Thoughts on Green Infrastructure: An Invitation to Growing Oases

by Brad Lancaster

www.HarvestingRainwater.com

www.DesertHarvesters.org

Have you ever experienced a true *living* oasis?

What was it like for you?

What did it enable?

Did you have a role in it?

Oasis

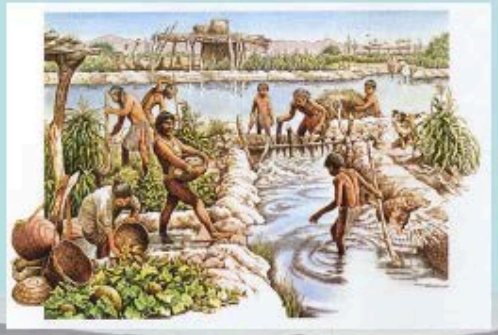
Oasis

Photo credit: Kevin Schraer

Oasis

The Ancient Oasis

4,000 Years of Agriculture and Irrigation in Tucson

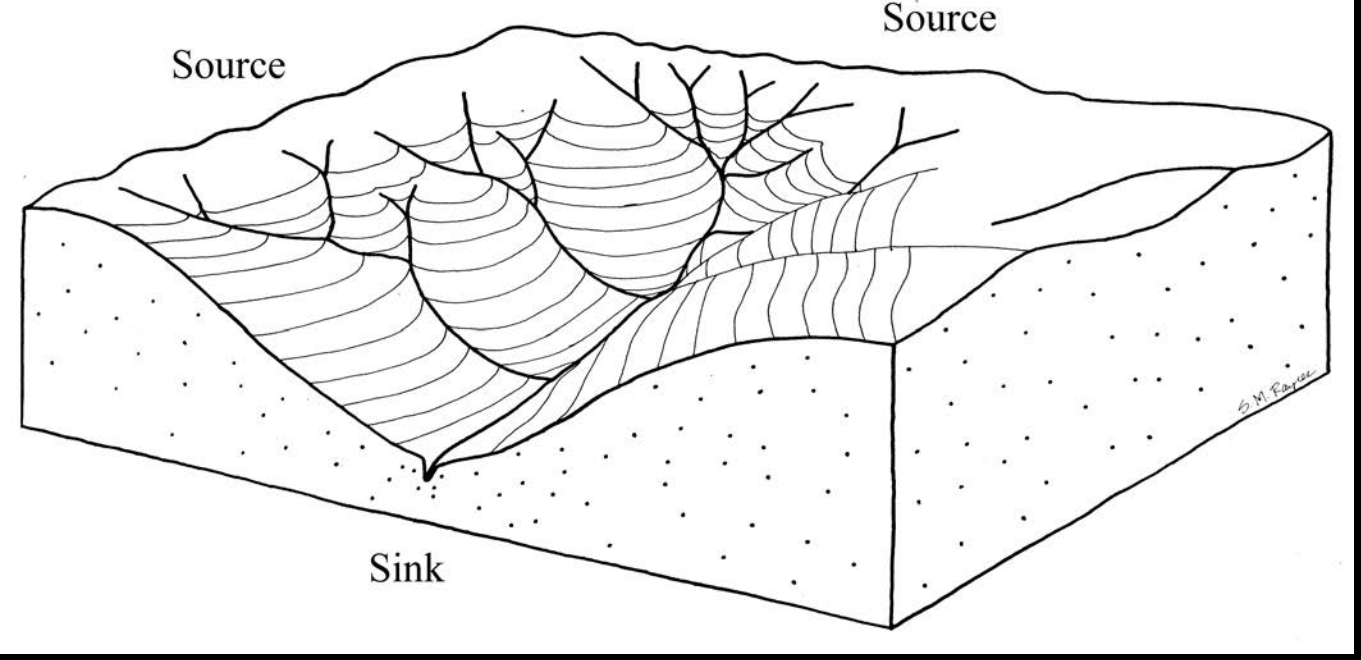


Hohokam farmers,
circa A.D. 1000

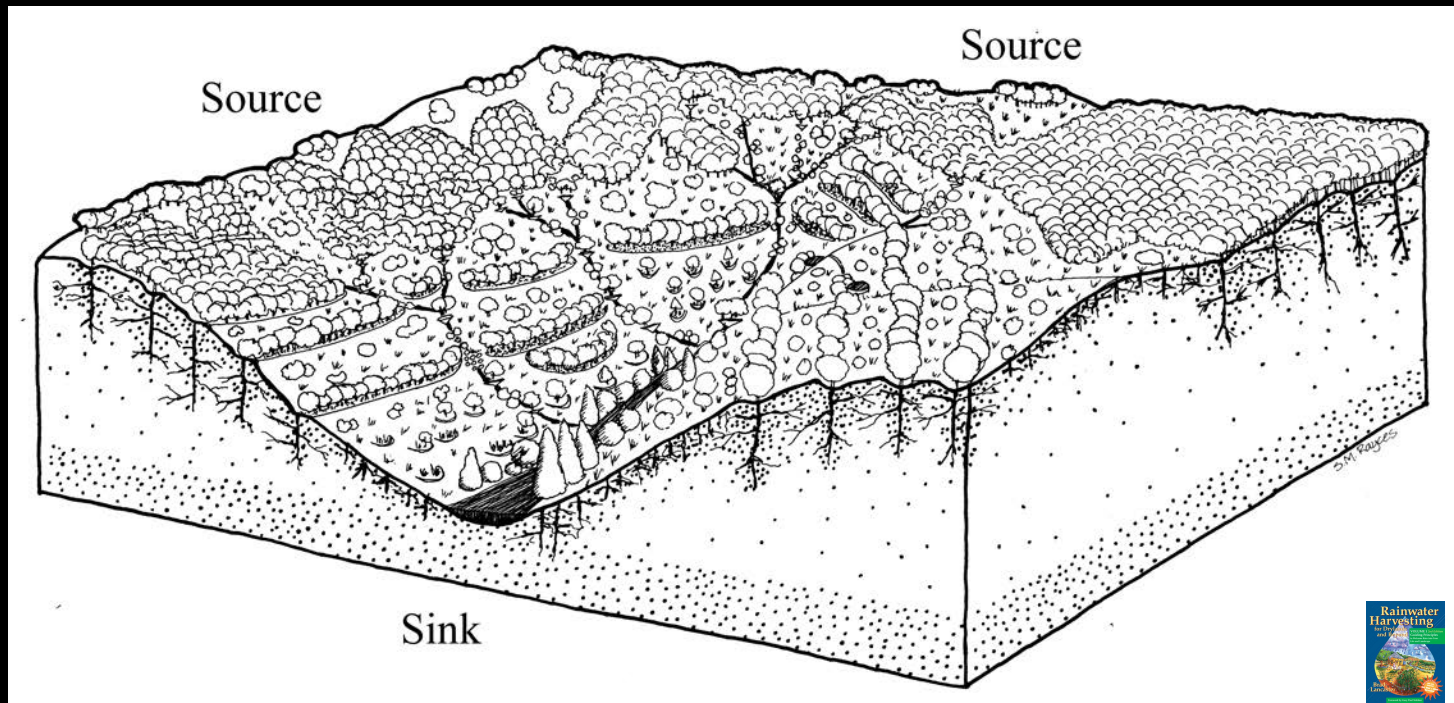
Tucson's fields, circa 1915

Jonathan Mabry
Tucson Historic Preservation Office

Mirage



Drain /
Dying mirage



Net /
Sponge/
Oasis

What is Green Infrastructure?

Green infrastructure is *living* infrastructure.
Living systems of vegetation, soil life, and infiltrated stormwaters are key to its function and effectiveness.
It strives to align design principles and ecological-systems understanding. Thus it works *with* and demonstrates natural processes within our built environment.

Why Green Infrastructure?

To improve and inform the design of living urban infrastructure so it contributes to larger, interconnected living systems in a way that enhances the health and wealth of communities, their environments, and the larger shared watershed.

Dead *drainage*way to living *infiltration*way

U of A Architecture and Landscape Architecture Building, Tucson, AZ

CALA landscape tour www.cala.arizona.edu

Mirage

Oasis

Mirage
– fertility extraction

Oasis
– fertility reinvestment

1996

2007

2013

2013

• Food-bearing native trees (*Prosopis velutina*) associated with mulched street runoff-harvesting earthworks did NOT uptake heavy metals into edible plant tissue.

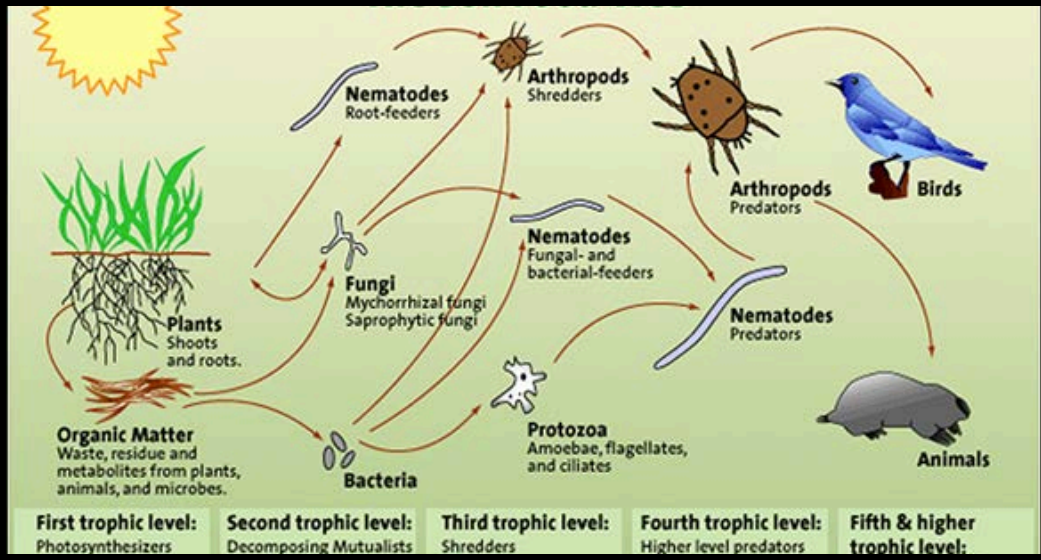
• Trees associated with mulched water-harvesting earthworks are able to grow 33% larger than those without.

This more than doubles the trees' potential sequestration of atmospheric carbon, passive cooling, and food production

• The presence of more organic matter in the soil enables the soil itself to sequester additional carbon

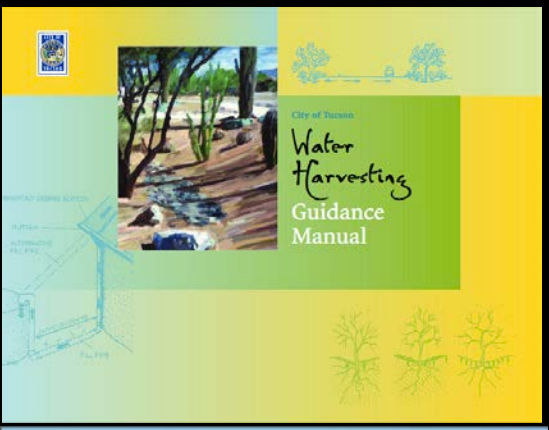
• The natural pollutant-filtering/ bioremediation ability of the soil mulched with organic material was ***ten times greater*** than that of rock- or gravel-mulched soil

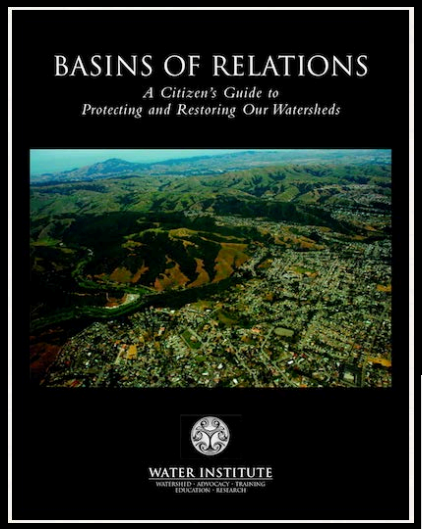
GENERATE AND SHARE REPUTABLE DATA THAT CAN EVOLVE PRACTICES AND POLICY

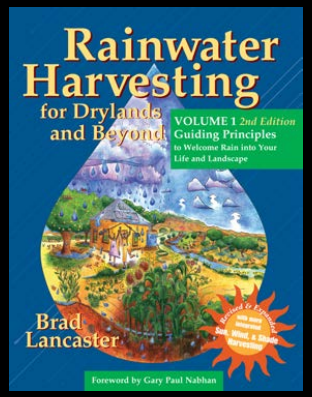


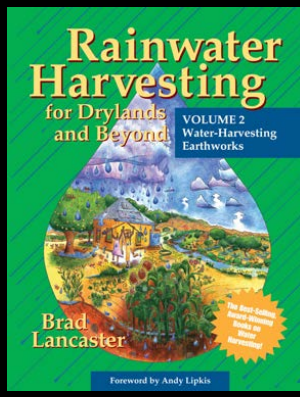
Mitchell Pavao-Zuckerman, PhD
Biosphere 2 & School of Natural Resources and Environment
University of Arizona mzuckerman@arizona.edu

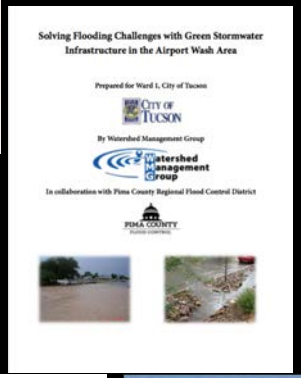
INCREASE AWARENESS OF GREEN INFRASTRUCTURE'S VALUE & POTENTIAL

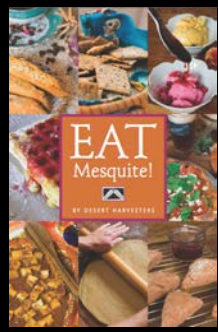


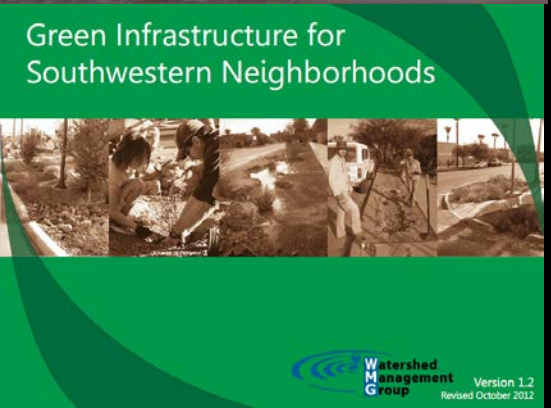


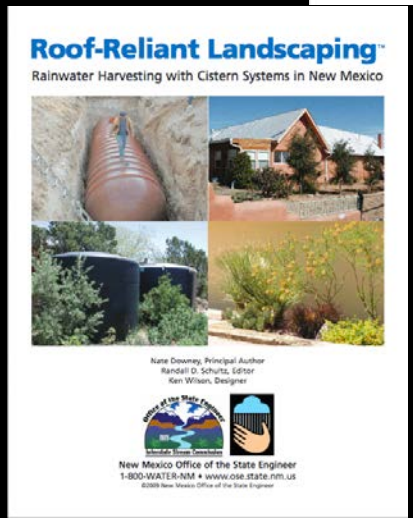


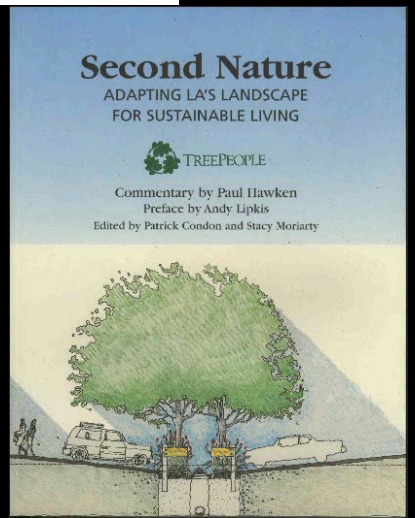


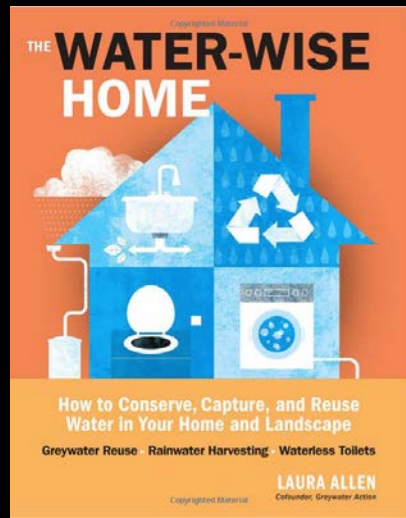












DEVELOP IMPLEMENTATION CAPABILITY AND HANDS-ON EXPERIENCE

La Paz, Baja, México, 2013

La Paz, Baja, México, 2013

INSPIRE AND GROW POLITICAL WILL

FOSTER A MARKET / ECONOMIC VIABILITY AROUND THE PRACTICE WITH INCENTIVES

- **Legalize the practice**

- **Promote the practice**

- **Rebates**

Rebates can create a financial carrot to encourage new practices. Rebates with requirements and education can enhance the quality of the rebated practice.

- **Stormwater utility fees or Green Infrastructure Fund**

Makes more clear the community costs and benefits of certain practices.
If a property helps reduce, rather than increase, downstream flooding, then the fee is less.

CHANGE PRACTICES, LAWS, AND POLICIES TO INCENTIVIZE RATHER THAN DISINCENTIVIZE BEST PRACTICES

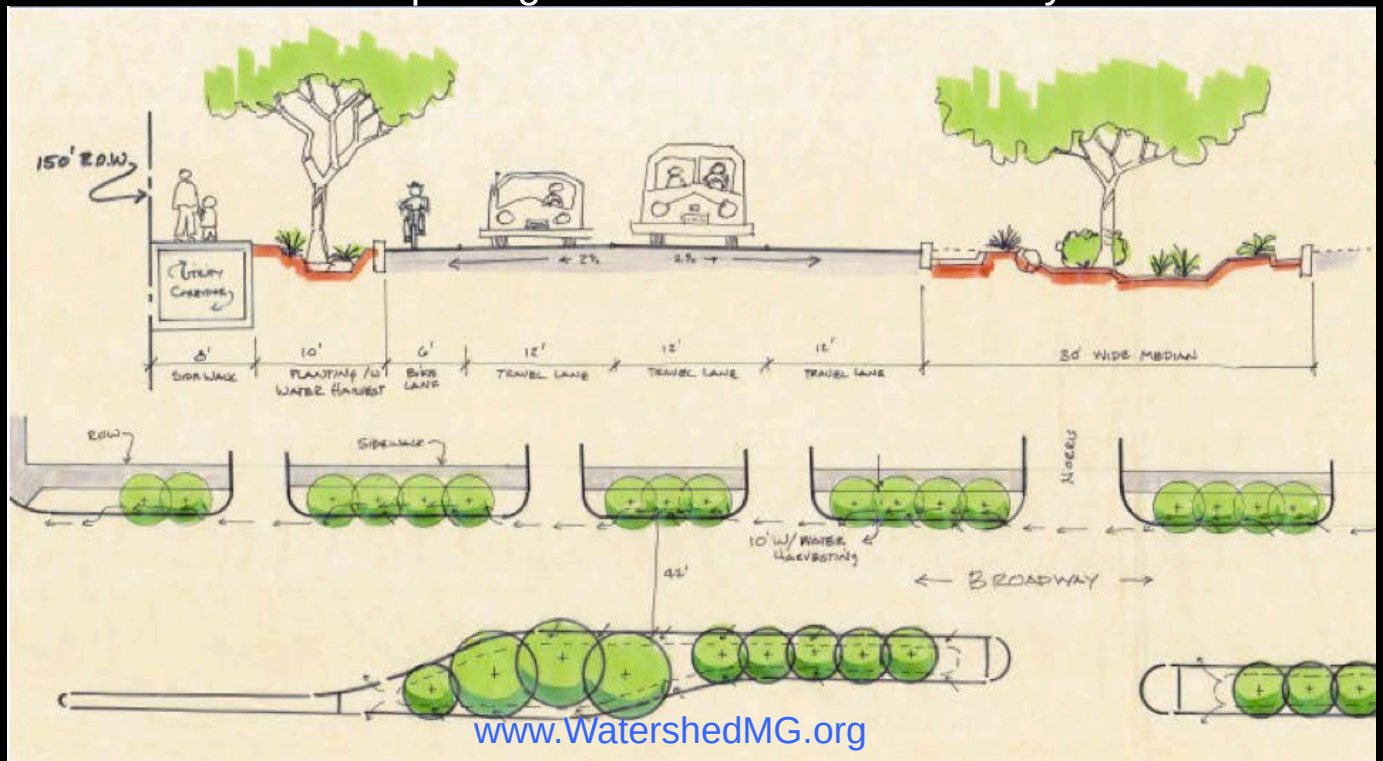
Green Streets Policy in Tucson, AZ

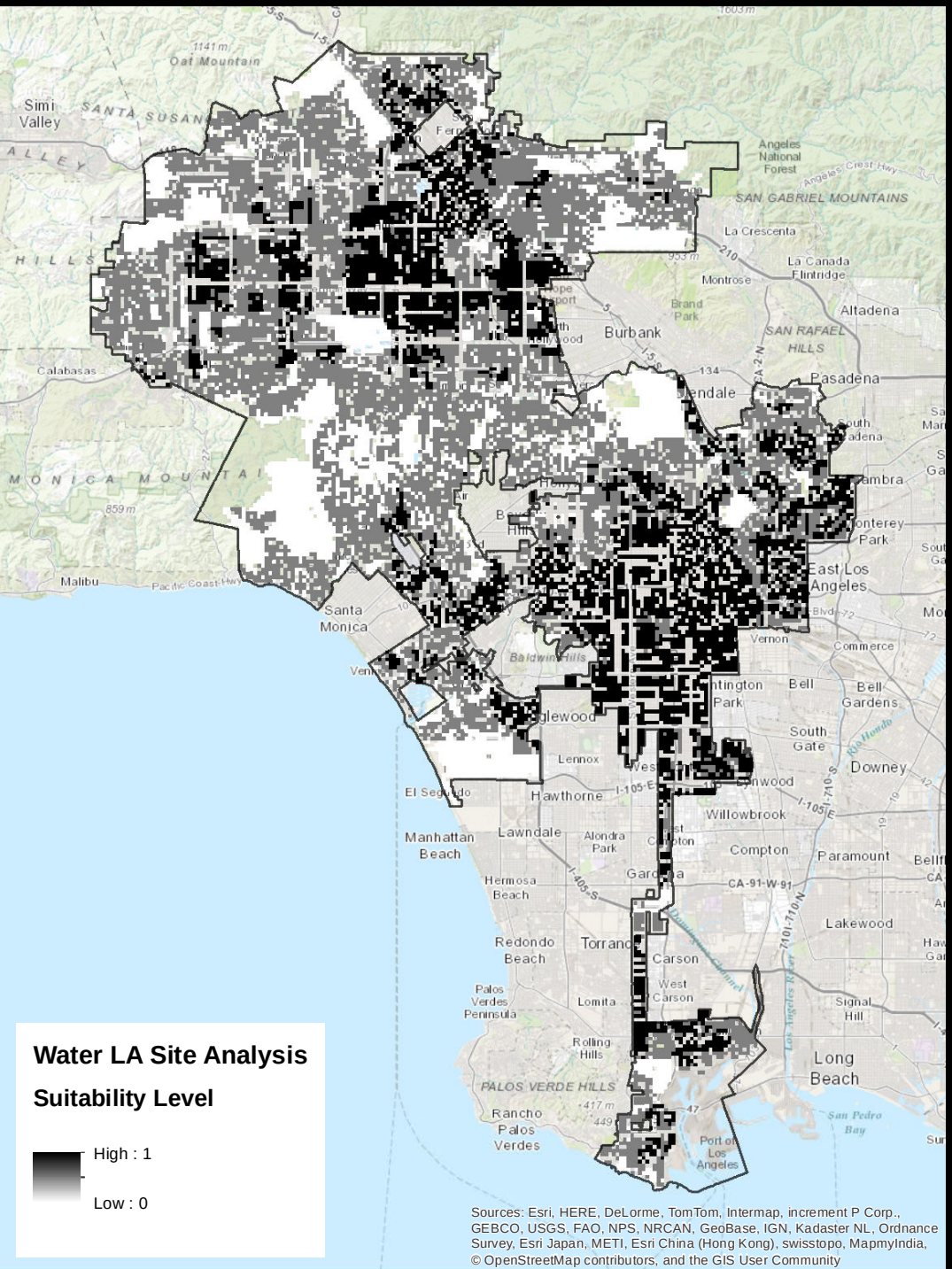
Minimum ½ -inch rainfall to be harvested in roadway or adjoining right-of-way

http://www.mayorrothschild.com/2013/05/29/tucson-to-capture-stormwater-for-irrigation-of-roadway-vegetation/

Commercial landscape policy

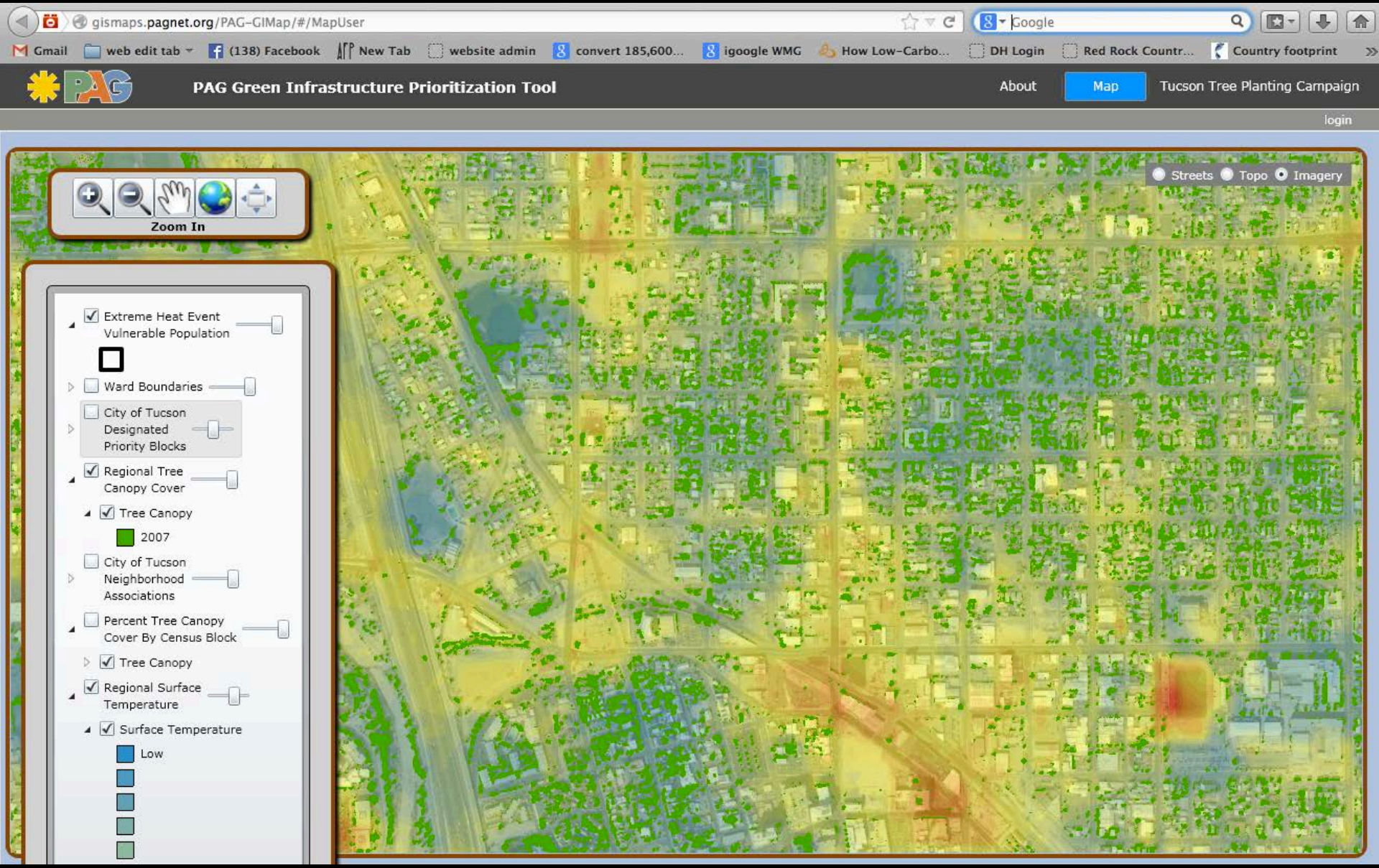
At least 50% of commercial landscape irrigation needs must be met by harvested on-site rainwater





GENERATE SITE ASSESSMENT PROTOCOL TO PLACE BEST PRACTICE IN BEST SITE

Soil percolation/infiltration
Local patterns of flooding
Slopes
Parkway width
Existing tree canopy
Volumes of street-side water flow
Climate vulnerability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Red Rock Countr...
Country footprint
PAG
PAG Green Infrastructure Prioritization Tool
About
Map
Tucson Tree Planting Campaign
login
Zoom In
Streets
Topo
Imagery
Extreme Heat Event Vulnerable Population
Ward Boundaries
City of Tucson Designated Priority Blocks
Regional Tree Canopy Cover
Tree Canopy
2007
City of Tucson Neighborhood Associations
Percent Tree Canopy Cover By Census Block
Tree Canopy
Regional Surface Temperature
Surface Temperature
Low

Dunbar/Spring neighborhood surface area is:

43% impervious cover (rooftops and pavement) + 17.8% bare earth = 60.8% of the neighborhood

Currently just 12% is under tree canopy

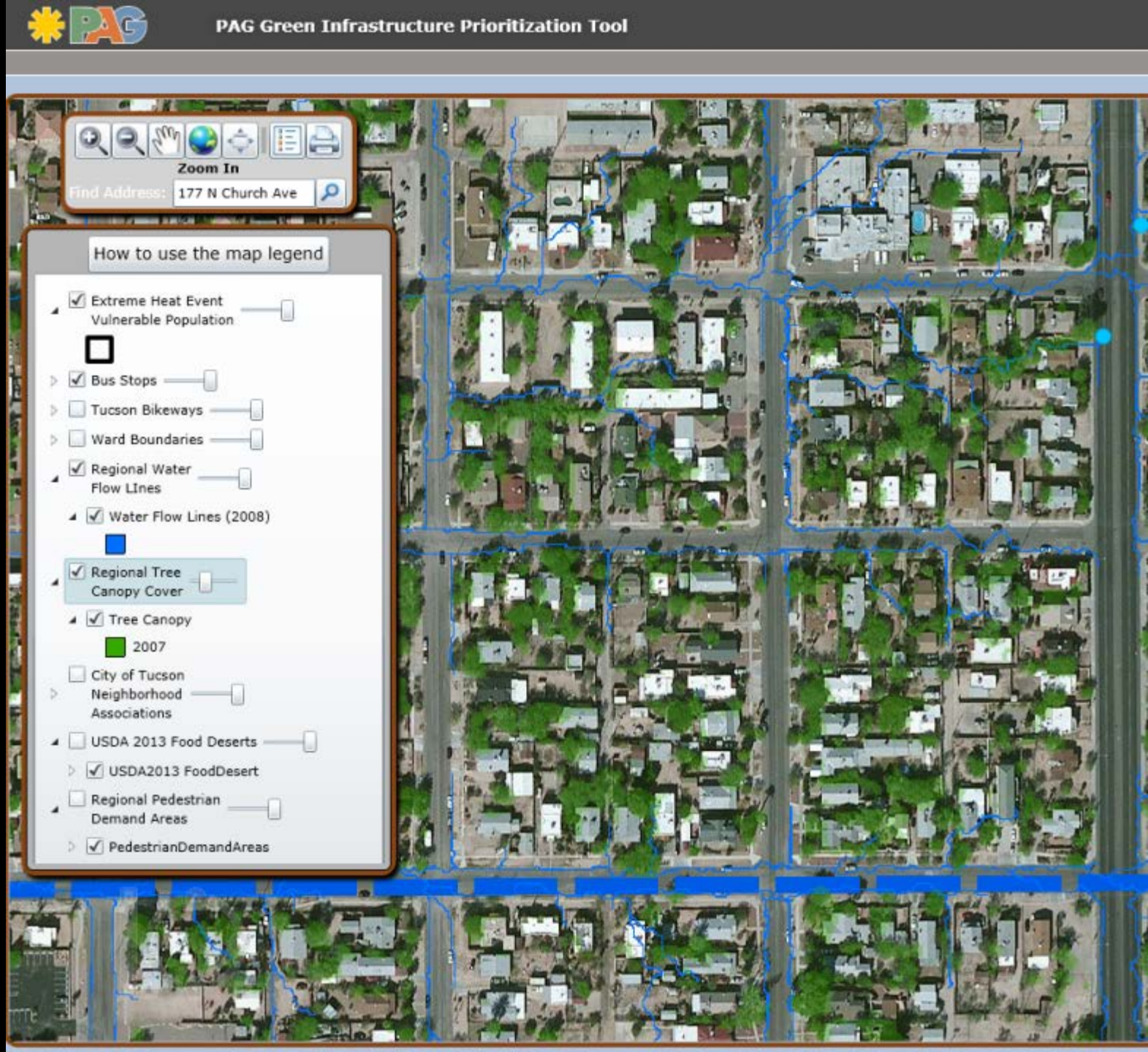
2011 data from PAG & RFCD

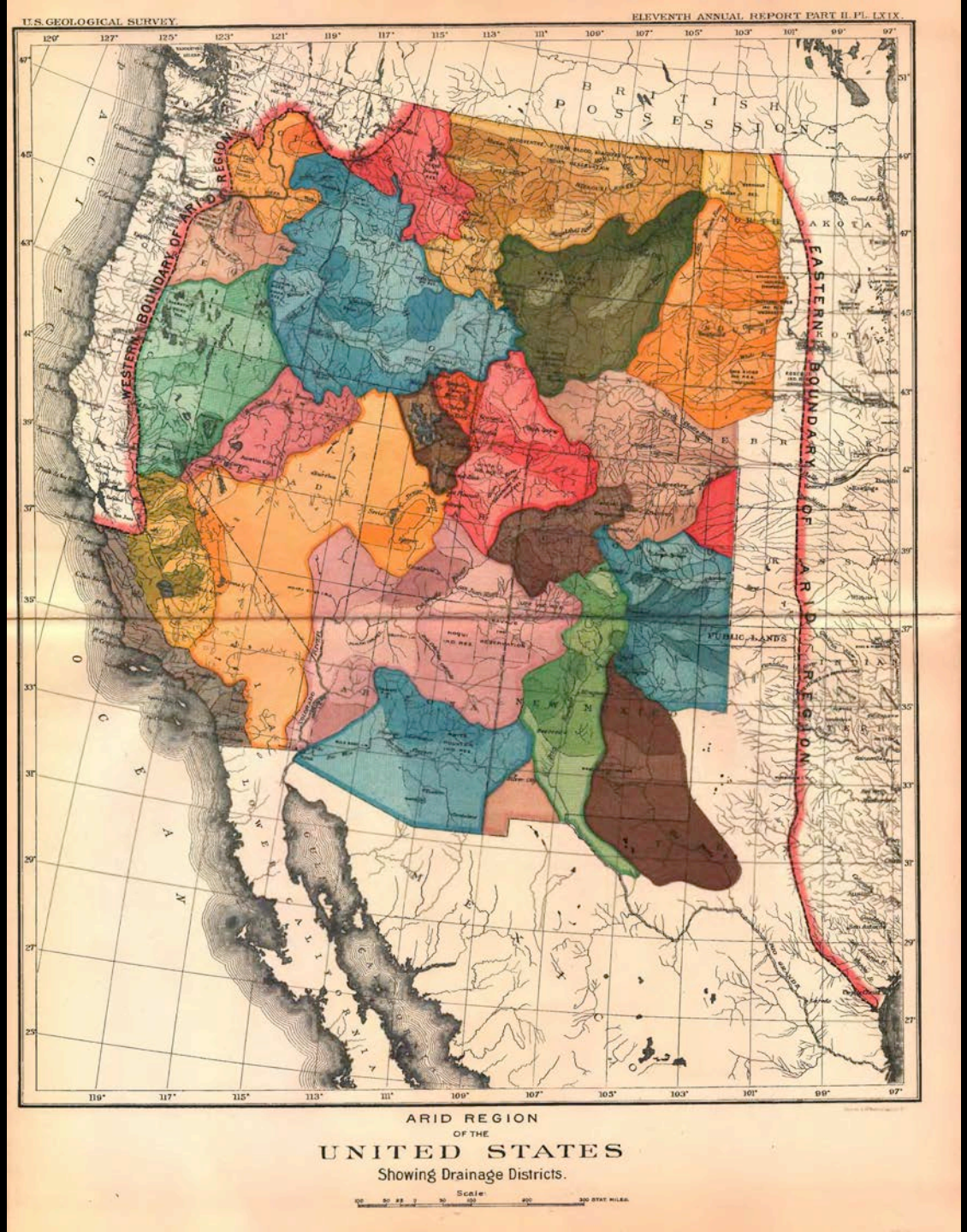
Storm water Flow Paths

Important water source to reduce irrigation

Aid planning efforts and implementation,

Plan which side of street or traffic circle



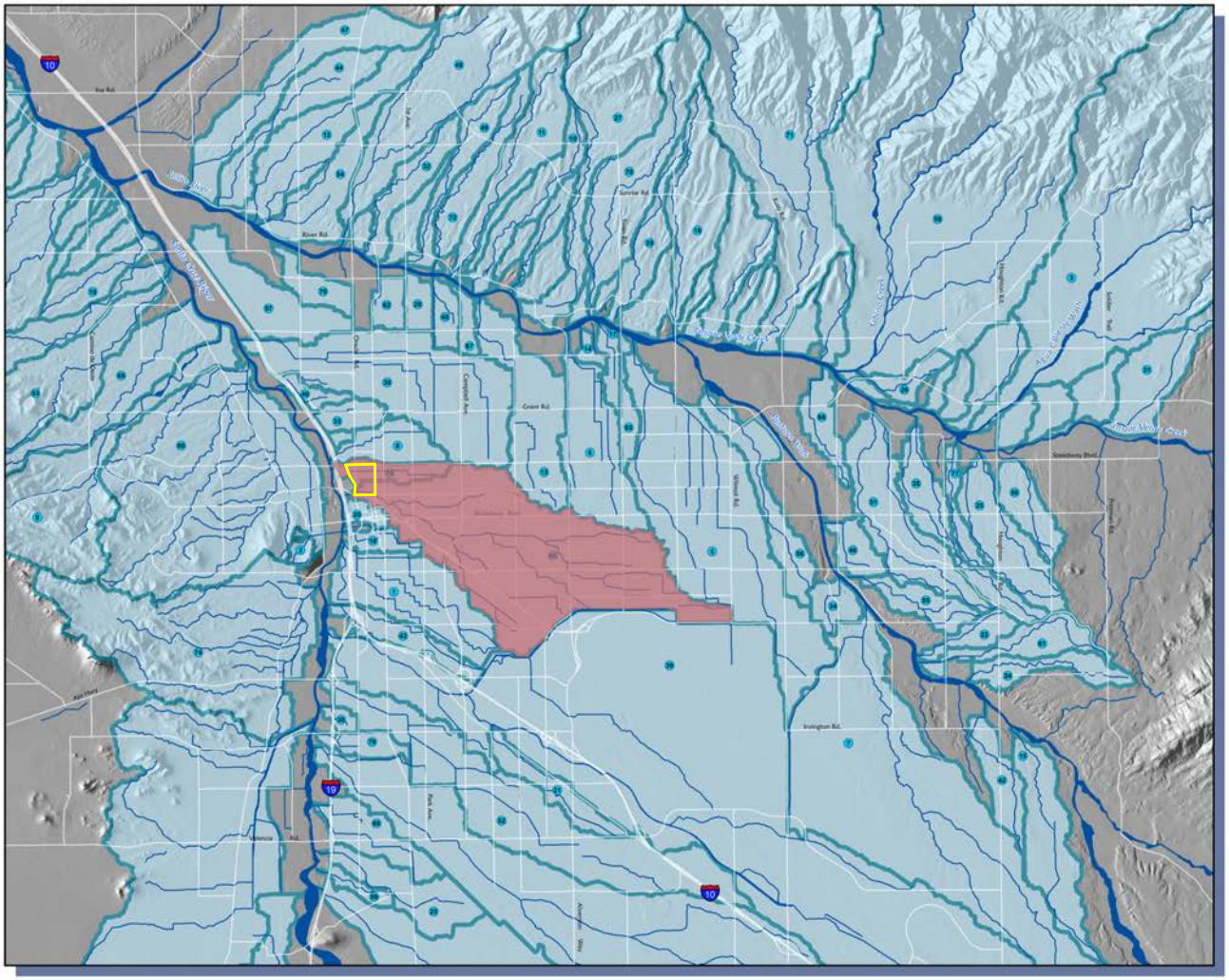


PRODUCE / PROMOTE EVOLVING BEST MANAGEMENT PRACTICES

Western United States delineated by their *watershed* boundaries as proposed by John Wesley Powell

SHOW THE FLOW

The Dunbar/Spring Neighborhood Washes & Their Watersheds*

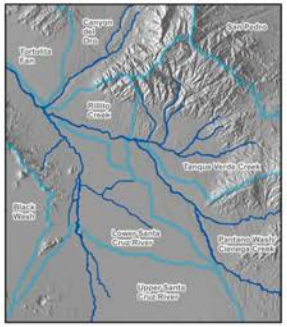


*shaded red on map & in list

Named Tucson Basin Watersheds

1. 18th Street Wash
2. A Mtn Detention
3. Agua Caliente
4. Airport Wash
5. Alamo Wash
6. Alvernon Wash
7. Atterbury Wash
8. Brone Wash
9. Camino de Oeste Wash
10. Camino Real Wash
11. Campbell Wash
12. Casas Adobes Wash
13. Christmas Wash
14. Christopher City Wash
15. Civano Wash
16. Craycroft Wash
17. Creekside Wash
18. Cushing Street Wash
19. Del Cerro Wash
20. Downtown Watershed
21. Earp Wash
22. Eastview Wash
23. El Vado Wash
24. Escalante Wash
25. Este Wash
26. Fahringer Wash
27. Finger Rock Wash
28. First Avenue Wash
29. Fletcha Caida Wash
30. Flowing Wells Wash
31. Fortyniners Wash
32. Friendly Village Wash
33. Grant Road Wash
34. Guillermo Wash
35. Hidden Hills Wash
36. Hughes Wash
37. Idle Hour Wash
38. Irvington (Michigan) Wash
39. Julian Wash
40. Kreuger Wash
41. Los Reales Diversion Channel
42. Mesquite Ranch Wash
43. Mission View Wash
44. Nanini Wash
45. North Mountain Ave. Wash
46. Owen Park Wash
47. Pegler Wash
48. Pima Wash
49. Race Track Wash
50. Reyes Wash
51. Robb Wash
52. Rodeo Wash
53. Roger Wash
54. Roller Coaster Wash
55. Rolling Hills Wash
56. Rose Hill Wash
57. Ruthrauff Wash
58. Sabino Creek
59. Santa Clara Wash
60. Silvercroft Wash
61. Spanish Trail Wash
62. Stone Avenue Wash
63. Swan Road Wash
64. Sweetwater Wash
65. Trails End Wash
66. Tucson Arroyo
67. Tucson General Wash
68. Udall Park Wash
69. Valencia Wash
70. Valley View Wash
71. Ventana Canyon Wash
72. Villa Entrada Wash
73. WBSCR Diversion Channel
74. West Branch Santa Cruz River
75. West University Wash
76. Wetmore Wash
77. Wrightstown Wash
78. Wyoming Wash

Pima County Watersheds



Arizona Watersheds

TerraSystems Southwest and the Watershed Management Group, Inc. would like to thank Pima County Department of Transportation Geographic Information Services Division and the City of Tucson Department of Transportation for graciously providing the datasets displayed on this map. The Hydrologic Unit Code (HUC) data, aggregated to subregions, was provided by the USDA-NRCS National Cartography and Geospatial Center. All data is accepted as-is, with all known and unknown inaccuracies and/or errors, and without warranty of any kind.

N

0 0.5 1 2 3 4 Miles

Map Date: March 23, 2009

Major Streets

Named Washes

Major Watersheds

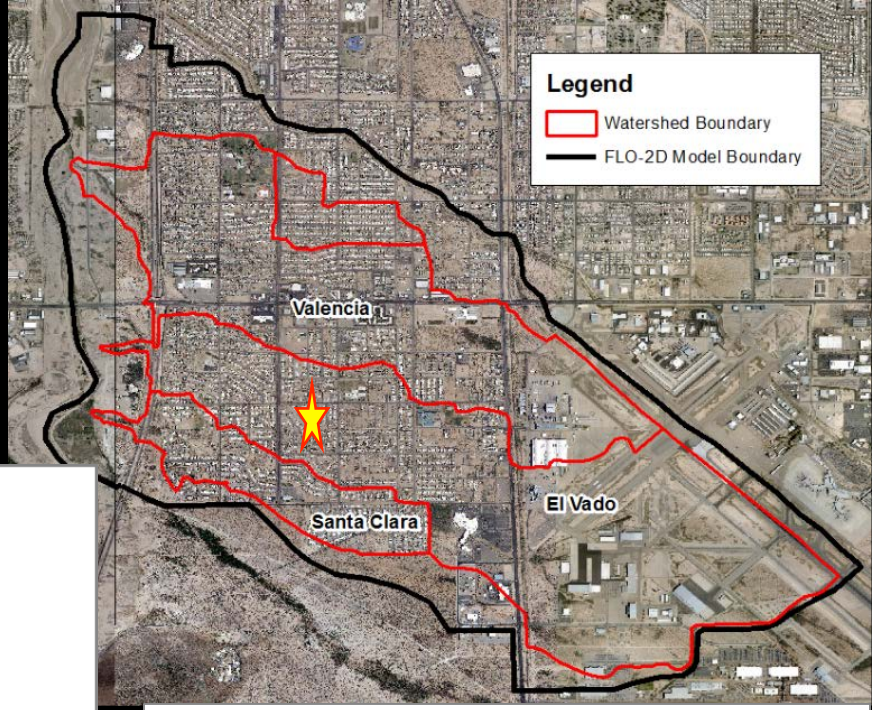
TerraSystems Southwest, Inc.

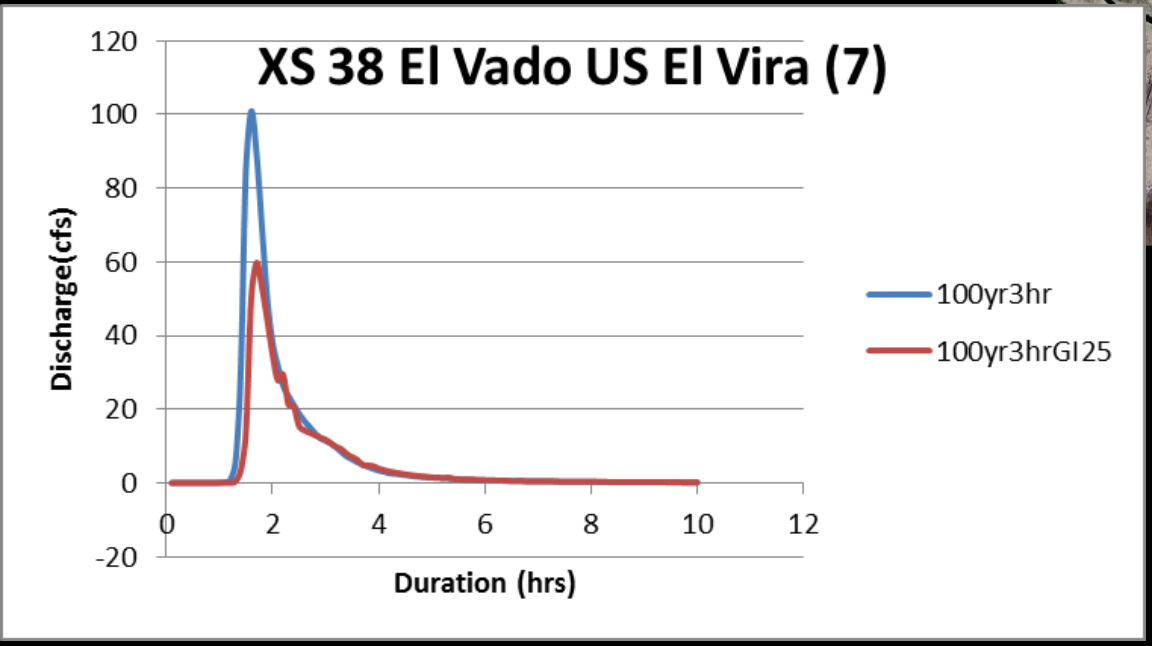
Watershed Management Group

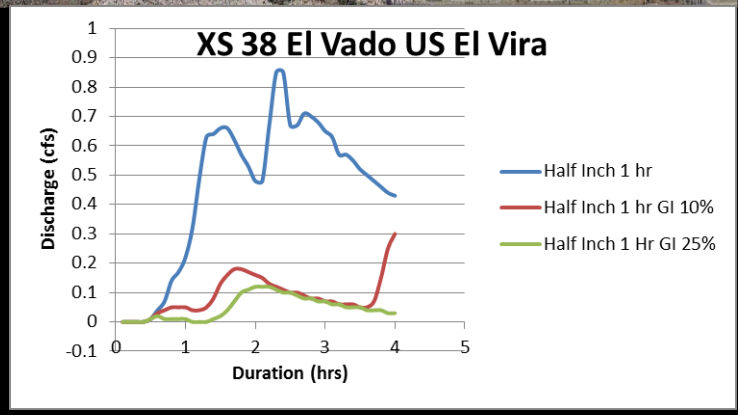
El Vado
subwatershed

Drainage Area:

30 acres







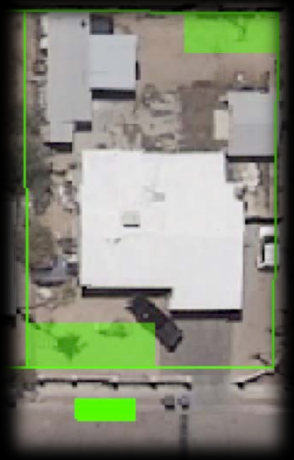
http://watershedmg.org/green-streets/resources#airport-wash

PIMA COUNTY FLOOD CONTROL

CITY OF TUCSON

WMG

Residential Rain Garden & Street Harvesting Benefit/Cost Ratio Initial Results



Benefit/Cost Ratio:	**$4.4 / $1**	**$2.9 / $1**
Direct benefits only:	**$3.1 / $1**	**$1.9 / $1**

PIMA COUNTY FLOOD CONTROL

CITY OF TUCSON

WMG

Green Streets
Benefit/Cost Ratio Initial Results

Model representation

Benefit/Cost Ratio: **$2.1 / $1**

Direct Value Only: **$1.5 / $1**

PIMA COUNTY FLOOD CONTROL

CITY OF TUCSON

WMG

Parking Lots and In-Street Features: Bustin' Up Asphalt

Model representation

Benefit/Cost Ratio: **$0.5 / $1**

PIMA COUNTY FLOOD CONTROL

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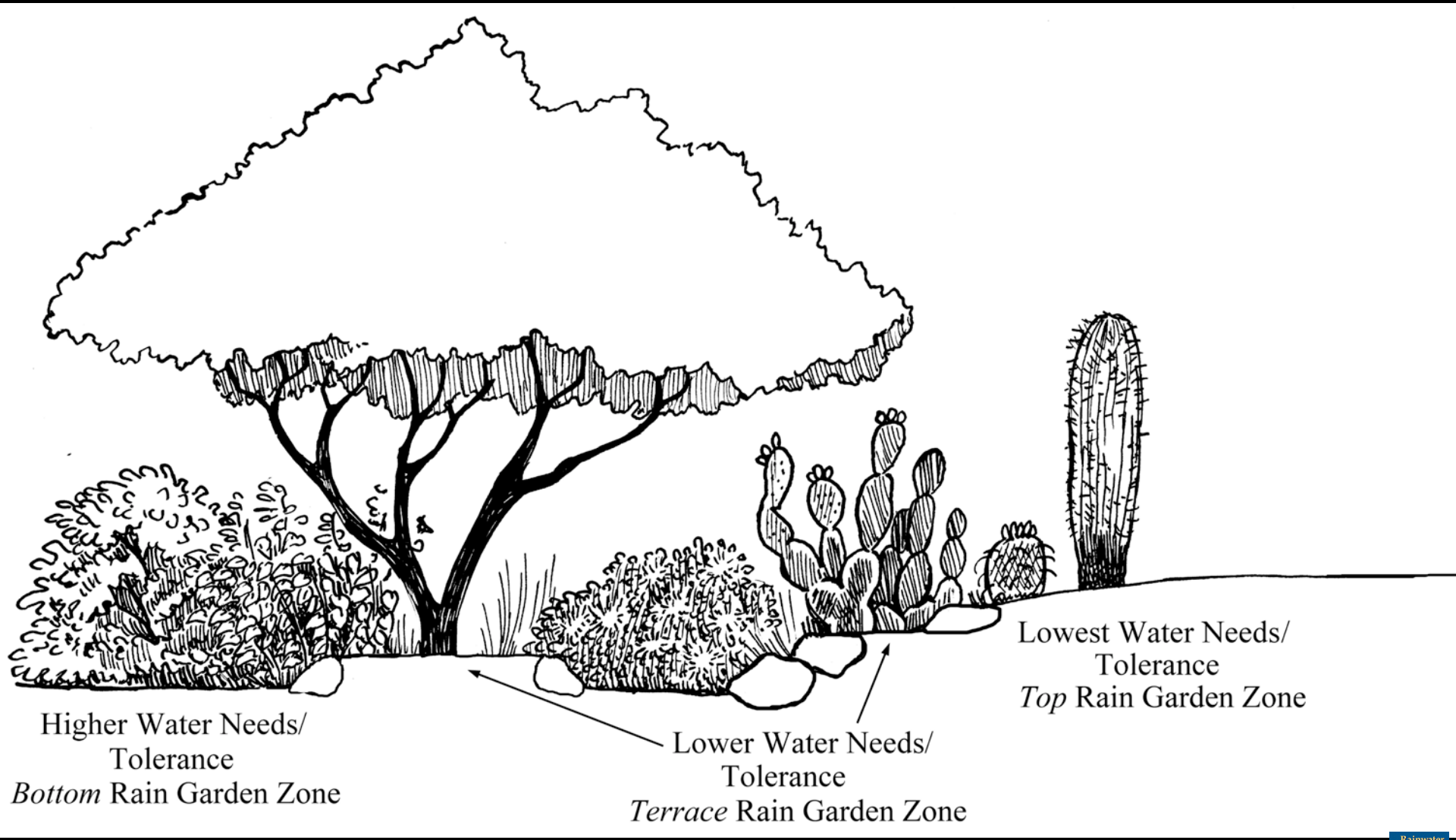
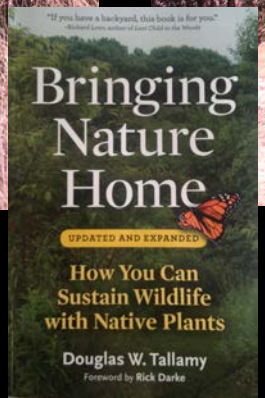
GATHER / CREATE RELIABLE SOURCES OF PLANTS & GUIDANCE ON HOW TO IRRIGATE THEM WITH HARVESTED ON-SITE WATER



Rain Garden Zones

Non-native mirage



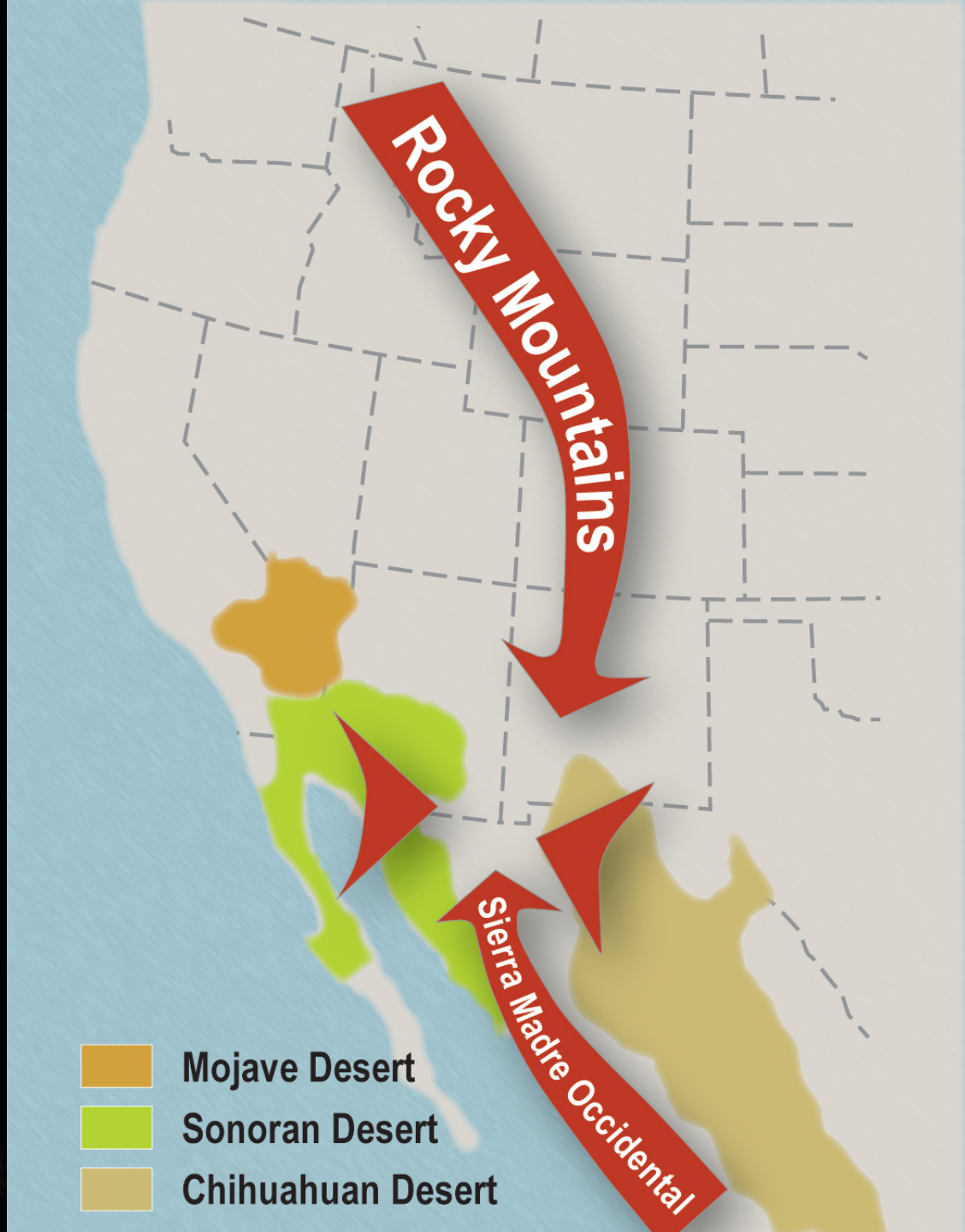
Native oasis


Rainwater
Harvesting

Watchable wildlife activities generate $1.4 billion in economic activity per year to Arizona

Native plants support native wildlife, because they have coevolved

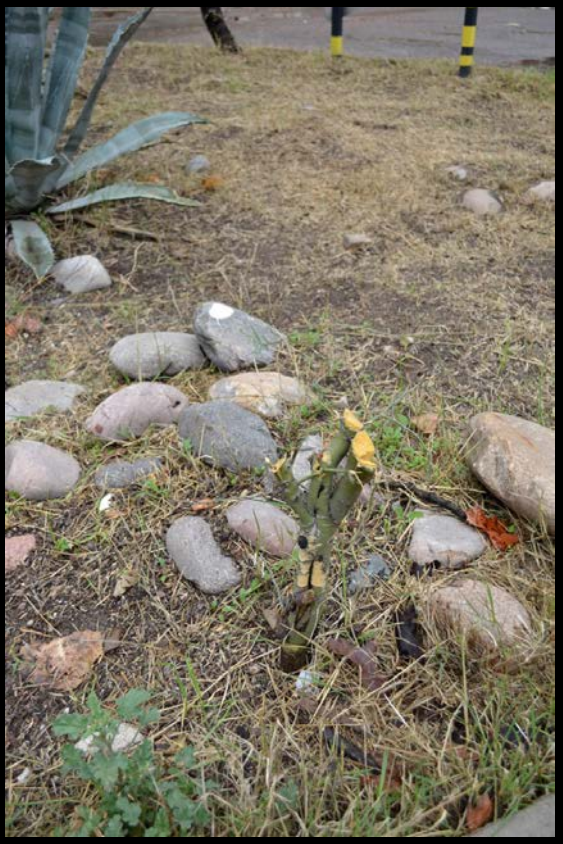
along with the region's climate (and its cyclical droughts and floods)



CONTINUALLY EVOLVE IRRIGATION PRACTICES

Drip irrigation bucket

NSPIRE A CONTINUALLY EVOLVING CULTURE AND PRACTICE OF STEWARDSHIP MAINTENANCE

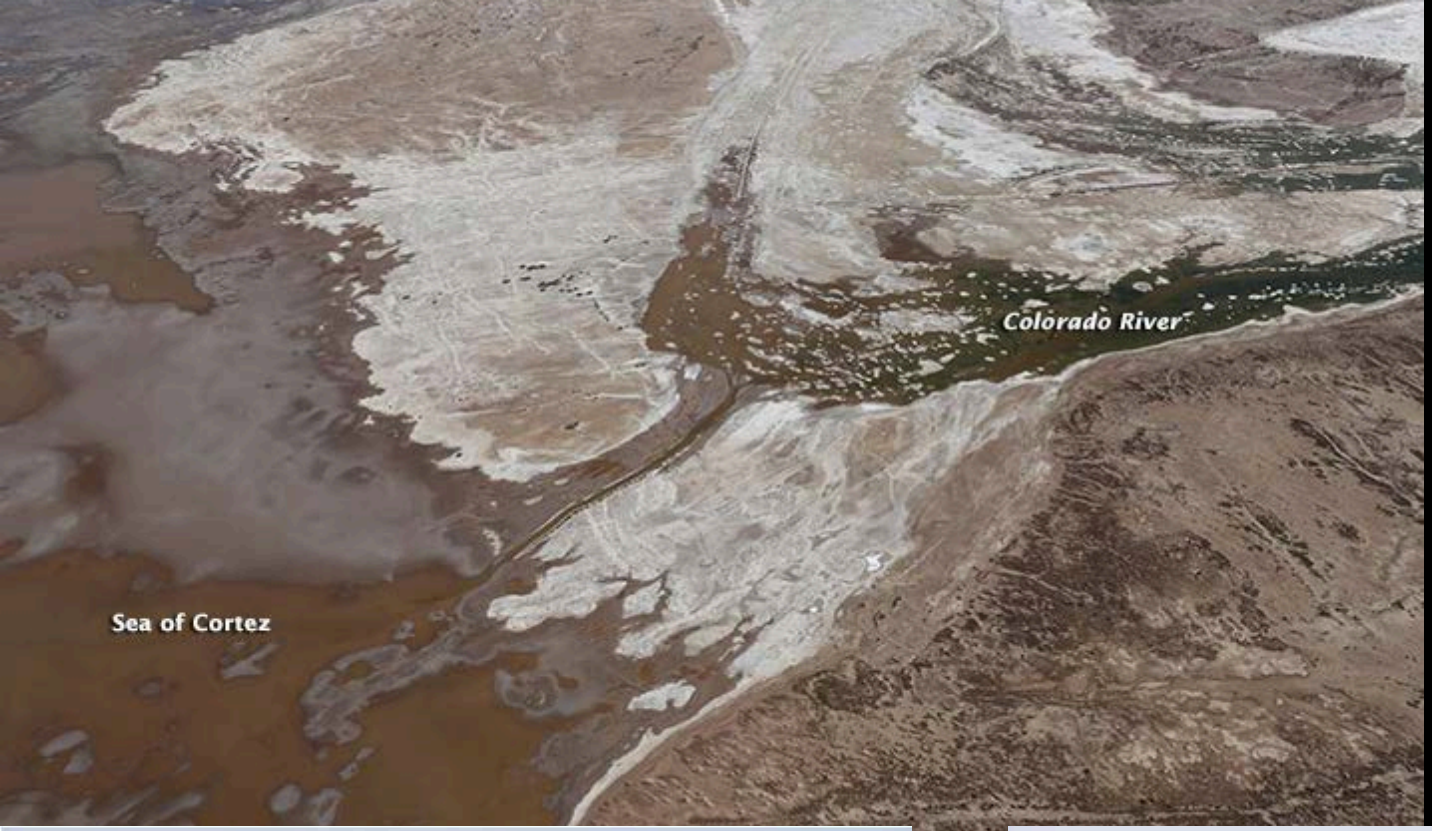


Bad “maintenance”
tree cut down
Photo credit: Sky Jacobs

Bad “maintenance”
all vegetation
clear cut
Photo credit: Sky Jacobs

Good maintenance
prunings reused on
site as mulch

SHOW THE FLOW



Phto credit: Francisco Zamora, Sonoran Institute, Colorado River Delta Legacy Program

BRING BACK THE FLOW

Colorado River reunited with the Sea of Cortez for the first time in 16 years on May 15, 2014

Where do you want to live
—in a mirage or a true oasis?

What will that choice enable in you, your community, and our shared watershed & world?

What will be your role in that choice?

For a downloadable

Evolving Checklist of Strategies to Build a Successful Green Infrastructure Program

- including links to resources, research, standards, and programs

see the webpage for the 2015 Border Green Infrastructure Forum

or the Drops in a Bucket blog at www.HarvestingRainwater.com