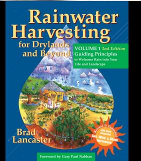
Regenerative Rights-of-Way: Local Harvests and Enhancements in Our Community Commons

by Brad Lancaster

www.HarvestingRainwater.com

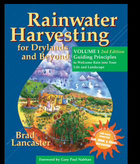
www.DesertHarvesters.org



Tucson, Arizona, U.S.A
and the Santa Cruz river

1904	2007

Sponge	Drain



Floods that occurred every 100 years begin to occur every 10 years -

after development paves the watershed and increases the rate and volume of stormwater running off site

Distance is energy

We ignore, deplete, or pollute our local waters
— then import ever more distant water

The largest consumer of electricity
(and single source producer of carbon)
in Arizona is the pumping of water

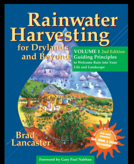
Photograph: Pete McBride on the parched Colorado River delta, by Jonathan Waterman

The average annual rainfall in Tucson is 280 mm (11 inches)

Yet more *rain* falls on the surface area of Tucson
in a year of average rainfall,
than the annual consumption of Tucson's *water-utility water*

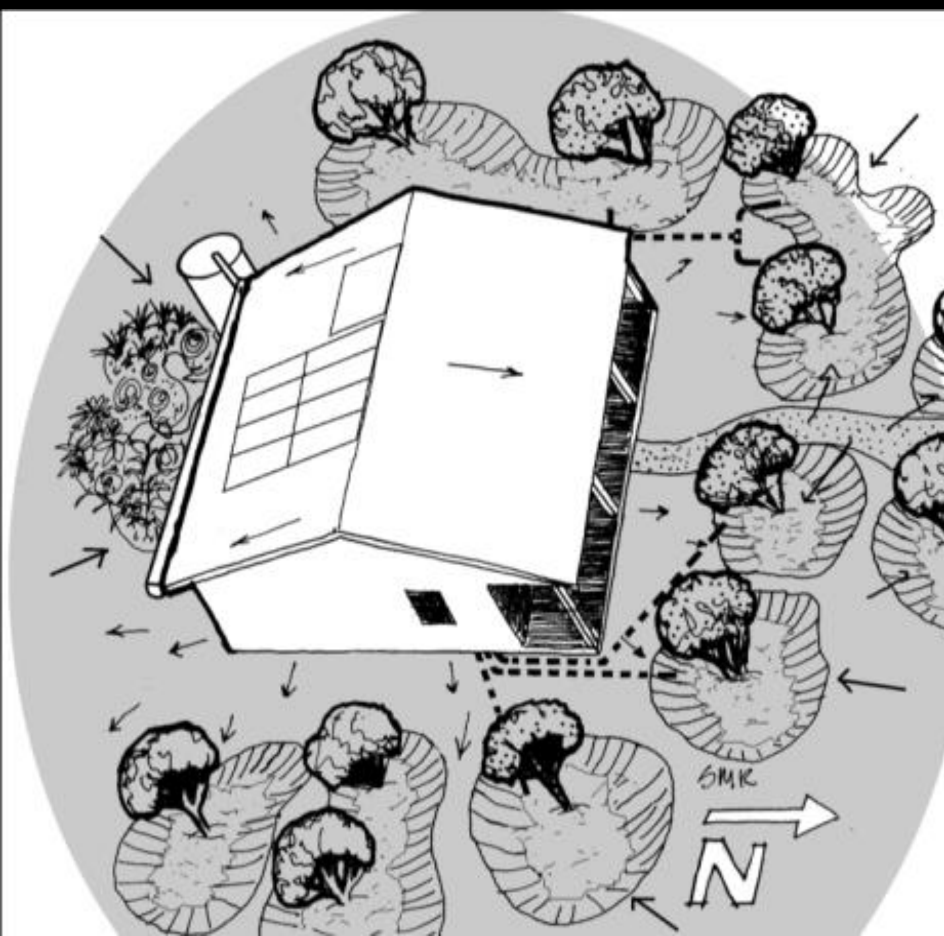
In Ciudad Juárez the numbers are:

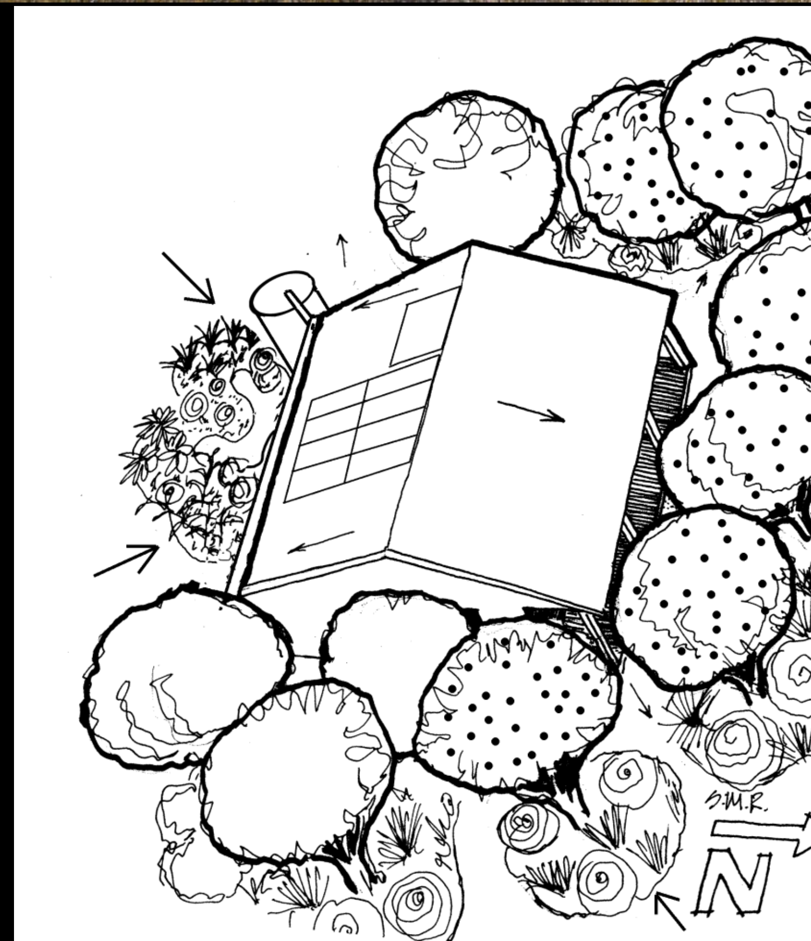
GANANCIA DE LLUVIA[f]	192	l/hab/día
	51	G/HAB/DÍA
USO DE AGUA MUNICIPAL[g]	336	l/hab/día
	89	G/HAB/DÍA

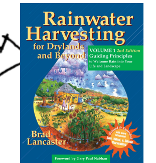


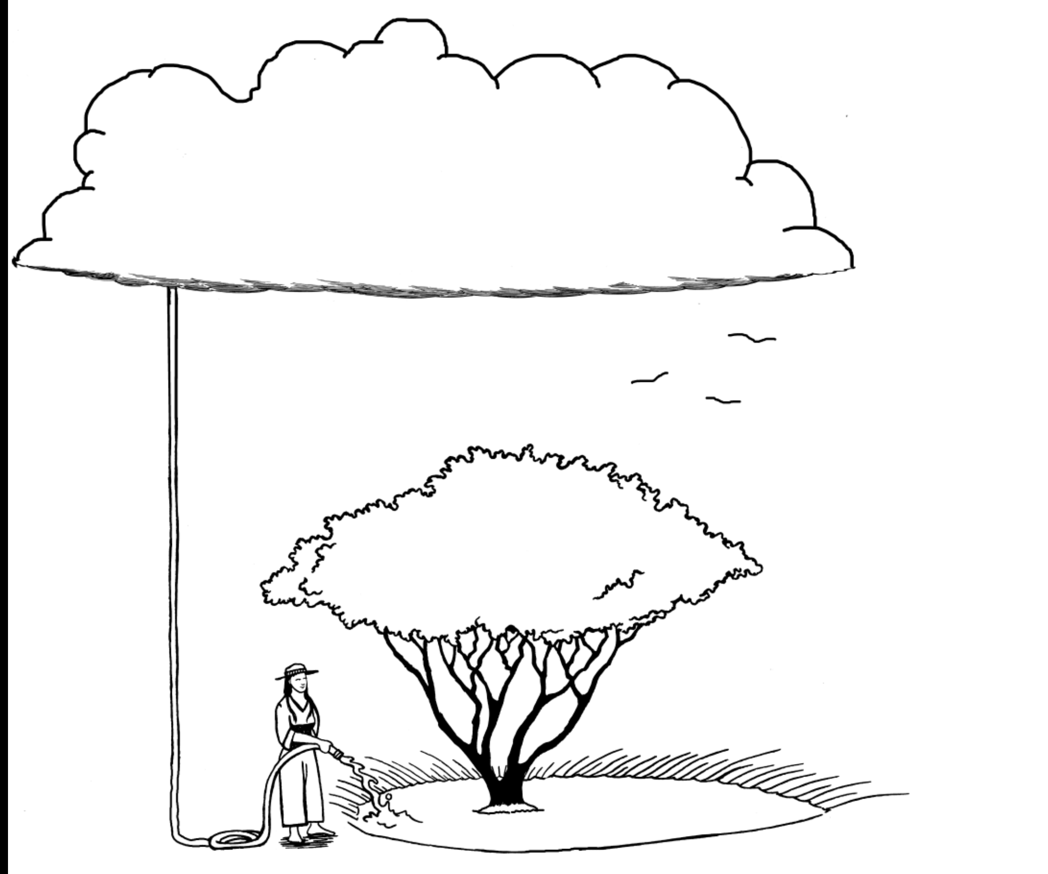
Harvest and utilize on-site water (rainwater, stormwater, greywater, condensate, etc) as close as possible to where it falls

within the **oasis zone**
- within 9 meters (30 feet) of catchment surface





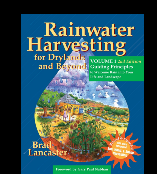




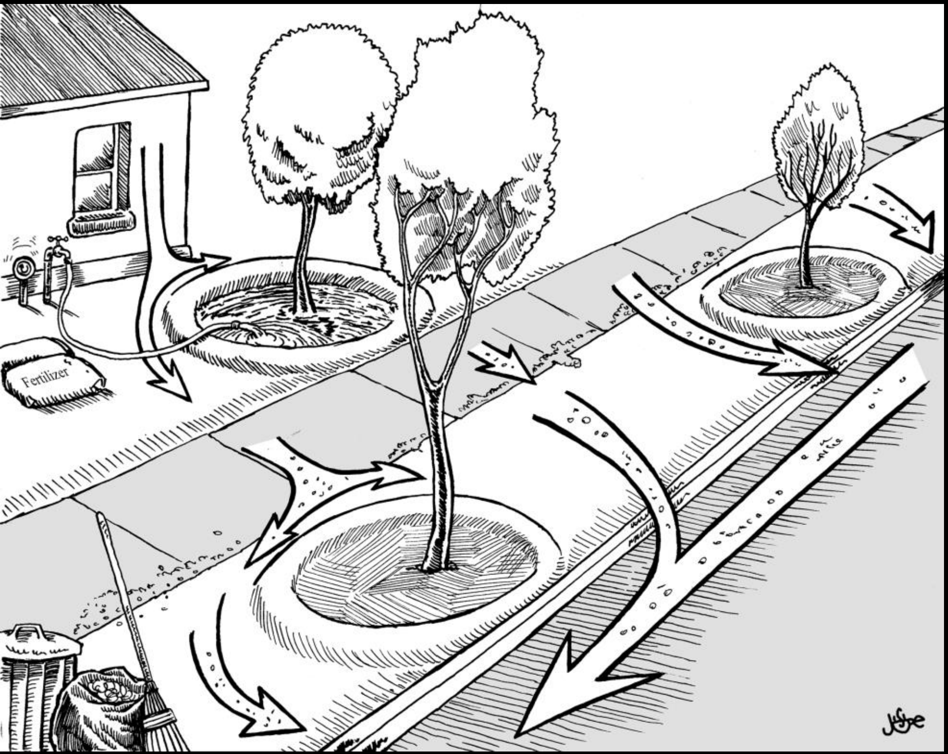
Plant the free rain, and other on-site “waste” waters, to grow *living* infrastructure

Make the rain the *primary* irrigation source of all our plantings, while greywater (on private property) is the *secondary* irrigation source.

(U.S. single-family households that do *not* harvest free “waste” waters currently use 30 to 70% of their *drinking water* for irrigation of plants.)

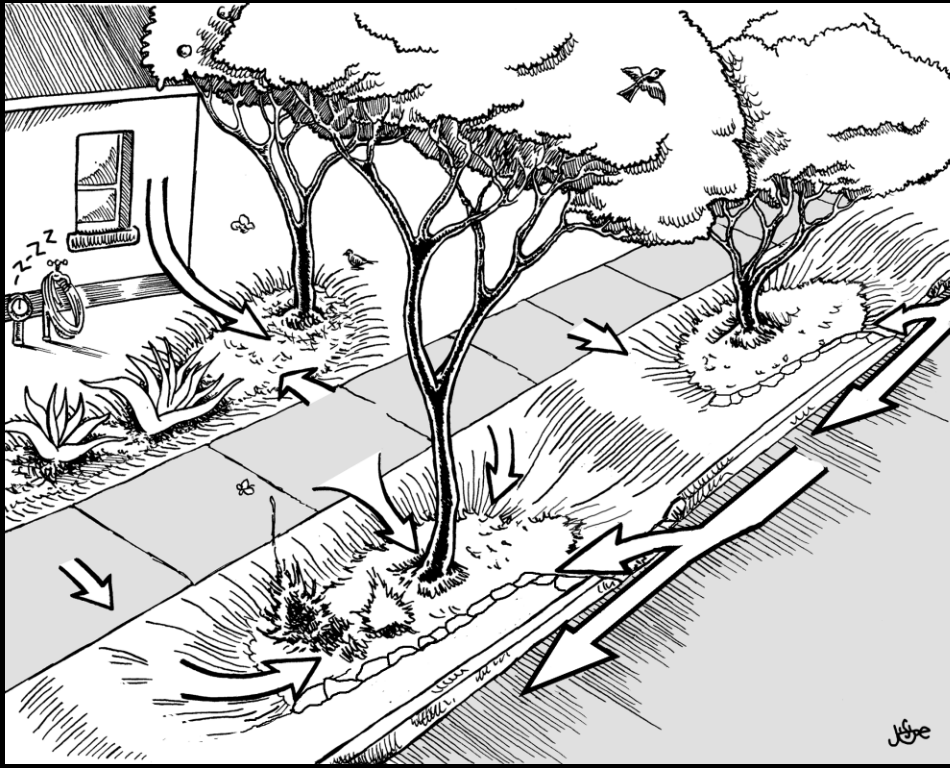


Path to Scarcity

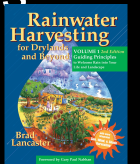


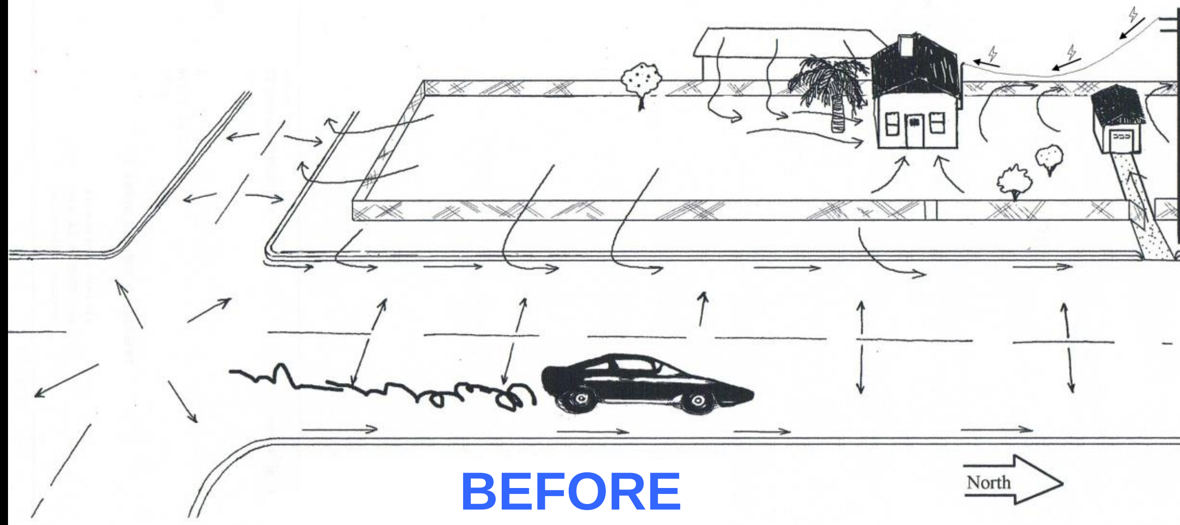
- Turns resources into wastes
- Relies on the costly and imported
- Consumes more than it produces
- Disintegrated Drains

Path to Abundance



- Turns “wastes” into resources
- Relies on the free and local
- Produces more than it consumes
- Integrated Harvests

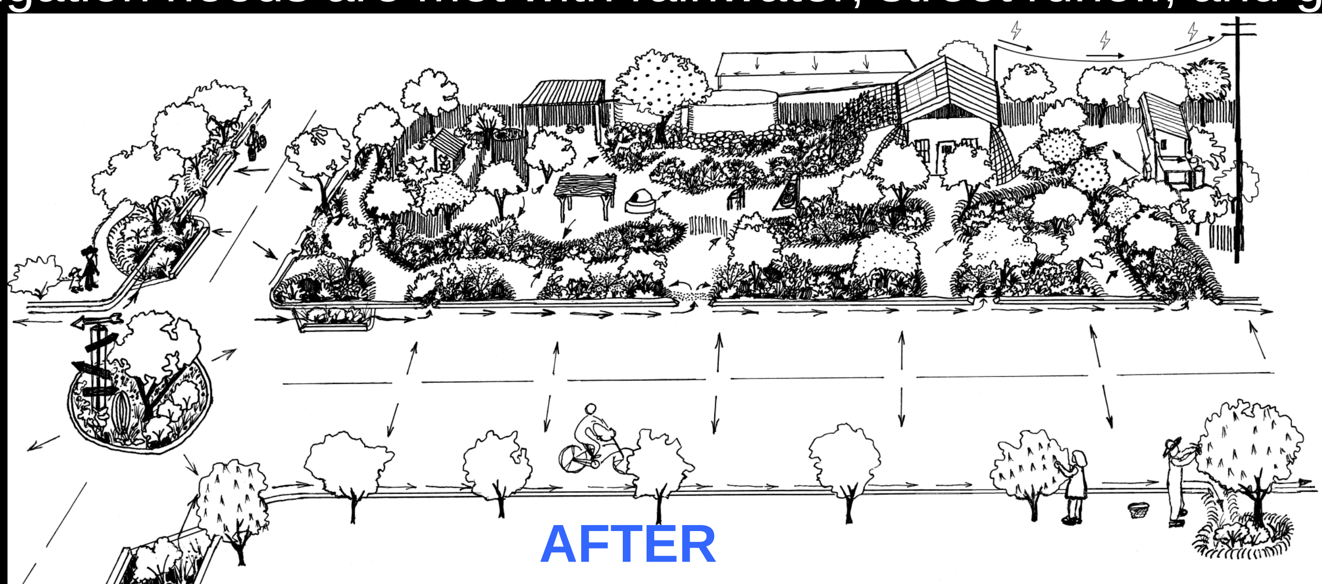


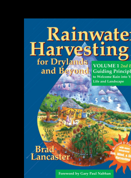


On 0.05-ha (1/8th-acre) lot and surrounding 6-m (20-ft) wide public right-of-way we harvest 378,000 liters (100,000 gallons) of rainwater in an average year of 280 mm (11 inches) of rain

– mostly in soil and vegetation (we have 19,000-liter [5,000-gallon] capacity in tanks)

95% of irrigation needs are met with rainwater, street runoff, and greywater





^ 1994

2006

>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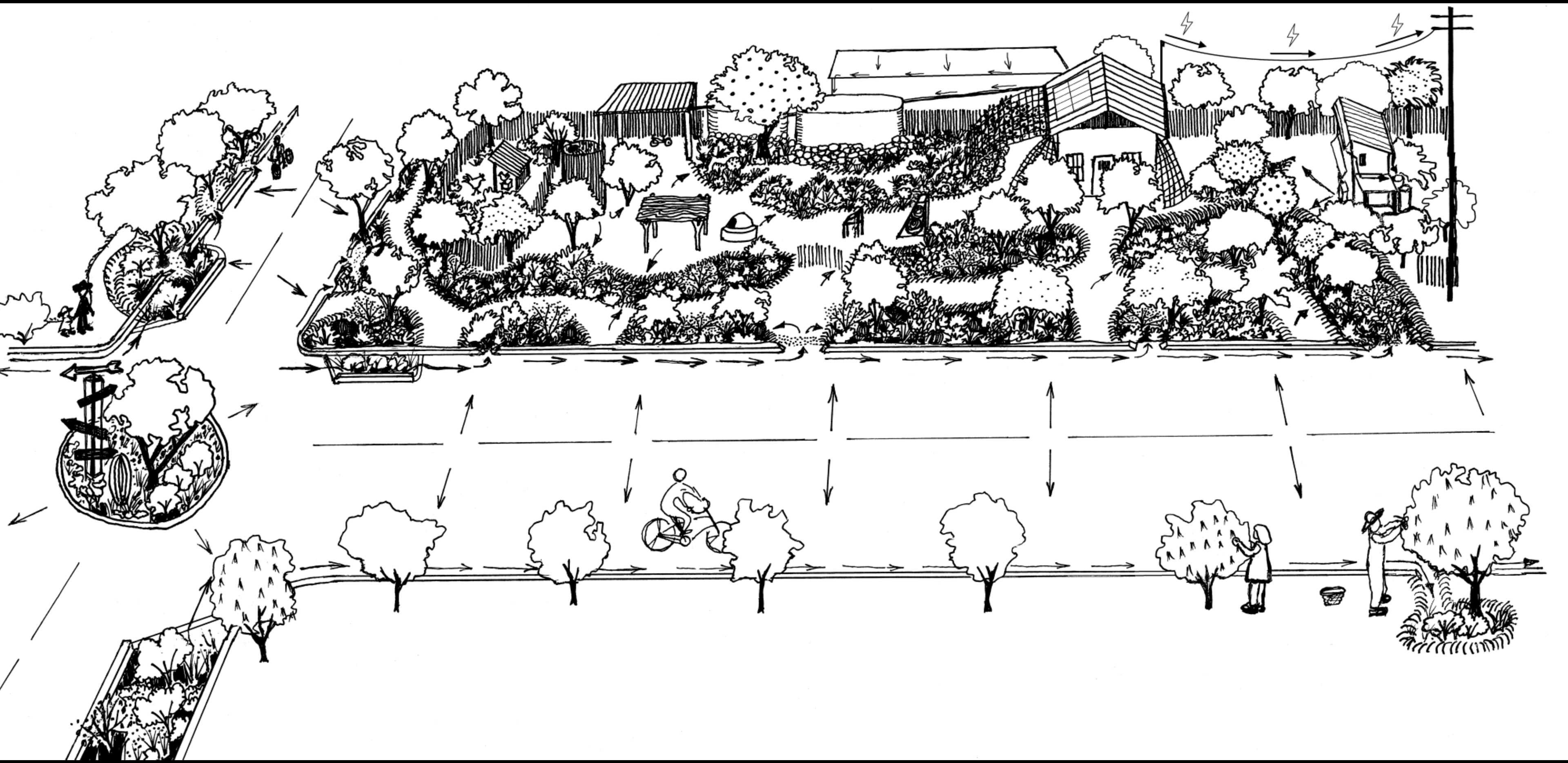
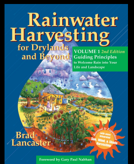
Lancaster

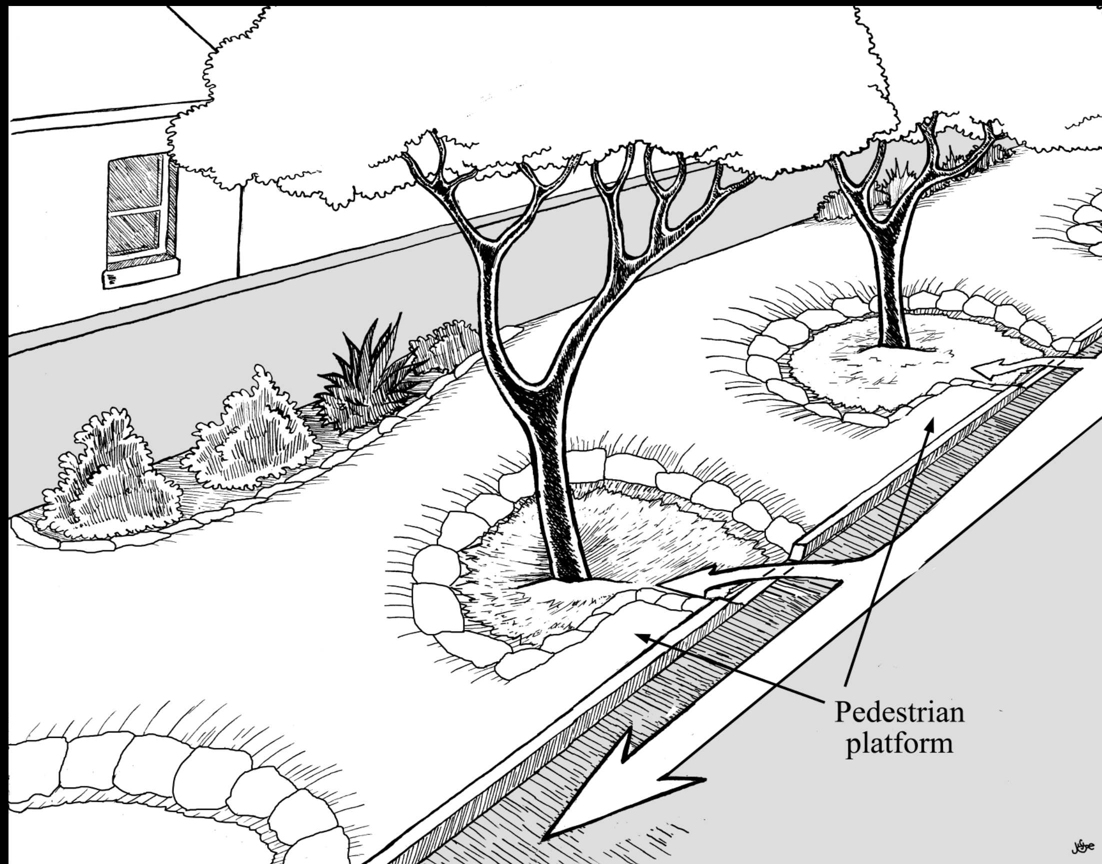

BEFORE
This photo was taken in 1994, prior to the 1996 planting of rain and trees in the
way adjoining the property at 813 N 9th Avenue. The asphalt driveway had just
of the current vegetation has been irrigated solely with passively harvested
runoff. All prunings and leaf-drop are reused as mulch in the basins
More information is available at HarvestingRainwater.com and
Rainwater Harvesting
for Drylands and Beyond
VOLUME 1 2nd Edition
Guiding Principles
to Welcome Rain into Your Life and Landscape
Brad Lancaster
Foreword by Gary Paul Nabhan

Lesson learned 1: Start at top of watershed – the water *source*





Lesson learned 2: Increase harvestable rain multifold with runoff from adjoining hardscape surfaces

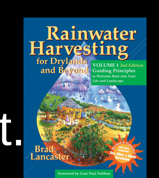


In Tucson, AZ (receiving 280mm [11 inches] of annual rainfall)

One kilometer of an average residential street drains over

3 MILLION LITERS of rainfall *per year*.

That's enough water to sustainably irrigate 225 native food trees per kilometer, or one tree every 7.5 meters on both sides of the street - irrigated by the street.

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Revised & Expanded
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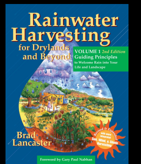
Cutting street curb

Curb cuts legalized in 2007
$50 permit



Curb core hole

100-mm (4-inch) diameter


YIELD
KEEP RIGHT
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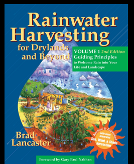
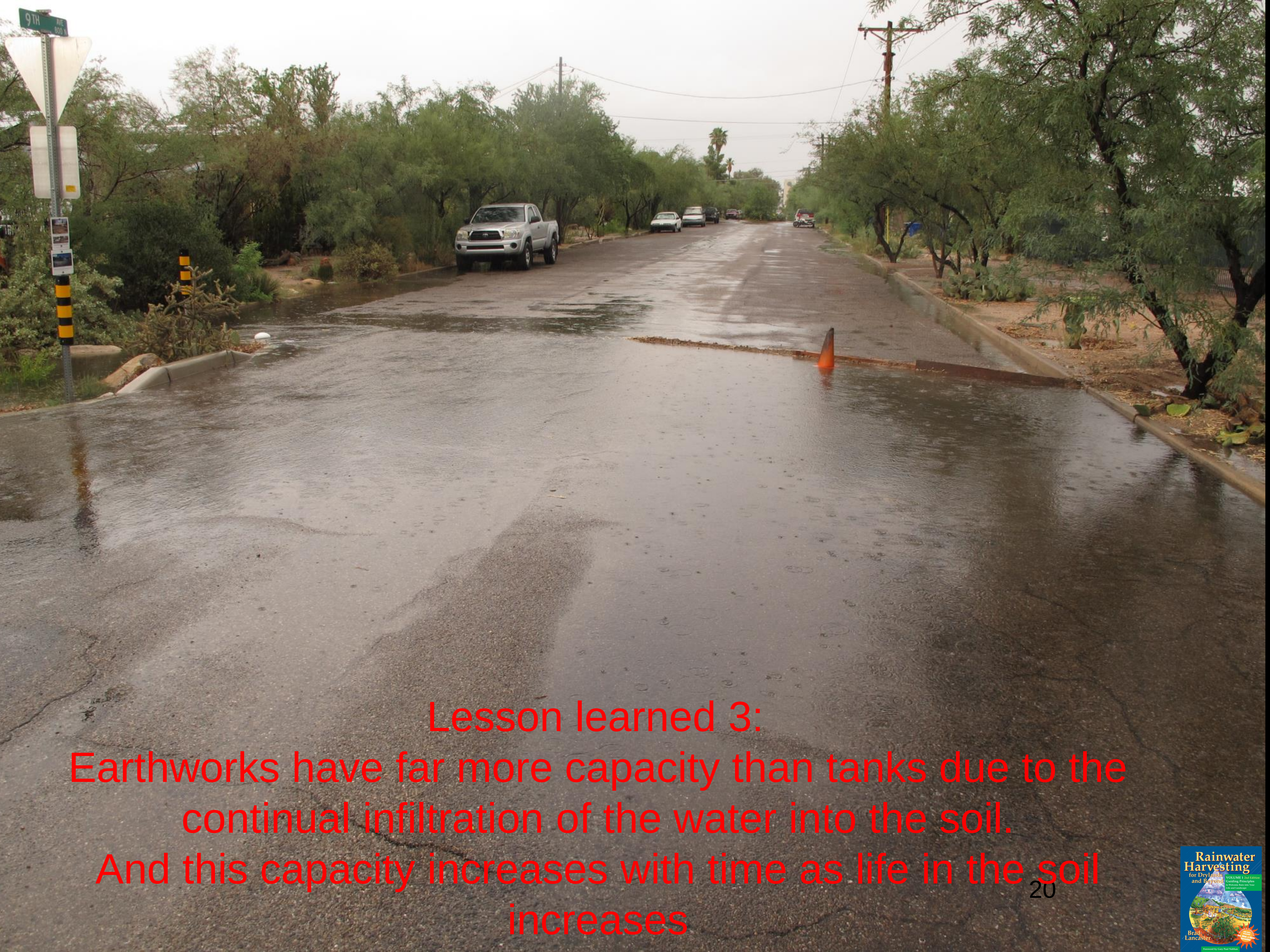
By diverting water from the east side of the street to our (west) side we increased the size of the watershed contributing to our five street-side basins, and two in-street basins, 6 times.

Thus during a single 38-mm (1.5-inch) storm, we harvested 75,000 liters (20,000 gal) in our seven right-of-way basins.

That is the amount of water our normal street catchment area (without diversion) would capture in a 1,000-year storm event.




Lesson learned 3:
Earthworks have far more capacity than tanks due to the continual infiltration of the water into the soil.
And this capacity increases with time as life in the soil increases
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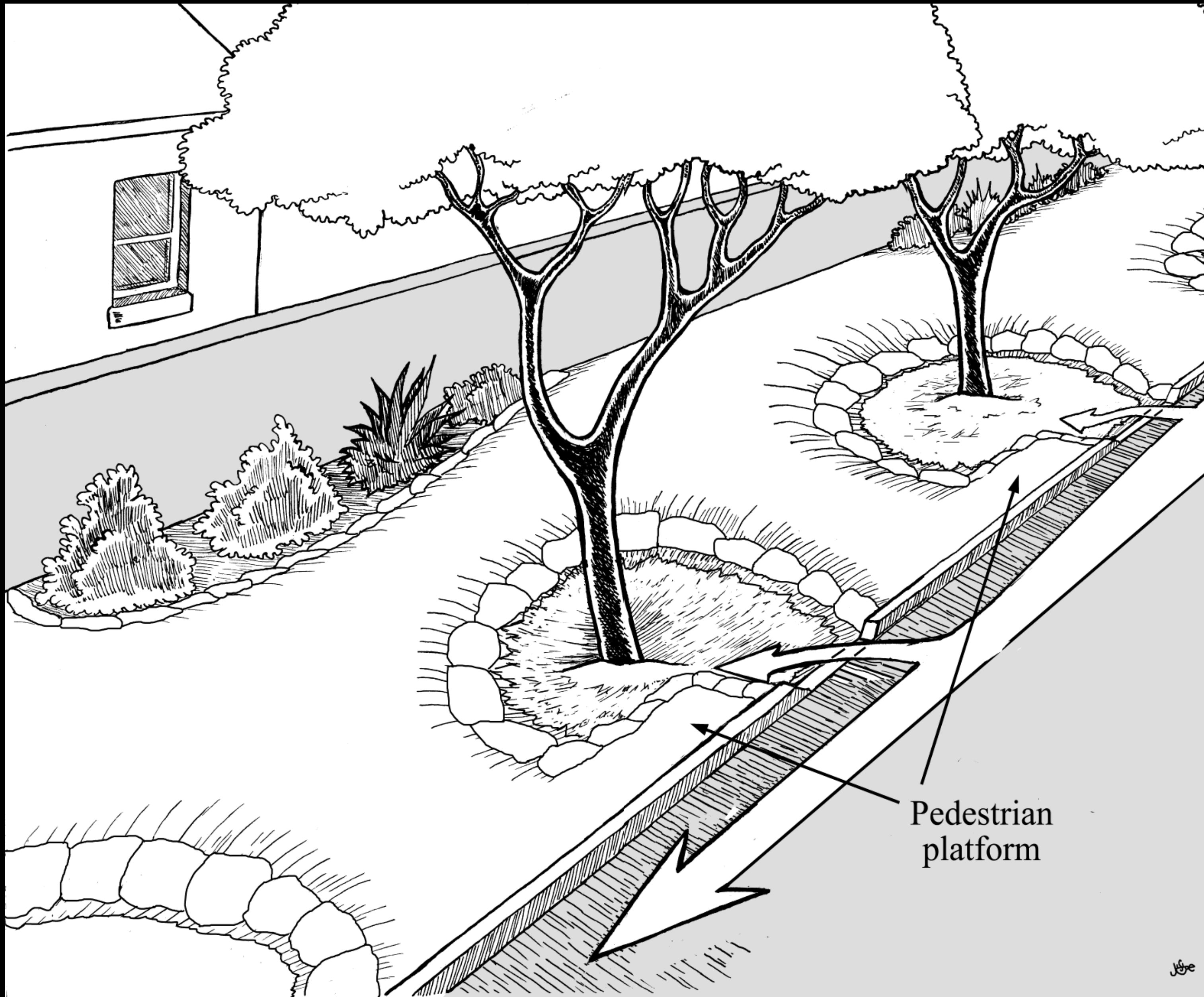
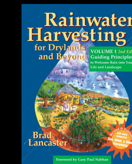
821
BEWARE
OF THE DOG
Rainwater
Harvesting
Brad
Lancaster

Lesson learned 4: “Backwater” or “eddy” street runoff-harvesting basins are the most stable and self-maintaining



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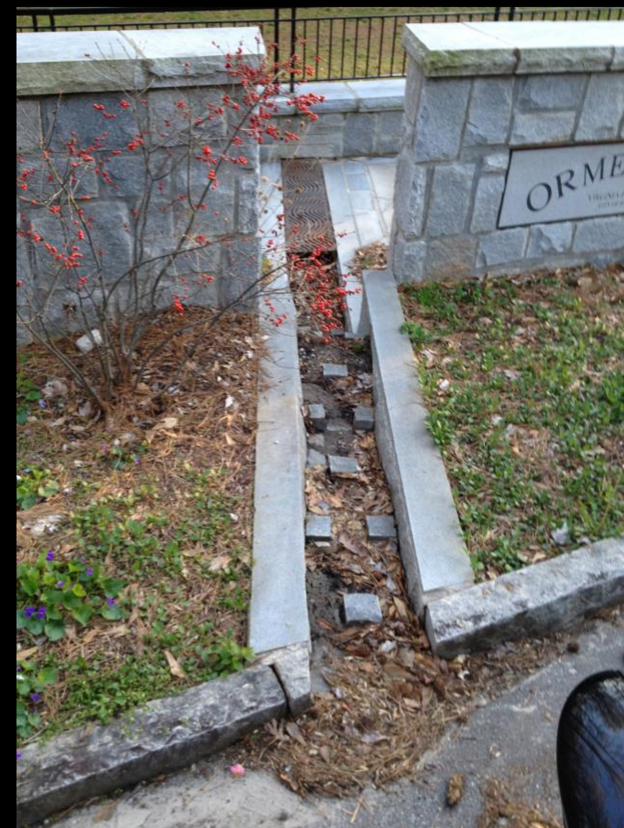
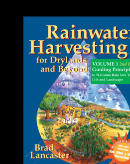
Lesson learned 5:
Have 50-mm (2-inch) drop at inlet point to speed up water flow and prevent a detritus dam from forming

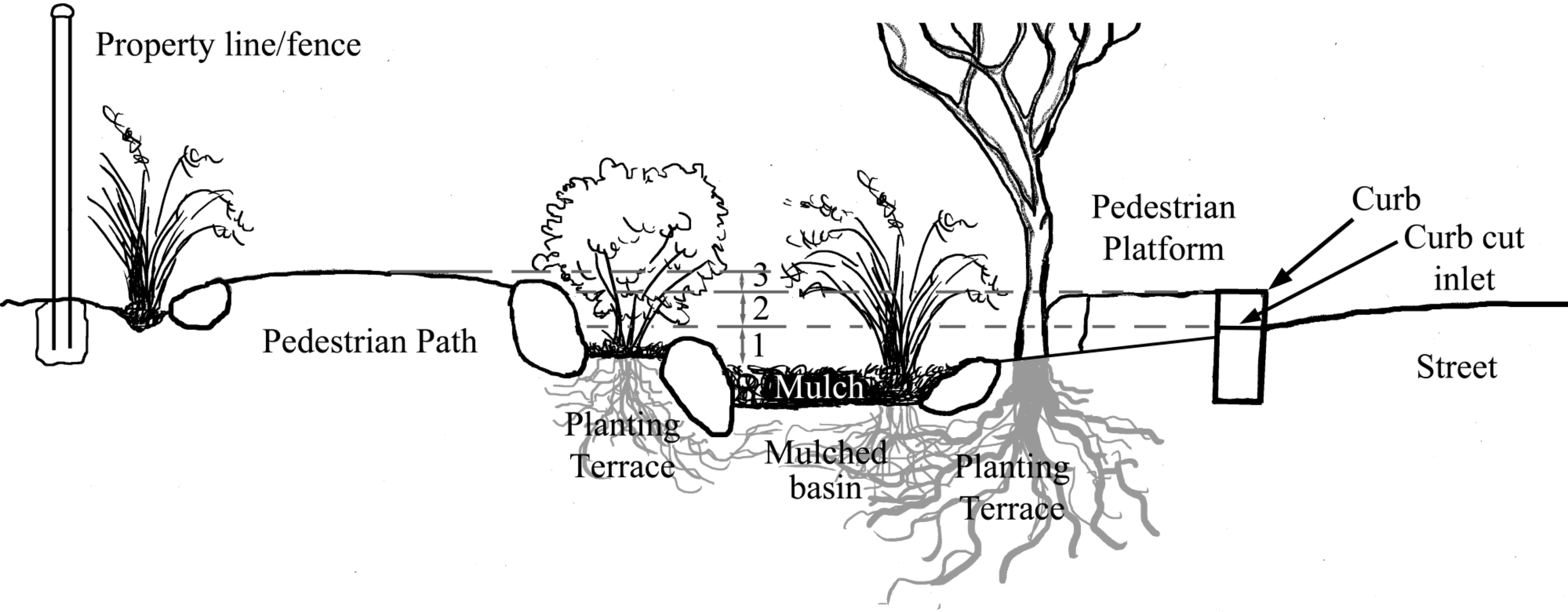
Good



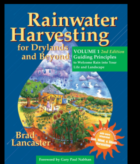
Bad



Lesson learned 6:
Three key elevation relationships



Elevation 1: Top of mulch within basin is lower than elevation of inlet.
Elevation 2: Inlet/overflow is the lowest point of the earthwork's perimeter.
Elevation 3: Property-side path is 50 mm (2 inches) higher than curb to ensure water never flows into property.



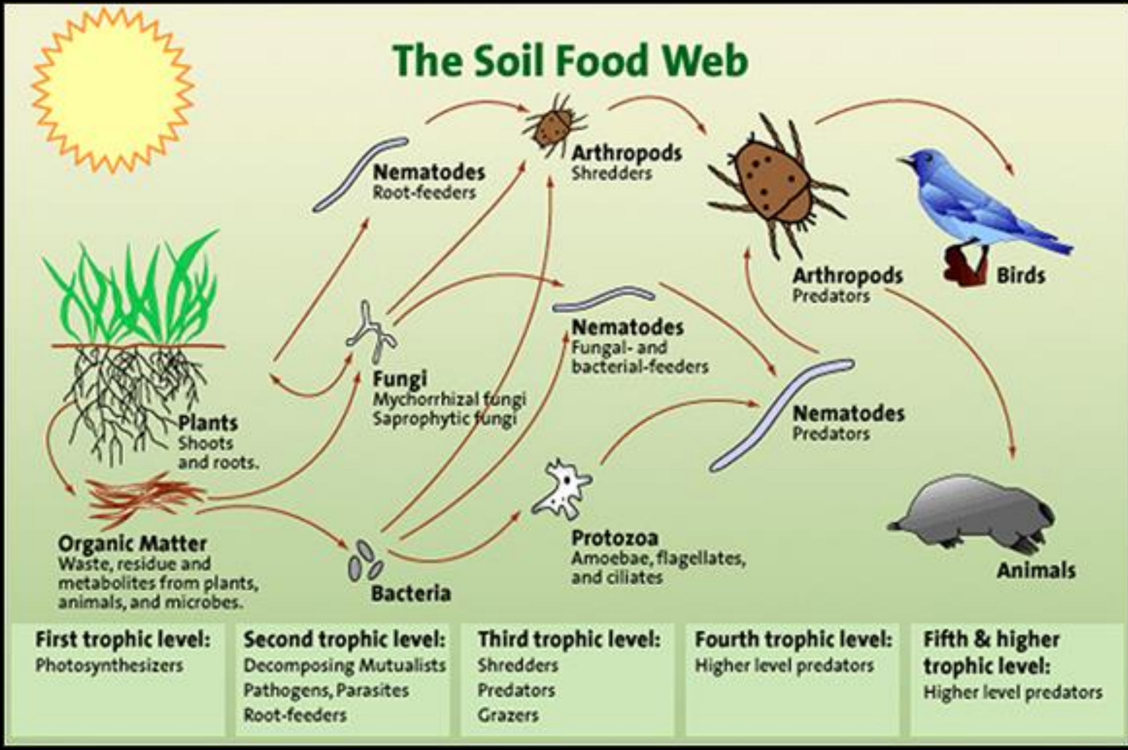
Lesson learned 7:
Living soil systems
are the most productive
and beneficial

• 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



Mitchell Pavao-Zuckerman, PhD
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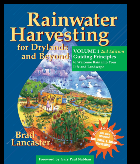
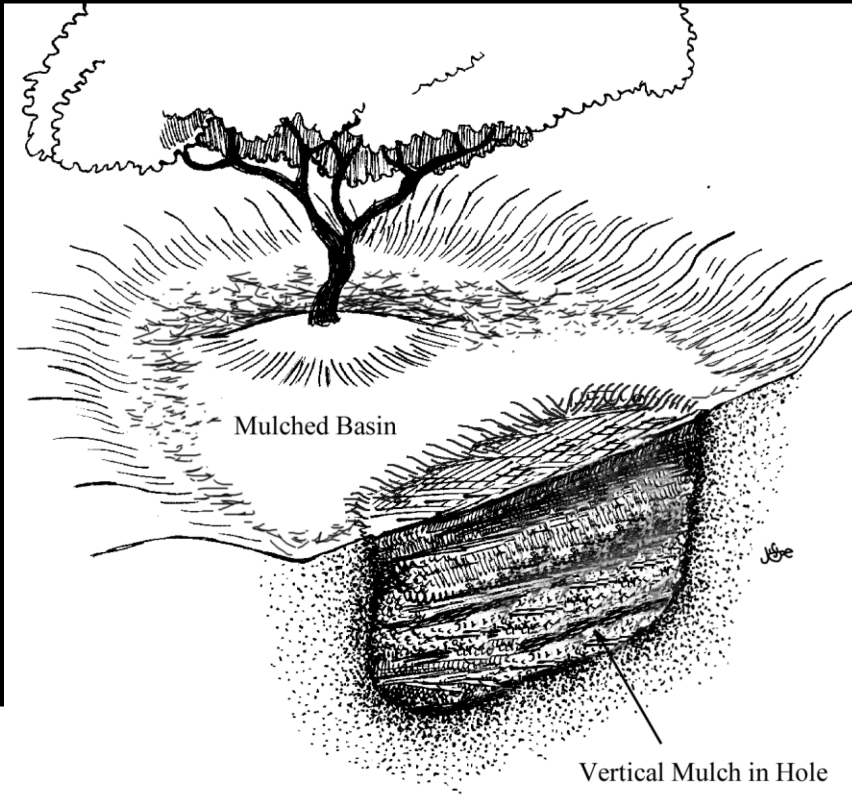
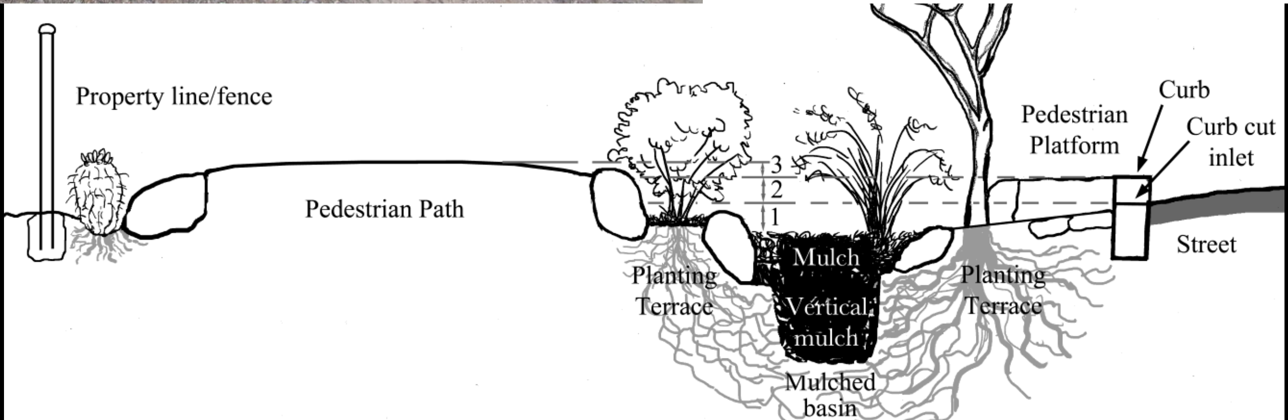
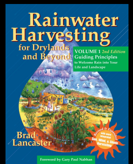


Chipped and Mulchy

Lesson learned 8: Vertical mulching can increase capacity, and reuse of “waste,” without increasing potential of standing water







Lesson learned 9:
Design public space to maximize the health and wealth of all

The neighborhood now annually harvests over **2.5 million liters** (660,000 gallons) of stormwater in the public right-of-way within 10 water-harvesting traffic circles, 33 chicanes, and 85 street-side basins fed by 50 curb cuts and 35 cores

But we could, and need to, increase that harvest by at least 30 times

Before chicane ^

After chicane >

Scarcity – heat island

5.5 ˚C (10˚F) *increase* of summer temperatures

Abundance – cool island

5.5 ˚C (10˚F) *decrease* of summer temperatures

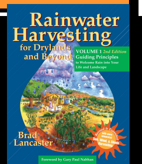
AGUA 4

PRECIPITACIÓN PROMEDIO (GANANCIA)[2] *PERÍODO 1901–2011*

	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC	ANUAL
mm	12.0	13.1	9.7	8.9	11.9	24.9	64.0	70.2	37.6	26.2	11.7	20.2	310.4
PULG.	0.47	0.52	0.38	0.35	0.47	0.98	2.52	2.76	1.48	1.03	0.46	0.80	12.22

EVAPORACIÓN PROMEDIO (PÉRDIDA)[e,2] *PERÍODO 1954–2013*

	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC	ANUAL
mm	67.4	85.9	141.0	188.0	208.5	244.4	224.8	188.9	158.8	127.7	87.2	65.5	1788.1
PULG.	2.66	3.38	5.55	7.40	8.21	9.62	8.85	7.44	6.25	5.03	3.43	2.58	70.40



Scarcity – heat island

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AGUA ⚐4

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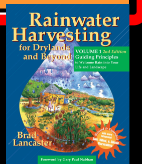


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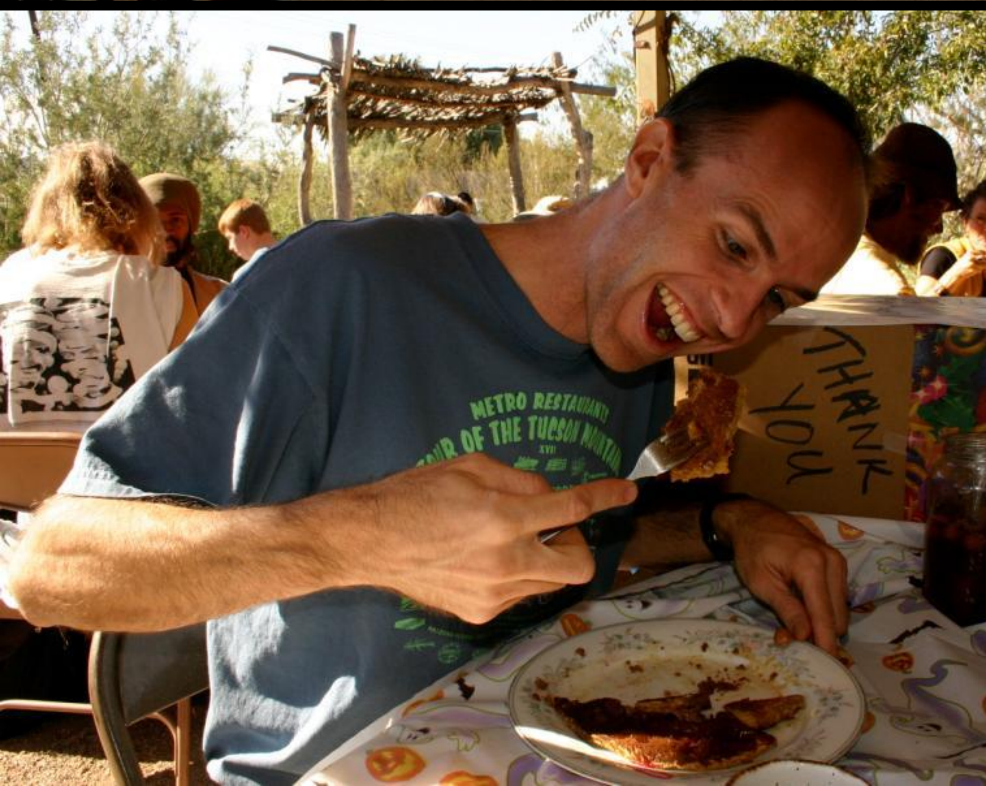
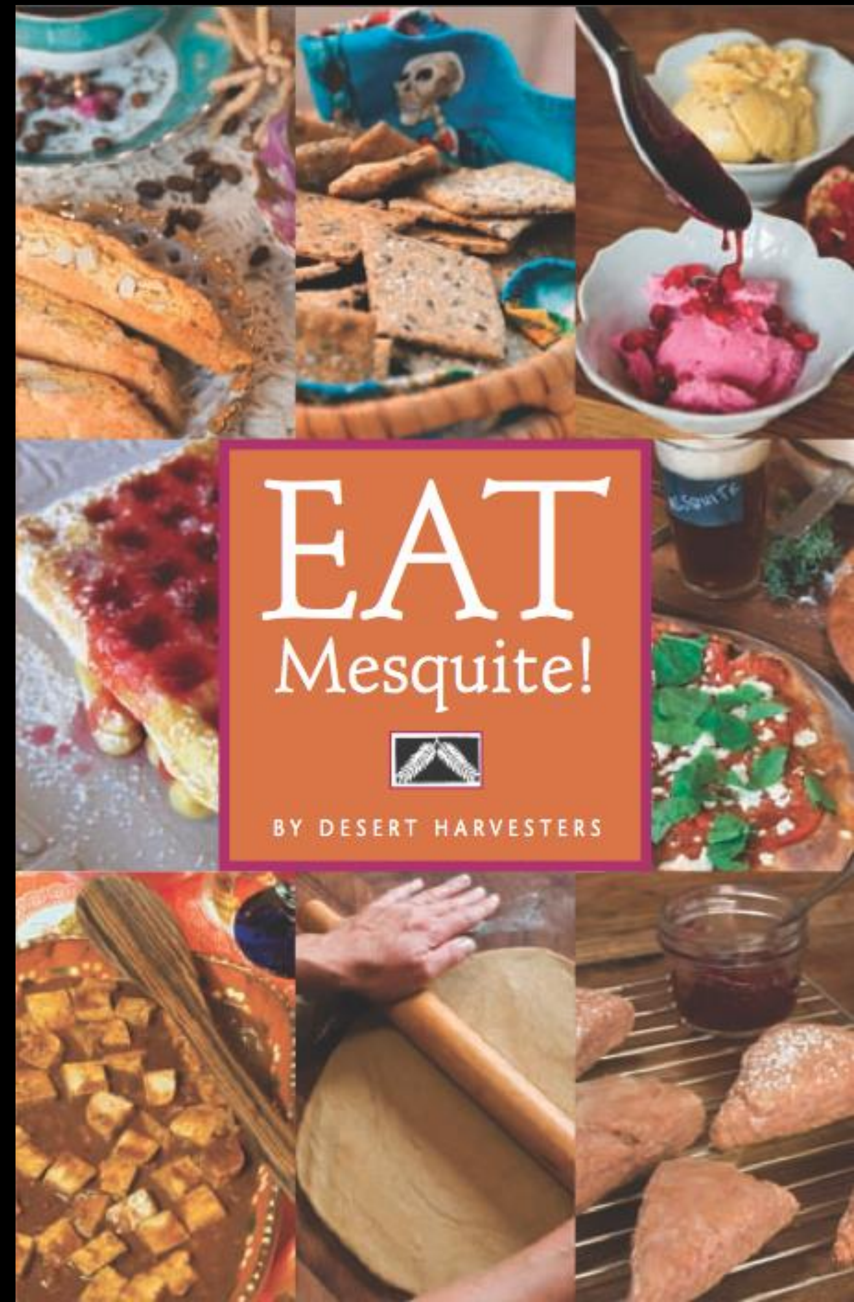
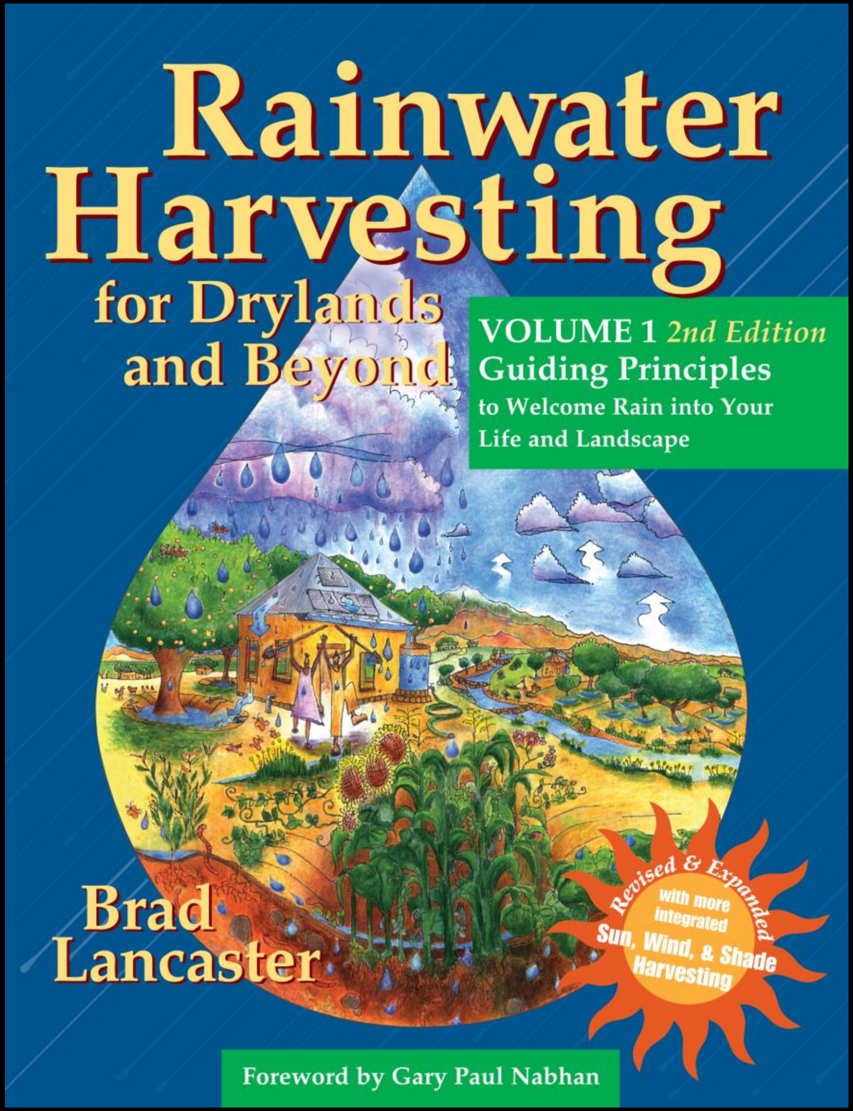
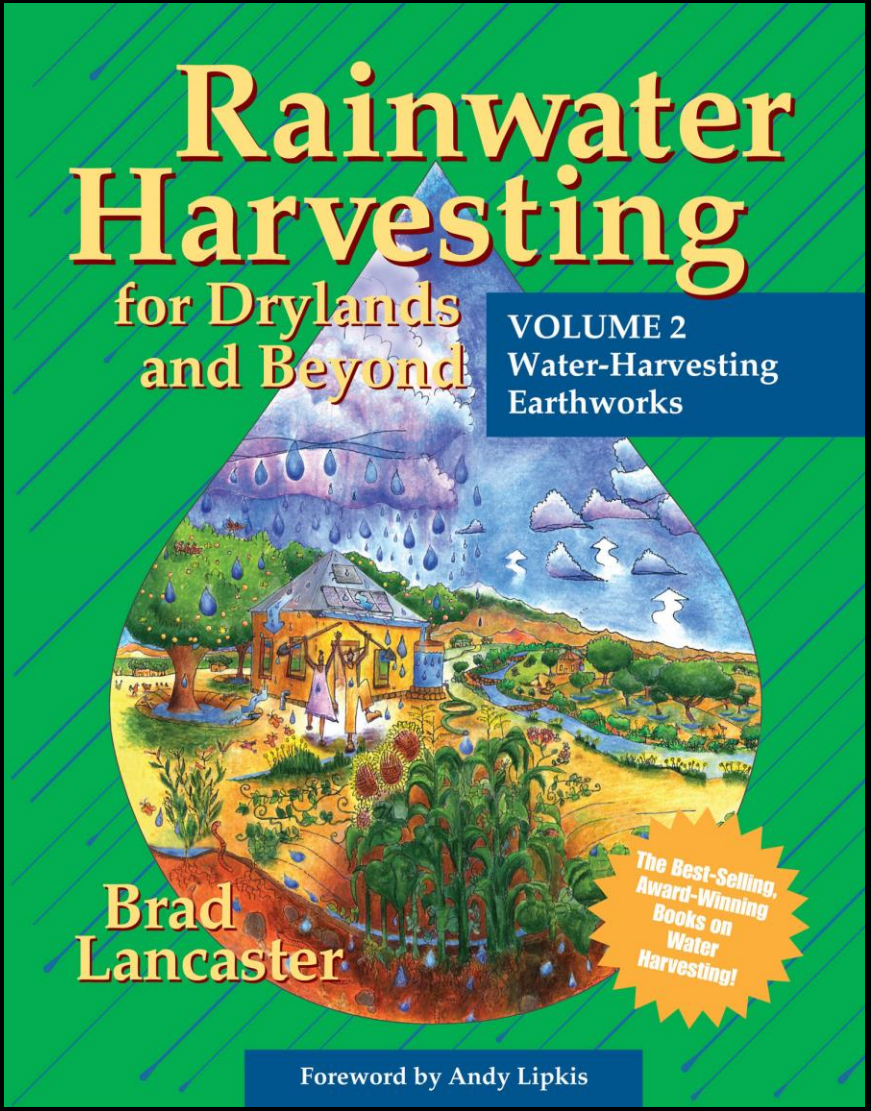




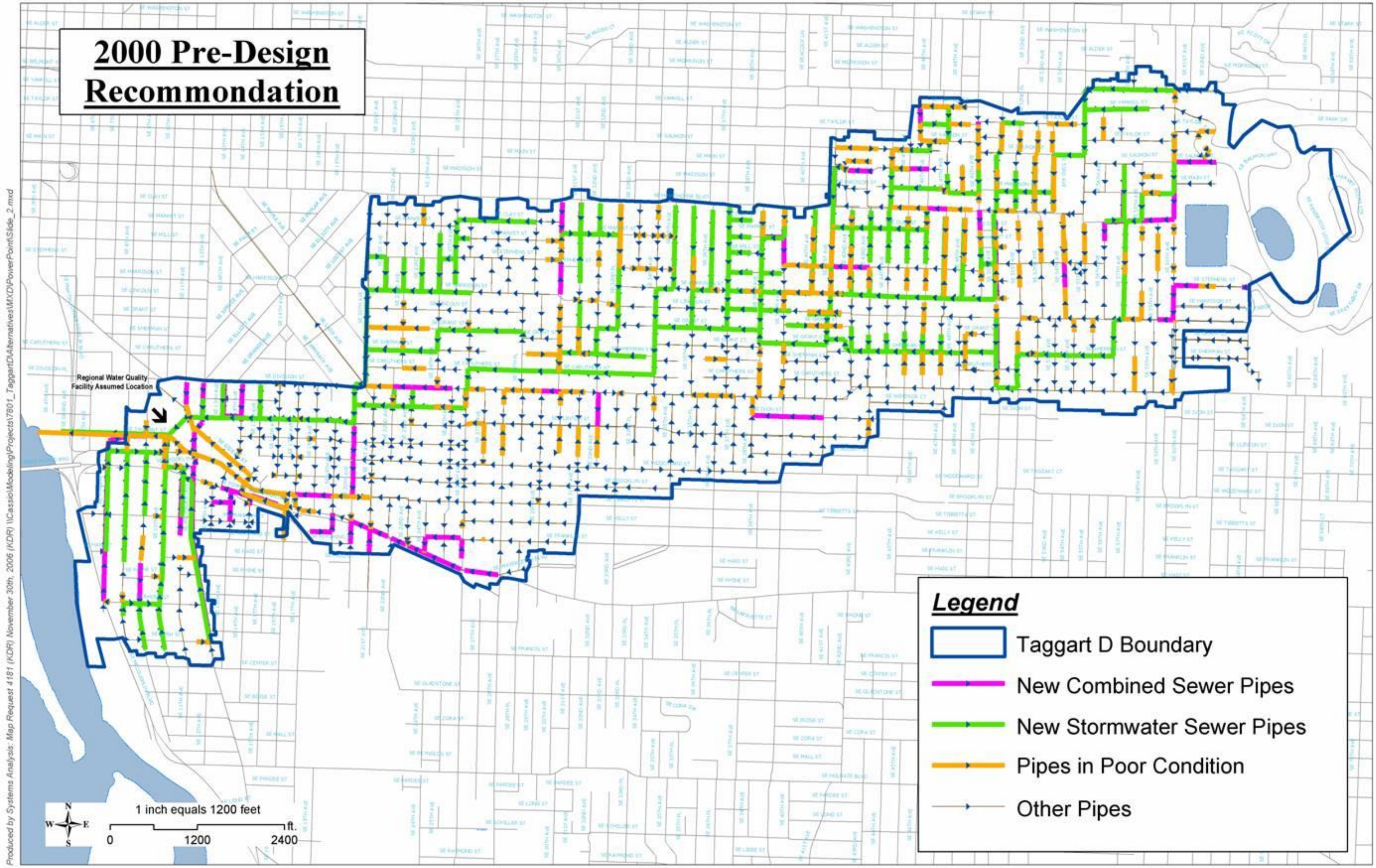
Lost Sonoran Sucker Fish and water-harvesting Horned Lizard sculpture by Joseph Lupiani in a water-harvesting traffic-calming chicane



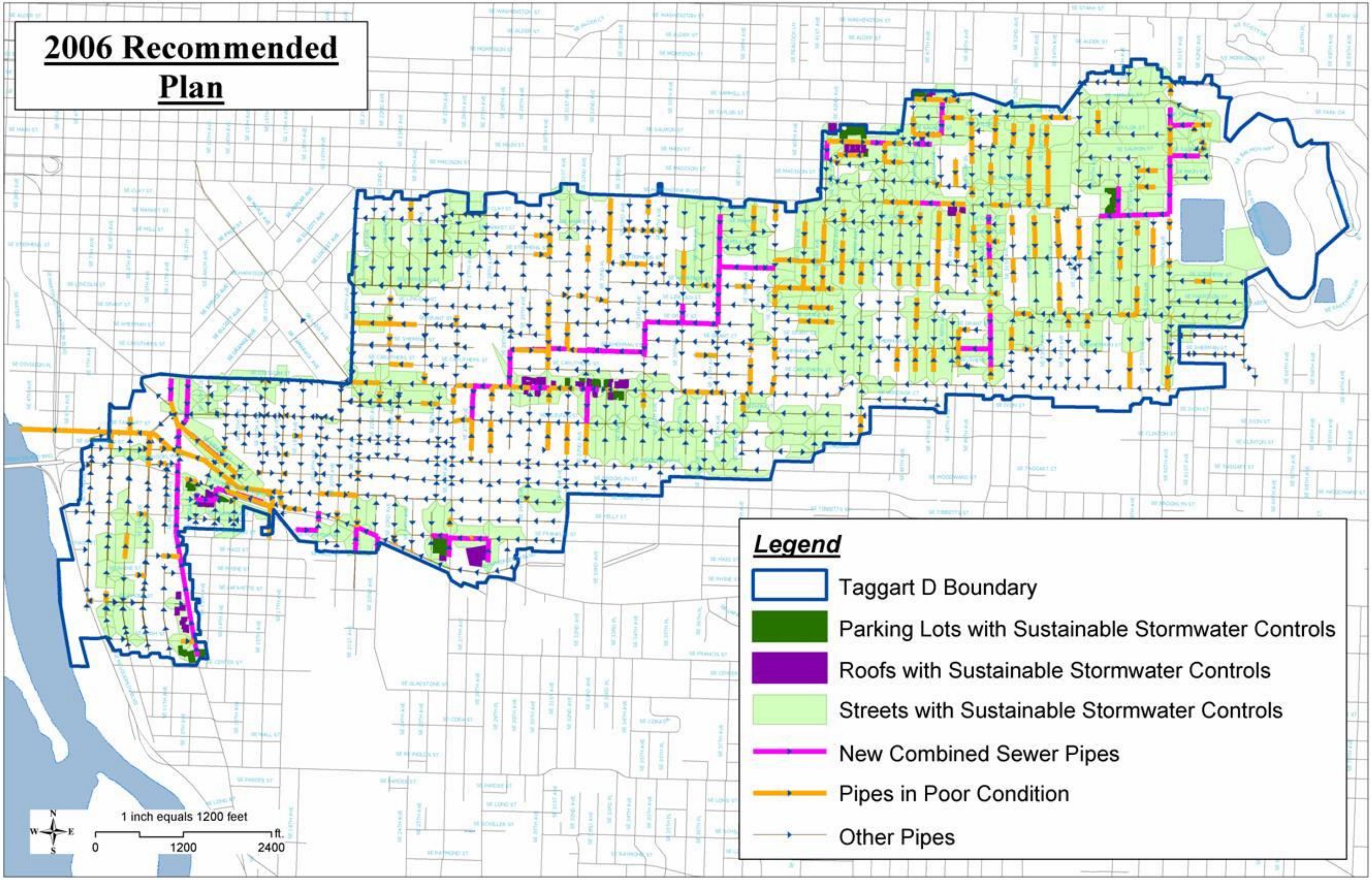


www.HarvestingRainwater.com

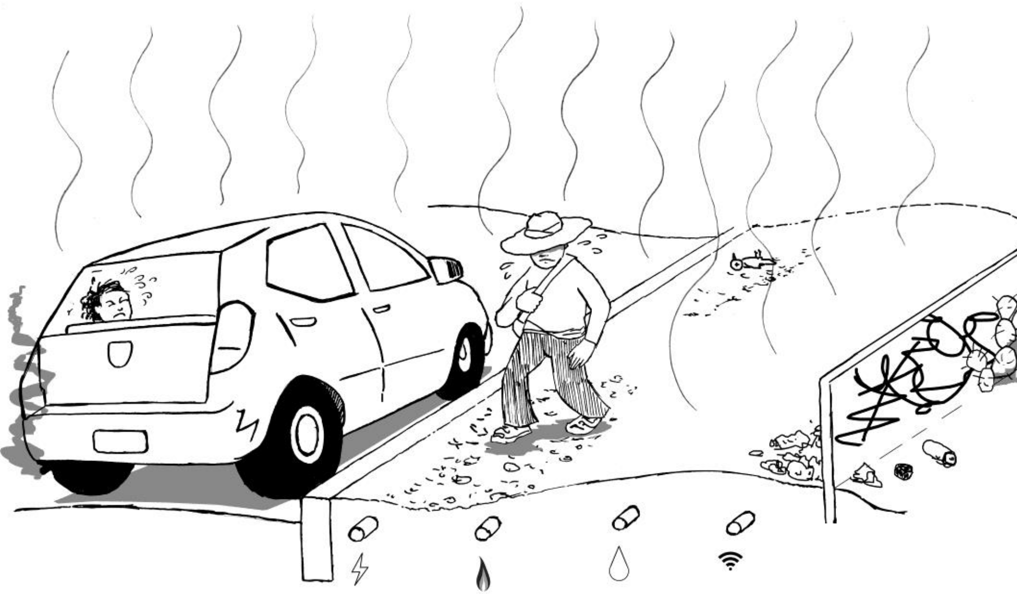
City is divided up into subwatersheds, and those of highest need are identified. Combined Sewer Overflows are the typical problem



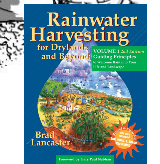
Conventional drainage design cost $144 million



Plan with sustainable stormwater strategies cost $86 million.
$58 million savings due to the reduction of needed pipe replacement



Public rights-of-way must not be limited to private utility rights-of-way



See
“One-Page
Place Assessment”
page at
HarvestingRainwater.com
for free download and
how-to guide

EVALUACIÓN DE CIUDAD JUÁREZ, CHIH., MÉXICO, EN UNA HOJA

UBICADO EN LA CUENCA RÍO BRAVO (RIO GRANDE FORT QUITMAN)

CLIMA 1

TEMPERATURAS MÁXIMAS & MÍNIMAS PROMEDIOS[1] *PERÍODO 1901–2011*

	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC	ANUAL
°C MÁX	13	16	19	24	28	34	36	34	33	28	22	22	25.8
°C MÍN	0	2	4	8	15	18	22	22	20	14	7	8	11.7
°F MÁX	55	61	66	75	82	93	97	93	91	82	72	72	78.4
°F MÍN	32	36	39	46	59	64	72	72	68	57	45	46	53.1

TEMP. MÁX. HISTÓRICA[1,2] 46.0° C | 114.8° F | *JUNIO 1994* TEMP. MÍN. HISTÓRICA[1,2] -18.5° C | -1.3° F | *FEBRERO 2011*

SOL 2

LATITUD 31.7°

ELEVACIÓN 1,128 m / 3,700 PIES

	21 MAR	21 JUN	21 SEP	21 DIC
GRADOS N o S DADO EL ESTE POR EL CUAL EL SOL SE LEVANTA[3]	0°	28°N	0°	27°S
GRADOS N o S DADO EL OESTE POR EL CUAL EL SOL SE OCULTA[3]	0°	28°N	0°	27°S
ÁNGULO DE ALTITUD AL MEDIODÍA SOLAR (POR ARRIBA DEL HORIZONTE)[a,3,4]	58°	82°	58°	35°

PROPORCIÓN OBJETO:SOMBRA EN EL SOLSTICIO DE INVIERNO AL MEDIODÍA SOLAR[b] 1 : 1.44 ...Y AZIMUT[c] 0°

PROPORCIÓN OBJETO:SOMBRA EN EL SOLSTICIO DE INVIERNO A LAS 9AM & 3PM SOLARES[b,3] 1 : 2.73 ...Y AZIMUT[c,3] 44°

VIENTO 3

DIRECCIÓN PREDOMINANTE DEL VIENTO (DESDE DÓNDE)[4,5] Y VELOCIDAD PROMEDIO[5]

VELOCIDAD MÁX.[5] 117 km/h | 73 MPH

	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC	
	WSW	WSW	WSW	WSW	WSW	WSW	ESE	ESE	ESE	WSW	WSW	SSW	ANUAL
km/h	14.8	18.5	20.4	24.1	20.4	16.7	14.8	14.8	14.8	14.8	16.7	16.7	17.3
MPH	9.2	11.5	12.7	15.0	12.7	10.4	9.2	9.2	9.2	9.2	10.4	10.4	10.7

AGUA 4

PRECIPITACIÓN PROMEDIO (GANANCIA)[2] *PERÍODO 1901–2011*

	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC	ANUAL
mm	12.0	13.1	9.7	8.9	11.9	24.9	64.0	70.2	37.6	26.2	11.7	20.2	310.4
PULG.	0.47	0.52	0.38	0.35	0.47	0.98	2.52	2.76	1.48	1.03	0.46	0.80	12.22

EVAPORACIÓN PROMEDIO (PÉRDIDA)[e,2] *PERÍODO 1954–2013*

	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC	ANUAL
mm	67.4	85.9	141.0	188.0	208.5	244.4	224.8	188.9	158.8	127.7	87.2	65.5	1788.1
PULG.	2.66	3.38	5.55	7.40	8.21	9.62	8.85	7.44	6.25	5.03	3.43	2.58	70.40

AÑO MÁS SECO[1,2] 14.73 mm | 0.58 PULG. | *1969* AÑO MÁS HÚMEDO[1,2]

PERIODO MÁS LARGO SIN PRECIPITACIÓN MENSURABLE[6]

GANANCIA DE LLUVIA[f] 192 l/hab/día | 51 G/HAB/DÍA

ÁREA[g,7] 300 km² | 115.8 MILLAS²

POBLACIÓN[h,8] 1,332,131 | *2010*

USO DE AGUA MUNICIPAL[9] 336 l/hab/día | 89 G/HAB/DÍA

PROFUNDIDAD DEL NIVEL FREÁTICO[i,10]

EXTRACCIÓN ACTUAL DE AGUA SUBTERRÁNEA | RECARGA NATURAL DE AGUA SUBTERRÁNEA[j,11]

ENERGUA 5

CANTIDAD DE ENERGÍA UTILIZADA PARA MOVER Y TRATAR AGUA / CANTIDAD DE AGUA UTILIZADA PARA PRODUCIR ELECTRICIDAD[k,12]

ESPECIES TOTEM 6

PECES:

AVES:

MEGAFAUNA:

REPTILES:

PLANTAS:

ANFIBIOS: *()*

MAMÍFEROS: *()*[l,13]

Disponible en línea en HarvestingRainwater.com/one-page-place-assessments


3D03001
4x4

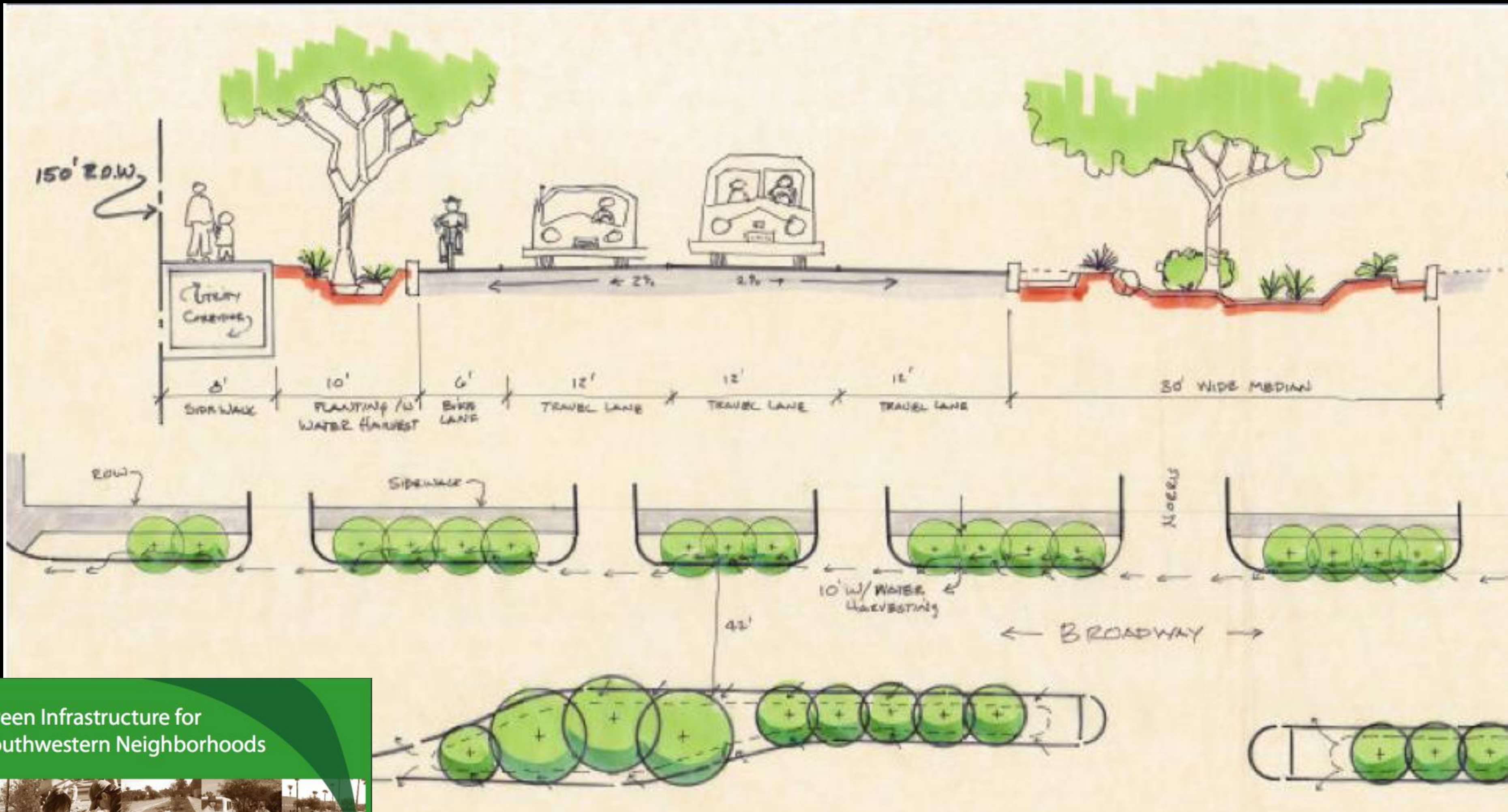
Dead *drainage*way to living *infiltration*way

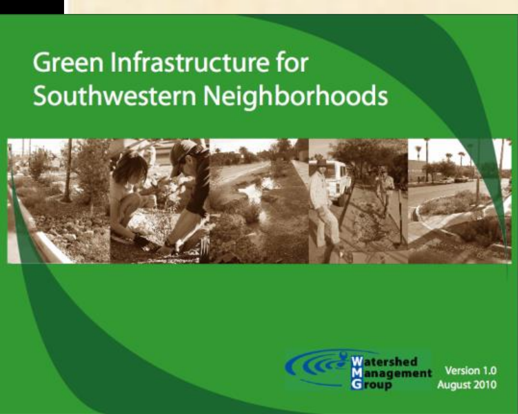
U of A Architecture and Landscape Architecture Building, Tucson, AZ
CALA landscape tour www.cala.arizona.edu

Green Streets Policy in Tucson, AZ

Minimum ½ -inch (12.7-mm) 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/

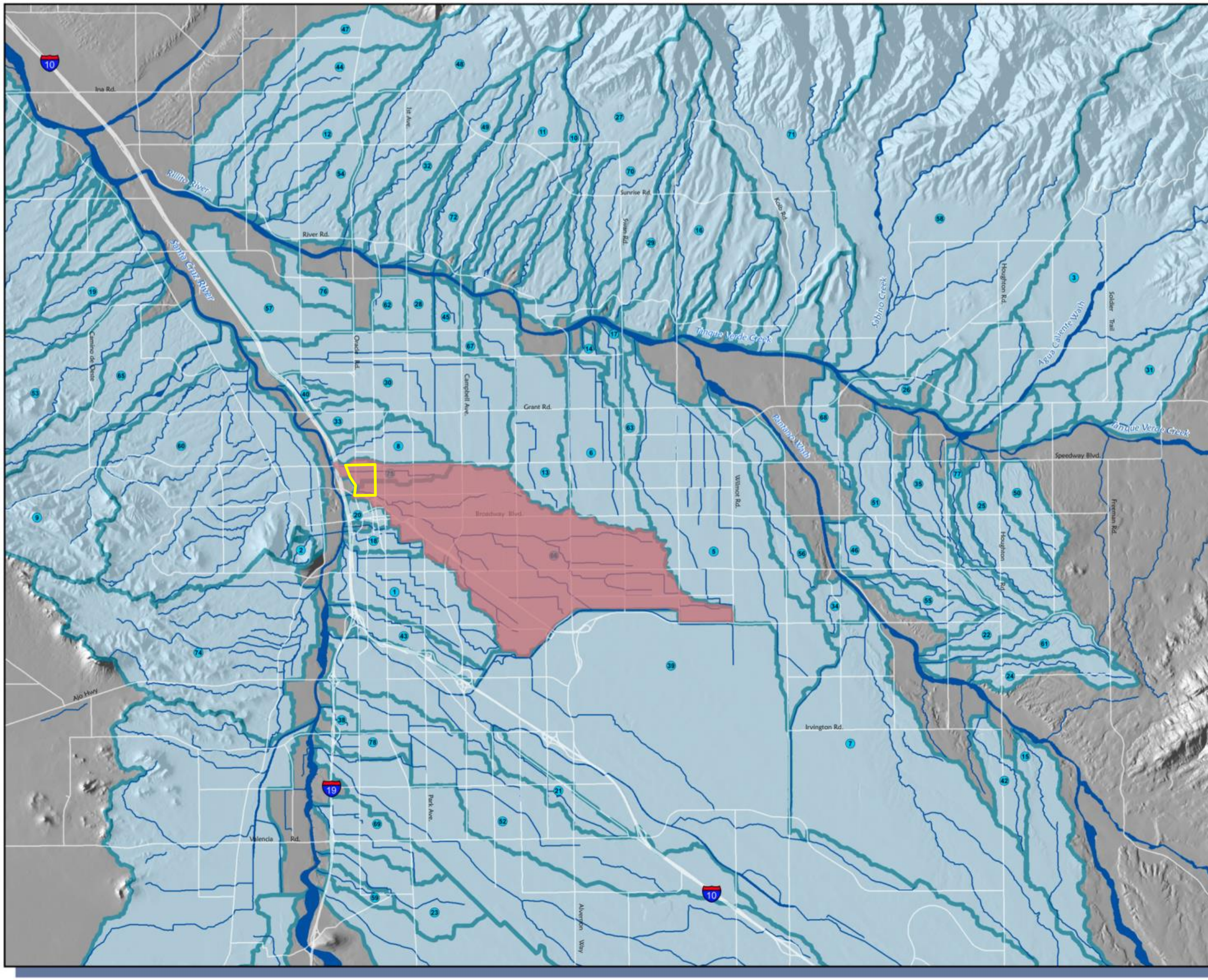




www.Watershedmg.org

Gila Monster bench by Hiro Tashima
next to neighborhood book nook

The Dunbar/Spring Neighborhood Washes & Their Watersheds*

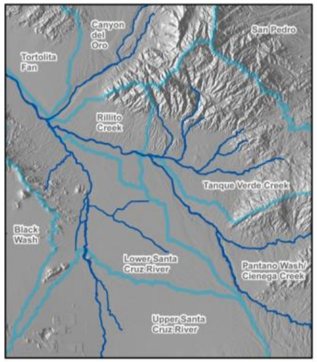


*shaded red on map & in list

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. Bronx 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. Mesqute 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

Major Streets

Named Washes

Major Watersheds

Map Date: March 23, 2009

TerraSystems Southwest, Inc.

Watershed Management Group

Economic Engine: neighborhood harvesters can make $25 per hour harvesting, milling, and then selling mesquite pods grown in their own neighborhoods

Dunbar/Spring neighborhood intersection repair, 2006