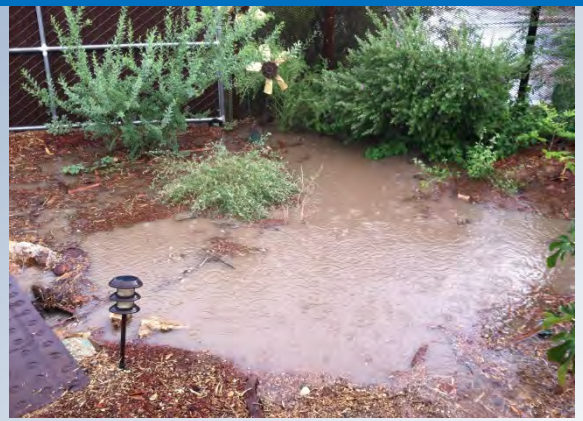
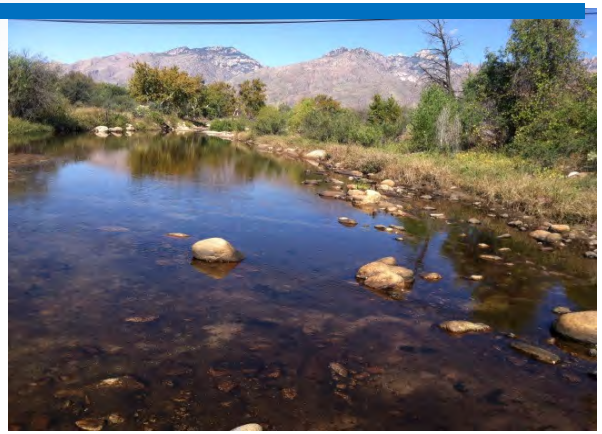
Rainwater Harvesting

James DeRoussel
Registered Landscape Architect
Certified Arborist
Certified Irrigation Auditor

Watershed Management Group

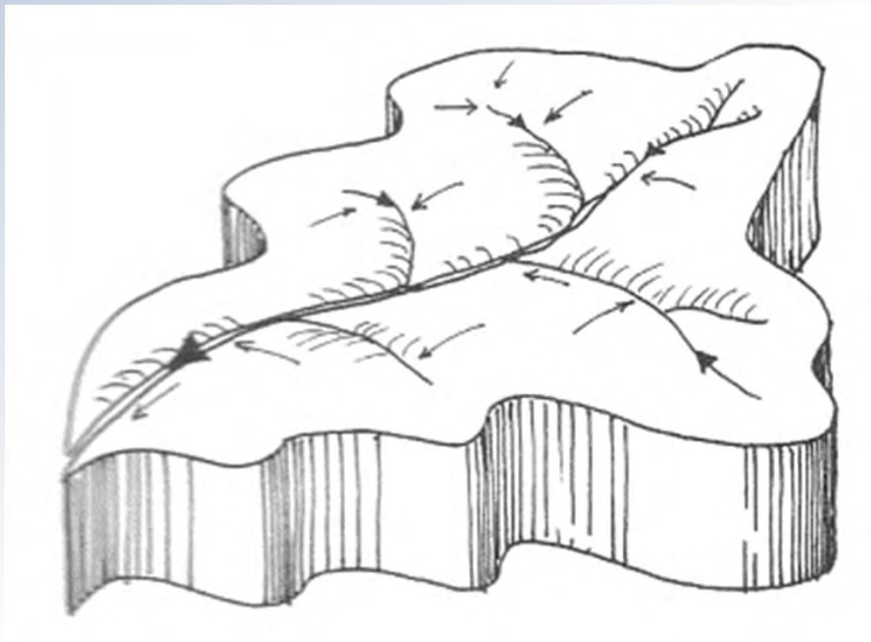
A 501(c)3 Non-profit organization





What is a watershed?

watershed: **a unit of land topographically defined where all surface water flows to a common outlet**



Watershed Management Group

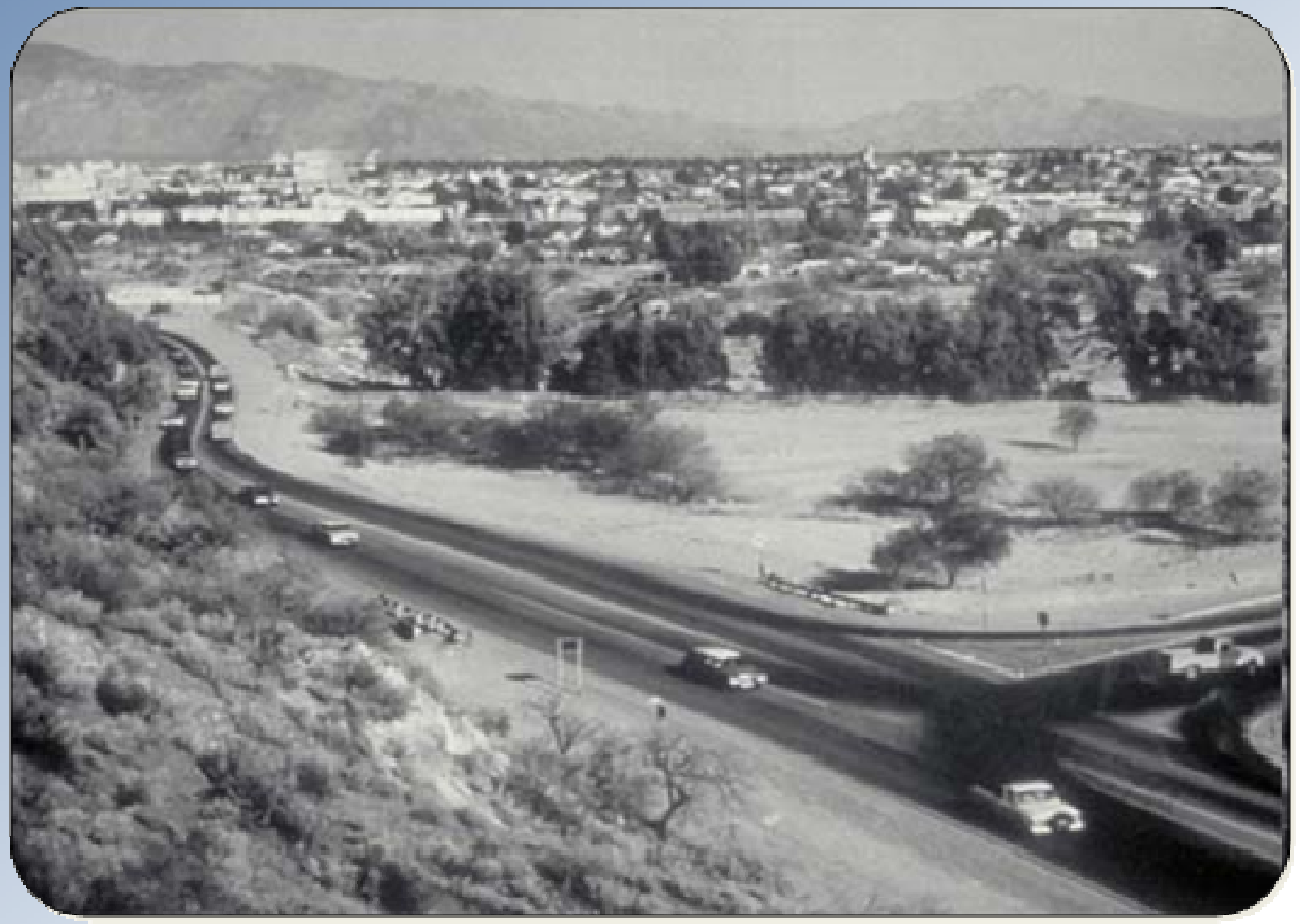
What is a watershed?

Watershed Management Group

Tucson, 1904. Santa Cruz River from “A” Mountain

Watershed Management Group

Tucson, 1981. Santa Cruz River from “A” Mountain

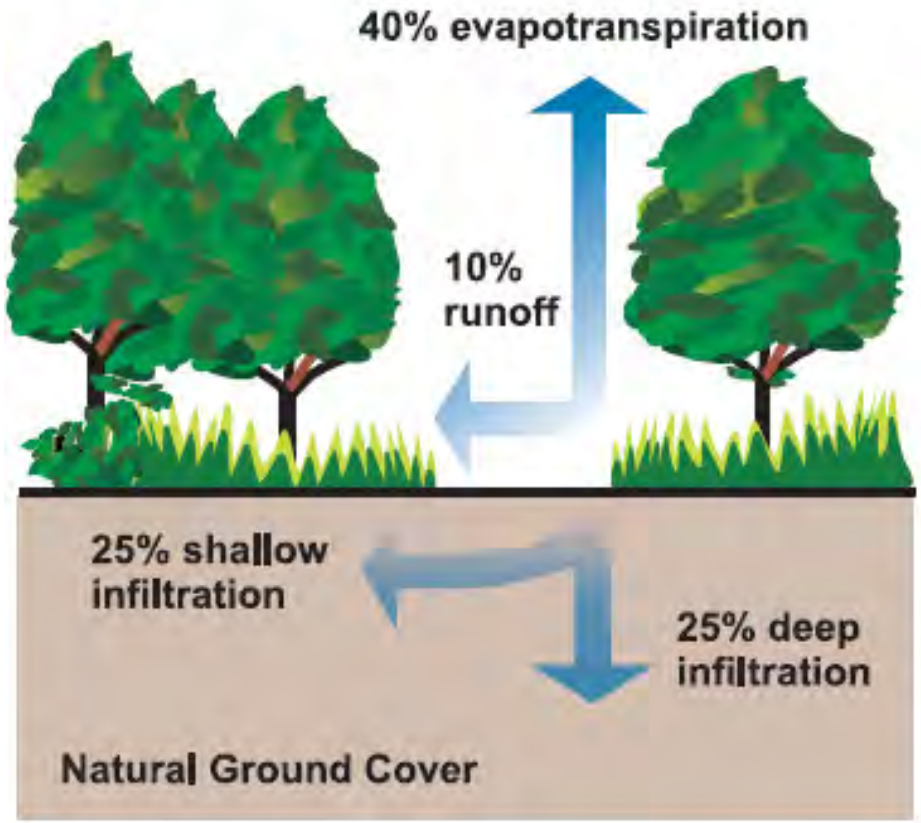


Watershed Management Group

…the future is urban.

Tucson, 2013. Santa Cruz River from "A" Mountain

How does water harvesting link to watershed health?



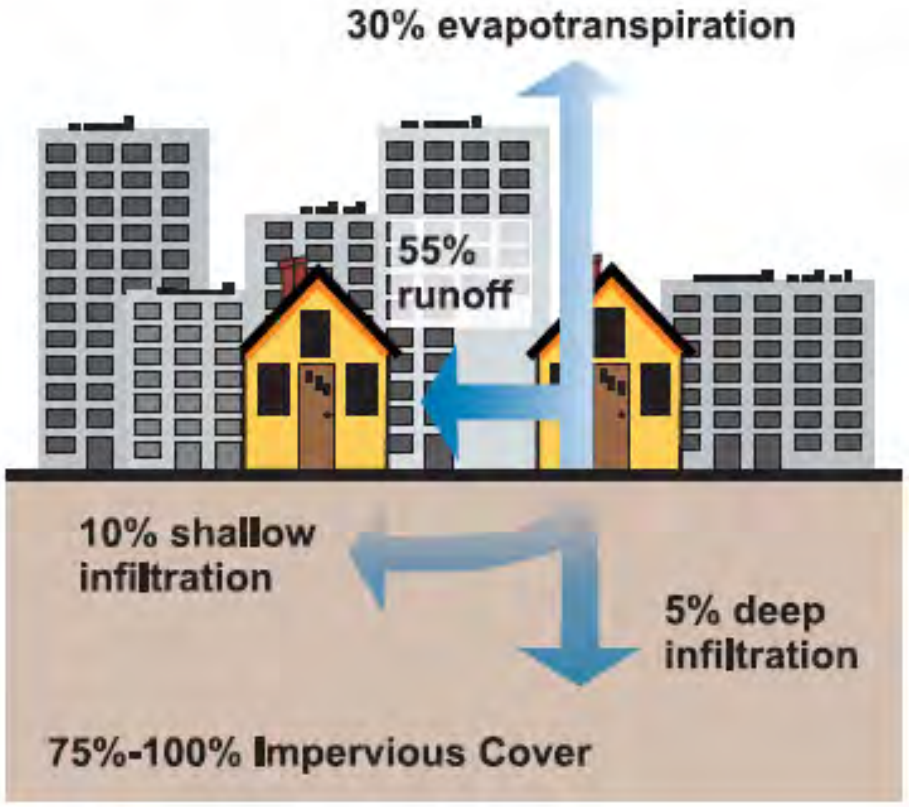


Image source: www.epa.gov

water harvesting restores local hydrology & can benefit our homes!

Images courtesy of Brad Lancaster, harvestingrainwater.com

Watershed Management Group

Your choice, to promote:

Resource Scarcity ? or Resource Abundance?

And Reduce (or eliminate) potable water use in your landscape!

Watershed Management Group

Rainwater Harvesting Practices

Capturing rainwater for beneficial use

Rainwater Storage Options:

1) **Passive (landscape/soil)** – allows plants to access moisture stored; organic mulch reduces evaporation

2) **Active (cisterns)** – allows user to distribute moisture manually as needed

Watershed Management Group

Residential Resources

Potential Annual Rainwater Supply:

- Roof, 1000sf = **7,200 gallons/yr**
- Driveway, 500sf = **3,600 gallons/yr**
- Landscape, 1000sf = **3,000 gallons/yr**

- Harvestable Rainfall on 1/5acre > **45,000 gallons/yr**

- **+ Greywater! (~4000 - 18,000 gal)**
- **+ AC condensate! (~200 – 500 gal)**

Estimated Annual Municipal Water Demand:

Total Use = 95gal/person/day x 2.5persons/home x 365 days = **86,700 gallons/yr**

Outdoor use (~40% of total) = **~34,000 gallons/yr**

Watershed Management Group

Summary of benefits from water harvesting

- Rain and greywater is free, save $$$
- Energy savings
  - local vegetation cooling benefits
  - less water to transport & treat
- Higher quality water for plants (rainwater)
- Reduce flooding and stormwater pollutants
- Reduce vulnerability to drought & rising price of water
- Increase vegetation without increasing city water usage
- Increased soil moisture, healthier soils

Remember those…

Water Harvesting PRINCIPLES

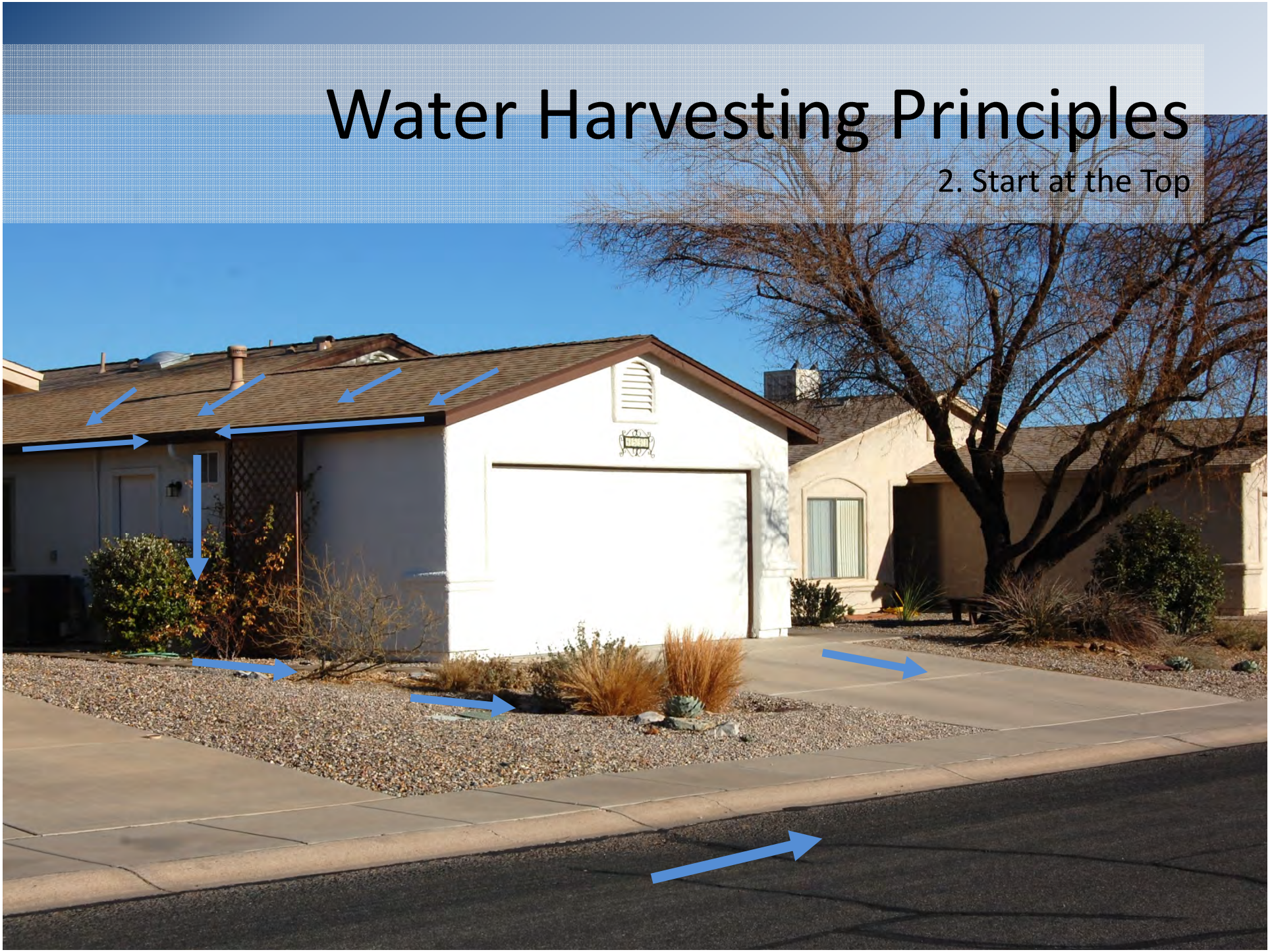
From Brad Lancaster's, Rainwater Harvesting for Drylands and Beyond

Water Harvesting Principles

1. Begin with Long and Thoughtful Observation

Water Harvesting Principles

2. Start at the Top

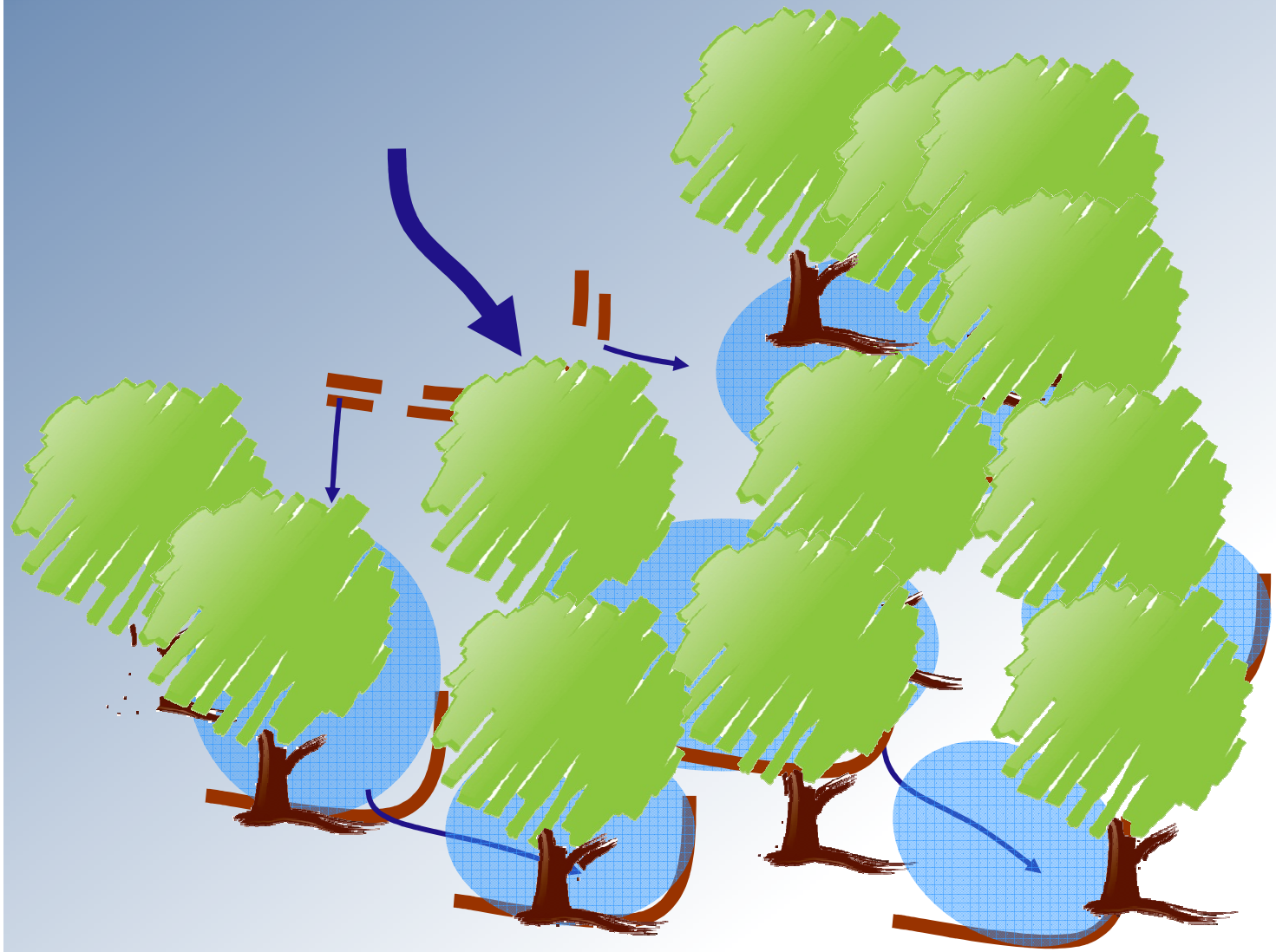


Water Harvesting Principles

3. Start small and simple

Water Harvesting Principles

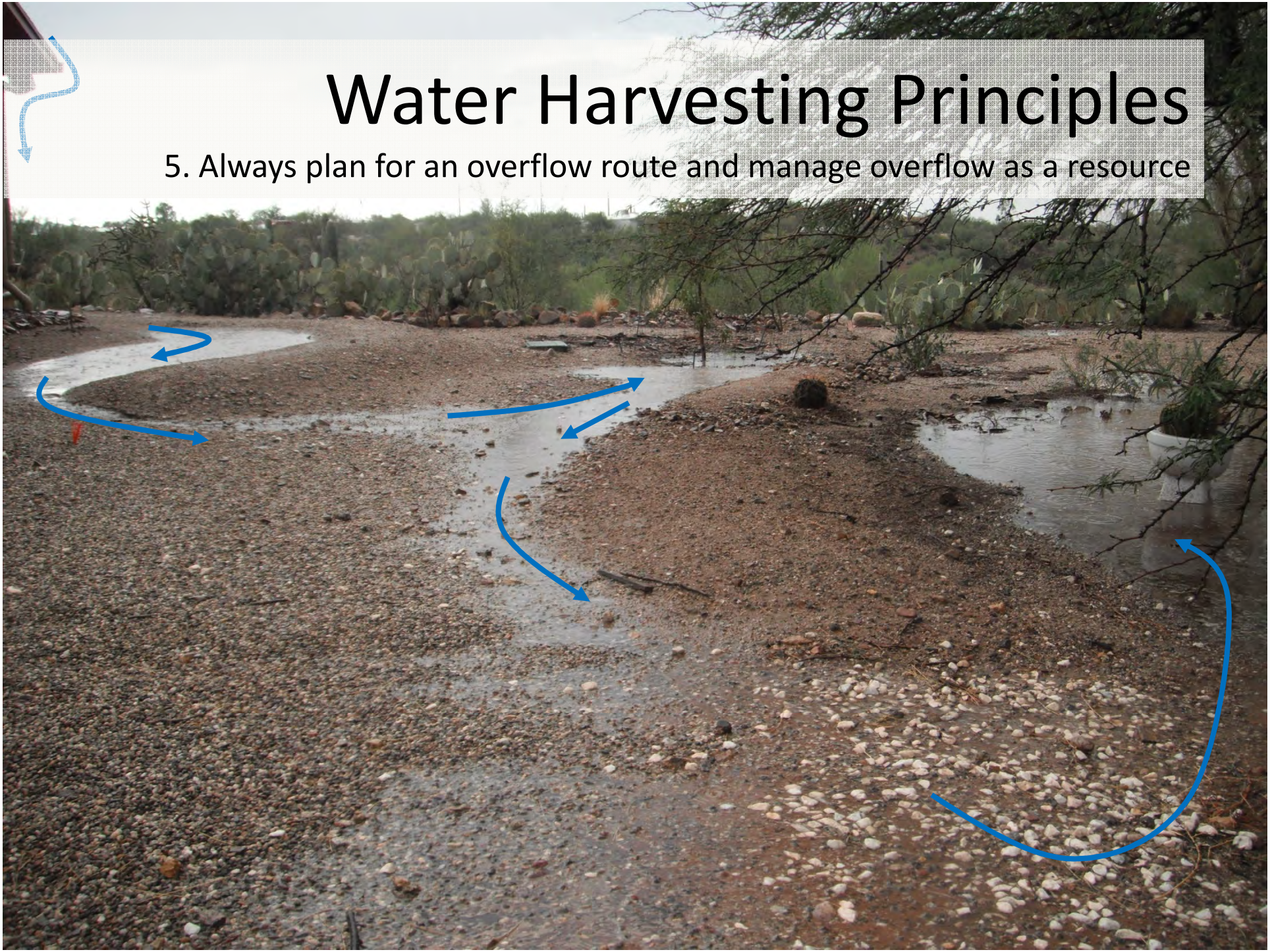
4. Spread and infiltrate the flow of water



Watershed Management Group

Water Harvesting Principles

5. Always plan for an overflow route and manage overflow as a resource

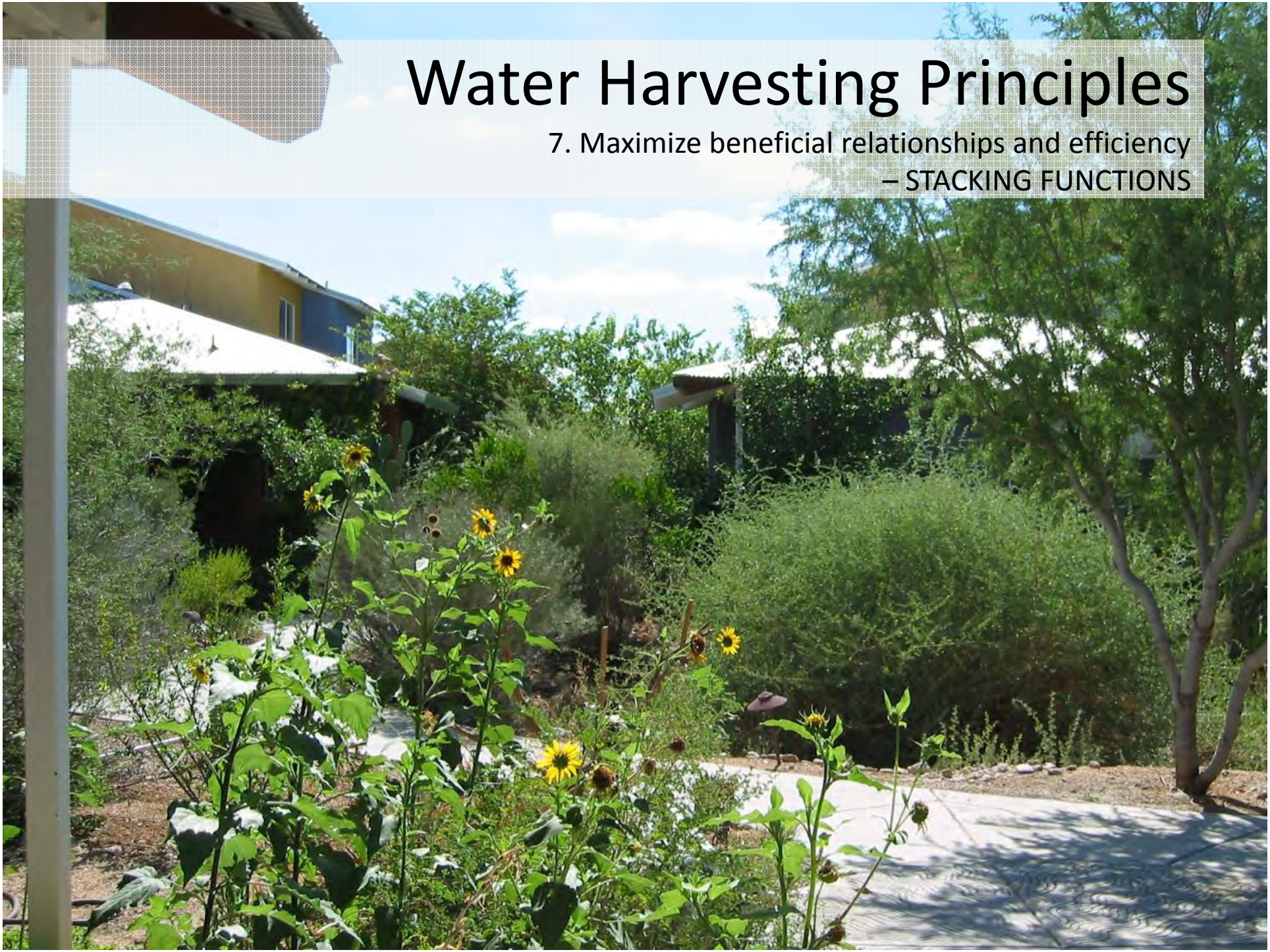


Water Harvesting Principles

6. Maximize living and organic groundcover

Water Harvesting Principles

7. Maximize beneficial relationships and efficiency – STACKING FUNCTIONS

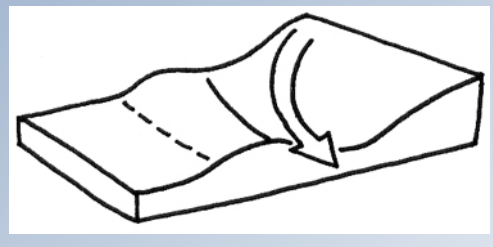


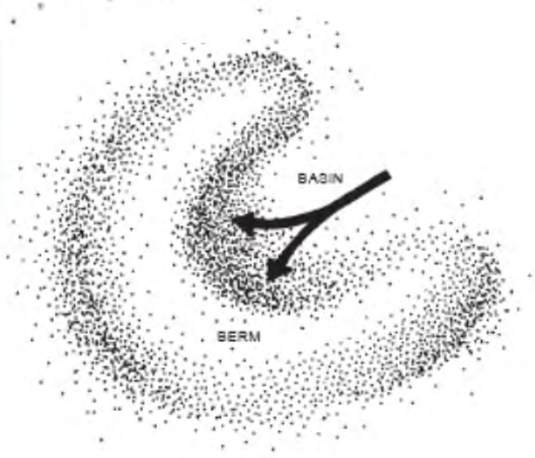
Water Harvesting Principles

8. Continually reassess your system

Passive earthworks

1. Conveyance
2. Collection
3. Infiltration





Watershed Management Group

Best Practices for Passive Systems

- Provide safe & controlled overflow routes
- Don’t Create a Flooding Problem
- Prevent Mosquitos – infiltrate water within 24hrs
- Protect infrastructure and utilities
- Minimize Erosion -> armor steeper slopes with rock or vegetation
- Provide safe & easy pathways through landscape

Watershed Management Group

Basins – a sunken feature to collect and infiltrate runoff

Watershed Management Group

Photo credit: Joanne Toms
Glendale Public Library
Catch the Rain Photo Contest Winner

Berms – a raised surface to slow and promote infiltration of runoff

Watershed Management Group

Directional berms

width of berm = 4 to 8 *x* height of berm

Watershed Management Group

Swales – conveys runoff and promotes infiltration

Watershed Management Group


Curb Cut /
Core drill

Terraces – cut and fill structures to increase plantable area

Watershed Management Group

Design Capacity for Passive Systems

Size for rainfall event = 1” to 2.5”

Volume (gallons) per 1” rain = Roof area (ft^2) x 0.6

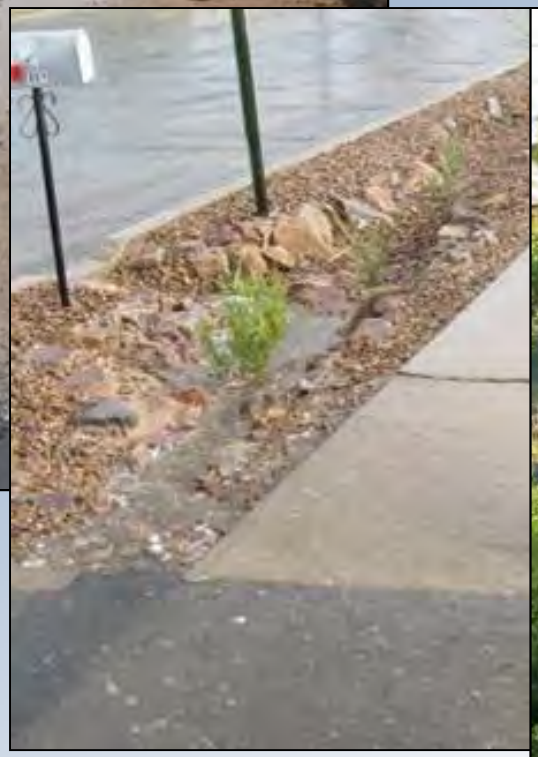
…

Example: 1000ft^2 x 0.6 = 600 gallons per 1” rainfall event

Watershed Management Group

Measure Soil Percolation

Watershed Management Group



Poor Maintenance Practices

Active Water Harvesting: Cisterns

- Cistern – reservoir or tank for holding water, especially catching and holding water for later use
- Purposes and Benefits:
  - Reduce reliance on extractive water delivery systems
  - **Support food production and landscape plants**
  - Provide potable supply of drinking water
  - Non-potable indoor use
  - Stormwater management
  - Fire protection
- **What are your goals for a cistern?**

Watershed Management Group

Review: Rain Tank Best Management Practices

- Secured Lid
- Overflow pipe!
- Vent
- Inflow pipe diameter = outflow pipe diameter
- Screened entry points (critter & mosquito proof)
- UV resistant materials

Watershed Management Group

Above Ground Cistern Placement Considerations

- Height in landscape
- Proximity to downspout
- Stacking functions (e.g. shade, screening, etc)
- Proximity to most frequent /higher usage plants
- Access
- In compliance with regulation. Local codes, HOA, utility setbacks, building setbacks etc.

Ferrous Cement

Fiberglass

Plastic

Plastic

Culvert

Pre-fab Metal

Recycled *(not eligible for rebate)* –
typically not rated for potable use

Tank Sizing Considerations

- Water demand required over length of dry period, 4 months (March – June)
- Available seasonal rooftop supply (~4-6” per rainy season)
- Available space
- Budget

Water Quality - Best Practices

- Allow Rainwater to settle after storms
- 4-8” height for hose bib
- Minimize organics and sediment entering
- Keep insects & critters out!
- Always test drinking water

Debris Screens

Gutter Screen

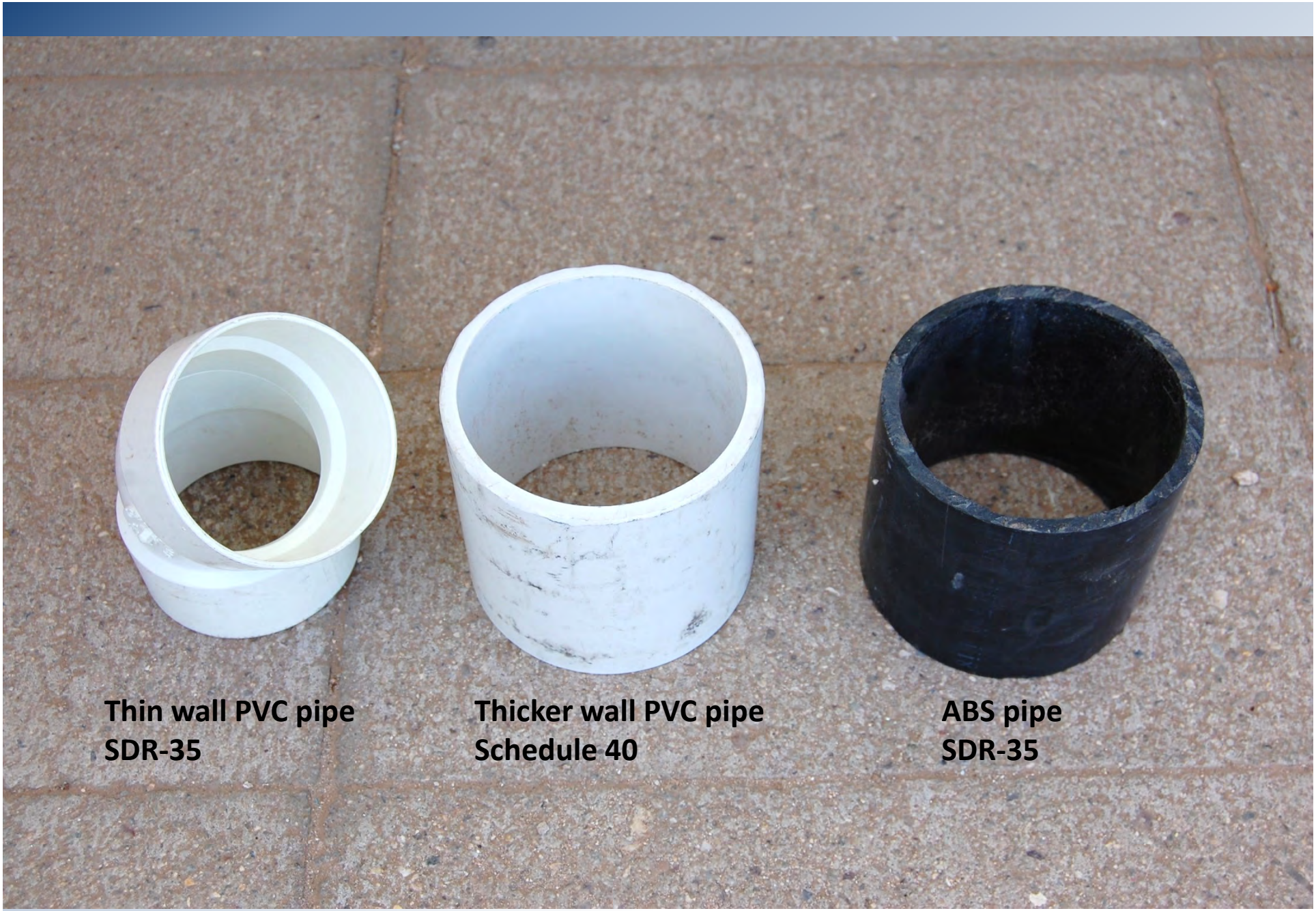
- Blocks large debris from entering gutter conveyance
- Requires regular maintenance
- Located at roof level makes access difficult

Leaf Diverters

Strainer Baskets

First Flush

Overflow – End of Pipe Critter Preventers


Thin wall PVC pipe
SDR-35
Thicker wall PVC pipe
Schedule 40
ABS pipe
SDR-35

Delivery systems

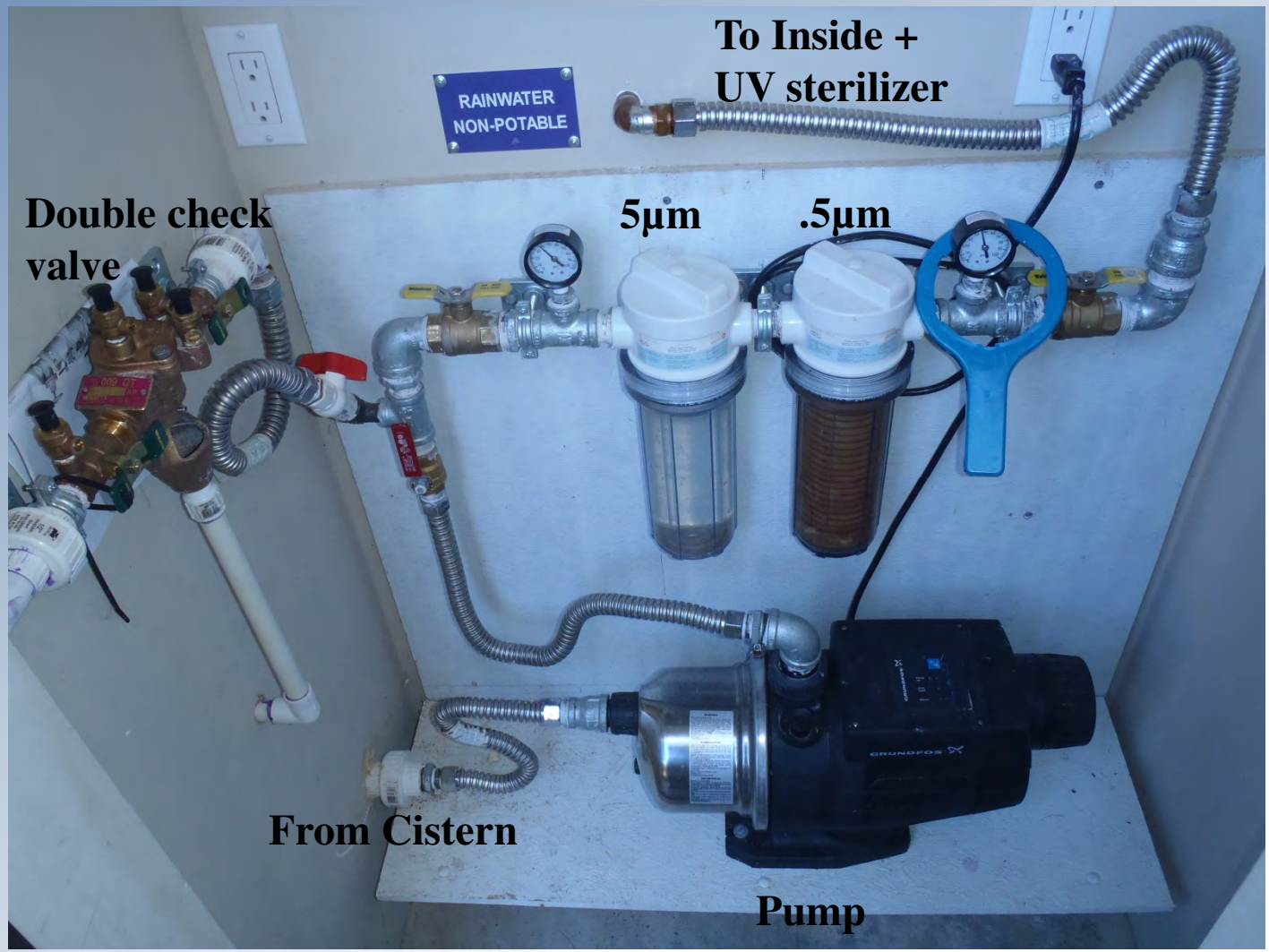
- Use at least 1” PVC pipe
- Use full-port hose-bibs and valves
- Locate cistern on high ground to maximize available pressure
- Can use larger diameter irrigation emitters (*flag emitters – best*) for gravity-based systems
- Pump systems require backflow prevention

Below Ground Tanks

Maintenance

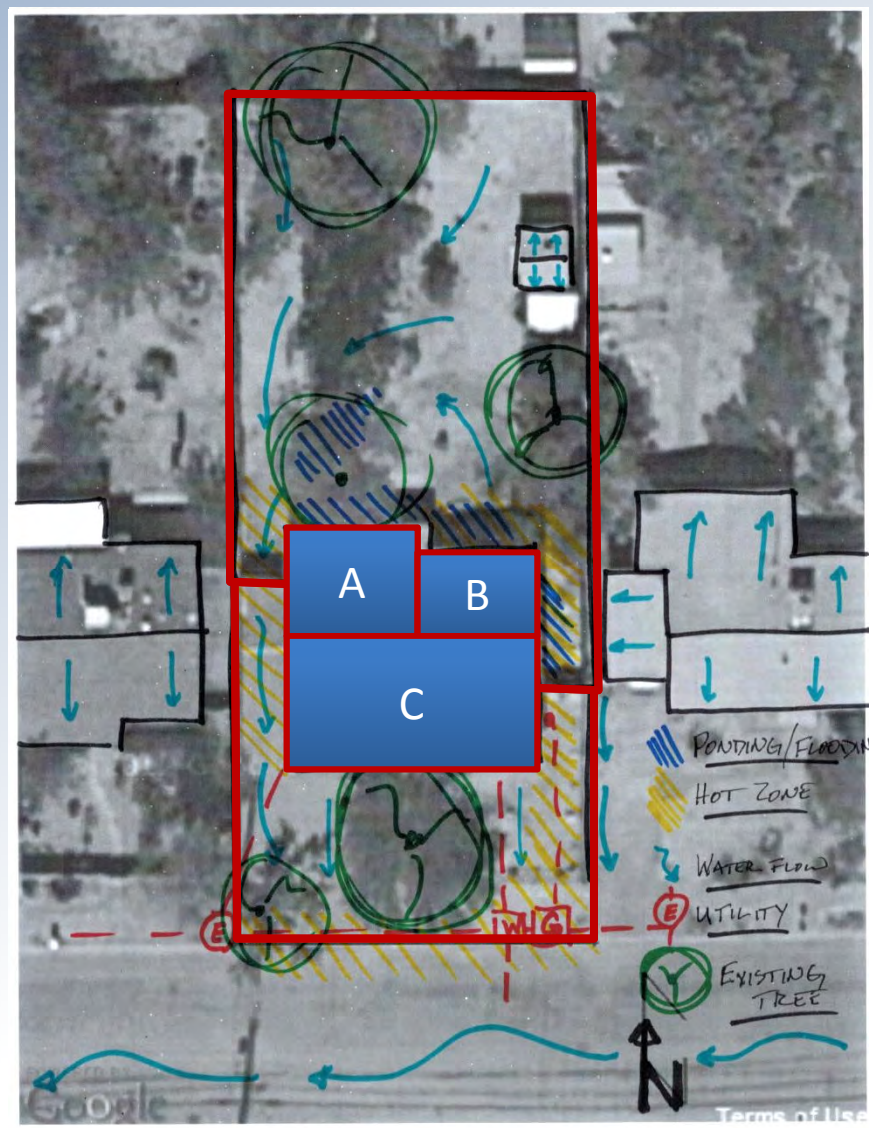
- **Have a specific maintenance plan!**
- **Clean gutters and leaf diverters**
- **Check and reset first flush**
- **Check for leaks**
- **Inspect site stability and tank integrity**
- **Clean/flush/replace filters**
- **Test water annually (if drinking)**

Potable Water



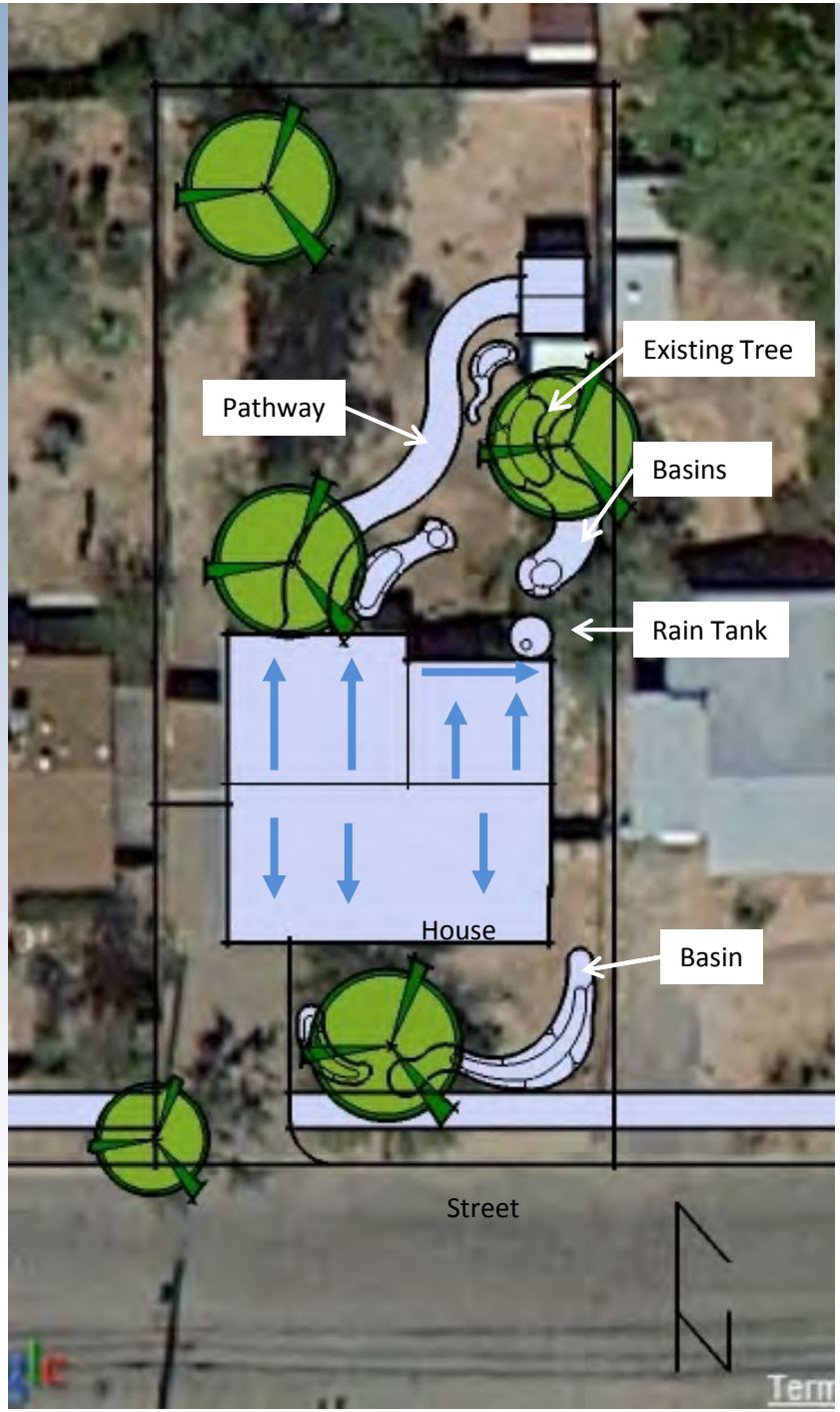
Let's Get Started at Your Site

1. Observe & Assess
   - Create a base map
   - Observe Influencing Factors
     - Solar orientation
     - Utilities
     - Existing Vegetation
     - Noise and Traffic
     - Soils
     - And more…
2. Divide into subwatersheds
   - Note water sources
   - Identify desired water infiltration zones



Create a Plan!

1. Layout uses including hardscapes and pathways
2. Place structural landscape features
   - Rain tanks
   - Large trees
3. Locate water harvesting basin extents
4. Determine spillway/overflow locations



Roof Rainfall Runoff Estimation

Volume (gallons) =

Catchment Area (square feet)

* Rainfall Depth (feet)

* 7.48 (Unit Conversion gallons/ft^3)

* Runoff Coefficient (~0.9)

Plant Demand

- Native, low-water use tree = 4,000-5,000 gal/yr
- Full citrus, high-water use tree = 8,000 gal/yr
- Pomegranate, mod-water use tree = 3,000 gal/yr
- Lawn & Veggie Garden, very-high water use = ~40-50 gal/sqft/yr

- Review your water bill:
  - compare **winter use** with **summer use**; the difference is your landscape irrigation

Thank you for visiting our

Living Lab and Learning Center

watershedmg.org/living-lab

Watershed Management Group