Meeting Future Water Needs Through Rainwater Harvesting

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Designing a Rainwater Catchment System based on estimated demand and geographic location.

Rainwater harvesting is the ultimate tool in the conservation of groundwater. Best management practices can further enhance water conservation efforts. The use of native/drought tolerant plants is a good first step. Water methods such as drip irrigation can be an effective tool in water conservation as can the liberal use of mulch to help prevent evaporation.

Typical landscaping around a home using appropriate plants and adequate mulching can thrive quite satisfactorily on one inch, or less of water per week.

Large areas of lawn should be shied away from. These are water hogs requiring 600 gallons of water per inch of application per 1,000 square foot of lawn. The application of a manure compost several times a year can result in a real water savings as well as the use of an appropriate groundcover of hardscape design.

It is not to say one can't design for this, but it runs the cost of the system up due to added collection surface area and additional storage capacity.

In designing a rainwater catchment system there are four main design parameters to consider.

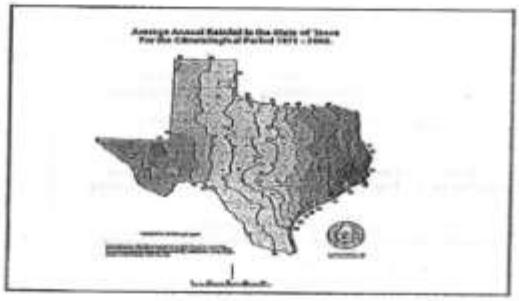
- Estimated water use demands
- Rainfall Patterns
- Storage capacity requirements
- Available surface collection requirements

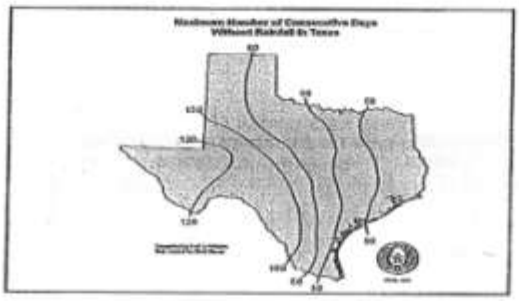
These design criteria apply to the design of a potable in-home catchment system or a non-potable outdoor landscape system

To get some idea of what demand number to use in design we can start with 600 gallons per 1,000 square feet per 1 inch of application for lawns. For established shrubs and groundcover an estimate of 2 inches per month times the area is square feet converted to gallons. (2"/12" x 1,000 SF X7.48 gal/CF = 1,250 gallons per month.)

Water used in a greenhouse can be estimated at 45 gallons per day per 1,000S.F. plus 1 gallon per day per SF for the evaporative water wall. Therefore, a 1,000 SF greenhouse with a 100SF water wall could use 145 gallons per day (45 + 100) or 4,350 gallons per month. Round the demand to 150 gallons per day per year.

Next, the annual average rainfall patterns and the average number of consecutive days with no rainfall needs to be considered for your location within the state. For Boerne, Texas the average rainfall is 34 inches per year and the number of dry days is approximately 90 days.

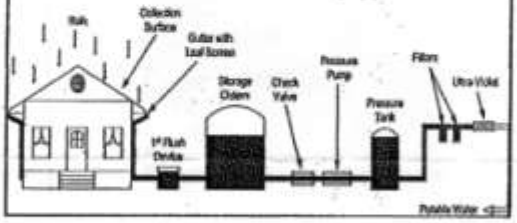




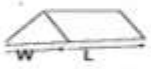
Assuming there was a constant demand of 150 gallons per day year round the annual demand would be 54,750 gallons. One inch of rainfall on 1,000 S.F. of surface area yields 623 gallons. Assuming an 80% collection efficiency that yields 500 gallons per 1,000 S.F. Also, assuming no rainfall for 90 days the minimum storage capacity would be 13,500 gallons which I would round up to 15,000 gallons to be conservative.

Based on 34 inches of rainfall per year and collecting 500 gallons per 1,000 S.F., the necessary collection surface area would be 3,220 S.F. which I would round to 3,500 S.F., again to be conservative. This would provide for three months operation with no rainfall which is inline with drought-of-record conditions.

Schematic for Rainwater Harvesting System



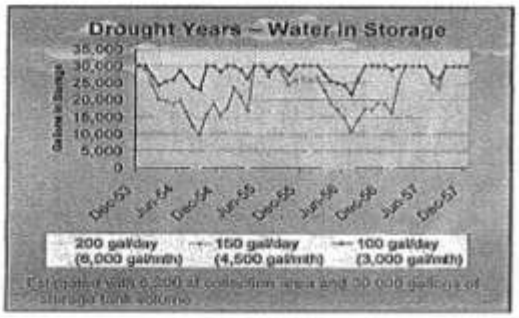
The available surface collection area of the roof is the plan footprint, not the combined sloped area.



W x L = footprint = floor area of single story house + overhang

Use a moderately steep roof so that during a rain the roof is cleaned off more quickly . Avoid flat roofs since water drains slowly and does a poor job of cleaning off contaminates. Metal roofs are ideal as are tile and slate. Composition shingles are acceptable provided they are not impregnated with chemicals to retard the growth of mildew, etc. Wood shingles should be avoided since they contain chemicals to retard rotting and burning which could be leached into your system.

Drought Years – Water in Storage



Estimated with 6,200 sf collection area and 30,000 gallons of storage tank volume

This chart is a summary of our water use for the past 8 years. Notice that about ½ to 2/3 of our annual water use is outside – dependant on rainfall. In the summer the outside water use can approach 90% of the total water used.

Year	Total Annual Use/Gal.	Daily Avg. Gal.	Average Indoor Gal/Day	Average Outdoor Gal/Day	Annual Rainfall Inches
2002	37,739	103	56 (58%)	44 (42%)	62.28
2003	46,774	128	56 (44%)	72 (56%)	27.33
2004	43,067	118	57 (48%)	61 (52%)	55.24
2005	53,451	146	53 (36%)	93 (64%)	24.36
2006	52,557	144	49 (34%)	95 (66%)	23.73
2007	34,602	95	51 (54%)	44 (46%)	58.96
2008	36,327	100	43 (43%)	57 (57%)	13.68
2009	32,927	90	41 (46%)	49 (54%)	28.80

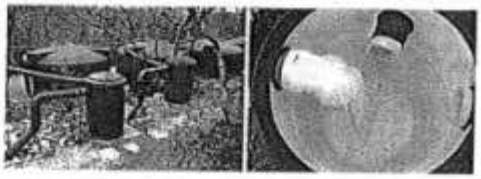
Water Quality Analysis Test Results for our System

Test	Typical Hill Country Parameters	Results Rainwater
Total Hardness	0-120 ppm – soft	21 ppm
Iron	0-0.3 ppm – OK	< 0.1 ppm
Sulfate	0-100 ppm – Good	< 0.1 ppm
Nitrate	0-2 ppm – Common	0.3 ppm
Flouride	0-0.6 ppm – Good	< 0.1 ppm
Chloride	0-30 ppm – Normal	3 ppm
pH	6.6-8.5 _ Normal	6.58
Conductivity	0-500 umhos/cm – Good	7.1
Total Dissolved Solids – less than 1000 ppm		4-5 ppm
Bacteria Analysis		
Total Coliform		Absent
E. Coli		Absent

There are a number of side benefits resulting from using harvested rainwater. Plants do better on the neutral to slightly acidic water. We find that organic fertilizers and rainwater do wonders for plant growth. Drip irrigation systems are not plagued with minerals plugging them up. The water wall evaporative cooling units used in greenhouses last longer since they don't get encrusted with the mineral residue deposits left over from the hard groundwater. And lastly, rainwater is still free in Texas.

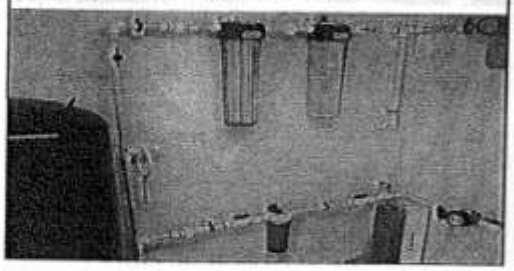
Downspout Filter

First Flush Barrels and Sock Filter



6 – 5,000-gallon Primary Storage Tanks

Filter System



A good reference for rainwater harvesting is the Third Edition of the Texas Water Development Board's "The Texas Manual on Rainwater Harvesting". www.twdb.state.tx.us

Another source for information on rainwater harvesting is the Texas Rainwater Catchment Association website www.TEXRCA.org which list suppliers and installers for rainwater systems.