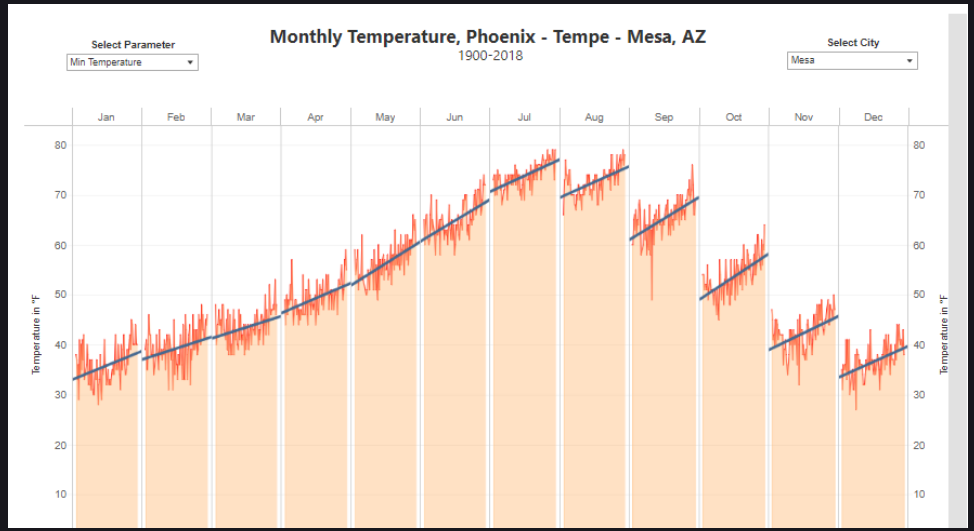
Heat Mitigation Through Native Vegetation

Presented by: Westwood High School

What is an Urban Heat Island?

- Urban structures tend to re-emit heat, and large areas create "heat islands".
- Structures trap heat during the day and don't cool down in the evening.



2. “Visualization: Temperatures in Maricopa County ,” Knowledge Exchange for Resilience (Arizona State University), accessed January 26, 2022, https://resilience.asu.edu/temperature.

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Why is this a Problem?

522

Deaths Due to Heat Related Causes in 2020

86°

Avg. Degrees Fahrenheit in Mesa

325

Days of Sun in 2021

75°-85°

Avg. Degrees Fahrenheit in Mesa at night

"Weatherspark.com," Mesa Climate, Weather By Month, Average Temperature (Arizona, United States) - Weather Spark, accessed January 26, 2022, https://weatherspark.com/y/2610/Average-Weather-in-Mesa-Arizona-United-States-Year-Round%E2%80%8B.

Solution

- Plant native trees and vegetation
  - Heat mitigation
  - Carbon absorption
  - Equity

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What Trees Should we Plant?

- The Mesquite Tree
  - Native to Arizona
  - Requires little water
  - Shade coverage with a span of 10 feet
  - Arizona Native trees use the Carbon Dioxide they consume to create more foliage than non-native plants

1. Lauren Waller and Warwick Allen, “Planting Non-Native Trees Accelerates the Release of Carbon Back into the Atmosphere,” The Conversation, November 16, 2021, https://theconversation.com/planting-non-native-trees-accelerates-the-release-of-carbon-back-into-the-atmosphere-139841.

Optimization

118, 204 → Trees needed to raise our city's tree equity score to 80%

x $251 → Amount needed to plant each tree (Mesquite)
By: Phoenix Trim-A-Tree LLC

$ 29,669,204 → Total amount

$ 5,933,840 → Amount per year if amount is spread out over 5 years

Do Trees Actually Work for Heat Mitigation?

Areas without greenspace are 5F to 3C warmer than areas with trees and plants.[1]

Table 3: Potential peak load reductions, annual energy savings, and annual monetary savings from boundary-layer and canopy-layer vegetative cooling in the Los Angeles Basin.

	Boundary-Layer	Canopy-Layer	Total
Physical effects	1 °C cooling	2 °C cooling, reduced wind speed, shading	
Peak load reduction	0.6 GW	0.3 GW	0.9 GW
Annual energy savings	0.3 BkWh/year	0.2 BkWh/year	0.5 BkWh/year
Monetary savings	$30 million	$20 million	$50 million

2

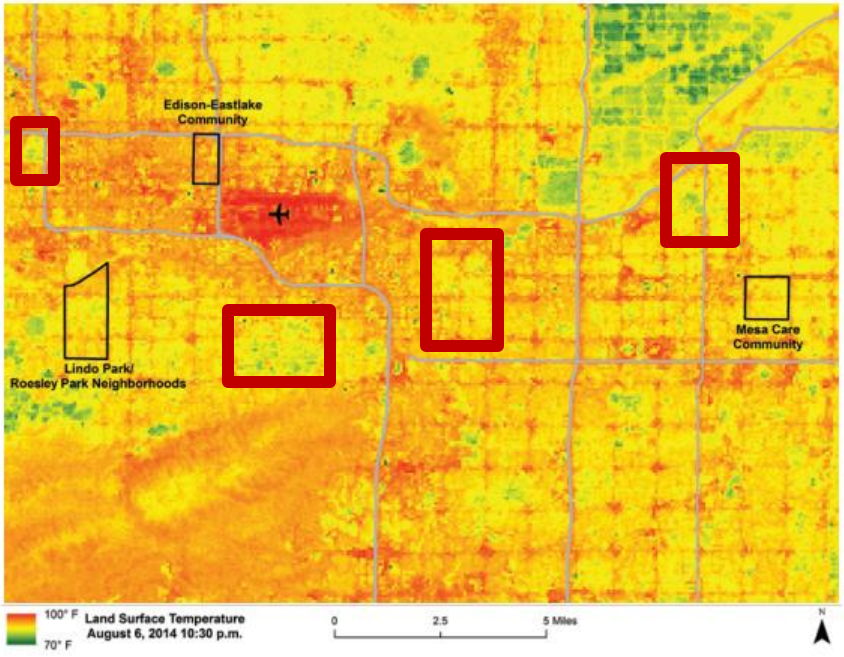
Total benefits	Ft. Collins	Cheyenne	Bismarck		
Energy	112,025	186,967	84,348		
CO_2	40,454	29,134	27,268	49,588	12,039
Air Quality	18,477	11,907	3,715	−20,635	32,571
Stormwater	403,597	55,297	496,227	215,648	37,298
Property increase	1,596,247	402,723	367,536	2,449,884	467,213
Total benefits	2,170,799	688,029	979,094	3,247,545	665,856
Total costs					
Planting	111,052	45,913	5,880	95,000	21,100
Pruning	405,344	84,677	94,850	770,000	88,412
Remove/dispo					
Im/liter/gm w					
Infrastructure					
Amin/inspect					
Total costs	997,638	327,897	316,640	2,372,000	276,456
Net benefits	1,173,161	358,133	662,454	875,545	389,421
BCRs	2.18	2.09	3.09	1.37	2.41

Total costs	997,638	327,897	316,640	2,372,000
Net benefits	1,173,161	358,133	662,454	875,545

3

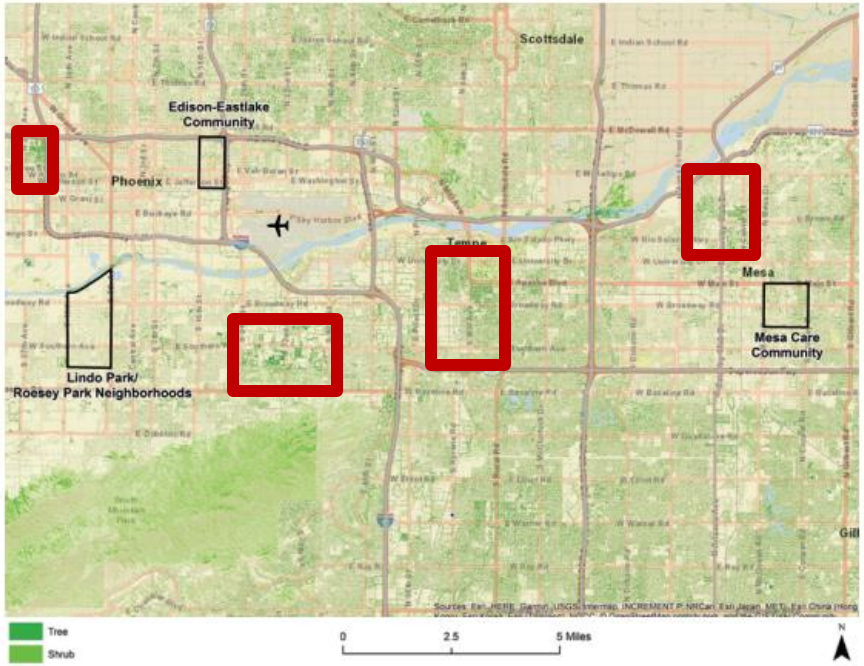
1. 1. Maricopa County, Department of Public Health. *Heat Action Planning Guide*. Nature's Cooling Systems Project, 2017.
2. 2. Kurn, D., S. Bretz, B. Huang, and H. Akbari. 1994. The Potential for Reducing Urban Air Temperatures and Energy Consumption through Vegetative Cooling (PDF) (31 pp, 1.76MB). ACEEE Summer Study on Energy Efficiency in Buildings, American Council for an Energy Efficient Economy. Pacific Grove, California.
3. 3. McPherson, E.G., J. R. Simpson, P. J. Peper, S. E. Maco, and Q. Xiao. 2005. Municipal forest benefits and costs in five US cities (PDF) EXITEXIT EPA WEBSITE (6 pp, 267K). *Journal of Forestry* 103(8):411–416

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



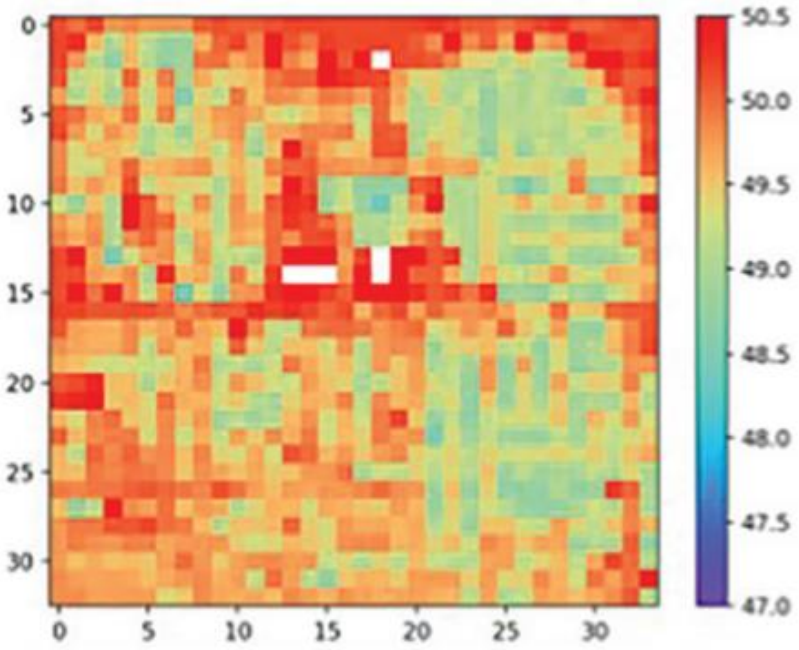
Source: NASA LANDSAT satellite imagery

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



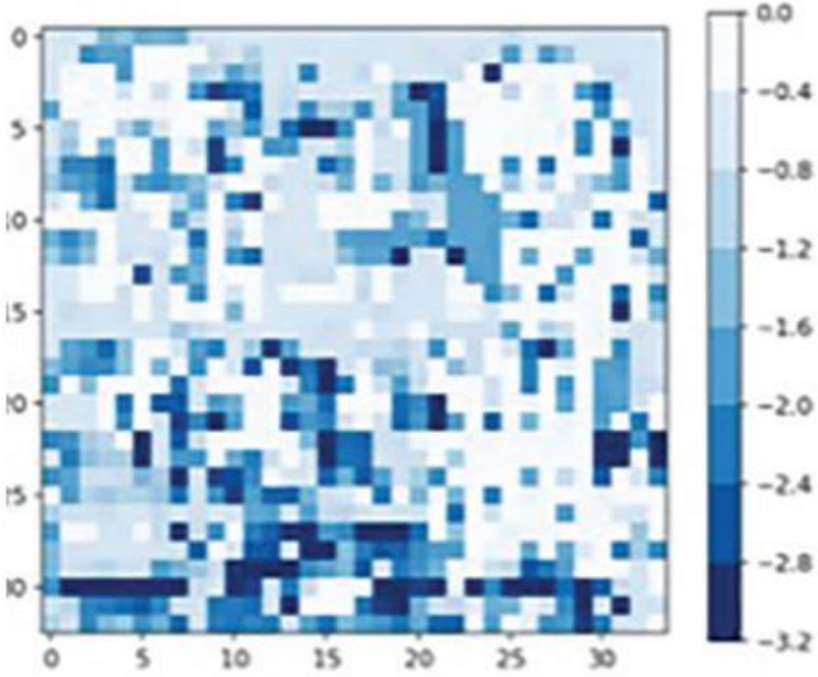
Source: CAP LTER land cover classification using 2010 National Agriculture Imagery Program (NAIP) Imagery

Baseline



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

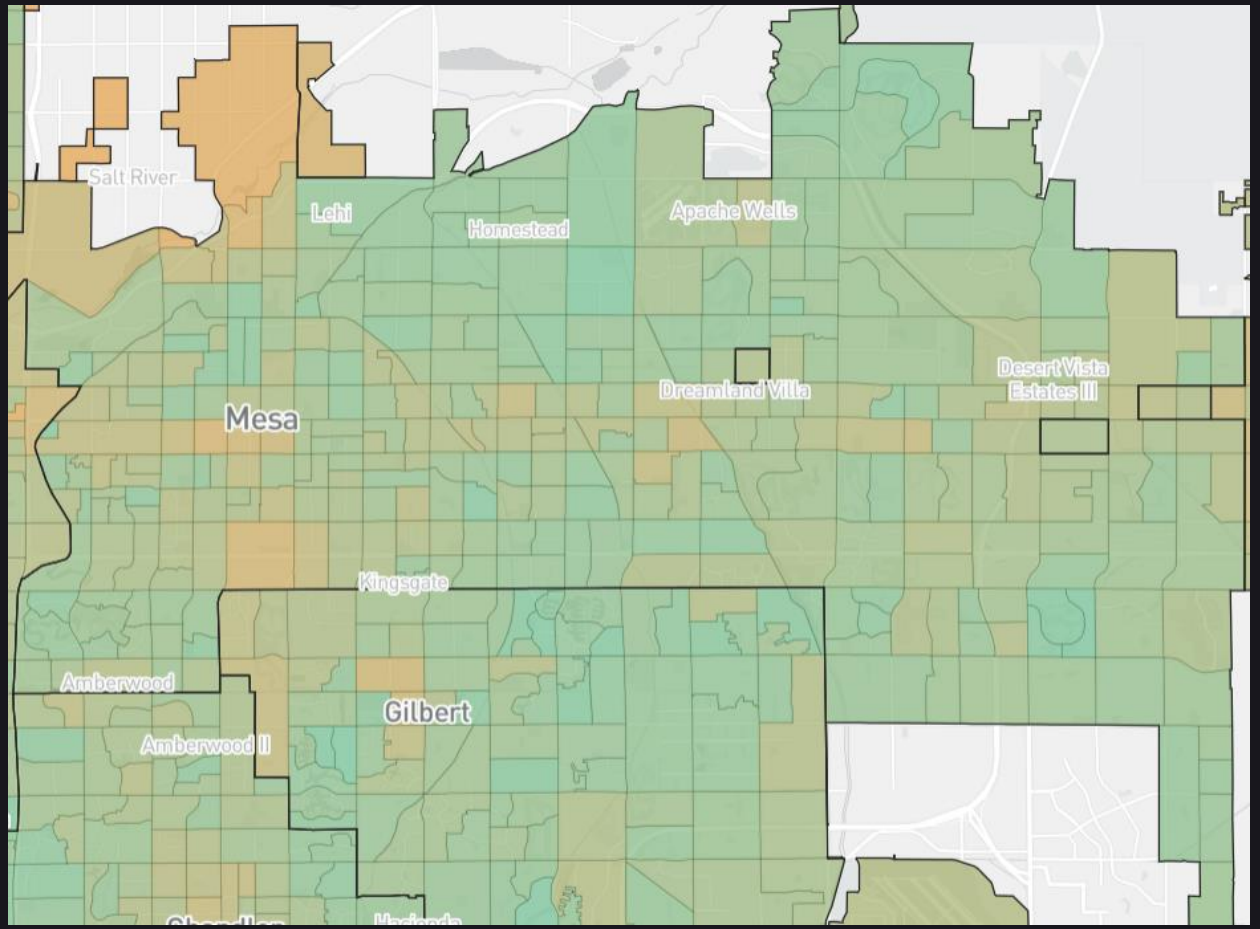
Cooling Scenario



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

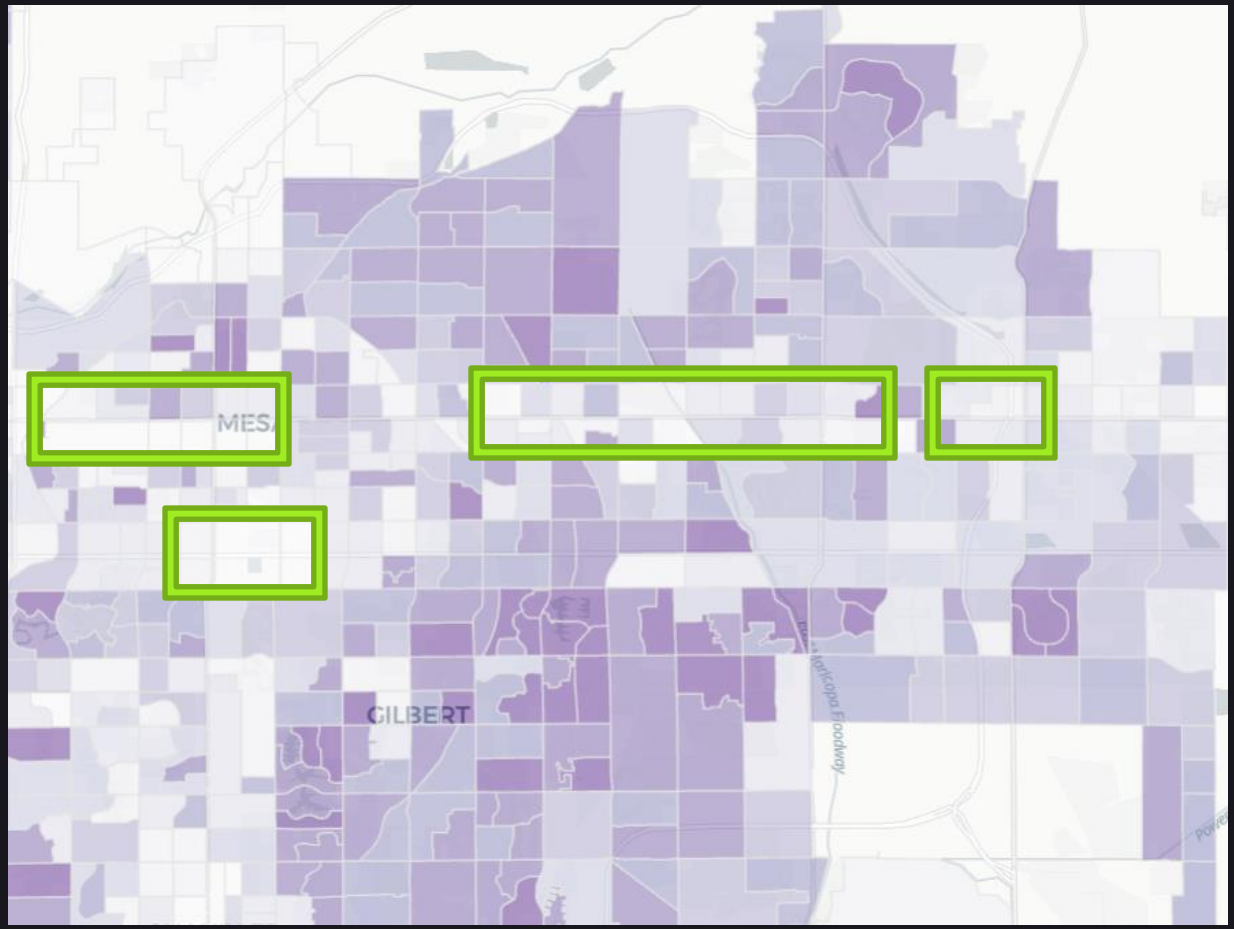
Tree Equity Score

- Scores
  - Coverage
  - Neighborhood demographics
  - Equity



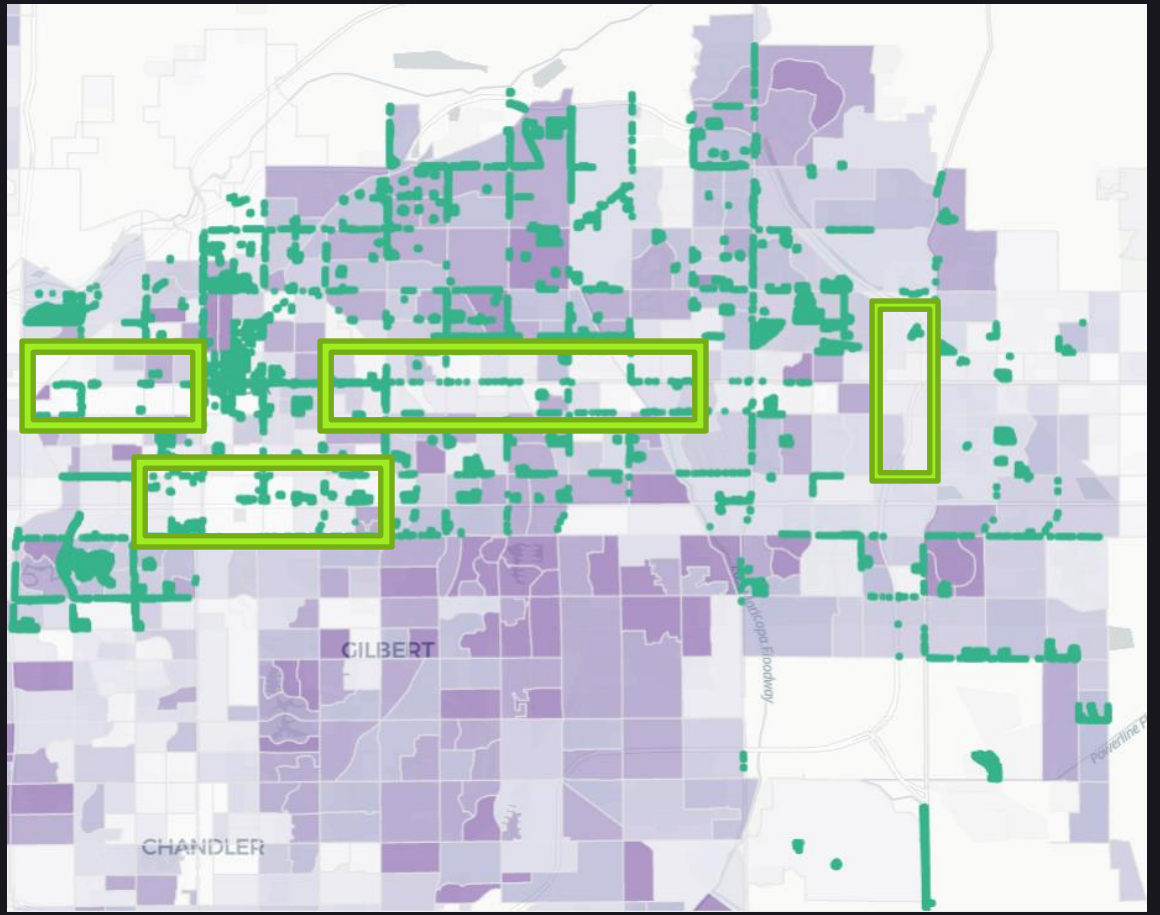
Tree Equity Score

- Our Visualization
  - Carto

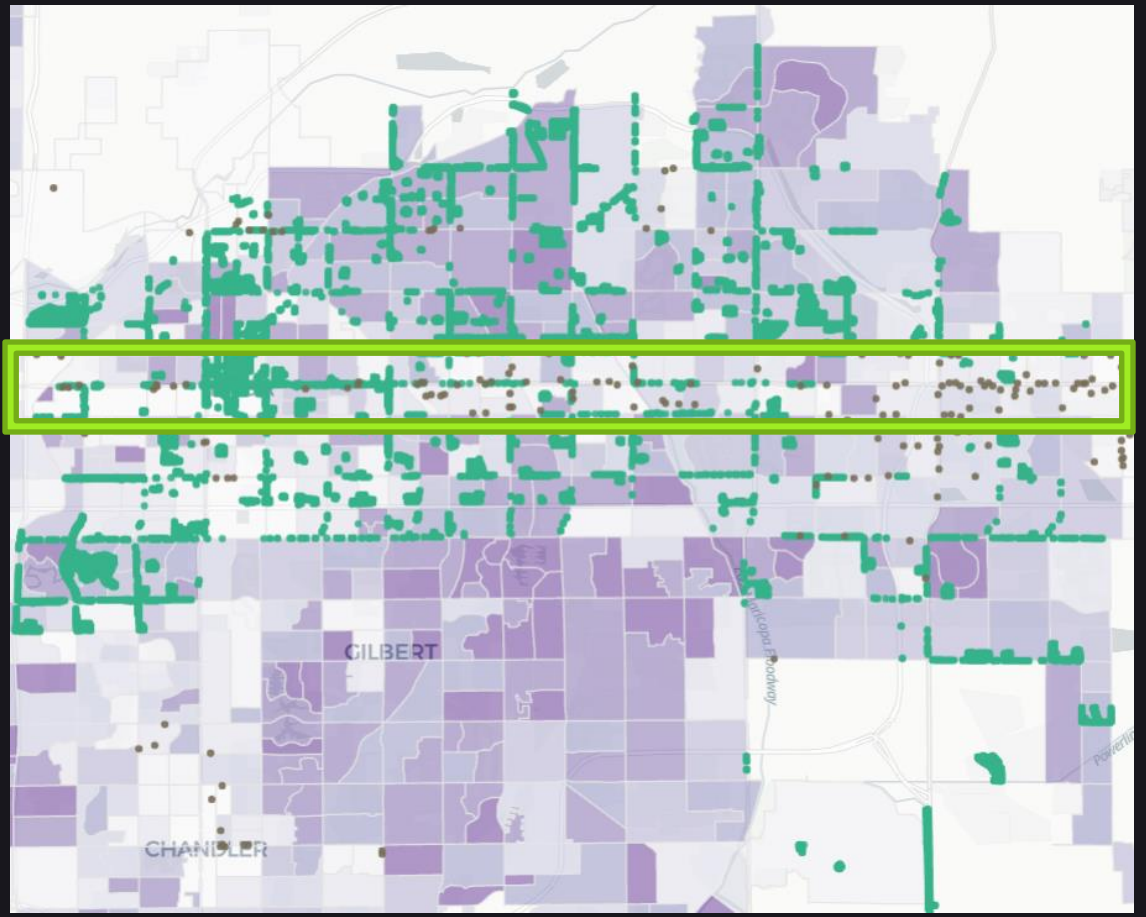


City Trees

- All known trees
  - Departments



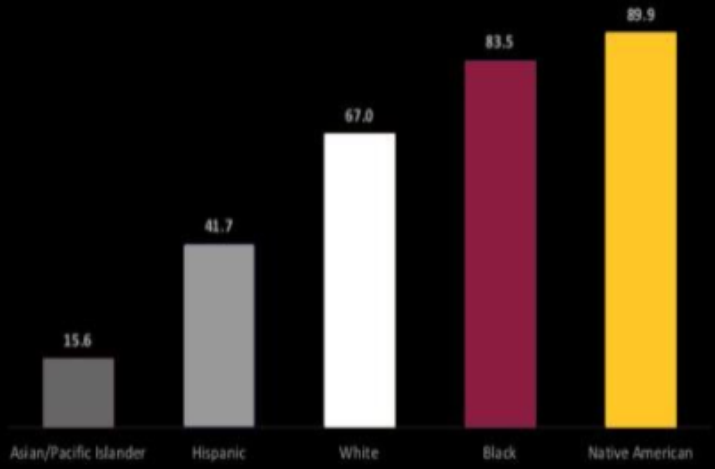
Where Do We Start?



Most women died indoors

Most men died outdoors

7 in 10 were at least 50 years old



Black and Native American Arizonans are disproportionately represented among all heat-associated deaths

Despite that 5% of housing is mobile homes, trailer residents make up 40% of indoor deaths

37% of outdoor deaths in 2019 without shelter

Thank You