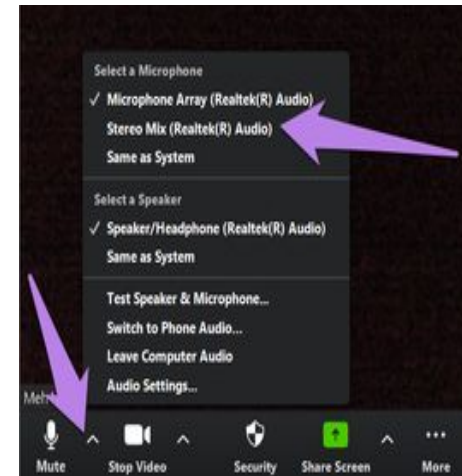


# Welcome to Hydrate San Tan: Hydrate Your Yard!

## To connect with us best here on Zoom:

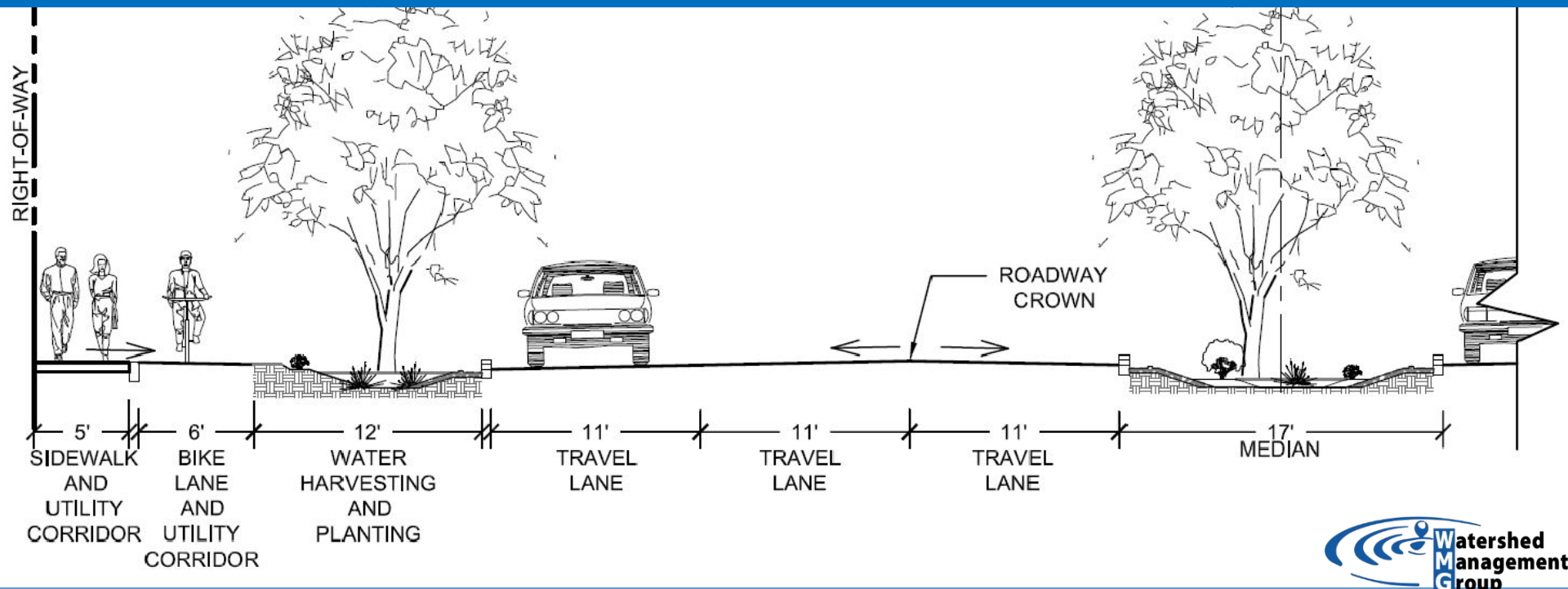
- Please keep yourself muted when not speaking.
- Check your audio settings (*see image on right*) to make sure your audio is working or switch to telephone audio.
- Please use the chat feature to ask questions. There will be time at the end of class where the moderator will share these questions with the presenter



And, see what else is coming up that may interest you: [watershedmg.org/event](https://watershedmg.org/event)



**Watershed Management Group** develops and implements community-based solutions to ensure the long-term **prosperity of people** and **health of the environment**. We provide people with the knowledge, skills, and resources for sustainable livelihoods.





# Hydrate: Your Yard

Harvest the rain with only a shovel





# Outline

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1. What: Water Harvesting Principles
2. Where: Getting Started at Your Site
3. How: Water Harvesting Essentials

# Rainwater Harvesting

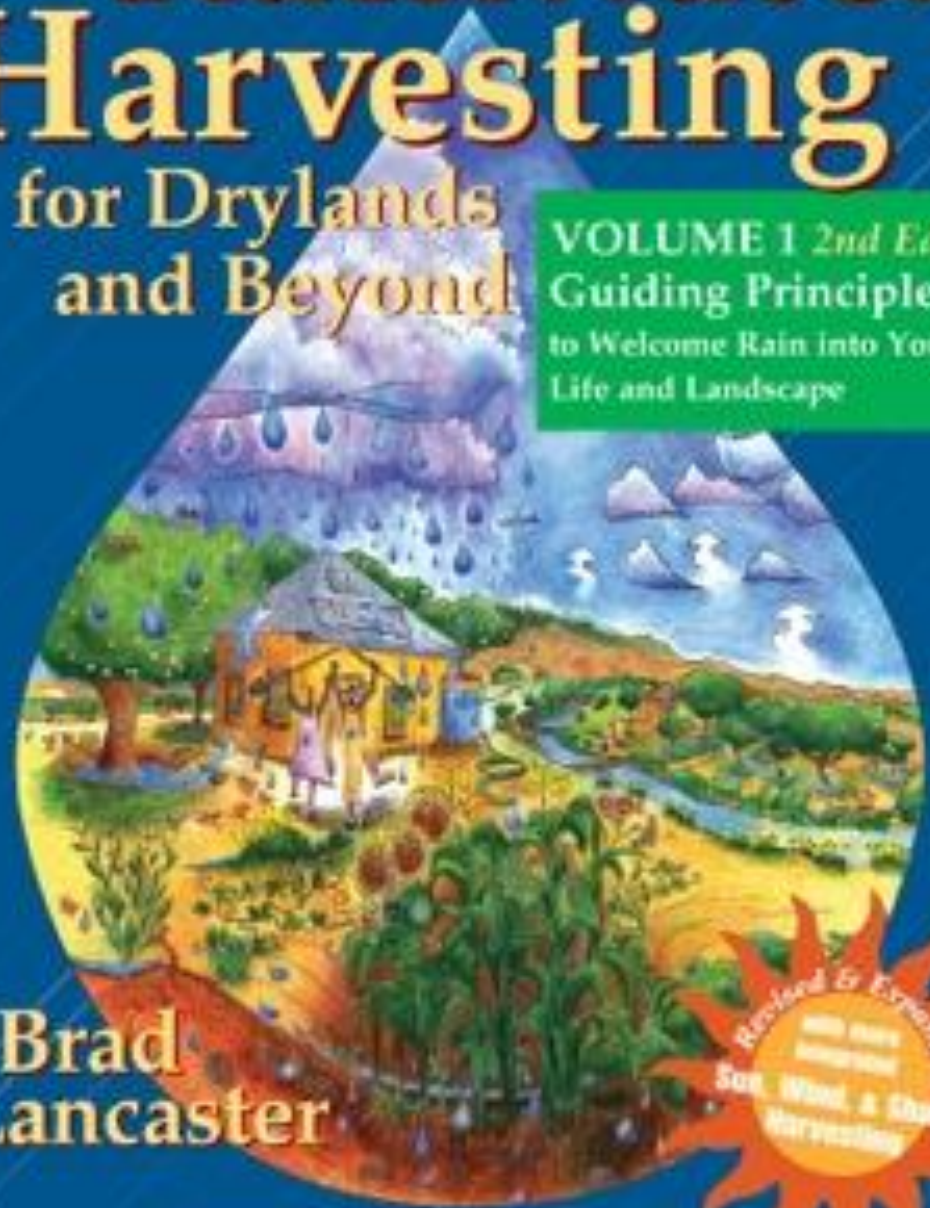
for Drylands  
and Beyond

VOLUME 1 *2nd Edition*  
Guiding Principles  
to Welcome Rain into Your  
Life and Landscape

Brad  
Lancaster

Foreword by Gary Paul Nabhan

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





# 1. Begin with Long and Thoughtful Observation

Water Harvesting Principles



## 2. Start at the Top

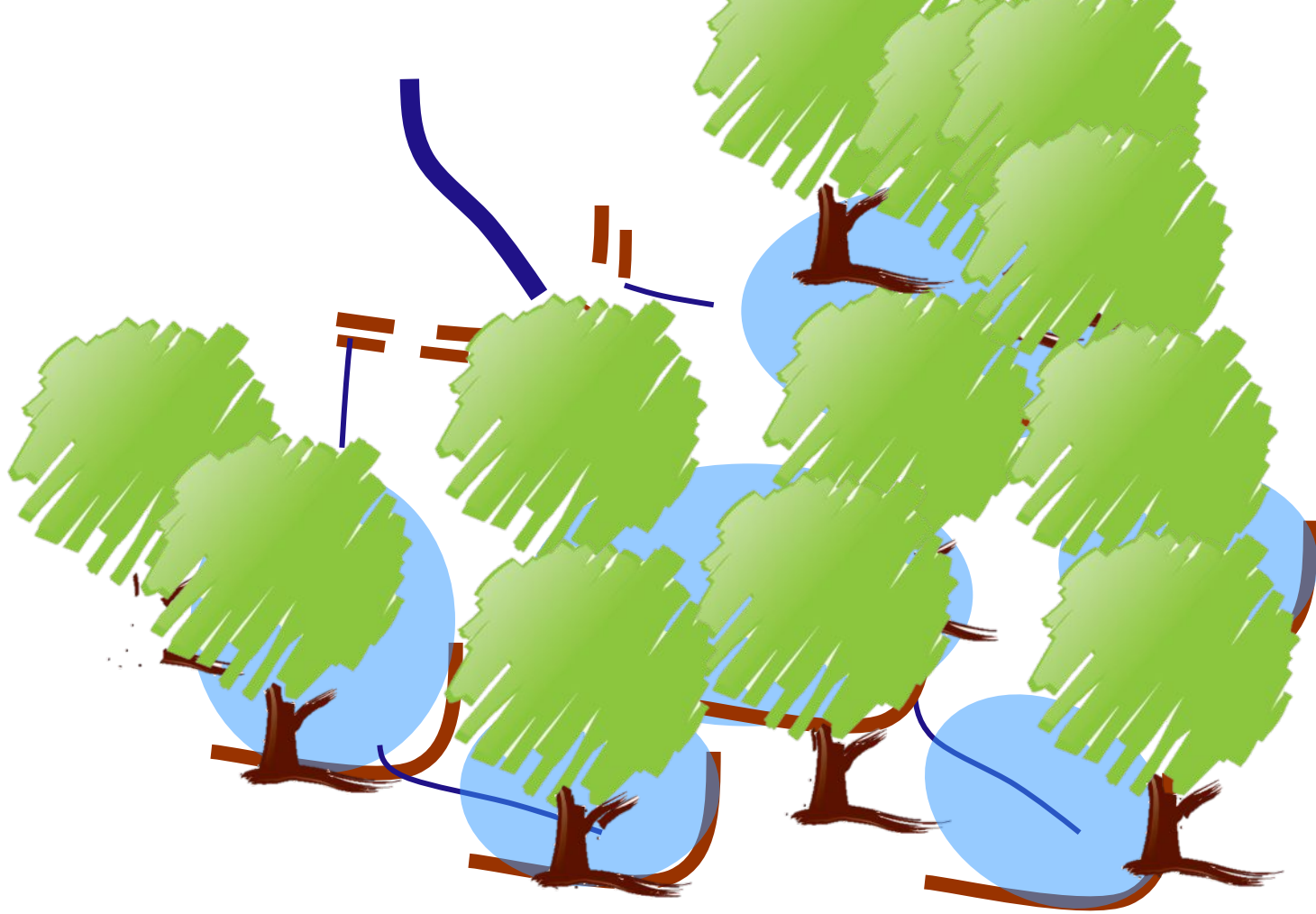
Water Harvesting Principles



# 3. Start small and simple

Water Harvesting Principles





## 4. Spread and infiltrate the flow of water

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

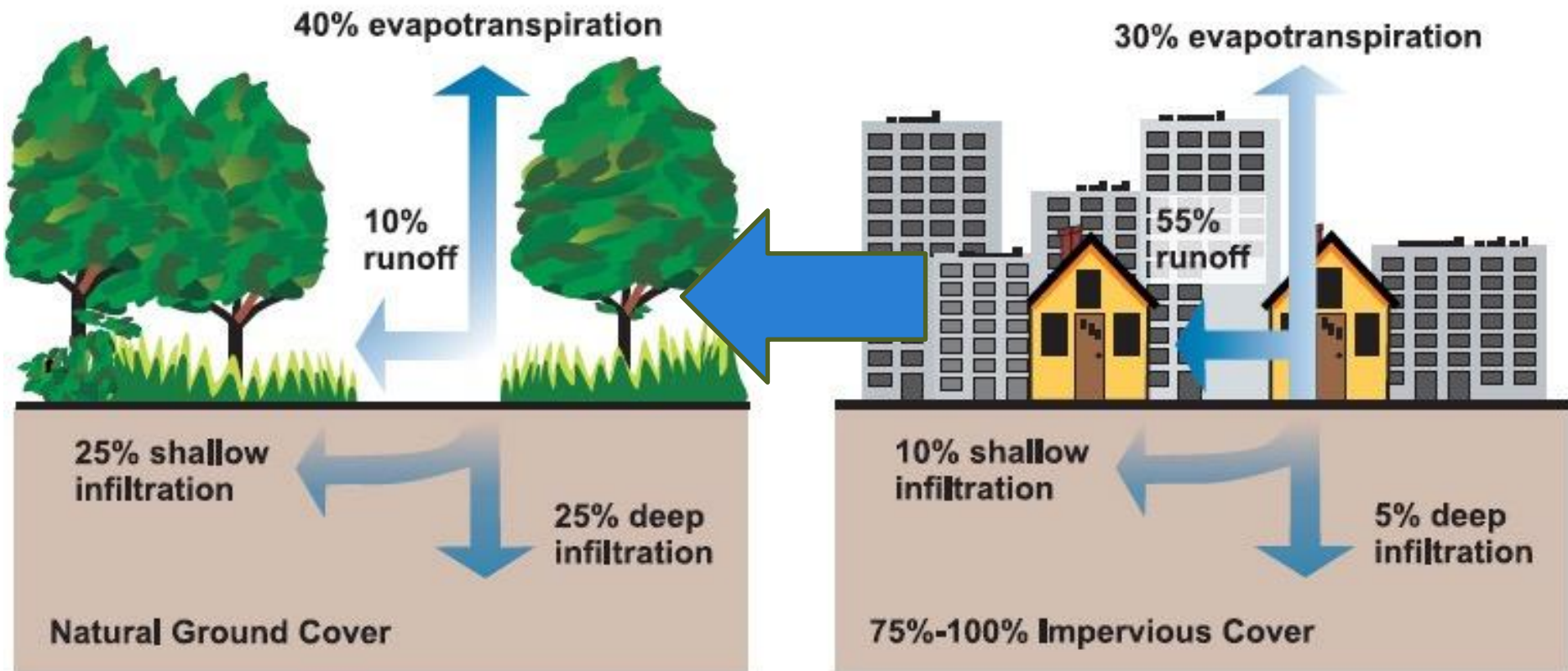
Water Harvesting Principles



# 8. Continually reassess your system

Water Harvesting Principles

# How does water harvesting link to watershed health?



**WHERE?**



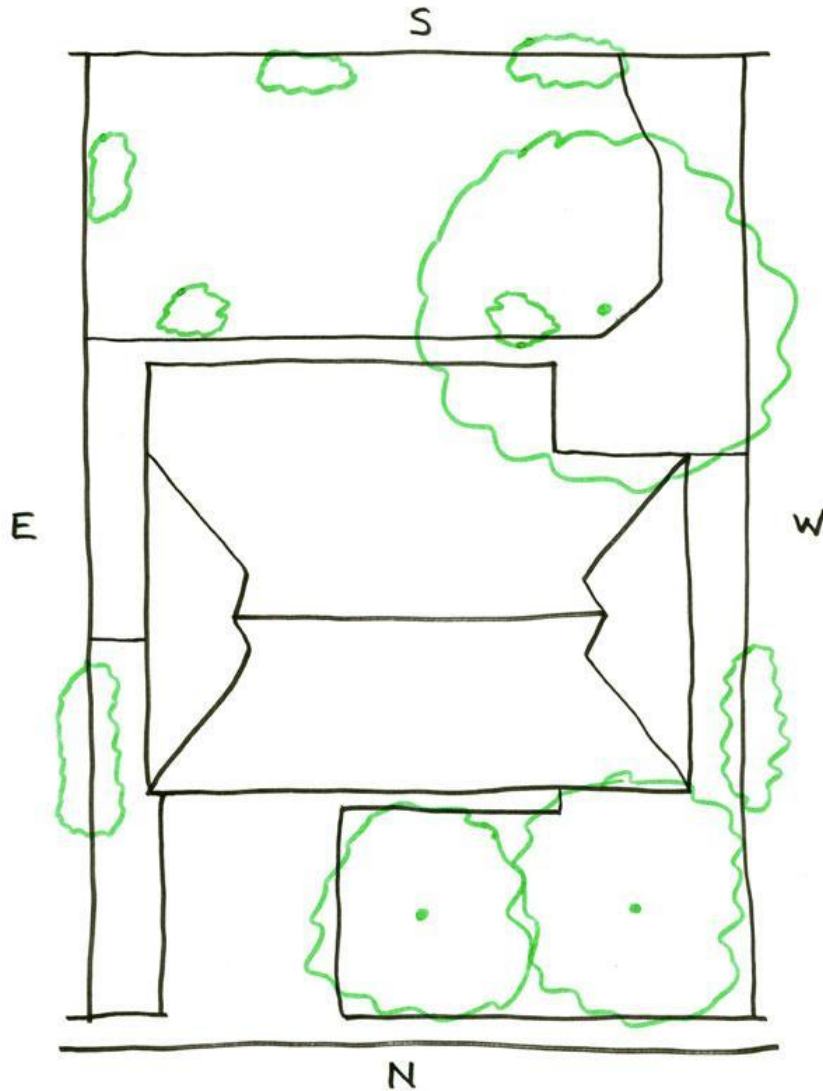
# 1. Begin with Long and Thoughtful Observation

Water Harvesting Principles



# DRAW YOUR SITE

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- Property lines
- House
- Other permanent structures (storage sheds, pool, driveway, sidewalks, etc.)
- Existing trees and shrubs
- Mark direction - North, South, East, West

# SECTORS / FACTORS

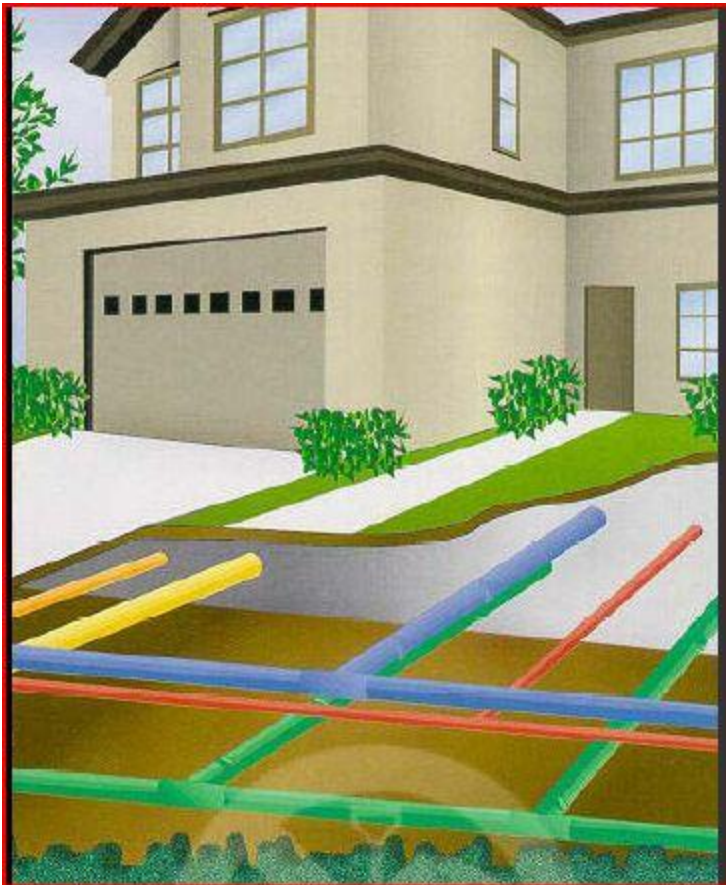
Sectors deal with the wild energies...from outside our system and pass through it.

*Intro to Permaculture* pg. 14

- Sun
- Water
- Wind
- Fire
- Wildlife
- Pollution
- View
- Utilities
- Community

# UTILITIES

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White = Proposed Excavation



Pink = Temporary Survey Markings



Red = Electric Power Lines, Cables, Conduit and Lighting Cables



Yellow = Gas, Oil, Steam, Petroleum or Gaseous Materials



Orange = Communication, Alarm or Signal Lines, Cables or Conduit



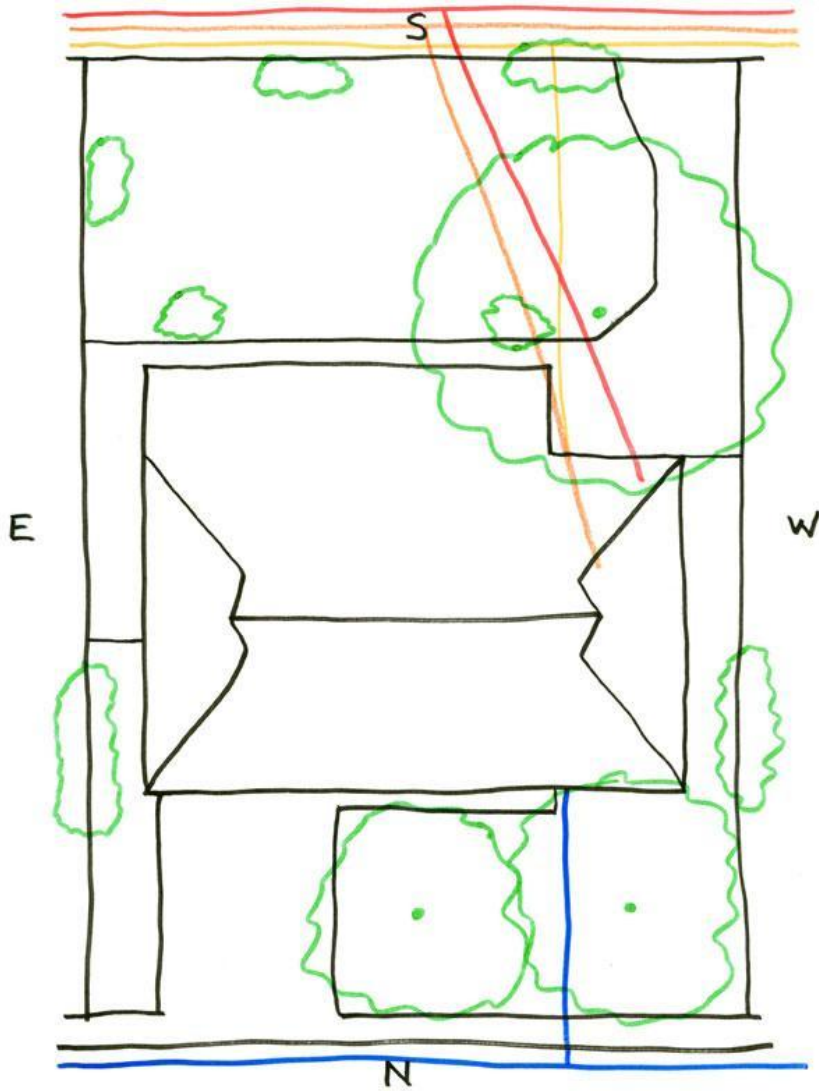
Blue = Potable Water



Purple = Reclaimed Water, Irrigation and Slurry Lines



Green = Sewer and Drain Lines



# UTILITIES

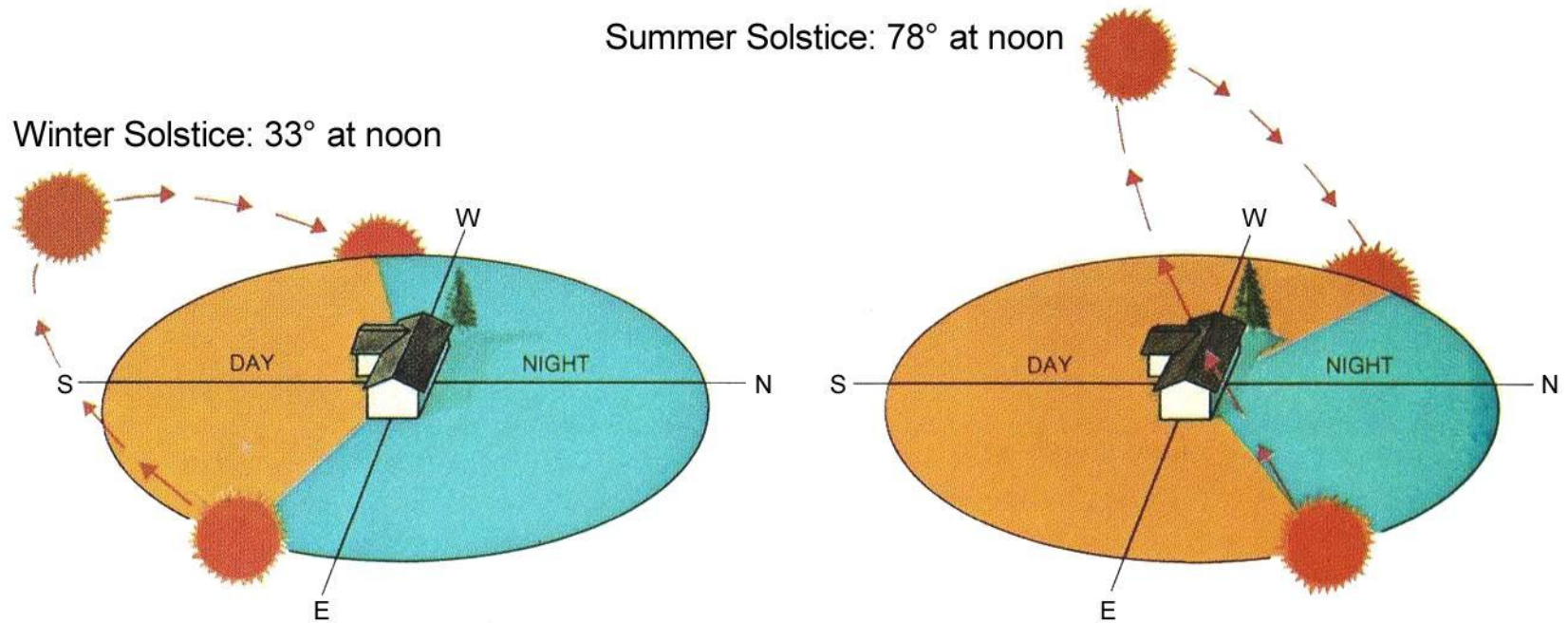
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- Water
- Gas
- Sewer
- Electric
- Cable
- Telephone
- Irrigation



# SEASONAL SUN ANGLES

## Seasonal Sun Angles - Phoenix, AZ



NOAA Solar Calculator

<http://www.esrl.noaa.gov/gmd/grad/solcalc/>

# SEASONAL SHADE PATTERNS

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9:00 AM



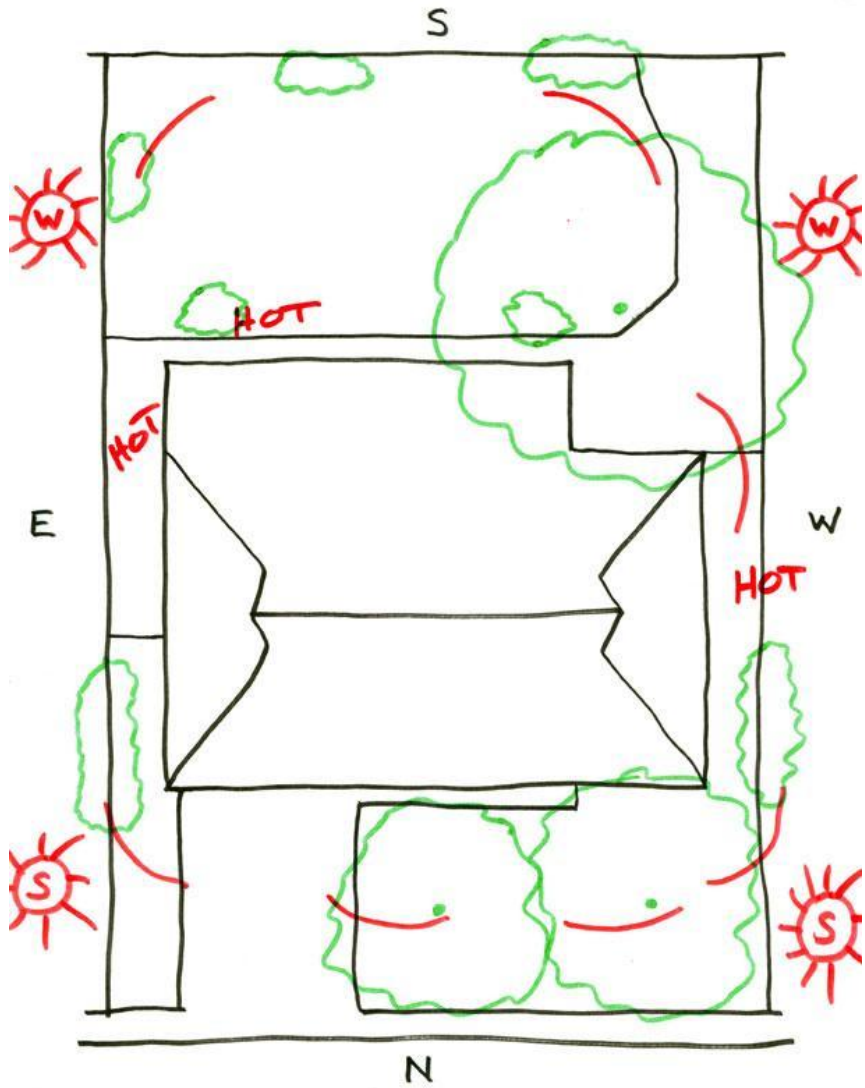
1:00 PM



5:00 PM



Winter Solstice  
2008



# SUN

---

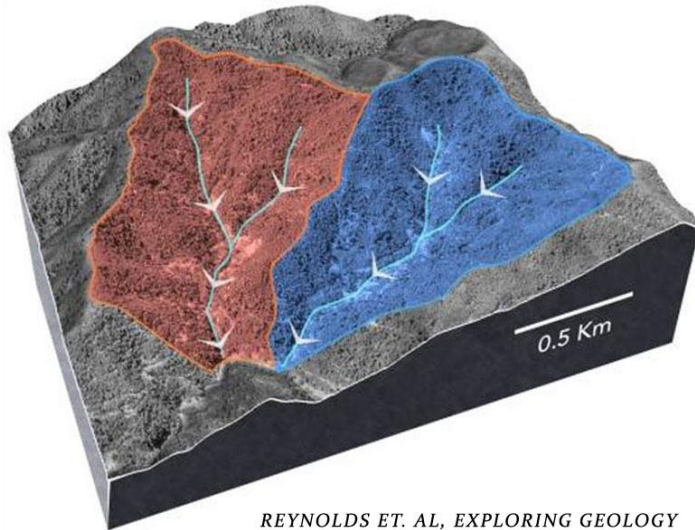
- Summer
- Winter
- Equinox
- Hot spots
- Shadow patterns
- Microclimates





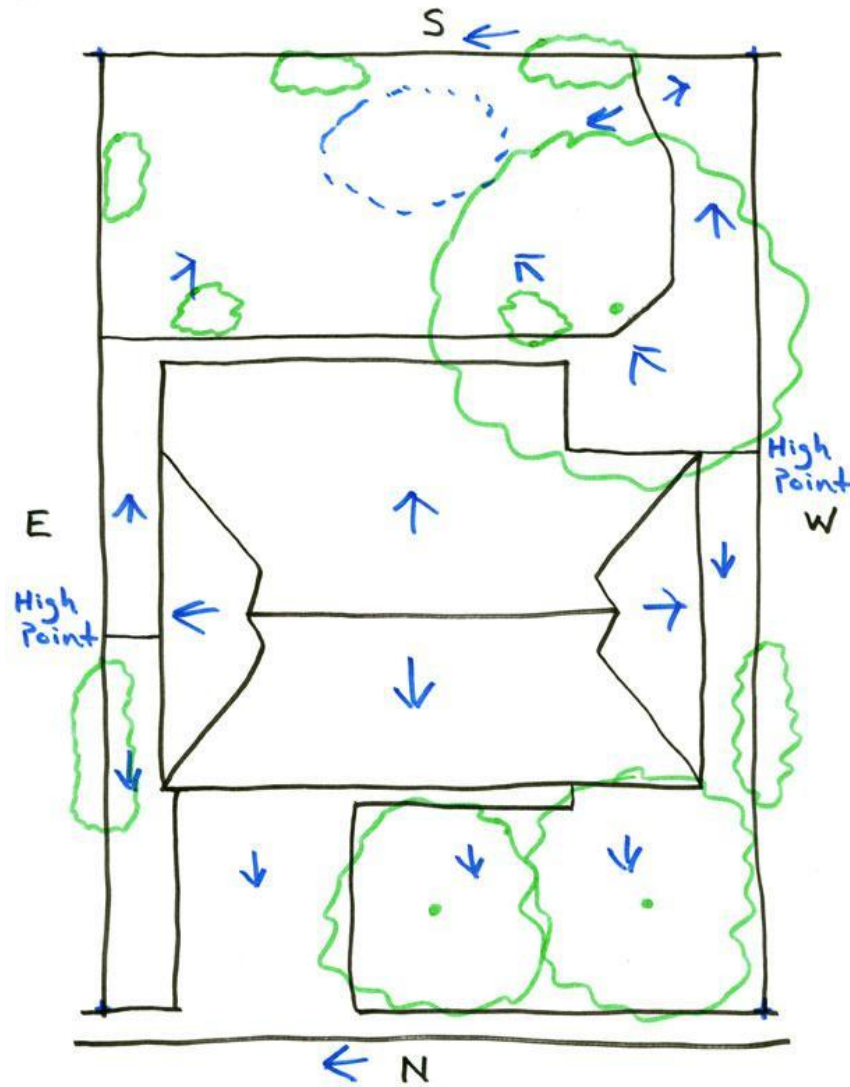
# Watersheds

Watershed: a watershed is the land area that drains water to a particular stream, river or lake. An area that drains to a common point.



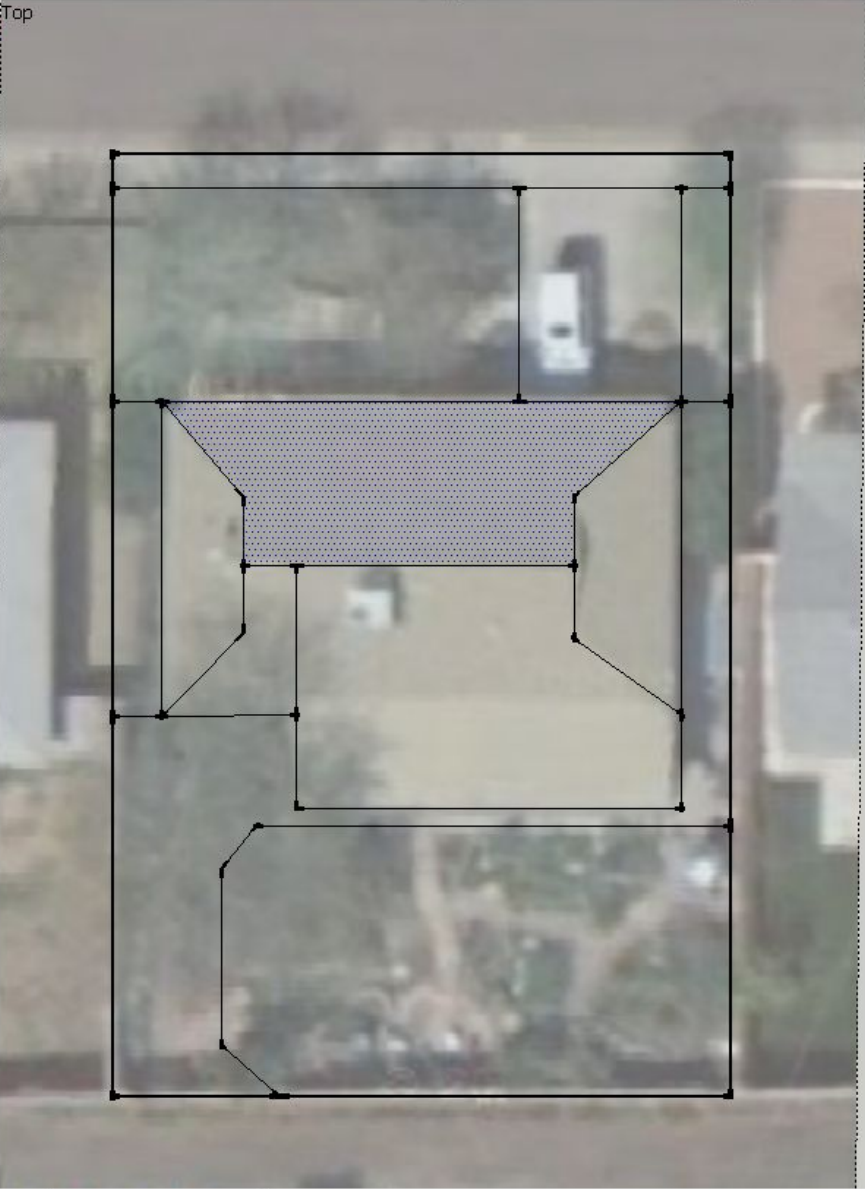
REYNOLDS ET. AL, EXPLORING GEOLOGY





# WATER

- Watersheds, subwatersheds
- Water movement
- Slope, topography
- Hose Bibs
- Annual rain fall
- Determine square feet
- Multiply square feet by .623 to convert into gallons for a 1" rain



Entity Info

Face

Layer: house

Area: 803.9574 Feet <sup>2</sup>

Measurements

1 parcels selected



Navigation toolbar with icons for ruler, highlighter, eraser, pan, zoom, print, and help.

Search [ ] Basemap Imagery

Measure Segment length: 55.35 feet Total length: 55.35 feet

Layer Visibility Options Parcel Parcel Labels Land Use Street Names Imagery Year Basemap Option Overview Map [x] Enable Parcel ToolTips

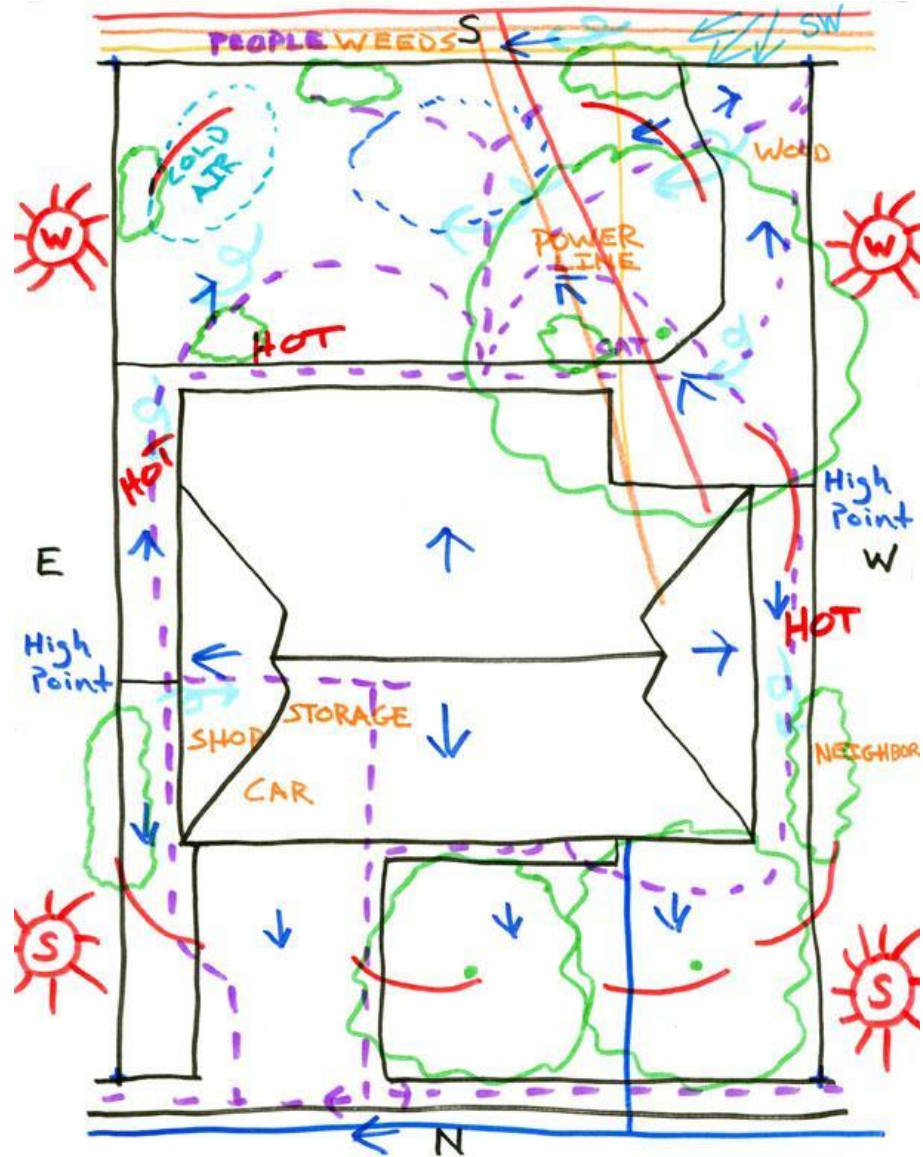
Compass rose and scale bar (5m / 30ft)

# SECTORS / FACTORS

Sectors deal with the wild energies...from outside our system and pass through it.

*Intro to Permaculture pg. 14*

- Sun
- Water
- Wind
- Fire
- Wildlife
- Pollution
- View
- Utilities
- Community



HOW?

# Water Harvesting (Passive) Earthworks

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Created features formed from soil, rock, or plant material

Use gravity to distribute rain runoff

- SLOW
- SPREAD
- SINK

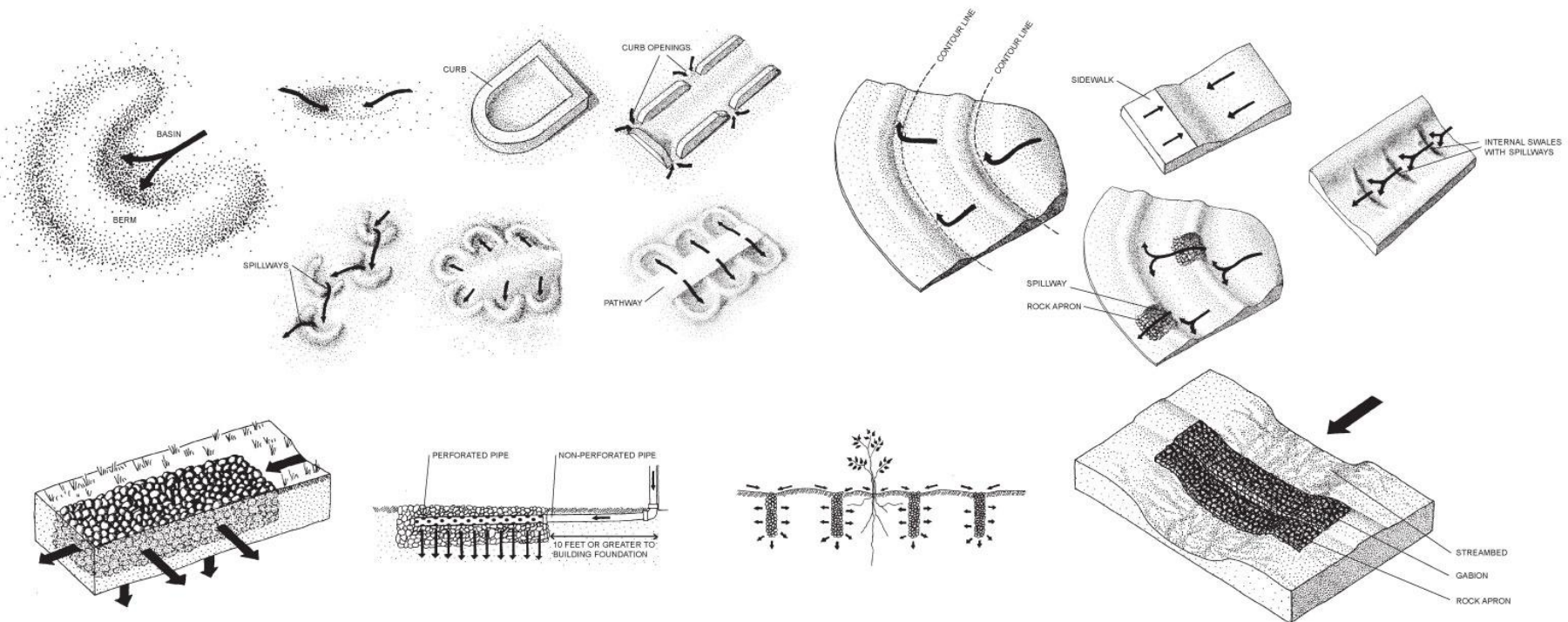
Cheapest storage option for large amounts of rainwater





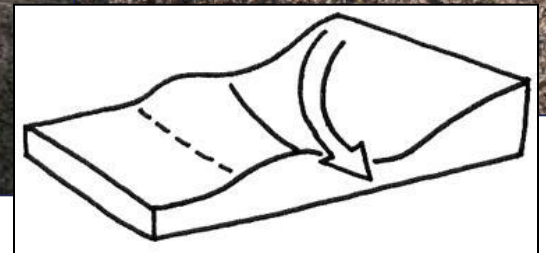
# Earthworks

## Slow it, Spread it, Sink it!



# Convey: Swales

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# Infiltration: Basins

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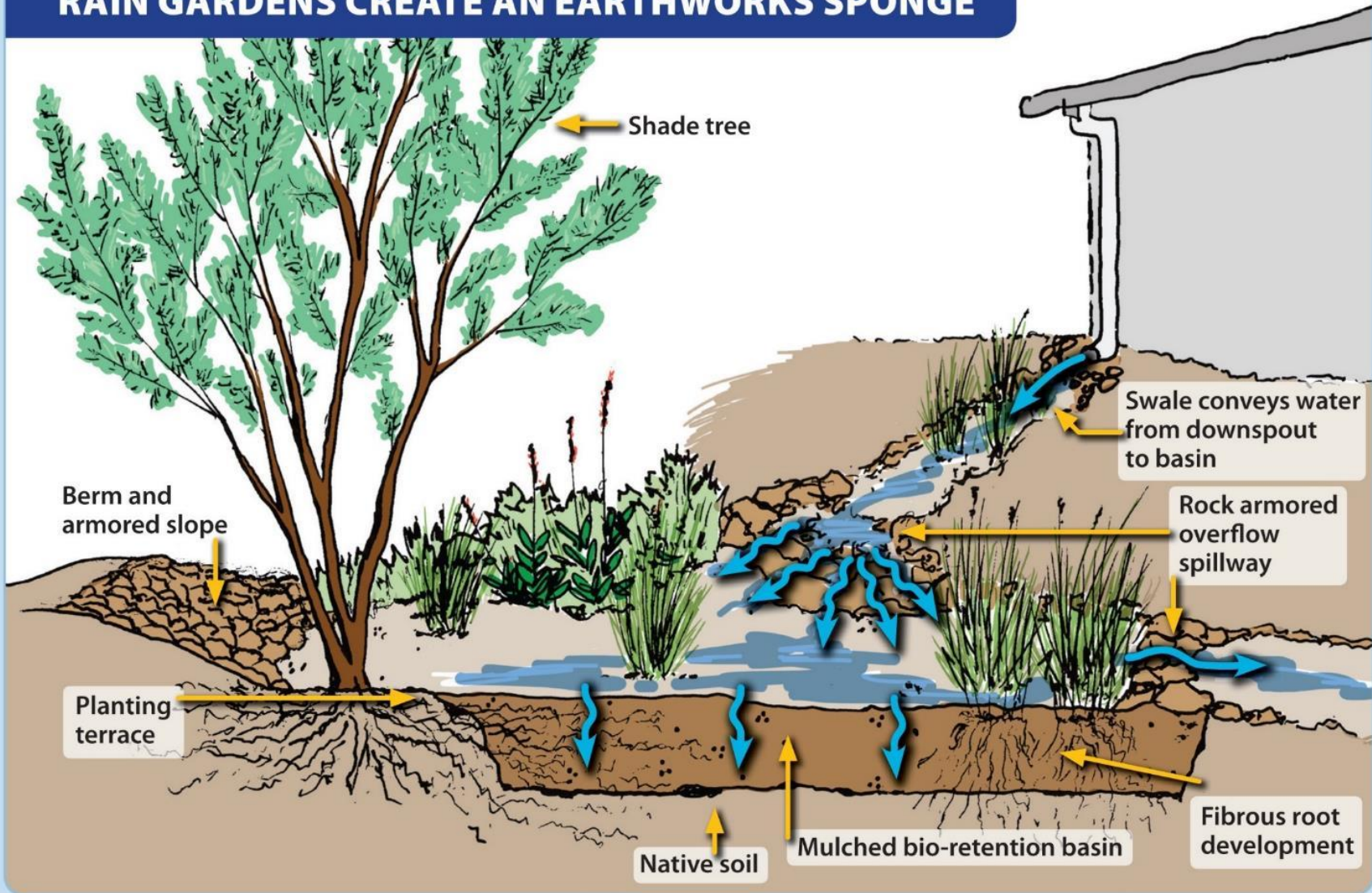
4232



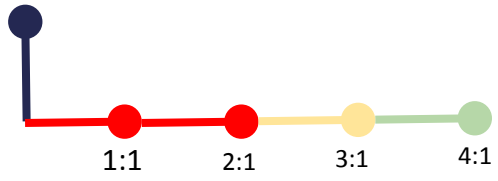




## RAIN GARDENS CREATE AN EARTHWORKS SPONGE



Organic mulch is applied to basins, 2 – 4 inches thick, to help infiltrate more water, reduce evaporation of soil moisture, and replenish nutrients in the soil.













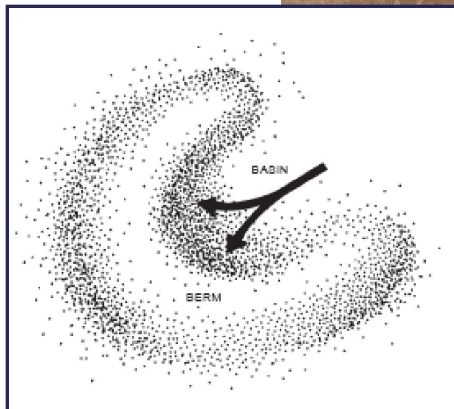
**BIG IDEA GROUND**  
**mūg**  
mesa urban garden  
Working to improve sustainable urban living in our community  
212 East 1st Avenue

**mūg**  
MESA URBAN GARDEN

**mūg**  
MESA URBAN GARDEN  
212 East 1st Avenue  
PHOTO: JESSICA BROWN

# Raised: Berms

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513







# Infiltration: French Drains

> 10ft from structure

Water source needs to be free of sediment & particulates

Use angular, uniform sized rock (~40% porosity)

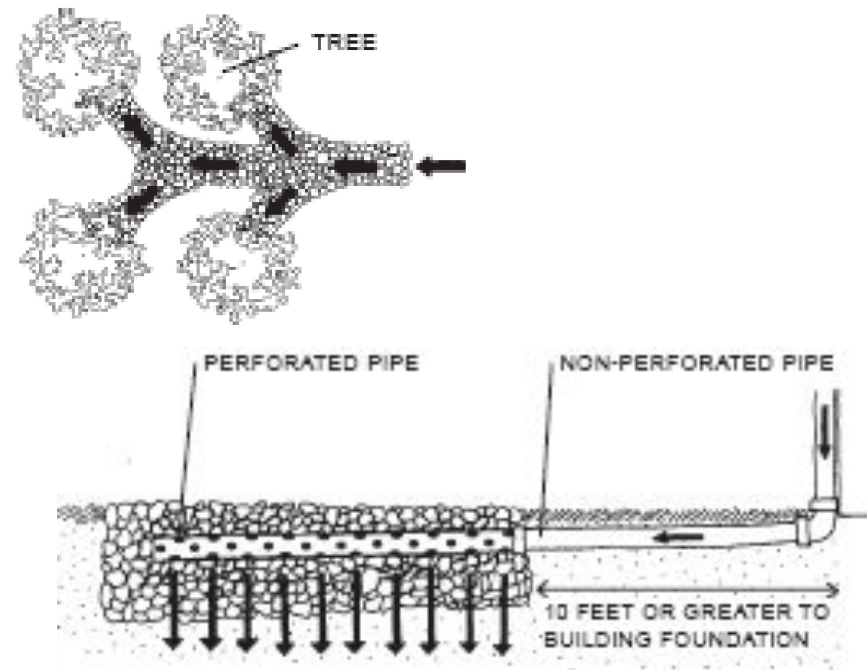
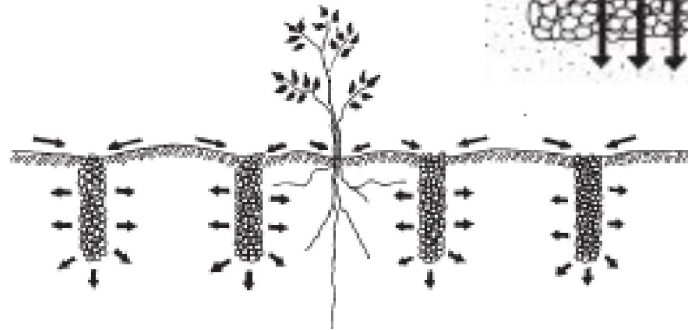
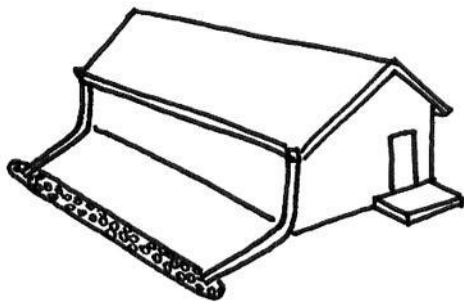


Figure Sources: City of Tucson Water Harvesting Guidance Manual and Watershed Management Group Earthworks Handout



# Sizing Earthwork Capacity

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## 1. Stormwater retention

(Design storm event: 25yr, 50yr, 100yr) – Flood control (Lancaster, Vol 2, pg 136)

- Calculate open capacity of feature
- Size to meet estimated stormwater runoff
- Ensure water will percolate in 12 to 24hrs

## 2. Percolation Rate Method

Greywater Systems (Ludwig, A., pg 13)

- Surface area needed to infiltrate peak water volume
- Based on percolation rate and discharge volume

## 3. Plant Needs

Irrigation/Dryland farming (Lancaster, Vol 2, pg 80)

- Sized to capture sufficient runoff from catchment area to irrigate specific plant(s)



# Sizing for Stormwater Retention

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[cfp.arizona.edu](http://cfp.arizona.edu)

# Sizing Earthwork Capacity

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## Runoff Coefficients for the Southwest United States

Surface	Runoff Range	Notes
Roof	0.80 – 0.95	Metal: 0.95, Concrete/asphalt: 0.90, Built up tar/gravel: 0.85 – 0.80
Paving	0.90 – .95	Older irregular surfaces may be lower than 0.90.
Bare Soil	0.20 – 0.75	A best guess based on characteristics of soil and experience. Unprotected soil surfaces tend to surface seal easily unless high levels of organic material or a high content of sand is present.
Soil with Vegetation	0.10 – 0.60	Leaf litter, basal area, and roots all help increase infiltration rates and can also absorb water.
Grass/Lawn	0.05 – 0.35	A high density of leaf area and root densities help reduce runoff. If soil underneath is compacted runoff rates can be higher.
Gravel	0.20 – 0.75	Use the coefficient of the ground below the gravel

\*Chart adapted from 1) Lancaster, Brad. 2006. Rainwater Harvesting for Drylands, Vol.1. Rainsource Press and 2) Waterfall, Patricia. 2006. Harvesting Rainwater for Landscape Use 2nd Ed. Pima County Cooperative Extension.

## Potential Harvested Rainwater Volume (gallons)

Catchment area (ft<sup>2</sup>) x rainfall depth (in) x 0.623 (conversion) x Runoff Coef. = Volume (gallons)

## Calculating Basin Volume (gallons)

- Quick Estimate: Average Surface Area (ft<sup>2</sup>) x Average depth (ft) x 7.48 (gal/ft<sup>3</sup>) = Volume (gallons)
- More Accurate Ballpark: Depth (ft) x ((L1 x W1) + [L2 x W2]) / 2 x 7.48 (gal/ft<sup>3</sup>) = Volume (gallons)
- Most Accurate: CAD or GIS based delineation and calculation

# Locating Earthworks

Consider:

- Utility Lines: ~ 2-10ft distance (Call a Utility Locating Service!)
- Structural Foundations: ~10ft distance
- Pathways: raise and use to manage runoff (i.e. berm)
- Right-of-ways (ROW): lookup local restrictions

Remember the 3 Elevations:

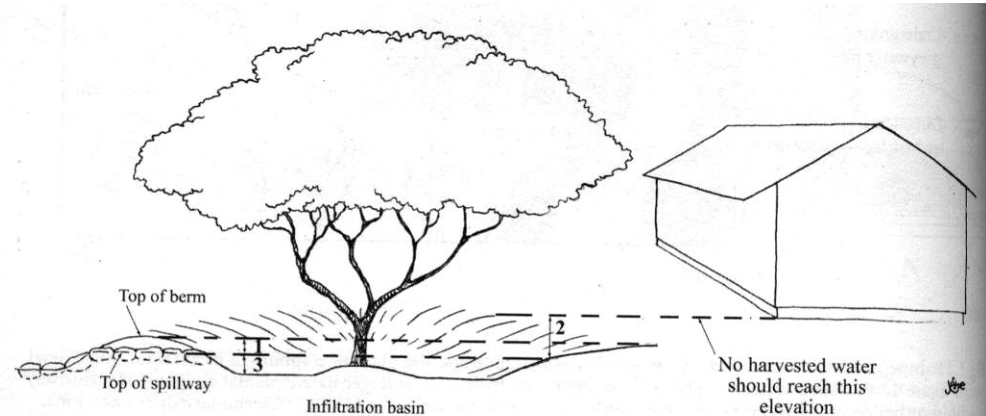
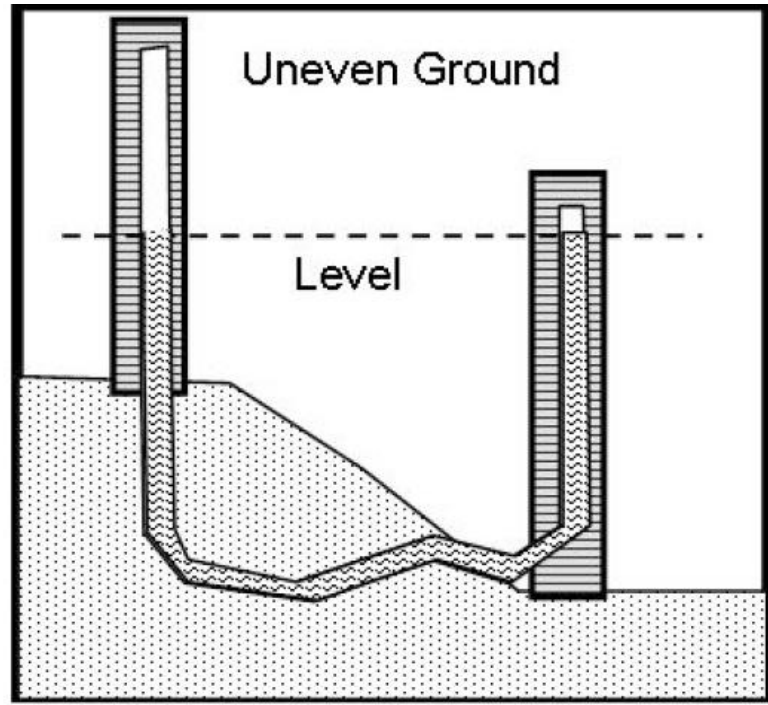
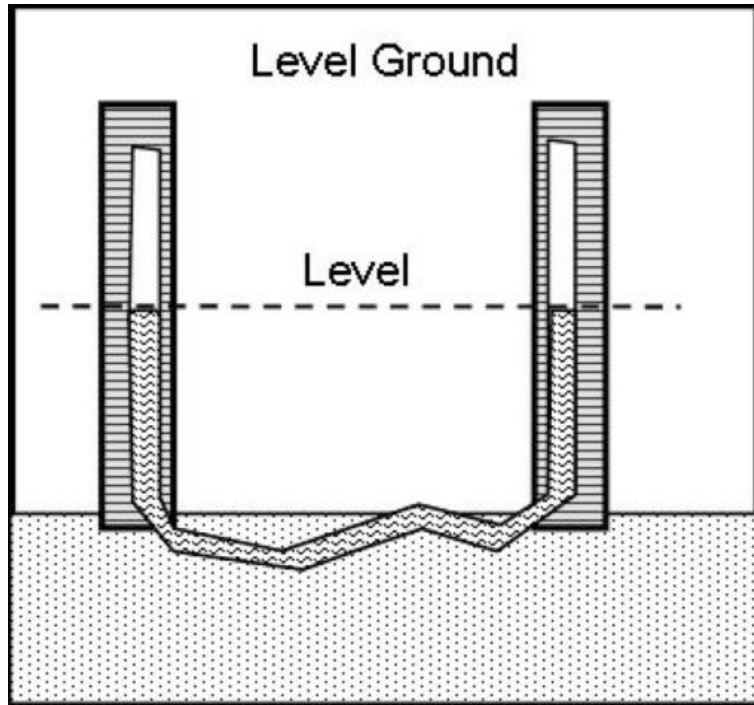


Fig. 1.12. Three important elevations: Elevation 1: Overflow spillway is the low point of earthwork's perimeter. Elevation 2: Spillway is low enough to ensure nothing is accidentally flooded. Elevation 3: Basin is lower than elevation of spillway to ensure water is harvested, rather than drained.

# Water Level (Bunyip)



# Toolbox – Passive Features

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# Vegetation: Native / Adapted

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# CAUTION!!

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Flooding

- Slowing Runoff -> backing up surface flow upstream

Ponding -> standing water risks

Mosquitos -> minimize ponding time

Structural and Utilities -> protect infrastructure

Soil Saturation/Loading -> slope instability/failure

Walkability/Bikeability -> Always promote alternative transportation activities

General Safety -> vertical drops (<18"); excavation and sediment control; traffic visibility; plant types, etc...

# Maintenance

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## **Observe:**

- During and after rainfall events
- Seasonally

## **Check:**

- Overflow – Appropriately sized and placed
- Percolation – Duration of standing water
- Capacity – Loss, undersized, ...
- Stability – Rocks are secured; soil surface stable
- Plant Productivity – Sufficient water, placement, ...
- Mulch Material – Need to add more?

## **Adjust & Improve:**

- Design – capacity, aesthetics, water routing, ...
- Plants – species, placement, ...
- Soil Improvements – drainage, nutrients, ...



# Questions?

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Watershed Management Group

[www.watershedmg.org](http://www.watershedmg.org)

Office: 520.396.3266

Ryan Wood Design

[ryan@ryanwooddesign.com](mailto:ryan@ryanwooddesign.com)

Cell: 602.618.6650

# Thank You!!!

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Phoenix Green Living Co-op Project 10/12/2013