



Adapting to Extreme Heat in Urban Areas of the Desert Southwest

Local Drought Impact Group
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Pima County Department of Environmental Quality

Green Infrastructure Principles

Reduce volume of runoff

- Simulating natural runoff (& infiltration)
- Reducing peak flows during storm events
- Watering the ecosystem

Improve surface water quality by:

- Using natural chemical processes
- Using natural biological processes

Mitigate Urban Heat Island effect

- Lower temperatures
- Lower power consumption of buildings

Improve urban living space:

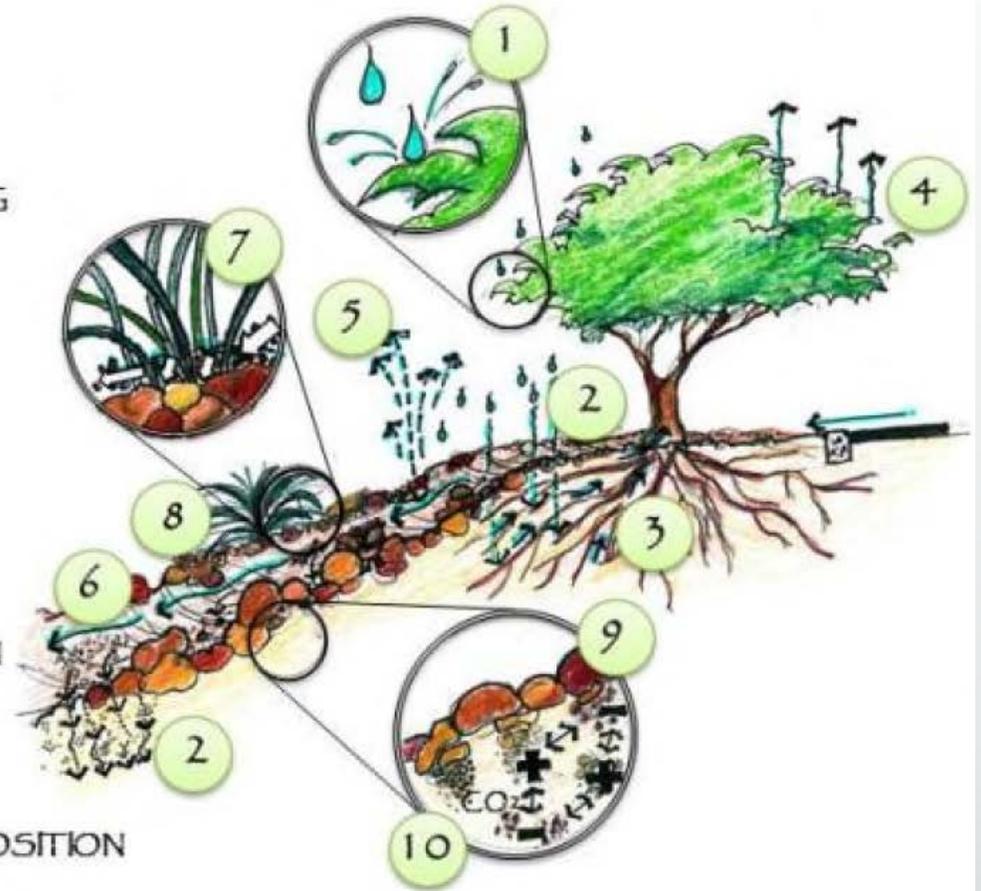
- Add greenery
- Reduce air pollution
- Reduce noise
- Increase property values



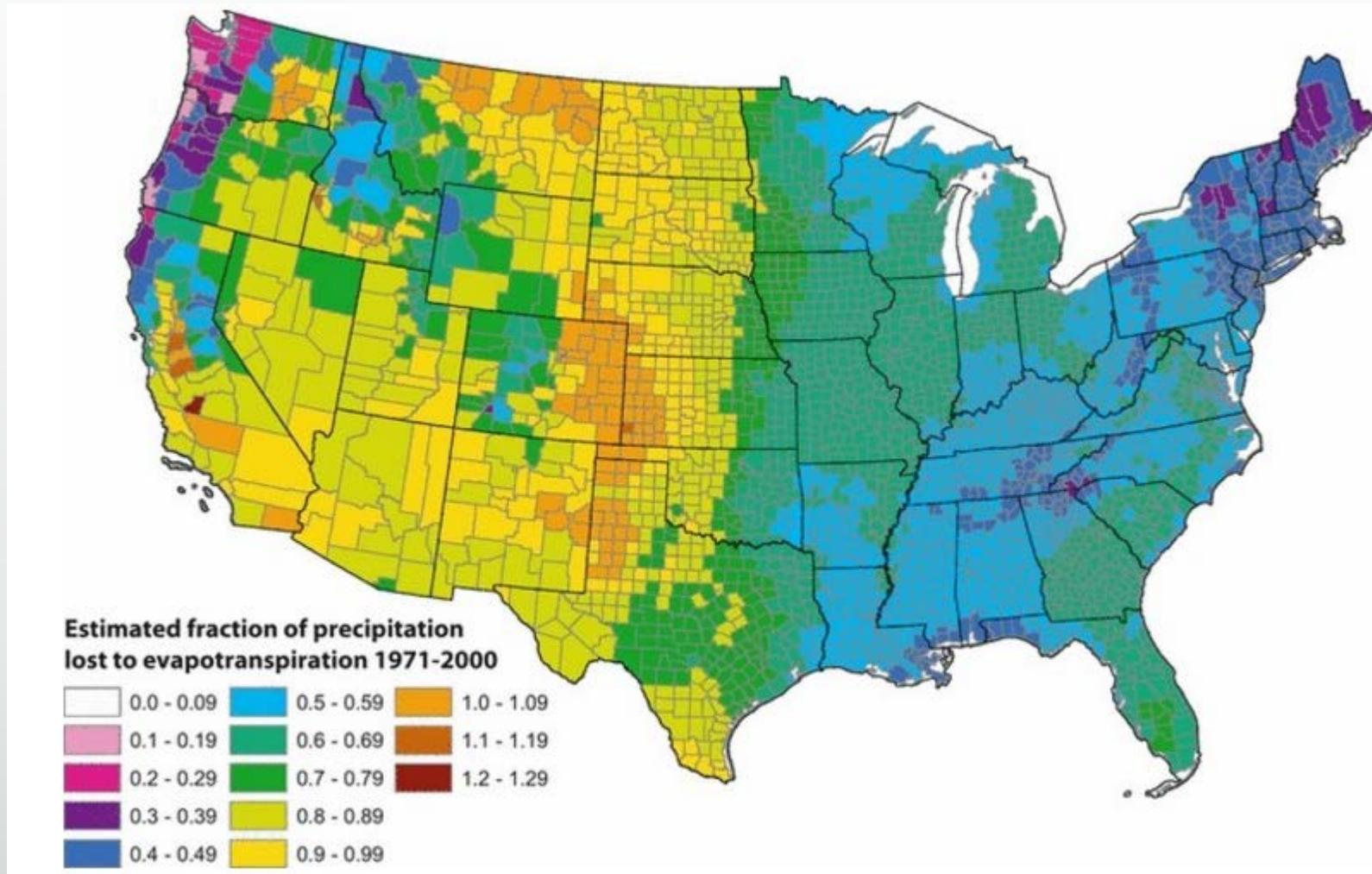
Natural Processes Enhanced by Green Infrastructure Features

KEY

- 1 INTERCEPTION
- 2 INFILTRATION
- 3 NUTRIENT RECYCLING
- 4 TRANSPIRATION
- 5 EVAPORATION
- 6 SEDIMENTATION
- 7 FILTRATION
- 8 ENERGY DISSIPATION
- 9 SOIL REACTIONS
- 10 MICROBIAL DECOMPOSITION



GI is different when Evaporation > Precipitation

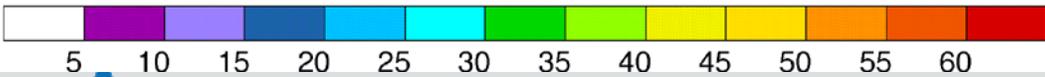
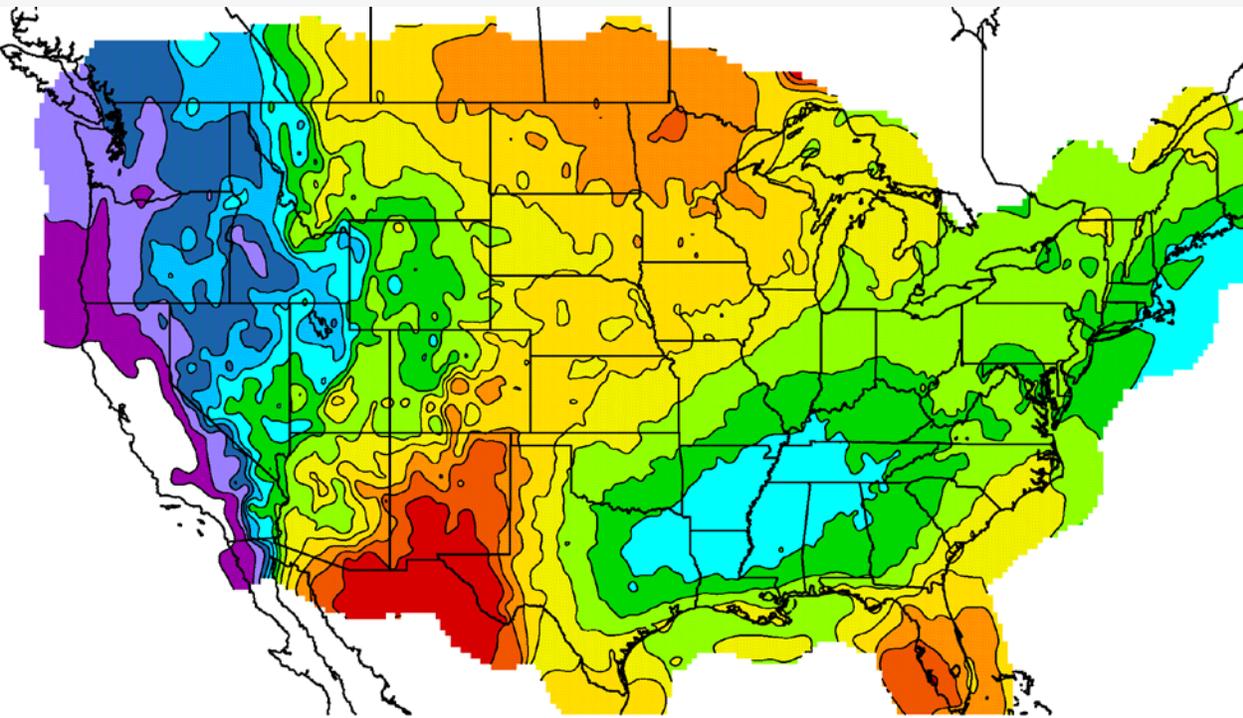


West's aesthetic is different from East's

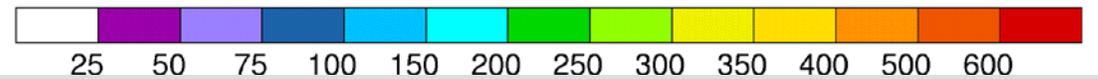
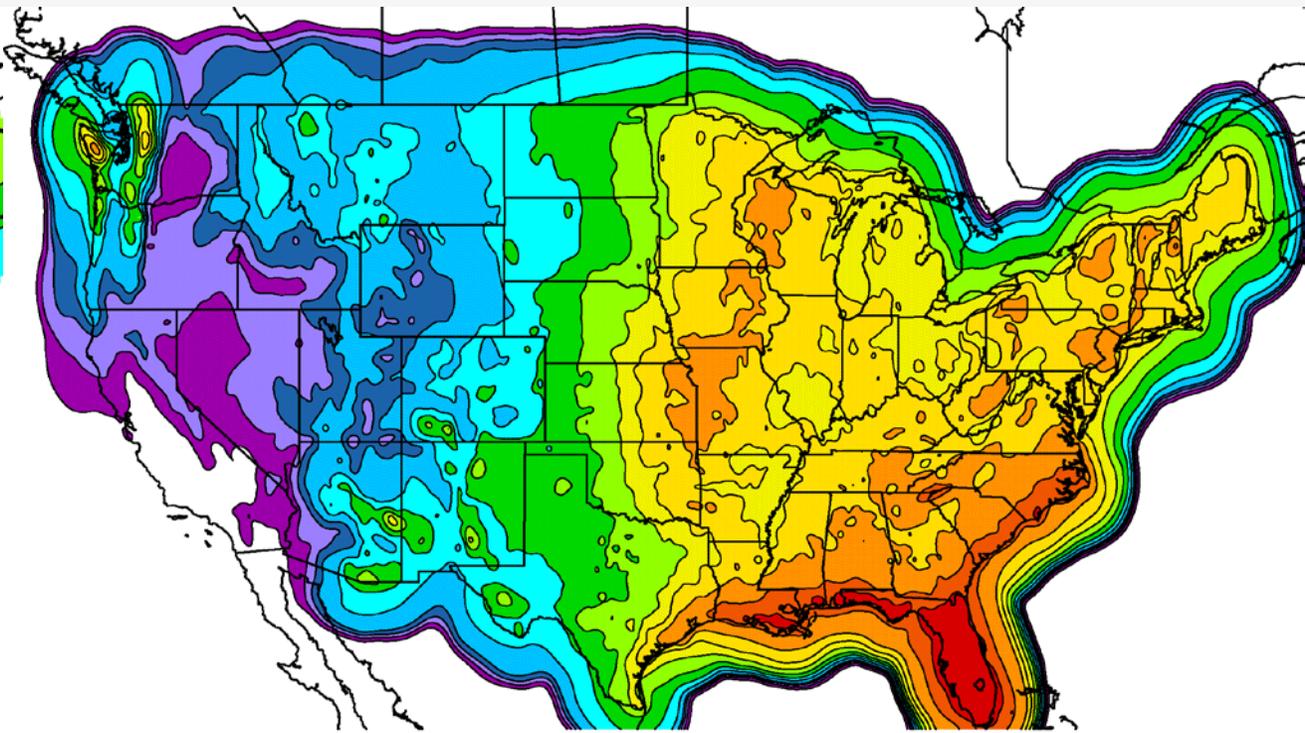


Rainfall Patterns

Percent of Precipitation during Warm Season (June 16 – Oct 15)



Percent of annual rainfall



Total rainfall during warm season

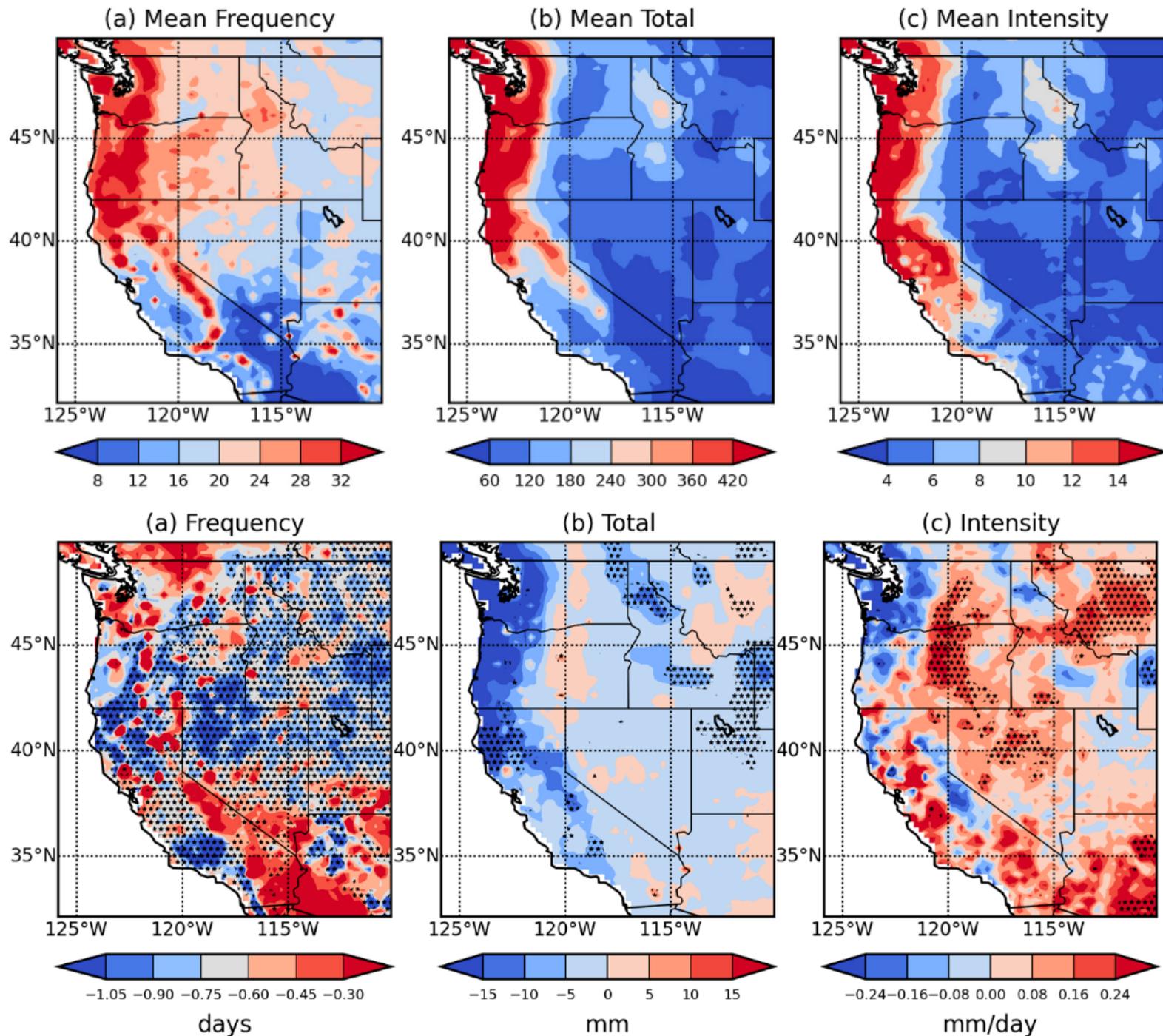


Rainfall Patterns Winter Rainfall (Dec 01 – Feb 28)

Change* in winter rains 1999-2016

- Hatch = statistically significant

Spatial and Temporal Variability in Winter Precipitation across the Western United States during the Satellite Era. Nash, et al (2017)



Green Infrastructure Features

Basins
Swales
Bioretention
Trenches
Cisterns
Porous surfaces
Dry Wells

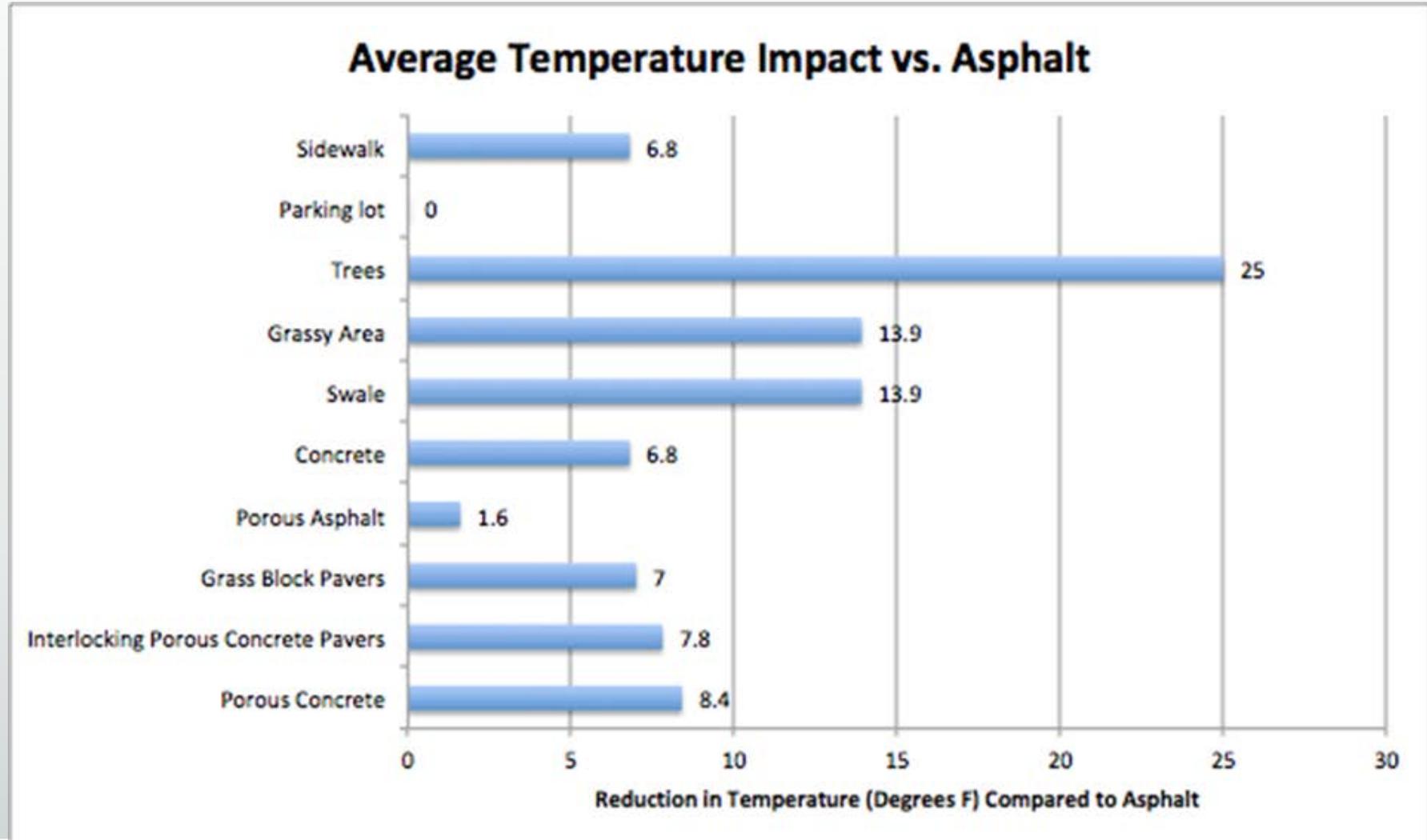


Sustainable Designs add Coolness

- Canopy shade reduces temperature
 - Walls and roofs by 20 - 40°F
 - Vines on walls by 36°F
 - Inside a parked car by 45°F
- Plant ET educes air temperature
 - Open terrain by 9°F
 - Suburbs without trees 4 - 6°F



Temperature changes due to land cover change



Resources

Guidance manuals
Policies
GIS tools



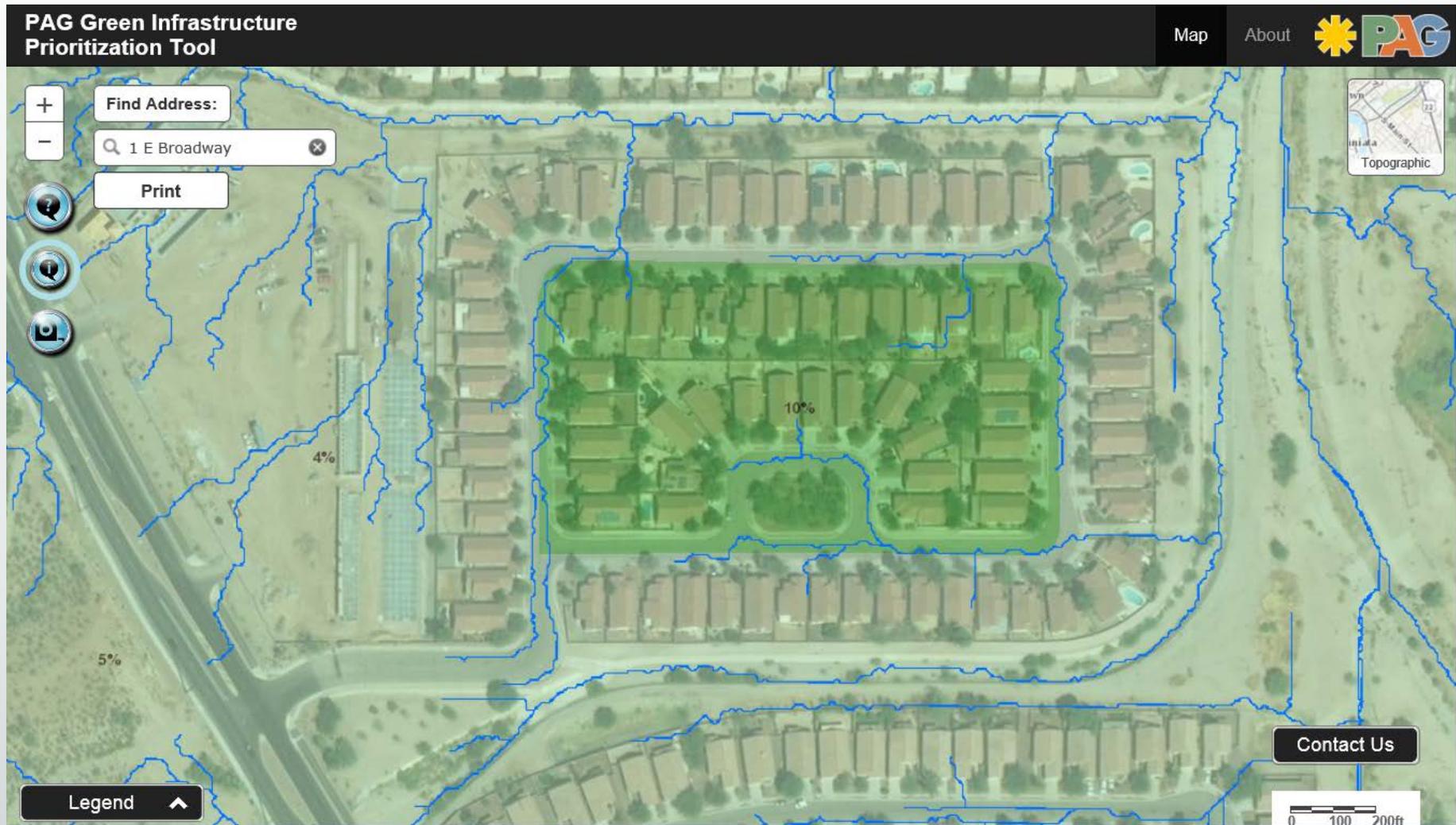
Board of Supervisors Memorandum

June 6, 2017

Resolution 2017~~39~~³⁹ Reaffirming Pima County's Commitment and Efforts to Address Climate Change

On June 1, 2017, President Donald Trump announced his decision to withdraw the United States (US) from the Paris Climate Accord, a nonbinding agreement signed by 195 countries that directs each nation to develop their own plans to reduce greenhouse gas emissions with the goal of limiting global temperature increases to 1.5° C above pre-industrial period levels. President Trump directed the federal government to immediately "cease all implementation of" the agreement and to use the official withdrawal process outlined in the agreement, which could take up to four years to complete.

GIS Tool showing flow paths



Moody's Investor Services – Nov 19, 2017

- What are you doing to mitigate exposure to physical effects of climate change?
 - Share of economic activity from coastal areas
 - Extreme weather damage as share of economy
 - Share of homes in flood plain
- Credit rating for states and local bonds will change
- States with greatest risk
 - Texas
 - Florida
 - Georgia
 - Mississippi

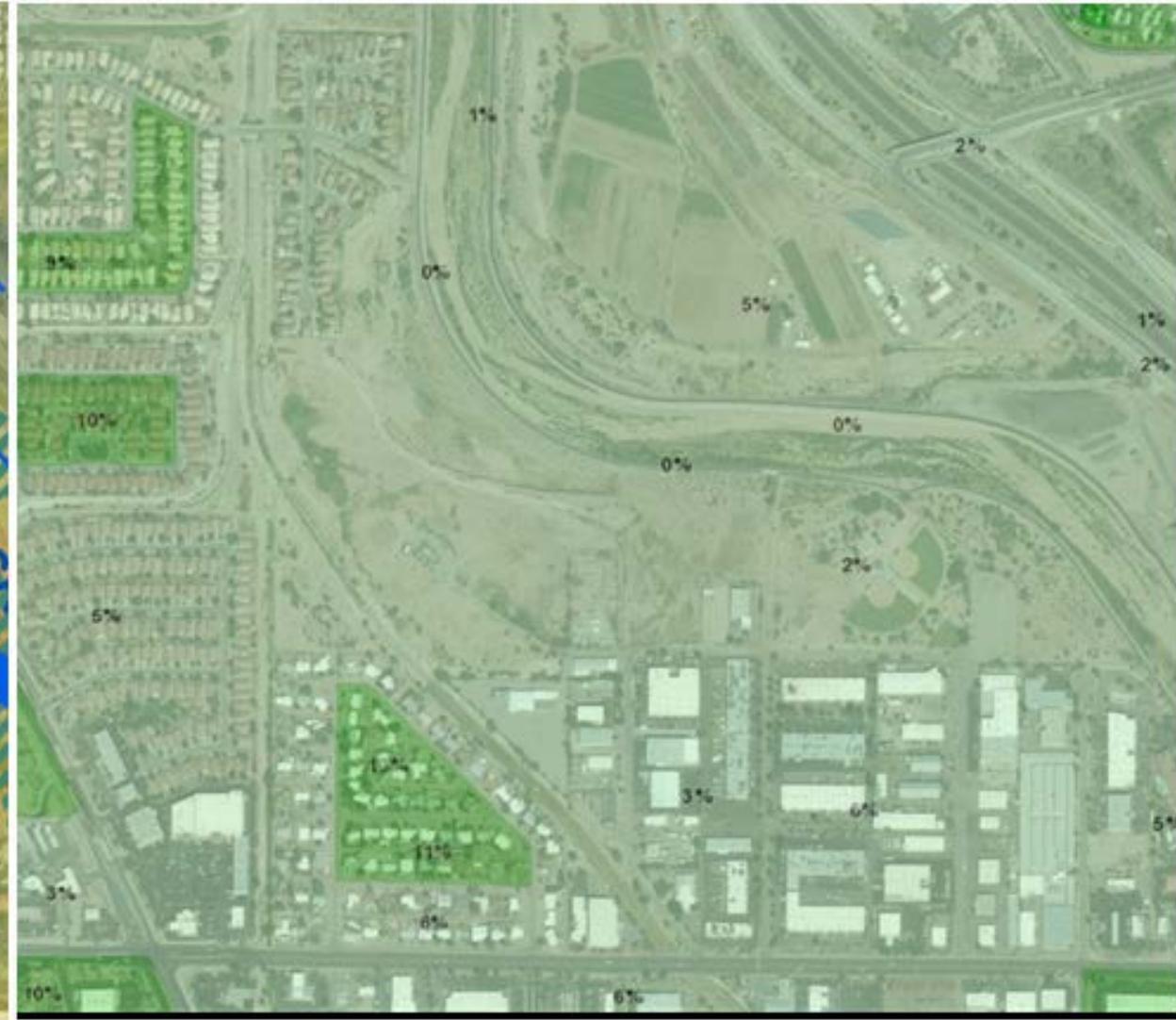
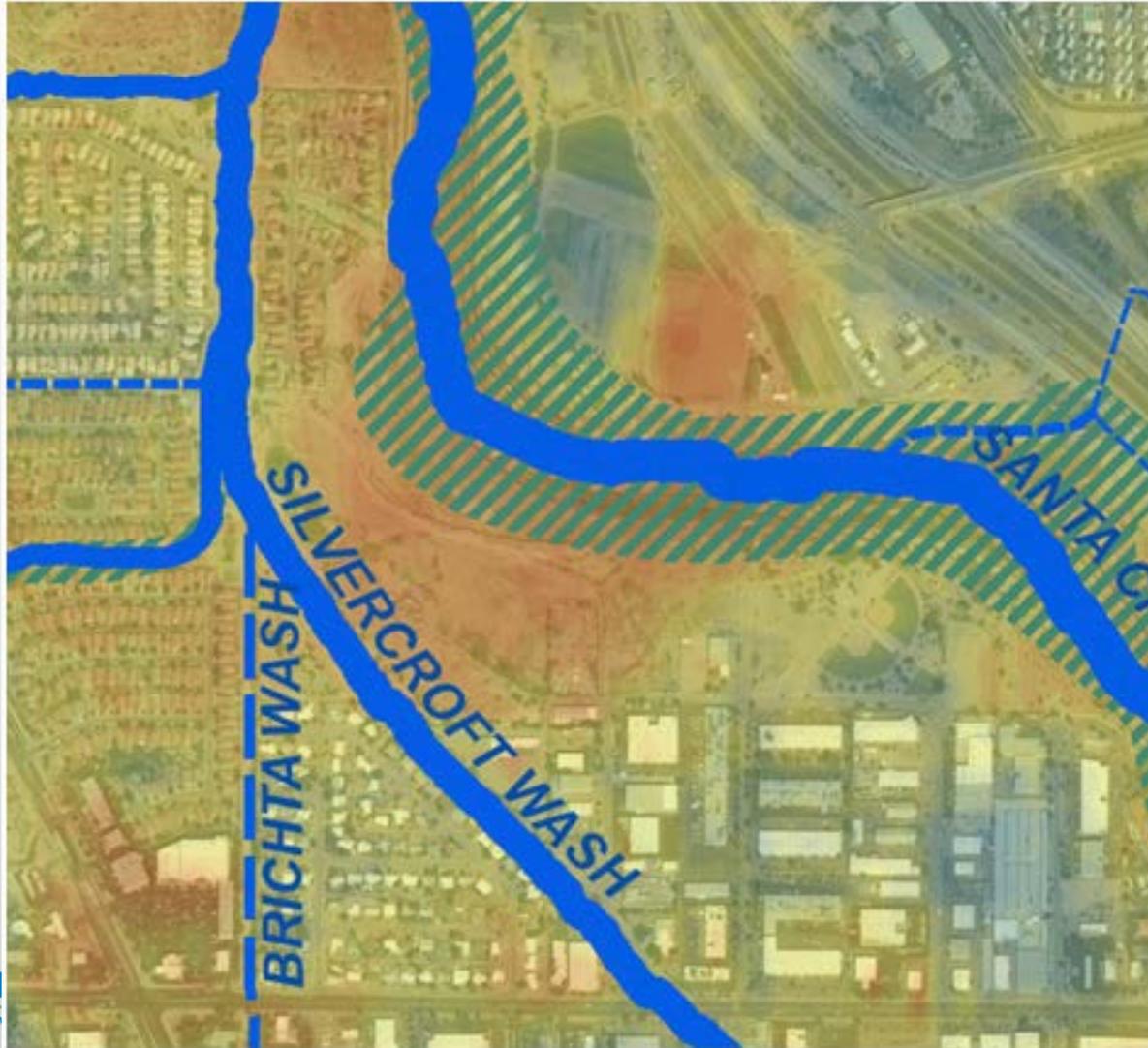
Evaluating Return On Investment (ROI)

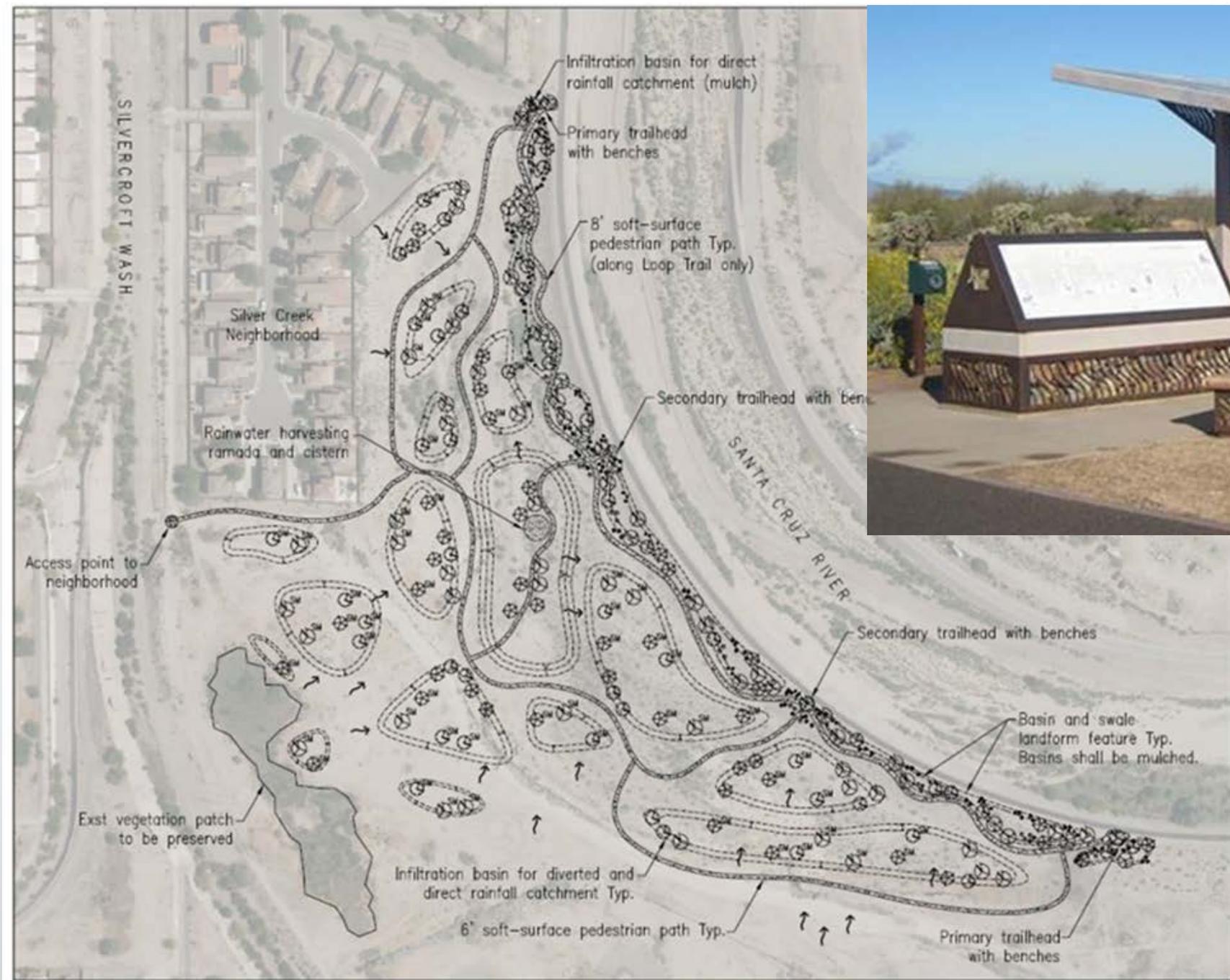
- Evaluate ROI given ability to address:
 - Increased temperature
 - Altered rainfall patterns causing either drought or flooding
 - Municipality mission and goals
- Tools:
 - Autocase
 - PAG Green Infrastructure Prioritization Tool
 - <https://gismaps.pagnet.org/PAG-GIMap/default.aspx>

Return on Investment - Meander Bend Park

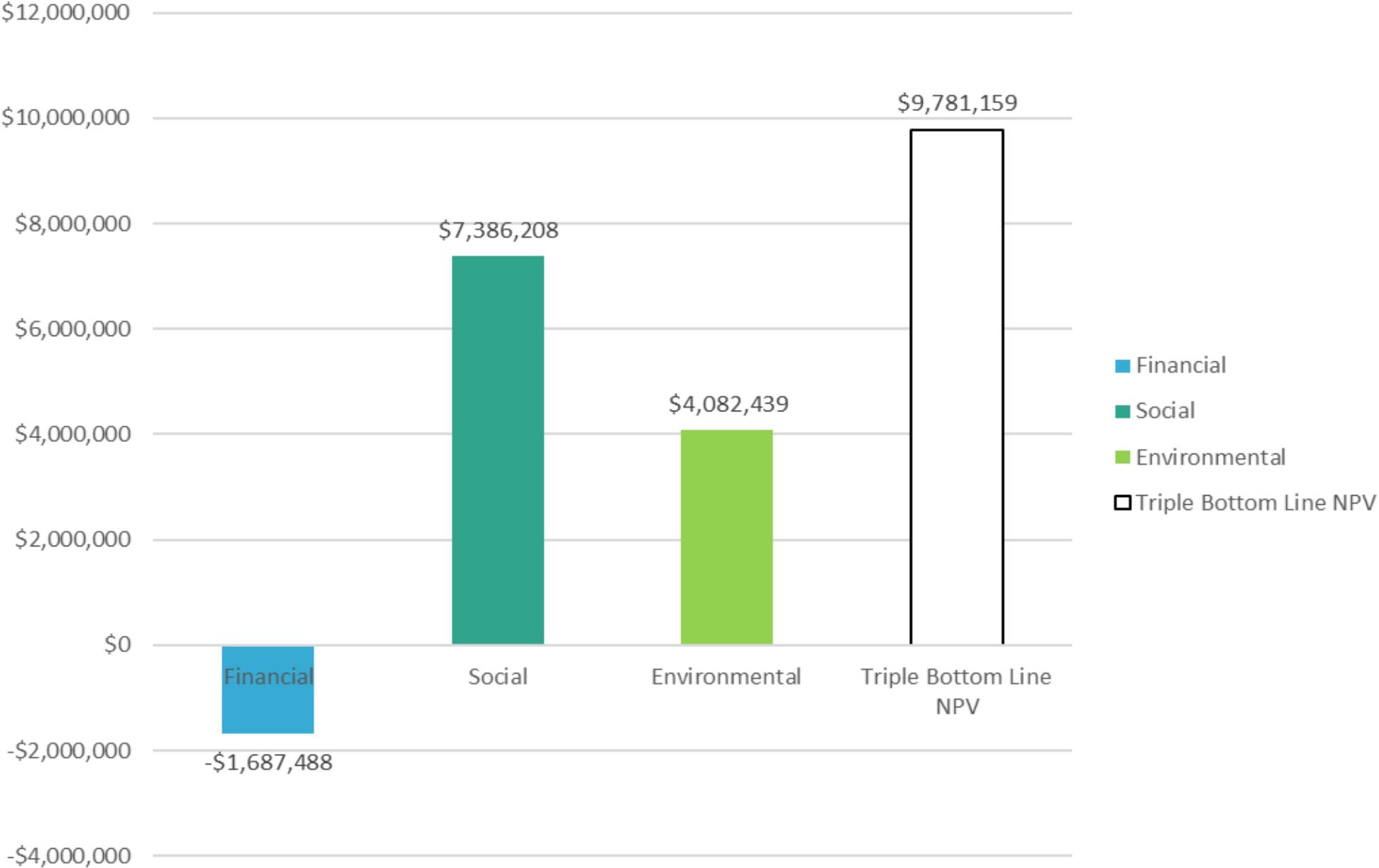
Regional Temperature

Canopy Density





Meander Bend Park TBL-CBA Results (\$2018)



Social Cost/Benefits

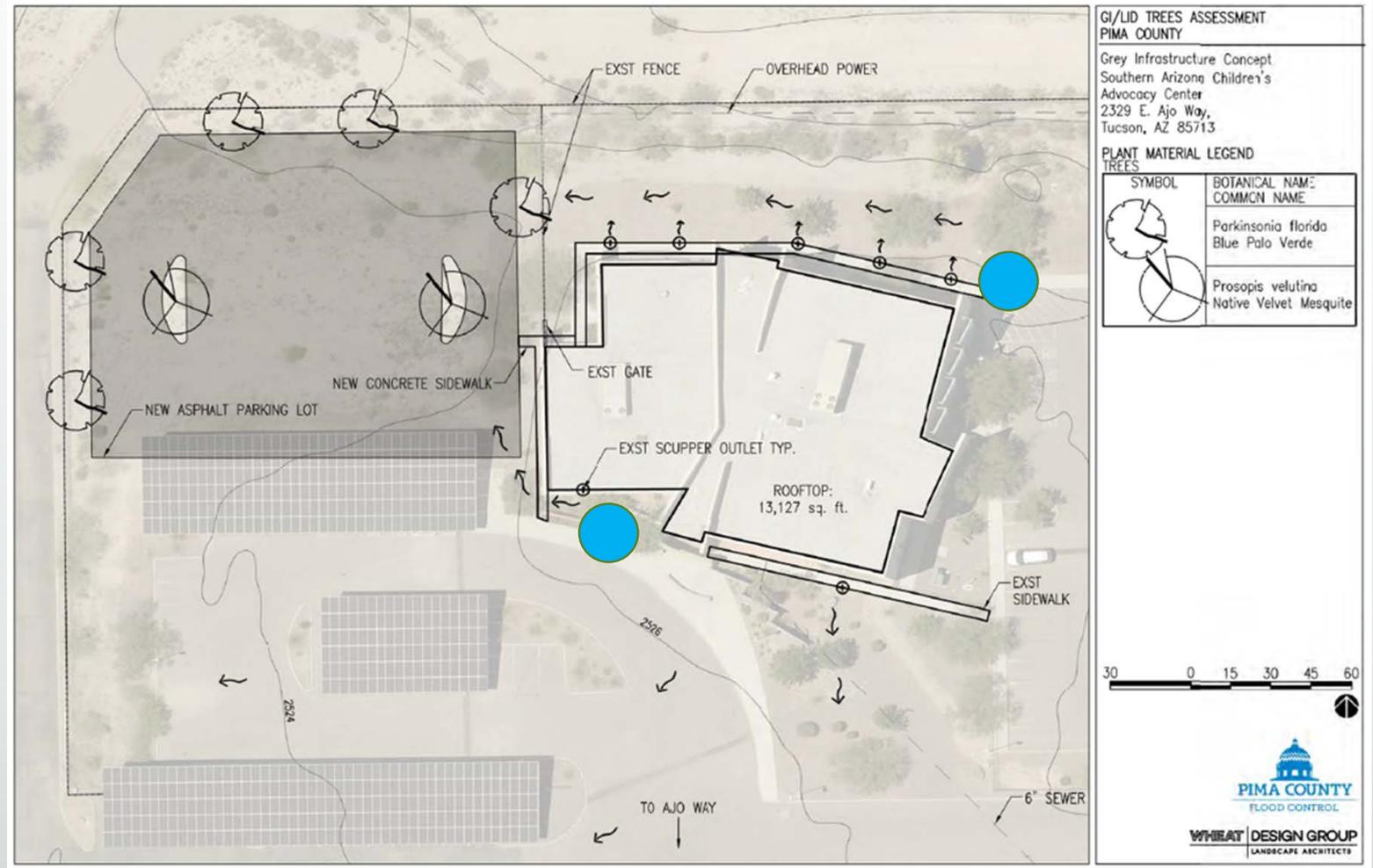
Cost/Benefit	Mean Value	2.5% confidence	97.5% confidence
Other Benefits	\$0	\$0	\$0
Flood Risk	\$100,913	\$100,913	\$100,913
Property Value	\$1,159,372	\$651,931	\$1,708,405
Education	\$16,149	\$9,388	\$24,516
Recreational Value	\$3,721,554	\$3,721,554	\$3,721,554
Public Health	\$38,012	\$6,879	\$86,165
Food	\$523,563	\$314,602	\$735,216
Social Value of Water	\$0	\$0	\$0

Environmental Cost/Benefits

Impact	Mean Value	2.5% Confidence	97.5% Confidence
Water quality	\$55,889	\$55,889	\$55,889
Concrete Carbon Emissions	\$0	\$0	\$0
Air Pollution: Vegetation	\$328,524	\$243,049	\$414,799
Carbon Reduction: Veg.	\$20,154	\$7,906	\$35,648
Air Pollution: Energy Use	\$25,970	\$13,270	\$41,597
Energy Use C Emissions	\$3,132,994	\$1,223,733	\$5,553,594
Habitat	\$385,145	\$385,145	\$385,145
Pollination	\$133,763	\$133,763	\$133,763

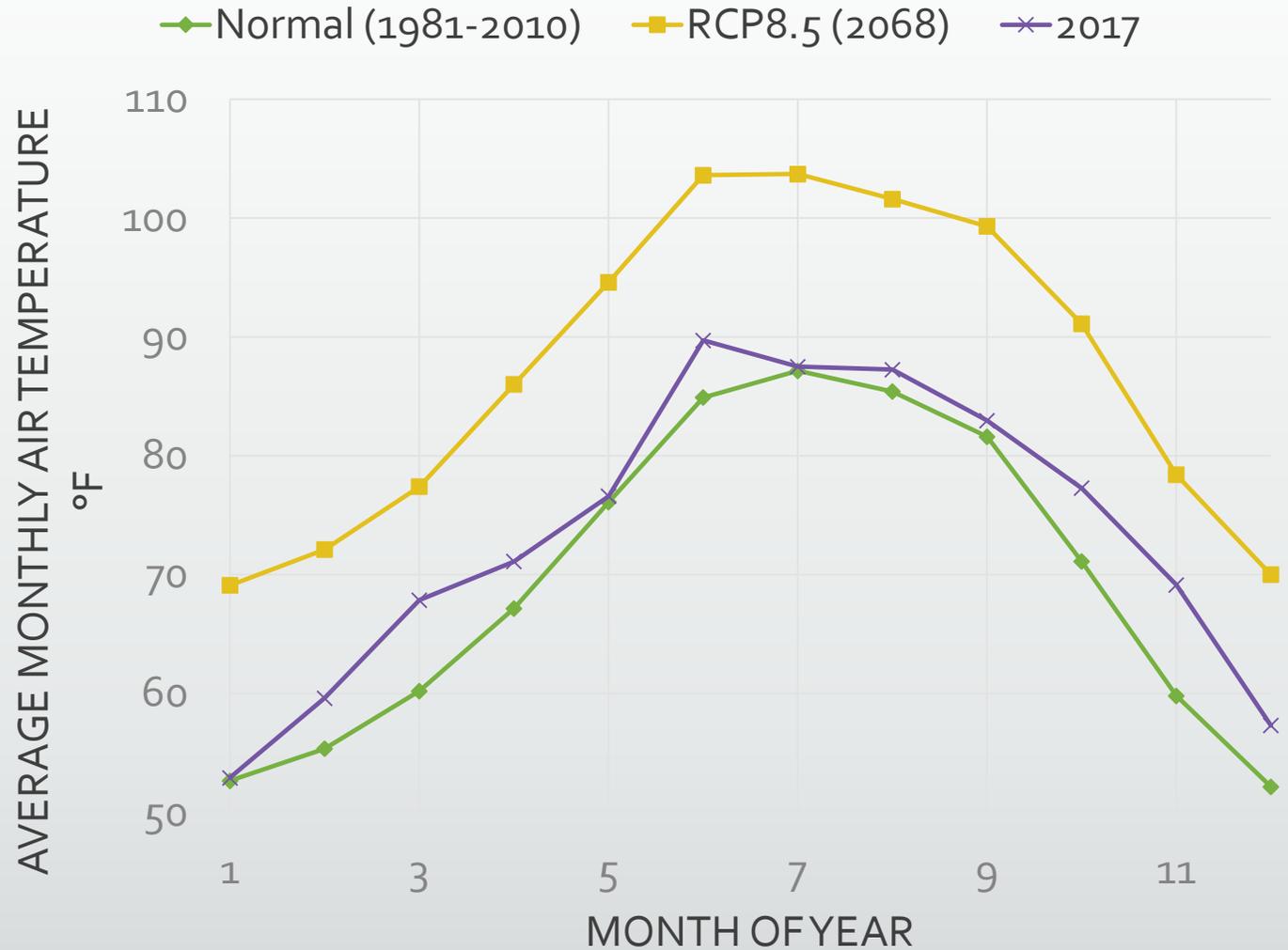
Design Emergency Irrigation: Preserve Shade Infrastructure

- Truck delivered water
- Curb Access 
- Gravity flow

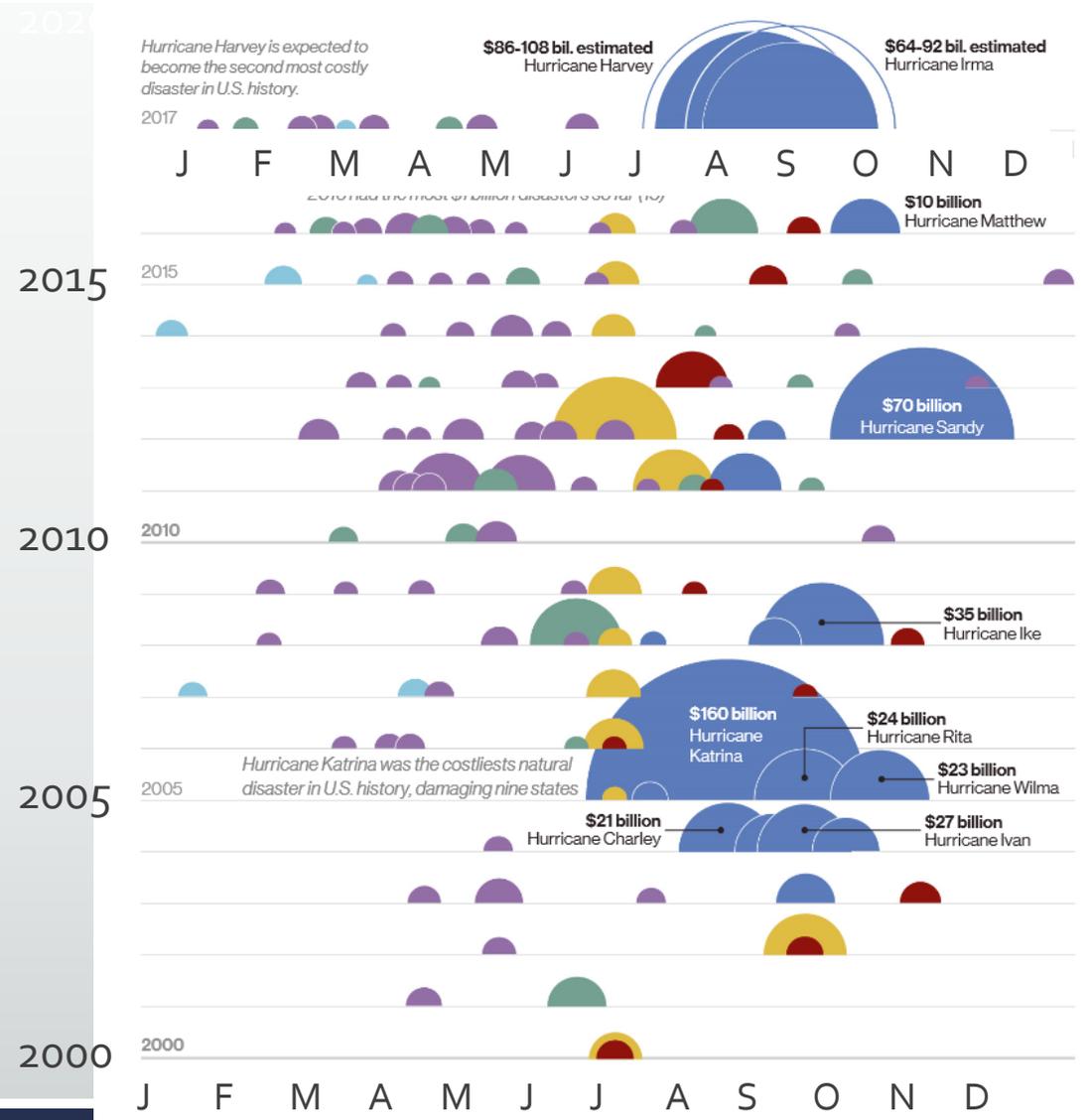
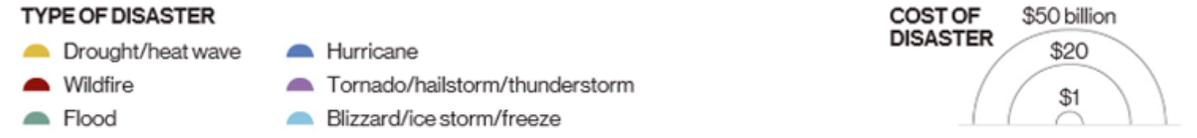
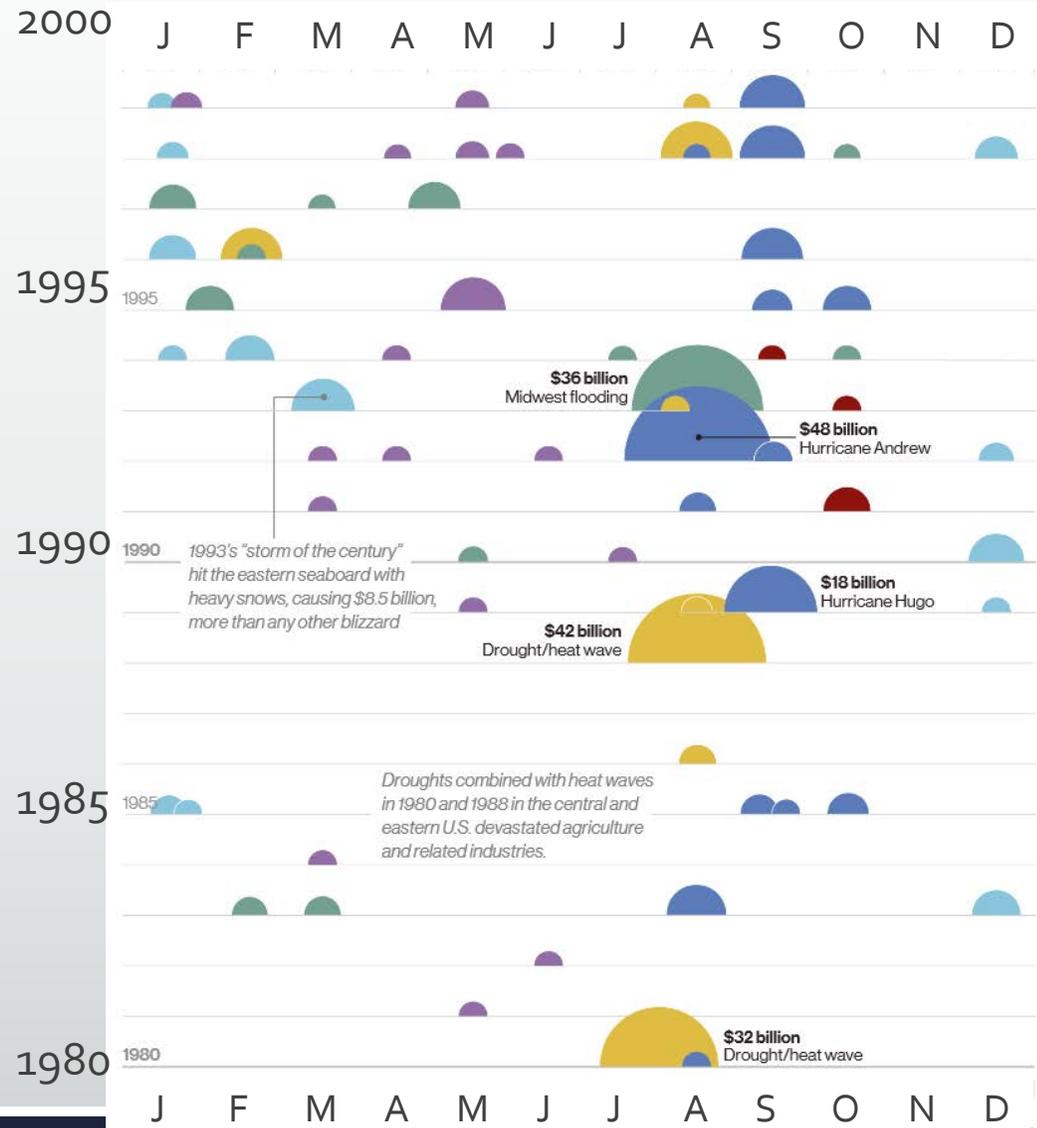


AIR TEMPERATURES FOR URBAN HEAT ISLAND IMPACTS

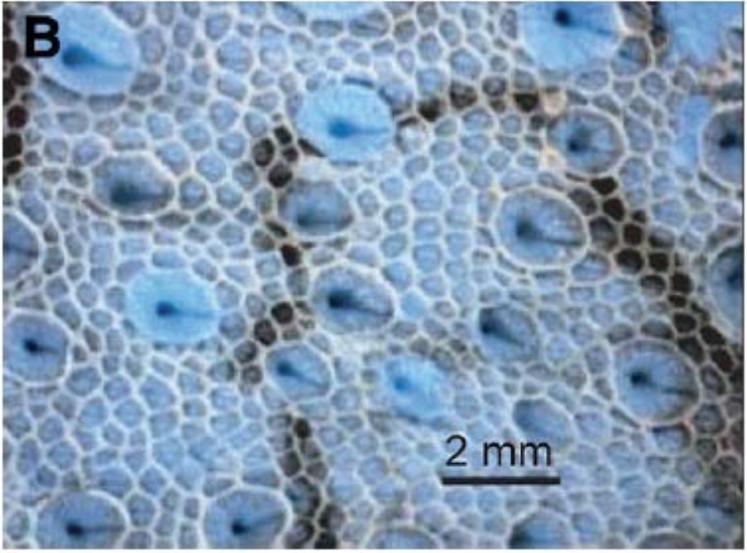
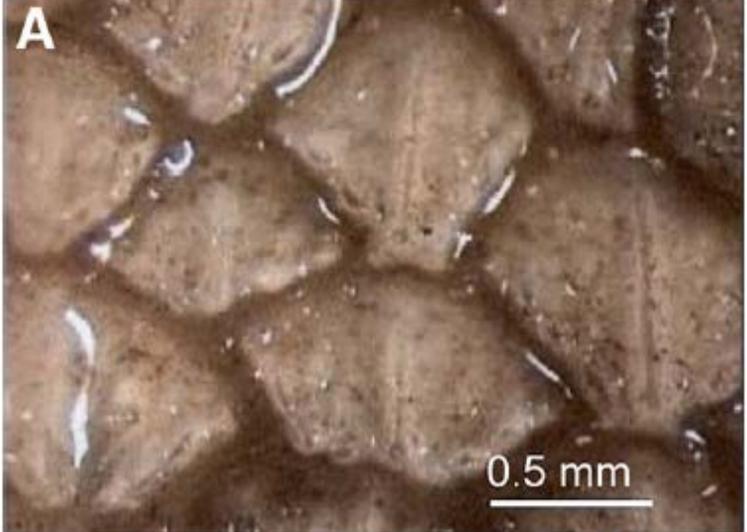
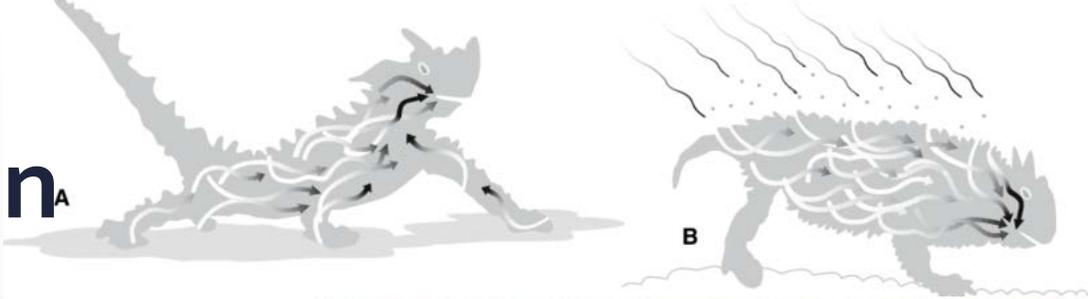
Climate	Low UHI	Med UHI	High UHI
Stationary	\$653,006	\$948,074	\$1,226,916
RCP8.5	\$1,255,961	\$1,826,645	\$2,374,508
Change	95%	95%	95%



Cost of Extreme Weather



Horned Lizards harvesting rain^A



Partnerships

Julie Robinson: Resolution by elected officials to build GI

Evan Canfield: GI life-cycle costs

Mead Mier: GI Prioritization Tool using GIS

Irene Ogata: Importance of UHI Impacts

Jessie Byrd: Growing native plants from seeds

Eve Halper: BOR Basin Study

Chris Castro: Modeling local climate change

LID Working Group:

LID Guidance Manual

Case Studies

