



(1) This presentation covers, large (>200 gal) and small “do-it-yourself” active RWH systems plus passive RWH systems.

Photo shows three 200 liter (50 gal.) used food containers and a small raised-bed vegetable garden behind.

Used food barrels are cheap (possibly free at a food distributor). These food barrels, originally orange (also come in white & blue) were painted after pre-treatment.

Black object on downspout is a water “diverter” that sends water from the downspout to the barrels.

Advantages of Rainwater Harvesting

- Better water: Rainwater has no chlorine, salt or other chemicals
- Save water & save money
- Reduce pumping water from our aquifer
- Save expense of adding pipelines
- Reduce runoff
- Reduce soil erosion

Photo shows Fiskars commercial rainbarrel (center) plus two used food barrels. Barrels are raised on concrete blocks. Left barrel was painted.



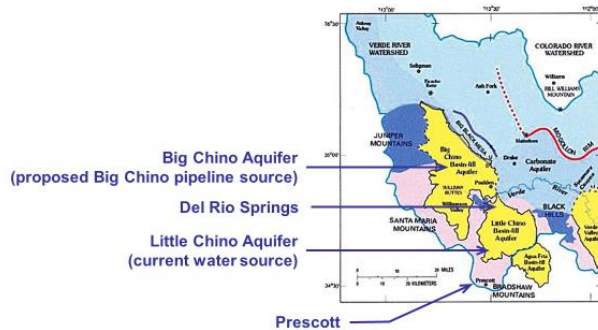
(2) 58 gal. Fiskars commercial barrel (center) included downspout diverter and one spigot. (Second spigot near bottom of barrel was added at extra cost.)

Used food barrels cost \$40 each at C-A-L Ranch store in Prescott, including small spigot. (You may wish to replace the spigot.) You also need to add a diverter. Barrels are raised on concrete blocks so a bucket can fit below.

Author has ten 50-60 gal barrels. Total capacity >550 gal.

Grey barrel was painted with latex house paint after pre-treatment.

Where does Prescott's water come from?



According to AZ Dept. of Water Resources the aquifer recharge rate (“safe yield”) is 4,000 acre-feet per year. Withdraw rate is over four times as high — about 18,000 acre-feet/year.

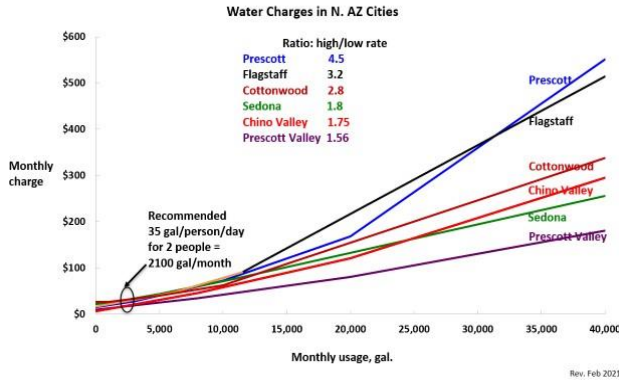
(3) Prescott’s drinking water comes from the Little Chino Aquifer near Chino Valley.

According to AZ Dept. of Water Resources, the withdrawal rate is over four times the aquifer recharge rate (18,000 vs. 4,000 acre-feet per year).

Some private wells in the shallow parts of the aquifer have already gone dry and more will go dry as the water table drops.

Del Rio Springs, where Prescott got its water 100 years ago, is projected by the Dept. to go dry by 2025.

Comparing Household Water Rates
Prescott & Flagstaff have strongest "conservation signal"



"Ratio" means the highest water rate divided by the lowest

Calculate how much water you use per day

City of Prescott - 201 S. Cortez St. - Prescott, AZ 86303

SERVICE ADDRESS			BILL DATE	07/13/2016
Previous Balance	\$62.86	Bill Number		
Payments	-\$62.86	Account Number		
Adjustments	\$0.00	Meter Number		
Finance Charge	\$0.00	Location	INSIDE CITY	
Beginning Balance	\$0.00	Water Class	SINGLE FAMILY	
Current Charges	\$62.60	Sewer Class	RESIDENTIAL	
Water Charges (1)	\$17.84	Number of Units	1	
Alternative Water Charge (2)	\$1.01	Last Meter Read	06/08/2016 - 106280	
Tax on Water	\$1.59	Current Meter Read	07/07/2016 - 107430	
Sewer Charges (3)	\$26.91	Water Used (GAL)	1150 - ACTUAL READ	
Street Light Fee (4)	\$0.75	Days Covered	29	
Sanitation Charge (5)	\$14.00			
Landfill Closure Charge (6)	\$0.50			
Total Amount Due	\$62.60			
TOTAL AMOUNT DUE	\$62.60			
PAYMENT DUE DATE	07/29/2016			

THE CITY OF PRESCOTT 2016 ANNUAL DRINKING WATER QUALITY AND CONSUMER CONFIDENCE REPORT IS NOW AVAILABLE ONLINE AT <http://www.prescottaz.gov/d/2016PrescottWaterQualityReport.pdf> LIMITED COPIES WILL BE AVAILABLE AT THE CITY LIBRARY AND AT CITY HALL

Gal. per day per person: $(1150 \text{ gal} / 29 \text{ days} / 2 \text{ people}) = 20$

Try to use less than 35 gal/day/person

Most households use over 100 gal/day/person
About half of summer water use is for landscaping

How much rainwater can you collect?

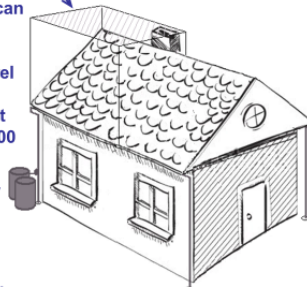
Rainwater collection:

Collection from horizontal projection of roof. 1000 sq. ft. times 1" (25 mm) rain \approx 600 gallons. Over a year, 1000 sq. ft. can collect 11,000 gal.

About 4 mm of rain will fill 50 gal. barrel

With 19" of rainfall per year, a small lot (0.15 acre or 6500 sq. ft.) collects 77,000 gal/year (1/4 acre ft.)

At the 2nd tier of City of Prescott water rates, 77,000 gal is worth \$462



You can also save irrigation water by pouring water used to wash vegetables on your plants

(4) Prescott and Chino Valley are in process of raising rates over several years

Note that Chino Valley, Prescott Valley & Sedona charge most for conserving homeowner (because of high fixed charge) but less for wasteful users.

(5) This is an actual water bill for a conserving household for the dry month of June – 20 gal per person per day. Many homes use over 100 gal/day/person. Try to use less than 35 gal.

About half of summer water use is for landscaping. With rainwater harvesting and draught-tolerant plants you can avoid using potable water for irrigation

(6) Collection area is the horizontal area covered by the roof (including overhangs). 1000 sq. ft. is a very small house and 6500 sq. ft. is a very small lot.

Collection example: 1/4 of a 2000 ft² house \Rightarrow 500 ft². With a 1" rain \Rightarrow 300 gal.

The first 1/2 mm or so just wets the roof and is not collected.

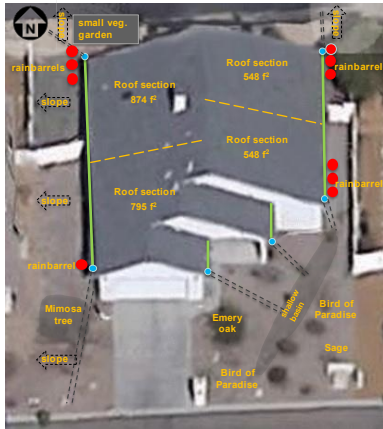
Water cost is from 2019 City of Prescott single family residential rates.

Rainwater harvesting at a Prescott home

Plants are drought-tolerant (except veg. garden)
Includes bear grass, silver sword, yellow bird of paradise, sage, blanket flower, prickly pear, etc.

Gutters shown in green, downspouts in blue

10 Rain barrels shown in red
Total capacity >550 gal



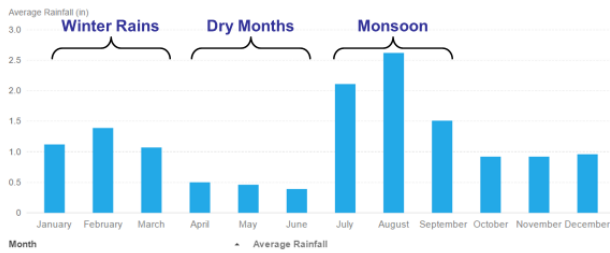
(7) Aerial view of Prescott home with gabled roof. Hip roof similar except gutters on all sides.

Gutters shown in green, downspouts in blue, 10 rain tanks in red.

Gutter drain at right-front discharges to shallow basin, which passively captures rainwater. Others discharge into ground.

How much rainwater do you need to store?
(Figure enough to last the dry months.)

Prescott average rainfall by month
Total for year ~ 14-19"

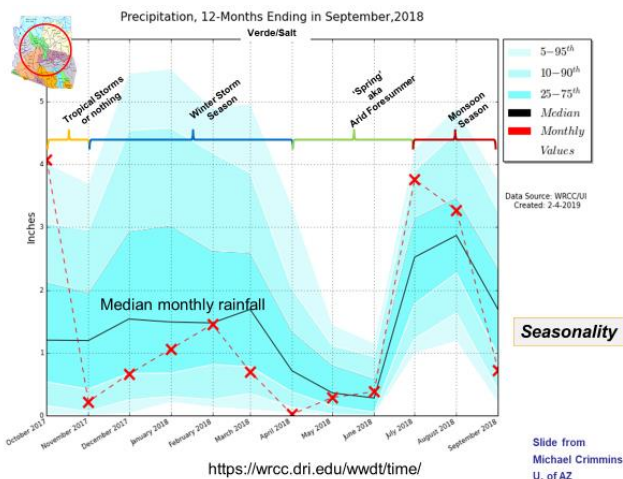


Source: <https://rainfall.weatherdb.com/121183/Prescott-Arizona>

(8) Store enough water to last the dry months, April through June. Fill your containers during late winter rains and again during the monsoon.

Ten 50-60 gal barrels (>550-gal total) at author's house is enough for a small yard with drought-tolerant plants plus a small vegetable garden.

Drought-tolerant plants need little water



(9) Precipitation for Verde River watershed Oct 2017-Sep 2018 plus median and extremes. Note the extreme variability of fall & winter storms but much less variation for spring & summer.

El Niño winters are often rainy.

Slide from Michael Crimmins, U. of AZ.
<crimmins@email.arizona.edu>

Getting Water to Your Tanks

Large system – direct fill from downspout with overflow pipe



Top-feeding barrel screen

Small system uses diverter



Recommended Fiskars DiverterPro

- Resists overflow
- Does not block downspout
- Can feed two barrels

Oatley "Mystic" diverter blocks ~7% of downspout



NOT RECOMMENDED Rubber diverter

- Blocks ¼ of downspout
- Overflows barrel

NOT RECOMMENDED — top-feeding barrel

- Overflows when barrel full
- Coarse screen admits mosquitoes
- Fine screen clogs with debris



Comparison: Small vs. Large RWH Systems

Small barrel(s) ~ 50–100 gal.



This barrel fills from other one

- Usually simple gravity-feed systems
- Several barrels can be attached to different downspouts to provide water at different places
- Used food barrels are cheapest (typically HDPE)
- Rainwater can supplement irrigation system
- Barrels can be connected together

Large system – 2500 gal tank



Installed by AZ Seamless Gutters

- Includes pump & valves for irrigation system
- Can be made to work automatically
- Overflow drain
- Cost ~\$1-3 per gal capacity
- Doubling size increases cost by ~50%

Prescott water customers can get a rebate (\$0.50/gallon up to \$500) and \$3/sq. ft. for passive rainwater harvesting (min. 50 sq.ft up to \$500)

Large Commercial System

Prescott Station Restaurant — twin 1060 gal "Slimline" tanks



Debris screen

System installed by Skywater Arizona

(10) Large system should have direct fill from downspout plus overflow line. Diverter not effective for more than ~200 gal.

Fiskars DiverterPro at middle from Fiskars.com. One Fiskars diverter will feed two barrels (need add'l fitting. Black tubes transfer water from downspout to barrels. Also recommended: Oatley "Mystic" diverter ~\$20, which blocks only 7% of downspout area.

Rubber diverter at center blocks (not recommended) ¼ of downspout -- backs up water and overflows barrel or even gutter. Many barrels come with similar diverters.

Top-fill barrel is prone to overflow because nothing stops the water flow when the barrel is full. Also, screen can clog and/or admit mosquitoes.

(11) Photo at left shows two of author's rainbarrels. The larger one on right fills after left barrel is full. The original rubber diverter overflowed the barrel (and even the gutter) so it was replaced with an Oatley "Mystic" diverter.

Multiple small containers can catch water from several sections of your roof.

Large 2500 gal. system at right is for house with fruit trees. It costs about 1/3 more for two tanks instead of one of double size but multiple tanks can catch water from more areas of your roof.

(12) Commercial system at restaurant with "Slimline" tanks funded through an Environmental Protection Agency grant. Note debris screen.

Cost: \$4550 / (2*1060 gal) = \$2.15/gal.

Large DIY home system uses Intermediate Bulk Containers



(13) IBC containers are plastic containers in a metal cage, 175-gal & up. Containers in photo at left are larger. Containers should be painted or covered with fabric.

First flush intercepts dirt flowing off roof when rain starts. It should be emptied after rain or have a dribbler valve for freezing weather.

Some people consider a first flush too much trouble.

Passive Rainwater Harvesting from Swales and Check Dams
 (Swales are shallow basins. Check dams are rows of stones in a drainage)



- Slow it down
- Spread it out
- Soak it in

Photo from Adult Center of Prescott



Check dams retain water & soil in small wash.
 Water should soak-in within a day or two to prevent mosquitoes.

Photo from Highlands Center

(14) Shallow basins collect water for nearby plants. Little cost if installed during yard grading or landscaping. No maintenance (other than routine yard clean-up).

Top photo from Adult Center of Prescott.

Check dams slow runoff and erosion and collect sediment to provide environment for plants. During storms, water pouring over rocks can make "plunge pool" damaging dam. An "apron" of flat rocks just below dam can deflect force of water.

Passive collection should be combined with active harvesting in rain barrels or tanks.

Save Water with Drought-tolerant plants



Photo from Prescott College

(15) California poppies at Prescott College: Attractive low-water use plants.

Passive Harvesting Do's & Don'ts



"Eyebrows" or "boomerang" berms retain water on a slope

"Passive Water Harvesting" from University of Arizona Cooperative Extension



Don't be a "mound builder"



Wasting rainwater

(16) Basins (swales) and berms can store water for plants. If you don't want to disturb existing plants by digging a basin, a berm alone will provide some benefit.

Irrigators should be at drip line to encourage roots to spread out, not close to base of tree (except for newly-planted trees).

Putting plants on mounds and running gutter drains to the street or a ditch wastes rainwater.

Gravity-feed pressure is very low

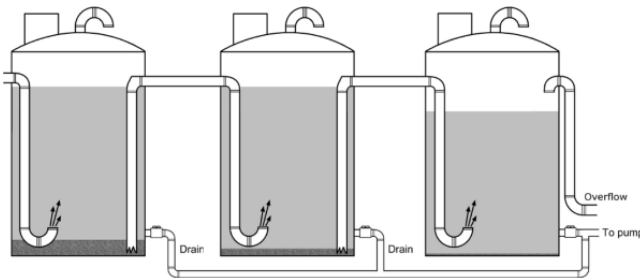


2' tall barrel on 1' base → 1.3 psi when full and 0.4 psi as it empties
 Need 70' for 30 psi (typical irrigation pressure)
 Irrigating without a pump means use bucket or dribble from hose
 Note small spigot on barrel. This was replaced with 1/4" ball valve spigot

(17) Pressure in psi = 0.43 times height in feet.
 2' tall barrel on 1' base supplies 1.3 psi when full and only 0.4 psi as it empties.

Irrigation water pressure is typically 20-40 psi.
 Would take 70' tower for 30 psi.

Connecting Multiple Barrels Together



Barrels above are connected at top – they fill sequentially.
 If connected at bottom, pump is practicable and all fill together but will also leak together and pipe may break if water freezes

(18) Note: If barrels are connected at bottom, a leak will drain all barrels. Water freezing in pipe may break pipe. But bottom-connected barrels may make a pump feasible.

In winter, water in small pipes may freeze. But in Prescott, only a "cap" of water in a barrel will freeze.

Other Suggestions

Mount barrel on base
To get watering can under spigot.
(Concrete blocks work for small barrels.)

Remove downspout to install
(easier to cut it on a table)

Tie barrels down
(So they don't blow away when empty)

Keep barrels closed & keep light out
(Don't breed mosquitoes or grow algae.)

Keep leaves, etc. out of water tanks



Leaf wedge over downspout



Good Ideas rainbarrels (modified) with Oatey diverter

(19) Right: Oatey diverter with Good Ideas Rain Wizard rain barrels, which originally were “pour in the top.” Screened openings were blocked and sealed. A vent hose beside the fill hose lets air out above the diverter (a lower vent will leak water).

Oatey “Mystic Rainwater Harvesting System” ~\$20 is fairly resistant to overflow. Oatey diverter may leak unless sealed. Supplied hose kinks during shipping.

Left photo: Wedge over downspout in gutter to block leaves.

Painting Polypropylene Barrels

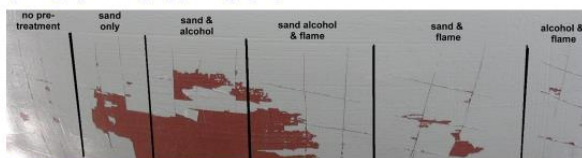
Paint to improve appearance or blend into house
Or hide barrels behind plants or screen



Paint durability test 1:

Polyethylene barrels painted with 2 coats of Rust-Oleum “American Accents” spray paint, scratched with knife then duct tape was applied & pulled off.

Before painting, surface was treated by rubbing with isopropyl alcohol, sanding (#400 grit) and/or lightly passing a propane torch flame over the surface.



Paint durability test 2:

Similar to durability test 1 except paint is Frazee latex house paint

(20) Some HOA's require rainbarrels to be hidden or painted to match the house.

Photo shows a paint durability test. Barrel surface was prepped by rubbing with isopropyl alcohol, sanding (#400 grit) and/or lightly passing a propane torch flame over the surface.

After 3 days to dry, paint was scratched with a knife and then duct tape was applied & removed.

Paint tested was Rust-oleum “American Accents” spray paint. Another paint is Krylon “Fusion for Plastic” (not tested).

Second test used Frazee latex house paint

The flame pre-treatment seems to work best.

Winterizing Rain Barrels

A “cap” of ice should not harm barrels

Small Barrels

~ Oct-Nov, disconnect diverters

Plug diverter outlets

Reduce water level in barrels

Mid-Dec give plants a good drink

Don't let water freeze in diverter or hoses

Secure barrels to prevent blowing away

Re-attach diverters when weather warms

so barrels are full by April

Large Tanks

Prescott not cold enough to freeze large tank

Tank should tolerate cold temperatures

Drain lines, pumps and valves

Don't let water freeze in first-flush system

(21) Small barrels can be stored in garage or shed or left outside in winter. If left outside, be sure they are tied down.

You can keep water in barrels in winter but drain small hoses and drain below diverter.

On large system any “first-flush” should include a “dribbler valve” so it doesn't freeze. (Can be just small hole blocked by screw when not needed.)

Citizens Water Advocacy Group (CWAG),
PO Box 13145 • Prescott, AZ 86304
www.cwagAZ.org • info@cwagAZ.org • 445-4218

Program Revised Apr, 2023.

For more information, see
Citizens Water Advocacy Group
(CWAG): cwagaz.org/

