Designing for trees for drought

Trees are a solar powered, temperature and water regulating, erosion controlling, pollutant filtrating, self sustaining AC system that traps carbon

And provides food and shelter....

Landscape designer are key to urban trees! You will be busy!

Designing with trees and drought in mind. But first, some facts....

What we will talk about today:

- Drought stress: water and soil factors
- Young tree establishment
- Mature trees
- Species
- Design considerations: soil quality-run off and percolation trough water wise design

Drought stress

- 1st Symptoms: Wilting
- Absence of water = absence of chemistry.
- No chemistry, no nutrients: diet (stored carbohydrates come into play)
- Photosynthesis shuts down at 90 degrees while chlorophyll breaks down at 100 ! No nitrogen production during dormancy.
- Starvation: damage to feeding roots membranes, immune system not functioning due to lack of tannins, alkaloids…,
- Door open to Insects and pathogen attacks: borers and root rots.

Water: how much ?

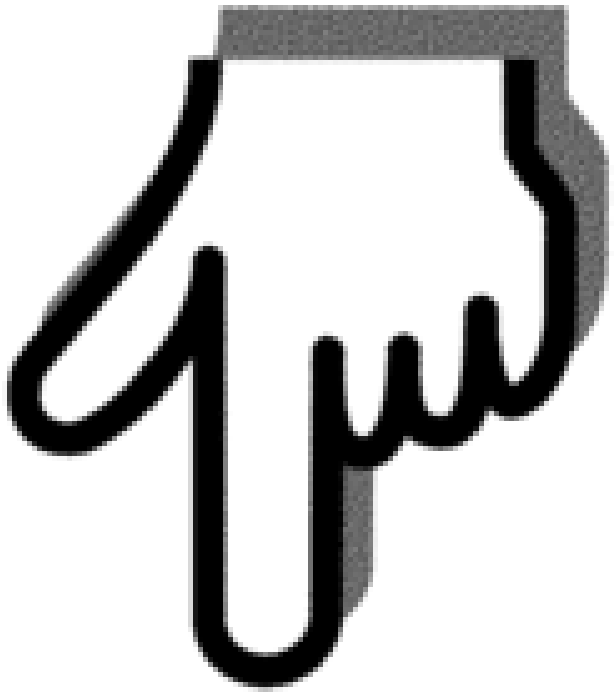
- 1sqft requires 1.2 gal to saturate 12” depth and is 1” of rainfall.
- A 20” tree → 1440 sqft CRZ
  → 1728 gal.
  → 2160 cuft soil

With a 3/4” hose, at 9gal/min, that is 3h 10 min !

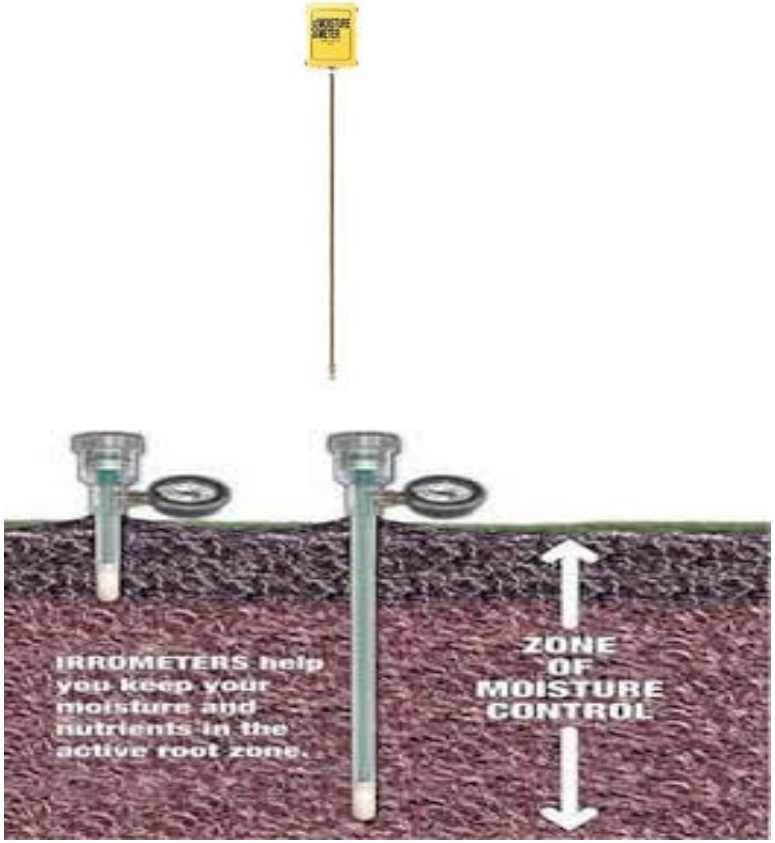
Spray irrigation soaks about 2-3 inches depth en encourages shallow tree roots. Trees become dependant on the turf schedule.

Water: how often?

- Too many Variables. Good ole finger test and rain gauge.



Moisture monitoring

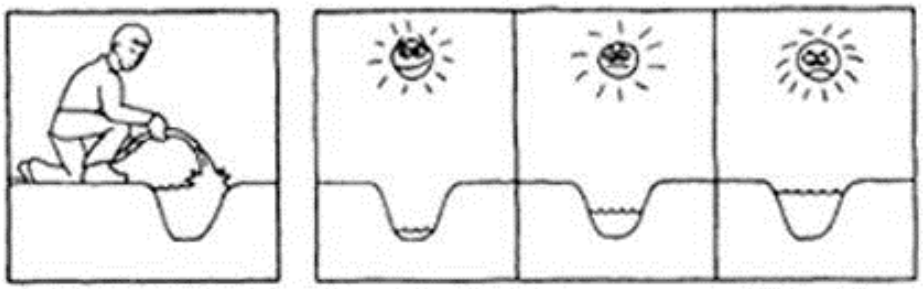


Texture	FC (v%)	PWP (v%)
Sand	10	5
Loamy sand	12	5
Sandy loam	18	8
Sandy clay loam	27	17
Loam	28	14
Sandy clay	36	25
Silt loam	31	11
Silt	30	6
Clay loam	36	22
Silty clay loam	38	22
Silty clay	41	27
Clay	42	30

How often ?

- Most of our local soils will keep deep moisture after a soaking rain for 2 weeks easily.
- Deep soaking with a frequency that allows for the top inches to dry up encourages deep roots but discourages needy groundcovers like jasmin, turf, english ivy, even berkeley sedge.
- Our rainfall's pattern is one of sudden large quantities, the opposite of what we see in temperate climates like in portland, even though our annual rainfall averages same quantities.
- Clay keeps moisture a long time and is an essential component of our local soils
- Local species are adapted to our local rain patterns

Water movement: percolation, Run off



Good Fair Poor

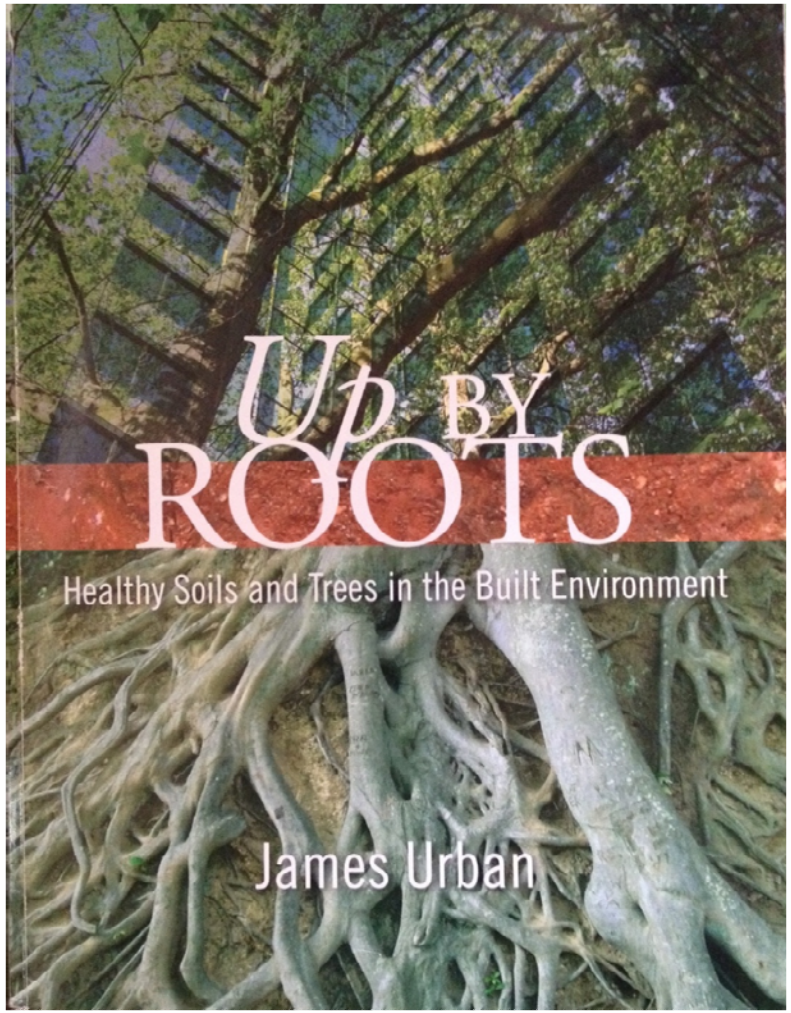
Dig hole 18 inches deep and fill with water

Drainage after one hour

Newsflash

- Water does not stand still, it is impacted by gravity
- Trees do not depend on rain only, they also obtain large amounts of water from run off
- More available water = more plants
- Alterations in grade and channeling changes drainage and average annual available water on site
- Conclusion:

Retain some of the storm water by all means necessary, including soil quality and quantity

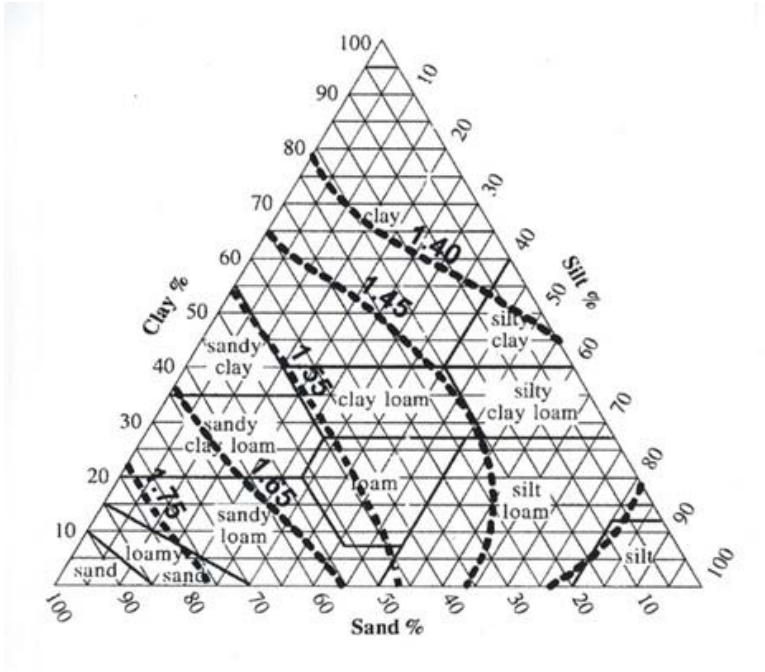

Up BY ROOTS
Healthy Soils and Trees in the Built Environment
James Urban

Root location !!!

- crz root mapping

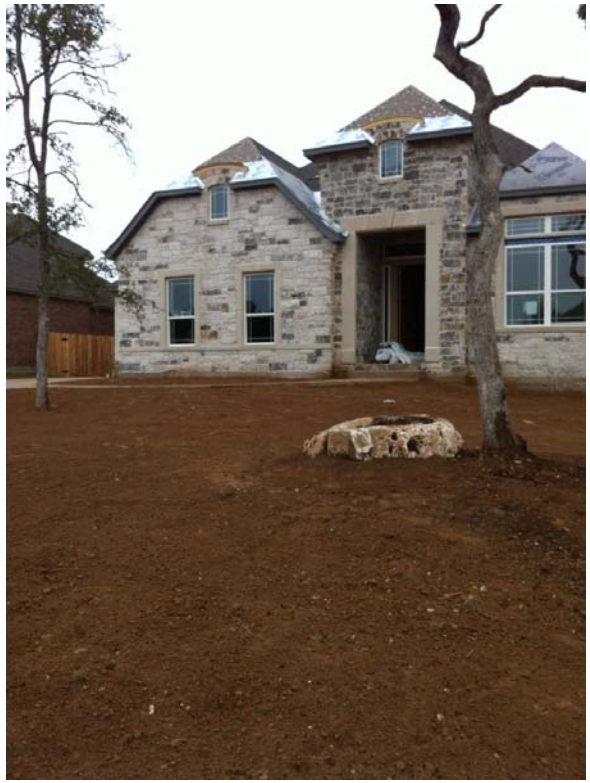
Soil properties:

- Texture: particle sizes. Clay-silt-sand-Gravel
- Structure: bonding of particles. Clay peds are strong. Sandy peds are weak.
- Density: degree to which particles are packed together. Bulk density is the measure of compaction of a soil.
- Water movement: speed at which water moves in response to capillarity and gravity.
- Nutrient holding capacity: clay holds better than sand.
- Temperature: 75F is ideal. Nitrification slows above 85 and roots are damaged at 95 and above.
- Organic activity: **rhyzosphere**, the last frontier.



Soils in south Austin.
Soil is the container for water and nutrients.

The building process



Compaction:

the process of killing soil and loosing water.

Conclusion

Soil: Dig it!

Young tree establishment.

From the nursery to the landscape.

- http://hort.ufl.edu/woody/documents/EP314.pdf

Start with a clean root stock: trees with girdling roots will get worse over time and channel less and less water. Florida's nursery standards and grades.

- From the nursery to the landscape:
- Nursery: ideal soil and moisture, tight spacing that shades the rootball and the stems
- Travel: trees dry from transports.
- Establishment: urban soils, exposed to sun and winds, irregular watering,…

Seedling in natural forest floor

Young trees are “nursed by shading and sheltering older trees, rolling water catching ground, “fluffy” humus layer, surrounded by live soil.

Soil first: Put a 5$ tree in a $50 panting hole

Water beyond the root ball to bait roots.

More than1 bubbler for a 2” tree!!

Mature trees

- Remember CRZ and soil volume
- Mulch can shed water….
- Mulch needs to be “fluffy”

Root flare? Telephone pole syndrome will reduce available water

Raised beds….choking roots and water shedding

Thinking outside the pipe!

Species: water requirements?

Aquatic
vs riparian
vs upland

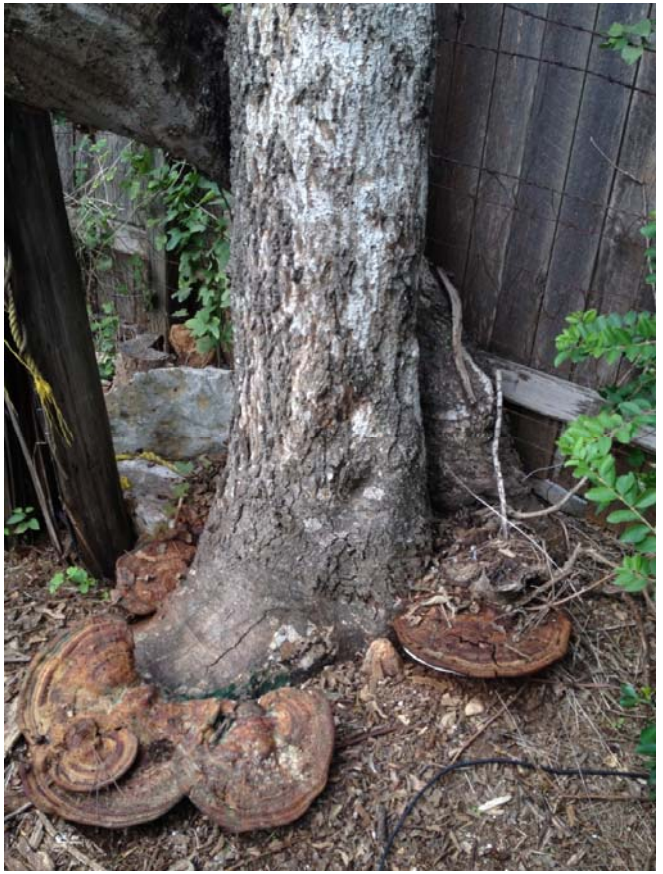
Upland	Riparian or understory low land	Aquatic
Live oak	Burr oak	Bald cypress
Cedar Elm	Chinquapin oak	Willow
Lacey oak	Pecan	Live oak
Eve’s necklace	Arizona black walnut	Box Elder
Ash Juniper	Shumard oak	Chinese Tallow
Mexican White oak	Live oak	
Little walnut	Red Bud	
Texas red oak	Buckeye	
Post oak	Hackberry	
Blackjack oak	Soapberry	
	Magnolia	

Layers of an ecosystem:

Shade trees
Ornamental trees and shrubs
Perennials
Annuals

Legumes
Edibles (for us and for wildlife)

Ganoderma basal rot, from drought stress



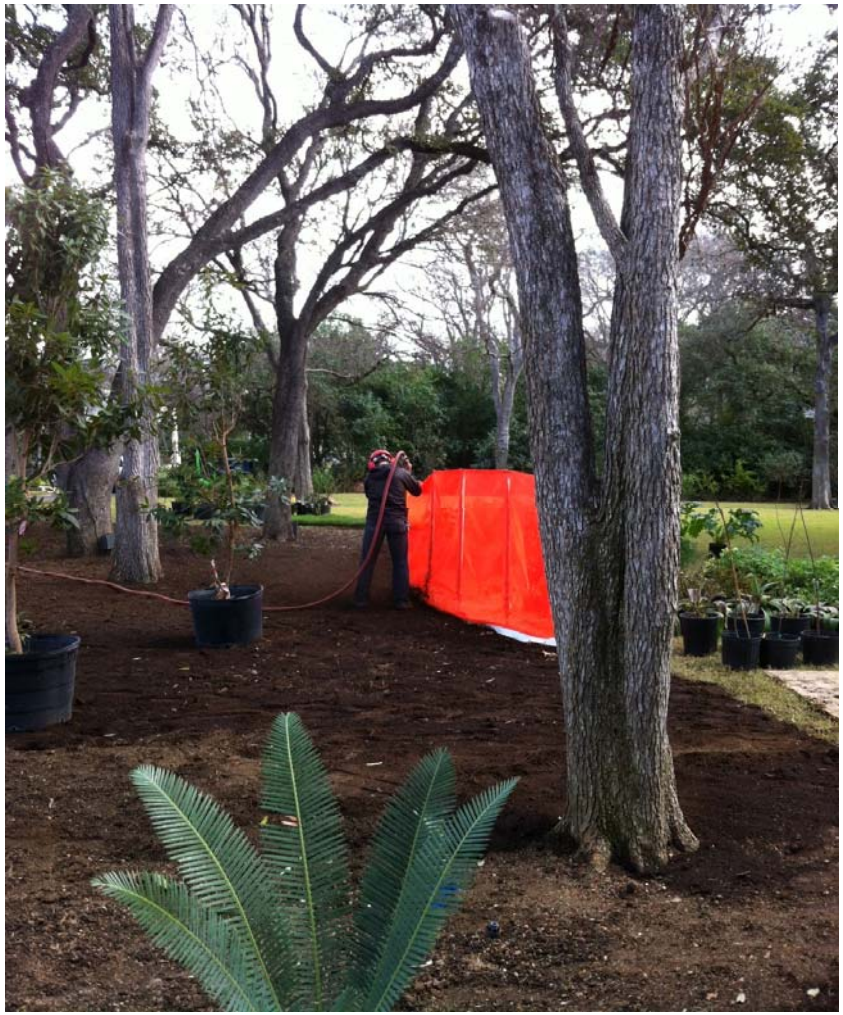
GANODERMA basal rot: Infection from drought stress

Phytophtora: cambium rot disease

Magnolia in the middle of a desert design.

Design and Install consideration

Instant Soil Rejuvenation in Root Zones



Blue hole park in wimberley:
grow zones and functional space allow for sustainable design.

“Earthworks”: earth is not flat…

From water shedding to water collecting earthworks

Water wise design: 100% of 2” rainfall controlled on site.

Roof run off control

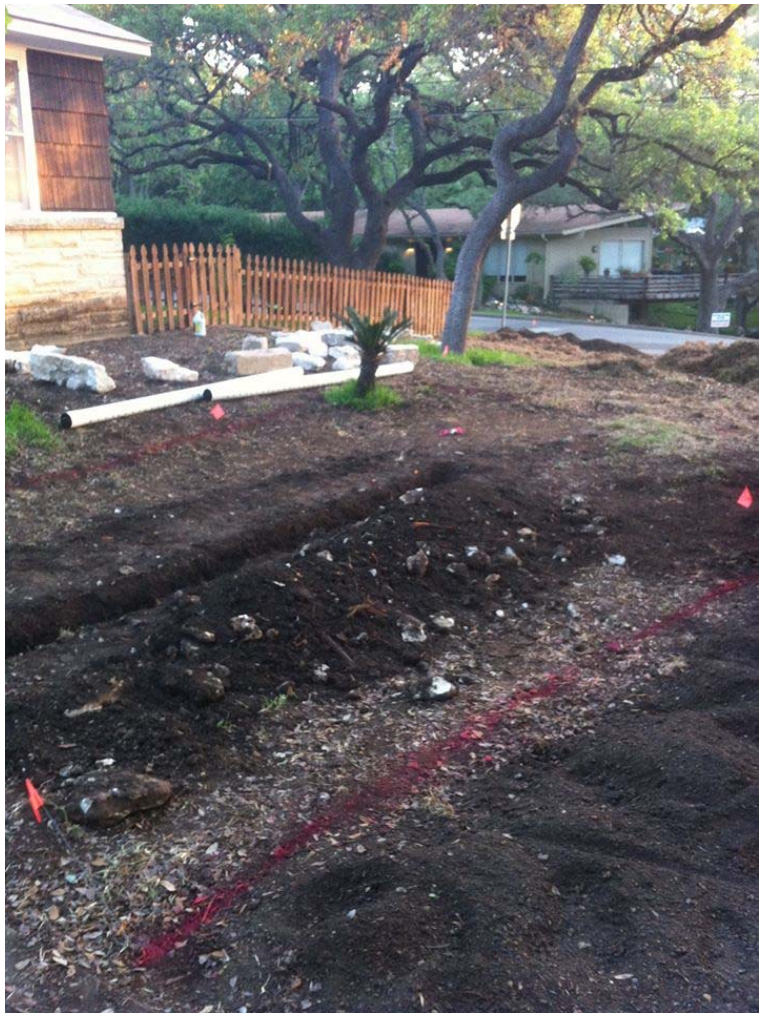
Earth and rock works for waterwise design

Check dams and cedar mulch trail

Edging as mini checkdams

Perennial woodland Garden

Herb and bulb Garden check dam



Infiltration trench

Infiltration trench pathway : river rock and gravel

Vegetated filter strip before the spillway

Spillway

Vegetated filter strip

Rain Garden

Rain Garden


share it for awareness