

# Greener Homes National Summit

## Rainwater Harvesting & Rain Garden Design and Performance



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Sustainable Water Management Session  
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# Water – More Precious than Oil

- In Illinois, our water costs ~0.5 cents per gallon
- Bottled Water (~\$3 per 1 liter bottle) costs ~\$11 per gallon!
- Aquifer levels are dropping, water supplies are being contaminated

So how much is it worth?

- Rainwater is “soft” water with very little mineral content
  - Sodium free, too
- Excellent wash water (lots of soap suds)
- Feel clean after washing
- Plants love rainwater

But, one must take care of their water



# Rainwater Harvest Reference

Texas Water Development Board's

“Texas Manual on Rainwater Harvesting”

[http://www.twdb.state.tx.us/publications/reports/RainwaterHarvestingManual\\_3rdedition.pdf](http://www.twdb.state.tx.us/publications/reports/RainwaterHarvestingManual_3rdedition.pdf)

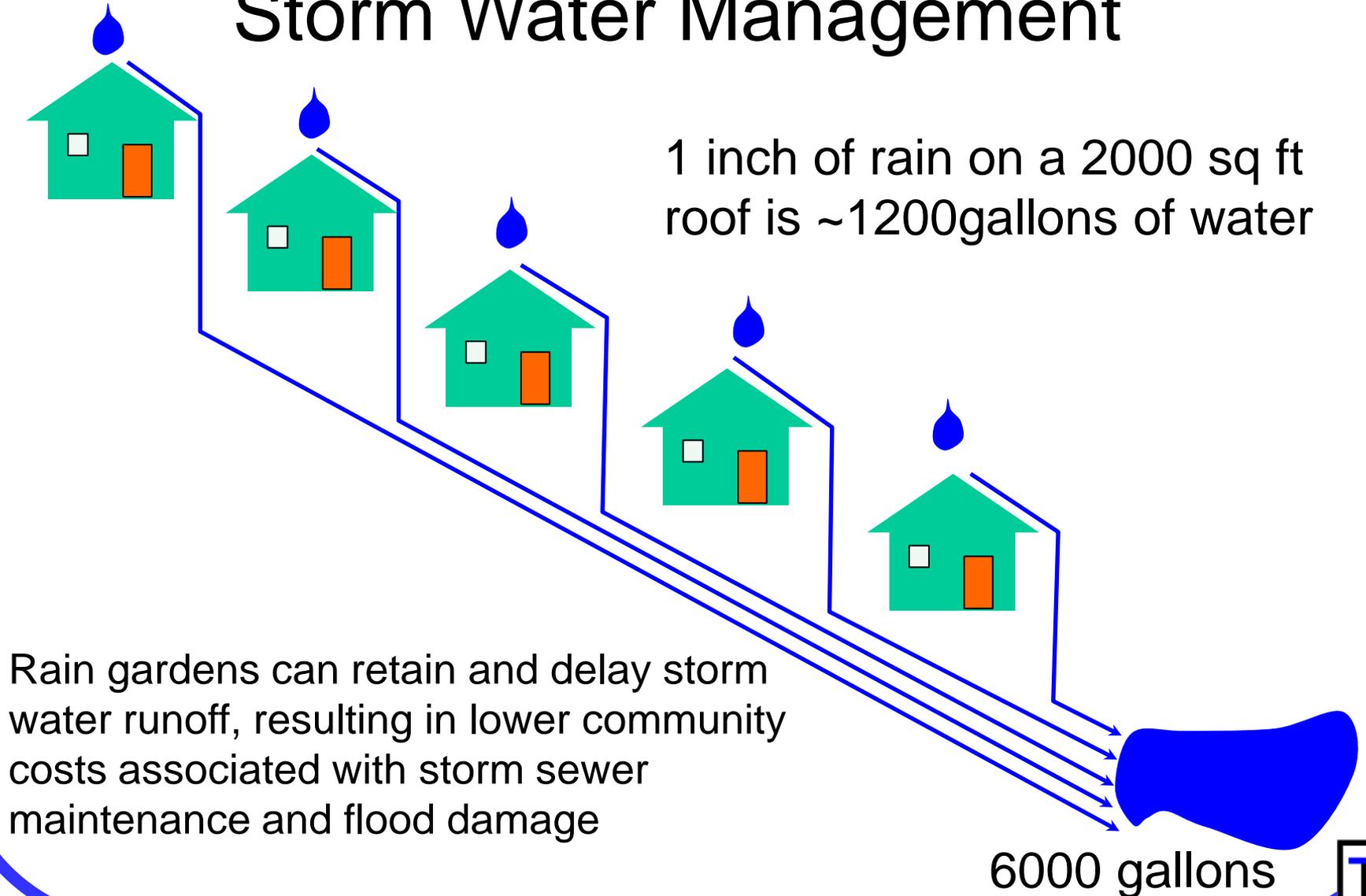
Excellent information on all phases of water collection, storage and usage



# Rain Gardens

## Storm Water Management

1 inch of rain on a 2000 sq ft roof is ~1200 gallons of water



Rain gardens can retain and delay storm water runoff, resulting in lower community costs associated with storm sewer maintenance and flood damage

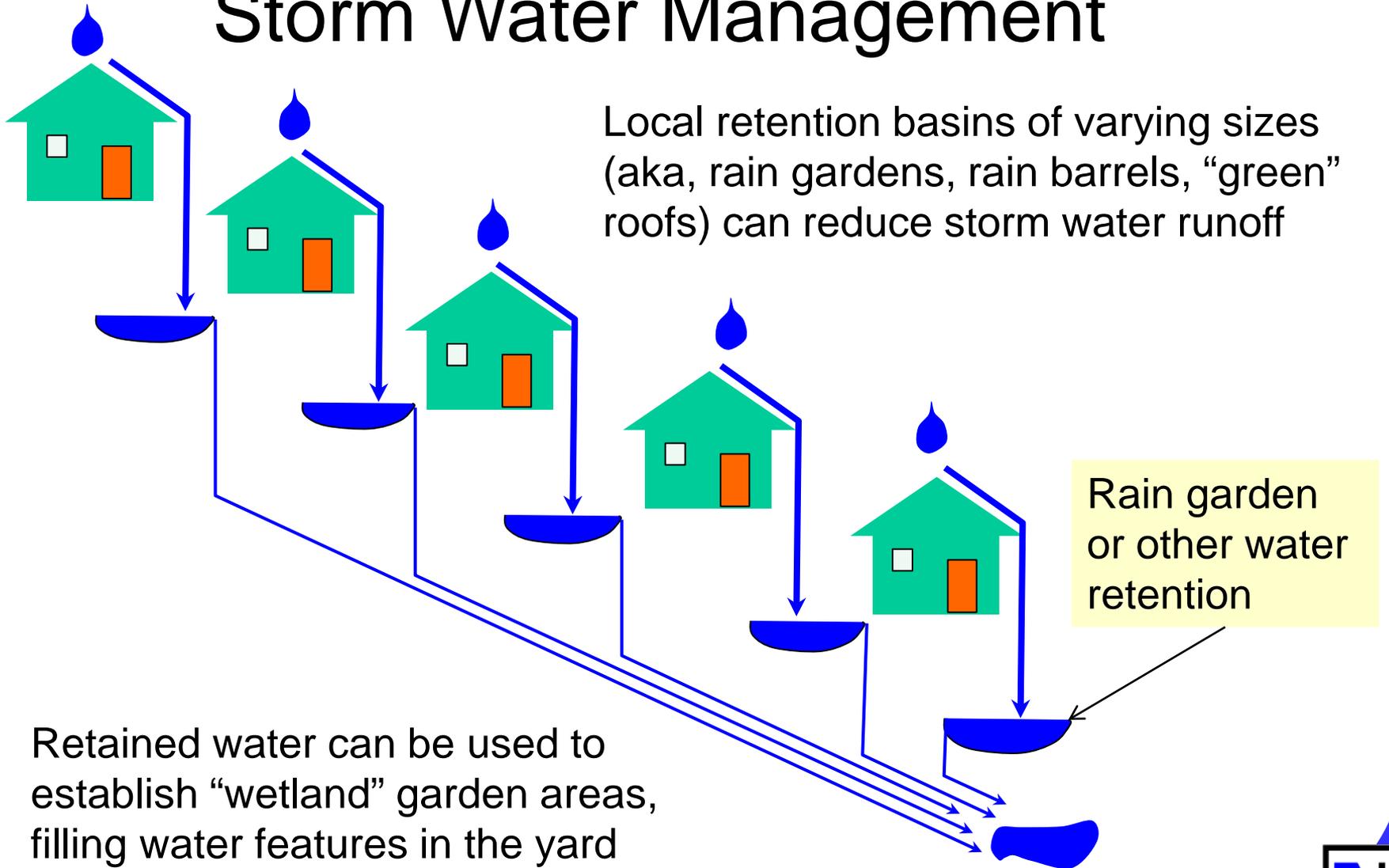
6000 gallons



# Rain Gardens

## Storm Water Management

Local retention basins of varying sizes (aka, rain gardens, rain barrels, “green” roofs) can reduce storm water runoff



Retained water can be used to establish “wetland” garden areas, filling water features in the yard

# Rainwater Harvesting

“Raingarden” area  
(~2000 gallon, 7600 liter)

Gutter rain  
collection system



1700 gallon cistern  
(6500 liters) with overflow to raingarden



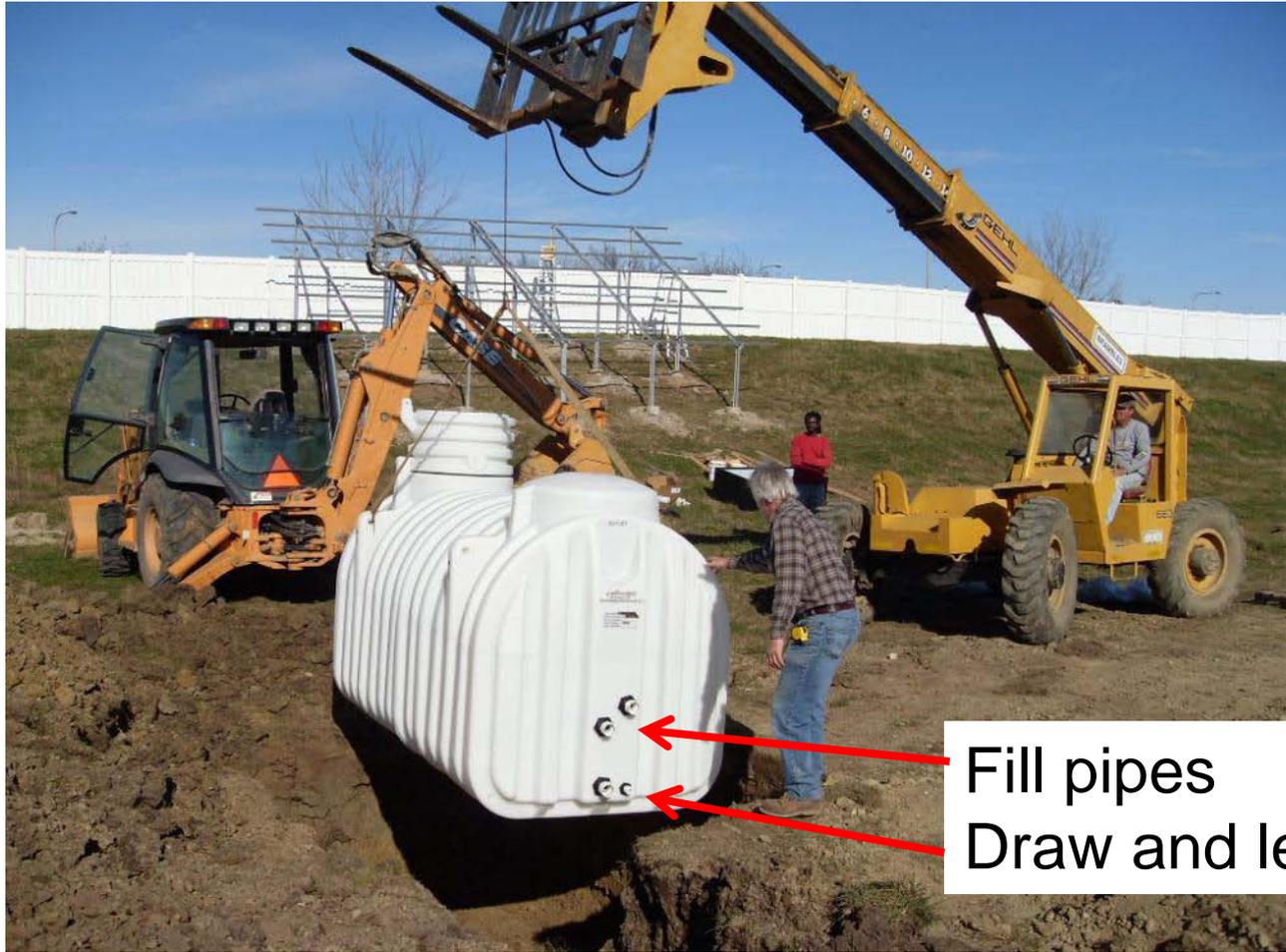
# Equinox Rainwater Harvesting System



- 1700 gallon cistern (6500 liters)
  - ~1" rainfall = 1000 gallons
  - ~2.5cm rainfall = 3800 liters
  - Rain garden catches overflow
  - System cost ~\$3000
- Designed for 80% of house water
  - Approved for toilets by Illinois State Dept of Public Health

Overflow – designed to be higher than ground level – flows into adjacent rain garden

# Installation



- Place cistern in hole
- Connect piping
- Fill cistern with water...at least halfway

Fill pipes

Draw and level reading

# Installation - cont



Hopefully, no leaks!



# Gutter Collection and Rain Garden Overflow



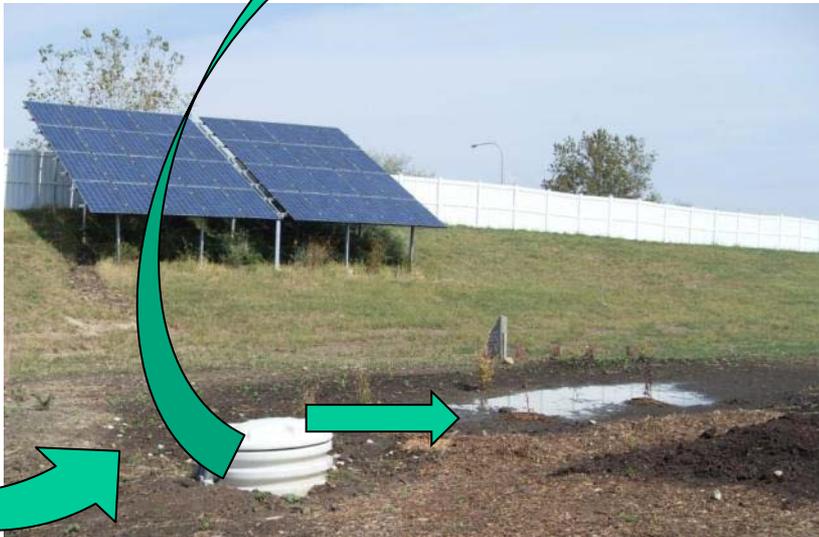
# Plumbing



- May require license plumber
- Remote cistern water level monitoring system
- Must mark non-potable water lines
- Air break required for potable connection for filling cistern
- Basic sediment filter
- Shallow well pump and diaphragm tank



# Rainwater Harvesting and Storm Water Retention



# Water Quality – Clean & Dirty Water



- Keep “clean” water and “dirty” water areas separate
- Septic and chickens on south end of building
- Water well and future rainwater system for Newell Instruments Lab on north end of building

Eggs coming soon!



# Water Quality

Managing rainwater quality is essential

Very little rainwater quality and management data available

- Non-potable usage (gardens and toilets) sedimentation filtration without sterilization (add chlorine tablets to toilet tank)
- Potable usage (drinking water, wash water) requires sanitation method(s)
  - Chlorination (basic swimming pool maintenance) with ~2ppm residual chlorine
  - UV (ultraviolet) light sterilization
  - Ozone sterilization
  - Microfiltration



# Water Quality - Chlorination

- Kills most everything (including you at high doses)
  - But, not Cryptosporidium nor Giardia
- Provides residual storage effect
- High contaminant loadings can be “shocked” for quick kill
  
- Chlorine compounds are not considered significant health risk, however compounds formed from chlorine reactions with organic contaminants (trihalomethanes) are considered unhealthy
  
- Protecting rainwater supply at all points in the collection, storage and supply system essential in order to reduce contaminant loadings (and chlorination level)



# Water Quality – UV and Ozone

UV and ozone kill most water contaminants

Both do not leave reaction compounds as does chlorination

Neither provides residual protection

- UV is generally applied in water supply line (after sediment filter)

More and more favored as a treatment method

- Ozone is often generated and bubbled in the storage tank



# Water Quality – Microfiltration

Microfiltration can remove both organic contaminants (bacteria, protozoa) and mineral substances

- Filter elements require replacement in cartridge systems
- Backflush systems can clean elements
- May be limited to point-of-use locations for potable water (drinking water)
- Systems available at many stores (Lowe's, Home Depot, etc)



# Water Quality Testing

Swimming pool test kits can give some information on water quality (acidity, chlorine, hardness, etc)

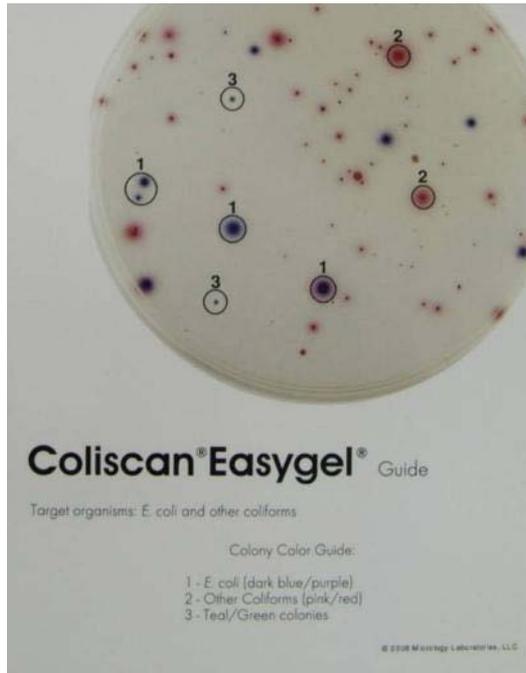
Other important tests are:

- Biological contaminants
  - Coliform indicators
- Inorganic contaminants
  - Arsenic, nitrates/nitrites





# Water Quality Biological Testing



Biological testing can be either by labs (public and commercial) or self-test kits

- ~\$20-40 per test by lab
- ~\$4 per test by kit

Tests examine samples for “coliform” and “fecal coliform” bacteria as indicators of biological activity

Drinking water should be free of all coliform

Non-potable (toilets, gardens) <~200 colonies per 100mL



Equinox House cistern = 2 colonies  
= 40 colonies per 100mL  
July 6, 2011

# Water Quality Biological Testing - cont

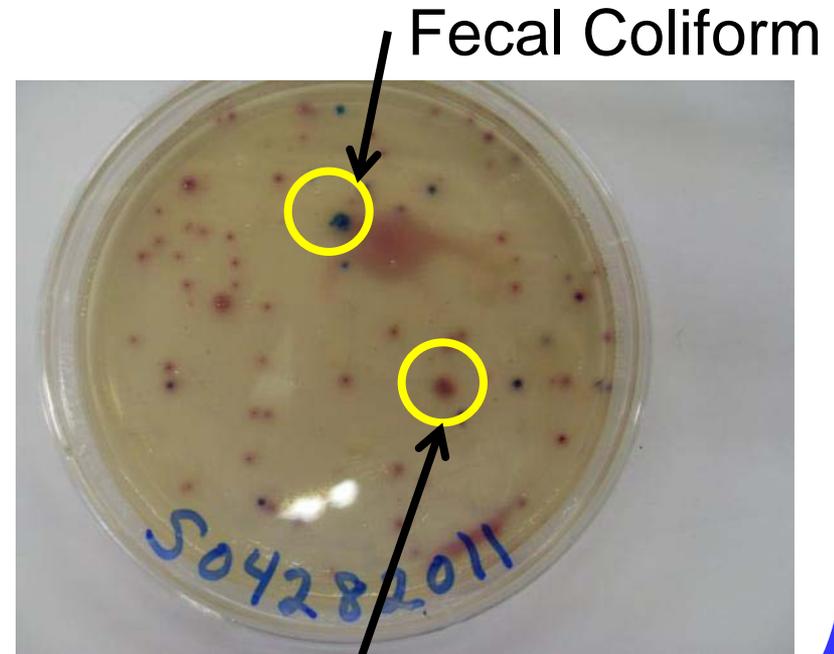


## Drink this!

- Equinox cistern water in April, 2011
  - Lots of overflow
- No treatment ... but will treat before potable house use

## Not this!!

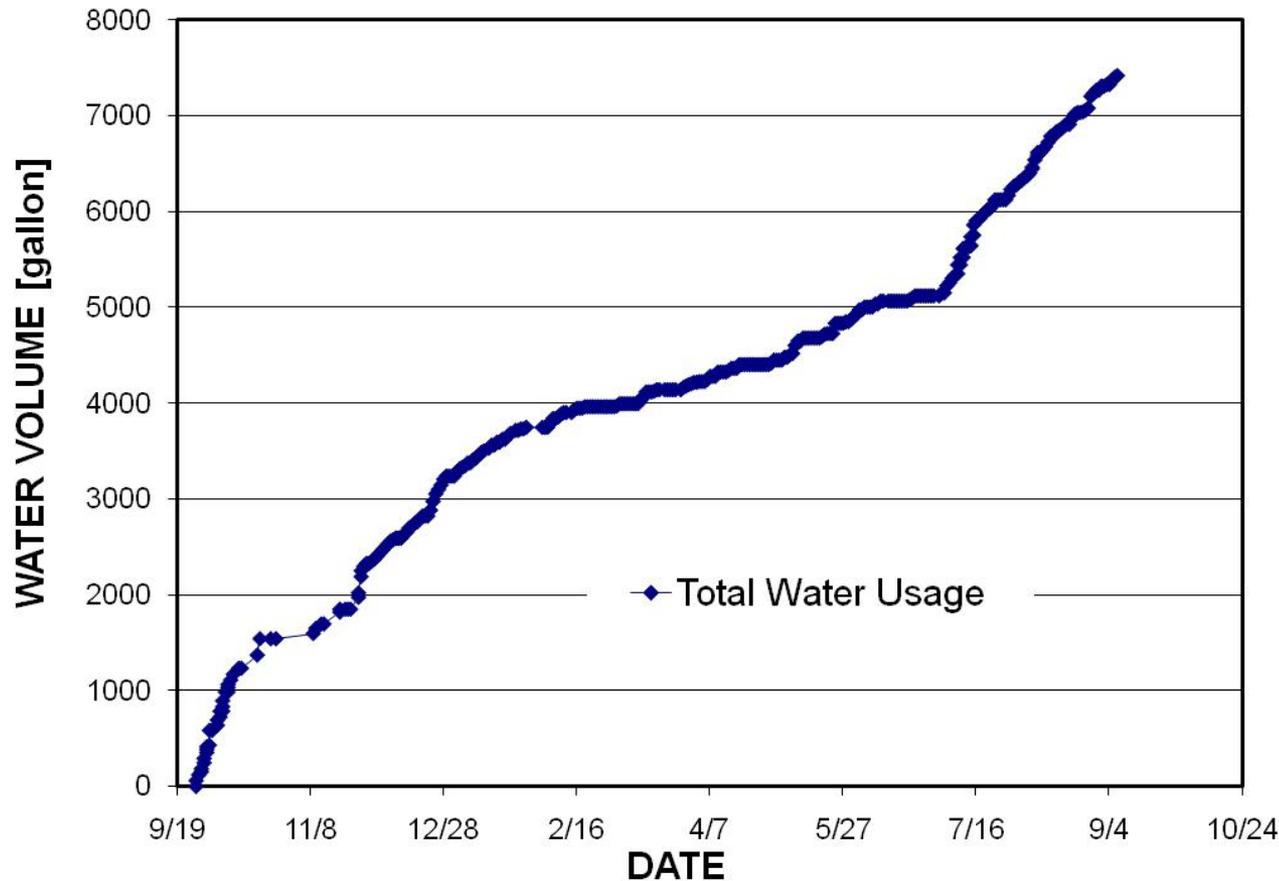
- Adjacent raingarden water
  - Water taken after rain overflow
- Total Coliform = 1420 per 100mL
- Fecal Coliform = 220 per 100mL



Non-Fecal Coliform

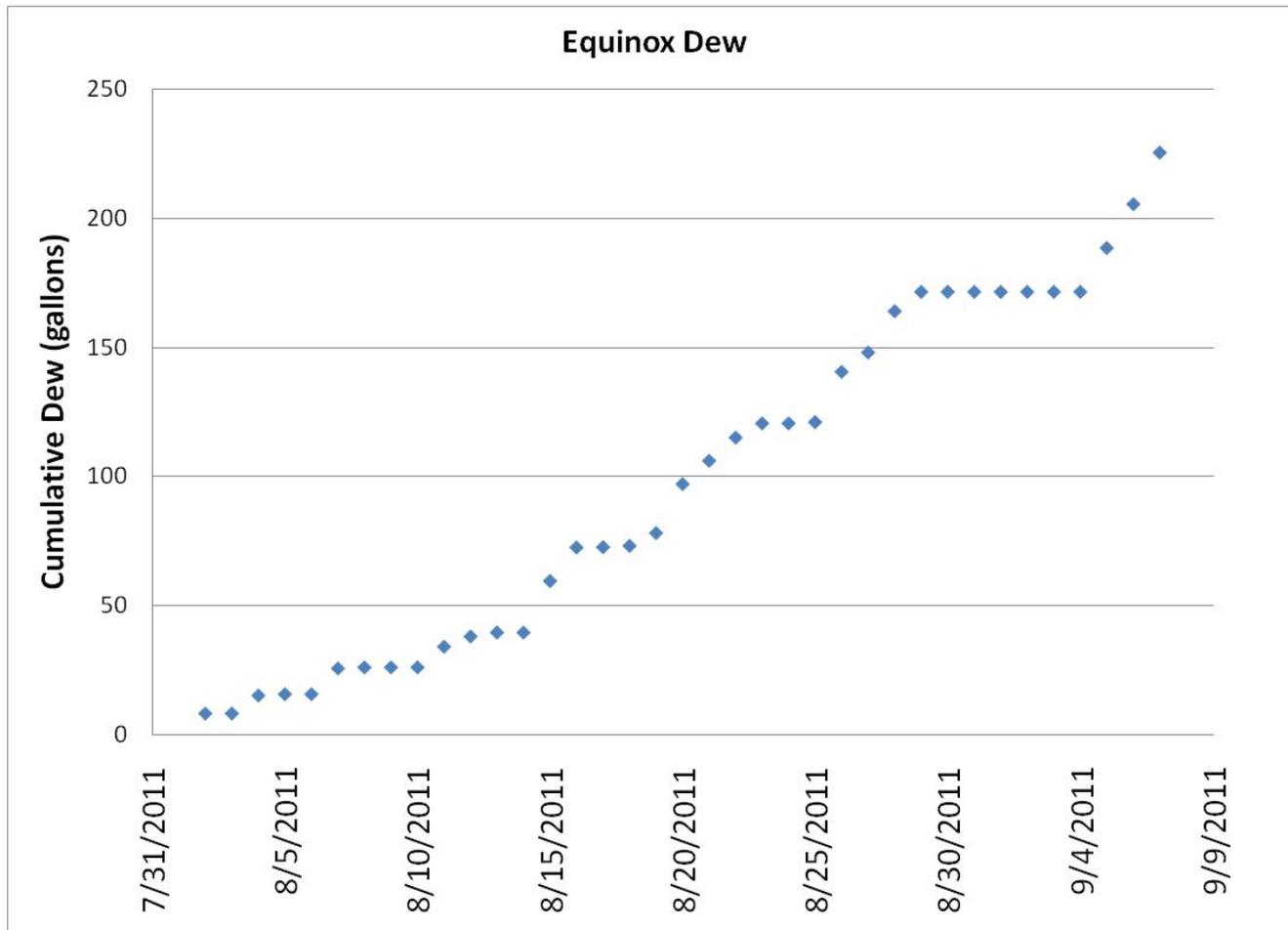
# Accumulated Rainwater Harvest

7000 gallons = \$35 of Water at 0.5 cents per gallon  
But .... \$700 at 10 cents per gallon

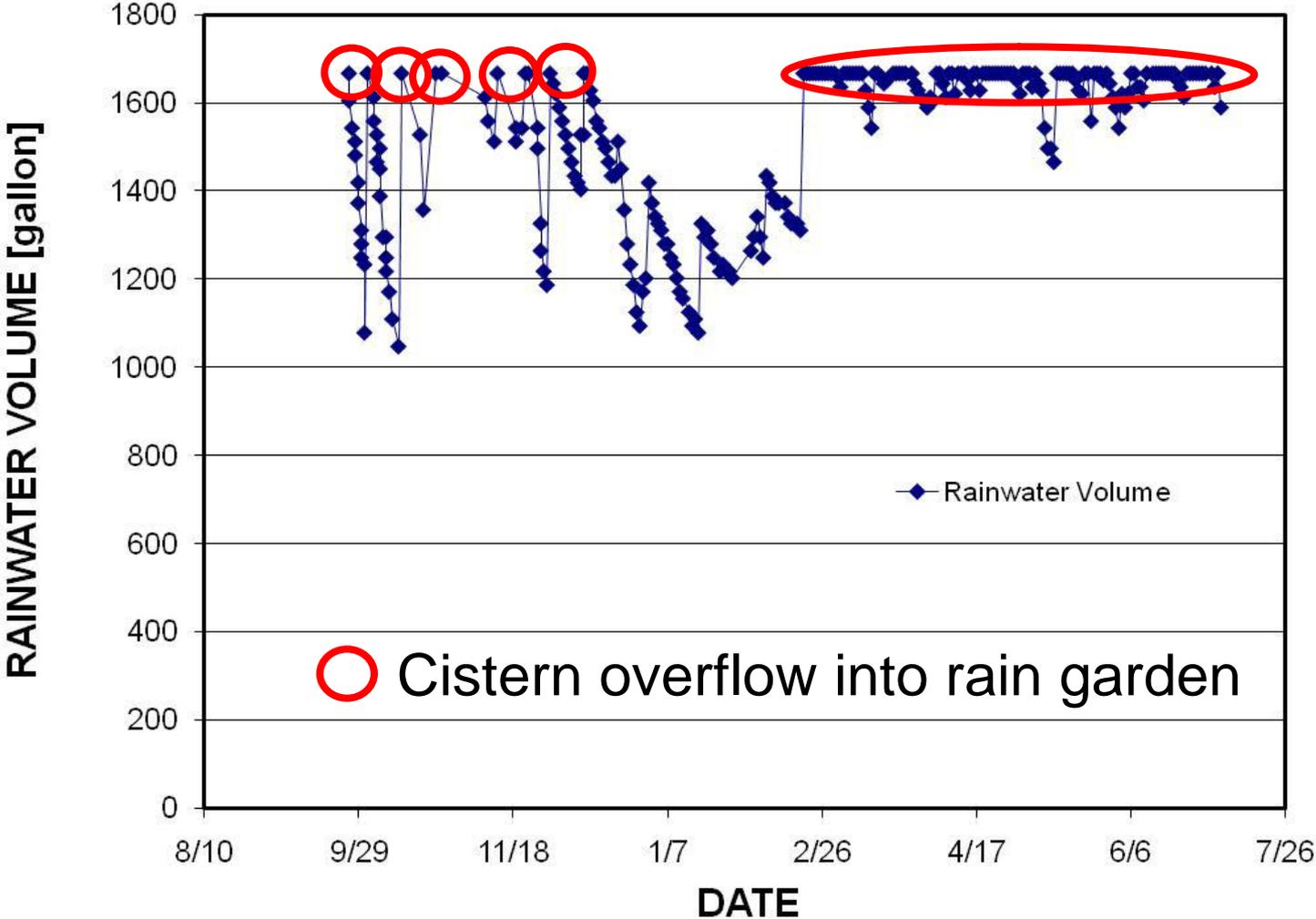


# Dew, Too!

With proper design of roof and collection system, dew (and frost) can be harvested (200 gallons in August 2011)

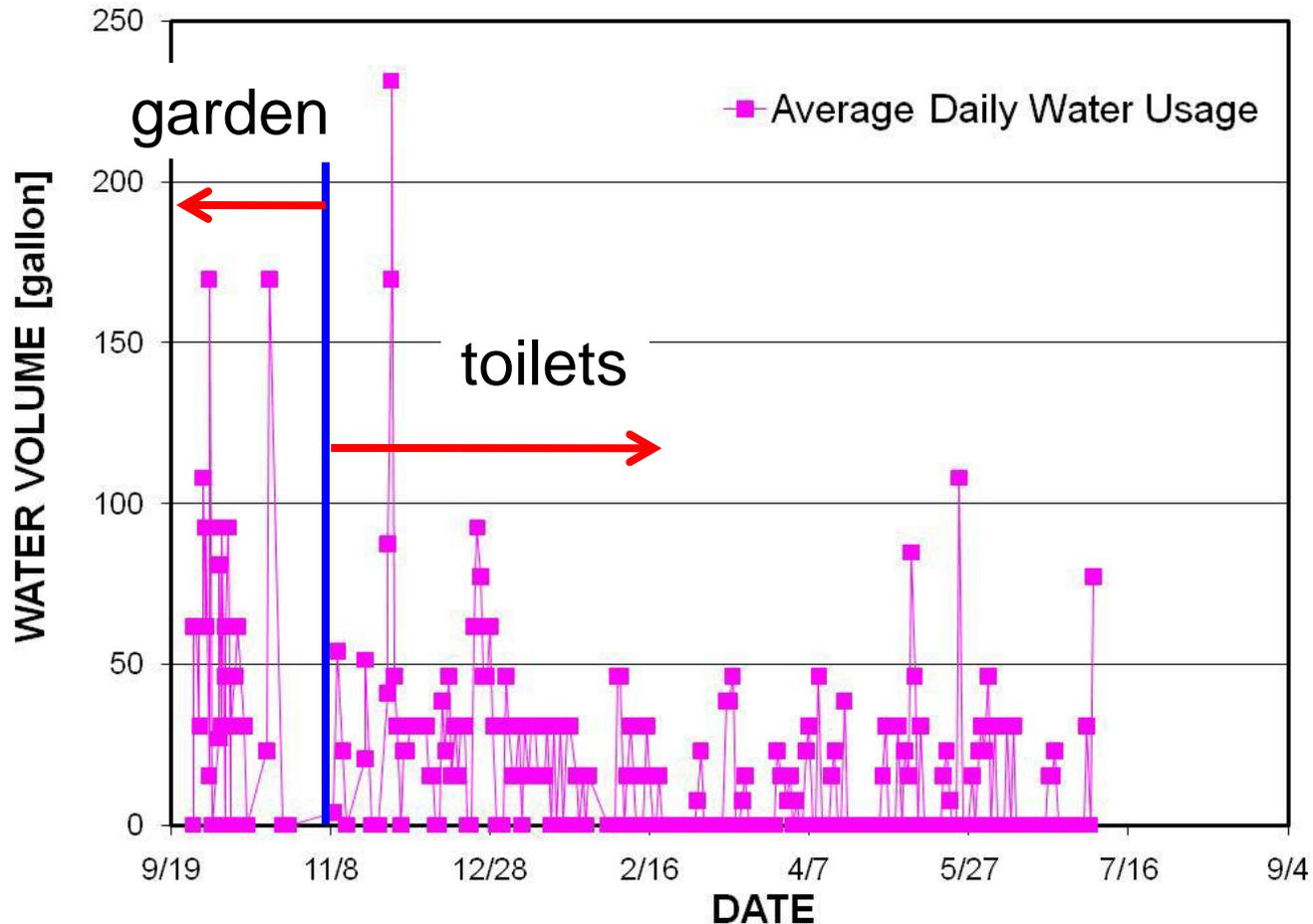


# Rainwater Storage Tank Inventory



# Rainwater Usage

Average usage with 1.3 gallon per flush toilets with 2 people ~20 gallons per day



# Summary

- Rainwater harvesting systems utilize existing water handling equipment, similar to those used for shallow well water systems
  - Pumps, filters, tanks, piping
  - Water quality test methods
- Although rainwater system cost may not compete with “city water”, the cost is not unreasonable and may be very competitive in the future as water resource shortages and water quality issues arise
- Rainwater systems increase local employment and self-reliance

