hotter than when I was a child."

Resident Visions for a Cooler Neighborhood

As a result of three workshops within each community, the residents brought forth ideas that they would like to see implemented to increase their thermal comfort and safety during extreme heat days. The ideas were similar across different neighborhoods, but specific applications of solutions varied across neighborhoods. For example, all neighborhoods would like to add shade to their walksheds but preferences for shade implementation differed, as some neighborhoods prioritized routes to public transportation, others prioritized routes used by children on their way to school, and others wanted to see shaded rest stops in key places.

Timing is an issue for the city decision-makers and residents alike. Residents would like to see improvements within a very short time, as in the next year. Yet, the planning and funding cycle for capital improvement projects can be five to ten years in the future. The adaptation and mitigation strategies developed from these workshops seek to balance a long time horizon with immediate, grave needs.



Lindo Park-Roesley Park in South Phoenix:

Primary Concerns:

1. Financial burden and lack of resources for tree planting and shade
2. The risk of heat-related illness and the need for safety during the heat, especially for students and seniors living alone
3. Children often stay inside during the summer months
4. Vacant lots and resulting dust
6. High electricity bills made worse by poor quality housing materials and lack of insulation in homes
7. Need to develop advocacy skills to promote the heat mitigation and adaptation strategies

Solution Story

This community is steeped in farming history and their heat mitigation and adaptation strategies reflect the importance of vegetation, mature trees, and indigenous methods of working with the land and environment. The Lindo Park-Roesley Park Neighborhood sees their community identity related to healing plants, collecting

water, trees that produce a harvest, "healthy roots," and other ancestral solutions. There are mature trees in the neighborhood that are not thriving due to lack of maintenance and new trees are not desired until the old, dead trees can be removed. Residents would like to see a fund developed that would help to maintain these large shade trees, assist with the financial burden of removing the dead trees, and the purchase of replacement trees. This fund can also be used for people who own land but do not have resources to install shade features such as trees, benches, and engineered shade structures. Land owners could agree to install a rest stop on their property to encourage neighbors to cool down and stay safe before continuing on their way. The redirecting of stormwater, through small curb cuts, or a stormwater capture system, could irrigate these spaces. Local businesses could also participate in this effort. Porous ceramic vessels called "ollas" could help to reduce water use for vegetation by keeping surrounding soil moist.

Shade, flooding, and pedestrian access routes can be a combined issue for more systems thinking approaches. Shade along walking routes, especially for children on their way to school, is a priority for Lindo Park-Roesley Park. Stormwater management along Roeser Road has been problematic in the past but this may be an opportunity to redesign the area using low impact development principles and foster the growth of shade trees, too. Residents expressed the need for both cooling and safety; many streets do not have sidewalks. Bioswales could be constructed along with sidewalks for safety. Availability of drinking water in public spaces are greatly desired and a drinking fountain could be installed at Roesley Park, for example, along with the construction of the bathrooms at this park. Shade could also be "creative shade" made from recycled materials, such as clothing.

Residents expressed an interest in approaching shade, water, and access to bus route as a system, especially along 7th Avenue and Alta Vista and Roeser Road between 7th and 15th Avenues. Walking paths that have amenities like shade, drinking fountains, and benches would allow for protection from the heat while outdoors, and the ability to rest and cool off on the way to their destination. The covered walking path on Southern Avenue should be replicated in other places, too. Wide streets could be made narrower and walkways with shade added in the gained space. Bus stops are a concern for residents now particularly since the pathways to the transit nodes are unshaded and the unsheltered bus stops, and the long wait for transit only increase exposure. Bus stops need some form of shade structure.

Reducing the risk of illness and creating safety during the heat, especially for students and seniors living alone, is a main concern. The elderly need more group programs, like an air-conditioned Senior Center, to keep them cool as many do not have air conditioning in their homes. Churches, of which there are many in this area, could open their doors to seniors during high heat events.

In this neighborhood, children often stay inside during the summer because the area has very little shade and activities are not free. Public pools are often

Lindo Park-Roesley Park

"We reduced our outings, we reduced our walks, we have to reschedule appointments... change of work, change of routine... the heat is very harmful to our time."

- South Phoenix Resident

"There's no place to keep cool, so we all talk about all that kind of stuff, we talk about how it is a cycle, where the kids don't really go outside to play because it's too hot. So, they'd rather stay indoors and watch movies, and play on Xbox, watch Netflix, and that brings about illnesses, or obesity, and that kind of stuff."

- South Phoenix Resident


© Ivan Martinez/TNC

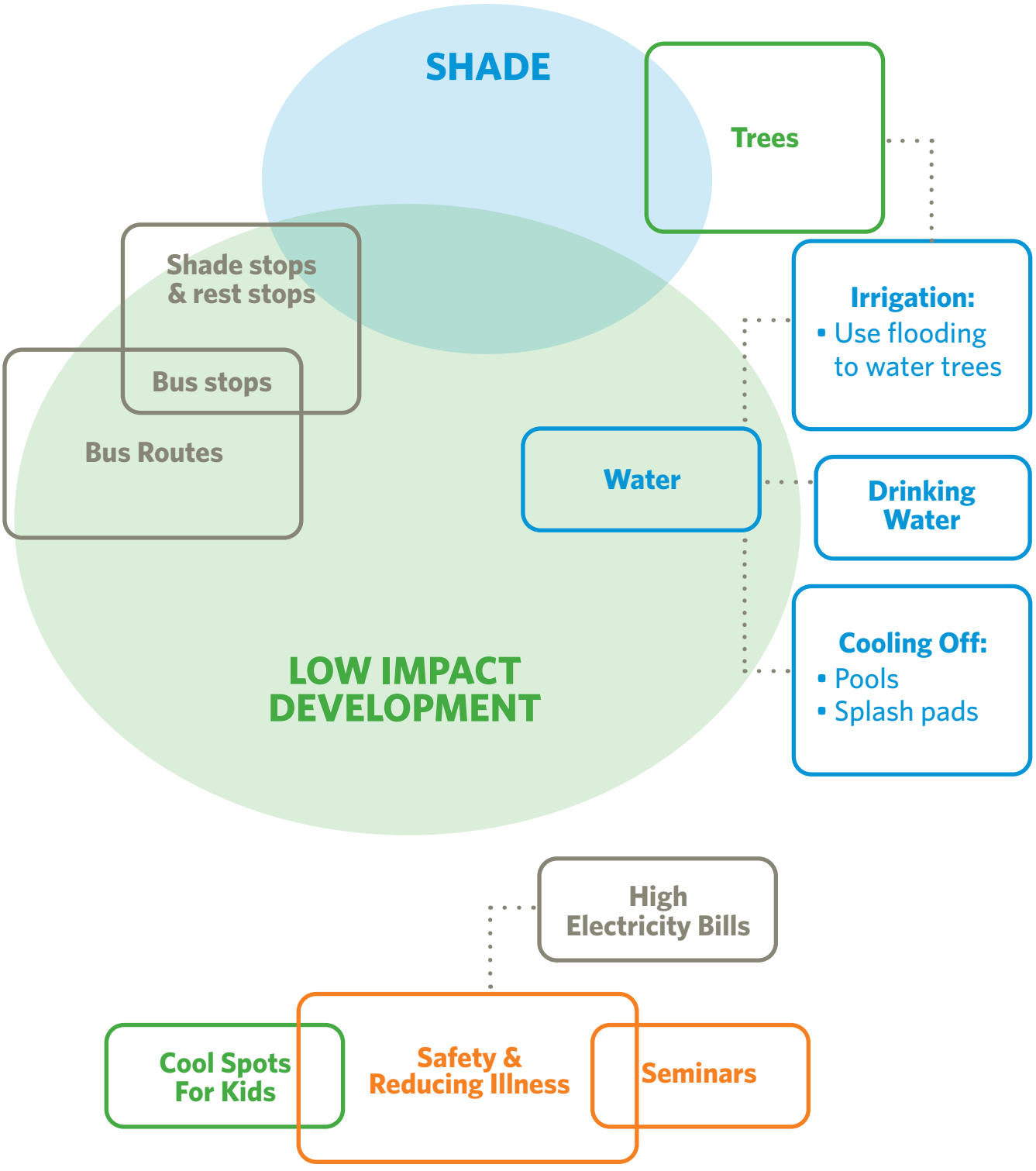
overcrowded and there are no public pools within the defined neighborhood boundary. Roosevelt Pool is close by at 7th St. and Alta Vista Road and El Prado Pool is at the boundary of the neighborhood at 19th Ave. and Alta Vista. More cool spots and places to cool down, especially for kids, are highly desired. This could be in the form of shaded parks, splash pads, or community centers that have air conditioning. Spaces of Opportunity or Roesley Park would be an ideal spot for a swimming pool and additional shade trees with ramadas.

Residents perceived that the plethora of empty lots contributes to the the prevalence of asthma in the community. During monsoon season, dust gets kicked up and adds to the poor air quality already present in the area. These empty lots could be used as potential cooling areas by planting vegetation and trees along the perimeters and should be prioritized if they have flood irrigation. The residents also expressed interest in a community water truck to assist with properties that are not flood irrigated. This community water truck would be managed by the community.

High electricity bills during the summer months are challenging for residents. Poor quality housing materials and lack of insulation in homes only exacerbates this issue. Adding trees that shade homes and installing better insulation would lower bills. Residents could benefit from understanding how to apply for reduced electricity rates or utility assistance in emergency situations and what the income qualification criteria for these programs are.

Residents felt strongly that they need to develop advocacy skills to promote the heat mitigation and adaptation strategies, as well as other concerns within the neighborhood. Elected officials and candidates for office need to be aware of the challenges faced by residents during the summer months. There is a desire for improved communication pathways to ensure that cooling features are included in projects underway but also for greater skills to proactively communicate to decision-makers the hot spots and hot problem areas within the community. The elected officials need to understand that this is a safety issue and a quality of life issue.

Residents' proposed heat solutions fell primarily into categories of shade, low impact development, safety and water, with variations on how and where to implement.



Modeled Changes to Urban Heat

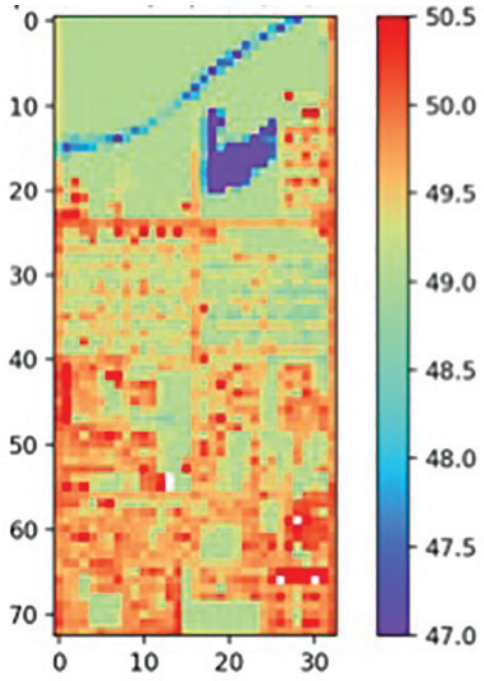
Lindo Park-Roesley Park Neighborhood in South Phoenix

Using data from June 2017 and land cover data (2010 NAIP) to study the potential impact of these heat actions on the neighborhood, the existing land cover was simulated along with representations of proposed changes to the neighborhood. Specifically, the neighborhood was conceptualized with increased tree coverage. In this tree coverage scenario, we increased percentage of tree canopy within the neighborhood to 30%.

These simulations are shown in the associated figures: the baseline, and then the cooling scenario which uses a "relative-to-baseline" legend to highlight the maximum cooling effect.

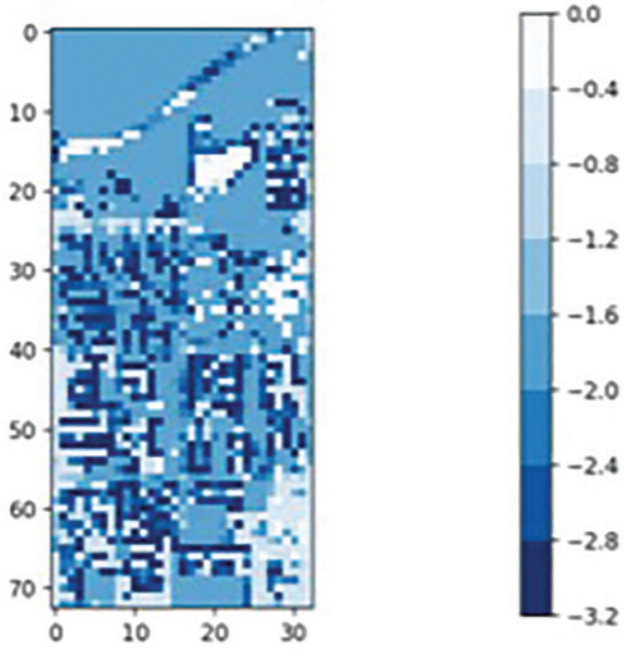
Just by modestly increasing the tree canopy to 30%, we see widespread cooling across the South Phoenix neighborhood (as much as 6° F in some pockets near water, closer to 3° F more broadly). This cooling will certainly be more localized in reality; however, this map shows the potential for significant cooling in the neighborhood. This cooling could then be prioritized near bus stops and along common active transit routes to provide increased shade for individuals spending time outdoors. Note: areas with no change in temperature are areas where the tree canopy in the 30 m by 30 m cell was at or above 30%.

Baseline



Simulated 4pm near surface air temperature (C) of the Lindo Park-Roesley Park Neighborhood on June 20, 2017.

Cooling Scenario



Simulated 4pm near surface air temperature (C) of the Lindo Park-Roesley Park Neighborhood with added trees on June 20, 2017.

Drawings of a Cooler Neighborhood

Cooler walking paths / Broadway (street section)

Improving right of way conditions can greatly impove safety of pedestrians in areas such as these.

Water park for children/Roesley Park (perspective)

Pathways to schools / 17th Ave. & Roeser Rd. (plan)

Increased landscape as well as safer roadway crossings are necessary in high traffic areas to improve conditions for community members and their well-being.

© Maggie Messerschmidt/TNC

Community Priorities and Common Barriers


© David Crummey

During the first Heat Action Planning workshop, residents were asked to identify top areas of concern. Those areas of concern were used to create a list of priority areas. The table on page 73 represents priorities for coping with and reducing urban heat that were voted upon by workshop attendees. The core team developed all subsequent discussions around these priority areas.

"I can't use the stove in the summer."

PRIORITIES IDENTIFIED DURING HEAT ACTION PLANNING WORKSHOP I		
EDISON-EASTLAKE COMMUNITY	**MESA CARE NEIGHBORHOOD**	**LINDO PARK-ROESLEY PARK NEIGHBORHOOD**
Heat training similar to First Aid certification	Campaigning and organizing for heat solutions	Cooler walking paths with amenities like shade, water fountains, and benches
Bus stop shade/ improvements	Organizing funding resources for changes on the ground	Mature trees and green spaces in neighborhood
Walkability of neighborhood	Limiting high exposure to heat in day to day life	Safe, cool routes to school
Preventative warning system	Educating the community	Better stormwater management/flooding on Roeser Road
Water availability	Embedding heat planning into other projects	Elderly living alone/vulnerable people

Barriers to cooling

Throughout the workshops, residents and advisors in all three communities spoke of common barriers to advancing urban heat solutions.

1. Neighborhood involvement is low, despite a strong sense of community and identity. How can people become more involved in the formal processes that exist, such as planning meetings, to let their voices be heard?
2. Residents are in a difficult situation during high heat days. It is too hot to be outside and it is too expensive to keep home air conditioning on at a level that is comfortable and healthy.
3. Large, mature shade trees are too costly for homeowners to maintain. As a result, older trees die. Residents do not want new, smaller trees unless the old ones are removed but they do not have the money to remove them.
4. Renters have no incentive to maintain trees and vegetation and, in turn, landlords do not want to plant trees or have trees removed.
5. There is collective resignation that hot weather is status quo and there is little that residents can do. While there are mitigation and adaptation strategies available, the timeframe for municipal projects is long, sometimes five to ten years in advance.
6. Decision-makers listen to the "squeaky wheel" and will invest in those communities with the capacity to advocate. This is compounded by a history of planning decisions resulting in disinvestment in some communities.
7. New ideas for cooling may require trade-offs, extra expenses, or they may present barriers (e.g. underground utilities). See suggestions on page 84 for financing urban heat solutions and for prioritizing need-based, high return on investment, and feasible projects.

A vertical shade structure concept demonstrated by ASU students as part of the Nature's Cooling Systems project Biophilic Shade Structure Design Competition.

© Ivan Martinez/TNC

Tree planting with Trees Matter, American Express, and the City of Phoenix Parks Department along the Rio Salado Recreational Trail as part of the Nature's Cooling Systems Project.

Strategies for Neighborhood Implementation

In order for communities to improve their ability to cope with or adapt to increased heat, as well as their capacity to reduce it through mitigation strategies, a clear roadmap is needed for accelerating the processes that lead to change, navigating the existing structure of governance, and building on knowledge and experience to promote mutual learning. Ultimately, these outcomes may require transformation. Transformation means a fundamental change in the system that is persistent (and able to keep changing), reflects what different voices want and need, is co-produced by as many of those voices as possible, is flexible in allowing for future change, is based on the best available knowledge, and acknowledges that changes in one part of a neighborhood, a city, or a region are likely to affect other parts.

Adopting strategies that can improve conditions now is an essential first step, but an iterative process that builds collaborations, empowers local leaders, continues the visioning process, and feeds back to higher levels of governance to change fundamental goals and policies gives hope for more persistent transformation (see figure on page 76).

Residents in the three Nature's Cooling Systems neighborhoods created visions for a cooler environment that are implementable now (Section VII, page 72). They also identified their highest priorities for changes

Strategic Themes

Advocate and Educate | **Improve Comfort/Ability to Cope** | **Improve Safety** | **Build Capacity**

Mesa Care

Using social media and hashtags to highlight child safety and bus route issues

Lindo-Roesley

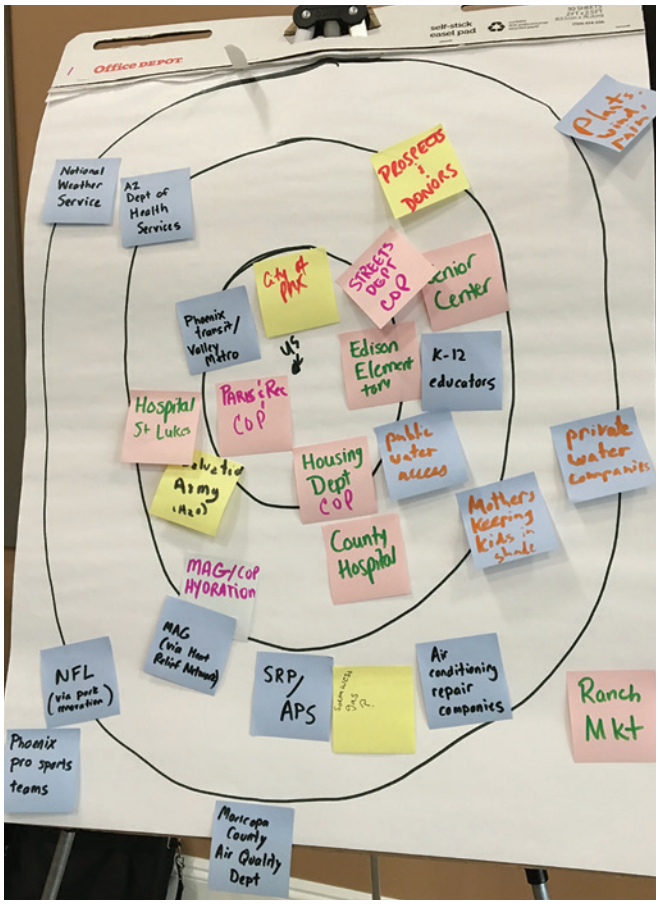
Planting vegetation for empty lots to reduce dust

Edison-Eastlake

Create signage for heat safety and wayfinding could reduce risk

to be made in their neighborhoods. In the final workshops, residents discussed how these Heat Action Plans might be promoted, integrated into city plans, and ultimately implemented. Residents were willing to take responsibility for their plans but recognized the need for support and that many players would need for support and that many players that would need to be involved to drive forward on advocacy, investment, accountability, and safety. The specific strategies to promote the implementation of the Heat Action Plans varied, not surprisingly, among the three neighborhoods. For example, as a Choice Neighborhood, the Edison-Eastlake Community has had opportunities to interact with multiple departments in the City of Phoenix and this is reflected in a large list of participants to be involved in Heat Action Plan implementation. The Lindo Park-Roesley Park Neighborhood has a long history has a long history of environmental activism, and thus a longer list of community organizations.

For all three communities, upcoming projects already in planning or early implementation stages represent both opportunities and barriers to implementing the visions they have created. To be able to define their future in terms of the neighborhood's visions will mean increased vigilance over city council or local planning board

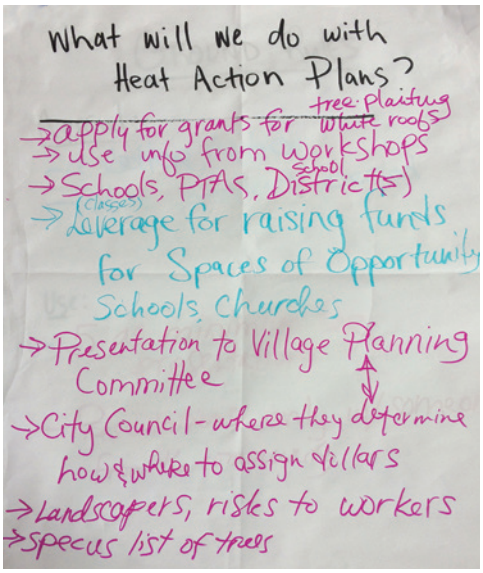


Mesa community members' ideas about who should be involved in implementing urban heat solutions.

decisions, but also a greater readiness to act to promote the future the community wants when decision making is at a crossroad. Empowerment of local leaders and continued communication is an essential element; the cities need to nurture the relationships throughout redevelopment processes and retrofits such as the Choice Neighborhoods redevelopment in Edison-Eastlake, Broadway Corridor in Mesa, and Roesley Park renovations in South Phoenix.

Communities can organize around ideas of developing or refining visions, but there often is a need to dedicate a physical space for meetings, which might be a 'climate action hub' with resources about heat such as those in the Heat Action Plans, or a dedicated person or organization to lead the way.

Residents were willing to take responsibility for their plans but recognized the need for support and that many players would need to be involved to drive urban heat solutions forward. The diagram reflects the pivotal role of local leadership and the importance of relationships between organizational levels.



Lindo Park-Roesley Park Neighborhood ideas for how to use their Heat Action Plan. Source: Maggie Messerschmidt/The Nature Conservancy

Advocacy and Implementation

WHO SHOULD BE INVOLVED IN ADVOCACY AND IMPLEMENTATION?			
TYPE	**EDISON-EASTLAKE**	**MESA CARE**	**LINDO-ROESLEY**
Government	City of Phoenix Housing	City of Mesa Housing & Community Development	Municipality - Village Planning Committee
	City of Phoenix Streets	City of Mesa Transit	State
	City of Phoenix Parks & Rec	City of Mesa Transportation	City Council
	Phoenix transit/Valley Metro	City of Mesa Engineering	Valley Metro
	MAG Heat Relief Network	City of Mesa Parks & Recreation	
	County Hospital	Maricopa County Health Improvement District	
	AZ Dept of Health Services	Mesa Public Schools / Charter Schools in the area	
		City of Mesa Electric / SRP / APS	
Community Organizations	Salvation Army		
	Senior Center	Community Bridges / Center of Hope	Comité de Madres (CHISPA)
	Phoenix Revitalization Corporation	RAILMesa	Spaces of Opportunity
	Trans Queer Pueblo	Catholic Charities Care Campus	Puente
		A New Leaf / Mesa CAN	Unlimited Potential
Private Sector	Gorman & Company		Food City
	Norris Design		Gas stations
	Local businesses		SRP
	SRP/APS		Investors/housing developers
	Air conditioning repair companies		Owners who rent out properties in the zone (landlords)
	Private water companies		
	Ranch Market		
	NFL, Phoenix pro sports teams		
Residents	Community members	Transit-dependent residents	Neighbors/residents
	Resident Leadership Council	People who walk	Promotoras
	Mothers keeping kids in share	Groups of mothers concerned about pregnant women and young children	

Advocating for Implementation of Urban Heat Solutions

What do residents think should be done with Heat Action Plans?

- Apply for grants for tree planting, white roofs, and other projects for urban heat solutions
- Seek assistance for implementing green space, trees, shade, water, bus services, light, malls
- Educate policy and decision-makers about lived experience during hot season in neighborhoods
- Share plans with schools, PTAs, and School Districts
- Leverage them to raise funds for projects in community gardens, schools, and churches
- Present them to Village Planning Committee / City Council to advocate for solutions
- Communicate them to increase safety for landscapers and other workers
- Share information about tree selection and location

Advocating for urban heat solutions – speaking to elected and appointed officials

In the short-term, Heat Action Plan elements may be integrated into planning and zoning processes including streets, transit, and neighborhood redevelopment. Below is some guidance for accessing and influencing target audiences to ensure that the proposed heat solutions are incorporated into redevelopment plans.

Why you? Advocating in any formal setting before a decision-making board may be confusing and uncomfortable for those unfamiliar with the process. Familiarity grows quickly. Fortunately, boards rarely hear from individuals backed with data-backed best practices. As an advocate for the Heat Action Plan, you are more than a fleeting opinion. The Heat Action Plan "has your back."

An overview of formalities and jargon at a meeting; how to indicate you are there to speak:

Agenda: Every meeting has one; it serves as a list of decisions (or "actions" or "items") for the meeting; each decision is commonly referred to as an "item on the agenda."

- Hearing from a "speaker" on an "item" on the agenda is routine for these meetings; anyone in attendance can be a "speaker".
- Consent Agenda: if the "item" is listed under the "consent" portion of the agenda, the board will decide on these group of items together in one vote.
- Regular Agenda: if the "item" is listed under the "regular" portion of the agenda, the board will decide on each item individually
- Study Session (or Work Session): Not considered a "regular meeting." Not intended for public comment. Study sessions are used for the board and the public to hear a detailed presentation of an item. The board may ask more detailed questions and explore the matters of the item more in-depth if a study session is held prior to the official decision made at a regular meeting.

Speaker Card: A sheet of paper where any person can request to speak concerning the decision on an item. Item number is required to be noted (see the agenda for your item's number). Fill out the brief information needed. This is an opportunity to briefly state if you are

in favor, opposed, or neutral in your comments. You may also opt NOT to speak and only enter the written comments for the record.

- Deliver a filled card to an officer or a clerk at the meeting; early is best and required prior to the decision being made on the item. Staff will be happy to assist taking your card to the board's chairperson or Mayor (the member who leads the meeting).
- Mesa Example: https://www.mesaaz.gov/home/showdocument?id=7518

Speaking: The Chair or Mayor will call people from the information provided on the card. A speaker may take up to three minutes to make their comments. Prepare to state your name and address for the record at the beginning of your statement.

Be recognized; be prioritized.

The decision-makers listed here benefit from making real-life connections between their decisions and the people impacted by those decisions. Everyone wants to make a conscientious decision and nobody wants to be responsible for human suffering. Setting priorities always entails a push and pull exercise. By having a presence, the priorities you represent (especially when well-established by a plan) can be elevated.

Who: Planning Commissions and Zoning Boards

Why: This board directs a substantial amount of authority for shaping physical resources, design, and policy, and either prioritize heat solutions or not. Many resources within the communities are influenced by this board as they oversee Zoning regulation and Subdivision design policies. Phoenix also has Village Planning Committees that serve a similar function.

When:

- Mesa's board traditionally meets the third Wednesday of the month at 4 PM.
- Phoenix's Commission meets the first Thursday of the month at 6 PM.
- Central City Village Committee meets the second Monday of the month at 6 PM.
- South Mountain Village Committee meets the second Tuesday of the month at 6 PM.

Where:

- Mesa's City Council Chambers (upper level) at 57 E. First Street, Mesa
- Phoenix's City Council Chambers at 200 W. Jefferson Street, Phoenix
- South Mountain Village at South Mountain Community Library, 7050 S. 24th Street, Phoenix
- Central City Village at Emerson Court, Phoenix Elementary School District, 1817 N. 7th Street, Phoenix

Advocacy tip:

The board is authorized to approve, deny, or recommend codes, subdivisions, and development proposals or broad policy documents. Codes, updated according to approved goals, establish the most direct requirements of physical designs regulated by the city. Written requirements provide opportunities to determine the considerations for heat solutions as detailed by the Heat Action Plan.

Who: City Council

Why: City Councils have the broadest authority to direct policy and, most importantly, to approve budgets (spending) and set priorities every year. Councils deal most directly with the City Manager who has the most influence over city staff initiatives, operations, and city-owned resources.

When: Typically starting in the month of April, cities will hold public hearings on a proposed budget, including the Capital Improvement Plans / Programs (CIP) with a 5-year outlook, including land acquisition, design, and construction costs for city projects and expenditures. These budgets are usually approved by late May to be in place by the start of the coming fiscal year (starting July 1). Example: A street repair project may envision a project scope that widens sidewalks, maybe it lacks adding trees to make the sidewalk more comfortable. This is an opportunity to remind the leadership of the Heat Action Plan goals and objectives to protect your health and safety.

Advocacy tip:

City Councils can be difficult to persuade. Referring to previously approved policy goals can be influential in advocating for maintenance of previously established momentum and continuation of progress by the City (such as Heat Action Plan goals).

Who: Neighbor-level organizing, Homeowner Associations/Neighborhood Associations

Why: The neighborhood-level will provide the most direct access to decisions, if an association exists. If one does not exist, resources are available to create one. Contact a city staff member affiliated with Neighborhood Services to learn how to be recognized.

Mesa https://www.mesaaz.gov/residents/neighborhood-outreach

Phoenix https://www.phoenix.gov/nsd

When: Every neighborhood will have different meeting schedules and routines.

How: Speaking at a neighborhood-level organization is often less formal, but there should still be an agenda to access and review the decisions scheduled for the meeting.

Other important areas of intersection between urban heat solutions and redevelopment

Opportunity Zones in Mesa and Central Phoenix

Opportunity Zones provide additional incentive to invest in profitable projects in certain low-income areas. These zones allow individuals and corporations with significant capital gains to invest their gains in communities and receive a tax benefit. There is no required community input, notification, or feedback mechanism in this tax-deferment program. Communities should be aware that investors may be looking with additional interest to Opportunity Zones, especially those that are adjacent to, or themselves are, "up and coming areas." Residents may organize to insist on Community Benefits Agreements with investors. If improvements in areas result in displacement, residents may lose out on benefits from urban heat solutions and cooling (see Whole Measures in Appendix D).

Redevelopment Projects like Choice Neighborhoods in Edison-Eastlake Community in Central Phoenix

The Heat Action Planning process helped to establish a baseline for heat in the area prior to redevelopment, and the visions from residents for cooling the neighborhood will be shared with the Design Team and carried forward by the Resident Leadership Team.

Grant Opportunities for Cities

Phoenix and Mesa both qualify for numerous grant opportunities, many of which recur annually with a timeline managed by city staff. For example, the Community Development Block Grant (CDBG) offers money to help redevelop areas of a City with fewer resources. Under-resourced communities leave their residents vulnerable to heat. Qualified heat solutions should be considered when scoping potential projects for community redevelopment.

Street Projects like the Broadway Corridor Study in Mesa

In 2017 & 2018, the City of Mesa held four public meetings to identify proposed improvements with the goal of creating an improved multi-modal streetscape which can accommodate vehicles, bicycles, pedestrians and transit. The study will also help to determine a phasing approach for construction. These proposed improvements will help to further develop the streetscape and livability of Broadway Road between Loop 101 and Lindsey Rd. This project directly impacts the Heat Action Planning area in Mesa; it is important to track changes to thermal comfort under the project and the resultant projects that come from the study.

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Supporting Implementation of Urban Heat Solutions

During workshops, we heard residents, city officials, and community leaders discuss the realities and constraints for implementing urban heat solutions. At the top of that list were budgetary constraints and institutional silos that prevent combining resources (public-private and public-public) towards commonly desired outcomes.

Below we share some of the ways in which transformation may be supported by decision-makers, organizations, municipalities and others. These solutions were offered by Heat Action Planning advisors, the organizing team, and residents. They include making the case for urban heat solutions, building relationships, visioning, integrating heat adaptation into policy and planning, promoting efficient design, and funding urban heat solutions.

Make the Case

Demonstrate proofs of concept: Create urban heat projects that a) demonstrate the benefits quantified in the Heat Action Plans and b) reflect the value of those benefits. For example, the city might support pilot projects by assigning projects associated with the Capital Improvement Plan to achieve triple-bottom-line benefits associated with urban heat solutions. Community benefit dollars from hospitals might be directed to urban heat amelioration demonstration projects targeting social determinants of health.

Develop and disseminate a business case for urban heat solutions tailored for specific audiences. For example, the business case directed at the health sector would illuminate ways in which heat solutions can improve social determinants of health and/or reduce emergency-room visits for heat-related illnesses or heat-impacted chronic illness. The business case targeting builders and developers might emphasize urban heat solutions like trees, cool roofs, or cooler building materials that improve property values and retail rates.

Invest in Supporting and Building Relationships in Service of Solutions

Networks are essential to creating social change. **Invest in existing community efforts to create stronger alliances for urban heat**, building from the successes that early partnerships have created. During the process of constructing Heat Action Plans, partnerships have been built with Spaces of Opportunity, Unlimited Potential, Catholic Charities Care Campus, Trees Matter, Watershed Management Group, Chispa, City of Phoenix, City of Mesa, TrueForm Architecture, Arizona Alliance for Livable Communities, and many others.

Sponsor competitions and awards for innovation like the shade structure competition. Support innovative team-building by providing workshop space and by providing seed funding for implementing winning projects.

Support local leadership on urban heat. There is great potential for neighborhood leadership on urban heat solutions, but local leaders have expressed that they feel like they lack the tools, expertise, influence, and credibility to enact change. Our work has prepared The Nature Conservancy and partners to build a collective strategy for future funding and projects. Those efforts should **support and mobilize neighborhood leaders** to implement proposed interventions.

The Heat Action Planning process helps to identify opportunities to incorporate a heat-mitigation lens into policy and practice. Stakeholders may integrate Heat Action Plan information into urban planning tools including related climate and resilience plans and programs by non-profits, cities, universities, regional authorities. Continued development of capacity and **multi-directional knowledge transfer** is essential.

Build partnerships between landowners, public stewards, and municipalities to improve cooling amenities in rights of way.

Develop Cross-Scale Transformative Visions

Neighborhood scale Heat Action Plans should serve as models for communities across a region, but every community is unique. **Multiple visions of transformation at various scales** help to create a more complete vision of a positive future.

Decision-support tools can assist in assessing the tradeoffs of investments in transformation. Examples of decision-support tools for guiding investments in heat solutions include Sustainable Futures Scenarios (UREx SRN), the Central Arizona Conservation Alliance natural infrastructure viewer, 2016 Shade Tree Planting Prioritization, LID Key Areas Study (forthcoming from Bureau of Reclamation), and the Arizona Department of Health Services Environmental Public Health Tracking Explorer.

Integrate Heat Adaptation into Planning and Policy

Integrating urban heat solutions into plans, goals, and policies for health and well-being, sustainability, transportation, hazard mitigation, and climate resilience will provide opportunities for various stakeholders to contribute solutions, and this will help to create cooler, better-connected, and safer neighborhoods. Factoring heat into state, regional, and municipal agencies' planning and investment decisions will go a long way to improving neighborhood conditions and reducing health risks of urban heat.

Efforts to integrate heat data and guidelines into city planning require **targeted integration into the mechanics of urban planning** through the identification of the appropriate platforms, targeted audiences for uptake, and iterative processes with planning professionals.

Adopt urban heat "measures of success" from Appendix D at neighborhood scale, city-wide scale, and regional scale (e.g., tree canopy targets city-wide and neighborhood-by-neighborhood). We hear frequently that cities are concerned about whether investments are equitable. The Whole Measures for Urban Heat Solutions provides assessment criteria for mitigation and adaptation projects that can be used by cities and other organizations.

Remove barriers to implementing innovative cooling techniques. Common practice, long-standing ordinances that may not serve well in the present, building codes, and design specifications can present barriers to innovation in urban heat solutions. Engineering specifications can be changed to include Low Impact Development specifications that enable alternative stormwater features to contribute to cooling. Innovative cooling methods like geothermal cooling and rotating shade can be simple and cost-effective, but design specifications or ordinances present barriers for permitting and implementation. Award-winning architect Nikken Sekkei designed evaporative cooling features in the Sony City Osaki building in Tokyo. The building is the first of its kind to use a natural cooling method that pulls heat away from the building as water evaporates from it, causing the air around the building to cool. Current code may not permit such innovative designs; changing codes would open up space for cooling innovation.

Promote Efficient and Sustainable Design

Traffic calming is an opportunity for greening. Features like chicanes and bump-outs help to slow traffic and provide opportunities to use stormwater runoff to water plants.

Consider cooling in terms of neighborhood-scale design and collective impact, rather than designing on a site-by-site basis. The impacts of cooling features are often amplified when developed in conjunction with others, and scaled appropriately.

Cooling often requires some use of water, but cooling should be coupled with sustainable use of recycled water, graywater, and stormwater. Localized flooding can be a resource rather than a threat. Community water trucks could help to irrigate rights of way. For sturdier, storm-resistant trees, establishment of native trees and plants is essential and over watering should be avoided. Techniques like "ollas" or ceramic pots promote

slow watering, tall pots permit plants with long taproots to thrive, and use of leaves as mulch can help to establish young plants while reducing water use.

Include landscape architects and drainage engineers in new project sites early on. Among other reasons, soil gets compacted quickly under development and available water for vegetation can be lost during drainage planning.

The technical guidance for shade and thermal comfort provided in Appendix B provide shade design principles and indicators for improved safety. Additionally, cool materials should be considered for components that people will touch, such as handrails, door hardware, bike racks, trash receptacles, etc.

Raise Awareness of Energy Saving Opportunities

Many residents feel burdened by the costs of electricity. Existing programs to reduce peak usage and weatherize homes can help to reduce this burden while providing the benefits of reducing waste heat created by A/C.

Fund and Finance Urban Heat Solutions

Everyone is aware that innovative solutions and retrofits may require capital investment, and cities often are challenged by prioritizing allocation of limited funds to these improvements. Yet, given that health and well-being of its over four million residents is profoundly affected by heat, the Phoenix metro area can be a leader in demonstrating how cities can thrive in a hot, arid environment. Most United States green infrastructure projects are financed by grants; the partnerships developed in this effort, if continued, may help to increase this source of funding. We make several recommendations for financing urban heat solutions:

1. Ensure that a **percentage of Capital Improvements Project funding** is dedicated to heat solutions.
2. Propose **thermal comfort minimum standards as funding or permitting criteria** for any urban development project.
3. Expedited permitting for projects that meet standards for thermal comfort: Implement procedure for **easy or fast-tracked permitting** of private projects with urban heat solutions that deliver benefits to the broader community.
4. **Triple-bottom line accounting** by public entities is critical for ensuring that the costs of cool and the benefits of cooling solutions are fully considered. Guidance for municipalities on cultivating a shift to triple-bottom line accounting in public project development is available here: https://bit.ly/2WkHa8k
5. Cultivate a shift from implementing projects which are opportunity-based to implementing **need-based projects** that will provide the largest benefits. Develop a list of priority areas for urban heat solutions projects and target those areas. Financing need-based projects will help to ensure greatest ROI on projects. Assess long-term ROI against cost and feasibility.
6. Consider developing a **funding reserve** to provide incentives to implement urban heat solutions based on site context, including for pruning and maintenance of residential trees.


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Lessons Learned on Heat Action Planning

In late February and early March, the core team and Community Based Organizers were invited to take part in individual 15 minute interviews to share reflections on:

- What had the project accomplished that was of unique value?
- If you could change one thing about the project, what would it be?
- What advice would you give to another group interested in heat action planning?
- Anything else?

Table 4 summarizes responses, with paraphrased comments, organized around key themes: 1) community building and participation; 2) equity and history; and 3) logistics.

Table 4: Core Team Responses

	ON COMMUNITY BUILDING AND PARTICIPATION	ON EQUITY AND HISTORY	ON LOGISTICS
Unique Value of Project	"What makes this project unique is that we're focused on improving quality of life, we're not just recording facts about heat and shade, etc., you need people's experiences to drive the process of change" "Having distinct organizations with different agendas coming together and sharing resources with each other" "Having conversations of high quality over a sustained period with deep emotional complexity — this was even deeper than I anticipated" "A key accomplishment has been to lend legitimacy to this resident oriented approach"	"When I saw that rich communities had swimming pools, A/C and trees, and poor communities had no bus shelters, pools, trees or A/C, well you can immediately understand the health disparities and implications — ensuring there are representatives from those communities at the table from the beginning, for example the stories that were collected from residents, the centrality of this really matters." "Reflecting on what it means to work in partnership with, rather than on behalf of, others"	"Having workshops in Spanish with English translation worked much better than the other way around, so outsiders get the translated version, that just makes sense" "The biggest accomplishment in the project was making an adjustment to introduce the fishbowl process into the neighborhood workshop, which was a very powerful way to see city officials listen to and learn from community members" "I think much of what we did with logistics was critically important: holding the meetings in the neighborhoods, asking about what time of day makes the most sense for residents, offering food and childcare"
Key Changes	"I would start with interviews, then get the community organizers in each neighborhood working together for broader reach and collaboration across different community groups (e.g. arts groups, activist groups, other groups)" "It's hard to draw participants into events about future planning and knowledge gaining, so there's a need to tie each event to immediate and permanent changes in the neighborhood — planting a tree or putting up a shade structure as an invitation into a deeper conversation about strategic planning for the future." "I would have changed how we prepared for the first workshop, perhaps by talking to other projects about their start ups, so that we would be ready and okay with building from small to larger turnouts, with the right activities"	"More up front work is needed to understand what other projects have taken place already, what conflicts might exist between groups, what it would take to have buy in." "It would be important for another organization taking on a project like this to understand the environmental injustice component, the history around this helps a lot for a project like this" "Make it more public — announce to the community, more flyers, radio/TV announcements, to draw more attention to the issue — 30 people coming out is good, but we should get a 100 or more" "I was surprised about how the community is coming to the workshop to learn from the experts, since I was seeing it the other way around: we were there to learn from residents. So given the expectation of learning from us as experts, perhaps we could think more explicitly about how we're fulfilling that role"	"Start with definitions and a glossary of terms, residents really need to understand what the words mean, in a fun way with visuals and multiple examples, since technical language like 'remediation' doesn't mean anything to residents, but they are intelligent, they just need the heat terminology to connect with their own terminology better." "Longer front-end design, to better scope expectations with community organizers, to further align heat action planning with their existing work" "Rather than us using some criteria to select neighborhoods for the project, start with inviting all neighborhoods to a town hall to explain parameters, expectations, outcomes, goals and budget of the project, and then let neighborhoods bid to participate, that way we have buy in right from the start, they're asking us to participate, rather than us asking them to work with us" "In workshops we could have a zero-waste policy, to reduce packaging"
Final Thoughts	"The real power is in storytelling — it's really the human stories that we have to learn from and pay more attention to, to understand how different people experience heat based on different socio-economic status." "Residents are connecting the dots and starting to see that there are ways they can remediate the heat"	"In terms of continuity, a solid hand off of the project really matters, to walk whoever is going to lead this further through all of the people involved, do introductions, so the person doesn't essentially have to start all over from scratch"	"Scale up the project: a) do more within these three neighborhoods to see through to completion and success, however defined, so we are balancing between a project team that shows up, does the workshops and leaves, versus a team that has been committed to (and remains committed) to facilitating capacity building for residents to take this on themselves; b) go to more neighborhoods and repeat; c) work with the city and higher up governance structures to institutionalize this process"

Measures of Success

Whole Measures for Urban Heat Solutions

Whole Measures, was produced in partnership with The Nature Conservancy's Arizona Chapter as part of the Nature's Cooling Systems Project. Led by Center for Whole Communities, the rubric was developed by a Design Team comprised of The Nature Conservancy, Phoenix Revitalization Corporation, Arizona State University, Maricopa County Department of Public Health, Puente Movement, and RAILMesa.

WMUHS is a rubric-based framework that helps people working in cities qualitatively plan for, measure, and evaluate the social and economic impacts of urban conservation, resilience, and sustainability work. The framework presented here provides a foundation for a highly integrated, whole-systems approach to urban heat solutions. WMUHS includes four primary areas of measurement and is a reference point for those interested in prioritizing benefits to low-income communities and advancing justice and equity in their work. It is intended to guide planning and evaluation through the lens of socioeconomic impacts and equitable outcomes and focuses on four broad social impact categories: justice and fairness, community engagement, community resilience, and economic vitality.

This document is part of the Heat Action Planning Guide for Greater Phoenix and may be used independently or adapted to assess social outcomes of future projects focused on urban heat solutions in Greater Phoenix or elsewhere. The full Whole Measures for Urban Heat Solutions rubric can be found in Appendix D.

Whole Measures Goals and Objectives

Justice and Fairness

Statement of intent: Prioritize urban heat solutions that foster equitable outcomes for historically under-resourced communities in Maricopa County

Objectives:

- Prioritize heat solutions that provide environmental benefits for under-resourced communities
- Provide equitable and ready access to natural areas and cooling amenities for urban residents
- Acknowledge urban communities' relationships to nature, past and present, in framing and communicating urban heat solutions

Community Engagement

Statement of intent: Work with communities to design and implement urban heat solutions that address community needs

Objectives:

- Cultivate reciprocal and supportive relationships with community-based organizations
- Engage authentically and respectfully with diverse community stakeholders
- Shift power in decision-making and authority to members of the community

Economic Vitality

Statement of intent: Contribute to the economic vitality of neighborhoods in Greater Phoenix through projects and policy initiatives that mitigate urban heat

Objectives:

- Support long-term economic vitality through investment in urban heat solutions
- Connect job opportunities generated through urban heat solutions with historically underrepresented job-seekers from the communities where projects are sited
- Quantify and communicate the economic value of heat-reducing solutions to communities
- Create opportunities for community members to expand or create new businesses in or near the neighborhood
- Encourage awareness in heat-related occupational safety

Community Resilience

Statement of intent: Develop and implement Heat Action Plans to support and improve social, physical, and ecological resilience in neighborhoods of Greater Phoenix

Objectives:

- Support social cohesion, leadership capacity, and community social goals (for example, public health, education, and emergency response)
- Create effective emergency response plans and urban heat solutions that ensure community safety in the face of extreme heat events
- Support urban heat solutions that result in community and individual health co-benefits
- Build resilience of community members to heat exposure in their homes, and provide pathways for communities to advocate for accessible and affordable housing
- Implement urban heat solutions that support improved transportation options or improved quality of existing alternative transportation options, accessible to under-resourced communities

Data-based Outcomes

As urban heat solutions are implemented in streets and in neighborhoods, health and wellness outcomes may be measured by tracking improvements against the neighborhood baselines at the Census tract and Census block group levels. Below are a list of a few essential outcomes for urban heat solutions that our team recommends measuring to assess success in limiting heat exposure, vulnerability, and creating adaptive capacity. Some projects that could be monitored to reveal the success of interventions are Complete

Streets improvements to Van Buren Street in Edison-Eastlake Community, Broadway Corridor in Mesa Care Neighborhood, and Spaces of Opportunity in Lindo Park-Roesley Park in South Phoenix.

Outcome #1: Risk Reduction -> Heat-Related Illnesses and Deaths

Maricopa County Heat Surveillance reports are generated weekly during the heat season and an annual heat surveillance mortality and morbidity report are available that summarize the data. While neighborhood scale data are not generated regularly, the rates of illnesses and deaths can be compared between smaller administrative units, like zip codes or census tracts.

Indicators: Heat Deaths, Heat-Related Illnesses, Indoor Heat Deaths

Target: A long-term goal is to arrive at zero heat-related deaths and illnesses regionally. In the next 5-15 years, reducing the rate of heat-related deaths and illnesses to the 2012-2017 regional average would be a sign of progress. In Maricopa County, the average annual rate of heat-related deaths per 1,000,000 is 27, and the average annual rate of heat-related illnesses per 1,000,000 is 496. Note that at the neighborhood scale, downward trends may not be detectable in the short-term because of the small size of the area and resultant small sample sizes in health data. However, as demonstrated in the baseline, it is possible to compare neighborhoods. Furthermore, it may be possible to observe long-term changes in rates of heat-related illness at the neighborhood scale.

Outcome #2: Risk Reduction -> Thermally Comfortable Routes

Paths that can be walked from start to finish that do not pose risks of heat-related health effects or perceived discomfort (Hondula, 2019). A reasonable goal would be to ensure that residents may walk[1] 20 minutes without risk of heat illness.

Indicators: quantified using indices such as the Wet Bulb Globe Temperature Index (WBGT), Mean Radiant Temperature (MRT), or Physiologically Equivalent Temperature (PET); Influenced by exchange of energy between body and environment including environmental factors (air temperature, radiant temperature, air velocity, humidity) and personal factors (clothing insulation, metabolic heat). Simpler indicators such as percent shade coverage may serve as alternates in the absence of meteorological measurements or models.

Target: A walking route is safe during 95% of the summer, but during the most extreme conditions (~6 days), conditions are unsafe.[2] To achieve these conditions, shade coverage, whether trees or mechanical shade, along pedestrian routes should achieve 30%.

Outcome #3: Heat Mitigation —> Distribution of Vegetation

Indicators: Greenness (NDVI), vegetation cover (NAIP), and land surface temperature (LST)

Tree Cover data available here, CAP LTER land cover classification using 2010 National Agriculture Imagery Program (NAIP) Imagery: https://sustainability.asu.edu/caplter/data/view/knb-lter-cap.623.1/

Greenness data may be calculated from NDVI (Normalized Difference Vegetation Index) image of Central Arizona – Phoenix from a 2005 Landsat Thematic Mapper image.

Land surface temperature and NDVI imagery may be accessed by spatialy via NASA's Earthdata Search tool. Baselines for neighborhoods were derived from NASA ASTER satellite imagery and NASA LANDSAT satellite imagery.

Targets: The City of Phoenix has established a goal of 25% citywide canopy coverage (through natural and engineered shade) by 2030. American Forests recommends a tree canopy of 15% for desert cities as a target, with higher percentages possible. For the Nature's Cooling Systems neighborhoods, increasing the minimum tree coverage in all census block groups to 10% by 2040 would be a significant achievement.

[1] For this analysis, we assume that walking is "light work," and the population is not acclimatized to the heat in order to account for a range of health needs.
[2] Unsafe here means that pedestrians experience temperatures higher than a WBGT of 87.9 during their walk.

Similarly, neighborhoods can target increases in their minimum greenness scores (NDVI) to at least 0.2, which represented the central Maricopa County average at the time of this report. Reducing land surface temperatures in the hottest portions of the neighborhoods to not exceed 31°C/88°F along the same timeframe would ensure that no residents are experiencing hotter conditions than the average neighborhood in the region.

Other measurable outcomes of urban heat solutions include:

- Waste heat reductions
- Greenhouse gas reductions (usually addressed under climate action plans)
- Air quality as related to heat (especially NOx and ozone)
- Walkability and connectivity
- Access to public cooled space
- Access to A/C
- Utility assistance calls and response rates
- Access to refillable water stations
- Heat health safety curricula in public schools
- Number of neighborhood tree care cooperatives

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Appendix

A. Resources for Implementing Urban Heat Solutions

B. Technical and Design Guidance for Shade and Respite

C. Core Team Interviews

D. Whole Measures for Urban Heat Solutions

A. Resources for Implementing Urban Heat Solutions

I. Community Resources

- Police, Fire, Ambulance 911
- Low Income Home Energy Assistance Program (LIHEAP) / Utility Repair and Replacement Deposit (URRD)
  - LIHEAP offers assistance on current and past energy bills, and URRD provides assistance for deposits to make repairs and/or replacements to existing utility related systems

  - For Mesa:
  A New Leaf's MesaCAN (480) 833-9200

  - For Phoenix Residents:
  City of Phoenix Human Services Department (602) 262-6666 City of Phoenix Neighborhood Services (602) 534-4444 ext 4 Foundation for Senior Living (602) 285-1800
- Free, confidential referral and information helpline that connects people to the essential health and human services, 24 hours a day, seven days a week: 211

In the event of a utilities emergency

- Salt River Project (SRP) (602) 236-8811 ENG (602) 236-1100 SPA
- City of Mesa Electricity (480) 644-2266
- Arizona Public Service (APS) (602) 371-7171
- Southwest Gas/City of Mesa Gas (602) 271-4277 or (480) 644-4277
- City of Phoenix/Mesa water (602) 261-8000 or (480) 644-2262

For information on heat relief resources

- Maricopa Association of Governments (MAG) (602) 452-5060
- Arizona Division of Emergency Management (602) 464-6500
- Cooling Stations / Water Donations Map maricopa.gov/2461/Cooling-Stations-Water-Donation

Weatherization Assistance Program for Homeowners

- City of Phoenix (602) 495-0700 www.phoenix.gov/nsd/programs/housing-repair-programs • MesaCAN (480) 833-9200

Neighborhood Services Departments

- **City of Mesa:** Neighborhood Outreach Coordinator, Districts 4 & 5, (480) 644-5434, lindsey.balinkie@mesaaz.gov
- **City of Phoenix:** nsd@phoenix.gov

Help for the Homeless

- Phoenix Rescue Mission
  1801 S. 35th Ave. • 35th Ave., North of Durango
  (602) 233-3000 or (602) 272-5643
- Phoenix: Day Resource Center
  PATH Outreach Program
  1125 W Jackson St. • 10th Ave. & Jackson St.
  (602) 393-9930

Weather-Ready Nation

- Receive free weather alerts on your phone or e-mails from www.weather.com/mobile
- Become a Weather-Ready Nation Ambassador to promote heat-ready and emergency messages, creating family emergency plans and kits, collaborate

with the National Oceanic and Atmospheric Administration (NOAA). To learn more visit the WRN website at www.noaa.gov/wrn or e-mail NOAA's Weather-Ready Nation Team at wrn.feedback@noaa.gov

Tree Planting

Urban Tree Selection List
http://cleanairmakemore.com/trees/

Plant watering guidance: Water Use it Wisely
https://wateruseitwisely.com/100-ways-to-conserve/landscape-watering-guide/plant/

I-tree Design to estimate energy savings: https://design.itreetools.org/

II. Community Organizations/Programs

Arizona Sustainability Alliance

https://www.azsustainabilityalliance.com

We provide help to a number of Arizona cities by cleaning up our local parks, planting trees, refreshing and repairing existing community garden beds, and much more. We provide these services because we recognize that sustainability is the core of continued improvement of the lives of Arizonans and the protection of the state's natural resources

Chispa

http://origin.lcv.org/chispa/

In the environmental community, Chispa is unique. We are one of the only environmental programs truly engaged in traditional community organizing that builds the capacity of Latino families to influence policy makers and pressure polluters to protect communities' rights to clean air and water, healthy neighborhoods and a safe climate for generations to come. In the long term, we are committed to building powerful Latino communities whose environmental voice cannot be ignored.

Keep Phoenix Beautiful

http://keepphxbeautiful.org/

Keep Phoenix Beautiful is an affiliate of Keep America Beautiful and a nonprofit 501(c)3 organization. Every day, Keep Phoenix Beautiful provides tools to empower our diverse communities to improve overall quality of life. Our vision is a vibrant Phoenix where each neighborhood is a healthy, beautiful place to live. To achieve that vision, we aim to inspire individuals and organizations through leadership, active partnerships, and meaningful volunteer experiences.

Love Your Block (Phoenix)

http://www.awardalley.com/loveyourblock/

Small grants for City of Phoenix residents to transform their neighborhoods. Love Your Block Toolkit includes Tree Planting instructions on page 17 and many other resources for creating changes with neighbors.

Love Your Neighborhood (Mesa)

https://www.mesaaz.gov/residents/neighborhood-outreach/love-your-neighborhood

The City of Mesa's Love Your Neighborhood program is dedicated to assisting Mesa neighborhoods in being clean, safe, diverse, and economically vibrant places to live. The goal of Love Your Neighborhood is for residents and business leaders to be engaged, informed, and take pride in their properties and their community.

Neighbors Helping Neighbors (Mesa)

www.mesaaz.gov/residents/neighborhood-outreach/love-your-block-program/neighbors-helping-neighbors

The Neighbors Helping Neighbors Program is a means of assisting Mesa residents who, due to limited financial resources and/or physical limitations are experiencing difficulties maintaining the exterior of their homes. This program also assists neighborhoods in completing community enhancement projects such as clean ups and painting projects that improve the look of the neighborhood. Projects can include assistance with landscaping, exterior painting, wall paintings, etc. All work is completed by community volunteers and must be appropriate for volunteers to assist with.

Phoenix Revitalization Corporation:
http://phxrevitalization.org

Phoenix Revitalization Corporation is a non-profit community development corporation dedicated to the revitalization of neighborhoods by facilitating community improvement projects, and the maintenance and creation of low-income and workforce housing. An emphasis is placed on the revitalization of Central City South, a community located immediately south of the Phoenix Downtown Business District and the Arizona State Capitol Mall.

Puente Movement
http://puenteaz.org/

The Puente Human Rights Movement is a grassroots migrant justice organization based in Phoenix, Arizona. We develop, educate, and empower migrant communities to protect and defend our families and ourselves.

RAILMesa
http://www.railmesa.org/

RAIL's mission is to positively promote policies and systems that build wealth, pathways out of poverty, and help our community thrive.

Spaces of Opportunity:
https://dbg.org/community/space-of-opportunity/

Mission is to enable all South Phoenix families to have affordable access to healthy food, active living and healthy roots of their cultures. Spaces is engineering a comprehensive, neighborhood-level food system where gardeners, farmers and farm workers are celebrated as artisans. Spaces is transforming a food desert to a food oasis through the coordination of a 10-acre incubator farm, family gardens and an on-site farmers market. Spaces provides quarter-acre to one-acre plots of land with a preference to farmers with limited resources who are part of the South Phoenix community. For more information, contact John at 602.509.6042. For $5 a month, community members can rent a plot to plant, grow and harvest produce for their own use, or to share with others. Regular events are also held at the community garden to celebrate food, diverse culture and community. For more information, contact Bruce at 602.826.9824.

Trees Matter
https://treesmatter.org/

Trees Matter is a local nonprofit organization whose mission is to inspire and promote an increased tree canopy in the Valley. Primary initiatives are tree plantings with schools, coordinating SRP free tree giveaways to SRP residents, and education on urban food forests in the Valley. They host community classes and events, as well as provide various free resources to the public. This includes an "ask an arborist" online group, a tree database, an advocacy resource page, and a blog with topics on local tree tips. For more information contact info@treesmatter.org.

Unlimited Potential:
https://www.unlimitedpotentialaz.org

Unlimited Potential was founded in 1985 as a grassroots non-profit agency serving primarily parents in South Phoenix. Our programs have grown out of community needs to address adult functional illiteracy, unemployment and resulting family problems.

Watershed Management Group:
https://watershedmg.org/

Watershed Management Group (WMG) develops community-based solutions to ensure the long-term prosperity of people and health of the environment. We provide people with the knowledge, skills, and resources for sustainable livelihoods.

III. Resources for Organizers

Examples from U.S. Cities

- Portland's Treebate Program
- Houston Cool Roof Guidelines
- Cool 502: Louisville, KY's Urban Heat Island Program
- Louisville's neighborhood-by-neighborhood / recommendations of actions database
- Chicago's Green Roof Interactive Database

Strategies and Planning Frameworks

- Local Climate Zones Framework Article
- Local Climate Zones Framework Presentation
- Local Climate Zones Mapping Presentation
- "Measures to Mitigate UHI" in Science and Technology Trends
- Trust for Public Land report: The Benefits of Green Infrastructure for Heat Mitigation and Emissions Reductions in Cities
- EPA's Reducing Heat Islands: Compendium of Strategies
- EPA's Heat Island Community Actions Database
- Healthy Community Design and Transportation Fact Sheet
- Community-Driven Climate Resilience Planning: A Framework

Phoenix Metropolitan Area Resources

- City of Phoenix Tree and Shade Plan
- City of Tempe Tree Master Plan
- Optimizing Green Space Locations (Phoenix, Arizona)
- Trees Matter's tree database for Maricopa County
- Greater Phoenix Green Infrastructure Handbook: Low Impact Development (LID) Details for Alternative Stormwater Management.
- Central Arizona Conservation Alliance natural infrastructure viewer
- Arizona Department of Forestry and Fire Management Urban and Community Forestry 2016 Shade Tree Planting Prioritization

Nature's Cooling Systems Project Educational Brochure

English: https://drive.google.com/drive/u/0/folders/k1e7AIya3UmVV9CWiJWKGdNcDYC1Y-LVo2

Spanish: https://drive.google.com/drive/u/0/folders/1e7AIya3UmVV9CWiJWKGdNcDYC1Y-LVo2

MCDPH annual heat mortality report
https://www.maricopa.gov/ArchiveCenter/ViewFile/Item/3492

Heat and Health

- Centers for Disease Control and Prevention Heat Preparedness Resources
- American Public Health Association Extreme Heat Fact Sheet
- Maricopa County Department of Public Health Heat Relief Resources
- Arizona Department of Health Services Heat Safety Resources
- Arizona Department of Health Services Environmental Public Health Tracking Explorer


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B. Technical and Design Guidance for Shade and Respite

Walking outside during the warm season in Maricopa County is a physically demanding activity, even for short distances. High environmental temperatures and abundant sunshine place significant demands on the body's cooling mechanisms, which become even more stressed with body heat production associated with walking. Heat exposure while walking in the warm season can be a physically uncomfortable experience for many, and in severe cases, lead to adverse health effects including heat exhaustion and dehydration. Providing thermally comfortable routes can make walking and biking more viable and appealing to individuals who are vehicle-reliant as well as those who depend on active transportation modes. In turn, increased use of active transportation modes can help to reduce the demand for sources of urban heat such as waste heat from cars and heat storage by asphalt.

Thermal comfort refers to people's subjective sense of how hot or cold they feel as they move throughout their environment. It is formally defined in ASHRAE Standard 55 as "the condition of mind that expresses satisfaction with the thermal environment." There are many variables that influence thermal comfort, some of which are about the physical environment (e.g., air temperature, sunlight, radiated heat, humidity, air movement), and others which are about people (e.g., their health status, thermal preference, clothing, or activity level). Urban planners and designers are thus key players in shaping the thermal comfort of people in cities. The decisions and recommendations of urban planners and designers ultimately determine the mixture of landscapes and infrastructure that produce environments with different thermal characteristics.

A Thermally Comfortable Pedestrian Route (TCPR) is defined as one that can be walked from start to finish without a risk of increasing human body core temperature and/or perceived discomfort. The analysis below guides a project planner in identifying a need for either cooling features and/or places of respite. Features may include street trees or engineered shade structure, materials that absorb and/or reflect heat, seating, and drinking water access. In addition, reducing waiting and walking times between destinations, transit stops, and at street crossings are strategies to increase thermal comfort.

Quantifying a Thermally Comfortable Pedestrian Route[1]

For a route to be considered thermally comfortable, residents should be able to walk 20 minutes from origin to destination without risk of heat illness or personal discomfort from heat exposure. This 20-minute standard derives from walkability standards in public health literature and municipal sustainability goals. Recommendations for shade coverage along walking routes below are based on well-established standards for occupational heat exposure according to the Wet Bulb Globe Thermometer[2] (WBGT) Index. Using contemporary observations, the WBGT was calculated in both full sun and shaded conditions at a representative urban weather station in Maricopa County under varying weather conditions. The next step was to determine the necessary fraction of a 20-minute route for the average WBGT to meet the recommended standard of a maximum of 87.9°F. Assumptions used in this calculation are that pedestrians are walking at light to moderate intensity (the metabolic equivalent of "light work,") and that the population is not fully acclimatized to heat, to account for a wide range of physiological needs, health statuses, and lifestyles.

The recommendations presented below are based on weather data collected over the period 2005–2015 for the afternoon hours, defined as noon through 6pm. Summer months in this analysis are considered May through October. Recommended shade fractions should be revisited on a decadal basis to account for projected changes in climate.

Recognizing that it may be impractical or impossible to provide sufficient shade coverage that fully protects the population throughout the entire summer, additional recommendations are presented below that provide targets that will keep residents safe on all but the most extreme summer days.

To achieve a walking route that is safe **during the entire summer**, target shade coverage on walking corridors (as measured during the hottest times of the day) should be greater than or equal to 62%.

To achieve a walking route that is safe for **95% of summer afternoon hours**, target shade coverage should be greater than or equal to 30%. Based on historical weather data, this shade coverage would have yielded unsafe conditions for at least one hour on an average of 12 days over the past decade.

To achieve a walking route that is safe for **90% of summer afternoon hours**, target shade coverage should be greater than or equal to 20%. Based on historical weather data, this shade coverage would have yielded unsafe conditions for at least one hour on an average of 25 days over the past decade.

Therefore, along a route that takes a pedestrian 20 minutes to complete (including walking and waiting times):

- Minimum acceptable shade coverage: 20%
- Good shade coverage: 30%
- Excellent shade coverage: 60%

[1] Developed by Arizona State University researchers, David Hondula and Ariane Middel, and Maggie Messerschmidt (The Nature Conservancy)

[2] The Wet Bulb Globe Temperature (WBGT) Index, which is the most widely used index for heat stress assessment in occupational and recreational settings. The WBGT index takes into account air temperature, humidity, air movement, and radiation and can be measured in the sun and shade (unlike, for example, the heat index, which is measured in shade only). The WBGT is a more comprehensive measure for assessing the thermal environment than other commonly-reported variables like the heat index (which only includes temperature and humidity) or the wet bulb temperature (which is a measure of only humidity).

Figure 1 Simple fabric shade devices, supported by columns in this instance, require minimal structure. Canopy can easily be removed in cooler months, replaced when needed for maintenance, or traded out for seasonal color.

Figure 2 Tall sculptural features should leverage their height to provide shade, but designers should seek creative ways to shape its form to maximize shade area for multiple times of day. This example provides an identity feature for the neighborhood, but only provides shade on a few seats for a very short time around solar noon, when foot traffic in the area is lighter.

Figure 3 Perforated screen parallel with roadway provides shade on one side at all times of day. The perforation is necessary to allow views into the shaded space for security. Photo Source: Kristian Kelley

Figure 4 Shade with seating. Temporary shade devices employed when needed.

Figure 5 Overhead perforated steel shade structure at intersections provides relief for pedestrians waiting for the light to change. These structures must be designed and placed in a manner that does not interfere with traffic signal visibility.

Shade Design Considerations

Many shade studies only examine shade patterns around noon and that has limited impact on thermal comfort. LEED ND v4 provides some specific standards for increasing shade to minimize the urban heat island effects. In contrast, the principles below can be applied contextually when selecting and designing shade at the site or corridor-level. The design principles are followed by examples illustrating those guiding concepts. These shade design principles are intended to be complementary to other existing meta-principles (adopted by the City of Phoenix) for reducing the impacts of urban heat.

Design Principles for Shade[3]

1. Simulate Worst Case Scenario: Create shade simulations through use of tools such as Revit, SketchUp, Rhino, or ENVI-met for worst case scenarios for time of year and time of day. In Maricopa County, that is during May through October in afternoon hours.

2. Connectivity: Through modeling and/or by inspecting shade percentage for achieving a Thermally Comfortable Pedestrian Route (TCPR) as described above, ensure pedestrian pathways adjacent to the project site have opportunities to occur in shaded conditions, especially in late afternoon.

3. Solar Orientation: Strive to maximize shading between May to October during afternoon hours. Also:

a) Rights-of-way orientation:

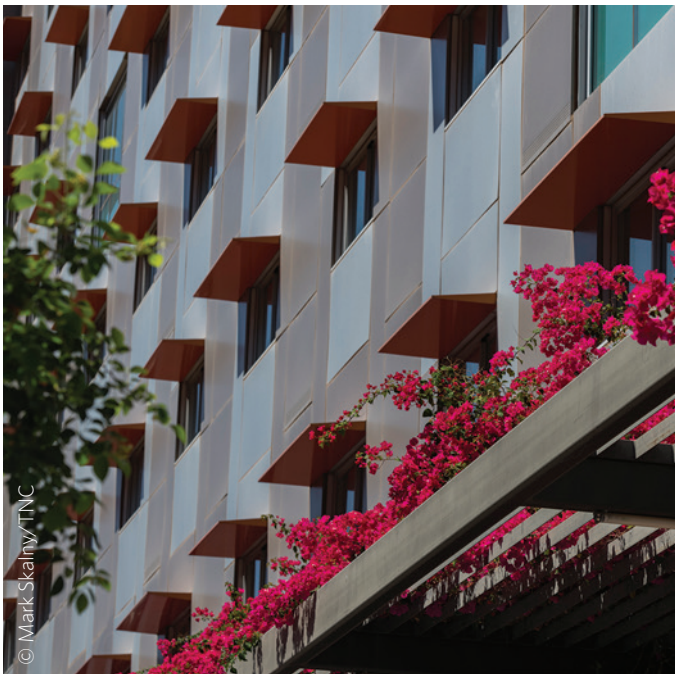
i) East-west (E-W) oriented rights-of-way are the most difficult to shade with buildings. However, the southside of E-W streets, on the northside of buildings, provide the greatest shading opportunity. The effectiveness of this northside building shade is minimized around the summer solstice and becomes more effective as the sun shifts south over the solar cycle, creating longer shadows. E-W streets may need the most additional shade elements to provide effective shade early and late in the day. On east-west oriented streets, consider placement of trees and shade structures that maximize shade over pedestrian walkways. This may result in unsymmetrical treatment of streetscape elements to ensure shade is falling on pedestrian walks. Vertical shading elements can take advantage of steep early morning and late afternoon sun angles to provide effective long shadows.

ii) North-south (N-S) oriented rights-of-way provide more opportunities to shade with buildings than on E-W streets. On streets with taller buildings (2+ stories), prioritize the shaded areas produced from buildings. On these streets, the challenge will be providing shade on either side of solar noon, for which horizontal structures might work best. If the N-S right of way has low or no buildings, apply principles for E-W oriented streets.

4. Sidewalk Location: On either E-W or N-S oriented streets, locate sidewalks as closely as possible to the building to maximize building shade for as much of the day as possible and provide ease of access to building entrances. Locating walks adjacent to buildings also may minimize walking distance.

5. Use of Space to Address Heat Equity: Prioritize shade on neighborhood walks that serve as critical pathways for essential life activities (e.g. commuting to work, school, day care, and grocery) for people more vulnerable to heat. Consider when people use the space and select designs that prioritize shade during times of use. Also consider volumes of pedestrian traffic in determining how much shade to provide. A remote technique to identify heat vulnerable locations is to combine data on residents' health, surface temperatures, and frequency of use including time of day to identify areas of critical heat vulnerability for transit. This may not depend on the total volume of people, but rather the frequency of use of walks by vulnerable residents. For more effective assessment

[3] Developed by Arizona State University landscape architects Paul Coseo and Kristian Kelley, Arizona State University researchers Ariane Middel and David Hondula, and Maggie Messerschmidt (The Nature Conservancy)



of how people move through and use spaces, conduct on-the-ground investigations during different times of day and different days of the week to confirm movement and use patterns (see Gehl and Svarre, 2013).

6. Types of Shade: Select shade types that optimize shade during worst case scenarios; some options include trees and vegetation, canvas/sails, awnings, vertical panels, solar panels, and shade by buildings. Shade may complement other cooling strategies to maximize thermal comfort.

7. Materials and Coatings: Select materials that decrease heat absorption. LEED-ND requires a three-year aged solar reflectance (SR) value of at least 0.28. Be cautious as to not utilize highly reflective materials that will redirect light onto pedestrian pathways as it adds to thermal discomfort (see Principle #11).

8. Vegetation: Incorporate trees to provide multiple benefits in addition to shade. Follow local guidance for the right tree in the right place, minimizing sidewalk maintenance issues, and water demand where possible by utilizing fit-for-purpose water sources, low-water demand plants, or bioretention. Vines and green walls can provide increased opportunities for cooling via evapotranspiration. Trees Matter maintains an online tree database for Maricopa County. Design guidance for a bioretention system with trees is available in the Greater Phoenix Green Infrastructure Handbook: Low Impact Development (LID) Details for Alternative Stormwater Management. Other decision support tools for green infrastructure planning include the Central Arizona Conservation Alliance natural infrastructure viewer (including an urban heat vulnerability assessment), the Arizona Department of Forestry and Fire Management Urban and Community Forestry 2016 Shade Tree Planting Prioritization, and the Arizona Department of Health Services Environmental Public Health Tracking Explorer.

9. Mixing and Layering: Combine multiple layers of shade to maximize coverage.

10. Working with Constraints: In compact development, complement building shade with trees and building awnings.

11. Reflected Light Mitigation: Consider reflected light as an additional source of exposure whether it comes from adjacent structures, passing vehicles, paved surfaces, or other off-site sources. Mitigate these conditions by shading adjacent high albedo surfaces, blocking incoming reflected light using shade structures or ground level vegetation, or through the modification of context materials.

12. Art: Aesthetic and artistic approaches to shade can convey community identity or create a sense of safety or play. Designs may include cut-outs and perforations for dappled shade, sculpture, and/or interactive elements.

13. Design for Human Comfort: Finally, it is critical to underscore for whom shade is being developed. Many of the above principles could be adhered to and it could still be uncomfortable or unusable for people. For successfully shaded spaces, shade on pedestrian walks and waiting spaces should address comprehensive comfort including:
1) separating modes of movement
2) designing for neighborhood sociability
3) constructing overall high-quality and intuitive spaces.

Shade Examples

Figure 6 shows Adams Street looking west in Downtown Phoenix at about solar noon on April 3, 2018. Sidewalks on east-west streets are of particular concern because of the length of the sun exposure. The metal shade awning on the Renaissance Hotel is designed to allow some light through and to be combined with tree shade. The material heats up more efficiently than other materials, but the alternating metal slots allows for more cooling than a solid sheet of metal. Coatings can be added to the metal to decrease absorption of shortwave radiation. The bioretention basins on the south side of the sidewalk have small ornamental tree species that will grow to 15′-0″ to enhance shade as they grow. The vegetation also provides transpiration up until 104°F, after which evaporative cooling only comes from water evaporating from the soil.

Combining multiple types of shade is highly recommended. Figure 7 illustrates the Roosevelt Light Rail stop with a north-south orientation (image looking north). Shade is provided from a combination of vertical structures, horizontal structures, angled canvas, and trees. Vertical shade structures are critical to provide shade in the early morning and late afternoon when sun angle is low.

In areas of compact development, sidewalks on north-south streets next to buildings provide shaded pathways. Figure 8 shows Central Avenue looking south toward Garfield Street, where pedestrians walking before noon can find shade on the eastern side sidewalk even as the western side of the street is in full sun. Later in the afternoon the entire street canyon is shaded by a nineteen-story mid-rise building. The benefits can be enhanced with street trees and building awnings.

Figure 6 Awning combined with trees

Figure 7 Multiple strategies for shade

Figure 8 Building shade

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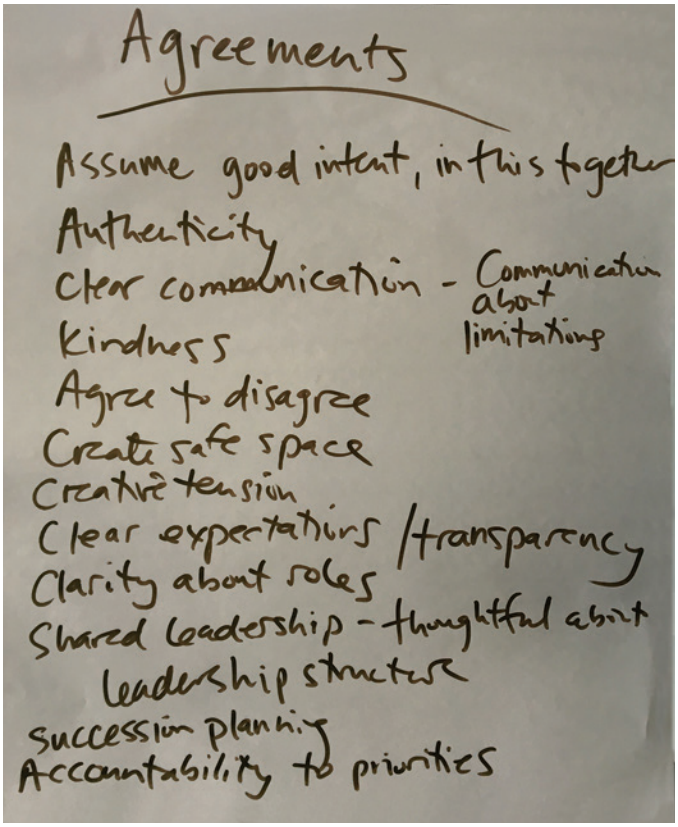
C. Core Team Interviews

The following paraphrased comments were collected through informal, 15 minute interviews with 10 of our core team members, conducted in late February and early March 2019:

When you look back now on your experience with the Nature's Cooling Systems Heat Action Planning, what stands out as the most significant accomplishment or unique feature of the project that you liked?

- "The biggest accomplishment in the project was making an adjustment to introduce the fishbowl process into the neighborhood workshop, which was a very powerful way to see city officials have to listen and learn from community members"
- "Being able to attend community events, participate in a change in the neighborhood, such as planting a tree and learning about rainwater harvesting"
- "A key accomplishment has been to lend legitimacy to this resident orientation approach"
- "Residents are connecting the dots and starting to see that there are ways they can remediate the heat"
- "Investing in bringing the community out with activities that people can understand and participate in meaningfully"
- "To have distinct organizations with different agendas coming together and sharing resources with each other"
- "having conversations of high quality over sustained period with deep emotional complexity — this was even deeper than I anticipated"



If you could change one element of the project — in the planning or implementation — what would it be?

- "I would start with interviews, then get the community organizers in each neighborhood working together for broader reach and collaboration across different community groups (e.g. arts groups, activist groups, other groups)"
- "More incentivizing to draw the community out from the start of the project"
- "Rather than us using some criteria to select neighborhoods for the project, start with inviting all neighborhoods from our list to a town hall where we explain parameters, expectations, outcomes, goals and budget of the project, and then let neighborhoods bid to participate, that way we have buy in right from the start, they're asking us to participate, rather than us asking them to work with us"
- "Longer front-end design, to better scope expectations with community organizers, to further align heat action planning with their existing work"
- "Grassroots organizing takes time, and it's hard for that to happen on the timeline of a project grant, but we are very impressed that you listened to us, we felt valued and able to participate as an equal, we felt confident saying something, we learned and you learned"
- "Make it more public — announce to the community, more flyers, radio/TV announcements, to draw more attention to the issue — 30 people coming out is good, but we should get a 100 or more"
- "Scope, the start/stop, to be able to go toward full implementation, more funding to go forward in a bigger way"
- "It was hard to see how disappointed team members were by the low turnout at the beginning, but the start is normally slow, so what I would have changed is how we prepared for that, perhaps by talking to other projects about their start ups, so that we didn't have to feel demoralized and we were ready and okay with building from small to larger turnouts, with the right activities"

What advice would you give another group interested in doing heat action planning?

- "Any core team of organizers will have a tendency to look to existing solutions based on their own biases—in our case this came as a focus on green infrastructure, trees, or public health benefits. But the real power is in storytelling — it's really the human stories that we have to learn from and pay more attention to, to understand how different people experience heat based on different socio-economic status."
- "Getting people in the room is always a challenge with community organizing, but for heat related illness this is a particularly difficult challenge since the immediate

threat is not obvious to most people, so hard to mobilize around. Partnerships with community groups is key, we need to build on these partnerships. So this needs to be more than a one year project, make it 3 years, so key partners can continue talking to people, building awareness of issues, so people can understand better how it affects them personally, or their kids, or grandparents"

- "It's hard to draw participants into events about future planning and knowledge gaining, so there's a need to tie each event to immediate and permanent changes in the neighborhood — planting a tree or putting up a shade structure, these may be symbolic gestures, but they could invite a conversation about how to plan more strategically and effectively for the future"
- "Spend more time upfront getting everything ready — clearer roles and a plan in place to show how through the workshops you move toward a vision of the future that can be packaged back for the city and for other organizations — so just knowing better ahead of time what are the core outlets where the work lands and building those pathways and alignments connecting the top-down and bottom-up"
- "Start with definitions and a glossary of terms, residents really need to understand what the words mean, in a fun way. Whenever you are telling a story, you need a visual, pictures and words — people need that, you can't just rely on words, you need multiple examples, since technical language like 'remediation' doesn't mean anything to residents, but they are an intelligent and resilient group of people, they just need the heat terminology to connect with their own terminology better.
- "It would be important for another organization taking on a project like this to understand the environmental injustice component, the history around this helps a lot for a project like this"
- "To continue building connections with groups already working on the ground, so connect with more stakeholders, school districts, city organizations too"
- "When I saw that rich communities had swimming pools, A/C and trees, and poor communities had no bus shelters, pools, trees or A/C, well you can immediately understand the health disparities and implications — this has to be central. And ensuring there are representatives from those communities at the table from the beginning, for example the stories that were collected from residents, the centrality of this really matters"
- "I was surprised by the comment about how the community is coming to the workshop to learn from the experts, since I was seeing it the other way around: we were there to learn from residents. So given the expectation of learning from us as experts, perhaps we could think more explicitly about how we're fulfilling that role"
- "I think much of what we did with logistics was critically important: holding the meetings in the neighborhoods, asking about what time of day makes the most sense for residents, offering food, and childcare"

Anything else you would like to share?

- "Replicating this: you can't take this and hope to replicate elsewhere, readymade. The approach is something that works because it is developed organically based on the team and its context"
- "What makes this project unique is that we're focused on improving quality of life, we're not just recording facts about heat and shade, etc., facts don't tell a story, you need people's experiences to drive the process of change"

Whole Measures for Urban Heat Solutions

Whole Measures for Urban Heat Solutions (WMUHS), based on Center for Whole Communities' Whole Measures, was produced in partnership with The Nature Conservancy's Arizona Chapter as part of the Nature's Cooling Systems Project. Led by Center for Whole Communities, the rubric was developed by a Design Team comprised of The Nature Conservancy, Phoenix Revitalization Corporation, Arizona State University, Maricopa County Department of Public Health, Puente Movement, and RAILMesa.

WMUHS is a rubric-based framework that helps people working in cities qualitatively plan for, measure, and evaluate the social and economic impacts of urban conservation, resilience, and sustainability work. The framework presented here provides a foundation for a highly integrated, whole-systems approach to urban heat solutions. WMUHS includes four primary areas of measurement and is a reference point for those interested in prioritizing benefits to low-income communities and advancing justice and equity in their work. It is intended to guide planning and evaluation through the lens of socioeconomic impacts and equitable outcomes and focuses on four broad social impact categories: justice and fairness, community engagement, and community resilience, and economic vitality.

This document is part of the Heat Action Planning Guide for Greater Phoenix and may be used independently or adapted to assess social outcomes of future projects focused on urban heat solutions in Greater Phoenix or elsewhere.

> **"There is no power for change greater than a community discovering what it cares about."**
>
> **-Margaret J. Wheatley**

ACKNOWLEDGMENTS

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For more information about the Whole Measures Design Process, please see Whole Measures for Urban Conservation

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I. Justice and fairness: heat solutions for all

Statement of intent: Prioritize urban heat solutions that foster equitable outcomes for historically under-resourced communities in Maricopa County

Objectives

- Prioritize heat solutions that provide environmental benefits for under-resourced communities
- Provide equitable and ready access to natural areas and cooling amenities for urban residents
- Acknowledge urban communities' relationships to nature, past and present, in framing and communicating urban heat solutions

II. Community engagement

Statement of intent: Work with communities to design and implement urban heat solutions that address community needs

Objectives

- Cultivate reciprocal and supportive relationships with community-based organizations
- Engage authentically and respectfully with diverse community stakeholders
- Shift power in decision-making and authority to members of the community

III. Economic vitality

Statement of intent: Contribute to the economic vitality of neighborhoods in Greater Phoenix through projects and policy initiatives that mitigate urban heat

Objectives

- Support long-term economic vitality through investment in urban heat solutions
- Connect job opportunities generated through urban heat solutions with historically underrepresented job-seekers from the communities where projects are sited
- Quantify and communicate the economic value of the heat-reducing solutions to communities
- Create opportunities for community members to expand or create new businesses in or near the neighborhood
- Encourage awareness in heat-related occupational safety

IV. Community resilience

Statement of intent: Develop and implement heat action plans to support and improve social, physical, and ecological resilience in neighborhoods of Greater Phoenix

Objectives

- Support social cohesion, leadership capacity, and community social goals (for example, public health, education, and emergency response)?
- Create effective emergency response plans and urban heat solutions that ensure community safety in the face of extreme heat events
- Support urban heat solutions that result in community and individual health co-benefits
- Build resilience of community members to heat exposure in their homes, and provide pathways for communities to advocate for accessible and affordable housing
- Implement urban heat solutions that support improved transportation options, improved quality of existing alternative transportation options, and accessibility of those options to under-resourced communities

"If you have come to help me, you are wasting your time. But if you have come because your liberation is bound up with mine, let us work together."

- Lilla Watson

Definitions

Adaptation Adjustment to environmental conditions

Biodiversity Values Regard or importance given to the total variability of life on earth

Catalyze Investment To bring about, initiate, and/or increase the level of resources

Co-benefits Additional community benefits above and beyond the traditionally defined conservation impacts of an urban conservation project.

Community-identified Solutions Solutions developed by the community being acted upon, rather from an outside or distant source

Complete Streets A transportation policy and design approach that requires streets to be planned, designed, operated, and maintained to enable safe, convenient and comfortable travel and access for users of all ages and abilities regardless of their mode of transportation

Dispossession The action of depriving someone of land, property, or other possessions

Heat Action Plans A collection of landscape, behavioral, structural or material solutions to lessen the impact of urban heat

Heat-Related Illness Health conditions caused by exposure to heat

Heat-Related Occupational Safety Safety in the workplace with regard to high temperature exposure

Heat Solutions A means of solving or alleviating problems of increasingly high temperatures in urban areas

Formal Accountability Mechanism A process that ensures that decision-makers are held responsible for specific outcomes

Landscape-level Cooling Heat adaptation or mitigation that occurs in the outside areas, as opposed to indoor solutions

Local Greening Efforts Projects or programs that plant or promote planting trees or other vegetation

Mitigation The action of reducing the severity, seriousness, or painfulness of something

Pilot Projects Small scale projects that provide information for larger scale implementation

Reciprocal A relationship of mutual dependence, action, or influence

Resilience Is the capacity to withstand, absorb, and bounce back from stressors and shocks; or, alternatively, 'bounce-forward' when the pre-disturbance status quo is not a desirable one to return to.

Social Cohesion The willingness of members of a community to work together for survival and prosperity

Social Justice Justice in terms of the distribution of wealth, opportunities, and privileges within a society

Sub-Awards Parts of larger awards or funding that are transferred from another institution or organization

Thermal Comfort A measure of someone's satisfaction with the heat conditions they experience at work, home, or as they move through their neighborhood

Underrepresented Insufficiently or inadequately acknowledged by those who are entitled or appointed to make decisions

Underresourced Provided with insufficient resources

Urban Heat The thermal effects of a changing climate and built up urban environments that are hotter than surrounding environments because of heat trapping materials, densely packed buildings, and heat from cars, air conditioning, and other machines

Urban Heat Solutions Ways of providing cooler alternatives for people and places within a city

Vulnerable Neighborhoods Geographically defined areas at high risk to harm from a threat

Walkable Urban Code, COP Part of the City of Phoenix (COP) transit oriented development plans that directs land-use development subdivision standards, lot requirements, setbacks and building codes that encourage and are conducive to walking.

Weatherization Simple home improvements such as installing insulation, sealing doors, ducts, and windows, and ensuring proper ventilation that can keep the home cool and reduce need for air conditioning

Well-Being The state of being comfortable, healthy, or happy

Justice and Fairness

HEAT SOLUTIONS FOR ALL

OBJECTIVES		MEASURES (OF SUCCESS) or METRICS	
		NEGATIVE (-3)	NEUTRAL (0)
1.01	Prioritize heat solutions that provide environmental benefits for under-resourced communities	Projects with known possible negative impacts are given high priority despite knowledge of impacts (for example, decreased access to public transportation, job loss, loss of housing, increased flood impacts).	The potential negative impacts of projects on the community are considered, but projects that provide clear benefits are not prioritized.
1.02	Provide equitable and ready access to natural areas and cooling amenities for urban residents	Projects are detrimental to and not accountable to the community for negative impacts. Establishment and care of natural areas or natural infrastructure result in exclusion of urban residents, loss of community pride, and/or increase in crime.	Projects support or develop cool, naturally diverse areas, but do not increase access for city residents. Motivated volunteers are welcomed but no outreach is done to welcome residents or newcomers. No financial resources allocated to support volunteer effort.
1.03	Acknowledge urban communities' relationships to nature, past and present, in framing and communicating urban heat solutions.	Framing and communication around urban conservation projects explicitly deny urban communities' relationships to nature, both past and present.	Framing and communication around the project make no mention of existing relationships between urban communities and nature, implying that outside experts must bring environmental benefits to urban communities.

Statement of Intent: Prioritize urban heat solutions that foster equitable outcomes for historically underresourced communities in Maricopa County.

MEASURES (OF SUCCESS) or METRICS			RATING
MODEST (+3)	STRONG (+5)	HIGHEST IMPACT (+10)	
Projects that result in some direct quality-of-life improvements are given additional weight when prioritizing strategies.	Projects that are likely to result in clear, measurable, positive impacts on health and other components of well-being are prioritized.	Highest priority is given to projects targeting problems in under-resourced communities. Projects are designed and implemented in response to the community's self-identified needs and priorities. Projects are successful in creating measurable improvements in health and well-being.	
Team members engage in discussion with communities about what types of benefits the community desires. A few pilot projects are implemented with minimal support for long-term maintenance. The projects support existing natural areas and introduce natural resources, amenities and programming. These opportunities provide access for a wide range of city residents to connect, care for, and/or find meaning in the spaces, while also fully protecting biodiversity values.	Based on discussion with community leaders and organizations, agreements are developed for projects. These agreements detail the benefits that the projects provide for the community, including the responsibilities for caring for these spaces. These opportunities provide access for a wide range of city residents to connect, care for, and/or find meaning in the spaces, while also fully protecting biodiversity values.	Program team solicits input from community members who have historically had low levels of access to natural areas. Together they prioritize projects and actions for increasing local access and connection to nature. Benefits and maintenance agreements that include a formal accountability mechanism are developed and adopted. Local greening efforts and residents are energized, supported, and connected with other groups that care for green spaces.	
Framing and communication acknowledge existing relationships between urban communities and their environment, but not the history of injustice or exclusion from the environment.	Framing and communication acknowledge existing and historical relationships between urban communities and their environment, and they articulate visions and strategies of connection and restoration that reflect community thinking and experience.	Framing and communication acknowledge existing and historical relationships between urban communities and the land, including the history of dispossession and loss. Communications are representative of the community, elevating visions of connection and restoration, and countering the dynamic of dispossession and loss.	

Community Engagement

OBJECTIVES		MEASURES (OF SUCCESS) or METRICS	
		NEGATIVE (-3)	NEUTRAL (0)
2.01	Cultivate reciprocal and supportive relationships with community-based organizations.	Project team disregarded community leaders, residents, and organizations. Project weakened existing partnerships and competed with local projects for resources, diverting resources away from the community.	Relationships and trust with community leaders and residents are unchanged. There is neither competition nor collaboration between new heat solution projects and existing community organizations or projects.
2.02	Engage authentically and respectfully with diverse community stakeholders.	Project team makes no effort to engage with community and cliquish behavior is prevalent. Emphasis is on targeting actors with influence and power rather than on shifting power dynamics. There is no attempt to overcome language barriers. Work results in stakeholder exclusion and causes the community to distrust program partners. Inequities are increased as a result of this project.s	Some demographic research and stakeholder analysis is conducted. The engagement strategy ignores cultural norms of community. Only "easy"/usual stakeholders are consulted. Engagement leaves little time, and/or insufficient resources to engage meaningfully with residents. Barriers for some groups are not acknowledged or addressed. If conflict emerges or excluded parties request access to the project, the need may be acknowledged, but not corrected.
2.03	Shift power in decision-making and authority to members of the community	Project team makes no effort to inform or involve community, leaving them unaware and uninvolved in the decision-making process.	Project team makes some effort to inform community members about the process and engage them in the work but is not influenced by their opinions. Core team seeks approval only for predetermined project plans.

Statement of Intent: Work with communities to design and implement urban heat solutions that address community needs.

MEASURES (OF SUCCESS) or METRICS			RATING
MODEST (+3)	STRONG (+5)	HIGHEST IMPACT (+10)	
Collaborative relationships are developed and maintained with community-based organizations. Funding relationships and capacity are explored to direct new and increased funding to community organizations.	Project develops strong and respectful relationships, based on reciprocity, trust, and respect. Funding relationships and capacity are leveraged to direct new and increased funding to community organizations.	Relationships between heat-vulnerable neighborhood residents, not-for-profit groups, universities, and municipal decision-makers are collaborative, strong, and based on trust and respect. Investment is made in sustaining these relationships beyond the length of individual projects. Relationships are leveraged to support greater thermal comfort and social justice and to direct new and increased funding to community organizations.	
Stakeholders are consulted but there is little information sharing, or only a one-way communication strategy that does not incorporate resident input. The project includes intentions to perform history and social impact research, but the work is not completed. Linguistic and other barriers to engage or get involved are recognized but adequate resources are not dedicated to provide access and understanding. Conflict may arise and is not addressed	Community leaders and residents participate and get involved. There is good communication of program objectives with a diversity of stakeholders, including those that have been historically marginalized. Engagement plan produces information but it is marginally included in the project. Marketing and communication efforts are translated and diversified but may not be democratic in vision or messaging. Conflict is addressed. History is researched and incorporated into programming.	Those historically marginalized and most highly impacted by lack of cooling features, programs, and information are centered in dialogue and decision-making. Barriers to participation are addressed adequately for all stakeholders. Communication, opinions, and proposals flow in both directions and there are ample resources to invest time and translate materials in a way that acknowledges cultural differences. Collaboration includes mutual support and transparency, and project team is willing to make changes as a result of engagement. Marketing and outreach allows residents and community leaders to speak for themselves in formats that are relevant to their community. Resources are allocated to enhance and sustain leadership for those traditionally underrepresented. If conflict arises, it is addressed in productive ways.	
Project informs and engages some members of the community and helps them play a more active role in developing, implementing, and sustaining the project.	Project informs and engages diverse cross-sections of community members and shares decision-making with them. Community plays a more active role in developing, implementing, advocating for, and managing cooling projects. The outcomes from community discussions are made public and readily available.	From the earliest stages, project engages fully with residents and community-based organizations as well as a diverse cross-section of stakeholders to make project decisions. Decision making is based upon consensus. Participating stakeholders play a more active role in providing for greater thermal comfort for neighborhood residents both for this project and for related or upcoming projects. The outcomes from community discussions are made public and readily available.	

Economic Vitality

OBJECTIVES		MEASURES (OF SUCCESS) or METRICS	
		NEGATIVE (-3)	NEUTRAL (0)
3.01	Support long-term economic vitality through investment in urban heat solutions.	Solutions and heat action plans don't result in tangible change, reinforcing doubt and mistrust, and contributing to underinvestment in urban heat solutions in the neighborhoods.	Plans end up on government shelves, instead of in the hands of community members, leaders, and local businesses.
3.02	Connect job opportunities generated through urban heat solutions with historically underrepresented job-seekers from the communities where projects are sited.	Plans are too expensive, complicated, and unrealistic to attract immediate investment. Requirements for permits stand in the way of any progress, and any business or job-creation opportunities.	There is no discussion of local job opportunities for implementation of heat action plans. There is no opportunity for outreach, recruitment, or training for job-seekers in the communities.
3.03	Quantify and communicate the economic value of the heat-reducing solutions to communities.	Project creates the impression that conserving natural systems, heat mitigation, and heat adaptation are deleterious to local economic vitality.	The project does not address the economic impact of heat on local communities / businesses, and there is no increased awareness or valuation of solutions by these groups.
3.04	Create opportunities for community members to expand or create new businesses in or near the neighborhood.	The project team contracts, sub-awards, and commits resources outside of neighborhoods and does not support improvements in capacity of community members in Heat Action Planning neighborhoods. The Heat Action Plans discourage local businesses from making the changes proposed in the plans.	The Heat Action Plans do not encourage local business to make changes proposed in the plans. Small, local companies lack access to the plans and the social networks for implementing the suggested changes.
3.05	Encourage awareness in heat-related occupational safety.	Project conveys mixed messages about the most appropriate methods for preventing, identifying, and responding to heat-related illness and injury in the workplace. Recommendations are anecdotal and not based on scientific evidence.	Project references existing material for preventing, identifying,and responding to heat-related illness and injury in the workplace, but makes no effort to make the material more accessible.

Statement of Intent: Contribute to the economic vitality of neighborhoods in Greater Phoenix through projects and policy initiatives that mitigate urban heat

MEASURES (OF SUCCESS) or METRICS			RATING
MODEST (+3)	STRONG (+5)	HIGHEST IMPACT (+10)	
The demonstration projects are short-lived, and do not provide any cooling effects or other economic benefits.	Croject demonstrations spur additional investment and momentum for more urban heat solutions in the neighborhoods.	Project creates a replicable model for planning and implementing urban heat solutions at the neighborhood scale. Local companies and a broad range of investors are using the project elements (plans, guidelines, etc.) to catalyze investment and implement changes in a more affordable, long-lasting manner.	
There is some outreach, recruitment and training for job-seekers in the communities, but only a few well-connected individuals acquire jobs as a result of this project.	obs are created and given to local community members, but the majority of jobs are temporary project-related jobs, not permanent jobs that provide long-term stability.	Project provides a platform for businesses to implement strategies for cooling and potential for expanding a local workforce dedicated to implementation of these strategies and to job skills advancement. Community members are prioritized for long-term, permanent, well-paying jobs.	
A small group of community members and business leaders learn about the ways in which heat impacts their community. However, the information is given in a complex, technical way and cannot be translated into economic benefits or relayed to others.	High profile leaders in community and neighborhood businesses and services understand and assist with heat-reducing solutions due, in part, to the economic value of these changes amd their understanding of the costs of doing nothing. These leaders help champion heat-reducing solutions in their communities.	Projects result in increased and widespread understanding of the economic impacts and costs of heat, both for individuals, local businesses, and communities, as well as the economic benefits of mitigating heat, thereby building a better understanding of the value of nature-based solutions for heat mitigation.	
Contracts and sub-awards only extend within existing networks but do not provide incentives or opportunities for new or existing community businesses.	Local community members create and expand businesses and become the catalysts for others to embrace heat reduction.	Project increases vitality of the neighborhoods by directing resources toward local businesses for various aspects of the projects (for example canvassing, child care, and food) and by creating opportunities for improved capacity of local leaders. Heat Action Plans clarify the role that reducing heat plays in supporting the vitality of localized economies.	
Project distributes existing safety material in the appropriate language and communication channel requested by the community (for example flyers, posters, presentations).	Project produces new safety material that is appropriate for the local setting and makes it easily accessible.	Project works with community members, organizations, and businesses to adapt messaging to local setting and create new material. Heat Action Plans and outreach materials also identify ways to keep people safe from heat in the workplace.	

Community Resilience

OBJECTIVES		MEASURES (OF SUCCESS) or METRICS	
		NEGATIVE (-3)	NEUTRAL (0)
4.01	Support social cohesion, leadership capacity, and community social goals (for example, public health, education, and emergency response)	Process reinforces community mistrust of institutions (and even their neighbors). Small groups and organizations do not cooperate or coordinate with each other. People don't understand heat risk or their options for dealing with heat; educational materials are not accessible to the community and communication with community is absent or inadequate.	Community members work independently to achieve goals, without strategic coordination. As a result of poor community engagement there is a limited understanding of heat-health safety and the kinds of solutions that would reduce heat or help them cope.
4.02	Create effective emergency response plans and urban heat solutions that ensure community safety in the face of extreme heat events	No emergency plans exist or new emergency plans are ineffective and extreme climate events result in illness and loss of life. No supportive solutions have been implemented and the community is extremely susceptible to these events.	Emergency plans exist and are executed by government agencies but are not regularly reviewed or utilized by community members.
4.03	Support urban heat solutions that result in community and individual health co-benefits	Natural resource management or solutions cause negative impacts on community environment and health.	No solutions are implemented at all.
4.04	Build resilience of community members to heat exposure in their homes, and provide pathways for communities to advocate for accessible and affordable housing	Solutions that are planned and implemented increase vulnerability of community members. Solutions are not created by community members or with community members.	Solutions and plans do not address continued exposure to heat in homes. Air conditioning is not affordable or is inadequate. Cheap building materials and poor design of homes make people more vulnerable to heat. Homes are not up to code and are susceptible to high temperatures.
4.05	Implement urban heat solutions that support improved transportation options, improved quality of existing alternative transportation options, and accessibility of those options to under-resourced communities.	Changes to the current design of bus stops and other public transportation elements make them become less effective resulting in increased traffic, temperatures, and heat exposure.	The current design standards/guidelines stay in place.

Statement of Intent: Develop and implement heat action plans to support and improve social, physical, and ecological resilience in neighborhoods of Greater Phoenix.

MEASURES (OF SUCCESS) or METRICS			RATING
MODEST (+3)	STRONG (+5)	HIGHEST IMPACT (+10)	
People know each other and have gained some confidence in asking for/offering help. People have learned more about the risks of heat and extreme events, and they understand what kinds of strategies could be employed.	Community groups interact with other stakeholders. Data are freely available and used by various community groups to support decision-making about changes/development/etc. (For example, a system that helps people see where vulnerable people live in the community).	Plans are utilized by local community leaders and government to effect change. A governance structure rooted in the community guides the implementation of heat action plans. The community has agency and the capacity to take charge of its own plans. Plans strengthen the communities' understanding of itself, including how to support the most vulnerable residents.	
Community receives education about preparedness and emergency planning. They improve personal skills for identifying and adapting to heat-related hazards but lack the ability to coordinate with other groups and decision-makers.	Project results in a measurable reduction in illness and death associated with heat waves. The community has some capacity to adjust based on these events and coordinates with other community groups, municipal agencies and project team.	There are highly effective and coordinated community safety efforts in the face of extreme heat. Events are handled, effects are studied, and the community is able to make adjustments in the solutions they have adopted; flexibility is enhanced.	
Any strategies that are implemented are single-solution, not affording any co-benefits.	Strategies are implemented on a pilot project basis and offer a limited number of co-benefits to residents.	Scaled-up solutions to improve resilience to heat also provide physical and mental health benefits such as enjoyment of nature, attraction of birds, beauty, reduction of cooling costs, and resilience to flooding .	
Accessibility and affordability of air conditioning and weatherization are considered and built into plans. Design and building materials are improved, or regulations are in place to ensure that all new buildings use improved materials. Local shading by vegetation and shade structures are present for a small percentage of residents.	An increased percentage of homes or surrounding areas are improved as a result of solutions and heat action plans, but impact is not widespread throughout the neighborhood.	Funding is identified to implement community-identified solutions that contribute to indoor and landscape-level cooling. Clear lines of communication are available and understood to express concerns, know rights, and advocate for changes in rental properties, apartments, and surrounding landscapes. Long-term plan for neighborhood resilience is underway with funding and/or financing opportunities.	
New transit and street designs and guidelines related to thermal comfort are proposed and adopted, but they are not implemented at scale.	Barriers to creating shade and thermal comfort are addressed in city and county design, planning, and funding criteria. Highly vulnerable neighborhoods become a funding priority.	Policies are implemented for bus stops and lightrail platforms to incorporate shade structures that do not retain heat. The paths to transportation will be walkable in the summer supported by policies like Walkable Urban Code and Complete Streets. Highly vulnerable neighborhoods have the same degree of shading as others.	

Impact Area: _____

OBJECTIVES		MEASURES (OF SUCCESS) OR METRICS				
		NEGATIVE (-3)	NEUTRAL (0)	MODEST (+3)	STRONG (+5)	HIGHEST IMPACT (+10)
____.1						
____.2						
____.3						
____.4						
____.5						

This blank rubric is a space for collaboratively identifying an area of measurement and serves as a reference point for prioritizing benefits to undersourced communities and advancing justice and equity in conservation.

Comments

This guide was created for the Nature's Cooling Systems Project, a partnership of The Nature Conservancy, Arizona State University's Urban Climate Research Center and Urban Resilience to Extremes Sustainability Research Network, Maricopa County Department of Public Health, Central Arizona Conservation Alliance, Phoenix Revitalization Corporation, RAILMesa, Puente Movement, and Center for Whole Communities.